BANNER WILDLIFE AREA
STAGE II, LAGRANGE POOL
CONTRACT NO. DACW25-99-B-0021

OPERATION AND MAINTENANCE INSTRUCTIONS

SECTION 15160 PUMPING EQUIPMENT
SECTION 16415-2.12 MOTOR CONTROLS

REPRESENTATIVE AND SERVICE CENTER
GENERAL PUMP & MACHINERY, INC.
1044 W. OLYMPIA DR.
PEORIA, IL 61615

PH. 309/693-7444
FX. 309/693-8166

SALES ORDER NO. 208181

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STANDARD SPECIFICATIONS: DSZ3

		Standard	Optional
Design	Bore (Column Dia.)	24 to 54 inch	
	Range of Input HP	10 to 422 HP	
	Range of Performance	Capacity: 2500 to 55000 GPM Total Head: 5 to 50 ft.	
	Liquid Temperature	32 to 104ºF	
	Max. Allw. Subm.	82 Ft.	
	Speed	~~1800, 1200, 900~~, 720, ~~600~~ R.P.M.	
Materials	Casing	Cast Iron	
	Impeller	~~Ductile Cast Iron~~	Bronze, ~~Stainless Steel~~
	Shaft	403 Stainless Steel	
	Motor Frame	Cast Iron	
	Fastener	304 Stainless Steel	
Construction	Impeller	Axial Flow or Mixed Flow	
	Shaft Seal	Cartridge Type Duplex Mechanical Seals in Tandem Arrange.	
	. . . Upper	Carbon/Ceramic	~~Carbon/Tungsten Carbide~~
	. . . Lower	Silicon Carbide/Silicon Carbide	~~Tungsten Carbide/Tungsten Carbide~~
	Bearing	Grease Lubricated Ball Bearing	
	Mounting Method	Sole Plate with Rotation Stopper	
Motor	Type	Air-Filled Motor	~~FM Explosion Proof~~
	Starting Method	Direct on Line	~~Class 1, Division 1, Groups C,D~~
	Hz, Voltage	60Hz 460V	
	Protection	Built-In Winding Temp. Detector Built-In Float Type Leakage Detector Thrust Bearing Temperature Detector	
Accessories		~~50~~ Ft. Submersible Cable Cable Glands for Each Cable Sole Plate with Rotating Stopper	Column Pipe
Codes & Standards		ISO 9000 ISO 9001	

	Standard		
Parts	**Type I**	**Type II**	**Type III**
Discharge Bowl	Cast Iron ASTM A48 CL35	→	→
Suction Bell Mouth	Cast Iron ASTM A48 CL35	→	→
Casing Liner	Stainless Steel ASTM A743 CF8	→	→
Impeller	~~Ductile Cast Iron ASTM A536 60-40-18~~	Bronze ASTM B584 C90300	~~Stainless Steel ASTM A743 CF8~~
Shaft	Stainless Steel AISI 403	→	→
Motor Frame	Cast Iron ASTM A48 CL35	→	→
Mechanical Seal	Upper: Carbon/Ceramic Lower: Silicon Carbide/Silicon Carbide		

Option	
Mechanical Seal	~~Upper: Carbon/Tungsten Carbide~~ ~~Lower: Tungsten Carbide/Tungsten Carbide~~

Note:
1. Other materials may be used if requested.

EBARA SUBMERSIBLE PROPELLER PUMPS

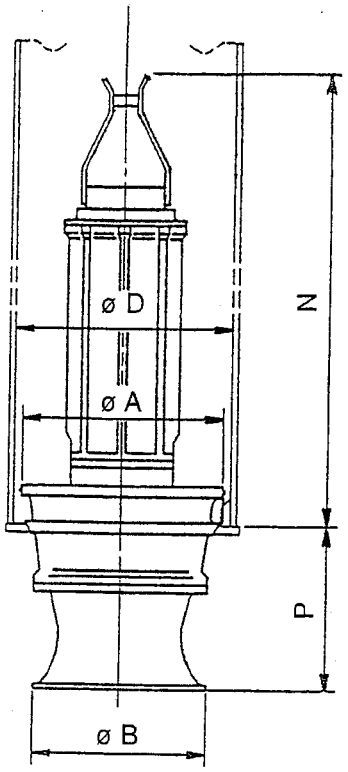
DSZ3

DIMENSIONS

3-233
November 10, 1997

PROJECT: MODEL: CHK'D: DATE:

■ APPLY TO MODEL V0754, V0854, V0974



■ DIMENSIONS : inch

Model (Pole)	HP	Pump & Motor					(※1) Weight Lbs
		A	B	P	N	Column Pipe Dia. D	
V0754-710 (10 POLES)	100	38 9/16	27 9/16	24 3/16	86 9/16	40	4600
V0854-710 (10 POLES)	100	38 9/16	28 11/16	25 9/16	86 3/16	40	4780
	120	38 9/16	28 11/16	25 9/16	86 3/16	40	5240
	145	38 9/16	28 11/16	25 9/16	90 3/16	40	5550
V0974-710 (10 POLES)	175	46 1/2	39 7/16	28 15/16	94 1/16	48	7700
	200	46 1/2	39 7/16	28 15/16	94 1/16	48	7920
	215	46 1/2	39 7/16	28 15/16	94 1/16	48	7920
	~~245~~	~~46 1/2~~	~~39 7/16~~	~~28 15/16~~	~~102~~	~~48~~	~~8230~~
→	265	46 1/2	39 7/16	28 15/16	102	48	8410

■ DIMENSIONS : mm

Model (Pole)	KW	PUMP & MOTOR					(※1) Weight kgf
		A	B	P	N	Column Pipe Dia. D	
V0754-710 (10 POLES)	75	980	700	615	2200	1000	2090
V0854-710 (10 POLES)	75	980	730	650	2190	1000	2170
	90	980	730	650	2190	1200	2380
	110	980	730	650	2290	1000	2520
A0974-710 (10 POLES)	132	1180	1000	735	2390	1200	3500
	150	1180	1000	735	2390	1200	3600
	160	1180	1000	735	2390	1200	3600
	185	1180	1000	735	2590	1200	3740
	200	1180	1000	735	2590	1200	3820

DIMENSIONS ARE APPROXIMATE

Note ※1. Cable weights of 33 ft are included.

MECHANICAL SEAL & BALL BEARING SPECIFICATIONS

Poles	kW	(Hp)	Frame No.	Mechanical Seal Size (Dia. mm)	Ball Bearing Size		
					Lower–Thrust	Thrust BRG Type	Upper–Radial
8	7.5	(10)	Contact Ebara				
	11	(15)					
	15	(20)					
	18.5	(25)	292	63	7214BDB	Double Row	6212ZZ
	22	(30)	292	63	7214BDB	Double Row	6212ZZ
	30	(40)	292	75	7220BDB	Double Row	6212ZZ
	37	(50)	292	75	7220BDB	Double Row	6212ZZ
	45	(60)	380	63	7216B+QJ	Double Row	6216ZZ
	55	(75)	380	75	7216B+QJ	Double Row	6216ZZ
	75	(100)	380	100	7222B+QJ	Double Row	6216ZZ
	90	(120)	480	100	7222B+QJ	Double Row	6218ZZ
	110	(145)	480	100	7222B+QJ	Double Row	6218ZZ
	132	(175)	480	100	7226B+QJ	Double Row	6218ZZ
	150	(200)	480	100	7226B+QJ	Double Row	6218ZZ
	160	(215)	480	100	7226BDT+QJ	Triple Row	6218ZZ
	185	(245)	590	120	7226BDT+QJ	Triple Row	6220ZZ
	200	(265)	590	120	7226BDT+QJ	Triple Row	6220ZZ
	220	(295)	590	120	7230BDT+QJ	Triple Row	6220ZZ
	250	(335)	590	120	7230BDT+QJ	Triple Row	6220ZZ
	280	(375)	590	135	7230BDT+QJ	Triple Row	6220ZZ
	315	(422)	Contact Ebara				
	355	(475)					
	400	(535)					
10	15	(20)	380	63	7216DBD	Double Row	6216ZZ
	18.5	(25)	380	63	7216BDB	Double Row	6216ZZ
	22	(30)	380	63	7216BDB	Double Row	6216ZZ
	30	(40)	380	63	7216BDB	Double Row	6216ZZ
	37	(50)	380	63	7216B+QJ	Double Row	6216ZZ
	45	(60)	380	75	7216B+QJ	Double Row	6216ZZ
	55	(75)	380	75	7216B+QJ	Double Row	6216ZZ
	75	(100)	480	100	7222B+QJ	Double Row	6218ZZ
	90	(120)	480	100	7222B+QJ	Double Row	6218ZZ
	110	(145)	480	120	7226B+QJ	Double Row	6218ZZ
	132	(175)	590	120	7226BDT+QJ	Triple Row	6220ZZ
	150	(200)	590	120	7226BDT+QJ	Triple Row	6220ZZ
	160	(215)	590	120	7226BDT+QJ	Triple Row	6220ZZ
	~~185~~	~~(245)~~	~~590~~	~~120~~	~~7230BDT+QJ~~	~~Triple Row~~	~~6220ZZ~~
→	200	(265)	590	120	7230BDT+QJ	Triple Row	6220ZZ
	~~220~~	~~(295)~~	~~590~~	~~135~~	~~7230BDT+QJ~~	~~Triple Row~~	~~6220ZZ~~
	250	(335)	590	135	7230BDT+QJ	Triple Row	6220ZZ
	280	(375)	Contact Ebara				
	315	(422)					
12	22	(30)	380	63	7216BDB	Double Row	6216ZZ
	30	(40)	380	63	7216B+QJ	Double Row	6216ZZ
	37	(50)	380	63	7216B+QJ	Double Row	6216ZZ
	45	(60)	380	100	7222BDB	Double Row	6216ZZ
	55	(75)	480	100	7222B+QJ	Double Row	6218ZZ
	75	(100)	480	100	7222B+QJ	Double Row	6218ZZ
	90	(120)	480	100	7222B+QJ	Double Row	6218ZZ
	110	(145)	590	120	7226BDT+QJ	Triple Row	6220ZZ
	132	(175)	590	120	7226BDT+QJ	Triple Row	6220ZZ
	150	(200)	590	120	7226BDT+QJ	Triple Row	6220ZZ
	160	(215)	590	120	7226BDT+QJ	Triple Row	6220ZZ
	185	(245)	590	120	7226BDT+QJ	Triple Row	6220ZZ
	200	(265)	590	120	7230BDT+QJ	Triple Row	6220ZZ
	220	(295)	590	135	7230BDT+QJ	Triple Row	6220ZZ
	250	(335)	Contact Ebara				
	280	(375)					
	315	(422)					

IMPELLER DESIGN

Curve No.	Type of Impeller	Nos. of Blades	Max. Solid Dia.
A0553	Axial Flow	3	3 9/16 inch (90 mm)
A0713			4 9/16 inch (116 mm)
A0843			5 7/16 inch (138 mm)
A1003			6 7/16 inch (164 mm)
C1125	Axial Flow	5	1 3/8 inch (35 mm)
C1285			1 9/16 inch (40 mm)
C1455			1 3/4 inch (45 mm)
C1605			2 inch (50 mm)
C1915			2 3/8 inch (60 mm)
C2185			2 11/16 inch (68 mm)
C2905			3 9/16 inch (91 mm)
V0494	Axial Flow	4	2 3/16 inch (56 mm)
V0554			2 1/2 inch (63 mm)
V0754			3 7/16 inch (87 mm)
~~V0854~~			~~3 7/8 inch (98 mm)~~
→ V0974			4 7/16 inch (112 mm)
~~V1154~~			~~5 1/4 inch (133 mm)~~

LUBRICATING OIL FOR MECHANICAL SEAL

MODEL DSZ

Curve No.	Pole	KW (HP)	Lubricating Oil (CC)
A0553-880	8	7.5 (10)	Contact Ebara
		11 (15)	
		15 (20)	
		18.5 (25)	3000
A 713-710	10	18.5 (25)	4700
		22 (30)	4700
		30 (40)	4700
		37 (50)	4700
A0843-710	10	37 (50)	6900
		45 (60)	6900
		55 (75)	6900
		75 (100)	6700
A1003-593	12	55 (75)	Contact Ebara
		75 (100)	
		90 (120)	
C1125-1760	4	22 (30)	Contact Ebara
		30 (40)	
		37 (50)	2700
C1455-1170	6	22 (30)	Contact Ebara
		30 (40)	3400
		37 (50)	3400
		45 (60)	3200
C1605-1170	6	45 (60)	4500
		55 (75)	4500
		75 (100)	4200
C2185-885	8	75 (100)	7100
		90 (120)	7700
		110 (145)	7700
		132 (175)	7600
C2905-710	10	150 (200)	10500
		160 (215)	10500
		185 (245)	10500
		200 (265)	10500
		220 (295)	10400
		250 (335)	10400
V0494-1170	6	18.5 (25)	Contact Ebara
		22 (30)	
		30 (40)	2600
		37 (50)	2600

Curve No.	Pole	KW (HP)	Lubricating Oil (CC)
V0494-880	8	7.5 (10)	Contact Ebara
		11 (15)	
		15 (20)	
V0554-1170	6	37 (50)	2800
		45 (60)	2700
		55 (75)	2700
V0554-880	8	15 (20)	Contact Ebara
		18.5 (25)	2800
		22 (30)	2800
		30 (40)	2700
V0754-885	8	75 (100)	5400
		90 (120)	5700
		110 (145)	5700
		132 (175)	5600
V0754-710	10	37 (50)	5800
		45 (60)	5800
		55 (75)	5800
		75 (100)	5700
V0854-710	10	75 (100)	5700
		90 (120)	5700
		110 (145)	5400
V0974-710	10	132 (175)	8800
		150 (200)	8800
		160 (215)	8800
		~~185 (245)~~	~~8800~~
	→	200 (265)	8800
V1154-593	12	~~150 (200)~~	Contact Ebara
		160 (215)	
		185 (245)	
		200 (265)	
		220 (295)	
		250 (335)	
		280 (375)	
		315 (442)	

PROJECT: MODEL: CHK'D: DATE:

LUBRICATION

	Lower Bearing	Upper Bearing	Shaft Seal
Lubricant	Grease	Grease	Turbine Oil (see Note 1)
Standard	NLGI grade 3	Mobil SHC32	ISO VG32
ESSO	UNIREX N3		TERESSO 32
MOBIL	MOBILITH AW3		MOBIL DTE OIL, OIL LIGHT
SHELL	–		SHELL TURBO OIL 32

Note 1 : Other lubricants may be used when the oil is not allowed.

SHOP PAINTING

Coating Spec. No.	I	II	III
Preparation	SSPC - SP - 10	SSPC - SP - 3	SSPC - SP - 10
Materials & coating nos.	Coal tar epoxy paint x 3	Zinc rich primer x 1	Zinc chromate primer x 1
			Alkyd resin enamel x 1
Color	Black	Gray	Gray
Total dry film thick. (mill)	8 to 18	.5 to 1	2 to 2.5

Spec. No. I : surfaces contacting pumping liquid
Spec. No. II : internal surface of motor
Spec. No. III : surfaces in air

Note: Non-ferrous material and stainless steel are not painted.

MOTOR SPECIFICATIONS AND ELECTRICAL DATA

PROJECT: MODEL: CHK'D: DATE:

Motor Data, 60Hz x 460V

Pole	kW	(Hp)	Frame No.	Full Load (A)	Efficiency %			Power Factor %		
					1/2 Load	3/4 Load	1/1 Load	1/2 Load	3/4 Load	1/1 Load
10	15	(20)	380	27	83.8	86.3	86.8	66.7	76.2	80.6
	18.5	(25)	380	33	85.1	87.4	87.9	67.4	76.7	81.1
	22	(30)	380	40	85.8	88.1	88.6	62.2	73.1	78.6
	30	(40)	380	53	88.1	89.7	89.8	64.1	74.4	79.3
	37	(50)	380	66	88.6	90.1	90.2	62.3	73.2	78.5
	45	(60)	380	78	89.2	90.6	90.5	66.2	75.8	80.3
	55	(75)	380	96	90.2	91.3	91.1	65.0	75.0	79.6
	75	(100)	480	118	91.5	92.6	92.6	78.3	84.6	86.2
	90	(120)	480	143	91.9	93.0	93.0	75.7	82.9	85.3
	110	(145)	480	174	92.4	93.5	93.5	74.9	82.5	85.2
	132	(175)	590	209	92.0	93.3	93.6	74.7	82.3	84.9
	150	(200)	590	236	92.2	93.4	93.7	75.4	82.8	85.2
	160	(215)	590	255	92.3	93.6	93.9	73.1	81.3	84.1
	~~185~~	~~(245)~~	~~590~~	~~292~~	~~92.2~~	~~93.4~~	~~93.7~~	~~75.7~~	~~82.8~~	~~84.9~~
	200	(265)	590	315	92.3	93.6	93.9	75.1	82.5	84.8
	~~220~~	~~(295)~~	~~590~~	~~344~~	~~92.6~~	~~93.7~~	~~93.8~~	~~76.0~~	~~84.2~~	~~85.6~~
	250	(335)	590	394	92.4	93.6	93.9	76.0	82.9	84.9
	280	(375)	Contact Ebara							
	315	(422)								

Pole	kW	(Hp)	Start Currt. %	Start Torq. %	Mech. Size	Cable Size x Nos.		Bearing Size		NEMA Code Letters
						Star-delta	Direct on Line	Lower	Upper	
10	15	(20)	507	127	63	N/A	AWG#8 x 1	7216BDB	6216ZZ	F
	18.5	(25)	515	129	63		AWG#8 x 1	7216BDB	6216ZZ	F
	22	(30)	540	138	63		AWG#8 x 1	7216BDB	6216ZZ	G
	30	(40)	513	128	63		AWG#6 x 1	7216BDB	6216ZZ	F
	37	(50)	523	132	63		AWG#4 x 1	7216B+QJ	6216ZZ	F
	45	(60)	510	126	75		AWG#4 x 1	7216B+QJ	6216ZZ	F
	55	(75)	504	125	75		AWG#1 x 1	7216B+QJ	6216ZZ	F
	75	(100)	535	100	100		AWG#1 x 1	7222B+QJ	6218ZZ	F
	90	(120)	558	105	100		AWG#2/0 x 1	7222B+QJ	6218ZZ	F
	110	(145)	576	109	120		AWG#4/0 x 1	7226B+QJ	6218ZZ	F
	132	(175)	602	113	120		AWG#1 x 2	7226BDT+QJ	6220ZZ	G
	150	(200)	597	111	120		AWG#1 x 2	7226BDT+QJ	6220ZZ	G
	160	(215)	605	114	120		AWG#1 x 2	7226BDT+QJ	6220ZZ	G
	~~185~~	~~(245)~~	~~570~~	~~106~~	~~120~~		~~AWG#2/0 x 2~~	~~7230BDT+QJ~~	~~6220ZZ~~	~~F~~
	200	(265)	588	110	120		AWG#2/0 x 2	7230BDT+QJ	6220ZZ	F
	~~220~~	~~(295)~~	~~549~~	~~102~~	~~135~~		~~AWG#2/0 x 2~~	~~7230BDT+QJ~~	~~6220ZZ~~	~~F~~
	250	(335)	565	106	135		AWG#2/0 x 3	7230BDT+QJ	6220ZZ	F
	280	(375)	Contact Ebara							
	315	(422)								

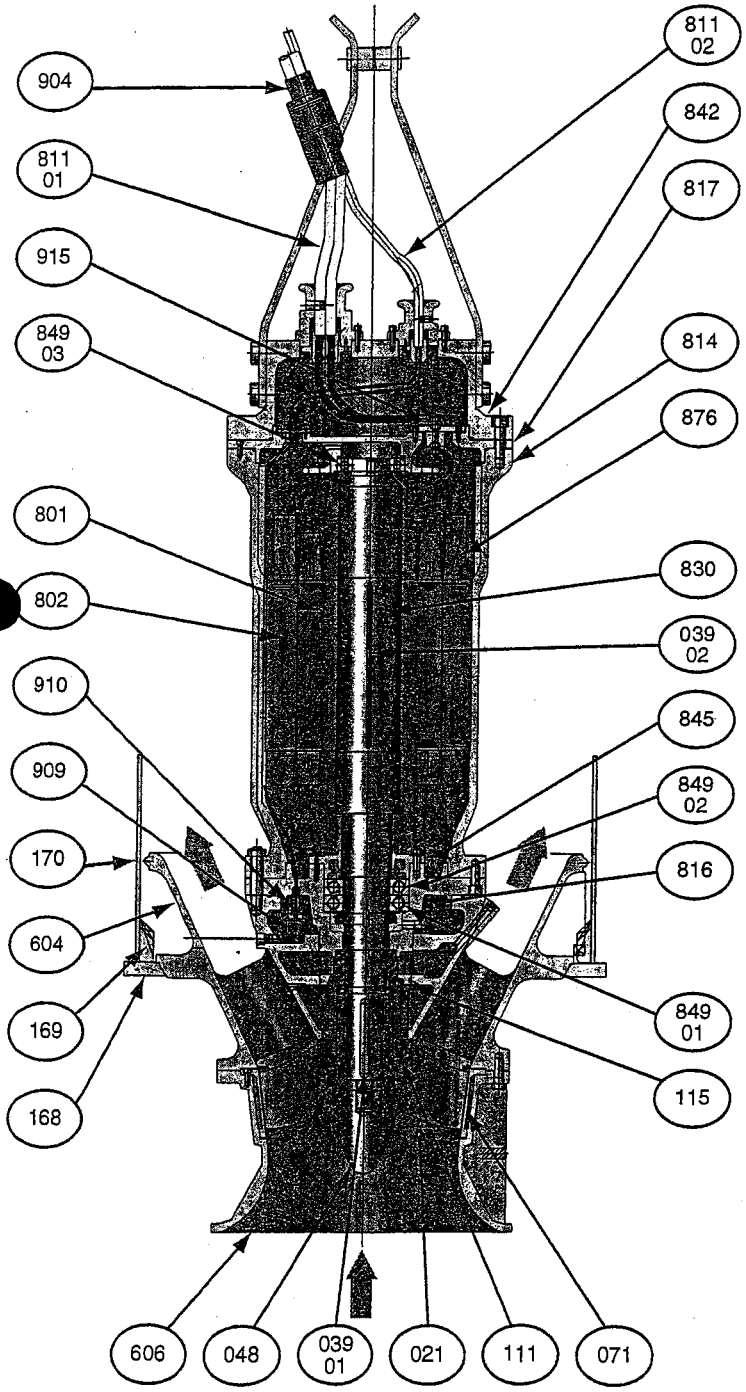
EBARA SUBMERSIBLE PROPELLER PUMPS

DSZ3

SECTIONAL VIEW

3-235
March 1, 1997

PROJECT: MODEL: CHK'D: DATE:



No.	Qty.	Part Name	Material	ASTM-AISI Code
915	1	Terminal Board		
910	1	Leakage Detector Support	Cast Iron	ASTM A48 CL. 30
909	1	Leakage Detector		
904	1	Lifting Hanger	Steel	ASTM A283 GR.D
876	1	Thermal Protector		
849-03	1	Ball Bearing	Steel	
849-02	1	Ball Bearing	Steel	
849-01	1	Ball Bearing	Steel	
845	1	Bearing Cover	Cast Iron	ASTM A48 CL. 30
842	1	Motor Cover	Cast Iron	ASTM A48 CL. 35
830	1	Shaft	Stainless	AISI 403
817	1	Opposite Side Bracket	Cast Iron	ASTM A48 CL. 35
816	1	Power Side Bracket	Cast Iron	ASTM A48 CL. 35
814	1	Motor Frame	Cast Iron	ASTM A48 CL. 35
811-02	1	Control Cable		
811-01	1	Power Cable		
802	1	Stator	Copper	
801	1	Rotor	Aluminum	
606	1	Suction Bell	Cast Iron	ASTM A48 CL. 35
604	1	Discharge Bowl	Cast Iron	ASTM A48 CL. 35
170	1	Column Pipe	Steel	ASTM A283 GR. D
169	1	Rotation Stopper	Steel	ASTM A283 GR. D
168	1	Sole Plate	Steel	ASTM A283 GR. D
115	1	O Ring	NBR	
111	1	Mechanical Seal	See Detail	
071	1	Casing Liner	Stainless	ASTM A743-CF8
048	1	Impeller Nut	Stainless	AISI 403
039-02	1	Key	Steel	AISI 1050
039-01	1	Key	Stainless	AISI 420
021	1	Impeller	Ductile Iron	ASTM A536-60-40-

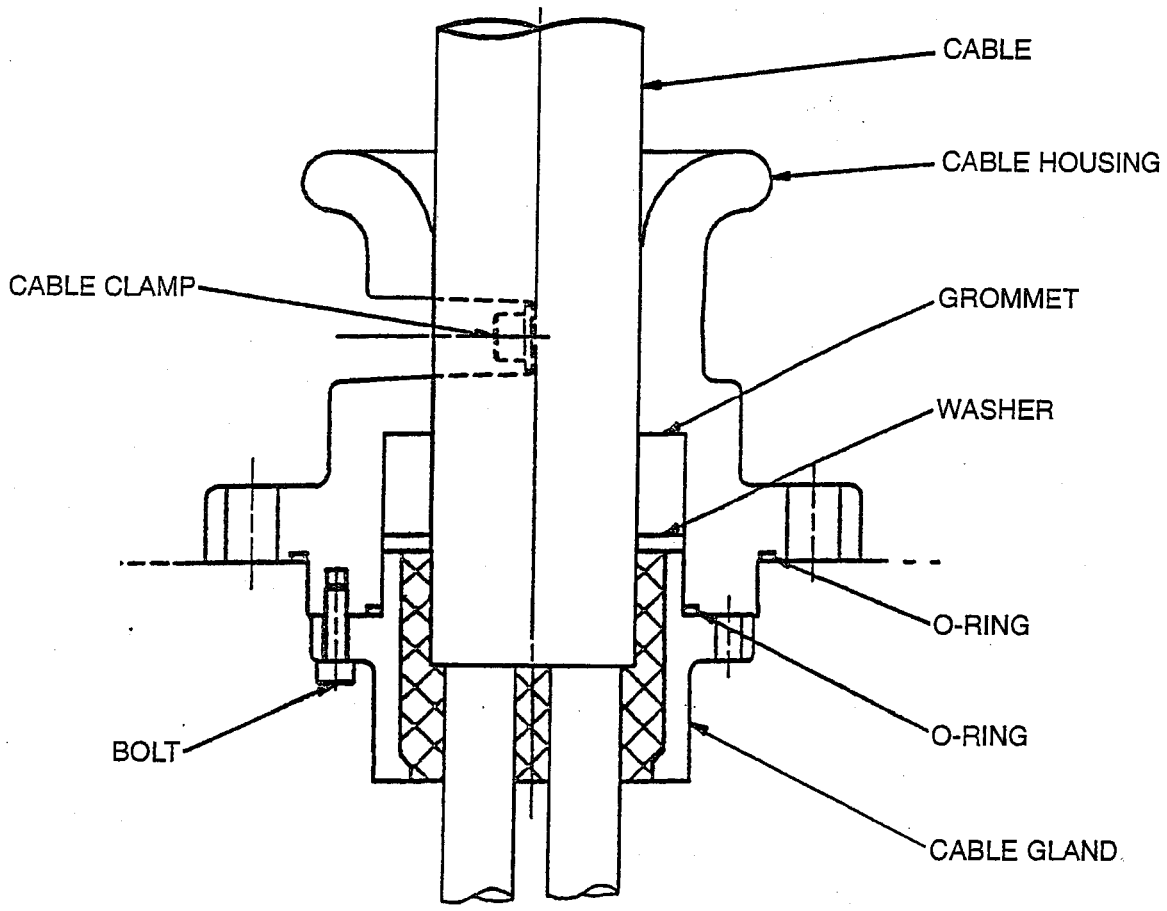
Optional Materials

021	1	Impeller	Stainless	ASTM A743 CF8
021	1	Impeller	Bronze	ASTM B584 C90300

PROJECT: MODEL: CHK'D: DATE:

CABLE SEAL (STANDARD SUPPLY)

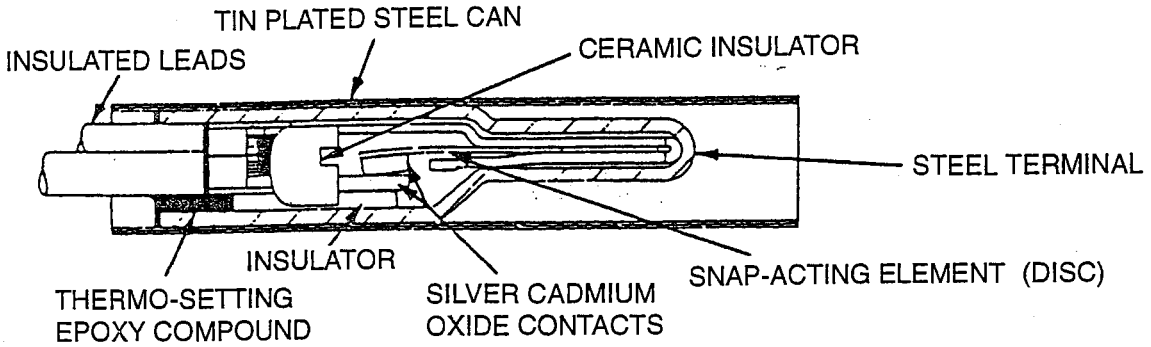
EBARA submersible pump model DSZ3 employs a highly reliable cable entry system with a single piece construction that provides easy maintenance.



PROJECT: MODEL: CHK'D: DATE:

WINDING TEMPERATURE DETECTOR (STANDARD SUPPLY)

A "KLIXON 9700 K" made by Texas Instruments Inc. is fitted to prevent the motor operating in an over-heated condition.



● SWITCH RATING

CONTACT RATING : AC115V, 18A/AC230V, 13A
CONTACT TYPE : B - CONTACT (NORMALLY CLOSED)
OPEN TEMP. : 284±41°F

● CHARACTERISTICS

The circuit is normally closed.
The disc is operated both by the current passing through it and by heat received from the windings.
When the temperature of the disc reaches a predetermined point corresponding to the maximum allowable temperature of winding, the disc snaps open to interrupt the circuit.
When the winding temperature returns to the safe operation range, the circuit is restored automatically.

MECHANICAL SEAL (STANDARD SUPPLY)

Ebara DSZ3 pumps employ the **cartridge type, duplex mechanical seals in tandem arrangement.**

Cartridge type mechanical seal provides

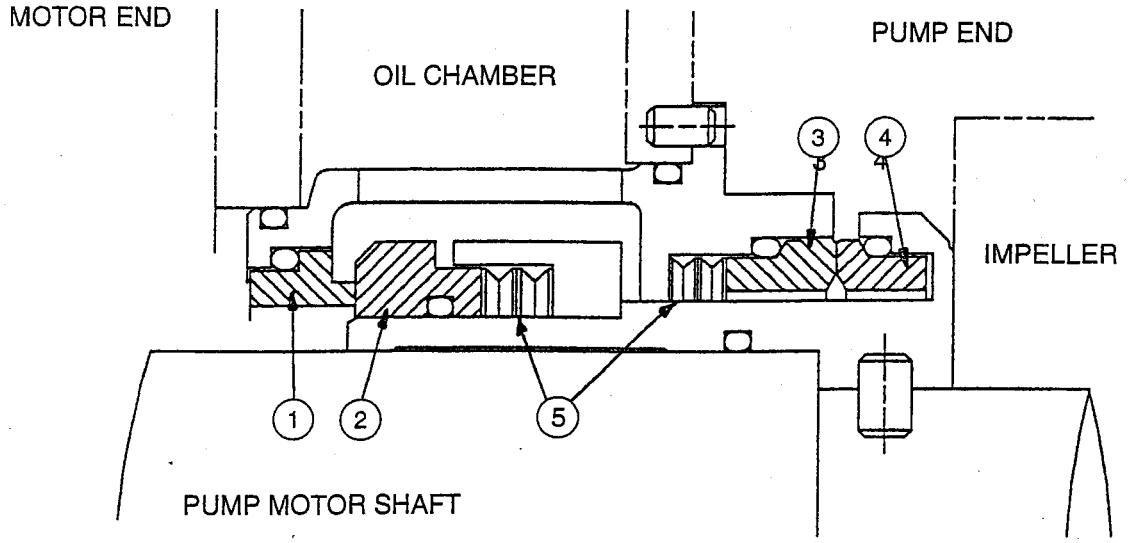
— Easy maintenance because it is handled as one unit

— High reliability due to assembly and adjustment separate from the bowl unit

Duplex mechanical seals in tandem arrangement provide

— High reliability because of dual seals construction

— Long life operation with oil lubrication



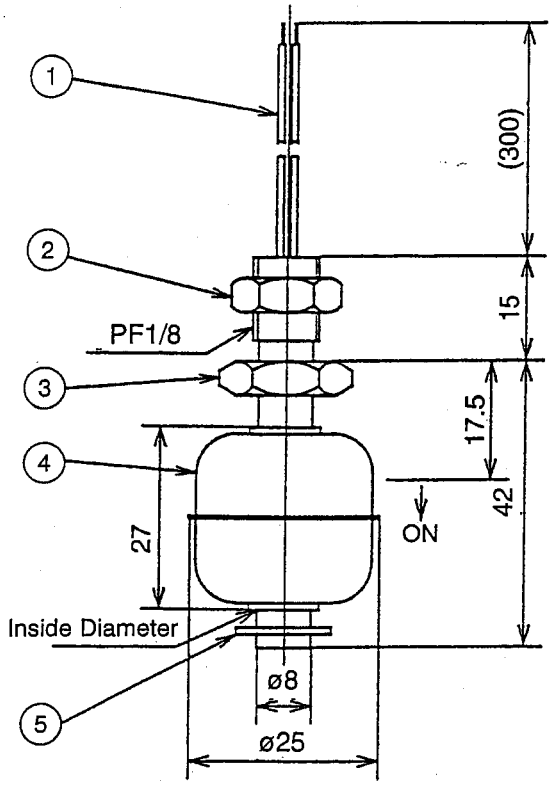
Part No.	Part Name	Material
5	Independent Springs	Stainless Steel
4	Seal Ring (L)	Silicon Carbide
3	Stationary Ring (L)	Silicon Carbide
2	Seal Ring (U)	Ceramic & Stainless Steel
1	Stationary Ring (U)	Carbon

NOTE: Optional Materials Available

PROJECT: MODEL: CHK'D: DATE:

LEAKAGE DETECTOR (STANDARD SUPPLY)

A built-in float type leakage detector with an encapsulated dry reed switch within the stem is fitted to sense leaking of pumping water and/or seal oil into the motor as a result of failure of the mechanical seal.



