National Integrated Creative Solutions

ABN 54 877 348 873

Aim to Excel in all Aspects of Business

Appendix M

Manufacturers Bondtech Full Autoclave Specifications

FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS

(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

CORRECTED COPY
May 11, 2012

1. Manufactured and certified by Fabrication Associates, Inc., 7950 Pence Road, Charlotte, NC 28215
(Name and address of Manufacturer)

2. Manufactured for Bondtech Corporation, 1278 Highway 461, Somerset, KY 42503
(Name and address of Purchaser)

3. Location of installation Unknown
(Name and address)

4. Type Horizontal tank (Horizontal or vertical, tank) | W11-1206 (Manufacturer's serial number) | NA (CRN) | W11-1206-01 Rev. 0 (Drawing number) | 659 (National Board number) | 2011 (Year built)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1 2010 (Year)
to no Addenda (Addenda, if applicable (date)) | – (Code Case numbers) | none (Special service per UG-120(d))

6. Shell SA-516 G70 (Material spec. number, grade) | .375" (Nominal thickness) | 0.125" (Corr. allow.) | 6'- 0" (Inner diameter) | 13'-0" (Length (overall))

7. Seams Double butt (Long. (welded, dbl., sngl., lap, butt)) | none (R.T. (spot or full)) | 70% (Eff., %) | no (H.T. temp.) | – (Time, hr) | Double butt (Girth (welded, dbl., sngl., lap, butt)) | none (R.T. (spot or full)) | 70% (Eff., %) | 3 (No. of courses)

8. Heads: (a) Material SA-516 G70 (Spec. no., grade) (b) Material SA-516 G70 (Spec. no., grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	door head	0.32"	0.125"	57"	7 3/4"	–	–	–	–	concave
(b)	shell head	0.32"	0.125"	57"	7 3/4"	–	–	–	–	concave

If removable, bolts used (describe other fastenings) (a) 72" ID Rapid Opening Door
(Material spec. number, grade, size, number)

9. MAWP 65 psi (Internal) | 15 psi (External) at max. temp. 500° F. (Internal) | 500° F. (External)

Min. design metal temp. -20° F. at 65 psi . Hydro., ~~pneu., or comb.~~ test pressure 98 psig . Proof test none .

10. Nozzles, inspection, and safety valve openings:

Purpose (Inlet, Outlet, Drain etc.)	No.	Diameter or Size	Type	Material		Nozzle Thickness		Reinforcement Material	Attachment Details		Location (Insp. Open.)
				Nozzle	Flange	Nom.	Corr.		Nozzle	Flange	
Service	10, 2	1/2", 3/4"	Coup.	SA105	–	0.1875"	–	–	UW-16.1(i)	–	–
Service	1, 2	2", 3"	Coup.	SA105	–	0.375"	–	–	UW-16.1(i)	–	–
Service	1	1/4"	Coup.	SA105	–	0.125"	–	–	UW-16.1(a)	–	–
Service	1	1"	Pipe	SA106B	–	0.179"	–	–	UW-16.1(i)	–	–
Service	2	4"	CL150SO	SA106B	SA105	0.337"	–	–	UW-16.1(i)	UW-21(1)	–
Service	2	1 1/4"	Coup.	SA105	–	0.3125"	–	–	UW-16.1(i)	–	–

11. Supports: Skirt no (Yes or no) Lugs 0 (Number) Legs 0 (Number) Other 2 saddles (Describe) Attached welded to shell (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: none
(Name of part, item number, Manufacturer's name and identifying stamp)

Vessel was tested at 1.5 times MAWP per the customers request.
Vessel has two 3" x 3/8" thick SA-36 stiffner rings, Body flange, head flange & locking ring are made of SA-105 N

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. "U" Certificate of Authorization Number 10,264 expires January 15, 2013 .

Date May 11, 2012 Co. name Fabrication Associates, Inc. (Manufacturer) Signed Paul Greene (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by Fabrication Associates, Inc. at 7950 Pence Road, Charlotte, NC 28215 .

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province of North Carolina and employed by The North Carolina Department of Labor have inspected the component described in this Manufacturer's Data Report on October 5, 2011 , and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME BOLIER AND PRESSURE VESSEL CODE, Section VIII, Division 1. By signing this certificate neither the Inspector nor his/her employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date May 11, 2012 Signed Ray Payne (Authorized Inspector) Commissions NB#11458(A)(B)(N), NC#1359 [Nat'l Board (incl. endorsements), State, Province, and number]

BONDTECH
CORPORATION

Dear BONDTECH Customer:

Thank you for your purchase of a Bondtech autoclave system.

Your Bondtech autoclave system was designed, engineered and manufactured and tested prior to shipment.

Please do not hesitate to call Bondtech for technical support.

Sincerely yours,

BONDTECH CORPORATION

Elsa J. Brown
President

Bondtech Corporation:
1278 Hwy 461, Somerset, Kentucky
Tel: 606-677-1450/Fax: 606-676-9157

BONDTECH
AUTOCLAVE SYSTEMS

NOTE

THROUGH THE MOUNTING HOLES PROVIDED, PLEASE SECURELY BOLT THIS AUTOCLAVE TO THE FLOOR USING BOLTS 1/8" SMALLER IN DIAMETER THAN THE MOUNTING HOLES.

ON AUTOCLAVES, ONLY SECURE THE FRONT LEG. LEAVE THE REAR LEG LOOSE TO ALLOW EXPANSION.

BONDTECH CORPORATION
1278 HWY 461, SOMERSET
TEL: 606-677-1450/FAX: 606-676-9157

CHAMBER DOOR SAFETY

FOUR SAFETY SYSTEMS ARE IN PLACE TO PREVENT A DOOR OPENING UNDER PRESSURE.

1. **MECHANICAL HANDLE.**
2. **VISUAL PINGPONG BALL MOVEMENT.**
3. **A PRESSURE SWITCH.**
4. **A LIMIT SWITCH.**

SETTING THE DOOR SAFETY PRESSURE SWITCH

WITH THE VESSEL DOOR CLOSED AND ABSOLUTELY NO PRESSURE, SET THE SWITCH TO ITS LOWEST SETTING.
THIS SHOULD PREVENT THE PUMP FROM RUNNING.
WITH SOMEONE ELSE HOLDING IN THE PUMP PUSH BUTTON, SLOWLY INCREASE THE PRESSURE SWITCH UNTIL THE PUMP STARTS TO RUN.

SETTING THE DOOR CLOSED LIMIT SWITCH

THIS SWITCH IS MOUNTED ON A SLOTTED BASE AND SHOULD BE SET TO OPEN ITS CONTACTS WHEN THE DOOR WEDGES ARE AT ABOUT 25% ENGAGEMENT. THE RESULT OF THIS IS THAT ANY PRESSURE PUSHING THE DOOR AWAY FROM THE SHELL WILL STOP THE HYDRAULIC PUMP BEFORE THE WEDGES DISENGAGE AND ALLOW THE DOOR TO OPEN.

CHAMBERS

WARNING

POSSIBLE ELECTRICAL SHOCK MAY OCCUR IF CONTACT IS MADE WITH ANY EXPOSED ELECTRICAL WIRING.

DANGER!
HIGH VOLTAGE

ONE OR TWO PSI READING ON THE PRESSURE GAUGE OVER THE ENTIRE SURFACE AREA OF THE CHAMBER DOOR WILL CREATE ENOUGH FORCE (IF OPENED) TO INJURE PERSONNEL.

DANGER!
EXHAUST ALL AIR BEFORE OPENING DOOR

POSSIBLE EXPLOSION MAY OCCUR IF OPERATING PRESSURE IS EXCEEDED.

DANGER!
DO NOT EXCEED OPERATING PRESSURE

ID	DESCRIPTION	MFG_NAME	MFG_PART_ID	QTY	U/M
A1-0011	FILTER 1/4" PORTS	ARROW	F300-02 (EN 41120)	1	EA
A1-0042	MUFFLER 1/2"	ARROW	SBM-4 (ASP-4)	2	EA
A1-0056	GAUGE-PRESSURE 0-160#	ARROW	102D-158F (E61-1C0160) (7051	3	EA
A1-0175	L/F GAUGE 2 1/2 0-3000# 1/4 LM (STYLE 2	WIKA	9310800	1	EA
A1-0313	MINI REGULATOR	ARROW	R162	3	EA
A1-0362	HYD. POWER UNIT 1 1/2 HP 230/460V 3PH, 1	DELTA	B6+B3154	1	EA
A1-0417	PANEL MOUNT CONVERSION KIT	ARROW	PK1611	2	EA
A1-0426	ELBOW FOR TYPE 740 VALVE	REXROTH	R432015301 (P68392)	3	EA
A1-0518	GAUGE 2 1/2" FACE 30-0-160 1/4" CBM L/F	ENGINEERING COMP.	202L-254CF	1	EA
EL1-0111	LIMIT SWITCH - SIDE ROTARY	OMRON	D4A-1101N(54-LA-12)	2	EA
EL1-0117	LIMIT SWITCH ARM FOR SWITCH D4A-1101N	OMRON	WL-2A111(54-LAP-644)	2	EA
EL1-0184	EMT CONNECTOR 1"		-	6	EA
EL1-0185	EMT CONNECTOR 3/4"		-	2	EA
EL1-0186	EMT CONNECTOR 1/2"		250-DC2	8	EA
EL1-0425	3/4 UNILET TEE FORM 85	APPLETON	T75-A	1	EA
EL1-0429	LIQUID TITE FLEX CONDUIT 1/2	OZ-GEDNEY		7	FT
EL1-0435	FLEXIGUARD CONDUIT 3/8 (PRICED PER FT.)		EFG	10	FT
EL1-0438	THHN WIRE #16		#16	75	FT
EL1-0439BK	BLACK THHN WIRE #14		# 14	50	FT
EL1-0444	1" EMT CONDUIT * 10 FT (PRICED PER FT)		-	12	FT
EL1-0445	3/4" EMT CONDUIT (PRICED PER FT)		-	5	FT
EL1-0446	1/2" EMT * 10 FT (PRICE PER FT)		-	15	FT
EL1-0478	UNILET 1/2" T FORM 85	APPLETON	T50-A	4	EA
EL1-0596	3/8 STR.LIQUID TITE CONNECTOR	OZ-GEDNEY	G4Q-38	12	EA

ID	DESCRIPTION	MFG_NAME	MFG_PART_ID	QTY	U/M
EL1-0622	THERMOCOUPLE TYPE J	OMEGA	NB1-ICIN-14U-12	1	EA
EL1-0634	1/2 IN. 90 DEG. LIQUID TITE CONNECTOR	OZ-GEDNEY	G4Q-950	5	EA
EL1-0792	LIMIT SWITCH-ROLLER PLUNGER	OMRON	D4A-1110N (54-LA-51)	1	EA
EL1-1020	1 IN. UNILET TEE		-	1	EA
EL1-1053	EMI FILTER 10 ET1 10A	CORCOM	52K4501(10ET1)	1	EA
EL1-1056	CONNECTOR FEMALE 9 POS.	NEWARK	01M1858 (276-1538)B	3	EA
EL1-1073	THERMOCOUPLE WIRE TYPE J (-450 TO 500 F)	OMEGA	TT-J-20-TWSH-SLE	25	FT
EL1-1078	CONNECTOR HOOD D-SUBMIN. 9 PIN	NEWARK	73K2965 (276-1539-B)	3	EA
EL1-1269	FUSE 6A - ATDR 6	GOULD	ATDR 6 (LP-CC-6)	3	EA
EL1-1353	FUSE 2A - ATDR 2	GOULD	ATDR 2 (LP-CC-2)	1	EA
EL1-1364	GREEN FLUSH PUSH BUTTON W/CAP (22.5 m	CUTLER HAMMER	E22P3	1	EA
EL1-1369	RED MUSHROOM HEAD PUSH BUTTON (22.5 m	CUTLER HAMMER	E22L2	1	EA
EL1-1370	2 POS.SELECTOR SWITCH MAINT.(22.5 mm)	CUTLER HAMMER	E22V51	1	EA
EL1-1371	3 POS.SELECTOR SW.SPRING RETURN TO CNTR	CUTLER HAMMER	E22VL1	3	EA
EL1-1379	1 N.O. CONTACT BLOCK (22.5 mm)	CUTLER HAMMER	E22B2	9	EA
EL1-1589	HOLE PLUG (22.5mm)	CUTLER HAMMER	E22BHP	3	EA
EL1-1613	WIRING DUCT (NARROW SLOT)	PANDUIT	F1X3LG6	7	FT
EL1-1617	WIRING DUCT COVER 1"	PANDUIT	C1LG6	7	FT
EL1-1652	ELECTROPNEUMATIC TRANSMITTER	NUMATICS (BELLOFRAM	R831-02BG (961-070)	1	EA
EL1-1752	FUSE 2A - ATQR 2	GOULD	ATQR 2 (FNQ-R-2)	2	EA
EL1-1885	DIGITAL TO ANALOG OUTPUT MODULE	MITSUBISHI	FX2N-4DA	1	EA
EL1-1886	THERMOCOUPLE MODULE	MITSUBISHI	FX2N-4AD-TC	1	EA
EL1-2015	DUPLEX RECEPTACLE BOX	BELL	5320-0	1	EA
EL1-2388	25 PIN CONNECTOR HOOD	NEWARK	89F003 (276-1549C)	1	EA

ID	DESCRIPTION	MFG_NAME	MFG_PART_ID	QTY	U/M
EL1-2645	25 PIN CONNECTOR - MALE	AMPHENOL	81F5173 (276-1547B)	1	EA
EL1-3077	PRESS. SWITCH 0-200PSI (15 AMP) w/ENCL	UNITED ELECTRIC	H54-164	1	EA
EL1-3304	TERMINAL BLOCK 6MM UL/CE	CONNECTWELL	CTS4U-N	66	EA
EL1-3305	END PLATE 6MM	CONNECTWELL	EP2.5/4UN	12	EA
EL1-3306	GROUND BLOCK 6MM UL/CE	CONNECTWELL	CGT4N	8	EA
EL1-3307	END CLAMP 6 MM	CUTLER HAMMER	XBAES35C	4	EA
EL1-3309	6MM 10P JUMPER	CONNECTWELL	CA722/10	2	EA
EL1-3314	ULTRASAFE FUSE HOLDER CC 1P 30A	FERRAZ/SHAWMUT	USCC1I	1	EA
EL1-3315	ULTRASAFE FUSE HOLDER CC 2P 30A	FERRAZ/SHAWMUT	USCC2I	1	EA
EL1-3316	ULTRASAFE FUSE HOLDER CC 3P 30A	FERRAZ/SHAWMUT	USCC3I	1	EA
EL1-3321	302 SS 1G SGL RECEP PLATE	PASS & SEYMOUR	P-S 302 (SS7)	1	EA
EL1-3322	15A 125V 5-15R SGL RECEPTACLE	PASS & SEYMOUR	5251-I	1	EA
EL1-3365	1/2 IN. STR. LIQUID TITE CONNECTOR	OZ-GEDNEY	G4Q-50	2	EA
EL1-3450	IEC CONTACTOR 7A	CUTLER HAMMER	XTCE007B10A	1	EA
EL1-3458	IEC OVERLOAD RELAY 2.4 - 4A	CUTLER HAMMER	XTOB004BC1	1	EA
EL1-3501	30A ROTARY MOTOR SWITCH BODY	CUTLER HAMMER	C362NR30	1	EA
EL1-3502	ROTARY SWITCH SELECT HANDLE	CUTLER HAMMER	CSYR6	1	EA
EL1-3503	305MM ROTARY SWITCH SHAFT	CUTLER HAMMER	CSSA300	1	EA
EL1-3530	TRANSFORMER 150 VA FS IND CONTROL	ACME	FS-3-150	1	EA
EL1-3725	4 HOLE 22mm PB STATION	AUSTIN	ABB2NPB22MM	1	EA
EL1-3742	WHITE LENS INDICATOR LIGHT (22.5 mm)	CHINT	ND16-22DS/4-110-WH	1	EA
EL1-3743	BLUE LENS INDICATOR LIGHT (22.5 mm)	CHINT	ND16-22DS/4-110-BL	1	EA
EL1-3744	RED LENS INDICATOR LIGHT (22.5 mm)	CHINT	ND16-22DS/4-110-RD	2	EA
EL1-3745	YELLOW LENS INDICATOR LIGHT (22.5 mm)	CHINT	ND16-22DS/4-110-YW	1	EA

ID	DESCRIPTION	MFG_NAME	MFG_PART_ID	QTY	U/M
EL1-3746	GREEN LENS INDICATOR LIGHT (22.5 mm)	CHINT	ND16-22DS/4-110-GN	1	EA
EL1-3788	PROGRAMMABLE CONTROLLER 24 IN, 24 OUT	MITSUBISHI	FX3U-48MR-ES	1	EA
EL1-3883	HMI TERMINAL 4.7 IN.B/W(BLUE & WHT)	MITSUBISHI	GT1040-QBBD	1	EA
EL1-3895	HMI CABLE CONNECTION CABLE TO FX PLC 3m	MITSUBISHI	GT01-C30R4-8P	1	EA
EL1-3975	ENCLOSURE 36 * 36 * 8 NEMA 12	WIEGMANN	N12363608	1	EA
EL1-3976	BACK PANEL FOR 36 * 36 NEMA 12	WIEGMANN	NP3636	1	EA
EL2-0051	1/2 FLEX 45 DEG. ELBOW	OZ-GEDNEY	4Q-938	2	EA
EL2-0402	PRESSURE TRANSDUCER 0-100PSI 0-50 mV	HONEYWELL	9308704	1	EA
EL2-0427	TRUE LINE CIRCULAR CHART RECORDER	HONEYWELL	DR45AT-3100-00-000-0-000L 00-0	1	EA
FIT-0029	2 MALLEABLE 90 DEG STREET ELBOW		2BS9	2	EA
FIT-0057	1 1/4 MALLEABLE TEE		114BT	2	EA
FIT-0078	1 1/4 MALLEABLE UNION		114BU	2	EA
FIT-0170	1 1/4 SCH 40 CLOSE NIPPLE		114XCLBN	2	EA
FIT-0194	2 * 4 SCH 40 NIPPLE		2X4BN	1	EA
FIT-0367	STEEL TUBING 3/8 OD * .049 WALL (PRICE		-	8	FT
FIT-0507	ELBOW 3/8 TUBE-1/4 NPT	PARKER	6-CBU-S	3	EA
FIT-0510	FEMALE BRANCH TEE 3/8 TUBE-1/4 NPT	PARKER	6-OBU-S	1	EA
FIT-0516	LONG ELBOW 3/8 TUBE 3/8 NPT	PARKER	6-CCCBU-S	1	EA
FIT-0660	3 * 2 MALLEABLE HEX BUSHING		3X2BB	2	EA
FIT-0893	ANCHOR COUPLING 1/4 NPT	PARKER	207ACBH-4	6	EA
FIT-1007	CROSS	BRENNAN	5652-4-4-4-4 (1/4KMMOO-S)	1	EA
FIT-1061	3" 125# FLANGE 90 DEG ELBOW			1	EA
FIT-1070	3" 150# NA FULL FACE GASKET		3NAFFG	5	EA
FIT-1073	4" FULL FACE GASKET 150#			2	EA

ID	DESCRIPTION	MFG_NAME	MFG_PART_ID	QTY	U/M
FIT-1255	S/S 3" FLANGED EXPANSION JOINT		66 2826/3X9SSFL1PC	1	EA
FIT-1256	4" 150# BLIND FLANGE		4CSBF	1	EA
FIT-1409	4" x 3" CONCENTRIC FLANGED REDUCER 125#			1	EA
FIT-1505	3 MALLEABLE CAP		-	2	EA
FIT-1506	3 * 2 SCH 40 NIPPLE		3X2BN	1	EA
FIT-1507	EXPANDER/ADAPTER	PARKER	5405-8-8 (1/2FG-S)	1	EA
FIT-1508	MALE RUN TEE 1/4 NPT x 3/8 COPPER TUBE	ANDERSON (PARKER)	00071-06-04 (171C-6-4)	1	EA
FIT-1520	1/4" NPT MALE RUN TEE	PARKER	1/4 MRO-S	1	EA
FST-0120	HEX MACH SCREW NUT	FASTENAL	5/8 UNC	56	EA
FST-0257	HEX HEAD CAP SCREW	FASTENAL	1/2 * 2 GR 5 UNC	16	EA
MS1-0026	ALUMINUM TAPE (PRICE PER ROLL) 2 MIL	INSULATING SERVICES	3" VENTURE	2	ROLL
MS1-0030	WASHERS FOR WELD PINS	INSULATING SERVICES	K125	175	EA
MS1-0098	5" BI-THERM THERMOMETER 50-550 DEG	PRECISION INSTRUMEN	B5B4-RR (B8-5-204-08)	1	EA
MS1-0237	WELD PINS FOR KETTLE INSULATION	INSULATING SERVICES	2 1/2	175	EA
MS1-0269	BIG WRAP 2" * 3' * 25' (PRICE PER SQ FT)	INSULATING SERVICES	-	361	SQFT
MS1-0708	ALUM.SHEET STUCCO EMBOSSED(WHITE)	INSULATING SERVICES	.016 X 3' X 100' (Z26040-002)	495	SQFT
SLS-0202	1/2"DIA BUNA N70 DURO 222"FOR 6' CHAMBER	WYATT SEAL		1	EA
V1-0026	BALL VALVE 3/8"	APOLLO	70-102-01	2	EA
V1-0197	MANIFOLD STATION SEGMENT	REXROTH	R432013813 (P67703)	1	EA
V1-0198	MANIFOLD INLET SEGMENT	REXROTH	R432013811 (P67701)	1	EA
V1-0199	MANIFOLD END SEGMENT	REXROTH	R432013812 (P67702)	1	EA
V1-0200	BLANKING CAP	REXROTH	8919905502 (H891990-5502)	3	EA
V1-0201	CONNECTOR (FOR PW67697-1 VALVE)	REXROTH	8941000302 (5300-10800)	3	EA
V1-0223	Y STRAINER 1 1/4 NPT 250#	TITAN	114CIYST	2	EA

ID	DESCRIPTION	MFG_NAME	MFG_PART_ID	QTY	U/M
V1-0227	BALL VALVE 1 1/4"	APOLLO	70-106-01	4	EA
V1-0238	SOLENOID VALVE SGL TYP 740 W/O CON 50/60	REXROTH	5727495270 (PW-67697-1)	3	EA
V1-0282	1 1/4" BRONZE SWING CHECK VALVE	POWELL	114PV560Y	2	EA
V1-0439	FLOAT THERMOSTATIC STEAM TRAP 1-1/4"	SPIRAX SARCO	FT30H (FT30-1 1/4) 58114	2	EA
V1-0629	1 1/2" AIR ACTUATED ANGLE SEAT VALVE	SCHUBERT & SALZER	7010/040V151007---H	1	EA
V1-0725	DELTA VALVE 3 POS-CL-CTR-110VAC	DELTA	22020120	3	EA
V1-0767	3" 150# ACTUATED CS BALL VALVE (NO)	FLOW-TEK	3RF15CS	1	EA
V1-0774	MANIFOLD 3 POSITION	DAMAN	AD03P032P	1	EA
V1-0875	2" AIR ACTUATED ANGLE SEAT PROP. VALVE	SCHUBERT & SALZER	7020/050V15206DX----S------K	1	EA
V1-0938	2" 60# STEAM VALVE 300 DEG F.	KUNKLE	6010HHM01-LM0060	2	EA

ID	DESCRIPTION	MFG_NAME	MFG_PART_ID	QTY	U/M
924-246B	HOSE ASSEMBLY (21" OAL)	INDESCO	BXX04-E04-06FJX	2	EA
B1-0408	BEARING	IKO	CRY28VUUEO1	8	EA
BU2-0153	BRONZE BUSHING 1 * 1 1/4 * 1	BOSTON	B1620-8 (EP1620-16)	1	EA
BU2-0169	FLANGED BRONZE BUSHING 5/8 * 3/4 * 1 1/4	BOSTON	FB1012-10	16	EA
CYL-0150	CYL.3" BORE * 10" STROKE FOR DOOR ON VES	CHIEF	214-349 (HPTR73010S)	1	EA
FIT-1250	3/4-16 SAE MALE TO 3/8 TUBE MALE ELBOW	TOMPKINS	FG6801-6-8	2	EA
FIT-1285	BULKHEAD UNION ADAPTER	PARKER	6XHBU2-S	2	EA
FIT-1523	1/2 NPT SOCKET HEAD PLUG			1	EA
FST-0122	HEX MACH SCREW NUT	FASTENAL	3/4 UNC	4	EA
FST-0179	STEEL SHAFT SET COLLAR 5/8	MI	5/8	6	EA
FST-0182	STEEL SHAFT SET COLLAR 1	MI	1	2	EA
FST-0300	HEX HEAD CAP SCREW	FASTENAL	3/4 * 3 GR 5 UNC	4	EA
FST-0410	SQUARE HEAD SET SCREW	FASTENAL	1/2 * 4 UNC	2	EA
FST-0696	HEX MACH JAM NUT	FASTENAL	1/2 - 13 UNC	2	EA
FST-0720	FLAT WASHER-PLAIN 5/8	FASTENAL	5/8	8	EA
FST-1322	SOCKET HEAD CAP SCREW	FASTENAL	1/2 * 2 1/4 UNC	4	EA
MS2-0091	DRILL ROD 0.625 DIA. TYPE O-1	MCMASTER-CARR	8893K48 (OHD-35040H)	22	IN
MS2-0097	DRILL ROD 1.000 DIA. TYPE O-1	MCMASTER-CARR	8893K57 (OHD-35064M)	10	IN

ID	DESCRIPTION	MFG_NAME	MFG_PART_ID	QTY	U/M
FIT-0006	1 MALLEABLE 90 DEG ELBOW		1B9	12	EA
FIT-0059	2 MALLEABLE TEE		2BT	1	EA
FIT-0077	1 MALLEABLE UNION		1BU	8	EA
FIT-0100	2 MALLEABLE PLUG		-	2	EA
FIT-0169	1 * 6 SCH 40 NIPPLE		1X6BN	4	EA
FIT-0233	2 * 1 MALLEABLE HEX BUSHING		2X1BB	2	EA
FIT-0249	1 * 3/8 MALLEABLE BELL REDUCER		-	4	EA
FIT-0914	3/8 SPIRAL CONE SPRAY NOZZLE, BRASS	MCMASTER-CARR	3282K38	4	EA
FIT-1057	3" 150# SLIP ON FLANGE		3CSSOF	1	EA
FIT-1060	8" 150# SLIP ON FLANGE		8CSSOF	2	EA
FIT-1061	3" 125# FLANGE 90 DEG ELBOW			1	EA
FIT-1069	8" GASKET FULL FACE 150#			2	EA
FIT-1070	3" 150# NA FULL FACE GASKET		3NAFFG	2	EA
FIT-1973	2" FS THD HALF COUPLING 3000#		2FSTHC	4	EA
FIT-1987	2 * 1 * 1 CI DOUBLE TAP HEX BUSHING	WARD		4	EA
FST-0082	FLAT WASHER-PLAIN 1/4	FASTENAL	1/4	4	EA
FST-0094	LOCKWASHER-PLAIN 1/4	FASTENAL	1/4	2	EA
FST-0111	HEX MACH SCREW NUT	FASTENAL	1/4 UNC	2	EA
FST-0159	HEX MACH NYLOCK NUT	FASTENAL	1/2 UNC	2	EA
FST-0195	HEX HEAD CAP SCREW	FASTENAL	1/4 * 1 1/4 GR 5 UNC	2	EA
FST-0255	HEX HEAD CAP SCREW	FASTENAL	1/2 * 1 1/2 GR 5 UNC	12	EA
FST-0257	HEX HEAD CAP SCREW	FASTENAL	1/2 * 2 GR 5 UNC	1	EA
FST-0259	HEX HEAD CAP SCREW	FASTENAL	1/2 * 2 1/2 GR 5 UNC	1	EA
V1-0664	2" AIR ACTUATED ANGLE BODY VALVE (WS)	SCHUBERT & SALZER	7010/050V15102S2	1	EA

ID	DESCRIPTION	MFG_NAME	MFG_PART_ID	QTY	U/M
FIT-0947	1" SQUARE HEAD PLUG T304 S/S		1ST4PL	1	EA
FIT-1275	1" S/S HALF COUPLING			1	EA
FST-0921	FLAT WASHER-S/S 3/8	FASTENAL	3/8	32	EA
FST-1007	HEX HEAD CAP SCREW S/S	FASTENAL	3/8 * 1 UNC	16	EA
FST-2476	TOP LOCKNUT S/S 3/8-16	STAR STAINLESS FASTE	3/8-16 18-8	16	EA
MS1-0652	RIGID CASTER 5" DIA	MINNESOTA CASTERS	HR-528-F1-MY (46-CIR-0520-R)	2	EA
MS1-0718	SWIVEL 5" CASTER	MINNESOTA CASTERS	HS-527-F1-MY (46-CIR-0520-S)	2	EA

BONDTECH CORPORATION

AUTOCLAVE SYSTEMS

WARRANTY

BONDTECH CORPORATION **WARRANTS THAT ALL MACHINERY, EQUIPMENT AND SUPPLIES SOLD AND DELIVERED TO THE PURCHASER SHALL BE FREE FROM DEFECTS IN WORKMANSHIP AND MANUFACTURING FOR A PERIOD OF NINETY (90) DAYS FROM DELIVERY. SELLER WILL CORRECT OR REPLACE ANY OF SAID DEFECTIVE**

MACHINERY, EQUIPMENT OR SUPPLIES, PROVIDED BUYER GIVES SELLER WRITTEN NOTICE DURING SAID 90-DAY PERIOD. PROVIDED THAT ALL SERVICE OF THE MACHINERY AND EQUIPMENT IS PERFORMED BY *BONDTECH CORPORATION* **AT** *BONDTECH CORPORATION* **EXPENSE,** ***BONDTECH CORPORATION WARRANTS THAT ALL MACHINERY, EQUIPMENT, AND SUPPLIES SOLD AND DELIVERED TO PURCHASER FROM TIME TO TIME SHALL HAVE A ONE (1) YEAR PARTS WARRANTY, EXCEPTING WEAR AND TEAR OR ABUSE.***

BOTH OF THE ABOVE WARRANTIES ARE LIMITED TO THE REPLACEMENT OR CORRECTION OF THE DEFECTIVE PARTS OR MACHINERY AND SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL DAMAGES. THERE ARE NO AGREEMENTS EXCEPT AS CONTAINED HEREIN AND NO WARRANTIES EXPRESSED OR IMPLIED OF MERCHANTABILITY OR OTHERWISE.

INSTALLATION INSTRUCTIONS

1. **HANDLING:** Exercise every care to prevent damage of the ***Bondtech*** autoclave auxiliary equipment in unloading and moving it about prior to erection. Attach ropes and slings in such manner that the weight is uniformly distributed.

2. Make certain that no dirt or other foreign matter finds its way to the interior of the ***Bondtech*** autoclave or vacuum pump unit.

3. Carefully store all loose material shipped in separate boxes to insure its being available when needed.

4. Perform the following operations, prior to actual installation.

5. Move all equipment to a protected area adjacent to the installation location.

6. Remove and save the packing list

7. Unpack with care. Place the vessel on the foundation. Unpack boxes and cartons (if any).

8. Check for damage, loose parts or loss.

9. Read all tags and instructions

10. Do not begin installation until all parts are accounted for and all instructions are clearly understood.

11. The floor plan drawings, locate the unit components in their final relative position, also foundation bolt hole sizes and locations.

12. **FOUNDATION** - The ***Bondtech*** autoclave unit as well as the shredder must rest upon a solid foundation, a support which is sufficiently rigid to provide stability.

13. Prepare space on the foundation, allowing enough space around the ***Bondtech*** autoclave for safe passage of the operator and for full opening of the door (see floor plan drawing).

14. Measure the relative position of the holes in the bottom of the supporting feet of the ***Bondtech*** autoclave. Transfer these measurements to the floor in the exact position for the installation of the ***Bondtech*** autoclave.

15. Drill the floor in the position as indicated on the Floor Plan Drawing. The holes must be of sufficient diameter and depth to accept expansion shields for 1" diameter bolts.

16. Locate the ***Bondtech*** autoclave in the prepared place and insert the bolts hand tight through the supporting feed and screw into the floor.

17. **LEVELING** - Use a level on both the front and back feet to level this unit from side to side. Use a level on the very top (inside) of the vessel to level from front to back. Slight adjustments might be required after the ***Bondtech*** autoclave has been opened in order to properly balance the door. An adjusting screw is provided at the bottom of the door hinge, to balance the door.

18. **GROUTING** - Before grouting units on concrete foundation, tighten foundation bolts firmly, but not to final tightness. Recheck alignment.

19. **PIPE CONNECTIONS.** The piping should be thoroughly cleaned to remove any foreign matter such as dirt, scale, welding soot and pipe joint compound before it is connected to the unit. Pipe lines should be supported in such a manner that no strain is imposed upon the unit. Flanges should meet properly and flange faces should be parallel. Pipe

strain will cause distortion of alignment of equipment, which may result in serious trouble. See steam piping drawings. Special care must be taken when installing the piping of the vacuum condenser assembly. Drawings are provided for proper installation.

20. Shredder installation - Refer to shredder section.

21. Bin Dumper must have a solid foundation. The dumper should be plumbed and leveled. It must be anchored to the floor through the holes provided in the base. Attach cut rigger support if supplied. Dumper can also be braced to shredder if needed. Locate power unit as shown on layout drawing. Reconnect plumbing to cylinders. Hydraulic pressure in factory set. Do not adjust. Mount control box and push button box in convenient location. Make all electrical connections to state and local codes.

22. Lift Table - position in front of autoclave. Hydraulic plumbing. Actuate lift table to full up position. Shim base, if needed to level table. Adjust height if needed by loosening and moving blocks on top of lift table platform. Tighten blocks securely after any adjustments. Anchor base to floor through holes provided.

CHECK LIST FOR INSTALLING THE *BONDTECH* AUTOCLAVE SYSTEM:

(a) Bring your 2' ips steam line, minimum 100 psig, to within approximately 6' of the vessel location, connect to the steam infeed valve located on the drawing. A manual shutoff valve should be included in this 2" line for maintenance purposes.

(b) Bring your 2" ips water line, minimum 40 psig, up to within approximately one foot of the location shown on the drawing and

connection to the water infeed valve. A Manual shutoff valve should be included in this 2" line for maintenance purposes.

(c) A 1 1/4" ips line should be available to an open drain (positively no back pressure) to remove condensate from the vessel. This will connect to the trap. Note: Discharge temperature can be up to 300 Deg. F from the trap.

(d) A 3" drain from the bottom of the condenser must be available to a vented sump outside the building. Piping should be steel or cast iron.

(e) A 4" ips line should be available to open drain with no back pressure to carry the water from the vacuum pump. This line will connect to the bottom of the vacuum pump as shown on the floor plan.

(f) There should be an 8" vent pipe from the top of the condenser tot he outside of the building to carry vent to atmosphere.

(g) A 1/2" ips air line, minimum 100 psig, should be available in the vicinity of the control panel. This line should include a shutoff valve for maintenance purposes. Connection to regulators and filters are 1/4" npt.

(h) The three phase electric power is connected to the motor on the vacuum system power package as shown on the Electrical Schematic. One leg of the three phase wire will then be connected to the transporter in the control panel.

(i) Two 2" ips pipe (steel or cast iron) should be provided to atmosphere for the pressure relief valve.

ASSEMBLY PIPING

(Note that all flanges of piping that have been disassembled for shipment will be easily matched. Place all piping assemblies on the floor according to the drawings). Once in order assemble as follows:

(1) Install gasket and bolt the flanges together. Use silicon gasket sealer rated for steam service. Be certain to place temporary supports under each piece as it is added to the vacuum pump assembly to avoid straining or twisting the pump casing.

(2) Connect the steam inlet pipe and valve as shown on layout drawings.

(3) Condensate drain piping is assembled, make sure that the condensate is going into the drain. Make sure the drain is cast iron or steel.

(4) When all piping is connected, provide permanent supports, as needed for the vacuum pump piping to prevent damage to the pump.

(5) Install safety valve to top of vessel and connect to vent piping.

DOOR OPERATION

IMPORTANT

▲! Operation of the door, is designed to be safe and reliable, however, if precautions are not followed, injury and property damage may occur. Be sure to read and thoroughly understand the procedures and principles stated here.

The operator must be aware of the design and operation of the mechanism as well as any special characteristics in its operation. The door mechanism is extremely heavy and movement must be gradual and gentle to prevent excessive swing or hitting of the various components.

INTERLOCKS

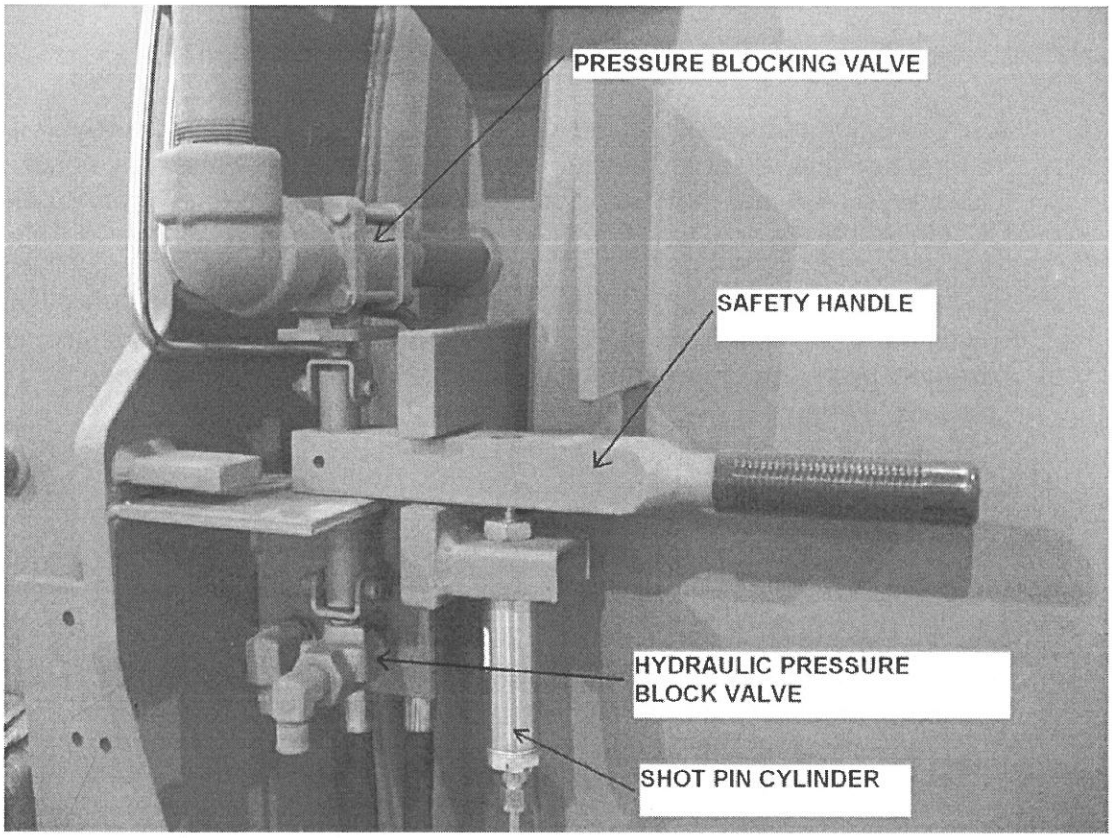
▲! The door is fitted with a DOOR SAFETY INTERLOCK. The purpose of this is to prevent the operator from inadvertently opening the door while under pressure. It is also used to disable the process inside the pressure vessel. Prior to shipment, the DOOR SAFETY INTERLOCK is tested to assure proper operation.

UNDER NO CIRCUMSTANCES ATTEMPT TO MODIFY, ALTER OR CIRCUMVENT THIS SAFETY DEVICE!

A small, vessel pressure operated spring opposed cylinder, a part of the DOOR SAFETY INTERLOCK pins the operating handle in the locked position any time there is pressure in the vessel. Operation of the DOOR SAFETY INTERLOCK HANDLE actuates the VESSEL PRESSURE INDICATOR VALVE, the function of which is to be a visual, audible indicator to alert the operator if any pressure remains in the vessel once the DOOR SAFETY INTERLOCK HANDLE is opened.

NOTE! – If pressure is vented from the VESSEL PRESSURE INDICATOR VALVE, **DO NOT UNLOCK THE DOOR!** This indicates that pressure is present in the vessel.

TYPICAL DOOR SAFETY INTERLOCK



TO OPEN THE DOOR

1. Check that there are no people or equipment in the path of the door.

2. Verify that there is no pressure or vacuum in the autoclave and that all processes inside the pressure vessel have been properly terminated.

3. Unlock the DOOR SAFETY INTERLOCK HANDLE. If the handle will not release, recheck the vessel for pressure.

4. Turn the hydraulic power unit "ON".

5. Push the hydraulic valve lever (or toggle switch) marked **"LOCK RING LOCK/UNLOCK"** and hold until the locking ring stops rotating. Release the lever and it will return to the neutral, center position. Rotation of the locking ring is approximately 6" to 7". Visually verify complete rotation by viewing the complete door lug is centered within the LOCKING RING cutout.

6. On autoclaves with door swing cylinders, push the hydraulic valve lever (or toggle switch) marked **"DOOR OPEN/CLOSE"** and hold it while the door swings open. As the door approaches the fully open position, *slowly* release the lever, allowing it to return to the neutral, center position. On manually opened doors, the operator must prevent the door from opening too quickly which can cause damage to the door components or any other obstructions.

NOTE! - Do not allow the door to come to a sudden stop while traveling at full speed. The door is very heavy and may damage the hydraulic system if allowed to stop suddenly. The speed of doors 72" diameter and larger can be adjusted with the flow controls located on the swing cylinder or elsewhere in the circuit.

Do not continue to drive the door open once it has reached the open position. To do so may damage the door's hinge.

7. The hydraulic power unit may be turned "OFF" at this time.

TO CLOSE THE DOOR

1. Check that there are no people or equipment in the path of the door.

2. Turn the hydraulic power unit "ON".

3. Push the hydraulic valve lever (or toggle switch) marked **"DOOR OPEN/CLOSE"** and hold it while the door swings closed. As the door approaches the fully closed position, slowly release the lever, allowing it to return to the neutral, center position.

NOTE! - Do not allow the door to slam closed as damage may result.

Do not continue to drive the door closed once it has reached the closed position. To do so may damage the door's hinge. The action of the LOCKING RING is used to fully seal and secure the door.

4. Pull the hydraulic valve lever (or toggle switch) marked **"LOCKRING LOCK/UNLOCK"** and hold, until the LOCKING RING lugs completely engage the door lugs and the LOCKING BLOCK clears the DOOR SAFETY INTERLOCK HANDLE. Release the lever and it will return to the neutral, center position.

5. Visually inspect that the door lugs are fully engaged by viewing their position within the LOCKING RING cutout. This must be +/- ½" of full wedge engagement.

LUBRICATION

WEDGES: Wipe clean and lubricate the face of all wedges on the locking ring and the door with high quality, high temperature grease similar to Chevron Molybdenum Grease EP, NLGI 2. A thin film of lubricant must be maintained on the wedges at all times. This needs to be verified at least once daily and more frequently if necessary depending on the number of cycles run each day.

LOCKING RING: Lubrication is provided via several hydraulic grease fittings on the rear of the lock ring. Use high-pressure grease similar to Chevron Molybdenum Grease EP, NLG12. Take care to not allow excessive grease or debris to accumulate. These surfaces, as well as the wedges need to be completely cleaned and re-greased on a monthly basis.

O-RING: Wipe clean and lubricate face of O-Ring daily or as often as necessary. The seal face and seal must be kept as clean as possible. Use O-Ring grease that is compatible with the gasket material and capable of withstanding operating temperatures.

HINGE BEARINGS: A hydraulic grease fitting is provided on both hinge bearings. Use a grease gun with grease conforming to NLG12 penetration, free from chemical impurities, such as dust, rust, metal particles or other abrasives. Chevron Black Pearl Grease EP, NLG12 is recommended. The grease should be pumped slowly until a slight bead forms around the seals. This bead, in addition to acting as an indicator of adequate re-lubrication, provides additional protection against the entry of foreign material. This should be performed approximately every 3 months. (Refer to the following table of maximum grease capacities).

LOCKING RING ROLLERS: A hydraulic grease fitting is provided in the rear of the roller axle to lubricate rollers. There are 2 rollers on each guide bracket.

NOTE! Any grease or lubricant used should be compatible with your operation.

DOOR MAINTENANCE

▲!! As with any type of machinery, periodic maintenance is necessary for reliable service. It also provides the benefit of maintenance personnel becoming familiar with the equipment for efficient and accurate trouble-shooting.

This schedule is based on a 40-hour operating week and should be used as a reference only. Your actual periodic maintenance schedule should be based on the results of regular inspection of maintenance items.

IMPORTANT! Refer to manufacturers data sheets for additional recommended operating and maintenance instructions.

EACH CYCLE:

1) Visually inspect door wedges (verify lubricant and no visual damage), sealing face and o-ring surfaces for accumulation of debris and foreign material. Clean and remove as required. Check and clean the lower inside surface of the locking ring to prevent debris from collecting and degrading or obstructing door operation.

2) DOOR SAFETY INTERLOCK – Check for free and complete motion and alignment. Clean or adjust if necessary.

MONTHLY:

1) Hydraulics – Inspect all equipment for leaks, cleanliness and wear. Verify proper hydraulic fluid level in the hydraulic power unit's reservoir.

2) Plumbing – Inspect and clean any piping strainers or filters, verify that no valves are leaking.

3) Inspect for alignment, clearance and smooth operation of interlocking parts.

a) Wedges – Check for foreign substance. Clean with solvent if necessary. Lubricate face of wedges with recommended grease.

b) Locking Ring – Check the inside surface of ring, where it rides on the vessel lugs, for foreign substance. Clean with solvent if necessary. Lubricate with recommended grease.

c) O-Ring – Wipe clean and inspect for signs of wear such as cracks, splits, cuts or permanent compression.

d) Hinge Bearings – Wipe seal clean and inspect for signs of wear such as cracks, splits, looseness and excess play. Bearing should sit flat against hinge arm and the adjustment bolts must be tight. Lubricate if necessary, as instructed in the "LUBRICATION" section of this manual.

e) Lower Hinge Thrust Washers (Horizontal Door) – Inspect for excess grease and debris buildup around washer. Wipe clean and lubricate if necessary as instructed in the "LUBRICATION" section of this manual.

f) Locking Ring Rollers – Check Locking Ring rollers for foreign substance. Clean with solvent if necessary. Lubricate if necessary, as instructed in the "LUBRICATION" section of this manual. Verify that rollers are making good contact with the locking ring and shell.

O-RING REPLACEMENT:

1) Remove the worn O-Ring from the groove. Inspect the groove for any rust, dirt or debris which might interfere with the o-ring sealing and clean if necessary.

2) Lubricating the O-Ring with O-Ring grease that is compatible with the gasket material is recommended.

3) To start, insert the new O-Ring into the gasket groove in four equally spaced locations; top, bottom, right and left sides. **Do Not** twist the O-Ring. A *soft* faced mallet or hammer may be used to push the gasket into a tight groove.

4) The O-Ring will be held in place by the dove-tailed gasket groove. Continue to install the O-Ring evenly in the groove. DO NOT stretch or twist the O-Ring while installing.

5) If the new O-Ring needs to be removed and will be re-used, an O-Ring pick tool is recommended so that the gasket can be removed without damage.

NOTE! – It may take one or more pressure / de-pressurization cycles to "seat" the new O-Ring.

RECOMMENDED MINIMUM PERIODIC MAINTENANCE SCHEDULE

TASK	SCHEDULE	NOTES
Door Safeties:		
Limit Switch	Monthly	Test for Proper Operation
Vessel Pressure indicator Valve	Monthly	Test for Proper Operation No leaks
Pneumatic Locking Cylinder	Monthly	Test for Proper Operation
Hydraulic Interlock Valve	Monthly	Test for Proper Operation
Autoclave Door:		
Clean & Inspect O-Ring	Each Cycle	Replace if Damaged
Clean Lower Areas of Locking Ring	Each Cycle	
Clean, Inspect & lubricate door wedges	Daily	
Clean, Inspect & Lubricate Locking Ring	Monthly	
Clean, Inspect & Lubricate Locking Ring Rollers	Monthly	
Inspect Door alignment	Monthly	
Lubricate Hinge Bearings	Quarterly	
Comprehensive Door & Vessel Inspection	Annually	Contact Bondtech
Hydraulic System:		
Inspect for leaks & cleanliness	Monthly	
Check Fluid Level in Hydraulic Reservoir	Monthly	
Check & Clean Breather Cap	Quarterly	
Check & Clean Screen Filter	Semi-Annually	
Change Hydraulic Fluid	Annually	
General: Operator Training & Review	Annually	
Verify Presence of Warning Labels	Annually	
Verify Operation of Pressure Gauge	Annually	

DOOR ADJUSTMENT

Door adjustment is performed at the factory and readjustment should not be necessary under most normal operating conditions. Should adjustment become necessary, use the Door adjustment procedures outlines below and the Door Adjustment Sketch to determine the direction of bolt adjustment.

Preliminary Conditions:

1. Hinge pin must be in vertical position so that the door will balance.

2. Center square end of hinge pin in top and bottom hinge brackets.

3. Any pitch to the vessel will require compensation in adjustment of the hinge pin. Centerline of the hinge pin must be parallel to the door face.

4. Door and skirt flange faces must meet squarely without restriction or without application of undue force. If either condition exists, the hinge pin is either too far forward, too far back or cocked at an angle.

Adjustment:

1. Close and lock door.

2. From vessel interior with gasket removed and door swung closed, with feeler gauge check space between door flange face and skirt flange face. Under correct operating conditions, this space should be the same all around, indicating parallel surfaces.

3. From vessel interior check concentricity of door I.D. and skirt I.D.

4. Three (3) vertical adjusting screws, located on the bottom hinge block or bearing, are provided to give up or down adjustment of the door horizontal centerline.

5. Door pivot adjustment is located in the hinge are web plate on the door centerline. This adjustment allows the door to close without restriction about the vertical axis, i.e., door flange and skirt flange touching at 9 o'clock or 3 o'clock. Loosen or tighten hex head cap screw as necessary for door sealing surfaces to attain parallel alignment. Tighten check nut to web plate.

6. Left and right set screw, located at top and bottom of hinge pin, compensate for sideways concentricity and adjustment error.

Adjustment continued:

7. Front and back set screws, located at top and bottom of hinge pin, compensate for relative planes of skirt flange and door flange faces with respect to each other on the vertical centerline. (Door in at bottom and out at top or vice-versa).

8. Compound adjustment of four (4) top and four (4) bottom set screws (left and right, front and back) may be required to accomplish proper door adjustment.

9. Do not try to compensate for misalignment in two directions at one time.

10. To remove the door for internal access during fabrication, be sure to brace under the hinge pin and secure the door with a crane. Back off two (2) set screws 90 degrees apart top and bottom and remove hinge pin. Unlock the door and remove by a crane. Be sure door flange face is protected from the damage as this is a machined surface. Any damage to this face can have serious pressure sealing effects.

MAINTENANCE PROCEDURES

1. AUTOCLAVE

SAFETY TIPS:

Please observe the safety precautions listed in order to minimize the risk of personal injury or improper maintenance methods which could damage the ***Bondtech*** autoclave system, or rather render it unsafe. Please understand that these precautions are not exhaustive.

IMPORTANT. Due to the nature of the ***Bondtech*** autoclave system, the potential for a service technician coming into contact with the contaminated products is present. Prior to any repair procedure of the unit, the following safety precautions must be followed:

1. Run an empty cycle to decontaminate the autoclave chamber and exhaust lines.
2. Prior to servicing, drain line components, decontaminate drain line strainer, trap, piping downstream of trap and valve by soaking them in a 5% hypo chlorite solution (e.g., Clorox) for 15-20 minutes.
3. Extra precaution is necessary if the unit has shut down prior to the required exposure cycle. Before removing any of the material inside the chamber allow steam to enter the autoclave. Allow the autoclave to stand at 285 Deg. for 60 minutes for decontamination.
4. If a bag has broken and waste has spilled out inside the autoclave chamber, a gloved, gowned, booted and masked operator should remove the waste from the autoclave and transfer it to a new bag. A cycle should then be run.
5. If the steam source is lost, the drain piping can be decontaminated using a 5% hypo chlorite solution (e.g., Clorox) allowed to stand for at least 20 minutes. If the autoclave requires servicing, it is recommended that the service be postponed until the steam source is restored and a cycle is ran.
6. Avoid spills around the area surrounding the autoclave. Caution must be taken regarding spilled items which are not decontaminated.

WARNING: THESE VESSELS SHOULD ONLY BE SERVICED BY PERSONNEL TRAINED IN VESSEL MAINTENANCE, OPERATION AND WHO ARE FAMILIAR WITH THIS MANUAL

1. **Do not weld** anything to any part of the vessel, door or locking ring, etc.
2. **Do not perform any cutting**, drilling or fastening to any part of the vessel or door
3. Assume the **vessel is pressurized** any time the door is closed. Do not remove or adjust any vessel fittings unless the door is opened.
4. **Do not enter** the vessel unless you are certain that there is sufficient oxygen present.

5. **Regularly check** the vessel for proper door closure, correct alignment, cracks, damage, or any unusual condition. Do not operate the vessel in the presence of any of the above conditions.

OPERATING PRECAUTIONS:

1. Use care in handling and processing infectious biomedical waste. Please follow local, state and/or federal guidelines to determine the category of infectious waste which can be autoclaved
2. Do not process sealed containers (ampule type, crimped sealed, screw capped, etc.), or aerosol containers. Potential of explosion exists which could cause personal injury from flying glass, hot liquids and metal fragments. Nursing must be advised to separate these containers.
3. Do not process toxic materials, radioactive waste, hazardous chemicals, pathological wastes, food chemonuclear waste or antineoplastic wastes in this unit.
4. Always process infectious bio-medical waste through the entire cycle. Failure to do so could cause injury.
5. Always wear proper equipment when working in the autoclave area.
6. Do not overfill carts.
7. Exercise care when opening autoclave door.
8. Use caution when loading and unloading carts.
9. The ***Bondtech*** autoclave system operates at 285 to 305 Deg. F. Do not touch door, ramps, cart, vessel or piping without protective gloves.
10. Before performing any inspection or maintenance procedures, ensure control key switch is turned off, facility power to unit is disconnected, and the autoclave and accessories are allowed to cool to room temperature.
11. Be careful of steam escaping from safety valve. To prevent burns, wear gloves or use an extension device if it becomes necessary to operate the safety valve.
12. Prior to servicing drain line components, decontaminate drain line strainer, trap, piping, downstream of trap and valve by soaking them in 5% hydrochloride solution (e.g., Clorox) for 20 minutes.
13. Do not open drain line while chamber is pressurized.
14. Considerable force may be required to unlock door manually. Use proper techniques to avoid strain and injury. Never use manual pry bar and hydraulic system at the same time.
15. Do not overfill hydraulic reservoir. Spilled oil creates slipping and fire hazard. Clean up all spills and leaks.
16. Before attempting any removal of controller parts, disconnect facility power to unit.
17. Exhaust to unit must be vented to atmosphere through a condenser. Building exhaust outlets must be removed from air-intake ports. Area immediately surrounding unit must have a minimum of 10 air changes per hour.
18. Do not permit unit to freeze. Ice found in pipe may inhibit operation or cause a bursting hazard. To avoid personal injury and equipment damage, maintain operating environment above 32 Deg. F.

WARNING - IMPORTANT - WARNING - IMPORTANT - WARNING - IMPORTANT

Repairs and adjustments must be performed only by experienced personnel, fully acquainted with this equipment. Maintenance done by inexperienced, unqualified personnel or installation of unauthorized parts could cause personal injury, invalidate the warranty, or result in costly damage. Contact your ***Bondtech*** sales or service representative regarding service operation.

CAUTION

DO NOT OPERATE UNIT DURING WATER FAILURE. DRAIN TEMPERATURE MAY EXCEED 140-150 DEG. F, DAMAGING FACILITY DRAIN SYSTEMS, AND THE STEAM IN THE ROOM WILL NOT BE CONDENSED CAUSING EXCESSIVE STEAM IN THE AUTOCLAVE AREA.

PREVENTIVE MAINTENANCE

Preventive maintenance is designed as an aid in setting up a schedule of regular inspections and checks to determine the actual condition of the unit and to maintain it in proper working order. The system use of a preventive maintenance program may be expected to reveal any potential adverse condition in the early stages when the remedy is relatively simple and inexpensive.

The ***Bondtech*** autoclave should be kept clean at all times and special attention should be given to the safety pressure interlock system to guard against sticking of parts:

PERIODIC INSPECTIONS:

- Check pressure relief valve for proper operation by operating it manually.
- Inspect for fine cracks at supports. These cracks are known as stress corrosion and are generally caused by concentrated stress due to settling of floor or piers.
- Check door gasket for deterioration and make sure that the door safety interlock assembly has free and complete motion and alignment, the gasket must be free of foreign material. Replace gasket if there is any evidence of splitting, cracking, fraying, cuts or other imperfections.
- Check for proper seating action of the head lip on the gasket and center if necessary using the hinge arm jam nut.
- Inspect all components of the door for loose attaching hardware and tighten as necessary.
- Check accuracy of instruments, gages and thermometers.
- Make sure trap in drain lines from steam supply line to vessel are functioning properly.
- Frequently inspect flanged joints and other pipe connections.

GENERAL INSPECTION AND MAINTENANCE

The following procedures should be performed at regular intervals, as indicated. This frequency is the minimum and should be increased if usage of unit demands.

SAFETY VALVE: *In accordance to the National Board of Boilers inspection code, periodic checking of the safety valve operation should be performed. Also periodic inspection of the autoclave by a qualified inspector is advisable. Check state and local requirements for such inspections.*

DOOR:

GENERAL - Maintenance of the door consists primarily of periodic lubrication, minor adjustment, and inspection at regular intervals to determine the necessity for parts replacement.

Caution - Cleanliness of the gasket seating surface is vitally important to proper sealing action and long gasket life.

Warning - Do not use any synthetic oils to lubricate this machine. (i.e., Marvel mystery oil. It may attack the seal and valves and air cylinders). Gasket face may be lubricated with liquid soap.

DOOR LUBRICATION

Lubricate at intervals depending on the frequency of operation.

1. Lubricate fittings at rear of the locking ring and shell once weekly
2. Guide and support rollers once weekly
3. Hinge pin bearing once monthly
4. Head and locking ring wedges once weekly. Use high temperature base grease.

INSPECTION: If the door fails to seal properly, check per instructions below:

1. Check for proper seating action of the head lip on the gasket and center if necessary using the hinge arm jam nuts. If any portion of the door seal comes out of the groove, use a hard rubber faced hammer to push it back into the groove. The hammer should contact only the outside of the gasket, not the inside lip portion.
2. Check the gasket for condition. Replace the gasket if there is any evidence of splitting, cracking, fraying, cuts and other imperfections. Refer to gasket installation instructions.
3. Inspect all components of the door for loose attaching hardware and tighten as necessary.
4. All wedges and sliding surfaces should be inspected for damage, excessive wear and missing wedges.
5.

WARNING: The wedges are an important factor in maintaining hydraulic pressure on the locking assembly to maintain vessel closure. Failure to repair or replace them immediately upon detection of damage, loss or excessive wear can be dangerous. Do not operate the vessel until repairs have been made by certified personnel.

MINOR MAINTENANCE

Control switch must be turned off, facility power to unit must be disconnected, and unit accessories must be cooled down to room temperature.

Warning: wear proper safety equipment, gown or protective suit, face shield, puncture and heat resistant gloves, head cover, shoe covers covering steel toe shoes, when cleaning or maintaining the ***Bondtech*** autoclave.

DAILY MAINTENANCE:

1. Clean chamber and drain line strainers.
2. Remove and bag any debris from autoclave floor
3. Check gages and controller for cracked or broken covers or obvious damage.
4. Inspect piping for loose fittings or other obvious defects.
5. Remove lint and dirt from around unit. Clean debris and spillage, especially around and between loading tracks.
6. Inspect cart, door and lift table for any burrs. Remove as necessary using file or grinding wheel.

WEEKLY MAINTENANCE:

1. Verify paper supply for the chart recorder.
2. During cycle, verify all control panel indicator lights operate properly.
3. During cycle, visually inspect door gasket for proper sealing of autoclave. Replace gasket as necessary.
4. Clean drain line with trisodium phosphate at a concentration of two tablespoons/gallon or equal.
5. Clean steam strainers as follows:
    a. Remove hex plug and gasket
    b. Pull strainer screen from body
    c. Scrape and polish all rust and residue from strainer screen and body; Ensure all perforations are clear. Use a wire brush or steel wool. Replace screen if damaged, badly rusted or corroded.
    d. Insert screen into strainer body. Ensure no dirt or other particles remain in strainer body.
    e. Return gasket and tighten hex plug. Use new gasket if needed.
    f. Ensure all pipe connections are tight after assembly.

MONTHLY MAINTENANCE:

WARNING: Do not overfill hydraulic reservoir

1. Check hydraulic fluid level. Open door and check fluid level in hydraulic reservoir by removing the breather cap and looking into reservoir.
2. Inject a high temperature grease into top and bottom of door hinge at grease fittings.
3. Grease door lock rollers, wedges and back surfaces of sliding ring.

QUARTERLY MAINTENANCE:

1. Check autoclave safety valve as follows:
    a. Inspect valve for accumulation of rust, scale or other foreign substances which would prevent free operation of valve. Any discharge piping opening must be clear and free from restrictions.
    b. Operate the lever several times. Lever should move freely and return to its closed position after operation.

c. Check valve for steam leakage. If valve is leaking, operate the lever several times to see if leakage will stop.
d. If leakage continues, discontinue operation of unit and replace leaky safety valve.

WARNING: BE CAREFUL OF STEAM ESCAPING FROM SAFETY VALVE. TO PREVENT BURNS, WEAR GLOVES OR USE AN EXTENSION DEVICE IF IT BECOMES NECESSARY TO OPERATE THE SAFETY VALVE.

2. Inspect insulation for holes or tears.

2. SHREDDER

WARNING: NEVER ENTER THE SHREDDER HOPPER WITHOUT THE ELECTRICAL SUPPLY LOCKED OFF.

Bondtech's systems shredder is designed for minimum maintenance. However, certain steps must be taken to ensure continued trouble free operation:

1. Every 750 hours, remove the drain plug at the bottom of the main gearbox and drain the old oil.
2. In time, depending on what kind of material is being shredded and how much has been through the shredder the knives may become rounded at the points. The knives may then be ground back to a point by removing the hopper and grinding the face of the knife hook with an appropriate grinder. Extreme caution must be used during this process to insure that the shredder is not inadvertently started. Power to the control panel should be switched off and the key removed.
3. If new knives or other parts are required, please call.
4. The oil in the electric motor gear heads should be changed as per Motor Manufacturer's manual.
5. The shredder should be inspected once per day (or per shift if applicable) for loose bolts, knife wear and other signs of distress and corrected prior to initiating further operation. The stack up of knives and spacers must remain tight. (Knives must not show any movement relative to shaft) Tighten as required.

SERVICE SCHEDULE FOR SHREDDER

SERVICE TO PERFORM	**FREQUENCY**
MECHANICAL	
Grease Rear Bearings	**Weekly -30-40 operating hours**
Check Gear Box Oil Level	**40 Hrs.**
Replace Gearbox Oil	**750 Hrs.**

Grease Motor Bearings **Per motor manual**
Tighten Shaft Nut Stack Up **Weekly or as Required**
Visual inspection of cutting Chamber **Every two weeks**

ELECTRICAL

Check Motor Thermal Overload Setting **6 months**
Check Control panel for Proper Functioning **6 months**

RECOMMENDED FLUIDS AND LUBRICANTS

MECHANICAL

Motor Grease **Monoplex #2 - Shell Brand**
#01-02 Bearing Grease **(or equivalent)**

GEAR OIL

Shredder Gearbox **85 W 140**

GENERAL SHREDDER MAINTENANCE:

Routine mainteannce of reduction equipment is a key element of minimising machine down-time and maximising process productivity. Conditions that cause wear and breakdown can vary dramatically, such as:

- Abrasive process materials
- Shock loading
- Operating hours
- Inside or outside environment
- Dust condition
- Excessive reversals

Correspondignly, the suggested maintenance schedule respresents average conditions over a 40 hour a week. Therefore, if abnormal conditions similar to the above are present, the maintenance program should be reviewed. It is also recommended to check for unusual noise or excessive vibrations. The temperature rise of machine parts including bearings and cutting chamber components sould be monitored. Any cause of overheating should be corrected immediately.
We recommend that the maintenance schedule be posted in an appropriate location for operations and maintenance personnel. Completed maintenance reports will form a valuable record for ordering parts and scheduling repairs.

GUIDE FOR PREVENTIVE MAINTENANCE

PREPARATION FOR PREVENTIVE MAINTENANCE

1. **Check Electrical Connections** _____
2. **Inspect printout for signs of trouble** _____
3. **Install test equipment** _____
4. **When necessary shut off building services and drain all lines** _____

DOOR ASSEMBLY

1. **Insert door for easy operation** _____
2. **Check condition of door gasket for wear and tear, and replace as necessary** _____
3. **Verify proper door alignment** _____
4. **Grease hinge, door lock, wedges and back surface of sliding ring** _____
5. **Inspect door lock mechanism for wear** _____

UNIT PIPING

1. **Inspect input strainer for debris** _____
2. **Clean strainers as necessary** _____
3. **Inspect steam trap for proper operation** _____
4. **Rebuild steam trap** _____
5. **Inspect each gauge for accuracy** _____
6. **Calibrate or replace gauge if required** _____
7. **Make internal inspection of each check valve** _____
8. **Replace or rebuild check valve if necessary** _____
9. **Check safety valve for proper operation** _____
10. **Check Each solenoid and ball valve for proper operation** _____
11. **Rebuild each solenoid and ball valve** _____
12. **Inspect chamber drain strainer for debris**
13. **Flush chamber drain line** _____

CONTROL SYSTEM

Solid state electronic device - No maintenance required _____

UNIT HYDRAULICS

1. **Verify correct operation of system** _____
2. **Check piping for leaks** _____
3. **check oil level** _____
4. **Change oil** _____
5. **Check pump output, adjust as necessary** _____

6. **Verify system enable/disable switch works** _____
7. **Inspect door lock cylinders; rebuild as required** _____

LIFT TABLE

1. **Check valve for sticking** _____
2. **If motor growls - pump is picking up air - Check suction line for lose fittings.** _____
3. **Check level of oil in reservoir** _____
4. **Check for bounces or vibrations of platform and bleed air from hydraulics** _____
5. **Check fittings, piston and ram** _____
6. **Check for obstructions under lift table** _____

SHREDDER:

1. **Check Gear Box oil** _____
2. **Check points of knives** _____
3. **Check the oil in the electric motor gear**
4. **Check for loose bolts, knife wear, or other signs of distress** _____

DOOR GASKET INSTALLATION

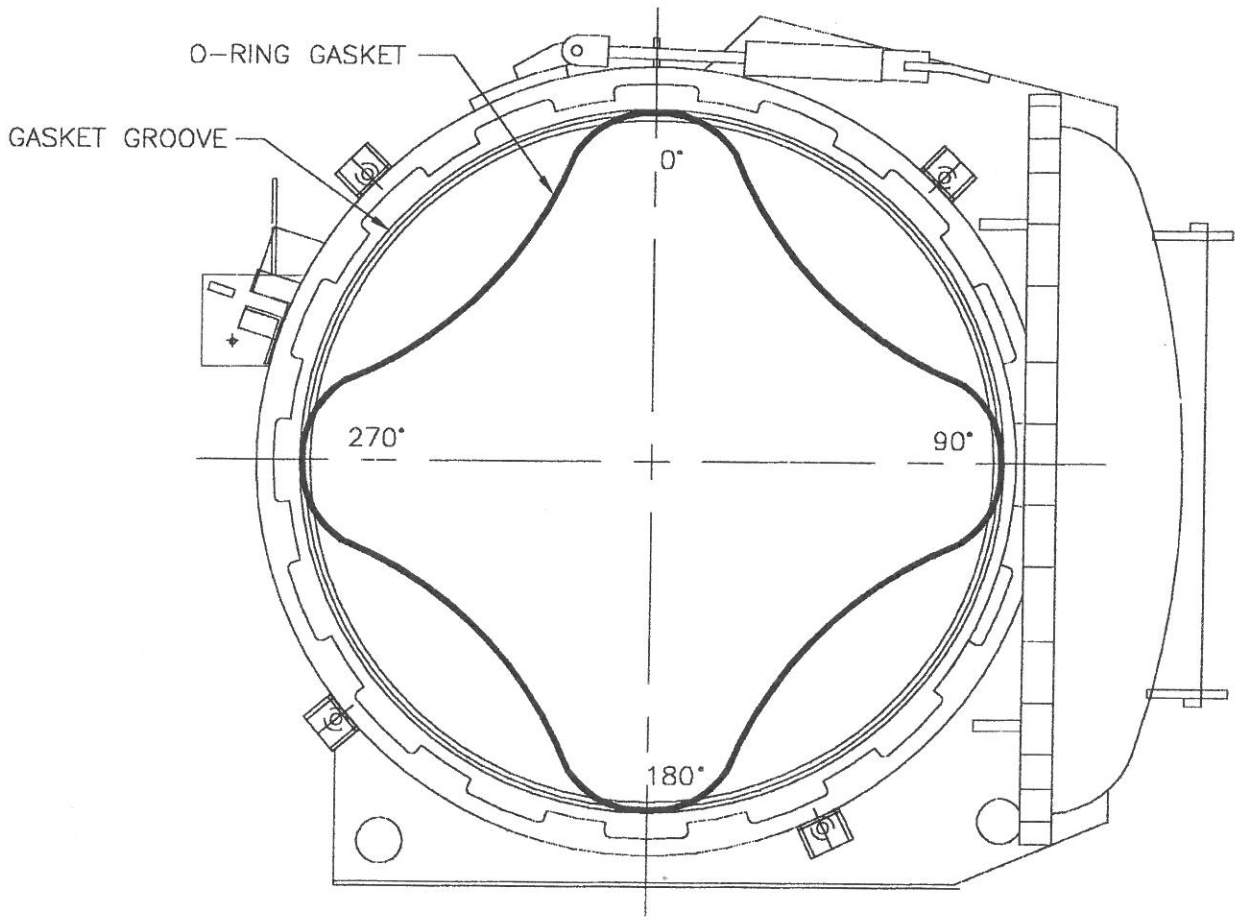
1.) INSERT O-RING GASKET AT 0, 90, 180, AND 270 DEGREES UNIFORMLY DISTRIBUTING GASKET.

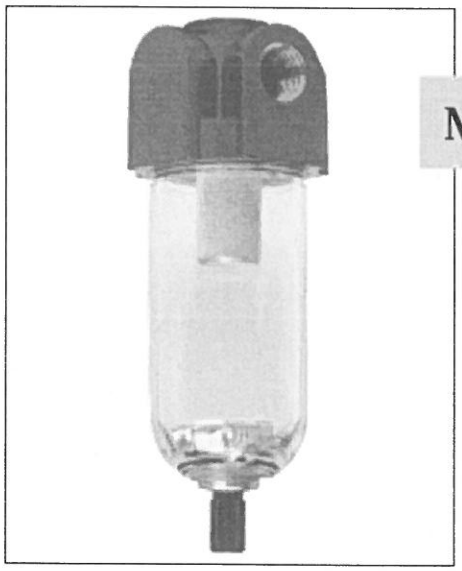
2.) INSERT REMAINING O-RING INTO GROOVE BETWEEN POINTS, BEING CAREFUL NOT TO STRETCH O-RING.

CAUTION:

* ONLY USE BUNA-N OR HIGH TEMP. SILICONE GASKETS.

* LUBRICATE GASKET WITH PASTE SOAP. DO NOT USE PETROLEUM BASED LUBRICANTS.





Miniature Particulate Filters

F3

FEATURES
- 20 micron sintered bronze element
- High strength, recleanable
- 1 oz. polycarbonate bowl
- Manual twist drain

OPTIONS
add suffix to part number in alpha and numeric order

Overnight Drains
An overnight drain operates when a compressed air system is shut down. It clears accumulated condensate from a filter bowl when pressure falls to 3 psig or less. It then closes when pressure rises to 6 psig.

J Overnight drain for polycarbonate bowl F300-01**J**
Push to manually drain.

K Overnight drain for metal bowl F300-01**KM**
Twist to manually drain.

M Metal bowl F300-01**M**

Z Piston drain F300-01**Z**

-5 5 micron element F300-01**-5**

SPECIFICATIONS
WARNING! *Polycarbonate plastic bowls could rupture if exposed to incompatible chemicals whether inside or outside the bowl. If such chemicals are present, use a metal bowl.*

Polycarbonate Bowl
- Max. pressure 150 psig
- Operating temperature range 40˚F to 125˚F

Metal Bowl
- Black coated aluminum
- Max. pressure 250 psig
- Operating temperature range 40˚F to 175˚F

Piston Drain
Note: Z option is differential drain which opens & ejects water only when a differential pressure is created at the start of air flow. The piston drain lifts up (approx. 1 second) & closes, it will not operate again until the flow stops, then starts back up again.
- Max. pressure 175 psig
- Operating temperature range 40˚F to175˚F

Body black coated zinc
Baffle plastic
Seals Buna N

Elements
- 20 micron sintered bronze
- 5 micron sintered bronze

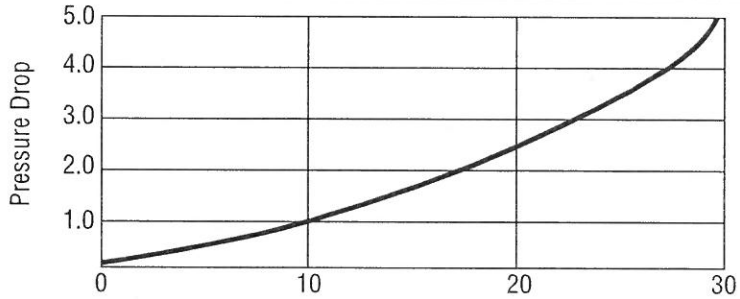
KITS
Bowl Kits
- Polycarbonate. BKF300
- Polycarbonate with overnight drain BKF300J
- Metal BKF300M

Element Kits
- 20 micron 2-pack EKF300
- 5 micron 2-pack EKF300-5

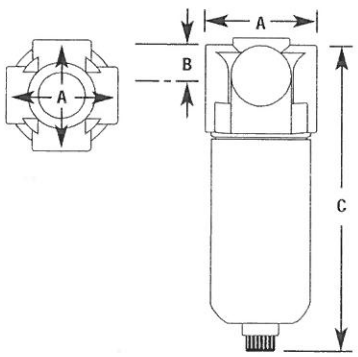
Drain Kit
- Piston drain kit PKF300

- Mounting Bracket FBK3

PERFORMANCE CHARACTERISTICS FOR 20 MICRON ELEMENT



* 5 micron element calculate a 10% less flow.



DIMENSIONS

PIPE SIZE	MODEL NO.	MAX. FLOW SCFM*	BOWL CAPACITY	DIMENSIONS (INCHES) A	B	C	WEIGHT (LBS.)
1/8"	F300-01	27	1 oz.	1 1/2	1/2	4 5/8	.5
1/4"	F300-02	27	1 oz.	1 1/2	1/2	4 5/8	.5

* Flow scfm based on 5.0 psi △ p @ 100 psig inlet.

Miniature Air Regulators

R26

FEATURES
- Micro seat finish to ensure no reduced pressure creep
- Diaphragm operation
- Relieving style standard
- Three position non-rising adjustment knob; push to lock, pull to adjust, detach to make tamper resistant
- Easily panel mounted
- Tamper-proof cap included
- Lightweight

OPTIONS
add suffix to part number in alpha order

B 2-Position Mechanical Lock Knob R262**B**
G Gauge (0-160 psi) R262**G**
I Instrument pressure . . . . R262**I** 3 to 20 psi adjustment
L Low pressure . . . . . R262**L** 3 to 60 psi adjustment
N Non-relieving R262**N**
P Panel mount R262**P**
U No gauge ports R262**U**
V All 1/4" ports R262**V**
Y1 Viton diaphragm/valve set R262**Y1**
Y2 EDPM diaphragm/valve set R262**Y2**

SPECIFICATIONS

Body
- Glass filled nylon

Bonnet
- Glass filled nylon

Seals
- Buna N

Supply Pressure
- 250 psig

Operating Pressure Range
- 5 to 125 psig standard
- 3 to 60 psig optional
- 3 to 20 psig optional

Operating Temperature Range
- 40°F to 120°F

Gauge Ports
- 1/8" standard, full flow

KITS

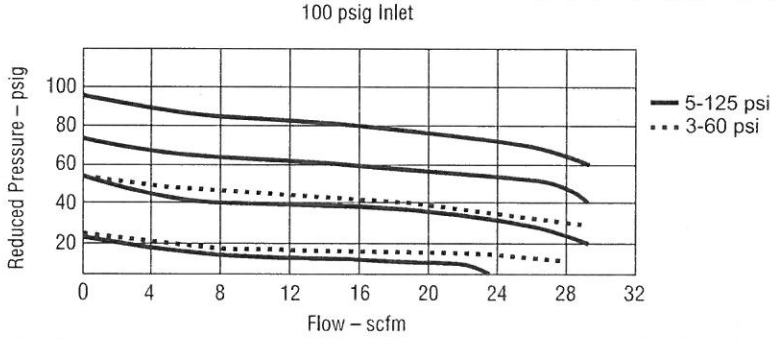
Panel Mounting Kit
- Ring only, panel hole size 1 3/16" PK1611

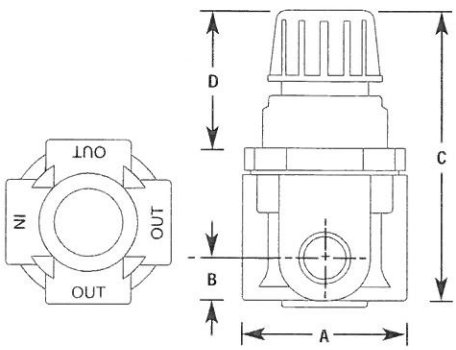
Diaphragm Kits
- Relieving RK260
- Non-relieving RK260N

Bracket Kit see page 65
- Bracket and ring BR1611

Applications
- Non-relieving diaphragm can be used on liquid applications

PERFORMANCE CHARACTERISTICS

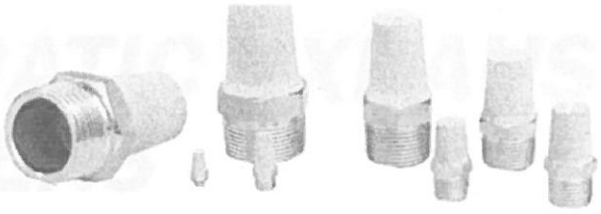




DIMENSIONS

PIPE SIZE	MODEL NO.	MAX. FLOW SCFM	DIMENSIONS (INCHES) A	B	C	D	WEIGHT (OZS.)
1/8"	R261	25	1 1/2	1/2	2 3/4	1 1/4	2
1/4"	R262	25	1 1/2	1/2	2 3/4	1 1/4	2

PNEUMATIC EXHAUST MUFFLERS



Quiet Flow muffler/filters utilize porous sintered bronze directly bonded to nickel plated steel pipe thread fillings to diffuse air and muffle noise from the exhausted ports or valves, cylinders and air tools. These units offer a combination of small size with the greatest possible sound deadening qualities to reduce exhaust noise to acceptable levels within OHSA noise requirements.

In addition, these units are used as filters for gasoline, oil and air. Standard unit contains a 40 micron element, and 20 or 90 micron units are available on special order. Model ASP-420 is a female thread (1/2" - 20) muffler for use on exhaust ports of most solenoid valves. It can be used with "exhaust to atmosphere" valves, including Skinner, Peter Paul, Allied, KIP, Pre Dyne or any muffler using 1/2" - 20 threads on the sleeve.

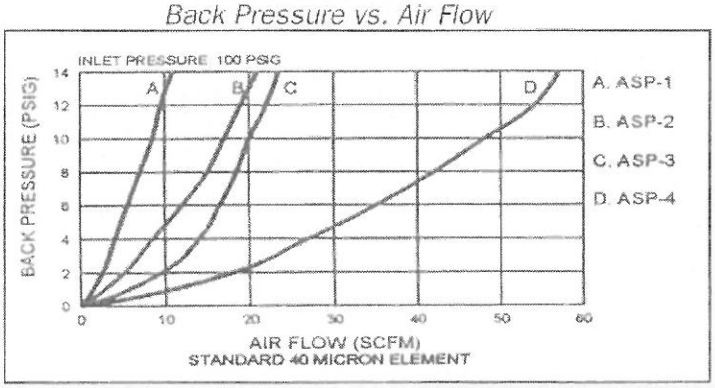
Maximum operating pressure: 300 PSI
Operating temperature: 35°F to 300°F

Part No. NPT	Part No. BSP	Thread Size	Overall Length	Dia.	Weight Lbs.
ASP-M*		10"-32	45/64"	5/16"	.01
ASP-1	ASP-1BS	1/8"	1-1/8"	7/16"	.02
ASP-2	ASP-2BS	1/4"	1-3/8"	9/16"	.04
ASP-3	ASP-3BS	3/8"	1-1/2"	11/16"	.06
ASP-4	ASP-4BS	1/2"	1-7/8"	7/8"	.10
ASP-6	consult factory	3/4"	2-1/4"	1-1/16"	.18
ASP-8	consult factory	1"	2-7/8"	1-5/16"	.34
ASP-10	consult factory	1-1/4"	3-1/4"	1-11/16"	.62
ASP-12	consult factory	1-1/2"	3-11/16"	2"	.88
ASP-420**		1/2"-20	1-3/16"	5/8"	.04

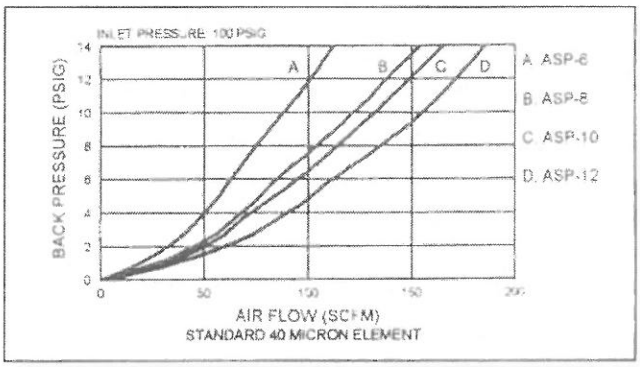
** Furnished with gasket.*
*** Female threads fits most solenoid valve exhaust ports.*

Flow Characteristics—Pneumatic Exhaust Mufflers

ASP-1 ASP-2 ASP-3, ASP-4
Back Pressure vs. Air Flow



ASP-6, ASP-8, ASP-10, ASP-12
Back Pressure vs. Air Flow



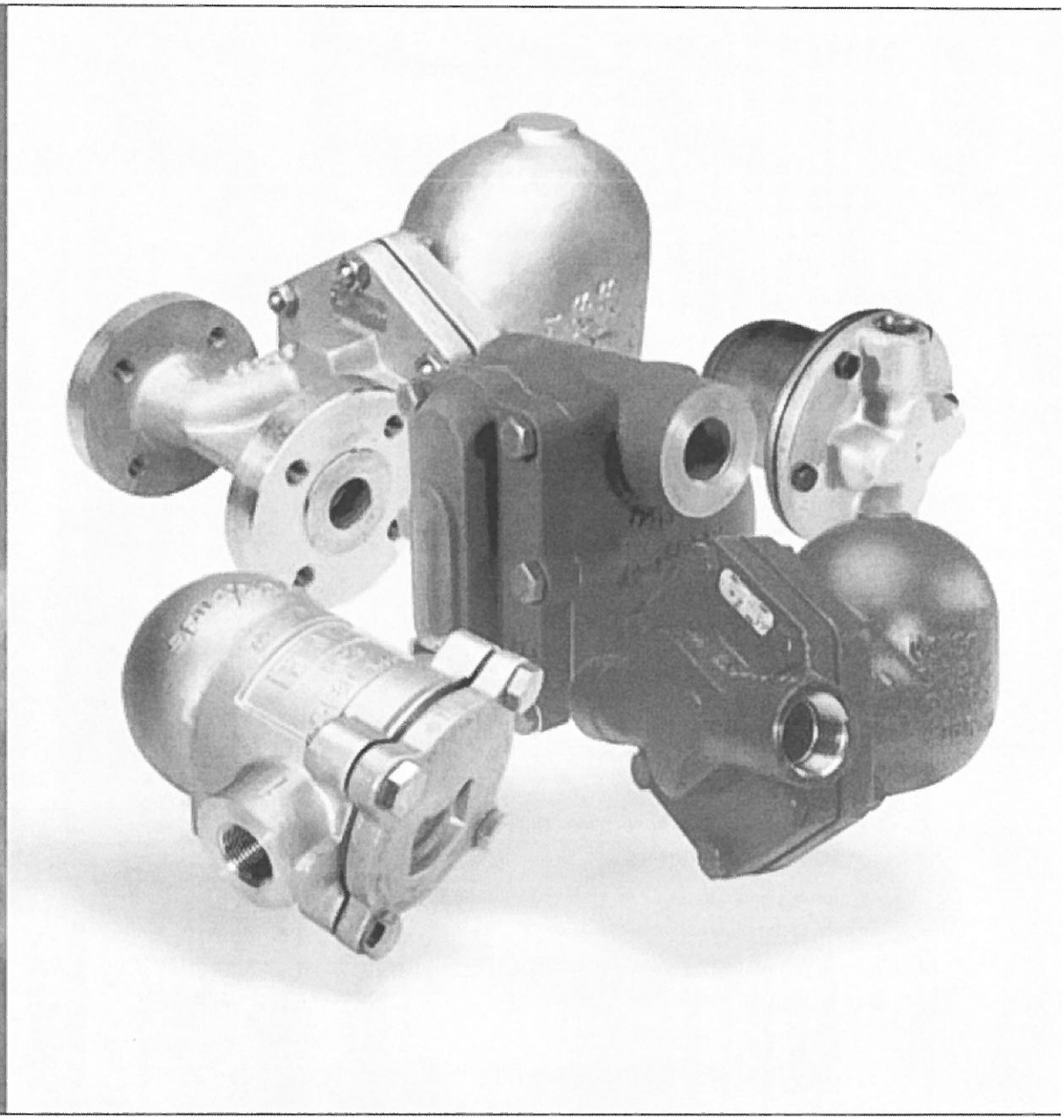
Sound Characteristics—Pneumatic Exhaust Mufflers

	ASP-1: 1/8"		ASP-2: 1/4"		ASP-3: 3/8"		ASP-4: 1/2"		ASP-6: 3/4"		ASP-8: 1"		ASP-10: 1-1/4"		ASP-12: 1-1/2"	
Back Pressure PSIG	Flow SCFM	dB	Flow SCFM	dB	Flow SCFM	dB	Flow SCFM	dB	Flow SCFM	dB	Flow SCFM	dB	Flow SCFM	dB	Flow SCFM	dB
1													38	102	52	111
2	4	72	5	75	9.5	81	17	92	32	99	45	109				
3													54	103	82	112
4	5	72	8	75	14	83	28	94	50	101	68	107				
5													70	107	108	111
6	6	73	12	76	16.5	83	35	98	63	101	84	106				
7													85	106	126	110
8	7	73	15	82	18.5	83	42	99	75	102	104	106				
9													110	105	150	109
10	7	76	16	83	20	84	48	100	88	102	122	106				
11													131	105	162	109
12	9	78	19	84	22	84	53	101	101	102	138	106				
13													154	105		
14	11	80	21	84	23.5	85	57	101	112	103	154	106				

Inlet pressure 100 psi

Float & Thermostatic Steam Traps

for efficient condensate drainage of industrial process and HVAC equipment



spirax sarco

steam specialties

Float & Thermostatic Steam Traps

from Spirax Sarco

About float & thermostatic steam traps

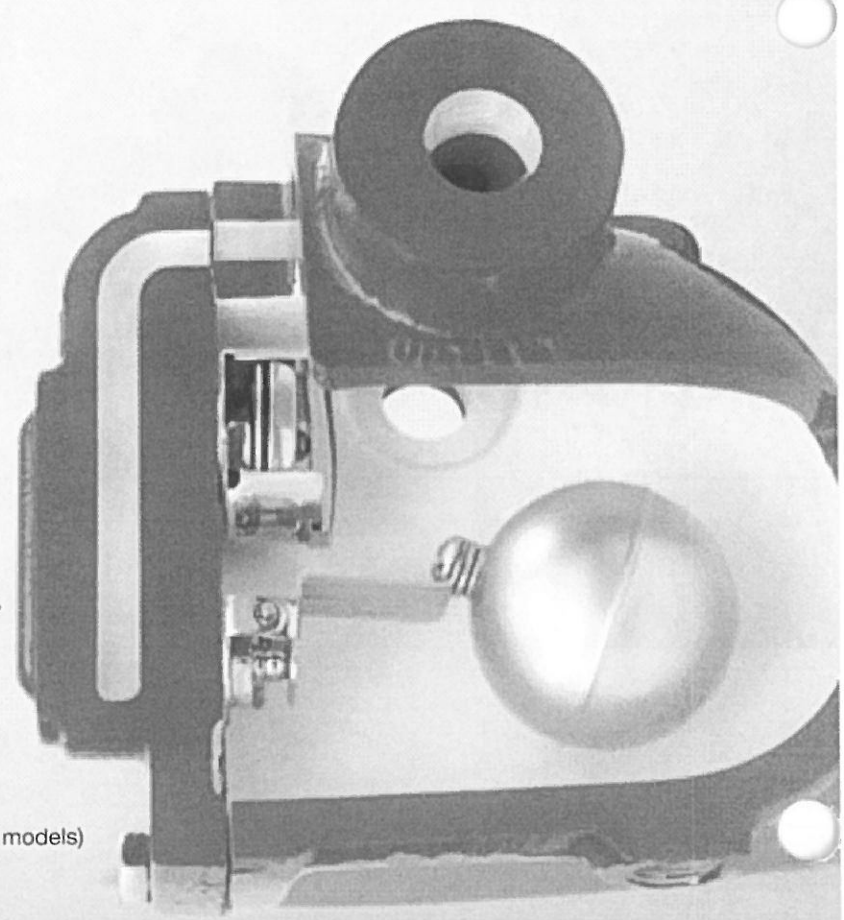
Most steam-using equipment is designed to utilize the heat given up by steam when it condenses. For efficient operation, the steam space must be kept free of condensate and air so that the entire heat transfer surface is exposed to steam.

Only a Float & Thermostatic steam trap can drain condensate as quickly as it forms while at the same time removing air and other non-condensible gases which may be present at start-up or collect during operation. Condensate never backs up into the steam space; gases collect in the top of the trap and are removed through a separate integral air vent.

Spirax Sarco offers the world's most complete line of Float & Thermostatic steam traps with cast iron, ductile iron, carbon steel and stainless steel bodies for steam pressures up to 465 psi and condensate loads up to 300,000 lb/h.

User benefits

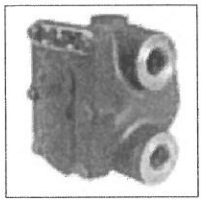
- Instantly adjusts to load and pressure variations.
- Automatic air venting reduces warm-up time and improves heat transfer.
- Continuously modulated discharge eliminates steam space pressure variations for closer temperature control.
- Stainless steel valve trim, floats and air vents increase service life.
- In-line horizontal piping connections simplify installation and maintenance.
- All internal parts can easily be renewed without disturbing the pipe connections.
- Float & Thermostatic traps can never "lose prime" and blow steam. When condensate is not present, the main valve closes tight.
- Steam loss is eliminated because during operation, the main valve is always sealed by condensate.
- The optional SLR prevents steam locking when condensate must be lifted to the trap. (available on limited models)
- Option Vacuum breaker built into trap to break vacuum on system shutdown. (available on limited models)

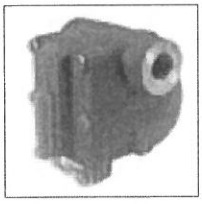


Key features and benefits

	Key features	Key reasons	Key benefits
	Stainless Steel float	Rugged, corrosion resistant, shock and surge resistant.	Automatically adjusts the valve opening to maintain a continuous condensate flow. Low lifetime failure rate.
	Unaffected by back pressure	Trap only requires differential pressure to operate. Infinite turn down on both pressure and flow.	Operation is regulated solely by condensate level inside the trap, which allows the trap to drain process equipment effectively under varying demands.
	Easy to service	Trap has either bolted cover or universal connection.	All internal parts can be serviced without disturbing the piping connections.
	Withstands waterhammer and superheat	Stainless steel balanced pressure thermostatic air vent.	Withstands waterhammer and steam temperatures up to 572° F.
	Stainless Steel valve trim	Corrosion resistant, hardened valve head.	Long wear life.
	No steam leakage	Maximum thermal efficiency, but drains condensate as soon as it forms.	Condensate seals the valve at all times, preventing steam leakage.

Float & Thermostatic Steam Traps





FT and FTI

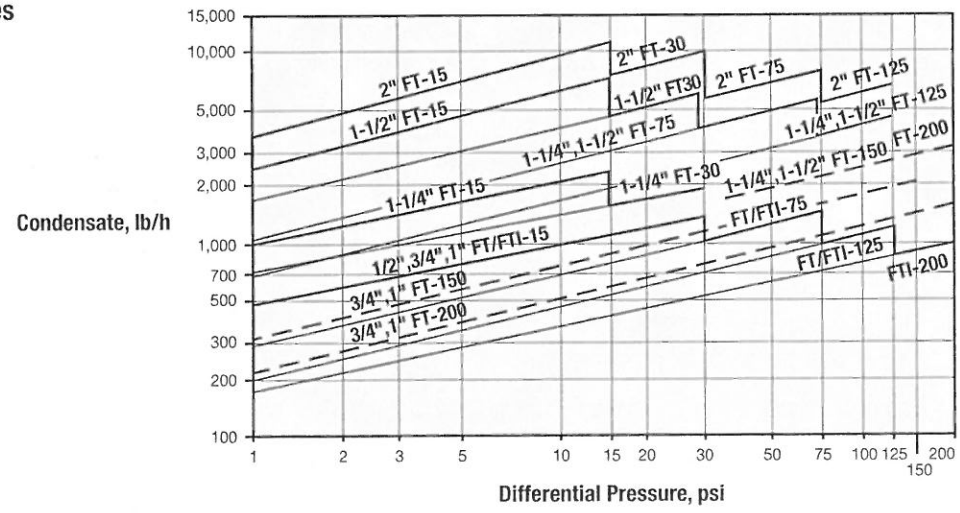
The FT and FTI Float & Thermostatic steam traps are traditional cast iron products available with either parallel (FT) or in-line (FTI) connections. These traps are offered for steam pressures up to 200 psig and condensate loads to 10,000 lb/hr. The stainless steel air vent, float, and valve eliminate air binding, resist corrosion and allow for continuous drainage of condensate.

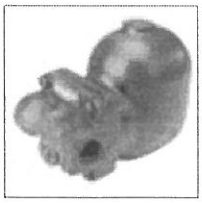
Model	Sizes	Body Material	Connections	Piping Configuration	Options	TI#	Maximum Operation Pressure
FT-15	3/4", 1", 1-1/4", 1-1/2", 2"	Cast Iron	NPT	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-313 US	15 psig
FT-30	3/4", 1", 1-1/4", 1-1/2", 2"	Cast Iron	NPT	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-313 US	30 psig
FT-75	3/4", 1", 1-1/4", 1-1/2", 2"	Cast Iron	NPT	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-313 US	75 psig
FT-125	3/4", 1", 1-1/4", 1-1/2", 2"	Cast Iron	NPT	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-313 US	125 psig
FT-150	3/4", 1", 1-1/4", 1-1/2", 2"	Cast Iron	NPT	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-314 US	150 psig
FT-200	3/4", 1", 1-1/4", 1-1/2", 2"	Cast Iron	NPT	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-314 US	200 psig

Model	Sizes	Body Material	Connections	Piping Configuration	Options	TI#	Maximum Operation Pressure
FTI-15	1/2", 3/4", 1"	Cast Iron	NPT	In-line horizontal	Integral Vacuum Breaker Gage Glass	TI-2-321 US	15 psig
FTI-30	1/2", 3/4", 1"	Cast Iron	NPT	In-line horizontal	Integral Vacuum Breaker Gage Glass	TI-2-321 US	30 psig
FTI-75	1/2", 3/4", 1"	Cast Iron	NPT	In-line horizontal	Integral Vacuum Breaker Gage Glass	TI-2-321 US	75 psig
FTI-125	1/2", 3/4", 1"	Cast Iron	NPT	In-line horizontal	Integral Vacuum Breaker Gage Glass	TI-2-321 US	125 psig
FTI-200	1/2", 3/4", 1"	Cast Iron	NPT	In-line horizontal	Integral Vacuum Breaker Gage Glass	TI-2-321 US	200 psig

FT & FTI-15 to FTI-200 Capacities

For complete capacity data, see TI-2-317-US.





FT14 and FT14C

The FT14 features rugged cast iron (1") or ductile iron (1-1/2" and 2") construction for pressures up to 200 psig. The convenient in-line connections allow for servicing of all trap internals without removing the trap from the pipeline. The stainless steel air vent, float, and valve eliminate air binding, resist corrosion and allow for continuous drainage of condensate.

Model	Sizes	Body Material	Connections	Piping Configuration	Options	TI#	Maximum Operation Pressure
FT14-4.5	1" HC, 1-1/2", 2"	Cast Iron (1"), Ductile Iron (1-1/2" & 2")	NPT	In-line horizontal	SLR with air vent	TI-2-320 US	65 psig
FT14-10	1" HC, 1-1/2", 2"	Cast Iron (1"), Ductile Iron (1-1/2" & 2")	NPT	In-line horizontal	SLR with air vent	TI-2-320 US	145 psig
FT14-14	1" HC, 1-1/2", 2"	Cast Iron (1"), Ductile Iron (1-1/2" & 2")	NPT	In-line horizontal	SLR with air vent	TI-2-320 US	200 psig

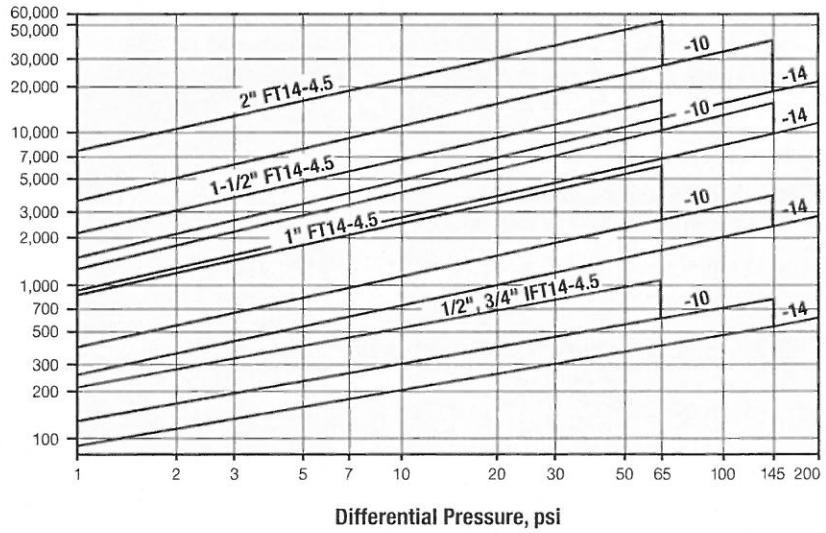
IFT14 and FT14C

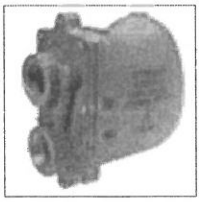
The IFT14 1/2" & 3/4" sizes offers a compact Float & Thermostatic steam trap with in-line flow designed for horizontal or vertical piping. The rugged ductile iron construction is suitable for pressures up to 200 psig and capacities to 1,000 lb/hr. The stainless steel air vent, float, and valve eliminate air binding, resist corrosion and allow for continuous drainage of condensate.

Model	Sizes	Body Material	Connections	Piping Configuration	Options	TI#	Maximum Operation Pressure
IFT14-4.5 FT14-4.5C	1/2", 3/4"	Ductile Iron	NPT	In-line horizontal	SLR with air vent	TI-2-320 US	65 psig
IFT14-10 FT14-10C	1/2", 3/4"	Ductile Iron	NPT	In-line horizontal	SLR with air vent	TI-2-320 US	145 psig
IFT14-14 FT14-14C	1/2", 3/4"	Ductile Iron	NPT	In-line horizontal	SLR with air vent	TI-2-320 US	200 psig

IFT-14, FT14 & FT14C Capacities

For complete capacity data, see TI-2-306-US.

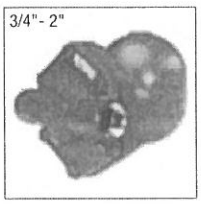


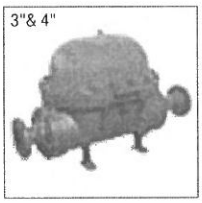


FTB

The FTB range of Super Capacity Float & Thermostatic steam traps are rugged cast iron products designed to handle large heat exchanger condensate loads to 100,000 lb/hr. The stainless steel air vent, float, and valve eliminate air binding, resist corrosion and allow for continuous drainage of condensate.

Model	Sizes	Body Material	Connections	Piping Configuration	Options	TI#	Maximum Operation Pressure
FTB-20	2"	Cast Iron	NPT	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-315 US	20 psig
FTB-30	2"	Cast Iron	NPT	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-315 US	30 psig
FTB-50	1-1/2"	Cast Iron	NPT	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-315 US	50 psig
FTB-125	2-1/2"	Cast Iron or Cast Steel (2-1/2" only)	NPT or SW (2-1/2" only)	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-315 US TI-2-322 US	125 psig
FTB-175	2", 2-1/2"	Cast Iron	NPT or SW (2-1/2" only)	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-315 US	175 psig
FTB-200	1-1/2"	Cast Iron	NPT	Parallel	Integral Vacuum Breaker Gage Glass	TI-2-315 US	200 psig
	2-1/2"	Cast Steel	SW			TI-2-322 US	





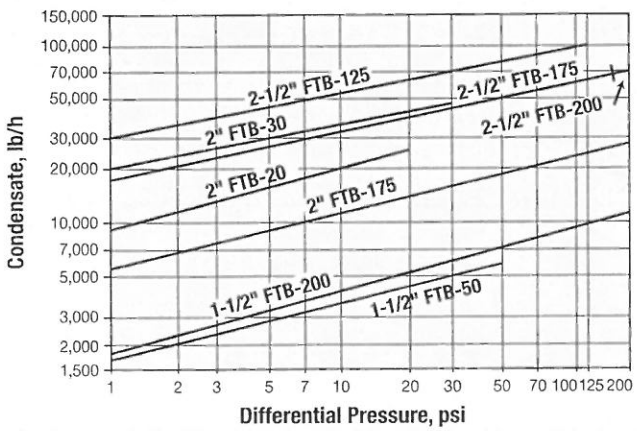
FT450

For processes that require pressures to 465 psig and/or steel construction, the FT450 offers the best solution. The FT450 is available in sizes ranging from 3/4" to 4" and with threaded, socket weld or flanged connections. The in-line design allows all internal parts to be serviced without removing the trap from the pipeline. The stainless steel air vent, float, and valve eliminate air binding, resist corrosion and allow for continuous drainage of condensate.

Model	Sizes	Body Material	Connections	Piping Configuration	Options	TI#	Maximum Operation Pressure
FT450-4.5	3/4", 1", 1-1/2", 2"	Cast Steel	NPT, SW, Flanged	In-line horizontal	Stainless Steel Special Order	TI-2-304 US	65 psig
FT450-10	3/4", 1", 1-1/2", 2"	Cast Steel	NPT, SW, Flanged	In-line horizontal	Stainless Steel Special Order	TI-2-304 US	145 psig
FT450-14	3/4", 1"	Cast Steel	NPT, SW, Flanged	In-line horizontal	Stainless Steel Special Order	TI-2-304 US	200 psig
FT450-21	3/4", 1"	Cast Steel	NPT, SW, Flanged	In-line horizontal	Stainless Steel Special Order	TI-2-304 US	300 psig
FT450-32	3/4", 1", 1-1/2", 2"	Cast Steel	NPT, SW, Flanged	In-line horizontal	Stainless Steel Special Order	TI-2-304 US	465 psig
FT450	3", 4"	Cast Steel	NPT, SW, Flanged	In-line horizontal	Stainless Steel Special Order	TI-2-3041 US	465 psig

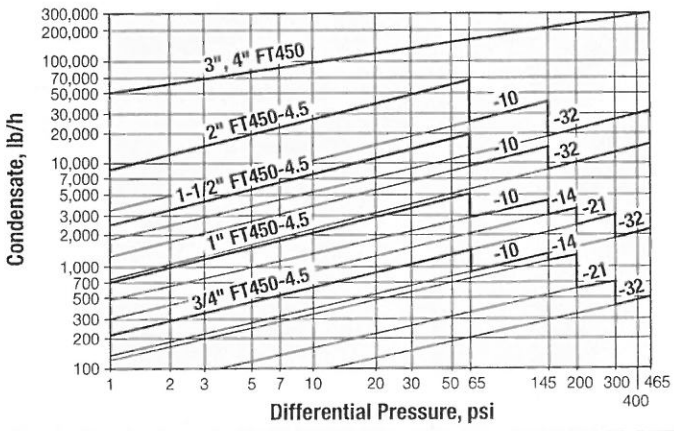
FTB 1-1/2" to 2-1/2" Capacities

For complete capacity data, see TI-2-317-US.



FT450 & FT46 Capacities

For complete capacity data, see TI-2-308-US and TI-2-3041 US (3" and 4").



spirax sarco

INSTALLATION AND MAINTENANCE INSTRUCTIONS

IM-2-300-US

DECEMBER 2006

Float & Thermostatic Steam Traps FT, FTB, FTI, OK

Description and Operation

Spirax Sarco Float & Thermostatic Steam Traps are ideally suited for most HVAC and process applications. The spherical stainless steel float automatically adjusts the position of the main valve so that condensate is discharged continuously at the same rate as it enters the trap. Air and other non-condensible gases which are present at start up or which enter the trap during operation are discharged through the integral balanced pressure thermostatic air vent (some high pressure F & T traps have a bimetal air vent). The traps will operate against any back-pressure lower than the inlet pressure. (The differential pressure—inlet pressure minus outlet pressure—determines the trap's capacity).

All Spirax Sarco F & T traps will tolerate at least 450°F of temperature. The superheat tolerance of some models is higher; refer to the appropriate Technical Information Sheet or call Spirax Sarco for further information.

Limiting Operating Conditions

The maximum operating pressure (PMO) is shown on the nameplate. The PMO depends on the valve mechanism; if the pressure at the trap inlet is higher than the PMO, the excess pressure may lock the valve closed. In some cases (for example, if there is a permanent back-pressure in the return line) in may be permissible to exceed the PMO. Please consult Spirax Sarco for details.

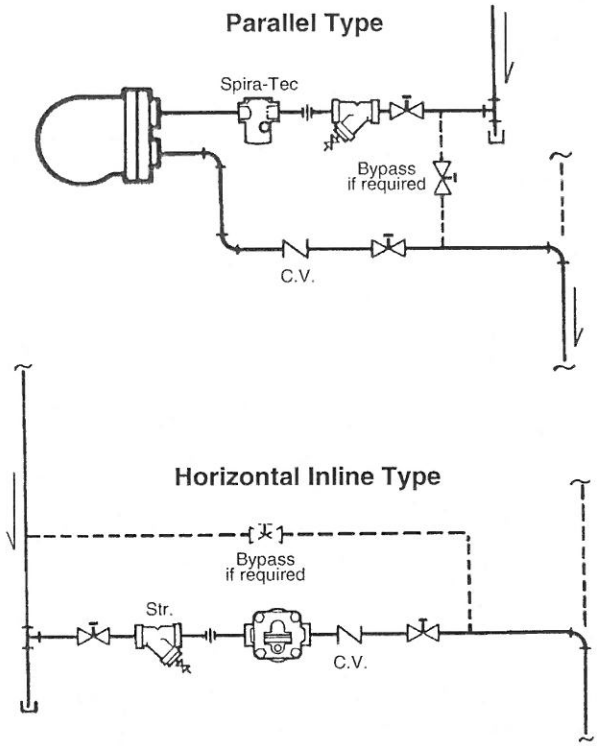
The maximum operating temperature depends on the superheat tolerance of the air vent. This is always at least 450°F as the TMA (see below) is not exceeded.

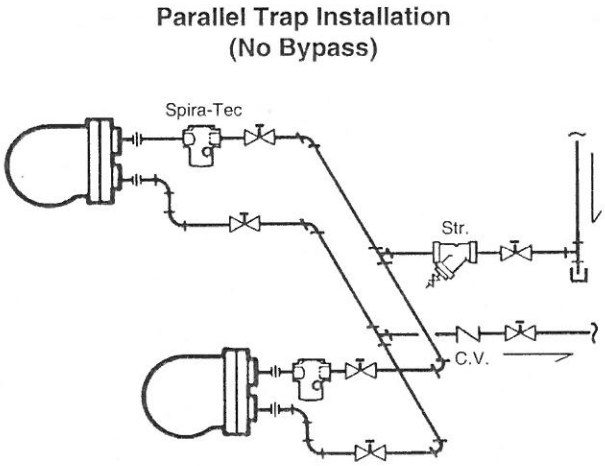
The maximum allowable pressure and temperature (PMA and TMA) are determined by the pressure shell design conditions, and must not be permanently exceeded. The trap may be subjected to a temporary cold hydraulic test pressure of 1-1/2 times the cold PMA, provided that the air vent is first removed. If the test pressure will exceed 600 psi, the float must also be removed.

Installation

1. Before installation, inspection or maintenance, the trap must be isolated from both supply and return line pressure.
2. The trap should be installed below the drainage point of the equipment or steam main so that condensate can flow by gravity into the trap. A vertical drop to the trap is advantageous, but long horizontal runs should be avoided because of the possibility of steam locking. If a long horizontal run to the trap is unavoidable, a trap with a steam lock release should be used.
3. If possible, a drop leg and dirt pocket should be installed ahead of the trap. The trap should be protected by a Spirax Sarco y-pattern stainer, preferably fitted with a blow down valve. Full-port isolating valves should be installed to permit servicing.
4. The trap must be installed in an upright position with the orientation arrow on the body or on the nameplate pointing straight down. The flow direction markings on the body or cover must be observed.
5. Before installing the trap, the inlet piping should be carefully blown down to remove any existing debris.
6. A Spira-tec® sensor chamber facilitates checking the trap's operation. A check valve downstream of the trap will prevent backflow from the return line.
7. If the condensate must be lifted to the return main, the trap, followed by a check valve, should be installed at the bottom of the lift. Sufficient pressure to lift the condensate (approximately 1 psi for each 2 ft. of lift) must be present at the trap inlet at all times.

   Note that a temperature control valve on the inlet steam may at times reduce the pressure below the amount required to lift the condensate. When the inlet steam is controlled and condensate must be lifted after the trap, a Spirax Sarco Pressure Powered Pump™ should be considered.
8. Bypass piping is not recommended because of the possibility of misuse. If continuous service is required, a second trap could be piped in parallel with suitable valving to allow one trap to be serviced while the other remains in operation. If a bypass line must be used, it should be at least one pipe size smaller than the trap.
9. Because condensate cannot drain completely from the body, an F & T trap installed outdoors can freeze up if it is not in continuous operation. If there is a possibility of an interruption in the steam supply, provisions should be made for draining or tracing the trap body.
10. The trap can be put into service by slowly opening the isolating valves. No priming is necessary.





Maintenance

1. After isolation from supply and return line pressure, all Spirax Sarco F & T traps can be serviced without disturbing the piping connections. On some models the cover with mechanism attached can be removed for servicing while the body remains in the pipeline.
2. On most models, dirt and sludge which may accumulate in the trap can be removed by "blowing down" through the drain plug in the bottom of the body.
3. The trap should be disassembled periodically for inspection and replacement if necessary of the valve mechanism and air vent.
4. Ensure that the trap is properly isolated, and that any pressure which may remain in the trap is relieved before the trap is opened. This can be accomplished by opening the blowdown valve on the upstream strainer and waiting until the trap has cooled. Some condensate will remain in the trap body. This can be drained by removing the drain plug or by cracking the body-cover joint.
5. Remove and save the cover bolts, and remove the body or cover. Using a suitable solvent, clean all dirt and incrustation from the body, cover and mechanism. Inspect the body and cover for condensate corrosion.
6. Inspect the valve head and seat for damage, wear or wiredrawing. Replace the mechanism if necessary, using a complete valve mechanism kit and following the instructions included with the kit.
7. Inspect the float for leakage or damage, and replace if necessary. A distorted or collapsed float is evidence of a severe and dangerous overpressure or waterhammer condition which must be corrected before the trap is returned to service.
8. The air vent should be removed, tested for proper operation, and replaced if necessary. Instructions are included with the air vent kit.
9. Remove all traces of the old gasket from the body and cover, and ensure that the gasket surfaces are clean and undamaged. Using a new cover gasket, reassemble the trap. Tighten the cover bolts to the torque shown on page 3.
10. The trap can be returned to service by slowly opening the isolating valves. Priming is not required.

Note: Flash steam is formed when a portion of the hot condensate re-evaporates as it passes from a higher to a lower pressure (for example, as it flows through a steam trap). This flash steam is normal, and it should not be mistaken for live steam leakage when the operation of the trap is being observed.

Spare Parts

The following spare parts are available for Spirax Sarco Float & Thermostatic Steam traps:

Valve Mechanism Kit - Complete valve mechanism with gasket and mounting screws as required.

Gasket Kit - Three each of cover and mechanism gaskets.

Air Vent Kit - Air vent assembly.

Replacement Kit - Valve mechanism with gasket, float with screw and washer, air vent assembly, cover gasket.

Float Kit - Float with screw and lockwasher as required.

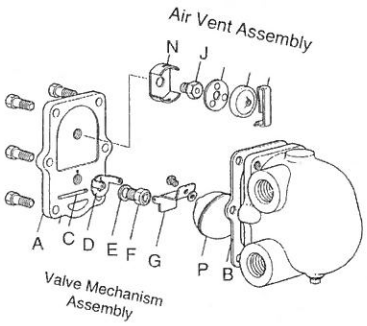
Note: In some models, the float is welded to the mechanism arm, and is included in the valve mechanism kit. A separate float kit is not available.

Model		Size(s)	Spare Parts Kits*			Torque Values ft•lb		TIS Number
			Valve Mechanism Kit	Gasket Kit	Float Kit	Cover Bolts	Valve Seat or mounting screws	
FT-15		3/4",1"	54749	55475	55448	11-14	27-31	2.313
			Replacement Module: 67908					
		1-1/4"	54752	55475	55447	11-14	34-37	
			Replacement Module: 67909					
		1-1/2"	58131	58127	58129	17-21	90-95	
		2	58135	58128	58130		118-122	
FT-30		3/4", 1"	54749	55475	55447	11-14	27-31	
			Replacement Module: 68592					
		1-1/4"	58139	55475	55447	11-14	34-37	
			Replacement Module: 68595					
		1-1/2"	58132	58127	58129	17-21	90-95	
		2	58136	58128	58130		118-122	
FT-75		3/4", 1"	54750	55475	55447	11-14	27-31	
			Replacement Module: 68593					
		1-1/4', 1-1/2"	58133	58127	58129	17-21	90-95	
		2"	58137	58128	58130		118-122	
FT-125		3/4", 1"	54751	55475	55447	11-14	27-31	
			Replacement Module: 68594					
		1-1/4", 1-1/2"	58134	58127	58129	17-21	90-95	
		2	58138	58128	58130		118-122	
FTI	15	1/2", 3/4", 1"	54749	67049	55448	17-21	27-31	2.321
	30		54749		55447			
	75		54750		55447			
	125		54751		55447			
	200		67048		55447			
FT-150		3/4", 1"	80087	55481	55447	17-21	8-11	2.314
		1-1/4", 1-1/2"	80090	55482	58130	27-31		
FT-200		3/4", 1"	81850	55481	55447	17-21	8-11	
		1-1/4", 1-1/2"	80091	55482	58130	27-31		
FTB-20		2"	58152	55479	58159	17-21	150-155	
FTB-30		2"	58177	58173	58160	85-90	53-55	
FTB-125		2-1/2"	58177	CI 58173/CS 68806	58160	85-90	53-55	2.315
FTB-200		2-1/2"	58158	68806	58160	85-90	16-19	2.322
FTB-50		1-1/2"	58179	58180	58129	23-27	8-11	
FTB-175		2"	61044	55479	58159	23-27	8-11	
		2-1/2"	58158	58173	58160	85-90	16-19	
FTB-200		1-1/2"	58179	74122	74123	27-31	8-11	2.315
OK 150		1/2"	63353	66576	55447	15-17	17-19	2.312
OK 300			63354					
FT450-	4.5	3/4"	66379	66392	N/A	27-31	27-31	2.304
	10		66380					
	14		66381					
	21		66382					
	32		66383					
FT450-	4.5	1"	66384	66392	N/A	27-31	27-31	
	10		66385					
	14		66386					
	21		66387					
	32		66388					
FT450-	4.5	1-1/2"	66395	66393	62541	80-85	7-9	
	10		66396					
	32		66397					
FT450-	4.5	2"	66389	66394	62541	93-97	15-18	
	10		66390					
	32		66391					
FT14-	4.5	1/2", 3/4'	1440080	1440081	N/A	29-33	37-41	2.320
	10		1440180					
	14		1440280					
FT10/14	}	1/2", 3/4", 1", 1-1/4"		Consult Factory		21-24	29-33	2.301
FT16	}	1-1/2"				44-49	7-9	2.319
FT46	}	2"				59-65	15-18	2.318

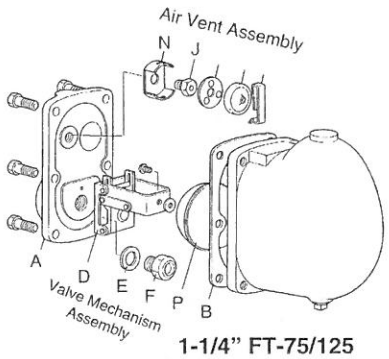
* Air Vent Kits - see next page

Air Vent Kits

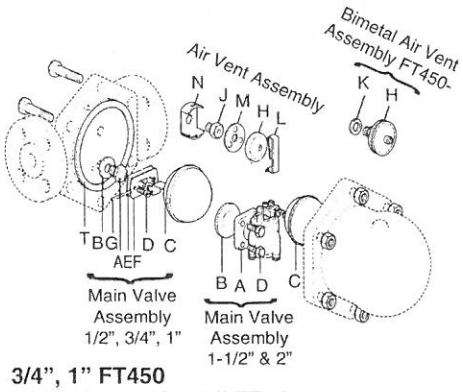
Model	Air Vent Kit No.	Air Vent Seat Torque ft•lb
FT14	1440081	37-40
FT450-32	66642	37-40
FT16, FT46	Consult Factory	
All Others	62652	26-30



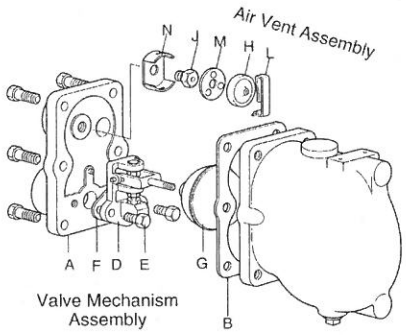
3/4", 1" FT-15/30/75/125
1-1/4" FT-15/30



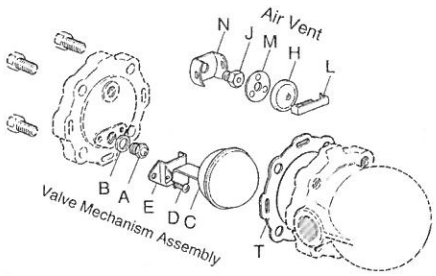
1-1/4" FT-75/125
1-1/2" FT-15/30/75/125
2" FTB-20



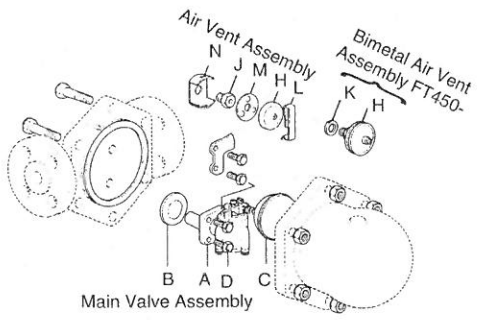
3/4", 1" FT450
1", 1-1/4", 1-1/2", 2" FT14
1/2", 3/4" FT16
1/2", 3/4", 1", 1-1/2", 2" FT46



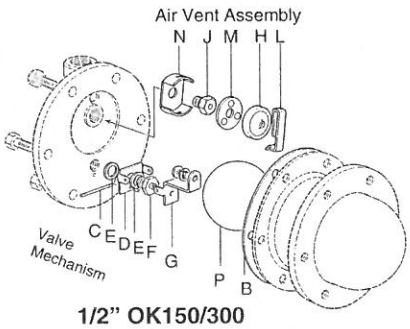
3/4", 1", 1-1/4", 1-1/2" FT-150/200



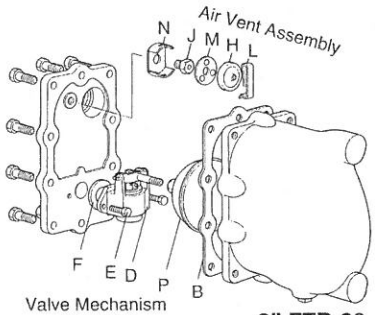
1/2", 3/4" FT14



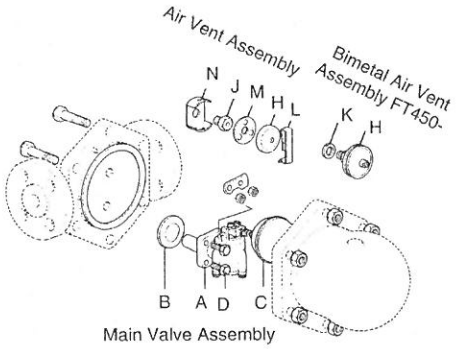
1-1/2"FT450



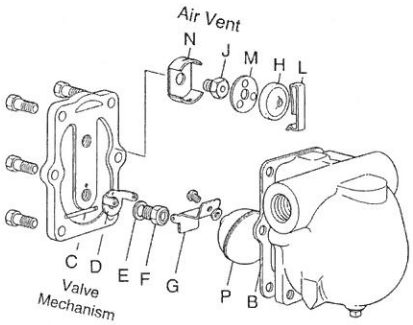
1/2" OK150/300



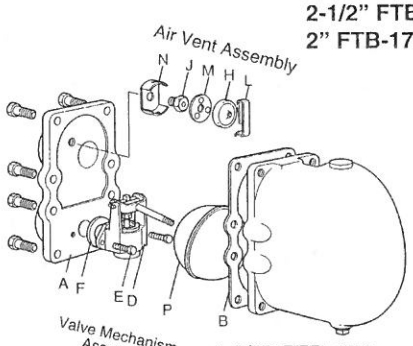
2" FTB-30
2-1/2" FTB-125
2-1/2" FTB-175
2" FTB-175



2"FT450



1/2",3/4",1" FTI-15/30/75/125/200



1-1/2" FTB-150
1-1/2" FTB-200

For any additional information you may require, contact:
Spirax Sarco Applications Engineering Department
Toll Free 1-800-833-3246

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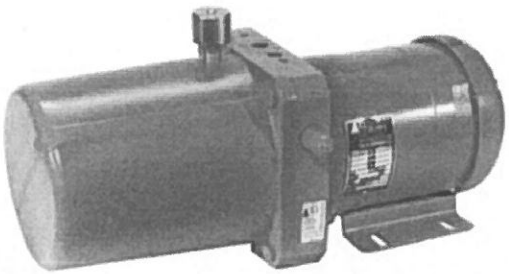
4484 Boeing Drive - Rockford, IL 61109

B Series



CT Series

BCV Series

INDEX

Description	Page
B Series Units	57
CT and CX Series Units	59
BCV Series Units	61

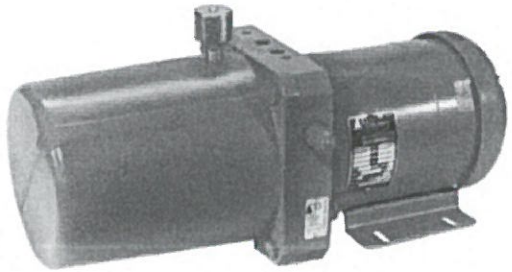
WARNING: The specifications/application data shown in our catalogs and data sheets are intended only as a general guide for the product described (herein). Any specific application should not be undertaken without independent study, evaluation, and testing for suitability.

Phone: (815) 397-6628 Fax: (815) 397-2526 E-mail: delta@delta-power.com

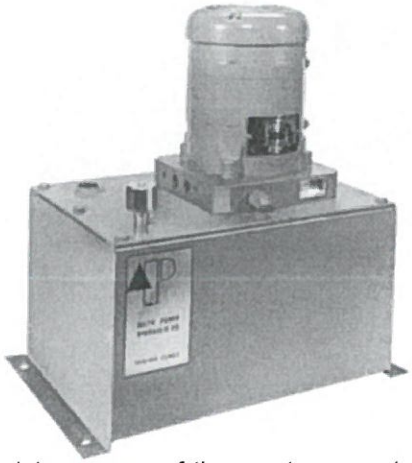
Delta Power Company
4484 Boeing Drive - Rockford, IL 61109

B Series Power Packages

B Series Power Unit with 1 Gallon Tank



B Series Power Unit with 5 Gallon Tank



Caution: Relief valves must be set prior to installation. They are not factory preset. Relief valves will include springs which will allow relief valves settings to the pressures indicated on the chart.

With the 1, 1 ½ or 2 ½ gallon tank and TEFC 56 frame motors, B models are one of the most compact, utilized power packages available today. The 1 and 1 ½ gallon tank unit includes a custom heat dissipating aluminum tank and an externally adjustable relief valve. Units can be mounted horizontally (foot down) or vertically (tank down). TEFC motors are 56 frame specially configured for Delta Power B units, 4 pole motors run at the highly desirable speed of 1725 RPM rather than the 3450 version normally used on competitor's units.

While each unit is a complete power unit, their scope is radically increased by adapting to valve accessories like 85005677 found in section 9 of this catalog. Please refer to Section 9 for other adaptations.

Pump / Motor Specifications

Data shown is for continuous duty. For intermittent peaking duty, 30 seconds at peak load, pressure as high as 150% is attainable, limited to 3000 PSI maximum.

Note: 3 phase motors can run on 50/60 cycles but flow at 50 cycles will be reduced to 5/6 of noted flow since the motor will run at 5/6 of the RPM.

Pump	B1	B2	B4	B6	B8
Motor	.00028 GPR	.00047 GPR	.0081 GPR	.00137 GPR	.00202 GPR
B154	.31 GPM	.70 GPM	1.33 GPM	2.32 GPM	3.46 GPM
1/2 H.P. 1725 RPM	1500 PSI	900 PSI	525 PSI	300 PSI	200 PSI
1 Phase TEFC	B1+B154	B2+B154	B4+B154	B6+B154	B8+B154
B354	.31 GPM	.70 GPM	1.33 GPM	2.32 GPM	3.46 GPM
1/2 H.P. 1725 RPM	1500 PSI	900 PSI	525 PSI	300 PSI	200 PSI
3 Phase TEFC	B1+B354	B2+B354	B4+B354	B6+B354	B8+B354
B174	.25 GPM	.65 GPM	1.28 GPM	2.28 GPM	3.44 GPM
3/4 H.P. 1725 RPM	2250 PSI	1350 PSI	775 PSI	450 PSI	300 PSI
1 Phase TEFC	B1+B174	B2+B174	B4+B174	B6+B174	B8+B174
B374	.25 GPM	.65 GPM	1.28 GPM	2.28 GPM	3.44 GPM
3/4 H.P. 1725 RPM	2250 PSI	1350 PSI	775 PSI	450 PSI	300 PSI
3 Phase TEFC	B1+B374	B2+B374	B4+B374	B6+B374	B8+B374
B1104	.25 GPM	.58 GPM	1.25 GPM	2.25 GPM	3.40 GPM
1 H.P. 1725 RPM	2250 PSI	1800 PSI	1050 PSI	625 PSI	425 PSI
1 Phase TEFC	B1+B1104	B2+B1104	B4+B1104	B6+B1104	B8+B1104
B3104	.25 GPM	.58 GPM	1.25 GPM	2.25 GPM	3.40 GPM
1 H.P. 1725 RPM	2250 PSI	1800 PSI	1050 PSI	625 PSI	425 PSI
3 Phase TEFC	B1+B3104	B2+B3104	B4+B3104	B6+B3104	B8+B3104
B1154			1.17 GPM	2.18 GPM	3.34 GPM
1-1/2 H.P. 1725 RPM			1550 PSI	925 PSI	625 PSI
1 Phase TEFC			B4+B1154	B6+B1154	B8+B1154
B3154			1.17 GPM	2.18 GPM	3.34 GPM
1-1/2 H.P. 1725 RPM			1550 PSI	925 PSI	625 PSI
3 Phase TEFC			B4+B3154	B6+B3154	B8+B3154
B3204				2.06 GPM	3.26 GPM
2 H.P. 1725 RPM				1225 PSI	850 PSI
3 Phase TEFC				B6+B3204	B8+B3204
B3304				1.90 GPM	3.12 GPM
3 H.P. 1725 RPM				1850 PSI	1250 PSI
3 Phase TEFC				B6+B3304	B8+B3304
Intermittent Duty					

B6+B174	**Pump/Motor/1 Gal. Tank**
To order Power unit with 1-1/2 gallon tank, specify as follows	
B6+B174-1-1/2 TK	**Pump/Motor/1-1/2 Gal. Tank**
To order Power unit with 2-1/2 gallon tank, specify as follows	
B6+B174-2-1/2 TK	**Pump/Motor/2-1/2 Gal. Tank**
To order Power unit with 5 gallon tank, (add letter T), as follows	
BT6+B174	**Pump/Motor/5 Gal. Tank**
To order Power unit with 5 gallon tank, (add letter X), as follows	
BX6+B174	**Pump/Motor/10 Gal. Tank**

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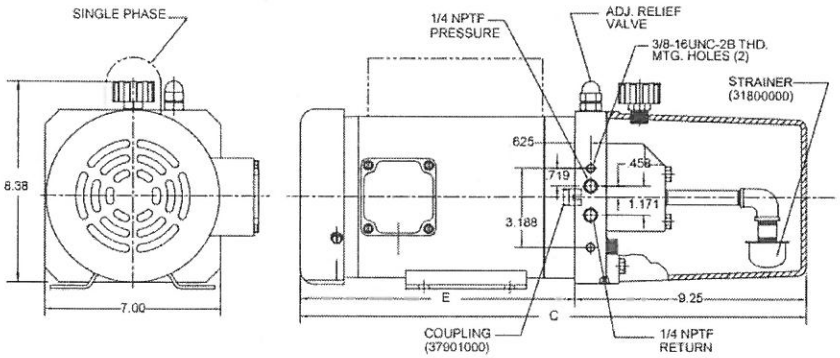
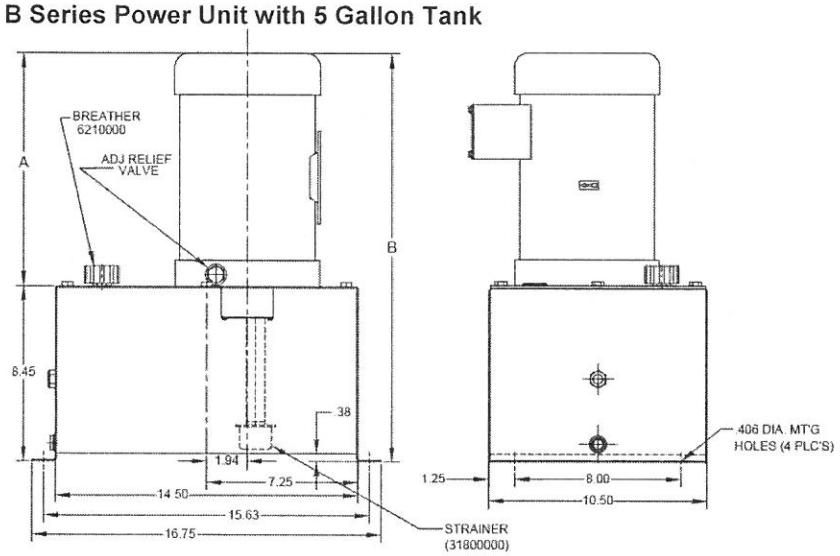
B Series Power Unit with 1 Gallon Tank



MOTOR	Dimension			
	A	B	C	E
B154	11.13	19.69	19.38	9.88
B354	10.50	19.06	18.75	9.25
B174	12.00	19.06	18.75	10.75
B374	10.50	19.06	18.75	9.25
B1104	12.13	20.69	20.38	10.88
B3104	11.13	19.56	19.25	9.88
B1154	13.01	21.06	20.75	11.76
B3154	11.00	19.56	19.25	9.75
B3204	12.13	20.69	20.38	10.88
B3304	13.00	21.44	21.13	11.75

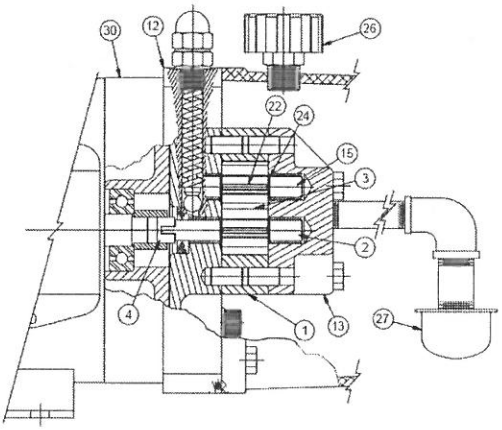
Note: Motor dimensions are approximate dependent on current availability

B Series Power Unit with 5 Gallon Tank



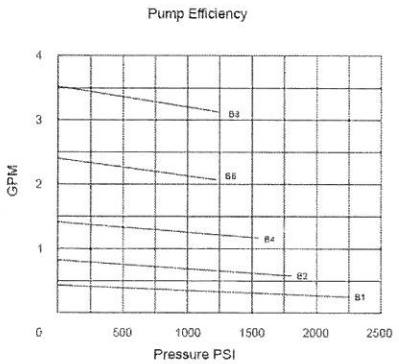
Ordering - Service Parts

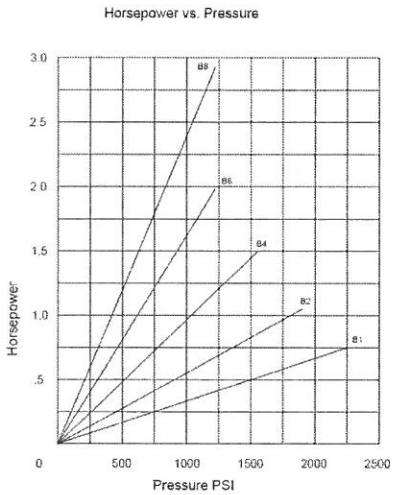
ITEM #	DESCRIPTION	QTY.
1	GEAR CASE	1
2	DRIVE SHAFT	1
3	GEARS	2
4	COUPLING	1
5	RESERVOIR	1
12	DRIVE PLATE	1
13	END PLATE	1
15	IDLER SHAFT	1
17	INLET STRAINER	1
22	GEAR PIN	2
24	RETAINING RING	4
26	BREATHER	1
30	MOTOR	1



NOTE: WHEN ORDERING PARTS, PLEASE SPECIFY COMPLETE MODEL NUMBER

Performance Data





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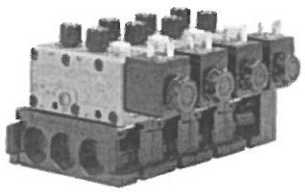
5/2, 5/3 Valves, Series 740, ND7, 8x1 or 10x1 dia.

Valve systems, electrical version 10, without connectors

Rexroth
Bosch Group

Technical Data

Working pressure	p max	10 bar (145 psi)
Ambient temperature range		-15 °C to +50 °C (+5 °F to +122 °F)
Medium		Compressed air, lubricated or non-lubricated
Material		POM/IXEF
Thread insert	Standard version	Brass
	Corrosion proof version	X 12 CrNi 18 8



Part no. for electrical version 10: 33545100810 ... - ...

- without connectors
- with unlimited number of valves

Part no.

	Inlet plate complete with O-rings	Inlet plate* complete with O-rings	Through plate complete with O-rings	End plate complete with O-rings
	8985003902	**8985003972**	**8985003922**	**8985003912**

*) Corrosion proof

Accessories (to be ordered separately)

Type	Part no.	
blanking plate	**5727406012**	
Kit for pressure supply on both sides	**5727400082**	incl. O-rings
Spare O-rings	**5727400092**	for mounting of 5 valves
Adapter for additional pressure port	**8939102500**	incl. O-ring and screws

70-100 Series

Bronze Ball Valve

Threaded, 600 psig WOG, Cold Non-Shock. 150 psig Saturated Steam. (See referenced P/T charts)
Vacuum Service to 29 inches Hg.
Federal Specification: WW-V-35C, Type: II, Composition: BZ, Style: 3.
MSS SP-110; Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

FEATURES

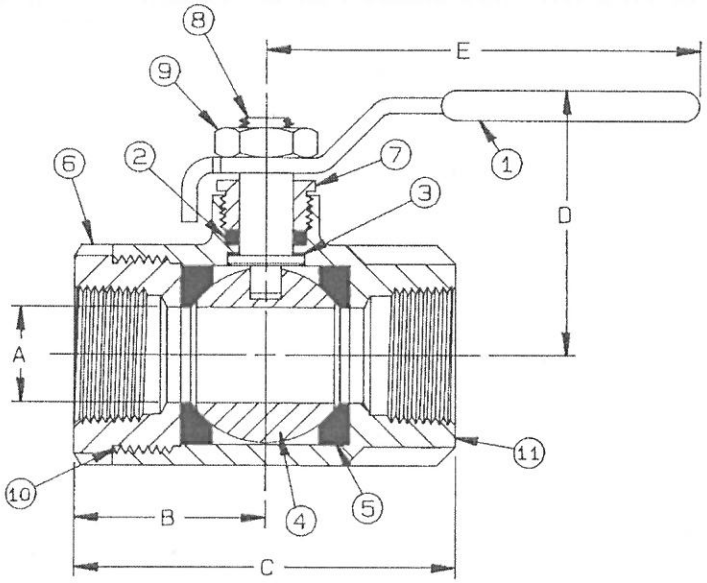
- Chromium plated ball
- RPTFE seats and stuffing box ring
- Blow-out-proof stem design
- Adjustable packing gland

STANDARD MATERIAL LIST

1. Lever and grip	Steel, zinc plated w/vinyl	7. Gland nut	B16
2. Stem packing	RPTFE	8. Stem	B16
3. Stem bearing	RPTFE	9. Lever nut	Steel, zinc plated
4. Ball	B16, chrome plated	10. Body seal (1-1/4" to 3")	PTFE
5. Seat (2)	RPTFE		
6. Retainer	B16 (1/4" to 1") B584-C84400 (1-1/4" to 3")	11. Body	B584-C84400

VARIATIONS AVAILABLE:

70-120 Series (Adjustable Stop Lever)
70-140 Series (316 SS Ball & Stem)
70-150 Series (Balancing Stop)
70-190 Series (Locked Retainer)



BRONZE BALL VALVE

NUMBER	SIZE	A	B	C	D	E	Wt.
70-101-01	1/4"	.37	1.03	2.06	1.75	3.87	.60
70-102-01	3/8"	.37	1.03	2.06	1.75	3.87	.56
70-103-01	1/2"	.50	1.12	2.25	1.75	3.87	.63
70-104-01	3/4"	.68	1.50	3.00	2.12	4.87	1.39
70-105-01	1"	.87	1.68	3.37	2.25	4.87	1.72
70-106-01	1-1/4"	1.00	2.00	4.00	2.62	5.50	3.26
70-107-01	1-1/2"	1.25	2.18	4.37	3.06	8.00	4.61
70-108-01	2"	1.50	2.34	4.68	3.25	8.00	6.06
70-109-01A	2-1/2"	2.00	3.12	6.25	3.72	8.00	17.25
70-100-01	3"	2.50	3.37	6.75	4.12	8.00	18.60
70-10A-01	4"	3.12	3.68	7.37	5.25	10.00	25.50

OPTIONS AVAILABLE:

(SUFFIX)	OPTION	SIZES
-02-	Stem Grounded	1/4" to 3"
-03-	1-1/4" CS Stem Extension	1/4" to 3"
-04-	2-1/4" CS Stem Extension	1/4" to 3"
-05-	Plain Ball	1/4" to 3"
-07-	Steel Tee Handle	1/4" to 2"
-08-	90° Reversed Stem	1/4" to 3"
-10-	SS Lever & Nut	1/4" to 3"
-14-	Side Vented Ball (Uni-Directional)	1/4" to 3"
-15-	Wheel Handle, Steel	1/4" to 2"
-16-	Chain Lever - Vertical	3/4" to 2"
-17-	Rough Chrome Plated - Bronze Valves	1/4" to 3"
-21-	UHMWPE Trim (Non-PTFE)	1/4" to 3"
-24-	Graphite Packing	1/4" to 3"
-27-	SS Latch-Lock Lever & Nut	1/4" to 3"
-30-	Cam-Lock and Grounded	1/4" to 2"
-32-	SS Tee Handle & Nut	1/4" to 2"
-35-	VTFE Trim	1/4" to 3"
-36-	SS Hi-Rise Round Handle, SS Nut	1/4" to 2"
-39-	SS Hi-Rise Locking Wheel Handle, SS Nut	1/4" to 2"
-40-	Cyl-Loc and Grounded	1/4" to 2"
-41-	Automatic Drain (Bronze Valves Only) see page J-8	1/4" to 2"
-45-	Less Lever & Nut	1/4" to 3"
-46-	Latch Lock Lever - Lock in Closed Position Only	1/4" to 3"
-47-	SS Oval Latch-Lock Handle & Nut	1/4" to 1"
-48-	SS Oval Handle (No Latch) & Nut	1/4" to 2"
-49-	Assembled Dry	1/4" to 3"
-50-	2-1/4" CS Locking Stem Extension	1/4" to 3"
-56-	Multifill Seats & Packing	1/4" to 3"
-57-	Oxygen Cleaned	1/4" to 3"
-58-	Chain Lever - Horizontal	3/4" to 2"
-60-	Static Grounded Ball & Stem	1/4" to 3"
-63-	NPT x Solder/Socket Weld	3/8" to 3"
-64-	250# Steam Trim	1/4" to 3"
-P01-	BSPP (Parallel) Thread Connection	1/4" to 3"
-T01-	BSPT (Tapered) Thread Connection	1/4" to 3"

For Pressure/Temperature Ratings, Refer to Page M-8, Graph No. 4

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(D) **Betriebsanleitung**

(GB) (USA) **Operating Instructions**

(F) **Manuel d'utilisation**

Typ 7010

SCHUBERT & SALZER
CONTROL SYSTEMS

Version: 12/2006

M7010-def.doc
Art.-Nr: 110 7010

Bunsenstrasse
Tel: (0841) 9654-0
www.schubert-salzer.com

D-85053 Ingolstadt
Fax: (0841) 9654-590

Inhalt/Content/Sommaire

Inhalt/Content/Sommaire 2

1 (D) Betriebsanleitung (deutsch) 3

1.1 Ersatzteilliste 3
1.2 Technische Daten 5
1.3 Einbau 5
1.4 Demontage des Ventils 6
1.5 Montage des Ventils 7
1.6 Schmier- und Klebeplan 9

2 (GB)(USA) Operating Instructions (English) 10

2.1 Spare Parts List 10
2.2 Technical Data 12
2.3 Mounting 12
2.4 Dismounting the Valve 13
2.5 Mounting the Valve 14
2.6 Lubrication and Bonding Plan 16

3 (F) Instructions de service (français) 17

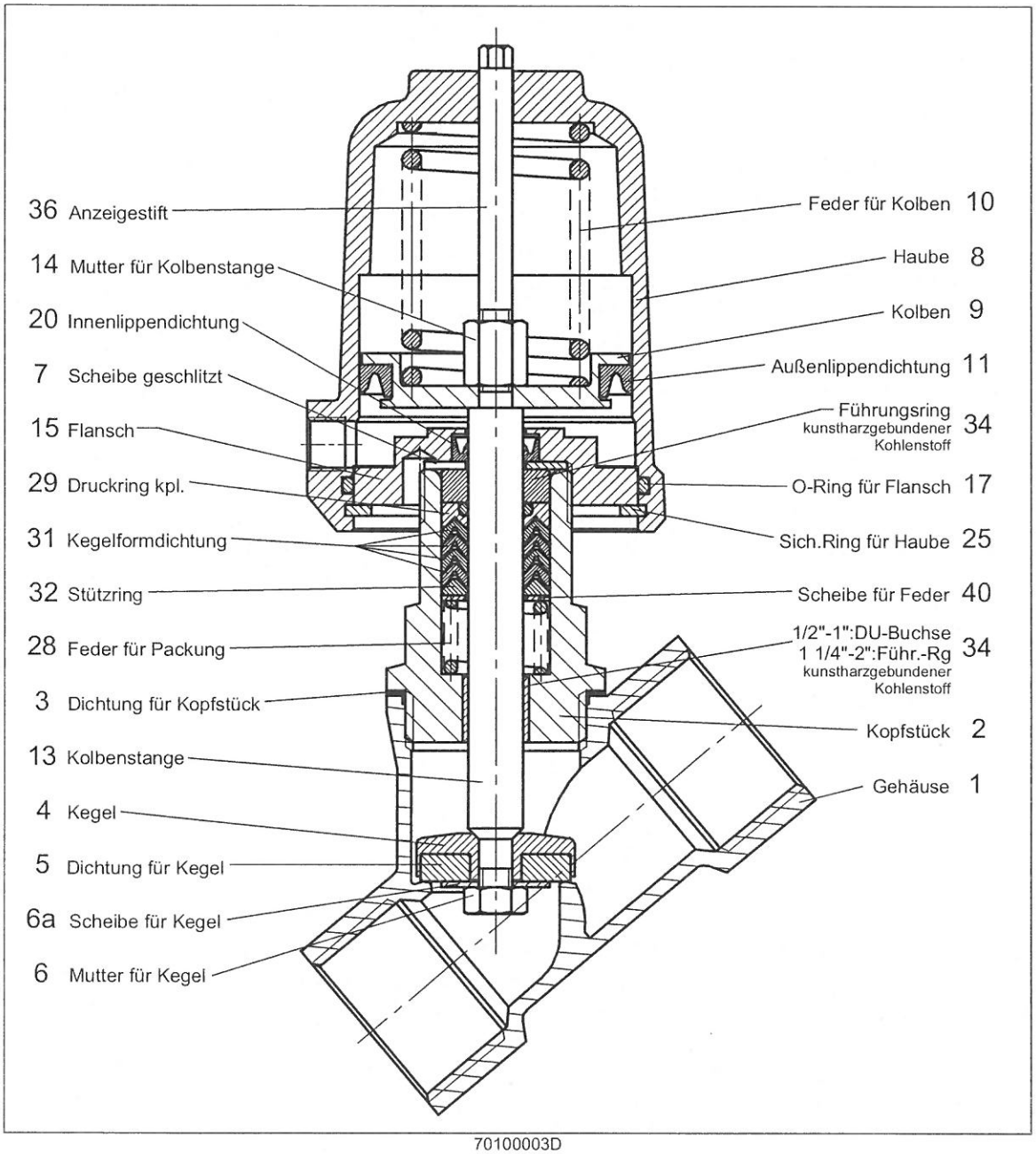
3.1 Liste des pièces de rechange 17
3.2 Caractéristiques techniques 19
3.3 Pose 19
3.4 Démontage de la vanne 20
3.5 Montage de la vanne 21
3.6 Plan de graissage et de collage 23

1 (D) Betriebsanleitung (deutsch)

1.1 Ersatzteilliste

⚠ (Nur Original-Ersatzteile von Schubert & Salzer Control Systems verwenden !)

1.1.1 Funktion Feder schließt



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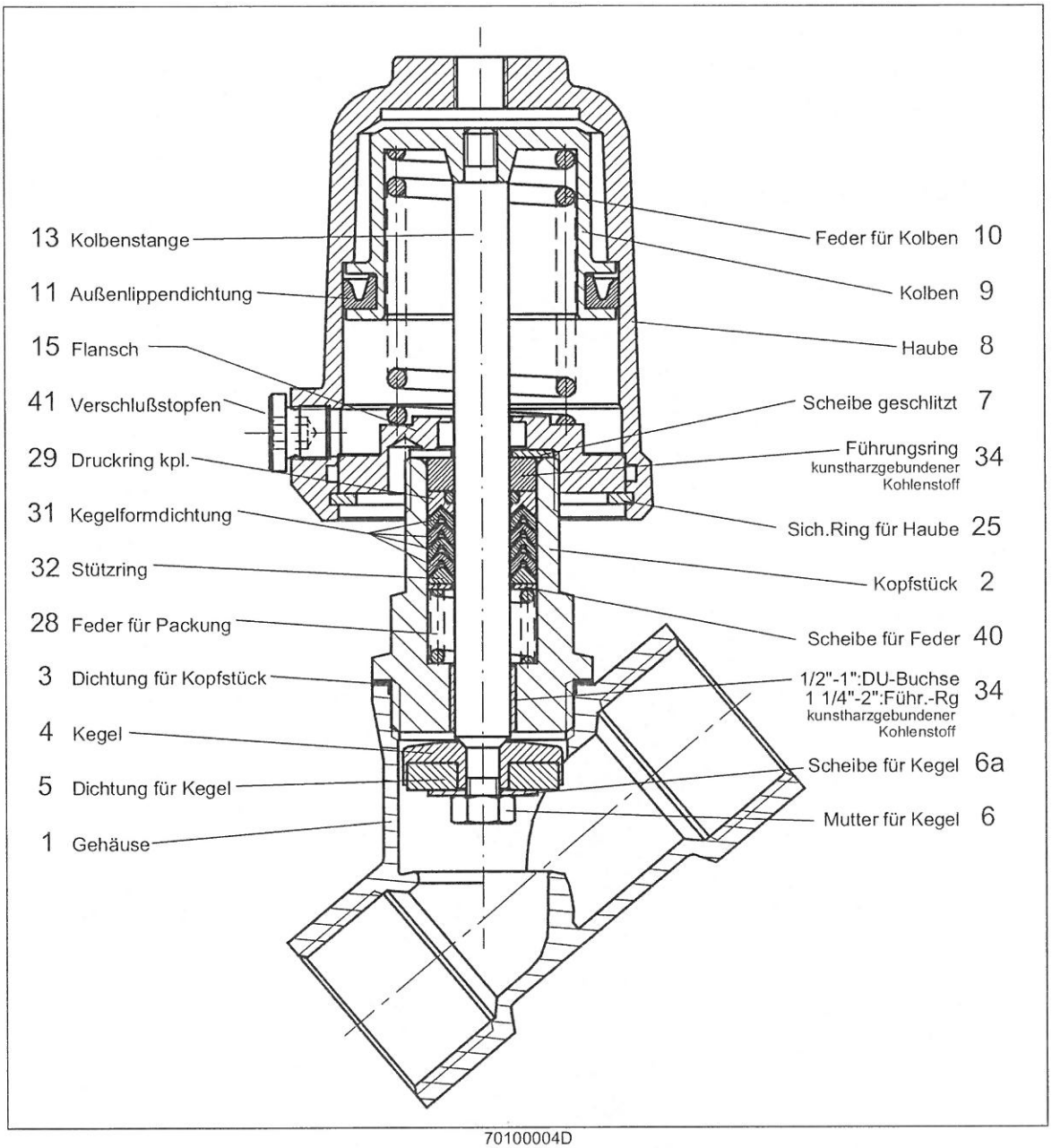
1.1.2 Funktion Feder öffnet



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⚠	Je nach Nennweite und Ausführung können die Anzahl und die Art der Führungsteile von denen in der Ersatzteilliste dargestellten Teilen abweichen. Im Bedarfsfall fordern Sie bitte eine detaillierte Ersatzteilliste an.

Neben den einzelnen Ersatzteilen sind für alle Ventile Reparatursätze erhältlich, die alle Dichtungs- und Verschleißteile enthalten

1.2 Technische Daten

	Gehäusewerkstoff		
	Messing	Rotguß	Edelstahl
Nennweiten	DN 65 und DN 80	DN 15 bis DN 50	DN 8 bis DN 65
Anschlüsse:			
Rohrgewinde nach DIN 2999	2 1/2" und 3"	1/2" - 2"	1/4" - 2 1/2"
NPT Gewinde	2 1/2" und 3"	1/2" - 2"	1/4" - 2 1/2"
Anschweißenden (DIN/ISO)			1/2" - 2 1/2"
Nenndruck	PN 16	PN 16	PN 40
Medientemperatur	-30°C bis +170°C	-30°C bis +170°C option. bis +200°C	-30°C bis +170°C option. bis +200°C
Umgebungstemperatur	-30°C bis +60°C		
Viskosität des Mediums	maximal 600 mm²/s (600cSt, 80°E)		
Vakuum	maximal 0,001 bar abs		
Betriebsdruck bei totraumfreier Ausführung	maximal 12 bar		

1.3 Einbau

Diese Anleitung gilt für die Funktionen „Feder schließt“ und „ Feder öffnet“.

⚠ Bei der Funktion „doppelwirkend“ ist entsprechend der Beschreibung der Funktion „Feder öffnet“ vorzugehen. Bei anderen Ausführungen ist gegebenenfalls Rücksprache mit der Firma Schuber & Salzer Control Systems GmbH zu nehmen.

Von der Armatur sind alle Verpackungsmaterialien zu entfernen.

Vor dem Einbau ist die Rohrleitung auf Verunreinigung und Fremdkörper zu untersuchen und ggf. zu reinigen.

Das Ventil ist entsprechend der Durchflußrichtung in die Rohrleitung einzubauen. Die Durchflußrichtung ist am Gehäuse durch einen Pfeil angegeben.

Die Rohrleitungen sind spannungsfrei an die einzubauende Armatur anzuschließen.
Die Rohrleitung darf dabei keinesfalls an die Armatur herangezogen werden.

Bei Gehäusen mit Muffenanschluss sind die Gewinde mit geeignetem Dichtungsmaterial abzudichten.

Wird die Armatur in die Rohrleitung eingeschweißt, so sind die Enden vorerst nur zu heften. Zum Fertigschweißen ist der Antrieb und das Kopfstück vom Gehäuse abzuschrauben, um Beschädigungen an den Dichtelementen zu vermeiden.

Bei Schweißarbeiten an der Rohrleitungen muß der Abstand zur Armatur mindestens 50 cm betragen, da sonst das Risiko einer Beschädigung des Sitzes besteht.

Die Funktion der kompletten eingebauten Armatur ist vor der Inbetriebnahme der Anlage zu überprüfen.

Einbaulage:
Die Einbaulage der Ventile ist beliebig.

1.4 Demontage des Ventils

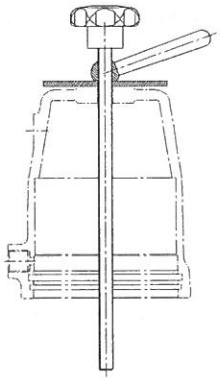
1.4.1 Funktion Feder schließt

1.4.1.1 Demontage des Antriebs

1 Anzeigestift (36) herausschrauben.
2 Montagewerkzeug (4010 408 für Antrieb D50, 4010 409 für Antrieb D80/D125) in die Haube einführen und in die Mutter (14) einschrauben.
3 Mit Kegelgriff des Montagewerkzeugs die Feder (10) etwas spannen, damit die Dichtung nicht mehr auf den Gehäusesitz drückt.
4 Den Antrieb vom Gehäuse (1) abschrauben.
5 Sicherungsring (25) mit einer Einsprengzange entfernen.
6 Durch Drehen des Kegelgriffs gegen den Uhrzeigersinn wird die Kolbenfeder (10) entspannt.

⚠ Die Montageschraube des Montagewerkzeugs sollte dabei festgehalten weden.

7 Montagewerkzeug entfernen.



Montagewerkzeug
D50: Art.-Nr: 4010 408
D80/D125: Art.-Nr: 4010 409

Montagedorn
Art.-Nr: 4010 410

1.4.1.2 Demontage des Kopfstücks.

1. Mutter (6) lösen. Dabei Mutter (14) festhalten.
2. Kolbenstange (13) aus dem Kopfstück herausziehen.
3. Flansch (15) in Schraubstock spannen.

⚠ Flansch nicht am Außendurchmesser spannen, da dies die Dichtfläche zur Haube ist und diese dadurch beschädigt würde.

4. Kopfstück (2) vom Flansch (15) abschrauben.

5. Führungsring (34) und Packung kpl. mit Montagedorn (4010 410) herausdrücken. (bitte Reihenfolge der Einzelteile für spätere Montage festhalten)

1.4.2 Funktion Feder öffnet

1 Den Antrieb vom Gehäuse (1) abschrauben.
2 Sicherungsring (25) mit einer Einsprengzange entfernen.
3 Haube (8) abnehmen.
4 Mutter (6) lösen. Dabei Kolben (9) festhalten.
5 Kolbenstange (13) aus dem Kopfstück herausziehen.
6 Flansch (15) in Schraubstock spannen.

Flansch nicht am Außendurchmesser spannen, da dies die Dichtfläche zur Haube ist und diese dadurch beschädigt würde.

7 Kopfstück (2) vom Flansch (15) abschrauben.
8 Führungsring (34) und Packung kpl. mit Montagedorn (4010 410) herausdrücken. (bitte Reihenfolge der Einzelteile für spätere Montage festhalten)

1.5 Montage des Ventils

	Schmier- und Klebeplan beachten ! Nur original Ersatzteile von Schubert & Salzer verwenden !

1.5.1 Funktion Feder schließt

1 Alle Teile reinigen.
2 Führungsringe und Packung in richtiger Reihenfolge in das Kopfstück (2) einschieben.

Die Kegelformdichtungen (31) müssen vor dem Einbau **einzeln** eingefettet werden.

3 Innenlippendichtung (20) und Scheibe (7) in den Flansch legen.
4 Kopfstück (2) mit Flansch (15) fest verschrauben.

Flansch nicht am Außendurchmesser spannen, da dies die Dichtfläche zur Haube ist und diese dadurch beschädigt würde.

5 Kolbenstange (13) und Kolben (9) mit Mutter (14) verschrauben.
6 Kolbenstange (13) vorsichtig von oben in das Kopfstück hineinschieben.
7 Einzelteile des Kegels mit Kolbenstange (13) verschrauben.
8 O-Ring in die Haube einsetzen.
9 Außenlippendichtung (11) auf den Kolben (9) montieren.
10 Feder (10) auf den Kolben (9) setzen.
11 Haube (8) aufsetzen.
12 Feder mit Montagewerkzeug soweit spannen, bis der Sicherungsring (25) eingesetzt werden kann.
13 Sicherungsring in Haube einsetzen. (auf sicheres Einschnappen des Sicherungsringes in die Haube achten).
14 Antrieb auf das Gehäuse (1) aufschrauben.

15 Montagewerkzeug entfernen und Anzeigestift (36) einschrauben

1.5.2 Funktion Feder öffnet

1 Alle Teile reinigen.
2 Führungsringe und Packung in richtiger Reihenfolge in das Kopfstück (2) einschieben.

Die Kegelformdichtungen (31) müssen vor dem Einbau **einzeln** eingefettet werden.

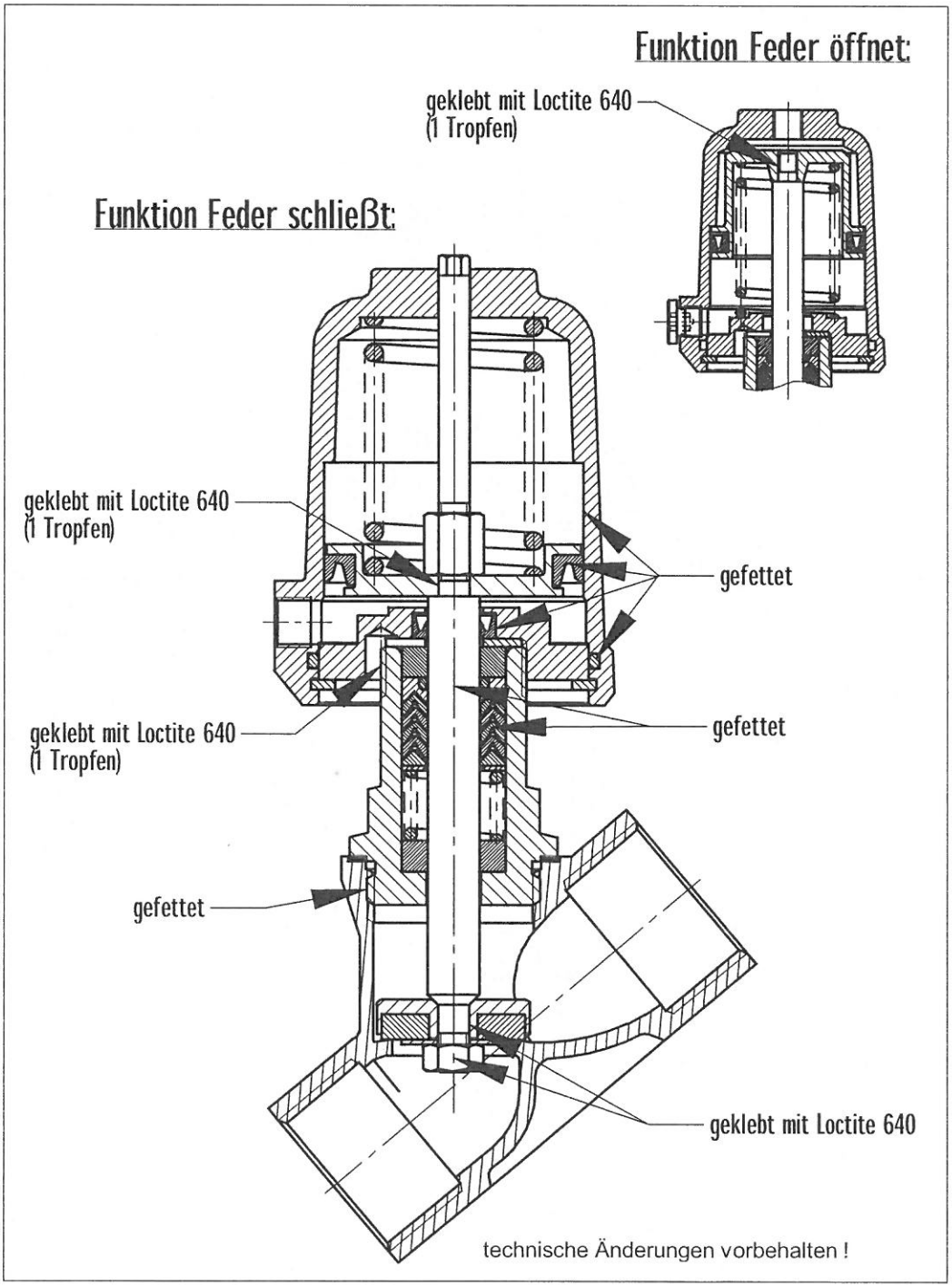
3 Scheibe (7) in den Flansch (15) legen.
4 Kopfstück (2) mit Flansch (15) fest verschrauben.

Flansch nicht am Außendurchmesser spannen, da dies die Dichtfläche zur Haube ist und diese dadurch beschädigt würde.

5 Kolbenstange (13) und Kolben (9) verschrauben.
6 Feder (10) in den Kolben stellen.
7 Kolbenstange (13) vorsichtig von oben in das Kopfstück hineinschieben.
8 Einzelteile des Kegels mit Kolbenstange (13) verschrauben.
9 Außenlippendichtung (11) auf den Kolben (9) montieren.
10 Haube (8) vorsichtig über Kolben (9) und Flansch (15) stülpen.
11 Haube fest auf das Kopfstück (2) und den Flansch (15) drücken.
12 Sicherungsring in Haube einsetzen. (auf sicheres Einschnappen des Sicherungsringes in die Haube achten).
13 Antrieb auf das Gehäuse (1) aufschrauben.

1.6 Schmier- und Klebeplan

⚠	Der Schmier- und Klebeplan gilt für alle Standardausführungen dieses Ventiltyps. Informieren Sie sich beim Hersteller über die geeigneten Schmierstoffe. Bei Sonderausführungen (z.B. silikonfrei, für Sauerstoffanwendungen oder für Lebensmittelanwendungen) sind gegebenenfalls andere Fettsorten zu verwenden.

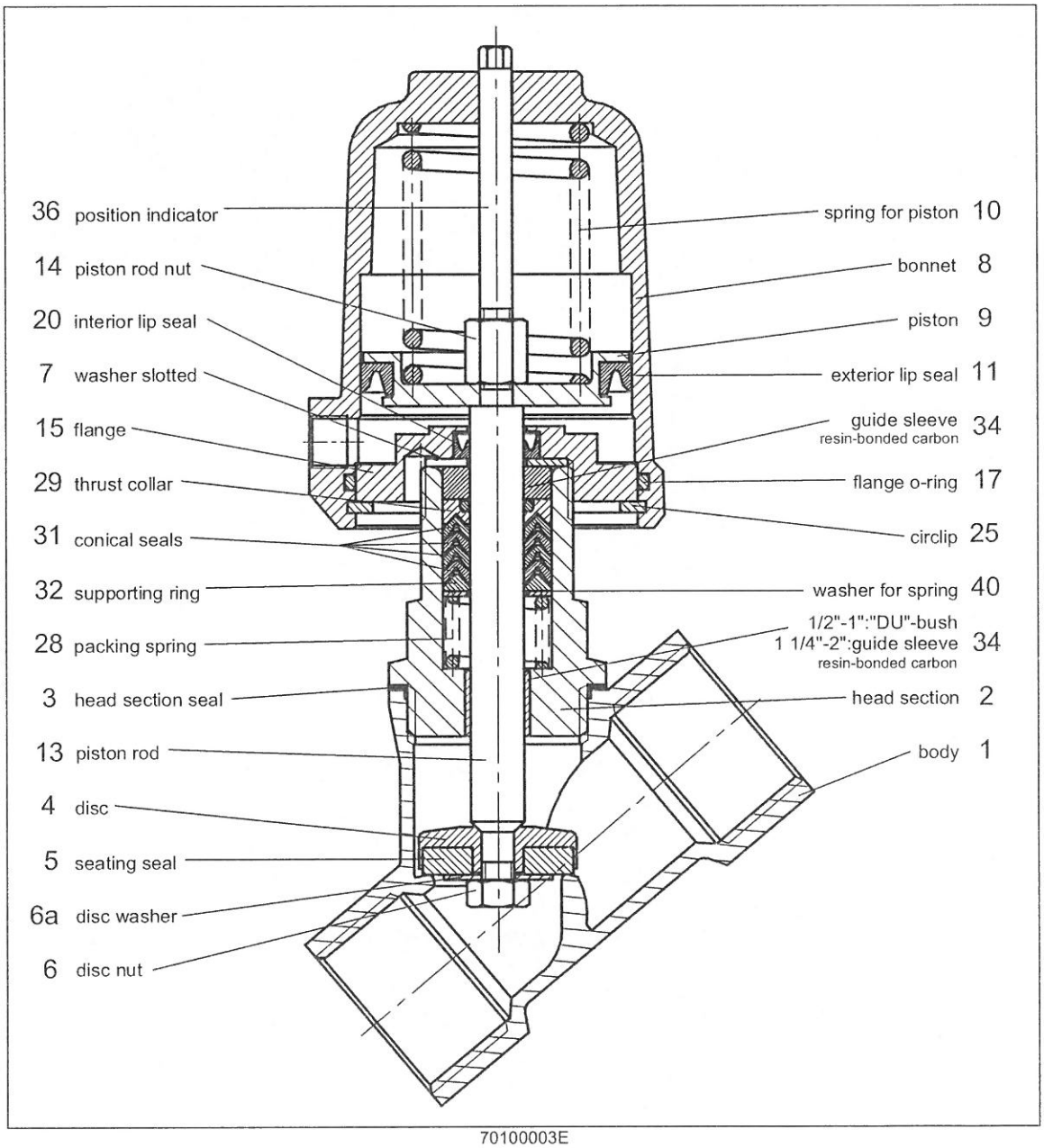


2 (GB)(USA) Operating Instructions (English)

2.1 Spare Parts List

⚠ Use original Schubert & Salzer Control Systems spare parts only!

2.1.1 Function Spring Closes



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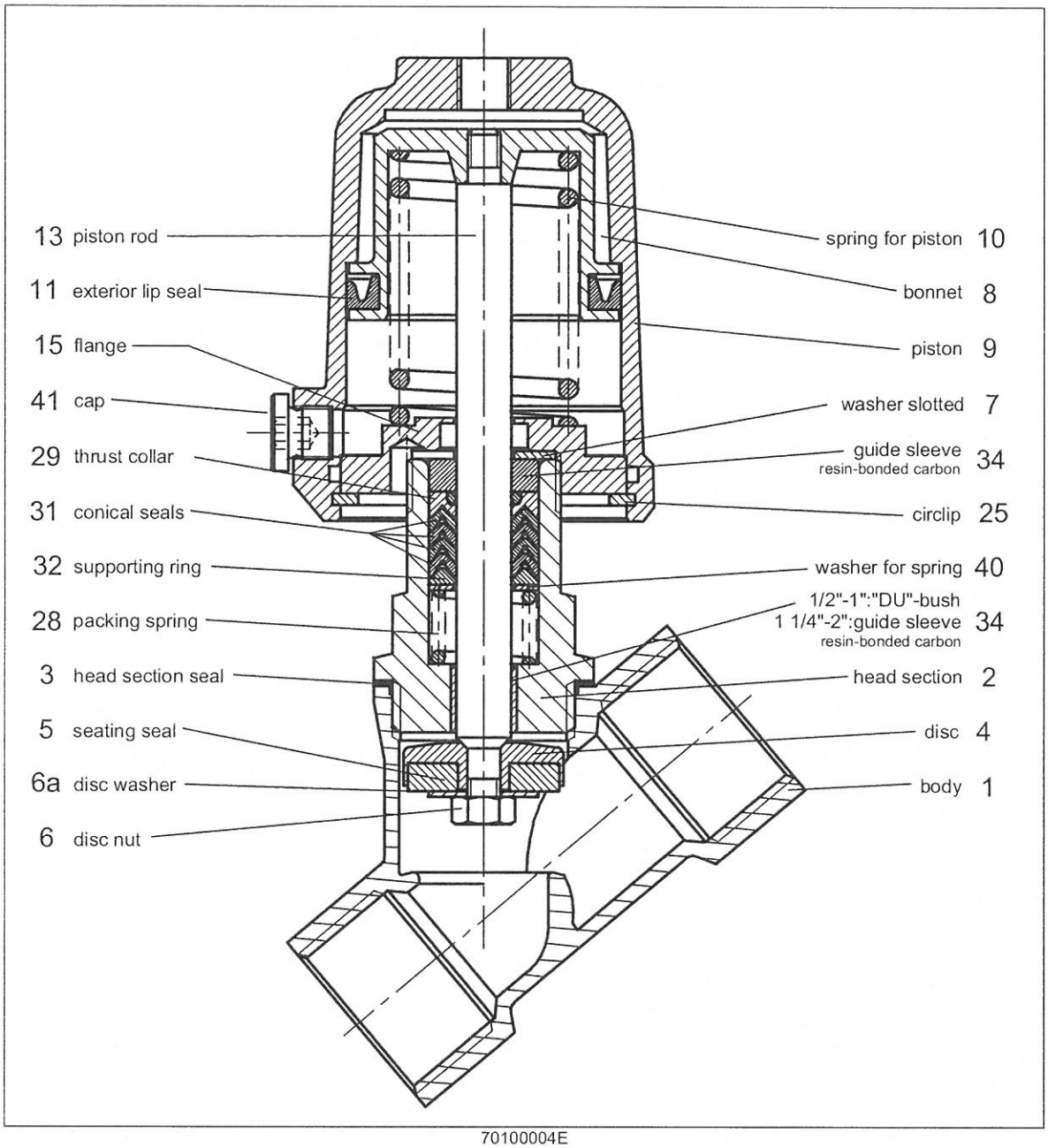
2.1.2 Function "Spring Opens"



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⚠	Depending on size and version number and kind of guiding parts may differ from those shown in the spare parts list. In case of need demand for a detailed spare parts list.

Besides the single spare parts repair kits are available for all valves containing all sealings and parts subject to wear.

2.2 Technical Data

	Body material		
	Brass	Bronze	Stainless steel
Nominal size	DN 65 and DN 80	DN 15 to DN 50	DN 8 to DN 65
Connections:			
Pipe thread acc. DIN 2999	2 1/2" and 3"	1/2" - 2"	1/4" - 2 1/2"
NPT thread	2 1/2" and 3"	1/2" - 2"	1/4" - 2 1/2"
welding ends (DIN/ISO)			1/2" - 2 1/2"
Nominal pressure	PN 16	PN 16	PN 40
Max. fluid temperat.	-30°C up to 170°C	-30°C up to 170°C	-30°C up to 170°C
*optional		Up to +200°C*	Up to +200°C*
Ambient temperature	-30°C up to +60°C		
Viscosity of the fluid	maximum 600 mm²/s (600cSt, 80°E)		
Vacuum	maximum 0,001bar abs		
Working pressure for hollow construction	maximum 12 bar		

2.3 Mounting

This instruction is valid for functions “spring closes” and “spring opens”.

For function „double acting“ proceed according to description of function „spring opens“. For all other versions consult Schubert & Salzer Control Systems if necessary.

Remove all packing material from the valve.

Before mounting check the pipeline for contaminations and foreign bodies and clean if necessary.

The valve has to be mounted to the pipeline according the direction of flow which is indicated by an arrow on the valve body.

The pipelines have to be connected to the valve avoiding stress on it. The pipeline must not be pulled up to the valve in any case.

On bodies with threaded ends the threads have to be sealed using a suitable sealant.

If the valve is welded to the pipeline its ends have to be only tacked first. For accomplishing welding actuator and head section have to be unscrewed from the body to avoid damage on the sealing elements.

Welding on the pipelines requires a distance to the valve of 50 cm min. as there is a risk of damage of the valve seat.

The function of the completely mounted valve has to be checked before putting the installation into service.

Mounting position:

The mounting position of the valve is arbitrary.

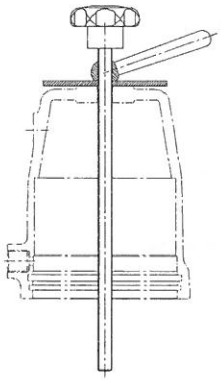
2.4 Dismounting the Valve

2.4.1 Function "Spring Closes"

2.4.1.1 Dismounting the Actuator

1. Unscrew indicator pin (36).
2. Insert mounting tool (4010 408 for actuator D50, 4010 409 for actuator D80/D125) into bonnet and screw to nut (14).
3. Tighten the spring (10) a little bit by turning the mounting tool lever until the sealing lifts off from the valve seat.
4. Unscrew actuator from body (1).
5. Remove circlip (25) using a suitable pair of tongues.
6. Release actuator spring (10) by turning the lever.

   ⚠ Hold mounting screw of mounting tool at the same time.
7. Remove mounting tool.



Mounting tool
D50: Art.-No: 4010 408
D80/D125: Art.-No: 4010 409

Mounting pin
Art.-No: 4010 410

2.4.1.2 Dismounting the Head Section

1 Loosen nut (6) while fixing nut (14).
2 Pull out piston rod (13) from head section.
3 Clamp flange to a (15) to a vice.

⚠ Do not clamp flange at its outer diameter, as this is a sealing surface for the bonnet which might be damaged then.

4 Unscrew head section (2) from flange (15).
5 Press out guiding sleeves (34) and packing with mounting pin (art.-No: 4010410). (Please keep order of parts in mind for later mounting.)

2.4.2 Function "Spring Opens"

1 Unscrew actuator from body (1).
2 Remove circlip (25) using a suitable pair of tongues.
3 Take off bonnet (8).
4 Loosen nut (6) while fixing piston (9).
5 Pull out piston rod (13) from head section.
6 Clamp flange to a (15) to a vice.

⚠ Do not clamp flange at its outer diameter, as this is a sealing surface for the bonnet which might be damaged then.

7 Unscrew head section (2) from flange (15).
8 Press out guiding sleeves (34) and packing with mounting pin (art.-No: 4010410). (Please keep order of parts in mind for later mounting.)

2.5 Mounting the Valve

⚠	Note lubrication and bonding plan! Use original Schubert & Salzer Control Systems spare parts only!

2.5.1 Function „Spring Closes"

1 Clean all parts.
2 Push guide sleeves and packing into the head section (2). Take care for the right order.

⚠ The conical seals (31) have to be greased **individually**.

3 Put interior lip seal (20) and washer (7) into flange.
4 Screw head section (2) to flange (15) firmly.

⚠ Do not clamp flange at its outer diameter, as this is a sealing surface for the bonnet which might be damaged then.

5 Screw piston rod (13) and piston (9) using nut (14).
6 Push piston rod (13) carefully into the head section (from the top).
7 Screw all disc parts to piston rod (13).
8 Insert O-ring into bonnet.
9 Mount exterior lip seal (11) to bonnet (9).
10 Put spring (10) on piston (9).
11 Mount bonnet (8).
12 Tighten spring with mounting tool until the circlip (25) can be mounted.
13 Insert circlip to bonnet (take care that the circlip has properly snapped to its groove).
14 Screw actuator to valve body (1).
15 Remove mounting tools an screw in indicator pin (36).

2.5.2 Function „Spring Opens“

1 Clean all parts.
2 Push guide sleeves and packing into the head section (2). Take care for the right order.

The conical seals (31) have to be greased individually.

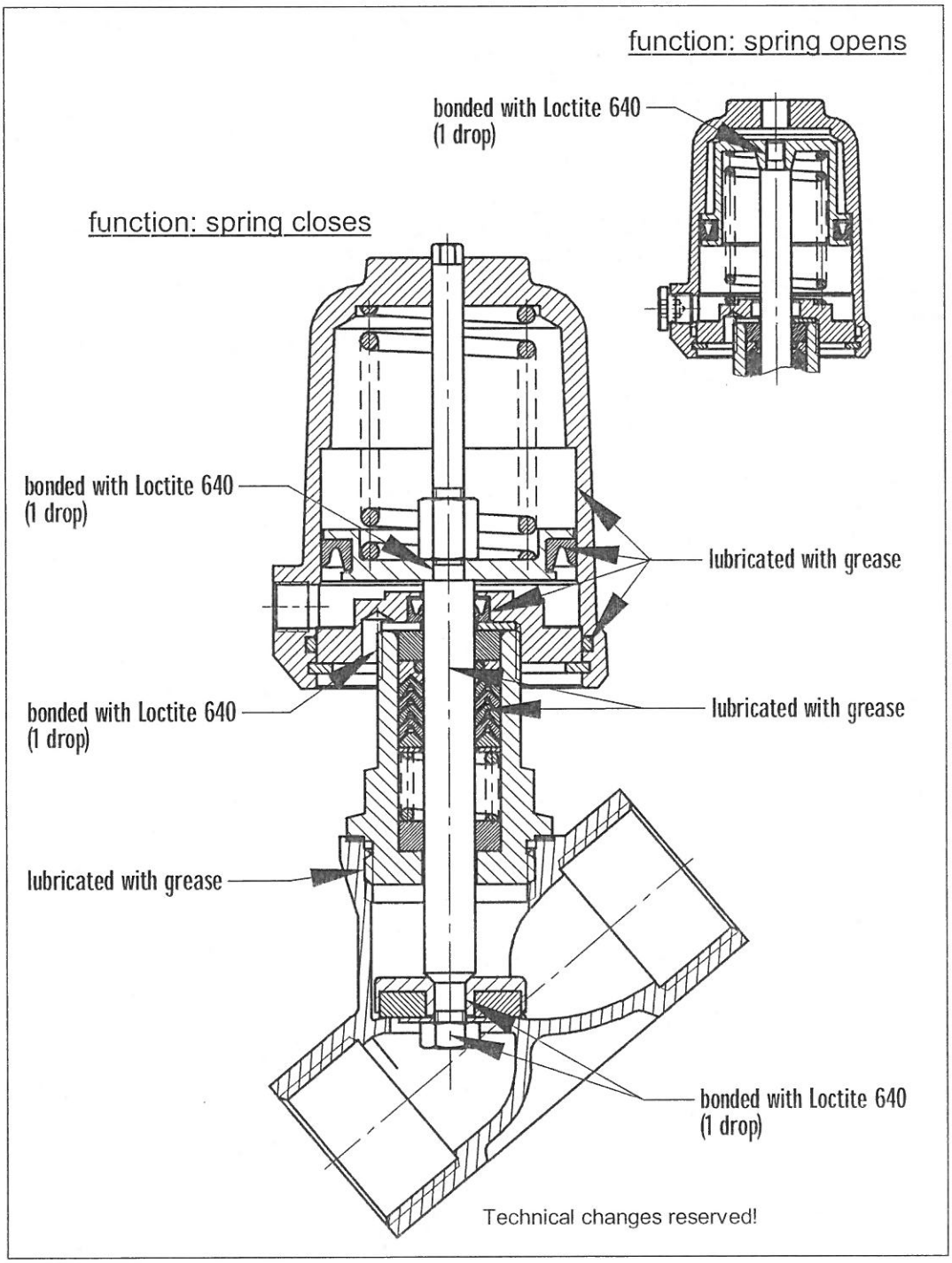
3 Put washer (7) into flange (15).
4 Screw head section (2) to flange (15) firmly.

Do not clamp flange at its outer diameter, as this is a sealing surface for the bonnet which might be damaged then.

5 Screw piston rod (13) and piston (9).
6 Put spring (10) into bonnet.
7 Push piston rod (13) carefully into the head section (from the top).
8 Screw all disc parts to piston rod (13).
9 Mount exterior lip seal (11) to bonnet (9).
10 Put bonnet (8) carefully over piston (9) and flange (15).
11 Press bonnet firmly to head section (2) and flange (15).
12 Insert circlip to bonnet (take care that the circlip has properly snapped to its groove).
13 Screw actuator to valve body (1).

2.6 Lubrication and Bonding Plan

⚠	The lubrication and bonding plan is valid for all standard versions of this valve type. Contact the manufacturer for suitable lubricants. Special versions (e.g. silicon free, oxygen service or food applications) require other lubricate qualities optionally.

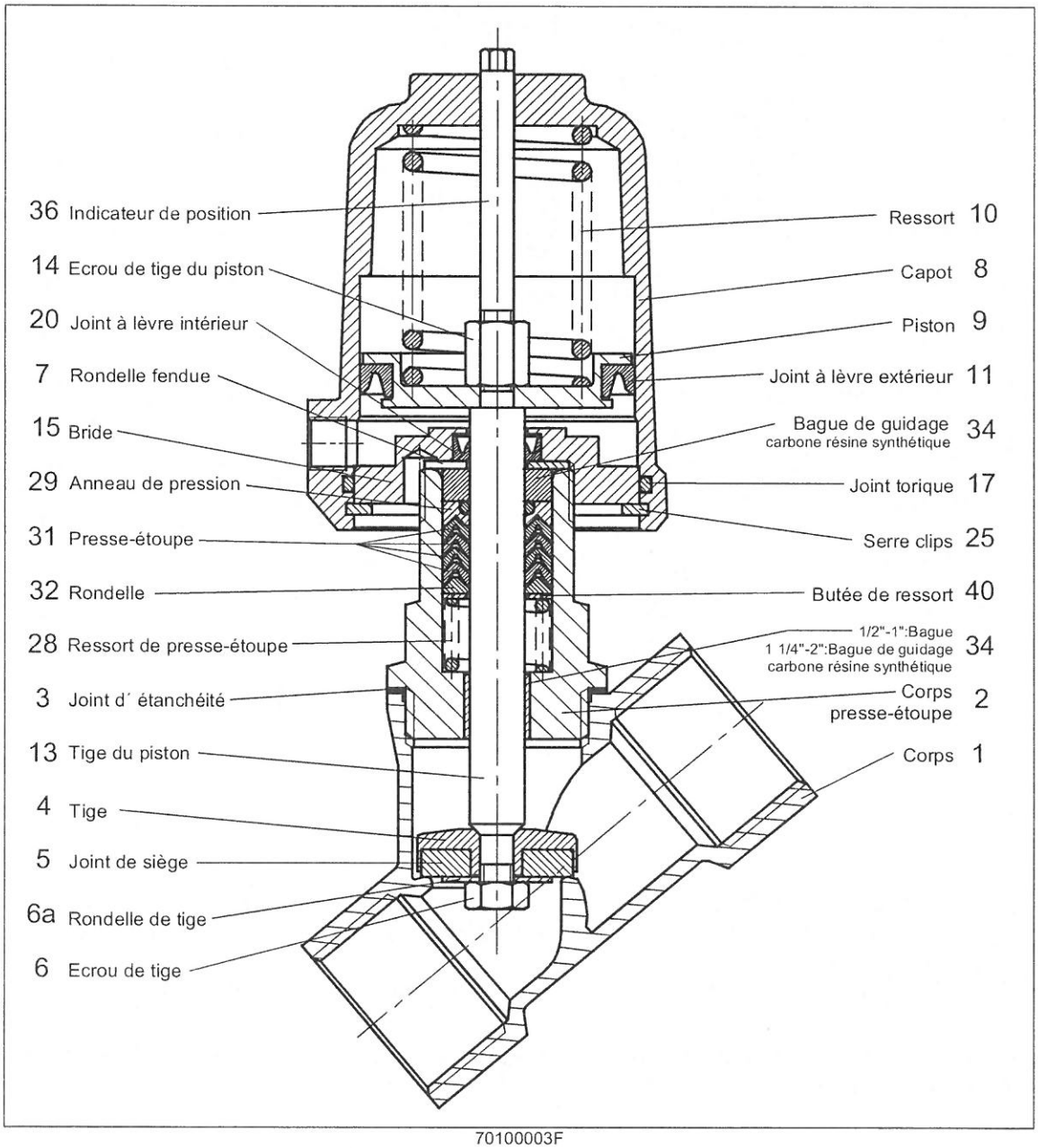


3 (F) Instructions de service (français)

3.1 Liste des pièces de rechange

⚠ (Utiliser uniquement des pièces de rechange d'origine Schubert & Salzer Control Systems !)

3.1.1 Fonction normalement fermée



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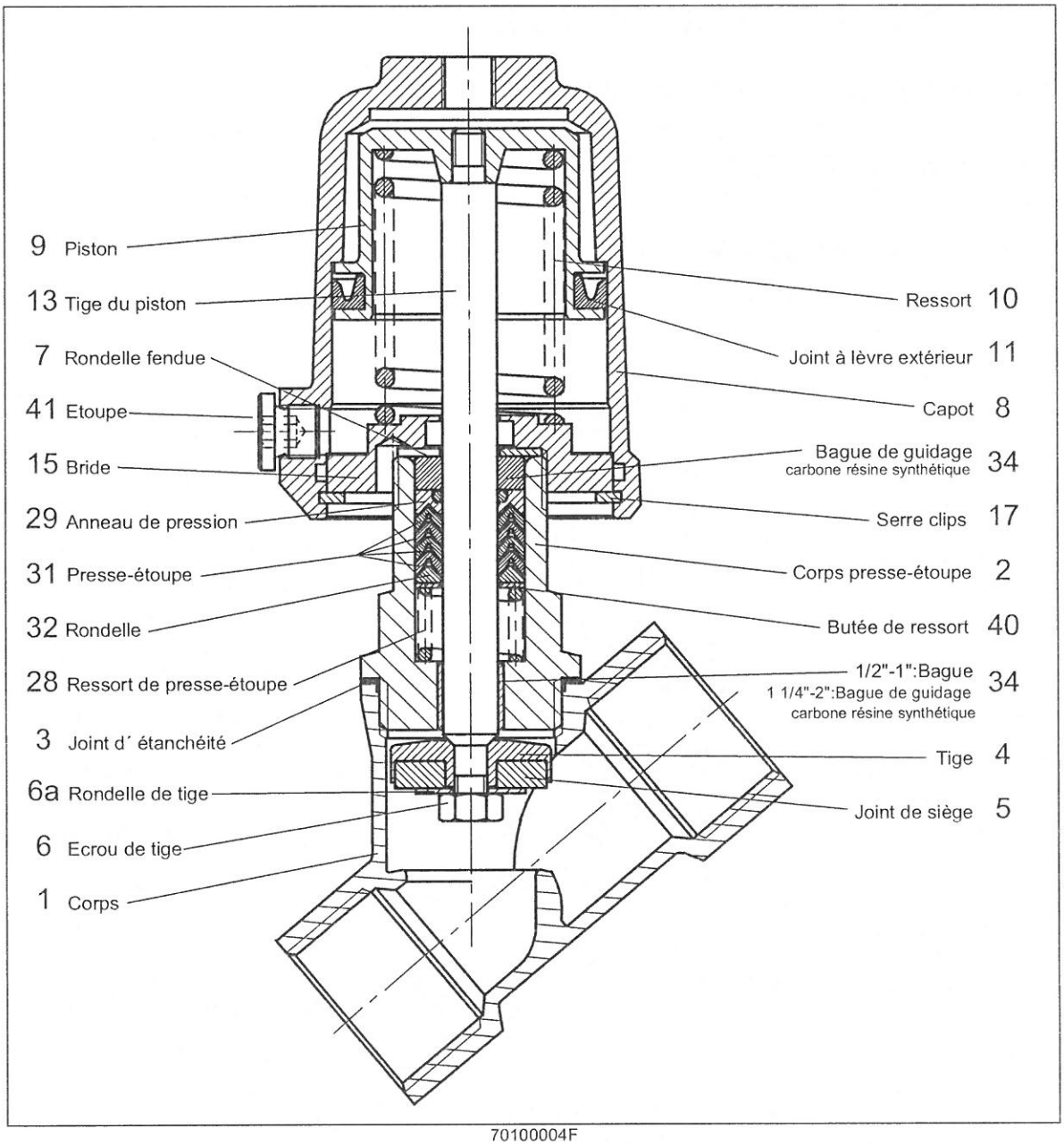
3.1.2 Fonction normalement ouverte



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⚠	Selon le diamètre nominal et la version, le nombre et le type de pièces de guidage peuvent varier de ceux des pièces représentées dans la liste des pièces de rechange. Au besoin, veuillez demander une liste détaillée.

En plus des pièces de rechange, nous proposons également pour toutes les vannes des kits de réparation contenant toutes les pièces d'étanchéité et d'usure.

3.2 Caractéristiques techniques

	Corps		
	Laiton	Bronze	Inox
Diamètre nominal	DN 65 et DN 80	DN 15 à DN 50	DN 8 à DN 65
Raccordement: Taraudage Whitworth Taraudage NPT extrémité à souder	 2 1/2" et 3" 2 1/2" et 3"	 1/2" - 2" 1/2" - 2"	 1/4" - 2 1/2" 1/4" - 2 1/2" 1/2" - 2 1/2"
Pression nominale	PN 16	PN 16	PN 40
Plage d'utilisation	-30°C à +170°C	-30°C à +170°C jusqu'à +200°C en option	-30°C à +170°C
Température ambiante	- 30° C à + 60°C		
Viscosité maxi. du fluide	max. 600 mm²/s (600cSt, 80°E)		
Vide	max. 0,001 bar abs		
Pression de service version sans espace mort	max. 12 bars		

3.3 Pose

Cette notice est valable pour les fonctions « normalement fermée » et « normalement ouverte ».

⚠ Pour la fonction « double effet », procéder comme pour la fonction « normalement ouverte ». Pour les autres modèles, veuillez contacter la société Schubert & Salzer Control Systems GmbH.

Déballer entièrement l'élément de robinetterie.

Avant la pose, vérifier que la canalisation est propre et ne contient pas de corps étrangers, et la nettoyer si nécessaire.

Poser la vanne dans la canalisation conformément au sens d'écoulement. Celui-ci est indiqué par une flèche sur le corps.

Raccorder les canalisations à l'élément de robinetterie, en veillant à supprimer toute tension. La canalisation ne doit en aucun cas être rapprochée par traction à l'élément de robinetterie.

Les filetages des corps à embout femelle doivent être colmatés avec du matériel d'étanchéité adapté.

Si l'élément de robinetterie doit être soudé dans la canalisation, commencer par seulement pointer les extrémités. Afin d'éviter d'endommager les éléments d'étanchéité, dévisser la commande et le corps presse-étoupe du corps avant de terminer la soudure.

Pour les opérations de soudage de canalisation, respecter une distance minimum de 50 cm par rapport à l'élément de robinetterie afin d'éliminer tout risque d'endommagement du siège.

Vérifier le fonctionnement de l'élément de robinetterie avant de mettre l'installation en service.

Position de montage :

L'élément de robinetterie peut être monté dans n'importe quelle position.

3.4 Démontage de la vanne

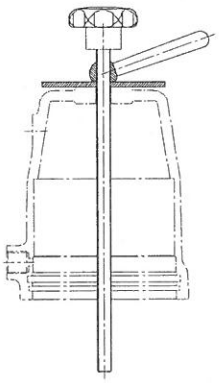
3.4.1 Fonction normalement fermée

3.4.1.1 Démontage de la commande

1 Dévisser l'indicateur de position (36).
2 Guider l'outil de montage (4010 408 pour la commande D50, 4010 409 pour la commande D80/D125) dans le chapeau et le visser dans l'écrou (14).
3 A l'aide de la poignée conique de l'outil de montage, tendre légèrement le ressort (10) pour que le joint n'appuie plus sur le siège.
4 Dévisser la commande du corps (1).
5 Enlever le circlip (25) à l'aide d'une pince spéciale.
6 Tourner la poignée conique dans le sens inverse des aiguilles d'une montre pour détendre le ressort de piston (10).

⚠ Ce faisant, maintenir la vis de montage de l'outil de montage.

7 Retirer l'outil de montage.



Outil de montage
D50 : Réf. : 4010 408
D80/D125 : Réf. : 4010 409

Broche de montage
Réf. : 4010 410

3.4.1.2 Démontage du corps presse-étoupe

1. Dévisser l'écrou (6) en maintenant l'écrou (14).
2. Retirer la tige de piston (13) du corps presse-étoupe.

3. Serrer la bride (15) dans un étau.

Ne pas serrer la bride sur son diamètre extérieur, car celui-ci constitue la surface d'étanchéité avec le chapeau et pourrait être endommagé.
4. Dévisser le corps presse-étoupe (2) de la bride (15).
5. Enlever la bague de guidage (34) et le presse-étoupe complet, avec broche de montage (4010 410). (Noter l'ordre des pièces pour le montage ultérieur)

3.4.2 Fonction normalement ouverte

1. Dévisser la commande du corps (1).
2. Enlever le circlip (25) à l'aide d'une pince spéciale.
3. Enlever le chapeau (8).
4. Dévisser l'écrou (6) en maintenant le piston (9).
5. Retirer la tige de piston (13) du corps presse-étoupe.
6. Serrer la bride (15) dans un étau.

Ne pas serrer la bride sur son diamètre extérieur, car celui-ci constitue la surface d'étanchéité avec le chapeau et pourrait être endommagé.
7. Dévisser le corps presse-étoupe (2) de la bride (15).
8. Enlever la bague de guidage (34) et le presse-étoupe complet, avec broche de montage (4010 410). (Noter l'ordre des pièces pour le montage ultérieur)

3.5 Montage de la vanne

	Respecter le plan de graissage et de collage ! Utiliser uniquement des pièces de rechange d'origine Schubert & Salzer !

3.5.1 Fonction normalement fermée

1. Nettoyer toutes les pièces.
2. Insérer les bagues de guidage et le presse-étoupe dans le corps presse-étoupe (2), dans le bon ordre.

Les presse-étoupe (31) doivent être graissés **individuellement** avant le montage.
3. Poser le joint à lèvre intérieur (20) et la rondelle (7) dans la bride.
4. Visser le corps presse-étoupe (2) avec la bride (15).

Ne pas serrer la bride sur son diamètre extérieur, car celui-ci constitue la surface d'étanchéité avec le chapeau et pourrait être endommagé.
5. Visser la tige de piston (13) et le piston (9) avec l'écrou (14).
6. Insérer avec précaution la tige de piston (13) dans le corps presse-étoupe, par le haut.
7. Visser les pièces du cône avec la tige de piston (13).
8. Poser le joint torique dans le chapeau.
9. Monter le joint à lèvre extérieur (11) sur le piston (9).

10. Poser le ressort (10) sur le piston (9).
11. Poser le chapeau (8).
12. Serrer le ressort à l'aide de l'outil de montage jusqu'à ce que le circlip (25) puisse être mis en place.
13. Poser le circlip dans le chapeau. (Veiller à bien l'enclencher dans le chapeau).
14. Visser la commande sur le corps (1).
15. Retirer l'outil de montage et visser l'indicateur de position (36).

3.5.2 Fonction normalement ouverte

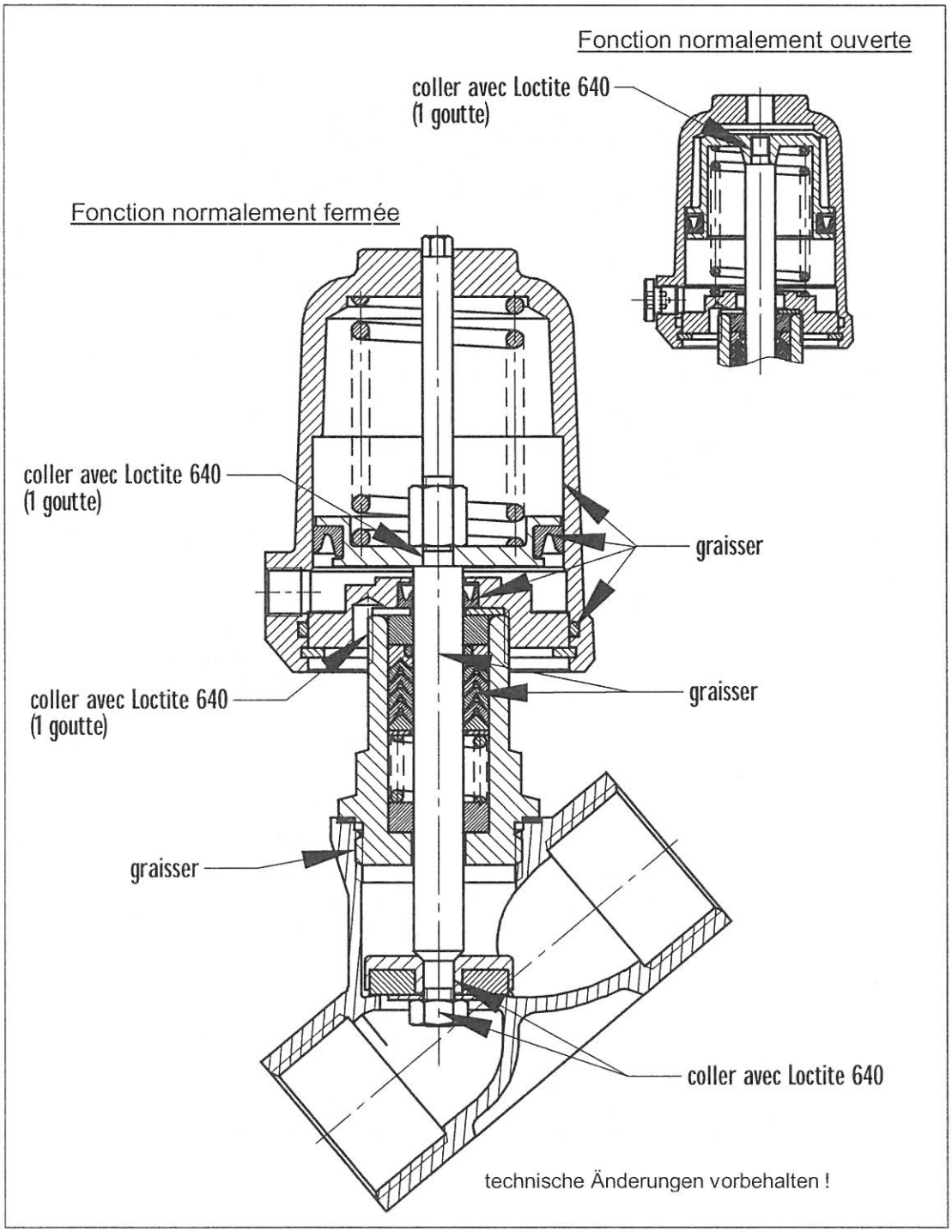
1. Nettoyer toutes les pièces.
2. Insérer les bagues de guidage et le presse-étoupe dans le corps presse-étoupe (2), dans le bon ordre.

   ⚠ Les presse-étoupe (31) doivent être graissés **individuellement** avant le montage.
3. Poser la rondelle (7) dans la bride (15).
4. Visser le corps presse-étoupe (2) avec la bride (15).

   ⚠ Ne pas serrer la bride sur son diamètre extérieur, car celui-ci constitue la surface d'étanchéité avec le chapeau et pourrait être endommagé.
5. Visser la tige de piston (13) et le piston (9).
6. Poser le ressort (10) dans le piston.
7. Insérer avec précaution la tige de piston (13) dans le corps presse-étoupe, par le haut.
8. Visser les pièces du cône avec la tige de piston (13).
9. Monter le joint à lèvre extérieur (11) sur le piston (9).
10. Retourner avec précaution le chapeau (8) sur le piston (9) et la bride (15).
11. Presser le chapeau sur le corps presse-étoupe (2) et la bride (15).
12. Poser le circlip dans le chapeau. (Veiller à bien l'enclencher dans le chapeau).
13. Visser la commande sur le corps (1).

3.6 Plan de graissage et de collage

⚠	Le plan de graissage et de collage est valable pour toutes les versions standard de ce modèle de vanne. Veuillez vous informer auprès du fabricant sur les lubrifiants appropriés. Les versions spéciales (par ex. sans silicone, pour les applications à l'oxygène ou alimentaires) requièrent éventuellement des types de graisses spécifiques.



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Original Schubert & Salzer products delivered by:

Les produits originaux Schubert & Salzer sont livrés par:

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SCHUBERT SALZER UK Ltd.
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SCHUBERT SALZER IBÉRICA
Made in Germany
Poligono Industrial No.7
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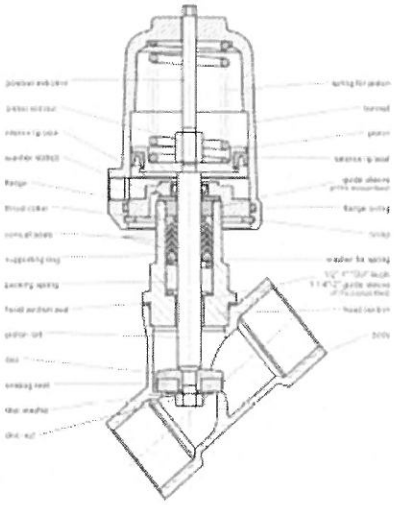
SCHUBERT SALZER FRANCE SARL
Made in Germany
2000, Route des Lucioles
06901 Sophia Antipolis Cedex
Tel. 049 294 4841
Fax 049 395 8052

Type 7010 Installation & Servicing

I&M 7010 Series provides full installation details

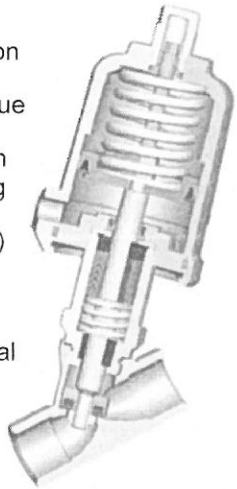
- The valves have to be mounted to the pipeline according to the direction of flow. The direction of flow is marked by an arrow on the valve body.
- The pilot connector is located at the actuator head on the valve body.
- The valves can be actuated pneumatically or hydraulically (in case of pneumatic operation slightly lubricated as well as oil-free compressed air can be used).
- The maximum working and pilot pressure is stamped on the valve nameplate.

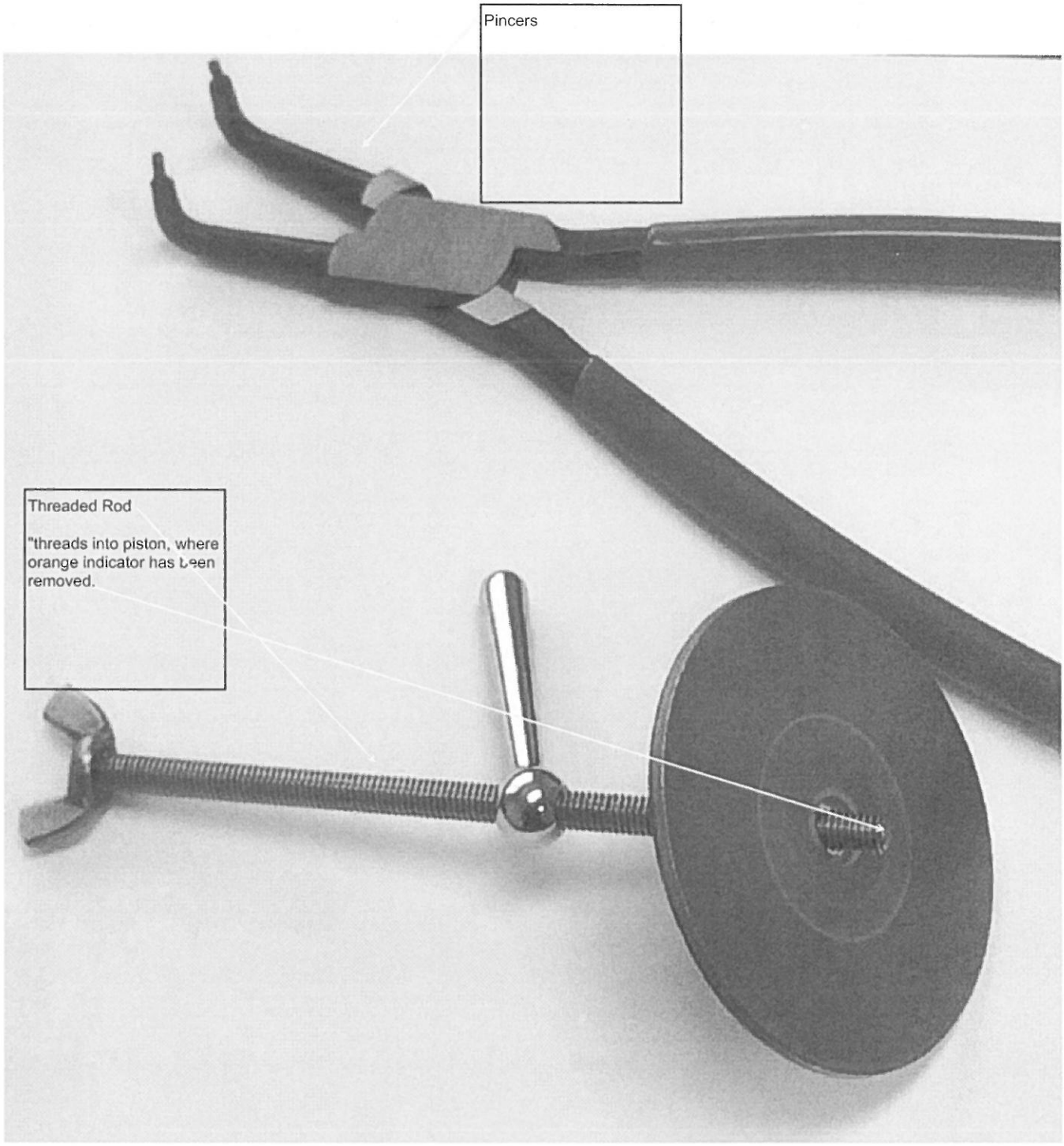
Danger: The actuator is spring loaded. Dismantle actuator with tools provided in repair kit.



Abbreviated Rebuild Procedure

- Follow standard warning statements
- Remove stroke indicator
- Using compression tool, screw threaded rod into piston nut
- Turn lever down rod until contacting actuator. Continue several turns to compress spring.
- Remove actuator head section from body with wrench
- Turn lever several additional turns to compress spring to remove force on circular clip.
- Carefully place piston nut in vise (don't damage stem)
- Remove circular clip with pincer pliers.
- Turn lever in opposite direction to release spring and remove actuator head
- Loosen seating seat disc nut, remove and replace seal
- Remove stem and polish with 1200 grit paper
- Remove inner lip seal, sleeve guide, thrust collar and then Chevron packing, one seal at a time
- At this point, valve should be completely disassembled

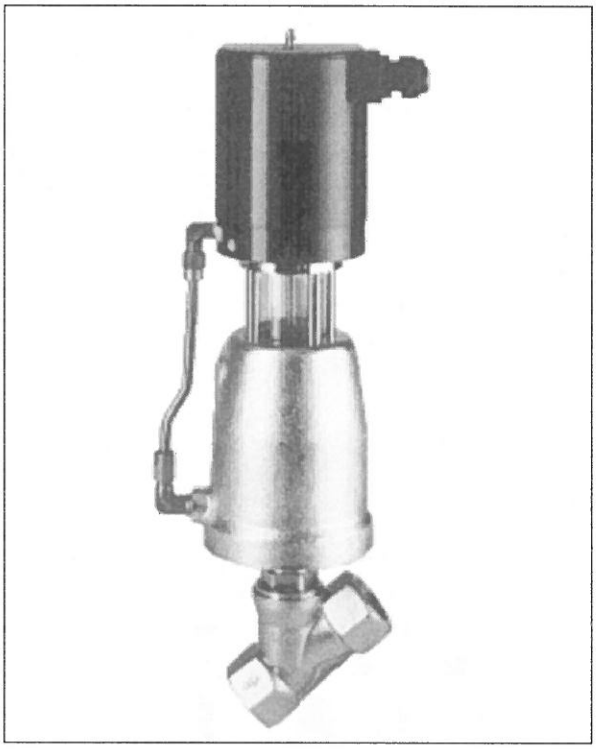



Pincers
Threaded Rod
"threads into piston, where orange indicator has been removed.

USA

Operating Instructions

Typ 7020



I. General Operation & Installation
II. P/P Positioner.....Page 9
III. I/P Analogue Positioner..Page 13
IV. 8048 Digital Positioner..Page 21
V. 8049 Digital Positioner..Page 29

Version: 12/2006

M7020.doc

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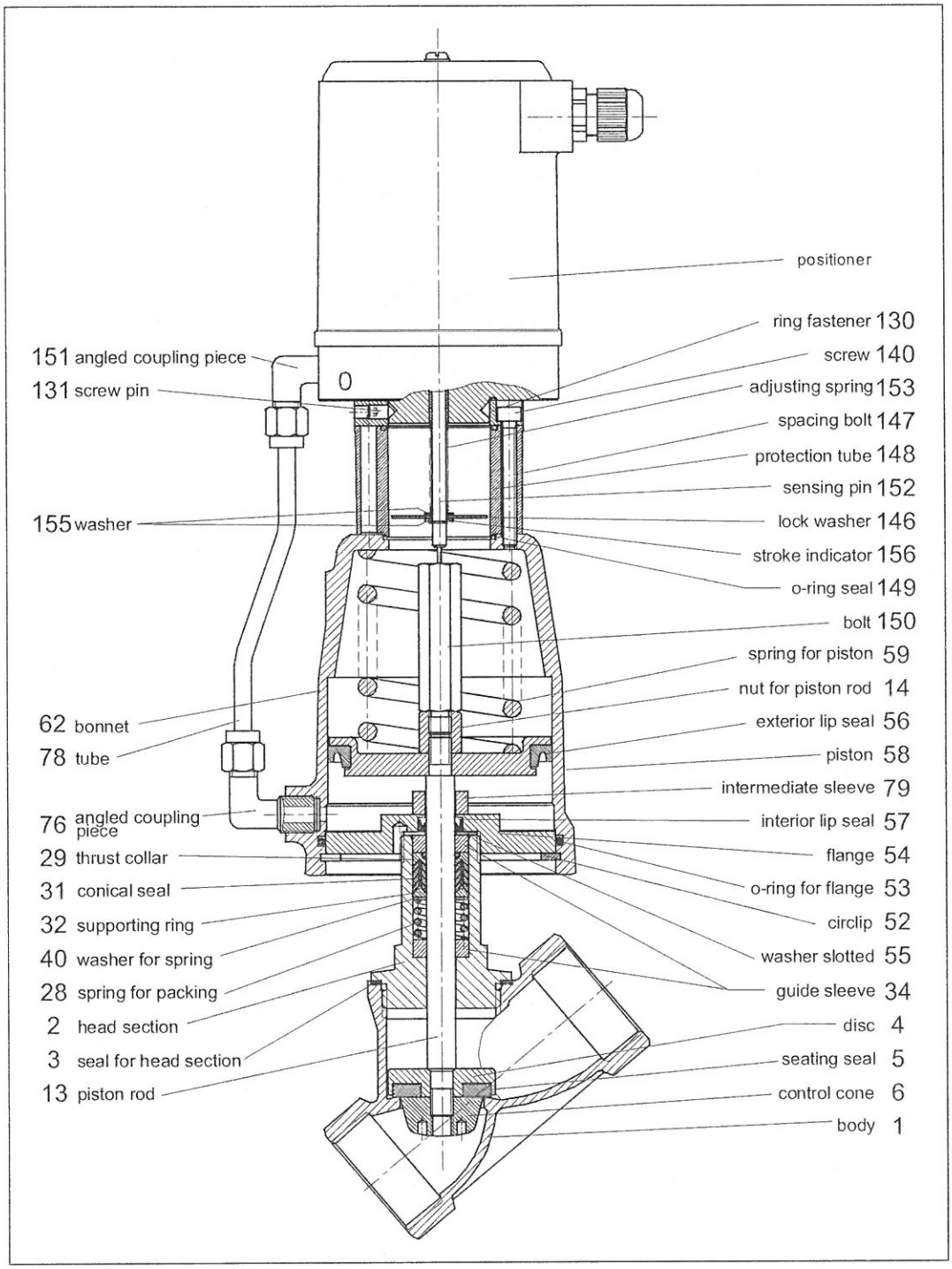
2 GB USA Operating Instructions (English)

2.1 Spare Parts List

(Use original Schubert & Salzer Control Systems spare parts only!)



	Depending on the mounted positioner the connecting parts may differ from the parts shown in the spare parts list. If needed, please ask for a detailed spare parts list.

Besides the individual spare parts, repair kits are available for all valves containing all seals and parts subject to wear.

2.2 Technical Data

Body material	stainless steel 1.4408
Nominal sizes	DN8 - DN50 (1/2" - 2")
Connections Pipe thread acc. DIN2999 NPT thread Welding ends	 DN8 - DN50 (1/2" - 2") DN8 - DN50 (1/2" - 2") DN15 - DN50 (1/2" - 2")
Nominal pressure	PN40
Fluid temperature	-30°C - + 200°C, -22°F - +392°F
Function	normally closed against the flow

2.3 Installation

Remove all packing materials from the valve.

Prior to the installation the pipeline should be checked for contamination and foreign particles and cleaned if necessary.

The control valve has to be mounted to the pipeline according to the direction of flow which is indicated by an arrow on the valve body.

The pipelines have to be connected stress-free to the installed valve. The pipeline must not be pulled up to the valve in any case.

Bodies with threaded ends have to be sealed by a suitable sealing material.

If the valve is welded to the pipeline, the ends have to be tack-welded first. To complete welding, the actuator and head section have to be removed from the valve body to avoid damage to the sealing elements.

Welding work on the pipelines must not be done within 50 cm of the valve. Otherwise valve seat and seals could be damaged.

The proper function of the completely mounted valve has to be checked prior to putting the installation into service.

Mounting position:
The mounting position of valves with pneumatic or digital positioner is arbitrary.

	Factory adjustment of the electro-pneumatic positioner 8047 is carried out for a horizontal mounting position of the valve (positioner on top). When changing the mounting position (especially overhead position) the positioner zero and span have to be readjusted.

2.4 Connection and Start-Up

The valves can be fitted with pneumatic positioners, electro-pneumatic positioners (type 8047) or digital positioners (types 8048 or 8049).

Please use the corresponding operating instructions for detailed guidance on connection and start-up.

2.5 Replacing the Positioner

2.5.1 Pneumatic Positioner

- Unscrew supply air from port "P" (G1/8")
- Loosen pipe fitting at tube to actuator
- Loosen 3 threaded pins (130) at the fastening ring
- Take off positioner

Before mounting a new p/p positioner, remove nuts (M5) for transport locking.
Reassemble in the reverse order.

	Do **not** open the positioner but send it back to the factory for repair.

2.5.2 Electro-Pneumatic Positioner Type 8047

- Remove signal cable
- Unscrew supply air from port "P" (G1/8")
- Loosen pipe fitting at tube to actuator
- Loosen 3 threaded pins (130) at the fastening ring
- Take off positioner

Reassemble in the reverse order.

	Do **not** open the positioner but send it back to the factory for repair.

2.5.3 Digital Positioner Types 8048 and 8049

- Unscrew supply air from port "P"
- Remove positioner cap and disconnect electrical connections
- Loosen pipe fitting at tube to actuator
- Loosen 3 threaded pins (130) at the fastening ring
- Take off positioner and sensing pin

Reassemble in the reverse order. Adjust positioner afterwards.

	When replacing the positioner always remove positioner and sensing pin and replace it by the new positioner and the enclosed new sensing pin! Take care to seal the connection between actuator and positioner properly!

2.6 Dismantling and Assembling

2.6.1 Dismantling the Valve

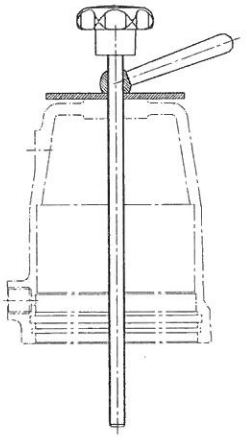
1 Remove positioner (see: replacing the positioner).
2 Remove fastening ring (130), cyl. screw (148) and window (140).
3 Remove bolt (150) (for p/p und i/p positioners: remove feedback spring unit).
4 Insert assembly tool (art. no: 4010 409) into cap and screw to the top screw (14).
5 Tighten the spring (59) a little bit by turning the assembly tool lever until the seal (5) lifts off the valve seat.
6 Unscrew actuator from body.
7 Remove circlip (52).
8 Release actuator spring by turning the lever.

⚠ While doing so, the assembly screw on the assembly tool should be held.

9 Remove assembly tool.
10 Remove all disc parts at the valve seat, while holding the stop screw (14).
11 Pull out piston rod (13) from head section.
12 Clamp flange (54) in a vice.

⚠ Do not clamp flange on its outer diameter since this is the sealing face with the cap and may result in damage.

13 Unscrew head section (2) from flange (54).
14 Press out guide sleeves (34) and packing with assembly pin (art. no: 4010410). (Please note sequence of individual parts for later assembly.)



Assembly tool
D50: Art. No: 4010 408
D80/D125: Art. No: 4010 409

Assembly pin
Art. No: 4010 410

2.6.2 Assembling the Valve

⚠	Note lubrication and bonding plan! Use original Schubert & Salzer Control Systems spare parts only!

1 Clean all parts.
2 Push guide sleeves and packing into the head section (2) in the right order.

⚠ The conical seals (31) have to be greased **individually**.

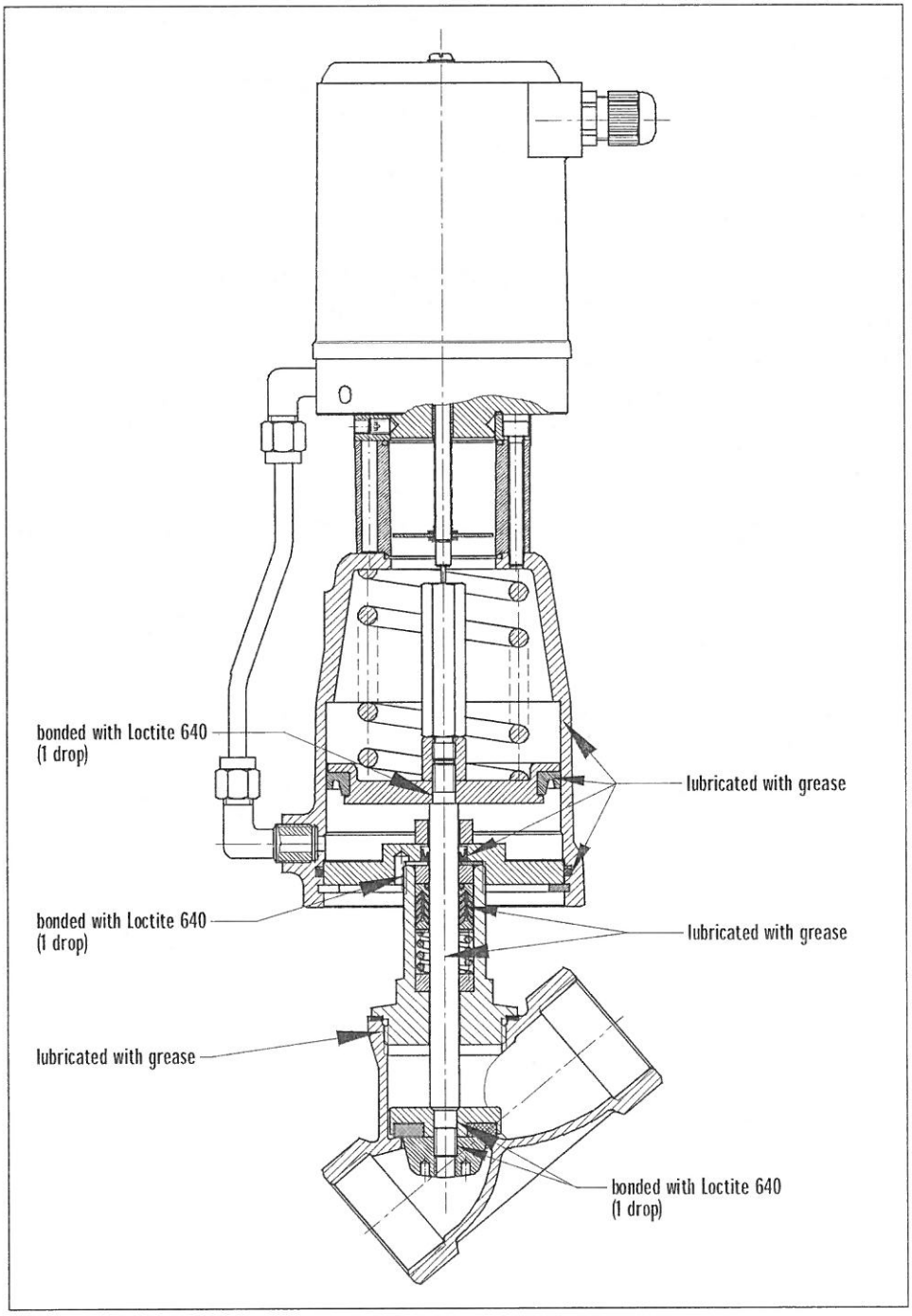
3 Put interior lip seal (57) and washer (55) into flange.
4 Screw head section (2) to flange (54) firmly.

⚠ Do not clamp the flange on its outer diameter since this is the sealing face with the cap and may result in damage.

5 Screw piston rod (13) and piston (58) using the top screw (14).
6 Push piston rod (13) carefully into the head section (from the top).
7 Screw all disc parts to piston rod (13).
8 Insert o-ring (53) into cap.
9 Mount exterior lip seal (56) to cap (58).
10 Put spring (59) on piston (58).
11 Fit cap (62).
12 Tighten spring with assembly tool until the circlip (52) can be inserted.
13 Insert circlip to cap (take care that the circlip has properly snapped in its groove).
14 Screw head section with seal (3) to valve body.
15 Remove assembly tool.
16 Insert bolt (150) (for digital positioners), or feedback spring unit (for p/p and i/p positioners).
17 Insert O-ring (149) into the cap.
18 Assemble ring fastener (130) and window (148) with screws (140).
19 Fit positioner.
20 Check positioner settings (readjust controller if necessary).

2.7 Lubrication and Bonding Plan

	The lubrication and bonding plan is valid for all standard versions of this valve type. Contact the manufacturer for suitable lubricants. Special versions (e.g. silicon free, oxygen service or food applications) may require other lubricant qualities.



ASSEMBLING AND OPERATING INSTRUCTIONS

FOR ANGLE BODIED CONTROL VALVES WITH

PISTON ACTUATOR

AND PNEUMATIC POSITIONER

TYPE 7020

1. The valves have to be installed in the pipeline according to the direction of flow (closing against the flow). The direction of flow is marked by an arrow on the valve body.

2. Pilot- and operating pressures:

The max. pilot pressure is 6 bar.

The max working- and pilot pressures are to be learned from the type plate.

3. Air connections:

Connect the air supply with the corresponding connection "P" (G1/8") (supply air has to be free from oil and water). The control signal has to be fitted to connection "w" (G1/8"). The supply air pressure must never be higher than 6 bars. The adjustment of the positioner has been carried out in the factory (generally for 4 bar supply air pressure). If the actual air supply pressure differs from this value, the positioner has to be in this case adjusted again.

Factory adjustment:	control signal	position
	0.3 bars	valve begins to open
	1.0 bar	valve is completely open

4. Adjustment of the positioner:

4.1. Adjustment of the zero point:

a. Loosen the nut (104) .

b. Set the control signal "w" to 0.3 bar.

c. Fix the beginning of the stroke by turning the zero point screw (106).

Turning clockwise the valve opens.

Turning counterclockwise the valve closes.

d. Fix the zero point securely by locking nut (104).

4.2. Adjustment of the stroke:

The stroke is adjusted by altering the working length of spring (84) (there is no need for any adjustment to be made by the user).

5. Adjustment of the air supply:

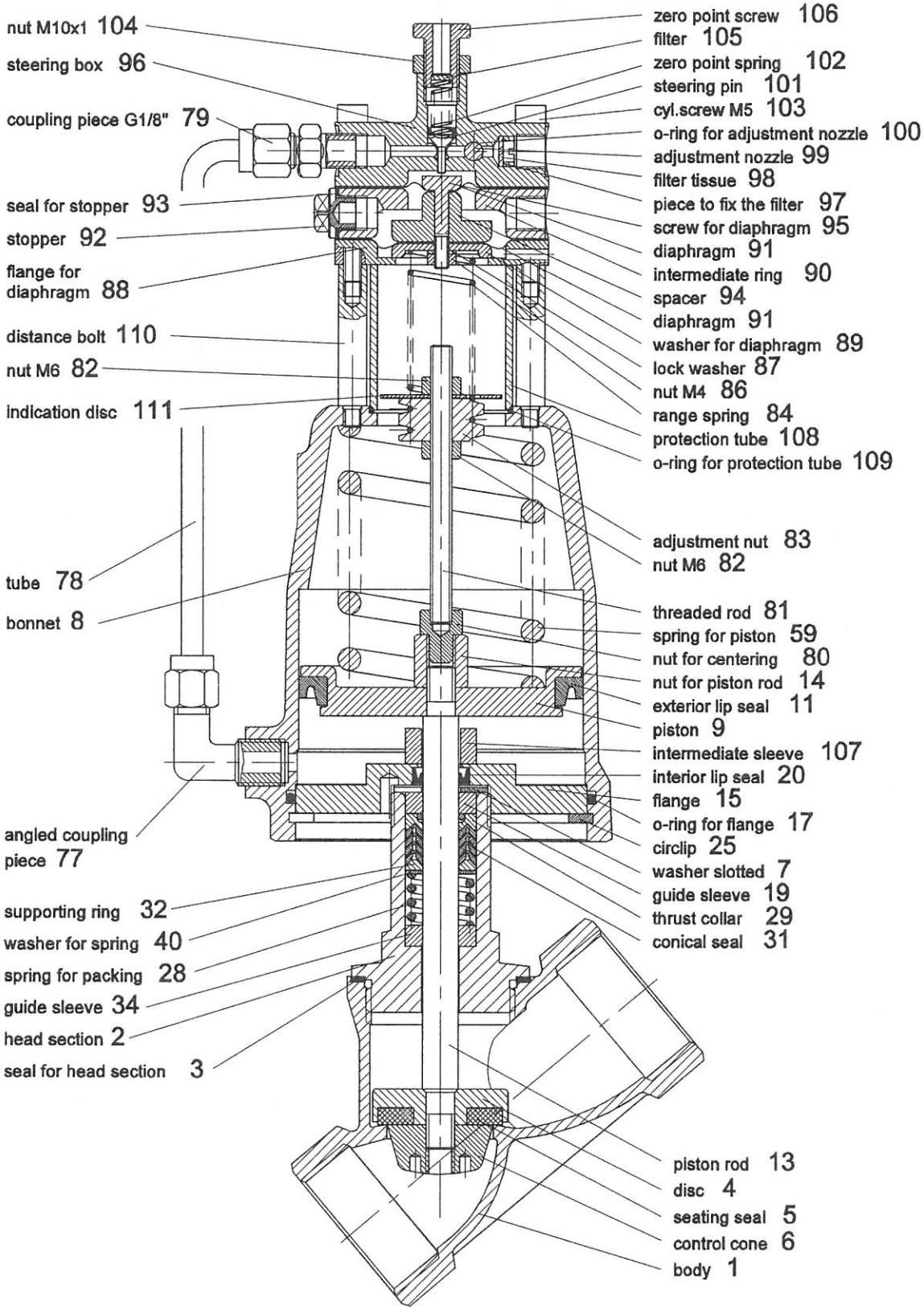
By turning nozzle (99) the air consumption and at the same time the actuator velocity are controlled.

Turning the nozzle screw clockwise makes the air consumption decrease. Furthermore the opening of the valve is slowed down. Throttling too far has to be avoided as the valve then will not be able to open completely. Turning the nozzle screw counter-clockwise makes the air consumption increase. The opening of the valve is speeded up and the closing is slowed down. Opening the nozzle too far has to be avoided as the valve then will not be able to close completely.

6. DANGER:

Actuator is spring-loaded. Injuries are risked when not dismantled in a suitable manner. Dismantle actuator exclusively with our suitable tools.

SCHUBERT & SALZER CONTROL SYSTEMS	LIST OF SPARE PARTS PNEUMATIC CONTROL VALVE WITH PISTON ACTUATOR	7020 0001 E



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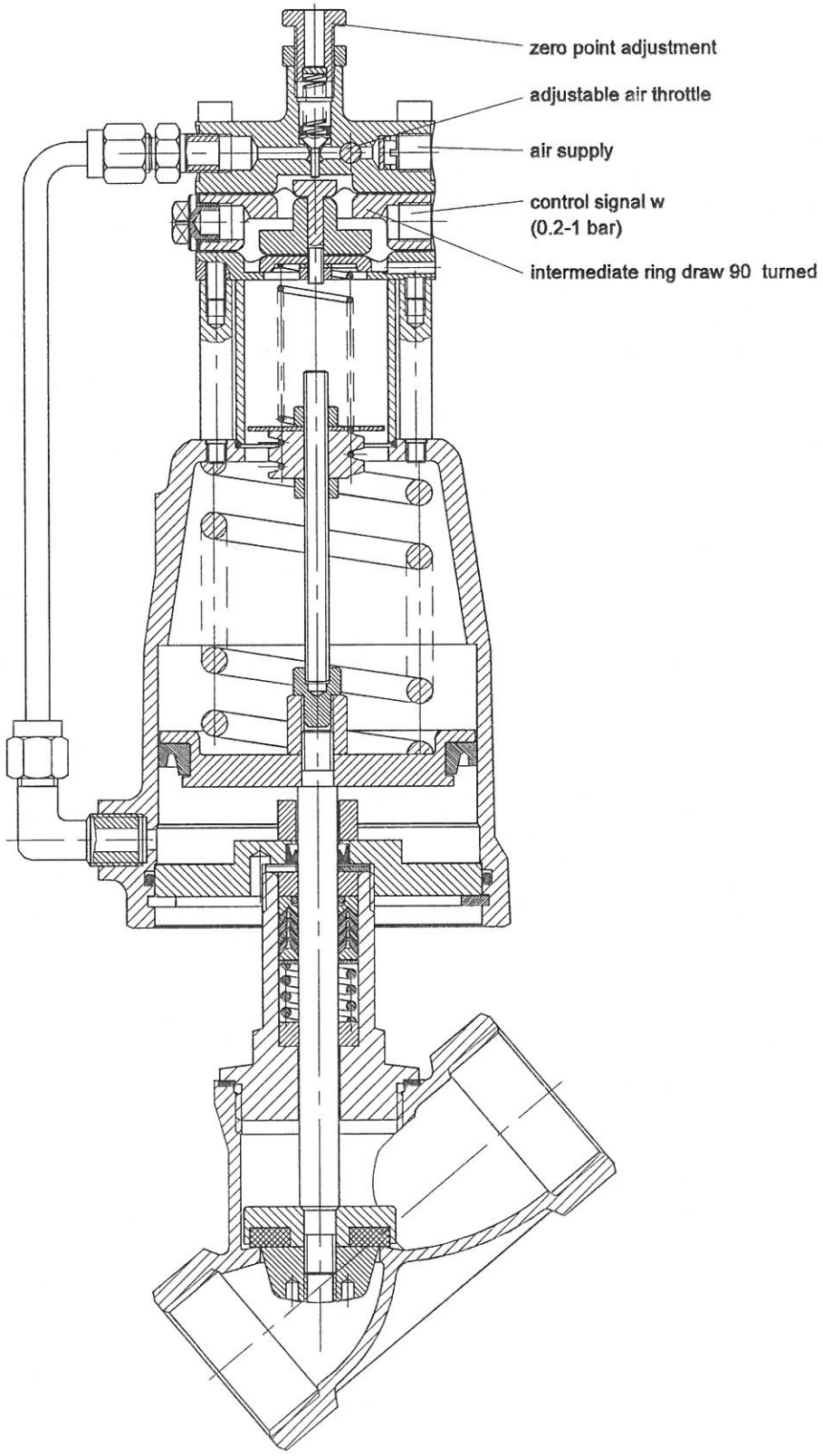
SCHUBERT & SALZER CONTROL SYSTEMS	STAINLESS STEEL ANGLE BODIED CONTROL VALVE WITH PISTON-ACTUATOR AND P/P-POSITIONER	7020 0002 E



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11.03.96	27.04.90	HAERTL	7020 0002 E	01

ASSEMBLING AND OPERATING INSTRUCTIONS

FOR ANGLE BODIED CONTROL VALVES WITH

PISTON ACTUATOR

AND INTEGRATED I/P-POSITIONER

TYPE 7020

1. Position

The adjustment of the i/p-positioner was carried through for a horizontal position of the valve in the pipeline (positioner upside). When changing the position, zero point and end value have to be readjusted.

2. Supply pressure

Supply air has to be connected to "P" (G1/8"). It has to be free from oil, water and dust (instrument air). The admissible supply pressure range is stated on the type label (max. 6 bar). The adjustment in the factory is carried out for 4 bar. When changing the supply pressure, zero point and end value have to be readjusted.

3. Input signal connection: 0(4) - 20mA resp. 20 - (4)0mA

The connection of the input signal is provided by a 2m two-wire cable or by a two-terminal clamp located in a side-mounted housing (clamp adapter). This housing with the cable bushing is closed by a screwed cap.
The ex-proof version of the positioner is delivered only with clamp adapter.

The polarity depends on the operating mode of the valve as follows:

standard:	
rising input signal opens the valve:	brown +
	white or black -
rising input signal closes the valve:	brown -
	white or black +
ex-proof:	
rising input signal opens the valve:	1 or brown "+"
	2 or black "-"
rising input signal closes the valve:	1 or brown "+" (works adjustment)
	2 or black "-" (works adjustment)

The factory adjustment of the i/p-positioner is stated on the type label. The electrical signal is converted to a signal pressure by an i/p-converter. This pressure can be controlled by a gauge fitted to the G1/8"-thread closed by a threaded cap. This eases adjustment and trouble-shooting.

4. Adjustment of the i/p-positioner:

Both zero point (ZERO) and end value (SPAN) of the converter have to be adjusted:

ZERO: remove cap 105, turn spur wheel with a screw driver
("+" converter pressure rises, "-" converter pressure falls)

SPAN: remove bleeder screw (142), turn trimmer with a small screw driver
("counter-clockwise" converter pressure rises,
"clockwise" converter pressure falls)

The adjustments of ZERO and SPAN are to be repeated alternatively for several times, as they are influencing each other. The further procedures are described below .

4.1. Rising signal opens, spring closes, signal range 0-20 mA

- connect current source for the input signal (input resistance < 220 Ω, ex-proof version: < 420 Ω)
- polartity: brown "+", white or black "-" (ex-proof version: 1 or brown "+", 2 or black "-")
- *input signal 0 mA:* valve is completely closed
- *input signal 2 mA:* valve starts to open
  pressure at control gauge approx. 0,3 ±0,03 bar
  (adjusted with "ZERO")
- *input signal 20 mA:* valve is completely opened
  pressure at control gauge approx. 1 ±0,03 bar
  (adjusted with "SPAN")

4.2. Rising signal opens, spring closes, signal range 4-20 mA

- connect current source for the input signal (input resistance < 285 Ω, ex-proof version: < 460 Ω)
- polartity: brown "+", white or black "-" (ex-proof version: 1 or brown "+", 2 or black "-")
- *input signal 4 mA:* valve is completely closed
- *input signal 6 mA:* valve starts to open
  pressure at control gauge approx. 0,3 ±0,03 bar
  (adjusted with "ZERO")
- *input signal 20 mA:* valve is completely opened
  pressure at control gauge approx. 1 ±0,03 bar
  (adjusted with "SPAN")

4.3. Rising signal closes, spring closes, signal range 0-20 mA

- connect current source for the input signal (input resistance < 220 Ω, ex-proof version: < 420 Ω)
- polarity: brown "-", white or black "+" (ex-proof version: factory adjustment required)
- *input signal 0 mA:* valve is completely opened
  pressure at control gauge approx. 1 ±0,03 bar
  (adjusted with "ZERO")
- *input signal 18 mA:* valve starts to close
  pressure at control gauge approx. 0,3 ±0,03 bar
  (adjusted with "SPAN")
- *input signal 20 mA:* valve is completely closed

4.4. Rising signal closes, spring closes, signal range 4-20 mA

- connect current source for the input signal (input resistance < 285 Ω, ex-proof version: < 460 Ω)
- polarity: brown "-", white or black "+" (ex-proof version: factory adjustment required)
- *input signal 4 mA:* valve is completely opened
  pressure at control gauge approx. 1 ±0,03 bar
  (adjusted with "ZERO")
- *input signal 18 mA:* valve starts to close
  pressure at control gauge approx. 0,3 ±0,03 bar
  (adjusted with "SPAN")
- *input signal 20 mA:* valve is completely closed

After the adjustment has been finished the control gauge is removed and the threaded cap (with sealing) is mounted again. The bleeder screw and the protection cap are inserted.

5. Adjustment of the supply air flow:

Using the adjustment nozzle (99) the air consumption and at the same time the actuator velocity are controlled.

Turning the nozzle screw clockwise makes the air consumption decrease. Furthermore the opening of the valve is slowed down. Throttling too far has to be avoided as the valve then will not be able to open completely.

Turning the nozzle screw counter-clockwise makes the air consumption increase. The opening of the valve is speeded up and the closing is slowed down. Opening the nozzle too far has to be avoided as the valve then will not be able to close completely.

6. Changing the i/p-positioner

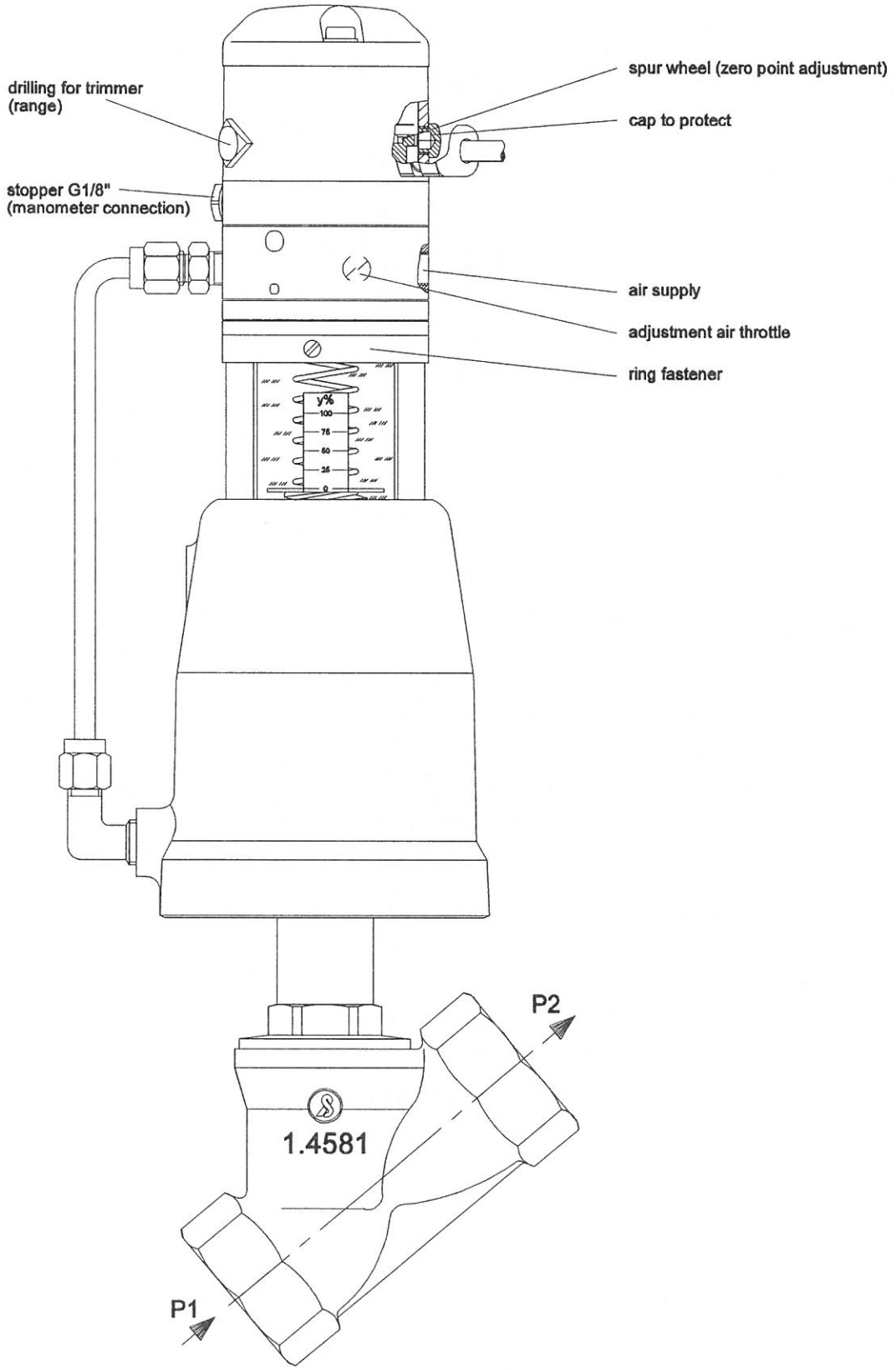
- disconnect cable from signal source
- disconnect air supply "P" (G1/8")
- loose 3 screws (131) at ring fastener (130) using a 2,5 mm hexagon screwdriver
- loose coupling piece (128) at pipe (78)
- remove positioner

Attn.: Do not open the i/p-positioner. If required send it to the factory for repair.

7. The positioner should be continously connected to supply air of min. 4 bar when being in contact with water or other fluids (e.g. when cleaning the installation).

8. **DANGER:** The actuator is spring-loaded. Injuries are risked when not dismantled in a suitable manner. Use exclusively our special tools for this purpose.

SCHUBERT & SALZER CONTROL SYSTEMS	ANGLE BODIED CONTROL VALVE WITH I/P-POSITIONER	7020 0005 E



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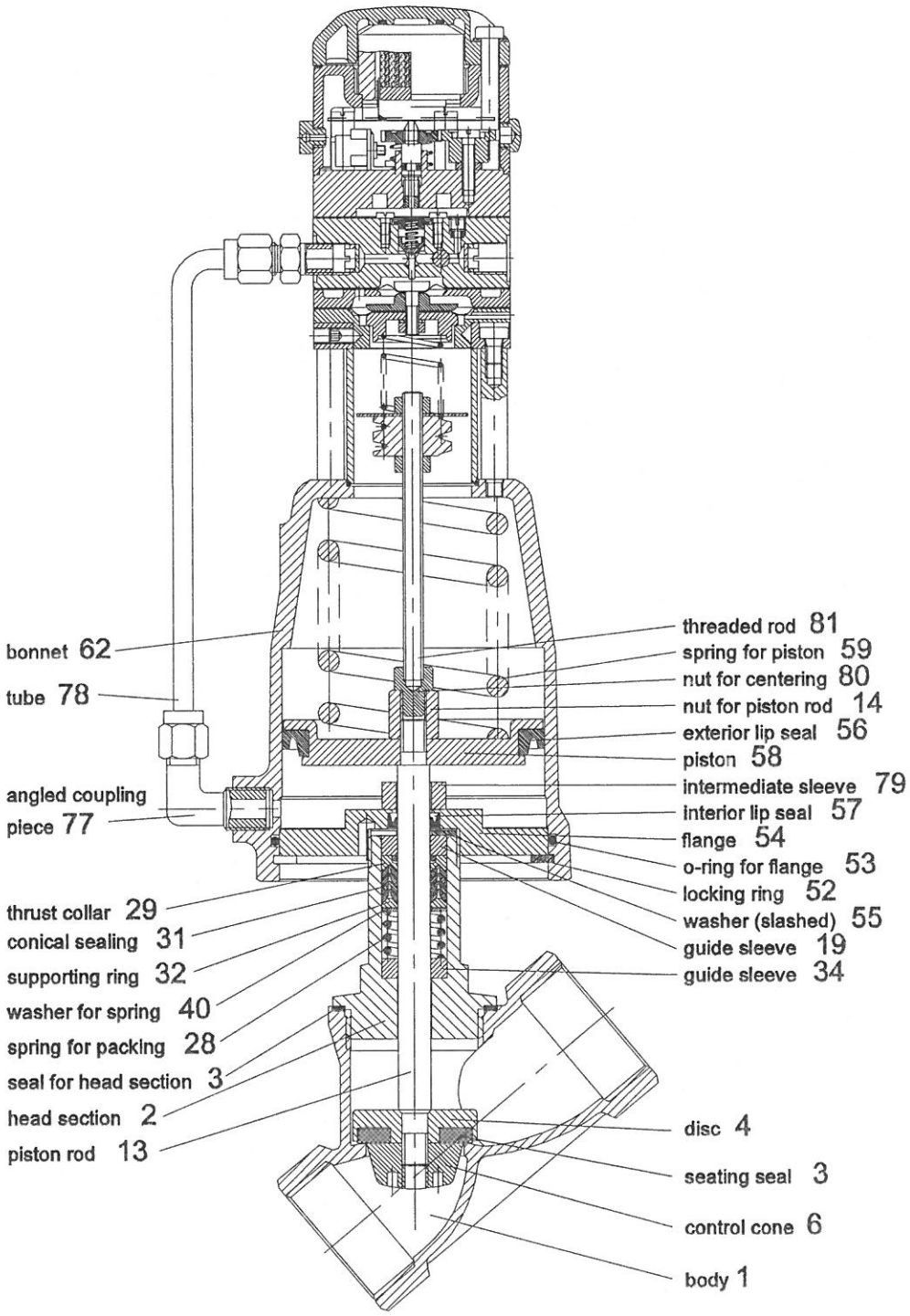

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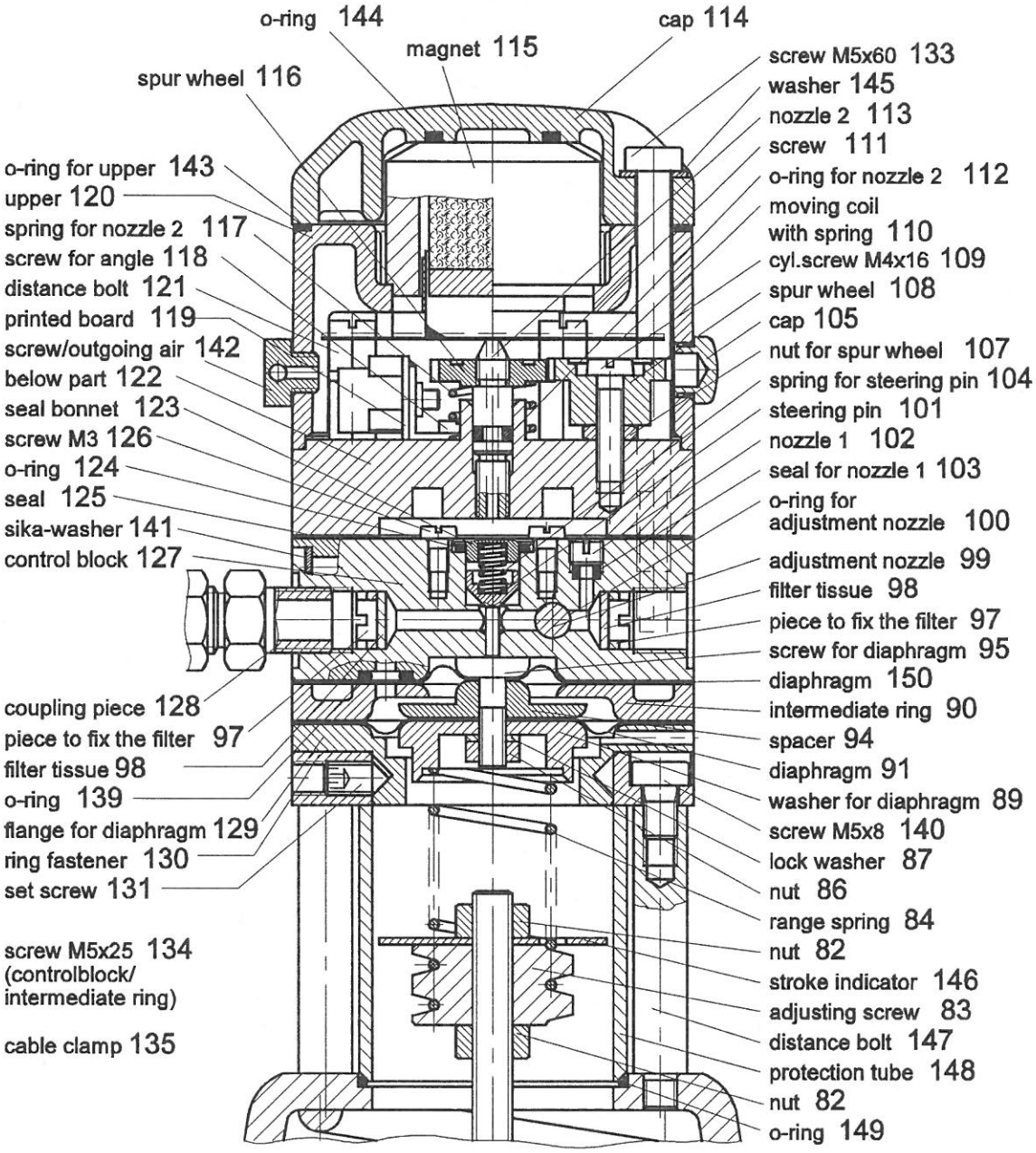
SCHUBERT & SALZER CONTROL SYSTEMS	List of spare parts i/p-positioner	8044 0008 E



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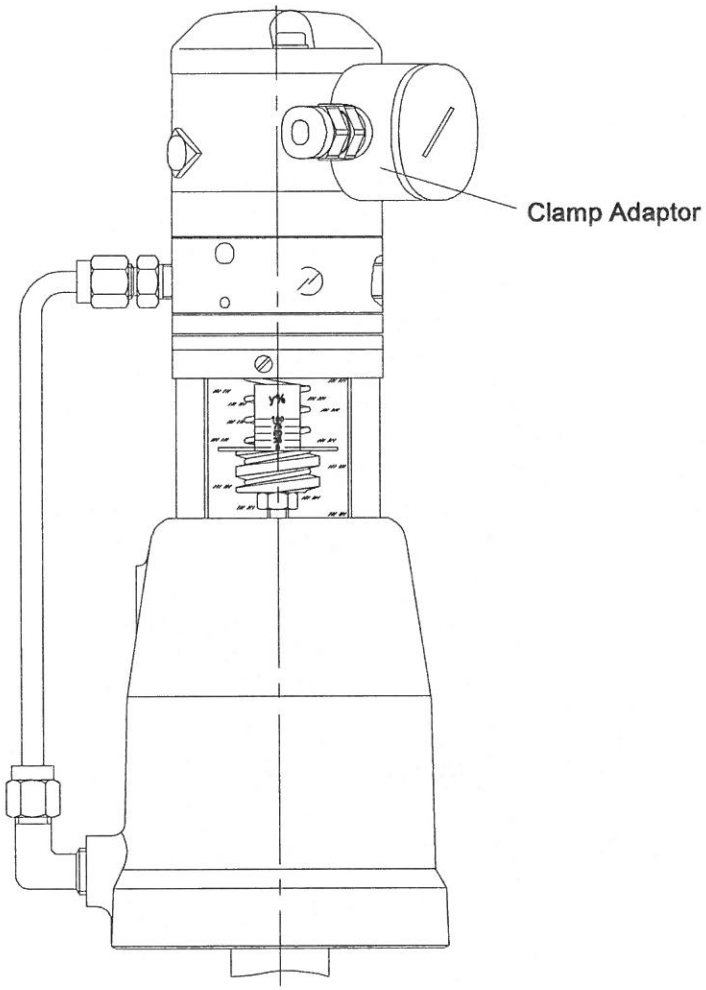
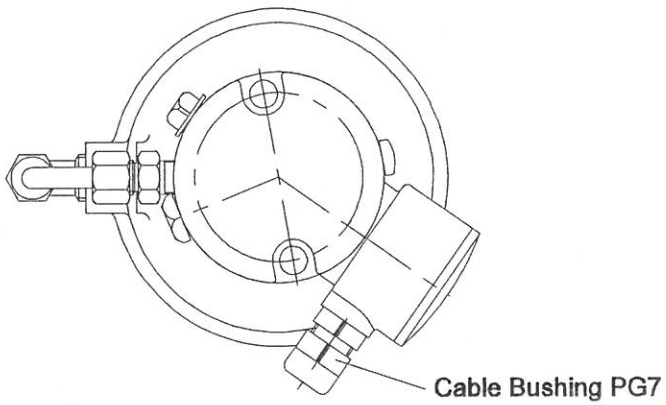
SCHUBERT & SALZER CONTROL SYSTEMS	I/P-Positioner With Clamp Adaptor	8044 0018 E





revised:	produced: 06.12.95	HAERTL	8044 0018 E	01

ASSEMBLING AND OPERATING INSTRUCTIONS

FOR ANGLE BODIED CONTROL VALVES WITH

PISTON ACTUATOR

Type 7020

AND DIGITAL I/P-POSITIONER Type 8048

Declaration by the manufacturer as defined by machinery directive 89/392/EEC Annex II B: Herewith we declare that the product described here is intended to be incorporated into machinery covered by this directive and must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of the directive as amended by 93/44/EEC.

1. Mounting

The control valve has to be installed into the pipeline according to its flow direction. This flow direction is marked by an arrow on the valve body. The mounting position of the valve is optional.

2. Supply Pressure

Supply air has to be connected to "P" (G1/8"). The required supply pressure is stated on the type label and must not exceed 6 bar.

3. Electrical Connections

The electrical connection of the set point signal should be carried through by a shielded cable. The supply voltage should be connected via a separate cable. After removing the cap (157) of the positioner the screwed terminals for the various connections are accessible (see wiring diagram on page 8).

3.1. Supply Voltage

The positioner requires external supply voltage **(24 VDC, filtered, ripple 10% max.)** which has to be connected as follows:

Supply +:	**Terminal**	**+ 24 V**
Supply -:	**Terminal**	**0 V**

The max. current consumption is approx. 400 mA.

3.2. Set Point Signal

The set point signal can be either current or voltage. Connection is carried through as follows:

3.2.1. Current signal 0/4-20 mA: **Signal +: Terminal + I**
Signal -: Terminal - I

Impedance: 100 Ω +/- 1%

3.2.2. Voltage signal 0/2-10 V: **Signal +: Terminal + U**
Signal -: Terminal - U

Impedance: 20.12 kΩ +/- 1%

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Attention: Between GND of the supply voltage and the negative element of the set point signal input (-I or -U) an offset voltage of ± 15V max. is admissible. In case the set point signal input has to be grounded against the negative element of the supply voltage.

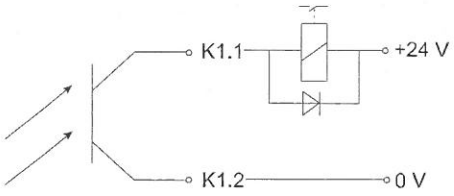
Please check, if at all both sources in your system are allowed to be grounded. Otherwise use a separate supply source for the positioner.

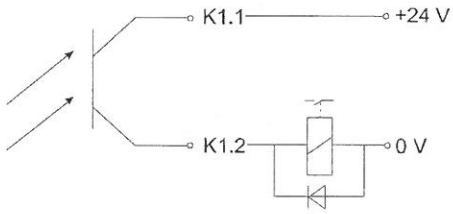
3.3. Alarm Output

In case the signal from an alarm output (terminals K1.1 and K1.2) can be evaluated for diagnosis of the valve function. The alarm output gets active if the stroke does not follow the set point signal (e.g. with an insufficient supply pressure level).

In that case the alarm output switches a connected voltage (max. 48 VDC) with pulses of 0.5 Hz. It can be charged up to 100 mA, so even relays can be operated directly. As shown below the easiest way for using the output is just wiring the supply voltage appropriately.

Example for a relay connection:





Use a recovery diode for inductive loads.

In this case the LED on the connecting plate gets active as well.

4. Adjustment of the digital positioner

Both valves and positioner are factory-adjusted. New adjustment normally must only be carried through after the positioner has been exchanged (see chapter 6) and is carried through as follows:

- Press both buttons "IN" and "OUT" until the LED flashes (after 2-3 secs)
- The valve opens/closes for several times, after completition the LED lights permanently. A flashing LED denotes a fault (e.g. low supply pressure level).
- Pressing both buttons "IN" and "OUT" simultaneously terminates the adjustment (LED flashes and turns off).

5. Manual Operation (version 6 and higher)

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The positioner has to be connected to both supply voltage and supply pressure. It might be connected to the set point signal too.

Press either button " IN " or " OUT " for 2 sec. approximately. The LED on the electronics plate flashes. By pressing button " IN " (air supplied to the actuator) or "OUT" (air released from actuator) the valve can be opened or closed.

The manual operation can be switched off by pressing both buttons simultaneously for a short period. The valve returns to its former position corresponding to the connected set point signal.

If both buttons are pressed too long (2-3 sec), the positioner returns to adjustment mode (see chapter4.)

6. Configuration

The adjustment of the operating parameters of the positioner is carried through via a PC-Interface and a corresponding configuration software.

This adjustment is factory-made following the customers specification, a user-specific version of configuration software is available on request.

7. Replacing the positioner

7.1. Replacing the analogue positioner type 8047

If the valve has been equipped with an analogue positioner type 8047 a rebuilding to the digital positioner type 8048 can be carried through as follows:

- Disconnect set point signal and supply air (port "P").
- Loosen 3 radial set screws (131) at the ring fastener (130) with a hexagon screw driver of size 2,5.
- Remove pipe from coupling pieces (128 and 76).
- Take off positioner and pipe (78).
- Remove feedback-spring unit from actuator.
- Screw in distance bolt (150).
- Insert pick-up pin (152) with spring (153) into the digital positioner, put the positioner onto the fastening ring (130), turn it into the right position and tighten the 3 radial set screws (131).
- Reconstruct the connection to the actuator using a new pipe and a new angled coupling piece (151) (shortening the pipe slightly is sufficient in case of a plastic pipe connection).
- Please take care that the connection from actuator to positioner is properly sealed!
- Arrange connections as shown in chapter 3 and carry through adjustment according chapter 4.

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7.2. Replacing the digital positioner type 8048

- Disconnect supply air (port "P").
- Remove cap (157) and disconnect the electrical connections.
- Loosen 3 radial set screws (131) at the ring fastener (130) using a hexagon screw driver of size 2,5.
- Remove pipe (78) from coupling pieces (76) and (151).
- Take off positioner and pick-up pin (152).
- Mount the new positioner in the analogue reverse way.
- Carry through adjustment of the positioner (see chapter 4).
- Please take care that the connection from actuator to positioner is properly sealed!

ATTENTION:

The actuator is spring-loaded. Injuries are risked when not dismantled in a suitable manner. Use exclusively our special tools for this purpose.

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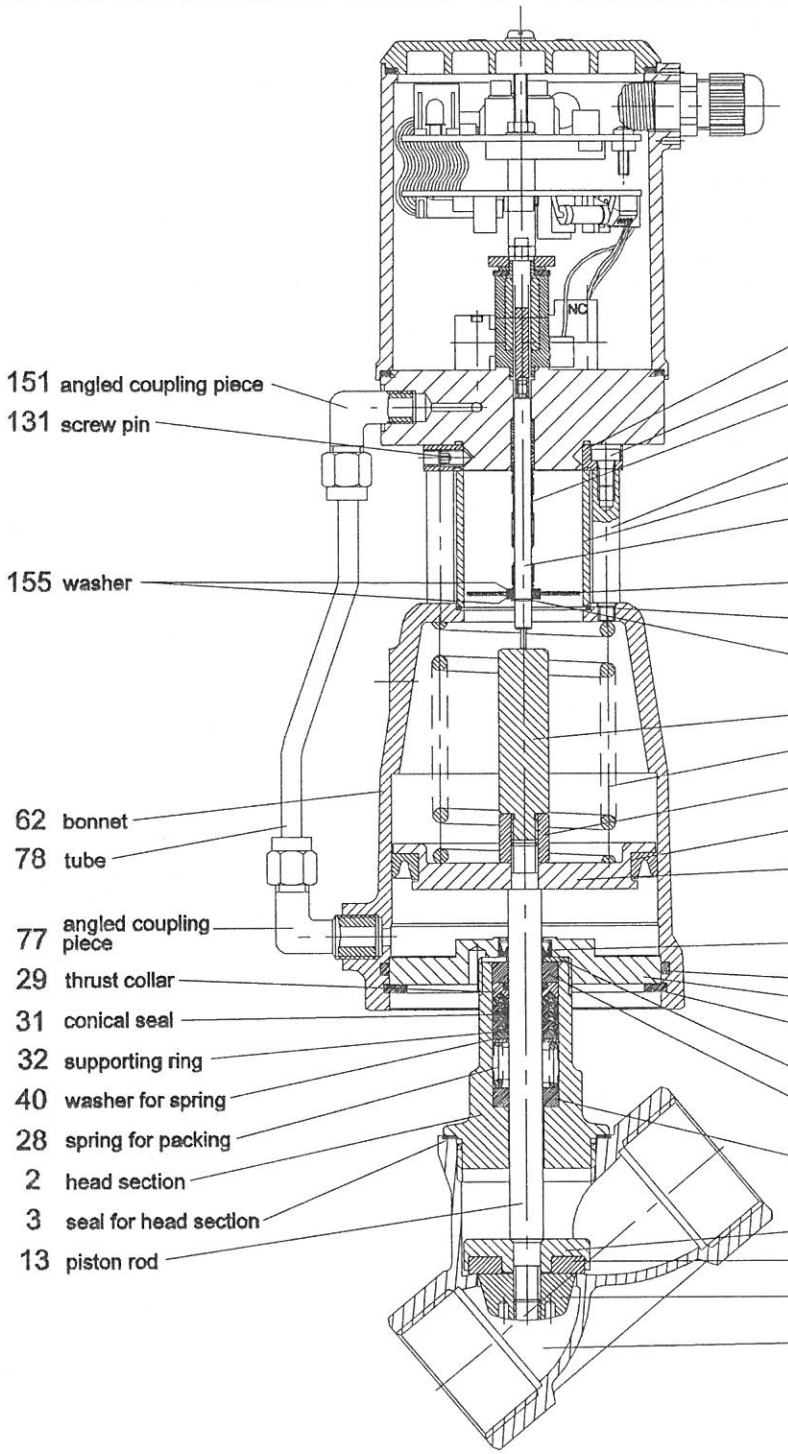
List of spare parts angle bodied control valve with µ/p-postioner

type 7020



151 angled coupling piece
131 screw pin
155 washer
62 bonnet
78 tube
77 angled coupling piece
29 thrust collar
31 conical seal
32 supporting ring
40 washer for spring
28 spring for packing
2 head section
3 seal for head section
13 piston rod

ring fastener 130
screw 140
adjusting spring 153
spacing bolt 147
protection tube 148
sensing pin 152
lock washer 146
o-ring seal 149
stroke indicator 156
bolt 150
spring for piston 59
nut for piston rod 14
exterior lip seal 56
piston 58
interior lip seal 57
o-ring for flange 53
flange 54
circlip 52
washer slotted 55
guide sleeve 19
guide sleeve 34
disc 4
seating seal 5
control cone 6
body 1

revised:	designed:	name:	
14.02.2001	16.07.1997	Walther	7020 0104 E

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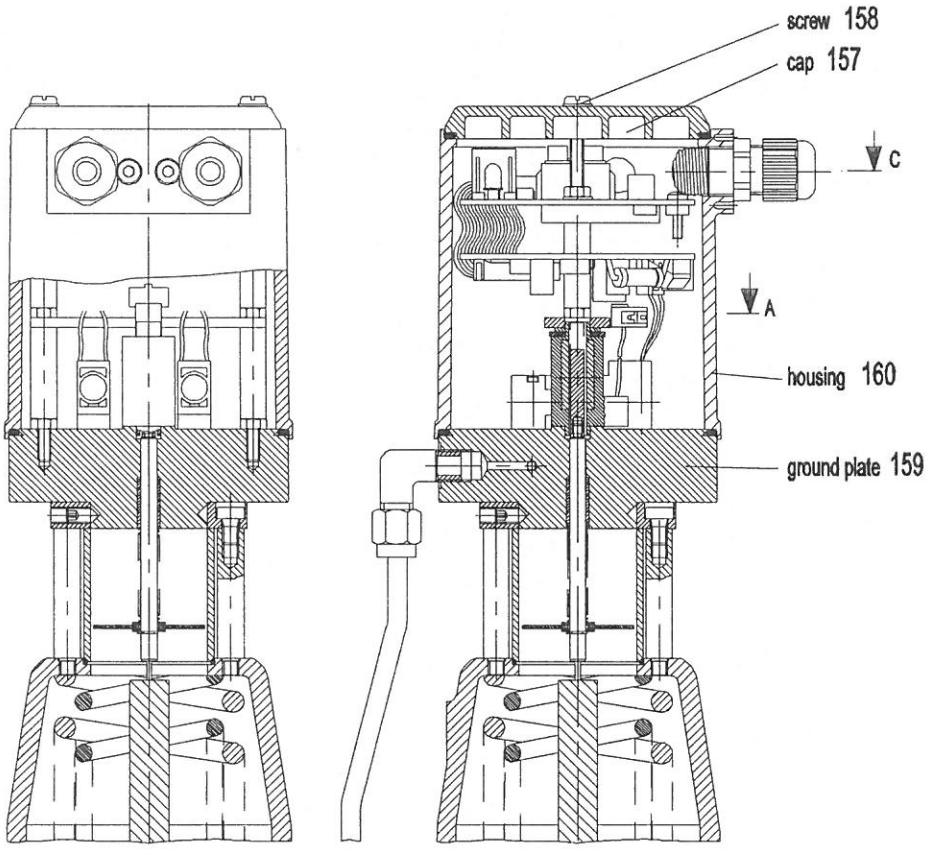
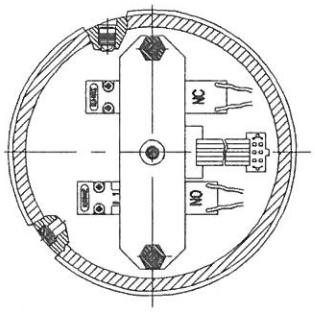
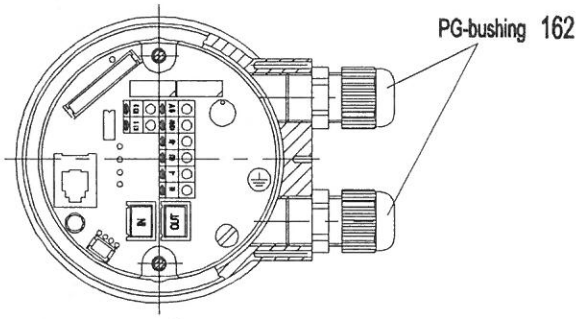
Digital-Positioner with piston indicator

8048 0001 E





view: A



view: C

revised: 14.01.2000	produced: 09.07.1998	HAERTL	8048 0001 E	01

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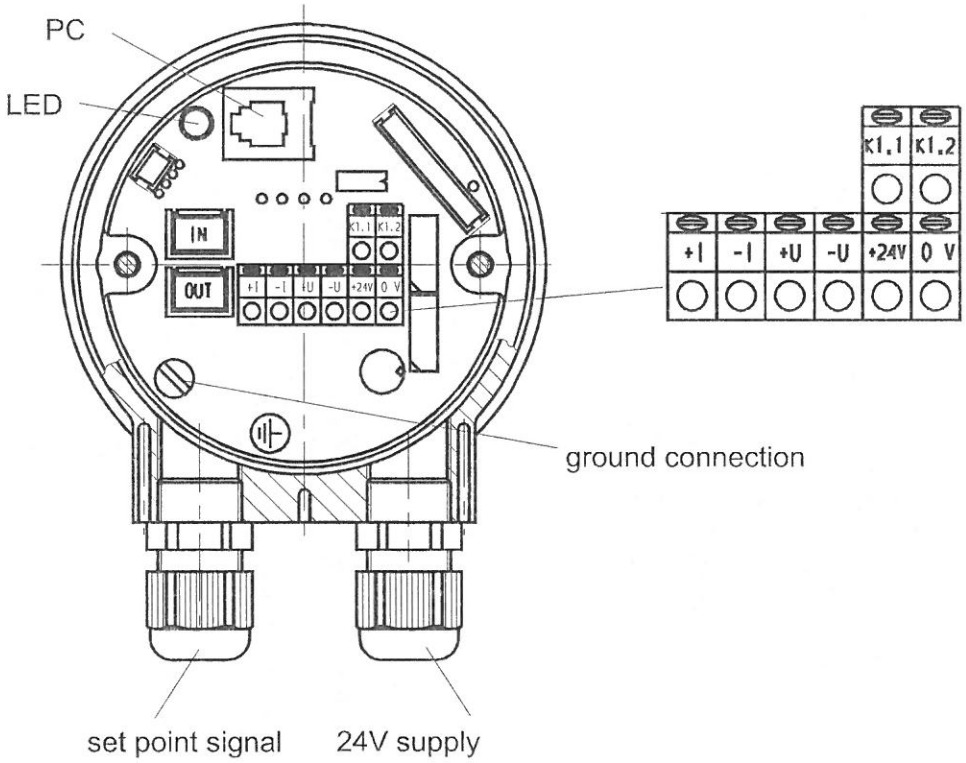
Connecting Plate



Connections:

+I	set point signal current	optional
- I	set point signal current	optional
+U	set point signal voltage	optional
- U	set point signal voltage	optional
+24V	supply voltage	
0V	supply voltage (0V)	
K1.1	alarm output	
K1.2	alarm output	

Others:

PC	PC-connection (configuration)
IN	inlet solenoid valve to actuator opens (start-up)
OUT	outlet solenoid valve to actuator opens (start-up)
LED	LED for adjustment (start-up) and error signal (alarm output error signal)

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2 (GB)(USA) Operating Instructions (English)

2.1 General

The positioner can be mounted to any pneumatic control valve with a stroke of 3 to 28 mm („top-mounted“ design).

To ease mounting the valve various mounting kits are available which contain the required parts to connect valve actuator and positioner, a feedback pin for sensing the valve stroke and a valve position indicator if required.

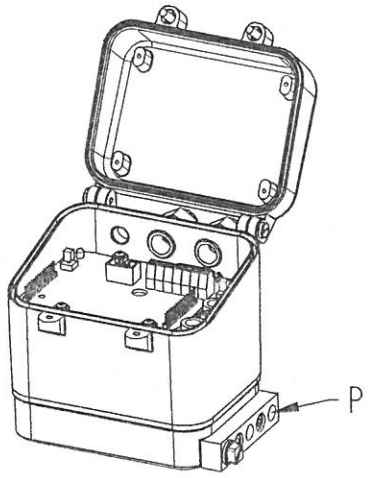
As the adaptation of positioner to valve stroke is carried through automatically a standard mounting kit is used, which can be adapted to the mechanical actuator requirements in case. All other operation parameters (e.g. "split-range" operation) can be set through configuration software which is supplied on request.

2.2 Technical Data

Version	4-wire	2-wire	AS-I
Set point signal	0/4 - 20 mA	4 - 20 mA	Single Slave, Slave Profil S - 7.3.4
Supply energy, electrical	24 VDC	none	supply with AS-I
Supply energy, pneumatical	4 - 6 bar (58 - 87 PSI)		
Stroke range linear actuators	3 - 28 mm (0,12 - 1,1 inches)		
Mounting to control valve	Standardized mounting kits (also with optical position indicator)		
Adaption to range and zero	self-learning		
Configuration	with PC-Software		
Air delivery* linear actuator	50 Nl/min.	according the version	50 Nl/min.
System air consumption	none		
Ambient temperature limits	-10 to 75°C (14 to 167°F)		
Supply connection	G 1/8" , 1/8" NPT		
Class of protection acc. DIN 40050	IP 65		

* 6 bar (87 psi) supply air

Supply Pressure



The supply pressure is connected to port "P" (G1/8").

It must **not** exceed 6 bars, malfunctions might occur then.

Air quality:

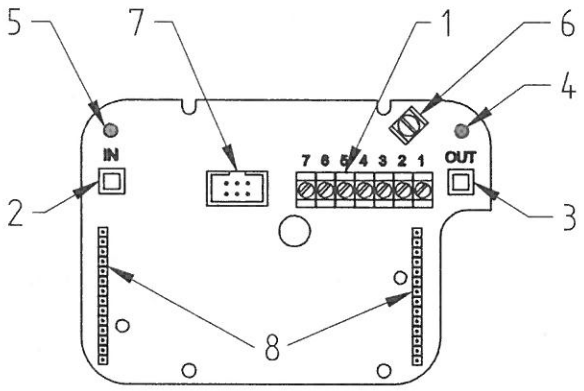
Non-oiled industrial air, solid content < 30 µm (1200 µinch), pressure dew point 20 K below lowest ambient temperature.

2.3 Electrical Connections

⚠	The electrical connection must only be carried through by qualified personnel. Follow the respective national safety standards (e. g. VDE 0100) for mounting, start-up and operation. All actions must only be carried through without voltage connected. Disregarding the corresponding standard may cause heavy injuries and/or property damage.

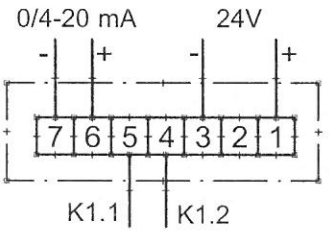
For the electrical connection of the set-point signal a shielded cable is recommended. An additionally required voltage supply should be connected through a separate second cable. After opening the positioner cover the screw terminals of the connecting block (1) can be accessed.

⚠	Cable bushings which are not used should be sealed in any case using a suitable sealing cap to preserve the protection class (IP65).



1	screw terminals
2	key "IN"
3	key "OUT"
4	LED red
5	LED green
6	grounding terminal
7	interface connection
8	plug terminal for additional modules

2.3.1 4-Wire Version



The positioner requires an external voltage supply (24 VDC, filtered, ripple 10% max.). Current consumption is 200 mA max.

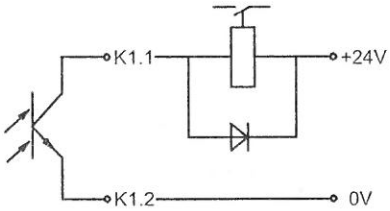
The standard set-point signal is 4-20 mA (the positioner can also be configured for a 0-20 mA range).
The load voltage is 1.1 V max.

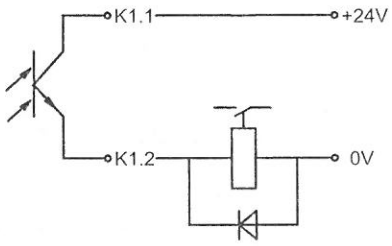
⚠	To assure sufficient compatibility to electromagnetic interferences the positioner has to be grounded. A grounding screw (6) is located on the connecting plate and on the positioner casing.

⚠	Between supply voltage GND and the negative set-point signal input pole an offset voltage of max. ± 2V is allowed. In case ground the set-point current source to the negative pole of the supply voltage source. Please check whether the voltage sources in your system can be grounded anyhow. In this case provide a separate supply for the positioner!

Alarm Output
If required an alarm output (terminals 4 and 5) can be monitored to evaluate the valve performance. It gets active if the positioner is not able to track the stroke value against the set-point signal (e.g. for failing or too low supply pressure). Inverting the alarm output is possible through the communication software.
In case of an alarm situation a connected voltage (0 ± 350V) is switched.
The admissible current load is 130 mA, allowing also relays to be operated directly. As shown below it is convenient to use the supply voltage (24 V) to operate the alarm output.

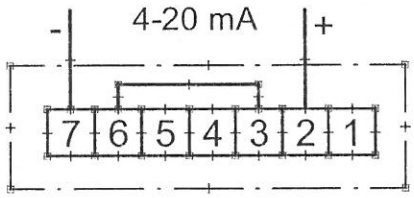
Examples for a relay connection:



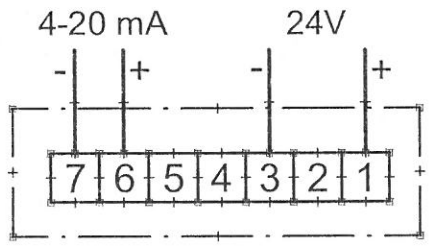


For inductive loads a recovery diode has to be provided.
With an active alarm output the **red** LED on the connecting plate is on.

2.3.2 2-Wire Version



The standard set-point signal is 4-20 mA (the positioner can also be configured for other signals within the 4-20 mA range).
The load voltage is 14 V approx.
An additional voltage supply is not required.



The positioner can be operated too as 4-wire version. This might be necessary if e.g. two or more positioners are set up in series for split-range-operation and the load voltage gets too high. In 4-wire operation the load voltage is 1.1 V only.

	Too assure a sufficient compatibility to electromagnetic interferences the positioner has to be grounded. A grounding screw (6) is located both on connecting plate and positioner casing.

Alarm Output
Positioners in 2-wire design do not provide an alarm output.

2.3.3 AS-I Version

Positioners in AS-Interface design have an AS-I plug connection on the rear side of the positioner which connects the positioner to the AS-I control circuit. An additional voltage supply is not required.

	As AS-I is a PELV system, the grounding terminal must **not** be connected to the system ground.

2.4 Manual Override

Switching over to manual operation requires an "active" positioner, i.e. the positioner has to be powered electrically and connected to the supply air.
Switching over to manual operation mode is carried through by pushing button "IN" (2) or "OUT" (3) on the connecting plate for two seconds approximately. The red LED (4) on the connecting plate lights up.
Pushing button "IN" (supply air to actuator) or "OUT" (actuator is vented) opens or closes the valve.
Switching off the manual operation mode is carried through by pushing both buttons for a short moment. The valve moves back to its initial position corresponding to the valid set-point signal.

	If both buttons are actuated more than 2-3 seconds, the positioner switches to self-adjusting mode.

2.5 Configuration

2.5.1 Self Adjusting Mode

	The adjustment (self adjusting) of mounted positioners has been carried through in the factory. Normally it is only required after replacing a positioner or repairing the valve.

After a new or replaced positioner has been mounted to the valve it has to be adjusted as follows:

1. Press both buttons "IN" and "OUT" until the green LED lights up (after 2-3 seconds).
2. The valve opens and closes several times, after completion the LED turns off. A lit red LED indicates an error (e.g. supply air pressure too low!).
3. After completing the adjustment free from errors the positioner return to control mode automatically.

2.5.2 Configuration

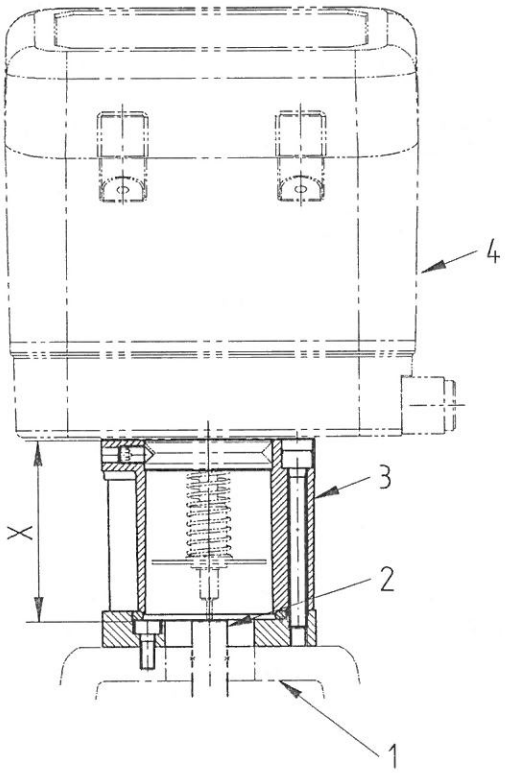
Setting the positioner function parameters can be carried through using a PC-interface and the corresponding configuration software.
This software is required if the factory-settings of the positioner have to be modified (e.g. setting up split-range-operation, implementation of special flow characteristics).
It is **not** required for start-up and operation of the 8049 positioner and adjustment after a potential replacement if no special local settings were stored.

Connecting the positioner to a Personal Computer for configuration or diagnosis is carried through with a special interface cable via the plug connection "PC".

The configuration software, a special interface cable and the corresponding operating manual are available on request.

2.6 Mounting On Linear Actuators

2.6.1 Fixing the Mounting Kit



1	valve actuator
2	stopper
3	mounting kit
4	positioner

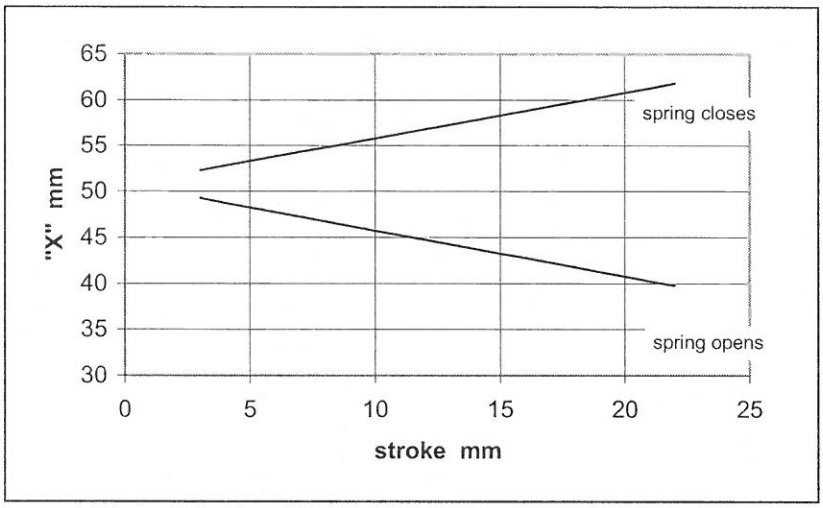
The mounting kit is attached to the upper end of the valve actuator. This attachment might vary due to the different actuator designs.

Coupling the positioner to the valve is carried through using a mechanical stopper which is connected to the valve stem. Feedback pin and spring are positioned on its flat surface and feed back the valve position to the positioner.

The stopper has to be adjusted in such a way that dimension "X" (measured from the upper edge of the adapting ring to the flat surface of the not actuated valve) is achieved (see below). The stopper has to be fixed by locking or some adhesive.

Remark: Depending on the actuator design possibly no position (e.g. diaphragm actuators with columns). In this case the adaptor ring is fixed directly to the valve actuator. However the adjustment dimension "X" remains the same, i.e. the feedback pin extends into the actuator.

Dimension "X" is not constant but depends on the valve stroke:



Valid for actuators with springs to close:

X in mm = 50.8 + stroke/2

Valid for actuators with springs to open:

X in mm = 50.8 - stroke/2

2.6.2 Mounting the Positioner

- Put positioner with feedback pin and spring on mounting kit.
- Tighten the three threaded pins in the fastening ring.
- Connect output "Y1" with valve actuator.
-

	Take care that this connection is sealed properly, as otherwise the solenoid valves in the positioner will operate permanently.

- Connect supply air (port „P").
- Open positioner cover and provide the electrical connections.
- Carry through positioner adjustment.
- Close positioner cover.

Dismount the positioner correspondingly in reverse order.

2.7 Versions

To achieve optimal control quality Schubert & Salzer recommends the following positioner version for their valves:

			2-Wire Positioner	4-Wire Positioner
Seat Valves with piston actuator	Piston actuator D80	DN15-25 / 1/2"-1"	Low air delivery	Standard version
		DN32-50 / 1 1/4"-2"	Standard version	Standard version
	Piston actuator D125	DN15-25 / 1/2"-1"	Standard version	Standard version
		DN32-50 / 1 1/4"-2"	High air delivery	Standard version
Sliding Gate Valves with piston actuator	Piston actuator D80	DN15-40 / 1/2"-1 1/2"	Low air delivery	Standard version
		DN50-100 / 2"-4"	Standard version	Standard version
	Piston actuator D125	all	Standard version	Standard version
Sliding Gate Valves with diaphragm actuator	Diaphragm actuator D125	all	Standard version	Standard version
	Diaphragm actuator D250	all	High air delivery	Standard version
	Diaphragm actuator D500	all	High air delivery	Standard version

2.8 Additional Modules

2.8.1 AS-I Communication-Module

The optional AS-Interface module allows integrating the digital positioner 8049 in an AS-I circuit and thus bypassing analogue output modules. This saves time in cabling and maintenance.
If the AS-I module is to be retrofitted to an existing installation the kit contains the AS-I plug-in plate, 1 connecting cable for M12-connections and a screw cap containing the common AS-I LED's for visualisation.

Mounting the AS-I-module:

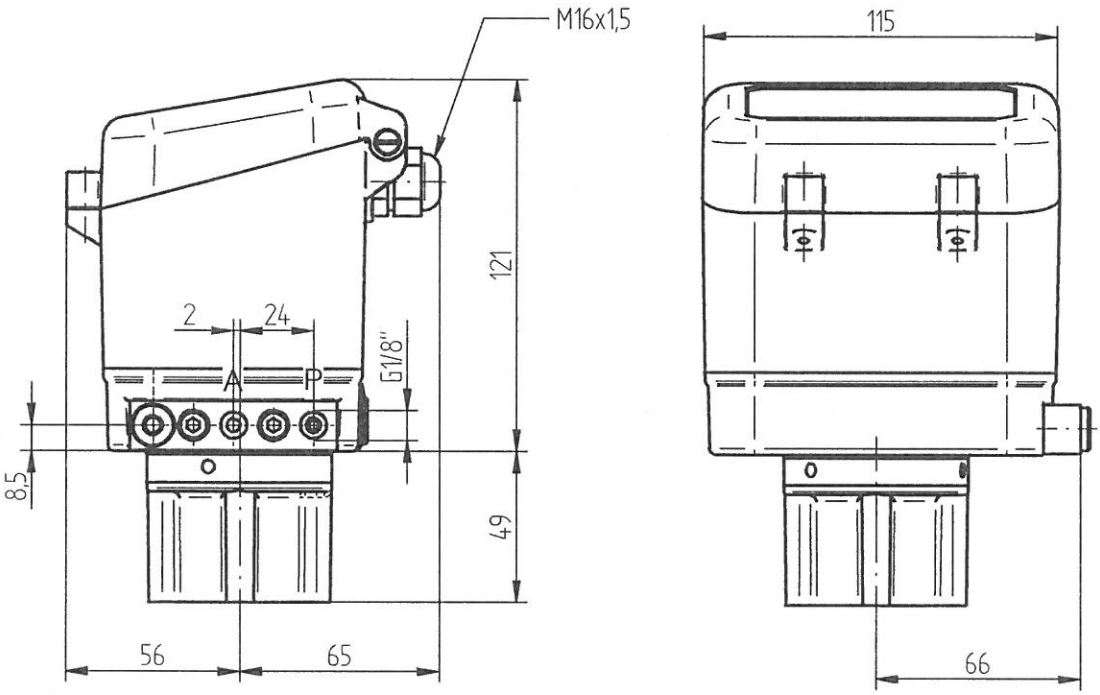
1. Open casing cover.
2. Connect positioner to Software DevConfig (plug 7).
3. Change set point source to „digital" (can be found at positioner setting in tab "Special").
4. Store data to positioner.
5. Cut positioner from 24 V DC supply.
6. Plug AS-I module to prepared plug connection on connecting plate (8).
7. Remove PG-gland on casing and screw in AS-I connection plug.
8. Mount LED with socket to second screw joint.
9. Connect AS-I and LED cables to AS-I module (plugs vary in pole number and cannot be connected in the wrong way).
10. Close casing cover.
11. Connect positioner to AS-I circuit.

The AS-I module is supplied with AS-I address 0 as a standard. So the device can be fitted to existing installations without problems.

- Profile 7.3 „Plug and Play“

Supply	AS-I
Value range	0 – 10000 (corresponds to 0 – 100%)
AS-I profile	7.3
ID-Code	3_{hex}
ID2-Code	4_{hex}
IO-Code	7_{hex}
Signals	
LED green	Voltage on AS-I terminals
LED red	AS-I communication error, peripheral error, positioner error
Design current	< 350 mA
Design voltage	AS-I (30 V DC)
Isolation voltage	> 500 V
EMC	Acc. EN 50081-2, EN61000-6-2

2.9 Dimensions and Weights



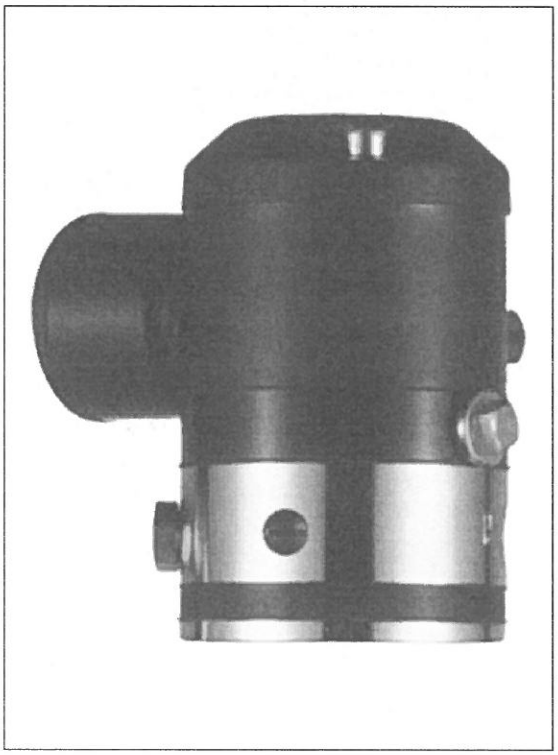
Weight 1 kg approx.

SCHUBERT & SALZER CONTROL SYSTEMS

Operating Instructions

Pneumatic And Electro-Pneumatic Valve Positioner

Type 8047



Version: 10/2004

Manual-8047e.doc
Art.-Nr. 112 8047

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Content

1 General 3

2 Mounting Kits 3

2.1 SELECTION 3
2.2 MOUNTING 4
2.3 USER-DEFINED SPRING ADJUSTMENT 4

3 Positioners 6

3.1 MOUNTING 7
3.2 ADJUSTMENT OF THE P/P-POSITIONER 7
3.3 ADJUSTMENT OF THE I/P-POSITIONER 7
3.4 ADJUSTMENT OF THE SUPPLY AIR FLOW 8

1 General

The positioners can be mounted on top of any pneumatic control valve with strokes from 5 to 22 mm. However the actuator has to be designed "air to open". The positioners are available in both p/p- and i/p-version as well as ex-proofed. To ease the adaption to the valve different mounting kits and feedback spring units are supplied (see table) including the required mounting parts for connecting valve actuator and positioner, an optical valve position indicator and a factory-adjusted range spring to be connected to the valve stem for proper feedback of the valve stroke.

2 Mounting Kits

2.1 Selection

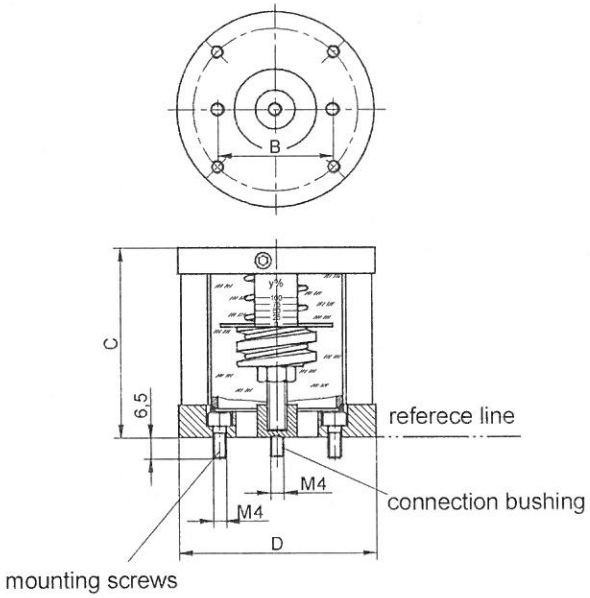
There are standard mounting kits and factory-adjusted feedback springs available for usual strokes. In this case select mounting kit and spring unit from the table with respect to the required valve stroke. If other strokes than indicated are needed, the feedback spring can be user-adjusted for this purpose (see below).

DN	Stroke	Mounting Kit	Feedback Spring Unit	Mounting Kit For Saunders Diaphragm Valves
8	5	4040900	4008202	- - - -
10	6	4040900	4008203	4 008 209
15	6	4040900	4008203	4 008 209
20	7	4040900	4008204	4 008 210
--	8	4040900	4040474	- - - -
--	9	4040900	4040475	- - - -
25	10	4040900	4008205	4 008 211
--	12	4040900	4040476	- - - -
--	12	4040901	4040477	- - - -
--	13	4040901	4040478	- - - -
--	14	4040901	4040479	- - - -
40	17	4040901	4008206	4 008 212
50	22	4040901	4008207	4 008 213

Dimensions in mm

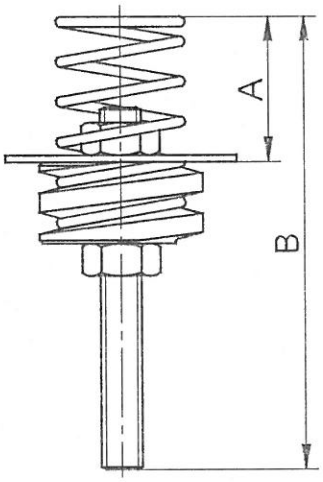
2.2 Mounting

Screw the mounting kit to the valve actuator with two M4-screws. An adaption bushing (M4) fixes the feedback spring and has to be connected to the valve stem. As all actuator designs differ from each other this connection has to be user-provided in such a way that for the closed valve the bushing is located in the shown position ("reference line"). This is essential for a proper correlation of stroke and positioner set point signal.

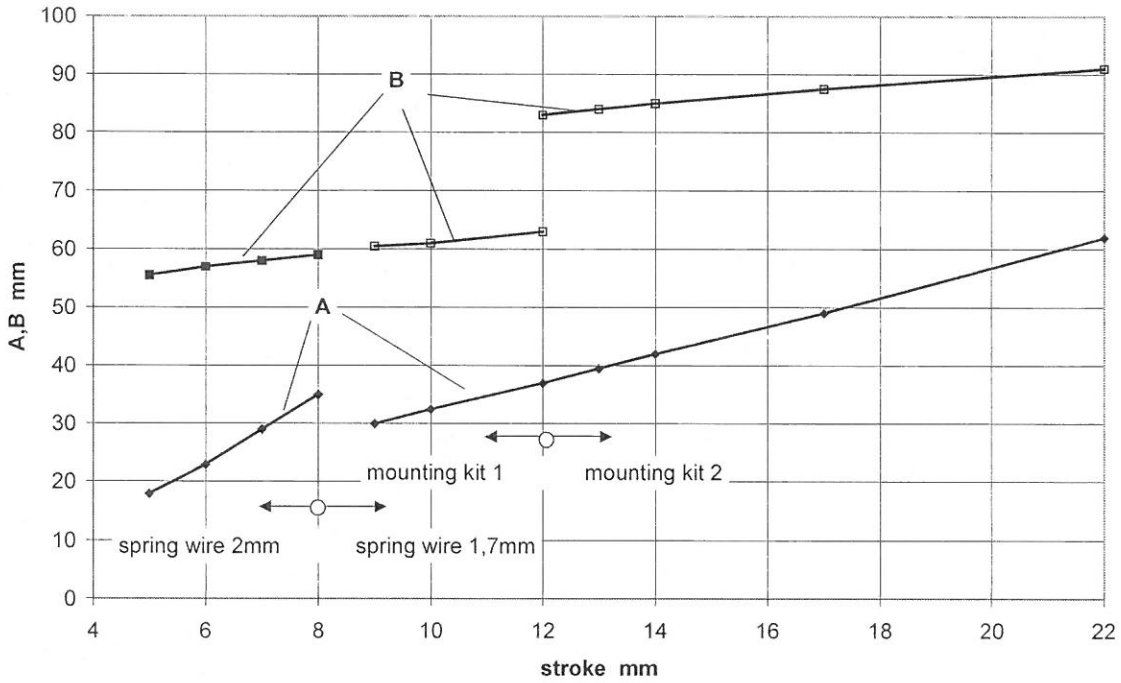


2.3 User-Defined Spring Adjustment

For strokes not indicated in the table above select the required range spring and the mounting kit and adjust "A" and "B" as shown in the table/chart "spring adjustment" (both "A" and "B" refer an unloaded spring!). Cut off the unused turns of the spring afterwards. Note that due to this further re-adjustment for a new stroke is only possible for shorter strokes as otherwise the spring becomes too short.



Spring Adjustment



Stroke	Mounting Kit				Spring Unit				Spring
	Art.-Nr.	ØD	C	B	Ød	Ød	A	B	Art.-Nr.
5	4040900	60	58	35	4008202	2	18	55,5	4104431
6	4040900	60	58	35	4008203	2	23	57	4104431
7	4040900	60	58	35	4008204	2	29	58	4104431
8	4040900	60	58	35	4040474	2	35	59	4104431
9	4040900	60	58	35	4040475	1,7	30	60,5	4104434
10	4040900	60	58	35	4008205	1,7	32,5	61	4104434
12	4040900	60	58	35	4040476	1,7	37	63	4104434
12	4040901	80	78	66	4040477	1,7	37	83	4104434
13	4040901	80	78	66	4040478	1,7	39,5	84	4104434
14	4040901	80	78	66	4040479	1,7	42	85	4104434
17	4040901	80	78	66	4008206	1,7	49	87,5	4104434
22	4040901	80	78	6	4008207	1,7	62	91	4104434

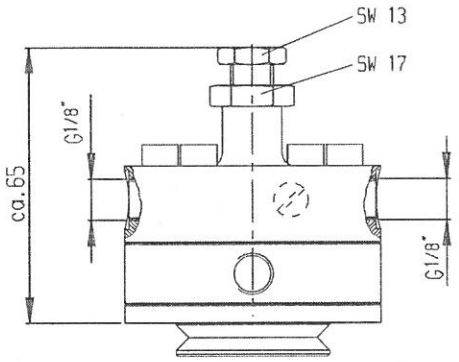
Dimensions in mm

Example: What is the right configuration for a stroke of 11 mm?

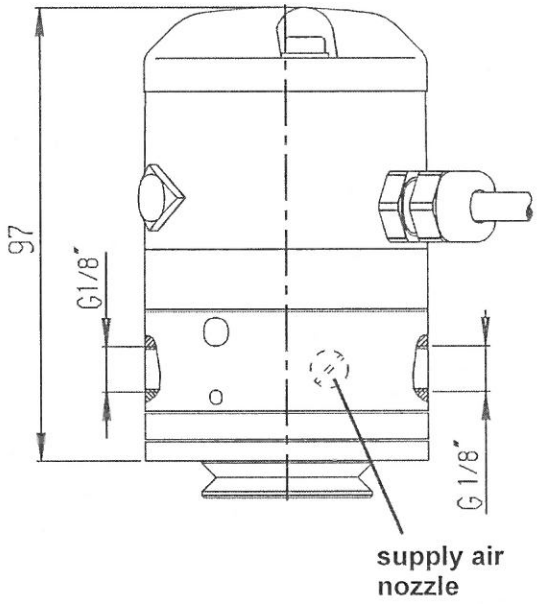
1. For strokes below 12 mm the 58 mm-high mounting kit has to be used.
2. Strokes longer than 8 mm require the 1,7 mm dia. range spring (part no. 4104434)
3. A should be adjusted to 35 mm.
4. B should be adjusted to 62 mm.

3 Positioners

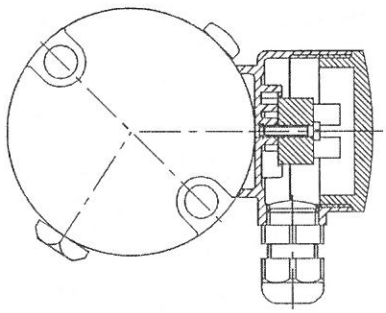
Pneumatic Positioner



Electro-Pneumatic Positioner



i/p-positioner (special version with screwed terminals)



	Art.-Nr.
i/p-standard 0...20 mA	4 008 174
i/p-standard 4...20 mA	4 008 175
i/p-intrinsic saftety 0...20 mA	4 040 342
i/p-intrinsic saftety 4...20 mA	4 040 343
i/p (clamp adaptor) 0...20 mA	4 040 120
i/p (clamp adaptor) 4...20 mA	4 040 121
p/p-standard 0,2...1 bar	4 008 178

3.1 Mounting

The positioner is fixed on the mounting kit by three socket screws. Take care that the range spring is centered properly in the diaphragm washer of the positioner. Connect output "A" to actuator and supply air (instrument quality) to port "P" and the 0,2-1 bar set point signal for the pneumatic version to "W" (all ports are G 1/8").
For the electropneumatic version the connection of the input signal is provided by a two-wire cable as follows:

Standard version	**brown „+"**	**black „-"**	impedance <220 Ω
Intrinsically safe version	**1 „+"**	**2 „-"**	impedance <420 Ω

Factory adjustment has been carried through at 4 bar supply pressure. Different supply pressures or other reasons might require a re-adjustment of the positioner.

3.2 Adjustment of the p/p-positioner

Loose fixing nut on top. Apply set point signals as follows:

Set point signal 0,2 bar	Valve is fully closed.
Set point signal 0,35 bar	Valve starts to open (first flow). Adjustment is done with zero point screw on top. Note that the signal range of 0,2-0,35 bar is required to ensure the proper shut-off of the valve (especially for pinch and diaphragm valves).
Set point signal 1 bar	Valve is fully opened. Adjustment is possible with range spring, however user adjustment is not required.

After the adjustment the zero point screw has to be locked again.

3.3 Adjustment of the i/p-positioner

For the i/p-version zero point (ZERO) and end value (SPAN) of the internal i/p-converter are factory adjusted. They have only to be re-adjusted in special cases:

ZERO: remove cap, turn spur wheel with a screw driver ("+" converter pressure rises, "-" converter pressure drops).
SPAN: remove bleeder screw, turn trimmer with a small screw driver ("counter-clockwise" converter pressure rises, "clockwise" converter pressure drops).

To ease the procedure it is recommended to use a small pressure gauge for controlling the converter pressure (to be mounted to the port which is closed by the screw cap). The adjustment of ZERO and SPAN have to be repeated alternatively for several times, as they are influencing each other.

Apply set point as follows:

Set point signal 4 mA	Valve is completely closed.
Set point signal 7 mA	Valve starts open, pressure at control gauge should be approx. 0,35 bar (adjusted by "ZERO"). Note that the signal range of 4-7 mA is required to ensure the proper shut-off of the valve (especially on pinch and diaphragm valves).
Set point signal 20 mA	Valve is completely opened, pressure at control gauge should be approx. 1 bar (adjusted by "SPAN").

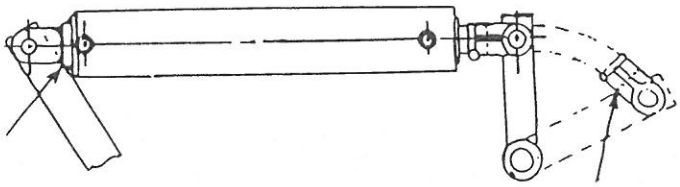
After the adjustment has been finished the control gauge is removed and the cap (with sealing) is mounted again. The bleeder screw and the protection cap are inserted.

3.4 Adjustment of the supply air flow

Using the adjustment nozzle the air consumption and at the same time the actuator velocity are controlled. Turning the nozzle screw clockwise makes the air consumption decrease. Furthermore the opening of the valve is slowed down. Throttling too far has to be avoided as the valve then will not able to open completely. Turning the nozzle screw counter-clockwise makes the air consumption increase. The opening of the valve is speeded up and the closing is slowed down. Opening the nozzle too far has to be avoided as the valve then will not be able to close completely. As we do not recommend any adjustment the nozzle screwed is fixed after factory adjustment.

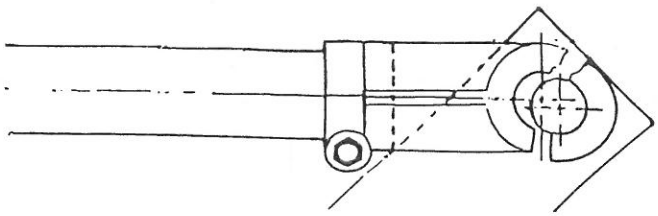
ENERGY®

Common Causes of Cylinder Damage



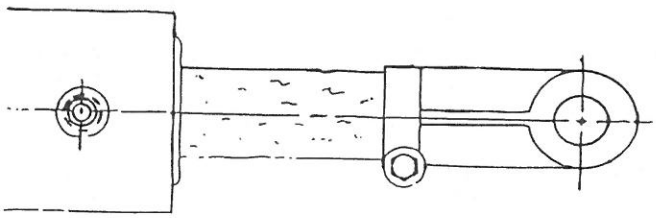
BINDING

Binding can cause a bent rod. Before operating the cylinder under pressure, make sure there is sufficient mounting bracket clearance in all positions from retracted to fully extended.



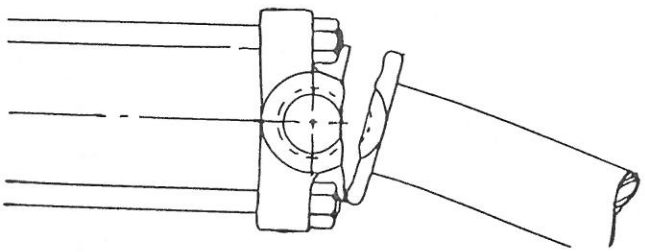
IMPROPER CLEARANCE

Improper clearance can cause broken clevis castings. Cylinder must be mounted so as to allow free movement throughout its stroke.



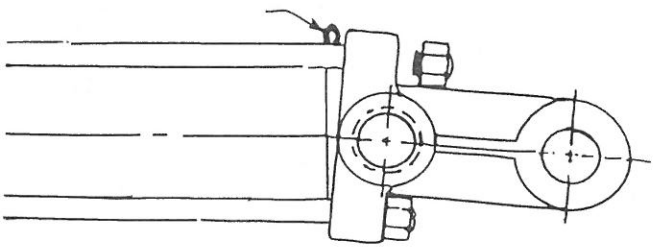
ROUGH OR SCORED ROD

Rough or scored rod will cause damage to the seals and premature leakage.



BENT PISTON ROD

Do not attempt to retract a bend rod, as it probably will cause the rod guide to crack or break.



TOO MUCH PRESSURE

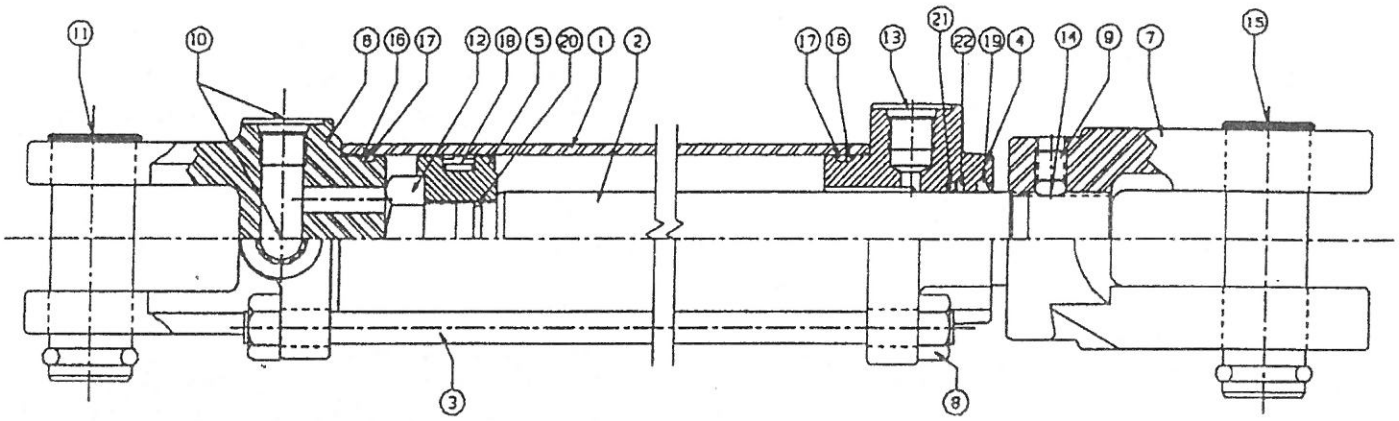
Do not exceed pressure rating of cylinder. Pressure beyond rated pressure could cause tie-rods to break or stretch and allow static seal to extrude. On welded-type cylinders, the retaining ring could be forced out of its groove or various other failures could occur.

ENERGY® *Manufacturing Company, Inc.*

ENERGY MANYFACTURING CO., INC.
204 Plastic Lane; Monticello, IA 52310-9472 USA
Phone: (319) 465-3537 Fax: (319) 465-5279
website: www.energymfg.com
e-mail address: info@energymfg.com

FORM CD-1A (Rev. 1/11)

ENERGY - PARTS LIST 2.00, 2.50, 3.00, 3.50, & 4.00 HPTR CYLINDERS 21016A



NO.	DESCRIPTION	QTY	720XX HPTR-2.00 1 1/8" ROD 2.00 BORE	725XX HPTR-2.50 1 1/8" ROD 2.50 BORE	730XX HPTR-3.00 1 1/4" ROD 3.00 BORE	735XX HPTR-3.50 1 1/2" ROD 3.50 BORE	740XX HPTR-4.00 2" ROD 4.00 BORE
01	CYLINDER WALL	1	A-9900-XX	A-9901-XX	A-9902-XX	A-9903-XX	A-9904-XX
02	PISTON ROD	1	B-7905-XX	B-7905-XX	B-7901-XX	B-7903-XX	B-7904-XX
03	TIE ROD	4	A-2450-XX	A-2450-XX	A-2450-XX	A-6642-XX	A-6894-XX
04	ROD GUIDE	1	18079B	18110B	17939B	18296B	18300B
05	PISTON	1	A-1845	A-1838	12580A	18302A	18304A
06	BOTTOM CLEVIS	1	18085C	18108C	17937C	18294C	18298C
07	PISTON ROD CLEVIS	1	18080B	18080B	17940B	18271B	18271B
08	TIE ROD NUT	8	82078	82078	82078	82077	82076
09	SET SCREW	1	82648	82648	82648	82648	82648
10	STEEL PIPE PLUG	2	82848	82751	82751	82751	82751
11	CLEVIS PIN & CLIP	1	A-542	A-9011	A-9011	A-6614	A-6614
12	PISTON NUT	1	80281	80281	82478	82598	82601
13	PLASTIC PLUG	1	12677A	82808	82808	82808	82808
14	NYLON BALL	1	82649	82649	82649	82649	82649
15	CLEVIS PIN & CLIP	1	A-9011	A-9011	A-9011	A-9011	A-9011
16	BACK-UP RING	2	15848A	15716A	82644	82697	81913
17	O-RING	2	18691A	18786A	82643	80347	80354
18	CROWN SEAL	1	21206X	21208X	21209X	21210X	21211X
19	ROD WIPER	1	83161	83161	83159	83147	83033
20	O-RING	1	80305	80305	80310	80315	80319
21	U-CUP SEAL	1	18077A	ES0030/1113	ES0030/1215	ES0030/1518	ES0030/2023
22	BACK-UP RING	1	81467	N/A	N/A	N/A	N/A
—	SEAL KIT (ITEMS 16-22)	1	18289X	18286X	18117X	18273X	18303X

Note: Where part number has a suffix of XX, replace the XX with the stroke.
Example: Cylinder Wall for a 4" bore 24" stroke would be A-9904-24

ENERGY HYDRAULICS®

No.: 2.00HPTR-110200

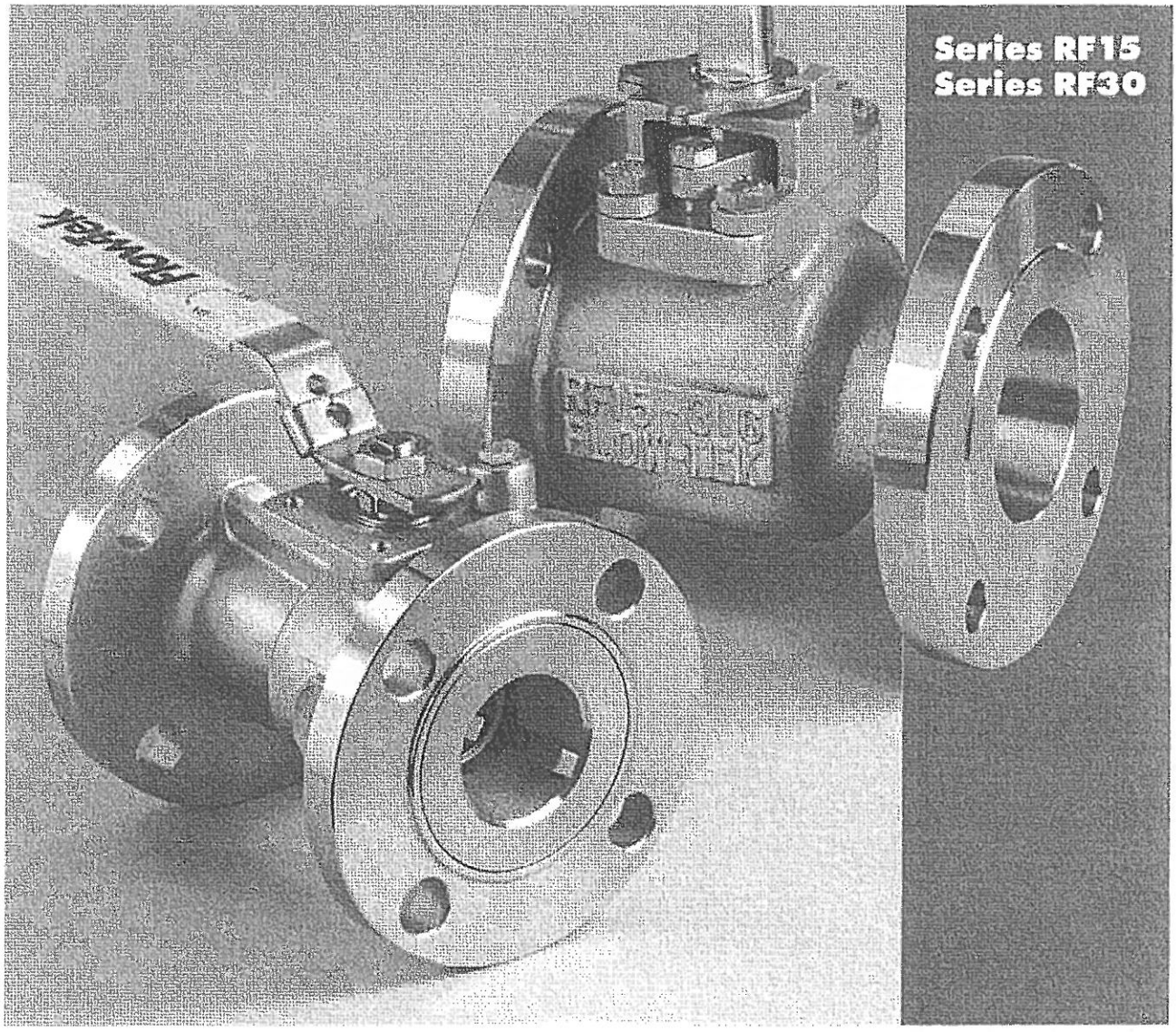
Energy Manufacturing Company, Inc.
204 Plastic Lane
Monticello, Iowa 52310-9472
Phone: 319/465-3537; Fax 319/465-5279
Web Site: http:/www.energymfg.com
E-mail Address: energy@ia.net

A
Bray
High
Performance
Company

Flow-Tek®
A Subsidiary of BRAY INTERNATIONAL, Inc.

1 Piece Flanged Standard Port Ball Valves: 1"- 12"

ASME Class 150 & Class 300



Flow-Tek's Series RF15 & RF30 ball valves feature a compact, one piece body design with threaded insert. The one piece body supplies maximum structural strength while minimizing the number of potential leak paths. A floating ball design offers low torque and increases valve cycle life. These rugged, economical, end entry flanged ball valves are ideal for industrial applications.

Non-Fire Safe and API 607 4th Edition Fire Safe Valves Series RF15/RF30 valves are available as non-fire safe with standard stem seals or fire safe to API 607 4th Edition with graphite stem seals.

Secure Mount Series RF15/RF30 valves offer ease of automation due to an integrally cast actuator mounting pad that complies with ISO 5211 through 2" valve sizes.

Pressure Ratings
Model RF15: ASME Class 150
Model RF30: ASME Class 300

Body Materials
Stainless Steel
Carbon Steel
Special Alloys upon request

Features

Stem Seals Series RF15/RF30 1"– 2" valves feature live-loaded, self-adjusting primary and secondary sealing. Utilizing belleville washers, the stem seal automatically adjusts to compensate for changes in temperature and normal wear. 3"– 12" valves utilize an independent packing gland which can be easily adjusted without removing mounting hardware or operator. The packing gland is contoured to more uniformly distribute the load across the packing.

The primary seal is a combination of a thrust washer and thrust washer protector. An adjustable stem packing creates a secondary seal between the stem and body. The stem packing is composed of RPTFE V-rings as standard – graphite stem packing is standard on all Fire Safe valves.

Ball Flow-Tek balls are precision machined and mirror finished for bubble-tight shut off and less operating torque. As an added safety feature, a hole in the stem slot of each ball equalizes pressure between the body cavity and the line media flow.

Body 1"–4" valve bodies are investment cast and all valve size castings are solution annealed/normalized for the highest quality and added strength. All body castings are marked with a foundry heat number for full traceability.

Seat Flow-Tek's seat design ensures bi-directional, bubble-tight sealing with low operating torque. All resilient seats feature relief slots or seat O.D. clearance to relieve pressure past the upstream seat and provide positive preloading to ensure low pressure/vacuum sealing.

Anti-Static Devices All RF15/RF30 valves have Anti-Static Devices as standard. These devices positively ground ball and stem.

Seat Selection

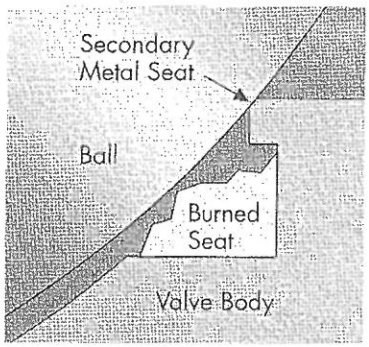
A wide range of seat materials are available to meet most applications. The standard seat is TFM 1600. Optional seats include RPTFE, Stainless Steel/PTFE (50/50), UHMWPE, Virgin PTFE, PEEK, Tek-Fil® (carbon/graphite filled TFM), and full metal seats and Cavity Fillers. PEEK seats offer high pressure/temperature capability. Tek-Fil seats offer reduced torque in high temperature, high cycle, and steam service applications. TFM1600 seats offer the exceptional chemical resistance of PTFE plus lower porosity and permeability, improved temperature range and reduced valve torques.

Options

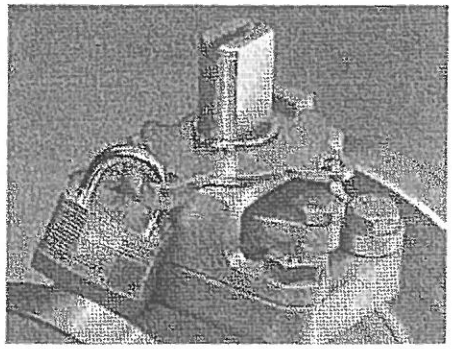
Flow-Tek Series RF15/RF30 valves are available as V-Control valves. For more information please see Flow-Tek VC brochure and Technical Bulletin 1006. A safety exhaust is available for downstream venting. Tri-Port balls for self draining and additional options are available upon request. For more information please consult the Flow-Tek factory.

Fire Safe: API 607-4 Certified

Flow-Tek's Series RF15/RF30 valves with graphite stem packing meet the highest fire safety standards under extreme conditions. In the event of a fire, after heat destroys the primary resilient seat, the ball makes contact with the secondary metal seat, forming a secure seal.



Flow-Tek offers a **Media Containment Unit** as an option. This unit easily mounts to standard valves through 10" and adds an additional stem packing seal for difficult services.



All manually operated valves feature a **Locking Device** to prevent accidental movement of ball position. 1"– 2" valves feature a Safety Trigger that locks the handle in the open or closed position. The handle lock can be bypassed, if needed, with a small bolt through the handle in the release position. On all sizes a **Padlock** can be added to secure the handle in position, preventing unwanted movement of the ball.

3" through 6" valves feature a NAMUR stem slot for ease of limit switch mounting.

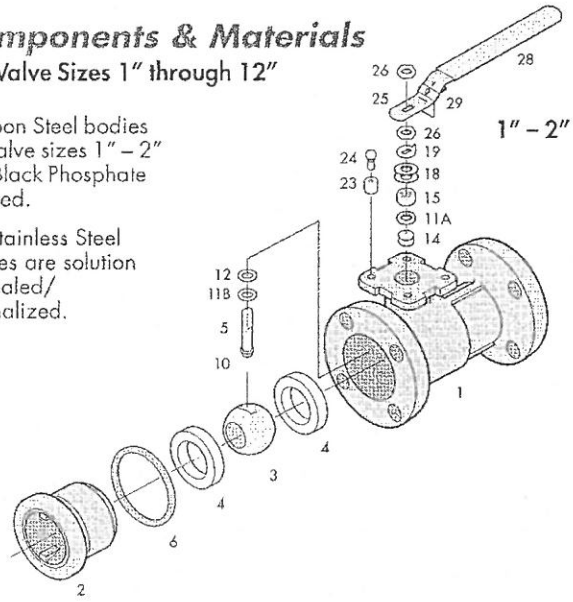
Technical Data

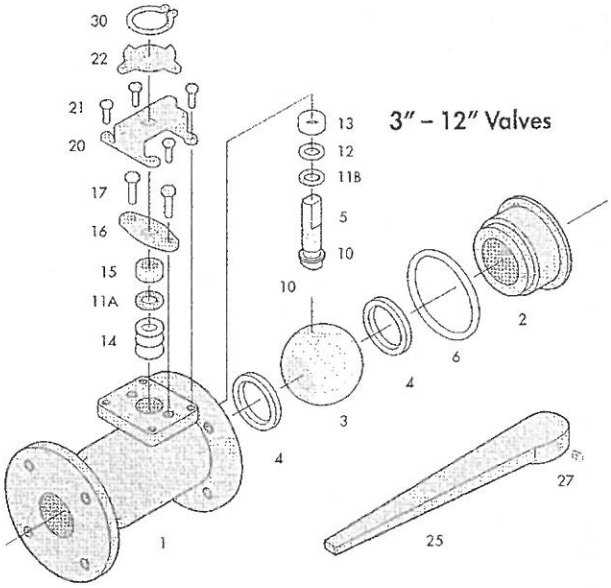
Components & Materials

For Valve Sizes 1" through 12"

Carbon Steel bodies on Valve sizes 1" – 2" are Black Phosphate Coated.

All Stainless Steel bodies are solution annealed/ normalized.





Specifications

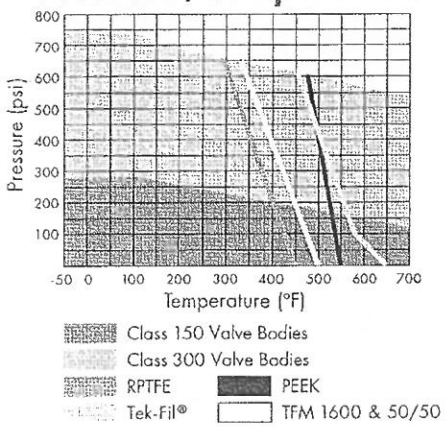
Flanged End Connections meet ASME Class 150/300.
Flanges meet ASME B16.5.
Face to Face Dimensions meet ASME B16.10 short pattern.
All valves meet ASME B16.34, MSS–SP–72 and API 608.

Fire Safe Valves with graphite Stem Packing are certified to API 607 4th Edition.

NACE MR0175 - All internal wetted parts.

All Valves are Hydrostatically Pressure Tested (Shell) and Air Pressure Tested (Seat) to the following in psi:
Class 150: Shell 450 [CS] 425 [SS] Seat 80
Class 300: Shell 1125 [CS] 1100 [SS] Seat 80

Pressure / Temperature



Note: Carbon Steel valves limited to -20°F.

Steam Service Pressure Ratings: WSP

Valve	TFM Seats PSI	°F	Tek-Fil Seats PSI	°F	PEEK Seats PSI	°F
Class 150	150	365	200	450	200	500
Class 300	150	365	425	450	425	500

Vacuum Service to 29 inches Hg. gauge.

Item	Name	Stainless Steel	Carbon Steel	Qty.
1	Body	ASTM A351 Gr CF8M	ASTM A216 Gr WCB	1
2	End Cap	ASTM A351 Gr CF8M	ASTM A216 Gr WCB	1
3	Ball	ASTM A351 Gr CF8M	ASTM A351 Gr CF8M	1
4	Seat*	TFM 1600	TFM 1600	2
5	Stem	ASTM A479 Gr 316	ASTM A479 Gr 316	1
6	Body Seal*	RPTFE	RPTFE	1
10	Anti-Static Device	SS316	SS316	2
11A	Packing Protector*	PEEK	PEEK	1
11B	Thrust Washer Protector*	PEEK	PEEK	1
12	Thrust Washer*	50% SS316 + 50% PTFE	50% SS316 + 50% PTFE	1
13	Stem Bearing*	15% RPTFE	15% RPTFE	1
14	Stem Packing*	RPTFE/Graphite	RPTFE/Graphite	3/1
15	Packing Gland Sleeve	SS304	Carbon Steel[1]	1
16	Packing Gland Plate	ASTM A351 Gr CF8	ASTM A216 Gr WCB	1
17	Gland Bolt	SS304	Carbon Steel	2
18	Belleville Washer	SS301	SS301	2
19	Tab Washer	SS304	SS304	1
20	Travel Stop Housing	ASTM A351 Gr CF8M	ASTM A216 Gr WCB	1
21	Housing Bolt	SS304	Carbon Steel	4
22	Travel Stop	SS304	Zinc Plated Carbon Steel	1
23	Travel Stop Set Sleeve	SS304	SS304	1
24	Travel Stop Bolt	SS304	SS304	1
25	Handle	Ductile Iron[2]	Ductile Iron[2]	1
26	Lock Nut	SS304	SS304	2
27	Handle Bolt	Carbon Steel	Carbon Steel	1
28	Handle Sleeve	Vinyl	Vinyl	1
29	Locking Device	SS304	SS304	1
30	Snap Ring	Nickel Plated Carbon Steel	Nickel Plated Carbon Steel	2

* Parts included in the repair kits.

[1] For 1"–2" RF15/RF30, this material is SS304.
[2] For 1"–2" RF15/RF30, this material is SS304.

Dimensions

MODEL RF15 – Class 150

SIZE ins	A	øB	C	C1	D	E	øF	N	øS	øT	C_V	TORQUE * lbs-in	WEIGHT lbs.
1	5.00	0.79	2.91	1.67	6.50	2.00	4.25	4	3.12	0.63	32	65	6
1 1/2	6.50	1.26	3.62	2.20	7.87	2.17	5.00	4	3.88	0.63	82	155	11
2	7.00	1.50	4.20	2.61	10.43	2.56	6.00	4	4.75	0.75	120	230	18
3	8.00	2.56	5.98	3.09	15.35	3.27	7.50	4	6.00	0.75	350	390	39
4	9.00	3.00	6.53	3.66	15.35	3.86	9.00	8	7.50	0.75	720	650	54
6	10.50	4.00	7.20	4.33	38.98	4.61	11.00	8	9.50	0.87	1,020	1,505	90
8	11.50	6.00	10.83	6.85	38.98	5.85	13.50	8	11.75	0.87	1,880	3,225	170
10	13.00	7.87	11.61	7.62	38.98	6.85	16.00	12	14.25	1.00	4,000	4,750	350
12	14.00	9.53	12.76	8.92	38.98	7.00	19.00	12	17.00	1.00	7,700	13,700	550

Face to Face dimensions meet ASME B16.10 short pattern.
***Torque** at maximum rated pressure, clean water, TFM 1600 seating material. Other seat materials exhibit different torques. Please refer to TB 1005 for specific torques.

MODEL RF30 – Class 300

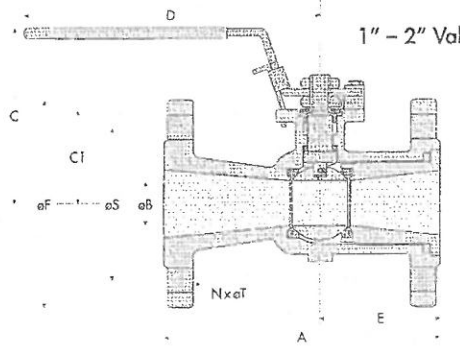
SIZE ins	A	øB	C	C1	D	E	øF	N	øS	øT	C_V	TORQUE * lbs-in	WEIGHT lbs.
1	6.50	0.79	2.98	1.67	6.34	2.18	4.88	4	3.50	0.75	32	70	8.5
1 1/2	7.48	1.25	3.65	2.20	7.72	2.60	6.14	4	4.51	0.87	82	175	17
2	8.50	1.50	4.17	2.61	9.69	2.92	6.50	8	5.00	0.75	120	270	24
3	11.14	2.50	5.98	3.00	15.35	3.75	8.28	8	5.00	0.87	350	600	55
4	12.00	3.00	6.53	3.66	15.35	3.86	10.00	8	6.18	0.87	720	850	74
6	15.88	4.00	7.21	4.33	15.35	4.61	12.52	12	8.50	0.87	1,020	2,600	132
8	16.50	6.00	11.22	6.85	38.98	5.85	15.00	12	13.00	1.00	1,880	5,300	300
10	18.00	8.00	12.72	7.62	38.98	6.85	17.50	16	15.25	1.13	4,000	7,600	460
12	19.75	9.53	13.70	8.92	38.98	7.00	20.50	16	17.75	1.25	7,700	17,800	800

SECURE MOUNT

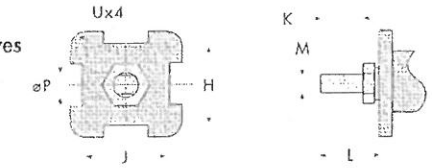
SIZE ins	H	J	Fo	BC DIA.	K	L	M	øP	U UNC
1	1.17	1.17	F04	1.65	0.31	0.55	0.25	0.37	#10-24
1 1/2	1.39	1.39	F05	1.97	0.43	0.75	0.31	0.43	1/4-20
2	1.95	1.95	F07	2.76	0.55	0.91	0.37	0.62	5/16-18
3-4[1]	3.54	1.87	–	–	1.75	2.97[1]	0.67	1.10	1/2-13
6	3.54	1.87	–	–	1.75	3.07	0.67	1.71	1/2-13
8	3.37	3.37	–	4.77	1.61	3.42	1.02	1.71	1/2-13
10	3.37	3.37	–	4.77	2.13	3.86	1.02	1.71	1/2-13
12	4.53	4.53	–	6.40	2.16	3.74	1.38	1.97	5/8-11

[1] For 4": L=3.07

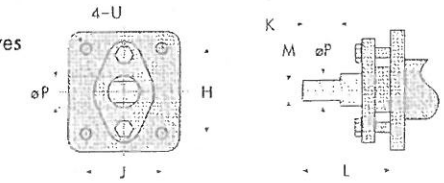
1" – 2" Valves



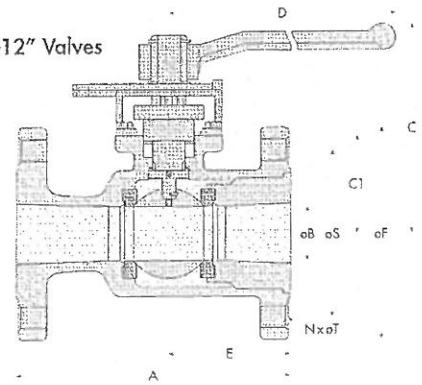
1" – 2" Valves



3" – 12" Valves



3"–12" Valves



NOTE: Gear Operators are suggested on size 10" and 12" valves.

NOTE: A trunnion-like Ball Support is included on size 12" valves.

Flow-Tek®
A Subsidiary of BRAY INTERNATIONAL, Inc.
11850 Tanner Road Houston, Texas 77041
832.912.2300 Fax: 832.912.2301
www.flow-tek.com

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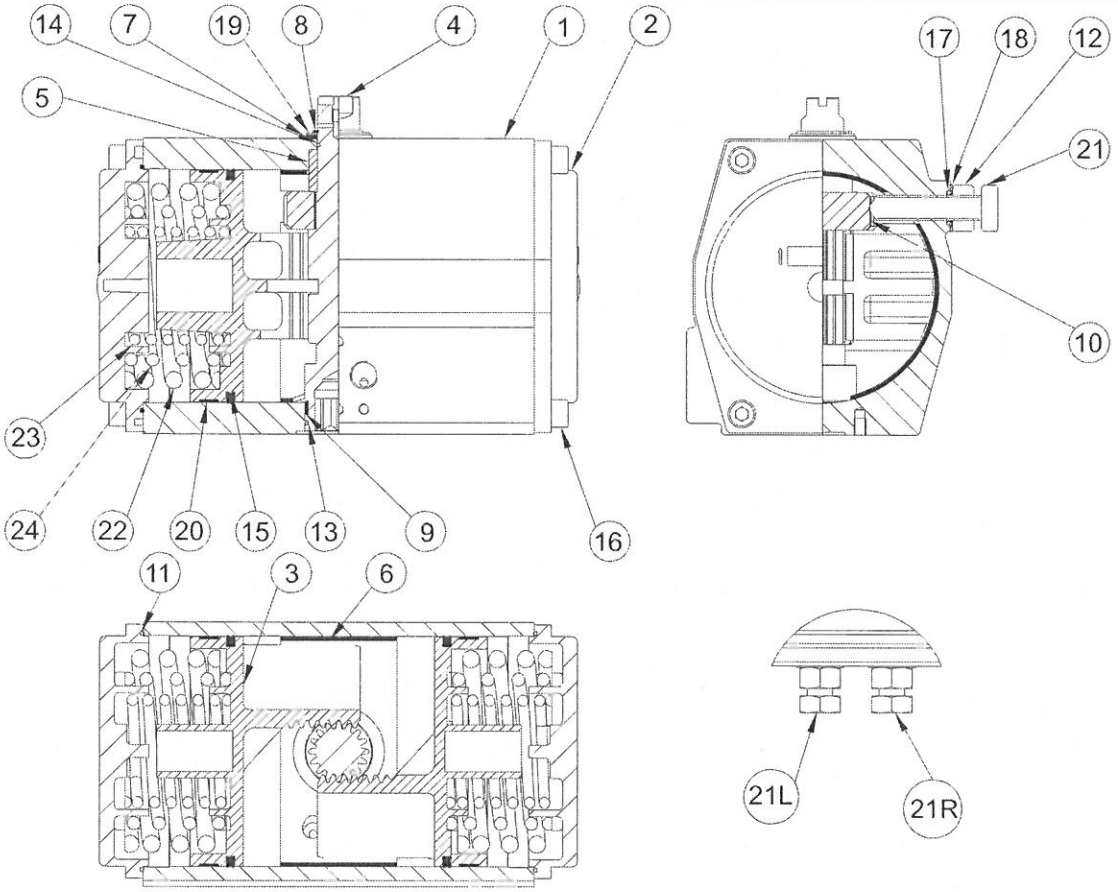

24	Middle spring	2	Spring Steel Grade 3	-	Epoxy Powder Coated
23	Inner spring	2	Spring Steel Grade 3	-	Epoxy powder coated
22	Outer spring	2	Spring Steel Grade 3		Epoxy powder coated
21	Stoke adjustment screw	2	HGA Steel	12.9 Grade	Zinc passivation
20	piston bearing	2	Polyacetal	-	-
19	Washer	1	AISI304	-	-
18	Washer	2	AISI304	-	-
17	O ring	2	NBR	-	-
16	Hex socket screw	8	AISI304	-	-
15	Piston Seal	2	Polyethylene	-	-
14	Pinion Seal	1	Polyethylene	-	-
13	Pinion Seal	1	Polyethylene	-	-
12	Lock nut	2	AISI304	-	-
11	Cover seal	2	NBR	-	-
10	Cam insert	1	cast carbon steel	ASTM A216 Grade WCB	Electroless nickel plated-
9	Pinion bearing	1	Polyacetal	-	-
8	External Circlip	1	Spring Steel	DIN471(IS3075)	Nickel plated-
7	Washer	1	Polyacetal	-	-
6	Piston bearing	1	Poyacetal	-	-
5	Pinion bearing	1	Polycetal	-	-
4	Pinion	1	Steel	EN-8	Electroless nickel plated
3	Piston with Rack	2	Aluminium	LM6	-
2	Cover	2	Aluminium	LM6	Epoxy powder coated
1	Body	1	Aluminum Alloy	6063T6	Hard anodized
NO	PART DESCRIPTION	QTY	MATERIAL	SPECIFICATION	CORROSION PROTECTION

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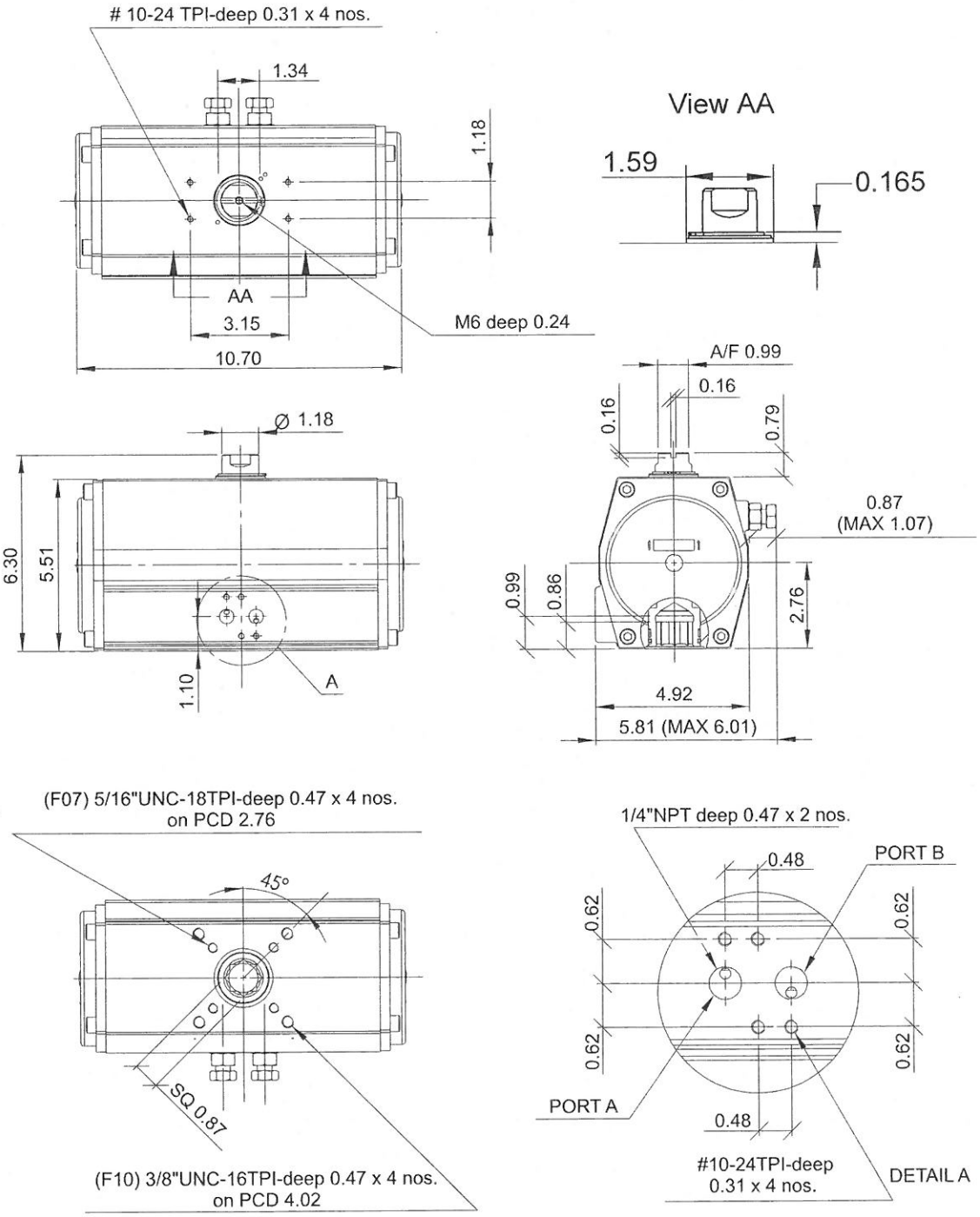

Pinion inches	Min	Max	Pinion mm	Min	Max
0.866	0.867	0.871	22.0	22.02	22.13

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INDEX

01	Introduction	04	Installation	07	Packaging & Storage
02	Technical Specs	05	Operation	08	Warnings
03	Parts Identification	06	Maintenance	09	Assistance

01 Introduction

This manual provides information on installation, operation, and maintenance procedures and related instructions for the ROTEX Infinity ECV Series spring return and double acting pneumatic actuators.

02 Technical Specifications

MOUNTING: In accordance with ISO 5211/DIN 3337/VDI/VDE 3845 NAMUR.

DIMENSIONS: As per Rotex Infinity Technical Brochure.

MATERIALS OF CONSTRUCTION: See Section 03 of this manual.

OPERATING PRINCIPLE (Standard Mode):

Double Acting:

Both ports A and B are used as inlet ports.
When air is supplied to Port A, the pistons #3 are moved *away from each other*, and the pinion #4 is rotated CCW.
When air is supplied through Port B, the pistons come closer and return to their home position, rotating the pinion CW.

Spring Return [Fail Closed]:

Port A is used as inlet.
When air is supplied to Port A, the pistons #3 are moved away from each other, the springs #16 are compressed, and the pinion #4 is rotated CCW.
When the air is exhausted through Port A, the springs return the pistons to the home position, rotating the pinion CW.

OPERATING MEDIUM:

Air or non-corrosive gas compatible with the internal materials of construction.
Dry or lubricated.
Gas must be clean and filtered to minimum 100 micron level.

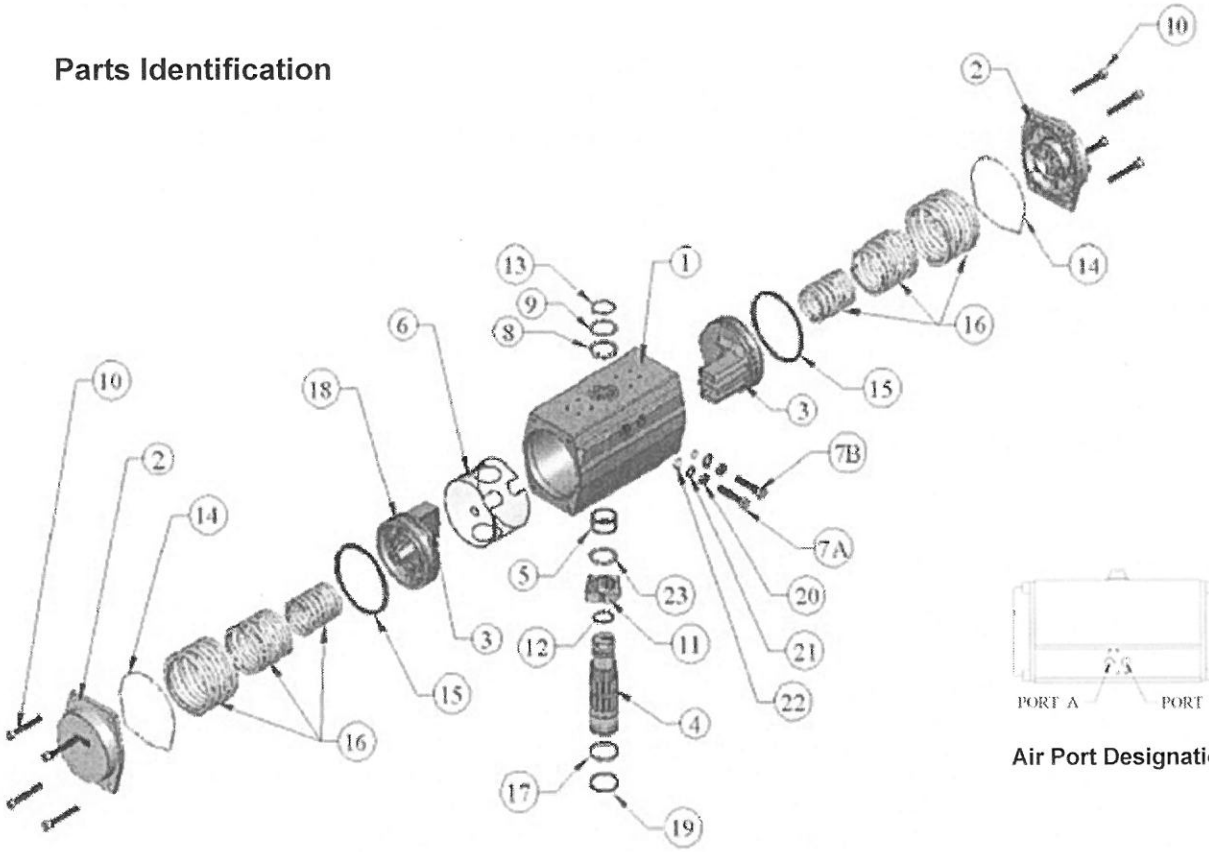
OPERATING CONDITIONS:

Maximum 120 psi, 180° F (8.3 Bar, 82° C)

OPERATING CONTROLS:

Stroke adjustment using stroke adjustment screws #7A/7B.

03 Parts Identification



Air Port Designation

PART NO	DESCRIPTION	MATERIAL OF CONSTRUCTION	PART NO	DESCRIPTION	MATERIAL OF CONSTRUCTION
1	BODY	ALUMINUM	12	TOP PINION SEAL	POLYETHYLENE
2	END COVER	ALUMINUM	13	EXTERNAL CIRCLIP	SPRING STEEL
3	PISTON WITH RACK	ALUMINUM	14	COVER SEAL	BUNA
4	PINION	STEEL/EN	15	PISTON SEAL	POLYETHYLENE
5	TOP PINION BEARING	POLYACETAL	16	SPRINGS	SPRING STEEL GR3
6	CENTER BORE SLEEVE	POLYACETAL	17	BOTTOM PINION BEARING	POLYACETAL
7A	STROKE ADJUSTMENT SCREW	STEEL	18	PISTON BEARING	POLYACETAL
7B	STROKE ADJUSTMENT SCREW	STEEL	19	BOTTOM PINION SEAL	POLYETHYLENE
8	WASHER	POLYACETAL	20	LOCK NUT	STEEL
9	WASHER	304SS	21	WASHER	STEEL
10	HEX SOCKET SCREW	304SS	22	O RING	NBR
11	CAM INSERT	STEEL	23	CAM WASHER [1]	POLYACETAL

[1] Cam washer only on ECV Models 80, 110, 125, and 175

04 Installation

NOTES:

N1 > Ensure the installation meets the legal and regulatory requirements of the country and state of use.
N2 > Until the actuator is installed, keep it in its original packaging and stored between 40° F and 120° F (4° C and 49° C).
N3 > Ensure the operating medium meets the above requirements.
N4 > Use proper rigging to handle the actuators weighing more than 60 lb (27 kg) to avoid personal injury.

04.1 Mounting

STEP 1 Keep the valve on which the actuator is to be mounted in home position, until the installation is complete. Ensure that valve is secure.
STEP 2 Fix the brackets on the valve.
STEP 3 Ensure the coupling slides on the stem smoothly without any play.
STEP 4 Check the other end of the coupling with the actuator for the length of engagement.
STEP 5 Mount the actuator *(Refer Note N4 above)* on the bracket with fasteners.
STEP 6 Tighten all the fasteners to the torque as recommended by the fastener manufacturer.

04.2 Adjustment of End Stops

NOTES:

N1 > All actuators are factory set to 0 and 90 degrees. Even minor adjustments of the stroke adjustment screws (#7A and 7B) will result in over travel or incomplete travel of the pinion.
N2> Only loosen the lock nut. Don't remove it fully.
N3> Don't tighten the stroke adjustment screw #7A or 7B more than the maximum limit of adjustment – if over-tightened, the screw may hit the piston #3 and cause damage.

CLOSING: For 0 Degrees, Adjust #7B
Turn counter-clockwise to travel further (over travel)
Turn clockwise to limit the travel.
When adjustment is set, tighten lock nut #20 on adjustment screw.

OPENING: For 90 Degrees, Adjust #7A
Turn counter-clockwise to travel further (over travel)
Turn clockwise to limit the travel.
When adjustment is set, tighten lock nut #20 on adjustment screw.

SAFETY CHECK FOR STROKE ADJUSTMENT SCREW POSITION:
Keep the piston in the home position.
Tighten the stroke adjustment screw (clockwise direction) until the screw touches the inner wall of the piston. This is the maximum safe limit of adjustment of the stroke adjustment screw.

05 Operation

STEP 1 Provide air connections using proper fittings.
STEP 2 Air supply must meet specifications on page 1.
STEP 3 Ensure air supply pressure is regulated to ensure maximum air supply is not exceeded.
STEP 4 Supply air to the actuator through a solenoid or manual air valve.

06 Maintenance

06.1 Recommended Servicing

At 1,000,000 Cycles:

Apply grease on seals #1/6/12/14/15/19. DO NOT APPLY EXCESSIVE GREASE.
Apply grease on rack #3 and pinion #4. DO NOT APPLY EXCESSIVE GREASE.
Replace all plastic #5/6/18 and rubber parts #12/14/15/19.
Inspect springs # 16 for any rust or deformity. Replace if necessary.

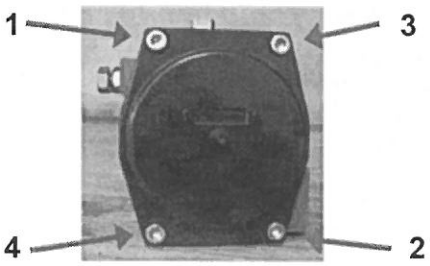
NOTES:

N1 > Carry out maintenance involving disassembling of actuator in a safe indoor place free from dust, water.
N2 > Ensure that air supply has been disconnected.
N3 > Ensure proper lifting procedures are followed when moving or lifting actuators.
N4 > DO NOT use accessory mounting holes on top of actuator for lifting.
N5 > If actuator is spring return, ensure actuator is in the failed position and spring are de-energized before disassembling.

06.2 End Cap Bolting Details

Actuators sizes ECV32 – ECV175

Actuators of these sizes have (4) end cap bolts on each end. All bolts are the same length. When gradually and evenly loosening, or tightening these bolts, use the following sequence;



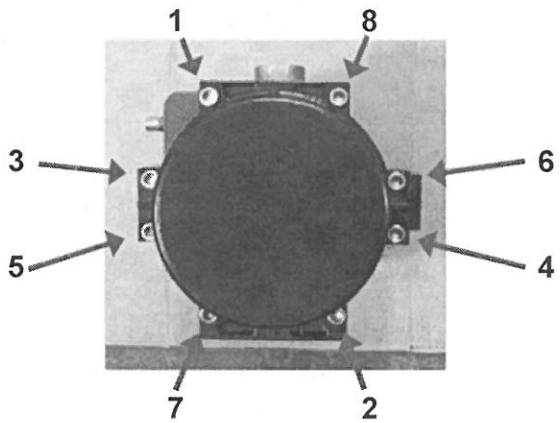
Actuators sizes ECV200 – ECV350

Actuators of these sizes have (8) end cap bolts on each end.

NOTE: Bolts in positions 1, 8, 7, and 2 are SHORTER than the side bolts in positions 3, 5, 6, and 4.

When removing the bolts, the sequence 1, 2, 3, 4, 5, 6, 7, 8, should be followed to GRADUALLY and evenly loosen the bolts, bearing in mind that the 1, 8, 7, and 2 bolts are shorter. Bolts 3, 5, 6, and 4. are longer, and should be removed **last**, to ensure that spring tension is released safely.

When reinstalling bolts, the longer bolts 3, 5, 6, and 4 will have to be started first and gradually and evenly tightened. When the end cap is close enough to engage the shorter bolts 1, 8, 7, and 2, follow the sequence 1, 2, 3, 4, 5, 6, 7, 8 to gradually and evenly tighten the bolts.



REFERENCE ONLY:
Shows bolts 1, 8, 7, 2 are shorter

06.3 Disassembly

Refer to the view on page 2 and details on page 5.

Step 1 Loosen the lock nuts #20, remove stroke adjustment screws #7A and 7B, washers #21, and o-rings #22.
Step 2 Loosen the cover bolts # 10 on each end cap gradually and evenly in sequence indicated in the detail information on page 5.

CAUTION: Spring return actuator end caps are under spring tension. Caution must be used when removing end cap bolts and end caps. It is suggested that the actuator be put into a press during removal of end caps to ensure safe release of spring tension.

Step 3 Rotate the pinion #4 in the counter-clockwise direction until the pinion becomes free.

NOTE: NEVER attempt to remove pistons from actuator body using air pressure when the end caps have been removed!!

Step 4 Pull the piston out from each side by holding with pliers.
Step 5 Remove external circlip # 13 and then washers #8 and #9.
Step 6 Tap the pinion gently from the top using a rubber mallet until the pinion is approximately half way into the body.
Step 7 Remove the top pinion seal #12 and the top pinion bearing #5.
Step 8 Remove the cam stop ring #11 and washer #23.
Step 9 Pull the pinion the rest of the way out of the body.
Step 10 Check the pinion bearing #5 for its condition.
Step 11 If removal and replacement of the pinion bearings is required, *carefully* push the pinion bearing off with the help of a screw driver and remove from the body.
Step 12 Push and remove the center bore sleeve #6.
Step 13 Remove the bottom pinion bearing #17, the bottom pinion seal #19, and the end cap seals #14.
Step 14 Change the necessary parts.

It is recommended that <u>all</u> wear parts are changed as a complete set, even if some of them are found to be in good condition. This will ensure uniform wear of the parts and assure smooth performance of the actuator.

06.4 Assembly for DOUBLE ACTING and STANDARD MODE SPRING RETURN (Fail Closed) Actuators

NOTES:

N1 > Follow the sequences as given below to ensure proper assembly.
N2 > Use only the recommended accessories and lubricants.
N3> Do not apply excessive lubricant – excess lubricant will inhibit proper operation of V-seals.
N4> Assembly instructions in this section are for double acting and standard mode spring return (fail closed / fail clockwise) actuators. For assembly notes on reverse mode spring return actuators (fail open / fail counter-clockwise) see notes in section 06.5.

Step 1 Clean all the parts.
Step 2 Insert center bore sleeve #6 into the body #1.
Step 3 Ensure that the hole in the center bore sleeve is aligned with port A.
Step 4 Fit bottom pinion bearing #17 and bottom pinion seal #19 on to the pinion #4. Apply recommended grease over the pinion bearing surface #17 and on the bottom pinion seal #19. Apply a thin coat all over the surface; DO NOT APPLY EXCESSIVE GREASE.
Step 5 Insert pinion carefully into the body #1 from the bottom, approximately half way.
Step 6 Install the cam stop ring #11 and polyacetal cam washer #23 on top of pinion.
Step 7 Install top pinion seal #12 on pinion and apply a light layer of grease.
Step 8 Install top pinion bearing #5 on pinion.
Step 9 Push the pinion the rest of the way into the body.
Apply gentle force while rotating the piston to facilitate the insertion.
Step 10 Install polyacetal washer #8, SS washer #9, and external circlip #13 on top of pinion.
Step 11 Check for free rotation of pinion.
Step 12 Apply recommended grease over the bore of the body and over the interior of the center bore sleeve; avoid excess grease.
Step 13 Rotate the pinion so that the dot on the pinion is positioned close to the single dot on the top pad of the actuator body. Accurate pinion alignment can now take place by lining the center of the slot on the top of the pinion with the single dot on the body. (See Figure 1, page 8)
Step 14 Insert the pistons, pressing only until the seals enter the body. Push in both the pistons simultaneously.

Extreme caution should be used as piston seals are slid into the actuator body. Misalignment of piston seals during this step WILL result in damage to the seal and air leak paths.

Step 15 Ensure both the pistons are engaged in the same position.
Same amount of gap between the face of each piston and the end of the body will confirm this.
Step 16 For spring return actuators, insert the springs #16.

When assembling springs and end caps on spring return actuators, it is necessary to have the actuator body in the vertical position. This is required to ensure that springs remain properly aligned and centered during assembly.

Step 17 Fix the seals #14 on the left and right end caps and install on to body.
Ensure the air ports on the end caps are aligned properly.
Ensure uniform tightening of end cap bolts, following sequence noted on page 5.

Step 18 Install stroke adjustment screws #7a and 7B with o-rings #22, washers #21, and lock nuts #20.
Step 19 Apply air to Port A to move pistons to the extended 90 degree position.
Step 20 Adjust stroke adjustment screw #7A for the 90 degree position, turning clockwise until the screw is barely touching the piston. Tighten the lock nut.
Step 21 For spring return actuators, release the air pressure, for double acting actuators, apply air to Port B. This will bring the pistons back to the 0 degree position.
Step 22 Adjust the stroke adjustment screw #7B for the 0 degree position, turning clockwise until the bolt is barely touching the piston. Tighten the lock nut.
Step 23 Apply air as required to stroke the actuator several times to confirm that the stroke adjustment screws are set correctly and ensure that there is no air leakage from any of the seals.
Step 24 Re-install or repack for storage (see section 7 for Packaging and Storage).

Figures 1 and 2:

Assembly diagram for use with Section 06.4 Step 13 and Section 06.5 Step 13. Assembly diagrams shown here are for reference to ensure the pinion is positioned in the correct general quadrant for the Fail Closed or Fail Open modes.

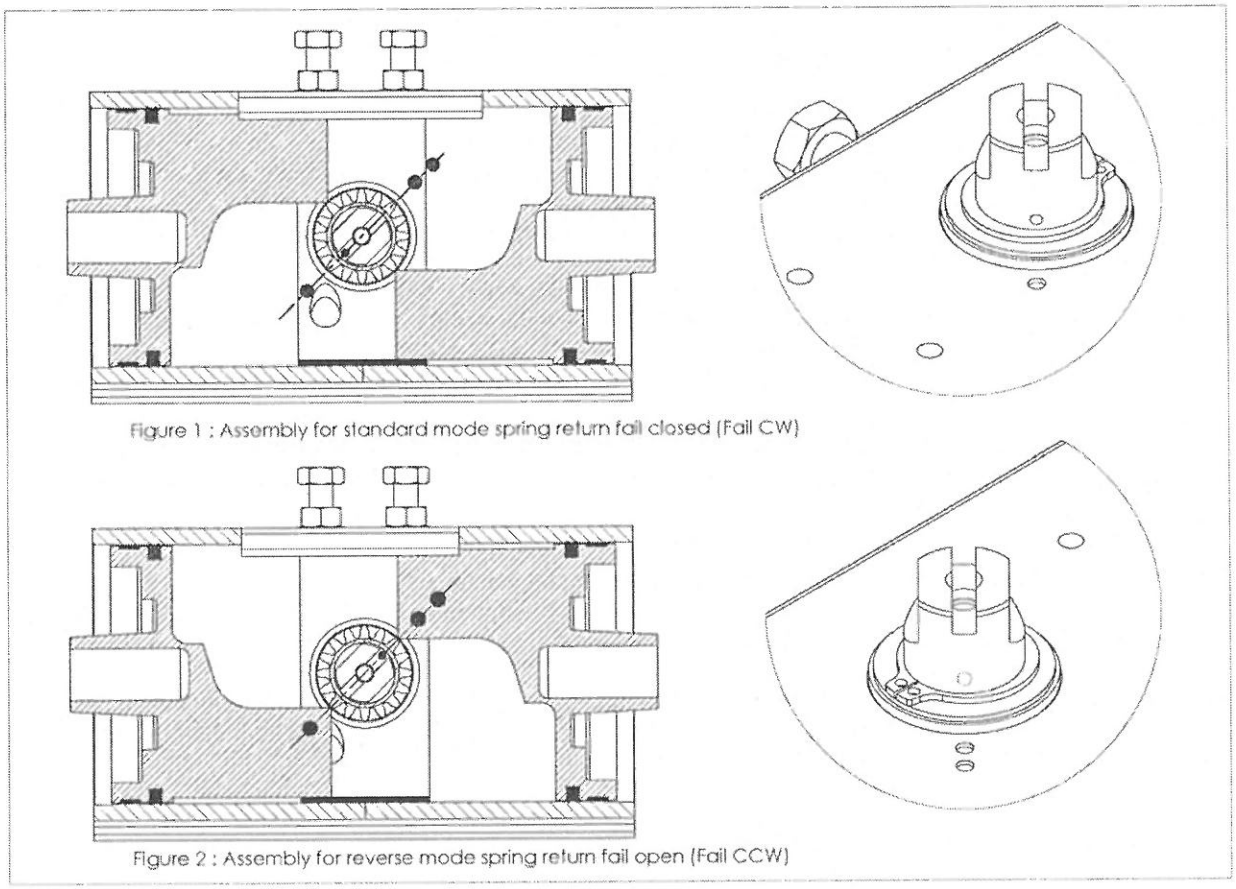


Figure 1 : Assembly for standard mode spring return fail closed (Fail CW)

Figure 2 : Assembly for reverse mode spring return fail open (Fail CCW)

06.5 Assembly for REVERSE MODE SPRING RETURN (Fail Open) Actuators

NOTES:

N1 > Follow the sequences as given below to ensure proper assembly.
N2 > Use only the recommended accessories and lubricants.
N3> Do not apply excessive lubricant – excess lubricant will inhibit proper operation of V-seals.
N4> Assembly instructions in this section are for spring return actuators in the reverse mode (fail open / fail CCW). For assembly notes on standard mode spring return actuators (fail closed / fail clockwise) see notes in section 06.4.

Step 1 Clean all the parts.
Step 2 Insert center bore sleeve #6 into the body #1.
Step 3 Ensure that the hole in the center bore sleeve is aligned with port A *(refer view).*
Step 4 Fit bottom pinion bearing #17 and bottom pinion seal #19 on to the pinion #4. Apply recommended grease over the bearing surface and on the O ring - uniformly and a thin coat all over the surface; avoid excess grease.
Step 5 Insert pinion carefully into the body from the bottom, approximately half way.
Step 6 Install the stop ring #11 and polyacetal washer #23 on top of pinion.
Step 7 Install top pinion seal #12 on pinion and apply a light layer of grease.
Step 8 Install top pinion bearing #5 on pinion.
Step 9 Push the pinion the rest of the way into the body.
Apply gentle force while rotating the piston to facilitate the insertion.
Step 10 Install polyacetal washer#8, SS washer #9, and external circlip #13 on top of pinion.
Step 11 Check for free rotation of pinion.
Step 12 Apply recommended grease over the bore of the body and over the interior of the center bore sleeve; avoid excess grease.
Step 13 Rotate the pinion so that the dot on the pinion is positioned close to the two dots on the top pad of the actuator body. Accurate pinion alignment can now take place by lining the center of the slot on top of the pinion with the two dots on the body. (See Figure 2, page 8).
Step 14 Insert the pistons, pressing only until the seals enter the body. Push in both the pistons simultaneously.

Extreme caution should be used as piston seals are slid into the actuator body. Misalignment of piston seals during this step WILL result in damage to the seal and air leak paths.

Step 15 Ensure both the pistons are engaged in the same position.
Same amount of gap between the face of each piston and the end of the body will confirm this.
Step 16 Insert the springs #16.

When assembling springs and end caps on spring return actuators, it is necessary to have the actuator body in the vertical position. This is required to ensure that springs remain properly aligned and centered during assembly.

Step 17 Fix the seals #14 on the left and right end caps and install on to body.
Ensure the air ports on the end caps are aligned properly.
Ensure uniform tightening of end cap bolts, following sequence noted on page 5.

Step 18 Install stroke adjustment screws #7A and 7B with o-rings #22, and lock nuts #20.
Step 19 Apply air to Port A to move pistons to the extended 0 degree position.
Step 20 Adjust stroke adjustment screw #7B for the 90 degree position, turning clockwise until the screw is barely touching the piston. Tighten the lock nut.
Step 21 Release the air pressure to bring the pistons back to the 90 degree position.
Step 22 Adjust the stroke adjustment screw #7A for the 0 degree position, turning clockwise until the screw is barely touching the piston. Tighten the lock nut.
Step 23 Apply air as required to stroke the actuator several times to confirm that the stroke adjustment screws are set correctly and ensure that there is no air leakage from any of the seals.
Step 24 Re-install or repack for storage (see section 07 for Packaging and Storage).

07 Packaging and Storage

When not in use, actuators should be kept in a sealed plastic bag in a cardboard box to prevent moisture or dust from contacting product. Boxes should be stored in a dry place free from water and dust.

Store at temperature between 40° and 120° F (4° C and 49° C).

Locate in an area to avoid damage by impact.

08 Warnings

Use only genuine spares parts supplied by ***Rotex.***

Use only the recommended accessories and lubricants.

Install, operate and maintain as per the instructions and recommendations of this manual.

Any **deviation** from the above warnings will cease the responsibilities of ***Rotex.***

09 Assistance

For technical questions or assistance, contact any authorized distributor of ***Rotex*** or:

Rotex Controls, Inc
21 Sullivan Parkway, Fort Edward, NY 12828
Tel: (888) 813 – 9772 Fax: (866) 478 – 9620
sales@rotexcontrols.com

Series 6000

KUNKLE

ASME Section I and VIII, Steam, 'V' and 'UV', ASME Section VIII, Air/Gas 'UV' National Board Certified. Models 6933, 6934, and 6935 are ASME Section IV, 'Steam', 'HV' National Board Certified. PED Certified for Non-Hazardous Gas.

Features

- **O-ring seats available** for exceptional leak-free performance, reduced maintenance cost, multiple cycles with tight shutoff, improved seating integrity.
- **Wide hex on valve nozzle** provides wrenching service clearance for easy installation.
- **Dual control rings offer easy adjustability** for precise opening with minimum preopen or simmer and exact blowdown control.
- **Pivot between disc and spring** corrects misalignment and compensates for spring side thrust.
- **Grooved piston model disc** reduces sliding area and friction.

Model Descriptions

Model 6010: Side outlet. Full nozzle design with bronze/brass trim. Available with O-ring seats. For exceptional leak-free performance.

Model 6021: Same as Model 6010 with Teflon® (PFA) disc insert. For exceptional leak-free performance (use on steam only).

Model 6030: Same as Model 6010 except SS trim (nozzle and disc). Available with O-ring seats for exceptional leak-free performance.

Model 6182: Top outlet. Full nozzle design with bronze/brass trim. O-ring seat available for exceptional leak-free performance.

Model 6121: Same as Model 6182 with Teflon® (PFA) disc insert. For exceptional non-leak performance (use on steam only).

Model 6130: Same as Model 6182 except SS trim (nozzle and disc). O-ring seat available for exceptional leak-free performance.

Model 6186: Top outlet. Full nozzle design with bronze/brass trim. 150 psig [10.3 barg] maximum set pressure. Replaces Model 86 (original equipment only).

Model 6283: Over-sized side outlet. Full nozzle design bronze/brass trim.

Model 6221: Same as Model 6283 with Teflon® (PFA) disc insert. For exceptional leak-free performance (use on steam only).

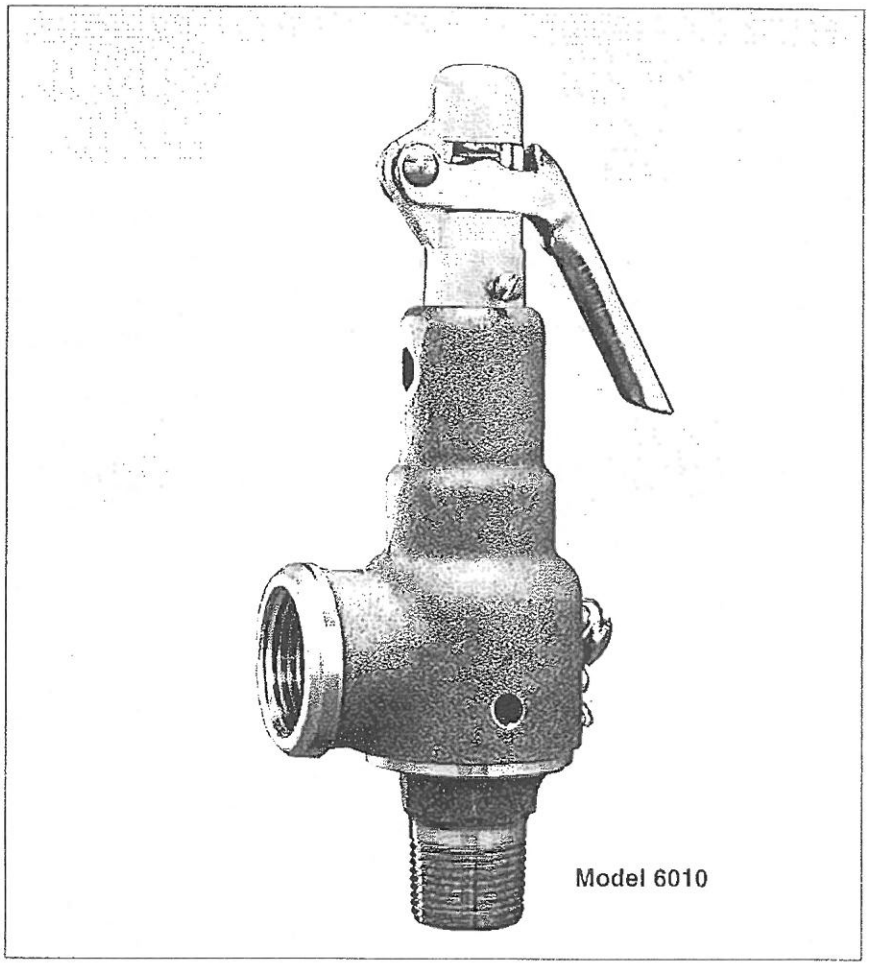
Model 6230: Same as Model 6283 except SS trim (nozzle and disc).

Model 6933: Same as Model 6010 except certified for ASME code Section IV. Low pressure steam heating boilers set at 15 psig [1.0 barg] only.

Model 6934: Same as Model 6021 except certified for ASME code Section IV. Low pressure steam heating boilers set at 15 psig [1.0 barg] only.

tyco *Flow Control*

Total Flow Control Solutions™



Model 6010

Model 6935: Same as Model 6030 except certified for ASME code Section IV. Low pressure steam heating boilers set at 15 psig [1.0 barg] only.

Applications

- Steam Boilers and Generators.
- Air/Gas Compressors - reciprocating or rotary - portable or stationary, intercoolers and aftercoolers.
- Pressure Vessels - containing steam, air or non-hazardous gas. Including tanks, receivers, sterilizers and autoclaves.
- Pressure Reducing Stations - protection of the discharge or low pressure side of system.

Pressure and Temperature Limits

Models 6010, 6021, 6182, 6283, 6221
Steam Service
3 to 250 psig [0.2 to 17.2 barg]
-60° to 406°F [-51° to 208°C]

Air/Gas Service
3 to 300 psig [0.2 to 20.7 barg]
-60° to 406°F [-51° to 208°C]

Models 6030, 6130, 6230
Steam and Air/Gas Service
3 to 300 psig [0.2 to 20.7 barg]
-60° to 425°F [-51° to 218°C]

1. Resilient seats determine temperature range. (see page 11)
2. Teflon® is a registered trademark of E.I. du Pont de Nemours Company.

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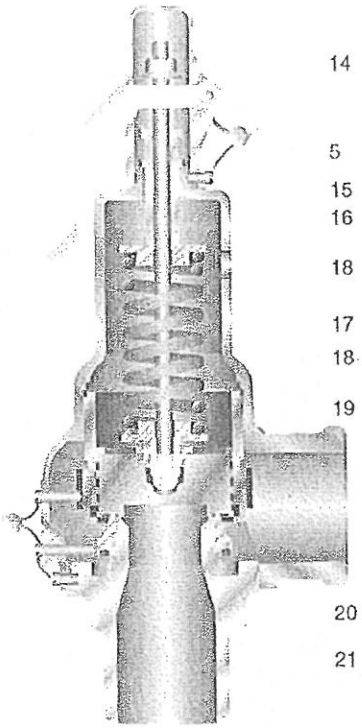
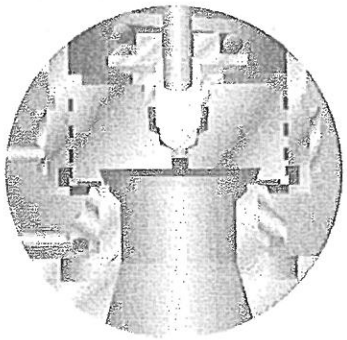
Series 6000

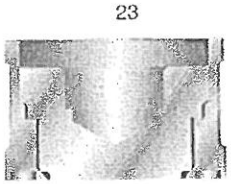
Parts and Materials



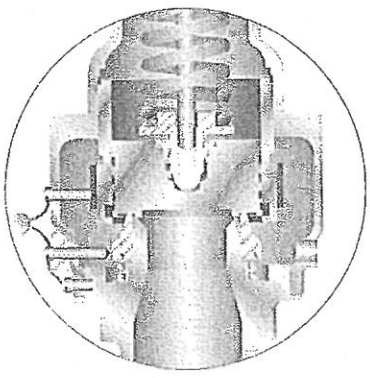
Models 6010, 6030, 6283,
6230, 6933, 6935



Models 6121, 6221, 6934
Teflon® Seat Configuration



Models 6010, 6030, 6283,
6230, 6933, 6935
Optional Soft Seat



Models 6182, 6121, 6130, 6186
Top Outlet Configuration

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Series 6000

Parts and Materials

No.	Part Name	Materials
1	Nozzle	BRS B283-C48500 for D Orifice[3] BRZ SB62 for E thru J Orifice[3]
2	Body Set Screw	SS 18-8
3	Warn Ring Set Screw	SS 18-8
4	Disc	B21 C48500[4]
5	Wire and Seal	SS Wire and Lead Seal
6	Guide Set Screw	SS 18-8
7	Retainer Nut[2]	Brass B16
8	Stem	SS, A582 TY416
9	Body	BRZ B584-C84400
10	Lever	STL A109 or JIS SPCC Equivalent/ZN Plated Yellow
11	Jam Nut	Brass B16
12	Lift Nut	STL A108-1018/ZN Plated
13	Cap	BRS B176 Alloy 230A
14	Lever Pin	STL A108-12L14
15	Cap Set Screw	SS 18-8
16	Compression Screw	BRS B16
17	Spring	ASTM A-313 TY 631
18	Spring Step	BRS B16
19	Stem Retainer	BRS B16
20	Guide	BRS B16 for D and E Orifice BRZ B584-C84400 for F thru J Orifice
21	Warn Ring	BRS B16
22	Seat	*Note 1*
23	Seat Retainer	BRS B16[5]

Notes

1. Models 6021, 6121, 6221 and 6934 Teflon®, optional O-ring seat available for all others except Models 6933 and 6935.
2. Section IV only.
3. Models 6030, 6130, 6230 and 6935 are SS SA351-CF8.
4. Models 6030, 6130, 6230 and 6935 are SS SA479-304 (D thru H Orifice) or SS SA479-316 (J Orifice).
5. Models 6030, 6130 and 6230 are SS SA479-304.

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Series 6000

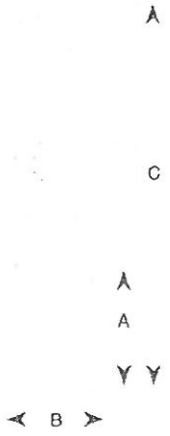
Series 6000 and Models 6933-6935 ASME Section I and VIII, Steam, ASME Section VIII, Air/Gas National Board Certified. Models 6933-6935 are ASME Section IV, 'Steam,' National Board Certified

Specifications

Model Number[1]	Orifice	Connections ANSI Standard Inlet		Outlet		Valve Dimensions in [mm] A		B		C		Approximate Weight lb	[kg]
60**DC#	D	1/2	[12.7]	3/4	[19.0]	2 1/8	[54]	1 5/8	[41]	6 1/2	[165]	1 1/2	[0.7]
60**DD#[2]	D	3/4	[19.0]	3/4	[19.0]	2 1/8	[54]	1 5/8	[41]	6 1/2	[165]	1 3/4	[0.8]
61**DC#	D	1/2	[12.7]	—		—		—		6 1/2	[165]	1 1/4	[0.6]
60**ED#	E	3/4	[19.0]	1	[25.4]	2 3/8	[60]	1 3/4	[44]	7 1/2	[191]	2 1/2	[1.1]
60**EE#[2]	E	1	[25.4]	1	[25.4]	2 1/2	[64]	1 3/4	[44]	7 5/8	[194]	2 3/4	[1.2]
61**ED#	E	3/4	[19.0]	—		—		—		7 1/2	[191]	2 1/4	[1.0]
62**ED#	E	3/4	[19.0]	1 1/4	[31.75]	2 7/8	[73]	1 3/4	[44]	7 1/2	[191]	2 3/4	[1.2]
60**FE#	F	1	[25.4]	1 1/4	[31.8]	2 5/8	[67]	2	[51]	8 1/2	[216]	3 1/2	[1.6]
60**FF#[2]	F	1 1/4	[31.8]	1 1/4	[31.8]	2 7/8	[73]	2	[51]	8 3/4	[222]	3 3/4	[1.7]
61**FE#	F	1	[25.4]	—		—		—		8 1/2	[222]	3 1/4	[1.5]
62**FE#	F	1	[25.4]	1 1/2	[38.0]	2 7/8	[73]	2	[51]	8 1/2	[222]	3 3/4	[1.7]
60**GF#	G	1 1/4	[31.8]	1 1/2	[38.0]	3 1/8	[79]	2 3/8	[60]	9 5/8	[244]	5 1/2	[2.5]
60**GG#[2]	G	1 1/2	[38.0]	1 1/2	[38.0]	3 3/8	[86]	2 3/8	[60]	10	[254]	5 3/4	[2.6]
61**GF#	G	1 1/4	[31.8]	—		—		—		9 5/8	[244]	5	[2.3]
62**GF#	G	1 1/4	[31.8]	2	[51.0]	3 3/8	[86]	2 1/4	[57]	9 5/8	[244]	5 3/4	[2.6]
60**HG#	H	1 1/2	[38.0]	2	[51.0]	3 5/8	[92]	2 3/4	[70]	10 5/8	[270]	7 3/4	[3.5]
60**HH#[2]	H	2	[51.0]	2	[51.0]	4 1/8	[105]	2 3/4	[70]	11 1/8	[283]	8	[3.6]
61**HG#	H	1 1/2	[38.0]	—		—		—		10 5/8	[270]	7 1/4	[3.3]
62**HG#	H	1 1/2	[38.0]	2 1/2	[64.0]	3 7/8	[98]	3	[76]	10 5/8	[270]	8	[3.6]
60**JH#	J	2	[51.0]	2 1/2	[64.0]	4 1/4	[108]	3 3/8	[86]	13 5/8	[346]	15 1/2	[7.0]
60**JJ#[2]	J	2 1/2	[64.0]	2 1/2	[64.0]	4 1/2	[114]	3 3/8	[86]	14	[356]	15 3/4	[7.2]
61**JH#	J	2	[51.0]	—		—		—		13 5/8	[346]	15	[6.8]
62**JH#	J	2	[51.0]	3	[76.0]	4 5/8	[117]	3 3/8	[86]	13 5/8	[345]	15 1/2	[7.0]

Notes

1. Replace asterisks with desired model number. Replace # with desired seat material.
2. Model 6030 available only 1/2 x 3/4-inch [12.7 x 19 mm], 3/4 x 1-inch [19 x 25.4 mm], 1 x 1 1/4-inch [25.4 x 31.8 mm], 1 1/4 x 1 1/2-inch [31.8 x 38 mm], 1 1/2 x 2-inch [38 x 51 mm] and 2 x 2 1/2-inch [51 x 64 mm].
3. Models 6933, 6934 and 6935 have same dimensions as Model 6010.