UNIT : mm

Part No.	Part Name	Part Material	ASTM, AISI Code	No. for 1 Unit
5	Stopper	316 S. Steel	AISI 316	1
4	Float	316 S. Steel	AISI 316	1
3	Housing	316 S. Steel	AISI 316	1
2	Nut	316 S. Steel	AISI 316	1
1	Lead Wire	Heatproof Polyvinyl Chloride Wire (UL1430, AWG22)		2

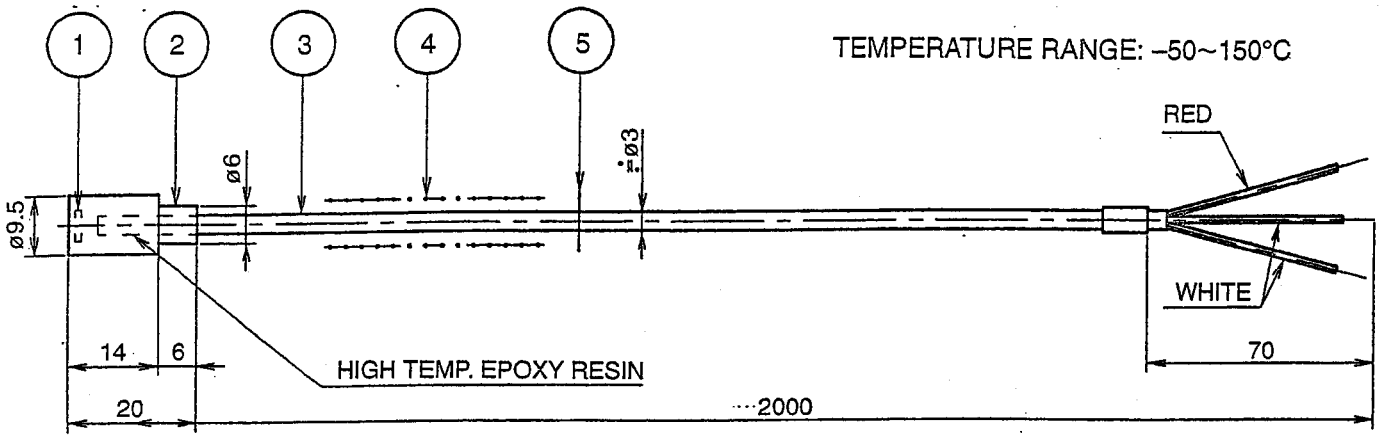
SWITCH RATING

CONTACT RATING : Breaking capacity : AC50VA/DC50W
Max. breaking current: AC0.5A/DC0.5A
Max. operating voltage : AC300V/DC300V

CONTACT TYPE : B - CONTACT (NORMALLY CLOSED)

PROJECT: MODEL: CHK'D: DATE:

THERMAL DETECTOR FOR THRUST BALL BEARING



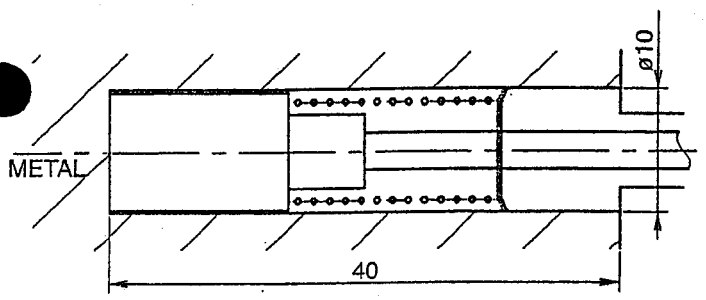


FIG. 5-5 R.T.D. **UNIT : mm**

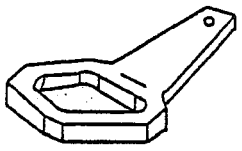
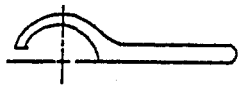
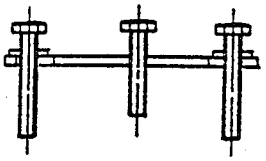
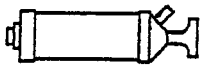
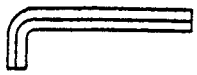
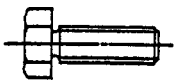
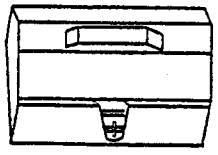
ASSEMBLY OF BEARING TYPE TEMP. DETECTOR

No.	Parts	Material	Q'ty	Remarks
1	Resistance Bulb	—	1	Pt100Ω at OC3W5mA
2	Cap	Stainless Steel	1	
3	Lead Wire	—	1	7/ø0.16 Teflon-Teflon
4	Spring	Stainless Steel	1	
5	Self Lock Retaining Ring	Spring Steel	1	

PROJECT: MODEL: CHK'D: DATE:

SPECIAL TOOL LIST

Special Tool List	Drawing No.

No.	Name	Sketch	Material	Supply	Remarks
1	Impeller Nut Wrench		Steel	1	For impeller nut
2	Hook Spanner		Steel	1~3	For cable supports
3	Extractor		Steel	1	For impeller
4	Oil Pump		–	1	
5	Hexagon Key Wrench		Steel	1 Set	
6	Push Bolt		Steel	2	For mechanical seal
7	Tool Box		Steel	1	

Title :
Dsgnr:
Description :

Date:

Job #

Scope :

Rev: 506001

Steel Column Base Plate

Description Banner Wildlife
Number Q284

Job

General Information

Loads

Axial Load	38.00 k
X-X Axis Moment	0.00 k-ft

Plate Dimensions

Plate Length	57.000 in
Plate Width	4.500 in
Plate Thickness	0.000 in

Support Pier Size

Pier Length	57.000 in
Pier Width	12.000 in

Steel Section MC18x42.7

Section Length	18.000 in
Section Width	3.950 in
Flange Thickness	0.625 in
Web Thickness	0.450 in

Allowable Stresses

Concrete f'c	3,000.0 psi
Base Plate Fy	36.00 ksi
Load Duration Factor	1.000

Anchor Bolt Data

Dist. from Plate Edge	1.500 in
Bolt Count per Side	4
Tension Capacity	1.000 k
Bolt Area	0.000 in2

Summary

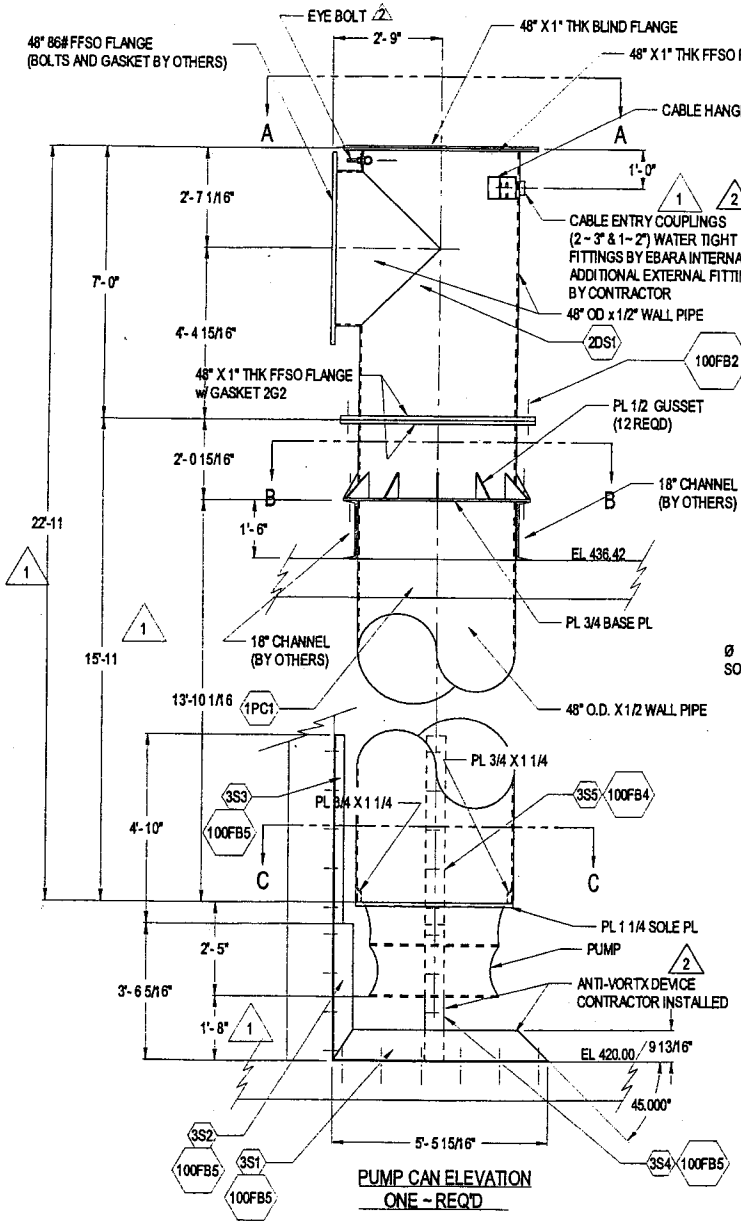
Baseplate OK

Concrete Bearing Stress	**Thickness OK**
Actual Bearing Stress	0.0 psi
Allow per ACI 10.15	0.0 psi
Allow per AISC J9	0.0 psi
Plate Bending Stress	**Bearing Too High!**
Actual fb	0.0 psi
Max Allow Plate Fb	0.0 psi
Tension Bolt Force	**Bolt Tension OK**
Actual Tension	0.000 k
Allowable	1.000 k

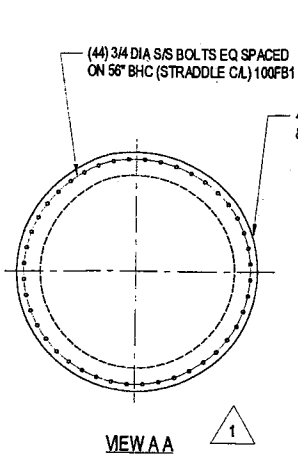
Full Bearing : No Bolt Tension

APPROVAL PRINT
DO NOT USE FOR ANCHOR SETTING OR ERECTION.
APPROVE AND RETURN ONE PRINT TO US
ARCHITECT'S APPROVAL _____
ENGINEER'S APPROVAL _____
CONTRACTOR'S APPROVAL _____

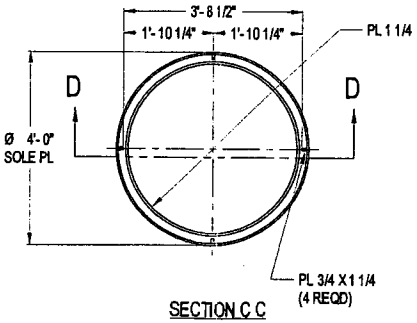
Pump Can weight = 11,700 #
Pump weight = 8,410 #
Can Full of H_2O = 18,031 #
38,141 # ⇒ 38 K



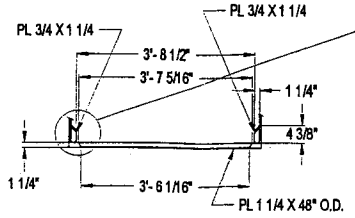
PUMP CAN ELEVATION
ONE ~ REQ'D



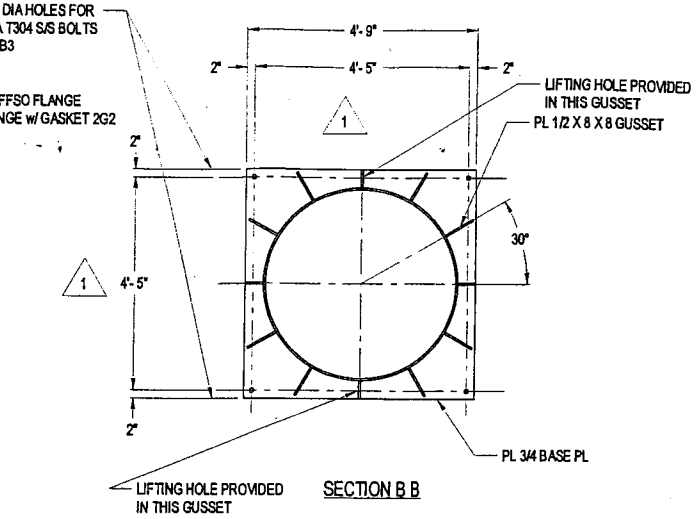
VIEW A A



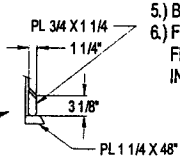
SECTION C C



SECTION D D



SECTION B B



NOTES:
1.) ALL MATERIAL TO BE DOMESTIC CARBON STEEL.
2.) PIPE MAY BE FABRICATED FROM PLATE WITH WELDED JOINTS.
3.) CARBON STEEL IS ASTM-A36 FOR PLATE OR A-53 FOR PIPE.
4.) ALL WELDS PER MANUFACTURERS STANDARD WELDING PROCEDURES & AWS D1.1. ALL WELDS BY CERTIFIED WELDERS.
5.) BOLTS TO BE T304S/S.
6.) FINISH: SP5 & PRIME W/2 COATS OF ZINC-RICH EPOXY (3 MILS EA.). FINISH W/3 COATS OF EPOXY POLYAMIDE. DFT TOTAL OF 12 MILS INSIDE AND OUTSIDE.

FIELD BOLTS
44 ~ 3/4 X 3 BOLT w/NUT 100FB1
44 ~ 3/4 X 3 1/2 BOLT w/NUT 100FB2
4 ~ 1 X 3 1/2 BOLT w/NUT 100FB3
5 ~ 1/2 X 6 EXPANSION ANCHOR 100FB4
19 ~ 3/4 X 6 EXPANSION ANCHOR 100FB5
180 ~ 3/4 FL WASHER
4 ~ 1" FL WASHER
4 ~ 1" BEV WASHER

REV	DESCRIPTION	DATE	APPROVED
2	REV PER CUST REQUEST	5/2/00	
1	REV PER CUST REQUEST	3/14/00	

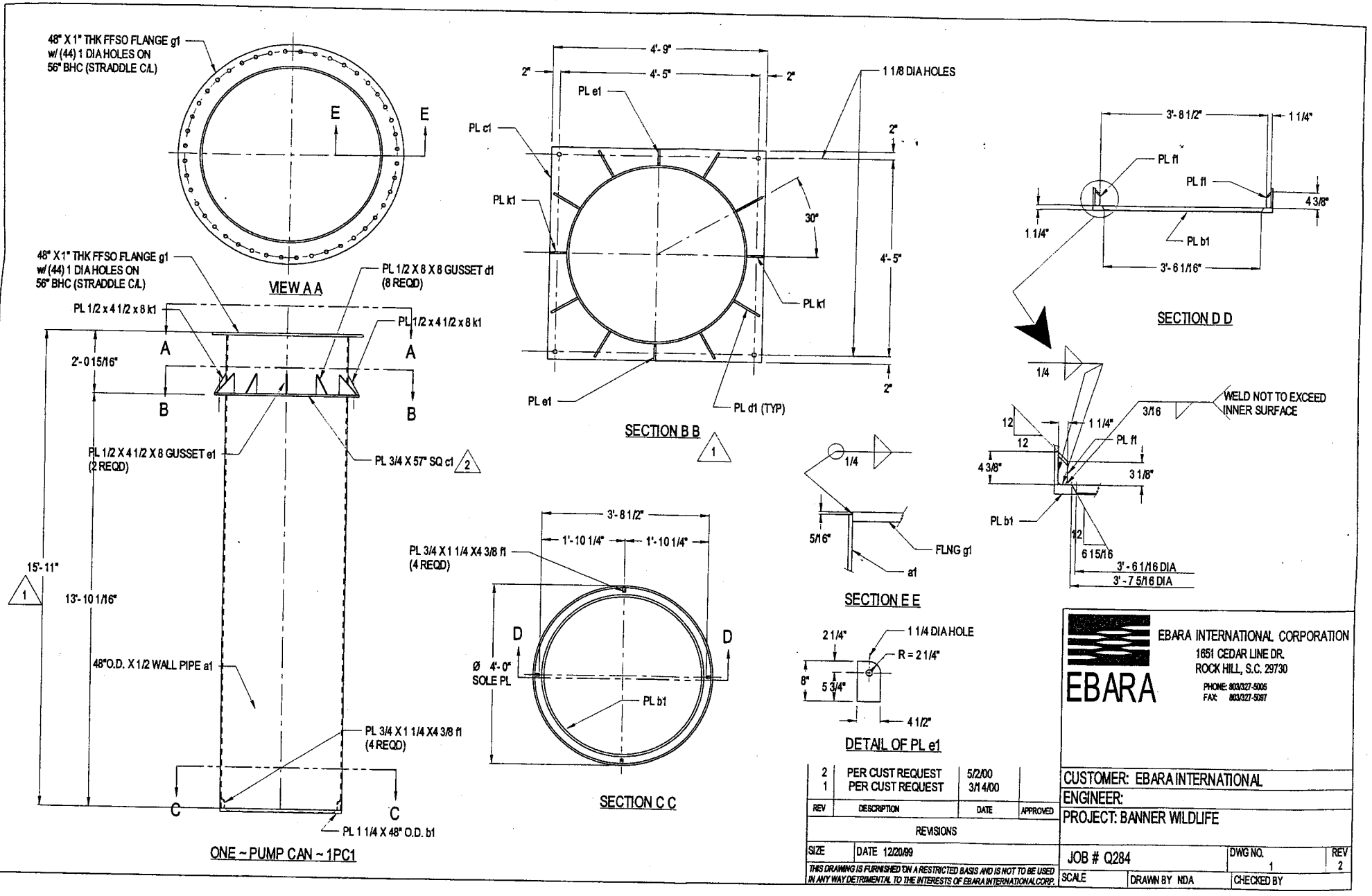
REVISIONS

SIZE	DATE 12/18/99

EBARA INTERNATIONAL CORPORATION
1651 CEDAR LINE DR.
ROCK HILL, S.C. 29730
PHONE: 803/327-5005
FAX: 803/327-5097

CUSTOMER: EBARA INTERNATIONAL
ENGINEER:
PROJECT: BANNER WILDLIFE

JOB # Q284	DWG NO. E1	REV 2
SCALE	DRAWN BY NDA	CHECKED BY



REV	DESCRIPTION	DATE	APPROVED
2	PER CUST REQUEST	5/2/00	
1	PER CUST REQUEST	3/14/00	

REVISIONS

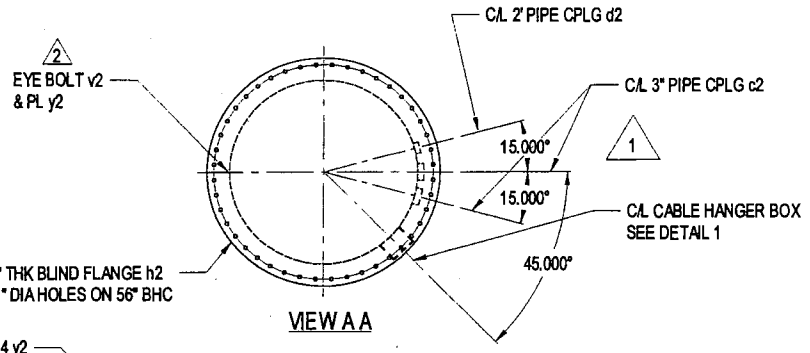
SIZE | DATE 12/20/99

EBARA INTERNATIONAL CORPORATION
1651 CEDAR LINE DR.
ROCK HILL, S.C. 29730
PHONE: 803/327-5005
FAX: 803/327-5097

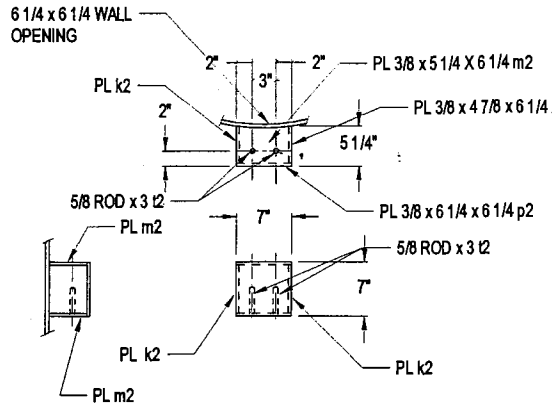
CUSTOMER: EBARA INTERNATIONAL
ENGINEER:
PROJECT: BANNER WILDLIFE

JOB # Q284 | DWG NO. 1 | REV 2

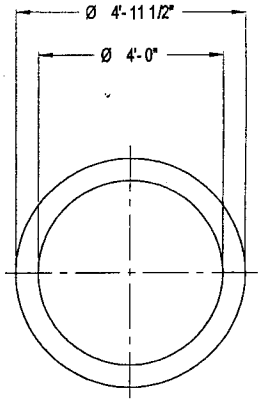
SCALE | DRAWN BY NDA | CHECKED BY



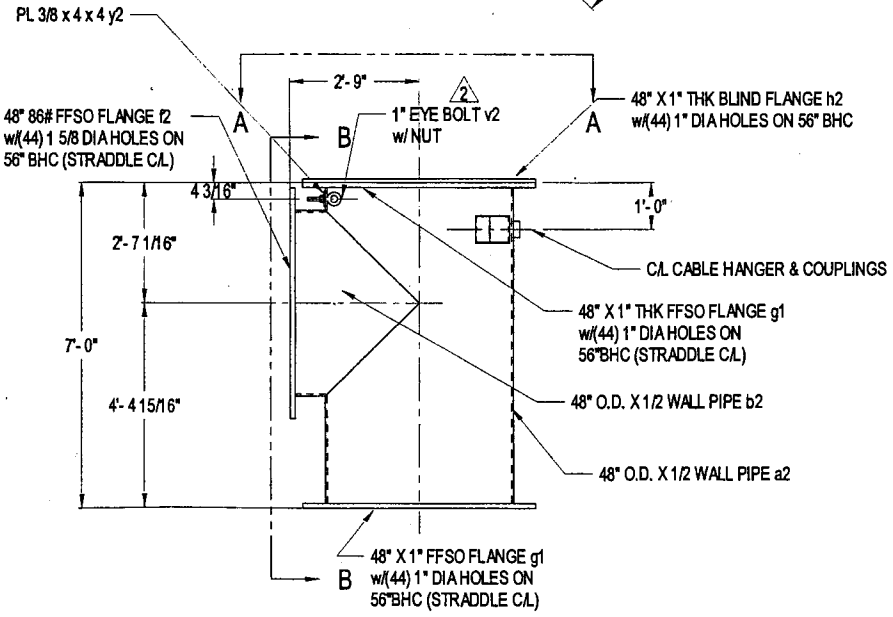
VIEW A A



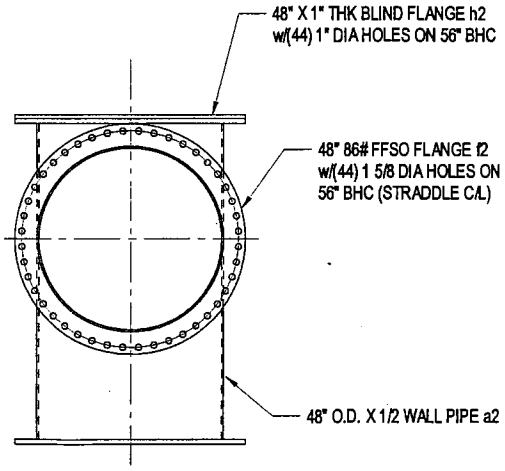
DETAIL 1



2 ~ GASKET ~ 2G2



ONE ~ DISCHARGE SPOOL ~ 2DS1



VIEW B B

REV	DESCRIPTION	DATE	APPROVED
2	ADDED EYE BOLT	5/12/00	
1	PER CUST REQUEST	3/14/00	

REVISIONS

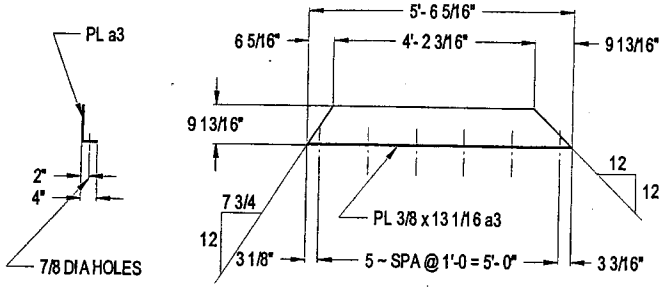
SIZE	DATE 12/20/99

EBARA INTERNATIONAL CORPORATION
1651 CEDAR LINE DR.
ROCK HILL, S.C. 29730
PHONE: 803/327-5005
FAX: 803/327-5097

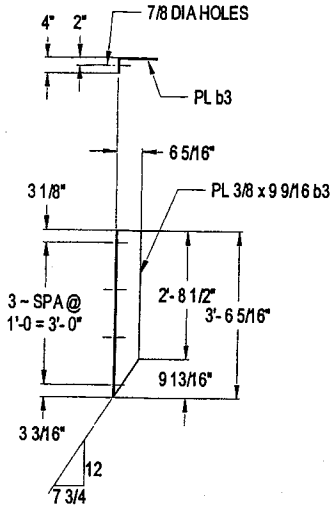
EBARA

CUSTOMER: EBARA INTERNATIONAL
ENGINEER:
PROJECT: BANNER WILDLIFE

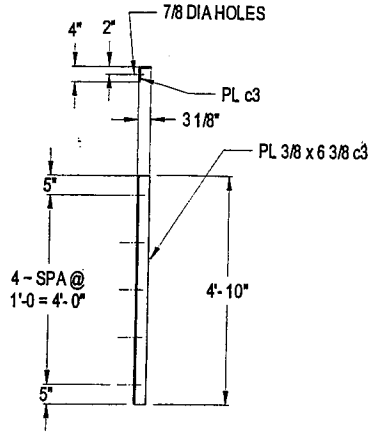
JOB # Q284	DWG NO. 2	REV 2
SCALE	DRAWN BY NDA	CHECKED BY



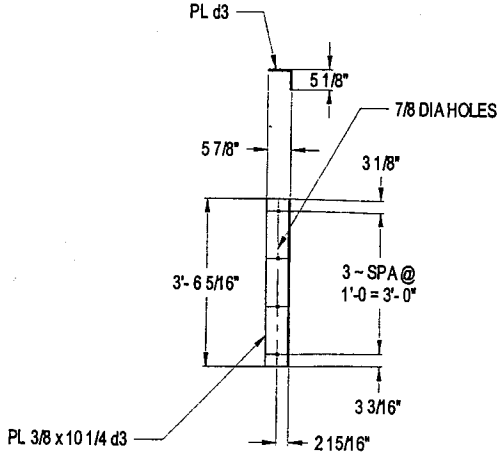
ONE ~ SPLITTER ~ 3S1



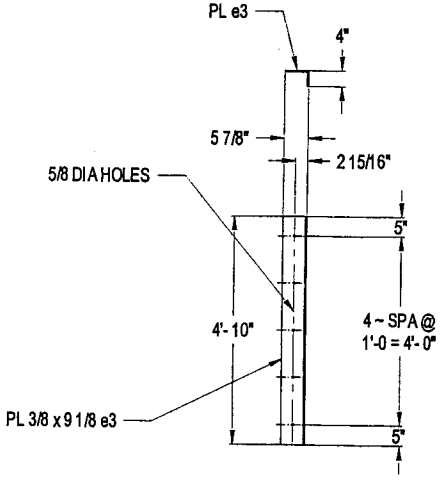
ONE ~ SPLITTER ~ 3S2



ONE ~ SPLITTER ~ 3S3



ONE ~ SPLITTER ~ 3S4



ONE ~ SPLITTER ~ 3S5

7/8" Dia. Holes require a 3/4" x 6" expansion anchor
5/8" Dia. Holes require a 1/2" x 6" expansion anchor

EBARA INTERNATIONAL CORPORATION
1651 CEDAR LINE DR.
ROCK HILL, S.C. 29730
PHONE: 803/327-5005
FAX: 803/327-5097

REV	DESCRIPTION	DATE	APPROVED
	REVISIONS		

CUSTOMER: EBARA INTERNATIONAL
ENGINEER:
PROJECT: BANNER WILDLIFE

SIZE	DATE 3/15/00	JOB # Q284	DWG NO. 3	REV
		SCALE	DRAWN BY NDA	CHECKED BY

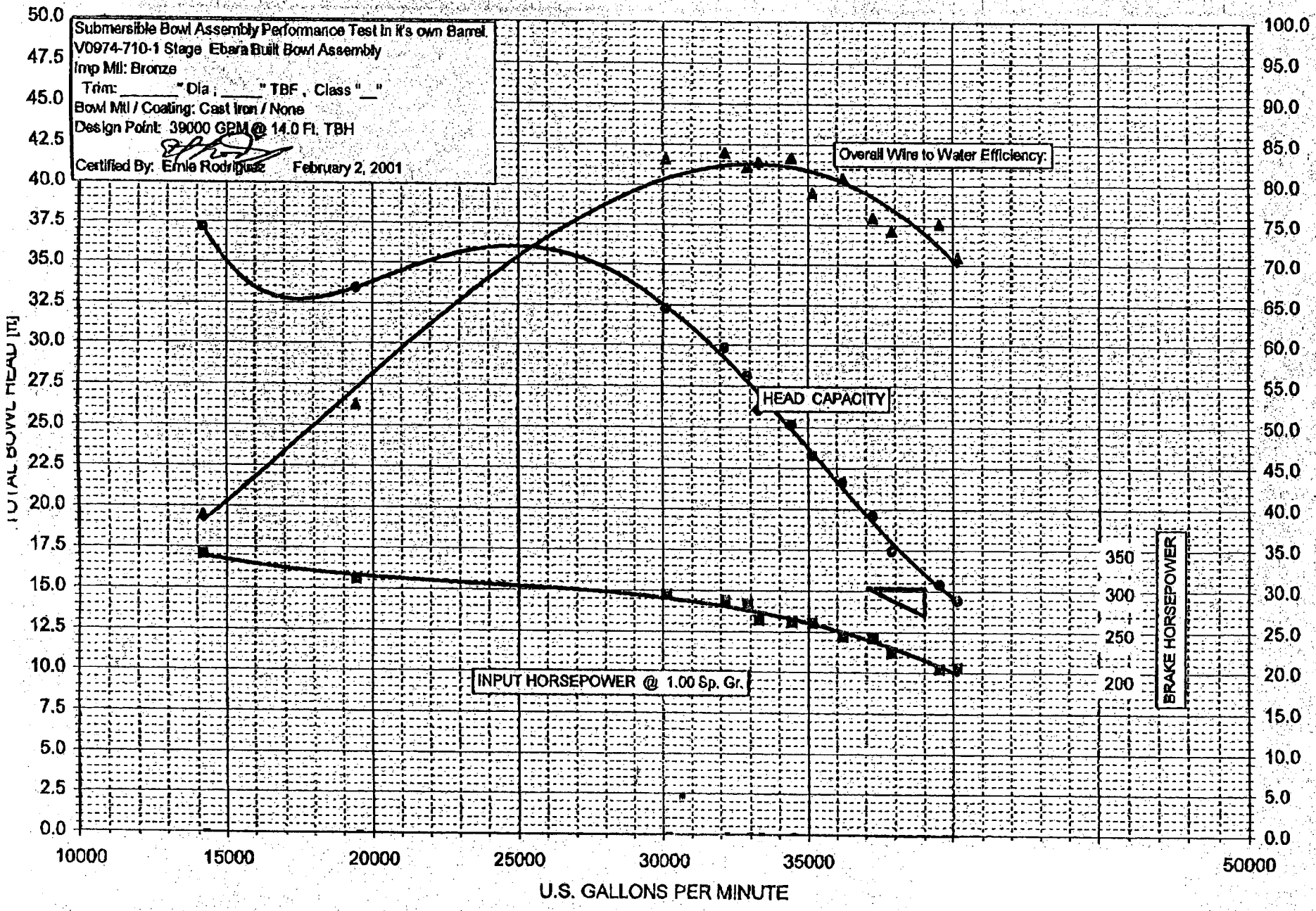
Johnston Pump Company

Brookshire, Texas

Customer: Ebara International Corporation

Job#: 00JA1222 TC- 9552 Rev #: 0

710 RPM



Ebara-V0974-710-1Stg_00JA1222-3_TC-.xls

FEB 05 '01 09:37AM

EBARA INTERNATIONAL CORPORATION

1651 CEDAR LINE DRIVE, ROCK HILL, SOUTH CAROLINA 29730
PHONE (803) 327-5005 FAX (803) 327-5097

EBARA

Pump Start Up Report

Date: May 24, 2001 Job Name: Banner Marsh Wildlife Job No.: ______

Contractor: Deal Earth Moving Inc Signature: [signature]

Design Conditions: 35000 GPM @ 21 TDH

Pump Model: 1650 DSZ3 HP: 265 Voltage: 460

Pump Serial #: #1 R00451901 #2 — #3 — #4

Control Manufacture: Sunbelt Control SC04912 Voltage: AB 495 AC 495 BC 477 Heater Size: Control 4.5 A

GRD Connected: YES OK Alternator Tested: N/A

Comments: Control Panel - Good Installation. Good Installation of pump & Can.

Megger Check 5/22/01	#1	INF	Red	INF	White	INF	Black — To Ground
	#2		Red		White		Black
5/24/01	#3	INF	Red	INF	White	INF	Black
	#4		Red		White		Black
Resistance Check 5/22/01	#1	0.11	RW	0.11	RB	0.12	WB — Rated 0.11
	#2	—	RW	—	RB	—	WB
5/24/01	#3	0.11	RW	0.11	RB	0.12	WB
	#4	—	RW	—	RB	—	WB
Amperage Check 5/24/01	#1	225	A	226	B	227	C — FL Amps 318
	#2	232	A	231	B	230	C
	#3	234	A	233	B	232	C
AVG	#4	230	A	230	B	229.6	C

Performance Test	#1	35000 42,000	GPM@	17'	TDH 8"
	#2	37250 41500	GPM@	17'	TDH
	#3		GPM@		TDH
	#4		GPM@		TDH

Flow Meter Provided By Corps. Water Level: ______

Check Oil Condition: YES OK 5/22/01 Check Moisture & Thermals: Yes Both Closed

Pump Seated Properly: OK Check for Leaks: OK Check Rotation: YES OK

Check Valves Operating Properly: N/A Guide Rails Vertical: N/A Debris in Station: N/A

Debris Removed: N/A Pumps Meet Design Condition: YES Check Float Operation: OK

Comments: Pump Ran Smoothly @ SU. When Elevation Reached 428' pump Cavitated. Do not run pump below that El. (428')

I certify this report to be accurate [signature]

May 24 2001
Official Start-Up Date

May 24 2001
Report Date

Ebara International Corporation
1651 Cedar Line Drive
Rock Hill, SC 29730

STANDARD CONDITIONS OF SALE

These STANDARD CONDITIONS OF SALE ("Conditions") exclusively define the contractual relationship between EBARA INTERNATIONAL CORPORATION ("EIC") and the Purchaser, and no terms proposed by the Purchaser in conflict with or additional to these Conditions shall become a part of the contract of sale unless expressly accepted in writing by EIC. Any EIC proposal to which these Conditions are attached shall be for information purposes only, and Purchaser's order is subject to acceptance and acknowledgment by EIC as the supplier of the equipment ordered in accordance with these conditions.

TERMS OF PAYMENT

Terms of Payment for any order based on these Conditions shall be included in the EIC Proposal of which these Conditions are a part.

PRICE ADJUSTMENT

The price clauses applicable to the contract of sale of which these Conditions are a part are included in the EIC Proposal and are based on the proposed shipping date of the equipment cited. In the event of delays in release to manufacture or in shipment for any reason, the contract price shall be adjusted to the price in effect at the time of shipment. Some equipment to be provided hereunder which is not manufactured by EIC ("Other Equipment") may be subject to different pricing adjustment policies than those stated for the EIC-manufactured equipment ("EIC Products"), which Other Equipment shall be identified in the Proposal of which these Conditions are a part and which shall be incorporated in the contract.

I. WARRANTY, REMEDY, DISCLAIMER

EIC warrants for a period of twelve months from the date of initial startup or eighteen months from the date of shipment, whichever shall first occur (the "Warranty Period") the EIC Products to be delivered hereunder against defects in material and workmanship, under normal use and service when installed, used and maintained in accordance with instructions supplied by EIC. This is EIC's sole and exclusive warranty. It applies only to EIC Products and specifically excludes Other Equipment, whether or not such Other Equipment is included in EIC's scope of supply hereunder. Such Other Equipment is warranted only by its manufacturer. If such a defect appears in EIC Products within the Warranty Period and Purchaser has given EIC immediate written notice of same, EIC will either repair the part, or at its option replace the part, by shipping a similar part F.O.B. EIC's shipping point, or at its option refund an equitable portion of the purchase price. EIC may require the return of the defective part, transportation prepaid, to establish the claim. All costs of removal, reinstallation, field labor and transportation shall be borne by the Purchaser. No allowance will be made for repairs without EIC's written consent or approval, and the Warranty Period shall not be suspended upon stopping operation for warranty repairs, nor recommence upon completion of the warranty repairs, but shall run continuously from commencement until normal expiration. Repair parts shall carry no greater warranty than the remaining balance of the underlying EIC Product into which they may be installed, expiring at the same time as said underlying warranty.

Any descriptions of the EIC Products or Other Equipment, any specifications, and any samples, models, bulletins, or similar material used in connection with this sale are for the sole purpose of identifying the said Equipment and are not to be construed as express or implied warranties. Unless during the warranty period all repairs or replacements or parts or components for EIC Products are with EIC-approved parts or components, and all warranty service is performed by EIC or its authorized distributor or representative, the warranty responsibility of EIC shall immediately terminate.

EIC MAKES NO OTHER WARRANTY OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED; AND ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED BY EIC AND EXCLUDED FROM THESE CONDITIONS. The Purchaser's sole and exclusive remedy, whether upon warranty, contract or tort, including negligence, will be to proceed under this warranty. All liability of EIC shall terminate no later than the expiration of the Warranty Period.

_N.B.: If the Equipment being sold hereunder is designated "Municipal: Permanent Installations," there is attached hereto, incorporated by reference herein and made a part hereof, as Attachment A., EIC's "5 Year (10,000 Hour) Pump Warranty" (hereinafter, "Municipal Warranty"). Said Municipal Warranty replaces and supersedes in its entirety this Warranty, Remedy, Disclaimer Paragraph I. All other terms and conditions of these STANDARD TERMS AND CONDITIONS OF SALE remain unchanged.