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Series 6000

Capacities

Note:

1. No code stamp or 'NB' on nameplate below 15 psig set.

Steam data (data ASME Section VIII Div 1 (English Set))

Set Pressure (psig)	Orifice Area, in²					
	D (0.121)	E (0.216)	F (0.338)	G (0.554)	H (0.863)	J (1.414)
3	28	50	78	127	198	325
4	32	57	89	146	228	374
6	39	70	109	178	278	456
8	45	80	125	205	319	523
10	50	89	139	228	355	582
15	64	114	178	292	454	744
20	73	131	205	336	524	858
25	83	148	232	381	593	972
30	93	166	259	425	663	1086
35	104	185	289	474	739	1211
40	114	204	319	523	815	1336
45	125	223	349	572	892	1461
50	136	242	379	621	968	1586
55	146	261	409	671	1045	1711
60	157	281	439	720	1121	1837
65	168	300	469	769	1197	1962
70	179	319	499	818	1274	2087
75	189	338	529	867	1350	2212
80	200	357	559	916	1426	2337
85	211	376	589	965	1503	2462
90	221	395	619	1014	1579	2588
95	232	414	648	1063	1656	2713
100	243	434	678	1112	1732	2838
105	254	453	708	1161	1808	2963
110	264	472	738	1210	1885	3088
115	275	491	768	1259	1961	3213
120	286	510	798	1308	2038	3339
125	296	529	828	1357	2114	3464
130	307	548	858	1406	2190	3589
135	318	567	888	1455	2267	3714
140	329	586	918	1504	2343	3839
145	339	606	948	1553	2420	3964
150	350	625	978	1602	2496	4090
160	371	663	1037	1700	2649	4340
170	393	701	1097	1798	2802	4590
180	414	739	1157	1897	2954	4841
190	436	778	1217	1995	3107	5091
200	457	816	1277	2093	3260	5341
210	478	854	1337	2191	3413	5592
220	500	892	1396	2289	3566	5842
230	521	931	1456	2387	3718	6092
240	543	969	1516	2485	3871	6343
250	564	1007	1576	2583	4024	6593
260	586	1045	1636	2681	4177	6843
270	607	1084	1696	2779	4329	7094
280	628	1122	1756	2877	4482	7344
290	650	1160	1815	2975	4635	7594
300	671	1198	1875	3074	4788	7845

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Series 6000

Capacities

Non-code and ASME Section VIII Air [Metric, bar/g]

Set Pressure [barg]	Orifice Area, cm²					
	D [0.781]	E [1.394]	F [2.180]	G [3.574]	H [5.567]	J [9.123]
0.2	45	81	126	207	322	528
0.3	55	98	154	252	393	644
0.4	63	113	177	290	452	740
0.6	77	138	215	353	549	900
1.0	104	180	281	461	718	1177
1.5	123	220	345	565	880	1443
2.0	146	261	408	669	1042	1708
2.5	171	305	477	782	1218	1996
3.0	196	350	547	896	1396	2288
3.5	221	394	616	1011	1574	2579
4.0	246	439	686	1125	1752	2871
4.5	271	483	756	1239	1930	3163
5.0	296	528	826	1353	2108	3455
5.5	321	572	895	1468	2286	3746
6.0	346	617	965	1582	2464	4038
6.5	371	662	1035	1696	2642	4330
7.0	396	706	1104	1811	2820	4622
7.5	421	751	1174	1925	2998	4913
8.0	446	795	1244	2039	3176	5205
8.5	471	840	1313	2153	3354	5497
9.0	496	884	1383	2268	3532	5788
9.5	521	929	1453	2382	3710	6080
10.0	545	974	1523	2496	3888	6372
10.5	570	1018	1592	2611	4066	6664
11.0	595	1063	1662	2725	4244	6955
11.5	620	1107	1732	2839	4422	7247
12.0	645	1152	1801	2953	4600	7539
12.5	670	1197	1871	3068	4778	7831
13.0	695	1241	1941	3182	4956	8122
13.5	720	1286	2011	3296	5134	8414
14.0	745	1330	2080	3411	5312	8706
14.5	770	1375	2150	3525	5490	8997
15.0	795	1419	2220	3639	5668	9289
16.0	845	1509	2359	3868	6024	9873
17.0	895	1598	2499	4096	6381	10456
18.0	945	1687	2638	4325	6737	11040
19.0	995	1776	2777	4553	7093	11623
20.0	1045	1865	2917	4782	7449	12207

1. No code stamp or 'NB' on nameplate below 1.0 barg set.

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Series 6000

Capacities

Note

1. No code stamp or 'NB' on nameplate below 15 psig set.

Non-code and ASME Section VIII Steam (English, lb/h)

Set Pressure (psig)	Orifice Area, in²					
	D (0.121)	E (0.216)	F (0.338)	G (0.554)	H (0.863)	J (1.414)
3	87	155	243	398	621	1017
4	100	178	279	457	711	1166
6	121	215	337	552	860	1409
8	137	245	384	629	980	1606
10	152	271	424	695	1083	1775
15	179	319	500	819	1276	2091
20	206	368	576	944	1471	2410
25	234	417	653	1070	1666	2730
30	261	466	729	1195	1861	3050
35	291	520	813	1333	2076	3401
40	321	573	897	1470	2291	3753
45	351	627	981	1608	2505	4105
50	381	681	1065	1746	2720	4456
55	411	734	1149	1884	2934	4808
60	442	788	1233	2022	3149	5160
65	472	842	1317	2159	3364	5511
70	502	896	1401	2297	3578	5863
75	532	949	1486	2435	3793	6215
80	562	1003	1570	2573	4008	6566
85	592	1057	1654	2710	4222	6918
90	622	1110	1738	2848	4437	7270
95	652	1164	1822	2986	4651	7621
100	682	1218	1906	3124	4866	7973
105	712	1272	1990	3262	5081	8325
110	742	1325	2074	3399	5295	8676
115	773	1379	2158	3537	5510	9028
120	803	1433	2242	3675	5725	9380
125	833	1487	2326	3813	5939	9731
130	863	1540	2410	3950	6154	10083
135	893	1594	2494	4088	6368	10434
140	923	1648	2578	4226	6583	10786
145	953	1701	2662	4364	6798	11138
150	983	1755	2746	4502	7012	11489
160	1043	1863	2915	4777	7442	12193
170	1104	1970	3083	5053	7871	12896
180	1164	2077	3251	5328	8300	13599
190	1224	2185	3419	5604	8729	14303
200	1284	2292	3587	5879	9159	15006
210	1344	2400	3755	6155	9588	15709
220	1404	2507	3923	6430	10017	16413
230	1465	2615	4091	6706	10446	17116
240	1525	2722	4259	6981	10876	17819
250	1585	2829	4428	7257	11305	18523
260	1645	2937	4596	7533	11734	19226
270	1705	3044	4764	7808	12163	19929
280	1766	3152	4932	8084	12592	20632
290	1826	3259	5100	8359	13022	21336
300	1886	3367	5268	8635	13451	22039

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Series 6000

Capacities

Non-code / and ASME Section VIII Steam [Metric, kg/h]

Set Pressure [barg]	Orifice Area, cm²					
	D [0.781]	E [1.394]	F [2.180]	G [3.574]	H [5.567]	J [9.123]
0.2	39	69	108	177	276	453
0.3	47	84	131	215	335	549
0.4	54	96	150	246	383	628
0.6	65	115	181	296	461	756
1.0	81	144	226	370	576	944
1.5	98	175	273	448	698	1144
2.0	116	207	324	530	826	1354
2.5	135	242	378	620	966	1582
3.0	155	277	433	711	1107	1814
3.5	175	312	489	801	1248	2045
4.0	195	348	544	892	1389	2276
4.5	215	383	599	982	1530	2508
5.0	234	419	654	1073	1671	2739
5.5	254	454	710	1164	1812	2970
6.0	274	489	765	1254	1954	3201
6.5	294	525	820	1345	2095	3433
7.0	314	560	876	1435	2236	3664
7.5	333	595	931	1526	2377	3895
8.0	353	631	986	1617	2518	4127
8.5	373	666	1041	1707	2659	4358
9.0	393	701	1097	1798	2800	4589
9.5	413	737	1152	1888	2942	4820
10.0	432	772	1207	1979	3083	5052
10.5	452	807	1262	2070	3224	5283
11.0	472	843	1318	2160	3365	5514
11.5	492	878	1373	2251	3506	5746
12.0	512	913	1428	2341	3647	5977
12.5	531	949	1483	2432	3788	6208
13.0	551	984	1539	2523	3929	6439
13.5	571	1019	1594	2613	4071	6671
14.0	591	1055	1649	2704	4212	6902
14.5	611	1090	1705	2795	4353	7133
15.0	630	1125	1760	2885	4494	7365
16.0	670	1196	1870	3066	4776	7827
17.0	710	1267	1981	3248	5059	8290
18.0	749	1337	2091	3429	5341	8752
19.0	789	1408	2202	3610	5623	9215
20.0	829	1479	2313	3791	5905	9678

Note

1. No code stamp or 'NB' on nameplate below 1.1 barg set.

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Series 6000

Capacities

ASME Certified Steam (Lbs/Hr)

Set Pressure (psig)	Orifice Area, in²					
	D (0.121)	E (0.216)	F (0.338)	G (0.554)	H (0.863)	J (1.414)
15	173	309	484	793	1236	2025
20	201	358	560	918	1431	2344
25	228	407	637	1044	1626	2664
30	255	456	713	1169	1821	2983
35	283	504	789	1294	2015	3302
40	310	553	866	1419	2210	3622
45	337	602	942	1544	2405	3941
50	365	651	1018	1669	2600	4260
55	392	700	1095	1794	2795	4580
60	419	748	1171	1919	2990	4899
65	447	797	1247	2045	3185	5219
70	474	847	1325	2172	3384	5544
75	503	897	1404	2301	3585	5873
80	531	947	1483	2430	3785	6202
85	559	998	1561	2559	3986	6531
90	587	1048	1640	2688	4187	6860
95	615	1098	1718	2817	4388	7189
100	643	1148	1797	2946	4588	7518
105	671	1199	1876	3074	4789	7847
110	700	1249	1954	3203	4990	8176
115	728	1299	2033	3332	5191	8505
120	756	1349	2112	3461	5392	8834
125	784	1400	2190	3590	5592	9163
130	812	1450	2269	3719	5793	9492
135	840	1500	2348	3848	5994	9821
140	869	1550	2426	3977	6195	10150
145	897	1601	2505	4105	6395	10479
150	925	1651	2583	4234	6596	10808
160	981	1751	2741	4492	6998	11466
170	1037	1852	2898	4750	7399	12123
180	1094	1952	3055	5008	7801	12781
190	1150	2053	3212	5265	8202	13439
200	1206	2153	3370	5523	8604	14097
210	1263	2254	3527	5781	9005	14755
220	1319	2354	3684	6039	9407	15413
230	1375	2455	3842	6297	9808	16071
240	1432	2555	3999	6554	10210	16729
250	1488	2656	4156	6812	10612	17387
260	1544	2756	4313	7070	11013	18045
270	1600	2857	4471	7328	11415	18703
280	1657	2957	4628	7585	11816	19360
290	1713	3058	4785	7843	12218	20018
300	1769	3158	4942	8101	12619	20676

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Series 6000

Capacities

ASME Section I Steam [Metric, kg/h]

Set Pressure [barg]	Orifice Area, cm²					
	D [0.781]	E [1.394]	F [2.180]	G [3.574]	H [5.567]	J [9.123]
1.5	95	170	266	436	680	1114
2.0	113	202	316	519	808	1324
2.5	131	234	367	601	936	1534
3.0	149	266	417	683	1064	1744
3.5	167	299	467	765	1192	1954
4.0	185	331	517	848	1320	2164
4.5	203	363	567	930	1449	2374
5.0	222	396	619	1014	1580	2589
5.5	240	429	670	1099	1712	2806
6.0	259	462	722	1184	1844	3022
6.5	277	495	774	1269	1976	3238
7.0	296	528	826	1353	2108	3455
7.5	314	561	877	1438	2240	3671
8.0	333	594	929	1523	2372	3887
8.5	351	627	981	1608	2504	4104
9.0	370	660	1032	1692	2636	4320
9.5	388	693	1084	1777	2768	4537
10.0	407	726	1136	1862	2900	4753
10.5	425	759	1187	1947	3032	4969
11.0	444	792	1239	2031	3164	5186
11.5	462	825	1291	2116	3296	5402
12.0	481	858	1343	2201	3428	5618
12.5	499	892	1394	2286	3560	5835
13.0	518	925	1446	2371	3692	6051
13.5	537	958	1498	2455	3824	6267
14.0	555	991	1549	2540	3957	6484
14.5	574	1024	1601	2625	4089	6700
15.0	592	1057	1653	2710	4221	6917
15.5	611	1090	1704	2794	4353	7133
17.0	629	1123	1756	2879	4485	7349
17.0	666	1189	1860	3049	4749	7782
18.0	703	1255	1963	3218	5013	8215
19.0	740	1321	2066	3388	5277	8647
20.0	777	1387	2170	3557	5541	9080

Models 6933-6935 ASME Section IV, Low Pressure Steam, 'HV' National Board Certified

Steam Relieving Capacities - Models 6933, 6934 and 6935

Steam Capacity, lb/h [kg/h]

Set Pressure (psig) [barg]	Orifice, Area in² [cm²]					
	D 0.121 [0.781]	E 0.216 [1.394]	F 0.338 [2.180]	G 0.554 [3.574]	H 0.863 [5.567]	J 1.414 [9.123]
15 [1.0]	190 [86]	338 [153]	530 [240]	868 [394]	1352 [613]	2215 [1005]

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Series 6000

Specifications

Service Recommendations for Resilient Seat/Seal Materials

Seat/Seal Materials	Service Recommendation
Viton® A (-10 to 406°F) [-23 to 208°C]	Air and Gas
Ethylene Propylene (-70 to 400°F) [-57 to 205°C]	Steam

ASME Section I and VIII, Steam, ASME Section VIII, Air/Gas National Board Certified. Models 6930, 6933, 6935 ASME Section IV, National Board Certified

Model Number/Order Guide

Model Number Position	1	2	3	4	5	6	7	7	8	9	10	11	12	13	14	15
Example	6	0	1	0	H	G	M	0	1	—	A	M	0	1	5	0

Model

6010	6130	6230
6021	6186	6933
6030	6283	6934
6182	6221	6935
6121		

Orifice

D	G
E	H
F	J

Inlet Size

C - ½-inch [12.7]	G - 1½-inch [38.1]
D - ¾-inch [19.0]	H - 2-inch [50.8]
E - 1-inch [25.4]	J - 2½-inch [63.5]
F - 1¼-inch [31.8]	

Seat Material

M - Metal
E - EPR
V - Viton®

Variation (01 through 99)

01 - Plain lever
02 - Plain lever with vibration dampener
03 - Plain lever with gag
60 - BSP Threads

Design Revision

Indicates non-interchangeable revision. Dash (-) if original design.

Valve Service

A - Steam ASME Section I
K - Air/Gas ASME Section VIII
L - Steam ASME Section VIII
G - Steam ASME Section IV (Models 6933, 6934, 6935 only)
P - Steam, Non-code
N - Air, Non-code

Spring Material

M - SS

Set Pressure

0015 - 15 psig [1.0 barg] only for Models 6933, 6934, 6935

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Facility Phone: 828-669-3700

Tyco Valves & Controls

www.kunklevalve.com

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Industrial Thermocouples
Protection Head Design

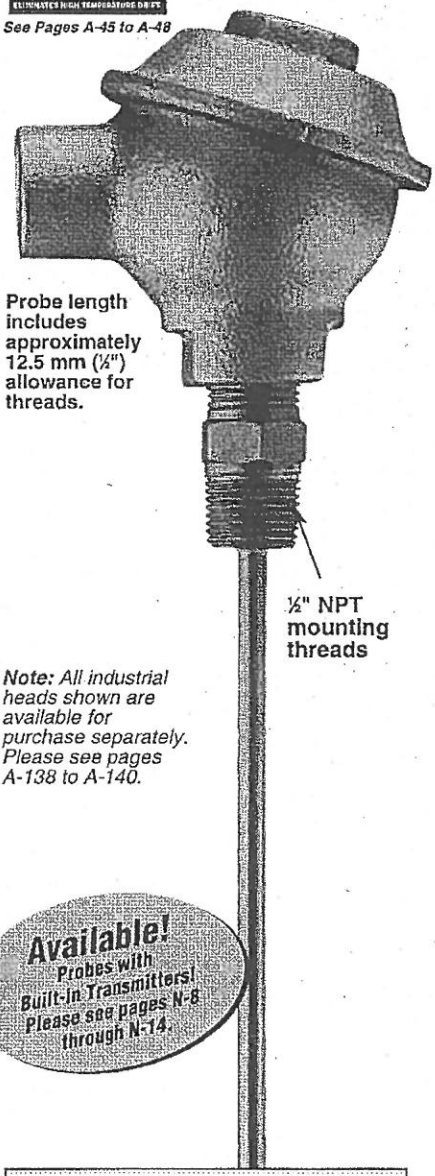
MADE IN USA | MEETS OR EXCEEDS SPECIAL LIMITS OF ERROR (SLE) AND EN 60584-2: Tolerance Class 1 | ANSI color code shown | To order IEC color code see omega.com

- Sheath Materials: 304SS, 310SS, 316SS, 321SS, Inconel or Super OMEGACLAD® XL
- Probe Length 300 mm (12"), 600 mm (24") Custom Lengths Available, Consult Sales

Available as

SUPER OMEGACLAD® XL THERMOCOUPLE WIRE

See Pages A-45 to A-48



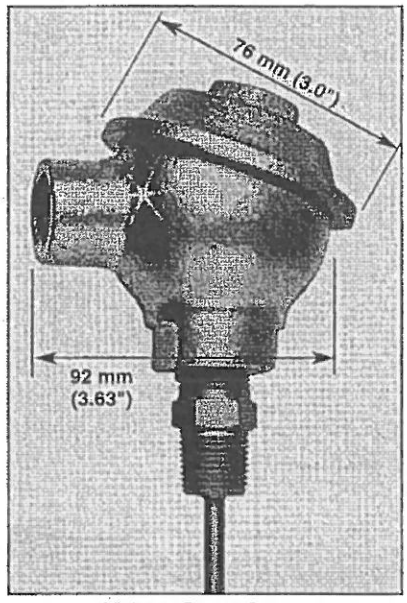
Probe length includes approximately 12.5 mm (½") allowance for threads.

½" NPT mounting threads

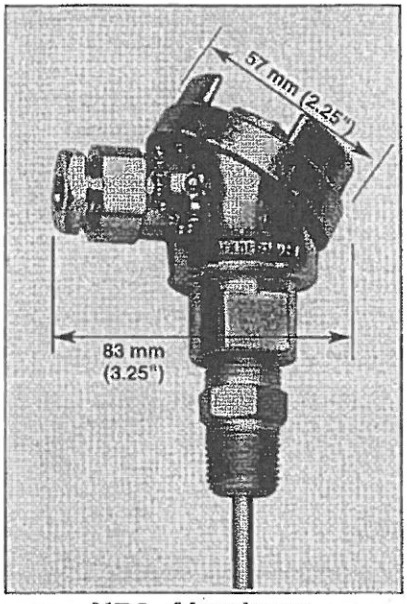
Note: All industrial heads shown are available for purchase separately. Please see pages A-138 to A-140.

Available! Probes with Built-in Transmitters! Please see pages N-8 through N-14.

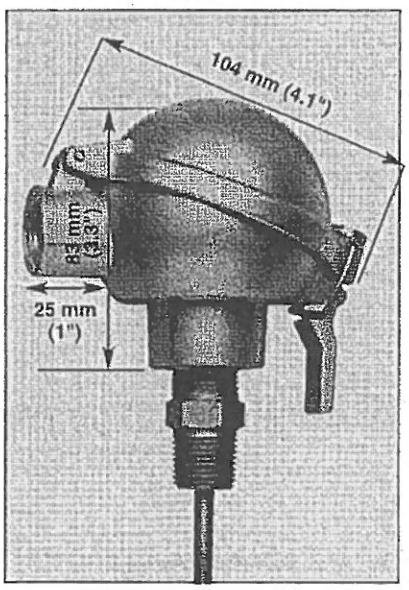
Complete your application with OMEGA's extension wire. Please see page H-37.



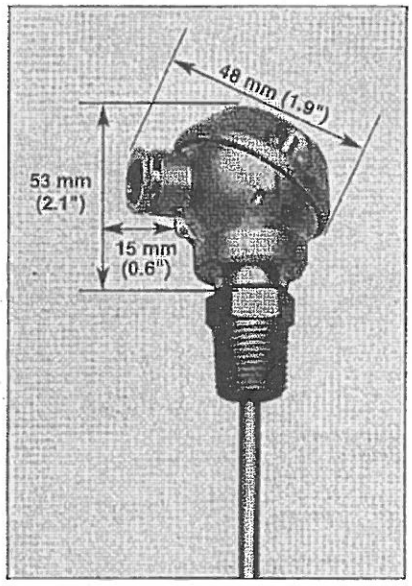
NB1, Cast Iron



NB2, Aluminum



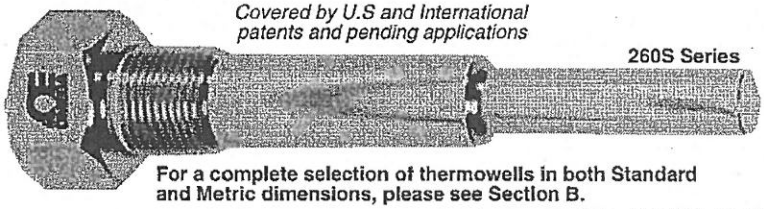
NB3, Aluminum with Snap-Lock



NB4, Sub-Miniature Aluminum

PATENTED

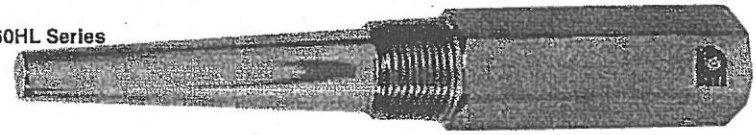
Covered by U.S and International patents and pending applications



260S Series

For a complete selection of thermowells in both Standard and Metric dimensions, please see Section B.

260HL Series



- NB1 Cast-Iron Protection Head with Internal Terminal Block
- NB2 Miniature Aluminum Head with Internal Terminal Block
- NB3 Aluminum Head Features Convenient Snap-Lock Design with Internal Terminal Block
- NB4 Subminiature Aluminum Head with Internal Terminal Block
- ½ NPT Mounting Thread
- 12" Length Standard†

Discount Schedule	
1 to 10	Net
11 to 24	10%
25 to 49	20%
55 and over	Consult Sales

Standard Dimensions

The industrial-style assemblies offer a variety of protection heads to meet the environmental and size requirements of most applications. They are available in J, K T, E, or N calibrations, with 304 SS, 310 SS, 316 SS, 321 SS, Super OMEGACLAD® XL, or Inconel® sheathing. Standard lengths are 12", including ½" for the pipe thread, with other lengths available. Both the thread on the probe and the extension-wire opening are ⅛ NPT. The NB2 and NB4 include a compression fitting nut and rubber ferrule for ⅛ to ¼" OD wires or tubing. The internal terminal block is standard on all models. Consult Technical Quotation Department for price and delivery on a wide variety of non-metallic and other specialized heads.

ANSI color code shown | To order IEC color code see omega.com

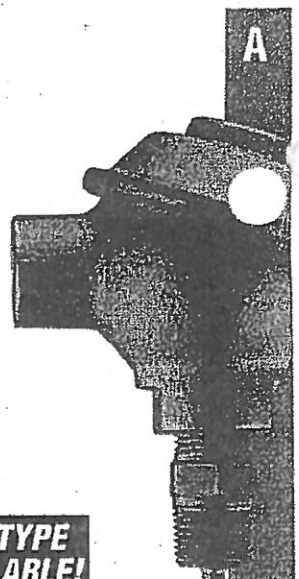
Available as SUPER OMEGACLAD® XL THERMOCOUPLE WIRE

See Pages A-45 to A-48

OMEGACLAD® Factory Drill AVAILABLE | MADE IN USA

MEETS OR EXCEEDS SPECIAL LIMITS OF ERROR (SLE) and EN 60584-2: Tolerance Class 1

OMEGALLOY® TYPE "N" NOW AVAILABLE!
Consult Factory for Pricing and Delivery



ALL MODELS AVAILABLE FOR FAST DELIVERY!

To Order 12" Lengths (Specify Model Number)

Alloy/ANSI Color Code	Sheath Dia. Inch	Grounded Junction	Ungrounded Junction	Exposed Junction
Iron-Constantan Inconel® Sheath J	1/16	NB(*)-ICIN-116G-12	NB(*)-ICIN-116U-12	NB(*)-ICIN-116E-12
	⅛	NB(*)-ICIN-18G-12	NB(*)-ICIN-18U-12	NB(*)-ICIN-18E-12
	3/16	NB(*)-ICIN-316G-12	NB(*)-ICIN-316U-12	NB(*)-ICIN-316E-12
	¼	NB(*)-ICIN-14G-12	NB(*)-ICIN-14U-12	NB(*)-ICIN-14E-12
Iron-Constantan 304 SS Sheath J	1/16	NB(*)-ICSS-116G-12	NB(*)-ICSS-116U-12	NB(*)-ICSS-116E-12
	⅛	NB(*)-ICSS-18G-12	NB(*)-ICSS-18U-12	NB(*)-ICSS-18E-12
	3/16	NB(*)-ICSS-316G-12	NB(*)-ICSS-316U-12	NB(*)-ICSS-316E-12
	¼	NB(*)-ICSS-14G-12	NB(*)-ICSS-14U-12	NB(*)-ICSS-14E-12
CHROMEGA®- ** ALOMEGA® Inconel® Sheath K	1/16	NB(*)-CAIN-116G-12	NB(*)-CAIN-116U-12	NB(*)-CAIN-116E-12
	⅛	NB(*)-CAIN-18G-12	NB(*)-CAIN-18U-12	NB(*)-CAIN-18E-12
	3/16	NB(*)-CAIN-316G-12	NB(*)-CAIN-316U-12	NB(*)-CAIN-316E-12
	¼	NB(*)-CAIN-14G-12	NB(*)-CAIN-14U-12	NB(*)-CAIN-14E-12
CHROMEGA®- ** ALOMEGA® 304 SS Sheath K	1/16	NB(*)-CASS-116G-12	NB(*)-CASS-116U-12	NB(*)-CASS-116E-12
	⅛	NB(*)-CASS-18G-12	NB(*)-CASS-18U-12	NB(*)-CASS-18E-12
	3/16	NB(*)-CASS-316G-12	NB(*)-CASS-316U-12	NB(*)-CASS-316E-12
	¼	NB(*)-CASS-14G-12	NB(*)-CASS-14U-12	NB(*)-CASS-14E-12
CHROMEGA®- Constantan Inconel® Sheath E	1/16	NB(*)-CXIN-116G-12	NB(*)-CXIN-116U-12	NB(*)-CXIN-116E-12
	⅛	NB(*)-CXIN-18G-12	NB(*)-CXIN-18U-12	NB(*)-CXIN-18E-12
	3/16	NB(*)-CXIN-316G-12	NB(*)-CXIN-316U-12	NB(*)-CXIN-316E-12
	¼	NB(*)-CXIN-14G-12	NB(*)-CXIN-14U-12	NB(*)-CXIN-14E-12
CHROMEGA®- Constantan 304 SS Sheath E	1/16	NB(*)-CXSS-116G-12	NB(*)-CXSS-116U-12	NB(*)-CXSS-116E-12
	⅛	NB(*)-CXSS-18G-12	NB(*)-CXSS-18U-12	NB(*)-CXSS-18E-12
	3/16	NB(*)-CXSS-316G-12	NB(*)-CXSS-316U-12	NB(*)-CXSS-316E-12
	¼	NB(*)-CXSS-14G-12	NB(*)-CXSS-14U-12	NB(*)-CXSS-14E-12
Copper-Constantan Inconel® Sheath T	1/16	NB(*)-CPIN-116G-12	NB(*)-CPIN-116U-12	NB(*)-CPIN-116E-12
	⅛	NB(*)-CPIN-18G-12	NB(*)-CPIN-18U-12	NB(*)-CPIN-18E-12
	3/16	NB(*)-CPIN-316G-12	NB(*)-CPIN-316U-12	NB(*)-CPIN-316E-12
	¼	NB(*)-CPIN-14G-12	NB(*)-CPIN-14U-12	NB(*)-CPIN-14E-12
Copper-Constantan 304 SS Sheath T	1/16	NB(*)-CPSS-116G-12	NB(*)-CPSS-116U-12	NB(*)-CPSS-116E-12
	⅛	NB(*)-CPSS-18G-12	NB(*)-CPSS-18U-12	NB(*)-CPSS-18E-12
	3/16	NB(*)-CPSS-316G-12	NB(*)-CPSS-316U-12	NB(*)-CPSS-316E-12
	¼	NB(*)-CPSS-14G-12	NB(*)-CPSS-14U-12	NB(*)-CPSS-14E-12

Note: PFA coating is available, 400°F (204°C) Max. †Other lengths available, consult Sales Department.
**Insert the number "1" through "12" for NB1, NB2, NB3, NB4, NB5, NB6, NB7, NB8, NB9, NB10, NB11 or NB12 heads, respectively.*
***For highest temperature and stability rating, change "SS" or "IN" to "XL" and add $3 to price.*
To order probes with lengths other than 12", change the last 2 digits of the model number from "12" to the desired length in inches, and add the appropriate price per additional foot from the last column.
To order with 310, 316 or 321 SS sheath, change "SS" in model number to "310SS", "316SS" or "321SS", respectively, no additional charge. Consult Sales for lengths between 2 and 12", or for lengths over 24".

***Ordering Examples:** NB1-CASS-14G-12, a 12" grounded 304 SS probe, Type K, ¼" sheath diameter, $47.*
NB2-ICSS-14U-12, a 12" ungrounded 304 SS, Type J, ¼" sheath diameter, $49.

54 Series Pressure Switches

Types
Enclosed: J54, J54A, H54
Skeleton: J54S, J54AS, H54S

UNITED ELECTRIC CONTROLS

Installation and Maintenance Instructions

Please read all instructional literature carefully and thoroughly before starting. Refer to the final page for the listing of Recommended Practices, Liabilities and Warranties.

GENERAL

BEFORE INSTALLING, CHECK THE SENSOR MODEL SELECTED FOR COMPATIBILITY BETWEEN THE PROCESS MEDIA AND THE SENSOR AND WETTED PARTS.

As the pressure changes, a diaphragm, bellows or piston sensor actuates one or two snap acting switches. The 54 Series offers two types of adjustments: internal hex screw adjustment on "J" types or a reference adjustment dial on "H" types.

PROOF PRESSURE* LIMITS STATED IN THE LITERATURE AND ON NAMEPLATES MUST NEVER BE EXCEEDED, EVEN BY SURGES IN THE SYSTEM. OCCASIONAL OPERATION OF UNIT UP TO PROOF PRESSURE IS ACCEPTABLE (E.G., START-UP, TESTING). CONTINUOUS OPERATION SHOULD NOT EXCEED THE DESIGNATED OVER RANGE PRESSURE.

*PROOF PRESSURE
THE MAXIMUM PRESSURE TO WHICH A PRESSURE SENSOR MAY BE OCCASIONALLY SUBJECTED, WHICH CAUSES NO PERMANENT DAMAGE (E.G., START-UP, TESTING). THE UNIT MAY REQUIRE RE-GAPPING.

THESE PRODUCTS DO NOT HAVE ANY FIELD REPLACEABLE PARTS.

Part I - Installation

Tools Needed
Adjustable Wrench
Screwdriver
Hammer (for alternate wire knockouts)

MOUNTING

LOCATE SWITCH WHERE VIBRATION, SHOCK, AND AMBIENT TEMPERATURE FLUCTUATIONS ARE MINIMAL. TO AVOID DAMAGE TO SWITCH, ALWAYS HOLD THE WRENCH ON THE WRENCH FLATS OR HEX PORTION OF THE PRESSURE CONNECTION WHEN TIGHTENING.

The switch can be mounted in any position.

Enclosed Versions J54, J54A, and H54

Remove cover first by removing the one captive screw located on the front of the cover.

Pipe Mounting
Mount the switch directly to the line via the NPT pressure connection.

Vertical Surface Mount
Two holes for #10 screws are provided in the bracket plate.

Conduit Connection
A 7/8" diameter hole has been provided in the bracket plate for mounting a conduit fitting.

Skeleton Versions J54S, J54AS H54S

Pipe Mounting
Mount the switch directly to the line via the NPT pressure connection.

Vertical Surface Mount
Two openings for #6 screws are provided in the rear of the bracket plate. (See Figure 1).

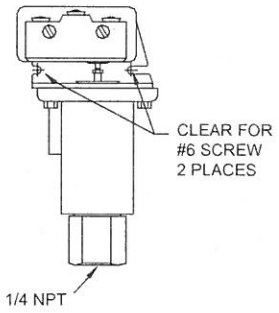


Figure 1

WIRING

DISCONNECT ALL SUPPLY CIRCUITS BEFORE WIRING UNIT. WIRE UNITS ACCORDING TO NATIONAL AND LOCAL ELECTRICAL CODES. MAXIMUM RECOMMENDED WIRE SIZE IS 14 AWG. THE RECOMMENDED TIGHTENING TORQUE FOR FIELD WIRING TERMINALS IS 7 TO 17 IN-LBS.

Bring wires up to the terminals from the rear, so that wires lay along insulator.

ELECTRICAL RATINGS STATED IN LITERATURE AND ON NAMEPLATES MUST NEVER BE EXCEEDED - OVERLOAD ON A SWITCH CAN CAUSE FAILURE ON THE FIRST CYCLE.

Part II - Adjustments

Tools Needed
1/4" open end wrench
Flatblade screwdriver

Uncalibrated Single Switch Versions J54, J54S

Mount switch onto a calibrated pressure source (vacuum source for model 22). Secure fitting to source tight enough to prevent leaks. Use pipe sealant or Teflon® tape to ensure tight seal. Apply tightening torque to the fitting only.

USING THE SENSOR HOUSING OR BRACKET TO TIGHTEN THE FITTING TO THE SOURCE WILL RESULT IN DAMAGE TO THE SWITCH.

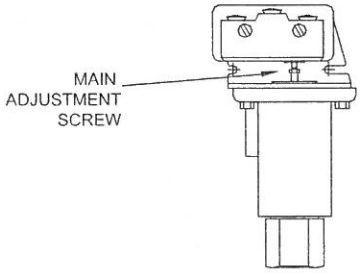


Figure 2

Using a 1/4" open end wrench, turn main adjustment screw counterclockwise (out of sensor plunger) to lower set point or clockwise (into sensor plunger) to raise set point. (See Figure 2).

ALWAYS RECHECK SET POINTS AFTER ANY ADJUSTMENTS ARE MADE.

Calibrating Single Switch Versions H54, H54S

Turn the reference dial to desired set point by aligning setting on dial with dowel pin. (See Figure 3).

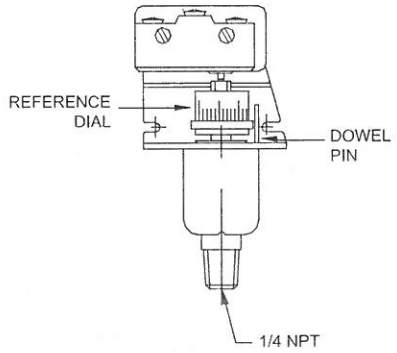


Figure 3

Calibrating All Dual Switch Versions J54A, J54AS

Mount switch via an NPT pressure connection onto a calibrated pressure source (vacuum source for model 22). Secure fitting to source tight enough to prevent leaks. Use pipe sealant or Teflon® tape to ensure tight seal. Apply tightening torque to the fitting only.

USING THE SENSOR HOUSING OR BRACKET TO TIGHTEN THE FITTING TO THE SOURCE WILL RESULT IN DAMAGE TO THE SWITCH.

High Set of Range

Using a 1/4" open end wrench, turn main adjustment screw counterclockwise (out of sensor plunger) to lower set point or clockwise (into sensor plunger) to raise set point. Turning the 1/4" hex screw clockwise until "high set" switch transfers at the target pressure point provides a pressure rise set point. (See Figure 4).

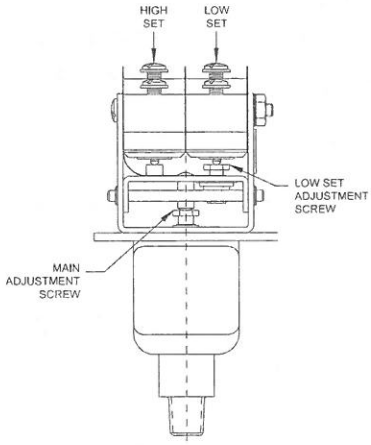


Figure 4

Low Set of Range

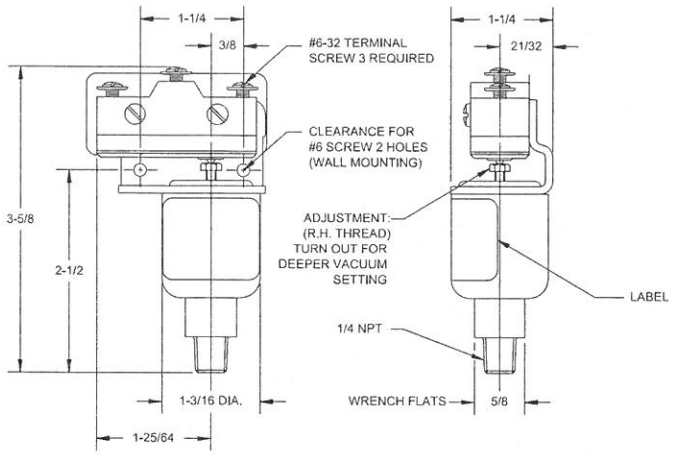
Using a 1/4" open end wrench, turn "low set" adjustment screw counterclockwise (out of sensor plunger) to lower set point or clockwise (into sensor plunger) to raise set point. Turn screw until both "high set" and "low set" switches transfer together on or near the target pressure on rise. Turn the "low set" switch adjustment screw clockwise (into sensor plunger) until the "low set" switch transfers at the desired pressure on fall (unless required otherwise). Raise the pressure source to the "high set" pressure value to check the set point pressure. Adjust the 1/4" hex screw accordingly if further fine adjustments are needed. Lower pressure to check the set point of the "low set". Fine adjust if necessary. (See Figure 4).

Manual Reset, Option 1530

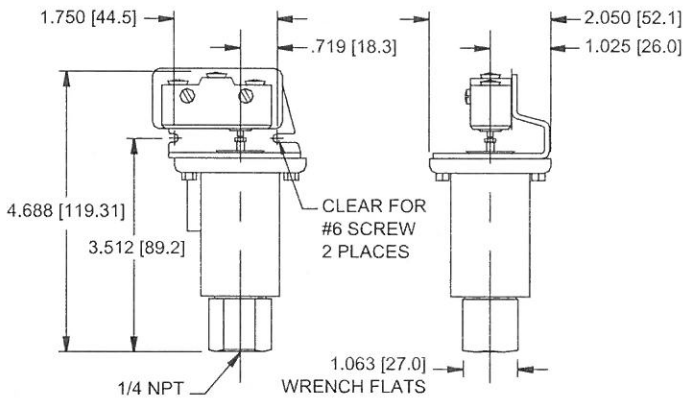
A snap-acting switch with this option will remain tripped until pressure changes (falls) and the reset button is manually depressed, which resets the switch.

Teflon® is a registered trademark of E. I. Dupont.

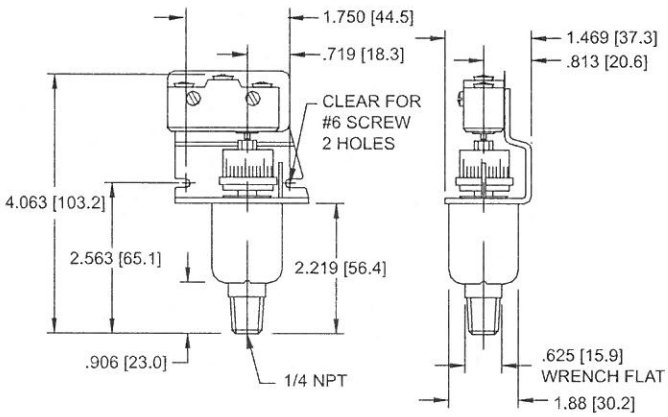
Dimensions



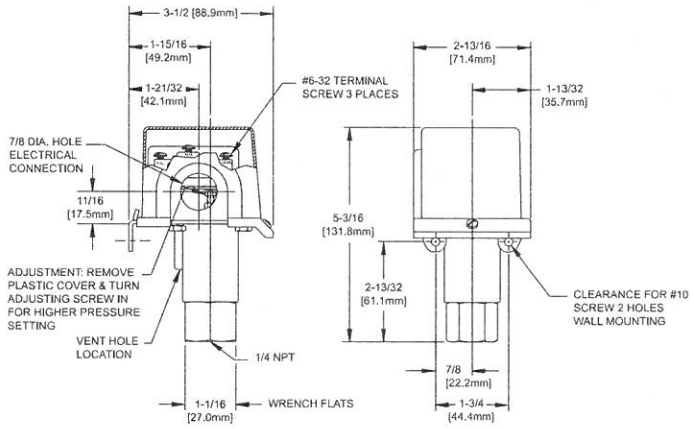
Type J54S models 22-28



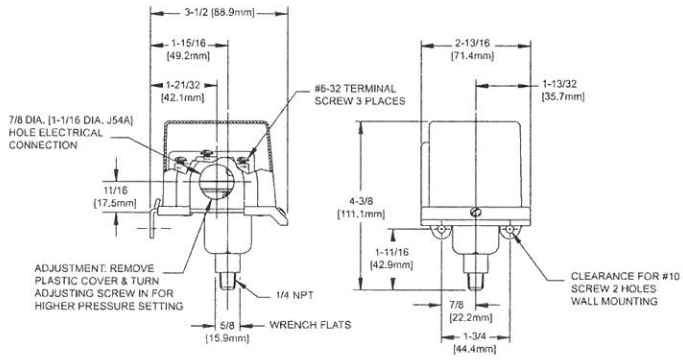
Type J54S models 610-614



Type H54S models 22-28



Type J54 models 610-614



Type H54, J54 & J54A models 22-28

RECOMMENDED PRACTICES AND WARNINGS

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the Installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and maximum temperature limits stated in literature and on nameplates must never be exceeded, even by surges in the system. Operation of the unit up to maximum pressure or temperature is acceptable on a limited basis (e.g., start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at maximum pressure or temperature limits could reduce sensor life.
- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where a dangerous runaway condition could result.
- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point cannot result in an unsafe system condition.
- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. When applicable, orient unit so that moisture does not enter the enclosure via the electrical connection. When appropriate, this entry point should be sealed to prevent moisture entry.
- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.
- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point or faulty display. Check unit immediately.
- Preventative maintenance and periodic testing is necessary for critical applications where damage could endanger property or personnel.
- Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, even on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.
- Do not mount unit in ambient temp. exceeding published limits.

LIMITED WARRANTY

Seller warrants that the product hereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by Seller (Ex-works, Factory, Watertown, Massachusetts. INCOTERMS); provided, however, that this warranty applies only to equipment found to be so defective within a period of 24 months from the date of manufacture by the Seller. Seller shall not be obligated under this warranty for alleged defects which examination discloses are due to tampering, misuse, neglect, improper storage, and in any case where products are disassembled by anyone other than authorized Seller's representatives. EXCEPT FOR THE LIMITED WARRANTY OF REPAIR AND REPLACEMENT STATED ABOVE, SELLER DISCLAIMS ALL WARRANTIES WHATSOEVER WITH RESPECT TO THE PRODUCT, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF SELLER'S LIABILITY

Seller's liability to Buyer for any loss or claim, including liability incurred in connection with (i) breach of any warranty whatsoever, expressed or implied, (ii) a breach of contract, (iii) a negligent act or acts (or negligent failure to act) committed by Seller, or (iv) an act for which strict liability will be inputted to seller, is limited to the "limited warranty" of repair and/or replacement as so stated in our warranty of product. In no event shall the Seller be liable for any special, indirect, consequential or other damages of a like general nature, including, without limitation, loss of profits or production, or loss or expenses of any nature incurred by the buyer or any third party.

UE specifications subject to change without notice.

UNITED ELECTRIC CONTROLS

180 Dexter Avenue, P.O. Box 9143
Watertown, MA 02471-9143 USA
Telephone: 617 926-1000 Fax: 617 926-2568
http://www.ueonline.com

APPLICATIONS

- HVAC
- GAS CHROMATOGRAPHY
- PAINT SPRAYING SYSTEMS
- ELECTRONIC PRESSURE SWITCHES
- MEDICAL DIAGNOSTICS
- HEAT PUMPS
- HYDRAULIC CONTROLS
- IRRIGATION SYSTEMS
- AUTOMOTIVE

MODEL MM • *MEDIAMATE PRESSURE TRANSDUCER*

The MEDIAMATE® pressure transducer provides you with the corrosion resistance of stainless steel at low OEM pricing. It is fully compensated and completely interchangeable without further calibration.

The MEDIAMATE's wetted parts and outer case are made from 300 series stainless steel. It is now being used with a wide variety of corrosive media such as Freon®, ammonia, water, and hydraulic fluids. Its rugged construction and proven reliability make it truly cost effective.

FEATURES

- Low cost
- Rugged, compact configuration
- PC mountable
- Threaded port

BENEFITS

- For use by the OEM
- Easy to package
- Mounting flexibility
- No adapter required

HOW TO ORDER

MM 100 P G 1 Q A

Model — MM

Range — PSI

015	100	01K
025	200	02K
050	500	05K
		07K

Unit — P = PSI

Pressure Port — 1 = 1/8-27 NPT; 3 = 3/8 UNF; 10 = G-1/8 BSP

Reference — G = Guage (PSIG)

Termination — H = Hirshmann (includes mate); Q = Hollingsworth

Output — A = 0-50 mV

Note: Not all combinations are available. Minimum quantity orders apply. Contact the factory for more details.

BOOT INSTALLATION

A special elastomeric boot is available to protect the electrical connections and transducer from the effects of moisture. It has four holes for inserting four leads. To install the boot, insert untrimmed leads through holes in boot. Run leads approximately 6 in. (15 cm) beyond boot. Strip leads, wire leads to connector (or solder directly to appropriate pin), and insert connector onto pins. While holding the leads behind the boot with one hand, slide the boot toward the transducer with the other hand until it bottoms on the Mediamate. Here are some important points about using the boot:

1. Although the boot has been tested to withstand submersion, it is not recommended for underwater use.

2. Using a boot effectively puts a sealed pressure chamber behind the Mediamate's pressure sensitive diaphragm. Mediamate models 0-100 psig or lower may have noticeable zero shifts with the boot if there are wide fluctuations of ambient temperature and/or barometric pressure.

   These shifts amount to 2 to 3 psi/100° F (47° C). If this presents a problem, pierce the boot so that its internal pressure and ambient pressure will equalize. Models of 0-200 psig or greater will show negligible zero shifts when used with the boot.

3. When Mediamate is used to measure pressure of a cold liquid or gas in a very humid environment, condensation may occur inside the transducer, even with a boot. This may damage the transducer.

PRECAUTIONS

The case and plastic connector of the Mediamate should never be used to apply torque to make or break the pressure connection. Always use a wrench on the hex directly behind the threaded port.

Do not subject the transducer to high temperature from soldering, brazing, or welding of the system plumbing. When using without the boot, avoid moisture traps by mounting the Mediamate with electrical connections pointing downward or sideways.

Guard against subjecting the Mediamate to temperatures above its specified maximum.

Avoid incorrect excitation. Connecting excitation voltage across a single gage (+ supply/+ signal, – supply/– signal) will cause damage.

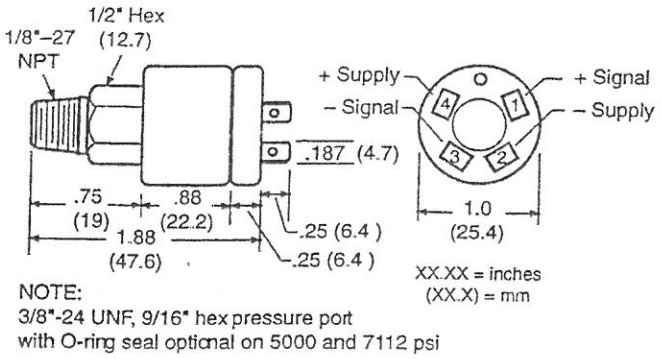
PRESSURE OVERLOADS

If the overload rating is exceeded, electrical failure may occur. Pressure fluctuations exist in most systems. An oscilloscope is a convenient tool for determining if high pressure transients or spikes exist. The transducer rating should be high enough to prevent overload at the peak pressure. Otherwise a snubber can be used to reduce the peak pressure applied to the transducer. The life of the Mediamate may be reduced if it is repeatedly overloaded. Snubbers may be obtained from the Mott Metallurgical Corporation, Farmington, CT (203) 677-7311. Catalog #4100-1/8-SS is recommended.

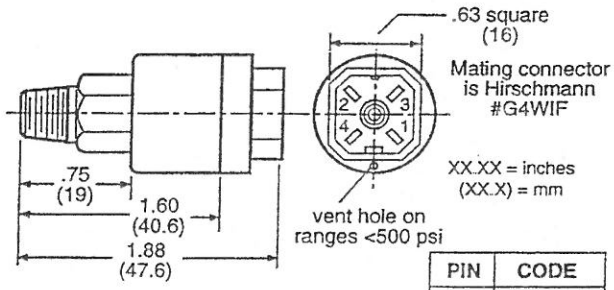
MAINTENANCE

No maintenance is required with these transducers.

DIMENSIONS

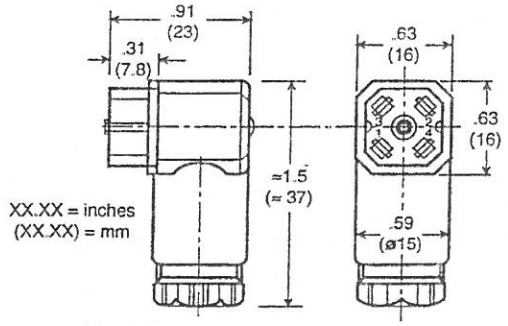


Mediamate



PIN	CODE
1	+ signal
2	– supply
3	– signal
4	+ supply

Mediamate with Hirschmann connector



Matching Hirschmann connector #G4WIF.
Included with psi or special units only.

WARRANTY

All Data Instruments products are warranted against defective materials and workmanship for a period of one year from the date of delivery to the original purchaser. Any product that is found within the one year period not to meet these standards will be replaced or repaired at the discretion of Data Instruments. No other warranty is expressed or implied. Data Instruments accepts no responsibility for misuse, misapplication or unauthorized modification of its products. Data Instruments accepts no liability for damages, including, any anticipated or lost profits, incidental damages, consequential damages, costs, time charges or other losses incurred in connection with the purchase, installation, repair or operation of our products, or any part thereof.

Specifications subject to change without notice.

Data Instruments' products are protected by one or more of the following patents: U.S. 4,203,074; 4,327,350; 4,368,575; 4,667,158; 5,068,607; 5,115,193; 5,174,014; 5,317,923; 5,410,908; European 0338966; 0,468,098; U.K. 2054954B; 1,482,494; Japan 1498268. France 2461939; 8101087; Germany DE3026785C2. Additional U.S. and foreign patents pending

Accessory Installation

Protective boot
For use with flush, extended and double head pushbutton operators only. To fit, discard pushbutton sealing washer, then pull the rim of the boot skirt over the bezel and flange of the operator and secure operator to panel.

Padlock cover
Fit padlockable cover to operator then fit additional panel seal (supplied) to operator between padlockable cover and panel.

Mechanical push
For use with pushbutton and mushroom operators (except twist to release and key release). To install, cut to desired length and insert into the back of operator.

Operator plug
Used for operating the center block on pushbutton and mushroom operators (except twist to release, key release, and push-push types). To assemble, push plug into the back of the operator. On mushroom operators cut down the plug to 15.2mm (0.62") prior to assembly. Plug is notched to indicate cut down length.

Hole plug
These plugs seal unused 22.5mm openings and include a panel sealing washer to provide Enclosure Ratings 1, 2, 3, 3R, 4, 4X, 12, and 13.

Panel Spacing Mounting Dimensions

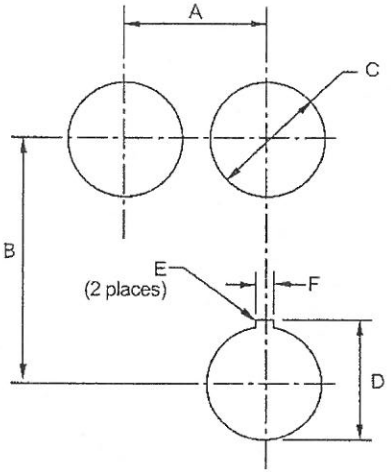
Minimum spacings:	mm (inches)	
Size/type of operator	A	B
All types except those listed below	30 (1.18)	50 (1.97)
Lever selector switches and 40mm dia. operators	45 (1.77)	50 (1.97)
50mm dia. operators	55 (2.16)	55 (2.16)
Operators fitted with 70mm dia. legend plate	75 (2.95)	75 (2.95)
Operators fitted with rubber boots or padlockable covers	35 (1.38)	50 (1.97)
Double head pushbutton	30 (1.18)	60 (2.36)
Double head pushbutton with boot	35 (1.38)	60 (2.36)

Panel Mounting and Drilling Dimensions

Panel thickness
Maximum 6.35mm (0.25"). Minimum 1mm (0.04"). For each accessory used subtract accessory thickness from 6.35mm (0.25").

	mm (inches)
Size/type of accessory	Thickness
Legend plate	1.25 (0.05)
Anti-rotation ring	1.5 (0.06)
70mm legend plate	1 (0.04)
Padlockable cover	2.4 (0.09)
Rubber boot	1.3 (0.05)

Panel Spacing and Drilling



Panel Drilling

mm (inches)

Dimensions		Tolerances
C	22.5 (0.89)	+0.4/-0 (0.016/-0)
D	24.3 (0.96)	+0.4/-0 (0.016/-0)
E	R0.8 (R0.03)	≈
F	3.2 (0.125)	+0.2/-0 (0.008/-0)

For additional information, refer to www.cutler-hammer.com

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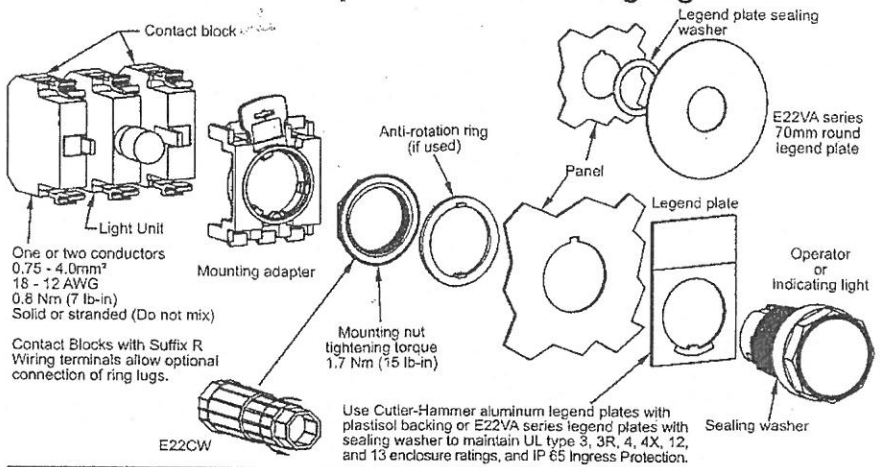
November, 2003

The installation and use of Cutler-Hammer products should be in accordance with the provisions of the U.S. National Electrical Code and/or other local codes or industry standards that are pertinent to the particular end use. Installation or use not in accordance with these codes and standards could be hazardous to personnel and/or equipment.

E22 Plastic Operators & Indicating Lights



UL LISTED IND CONT EQ A161 E 131568
CSA LR 68551

UL Listed for use on a flat surface of type 1, 2, 3, 3R, 4, 4X, 12 and 13 enclosures.

NEMA Enclosure Types: 1, 2, 3, 3R, 4, 4X, 12, 13

Double Head Pushbutton:
without boot - NEMA Type 1
with boot - as listed above

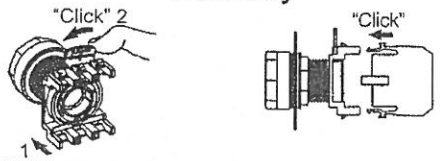
Contact Rating Codes: A600 / Q600
E22BR1 Only: A600 / Q300

IEC 60947-5-1 / EN 60947-5-1
AC 15, DC 13, Pollution Degree 3
Ui = 690 V Uimp = 4KV
Short Circuit Coordination

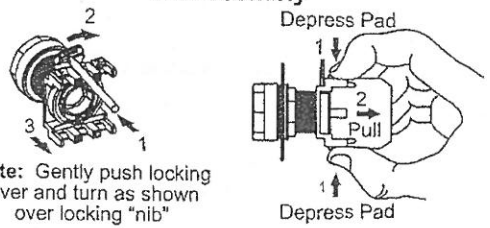
Fuse
GE Power Controls TIA 10
Red Spot Type gG, 10A, 660 VAC
460 VDC, BS88-2, IEC 60269-2-1

Ingress Protection (IEC 60529): IP 65
Double head pushbutton without boot: IP 40
Double head pushbutton with boot: IP 65
Degree of protection against electrical contact (IEC 60529) - IP 2X Fingerproof protection.
Zb (Opposite Polarity)

Assembly



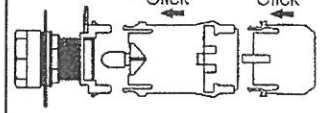
Disassembly



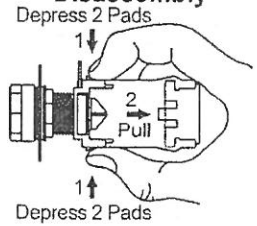
Note: Gently push locking lever and turn as shown over locking "nib"

Transformer Units

Assembly



Disassembly



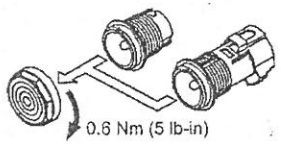
Note: Do not use E22B4/E22B4R/E22BF4 Contact Blocks with Push-Push Operators.

⚠ WARNING	⚠ AVERTISSEMENT
RISK OF ELECTRIC SHOCK Turn power off before wiring and bulb replacement.	RISQUE DE CHOC ELECTRIQUE Couper l'alimentation électrique avant de câbler ou de remplacer une ampoule.

Note: For ease in wiring **two-circuit contact blocks**, wire front terminals (terminals closest to panel) first.

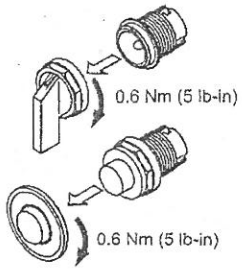
Bulb Replacement - Front of Panel

Indicating Lights and Illuminated Pushbuttons

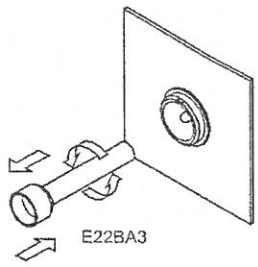


Push-Push Operators - Replace bulb from back of panel

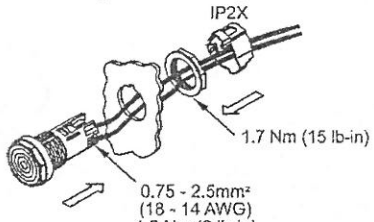
Illuminated Selector Switches and Push/Pull Operators



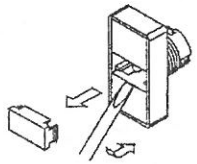
Bulb Removal Tool



Monoblock Indicating Light Wiring and Mounting

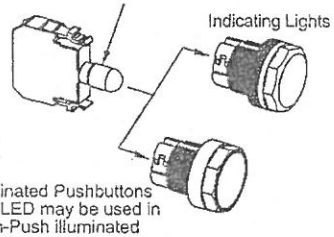


Double Head Pushbutton

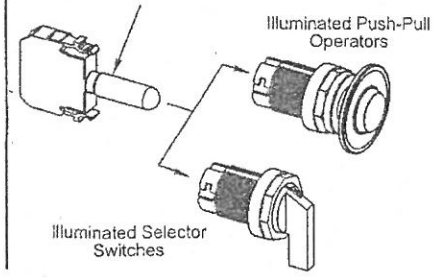


Bulb Type Usage Instructions

Standard Incandescent Bulb / LED



Tall Incandescent Bulb / LED



⚠ CAUTION	⚠ ATTENTION
RISK OF OVERHEATING To avoid damage to Illuminated Operators, do not exceed 60 V, 1.2 W Incandescent Bulb Ratings.	RISQUE DE SURCHAUFFE Pour éviter d'endommager le dispositif lumineux, ne pas utiliser une ampoule incandescente supérieure à 60 V, 1.2 W.

Contact Block Selection Charts

2 Position Push Pull Operators

Circuit Configurations (Viewed from front of panel)		Contact Block Mounting Position (Viewed from back of panel)			Contact Arrangement	Contact Block *
Pulled	Pushed	Left 1	Center 3	Right 2		
X	O	■	□	□	12—11	E22B1
O	X	■	□	□	14—13	E22B2
O X	X O	■	□	□	14—13 12—11	E22B11
O O	X X	■	□	□	14—13 14A—13A	E22B20

3 Position Push Pull Operators

Circuit Configurations (Viewed from front of panel)			Contact Block Mounting Position (Viewed from back of panel)			Contact Arrangement	Contact Block *
Pulled	Central	Pushed	Left 1	Center 3	Right 2		
X X	O X	O O	■ □	□ □	□ ■	12—11 22—21	E22B1 E22B4
X O	O O	O X	■ □	□ □	□ ■	12—11 24—23	E22B1 E22B5

* May include Suffix R

Contact blocks mounted in position 2 (right) produces identical circuit configurations.

Push-Pull operators will accept a maximum of 2 contact blocks.

X = Circuit closed O = Circuit open ■ = Position occupied

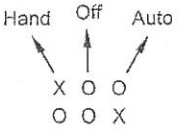
Selector Switch Operators

Circuit Configurations (Viewed from front of panel) 2 Position Cam 2 or	Cam 1	3 Position Cam 2	Contact Block Mounting Position (Viewed from back of panel) Left 1	Center 3	Right 2	Contact Arrangement	Contact Block (May include Suffix R)
O X	X O O	X O X	■	□	□	14—13	E22B2
X O	O X X	O X O	■	□	□	12—11	E22B1
O X X O	X O O O X X	X O X O X O	■	□	□	14—13 12—11	E22B11
O X O X	X O O X O O	X O X X O X	■	□	□	14—13 14A—13A	E22B20
O X	O O X	O O X	□	□	■	24—23	E22B2
X O	X X O	X X O	□	□	■	22—21	E22B1
O X X O	O O X X X O	O O X X X O	□	□	■	24—23 22—21	E22B11
O X O X	O O X O O X	O O X O O X	□	□	■	24—23 24A—23A	E22B20
O X X O	X O O O X O	X O X O X O	■ B11	□	■ B1	14—13 12—11 22—21 External jumper	E22B11+B1 or E22B12
O X X O O X	X O O O X O O O X	X O X O X O O O X	■ B11	□	■ B11	14—13 12—11 22—21 24—23	E22B11+B11 or E22B22

Explanation of How to Use Selector Switch Contact Block Selection Chart

1. Determine the "X O" sequence you require for your application.

Example:



X = Circuit closed
O = Circuit open
■ = Position occupied

2. Locate the first sequence "X O O" under column marked Cam 1 or Cam 2, then identify which cam and contact is used and what position it is assembled.
Example: "X O O" uses Cam 1, E22B2, mounting position 1 (left).

3. Repeat for second sequence "O O X". Do not mix sequences from Cam 1 and Cam 2.
Example: "O O X" uses Cam 1, E22B2, mounting position 2 (right).

4. Assemble contact block(s) to adaptor in the mounting position selected (two contact blocks per switch), using the selector switch with the appropriate cam and switch positions. **Cam 1 has one peak, Cam 2 has two peaks, viewed from the back.**

Terminal numbers
These identify the contact position and contact function.
Example: 14—13
The "1" indicates sequence (position) number 1. Numbers "3 & 4" indicate the circuit is normally open.

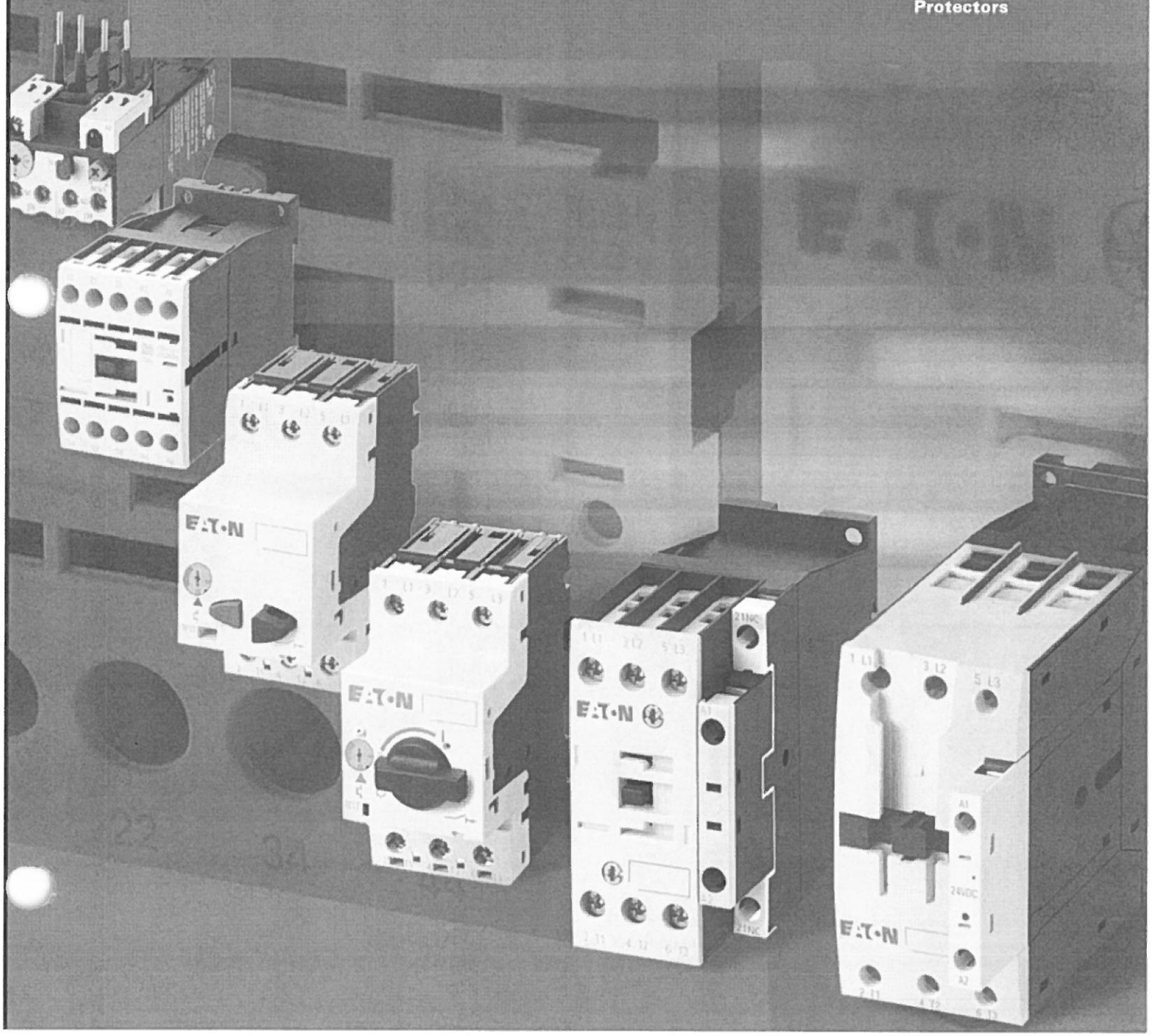
NOTE: Do not use 5-way mounting adapter with E22B4/E22B4R/E22BF4 contact blocks, 3-position push-pull operators, E22LTA emergency stop operators, push-push operator or Cam 2 3-position selector switches.

EATON | Cutler-Hammer

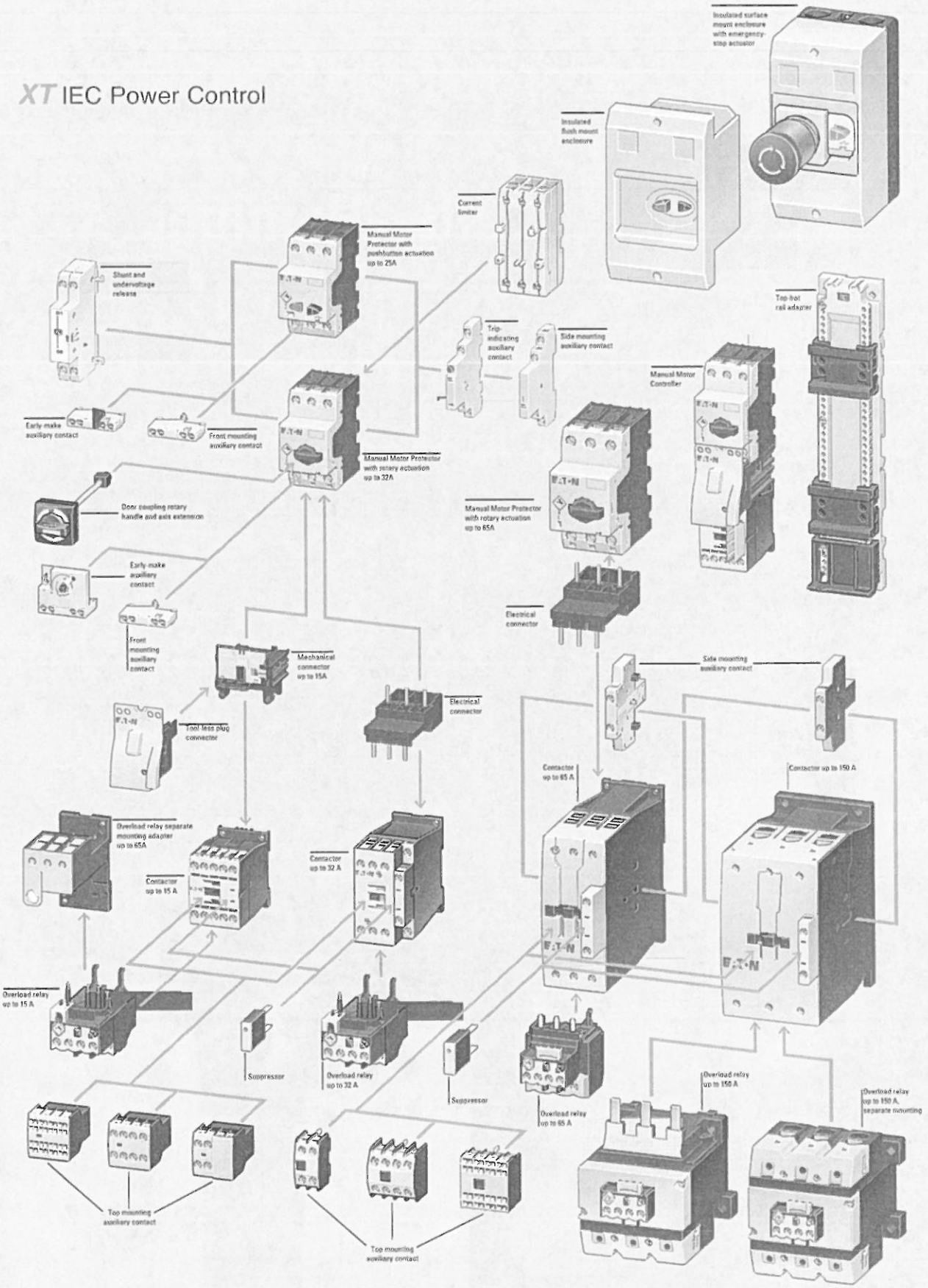
XT IEC Power Control

Quick Reference Guide

Contactors
Starters
Manual Motor Protectors



XT IEC Power Control



Also available (not shown):
- *XT* Mini Contactors, 6-9A
- *XT* Contactors up to 2000A
- *XT* Overload Relays up to 630A

XT Manual Motor Protectors

Catalog Number Selection	kW@ 400V	Max hp @ 460V	Amp Range	Pushbutton B-Frame	Rotary B-Frame	Rotary D-Frame
	①	①	0.1 – 0.16	XTPBP16BC1	XTPRP16BC1	
	0.06	①	0.16 – 0.25	XTPBP25BC1	XTPRP25BC1	
	0.09	①	0.25 – 0.40	XTPBP40BC1	XTPRP40BC1	
	0.12	①	0.40 – 0.63	XTPBP63BC1	XTPRP63BC1	
	0.25	1/2	0.63 – 1.0	XTPB001BC1	XTPR001BC1	
	0.55	3/4	1.0 – 1.6	XTPB1P6BC1	XTPR1P6BC1	
	0.75	1	1.6 – 2.5	XTPB2P5BC1	XTPR2P5BC1	
	1.5	2	2.5 – 4.0	XTPB004BC1	XTPR004BC1	
	2.2	3	4.0 – 6.3	XTPB6P3BC1	XTPR6P3BC1	
	4.0	7-1/2	6.3 – 10	XTPB010BC1	XTPR010BC1	
	5.5	7-1/2	8 – 12	XTPB012BC1	–	
	7.5	10	9 – 12	–	XTPR012BC1	
	7.5	10	10 – 16	XTPB016BC1	XTPR016BC1	XTPR016DC1
	9.0	10	16 – 20	XTPB020BC1	XTPR020BC1	XTPR025DC1
	12.5	15	20 – 25	XTPB025BC1	XTPR025BC1	XTPR025DC1
	15	25	25 – 32		XTPR032BC1	XTPR032DC1
	20	30	32 – 40			XTPR040DC1
	25	30②	40 – 50			XTPR050DC1
	30	40②	50 – 58			XTPR058DC1
	34	–	55 – 65			XTPR063DC1

Example:

XTPB (Prefix) P16 (Max Overload Setting) B (Frame Size) C1 (Trip Class C1 = 10)

Width	mm	45	45	55
Height	mm	93	93	140
Depth	mm	90.5	76	160
Auxiliary contact modules, front mount		XTPAXFA__③		
Auxiliary contact modules, side mount		XTPAXSA__③		
Short circuit breaking capacity I_{cu} at 10A / 400V	kA	50 AC/60 DC	150 AC/60 DC	–
Short circuit breaking capacity I_{cu} at 12A / 400V	kA	50 AC/60 DC	50 AC/60 DC	–
Short circuit breaking capacity I_{cu} at 25A / 400V	kA	50 AC/60 DC	50 AC/40 DC	150 AC/60 DC
Short circuit breaking capacity I_{cu} at 32A / 400V	kA	–	50 AC/40 DC	50 AC/60 DC
Short circuit breaking capacity I_{cu} at 65A / 400V	kA	–	–	50 AC/60 DC
Electrical lifespan	Operations	50,000	100,000	30,000
Single-phasing sensitivity		yes	yes	yes
Undervoltage release		XTPAXUVR120V60H④		
Shunt release		XTPAXSR120V60H④		
Three-phase commoning link (number of MMPs on bus bar)	MMPs only	2 – 5	2 – 5	2 – 4
	With 1 aux	2 – 5	2 – 5	2 – 4
	With 2 auxs	2 or 4	2 or 4	2 or 4

① Use motor current for sizing.
② Consult Eaton for availability.
③ Consult catalog for available auxiliary contact configurations.
④ Consult catalog for other voltage options.

General Applicatons

Enclosed manual motor protectors (MMPs) are often specified for small fans and blower motors in commercial and industrial applications. OEM opportunities include woodworking machinery, small machine tools, pumps and compressors.

Group Motor Applications

XT manual motor protectors are UL listed for group motor installations. A group motor installation consists of two or more motor circuits protected by a single set of fuses or circuit breaker. This eliminates the need for individual branch fusing or circuit protection.

The reduced cost of components, panel size, wiring, assembly charges and labor are substantial with group motor installations.

Consult NEC Article 430-52 for sizing the branch circuit protective device for a group motor application.

XT IEC Power Control

	Frame Size A				Frame Size B						Frame Size C					
Contactor: Basic Catalog Number	XTMC6A		XTMC9A		XTCE007B		XTCE009B		XTCE012B		XTCE015B		XTCE018C		XTCE025C		XTCE032C	
Current Ratings (I) IEC 60947-4-1 AC-1 Thermal Current I_{th}	20 Amperes		25 Amperes		20 Amperes		25 Amperes		25 Amperes		25 Amperes		35 Amperes		40 Amperes		40 Amperes	
AC-3 Operational Power Ratings I_e	kW	hp	kW	hp	kW	hp	kW	hp	kW	hp	kW	hp	kW	hp	kW	hp	kW	hp
200V	–	1-1/2	–	2	–	1-1/2	–	2	–	3	–	3	–	5	–	7-1/2	–	10
220/230V	1.5	2	2.2	3	2.2	2	2.5	3	3.5	3	4	5	5	5	7.5	7-1/2	10	10
380/400V	3	–	4	–	3	–	4	–	5.5	–	7.5	–	7.5	–	11	–	15	–
460V	–	3	–	5	–	3	–	5	–	10	–	10	–	10	–	15	–	–
575V	–	3	–	5	–	5	–	7-1/2	–	10	–	10	–	15	–	20	–	20
660/690V ❶	3	–	4	–	3.5	–	4.5	–	6.5	–	7	–	11	–	14	–	17	25
1000V ❶	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Built-in Auxiliary Contacts	10 = 1NO 01 = 1NC																	
Coil Options																		
AC Magnet Coil Data																		
Pick-Up VA 50/60 Hz	25		25		24 – 29		24 – 29		24 – 29		24 – 29		50 – 62		50 – 62		50 – 62	
Sealed VA 50/60 Hz	4.6		4.6		4.0 – 4.4		4.0 – 4.4		4.0 – 4.4		4.0 – 4.4		8.0 – 9.1		8.0 – 9.1		8.0 – 9.1	
Wire Ranges	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²
Main Cable ❹	18 – 14	1 x (0.75-1.5) 2 x (0.75-1.5)	18 – 14	1 x (0.75-1.5) 2 x (0.75-1.5)	18 – 14	1 x (0.75-4) 2 x (0.75-2.5)	18 – 14	1 x (0.75-4) 2 x (0.75-2.5)	18 – 14	1 x (0.75-4) 2 x (0.75-2.5)	18 – 14	1 x (0.75-4) 2 x (0.75-2.5)	18 – 8	1 x (0.75-16) 2 x (0.75-10)	18 – 8	1 x (0.75-16) 2 x (0.75-16)	18 – 8	1 x (0.75-16) 2 x (0.75-10)
Control Circuits ❹	18 – 14	1 x (0.75-1.5) 2 x (0.75-1.5)	18 – 14	1 x (0.75-1.5) 2 x (0.75-1.5)	18 – 14	1 x (0.75-4) 2 x (0.75-2.5)	18 – 14	1 x (0.75-4) 2 x (0.75-2.5)	18 – 14	1 x (0.75-4) 2 x (0.75-2.5)	18 – 14	1 x (0.75-4) 2 x (0.75-2.5)	18 – 14	1 x (0.75-4) 2 x (0.75-4)	18 – 14	1 x (0.75-4) 2 x (0.75-4)	18 – 14	1 x (0.75-4) 2 x (0.75-4)
Auxiliary Contacts	XTMCX F A C 02 F = Front mount; Blank = Screw terminals; C = Spring cage terminals 02 = 2NC, 04 = 4NC, 11 = 1NO-1NC, 13 = 1NO-3NC, 20 = 2NO, 22 = 2NO-2NC, 31 = 3NO-1NC, 40 = 4NO				XTCEX F A C C 11 F = Front mount; A = seq A, AL = seq AL, C = seq C, CL = seq CL, D = seq D; C = Frames B – C; Blank = Screw terminals, C = Spring cage terminals 02 = 2NC, 04 = 4NC, 11 = 1NO-1NC, 13 = 1NO-3NC, 20 = 2NO, 22 = 2NO-2NC, 31 = 3NO-1NC, 40 = 4NO										
Overload Relay	XTOM 004 A C1 P16 = 0.10 – 0.16A, P24 = 0.16 – 0.24A, P40 = 0.24 – 0.40A, P60 = 0.40 – 0.60A, 001 = 0.60 – 1A, 1P6 = 1.0 – 1.6A, 2P4 = 1.6 – 2.4A, 004 = 2.4 – 4A, 006 = 4 – 6A, 010 = 6 – 10A, 012 = 9 – 12A C1 = Class 10				XTOB 001 B C1 P16 = 0.10 – 0.16A, P24 = 0.16 – 0.24A, P40 = 0.24 – 0.40A, P60 = 0.40 – 0.60A, 001 = 0.60 – 1A, 1P6 = 1.0 – 1.6A, 2P4 = 1.6 – 2.4A, 004 = 2.4 – 4A, 006 = 4 – 6A, 010 = 6 – 10A, 012 = 9 – 12A, 016 = 12 – 16A C1 = Class 10							XTOB 010 C C1 P16 = 0.10 – 0.16A, P24 = 0.16 – 0.24A, P40 = 0.24 – 0.40A, P60 = 0.40 – 0.60A, 001 = 0.60 – 1A, 1P6 = 1.0 – 1.6A, 2P4 = 1.6 – 2.4A, 004 = 2.4 – 4A, 006 = 4 – 6A, 010 = 6 – 10A, 012 = 9 – 12A, 016 = 12 – 16A, 024 = 16 – 24A, 032 = 24 – 32A C1 = Class 10			

	Frame Size D						Frame Size F				Frame Size G			
Contactor: Basic Catalog Number	XTCE040D		XTCE050D		XTCE065D		XTCE080F		XTCE095F		XTCE115G		XTCE150G	
Current Ratings (I) IEC 60947-4-1 AC-1 Thermal Current I_{th}	50 Amperes		60 Amperes		72 Amperes		110 Amperes		110 Amperes		160 Amperes		160 Amperes	
AC-3 Operational Power Ratings I_e	kW	hp	kW	hp	kW	hp	kW	hp	kW	hp	kW	hp	kW	hp
200V	–	10	–	15	–	20	–	25	–	25	–	40	–	40
220/230V	12.5	15	15.5	20	20	25	25	30	30	40	37	50	48	60
380/400V	18.5	–	22	–	30	–	37	–	45	–	55	–	75	–
460V	–	30	–	40	–	50	–	60	–	75	–	100	–	125
575V	–	40	–	50	–	60	–	75	–	100	–	125	–	125
660/690V ❶	23	–	30	–	35	–	53	–	75	–	90	–	98	–
1000V ❶	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Built-in Auxiliary Contacts	00 = 0NO-0NC													
Coil Options														
AC Magnet Coil Data														
Pick-Up VA 50/60 Hz	150 – 185		150 – 185		150 – 185		310 – 375		310 – 375		130		130	
Sealed VA 50/60 Hz	16.0 – 19.0		16.0 – 19.0		16.0 – 19.0		26.0 – 31.0		26.0 – 31.0		3.5		3.5	
Wire Ranges	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²
Main Cable ❹	12 – 2	1 x (2.5-35) 2 x (2.5-25)	12 – 2	1 x (2.5-35) 2 x (2.5-25)	12 – 2	1 x (2.5-35) 2 x (2.5-25)	8 – 2/0MCM	1 x (10-95) 2 x (10-70)	8 – 2/0MCM	1 x (10-95) 2 x (10-70)	6 – 2/0MCM	1 x (10-95) 2 x (10-70)	6 – 2/0MCM	1 x (10-95) 2 x (10-70)
Control Circuits ❹	18 – 14	1 x (0.75-4) 2 x (0.75-4)	18 – 14	1 x (0.75-4) 2 x (0.75-4)	18 – 14	1 x (0.75-4) 2 x (0.75-4)	18 – 14	1 x (0.75-4) 2 x (0.75-4)	18 – 14	1 x (0.75-4) 2 x (0.75-4)	18 – 14	1 x (0.75-4) 2 x (0.75-4)	18 – 14	1 x (0.75-4) 2 x (0.75-4)
Auxiliary Contacts	XTCEX F A G C 22 F = Front mount; S = Side mount A = seq A, B = seq B, BL = seq BL Blank = Screw terminals, C = Spring cage terminals G = Front mount, frames D-G, N = Side mount, frames D-N 02 = 2NC, 04 = 4NC, 11 = 1NO-1NC, 13 = 1NO-3NC, 20 = 2NO, 22 = 2NO-2NC, 31 = 3NO-1NC, 40 = 4NO													
Overload Relay	XTOB 040 D C1 010 = 6 – 10A, 016 = 10 – 16A, 024 = 16 – 24A, 040 = 24 – 40A, 057 = 40 – 57A, 065 = 50 – 65A C1 = Class 10						XTOB 100 F C1 035 = 25 – 35A, 050 = 35 – 50A, 070 = 50 – 70A, 100 = 70 – 100A, 125 = 95 – 125A, G-frame only 150 = 120 – 150A F = 80 – 95A, G = 115 – 150A C1 = Class 10						

Catalog Numbering System

Mini Contactors Example:

XTMC 5 A 01 A
- XTMC: XT Non-reversing Mini Contactor
- 5: Amp Rating
- A: Frame
- 01: Auxiliary Contact Configuration
- A: Coil Code

Contactors Example:

XTCE 007 B 01 A
- XTCE: XT Non-reversing Contactor
- 007: Amp Rating
- B: Frame
- 01: Auxiliary Contact Configuration
- A: Coil Code

Starters Example:

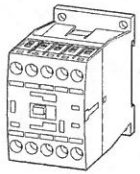
XTAE 007 B 10 A 004
- XTAE: XT Non-reversing Starter
- 007: Amp Rating
- B: Frame
- 10: Auxiliary Contact Configuration
- A: Coil Code
- 004: Overload Relay Amp Range

❶ For 185 – 2000A Contactors at 660/690V or 1000V: Do not reverse directly. ❹ 7 – 65A — flexible with ferrule cable, 185 – 2000A — flexible with cable lug. ❹ Flexible with ferrule cable. ❻ With DC Operation: Integrated diode-resistor combination, coil rating 2.6W. ❼ Contact Eaton for availability.

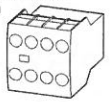
Pub51210 April 2005

Installation Instructions
Montageanweisung
Notice d'installation
Istruzioni per il montaggio
Instrucciones de montaje
Инструкция по монтажу
安装说明

XTCE...B, 7-15A
XTCEC...B, 7-12A
XTCF...B, 20A
XTRE...
XTREC...



XTCEXFAC... **XTCEXFCC...**
XTCEXFACC... **XTCEXFCCC...**
XTCEXFCLC...
XTCEXFCLCC...
Auxiliary contact module
Hilfsschalterbaustein
Module de contacts auxiliaires
Modulo contatti ausiliari
Módulo de contactos auxiliares
Модуль вспомогательных выключателей
辅助开关组



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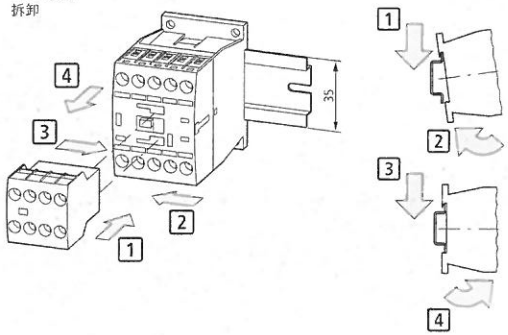
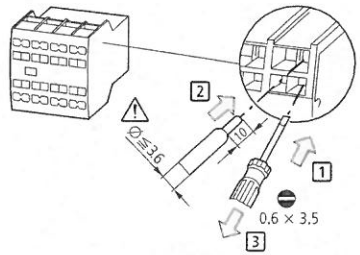
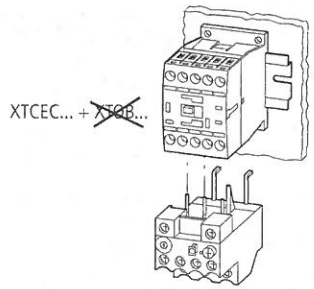
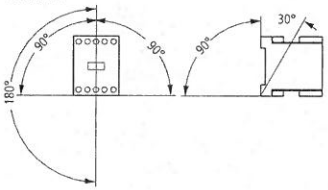
Mounting	① place in position	① aufsetzen	① mettre en place	① 装配
Montage	② latch in	② rasten	② encliqueter	② 装上嵌入
Montage				
Montaggio	① appoggiare	① colocar en posición	① осадить	
Montaje	② inserire a scatto	② enclavar	② зафиксировать	
Монтаж				
安装				
Dismantling	③ push	③ schieben	③ pousser	③ 推
Demontage	④ remove	④ abziehen	④ retirer	④ 拔出
Démontage,				
Smontaggio	③ inserire	③ desplazar	③ задвинуть	
Desmontaje	④ estrarre	④ extraer	④ снять	
Разберка				
拆卸				





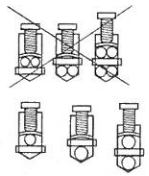


Mounting position – Einbaulage
Position de montage – Posizione di montaggio
Posición de montaje – Положение установки
安装位置



XTCE

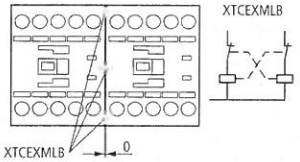
	mm²	AWG ≧ – ≦	Nm	lb-in
	1 × (0.75 – 4) 2 × (0.75 – 2.5)	18 – 14	1.2	11
	1 × (0.75 – 2.5) 2 × (0.75 – 2.5)			
	–			

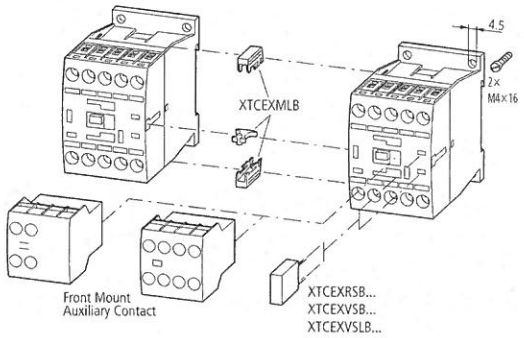


XTCEC

mm²		mm²	
1 × (0.75 – 2.5) 2 × (0.75 – 2.5)		1 × (0.75 – 2.5) 2 × (0.75 – 2.5)	
1 × (0.75 – 2.5) 2 × (0.75 – 2.5)		AWG 18 – 12	

7, 9 and 12A XTCE... and XTCEC...
XTCE015B...
XTCF020B...





Pub51210 April 2005 Doku

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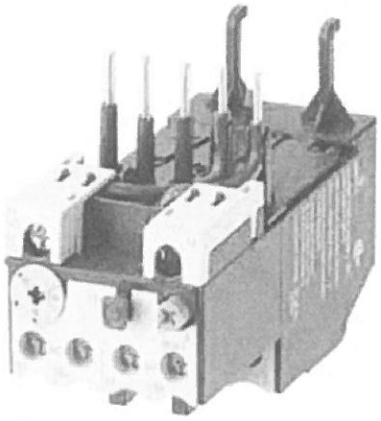
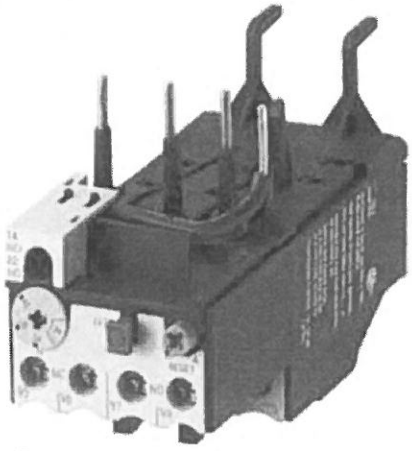
XTOB Frames B and C Overload Relays

User Manual

May 2006
New Information



Frame B



Frame C

May 2006

Important Notice – Please Read

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The information contained in this manual is subject to change without notice.

Cover Photo: XTOB Frames B and C Overload Relays

Table of Contents

LIST OF FIGURES iii
LIST OF TABLES iv
SAFETY
Definitions and Symbols v
Hazardous High Voltage vii
Warnings and Cautions ix
CHAPTER 1 — ABOUT THIS MANUAL
Target Group 1-1
Abbreviations 1-1
CHAPTER 2 — XTOB FRAMES B AND C OVERLOAD RELAYS
Preface 2-1
Overview of the Devices 2-1
Device Description 2-2
CHAPTER 3 — CONFIGURATION
Monitoring Overload of Motors in the EEx e (Explosive) Areas 3-1
Adjusting the Overload Current Protection 3-1
Approvals 3-4
CHAPTER 4 — INSTALLATION
Notes on Installation 4-1
Mounting the Devices 4-3
CHAPTER 5 — OPERATING THE DEVICES
Settings 5-1
APPENDIX A
Rating Plate A-1
Tripping Characteristics A-4
Declaration of Conformity A-34

List of Figures

Figure 2-1: XTOB Frame B Overload Relay 2-1
Figure 2-2: XTOB Frame C Overload Relay 2-1
Figure 2-3: Circuit Diagram of a Motor Tap with Overload Relay 2-3
Figure 2-4: Function of the Phase Sensitivity by Means of Tripping and Differential Bridge 2-5
Figure 2-5: Wiring of the Overload Relay for the Protection of AC or DC Motors (Bimetallic Release Switched in Series) 2-6
Figure 3-1: Tripping Characteristics of the Overload Relay 3-2
Figure 4-1: Circuit Prevents an Automatic Restart 4-2
Figure 4-2: Mounting the XTOB 4-3
Figure 4-3: Mains Wiring 4-4
Figure 5-1: Switching Options of the Reset Selector Button 5-1
Figure 5-2: Switching Options of the Test Button 5-2
Figure A-1: Rating Plate XTOB A-1
Figure A-2: XTOBP16BC1 and XTOBP16CC1 ..... A-5
Figure A-3: XTOBP24BC1 and XTOBP24CC1 ..... A-7
Figure A-4: XTOBP40BC1 and XTOBP40CC1 ..... A-9
Figure A-5: XTOBP60BC1 and XTOBP60CC1 ..... A-11
Figure A-6: XTOB001BC1 and XTOB001CC1 ..... A-13
Figure A-7: XTOB1P6BC1 and XTOB1P6CC1 ..... A-15
Figure A-8: XTOB2P4BC1 and XTOB2P4CC1 ..... A-17
Figure A-9: XTOB004BC1 and XTOB004CC1 ..... A-19
Figure A-10: XTOB006BC1 and XTOB006CC1 ..... A-21
Figure A-11: XTOB010BC1 and XTOB010CC1 ..... A-23
Figure A-12: XTOB012BC1 ..... A-25
Figure A-13: XTOB016BC1 ..... A-27
Figure A-14: XTOB016CC1 ..... A-29
Figure A-15: XTOB024CC1 ..... A-31
Figure A-16: XTOB032CC1 ..... A-33

List of Tables

Table 1-1: Abbreviations 1-1
Table 2-1: Direct Mounting 2-2
Table 2-2: Individual Mounting 2-2
Table 2-3: XTOB Frame B Overload Relay Current Ranges 2-4
Table 2-4: XTOB Frame C Overload Relay Current Ranges 2-4
Table 3-1: XTOB Frame B Direct Mounting 3-3
Table 3-2: Direct Mounting or Individual Installation of the XTOB Frame C Overload Relay 3-3
Table 4-1: Direct Mounting 4-3
Table 4-2: Individual Installation 4-3
Table 4-3: Mounting Dimensions 4-3
Table 4-4: Conductor Cross-Sections 4-4
Table A-1: Values of the Various Types A-3
Table A-2: XTOBP16BC1 and XTOBP16CC1 — Technical Data A-4
Table A-3: XTOBP16BC1 and XTOBP16CC1 — Tripping Time A-4
Table A-4: XTOBP24BC1 and XTOBP24CC1 — Technical Data A-6
Table A-5: XTOBP24BC1 and XTOBP24CC1 — Tripping Time A-6
Table A-6: XTOBP40BC1 and XTOBP40CC1 — Technical Data A-8
Table A-7: XTOBP40BC1 and XTOBP40CC1 — Tripping Time A-8
Table A-8: XTOBP60BC1 and XTOBP60CC1 — Technical Data A-10
Table A-9: XTOBP60BC1 and XTOBP60CC1 — Tripping Time A-10
Table A-10: XTOB001BC1 and XTOB001CC1 — Technical Data A-12
Table A-11: XTOB001BC1 and XTOB001CC1 — Tripping Time A-12
Table A-12: XTOB1P6BC1 and XTOB1P6CC1 — Technical Data A-14
Table A-13: XTOB1P6BC1 and XTOB1P6CC1 — Tripping Time A-14
Table A-14: XTOB2P4BC1 and XTOB2P4CC1 — Technical Data A-16
Table A-15: XTOB2P4BC1 and XTOB2P4CC1 — Tripping Time A-16
Table A-16: XTOB004BC1 and XTOB004CC1 — Technical Data A-18
Table A-17: XTOB004BC1 and XTOB004CC1 — Tripping Time A-18
Table A-18: XTOB006BC1 and XTOB006CC1 — Technical Data A-20
Table A-19: XTOB006BC1 and XTOB006CC1 — Tripping Time A-20
Table A-20: XTOB010BC1 and XTOB010CC1 — Technical Data A-22
Table A-21: XTOB010BC1 and XTOB010CC1 — Tripping Time A-22
Table A-22: XTOB012BC1 — Technical Data A-24
Table A-23: XTOB012BC1 — Tripping Time A-24
Table A-24: XTOB016BC1 — Technical Data A-26
Table A-25: XTOB016BC1 — Tripping Time A-26
Table A-26: XTOB016CC1 — Technical Data A-28
Table A-27: XTOB016CC1 — Tripping Time A-28
Table A-28: XTOB024CC1 — Technical Data A-30
Table A-29: XTOB024CC1 — Tripping Time A-30
Table A-30: XTOB032CC1 — Technical Data A-32
Table A-31: XTOB032CC1 — Tripping Time A-32

Safety

Definitions and Symbols

⚠ WARNING

This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment. Read the message and follow the instructions carefully.

⚠ ADVERTENCIA

Este símbolo indica alto voltaje. Llama su atención hacia elementos u operaciones que podrían ser peligrosas para usted y para otras personas que operen este equipo. Lea el mensaje y siga las instrucciones cuidadosamente.

⚠ AVERTISSEMENT

Ce symbole signale une haute tension. Il attire l'attention sur des éléments ou actions susceptibles de présenter un danger pour les personnes utilisant ce matériel. Lire le message et suivre les instructions avec attention.

This symbol is the "Safety Alert Symbol." It occurs with either of two signal words: CAUTION or WARNING, as described below.

Este símbolo corresponde al "Símbolo de alerta de seguridad". Se encuentra en dos palabras de advertencia: PRECAUCIÓN o ADVERTENCIA, según se describe a continuación.

Ce symbole est le « symbole d'alerte à la sécurité ». Il accompagne les termes de mise en garde ATTENTION ou AVERTISSEMENT décrits ci-dessous.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

⚠ ADVERTENCIA

Indica una situación potencialmente peligrosa que, de no evitarse, puede provocar lesiones graves o la muerte.

⚠ AVERTISSEMENT

Indique une situation potentiellement dangereuse qui, si elle n'est pas évitée, peut entraîner des blessures graves ou la mort.

⚠ CAUTION

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING).

⚠ PRECAUCIÓN

Indica una situación potencialmente peligrosa que, de no evitarse, puede provocar lesiones menores a moderadas; o graves daños al producto. Es posible que si no se evita la situación descrita en PRECAUCIÓN, ésta provoque graves consecuencias. Las medidas de seguridad importantes se describen en la PRECAUCIÓN, así como también en la ADVERTENCIA.

⚠ ATTENTION

Indique une situation potentiellement dangereuse qui, si elle n'est pas évitée, peut entraîner des blessures mineures à moyennes ou des dommages graves du produit. La situation décrite dans la mise en garde ATTENTION peut, si elle n'est pas évitée, avoir des conséquences graves. Des mesures de sécurité importantes sont fournies sous ATTENTION (ainsi que sous AVERTISSEMENT).

Hazardous High Voltage

⚠ WARNING

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

⚠ ADVERTENCIA

El equipo de control del motor y los controladores electrónicos se conectan a voltajes de línea peligrosos. Al realizar mantenimiento a los accionamientos y controladores electrónicos, pueden haber componentes expuestos con aberturas o protuberancias en la línea o debajo de ésta. Se debe tener sumo cuidado para protegerse de las descargas.

Párese en una almohadilla aislante y hágalo un hábito para usar sólo una mano cuando inspeccione los componentes. Siempre trabaje con otra persona en caso de que se produzca una emergencia. Desconecte la energía antes de inspeccionar los controladores o realizar mantenimiento. Compruebe que el equipo esté adecuadamente conectado a tierra. Use anteojos de seguridad siempre que trabaje con controladores electrónicos o maquinaria giratoria.

⚠ AVERTISSEMENT

Le matériel de commande moteur et les contrôleurs électroniques sont raccordés à des tensions de secteur dangereuses. Lors d'interventions sur les moteurs et contrôleurs électroniques, certains éléments exposés peuvent présenter des logements ou saillies au même potentiel que la secteur ou au-dessus. Faire preuve de la plus grande prudence pour se protéger contre les électrisations.

Se tenir sur une plaque isolante et prendre l'habitude de n'utiliser qu'une seule main pour contrôler des pièces. Toujours travailler en présence d'une autre personne pour les cas d'urgence. Débrancher l'alimentation avant de vérifier les contrôleurs ou d'effectuer l'entretien. Vérifier que le matériel est correctement relié à la terre. Porter des lunettes de sécurité pour toute intervention sur des contrôleurs électroniques ou des machines tournantes.

⚠ WARNING

Before commencing the installation:

- Disconnect the power supply of the device.
- Ensure when resetting overload that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Connect to earth and short-circuit.
- Cover or fence off adjacent live parts.
- Follow the installation instructions included with the device.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The rated value of the mains voltage may not fluctuate or deviate by more than the tolerance specified, otherwise malfunction and hazardous states are to be expected.
- Panel-mount devices may only be operated when properly installed in the cubicle or control cabinet.

⚠ ADVERTENCIA

Antes de comenzar la instalación:

- Desconecte el suministro de energía del dispositivo.
- Compruebe al restablecer la sobrecarga que los dispositivos no se puedan arrancar de nuevo accidentalmente.
- Verifique el aislamiento del suministro.
- Conecte a tierra y cortocircuite.
- Cubra o separe las piezas adyacentes con corriente.
- Siga las instrucciones de instalación que se incluyen con el dispositivo.
- Sólo personal adecuadamente capacitado en conformidad con la norma EN 50110-1/-2 (VDE 0105 Parte 100) puede trabajar en este dispositivo/sistema.
- Antes de la instalación y de tocar el dispositivo compruebe que usted esté libre de carga electrostática.
- El valor nominal del voltaje de alimentación no debe fluctuar ni desviarse más allá de la tolerancia específica, de lo contrario se esperan condiciones de mal funcionamiento y de peligro.
- Los dispositivos de montaje en el panel sólo se pueden operar cuando estén adecuadamente instalados en el cubículo o en el gabinete de control.

⚠ AVERTISSEMENT

Avant de débuter l'installation :

- Débrancher l'alimentation électrique de l'appareil.
- S'assurer qu'aucun appareil ne peut redémarrer accidentellement lors du réarmement du relais.
- Vérifier l'isolement par rapport à l'alimentation.
- Raccorder à la terre et court-circuiter.
- Couvrir ou clôturer les éléments sous tension avoisinants.
- Suivre les instructions de pose fournies avec l'appareil.
- Seul du personnel qualifié en vertu de EN 50110-1/-2 (VDE 0105 Part 100) est autorisé à travailler sur ce dispositif/système.
- Avant la pose et avant de toucher l'appareil, veiller à n'être porteur d'aucune charge électrostatique.
- La valeur nominale de la tension de secteur ne doit pas fluctuer ni dévier de plus de la tolérance indiquée afin d'éviter les mauvais fonctionnements ou les états dangereux.
- Les appareils à monter sur panneau ne doivent être utilisés que s'ils sont correctement posés dans la cabine ou l'armoire de commande.

Warnings and Cautions

⚠ WARNING

To ensure explosion-proof operation, the overload relay may only be reset/switched on manually, or automatically via a control interlock circuit for the motor or electrical machinery, after the bimetallic release has cooled down.

A manual reset may be carried out locally by trained personnel or in the control room.

⚠ ADVERTENCIA

Para garantizar el funcionamiento a prueba de explosiones, el relé de sobrecarga sólo se puede reestablecer/encender de forma manual o automáticamente mediante el circuito de interbloqueo de control del motor o de la maquinaria eléctrica, después de que se haya enfriado la desconexión bimetálica.

Un restablecimiento manual se puede llevar a cabo localmente o en la sala de control por personal capacitado.

⚠ AVERTISSEMENT

Pour écarter les risques d'explosion, il convient de réarmer/activer le relais de protection manuellement, ou automatiquement au moyen du circuit de verrouillage du moteur ou de la machine électrique, uniquement une fois que le déclencheur bimétallique a refroidi.

Le réarmement manuel peut être effectué sur place par du personnel qualifié ou depuis la salle de commande.

⚠ WARNING

The selected current overload protection system must not only ensure proper motor current monitoring, but also that the seized motor is switched off within the temperature rise time t_E. This means the protective device must be rated in such a way to ensure that the tripping time t_A for the ratio I_A/I_N of the EEx e motor is not higher than its temperature rise time t_E according to its characteristics curve, in order to safely switch off the motor within that period.

⚠ ADVERTENCIA

El sistema de protección de sobrecargas por corriente seleccionado no sólo debe garantizar la supervisión correcta de la corriente del motor, sino que también el motor agarrotado se apague dentro del tiempo de aumento de la temperatura t_E. Esto significa que el dispositivo de protección debe estar clasificado de forma de garantizar que el tiempo de desconexión t_A para la proporción I_A/I_N del motor EEx e no sea mayor que su tiempo de aumento de la temperatura t_E según su curva característica, a fin de apagar con seguridad el motor en dicho período.

⚠ AVERTISSEMENT

Le système de protection contre les surintensités choisi doit non seulement assurer un suivi correct de l'intensité du moteur, mais également une coupure d'alimentation d'un moteur bloqué dans les limites de la durée de montée en température t_E. Ceci signifie que les caractéristiques nominales de l'appareil de protection doivent être telles que la durée de déclenchement t_A pour le rapport I_A/I_N du moteur EEx e ne dépasse pas sa durée de montée en température t_E en vertu de sa courbe caractéristique, afin de couper la moteur dans ce délai.

⚠ CAUTION

Only co-ordination type "2" is permissible for the protection of EEx e motors.

⚠ PRECAUCIÓN

Sólo se acepta la coordinación tipo "2" para la protección de motores EEx e.

⚠ ATTENTION

Seule une coordination de type « 2 » est permise pour la protection des moteurs EEx e.

⚠ WARNING

Particularly in EEx e applications, an automatic restart must be prevented after an interruption and restoration of the control voltage. This is prevented safely by means of the latching function of the power relay.

⚠ ADVERTENCIA

Especialmente en las aplicaciones EEx e, se debe impedir un nuevo arranque automático después de una interrupción y restauración del voltaje de control. Ello se evita con seguridad por medio de la función de enganche del relé de potencia.

⚠ AVERTISSEMENT

Dans les applications EEx e en particulier, il convient d'empêcher tout redémarrage automatique à la suite de l'interruption et du rétablissement de la tension de commande. Ceci peut être réalisé sans danger au moyen de la fonction de verrouillage du relais d'alimentation.

⚠ CAUTION

If the overload relay is installed at a cool location (e.g. 23°F [-5°C]) and the motor is installed at a warm motor location (e.g. 104°F [40°C]), it is possible that there will be a delayed release during an overload if the devices are operated in the lower current setting range.

⚠ PRECAUCIÓN

Si el relé de sobrecarga se instala en un lugar frío (por ejemplo, a -5° C [23° F]) y el motor en un lugar cálido (por ejemplo, a 40° C [104° F]), es posible que haya una desconexión retardada durante una sobrecarga si los dispositivos se operan en el margen de intensidad de regulación más bajo.

⚠ ATTENTION

Si le relais de protection est installé dans un endroit froid (-5°C [23°F], par ex.) et le moteur dans un endroit chaud (40°C [104°F], par ex.), il est possible qu'il y ait un retard de déclenchement en cas de surintensité si les appareils fonctionnent dans la plage de réglage d'intensité inférieure.

⚠ WARNING

Faulty devices may not be opened for repairs and may only be replaced by qualified personnel.

⚠ ADVERTENCIA

Los dispositivos defectuosos no se deben abrir para su reparación y sólo los debe cambiar personal calificado.

⚠ AVERTISSEMENT

Ne pas ouvrir les appareils défectueux pour les réparer et les faire changer exclusivement par du personnel qualifié.

Chapter 1 — About This Manual

This manual applies to the overload relays, XTOB Frames B and C (XTOB...BC1 and XTOB...CC1).

It describes the overload monitoring system for the protection of motors operating in potentially explosive atmospheres EEx e areas.

Target Group

This manual addresses special personnel who install, commission and service the overload relay.

Abbreviations

The abbreviations used in this manual have the following meaning:

Table 1-1: Abbreviations

Abbrev.	Meaning
EEx e	"Increased safety" degree of protection (European markets)
PTB	**P**hysikalisch **T**echnische **B**undesanstalt. German Federal Testing Laboratory: Accredited certification authority for devices operated in **EEx** e areas (European markets).
NM	Lowest possible setup current
HM	Highest possible setup current

Chapter 2 — XTOB Frames B and C Overload Relays

Preface

In addition to the type of protection specified in the standards EN 60079-14 and VDE 0165 Part 1, further provisions have been made to ensure the safety from ignition for motors operated in potentially explosive atmospheres. EN 50019 demands additional measures for operating motors with "increased safety" type of protection "e". These measures provide a higher degree of safety and prevent impermissible high temperature and development of sparking and arcing on the motors, which usually does not occur under normal operating conditions. The motor protective equipment used for this is operated at a location separate from the EEx e area and must be certified by an accredited certification authority.

The guidelines on the application of Directive 94/9/EC (ATEX 100a) on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres has been enforced since 30th June 2003.

The XTOB overload relays are certified by PTB according to the 94/9/EC (ATEX 100a) Directives.

Note: The EU Certification of Conformity numbers are:

XTOB...B: [?]

XTOB...C: [?]

Overview of the Devices

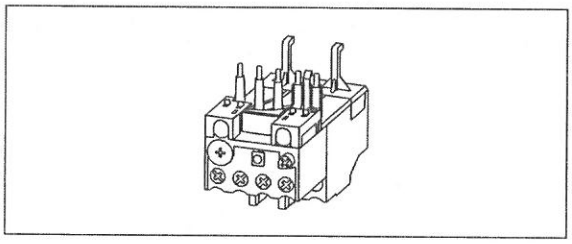

Figure 2-1: XTOB Frame B Overload Relay

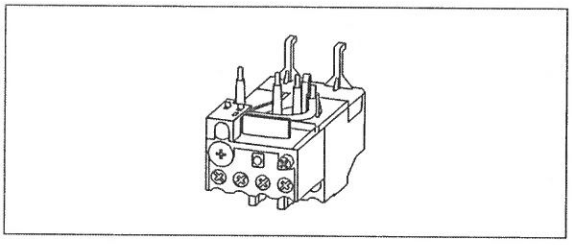

Figure 2-2: XTOB Frame C Overload Relay

Device Description

Overload Protection Relays with Bimetallic Release

The XTOB overload relays are three-pole electromechanical overload relays and are equipped with bimetallic releases. They are suitable for monitoring direct (DC) and alternating (AC) current.

The XTOB overload relays can be mounted directly on the XTCE contactors.

Table 2-1: Direct Mounting

Overload Relay	Contactor
XTOB...BC1	XTCE007B XTCE009B XTCE012B XTCE015B
XTOB...CC1	XTCE018C XTCE025C XTCE032C

Furthermore, the XTOB...C relay can be used individually in combination with an individual mounting.

Table 2-2: Individual Mounting

Overload Relay	Individual Mounting
XTOB...CC1	XTOBXDINC

In the event of overload tripping, the auxiliary contacts 95-96 and 97-98 change over and disconnect the control voltage circuit from the corresponding contactor relay, and thus indirectly switch off the current flow to the monitored motor.

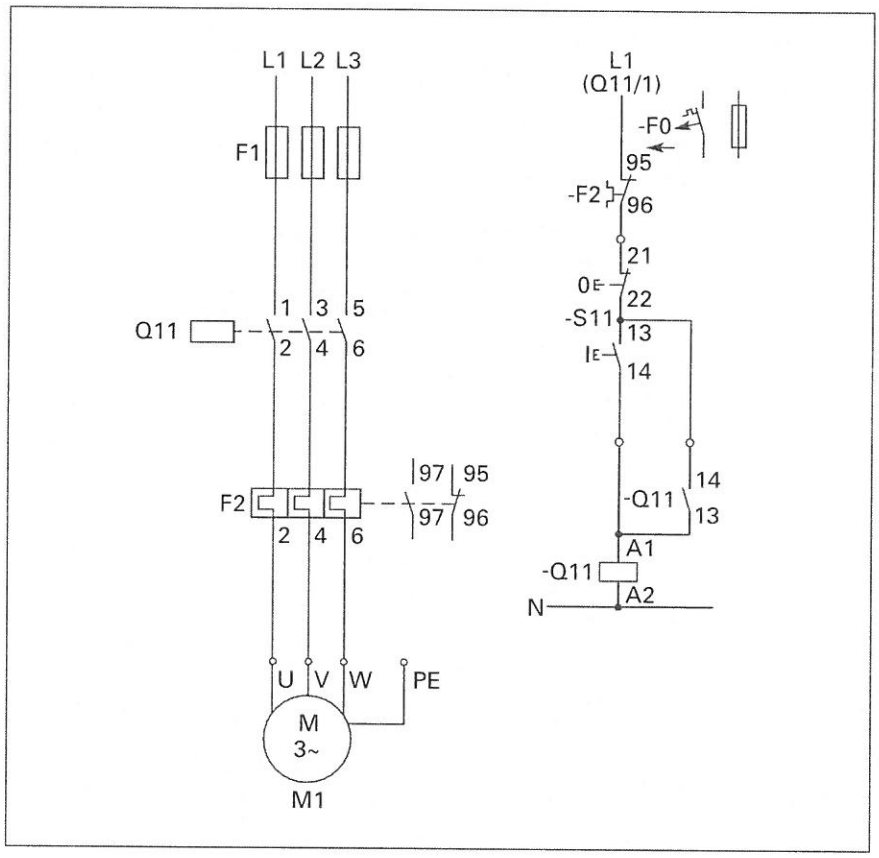

Figure 2-3: Circuit Diagram of a Motor Tap with Overload Relay

F1 = Fuse

F2 = Overload relay

M1 = Motor

Q11 = Motor contactor

Current Ranges of the Overload Relays

The rated motor current is set on the XT relays by means of a current setting dial.

The various types can be used to monitor motors operating at a rated current of 0.1 to 32A.

Table 2-3: XTOB Frame B Overload Relay Current Ranges

Type	Current Range *I* [A]
XTOBP16BC1	0.1 to 0.16
XTOBP24BC1	0.16 to 0.24
XTOBP40BC1	0.24 to 0.4
XTOBP60BC1	0.4 to 0.6
XTOB001BC1	0.6 to 1.0
XTOB1P6BC1	1.0 to 1.6
XTOB2P4BC1	1.6 to 2.4
XTOB004BC1	2.4 to 4.0
XTOB006BC1	4.0 to 6.0
XTOB010BC1	6.0 to 10
XTOB012BC1	9 to 12
XTOB016BC1	12 to16

Table 2-4: XTOB Frame C Overload Relay Current Ranges

Type	Current Range *I* [A]
XTOBP16CC1	0.1 to 0.16
XTOBP24CC1	0.16 to 0.24
XTOBP40CC1	0.24 to 0.4
XTOBP60CC1	0.4 to 0.6
XTOB001CC1	0.6 to 1.0
XTOB1P6CC1	1.0 to 1.6
XTOB2P4CC1	1.6 to 2.4
XTOB004CC1	2.4 to 4.0
XTOB006CC1	4.0 to 6.0
XTOB010CC1	6.0 to 10
XTOB016CC1	10 to 16
XTOB024CC1	16 to 24
XTOB032CC1	24 to 32

Temperature Compensation

Two parameters influence the deflection of the bimetallic releases. There is for one the heat which is generated in proportion to the current flow, and secondly, the influence of the ambient temperature.

The influence of the ambient temperature is automatically compensated within a temperature range from 23°F to 131°F (-5°C to +55°C) by means of an additional current-free bimetallic release that continuously corrects the tripping range.

Phase Loss

The XTOB overload relay is single-phasing sensitive. The deflecting action of all three bimetallic releases is directed towards a tripping bridge that switches over a quick-break switch when the limit value is reached. At the same time, all three bimetallic releases shift the differential bridge. If the path of action of one of the bimetallic releases is reduced due to a phase loss, the differential bridge is retarded and the distance is converted into an additional tripping distance, which leads to an early tripping.

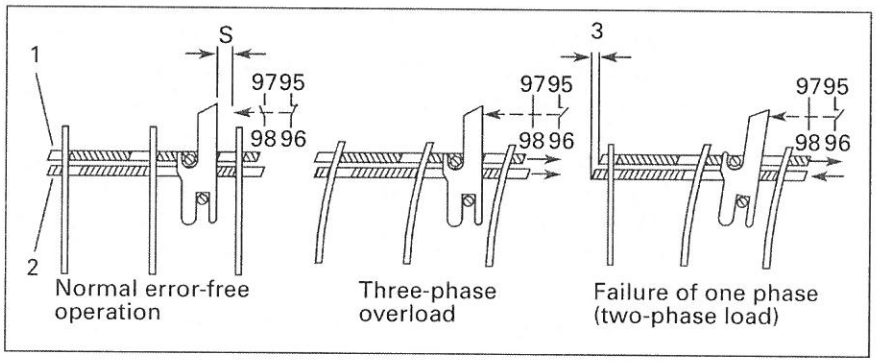

Figure 2-4: Function of the Phase Sensitivity by Means of Tripping and Differential Bridge

1. Tripping bridge
2. Differential bridge
3. Differential distance

   S = Tripping distance

Note: When an XTOB relay is to be used for monitoring an AC or DC motor, the current must flow across all three current paths in order to avoid early tripping.

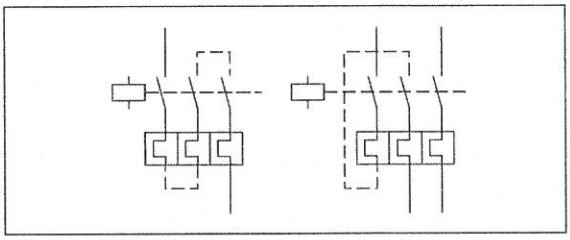

Figure 2-5: Wiring of the Overload Relay for the Protection of AC or DC Motors (Bimetallic Release Switched in Series)

See "Tripping Characteristics" on **Page A-4**.

Reset

After tripping, the bimetallic releases must first cool down before the overload relay can be reset. Manual and automatic reset can be selected by means of a selector switch (see "Reset" **Page 5-1**).

In auto mode, the contacts automatically fall back after the bimetallic releases have cooled down, whereas in manual mode the tripping must be acknowledged locally on the overload relay.

⚠ WARNING

To ensure explosion-proof operation, the overload relay may only be reset/switched on manually, or automatically via a control interlock circuit for the motor or electrical machinery, after the bimetallic release has cooled down.

A manual reset may be carried out locally by trained personnel or in the control room.

Test Function

The function of the auxiliary contacts can be verified by means of an additional test button that has a dual function:

- Pressing the test button will open the break contact (NC) 95-96. The open contact will return to the closed position as soon as the button is released. This function can also be used to switch off the motor manually.
- Pulling the button will trip the overload relay. The break contact 95-96 opens and the make contact 97-98 closes. After the test button is released, the overload relay must be reset in the same way as after a normal tripping (see "Reset" above).

Chapter 3 — Configuration

Monitoring Overload of Motors in the EEx e (Explosive) Areas

EEx e type of protection is achieved on motors by special constructive measures. The motors are assigned according to the highest permissible surface temperature classes. The temperature rise time t_E and the ratio between startup current and rated current I_A/I_N are calculated also and specified on the rating plate of the motor.

The temperature rise time t_E represents the time that expires for the temperature of the motor winding to rise from its final rated operational temperature up to the limit temperature, at a startup current of $I_A t$.

However, since EEx e motors are not intrinsically safe, explosion safety is only achieved by taking special measures during installation and by selecting appropriate operating conditions (PTB testing regulations), e.g. by a combination of the circuit with a correctly rated and set overload current protection.

Adjusting the Overload Current Protection

⚠ WARNING

The selected current overload protection system must not only ensure proper motor current monitoring, but also that the seized motor is switched off within the temperature rise time t_E. This means the protective device must be rated in such a way to ensure that the tripping time t_A for the ratio I_A/I_N of the EEx e motor is not higher than its temperature rise time t_E according to its characteristics curve, in order to safely switch off the motor within that period (see following example).

Example: $I_A/I_N = 6$, $t_E = 10$ s

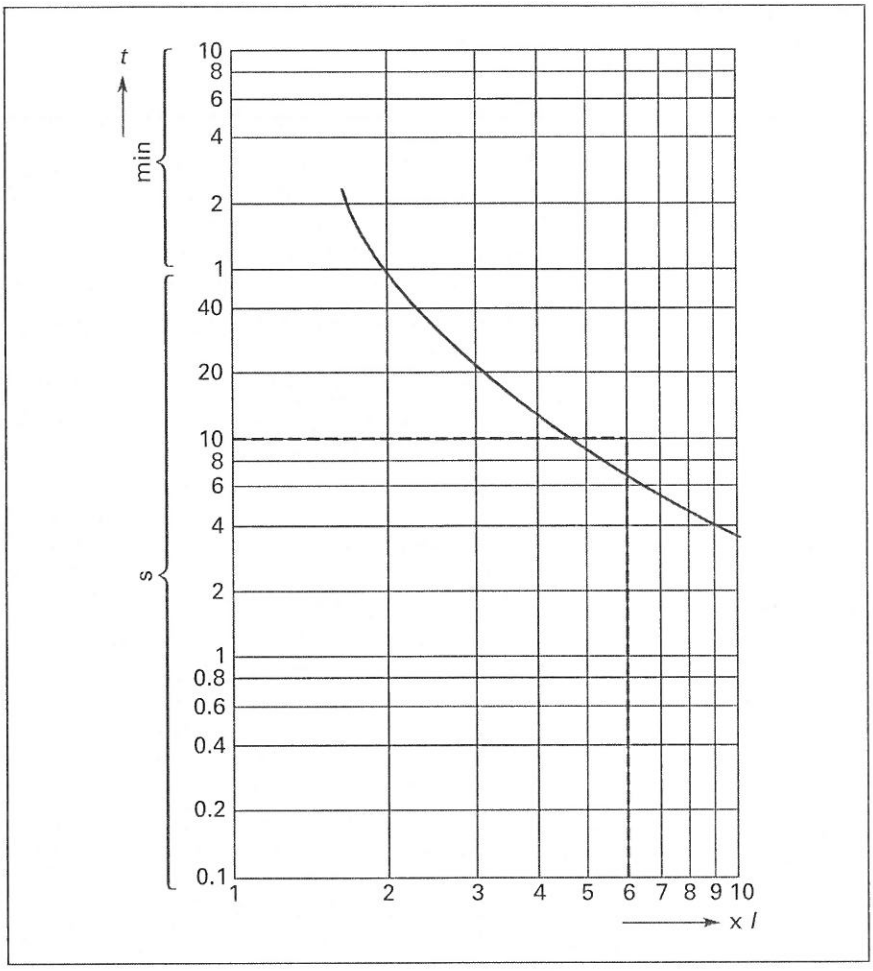

Figure 3-1: Tripping Characteristics of the Overload Relay

The motor is reliably protected.

Short-Circuit Protection of the Overload Relays

The overload relays are short-circuit protected by means of fuses. When the relay is mounted directly onto a contactor relay, the corresponding primary fuse of the contactor relay is taken into account accordingly.

⚠ CAUTION

Only co-ordination type "2" is permissible for the protection of EEx e motors.

Table 3-1: XTOB Frame B Direct Mounting

	Contactor Relay	Fuse gG/gL [A]		Rate Short-Circuit
		Type of Assignment "1" ①	Type of Assignment "2" ①	Current I_q [kA]
XTOBP16BC1 XTOBP24BC1 XTOBP40BC1 XTOBP60BC1	XTCE007B XTCE009B XTCE012B	25 25 25 25	0.5 1 2 4	100
XTOB001BC1 XTOB1P6BC1 XTOB2P4BC1 XTOB004BC1		25 25 25 25	4 6 10 16	
XTOB006BC1 XTOB010BC1 XTOB012BC1 XTOB016BC1		25 50 50 50	20 25 25 25	

① To IEC/EN 60947.

Table 3-2: Direct Mounting or Individual Installation of the XTOB Frame C Overload Relay

	Contactor Relay	Fuse gG/gL [A]		Rate Short-Circuit
		Type of Assignment "1" ②	Type of Assignment "2" ②	Current I_q [kA]
XTOBP16CC1 XTOBP24CC1 XTOBP40CC1 XTOBP60CC1	XTCE018C XTCE025C XTCE032C	25 25 25 25	0.5 1 2 4	100
XTOB001CC1 XTOB1P6CC1 XTOB2P4CC1 XTOB004CC1		25 25 25 25	4 6 10 16	
XTOB006CC1 XTOB010CC1 XTOB016CC1		25 50 63	20 25 35	
XTOB024CC1 XTOB032CC1		100 125	35 63	

② To IEC/EN 60947.

Approvals

The XTPR Manual Motor Protector is manufactured to conform to the IEC/EN 60947 low-voltage switchgear standards and comply with the demands of the 94/9/EC (ATEX 100a) directives standards for the protection of EEx e motors.

Furthermore, motors in zones 21 and 22 (areas with combustible dusts) can be protected conform to EN 50281-1-1 and EN 50281-1-2. The motor outgoer wiring should be implemented to conform to IEC/EN 60947-1, table 9.

CE 0102 Ex II(2)GD

XTOB...B: [?]

XTOB...C: [?]

The system is approved by UL and CSA for the USA and Canada.

Chapter 4 — Installation

Notes on Installation

Note: The mechanical and electrical installation instructions must be observed. The installation instructions are printed on the inside of the cardboard packaging, Pub 51222.

⚠ WARNING

To ensure explosion-proof operation, the overload relay may only be reset/switched on manually, or automatically via a control interlock circuit for the motor or electrical machinery, after the bimetallic release has cooled down.

A manual reset may be carried out locally by trained personnel or in the control room.

⚠ WARNING

Particularly in EEx e applications, an automatic restart must be prevented after an interruption and restoration of the control voltage. This is prevented safely by means of the latching function of the power relay.

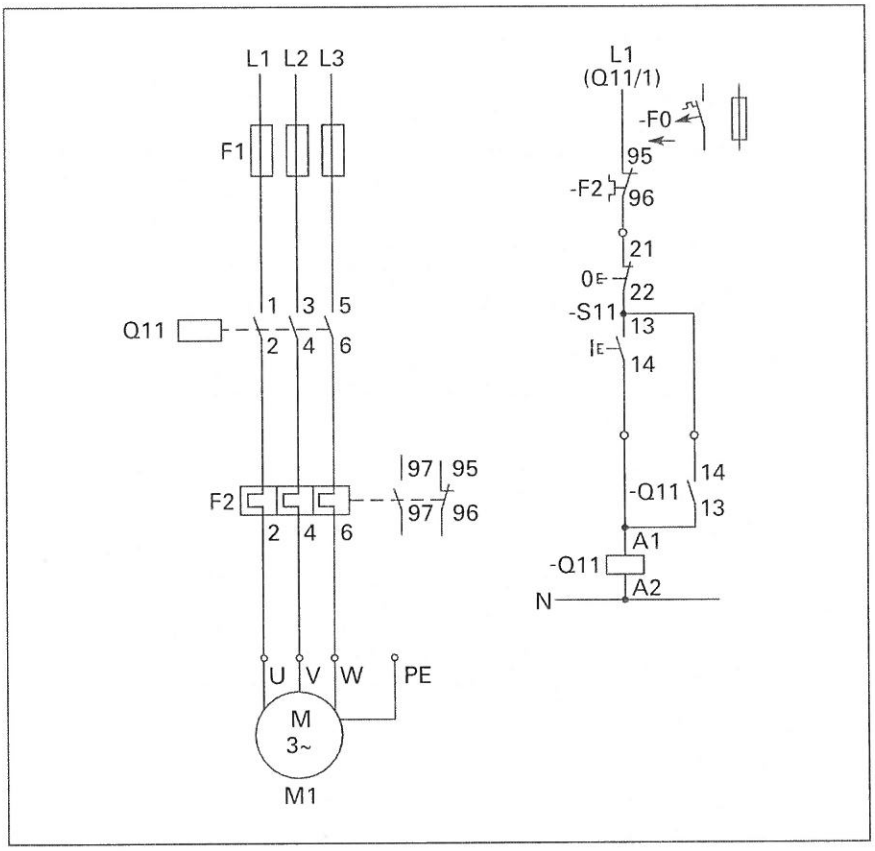

Figure 4-1: Circuit Prevents an Automatic Restart

F1 = Fuse

F2 = Overload relay

M1 = Motor

Q11 = Contactor relay

The latching function of the Q11 contactor relay prevents an automatic restart.

Mounting the Devices

The XTOB overload relays can be mounted directly on the contactor.

The XTOB Frame C can additionally be used in combination with an individual mounting.

Table 4-1: Direct Mounting

Contactor Relay	Overload Relay
XTCE007B, XTCE009B, XTCE012B, XTCE015B	XTOB...B
XTCE018C, XTCE025C, XTCE032C	XTOB...C

Table 4-2: Individual Installation

Overload Relay	Individual Mounting
XTOB...CC1	XTOBXDINC

1. Mount the devices as shown in the figures below.

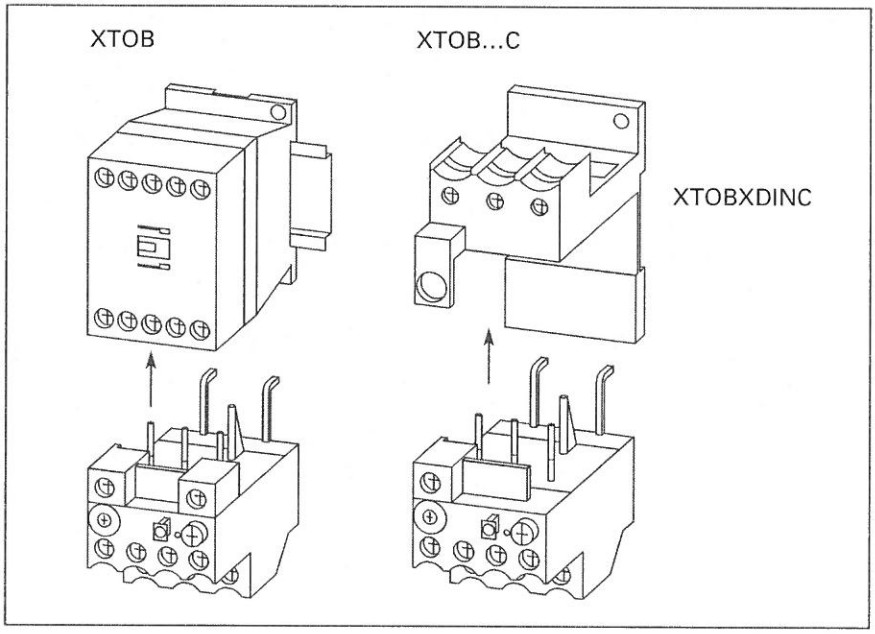

Figure 4-2: Mounting the XTOB

The individually mounted XTOBXDINC can be mounted on a top-hat rail or directly on a mounting plate.

Table 4-3: Mounting Dimensions

	XTOBXDINC
Bore dimensions (W x H) [mm]	35 x 75
Screw [mm]	2 x (M4 x 12)

2. Wire the motor cables.

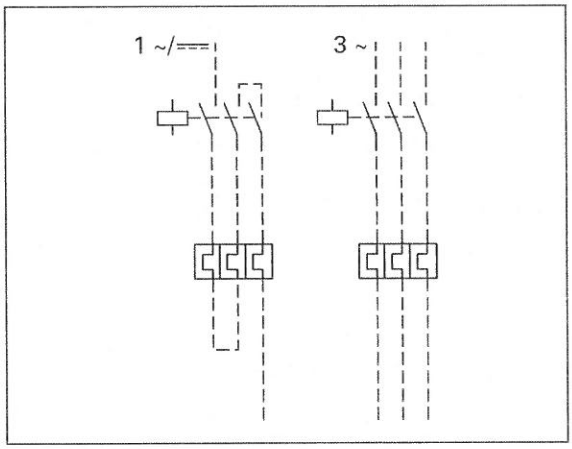

Figure 4-3: Mains Wiring

The following conductor cross-sections can be used.

Table 4-4: Conductor Cross-Sections

	Mains Circuit		Auxiliary Voltage Circuit
	XTOB...BC1	XTOB...CC1	95-96 97-98
[mm²]	1 x (1 – 6)	1 x (1 – 6)	1 x (0.75 – 4)
	2 x (1 – 6)	2 x (1 – 6)	2 x (0.75 – 4)
① [mm²]	1 x (1 – 6)	1 x (1 – 6)	1x (0.75 – 2.5)
	2 x (1 – 6)	2 x (1 – 6)	2x (0.75 – 2.5)
AWG	1 x (14 – 8)	1 x (14 – 8)	1 x (18 – 12)
	2 x (14 – 8)	2 x (14 – 8)	2 x (18 – 12)
Tightening Torque Nm (in-lb)	1.8 (16)	1.8 (16)	1.2 (11)

① Ferrule to DIN 46228.

Chapter 5 — Operating the Devices

Settings

Prior to initial commissioning, the rated motor current must be set on the overload relay by means of the current dial (see **Tables 2-3** and **2-4** on **Page 2-4**).

⚠ CAUTION

If the overload relay is installed at a cool location (e.g. 23°F [-5°C]) and the motor is installed at a warm motor location (e.g. 104°F [40°C]), it is possible that there will be a delayed release during an overload if the devices are operated in the lower current setting range.

Reset

The user can select automatic restart "A" or manual reset "H" on the XTOB Frames B and C Overload Relays by means of the Reset selector button.

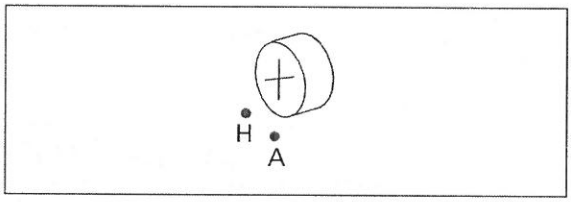

Figure 5-1: Switching Options of the Reset Selector Button

The factory set position "H" on the Frames B and C Overload Relay prevents automatic restarts. In position "H", the relay must be reset manually after it has tripped by pressing the selector button.

Test

The XTOB overload relay is equipped with a test button that has an integral dual function.

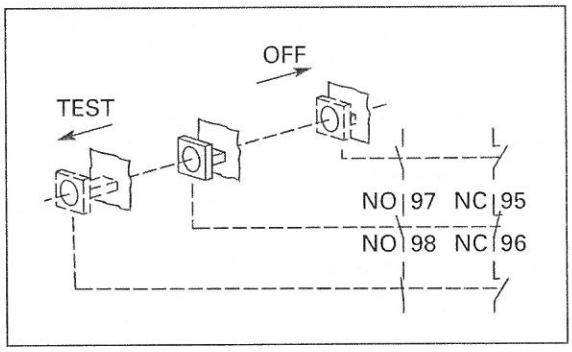

Figure 5-2: Switching Options of the Test Button

The auxiliary contact 95-96 is opened by pressing the button, and can thus be used to switch off the contactor relay.

The function of both auxiliary contacts can be tested in current-less state by pressing the button.

⚠ WARNING

Faulty devices may not be opened for repairs and may only be replaced by qualified personnel.

Appendix A

Rating Plate

Overload Relay XTOB

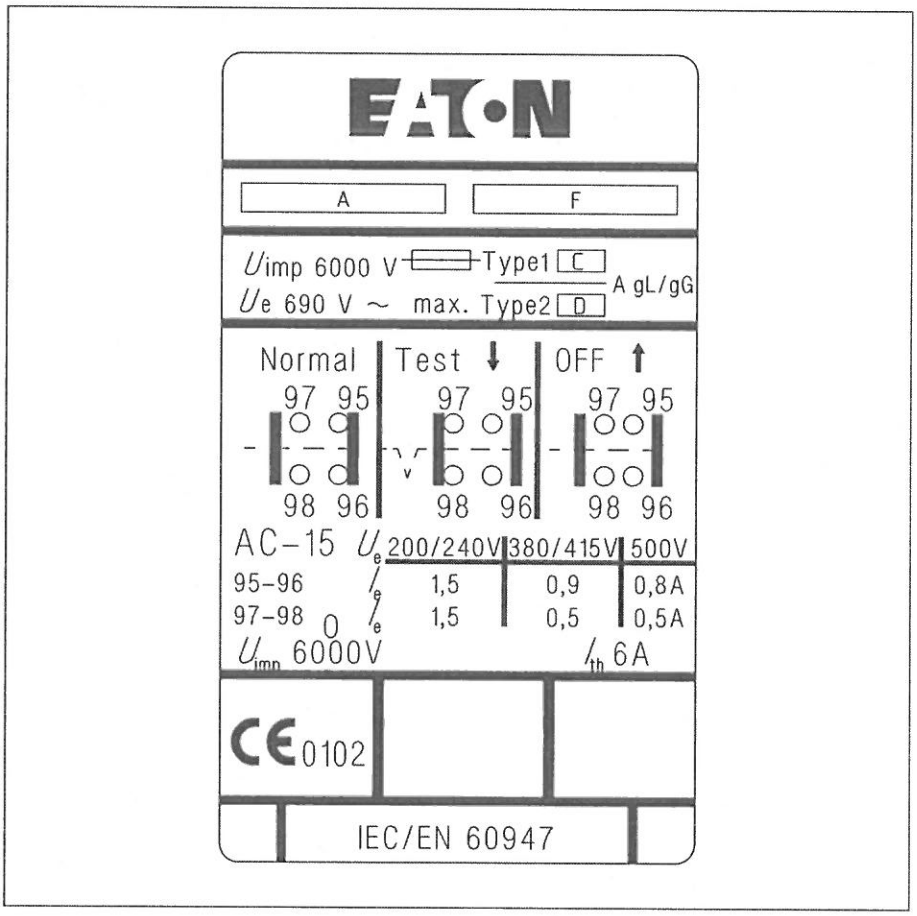

Figure A-1: Rating Plate XTOB

For information on the assignment of values (F, C, D) to the relevant types (A), please refer to **Table A-1.**

Table A-1: Values of the Various Types

A	F	C	D
XTOBP16BC1	0.1 – 0.16A	25	0.5
XTOBP24BC1	0.16 – 0.24A	25	1
XTOBP40BC1	0.24 – 0.4A	25	2
XTOBP60BC1	0.4 – 0.6A	25	4
XTOB001BC1	0.6 – 1A	25	4
XTOB1P6BC1	1 – 1.6A	25	6
XTOB2P4BC1	1.6 – 2.4A	25	10
XTOB004BC1	2.4 – 4A	25	16
XTOB006BC1	4 – 6A	25	20
XTOB010BC1	6 – 10A	50	25
XTOB012BC1	9 – 12A	50	25
XTOB016BC1	12 – 16A	50	25
XTOBP16CC1	0.1 – 0.16A	25	0.5
XTOBP24CC1	0.16 – 0.24A	25	1
XTOBP40CC1	0.24 – 0.4A	25	2
XTOBP60CC1	0.4 – 0.6A	25	4
XTOB001CC1	0.6 – 1A	25	4
XTOB1P6CC1	1 – 1.6A	25	6
XTOB2P4CC1	1.6 – 2.4A	25	10
XTOB004CC1	2.4 – 4A	25	16
XTOB006CC1	4 – 6A	25	20
XTOB010CC1	6 – 10A	50	25
XTOB016CC1	10 – 16A	63	35
XTOB024CC1	16 – 24A	100	35
XTOB032CC1	24 – 32A	125	63

Tripping Characteristics

XTOBP16BC1 and XTOBP16CC1

Table A-2: XTOBP16BC1 and XTOBP16CC1 — Technical Data

Item	Specification
Range	0.1 – 0.16A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-3: XTOBP16BC1 and XTOBP16CC1 — Tripping Time

	Tripping Time *t* [s]			
	NM		HM	
Setting	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	23.0	17.5	21.0	14.0
7.2 x *I*	5.5	4.6	5.2	4.0

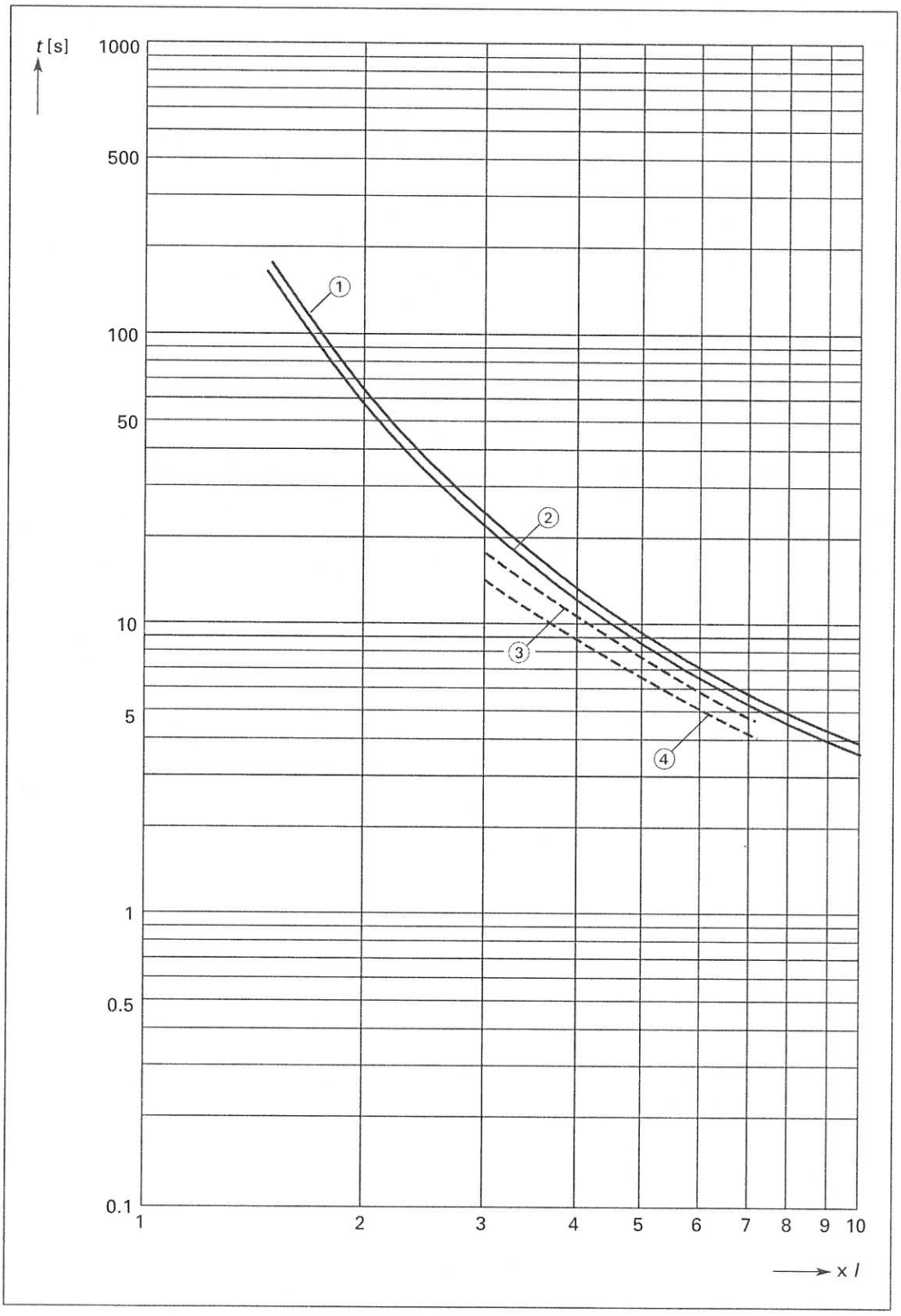

Figure A-2: XTOBP16BC1 and XTOBP16CC1

XTOBP24BC1 and XTOBP24CC1

Table A-4: XTOBP24BC1 and XTOBP24CC1 — Technical Data

Item	Specification
Range	0.16 – 0.24A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-5: XTOBP24BC1 and XTOBP24CC1 — Tripping Time

	Tripping Time *t* [s]			
	NM		HM	
Setting	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	21.0	15.0	21.0	13.5
7.2 x *I*	5.1	4.0	5.1	3.6

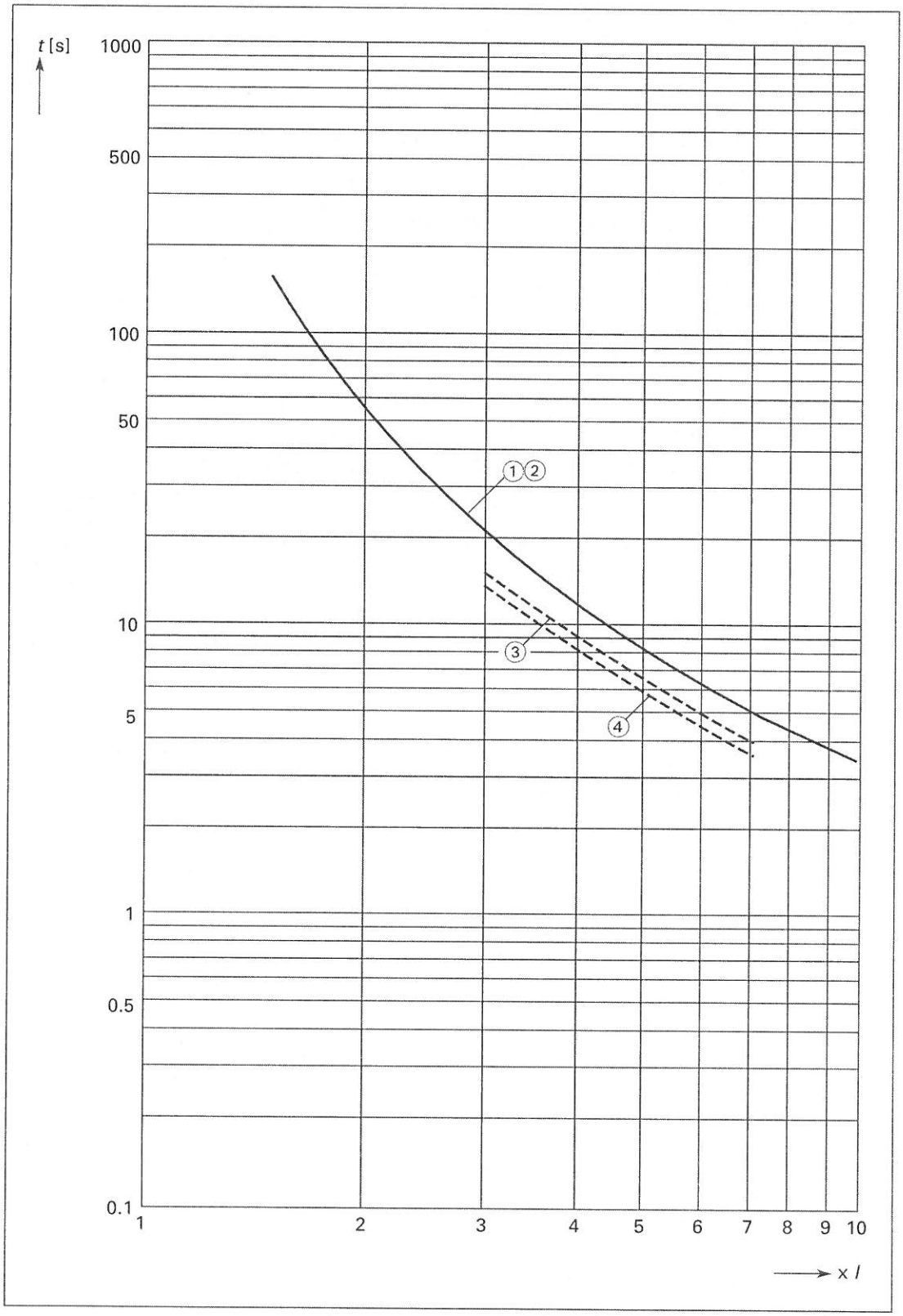

Figure A-3: XTOBP24BC1 and XTOBP24CC1

XTOBP40BC1 and XTOBP40CC1

Table A-6: XTOBP40BC1 and XTOBP40CC1 — Technical Data

Item	Specification
Range	0.24 – 0.4A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-7: XTOBP40BC1 and XTOBP40CC1 — Tripping Time

Setting	Tripping Time *t* [s]			
	NM		HM	
	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	23.5	18.0	22.0	13.5
7.2 x *I*	5.9	4.8	5.5	4.0

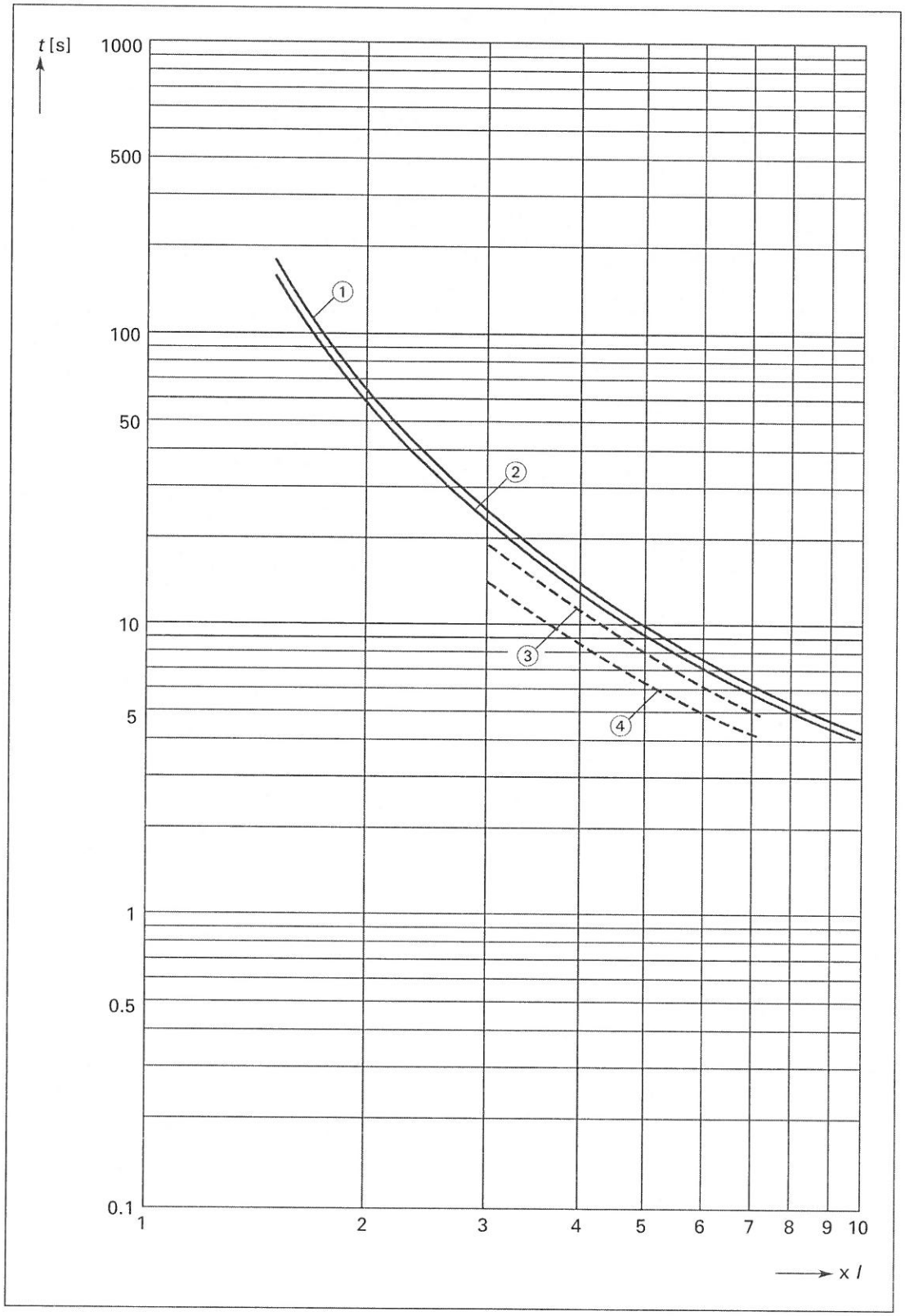

Figure A-4: XTOBP40BC1 and XTOBP40CC1

XTOBP60BC1 and XTOBP60CC1

Table A-8: XTOBP60BC1 and XTOBP60CC1 — Technical Data

Item	Specification
Range	0.4 – 0.6A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-9: XTOBP60BC1 and XTOBP60CC1 — Tripping Time

Setting	Tripping Time *t* [s]			
	NM		HM	
	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	27.0	19.5	25.0	15.5
7.2 x *I*	6.5	5.4	6.2	4.6

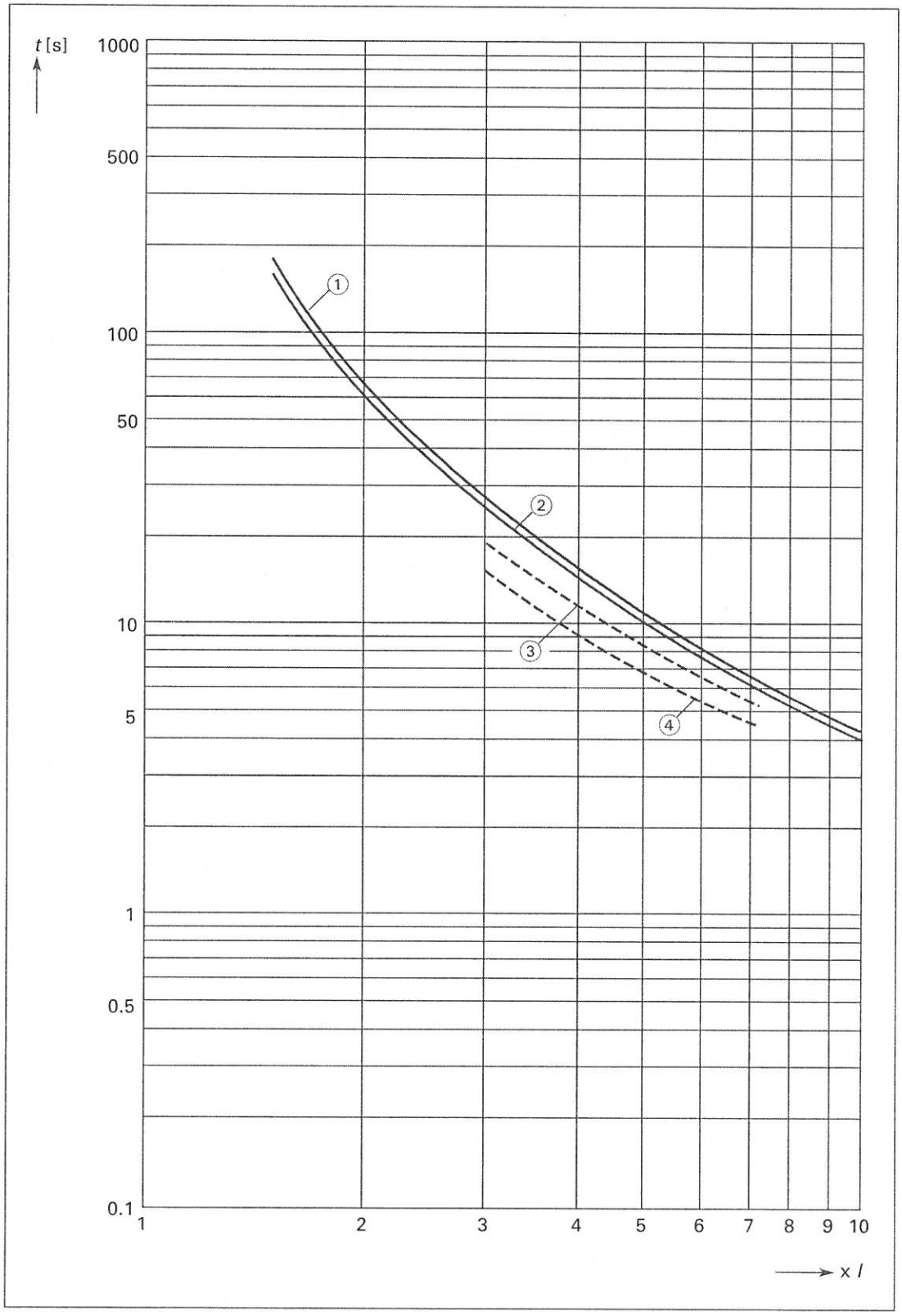

Figure A-5: XTOBP60BC1 and XTOBP60CC1

XTOB001BC1 and XTOB001CC1

Table A-10: XTOB001BC1 and XTOB001CC1 — Technical Data

Item	Specification
Range	0.6 – 1A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-11: XTOB001BC1 and XTOB001CC1 — Tripping Time

Setting	Tripping Time *t* [s]			
	NM		HM	
	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	29.4	22.0	26.0	15.0
7.2 x *I*	7.3	5.9	6.5	4.6

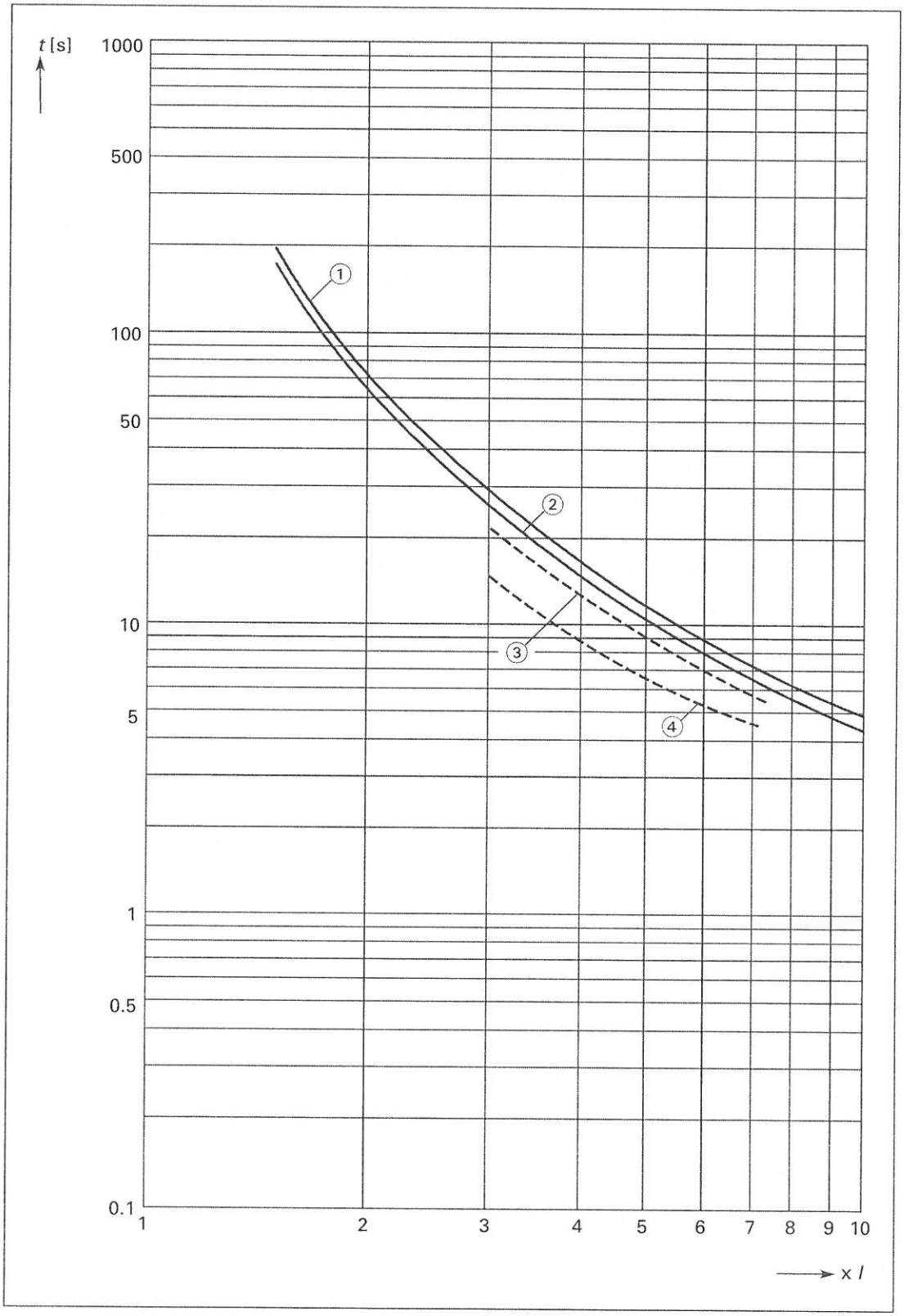

Figure A-6: XTOB001BC1 and XTOB001CC1

XTOB1P6BC1 and XTOB1P6CC1

Table A-12: XTOB1P6BC1 and XTOB1P6CC1 — Technical Data

Item	Specification
Range	1 – 1.6A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-13: XTOB1P6BC1 and XTOB1P6CC1 — Tripping Time

Setting	Tripping Time *t* [s]			
	NM		HM	
	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	29.0	20.0	27.0	16.0
7.2 x *I*	6.9	5.5	6.5	4.4

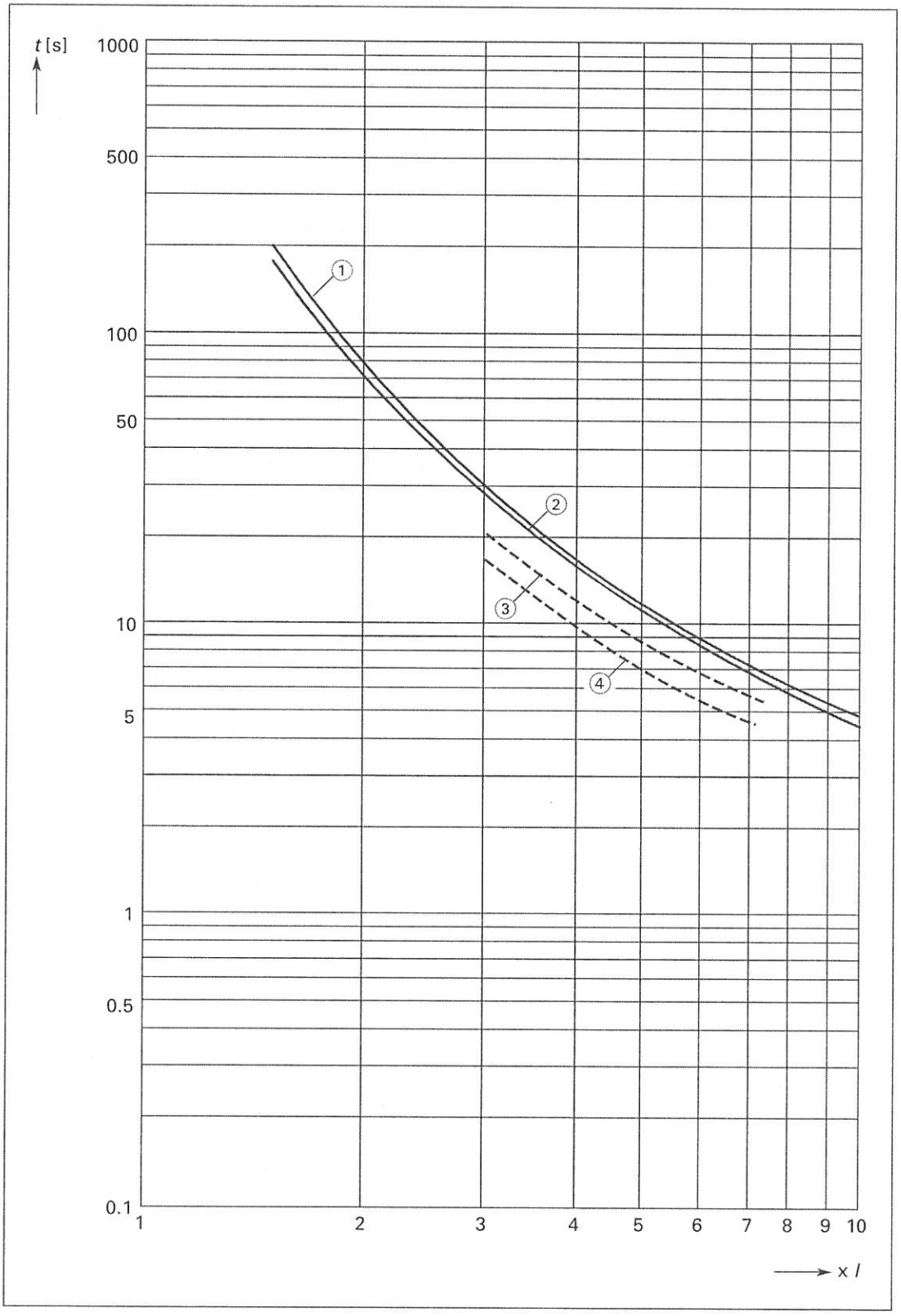

Figure A-7: XTOB1P6BC1 and XTOB1P6CC1

XTOB2P4BC1 and XTOB2P4CC1

Table A-14: XTOB2P4BC1 and XTOB2P4CC1 — Technical Data

Item	Specification
Range	1.6 – 2.4A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-15: XTOB2P4BC1 and XTOB2P4CC1 — Tripping Time

Setting	Tripping Time *t* [s]			
	NM		HM	
	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	28.5	19.0	25.0	15.3
7.2 x *I*	6.8	5.3	6.3	4.7

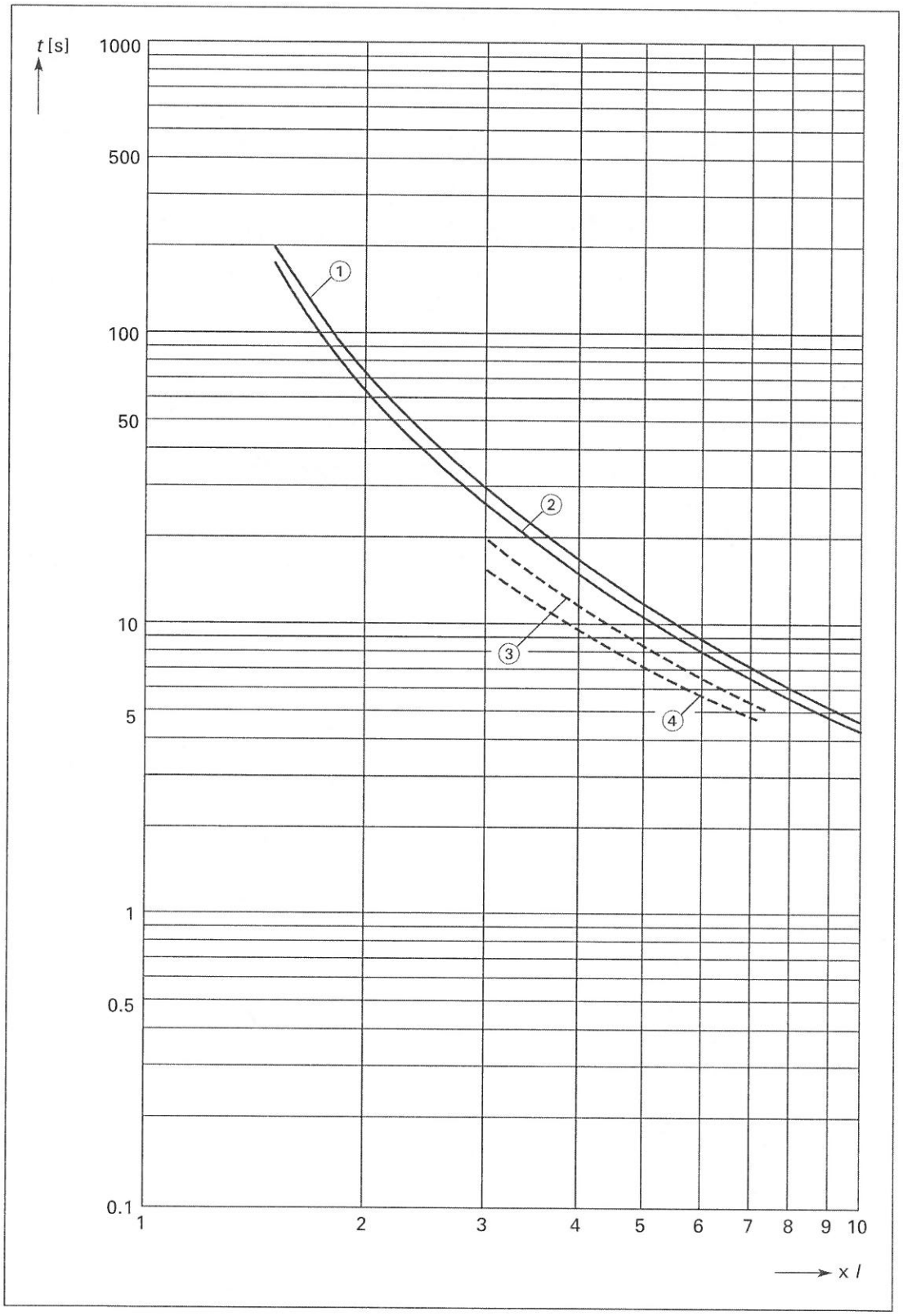

Figure A-8: XTOB2P4BC1 and XTOB2P4CC1

XTOB004BC1 and XTOB004CC1

Table A-16: XTOB004BC1 and XTOB004CC1 — Technical Data

Item	Specification
Range	2.4 – 4A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-17: XTOB004BC1 and XTOB004CC1 — Tripping Time

Setting	Tripping Time *t* [s]			
	NM		HM	
	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	32.1	24.0	30.0	17.9
7.2 x *I*	7.8	6.5	7.3	5.2

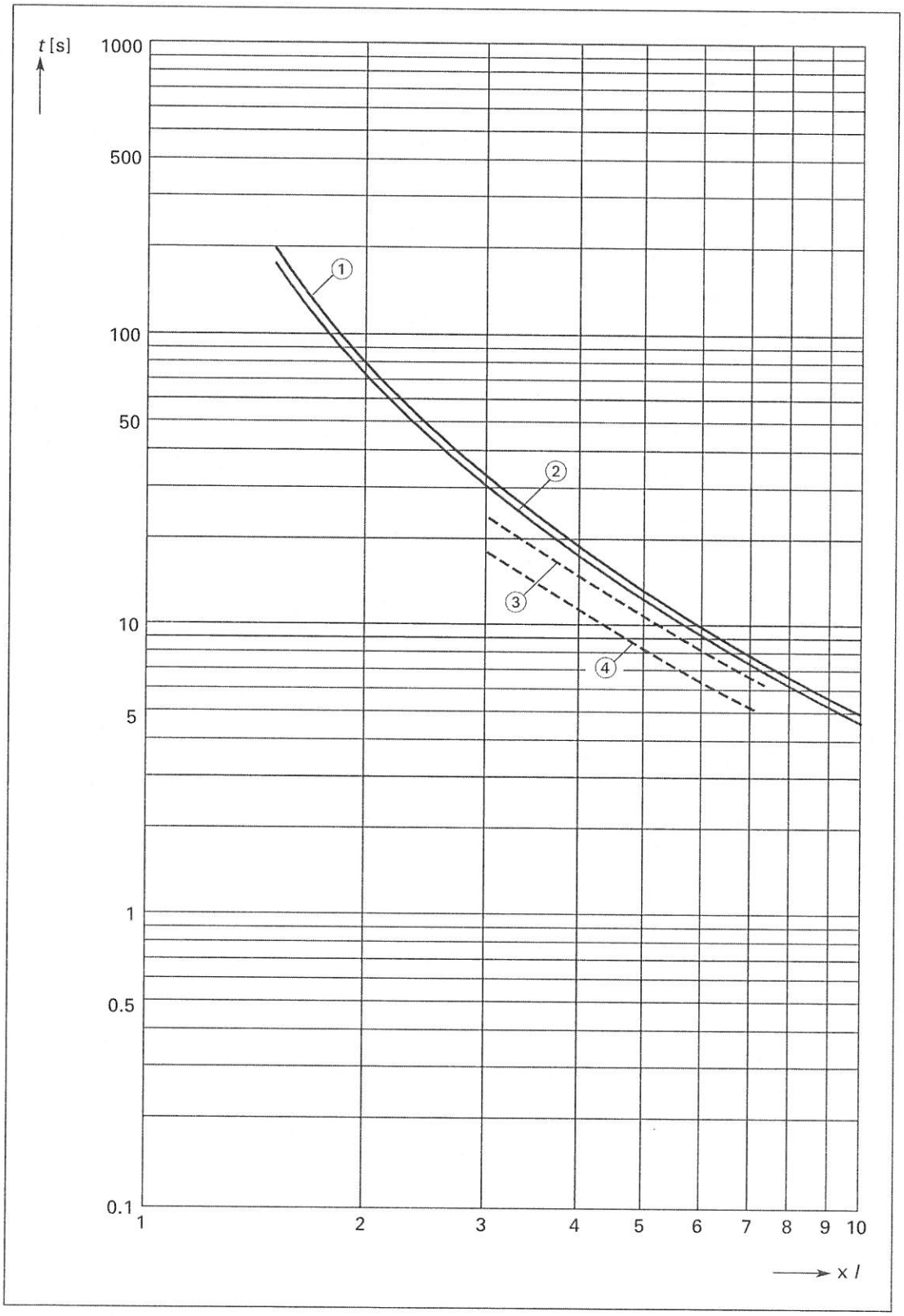

Figure A-9: XTOB004BC1 and XTOB004CC1

XTOB006BC1 and XTOB006CC1

Table A-18: XTOB006BC1 and XTOB006CC1 — Technical Data

Item	Specification
Range	4 – 6A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-19: XTOB006BC1 and XTOB006CC1 — Tripping Time

Setting	Tripping Time *t* [s]			
	NM		HM	
	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	32.5	24.5	30.0	19.2
7.2 x *I*	7.4	6.0	6.9	5.0

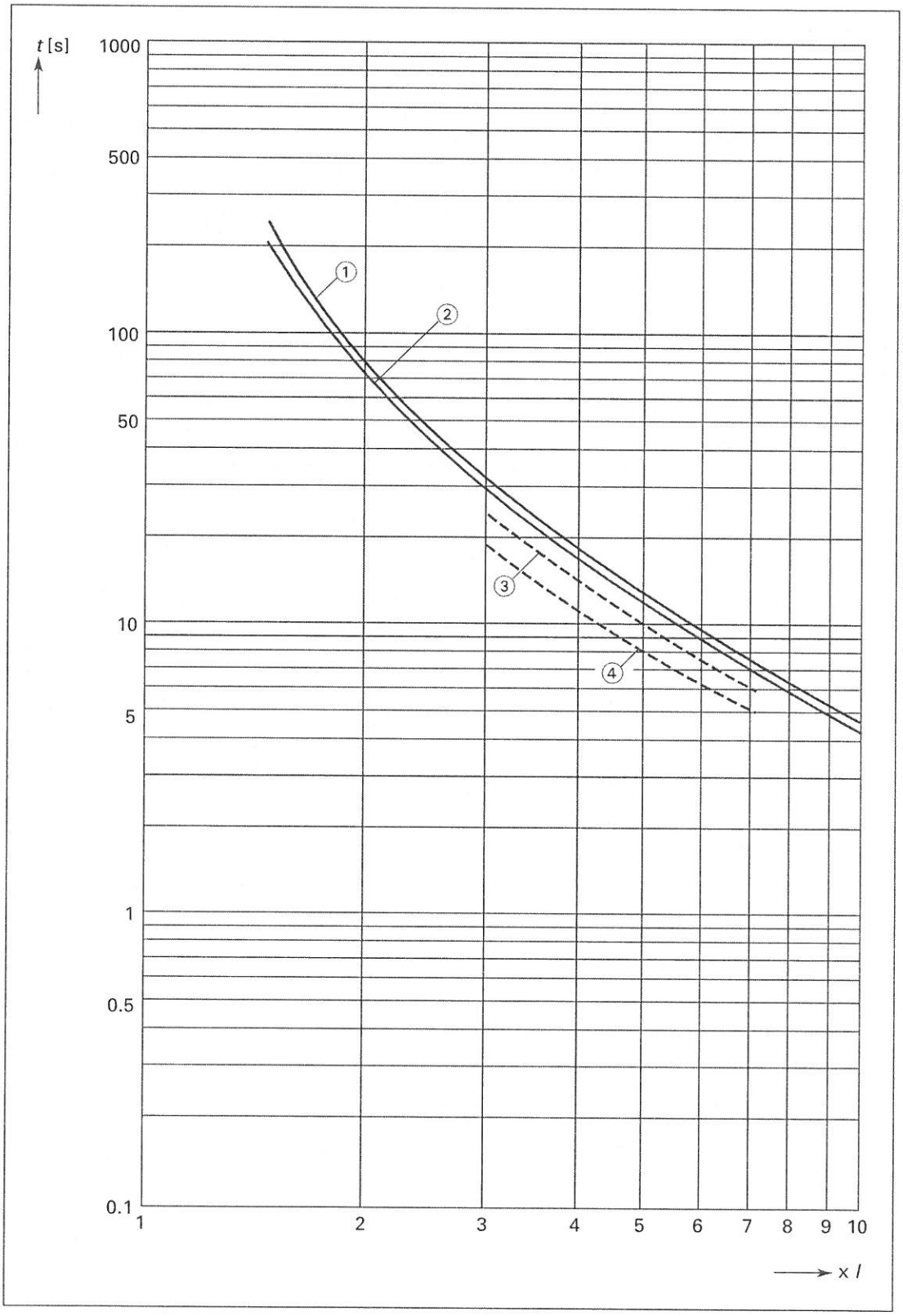

Figure A-10: XTOB006BC1 and XTOB006CC1

XTOB010BC1 and XTOB010CC1

Table A-20: XTOB010BC1 and XTOB010CC1 — Technical Data

Item	Specification
Range	6 – 10A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-21: XTOB010BC1 and XTOB010CC1 — Tripping Time

Setting	Tripping Time *t* [s]			
	NM		HM	
	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	33.5	23.7	31.0	19.0
7.2 x *I*	7.0	5.3	6.2	4.4

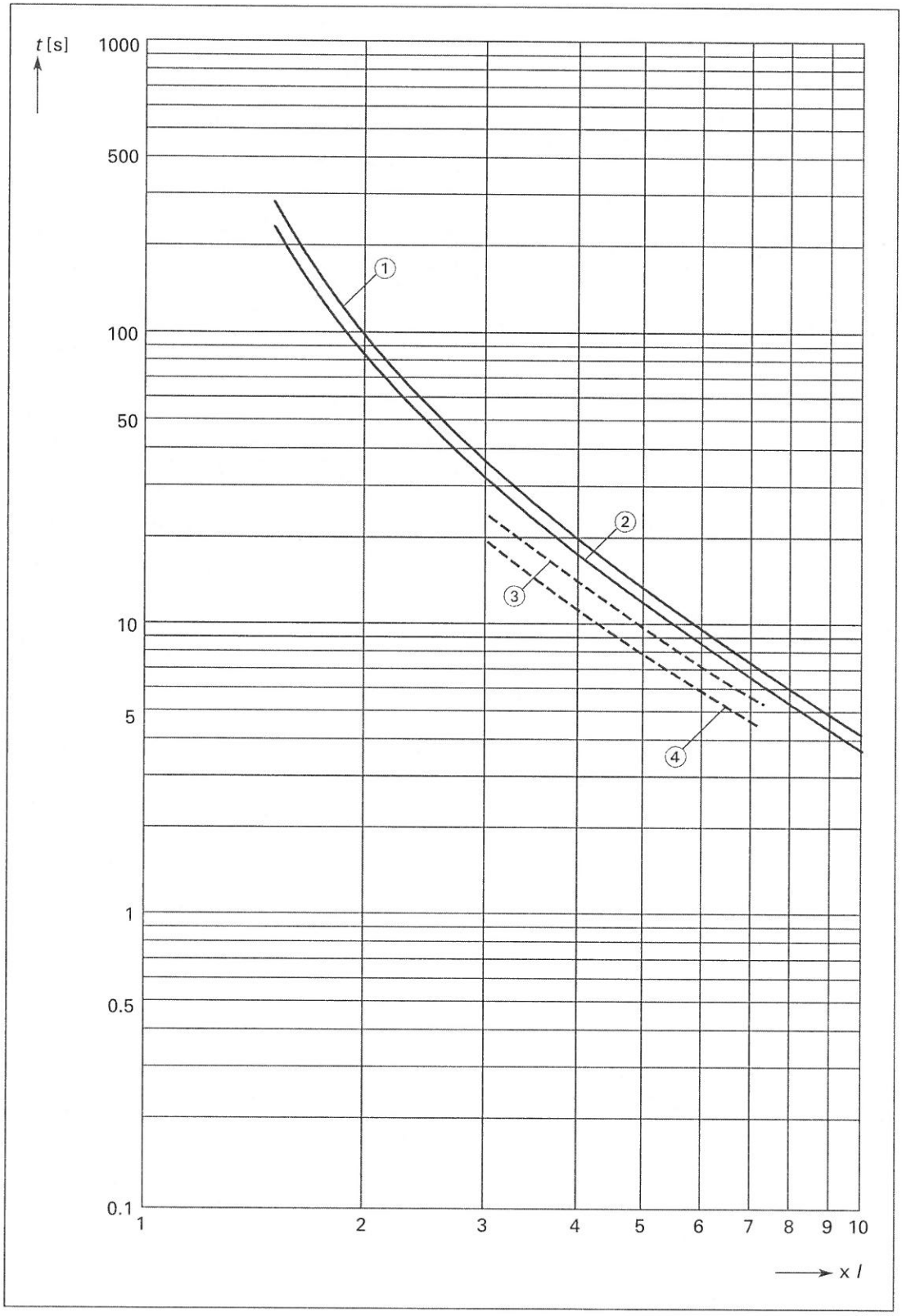

Figure A-11: XTOB010BC1 and XTOB010CC1

XTOB012BC1

Table A-22: XTOB012BC1 — Technical Data

Item	Specification
Range	9 – 12A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-23: XTOB012BC1 — Tripping Time

	Tripping Time *t* [s]			
	NM		HM	
Setting	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	30.7	18.8	27.2	15.7
7.2 x *I*	6.1	4.1	5.6	3.6

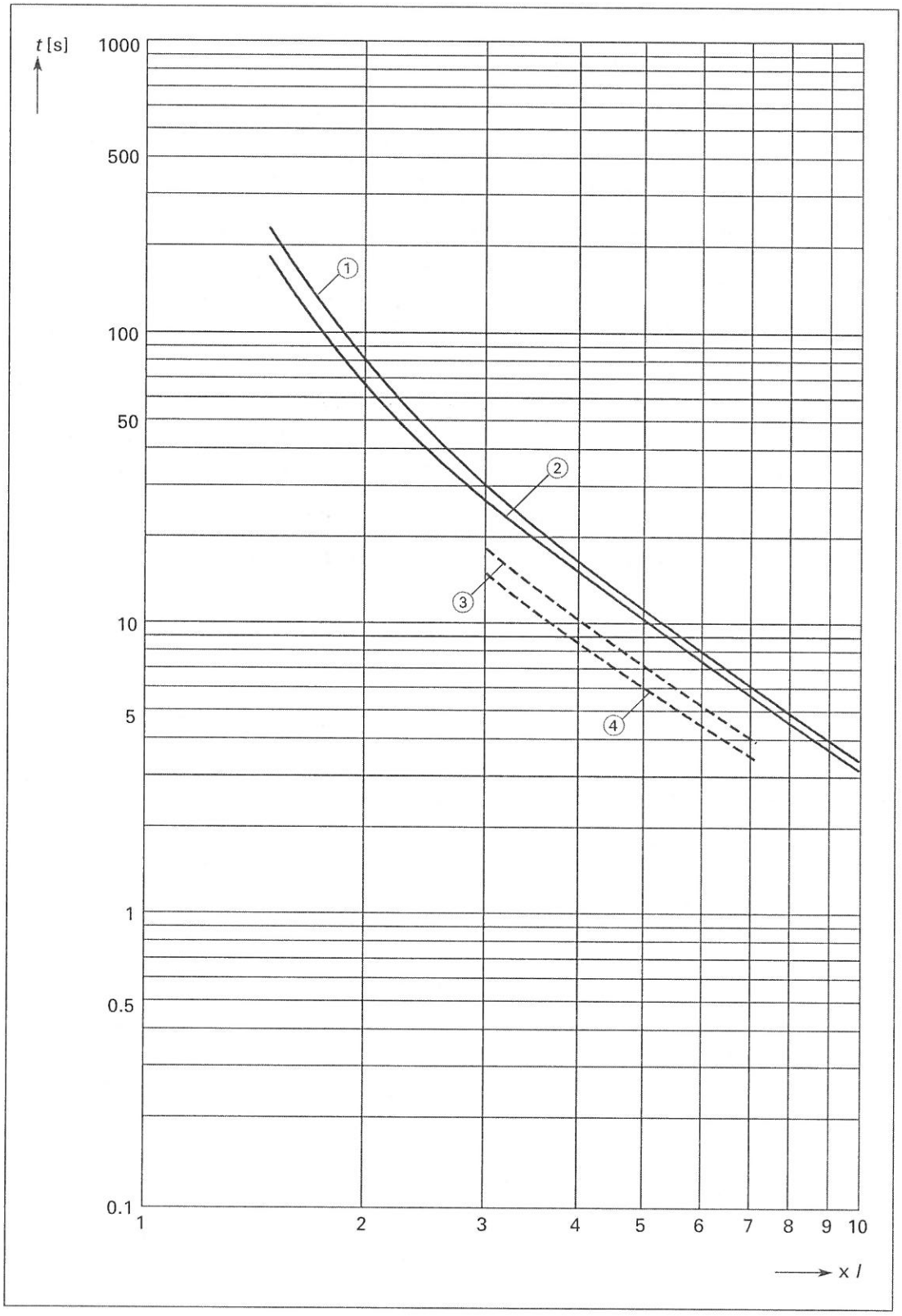

Figure A-12: XTOB012BC1

XTOB016BC1

Table A-24: XTOB016BC1 — Technical Data

Item	Specification
Range	12 – 16A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-25: XTOB016BC1 — Tripping Time

	Tripping Time *t* [s]			
	NM		HM	
Setting	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	30	24	29	19
7.2 x *I*	4.3	3.6	4.1	3.0

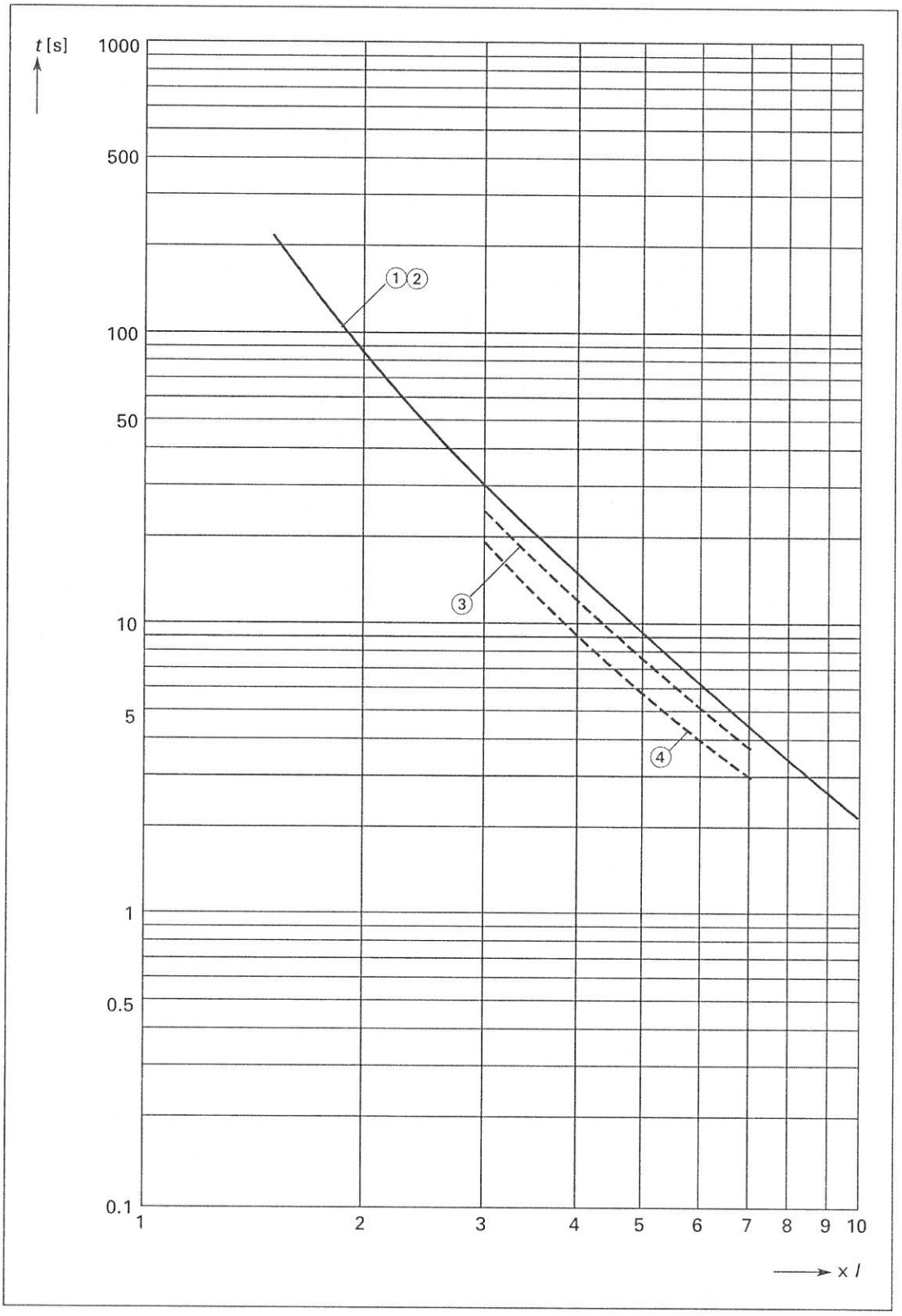

Figure A-13: XTOB016BC1

XTOBP016CC1

Table A-26: XTOB016CC1 — Technical Data

Item	Specification
Range	10 – 16A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-27: XTOB016CC1 — Tripping Time

Setting	Tripping Time *t* [s]			
	NM		HM	
	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	30.0	22.0	28.0	16.4
7.2 x *I*	4.1	3.2	3.8	2.4

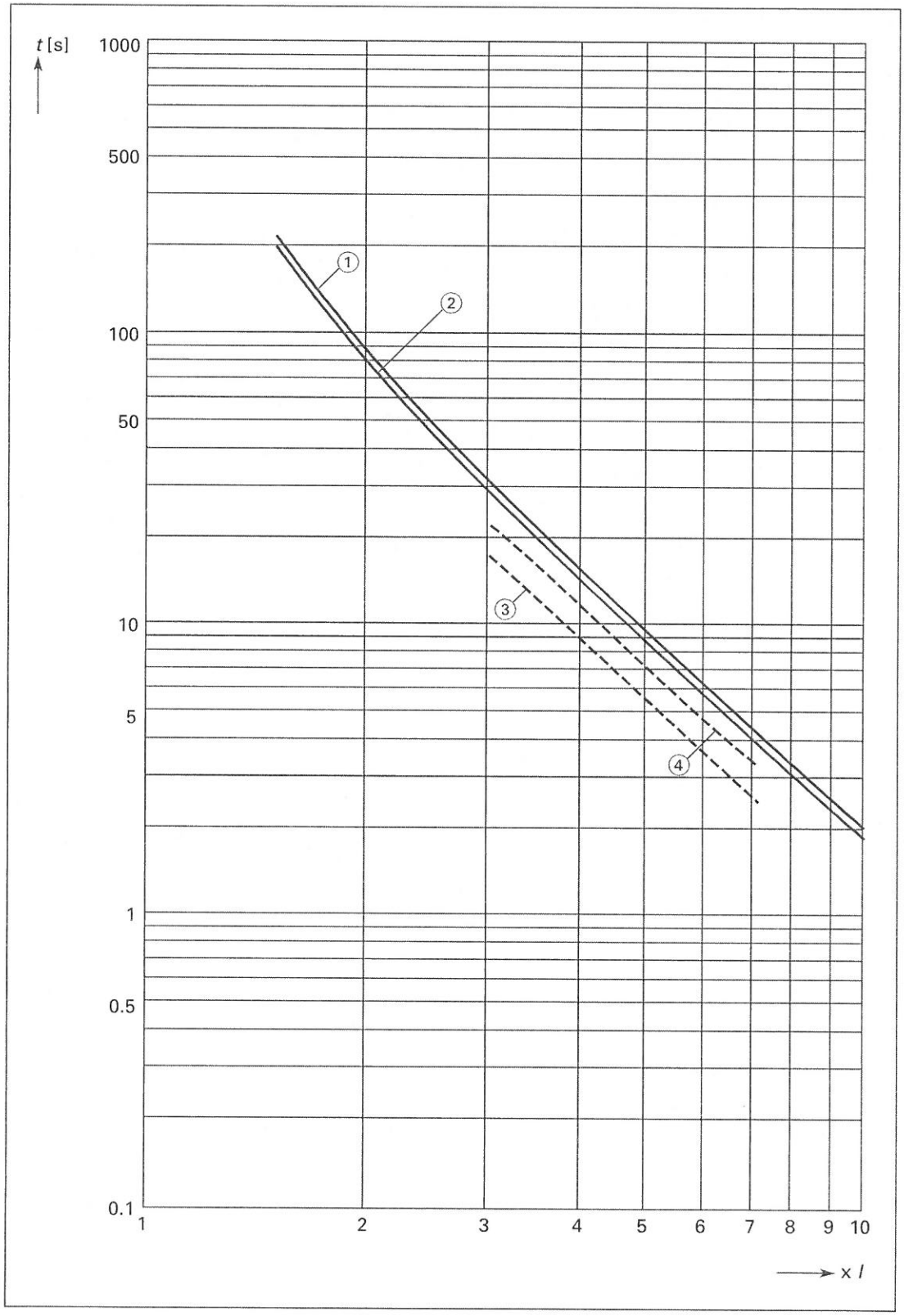

Figure A-14: XTOB016CC1

XTOB024CC1

Table A-28: XTOB024CC1 — Technical Data

Item	Specification
Range	16 – 24A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-29: XTOB024CC1 — Tripping Time

	Tripping Time *t* [s]			
	NM		HM	
Setting	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	34.5	24.5	30.0	19.0
7.2 x *I*	6.3	4.9	5.6	4.0

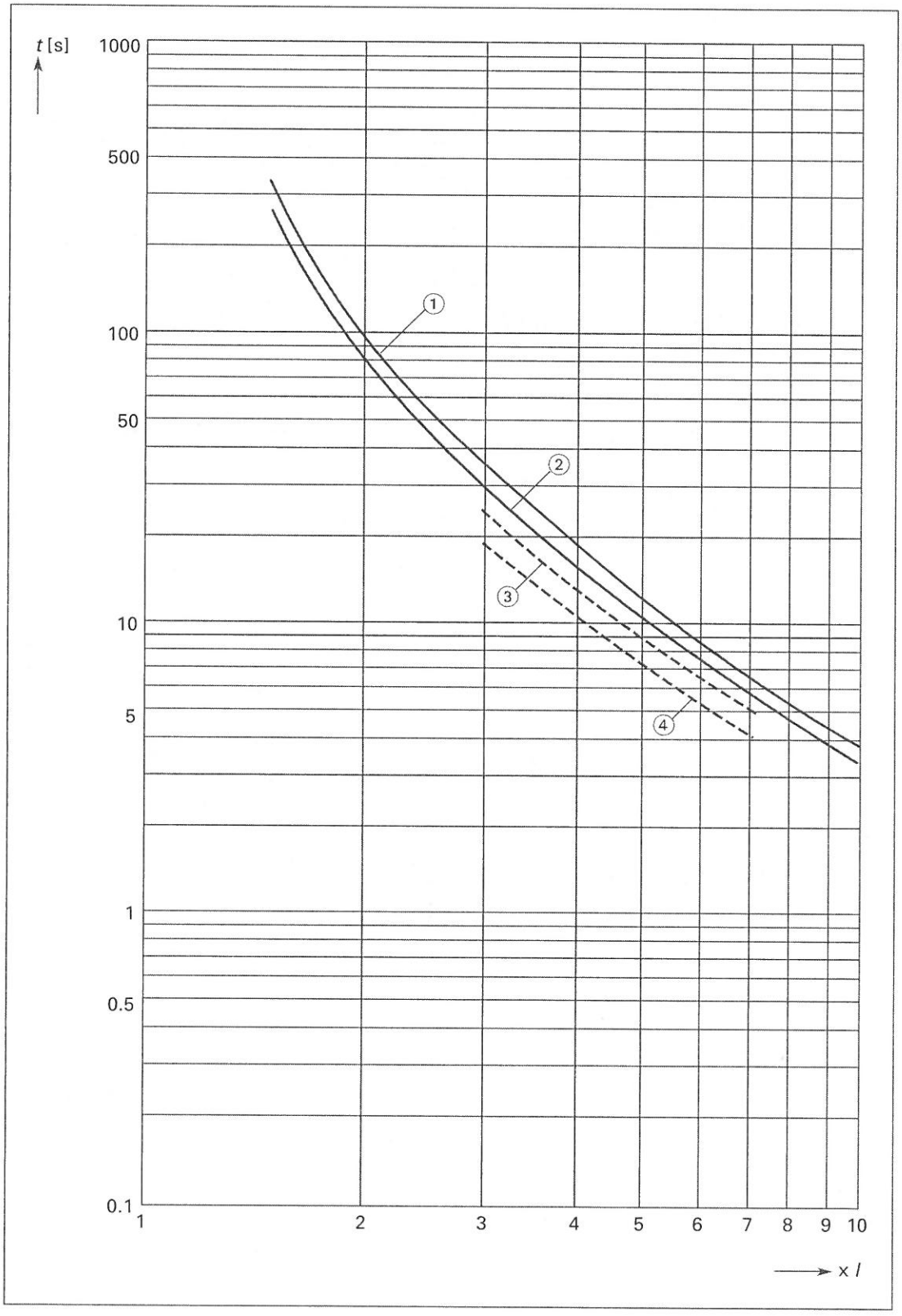

Figure A-15: XTOB024CC1

XTOB032CC1

Table A-30: XTOB032CC1 — Technical Data

Item	Specification
Range	24 – 32A (NM – HM)
Ambient temperature	68°F (20°C)
Tripping class	10A
Tolerance range	± 20%

Table A-31: XTOB032CC1 — Tripping Time

	Tripping Time *t* [s]			
	NM		HM	
Setting	Three-Phase ①	Two-Phase ③	Three-Phase ②	Two-Phase ④
3 x *I*	30.2	21.8	26.6	17.8
7.2 x *I*	6.1	4.7	5.4	3.9

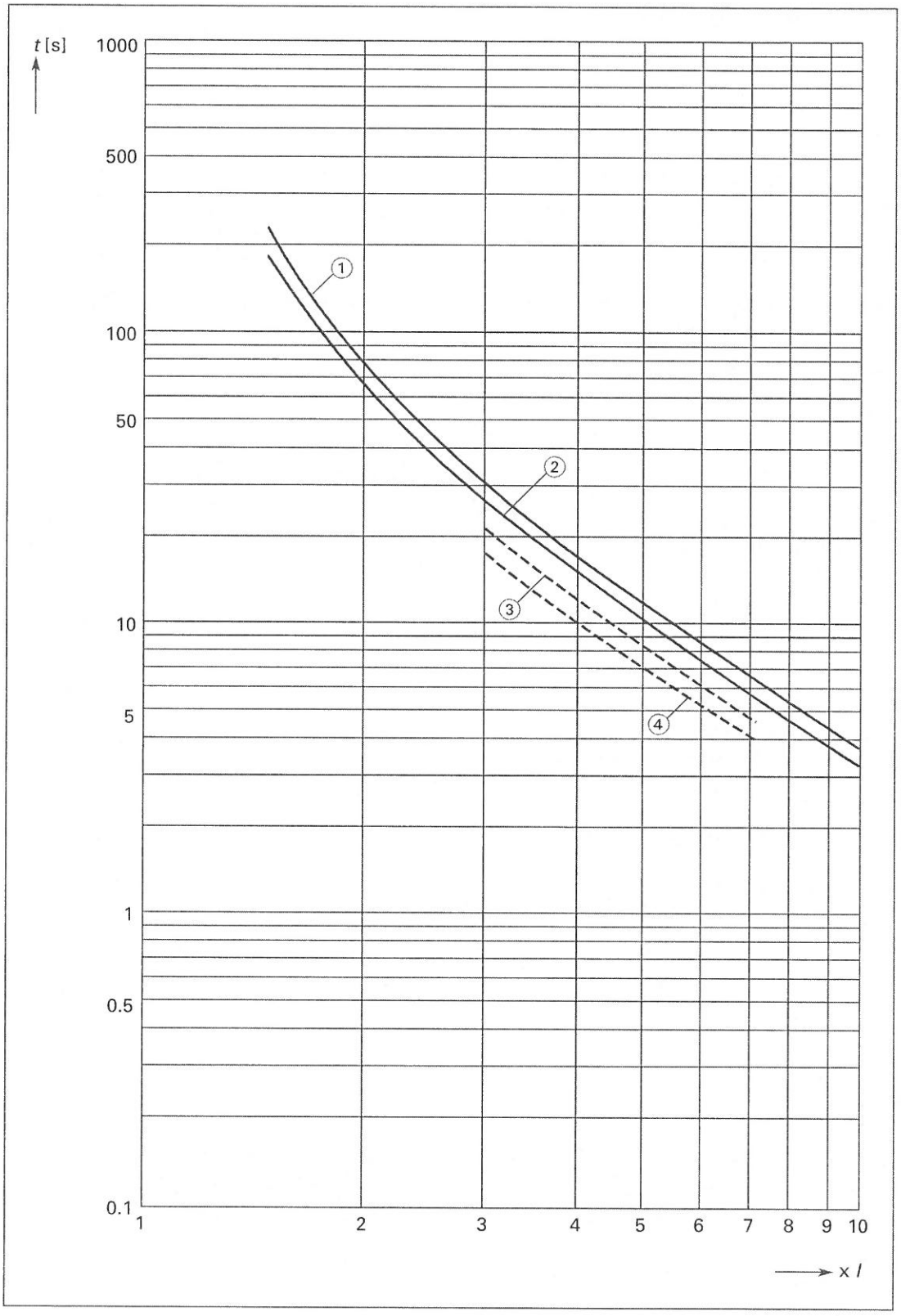

Figure A-16: XTOB032CC1

May 2006

EC Declaration of Conformity

We, Eaton Electrical, declare under our sole responsibility that our product:

XT Overload Relay Frame B, Frame C and Accessories

(Product Name)

with the following type reference:

XTOB...BC1, XTOB...CC1

(Model Name)

to which this declaration relates is in conformity with the following standard(s) or normative document(s):

EN 60947-4-1:2001 + A1:2002
EN 60947-5-1:1997 + A12:1999 + A1:1999 + A2:2000
EN 60947-1:1999 + A1:2000 + A2:2001

and is in accordance with the provisions of the following EC-directive(s):

Low Voltage Directive 73/23/EEC + 93/68/EEC
EMC Directive 89/336/EEC + 92/31/EEC + 93/68/EEC

The CE marking was affixed in the year 2006.

This declaration is issued from:

Eaton Corporation
Standard and Logic Control BU — Industrial Control Division
4201 N. 27th Street
Milwaukee, Wisconsin 53216 USA

on 31 January 2006.

Issued by: **Eaton Electrical Inc.**

Christopher J. Roche

(Name)

Senior Manager, Product Development Standard and Logic Control BU
Industrial Control Division

(Position/Title)

CMS Name	Approval Date	Revision Date	Revision No.	Revision Control
466-1071	31 January 2006		01	This document must be modified through CMS.

Annex to EC Declaration of Conformity for XT Overload Relay Frame B, Frame C and Accessories, 466-1071 dated 31 January 2006

Accessories:

XTOBXDINC

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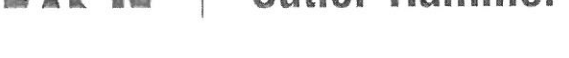

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May 2006

TYPE 1000 TRANSDUCER
Product Instructions

PRINCIPLE OF OPERATION

The Type 1000 transducer is a force balance device in which a coil is suspended in the field of a magnet by a flexure. Current flowing through the coil generates axial movement of the coil and flexure. The flexure moves against the end of a nozzle, and creates a back pressure in the nozzle by restricting air flow. This back pressure acts as a pilot pressure to an integral booster relay. Consequently, as the input signal increases (or decreases, for reverse acting), output pressure increases proportionally.

Zero and span are calibrated by turning easily accessible adjusting screws on the front face of the unit. The zero adjustment causes the nozzle to move relative to the flexure. The span adjustment is a potentiometer that limits the flow of current through the coil. A thermistor circuit in series with the coil provides temperature compensation.

MOUNTING

→ The T1000 can be mounted at any angle, but should be calibrated after mounting. For maximum output pressure stability, the Type 1000 should be mounted vertically in a vibration free location or such that the vibration is isolated to the X and Z axis as shown in ***Figure 3***.

Pipe: Due to its light weight , the Type 1000 may be supported by the piping used for the supply and output.

Panel: *(with access to rear of panel)* Attach transducer (***See Fig. 3***), to panel using two 10-32 screws and two threaded mounting holes on the back of the unit.

Panel: *(with no access to rear of panel)* Attach bracket ***(see Fig 1 and 3)***, to transducer using two 10-32 screws on the back of the unit and mount bracket to panel using four 8-32 screws.

Pipe mount U-Bolt Option: The pipe mounting hardware is not standard. Attach the bracket from Valve Mounting Kit, (order 010134000) to transducer using two 10-32 screws. Place u-bolt from 2" Pipe Mounting Kit (order 010-143-000) around pipe and through the bracket. Place lock washers and nuts on u-bolt and tighten.

DIN Rail Mounting Kit Option: The DIN rail mounting kit is not standard. Order DIN Rail Kit (010115000).

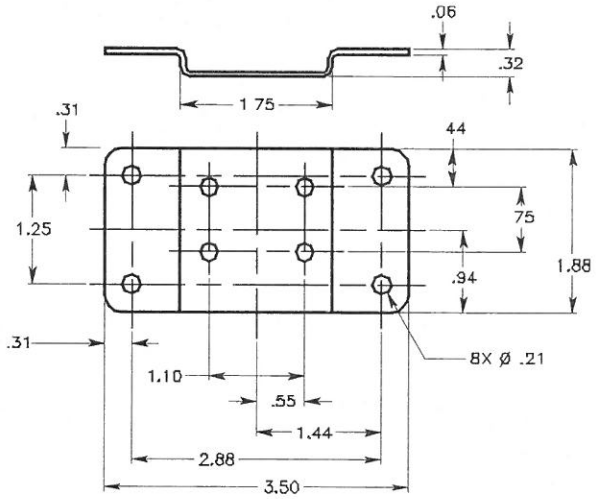


Figure 1

Warranties of Sale, disclaimer thereof and limitations of liability are covered exclusively by Marsh Bellofram's printed warranty statement for the T-1000 transducer. These instructions do not expand, reduce, modify or alter Marsh Bellofram's warranty statement and no warranty or remedy in favor of a customer or any other person arises out of these instructions.

AIR CONNECTIONS

- Supply Air must be instrument quality air regulated between the minumum and maximum specified on the nameplate of the transducer.
- Instrument quality air consists of :
  - a A dew point less than 35 deg. F
  - b No particles larger than three microns
  - c Maximum oil content of 1 ppm
- All unused ports must be plugged.

Supply: Connect supply to the1/4 NPT ports marked "IN" on the base of the transducer. Avoid getting pipe sealant inside the piping or transducer.

Output: Connect output to the 1/4 NPT ports marked"OUT" on the base of the transducer. The pipe plugs may be removed from the two auxiliary output ports for a pressure gauge or as an alternative output port. Note: On certain special models the pipe plugs are not factory installed, and must be installed air tight by the customer.

PRODUCT CERTIFICATIONS

FACTORY MUTUAL

INTRINSIC SAFETY: The Type 1000 (I / P Models 961-099-000 and 961-100-000) transducers are rated intrinsically safe by FM for:
- CLASS I, DIVISION 1, GROUPS A,B,C,D,E,G HAZARDOUS LOCATIONS when installed in accordance with interconnection drawing 229-541-000-012, and the specifiec barrier models.

NOTICE: The above ratings only apply when installed per Interconnection Drawing 229-541-000-012
- Nonincendive for CLASS I, DIVISION II, GROUPS A, B, C, D.
- Suitable for CLASS II and III, DIVISION II, GROUP G. Barriers are not required for nonincendive rating.

CANADIAN STANDARDS ASSOCIATION

INTRINSIC SAFETY: The Type 1000 Transducers, (models 961-105-000 and 961-106-000) are rated intrinsically safe by CSA when connected through certified diode safety barriers in accordance with Bellofram Installation diagram, 229-541-000-012

CENELEC

INTRINSIC SAFETY: The Type 1000 Transducers, (models 961-108-000 and 961-109-000) are CENELEC and Iniex approved for intrinsic safety service. Iniex Certicat de Conformite no. 86.101.068X.

NOTICE: The above ratings only apply when installed per Interconnection Drawing 229-541-000-032

ELECTRICAL CONNECTIONS

PRECAUTIONS TO BE OBSERVED DURING INSTALLATION

The Bellofram T-1000 Transducers were tested at the EMC Test Centre, Dunfermline, Fife, KY11 5LB to the Electromagnetic Compatibility Directive effective January 1, 1996. The relevant EMC specifications tested were the following: EN 50081-1 (1992) and EN 50082-1 (1992). A Technical Construction File, Serial #107 was written and Certificate of Conformity issued by a Competent Body.

EN 50081-1 (1992): Test results confirmed that no precautions need to be observed during installation regarding electromagnetic emissions from the T-1000 Transducers.

EN 50082-1 (1992): The following precautions should be taken during installation to maintain the advertised accuracy specifications for the T-1000 Transducers. The input wiring to the transducer should be isolated from other high voltage transient wiring. The momentary switching on and off of nearby relays, motors, or other high capacitive or inductive loads can have a minor effect on the terminal based linearity specification (1.0% of span, standard range models) for the T-1000. Any change in output pressure is minimal and momentarily, and is considered to be within the performance capabilities of the T-1000. Use of a ferrite bead collar on the input wires entering the transducer is recommended should installation next to high electromagnetic interference be necessary.

Connect electrical signal to the wires exiting from the side of transducer through the 1/2" NPT conduit fitting.

For **DIRECT ACTING:** (where increasing the input signal increases output pressure), connect the positive input signal to the **black** transducer lead, and the negative to the **white** transducer lead.

For **REVERSE ACTING:** (where increasing the input signal decreases output pressure), connect the positive input signal to the **white** transducer lead, and the negative to the **black** transducer lead. Agency Approved Models may also be operated in either mode.

CALIBRATION

Once the transducer has been mounted, and air supply connections finished, the unit's calibration must be checked before placing into service. The plastic covers must be removed to gain access to the "ZERO" and "SPAN" adjustment screws. When calibration is completed, the covers should be replaced.

Note: input percentage refers to the following examples:

If 4 to 20 mA	If 10 to 50 mA
0 % = 4 mA	0 % = 10 mA
25 % = 8 mA	25 % = 20 mA
50 % = 12 mA	50 % = 30 mA
75 % = 16 mA	75 % = 40 mA
100 % = 20 mA	100 % = 50 mA

if 1 to 10 VDC	if 0 to 10 VDC	if 1 to 9 VDC	If 0 to 5 VDC	If 1 to 5 VDC
0 % = 1.00 VDC	0 % = 0.00 VDC	0 % = 1.00 VDC	0 % = 0.00 VDC	0 % = 1.00 VDC
25 % = 3.25 VDC	25 % = 2.50 VDC	25 % = 3.00 VDC	25 % = 1.25 VDC	25 % = 2.00 VDC
50 % = 5.50 VDC	50 % = 5.00 VDC	50 % = 5.00 VDC	50 % = 2.50 VDC	50 % = 3.00 VDC
75 % = 7.75 VDC	75 % = 7.50 VDC	75 % = 7.00 VDC	75 % = 3.75 VDC	75 % = 4.00 VDC
100 % = 10.00 VDC	100 % = 10.00 VDC	100 % = 9.00 VDC	100 % = 5.00 VDC	100 % = 5.00 VDC

Forward Acting

1. Apply the 0 % input signal to unit and adjust the "Zero" adjusting screw to the low setpoint output. Turn screw counter-clockwise to increase output. If there is no change in output, keep turning adjustment screw counter-clockwise until output begins to rise. It is imperative that the output pressure be closely monitored as turning the zero screw excessively could damage the flexure.

2. Apply the 100 % signal to unit and adjust "Span" adjusting screw until output is at the high setpoint.

3. **IMPORTANT:** On I / P (Current) input models, turn the "Span" adjusting screw ***counter-clockwise*** to increase output. On E / P (Voltage) input models, turn the "Span" adjusting screw ***clockwise*** to increase the output pressure.

4. Repeat steps 1& 2 until unit is calibrated.

Reverse Acting

1. Apply the 0 % input signal to unit and adjust "Zero" adjusting screw until output reaches the high output pressure setpoint. Turn counter-clockwise to increase.

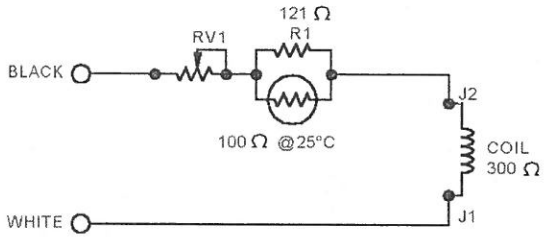
2. Apply the 100 % input signal to unit and adjust "Span" adjustment until output pressure is at the low setpoint.

IMPORTANT: On I / P (Current) input models, turn the "Span" adjusting screw ***clockwise*** to increase output. On E / P (Voltage) input models, turn the "Span" adjusting screw ***counter-clockwise*** to increase the output pressure.

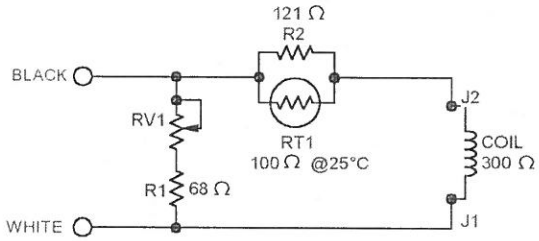
3. Repeat steps 1& 2 until unit is calibrated.

FIGURE 2

E / P SCHEMATIC



I / P SCHEMATIC



SIGNAL IMPEDANCE

The input impedance will vary depending upon the potentiometer setting of the "SPAN (RV1)", (***SEE FIG. 2)***.. The I / P circuit design consists of a resistor and potentiometer in parallel with the coil / flexure. The E / P circuit utilizes a potentiometer in series with the coil / flexure The following are some of the nominal impedences that would be measured across the signal leads of the average calibrated transducer. These values are helpfull when determining power requirements and for trouble shooting.

INPUT SIGNAL	OUTPUT RANGE	NOMINAL IMPEDANCE (OHMS)	POTENTIOMETER RV 1 SIZE (OHMS)
4 - 20 mA	3 - 15 psi	180	1000
4 - 20 mA	3 - 27 psi	215	1000
4 - 20 mA	3 - 120 psi	260	1000
4 - 20 mA	2 - 60 psi	225	1000
10 - 50mA	3 - 15 psi	70	100
0 - 5 VDC	3 - 15 psi	615	500
0 - 5 VDC	3 - 27 psi	530	500
1 - 9 VDC	3 - 15 psi	985	1000
1 - 9 VDC	3 - 27 psi	840	1000
0 - 10 VDC	3 - 120 psi	800	1000

TROUBLESHOOTING

SYMPTOM	CAUSE	SOLUTION
Sluggish Performance or Reduced Range.	1) Plugged or blocked orifice.	1) Remove orifice screw and clean orifice with wire or pin <0.009 in. diameter
	2) Supply pressure too low.	2) Supply pressure must be at least 5 psi above the 100% output.
Transducer remains at start up no matter the input signal.	1) Zero set too low.	1) Turn zero adjustment counter-clockwise until output pressure increases then follow calibration procedure.
	2) Electrical connection has opened or wrong type of signal applied.	2) Check electrical connections to insure that there is a correct input signal reaching the transducer.
Transducer works in reverse. (Pressure goes down when input signal goes up.)	Wires connected in reverse	Insure wiring is connected per Electrical Connection section.
Output Pressure same as supply Pressure with no signal effect.	Pneumatic connections reversed or supply and output both connected to "IN" ports.	Insure supply is connected to port marked "IN" and output is connected to port marked "OUT".

Note: If you experience an unusual problem that is not described in this section, or if troubleshooting procedures will not restore the unit to normal operation, please consult a factory applications engineer at (304)387-1200.

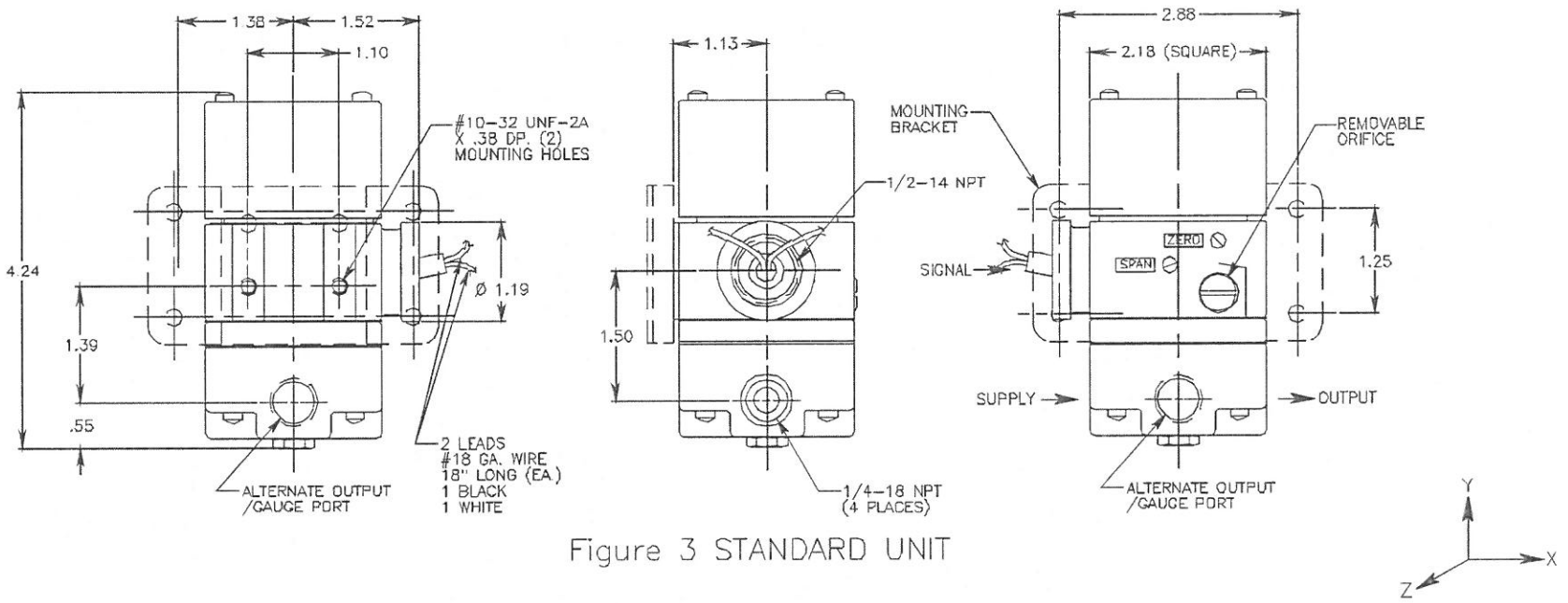


Figure 3 STANDARD UNIT

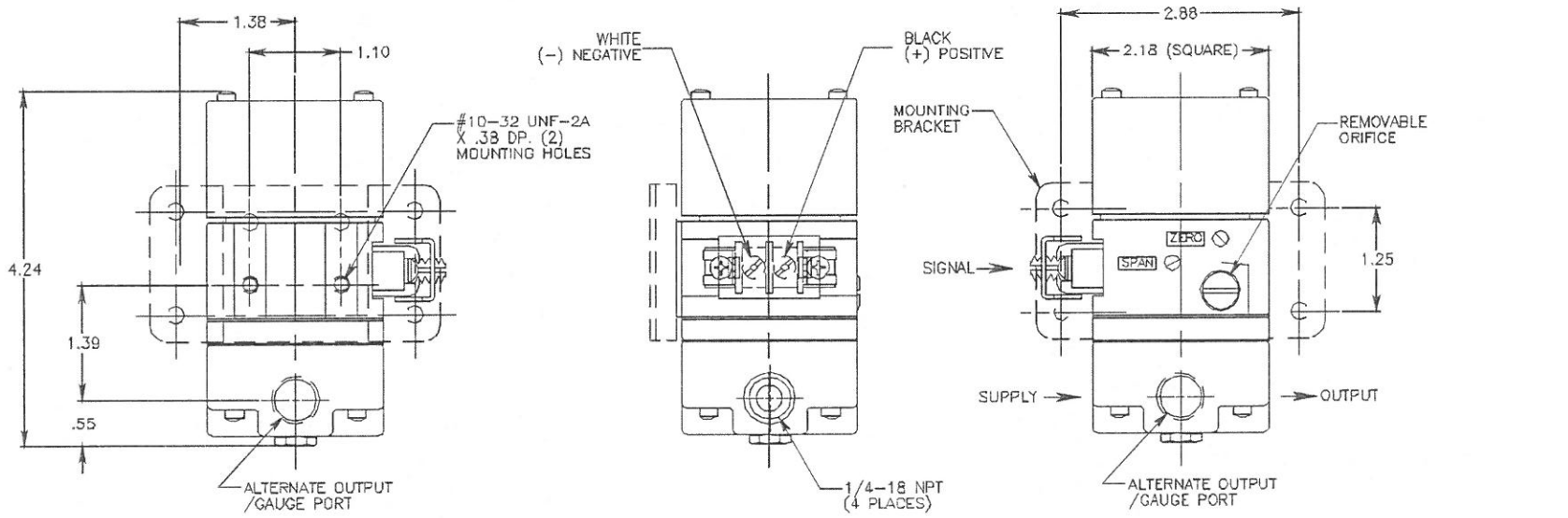


Figure 3 TEMINAL BLOCK UNIT

General-purpose Limit Switch
D4A-□N

The Limit Switch with Better Seal, Shock Resistance, and Strength

- A double seal on the head, a complete gasket cover, and other features ensure a better seal (meets UL NEMA 3, 4, 4X, 6P, 12, 13).
- Block mounting method to reduce weight to 290 g.
- Block mounting method also reduces downtime for maintenance.
- Wide standard operating temperature range: –40°C to 100°C (standard type).
- Models with fluoro-rubber available for greater resistance to chemicals.
- DPDT, double-break models available for complex operations.
- Approved by UL, CSA, and CCC (Chinese standard).

Model Number Structure

■ Model Number Legend

D4A-□□□□N
1 2 3

1. **Receptacle Box**
   - 1: 1/2-14 NPT conduit (SPDT, double-break)
   - 2: 1/2-14 NPT conduit (DPDT, double-break)
   - 3: G 1/2 conduit (SPDT, double-break)
   - 4: G 1/2 conduit (DPDT, double-break)
2. **Switch Box**
   - 1: SPDT, double-break, without indicator
   - 3: SPDT, double-break, neon lamp
   - E: SPDT, double-break, LED (24 VDC, leakage current: 1.3 mA)
   - 5: DPDT, double-break, simultaneous operation, without indicator
   - 7: DPDT, double-break, sequential operation, without indicator (See note 1.)
   - 9: DPDT, double-break, center neutral operation, without indicator (See note 2.)
   - L: DPDT, double-break, simultaneous operation, neon lamp
   - P: DPDT, double-break, simultaneous operation, LED
3. **Head**
   - 01: Roller lever, standard
   - 02: Roller lever, high-sensitivity
   - 03: Roller lever, low torque
   - 04: Roller lever, high-sensitivity, low torque
   - 05: Roller lever, maintained
   - 17: Roller lever, sequential operation
   - 18: Roller lever, center neutral operation
   - 06: Side plunger, standard
   - 07-V: Side plunger, vertical roller
   - 07-H: Side plunger, horizontal roller
   - 08: Side plunger, adjustable
   - 09: Top plunger, standard
   - 10: Top plunger, roller
   - 11: Top plunger, adjustable
   - 12: Flexible rod, spring wire
   - 14: Flexible rod, plastic rod
   - 15: Flexible rod, cat whisker
   - 16: Flexible rod, coil spring

Note: 1. Use the D4A-0017N Special Head.
2. Use the D4A-0018N Special Head.
3. Fluoro-rubber sealed type is also available.

Ordering Information

List of Models

SPDT, Double-break Switches

Actuator	Receptacle box / Indicator	G 1/2 Conduit				
		Without indicator		With neon lamp indicator (AC)		With LED indicator (DC)
		Model	Approved standards	Model	Approved standards	Model
Roller lever (See note 1.)	Standard	D4A-3101N	UL, CSA	D4A-3301N	UL, CSA	D4A-3E01N
	High-sensitivity	D4A-3102N	UL, CSA	D4A-3302N	UL, CSA	D4A-3E02N
	Low-torque	D4A-3103N	UL, CSA	---	UL, CSA	---
	High-sensitivity, Low-torque	D4A-3104N	UL, CSA	D4A-3304N	UL, CSA	---
	Maintained (See note 2.)	D4A-3105N	UL, CSA	D4A-3305N	UL, CSA	D4A-3E05N
Side plunger	Standard	D4A-3106N	UL, CSA	---	UL, CSA	---
	Vertical roller	D4A-3107-VN	UL, CSA	D4A-3307-VN	UL, CSA	D4A-3E07-VN
	Horizontal roller	D4A-3107-HN	UL, CSA	D4A-3307-HN	UL, CSA	---
	Adjustable	D4A-3108N	UL, CSA	D4A-3308N	UL, CSA	D4A-3E08N
Top plunger	Standard	D4A-3109N	UL, CSA	D4A-3309N	UL, CSA	---
	Roller	D4A-3110N	UL, CSA	D4A-3310N	UL, CSA	---
	Adjustable	D4A-3111N	UL, CSA	D4A-3311N	UL, CSA	---
Flexible rod	Spring wire	D4A-3112N	UL, CSA	D4A-3312N	UL, CSA	D4A-3E12N
	Plastic rod	D4A-3114N	UL, CSA	D4A-3314N	UL, CSA	D4A-3E14N
	Cat whisker	D4A-3115N	UL, CSA	D4A-3315N	UL, CSA	D4A-3E15N
	Coil spring	D4A-3116N	UL, CSA	D4A-3316N	UL, CSA	D4A-3E16N

Note: 1. The lever is not included with the Roller Level Models. Select the lever from those listed in this data sheet and order it separately (refer to *Levers* on pages 92 and 93).

2. The Maintained Switches have a lock mechanism for the switch operation and thus use a Fork Lever Lock.

3. Switches are also available with □1/2-14 NPT conduits. The model numbers correspond as follows:

G 1/2 Conduits	1/2-14 NPT Conduits
D4A-3□□□N	D4A-1□□□N
D4A-4□□□N	D4A-2□□□N

4. Switches are also available with fluoro-rubber seals for higher resistance to chemicals. (The operating temperature range for these Switches, however, is –10 to 120°C.) Add "-F" to the model number. (Example: D4A-3101N becomes D4A-3101N-F.) Ask your nearest OMRON representative for details.

DPDT, Double-break Switches

Actuator	Receptacle box / Indicator	G 1/2 Conduit				
		Without indicator		With neon lamp indicator (AC)		With LED indicator (DC)
		Model	Approved standards	Model	Approved standards	Model
Roller lever (See note 1.)	Standard	D4A-4501N	UL, CSA	D4A-4L01N	UL, CSA	D4A-4P01N
	High-sensitivity	D4A-4502N	UL, CSA	---	---	---
	Low-torque	D4A-4503N	UL, CSA	---	---	---
	High-sensitivity, Low-torque	D4A-4504N	UL, CSA	---	---	---
	Maintained (See note 2.)	D4A-4505N	UL, CSA	---	---	---
	Sequential operation	D4A-4717N	UL, CSA	---	---	---
	Center neutral operation	D4A-4918N	UL, CSA	---	---	---
Side plunger	Standard	D4A-4506N	UL, CSA	---	---	---
	Vertical roller	D4A-4507-VN	UL, CSA	---	---	---
	Horizontal roller	D4A-4507-HN	UL, CSA	---	---	---
	Adjustable	D4A-4508N	UL, CSA	---	---	---
Top plunger	Standard	D4A-4509N	UL, CSA	---	---	---
	Roller	D4A-4510N	UL, CSA	D4A-4L10N	UL, CSA	D4A-4P10N
	Adjustable	D4A-4511N	UL, CSA	---	---	---
Flexible rod	Spring wire	D4A-4512N	UL, CSA	---	---	---
	Plastic rod	D4A-4514N	UL, CSA	---	---	---
	Cat whisker	D4A-4515N	UL, CSA	---	---	---
	Coil spring	D4A-4516N	UL, CSA	---	---	---

Note: 1. The lever is not included with the Roller Level Models. Select the lever from those listed in this data sheet and order it separately (refer to *Levers* on pages 92 and 93).

2. The Maintained Switches have a lock mechanism for the switch operation and thus use a Fork Lever Lock.

3. Switches are also available with □1/2-14 NPT conduits. The model numbers correspond as follows:

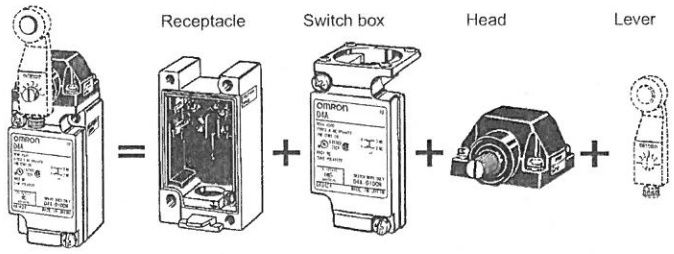
G 1/2 Conduits	1/2-14 NPT Conduits
D4A-3□□□N	D4A-1□□□N
D4A-4□□□N	D4A-2□□□N

4. Switches are also available with fluoro-rubber seals for higher resistance to chemicals. (The operating temperature range for these Switches, however, is –10 to 120°C.) Add "-F" to the model number. (Example: D4A-4501N becomes D4A-4501N-F.) Ask your nearest OMRON representative about delivery times and prices.

Individual Parts

Replacement of Parts

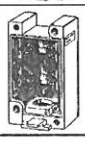
Because the D4A-□N employs block mounting construction, the switch box, receptacle, and operating head may be ordered as a complete assembly or individually as replacement parts.



D4A-1101N D4A-1000N D4A-0100N D4A-0001N

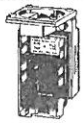
Levers for Roller Lever Switches are optionally available. Select the lever from those listed in this datasheet and order (refer to *Levers* on pages 92 and 93).

Receptacle Box

Type	Appearance	1/2-14NPT conduit (See note 2.)		G1/2 conduit (See note 1.)	
		Model	Approved standards	Model	Approved standards
SPDT double-break		D4A-1000N	UL, CSA	D4A-3000N	UL, CSA
DPDT double-break		D4A-2000N	UL, CSA	D4A-4000N	UL, CSA

Note: 1. M6-screw mounting (standard mounting)
2. 10-32UNF-screw mounting (standard mounting)

Switch Box

Type	Appearance		Without indicator		With neon lamp indicator (AC)		With LED indicator (DC)
			Model	Approved standards	Model	Approved standards	Model
SPDT double-break	(Without indicator lamp)		D4A-0100N	UL, CSA	D4A-0300N	UL, CSA	D4A-0E00N
DPDT double-break	 (Without indicator lamp)	Simultaneous operation	D4A-0500N	UL, CSA	D4A-0L00N	---	D4A-0P00N
		Sequential operation	D4A-0700N	UL, CSA	---	---	---
		Center neutral operation	D4A-0900N	UL, CSA	---	---	---

Heads

Type	Appearance	Approved standards
Roller lever (See note 1.)	Standard: D4A-0001N High-sensitivity: D4A-0002N Low torque: D4A-0003N (see note 2) Sequential operation: D4A-0017N (see note 3) Center neutral operation: D4A-0018N (see note 3)	UL, CSA
	Maintained: D4A-0005N	UL, CSA
Side plunger	Standard: D4A-0006N Horizontal roller: D4A-0007-HN Vertical roller: D4A-0007-VN Side adjustable: D4A-0008N	UL, CSA
Top plunger	Standard: D4A-0009N Roller plunger: D4A-0010N Plunger adjustable: D4A-0011N	UL, CSA
Flexible rod	Spring wire D4A-0012N Plastic rod D4A-0014N Cat whisker D4A-0015N Coil spring D4A-0016N	UL, CSA

Note: 1. Levers for Roller Lever Switches are optionally available. Select the lever from those listed in this data sheet and order (refer to *Levers* on pages 92 and 93).

2. The D4A-C00 adjustable roller lever is too heavy and long for these heads and it should not be used or mechanical malfunction will result.

3. These heads cannot be used for double break operations.

Levers

Actuator type	Model
Roller Lever	D4A-A00
	D4A-A10
	D4A-A20
	D4A-A30
	D4A-B06
Adjustable Roller Lever	D4A-C00
	D4A-D00
Resin Loop Lever	D4A-F00
Fork Lever Lock	D4A-E30
	D4A-E20
	D4A-E10
	D4A-E00

Note: Refer to page 92 for Lever shapes and applicable models.

Specifications

Approved Standards

Agency	Standard	File No.
UL	UL508	E76675
CSA	CSA C22.2 No. 14	LR45746
CCC (CQC)	GB14048.5	2003010305077615

Note: Ask your OMRON representative for information on approved models.

Approved Standard Ratings

UL/CSA

A600

D4A-□1□□N (SPDT, Double-break, Without Indicator)

Rated voltage	Carry current	Current		Volt-amperes	
		Make	Break	Make	Break
120 VAC 240 VAC 480 VAC 600 VAC	10 A	60 A 30 A 15 A 12 A	6 A 3 A 1.5 A 1.2 A	7,200 VA	720 VA

A300

D4A-□3□□N (SPDT, Double-break, With Neon Lamp)

Rated voltage	Carry current	Current		Volt-amperes	
		Make	Break	Make	Break
120 VAC 240 VAC	10 A	60 A 30 A	6 A 3 A	7,200 VA	720 VA

B600

D4A-□5□□N (DPDT, Double-break, Simultaneous Operation)
D4A-□7□□N (DPDT, Double-break, Sequential Operation)
D4A-□9□□N (DPDT, Double-break, Center Neutral Operation)

Rated voltage	Carry current	Current		Volt-amperes	
		Make	Break	Make	Break
120 VAC 240 VAC 480 VAC 600 VAC	5 A	30 A 15 A 7.5 A 6.0 A	3 A 1.5 A 0.75 A 0.6 A	3,600 VA	360 VA

CCC (GB14048.5)

Applicable category and ratings
AC-15 2 A/125 VAC

■ General Ratings

Type	Rated voltage	Non-inductive load				Inductive load			
		Resistive load		Lamp load		Inductive load		Motor load	
		NC	NO	NC	NO	NC	NO	NC	NO
SPDT double-break (with/without indicator)	125 VAC (See note 5.)	10 A	10 A	3 A	1.5 A	10 A		5 A	2.5 A
	250 VAC (See note 5.)	10 A	10 A	2 A	1 A	10 A		3 A	1.5 A
	480 VAC	10 A	10 A	1.5 A	0.8 A	3 A		1.5 A	0.8 A
	600 VAC	3 A	1 A	1 A	0.5 A	1.5 A		1 A	0.5 A
	8 VDC	10 A		6 A	3 A	10 A		6 A	
	14 VDC	10 A		6 A	3 A	10 A		6 A	
	30 VDC	6 A		4 A	3 A	6 A		4 A	
	125 VDC (See note 5.)	0.8 A		0.2 A	0.2 A	0.8 A		0.2 A	
	250 VDC (See note 5.)	0.4 A		0.1 A	0.1 A	0.4 A		0.1 A	
DPDT double-break (without indicator)	125 VAC	5 A		2 A		4 A		3 A	
	250 VAC	3 A		1 A		2 A		1.5 A	
	480 VAC	1.5 A		0.5 A		1 A		0.8 A	
	600 VAC	1 A		0.4 A		0.7 A		0.5 A	
	14 VDC	5 A		2 A		4 A		3 A	
	30 VDC	3 A		1 A		2 A		1.5 A	
	125 VDC	0.4 A		0.1 A		0.4 A		0.1 A	
	250 VDC	0.2 A		0.05 A		0.2 A		0.05 A	
DPDT double-break (with indicator)	125 VAC	5 A		2 A		4 A		3 A	
	250 VAC	3 A		1 A		2 A		1.5 A	
	12 VDC	5 A	---	---		---		---	
	24 VDC	3 A							
	48 VDC	1 A							

Type		SPDT, double-break		DPDT, double-break	
		Without indicator	With indicator	Without indicator	With indicator
Inrush current	Normally closed	30 A max.			
	Normally open	20 A max.			

Note: 1. The above current ratings are for steady-state current.
2. Inductive loads have a power factor of 0.4 min. (AC) and a time constant of 7 ms max. (DC).
3. Lamp loads have an inrush current of 10 times the steady-state current.
4. Motor loads have an inrush current of 6 times the steady-state current.
5. For those with indicators, refer to the following rated voltages.

Ratings for Indicators

Classification	Indicator	Model	Rated voltage	Carry current	Internal resistance
SPDT double-break	Neon lamp	D4A-0300N	125 VAC, 250 VAC	Approx. 0.47 mA	150 kΩ
	LED	D4A-0E00N	12 VDC	Approx. 3.2 mA	2.2 kΩ
			24 VDC	Approx. 4 mA	4.7 kΩ
			24 VDC	Approx. 1.3 mA	15 kΩ
			48 VDC	Approx. 2 mA	22 kΩ
DPDT double-break	Neon lamp	D4A-0L00N	125 VAC, 250 VAC	Approx. 0.28 mA	240 kΩ
	LED	D4A-0P00N	48 VDC	Approx. 1.4 mA	---

Characteristics

Degree of protection	IP67
Durability (See note 3.)	Mechanical: SPDT, double-break, roller lever: 50,000,000 operations min. (See note 2.) DPDT, double-break, roller lever: 30,000,000 operations min. (See note 2.) Electrical: SPDT, double-break: for 125 VAC, 10 A resistive load: 1,000,000 operations min. DPDT, double-break: for 125 VAC, 5 A resistive load: 750,000 operations min.
Operating speed	1 mm to 2 m/s (for D4A-3101N roller lever model)
Operating frequency	Mechanical: 300 operations/minute Electrical: 30 operations/minute
Rated frequency	50/60 Hz
Insulation resistance	100 MΩ min. (at 500 VDC) between terminals of the same polarity, between current-carrying metal parts and ground, and between each terminal and non-current-carrying metal part
Contact resistance	25 mΩ max. (initial value)
Temperature rise	50°C max.
Dielectric strength	1,000 VAC, 50/60 Hz for 1 min. between terminals of same polarity 2,200 VAC, 50/60 Hz for 1 min. between current-carrying metal parts and ground, and between each terminal and non-current-carrying metal part (See note 4.)
Pollution degree (operating environment)	3
Protection against electric shock	Class I (with grounding terminal)
Vibration resistance	Malfunction: 10 to 55 Hz, 1.5-mm double amplitude (See note 5.)
Shock resistance	Destruction: 1,000 m/s^2 min. Malfunction: SPDT, double-break, roller lever: 600 m/s^2 min. (See note 5.) DPDT, double-break, roller lever: 300 m/s^2 min. (See note 5.)
Ambient operating humidity	35% to 95% (with no icing)
Weight	Approx. 290 g (for D4A-3101N roller lever model)

Note: 1. The above figures are initial values.

2. Excluding maintained models.

3. The values are calculated at an operating temperature of 5°C to 35°C, and an operating humidity of 40% to 70%. Contact your OMRON sales representative for more detailed information on other operating environments.

4. 1,500 VAC is applied to the indicator lamp type.

5. Not including wobble levers (cat whisker, plastic rod, coil spring, and spring wire types).

Type	Roller lever (See note 5-1.)	Plunger, flexible rod (See note 5-2.)	With indicator	Fluoro-rubber seal
Ambient temperature	–40°C to 100°C	–20°C to 100°C	–10°C to 80°C	–10°C to 120°C

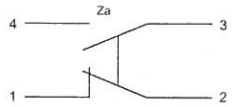
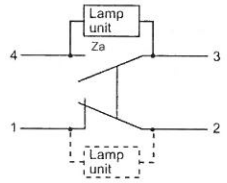
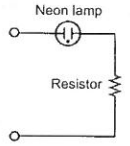
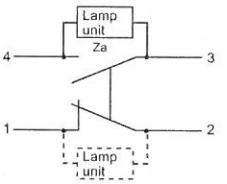
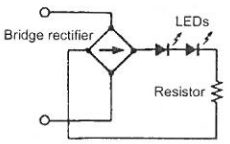
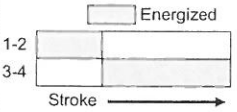
5-1. Excluding low-torque and high-sensitivity models.

5-2. Including roller lever low-torque and high-sensitivity operating models.

Connections

■ Contact Forms (Switch Boxes)

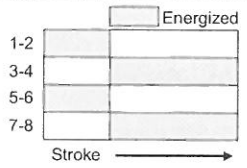
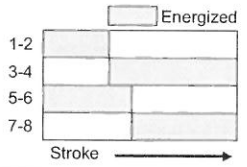
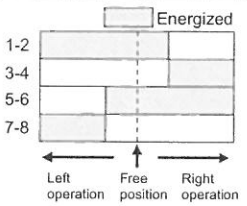
STDP Double-break Switches

Type	Contact model			Operating pattern
	Without indicator	With neon lamp indicator (See note.)	With LED indicator (See note.)	
1NC/1NO snap-action	D4A-0100N 	D4A-0300N  Lamp Unit Internal Circuits 	D4A-0E00N  Lamp Unit Internal Circuits 	

Note: Switches with indicators are factory-set to light when the switch is not operated.

DTDP Double-break Switches

Each of these Switches can be used to replace two limit switches in applications, such as high-speed control in machine tools and switching motors between forward and reverse, that previously required 2 limit switches. This simplifies wiring, saves space, and reduces costs.

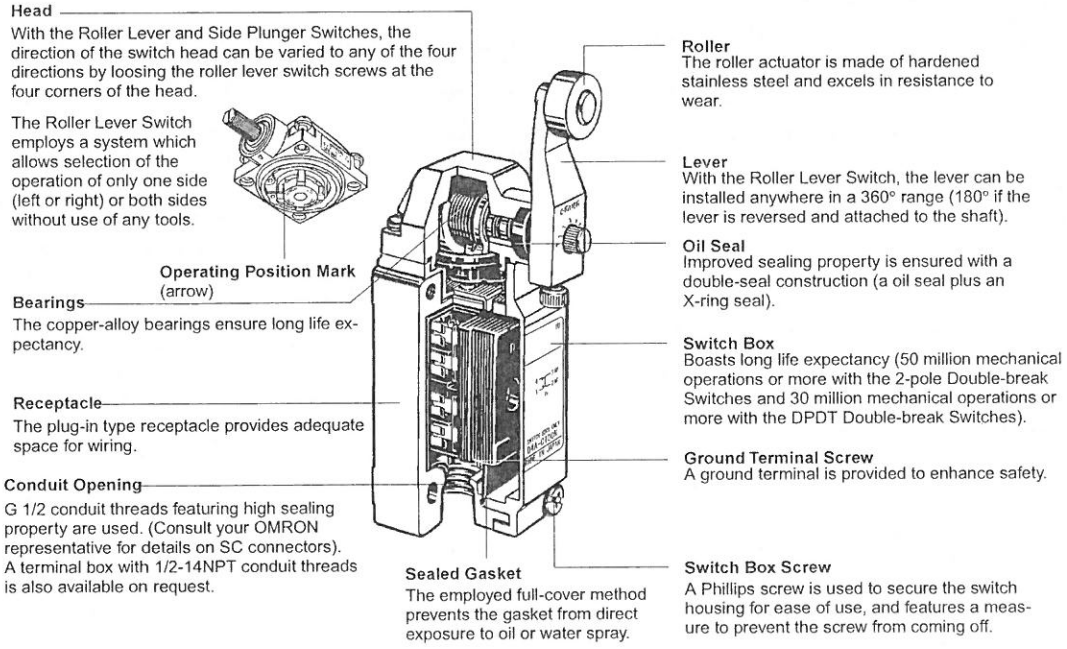
Type	Contact model			Operating pattern	Remarks
	Without indicator	With neon lamp indicator (See note.)	With LED indicator (See note.)		
2NC/2NO snap-action, simultaneous operation	D4A-0500N	D4A-0L00N	D4A-0P00N		Head is compatible with double-break head. Can be switched for operation on both sides of actuator.
2NC/2NO snap-action, sequential operation (2-step operation)	D4A-0700N	---	---		Use the D4A-0017N Special Head.
2NC/2NO snap-action, central neutral operation	D4A-0900N	---	---		Use the D4A-0018N Special Head.

Item	Without indicator	With neon lamp indicator (See note.)	With LED indicator (See note.)
Contact form	D4A-0500N D4A-0700N D4A-0900N	D4A-0L00N	D4A-0P00N
Lamp unit internal circuit	---	Neon lamp Resistor	Bridge rectifier Constant current diode LED

Note: Switches with indicators are factory-set to light when the switch is not operated, but the setting can be changed to light for operation (dotted lines).

Nomenclature

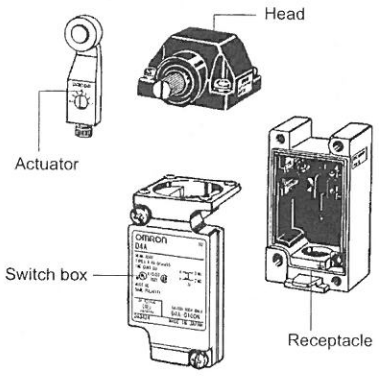
DPDT Double-break



Note: 1. NBR is used in rubber components.
2. Fluoro-rubber sealed types use fluoro-rubber.
3. For Roller Levers, there is some lever play in the free position (about 2 mm), but this is due to the structure of the head and does not interfere with performance.

Easy-maintenance Block Mounting

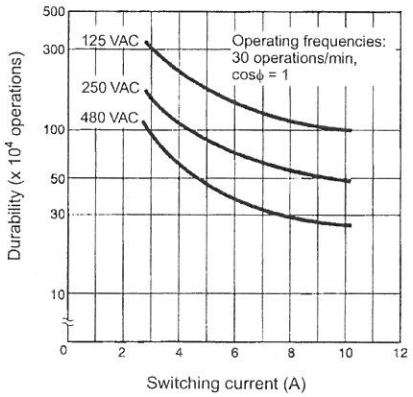
Block mounting makes it possible to easily assemble or disassemble the head, switch body, and receptacle of the D4A-□N by tightening or loosening the attached screws.

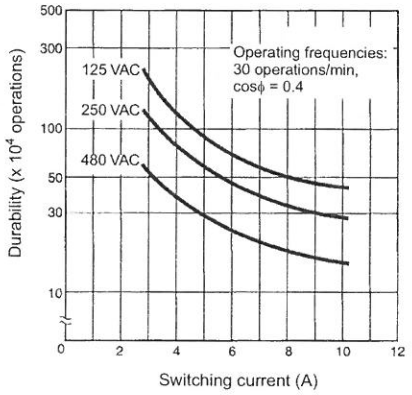


Engineering Data

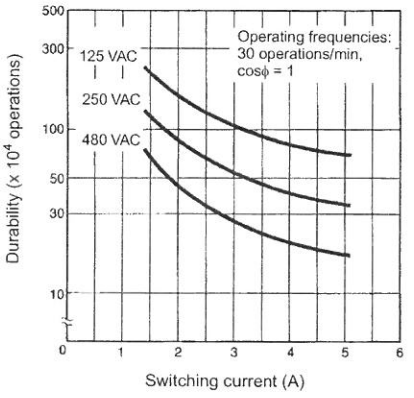
■ Electrical Durability (SPDT Double-break)

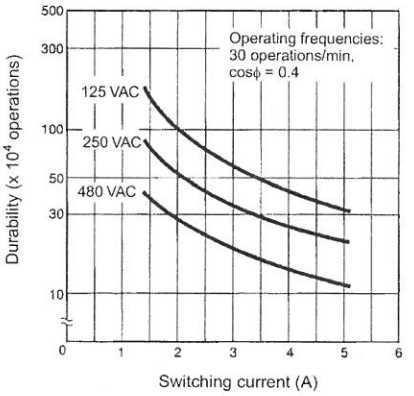
(Ambient temperature: 5°C to 35°C; ambient humidity: 40% to 70%)





Electrical Durability (DPDT Double-break)





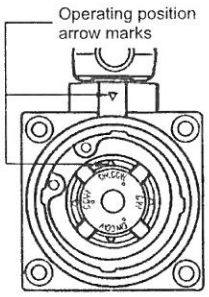
Installation

Operation

Changing the Operating Direction

The head of the side rotary type can be converted in seconds to CW, CCW, or both-way operation. Follow the procedures on the right hand side for conversion (not applicable to the Maintained, Sequential Operating, Center Neutral Operating Switches).

Operating Part (Rear of Head)



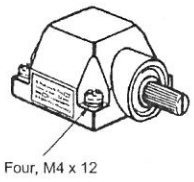
Procedures

1. Dismount the head by loosening the four screws that secure it.
2. Turn over the head to set the desired operation (CW, CCW, or both). The desired side can be selected by setting the mode selector knob shown in the figure. This knob is factory set to the "CW+CCW" (both-way operation) position.
3. When set to the CW position, the head rotates in clockwise direction.
   When set to the CCW position, the head rotates in counterclockwise direction.
   In either case, be sure to accurately align the arrow mark to the setting position.

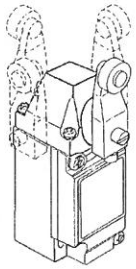
Head and Lever Positions

The operating head can be positioned and locked in any of four 90° positions and a lever can lock in any position through 360° around the shaft of the Limit Switch. Furthermore, the lever can be reversed and attached to the shaft (refer to the figures below on the right hand side). Therefore the roller is compatible with a wide movement range of a dog. A Fork Lever Lock can be used with maintained models (D4A-0005N) only.

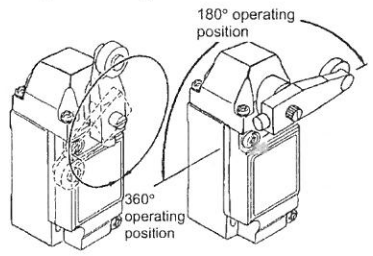
Remove the head from the Switch by loosening the screws (the screws can be loosened but not removed from the head).



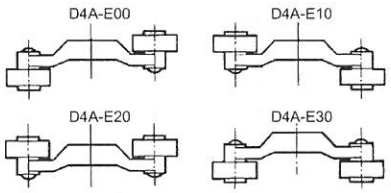
The operating head can be positioned and locked in any of four 90° positions.



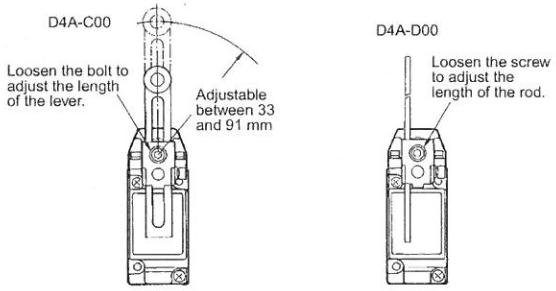
The lever can lock in any position through 360° around the shaft. The lever can be reversed and attached to the shaft, in which case the switching operation should complete in a range of 0° to 180°.



There are four kinds of fork lever locks. The position of each roller is different. It is possible to use D4A-E00 through D4A-E30 levers instead, if they are reversed before attaching. They can be used with D4A-□□05N models only.



By loosening the Allen-head bolt on an adjustable roller lever or rod lever, the length of the lever can be adjusted.

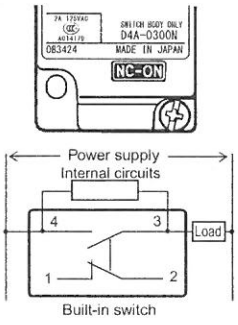


Lighting Mode Selection of Indicators

The lighting mode of the operation indicator can be changed easily between two modes: lighting when the Switch is operating and lighting when the Switch is not operating.

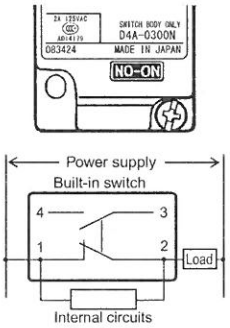
Lights When Not Operating

(See note 1.)



Lights When Operating

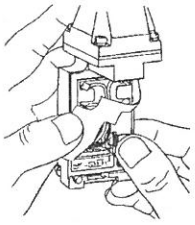
(See note 2.)



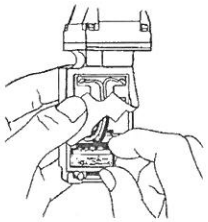
Note: 1. The lamp is lit when the actuator is at the free position. The lamp will be off when the contacts of the Limit Switch have been actuated and snapped to each other at the operating position.

2. The lamp is lit when the contacts have been released and snapped only from the operating position.

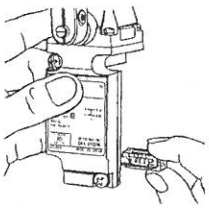
Change the lighting mode as follows:



Push the claw securing the lamp section to the right (do not push strongly).



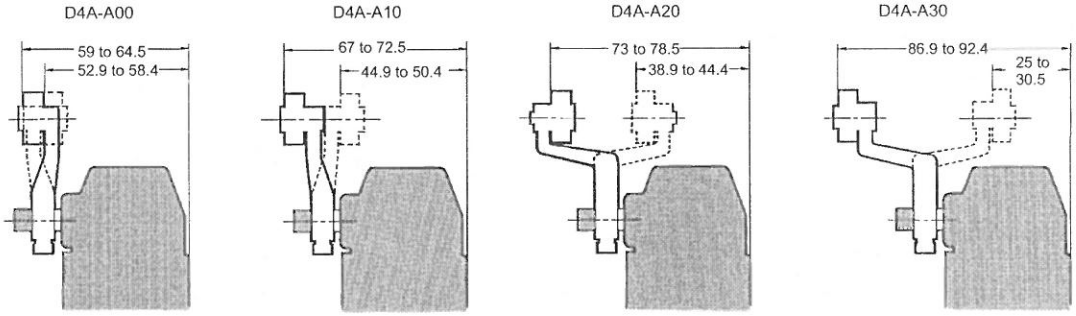
Remove the lamp section.



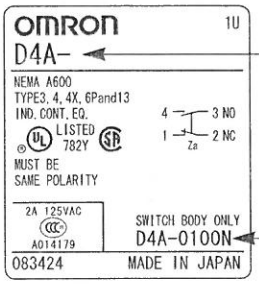
Mount the lamp section so that legend "NC-ON" or "NO-ON" will appear in the display window.

Note: In either case, the lamp will not light when the load is ON.

Lever Position



■ Nameplate

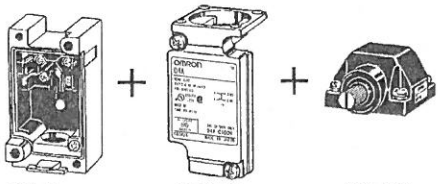


The whole switch model without lever is printed.

The type of switch box is printed. (The type is also indicated on the head and receptacle.)

■ Compatibility with D4A-□

The D4A-□N is compatible with the D4A-□ when the following accessories are attached to the D4A-□N.



D4A-□
Receptacle box

D4A-□N
Switch box

D4A-□N
Head

Note: The D4A-□N without the above accessories is not compatible with the D4A-□.

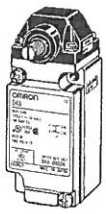
Dimensions

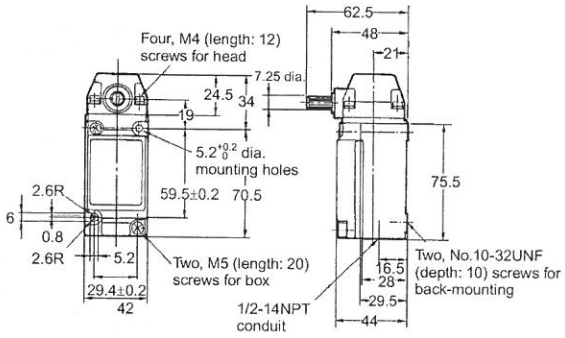
Note: 1. All units are in millimeters unless otherwise indicated.
2. Insert the model number code in □ for the switch body.
3. Unless otherwise specified, a tolerance of ±0.4 mm applies to all dimensions.

Roller Lever Switches

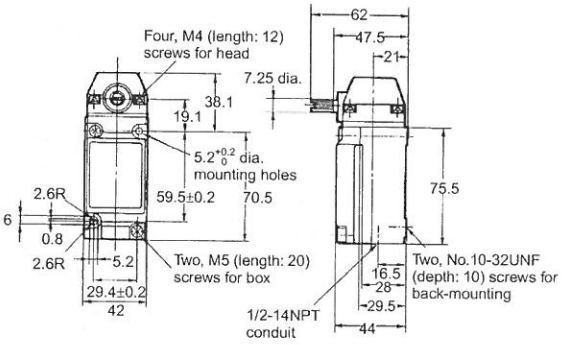
Note: Levers of the side rotary type are optionally available.

Standard
D4A-1□01N, D4A-2□01N
High-sensitivity
D4A-1□02N, D4A-2□02N
Low Torque
D4A-1□03N, D4A-2□03N
High-sensitivity/Low Torque
D4A-1□04N, D4A-2□04N
Sequential Operation
D4A-2□17N
Center Neutral Operating
D4A-2□18N





Maintained
D4A-1□05N, D4A-2□05N



SPDT Double-break

Model	D4A-1□01N	D4A-1□02N	D4A-1□03N	D4A-1□04N	D4A-1□05N
OF max.	0.39 N·m	0.39 N·m	0.2 N·m	0.2 N·m	0.39 N·m
RF min.	0.05 N·m	0.05 N·m	---	---	---
PT max.	15° (12°)	7° (6°)	15° (12°)	7° (6°)	65° (60°)
OT min.	70°	75°	70°	75°	20°
MD max.	5° (4°)	4° (3°)	5° (4°)	4° (3°)	35° (30°)

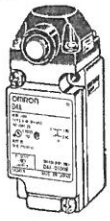
DPDT Double-break

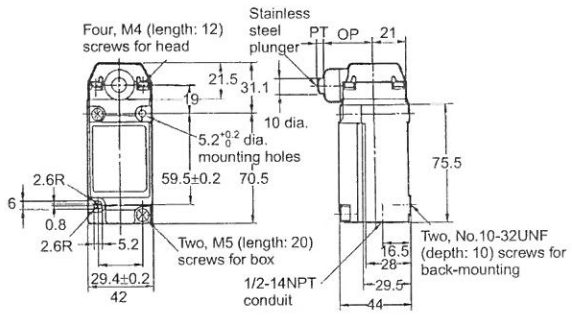
Model	D4A-2□01N	D4A-2□02N	D4A-2□03N	D4A-2□04N	D4A-2□05N	D4A-2□17N	D4A-2□18N
OF max.	0.39 N·m	0.39 N·m	0.2 N·m	0.2 N·m	0.39 N·m	0.39 N·m	0.39 N·m
RF min.	0.05 N·m	0.05 N·m	---	---	---	0.05 N·m	0.02 N·m
PT max.	15° (12°)	7° (6°)	15° (12°)	7° (6°)	65° (60°)	1-stage: 12° (10°) 2-stage: 20° (17°)	19° (15°)
OT min.	70°	75°	70°	75°	20°	65°	65°
MD max.	7° (6°)	5° (4°)	7° (6°)	5° (4°)	35° (30°)	6° (5°)	5° (4°)

The figures in the parentheses are average values.

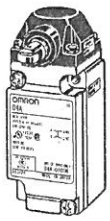
Side Plunger Switches

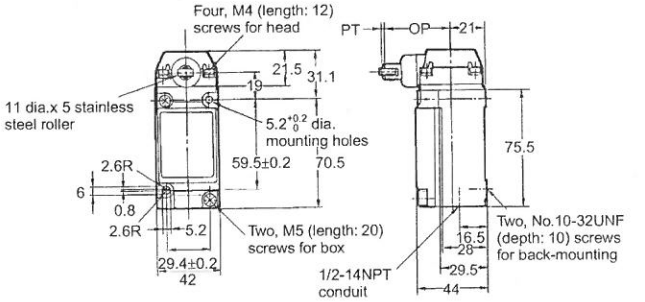
Standard
D4A-1□06N, D4A-2□06N



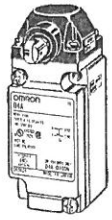


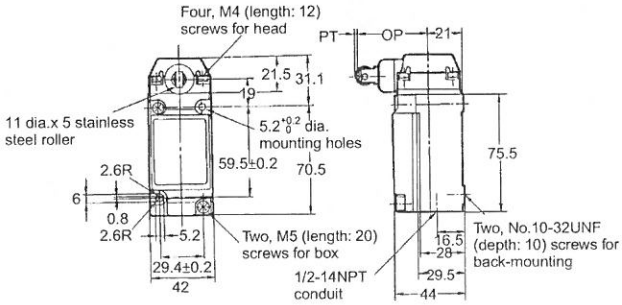
Horizontal Roller
D4A-1□07-HN, D4A-2□07-HN



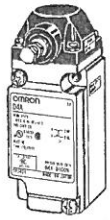


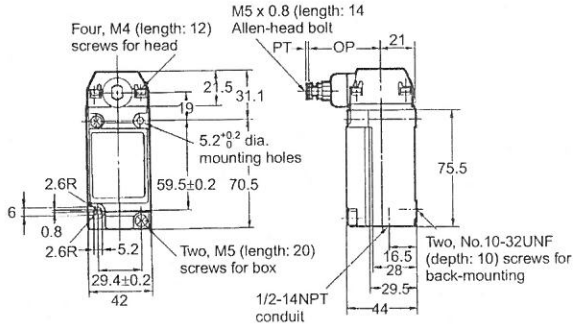
Vertical Roller
D4A-1□07-VN, D4A-2□07-VN





Adjustable
D4A-1□08N, D4A-2□08N

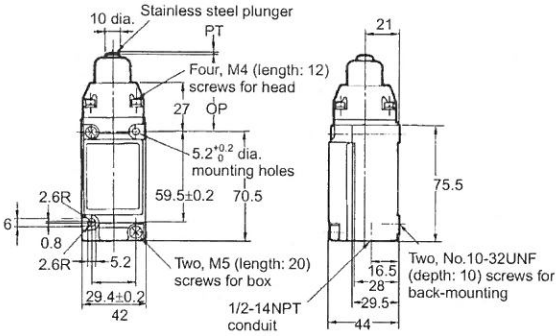




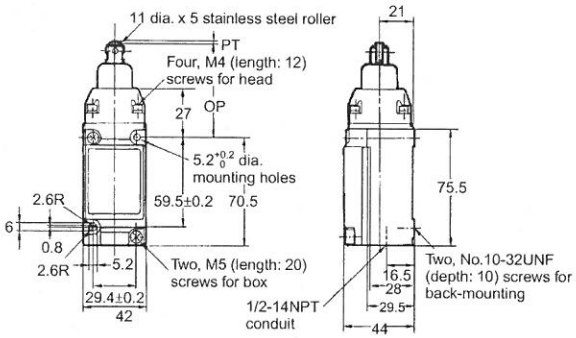
Model	SPDT double-break				DPDT double-break			
	D4A-1□06N	D4A-1□07-HN	D4A-1□07-VN	D4A-1□08N	D4A-2□06N	D4A-2□07-HN	D4A-2□07-VN	D4A-2□08N
OF max.	19.61 N	19.61 N	19.61 N	19.61 N	19.61 N	19.61 N	19.61 N	19.61 N
RF min.	4.90 N	4.90 N	4.90 N	4.90 N	4.90 N	4.90 N	4.90 N	4.90 N
PT max.	2.4 mm	2.4 mm	2.4 mm	2.4 mm	2.4 mm	2.4 mm	2.4 mm	2.4 mm
OT min.	5.1 mm	5.1 mm	5.1 mm	5.1 mm	5.1 mm	5.1 mm	5.1 mm	5.1 mm
MD max.	0.6 mm	0.6 mm	0.6 mm	0.6 mm	1.0 mm	1.0 mm	1.0 mm	1.0 mm
OP	34±0.8 mm	44±0.8 mm	44±0.8 mm	41 to 47.5 mm	34±0.8 mm	44±0.8 mm	44±0.8 mm	41 to 47.5 mm

Top Plunger Switches

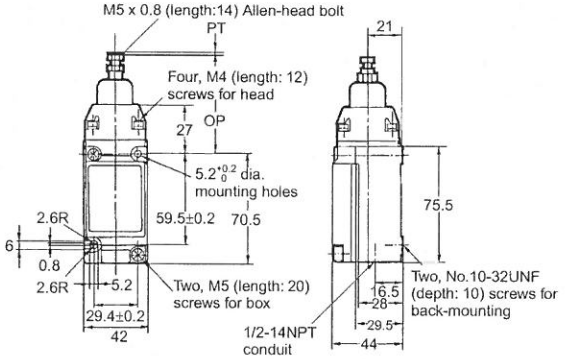
Standard
D4A-1□09N, D4A-2□09N



Roller Plunger
D4A-1□10N, D4A-2□10N



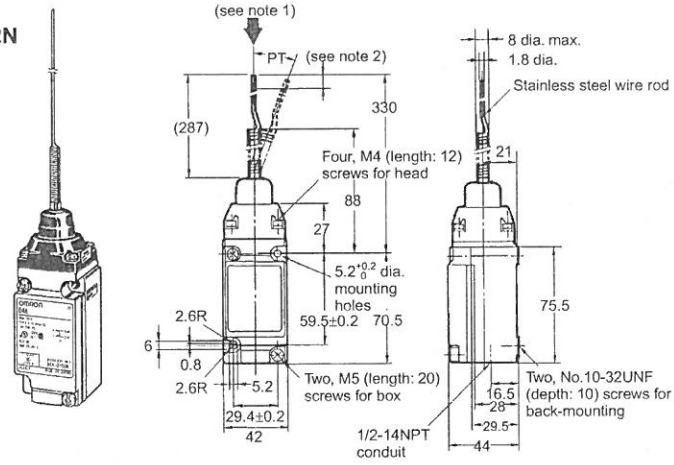
Adjustable
D4A-1□11N, D4A-2□11N



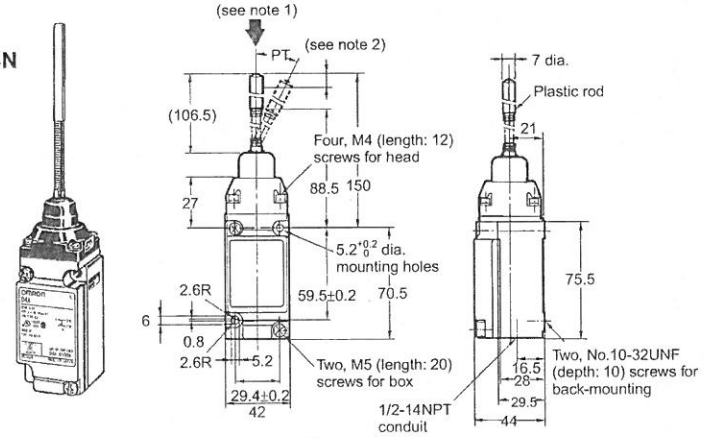
Model	SPDT double-break			DPDT double-break		
	D4A-1□09N	D4A-1□10N	D4A-1□11N	D4A-2□09N	D4A-2□10N	D4A-2□11N
OF max.	17.65 N	17.65 N	17.65 N	17.65 N	17.65 N	17.65 N
RF min.	4.90 N	4.90 N	4.90 N	4.90 N	4.90 N	4.90 N
PT max.	1.6 mm	1.6 mm	1.6 mm	1.6 mm	1.6 mm	1.6 mm
OT min.	5.1 mm	5.1 mm	5.1 mm	5.1 mm	5.1 mm	5.1 mm
MD max.	0.4 mm	0.4 mm	0.4 mm	1.0 mm	1.0 mm	1.0 mm
OP	46±0.8 mm	56±0.8 mm	55.5 to 62 mm	46±0.8 mm	56±0.8 mm	55.5 to 62 mm

Flexible Rod Switches

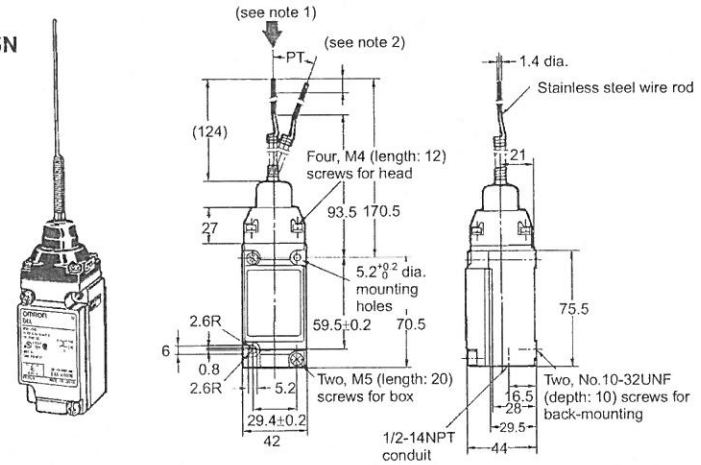
Spring Wire
D4A-1□12N, D4A-2□12N



Plastic Rod
D4A-1□14N, D4A-2□14N



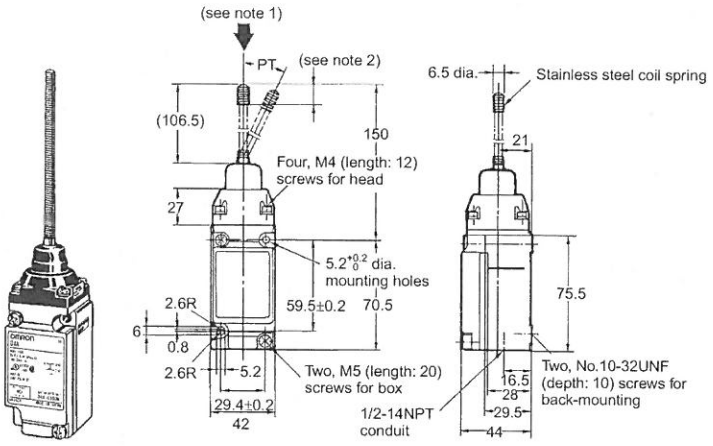
Cat Whisker
D4A-1□15N, D4A-2□15N



Note: 1. The stainless rod can be operated from any direction except the axial direction (i.e., from the top).

2. The optimum operating range of the stainless rod is within 1/3 of the entire length from the top end.

Coil Spring
D4A-1□16N, D4A-2□16N



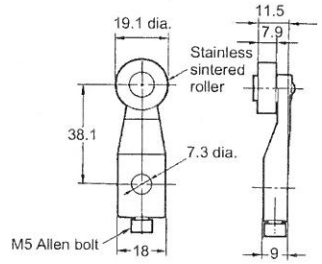
Note: 1. The stainless rod can be operated from any direction except the axial direction (i.e., from the top).
2. The optimum operating range of the stainless rod is within 1/3 of the entire length from the top end.

Model	SPDT double-break			DPDT double-break		
	D4A-1□12N	D4A-1□14N D4A-1□15N	D4A-1□16N	D4A-2□12N	D4A-2□14N D4A-2□15N	D4A-2□16N
OF max.	0.98 N	1.47 N		0.98 N	1.47 N	
PT max.	15° (5°)	15° (5°)		15° (5°)	15° (5°)	

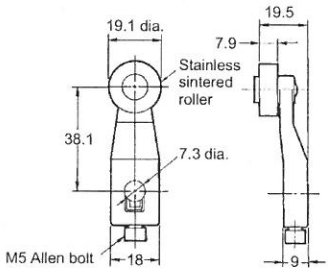
Levers (for Roller Lever Switches)

Note: No D4A-0003N or D4A-0004N head should be used with the adjustable roller lever or mechanical malfunctioning could result because the total weight of the adjustable roller lever is comparatively large. Use a standard-load head (D4A-0001N or D4A-0002N) instead.

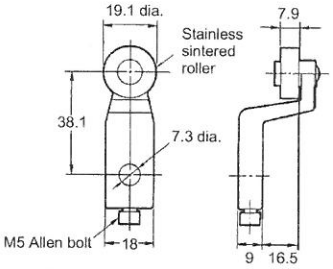
Roller Lever
D4A-A00



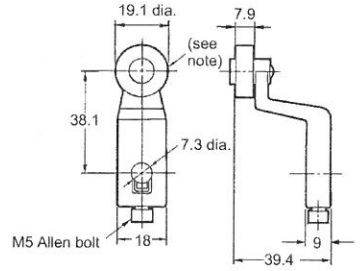
Roller Lever
D4A-A10



Roller Lever
D4A-A20

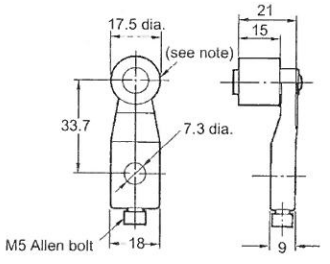


Roller Lever
D4A-A30



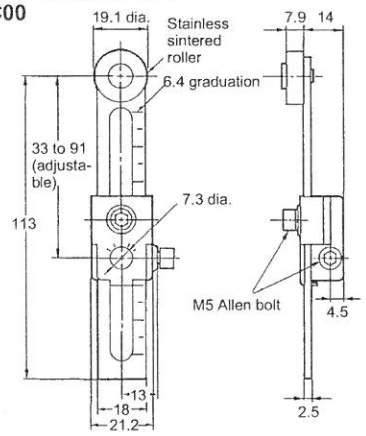
Note: Stainless sintered roller

Roller Lever
D4A-B06

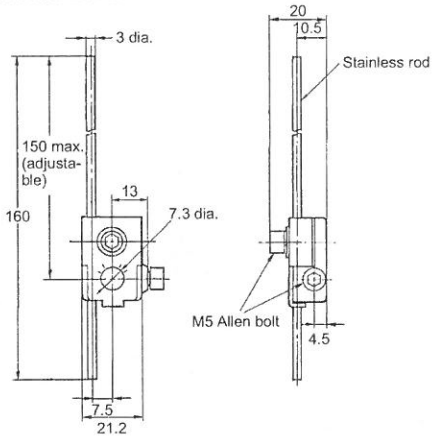


Note: Stainless sintered roller

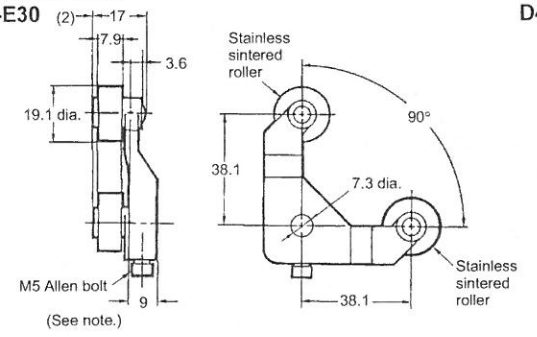
Adjustable Roller Lever
D4A-C00



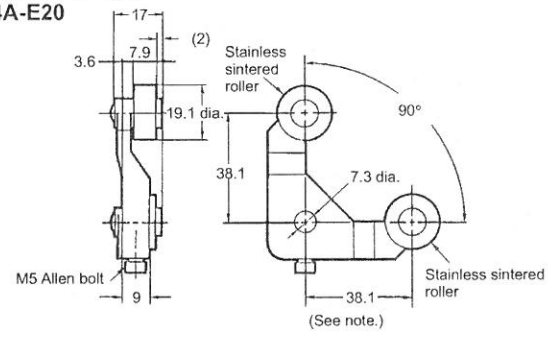
Adjustable Rod Lever
D4A-D00



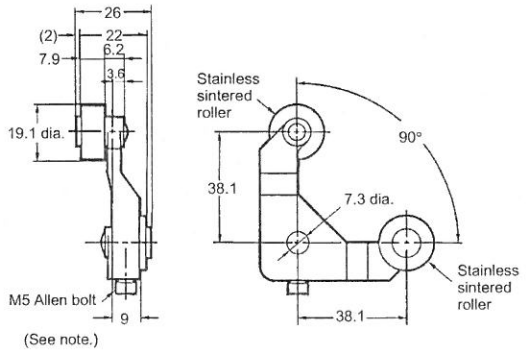
Fork Lever Lock
D4A-E30



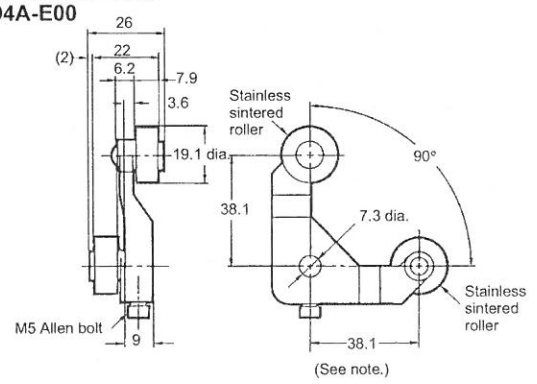
Fork Lever Lock
D4A-E20



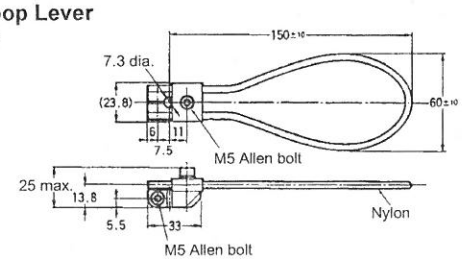
Fork Lever Lock
D4A-E10



Fork Lever Lock
D4A-E00



Nylon Loop Lever
D4A-F00



Note: A Fork Lever Lock can be used with D4A-□□05N models only.

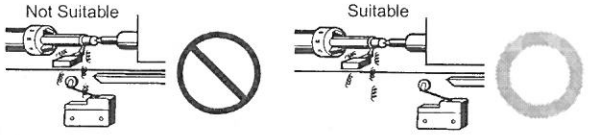
Precautions

Refer to the *"Precautions for General-purpose Limit Switches (Including Multiple Limit Switches, Mechanical Touch Switches, High-precision Switches, Touch Switches, On-site Flexible Switches; Not Including Safety Switches)" on page 17.*

■ Correct Use

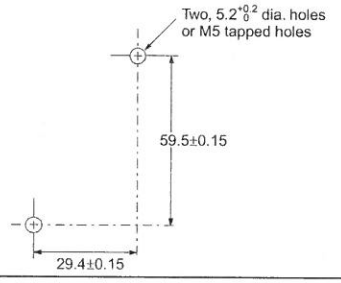
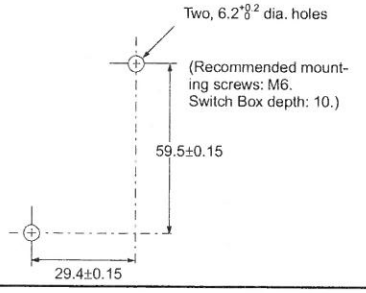
Operating Environment

- Seal material may deteriorate if a Switch is used outdoor or where subject to special cutting oils, solvents, or chemicals. Always appraise performance under actual application conditions and set suitable maintenance and replacement periods.
- Install Switches where they will not be directly subject to cutting chips, dust, or dirt. The Actuator and Switch must also be protected from the accumulation of cutting chips or sludge.



- Constantly subjecting a Switch to vibration or shock can result in wear, which can lead to contact interference with contacts, operation failure, reduced durability, and other problems. Excessive vibration or shock can lead to false contact operation or damage. Install Switches in locations not subject to shock and vibration and in orientations that will not produce resonance.
- The Switches have physical contacts. Using them in environments containing silicon gas will result in the formation of silicon oxide (SiO_2) due to arc energy. If silicon oxide accumulates on the contacts, contact interference can occur. If silicon oil, silicon filling agents, silicon cables, or other silicon products are present near the Switch, suppress arcing with contact protective circuits (surge killers) or remove the source of silicon gas.

Mounting

Model	1/2-14NPT Conduit D4A-1□□□N D4A-2□□□N
Front Mounting	
Rear Mounting (Rear View)	

Tightening Torque

To maintain the high sealing capability of the Limit Switch, tighten the screws for the head and switch box with the following torques:

Head (four 12-mm M4 screws): 1.2 to 1.4 N·m
Switch box (two 20-mm M5 screws): 2.4 to 2.7 N·m

Solderless Terminals

The D4A-□N with DPDT double-break incorporates solderless terminals.

Operation

The operating methods, cam and dog shapes, operating frequency, and overtravel (OT) have a significant effect on the service life and accuracy of the Limit Switch. The shape of the cam should be as smooth as possible.

A marginal overtravel (OT) value should be set. The ideal value is the rated OT value x 0.7.

The actuator should not be remodeled to change the operating position.

Connectors

To satisfy IP67, apply sealing tape to the connector conduit.

Appropriate outer diameter of cables is 5.5 to 14 dia.

Use OMRON's SC-□M Series.

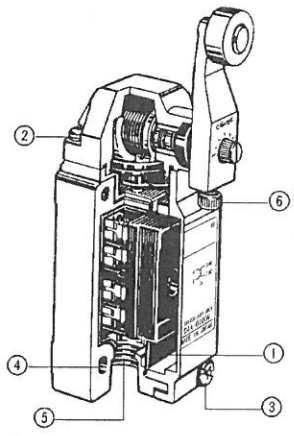
Tighten the Connectors to a torque of 1.8 to 2.2 N·m.

Maintenance and Repair

The user must not maintain or repair equipment incorporating any D4A-N model. Contact the manufacturer of the equipment for any maintenance or repairs required.

Tightening Torque

A loose screw may cause malfunctions. Be sure to tighten each screw to the proper tightening torque as shown in the table.



No.	Type	Appropriate tightening torque
1	Terminal screws (M3.5 screws) (including grounding terminals)	0.78 to 0.88 N·m
2	Head mounting screws	1.18 to 1.37 N·m
3	Switch box mounting screws	2.35 to 2.75 N·m
4	Body mounting screws (See note.)	4.90 to 5.88 N·m
5	Connectors	1.77 to 2.16 N·m
6	Actuator mounting screws	2.45 to 2.65 N·m

Note: When using M5 Allen-head bolts, particularly when the head direction has been changed, check the torque of each screw and make sure that the screws are free of foreign substances, and that each screw is tightened to the proper torque.

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About This Document

References

The following list identifies all documents that may be sources of reference for material discussed in this publication.

Document Title	Doc ID
How to Apply Digital Instrumentation in Severe Electrical Noise Environments	51-52-05-01
Modbus® RTU Serial Communications User Manual	51-52-25-66
Modbus® RTU Serial Communications User Manual Configuration Interface for DR4500	51-52-25-69

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Symbol Definitions

The following table lists those symbols used in this document to denote certain conditions.

Symbol	Definition
	This CAUTION symbol on the equipment refers the user to the Product Manual for additional information. This symbol appears next to required information in the manual.
	WARNING: risk of electrical shock. This symbol warns the user of a potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 VDC may be accessible.
	ATTENTION, Electrostatic Discharge (ESD) hazards. Observe precautions for handling electrostatic sensitive devices
	Protective Earth (PE) terminal. Provided for connection of the protective earth (green or green/yellow) supply system conductor.
	Functional earth terminal. Used for non-safety purposes such as noise immunity improvement. NOTE: This connection shall be bonded to protective earth at the source of supply in accordance with national local electrical code requirements.
	Earth Ground. Functional earth connection. NOTE: This connection shall be bonded to Protective earth at the source of supply in accordance with national and local electrical code requirements.
	Chassis Ground. Identifies a connection to the chassis or frame of the equipment shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.

Contents

1. Overview 1
   1.1 Introduction 1
   1.2 Operator Interface 3
   1.3 Set-up Tasks 5

2. Installation 7
   2.1 Overview 7
   2.2 Model Number Interpretation 13
   2.3 Mounting Considerations and Overall Dimensions 16
   2.4 Mounting Methods 17
   2.5 Wiring Prerequisites 27
   2.6 Input Wiring Procedures 29
   2.7 Output Wiring Procedures 39
   2.8 Option Wiring Procedures 45
   2.9 Lockout Switch Configuration 54

3. Configuration 55
   3.1 Overview 55
   3.2 Configuration Prompts 57
   3.3 How To Get Started 60
   3.4 Configuration Tips 61
   3.5 Configuration Procedure 62
   3.6 Input Set Up Group 64
   3.7 Pen Set Up Group 66
   3.8 Chart Set Up Group 67
   3.9 Time Set Up Group 69
   3.10 Totalizer Set Up Group 70
   3.11 Input Algorithm Set Up Group 72
   3.12 Control Set Up Group 73
   3.13 Tuning Parameters Set Up Group 75
   3.14 SP Ramp Set Up Groups 76

3.15 Timer Set Up Group 77
3.16 Alarms Set Up Group 78
3.17 Auxiliary Output Set Up Group 80
3.18 Modbus Communications Set Up Group 81
3.19 Options Set Up Group 82
3.20 Event Message Configuration 83
3.21 Lockout Set Up Group 86
3.22 Adjust Printing 87
3.23 Configuration Record Sheet 88

4. Configuration Parameter Definitions 93
4.1 Overview 93
4.2 Input Parameters Set Up Group 94
4.3 Pen Parameters Set Up Group 98
4.4 Chart Parameters Set Up Group 100
4.5 Time Parameters Set Up Group 103
4.6 Total Parameters Set Up Group 104
4.7 Input Algorithm Set Up Group 106
4.8 Control Parameters Set Up Group 109
4.9 Tuning Parameters Set Up Group 119
4.10 Setpoint Ramp Set Up Group 122
4.11 Timer Set Up Group 124
4.12 Alarms Set Up Group 125
4.13 Auxiliary Output Set Up Group 128
4.14 Modbus Communications Set Up Group 130
4.15 Options Set Up Group 131
4.16 Event Message Set Up Group 133
4.17 Lockout Parameters Set Up Group 134
4.18 Printing Characteristics Adjustments 135

5. Operation 137
5.1 Overview 137
5.2 Start-up 138
5.3 Monitoring Your Recorder 142
5.4 Operator Functions 148
5.5 Operating Modes 149
5.6 Setpoints 151

5.7 Single Setpoint Ramp 153
5.8 Using Two Sets of Tuning Constants (PID Values) 156
5.9 Using Accutune II 159
5.10 Alarm Setpoints 162
5.11 Three Position Step Control Algorithm 163
5.12 Digital Input Option (Remote Switching) 164
5.13 Resetting and Displaying Totalizer Value 165
5.14 Monitoring the External Event Operation 167
5.15 Maximizing Pen Life 168
5.16 Routine Maintenance 169
5.17 Installing/Replacing Chart 170
5.18 Chart Operation 171

6. Setpoint Ramp/Soak Programming and Operation 173
6.1 Overview 173
6.2 Setpoint Program Contents 175
6.3 Drawing a Ramp/Soak Profile 178
6.4 Entering the Setpoint Program Data 183
6.5 SP RAMP1 and SP RAMP2 Set Up Group 185
6.6 Setpoint Program Profiles Set Up Group 187
6.7 Setpoint Program Segments Set Up Group 189
6.8 Setpoint Program Event Set Up Group 192
6.9 Run/Monitor the Program 196

7. Input Calibration 199
7.1 Overview 199
7.2 Restoring Factory Calibration 200
7.3 Minimum and Maximum Range Values 202
7.4 Preliminary Information 203
7.5 Calibration Set Up and Wiring for PV Inputs 205
7.6 Calibration Procedure 214
7.7 Printing Characteristics Adjustments 217

8. Output Calibration 219
8.1 Overview 219
8.2 Current Proportional Output/Aux Out 2 and 3 Calibration 220
8.3 Position Proportional and Three Position Step Output Calibration 222

8.4 Auxiliary Output Calibration 225

9. Troubleshooting / Service 227
9.1 Overview 227
9.2 Troubleshooting Aids 229
9.3 Self Diagnostics 231
9.4 Visual Failure Symptoms 237
9.5 Troubleshooting Procedures 238

10. Parts List 245
10.1 Overview 245
10.2 Exploded Views 246
10.3 Miscellaneous Hardware Kit Contents 252
10.4 Internal Cabling Data 253
10.5 Internal Wiring Diagram – Options Only 254

A. Model DR45AR 255
A.1 Overview 255
A.2 Hardware Identification 256
A.3 Fo Reset Configuration 258
A.4 Options Configuration 259
A.5 Operations Additions 261
A.6 Configuration Worksheet Additions 262

B. Security Lockout 263
B.1 Overview 263

C. Foreign Language Safety Instructions 265
DA2I-6056 266
DU2I-6056 267
FI2I-6056 268
FR2I-6056 269
GE2I-6056 270
GR2I-6056 271
IT2I-6056 272
NO2I-6056 273
PO2I-6056 274

SP2I-6056 275
SW2I-6056 276

Index 277

Tables

Table 1-1 Function of Keys 4
Table 2-1 Operating Limits and Condensed Specifications 8
Table 2-2 Procedure to Access Components 14
Table 2-3 Mounting Flush in a New Panel Cutout 18
Table 2-4 Reference Data for Mounting DR4500A in Existing Panel Cutouts 19
Table 2-5 Mounting Flush in a Panel Using Universal Filler Kit 20
Table 2-6 Mounting Flush in a Panel Using Kent Model 105M Cutout 21
Table 2-7 Procedure for Mounting Recorder with Heavy Duty Door 22
Table 2-8 Pipe Mounting Procedure 24
Table 2-9 Mounting Flush on a Surface (of Panel or Wall) 25
Table 2-10 Permissible Wiring Bundling 28
Table 2-11 AC Line Power Wiring 31
Table 2-12 Thermocouple, RTD, Radiamatic, mV, or 0–5 Vdc Input Wiring 33
Table 2-13 4-20 mA Input Wiring 35
Table 2-14 0-10 Volt dc Input Wiring 37
Table 2-15 4-20 mA Control Output Wiring 39
Table 2-16 Position Proportional Control Output Wiring 41
Table 2-17 Relay Control Output Wiring 43
Table 2-18 Alarm Output or Digital Input Wiring 45
Table 2-19 Alarm 3 and Alarm 4 Output Wiring 47
Table 2-20 Alarm 5 and Alarm 6 Output Wiring 48
Table 2-21 RS485 Modbus Communications Wiring 50
Table 2-22 4-20 mA Auxiliary Output Wiring 52
Table 3-1 Configuration Tips 61
Table 3-2 Configuration Procedure 62
Table 3-3 Input Group Function Prompts 64
Table 3-4 Pen 1, 2, 3, 4 Group Function Prompts 66
Table 3-5 Chart Group Function Prompts 67
Table 3-6 Time Group Function Prompts 69
Table 3-7 Totalizer Group Function Prompts 70
Table 3-8 Input Algorithm Group Function Prompts 72
Table 3-9 Control 1 or Control 2 Group Function Prompts 73
Table 3-10 Tuning 1 or Tuning 2 Group Function Prompts 75
Table 3-11 SP Ramp 1 or 2 Group Function Prompts 76
Table 3-12 Timer Group Function Prompts 77
Table 3-13 Priority of functions that operate relays 78
Table 3-14 Alarms Group Function Prompts 79
Table 3-15 Auxiliary Output Group Function Prompts 80
Table 3-16 Modbus Communications Group Function Prompts 81
Table 3-17 Options Group Function Prompts 82
Table 3-18 Event Message Group Function Prompts 83
Table 3-19 Lockout Group Function Prompts 86
Table 3-20 Adjust Group Function Prompts 87
Table 4-1 Input Group Definitions 94
Table 4-2 Pen 1, 2, 3, or 4 Group Definitions 98
Table 4-3 Chart Parameters Group Definitions 100
Table 4-4 Time Parameters Group Definitions 103
Table 4-5 Totalizer Group Definitions 104
Table 4-6 Input Algorithm Group Definitions 106
Table 4-7 Control 1 or 2 Group Definitions 109
Table 4-8 Tuning Group Prompt Definitions 119
Table 4-9 Setpoint Ramp 1 or 2 Group Definitions 122
Table 4-10 Timer Group Definitions 124

Table 4-11 Priority of functions that operate relays 125
Table 4-12 Alarms Group Definitions 126
Table 4-13 Auxiliary Output Group Definitions 128
Table 4-14 Modbus Communications Group Definitions 130
Table 4-15 Option Group Definitions 131
Table 4-16 Event Message Group Definitions 133
Table 4-17 Lockout Group Definitions 134
Table 4-18 Printing Characteristics Adjustment Procedure 136
Table 5-1 Power Up Diagnostic Tests 138
Table 5-2 Procedure for Testing the Displays and Keys 139
Table 5-3 Procedure for Starting Up the Recorder 140
Table 5-4 Meaning of Indicators 143
Table 5-5 Lower Display Key Parameter Prompts 145
Table 5-6 Error Messages 146
Table 5-7 Alarm and tuning messages 147
Table 5-8 Operating Mode Definitions 149
Table 5-9 Changing Operating Modes 149
Table 5-10 Procedure for Selecting Automatic or Manual Mode 150
Table 5-11 Procedure for Selecting the Setpoint Source 151
Table 5-12 Procedure for Changing the Local Setpoint 151
Table 5-13 Procedure for Switching Between Setpoints 152
Table 5-14 Setpoint Selection Indication 152
Table 5-15 Procedure for Configuring a Single Setpoint Ramp 153
Table 5-16 Procedure for Running a Setpoint Ramp 154
Table 5-17 Procedure for Selecting Two Sets of Tuning Constants 156
Table 5-18 Procedure for Setting Switchover Values 157
Table 5-19 Procedure for Setting Tuning Constant Values 157
Table 5-20 Procedure for Switching PID Sets from the Keyboard 158
Table 5-21 Procedure for Starting Accutune II 159
Table 5-22 Procedure for Using Accutune for Duplex Control 160
Table 5-23 Procedure for Displaying or Changing the Alarm Setpoints 162
Table 5-24 Procedure for Displaying the 3PSTEP Motor Position 163
Table 5-25 Digital Input Option Action on Contact Closure 164
Table 5-26 Procedure for Resetting the Totalizer 165
Table 5-27 Procedure for Displaying the Totalizer Value 166
Table 5-28 Maximizing Pen Life 168
Table 5-29 Cleaning the Pen Tip 169
Table 5-30 Replacing a Chart Lamp 169
Table 5-31 Installing/Replacing the Chart 170
Table 5-32 Remote Chart Modes 172
Table 6-1 Parameter settings for example 12-step profile 179
Table 6-2 Setpoint program data entry procedure 183
Table 6-3 SP RAMP prompts and available selections 185
Table 6-4 Setpoint Program Profiles Group Definitions 187
Table 6-5 Setpoint Program Segments Group Definitions 189
Table 6-6 Setpoint Program Event Group Definitions 192
Table 6-7 Segment Event relay operation requirements 193
Table 6-8 Run/Monitor Functions 196
Table 7-1 Restoring Factory Calibration 200
Table 7-2 Voltage and Resistance Equivalents for 0 % and 100 % Range Values 202
Table 7-3 Disconnect the Field Wiring 203
Table 7-4 Equipment Needed 204
Table 7-5 General Set Up Procedure 206
Table 7-6 Set Up Wiring Procedure for Thermocouple Inputs Using an Ice Bath 207
Table 7-7 Set Up Wiring Procedure for Thermocouple Inputs Using a Compensated Calibrator Method 208

Table 7-8 Set Up Wiring Procedure for Thermocouple Inputs Using the Ambient Temperature Method 209
Table 7-9 Set Up Wiring Procedure for RTD Inputs 210
Table 7-10 Set Up Wiring Procedure for Radiamatic, Millivolts, and Volts Inputs (except 0-10 Volts) 211
Table 7-11 Set Up Wiring Procedure for 0–10 Volt Inputs 212
Table 7-12 Set Up Wiring Procedure for 4–20 mA Inputs 213
Table 7-13 Calibration Procedure Sequence 214
Table 8-1 Set Up Wiring Procedure Current Proportional Output/Aux Out 2 and 3 220
Table 8-2 Current Proportional Output/Aux Output 2 and 3 Calibration Procedure 221
Table 8-3 Position Proportional and 3 Position Step Output Calibration Procedure 223
Table 8-4 Set Up Wiring Procedure Auxiliary Output 225
Table 8-5 Auxiliary Output Calibration Procedure 226
Table 9-1 Identifying the software version 230
Table 9-2 Power-up tests 231
Table 9-3 Displaying the test results 232
Table 9-4 Error message prompts 233
Table 9-5 Visual failure symptoms 237
Table 9-6 Procedure #1—Troubleshooting recorder failure symptoms 238
Table 9-7 Procedure #2—Troubleshooting pen trace failure symptoms 239
Table 9-8 Procedure #3—Troubleshooting chart rotation failure symptoms 239
Table 9-9 Procedure #4—Troubleshooting chart rotation failure symptoms 240
Table 9-10 Procedure #5—Troubleshooting pen failure symptoms 240
Table 9-11 Procedure #6—Troubleshooting keyboard and/or display failure symptoms 240
Table 9-12 Procedure #7—Troubleshooting current proportional output failure symptoms 241
Table 9-13 Procedure #8—Troubleshooting position proportional output failure symptoms 241
Table 9-14 Procedure #9—Troubleshooting relay output failure symptoms 242
Table 9-15 Procedure #10—Troubleshooting current/time or time/current failure symptoms 242
Table 9-16 Procedure #11—Troubleshooting the auxiliary output 243
Table 9-17 Procedure #12—Troubleshooting external alarm function failure symptoms 243
Table 9-18 Procedure #13—Troubleshooting Modbus communications 243
Table 10-1 Door assembly parts 246
Table 10-2 Chart plate assembly parts 247
Table 10-3 Basic recorder parts without options 249
Table 10-4 Recorder parts associated with options 251
Table 10-5 Miscellaneous hardware kit 252
Table A-1 Fo RESET group function prompts 258
Table A-2 Options group function prompts, continued from Section 3/Table 3-17 259
Table A-3 Option group definitions, continued from Section 4/Table 4-15 260

Figures

Figure 1-1 Operator Interface 3
Figure 1-2 Set-up Tasks 5
Figure 2-1 Model Number Interpretation 13
Figure 2-2 DR4500A Recorder Hardware Components Versus "Table" Selections 15
Figure 2-3 Overall Dimensions 16
Figure 2-4 How to Remove Knockouts 17
Figure 2-5 Mounting Flush in a New Panel Cutout 18
Figure 2-6 Mounting in a Panel Using Universal Filler Kit 20
Figure 2-7 Mounting in a Panel using Kent Model 105M Cutout 21
Figure 2-8 Panel Mounting Recorder with Heavy Duty Door 23
Figure 2-9 Pipe Mounting Brackets 24
Figure 2-10 Mounting Flush on a Surface (of Panel or Wall) 26
Figure 2-11 Ferrite Filter Locations and Shield Wiring (CE Mark) 30
Figure 2-12 AC Line Power Wiring 32
Figure 2-13 Thermocouple, RTD, Radiamatic, mV, or 0–5 Vdc Input Wiring 34
Figure 2-14 4-20 mA Input Wiring 36
Figure 2-15 0-10 Volt dc Input Wiring 38
Figure 2-16 4-20 mA Control Output Wiring (or Aux Out #2 and #3 Wiring) 40
Figure 2-17 Position Proportional Control Output or Three Position Step Wiring 42
Figure 2-18 Relay Control Output Wiring 44
Figure 2-19 Alarm Output or Digital Input Wiring 46
Figure 2-20 Alarm outputs #3, 4, 5, and 6 wiring 49
Figure 2-21 RS485 Modbus Communications Wiring 51
Figure 2-22 4-20 mA Auxiliary Output #1 Wiring 53
Figure 2-23 S1 Lockout Switch Location 54
Figure 3-1 DR4500A Prompt Hierarchy 57
Figure 5-1 Operator Interface 142
Figure 5-2 Deviation Bargraph 144
Figure 6-1 Ramp/Soak Profile Example 178
Figure 7-1 Location of the Input Connections on the Input Boards 203
Figure 7-2 Location of Jumper Positions W1/MA and W3 on the Input Boards 205
Figure 7-3 Calibration Set Up Diagram for Thermocouple Inputs Using an Ice Bath 207
Figure 7-4 Calibration Set Up Diagram for Thermocouple Inputs Using a Compensated Calibrator Method 208
Figure 7-5 Calibration Set Up Diagram for Thermocouple Inputs using the Ambient Temperature Method 209
Figure 7-6 Calibration Set Up Diagram for RTD Inputs 210
Figure 7-7 Calibration Set Up Diagram for Radiamatic, Millivolts, and Volts Inputs (except 0-10 Volts) 211
Figure 7-8 Calibration Set Up Diagram for 0–10 Volt Inputs 212
Figure 7-9 Calibration Set Up Diagram for 4–20 mA Inputs 213
Figure 8-1 Test Equipment Connections for Calibrating Current Proportional Output 220
Figure 8-2 Test Equipment Connections for Calibrating Auxiliary Output 225
Figure 10-1 Door assembly 246
Figure 10-2 Chart plate assembly 247
Figure 10-3 Basic recorder components without options 248
Figure 10-4 Recorder components associated with options 250
Figure 10-5 Internal cabling for DR4500A Truline recorder 253
Figure 10-6 Internal diagram for DR4500A Truline recorder – options only 254
Figure A-1 DR45AR with one input 256
Figure A-2 DR45AR with two to four inputs 257

1. Overview

1.1 Introduction

Function

The DR4500A Truline Recorder is a one to four-channel microprocessor-based circular chart recorder. Its "one-pen" stylus printhead produces up to four analog traces and prints alphanumeric chart data on a blank heat-sensitive chart. All four traces share the same time line reference which the Truline prints. This eliminates the error caused by pen alignment offsets in conventional pen designs. Since the Truline prints the chart and generates the analog traces at the same time, there is no error due to variations in chart size caused by changes in temperature and humidity.

In addition to printing chart records, the Truline recorder alternately displays process variable values for all channels in the selected engineering units.

Models with up to four input channels accept inputs from any one of a variety of sensors or transmitters within the configurable range limits.

The Truline is also available with one or two independent digital controllers and setpoint programmers.

CE Conformity (Europe)

Indicated models of this product are in conformity with the protection requirements of the following European Council Directives: **73/23/EEC**, the Low Voltage Directive, and **89/336/EEC**, the EMC Directive. Conformity of this product with any other "CE Mark" Directive(s) shall not be assumed.

Deviation from the installation conditions specified in this manual, and the special conditions for CE conformity in Subsection 2.1, may invalidate this product's conformity with the Low Voltage and EMC Directives.

ATTENTION

The emission limits of EN 61326 are designed to provide reasonable protection against harmful interference when this equipment is operated in an industrial environment. Operation of this equipment in a residential area may cause harmful interference. This equipment generates, uses, and can radiate radio frequency energy and may cause interference to radio and television reception when the equipment is used closer than 30 meters (98 feet) to the antenna(e). In special cases, when highly susceptible apparatus is used in close proximity, the user may have to employ additional mitigating measures to further reduce the electromagnetic emissions of this equipment.

Microprocessor controlled recording and printing

Both the chart and printhead are driven by stepper motors controlled by the microprocessor with configurable chart speed through the keypad.

You can configure various "printed" chart data such as range marking in engineering units, digital values for process variables, and trace identification. This data plus printed time lines and engineering units of scale eliminate the need to maintain an inventory of a variety of preprinted charts.

The Truline recorder uses a dot fill technique from a microprocessor algorithm to produce a continuous analog trace of a process variable.

Digital controller

The DR4500A recorder controller includes an integral microprocessor-based, single or dual loop PID controller with optional setpoint program. A variety of output types, including a duplex variation for heat cool applications, lets you select the output that is right for your final control element. Accutune II lets you automatically tune your loops.

You can configure the control action as On-Off, PID-A, PID-B, PD with manual reset, or Three Position Step. English language prompts guide you through the entry of all the controller's configurable parameters.

Construction

The DR4500A recorder is housed in a molded case which can be panel or surface mounted. A glass or acrylic windowed door (A UL and FM approved NEMA4X door is also available)protects the internal components while allowing easy access to the chart and operator interface. An optional external keypad that allows operator selections without opening the door is available.

Circuitry is partitioned on printed circuit boards for ease of service.

Power, input, and output wiring connect to terminations inside the case. Knockouts in the sides and bottom of the case accept conduit connections for convenient wire entry.

1.2 Operator Interface

Operator interface

Figure 1-1 shows the operator interface and defines the displays and indicators. The function of the keys is described in Table 1-1.

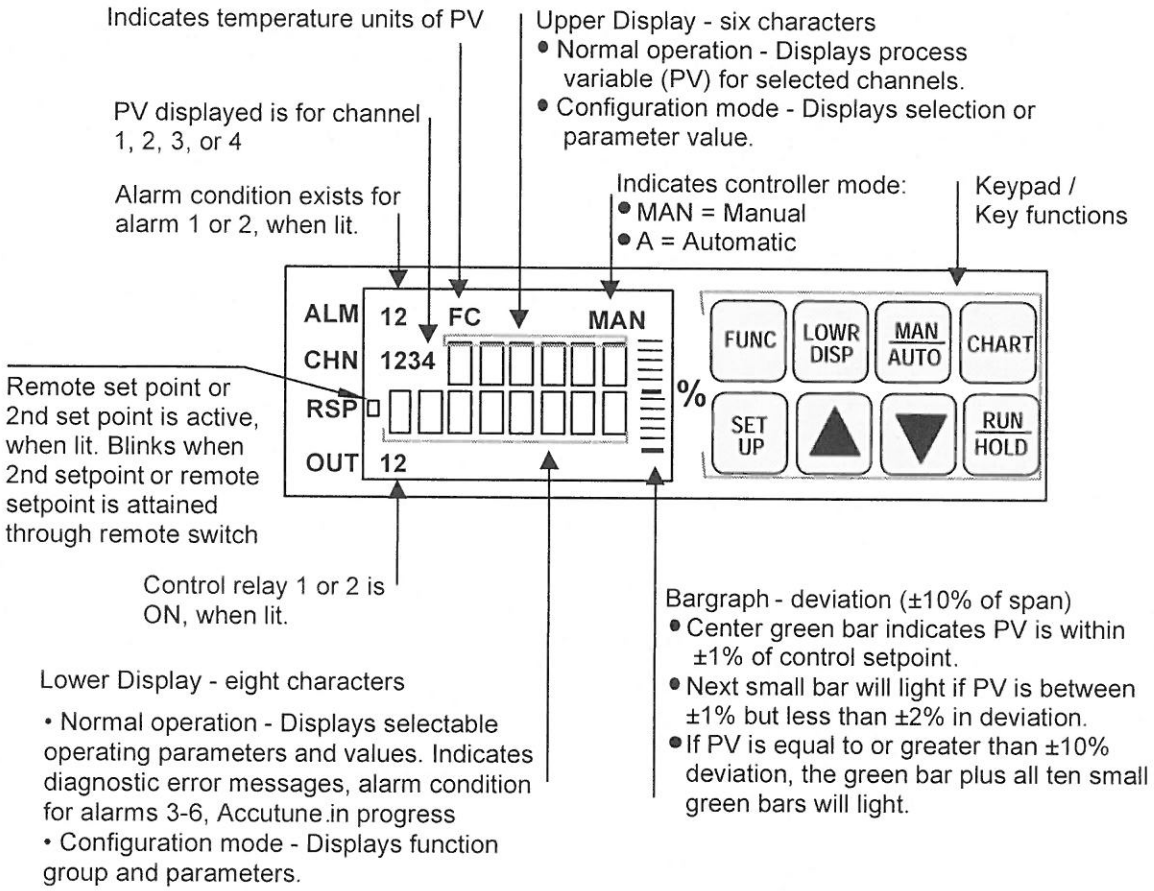

Figure 1-1 Operator Interface

Key functions

Table 1-1 shows each key on the operator interface and defines its function.

Table 1-1 Function of Keys

Key	Function
SET UP	• Places the controller in the Configuration Set Up group select mode. Sequentially displays Set Up groups and allows the **FUNC** key to display individual functions in each Set Up group.
FUNC	• Used in conjunction with the **SET UP** key to select the individual functions of a selected Configuration Set Up group. • Used to toggle between SP1 and SP2. • Used during field calibration procedure.

LOWR DISP	• Selects an operating parameter to be shown in the lower display:
	OUT = Output Value (estimated motor position for 3 Position Step)
	SP = Local Setpoint 1
	SPN = Current setpoint for setpoint rate applications
	2SP = Local Setpoint 2
	RSP = Remote Setpoint
	1IN = Input 1 (if Loop 1 is a derived PV)
	2IN = Input 2
	3IN = Input 3
	4IN = Input 4
	DEV = Deviation
	EU = PV Engineering Units
	RH = % RH Value
	PIDSETX = Tuning Parameter Set X=1 or 2
	RAMP = Minutes remaining in Setpoint Ramp
	#RA = Minutes remaining in SP Prog Ramp
	#SK = Minutes remaining in SP Prog Soak
	RECYC = Number of recycles left in SP Program
	↓ □.□□ = Time remaining in Timer function
	↑ □.□□ = Time elapsed in Timer function
	TUNExXXX = Accutune II indicator. x = 1 or 2
	ATTENTION The lower display can be configured to scroll through the operating parameters.

MAN AUTO	• Alternately selects: AUTO Lower display automatically displays setpoint value in engineering units. MAN Lower display automatically indicates output in %.
CHART	• Used to stop printing operation and move pen to outer limit for chart change. Display will revert to date and time.
RUN HOLD	• Alternate action switch initiates or holds the Setpoint Ramp or Setpoint Program. • In configuration mode, restores the original value or selection if you do not want to enter a change you are making to a parameter.
▲	• Increases the setpoint, output, or configuration values displayed.
▼	• Decreases the setpoint, output, or configuration values displayed.

1.3 Set-up Tasks

Major set-up tasks

As shown in Figure 1-2, there are four major tasks that you must complete to "Set Up" the DR4500A recorder for operation. For easy reference the section numbers for each task are shown.

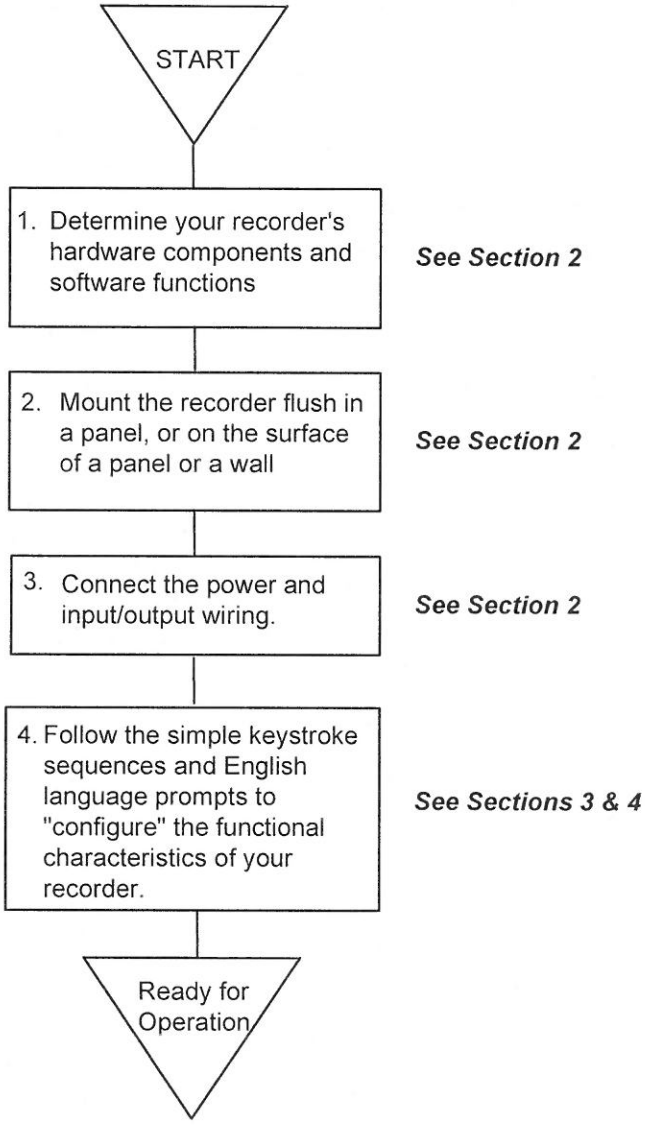

Figure 1-2 Set-up Tasks

2. Installation

2.1 Overview

Introduction

Installation of the DR4500A Recorder consists of mounting and wiring the recorder according to the instructions given in this section.

Read the preinstallation information, check the model number interpretation and become familiar with your model selections, then proceed with installation.

What's in this section?

This section contains the following information:

	Topic	See Page
2.1	Overview	7
2.2	Model Number Interpretation	13
2.3	Mounting Considerations and Overall Dimensions	16
2.4	Mounting Methods	17
2.5	Wiring Prerequisites	27
2.6	Input Wiring Procedures	29
2.7	Output Wiring Procedures	39
2.8	Option Wiring Procedures	45
2.9	Lockout Switch Configuration	54

Pre-installation information

If the recorder has not been removed from its shipping carton, inspect the carton for damage and remove the recorder. Inspect the unit for any obvious shipping damage and report any damage due to transit to the carrier.

Make sure a bag containing mounting hardware is included in the carton with the recorder.

Check that the model number shown on the chart plate agrees with what you have ordered.

CE Conformity special conditions (Europe)

Braid shielded twisted pair cables are required for all Analog I/O, Process Variable, RTD, Thermocouple, dc millivolt, low level signal, 4-20 mA, and relay output circuits. Supplementary bonding of the recorder enclosure to a local ground, using a 3/4" braided copper conductor, is required. Ferrite suppression filters and capacitor filters (see *Subsection 2.5* for Wiring Prerequisites) shall be installed on all cables connected to the recorder/controller.

Refer to document *51-52-05-01, How to Apply Digital Instrumentation in Severe Electrical Noise Environments,* for additional installation guidance.

Operating limits and condensed specifications

We recommend that you review and adhere to the operating limits listed in Table 2-1 when you install your recorder.

Table 2-1 Operating Limits and Condensed Specifications

Condition	Specifications
Ambient Temperature	32 °F to 131 °F (0 °C to 55 °C)
Relative Humidity	5 % to 90 % RH at 40 °C (104 °F)
Vibration Frequency Acceleration	 0 to 200 Hz 0.2 g
Mechanical Shock Acceleration Duration	 5 g 30 ms
Power	102 Vac to 132 Vac 50/60 Hz 204 Vac to 264 Vac 50/60 Hz
Power Consumption	20 VA maximum
Digital Indication Accuracy	1 digit
Minimum Input Span	Range is fully configurable with span limitation of the operating range selected.
Input Impedance	*4-20 mA dc:* 250 ohms *0-10 Vdc:* 200K ohms *All others:* 10 Megohms
Source Impedance	*RTD:* 100 ohms per lead maximum
Sampling Rate	Each input sampled 3 times a second (1 or 2 inputs); 3 times in 2 seconds (3 or 4 inputs).
Input Filter	*Software:* Single pole low pass section with selectable time constants (off to 120 seconds).
Digital Displays	Vacuum fluorescent, alphanumeric. A six-digit display dedicated to the process variable. Alternate information displayed during configuration mode. An eight-digit display shows key selected operating parameters. Also provides guidance during configuration.
Indicators	Channel PV display (CHN 1, 2, 3, or 4) Alarm status (ALM 1, 2) Controller Output (OUT 1, 2) Remote Setpoint (RSP) Temperature unit (F or C) or Engineering Units Controller's mode (A or MAN)
Deviation Bargraph	21 segment, color coded deviation bargraph: Green (large) = On Control Green (small) = Deviation to ± 10 % of PV
Controller Modes of Operation	Manual Operation Automatic with local setpoint Automatic with remote setpoint
Transmitter Supply Voltage	22 Vdc to 26 Vdc at input terminals (50 mA dc at 24 Vdc)

Condition	Specifications
Controller Output[1] (Optional)	• *On-Off or Time Proportional* One SPST electromechanical relay. Control action can be set for direct or reverse; N.O. or N.C. contact selectable. • *On-Off Duplex or Time Proportional Duplex* Two SPST electromechanical relays. Control action can be set for direct or reverse; N.O. or N.C. contact selectable. • *Current Proportional* 21 mA dc maximum into a negative or positive grounded or non-grounded load of 0 to 1000 ohms. Output range can be set between 4 and 20 mA, and as direct or reverse action. *Resolution:* 10 bits *Accuracy:* 0.5 % full scale FM Approved Output (optional) • *Position Proportional and Three Position Step* Two SPST electromechanical relays operate motor having a 100 ohm to 1000 ohm slidewire. • *Current/Time Duplex and Time/Current Duplex* Variation of time proportional duplex for Heat/Cool applications. Time proportional output (heat or cool) is a SPST electromechanical relay. Current proportional output (heat or cool) is a 4-20 mA signal that can be fed into a negative or positive grounded load of 0 to 1000 ohms and is operational over 50 % of range or the entire range. *Time Proportional Relay Resolution:* 4.4 mSec Relay Contact Ratings: Resistive Load: 5 A @ 120 Vac, 2.5 A @ 240 Vac Inductive Load: 50 VA @ 120 Vac or 240 Vac Cycle Time: 1 second to 120 seconds *Current Proportional:* Resolution: 10 bits Accuracy: 0.5 % full scale
Auxiliary Output (Optional)	21 mA dc maximum into a negative or positive grounded load of 0 to 1000 ohms. The range can be set between 0 to 21 mA. It can be configured to represent any one of 12 control parameters. *Resolution:* 12 bits over 0 to 21 mA *Accuracy:* 0.2 % of full scale *Temperature Stability:* 0.03 % F.S./°C

Types of Input Actuations[2]	Range		Reference Accuracy		Temp Stability ± Degrees Error Per 1 Degree ΔT
	°F	°C	± °F	± °C	
Thermocouples[3]	**105 to 3300**	**41 to 1816**			
B	105 to 150	41 to 66	42.00	23.00	2.00
	150 to 500	66 to 260	14.00	7.70	2.00
	500 to 1000	260 to 538	3.00	1.70	0.50
	1000 to 3300	538 to 1815	1.50	0.80	0.20
E	**–454 to 1832**	**–270 to 1000**			
	–454 to –202	–270 to –130	18.00	10.00	0.70
	–202 to 1832	–130 to 1000	1.00	0.55	0.35
E (low)	**–200 to 1100**	**–129 to 593**	0.50	0.30	0.20
J	**0 to 1600**	**–18 to 871**	0.40	0.22	0.06
J (low)	**20 to 770**	**–7 to 410**	0.20	0.11	0.04
K	**–320 to 2500**	**–196 to 1371**			
	–320 to 0	–196 to –18	1.25	0.70	0.18
	0 to 2500	–18 to 1371	0.60	0.35	0.09
K (low)	**–20 to 1000**	**–29 to 538**	0.30	0.16	0.05
NNM (Ni Ni Moly)	**32 to 2500**	**0 to 1371**			
	32 to 500	0 to 260	0.75	0.40	0.09
	500 to 2500	260 to 1371	0.50	0.30	0.07
NIC (Nicrosil-Nisil)	**0 to 2372**	**–18 to 1300**	1.0	0.55	0.01
R	**0 to 3100**	**–18 to 1704**			
	0 to 500	–18 to 260	2.00	1.10	0.25
	500 to 3100	260 to 1704	1.00	0.55	0.13
S	**0 to 3100**	**–18 to 1704**			
	0 to 500	–18 to 260	2.00	1.10	0.23
	500 to 3100	260 to 1704	1.00	0.55	0.13
T	**–300 to 700**	**–184 to 371**	0.60	0.35	0.07
T (low)	**–200 to 600**	**–129 to 316**	0.40	0.22	0.07
W5W26	**0 to 4200**	**–18 to 2315**			
	0 to 600	–18 to 316	1.40	0.77	0.17
	600 to 3600	316 to 1982	1.30	0.70	0.17
	3600 to 4200	1982 to 2315	1.60	0.90	0.29
W5W26 (low)	**0 to 2240**	**–18 to 1227**			
	0 to 600	–18 to 316	1.10	0.60	0.14
	600 to 2240	316 to 1227	1.00	0.55	0.10
Radiamatic	**1400 to 3400**	**760 to 1871**	1.00	0.55	0.10
RTD					
Platinum					
100 ohms	**–300 to 900**	**–184 to 482**	0.40	0.22	0.05
200 ohms (high)[5]	**32 to 752**	**0 to 400**	0.30	0.16	0.05
200 ohms (low)[5]	**32 to 392**	**0 to 200**	0.20	0.12	0.05
500 ohms	**–300 to 900**	**–184 to 482**	0.20	0.11	0.05

Types of Input Actuations[2]	Range		Reference Accuracy		Temp Stability ± Degrees Error Per 1 Degree ΔT
	°F	°C	± °F	± °C	
Linear					
Milliamperes dc	4 to 20	—	0.10 %	—	0.004 %/°F
Millivolts dc	0 to 10 10 to 50	—	0.05 % 0.05 %	—	0.004 %/°F 0.004 %/°F
Volts dc	1 to 5 (can be calibrated 0 to 5) 0 to 10	— —	0.05 % 0.10 %	— —	0.004 %/°F 0.004 %/°F
Relative Humidity Platinum 100 ohm Wet/Dry Bulb*					
Wet/Dry Input	**–130 to 392**	**–90 to 200**	0.30	0.03	0.03

	Measured % RH	Dry Bulb Range		Reference Accuracy	Temp. Stability 53 °F to 104 °F/ 12 °C to 40 °C
		°F	°C		
% RH[4]	0 to <20	–103 to 212	–75 to 100	2 % RH	0.11 % RH/°F
	20 to 100	35 to 40	2 to 4	2 % RH	0.11 %RH/°F
		>40 to 100	>4 to 38	1 % RH	0.06 % RH/°F
		100 to 212	38 to 100	1 % RH	0.03 % RH/°F

Condition	Specifications
Case	Molded, foamed-Noryl** with gasketed door. A UL and FM approved NEMA4X door is also available.
Chart	12-inch (304.8 mm) diameter chart. Plain thermal-sensitive paper.
Wiring Connections	Terminals inside the case.
Color	*Case:* Black *Door (standard):* Caribbean Blue, Black, or Gray
Approval Bodies	U.L. Approval depending on model. CSA Approval. Consult Model Selection Guide for information. FM approved for Class I, Div. 2, Groups A, B, C, D areas depending on model.
Weight	13.2 lbs (6 kg)
Mounting	Panel, 2-inch pipe, or surface mounted. Some adapter kits available for existing panel cutouts.
OPTIONS	
Alarm Output	Two, four, or six relays available. *Relay Contact Ratings:* *First Relays, Resistive Load:* 1 A @ 120 Vac, 1/2 A @ 240 Vac *Relays 3 through 6, Resistive Load:* 5 A @ 120 Vac, 2.5 A @ 240 Vac
Digital Input	+20 Vdc source for external dry contact or isolated solid state contacts. Selects one configured input.
Totalizers	One to four totalizers depending on model. Eight digit "totals" with multiplier on digital display; 14 digit totalization printout on chart.
RS485 Modbus RTU Communications	*Baud rate:* 300, 600, 1200, 2400, 4800, 9600,19,200, 38,400 *Protocol:* RS485 Modbus RTU Communications *Length of Link:* 4000 ft (1,219 m) maximum *Link Characteristics:* Two-wire, multidrop

Condition	Specifications
Calculations	F_o calculation available on DR45AR, Math function.
Miscellaneous	• FM Approved 4-20 mA Control Output • A UL and FM approved NEMA4X door • Door Lock • External Keypad • Chart Illumination • U.L. Listing, CSA Approval, FM Class I Div. 2 • Control with Accutune II Tuning capability • Math • Glass or Acrylic Window • Configuration Lockout Switch • Customer ID Tag (30 characters maximum) • Pulse output counter alarm function on DR45AW model
CE Conformity (Europe)	This product is in conformity with the protection requirements of the following European Council Directives: **73/23/EEC**, the Low Voltage Directive, and **89/336/EEC**, the EMC Directive. Conformity of this product with any other "CE Mark" Directive(s) shall not be assumed.
Product Classification	Class 1: Permanently connected, Panel/Surface Mounted Industrial Control Equipment with protective earthing (grounding). (EN 61010-1)
Enclosure Rating	Panel/Surface Mounted Equipment, IP 54. (ref. IEC 529)
Installation Category (Overvoltage Category)	Category II: Energy-consuming equipment supplied from the fixed installation. Local level appliances, and Industrial Control Equipment. (EN 61010-1)
Pollution Degree	Pollution Degree 2: Normally non-conductive pollution with occasional conductivity caused by condensation. (ref. IEC 664-10
EMC Classification	Group 1, Class A, ESM Equipment (EN 55011, emissions), Industrial Equipment (EN 50082-2, immunity)
Method of EMC Assessment	Technical File (TF)
Declaration of Conformity	Document #51197639-000

*IEC Alpha (α) = 0.00385 $\Omega/\Omega/°C$

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[1] Not all controller outputs are available on all models of the Truline Recorder. Consult Model Selection Guide for information.

[2] Not all Input Actuations are available on all models of the Truline Recorder. Consult Model Selection Guide for information.

[3] Includes reference junction calibration of ±0.01 degrees using standard "ice bath" method of calibration. Factory calibration at reference ± 1.2 °F. Note that factory calibration may vary by as much as ± 10 microvolts or ± 0.3 ohms for RTDs, which means recalibration may be required to achieve stated accuracy.

[4] The RH calculation is inoperative when temperature goes below 32 °F (0 °C) or above 212 °F (100 °C). However, the dry bulb temperature will be monitored to –103 °F (–75 °C). Accuracy stated is for Classic Series Recorder only, and does not include remaining system accuracies.

[5] Only available with Model DR45AR.

2.2 Model Number Interpretation

Model number

The model number interpretation is shown in Figure 2-1. Write the model number into the spaces provided and compare it to the model number interpretation. This information will also be useful when you wire your recorder. The example on the next page will help you to decode the model.

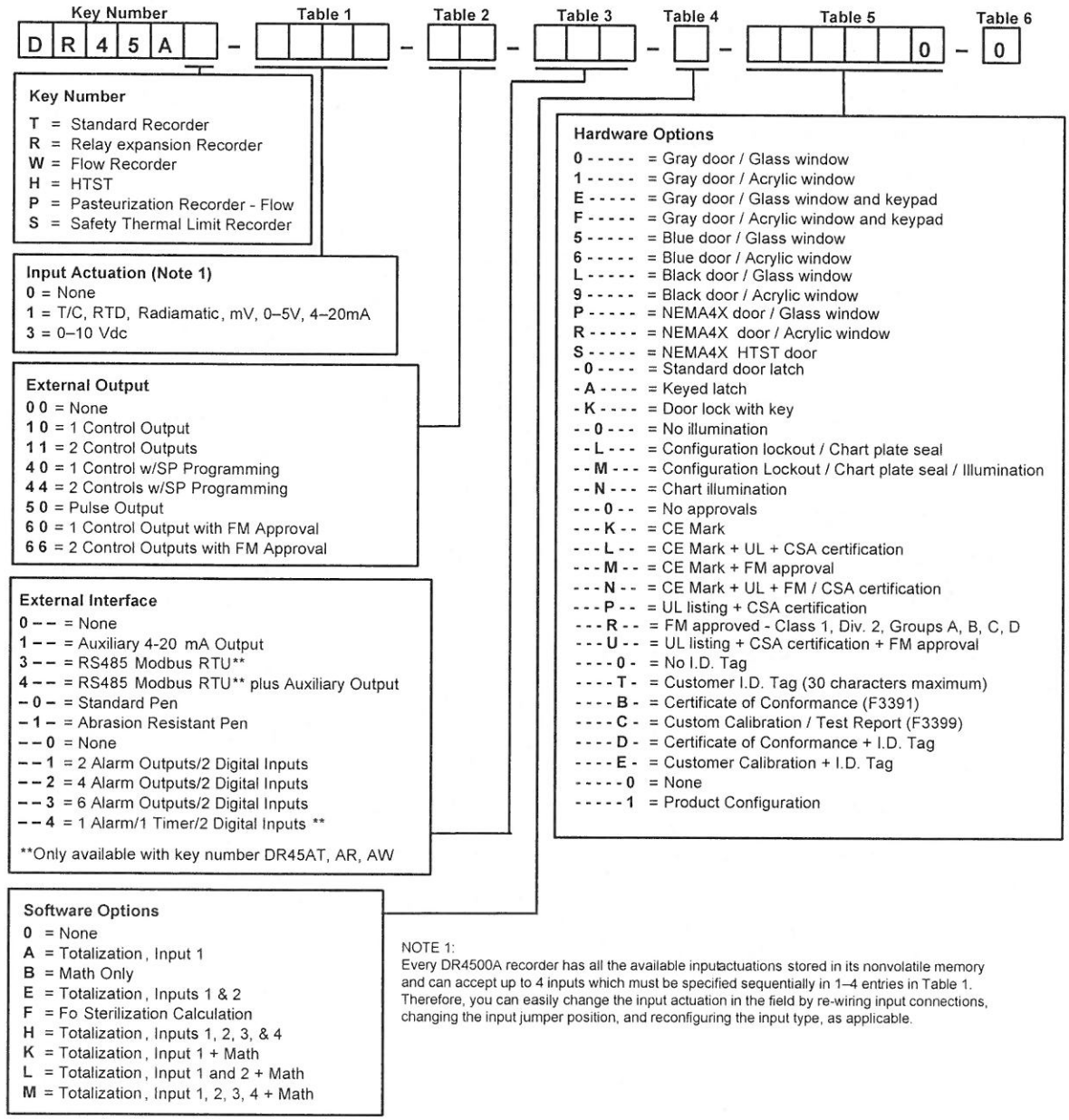


Figure 2-1 Model Number Interpretation

Example of model number decoding

Assume that the model number on the label is

DR45AT - 1300 - 44 - 001 - A - 1KN0T0 - 0

Using the table code definitions from Figure 2-1, this recorder has the following features and options:

- 2-input type with thermocouple, RTD, Radiamatic, mV, 0-5 Vdc or 4-20 mA input for channel 1
- 0-10 Vdc input for channel 2
- Two controllers with setpoint programming capability
- Alarm output / digital input capability
- High speed pen
- Totalization for input 1
- Gray door with acrylic window
- Door lock
- Chart illumination
- Customer I.D. tag
- No approvals

Location of hardware components

After you decode your recorder's model number, refer to Figure 2-2 to match "table" selections with the location of actual recorder hardware components. This will help you to determine applicable input / output wiring requirements, as well as identify appropriate software functions to be configured later.

To access and view the actual components inside your recorder, follow the procedure in Table 2-2.

Table 2-2 Procedure to Access Components

Step	Action
1	Turn the latch on the recorder door and swing the door open.
2	Loosen the captive screw on the right hand side of the chart plate and swing the chart plate out.
3	Reverse the steps to close the chart plate and door.

View of hardware components

Figure 2-2 shows the location of the actual hardware components for key number DR45AT. If key number is DR45AR, see Appendix A for internal views.

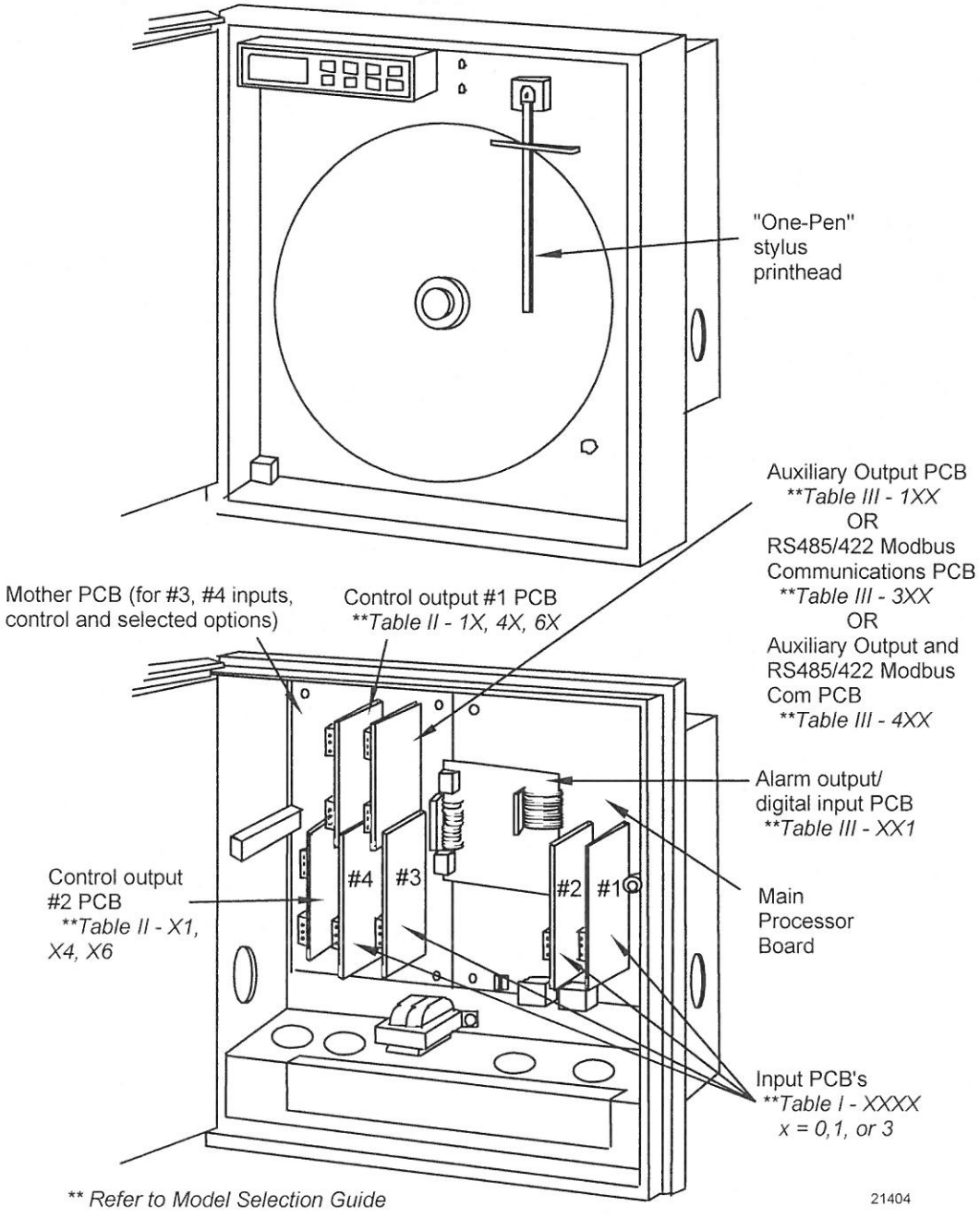


Figure 2-2 DR4500A Recorder Hardware Components Versus "Table" Selections

2.3 Mounting Considerations and Overall Dimensions

Physical considerations

The recorder can be mounted in a panel by making a new cutout or using an existing cutout with a filler plate (see Table 2-4). Use the mounting kit supplied. Adequate access space must be available at the back of the panel for installation and servicing activities.

The overall dimensions and panel cutout requirements for mounting the recorder are shown in Figure 2-3.

Overall dimensions

Figure 2-3 shows the overall dimensions for mounting the recorder.

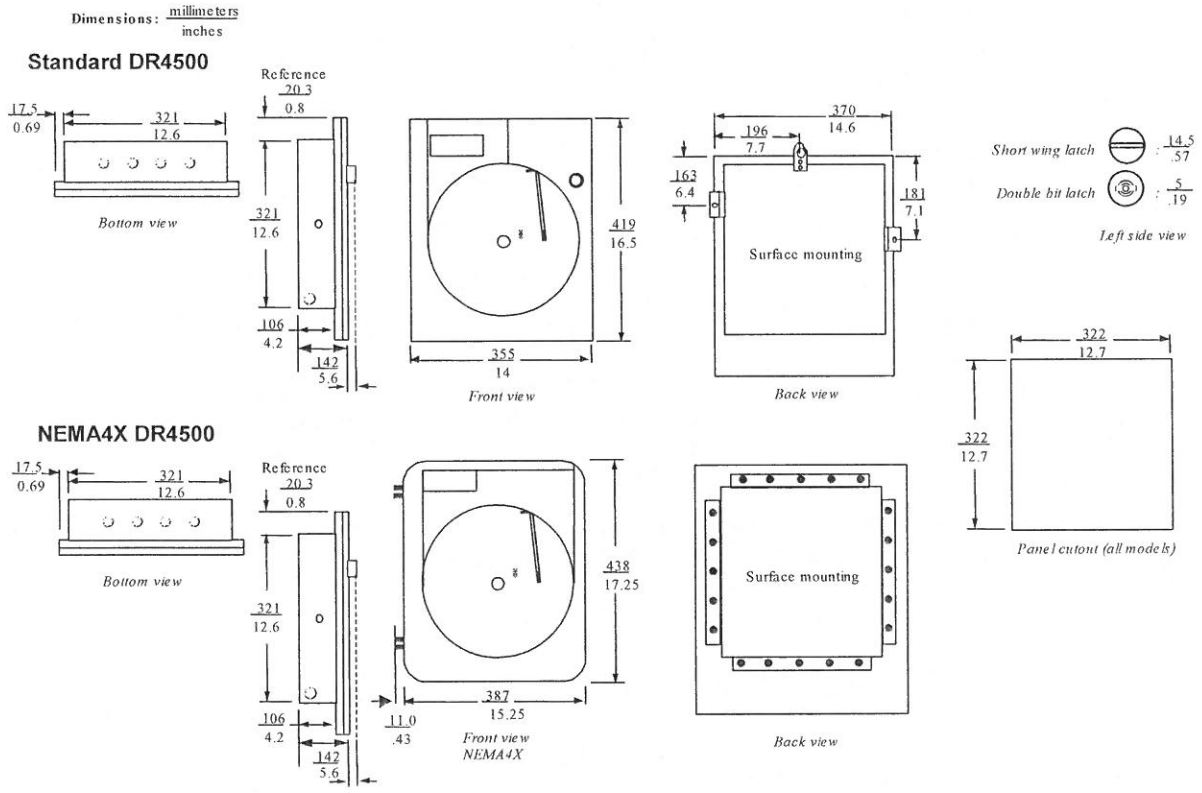


Figure 2-3 Overall Dimensions

2.4 Mounting Methods

Introduction

There are several methods available for mounting your recorder.

- Flush in Panel (new panel cutout)
- Flush in Panel (using an existing panel cutout)
  - using universal filler plate kit
  - using cutout made for Kent Model 105M
- Flush in Panel for recorders with NEMA4 Door
- On a 2-inch Pipe
- On Surface (of panel or wall)

Procedures for each method follow. Choose the one that meets your mounting requirements. Use the associated dimension drawings for reference.

How to remove knockouts for conduits

Before you mount the recorder, remove the appropriate "knockouts" in the bottom and/or sides of the recorder case for wire entry via 1/2" (12.7 mm) conduits. Refer to Figure 2-4 for knockout locations.

ATTENTION

The knockouts are really plugs that you just have to push out to remove.

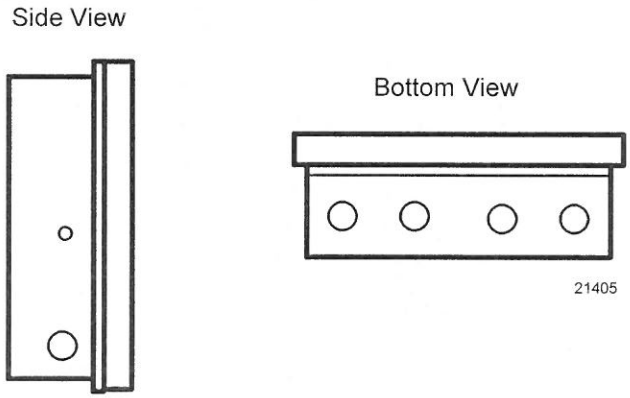


Figure 2-4 How to Remove Knockouts

Mounting flush in panel (New panel cutout)

Refer to Figure 2-5 and follow the procedure in Table 2-3 to make a new cutout in a panel and mount your recorder in the cutout.

Table 2-3 Mounting Flush in a New Panel Cutout

Step	Action
1	At the appropriate location, make a square cutout in the panel measuring 12.7 ± 0.060 inches by 12.7 ± 0.060 inches (322.58 ± 1.52 by 322.58 ± 1.52 millimeters). See Figure 2-3.
2	Orient the recorder case properly and slide it into the cutout from the front of the panel. Support the recorder as shown in steps 3 and 4.
3	Refer to Figure 2-5. From the back of the panel, attach a mounting bracket to each side of the recorder case using a 1/4-20 x 1/2 inch hex screw and a lockwasher for each bracket (mounting hardware supplied with recorder). Leave the screws slightly loose so you can adjust the brackets.
4	While holding the recorder firmly against the panel, slide each bracket against the back of the panel and tighten the screws.

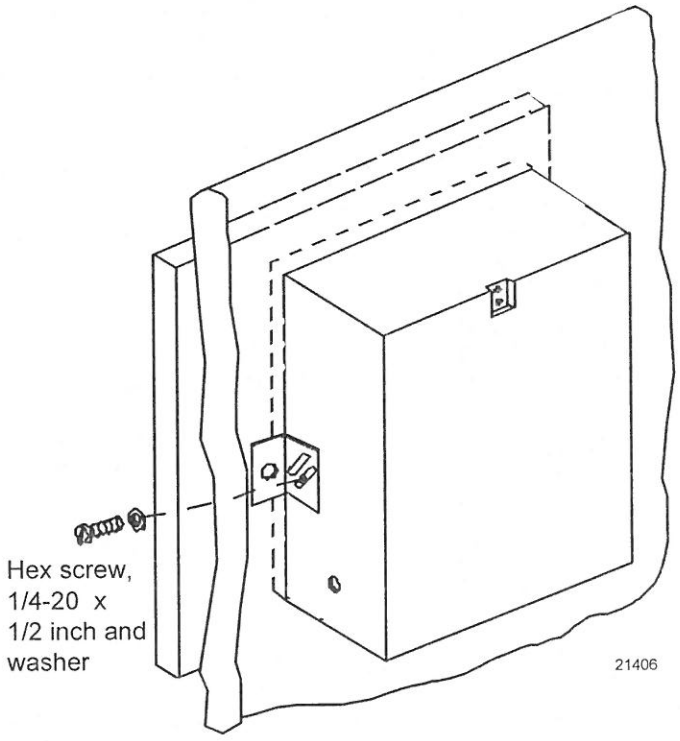


Figure 2-5 Mounting Flush in a New Panel Cutout

Reference data for existing panel cutouts

Refer to Table 2-4 to determine whether the existing panel cutout can be used. Use the procedure for mounting with the universal filler kit unless otherwise noted.

Table 2-4 Reference Data for Mounting DR4500A in Existing Panel Cutouts

Manufacturer / Instrument	Dimensions of Existing Panel Cutout (inches)	Need Universal Filler Plate Kit 30755134-001 Blue Color 30755134-002 Gray Color
Honeywell/Model AR100*, DR4200	12.7 x 12.7	No*
Honeywell/Class 15	15.8 x 17.2	Yes
Honeywell/Class 45	13.12 x 17.12	Yes
Badger Meter/Model Micro Chart	14.25 x 17.88	Yes
Bristol/Models 4330, 500 Classes 1, 2A, 3B, and 5	3.56 x 18.56	Yes
Fisher and Porter/Model 51-1100	13.75 x 17.31	Yes
Foxboro/Model 40	14.38 x 17.06	Yes
Kent/Model 105M**	13.6 x 13.46	No**
Partlow/Model ER*	13.5 x 12.69	No*
Taylor/Model 76J	13.78 x 16.5	Yes

*No adaptation is required, use procedure for "Flush in Panel - New Panel Cutout"

**Use procedure for "Cutout made for Kent Model 105M"

Adapter plate dimensions

The dimensions of the adapter plate (part number 30755134) are 16.5" x 19".

Mounting flush in panel (using universal filler plate kit)

Refer to Figure 2-6 and follow the procedure in Table 2-5 to mount your recorder in an existing cutout using the Universal Filler Kit.

Table 2-5 Mounting Flush in a Panel Using Universal Filler Kit

Step	Action
1	Lay the recorder face down on a clean work surface and position the universal filler plate as shown in Figure 2-6.
2	Measure the height of the existing panel cutout.
3	Refer to Figure 2-6. Position the support brackets, supplied with the kit, so that the distance from the top of the "window" in the filler plate to the right angle of the support brackets is just less than the height of the existing panel cutout.
4	Secure brackets with two 10-32 x 1/4 inch screws, provided in the kit, by inserting them through the holes in the filler plate into the tapped screw holes in the recorder case.
5	Insert the recorder into the cutout from the front of the panel as shown in Figure 2-6.
6	Refer to Figure 2-6. From the back of the panel attach a mounting bracket to each side of the recorder case using a 1/4-20 x 1/2-inch hex screw and a lockwasher for each bracket (mounting hardware supplied with recorder). Leave the screws slightly loose so you can adjust the brackets.
7	While holding the recorder firmly against the panel, slide each bracket against the back of the panel and tighten the screws.

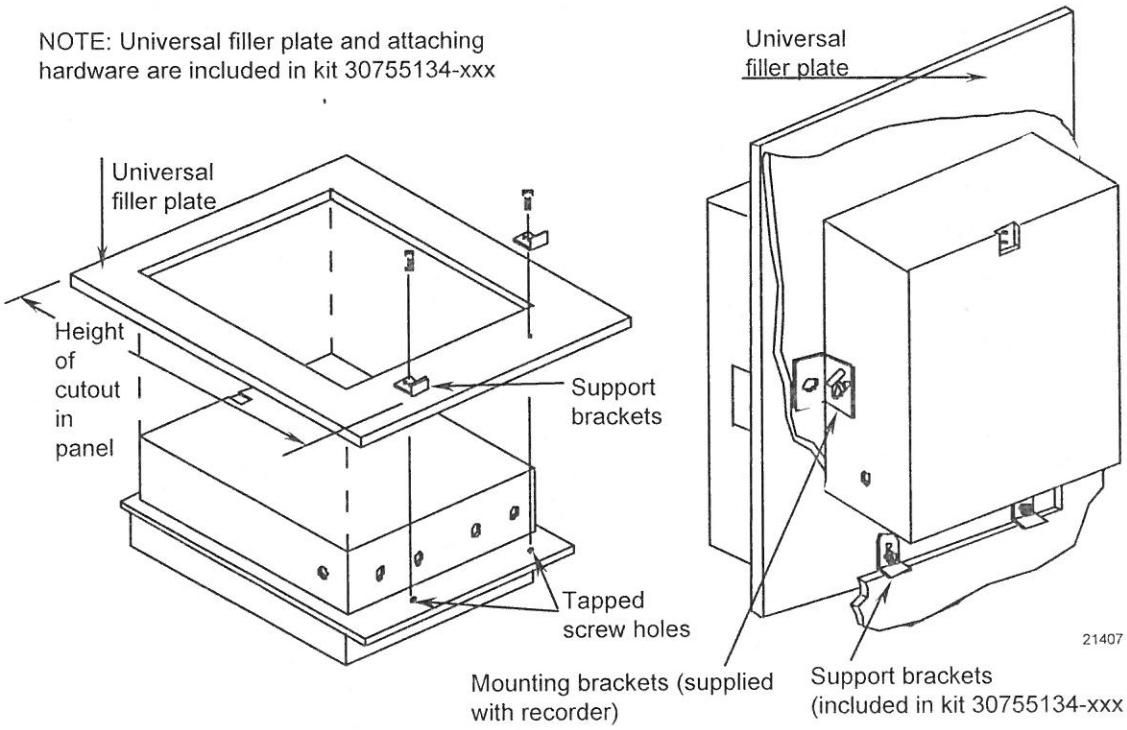


Figure 2-6 Mounting in a Panel Using Universal Filler Kit

Mounting flush in panel (using cutout made for Kent Model 105M)

Refer to Figure 2-7 and follow the procedure in Table 2-6 to mount your recorder in an existing cutout using the cutout made for Kent Model 105M.

Table 2-6 Mounting Flush in a Panel Using Kent Model 105M Cutout

Step	Action
1	Drill two 1/4-inch holes in the back of the panel as shown in Figure 2-7. These holes are for 10-32 screws to be inserted from back of panel into threaded inserts in the back of the recorder case. **ATTENTION** If the panel is more than 1/4-inch thick, substitute 10-32 x 1/2-inch long screws for the 3/8-inch long screws supplied with the recorder.
2	While supporting the recorder, insert it through the panel cutout and orient the case so that the threaded inserts at the bottom of the case align with the holes drilled in the panel.
3	From the rear of the panel, insert two 10-32 pan head screws of appropriate length into threaded inserts in the recorder case.
4	From the back of the panel, attach a mounting bracket to each side of the recorder case using a 1/4-20 x 1/2-inch hex screw and a lockwasher for each bracket (mounting hardware supplied with recorder). Leave the screws slightly loose so you can adjust the brackets.
5	While holding the recorder firmly against the panel, slide each bracket against the back of the panel and tighten the screws.

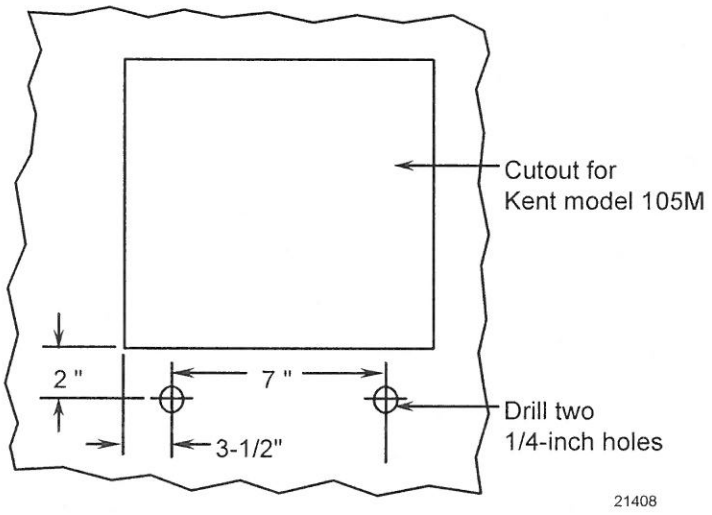


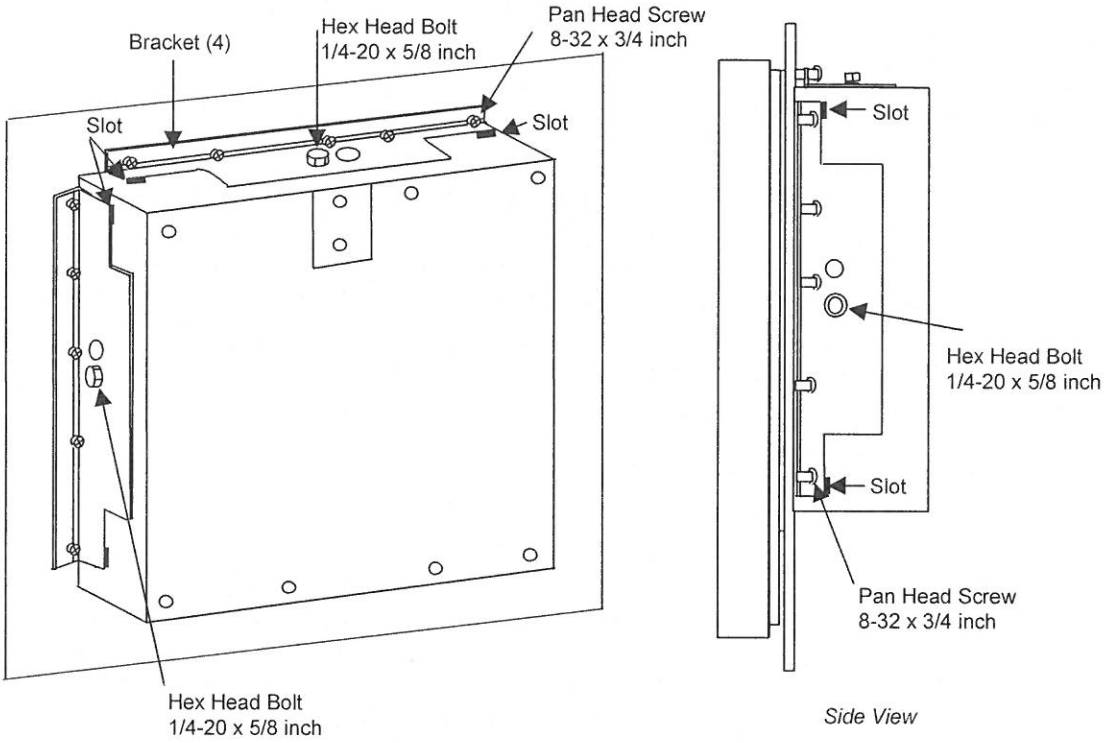
Figure 2-7 Mounting in a Panel using Kent Model 105M Cutout

Panel mounting recorder with NEMA4X door

Refer to Figure 2-8 and follow the procedure in Table 2-7 to panel-mount your recorder if it has a NEMA4X door.

Table 2-7 Procedure for Mounting Recorder with NEMA4X Door

Step	Action
1	Place the panel gasket onto the rear flange of the recorder case.
2	Install five #8-32 x 3/4 screws on each of the four mounting brackets so the ends of the screw threads are flush with the face of the bracket. NOTE: Screw heads to be flange side of brackets.
3	Insert the case with gasket into the panel opening.
4	Position the bracket so that the tabs on the end of the bracket slide into the holes in the case, Secure the four brackets with 1/4-20 x 5/8 long bolts and lockwashers; one to the top, bottom and each side of the case. Tighten the bolts.
5	Start to tighten the #8-32 x 3/4 screws on a bracket. Tighten the end screws first then those toward the middle until all five screws have a 5 to 8 lb-in of torque applied. Do the same to both the other three brackets. When completed all twenty screws should have a 5 to 8 lb-in of torque applied. This assures that the case and panel gaskets are adequately sealed against the panel.



NOTE: Mounting brackets, attaching hardware, and panel gasket are included in kit 30755065-503

Figure 2-8 Panel Mounting Recorder with NEMA4X Door

Mounting on a 2-inch pipe

Refer to Figure 2-9 and follow the procedure in Table 2-8 to mount your recorder on a 2-inch pipe.

Table 2-8 Pipe Mounting Procedure

Step	Action
1	Using the eight plastite screws supplied with the pipe mounting bracket kit, attach the two mounting brackets (flat side against the case) to the back of the recorder. Refer to Figure 2-9 for location.
2	Position the recorder with brackets on the 2-inch pipe.
3	Install the U-bolts around the pipe and through the bracket holes. Secure with lockwashers and hex nuts provided.

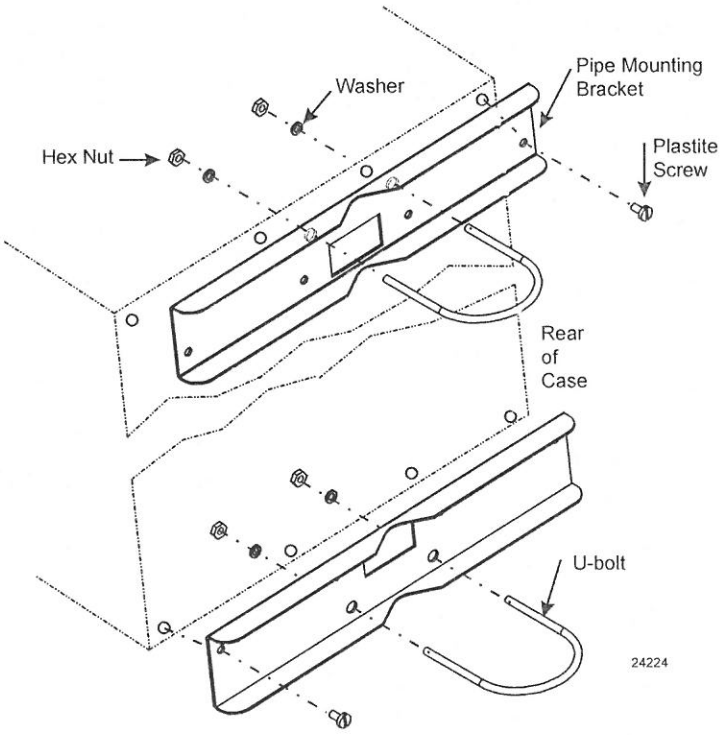


Figure 2-9 Pipe Mounting Brackets

Mounting on surface (of panel or wall)

Refer to Figure 2-10 and follow the procedure in Table 2-9 to mount your recorder on a surface (panel or wall).

ATTENTION

You must supply three (3) screws for attaching the mounting hardware (brackets and support hook) to panel or wall.

Table 2-9 Mounting Flush on a Surface (of Panel or Wall)

Step	Action
1	Using two flat-head 10-32 x 1/4-inch screws supplied with the recorder, fasten the support hook into the recess at the back of the recorder case as shown in Figure 2-10.
2	Using 1/4-20 x 1/2-inch hex screws and lockwashers, attach a mounting bracket to each side of the case. Leave the screws slightly loose so as to permit some adjustments of the brackets.
3	On the panel mark the locations for the three holes as shown by the hole pattern in Figure 2-10.
4	Using a drill of appropriate size for user-supplied screws, drill a hole in the front of the panel for the eye of the support hook.
5	Insert the screws for the support hook into the panel, allowing the screw head to protrude approximately 5/16-inch.
6	Hang the recorder support hook on the screw. Make sure that the locations for the other two holes (marked in step three) are correct. If not, make sure that the recorder is aligned vertically and use the brackets as templates to mark the proper locations.
7	Remove the recorder from the panel and drill the other two holes.
8	Hang the recorder on the screw by the support hook and insert the other two user-supplied screws through the brackets into the panel. Tighten the two hex screws that attach the brackets to the case.

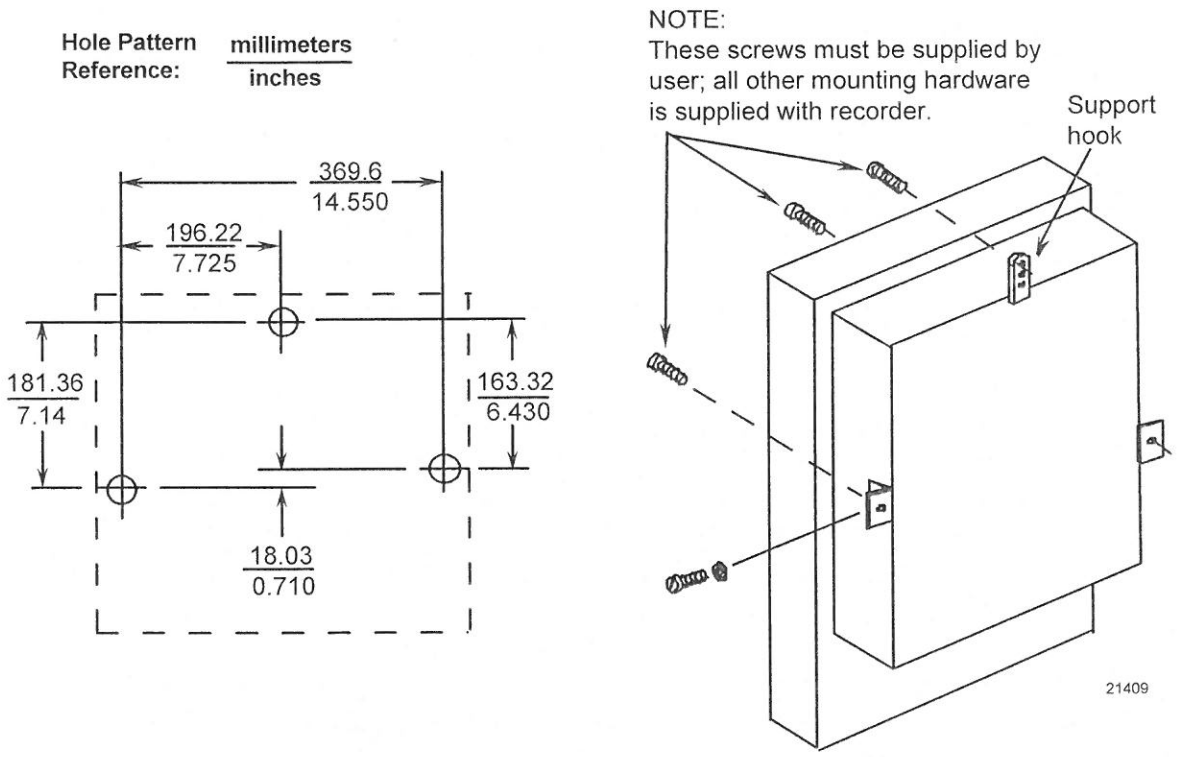


Figure 2-10 Mounting Flush on a Surface (of Panel or Wall)

2.5 Wiring Prerequisites

Taking electrical noise precautions

Electrical noise is composed of unabated electrical signals which produce undesirable effects in measurements and control circuits.

Digital equipment is especially sensitive to the effects of electrical noise. Your recorder has built-in circuits to reduce the effect of electrical noise from various sources. If there is a need to further reduce these effects:

- Separate External Wiring - separate connecting wires into bundles (see Table 2-10) and route the individual bundles through separate conduits or metal trays.
- Use Suppression Devices - for additional noise protection, you may want to add suppression devices at the external source; appropriate suppression devices are commercially available.

REFERENCE

For additional noise information, refer to *document number 51-52-05-01.*

Electrical considerations

The recorder is considered "rack and panel mounted equipment" per EN 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements.

Recorder grounding

PROTECTIVE BONDING (grounding) of this recorder shall be in accordance with National and local electrical codes.

Functional earth

To minimize electrical noise and transients that may adversely affect the system, supplementary bonding of the recorder enclosure to a functional earth ground, using a 3/4" braided copper conductor, is required.

A terminal on the rear of the recorder is provided for this connection.

CE conformity special conditions (Europe)

Braid shielded cable is required for all Input I/O and Output Relay cables. All recorder cable shield wires, except the RS485 Modbus communications cable shield, must be connected to a low impedance earth ground at the recorder. This can be done by bussing the shields to an earth ground point, or by connecting the shields to the conduit entry fittings if they are in electrical contact with the enclosure conductive coating. In either case, the shields shall not extend into the recorder enclosure. The cable shields shall also be connected to a low impedance earth ground at the farthest end of the cable, through a 0.0047 uF capacitor. See each of the individual wiring diagrams.

For the RS485 Modbus communications cable, Alpha XTRA Guard I cable (Alpha P/N 5121C) is required. At the recorder end, the communications cable shield must be unconnected and must not extend into the recorder enclosure. The shield of the communications cable must be connected to earth ground at the farthest end of the cable. See the option wiring procedure for the RS485 Communications Card.

Inside of the enclosure, the user must install ferrite suppression filters and capacitors on all wires connected to the recorder. ©Fair-Rite Products Corp. part number 0443164151, or equivalent, shall be installed as shown in Figure 2-11 to Figure 2-22, one filter for each circuit group.

Cable with an outer jacket diameter larger than 6.7 mm (0.264 in.) may require the outer jacket to be removed to fit the required one turn in the filter, or the selection of a different cable.

Permissible wire bundling

Table 2-10 shows which wire functions should be bundled together.

Table 2-10 Permissible Wiring Bundling

Bundle No.	Wire Functions
1	• Line power wiring • Earth ground wiring • Control relay output wiring • Line voltage alarm wiring
2	Analog signal wire, such as: • Input signal wire (thermocouple, 4 to 20 mA, etc.) • 4-20 mA output signal wiring • Slidewire feedback circuit wiring • Digital input signals • Communications • 4-20 mA auxiliary output
3	• Low voltage alarm relay output wiring • Low voltage wiring to solid state type control circuits

Identify your wiring requirements

To determine the appropriate diagrams for wiring your recorder, refer to the model number interpretation in this section. The model number of the recorder can be found on the chart plate.

2.6 Input Wiring Procedures

Wiring the recorder

Using the information contained in the model number, select the appropriate wiring diagrams from the figures listed below and wire the recorder accordingly.

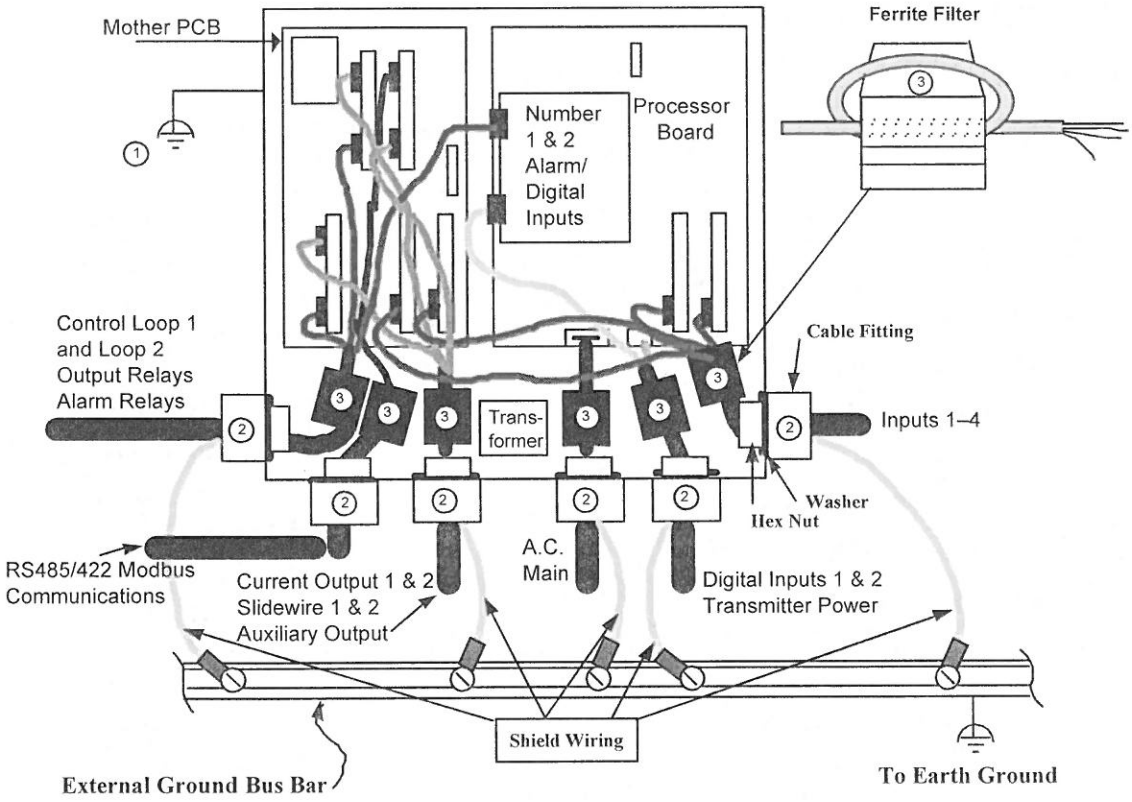
Wiring Requirements	Refer to
Ferrite Filter Locations	Figure 2-11
AC Line Power	Figure 2-12
Thermocouple, RTD, Radiamatic, mV, or 0–5 Vdc Inputs	Figure 2-13
4–20 mA Inputs	Figure 2-14
0–10 Vdc Inputs	Figure 2-15
4–20 mA Current Outputs or Auxiliary Outputs #2 and #3	Figure 2-16
Position Proportional Control Outputs	Figure 2-17
Relay Control Outputs – Time Proportioning	Figure 2-18
Alarm #1 and #2 Outputs and Digital Inputs	Figure 2-19
Alarm Outputs #3, #4, #5, and #6	Figure 2-20
RS485 Modbus Communications	Figure 2-21
Auxiliary Output #1	Figure 2-22

Ferrite filter locations (CE Mark)

Inside of the enclosure, install ferrite suppression filters on all wires connected to the recorder. ©Fair-Rite Products Corp. part number 0443164151, or equivalent, shall be installed as shown in Figure 2-11, one filter for each circuit group. Cable with an outer jacket diameter larger than 6.7 mm (0.264 in.) may require the outer jacket to be removed to fit the required one turn in the filter, or the selection of a different cable.

Shield Wiring

The shield wires of all cables, except the RS485 communications cable, should be tied to earth ground at the recorder end and to earth ground through a .0047 µF Capacitor at the other end of the cable. An example of shield wiring to an external ground bus bar is shown in Figure 2-11.



(1) Recorder Grounding, rear of case - Use 3/4 inch braided copper conductor.

(2) Use Cable fitting to support wiring and hold in place. Place the washer on the inside of the recorder between the case and the fastening nut to protect the recorder conductive case coating.

(3) Ferrite Filter location - Cable with an outer jacket diameter larger than 6.7 mm (0.264 in.) may require the outer jacket to be removed to fit the required one turn in the filter, or the selection of a different cable.

23685

Figure 2-11 Ferrite Filter Locations and Shield Wiring (CE Mark)

AC line power

Refer to Figure 2-12 and follow the procedure in Table 2-11 to connect the AC line power.

WARNING

Be sure that the line voltage is OFF before connecting the power wires to the recorder or personal injury could result.

This equipment is suitable for connection to 120/240 Vac, 50/60 Hz, power supply mains. It is the user's responsibility to provide a switch and non-time delay (North America), quick-acting, high breaking capacity, Type F, (Europe) 1/2 A, 250 V fuse(s) or circuit-breaker as part of the installation. The switch or circuit-breaker shall be located in close proximity to the recorder, within easy reach of the OPERATOR. The switch or circuit-breaker shall be marked as the disconnecting device for the recorder.

Table 2-11 AC Line Power Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Locate connector J10 on the bottom edge of the main printed circuit board. (Refer to Figure 2-12.)
3	Remove the unwired plug from J10.
4	Run the power wires separately through second conduit from the right.
5	For CE Mark conformity, install the ferrite filter as shown in Figure 2-11.
6	Strip insulation from the end of each wire.
7	Loosen the screws in plug J10 terminals and position the plug as you would to plug it into J10.
8	Insert • the ***green*** wire (G) into the first screw clamp from the right, • the ***white*** wire (L2) into the second screw clamp from the right, and • the ***black*** wire (L1) into the third screw clamp from the right. Tighten the screws to secure the wires. **CAUTION To avoid damaging the recorder, be sure that you install the power wires into the correct screw clamps. Make sure the fuse block is installed properly for the given supply rating — 120 Vac or 240 Vac. The fuse is in the 120 Vac location from the factory.**
9	Make sure the fuse block is installed in the proper location. Refer to Figure 2-12 for fuse block location. • **120 Vac** – Fuse block in location **F2** • **240 Vac** – Fuse block in location **F1**
10	Dress the wires as slack as possible. This keeps the noise signal on these wires from bypassing built-in suppression. Also, do not bundle any low level signal wires with the power wires. Refer to Table 2-10 for permissible wire bundling. • Refer to document 51-52-05-01 for additional information concerning noise interference prevention.
11	Insert the wired plug into J10. **WARNING Input line voltage will be present on the instrument ground plane if safety ground is not attached; personal injury and product damage could result.**

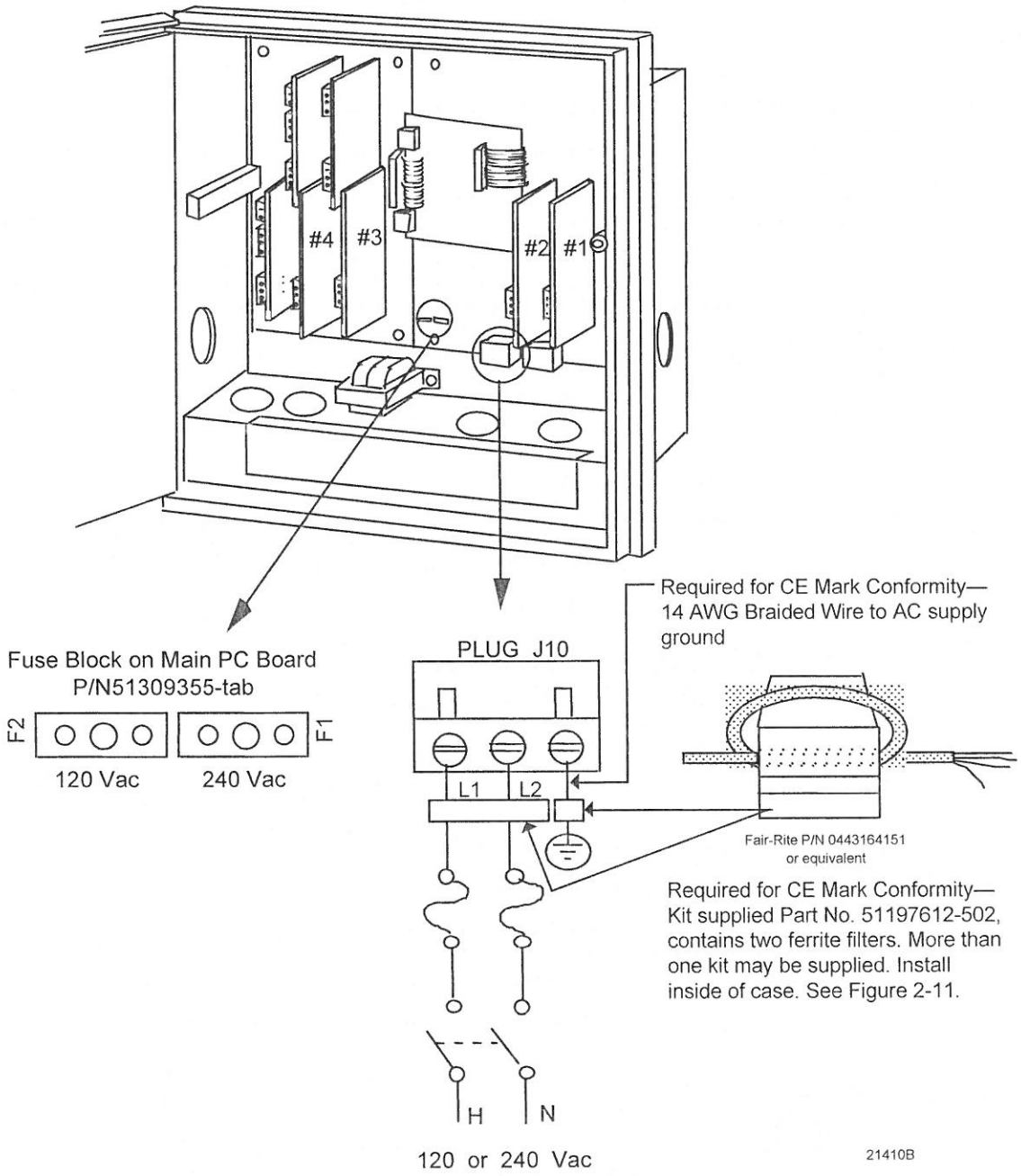


Figure 2-12 AC Line Power Wiring

Thermocouple, RTD, Radiamatic, mV, or 0-5 Vdc inputs

You can wire input 1, 2, 3, or 4 for thermocouple, RTD, Radiamatic, mV, or 0-5 Vdc actuations.

The polarity for inputs #1, #2, #3, and #4 is identical.

The prerequisites are:

- Model Number - Table 1 = 1XXX, X1XX, XX1X, XXX1

ATTENTION

For thermocouple or RTD inputs, calibrate the recorder to achieve the stated accuracy. Refer to *Section 7 – Input Calibration*

Refer to Figure 2-13 and follow the procedure in Table 2-12 to wire Thermocouple, RTD, Radiamatic, mV, or 0–5 Vdc inputs.

Table 2-12 Thermocouple, RTD, Radiamatic, mV, or 0–5 Vdc Input Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Locate connector J2 on the printed circuit board for input 1 (refer to Figure 2-13).
3	Remove the unwired plug from J2.
4	Run the input wires through the desired knockout - DO NOT bundle them with the power wires.
5	For CE Mark conformity: • Install the ferrite filter as shown in Figure 2-11. • Install a .01 µF capacitor across the J2 terminals and a .0047 µF capacitor at the sensor end of the input wiring as shown in Figure 2-13.
6	Locate jumper position MA/W1 and make sure the jumper is in the W1 position. (See Figure 2-13 for the location.)
7	Locate jumper position W3 and make sure the jumper is in the proper position for your input type. (See Figure 2-13 for the jumper locations.)
8	Strip insulation from the end of each wire.
9	Loosen the screws in plug J2 terminals and position the plug as you would to plug it into J2.
10	Insert the wires into the appropriate screw clamps for the applicable input type. See Figure 2-13 for specific input actuation plug wiring. Tighten the screws to secure the wires.
11	Insert the wired plug into J2.
12	Repeat steps 2 through 11 for input 2, 3, and 4 printed circuit boards as applicable.