II. INSPECTIONS, TESTS

Any Purchaser inspections or shop testing of EIC Product at EIC's facilities prior to its shipment must be authorized by EIC in writing at least ten (10) days prior to such inspection, and shall be subject to EIC's manufacturing cycle availability and facility security requirements. Field testing of EIC Products may be conducted by Purchaser to confirm mechanical compatibility of the EIC Product and that there has been no damage in transit, but compliance with specifications shall be conclusively established by shop tests at EIC's facilities.

III. LIMITATION OF LIABILITY

_EIC shall not in any event be liable for special, indirect, incidental or consequential damages, including liquidated damages in any amount. EIC's liability on any claim of any kind, including negligence, for any loss or damage arising out of, connected with, or resulting from a contract based on these Conditions, or the performance or breach thereof, or the design, manufacturer, sale, delivery, resale, installation, technical direction of installation, inspection, repair, operation or use of any EIC Products covered by or furnished hereunder shall in no case exceed the price paid by the Purchaser for the Equipment. EIC also disclaims liability, whether in contract, tort, warranty or otherwise, to any party other than Purchaser, and EIC's sole responsibilities with respect to Other Equipment furnished hereunder shall be to ensure mechanical compatibility of EIC Equipment with the Other Equipment and to pass through to the Purchaser whatever warranty the Other Equipment manufacturer has provided to EIC.

IV. SHIPPING DATES/FORCE MAJEURE

The time for shipment given herein is approximate and is estimated from the date of receipt of order with complete manufacturing information and approval of drawings as may be necessary. EIC shall not be liable for any loss or damage for delay or non-delivery due to the acts of civil or military author-

LIMITED WARRANTY PUMP ONLY
MUNICIPAL: PERMANENT INSTALLATIONS

EIC warrants for a period of five (5) years or ten thousand (10,000) hours of operation, whichever shall first occur, measured from the date of shipment from EIC (the "Warranty Period"), the Equipment of its own manufacture against defects in material and workmanship, when installed, used and maintained in accordance with instructions as provided by EIC in permanent municipal installations under the following conditions of service only:

1) Raw Sewage; or
2) Municipal Wastewater; or
3) Potable or Raw Water; or
4) Storm Water; and
5) Liquids must be abrasive-free and non-corrosive.

This is a LIMITED warranty. The following are CONDITIONS OF WARRANTY:

1) Only Municipal Applications are qualified to participate hereunder;
2) Start-Up Procedures in accordance with instructions provided by EIC must be properly completed, and a report confirming same must be prepared & submitted with all warranty claims.
3) Elapsed-time meters must be installed and be operational within the electrical control panel;
4) All EIC-prescribed maintenance procedures must be followed, documented and proof thereof submitted to EIC with any warranty claim hereunder;
5) Each warranty claim must be submitted in accordance with EIC's Warranty Procedures, which require notification to EIC and assignment by EIC of a Materials Return Authorization ("MRA") number. EIC's Warranty Procedures are provided with each item of EIC Equipment sold hereunder by EIC.
6) Any repairs to EIC Equipment, whether warranty claims or otherwise, by other than an EIC-authorized repair or service facility may invalidate the warranty hereunder.

If a defect appears in the EIC Equipment warranted hereunder during the Warranty Period and Purchaser has given EIC immediate written notice of same, EIC will either repair the part, or replace the part, by shipping a similar part F.O.B. EIC's shipping point, or at is option grant a credit reimbursement or refund an equitable portion of the purchase price. EIC may require Electrical System Schematics (including Bills of Materials) and other data regarding maintenance and applications, as well as return of the Equipment, transportation prepaid, to substantiate and validate the warranty claim. The warranty shall not apply to any Equipment which has been subjected to misuse, accident or neglect or used in any manner not consistent with the applications disclosed to EIC at the time of purchase, or to Equipment damaged due to defective power supply, incorrect electrical protections or faulty installation or maintenance. All costs of field labor, removal, reinstallation and transportation shall be borne by the Purchaser.

The Warranty Period shall not be suspended or tolled upon stopping operations for the warranty repairs, nor recommence upon completion of said repairs, but rather shall run continuously from commencement until normal expiration. Repair parts shall carry no greater warranty than the remaining balance of the underlying Equipment into which the repair part may be installed, expiring at the same time as said underlying warranty.

This is a *pro rata* limited warranty. EIC will pay the following share of the cost of replacement or repair parts:

Warranty Period Following Shipment

Lesser of:

Months:	0-18	19-39	40-60
Hours of Operation:	0-3,000	3001-6500	6501-10000
Warranty Repair Costs:	100%	50%	25%

This is EIC's sole and exclusive warranty. It applies only to EIC Equipment, including QDC (Quick Discharge Connector) Power Cables when originally purchased with EIC Equipment, but specifically excludes all other equipment of others' manufacture, whether or not such equipment is included in EIC's scope of supply hereunder. Such other equipment is warranted only by its manufacturer.

EIC MAKES NO OTHER WARRANTY OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, AND ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED BY EIC AND EXCLUDED FROM THESE TERMS AND CONDITIONS OF SALE. The Purchaser's sole and exclusive remedy, whether in warranty, tort or contract, including negligence, will be to proceed under this warranty. All liability of EIC shall terminate no later than the expiration of the Warranty Period. EIC SHALL IN NO EVENT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER.

March, 2000

TITLE **INSTRUCTION MANUAL** DOC. No. REV.

CUSTOMER ARMY CORPS OF ENGINEERS

COMPLETE IN 33 SHEETS WITH COVER

FINAL USER STATE OF ILLINOIS
DEPARTMENT OF NATURAL RESOURCES

PROJECT DACW25-99-B-0021 SERVICE DRAINAGE PUMP

JOB No. Q284 EBARA SER. No. R0045/901

ITEM No. MODEL / EQUIP. 1050DS23 SET

Reference drawings and documents

(1) Outline drawing (Dwg.no._____)
(2) Sectional drawing (Dwg.no._____)
(3) Sole plate drawing (Dwg.no._____)
(4) Submersible pump data sheet (Doc.no._____)
(5) Electrical specification (Doc.no._____)
These drawings and documents are previously submitted.

Additional information

Following should be prepared before disassembly / reassembly of pump(s).

(1) Tools and devices:
Lifting devices, wooden supports and pads.
Standard tools and special tools.
Liquid packing (Three bond #1102 or equivalent).
Silicon-rubber sealant (SIN-ETU CHEMICAL Co., LTD. KE-45 or equivalent).
Rags.
(2) Oil quantity for mechanical seal:
Approx. __ litters per one(1) unit. Refer to Para. 4.3 for the brands of oil.
(3) Size of snap ring plier (tool for retaining ring of mechanical seal):
Max. diameter of tips: ___mm
Max. opening of tips:_____mm
(4) Painting specification on surfaces contacting pumping liquid:
Surface preparation : SSPC-SP-10
Material & coating nos.: Coal tar epoxy paint × 3coats

TO SET

ISSUED BY

APPROVED BY

CHECKED BY

PREPARED BY

REV.	PAGE	DATE	APP'D	BY
5				
4				
3				
2				
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Contents

1. Preface

Design of this EBARA pump is based on superior engineering and long experience. To prevent trouble and provide satisfactory operation and long life, it is important to understand the EBARA pump thoroughly by careful study of this manual. If any questions arise regarding this manual, please direct them to EBARA. Your questions will be promptly answered and your suggestion may be considered for incorporation into our future products.

CAUTION: *THIS INSTRUCTION MANUAL INCLUDES NECESSARY ITEMS FOR INSTALLATION, OPERATION AND MAINTENANCE. READ THIS MANUAL CAREFULLY TO ENSURE CORRECT INSTALLATION,OPERATION AND MAINTENANCE.*
BE SURE TO KEEP THIS INSTRUCTION MANUAL ON HAND FOR FUTURE REFERENCE.

Safety Labels

Four different types of safety labels are used in this manual. Please study the labels carefully so that the meaning of any safety warning you encounter is immediately clear.

⚠***DANGER*** : indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠***WARNING*** : indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠***CAUTION*** : indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or possible damage to the equipment or machine.

Note : is used to call attention or to emphasize essential information.

2. Construction

Compact and easily installed without bolts, this axial flow pump is kept securely in place by it's own weight. It can be installed / removed without personnel entering the pit. Small column bore size can be selected.
Pump weight is shown in Outline drawing.

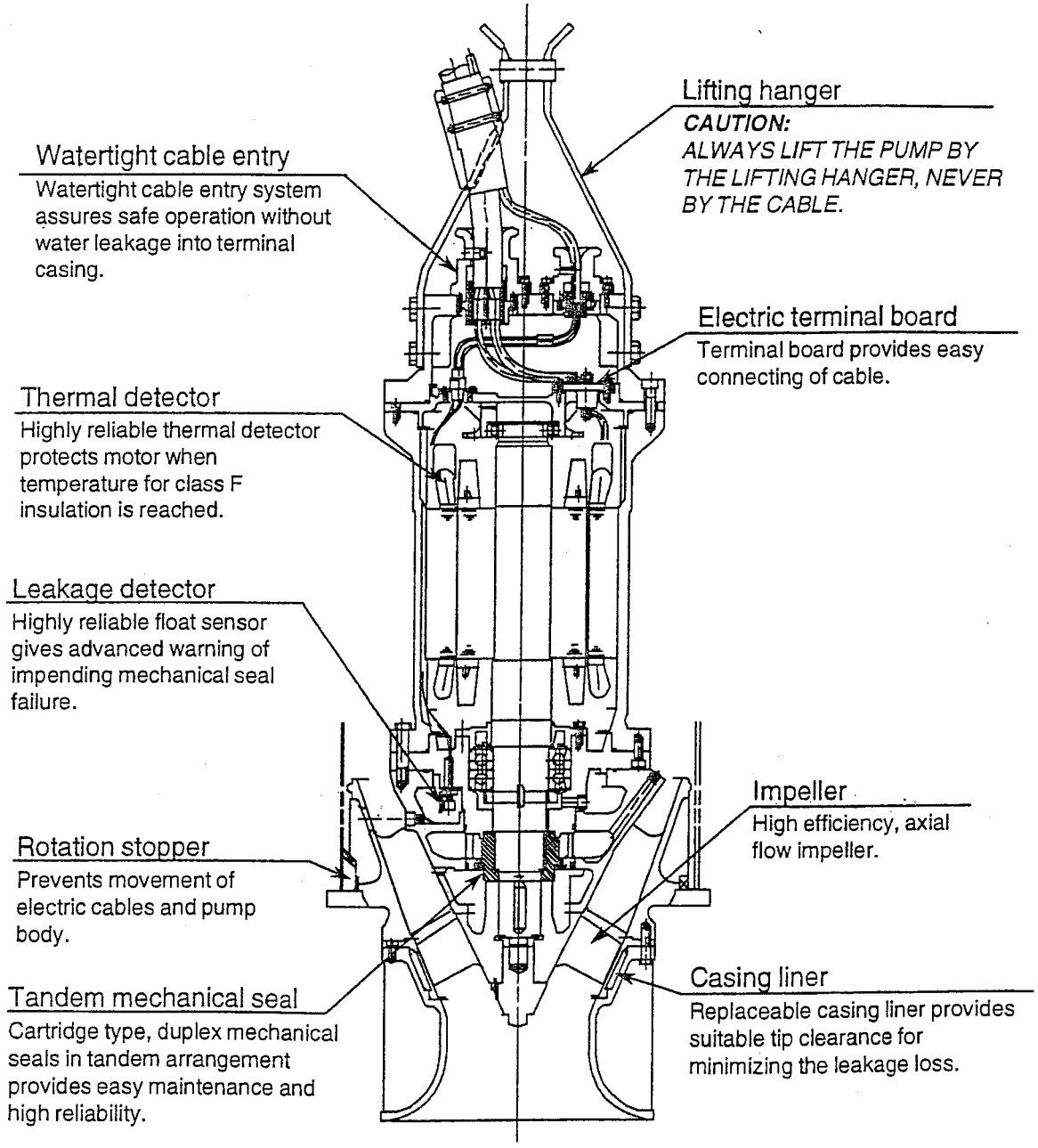


Fig. 2.1

3. Cautions when working on Pump

3.1 Safety Precautions

⚠*DANGER : WHEN LIFTING THE PUMP, USE APPROPRIATE CRANE (OR HOIST) AND WIRE ROPES. CHECK POSITION AND TIGHTNESS OF WIRE ROPES SO THAT WEIGHT OF THE PUMP IS NOT* ***UNBALANCED.***
FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN SERIOUS ACCIDENTS.

Note : Pump dimensions and weight are shown in Outline Drawing.

(1) Clean the working area.
(2) Follow local codes and ordinances.
(3) All electrical work shall be performed by a qualified electrician.
(4) Check explosion risk before welding or using electric hand tools.
(5) Make sure the lifting equipments and tools are in good condition.
(6) Do not use motor cables to lift pump unit.
(7) Handle the cables very carefully. If they are bent or pulled on excessively cables may be damaged.
(8) Provide a suitable barrier, such as a guard rail, around the work area.
(9) Use safety helmet, safety goggles and protective shoes.
(10) When lifting heavy components, do not raise or lower too rapidly with crane.
(11) When assembling components on the floor, use protective blocks under components to protect coated surfaces and prevent rolling.

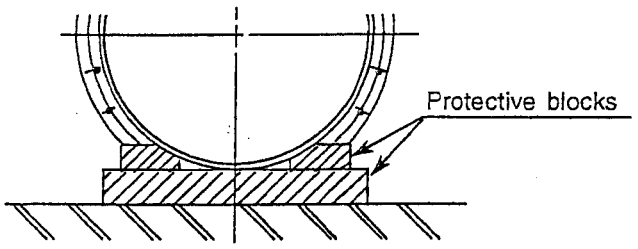


Fig. 3.1

3.2 Preparation for working on Pump

An adequate work space should be found which is as wide as possible, and has a rigid floor. The area should be safe from hazards. Following should be prepared before working on pump.

Lifting devices to be able to hoist the pump straight up and down in the column pipe. Minimum height between the lifting hook and cover or floor shall be the length of the pump unit +1m.

Wooden supports and pads. (Strong enough to support pump weight.)

Rags.

Tools.

3.3 Cautions when moving Pump

⚠ ***WARNING :*** *ALWAYS LIFT THE PUMP BY THE LIFTING LUGS, NEVER BY THE MOTOR CABLES.*

⚠ ***WARNING :*** *WHEN LIFTING BY CRANE OR WITH WIRE ROPES FASTENED TO THE LIFTING LUG, ENSURE THAT THE HOOK OR WIRES ENGAGE THE LIFTING LUG SECURELY.*

(1) Standing the pump in a vertical position.
(a) Gradually lift the pump with the lifting lug and the wire rope fastened to the suction bell (Fig. 3.2)

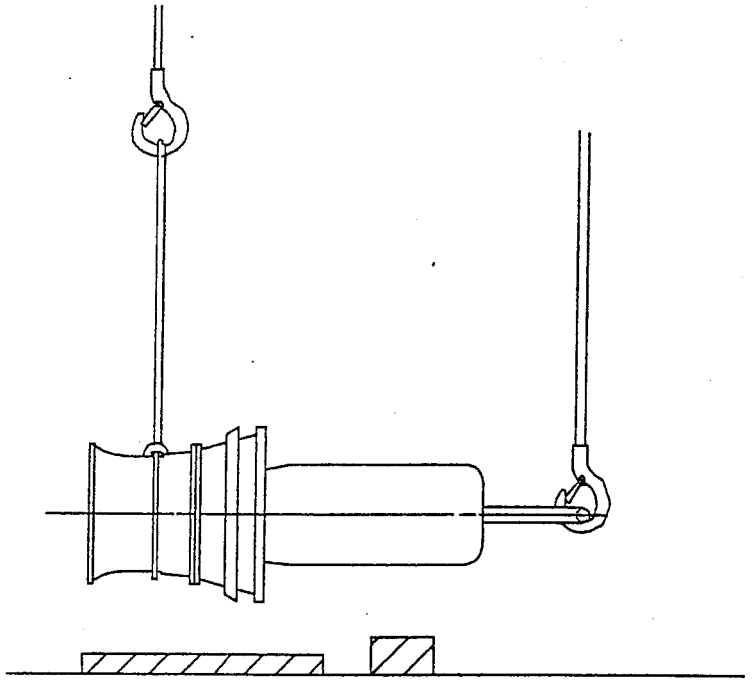


Fig. 3.2

(b) Gradually lift the lifting lug side. Then the pump is a vertical position. (Fig. 3.3)

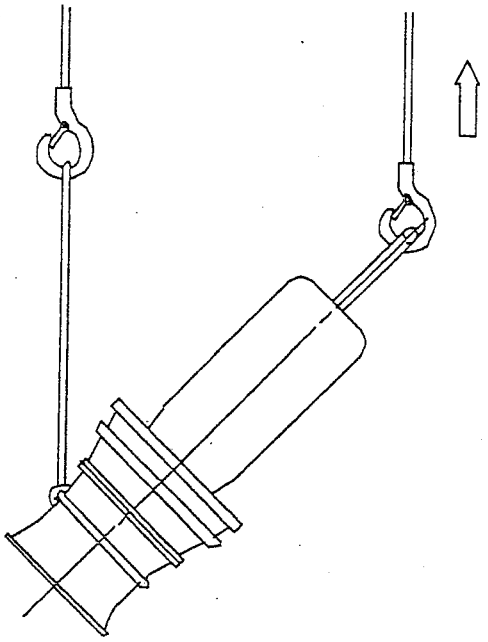


Fig. 3.3

(2) Laying the pump in a horizontal position.

(a) Stand the pump on the floor. Fasten the wire rope to the suction bell. (Fig. 3.4)

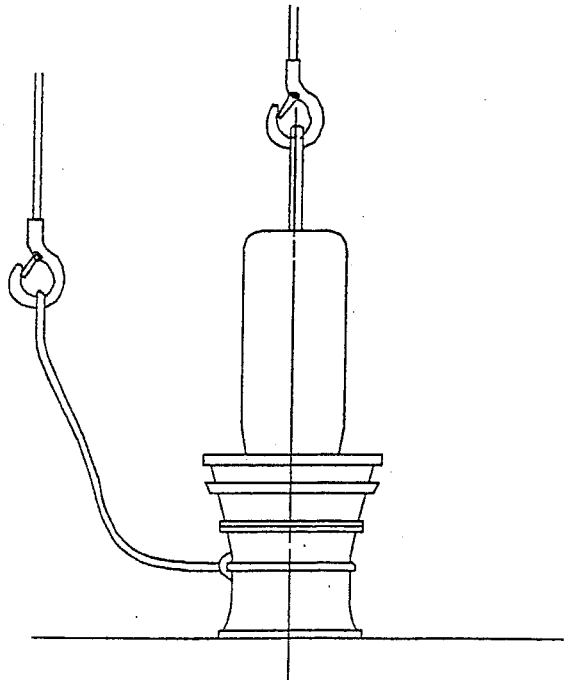


Fig. 3.4

(b) Lift the pump with the lifting lug. (Fig. 3.5)

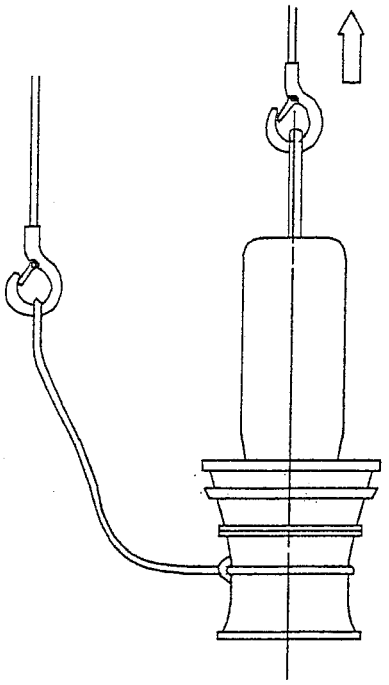


Fig. 3.5

(c) Tense the wire rope fastened to the suction bell. (Fig. 3.6)

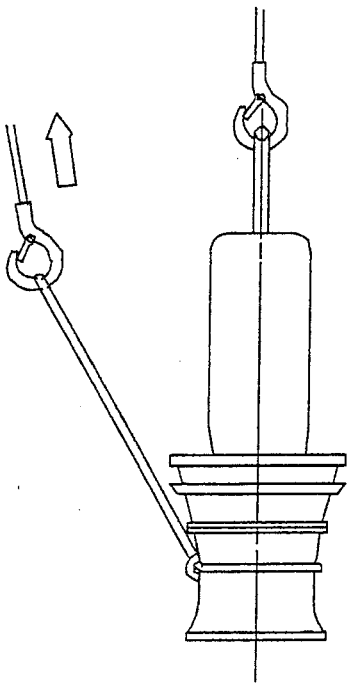


Fig. 3.6

(d) Lower the lifting lug side gradually. (Fig. 3.7)

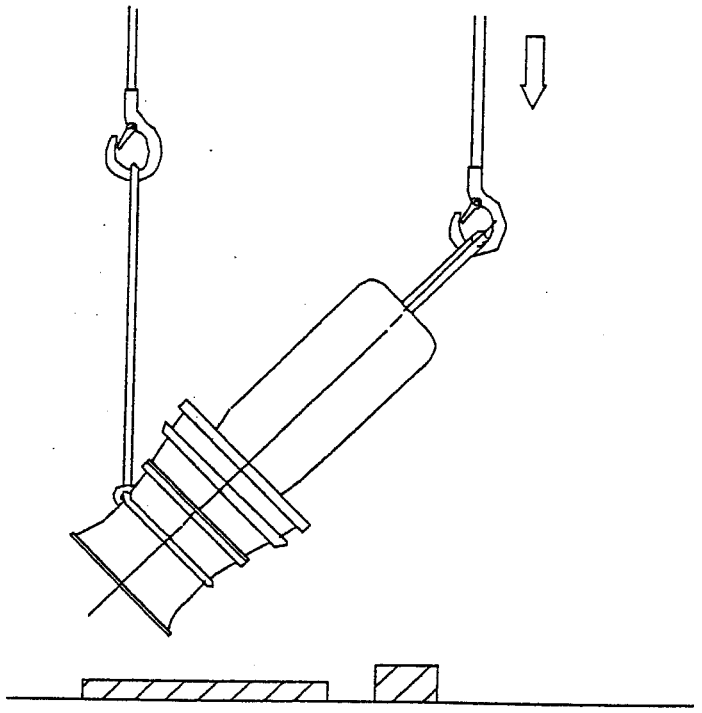


Fig. 3.7

⚠ ***WARNING :*** *USE PROTECTIVE BLOCKS TO PREVENT ROLLING.*

⚠ ***DANGER :*** *KEEP OUT FROM UNDER SUSPENDED LOADS.*

4. Pump Checks

⚠ ***WARNING:*** *WHEN CHECKING PUMP, ENSURE THAT CABLES ARE DISCONNECTED AND ISOLATED FROM POWER SUPPLY. .*

4.1 Name Plate

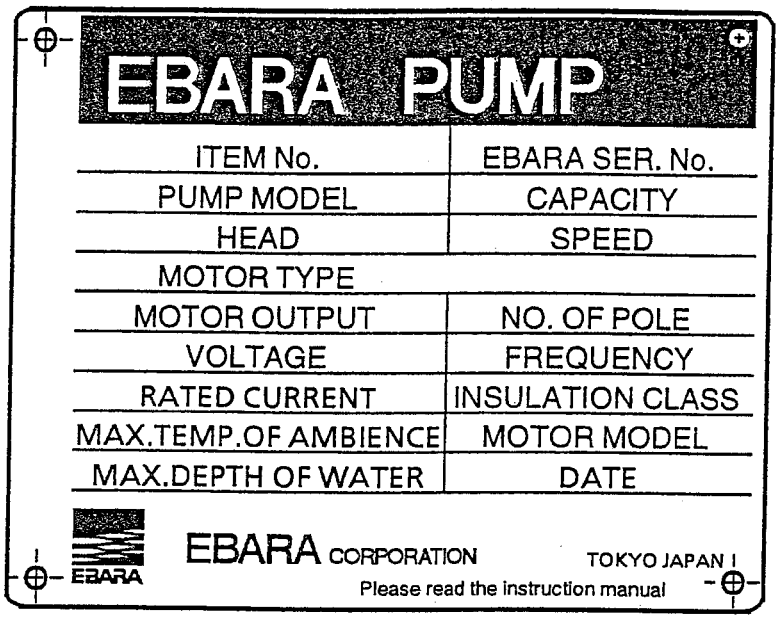


Fig. 4.1

Install nameplate in highly visible area. (Ex. column top cover)

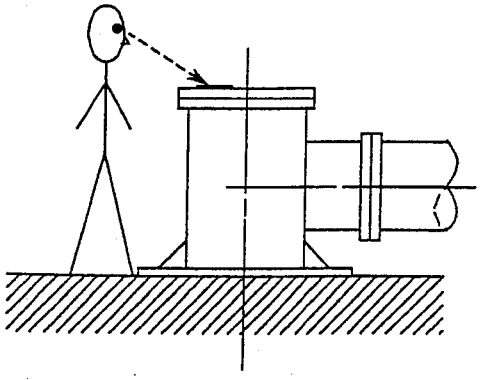


Fig. 4.2

4.2 Checks Prior to Installation

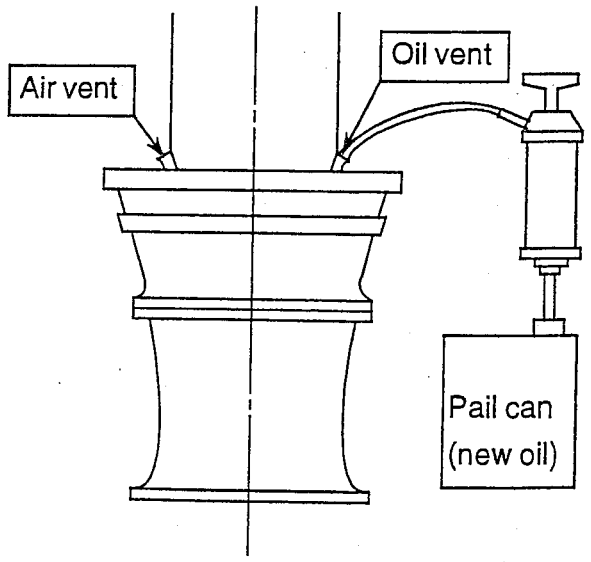
(1) Check the name plate to confirm that it is the pump ordered.
(2) Check accessories and spare parts against the packing list and previously submitted drawings and documents.
(3) Ensure that the mechanical seal chamber is filled with specified amount of oil.
(4) All plugs and fastening bolts are properly tightened.
(5) The pump is not damaged and the cable glands and cables are in satisfactory condition.
(6) The impeller turns smoothly by hand.
(7) Insulation resistance values are within limits.
(8) Ensure that the main (line) voltage and frequency agree with specifications on pump name plate.

4.3 Oil Supply

The motor shaft is sealed with a tandem mechanical seal. The seal chamber provided between the two sealing stages can be filled with oil by standing the pump vertically and unplugging "oil port" and "air vent".The quantity of oil to be prepared is shown on the cover of this manual.

⚠***CAUTION:*** *THE SEAL CHAMBER MAY BE UNDER PRESSURE. HOLD A RAG OVER THE OIL PLUG TO PREVENT SPLATTER.*

Pour the specified oil into the sealing chamber through the oil ports until the oil flows out of the air vent.
After the sealing chamber is filled to the specified level, coat threads of the oil port plug and the air vent plug with liquid packing (Three bond #1102 or equivalent) and install plugs.



Use one of the following oils or equivalent.

〔Turbine oil〕
Shell : Turbo oil T32
Mobil : Mobil DTE oil light
Esso : Esso Tresso 32
Exxon : Teresstic 32
Gulf : Harmony 32, Crest 32
Caltex : Regal Oil R&O 32
〔Liquid paraffin〕
Esso : Esso Crystol 172

Fig. 4.3

4.4 Insulation Resistance Measurement

⚠ ***WARNING:*** *ALL ELECTRIC WORK SHOULD BE PERFORMED BY A QUALIFIED ELECTRICIAN AND ALL NATIONAL AND LOCAL ELECTRICAL CODES MUST BE OBSERVED.*

Although insulation resistance of this pump has been shop tested, it should be rechecked prior to installation, using the following procedure. Usually, insulation resistance of a minimum of 50MΩ is considered satisfactory (when measured with a DC 500V Megger).

Measurement procedure (Refer to Figs. 4.4 & 4.5)

Connect the minus (–) terminal of the DC 500V Megger to the G terminal (green)of the power cable, or a motor bolt.

Touch the plus (+) terminal of the Megger to L1-phase (or L2, L3, L4, L5 or L6-phase) of the power cable, and read the insulation resistance.

Touch the plus (+) terminal of the Megger to P1 (or P2), P3 (or P4) and P5 (or P6 or P7) of the protective device cable, with the minus (–) terminal G connected as above, and read the insulation resistance.

⚠ ***CAUTION :*** *DO NOT CONNECT THE TWO MEGGER TERMINALS BETWEEN P1 AND P2 OR P3 AND P4 OR P5 AND P6 (OR P7), TO AVOID DAMAGE TO THE PROTECTIVE DEVICE. KEEP THE CABLES OFF THE GROUND WHILE TAKING ALL MEASUREMENTS.*

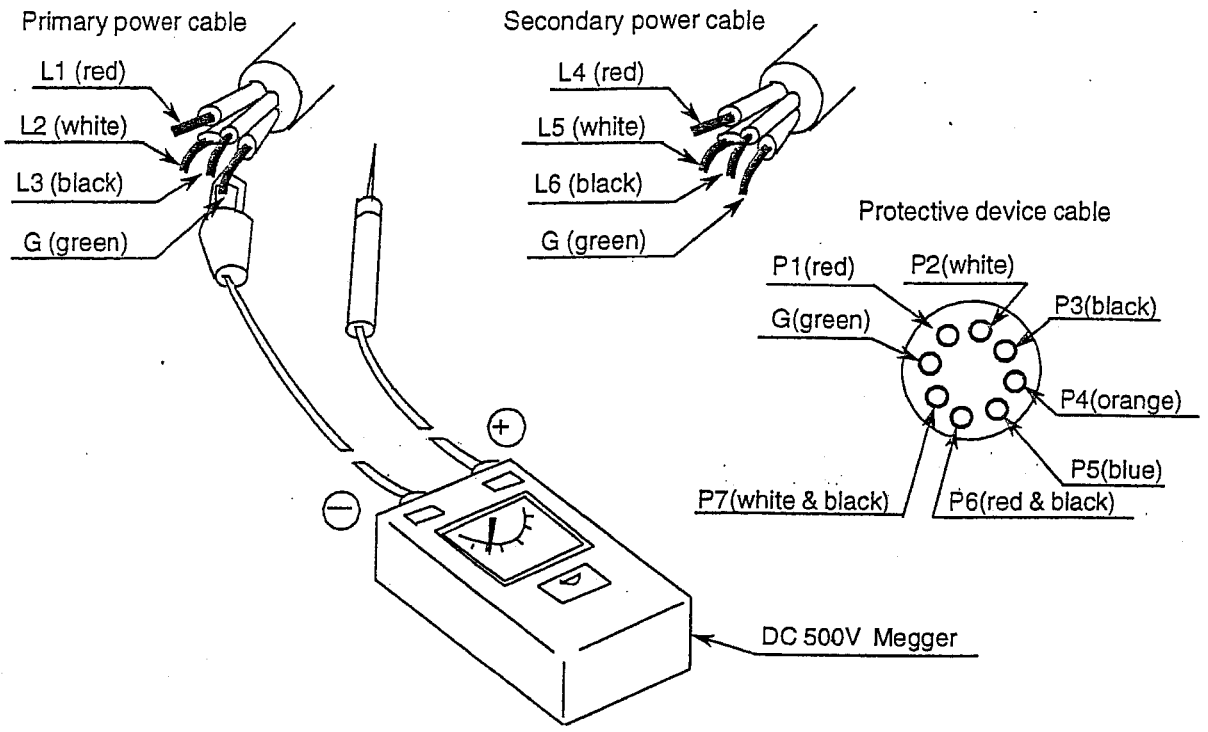

Primary power cable
L1 (red)
L2 (white)
L3 (black)
G (green)
Secondary power cable
L4 (red)
L5 (white)
L6 (black)
G (green)
Protective device cable
P1(red)
P2(white)
P3(black)
G(green)
P4(orange)
P5(blue)
P7(white & black)
P6(red & black)
DC 500V Megger

Fig. 4.4

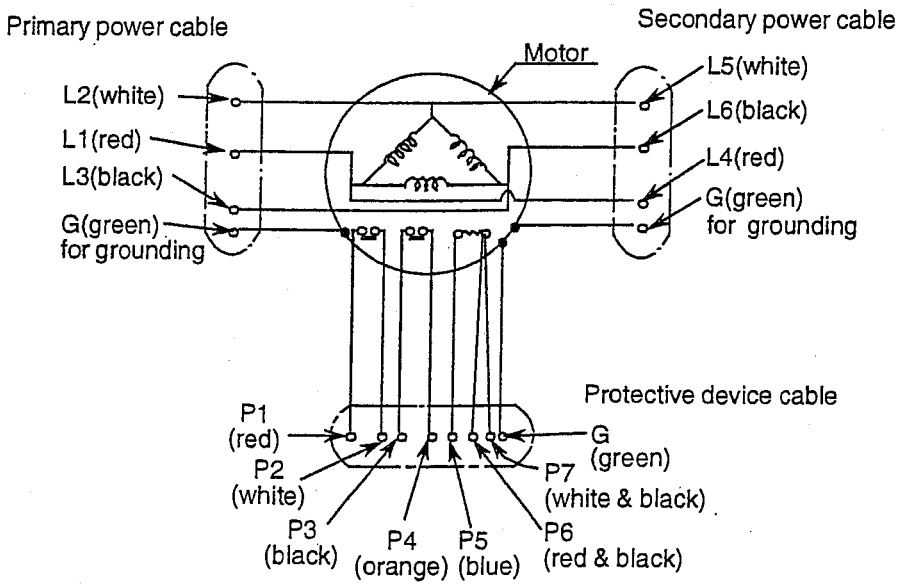

Primary power cable
Secondary power cable
Motor
L2(white)
L1(red)
L3(black)
G(green)
for grounding
L5(white)
L6(black)
L4(red)
G(green)
for grounding
Protective device cable
P1
(red)
P2
(white)
P3
(black)
P4
(orange)
P5
(blue)
P6
(red & black)
P7
(white & black)
G
(green)

Fig. 4.5

5. Storage

The pump may be stored in either a vertical or horizontal position. Protect pump from rolling or falling over.

⚠ ***WARNING:*** *ALWAYS LIFT THE PUMP BY THE LIFTING LUGS, NEVER BY THE MOTOR CABLE.*

The impeller should be rotated by hand occasionally or, if the pump is submerged, operate for 30 seconds every other month or at least every three months.

Do not store in direct sunlight or in wet environment.

After long periods of storage, check the pump in reference to "4. Pump Checks". In addition, check pump exterior for corrosion.

6. Installation

6.1 Safety Precautions

⚠DANGER: *WHEN LIFTING THE PUMP, USE APPROPRIATE CRANE (OR HOIST) AND WIRE ROPES. CHECK POSITION AND TIGHTNESS OF WIRE ROPES SO THAT WEIGHT OF THE PUMP IS NOT* ***UNBALANCED.***
FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN SERIOUS ACCIDENTS.

(1) Clean the installation area.
(2) Follow local codes and ordinances.
(3) All electrical work shall be performed by a qualified electrician.
(4) Do not use motor cables to lift pump unit.
(5) Handle the cables very carefully. If they are bent or pulled on excessively cables may be damaged.
(6) Check explosion risk before welding or using electric hand tools.
(7) Provide a suitable barrier, such as a guard rail, around the work area.
(8) Use safety helmet, safety goggles and protective shoes.

6.2 Column Pipe Installation

(1) Column Pipe shall be installed on the floor or construction which have sufficient strength to withstand pump static weight and dynamic loading.
(2) Floor or supports must be level and suitable provisions must be made for securing pump.
(3) After installing column pipe, check column for verticality by placing spirit level on column top flange surfaces. Maximum allowable tolerance is 0.3mm per meter.