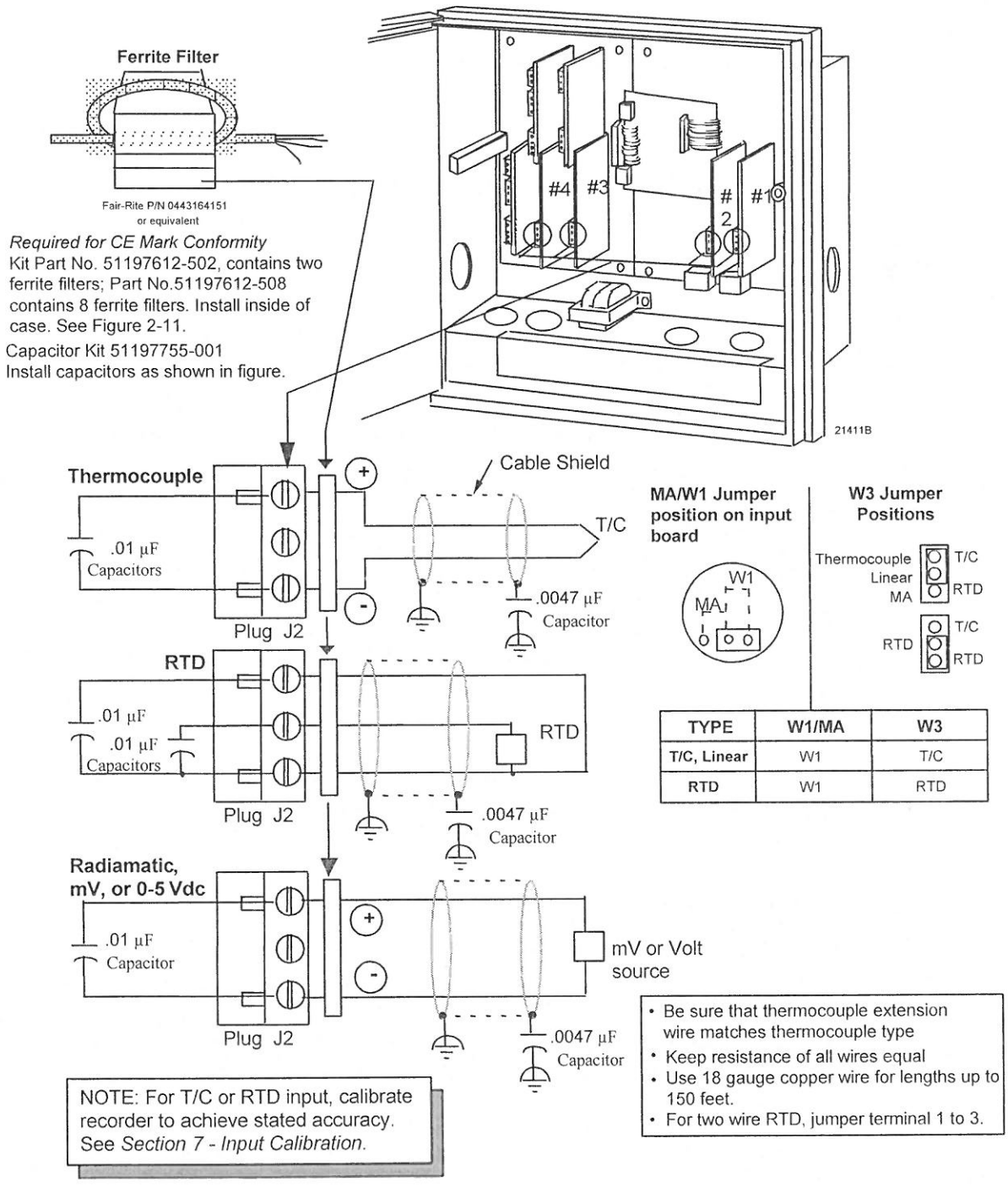


Figure 2-13 Thermocouple, RTD, Radiamatic, mV, or 0–5 Vdc Input Wiring

4-20 mA inputs and transmitter power

You can wire input 1, 2, 3, or 4 for 4–20 mA actuations.

The polarity for inputs #1, #2, #3, and #4 is identical.

The prerequisites are:

- Model Number - Table 1 = 1XXX, X1XX, XX1X, XXX1

ATTENTION

Connector J11 on the main processor printed circuit board can be used to provide 24 Vdc power to up to two field transmitters (without power) which are supplying the 4–20 mA input signals to the recorder (1.2W @ 24 Vdc = 50 mA available).

Refer to Figure 2-14 and follow the procedure in Table 2-13 to wire 4-20 mA inputs.

Table 2-13 4-20 mA Input Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Be sure that the jumper MA/W1 is installed in the position labeled "MA"; this connects an internal 250-ohm resistor across the 4-20 mA input terminals on J2. (Refer to Figure 2-14 for location of jumper.)
3	Locate jumper position W3 and make sure the jumper is in the proper position for your input type (see Figure 2-14 for the location).
4	Locate connector J2 on the printed circuit board for input 1 (refer to Figure 2-14).
5	Remove the unwired plug from J2.
6	Run the input wires through the desired knockout - DO NOT bundle them with the power wires.
7	For CE Mark conformity, install the ferrite filter as shown in Figure 2-11 and the capacitors as shown in Figure 2-14.
8	Strip insulation from the end of each wire.
9	Loosen the screws in plug J2 terminals and position the plug as you would to plug it into J2.
10	• *For transmitters with power:* Insert the wires into the appropriate screw clamps and tighten the screws to secure the wires. **ATTENTION** The DR4500A Recorder inputs are protected from overvoltage by a protection diode. The wake-up pulse on the ST3000 may not be recognized by the transmitter due to this clamping action. It may be necessary to add 100 ohms of additional loop resistance so the transmitter and SFC can communicate. • *For transmitters which require power:* Remove the unwired plug from J11 then wire the transmitter power to J11 and the input to J2. Tighten the screws in the plugs to secure the wires.
11	Insert the wired plug into J2 and J11 as applicable.
12	Repeat steps 2 through 11 for input 2, 3, and 4 printed circuit boards as applicable.

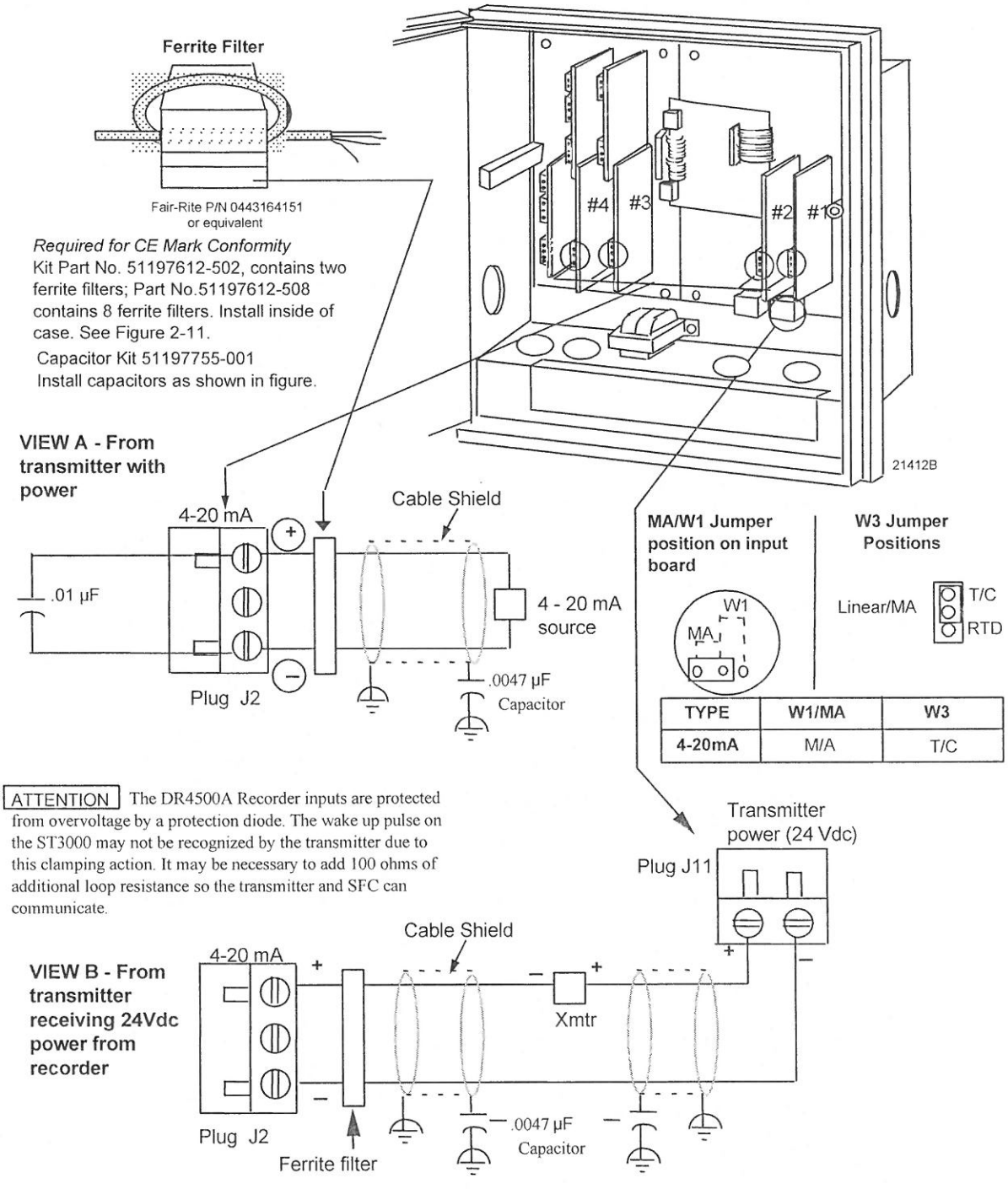


Figure 2-14 4-20 mA Input Wiring

0-10 Volt dc inputs

You can wire input 1, 2, 3, or 4 for 0–10 Volt dc actuations.

The polarity for inputs #1, #2, #3, and #4 is identical.

The prerequisites are:

- Model Number - Table 1 = 3XXX, X3XX, XX3X, XXX3

ATTENTION

Calibrate the recorder to achieve the stated accuracy. Refer to *Section 7 – Input Calibration.*

Refer to Figure 2-15 and follow the procedure in Table 2-14 to wire 0-10 Vdc inputs.

Table 2-14 0-10 Volt dc Input Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Locate connector J2 on the printed circuit board for input 1 (refer to Figure 2-15).
3	Remove the unwired plug from J2 and replace it with the modified 4-screw plug from the bag of accessories supplied with the recorder.
4	Run the input wires through the desired knockout—DO NOT bundle them with the power wires.
5	For CE Mark conformity: • Install the ferrite filter as shown in Figure 2-11. • Install the .01 µF capacitor and the .0047 µF capacitor as shown in Figure 2-15.
6	Strip insulation from the end of each wire.
7	Loosen the screws in plug J2 terminals and position the plug as you would to plug it into J2.
8	Using the 30755232-002, 100K-ohm, voltage divider connector kit supplied in the bag of accessories, insert the wires into the appropriate screw clamps. Tighten the screws to secure the wires.
9	Install the wired plug into J2. Since J2 has only three receptacles, one of the modified plug connectors is designed to slide outside J2 when the plug is installed.
10	Locate jumper position W3 and make sure the jumper is in the proper position for your input type. (See Figure 2-15 for the location.)
11	Locate jumper position MA/W1 and make sure the jumper is in the **W1** position. (See Figure 2-15 for the location.)
12	Repeat steps 2 through 11 for input 2, 3, and 4 printed circuit boards as applicable.

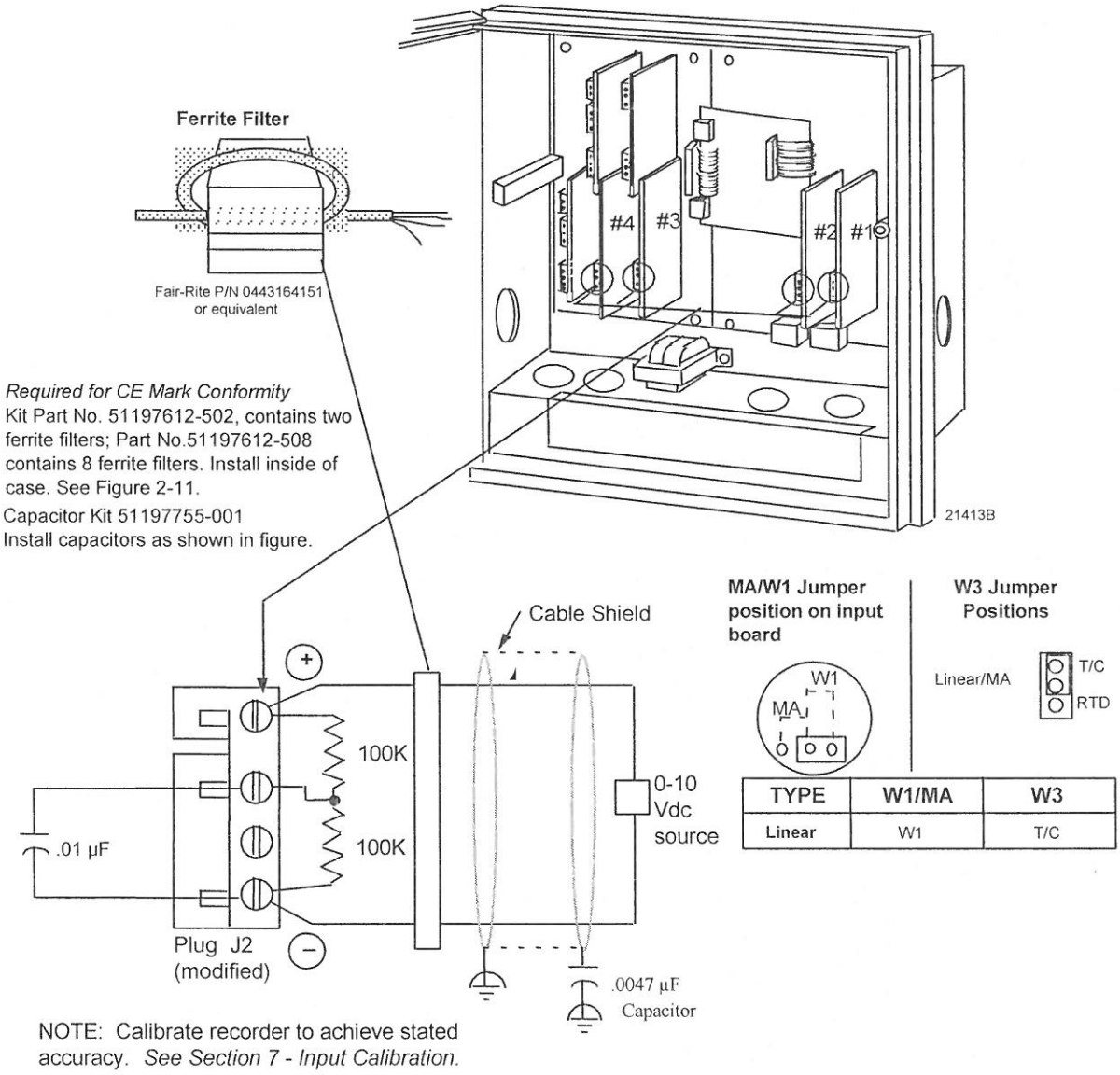


Figure 2-15 0-10 Volt dc Input Wiring

2.7 Output Wiring Procedures

4-20 mA control output wiring

You can wire control output 1 or 2 for 4-20 mA output.

The prerequisites are:

- Model Number - Table 2 = 10, 40, 44, 60, or 66

Refer to Figure 2-16 and follow the procedure in Table 2-15 to wire 4-20 mA control outputs.

Table 2-15 4-20 mA Control Output Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Locate connector J1 near the top of the control output #1 or #2 printed circuit board (refer to Figure 2-16 for location).
3	Remove the unwired plug from J1.
4	Run the output wires through the desired knockout.
5	For CE Mark conformity, install the ferrite filter as shown in Figure 2-11 and the .0047 µF capacitor as shown in Figure 2-16.
6	Strip insulation from the end of each wire.
7	Loosen the screws in plug J1 terminals and position the plug as you would to plug it into J1.
8	Observing the polarity, insert the wires into the appropriate screw clamps as shown (refer to Figure 2-16). Tighten the screws to secure the wires.
9	Install the wired plug into J1.
10	Locate jumper position W6/W7 on the bottom left portion of the board. Make sure W7 position is selected for 4-20 mA output.
11	Repeat steps 2 through 10 for control output #2 printed circuit board as applicable.

TIP

The 4-20 mA output can be used as a retransmission output if it is not used as a control output.

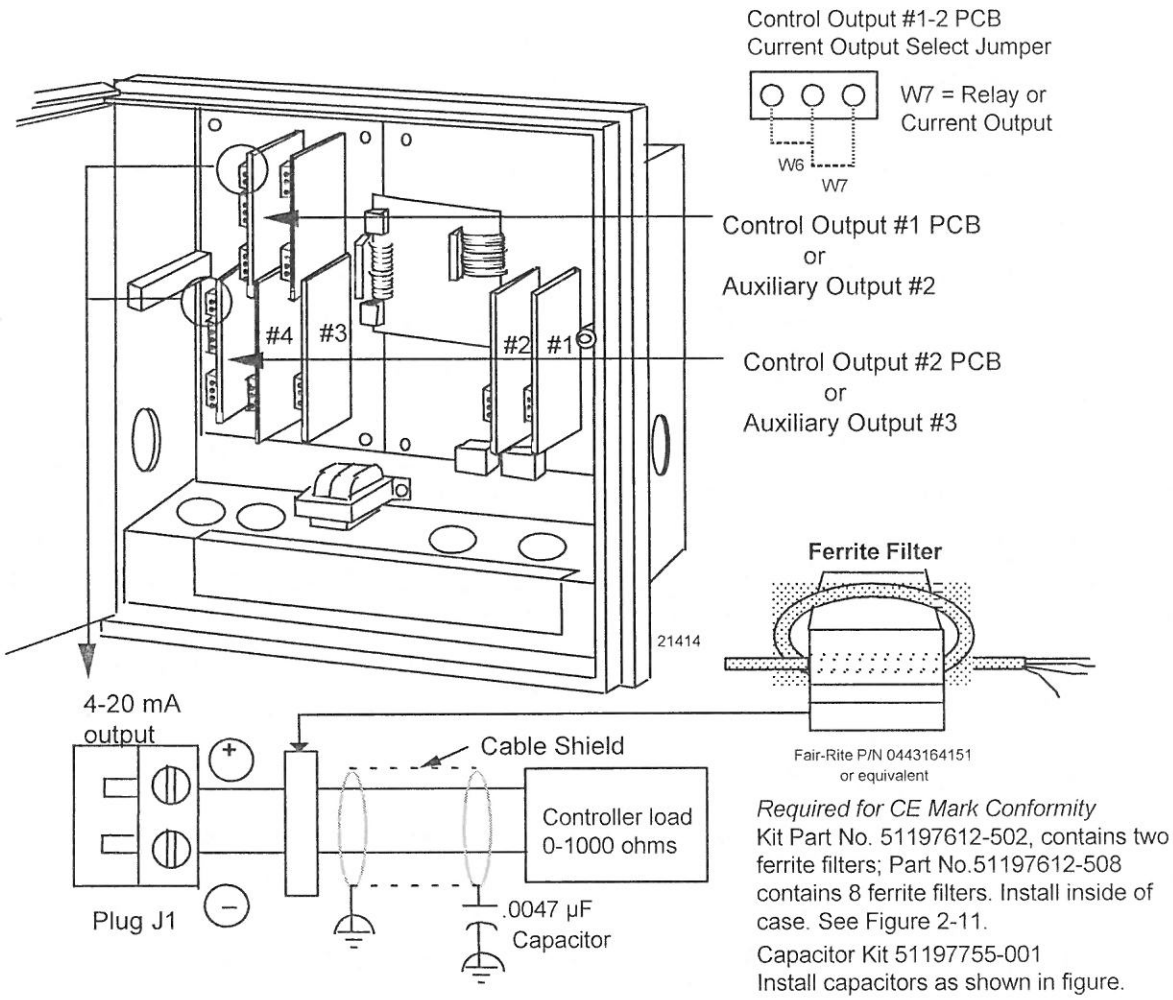


Figure 2-16 4-20 mA Control Output Wiring (or Aux Out #2 and #3 Wiring)

Position proportional or 3-position step control output wiring

You can wire control output 1 or 2 for position proportional or 3 position step output.

The prerequisites are:

- Model Number Key = DR45AT
- Model Number - Table 2 = 10, 40, or 44

Refer to Figure 2-17 and follow the procedure in Table 2-16 to wire position proportional or 3 position step control outputs.

ATTENTION

Be sure to calibrate the position proportional control output so that the increase and decrease relays operate properly with respect to the position of the external feedback slidewire. Refer to *Section 8 - Output Calibration* in this manual.

Slidewire input is not required for 3 position step control but can be used for motor position indication.

Table 2-16 Position Proportional Control Output Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Locate connector J2 and J5 on the control output #1 printed circuit board (refer to Figure 2-17 for location).
3	Locate jumper positions W2/W3 and W4/W5 below connector J5 on the printed circuit board. Remove plug-in output #1 printed circuit board for better access to the jumpers. Be sure to tag and remove all the plug connections to the printed circuit board before removing it. Position the jumpers as shown in Figure 2-17 for desired relay contact action. Locate jumper position W6/W7 on the bottom left portion of the board. Make sure position W6 is selected for position proportioning, then reinstall the printed circuit board.
4	Run the feedback slidewire (not required for 3 position step) and motor drive wires through the desired knockouts.
5	For CE Mark conformity: • install the ferrite filter as shown in Figure 2-11 • install the shield capacitors as shown in Figure 2-17.
6	Strip insulation from the end of each wire.
7	Loosen the screws in plug J2 terminals and position the plug as you would to plug it into J2.
8	Insert the wires from the motor's feedback slidewire into the appropriate screw clamps as shown (refer to Figure 2-17). Tighten the screws to secure the wires.
9	Loosen the screws in plug J5 terminals and position the plug as you would to plug it into J5.
10	Insert the wires for the motor into the appropriate screw clamps as shown (refer to Figure 2-17). Tighten the screws to secure the wires.
11	Install the wired plug into J2 and J5, as applicable.
12	Repeat steps 2 through 11 for Control Output #2 printed circuit board as applicable.

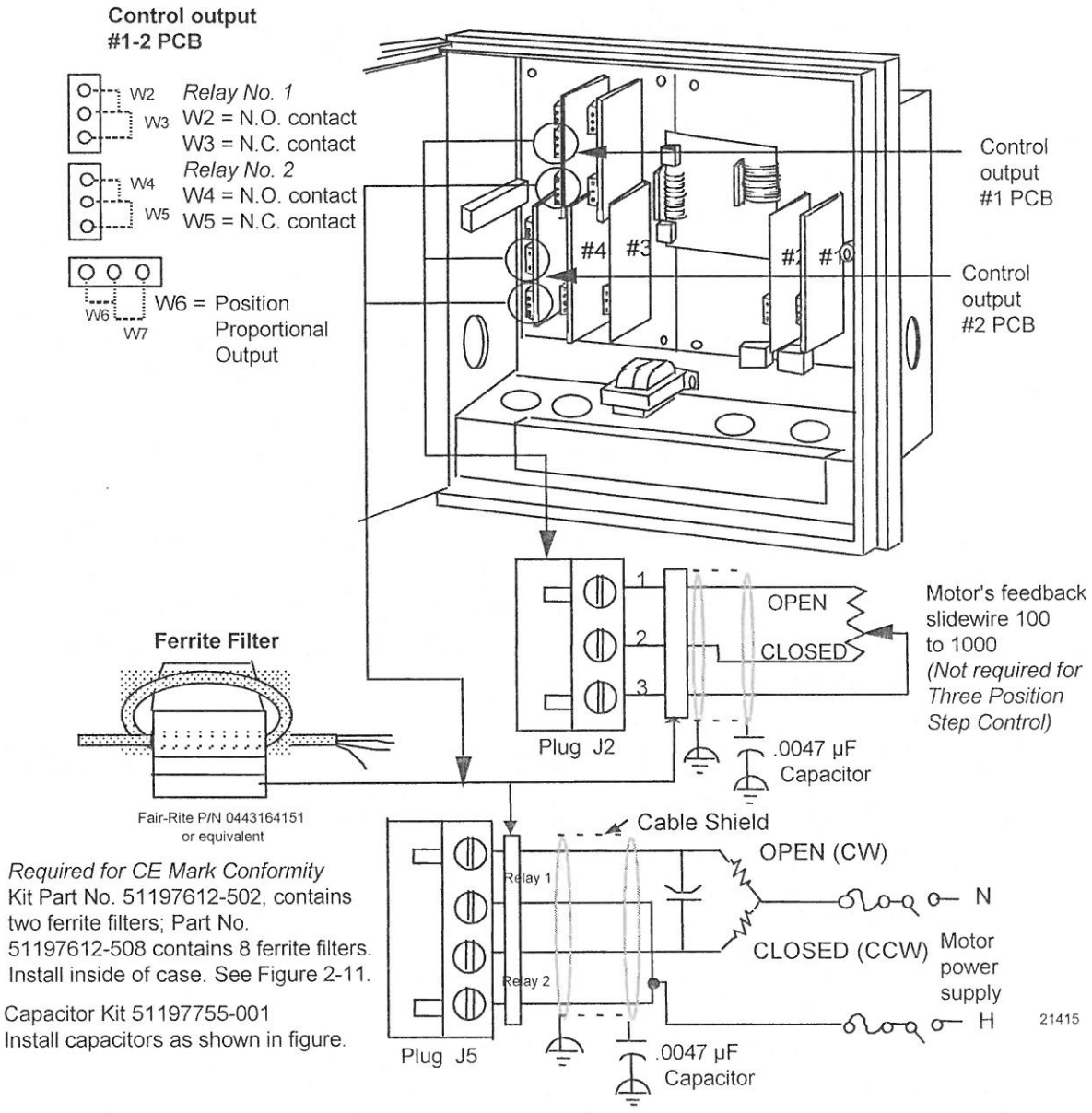


Figure 2-17 Position Proportional Control Output or Three Position Step Wiring

Relay control output wiring

You can wire control output 1 or 2 for relay output including Time proportional and 3 position step applications.

The prerequisites are:

- Model Number - Table 2 = 10, 40, 60, 11, 44, 66

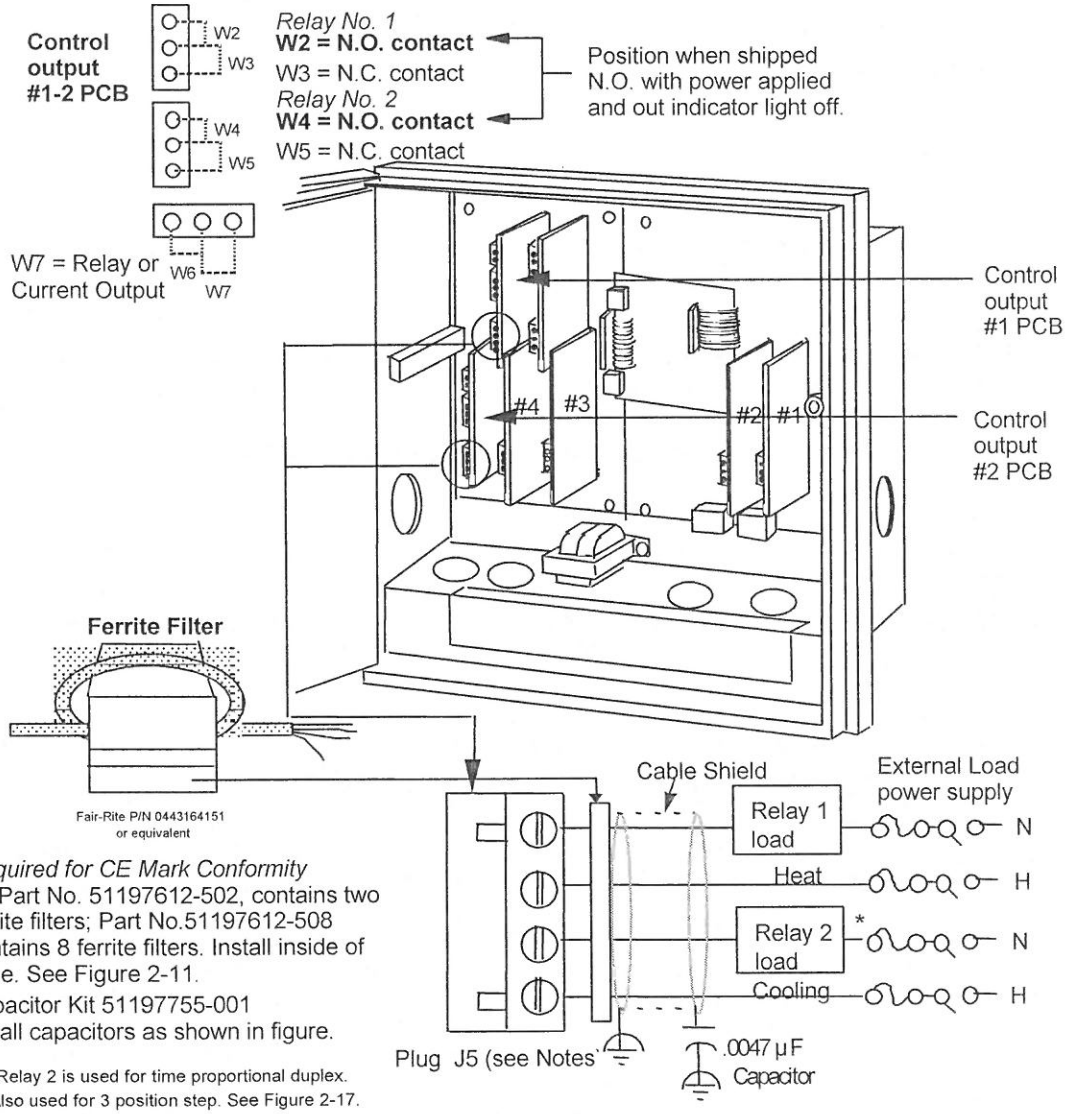
Refer to Figure 2-18 and follow the procedure in Table 2-17 to wire relay control outputs.

ATTENTION

Relay #2 is used for time proportional control. Relay 2 can also be used for 3 position step control (see Figure 2-17).

Table 2-17 Relay Control Output Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Locate connector J5 on the control output #1 printed circuit board (refer to Figure 2-18 for location).
3	Remove the unwired plug from J5.
4	Locate jumper positions W2/W3 and W4/W5 below connector J5 on the printed circuit board. Remove plug-in output #1 printed circuit board for better access to the jumpers. Be sure to tag and remove all the plug connections to the printed circuit board before removing it. Position the jumpers as shown in Figure 2-18 for desired relay contact action. Locate jumper position W6/W7 on the bottom left portion of the board. Make sure W7 position is selected for relay control output, then reinstall the printed circuit board.
5	Run the relay load wires through the desired knockouts.
6	For CE Mark conformity: - install the ferrite filter as shown in Figure 2-11. - install the shield capacitor as shown in Figure 2-18.
7	Strip insulation from the end of each wire.
8	Loosen the screws in plug J5 terminals and position the plug as you would to plug it into J5.
9	Insert the relay wires and relay power into the appropriate screw clamps for single or duplex action as shown (refer to Figure 2-18); tighten the screws to secure the wires.
10	Install the wired plug into J5.
11	Repeat steps 2 through 10 for control output #2 printed circuit board as applicable.



Required for CE Mark Conformity
Kit Part No. 51197612-502, contains two ferrite filters; Part No.51197612-508 contains 8 ferrite filters. Install inside of case. See Figure 2-11.

Capacitor Kit 51197755-001
Install capacitors as shown in figure.

*Relay 2 is used for time proportional duplex. Also used for 3 position step. See Figure 2-17.

Notes:

1. J5 terminals 2 and 4 are the non-switched connections to an SPST relay. Selectable for normally open or normally closed as required.
2. This relay supplies a dry contact closure. User must supply appropriate power connections for his external device.
3. This relay has a resistive load rating of 5A @ 120 Vac
   Load calculation example:

$$\frac{\text{Supply voltage (for example: 115 Vac)}}{\text{Resistance of customer controlled device}} = \text{must equal a number less than 5 amps}$$

21416

Figure 2-18 Relay Control Output Wiring

2.8 Option Wiring Procedures

Alarm output and digital input wiring

You can wire #1 and #2 Alarm Outputs and Digital Inputs.

The prerequisites are:

- Model Number - Table 3 = XX1

Refer to Figure 2-19 and follow the procedure in Table 2-18 to wire alarm outputs or digital inputs.

The alarm output is a dry contact closure.

Table 2-18 Alarm Output or Digital Input Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Locate connector J3 and J4 on the alarm output/digital input printed circuit board (refer to Figure 2-19 for location).
3	Remove the unwired plug from J3.
4	Run the digital input wires through the desired knockout.
5	For CE Mark conformity, install the ferrite filter as shown in Figure 2-11.
6	Strip insulation from the end of each wire.
7	Loosen the screws in plug J3 terminals and position the plug as you would to plug it into J3.
8	Insert the wires for the digital inputs into the appropriate screw clamps as shown (refer to Figure 2-19). Note that you can wire the contacts in an **and/or** fashion, so that **both** contacts **or** either contact initiates the configured action. Tighten the screws to secure the wires.
9	Install the wired plug into J3.
10	Remove the unwired plug from J4.
11	Run the alarm output wires through the desired knockout.
12	For CE Mark conformity: • install the ferrite filter as shown in Figure 2-11 • install the shield capacitors as shown in Figure 2-19.
13	Strip insulation from the end of each wire.
14	Loosen the screws in plug J4 terminals and position the plug as you would to plug it into J4.
15	Insert the wires for the alarm devices into the appropriate screw clamps as shown (refer to Figure 2-19). Tighten the screws to secure the wires.
16	Locate the jumper positions W1/W2 and W3/W4 on the printed circuit board. Reposition the jumpers as shown in Figure 2-19 for the desired relay control action. The recorder is shipped with the W1 and W3 in N.C. positions.
17	Install the wired plug into J4.

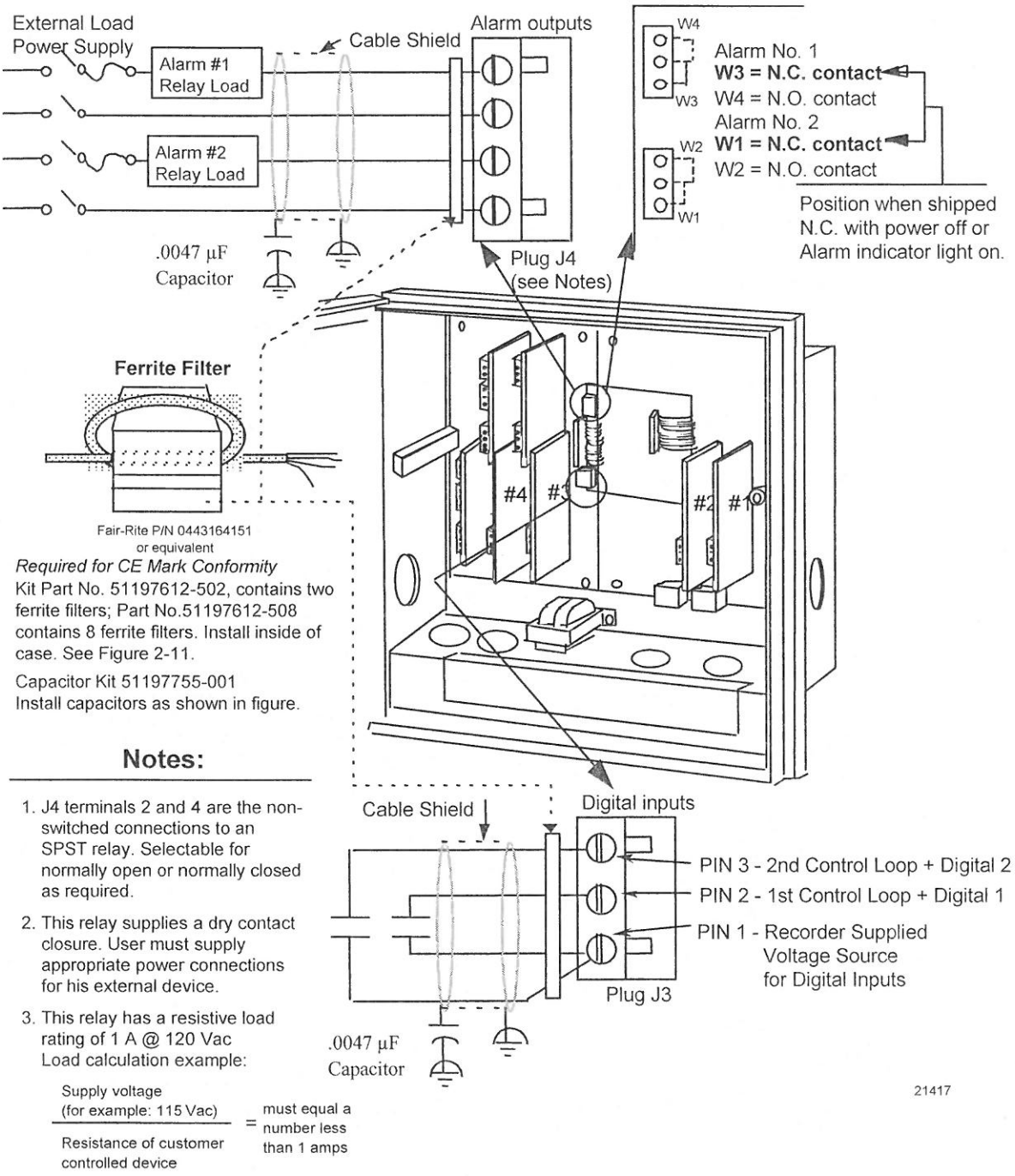


Figure 2-19 Alarm Output or Digital Input Wiring

Additional alarm wiring information

The DR4500 has the ability to provide for Alarm outputs 3, 4, 5, and 6.

Follow the procedures listed below to wire No. 3 and No. 4 Alarm Outputs and No. 5 and No. 6 Alarm Outputs.

Alarms 3 and 4 output wiring

You can wire #3 and #4 Alarm Outputs.

The prerequisites are:

- Model Number - Model Table 2 = 1X, 4X, 6X*

  **If control output is 4-20 mA, then the relays on the control card are available for use as alarms on all models except DR45AH/AS/AP models.*

Refer to Figure 2-20 and follow the procedure in Table 2-19 to wire Alarm 3 and Alarm 4 outputs.

Table 2-19 Alarm 3 and Alarm 4 Output Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Locate connector J5 on the 4-20 mA control output printed circuit board to wire relays #3 and #4. Refer to Figure 2-20 for location.
3	Remove the unwired plug from J5.
4	Locate jumper position W2/W3 and W4/W5 below connector J5 on the printed circuit board. Note that you may want to remove the plug-in output printed circuit board for better access to jumpers. Be sure to tag and remove all the plug connections to the printed circuit boards before removing it. Position the jumpers as shown for the desired relay contact action and reinstall the printed circuit board.
5	Run the alarm output wires through the desired knockout.
6	For CE Mark conformity: • install the ferrite filter as shown in Figure 2-11 • install the capacitors as shown in Figure 2-20
7	Strip insulation from the end of each wire.
8	Loosen the screws in plug J5 terminals and position the plug as you would to plug it into J5.
9	Insert the wires for the alarm devices into the appropriate screw clamps as shown. Refer to Figure 2-20. Tighten the screws to secure the wires.
10	Install the wired plug into J5.

Alarms 5 and 6 output wiring

You can wire #5 and #6 Alarm outputs.

The prerequisites are:

- Model Number - Model Table 2 = X1, X4, X6*

**If control output is 4-20 mA, then the relays on the control card are available for use as alarms on all models except DR45AH/AS/AP models.*

Refer to Figure 2-20 and follow the procedure in Table 2-20 to wire Alarm 5 and Alarm 6 outputs.

Table 2-20 Alarm 5 and Alarm 6 Output Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Locate connector J5 on the 4-20 mA control output printed circuit board to wire relays #5 and #6. Refer to Figure 2-20 for location.
3	Remove the unwired plug from J5.
4	Locate jumper position W2/W3 and W4/W5 below connector J5 on the printed circuit board. Note that you may want to remove the plug-in output printed circuit board for better access to jumpers. Be sure to tag and remove all the plug connections to the printed circuit boards before removing it. Position the jumpers as shown for the desired relay contact action and reinstall the printed circuit board.
5	Run the Alarm output wires through the desired knockout.
6	For CE Mark conformity: • install the ferrite filter as shown in Figure 2-11 • install the capacitors as shown in Figure 2-20
7	Strip insulation from the end of each wire.
8	Loosen the screws in plug J5 terminals and position the plug as you would to plug it into J5.
9	Insert the wires for the alarm devices into the appropriate screw clamps as shown. Refer to Figure 2-20. Tighten the screws to secure the wires.
10	Install the wired plug into J5.

Wiring for alarm outputs #3, 4, 5, and 6

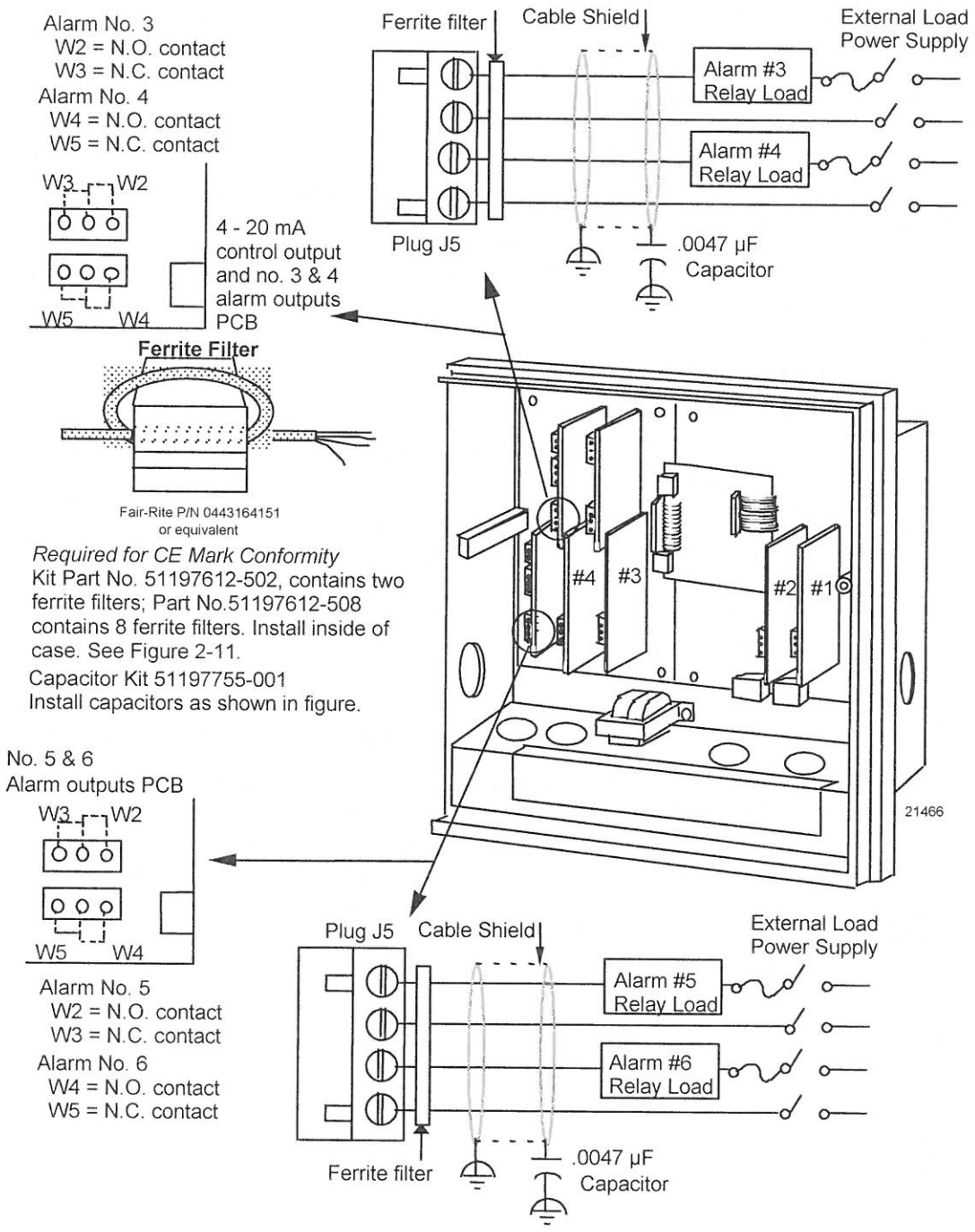


Figure 2-20 Alarm outputs #3, 4, 5, and 6 wiring

RS485 Modbus communications wiring

RS485 Modbus Communications is an option available on the DR4500A recorder.

The prerequisites are:

- Model Key Number - All models except DR45AH/AP/AS
- Model Number - Table 3 = 3XX or 4XX

Refer to Figure 2-21 and follow the procedure in Table 2-21 to wire the RS485 Modbus communications option.

Table 2-21 RS485 Modbus Communications Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Locate connector J3 on the RS485 Modbus communications option printed circuit board (refer to Figure 2-21 for location).
3	Remove the unwired plug from J3.
4	Run the communications option wires through the desired knockout.
5	For CE Mark conformity • Install the ferrite filter as shown in Figure 2-11. • Refer to Figure 2-21 for shield information.
6	Strip insulation from the end of each wire.
7	Loosen the screws in plug J3 terminals and position the plug as you would to plug it into J3.
8	Insert the wires for the communications option into the appropriate screw clamps as shown (refer to Figure 2-22). Tighten the screws to secure the wires.
9	Install the wired plug J3 into J3 connector on the communications board.

REFERENCE

Refer to documents 51-52-25-66 and 51-52-25-69 for a complete description of RS485 Modbus Communications Option.

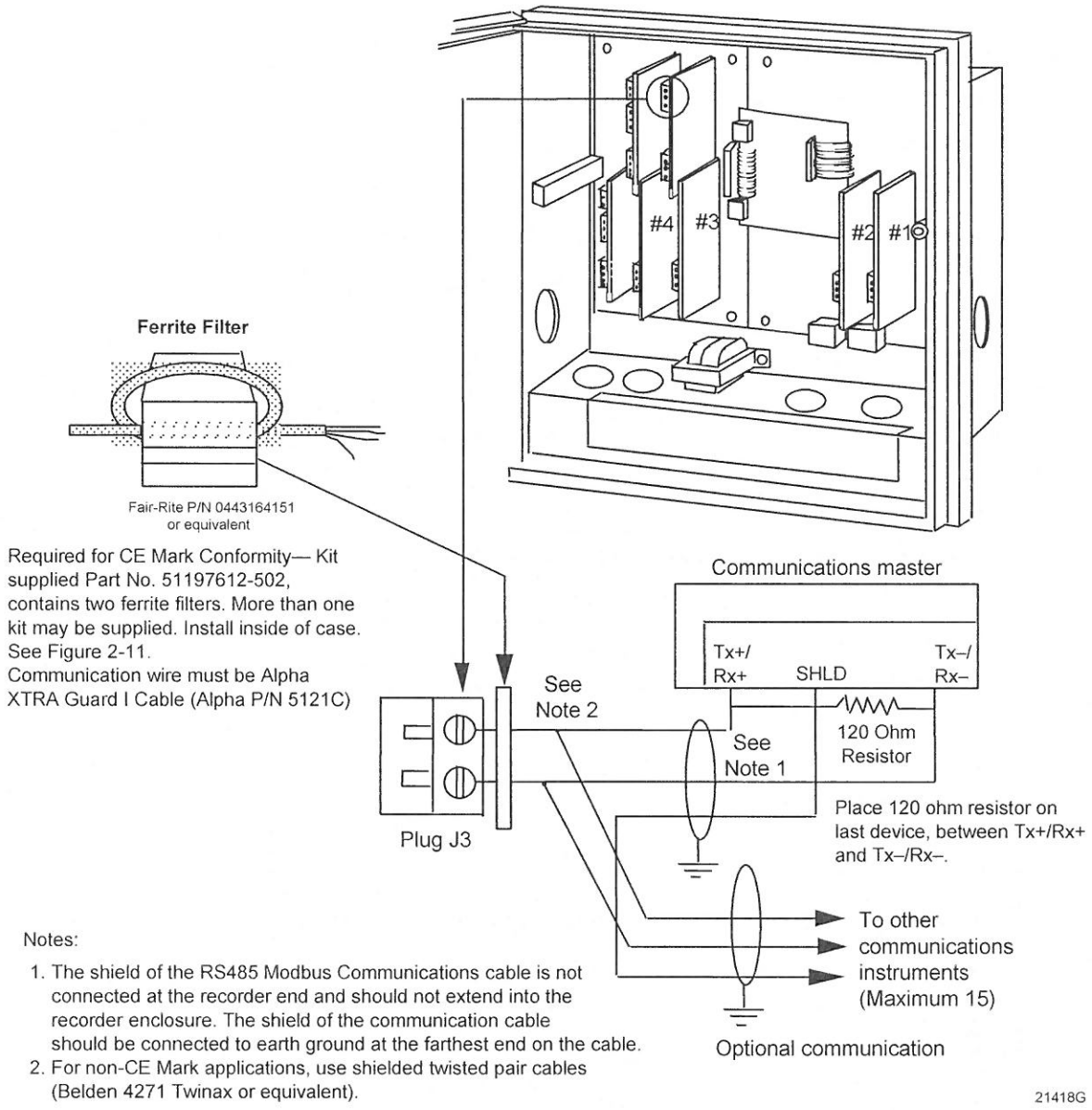


Figure 2-21 RS485 Modbus Communications Wiring

4-20 mA auxiliary output wiring

You can wire an auxiliary output for 4–20 mA.

The prerequisites are:

- Model Number - Table 3 = 1XX or 4XX

Refer to Figure 2-22 and follow the procedure in Table 2-22 to wire 4–20 mA auxiliary output.

Table 2-22 4-20 mA Auxiliary Output Wiring

Step	Action
1	Open the recorder door. Loosen the captive screw in the chart plate and swing the plate out.
2	Locate connector J2 near the bottom of the auxiliary output printed circuit board (refer to Figure 2-22 for location).
3	Remove the unwired plug from J2.
4	Run the output wires through the desired knockout.
5	For CE Mark conformity, install the ferrite filter as shown in Figure 2-11.
6	Strip insulation from the end of each wire.
7	Loosen the screws in plug J2 terminals and position the plug as you would to plug it into J2.
8	Observing the polarity, insert the wires into the appropriate screw clamps as shown (refer to Figure 2-22). Tighten the screws to secure the wires.
9	Install the wired plug into J2.

ATTENTION

Be sure that the 4-20 mA auxiliary output is aligned. Refer to *Subsection 8.4 Auxiliary Output Calibration.*

TIP

The 4-20 mA output on the control output board can also be set up for an Auxiliary retransmission output if it is not being used for a control output. This requires model selection option Table II = 10, 40, 44, 60, 66.

TIP

Auxiliary output 2 and Auxiliary output 3 use Control current output 1 and Control current output 2 if Control "OUT ALG" is not set to "CURRENT". *Refer to Figure 2-16 for Aux Out #2 and #3 wiring.*

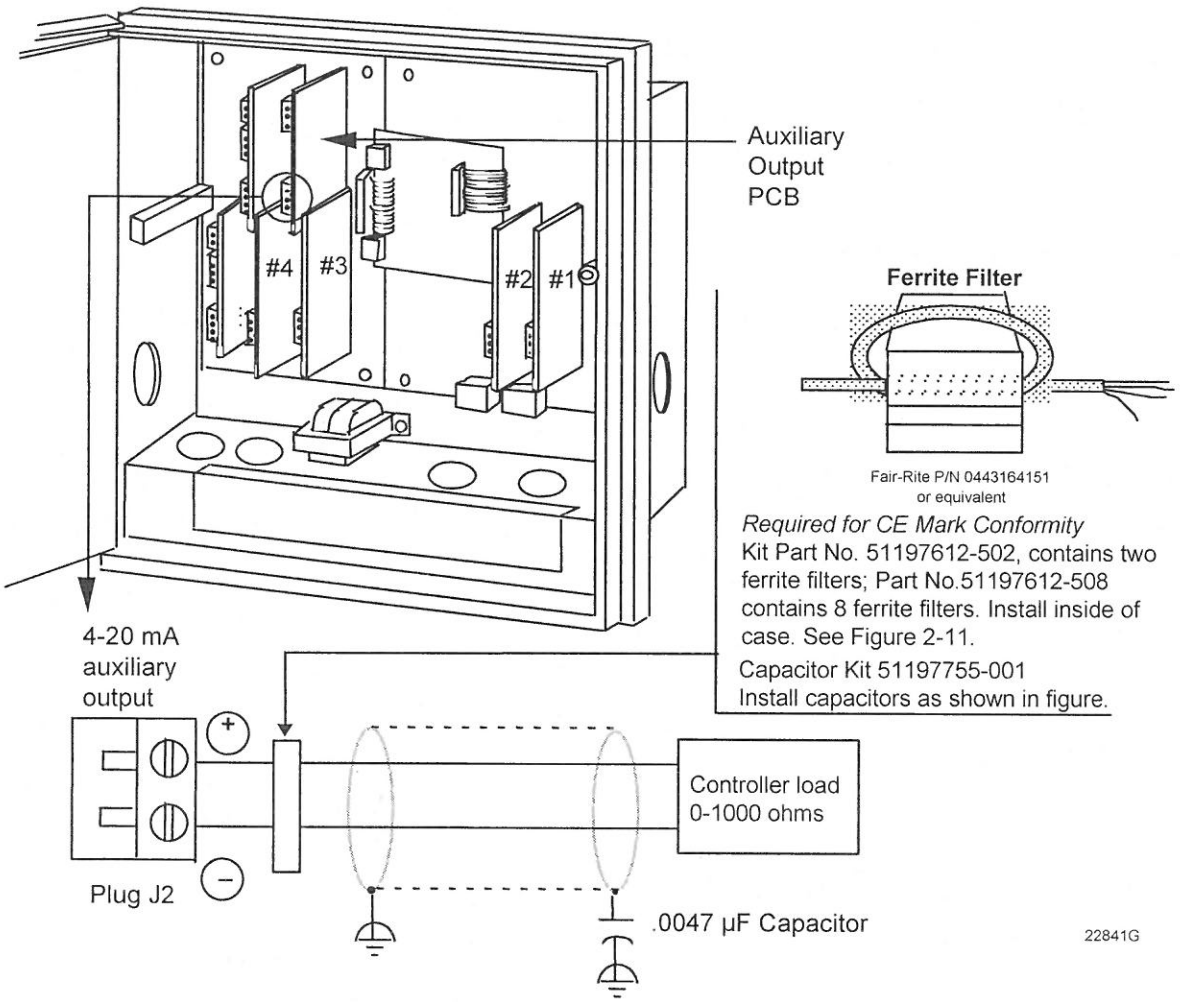


Figure 2-22 4-20 mA Auxiliary Output #1 Wiring

ATTENTION

Refer to Figure 2-16 for Auxiliary Output 2 and Auxiliary Output 3 wiring.

2.9 Lockout Switch Configuration

Introduction

The configuration can be locked using S1 switch located next to the microprocessor U17 on the main printed circuit board.

Restrictions based on lockout switch position

Figure 2-23 shows the location of the S1 lockout switch on the main printed circuit board.

When the lockout switch is OFF (**Down**—Configure):

- You can view and change all applicable operating parameters as described in *Section 4 – Configuration Parameter Definitions.*

When the lockout switch is ON (**Up**—Locked):

- Most parameters for the recorder are locked and the parameters may not be changed except for Tuning 1 and Tuning 2 parameters and adjustments to time/date/day/year.

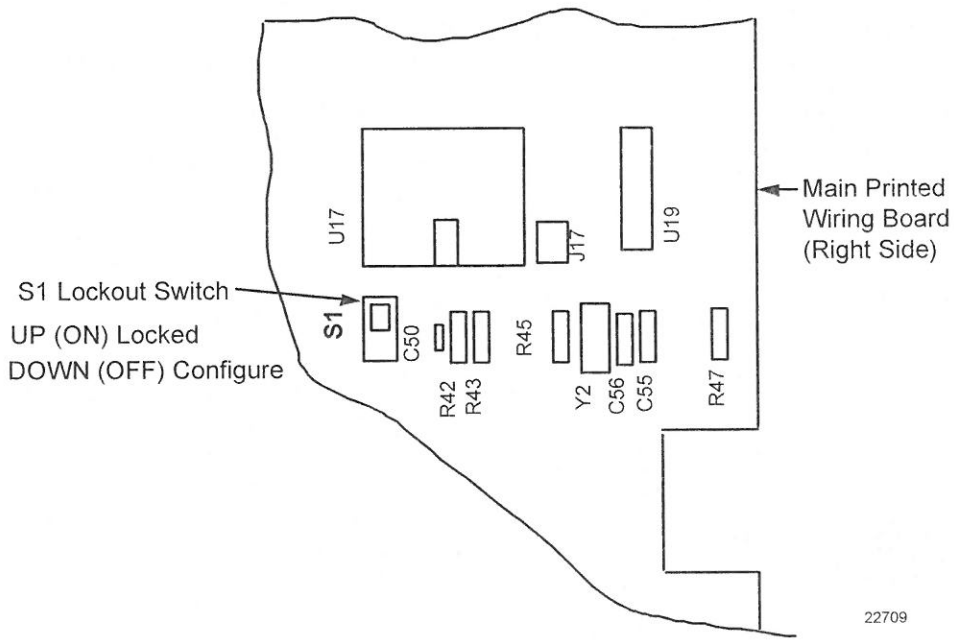


Figure 2-23 S1 Lockout Switch Location

ATTENTION

Lockout can also be configured under set up group "LOCKOUT". See *Subsection 3.21.*

This feature also includes the special screw and plate that provide the lead seal capability for sealing the chart plate. This feature is normally used with DR45AH model recorders.

3. Configuration

3.1 Overview

Introduction

Configuration is a dedicated operation where you use straightforward keystroke sequences to select and establish (configure) pertinent control data best suited for your application.

What's in this section?

The table below lists the topics that are covered in this section.

	Topic	See Page
3.1	Overview	55
3.2	Configuration Prompts	57
3.3	How to Get Started	60
3.4	Configuration Tips	61
3.5	Configuration Procedure	62
3.6	Input Set Up Group	64
3.7	Pen Set Up Group	66
3.8	Chart Set Up Group	67
3.9	Time Set Up Group	69
3.10	Totalizer Set Up Group	70
3.11	Input Algorithm Set Up Group	72
3.12	Control Set Up Group	73
3.13	Tuning Parameters Set Up Group	75
3.14	SP Ramp Set Up Group	76
3.15	Timer Set Up Group	77
3.16	Alarms Set Up Group	78
3.17	Auxiliary Output Set Up Group	80
3.18	Modbus Communications Set Up Group	81
3.19	Options Set Up Group	82
3.20	Event Message	83
3.21	Lockout Set Up Group	86
3.22	Adjust Printing	87
3.23	Configuration Record Sheet	88

Prompts

To assist you in the configuration process, there are prompts that appear in the upper and lower displays. These prompts let you know what group of configuration data (set up prompts) you are working with and also the specific parameters (function prompts) associated with each group.

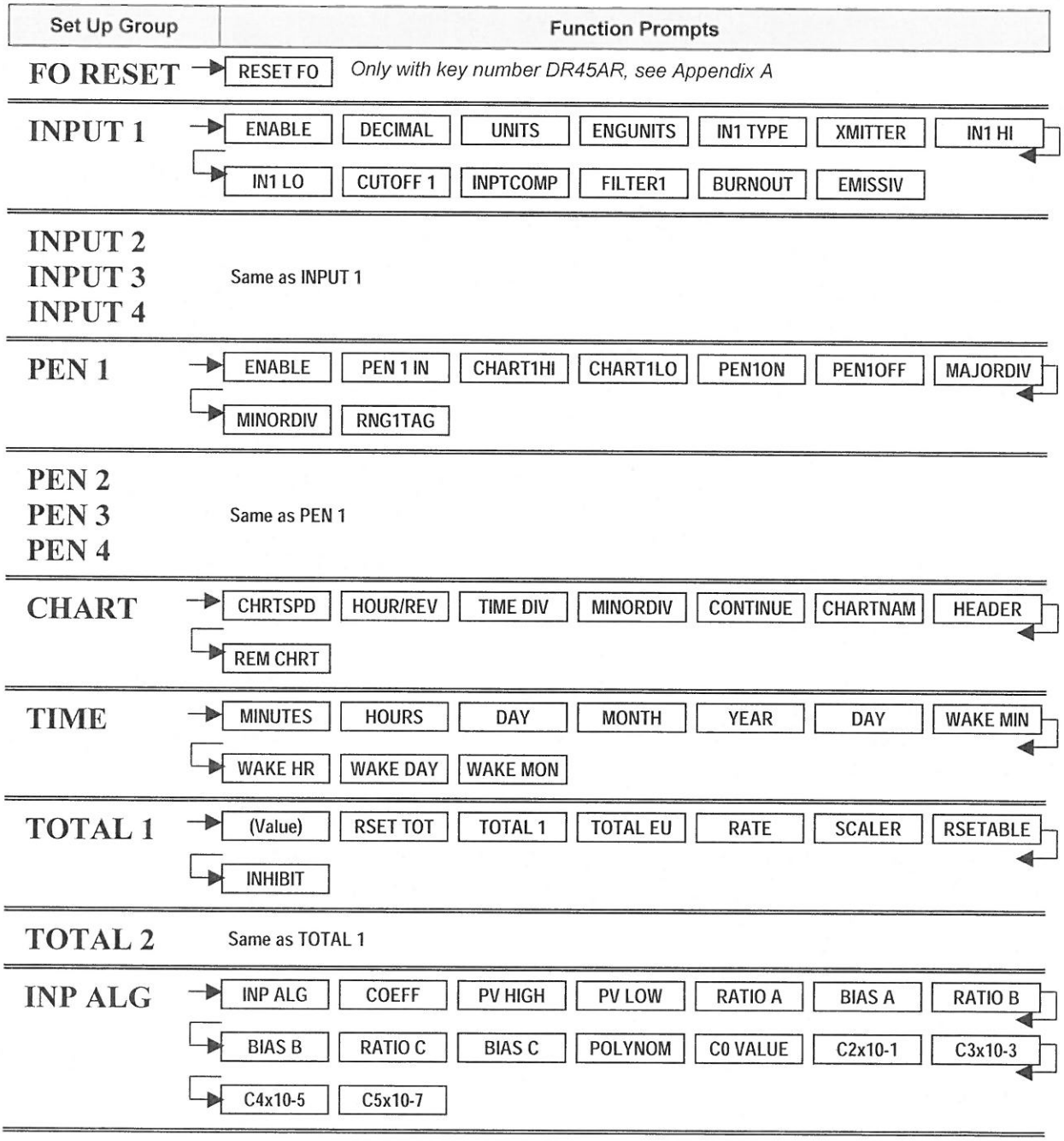
Figure 3-1 shows an overview of the prompt hierarchy.

3.2 Configuration Prompts

Diagram: prompt hierarchy

Figure 3-1 shows an overview of the DR4500A Set Up prompts and their associated Function prompt - read from left to right.

Figure 3-1 DR4500A Prompt Hierarchy



Set Up Group	Function Prompts						
CONTROL 1	ENABLE	PID SETS	SW VALUE	SP SOURC	RATIO	BIAS	SP TRACK
	POWER UP	PWR OUT	SP HILIM	SP LOLIM	ACTION	OUT HILIM	OUT LOLIM
	DROPOFF	DEADBAND	OUT HYST	FAILSAFE	REM SW	MAN KEY	PBorGAIN
	MINorRPM	CONT1ALG	OUT1ALG	4-20 RNG			
CONTROL 2	Same as CONTROL 1						
TUNING 1	FUZZY	ACCUTUNE	AT ERR	PROP BD or GAIN	RATE MIN	RSET MIN or RSET RPM	MAN RSET
	PROP BD2 or GAIN 2	RATE2MIN	RSET2MIN or RSET2RPM	CYC SEC	CYC2SEC		
TUNING 2	Same as TUNING 1						
SP RAMP1	ENABLE	SP RAMP	TIME MIN	FINAL SP			
		SP RATE	EU/HR UP	EU/HR DN			
		SP PROG	RECYCLES	SOAK DEV	PROFILE	STATE	RECOVERY
	PROG END						
SP RAMP2	Same as SP RAMP1						
PROFILES	PRx STRT	PRx END	RAMPUNIT	SYNC 1+2			
SPP SEGS	SEGxRAMP	SEGx SP	SEGxTIME				
SPP EVNT	SEGx EV						
TIMER	TIMER	PERIOD	START	LDISPLAY	RSET	ON-TIME	INCRMENT
ALARM 1	A1S1 VAL	A1S2 VAL	A1S1TYPE	A1S2TYPE	A1S1 H L	A1S1SCAL	A1S2 H L
	A1S2SCAL	AL1 HYST					
ALARM 2 ALARM 3 ALARM 4 ALARM 5 ALARM 6	Same as ALARM 1						

Set Up Group	Function Prompts
AUX OUT	AUX OUT → 4 mA VAL → 20mA VAL → AUX OUT 2 → 4 mA VAL → 20mA VAL → AUX OUT 3 → 4mA VAL → 20 mA VAL
COMM	ComSTATE → Com ADDR → BAUD → XMT DLAY → DBL BYTE
OPTIONS	REJ FREQ → HF REJ → RELHUMID → ATMPRES → DEVIATION → DEVSETPT → SCROLL → GRANDTOT *If key number is DR45AR, see Appendix A for Fo calculation prompts.*
EVNT MSG	EVENT 1 → MESSAGE1 → POSITION1 → EVENT 2 → MESSAGE2 → POSITION2 → EVENT 3 → MESSAGE3 → POSITION3 → EVENT 4 → MESSAGE4 → POSITION4 → EVENT 5 → MESSAGE5 → POSITION5 → EVENT 6 → MESSAGE6 → POSITION6
LOCKOUT	PASSWORD → LOCKOUT → CHANGE
ADJUST	TRACE LN → GRID LN → PEN TYPE
CALIB	For field calibration—see Calibration section of manual
STATUS	VERSION → FAILSAFE* → RAM TEST → CONFTEST → CAL TEST → COMMTEST → FACT CRC → BATTERY **Displayed on test failure only*

3.3 How To Get Started

Read the configuration tips

Read *Subsection 3.4 Configuration Tips* which will help you to easily and quickly configure your recorder.

Read configuration procedure

Read *Subsection 3.5 Configuration Procedure* which tells you how to access the Set Up groups, and the function parameters within each of these groups that are shown in the Prompt Hierarchy in Figure 3-1.

Set Up groups

The Set Up groups and function parameters are listed in the order of their appearance. The list includes the name of the prompt, the range of setting or selections available, and the factory setting. It allows you to quickly find a parameter and obtain the available range or selection you require.

Parameter explanations or definitions

If you need a detailed explanation of any prompt listed, refer to *Section 4 – Configuration Parameter Definitions.* This section lists the set up and function prompts, the selections or range of settings that you can make for each, plus a detailed explanation or definition of each parameter.

Configuration record sheet

Located in *Subsection 3.23* is a *Configuration Record Sheet.* When you make your configuration selections, record them on this sheet. Then you will have a record of how the recorder was configured.

Set up the recorder in this order:

- Inputs (Display will be correct)
- Pens (Trace will agree with display)
- Chart
- Alarms
- Control
- Tuning
- Other functions as needed

3.4 Configuration Tips

Introduction

Listed below in Table 3-1 are some tips that will help you enter the configuration data more quickly.

Table 3-1 Configuration Tips

Function	Tip
Displaying groups	Use the **SET UP** key to display the Set Up groups. The group titles are listed in this section in the order that they appear in the recorder.
Displaying functions	Use the **FUNC** key to display the individual parameters under each group. The prompts are listed in the order of their appearance in each group.
Scrolling	To get to a Set Up group prompt more quickly, hold the **SET UP** key in. To get to a function prompt more quickly, hold the **FUNC** key in. The display will scroll through the parameters. **ATTENTION** The prompting scrolls at a rate of 2/3 seconds when the **SET UP** or **FUNC** key is held in. Also, [▲] [▼] keys will move group prompts forward or backward at a rate twice as fast.
Changing values quickly	When Changing the value of a parameter, you can adjust a more significant digit in the upper display by holding in one key [▲] or [▼] , and pressing the other [▲] or [▼] at the same time. • The adjustment will move one digit to the left. • Press the key again and you will move one more digit to the left.
Restoring to the original value	When you change the value or selection of a parameter while in Set Up mode and decide not to enter it, press **RUN/HOLD** once, the original value or selection will be recalled.
Exiting Set Up mode	To exit Set Up mode, press the **LOWR DISP** key. This returns the display to the same state it was in immediately preceding entry into the Set Up mode.
Timing out from Set Up mode	If you are in Set Up mode and do not press any keys for one minute, the recorder will time out and revert to the mode and display that was being used prior to entry into Set Up mode.
Key error	When a key is pressed and the prompt "KEY ERROR" appears in the lower display, it will be for one of the following reasons: • parameter not available • not in Set Up mode, press **SET UP** key first • key malfunction, do keyboard test (operation) • individual key locked out

3.5 Configuration Procedure

Introduction

- Each of the Set Up groups and their functions are preconfigured at the factory.
- The factory settings are shown in the Set Up group tables that follow this procedure.
- If you want to change any of these selections or values, follow the procedure in Table 3-2. This procedure tells you the keys to press to get to any Set Up group and any associated Function parameter prompt.
- **If you need a detailed explanation of any prompt, refer to *Section 4 – Configuration Parameter Definitions*.**

Procedure

Follow the procedure listed in Table 3-2 to access the Set Up groups and Function prompts.

TIP

The prompting scrolls at a rate of 2/3 seconds when the **SET UP** or **FUNC** key is held in. Also, [▲] [▼] keys will move group prompts forward or backward at a rate twice as fast.

Table 3-2 Configuration Procedure

Step	Operation	Press	Result
1	Select Set Up mode	**SET UP**	*Upper Display:* SET UP—Lets you know you are in the configuration mode and a Set Up group title is being displayed in the lower display. *Lower Display:* INPUT 1—This is the first Set Up group title.
2	Select any Set Up group	**SET UP**	• Successive presses of the **SET UP** key will sequentially display the other Set Up group titles shown in the prompt hierarchy in Figure 3-1. • You can also use the [▲] [▼] keys to scan the Set Up groups in both directions. • Stop at the Set Up group title which describes the group of parameters you want to configure. Then proceed to the next step.
3	Select a Function parameter	**FUNC**	*Upper Display:* Shows the current value or selection for the first function prompt of the particular Set Up group that you have selected (EXAMPLE: ENABLE/DISABLE). *Lower Display:*—Depends on what is selected in Set Up group. Shows the first function prompt within that Set Up group. Example: "INPUT 1"
4	Select other Function parameters	**FUNC**	• Successive presses of the **FUNC** key will sequentially display the other function prompts of the Set Up group you have selected. • Stop at the function prompt that you want to change, then proceed to the next step.

Step	Operation	Press	Result
5	Change the value or selection	▲ or ▼	• These keys increment or decrement the value or selection that appears for the function prompt you have selected. • See *Subsection 3.4 Configuration Tips* for instructions to increase or decrease value quickly. • Change the value or selection to meet your needs. • If the display flashes, you are trying to make an unacceptable entry.
6	Enter the value or selection	**FUNC** or **SET UP**	• This key selects another function prompt. • This key selects another Set Up group. The value or selection you have made will be entered into memory after another key is pressed.
7	Exit configuration	**LOWR DISP**	This exits configuration mode and returns the recorder to the same state it was in immediately preceding entry into the Set Up mode. It stores any changes you have made.

3.6 Input Set Up Group

Introduction

This data deals with various parameters required to configure input 1, input 2, input 3, or input 4.

Function prompts

Table 3-3 lists all the function prompts in the "INPUT 1" Set Up group. Repeat the process for each input you want to set up.

- Press the SET UP key until INPUT 2, INPUT 3, or INPUT 4 appears in the display.

Table 3-3 Input Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
INPUT 1	Input 1 Actuation	DISABL ENABLE	ENABLE
DECIMAL	Decimal Point Location	XXXX None XXX.X One XX.XX Two X.XXX Three	XXX.X
UNITS	Temperature Units	DEG F DEG C XXXXX (make selection at prompt "ENGUNITS")	DEG F
ENGUNITS	Engineering Units	0 to 9 A to Z + – \ (blank)	
IN1 TYPE	Input 1 Actuation Type	B TC E TC H E TC L J TC H J TC L K TC H K TC L NNM TC NIC TC R TC S TC T TC H T TC L W TC H W TC L 100 PT 200 HI* 200 LO* 500 PT 100 RH 4-20 mA 0-10 mV 10-50m 0-5 V 0-10 V RADIAM *DR45AR only	100 PT or 0-5 V with Control

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
XMITTER	Transmitter Characterization	B TC E TC H E TC L J TC H J TC L K TC H K TC L NNM TC H NIC TC R TC S TC T TC H T TC L W TC H W TC L 100 PT 500 PT 100 RH LINEAR* SQROOT* *Set "IN1HI" and "IN1LO"	Linear
IN1 HI	Input 1 High Range Value (linear inputs only)	–999.0 to 9999. in engineering units	900
IN1 LO	Input 1 Low Range Value (linear inputs only)	–999.0 to 9999. in engineering units	-300
CUTOFF 1	Low Flow Cutoff Selection	0 to 100 % of input range	0
INPTCOMP	Input Compensation	–999.9 to 9999.	0
FILTER 1	Input 1 Filter	0 to 120 seconds	0
BURNOUT	Burnout Protection	NONE UP DOWN	UP
EMISSIV	Emissivity	.01 to 1.00	.01

Repeat this procedure for INPUT 2, INPUT 3, and INPUT 4.

3.7 Pen Set Up Group

Introduction

The functions listed in this group deal with how to configure pen #1, pen #2, pen #3, or pen #4. The procedure for configuring each pen is the same. The prompts shown in Table 3-4 show PEN 1.

- Repeat the process for each pen you want to set up.
- Press the SET UP key until PEN 2, PEN 3, or PEN 4 appears in the display.

Function prompts

Table 3-4 lists all the function prompts in the PEN Set Up groups.

Table 3-4 Pen 1, 2, 3, 4 Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
PEN 1 (or **PEN 2, PEN 3, PEN 4**)	Pen Record	ENABLE DISABL	ENABLE
PEN1IN (or **PEN2IN, PEN3IN, PEN4IN**)	Pen Input	INPUT1 RH SETPT2 INPUT2 OUTPT1 DGTL1 INPUT3 OUTPT2 DGTL2 INPUT4 SETPT1 PV1	INPUT 1
CHART1HI (or **CHART2HI, CHART3HI, CHART4HI**)	Chart High Range Value	–999.0 to 9999	302.0
CHART1LO (or **CHART2LO, CHART3LO, CHART4LO**)	Chart Low Range Value	–999.0 to 9999	292.0
PEN1ON (or **PEN2ON, PEN3ON, PEN4ON**)	Pen Chart Position for ON Event	0 to 100 %	91.0
PEN1OFF (or **PEN2OFF, PEN3OFF, PEN4OFF**)	Pen Chart Position for OFF Event	0 to 100 %	93.0
MAJORDIV	Major Chart Divisions	2 to 10	10
MINORDIV	Minor Chart Division	2 to 10	10
RNG1TAG	Range 1 Tag Name	0 to 9 A to Z + – / (blank)	RNG 1

Repeat this procedure for PEN 2, PEN 3, and PEN 4.

3.8 Chart Set Up Group

Introduction

The functions listed in this group deal with the parameters that must be set to assure proper chart function.

CAUTION

Before making any configuration changes to the "Chart" Set Up group, place the recorder in "Chart Hold". Press the **CHART** key to stop the chart rotation. Press again after configuration entry is made.

Function prompts

Table 3-5 lists all the function prompts in the "Chart" Set Up group.

Table 3-5 Chart Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
CHRTSPD	Chart Speed Selection	8HR 12HR 24HR 7DAYS XHR (See prompt "HOUR/REV")	XHR
HOUR/REV	Hours per Revolution (appears only if "XHR" is selected above)	6 to 744 (12 hrs for abrasion resistant pen) NOTE: Below 8 hrs chart speed (24 hrs chart speed with abrasion resistant pen), printing may be degraded.	12
TIME DIV	Time Division	8 to 24 time periods	24
MINORDIV	Minor Time Division	Four Eight	Four
CONTINUE	Continue Chart Rotation	YES NO	NO
CHARTNAM	Chart Name	0 to 9 A to Z + – / (blank)	TRULIN
HEADER	Header for Chart	YES NO	NO

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
REM CHRT	Remote Chart Activation	NONE EXT SW1 EXT SW2 ALARM 1 ALARM 2 TIME (See "WAKE MIN", "WAKE HOUR", "WAKE DAY", "WAKE MON" in Time Set Up group.) ALARM 3 ALARM 4 ALARM 5 ALARM 6	NONE

3.9 Time Set Up Group

Introduction

The functions listed in this group deal with the parameters that let you configure the real time that will appear on the chart.

Function prompts

Table 3-6 lists all the function prompts in the "Time" Set Up group.

Table 3-6 Time Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
MINUTES	Real Time in Minutes Chart Speed Selection	0 to 59	Set to local time
HOURS	Real Time in Hours	0 to 23	
DAY	Real Time in Days	1 to 31	
MONTH	Real Time in Months	1 to 12	
YEAR	Real Time in Years	0 to 99	
DAY	Day of the Week Chart Name	MONDAY TUEDAY WEDDAY THRDAY FRIDAY SATDAY SUNDAY	
WAKE MIN	Wake Minutes	0 to 59	0
WAKE HR	Wake Hour	0 to 23	0
WAKE DAY	Wake Day	0 to 31	0
WAKE MON	Wake Month	1 to 12	1

3.10 Totalizer Set Up Group

Introduction

The functions listed in this group deal with the calculation and display of the total flow volume as measured by input 1 (total 1) or input 2 (total 2). The displayed value is 8 digits with a configurable scale factor.

Function prompts

Table 3-7 lists all the function prompts in the "TOTAL 1" Set Up group. Repeat the process for each input you want to set up.

- Press the **SET UP** key until TOTAL 2 appears in the display.

Table 3-7 Totalizer Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
Actual Current Totalized Value	View Current Totalized Value	Current Scale Factor Example: E1 GPM	E0 GAL
RSET TOT	Reset Totalizer to Zero (RSETABLE must be set to "LOCAL")	NO YES	NO
TOTAL 1 **TOTAL 2**	Totalizer 1 Totalizer 2	DISABL, INPUT1, PV1, INPUT2, INPUT 3, INPUT 4, E TIME	DISABL
TOTAL EU	Total Engineering Units	0 to 9 A to Z + – / (blank)	GAL
RATE	Rate of Integration	SECOND MINUTE HOUR DAY M/DAY (Millions of Units per Day)	SECOND
SCALER	Totalizer Scale Factor	1 10 100 1000 10000 100000 1E6 (1,000,000)	1
RSETABLE	Totalizer Reset	NO LOCAL EXTSW1* EXTSW2* TIME *Total will be set to "0" on closure of the assigned external switch.	NO

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
INHIBIT	Totalizer Inhibit	NONE S1 OPEN S1 CLOSE S2 OPEN S2 CLOSE	NONE

Repeat this procedure for INPUT 2.

3.11 Input Algorithm Set Up Group

Introduction

Input Algorithm set up group lets you calculate a process variable (PV1) using Inputs 1, 2, and 3. Input 1 is represented by 'A', Input 2 by 'B', Input 3 by 'C'.

Function prompts

Table 3-8 lists all the function prompts in the Input Algorithm Set Up group.

Table 3-8 Input Algorithm Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
INP ALG	Input Algorithm	NONE A+B+C (Summer) √A*B/C (Square Root Multiplier/Divider) √A*B*C (Square Root Multiplier) A*B/C (Multiplier/Divider) A*B*C (Multiplier) (A–B)*C (Difference Multiply) HI SELECT LO SELECT	NONE
COEFF	Coefficient K	0.000 to 1000.0	1.0
PV HIGH	Calculated PV High Limit	–999 to 9999	0.0
PV LOW	Calculated PV Low Limit	–999 to 9999	0.0
RATIO A	Ratio for Input 1	–20.00 to 20.00	1.0
BIAS A	Bias for Input 1	–999 to 9999	0.0
RATIO B	Ratio for Input 2	–20.00 to 20.00	1.0
BIAS B	Bias for Input 2	–999 to 9999	0.0
RATIO C	Ratio for Input 3	–20.00 to 20.00	1.0
BIAS C	Bias for Input 3	–999 to 9999	0.0
POLYNOM	Polynomial characterizer	NONE, INPUT 1, INPUT 2, INPUT 3, INPUT 4	NONE
C0 VALUE	Polynomial coefficient CO	–99.99 to 99.99	0
C1 VALUE	Polynomial coefficient C1	–9.999 to 9.999	0
C2x10-1	Polynomial coefficient C2	–9.999 to 9.999	0
C3x10-3	Polynomial coefficient C3	–9.999 to 9.999	0
C4x10-5	Polynomial coefficient C4	–9.999 to 9.999	0
C5x10-7	Polynomial coefficient C5	–9.999 to 9.999	0

3.12 Control Set Up Group

Introduction

This data deals with various parameters required to effectively control your process.

Function prompts

Table 3-9 lists all the function prompts in the "CONTROL 1" or "CONTROL 2" Set Up group. You can enable the Control groups in the Option group.

Table 3-9 Control 1 or Control 2 Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
CONTROL1	Control Loop 1	DISABL ENABLE	ENABLE
PID SETS	Tuning Parameter Sets	1 ONLY 2KEYBD 2PV SW 2SP SW	1 ONLY
SW VALUE	Automatic Switchover Value	–999.0 to 9999	0.00
SP SOURC	Setpoint Source	1 LOCAL REMOTE 2 LOCAL OUT 2 (available for Control 1 only) NOTE: If you select "REMOTE," Input #3 is automatically assigned as your RSP source for control #1; Input #4 is assigned for control #2. However, if the unit has only 2 inputs, then RSP will be on Input 2.	1 LOCAL
RATIO	Ratio for Remote Setpoint	–20.00 to 20.00	1.0
BIAS	Bias for Remote Setpoint	–999.0 to 9999 in engineering units	0
SP TRACK	Setpoint TrackingTotalizer Scale Factor	NONE RSP	NONE
POWER UP	Power Up Controller Mode Recall	MANUAL A LSP A RSP AM SP AM LSP	MANUAL
PWR OUT	Power Up Output	LAST FAIL SF NOTE: This prompt will appear only if "3PSTEP" is selected at function prompt "CONT ALG".	LAST
SP HILIM	High Setpoint Limit	–999.0 to 9999.	500
SP LOLIM	Low Setpoint Limit	–999.0 to 9999.	0

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
ACTION	Control Output Direction	DIRECT REVRSE	REVERSE
OUTHILIM	High Output Limit	–5.0 to 105.0 % of output	100.0
OUTLOLIM	Low Output Limit	–5.0 to 105.0 % of output	0
DROPOFF	Controller Dropoff Value	–5.0 to 105.0 % of output	0.0
DEADBAND	Output Relay Deadband	• Time Proportional Duplex: –5.0 to 25.0 % • On-Off Duplex: 0.0 to 25.0 % • Position Proportional 0.5 to 5.0 %	2.0
OUT HYST	Output Relay Hysteresis	0.0 to 5.0 % of PV Span	0.5
FAILSAFE	Failsafe Output Value	0 to 100 %	50
		For 3 Position Step Control: 100PCT Set motor position to 100 % output position 0PCT Set motor to 0 % output position	0.0
REM SW or **REM SW2**	Remote Switching (Digital Input)	NONE, TO 2SP, TUNE, TO MAN, TO DIR, TIMER, TO LSP, RN/HLD	NONE
MAN KEY	Manual Mode Key Selection	ENABLE DISABL	ENABLE
PB orGAIN	Proportional Band or Gain Units	PB PCT GAIN	GAIN
MIN orRPM	Reset Units	R P M (repeats per minute) M I N (minutes per repeat)	MIN
CONT1 ALG or **CONT2 ALG**	Control Algorithm	ON-OFF, PD+MR, PID-A, 3PSTEP*, PID-B *not applicable for model DR45AR	PID-A
OUT1 ALG or **OUT2 ALG** (appears if not 3PSTEP above)	Output Algorithm	TIME*, TIME D*, CURRNT, CUR TI*, POSITN*, TI CUR* *not applicable for Model DR45AR	CURRENT
4–20RNG	Current/Time Duplex Range (CUR D)	100PCT (FULL) 50 PCT (SPLIT)	50PCT

3.13 Tuning Parameters Set Up Group

Introduction

These Tuning Set Up groups contain the Function parameters that will allow your recorder to respond correctly to changes in process variable or setpoint. You can start with predetermined values but you will have to watch your process to determine how to modify them.

Function prompts

Table 3-10 lists all the function prompts in the Tuning 1 or Tuning 2 Set Up groups. How the "Algorithm" and "Control" Set Up groups are configured determines which prompts will appear.

Table 3-10 Tuning 1 or Tuning 2 Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
FUZZY	Fuzzy Overshoot Suppression	DISABL ENABLE	DISABL
ACCUTUNE	Accutune II for Control Loop	DISABL ENABLE	DISABL
AT ERR	Accutune Error Codes	No message under normal conditions Read Only message displayed if tuning has been manually aborted	—
PROP BD or GAIN	Proportional Band or Gain	0.1 to 1000 % 0.1 to 1000	1.0
RATE MIN	Rate in minutes	0.00 to 10.00 minutes	0.00
RSET MIN or RSET RPM	Reset in minutes/repeat or Reset in repeats/minute	0.02 to 50.00 0.02 to 50.00	1.0 1.0
MAN RSET	Manual Reset	–100 to 100 % output	0.0
PROP BD2 or GAIN 2	Proportional Band 2 or Gain 2	0.1 to 1000 % 0.1 to 1000	5.0
RATE2MIN	Rate 2 in minutes	0.08 to 10.00 minutes	0.00
RSET2MIN RSET2RPM	Reset 2 in minutes/repeat Reset 2 in repeats/minute	0.02 to 50.00 0.02 to 50.00	0.2 0.2
CYC SEC	Cycle Time (Heat) Electromechanical Relays	1 to 120 seconds	20.0
CYC2 SEC	Cycle Time 2 (Cool) Electromechanical Relays	1 to 120 seconds	20.0

3.14 SP Ramp Set Up Groups

The Setpoint Ramp 1 or 2 Set Up groups let you configure 2 setpoint ramps. Each group (SP RAMP1 and SP RAMP 2) can be configured one of three ways: ramp, rate, or setpoint program.

Setpoint Ramp

Setpoint will ramp between the current local setpoint and a final setpoint over a time interval (SP RAMP).

Setpoint Rate

The Setpoint Ramp Set Up group also contains the function parameters that let you configure a specific ramp rate up and ramp rate down (SP RATE). These rates are used when the local setpoint is manually changed.

Setpoint Program

Also included under this group are prompts for configuring a Setpoint program (SP PROG). The prompts and instructions for Setpoint programming are presented in the *Section 6 - Setpoint Ramp/Soak Programming and Operation.*

Function prompts

Table 3-11 lists all the function prompts in the SP RAMP 1 or SP RAMP 2 Set Up group. Configure each ramp separately. When you enable the ramp type (SP RAMP, SP RATE, SP PROG) the other two types are hidden from the display.

Table 3-11 SP Ramp 1 or 2 Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
SP RAMP*	Single Setpoint Ramp Selection	DISABL ENABLE	DISABL
TIME MIN	Single Setpoint Ramp Time	0 to 255 minutes	0
FINAL SP	Single Setpoint Ramp Final Setpoint	Enter a value within the setpoint limits	100.0
SP RATE*	Setpoint Rate	DISABL ENABLE	DISABL
EU/HR UP	Rate up value (SP Rate enabled)	0 to 9999 in units per hour	0
EU/HR DN	Rate down value (SP Rate enabled)	0 to 9999 in units per hour	0
SP PROG*	Setpoint Programming (Refer to Section 6)	DISABL ENABLE	DISABL

*Only one of these can be enabled at a time.

3.15 Timer Set Up Group

Introduction

The Timer gives a countdown or elapsed time, after which Relay 1 energizes. If Timer is enabled, it has exclusive control over Relay 1; Alarm 1 will not control the relay.

Function prompts

Table 3-12 lists all the function prompts in the TIMER Set Up group.

Table 3-12 Timer Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
TIMER	Timer Enable/Disable	ENABLE DISABL	DISABL
PERIOD	Timeout Period	0:00 to 99:59	0
START	Start Initiation	RHKEY ALARM2 TIME	RHKEY
LDISPLAY	Timer Display	TREM ET	TREM
RESET	Timer Reset Control	RHKEY ALARM1 REPEAT	RHKEY
ON-TIME	Timer Repeat Mode On-Time	1 SEC 2 SEC 3 SEC 4 SEC 5 SEC	
INCRMENT	Timer Count Increment	MINUTE SECOND	MINUTE

3.16 Alarms Set Up Group

Introduction

This data deals with the Alarms function that is available with your recorder.

- There are six alarms available. Each alarm has two setpoints.
- You can configure each of these two setpoints to alarm on various recorder parameters. There are two alarm output selections, high or low.
- You can also configure the two setpoints to alarm on the same event and to alarm both high and low, if desired. An adjustable hysteresis of 0.0 % to 100.0 % is configurable for each alarm.

Priority of functions that operate relays

During alarm conditions an alarm will deenergize its associated relay unless a higher priority function has been configured for that relay. See Table 3-13. If you want the alarm to control the relay, do not configure a higher priority function.

Table 3-13 Priority of functions that operate relays

Relay	Relay is controlled by (in order of priority)
1	1. Timer function 2. Alarm 1
2	Alarm 2 only
3	1. Controller 1 output algorithms Relay Simplex, Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 3
4	1. Controller 1 output algorithms Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 4
5	1. Controller 2 output algorithms Relay Simplex, Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 5
6	1. Controller 2 output algorithms Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 6

Function prompts

Table 3-14 lists all the function prompts in the Alarms Set Up group.

Table 3-14 Alarms Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
AxS1 VAL	Alarm 1, Setpoint 1 Value	Value in engineering units	90
AxS2 VAL	Alarm 1, Setpoint 2 Value	Value in engineering units	95
AxS1TYPE	Alarm 1, Setpoint 1 Type	NONE IN 1 (Input 1) IN 2 (Input 2) IN 3 (Input 3) IN 4 (Input 4) RH (Relative Humidity) PV (Process Variable Loop 1) DEV (Loop 1 Deviation) OUT (Loop 1 Output) DEV2 (Loop 2 Deviation) OUT2 (Loop 2 Output) EVENT (SP Programming-Segment Event) TOTAL 1 (Totalizer to Alarm On) TOTAL 2 (Totalizer to Alarm On) TOTAL 3 (Model DR45AW only) TOTAL 4 (Model DR45AW only)	IN 1
AxS2TYPE	Alarm 1, Setpoint 2 Type	Same as A1S1TYPE	IN 1
AxS1 H L	Alarm 1, Setpoint 1 State	LO (Low Alarm) H I (High Alarm)	LO
AxS1SCAL	Alarm 1, Setpoint 1 Scaling Multiplier for Totalizer Selection	1 10000 10 100000 100 1E6 1000	1
AxS2 H L	Alarm 1, Setpoint 2 State	LO H I	HI
AxS2SCAL	Alarm 1, Setpoint 2 Scaling Multiplier for Totalizer Selection	1 10 100 1000 10000 100000 1E6	1
ALx HYST	Alarm Hysteresis	0.0 to 100.0 % of Input Span as appropriate	0.1

Repeat this procedure for ALARM 2, ALARM 3, ALARM 4, ALARM 5, ALARM 6.

3.17 Auxiliary Output Set Up Group

Introduction

The auxiliary output will supply a 4-20mA output scaled to one of four operating parameters: Input, Output, Setpoint, or Deviation. This current is supplied from a separate option card. AUX OUT 2 and AUX OUT 3 use CONTROL CURRENT OUT 1 and CONTROL CURRENT OUT 2 if CONTROL OUT ALG is not set to CURRENT.

Function prompts

Table 3-15 lists all the function prompts in the Auxiliary Output Set Up group.

Table 3-15 Auxiliary Output Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
AUX OUT 1	Auxiliary Output Representation	DISABL IN 1 IN 2 PV 1 DEV 1 OUT 1 SP 1 PV 2 DEV 2 OUT 2 SP 2 IN 3 IN 4	DISABL
4 mA VAL	Low Scaling Factor	Low scale value to represent 4 mA	0.0
20mA VAL	High Scaling Factor	High scale value to represent 20 mA	100.0

Repeat this procedure for AUX OUT 2 and AUX OUT 3.

3.18 Modbus Communications Set Up Group

Introduction

This data deals with the Communications option that is available with your recorder. This option allows the recorder to be connected to a host computer via the Modbus protocol.

If your recorder does not have this option the prompts will not appear.

ATTENTION

Refer to Documents *51-52-25-66* and *51-52-25-69* for a complete description of the RS485 Modbus Communications Option.

Function prompts

Table 3-16 lists all the function prompts in the Modbus Communications Set Up group.

Table 3-16 Modbus Communications Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
ComSTATE	Modbus Communications	DISABL MODBUS	DISABL
Com ADDR	Communications Station Address	1 to 99	1
BAUD	Communications Baud Rate	300 600 1200 2400 4800 9600 19200 38400	9600
XMT DLAY	Transmit Delay (in milliseconds)	NONE 10MSEC 20MSEC 30MSEC 40MSEC 50MSEC	NONE
DBL BYTE	Double Byte Order	FP B FP BB FP L FP LB	FP B

3.19 Options Set Up Group

Introduction

This data deals with various options that are available with your recorder. If your recorder does not have any of these options the prompts will not appear.

Function prompts

Table 3-17 lists all the function prompts in the Option Set Up group.

Table 3-17 Options Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
REJ FREQ	Rejection Frequency	50HZ 60HZ	60HZ
HF REJ	High Frequency Rejection	ENABLE DISABL	ENABLE
RELHUMID	Relative Humidity	NO YES	NO
ATMPRES	Atmospheric Pressure Compensation	590 to 800 mmHg	—
DEVIATION	Deviation Recording Action	NONE SETPNT CHAN1	NONE
DEVSETPT	Deviation Setpoint Value	–999.0 to 9999	0
SCROLL	Lower Display Scroll	NONE 1 SEC 2 SEC 3 SEC	NONE
GRANDTOT	Grand Totalizer	ENABLE DISABL	DISABL

3.20 Event Message Configuration

Introduction

This Set Up group allows you to specify an event message to be printed on a designated area of the chart when triggered by a specific selectable actuation.

Function prompts

Table 3-18 lists all the function prompts in the "Event Message" Set Up group.

Table 3-18 Event Message Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
EVENT1	Event 1 Trigger	NONE EXTSW1 EXTSW2 ALARM1 ALARM2 ALARM3 ALARM4 ALARM5 ALARM6	NONE
MESSAGE1	Message for Event 1 (up to six characters)	0 to 9 A to Z + – / (blank)*	EVENT1
POSITON1	Chart Position for Message 1 Printing	0 to 100 %	87.3
EVENT 2	Event 2 Trigger	NONE EXTSW1 EXTSW2 ALARM1 ALARM2 ALARM3 ALARM4 ALARM5 ALARM6	NONE
MESSAGE2	Message for Event 2 (up to six characters)	0 to 9 A to Z + – / (blank)*	EVENT2
POSITON2	Chart Position for Message 2 Printing	0 to 100 %	85.5

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
EVENT 3	Event 3 Trigger	NONE EXTSW1 EXTSW2 ALARM1 ALARM2 ALARM3 ALARM4 ALARM5 ALARM6	NONE
MESSAGE3	Message for Event 3 (up to six characters)	0 to 9 A to Z + – / (blank)*	EVENT3
POSITON3	Chart Position for Message 3 Printing	0 to 100 %	83.6
EVENT 4	Event 4 Trigger	NONE EXTSW1 EXTSW2 ALARM1 ALARM2 ALARM3 ALARM4 ALARM5 ALARM6	NONE
MESSAGE4	Message for Event 4 (up to six characters)	0 to 9 A to Z + – / (blank)*	EVENT4
POSITON4	Chart Position for Message 4 Printing	0 to 100 %	80.0
EVENT 5	Event 5 Trigger	NONE EXTSW1 EXTSW2 ALARM1 ALARM2 ALARM3 ALARM4 ALARM5 ALARM6	NONE
MESSAGE5	Message for Event 5 (up to six characters)	0 to 9 A to Z + – / (blank)*	EVENT5

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
POSITON5	Chart Position for Message 5 Printing	0 to 100 %	78.2
EVENT 6	Event 6 Trigger	NONE EXTSW1 EXTSW2 ALARM1 ALARM2 ALARM3 ALARM4 ALARM5 ALARM6	NONE
MESSAGE6	Message for Event 6 (up to six characters)	0 to 9 A to Z + – / (blank)*	EVENT6
POSITON6	Chart Position for Message 6 Printing	0 to 100 %	76.9

*For alphanumeric entries, the display will cycle, from left to right, with highlighting (increased brightness) of each digit. The value of each digit can be changed only when it is highlighted.

3.21 Lockout Set Up Group

Introduction

These are the parameters that you will select to lockout any unauthorized changes to the recorder's configuration and calibration prompts. You must know the password in order to change the Lockout configuration.

Function prompt

Table 3-19 lists all the function prompts in the Lockout Set Up group.

Table 3-19 Lockout Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
PASSWORD	Lockout Password	Select up to 4 alphanumeric characters (++++ is factory default password) For more information on password security, refer to Appendix B.	XXXX
LOCKOUT	Lockout	NONE CALIB +CONF MAX	CALIB
CHANGE	Change Password	0 to 9 A to Z	XXXX

ATTENTION

Configuration can also be locked using S1 switch on the main printed circuit board. Refer to *Subsection 2.9 –Lockout Switch Configuration.*

This feature also includes the special screw and plate that provide for the lead seal capability for sealing the chart plate.

3.22 Adjust Printing

Introduction

This data deals with the "Adjust Printing" feature of the Truline recorder. This feature is important to the operation of the hot stylus pen.

Configuration choices are provided for PEN TYPE and the selection must match the stylus design.

- PEN TYPE = NORMAL is for the high-speed stylus design.
- PEN TYPE = JEWEL is used *only* for abrasion resistant stylus design.

CAUTION

If the "JEWEL" selection is accidentally used with the high-speed design, the life of that stylus will be shortened.

You can also make slight adjustments to the print contrast.

Function prompt

Table 3-20 lists all the function prompts in the Adjust Set Up group.

Table 3-20 Adjust Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
TRACE LN	Trace Line Contrast	DARK MEDIUM LIGHT	MEDIUM
GRID LN	Grid Line Contrast	DARK MEDIUM LIGHT	MEDIUM
PEN TYPE	Stylus Selection	NORMAL – Select if high speed stylus (black tip) is installed. JEWEL – Select if abrasion resistant stylus (beige tip) is installed.	NORMAL

3.23 Configuration Record Sheet

Keep a record

Enter the value or selection for each prompt on this sheet so you will have a record of how your recorder was configured.

Group Prompt	Function prompt	Value or Selection	Factory Setting
INPUT 1	DECIMAL	_____	XXX.X
	UNITS	_____	DEGF
	ENGUNITS	_____	—
	IN1 TYPE	_____	100PT
	XMITTER	_____	LINEAR
	IN1 HI	_____	900
	IN1 LO	_____	-300
	CUTOFF 1	_____	0
	INPTCOMP	_____	0
	FILTER 1	_____	0
	BURNOUT	_____	UP
	EMISSIV	_____	.01
INPUT 2	DECIMAL	_____	XXX.X
	UNITS	_____	DEGF
	ENGUNITS	_____	—
	IN2 TYPE	_____	100PT
	XMITTER	_____	LINEAR
	IN2 HI	_____	900
	IN2 LO	_____	-300
	CUTOFF 2	_____	0
	INPTCOMP	_____	0
	FILTER 2	_____	0
	BURNOUT	_____	UP
	EMISSIV	_____	.01
INPUT 3	DECIMAL	_____	XXX.X
	UNITS	_____	DEGF
	ENGUNITS	_____	—
	IN3 TYPE	_____	100PT
	XMITTER	_____	LINEAR
	IN3 HI	_____	900
	IN3 LO	_____	-300
	CUTOFF 3	_____	0
	INPTCOMP	_____	0
	FILTER 3	_____	0
	BURNOUT	_____	UP
	EMISSIV	_____	.01
INPUT 4	DECIMAL	_____	XXX.X
	UNITS	_____	DEGF
	ENGUNITS	_____	—
	IN4 TYPE	_____	100PT
	XMITTER	_____	LINEAR
	IN4 HI	_____	900
	IN4 LO	_____	-300
	CUTOFF 4	_____	0
	INPTCOMP	_____	0
	FILTER 4	_____	0
	BURNOUT	_____	DEGF
	EMISSIV	_____	.01

Group Prompt	Function prompt	Value or Selection	Factory Setting
PEN 1	PEN1IN	_____	INPUT1
	CHART1HI	_____	302.0
	CHART1LO	_____	292.0
	PEN1ON	_____	91.0
	PEN1OFF	_____	93.0
	MAJORDIV	_____	10
	MINORDIV	_____	10
	RNG1TAG	_____	RNG1
PEN 2	PEN2IN	_____	INPUT2
	CHART2HI	_____	302.0
	CHART2LO	_____	292.0
	PEN2ON	_____	91.0
	PEN2OFF	_____	93.0
	MAJORDIV	_____	10
	MINORDIV	_____	10
	RNG2TAG	_____	RNG2
PEN 3	PEN3IN	_____	INPUT3
	CHART3HI	_____	302.0
	CHART3LO	_____	292.0
	PEN3ON	_____	91.0
	PEN3OFF	_____	93.0
	MAJORDIV	_____	10
	MINORDIV	_____	10
	RNG3TAG	_____	RNG3
PEN 4	PEN4IN	_____	NPUT4
	CHART4HI	_____	302.0
	CHART4LO	_____	292.0
	PEN4ON	_____	91.0
	PEN4OFF	_____	93.0
	MAJORDIV	_____	10
	MINORDIV	_____	10
	RNG4TAG	_____	RNG4
CHART	CHRTSPD	_____	XHR
	HOUR/REV	_____	12
	TIME DIV	_____	24
	MINORDIV	_____	Four
	CONTINUE	_____	NO
	CHARTNAM	_____	TRULIN
	HEADER	_____	NO
	REM CHRT	_____	NONE
TIME	MINUTES	_____	Set
	HOURS	_____	to
	DAY	_____	local
	MONTH	_____	time
	YEAR	_____	
	DAY	_____	
	WAKE MIN	_____	0
	WAKE HR	_____	0
	WAKE DAY	_____	0
	WAKE MON	_____	0

Group Prompt	Function prompt	Value or Selection	Factory Setting
TOTAL 1	(Value)	_____	E0 GAL
	RSET TOT	_____	NO
	TOTAL 1	_____	DISABL
	TOTAL EU	_____	GAL
	RATE	_____	SECOND
	SCALER	_____	1
	RSETABLE	_____	NO
	INHIBIT	_____	NONE
TOTAL 2	(Value)	_____	E0 GAL
	RSET TOT	_____	NO
	TOTAL 2	_____	DISABL
	TOTAL EU	_____	GAL
	RATE	_____	SECOND
	SCALER	_____	1
	RSETABLE	_____	NO
	INHIBIT	_____	NONE
INP ALG	INP ALG	_____	NONE
	COEFF	_____	1.0
	PV HIGH	_____	0.0
	PV LOW	_____	0.0
	RATIO A	_____	1.0
	BIAS A	_____	0.0
	RATIO B	_____	1.0
	BIAS B	_____	0.0
	RATIO C	_____	1.0
	BIAS C	_____	0.0
	POLYNOM	_____	NONE
	C0 VALUE	_____	0
	C1 VALUE	_____	0
	C2x10-1	_____	0
	C3x10-3	_____	0
	C4x10-5	_____	0
	C5x10-7	_____	0
CONTROL 1	CONTROL1	_____	ENABLE
	PID SETS	_____	1ONLY
	SW VALUE	_____	0.0
	SP SOURC	_____	1LOCAL
	RATIO	_____	1.0
	BIAS	_____	0
	SP TRACK	_____	NONE
	POWER UP	_____	MANUAL
	PWR OUT	_____	LAST
	SPHILIM	_____	500
	SPLOLIM	_____	0
	ACTION	_____	REVRSE
	OUT HILIM	_____	100.0
	OUT LOLIM	_____	0
	DROPOFF	_____	0.0
	DEADBAND	_____	2.0
	OUT HYST	_____	0.5
	FAILSAFE	_____	50
	REM SW	_____	NONE
	MAN KEY	_____	ENABLE
	PBorGAIN	_____	GAIN
	MINorRPM	_____	MIN
	CONT1ALG	_____	PIDA
	OUT1ALG	_____	CURRENT
	4-20 RNG	_____	50PCT

Group Prompt	Function prompt	Value or Selection	Factory Setting
CONTROL 2	CONTROL2	_____	ENABLE
	PID SETS	_____	1ONLY
	SW VALUE	_____	0.0
	SP SOURC	_____	1LOCAL
	RATIO	_____	1.0
	BIAS	_____	0
	SP TRACK	_____	NONE
	POWER UP	_____	MANUAL
	PWR OUT	_____	LAST
	SP HILIM	_____	500
	SP LOLIM	_____	0
	ACTION	_____	REVRSE
	OUTHILIM	_____	100.0
	OUTLOLIM	_____	0
	DROPOFF	_____	0.0
	DEADBAND	_____	2.0
	OUT HYST	_____	0.5
	FAILSAFE	_____	50
	REM SW2	_____	NONE
	MAN KEY	_____	ENABLE
	PBorGAIN	_____	GAIN
	MINorRPM	_____	MIN
	CONT2ALG	_____	PIDA
	OUT2ALG	_____	CURRENT
	4-20 RNG	_____	50PCT
TUNING 1	FUZZY	_____	DISABL
	ACCUTUNE	_____	DISABL
	AT ERR	Read only	
	PROP BD	_____	1.0
	or		
	GAIN	_____	1.0
	RATE MIN	_____	0.00
	RSET MIN	_____	1.0
	or		
	RSET RPM	_____	1.0
	MAN RSET	_____	0.0
	CYCSEC	_____	20.0
	PROP BD2	_____	1.0
	or		
	GAIN 2	_____	1.0
	RATE2MIN	_____	0.00
	RSET2MIN	_____	1.0
	or		
	RSET2RPM	_____	1.0
	CYC2SEC	_____	20.0

Group Prompt	Function prompt	Value or Selection	Factory Setting
TUNING 2	FUZZY	_____	DISABL
	ACCUTUNE	_____	DISABL
	AT ERR	Read only	—
	PROP BD	_____	1.0
	or		
	GAIN	_____	1.0
	RATE MIN	_____	0.00
	RSET MIN	_____	1.0
	or		
	RSET RPM	_____	1.0
	MAN RSET	_____	0.0
	CYCSEC	_____	20.0
	PROP BD2	_____	1.0
	or		
	GAIN 2	_____	1.0
	RATE2MIN	_____	0.00
	RSET2MIN	_____	1.0
	or		
	RSET2RPM	_____	1.0
	CYC2SEC	_____	20.0
SP RAMP1	SP RAMP	_____	DISABL
	TIME MIN	_____	0
	FINAL SP	_____	100.0
	SP RATE	_____	DISABL
	EU/HR UP	_____	—
	EU/HR DN	_____	—
	SP PROG	_____	DISABL
	RECYCLES	_____	—
	SOAK DEV	_____	—
	PROFILE	_____	—
	STATE	_____	—
	RECOVERY	_____	—
	PROG END	_____	—
SP RAMP2	SP RAMP	_____	DISABL
	TIME MIN	_____	0
	FINAL SP	_____	100.0
	SP RATE	_____	—
	EU/HR UP	_____	—
	EU/HR DN	_____	—
	SP PROG	_____	DISABL
	RECYCLES	_____	—
	SOAK DEV	_____	—
	PROFILE	_____	—
	STATE	_____	—
	RECOVERY	_____	—
	PROG END	_____	—
PROFILES	PRx STRT	_____	—
	PRx END	_____	—
	RAMPUNIT	_____	—
	SYNC 1+2	_____	—
SPP SEGS	SEGxRAMP	_____	—
	SEGx SP	_____	—
	SEGxTIME	_____	—
SPP EVNT	SEGx EV	_____	—

Group Prompt	Function prompt	Value or Selection	Factory Setting
TIMER	TIMER	_____	DISABL
	PERIOD	_____	0:01
	START	_____	KEY
	LDISPLAY	_____	TREM
	RESET	_____	KEY
	ON-TIME	_____	—
	INCRMENT	_____	MIN
ALARM 1	A1S1 VAL	_____	90
	A1S2 VAL	_____	95
	A1S1TYPE	_____	INPUT1
	A1S2TYPE	_____	INPUT1
	A1S1 H L	_____	LO
	A1S1SCAL	_____	1
	A1S2 H L	_____	HI
	A1S2SCAL	_____	1
	AL1 HYST	_____	0.1
ALARM 2	A2S1 VAL	_____	90
	A2S2 VAL	_____	95
	A2S1TYPE	_____	INPUT1
	A2S2TYPE	_____	INPUT1
	A2S1 H L	_____	LO
	A2S1SCAL	_____	1
	A2S2 H L	_____	HI
	A2S2SCAL	_____	1
	AL2 HYST	_____	0.1
ALARM 3	A3S1 VAL	_____	90
	A3S2 VAL	_____	95
	A3S1TYPE	_____	INPUT1
	A3S2TYPE	_____	INPUT1
	A3S1 H L	_____	LO
	A3S1SCAL	_____	1
	A3S2 H L	_____	HI
	A3S2SCAL	_____	1
	AL3 HYST	_____	0.1
ALARM 4	A4S1 VAL	_____	90
	A4S2 VAL	_____	95
	A4S1TYPE	_____	INPUT1
	A4S2TYPE	_____	INPUT1
	A4S1 H L	_____	LO
	A4S1SCAL	_____	1
	A4S2 H L	_____	HI
	A4S2SCAL	_____	1
	AL4 HYST	_____	0.1

Group Prompt	Function prompt	Value or Selection	Factory Setting
ALARM 5	A5S1 VAL	_____	90
	A5S2 VAL	_____	95
	A5S1TYPE	_____	INPUT1
	A5S2TYPE	_____	INPUT1
	A5S1 H L	_____	LO
	A5S1SCAL	_____	1
	A5S2 H L	_____	HI
	A5S2SCAL	_____	1
	AL5 HYST	_____	0.1
ALARM 6	A6S1 VAL	_____	90
	A6S2 VAL	_____	95
	A6S1TYPE	_____	INPUT1
	A6S2TYPE	_____	INPUT1
	A6S1 H L	_____	LO
	A6S1SCAL	_____	1
	A6S2 H L	_____	HI
	A6S2SCAL	_____	1
	AL6 HYST	_____	0.1
AUX OUT	AUX OUT	_____	DISABL
	4 mA VAL	_____	0.0
	20mA VAL	_____	100.0
AUX OUT2	AUX OUT2	_____	DISABL
	4 mA VAL	_____	0.0
	20mA VAL	_____	100.0
AUX OUT3	AUX OUT3	_____	DISABL
	4 mA VAL	_____	0.0
	20mA VAL	_____	100.0
COMM	ComSTATE	_____	DISABL
	Com ADDR	_____	1
	BAUD	_____	9600
	XMT DLAY	_____	NONE
	DBL BYTE	_____	FP B
OPTIONS	REJ FREQ	_____	60
	HF REJ	_____	ENABLE
	RELHUMID	_____	NO
	ATMPRES	_____	—
	DEVIATION	_____	NONE
	DEVSETPT	_____	0
	SCROLL	_____	NONE
	GRANDTOT	_____	DISABL

Group Prompt	Function prompt	Value or Selection	Factory Setting
EVNT MSG	EVENT 1	_____	NONE
	MESSAGE1	_____	EVENT1
	POSITION1	_____	87.3
	EVENT 2	_____	NONE
	MESSAGE2	_____	EVENT2
	POSITION2	_____	85.5
	EVENT 3	_____	NONE
	MESSAGE3	_____	EVENT3
	POSITION3	_____	83.6
	EVENT 4	_____	NONE
	MESSAGE4	_____	EVENT4
	POSITION4	_____	80.0
	EVENT 5	_____	NONE
	MESSAGE5	_____	EVENT5
	POSITION5	_____	78.2
	EVENT 6	_____	NONE
	MESSAGE6	_____	EVENT6
	POSITION6	_____	76.9
LOCKOUT	PASSWORD	_____	XXXX
	LOCKOUT	_____	CALIB
	CHANGE	_____	XXXX
ADJUST	TRACE LN	_____	MEDIUM
	GRID LN	_____	MEDIUM
	PEN TYPE	_____	NORMAL

4. Configuration Parameter Definitions

4.1 Overview

Introduction

This section provides information for all the user-configurable control parameters listed in the configuration section. If you aren't familiar with these parameters, this section gives you the parameter prompt, the selection or range of setting that you can make, and a definition of how each parameter setting affects recorder performance. It will also refer you to any other prompts that might be affected by your selection.

Parameter groups and prompts

- The control information is found in three configuration groups which are accessed by the **SET UP** key.
- Each of these groups contains prompts, viewed in the lower display, which deal with functions that are pertinent to that particular group. These are accessed by pressing the **FUNC** key.
- The selections or values are listed in the upper display. Refer to *Section 3 - Configuration* for step by step instructions.

What's in this section?

The table below lists the topics that are covered in this section. They are listed in the order of their appearance in the recorder.

	Topic	See Page
4.1	Overview	93
4.2	Input Parameters Set Up Group	94
4.3	Pen Parameters Set Up Group	98
4.4	Chart Parameters Set Up Group	100
4.5	Time Parameters Set Up Group	103
4.6	Total Parameters Set Up Group	104
4.7	Input Algorithm Set Up Group	106
4.8	Control Parameters Set Up Group	109
4.9	Tuning Parameters Set Up Group	119
4.10	Setpoint Ramp Set Up Group	122
4.11	Timer Set Up Group	124
4.12	Alarms Set Up Group	125
4.13	Auxiliary Output Set Up Group	128
4.14	Modbus Communications Set Up Group	130
4.15	Options Set Up Group	131
4.16	Event Message Set Up Group	133
4.17	Lockout Parameters Set Up Group	134
4.18	Printing Characteristics Adjustments	135

4.2 Input Parameters Set Up Group

Introduction

These are the parameters required for input 1, 2, 3, or 4; temperature units, decimal location, actuation, transmitter characterization, high and low range values in engineering units, input compensation, filter, and burnout.

Input group prompts

Table 4-1 lists all the function prompts in the Input 1, 2, 3, or 4 setup group and their definitions.

Table 4-1 Input Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
DECIMAL	XXXX XXX.X XX.XX X.XXX	**DECIMAL POINT LOCATION** -- This selection determines where the decimal point appears in the display. None One Place Two Places Three Places NOTE: Auto-ranging will occur when one decimal position has been selected and the value increases above 999.9 but auto-ranging *will not* similarly occur when two decimal positions are selected.
UNITS	DEG F DEG C EU	**TEMPERATURE UNITS** -- This selection will be indicated on the PV display. If you select EU, go to prompt "ENGUNITS" Degrees Fahrenheit Degrees Celsius Engineering Units
ENGUNITS	0 to 9 A to Z + – / (blank)	**ENGINEERING UNITS** – Make up 5 selections to create unit identifier. • For example, create unit identifier H_2O by selecting an "H" from A to Z, a "2" from 0 to 9, and an "O" from A to Z. • For alphanumeric entries, the display will cycle, from left to right, with highlighting (increased brightness) of each digit. The value of each digit can be changed only when it is highlighted.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
INn TYPE **(n = 1, 2, 3, or 4)**		**INPUT ACTUATION TYPE** -- This selection determines what actuation you are going to use for input one. Be sure that the values configured for high and low chart range, soak setpoint, alarm setpoint, etc. are within the measuring range for the selected actuation type.
	B TC	B thermocouple 105 to 3300°F 41 to 1815°C
	E TC H	E thermocouple high –454 to 1832°F –270 to 1000°C
	E TC L	E thermocouple low –200 to 1100°F –129 to 593°C
	J TC H	J thermocouple high 0 to 1600°F –18 to 871°C
	J TC L	J thermocouple low 20 to 770°F –7 to 410°C
	K TC H	K thermocouple high –320 to 2500°F –196 to 1371°C
	K TC L	K thermocouple low –20 to 1000°F –29 to 538°C
	NNM TC[1]	NNM NiNiMo thermocouple 32 to 2500°F 0 to 1371°C
	NIC TC[1]	NIC Nicrosil-Nisil thermocouple 0 to 2372°F –178 to 1300°C
	R TC[1]	R thermocouple 0 to 3100°F –18 to 1704°C
	S TC	S thermocouple 0 to 3100°F –18 to 1704°C
	T TC H	T thermocouple high –300 to 700°F –184 to 371°C
	T TC L	T thermocouple low –200 to 500°F –129 to 316°C
	W TC H[1]	W5W26 thermocouple high 0 to 4200°F –18 to 2316°C
	W TC L[1]	W5W26 thermocouple low 0 to 2240°F –18 to 1227°C
	100 PT	100 Ohm–RTD –300 to 1200°F –184 to 649°C
	200 HI[2]	200 Ohm–RTD 32 to 752 0 to 400
	200 LO[2]	200 Ohm–RTD 32 to 392 0 to 200
	500 PT	500 Ohm–RTD –300 to 900°F –184 to 482°C
	100 RH	100 Ohm–RTD –130 to 392°F –90 to 200°C
	4-20mA	4 to 20 Milliamps[3]
	0-10mV	0 to 10 Millivolts[3]
	10-50m	10 to 50 Millivolts[3]
	0-5 V	0 to 5 Volts[3]
	0-10 V	0 to 10 Volts[3]
	RADIAM	Radiamatic 1400 to 3400°F 760 to 1871°C
		[1]Only available with Model DR45AT [2]Only available with Model DR45AR [3]Go to prompt "XMITTER" to characterize the input.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
XMITTER		**TRANSMITTER CHARACTERIZATION** — This selection lets you instruct the recorder to characterize a linear input to represent a nonlinear one. • NOTE: Prompt only appears when a linear actuation is selected at prompt 'IN1 TYPE". • FOR EXAMPLE: If input 1 is a 4 to 20 mA signal, but the signal represents a type "K" thermocouple; select "K TC H" and the recorder will characterize the 4 to 20 mA signal so that it is treated as a type "K" thermocouple input (high range).
	B TC E TC H E TC L J TC H J TC L K TC H K TC L NNM H NIC TC R TC S TC T TC H T TC L W TC H W TC L 100 PT 500 PT 100 RH LINEAR SQROOT	B Type Thermocouple E Type Thermocouple High E Type Thermocouple Low J Type Thermocouple High J Type Thermocouple Low K Type Thermocouple High K Type Thermocouple Low NNM NiNiMo Type Thermocouple High NIC Nicrosil Nisil Thermocouple R Type Thermocouple S Type Thermocouple T Type Thermocouple High T Type Thermocouple Low W5W26 Type Thermocouple High W5W26 Type Thermocouple Low 100 Ohm–RTD 500 Ohm–RTD 100 Ohm –RTD Linear Range Extracts Square Root
INn HI **(n = 1, 2, 3, or 4)**	–999.9 to 9999. or –999 to 9999 in engineering units	**INPUT HIGH RANGE VALUE** in engineering units is displayed for all inputs but can only be configured for linear or square root transmitter characterization. Otherwise, this is a read-only display of the higher range value for the selected T/C or RTD input including transmitter characterization, if applicable. • Scale the #1 input signal to the display value you want for 100 %. • **EXAMPLE:** Actuation (Input) = 4 mA to 20 mA Process Variable = Flow Range of Flow = 0 to 250 Gal/Min High Range display value = 250 Then 20 mA = 250 Gal/Min The control setpoint will be limited by the range of units selected here.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
INn LO **(n = 1, 2, 3, or 4)**	–999.9 to 9999. or –999 to 9999 in Engineering units	**INPUT LOW RANGE VALUE** in engineering units is displayed for all inputs but can only be configured for linear or square root transmitter characterization. • Otherwise, this is a read-only display of the low range value for the selected T/C or RTD input including transmitter characterization, if applicable. • Scale the input signal to the display value you want for 0 %. See example on previous page. The control setpoint for Input will be limited by the range of units selected here.
CUTOFF n **(n = 1, 2, 3, or 4)**	0 to 100 % of Input Range	**LOW FLOW CUTOFF**—Lets you set a value in percent of range below which the applicable totalizer does not increment. **ATTENTION** Prompt appears only if totalizer option is present in the recorder.
INPTCOMP	–999.9 to 9999.	**INPUT COMPENSATION** — used to compensate the input for drift of an input value due to deterioration of a sensor, or some other cause; select the value you want on the input.
FILTER n **(n = 1, 2, 3, or 4)**	0 to 120 seconds No filter = 0	**FILTER FOR INPUT** — a software digital filter is provided for the input to smooth the input signal. You can configure the first order lag time constant from 1 to 120 seconds. If you do not want filtering, enter 0.
BURNOUT		**BURNOUT PROTECTION (SENSOR BREAK)** provides most input types with upscale or downscale protection if the input fails. • Not available for inputs 0-5 V, 0-10 V, or 4-20 mA.
	NONE	**NO BURNOUT** — Failsafe output applied for failed input.
	UP	**UPSCALE BURNOUT** will make the indicated PV signal increase when a sensor fails, and flash the upper display.
	DOWN	**DOWNSCALE BURNOUT** will make the indicated PV signal decrease when a sensor fails, and flash the upper display. NOTE: For no Burnout (that is, "None") to function properly on a linear input, there must be a dropping resistor directly across the *input* terminals (that is, not remote), then the unit can detect the "zero" voltage that occurs when the 4-20 mA line is opened.
EMISSIV	.01 to 1.00	**EMISSIVITY** is a correction factor applied to the Radiamatic input signal that is the ratio of the actual energy emitted from the target to the energy which would be emitted if the target were a perfect radiator. Available only for "Radiamatic" inputs.

Repeat the procedure for INPUT 2, INPUT 3, and INPUT 4 configuration.

4.3 Pen Parameters Set Up Group

Introduction

The functions listed in this group deal with how to configure pen #1, pen #2, pen #3, or pen #4. The procedure for configuring each pen is the same. The prompts shown in Table 4-2 show PEN 1.

- Press the **SET UP** key until PEN 1, PEN 2, PEN 3, or PEN 4 appears in the display.

Pen 1-2-3-4 group prompts

Table 4-2 lists all the function prompts in the Pen 1, 2, 3, 4 set up groups and their definitions.

Table 4-2 Pen 1, 2, 3, or 4 Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PENn **(n - 1, 2, 3 or 4)**	ENABLE DISABL	**PEN RECORD** —This selection lets you enable or disable the pen (channel) record • Remember, the lower display prompt could read PEN2, PEN3, or PEN4.
PENnIN **(n = 1, 2, 3 or 4)**	 INPUT 1 INPUT 2 INPUT 3 INPUT 4 RH OUTPT1 OUTPT2 SETPT1 SETPT2 DGTL1 DGTL2 PV1	**PEN INPUT**—What do you want the pen to record? **INPUT 1**—records Input 1 **INPUT 2**—records Input 2 **INPUT 3**—records Input 3 **INPUT 4**—records Input 4 **RELATIVE HUMIDITY**—records in % RH. It initiates an external calculation for measuring relative humidity. INPUT 1, IN TYP must be configured for 100 PT. INPUT 2, IN TYP must be configured for 100 RH. The RH prompt only appears when RELHUMID prompt in the OPTIONS group is configured as YES. **OUTPUT 1**—records Output 1 **OUTPUT 2**—records Output 2 **SETPOINT 1**—records Setpoint 1 **SETPOINT 2**—records Setpoint 2 **DIGITAL 1 INPUT**—records EVENT pen function on contact closure across digital 1 input. **DIGITAL 2 INPUT**—records EVENT pen function on contact closure across digital 2 input. **PV1**—records calculated PV1 when an input algorithm (INP ALG) has been selected in the Options group. (Available only in units with software Math Option.)
CHARTnHI **(n = 1, 2, 3 or 4)**	–999.0 to 999	**CHART HIGH RANGE VALUE**—Enter a value that corresponds with the chart high range value for pen 1 (pen 2, pen 3, or pen 4).
CHARTnLO **(n = 1, 2, 3 or 4)**	–999.0 to 999	**CHART RANGE LOW VALUE**—Enter a value that corresponds with the chart low range value for pen 1 (pen 2, pen 3, or pen 4).

<table>
<tr><th>Lower Display Prompt</th><th>Upper Display Range of Setting or Selection</th><th>Parameter Definition</th></tr>
<tr><td>PENnON

(n = 1, 2, 3 or 4)</td><td>0 to 100 %</td><td>PEN CHART POSITION FOR ON EVENT — This is the event marker configuration using digital inputs. Select the chart position where pen 1 (pen 2, pen 3, and pen 4) is to mark (trace) occurrence of an ON event.

• Prompt only appears if DGTL1 or 2 is selected as pen 1 (pen 2, pen 3, or pen 4) input.</td></tr>
<tr><td>PENnOFF

(n = 1, 2, 3 or 4)</td><td>0 to 100 %</td><td>PEN CHART POSITION FOR OFF EVENT — This is the event marker configuration using digital inputs. Select the chart position where Pen 1 (pen 2, pen 3, and pen 4) is to mark (trace) occurrence of an OFF event.

• Prompt only appears if DGTL1 or 2 is selected as pen 1 (pen 2, pen 3, or pen 4) input.</td></tr>
<tr><td>MAJORDIV</td><td>2 to 10</td><td>MAJOR CHART DIVISIONS — This is the number of Major Divisions in range of chart 1 (2, 3, or 4) scale (between CHART1HI and CHART1LO). Must divide evenly into chart range.

ATTENTION The values of major divisions are now printed with decimal points when possible. The restriction is four characters, including the decimal and (–) sign.

EXAMPLES:
<table>
<tr><th>Pen Range</th><th>Print Format</th></tr>
<tr><td>0 to 99</td><td>XX.X</td></tr>
<tr><td>0 to 9</td><td>X.XX</td></tr>
<tr><td>–9 to 9</td><td>XX.X</td></tr>
<tr><td>–99 to 99</td><td>XXX</td></tr>
<tr><td>0 to 999</td><td>XXX</td></tr>
</table></td></tr>
<tr><td>MINORDIV</td><td>2 to 10</td><td>MINOR CHART DIVISIONS — This is the number of Minor Divisions in range of chart 1 (2, 3, or 4) scale (increments in each Major Division).</td></tr>
<tr><td>RNGnTAG

(n = 1, 2 , 3 or 4)</td><td>0 to 9
A to Z
+
–
/
(blank)</td><td>RANGE 1 TAG NAME — Enter a tag name for chart 1 (2, 3, or 4) range. It can be up to 5 characters.

• For alphanumeric entries, the display will cycle, from left to right, with highlighting (increased brightness) of each digit. The value of each digit can only be changed when it is highlighted.</td></tr>
</table>

Repeat this procedure for PEN 2, PEN 3, and PEN 4 configuration.

4.4 Chart Parameters Set Up Group

Introduction

The functions listed in this group deal with how the chart will be set up. It includes time divisions, speed, name, rotation, header, remote activation, and wake time parameters that have to be set for the proper chart function.

CAUTION

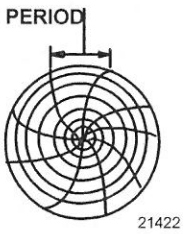
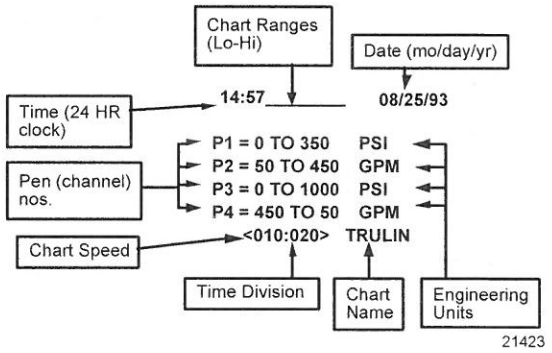
Before making any configuration changes to the "Chart" Set Up group, place the recorder in "Chart Hold". Press the **CHART** key to stop the chart rotation. Press again after configuration entry is made.

Chart group prompts

Table 4-3 lists all the function prompts in the chart parameters setup group and their definitions.

Table 4-3 Chart Parameters Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
CHRTSPD	8HR 12HR 24HR 7DAYS XHR	**CHART SPEED** — This is the time it will take to drive the chart one complete revolution. 8 Hour revolution 12 Hour revolution 24 Hour revolution 7 Day revolution X hour revolution - make Hours per Revolution selection at prompt "HOUR/REV". **ATTENTION** If the chart speed selection is 8 hr/8 division, 12 hr/12 division, 24 hr/24 division, 7 day/14 division, or 7 day/21 division, then standard chart has been selected. This means that the chart will be printed with the time lines on the hour. Limited information will be printed on the chart during the first incomplete segment following chart initiation and before the first valid hour mark. NOTE: If X hour chart is selected, standard charts are disabled.
HOUR/REV	6 to 744 Hours (12 hrs for abrasion resistant pen)	**HOURS PER REVOLUTION** — Set the desired chart speed. Appears only if XHR was selected at prompt "CHRT SPD". **ATTENTION** Below 8-hour chart speed (24 hours with abrasion resistant pen) printing may be degraded.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
TIME DIV MAJOR **TIME DIV MINOR**	8 to 24 time periods Software set for 4 or 8 seg/minor time divisions	**TIME DIVISION** — This is the number of time periods into which the chart record is to be divided.  **ATTENTION** Make sure that the chart selected is evenly divisible into the time periods. For example: 7 day = 14 or 21 lines.
CONTINUE	YES NO	**CONTINUE CHART ROTATION** — Do you want to continue or stop the chart drive after a single 360° rotation. Yes—continue chart drive No—stop chart drive (If "NO" is selected, chart paper must be replaced for proper printout.)
CHARTNAM	0 TO 9 A TO Z + – / (BLANK)	**CHART NAME** - This is where you determine the chart name identifier. For example: TRULINE/4. • For alphanumeric entries, the display will cycle, from left to right, with highlighting (increased brightness) of each digit. • The value of each digit can be changed only when it is highlighted.
HEADER	YES NO	**HEADER FOR CHART –** Is the header to be printed each time the recorder goes from chart hold to chart run the **CHART** key is pressed. **HEADER EXAMPLE**  • If you select "NO" only the chart name will be printed.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
REM CHRT		**REMOTE CHART ACTIVATION –** Select the desired function to activate the chart from a remote location or an internal signal.
	NONE	**NONE** - No selection
	EXT SW1	**EXT SW 1** - External Switch #1 activates chart (DIgital Input #1)
	EXT SW2	**EXT SW 2** - External Switch #2 activates chart (Digital Input #2)
	ALARM 1	**ALARM 1** - Alarm 1 activates chart
	ALARM 2	**ALARM 2** - Alarm 2 activates chart
	TIME	**TIME** - Wake Time activates chart
	ALARM 3	**ALARM 3** - Alarm 3 activates chart
	ALARM 4	**ALARM 4** - Alarm 4 activates chart
	ALARM 5	**ALARM 5** - Alarm 5 activates chart
	ALARM 6	**ALARM 6** - Alarm 6 activates chart
		• If you select "TIME", set wake minutes at prompt "WAKE MIN" and wake hours at prompt "WAKE HR" in Time Set Up group.

4.5 Time Parameters Set Up Group

Introduction

The functions listed in this group deal with how to configure the real-time in minutes, hours, days, months, and years. There is also a selection for days of the week.

Time group prompts

Table 4-4 lists all the function prompts in the Time parameters setup group and their definitions.

Table 4-4 Time Parameters Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
MINUTES	0 to 59	**REAL-TIME IN MINUTES** — Set the present time in minutes.
HOURS	0 to 23	**REAL-TIME IN HOURS** — Set the hour in 24 HR clock format.
DAY	1 to 31	**REAL-TIME IN DAYS** — Set a number corresponding to a day.
MONTH	1 to 12	**REAL-TIME IN MONTHS —** Set a number corresponding to a month.
YEAR	0 to 99	• **REAL-TIME IN YEARS —** Set a number corresponding to a year.
DAY	MONDAY TUEDAY WEDDAY THRDAY FRIDAY SATDAY SUNDAY	• **DAY OF THE WEEK —** Select a day of the week.
WAKE MIN	0 to 59	**WAKE MINUTES –** Wake time specifies time, in minutes, at which Wake Time Event occurs.
WAKE HR	0 to 23	**WAKE HOUR –** Wake time specifies time, in hours, at which Wake Time Event occurs.
WAKE DAY	0 to 31	**WAKE DAY –** Wake time specifies time, in days, at which Wake Time Event occurs. **ATTENTION** If day is set to "0", the wake up day and month are ignored and only a successful match of the hours and minutes will cause the event.
WAKE MON	1 to 12	**WAKE MONTH –** Wake time specifies time, in months, at which Wake Time Event occurs.

4.6 Total Parameters Set Up Group

Introduction

The functions listed in this group deal with the calculation and display of the total flow volume as measured by Input 1 (Total 1), or Input 2 (Total 2). The displayed value is eight digits with a configurable scale factor.

Totalizer 1 and 2 group prompts

Table 4-5 lists all the function prompts in the Totalizer 1 and 2 Set Up group and their definitions.

Table 4-5 Totalizer Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
(Actual Current totalized value)	(Current scale factor) Example: E1 GPM	**VIEW CURRENT TOTALIZED VALUE** — this selection lets you view the current totalized value. • In the example shown, E1 represents exponential value of total (total times 10^1). GPM represents total engineering units selected. • See "SCALER" and "TOTAL EU" function prompts in this group for selections.
RSETTOT	YES NO	**RESET TOTALIZER TO ZERO** — this selection lets you reset the totalizer to zero. • Selecting YES will reset the totalizer to zero. Function prompt "RSETABLE" must be set to "LOCAL".
TOTAL1 **TOTAL2**	DISABL, INPUT 1, INPUT 2, INPUT 3, INPUT 4, PV1, E TIME	**TOTALIZATION FOR INPUT 1 OR 2** — this selection allows you to select the input to Totalizer 1 or 2. • E TIME accumulates elapsed time since last reset in the units specified under RATE function. • Not DISABL allows selection of the rest of the prompts associated with totalization.
TOTALEU	0 to 9 A to Z + – / (blank)	**TOTAL ENGINEERING UNITS** — this selection allows you to make up to 3 selections to create a unit identifier that the total represents. • For alphanumeric entries, the display will cycle, from left to right, with highlighting (increased brightness) of each digit. The value of each digit can be changed only when it is highlighted.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
RATE	 SECOND MINUTE HOUR DAY M/DAY	**RATE OF INTEGRATION** — This selection allows you to select the desired rate of integration. It must match input units: Example: GPM must use "MINUTE" PPH must use "HOUR" **SECOND** - EU (Engineering Units) per second. **MINUTE** - EU per minute **HOUR** - EU per hour **DAY** - EU per day **M/DAY** - Millions of Units per day (multiplier) 10^6 x input
SCALER	1 10 100 1000 10000 100000 1E6	**TOTALIZER SCALE FACTOR —** this selection allows you to select a scale factor (that is, a Multiplier) for the totalizer display. It affects only the display. • The desired factor is applied to the calculated value to extend the maximum flow range that can be displayed. • Scaler selection does not affect the totalization value printed on the chart. **EXAMPLE:** • 1E6 equals 1 times 10^6. (1,000,000)
RSETABLE	NO LOCAL EXT SW1 EXT SW2 TIME	 **LOCAL TOTALIZER RESET—** Allows the totalizer value to be reset via the display/keypad. **EXTERNAL SWITCH 1**—Allows the totalizer to be set to zero upon switch #1 closure. (Digital Input #1) **EXTERNAL SWITCH 2**—Allows the totalizer to be set to zero upon switch #2 closure. (Digital Input #2) **WAKE TIME**—Resets the totalizer when the value configured for the Wake Time Event is reached. (See WAKE MIN, WAKE HR, WAKE DAY, WAKE MON in the Time Set Up group.)
INHIBIT	 NONE S1 OPEN S1 CLOSE S2 OPEN S2 CLOSE	The totalizer will be inhibited while the configured action is true. External SW1 open inhibits totalizer. External SW1 closed inhibits totalizer. External SW2 open inhibits totalizer. External SW2 closed inhibits totalizer.

Repeat the configuration for TOTAL 2.

4.7 Input Algorithm Set Up Group

Introduction

The Input Algorithm Set Up Group lets you apply various math algorithms to the inputs.

Prompts

Table 4-6 lists all the function prompts in the Input Algorithm set up group and their functions.

Table 4-6 Input Algorithm Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
INP ALG		**INPUT ALGORITHM** has the following selections from which to choose: **ATTENTION** If the input is disabled, the corresponding term is set to 1 except if the Summer (A+B+C) is selected in which case the term is set to 0. The calculated PV1 can be the pen 1-4 source as well as the input to totalizer 1. The ratio and bias values are still applied so that the term corresponding to the unused input can be made into any constant value.
	NONE	**NONE**—No algorithm configured
	A+B+C (NOTE 1)	**SUMMER WITH RATIO AND BIAS**—The following formula applies: PV = K x (Input 1xRatio A+Bias A) + (Input 2xRatio B+Bias B) + (Input 3xRatio C+Bias C)
	√A*B/C (NOTE 1)	**MULTIPLIER DIVIDER WITH SQUARE ROOT**—The following formula applies: PV = K x **Error!**x (PV_{HI}–PV_{LO})
	√A*B*C (NOTE 1)	**MULTIPLIER WITH SQUARE ROOT**—The following formula applies: PV = K x **Error!**x (PV_{HI}–PV_{LO})
	A*B/C (NOTE 1)	**MULTIPLIER DIVIDER**—The following formula applies: PV = K x **Error!**x (PV_{HI}–PV_{LO})
	A*B*C (NOTE 1)	**MULTIPLIER**—The following formula applies: PV = K x (Input 1xRatio A+Bias A)x(Input 2xRatio B+Bias B)x(Input 3xRatio C+Bias C) x (PV_{HI}–PV_{LO})

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
	A–B*C (NOTE 1)	**SUBTRACTOR MULTIPLIER**—For BTU calculations. The following formula applies:
PV = Kx [(Input 1xRatio A+Bias A)–(Input 2xRatio B+Bias B)]x(Input 3xRatio C+Bias C)		
	LO SEL	**LOW SELECT**—PV is the lower of INPUT 1 or INPUT 2.
	HI SEL	**HI SELECT**—PV is the higher of INPUT 1 or INPUT 2.
COEFF	0.00 to 99.00	**K CONSTANT**—Appears only if a selection is made at "INP ALG" prompt.
PV HIGH	–999 to 9999	**CALCULATED PV HIGH LIMIT**—Only applicable for algorithms "√A*B/C", "√A*B*C", "A*B/C", "A*B*C".
PV LOW	–999 to 9999	**CALCULATED PV LOW LIMIT**—Only applicable for algorithms "√A*B/C", "√A*B*C", "A*B/C", "A*B*C".
RATIO A	–20 to 20	**RATIO FOR INPUT 1**—Used with the "A" term in the match equation selected at prompt "INP ALG".
BIAS A	–999 to 9999	**BIAS FOR INPUT 1**—Used with the "A" term in the math equation selected at prompt "INP ALG".
RATIO B	–20 to 20	**RATIO FOR INPUT 2**—Used with the "B" term in the math equation selected at prompt "INP ALG".
BIAS B	–999 to 9999	**BIAS FOR INPUT 2**—Used with the "B" term in the math equation selected at prompt "INP ALG".
RATIO C	–20 to 20	**RATIO FOR INPUT 3**—Used with the "C" term in the math equation selected at prompt "INP ALG".
BIAS C	–999 to 9999	**BIAS FOR INPUT 3**—Used with the "C" term in the math equation selected at prompt "INP ALG".
POLYNOM	NONE, INPUT 1, INPUT 2, INPUT 3, INPUT 4	**POLYNOMIAL EQUATION -** A fifth order Polynomial Equation can be used on any one of the four Analog Inputs. The equation is in the form:
	$Y = C_5 * 10^{-7} X^5 + C_4 * 10^{-5} X^4 + C_3 * 10^{-3} X^3 + C_2 * 10^{-1} X^2 + C_1 X + C_0$ Where: X is the analog input selected in % of span $X\% = \frac{X_{EU}}{Span_{EU}} \cdot 100$ C_0 is a value between –99.99 to +99.99 C_1 - C_5 are values between –9.999 to +9.999	
C0 VALUE	–99.99 to 99.99	**Polynomial coefficient C0**
C1 VALUE	–9.999 to 9.999	**Polynomial coefficient C1**
C2x10-1	–9.999 to 9.999	**Polynomial coefficient C2**

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
C3x10-3	–9.999 to 9.999	**Polynomial coefficient C3**
C4x10-5	–9.999 to 9.999	**Polynomial coefficient C4**
C5x10-7	–9.999 to 9.999	**Polynomial coefficient C5**

NOTE 1: A = (Input 1 x Ratio A + Bias A)
B = (Input 2 x Ratio B + Bias B)
C = (Input 3 x Ratio C + Bias C)
The order of the inputs are fixed in the equations.

4.8 Control Parameters Set Up Group

Introduction

The functions listed in this group deal with how the DR4500A will control the process including: number of tuning parameter sets, setpoint source, ratio, bias, tracking, power-up recall, setpoint limits, output direction and limits, deadband and hysteresis, control algorithm, output algorithm, and the current duplex range. There are two control groups.

Control group prompts

Table 4-7 lists all the function prompts in the Control 1 or Control 2 set up groups and their definitions.

Table 4-7 Control 1 or 2 Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
CONTROL 1	ENABLE DISABL	**CONTROL 1** — allows you to enable or disable control loop #1.
PID SETS		**NUMBER OF TUNING PARAMETER SETS** — this selection lets you choose one or two sets of tuning constants (gain, rate, and reset).
	1 ONLY	**ONE SET ONLY** — only one set of tuning parameters is available. Configure the values for: Gain (proportional band) Rate Reset Time Cycle Time (if time proportional is used)
	2KEYBD	**TWO SETS KEYBOARD SELECTABLE** — two sets of tuning parameters can be configured and can be selected at the operator interface. • Press **LOWR DISP** key until you see "PID SET1" or "PID SET2" to switch between sets. Configure the values for: Gain, Rate , Reset, Cycle Time Gain #2, Rate #2, Reset #2, Cycle #2 Time
	2PV SW	**TWO SETS PV AUTOMATIC SWITCHOVER** — when the process variable is *GREATER* than the value set at prompt "SW VALUE" (Switchover Value), the recorder will use Gain, Rate, Reset, and Cycle Time. The active PID SET can be read in the lower display. • When the process variable is *LESS* than the value set at prompt "SW VALUE," the recorder will use Gain #2, Rate #2, Reset #2, and Cycle #2 Time. The active PID SET can be read in the lower display. Other prompts affected: SW VALUE

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PID SETS (continued)	2SP SW	**TWO SETS SP AUTOMATIC SWITCHOVER** — when the setpoint is *GREATER* than the value set at prompt "SW VALUE" (Switchover Value), the recorder will use Gain, Rate, Reset, and Cycle. • When the setpoint is *LESS* than the value set at prompt "SW VALUE," the recorder will use Gain #2, Rate #2, Reset #2, and Cycle #2. • Other prompts affected: SW VALUE
SW VALUE	–999.0 to 9999	**AUTOMATIC SWITCHOVER VALUE** —this is the value of process variable or setpoint at which the recorder will switch from Tuning Constant Set #2 to Set #1. Only appears when PID SETS selections "2PV SW" or "2SP SW" are selected.
SP SOURC		**SETPOINT SOURCE** — this selection determines what your setpoint source will be; One local or Two local. Toggled by the "SETPOINT SELECT" key.
	1LOCAL	**LOCAL SETPOINT** — the setpoint entered from the keyboard or from the setpoint program.
	REMOTE	**REMOTE SETPOINT** — a signal is brought in through the second input printed circuit board connector J2 and used as the control setpoint. • If you select "REMOTE", Input #3 is automatically assigned as your RSP source for CONTROL #1; INPUT #4 is assigned for CONTROL #2. However, if the unit has only 2 inputs then RSP will be on input 2. • Ratio and Bias can be applied to the remote setpoint. Mutually exclusive with 2 Local setpoints. • Other prompts affected: RATIO, BIAS.
	2LOCAL	**TWO LOCAL SETPOINTS** — this selection lets you switch between two local setpoints. Mutually exclusive with Remote setpoint.
	OUT2	Only for Loop 1— Setpoint is the output of Control Loop 2.
RATIO	–20.00 to 20.00	**RATIO** — used when input 2* operates as a remote setpoint, prompt "REMOTE." • This ratio value can be applied to the remote setpoint. It establishes the correct relationship between the remote setpoint and the input 2 signal applied according to the formula below (under Bias). • Input 2 must be enabled. *For recorders with two controllers, use input 3 for controller #1 and input 4 for controller #2.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
BIAS	–9999 to 9999 (engineering units)	**BIAS** — used when input 2 operates as a remote setpoint (prompt "REMOTE"). • Bias, together with ratio, establishes the correct relationship between the remote setpoint and the input 2 signal applied according to the formula: REMOTE SETPOINT = IN2 VALUE (RATIO) + BIAS NOTE: IN2 VALUE = Actual (engineering units) • All values must be within configured setpoint high and low limits. • Input 2 must be enabled.
SP TRACK		**SETPOINT TRACKING** — the local setpoint can be configured to track the remote setpoint as listed below:
	NONE	• **NO TRACKING** — if local setpoint tracking is not configured, the LSP will not be altered when transfer from RSP to LSP is made.
	RSP	• **LSP (LOCAL SETPOINT) TRACKS RSP (REMOTE SETPOINT) IN AUTO** — if configured, when the recorder transfers out of remote setpoint, the last value of the remote setpoint (RSP) is inserted into the local setpoint.
POWER UP		**POWER UP CONTROLLER MODE RECALL** — this selection determines which mode and setpoint the recorder will use when the it restarts after a power loss. Select one from below:
	MANUAL	• **MANUAL, LSP** — at power-up, the recorder will use *manual* mode with the output value displayed.
	A LSP	• **AUTOMATIC, LOCAL SETPOINT** — at power-up, the recorder will return to the *automatic* mode and will use the local setpoint for control.
	A RSP	• **AUTOMATIC, REMOTE SETPOINT** — at power-up, the recorder will return to the *automatic* mode and will use the remote setpoint for control.
	AM SP	• **LAST MODE, LAST SETPOINT** used before power down.
	AM LSP	• **LAST MODE, LAST LOCAL SETPOINT** on power down.
PWR OUT		**POWER UP OUTPUT SELECTION (for 3P Step Control only)** — this selection determines what position the motor will be in when powered up.
	LAST	**LAST** — at power up in automatic mode, the motor position will be the last one prior to power down. When the unit goes into FAILSAFE, it will stay in automatic mode; motor will **not** be driven to the configured Failsafe position.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PWR OUT (continued)	FAIL SF	**FAIL SF** — at power up in manual mode, the motor will be driven to either the 0 % or 100 % output position, whichever is selected at prompt "FAILSAFE". When the unit goes into FAILSAFE, it will go to manual mode; motor will be driven to the configured Failsafe position.
SP HILIM	–999.0 to 9999. input units	**SETPOINT HIGH LIMIT*** — this selection prevents the local and remote setpoints from going above the value selected here. The setting must be equal to or less than the upper range of input 1 and input 2. Input 2,** when configured for remote setpoint, will be restricted to this upper limit.
SP LOLIM	-999.0 to 9999. inputs units	**SETPOINT LOW LIMIT*** — this selection prevents the local and remote setpoints from going below the value selected here. The setting must be equal to or greater than the lower range of input 1 and input 2. Input 2,** when configured for remote setpoint, will be restricted to this lower limit.
ACTION		**CONTROL OUTPUT DIRECTION** — in what direction do you want the recorder output to go when the process variable increases.
	DIRECT	**DIRECT ACTING CONTROL** — the recorder's output *increases* as the process variable increases.
	REVRSE	**REVERSE ACTING CONTROL** — the recorder's output *decreases* as the process variable increases.
OUTHILIM	–5.0 to 105.0 % of output	**HIGH OUTPUT LIMIT** — this is the highest value of output beyond which you do not want the recorder automatic output to exceed. Use 0 % to 100 % for time proportional output type.
OUTLOLIM	–5.0 to 105.0 % of output	**LOW OUTPUT LIMIT** — this is the lowest value of output below which you do not want the recorder automatic output to exceed. Use 0 % to 100 % for time proportional output type.
DROPOFF	–5 to 105.0 % of output	**CONTROLLER DROPOFF VALUE** — select an output value that below which the recorder output will dropoff to the low output limit value set in prompt "OUT LOLIM."
DEADBAND	–5.0 to 25.0 % 0 to 25.0 % 0.5 to 5.0 %	**DEADBAND** is an adjustable gap between the operating ranges of output 1 and output 2 in which neither output operates (positive value) or both outputs operate (negative value). It is the difference between the nominal trip points of relay 1 and relay 2. Time Duplex On-Off Duplex Position Proportional

*The Local Setpoint will automatically adjust itself to be within the setpoint limit range. For example, if SP = 1500 and the SP HILIM is changed to 1200, the new Local Setpoint will be 1200.

** Applies for Input 3 and Input 4 for recorders with two controllers.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
OUT HYST	0.0 to 5.0 % of PV span	**HYSTERESIS (OUTPUT RELAY ONLY)** is an adjustable overlap of the ON/OFF states of each control output. This is the difference between the value of the process variable at which the control outputs energize and the value at which they de-energize. Only applicable for ON-OFF control.
FAILSAFE	0 to 100 %	**FAILSAFE OUTPUT VALUE** — the output level used when you have communications SHED or when NO BURNOUT is configured and input 1 fails.
	100PCT 0PCT	***For 3 Position Step Control*** **100PCT** — motor position set to 100 % output position **0PCT** — motor position set to 0 % output position
REM SW **REM SW2**		**REMOTE SWITCHING (DIGITAL INPUT)** — contact closure enables one of the following:
	NONE	**NO DIGITAL INPUT SELECTION**
	TO MAN	**TO MANUAL** — contact closure selects Manual mode.
	TO LSP	**TO LOCAL SETPOINT** — contact closure selects the local setpoint.
	TO 2SP	**TO LOCAL SETPOINT 2** — contact closure selects local setpoint 2.
	TO DIR	**TO DIRECT ACTION** — contact closure selects Direct Control Action.
	RN/HLD	**RUN/HOLD** — contact closure suspends setpoint Ramp/Program. Contact open resumes.
	TUNE	**AUTOTUNE** — contact closure initiates Autotune.
	TIMER	**TIMER** — starts the timer, if enabled. The Timer can also be started by the RH KEY or ALARM2. These parameters are found under the Timer set up group.
MAN KEY		**MANUAL MODE KEY SELECTION** — make selection to enable or disable the Manual Mode selection through the **MAN/AUTO** key.
	ENABLE	**ENABLE** — allows you to use the **MAN/AUTO** key to select Manual Mode.
	DISABL	**DISABLE** — disables the **MAN/AUTO** key.
PBorGAIN		**PROPORTIONAL BAND UNITS** — select one of the following for the Proportional (P) term of the PID algorithm:

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
	PB PCT	• **PROPORTIONAL BAND** — selects units of percent proportional band for the P term of the PID algorithm, where: $PB\ \% = \frac{100\ \%\ FS}{GAIN}$
	GAIN	• **GAIN** selects the unitless term of gain for the P term of the PID algorithm, where: $GAIN = \frac{100\ \%\ FS}{PB\ \%}$
MINorRPM		**RESET UNITS** — selects units of minutes or repeat per minutes for the I term of the PID algorithm. 20 Repeats per Minute = 0.05 Minutes per Repeat.
	RPM	**REPEATS PER MINUTE** — the number of times per minute that the proportional action is repeated by reset.
	MIN	**MINUTES PER REPEAT** — the time between each repeat of the proportional action by reset.
CONT1ALG		The **CONTROL ALGORITHM** lets you select the type of control that is best for your process. **ATTENTION** If the recorder has two controllers (both enabled), CONT1ALG applies for controller #1 and CONT2ALG applies for controller #2.
	ON-OFF	**ON/OFF** is the simplest control type. The output can be either ON (100 %) or OFF (0 %). The Process Variable (PV) is compared with the setpoint (SP) to determine the sign of the error (ERROR = PV-SP). The ON/OFF algorithm operates on the sign of the error signal. • In Direct Acting Control, when the error signal is positive, the output is 100 %; and when the error signal is negative, the output is 0 %. If the control action is reverse, the opposite is true. An adjustable overlap (Hysteresis Band) is provided between the on and off states. • Other prompts affected: "OUT HYST" **DUPLEX ON/OFF** is an extension of this algorithm when the output is configured for Duplex. It allows the operation of a second ON/OFF output. There is a deadband between the operating ranges of the two inputs and an adjustable overlap (hysteresis) of the on and off states of each output. Both Deadband and Hysteresis are separately adjustable. With no relay action the controller will read 50 %. • Other prompts affected: "OUT HYST" and "DEADBAND"

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
CONT1ALG (continued)	PID A NOTE: PID A should not be used for Proportional only action (that is, no integral (reset) action.) Instead, use PD+MR with rate set to 0.	**PID A** is normally used for three-mode control. This means that the output can be adjusted somewhere between 100 % and 0 %. It applies all three control actions — Proportional (P), Integral (I), and Derivative (D) — to the error signal. *Proportional (Gain)* — regulates the controller's output in proportion to the error signal (the difference between Process Variable and Setpoint). *Integral (Reset)* — regulates the controller's output to the size of the error and the time the error has existed. (The amount of corrective action depends on the value of proportional Gain.) *Derivative (Rate)* — regulates the controller's output in proportion to the rate of change of the error. (The amount of corrective action depends on the value of proportional Gain.)
	PID B	**PID B** unlike the PID-A equation, the controller gives only an integral response to a setpoint change, with no effect on the output due to the gain or rate action, and it gives full response to PV changes. Otherwise controller action is as described for the PID-A equation. See note on PID-A.
	PD+MR	**PD WITH MANUAL RESET** is used whenever integral action is not wanted for automatic control. The equation is computed with no integral contribution. The MANUAL RESET, which is operator adjustable, is then added to the present output to form the controller output. Switching between manual and automatic mode will not be bumpless. • If you select PD with Manual Reset you can also configure the following variations: – PD (Two Mode) control, – P (Single Mode) control. Set Rate (D) and/or Reset Time (I) to 0. • Other prompts affected: "MAN RSET"

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
CONT1ALG (continued)	3PSTEP	The **THREE POSITION STEP** algorithm allows the control of a valve (or other actuator), with an electric motor driven by two controller relay outputs; one to move the motor upscale, the other downscale without a feedback slidewire linked to the motor shaft. The deadband and hysteresis are adjustable in the same manner as the duplex output algorithm. The Three Position Step Control algorithm provides an output display (OUT) which is an estimated motor position since the motor is not using any feedback. Although this output indication is only an approximation, it is "corrected" each time the controller drives the motor to one of its stops (0 % or 100 %). It avoids all the control problems associated with the feedback slidewire (wear, dirt, noise). When operating in this algorithm, the estimated "OUT" display is shown to the nearest percent (i.e., no decimal). Refer to the Operation section for motor position displays. • Other prompts affected: "DEADBAND" and Tuning prompts "GAIN", "RATE", "RESET".
OUT1ALG		The **OUTPUT ALGORITHM** lets you select the type of output you want. Not applicable with Control Algorithm prompt "3PSTEP." **ATTENTION** If the recorder has two controllers (both enabled), OUT1ALG applies for controller #1 and OUT2ALG applies for controller #2. *Selections are model dependent. For example, current output models cannot be configured for Time Proportioning Simplex Output.*
	TIME	**RELAY SIMPLEX** — type of output using one SPDT relay. Its normally open (NO) or normally closed (NC) contacts are selected by positioning an internal jumper. • Other prompts affected: "OUT HYST" • Controller #1 uses Relay 3 and overrides control of relay by Alarm 3. Controller #2 uses Relay 5 and overrides control of relay by Alarm 5.
	CURRNT	**CURRENT SIMPLEX** — type of output using one 4 to 20 mA signal that can be fed into a positive or negative grounded load of 0 to 1000 ohms. The signal can be recalibrated for any desired range from 3.25 mA to 21 mA for 0 % to 100 % output.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
OUT1ALG (continued)	POSITN	**POSITION PROPORTIONAL SIMPLEX** — type of output using two SPDT relays and a motor which has a 100 to 1000 ohms feedback slidewire. (Automatically selected when CONT ALG = 3PSTEP) • Other prompt affected: "DEADBAND" • Controller #1 uses Relays 3 and 4 and overrides control of relays by Alarms 3 and 4. Controller #2 uses Relays 5 and 6 and overrides control of relays by Alarms 5 and 6.
	TIME D	**RELAY DUPLEX** — type of output using two SPDT relays. Its normally open (NO) or normally closed (NC) contacts are selected by positioning an internal jumper (see Installation section). • Other prompts affected: "DEADBAND" • Controller #1 uses Relays 3 and 4 and overrides control of relays by Alarms 3 and 4. Controller #2 uses Relays 5 and 6 and overrides control of relays by Alarms 5 and 6.
	CUR TI	**CURRENT/RELAY DUPLEX (RELAY = HEAT)** is a variation of duplex with current active for 0 % to 50 % output (tuning set 2) and relay active for 50 % to 100 % output (tuning set 1). • Other prompts affected: "4-20 RNG," "DEADBAND" • Controller #1 uses Relay 3 and overrides control of relay by Alarm 3. Controller #2 uses Relay 5 and overrides control of relay by Alarm 5.
	TI CUR	**RELAY/CURRENT DUPLEX (RELAY = COOL)** is similar to "CUR-TI" except that current is active for 50 % to 100 % and relay is active for 0 % to 50 %. • Other prompts affected: "4-20 RNG," "DEADBAND" • Controller #1 uses Relay 4 and overrides control of relay by Alarm 4. Controller #2 uses Relay 6 and overrides control of relay by Alarm 6.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
4-20 RNG		**CURRENT DUPLEX RANGE ALGORITHM** — used with Output Algorithm selections "CUR-TI" or "TI-CUR."
	50 PCT	**CURRENT DUPLEX RANGE (SPLIT)** enables the normal control current output to provide its full range for 50 % output change. • If "CUR-TI" duplex was selected, the current output provides cool control.
	100PCT	**CURRENT DUPLEX RANGE (FULL)** enables the normal control current output to provide duplex heat control over 0-100 % output change and the relay output to provide cool control.

Repeat this procedure for Control 2 configuration.

4.9 Tuning Parameters Set Up Group

Introduction

Tuning consists of establishing the appropriate values for the tuning constants you are using so that your recorder responds correctly to changes in process variable and setpoint. You can start with predetermined values but you will have to watch the system to see how to modify them. There are two Tuning groups available.

Tuning group prompts

Table 4-8 lists all the function prompts in the Tuning 1 and Tuning 2 setup group and their definitions.

Table 4-8 Tuning Group Prompt Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
FUZZY	DISABL ENABLE	**FUZZY OVERSHOOT SUPPRESSION FEATURE** DISABLE - Disables fuzzy overshoot suppression ENABLE - The recorder will use fuzzy logic to suppress or mimimize any overshoot that may occur as a result of the existing tuning parameters. It does NOT change the parameters.
ACCUTUNE	DISABL ENABLE	**ACCUTUNE II** - On demand tuning algorithm DISABLE - Disables ACCUTUNE II ENABLE - TuneOF will be displayed as a status message. Use the Increment or Decrement key to toggle status to TuneON. New PID parameters will be entered automatically when tuning is complete.
AT ERR	NONE IDFL ABRT RUN	ACCUTUNE ERROR CODES (Read Only)

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PROP BD or **GAIN**	0.1 to 1000 % or 0.1 to 1000	**PROPORTIONAL BAND** is the percent of the range of the measured variable for which a proportional recorder will produce a 100 % change in its output. **GAIN** is the ratio of output change (%) over the measured variable change (%) that caused it. $G = \frac{100\%}{PB\%}$ where PB is the proportional band (in %) • If the PB is 20 %, then the Gain is 5. Likewise, a 3 % change in the error signal (SP-PV) will result in a 15 % change in the recorder's output due to proportional action. If the gain is 2, then the PB is 50 %. • Used with control algorithm PID-A or PID-B. Defined as "HEAT" Gain on Duplex models for variations of Heat/Cool applications. • The selection of Proportional Band or Gain is made in the control parameter group under prompt "PBorGAIN."
RATE MIN	0.08 to 10.00 minutes 0.08 or less = OFF	**RATE** action affects the recorder's output whenever the deviation is changing; and affects it more when the deviation is changing faster. • Used with control algorithm PID-A or PID-B. Defined as "HEAT" Rate on Duplex models for variations of Heat/Cool applications.
RSET MIN or **RSET RPM**	0.02 to 50.00	**RSET MIN** = RESET IN MINUTES / REPEAT **RSET RPM** = RESET IN REPEATS / MINUTE **RESET** adjusts the recorder's output in accordance with both the size of the deviation (SP-PV) and the time it lasts. The amount of the corrective action depends on the value of Gain. The Reset adjustment is measured as how many times proportional action is repeated/minute. • Used with control algorithm PID-A or PID-B. Defined as "HEAT" Reset on Duplex models for variations of Heat/Cool applications. • The selection of minutes per repeat or repeats per minute is made in the control parameters group under prompt "MINorRPM."
MAN RSET	–100 to +100 (in % output)	**MANUAL RESET** is only applicable if you have control algorithm PD WITH MANUAL RESET. Because a proportional recorder will not necessarily line out at setpoint, there will be a deviation (offset) from setpoint. This eliminates the offset and lets the PV line out at setpoint.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PROP BD2 or **GAIN 2**	0.1 to 1000 % or 0.1 to 1000	**PROPORTIONAL BAND 2** or **GAIN 2**, **RATE 2**, and **RESET 2** parameters are the same as previously described for "Heat" except that they refer to the **cool** zone tuning constants on duplex models or the second set of PID constants, whichever is pertinent.
RATE2MIN	0.08 to 10.00 minutes 0.08 or less = OFF	
RSET2MIN **RSET2RPM**	0.02 to 50.00	
CYC SEC	1 to 120 seconds	**CYCLE TIME (HEAT)** determines the length of one time proportional output relay cycle. Defined as "HEAT" cycle time for Heat/Cool applications. • Electromechanical relays
CYC2 SEC	1 to 120 seconds	**CYCLE TIME 2 (COOL)** is the same as above except it applies to Duplex models as the cycle time in the "COOL" zone of Heat/Cool applications or for 2nd set of PID constants. • Electromechanical relays

4.10 Setpoint Ramp Set Up Group

Introduction

The Setpoint Ramp 1 and 2 Set Up groups contain the Function parameters that enable you to configure 2 setpoints. Each setpoint (SP RAMP 1 and SP RAMP 2) can be configured only one of three ways: ramp, rate, or setpoint program.

Single Setpoint Ramp

Setpoint will ramp between the current local setpoint and a final setpoint over a time interval of up to 255 minutes. (SP RAMP).

Setpoint Rate

The Setpoint Ramp Set Up group also contains the function parameters that let you configure a specific rate of change for any local setpoint change (SP RATE). It includes selections for Rate Up and Rate Down.

Setpoint Program

Also included under this group are prompts for configuring a 36-segment Setpoint program (SP PROG). The prompts and instructions for Setpoint programming are presented in the *Section 6 - Setpoint Ramp/Soak Programming and Operation.*

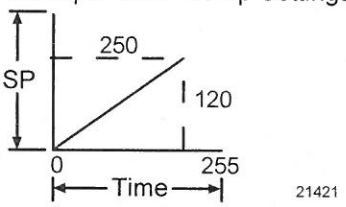
- You can start and stop the ramp/program using the **RUN/HOLD** key.

Setpoint Ramp/ Program group prompts

Table 4-9 lists all the function prompts in the Setpoint Ramp 1 or 2 setup group and their definitions. When you enable the ramp type (SP RAMP, SP RATE, SP PROG) the other two types are hidden from the display.

Table 4-9 Setpoint Ramp 1 or 2 Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
SP RAMP		**SINGLE SETPOINT RAMP** — Make selection to enable or disable the setpoint ramp function. Make sure you configure a ramp time and a final setpoint value. "SP PROG" and "SP RATE" must be disabled.
	ENABLE	**ENABLE SETPOINT RAMP** — Allows you to start the setpoint ramp (in automatic mode).
	DISABL	**DISABLE SETPOINT RAMP** — Disables the setpoint ramp.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
TIME MIN	0 to 255 minutes	**SETPOINT RAMP TIME** — Enter the number of minutes desired to reach the final setpoint. A ramp time of "0" implies an immediate change of setpoint. Example of SP Ramp Settings: 
FINAL SP	Within SP limits	**SETPOINT RAMP FINAL SETPOINT** — Enter the value desired for the final setpoint. The recorder will operate at the setpoint set here when ramp is ended.
SP RATE (option)	 ENABLE DISABL	**SETPOINT RATE**—Lets you configure a specific rate of change for any local setpoint change. "SP RAMP" and "SP PROG" must be disabled. **ENABLE SETPOINT RATE**—Allows the SP rate feature. **DISABLE SETPOINT RATE**—Disables the setpoint rate.
EU/HR UP	0 to 9999 in Engineering Units per hour	**RATE UP**—Value for SP Rate selection.
EU/HR DN	0 to 9999 in Engineering Units per hour	**RATE DOWN**—Value for SP Rate selection.
SP PROG (option)	 ENABLE DISABL	**SETPOINT RAMP/SOAK PROGRAM** Available only with recorders that contain this option. "SP RAMP" and "SP RATE" must be disabled. For reasons of convenience, the prompts used when SP PROG is enabled are included in *Section 6 — Setpoint Ramp/Soak Programming and Operation.*

4.11 Timer Set Up Group

Introduction

The Timer gives a countdown or elapsed time, after which Relay 1 energizes. If Timer is enabled, it has exclusive control over Relay 1; that is, Alarm 1 will not control the relay.

Timer group prompts

Table 4-10 lists all the function prompts in the Timer setup group and their definitions.

Table 4-10 Timer Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
TIMER	ENABLE DISABL	Enables or disables the timer option
PERIOD	0:00 to 99:59	Configures the length of the timeout period (from 0 to 99 hours, 59 minutes).
START	RH KEY ALARM 2 TIME	Timer starts with the keyboard (Run/Hold key). Timer starts with Alarm 2. Wake time parameter—Starts timer when the value configured for the Wake Time Event is reached. (See WAKE MIN, WAKE HR, WAKE DAY, WAKE MON in the Time Set Up group.) The Timer can also be started by a discrete input, REM SW or REM SW2. These prompts are found under the Control Set Up Group.
LDISPLAY	TREM ET	Select whether time remaining (TREM) or elapsed time (ET) is displayed for the timer option. The time is shown on the lower display in hh:mm format along with a rotating "clock" character. Time remaining: If the "clock" rotation is clockwise, elapsed time is indicated. □.□□ Elased time: If the "clock" rotation is counterclockwise, time left is indicated. □.□□
RESET	RH KEY ALARM 1 REPEAT	Timer resets with the keyboard (Run/Hold key). Timer resets with Alarm 1. In Repeat Mode, the timer restarts immediately upon timeout and activates the relay for 1 to 5 seconds.
ON-TIME	1 SEC 2 SEC 3 SEC 4 SEC 5 SEC	Relay 1 on-time when timer is in repeat mode.
INCRMENT	MINUTE SECOND	Select the units of the timer.

4.12 Alarms Set Up Group

Introduction

An alarm is an indication that an event that you have configured (for example—Process Variable) has exceeded one or more alarm limits. There are six alarms available, each with two setpoints. You can configure each of these two setpoints to alarm on various controller parameters. There are two alarm output selections, high and low. You can configure each setpoint to alarm either high or low. These are called single alarms. You can also configure the two setpoints to alarm on the same event and to alarm both high and low. An adjustable hysteresis of 0.0 % to 100.0 % is configurable for each alarm setpoint.

Priority of functions that operate relays

During alarm conditions an alarm will deenergize its associated relay unless a higher priority function has been configured for that relay. See Table 4-11. If you want the alarm to control the relay, do not configure a higher priority function.

Table 4-11 Priority of functions that operate relays

Relay	Relay is controlled by (in order of priority)
1	1. Timer function 2. Alarm 1
2	Alarm 2 only
3	1. Controller 1 output algorithms Relay Simplex, Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 3
4	1. Controller 1 output algorithms Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 4
5	1. Controller 2 output algorithms Relay Simplex, Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 5
6	1. Controller 2 output algorithms Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 6

Alarms group prompts

Table 4-12 lists all the function prompts in the Alarms setup group and their definitions. These prompts repeat for all 6 alarms.

TIP

To configure an alarm for a setpoint program segment event, program either type (AxS1TYPE or AxS2TYPE) as EVENT. It is not necessary to configure any other alarm prompts.

Table 4-12 Alarms Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
AxS1 VAL	Value in engineering units	**ALARM x SETPOINT 1 VALUE** — this is the value at which you want the alarm type chosen in prompt "AxS1TYPE" to actuate. The value depends on what the setpoint has been configured to represent. NO setpoint is required for Communications SHED. For SP Programming the value is the segment number for which the event applies.
AxS2 VAL	Value in engineering units	**ALARM x SETPOINT 2 VALUE** — this is the value at which you want the alarm type chosen in prompt "AxS2TYPE" to actuate. • The details are the same as "AxS1 VAL".
AxS1TYPE		**ALARM x SETPOINT 1 TYPE** — select what you want Setpoint 1 of Alarm 1 to represent. It can represent any of the Inputs, Relative Humidity, Deviation (loop 1 or 2), Output (loop 1 or 2), and if you have a model with communications, you can configure the recorder to alarm on SHED. If you have setpoint programming, you can alarm when a segment goes ON or OFF (loop 1 or 2). An alarm can also be set to activate if a totalizer value has exceeded a configured alarm value.
	NONE IN 1 IN 2 IN 3 IN 4 RH DEV (loop 1) OUT (loop 1) DEV2 (loop 2) OUT2 (loop 2) EVENT TOTAL 1 TOTAL 2 TOTAL 3 TOTAL 4	**NO ALARM** **INPUT 1** **INPUT 2** **INPUT 3** **INPUT 4** **RELATIVE HUMIDITY** **LOOP 1 DEVIATION** **LOOP 1 OUTPUT** **LOOP 2 DEVIATION** **LOOP 2 OUTPUT** **EVENT ON (SP PROGRAMMING)** **TOTALIZER TO ALARM ON** **TOTALIZER TO ALARM ON** **TOTALIZER TO ALARM ON - MODEL DR45AW ONLY** **TOTALIZER TO ALARM ON - MODEL DR45AW ONLY**

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
AxS2TYPE	Same as AxS1TYPE	**ALARM x SETPOINT 2 TYPE** — select what you want Setpoint 2 of Alarm x to represent. The selections are the same as AxS1TYPE.
AxS1 H L	H I LO	**ALARM x SETPOINT 1 STATE** — select whether you want the alarm type chosen in prompt "AxS1TYPE" to alarm high or low or the beginning or end of a segment in setpoint Ramp/Soak programming. **HI ALARM** – Relay coil is de-energized when the PV is **above** the setpoint. **LO ALARM** – Relay coil is de-energized when the PV is **below** the setpoint.
AxS1SCAL	1 10 100 1000 10000 100000 1E6	**MULTIPLIER FOR ALARM TYPE "TOTAL" SELECTION** — the alarm is only a high value. Enter a scaler of from 1 to 1000000. (Base value x multiplier = alarm setpoint value)
AxS2 H L	H I LO	**ALARM x SETPOINT 2 STATE** — select whether you want the alarm type chosen in prompt "AxS2TYPE" to alarm high or low or the beginning or end of a segment in setpoint Ramp/Soak programming. **HI ALARM** **LO ALARM**
AxS2SCAL	1 10 100 1000 10000 100000 1E6	**MULTIPLIER FOR ALARM TYPE "TOTAL" SELECTION** — the alarm is only a high value. Enter a scaler of from 1 to 1000000. (Base value x multiplier = alarm setpoint value)
ALx HYST	0.0 to 100.0 % of span or full output as appropriate	**ALARM HYSTERESIS** — an adjustable hysteresis is provided on each alarm such that when the alarm is OFF it activates at exactly the alarm setpoint; when the alarm is ON, it will not deactivate until the variable is 0.0 % to 100.0 % (whatever has been set) away from the alarm setpoint. • Configure the hysteresis of the alarms based on INPUT signals as a % of input range span. • Configure the hysteresis of the alarm based on OUTPUT signals as a % of the full scale output range.

Repeat this procedure for Alarm 2, Alarm 3, Alarm 4, Alarm 5, Alarm 6 configuration.

4.13 Auxiliary Output Set Up Group

Introduction

This provides a milliampere output representing any of twelve control parameters: Input 1-4, PV 1-2, Deviation 1-2, Output 1-2, Setpoint 1-2. The display for auxiliary Output viewing will be in engineering units for all but output. Output will be designated in percent (%).

Timer group prompts

Table 4-13 lists all the function prompts in the Auxiliary Output setup group and their definitions.

Table 4-13 Auxiliary Output Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
AUX OUT		**AUXILIARY OUTPUT SELECTION** provides an mA output representing any of twelve control parameters. The display for Auxiliary Output viewing will be in engineering units for all but output. Output will be designated in percent (%). • Other prompts affected by these selections: "4 mA VAL" and "20mA VAL".
	DISABL	**NO AUXILIARY OUTPUT**
	IN 1	**INPUT 1**—This represents the configured range of input 1. FOR EXAMPLE: Type "J" Thermocouple (0 to 1600 °F) 0 °F display = 0 % output 1600 °F display = 100 % output
	IN 2	**INPUT 2** represents the value of the configured range of input 2.
	PV 1	**PROCESS VARIABLE 1**—Represents the value of the Process Variable for Loop 1. PV = Input 1 + Bias
	DEV 1	**DEVIATION 1 (PROCESS VARIABLE MINUS SETPOINT)**—Represents –100 % to +100 % of the selected PV span in engineering units for Loop 1. FOR EXAMPLE: Type "T" Thermocouple PV range = –300 °F to +700 °F PV span = 1000 °F Deviation range = –1000 °F to +1000 °F If PV = 500 °F and SP = 650 °F then Deviation Display = –150 °F Auxiliary Output = 42.5 % NOTE: A deviation of 0 °F yields an auxiliary output of 50 %.
	OUT 1	**OUTPUT 1**—Represents the displayed controller output in percent (%) for Loop 1.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
AUX OUT (continued)	SP 1	**SETPOINT 1**—Represents the value of the setpoint in units of PV for Loop 1.
	PV 2	**PROCESS VARIABLE 2**—Represents the value of the process variable for Loop 2.
	DEV 2	**DEVIATION 2 (PROCESS VARIABLE MINUS SETPOINT)**—Represents –100 % to +100 % of the selected PV span for Loop 2. See Example at DEV 1.
	OUT 2	**OUTPUT 2**—Represents the displayed controller output in percent (%) for Loop 2.
	SP 2	**SETPOINT 2**—Represents the value of the setpoint in units of PV for Loop 2.
	IN 3	**INPUT 3**—Represents the value of the configured range of Input 3.
	IN 4	**INPUT 4**—Represents the value of the configured range of Input 4.
4 mA VAL	Low Scale Value within the range of the selected variable to represent 4 mA	**AUXILIARY OUTPUT LOW SCALING FACTOR**—Use a value in engineering units for all selections above except Output. Use value in percent (%) for Output. (Output can be between –5 % and +105 %.)
20mA VAL	High Scale Value within the range of the selected variable to represent 20 mA	**AUXILIARY OUTPUT HIGH SCALING FACTOR**—Use a value in engineering units for: Input 1, Input 2, Process Variable, Deviation,* and Setpoint. Use a value in percent (%) for Output. (Output can be between –5 % and +105 %.) *When Deviation is selected, only one operating parameter will be entered. This value represents the deviation level that will produce 20 mA output. Zero deviation will produce a center scale (12 mA) output. A negative deviation equal in magnitude to the Auxiliary Output High Value will produce a low end (4 mA) output.

Repeat for AUX OUT 2 and AUX OUT 3.

4.14 Modbus Communications Set Up Group

Introduction

This option allows the DR4500A to be connected to a host computer via the Modbus protocol. Up to 99 addresses and a maximum of 15 units can be configured over this link.

REFERENCE

Refer to Documents 51-52-25-66 and 51-52-25-69 for a complete description of the RS485 Modbus Communications Option.

Communications group prompts

Table 4-14 lists all the function prompts in the Modbus Communications set up group and their functions.

Table 4-14 Modbus Communications Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
ComSTATE	DISABL MODBUS	**DISABL**—Disables the communications option. **MODBUS**—Allows Modbus communication prompts.
Com ADDR	1 to 99	**COMMUNICATIONS STATION ADDRESS** — This is a number that is assigned to the recorder that is to be used with the communications option.
BAUD	 300 600 1200 2400 4800 9600 19200 38400	**BAUD RATE** is the transmission speed in bits per second. **300 Baud** **600 Baud** **1200 Baud** **2400 Baud** **4800 Baud** **9600 Baud** **19200 Baud** **38400 Baud**
XMT DLAY	NONE 10MSEC 20MSEC 30MSEC 40MSEC 50MSEC	**TRANSMIT DELAY**—This is the approximate time delay between receipt of Modbus request message and start of response message (in addition to message processing time).
DBL BYTE	 FP B FP BB FP L FP LB	**DOUBLE REGISTER BYTE ORDER**—The transmitted or received order of the 4 bytes comprising an IEEE floating point value. The default order is EXP, MH, MM, ML, or 0123 for reference. **0123** (Big Endian) **1032** (Big Endian, Byte Swapped) **3210** (Little Endian) **2301** (Little Endian, Byte Swapped)

4.15 Options Set Up Group

Introduction

The Options Set Up Group lets you enable or disable some of the options that are available on the DR4500. You can select the power frequency, select relative humidity as a measurement and a atmospheric pressure compensation, select deviation recording action, and set the desired deviation setpoint.

Options group prompts

Table 4-15 lists all the function prompts in the Option set up group and their functions.

Table 4-15 Option Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
REJ FREQ	60HZ 50HZ	**REJECTION FREQUENCY** – be sure that this selection agrees with the line voltage frequency.
HF REJ	ENABLE DISABL	**HIGH FREQUENCY REJECTION** – This selection allows high frequency noise rejection. It is used to quiet noisy pens or PV. **ATTENTION** For fast processes it will cause additional lag.
RELHUMID	NO YES	**RELATIVE HUMIDITY –** allows you to activate or deactivate the RH calculation algorithm. • You must select 100RH input type for two inputs to measure RH. It requires two 100-ohm RTD inputs so INPUT 2 must be enabled for this prompt to appear. • Also, you must select RH for "PEN2IN" which represents the "wet bulb" temperature when input 2 is selected.
ATMPRES	590 to 800 mmHg	**ATMOSPHERIC PRESSURE COMPENSATION** – This prompt only appears if you select "YES" at "RELHUMID" prompt previously. Select the desired compensation.
DEVIATION	NONE SETPNT CHAN1	**DEVIATION –** selects deviation recording action. • NONE – No deviation recording • SETPNT – Records deviation from setpoint • CHAN1 – Pen 1 records the difference between Input 1 and Input 2.
DEVSETPT	–999.0 to 9999	**DEVIATION SETPOINT VALUE –** sets the desired deviation setpoint value for deviation recording. • This prompt only appears if "SETPNT" was selected at prompt "DEVIATION" previously.

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
SCROLL		**LOWER DISPLAY SCROLL**—The lower display will automatically change to the next item (as if the **LOWR DISP** key had been pressed) at the interval selected.
	NONE	**NONE**—Disables the scroll function.
	1 SEC	**1 SEC**—One second intervals
	2 SEC	**2 SEC**—Two second intervals
	3 SEC	**3 SEC**—Three second intervals
GRANDTOT	ENABLE DISABL	**GRAND TOTALIZER**—When enabled it prints, on the chart, the sum of ALL the enabled totalizers as TOTAL = XXXXXXXXXX. This is printed in the space for totalizer 4. If grand total is disabled, total 4 on the DR45AW model will print normally.

4.16 Event Message Set Up Group

Introduction

This Set Up group allows you to specify six event messages to be printed on a designated area of the chart and triggered by a specific selectable actuation. The message can be six characters long.

Press the **FUNC** key until the specific event prompt appears in the lower display.

Event Message group prompts

Table 4-16 lists all the function prompts in the Event Message set up group and their definitions.

Table 4-16 Event Message Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
EVENT n (n = 1, 2, 3, 4, 5, or 6)	60HZ 50HZ	**EVENT TRIGGER**—Select the triggering source for each of the six event messages.
	NONE	**NONE**—No event message
	EXT SW1	**EXT SW1**—Event triggered by external switch 1 closure
	EXT SW2	**EXT SW2**—Event triggered by external switch 2 closure
	ALARM 1	**ALARM 1**—Event triggered by Alarm 1
	ALARM 2	**ALARM 2**—Event triggered by Alarm 2
	ALARM 3	**ALARM 3**—Event triggered by Alarm 3
	ALARM 4	**ALARM 4**—Event triggered by Alarm 4
	ALARM 5	**ALARM 5**—Event triggered by Alarm 5
	ALARM 6	**ALARM 6**—Event triggered by Alarm 6
MESSAGEn (n = 1, 2, 3, 4, 5, or 6)	0 to 9 A to Z + – / (blank)*	**MESSAGE FOR EVENT**—Select a message to be printed when Event is triggered. You can use up to six characters. *For alphanumeric entries, the display will cycle, from left to right, with highlighting (increased brightness) of each digit. The value of each digit can be changed only when it is highlighted.
POSITIONn (n = 1, 2, 3, 4, 5, or 6)	0 to 100 %	**CHART POSITION FOR MESSAGE**—Select where you want the message to appear on the chart.

Repeat for all messages required.

4.17 Lockout Parameters Set Up Group

Introduction

These are the parameters that you will set to lockout any unauthorized changes to the recorder's configuration and calibration prompts. You must know the PASSWORD in order to change the Lockout configuration. Refer to *Appendix B* for more information on security lockout.

ATTENTION

Configuration can also be locked using S1 switch on the main printed circuit board. Refer to *Subsection 2.9 –Lockout Switch Configuration.*

This feature also includes the special screw and plate that provide for the lead seal capability for sealing the chart plate.

Set this group last

Because this group contains functions that have to do with security and lockout, we recommend that you configure this group last, after all the other configuration data has been loaded.

Lockout group prompts

Table 4-17 lists all the function prompts in the Lockout set up group and their definitions.

Table 4-17 Lockout Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PASSWORD	Select up to four alphanumeric characters	**PASSWORD** -- this selection determines the password that will be required to gain access to the lockout prompt. • ++++ is the factory default password.
LOCKOUT	 NONE CALIB +CONF MAX	**LOCKOUT** applies to one of the functional groups: Configuration, Calibration, Tuning, Adaptive Tune. DO NOT CONFIGURE UNTIL ALL CONFIGURATION IS COMPLETE. • If the correct password was entered, you can call up this prompt. No Lockout – all groups read/write. **CALIB** – All are available for read/write except for the Calibration group. **+CONF** – Tuning, SP Ramp and program groups are read/write. All other groups are read only. Calibration group is not available. **MAX** – Calibration group not available. All other groups are Read-only. **ATTENTION** Do not leave in "NONE" Lockout.
CHANGE	Selections are: 0 to 9 A to Z	**CHANGE PASSWORD** – Changes default password to one of your own. Be sure to record the new password in a safe location.

4.18 Printing Characteristics Adjustments

Introduction

With software version 1005 (and newer), two different hot stylus pen designs are available; check your model number for:

Table III = _0_ for high speed stylus 30756304-001 (black tip)

Table III = _1_ for abrasion resistant jewel tip stylus 30756304-002 (beige tip)

The abrasion resistant stylus is designed for recording applications that include highly abrasive environments. The abrasion resistant stylus should only be used with chart speeds from 24 hrs/rev to 31 days/rev.

Configuration choices

Configuration choices are now provided for **PEN TYPE** and the selection made must match the stylus design.

- **PEN TYPE = NORMAL** is for the high speed stylus design.
- **PEN TYPE = JEWEL** is used **only** for abrasion resistant stylus design.

CAUTION

If the "JEWEL" selection is accidentally used with the high-speed design, the life of that stylus will be shortened.

Printing characteristics adjustments

Normally there is no need to adjust the printing characteristics as part of an input or output calibration procedure. However, if the chart printing appears to be faded, you can use the procedure in Table 4-18 to make slight adjustments in the print contrast.

ATTENTION

To access Set-up group prompt "ADJUST", the Set Up group prompt "LOCKOUT" must be set to "NONE". If the group prompt "LOCKOUT" has been configured for "CALIB" or "MAX" selection, you will not be able to access the Printing Characteristics Group prompt. Refer to *Subsection 4.17* for details.

Printing characteristics adjustments procedure

Table 4-18 is the procedure to adjust the printing characteristics of your recorder.

Table 4-18 Printing Characteristics Adjustment Procedure

Step	Description	Press	Action
1	Enter Set Up Group ADJUST	**SET UP**	Until you see: *Upper Display:* ADJUST *Lower Display:* {PRINTING)
2	Select Trace Line Contrast	**FUNC**	Until you see: *Upper Display:* DARK, MEDIUM, or LIGHT *Lower Display:* TRACE LN • Press ▲ or ▼ to select the desired contrast.
3	Select Grid Line Contrast	**FUNC**	Until you see: *Upper Display:* DARK, MEDIUM, or LIGHT *Lower Display:* GRID LN • Press ▲ or ▼ to select the desired contrast..
4	Select Stylus	**FUNC**	Until you see: *Upper Display:* NORMAL or JEWEL *Lower Display:* PEN TYPE • Press ▲ or ▼ to select the pen type. • Select "**NORMAL**" if high speed stylus (black tip) is installed. • Select "**JEWEL**" only if abrasion resistant stylus (beige tip) is installed.
5	Return to normal operation	**LOWR DISP**	Return to normal operation and observe the change in printing characteristics. • Change Set Up group "LOCKOUT" to something other than "NONE".

5. Operation

5.1 Overview

Introduction

This section gives you all the information necessary to monitor and operate your recorder and for performing routine maintenance tasks. In this section assume that the recorder has been properly installed and configured, and that the inputs are properly calibrated.

Some of the procedures in this section are required only initially, and some are required only randomly, as conditions dictate. Once the recorder is up and running, required operation actions are infrequent and straightforward.

Review the Operator Interface, Display and Keypad descriptions shown in *Section 1 - Overview*.

What's in this section?

This section contains the following topics:

	Topic	See Page
5.1	Overview	137
5.2	Start-up	138
5.3	Monitoring Your Recorder	142
5.4	Operator Functions	148
5.5	Operating Modes	149
5.6	Setpoints	151
5.7	Single Setpoint Ramp	153
5.8	Using Two Sets of Tuning Constants (PID Values)	156
5.9	Using Accutune II	159
5.10	Alarm Setpoints	162
5.11	Three Position Step Control Algorithm	163
5.12	Digital Input Option (Remote Switching)	164
5.13	Resetting and Displaying Totalizer Value	165
5.14	Monitoring the External Event Operation	167
5.15	Maximizing Pen Life	168
5.16	Routine Maintenance	169
5.17	Installing/Replacing Chart	170
5.18	Chart Operation	171

5.2 Start-up

Preparation

Before start-up, there are two tasks to perform:

- Install or replace the circular chart as described in 5.16 - *Routine Maintenance.*
- Be sure that the configured settings for the current time and wake time (time at which recording begins) are correct. Note that the recorder is "awake" during start-up to verify interaction with the process.

During start-up, you should verify the interaction between your process and the DR4500A recorder to be sure that your process can tolerate some upsets during this procedure.

Diagnostic tests

When power is applied, the recorder will run four diagnostic tests. Table 5-1 lists the four diagnostic tests.

Table 5-1 Power Up Diagnostic Tests

Prompt on Lower Display	Condition
RAM TEST	Check RAM
CONFTEST (configuration checksum)	Check nonvolatile memory
CAL TEST (working calibration)	Check calibration
BATTERY	Check the battery

Test failures

If control is enabled and one or more of these tests fail, the recorder will go to the Failsafe Manual Mode, and "FAILSAFE" will flash in the lower display.

If control is *not* configured, the self-test failures will be displayed periodically as other messages are presently displayed (CNFG ERR, CAL1 ERR, CAL2 ERR, or BATT LOW).

Troubleshooting

Refer to "DEVICE STATUS" in *Section 9 - Troubleshooting/Service* to identify and correct the problem.

Check the displays and keys

Use the procedure in Table 5-2 to run the display and key test.

Table 5-2 Procedure for Testing the Displays and Keys

<table>
<tr><th>Press</th><th>Result</th></tr>
<tr><td>SET UP
and hold in, then press
FUNC
at the same time</td><td>The recorder runs a display test. All the displays will light for 8 seconds, then you will see:
Upper Display: keys
Lower Display: try all</td></tr>
<tr><td>Press each key to see if it works</td><td>When the key is pressed, the lower display indicates the name of the key pressed.
<table>
<tr><th>Key Pressed</th><th>Lower Display</th></tr>
<tr><td>SET UP</td><td>SET UP</td></tr>
<tr><td>LOWR DISP</td><td>LWR DISP</td></tr>
<tr><td>MAN/AUTO</td><td>AUTO MAN</td></tr>
<tr><td>RESET</td><td>RESET</td></tr>
<tr><td>CHART</td><td>CHART</td></tr>
<tr><td>▲</td><td>INCRMENT</td></tr>
<tr><td>▼</td><td>DECRMENT</td></tr>
<tr><td>RUN/HOLD</td><td>RUN HOLD</td></tr>
</table></td></tr>
</table>

- If no key is pressed for 25 seconds, the test times out and the recorder exits the key test.
- If any test fails, go to *Subsection 9.3 Self Diagnostics* for more information.

Key error

When a key is pressed and the prompt "KEY ERROR" appears in the lower display, it will be for one of the following reasons:

- parameter not available,
- not in Set Up mode, press **SET UP** key first,
- key malfunction, perform keyboard test.

Start-up procedure

Use the procedure listed in Table 5-3 to start up the recorder.

Open the recorder door. Apply power and wait for the recorder to run its power-up tests.

ATTENTION

- If FAILSAFE starts blinking in the lower display, refer to *Section 9* for troubleshooting data.
- For recorders with two controllers (both enabled), be sure the CHN '1' indication is lit for steps 2-6. If CHN 1 is not lit, sequentially press the **LOWR DISP** key until "1" is lit when "OUT" is displayed.

Table 5-3 Procedure for Starting Up the Recorder

Step	Description	Press	Action
1	Pen check		For RECORDER ONLY models, just check that the pen is operating and skip to step 6.
2	Select manual mode	**MAN AUTO**	Until "MAN" indicator is ON. The recorder is in manual mode and the Output (OUT) in percent is displayed in the lower display.
3	Adjust the output	▲ or ▼	Adjust the output value and ensure that the final control element is functioning correctly. *Upper Display:* shows the PV value *Lower Display:* shows **OUT** and the output value in % Make sure the pen trace on the chart corresponds to the change in output.
4	Tune the recorder	**SET UP**	Make sure the recorder has been configured properly and all the values and selections have been recorded on the Configuration Record Sheet. To tune your recorder automatically, see *Subsection 5.9 Using Accutune II.* Refer to Set Up group TUNING 1 or TUNING 2 to ensure that the proper selections for PROP BD or GAIN, RATE MIN, and RSET MIN or RSET RPM have been entered.
5	Enter the local setpoint	**LOWR DISP**	Until you see: *Upper Display:* shows the PV value *Lower Display:* **SP** and the local setpoint value
		▲ or ▼	Adjust the local setpoint to the value at which you want the process variable maintained. The local setpoint cannot be changed if the Setpoint Ramp function is enabled. "H" or "R" appears in the upper display.

Step	Description	Press	Action
6	Select automatic mode	**MAN AUTO**	Until "A" indicator is ON. The recorder is in Automatic mode. The recorder will automatically adjust the output to maintain the process variable at setpoint as tracked by the pen trace, if the recorder is properly tuned.
7	Start up Controller #2	**LOWR DISP**	Until "2" is lit when "OUT" is displayed. For recorders with two controllers (both enabled), repeat steps 2-6 for controller #2, but be sure CHN "2" indicator is lit instead of CHN "1".
8	Exit Start-up		Close the door and monitor the operation.

5.3 Monitoring Your Recorder

Introduction

Besides the historical chart record, you can monitor the recorder's indicators and displays to get an instantaneous view of various process conditions and of the control loop status.

Diagnostic error messages signal detection of malfunctions in certain internally monitored data. Alarm and tuning messages indicate alarms in effect and control loops being tuned.

Operator interface

The indicators and displays on the operator interface let you see what is happening to your process and how the recorder is responding.

Figure 5-1 is a view of the operator interface. A description of the displays and indicators is included.

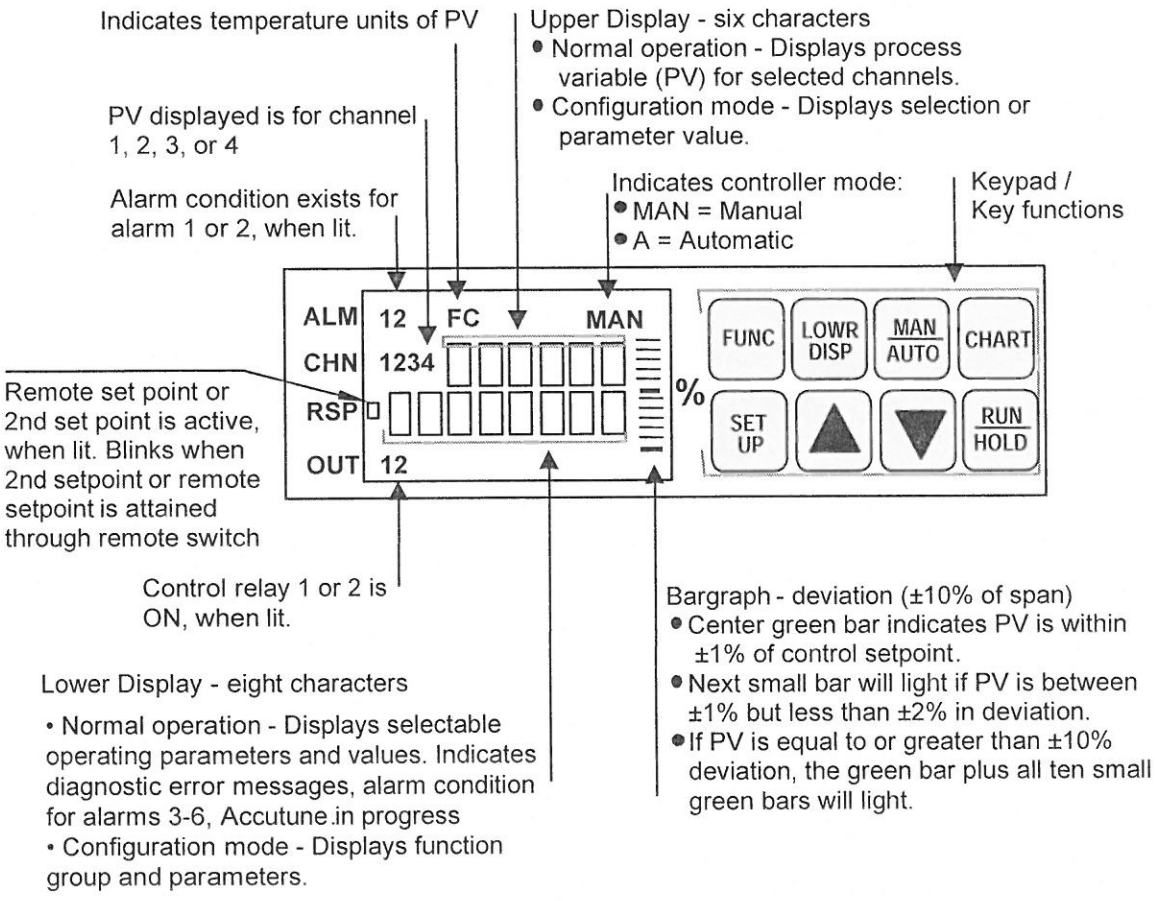


Figure 5-1 Operator Interface

Meaning of indicators

During normal operation, the indicators will light for the reasons shown in Table 5-4.

Table 5-4 Meaning of Indicators

Indicator	Definition when lit
ALM 1 2	Alarm condition exists for alarm 1 or 2.*
CHN 1 2 3 4	PV displayed is for channel 1, 2, 3, or 4.
RSP	Remote Setpoint (when available) or 2nd setpoint is active.
OUT 1 2	Control relay 1 or 2 is ON.
A or MAN	Indicates the mode of operation: A = Automatic MAN = Manual
F or C or blank	Indicates the temperature units of PV: F = Fahrenheit C = Celsius
R or H or G or blank (in upper display)	Indicates the state of the setpoint ramp or program if enabled: R = Run H = Hold G = Guar Soak blank = Disabled
T	Totalizer
KEY ERR (in lower display)	Indicates parameter not available, not in set up mode, or key malfunction.

* AL1 indicator can also mean the Interval Timer has timed out. Alarms 3-6 are indicated by a message on the lower display. See Table 5-7.

Reading the deviation bargraph

In addition to the indicators, a bargraph containing 21 bars displays Process Variable (PV) deviation from Setpoint (SP).

ATTENTION

When CHN "1" indicator is lit, the bargraph display applies for Controller #1. It applies for Controller #2 when CHN "2" indicator is lit. Sequentially press the **LOWR DISP** key to light the appropriate CHN indicator (1 or 2) and view the corresponding controller displays.

- The green "on-control" bar lights when the PV is within ± 1 % of setpoint.
- The 10 small green bars above the "on-control" bar light for each positive deviation up to +10 % and the 10 below light for each negative deviation down to –10 %. If the process deviation is greater than ± 10 %, the "on-control" bar and the specific small green bars light.

Figure 5-2 shows how the deviation bargraph works.

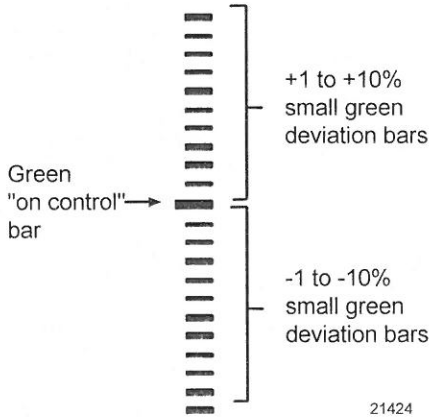


Figure 5-2 Deviation Bargraph

Viewing the operating parameters

The upper display is a six-character display, four of which show the value of the PV during normal operation.

- The lower display is an eight-character display. During normal operation, you can view various operating parameters. Press the **LOWR DISP** key to scroll through the operating parameters listed in Table 5-5.
- The lower display shows only those parameters and their values that apply to your specific model and the way in which it was configured.
- You can configure the lower display to scroll through the items in Table 5-5 at an interval of 1, 2, or 3 seconds. Refer to *Subsection 3.19 – Options Set Up group, function prompt "SCROLL"* to make your selection.

  Pressing the **LOWR DISP** key will freeze the lower display at the presently viewed item; pressing it again will advance to the next item and scrolling will resume.
- Pressing ▼while pressing **LOWR DISP** will scroll backwards.

For recorders with two controllers (both enabled) remember that any controller-related values displayed correspond with the lighted CHN indicator — "1" means that the values apply for Controller #1 and "2" means that the values apply for Controller #2.

Table 5-5 Lower Display Key Parameter Prompts

Prompt	Description
OUT**	Output Value in Percent (%). Note that the output can only be adjusted through the raise/lower keys when the controller in manual mode. (Estimated motor position for 3 Position Step Control)
SP**	Local Setpoint 1. Also current setpoint of SP Ramp, or SP Ramp/Soak Program.
SPN	Current setpoint for setpoint rate applications.
2SP**	Local Setpoint 2 (where remote setpoint does not apply)
RSP	Remote Setpoint (when configured)
1IN	Value of Channel 1 input (if Loop1 is a derived PV)
2IN	Value of Channel 2 input (when available)
3IN	Value of Channel 3 input (when available)
4IN	Value of Channel 4 input (when available)
DEV	PV deviation from setpoint (±999.9 maximum)
EU	Engineering units that PV represents (when available)
RH	RH value in percent (%) (when available)
PIDSETx**	Tuning Parameter Set **x** =1 or 2
RAMP	The time (minutes) remaining in the setpoint ramp
#RA	The time (minutes) remaining in the SP Ramp segment
#SK	The time (minutes) remaining in the SP Soak segment
RECYC	The number of recycles remaining to be run in the Setpoint Program

Prompt	Description
↓ □.□□ **	Time remaining in Timer function
↑ □.□□ **	Time elapsed in Timer function
TUNExXXX**	Accutune II indicator. **x** = Loop number (1 or 2). **XXX** = ON or OFF.

**You can press ▲ or ▼ to change the value of this parameter.

Diagnostic error messages

The DR4500A runs background tests to verify data and memory integrity. If there is a malfunction, an error message will blink in the lower display.

In the case of more than one simultaneous malfunction or alarm, each message will be shown in succession.

A list of error messages is contained in Table 5-6. If any of these error messages occur, refer to *Section 9 - Troubleshooting/Service* for information to correct the failure.

Table 5-6 Error Messages

Prompt	Description
EE FAIL	Unable to write to nonvolatile memory
FAILSAFE	Failsafe
INP1FAIL	Two consecutive failures of input 1 integration
INP2FAIL	Two consecutive failures of input 2 integration
INP3FAIL	Two consecutive failures of input 3 integration
INP4FAIL	Two consecutive failures of input 4 integration
INP1 RNG **INP2 RNG** **INP3 RNG** **INP4 RNG**	Input out-of-range
PV LIMIT	PV ± 10 % out-of-range
RV LIMIT	Remote Variable out-of-range Note: RV = (input 2 x ratio) + bias
CNFG ERR	Configuration data is in error.
CAL1 ERR	Working CAL TEST failure (Control Output #1, Input 1, Input 2)
CAL2 ERR	Working CAL TEST failure (Control Output #2, Input 3, Input 4)
BATT LOW	Battery failure

Alarm and tuning messages

Alarms #3 through #6 and Accutune II for Control Loops #1 and #2 are indicated in the lower display.

In the case of more than one simultaneous diagnostic or alarm message, each message will be shown in succession.

Table 5-7 Alarm and tuning messages

Prompt	Description
ALARM 3	Indicates an alarm 3 action.
ALARM 4	Indicates an alarm 4 action.
ALARM 5	Indicates an alarm 5 action.
ALARM 6	Indicates an alarm 6 action.
TUNING 1	Indicates Accutune II in progress for Control Loop 1.
TUNING 2	Indicates Accutune II in progress for Control Loop 2.

ATTENTION

An active alarm will always provide an indication on the display but may not control its associated relay; that is, a higher priority function such as a control loop or timer may have control of the relay.

5.4 Operator Functions

Actions an operator can initiate

An operator can do the following:

- Change the Control Mode (Auto/Man)
- Adjust the Output Manually
- Change the Setpoint
- Switch between Setpoints
- Run or Disable a Setpoint Ramp
- Run or Disable a Setpoint Program
- Switch between Two Sets of PID Values
- Run or Disable Control Loop Tuning
- Check the Alarm Setpoints
- Reset the Totalizer
- Run a Key Test

Note that some actions depend upon how the recorder was configured and the features supplied on your particular recorder model.

Refer to the following pages for functions and procedures.

CHN indicator

Remember, for recorders with two controllers (both enabled) remember that any controller-related values displayed, including control mode, correspond with the lighted CHN indicator — "1" means that the values apply for Controller #1 and "2" means that the values apply for Controller #2. Sequentially press the **LOWR DISP** key to scroll through the displays and light the appropriate CHN indicator for controller-related values.

5.5 Operating Modes

Available modes

The recorder can operate in any of three basic modes:

- Manual
- Automatic with Local Setpoint
- Automatic with Remote Setpoint

Manual and Automatic with Local setpoint are standard features and Automatic with Remote Setpoint is optional.

Mode definitions

Table 5-8 Operating Mode Definitions

Operating Mode	Definition
MANUAL	When switched to manual mode, the recorder holds its output at the last value used during automatic operation and stops adjusting the output for changes in setpoint or process variable. Instead, you adjust the output by changing the value shown in the lower display. See "*Selecting Modes*".
AUTOMATIC with LOCAL SETPOINT	In automatic local mode, the recorder operates from the local setpoint and automatically adjusts the output to maintain the setpoint at the desired value. In this mode you can adjust the setpoint. See "*Setpoints*".
AUTOMATIC with REMOTE SETPOINT	In automatic remote mode, the recorder operates from the setpoint measured at input 2. Adjustments are available to ratio this input and add a constant bias before it is applied to the control equation. See *Subsection 3.12 Control Set Up Group*.

What happens when you change modes

Table 5-9 explains what happens to the recorder when you switch from one mode to another.

Table 5-9 Changing Operating Modes

Operating Mode	Definition
Manual to Automatic Local Setpoint	The local setpoint is usually the value previously stored as the local setpoint.
Manual or Auto Local to Automatic Remote SP	The second input value with ratio and bias applied is used to calculate the control setpoint.
Automatic Remote SP to Manual or Auto Local Setpoint	If configured for RSP Tracking, when the recorder transfers out of remote setpoint, the last value of the control setpoint is inserted into the local setpoint. If RSP tracking is not configured, the local setpoint will not be altered when the transfer is made.

Selecting manual or automatic mode

An alternate action switch places the recorder in automatic or manual mode of operation.

- Switching between manual and automatic will be bumpless, except when the PD+MR algorithm is selected.
- Table 5-10 includes procedures for selecting automatic or manual mode and changing the output while in manual.

Table 5-10 Procedure for Selecting Automatic or Manual Mode

Step	Operation	Press	Action/Result
1	Selecting automatic mode	**MAN AUTO**	Until "A" indicator is ON. The recorder regulates its output to maintain the PV at the desired setpoint. *Upper Display:* shows the PV value *Lower Display:* shows **SP** and the setpoint value The deviation bargraph indicates the PV deviation from the setpoint.
2	Selecting manual mode	**MAN AUTO**	Until "MAN" indicator is ON. The recorder holds its output at the last value used during automatic operation and stops adjusting the output for changes in setpoint or process variable. *Upper Display:* shows the PV value *Lower Display:* shows **OUT** and the output value in % The deviation bargraph indicates the PV deviation from the setpoint.
3	Adjust the output in manual mode	▲ or ▼	Adjust the output value while in manual mode. *Upper Display:* shows the PV value *Lower Display:* shows **OUT** and the output value in %
4	Return to automatic mode	**MAN AUTO**	"A" indicator appears indicating automatic mode.

Position proportional backup mode

This feature provides for Position Proportional models to automatically change to a Three Position Step algorithm if the slidewire input signal fails. This will maintain control of your process.

"SWFAIL" or "SW2FAIL" will flash in the lower display and the "OUT" display will show an estimated motor position WITHOUT a decimal point.

5.6 Setpoints

Introduction

You can configure the following setpoints for the DR4500A recorder.

- A single local setpoint
- 2 local setpoints
- A local setpoint and a remote setpoint
- A computer setpoint.

These setpoints can be toggled by the **FUNC** key.

Selecting the setpoint source

Use the procedure in Table 5-11 to select a single local setpoint source, a remote setpoint source, or two local setpoints.

Table 5-11 Procedure for Selecting the Setpoint Source

Step	Operation	Press	Action/Result
1	Enter set up mode	**SET UP**	Until the displays read: *Upper Display:* **SET UP** *Lower Display:* **CONTROL**
2	Display local setpoint source selections	**FUNC**	Until the displays read: *Upper Display:* Setpoint source selections **1LOCAL** **2LOCAL** **REMOTE** *Lower Display:* **SP SOURCE**
3	Select the desired source	▲ or ▼	Select the desired setpoint source in the upper display.
4	Return to control	**LOWR DISP**	Controller assumes normal control.

Changing the local setpoints

Use the procedure in Table 5-12 to change either local setpoint value.

Table 5-12 Procedure for Changing the Local Setpoint

Step	Operation	Press	Action/Result
1	Select the setpoint	**LOWR DISP**	Until you see: *Upper Display:* PV value *Lower Display:* **SP** or **SP2** and the local setpoint value
2	Change the value	▲ or ▼	Change the local setpoint to the value at which you want the process maintained. The deviation bargraph indicates PV deviation from setpoint.

Switching between setpoints

You can switch between Local and Remote setpoints or between two Local setpoints when configured. Use the procedure in Table 5-13 to switch between setpoints.

Table 5-13 Procedure for Switching Between Setpoints

Step	Operation	Press	Action/Result
1	Switch between setpoints	**FUNC** or **LOWR DISP**	Alternately select Local setpoint 1 and Remote setpoint or switch between the 2 Local Setpoints. or Press appropriate key until you see the desired setpoint indicated. **ATTENTION** "KEY ERROR" appears in the lower display if the remote setpoint or second local setpoint is not configured as a setpoint source, or if you attempt to change the setpoint while a setpoint ramp is enabled.
2	Change the **Local** setpoint value	▲ or ▼	The **REMOTE** setpoint cannot be changed at the keyboard.

Setpoint selection indication

Table 5-14 shows how the indicators react and what the displays show for each type of setpoint.

Table 5-14 Setpoint Selection Indication

	Using Local Setpoint	Using Remote Setpoint	Using 2nd Local Setpoint
RSP Indicator	OFF	ON (Note 1)	ON (Note 2) (Note 3)
Upper Display	PV	PV	PV
Lower Display	**SP** and the Local Setpoint Source	**RSP** and Remote Setpoint Value	**2SP** and the 2nd Local Setpoint Value
To Change Setpoint Value	Press ▲ or ▼	Cannot change the value at the keyboard.	Press ▲ or ▼

Note 1—RSP blinks when RSP is reached using Digital Input
Note 2—RSP solid for 2nd Setpoint
Note 3—RSP blinks for 2nd setpoint activated by Digital Switch

5.7 Single Setpoint Ramp

Configuring the setpoint ramp

You can configure a single setpoint ramp to occur between the current local setpoint and a final local setpoint over a time interval of from 1 to 255 minutes. You can RUN or HOLD the ramp at any time.

Procedure

Table 5-15 lists the procedure for configuring the Setpoint Ramp 1 or 2 parameters. The procedure for **Setpoint Program** is in *Section 6 – Setpoint Ramp/Soak Programming and Operation.*

Table 5-15 Procedure for Configuring a Single Setpoint Ramp

Step	Operation	Press	Action/Result
1	Select SP RAMP 1 or SP RAMP 2 Set Up group	**SET UP**	Until you see: *Upper Display:* **SET UP** *Lower Display:* **SP RAMP X** **X** = 1 or 2
2	Select the Setpoint Ramp function	**FUNC**	Until you see: *Upper Display:* **DISABL** *Lower Display:* **SP RAMP X**
3	Enable Setpoint Ramp	▲	Until you see: *Upper Display:* **ENABLE** *Lower Display:* **SP RAMP X** NOTE: You cannot change the current local setpoint if the setpoint ramp function is enabled. Make sure SP PROG is disabled.
4	Set the Ramp Time	**FUNC**	Until you see: *Upper Display:* The ramp time in minutes *Lower Display:* **TIME MIN**
		▲ or ▼	Change the upper display value to the number of minutes in which you want the final setpoint to be reached. Setting Range = 1 to 255 minutes NOTE: Entering "0" implies an immediate step change to the final SP.
5	Set the Final Setpoint value	**FUNC**	*Upper Display:* The final setpoint value *Lower Display:* **FINAL SP**
		▲ or ▼	Change the upper display value to the desired final setpoint value. Setting Range = within the setpoint limits

Running the setpoint ramp

Running a setpoint ramp includes starting, holding, viewing the ramp time, ending the ramp and disabling it.

Procedure

Table 5-16 lists the procedure for running the setpoint ramp.

Table 5-16 Procedure for Running a Setpoint Ramp

Step	Operation	Press	Action/Result
1	Put the controller into automatic mode	**MAN AUTO**	Until "A" indicator is ON and you will see: *Upper Display:* **H** and the PV value *Lower Display:* **SP** and the present setpoint value
2	Set Start SP	▲ or ▼	Until the start setpoint value you desire is indicated in the lower display: *Upper Display:* **H** and the PV value *Lower Display:* **SP** and the start setpoint value
3	Start the ramp	**RUN HOLD**	You will see: *Upper Display:* **R** and the PV value *Lower Display:* **SP** and a changing setpoint value NOTE: The value in the lower display will be increasing or decreasing toward the final setpoint value. The PV value in the upper display and the pen trace will also change.
4	Hold the ramp at the current value	**RUN HOLD**	This holds the ramp at the current setpoint value. Press again to continue run. A "KEY ERROR" prompt appears if **RUN/HOLD** key is pressed while "SP RAMP" is disabled.
5	View the remaining ramp time	**LOWR DISP**	Until you see: *Upper Display:* **R** or **H** and the PV value *Lower Display:* **RAMP XXXM** (time remaining)
6	End the ramp		When the final setpoint is reached, the "R" changes to "H" in the upper display and the recorder operates at the new setpoint. **ATTENTION** Any time the local setpoint is different from the final setpoint value and the **RUN/HOLD** key is pressed — the ramp will start again.

Step	Operation	Press	Action/Result
7	Disable the setpoint ramp function	**SET UP**	Until you see: *Upper Display:* **SET UP** *Lower Display:* **SP RAMP X**
		FUNC	You will see: *Upper Display:* **ENABLE** *Lower Display:* **SP RAMP X**
		▲	You will see: *Upper Display:* **DISABL** *Lower Display:* **SP RAMP X**
8	Return to normal operating mode	**LOWR DISP**	Returns to normal operating mode.

5.8 Using Two Sets of Tuning Constants (PID Values)

Introduction

You can use two sets of tuning constants for single output types and choose the way they are to be switched.

The sets can be:

- Keyboard selected
- Automatically switched when a predetermined Process Variable value is reached.
- Automatically switched when a predetermined Setpoint value is reached.

The following procedures show you how to:

- Select two sets
- Set the switchover value
- Set tuning constant value for each set
- Switch between two sets via the keyboard (without automatic switchover)

ATTENTION

For recorders with two controllers (both enabled) remember that any controller-related values displayed correspond with the lighted CHN indicator — "1" means that the values apply for Controller #1 and "2" means that the values apply for Controller #2.

Select two sets

The procedure in Table 5-17 tells you how to select two sets of tuning constants.

Table 5-17 Procedure for Selecting Two Sets of Tuning Constants

Step	Operation	Press	Action/Result
1	Select Control Set Up group	**SET UP**	Until you see: *Upper Display:* **SET UP** *Lower Display:* **CONTROL**
2	Select PID SETS function	**FUNC**	You will see: *Upper Display:* Available selections are— **1 ONLY** – 1 set of constants **2 KEYBD** – 2 sets, keyboard selectable **2 PVSW** – 2 sets, auto switch at PV value **2 SPSW** – 2 sets, auto switch at SP value *Lower Display:* **PIDSETS**
		▲ or ▼	Select the type of PID set.

Set switchover value

If you select 2 PVSW or 2 SPSW, you must set a value at which the sets will switch over.

The procedure in Table 5-18 shows you how to set this value.

Table 5-18 Procedure for Setting Switchover Values

Step	Operation	Press	Action/Result
1	Select switchover value function	**FUNC** assuming you are still in Set Up group CONTROL	Until you see: *Upper Display:* The switchover value *Lower Display:* **SW VALUE**
		▲ or ▼	Select the switchover value in the upper display.

Set tuning constant values for each set

There are specific tuning constants that must be set for each set. The procedure in Table 5-19 shows you how to access these constants and change their values.

Table 5-19 Procedure for Setting Tuning Constant Values

Step	Operation	Press	Action/Result
1	Select Tuning Set Up group	**SET UP**	Until you see: *Upper Display:* **SET UP** *Lower Display:* **TUNING**
2	Select the tuning constants	**FUNC**	Successively displays the following constants: *Upper Display:* Tuning constant value *Lower Display:* **PROPBD** or **GAIN*** **RATEMIN*** **RSETMIN** or **RSETRPM*** **PROPBD2** or **GAIN2**** **RATE2MIN**** **RSET2MIN** or **RSET2RPM**** *PIDSET1 – will be used when PV or SP, whichever is selected, is ***greater*** than the switchover value. **PIDSET2 – will be used when PV or SP, whichever is selected, is ***less*** than the switchover value.
		▲ or ▼	Change the value of any of the above listed prompts in the lower display.

Switch between two sets via the keyboard (without automatic switchover)

This procedure is operational only if 2 PID SETS was configured at "CONTROL" set up group.

The procedure in Table 5-20 shows you how to switch from one set to another.

Table 5-20 Procedure for Switching PID Sets from the Keyboard

Step	Operation	Press	Action/Result
1	Access the PID set display	**LOWR DISP**	Until you see: *Upper Display:* The PV value *Lower Display:* **PIDSETX** **X** = 1 or 2
		▲ or ▼	Change PIDSET1 to PIDSET2 or vice versa.

5.9 Using Accutune II

Introduction

Accutune II provides foolproof, trouble-free on-demand tuning in the recorder. No knowledge of the process is required at start-up. The operator simply enters the desired setpoint and initiates the tuning. The recorder immediately starts controlling to the setpoint while it identifies the process, calculates the tuning constants and enters them into the tuning set up group, and begins PID control with the correct tuning parameters. This works with any process, including integrating type processes, and allows retuning at a fixed setpoint. The tuning sequence will cycle the recorder's output two full cycles between 0 % and 100 % (or low and high output limits) while allowing only a very small process variable change above and below the setpoint during each cycle.

- Accutune works for all control algorithms except ON/OFF.
- The recorder must be in Auto mode.
- Accutune works for integrating processes.

Enable/disable Accutune using the tuning set up group ACCUTUNE parameter described in *Section 4*.

Detailed instructions for using Accutune follow.

Starting and Stopping Tuning with Accutune II

After "ACCUTUNE" has been enabled in the tuning set up group as described in *Section 4*, use the procedure in Table 5-21 to start tuning.

To abort tuning in progress, press the MAN/AUTO/RESET key to take the recorder out of Auto mode. The message "AbRT" (abort) will be displayed as the value of tuning set up group parameter "AT ERR". The tuning parameters will retain the values they had at the start of the Accutune operation.

Table 5-21 Procedure for Starting Accutune II

Step	Press	Action/Result
1	**DISP** until you see	Until you see *Lower Display:* **TUNExOFF (x = 1 or 2)** If "TUNExOFF" (tune off) does not appear, then Accutune is not enabled.
2	▲ **or** ▼	to toggle to *Lower Display:* **TUNExON (x = 1 or 2)** Tuning will begin and the lower display will flash "TUNING". When tuning has been ompleted the lower display will again show "TUNExOFF".

Using Accutune with Duplex (Heat/Cool) Control

"TUNE" can be done for applications using Duplex (Heat/Cool) control.

During tuning, Accutune II assumes SP 1 will cause a Heating demand, and then the calculated tuning parameters will be automatically entered as the first set of PID constants. Likewise, it assumes tuning at Local SP 2 will cause a Cooling demand, and the cooling parameters will be entered as the second set of PID constants.

Procedure

After "ACCUTUNE" has been enabled in the tuning set up group as described in *Section 4*, use the procedure in Table 5-22 to start tuning. Note that control group parameter "SP SOURC" must be set to "2LOCAL" to enable the second setpoint.

To abort tuning in progress, press the MAN/AUTO key to take the recorder out of Auto mode. The message "AbRT" (abort) will be displayed as the value of tuning set up group parameter "AT ERR". The tuning parameters will retain the values they had at the start of the Accutune operation.

Table 5-22 Procedure for Using Accutune for Duplex Control

Step	Press	Action/Result
	Heating Tuning	
1	**DISP**	Until you see Setpoint 1. *Lower Display:* **SP nnn**
2	▲ or ▼	Until the value of Setpoint 1 is at the desired value within the Heat zone. Make sure the recorder is in Auto mode. ("A" indicator lit.) If not, use the MAN/AUTO/RESET key to put the unit in Auto.
3	**DISP**	Until you see *Lower Display:* **UseSPn** This is the prompt used to select the setpoint. If it is not "USESP1", use ▲ or ▼ to switch to "USESP1".
4	**DISP**	Until you see *Lower Display:* **TUNExOFF (x = 1 or 2)** If "TUNExOFF" (tune off) does not appear, then Accutune is not enabled.
5	▲ or ▼	to toggle to *Lower Display:* **TUNExON (x = 1 or 2)** Tuning will begin and the lower display will flash "TUNING". The output will cycle between 50 % and 100 % (or high output limit). When tuning has been completed the lower display will again show "TUNExOFF". The Heat tuning parameters are entered for the first set of PID constants in the tuning set up group.

Step	Press	Action/Result
	Cooling Tuning	
6	**DISP**	Until you see Setpoint 2. *Lower Display:* **SP nnn**
7	▲ **or** ▼	Until the value of Setpoint 2 is at the desired value within the Cooling zone.
8	**DISP**	Until you see *Lower Display:* **Use SP1**
9	▲ **or** ▼	to toggle to *Lower Display:* **Use SP2**
10	**DISP**	*Lower Display:* **TUNExOFF**
11	▲ **or** ▼	to toggle to *Lower Display:* **TUNExON** Tuning will begin and the lower display will flash "TUNING". The output will cycle between 0 % and 50 % (or low output limit). When tuning has been completed the lower display will again show "TUNExOFF". The Cool tuning parameters are entered for the second set of PID constants in the tuning set up group.

5.10 Alarm Setpoints

Introduction

- An alarm consists of a relay contact and an operator interface indication. The alarm relay is de-energized if Alarm Setpoint 1 or Setpoint 2 is exceeded.
- The alarm relay is energized when the monitored value goes into the allowed region by more than the hysteresis.
- There are twelve alarm setpoints, two for each alarm.
- The type and state (High or Low) is selected during configuration: see *Section 3 - Configuration* for details.

ATTENTION

An active alarm will always provide an indication on the display but may not control the relay; that is, a higher priority function such as a control loop or timer may have control of the relay.

Procedure for displaying the alarm setpoints

The procedure for displaying and changing the alarm setpoints is listed in Table 5-23.

Table 5-23 Procedure for Displaying or Changing the Alarm Setpoints

Step	Operation	Press	Action/Result
1	Access the Alarm Set Up group	**SET UP**	Until you see: *Upper Display:* **SET UP** *Lower Display:* **ALARM X** **X** = 1, 2, 3, 4, 5, 6
2	Access the Alarm Setpoint Values	**FUNC**	Successively displays the alarm setpoints and their values. *Upper Display:* The alarm setpoint value *Lower Display:* **AXS1 VAL** – Setpoint 1 value of alarm 1, 2, 3, 4, 5, or 6 **AXS2 VAL** – Setpoint 2 value of alarm 1, 2, 3, 4, 5, or 6
		▲ or ▼	Change any alarm setpoint value you select in the upper display.
3	Return to normal operation	**LOWR DISP**	Returns to normal operation.

5.11 Three Position Step Control Algorithm

Introduction

The Three Position Step Control algorithm allows the control of a valve (or other actuator) with an electric motor driven by two controller output relays; one to move the motor upscale, the other to move it downscale, without a feedback slidewire linked to the motor shaft.

Estimated motor position

The Three Position Step Control algorithm provides an output display ("OUT") which is an estimated motor position since the motor is not using any feedback.

Although this output indication is only accurate to a few percent, it is corrected each time the controller drives the motor to one of its stops (0 % or 100 %).

It avoids all the control problems associated with the feedback slidewire (wear, dirt, noise).

When operating in this algorithm, the estimated "OUT" display is shown to the nearest percent (i.e., no decimal).

Displaying the motor position

Table 5-24 lists the procedure for displaying the motor position.

Table 5-24 Procedure for Displaying the 3PSTEP Motor Position

Step	Operation	Press	Action/Result
1	Access the displays	**LOWR DISP**	Until you see: *Upper Display:* The PV value *Lower Display:* **OUT** Estimated 3PStep motor position

Power up output

When the controller powers up after a power outage, the position of the motor will correspond to whatever was configured at set up group prompt "CONTROL", function prompt "PWR OUT", selection LAST or FAILSAFE. Refer to *Subsection 4.8, Table 4-7* for definition of each selection.

5.12 Digital Input Option (Remote Switching)

Introduction

The digital input option detects the state of external contacts wired to it. On contact closure, the controller responds according to how each digital input is configured.

- Make your selection under set up group "CONTROL1" or "CONTROL2", function group prompt "REM SW": see *Subsection 3.12—Table 3-9* or *Subsection 4.8—Table 4-7.*

Action on contact closure

Table 5-25 lists the configuration prompt selections, the "Action on Contact Closure", and the display indication for each selection available.

Table 5-25 Digital Input Option Action on Contact Closure

REM SW Selections	Display Indication	Action on Contact Closure
None	None	No Digital Input selection
To MAN	"MAN" blinks	Puts the controller into manual mode; contact open returns the controller to former mode unless **AUTO/MAN** key is pressed while digital input is active.
To LSP	"RSP" blinks	Puts the controller into local setpoint 1 (switches out of remote). When contact opens, the controller returns to former operation unless the **FUNC** key is pressed while digital input is active.
To 2SP	"RSP" blinks	Puts the controller into local setpoint 2.
To DIR	None	Selects direct controller action (transfer if in reverse).
RN/HOLD	"H" blinks in upper display	Suspends setpoint program or setpoint ramp. • Keyboard takes priority over external switch for RUN/HOLD function. • Contact open runs the program or ramp. • If initially in the HOLD state, close then open the contact to remotely start the SP ramp or Program
TUNE	TUNING x	Initiates Accutune

Keyboard operation

If a particular mode or parameter is selected by the contact closure, using the keyboard to select the same parameter ensures that the selected mode will be maintained after the remote digital switch is reopened.

5.13 Resetting and Displaying Totalizer Value

Introduction

If the totalizer is enabled and has been configured to allow resetting, you can reset the current totalizer value as follows.

- Refer to *Section 3 - Configuration*, under set up prompt "TOTAL 1" for Input #1 or "TOTAL 2" for Input #2 to enable the totalizer function and allow the totalizer to be reset.
- Refer to the procedures that follow to:
  - reset the totalizer locally,
  - reset the totalizer using the Wake Time feature,
  - reset the totalizer externally (switch),
  - display the totalizer value.

Resetting the totalizer locally

Follow the procedure in Table 5-26 to reset the totalizer value.

Table 5-26 Procedure for Resetting the Totalizer

Step	Operation	Press	Action/Result
1	Access the Totalizer Set Up group	**SET UP**	Until you see: *Upper Display:* **SET UP** *Lower Display:* **TOTAL 1** or **TOTAL 2**
2	Allow Totalizer Reset	**FUNC** once	You will see: *Upper Display:* **Ex XXX** *Lower Display:* **(a value)**
		FUNC again	You will see: *Upper Display:* **NO** *Lower Display:* **RSET TOT**
		▲ or ▼	Change NO to YES in the upper display. **ATTENTION** Function prompt "RSETABLE" must be set to "LOCAL".
3	Return to normal operation	**LOWR DISP**	Returns to normal operation.

Resetting the totalizer using the Wake Time feature

To reset the totalizer using the Wake Time feature, set the Wake Time ("WAKE MIN", "WAKE HR", "WAKE DAY", "WAKE MON" in *Subsection 3.9 – Time Set Up Group*) as desired. Then set function prompt "RSETABLE" *(Subsection 3.10 – Totalizer Set Up Group)* to "TIME". When the configured Wake Time value is reached, the totalizer will reset to "0".

External totalizer reset

The totalizer can be reset to "0" from external switch #1 or external switch #2. Refer to *Subsection 3.10 – Totalizer Set Up Group* and set function prompt "RSETABLE" to "EXT SW1" or "EXT SW2".

Displaying the totalizer value

Follow the procedure in Table 5-27 to display the totalizer value.

Table 5-27 Procedure for Displaying the Totalizer Value

Step	Operation	Press	Action/Result
1	Alternating Totalizer Display	**LOWR DISP**	Until you see: *Upper Display:* **tPV VALUE** *Lower Display:* **(total value)** **ATTENTION** When two totalizers are configured, notice that channels #1 and #2 totalizer values are alternately displayed.
2	Display Channel #1 totalizer	▲ or ▼	Until CHN "1" indicator lights. *Upper Display:* **1TPV VALUE** *Lower Display:* **(total value)**
3	Display Channel #2 totalizer	▲ or ▼	Until CHN "2" indicator lights. *Upper Display:* **2TPV VALUE** *Lower Display:* **(total value)**
4	Return to Alternating Display	▲ and ▼ simultaneously	You will see: *Upper Display:* **SCAN** *Lower Display:* **(total value)** After the keys are released, the upper display alternately shows #1, #2 PV values while lower display shows #1, #2 totalization values.
5	Return to Normal PV Display	**LOWR DISP**	Returns to normal PV display.

5.14 Monitoring the External Event Operation

Event pen function

If Function prompt "PEN 1IN" under Set-up prompt "PEN 1" has been configured as DGTL1 or DGTL2, the pen (channel) operates as an "event pen" and tracks the remote contact (switch) closure by way of the digital 1 or digital 2 input wired to the alarm output/digital input printed circuit board.

Event pen operation

When the switch opens, the trace for the channel tracks at the configured OFF position (0-100 %) on the chart.

When the switch closes, the trace tracks at the configured ON position (0-100 %) on the chart and tracks at this position until the switch is opened.

Thus, the "Event Pen" record makes it easy to monitor the on/off operation of an external event.

5.15 Maximizing Pen Life

Steps for maximizing pen life

Table 5-28 lists nine steps that will help to maximize the life of your chart pen.

Table 5-28 Maximizing Pen Life

Step	Action
1	Store the chart paper in a cool, clean dry place where the temperature does not exceed 40 °C (104 °F) and the humidity is below 65 % RH.
2	Do not expose the pen tip and chart paper to abrasive chemicals or dust that cause excessive pen wear.
3	If the recorder is used in a dusty atmosphere, provide a positive 'clean air purge' to minimize dust particle accumulation on the chart paper.
4	Periodically clean the pen arm using a cotton swab dipped in alcohol. This is more important when the recorder is located in a dusty environment and no 'clean air purge' is used.
5	Never let the pen tip ride on the chart plate when the paper is not present. Use the pen lifter to raise the arm when changing the paper.
6	Keep the door closed while recording.
7	Always insert the pen arm tip into the shipping sponge when storing or shipping the recorder.
8	Be sure that the chart paper lays flat against the chart plate. Any ripple in the paper will cause light pen printing.
9	Be sure the chart hub assembly is pushed onto the motor shaft so that it is flush with the chart plate.

5.16 Routine Maintenance

Introduction

The DR4500A recorder does not require any periodic maintenance as such. But, you will have to clean the pen tip, and replace the chart and optional chart lamp as required.

WARNING

Do not lubricate the plastic gears on the chart and pen motors.

Cleaning the pen tip

Follow the procedure in Table 5-29 to clean the pen tip.

CAUTION

Cleaning frequency varies with the recording application environment.

Table 5-29 Cleaning the Pen Tip

Step	Action
1	Open the recorder door.
2	Pull the pen lifter up in order to raise the pen from the chart.
3	Carefully clean the pen tip with a cotton swab that has been dipped in alcohol.
4	Push the pen lifter down to lower the pen.
5	Close the door and resume normal operation.

Replacing a burned-out chart lamp (optional)

Follow the procedure in Table 5-30 to replace a burned-out chart lamp.

Table 5-30 Replacing a Chart Lamp

Step	Action
1	Open the recorder door and remove power.
2	Unscrew and remove the hood from the lamp assembly.
3	Push the (bayonet-type) lamp in and turn it counterclockwise to remove it from the socket.
4	Reverse step 3 and install the replacement lamp (General Instrument type 1828 or equivalent) in the socket.
5	Replace the hood on the lamp assembly.
6	Close the door and apply the power.

5.17 Installing/Replacing Chart

Installing/replacing chart procedure

Follow the procedure in Table 5-31 to install/replace the chart.

CAUTION

Store replacement charts in a dust-resistant location. Otherwise, accumulated dust on the chart may cause excessive pen tip abrasion which can shorten expected pen life. In addition, you may want to air purge the case if the recorder is mounted in an extremely dusty environment.

Table 5-31 Installing/Replacing the Chart

Step	Action
1	Open the recorder door.
2	Press the **CHART** key. The pen moves to and stops at the outer limit of pen travel near the edge of the chart. Also, chart rotation stops and the date and time appear in the displays.
3	Pull the pen lifter up to raise the pen from the chart.
4	Carefully remove the used chart from the hub and retaining clips (do not remove the hub adapter).
5	Install the new chart so that its edges are under the four retaining clips and its small alignment hole is over the alignment pin on the hub (that is, press the chart down completely around the hub adapter).
6	Push the pen lifter down to lower the pen.
7	Press the **CHART** key. The recorder goes to the "CHART RUN." The date and time in the display is replaced by the parameter prompt/value that was last selected using the **LOWR DISP** key. **ATTENTION** The recorder has a non-volatile memory. You can reset the processor by cycling the power, but it will have no affect on any data stored. One portion of this stored data is how many motor steps remain in the 7200 steps contained in 360 degrees of chart rotation. The counter that holds this data is reset by going from "CHART HOLD" to "CHART RUN." If, in the "CHART" set up group, the recorder is configured for "HEADER" (YES), a new header is printed, then the pen recording of input values resumes. If "HEADER" (NO) is configured, recording resumes immediately.
8	Be sure to keep the door closed during operation to minimize dust collection on the chart.

5.18 Chart Operation

Normal operation

The recorder functions differently if "NO CONTINUE" or "YES CONTINUE" is selected in Configuration Setup Group "CHART," function prompt "CONTINUE." Refer to *Subsection 3.8* for selection instructions.

NO CONTINUE Operation

- A header is printed (only if "HEADER YES" is selected in Configuration Setup Group "CHART," function prompt "HEADER." Refer to *Subsection 3.8* for selection instructions.)
- Graph starts with a major time line if not a standard chart.

  If standard chart, graph starts with a solid line indicating where the chart began. An incomplete segment will be printed with *no* time or text information up to the next hour mark. At that point, a new time line will be printed, on the hour. The initial incomplete segment will be completed, including any partially printed range values, at the end of the rotation. Additionally, any time or text information being printed when the chart hits 7200 steps will continue to be completed.
- Chart motor takes 7200 steps printing graph, time lines, and PV.
- Counter decrements to 0.
- Chart stops rotation.

YES CONTINUE Operation

- A header is printed (only if "HEADER YES" is selected in Configuration Setup Group "CHART," function prompt "HEADER." Refer to *Subsection 3.8* for selection instructions.)
- Graph starts with a major time line.
- Chart motor takes 7200 steps printing graph, time lines, and PV.
- Counter decrements to 0.
- Graph stops printing.
- PV prints forever (or until the next transition from "CHART RUN" to "CHART HOLD."

Remote chart operation

The Remote Chart feature can be configured to activate on any one of six events. Refer to *Subsection 3.8—Table 3-5* or *Subsection 4.4—Table 4-3* under Function prompt "REMCHT" to select an event.

When the Remote Chart feature is activated, there are three chart modes as defined in Table 5-32.

Table 5-32 Remote Chart Modes

Mode	Definition
HOLD	HOLD is the mode when you are changing the paper or when the chart has completed. HOLD is indicated by the "CHT HLD" flashing in the lower display.
READY	You enter the READY mode from the Hold mode by pressing the **CHART** key *once*. When in the READY mode, the lower display will flash "REM CHT". READY is the "armed" mode where the remote events are allowed. The chart is waiting to be activated by whatever event has been configured or by pressing **CHART** again. It is not retriggerable.
RUN	RUN is the mode where the chart has received its trigger. The chart will remain in RUN until the chart is finished (for non-continue charts) or until you press the **CHART** key. When the **CHART** key is pressed during the RUN mode, the chart will enter the HOLD mode. RUN mode can be *forced* from the READY mode by pressing the **CHART** key.

All modes are saved in battery backed RAM and will be maintained over power cycles.

Recovery from a power loss

The chart will operate as listed below when power is restored after a power loss.

- Recorder shuts down with the remainder of the 7200 motor steps stored.
- The processor goes through memory self-test when power is restored.
- The recorder prints a new motor time line if not a standard chart.
  If standard chart, text information will be lost until the next hour mark.
- The chart counter starts to decrement from the motor step value stored at power loss.
- Normal chart operation resumes.
- A new "HEADER" is *not* printed.
- If power is not interrupted again and normal operation is allowed to continue, the time and date will be printed behind the new major time line. This documents the time that power was restored.

ATTENTION

Multiple major time divisions on varying time bases indicate power or operator problems.

6. Setpoint Ramp/Soak Programming and Operation

6.1 Overview

Introduction

As an option, the recorder can support the programming of a 36-segment setpoint program containing 18 ramp segments and 18 soak segments. In a ramp segment the setpoint value is changed as specified during configuration. The ramp is configured in terms of ramp time or ramp rate, depending on how you have configured the RAMPUNIT parameter. During a soak segment the setpoint is held at the specified value.

For each control loop you can build up to 6 profiles using any number of consecutive segments of the program.

Odd-numbered segments are always ramp segments. Even-numbered segments are always soaks. These ramp and soak segments can be used in up to six programs. You designate the beginning and end segments to determine where the program will start or stop.

- Every profile must start with a ramp segment and end on a soak segment.
- Control Loop must have Setpoint Source set to 1LOCAL.
- Control Loop 1 uses SP RAMP1, Control Loop 2 uses SP RAMP2. SP RAMP1 and SP RAMP2 are the prompts under which the setpoint program is configured.
- Recorder must be set to use SP1 (setpoint 1).
- Only contiguous segments can be used by a profile.
- There can be overlap between programs. For example, Profile 1 could use Segments 1, 2, 3, 4, 5, and 6. Profile 2 could be configured to begin with Segment 5 and end with Segment 8.

This section contains instructions for setting up a setpoint program, and for executing the program at runtime.

Note that Section 4 contains instructions for using the setpoint ramp or setpoint rate. **The SP RAMP (setpoint ramp) and SP RATE (setpoint rate) parameters described in Section 4 must be set to DISABL (disabled) if a setpoint program is to be used.**

ATTENTION

If power is lost during execution of a program, upon power-up the recorder will use the last setpoint value prior to the beginning of the setpoint program. The program is placed in hold at the beginning. The Manual/Auto mode will be as configured under "POWER UP" in the "CONTROL" group.

What's in this section?

This section contains the following information:

Topic	See Page
6.2 Setpoint Program Contents	175
6.3 Drawing a Ramp/Soak Profile	178
6.4 Entering the Setpoint Program Data	183
6.5 SP RAMP1 and SP RAMP2 Set Up Group	185
6.6 Setpoint Program Profiles Set Up Group	187
6.7 Setpoint Program Segments Set Up Group	189
6.8 Setpoint Program Event Set Up Group	192
6.9 Run/Monitor the Program	196

6.2 Setpoint Program Contents

What you will configure

You will configure all the data that is relevant to each ramp and soak segment for a given setpoint versus time program (profile). The recorder will prompt you through the sequence of segments and associated functions. These prompts and functions are described below.

Recycle number

The recycle number allows the program to recycle a specified number of times from beginning to end.

- Range = 0 to 99

Guaranteed soak

A SOAK DEV (soak deviation) parameter is provided. If its value is not zero, then soaking will be frozen for each segment until the difference (plus or minus) between PV and SP is less than or equal to the value of SOAK DEV.

There are no guaranteed soaks whenever SOAKDEV = 0. In this case, soak segments start timing soak duration as soon as the soak setpoint is first reached, regardless of where the process variable remains relative to the soak setpoint during the duration of the segment.

The decimal location corresponds to input 1 decimal selection.

Profile number

The profile number specifies which of up to six profiles will run. Up to 6 profiles can be configured out of any even number of consecutive segments from the 36 segments configured.

Program state

The program state selection determines the program state after completion.

The selections are:

- DISABL = program is disabled
- HOLD = program on hold

Recovery

If Recovery is enabled the setpoint program will continue from where it left off after the last power down.

Program End State

This determines the status of the recorder upon completion of the profile. The selections are:

- LAST SP = hold at the last setpoint in the program
- F SAFE = Manual mode, Failsafe Output

Profile Start and Profile End

These selections let you specify the segments that will comprise each of the 6 profiles. The first segment must be a ramp (odd-numbered segment) and the last segment must be a soak (even-numbered).

Ramp unit

The ramp unit selection determines the engineering units for the ramp segments.

The selections are:

- TIME = Hours:Minutes
- EU-H = Degrees/Hour OR EU-M = Degrees/Minute

Ramp time or rate segments

A ramp segment is used to change the setpoint to the next soak setpoint value in the program.

- Ramps are odd-numbered segments. Segment 1 will be the initial ramp.
- Ramps are specifed in terms of either:

  TIME* - Hours:Minutes Range = 0-99 hrs:59 min.

  or

  EU-M* - Degrees/Minute Range = 0 to 999
  EU-H* - Degrees/Hour
  ** The selection of time or rate is made at prompt "RAMP UNIT"*

Set this prompt before entering any Ramp information.

ATTENTION

Entering "0" will imply an immediate step change in setpoint to the next soak.

Soak segments

A soak segment is a combination of soak setpoint (value) and a soak duration (time).

- Soaks are even-numbered segments.
- Segment 2 will be the initial soak value and soak time.
- The soak setpoint range value must be within the setpoint high and low range limits in engineering units. (Specify the setpoint range with SP HI and SP LO in the control group as described in Section 4.)
- Soak time is the duration of the soak and is determined in:

  TIME - Hours:Minutes Range = 0-99 hrs:59 min.

Segment Events

Each segment can be programmed to trigger an alarm which in turn deenergizes the associated relay. The selected alarm must be programmed as an event type for this to occur. Selections are:

ALARM 1 – ALARM 6.

Segment events will not trigger a relay if that relay is configured with one of these higher priority functions:

- Control loop output
- Interval Timer
- alarm type other than "Event".

See Table 6-7.

Digital input (remote) operation

Program can be placed in RUN or HOLD state through a remote dry contact connected to optional digital input terminals. The Control Loop parameters REM SW and REM SW2 parameters must be configured as RN/HLD to support this function. The valid states of the contacts are:

- RUN—contact closure places program in HOLD state
- HOLD—contact open places program in RUN state

6.3 Drawing a Ramp/Soak Profile

Ramp/soak profile example

Before you perform the actual configuration, we recommend that you draw your Ramp/Soak profiles in the space provided on the blank graphs and fill in the associated information on the worksheet. An example of a Ramp-Soak Profile using the first twelve segments for Profile 1 is shown in Figure 6-1. Start setpoint in this example is at 200 °F. Assume each soak segment is desired to trigger an event. Assume you are configuring the program to be used by Control Loop1 (SP RAMP1).

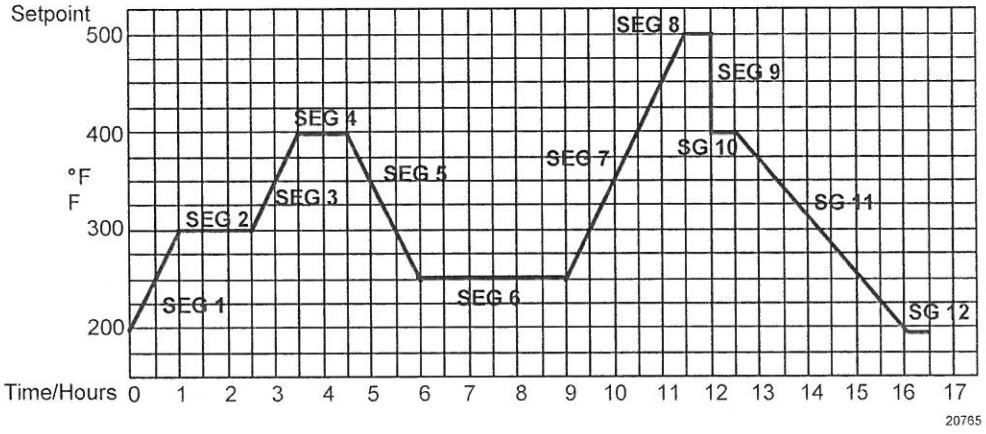


Figure 6-1 Ramp/Soak Profile Example

Table 6-1 Parameter settings for example 12-step profile

Prompt	Function	Segment	Value
SP RAMP1	Settings for Control Loop 1 ramp		
SP PROG	Enables SP prompts.		ENABLE
RECYCLES	Number of Recycles		2
SOAK DEV	Deviation Value		0
PROFILE	Number of profile to run		1
STATE	Program State at end		HOLD
RECOVERY	Program resumes after power interruption		ENABLE
PROG END	SP value after last segment		LAST SP
SPP SEGS	Settings for segments		
PR1 STRT	Profile 1 Start Seg.		1
PR1 END	Profile 1 End Seg.		12
RAMPUNIT	Ramp Units		TIME
SEG1 RAMP	Ramp	1	1 hr.
SEG2 SP	Soak SP	2	300
SEG2TIME	Soak Time	2	1hr.:30 min.
SEG3RAMP	Ramp	3	1hr.
SEG4 SP	Soak SP	4	400
SEG4TIME	Soak Time	4	1 hr.
SEG5RAMP	Ramp	5	1hr.:30 min.
SEG6 SP	Soak SP	6	250
SEG6TIME	Soak Time	6	3hrs.:0min.

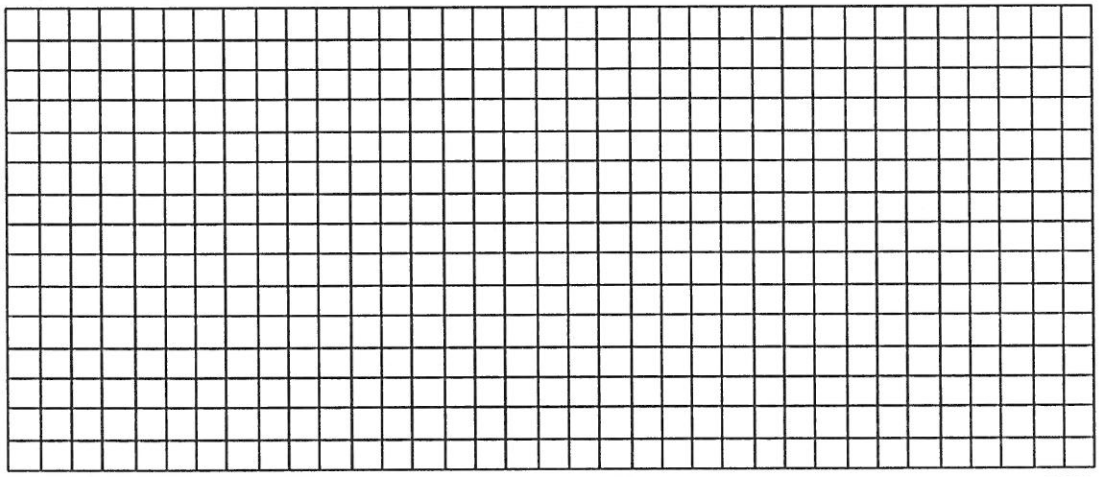
Prompt	Function	Segment	Value
SEG7RAMP	Ramp	7	2hrs:30min.
SEG8 SP	Soak SP	8	500
SEG8TIME	Soak Time	8	0hr.:30 min.
SEG9RAMP	Ramp	9	0
SEG10 SP	Soak SP	10	400
SEG10TIME	Soak Time	10	0hr.:30 min.
SEG11RAMP	Ramp	11	3hrs:30min.
SEG12 SP	Soak SP	12	200
SEG12TIME	Soak Time	12	0hr.:30 min.
SEG1 EV	Event	1	NONE
SEG2 EV	Event	2	ALARM1
SEG3 EV	Event	3	NONE
SEG4 EV	Event	4	ALARM1
SEG5 EV	Event	5	NONE
SEG6 EV	Event	6	ALARM1
SEG7 EV	Event	7	NONE
SEG8 EV	Event	8	ALARM1
SEG9 EV	Event	9	NONE
SEG10 EV	Event	10	ALARM1
SEG11 EV	Event	11	NONE
SEG12 EV	Event	12	ALARM1

Reminder: There are up to 36 segments available for inclusion in a profile. The above example uses only the first 12.

Profile graphs

Draw your six ramp/soak profiles on the graphs below and fill in the associated information in the worksheets that follow in the next sections. This will give you a permanent record of your program and will assist you when entering the ramp and soak values.

Profile 1



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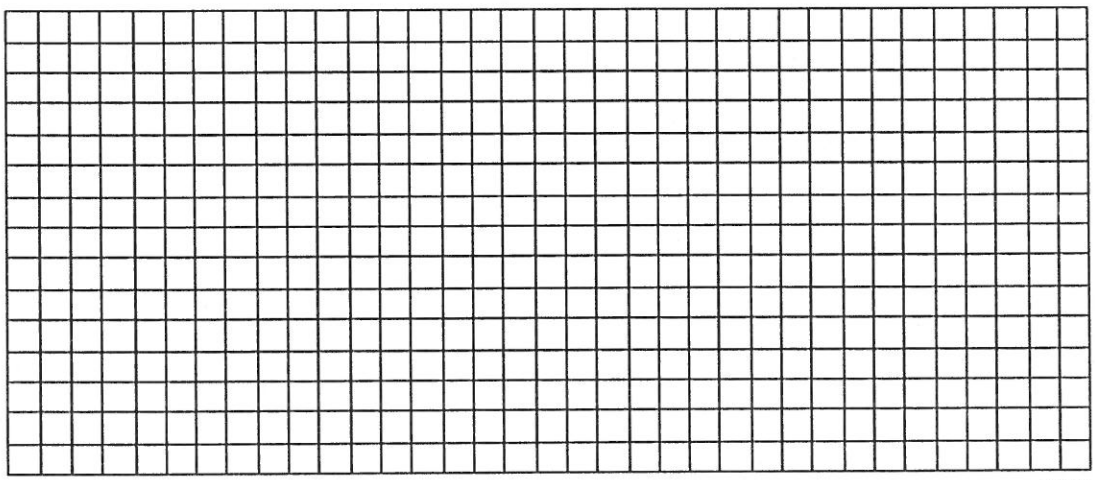
Profile 2



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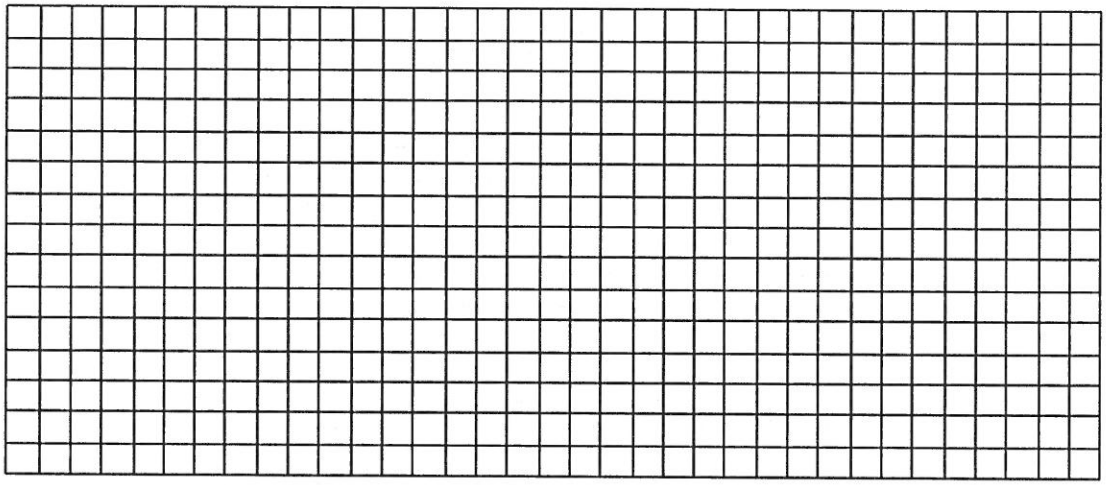
Profile 3



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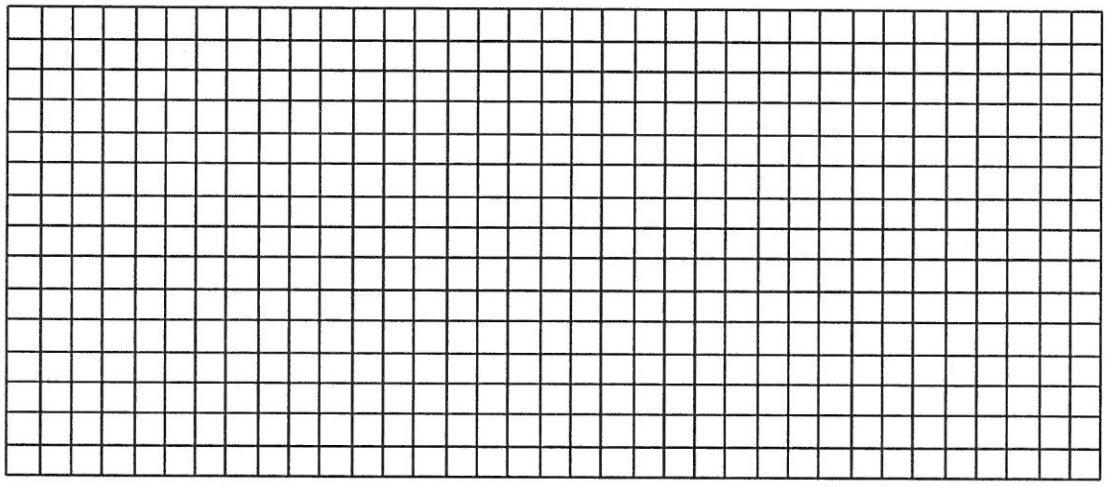
Profile 4



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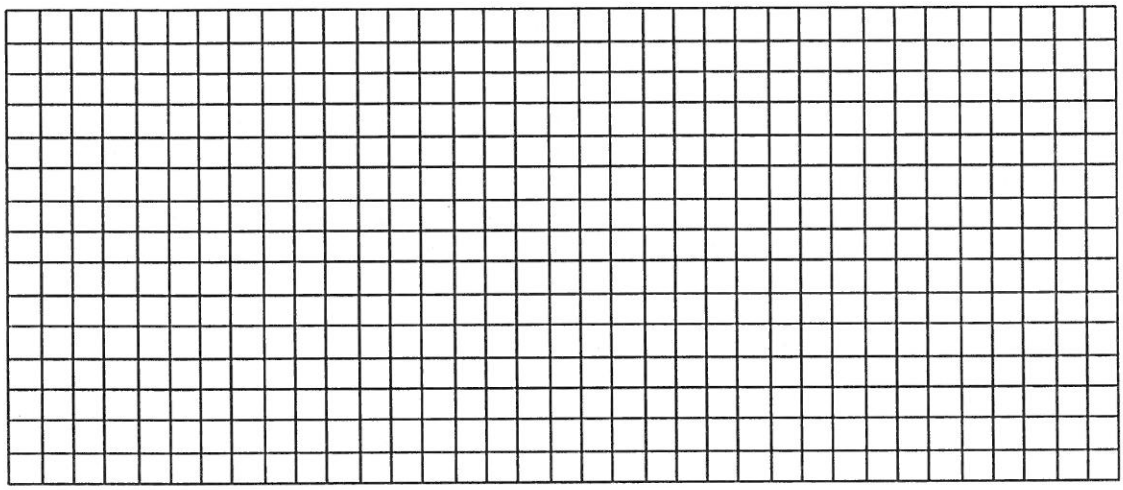
Profile 5



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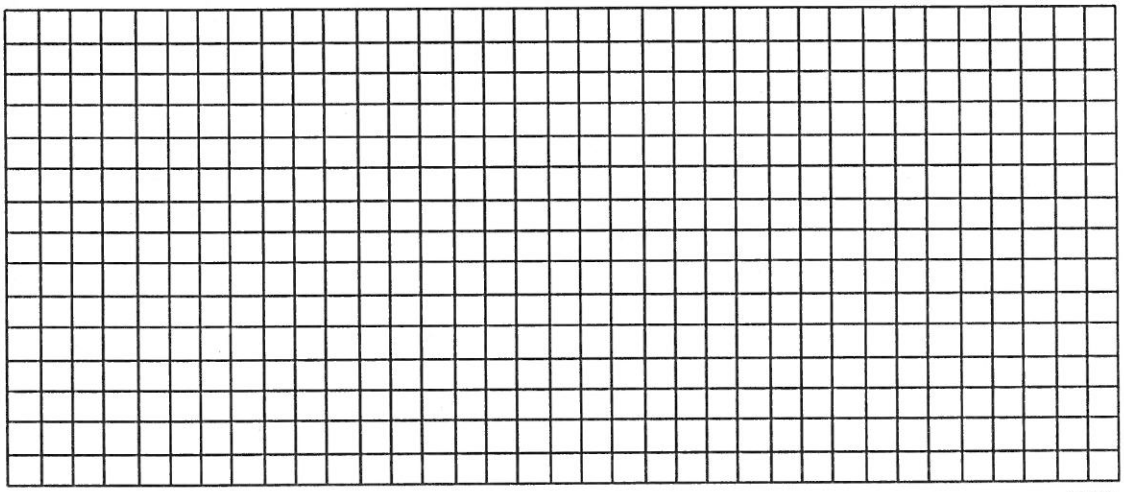
Profile 6



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6.4 Entering the Setpoint Program Data

Introduction

The procedure listed in Table 6-2 tells you what keys to press and what prompts you will see when entering the setpoint program data. Follow the prompts in Subsections 6.5 through 6.8 when selecting the functions for setpoint programming.

ATTENTION

Make sure SP RAMP and SP RATE are disabled first.

Table 6-2 Setpoint program data entry procedure

Step	Operation	Press	Action/Result
1	Select SP PROG Group	**SET UP**	Until you see: *Upper Display:* **SET UP** *Lower Display:* **SP RAMPn** **n** = 1 or 2
2	Access SP PROG	**FUNC**	Until you see: *Upper Display:* **DISABL** *Lower Display:* **SP PROG** If you see *Upper Display:* **ENABLE** *Lower Display:* **SP RAMP** or *Upper Display:* **ENABLE** *Lower Display:* **SP RATE** you must disable them. SP PROG and its subordinate prompts are not visible unless SP RAMP and SP RATE are disabled. Once they are disabled, press FUNC until you see SP PROG.
3	Enable SP PROG	▲ or ▼	Until you see: *Upper Display:* **ENABLE** *Lower Display:* **SP PROG**
4	Select the functions	**FUNC**	*Upper Display:* shows current value for each prompt *Lower Display:* shows individual function prompts within the setpoint program group • Successive presses of the **FUNCTION** key sequentially displays all the functions and their values or selections. • Using the **FUNCTION** key, follow the prompts shown in Sections 6.5 through 6.8.

Step	Operation	Press	Action/Result
5	Change the value or selection of a function prompt	▲ or ▼	This changes the value or selection in the upper display. If the display blinks, you are trying to select an unacceptable value.
6	Enter value or selection into memory	**FUNC**	This enters the value or selection and goes to another prompt. • Repeat steps 4 and 5 for each function you want to change.
7	Exit configuration	**LOWR DISP**	This exits from the configuration mode.

6.5 SP RAMP1 and SP RAMP2 Set Up Group

Introduction

There is a SP RAMP set up group for each control loop. Use the prompts to select the settings for each loop's program.

SP RAMP prompts

Table 6-3 lists all the function prompts for SP RAMP configuration in the order of their appearance. These prompts are available when SPPROG is enabled in the SPRAMP set up group described in *Section 4.*

All parameters may be changed while the program is disabled or in HOLD.

Table 6-3 SP RAMP prompts and available selections

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
SPPROG	DISABL ENABLE	SETPOINT PROGRAMMING—This must be set to ENABLE for the setpoint program feature to work, and for the associated operating parameters to be displayed. SPRAMP and SP RATE must be disabled. *(See Section 4.)* DISABL—Disabled ENABLE—Enabled
RECYCLES	0 to 99	RECYCLES—Enter the number of times the program selected for execution will be repeated.
SOAKDEV	-99.9 to 99.9 engineering units	SOAK DEVIATION—Enter the acceptable deviation from setpoint during a soak cycle. If the PV differs from the setpoint by more than the value of SOAKDEV, soak time is frozen. There are no guaranteed soaks if SOAKDEV = 0.
PROFILE	1 to 6	PROFILE used by Setpoint Program. This can also be set or changed when viewed in the lower display and the current profile is in the HOLD state.
STATE	DISABLE HOLD	Determines the state of the program after it completes the final program segment cycles. If you select DISABL, you must enable the program through the function prompt before you can run the program again. If you select HOLD, you can run the program again by pressing the **RUN/HOLD** key.
RECOVERY	ENABLE DISABL	This mode, when enabled, will allow the SP Program to continue from the point at which the power was removed when there is a power interruption.
PROG END	ENABLE DISABL	Determines the status of the control output after the program is run. If you select LASTSP, the recorder controls to the last setpoint value which becomes the LSP. For FSAFE selection, the recorder is switched to manual mode and to the selected failsafe output value.

SP RAMP 1 and SP RAMP 2 worksheet

Use this worksheet to make a record of your SP RAMP1 and SP RAMP2 settings.

Prompt	Description	Range	Your selection
SP RAMP1	Accesses prompts for Control Loop 1's profile	N/A	N/A
SP PROG	Enables SP Program prompts.	ENABLE DISABLE	ENABLE
RECYCLES	Number of Recycles	0-99	
SOAK DEV	Deviation Value	0.0-99	
PROFILE	Number of profile to run	1-6	
STATE	Program State at end	DISABL HOLD	
RECOVERY	Program resumes after power interruption	ENABLE DISABLE	
PROG END	SP value after last segment	LASTSP FSAFE	
SP RAMP2	Accesses prompts for Control Loop 2's profile	N/A	N/A
SP PROG	Enables SP Program prompts.	ENABLE DISABLE	ENABLE
RECYCLES	Number of Recycles	0-99	
SOAK DEV	Deviation Value	0.0-99	
PROFILE	Number of profile to run	1-6	
STATE	Program State at end	DISABL HOLD	
RECOVERY	Program resumes after power interruption	ENABLE DISABLE	
PROG END	SP value after last segment	LASTSP FSAFE	

6.6 Setpoint Program Profiles Set Up Group

Introduction

You can configure up to six profiles; each profile contains a subset of the 36 segments. Each profile starts with a ramp segment and ends with a soak segment. Each control loop uses one of these profiles. They can use the same profile, too. The profiles can be synchronized to RUN/HOLD together.

Setpoint program profiles group prompts

Table 6-4 lists all the function prompts in the Setpoint Program Profiles setup group and their definitions.

Table 6-4 Setpoint Program Profiles Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
PRx STRT	RAMP1 – RAMP 35	You can configure up to 6 profiles (PR1 – PR6). Each profile contains a subset of the 36 ramp and soak segments configured later. PRx STRT designates the number of the first segment of the profile. It will be a ramp segment (odd number).
PRx END	SOAK2 – SOAK36	This designates the number of the last segment of the profile. It will be a soak segment (even number).
RAMPUNIT	TIME (Hours:Minutes) EU/MIN (Engineering Units/Minute) EU/HR (Engineering Units/Hour)	This determines the engineering units for the ramp segments.
SYNC 1+2	ENABLE DISABL	Synchronizes the profiles for Control Loops 1 and 2. This means that: a) Both SP programs will RUN or HOLD simultaneously. b) A Guaranteed Soak Hold on one profile will cause the other profile to HOLD for the duration of the Guaranteed Soak Hold.

Setpoint program profiles worksheet

Use this worksheet to keep a record of your setpoint profile settings.

Prompt	Function	Range	Your selection
PROFILES	Settings for profiles		
PR1 STRT	Start Segment for Progam 1	RAMP1 to RAMP35	
PR1 END	End Segment for Program 1	SOAK2 to SOAK36	
PR2 STRT	Start Segment for Program 2	RAMP1 to RAMP35	
PR2 END	End Segment for Program 2	SOAK2 to SOAK36	
PR3 STRT	Start Segment for Program 3	RAMP1 to RAMP35	
PR3 END	End Segment for Program 3	SOAK2 to SOAK36	
PR4 STRT	Start Segment for Program 4	RAMP1 to RAMP35	
PR4 END	End Segment for Program 4	SOAK2 to SOAK36	
PR5 STRT	Start Segment for Program 5	RAMP1 to RAMP35	
PR5 END	End Segment for Progam 5	SOAK2 to SOAK36	
PR6 STRT	Start Segment for Program 6	RAMP1 to RAMP35	
PR6 END	End Segment for Program 6	SOAK2 to SOAK36	
RAMPUNIT	Ramp type	TIME EU/MIN EU/HR	
SYNC 1+2	Synchronizes profile for Control Loops 1 and 2.	ENABLE DISABL	

6.7 Setpoint Program Segments Set Up Group

Introduction

You can configure up to 36 ramp and soak segments.

Setpoint program segments group prompts

Table 6-5 lists all the function prompts in the Setpoint Program Segments setup group and their definitions.

Table 6-5 Setpoint Program Segments Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
SEGxRAMP (x = 1, 3, 5,...35)	0-99 hrs:59 min. (Time) 0 to 999 (Rate)	A ramp segment is the time it takes to change the setpoint to the next setpoint value in the program. • Ramps are odd number segments. Segment #1 will be the initial ramp time. • This selection of time or rate is made at prompt "RAMPUNIT". ATTENTION: Entering "0" implies an immediate step change in setpoint to the next soak.
SEGx SP (x = 2, 4, 6...36)	Within the setpoint high and low range limits in engineering units	The soak segment's setpoint value
SEGxTIME (x = 2, 4, 6...36)	0-99 hrs:59 min.	The soak segment's duration.

Setpoint program segments worksheet

Use this worksheet to keep a record of your setpoint segment settings.

Prompt	Function	Range	Your Selection
SPP SEGS	Settings for segments		
SEG1RAMP	Start Seg Prog 1	RAMP1 to RAMP35	
SEG2 SP	End Seg Prog 1	SOAK2 to SOAK36	
SEG2 TIME	Start Seg Prog 2	RAMP1 to RAMP35	
SEG3 RAMP	Ramp	00 to 99.59	
SEG4 SP	Soak SP	Within SP limits	
SEG4TIME	Soak Time	00.00 to 99.59	
SEG5 RAMP	Ramp	00 to 99.59	
SEG6 SP	Soak SP	Within SP limits	
SEG6TIME	Soak TIme	00.00 to 99.59	
SEG7 RAMP	Ramp	00 to 99.59	
SEG8 SP	Soak SP	Within SP limits	
SEG8TIME	Soak TIme	00.00 to 99.59	
SEG9RAMP	Ramp	00 to 99.59	
SG10 SP	Soak SP	Within SP limits	
SG10TIME	Soak TIme	00.00 to 99.59	
SG11RAMP	Ramp	00 to 99.59	
SG12 SP	Soak SP	Within SP limits	
SG12TIME	Soak TIme	00.00 to 99.59	
SG13RAMP	Ramp	00 to 99.59	
SG14 SP	Soak SP	Within SP limits	
SG14TIME	Soak TIme	00.00 to 99.59	

Prompt	Function	Range	Your Selection
SG15RAMP	Ramp	00 to 99.59	
SG16 SP	Soak SP	Within SP limits	
SG16TIME	Soak Time	00.00 to 99.59	
SG17RAMP	Ramp	00 to 99.59	
SG18 SP	Soak SP	Within SP limits	
SG18TIME	Soak TIme	00.00 to 99.59	
SG19RAMP	Ramp	00 to 99.59	
SG20 SP	Soak SP	Within SP limits	
SG20TIME	Soak TIme	00.00 to 99.59	
SG21RAMP	Ramp	00 to 99.59	
SG22 SP	Soak SP	Within SP limits	
SG22TIME	Soak TIme	00.00 to 99.59	
SG23RAMP	Ramp	00 to 99.59	
SG24 SP	Soak SP	Within SP limits	
SG24TIME	Soak TIme	00.00 to 99.59	
SG25RAMP	Ramp	00 to 99.59	
SG26 SP	Soak SP	Within SP limits	
SG26TIME	Soak Time	00.00 to 99.59	
SG27RAMP	Ramp	00.00 to 99.59	
SG28 SP	Soak SP	Within SP limits	
SG28TIME	Soak Time	00.00 to 99.59	
SG29RAMP	Ramp	00.00 to 99.59	

Prompt	Function	Range	Your Selection
SG30 SP	Soak SP	Within SP limits	
SG30TIME	Soak Time	00.00 to 99.59	
SG31RAMP	Ramp	00.00 to 99.59	
SG32 SP	Soak SP	Within SP limits	
SG32TIME	Soak Time	00.00 to 99.59	
SG33RAMP	Ramp	00.00 to 99.59	

Prompt	Function	Range	Your Selection
SG34 SP	Soak SP	Within SP limits	
SG34TIME	Soak Time	00.00 to 99.59	
SG35RAMP	Ramp	00.00 to 99.59	
SG36 SP	Soak SP	Within SP limits	
SG36TIME	Soak Time	00.00 to 99.59	

6.8 Setpoint Program Event Set Up Group

Introduction

Segment events are used to activate relays by means of alarms. There are six alarms and six corresponding relays. Alarm 1 controls Relay 1, Alarm 2 controls Relay 2, etc. When the setpoint program reaches the segment, the segment event triggers the alarm which triggers the relay. The relay stays on for the duration of the segment. There are no alarm conditions to be satisfied, that is, when the event goes on the alarm goes on.

How to trigger a relay with a segment event

1. Program the segment event with the alarm corresponding with the desired relay.
2. Program that alarm as type EVENT. It is not necessary to program any alarm parameters other than the alarm type.
3. Do not program other functions that have higher priority control of the relay. See Table 6-7.

Setpoint Program Event group prompts

Table 6-6 lists all the function prompts in the Setpoint Program Event setup group and their definitions.

Table 6-6 Setpoint Program Event Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
SEGx EV (x = 1-36)	NONE ALARM1, ALARM2, ALARM3, ALARM4, ALARM5, ALARM6	Configured event will be active during the segment. All others will be inactive.

Example of how a segment event works

For example, to have Segment 1 energize Relay 1:

- Program SEG1 EV as ALARM1.
- Program A1S1TYPE or A1S2TYPE as EVENT.
- Do not program the Timer function Relay 1; namely, Timer.

For alarm programming information, see *Subsection 4.12.*

To ensure control of relay by segment event

To make sure a segment event operates the associated relay, observe the requirements below.

Table 6-7 Segment Event relay operation requirements

Relay	Relay is controlled by (in order of priority)	Requirements for operation of relay by segment event
1	1. Timer function 2. Alarm 1	• Do not configure Timer. • Configure Alarm 1 type Event.
2	Alarm 2	Configure Alarm 2 type Event.
3	1. Controller 1 output algorithms Relay Simplex, Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 3	• Do not configure Controller #1 with these output algorithms. • Configure Alarm 3 type Event.
4	1. Controller 1 output algorithms Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 4	• Do not configure Controller #1 with these output algorithms. • Configure Alarm 4 type Event.
5	1. Controller 2 output algorithms Relay Simplex, Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 5	• Do not configure Controller #2 with these output algorithms. • Configure Alarm 5 type Event.
6	1. Controller 2 output algorithms Position Proportional, Relay Duplex, Current/Relay Duplex 2. Alarm 6	• Do not configure Controller #2 with these output algorithms. • Configure Alarm 6 type Event.

Setpoint program events worksheet

Use this worksheet to make a record of the segment event settings.

Prompt	Description	Range	Your selection
SPP EVNT	Access to events	N/A	N/A
SEG1 EV	Event status	NONE ALARM1 ALARM2 ALARM3 ALARM4 ALARM5 ALARM6	
SEG2 EV	Event status	Same	
SEG3 EV	Event status	Same	
SEG4 EV	Event status	Same	
SEG5 EV	Event status	Same	
SEG6 EV	Event status	Same	
SEG7 EV	Event status	Same	
SEG8 EV	Event status	Same	
SEG9 EV	Event status	Same	
SEG10 EV	Event status	Same	
SEG11 EV	Event status	Same	
SEG12 EV	Event status	Same	
SEG13 EV	Event status	Same	
SEG14 EV	Event status	Same	
SEG15 EV	Event status	Same	
SEG16 EV	Event status	Same	
SEG17 EV	Event status	Same	
SEG18 EV	Event status	Same	
SEG19 EV	Event status	Same	
SEG20 EV	Event status	Same	
SEG21 EV	Event status	Same	
SEG22 EV	Event status	Same	
SEG23 EV	Event status	Same	
SEG24 EV	Event status	Same	
SEG25 EV	Event status	Same	
SEG26 EV	Event status	Same	

Prompt	Description	Range	Your selection
SEG27 EV	Event status	Same	
SEG28 EV	Event status	Same	
SEG29 EV	Event status	Same	
SEG30 EV	Event status	Same	
SEG31 EV	Event status	Same	
SEG32 EV	Event status	Same	
SEG33 EV	Event status	Same	
SEG34 EV	Event status	Same	
SEG35 EV	Event status	Same	
SEG36 EV	Event status	Same	

6.9 Run/Monitor the Program

Introduction

Make sure all the "SP PROG" function prompts under the Set Up group "SP RAMP" have been configured with the required data.

- An "H" appears in the upper display indicating that the program is in the HOLD state. If an "H" doesn't appear, go to the SP Program configuration procedure and enable the program instead of disabling.

ATTENTION

For recorders with two controllers (both enabled), remember that any controller-related values displayed correspond with the lighted CHN indicator. "1" means that the values apply for Controller #1 and "2" means that the values apply for Controller #2.

Run/Monitor functions

Table 6-8 lists all the functions required to run and monitor the program.

Table 6-8 Run/Monitor Functions

Function	Press	Result
Run State	RUN HOLD	Initiates the setpoint program. "**H**" changes to "**R**" in the upper display indicating that the program is running. PV value and pen trace tracks the ramp soak profile.
Hold State	RUN HOLD	Holds the setpoint program. • An "**H**" appears in the upper display indicating that the program is in the HOLD state. • The setpoint holds at the current setpoint. Press again to continue to run.
External Hold		If Remote Switching (Digital Input Option) is present on your recorder, contact closure places the recorder in the HOLD state, if the setpoint program is running. • The "**H**" in the upper display blinks. **ATTENTION** The keyboard takes priority over external switch for the RUN/HOLD function. • Contact reopening runs program.

Function	Press	Result
Viewing the present ramp or soak segment number and time	**LOWR DISP**	Until you see: *Upper Display:* **R** and the PV value *Lower Display:* For Ramp segments: **# RA XX.XX** Segment Number (odd only) Indicates Ramp segment Ramp Time - Hours:Minutes or Ramp Rate - Degrees/Minute For Soak segments: **# SK XX.XX** Segment Number (even only) Indicates Soak segment Time remaining in segment in Hrs:Minutes including current partially completed minute
Skipping segments	**LOWR DISP**	Until you see: *Upper Display:* **R** and the PV value *Lower Display:* **#RA XX.XX** (Ramp Segment) **#SK XX.XX** (Soak Segment)
	RUN HOLD	To hold the SP Program • An "**H**" appears in the upper display indicating that the program is in the HOLD state.
	▲ or ▼	To select new segment
	RUN HOLD or **LOWR DISP**	To begin running at new segment To retain the old segment
Viewing the number of cycles left in the program	**LOWER DISP**	Until you see: *Upper Display:* **R** and the PV value *Lower Display:* **RECYC XX** Remaining cycles 0 to 99 This number includes the current partially completed cycle.
End Program		When the final segment is completed, the "**R**" in the upper display either changes to "**H**" if configured for HOLD state, or disappears if configured for DISABL of setpoint programming. • The recorder operates at the last setpoint in the program in automatic or will be in manual mode at the failsafe output.

7. Input Calibration

7.1 Overview

SHOCK HAZARD – WARNING!

Disregard of these instructions may cause injury or death.
INPUT CALIBRATION MAY REQUIRE ACCESS TO HAZARDOUS LIVE CIRCUITS, AND SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL. MORE THAN ONE SWITCH MAY BE REQUIRED TO DE-ENERGIZE UNIT BEFORE CALIBRATION.

Introduction

This section describes the field calibration procedures for inputs 1, 2, 3, and 4. All DR4500A recorders are factory calibrated prior to shipment. It should not, therefore, be necessary to recalibrate the recorder when it is initially installed. However, you must recalibrate the input if any one of the conditions summarized below applies:

- The thermocouple or RTD input must meet published* accuracy rates. Note that the factory calibration at reference is ± 1.2 °F plus ± 10 microvolts for thermocouples or ± 0.3 ohms for RTDs.
  * Specifications 44-45-03-14
- You are using a 0-10 Vdc input. Recalibration is necessary because the resistor network used for this input has a tolerance of ± 1.0 %.
- You have cause to believe that the recorder is out of calibration.
- You must perform regularly scheduled or periodic recalibration based on your own needs.
- You have performed specific servicing activities such as replacement of an input PCB.

ATTENTION

Replacing a main PCB does not normally require recalibration since a new main PCB is already factory calibrated, whereas an input PCB is not.

- You have changed the input type through configuration which results in the loss of the previous field calibration, but restores factory calibration. See *Subsection 7.2 Restoring Factory Calibration* paragraph that follows.

What's in this section?

This section contains the following topics:

	Topic	See Page
7.1	Overview	199
7.2	Restoring Factory Calibration	200
7.3	Minimum and Maximum Range Values	202
7.4	Preliminary Information	203
7.5	Calibration Set Up and Wiring for PV Inputs	205
7.6	Calibration Procedure	214
7.7	Printing Characteristics Adjustments	217

7.2 Restoring Factory Calibration

How to restore it

The factory calibration constants for all the input actuation types that can be used with the DR4500A recorder are stored in its nonvolatile memory. Thus, you can quickly restore the "Factory Calibration" for a given input actuation type by simply configuring the actuation type through the IN1 TYPE (or IN2 TYPE, IN3 TYPE, IN4 TYPE) prompt to another type and then changing it back to the original type. See Table 7-1 for the procedure.

ATTENTION

This procedure applies only for factory-installed inputs. Any input that was field-installed must be field calibrated.

Procedure

Table 7-1 lists the procedure for restoring factory calibration.

Table 7-1 Restoring Factory Calibration

Step	Operation	Press	Action/Result
1	Enter Input Setup Group	**SET UP**	Until you see: *Upper Display:* **SET UP** *Lower Display:* **INPUT n** **n** = 1, 2, 3, or 4
2	Change input type	**FUNC**	Until you see: *Upper Display:* Note the input type in the upper display. Make sure that the selection matches the type of sensor that is connected to the input in your application. Write it down, if necessary. *Lower Display:* **INn TYPE** **n** = 1, 2, 3, or 4
		▲ or ▼	Until you see: *Upper Display:* **0-10V** *Lower Display:* **INn TYPE** **ATTENTION** If you are already using a 0-10V input, change to a 0-5V input type.
		FUNC	Until the upper display rolls through the input types and returns to *Upper Display:* **0-10V** *Lower Display:* **INn TYPE**

Step	Operation	Press	Action/Result
		▲ or ▼	Until you change the input selection in the upper display back to the proper selection. You will see: *Upper Display:* Original input selection that matches your type of sensor. *Lower Display:* **INn TYPE**
3	Return to normal operating mode	**LOWR DISP**	To return to Normal operating mode. The factory calibration will be restored. If the problem is not corrected, contact the Honeywell Technical Assistance Center. 1-800-423-9883 USA and Canada

CAUTION

A restored factory calibration overwrites any previous field calibration done for the input. Be sure to protect any field calibration from accidental overwrites by configuring the appropriate "LOCKOUT" selection after calibration. See the *Section 3 - Configuration* for specific instructions to set the lockout.

7.3 Minimum and Maximum Range Values

Select the range values

You should calibrate the recorder for the minimum (0 %) and maximum (100 %) range values of your particular sensor.

- If your recorder has two or more inputs, calibrate each input separately. Select the voltage or resistance equivalent for 0 % and 100 % range values from Table 7-2, use these values when calibrating your recorder.

Table 7-2 Voltage and Resistance Equivalents for 0 % and 100 % Range Values

Sensor Type	PV Input Range		Range Values*		
Thermocouples	°F	°C	0 %	68 °F/20 °C	100 %
B	105 to 3300	41 to 1816	0 mV	0.003 mV	13.763 mV
E	–454 to 1832	–270 to 1000	–9.835 mV	1.192 mV	76.358 mV
E (low)	–200 to 1100	–129 to 593	–6.471 mV		44.547 mV
J	0 to 1600	–18 to 871	–0.885 mV	1.019 mV	50.059 mV
J (low)	20 to 770	–7 to 410	–0.334 mV		22.397 mV
K	–320 to 2500	–196 to 1371	–5.822 mV	0.798 mV	54.845 mV
K (low)	–20 to 1000	–29 to 538	–1.114 mV		22.251 mV
NiNiMoly	32 to 2500	0 to 1371	–0.001 mV	1.458 mV	71.330 mV
NIC Nicrosil Nisil	0 to 2372	–17.8 to 1300	–0.461 mV	0.525 mV	47.502 mV
R	0 to 3100	–18 to 1704	–0.089 mV	0.111 mV	20.275 mV
S	0 to 3100	–18 to 1704	–0.092 mV	0.113 mV	17.993 mV
T	–300 to 700	–184 to 371	–5.341 mV	0.789 mV	19.095 mV
T (low)	–200 to 600	–129 to 316	–4.149 mV		15.769 mV
W5W26	0 to 4200	–18 to 2315	–0.234 mV	0.062 mV	37.066 mV
W5W26 (low)	0 to 2240	–18 to 1227	–0.234 mV		22.277 mV
RTD***					
100 Ω	–300 to 900	–184 to 482	25.18 Ω		274.96 Ω
100 Ω (RH)	–130 to 392	–90 to 200	64.30 Ω		175.84 Ω
200 Ω	32 to 752	0 to 400	200 Ω		498.10 Ω
200 Ω	32 to 392	0 to 200	200 Ω		353.74 Ω
500 Ω	–300 to 900	–184 to 482	125.90 Ω		1374.80 Ω
Milliamps	4 to 20 mA		4 mA		20 mA
Millivolts	0 to 10 mV		0 mV		10 mV
	10 to 50 mV		10 mV		50 mV
Volts	0 to 5 Volts		0 Volts		5 Volts
	0 to 10 Volts**		0 Vols		10 Volts
Radiamatic (RH)	1400 to 3400	760 to 1871	0.99 mV		57.12 mV

*Range values for thermocouples are based on a cold junction temperature of 32 °F (0 °C). These values must be adjusted for the actual cold junction temperature when using the ambient temperature method for calibrating thermocouple inputs.

**Resistor network 30755232-002 must be installed in inputs #1, #2, #3, and #4 when using this range, see set up diagram for details.

***IEC = .00385—100 Ω
IEC = .003902—200 Ω

7.4 Preliminary Information

Disconnect the field wiring

Depending on which input (#1, #2, #3, or #4) you are going to calibrate, tag and disconnect any field wiring connected to the input terminals on the input boards inside the recorder. Reference Figure 7-1 and follow the procedure in Table 7-3.

Table 7-3 Disconnect the Field Wiring

Step	Action
1	Remove the operating power from the recorder.
2	Open the door on the recorder.
3	Loosen the phillips screw on the right side of the chart plate, and open the chart plate.
4	Depending on the input (1, 2, 3, or 4) you are going to calibrate, remove the wired plug from the input connector (J2) on the applicable circuit board. See Figure 7-1 for the location of the circuit boards and input connectors.
5	Tag and disconnect the field wiring installed in the applicable input connector plug.

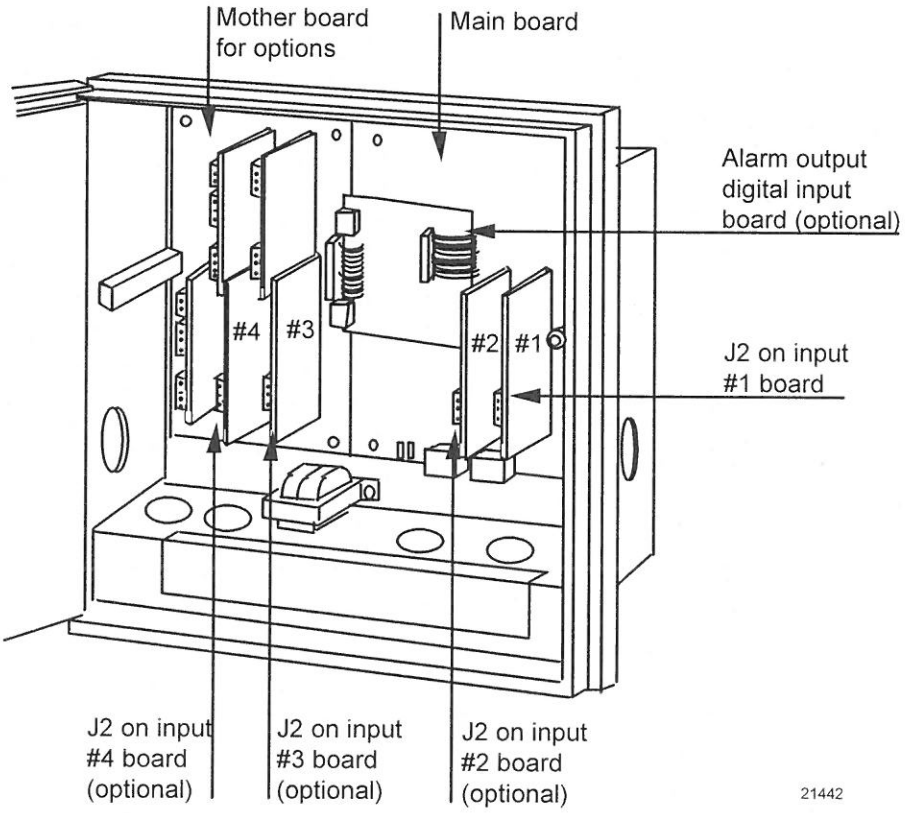


Figure 7-1 Location of the Input Connections on the Input Boards

Equipment needed

Table 7-4 lists the equipment required to calibrate the specific types of inputs listed in the table. You will need a medium size bladed screwdriver for general use and a small size bladed screwdriver for use with the screws on the connector plugs.

Table 7-4 Equipment Needed

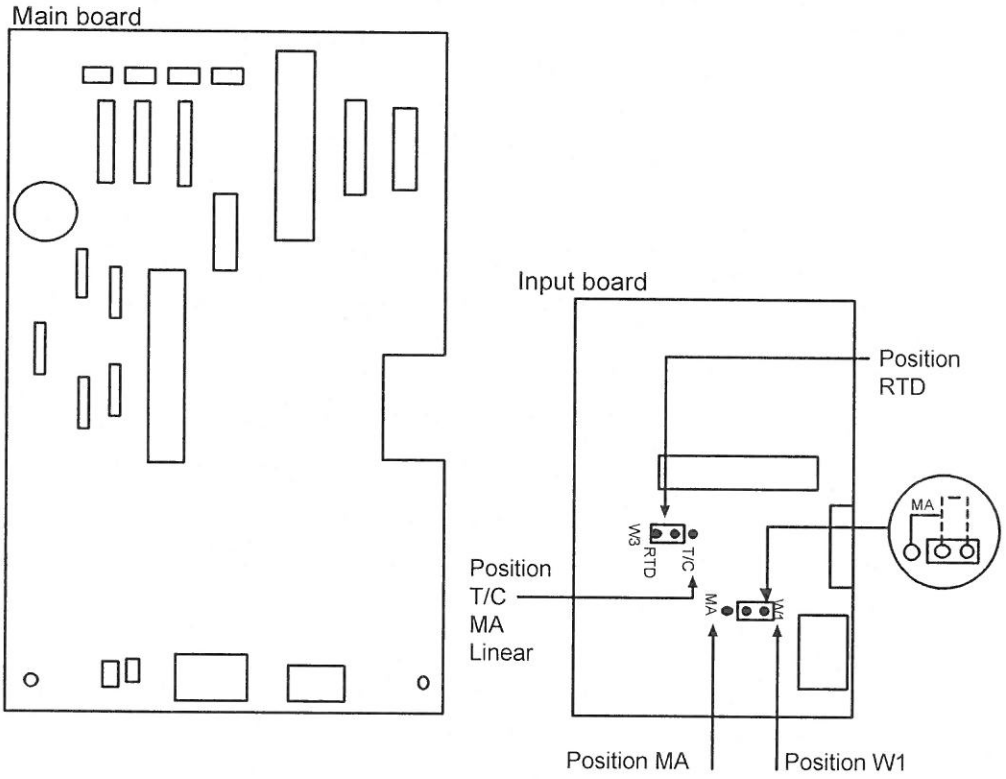
Type of Input	Equipment Needed
Thermocouple Inputs (Ice Bath)	• A calibrating device with ± 0.02 % accuracy for use as a signal source such as a millivolt source. • Thermocouple extension wire that corresponds with the type of thermocouple that will be used with the recorder input. • Two insulated copper leads for connecting the thermocouple extension wire from the ice baths to the precision calibrator. • Two containers of crushed ice.
Thermocouple Inputs (Ambient Temperature)	• A calibrating device with ± 0.02 % accuracy for use as a signal source such as a millivolt source. • Two insulated copper leads for connecting the calibrator to the controller.
Thermocouple Inputs (Compensated Calibrator)	• A calibrating device with temperature compensation and ± 0.02 % accuracy for use as a signal source. • Thermocouple extension wire that corresponds with the type of thermocouple that will be used with the recorder input.
RTD (Resistance Thermometer Device)	• A resistance decade box, with ± 0.02 % accuracy, capable of providing stepped resistance values over a minimum range of 0 to 1400 ohms with a resolution of 0.01 ohm. • Three insulated copper leads for connecting the decade box to the controller.
Radiamatic, Milliampere, Millivolt, and Volts Inputs	• A calibrating device with ± 0.02 % accuracy for use as a signal source. • Two insulated copper leads for connecting the calibrator to the controller.

7.5 Calibration Set Up and Wiring for PV Inputs

Jumper positions

Before starting the calibration activity, check that the jumper plugs on the applicable input circuit board are installed in the proper jumper position (in W1/MA and W3) for the particular sensor being used (refer to the wiring connection drawings in this section for each individual setting).

Refer to Figure 7-2 for the location of jumper positions W1/MA and W3 on these circuit boards, and the status of these jumpers for each type of input sensor.



Status of jumper plugs

1. Install W1/MA plug in position W1 for thermocouple, RTD, Radiamatic, mV, 0-5 Vdc, 0-10 Vdc inputs.
2. Install W1/MA plug in position MA for 4-20 mA inputs.
3. Install plug in W3 according to your input type.

21443

Figure 7-2 Location of Jumper Positions W1/MA and W3 on the Input Boards

Thermocouple input calibration methods

You can calibrate for a thermocouple input using one of three methods:

- using an ice bath,
- using a compensated calibrator, or
- by measuring the ambient temperature at the input terminals and subtracting the voltage contribution of the input terminal junction.

General set up procedure

Table 7-5 lists the general set up procedure for all methods of calibration. Do this procedure and then refer to the set up procedure and diagram for your specific input.

Table 7-5 General Set Up Procedure

Step	Action
1	Set up and connect the calibrator to the input plug for the applicable input circuit board in your recorder according to the particular input sensor being used. Refer to the following figures for corresponding set-up diagrams: • Figure 7-3 Thermocouple inputs using an ice bath • Figure 7-4 Thermocouple inputs using a compensated calibrator • Figure 7-5 Thermocouple inputs using the ambient temperature method • Figure 7-6 RTD (Resistance Thermometer Device) inputs • Figure 7-7 Radiamatic, mV and Volts (except 0–10 Volts) inputs • Figure 7-8 0-10 Volts input • Figure 7-9 4–20 mA inputs
2	Route leads (for example: copper leads or thermocouple extension wires) through a conduit hole in the recorder case so that you will be able to close the chart plate.
3	Close the chart plate after you have completed the applicable calibration set up.

Thermocouple inputs using an ice bath

Refer to Figure 7-3 and wire the recorder according to the procedure given in Table 7-6.

Table 7-6 Set Up Wiring Procedure for Thermocouple Inputs Using an Ice Bath

Step	Action
1	Connect the copper leads to the calibration source (see Figure 7-3).
2	Connect a length of thermocouple extension wire to the end of each copper lead and insert the junction points into the ice bath.
3	Connect the other end of the thermocouple extension wires to the clamp type terminals in the plug for the applicable input connector (J2).
4	Reinstall the plug into the input connector (J2) on the applicable circuit board for Input 1, Input 2, Input 3, or Input 4.

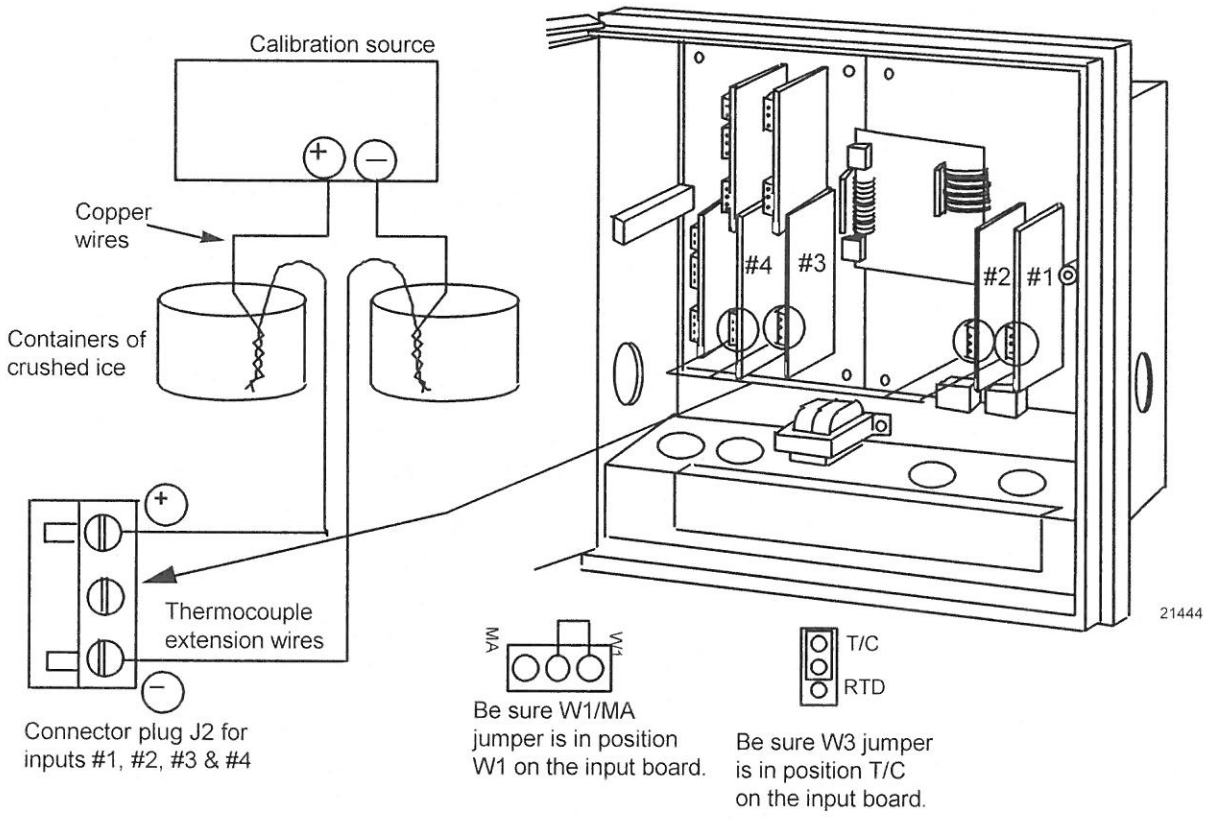


Figure 7-3 Calibration Set Up Diagram for Thermocouple Inputs Using an Ice Bath

Thermocouple inputs using a compensated calibrator method

Refer to Figure 7-4 and wire the recorder according to the procedure given in Table 7-7.

Table 7-7 Set Up Wiring Procedure for Thermocouple Inputs Using a Compensated Calibrator Method

Step	Action
1	Connect the thermocouple extension wire to the Precision Compensated Calibrator (see Figure 7-4).
2	Connect the other end of the thermocouple extension wires to the clamp type terminals in the plug for the applicable input connector (J2).
3	Reinstall the plug into the input connector (J2) on the applicable circuit board for Input 1, Input 2, Input 3, or Input 4.

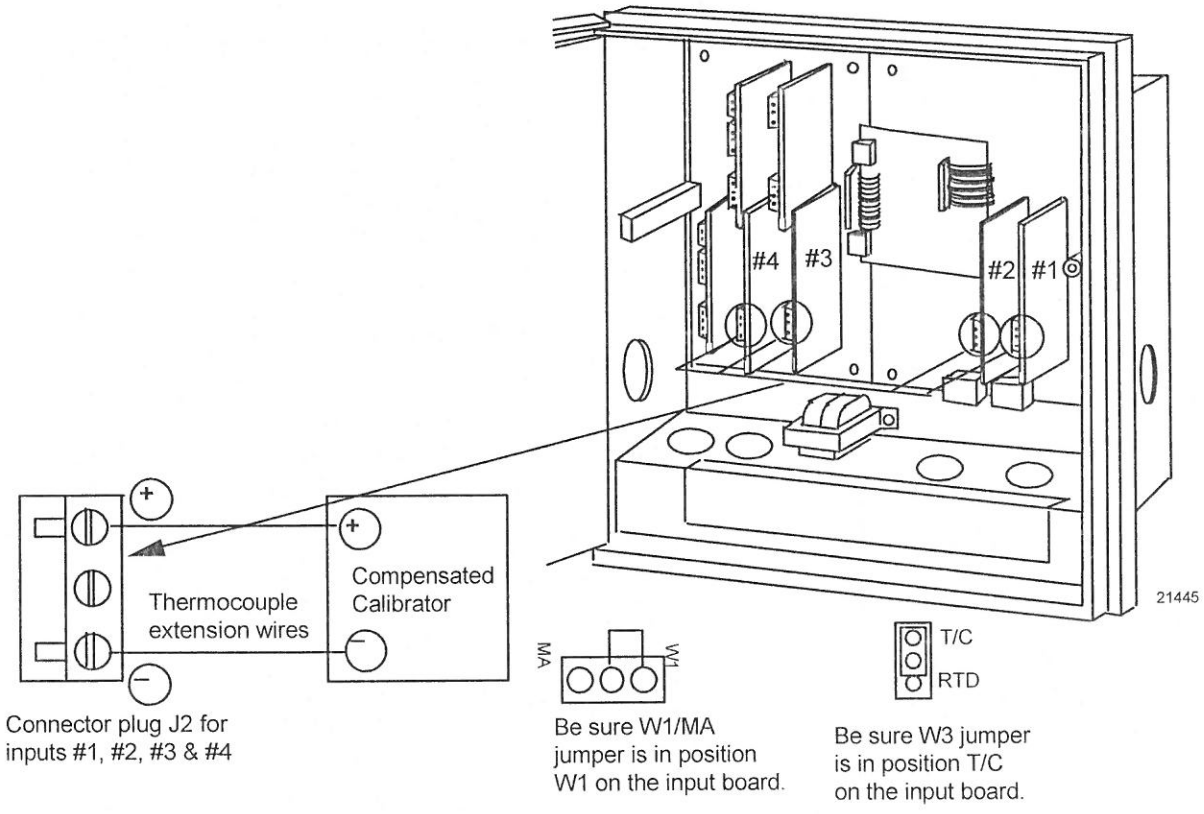


Figure 7-4 Calibration Set Up Diagram for Thermocouple Inputs Using a Compensated Calibrator Method

Thermocouple inputs using the ambient temperature method

Refer to Figure 7-5 and wire the recorder according to the procedure given in Table 7-8.

Table 7-8 Set Up Wiring Procedure for Thermocouple Inputs Using the Ambient Temperature Method

Step	Action
1	Connect the copper wire to the Precision Millivolt Source (see Figure 7-5).
2	Connect the other end of the copper wire to the clamp type terminals in the plug for the applicable input connector (J2).
3	Reinstall the plug into the input connector (J2) on the applicable circuit board for input 1, input 2, input 3, or input 4.

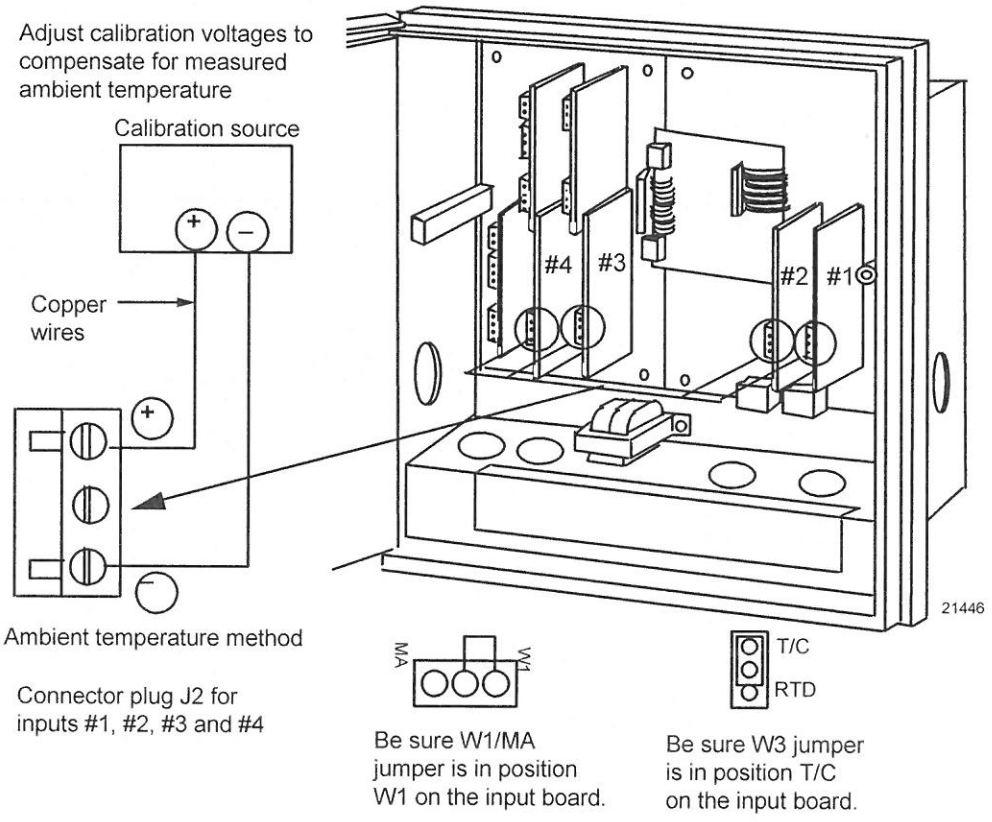


Figure 7-5 Calibration Set Up Diagram for Thermocouple Inputs using the Ambient Temperature Method

RTD (Resistance Thermometer Device) inputs

Refer to Figure 7-6 and wire the recorder according to the procedure given in Table 7-9.

Table 7-9 Set Up Wiring Procedure for RTD Inputs

Step	Action
1	Connect the copper wire to the calibration source (see Figure 7-6).
2	Connect the other end of the copper wire to the clamp type terminals in the plug for the applicable input connector (J2).
3	Reinstall the plug into the input connector (J2) on the applicable circuit board for input 1, input 2, input 3, or input 4.

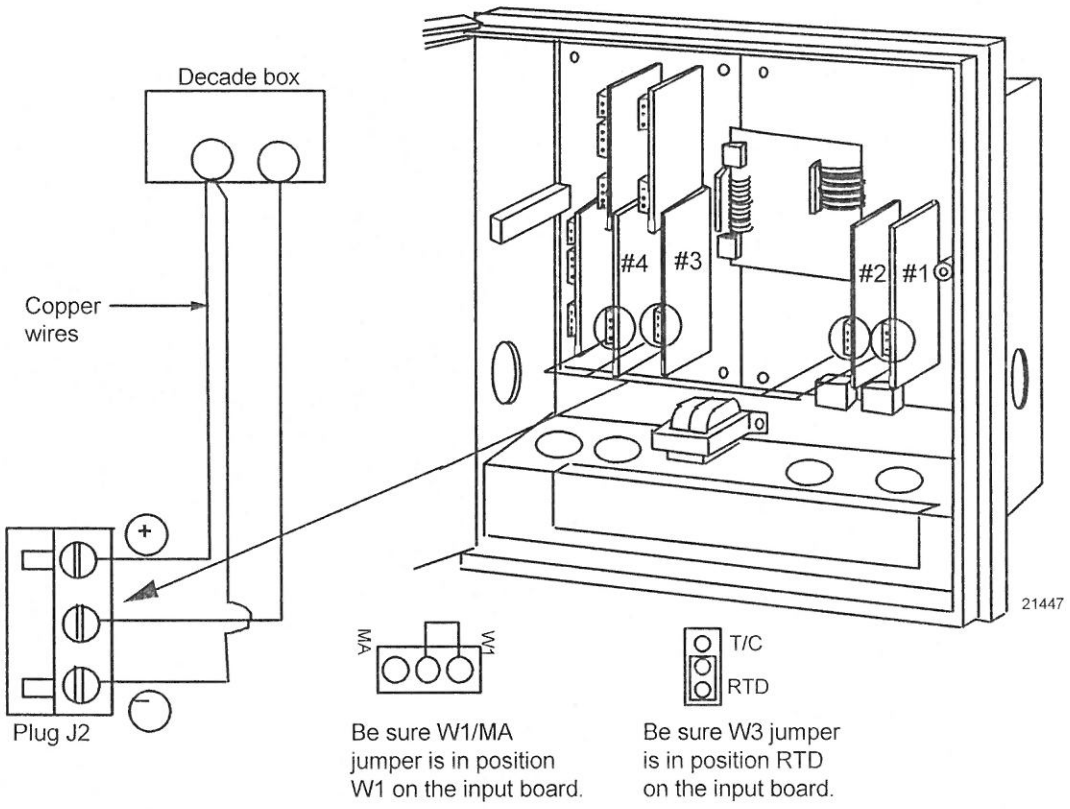


Figure 7-6 Calibration Set Up Diagram for RTD Inputs

Radiamatic, millivolts, and volts inputs (except 0–10 Volts)

Refer to Figure 7-7 and wire the recorder according to the procedure given in Table 7-10.

Table 7-10 Set Up Wiring Procedure for Radiamatic, Millivolts, and Volts Inputs (except 0-10 Volts)

Step	Action
1	Connect the copper wire to the calibration source (see Figure 7-7).
2	Connect the other end of the copper wire to the clamp type terminals in the plug for the applicable input connector (J2).
3	Reinstall the plug into the input connector (J2) on the applicable circuit board for input 1, input 2, input 3, or input 4.

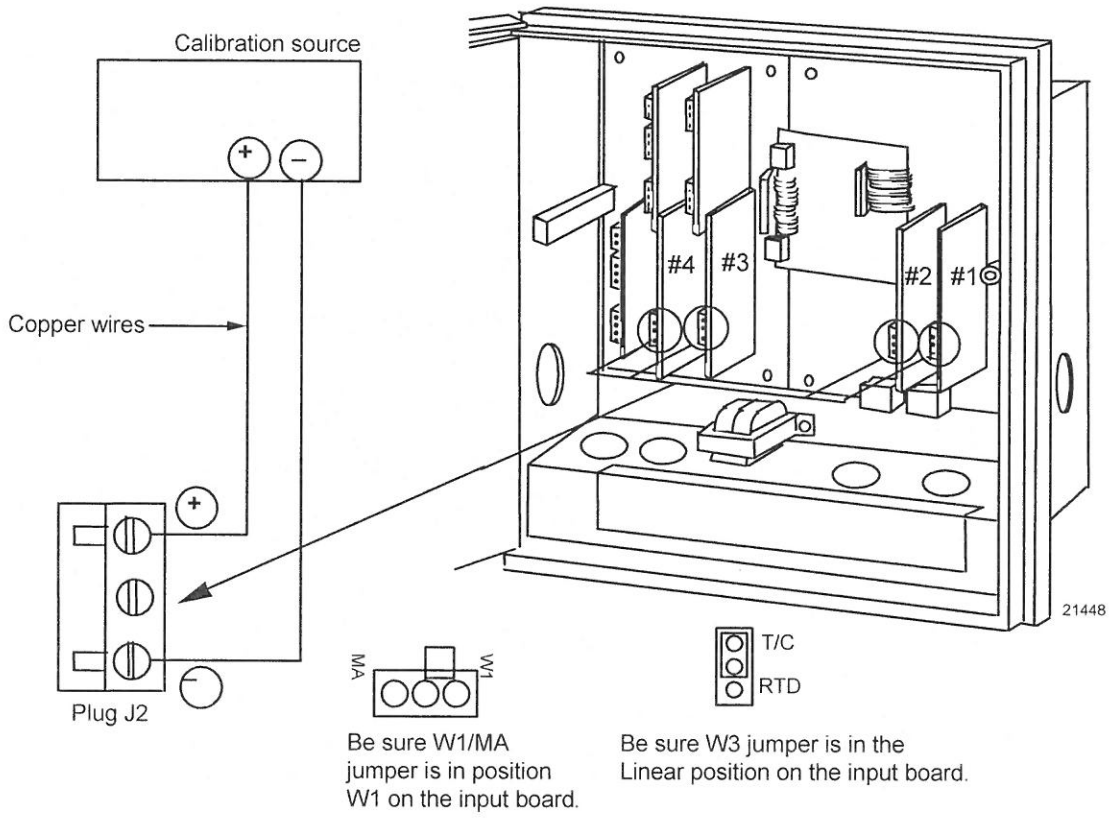


Figure 7-7 Calibration Set Up Diagram for Radiamatic, Millivolts, and Volts Inputs (except 0-10 Volts)

0–10 Volt inputs

Refer to Figure 7-8 and wire the recorder according to the procedure given in Table 7-11.

Table 7-11 Set Up Wiring Procedure for 0–10 Volt Inputs

Step	Action
1	Connect the copper wire to the calibration source (see Figure 7-8).
2	Connect the other end of the copper wire to the clamp type terminals in the plug for the applicable input connector (J2).
3	Reinstall the plug into the input connector (J2) on the applicable circuit board for input 1, input 2, input 3, or input 4.

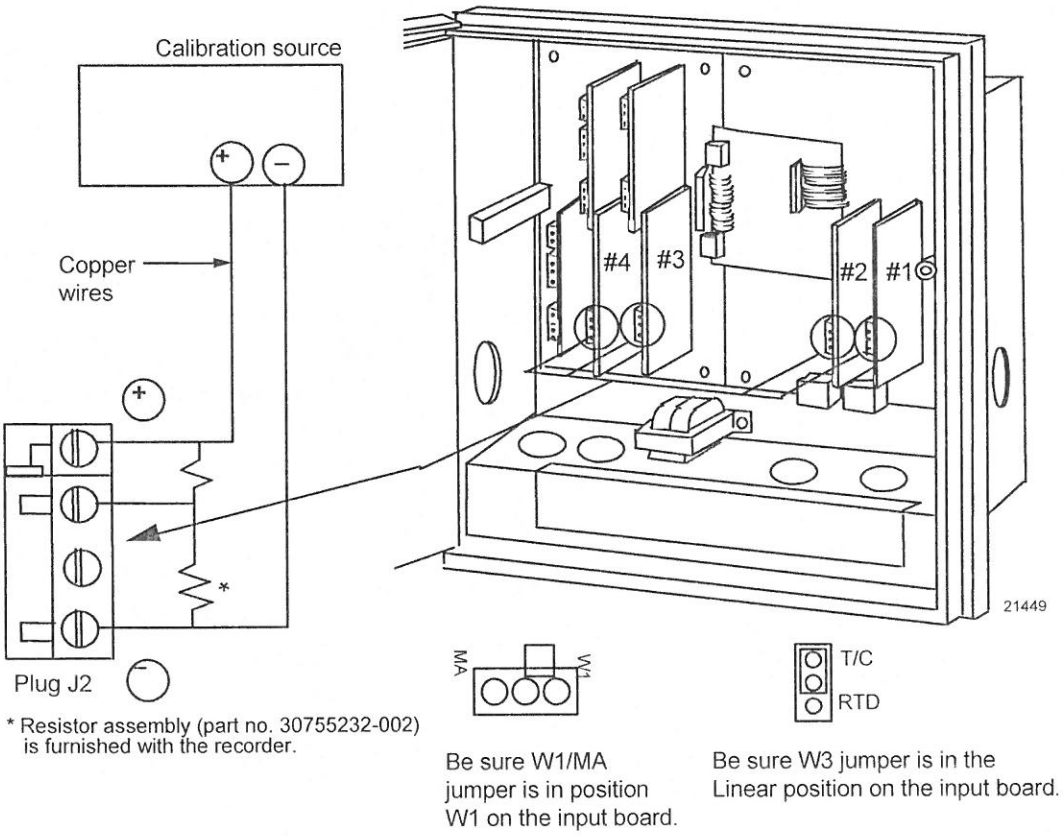


Figure 7-8 Calibration Set Up Diagram for 0–10 Volt Inputs

4–20 mA inputs

Refer to Figure 7-9 and wire the recorder according to the procedure given in Table 7-12.

Table 7-12 Set Up Wiring Procedure for 4–20 mA Inputs

Step	Action
1	Connect the copper wire to the calibration source (see Figure 7-9).
2	Connect the other end of the copper wire to the clamp type terminals in the plug for the applicable input connector (J2).
3	Reinstall the plug into the input connector (J2) on the applicable circuit board for input 1, input 2, input 3, or input 4.

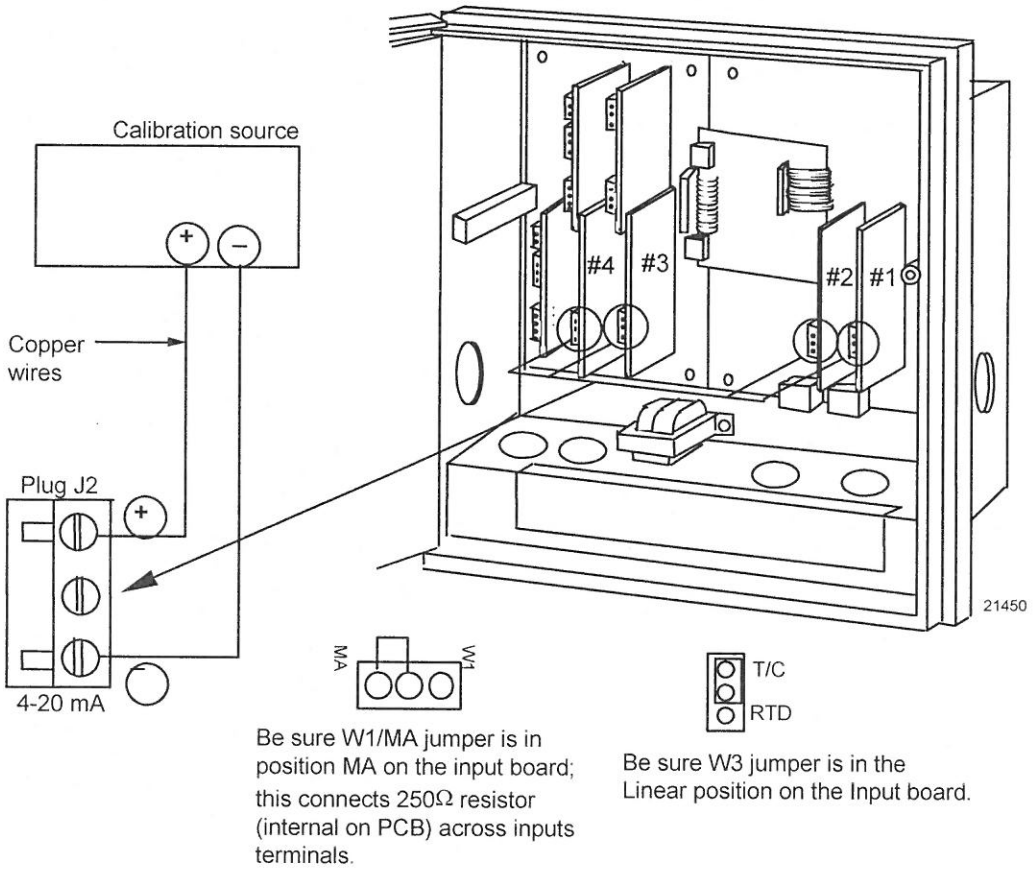


Figure 7-9 Calibration Set Up Diagram for 4–20 mA Inputs

7.6 Calibration Procedure

Introduction

Apply power and allow the recorder to warm up for one hour before you calibrate.

- Please read "*Set Up Wiring*" before beginning the procedure.
- Make sure "LOCKOUT" is set to "NONE." (see *Section 3 – Configuration).*
- The calibration procedure for inputs #1, #2, #3, and #4 are identical. The displays indicate the input number.

CAUTION

For *milliampere inputs*, be sure the current source is at zero before switching on the calibrator. Do not switch the calibrator on/off while it is connected to the recorder's input.

ATTENTION

For *linear inputs*, avoid step changes in input signal. Vary calibration source signal smoothly from initial value to final 100 % value.

Calibration procedure sequence

The calibration procedure sequence for all inputs is listed in Table 7-13.

Table 7-13 Calibration Procedure Sequence

Step	Operation	Press	Action/Result
1	Enter Calibration Mode	**SET UP**	Until you see: *Upper Display:* **CALIB** *Lower Display:* **INPUT n** **n** = 1, 2, 3, or 4
		FUNC	You will see: *Upper Display:* **DISABL** *Lower Display:* **CAL INn** **n** = 1, 2, 3, or 4
		▲	The calibration sequence is enabled and you will see: *Upper Display:* **BEGIN** *Lower Display:* **CAL INn**

<table>
<tr><th>Step</th><th>Operation</th><th>Press</th><th>Action/Result</th></tr>
<tr><td>2</td><td>Calibrate 0 %</td><td>FUNC</td><td>You will see:
Upper Display: APPLY
Lower Display: INn ZERO n = 1, 2, 3, or 4
• Adjust your calibration device to an output signal equal to the 0 % range value for your particular input sensor, see Table 7-2 for Voltage or Resistance equivalents.
• Wait 30 seconds, then go to step 3.</td></tr>
<tr><td></td><td>Using Ambient Temperature Method</td><td></td><td>ATTENTION If you are using the Ambient Temperature method to calibrate a thermocouple input, be sure to measure the temperature at the input terminals and subtract the equivalent millivolt value (for your particular thermocouple) from the 0 % value just prior to doing calibration.
For example, for a Type J Thermocouple and input temperature of 68 °F:
From –0.885 mV (Type J @ 0° F)
Subtract –1.019 mV (Type J @ 68 °F)
To yield –1.904 mV (calibrator output for INn ZERO)</td></tr>
<tr><td>3</td><td>Calibrate 100 %</td><td>FUNC</td><td>You will see:
Upper Display: APPLY
Lower Display: INn SPAN n = 1, 2, 3, or 4
Adjust your calibration device to an output signal equal to the 100 % range value for your particular input sensor, see Table 7-2 for voltage or resistance equivalents, wait 30 seconds, and
<table>
<tr><th>If ...</th><th>Then ...</th></tr>
<tr><td>you are calibrating a thermocouple input</td><td>Go to step 4</td></tr>
<tr><td>you are calibrating other than a thermocouple input</td><td>Go to step 5</td></tr>
</table></td></tr>
<tr><td></td><td>Using Ambient Temperature Method</td><td></td><td>ATTENTION If you are using the Ambient Temperature method to calibrate a thermocouple input, be sure to measure the temperature at the input terminals and subtract the equivalent millivolt value (for your particular thermocouple) from the 100 % value.
For example, for a Type J Thermocouple and input temperature of 68 °F:
From 50.059 mV (Type J @ 1600 °F)
Subtract –1.019 mV (Type J @ 68 °F)
To yield 49.040 mV (calibrator output for INn SPAN)</td></tr>
</table>

Step	Operation	Press	Action/Result
4	Check the Cold Junction Temperature **WARNING** The accuracy of the recorder is directly affected by the accuracy of this value. Change this value only if the zero and span calibration procedures did not bring the controller within the specified accuracy requirements.	**FUNC**	The calculations for zero and span are now stored and you will see: *Upper Display:* The cold junction temperature at the rear terminals *Lower Display:* **C-J TEMP** • The value in the upper display is in the tenths of a degree. It is the current reading of the temperature as measured at the thermocouple terminals (that is, at J2) and recognized by the recorder. • When using the Ice Bath method, this value should be the terminal ambient temperature. – You can change this value, if it is in error, using the ▲ or ▼ key.
5	Exit the Calibration Mode	**FUNC**	The recorder stores the calibration constants and exit calibration mode.

7.7 Printing Characteristics Adjustments

Printing characteristics adjustments

Normally there is no need to adjust the printing characteristics as part of an input or output calibration procedure. However, if the chart printing appears to be faded, you can use the procedure in *Section 4 - Configuration Parameter Definitions,* Table 4-18, to make slight adjustments in the print contrast.

ATTENTION

To access Set Up group prompt "ADJUST", the Set Up group prompt "LOCKOUT" must be set to "NONE". If the group prompt "LOCKOUT" has been configured for "CALIB", "+VIEW", or "MAX" selection, you will not be able to access the Printing Characteristics Group prompt. Refer to *Section 3 - Configuration* for details.

8. Output Calibration

8.1 Overview

SHOCK HAZARD – WARNING!

Disregard of these instructions may cause injury or death.

OUTPUT CALIBRATION MAY REQUIRE ACCESS TO HAZARDOUS LIVE CIRCUITS, AND SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL. MORE THAN ONE SWITCH MAY BE REQUIRED TO DE-ENERGIZE UNIT BEFORE CALIBRATION.

Introduction

This section describes the field calibration procedures for the following types of outputs:

- Current Output
- Position Proportional Output
- Auxiliary Output

ATTENTION

Calibration for Control Outputs #1 and #2 is identical except for the particular printed circuit board involved.

What's in this section?

This section contains the following topics:

	Topic	See Page
8.1	Overview	219
8.2	Current Proportional Output/Aux Out 2 and 3 Calibration • Introduction • Equipment needed • Calibrator connections • Calibration Procedure	220 220 220 220 221
8.3	Position Proportional and Three Position Step Output Calibration • Position proportional control • Equipment needed • Connections • Auto mode vs manual mode • Displayed values • Calibration Procedure	222 222 222 222 222 222 222
8.4	Auxiliary Output Calibration • Introduction • Equipment needed • Calibrator connections • Calibration Procedure	225 225 225 225 226

8.2 Current Proportional Output/Aux Out 2 and 3 Calibration

Introduction

Calibrate the recorder so that the output provides the proper amount of current over the desired range.

- The recorder can provide an output current range of from 2 to 21 milliamperes and can be calibrated at 4 mA for 0 % of output and 20 mA for 100 % of output or any other values between 2 and 21 mA.

Equipment needed

You will need a standard shop type milliammeter, with whatever accuracy is required, capable of measuring 0 to 20 milliamps.

Calibrator connections

Refer to Figure 8-1 and wire the recorder according to the procedure given in Table 8-1.

Table 8-1 Set Up Wiring Procedure Current Proportional Output/Aux Out 2 and 3

Step	Action
1	With the power off, door open, and the chart plate swung out; tag and disconnect field wiring from the plug in connector J1 on the appropriate control output PCB (see Figure 8-1).
2	Observing polarity, connect a milliammeter's leads to the plug for connector J1.
3	Close the chart plate; apply power and allow the recorder to warm up 15 minutes before you calibrate.

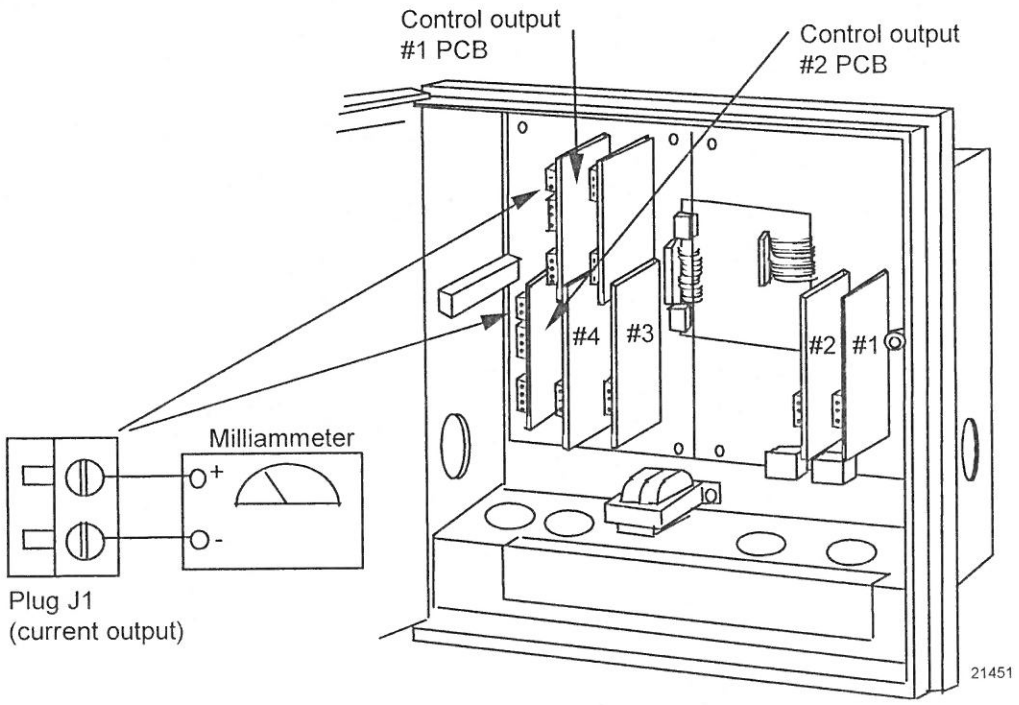


Figure 8-1 Test Equipment Connections for Calibrating Current Proportional Output

Procedure

The procedure for calibrating the Current Proportional Output is listed in Table 8-2. Make sure "LOCKOUT" in the Set Up group is set to "NONE." See *Section 3 – Configuration.* Also, "CONTROL 1/2" must be enabled and "OUT ALG" must be set to "CURRNT" in the Control Set Up group.

ATTENTION

Follow this procedure when calibrating Auxiliary Output #2 or #3. Make sure "LOCKOUT" in the Set Up group is set to "NONE" and "AUX OUT" must **NOT** be disabled in the Auxiliary Output group.

Table 8-2 Current Proportional Output/Aux Output 2 and 3 Calibration Procedure

Step	Operation	Press	Action/Result
1	Enter Calibration Mode	**SET UP**	Until you see: *Upper Display:* **CALIB** *Lower Display:* **CURRENT**
2	Calibrate 0 %	**FUNC**	You will see: *Upper Display:* **(a value)** (approximately 380) *Lower Display:* **ZERO VAL**
		▲ or ▼	Until the desired 0 % output is read on the milliammeter. Use the values shown below depending on the action of your recorder. 4 mA For 4 to 20 mA Direct Action 20 mA For 4 to 20 mA Reverse Action
3	Calibrate 100 %	**FUNC**	Stores the 0 % value and you will see: *Upper Display:* **(a value)** (approximately 1890) *Lower Display:* **SPAN VAL**
		▲ or ▼	Until the desired 100 % output is read on the milliammeter. Use the values shown below depending on the action of your recorder. 20 mA For 4 to 20 mA Direct Action 4 mA For 4 to 20 mA Reverse Action
4	Exit the Calibration Mode	**FUNC**	The recorder stores the span value.
		LOWR DISP or **SET UP**	To exit the calibration mode.

8.3 Position Proportional and Three Position Step Output Calibration

Position proportional control

When the DR4500A Recorder has a position proportional control output, calibrate the recorder so that the increase and decrease relays operate properly with respect to the position of the external feedback slidewire.

3 Position Step control

This model only requires that the "Motor Time" be entered as shown in the calibration procedure. FULL CALIBRATION IS NOT REQUIRED.

Equipment needed

None

Connections

Apply power and allow the recorder to warm up 15 minutes before you calibrate.

Leave all field wiring connected to the plugs in connectors J2 and J5 on the appropriate control output printed circuit board.

Auto mode vs manual mode

There are two ways in which to calibrate Position Proportional control:
AUTO mode or MANUAL mode.

Rules for auto mode vs manual mode

The auto-mode selection must be done at least once before the manual mode will operate properly. Failure to use the auto-mode procedure will prevent the recorder from going into automatic control mode.

Displayed values

During the auto-mode calibration procedure, the values being displayed are used only to indicate if the motor is still traveling.

To view the actual calibration value, use the manual mode after the auto-mode is completed. These values can be changed for purposes of tweaking the calibration.

Procedure

The procedure for calibrating the position proportional output and 3 Position Step control output is listed in Table 8-3.

- Make sure "LOCKOUT" in the Set Up group is set to "NONE." See *Section 3 – Configuration.* Also, "CONTROL 1/2" must be enabled in the Control Set Up group.
- For *"Three Position Step Control Output models"*, do steps 1 and 2 only. Make sure "CONT ALG" = "3P STEP" in the Control Set Up group.
- For *"Position Proportional Output"*, follow the entire calibration procedure. Make sure "CONT ALG" = "PID A" and "OUT ALG" = "POSITN" in the Control 1 Set Up group.

Table 8-3 Position Proportional and 3 Position Step Output Calibration Procedure

Step	Operation	Press	Action/Result
1	Enter Calibration Mode	**SET UP**	Until you see: *Upper Display:* **CALIB** *Lower Display:* **POS PROP**
2	Set Motor Traverse Time NOTE: This is the time it takes the motor to travel from 0 % to 100 %.	**FUNC**	Until you see: *Upper Display:* **(a value)** *Lower Display:* **MTR TIME**
		▲ or ▼	Until the proper motor stroke time is reached (see the motor specs or measure the time). • Range of setting = 5 to 255 Seconds
3	Select Automatic or Manual Calibration	**FUNC**	Until you see: *Upper Display:* **DISABL** *Lower Display:* **POS PROP** • You can calibrate the control output manually or let the recorder calibrate the control output automatically. • In the "Automatic Calibration Mode" (DO AUTO), the control relays automatically move the motor in the proper direction. • If desired, however, the motor may be manually positioned to 0 % and 100 % positions. Disconnect the relay wires. "DO MAN". • In the "Manual Calibration Mode" (DO MAN) the motor does not move. Instead, the existing 0 % and 100 % values may be changed with the ▲ or ▼ keys.
		▲ or ▼	Select automatic or manual calibration. *Upper Display:* **DO AUTO** or **DO MAN** *Lower Display:* **POS PROP** • If you select DO AUTO, go to step 4. • If you select DO MAN, go to step 6. **ATTENTION** When calibration is terminated, this selection reverts to DISABL.
4	**DO AUTO** Set 0 % value	**FUNC**	The decrement relay is turned on to move the motor to 0 % position. *Upper Display:* **(counts of feedback slidewire)** (0 to 2047) *Lower Display:* **ZERO VAL** • When the motor stops, the display should stop counting; go to the next step.

Step	Operation	Press	Action/Result
5	Set 100 % value	**FUNC**	The increment relay is turned on to move the motor to 100 % position. *Upper Display:* **(counts of feedback slidewire)** (0 to 2047) *Lower Display:* **SPAN VAL** • When the motor stops, the display should stop counting, then go on to step 8.
6	**DO MAN** Set 0 % value	**FUNC**	You will see: *Upper Display:* **(existing zero calibration value in counts)** (approximately 100) *Lower Display:* **ZERO VAL**
		▲ or ▼	Until the desired zero value is reached in the upper display. *Upper Display:* **(desired zero value)** *Lower Display:* **ZERO VAL**
7	Set 100 % value	**FUNC**	The recorder stores the 0 % value and you will see: *Upper Display:* **(existing span calibration value in counts)** (approximately 1500) *Lower Display:* **SPAN VAL**
		▲ or ▼	Until the desired span value is reached in the upper display. *Upper Display:* **(desired span value)** *Lower Display:* **SPAN VAL** For manual calibration, the motor does not move from its position prior to the start of position proportional calibration.
8	Exit the Calibration Mode	**FUNC**	The recorder stores the 100 % value.
		LOWR DISP or **SET UP**	To exit the calibration mode.

8.4 Auxiliary Output Calibration

Introduction

Calibrate the recorder so that the auxiliary output provides the proper amount of current over the desired range.

- The recorder can provide an auxiliary output current range of from 2 to 21 milliamperes and can be calibrated at 4 mA for 0 % of output and 20 mA for 100 % of output or any other values between 2 and 21 mA.

Equipment needed

You will need a standard shop type milliammeter, with whatever accuracy is required, capable of measuring 0 to 20 milliamps.

Calibrator connections

Refer to Figure 8-2 and wire the recorder according to the procedure given in Table 8-4.

Table 8-4 Set Up Wiring Procedure Auxiliary Output

Step	Action
1	With the power off, door open, and the chart plate swung out; tag and disconnect field wiring from the plug in connector J2 on the auxiliary output PCB (see Figure 8-2).
2	Observing polarity, connect a milliammeter's leads to the plug for connector J2.
3	Close the chart plate; apply power and allow the recorder to warm up 15 minutes before you calibrate.

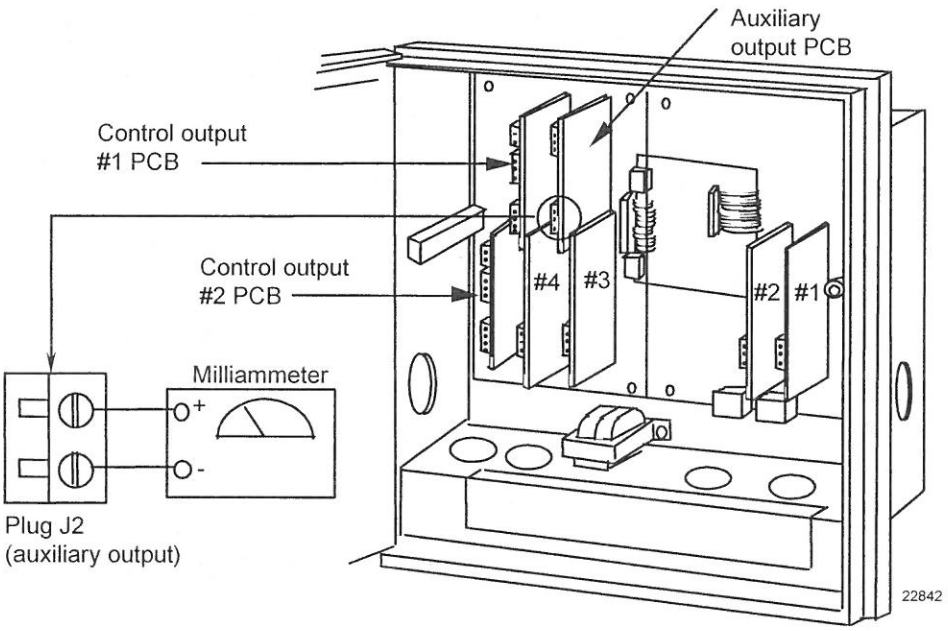


Figure 8-2 Test Equipment Connections for Calibrating Auxiliary Output

Procedure

The procedure for calibrating the Auxiliary Output is listed in Table 8-5. Make sure "LOCKOUT" in the Set Up group is set to "NONE." See *Section 3 – Configuration.* Also, "AUX OUT" must **NOT** be disabled in the Auxiliary Output group.

Table 8-5 Auxiliary Output Calibration Procedure

Step	Operation	Press	Action/Result
1	Enter Calibration Mode	**SET UP**	Until you see: *Upper Display:* **CALIB** *Lower Display:* **AUX OUT**
2	Calibrate 0 %	**FUNC**	You will see: *Upper Display:* **(a value)** *Lower Display:* **ZERO VAL**
		▲ or ▼	Until the desired 0 % (4 mA) output is read on the milliammeter.
3	Calibrate 100 %	**FUNC**	Stores the 0 % value and you will see: *Upper Display:* **(a value)** *Lower Display:* **SPAN VAL**
		▲ or ▼	Until the desired 100 % (20 mA) output is read on the milliammeter.
4	Exit the Calibration Mode	**FUNC**	The recorder stores the span value.
		LOWR DISP or **SET UP**	To exit the calibration mode.

ATTENTION

The calibration for Auxiliary Outputs #2 and #3 follows the procedure for calibrating the current proportional output *(refer to Subsection 8.2).*

9. Troubleshooting / Service

9.1 Overview

SHOCK HAZARD – WARNING!

Disregard of these instructions may cause injury or death.

TROUBLESHOOTING MAY REQUIRE ACCESS TO HAZARDOUS LIVE CIRCUITS, AND SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL. MORE THAN ONE SWITCH MAY BE REQUIRED TO DE-ENERGIZE UNIT BEFORE SERVICING.

Introduction

This section explains how to troubleshoot the DR4500A recorder using self-diagnostic test results and error messages as well as some visual failure symptoms. Using an optimum replacement unit repair philosophy, trouble is traced to a printed circuit board (PCB)/hardware assembly level rather than to an individual PCB/hardware assembly component. While troubleshooting is straightforward, we recommend that only trained service technicians repair the recorder.

What's in this section?

The following topics are covered in this section.

	Topic	See Page
9.1	Overview	227
9.2	Troubleshooting Aids	229
9.3	Self Diagnostics	231
9.4	Visual Failure Symptoms	237
9.5	Troubleshooting Procedures	238

Types of problems

Instrument performance can be adversely affected by installation and application problems as well as hardware problems. We recommend that you investigate the problems in the following order:

- Installation related problems
- Application related problems
- Hardware and software related problems

and use the information presented in this section to solve them.

If a replacement of any part is required, follow the instructions shipped with the replacment part.

Installation related problems

Read the Installation section in this manual to make sure the DR4500A has been properly installed. The installation section provides information on protection against electrical noise, connecting external equipment to the recorder, and shielding and routing external wiring.

ATTENTION

System noise induced into the recorder will result in diagnostic error messages recurring. If the diagnostic error messages can be cleared, it indicates a "soft" failure and is probably noise related.

If system noise is suspected, completely isolate the recorder from all field wiring. Use calibration sources to simulate PV and check all recorder and control functions; that is, Pen functions, Chart Trace, Gain, Rate, Reset, Output, Alarms, etc.

Application related problems

Review the application of the recorder; then, if necessary, direct your questions to the local sales office.

Hardware and software related problems

Use the troubleshooting error message prompts and recorder failure symptoms to identify typical failures which may occur in the recorder. Follow the troubleshooting procedures to correct them.

9.2 Troubleshooting Aids

Self diagnostics

The DR4500A recorder runs self-diagnostic tests to monitor the recorder's general health. The tests are divided into three main groups and will produce an error message when failed.

An error message can occur

- at power-up — run when power is cycled off and on,
- during continuous background tests while in normal operation, and
- when the Status Tests are requested by the operator.

Table 9-4 lists all the error message prompts that you could see, the reason for the failure, and how to correct the problem

Visual failure symptoms

Other failures may occur that deal with the power, pen functions, chart rotation, output, or alarms. Refer to the visual failure symptom in Table 9-5 to determine what is wrong and the troubleshooting procedures to use to correct the problem.

Check Installation

If a set of symptoms still persists, refer to *Section 2 - Installation* and ensure proper installation and proper use of the recorder in the system.

Customer support

If you cannot solve the problem using the troubleshooting procedures listed in this section; get the **model number** and **serial number** from the label on the chart plate, and **software** version (see "Determining the software version") then:

- call Customer Support Phone Number
  1-800-423-9883 USA and Canada

If it is determined that a hardware problem exists and the recorder is still within the two year warranty, a replacement recorder will be shipped with instructions for returning the defective unit.

Determining the software version

Table 9-1 lists the procedure for identifying the software version number.

Table 9-1 Identifying the software version

Step	Operation	Press	Action/Result
1	Select STATUS Set Up Group	**SET UP**	Until you see: *Upper Display:* **READ** *Lower Display:* **STATUS**
2	Read the software version	**FUNC**	Until you see: *Upper Display:* **(Software Version Number)** *Lower Display:* **VERSION** Please give this number to the Customer Support person. It will indicate which version of DR4500A you have and help them determine a solution to your problem.

Troubleshooting

The troubleshooting procedures are divided into two parts:

- Self Diagnostics – Error Message Prompts, and
- Visual Failure Symptoms.

If a "Failed" indication is given for one of the power-up tests and/or an error message prompt blinks in the lower display, refer to the Self Diagnostic error message prompts.

If erratic operation is observed, refer to the Visual Failure symptoms.

In either case, run the status tests to verify the status of the recorder's basic self-diagnostic tests.

9.3 Self Diagnostics

Power-up tests

When the recorder is powered-up, four tests are run by the DR4500A software to ensure memory integrity.

- As the tests are run, the displays appear as shown in Table 9-2.

Table 9-2 Power-up tests

Lower Display	Upper Display
RAM TEST	PASS or FAIL
CONFTEST (configuration checksum)	PASS or FAIL
CAL TEST (working calibration)	PASS or FAIL
BATTERY*	PASS or FAIL

*Battery test failure does not cause a failsafe.

Failsafe

- If control is configured, and any of these tests fail, "FAIL" appears momentarily in the upper display, then a display test is run, after which the controller goes into manual mode and you will see:

  Upper Display: **(PV value)**

  Lower Display: **FAILSAFE** (blinking)

  Refer to *"Device Status"* (next page) to determine which tests have failed and how to correct them.

- If control is *not* configured, self-test failures will be displayed periodically as other error messages are presently displayed (CNFG ERR, CAL1 ERR, CAL2 ERR, or BATT LOW).

Device status

When required, the results of the power-up tests can be checked to determine the reason the recorder has gone to "Failsafe".

The following procedure in Table 9-3 tells you how to display the results of the latest tests run. Table 9-4 lists the tests, the reason for the failure, and how to correct the problem.

Table 9-3 Displaying the test results

Step	Operation	Press	Action/Result
1	Select STATUS Set Up Group	**SET UP**	Until you see: *Upper Display:* **READ** *Lower Display:* **STATUS**
2	Read the status tests results	**FUNC**	Until you see: *Upper Display:* **NO** or **YES** (YES indicates a failure) *Lower Display:* **FAILSAFE** • Successive presses of the **FUNC** key will display the results of the tests (PASS or FAIL) in the following order: RAM TEST CONFTEST CAL TEST FACT CRC BATTERY • Identify the problem from the error message and correct the failure as shown under "lower display indication" in Table 9-4.

Error message prompts

The messages listed in Table 9-4 may appear during the power-up test or status test, or they may blink in the lower display as the result of ongoing background tests that verify data and memory integrity.

Simultaneous error messages will be displayed in rotation.

Table 9-4 lists the error message, the test group that prompted the message, the reason for the failure, and how to correct the problem.

Table 9-4 Error message prompts

Lower Display Indication	Test Group	Reason for Failure	How to Correct the Problem
FAILSAFE (Note 1)	Status or Background	This error message shows whenever the recorder goes into a failsafe mode of operation. This will happen if control is enabled and: • a power-up test fails, • a specific background test fails.	1. Run through the "Device Status" check (page 232) to determine the reason for the failsafe indication. 2. Identify the other failure message in the display and correct the problem according to the recommendations given in this table for that particular error message.
RAM TEST (Note 1)	Power-up	RAM failure	1. Cycle power. 2. Check "Device Status" (page 232) to see if error clears. 3. If error doesn't clear, replace the main printed circuit board.
CONFTEST (Note 1)	Power-up	Configuration data is in error.	1. Check all the configuration prompts for accuracy. • See *Section 3 - Configuration* for selections and limits. 2. Change *any* configuration item, check "Device Status" to see if CONFTEST=PASS, return configuration item to original value. • See *Section 3 - Configuration* for instructions to change a configuration item.

Lower Display Indication	Test Group	Reason for Failure	How to Correct the Problem
CNFG ERR	Background	Configuration data is in error.	1. Check all the configuration prompts for accuracy. • See *Section 3 - Configuration* for selections and limits. 2. Change *any* configuration item, then return it to the original value. • See *Section 3 - Configuration* for instructions to change a configuration item.
CAL TEST (Note 1)	Power-up	The working calibration constants in the recorder are in error.	1. Change to a different input type. • See *Section 3 – Configuration.* 2. Check "Device Status" (page 232) to see if FACT CRC=PASS. • If PASS—return to original input type. • If FAIL—field calibrate. Refer to *Section 7 – Input Calibration.*
CAL1 ERR	Background	Working CAL TEST failure (Control 1, Input 1, Input 2)	1. Change to a different input type. • See *Section 3 – Configuration.* 2. Check "Device Status" (page 232) to see if FACT CRC=PASS. • If PASS—return to original input type. • If FAIL—field calibrate Control Output #1, Input 1, or Input 2. Refer to *Section 7 – Input Calibration* and *Section 8 – Output Calibration.*
CAL2 ERR	Background	Working CAL TEST failure (Control 2, Output)	1. Field calibrate Control Output 2. • Refer to *Section 8 – Output Calibration.*
FACT CRC	Check "Device Status" See page 232.	Factory-set input constants have been changed due to the change in input type.	1. Check background test error message being displayed. 2. Recalibrate Input or Output. • Refer to *Section 7 – Input Calibration* or *Section 8 – Output Calibration.*

Lower Display Indication	Test Group	Reason for Failure	How to Correct the Problem
EE FAIL	Background	Unable to write to nonvolatile memory. Any time you change a parameter and it is not accepted, you will see EE FAIL.	1. Check the accuracy of the parameter and re-enter. 2. Try to change something in configuration. 3. Call Customer Support 1-800-423-9883 USA and Canada.
IN1FAIL **IN2FAIL** **IN3FAIL** **IN4FAIL**	Background	Two consecutive failures of input 1 integration (for example, cannot make analog to digital conversion)	1. Be sure the range and actuation are configured correctly. 2. Check the input source. 3. Recalibrate. Refer to *Section 7 - Input Calibration.* 4. Replace the input card. 5. Call Customer Support 1-800-423-9883 USA and Canada.
BATTERY	Power-up or Status	Battery test failure.	1. Replace battery. 2. Call Customer Support 1-800-423-9883 USA and Canada
BATT LOW	Background		
PV LIMIT	Background	Process Variable is out of range. ± 10 % of range	1. Be sure pen input configuration is correct. 2. Check the displayed PV value to see if it is outside input limits. 3. Call Customer Support 1-800-423-9883 USA and Canada.
RV LIMIT	Background	The result of the formula shown below is beyond the range of the remote variable. RV = INP2 X RATIO + BIAS	1. Make sure the input signal is correct. 2. Make sure the ratio and bias settings are correct. 3. Go to CONTROL prompt REMOTE SOURCE and change REMOTE to 1LOCAL.
SW FAIL **SW2 FAIL**	Background	Position proportional slidewire feedback failure	1. Check motor slidewire connections. 2. Recalibrate the slidewire motor position. 3. Replace the control card.

Lower Display Indication	Test Group	Reason for Failure	How to Correct the Problem
IN1RNG **IN2RNG** **IN3RNG** **IN4RNG**	Background	Input out of range. The process input is outside the range limits.	1. Make sure the range and actuation are configured properly. 2. Check the input source. 3. Restore the factory calibration: a) Disconnect the wiring from the terminals on plug J2 on the input board (see Figure 2-13). Place a jumper across these terminals. The controller should read room temperature if it is configured for a thermocouple input. b) If it does not read room temperature, see *Section 3 - Configuration* and change the IN1TYP prompt in the INPUT 1 group to another type of thermocouple. c) After the change, press **FUNC** key, then the **LOWR DISP** key. The controller should read the correct room temperature. If it does not, the unit has an input failure. d) Repeat step b. This time switch the IN1TYP back to the originally selected thermocouple. e) Repeat step c. The controller is restored with factory calibration. f) Remove the jumper and reconnect the thermocouple to plug J2. 4. Field calibrate. See *Section 7 – Input Calibration.* 5. Replace the input card. 6. Call Customer Support 1-800-423-9883 USA and Canada.

NOTE 1: Will appear in "STATUS" Set Up Group—See procedure for displaying the test results on page 232.

9.4 Visual Failure Symptoms

Introduction

In addition to the error message prompts, there are visual failure symptoms that can be identified by noting the erratic recorder functions.

Symptoms

Compare your symptoms with those shown in Table 9-5 and refer to the troubleshooting procedure indicated to correct the problem.

Table 9-5 Visual failure symptoms

Symptom	Troubleshooting Procedure
Recorder will not operate	1
Recorder operation is normal but pen trace is incorrect	2
Chart rotates at wrong speed or will not rotate (pen indication correct)	3
Pen remains at high end of range when input signal is low	4
Pen does not move when input signal changes	5
A key does not respond and/or a display does not light	6
Displayed output does not agree with controller output	
Current Proportional Output Type	7
Position Proportional Output Type	8
Single or Dual Relay Output Type	9
Duplex Current/Time or Time/Current Proportional Output Type	10
Auxiliary Output Type	11
External Alarm Function does not operate properly	12
Modbus Communications Failure	13

9.5 Troubleshooting Procedures

Introduction

The troubleshooting procedures for the Visual Failure Symptoms are listed in numerical order as they appear in Table 9-5. Each procedure lists what to do if you have that particular failure and how to do it or where to find the data needed to accomplish the task. Progressive steps provide aid in finding and fixing the problem.

Equipment needed

You will need the following equipment in order to troubleshoot the symptoms listed in the tables that follow:

- DC Milliammeter – mAdc
- Calibration sources – T/C, mV, Volt, etc.
- Voltmeter

Table 9-6 Procedure #1—Troubleshooting recorder failure symptoms

Step	What to do	How to do it or where to find the data
1	Check the fuse on the main printed circuit board.	Replace if defective.
2	Check the supply voltage.	Measure the line voltage across J10 on the Main printed circuit board.
3	Check the connections to J10 on the main printed circuit board.	Refer to *Subsection 2.6 - Input Wiring Procedures (Figure 2-12 AC Line Power Wiring).*
4	Check the transformer leadwire connections to the main printed circuit board.	Refer to Figure 10-5 in *Section 10 - Parts List.*
5	Check the system for brown-outs, heavy load switching, etc.; and conformance to installation instructions.	Refer to *Section 2 - Installation.*
6	Replace the transformer.	Disconnect the transformer lead wires from the main printed circuit board. Replace the transformer and tighten the screws. Connect the lead wires to the main printed circuit board.
7	Call Technical Assistance Center.	1-800-423-9883 USA and Canada

Table 9-7 Procedure #2—Troubleshooting pen trace failure symptoms

WARNING

Do not lubricate the plastic gears on the chart and pen motors.

Step	What to do	How to do it or where to find the data
1	Check the sensor for the proper type and its ability to function.	Verify the input configuration data and operation of the sensor.
2	Recalibrate the recorder.	Refer to *Section 7 - Input Calibration*. For thermocouple input, be sure to confirm cold-junction temperature calibration.
3	Replace the servo plate assembly.	Refer to the instructions included with the replacement part.
4	Call Technical Assistance Center.	1-800-423-9883 USA and Canada

Table 9-8 Procedure #3—Troubleshooting chart rotation failure symptoms

WARNING

Do not lubricate the plastic gears on the chart and pen motors.

Step	What to do	How to do it or where to find the data
1	Check the chart installation.	Be sure the drive pin on the hub is in the drive hole on the chart.
2	Check the configured chart speed value and change it, if required.	Refer to *Section 3 - Configuration*.
3	Check the motor cable plug connection at connector J7 on the main printed circuit board.	Visually examine the plug and reset it.
4	Replace the chart motor.	Refer to the instructions included with the replacement part.
5	Call Technical Assistance Center.	1-800-423-9883 USA and Canada

Table 9-9 Procedure #4—Troubleshooting chart rotation failure symptoms

WARNING

Do not lubricate the plastic gears on the chart and pen motors.

Step	What to do	How to do it or where to find the data
1	Check the sensor and lead wires for continuity. Check the connections.	Replace the sensor lead wires as needed. Tighten the connections.
2	Check the pen and input configuration data.	Refer to *Section 3 - Configuration.*
3	Replace the servo plate assembly.	Refer to the instructions included with the replacement part.
4	Call Technical Assistance Center.	1-800-423-9883 USA and Canada

Table 9-10 Procedure #5—Troubleshooting pen failure symptoms

WARNING

Do not lubricate the plastic gears on the chart and pen motors.

Step	What to do	How to do it or where to find the data
1	Check the sensor and lead wires for continuity. Check the connections.	Replace the sensor lead wires as needed. Verify and tighten the input connections.
2	Check the pen arm for secure mechanical attachment to the servo shaft.	Verify that the flat-head screw that attaches the pen arm to the plastic servo gear on the servo shaft is tight.
3	Check the servo cable plug connection (J6) on the main printed circuit board.	Visually examine the plug and reseat it.
4	Replace the servo plate.	Refer to the instructions included with the replacement part.
5	Call Technical Assistance Center.	1-800-423-9883 USA and Canada

Table 9-11 Procedure #6—Troubleshooting keyboard and/or display failure symptoms

Step	What to do	How to do it or where to find the data
1	Run a Key Test to check the operation of the keys and displays.	Refer to *Section 5 - Operation* for procedures on running a key test.
2	Replace the membrane switch (keyboard) and /or display printed circuit board as required.	Refer to the instructions included with the replacement part.

Table 9-12 Procedure #7—Troubleshooting current proportional output failure symptoms

Step	What to do	How to do it or where to find the data
1	Be sure the recorder is configured for current output.	Refer to *Section 3 - Configuration.* Make sure OUT ALG selection = CURRENT.
2	Check the field wiring.	Refer to *Section 2 - Installation.*
3	Be sure all the recorder and control related data is correct.	Refer to *Section 3 - Configuration.* Check the tuning, algorithm, and control data.
4	Check the output.	Put the recorder into Manual Mode and raise/lower the output manually from 0 % to 100 % (4-20 mA). Use a milliammeter at connection J1 on the control output printed circuit board.
5	Recalibrate the current proportional output.	Refer to *Section 8 - Output Calibration.*
6	Replace the control output printed circuit board.	Refer to the instructions included with the replacement part.

Table 9-13 Procedure #8—Troubleshooting position proportional output failure symptoms

Step	What to do	How to do it or where to find the data
1	Be sure the recorder is configured for position proportional output.	Refer to *Section 3 - Configuration.* Make sure OUT ALG selection = POSITN.
2	Check the field wiring.	Refer to *Section 2 - Installation.*
3	Check the output.	Put the recorder into manual mode and adjust the output manually to drive the motor from 0 % to 100 %.
4	Check whether the motor drives in both directions. If it does, go to step 5. If the motor drives in one direction only, check the slidewire. If the motor does not drive in either direction, check the motor.	Refer to *Section 8 - Output Calibration* for motor slidewire calibration. Refer to the motor instructions.
5	Check the output voltage to the slidewire.	Put the voltmeter across the slidewire terminals at connector J2 on the control output printed circuit board and check that the slidewire voltage varies with the motor position.
6	Be sure that the output relays are actuating properly. If they are not, check the field wiring, then go to step 4. If they are, go to step 7.	Put the recorder into manual mode and adjust the output manually above and below the present value. Listen for the click of the relays. One relay should click when the output is adjusted higher, and the other should click when the output is adjusted lower than the present value. Observe OUT 1 and 2 indicators on the front display.
7	Check the control relay jumper position.	Refer to *Section 3 - Configuration.*
8	Replace the control output printed circuit board.	Refer to the instructions included with the replacement part.
9	Recalibrate the position proportional output.	Refer to *Section 8 - Output Calibration.*

Table 9-14 Procedure #9—Troubleshooting relay output failure symptoms

Step	What to do	How to do it or where to find the data
1	Be sure the recorder is configured for relay output.	Refer to *Section 3 - Configuration*. Make sure OUT ALG selection = TIME.
2	Be sure all the recorder and control related data is correct.	Refer to *Section 3 - Configuration*. Check the Tuning, Algorithm, and Control data.
3	Check that the applicable output relay actuates properly. If it does, go to step 4.	Put the recorder into manual mode and adjust the output manually to raise or lower the PV around the setpoint. Listen for the click of the relay as the PV moves in either direction. Observe OUT 1 or 2 indicator on the front display.
4	Check the control relay jumper positions.	Refer to *Section 3 - Configuration*.
5	Check the field wiring.	Refer to *Section 2 - Installation*.
6	Replace the control output printed circuit board.	Refer to the instructions included with the replacement part.

Table 9-15 Procedure #10—Troubleshooting current/time or time/current failure symptoms

Step	What to do	How to do it or where to find the data
1	Be sure the recorder is configured for current time/time current output.	Refer to *Section 3 - Configuration*. Make sure OUT ALG selection = TI CUR or CUR TI.
2	Be sure all the recorder and control related data is correct.	Refer to *Section 3 - Configuration*. Check the tuning, algorithm, and control data.
3	Check that the applicable output relay actuates properly. If it does, go to step 4. If it does not check the field wiring; then go to step 5.	Put the recorder into manual mode and adjust the output manually to raise or lower the PV around the setpoint. Listen for the click of the relay as the PV moves in either direction. Observe OUT 1 or 2 indicator on the front display.
4	Check the control relay jumper positions.	Refer to *Section 3 - Configuration*.
5	Check the current proportional output.	Put the recorder in manual mode and manually adjust the output from 0 % to 100 % (4-20 mA). Use a milliammeter across the terminals in connector J1 on the control output printed circuit board to verify the output.
6	Recalibrate the current output.	Refer to *Section 8 - Output Calibration*.
7	Replace the control output printed circuit board.	Refer to the instructions included with the replacement part.

Table 9-16 Procedure #11—Troubleshooting the auxiliary output

Step	What to do	How to do it or where to find the data
1	Be sure the controller is configured for Auxiliary Output.	Refer to *Subsection 3.17 – Auxiliary Output Group*. Make sure AUX OUT is enabled and the correct parameter is chosen. Check the High and Low Scale values.
2	Check the field wiring.	Refer to *Section 2 – Installation.*
3	Check the output.	Use a milliammeter at connection J2 on the Auxiliary Output printed circuit board to determine the correct output based on your representation of 4 mA and 20 mA.
4	Recalibrate the Auxiliary Output.	Refer to *Subsection 8.4 – Auxiliary Output Calibration.*
5	Replace the Auxiliary Output printed circuit board.	Refer to the instructions included with the replacement part.

Table 9-17 Procedure #12—Troubleshooting external alarm function failure symptoms

Step	What to do	How to do it or where to find the data
1	Be sure all the alarm configuration data is correct.	Refer to *Section 3 - Configuration.*
2	Check the applicable alarm relay jumper position.	Refer to *Section 3 - Configuration.*
3	Check the field wiring.	Refer to *Section 2 - Installation.*
4	Check that the applicable alarm relay actuates properly depending on ALARM TYPE configuration selection.	Alarms can be triggered either by: • reconfiguring the value of the trip points (AnSnVAL), or • connecting a signal generator to the input and setting the generator level beyond the trip-point values.

Table 9-18 Procedure #13—Troubleshooting Modbus communications

Step	What to do	How to do it or where to find the data
1	Check the field wiring and termination resistor.	Refer to Figure 2-21 in *Section 2 – Installation* in this manual.
2	Make sure the Modbus Communications board is properly installed in the recorder.	Open the recorder door and chart plate, and inspect the board. Refer to Figure 10-4 for location of the board.
3	Run a Loopback test.	Refer to Modbus Communications manual 51-52-25-66 for loopback information.

10. Parts List

10.1 Overview

Introduction

This section provides the replacement parts lists for the DR4500A Truline Recorder. Most parts are supplied on an optimum replacement unit basis; that is, part numbers are given for complete printed circuit boards rather than for individual PCB components.

The figures that follow are exploded views of the DR4500A recorder. Each part is labeled with a key number and the key numbers are listed in tables with associated part number.

Also included for your reference are an Internal Cabling drawing (Figure 10-5) and an Internal Wiring Diagram (Figure 10-6) for options only.

When ordering parts, be sure to specify your recorder's serial and model numbers (on nameplate) as well as the part identification.

What's in this section?

This section contains the following topics:

Topic			See Page
10.1	Overview		245
10.2	Exploded Views		246
	Figure 10-1	Door assembly	246
	Figure 10-2	Chart plate assembly	247
	Figure 10-3	Basic recorder components without options	248
	Figure 10-4	Recorder components associated with options	250
10.3	Miscellaneous Hardware Kit Contents		252
10.4	Figure 10-5	Internal Cabling Data	253
10.5	Figure 10-6	Internal Wiring Diagram – Options Only	254

10.2 Exploded Views

Door assembly

Figure 10-1 is an exploded view of the Door Assembly. Table 10-1 is a list of the associated part numbers.

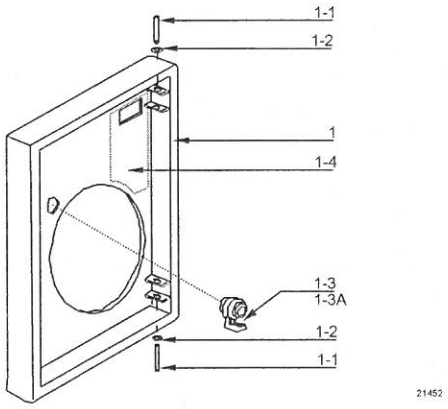


Figure 10-1 Door assembly

Table 10-1 Door assembly parts

Key	Part Number	Description	Recommended Spare Parts per		Quantity per Unit
			10	100	
1 (Note 3)		**Door Assembly**			1
	30754955-501	Blue with glass window and latch			
	30754955-504	Blue with acrylic window and latch			
	30754955-505	Gray with glass window and latch			
	30754955-506	Gray with acrylic window and latch			
	30754955-507	Black with glass window and latch			
	30754955-508	Black with acrylic window and latch			
	51452435-501	NEMA4X Door with Plastic window			
	51452435-502	NEMA4X Door with Glass window			
	51452435-503	NEMA4X Door with HTST window			
1-1	(K)30755980-001	Hinge Pin (Note 1)			2
1-2	(K)30755980-001	Retaining Ring (Note 1)			2
1-3	51309609-503	Latch/Lock Assembly Kit	1	3	1
1-3A	30755980-006	Key kit for keyed latch or lock			
1-4	30755136-502	Truline Door Overlay			1
	51404929-501	External Keypad Upgrade Kit (not shown)			1

NOTE 1: **For Door 30754955-50X**, (K) denotes that these parts are included in the miscellaneous hardware kit 30755980-001. For all other doors, the parts are included with applicable door assembly.

Chart plate

Figure 10-2 is an exploded view of the Chart Plate Assembly.
Table 10-2 is a list of the associated part numbers.

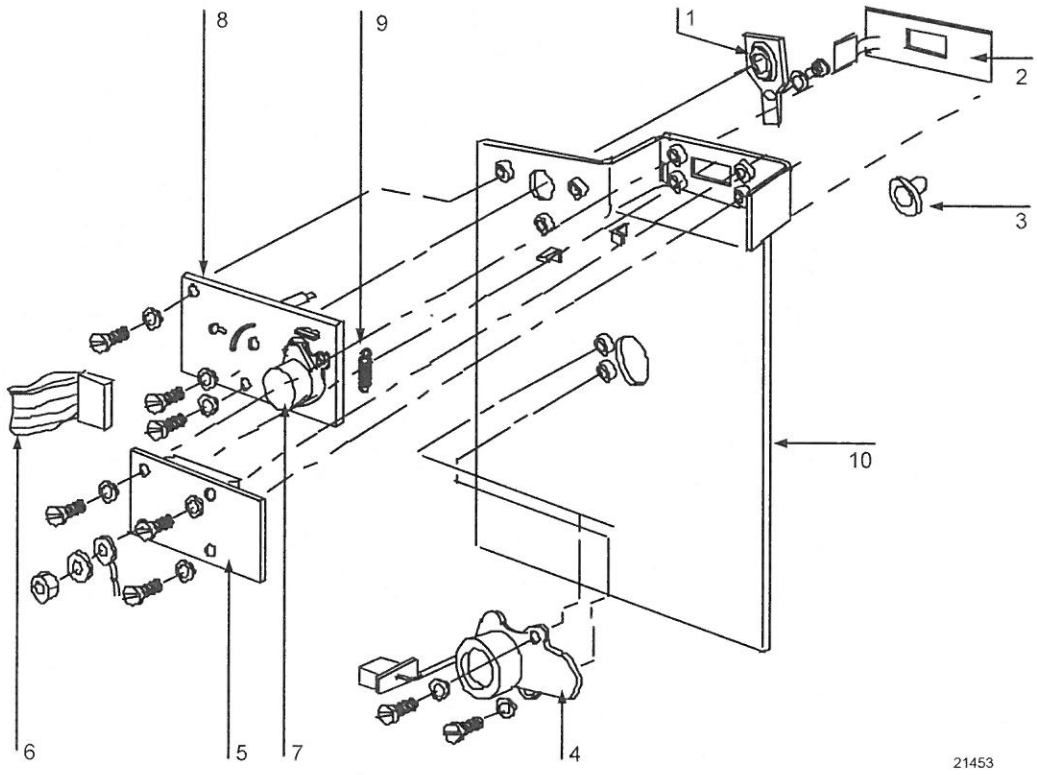


Figure 10-2 Chart plate assembly

Table 10-2 Chart plate assembly parts

Key	Part Number	Description	Recommended Spare Parts per		Quantity per Unit
			10	100	
1	30756304-501 30756304-502	Truline Pen Arm Assembly (high speed) Truline Pen Arm Assembly (abrasion resistant)	1	5	1
2	30754957-501	Membrane Switch Key Pad	1	5	1
3	(K)30756150-001	Chart Hub Kit	1	3	2
4	30756113-501	Chart Motor	1	3	1
5	30757571-501	Display PCB (includes key no. 6)	1	5	1
6	See above	Ribbon Cable, Display (included with key no. 5)			
7	See below	Servo Motor Assembly (included with key no. 8)			
8	30754975-503	Servo Plate Assembly (includes key no. 7)	1	2	1
9	(K)30755980-002	Spring, tension			1
10	30754977-503 30754977-504 30754977-513 30754977-514	Chart plate for standard (high speed) pen Chart plate for abrasion resistant pen Chart plate for standard (high speed) pen - CE Mark Chart plate for abrasion resistant pen - CE Mark	1	2	1

Basic recorder components without options

Figure 10-3 is an exploded view of the basic recorder components.
Table 10-3 is a list of the associated part numbers.

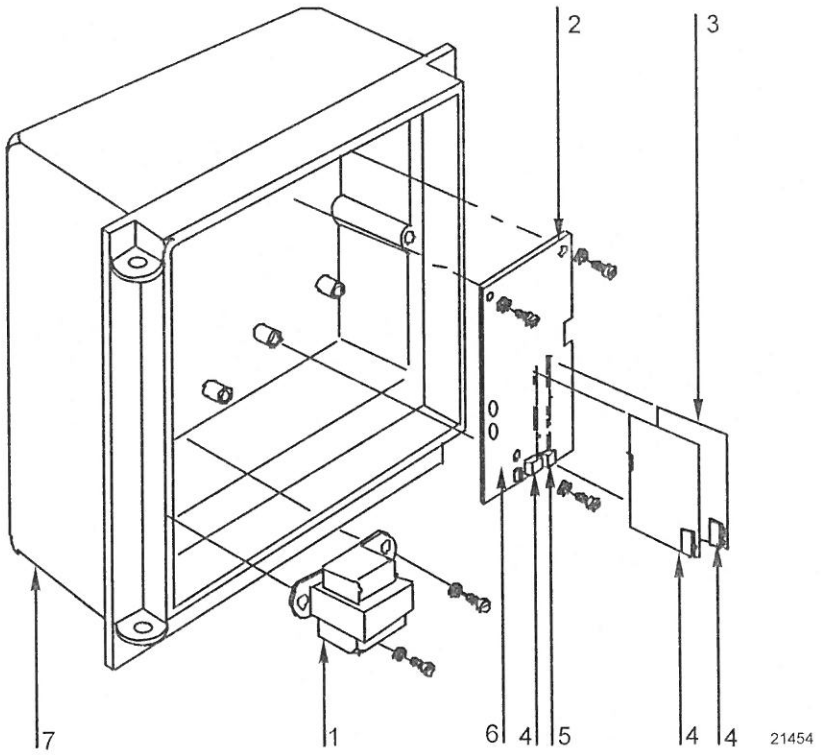


Figure 10-3 Basic recorder components without options

Table 10-3 Basic recorder parts without options

Key	Part Number	Description	Recommended Spare Parts per		Quantity per Unit
			10	100	
1	30754982-502	Main Transformer	1	3	1
2	51309355-502 51309355-503 51309355-504 51309355-505	Main PCB - CE Mark (model DR45AT) Main PCB - CE Mark (model DR45AR) Main PCB - CE Mark (model DR45AW) Main PCB - CE Mark (model DR45AH/AP/AS)	1	5	1
3	(K)30756141-003	Input PCB (input 1, 2, 3, or 4)			1/4
4	See Note 2	3-position connector**			2
5	See Note 2	2-position connector**			1
6	30755980-005	Fuse (Wilkman 19374-K-500 ohm or equal)**			1
7	30754924-502	Case			1
PARTS NOT SHOWN					
	See Note 2	Card guides for Input PCBs**			2
	51197612-502 51197612-508	Ferrite Filter - Package of 2 (CE Mark) Ferrite Filter - Package of 8 (CE Mark)			1
	51197650-501	Washer Kit (package of 6)			1
	51197755-001	Capacitor Kit (.01mfd) - 12 per kit (CE Mark)			
	30755232-502	0-10 Vdc Input Divider (input PCBs)			*
	30756461-002	250 ohm Resistor Assembly			*
	30755317-001	Box of 100 12" Truline Chart Paper			
	(K)30755065-501 (K)30755065-503	Mounting Kit (standard) Mounting Kit (NEMA4X)			1
	(K)30755134-001 (K)30755134-002	Blue Universal Filler Plate Kit Gray Universal Filler Plate Kit			*
	(K)30755011-001	Filler Panel Kit (for replacing Servoline recorder)			*
	(K)30757301-001	Configuration Lockout Hardware			1
	51197657-501	DR4300/DR4500 Panel Gasket			1
	51198150-501	Pipe Mounting Kit 2" Pipe Size			1
	51197657-501 51197657-502	Panel Mounting Gasket Kit (standard) Panel Mounting Gasket Kit (NEMA4X)			1

NOTE 2: These parts are included with applicable PCB kits, as required.
* As required
** These parts are also included in the miscellaneous hardware kit 30755980-006

Additional recorder components associated with options

Figure 10-4 is an exploded view of the recorder components associated with options.
Table 10-4 is a list of the associated part numbers.

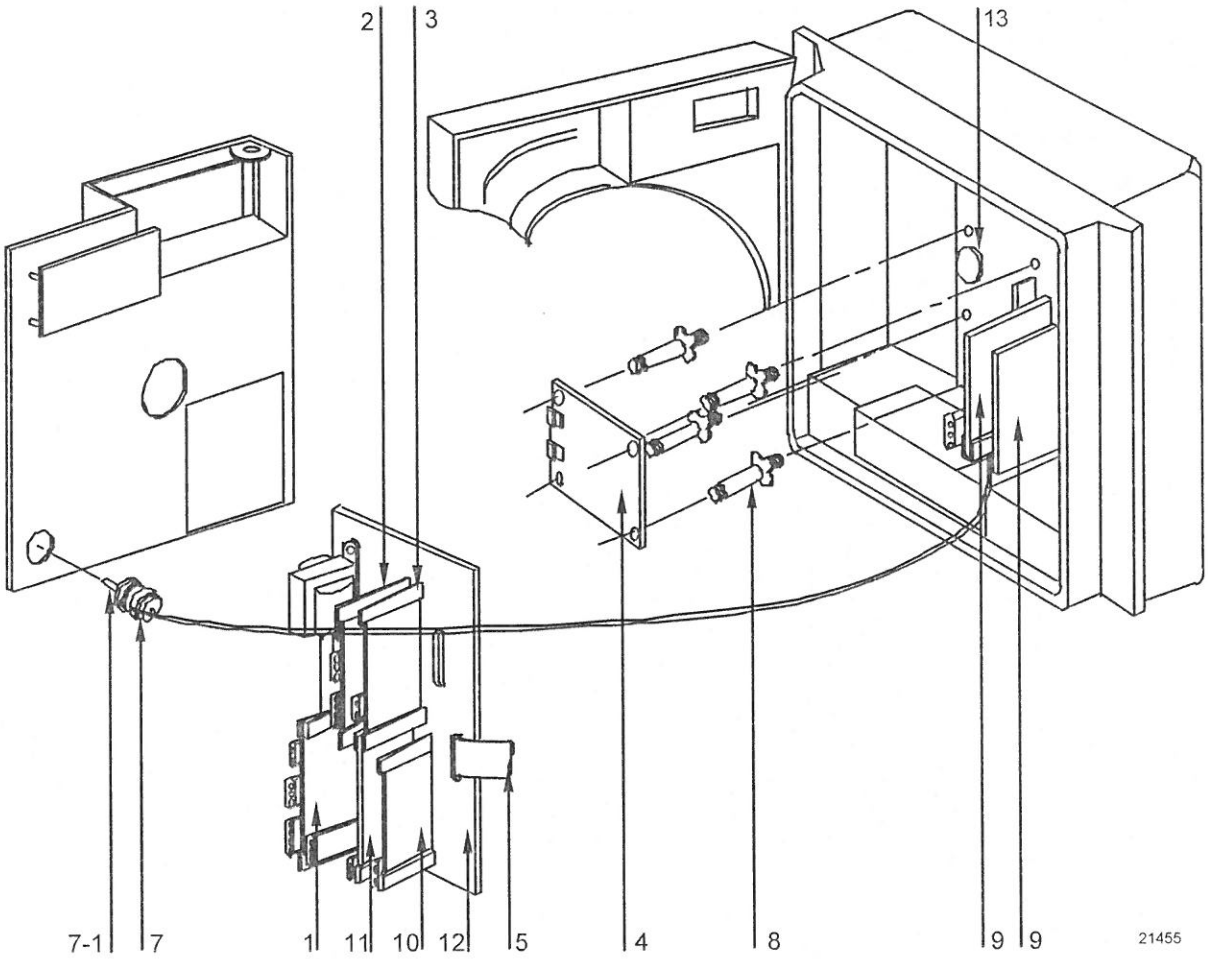


Figure 10-4 Recorder components associated with options

Table 10-4 Recorder parts associated with options

Key	Part Number	Description	Recommended Spare Parts per		Quantity per Unit
			10	100	
1	30754922-501 30754922-502	Second Control Output PCB Second Current Output PCB - Current Out Only (Note 4)			1
2	30754922-501 30754922-502	First Control Output PCB First Control Output - PCB - Current Out Only	1	5	1
	30754499-005	Control Output Relay Kit (2 relays per kit)	1	5	2
3	51404561-501 51404561-502 51404561-503	Auxiliary Output PCB (includes terminal blocks and card guides as required) RS485 Modbus RTU Communications PCB RS485 Modbus RTU plus Auxiliary Output PCB	1	5	1
4	(K)30756140-001	Alarm output/digital input PCB kit			1
5	See Note 3 30755119-501	Ribbon cable (34 conductor)	1	3	1
7	30755127-502	Light accessory kit			1
7-1	(K)30749598-501	Kit of 5 Bulbs (General Instruments 1828 or equivalent)			1
8	(K)30756140-001	Spacers			4
9, 10, 11	(K)30756141-003	Input PCBs (1, 2, 3, or 4)	1	5	1/4
12	30754919-501	Mother board	1	3	0/1
13	30755980-004	Battery (Duracell DL2450 or equivalent)	1	1	1

NOTE 3: Part included with alarm output/digital input PCB kit 30756140-001.
NOTE 4: 30754922-502 Control Output board is used for Table II Options 60 or 66.

10.3 Miscellaneous Hardware Kit Contents

Kit contents

Table 10-5 lists the kit contents of miscellaneous hardware kit — part number 30755980-TAB.

Table 10-5 Miscellaneous hardware kit

Part Description	Quantity					
	Tab 001	Tab 002	Tab 003	Tab 004	Tab 005	Tab 006
Pen lifter/retainer		1				
Screw 10-32, 3/4" lg.		5				
O-ring		5				
Spring, tension		2				
Hinge pin	2					
Retaining ring	2					
Pen arm #1 (classic)		1				
Pen arm #2 (classic)		1				
Latch without lock	1					
Latch pin	1					
Latch gasket	1					
Card guide			2			
4-position connector			2			
3-position connector			2			
3-position connector—CE Mark			2			
2-position connector			2			
Fuse 0.5 A, 250 V					20	
Batteries 3.0 V Lithium Button Cell				5		
Key for latch or lock						1
Key for Door/Keyed latch						1

10.4 Internal Cabling Data

View of internal cabling

Figure 10-5 is a view of the internal cabling for the DR4500A Truline Recorder.

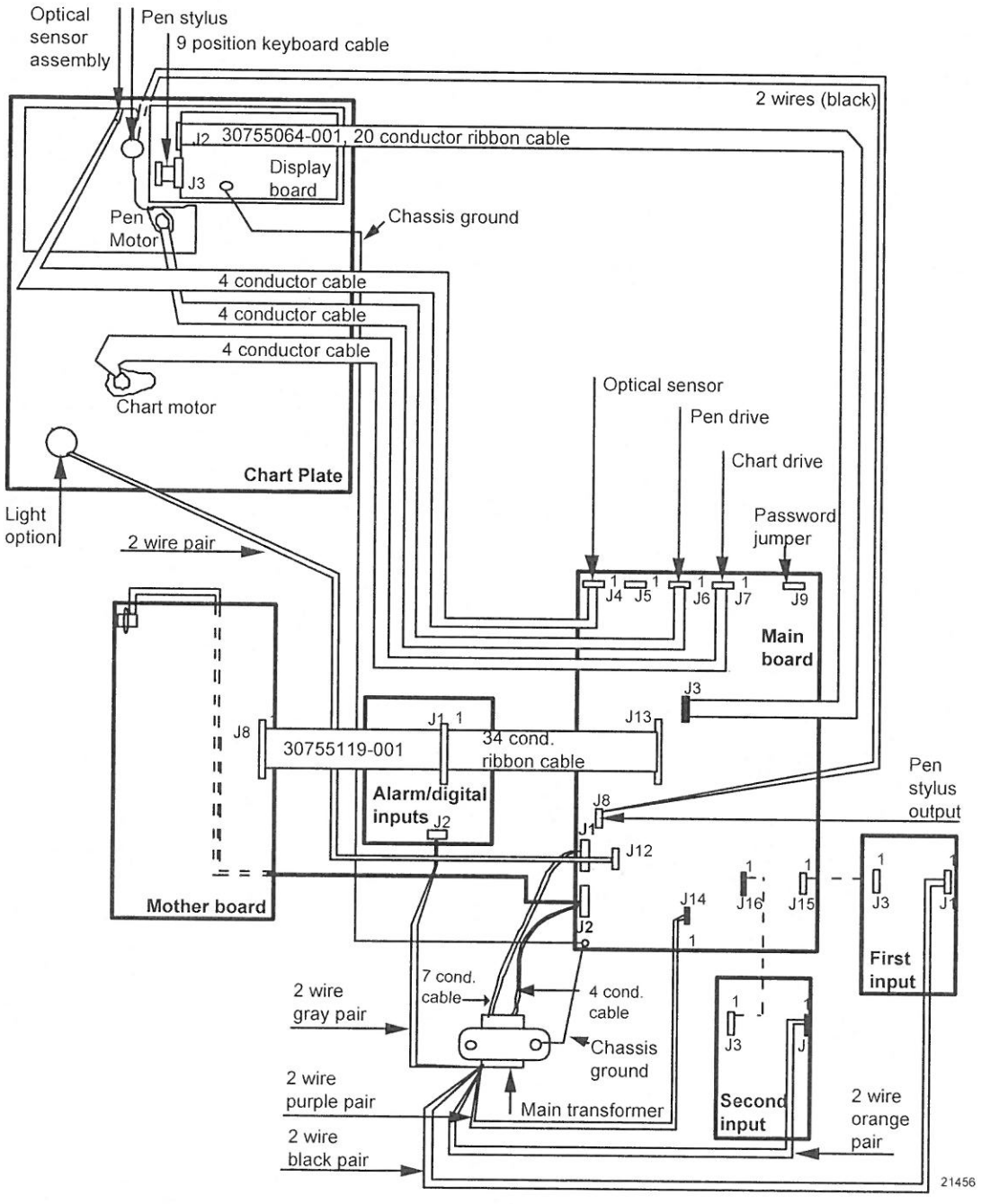


Figure 10-5 Internal cabling for DR4500A Truline recorder

10.5 Internal Wiring Diagram – Options Only

View of internal option wiring

Figure 10-6 is a view of the internal wiring diagram - options only for the DR4500A Truline Recorder.

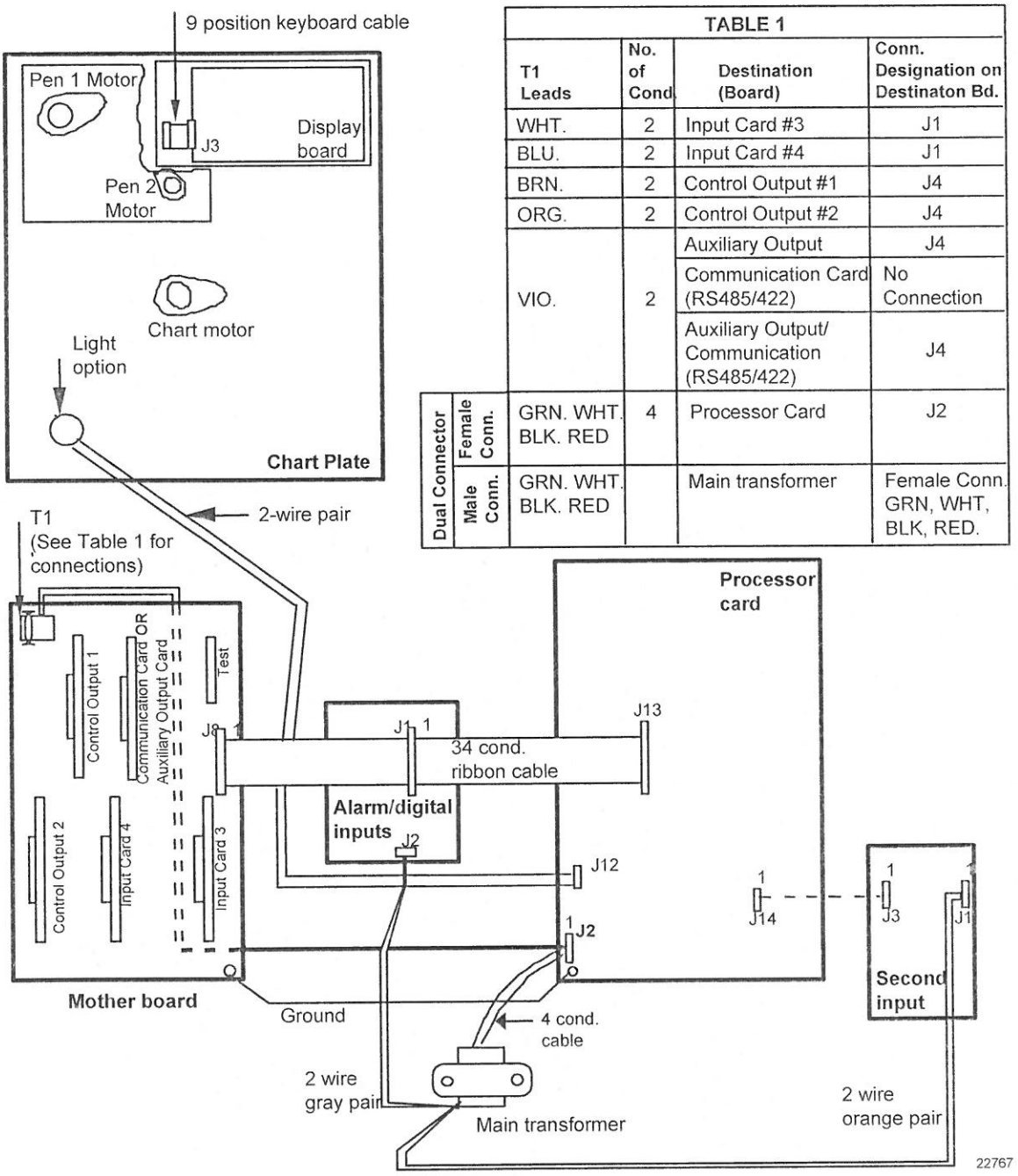


TABLE 1

T1 Leads	No. of Cond.	Destination (Board)	Conn. Designation on Destinaton Bd.
WHT.	2	Input Card #3	J1
BLU.	2	Input Card #4	J1
BRN.	2	Control Output #1	J4
ORG.	2	Control Output #2	J4
VIO.	2	Auxiliary Output	J4
		Communication Card (RS485/422)	No Connection
		Auxiliary Output/ Communication (RS485/422)	J4
Dual Connector Female Conn. GRN. WHT. BLK. RED	4	Processor Card	J2
Dual Connector Male Conn. GRN. WHT. BLK. RED		Main transformer	Female Conn. GRN, WHT, BLK, RED.