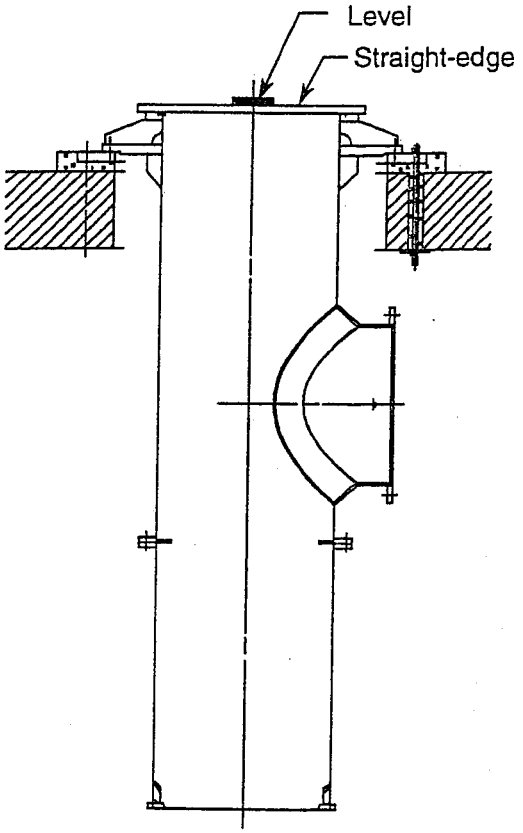


Fig. 6.1

6.3 Cable Connections

Before connecting cables to control panel, thread the cables through the cable glands at the top of column pipe.

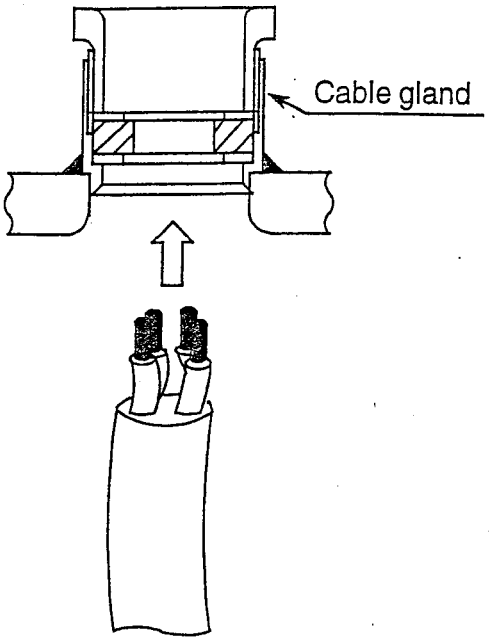


Fig. 6.2

Note : Power cables should be cut to the necessary length. Avoid coiling cables or exposure to direct sunlight, as excessive heat may be generated resulting in insulation breakdown.
Splices in power cables must never be immersed in water.
Cables should be secured by a cable holder installed at 180° from the discharge side.
As with a standard motor, if the wiring of a submerged motor is connected to the wrong terminals, the direction of rotation will be reversed. To prevent this the following wiring procedure is recommended.

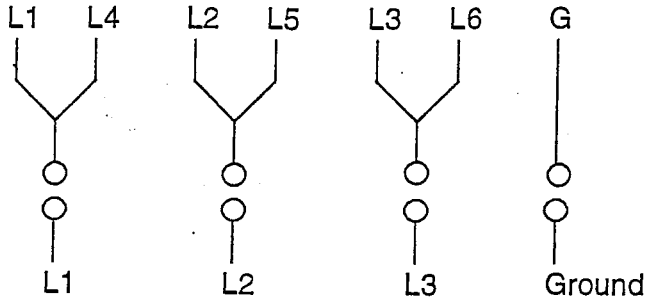
⚠ ***WARNING:*** *CHECK THAT THE POWER IS LOCKED OFF AND DISCONNECTED BEFORE WORKING ON PUMP.*

(1) Cable Connection

The electric wiring for a submersible motor is no different from that of an ordinary motor, except that the direction of rotation cannot be easily verified.

Wiring to wrong terminals results in a reversed motor, and to prevent this and to achieve best results, the following wiring procedure is recommended.

Connect terminals combined in pairs as L1-L4, L2-L5 and L3-L6 to the secondary terminals of the electromagnetic switch or breaker in the order of L1, L2 and L3. Connect the remaining terminal G to ground.



⚠ ***WARNING :*** *WHEN PREPARING POWER CABLE LEADS FOR CONNECTION TO CONTROL, IT IS ESSENTIAL THAT THE GROUND LEAD BE LONGER THAN THE POWER LEADS. THE GROUND LEAD MUST HAVE AT LEAST 2" (50 MM) SLACK REMAINING AFTER CONNECTION, WHEN SPACE PERMITS. THIS IS DONE FOR ELECTRICAL SAFETY. IF THE CABLE IS MISTAKENLY PULLED OUT, THE GROUND LEAD WILL BE THE LAST WIRE BROKEN.*

(2) Grounding (Fig. 6.3 and Table 6.1)

Be sure to connect the ground line (labeled "G") to ground. Prior to grounding, ensure that the wire is the specified one (labeled "G").

Also, verify that grounding continuity has been established inside the motor by checking that the ground wire (labeled "G") is electrically conductive with the bolt on top of the motor (to be stripped of paint).

Ground the motor according to local codes.

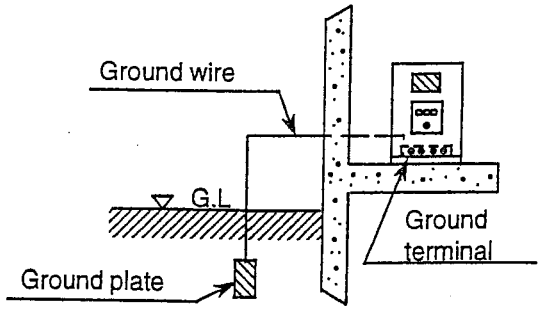


Fig. 6.3

Table 6.1 (Example)

Motor classification	Grounding work Classification	Grounding resistance	Grounding line diameter
AC 600V below	3rd grade	10Ω	ϕ1.6 mm

(Source : Electrical Equipment Technical Standards, Ministry of International Trade and Industry)

(3) Protective device cable connection (Fig. 6.4 and Table 6.2)
This pump has a leakage detector at the motor bottom, a thermal protector in the stator coil and a bearing temperature detector(RTD) in the thrust bearing bracket to protect the motor, with cable connections as illustrated in Fig.6.4 Connect terminals P1 and P2 for the thermal detector to P1 and P2 of the control connector, and P3 and P4 for the leakage detector to P3 and P4, and terminals P5, P6 and P7 for the bearing temperature detector to P5, P6 and P7 of the same connector. Connect the remaining terminal G to ground. Table 6.2 shows detailed specifications regarding protective devices.

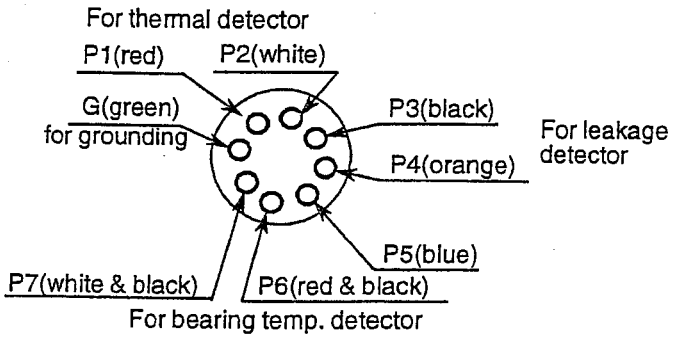


Fig. 6.4

Table 6.2

	THERMAL DETECTOR	LEAKAGE DETECTOR
TYPE	KLIXON 9700K	OLV-5
CONTACT CAPACITY	AC115V,18A / 230V,13A	AC50VA, 0.5A(max)
CONTACT	B-contact (Normal closed)	B-contact (Normal closed)
TERMINAL NO.	P1(red), P2(white)	P3(black), P4(orange)

	BEARING TEMP. DETECTOR
TYPE	RTD
RESISTANCE	Pt 100Ω at 0°c
RATED CURRENT	5mA (max.)
TERMINAL NO.	P5(blue), P6(red & black), P7(white & black)

⚠WARNING : *AN EARTH LEAKAGE BREAKER MUST BE USED ACCORDING TO LAW TO PREVENT ELECTRICAL ACCIDENTS.*
⚠CAUTION : *A MOTOR PROTECTIVE DEVICE SHOULD BE INSTALLED TO PROTECT THE SUBMERSIBLE MOTOR AGAINST OPEN-PHASE, OVER-CURRENT OR INCHING.*

6.4 Direction of Rotation

The correct direction of rotation for normal operation is "clock wise", as viewed from above. After electric wiring is completed, stand the pump unit vertically on the floor, and check direction of rotation by momentarily turning the pump switch on. If rotation direction is reversed, transpose two of the phase leads.

⚠***CAUTION:*** *SINCE THE STARTING TORQUE ON LARGE PUMPS CAN BE POWERFUL, THE PUMP MUST BE SUPPORTED.*

⚠***DANGER:*** *DURING CHECKING THE DIRECTION OF ROTATION, DO NOT TOUCH ROTATING PARTS OF THE PUMP. KEEP HANDS, HAIR AND TOOLS AWAY FROM ROTATING PARTS TO PREVENT SERIOUS ACCIDENTS.*

6.5 Pump Installation

⚠***WARNING:*** *WHEN INSTALLING THE PUMP, REMOVE THE FUSES OR OPEN THE CIRCUIT BREAKER TO PREVENT START.*

After the pump has been thoroughly checked to verify that it is in order, lift the pump unit with a hoist or a motor-driven chain block. Then, slowly lower the pump down the column pipe, keeping the pump in center of the column pipe to prevent the pump to hit against the column pipe.
The pump will automatically rest on the sole plate on the bottom of the column pipe.
If the pump cannot be slid down smoothly, the column pipe may not be vertical or the lifting method may be wrong.

⚠***CAUTION:*** *HANDLE THE CABLES VERY CAREFULLY. IF THEY ARE BENT OR PULLED EXCESSIVELY, THE CABLE AND THE SEAL MEASURE OF THE CABLE ENTRY MAY BE DAMAGED, RESULTING IN INSULATION FAILURE.*
ALSO, CARE IS NEEDED TO PROTECT CABLE ENDS AGAINST WATER INTRUSION.

Before installing the column top cover, remove all slack in cables and mark them with tape a few inches above the top of the column pipe. Thread the cables through the cover and cable holder and install while maintaining the same measured distance on the cables and fix the cables with the cable gland. (Refer to Fig. 6.5)

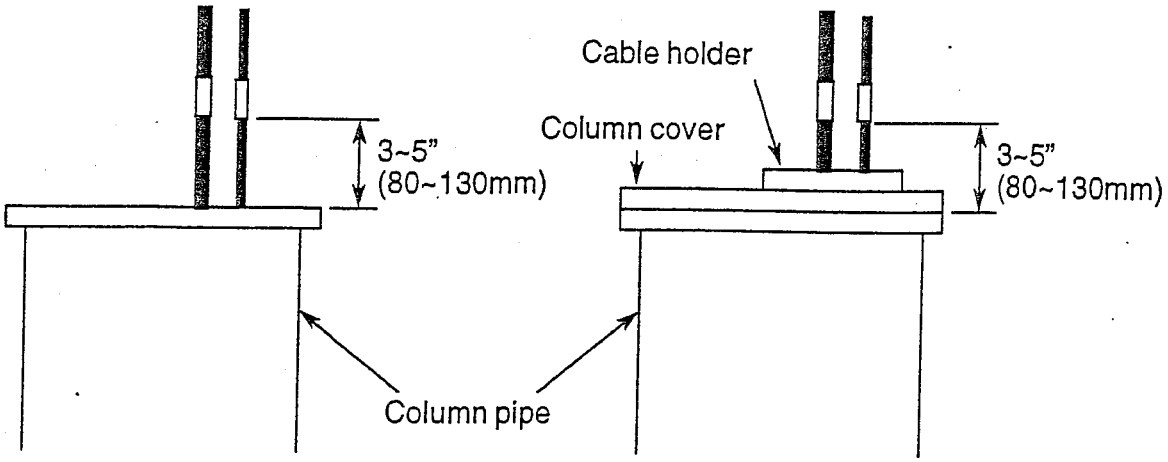

Cable holder
Column cover
3~5"
(80~130mm)
3~5"
(80~130mm)
Column pipe

Fig.6.5

7. Operation

7.1 Operational Limitations

This pump is designed to operate under the following conditions:

(1) Liquid temperature : max. 40°C (105°F)

(2) Liquid : This pump must not be used with corrosive chemicals or combustible liquids.

(3) Lowest liquid level : Refer to lowest liquid level shown in the General View Drawing.

(4) Voltage limitations : The motor is designed to supply its rated output at deviations of up to ±10 % of the rated voltage at rated frequency.

(5) Voltage balance : Balance among the supply phases should not exceed deviations in excess of ±1 %.

(6) Frequency variations : The motor is designed to supply its rated output at variations of up to ±5 % of the rated frequency at the rated voltage.

(7) Frequency of starts : The pump should not be started in excess of 10 times per hour.

7.2 Operation

(1) Starting

Open the valve if provided.

Note : A pump of lower shut off power than rated horse power may be started with the valve closed.

In such case, open the valve within 1 minute after motor start.

Start motor

⚠CAUTION : *DO NOT START THE MOTOR IF REVERSE FLOW OCCURS.*

(2) Stopping

Stop motor

Note : A pump of lower shut off power than rated horse power may be stopped just after the valve is closed .

7.3 Cautions During Operation

Pay attention to abnormal noise and vibration. If air or foreign matter enters the pump or if there is a change in the operating point, mis-operation or valve defect in the discharge lines, abnormal noise and vibration can occur. Pump discharge pressure can also vary greatly or the current meter of the motor can vary suddenly during operation.

In such cases, immediately check to find the cause of these problems.

8. Maintenance

While pump life largely depends on ambient conditions, daily servicing and inspections help extend service life considerably. To achieve long pump life, follow the following maintenance procedures:

8.1 Daily Checks

Check the following items at least once a week.

(1) Current

If the ammeter reading exceeds the motor rating listed on the data plate (name plate) or is abnormally lower than usual, it is an indication of a problem.

(2) Voltage

Voltage should be within ±10% of the rated value throughout operation.

(3) Frequency should be within ±5% of the rated value throughout operation.

(4) Vibration

Check for abnormal vibrations.

(5) Protective devices

Check protective devices by reading the panel indicator.

8.2 Monthly Checks

Check the following items at least once a month.

(1) Discharge pressure

Check pump discharge pressure and discharge flow rate (if flowmeter is provided).

(2) Insulation resistance

Operation is safe as long as insulation resistance is more than 1.5MΩ. If higher than 1.5MΩ, but this occurs after a sharp decline from a certain value, check the cables, and / or overhaul is required.

(3) Cables

Ensure that the cable has not loosened in the column pipe by checking the distance from marks on the cables to the top of the column pipe. (Refer to Fig. 8.1)

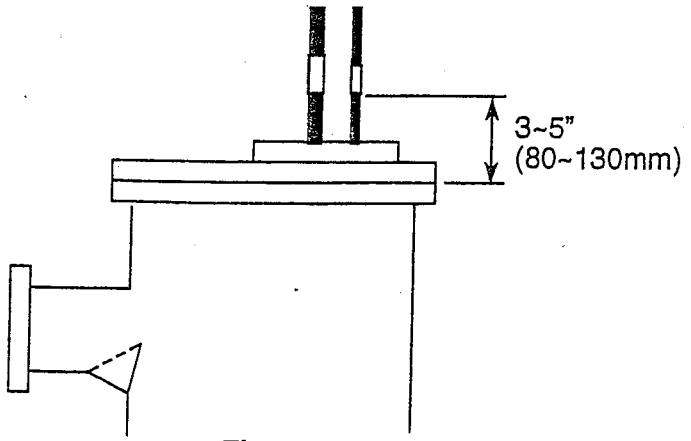


Fig. 8.1

8.3 Annual Checks

⚠***WARNING:*** *BEFORE PULLING THE PUMP, DISCONNECT ALL CABLES AND ENSURE THAT THE PUMP IS ISOLATED FROM THE POWER SUPPLY.*
⚠***WARNING:*** *ALWAYS LIFT THE PUMP BY THE LIFTING LUGS, NEVER BY THE MOTOR CABLE.*

⚠***DANGER:*** *WHEN LIFTING THE PUMP, USE APPROPRIATE CRANE (OR HOIST) AND WIRE ROPES. CHECK POSITION AND TIGHTNESS OF WIRE ROPES SO THAT WEIGHT OF THE PUMP IS NOT* ***UNBALANCED.***
FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN SERIOUS ACCIDENTS.

The pump should be pulled and inspected at least once a year and more frequently under severe operating conditions.
Pull the pump unit slowly, using a hoist or a motor-driven chain block. Handle the cables very carefully. If they are bent or pulled excessively the cable (especially the seal measure of the cable entry) may be damaged, resulting in insulation failure.

(1) Appearance check
Check the impeller, cables, bolts and nuts, external surface conditions, etc. for abnormal conditions.

(2) Mechanical seal

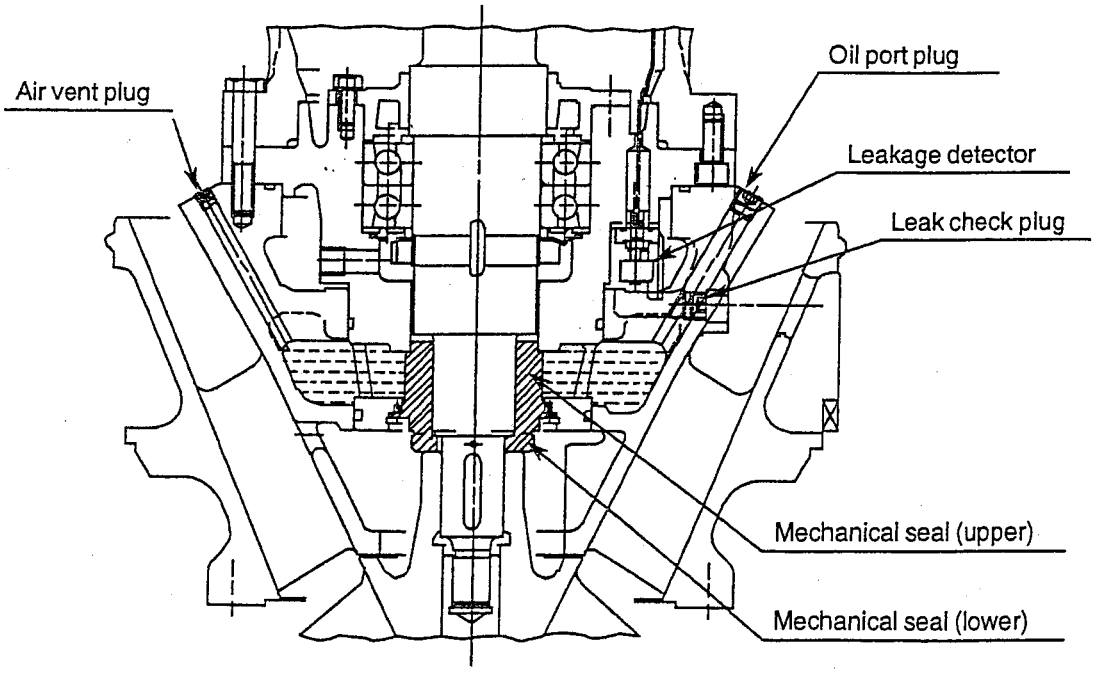


Fig. 8.2

(a) Upper

Stand the pump on the floor in a vertical position. Unplug the "leak check" in the discharge bowl of the pump.

If neither oil nor water leaks from the hole, the mechanical seal is in satisfactory condition.

If a very small quantity, of oil is emitted there is no practical problem.

If water or oil containing water, in excess of 0.8 liter (after one year of use), is emitted, the mechanical seal must be replaced.

If much water is emitted, the mechanical seal or other components may be damaged, and an overhaul is necessary.

When inspection is completed, coat the plug threads with Teflon tape or liquid packing, (Three Bond #1102 or equivalent) and install.

⚠ ***CAUTION** : THE SEAL CHAMBER MAY BE UNDER PRESSURE. HOLD A RAG OVER THE OIL PLUG TO PREVENT SPLATTER.*

(b) Lower

Unplug the"oil port" and "air vent" and drain all internal oil. (Refer to "Changing oil", Para 8.6)

If the drained oil is muddy, or milky-white, it contains water.

The mechanical seal (lower) is in satisfactory condition as long as the oil does not contain much water. Otherwise, it must be replaced.

After the oil has been inspected, pour fresh oil through the "oil port", with the pump in a vertical position, till oil overflows from the air vent plug. The quantity of oil is shown on the cover of this manual.

Replug the "oil port" and "air vent" as carefully as the other ports.

To replace either upper or lower mechanical seal, the pump must be disassembled. As the mechanical seal is a cartridge type, removing the retaining ring permits seal removal as a complete assembly.(Refer to Fig 8.6)

After the mechanical seal has been replaced with a new one, reassemble the pump and supply the specified oil through the "oil port" in the manner described above. At this point, turn the rotating body by hand to ensure that it turns smoothly.

Also, check for oil leaks. If you want the mechanical seal repaired, please contact us. and return it to us. We will repair used mechanical seal and return it to you.

(3) Rotor

Manually rotate the impeller. If it turns smoothly, the rotary components should be in satisfactory condition. If the impeller resists or feels locked, the pump requires overhaul.

(4) Reinstallation

After the pump has been thoroughly inspected, reinstall using the procedures mentioned in Para. 6.

8.4 Overhaul

When the pump requires an overhaul due to operational problems, poor insulation or as a result of inspection, please contact us.

Pump should be overhauled for general inspection every third year to prevent major trouble even if there are no apparent problems.

(1) Cable disposition

When the pump is lifted for overhauling, it is necessary to disconnect all cables from the control panel terminal board. At this time, handle the cables very carefully.

(2) Details of overhaul

Factory overhaul consists of the following;

Complete disassembly, inspection and cleaning of pump unit. (including motor)
Replacement of worn and damaged components.
Functional test.
Performance test. (if required)
Mechanical seal replacement.

8.5 Disassembly and Reassembly

⚠ ***WARNING:*** *WHEN DISASSEMBLING THE PUMP, WARNING SIGNS MUST BE POSTED NEARBY TO PREVENT MISOPERATION BY THIRD PARTIES. FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN DAMAGE OR SERIOUS ACCIDENTS.*

⚠ ***WARNING:*** *DURING PUMP DISASSEMBLY AND REASSEMBLY, ENSURE THAT THE CABLES ARE DISCONNECTED AND ISOLATED FROM THE POWER SUPPLY.*

8.5.1 Preparation for Disassembly and Reassembly

An adequate work space should be found which is as wide as possible, and has a rigid floor. The area should be safe from hazards. Following should be prepared before disassembly and reassembly.

Lifting devices.
Wooden supports and pads.
Standard tools.
Special tools.
Liquid packing.
Silicon-rubber sealant
Rags.

⚠ ***WARNING:*** *DURING DISASSEMBLY AND REASSEMBLY, BE SURE TO USE APPROPRIATE CRANE (OR HOIST) AND WIRE ROPES. USE OF IMPROPER CRANE AND WIRE ROPES CAN RESULT IN SERIOUS ACCIDENTS.*
FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN SERIOUS ACCIDENTS.

8.5.2 Cautions for Disassembly

(1) Cautions for unloading products
  (a) When hoisting heavy loads such as the pump proper, pay careful attention to attaching the sling so that the load will be centered and the sling does not slip.
  (b) When lifting heavy parts, use soft padding under the wire to protect the coated and machined surfaces. Do not raise or lower the parts too rapidly with the crane.
  (c) When assembling components on the floor, use protective blocks under the components to protect the coated surfaces and prevent rolling.

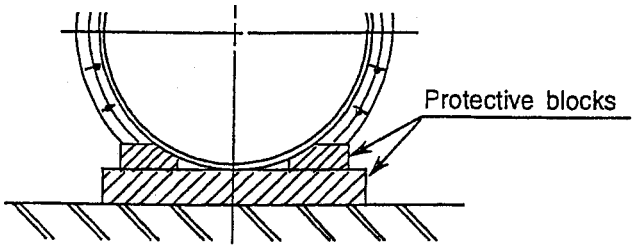


Fig. 8.3

(2) Protect surfaces of mating flanges and the corners of spigot and socket.
(3) Cover the shaft threads to protect from damage after disassembly.
(4) After disassembly, apply temporary rust prevention to the machined surfaces such as fitted surfaces, threads, shafts, etc.

(5) Be careful not to drop tools and parts into the sump pit.
(6) To protect against lost parts and mixing of parts with those from another machine, provide cases for disassembled parts and store parts in cases.
(7) Store bolts in bags as a set.
(8) Do not disassemble the motor. If the motor requires disassembly, please contact us.

8.6 Replacing Components

(1) Changing oil

Stand the pump in a vertical position, and unplug "oil port" and "air vent".
Install oil pump to "oil port". Drain all oil from the "oil port" by using the oil pump.

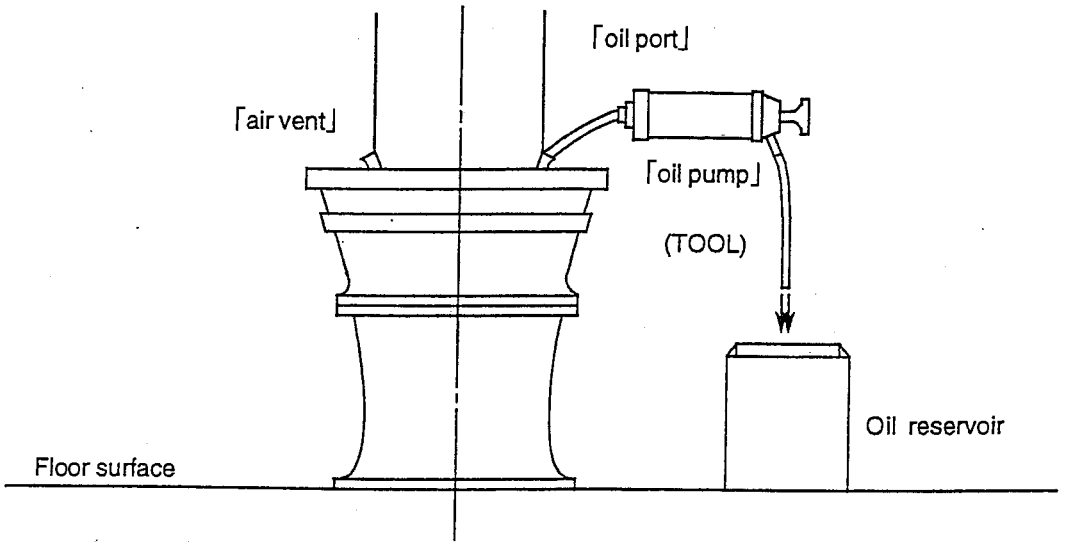


Fig. 8.4

Inspect the oil for water contamination. If the oil contains much water, mechanical seal must be replaced.
After the oil has been inspected, pour oil through the "oil port", until oil overflows from the air vent.
Coat threads of oil port plug and air vent plug with liquid packing and reinstall. (Refer to Para. 4.3)

(2) Impeller disassembly

Loose and remove the set-screw on the impeller nut. After that, remove the impeller nut with spanner or special tool "impeller nut wrench" and the impeller with special tool "Extractor".(Refer to Fig. 8.5)

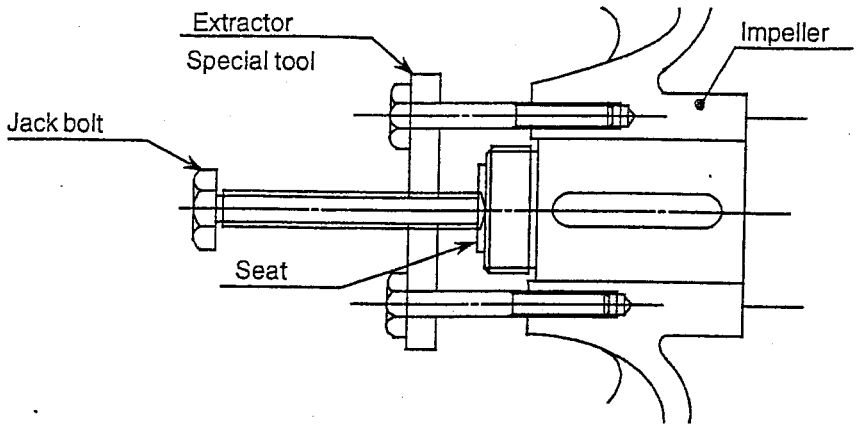


Fig. 8.5

(3) Mechanical seal replacement

(a) Remove the retaining ring Ⓐ from motor power side bracket, using a snap ring plier shown on the cover of this manual.

(b) Remove the mechanical seal by using push bolts Ⓑ.

⚠ ***CAUTION :*** *DO NOT COMPLETELY DISASSEMBLE THE MECHANICAL SEAL.*

For assembly, reverse the above steps.

(c) After installing the mechanical seal, fill the threads Ⓒ with the silicon-rubber sealant (SHIN-ETSU CHEMICAL Co., Ltd. KE-45 or equivalent).

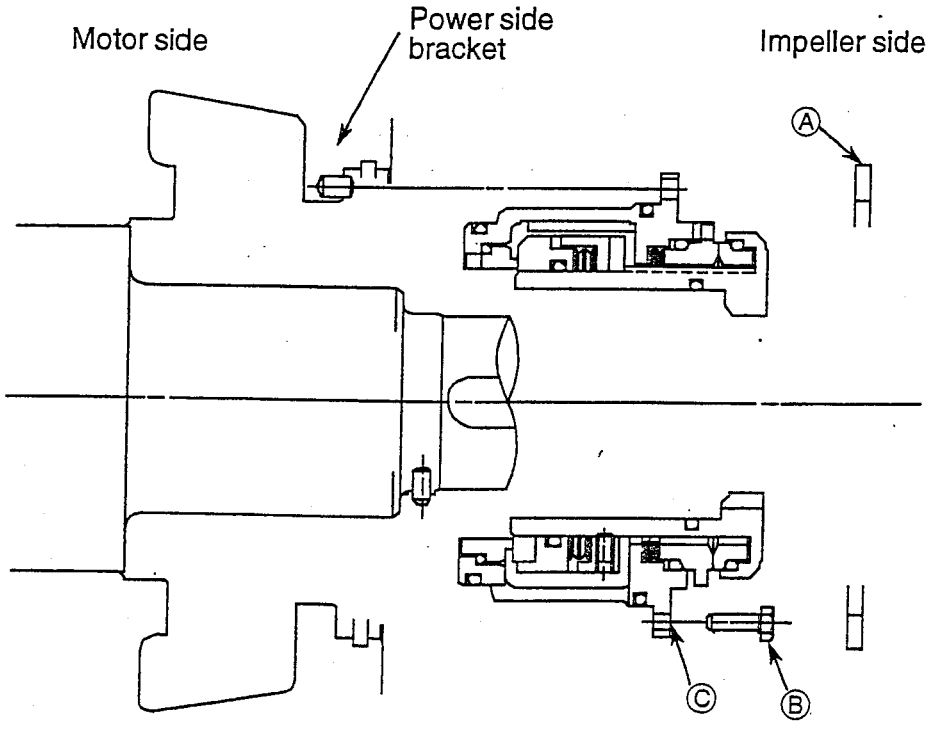


Fig. 8.6

(d) Furthermore, perform touch-up painting on / around the entrance of the retaining ring (refer to Fig. 8.7) to prevent the surface of the entrance from corrosion.

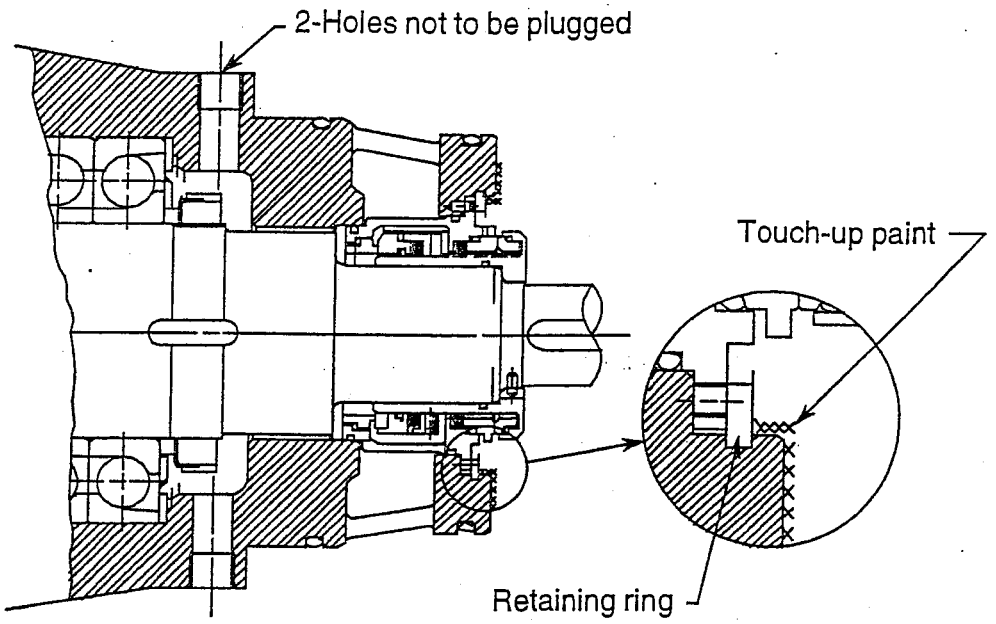


Fig. 8.7

⚠ ***CAUTION :****WHEN PERFORMING TOUCH-UP PAINTING, BE CAREFUL NOT TO DROP THE PAINTING MATERIAL ON THE MECHANICAL SEAL.*

Note : Confirm that the holes showing on Fig. 8.7 are surely opened or not plugged. These holes fulfill as paths of leaked oil from the mechanical seal.

(4) Torque table

Table 8.1

Bolt size	Torque kg·m (Ft.lbs.)	
	without anti seize compound	with anti seized compound
M8	1.1 (8)	0.8 (6)
M10	2.2 (16)	1.5 (11)
M12	3.8 (28)	2.6(18)
M16	9.1 (66)	6.2 (45)
M20	17.8 (129)	12.1 (88)
M22	24.0 (174)	16.2 (117)
M24	30.8 (223)	20.9 (151)
M30	61.4 (444)	41.6 (301)
M36	107.0 (774)	72.4 (524)

⚠ ***WARNING:*** *WHEN MACHINED SURFACES ARE DAMAGED AND MUST BE REPAIRED, USE AN APPROPRIATE GRINDER. DURING GRINDING WORK, APPROVED PROTECTIVE GOGGLES MUST ALSO BE WORN.*

8.7 Recommended Spare Parts List

NO.	Name	Q'ty for 1 Set (5 years)	Remarks
111	MECHANICAL SEAL	1 Set	
115	O-RING	2 Set	
811-01	LINE CORD	1 Set	
811-02	CONTROL CORD	1 Set	
849-01	BALL BEARING	1 Set	
849-02	BALL BEARING	1 Set	
909	LEAKAGE DETECTOR	1 Set	

8.8 Maintenance Log

Date	Pump No.	Hours of Operation	Remarks	Init.

9. Troubleshooting

Symptoms	Probable Causes	Remedies
Pump fails to start	Defective cable or motor. Malfunction inside control panel. Power source trouble. Pump is mechanically locked. Defective protector.	Lift pump and replace cable or motor. Inspection made by competent electrician. Inspection made by competent electrician. Lift pump, inspect and/or overhaul. Replace protector.
Pump fails to function despite motor operation	System head too high. Clogged discharge pipe. (Pressure too high) Clogged pump or strainer. (Pressure too low) Wrong direction rotation. Internal pump wear. Valve is closed.	Recheck requirements. Clean discharge pipe. Clean strainer or impeller and bowl. Check and change rotation. Transpose two of the three phase leads at panel. Repair and/or replace. Check valve position.
Insufficient capacity	Air suction. Vortex in suction pit. System head too high. Clogged discharge pipe. (Pressure too high) Clogged pump or strainer. (Pressure to low) Air accumulation in pipe. Internal pump wear. Wrong direction rotation. Liquid viscosity different from design value. Damaged impeller.	Raise water level in suction pit. Install block to stop vortex. Recheck requirements. Clean discharge pipe. Clean strainer, impeller and bowl. Install air vent valve. Repair and/or replace. Check and change rotation. Transpose two of the three phase leads at panel. Recheck requirements. Repair and/or replace.
Excessive current	Reverse vortex at suction bell. Gravity of pumped liquid greater than that specified. Sand mixed with water. Refer to "Pump fails to start."	Install block to stop vortex. Change pump unit. Lift the pump and overhaul. Remove sand in pit.
Vibration and/or noise	Internal pump wear. Clogged pump. Cavitation or vortex. Resonance in pipe line or foundation. Rotating component in contact with fixed component. Damaged impeller.	Repair and/or replace. Clean pump. Raise suction water level. Operate at proper flow rate. Repair to change characteristic vibration. Internal pump check. Repair and/or replace. Repair and/or replace.

LIMITED WARRANTY

MUNICIPAL: PERMANENT INSTALLATIONS

EIC warrants for a period of five (5) years or ten thousand (10,000) hours of operation, whichever shall first occur, measured from the date of shipment from EIC (the "Warranty Period"), the Equipment of its own manufacture against defects in material and workmanship, when installed, used and maintained in accordance with instructions as provided by EIC in permanent municipal installations under the following conditions of service only:

1) Raw Sewage; or
2) Municipal Wastewater; or
3) Potable or Raw Water; or
4) Storm Water; and
5) Liquids must be abrasive-free and non-corrosive.

This is a LIMITED warranty. The following are CONDITIONS OF WARRANTY:

1) Only Municipal Applications are qualified to participate hereunder;
2) Start-Up Procedures in accordance with instructions provided by EIC must be properly completed, and a report confirming same must be prepared & submitted with all warranty claims.
3) Elapsed-time meters must be installed and be operational within the electrical control panel;
4) All EIC-prescribed maintenance procedures must be followed, documented and proof thereof submitted to EIC with any warranty claim hereunder;
5) Each warranty claim must be submitted in accordance with EIC's Warranty Procedures, which require notification to EIC and assignment by EIC of a Materials Return Authorization ("MRA") number. EIC's Warranty Procedures are provided with each item of EIC Equipment sold hereunder by EIC.
6) Any repairs to EIC Equipment, whether warranty claims or otherwise, by other than an EIC-authorized repair or service facility may invalidate the warranty hereunder.

If a defect appears in the EIC Equipment warranted hereunder during the Warranty Period and Purchaser has given EIC immediate written notice of same, EIC will either repair the part, or replace the part, by shipping a similar part F.O.B. EIC's shipping point, or at is option grant a credit reimbursement or refund an equitable portion of the purchase price. EIC may require Electrical System Schematics (including Bills of Materials) and other data regarding maintenance and applications, as well as return of the Equipment, transportation prepaid, to substantiate and validate the warranty claim. The warranty shall not apply to any Equipment which has been subjected to misuse, accident or neglect or used in any manner not consistent with the applications disclosed to EIC at the time of purchase, or to Equipment damaged due to defective power supply, incorrect electrical protections or faulty installation or maintenance. All costs of field labor, removal, reinstallation and transportation shall be borne by the Purchaser.

The Warranty Period shall not be suspended or tolled upon stopping operations for the warranty repairs, nor recommence upon completion of said repairs, but rather shall run continuously from commencement until normal expiration. Repair parts shall carry no greater warranty than the remaining balance of the underlying Equipment into which the repair part may be installed, expiring at the same time as said underlying warranty.

This is a *pro rata* limited warranty. EIC will pay the following share of the cost of replacement or repair parts:

Lesser of:	Warranty Period Following Shipment		
Months:	0-18	19-39	40-60
Hours of Operation:	0-3,000	3001-6500	6501-10000
Warranty Repair Costs:	100%	50%	25%

This is EIC's sole and exclusive warranty. It applies only to EIC Equipment, including QDC (Quick Discharge Connector) Power Cables when originally purchased with EIC Equipment, but specifically excludes all other equipment of others' manufacture, whether or not such equipment is included in EIC's scope of supply hereunder. Such other equipment is warranted only by its manufacturer.

EIC MAKES NO OTHER WARRANTY OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, AND ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED BY EIC AND EXCLUDED FROM THESE TERMS AND CONDITIONS OF SALE. The Purchaser's sole and exclusive remedy, whether in warranty, tort or contract, including negligence, will be to proceed under this warranty. All liability of EIC shall terminate no later than the expiration of the Warranty Period. EIC SHALL IN NO EVENT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER.

Ship To:	Checked by RK	Checked by LS	Date Faxed
FOR SUBMITTAL TO EBARA			
	Special Instructions		
	Freight Company	Freight Phone	
Tag			
	Ship Method	Declared Value	# of Panels
		$0.00	1

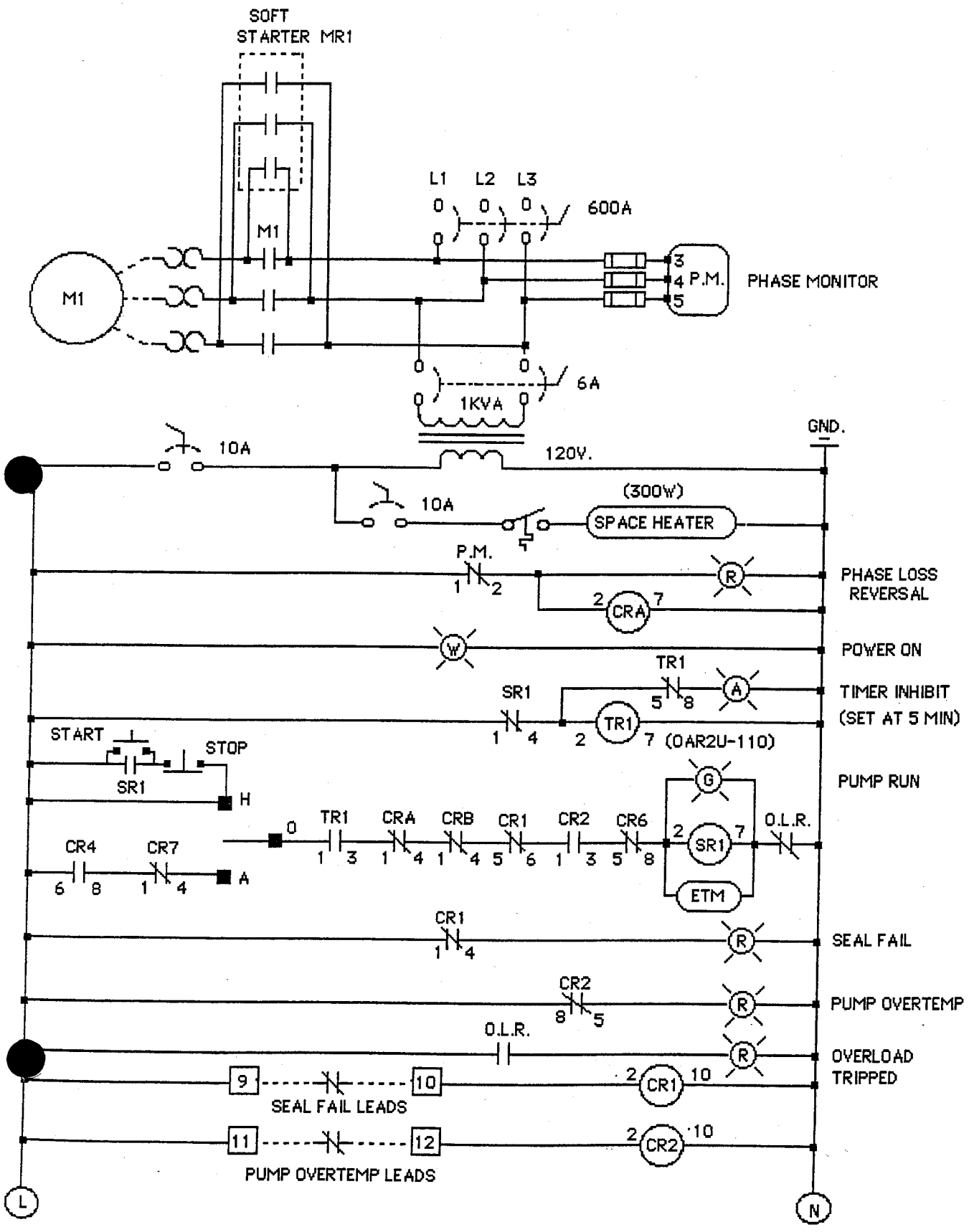
Customer	PO#	Ship Instruct.	Ship Date	Serial#
Ebara International	RANDOLPH	HFA		S994912

Sales Rep	RK to Witness	Video Tape	Drawing#	Wire Size
House	No		S133SFHPEB	

Type	Voltage	Hertz	Phase	HP	FLA	Model#
Simplex	480	60	3	265	310	

Qty	Description	Size
1	Enclosure Nema 12	60" X 36" X 12"
1	Phase Monitor - TimeMark w/ fuse block & fuses	TIMEMARK: MODEL A258B
1	Circuit Breaker - 3 Pole (600A)	ABB: S6N600BW
1	Circuit Breaker - 2 Pole (6A)	ABB: S272-K6
2	Circuit Breaker - 1 Pole	SQD: QOU110
1	Circuit Breaker thru door handle	ABB: K6VD-25S12
1	Transformer, Fuse, Block (1 KVA)	MICRON: VFIK0BTZ13JK
1	Space Heater & Thermostat (300W)	Chromallox: Pt-603; Stego: KTO 1140
1	Contactor	ABB: EH450C-1
1	Contactor - Soft Start	ABB: SSA300-481
1	Overload (FREE STANDING)	ABB: T450DU400
1	HOA Switch - 600V 22MM Tele	Telemecanique: ZA2 BD3
4	120V Push Button Mom - 22mm Tele 2-n.o/2-n.c	Telemecanique: ZA2 BA3
11	Lamps - 22MM Tele (R-7, G-1, W-1, A-2)	Telemecanique: ZA2 BVO*
1	Elapsed Time Meter - AC/DC	GRASSLILN: FWZ 72
1	RTD Relay and 20 PIN Base	Wilkerson Inst.: MM1410
9	Relay - 2PDT	OMRON: MK2P-S-AC120
2	Relay - 3PDT	OMRON: MK3P5-S-AC120
7	Socket - 8 Pin	STANDARD
2	Socket - 11 Pin	STANDARD
1	Alarm - Horn (AC/DC) Weatherproof	FARADAY: FARA-MOD
2	Timer - Delay On Or Off: OAR2U-110	Syrelec: OAR2U
1	Terminal Strip & #-marker (23pt.)	WECO: 324- HDS/12
1	Lug - Ground	STANDARD
1	Labels - Standard	Black w/ White Letters

S-5 SIMPLEX	**SUNBELT POWER CONTROLS, INC.** **2412 RICHLAND AVE.** **SUITE 102** **DALLAS,TEXAS 75234**	DATE 1/21/2000 HP. 265 DRAWING# S133SFHPHWLWRTEB VOLT. 480 PHASE 3 SERIAL # S994912 DRAWN BY RAK

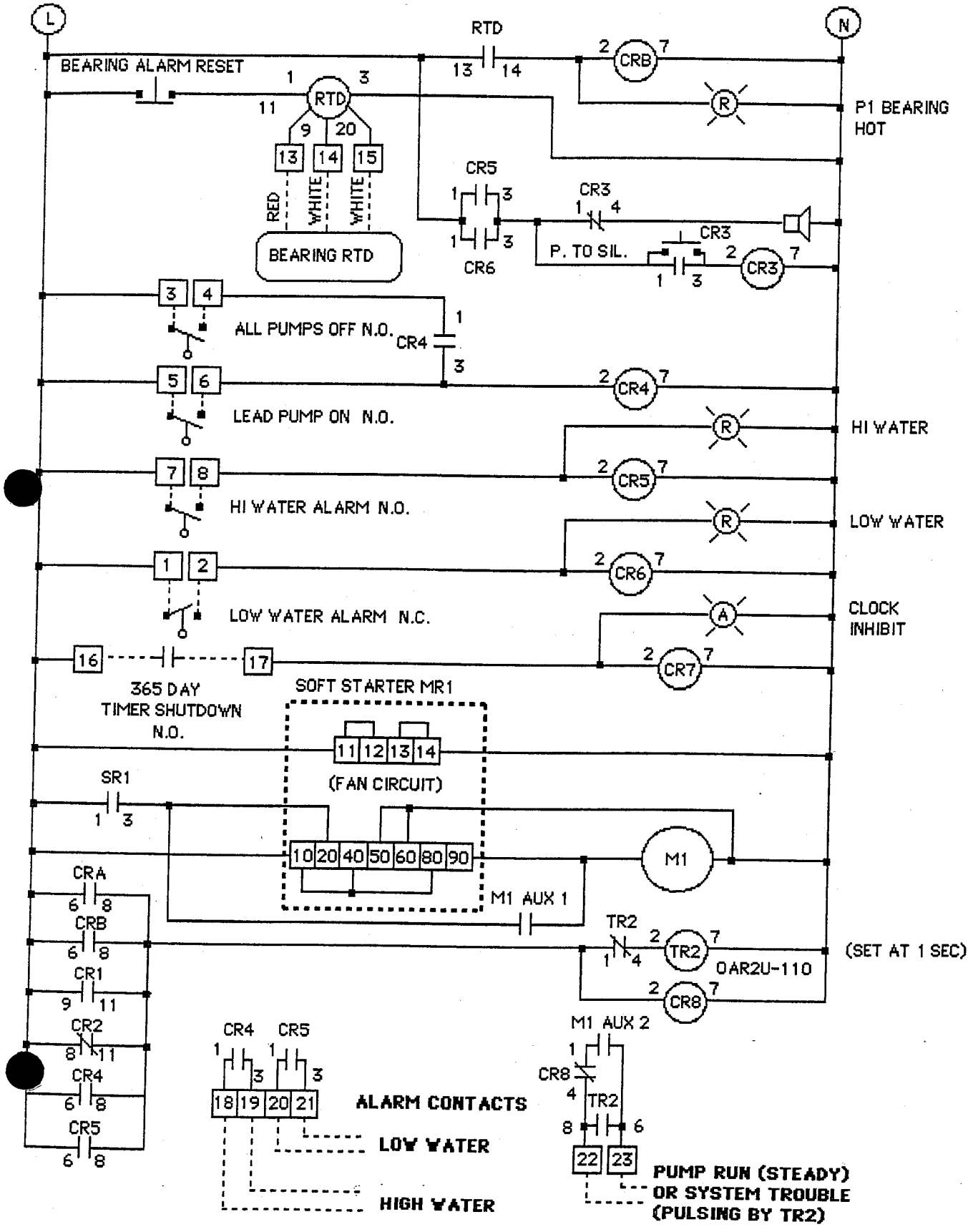


S-5 SIMPLEX

SUNBELT POWER CONTROLS, INC.
2412 RICHLAND AVE.
SUITE 102
DALLAS, TEXAS 75234

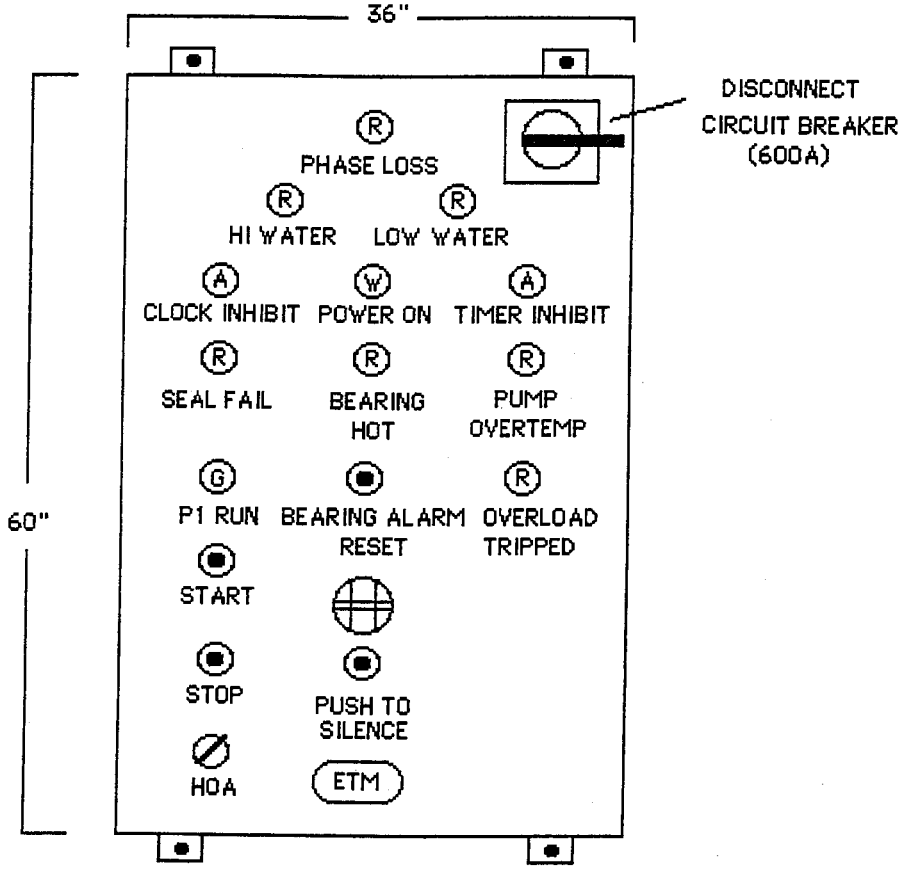
DATE 1/21/2000
DRAWING # S133SFHPHWLWRTEB
SERIAL # S994912

HP. 265
VOLT. 480
PHASE 3
DRAWN BY RAK



SIMPLEX CONTROL NEMA 12 ENCLOSURE	SUNBELT POWER CONTROLS, INC. 2412 RICHLAND AVE. SUITE 102 DALLAS, TX 75234	DATE 1/21/2000 HP. DRAWING# D1012HWSFHPET VOLT. PHASE SERIAL # DRAWN BY RAK

NOT TO SCALE



FRONT VIEW

SINGLE-DOOR LARGE OIL TIGHT NEMA 12 ENCLOSURES

APPLICATION

EMF Nema 12 Large oil tight boxes are used to house controls, and related electrical devices.

FEATURES

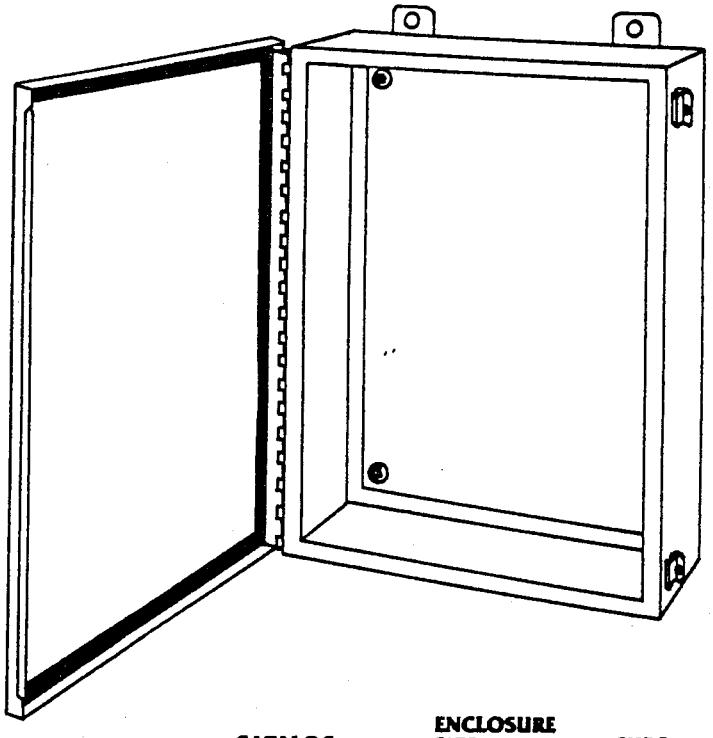
- U.L. Listed
- 14 ga. Steel
- Mounting Feet
- Exterior Door Clamps
- Continuously hinged door
- Grey Enamel finish inside and outside over a Phosphatized Surface
- Collar studs for mounting panel
- Continuously welded seams
- Neoprene oil-resistant gasket

ACCESSORIES

- Louvers
- Window Kits

MODIFICATIONS

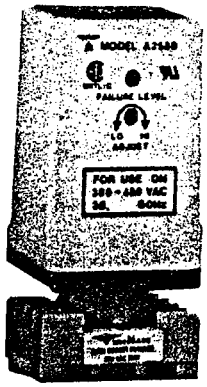
- Special paints
- Special latches
- Knockouts/Cutouts
- Aluminum, Galvanized, Stainless



CATALOG NUMBER	ENCLOSURE SIZE A†×B×C	SHPG. WT.
J-20H16A	20×16×7	31
J-20H20A	20×20×7	36
J-24H20A	24×20×7	41
J-24H24A	24×24×7	48
J-30H20A	30×20×7	49
J-30H24A	30×24×7	58
J-36H24A	36×24×7	66
J-20H16B	20×16×9	36
J-20H20B	20×20×9	36
J-24H20B	24×20×9	47
J-24H24B	24×24×9	52
J-30H20B	30×20×9	54
J-30H24B	30×24×9	66
J-36H24B	36×24×9	76
J-36H30B	36×30×9	90
J-42H30B	42×30×9	102
J-42H36B	42×36×9	121
J-24H24C	24×24×11	57
J-36H24C	36×24×11	80
J-48H36C	48×36×11	155
J-30H24D	30×24×13	72
J-36H30D	36×30×13	104

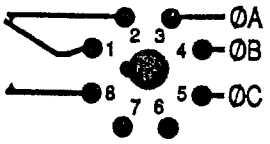
Model 258
3-PHASE POWER MONITOR

Monitors 3-phase power lines for abnormal power conditions

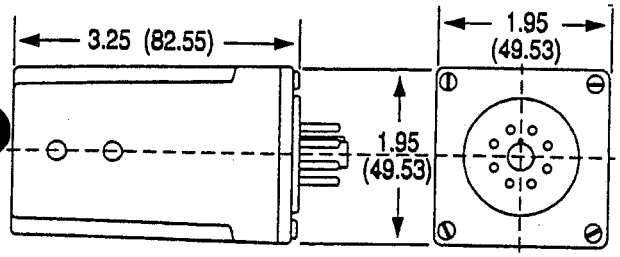


- **Detects phase loss, low voltage and phase reversal**
- **60 Hz, 50 Hz, and 400 Hz models available**
- **Automatic or optional manual reset**

NRTL/C

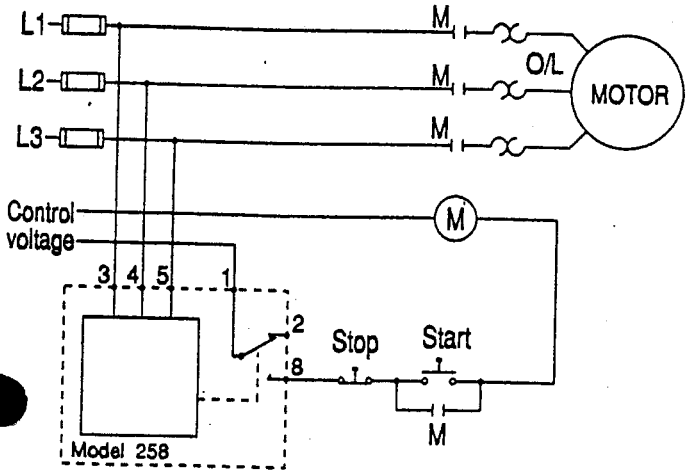


The Model 258 continuously monitors 3-phase power lines for abnormal conditions. When properly adjusted, the Model 258 will detect phase loss on a loaded motor even when regenerated voltage is present. The device consists of a solid-state voltage and phase-angle sensing circuit driving an electromechanical relay. When correct voltage and phase rotation are applied, the internal relay will energize. A fault condition will de-energize the relay; when the fault is corrected the 258 will automatically reset (a manual reset version is available). The 258 does not require a neutral connection and can be used with Wye or Delta systems. Standard versions cover 120v, 208/240v and 480v, 60 Hz; 380v, 50 Hz; 120v and 208/240v, 400Hz. Adjustment ranges are sufficiently wide to allow for proper adjustment to existing conditions. A failure indicator is provided to aid in adjustment and system troubleshooting.



Model	B258B	258B	A258B	EX258B
Nominal AC voltage (phase-to-phase)	120vac	208/240vac	480vac	380vac
Adjustment range	85-120vac	160-240vac	380-480vac	300-380vac
Frequency	60 Hz	60 Hz	60 Hz	50 Hz
Power consumption	.25 W/ph.	.50 W/ph.	1.5 W/ph.	1.25 W/ph.
Transient protection	2500 VRMS for 10ms			
Repeat accuracy (fixed conditions)	± 0.1% of set point			
Response time	50 milliseconds			
Reset time	.05 seconds			
Reset type	Automatic (optional manual reset)			
Dead band	2%			
Output contacts	SPDT			
Contact rating	Resistive: 10A at 240VAC			
Expected relay life	Mechanical: 50,000,000 operations Electrical: 100,000 at rated load			
Operating temperature	-40° to 55° C			
Humidity tolerance	97% w/o condensation			
Case material	ABS plastic			
Mounting	8-pin octal socket (order separately)*			
Weight	5 oz. (141.74 grams)			
Agency approval	UL Recognized and CSA NRTL/C Certified (Condition of acceptability: A258B & EX258B must be used with a UL Recognized, 600 volt socket)			

*Order socket number 51X00120-01

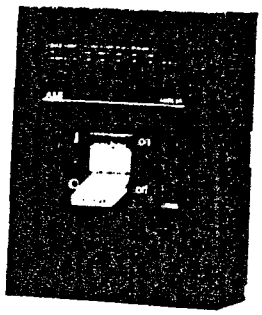


TIME MARK® CORPORATION

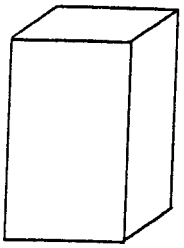
11440 East Pine Street
Tulsa, OK 74116
(918)438-1220
FAX(918)437-7584

Dimensions are in inches and (millimeters) unless otherwise specified. Drawings show no power applied.

S6
600A / 800A, 600VAC
Electronic trip type



S6



H x W x D
10.55" x8.27" x 4.07" (a)
14.25" x 8.27" x 4.07" (b)

Standard S6 package includes complete circuit breaker and mounting hardware. **Order cable lugs or other connection scheme as a separate item.**

(a) With K6TH cable lugs breaker is 10.55" tall.
(b) With K6TJ cable lugs, terminal covers are provided and breaker is 14.25" tall.

General

The S6 breaker family is an 800A frame with a 600A and 800A version, both utilizing a microprocessor based overcurrent protective trip system. Both versions are adjustable from 40% to 100% of rating without the addition of any parts or rating plugs. As standard, the S6 includes adjustable long time function for overload protection and adjustable instantaneous function for short circuit protection.

2

Versions

To meet all application needs, the S6 is available in various versions:

B = Adjustment LI
C = Adjustment LSI
E = Adjustment LSIG
Q = 100% UL rated
D = Molded case switch
M = Magnetic only (MCP)

Trip Functions

These tripping functions are available:

L = Long time
S = Short time
I = Instantaneous
G = Ground fault

Performance level

Each version is also available in different maximum fault interrupting levels

N = Normal
H = High
L = Extra high

Number of poles

In UL/CSA version, the S6 is available as in two pole or three pole version, both with the same dimensions. A four pole version is also available in IEC form. For price estimate, add 35% to list price of selected version three pole breaker, contact ABB Control for details.

Accessory mounting

Internal accessories are UL/CSA approved for both factory or field installation. Accessories require control cable connectors. Shunt trips or UVR's mount in the left cavity. Auxiliary or bell alarm switches mount in the right cavity.

Reverse feeding

All versions of the S6 family are suitable for reverse feed applications.

Molded case switches

UL1087 switches include no overcurrent protection except for a high instantaneous trip mechanism for self protection. IEC type molded case switches with no trip protection are also available.

UL/CSA Interrupting capacity (kA RMS)
UL489 / CSA C22.2

Voltage	N	H	L
240VAC	65	150	200
480VAC	50	65	100
600VAC	25	35	42

IEC-947 Interrupting capacity (kA RMS)

Voltage	N	H	L
230VAC	65	100	200
380/400/415VAC	35	65	100
440VAC	30	50	80
500VAC	25	40	65
690VAC	20	25	35

S6
600A / 800A, 600 VAC
Electronic trip type

S6

The S6 breaker family uses two available microprocessor based internal trip units. The standard **PR211** trip unit includes adjustments for long time current pick-up and instantaneous current trip point.

The optional **PR212** trip unit includes adjustments for long time current pick-up/ delay, short time pick-up/delay, I^2t (on/off), instantaneous current trip point and further optional ground fault protection.

600A Frame (240 – 600A adjustable continuous range)

Breaker	IC at 480VAC	Trip type	Adjustment	2 pole, 600VAC catalog number	List price	3 pole, 600VAC catalog number	List price
S6N	50kA	PR211 PR212 PR212	LI LSI LSIG	S6N600BW-2 S6N600CW-2 —	$ 2847 4237 —	S6N600BW S6N600CW S6N600EW	$ 3608 4998 6998
S6H	65kA	PR211 PR212 PR212	LI LSI LSIG	S6H600BW-2 S6H600CW-2 —	4275 5665 —	S6H600BW S6H600CW S6H600EW	5271 6661 8661
S6L	100kA	PR211 PR212 PR212	LI LSI LSIG	S6L600BW-2 S6L600CW-2 —	5481 6871 —	S6L600BW S6L600CW S6L600EW	6482 7872 8972

800A Frame (320 – 800A adjustable continuous range)

Breaker	IC at 480VAC	Trip type	Adjustment	2 pole, 600VAC catalog number	List price	3 pole, 600VAC catalog number	List price
S6N	50kA	PR211 PR212 PR212	LI LSI LSIG	S6N800BW-2 S6N800CW-2 —	$ 3842 5232 —	S6N800BW S6N800CW S6N800EW	$ 4802 6192 8192
S6H	65kA	PR211 PR212 PR212	LI LSI LSIG	S6H800BW-2 S6H800CW-2 —	4275 5665 —	S6H800BW S6H600CW S6H800EW	6465 7855 9855
S6L	100kA	PR211 PR212 PR212	LI LSI LSIG	S6L800BW-2 S6L800CW-2 —	6476 7866 —	S6L800BW S6L800CW S6L800EW	7676 9066 11,066

Trip settings

Adjustment	Trip function	Range	Individual settings
L	Long time pick-up Long time delay	0.4 - 1.0 3.0 - 18 sec.	0.4-0.5-0.6-0.7-0.8-0.9-0.95-1.0 x Frame rating A - B - C - D
S	Short time pick-up Short time delay	1.0 - 10.0 0.05 - 0.5 sec.	Off-1.0-2.0-3.0-4.0-6.0-8.0-10.0 x Frame rating A - B - C - D (I^2t On-Off)
I	Instantaneous trip	1.5 - 12.0	1.5-2.0-4.0-6.0-8.0-10.0-12.0 x Frame rating
G	Ground fault Ground fault delay	0.2 - 1.0 0.1 - 0.8 sec.	Off-0.2-0.3-0.4-0.6-0.6-0.9-1.0 x Frame rating A - B - C - D

Continuous amperage settings (long time adjustment)

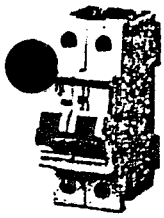
Frame	Set points								
	0.4	0.5	0.6	0.7	0.8	0.9	0.95	1.0	Setting
600A	240	300	360	420	480	540	570	600	Amps
800A	320	400	480	560	640	720	760	800	Amps

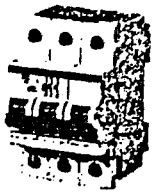
S270
480 VAC Class

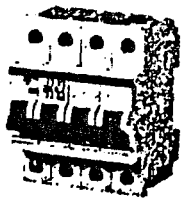
UL 1077 CSA C22.2 - NO. 235
VDE 0641 IEC-898
Cable & equipment protection

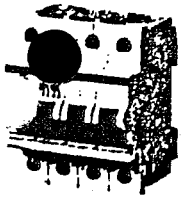

S271-K10
Single pole (277VAC)


S271-K2NA
Single pole with neutral


S272-K16
Two pole


S273-K10
Three pole


S273-K20NA
Three pole with neutral

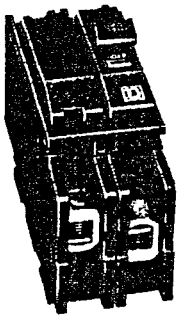

S274-K10
Four pole

Rated current	Catalog number	List price	Delivery class	Sugg. order qty	Wgt. oz. (1 pc.)
0.5	S271-K0.5	$ 42	A	10	4.5
1	S271-K1	42			
1.6	S271-K1.6	42			
2	S271-K2	42			
3	S271-K3	42			
4	S271-K4	42			
6	S271-K6	42			
8	S271-K8	42			
10	S271-K10	42			
13	S271-K13	42			
16	S271-K16	42			
20	S271-K20	42			
25	S271-K25	46			
32	S271-K32	48			
40	S271-K40	52			
50	S271-K50	60			
63	S271-K63	68			
0.5	S271-K0.5NA	84	C	5	9.0
1	S271-K1NA	84			
1.6	S271-K1.6NA	84			
2	S271-K2NA	84			
3	S271-K3NA	84			
4	S271-K4NA	84			
6	S271-K6NA	84			
8	S271-K8NA	84			
10	S271-K10NA	84			
13	S271-K13NA	84			
16	S271-K16NA	84			
20	S271-K20NA	84			
25	S271-K25NA	88			
32	S271-K32NA	90			
40	S271-K40NA	96			
50	S271-K50NA	112			
63	S271-K63NA	130			
0.5	S272-K0.5	96	A	5	9.0
1	S272-K1	96			
1.6	S272-K1.6	96			
2	S272-K2	96			
3	S272-K3	96			
4	S272-K4	96			
6	S272-K6	96			
8	S272-K8	96			
10	S272-K10	96			
13	S272-K13	96			
16	S272-K16	96			
20	S272-K20	96			
25	S272-K25	106			
32	S272-K32	106			
40	S272-K40	116			
50	S272-K50	138			
63	S272-K63	152			

Rated current	Catalog number	List price	Delivery class	Sugg. order qty	Wgt. oz. (1 pc.)
0.5	S273-K0.5	$ 138	A	3	13.5
1	S273-K1	138			
1.6	S273-K1.6	138			
2	S273-K2	138			
3	S273-K3	138			
4	S273-K4	138			
6	S273-K6	138			
8	S273-K8	138			
10	S273-K10	138			
13	S273-K13	138			
16	S273-K16	138			
20	S273-K20	138			
25	S273-K25	156			
32	S273-K32	158			
40	S273-K40	174			
50	S273-K50	200			
63	S273-K63	228			
0.5	S273-K0.5NA	200	C	2	18.0
1	S273-K1NA	200			
1.6	S273-K1.6NA	200			
2	S273-K2NA	200			
3	S273-K3NA	200			
4	S273-K4NA	200			
6	S273-K6NA	200			
8	S273-K8NA	200			
10	S273-K10NA	200			
13	S273-K13NA	200			
16	S273-K16NA	200			
20	S273-K20NA	200			
25	S273-K25NA	206			
32	S273-K32NA	212			
40	S273-K40NA	224			
50	S273-K50NA	264			
63	S273-K63NA	304			
0.5	S274-K0.5	218	C	2	18.0
1	S274-K1	218			
1.6	S274-K1.6	218			
2	S274-K2	218			
3	S274-K3	218			
4	S274-K4	218			
6	S274-K6	218			
8	S274-K8	218			
10	S274-K10	218			
13	S274-K13	218			
16	S274-K16	218			
20	S274-K20	218			
25	S274-K25	234			
32	S274-K32	238			
40	S274-K40	260			
50	S274-K50	300			
63	S274-K63	338			

Switched neutral
To create a miniature circuit breaker from stock items with a switched neutral, order standard MCB (usually a single or three pole version) and a neutral disconnect module, S2-NT, which can be field added to the MCB.

QOU Unit Mount
Miniature Circuit Breakers
Class 720



Low Ampere QOU Miniature Circuit Breakers

General Specifications Common to All Low Ampere QOU Circuit Breakers

- Terminal lug wire size 1 – #14 - #2 AWG Cu or Al.
- Reversible line and load lugs for convenient flush or surface mount wiring.
- DIN mount (symmetrical rail 35 x 7.5 DIN/EN 50 022).
- UL Listed as HACR type – 15-70A.
- Field installable quick connectors.
- Single handle with internal common trip.
- UL Listed 48Vdc (5,000 AIR).
- Bulk pack circuit breakers do not have mounting feet included.