Figure 10-6 Internal diagram for DR4500A Truline recorder – options only

A. Model DR45AR

A.1 Overview

Introduction

If the key number for your recorder is DR45AR, it is a relay expansion model Truline recorder that can have up to six alarm relay outputs and include Fo calculation function. While its basic functions are identical to the standard (DR45AT) Truline recorder, it does have some unique hardware, wiring and configuration features. This section provides the data pertinent to these unique features as a supplement to the standard Truline in this product manual.

What's in this section?

The table below lists the topics that are covered in this section.

Topic		See Page
A.1	Overview	255
A.2	Hardware Identification	256
A.3	Fo Reset Configuration	258
A.4	Options Configuration	259
A.5	Operations Additions	261
A.6	Configuration Worksheet Additions	262

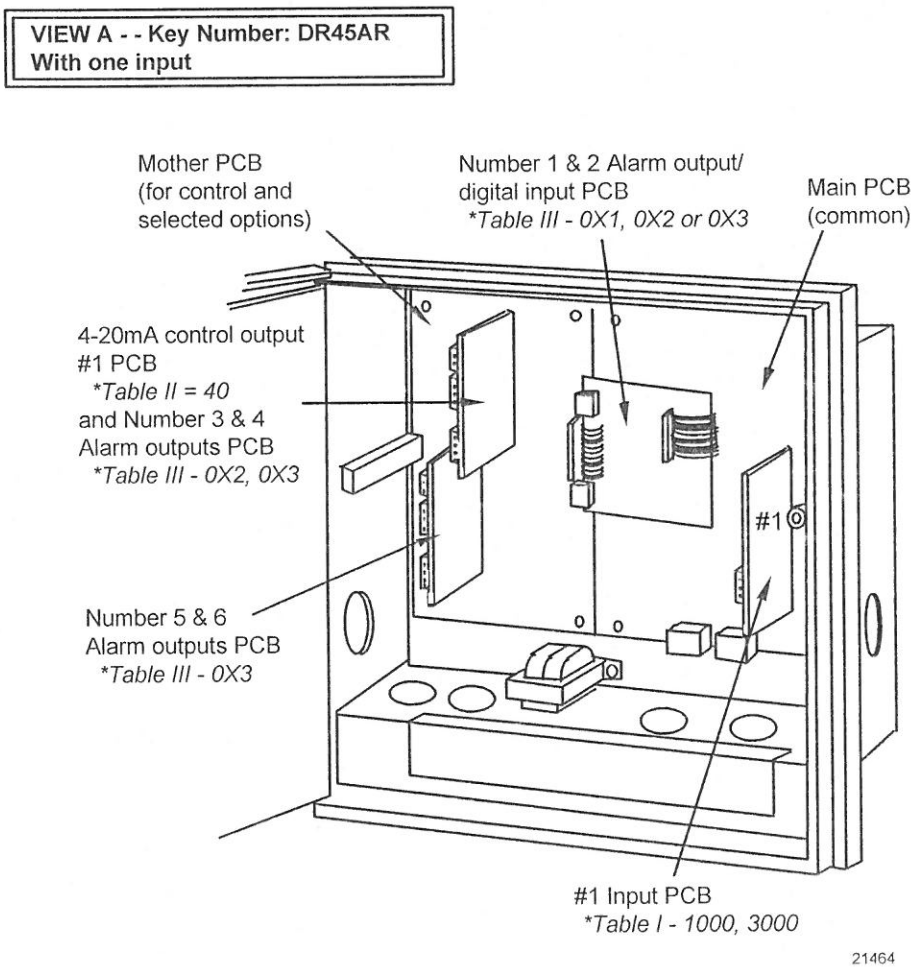
A.2 Hardware Identification

Introduction

Figure A-1 (DR45AR with one input) and Figure A-2 (DR45AR with two to four inputs) identify the hardware components of the DR45AR model versus "Table" selections.

DR45AR with one input

Figure A-1 identifies the hardware components of the DR45AR with one input.



* *Refer to Model Selection Guide*

Figure A-1 DR45AR with one input

DR45AR with two to four inputs

Figure A-2 identifies the hardware components of the DR45AR with two to four inputs.

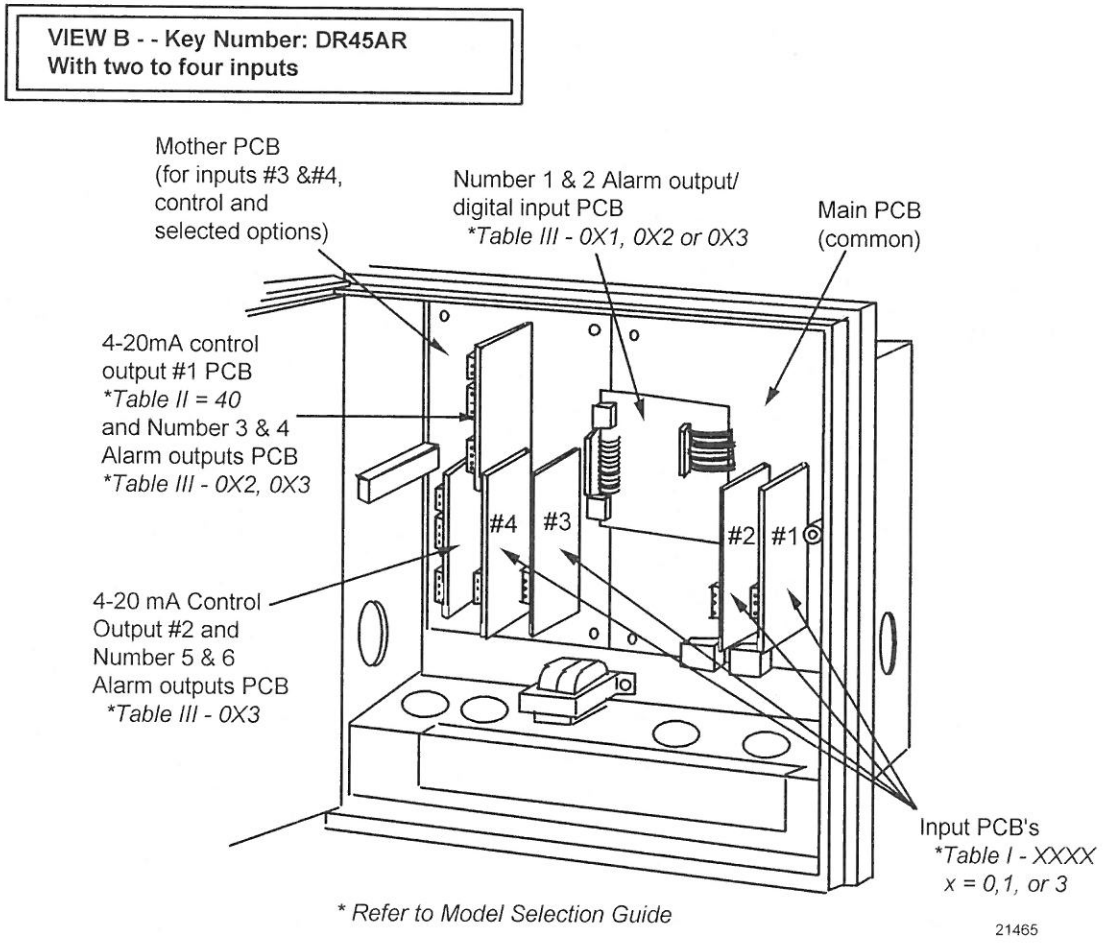


Figure A-2 DR45AR with two to four inputs

A.3 Fo Reset Configuration

Introduction

This SET UP group is specific to Model DR45AR. It allows you to reset the Fo sterilization calculation.

Accessing Fo reset prompts

Press the **SET UP** key until you see:

Upper Display: **SET UP**

Lower Display: **FO RESET**

Press the **FUNC** key to call up the Fo Reset function prompt that will allow you to reset the Fo sterilization calculation. The function prompt for the Fo Reset group is listed in Table A-1.

Function prompts

Table A-1 lists the function prompt in the "Fo RESET" Set Up group for model DR45AR.

Table A-1 Fo RESET group function prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
RESET Fo	Reset Fo Sterilization Calculation (REM SW or REM SW2 under "OPTIONS" group must be configured for "FO RST".)	NO YES	

A.4 Options Configuration

Introduction

For Model DR45AR there are several additions to be added to Table 3-17 Options Group Function Prompts (from Section 3). They cover additional options that are only available with this model number.

Table A-3 on the next page shows the additions made for Model DR45AR in the options group definitions.

Table A-2 Options group function prompts, continued from Section 3/Table 3-17

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
STERILIZ	Fo Sterilization Time	YES NO	
IN TEMP	Input for Product Temperature	INPUT 1 INPUT 2 INPUT 3 INPUT 4	
STDTEMP	Standard Reference Temperature	0.1 to 9999	
Z VALUE	Thermal Resistance	0.1 to 9999	
REM SW	Remote Switching	NONE TO MAN (from AUTO) TO LSP (from REMOTE) TO 2SP (from LSP) TO DIR (from REV) TO HOLD (from RUN) TUNE FO RST	
REM SW2	Remote Switching — digital input 2	NONE FO RST	

Table A-3 Option group definitions, continued from Section 4/Table 4-15

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
STERILIZ	YES (activates Fo sterilization calculation) NO	**Fo STERILIZATION TIME** — This function computes equivalent sterilization time by accumulating lethality rates for a product over each 1/3 or 2/3 second scan interval of the recorder using this equation: $Ts = Ts_{(t-1)} + dt \times 10^{\frac{(t-Tb)}{z}}$ *Where:* Ts = sterilization time in minutes $Ts_{(t-1)}$ = previous sterilization time dt = time interval (1/3 or 2/3 second) NOTE: 1/3 second if less than 3 configured inputs; 2/3 second if greater than 2 configured inputs. Tb = standard reference temperature (configurable) t = product (input) temperature (°F or °C) z = thermal resistance (configurable) Only applicable if Model Table II is 40, Model Table III is 0X3, and Model Table IV is F.
INTEMP	INPUT 1 INPUT 2 INPUT 3 INPUT 4	**INPUT FOR PRODUCT TEMPERATURE** — selects which input will supply product temperature for sterilization calculation.
STDTEMP	0.1 to 9999	**STANDARD REFERENCE TEMPERATURE** — selects a reference temperature constant for sterilization calculation — usually 250 °F or 121 °C.
Z VALUE	0.1 to 9999	**THERMAL RESISTANCE** — selects a thermal resistance constant for sterilization calculation — usually 18 °F or 10 °C.
REM SW	NONE TO MAN (from AUTO) TO LSP (from REMOTE) TO 2SP (from LSP) TO DIR (from REV) TO HOLD (from RUN) TUNE FO RST	**REMOTE SWITCHING** — allows you to select an action to be initiated by remote contact closure through digital input . NONE — No Selection TO MAN — switch to manual mode from automatic TO LSP — switch to local setpoint from remote TO 2SP — switch to 2nd setpoint from local setpoint TO DIR — switch to direct output action from reverse TO HOLD — put ramp/soak program in hold TUNE — start Accutune FO RST — reset sterilization calculation.
REM SW2	NONE FO RST	**REMOTE SWITCHING DIGITAL 2 INPUT** — allows you to select remote contact closure through digital 2 input to reset sterilization calculation or not.

A.5 Operations Additions

Introduction

In addition to the standard operating functions in this manual the addition listed below appears if you have model DR45AR.

Viewing F_O sterilization display

Add the following prompt to Table 5-5 Lower Display Key Parameter Prompts.

Prompt	Description
F_O	F_O sterilization time in the lower display with the appropriate input in the upper display

Digital input (REM SW) prompt selection

Add the following selections to Table 5-25 Digital Input Option Action on Contact Closure.

REM SW Selections	Display Indication	Action on Contact Closure
F_O RST	None	Resets F_O sterilization calculation — if F_O RESET prompt is enabled.

A.6 Configuration Worksheet Additions

Configuration additions

In addition to the Configuration worksheet items that are listed in *Section 3 - Configuration*, the following parameters also appear in Model DR45AR.

Group Prompt	Function prompt	Value or Selection	Factory Setting
FO RESET	RESET FO	_____	
OPTIONS	REJ FREQ	_____	60
	HF REJ	_____	ENABLE
	RELHUMID	_____	NO
	ATMPRES	_____	—
	DEVIATION	_____	NONE
	DEVSETPT	_____	0
	SCROLL	_____	NONE
	GRANDTOT	_____	DISABL
	STERILIZ	_____	
	IN TEMP	_____	
	STDTEMP	_____	
	Z VALUE	_____	
	REM SW	_____	
	REM SW2	_____	

B. Security Lockout

B.1 Overview

Introduction

Your recorder has a security bypass code which allows you to enter secured areas if you have forgotten or lost the operator security code.

To use the universal password, go to the Lockout Set Up group. At PASSWORD enter 1502. This overrides the existing password.

Be sure to re-enter a new password to lockout any unauthorized changes to the recorder's configuration and calibration prompts.

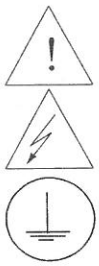
ATTENTION

Remove this page for security.

C. Foreign Language Safety Instructions

SIKKERHESKRAV

DA2I-6056



For at undgå elektrisk stød med mulighed for personskade, skal alle sikkerhedsbestemmelser i denne manual følges nøje.

Dette symbol advarer brugeren om en potentiel berøringsfare, såfremt der kan være adgang til den livsfarlige netspænding.

Beskyttende jordterminal. Terminalen er forberedt for og skal forbindes til beskyttelses-jordledning i henhold til stærkstrømsberkendtgørelsen (DK).

- Hvis udstyret ikke bruges som specificeret i manualen, kan den beskyttelse udstyret yder blive nedsat eller forsvinde.
- Eerstat kun komponenter som udtrykkeligt er specificeret som udskiftelige i manualen.
- Alle ledningsforbindelser skal følge stærkstrømsberkendtgørelsen (DK) og udføres af autoriseret erfarent personel.
- Den beskyttende jordterminal skal forbindes først af alle forbindelser (og fjernes som den sidste).
- Det anbefales jvf. stærkstrømsberkendtgørelsen, at der installeres en afbryder til frosyningsspændingen nær udstyret.

UDSTYRS SPECIFIKATIONER

Strømforsyning	102 til 132 Vac - 204 til 264 Vac
Frekvens	50 – 60 Hz
Nominel effekt	20 watts max.

OMGIVELSES SPECIFIKATIONER

Placer ikke udstyret i nærheden af brandbare væsker eller dampe.

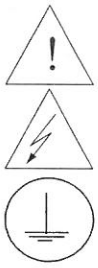
Temperatur	Rumtemperatur : 0 til 55°C
Fugtighed	5 til 90% RH - 40°C
Vibration	0 til 200 Hz acceleration 0.2 g

UDSTYRS INSTALLATION

Skriveren skal monteres i en tavle for at forhindre adgang til bagterminaler.

VEILIGHEIDSVEREISTEN

DU2I-6056



Ter vermindering van het gevaar van elektrische schokken die lichamelijk letsel kunnen veroorzaken, dient u alle veiligheidsaanwijzingen in dit dokument te volgen.

Dit symbool waarschuwt de gebruiker voor een potentieel schokgevaar wanneer toegang bestaat tot onderdelen die onder gevaarlijke spanning staan.

Beschermende aarde-aansluiting. Bestemd voor aansluiting van de aardingsdraad van de voeding.

- Indien de apparatuur wordt gebruikt anders dan door de fabrikant gespecificeerd, kan de bescherming, die de apparatuur biedt ongedaan worden gemaakt.
- Alleen die onderdelen mogen worden vervangen die door de fabrikant als uitwisselbaar zijn aangemerkt.
- Alle bedrading moet in overeenstemming zijn met de lokale elektriciteiseisen en moet aangelegd worden door geauthoriseerd, ervaren personeel.
- De aardingsdraad moet worden aangesloten vóórdat alle andere bedrading wordt aangesloten (en als laatste worden verbroken).
- Het verdient aanbeveling een netschakelaar aan te brengen vlakbij het instrument.

APPARATUUR VOORWAARDEN

Voedingsspanning	102 tot 132 Vac - 204 to 264 Vac
Frequentie	50 – 60 Hz
Vermogen of stroomvermogen	20 watts max.

OMGEVINGSCONDITIES

Gebruik het instrument niet in de aanwezigheid van ontvlambare vloeistoffen of dampen. Het gebruik van elk elektrisch instrument in een dergelijke omgeving vormt een gevaar voor uw veiligheid.

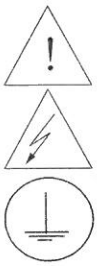
Temperatuur	In bedrijf : 0 tot 55°C
Vochtigheid	5 tot 90% RH - 40°C
Trilling	0 tot 200 Hz versnelling 0.2 g

MONTAGE VAN DE APPARATUUR

De recorder moet worden gemonteerd in een paneel om de toegankelijkheid tot de achterste aansluitpunten te beperken.

TURVALLISUUSMÄÄRÄYKSET

FI2I-6056



Noudata tämän ohjeen kaikkia turvaohjeita välttääksesi sähkötapaturman vaaraa.

Tämä merkki varoittaa käyttäjää sähköiskun vaarasta paikassa, missä voi koskettaa vaarallisia jännitteitä.

Suojamaaliitin. Kytke maadoitsjohdin tähän liittimeen.

- Jos laitetta käytetään olosuhteissa, joihin sitä ei ole suunniteltu, käyttöturvallisuus voi heikentyä.
- Älä vaihda mitään komponettia tai osaa, jota valmistaja ei ole määritellyt käyttäjän vaihdettavaksi.
- Asennus ja johdotus on tehtävä paikallisten varmuusmääräysten mukaisesti valtuutetun sähköasentajan toimesta.
- Ensimmäiseksi on kytkettävä suojamaa-liitin (ja viimeiseksi irroittettava).
- Laitteen läheisyyteen suositellaan asennettavaksi verkkokytkin.

LAITTEEN VAATIMUKSET

Syöttöjännite	102 - 132 Vac / 204 - 264 Vac
Taajuus	50 – 60 Hz
Teho	20 watts

KÄYTTÖOLOSUHTEET

Älä käytä laitetta paikassa jossa on syttyviä nesteitä tai kaasuja, koska laitteen käyttö aiheuttaa räjähdysvaaran.

Lämpötila	ympäröivä : 0 ... 55°C
Kosteus	5 ... 90% RH - 40°C
Tärinä	0 ... 200 Hz
	Kiihtyvyys 0.2 g

LAITTEEN ASENNUS

Piirturi on asennettava paneeliin siten, että peräliitimille jää riittävästi tilaa.

CONSIGNES DE SECURITE

FR2I-6056

Pour réduire tout risque de décharge électrique qui pourrait provoquer une lésion corporelle, respectez toutes les consignes de sécurité de cette documentation.

Ce symbole avertit l'utilisateur d'un risque électrique potentiel lorsqu'il peut avoir accès à des éléments sous tension.

Borne de mise à la terre. Destinée au raccordement du conducteur de mise à la terre de l'alimentation.

- Si l'équipement est utilisé dans un but non spécifié par le constructeur, la protection fournie avec cet équipement peut être affectée.
- Aucun composant (ou pièce) ne doit être remplacé s'il n'est pas explicitement spécifié comme tel par le constructeur.
- Tous les câblages doivent être conformes aux normes locales et doivent être réalisés par un personnel autorisé et expérimenté.
- La borne de masse doit être raccordée avant tout autre câblage (et débranchée en dernier).
- Il est obligatoire de connecter cet appareil sur une ligne possédant un moyen de coupure près de l'appareil.

CARACTERISTIQUES DE L'EQUIPEMENT

Tension d'alimentation	102 à 132 Vac ou 204 à 264 Vca
Fréquence	50 – 60 Hz
Puissance ou courant	20 watts max.

CONDITIONS AMBIANTES

Ne jamais utiliser cet équipement en présence de liquides ou vapeurs inflammables.
L'utilisation de tout instrument électrique dans un tel environnement pourrait présenter un risque pour la sécurité.

Température	Ambiante : 0 à 55°C
Humidité	5 à 90 % HR à 40°C
Vibration	Fréquence : 0 à 200 Hz Accélération 0.2 g

INSTALLATION DE L'EQUIPEMENT

Cet appareil doit être monté dans un panneau pour limiter l'accès aux bornes arrières par l'opérateur.

SICHERHEITSHINWEISE

GE2I-6056

Befolgen Sie alle Sicherheitshinweise in diesen Unterlagen, um das Risiko eines Stromschlags zu verringern, der zu Körperverletzung führen kann.

Dieses Symbol warnt den Benutzer vor eventueller Berührungsgefahr, wo lebensgefährliche Spannungen zugänglich sein können.

Schützende Erdung. Für den Anschluß der schützenden Erdung der Versorgungssystemleitung.

- Bei Benutzung der Ausrüstungen auf nicht vom Hersteller angegebene Art und Weise kann der von der Ausrüstung gewährleistete Schutz beeinträchtigt werden.
- Ersetzen Sie keine Komponente (oder Teil), die/das nicht ausdrücklich vom Lieferanten als ersetzbar angegeben ist.
- Die gesamte Verkabelung muß den örtlichen Normen entsprechen und von zugelassenem, erfahrenem Personal durchgeführt werden.
- Die Erde muß vor allen anderen Kabeln angeschlossen (und zuletzt abgeklemmt) werden.
- In der Nähe der Ausrüstung muß ein Schalter in der Hauptstromversorgung vorhanden sein.

AUSRÜSTUNGSDATEN

Netzspannung	102 bis 132 Vac oder 204 bis 264 Vac
Frequenz	50 – 60 Hz
Nennleistung	20 watts max.

UMGEBUNGSBEDINGUNGEN

Betreiben Sie das Gerät nicht in Gegenwart entflammbarer Flüssigkeiten oder Dämpfe. Der Betrieb elektrischer Geräte in solchen Umgebungen stellt ein Sicherheitsrisiko dar.

Temperatur	Umgebung : 0 bis 55°C
Feuchtigkeit	5 bis 90% RH - 40°C
Vibration	0 bis 200 Hz Beschleunigung 0.2 g

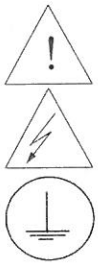
ANBRINGUNG DER AUSRÜSTUNGEN

Der Regler muß in ein Pult eingebaut sein, damit der Bediener nicht zu oft auf die hinteren Anschlüsse zugreifen muß.

GR2I-6056

NORME DI SICUREZZA

IT2I-6056



Per ridurre i rischi di scariche elettriche che potrebbero causare alle persone, seguire tutte le precauzioni circa la sicurezza indicate in questa documentazione.

Questo simbolo avverte del pericolo di scossa elettrica nelle aree in cui sono accessibili conduttori sotto tensione.

Terminale di protezione verso terra. Previsto per il collegamento del conduttore di protezione verso terra del sistema di alimentazione.

- Se lo strumento viene utilizzato in modo diverso dalla specifica del costruttore, la protezione fornita dallo strumento puó essere diversa.
- Non sostituire alcun componente (o parte) non specificato esplicitamente come ricambio dal vostro fornitore.
- Tutti i cablaggi devono essere in accordo con i regolamenti locali e devono essere eseguiti da personale esperto ed autorizzato.
- Il terminale di massa deve essere collegato prima di ogni altro filo (e scollegato per ultimo).
- E necessario che sia presente un interruttore nell'alimentazione principale accanto all'apparecchio.

ALIMENTAZIONE APPARECCHIATURA

Tensione di alimentazione	Da 102 a 132 Vac ó da 204 a 264 Vac
Frequenza	50 – 60 Hz
Potenza o corrente	20 watts max.

CONDIZIONI AMBIENTALI

Non far funzionare l'apparecchio in presenza di liquidi o gas infiammabili, in quanto questo potrebbe essere estremamente pericoloso.

Temperatura	Ambiente : da 0 a 55°C
Umidità relativa	Da 5 a 90% UR a 40°C
Vibrazioni	Da 0 a 200 Hz accelerazione 0.2 g

INSTALLAZIONE DELL'APPARECCHIO

Il apparecchio deve essere montato su un pannello per limitare l'accesso ai terminali posteriori.

SIKKERHETSKRAV

NO2I-6056

Følg alle retningslinjene i dette dokumentet, slik at du reduserer risikoen for elektrisk støt og mulige personskader.

Dette symbolet advarer brukeren om tilgjengelige terminaler med farlige spenninger og en potensiell fare for elektrisk støt.

Jordingsterminal. kabelen for jording av systemet skal tilknyttes til denne terminalen.

- Dersom utstyret benyttes på en måte annerledes enn spesifisert av produsent, kan utstyrets beskyttelsesgrad forringes.
- Ingen komponenter eller deler skal skiftes ut dersom de ikke er uttrykkelig spesifisert som utskiftbare av din forhandler.
- Det er påkrevet med en hovedstrømsbryter i nærheten av utstyret.
- All kabling må utføres i henhold til gjeldende forskrifter og installeres av autoriser og erfaren installatør.
- Jord må tilknyttes før all annen kabling (og frakobles sist).

UTSTYRSPESIFIKASJONER

Strømtilførsel	102 til 132 Vac - 204 til 264 Vac
Nettfrekvens	50 – 60 Hz
Kraftforbruk	20 watts max.

OMGIVELSER

Instrumentet må ikke opereres i nærheten av lettantennelige væsker eller gasser. Bruk av elektriske instrumenter i slike omgivelser utgjør en sikkerhetsrisiko.

Temperatur	omgivelse : 0 til 55°C
Fuktighet	5 til 90% HR - 40°C
Vibrasjon	0 til 200 Hz
	akselerasjon 0.2 g

UTSTYRSINSTALLASJON

Pass på å montere panelene på regulatoren, slik at berøring av terminalene på baksiden forhindres.

INSTRUÇÕES DE SEGURANÇA

PO2I-6056

Para reduzir o risco de choque eléctrico que pode causar danos corporais, seguir todas as normas de segurança contidas nesta documentação.

Este símbolo avisa o utilizador sobre um eventual perigo de choque quando são acessíveis voltagens sob tensão perigosas.

Terminal de protecção de terra. Fornecido para ligação do condutor do sistema da protecção de terra.

- Se este equipamento for usado de modo não especificado pelo fabricante, a protecção fornecida pelo equipamento pode não ser adequada.
- Não se deve substituir qualquer componente (ou peça) que não seja explicitamente especificado como substituível pelo nosso revendedor.
- Toda a cablagem deve estar de acordo com os códigos eléctricos locais e deve ser realizada por pessoal experiente devidamente autorizado.
- O terminal de terra deve ser ligado antes de ser feita qualquer outra cabelagem (e desligado em último lugar).
- Recomenda-se um comutador na fonte de alimentação principal próximo do equipamento.

ESPECIFICAÇÕES DO EQUIPAMENTO

Voltagem	102 a 132 Vac - 204 a 264 Vac
Frequência	50 – 60 Hz
Potência ou consumo de corrente	20 Watts max.

CONDIÇÕES AMBIENTAIS

Não operar o instrumento na presença de líquidos ou vapores inflamáveis. A operação de qualquer instrumento eléctrico em tal ambiente constitui um perigo para a segurança.

Temperatura	Ambiente : 0 a 55°C
Humidade	5 a 90% RH a 40°C
Vibração	0 a 200 Hz aceleração 0.2 g

INSTALAÇÃO DO EQUIPAMENTO

O Registrador deve ser montado num painel para limitar o acesso do operador aos terminais traseiros.

NORMAS DE SEGURIDAD

SP2I-6056

Para reducir el riesgo de choque eléctrico el cual podría causar lesiones personales, seguir todas las indicaciones de este documento.

Este símbolo previene al usuario de un riesgo potencial de descarga cuando se puede acceder a corrientes de tensión peligrosas.

Terminal de tierra de protección. Proporcionado para la conexión de la tierra de protección del conductor del sistema de alimentación.

- Si el equipo es utilizado de forma no especificada por el fabricante, la protección suministrada con el mismo podría resultar dañada.
- No reemplazar ningún componente (o parte) no explicitamente especificado por el suministrador.
- Todo el cableado debe realizarse de acuerdo con las normas eléctricas locales y debe ser realizado por personal experimentado.
- El terminal de tierra debe ser conectado antes que cualquier otro cable y desconectado el último.
- Se recomienda la instalación de un interruptor de la alimentación principal, cerca del equipo.

DATOS ELECTRICOS DEL EQUIPO

Tensión de alimentación	102 a 132 Vac - 204 a 264 Vac
Frecuencia	50 – 60 Hz
Potencia o corriente	20 watts max.

CONDICIONES AMBIENTALES

No operar con el instrumento en presencia de liquidos o gases inflamables. La operación de cualquier equipo eléctrico en tal ambiente constituye un riesgo contra la seguridad.

Temperatura	Ambiente : 0 a 55°C
Humedad	5 a 90% RH a 40°C
Vibración	0 a 200 Hz acceleración 0.2 g

INSTALACION DEL EQUIPO

Este equipo debe ser montado en un panel para limitar al operador el acceso a los terminales traseros.

SÄKERHETSFÖRESKRIFTER

SW2I-6056

För att reducera riskerna av elektriska chocker som kan orsaka personskador, följ alla säkerhetsföreskrifter i denna dokumentation.

Denna symbol varnar användaren för risk för elchock vid tillfällig åtkomst av spänningsförande del.

Anslutning av skyddsjord. Avsedd för anslutning av elsysternets skyddsjordsledare.

- Om utrustningen används på ett sådant sätt, att det inte innefattas av tillverkarens specifikation, kan de inbyggda säkerhetsfunktionerna äventyras.
- Ersätt aldrig någon komponent (eller del) som inte är specificerad som ersättningsbar av tillverkaren.
- All ledningsdragning måste utföras i enlighet med lokala bestämmelser och skall utföras av behörig personal med erfarenhet av sådant arbete.
- Skyddsjordsanslutningen skall anslutas före alla andra anslutningar (och losskopplas sist).
- En strömbrytare för näströmmen rekommenderas.

STRÖMFÖRSÖRJNING

Spänning	102 a 132 Vac - 204 a 264 Vac
Frekvens	50 – 60 Hz
Effekt eller märkström	20 watts max.

OMGIVNINGSVILLKOR

Använd ej instrumentet i närhet av brännbara vätskor eller gaser. Användandet av instrumentet i sådant miljö är en direkt säkerhetsrisk.

Temperatur	Omgivande : 0 till 55°C
Fuktighet	5 till 90% RH - 40°C
Vibration	0 till 200 Hz acceleration 0.2 g

INSTALLATION

Instrumentet skall monteras i en panel eller i en låda för att undvika att personalen kommer i beröring med bakre inkopplingsplintar.

Index

0

0-10 Volt dc inputs, *37*
0–10 Volt inputs, *212*

4

4-20 mA auxiliary output wiring, *52*
4-20 mA control output wiring, *39*
4-20 mA input wiring, *35*
4–20 mA inputs, *213*

A

AC line power, *30*
Accutune II, *159*
Alarm hysteresis, *79*, *127*
Alarm messages, *147*
Alarm outputs, *45*
Alarm setpoints, *162*
Alarms group definitions, *126*
Atmospheric pressure compensation, *82*, *131*
Automatic calibration mode, *223*
Automatic local mode, *149*
Automatic mode
  Return to, *150*, *184*
  Selecting, *149*
Automatic remote mode, *149*
Automatic switchover, *109*
Automatic switchover value, *73*, *110*
Auxiliary Output, *79*, *80*, *84*
Auxiliary output 2 and 3 calibration, *220*

B

Basic recorder components without options, *248*
Battery test failure, *235*
Baud rate, *81*
Bias, *111*
Bias for remote setpoint, *73*
Burnout, *65*
Burnout protection, *97*

C

Calibration procedure, *214*
Calibration set up, *206*
  0-10 Volt inputs, *212*
  4-20 mA inputs, *213*
  Millivolts and Volts inputs (except 0-10 Volts), *211*
  RTD inputs, *210*
  Thermocouple inputs using a compensated calibrator method, *208*
  Thermocouple inputs using an ice bath, *207*
  Thermocouple inputs using the ambient temperature method, *209*
CE Conformity (Europe), *1*
CE Conformity special conditions, *7*
CE conformity special conditions (Europe), *27*
Chart high range value, *98*
Chart lamp, *169*
  Replacing, *169*
Chart low range value, *98*
Chart name, *67*, *69*, *101*
Chart plate assembly parts, *247*
Chart speed selection, *67*, *69*
CHN indicator, *148*
Circuit-breaker, *30*
Cleaning, *169*
Communications station address, *81*, *130*
Condensed specifications, *8*
Configuration procedure, *62*
Configuration prompts, *57*
Configuration tips, *61*
Control algorithm, *74*, *114*
Control output direction, *74*, *112*
Controller dropoff value, *74*, *112*
Current proportional output calibration, *220*, *225*
Current simplex, *116*
Current/relay duplex, *117*
Current/time duplex range, *74*
Customer support, *229*
Cycle time (heat), *121*
Cycle time 2 (cool), *121*

D

Deadband, *74*, *112*
Decimal point location, *64*, *94*
Deviation, *131*
Deviation bargraph, *144*
Deviation recording action, *82*
Deviation setpoint value, *82*, *131*
Device status, *232*
Diagnostic error messages, *146*
Diagnostic tests, *138*
Digital inputs, *45*
Dimensions, *16*
Direct acting control, *112*
Display test, *139*
Displaying totalizer value, *166*
Displays, *3*

E

Electrical noise, *27*
Emissivity, *65*
Engineering units, *94*
Error message
  BATT LOW. *See*
  BATTERY, *235*
  CAL TEST, *234*
  CAL1 ERR, *234*
  CAL2 ERR, *234*
  CONFTEST, *233*
  EE FAIL, *235*
  FACT CRC, *234*
  FAILSAFE, *233*
  INxFAIL, *235*
  PV LIMIT, *235*
  RAM TEST, *233*
  RV LIMIT, *235*
  SW FAIL, *235*
Error message prompts, *233*
Error messages, *146*
Event message configuration, *83*
Event pen function, *167*
Event pen operation, *167*

F

Factory calibration, *200*
Failsafe, *231*
Failsafe output value, *74*
Failure symptoms, *229*
Ferrite filter locations (CE Mark), *29*
Field wiring, *203*
Filter, *65*, *97*
Fo reset, *258*
Fo sterilization calculation, *258*
Fo sterilization time, *259*

G

Gain, *120*
Gain 2, *121*
Gain units, *74*
Grid line contrast, *136*, *140*

H

Hardware kit contents, *252*
Header for chart, *67*, *101*
High output limit, *74*, *112*
High range value, *65*, *96*
High setpoint limit, *73*
Hours per revolution, *100*
Hysteresis, *74*, *113*, *127*

I

Ice bath, *204*
Indicators, *3*
Input 1 actuation type, *64*
Input actuation type, *95*
Input compensation, *65*, *97*
Input out of range, *236*
Input terminals, *203*
Inputs
  0–5 Vdc, *33*
  Radiamatic, mV, *33*
  RTD, *33*
  Thermocouple, *33*
Installation
  Operating limits, *8*
  Preinstallation information, *7*
Installing chart, *170*
Internal cabling, *253*

J

Jumper positions, *205*

K

Key test, *139*
Knockout locations, *17*

L

Local setpoint, *151*
Local setpoint, *110*
Lockout, *86*, *87*, *134*
Lockout password, *86*, *87*
Low flow cutoff selection, *65*
Low output limit, *74*, *112*
Low range value, *65*, *97*
Low setpoint limit, *73*

M

Maintenance, *169*
Manual calibration mode, *223*
Manual mode, *149*
  Adjusting output, *150*, *151*, *183*, *184*
  Selecting, *150*
Manual reset, *120*
Minutes per repeat, *114*
Monitoring your recorder, *142*
Motor traverse time, *223*
Mounting
  Overall dimensions, *16*
Mounting methods, *17*
  2-inch pipe, *24*
  Flush in panel, *18*, *20*
  Flush in panel, *21*
  NEMA4X door, *22*
  Surface, *25*

O

ON/OFF algorithm, *114*
Operating limits, *8*
Operating modes, *149*
Operating parameters, *145*

Operator functions, *148*
Operator interface, *3*, *142*
Output algorithm, *74*, *116*
Output wiring for alarms 3 and 4, *47*
Output wiring for alarms 5 and 6, *48*

P

Parts lists, *245*
Password, *134*
PD with manual reset, *115*
Pen Set Up group, *66*
Pen tip, *169*
  Cleaning, *169*
Physical considerations, *16*
PID A, *115*
PID B, *115*
PID sets, *158*
Pipe mounting, *24*
Polynomial Equation, *107*
Position proportional control output wiring, *41*
Position proportional output calibration, *222*
Position proportional simplex, *117*
Power loss, *172*
Power supply mains, *30*
Power up controller mode recall, *73*, *111*
Power up diagnostic tests, *138*
Power-up tests, *231*
Printing characteristics adjustments, *135*, *217*
Prompt hierarchy, *57*
Proportional band, *120*
Proportional band 2, *121*
Proportional band units, *113*

R

Radiamatic, millivolts, and volts inputs (except 0–10 Volts), *211*
Ramp/soak program, *123*
Rate 2, *121*
Rate action, *120*
Rate of integration, *70*, *105*
Ratio, *110*
Ratio for remote setpoint, *73*
Recorder components associated with options, *250*
Recovery from a power loss, *172*
RECYCL parameter, 185
Rejection frequency, *79*, *82*, *84*, *131*
Relative humidity, *82*, *131*
Relay control output wiring, *43*
Relay duplex, *117*
Relay/current duplex, *117*
Remote chart activation, *68*, *102*
Remote setpoint, *110*
Remote switching, *164*
Repeats per minute, *114*
Replacing chart, *170*
Reset, *120*
Reset 2, *121*
Reset units, *74*, *114*
Resetting totalizer value, *165*
Resistance equivalent, *202*
Restoring factory calibration, *200*
Reverse acting control, *112*
RS485 Modbus communications wiring, *50*
RSP, 152
RTD inputs, *210*

S

Safety Requirements for Electrical Equipment, *27*
Self diagnostics, *229*
Setpoint high limit, *112*
Setpoint low limit, *112*
Setpoint program
  profiles set-up, *187*
Setpoint Program
  Data entry, *183*
  event setup, *192*
  overview, *173*
  ramp setup, *185*
  run/monitor functions, *196*
  segment setup, *189*
Setpoint ramp, *122*
  Configuring, *153*
  Running, *154*
Setpoint ramp final setpoint, *123*
Setpoint ramp time, *123*
Setpoint selection indication, *152*
Setpoint source, *73*, *110*, *151*
Setpoint tracking, *73*, *111*
Set-up tasks, *5*
Shield wiring, *29*
Single setpoint ramp, *122*, *153*
SOKDEV parameter, 185
SPPROG parameter, 185
Start up, *139*
Stylus, *136*, *140*
Suppression filters, *29*
Switchover value, *157*

T

Temperature units, *64*, *94*
Thermal resistance, *259*
Thermocouple inputs using a compensated calibrator method, *208*
Thermocouple inputs using an ice bath, *207*
Thermocouple inputs using the ambient temperature method, *209*
Three position step control output wiring, *41*
Time division, *101*
Time parameters group definitions, *103*
Totalizer, *70*
Totalizer group definitions, *104*
Totalizer reset, *70*, *73*
Totalizer scale factor, *70*, *73*
Totalizer value, *165*
  Displaying, *166*
  Resetting, *165*
Trace line contrast, *136*, *140*
Transmitter characterization, *65*, *96*

Troubleshooting procedures, *238*
Ttransmitter power, *35*
Tuning constants, *156*
Tuning group prompt definitions, *119*
Tuning messages, *147*
Tuning parameter sets, *73*, *109*
Two local setpoints, *110*
Two sets of tuning constants, *156*

V

Visual failure symptoms, *229*, *237*
Voltage equivalent, *202*

W

Wake time days, *103*
Wake time hours, *103*
Wake time minutes, *103*
Wake time months, *103*
Wire bundling, *28*
Wiring
  0-10 Vdc inputs, *37*
  0-5 Vdc inputs, *33*
  4-20 mA auxiliary output, *52*
  4-20 mA control output, *39*
  4-20 mA inputs. *See*
  AC line power. *See*
  Electrical noise precautions, *27*
  mV inputs, *33*
  Position proportional control output, *41*
  Radiamatic inputs, *33*
  Relay control output, *43*
  RS485 Modbus communications, *50*
  RTD inputs, *33*
  Shields, *29*
  Thermocouple inputs, *33*
  Three position step control output, *41*
  Transmitter power. *See*
  Wire bundling, *28*
  Wiring the recorder, *29*
Wiring for PV inputs, *206*
  0-10 Volt inputs, *212*
  4-20 mA inputs, *213*
  Millivolts and Volts inputs (except 0-10 Volts), *211*
  RTD inputs, *210*
  Thermocouple inputs using a compensated calibrator method, *208*
  Thermocouple inputs using an ice bath, *207*
  Thermocouple inputs using the ambient temperature method, *209*

DR4500 Configuration Record Sheet

(Pressure = psi and Temperature = Degree F)

WO:

Group Prompt	Function Prompt	Value or Selection	Factory Setting
INPUT 1	DECIMAL	XXXX	XXX.X
	UNITS	XXXXX	DEGF
	ENG UNITS	PSI	_
	IN 1 TYPE	0-5V	100PT
	XMITTER	LINEAR	LINEAR
	IN 1 HI	200	900
	IN 1 LO	-48	-300
	CUTOFF 1		0
	UNPTCOMP		0
	FILTER 1	20	0
	BURNOUT	UP	UP
	EMISSIV		.01
INPUT 2	DECIMAL	XXX.X	XXX.X
	UNITS	DEGF	DEGF
	ENG UNITS		_
	IN 2 TYPE	J TC H	100PT
	XMITTER		LINEAR
	IN 2 HI	1600	900
	IN 2 LO	0.0	-300
	CUTOFF 2		0
	UNPTCOMP		0
	FILTER 2		0
	BURNOUT	UP	UP
	EMISSIV		.01
INPUT 3	DECIMAL		XXX.X
	UNITS		DEGF
	ENG UNITS		_
	IN 3 TYPE		100PT
	XMITTER		LINEAR
	IN 3 HI		900
	IN 3 LO		-300
	CUTOFF 3		0
	UNPTCOMP		0
	FILTER 3		0
	BURNOUT		UP
	EMISSIV		.01
INPUT 4	DECIMAL		XXX.X
	UNITS		DEGF
	ENG UNITS		_
	IN 4 TYPE		100PT
	XMITTER		LINEAR
	IN 4 HI		900
	IN 4 LO		-300
	CUTOFF 4		0
	UNPTCOMP		0
	FILTER 4		0
	BURNOUT		UP
	EMISSIV		.01

Group Prompt	Function Prompt	Value or Selection	Factory Setting
PEN 1	PEN 1 IN	INPUT 1	INPUT 1
	CHART 1 HI	60	302.0
	CHART 1 LO	-15	292.0
	PEN 1 ON		91.0
	PEN 1 OFF		93.0
	MAJOR DIV	10	10
	MINOR DIV	10	10
	RNG 1 TAG	PSI	RNG 1
PEN 2	PEN 2 IN	INPUT 2	INPUT 2
	CHART 2 HI	600	302.0
	CHART 2 LO	-150	292.0
	PEN 2 ON		91.0
	PEN 2 OFF		93.0
	MAJOR DIV	10	10
	MINOR DIV	10	10
	RNG 2 TAG	TEMP	RNG 2
PEN 3	PEN 3 IN		INPUT 3
	CHART 3 HI		302.0
	CHART 3LO		292.0
	PEN 3 ON		91.0
	PEN 3 OFF		93.0
	MAJOR DIV		10
	MINOR DIV		10
	RNG 3 TAG		RNG 3
PEN 4	PEN 4 IN		INPUT 4
	CHART 4 HI		302.0
	CHART 4 LO		292.0
	PEN 4 ON		91.0
	PEN 4 OFF		93.0
	MAJOR DIV		10
	MINOR DIV		10
	RNG 4 TAG		RNG 4
CHART	CHRTSPD	12 HR	-XHR
	HOUR/REV		12
	TIME DIV	24	24
	MINOR DIV	FOUR	FOUR
	CONTINUE	NO	NO
	CHART NAM		TRULIN
	HEADER	YES	NO
	REM CHRT	NONE	NONE
TIME	MINUTES		SET
	HOURS		TO
	DAY		LOCAL
	MONTH		TIME
	YEAR		
	DAY		
	WAKE MIN		0
	WAKE HR		0
	WAKE DAY		0
	WAKE MON		0

DR4500 Configuration Record Sheet

(Pressure = BAR and Temperature = Degree C)

WO:

Group Prompt	Function Prompt	Value or Selection	Factory Setting
Input 1	Decimal	xxx.x	xxx.x
	Units	xxxxx	degF
	Eng Units	BAR	_
	In 1 Type	0-5V	100Pt
	Xmitter	Linear	Linear
	In 1 Hi	13.4	900
	In 1 Lo	-3.2	-300
	Cutoff 1		0
	Unptcomp		0
	Filter 1	20	0
	Burnout	UP	UP
	Emissiv		.01
Input 2	Decimal	xxx.x	xxx.x
	Units	DEGC	degF
	Eng Units		_
	In 2 Type	J TC H	100Pt
	Xmitter		Linear
	In 2 Hi	871.1	900
	In 2 Lo	-17.8	-300
	Cutoff 2		0
	Unptcomp		0
	Filter 2		0
	Burnout		UP
	Emissiv		.01
Input 3	Decimal		xxx.x
	Units		degF
	Eng Units		_
	In 3 Type		100Pt
	Xmitter		Linear
	In 3 Hi		900
	In 3 Lo		-300
	Cutoff 3		0
	Unptcomp		0
	Filter 3		0
	Burnout		UP
	Emissiv		.01
Input 4	Decimal		xxx.x
	Units		degF
	Eng Units		_
	In 4 Type		100Pt
	Xmitter		Linear
	In 4 Hi		900
	In 4 Lo		-300
	Cutoff 4		0
	Unptcomp		0
	Filter 4		0
	Burnout		UP
	Emissiv		.01

Group Prompt	Function Prompt	Value or Selection	Factory Setting
Pen 1	Pen 1 In	Input 1	Input 1
	Chart 1 Hi	5.0	302.0
	Chart 1 Lo	-1.0	292.0
	Pen 1 On		91.0
	Pen 1 Off		93.0
	Major Div	10	10
	Minor Div	10	10
	Rng 1 Tag	BAR	Rng 1
Pen 2	Pen 2 In	Input 2	Input 2
	Chart 2 Hi	500	302.0
	Chart 2 Lo	-100	292.0
	Pen 2 On		91.0
	Pen 2 Off		93.0
	Major Div	10	10
	Minor Div	10	10
	Rng 2 Tag	TEMP	Rng 2
Pen 3	Pen 3 In	Input 3	Input 3
	Chart 3 Hi		302.0
	Chart 3Lo		292.0
	Pen 3 On		91.0
	Pen 3 Off		93.0
	Major Div		10
	Minor Div		10
	Rng 3 Tag		Rng 3
Pen 4	Pen 4 In		Input 4
	Chart 4 Hi		302.0
	Chart 4 Lo		292.0
	Pen 4 On		91.0
	Pen 4 Off		93.0
	Major Div		10
	Minor Div		10
	Rng 4 Tag		Rng 4
Chart	Chrtspd	12 HR	-xHR
	Hour/Rev		12
	Time Div	24	24
	Minor Div	FOUR	FOUR
	Continue	NO	NO
	Chart Nam		TRULIN
	Header	YES	NO
	Rem Chrt	NONE	NONE
Time	Minutes		SET
	Hours		TO
	Day		LOCAL
	Month		TIME
	Year		
	Day		
	Wake Min		0
	Wake Hr		0
	Wake Day		0
	Wake Mon		0

* 1400

General Operating Procedure

TO START PROGRAM CYCLE:

1. Apply power and wait for system to stabilize.
   1a. System should read ambient temperature and 0 pressure with door open.
2. Roll 1 bin onto the center of the lift table (if unit is pit mounted proceed to step 3) (only 1 bin to be lifted and loaded at a time).
3. Clear all persons from the work area. Move the scissor lift selector switch to the UP position (or move rolling bridge into place aligning tracks and lock into place with sliding pin, continue to step 5).
4. Raise lift until it is full up and tracks align.
5. Push bin into autoclave (until it contacts the rear stop) (if unit has rolling bridge load all bins).
6. Clear all persons from the work area. Move the scissor lift selector switch to the DOWN position until lift comes to a complete stop and aligns with ramp track (if unit is pit mounted finish loading all bins before lowering lift table) (if unit has rolling bridge return bridge to home position before closing door. NOTE: Door will not swing closed until bridge is in home position and limit switch is actuated).
7. Repeat steps 2 through 6 until the last bin is loaded (Last bin should be rolled into autoclave until it is even with the seal face of autoclave).
8 Lift the latch plate on the door hinge and push the door towards the Autoclave (skip this step if unit is equipped with powered door swing)
9 Take door handle in your hand and pull door shut (or use the door selector switch to close the door if unit is equipped with powered door swing).
10. Once the limit switch plunger is depressed use your move the lock ring selector switch to LOCK.
11. Rotate the safety valve handle down until it lies flat on the lock ring.
12. Confirm proper connection and settings of all external utilities such as Water, Air, and electrical services.
13. Push the ***start button*** and the program will begin cycle.

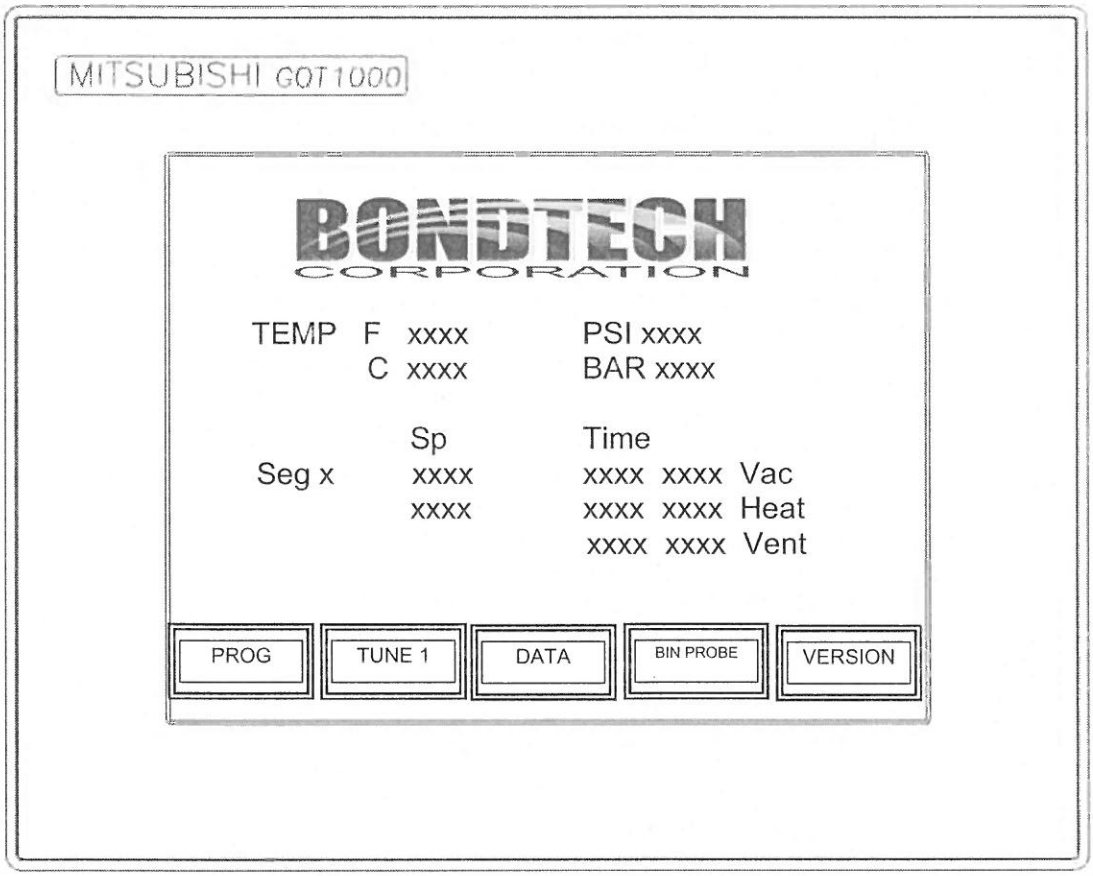
WHEN PROGRAM CYCLE IS COMPLETE:

1. Check the pressure gauge on the side of the autoclave. Make sure it reads zero pressure. Do not do anything until you are sure all pressure has been vented from the autoclave.
2. Rotate the safety valve handle up until it is at 90 degrees to the lock ring. Observe the ping pong ball. If there is any motion wait until the ball comes to rest.
3. Take the handle on the door in your hand (skip this step if unit is equipped with powered door swing).
4. Move the lock ring selector switch to UNLOCK. Continue holding the switch until the lock ring is fully unlocked.
5. Swing the door fully open until the latch drops into place (if unit is equipped with powered door swing move the door selector switch to open. Open the door fully).
6. Raise the scissor lift by selecting up on the scissor lift selector switch (if unit is pit mounted and has rolling bridge move bridge into place aligning track and lock into place with sliding pin).
7. Product bins may be unloaded onto the scissor lift or rolling bridge (if unit is pit mounted unload all bins before proceeding to next step).
8 Clear all persons from the work area. Move the scissor lift selector switch to the DOWN position until lift comes to a complete stop and aligns with ramp track. Remove bin from lift table (if unit is pit mounted the scissor lift can be left in the up position ready for the next cycle).
9. Repeat steps 6 through 9 until the last bin is unloaded

CONTROL SYSTEM OVERVIEW

The GOT 1000 is an operator interface device, used to set variable parameters and functions in the PLC program. The following pages detail the information found on the various screens, how to edit programs and tune the machine.

MAIN SCREEN



Main Screen:

This screen shows the current temperature and pressure in the autoclave. When the program is running the current segment is displayed as well as the setpoints and time for that segment as advances.

Press "Prog" to go to the EDIT(PROGRAM) screen (password protected)

Press "Tune 1" to go to the TUNE 1 and Tune 2 and Condenser Control screens (password protected)

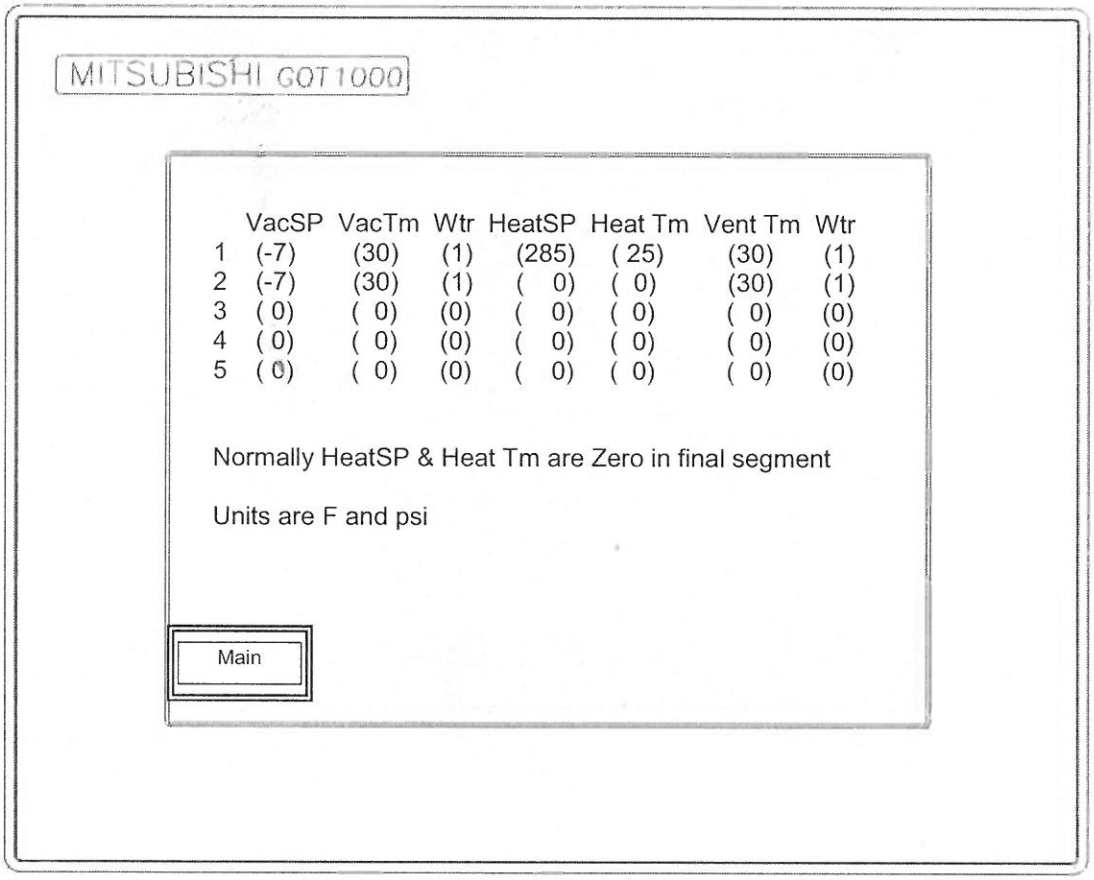
Press "Data" to go to the DATA screen (password protected)

Press "Bin Probe" to go to the Bin probe screen to view the temperature reading of the optional bin probe

Press "Version" to go to the Software Version screen

(Any password protected screen prompts to enter the password to proceed)

PROGRAM/EDIT SCREEN



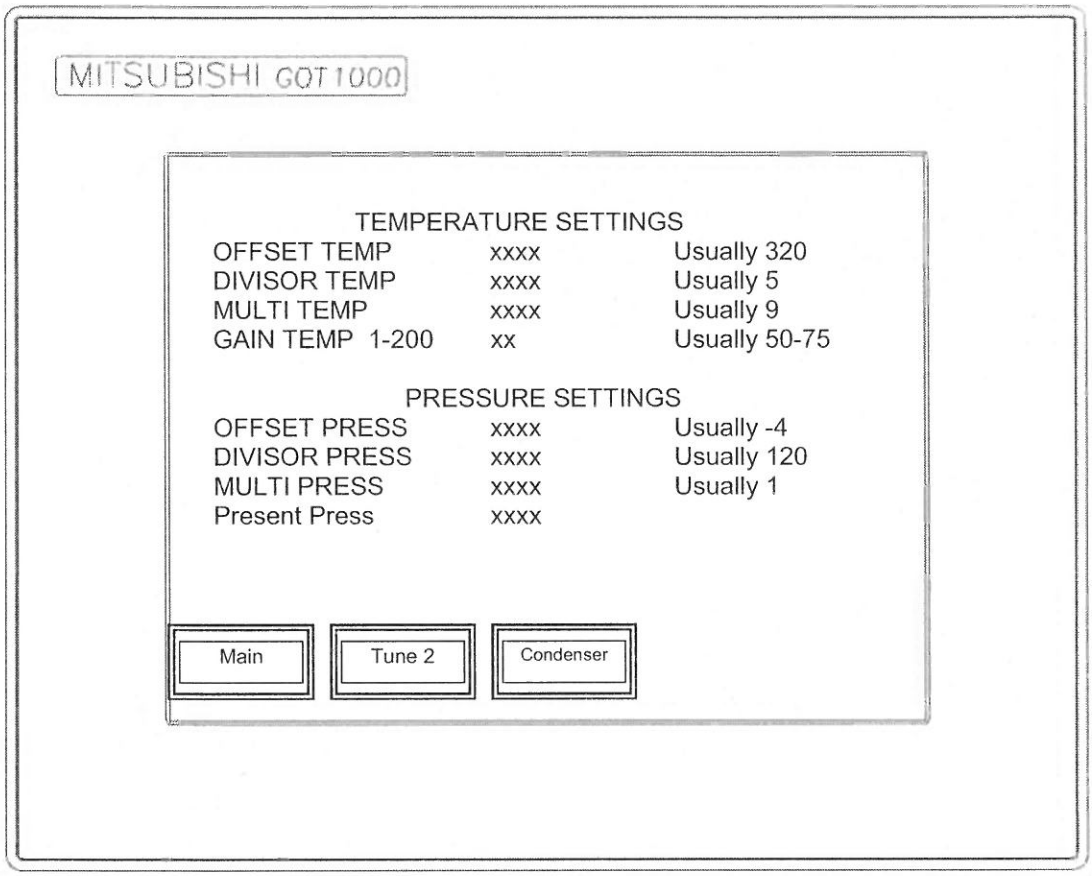
Program/Edit screen (password protected):

VacSp = vacuum set point in negative pounds per square inch (psi)
VacTm= vacuum time duration in seconds
Wtr = condenser spray water on or off during vacuum(1=on, 0=off)
HeatSP = Heat set point in degree Fahrenheit
HeatTm = heat time duration in minutes
VentTm = vent time duration in seconds
Wtr = condenser water spray on or off during vent (1=on, 0=off)

Programming:

Up to 5 segments can be programmed. A segment can consist of vacuum, heat and vent, vacuum and vent or heat and vent. Anytime vacuum or heat is used there must be a vent. Condenser water can be turned on or off for the corresponding vacuum or vent. Normally the last segment is vacuum and vent with zero (0) HeatSP and zero (0) HeatTm.

TUNE 1 SCREEN



Tune Screen (password protected):

This series of 2 screens allow various parameters of temperature, pressure, alarms and spitters to be configured. It consists of 2 different screens of information.

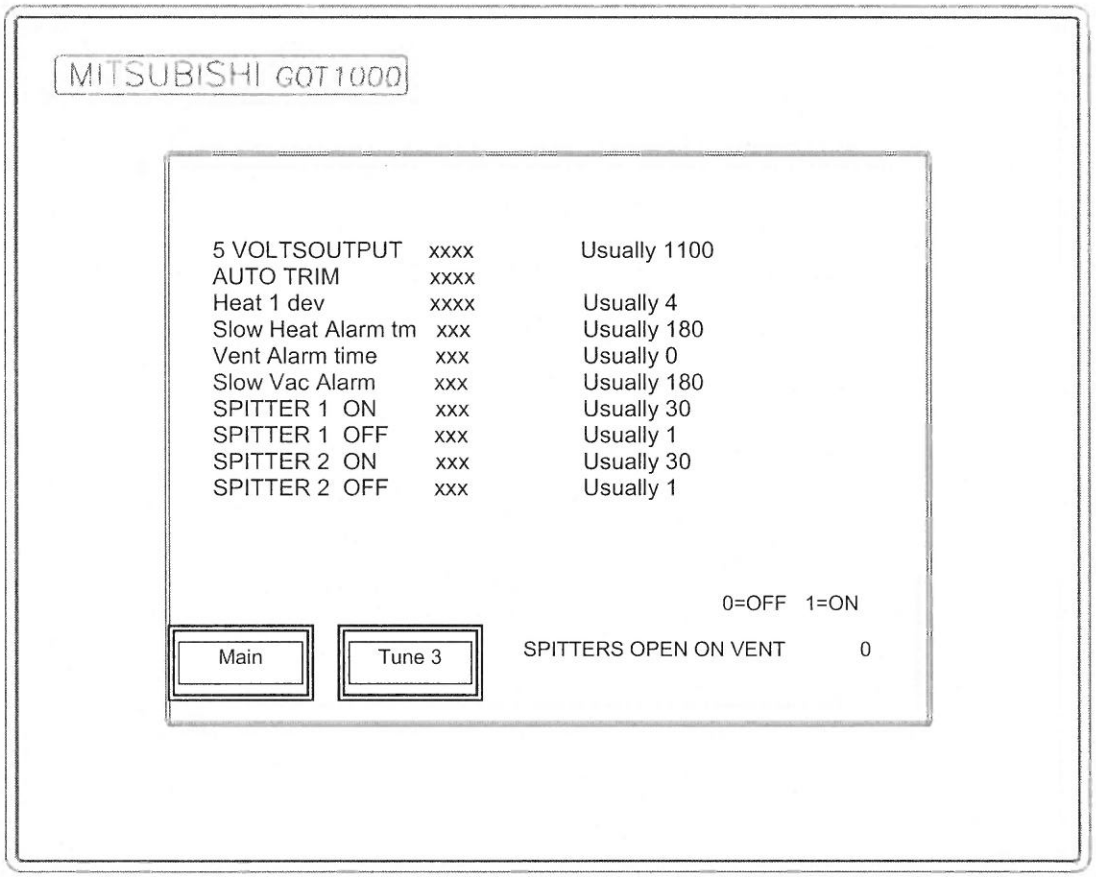
Offset Temp – increase or decrease this number to raise or lower temperature reading.
Divisor Temp – no adjustment
Multi Temp – no adjustment
Gain Temp – use to adjust the heating response based on the size of the autoclave.

Offset Press – increase or decrease this number to zero the pressure reading
Divisor Temp – increase or decrease to adjust pressure reading
Multi Temp – no adjustment
Present Press – displays real time pressure as changes are made.

Press "Tune 2" to display another Tune Screen

Press "Condenser" to display Condenser Cooling Control Screen

TUNE 2 SCREEN



5 volts output – increase or decrease this number to adjust the output voltage to the pressure transducer

Auto Trim – non adjustable. This number increases or decreases as the system zero pressure is tuned. The lower the number the more stable the zero will be.

Heat deviation 1 – Allows a plus and minus range (in psi) for the system to go into a guaranteed soak period if the temperature falls within the set range. Timing will not start until achieving the set point plus or minus the deviation. Timing will stop if the temperature falls out of the deviation range.

Slow Heat Alarm time – time in seconds of no heating change before alarm light flashes.

Vent Alarm time – time in seconds of no change in pressure before alarm light flashes.

Slow Vacuum Alarm time – time in seconds of no change in pressure before alarm light flashes.

SPITTER 1 ON - amount of time in seconds before valve changes state from open to closed or closed to open

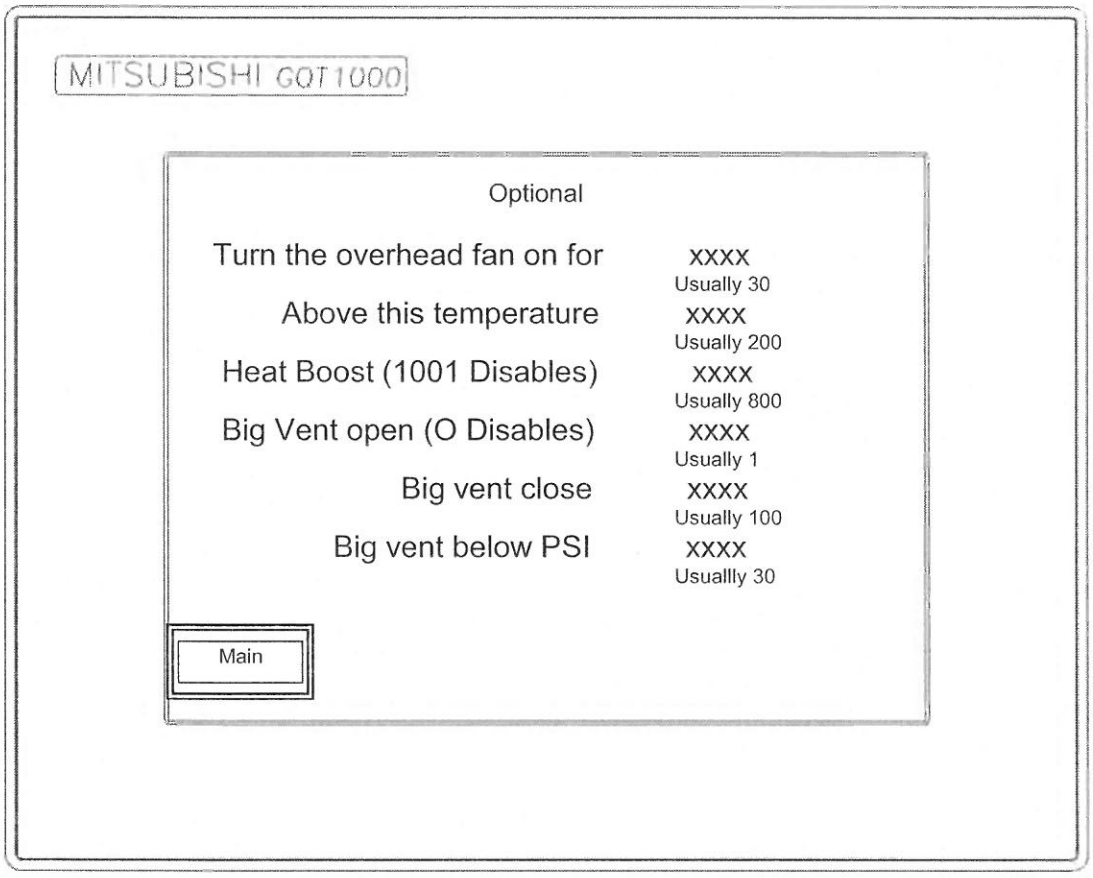
SPITTER 1 OFF – overlap time in seconds between the valves. Larger number exhausts more condensate.

SPITTER 2 ON - amount of time in seconds before valve changes state from open to closed or closed to open

SPITTER 2 OFF - overlap time in seconds between the valves. Larger number exhausts more condensate.

Spitters open on vent – allows optional spitter traps to be open or closed during vent . 0=off, 1=on

TUNE 3 SCREEN



Settings for optional features your autoclave system may have:

Turn the overhead fan on: Time overhead ventilation fan runs for (in seconds)

Above this temperature: Temperature overhead fan runs at (in degree F)

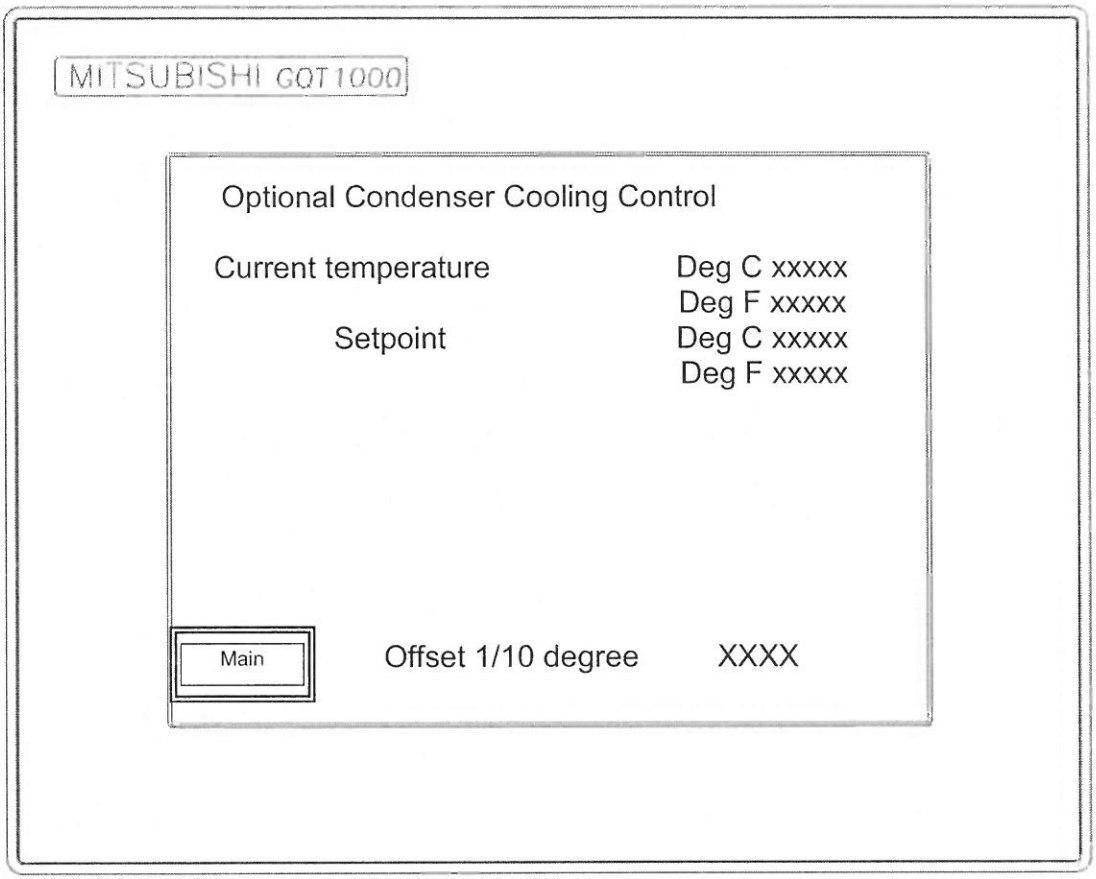
Heat boost (1001 Disables): (1-1001) percentage proportional steam in valve is open that Boost Heat valve is on.

Big (proportional) vent open (0 disables): Controls how quick proportional vent valve opens (0-100) 0 = no open Lower number = slower open

Big (proportional) vent close: Controls how quick proportional vent valve closes. (1-100) Lower number = slower close

Big (proportional) vent below: Pressure big (proportional) vent valve starts to open.

CONDENSER CONTROL SCREEN

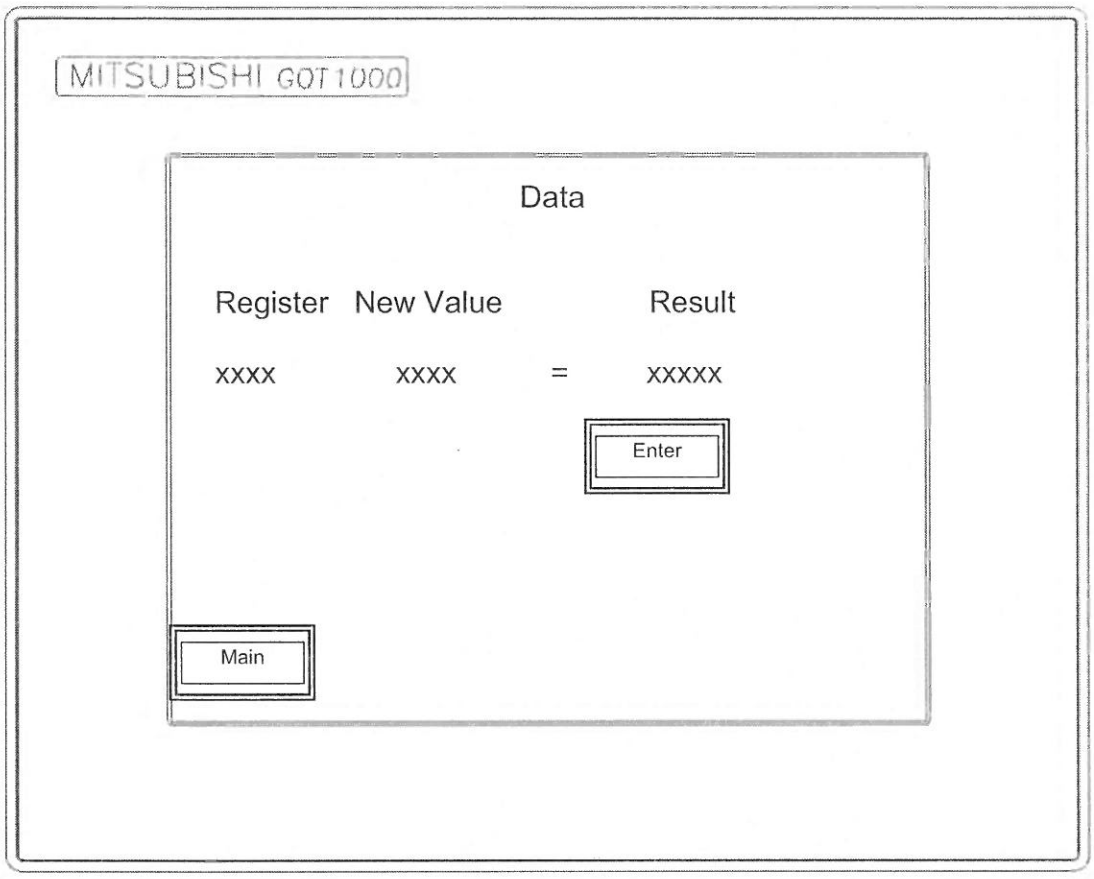


Condenser Control Screen (password protected through Tune 1 screen):

This screen shows the current temperature value of the condenser and temperature set point of the condenser when autoclave is equipped with optional condenser cooling water feature.

Offset allows calibration of the temperature reading in $1/10^{th}$ of a degree.

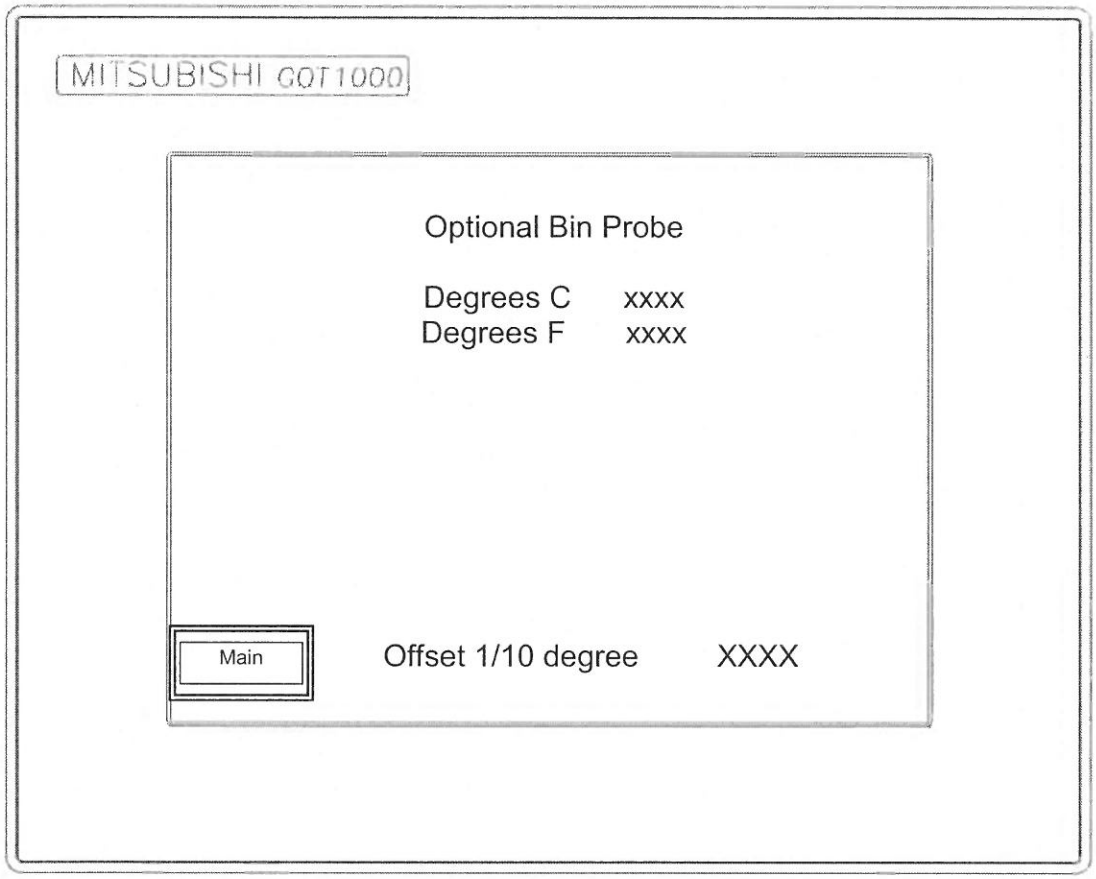
DATA SCREEN



Data Screen (password protected):

This screen shows the current value of the selected data registers. This can also be used to force a value into a data register. This is used for advanced trouble shooting. Changes to data should be made with caution as unexpected results can occur.

BIN PROBE SCREEN

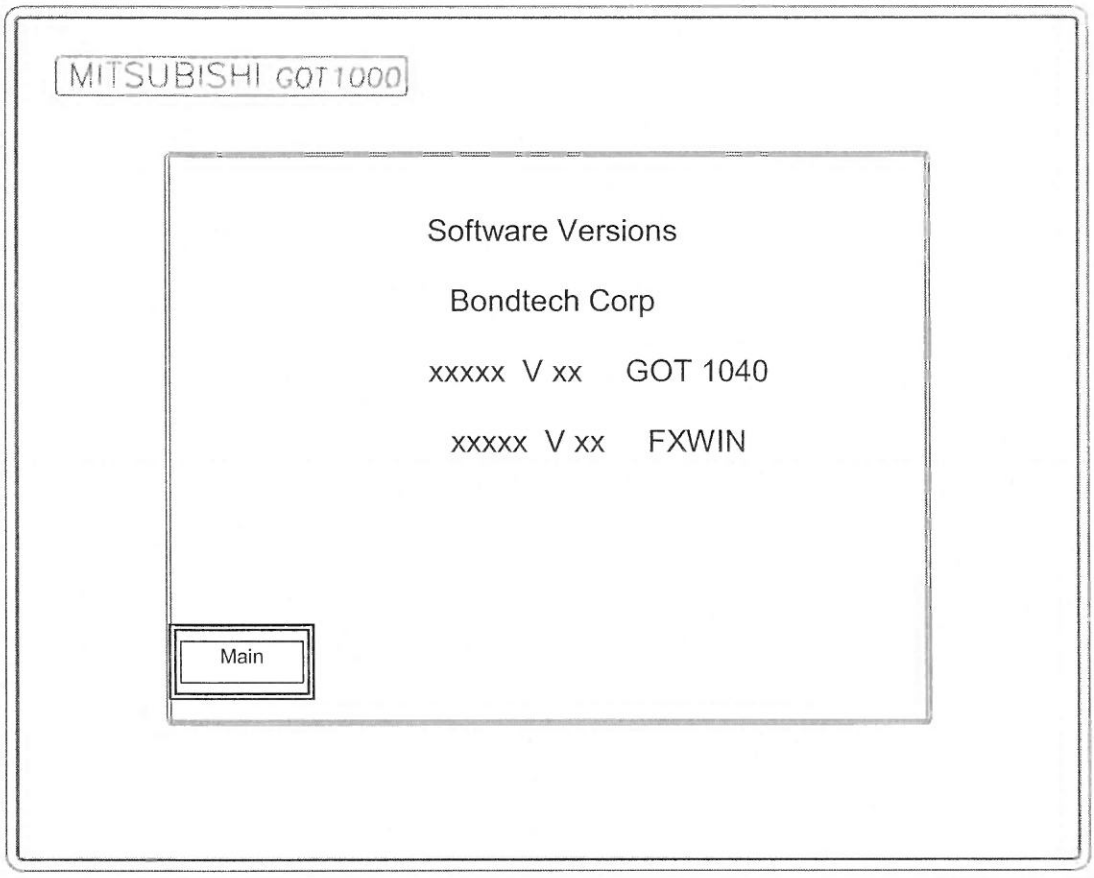


Bin Probe Screen:

This screen shows the current temperature of the optional bin probe.

The offset can be used to calibrate the temperature reading.

VERSION SCREEN



Version Screen:

This screen shows the current software version that is loaded in the GOT 1040 operator interface and the plc (FXWIN).

Mitsubishi GOT1040 Program
BTT6x13
wo 12457

5/22/12

Bondtech Corp.

[Base Screen Title List]

1	Main
2	Program
3	Tune1
4	Tune 2
5	Bin Probe
6	Condenser Control
7	Data
8	Versions
9	Trends
10	Tune 3

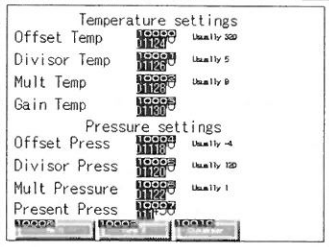
File Name:Y:\Jobs By Order Number\12457 State Waste Services - Australia 6x13 LH\PLC 12457\12457 Got 1040 V38\12457 Got 1040 V38
Date:2012-05-22

[Base Screen Image List]

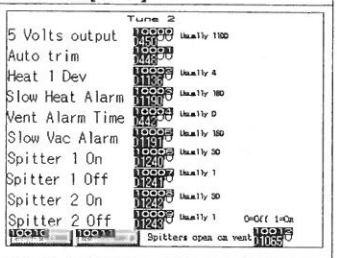
1:Main[OFF]

2:Program[OFF]

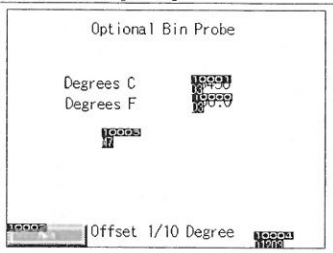
3:Tune1[OFF]



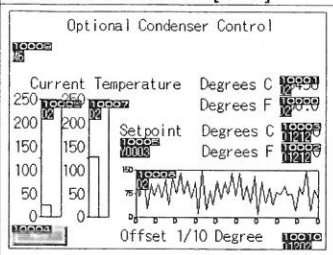
4:Tune 2[OFF]



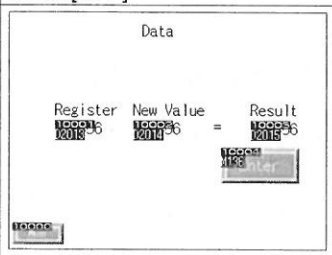
5:Bin Probe[OFF]



6:Condenser Control[OFF]

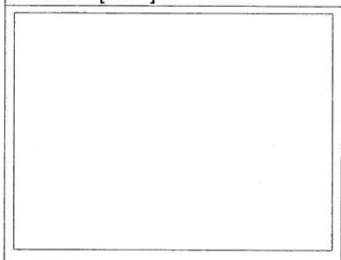


7:Data[OFF]

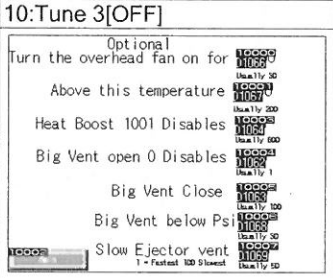


8:Versions[OFF]

9:Trends[OFF]



10:Tune 3[OFF]



[Screen Image / Setting]

Base Screen1
[Base Screen Details]

Screen Name	Main
Size	320X240
Detailed Description	-
Security	0
Use screen color	No
Pattern	-
Pattern Color	-
Background Color	-
Specify the touch area	Yes
Display alarm flow	No
Display Position	-

[Key Window Setting]
Key Window Setting

Key Window	Standard Key Window

DEC key sheet No	0
HEX key sheet No	0
ASCII key sheet No	0

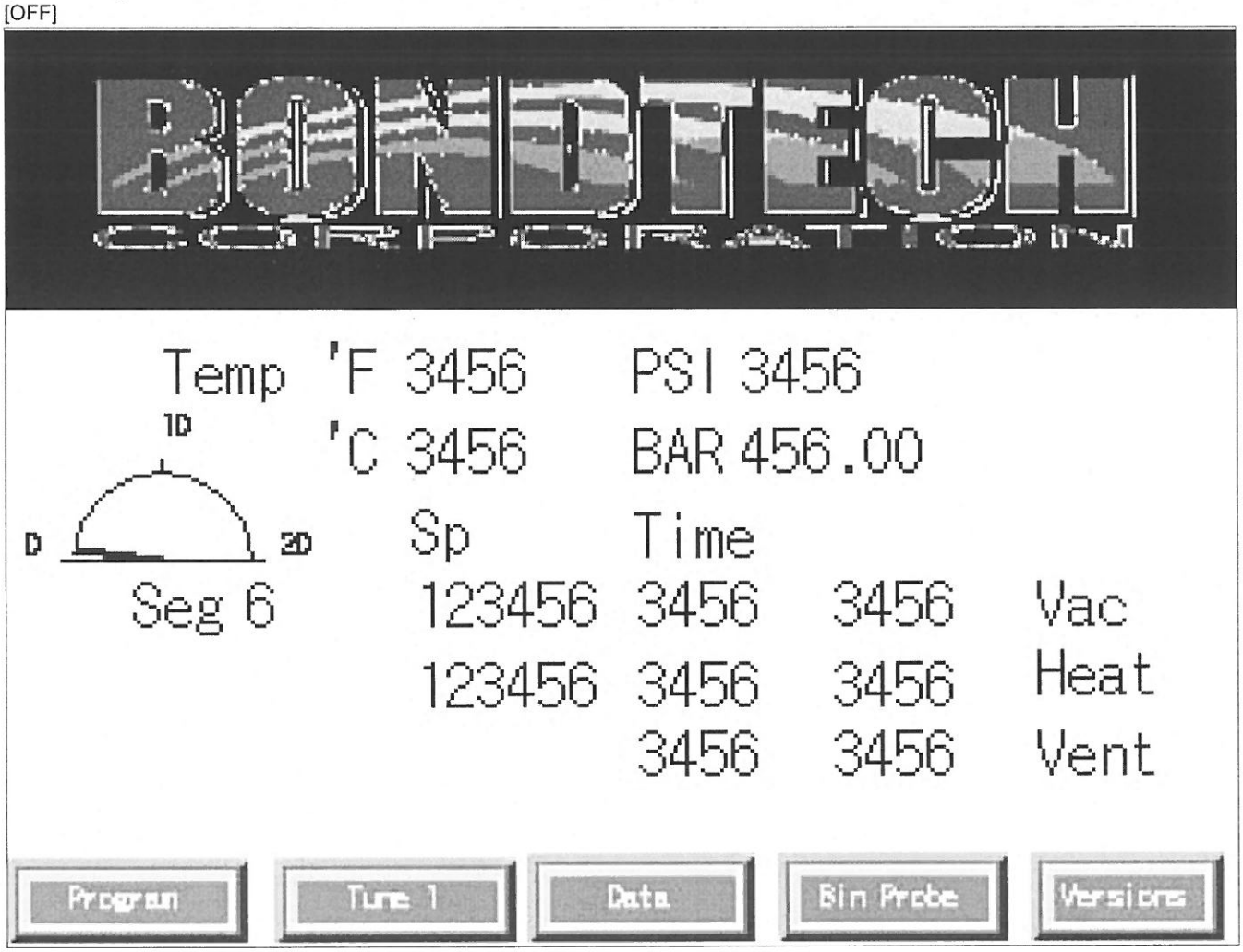
Key Window/Cursor Display Setting
When operating conditions are satisfied

Key Window/Cursor Display Setting	Same as the project setting

Key Window/Cursor Movement

Key Window/Cursor Movement	Same as the project setting

[Screen Image]
[Screen size]320X240
[OFF]



[Object List]

	Object ID	Coordinates	Device
Go To Screen Switch	10013	69,217	-
	10014	200,216	-
	10015	135,216	-
	10016	266,216	-
	10021	0,217	-
Numerical Display	10000	104,82	D32
	10001	191,82	D11
	10002	191,103	D11
	10003	104,103	D29
	10004	106,143	D60
	10005	106,164	D61
	10006	164,143	D202
	10007	164,164	D206
	10008	164,182	D210
	10009	215,143	D218
	10010	215,164	D222
	10011	215,182	D226
	10012	62,143	C31
Bit Comment Display	10017	4,162	M5
	10018	4,190	M3
	10019	106,182	Y0006

[Object List]

Panel Meter	10020	17,116	D1184

Base Screen2

[Base Screen Details]

Screen Name	Program
Size	320X240
Detailed Description	-
Security	1
Use screen color	No
Pattern	-
Pattern Color	-
Background Color	-
Specify the touch area	No
Display alarm flow	Yes
Display Position	Bottom

[Key Window Setting]

Key Window Setting

Key Window Setting	Same as the project setting

Key Window/Cursor Display Setting

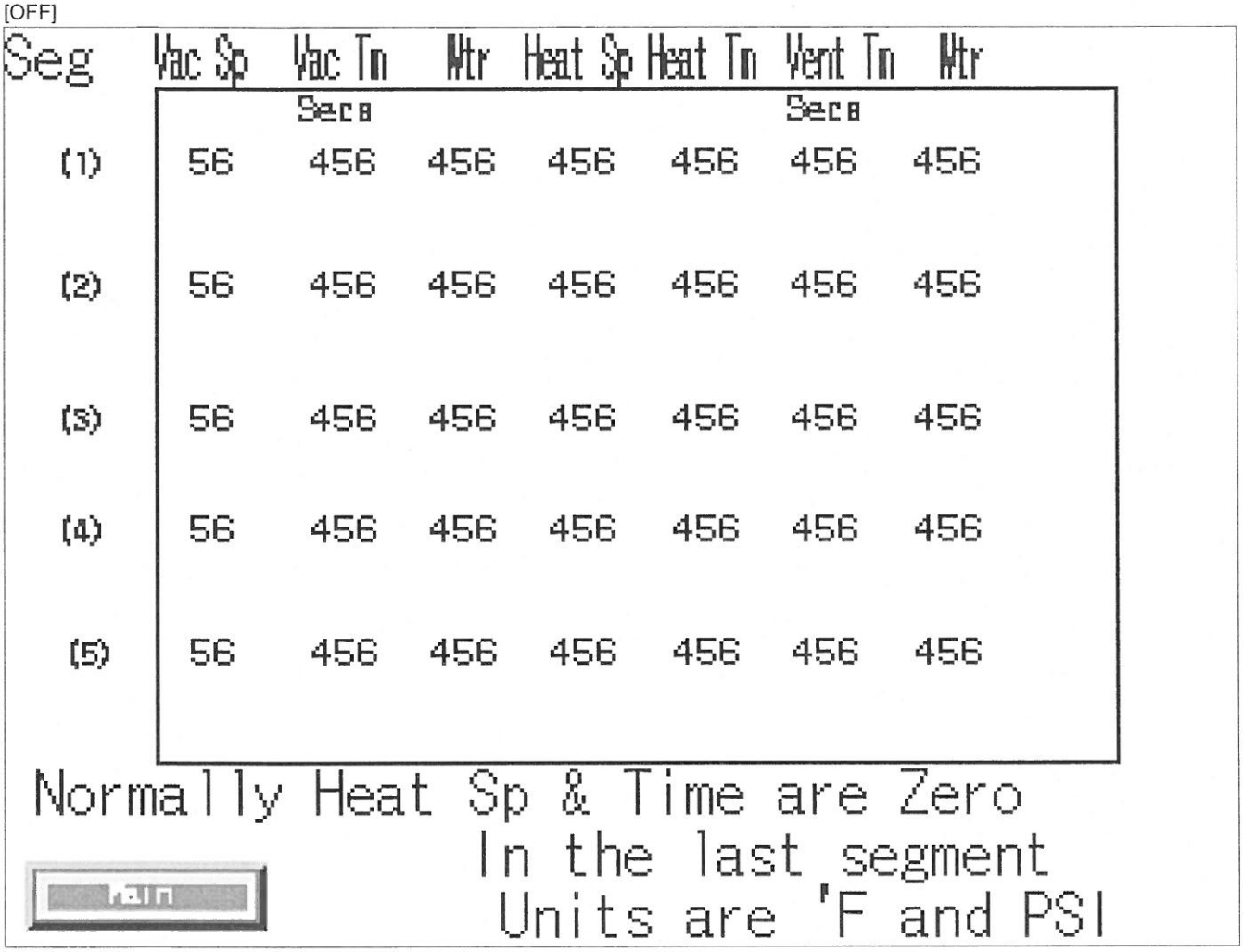
When operating conditions are satisfied

Key Window/Cursor Display Setting	Same as the project setting

Key Window/Cursor Movement

Key Window/Cursor Movement	Same as the project setting

[Screen Image]
[Screen size]320X240
[OFF]



[Object List]

	Object ID	Coordinates	Device
Go To Screen Switch	10035	5,218	-
Numerical Input	10000	48,32	D3000
	10001	48,64	D3007
	10002	48,99	D3014
	10003	48,128	D3021
	10004	48,160	D3028
	10005	79,32	D3001
	10006	110,32	D3002
	10007	141,32	D3003
	10008	173,32	D3004
	10009	204,32	D3005
	10010	236,32	D3006
	10011	79,64	D3008
	10012	79,99	D3015
	10013	79,128	D3022
	10014	79,160	D3029
	10015	110,64	D3009
	10016	110,99	D3016
	10017	110,128	D3023
	10018	110,160	D3030
	10019	141,64	D3010

[Object List]

	10020	141,99	D3017
	10021	141,128	D3024
	10022	141,160	D3031
	10023	173,64	D3011
	10024	173,99	D3018
	10025	173,128	D3025
	10026	173,160	D3032
	10027	204,64	D3012
	10028	204,99	D3019
	10029	204,128	D3026
	10030	204,160	D3033
	10031	236,64	D3013
	10032	236,99	D3020
	10033	236,128	D3027
	10034	236,160	D3034

Base Screen3

[Base Screen Details]

Screen Name	Tune1
Size	320X240
Detailed Description	-
Security	1
Use screen color	No
Pattern	-
Pattern Color	-
Background Color	-
Specify the touch area	No
Display alarm flow	Yes
Display Position	Bottom

[Key Window Setting]

Key Window Setting

Key Window Setting	Same as the project setting

Key Window/Cursor Display Setting

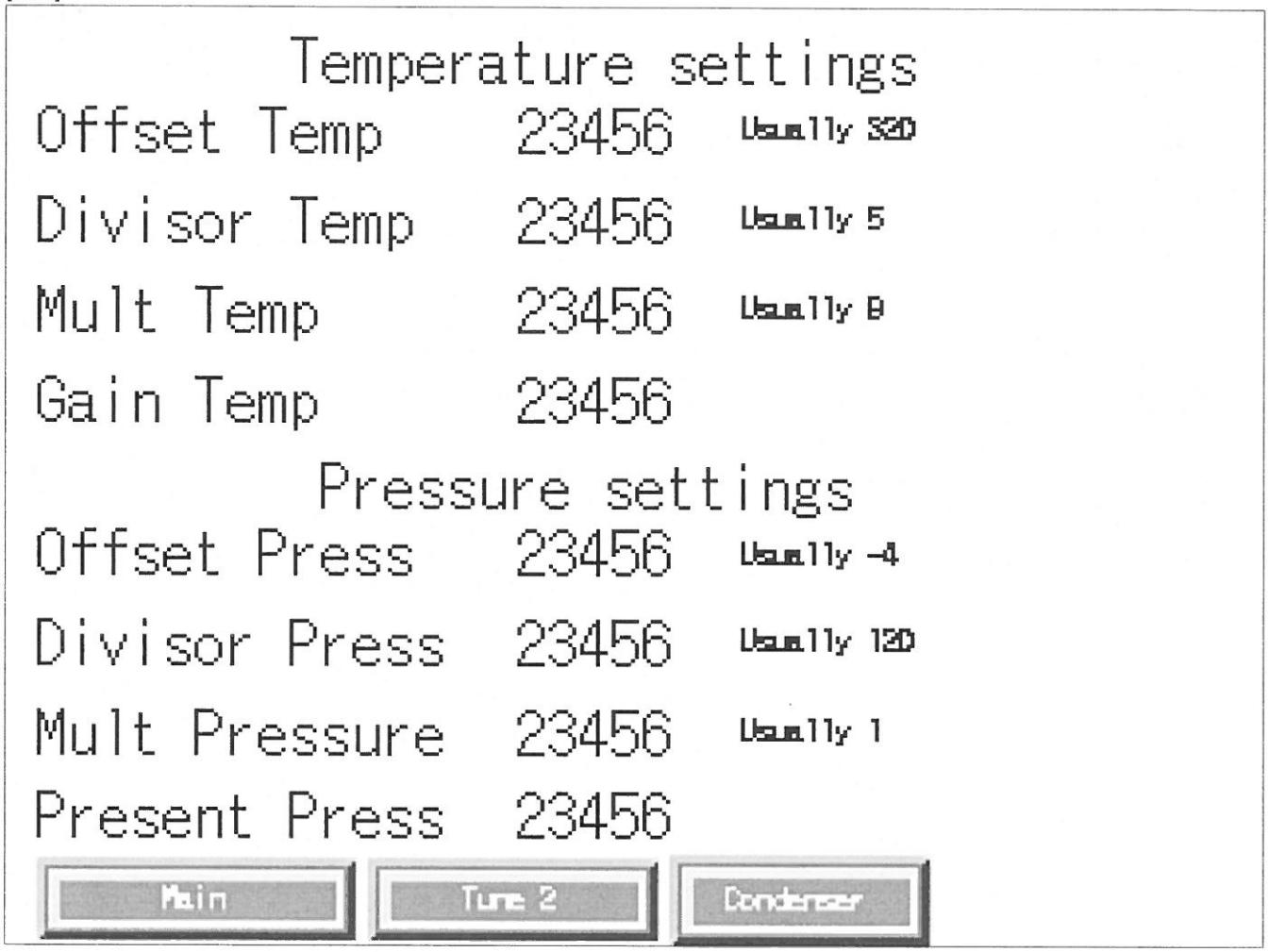
When operating conditions are satisfied

Key Window/Cursor Display Setting	Same as the project setting

Key Window/Cursor Movement

Key Window/Cursor Movement	Same as the project setting

[Screen Image]
[Screen size]320X240
[OFF]



[Object List]

	Object ID	Coordinates	Device
Switch	10008	8,218	-
	10009	92,218	-
Go To Screen Switch	10010	169,217	-
Numerical Display	10007	130,199	D11
Numerical Input	10000	130,24	D1124
	10001	130,47	D1126
	10002	130,70	D1128
	10003	130,93	D1130
	10004	130,132	D1118
	10005	130,155	D1120
	10006	130,178	D1122

Base Screen4

[Base Screen Details]

Screen Name	Tune 2
Size	320X240
Detailed Description	-
Security	1
Use screen color	No
Pattern	-
Pattern Color	-
Background Color	-
Specify the touch area	No
Display alarm flow	Yes
Display Position	Bottom

[Key Window Setting]

Key Window Setting

Key Window Setting	Same as the project setting

Key Window/Cursor Display Setting

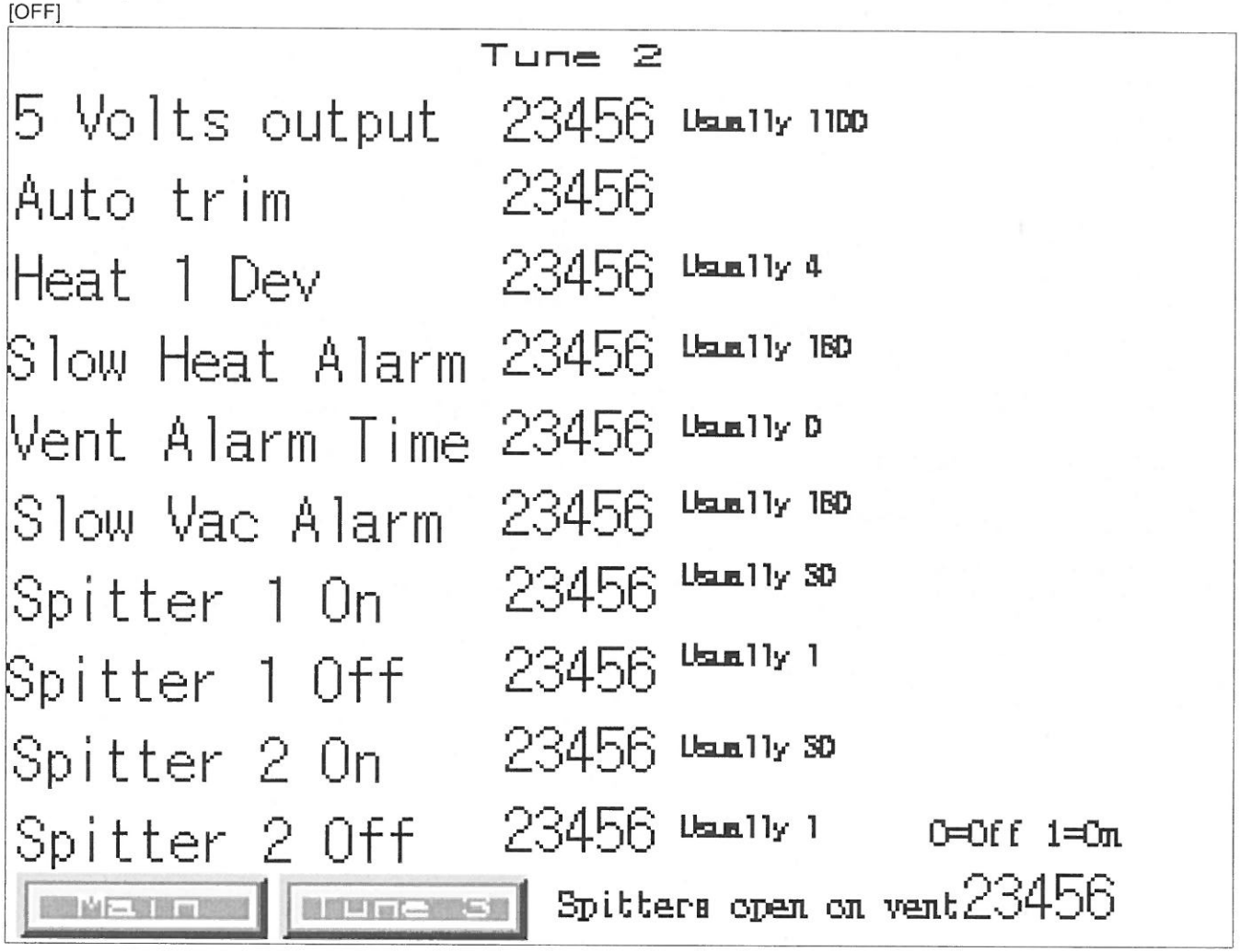
When operating conditions are satisfied

Key Window/Cursor Display Setting	Same as the project setting

Key Window/Cursor Movement

Key Window/Cursor Movement	Same as the project setting

[Screen Image]
[Screen size]320X240
[OFF]



[Object List]

	Object ID	Coordinates	Device
Go To Screen Switch	10010	3,222	-
	10011	71,222	-
Numerical Display	10001	129,35	D448
Numerical Input	10000	129,16	D450
	10002	129,56	D1136
	10003	129,77	D1190
	10004	129,98	D442
	10005	129,119	D1191
	10006	130,139	D1240
	10007	130,160	D1241
	10008	130,181	D1242
	10009	130,202	D1243
	10012	250,219	D1065

Base Screen5

[Base Screen Details]

Screen Name	Bin Probe
Size	320X240
Detailed Description	-
Security	0
Use screen color	No
Pattern	-
Pattern Color	-
Background Color	-
Specify the touch area	No
Display alarm flow	Yes
Display Position	Bottom

[Key Window Setting]

Key Window Setting

Key Window Setting	Same as the project setting

Key Window/Cursor Display Setting

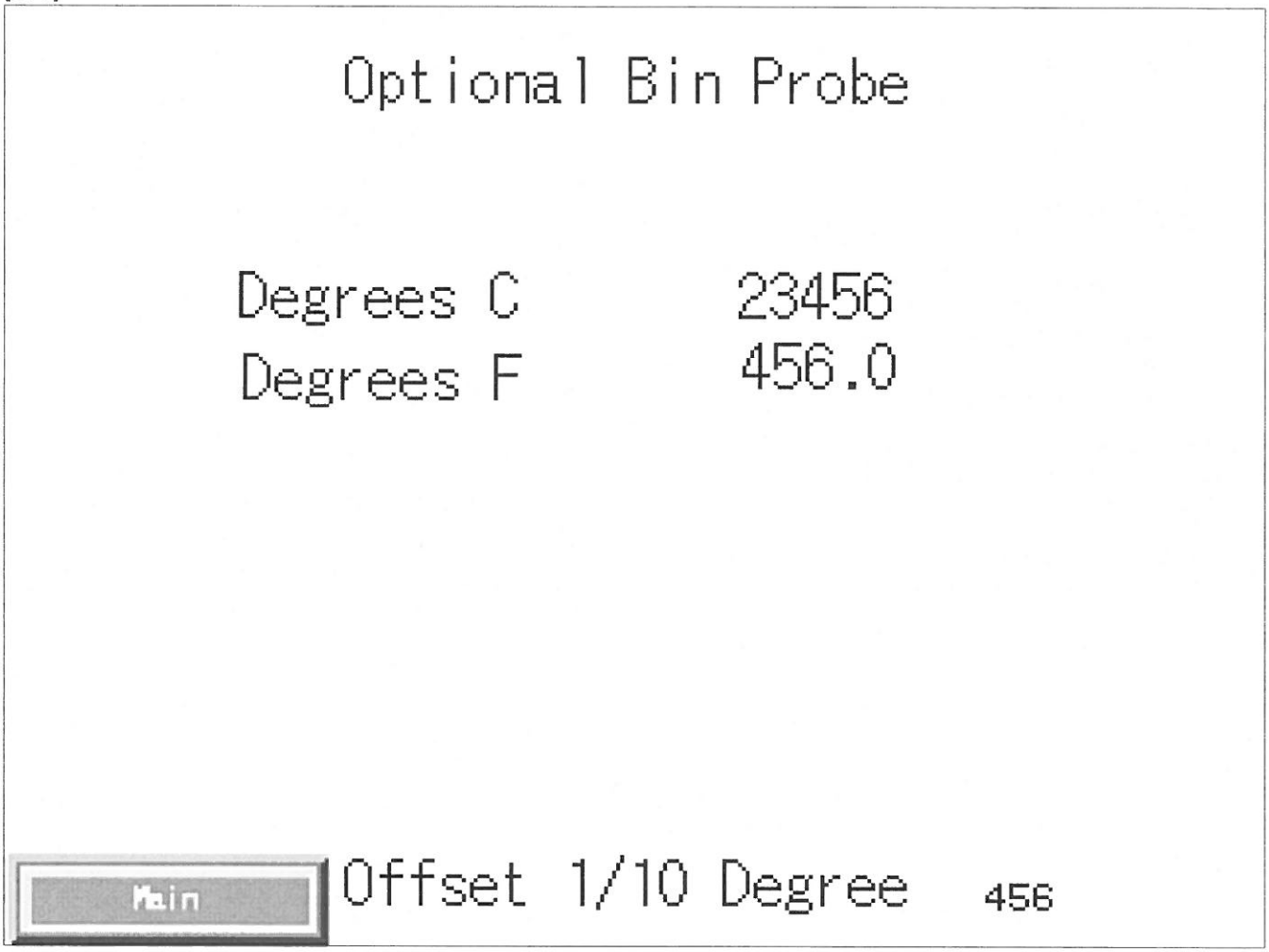
When operating conditions are satisfied

Key Window/Cursor Display Setting	Same as the project setting

Key Window/Cursor Movement

Key Window/Cursor Movement	Same as the project setting

[Screen Image]
[Screen size]320X240
[OFF]



[Object List]

	Object ID	Coordinates	Device
Switch	10002	1,217	-
Numerical Display	10000	187,84	D3
	10001	186,66	D3
Numerical Input	10004	249,224	D1203
Bit Comment Display	10003	96,120	M7

Base Screen6

[Base Screen Details]

Screen Name	Condenser Control
Size	320X240
Detailed Description	-
Security	1
Use screen color	No
Pattern	-
Pattern Color	-
Background Color	-
Specify the touch area	No
Display alarm flow	Yes
Display Position	Bottom

[Key Window Setting]

Key Window Setting

Key Window Setting	Same as the project setting

Key Window/Cursor Display Setting

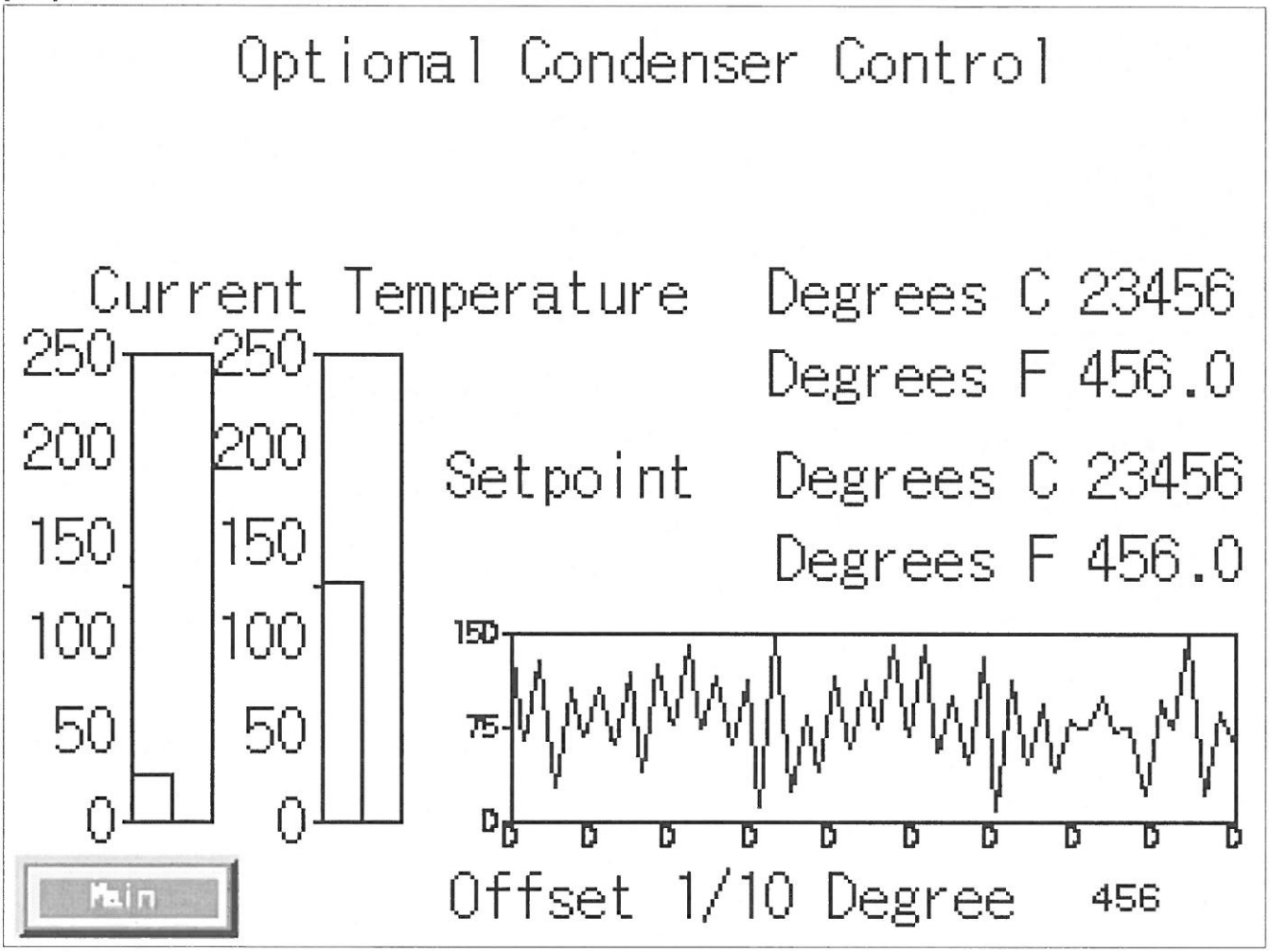
When operating conditions are satisfied

Key Window/Cursor Display Setting	Same as the project setting

Key Window/Cursor Movement

Key Window/Cursor Movement	Same as the project setting

[Screen Image]
[Screen size]320X240
[OFF]



[Object List]

	Object ID	Coordinates	Device
Go To Screen Switch	10004	3,217	-
Numerical Display	10000	273,86	D2
	10001	273,65	D2
Numerical Input	10002	275,133	D1212
	10003	275,112	D1212
	10010	276,224	D1202
Bit Comment Display	10005	112,128	Y0003
	10009	3,32	M6
Trend Graph	10008	128,160	D2
Bar Graph	10006	32,89	D2
	10007	80,89	D2

Base Screen7

[Base Screen Details]

Screen Name	Data
Size	320X240
Detailed Description	-
Security	1
Use screen color	No
Pattern	-
Pattern Color	-
Background Color	-
Specify the touch area	No
Display alarm flow	Yes
Display Position	Bottom

[Key Window Setting]

Key Window Setting

Key Window Setting	Same as the project setting

Key Window/Cursor Display Setting

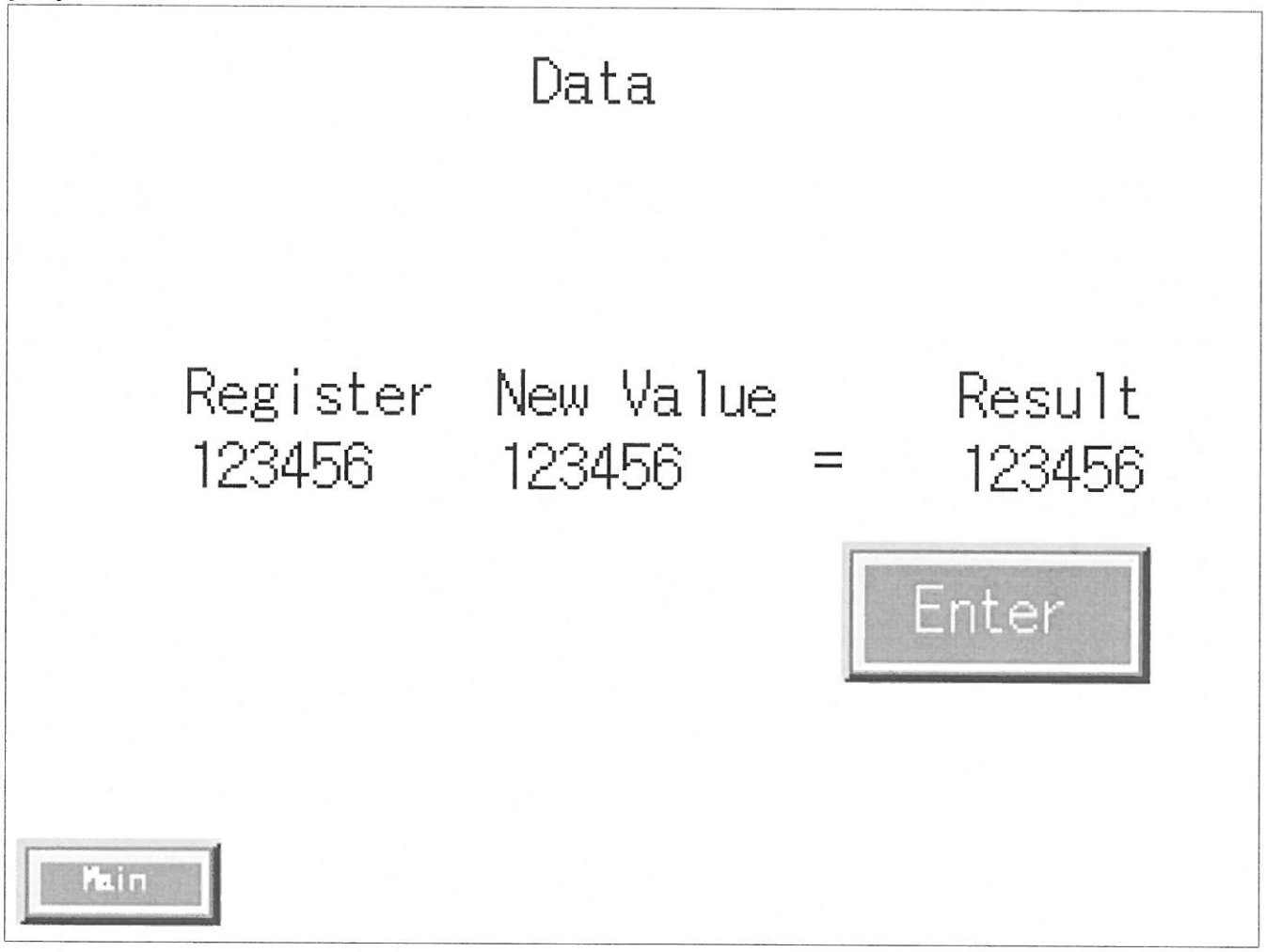
When operating conditions are satisfied

Key Window/Cursor Display Setting	Same as the project setting

Key Window/Cursor Movement

Key Window/Cursor Movement	Same as the project setting

[Screen Image]
[Screen size]320X240
[OFF]



[Object List]

	Object ID	Coordinates	Device
Bit Switch	10004	213,137	M136
Go To Screen Switch	10000	3,214	-
Numerical Display	10003	243,110	D2015
Numerical Input	10001	46,110	D2013
	10002	125,110	D2014

Base Screen8

[Base Screen Details]

Screen Name	Versions
Size	320X240
Detailed Description	-
Security	0
Use screen color	No
Pattern	-
Pattern Color	-
Background Color	-
Specify the touch area	No
Display alarm flow	Yes
Display Position	Bottom

[Key Window Setting]

Key Window Setting

Key Window Setting	Same as the project setting

Key Window/Cursor Display Setting

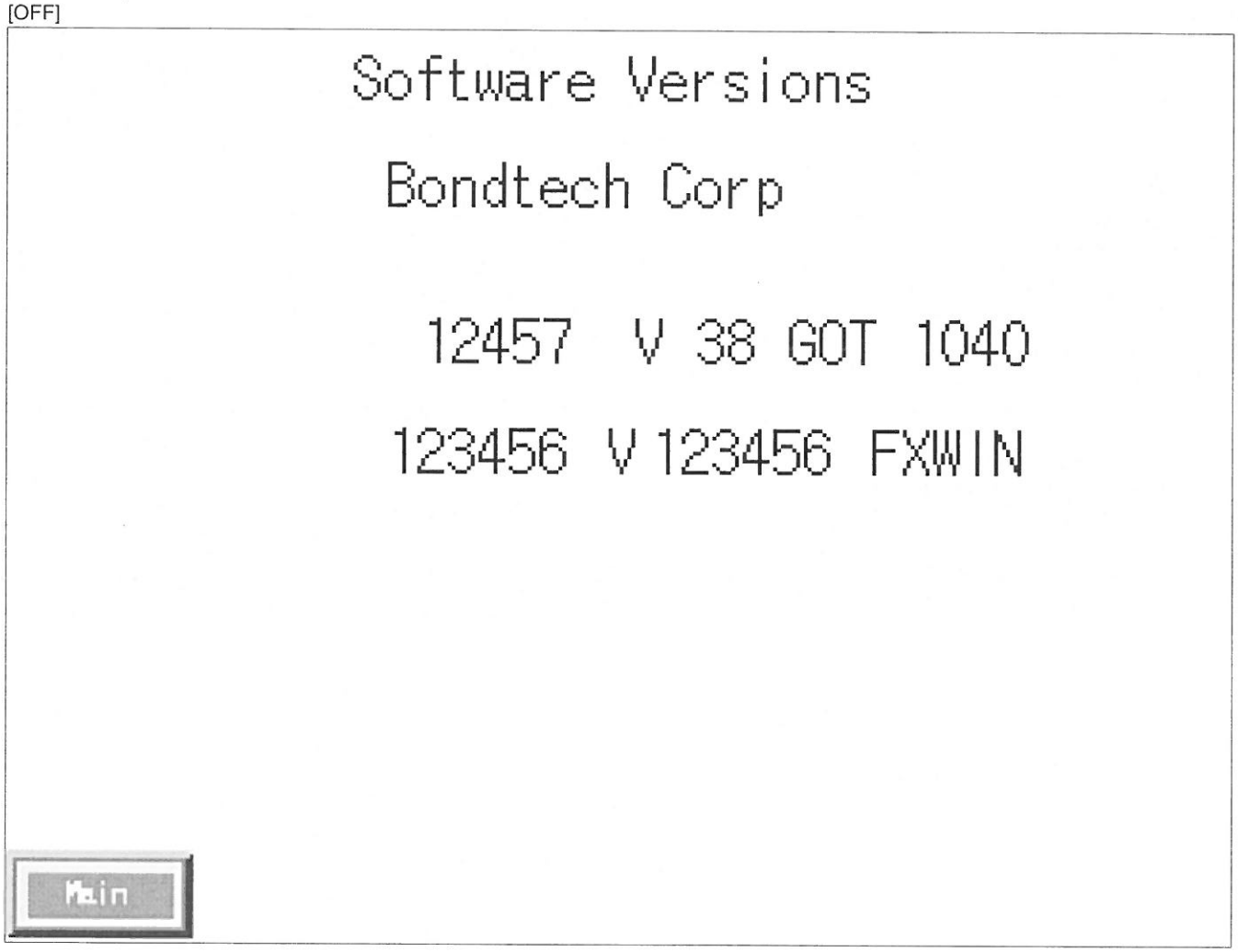
When operating conditions are satisfied

Key Window/Cursor Display Setting	Same as the project setting

Key Window/Cursor Movement

Key Window/Cursor Movement	Same as the project setting

[Screen Image]
[Screen size]320X240
[OFF]



[Object List]

	Object ID	Coordinates	Device
Go To Screen Switch	10000	0,216	-
Numerical Display	10001	99,103	D123
	10002	168,103	D125

Base Screen9

[Base Screen Details]

Screen Name	Trends
Size	320X240
Detailed Description	-
Security	0
Use screen color	No
Pattern	-
Pattern Color	-
Background Color	-
Specify the touch area	No
Display alarm flow	Yes
Display Position	Bottom

[Key Window Setting]

Key Window Setting

Key Window Setting	Same as the project setting

Key Window/Cursor Display Setting

When operating conditions are satisfied

Key Window/Cursor Display Setting	Same as the project setting

Key Window/Cursor Movement

Key Window/Cursor Movement	Same as the project setting

[Screen Image]
[Screen size]320X240
[OFF]

Base Screen10

[Base Screen Details]

Screen Name	Tune 3
Size	320X240
Detailed Description	-
Security	1
Use screen color	No
Pattern	-
Pattern Color	-
Background Color	-
Specify the touch area	No
Display alarm flow	Yes
Display Position	Bottom

[Key Window Setting]

Key Window Setting

Key Window Setting	Same as the project setting

Key Window/Cursor Display Setting

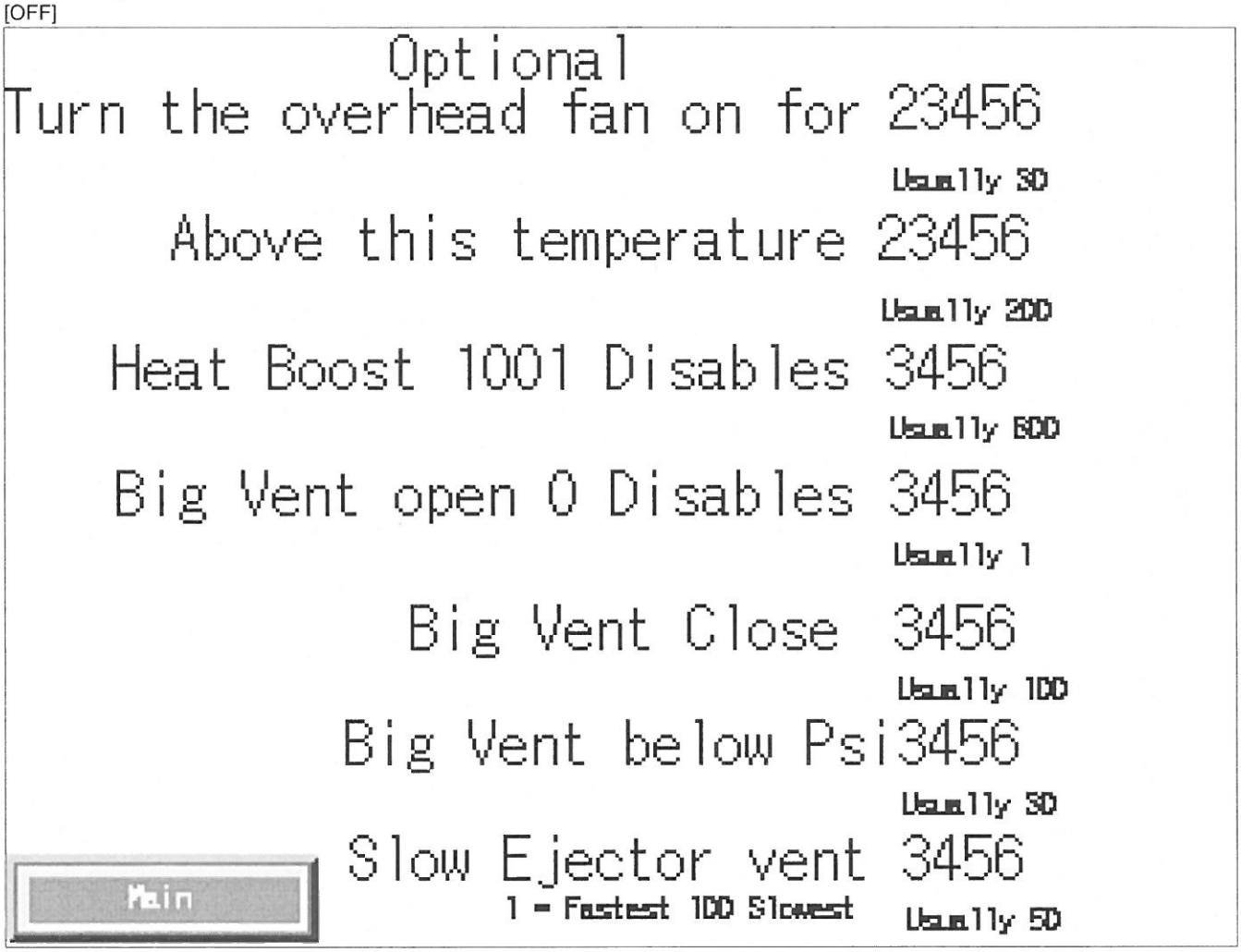
When operating conditions are satisfied

Key Window/Cursor Display Setting	Same as the project setting

Key Window/Cursor Movement

Key Window/Cursor Movement	Same as the project setting

[Screen Image]
[Screen size]320X240
[OFF]



[Object List]

	Object ID	Coordinates	Device
Switch	10002	0,216	-
Numerical Input	10000	230,13	D1066
	10001	227,47	D1067
	10003	229,81	D1064
	10004	230,114	D1062
	10005	231,149	D1063
	10006	232,179	D1068
	10007	233,209	D1069

[Common Setting]

Project information
[Project Title]
2

[Project ID]
1

[Detail Description]
Sterilizer HMI

[Created By]
ARC

GOT Setting
GOT Type Setting
[GOT Type]
GT10**-Q (320x240)

[Setup Direction]
Horizontal

[Color Setting]
16(Grayscale)

[Project Folder]
Japanese(supporting Europe)

[Font]
Gothic

[16dot Standard Font]
7-Segment

[TrueType Numerical Font]
No

Environmental Setting
[Screen Switching/Window]

	Screen Switching Device	X Display Position	Y Display Position	Window Bar
Base Screen	GD100	-	-	-
Overlap Window1	GD101	-	-	Yes
Overlap Window2	-	-	-	-
Superimpose Window1	GD100	-	-	-
Superimpose Window2	GD100	-	-	-

Setting

Screen Switching Device Data Type	BIN
Disable background colors of overlay screen when setting an ove rlay screen	No
Place the overlay screen under the basic screen	No

[Key Window]
Key Window Setting

Key Window	Standard Key Window

Window Screen No. for DEC	0
Window Screen No. for HEX	0
Window Screen No. for ASCII	0

Key Window/Cursor Display Setting
When operating conditions are satisfied

Key Window	Display when touched

When screens are switched

Display the key window	No
Display the cursor	No

Cursor Advanced Setting

Cursor Type	1-character blink

Key Window/Cursor Movement

Defined key action	Clear the key window and the cursor
Reference for determining cursor destination	Upper left

[Security]
[Authentication Method] : Password
[Security Level Device] : D100

Level	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Password	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No

Data Transmission/Utility Password	No

[Startup Logo]

Specify Startup Logo	No

Communication Settings
[CH 1]

Manufacturer	MITSUBISHI
Controller Type	MELSEC-FX
I/F	Standard I/F(RS422)
Driver	MELSEC-FX

Detail Setting

Transmission Speed	38400

[I/F Communication Setting]

	CH No.	I/F	Driver
StandardI/F-1	1	RS422	MELSEC-FX
StandardI/F-2	9	RS232	Host (PC)
StandardI/F-3	9	USB	Host (PC)

[Gateway]
[Communication Setting]
Destination I/F : Not connected

Peripheral Unit Setting
[PC (Data Transfer)]
Host (PC)
Destination I/F 1:Standard I/F(USB)
Destination I/F 2:Standard I/F(RS232)
Destination I/F 3:Not connected
Host (Modem)
Destination I/F:Not connected

[Bar Code]
Destination I/F : Not connected

Other Setting

[Device List]

[GOT Device]
[Word Device]
[GD List]

	Device
0-FF	GD100 GD101

[CH1:MELSEC-FX]
[Bit Device]
[Y List]

	Device
0-FF	Y0003 Y0006

[M List]

	Device
0-FF	M3 M5 M6 M7 M136

[Word Device]
[D List]

	Device
0-FF	D2 D3 D11 D29 D32 D60 D61 D100 D123 D125 D202 D206 D210 D218 D222 D226 D442 D448 D450 D1062 D1063 D1064 D1065 D1066 D1067 D1068 D1069 D1118 D1120 D1122 D1124 D1126 D1128 D1130 D1136 D1184 D1190 D1191 D1202 D1203 D1212 D1240 D1241 D1242 D1243 D2013 D2014 D2015 D3000 D3001 D3002 D3003 D3004 D3005 D3006 D3007 D3008 D3009 D3010 D3011 D3012 D3013 D3014 D3015 D3016 D3017 D3018 D3019 D3020 D3021 D3022 D3023 D3024 D3025 D3026 D3027 D3028 D3029 D3030 D3031 D3032 D3033 D3034

[C List]

	Device
0-FF	C31

[Device Details]

[GOT Device]
[Word Device]
[GD Details]

	Device	Points	Screen Number	Object	Coordinates	Object ID
0-FF	GD100		Common Setting	Screen Switching	-	-
			Common Setting	Screen Switching	-	-
			Common Setting	Screen Switching	-	-
	GD101		Common Setting	Screen Switching	-	-

[CH1:MELSEC-FX]
[Bit Device]
[Y Details]

	Device	Points	Screen Number	Object	Coordinates	Object ID
0-FF	Y0003		Base - 6	Bit Comment Display	112,128	10005
	Y0006		Base - 1	Bit Comment Display	106,182	10019

[M Details]

	Device	Points	Screen Number	Object	Coordinates	Object ID
0-FF	M3		Base - 1	Bit Comment Display	4,190	10018
	M5		Base - 1	Bit Comment Display	4,162	10017
	M6		Base - 6	Bit Comment Display	3,32	10009
	M7		Base - 5	Bit Comment Display	96,120	10003
	M136		Base - 7	Bit Switch	213,137	10004

[Word Device]
[D Details]

	Device	Points	Screen Number	Object	Coordinates	Object ID
0-FF	D2		Base - 6	Numerical Display	273,86	10000
			Base - 6	Numerical Display	273,65	10001
		1	Base - 6	Trend Graph	128,160	10008
		1	Base - 6	Bar Graph	32,89	10006
		1	Base - 6	Bar Graph	80,89	10007
	D3		Base - 5	Numerical Display	187,84	10000
			Base - 5	Numerical Display	186,66	10001
	D11		Base - 1	Numerical Display	191,82	10001
			Base - 1	Numerical Display	191,103	10002
			Base - 3	Numerical Display	130,199	10007
	D29		Base - 1	Numerical Display	104,103	10003
	D32		Base - 1	Numerical Display	104,82	10000
	D60		Base - 1	Numerical Display	106,143	10004
	D61		Base - 1	Numerical Display	106,164	10005
	D100		Common Setting	Security	-	-
	D123		Base - 8	Numerical Display	99,103	10001
	D125		Base - 8	Numerical Display	168,103	10002
	D202		Base - 1	Numerical Display	164,143	10006
	D206		Base - 1	Numerical Display	164,164	10007
	D210		Base - 1	Numerical Display	164,182	10008
	D218		Base - 1	Numerical Display	215,143	10009
	D222		Base - 1	Numerical Display	215,164	10010
	D226		Base - 1	Numerical Display	215,182	10011
	D442		Base - 4	Numerical Input	129,98	10004
	D448		Base - 4	Numerical Display	129,35	10001
	D450		Base - 4	Numerical Input	129,16	10000
	D1062		Base - 10	Numerical Input	230,114	10004
	D1063		Base - 10	Numerical Input	231,149	10005
	D1064		Base - 10	Numerical Input	229,81	10003
	D1065		Base - 4	Numerical Input	250,219	10012
	D1066		Base - 10	Numerical Input	230,13	10000
	D1067		Base - 10	Numerical Input	227,47	10001

[Word Device]
[D Details]

	D1068		Base - 10	Numerical Input	232,179	10006
	D1069		Base - 10	Numerical Input	233,209	10007
	D1118		Base - 3	Numerical Input	130,132	10004
	D1120		Base - 3	Numerical Input	130,155	10005
	D1122		Base - 3	Numerical Input	130,178	10006
	D1124		Base - 3	Numerical Input	130,24	10000
	D1126		Base - 3	Numerical Input	130,47	10001
	D1128		Base - 3	Numerical Input	130,70	10002
	D1130		Base - 3	Numerical Input	130,93	10003
	D1136		Base - 4	Numerical Input	129,56	10002
	D1184		Base - 1	Panelmeter	17,116	10020
	D1190		Base - 4	Numerical Input	129,77	10003
	D1191		Base - 4	Numerical Input	129,119	10005
	D1202		Base - 6	Numerical Input	276,224	10010
	D1203		Base - 5	Numerical Input	249,224	10004
	D1212		Base - 6	Numerical Input	275,133	10002
			Base - 6	Numerical Input	275,112	10003
	D1240		Base - 4	Numerical Input	130,139	10006
	D1241		Base - 4	Numerical Input	130,160	10007
	D1242		Base - 4	Numerical Input	130,181	10008
	D1243		Base - 4	Numerical Input	130,202	10009
	D2013		Base - 7	Numerical Input	46,110	10001
	D2014		Base - 7	Numerical Input	125,110	10002
	D2015		Base - 7	Numerical Display	243,110	10003
	D3000		Base - 2	Numerical Input	48,32	10000
	D3001		Base - 2	Numerical Input	79,32	10005
	D3002		Base - 2	Numerical Input	110,32	10006
	D3003		Base - 2	Numerical Input	141,32	10007
	D3004		Base - 2	Numerical Input	173,32	10008
	D3005		Base - 2	Numerical Input	204,32	10009
	D3006		Base - 2	Numerical Input	236,32	10010
	D3007		Base - 2	Numerical Input	48,64	10001
	D3008		Base - 2	Numerical Input	79,64	10011
	D3009		Base - 2	Numerical Input	110,64	10015
	D3010		Base - 2	Numerical Input	141,64	10019
	D3011		Base - 2	Numerical Input	173,64	10023
	D3012		Base - 2	Numerical Input	204,64	10027
	D3013		Base - 2	Numerical Input	236,64	10031
	D3014		Base - 2	Numerical Input	48,99	10002
	D3015		Base - 2	Numerical Input	79,99	10012
	D3016		Base - 2	Numerical Input	110,99	10016
	D3017		Base - 2	Numerical Input	141,99	10020
	D3018		Base - 2	Numerical Input	173,99	10024
	D3019		Base - 2	Numerical Input	204,99	10028
	D3020		Base - 2	Numerical Input	236,99	10032
	D3021		Base - 2	Numerical Input	48,128	10003
	D3022		Base - 2	Numerical Input	79,128	10013
	D3023		Base - 2	Numerical Input	110,128	10017
	D3024		Base - 2	Numerical Input	141,128	10021
	D3025		Base - 2	Numerical Input	173,128	10025
	D3026		Base - 2	Numerical Input	204,128	10029
	D3027		Base - 2	Numerical Input	236,128	10033
	D3028		Base - 2	Numerical Input	48,160	10004
	D3029		Base - 2	Numerical Input	79,160	10014
	D3030		Base - 2	Numerical Input	110,160	10018
	D3031		Base - 2	Numerical Input	141,160	10022
	D3032		Base - 2	Numerical Input	173,160	10026
	D3033		Base - 2	Numerical Input	204,160	10030
	D3034		Base - 2	Numerical Input	236,160	10034

[Word Device]
[C Details]

	Device	Points	Screen Number	Object	Coordinates	Object ID
0-FF	C31		Base - 1	Numerical Display	62,143	10012

[Category]

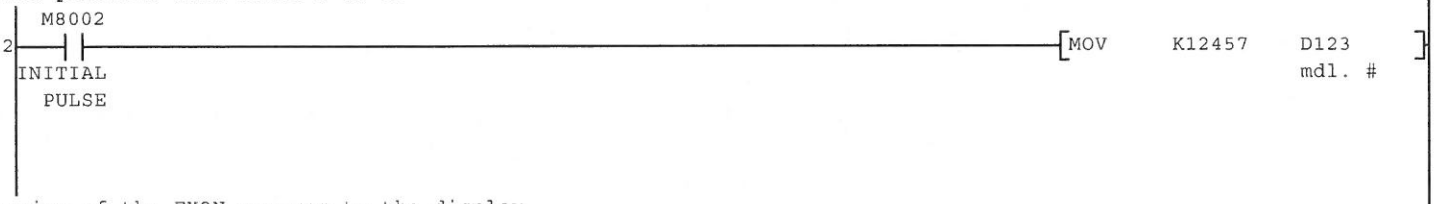
[Switch]

	Screen	Coordinates
Go To Screen Switch	B-1	69,217
Go To Screen Switch	B-1	200,216
Go To Screen Switch	B-1	135,216
Go To Screen Switch	B-1	266,216
Go To Screen Switch	B-1	0,217
Go To Screen Switch	B-2	5,218
Switch	B-3	8,218
Switch	B-3	92,218
Go To Screen Switch	B-3	169,217
Go To Screen Switch	B-4	3,222
Go To Screen Switch	B-4	71,222
Switch	B-5	1,217
Go To Screen Switch	B-6	3,217
Go To Screen Switch	B-7	3,214
Bit Switch	B-7	213,137
Go To Screen Switch	B-8	0,216
Switch	B-10	0,216

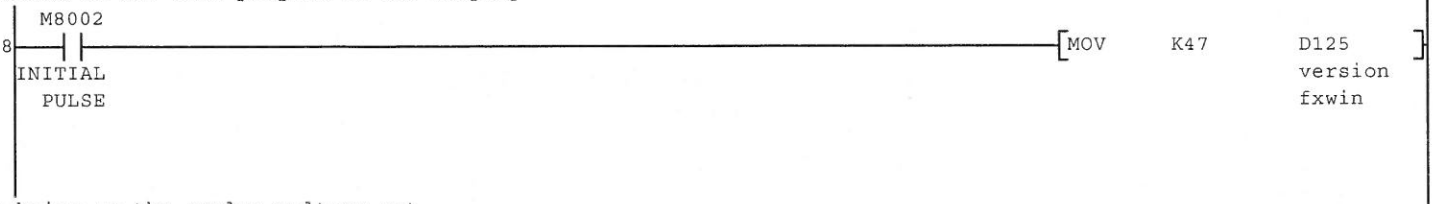
[Other]

	Screen	Coordinates
Text	B-1	41,82
Numerical Display	B-1	104,82
Text	B-1	81,103
Numerical Display	B-1	191,82
Numerical Display	B-1	191,103
Text	B-1	163,82
Text	B-1	163,103
Numerical Display	B-1	104,103
Numerical Display	B-1	106,143
Numerical Display	B-1	106,164
Numerical Display	B-1	164,143
Numerical Display	B-1	164,164
Numerical Display	B-1	164,182
Numerical Display	B-1	215,143
Numerical Display	B-1	215,164
Numerical Display	B-1	215,182
Text	B-1	268,143
Text	B-1	268,161
Text	B-1	268,182
Text	B-1	105,124
Text	B-1	163,125
Numerical Display	B-1	62,143
Text	B-1	33,143
Bit Comment Display	B-1	4,162
Bit Comment Display	B-1	4,190
Bit Comment Display	B-1	106,182
Bitmap	B-1	0,1
Panelmeter	B-1	17,116
Numerical Input	B-2	48,32
Numerical Input	B-2	48,64
Numerical Input	B-2	48,99
Numerical Input	B-2	48,128
Numerical Input	B-2	48,160
Numerical Input	B-2	79,32
Numerical Input	B-2	110,32
Numerical Input	B-2	141,32
Numerical Input	B-2	173,32

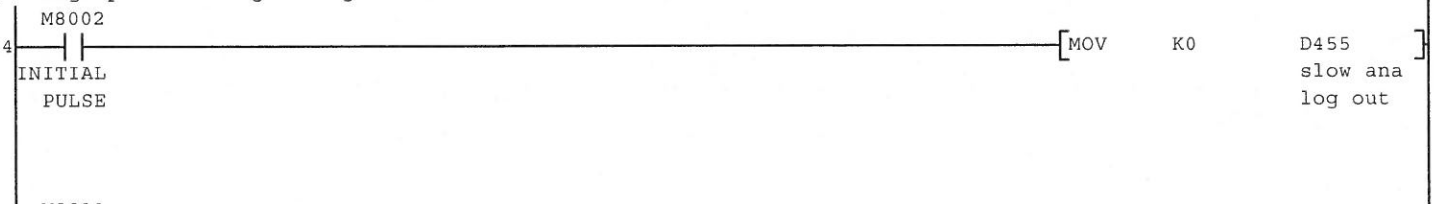
fixed 30ma out
Added proportional blowdown
Vac and Vent time in seconds 11-15-2010
moved slow steam out from x35 to x13
added zero password with start 5-18-12

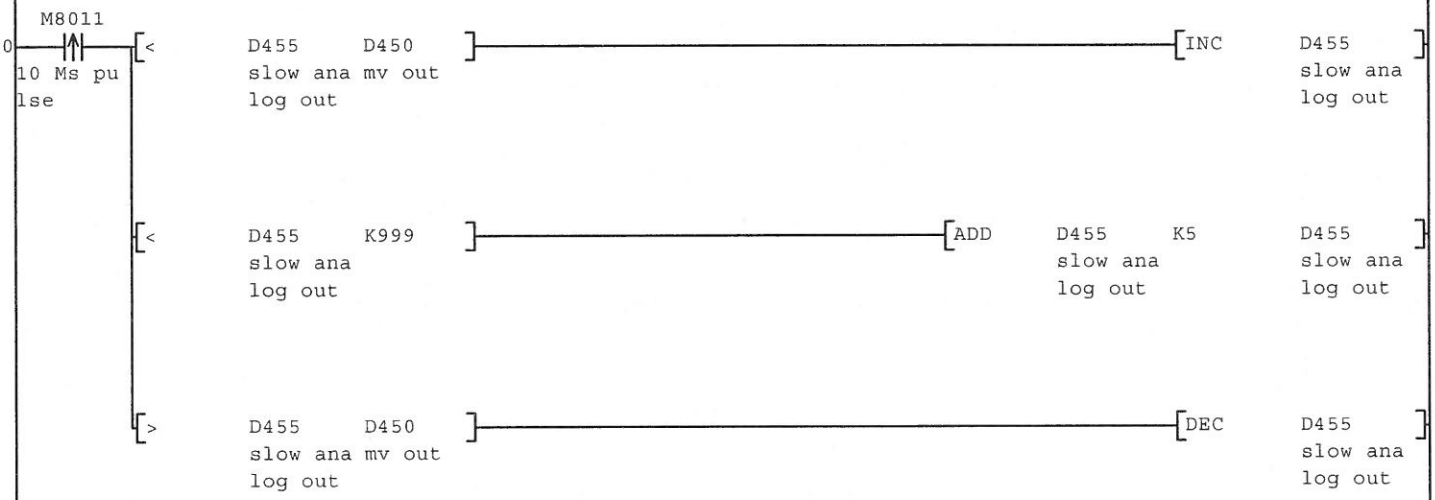


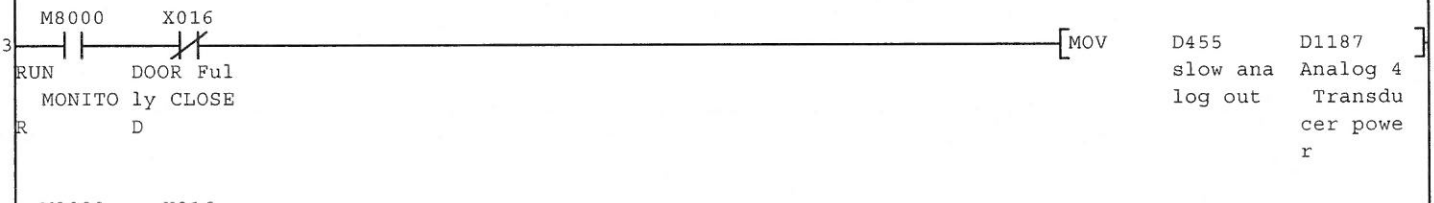
move version of the FX2N program to the display

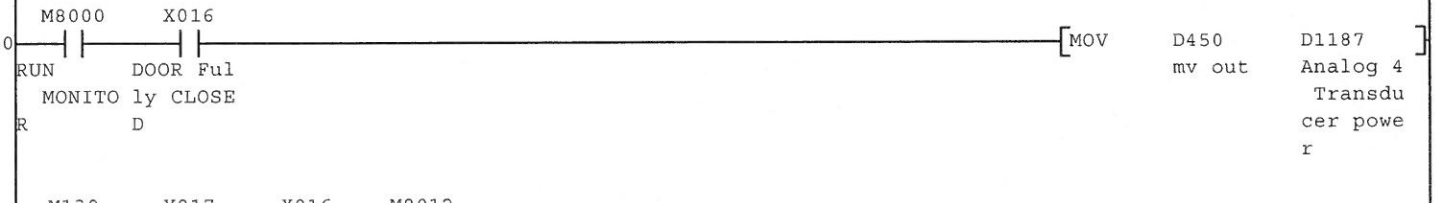


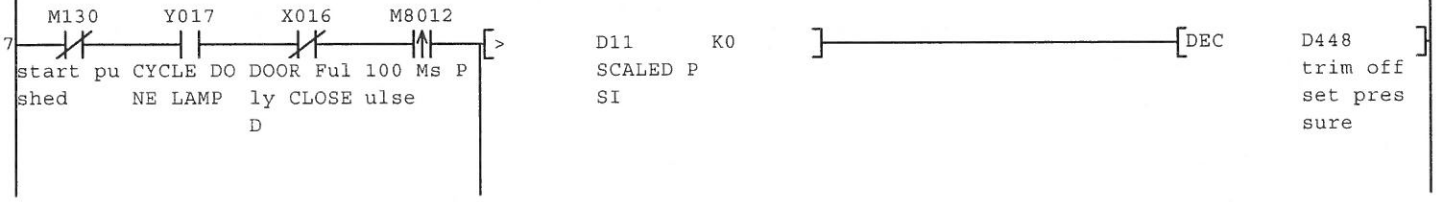
Slowly bring up the analog voltage out

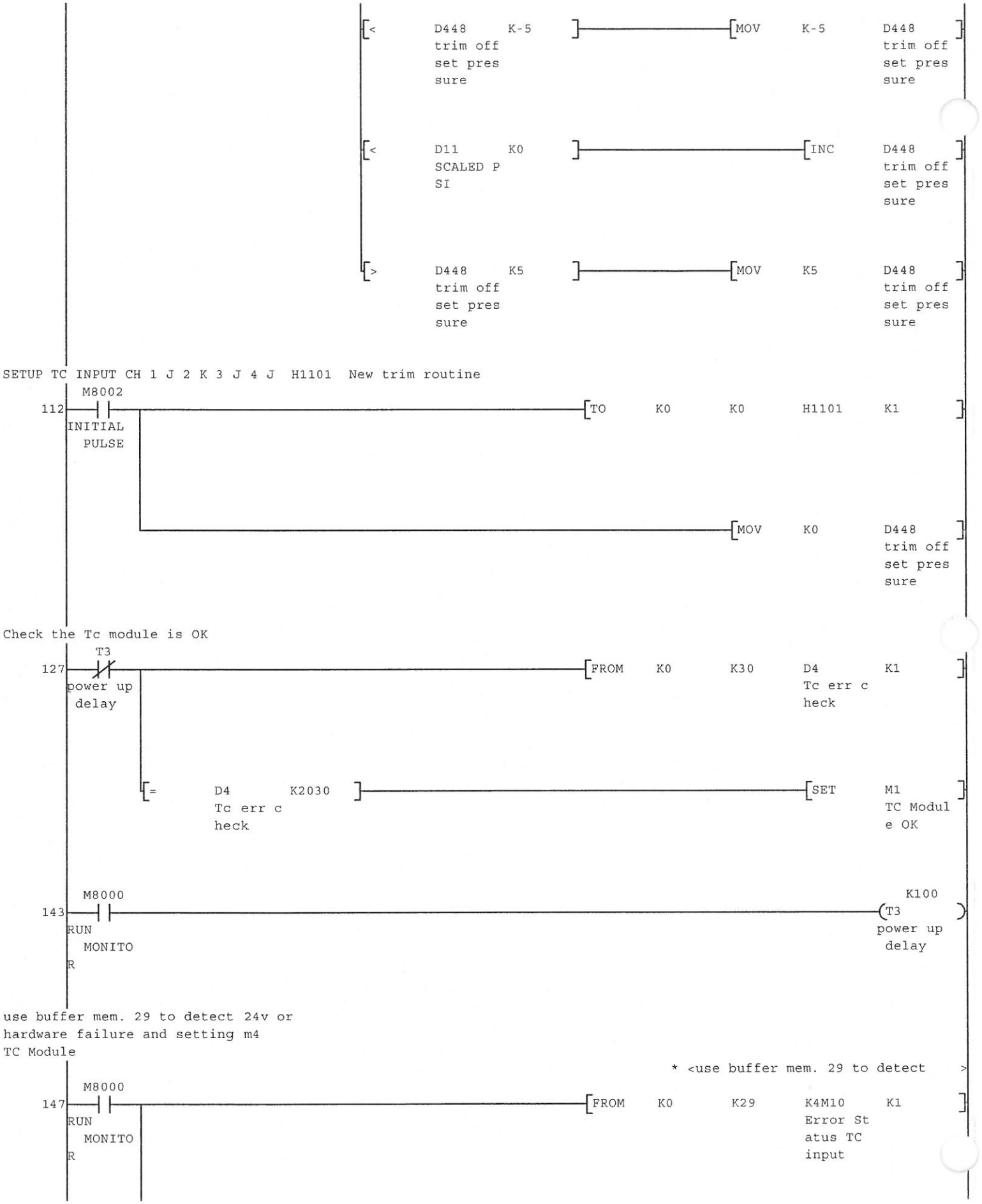


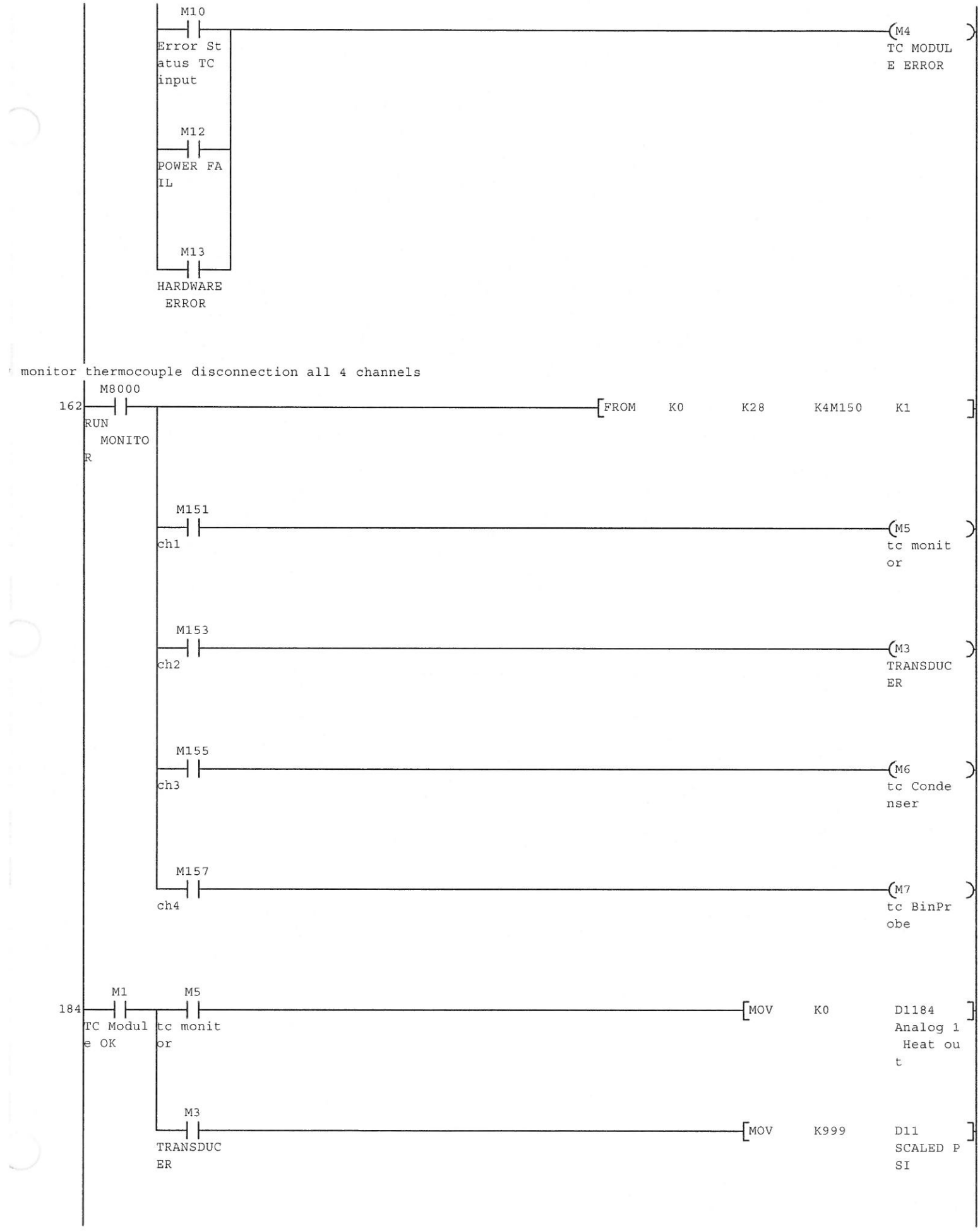




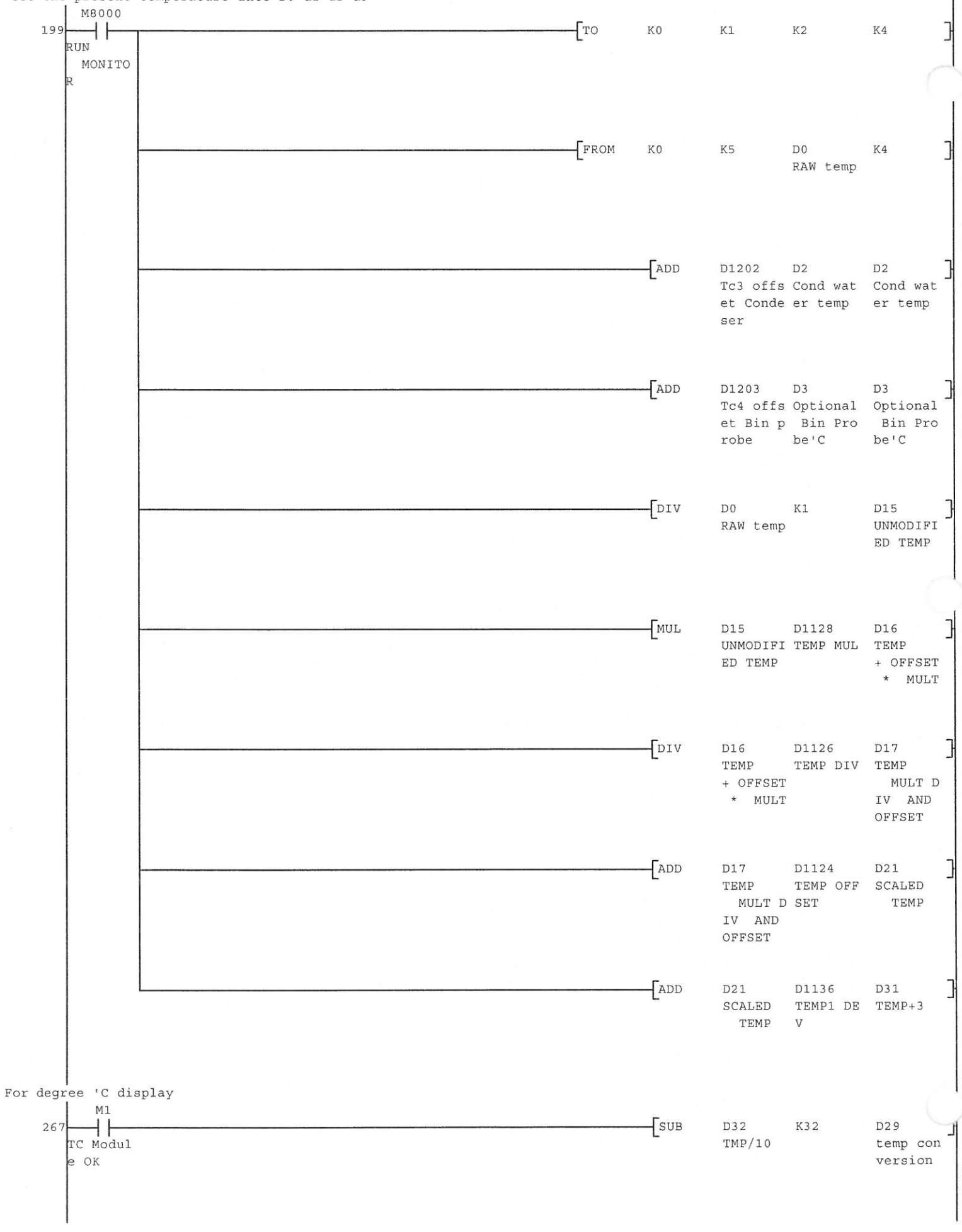




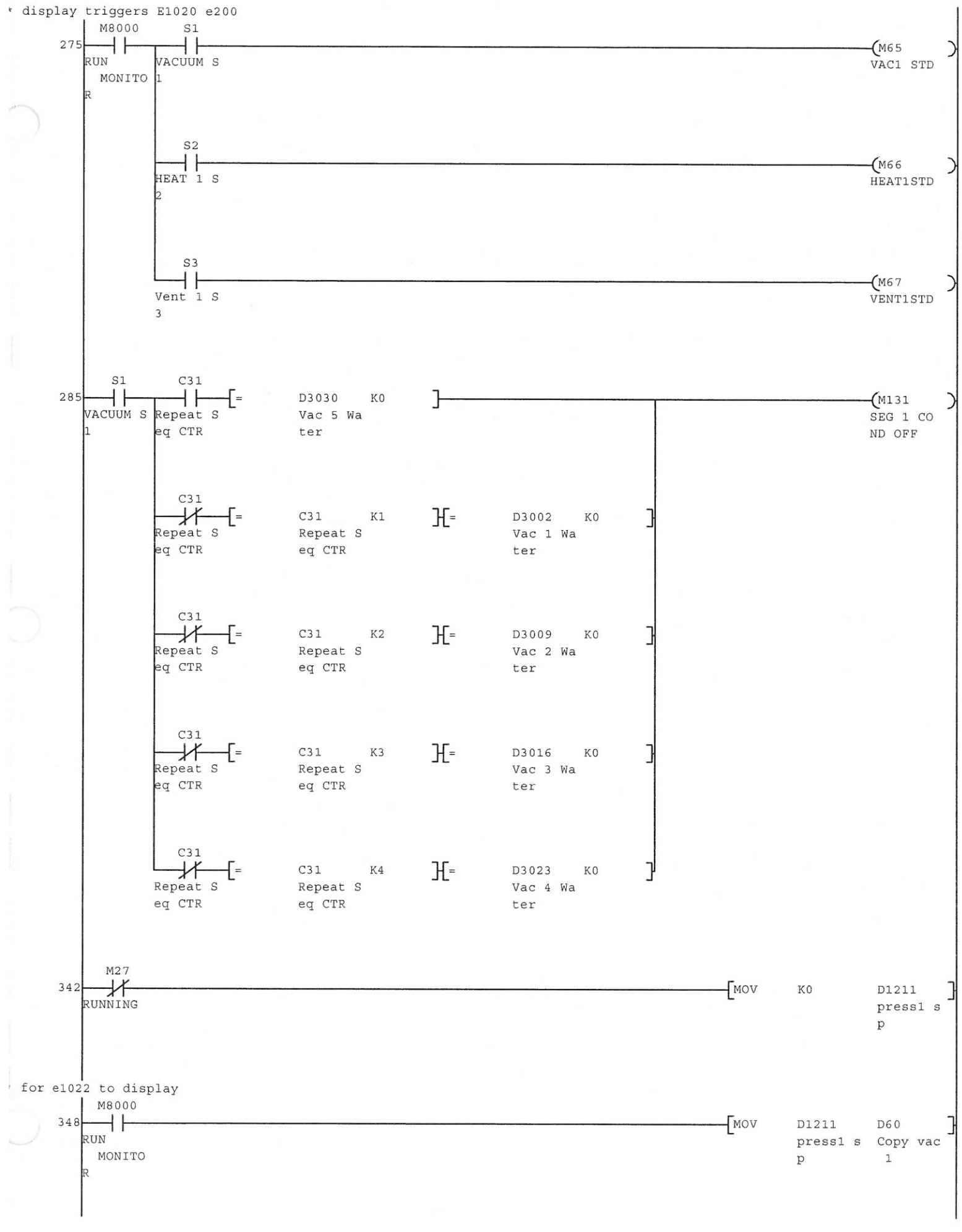

< D448 K-5 trim off set pres sure
MOV K-5 D448 trim off set pres sure
< D11 K0 SCALED P SI
INC D448 trim off set pres sure
> D448 K5 trim off set pres sure
MOV K5 D448 trim off set pres sure
SETUP TC INPUT CH 1 J 2 K 3 J 4 J H1101 New trim routine
M8002
112
INITIAL PULSE
TO K0 K0 H1101 K1
MOV K0 D448 trim off set pres sure
Check the Tc module is OK
T3
127
power up delay
FROM K0 K30 D4 Tc err c heck K1
= D4 Tc err c heck K2030
SET M1 TC Modul e OK
M8000
143
RUN MONITOR
K100
T3 power up delay
use buffer mem. 29 to detect 24v or hardware failure and setting m4
TC Module
* <use buffer mem. 29 to detect >
M8000
147
RUN MONITOR
FROM K0 K29 K4M10 Error St atus TC input K1

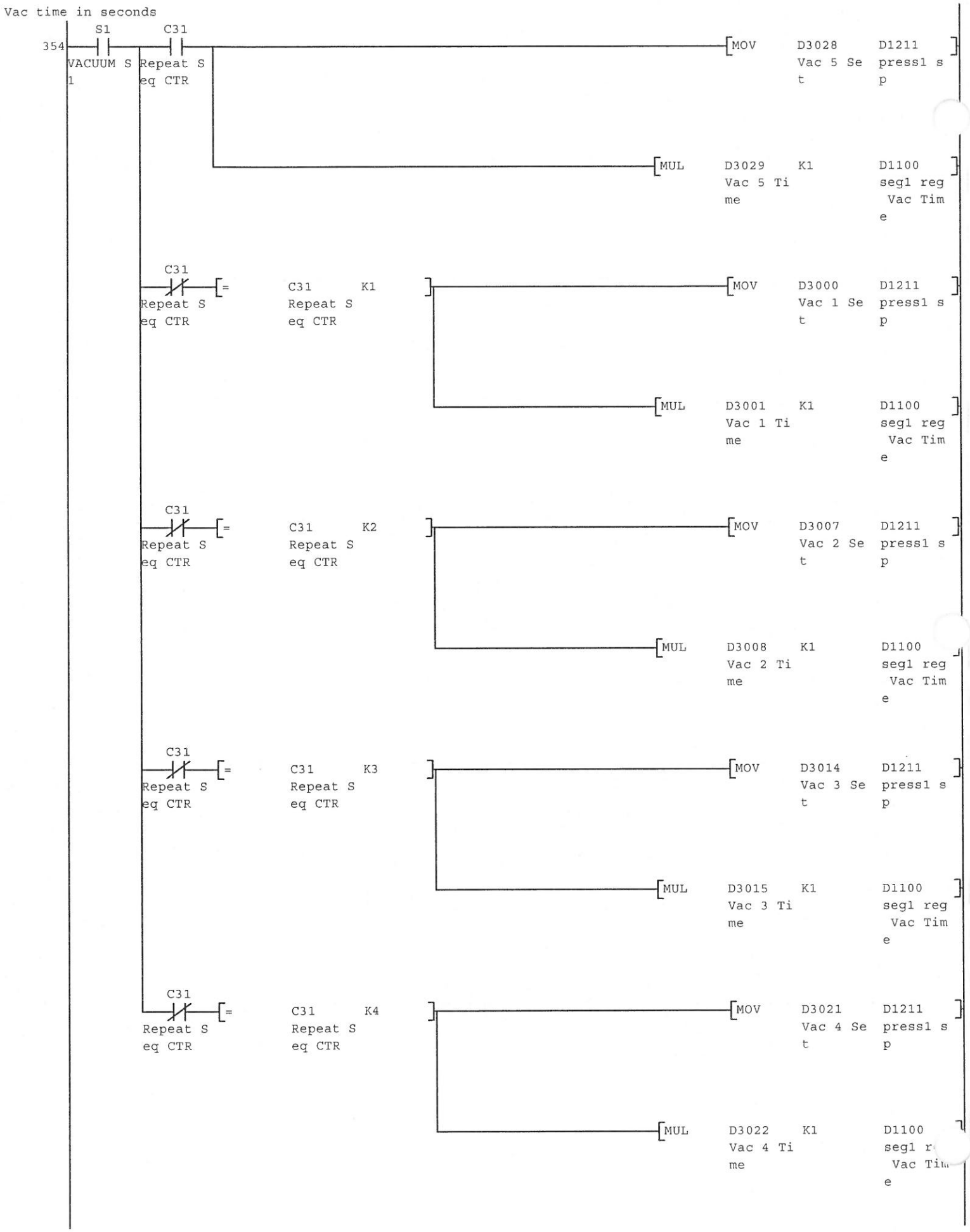

M10
Error St atus TC input
M12
POWER FA IL
M13
HARDWARE ERROR
M4
TC MODUL E ERROR
monitor thermocouple disconnection all 4 channels
M8000
162
RUN MONITO R
FROM K0 K28 K4M150 K1
M151
ch1
M5
tc monit or
M153
ch2
M3
TRANSDUC ER
M155
ch3
M6
tc Conde nser
M157
ch4
M7
tc BinPr obe
M1
M5
184
TC Modul e OK
tc monit or
MOV K0 D1184
Analog 1 Heat ou t
M3
TRANSDUC ER
MOV K999 D11
SCALED P SI

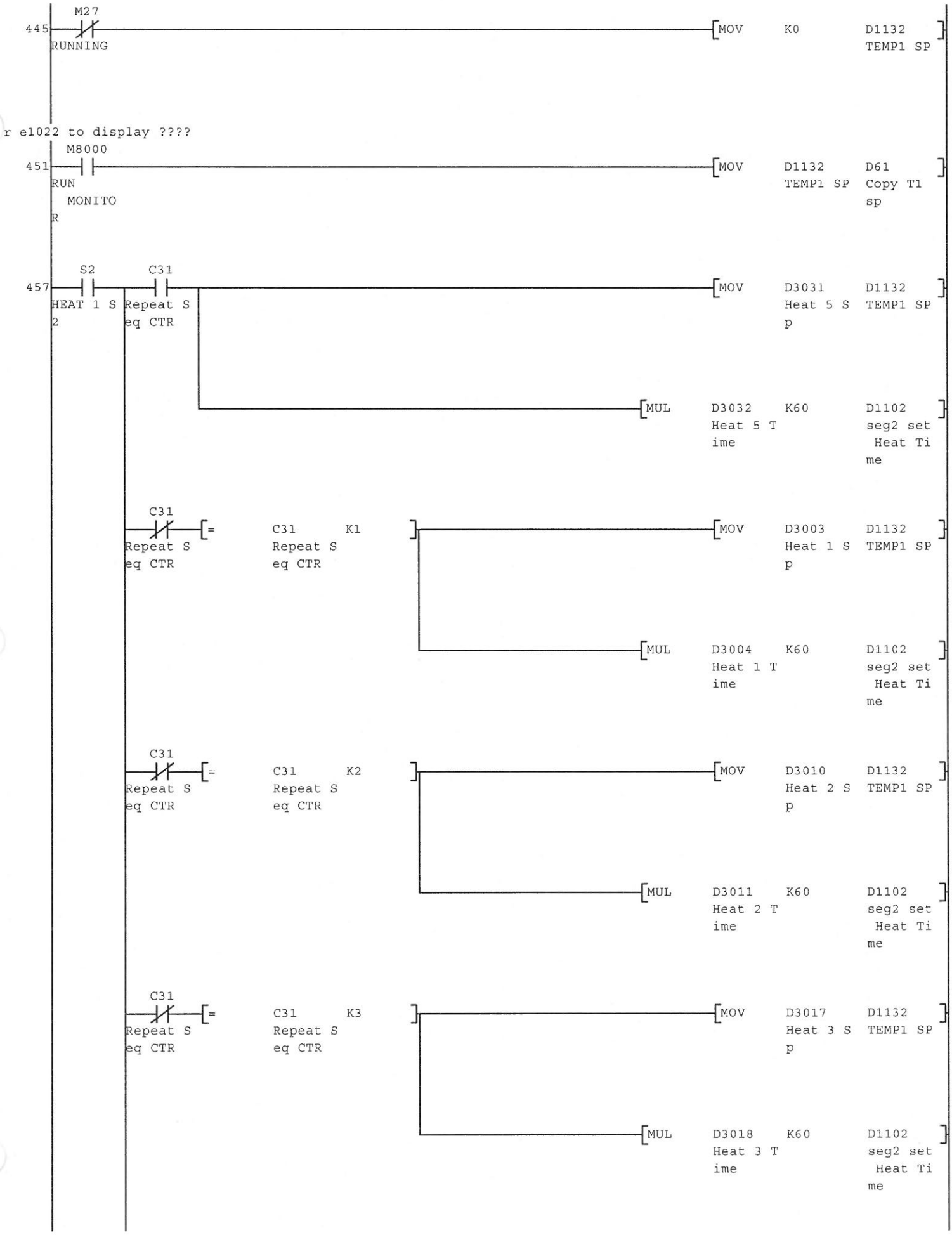
TEMPERATURE Set number of samples to 2
Get the present temperature into D0 d1 d2 d3

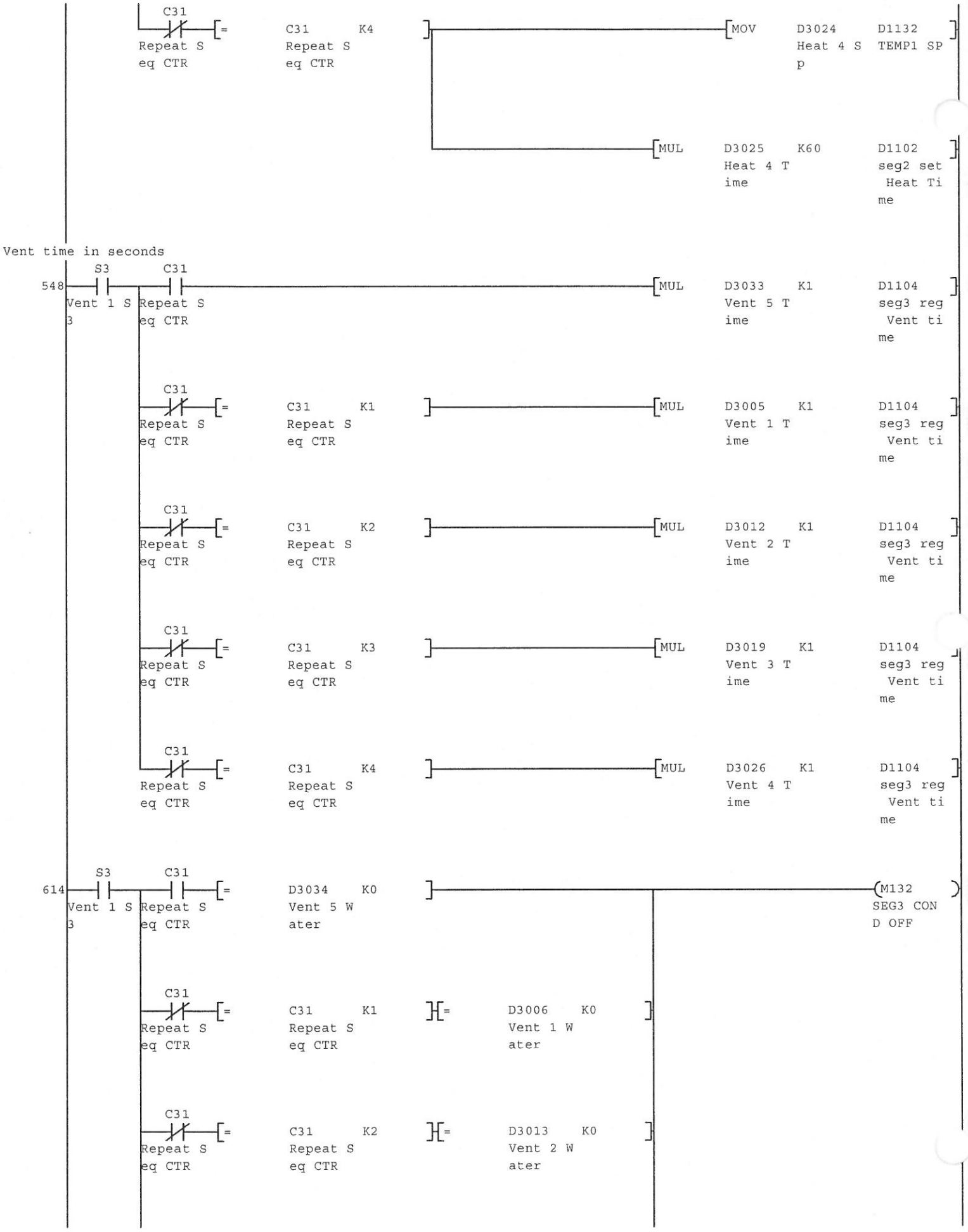


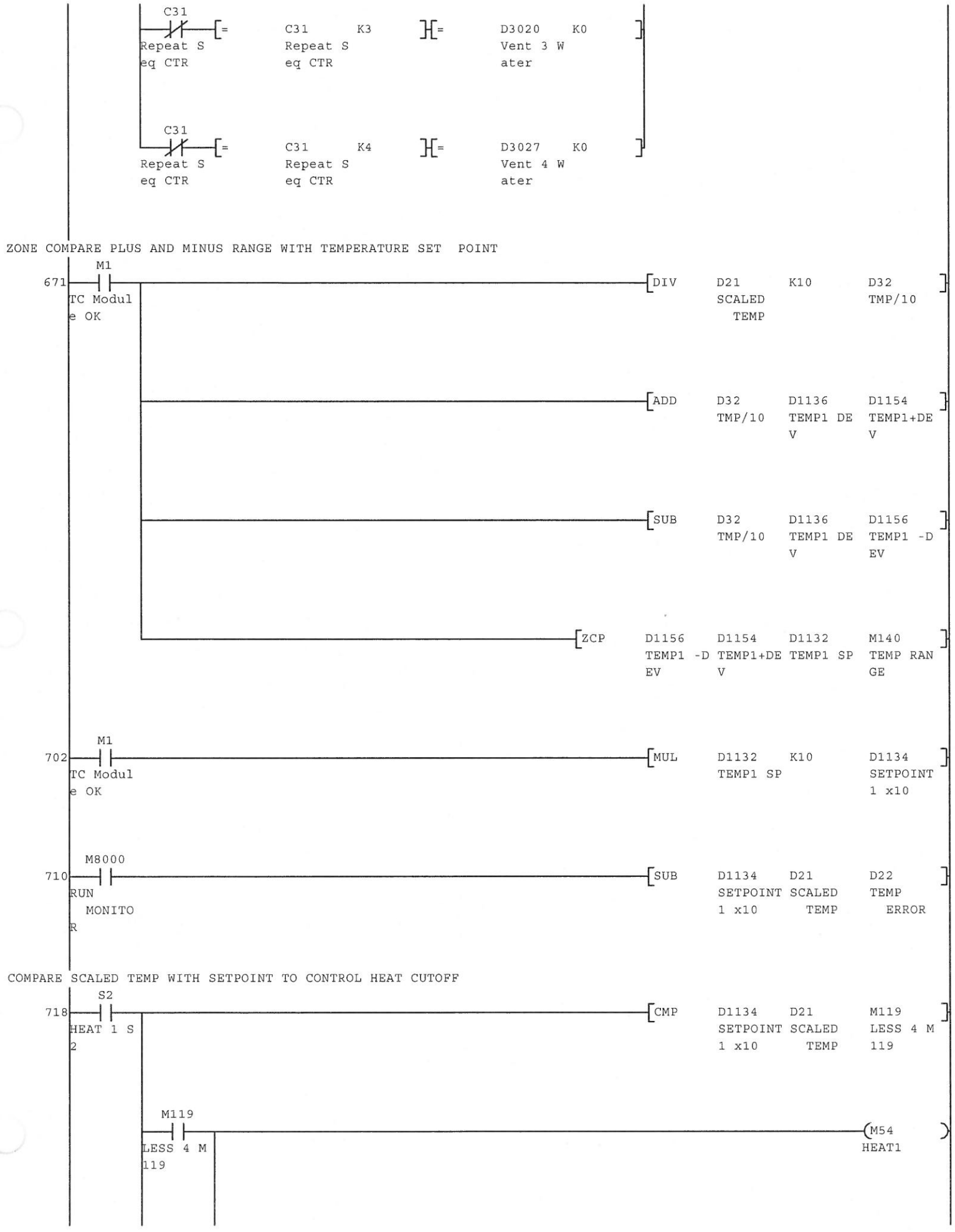
For degree 'C display

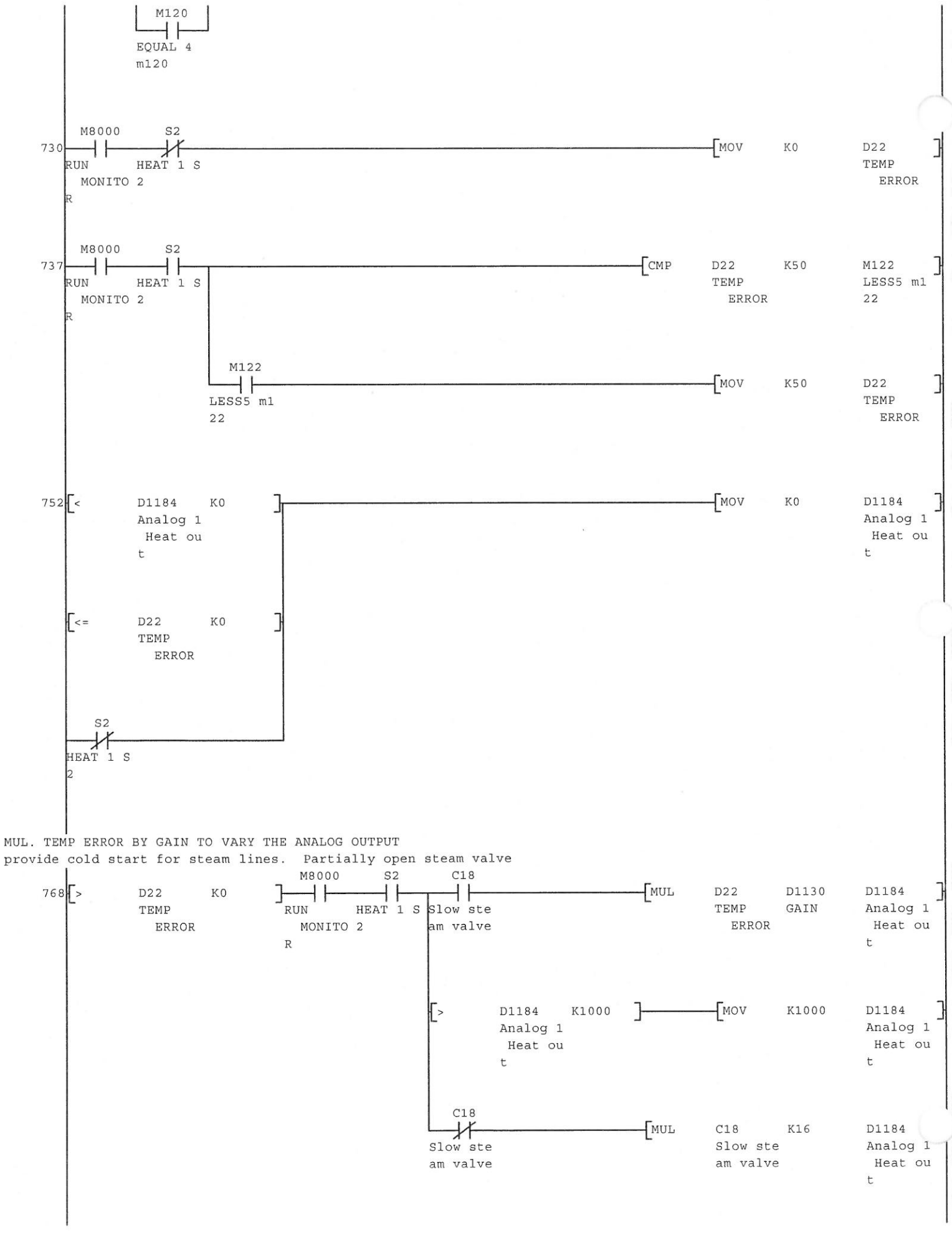

* display triggers E1020 e200
275
M8000
RUN MONITOR
S1
VACUUM S 1
M65
VAC1 STD
S2
HEAT 1 S 2
M66
HEAT1STD
S3
Vent 1 S 3
M67
VENT1STD
285
S1
VACUUM S 1
C31
Repeat S eq CTR
D3030 K0
Vac 5 Water
M131
SEG 1 COND OFF
C31
Repeat S eq CTR
C31 K1
Repeat S eq CTR
D3002 K0
Vac 1 Water
C31
Repeat S eq CTR
C31 K2
Repeat S eq CTR
D3009 K0
Vac 2 Water
C31
Repeat S eq CTR
C31 K3
Repeat S eq CTR
D3016 K0
Vac 3 Water
C31
Repeat S eq CTR
C31 K4
Repeat S eq CTR
D3023 K0
Vac 4 Water
342
M27
RUNNING
MOV K0 D1211
press1 s p
* for e1022 to display
348
M8000
RUN MONITOR
MOV D1211 press1 s p D60 Copy vac 1