Special Ordering Instructions:

For Bulk Packed QOU Circuit Breakers and Accessories

QOU circuit breakers and accessories must be ordered in multiples of the quantities listed. Units provided in standard quantity of one are individually packaged: standard quantities greater than one are bulk packed. Bulk packed circuit breakers do not include mounting brackets.

EXAMPLE:

Individual pack – small quantity orders: To receive five QOU220 circuit breakers, order five individual QOU220 circuit breakers at **$55.00** each. Product will be individually packaged, and will include necessary mounting feet.

Bulk pack – large quantity order. To order 440 QOU220 circuit breakers using bulk packaging, order 440 QOU220B at **$53.00** each. Product will be packaged in 22 packages of 20 pieces each. Product will not include mounting feet. To order mounting feet, order 880 pieces of QOUMFB2. Product will be packaged in eleven packages of 80 pieces each.

For QOUQ Low Amp Circuit Breakers with Four Point Quick Connect Terminals

QOUQ Low Amp circuit breakers with four point quick connect terminals are provided with permanent factory installed terminals which are affixed to the Load or "OFF" end of the circuit breaker. This special terminal will accommodate up to four 1/4 inch female quick connect wire terminations. Total ampacity of these connections must not exceed the rating of the circuit breaker. Price addition is **$5.60** for single-pole, **$11.20** for 2-pole and **$16.80** for 3-pole circuit breakers.

EXAMPLE:

To order QOUQ circuit breakers, change the Catalog Number prefix from "QOU" to "QOUQ". To order a QOU220 with factory installed four point quick connect terminals, order one QOUQ220 circuit breaker at **$55.00** each plus **$5.60** per pole (a total price of **$65.60**).

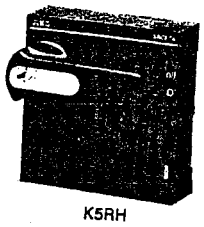
Low Ampere QOU Series 3 Circuit Breaker

No. of Poles	Description	AIR Rating	Voltage Rating	Ampere Rating	Catalog Number	Unit Price	Order Qty.
One	Thermal-Magnetic Circuit Breaker	10,000 AIR	120/240 Vac	10	QOU110 QOU110B	$ 25.50 24.00	1 40
		5,000 AIR	277 Vac	10	QYU110□ QYU110B□	77.00 76.00	1 40
		10,000 AIR	120/240 Vac	15	QOU115 QOU115B	25.50 24.00	1 40
				15	QOU115HM QOU115HMB	25.50 24.00	1 40
		5,000 AIR	277 Vac	15	QYU115□ QYU115B□	77.00 76.00	1 40
		10,000 AIR	120/240 Vac	20	QOU120 QOU120B	77.00 24.00	1 40
				20	QOU120HM QOU120HMB	25.50 24.00	1 40
		5,000 AIR	277 Vac	20	QYU120□ QYU120B□	77.00 76.00	1 40
		10,000 AIR	120/240 Vac	25	QOU125 QOU125B	25.50 24.00	1 40
		5,000 AIR	277 Vac	25	QYU125□ QYU125B□	77.00 76.00	1 40
		10,000 AIR	120/240 Vac	30	QOU130 QOU130B	25.50 24.00	1 40
		5,000 AIR	277 Vac	30	QYU130□ QYU130B□	77.00 76.00	1 40
		10,000 AIR	120/240 Vac	35	QOU135 QOU135B	25.50 24.00	1 40
				40	QOU140 QOU140B	25.50 24.00	1 40
				45	QOU145 QOU145B	25.50 24.00	1 40
				50	QOU150 QOU150B	25.50 24.00	1 40
				60	QOU160 QOU160B	25.50 24.00	1 40
				70	QOU170 QOU170B	49.40 44.90	1 40
Two	Thermal-Magnetic Circuit Breaker	10,000 AIR	120/240 Vac	10	QOU210 QOU210B	55.00 53.00	1 20
				15	QOU215 QOU215B	55.00 53.00	1 20
			240 Vac	15	QOU215H QOU215HB	107.00 102.00	1 20
			120/240 Vac	20	QOU220 QOU220B	55.00 53.00	1 20
			240 Vac	20	QOU220H QOU220HB	107.00 102.00	1 20
			120/240 Vac	25	QOU225 QOU225B	55.00 53.00	1 20
			240 Vac	25	QOU225H QOU225HB	107.00 102.00	1 20
			120/240 Vac	30	QOU230 QOU230B	55.00 53.00	1 20
			240 Vac	30	QOU230H QOU230HB	107.00 102.00	1 20
			120/240 Vac	35	QOU235 QOU235B	55.00 53.00	1 20
				40	QOU240 QOU240B	55.00 53.00	1 20
				45	QOU245 QOU245B	55.00 53.00	1 20
				50	QOU250 QOU250B	55.00 53.00	1 20
	Non-Auto Switch	N/A	240Vac	60	QOU200 QOU200B	55.00 53.00	1 20
	Thermal-Magnetic Circuit Breaker	10,000 AIR	120/240 Vac	60	QOU260 QOU260B	55.00 53.00	1 20
				70	QOU270 QOU270B	109.00 107.00	1 20
Three	Thermal-Magnetic Circuit Breaker	10,000 AIR	240 Vac	10	QOU310 QOU310B	181.00 178.00	1 40
				15	QOU315 QOU315B	181.00 178.00	1 40
				20	QOU320 QOU320B	181.00 178.00	1 40
				25	QOU325 QOU325B	181.00 178.00	1 40
				30	QOU330 QOU330B	181.00 178.00	1 40
				35	QOU335 QOU335B	181.00 178.00	1 40
				40	QOU340 QOU340B	181.00 178.00	1 40
				45	QOU345 QOU345B	181.00 178.00	1 40
				50	QOU350 QOU350B	181.00 178.00	1 40
				60	QOU360 QOU360B	181.00 178.00	1 40
	Non-Auto Switch	N/A	240Vac	60	QOU300 QOU300B	181.00 178.00	1 40

□ UL Recognized Component, Supplementary Protector.

Note: See ordering instructions (Page 5-28), all catalog numbers ending in B must be ordered in bulk package quantities.

Accessories
Handle operators

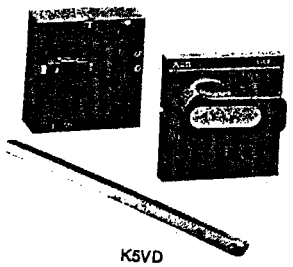


K5RH

Rotary handle operating mechanism

Frame	Catalog number NEMA type 1	List price
S3 - S4 - S5	K5RH	$ 108
S6	K6RH	124
S7	K7RH	145

Mounts directly onto breaker. Includes door interlock to prevent CB door opening while CB is is in ON position. Padlock provision included to padlock CB in open position. Can also be key locked with optional cylinder lock assembly. Door interlock bracket must be ordered separately, if required. See next page.



K5VD

Variable depth rotary handle mechanism

Frame	NEMA type	Shaft length (inches)	Catalog number Handle, shaft & mech.	List price
S3 - S4 - S5	1	12	K5VD ①	$ 98
	1/3R/12	25	K5VD-25S12 ②	138
	4/4X	25	K5VD-25S4 ②	165
S6	1	18	K6VD ①	135
	1/3R/12	25	K6VD-25S12 ②	175
	4/4X	25	K6VD-25S4 ②	201
S7	1	18	K7VD ①	135
	1/3R/12	25	K7VD-25S12 ②	175
	4/4X	25	K7VD-25S4 ②	201

Uses door mounted rotary handle and an operating shaft that can be cut to match user compartment requirements. Includes padlock device for open condition to prevent the circuit breaker from being closed. NEMA type 1 includes modular square base with rotary handle. NEMA type 1/3R/12 and 4/4X share rotary handle with ABB disconnect switches. Contact ABB Control for optional shafts and handles.

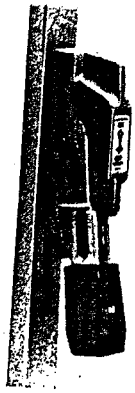
Variable depth shaft support

For frames	Catalog number	List price
S3 - S4 - S5	KVD5-LSS	$ 25

Flange mounted handle mechanism kits ③

Frame	NEMA type	Catalog number Handle, shaft & mech.	List price
S3 - S4 right only	1/3R/12 4/4X	K4FH-17S12	$ 248
		K4FH-17S4	298
S5 right only	1/3R/12 4/4X	K5FH-17S12	248
		K5FH-17S4	298
S6 right only	1/3R/12 4/4X	K6FH-17S12	531
		K6FH-17S4	581
S7 right only	1/3R/12 4/4X	K7FH-17S12	531
		K7FH-17S4	581

Available as complete kits including flange handle, shaft and breaker operating mechanism. Mechanism mounts directly onto breaker and shaft can be cut to the desired length for the breaker enclosure. Door is interlocked with the handle when the breaker is in the closed (ON) position; handles include interlock defeater for emergency override. Handle can be padlocked in the open (OFF) position. Consult factory for left hand flange mounting.



K4FH-17S12

Door hardware

Item	Catalog number	List price
Safety door latch, 2 point with 6" handle	FH-DHK	$ 150
Roller for 2 point latch, add to FH-DHK	FH-3RL	30

① HM is as shown.
② Uses handle similar to ABB disconnect switches.
③ Consult factory.

Transformer Specifications

DIRECTORY

Group **A**

MICRON

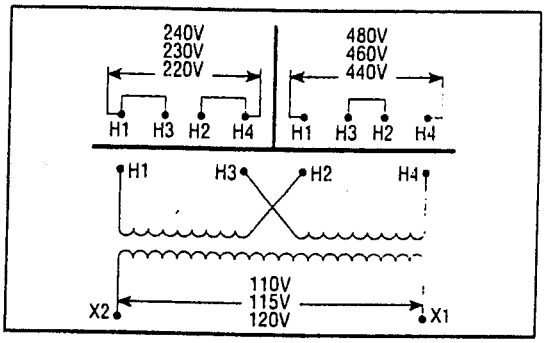
Primary Volts

240 x 480, 230 x 460, 220 x 440

Secondary Volts

120 • 115 • 110

UL and CSA Listed 50 / 60 Hz



10

VA Rating	Catalog Number	Construction Figure	Output Amps	DIMENSIONS (inches) • mm A	B	C	D	E	Mounting Slots	Approx. Wt. (lbs.) • kg
25	B025BTZ13JK	B	0.22	2½ •64	3 •76	2⁹⁄₁₆ •65	1½ •38	2½ •64	¹³⁄₆₄ X ⅜ •5 X 10	1.7 • 0.8
50	B050BTZ13JK	B	0.43	3 •76	3 •76	2⁹⁄₁₆ •65	2 •51	2½ •64	¹³⁄₆₄ X ⅜ •5 X 10	2.6 • 1.2
75	B075BTZ13JK	B	0.65	3½ •89	3 •76	2⁹⁄₁₆ •65	2½ •64	2½ •64	¹³⁄₆₄ X ⅜ •5 X 10	3.5 • 1.6
100	B100BTZ13JK	B	0.87	3⅜ •86	3⅜ •86	2⅞ •73	2⅜ •60	2¹³⁄₁₆ •71	¹³⁄₆₄ X ⅜ •5 X 10	4.2 • 1.9
150	B150BTZ13JK	B	1.30	4 •102	3¾ •95	3⁵⁄₁₆ •81	2⅞ •73	3⅛ •79	¹³⁄₆₄ X ⅜ •5 X 10	6.7 • 3.1
200	B200BTZ13JK	B	1.74	4 •102	4½ •114	3¹³⁄₁₆ •97	2½ •64	3¾ •95	¹³⁄₆₄ X ⅜ •5 X 10	8.5 • 3.9
250	B250BTZ13JK	B	2.17	4⅜ •111	4½ •114	3¹³⁄₁₆ •97	2⅞ •73	3¾ •95	¹³⁄₆₄ X ⅜ •5 X 10	10.0 • 4.6
300	B300BTZ13JK	B	2.61	4¾ •121	4½ •114	3¹³⁄₁₆ •97	3¼ •83	3¾ •95	¹³⁄₆₄ X ⅜ •5 X 10	11.3 • 5.1
350	B350BTZ13JK	B	3.04	5¼ •133	4½ •114	3¹³⁄₁₆ •97	3¾ •95	3¾ •95	¹³⁄₆₄ X ⅜ •5 X 10	13.6 • 6.2
500	B500BTZ13JK	B	4.35	5½ •140	5¼ •133	4¾ •121	4¼ •108	4⅜ •111	⁹⁄₁₆ X ¹¹⁄₁₆ •8 X 17	19.2 • 8.7
750	B750BTZ13JK	B	6.52	7 •178	5¼ •133	4¾ •121	5¾ •146	4⅜ •111	⁹⁄₁₆ X ¹¹⁄₁₆ •8 X 17	28.1 • 12.8
1000	VF1K0BTZ13JK	V	8.70	5 •127	6¾ •171	5¾ •146	3⅝ •92	6¹⁄₁₆ •154	⁹⁄₁₆ X ⁹⁄₁₆ •8 X 14	28.0 • 12.7
1000	EF1K0BTZ13	E	8.70	7⅞ •200	5¼ •133	4⁷⁄₁₆ •113	5½ •140	4⅜ •111	⁹⁄₃₂ X ¹³⁄₃₂ •7 X 10	29.8 • 13.6
1500	EF1K5BTZ13	E	13.04	6¾ •171	6¾ •171	5¹¹⁄₁₆ •144	3⁹⁄₁₆ •91	6¹⁄₁₆ •154	⁹⁄₃₂ X ⁹⁄₁₆ •7 X 14	30.0 • 13.6
2000	EF2K0BTZ13	E	17.39	7 •178	6¾ •171	5¹¹⁄₁₆ •144	4⁷⁄₁₆ •113	6¹⁄₁₆ •154	⁹⁄₃₂ X ⁹⁄₁₆ •7 X 14	38.0 • 17.3
3000	EF3K0BTZ13	E	26.09	7½ •191	9 •229	7⁹⁄₁₆ •192	4⅛ •105	6½ •165	⁷⁄₁₆ X ¾ •11 X 19	53.0 • 24.1
5000	EF5K0BTZ13	E	43.48	7¾ •197	9 •229	7⁹⁄₁₆ •192	6 •152	6½ •165	⁷⁄₁₆ X ¾ •11 X 19	89.0 • 40.5

JK suffix denotes transformer supplied with primary J-2 jumpers & secondary fuse clips for a ¹³⁄₃₂ x 1½ fuse.
Construction figure E units rated for 60Hz at 240 x 480 input.

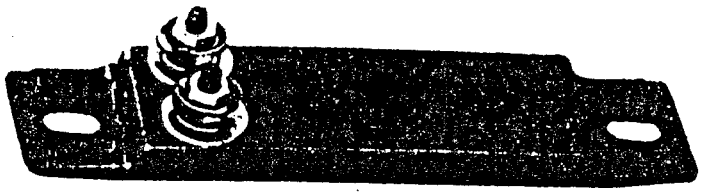
1½" strip

125 to 750 Watts

2 terminals at right angle at one end

U.L. Component Recognized and C.S.A. Certified

Type PT



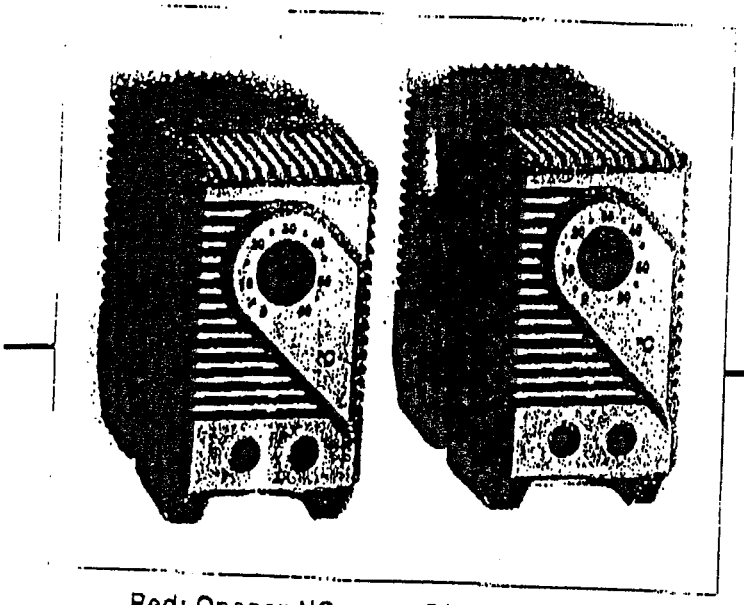
Dimensions — Inches

			Rust-resisting Iron Sheath*							Chrome Steel Sheath*							
A	B	D	Watts	W/in²	Catalog No.	PCN 120V	Status	PCN 240V	Status	Watts	W/in²	Catalog No.	PCN 120V	Status	PCN 240V	Status	Wt. lbs.
5½	4½	4	125	14	PT-512	131959	S	257017	S	250	27	PT-502	132329	S	257025	S	.4
6	5	4½	150	14	PT-615	131967	S	131975	S	300	27	PT-603	132337	S	132345	S	.5

For standard lengths between 7½" and 23¾" use the OT type†

†PT strips with these dimensions are no longer available as standard stock items, but they can be furnished as "made to order" items.
Specify: Made to order, must be PT type.
*See page A/6 for maximum sheath temperatures.
Delivery: S, Stock; NS, two weeks.
Specify: Quantity, catalog no., PCN, watts, volts, strip heaters.

TEGO INC



Red: Opener-NC Blue: Closer-NO

Small Thermostat

KTO 1140 / KTS 1141

- Easy installation
- Wide adjustment range
- Small dimensions

Air temperature control and monitoring in switch-gear cabinets

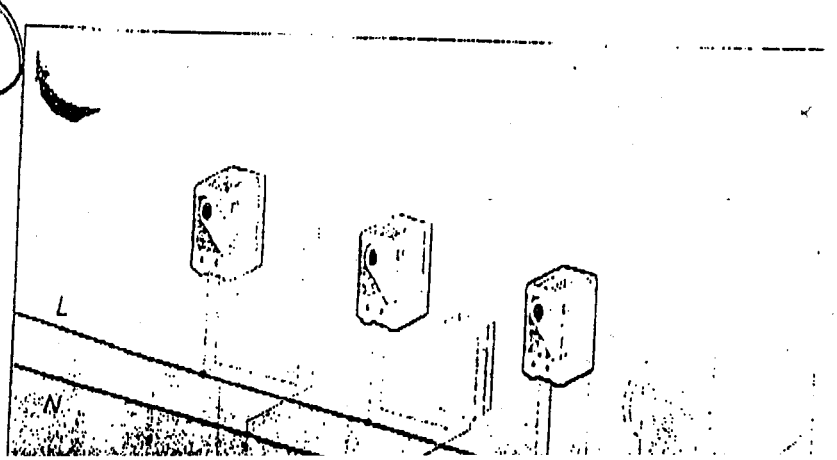
- Heaters
- Filter ventilators
- Heat exchangers
- Signal transmitters

Technical data:

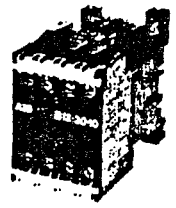
Sensor element:	thermostatic bi-metal
Adjustment range:	30 - 140°F, switching difference approx. 4 K
Contact type:	NC (normally closed), quick-acting contact NO (normally open), quick-acting contact
Switching capacity:	NC: 15 A (1) AC 120 V NO: 15 A (1) AC 120 V
Noise suppression:	"N" (acc. to VDE 0875)
Dimensions:	2.4 x 1.3 x 1.4" (H x W x D)
Connections:	2-pole terminal for AWG 14 (0.04 in²)
Mounting:	clip mounting for 1.375" rails
Housing:	plastic UL 94 VO
Protection:	IP 30
Weight:	1.27 oz
Approval:	UL (recognized) C-UL (recognized)

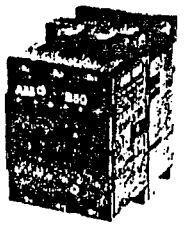
Thermostat NC
for the control of heaters

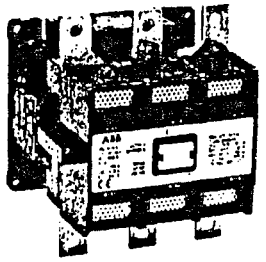
Thermostat NO
for the control of filter ventilators, or for switching signal transmitters in the case of overheating.



Across the line contactors
Non-reversing, 3 pole


B12C-1


B50C-1


EH260C-1

3 Pole, A.C., Open

	General purpose current		Maximum motor horsepower ratings Ⓤ Ⓒ				AC operated		DC operated	
			200V	230V	460/480V	575/600V	Catalog number	List price	Catalog number	List price
	AC1	AC3	UL rated							
—	21	9	2	2	5	7.5	B9C-1	$ 52	BC9C-P	$ 82
—	21	11	3	3	7.5	10	B12C-1	56	—	—
—	21	17	5	5	10	15	B16C-1	68	BC16C-P	98
—	33	28	7.5	10	20	25	B25C-1	122	BC25C-P	152
—	45	32	10	10	20	30	B30C-1	168	BC30C-P	198
—	55	41	10	15	30	40	B40C-1	198	BE40C-P	228
—	65	52	15	20	40	50	B50C-1	220	BE50C-P	250
—	85	65	20	25	50	50	B63C-1	248	BE63C-P	318
—	105	80	25	30	60	75	B75C-1	275	BE75C-P	345
—	125	80	30	30	60	75	A95C-1	300	AE95C-P	370
—	140	105	30	40	75	100	A110C-1	320	AE110C-P	460
—	170	130	40	50	100	125	EH145C-1	600	EH145C-P	740
—	190	156	50	60	125	150	EH175C-1	920	EH175C-P	1090
—	230	192	60	75	150	200	EH210C-1	1150	EH210C-P	1320
—	300	242	75	100	200	250	EH260C-1	1300	EH260C-P	1490
—	350	302	100	100	250	250	EH300C-1	1400	EH300C-P	1590
—	525	420	125	150	350	400	EH450C-1	2200	EH450C-P	2440
—	600	480	150	200	400	500	EH550C-1	3100	EH550C-P	3430
—	715	602	200	250	500	600	EH700C-1	4800	EH700C-P	5130
—	900	810	250	300	600	700	EH800C-1	5000	EH800C-P	5330
NEMA Size	Continuous current									
			NEMA rated							
00	9		1.5	1.5	2	2	BN9C-1	$ 75	BCN9C-P	$ 105
0	18		3	3	5	5	BN16C-1	108	BCN16C-P	138
1	27		7.5	7.5	10	10	BN25C-1	148	BCN25C-P	178
2	45		10	15	25	25	BN50C-1	220	BEN50C-P	250
3	90		25	30	50	50	BN75C-1	275	BEN75C-P	345
4	135		40	50	100	100	EHN145C-1	600	EHN145C-P	740
5	270		75	100	200	200	EHN260C-1	1300	EHN260C-P	1490
6	540		150	200	400	400	EHN550C-1	3100	EHN550C-P	3430
7	810		—	300	600	600	EHN800C-1	5000	EHN800C-P	5330

Coil voltage selection

All AC operated catalog numbers include a 120VAC coil. All DC operated catalog numbers include a 110VDC coil. To select other coil voltages, substitute the code from the Coil Voltage Selection chart for the first digit after the dash in the catalog number.

Coil voltage selection chart

Hz	Contr.	Volts														
		24	48	110	120	125	208	220	240	277	380	415	440	480	500	600
60	EH	F	G		1		B		2	C	Z		3	4		6
50	A,B	F		1				2			3	4			6	
50	EH	N		1				J			3	M			5	
[illegible]	[illegible],EH	Y	W	P		Q		R					T			

- For other voltages, consult factory.
- 24 & 48VAC coils are not available for sizes EH450 – EH800. For these applications, use an interposing control relay.

Auxiliary contacts as standard

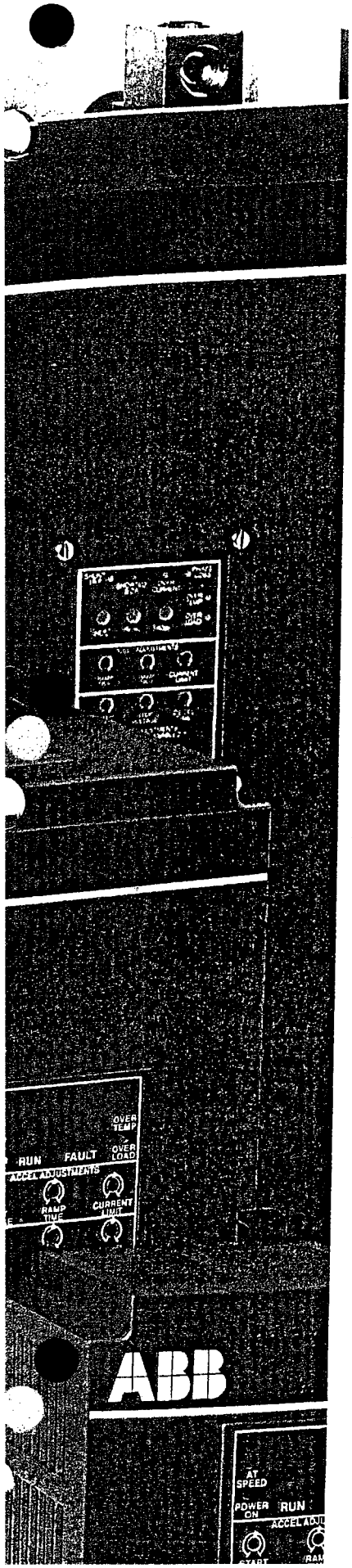
Frame size	Number of contacts	Mounting
B(C)9 – B(C)25 Ⓓ	1 N.O.	Internal
B(C)30	2 N.O. & 2 N.C.	Top
B(E)40 – EH800	1 N.O. & 1 N.C.	Side
A(E)95 – A(E)110	1 N.O. & 1 N.C.	Side

Additional auxiliary contacts are available for all contactor sizes. See Accessories.

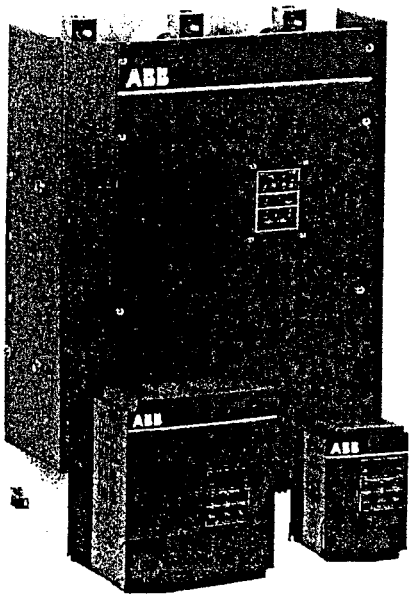
EH Contactors are supplied with lugs

If terminal lugs are not required, subtract the terminal kit price shown on page 1.13. Add the "L" suffix as the last digit in the catalog number. Example: EH145C-1L, $575

Ⓓ Frame size B(C)9 – 25 [illegible]



Softstarters
Type SSA



Description
Type SSA Softstarters

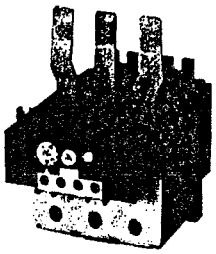
- Type SSA designed for starting pumps, conveyor belts, compressors, etc.
- Class 10 overcurrent protection standard for Type SSA. Class 20 available as an option
- Soft start
  - Separately adjustable linear ramp with adjustable initial voltage
  - Time: Adjustable from 0 – 60 sec.
  - Initial voltage: Adjustable from 0 – 100% of full voltage
  - Current limit is adjustable from 200% to 500% of the motors rated current. The current limit is active during the start ramp.
  - 500% rated for 60 sec.
- Selectable soft stop
  - Separately adjustable linear ramp with adjustable step-down voltage
  - Time: Adjustable from 0 – 30 sec
  - Step down: Adjustable from 0 – 100% of full voltage
- UL & cUL approved
  UL File # E161428
- LED indicators
  - Power on
  - Run
  - At speed
  - Over temperature
  - Overload
  - Phase loss
  - Shorted SCR
  - Fault
  - Over current
  - Shunt trip
- Relay contacts
  - Run relay
  - Programmable relay either for fault condition signal or up to speed condition.
  - Emergency shunt trip relay
  - Optical output for fault indication
- Enclosed units include control power transformer as standard

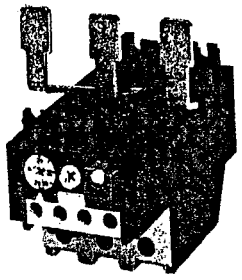
Open
Type SSA

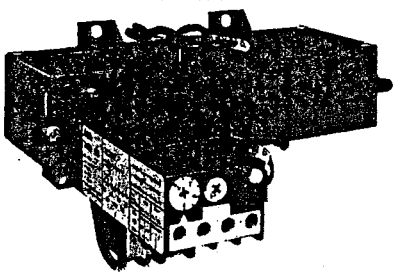
Max. motor amps	Maximum motor horsepower ratings				480V Without class 10 OLR		480V With class 10 OLR		600V Without class 10 OLR		600V With class 10 OLR	
FLA	208V	240V	480V	600V	Catalog number	List price	Catalog number	List price	Catalog number	List price	Catalog number	List price
6	1 —	1 —	3 —	— 5	SA003-48①	$ 600	— —	— —	— SA005-60 ①	— $ 660	— —	— —
11	3 —	3 —	7.5 —	— 10	SA007-48 ①	850	— —	— —	— SA010-60 ①	— 935	— —	— —
17	5 —	5 —	10 —	— 15	SA020-48 ①	1050	— —	— —	— SA025-60 ①	— 1155	— —	— —
25	7.5 —	7.5 —	15 —	— 20	SA020-48 ①	1050	— —	— —	— SA025-60 ①	— 1155	— —	— —
32	10 —	10 —	20 —	— 25	SA020-48 ①	1050	— —	— —	— SA025-60 ①	— 1155	— —	— —
34	— —	— —	25 —	— 30	SA030-48 ②	1310	SSA025-481	1405	— SA040-60 ②	— 1440	SSA030-601	1545
42	10 —	15 —	30 —	— 40	SA030-48 ②	1310	SSA030-481	1435	— SA040-60 ②	— 1440	SSA040-601	1580
54	15 —	20 —	40 —	— 50	SA040-48 ②	1725	SSA040-481	1820	— SA050-60 ②	— 1900	SSA050-601	2000
68	20 —	25 —	50 —	— 60	SA050-48 ②	1725	SSA050-481	1850	— SA060-60 ②	— 1900	SSA060-601	2035
80	25 —	30 —	60 —	— 75	SA060-48 ②	2400	SSA060-481	2545	— SA075-60 ②	— 2640	SSA075-601	2800
104	30 —	40 —	75 —	— 100	SA075-48 ②	2400	SSA075-481	2575	— SA100-60 ②	— 2640	SSA100-601	2830
[illegible]	40 —	50 —	100 —	— 125	— —	— —	SSA100-481 ③	3650	— —	— —	— SSA125-601 ③	— 4015
154	50 —	60 —	125 —	— 150	— —	— —	SSA125-481 ③	3700	— —	— —	— SSA150-601 ③	— 4070
192	60 —	75 —	150 —	— 200	— —	— —	SSA150-481 ③	4200	— —	— —	— SSA200-601 ③	— 4640
248	75 —	100 —	200 —	— 250	— —	— —	SSA200-481 ③	4520	— —	— —	— SSA250-601 ③	— 4975
312	100 —	125 —	250 —	— 300	— —	— —	SSA250-481 ③	4870	— —	— —	— SSA300-601 ③	— 5360
360	125 —	150 —	300 —	— 350	— —	— —	SSA300-481 ③	5070	— —	— —	— SSA350-601 ③	— 5575
414	— —	— —	350 —	— 400	— —	— —	SSA350-481 ③	5890	— —	— —	— SSA400-601 ③	— 6480
480	150 —	200 —	400 —	— 500	— —	— —	SSA400-481 ③	6840	— —	— —	— SSA500-601 ③	— 7525
600	200 —	250 —	500 —	— 600	— —	— —	SSA500-481 ③	9400	— —	— —	— SSA600-601 ③	— 10,340
720	250 —	300 —	600 —	— 700	— —	— —	SSA600-481 ③	10,600	— —	— —	— SSA700-601 ③	— 11,660
840	300 —	350 —	700 —	— 800	— —	— —	SSA700-481 ③	12,000	— —	— —	— SSA800-601 ③	— 13,200
960	350 —	400 —	800 —	— 900	— —	— —	SSA800-481 ③	17,300	— —	— —	— SSA900-601 ③	— 19,030
1100	400 —	450 —	900 —	— 1000	— —	— —	SSA900-481 ③	20,000	— —	— —	— SSA1000-601 ③	— 22,000
1250	450 —	500 —	1000 —	— 1125	— —	— —	SSA1000-481 ③	23,000	— —	— —	— SSA1125-601 ③	— 25,300

Use base mounted TA25 overload if Class 10 overload is needed.
Use base mounted TA25 overload if Class 10 overload is needed, mounted internally and connected to CT's
Class 20 overload relay optional, insert a 2 instead of 1 at the end of the part number for Class 20.

Overload relays
For contactors A95 - EH800
Type T, Class 10


TA80DU


TA110DU


T450DU185

Overload relay selection chart — Class 10

For contactor sizes	Current range (motor fla)	Catalog number	Starter suffix: NEMA size 4 only	Starter suffix: All other sizes	List price
A95	29 - 42	TA80DU42		A	$ 90
	36 - 52	TA80DU52		B	
	45 - 63	TA80DU63		C	
	60 - 80	TA80DU80	R	D	
A110	65 - 90	TA110DU90	S	A	110
	80 - 110	TA110DU110	T	B	
EH145	100 - 135	T200DU135		A	150
	110 - 150	T200DU150		B	
[illegible]0	130 - 175	T200DU175		C	
	150 - 200	T200DU200		D	
EH260	130 - 185	T450DU185		A	325
	165 - 235	T450DU235		B	
	220 - 310	T450DU310		C	
EH300	130 - 185	T450DU185		A	
	165 - 235	T450DU235		B	
	220 - 310	T450DU310		C	
	285 - 400	T450DU400		D	
EH450	130 - 185	T450DU185		A	
	165 - 235	T450DU235		B	
	220 - 310	T450DU310		C	
	285 - 400	T450DU400		D	
EH550	265 - 375	T900DU375		A	450
	355 - 500	T900DU500		B	
	465 - 650	T900DU650		C	
EH700 & EH800	265 - 375	T900DU375		A	
	355 - 500	T900DU500		B	
	465 - 650	T900DU650		C	
	610 - 850	T900DU850		D	

Busbar Kits

Contactor type	Overload type	Catalog number	List price
EH175, EH210	T450	AT450/EH175	$ 150
EH260, EH300		AT450/EH300	
EH450		AT450/EH450	
EH450,EH550	T900	AT900/EH550	200
EH700		AT900/EH700	
EH800		AT900/EH800	

Overload relay separate mounting kits

Overload type	Amps	Catalog number	List price
TA80DU	18 - 80	AB80A	$ 30
TA110DU, T200DU	100 - 200	AB200A	40

Type T overload relays can be mounted on a base for separate panel mounting.

Overload relay selection chart — Class 30

For contactor sizes	Current range (motor fla)	Catalog number	Starter suffix	List price
EH175, EH210 EH260, EH300 EH450	40 ... 60	T450SU60	K	$ 350
	55 ... 80	T450SU80	L	
	70 ... 105	T450SU105	M	
	95 ... 140	T450SU140	N	
	130 ... 185	T450SU185	P	475
	165 ... 235	T450SU235	R	
	220 ... 310	T450SU310	S	
	285 ... 400	T450SU400	T	
EH450, EH550 EH700 EH800	265 ... 375	T900SU375	P	550
	355 ... 500	T900SU500	R	
	465 ... 650	T900SU650	S	
	610 ... 850	T900SU850	T	

Terminal kits

Contactor type	Overload type	Wire size	Catalog number	List price
EH175, EH210	T450	6 – 250 MCM	EHTK210	$ 30
EH260		4 – 500 MCM	EHTK260	45
EH300, EH450		(2) 4 – 500 MCM	EHTK550/OL ①	75
EH450, EH550	T900	(2) 4 – 500 MCM	EHTK550N	75
EH700		(2) 4 – 500 MCM	EHTK700	100
EH800		(3) 2 – 600 MCM	EHTK800	225

Terminal covers for overload relays

Contactor type	Overload type	Catalog number	List price
EH145 - EH210	T200	LT200/160	$ 60
EH175 - EH300	T450	LT450/250	80
EH450	T450	LT450/450	100
EH450 - EH700	T900	LT900/700	120
EH800	T900	LT900/800	140

Base mounted overload relays for T450 – T900

Overload relay type	Catalog number suffix	List price adder
T450	-B	$ 300
T900	-B	425

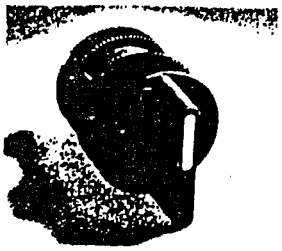
① The standard EHTK300 terminal kit will not mount properly on the busbar; therefore, the EHTK550/OL is required.

Non-illuminated operators

Mushroom

Operator

Type	Size	Color	Catalog number	List price
Mushroom	1 3/16	Red	ZA2 BC44	$11.90
	1 9/16	Red	ZA2 BC4	11.90
Turn to release	1 3/16	Red	ZA2 BS44	34.80
	1 9/16	Red	ZA2 BS54	34.80
Key release	1 3/16	Red	ZA2 BS74	49.80
	1 9/16	Red	ZA2 BS14	49.80



Standard

Non-illuminated selector switches

Type	Positions	Catalog number	List price
Standard	2-maintained	ZA2 BD2	$10.60
	2-spring return from RT to LT	ZA2 BD4	11.90
	3-maintained	ZA2 BD3	10.60
	3-spring return to center from LT and RT	ZA2 BD5	11.90
	3-spring return from RT to center	ZA2 BD8	11.90
	3-spring return from LT to center	ZA2 BD7	11.90

Key switch

Key selectors

Type	Positions	Key removal	Catalog number	List price
Key switch	2-maintained	LT	ZA2 BG2	$30.00
	2-maintained	LT, RT	ZA2 BG4	30.00
	2-spring return RT to LT	LT	ZA2 BG6	30.00
	3-maintained	All	ZA2 BG0	30.00
	3-maintained	Center	ZA2 BG3	30.00
	3-maintained	LT, RT	ZA2 BG5	30.00
	3-maintained	LT	ZA2 BG9	30.00
	3-spring return to center from LT and RT	Center	ZA2 BG7	37.50
	3-spring return to center from LT	RT	ZA2 BG1	37.50
	3-spring return to center from RT	Center	ZA2 BG8	37.50

Contact blocks for XAL stations

Type	Contacts NO	Contacts NC	Catalog number	List price
1 Contact block	1	-	XEN L1111	$7.50
	-	1	XEN L1121	7.50

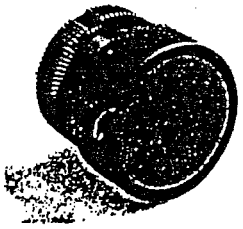
Contact blocks and mounting collar for XA2 B pilot devices

Type	Contacts NO	Contacts NC	Catalog number	List price
1 Contact block	1	-	ZA2 BZ101	$11.30
	-	1	ZA2 BZ102	11.30
2 Contact blocks	2	-	ZA2 BZ103	18.80
	-	2	ZA2 BZ104	18.80
	1	1	ZA2 BZ105	18.80

Pushbuttons

Non-illuminated operators

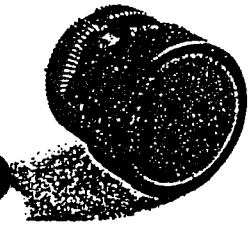
Operator



Flush head

Type	Color	Catalog number	List price
Flush head	Black	ZA2 BA2	$4.80
	Green	ZA2 BA3	4.80
	Red	ZA2 BA4	4.80
	Yellow	ZA2 BA5	4.80
	Blue	ZA2 BA6	4.80
	*Green-start	ZA2 BA333	7.30
	*Green-on	ZA2 BA341	7.30
	*Red-stop	ZA2 BA434	7.30
	*Red-off	ZA2 BA435	7.30
Transparent flush head (for use with ZB2 BY 1• stick on legends see page 5-22)	Green	ZA2 BA38	6.00
	Red	ZA2 BA48	6.00
	Yellow	ZA2 BA58	6.00
	Blue	ZA2 BA68	6.00
	Clear	ZA2 BA78	6.00
Extended head	Black	ZA2 BL2	4.80
	Green	ZA2 BL3	4.80
	Red	ZA2 BL4	4.80
	Yellow	ZA2 BL5	4.80
	Blue	ZA2 BL6	4.80
	*Red-stop	ZA2 BL434	7.30
	*Red-off	ZA2 BL435	7.30
Booted head	Black	ZA2 BP2	13.50
	Green	ZA2 BP3	13.50
	Red	ZA2 BP4	13.50
	Yellow	ZA2 BP5	13.50
	Blue	ZA2 BP6	13.50
Flush plunger (with full guard)	Black	ZA2 BA24	14.80
	Green	ZA2 BA34	14.80
	Red	ZA2 BA44	14.80
	Yellow	ZA2 BA54	14.80
	Blue	ZA2 BA64	14.80
Flush plunger (with half guard)	Black	ZA2 BA22	14.80
	Green	ZA2 BA32	14.80
	Red	ZA2 BA42	14.80
	Yellow	ZA2 BA52	14.80
	Blue	ZA2 BA62	14.80

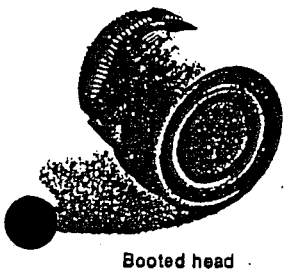
Transparent flush head



Extended head

*Premarked operators

Booted head



Contact blocks for XAL stations

Type	Contacts NO	Contacts NC	Catalog number	List price
1 Contact block	1	-	XEN L1111	$7.50
	-	1	XEN L1121	7.50

Contact blocks and mounting collar for XA2 B pilot devices**

1 Contact block	1	-	ZA2 BZ101	11.30
	-	1	ZA2 BZ102	11.30
2 Contact blocks	2	-	ZA2 BZ103	18.80
	-	2	ZA2 BZ104	18.80
	1	1	ZA2 BZ105	18.80

**Other contact blocks available for special applications. See page 5-19.

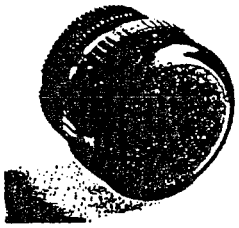
7/8" (22mm) Corrosion resistant pilot devices

Pilot lights and lampholder blocks

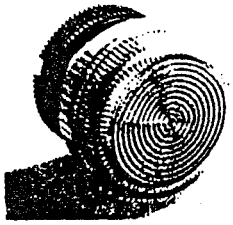
The XA2 B: Recipient of an Industrial Design Award at Hanover Fair for the complete line of plastic pushbuttons, pilot lights, and selector switches.

These compact low-profile products reduce the surface area and volume required for man-machine dialog: they cannot be disassembled from the exterior and thus prevent unauthorized access or modifications. They are particularly suited for severe environments or special applications in chemical, food processing, surface treatment, painting and waste water treatment environments. Pushers and shrouds are polyamid 6-6. Lenses are polycarbonate.

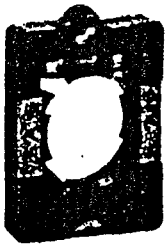
Rounding out TE's offerings, the XA2 B now provides the user a NEMA 4X device. For use with the XA2 B pushbuttons, pilot lights, and selector switches. Telemecanique has designed a new mounting collar (shown below) which accepts the full complement of ZB2 contact blocks, pneumatic blocks, and XA2 B operators used with the XAL B plastic wall stations.



Standard



Special lens for neon bulbs



Mounting collar

Locking ring wrench

Pilot lights

Type	Description	Catalog number	List price
Standard	Green	ZA2 BV03	$3.50
	Red	ZA2 BV04	3.50
	Amber	ZA2 BV05	3.50
	Blue	ZA2 BV06	3.50
	Clear	ZA2 BV07	3.50
Special lens for neon bulbs	Red	ZA2 BV043	11.00
	Amber	ZA2 BV053	11.00
	Clear	ZA2 BV073	11.00

Lamp holder blocks for XAL stations

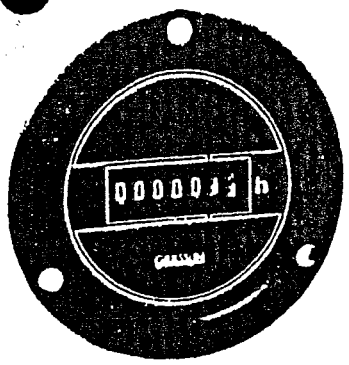
Type	Catalog number	List price
Direct supply bulb included	XAL V6(6-380V)	$22.50
Transformer type 1.2VA/6V bulb included (2 spaces required)	XAL V3(120V)	45.00
	XAL V94(240V)	45.00
	XAL V95(440/480V)	45.00
Resistor type 130-V bulb	XAL V7(220-250V)	27.50

Lamp holder blocks for XA2-B pilot lights

Type	Voltage	Catalog number	List price
Direct supply bulb included	6,12,24,48 120 (specify)	ZA2 BV6	$22.50
Transformer type 1.2VA/6V bulb included	24	ZA2 BV1	45.00
	48	ZA2 BV2	45.00
	110/120	ZA2 BV3	45.00
	220/240	ZA2 BV94	45.00
	440/480	ZA2 BV95	45.00
	550/600	ZA2 BV96	45.00
Resistor type bulb included	220/250V	ZA2 BV7	27.50

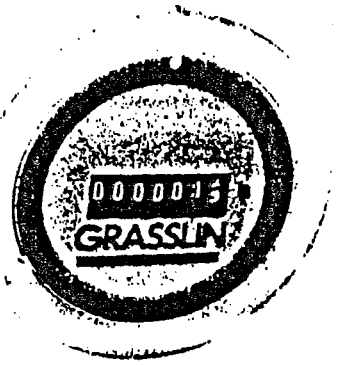
Accessories

Description	Lot size	Catalog number	List price
Mounting collar only- for attaching contact block(s) to operator heads.	10	ZA2 BV009	$37.50
Locking ring wrench	1	ZA2 BZ905	17.50



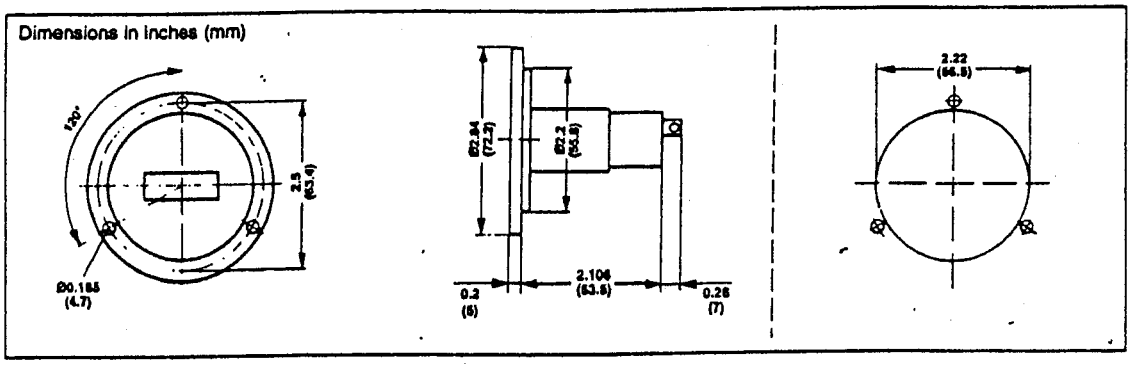
FWZ 72 Deluxe

- Sealed bezel
- 3 bolt flange mount
- Shatterproof lens and bezel
- Time recording accuracy
- Display to 1/100 hour



FWZ 72
Black Polycarbonate

FWZ 72B
Blue-Silver on Colorless frosted Polycarbonate



FWZ models have white numerals on black background with tenths and hundreths in yellow. All have combination 1/4" spade with removeable screw clamp terminals.

ORDERING DATA	Mounting	Bezel Size	Input Voltage, Hz
FWZ 36 (K)	Flush	36mm (1.42")	All models available w/24, 120, 240V Input 50 or 60Hz
FWZ 53 (K)	2 bolt rectangular flange	53mm (2.09")	
FWZ 55 (K)	Flush	55mm (2.17")	
FWZ 72, FWZ 72B (K)	3 bolt round flange	72mm (2.83) dia.	

(K) Models also available with rear access screw terminals

HOUR METER ACCESSORIES

BEZ-55G	55mm Sq. Bezel Adaptor, Grey, UWZ 48E
BEZ-55B	55mm Sq. Bezel Adaptor, Black, UWZ 48E
BEZ-60	60mm Rd. Bezel Adaptor, Grey, UWZ 52E
BEZ-72	72mm Sq. Bezel Adaptor, Grey, UWZ 48E
BEZ-72P	72mm Sq. Bezel Adaptor w/pins for 3-Hole Pattern, Grey, UWZ 48E
AR-60	60mm Adaptor Ring, EGZQ & RZ
MB-60	60mm Mounting Bracket, EGZQ & RZ

AC/DC EQUIP. CO.

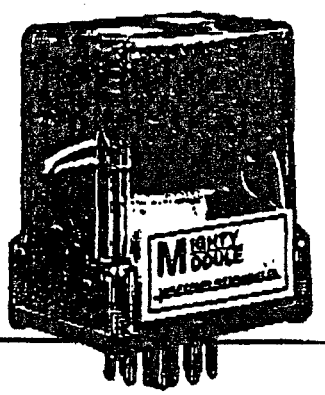
8065 Production Dr. • Florence, KY 41042-3046 (606) 727-0330

WILKERSON INSTRUMENT CO., INC.

NICK PADGETT, 704/535-2345
SPK INSTRUMENTATION
P.O. BOX 10150
CHARLOTTE, NC 28212

mm1401

MM140X and MM141X RTD LIMIT ALARM



FEATURES

- Provides a DPDT Relay Contact Closure at a Preset RTD Input
- 3-Wire or 2-Wire, 10 ohms to 2000 ohms RTDs
- Standard "Fail-safe" Operation
- Red and Green LED Alarm Status Indicators
- Adjustable Deadband
- Latching Alarm Available (MM141X)
- Unlimited* Choice of Input Ranges
- Choice of Power Options
- 10 + 5 Year Warranty

SPECIFICATIONS

RTD INPUT
3-Wire or 2-Wire,
10 ohms to 2000 ohms

INPUT RANGE
. select any *range* within RTD limit
[min span 25°F/14°C
(100°F/55°C with 10 ohms RTD)]

EXCITATION CURRENT

10 ohms	10 mA
100 ohms	5 mA
1000 ohms	0.5 mA
2000 ohms	0.2 mA

SETPOINT
0 to 100% of span

DEADBAND
0.5% to 100% of span

OPEN SENSOR OUTPUT
≥full scale

ACCURACY
±0.1% of span or 0.02 ohms, whichever is greater

LINEARITY
(Option T)
(Pt RTD, output vs. temp)
±0.5% of span (temp ≥32°F/0°C)
±0.15% of span (temp <32°F/0°C)
(others, output vs. res)
±0.01% of span

COMMON MODE REJECTION
120 dB, DC to 60 Hz

RELAY CONTACTS
(dpdt)
Resistive Load:
5 A max, 150 W max, 220 VAC max, 30 VDC max
Inductive Load:
(Power Factor ≥0.4)
2.5 A max, 75 W max, 220 VAC max, 30 VDC max

TRANSISTOR OUTPUT
(Option V)
relay driver (12 V coil, ≥220 ohms) or open-collector outputs sink 100 mA, 30 V supply max

OPERATING TEMPERATURE
14°F to 140°F/–10°C to 60°C

TEMPERATURE STABILITY
±0.02% of span or 0.025°C/°C, whichever is greater

POWER
115 VAC ±10%, 50 or 60 Hz
(2.5 W max)
230 VAC ±10%, 50 or 60 Hz
(2.5 W max)
(DC Power Option)
12 VDC (limits 10 VDC to 15 VDC)
(2.5 W max)
24 VDC (limits 21 VDC to 32 VDC)
(2.5 W max)
Isolation, DC power supply to input common: 10 megohms

* *Within specified range limits.*

ORDERING INFORMATION

1. Model:
MM14 ( ) ( )

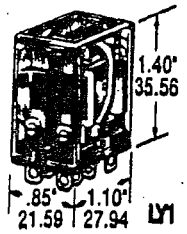
SETPOINT
- 0 = *25-turn screwdriver* adjust (standard)
- 1 = Single turn top mounted dial
- 2 = Remote potentiometer setpoint, (10 kilohms recommended, 1 kilohm min)
- 3 = 0 to 1 volt DC input setpoint control voltage
- 4 = Ten turn precision top mounted dial

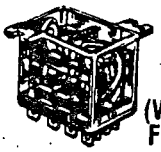
TYPE
- 0 = Single alarm, adjustable deadband (0.5 – 100%)
- 1 = Single alarm, latching

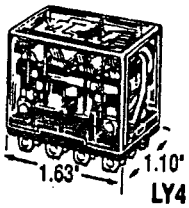
2. Option:	(see options)
3. RTD Type and Temperature Coefficient:	(i.e.: 100 ohms Pt, .00385)
4. Input Range:	(see specifications)
5. High or Low alarm:	H/L*
6. Power:	(see specifications)

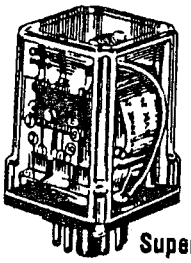
* *H/L*
H = High alarm.
Alarm occurs on an increasing signal.
L = Low alarm.
Alarm occurs on a decreasing signal.
Specify H or L.
(H supplied if not specified.)

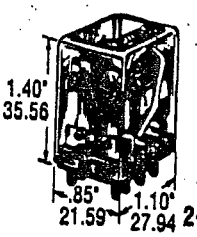
Purpose Relays and Sockets

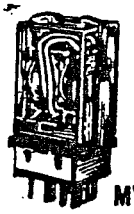












LY General-Purpose Relays

- High Shock and Vibration Resistant
- Arc Barrier Equipped
- High Dielectric Strength (2000 VAC)
- Operate/Release Time, 25 mS
- Small
- Low Cost
- Modern Design
- Versatile
- 12 Amps to 15 Amps
- UL-CSA

#	Mfr.'s Type	Coil Voltage	Contact Action	Contact Amps	Coil mA	Coil Ohms	Terminal Type*	Case Style	EACH 1-24	EACH 25-99	EACH 50-99
000	LY1-AC120	120 AC	SPDT	15	9.2	4430	Q/C	STD	4.88	4.48	4.13
001	LY1-AC24	24 AC	SPDT	15	46.0	180	Q/C	STD	8.70	7.97	7.36
002	LY1-DC12	24 DC	SPDT	15	75.0	160	Q/C	STD	4.69	4.30	3.97
003	LY1-DC24	24 DC	SPDT	15	36.9	650	Q/C	STD	4.67	4.28	3.95
006	LY1F-AC120	120 AC	SPDT	15	9.2	4430	Q/C	UBM	4.96	4.55	4.20
007	LY1F-AC24	24 AC	SPDT	15	46.0	180	Q/C	UBM	7.10	6.51	6.01
009	LY1F-DC24	24 DC	SPDT	15	36.9	650	Q/C	UBM	4.96	4.55	4.20
10	LY2-AC120	120 AC	DPDT	10	9.2	4430	Q/C	STD	5.48	5.02	4.64
11	LY2-AC24	24 AC	DPDT	10	46.0	180	Q/C	STD	5.48	5.02	4.64
12	LY[illegible]C240	240 AC	DPDT	10	4.6	18790	Q/C	STD	5.68	5.21	4.81
1[illegible]	[illegible]12	12 DC	DPDT	10	75.0	160	Q/C	STD	5.48	5.02	4.64
1[illegible]	[illegible]C24	24 DC	DPDT	10	36.9	650	Q/C	STD	5.48	5.02	4.64
1[illegible]	[illegible]2-0-DC12	12 DC	DPDT	10	75.0	160	PCB	STD	5.49	5.03	4.64
17	LY2-0-DC24	24 DC	DPDT	10	36.9	650	PCB	STD	5.48	5.02	4.64
18	LY2F-AC120	120 AC	DPDT	10	9.2	4430	Q/C	UBM	5.48	5.02	4.64
19	LY2F-DC12	12 DC	DPDT	10	75.0	160	Q/C	UBM	5.60	5.13	4.74
20	LY2F-DC24	24 DC	DPDT	10	36.9	650	Q/C	UBM	5.60	5.13	4.74
21	LY4-AC120	120 AC	4PDT	10	16.4	2200	Q/C	STD	5.60	5.13	4.74
22	LY4-AC24	24 AC	4PDT	10	80.0	78	Q/C	STD	13.43	11.68	10.35
23	LY4-DC12	12 DC	4PDT	10	120.0	100	Q/C	STD	8.75	8.02	7.40
24	LY4-DC24	24 DC	4PDT	10	69.0	350	Q/C	STD	8.75	8.02	7.40

*inal type, UBM means Upper Bracket Mount, Q/C fits sockets or 0.200" quick connect terminals.

MK Series

, high quality, long life. Silver contacts rated at 10 amps. UL, CSA rated.

#	Mfr.'s Type	Voltage	Contact Action	Coil mA	Coil Ohms	EACH 1-24	EACH 25-99	EACH 50-99
0	MK2P-S-AC120	120 AC	DPDT	18.0	1578	9.43	8.64	7.98
5	MK2P-S-AC24	24 AC	DPDT	88.0	68	7.36	6.74	6.22
0	MK2P-S-AC240	240 AC	DPDT	9.2	6737	8.73	8.00	7.39
5	MK2P-S-DC12	12 DC	DPDT	126.0	95	7.36	6.74	6.22
0	MK2P-S-DC24	24 DC	DPDT	56.0	430	7.36	6.74	6.22
0	MK3P5-S-AC120	120 AC	3PDT	18.0	1578	9.00	8.25	7.62
5	MK3P5-S-AC24	24 AC	3PDT	88.0	68	8.41	7.71	7.11
0	MK3P5-S-AC240	240 AC	3PDT	9.2	6737	11.20	10.27	9.48
5	MK3P5-S-DC12	12 DC	3PDT	126.0	95	9.90	9.08	8.38
0	MK3P5-S-DC24	24 DC	3PDT	56.0	430	8.41	7.71	7.11
5	MK3P5-S-DC110	110 DC	3PDT	15.1	7300	11.20	10.27	9.48

— Magnetic Latching

3	MK2KP-UA-AC24	24 AC	DPDT-S*	66.0	105	27.98	25.65	23.68
			DPDT-R*	10.8	965			
	MK2KP-UA-AC120	120 AC	DPDT-S*	19.0	1900	27.98	25.65	23.68
			DPDT-R*	3.6	14400			
	[illegible]UA-DC12	12 DC	DPDT-S*	128.0	25	27.98	25.65	23.68
			DPDT-R*	14.4	325			
	MK2KP-UA-DC24	24 DC	DPDT-S*	66.0	105	27.98	25.65	23.68
			DPDT-R*	10.6	965			

= Reset in coil resistance. DPDT — 11 pin octal socket.

MY Series

MY Series or "ice cube" relay provides high reliability and up to 500 K operations. high sensitivity and quick response. Offered in multi-pole configurations, they are id switching multiple loads with one compact device. Three pole versions, flange moun mount and other coil voltages available. Vibration and shock resistant. UL recognizec certified, VDE approved. MY2 = 2 pole; MY4 = 4 pole; N = LED; Z = bifurcated; I = pu test.

Stock No.	Mfr.'s Type	Rated Load (A)	Features	Coil Resistance mA	Coil Resistance Ohms	EACH 1-24	EACH 25-99	EACH
821-6000	MY2AC110/120(S)	10	2 pole	8.4/9.2	4430	4.77	4.37	
821-6002	MY2AC220/240(S)	10	2 pole	4.2/4.6	18790	5.41	4.96	
821-6004	MY2AC24(S)	10	2 pole	46.0	180	4.60	4.21	
821-6006	MY2DC24(S)	10	2 pole	36.9	636	4.60	4.21	
821-6008	MY2NAC110/120(S)	10	2 pole/LED	8.4/9.2	4430	5.33	4.88	
821-6010	MY2NDC24(S)	10	2 pole/LED	36.9	636	5.16	4.73	
821-6012	MY4AC110/120(S)	5	4 pole	8.4/9.2	4430	5.64	5.17	
821-6014	MY4AC220/240(S)	5	4 pole	4.2/4.6	18790	6.06	5.56	
821-6016	MY4AC24(S)	5	4 pole	46.0	180	5.50	5.04	
821-6018	MY4DC24(S)	5	4 pole	36.9	636	5.50	5.04	
821-6020	MY4INAC110/120(S)	5	4 pole/test button/LED	8.4/9.2	4430	6.55	6.00	
821-6022	MY4INAC220/240(S)	5	4 pole/test button/LED	4.2/4.6	18790	11.05	10.13	
821-6024	MY4INDC24(S)	5	4 pole/test button/LED	36.9	636	6.44	5.91	
821-6026	MY4NAC110/120(S)	5	4 pole/LED	8.4/9.2	4430	6.20	5.68	
821-6028	MY4NAC220/240(S)	5	4 pole/LED	4.2/4.6	18790	6.93	6.35	
821-6030	MY4NDC24(S)	5	4 pole/LED	36.9	636	6.09	5.58	
821-6032	MY4ZINAC110/120(S)	5	4 pole/bi./test button/LED	8.4/9.2	4430	19.27	17.66	
821-6034	MY4ZINDC24(S)	5	4 pole/bi./test button/LED	36.9	636	18.85	17.27	

MY Relay Accessories

Stock No.	Mfr.'s Type	Description	EACH 1-24	EACH 25-99	EACH
821-3024	PY08	Back connecting socket; solder terminals (DPDT)	2.04	1.86	
821-3025	PY11	Back connecting socket; solder terminals (3PDT)	1.79	1.55	
821-1001	PYC-P	Standard relay hold down clip (back connecting socket)	.30	.27	

Quality Sockets and Clips for Relays

Stock No.	Mfr.'s Type	For Relay Series	Application	EACH 1-24	EACH 25-99	EACH
821-3013	PF083A-E	MK 1 and 2 pole	Surface mount or rail	3.43	3.14	
821-3014	PF113A-E	MK 3 pole	Surface mount or rail	4.92	4.51	
821-3015	PL08	MK 2 pole	Solder	1.28	1.18	
821-3016	PL11	MK 3 pole	Solder	3.31	3.04	
821-3017	PFP-100N	All relays	Mounting rail	4.74	4.34	
821-3021	PYF08A-E	MY 2 pole	Surface or rail mount	3.83	3.51	
821-3023	PYF14A-E	MY 4 pole	Surface or rail mount	6.57	6.02	
821-3027	PYC-A1	LY	Hold-down clip	.26	.24	
821-3028	PTF08A-E	LY 1 and 2 pole	Surface or rail mount	3.76	3.44	
821-3029	PTF14A-E	LY 4 pole	Surface or rail mount	4.98	4.57	
821-3030	PT08	LY 1 and 2 pole	Chassis — solder	1.57	1.44	
821-3032	PT08-0	LY 1 and 2 pole	PCB terminal	1.34	1.22	
821-3033	PT14-0	LY 4 pole	PCB terminal	1.59	1.46	

0.295" 0.492"

G5V1 Series General Purpose, Horizontal Mount Relays

FARADAY

FARA-MOD HORNS, HORN STROBES & HORN LIGHTS

FEATURES

- Modular Construction
- Mounts To Standard 4-Inch Square Box
- Low Operating Current
- High Lumen Strobe Output
- High Lumen Output
- Separate Horn And Light Inputs
- U.L., U.L.C. Listed
- FM Approved

DESCRIPTION:

Faraday's new horn design allows for either surface or low-profile mounting on a standard 4-inch square electrical box. This new design does not require a special backbox or plate when flush or semi-flush mounted. The surface and low-profile versions are both a mere 5/8-inch thick. Accessories are available for weather-resistant and concealed conduit mounting. The horn with a grille, strobe grille, or light grille are U.L., U.L.C. listed and FM approved.

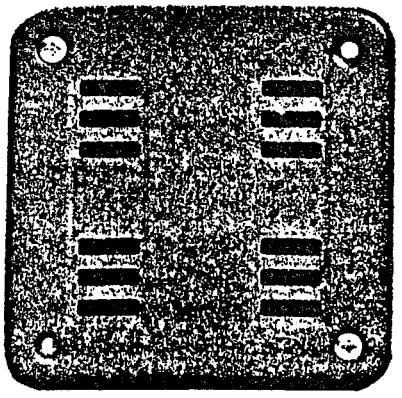
The strobe and light grilles are designed to mount directly to the basic horn mechanism. Both are available for surface or low-profile mounting. The strobe unit utilizes a Xenon flash tube that produces a high intensity flash. The light unit produces a visual indication using two incandescent light bulbs. Both units are front mounted and visable from all sides of the lens.

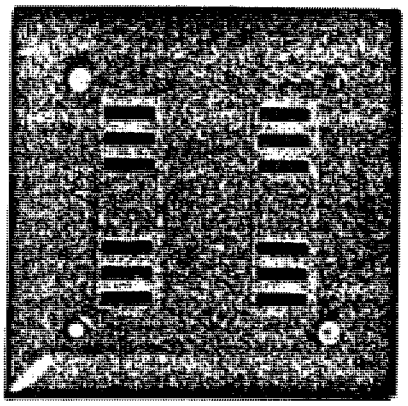
The high impact, Lexan lens can be silkscreened with up to five 1/2 inch high letters. The lenses are available in white, red, amber, or blue.

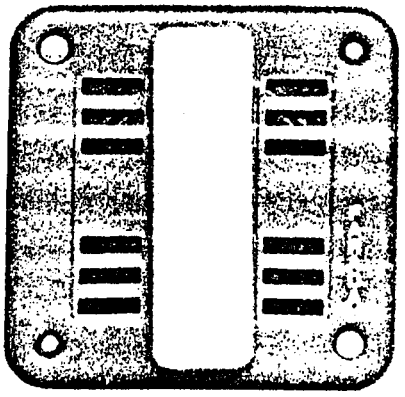
To provide maximum versatility, the Fara-Mod horn, strobe grille, and light grille are available in several voltages and in the case of the D.C. strobe unit, two intensity levels. The horn is available in polarized parallel A.C. and D.C. as well as series A.C. In addition, the D.C. horn includes noise cancellation circuitry to prevent the transmission of high voltage spikes that are typically generated by contact type electromechanical devices. The strobe and light grilles are available in 12VDC, 21-28VDC, and 120VAC.

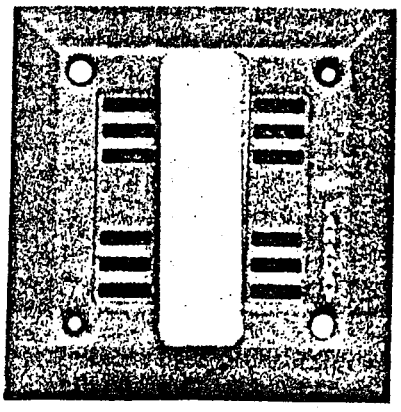
The U.L. output rating for both the A.C. and D.C. horn is a minimum of 87dB. The D.C. strobe is U.L. rated at 3.0 candela for the standard intensity unit and 12.0 candela for the high intensity unit. The U.L. rating for the A.C. strobe is 2.5 candela. Peak light intensity levels are 30,000 candlepower for the standard intensity D.C. strobe and 110,000 candlepower for the high intensity D.C. strobe. The A.C. strobe has a peak intensity level of 25,000 candlepower. Flash rates are 1 to 1.5 flashes per second for the standard intensity strobes and 1 flash per second for the high intensity strobe. The incandescent light unit is available with a built in flasher that will provide a flash rate of .5 to 2.0 flashes per second.

The strobe and incandescent unit are provided with two wire leads while the horn is supplied with three. The additional lead is for grounding the horn to the backbox.









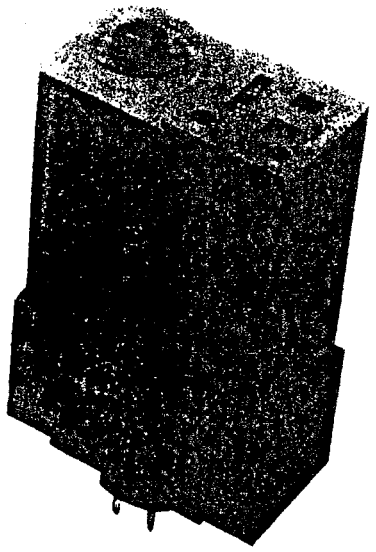
AR2 U SERIES

DELAY ON MAKE TIMER

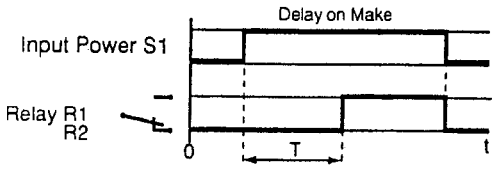
UL-E87133 CSA-LR56339

- **Multi Timing Range (.1 sec. to 10 hours)**
- **Direct Reading**
- **Dual Voltage**
- **DPDT 10 Amp Relay Output**
- **LED Power On Indicator**
- **LED Relay Indicator**

CE



Function A:

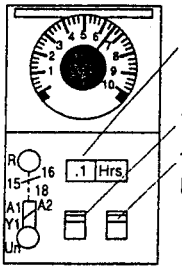


When input power (S1) is applied, the relay delays the present time period (T) prior to energizing. Interrupt power to de-energize the relay.

SPECIFICATIONS:

Input Power	220VAC/24 VAC/DC, 110VAC/24 VAC/DC 48VAC/DC/24 VAC/DC, 12 VDC ± 15% 50/60 Hz	
Max. power consumption	24 VAC: 1 VA 48 VAC: 1.2 VA 110 VAC: 3.5VA 220 VAC: 7 VA	12 VDC: 0.5W 24 VDC: 0.6W 48 VDC: 1.2W
Output	DPDT Relay	
Contact Material	Ag Cdo	
Maximum loading	10A AC resistive	8A DC resistive
Max. switching voltage	250 VAC	250VDC
Relay max. power rating	2200 VA	80W
Transient protection	2500VA	
Mechanical Life of Relay	30 x 10^5 operations	
Electrical Life of Relay	2 x 10^5 at 2400 VA resistive load	
Repetition accuracy	± 0.2% at constant ambient	
Reset time	50ms after timing 100ms during timing	
Operating temperature	-4°F to + 140°F	-20°C to +60°C
Weight	2.8 oz. (80 grams)	

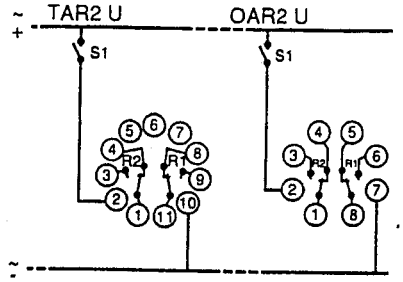
TIME RANGE SELECTION:



Six Time Ranges can be selected with two front panel switches.

- X 0.1 s - 0.1 to 1 second
- X 1s - 1 to 10 seconds
- X 0.1 mn - 0.1 to 1 minute
- X 1 mn - 1 to 10 minutes
- X 0.1 hrs - 0.1 to 1 hour
- X 1 hrs - 1 to 10 hours

WIRING DIAGRAM:



The OAR2 U is a single voltage timer.
The TAR2 U is a dual voltage timer.
(Jumper 7 & 10 for 24 VAC/DC).

ORDERING INFORMATION:

O / MOUNTING — AR2 / SERIES — U / TIME RANGE — 220A / INPUT POWER

DIMENSIONS See page 145

MOUNTING
O = 8 pin plug-in
T = 11 pin plug-in

SERIES
AR2

TIME RANGE
U Range
.1 sec. to 10 hours

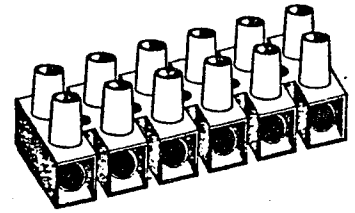
INPUT POWER

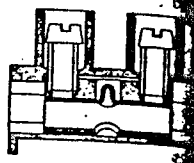
12D	= 12 VDC
24AD	= 24 VAC/DC (OAR 2 U only)
48AD	= 48 VAC/DC/24 VAC/DC
110A	= 110 VAC/24 VAC/DC
220A	= 220 VAC/24 VAC/DC

Screw Terminal Strips For Panel/Chassis Mounting — Series 300

Series 300 terminal strips are used for connecting stripped, unterminated, solid or stranded copper wires, ranging from 6 to 26 AWG depending on the product selected. Each strip has 12 circuits and can be easily cut to the required number of poles. Mounting holes are provided between each circuit. Captive screws are backed out and ready for wiring.