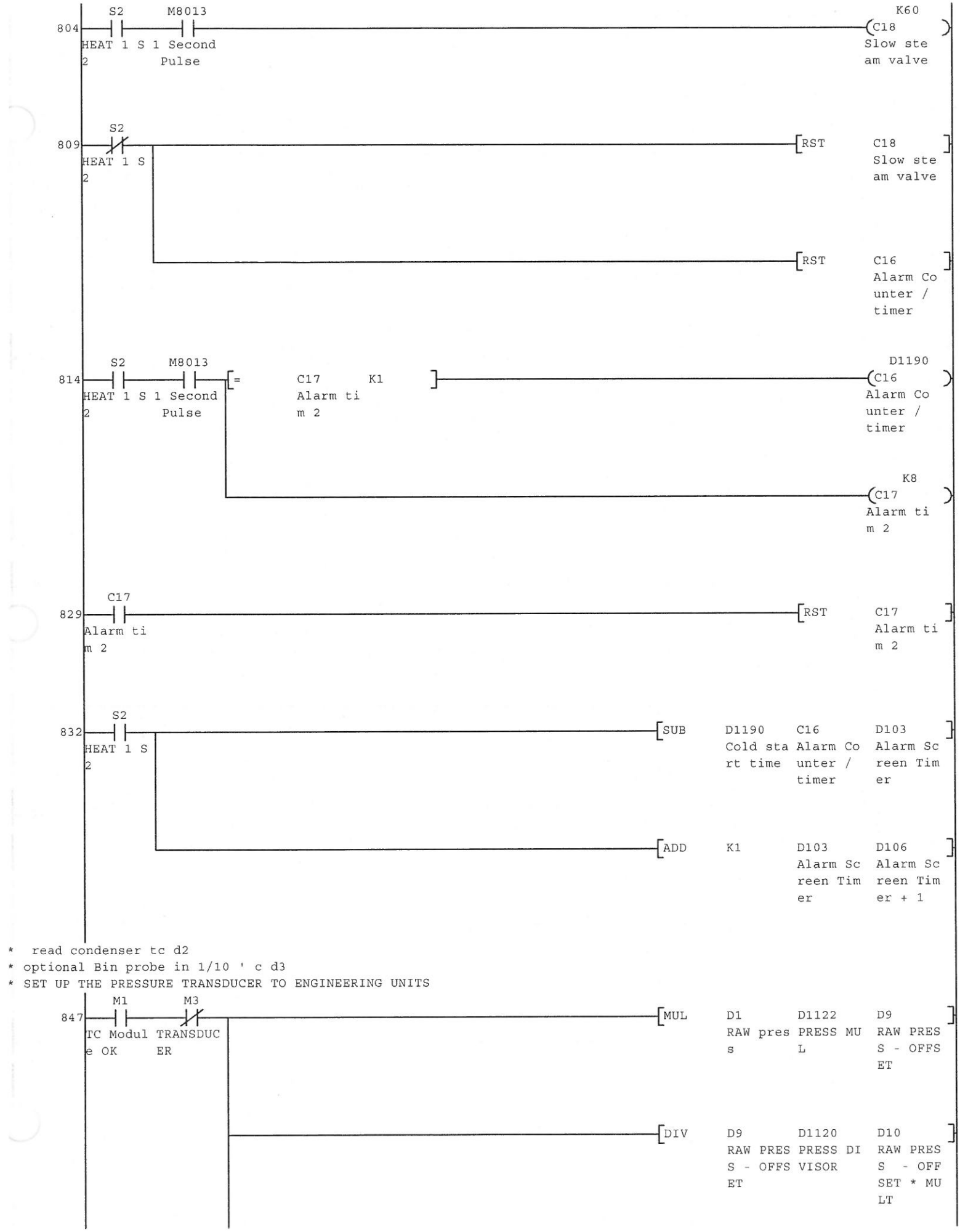

Vac time in seconds
354
S1
VACUUM S 1
C31
Repeat S eq CTR
MOV D3028 Vac 5 Set D1211 press1 sp
MUL D3029 Vac 5 Time K1 D1100 seg1 reg Vac Time
C31
Repeat S eq CTR
= C31 Repeat S eq CTR K1
MOV D3000 Vac 1 Set D1211 press1 sp
MUL D3001 Vac 1 Time K1 D1100 seg1 reg Vac Time
C31
Repeat S eq CTR
= C31 Repeat S eq CTR K2
MOV D3007 Vac 2 Set D1211 press1 sp
MUL D3008 Vac 2 Time K1 D1100 seg1 reg Vac Time
C31
Repeat S eq CTR
= C31 Repeat S eq CTR K3
MOV D3014 Vac 3 Set D1211 press1 sp
MUL D3015 Vac 3 Time K1 D1100 seg1 reg Vac Time
C31
Repeat S eq CTR
= C31 Repeat S eq CTR K4
MOV D3021 Vac 4 Set D1211 press1 sp
MUL D3022 Vac 4 Time K1 D1100 seg1 r Vac Tim e

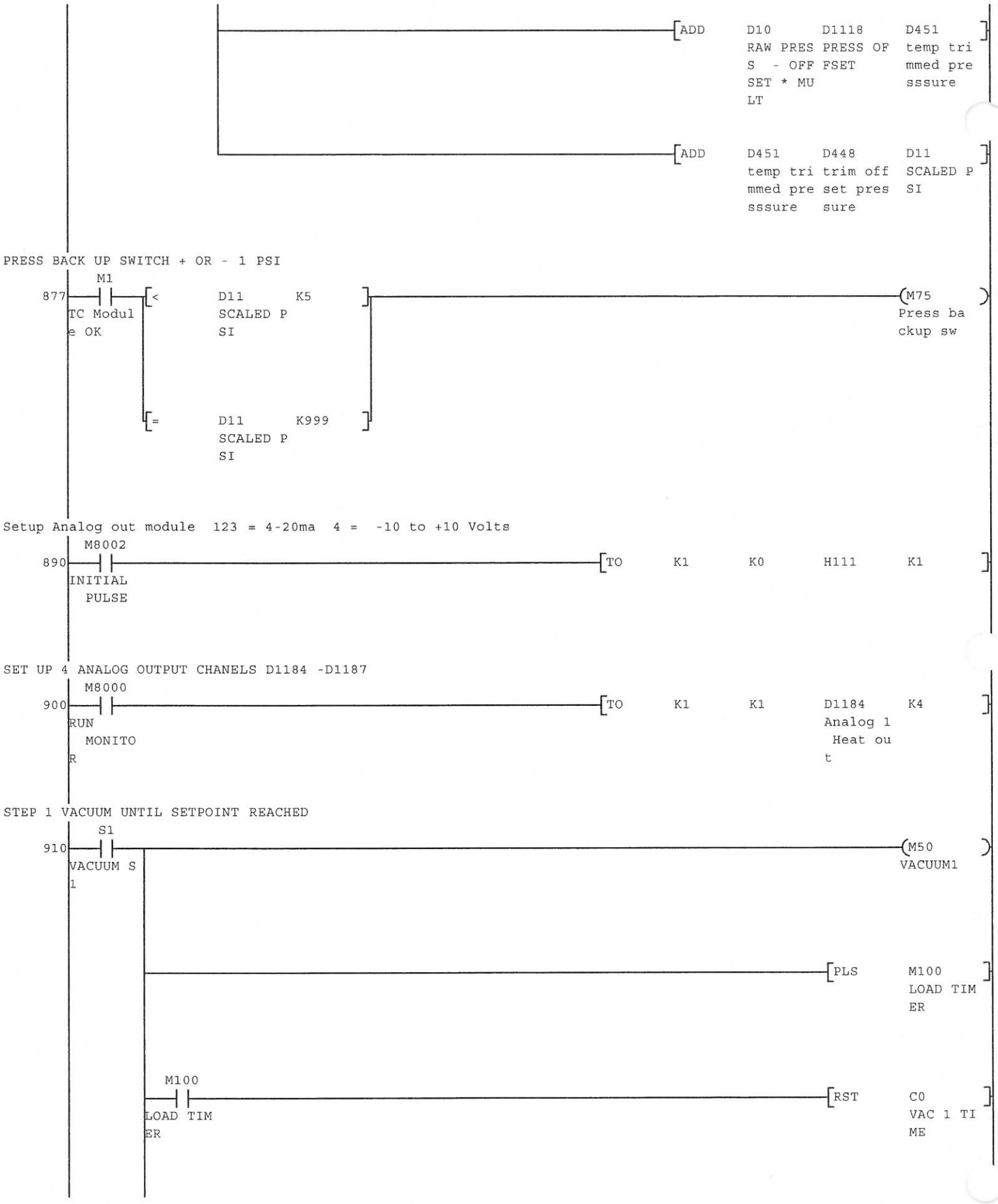

M27
445
RUNNING
MOV K0 D1132 TEMP1 SP
r e1022 to display ????
M8000
451
RUN MONITOR
MOV D1132 TEMP1 SP D61 Copy T1 sp
S2
C31
457
HEAT 1 S 2
Repeat S eq CTR
MOV D3031 Heat 5 S p D1132 TEMP1 SP
MUL D3032 Heat 5 Time K60 D1102 seg2 set Heat Time
C31
Repeat S eq CTR
= C31 Repeat S eq CTR K1
MOV D3003 Heat 1 S p D1132 TEMP1 SP
MUL D3004 Heat 1 Time K60 D1102 seg2 set Heat Time
C31
Repeat S eq CTR
= C31 Repeat S eq CTR K2
MOV D3010 Heat 2 S p D1132 TEMP1 SP
MUL D3011 Heat 2 Time K60 D1102 seg2 set Heat Time
C31
Repeat S eq CTR
= C31 Repeat S eq CTR K3
MOV D3017 Heat 3 S p D1132 TEMP1 SP
MUL D3018 Heat 3 Time K60 D1102 seg2 set Heat Time

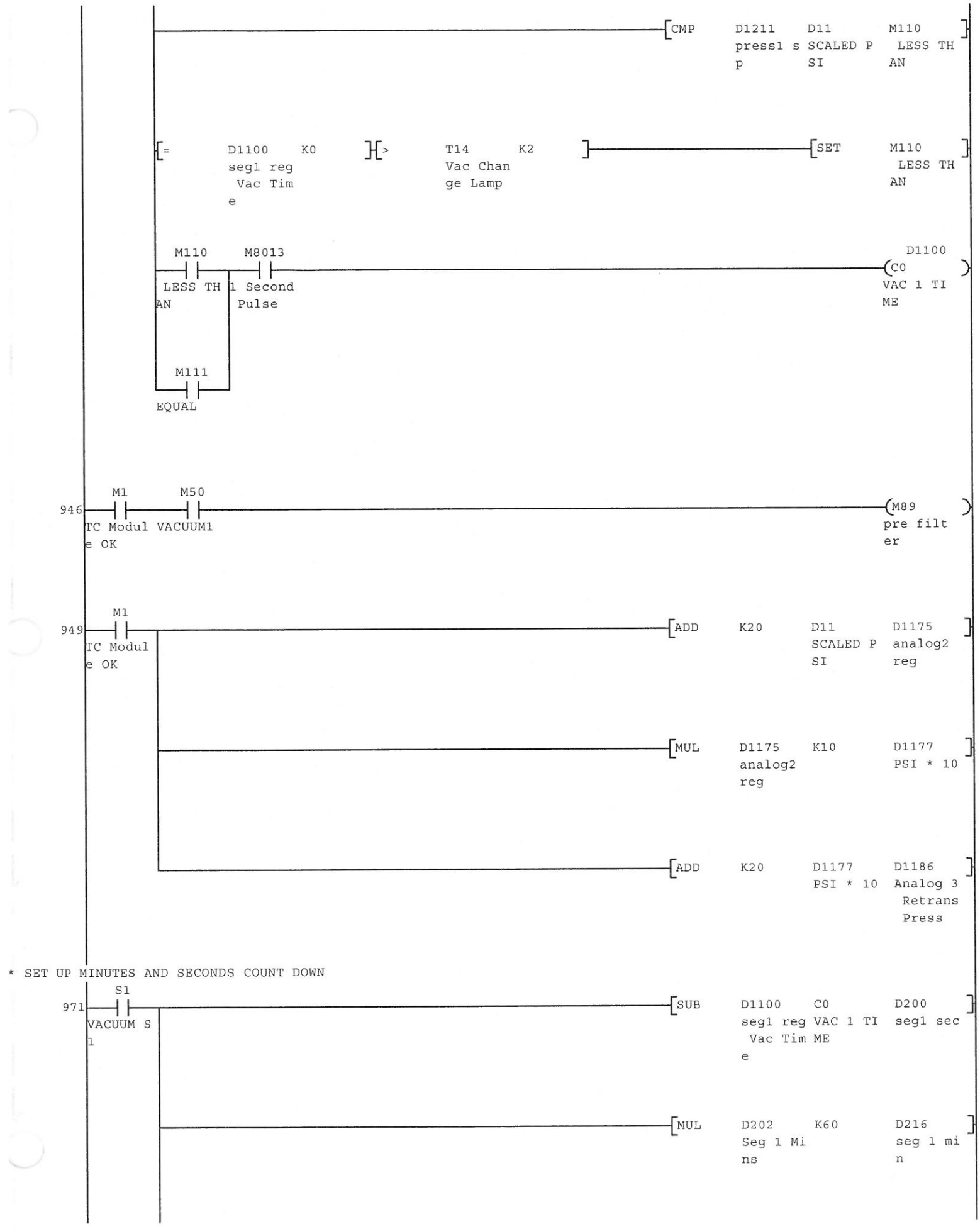

C31
Repeat S eq CTR
=
C31 K4
Repeat S eq CTR
MOV D3024 Heat 4 Sp D1132 TEMP1 SP
MUL D3025 Heat 4 Time K60 D1102 seg2 set Heat Time
Vent time in seconds
548
S3
Vent 1 S3
C31
Repeat S eq CTR
MUL D3033 Vent 5 Time K1 D1104 seg3 reg Vent time
C31
Repeat S eq CTR
=
C31 K1
Repeat S eq CTR
MUL D3005 Vent 1 Time K1 D1104 seg3 reg Vent time
C31
Repeat S eq CTR
=
C31 K2
Repeat S eq CTR
MUL D3012 Vent 2 Time K1 D1104 seg3 reg Vent time
C31
Repeat S eq CTR
=
C31 K3
Repeat S eq CTR
MUL D3019 Vent 3 Time K1 D1104 seg3 reg Vent time
C31
Repeat S eq CTR
=
C31 K4
Repeat S eq CTR
MUL D3026 Vent 4 Time K1 D1104 seg3 reg Vent time
614
S3
Vent 1 S3
C31
Repeat S eq CTR
=
D3034 Vent 5 Water K0
M132 SEG3 COND OFF
C31
Repeat S eq CTR
=
C31 K1
Repeat S eq CTR
=
D3006 Vent 1 Water K0
C31
Repeat S eq CTR
=
C31 K2
Repeat S eq CTR
=
D3013 Vent 2 Water K0

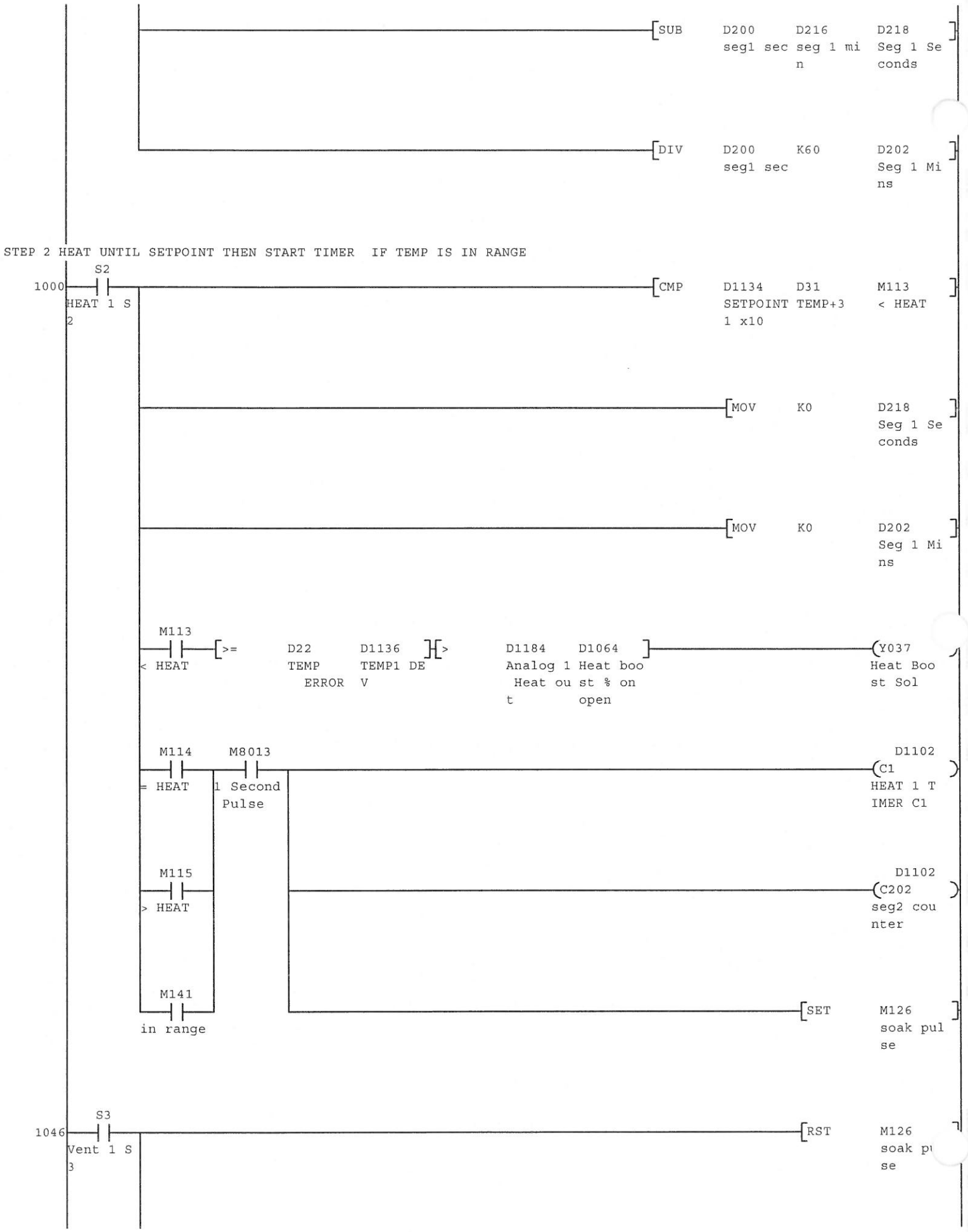

C31
Repeat S
eq CTR
=
C31
Repeat S
eq CTR
K3
=
D3020
Vent 3 W
ater
K0
C31
Repeat S
eq CTR
=
C31
Repeat S
eq CTR
K4
=
D3027
Vent 4 W
ater
K0
ZONE COMPARE PLUS AND MINUS RANGE WITH TEMPERATURE SET POINT
671
M1
TC Modul
e OK
DIV
D21
SCALED
TEMP
K10
D32
TMP/10
ADD
D32
TMP/10
D1136
TEMP1 DE
V
D1154
TEMP1+DE
V
SUB
D32
TMP/10
D1136
TEMP1 DE
V
D1156
TEMP1 -D
EV
ZCP
D1156
TEMP1 -D
EV
D1154
TEMP1+DE
V
D1132
TEMP1 SP
M140
TEMP RAN
GE
702
M1
TC Modul
e OK
MUL
D1132
TEMP1 SP
K10
D1134
SETPOINT
1 x10
710
M8000
RUN
MONITO
R
SUB
D1134
SETPOINT
1 x10
D21
SCALED
TEMP
D22
TEMP
ERROR
COMPARE SCALED TEMP WITH SETPOINT TO CONTROL HEAT CUTOFF
718
S2
HEAT 1 S
2
CMP
D1134
SETPOINT
1 x10
D21
SCALED
TEMP
M119
LESS 4 M
119
M119
LESS 4 M
119
M54
HEAT1

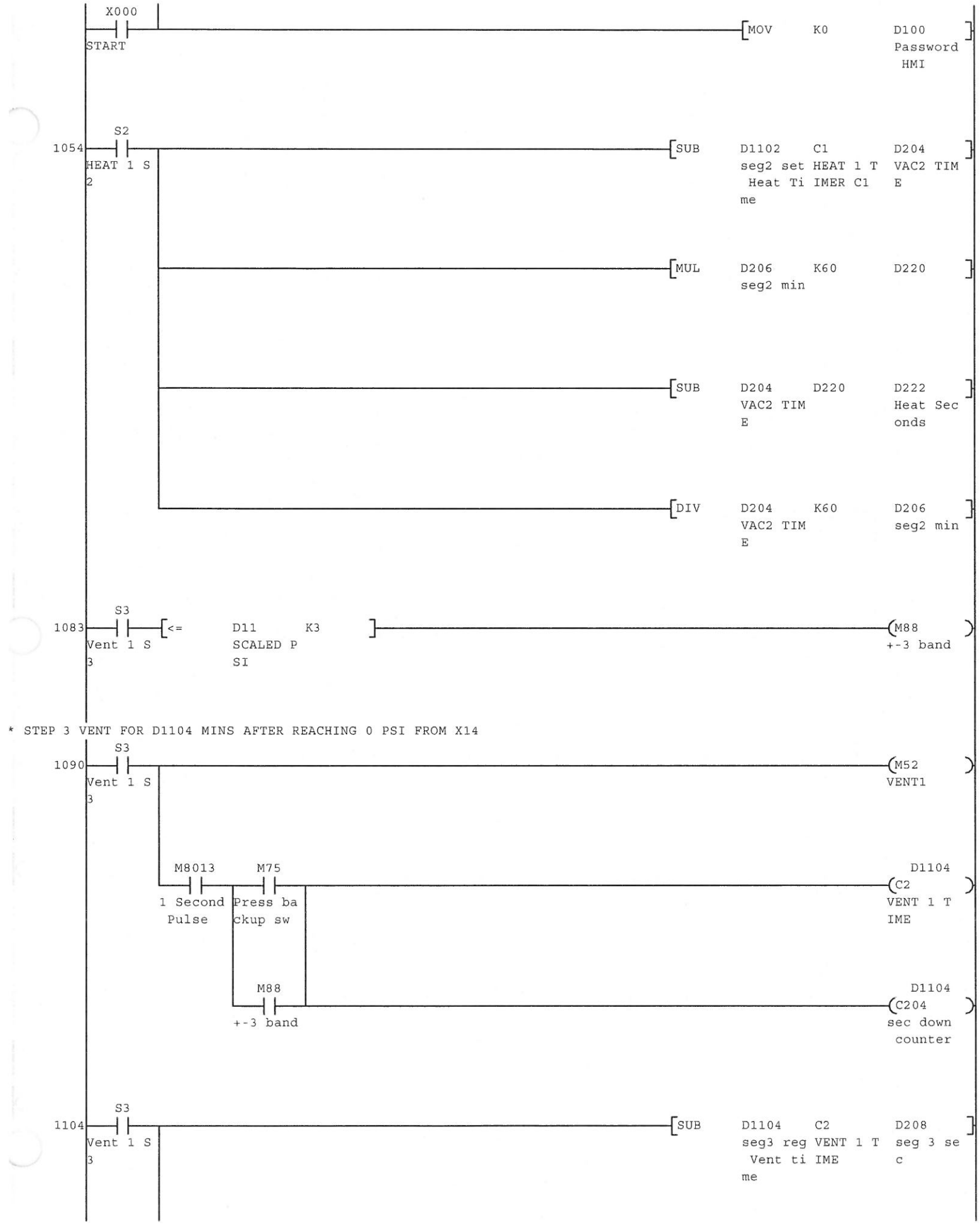

M120
EQUAL 4
m120
730
M8000
RUN
MONITO 2
R
S2
HEAT 1 S
MOV K0 D22 TEMP ERROR
737
M8000
RUN
MONITO 2
R
S2
HEAT 1 S
CMP D22 TEMP ERROR K50 M122 LESS5 m1 22
M122
LESS5 m1
22
MOV K50 D22 TEMP ERROR
752
< D1184 Analog 1 Heat ou t K0
MOV K0 D1184 Analog 1 Heat ou t
<= D22 TEMP ERROR K0
S2
HEAT 1 S
2
MUL. TEMP ERROR BY GAIN TO VARY THE ANALOG OUTPUT
provide cold start for steam lines. Partially open steam valve
768
> D22 TEMP ERROR K0
M8000
RUN
MONITO 2
R
S2
HEAT 1 S
C18
Slow ste am valve
MUL D22 TEMP ERROR D1130 GAIN D1184 Analog 1 Heat ou t
> D1184 Analog 1 Heat ou t K1000
MOV K1000 D1184 Analog 1 Heat ou t
C18
Slow ste am valve
MUL C18 Slow ste am valve K16 D1184 Analog 1 Heat ou t

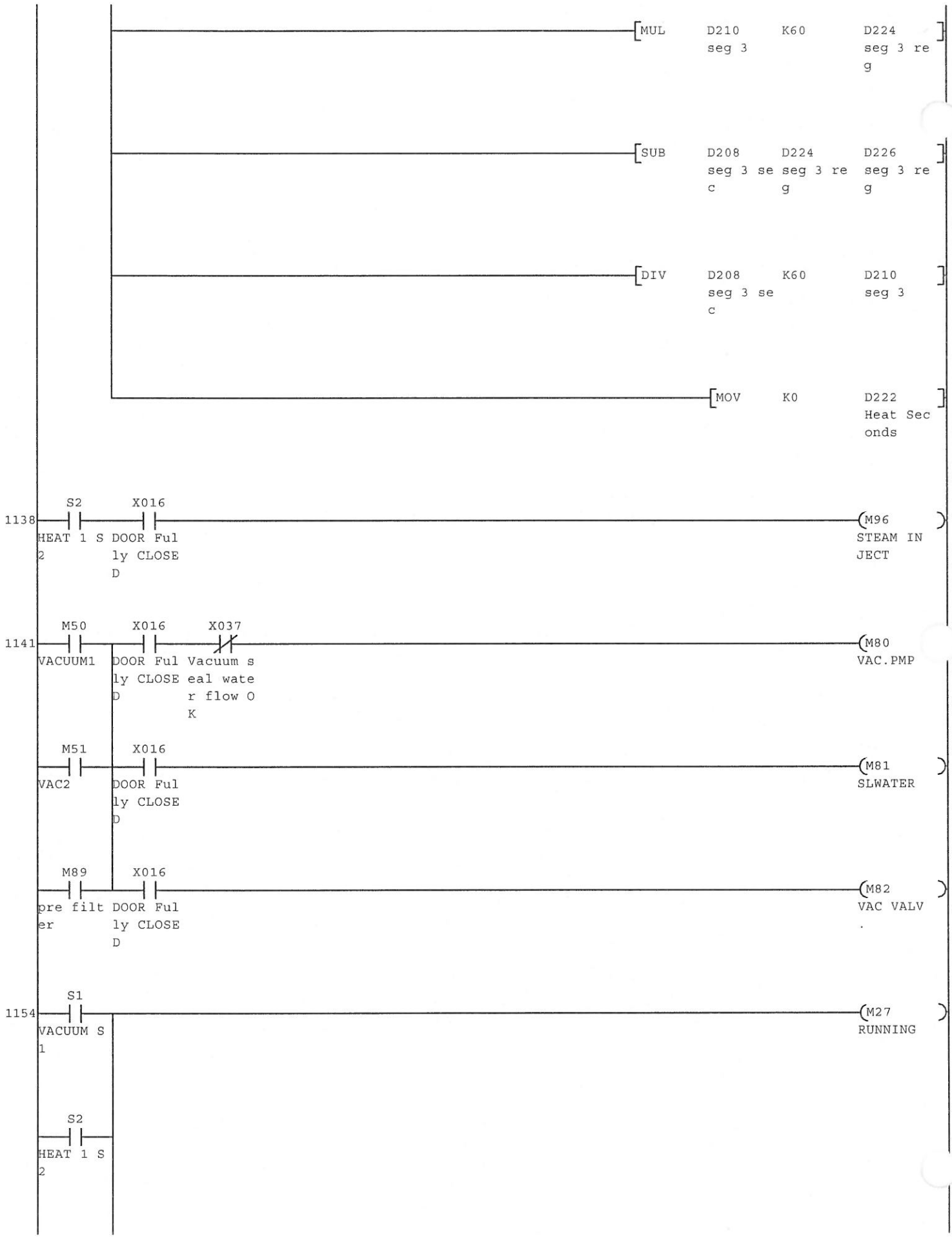

804
S2
HEAT 1 S 2
M8013
1 Second Pulse
K60
C18
Slow steam valve
809
S2
HEAT 1 S 2
RST
C18
Slow steam valve
RST
C16
Alarm Counter / timer
814
S2
HEAT 1 S 2
M8013
1 Second Pulse
=
C17
Alarm tim 2
K1
D1190
C16
Alarm Counter / timer
K8
C17
Alarm tim 2
829
C17
Alarm tim 2
RST
C17
Alarm tim 2
832
S2
HEAT 1 S 2
SUB
D1190
Cold start time
C16
Alarm Counter / timer
D103
Alarm Screen Timer
ADD
K1
D103
Alarm Screen Timer
D106
Alarm Screen Timer + 1
* read condenser tc d2
* optional Bin probe in 1/10 ' c d3
* SET UP THE PRESSURE TRANSDUCER TO ENGINEERING UNITS
847
M1
TC Module OK
M3
TRANSDUCER
MUL
D1
RAW press
D1122
PRESS MUL
D9
RAW PRESS - OFFSET
DIV
D9
RAW PRESS - OFFSET
D1120
PRESS DIVISOR
D10
RAW PRESS - OFFSET * MULT

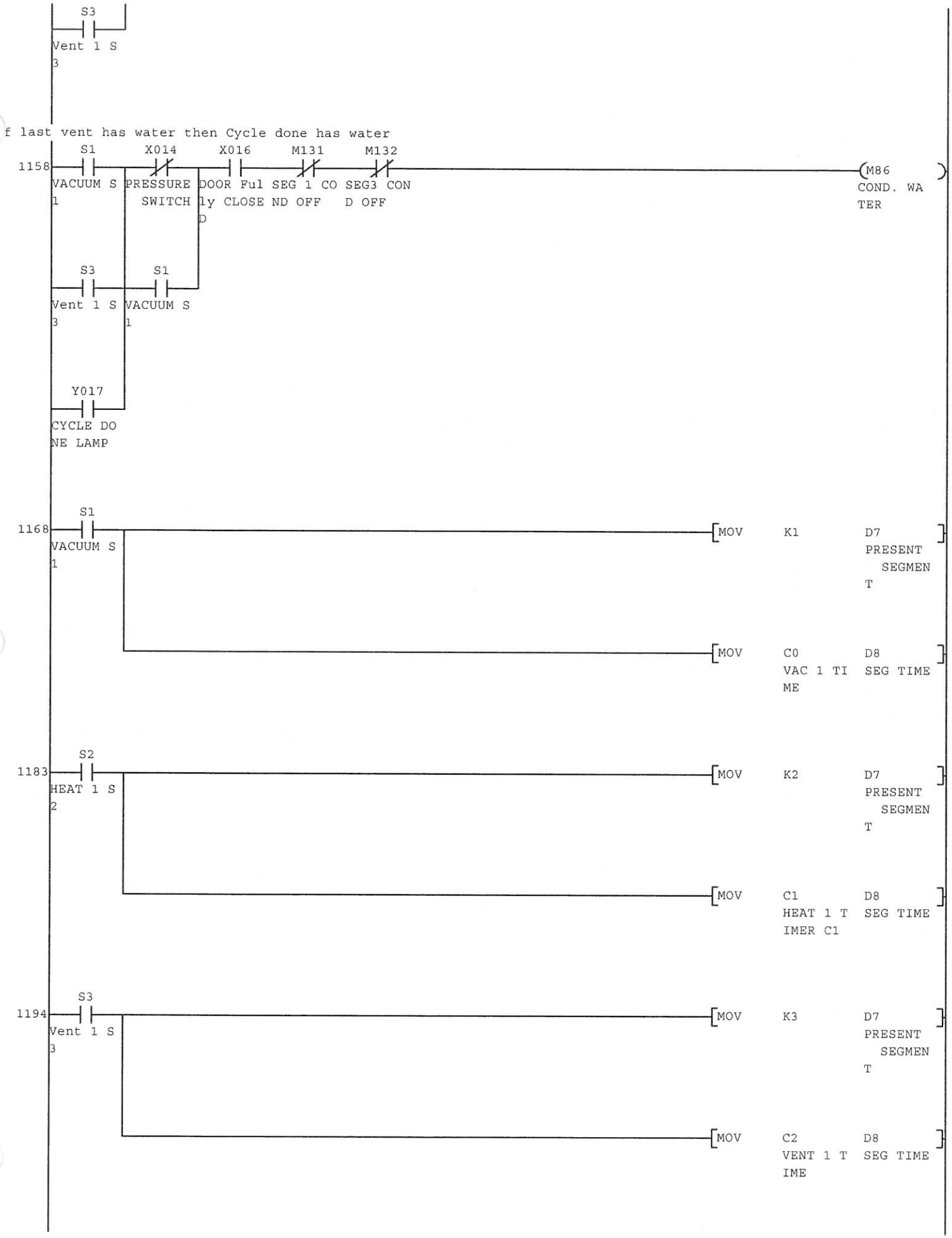

ADD D10 RAW PRES S - OFF SET * MU LT D1118 PRESS OF FSET D451 temp tri mmed pre sssure
ADD D451 temp tri mmed pre sssure D448 trim off set pres sure D11 SCALED P SI
PRESS BACK UP SWITCH + OR - 1 PSI
M1
877
TC Modul e OK
< D11 SCALED P SI K5
= D11 SCALED P SI K999
M75 Press ba ckup sw
Setup Analog out module 123 = 4-20ma 4 = -10 to +10 Volts
M8002
890
INITIAL PULSE
TO K1 K0 H111 K1
SET UP 4 ANALOG OUTPUT CHANELS D1184 -D1187
M8000
900
RUN MONITO R
TO K1 K1 D1184 Analog 1 Heat ou t K4
STEP 1 VACUUM UNTIL SETPOINT REACHED
S1
910
VACUUM S 1
M50 VACUUM1
PLS M100 LOAD TIM ER
M100
LOAD TIM ER
RST C0 VAC 1 TI ME

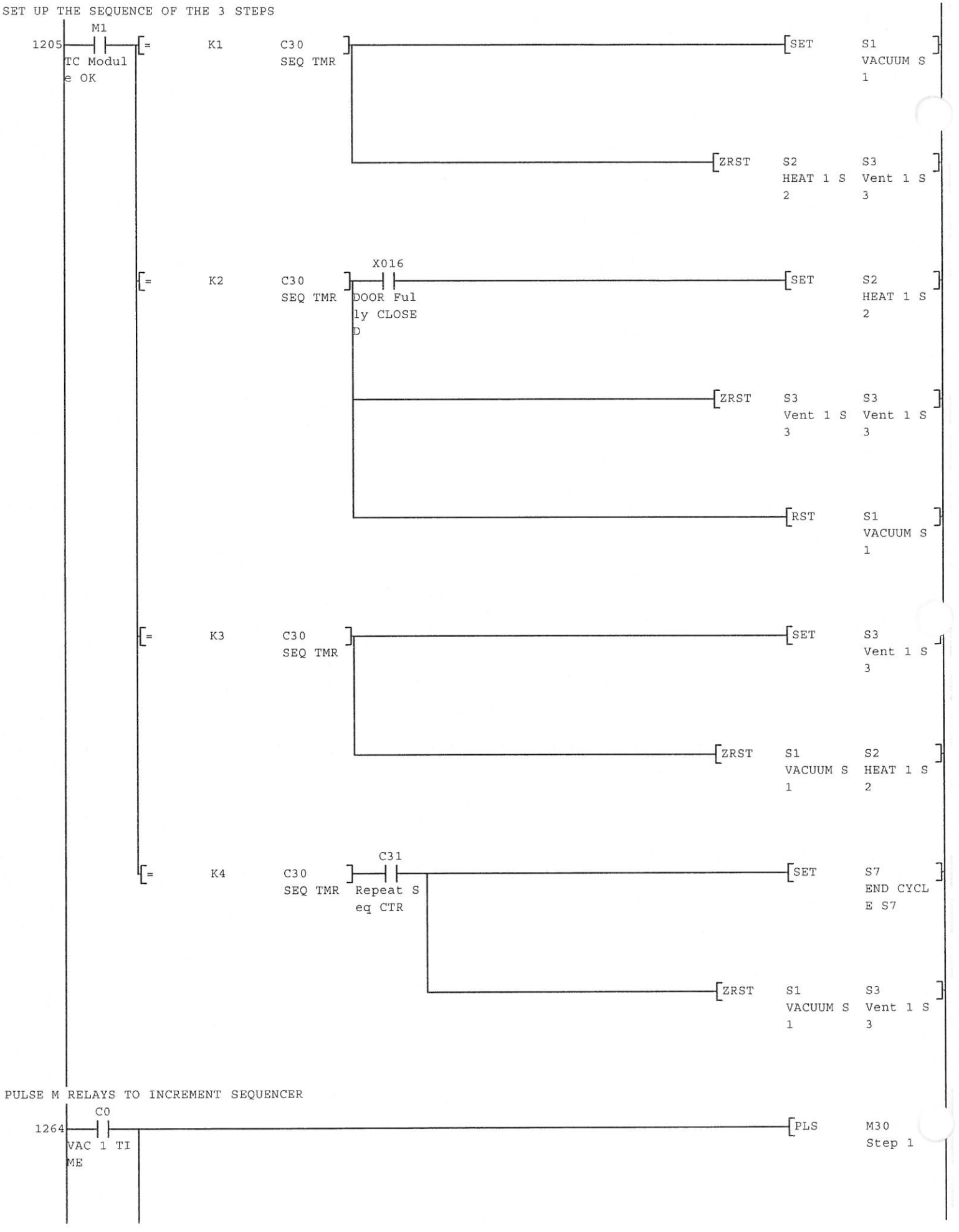

CMP D1211 press1 s p D11 SCALED P SI M110 LESS TH AN
= D1100 seg1 reg Vac Tim e K0
> T14 Vac Chan ge Lamp K2
SET M110 LESS TH AN
M110 LESS TH AN
M8013 1 Second Pulse
M111 EQUAL
D1100 C0 VAC 1 TI ME
946
M1 TC Modul e OK
M50 VACUUM1
M89 pre filt er
949
M1 TC Modul e OK
ADD K20 D11 SCALED P SI D1175 analog2 reg
MUL D1175 analog2 reg K10 D1177 PSI * 10
ADD K20 D1177 PSI * 10 D1186 Analog 3 Retrans Press
* SET UP MINUTES AND SECONDS COUNT DOWN
971
S1 VACUUM S 1
SUB D1100 seg1 reg Vac Tim e C0 VAC 1 TI ME D200 seg1 sec
MUL D202 Seg 1 Mi ns K60 D216 seg 1 mi n

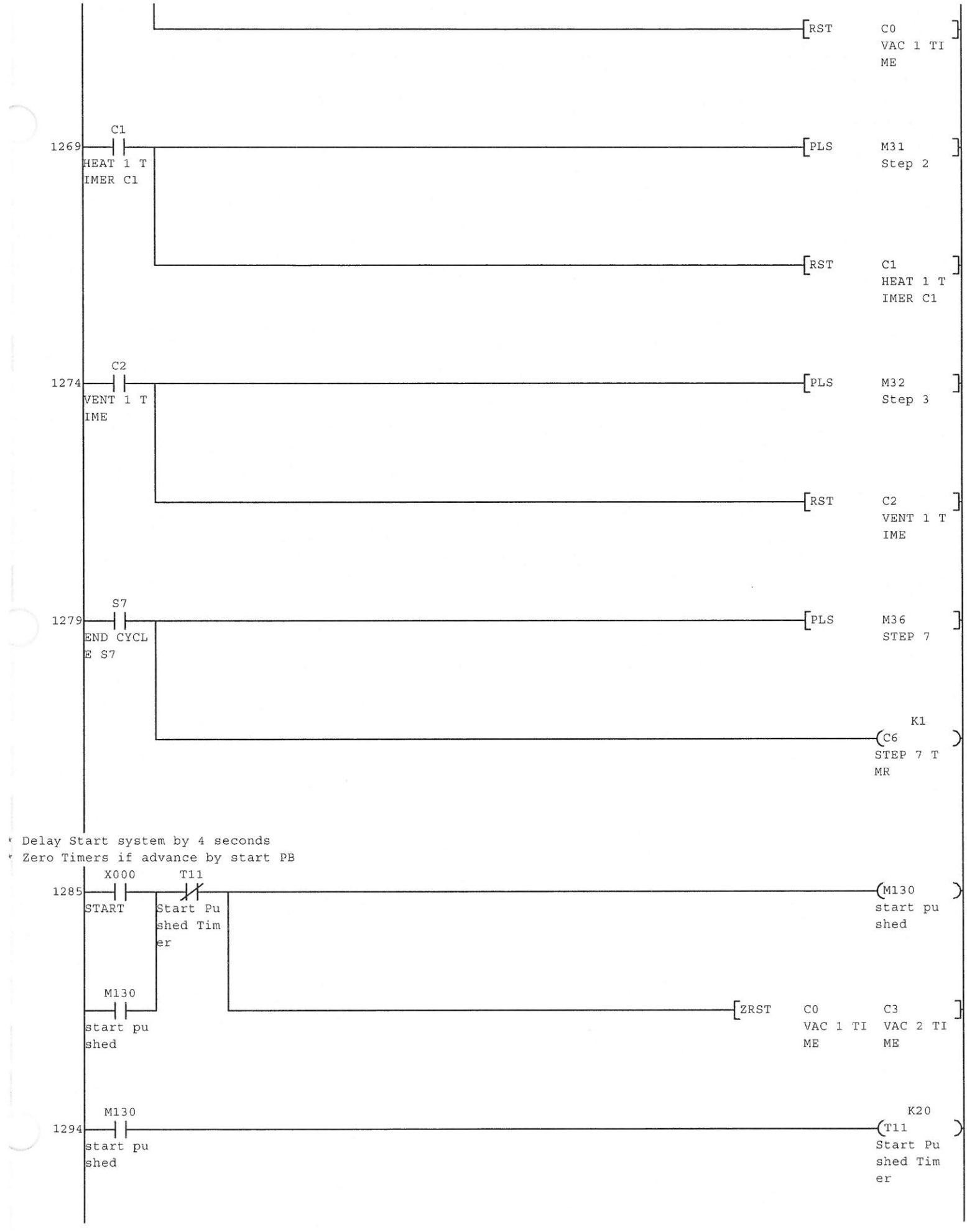

SUB D200 seg1 sec D216 seg 1 min D218 Seg 1 Seconds
DIV D200 seg1 sec K60 D202 Seg 1 Mins
STEP 2 HEAT UNTIL SETPOINT THEN START TIMER IF TEMP IS IN RANGE
1000
S2
HEAT 1 S 2
CMP D1134 SETPOINT 1 x10 D31 TEMP+3 M113 < HEAT
MOV K0 D218 Seg 1 Seconds
MOV K0 D202 Seg 1 Mins
M113
< HEAT
>= D22 TEMP ERROR D1136 TEMP1 DEV
> D1184 Analog 1 Heat out D1064 Heat boost % on open
Y037 Heat Boost Sol
M114
= HEAT
M8013
1 Second Pulse
D1102 C1 HEAT 1 TIMER C1
M115
> HEAT
D1102 C202 seg2 counter
M141
in range
SET M126 soak pulse
1046
S3
Vent 1 S 3
RST M126 soak pulse

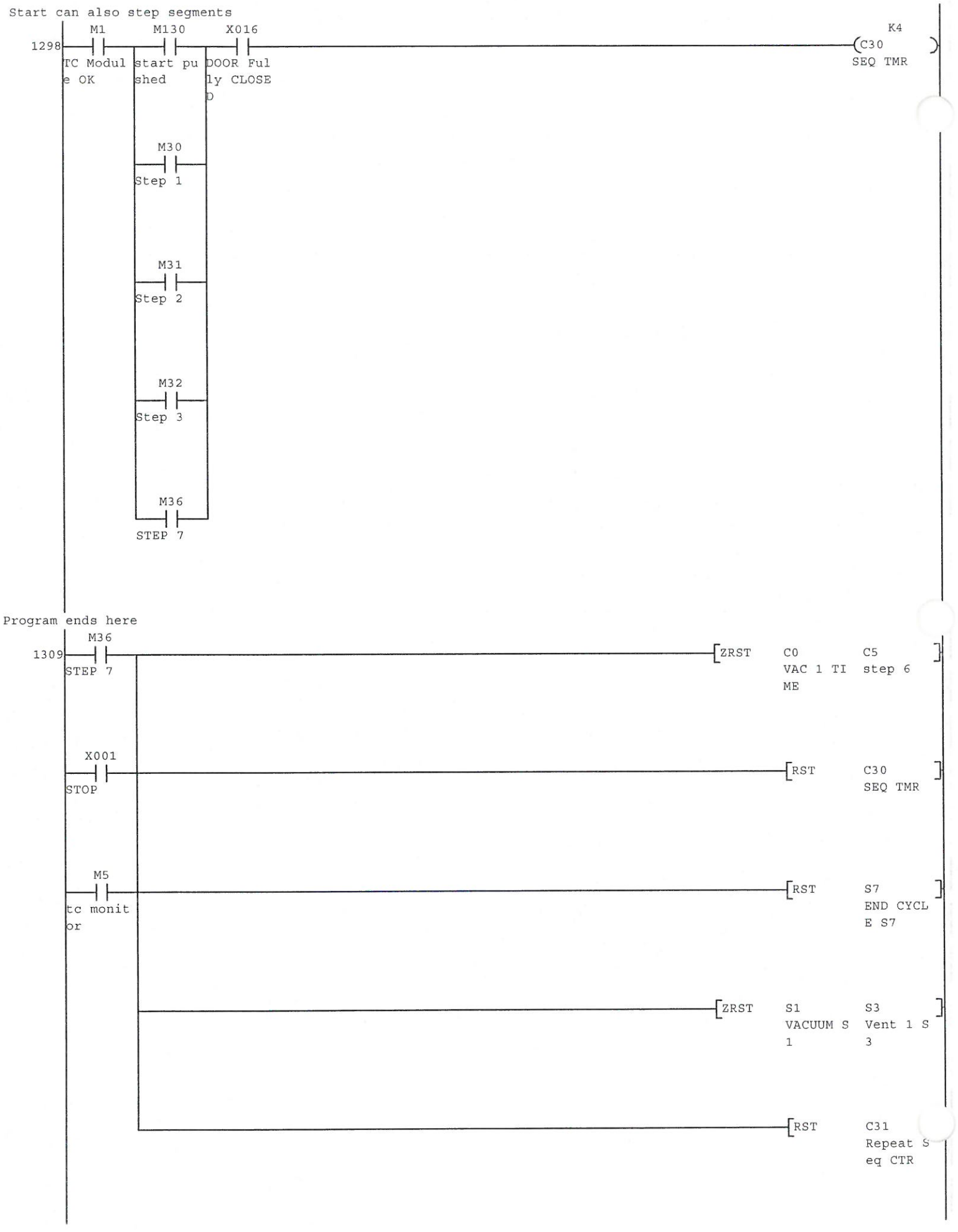

X000
START
MOV K0 D100 Password HMI
1054
S2
HEAT 1 S 2
SUB D1102 seg2 set Heat Time C1 HEAT 1 TIMER C1 D204 VAC2 TIME
MUL D206 seg2 min K60 D220
SUB D204 VAC2 TIME D220 D222 Heat Seconds
DIV D204 VAC2 TIME K60 D206 seg2 min
1083
S3
Vent 1 S 3
<= D11 SCALED PSI K3
M88 +-3 band
* STEP 3 VENT FOR D1104 MINS AFTER REACHING 0 PSI FROM X14
1090
S3
Vent 1 S 3
M52 VENT1
M8013 1 Second Pulse
M75 Press backup sw
D1104 C2 VENT 1 TIME
M88 +-3 band
D1104 C204 sec down counter
1104
S3
Vent 1 S 3
SUB D1104 seg3 reg Vent time C2 VENT 1 TIME D208 seg 3 sec

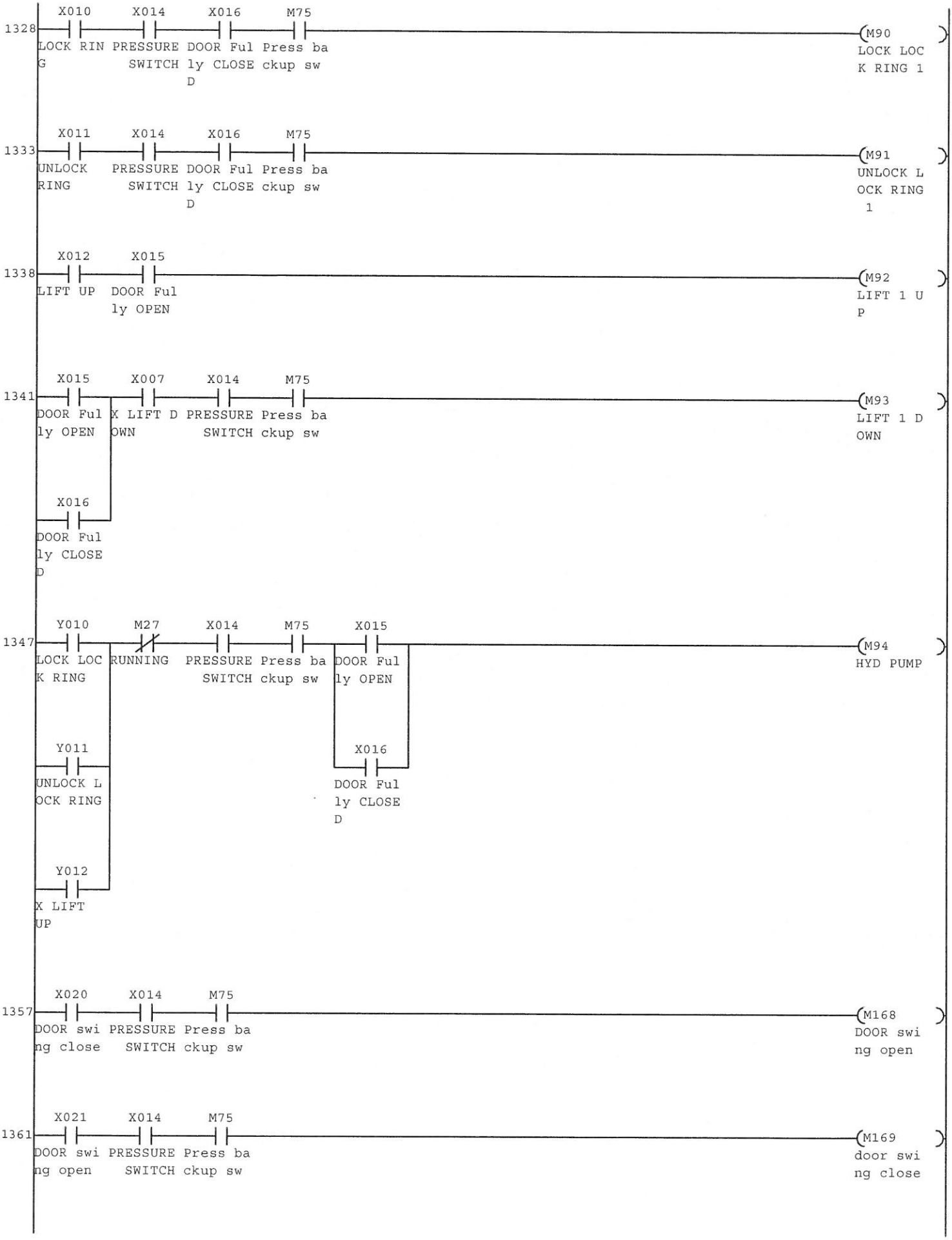

MUL D210 seg 3 K60 D224 seg 3 reg
SUB D208 seg 3 sec D224 seg 3 reg D226 seg 3 reg
DIV D208 seg 3 sec K60 D210 seg 3
MOV K0 D222 Heat Seconds
1138
S2 HEAT 1 S 2
X016 DOOR Fully CLOSED
M96 STEAM INJECT
1141
M50 VACUUM1
X016 DOOR Fully CLOSED
X037 Vacuum seal water flow OK
M80 VAC.PMP
M51 VAC2
X016 DOOR Fully CLOSED
M81 SLWATER
M89 pre filter
X016 DOOR Fully CLOSED
M82 VAC VALV
1154
S1 VACUUM S 1
M27 RUNNING
S2 HEAT 1 S 2

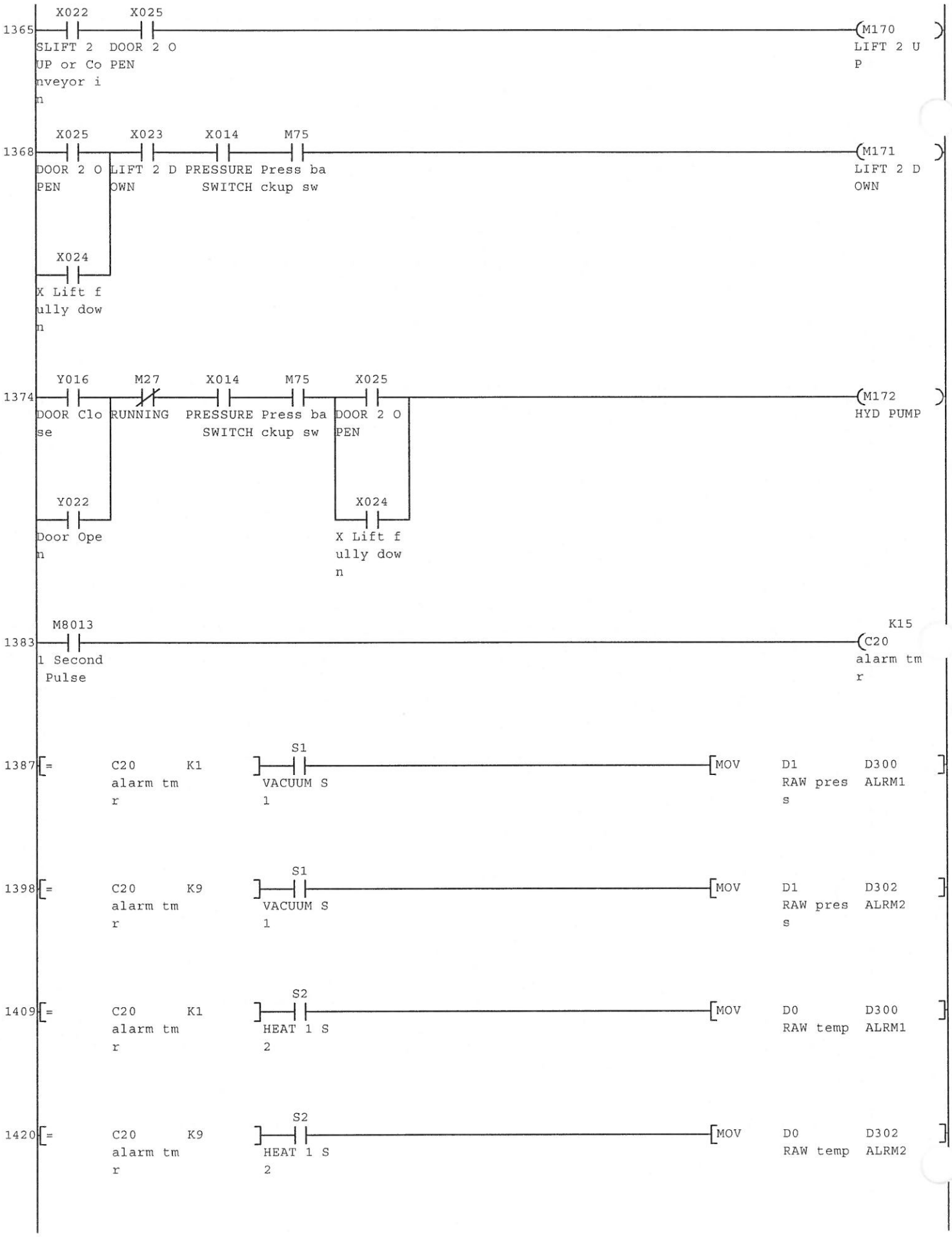

S3
Vent 1 S
3
f last vent has water then Cycle done has water
1158
S1
VACUUM S
1
X014
PRESSURE
SWITCH
X016
DOOR Ful
ly CLOSE
D
M131
SEG 1 CO
ND OFF
M132
SEG3 CON
D OFF
M86
COND. WA
TER
S3
Vent 1 S
3
S1
VACUUM S
1
Y017
CYCLE DO
NE LAMP
1168
S1
VACUUM S
1
MOV
K1
D7
PRESENT
SEGMEN
T
MOV
C0
VAC 1 TI
ME
D8
SEG TIME
1183
S2
HEAT 1 S
2
MOV
K2
D7
PRESENT
SEGMEN
T
MOV
C1
HEAT 1 T
IMER C1
D8
SEG TIME
1194
S3
Vent 1 S
3
MOV
K3
D7
PRESENT
SEGMEN
T
MOV
C2
VENT 1 T
IME
D8
SEG TIME

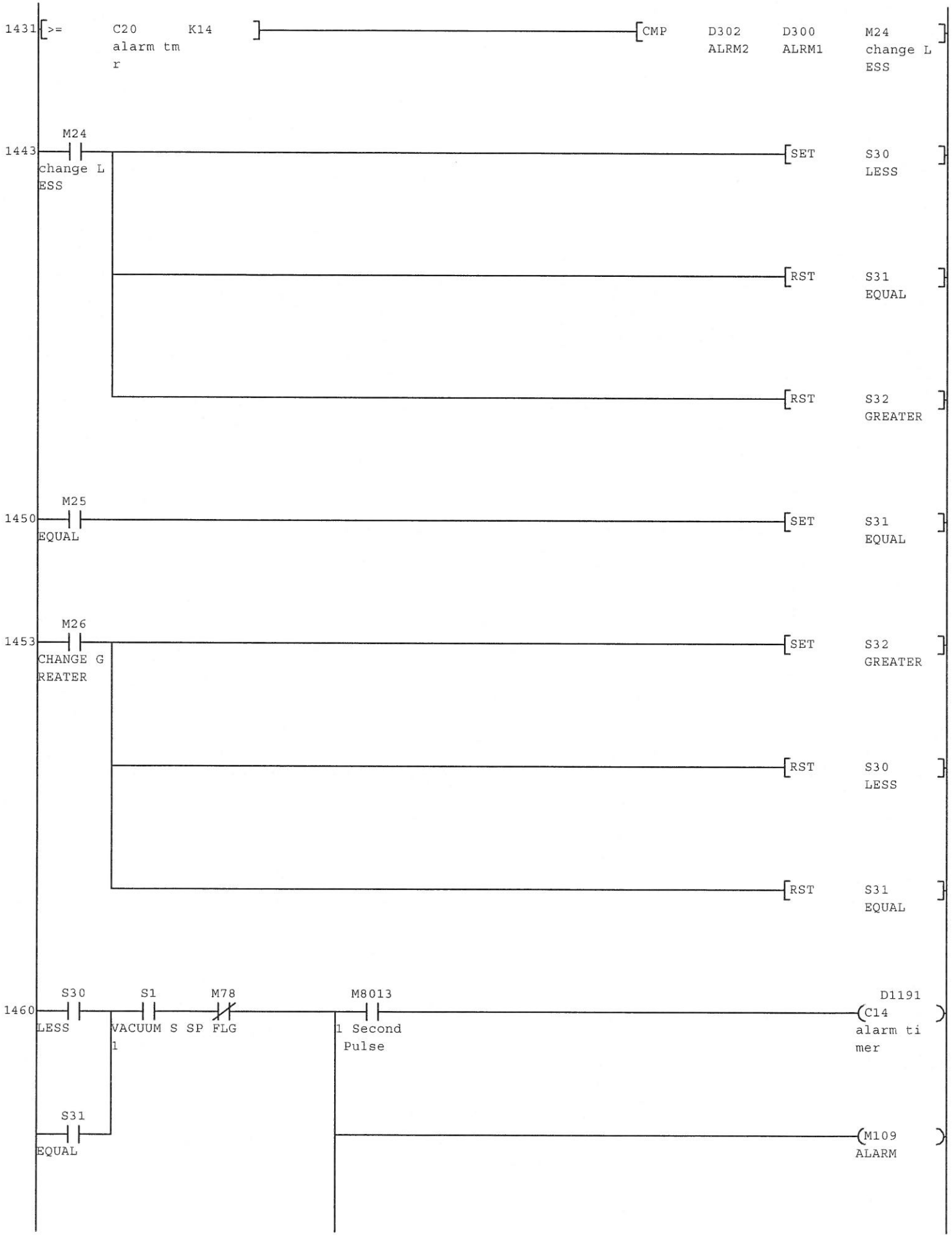

SET UP THE SEQUENCE OF THE 3 STEPS
M1
1205
TC Modul e OK
= K1 C30 SEQ TMR
SET S1 VACUUM S 1
ZRST S2 HEAT 1 S 2
S3 Vent 1 S 3
X016
= K2 C30 SEQ TMR
DOOR Ful ly CLOSE D
SET S2 HEAT 1 S 2
ZRST S3 Vent 1 S 3
S3 Vent 1 S 3
RST S1 VACUUM S 1
= K3 C30 SEQ TMR
SET S3 Vent 1 S 3
ZRST S1 VACUUM S 1
S2 HEAT 1 S 2
C31
= K4 C30 SEQ TMR
Repeat S eq CTR
SET S7 END CYCL E S7
ZRST S1 VACUUM S 1
S3 Vent 1 S 3
PULSE M RELAYS TO INCREMENT SEQUENCER
C0
1264
VAC 1 TI ME
PLS M30 Step 1

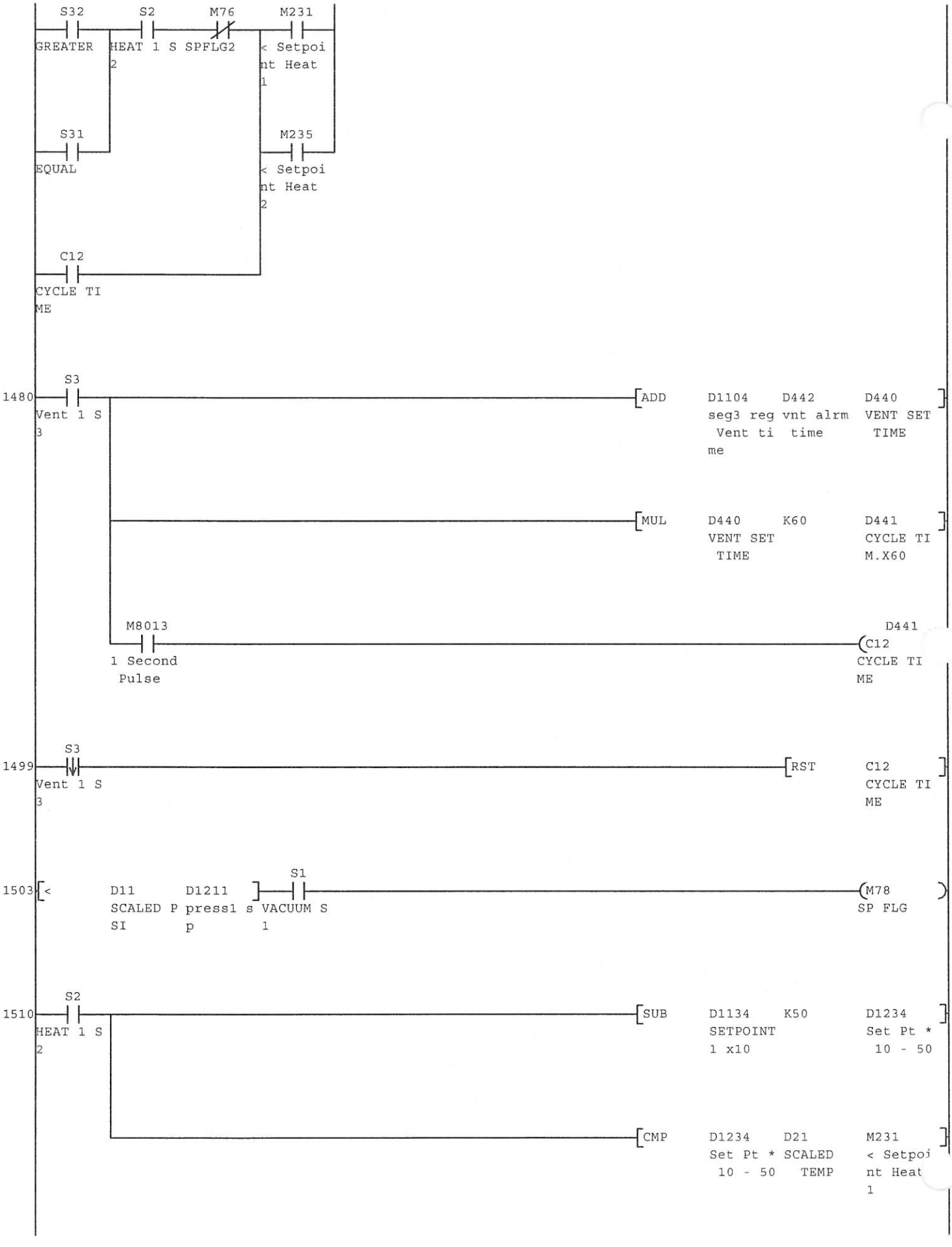

RST C0 VAC 1 TIME
C1
1269
HEAT 1 TIMER C1
PLS M31 Step 2
RST C1 HEAT 1 TIMER C1
C2
1274
VENT 1 TIME
PLS M32 Step 3
RST C2 VENT 1 TIME
S7
1279
END CYCLE S7
PLS M36 STEP 7
K1
C6 STEP 7 TMR
* Delay Start system by 4 seconds
* Zero Timers if advance by start PB
X000
START
T11
Start Pushed Timer
1285
M130 start pushed
M130
start pushed
ZRST C0 VAC 1 TIME C3 VAC 2 TIME
M130
1294
start pushed
K20
T11 Start Pushed Timer

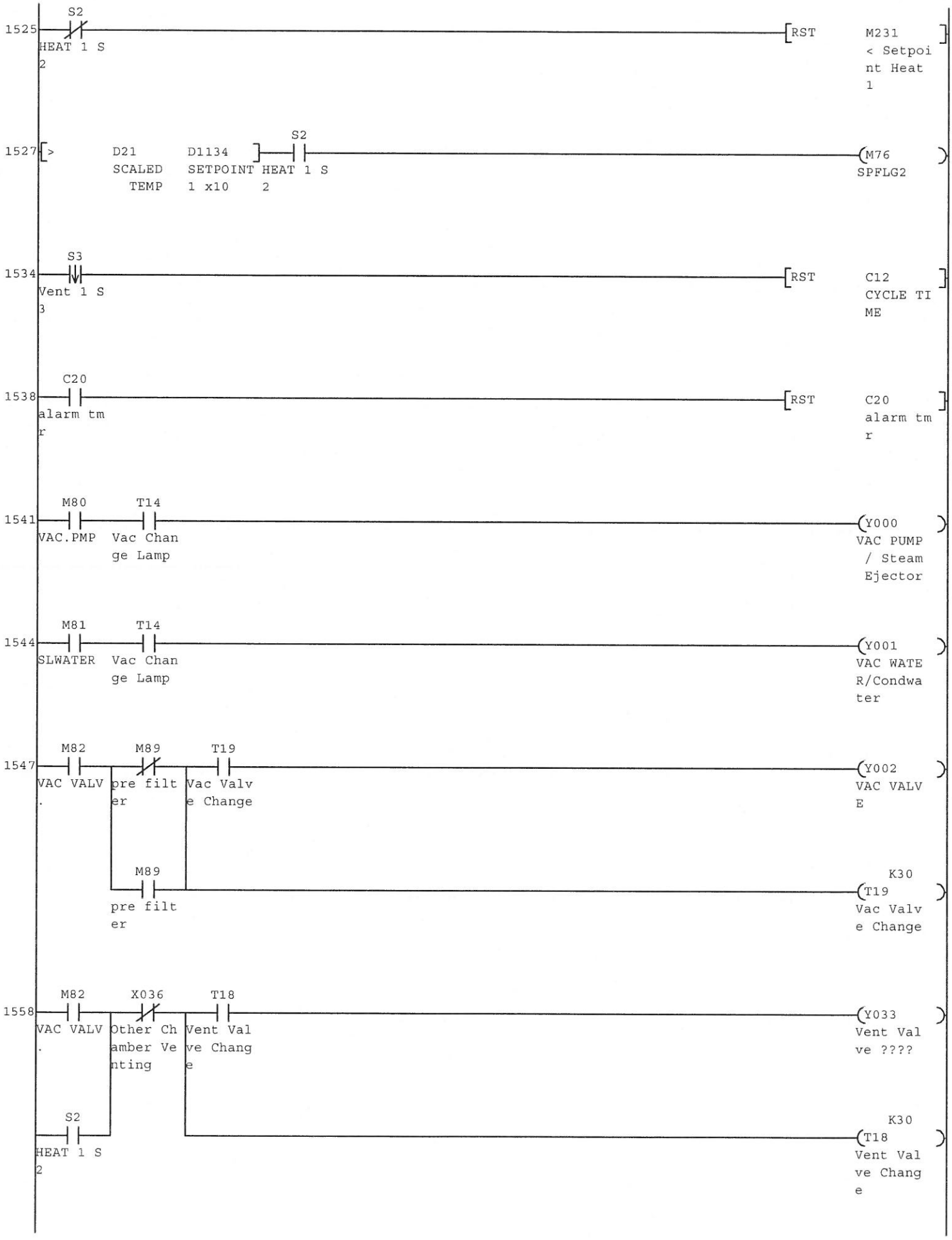

Start can also step segments
1298
M1
TC Modul e OK
M130
start pu shed
X016
DOOR Ful ly CLOSE D
K4
C30
SEQ TMR
M30
Step 1
M31
Step 2
M32
Step 3
M36
STEP 7
Program ends here
1309
M36
STEP 7
ZRST
C0
VAC 1 TI ME
C5
step 6
X001
STOP
RST
C30
SEQ TMR
M5
tc monit or
RST
S7
END CYCL E S7
ZRST
S1
VACUUM S 1
S3
Vent 1 S 3
RST
C31
Repeat S eq CTR

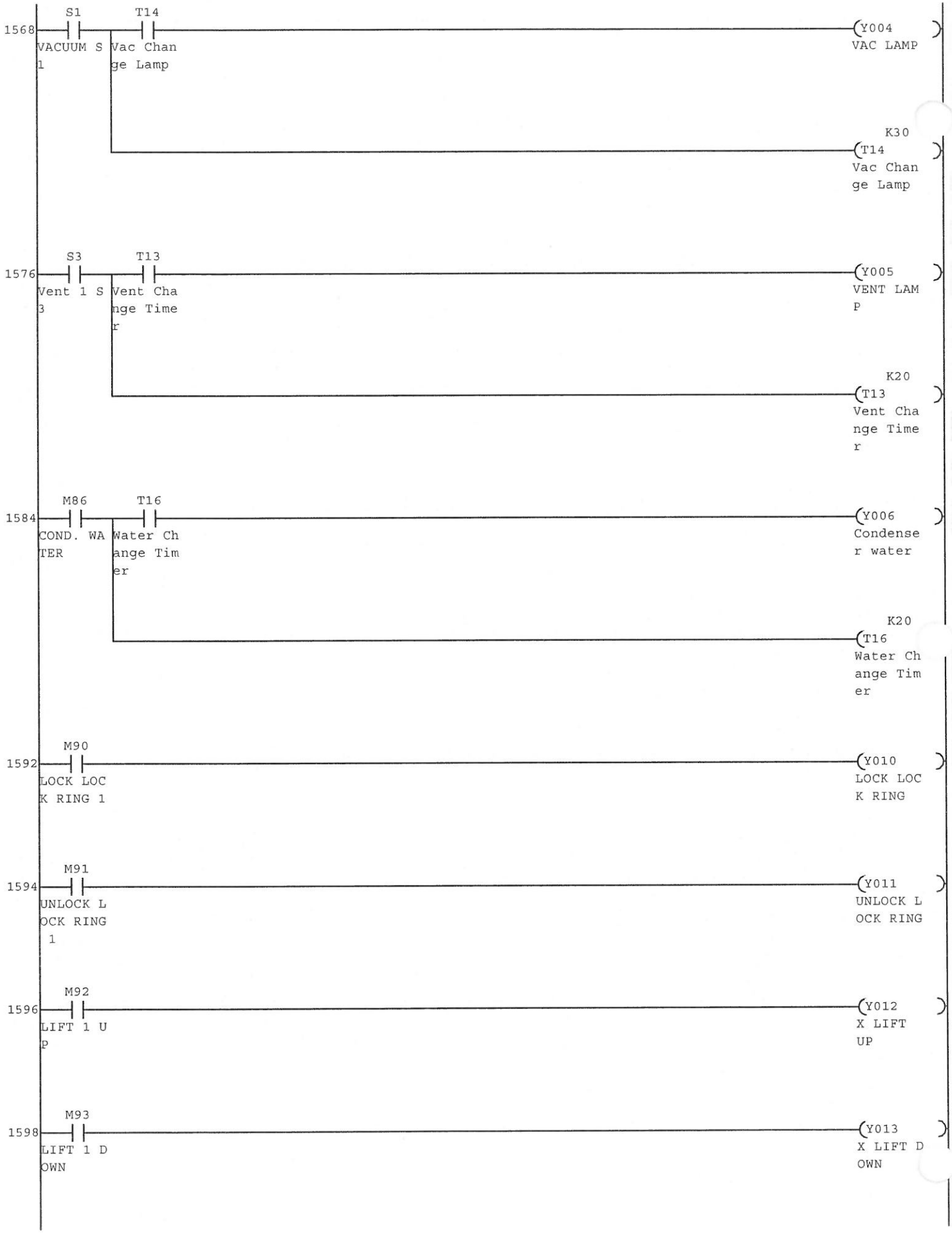

1328
X010
LOCK RIN G
X014
PRESSURE SWITCH
X016
DOOR Ful ly CLOSE D
M75
Press ba ckup sw
M90
LOCK LOC K RING 1
1333
X011
UNLOCK RING
X014
PRESSURE SWITCH
X016
DOOR Ful ly CLOSE D
M75
Press ba ckup sw
M91
UNLOCK L OCK RING 1
1338
X012
LIFT UP
X015
DOOR Ful ly OPEN
M92
LIFT 1 U P
1341
X015
DOOR Ful ly OPEN
X007
X LIFT D OWN
X014
PRESSURE SWITCH
M75
Press ba ckup sw
M93
LIFT 1 D OWN
X016
DOOR Ful ly CLOSE D
1347
Y010
LOCK LOC K RING
M27
RUNNING
X014
PRESSURE SWITCH
M75
Press ba ckup sw
X015
DOOR Ful ly OPEN
M94
HYD PUMP
Y011
UNLOCK L OCK RING
X016
DOOR Ful ly CLOSE D
Y012
X LIFT UP
1357
X020
DOOR swi ng close
X014
PRESSURE SWITCH
M75
Press ba ckup sw
M168
DOOR swi ng open
1361
X021
DOOR swi ng open
X014
PRESSURE SWITCH
M75
Press ba ckup sw
M169
door swi ng close

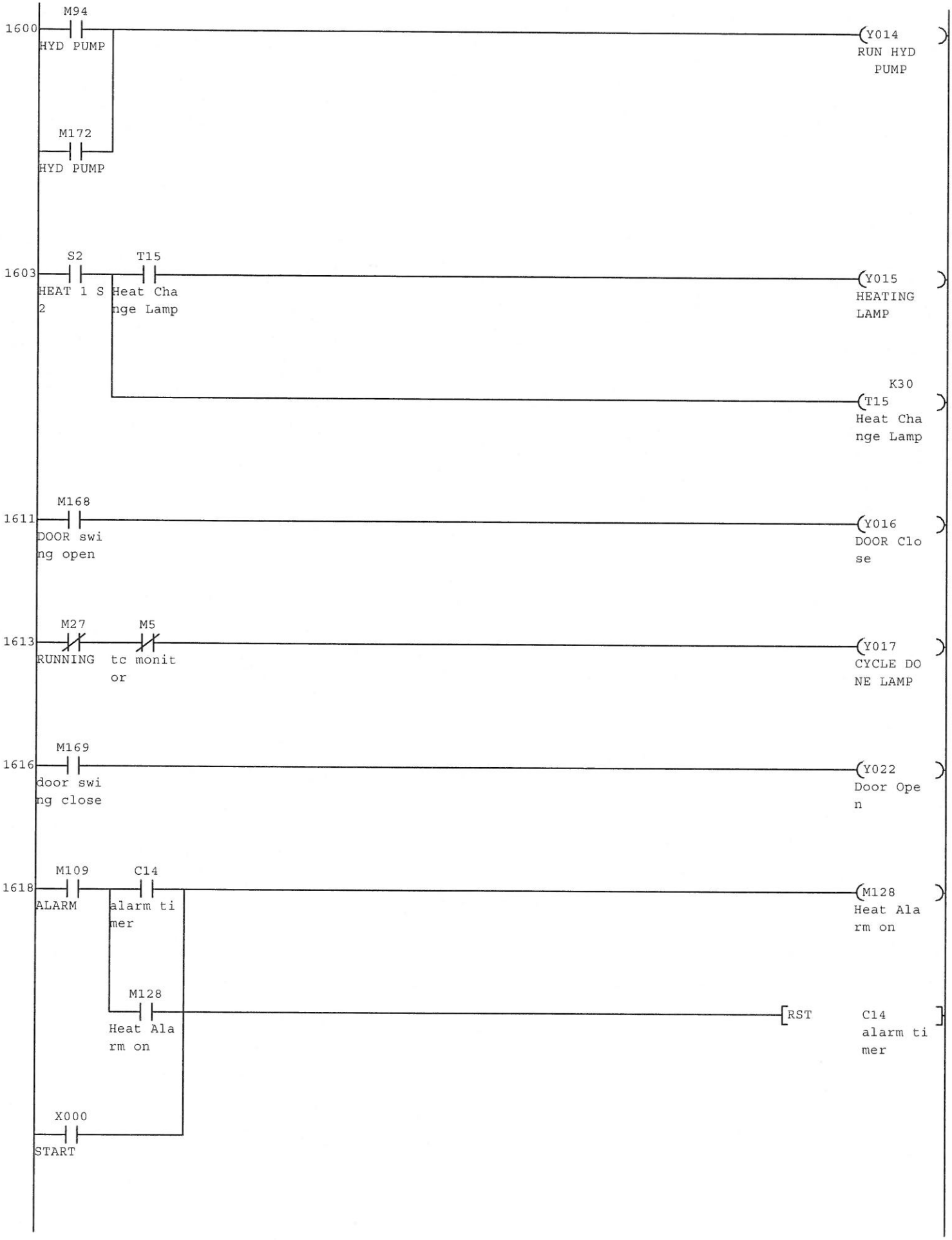

1365
X022
SLIFT 2 UP or Conveyor in
X025
DOOR 2 OPEN
M170
LIFT 2 UP
1368
X025
DOOR 2 OPEN
X023
LIFT 2 DOWN
X014
PRESSURE SWITCH
M75
Press back sw
M171
LIFT 2 DOWN
X024
X Lift fully down
1374
Y016
DOOR Close
M27
RUNNING
X014
PRESSURE SWITCH
M75
Press back sw
X025
DOOR 2 OPEN
M172
HYD PUMP
Y022
Door Open
X024
X Lift fully down
1383
M8013
1 Second Pulse
K15
C20
alarm tmr
1387
=
C20
alarm tmr
K1
S1
VACUUM S1
MOV
D1
RAW press
D300
ALRM1
1398
=
C20
alarm tmr
K9
S1
VACUUM S1
MOV
D1
RAW press
D302
ALRM2
1409
=
C20
alarm tmr
K1
S2
HEAT 1 S2
MOV
D0
RAW temp
D300
ALRM1
1420
=
C20
alarm tmr
K9
S2
HEAT 1 S2
MOV
D0
RAW temp
D302
ALRM2

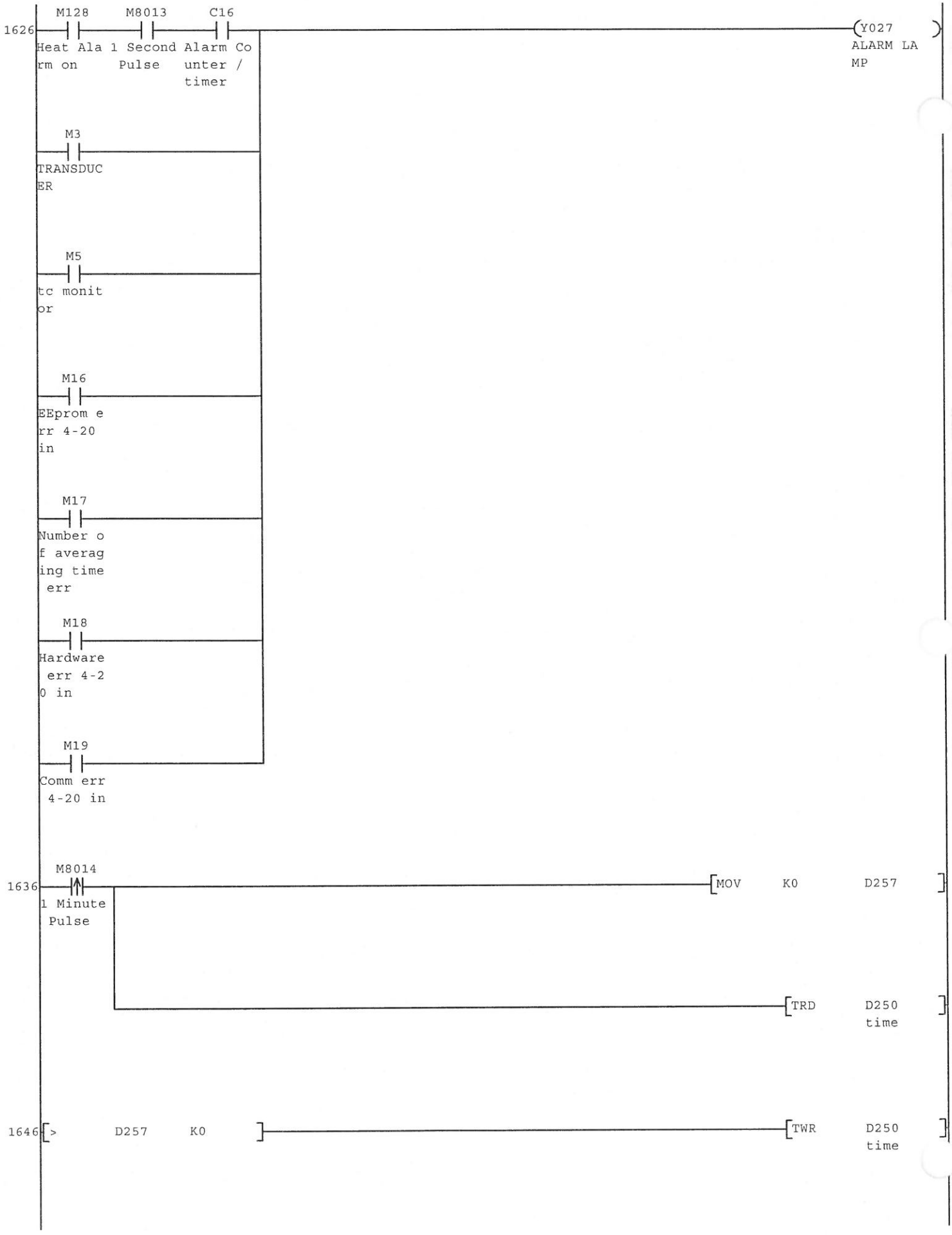

1431
>=
C20
alarm tm
r
K14
CMP
D302
ALRM2
D300
ALRM1
M24
change L
ESS
M24
1443
change L
ESS
SET
S30
LESS
RST
S31
EQUAL
RST
S32
GREATER
M25
1450
EQUAL
SET
S31
EQUAL
M26
1453
CHANGE G
REATER
SET
S32
GREATER
RST
S30
LESS
RST
S31
EQUAL
S30
S1
M78
M8013
D1191
1460
LESS
VACUUM S SP FLG
1
1 Second
Pulse
C14
alarm ti
mer
S31
EQUAL
M109
ALARM

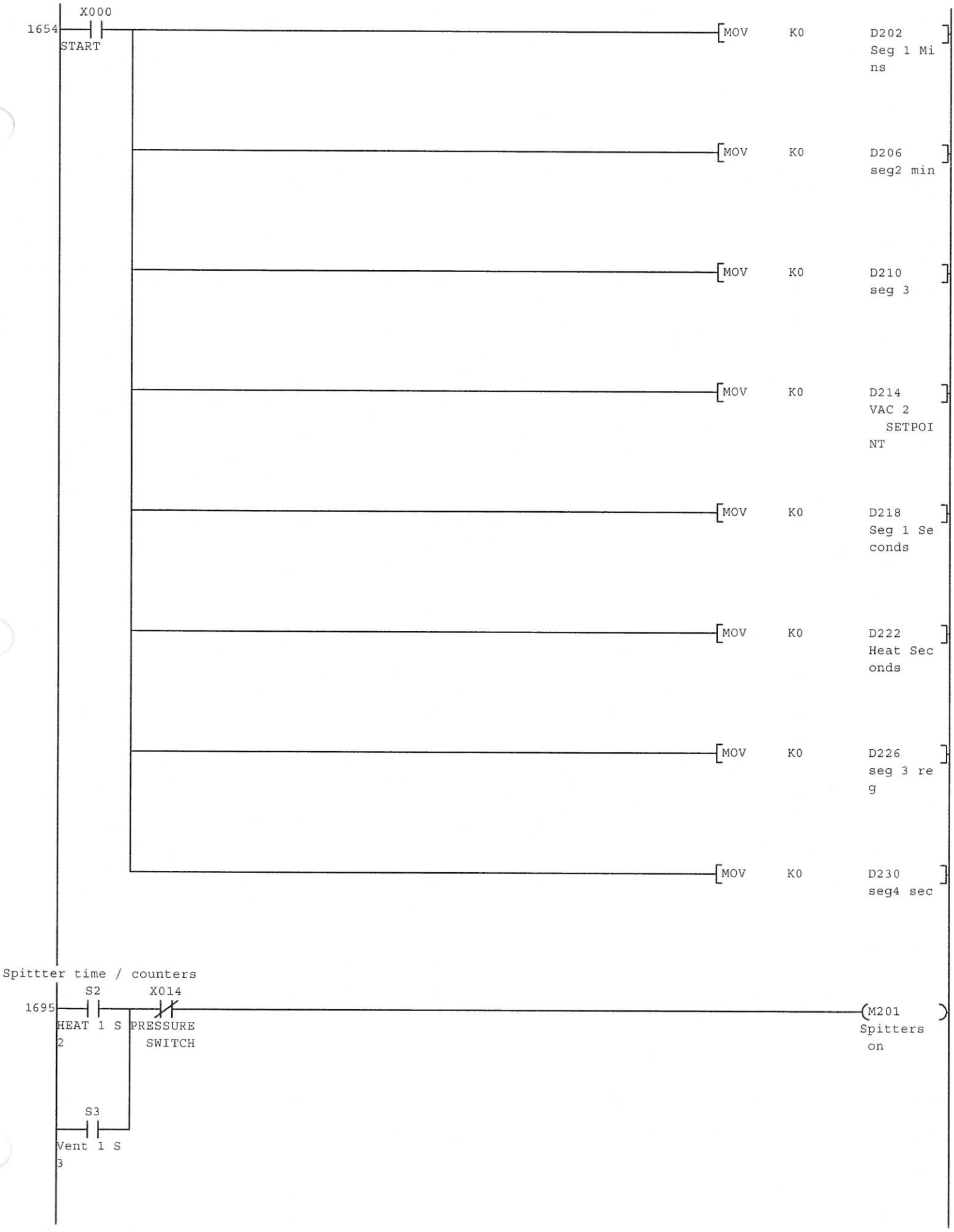

S32
GREATER
S2
HEAT 1 S 2
M76
SPFLG2
M231
< Setpoint Heat 1
S31
EQUAL
M235
< Setpoint Heat 2
C12
CYCLE TIME
1480
S3
Vent 1 S 3
ADD
D1104 seg3 reg Vent time
D442 vnt alrm time
D440 VENT SET TIME
MUL
D440 VENT SET TIME
K60
D441 CYCLE TIME.X60
M8013
1 Second Pulse
D441
C12 CYCLE TIME
1499
S3
Vent 1 S 3
RST
C12 CYCLE TIME
1503
<
D11 SCALED PSI
D1211 press1 sp
S1
VACUUM S 1
M78 SP FLG
1510
S2
HEAT 1 S 2
SUB
D1134 SETPOINT 1 x10
K50
D1234 Set Pt * 10 - 50
CMP
D1234 Set Pt * 10 - 50
D21 SCALED TEMP
M231 < Setpoint Heat 1

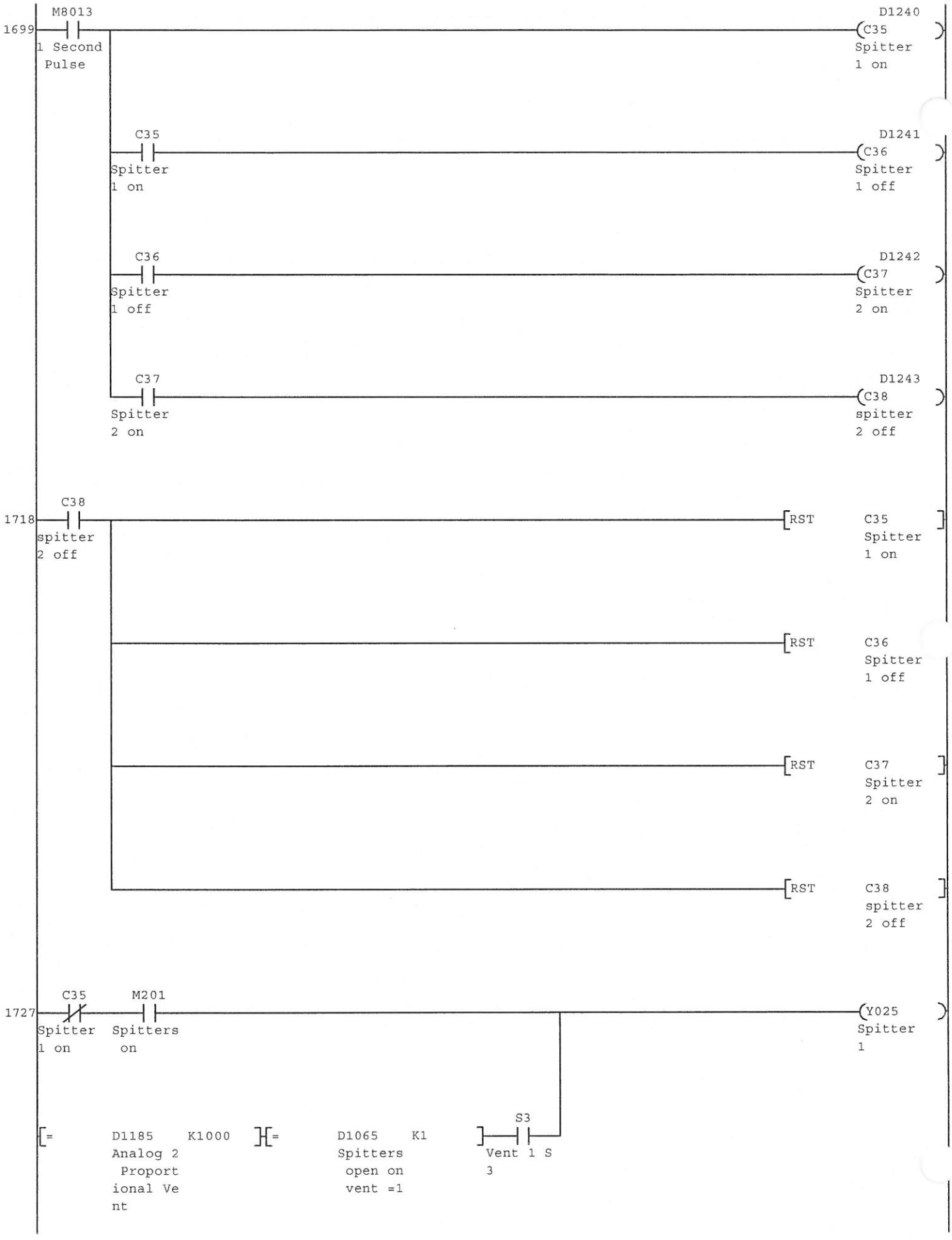

1525
S2
HEAT 1 S 2
RST
M231 < Setpoint Heat 1
1527
>
D21 SCALED TEMP
D1134 SETPOINT HEAT 1 x10
S2
HEAT 1 S 2
M76 SPFLG2
1534
S3
Vent 1 S 3
RST
C12 CYCLE TIME
1538
C20
alarm tmr
RST
C20 alarm tmr
1541
M80
VAC.PMP
T14
Vac Change Lamp
Y000 VAC PUMP / Steam Ejector
1544
M81
SLWATER
T14
Vac Change Lamp
Y001 VAC WATER/Condwater
1547
M82
VAC VALV.
M89
pre filter
T19
Vac Valve Change
Y002 VAC VALVE
M89
pre filter
K30
T19 Vac Valve Change
1558
M82
VAC VALV.
X036
Other Chamber Venting
T18
Vent Valve Change
Y033 Vent Valve ????
S2
HEAT 1 S 2
K30
T18 Vent Valve Change

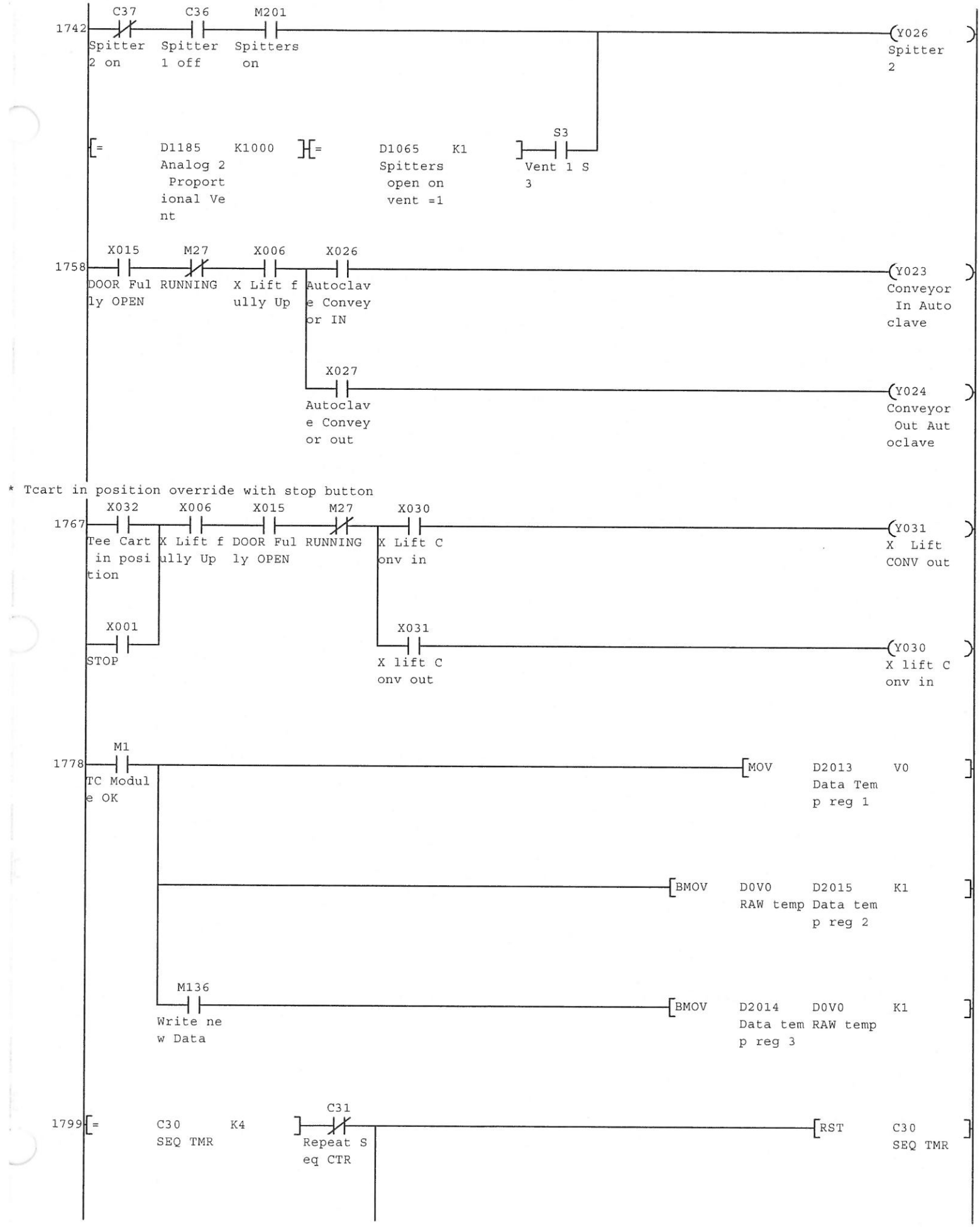

1568
S1
VACUUM S 1
T14
Vac Chan ge Lamp
Y004
VAC LAMP
K30
T14
Vac Chan ge Lamp
1576
S3
Vent 1 S 3
T13
Vent Cha nge Time r
Y005
VENT LAM P
K20
T13
Vent Cha nge Time r
1584
M86
COND. WA TER
T16
Water Ch ange Tim er
Y006
Condense r water
K20
T16
Water Ch ange Tim er
1592
M90
LOCK LOC K RING 1
Y010
LOCK LOC K RING
1594
M91
UNLOCK L OCK RING 1
Y011
UNLOCK L OCK RING
1596
M92
LIFT 1 U P
Y012
X LIFT UP
1598
M93
LIFT 1 D OWN
Y013
X LIFT D OWN

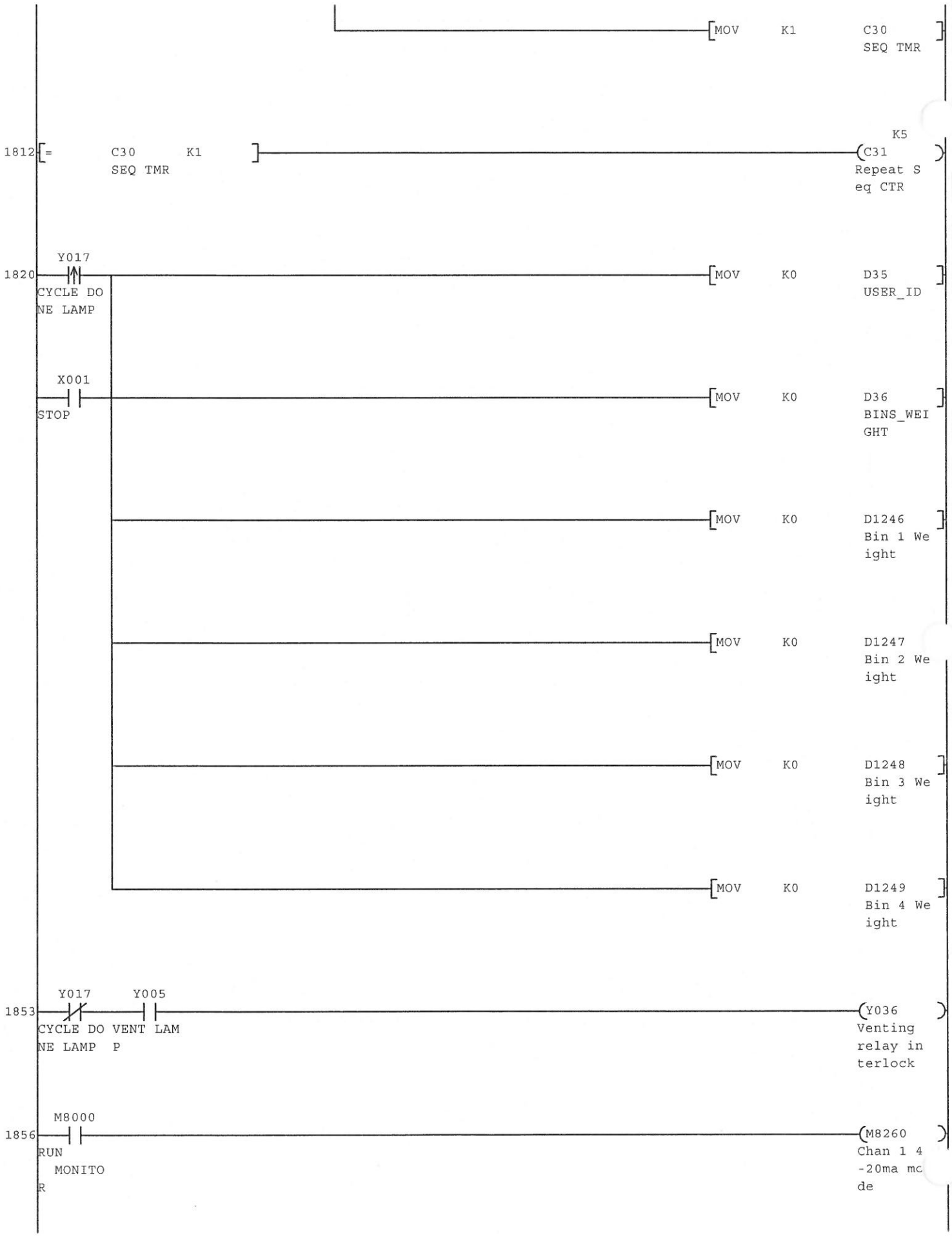

1600
M94
HYD PUMP
M172
HYD PUMP
Y014
RUN HYD PUMP
1603
S2
HEAT 1 S 2
T15
Heat Change Lamp
Y015
HEATING LAMP
K30
T15
Heat Change Lamp
1611
M168
DOOR swing open
Y016
DOOR Close
1613
M27
RUNNING
M5
tc monitor
Y017
CYCLE DONE LAMP
1616
M169
door swing close
Y022
Door Open
1618
M109
ALARM
C14
alarm timer
M128
Heat Alarm on
M128
Heat Alarm on
RST
C14
alarm timer
X000
START

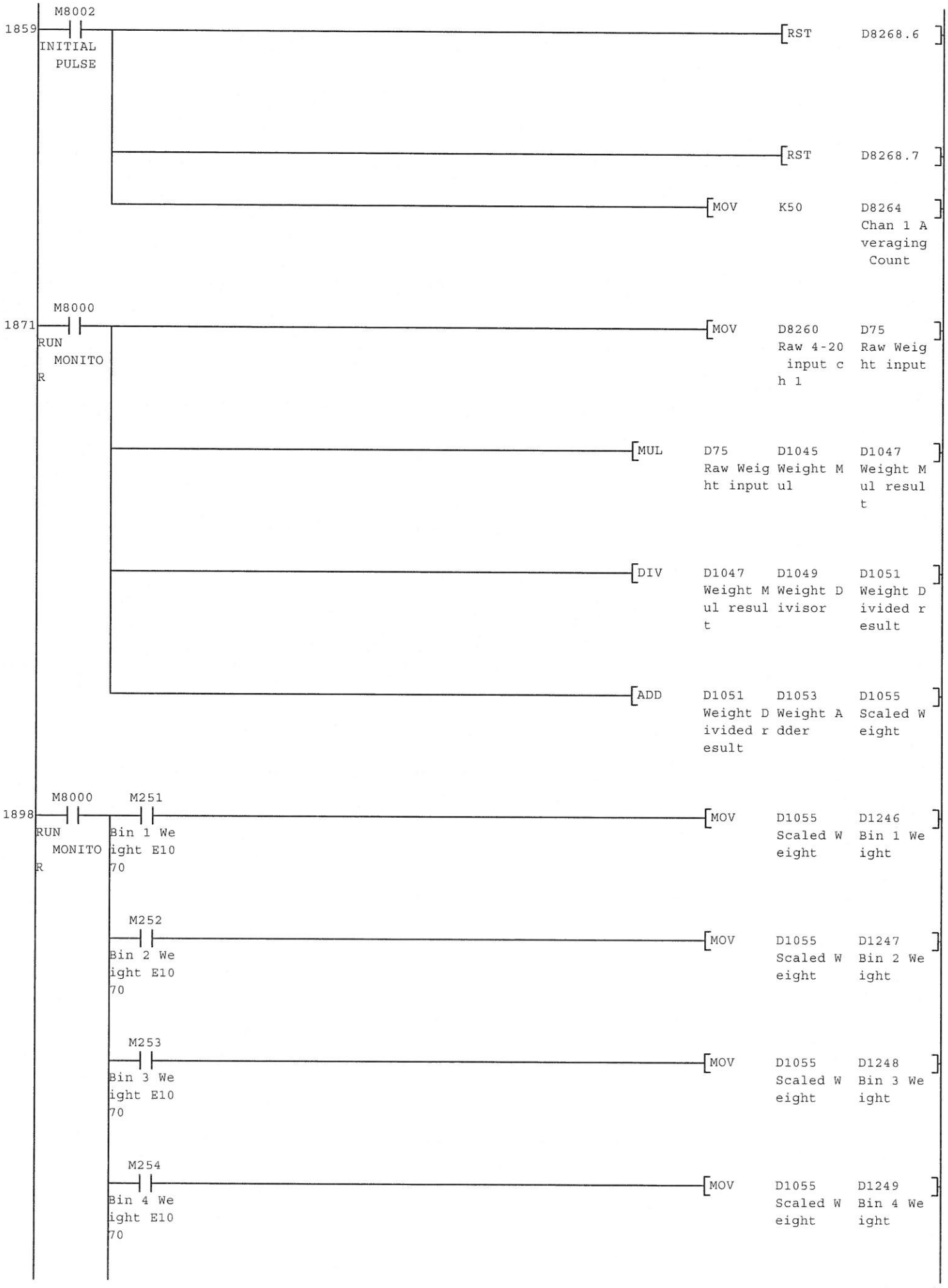

1626
M128
Heat Ala rm on
M8013
1 Second Pulse
C16
Alarm Co unter / timer
Y027
ALARM LA MP
M3
TRANSDUC ER
M5
tc monit or
M16
EEprom e rr 4-20 in
M17
Number o f averag ing time err
M18
Hardware err 4-2 0 in
M19
Comm err 4-20 in
1636
M8014
1 Minute Pulse
MOV K0 D257
TRD D250 time
1646
> D257 K0
TWR D250 time

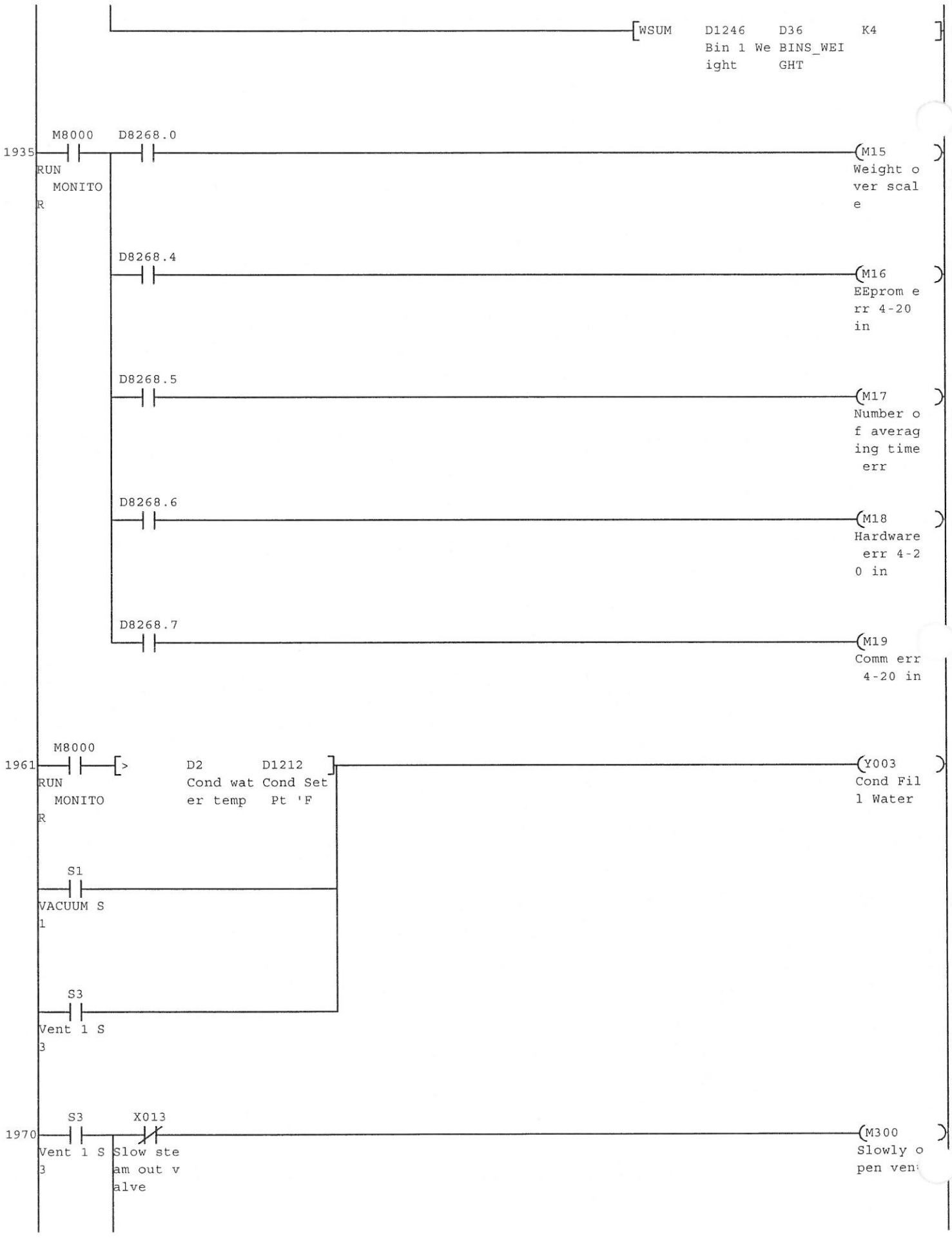

X000
1654
START
MOV K0 D202 Seg 1 Mins
MOV K0 D206 seg2 min
MOV K0 D210 seg 3
MOV K0 D214 VAC 2 SETPOINT
MOV K0 D218 Seg 1 Seconds
MOV K0 D222 Heat Seconds
MOV K0 D226 seg 3 reg
MOV K0 D230 seg4 sec
Spittter time / counters
S2
X014
1695
HEAT 1 S 2
PRESSURE SWITCH
M201 Spitters on
S3
Vent 1 S 3

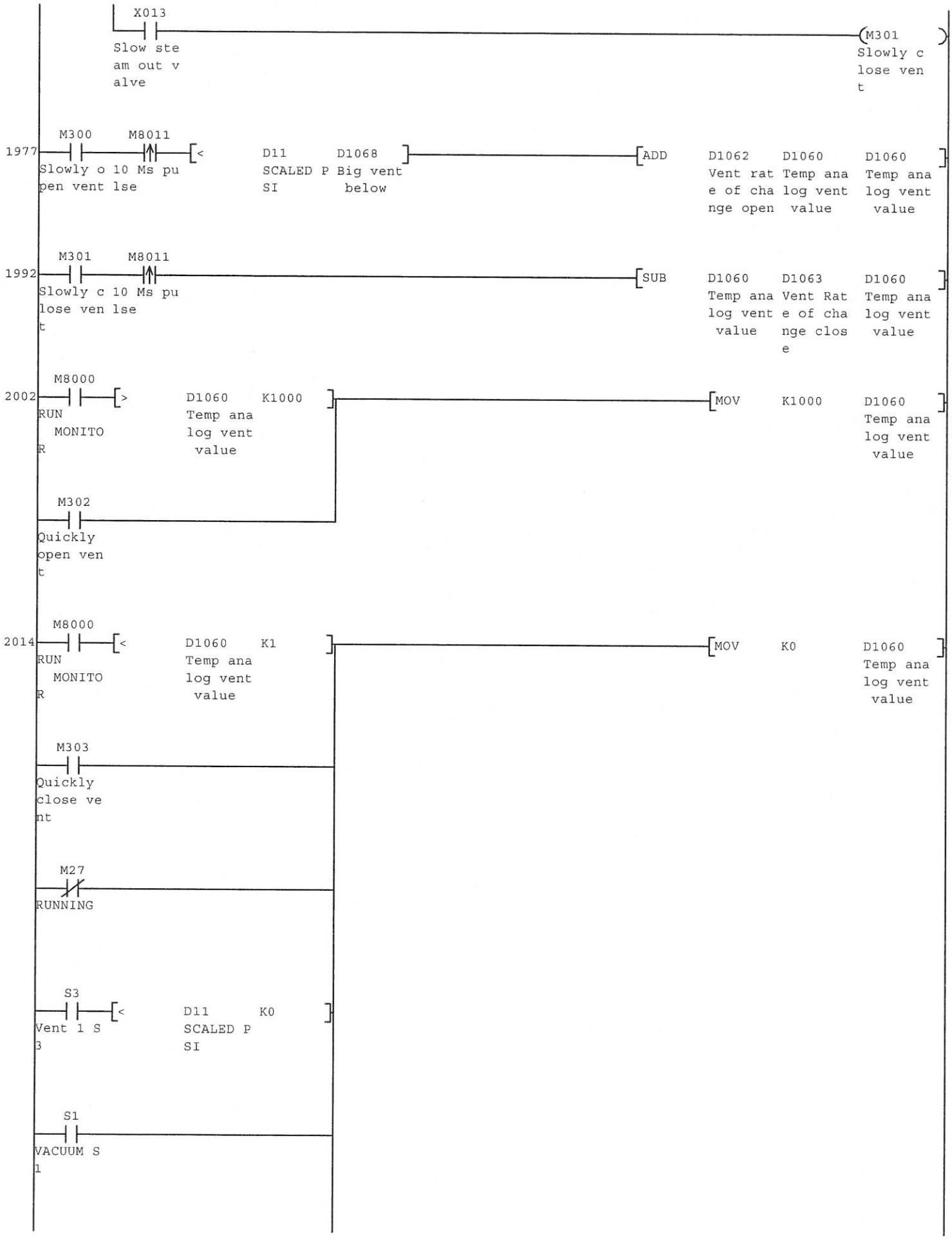

1699
M8013
1 Second Pulse
D1240
C35
Spitter 1 on
C35
Spitter 1 on
D1241
C36
Spitter 1 off
C36
Spitter 1 off
D1242
C37
Spitter 2 on
C37
Spitter 2 on
D1243
C38
spitter 2 off
1718
C38
spitter 2 off
RST
C35
Spitter 1 on
RST
C36
Spitter 1 off
RST
C37
Spitter 2 on
RST
C38
spitter 2 off
1727
C35
Spitter 1 on
M201
Spitters on
Y025
Spitter 1
S3
Vent 1 S 3
=
D1185
K1000
Analog 2 Proport ional Ve nt
=
D1065
K1
Spitters open on vent =1

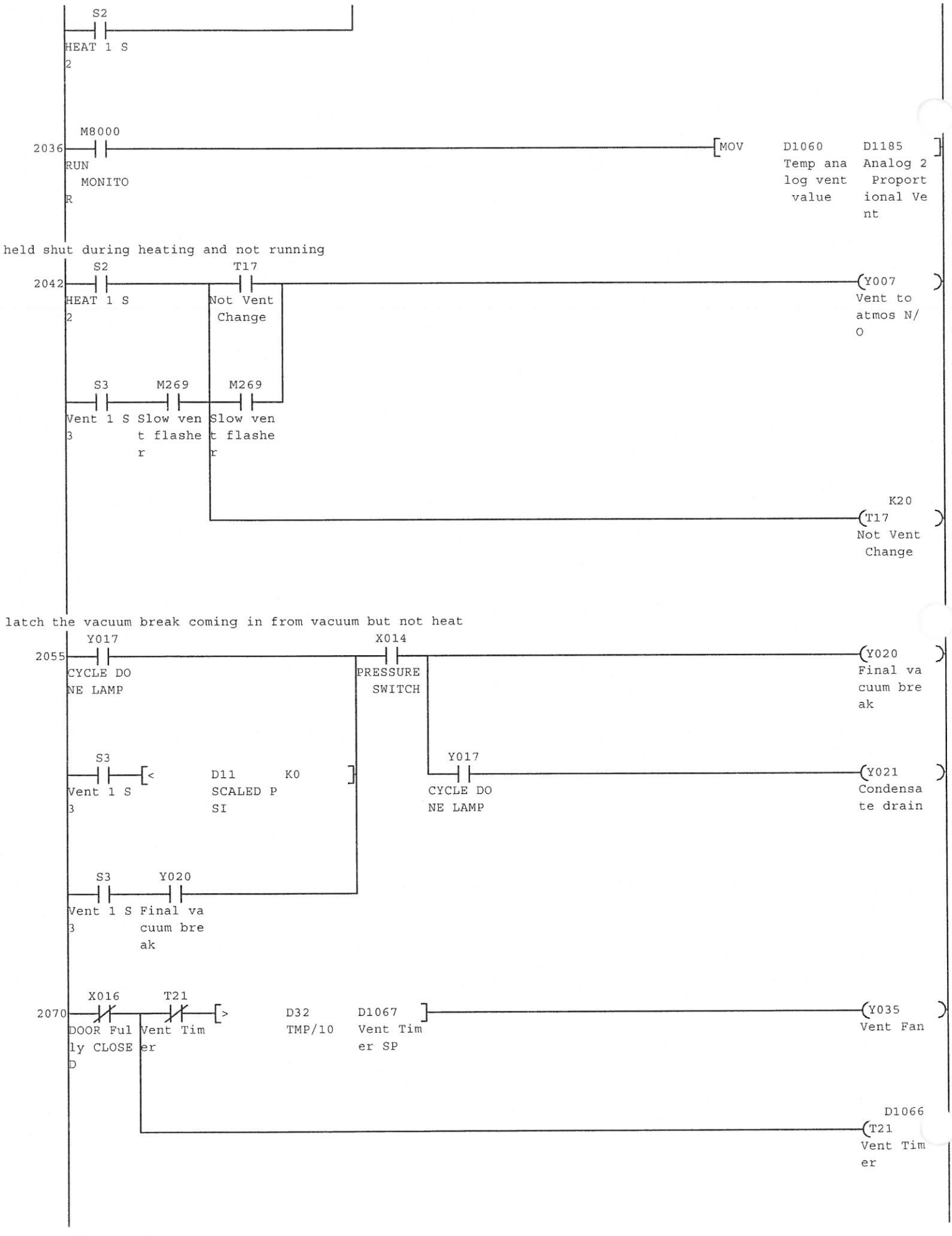

1742
C37
Spitter 2 on
C36
Spitter 1 off
M201
Spitters on
Y026
Spitter 2
[=
D1185
Analog 2 Proportional Vent
K1000
][=
D1065
Spitters open on vent =1
K1
]
S3
Vent 1 S 3
1758
X015
DOOR Fully OPEN
M27
RUNNING
X006
X Lift fully Up
X026
Autoclave Conveyor IN
Y023
Conveyor In Autoclave
X027
Autoclave Conveyor out
Y024
Conveyor Out Autoclave
* Tcart in position override with stop button
1767
X032
Tee Cart in position
X006
X Lift fully Up
X015
DOOR Fully OPEN
M27
RUNNING
X030
X Lift Conv in
Y031
X Lift CONV out
X001
STOP
X031
X lift Conv out
Y030
X lift Conv in
1778
M1
TC Module OK
[MOV
D2013
Data Temp reg 1
V0
]
[BMOV
D0V0
RAW temp
D2015
Data temp reg 2
K1
]
M136
Write new Data
[BMOV
D2014
Data temp reg 3
D0V0
RAW temp
K1
]
1799
[=
C30
SEQ TMR
K4
]
C31
Repeat Seq CTR
[RST
C30
SEQ TMR
]

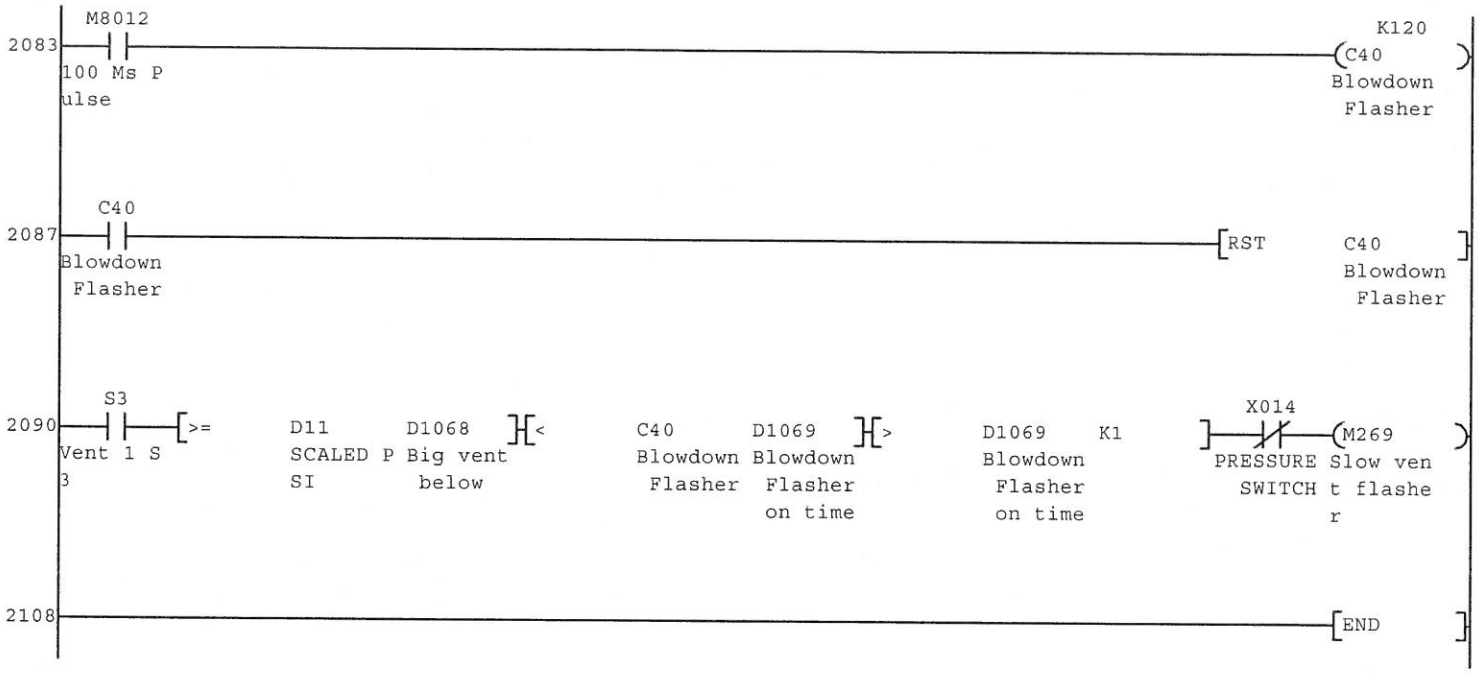

MOV K1 C30 SEQ TMR
1812 = C30 SEQ TMR K1
K5 C31 Repeat Seq CTR
1820 Y017 CYCLE DONE LAMP
MOV K0 D35 USER_ID
X001 STOP
MOV K0 D36 BINS_WEIGHT
MOV K0 D1246 Bin 1 Weight
MOV K0 D1247 Bin 2 Weight
MOV K0 D1248 Bin 3 Weight
MOV K0 D1249 Bin 4 Weight
1853 Y017 CYCLE DONE LAMP
Y005 VENT LAMP
Y036 Venting relay interlock
1856 M8000 RUN MONITOR
M8260 Chan 1 4-20ma mode


1859
M8002
INITIAL PULSE
RST D8268.6
RST D8268.7
MOV K50 D8264 Chan 1 Averaging Count
1871
M8000
RUN MONITOR
MOV D8260 Raw 4-20 input ch 1 D75 Raw Weight input
MUL D75 Raw Weight input D1045 Weight Mul D1047 Weight Mul result
DIV D1047 Weight Mul result D1049 Weight Divisor D1051 Weight Divided result
ADD D1051 Weight Divided result D1053 Weight Adder D1055 Scaled Weight
1898
M8000
RUN MONITOR
M251
Bin 1 Weight E1070
MOV D1055 Scaled Weight D1246 Bin 1 Weight
M252
Bin 2 Weight E1070
MOV D1055 Scaled Weight D1247 Bin 2 Weight
M253
Bin 3 Weight E1070
MOV D1055 Scaled Weight D1248 Bin 3 Weight
M254
Bin 4 Weight E1070
MOV D1055 Scaled Weight D1249 Bin 4 Weight


WSUM D1246 Bin 1 We ight D36 BINS_WEI GHT K4
1935
M8000 RUN MONITOR
D8268.0
M15 Weight over scale
D8268.4
M16 EEprom err 4-20 in
D8268.5
M17 Number of averaging time err
D8268.6
M18 Hardware err 4-20 in
D8268.7
M19 Comm err 4-20 in
1961
M8000 RUN MONITOR
> D2 Cond water temp D1212 Cond Set Pt 'F
Y003 Cond Fill Water
S1 VACUUM S1
S3 Vent 1 S3
1970
S3 Vent 1 S3
X013 Slow steam out valve
M300 Slowly open ven


X013
Slow ste am out v alve
M301 Slowly c lose ven t
1977
M300 Slowly o pen vent
M8011 10 Ms pu lse
< D11 SCALED P SI
D1068 Big vent below
ADD D1062 Vent rat e of cha nge open
D1060 Temp ana log vent value
D1060 Temp ana log vent value
1992
M301 Slowly c lose ven t
M8011 10 Ms pu lse
SUB D1060 Temp ana log vent value
D1063 Vent Rat e of cha nge clos e
D1060 Temp ana log vent value
2002
M8000 RUN MONITO R
> D1060 Temp ana log vent value
K1000
MOV K1000
D1060 Temp ana log vent value
M302 Quickly open ven t
2014
M8000 RUN MONITO R
< D1060 Temp ana log vent value
K1
MOV K0
D1060 Temp ana log vent value
M303 Quickly close ve nt
M27 RUNNING
S3 Vent 1 S 3
< D11 SCALED P SI
K0
S1 VACUUM S 1


S2
HEAT 1 S
2
2036
M8000
RUN
MONITO
R
MOV
D1060
Temp ana
log vent
value
D1185
Analog 2
Proport
ional Ve
nt
held shut during heating and not running
2042
S2
HEAT 1 S
2
T17
Not Vent
Change
Y007
Vent to
atmos N/
O
S3
Vent 1 S
3
M269
Slow ven
t flashe
r
M269
Slow ven
t flashe
r
K20
T17
Not Vent
Change
latch the vacuum break coming in from vacuum but not heat
2055
Y017
CYCLE DO
NE LAMP
X014
PRESSURE
SWITCH
Y020
Final va
cuum bre
ak
S3
Vent 1 S
3
<
D11
SCALED P
SI
K0
Y017
CYCLE DO
NE LAMP
Y021
Condensa
te drain
S3
Vent 1 S
3
Y020
Final va
cuum bre
ak
2070
X016
DOOR Ful
ly CLOSE
D
T21
Vent Tim
er
>
D32
TMP/10
D1067
Vent Tim
er SP
Y035
Vent Fan
D1066
T21
Vent Tim
er


2083
M8012
100 Ms P
ulse
K120
C40
Blowdown
Flasher
2087
C40
Blowdown
Flasher
RST
C40
Blowdown
Flasher
2090
S3
Vent 1 S
3
>=
D11
SCALED P
SI
D1068
Big vent
below
<
C40
Blowdown
Flasher
D1069
Blowdown
Flasher
on time
>
D1069
Blowdown
Flasher
on time
K1
X014
PRESSURE
SWITCH
M269
Slow ven
t flashe
r
2108
END

PROPERTIES OF SATURATED STEAM IN FOOT-POUND FAHRENHEIT UNITS

Gauge lb.in2	Temp 'f	Heat in British thermal units per lb from 32 ' F. Water total heat	Latent heat of vaporisation	Steam total heat	Entropy ranks per lb Water	Steam	Volume cub ft per lb Dry Sat
.3	213.0	181.2	970.0	1151.2	.3137	1.7556	26.28
1.3	216.3	181.5	967.9	1152.4	.3187	1.7505	24.74
2.3	219.5	187.6	965.9	1153.5	.3231	1.7456	23.38
3.3	222.4	190.6	964.0	1154.6	.3276	1.7411	22.17
4.3	225.2	193.5	962.2	1155.7	.3319	1.7368	21.07
5.3	228.0	196.3	960.4	1156.7	.3358	1.7327	20.09
6.3	230.6	198.9	958.8	1157.7	.3396	1.7287	19.19
7.3	233.1	201.4	957.2	1158.6	.3433	1.7250	18.38
8.3	235.5	203.9	955.6	1159.5	.3468	1.7215	17.63
9.3	237.8	206.3	954.0	1160.3	.3502	1.7181	16.94
10.3	240.1	208.6	952.5	1161.1	.3534	1.7148	16.30
11.3	242.2	210.8	951.1	1161.9	.3565	1.7118	15.72
12.3	244.4	212.9	949.7	1162.6	.3595	1.7089	15.17
13.3	246.4	215.0	948.3	1163.3	.3625	1.7060	14.67
14.3	248.4	217.0	947.0	1164.0	.3654	1.7032	14.19
15.3	250.3	219.0	945.6	1164.6	.3682	1.7004	13.73
16.3	252.2	220.9	944.3	1165.2	.3709	1.6977	13.31
17.3	254.0	222.7	943.1	1165.8	.3735	1.6952	12.93
18.3	255.8	224.5	941.9	1166.4	.3760	1.6928	12.56
19.3	257.6	226.3	940.7	1167.0	.3785	1.6905	12.21
20.3	259.3	228.0	939.6	1167.6	.3809	1.6883	11.89
21.3	260.9	229.7	938.5	1168.2	.3833	1.6860	11.58
22.3	262.5	231.4	937.4	1168.8	.3856	1.6838	11.29
23.3	264.1	233.0	936.4	1169.4	.3879	1.6817	11.02
24.3	265.7	234.6	935.4	1170.0	.3901	1.6796	10.76
25.3	267.2	236.1	934.4	1170.5	.3923	1.6776	10.50
27.3	270.3	239.1	932.3	1171.4	.3964	1.6737	10.03
29.3	273.1	242.0	930.3	1172.3	.4003	1.6700	9.60
31.3	275.8	244.9	928.3	1173.2	.4041	1.6664	9.21
33.3	278.5	247.6	926.4	1174.0	.4077	1.6630	8.85
35.3	281.0	250.2	924.6	1174.8	.4112	1.6597	8.52
37.3	283.5	252.7	922.9	1175.6	.4146	1.6566	8.21
39.3	285.9	255.2	921.1	1176.3	.4179	1.6536	7.92
41.3	288.3	257.6	919.4	1177.0	.4211	1.6507	7.66
43.3	290.5	259.9	917.8	1177.7	.4242	1.6478	7.41
45.3	292.7	262.2	916.2	1178.4	.4272	1.6450	7.17
47.3	294.9	264.4	914.6	1179.0	.4302	1.6423	6.96
49.3	296.9	266.5	913.1	1179.6	.4331	1.6398	6.75
51.3	299.0	268.6	911.6	1180.2	.4359	1.6374	6.56
53.3	301.0	270.7	910.1	1180.8	.4386	1.6350	6.38
55.3	302.9	272.7	908.7	1181.4	.4412	1.6327	6.21
57.3	301.8	274.6	907.4	1182.0	.4437	1.6304	6.04
59.3	306.7	276.5	906.0	1182.5	.4462	1.6282	5.89

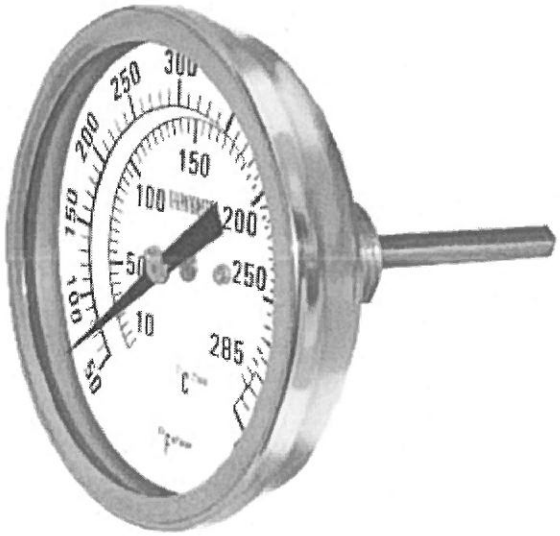
PRECISION INSTRUMENT COMPANY

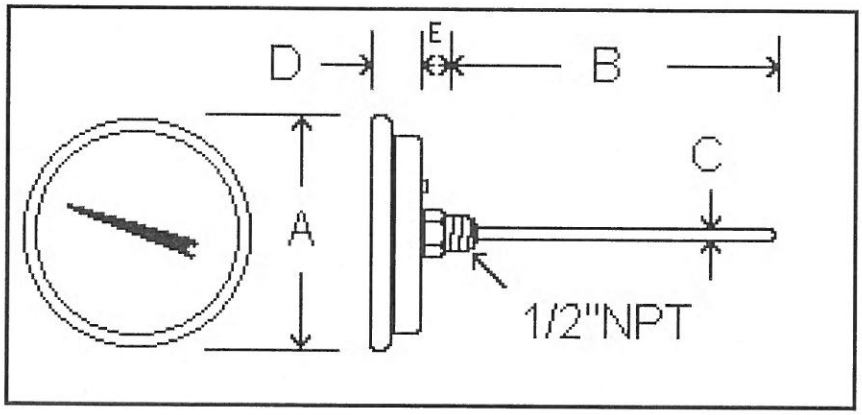
BIMETAL THERMOMETER

90° BACK ANGLE TYPE

STANDARD FEATURES

- All Stainless Construction
- With Glass Lens
- Anti-Parallax Dial
- Vibration Resistant (No Needle Flutter)
- Fast Response To Temperature Change
- Hermetically Sealed (Moisture Proof)
- +/- 1 % Full Scale Accuracy
- Stem Welded To Connection
- Zero Adjustment on Back of Case





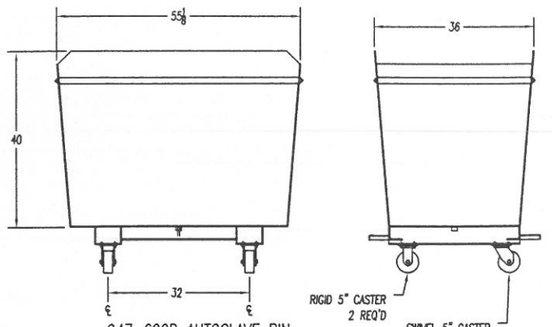
		A	B	C	D	E
3" Dial	IN.	3.18"	STEM LENGTH	.25"	.60"	.38"
	MM	80.78	STEM LENGTH	6.45	15.24	9.76
5" Dial	IN.	5.13"	STEM LENGTH	.25"	.67"	.38"
	MM	130.87	STEM LENGTH	6.45	16.95	9.76

*Note:

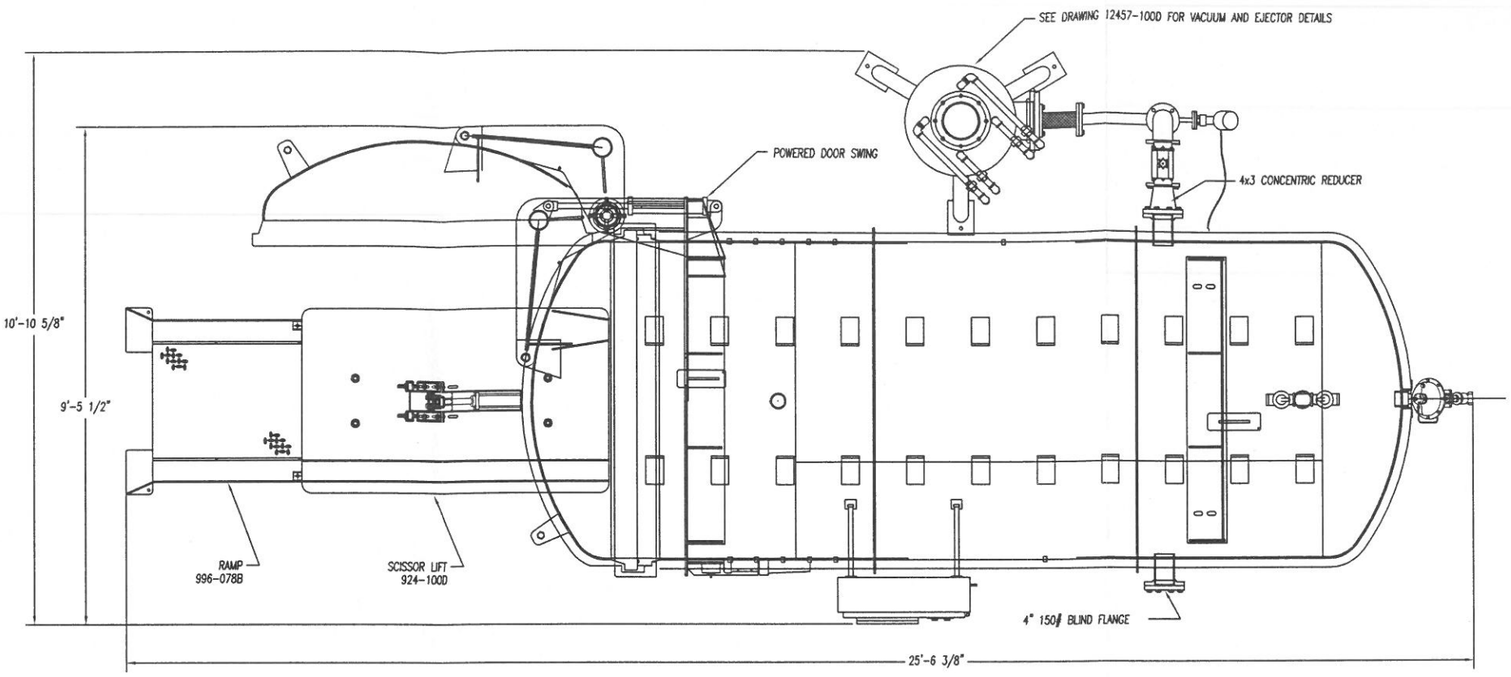
- Other Ranges, Stem Lengths And Configurations Are Available Upon Request.
- Thermowells of all sizes and materials of construction are available also.
- Please Call With Any Inquiries.

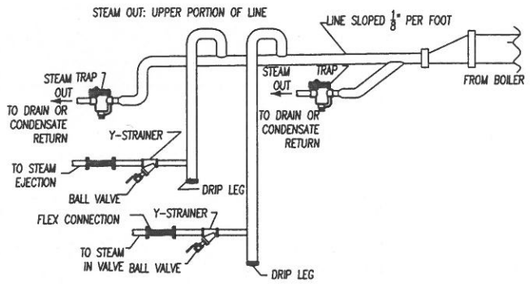
STEM LENGTH*	PART NUMBER	
	3" DIAL	5" DIAL
2 ½	B3B2	B5B2
4"	B3B4	B5B4
6"	B3B6	B5B6
9"	B3B9	B5B9
12"	B3B12	B5B12
15"	B3B15	B5B15
18"	B3B18	B5B18
24"	B3B24	B5B24

STANDARD RANGES*	
CODE	RANGE
AA	-40/120 F & C
BB	-40/160 F & C
EE	0/150 F & C
GG	0/200 F & C
JJ	20/240 F & C
II	0/250 F & C
MM	50/300 F & C
PP	50/400 F & C
RR	50/550 F & C
SS	150/750 F & C
TT	200/1000 F & C

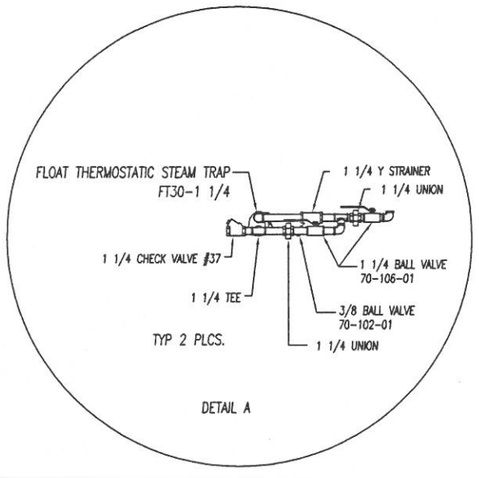


947-600D AUTOCLAVE BIN
(4 PER LOAD)

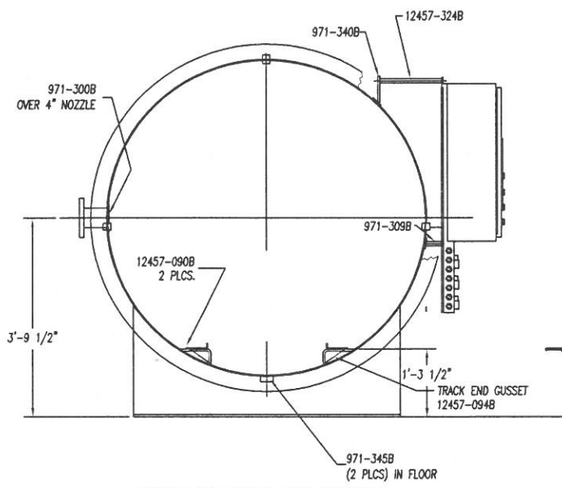




TYPICAL STEAM PIPING

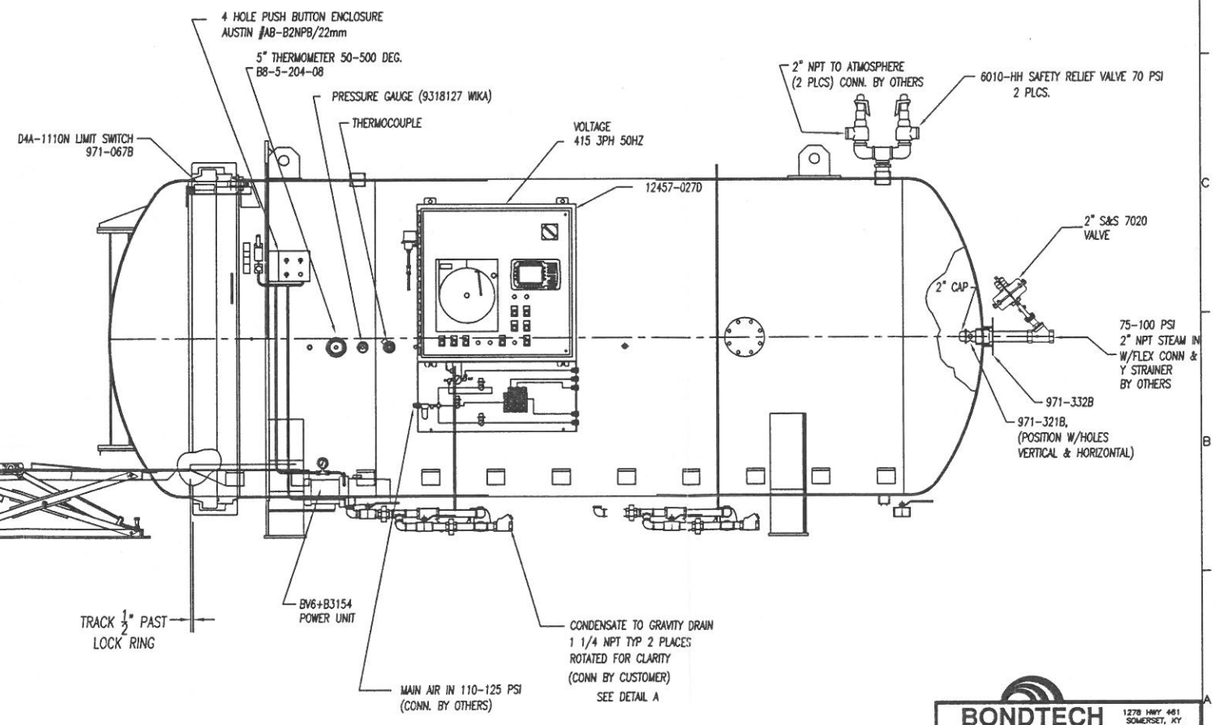


DETAIL A



DOOR NOT SHOWN FOR CLARITY

VIEW A



WEIGHTS: AUTOCLAVE 13,250 lbs
SCISSOR LIFT 525 lbs
CONDENSER 1,000 lbs
S/S BIN 550 lbs
RAMP 130 lbs

UNLESS OTHERWISE INDICATED, TOLERANCES:
X.X = ± 0.025 ANGLES ± 1 DEG.
X.XX = ± 0.010 FRACTIONS ± 1/64
X.XXX = ± 0.005

DO NOT SCALE
BREAK ALL SHARP EDGES
REPORT ALL ERRORS TO ENGINEERING DEPT.

REV	DATE	REVISION DESCRIPTION	BY	CHK

PROPRIETARY DATA NOT TO BE DISCLOSED, USED OR DUPLICATED FOR ANY PURPOSE EXCEPT AS AUTHORIZED IN WRITING BY BONDTECH CORPORATION.

MATERIAL	NO. REQ'D
	1

BONDTECH CORPORATION
1278 HWY. 461
SOMERSET, KY
42503 USA

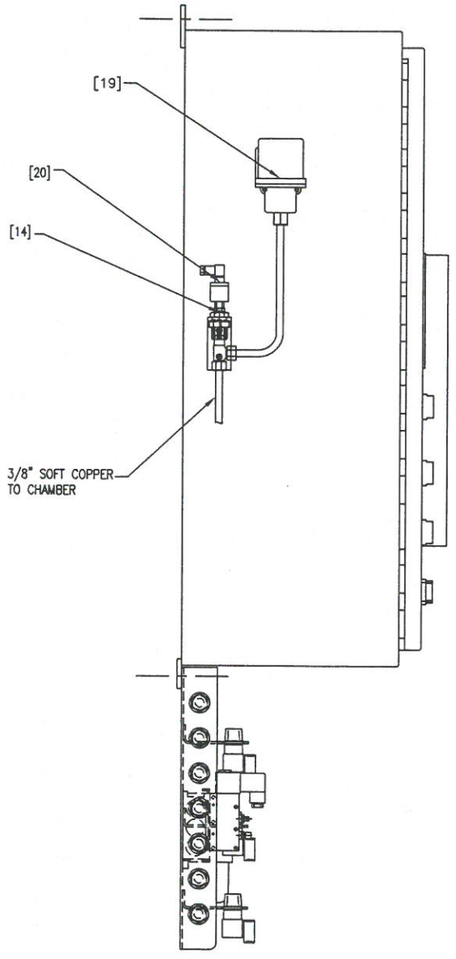
DRN. DWI		DATE: 5/10/12	
CHK.	APP.	SCALE: 1:16	

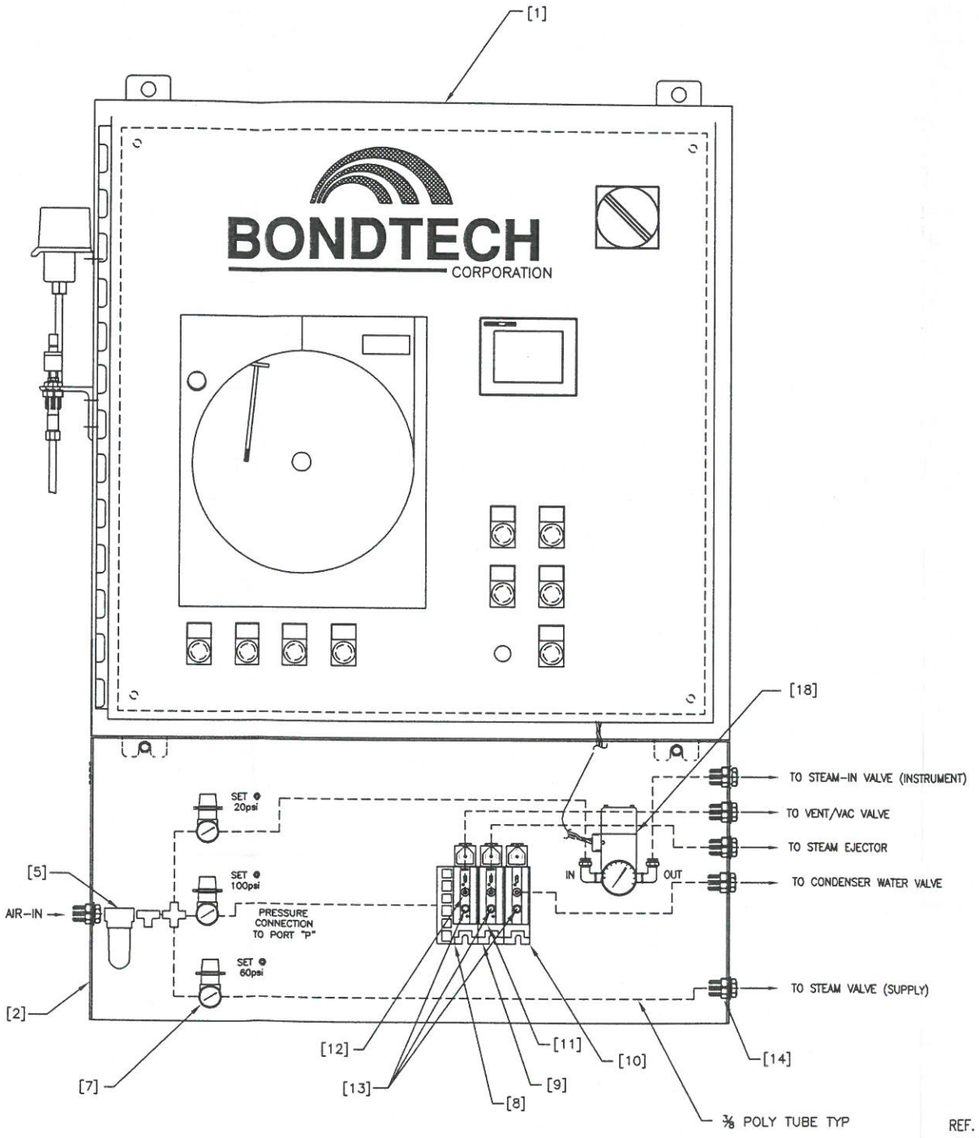
STATE WASTE SERVICES (NSW) AUSTRALIA
BTT6x13 ASSLEMBLY AND INSTALLATION DETAILS

NO. 12457-0000 REV. 0

BILL OF MATERIALS				
ITEM	QTY	DESCRIPTION	DWG/PART NO.	VENDER
1	1	ENCLOSURE w/MODIFICATIONS	971-325B	IMS
2	1	PNEU COMPONENTS BASE PLATE	971-312B	IMS
3				
4				
5	1	FILTER	F300-02	ARROW
6	–	–	–	–
7	3	REGULATOR	R162	ARROW
8	1	MANIFOLD INLET SEGMENT	P67701	RXRTH
9	1	MANIFOLD STATION SEGMENT	P67703	RXRTH
10	1	MANIFOLD END SEGMENT	P67702	RXRTH

BILL OF MATERIALS				
ITEM	QTY	DESCRIPTION	DWG/PART NO.	VENDER
11	3	4-WAY DIRECTIONAL VALVE	PW67697-1	RXRTH
12	3	3/8 TUBE ELBOW	P68392	RXRTH
13	3	BLANKING CAP	H891990-5502	RXRTH
14	6	1/4 ANCHOR COUPLING	207ACBH-4	PARKER
16				
17				
18	1	ELECTROPNEUMATIC TRANSMITTER	961-070	BELLOFRAM
19	1	PRESSURE SWITCH 0-200psi	H54-164	UN EL
20	1	PRESSURE TRANSDUCER	9308704	HONEYWELL





REV	DATE	REVISION DESCRIPTION	BY	CHK
1	xx/xx/xx	x	x	

REF. DRAWING:
12457-000D

MATERIAL	NO. REQ'D
	1

PROPRIETARY DATA NOT TO BE DISCLOSED, USED OR DUPLICATED FOR ANY PURPOSE EXCEPT AS AUTHORIZED IN WRITING BY BONDTECH CORPORATION.

BONDTECH CORPORATION
1278 HWY 461
SOMERSET, KY
42503 USA

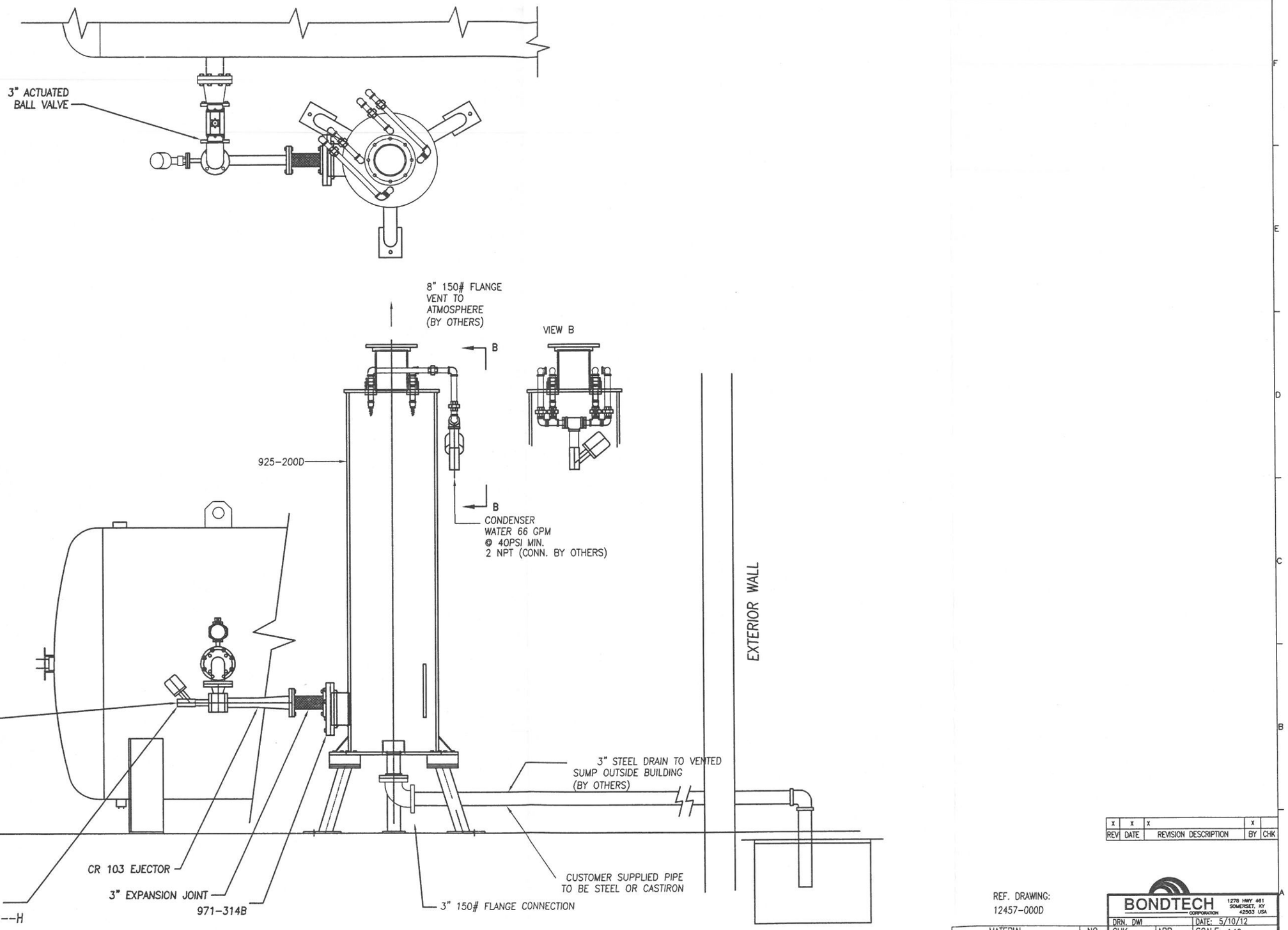
DRN. DWI	DATE: 10/23/09
CHK.	APP. SCALE: 1:4

ELECTRICAL / PNEUMATIC CONTROL CABINET ASSEMBLY

NO. 12457-027D REV. 0

UNLESS OTHERWISE INDICATED, TOLERANCES:
X.X = ± 0.025 ANGLES ± 1 DEG.
X.XX = ± 0.010 FRACTIONS ± 1/64
X.XXX = ± 0.005

DO NOT SCALE
BREAK ALL SHARP EDGES
REPORT ALL ERRORS TO ENGINEERING DEPT.



REV	DATE	REVISION DESCRIPTION	BY	CHK
X	X	X	X	

REF. DRAWING:
12457-000D

MATERIAL	NO. REQ'D
—	
—	1

PROPRIETARY DATA. NOT TO BE DISCLOSED, USED OR DUPLICATED FOR ANY PURPOSE EXCEPT AS AUTHORIZED IN WRITING BY BONDTECH CORPORATION.

BONDTECH CORPORATION
1278 HWY 461
SOMERSET, KY
42503 USA

DRN. DWI	DATE: 5/10/12
CHK. APP.	SCALE: 1:12
VACUUM EJECTOR PIPING DETAILS BTT6'x13'	
NO. 11711-100D	REV. 0

UNLESS OTHERWISE INDICATED, TOLERANCES:
X.X = ± 0.025 ANGLES ± 1 DEG.
X.XX = ± 0.010 FRACTIONS ± 1/64
X.XXX = ± 0.005

DO NOT SCALE
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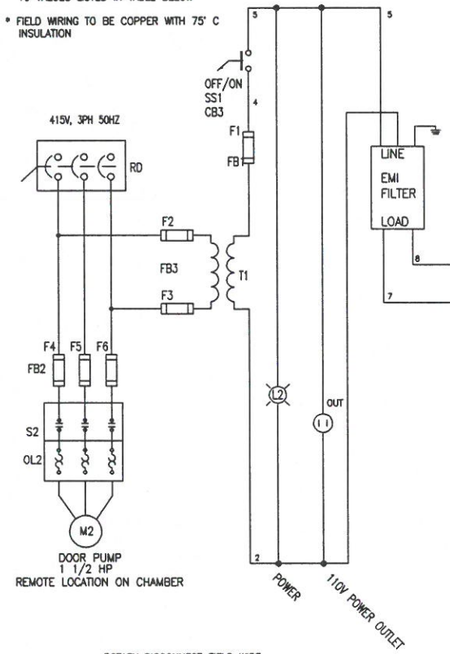
REPORT ALL ERRORS TO ENGINEERING DEPT.

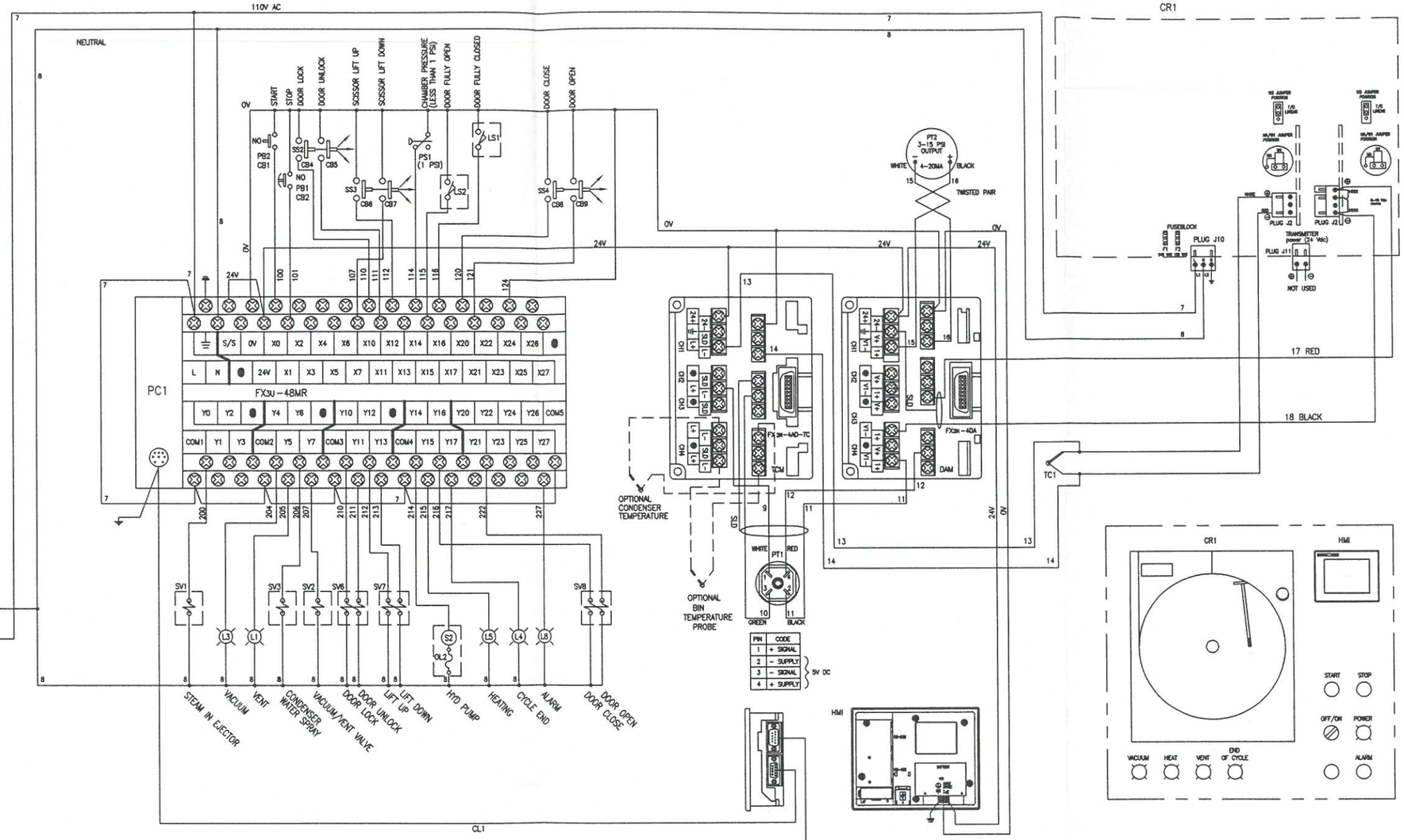
BILL OF MATERIALS			
ID	DESCRIPTION	PART#	VENDOR
CB1-9	CONTACT BLOCK N/O	E22B2	CUT-HAM
CL1	PLC TO DISPLAY CABLE	GT01-C30R4-8P	MITSUBISHI
CL2	DISPLAY TO PC CABLE	12457-705B	IMS
CR1	TRUE LINE CIRCULAR CHART RECORDER	DR45AT-3100-00-000-000L00-0	HONEYWELL
DAM	DIGITAL TO ANALOG OUTPUT MOD.	FX2N-4DA	MITSUBISHI
EMI	EMI FILTER	46F4401	NEWARK
F1	FUSE	ATDR2	FS
F2-3	FUSE	ATQ 1.5	FS
F4-6	FUSE	ATDR6	FS
FB1	FUSE BLOCK	USCC1I	FS
FB2	FUSE BLOCK	USCC3I	FS
FB3	FUSE BLOCK	USCC2I	FS
HMI	HMI TERMINAL	GT1040-QBBD	MITSUBISHI
L1	INDICATOR LIGHT/AMBER LENS	ND16-22DS/4-110-YW	CHINT
L2	INDICATOR LIGHT/WHITE LENS	ND16-22DS/4-110-WH	CHINT
L3	INDICATOR LIGHT/BLUE LENS	ND16-22DS/4-110-BL	CHINT
L4	INDICATOR LIGHT/GREEN LENS	ND16-22DS/4-110-GN	CHINT
L5,L8	INDICATOR LIGHT/RED LENS	ND16-22DS/4-110-RD	CHINT
LS1	LIMIT SWITCH	D4A-1110N	OMRON
LS2	LIMIT SWITCH	D4A-1101N	OMRON
OL2	OVERLOAD	XTOB0048C1	CUT-HAM
OUT	SINGLE OUTLET	5251	P.SEY.
PC1	PROGRAMMABLE CONTROLLER	FX3U-48MR	MITSUBISHI
PB1	MUSHROOM PUSH BUTTON/RED	E22L2	CUT-HAM
PB2	PUSH BUTTON/GREEN	E22P3	CUT-HAM
PS1	PRESSURE SWITCH	H54-164	UNITED ELECT
PT1	PRESSURE TRANSDUCER	9308704	HONEYWELL
PT2	ELECTROPNEUMATIC TRANS.	961-070	BELLOFRAM
RD	ROTARY DISCONNECT (30 AMP)	362NR30	CUT-HAM
S2	STARTER	XTCE007B10A	CUT-HAM
SS1	2 POSITION SELECTOR SWITCH	E22V51	CUT-HAM
SS2-4	3 POS. SEL SW. (SPNG TO CENT.)	E22VL1	CUT-HAM
SV1-3	SOLENOID VALVE	P67697-1	REXROTH
SV6-8	SOLENOID VALVE	22020120	DELTA
T1	150VA TRANSFORMER	FS-3-150	ACME
TCM	THERMOCOUPLE MODULE	FX2N-4AD-TC	CUT-HAM
TC1	THERMOCOUPLE	NB1-ICIN-14U-12	OMEGA

NOTE:
- TORQUE ROTARY DISCONNECT FIELD TERMINAL WIRING SCREWS TO VALUES LISTED IN TABLE BELOW
- FIELD WIRING TO BE COPPER WITH 75° C INSULATION



ROTARY DISCONNECT FIELD WIRE TERMINAL TORQUE VALUES

WIRE GAUGE	TORQUE (LB-IN)
6 AWG	35
8 AWG	25
10-14AWG	20



MAIN DISCONNECT AND BRANCH CIRCUIT PROTECTION PROVIDED BY INSTALLER

BLACK – LINE & LOAD CIRCUITS, AC OR DC ABOVE 150 VOLTS.
RED – AC CONTROL CIRCUITS, 150 VOLTS & LOWER.
BLUE – DC CONTROL CIRCUITS, 150 VOLTS & LOWER.
YELLOW – ALL CONTROL CIRCUITS WHICH MAY REMAIN ENERGIZED WHEN MAIN DISCONNECTING MEANS IS IN THE OFF POSITION, AND AC CONTROL CIRCUITS ABOVE 150 VOLTS.
GREEN – (WITH OR WITHOUT A YELLOW STRIPE) – EQUIPMENT GROUNDING CONDUCTORS (NON-CURRENT CARRYING).
WHITE – GROUNDED (CURRENT CARRYING) AC CIRCUIT CONDUCTORS (NEUTRAL)

DC WIRING
AC WIRING

REV	DATE	REVISION DESCRIPTION	BY	CHK
0	xx/xx/xx	X	X	

UNLESS OTHERWISE INDICATED, TOLERANCES:
X.X = ± 0.025 ANGLES ± 1 DEG.
X.XX = ± 0.010 FRACTIONS ± 1/64
X.XXX = ± 0.005

DO NOT SCALE
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REPORT ALL ERRORS TO ENGINEERING DEPT.

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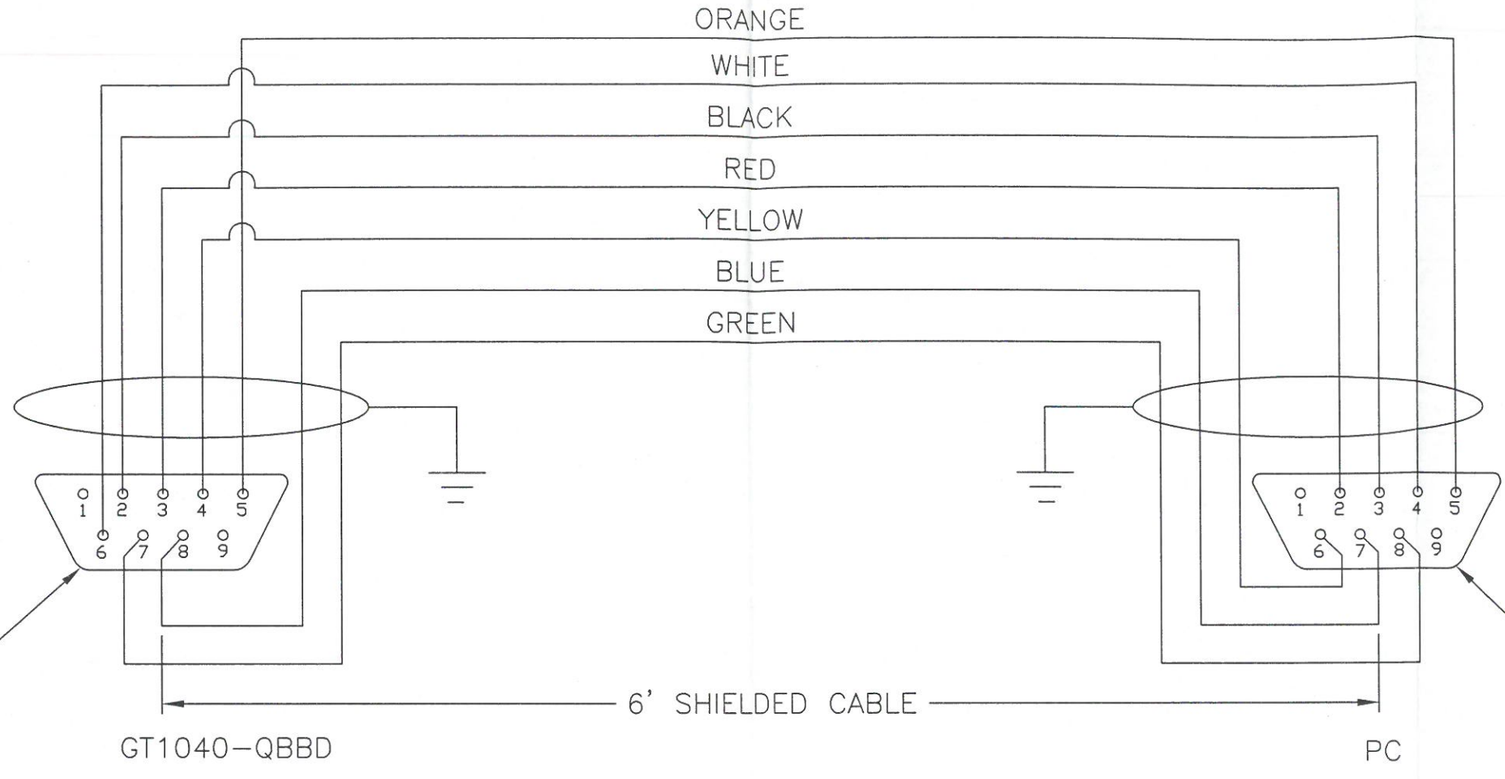
MATERIAL	NO. REQ'D
	1

BONDTECH CORPORATION
1278 HWY 461
SOMERSET, KY
42503 USA

DRN. DWI		DATE: 8/05/11	
CHK.	APP.	SCALE: 1:1.2	

POWER AND CONTROL SCHEMATIC

NO. 12457-700D REV. 0



CONN. FEMALE 9 POS.
NEWARK –
CONN. #81F5176
HOOD #89F001

GT1040–QBBD

6' SHIELDED CABLE

PC

CONN. FEMALE 9 POS.
NEWARK –
CONN. #81F5176
HOOD #89F001

REV	DATE	REVISION DESCRIPTION	BY	CHK
#	xx/xx/xx	X	X	

*FOR PROGRAMMING PLC & GT1040–QBBD

REF. DRAWING:
12457–700D

MATERIAL	NO. REQ'D
AS NOTED	1

PROPRIETARY DATA NOT TO BE DISCLOSED, USED OR DUPLICATED FOR ANY PURPOSE EXCEPT AS AUTHORIZED IN WRITING BY BONDTECH CORPORATION.

BONDTECH CORPORATION
1278HWY 461
SOMERSET, KY
42503 USA

DRN. JLL		DATE: 06/24/10
CHK.	APP.	SCALE: NTS

DISPLAY TO PC CABLE

NO. 12457–705B REV. 0

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X.XXX = ± 0.005

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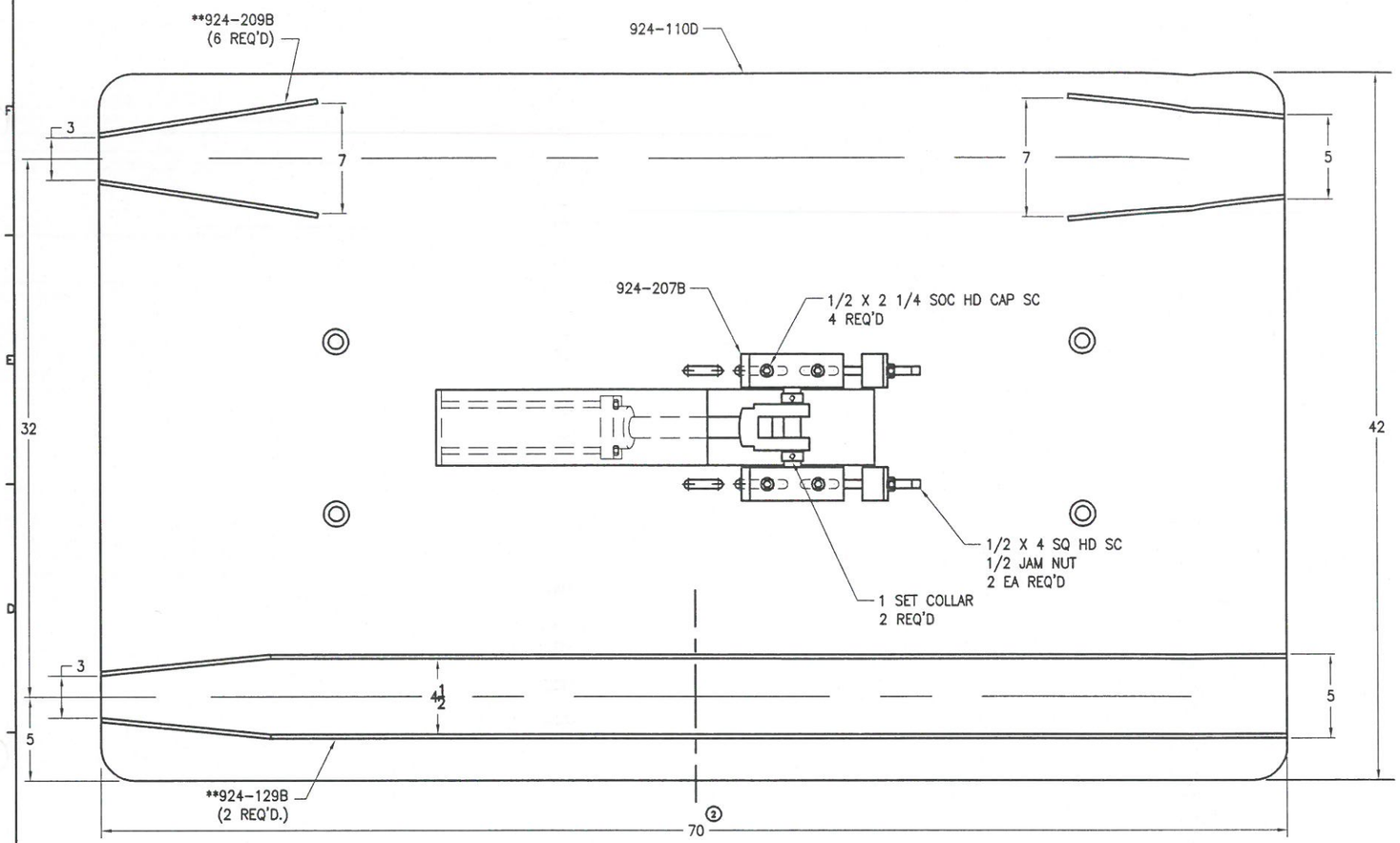
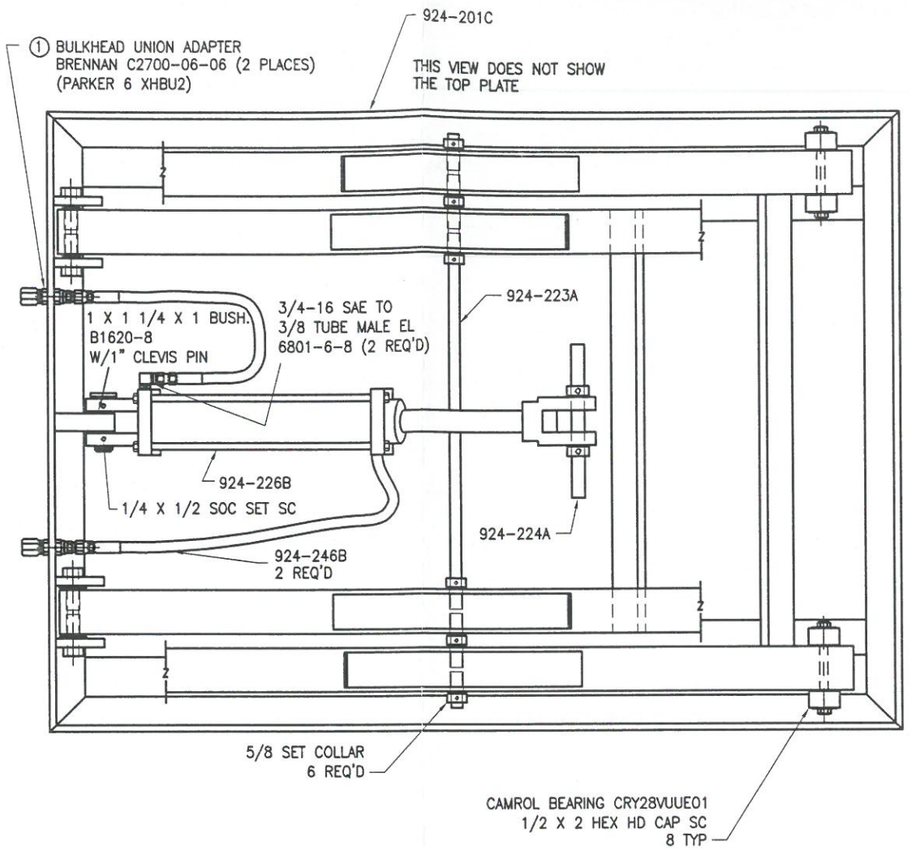
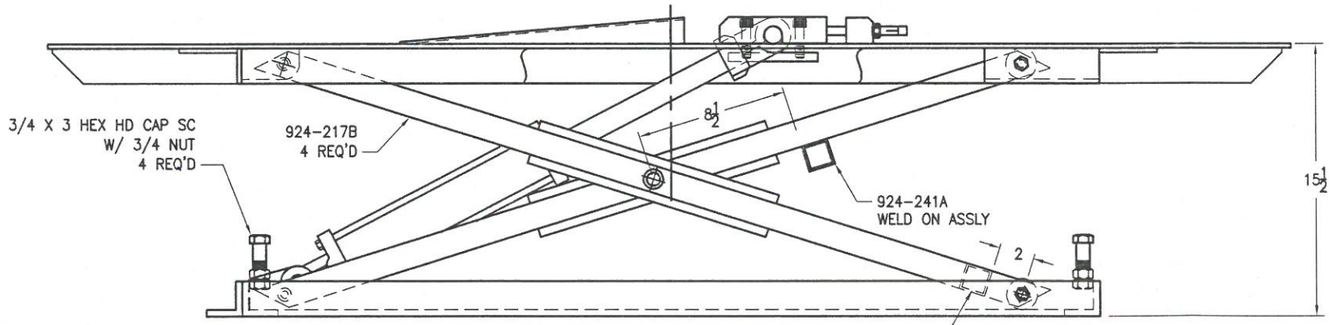
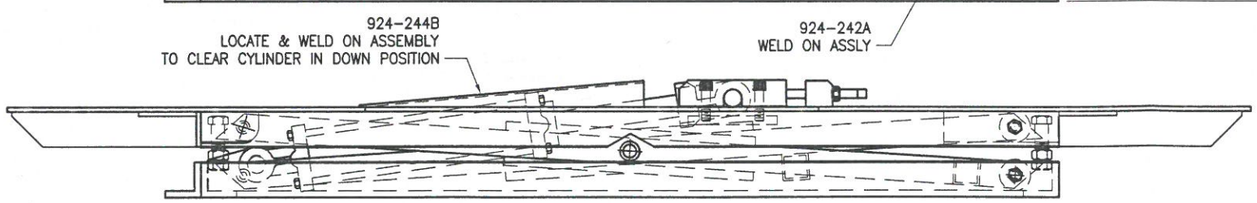




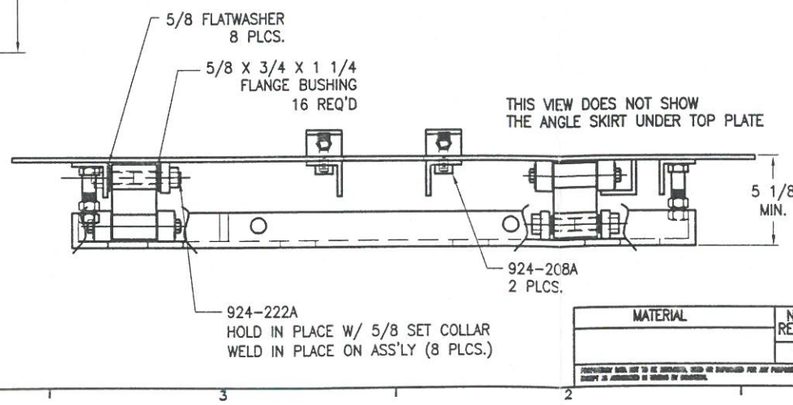


THIS VIEW SHOWS CYLINDER EXTENDED

** THESE PIECES ARE TO BE WELDED ON AFTER CHAMBER DOOR SWING IS DETERMINED.



THESE VIEWS SHOW CYLINDER RETRACTED



REV	DATE	REVISION DESCRIPTION	BY	CHK
2	1-9-03	LENGTH DIMENSION WAS 64	BRB	
1	8-15-01	REPLACED FITTING WITH B.H. UNION	BRB	

REF. DRAWING:

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X.XX = ± 0.010 FRACTIONS ± 1/64
X.XXX = ± 0.005

DO NOT SCALE
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REPORT ALL ERRORS TO ENGINEERING DEPT.

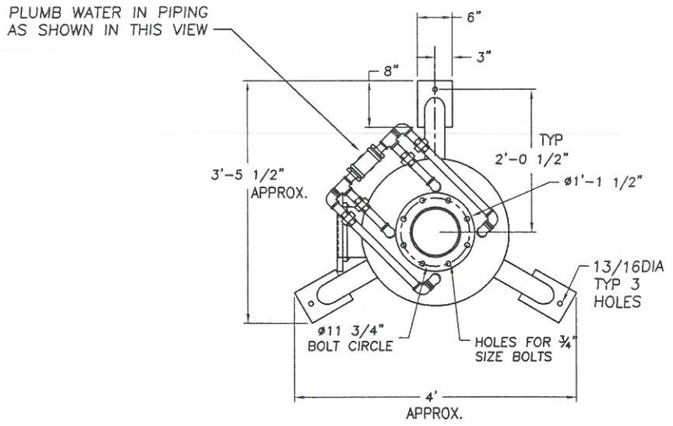
MATERIAL	NO. REQ'D
	1

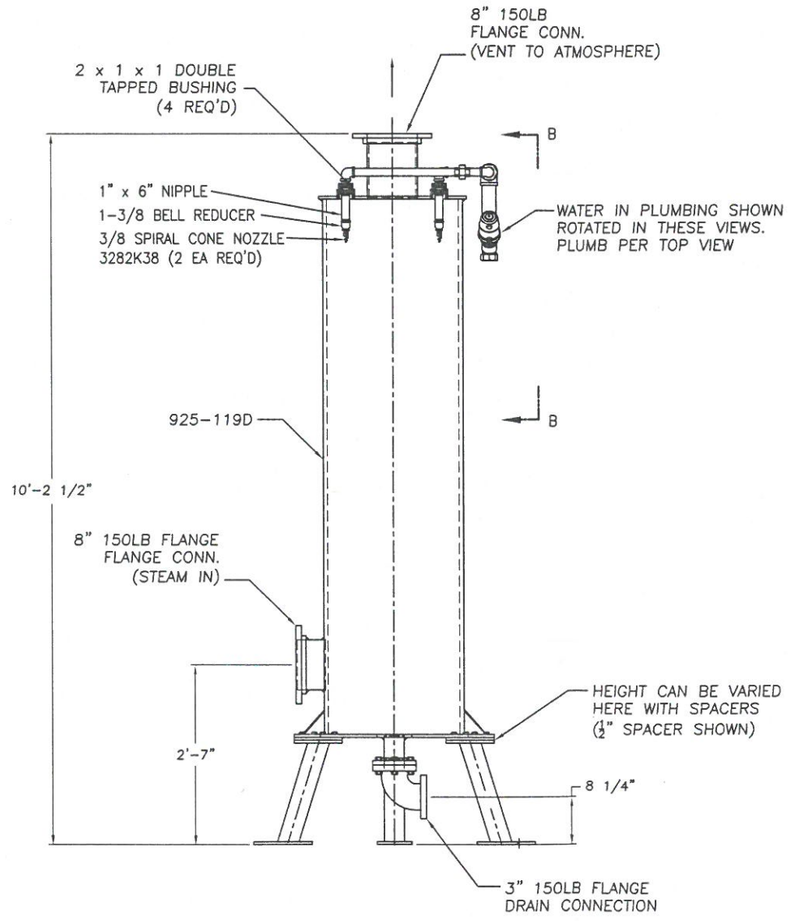
BONDTECH CORPORATION
2400 N. HWY. 27
SOMERSET, KY
42503 USA

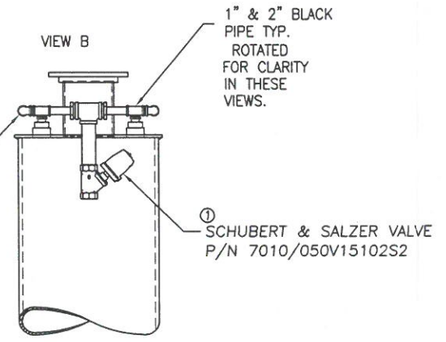
DRN. LU		DATE: 3-1-06	
CHK.	APP.	SCALE: 1/4	

SCISSOR LIFT ASSEMBLY WITH EXTENDED TOP FOR PIT INSTALLATION

NO. 924-100D REV. 2







FOR 19' LONG CHAMBERS

REV	DATE	REVISION DESCRIPTION	
3	11/23/10	OAH SHORTENED 3/4"	JLL
2	07/19/22	CHG 24" PIPE FROM 96" TO 93"	-
1	11/29/04	REV. TO ANGLE BODY VALVE	-

UNLESS OTHERWISE INDICATED, TOLERANCES:
X.X = ± 0.025 ANGLES ± 1 DEG.
X.XX = ± 0.010 FRACTIONS ± 1/64
X.XXX = ± 0.005

DO NOT SCALE
BREAK ALL SHARP EDGES
REPORT ALL ERRORS TO ENGINEERING DEPT.

MATERIAL	NO. REQ'D
	1

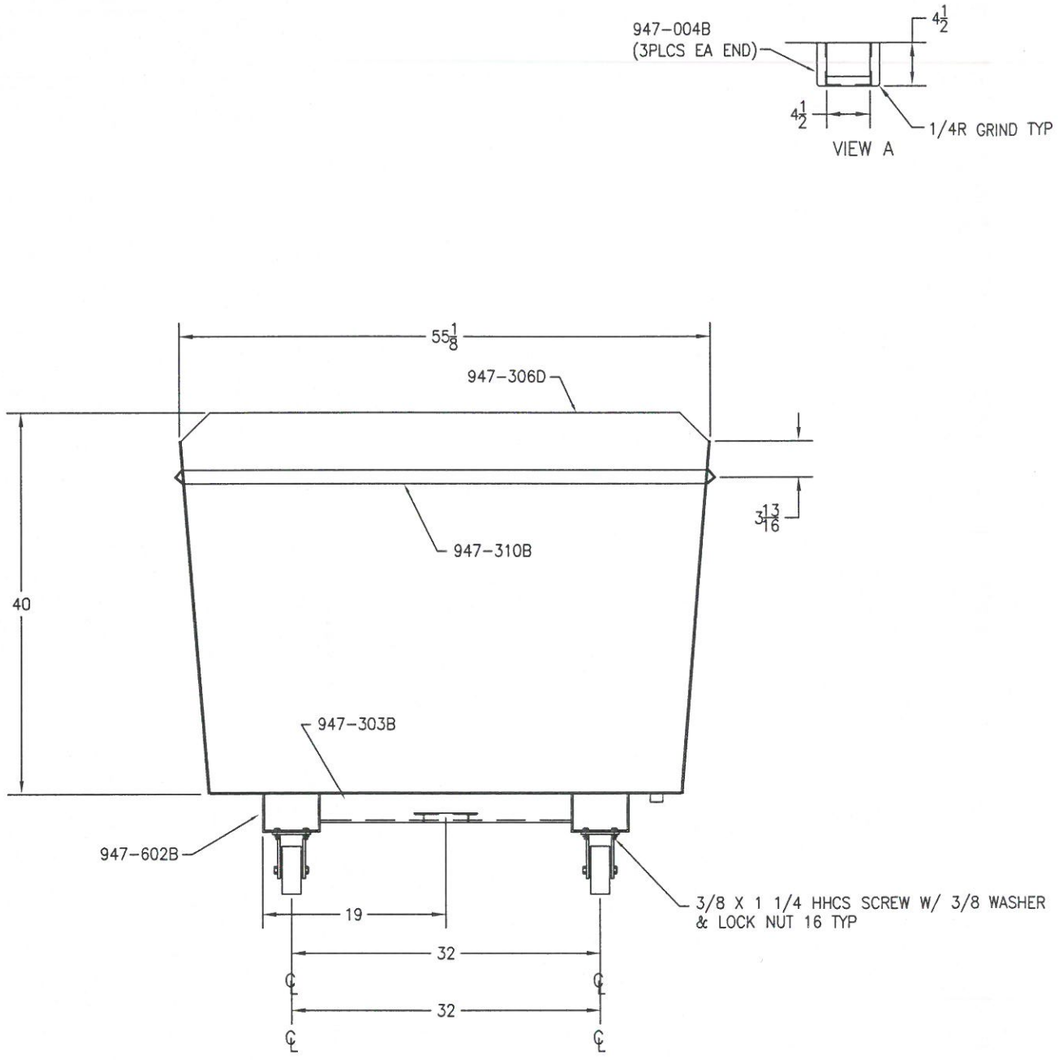
PROPRIETARY DATA NOT TO BE DISCLOSED, USED OR DUPLICATED FOR ANY PURPOSE EXCEPT AS AUTHORIZED IN WRITING BY BONDTECH CORPORATION.

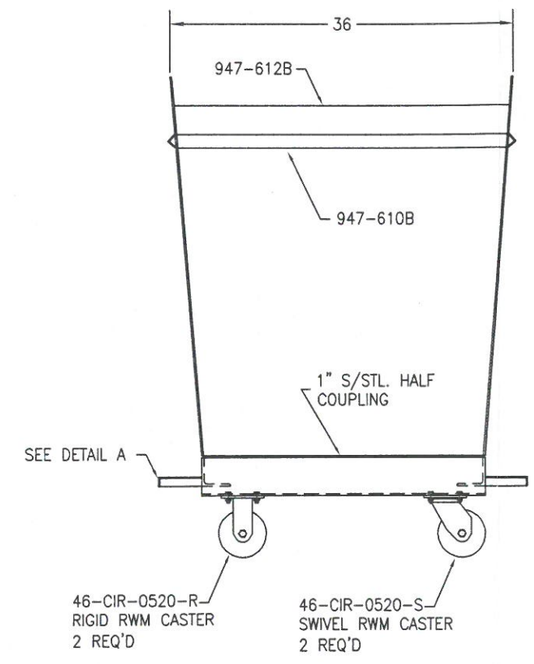
BONDTECH CORPORATION
1278 HWY. 461
SOMERSET, KY
42503 USA

DRN. DGP | DATE: 06/14/00
CHK. | APP. | SCALE: 1"=1'-0"

CONDENSER ASSEMBLY FOR 8' DIA. CHAMBER

NO. 925-2000 | REV. 3





WO# 12873-02

DO NOT SCALE
BREAK ALL SHARP EDGES
REPORT ALL ERRORS TO ENGINEERING DEPT.

UNLESS OTHERWISE INDICATED, TOLERANCES:
± X.X = 0.025
± X.XX = 0.010
± X.XXX = 0.005
ANGLES ± 1 DEG.
FRACTIONS ± 1/64

MATERIAL	NO. REQ'D
	4

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BONDTECH CORPORATION
2400 N. HWY 27
SOMERSET, KY
42503 USA

DRN. LLI | DATE: 3-1-06
CHK. | APP. | SCALE: 1/8

STAINLESS STEEL CART ASSBY.
13' LG. AUTOCLAVE

NO. 947-600D | REV.