Each circuit has a wire protector to prevent damage to the wire from the turning screw. All metal parts are completely recessed in the flexible polyamide moulding. This dead front design ensures safety and prevents short circuiting. **Specifications. Insulating Material:** Polyamide, self extinguishing to UL 94, V-0 or V-2, natural. **Temperature Limits:** Short time — 140°C/284°F; Continuous — 80°C/176°F; Low limit — –40°C/–40°F. **Comparative Tracking Index:** CTI >600. **Oxygen Index Rating:** 25% (33% for types 326 and 327). UL File E69841. CSA File LR24322.



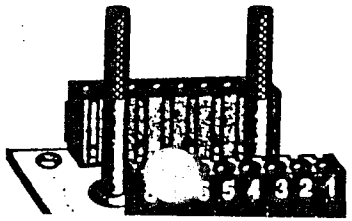


Stock No.	Mfr.'s Type	No. of Circuits	Length		Height		Width		Center-Center Spacing		Screw Size	Mounting Hole Diameter		Spacing Between Current Carrying Parts: Through Air		Spacing Between Current Carrying Parts: Over Surface		Screw Tightening Torque (Lb./In.)	Wire Stripping Length		UL Rating			CSA Rating		
			mm	In.	mm	In.	mm	In.	mm	In.		mm	In.	mm	In.	mm	In.		mm	In.	Volts	Amps	AWG	Volts	Amps	A
924-2806	302-N-HDS/02	2	14.0	0.55	12.0	0.47	16	0.63	8.0	0.315	M2.6	2.8	0.11	4.3	0.17	3.2	0.13	3.5	5.0	0.20	300	20	12-20	300	20	14
924-2808	302-N-HDS/03	3	22.0	0.87	12.0	0.47	16	0.63	8.0	0.315	M2.6	2.8	0.11	4.3	0.17	3.2	0.13	3.5	5.0	0.20	300	20	12-20	300	20	14
924-2810	302-N-HDS/04	4	30.0	1.18	12.0	0.47	16	0.63	8.0	0.315	M2.6	2.8	0.11	4.3	0.17	3.2	0.13	3.5	5.0	0.20	300	20	12-20	300	20	14
924-2812	302-N-HDS/06	6	46.0	1.81	12.0	0.47	16	0.63	8.0	0.315	M2.6	2.8	0.11	4.3	0.17	3.2	0.13	3.5	5.0	0.20	300	20	12-20	300	20	14
924-0100	302-N-HDS/12	12	94.0	3.70	12.0	0.47	16	0.63	8.0	0.315	M2.6	2.8	0.11	4.3	0.17	3.2	0.13	3.5	5.0	0.20	300	20	12-20	300	20	14
924-2814	302-HDS/02	2	14.0	0.55	15.0	0.59	16	0.63	8.0	0.315	M2.6	2.8	0.11	4.3	0.17	3.2	0.13	3.5	5.0	0.20	300	20	12-20	300	20	14
924-2816	302-HDS/03	3	22.0	0.87	15.0	0.59	16	0.63	8.0	0.315	M2.6	2.8	0.11	5.8	0.23	5.8	0.23	3.5	5.0	0.20	300	20	12-20	300	20	14
924-2818	302-HDS/04	4	30.0	1.18	15.0	0.59	16	0.63	8.0	0.315	M2.6	2.8	0.11	5.8	0.23	5.8	0.23	3.5	5.0	0.20	300	20	20-12	300	20	14
924-2820	302-HDS/06	6	46.0	1.81	15.0	0.59	16	0.63	8.0	0.315	M2.6	2.8	0.11	5.8	0.23	5.8	0.23	3.5	5.0	0.20	300	20	20-12	300	20	14
924-0110	302-HDS/12	12	94.0	3.70	15.0	0.59	16	0.63	8.0	0.315	M2.6	2.8	0.11	5.8	0.23	5.8	0.23	3.5	5.0	0.20	300	20	20-12	300	20	14
924-2822	323-HDS/02	2	16.5	0.65	16.0	0.65	21	0.83	10.0	0.394	M2.6	2.8	0.11	5.8	0.23	5.8	0.23	3.5	5.0	0.20	300	20	20-12	300	20	14
924-2824	323-HDS/03	3	26.5	1.04	16.0	0.65	21	0.83	10.0	0.394	M3.0	3.5	0.14	6.1	0.24	6.1	0.24	3.5	5.0	0.20	300	20	20-12	300	20	14
924-2826	323-HDS/04	4	36.5	1.44	16.0	0.65	21	0.83	10.0	0.394	M3.0	3.5	0.14	6.1	0.24	6.1	0.24	4.5	6.5	0.25	600	30	10-22	300	25	10
924-9981	323-HDS/06	6	56.5	2.22	16.0	0.65	21	0.83	10.0	0.394	M3.0	3.5	0.14	6.1	0.24	6.1	0.24	4.5	6.5	0.25	600	30	10-22	300	25	10
924-0120	323-HDS/12	12	117.0	4.59	16.0	0.65	21	0.83	10.0	0.394	M3.0	3.5	0.14	6.1	0.24	6.1	0.24	4.5	6.5	0.25	600	30	10-22	300	25	10
924-2830	324-HDS/02	2	19.5	0.77	18.5	0.73	22	0.87	11.5	0.453	M3.5	3.5	0.14	6.1	0.24	6.1	0.24	4.5	6.5	0.25	600	30	10-22	300	25	10
924-2832	324-HDS/03	3	31.0	1.22	18.5	0.73	22	0.87	11.5	0.453	M3.5	3.5	0.14	6.1	0.24	6.1	0.24	4.5	6.5	0.25	600	30	10-22	300	25	10
924-2834	324-HDS/04	4	42.5	1.67	18.5	0.73	22	0.87	11.5	0.453	M3.5	3.5	0.14	6.1	0.24	6.1	0.24	7.0	7.0	0.28	600	35	8-26	600	40	10
924-2836	324-HDS/06	6	65.5	2.58	18.5	0.73	22	0.87	11.5	0.453	M3.5	3.5	0.14	6.1	0.24	6.1	0.24	7.0	7.0	0.28	600	35	8-26	600	40	10
924-0150	324-HDS/12	12	135.0	5.30	18.5	0.73	22	0.87	11.5	0.453	M3.5	3.5	0.14	6.1	0.24	6.1	0.24	7.0	7.0	0.28	600	35	8-26	600	40	10
924-2838	326-HDS/02	2	26.0	1.02	22.5	0.87	30	1.18	14.5	0.571	M4.0	4.3	0.17	7.9	0.31	7.9	0.31	10.0	9.0	0.35	600	50	8-14	600	55	10
924-2840	326-HDS/03	3	40.5	1.59	22.5	0.87	30	1.18	14.5	0.571	M4.0	4.3	0.17	7.9	0.31	7.9	0.31	10.0	9.0	0.35	600	50	8-14	600	55	10
924-2842	326-HDS/04	4	55.0	2.17	22.5	0.87	30	1.18	14.5	0.571	M4.0	4.3	0.17	7.9	0.31	7.9	0.31	10.0	9.0	0.35	600	50	8-14	600	55	10
924-2844	326-HDS/06	6	84.0	3.31	22.5	0.87	30	1.18	14.5	0.571	M4.0	4.3	0.17	7.9	0.31	7.9	0.31	10.0	9.0	0.35	600	50	8-14	600	55	10
924-0170	326-HDS/12	12	171.0	6.73	22.5	0.87	30	1.18	14.5	0.571	M4.0	4.3	0.17	7.9	0.31	7.9	0.31	10.0	9.0	0.35	600	50	8-14	600	55	10
924-2846	327-HDS/02	2	26.0	1.02	25.0	0.98	30	1.18	14.5	0.571	M5.0	4.3	0.17	7.5	0.30	9.6	0.38	16.0	9.0	0.35	600	65	6-14	600	80	10
924-2848	327-HDS/03	3	40.5	1.59	25.0	0.98	30	1.18	14.5	0.571	M5.0	4.3	0.17	7.5	0.30	9.6	0.38	16.0	9.0	0.35	600	65	6-14	600	80	10
924-2850	327-HDS/04	4	55.0	2.17	25.0	0.98	30	1.18	14.5	0.571	M5.0	4.3	0.17	7.5	0.30	9.6	0.38	16.0	9.0	0.35	600	65	6-14	600	80	10
924-2852	327-HDS/06	6	84.0	3.31	25.0	0.98	30	1.18	14.5	0.571	M5.0	4.3	0.17	7.5	0.30	9.6	0.38	16.0	9.0	0.35	600	65	6-14	600	80	10
924-0180	327-HDS/12	12	171.0	6.73	25.0	0.98	30	1.18	14.5	0.571	M5.0	4.3	0.17	7.5	0.30	9.6	0.38	16.0	9.0	0.35	600	65	6-14	600	80	10

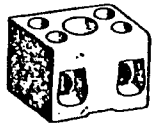
Low Profile D-Subminiature Interface Modules — Series MTDA

Type MTDA interface modules were designed for use in motor control machinery, electronic assembly equipment, material handling, specialty machinery and multi-axis systems, etc. Its particular advantage is that it provides a low profile interface between discrete wiring and a D-Subminiature connector.

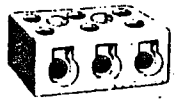
Male D-Subminiature Connector



Ceramic Terminal Blocks



2-DIN-46284

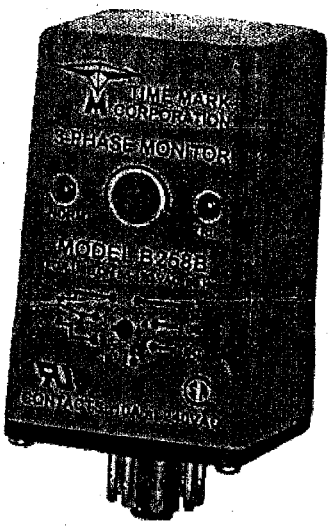


4011-B

Ceramic terminal blocks are designed for high

MODEL 258

3-Phase Monitor



- **Detects phase loss, low voltage, phase reversal**
- **50 Hz, 60 Hz and 400 Hz models**
- **Automatic or manual reset**
- **Five year unconditional warranty**

DESCRIPTION

The **Model 258** continuously monitors 3-phase power lines for abnormal conditions. When properly adjusted, the Model 258 Monitor will detect phase loss on a loaded motor even when regenerated voltage is present.

This device consists of a solid-state voltage and phase-angle sensing circuit, driving an electro-mechanical relay. When correct voltage and phase rotation are applied, the internal relay will energize. A fault condition will de-energize the relay. When the fault is corrected, the monitor will automatically reset *(a manual reset version is also available)*.

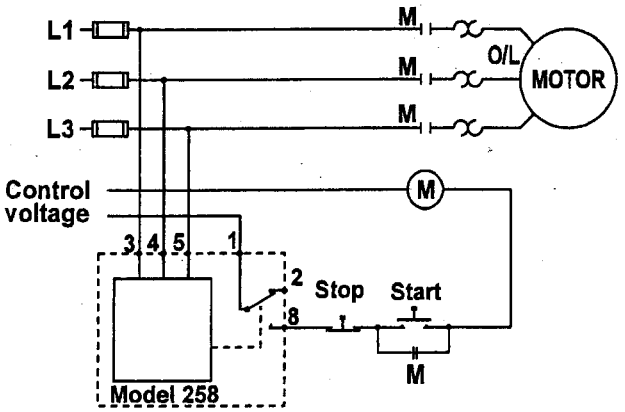
The Model 258 3-Phase Monitor does not require a neutral connection and can be used with Wye or Delta systems. Voltage ranges are sufficiently wide to allow for proper adjustment to existing conditions. Both "TRIP" and "NORM" condition indicators are provided to aid in adjustment and system trouble-shooting.

SPECIFICATIONS

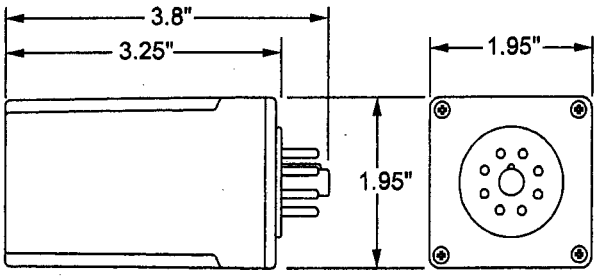
AUTO Reset MANUAL Reset	B258B B258BM	258B 258BM	A258B A258BM	EX258B EX258BM	B258B-400 B258BM-400	258B-400 258BM-400
Nominal AC voltage (phase to phase)	120 vac	208/240 vac	480 vac	380 vac	120 vac	208/240 vac
Case Color	Gray	Red	Yellow	Yellow	Gray	Red
Adjustment range	85-120 vac	160-240 vac	380-480 vac	300-400 vac	85-120 vac	160-240 vac
Frequency	60 Hz	60 Hz	60 Hz	50 Hz	400 Hz	400 Hz
Pwr consumption	0.75W	1.5W	4.5W	3.75W	0.75W	1.5W
Transient protection	2500 VAC for 10 ms					
Repeat accuracy	± 0.1% of set point (fixed conditions)					
Response time	50 msec (set or reset)					
Dead band	Approx. 2%					
Output contacts	SPDT 10 amps at 240 VAC resistive					
Expected relay life	Mechanical: 10 million operations Electrical: 100,000 operations at rated load					
Operating temp.	-40° to +131° F					
Humidity tolerance	0 - 97% w/o condensation					
Enclosure material	Dust cover: ABS plastic					
Mounting	8-pin socket (**sold separately)					
Weight	5 oz.					
Agency approvals	UL Recognized* and CSA Certified *condition of acceptability: the 380V and 480V versions must be used with a UL Recognized 600 VAC socket					

** Order 8-pin socket number **51X120**

TYPICAL APPLICATION



DIMENSIONS



Telephone: Main - (918) 438-1220
Sales - (800) 862-2875
Fax: (918) 437-7584

E-mail: sales@time-mark.com
Internet: http://www.time-mark.com

TIME MARK CORPORATION

11440 East Pine Street
Tulsa, Oklahoma 74116

Doc No. 87A123 4/00

TIME MARK is a division of AEMT, Inc.

MODEL 258 3-Phase Monitor

READ ALL INSTRUCTIONS BEFORE INSTALLING, OPERATING OR SERVICING THIS DEVICE.
KEEP THIS DATA SHEET FOR FUTURE REFERENCE.

GENERAL SAFETY

POTENTIALLY HAZARDOUS VOLTAGES ARE PRESENT AT THE TERMINALS OF THE MODEL 258. ALL ELECTRICAL POWER SHOULD BE REMOVED WHEN CONNECTING OR DISCONNECTING WIRING. THIS DEVICE SHOULD BE INSTALLED AND SERVICED BY QUALIFIED PERSONNEL.

Installation Instructions

WARNING
IN APPLICATIONS WHERE VOLTAGES IN EXCESS OF 300 VAC ARE TO BE MONITORED, BE CERTAIN TO USE THE TIME MARK MODEL 51X120 8-PIN SOCKET, OR AN EQUIVALENT UL APPROVED 600 VAC RATED

INSTALLATION

Mount the 8-pin socket in a suitable enclosure. A NEMA-1 rated enclosure, designed for socket-mounted relays is available from Time Mark Corporation.

Connect 3-phase power to terminals 3, 4, and 5 on the socket. Phase rotation should be verified using a Time Mark Model 108A or 108B Phase Sequence Detector.

Connect the load control wiring to the appropriate terminals on the socket:

For motor control applications; use terminals 1 and 8.
For phase loss alarm applications; use terminals 1 and 2.

Insert the Model 258 into the socket and apply power. If the contact does not transfer *(green light ON)*, check that all phases are present, and of the correct voltage. If power is correct, rotate the level adjustment counter-clockwise.

If the contact still does not transfer, remove power and reverse any two of the three phase wires at the socket *(phase rotation is reversed)*. Re-apply power. The contact should transfer to provide a signal path between pins 1 and 8.

NOTE: *When installing the Model 258 monitor in areas of high humidity or contamination, it is recommended that the base area and all exposed metal parts of the socket be coated liberally with a good quality silicon grease, such as Dow Corning DC-4 or DC-4X. Insert the unit into the socket and wipe off excess grease around the base. This will prevent the entrance of moisture and other contaminates into the base and socket areas.*

ADJUSTMENT SETTINGS

The following procedure will allow the Model 258 to be adjusted to achieve a trip point just below the nominal phase-to-phase voltage, where the unit is applied.

Rotate the adjustment control fully clockwise, or until the red (TRIP) indicator illuminates.

Slowly rotate the adjustment control in a counter-clockwise direction, just until the green (NORM) indicator illuminates.

At this point, the Model 258 is the most sensitive to irregular power line conditions. If nuisance tripping occurs, turn the control slightly further counter-clockwise.

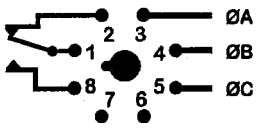
A more accurate setting will require the use of a 3-phase variac to lower the voltage to an exact measurable setting. Time Mark also offers a factory set version of all models and voltage ranges, for only a small additional charge.

TROUBLESHOOTING

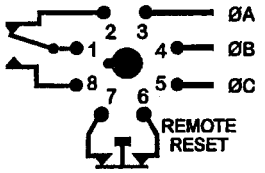
Should the Model 258 Monitor fail to operate properly, check that all three voltages are present, and are of the correct voltage level and phase rotation (a Model 108A or 108B Phase Sequence Detector should be used to verify phase rotation). Check all fuses and verify that all wiring connections are correct. If problems persist, contact your local Time Mark Distributor, or the factory for assistance *(Monday-Friday, 8 a. m. to 5 p.m. CST)*.

MANUAL RESET VERSIONS

IF YOU DO NOT WISH TO USE A NORMALLY CLOSED EXTERNAL RESET SWITCH ON THE MANUAL RESET VERSION, YOU MUST JUMPER PINS 6 AND 7. Refer to the Manual Reset 8-pin diagram.



Automatic Reset



Manual Reset

WARRANTY

The **Model 258 3-Phase Monitor** is warranted to be free from defects in materials and workmanship, and is covered by our exclusive **5-year Unconditional Warranty**. If this device fails to operate, for any reason, we will repair or replace it free, for five years from the date of purchase. Contact the Time Mark Sales department for further details.

Telephone: Main - (918) 438-1220
Sales - (800) 862-2875
Fax: (918) 437-7584

E-mail: sales@time-mark.com
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TIME MARK CORPORATION

11440 East Pine Street
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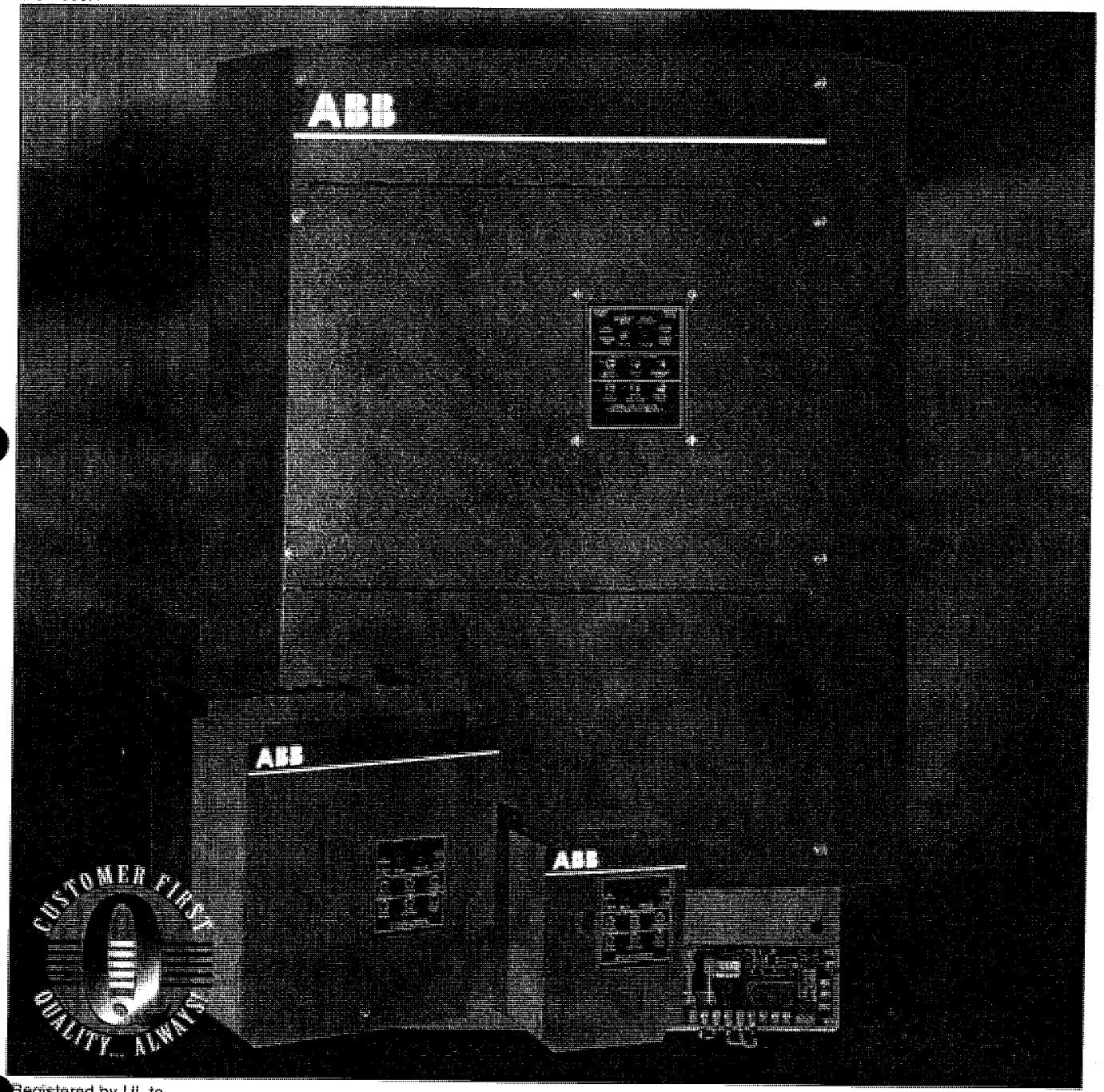
TIME MARK is a division of AEMT, Inc.

Installation
and maintenance

Softstarters

Type SSA
25 – 1125 HP

AC 1006.1



Registered by UL to
ISO 9002

ABB Control Inc.

ABB

Power terminal wire range and tightening torque

480V	600V	WIRE RANGE	TORQUE LBS/IN
SA030-48	SA040-60	#18 - #4	20
SA040-48 SA050-48	SA050-60 SA060-60	#14 - #4	50
SA060-48 SA075-48	SA075-60 SA100-60	#14 - #1/0	50
SA100-48 SA125-48	SA125-60 SA150-60	#6 - 250kcmil	325
SA150-48 SA200-48	SA200-60 SA250-60	(2)#6 - 250kcmil	325
SA250-48 thru SA400-48	SA300-60 thru SA500-60	(2)#2 - 600kcmil	375
SA500-48 thru SA700-48	SA600-60 thru SA800-60	(3)4/0 - 600kcmil	375
SA800-48	SA900-60	(4)4/0 - 600kcmil	375
SA900-48 SA1000-48	SA1000-60 SA1125-60	(4)300kcmil - 800kcmil	500

ALL TERMINALS ARE FOR 75°C CU CABLES

Warranty policy

ABB warrants its products to be free from defects in material and/or workmanship for a period of one year from the date of installation, to a maximum of 18 months from the date of shipment as indicated by the unit's date code. The Company reserves the right to repair or replace any malfunctioning units under warranty at their option. All warranty repairs must be performed by the Company factory, or on site by factory authorized service firms or personnel approved by the Company.

Solid state controls have different operating characteristics from those of electro-mechanical equipment. Because of these differences and the wide variety of applications for solid state controls, each application designer must verify that the solid state equipment is acceptable for his application. In no event will ABB be liable or responsible for indirect or consequential damages resulting from the use or application of this equipment. The diagrams and illustrations in this document are included solely for illustrative purposes. Because of the number of different applications, ABB can not be responsible or liable for actual use based on the examples or diagrams.

Softstarters
Type SSA
Open & enclosed
Installation & maintenance

Table of contents

AC 1006.1 – 10/98

Type SSA Softstarters
Installation & Maintenance
Chapter 1 – Introduction

1.1 – General

The Type SSA solid state reduced voltage starter is a six SCR design which features a voltage/current ramp with an anti-oscillation circuit for smooth load acceleration. The SCRs are sized to withstand starting currents of 500% for 60 seconds (compared with 350% for 30 seconds from other manufacturers). The Type SSA features smooth, stepless ramp control which reduces motor inrush current and excessive wear on the mechanical drive train components. In addition to having easy to understand diagnostic lights, the Type SSA can be set up for the ideal starting cycle. Starting torque, ramp time, current limit, and decel control are standard adjustments on the Type SSA. By adjusting the starting torque, ramp time and current limit potentiometers, the starting electrical characteristics of the motor can be matched to the mechanical characteristics of the drive train for controlled acceleration of the load. The Type SSA includes adjustable overload protection (standard 100HP, optional < 100HP at 480V), shorted SCR detection and phase loss detection. It is factory wired for 120VAC control voltage (or 240VAC for 415 VAC and 380 VAC units). Auxiliary contacts and provisions for interlocking are also included.

1

1.3 – Receiving and unpacking

Upon receipt of the product you should immediately do the following:

- Carefully unpack the unit from the shipping carton and inspect it for shipping damage (if damaged, notify the freight carrier and file a claim within 15 days of receipt).
- Verify that the model number on the unit matches your purchase order.
- Confirm that the ratings sticker on the unit matches or is greater than the motor's HP, current and voltage rating.

1.2 – Specifications and performance features

Type of load	Three phase AC induction motor
AC Supply voltage	208, 240, 380, 415, 480 or 575 (VAC ± 10%, 50/60 Hz line voltages)
HP ratings	Up to 1125HP
Power circuit	6 SCRs
SCR/Diode peak inverse Voltage	Line voltage / PIV Ratings 208 to 480 / 1200 575 / 1500
Phase insensitivity	Unit operates with any phase sequence
Cooling	Convection or fan cooling
Ambient operating Temperature	Chassis units: 0° to 50°C (32° to 122°F) Enclosed units: 0° to 40°C (32° to 104°F)
Control	2 or 3 wire 120 VAC (customer supplied). On 380 and 415V units, the control voltage is 240VAC. CPTs are standard on enclosed units.
Standard adjustments	Starting torque 0 to 100% Starting ramp time 0 to 60 seconds Current limit 200% to 500%
Decel adjustments	Step down voltage 0 to 100% Deceleration ramp time 0 to 30 seconds Stop level voltage 0 to 100%
Current trip	Fixed 10 times FLA
Auxiliary contacts	3 Form C (N.O., N.C.) 5A @ 240V (1200VA maximum)
Overload capacity	115% continuous 500% 60 seconds unit rating
Approvals	UL Listed, Canadian UL
Standard overload	Class 10, 600% ± 20% for 10 sec. (adjustable) 100HP and above at 480V

2.1 – Location

Proper location of the Type SSA is necessary to achieve specified performance and normal operation lifetime. The Type SSA should always be installed in an area where the following conditions exist:

- Ambient operating temperature:
  Chassis unit: 0 to 50°C (32 to 122°F)
  Enclosed unit: 0 to 40°C (32 to 104°F)
- Protected from rain and moisture
- Humidity: 5 to 95% non-condensing
- Free from metallic particles, conductive dust and corrosive gas
- Free from excessive vibration (below 0.5G)
- Open panel units must be mounted in the appropriate type of enclosure. Enclosure size and type must be suitable to dissipate heat generated by the soft starter. Contact factory.

2.2 – Initial unit inspection

Prior to installing, make a complete visual check of the unit for damage in shipping and handling. Report damage immediately before attempting to run unit. Check for loose mechanical assemblies or broken wires which may have occurred during transportation or installation. Loose electrical connections will increase resistance and cause the unit to function improperly. Prior to beginning the installation verify that the motor and the unit are rated for the proper amperage and motor current. Check the motor FLA to ensure that the nameplate rating of the unit will handle this specific motor.

2.3 – Dimensions

Open panel units must be mounted in the appropriate type of enclosure. Enclosure size and type must be suitable to dissipate heat generated by the SCRs. Contact factory for assistance in sizing enclosures.

2.4 – Warning

Do not service equipment with voltage applied! Unit can be source of fatal electrical shocks! To avoid shock hazard, disconnect main power and control power before working on the unit. Warning labels must be attached to terminals, enclosure and control panel to meet local codes.

2.5 – Mounting and cleaning

When drilling or punching holes in the enclosure, cover the electrical assembly to prevent metal filings from becoming lodged in areas which can cause clearance reduction or actually short out electronics. After work is complete, thoroughly clean the area and re-inspect the unit for foreign material. Make sure there is sufficient clearance (six inches) all around the unit for cooling, wiring and maintenance purposes. To maximize effective air flow and cooling, the unit must be installed with its heat sink ribs oriented vertically and running parallel to the mounting surface.

Warning: Remove all sources of power before cleaning the unit.

In dirty or contaminated atmospheres the unit should be cleaned on a regular basis to ensure proper cooling. Do not use any chemicals to clean the unit. To remove surface dust, use 80 to 100 psi clean dry compressed air only. A three inch high quality dry paint brush is helpful to loosen up the dust prior to using compressed air on the unit.

Model		Unit maximum amp rating	HP/Voltage				Dimensions		
480V	600V		208V	240V	480V	600V	H	W	D
SSA025 – SSA030	**SSA030 – SSA040**	42	10	15	30	40	16.5	10	10
SSA040 – SSA050	**SSA050 – SSA060**	68	20	25	50	60			
SSA060 – SSA075	**SSA075 – SSA100**	104	30	40	75	100			
SSA100 – SSA125	**SSA125 – SSA150**	154	50	60	125	150	20	20	12.0
SSA150	**SSA200**	192	60	75	150	200	27	20	11.5
SSA200	**SSA250**	248	75	100	200	250			
SSA250 – SSA300	**SSA300 – SSA350**	360	125	150	300	350	29.5	20	11.5
SSA350	**SSA400**	414	—	—	350	400			
SSA400	**SSA500**	480	150	200	400	500			
SSA500 – SSA700	**SSA600 – SSA800**	840	300	350	700	800	45	33	12.75
SSA800	**SSA900**	960	350	400	800	900	33	33	15.25
SSA900 – SSA1000	**SSA1125**	1250	450	500	1000	1125			

3.1 – Thermal overload relay

The Type SSA provides motor overload protection using an adjustable thermal overload relay. The standard Type SSA is furnished with a Class 10 thermal overload. A Class 10 overload will trip after 600% current for 10 seconds or less. Class 20 overload heater packs are also available. These overloads will trip after 600% current for 20 seconds or less.

3.2 – Overload relay

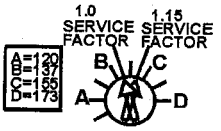
The bimetallic ambient compensated overload relay has an adjustable FLA range set by the dial. The overload relay will ultimately trip at 125% FLA for a 1.15 service factor motor, and 115% FLA for a 1.0 service factor motor. For 25 to 1000 Hp see section 3.3.

3.3 — Class 10 OLR dial adjustment, 25 Hp and larger

Soft starter	Overload relay	Overload dial setting to actual FLA						
		3.5	4.0	4.5	5.0	5.5	6.0	6.5
SSA025	TA25DU5.0	28.0	32.0	36.5	40.0	—	—	—
SSA030	TA25DU6.5	—	—	36.0	40.0	44.5	48.0	52.5
SSA040	TA25DU5.0	42.0	48.0	54.0	60.0	—	—	—
SSA050	TA25DU5.0	52.5	60.0	67.5	75.0	—	—	—
SSA060	TA25DU5.0	56.0	64.0	72.5	80.0	—	—	—
SSA075	TA25DU5.0	84	96	108	120	—	—	—
SSA100	TA25DU5.0	105	120	135	150	–	–	–
SSA125	TA25DU6.5	–	–	135	150	165	180	195
SSA150	TA25DU5.0	140	160	180	200	–	–	–
SSA200	TA25DU5.0	175	200	225	250	–	–	–
SSA250	TA25DU5.0	210	240	270	300	–	–	–
SSA300	TA25DU5.0	280	320	360	400	–	–	–
SSA350	TA25DU5.0	315	360	405	450	–	–	–
SSA400	TA25DU5.0	350	400	450	500	–	–	–
SSA500	TA25DU5.0	420	480	540	600	–	–	–
SSA600	TA25DU5.0	525	600	675	750	–	–	–
SSA700	TA25DU5.0	560	640	720	800	–	–	–
SSA800	TA25DU5.0	700	800	900	1000	–	–	–
SSA900	TA25DU5.0	840	960	1080	1200	–	–	–
SSA1000	TA25DU5.0	840	960	1080	1200	–	–	–

3.4 – Class 20 OLR dial adjustment, 100 Hp and larger

The FLA value for each position of the overload adjustment dial is shown on the model label. Refer to the label on the unit for the current values corresponding to the A, B, C and D letters. For motors having a 1.15 service factor, position the FLA adjustment dial to correspond to the motor FLA rating. Estimate the dial position when the motor FLA falls between two letter values. For motors having a 1.0 service factor (or IEC requirements), rotate the FLA dial as shown on Figure 3.1.



Example of a 150 FLA setting for model label rating as listed showing position for 1.0 or 1.15 service factor motors.

Figure 3.1 – FLA adjustable dial

WARNING: **To provide continued protection against fire or shock hazard, the complete overload relay must be replaced if burnout of the heater element occurs.**

3.5 – Manual/automatic reset

The overload relay is factory set at "M" for manual reset operation. The manual setting is recommended. However, for automatic reset operation, turn the reset adjustment dial marked A and M to the "A" position. To prevent automatic restart on over-temperature or motor overload, two-wire control must be interlocked with the auxiliary contact so the start contact is removed on trip.

3.6 – Test for trip indication

To test overload relay for trip indication when in manual reset, activate the test trip button on the overload. An indicator flag appears when the device trips and the LEDs on the display indicate "Overload." Push reset button on overload to clear the fault. This test is recommended to ensure that the motor protection is active. On major faults it is recommended that the overload be checked or changed.

4.1 – Power connections

Connect appropriate power lines to the unit input terminals marked L1, L2, L3. Avoid routing power wires near the control board. Connect the motor leads to the unit terminals marked T1, T2, T3. Refer to NEC standards for wire length, sizing and lug torque. Never interchange input and output connections to the unit. This could cause excessive voltage in the control logic circuit and may damage the unit. Note: Never connect power factor correction capacitors on the load side of the unit. If capacitors are located on the load side, serious damage to the SCRs will occur. The unit cannot be tested without a motor or other test load connected to the load side of the unit. It may be necessary to use a load bank to test the unit without a motor. Note that line voltage will appear across the output terminals if there is no motor or load connected to the unit. In areas where lightning is a significant problem, station-type air gap lightning arrestors should be considered and utilized on the input power source.

Note: Some units may have the overload on the load side of the starter.

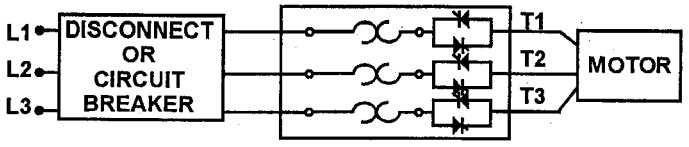


Figure 4.1 – Power Connections

4.1.1 – Grounding

Connect the ground cable to the ground terminal as labeled on the unit. Refer to the National Electrical Code for the proper ground wire sizing and be sure that the ground connector is connected to earth ground.

4.2 – Control connections

4.2.1 – Control power connections

Separate 120VAC supply is required (240VAC on 380V and 415V models). The control voltage should be connected to pins 1 and 6 of TB1. This control voltage must be customer supplied unless an optional control power transformer has been supplied with the unit. On units below 75 HP, the TB1 terminal block is located on the main control board.

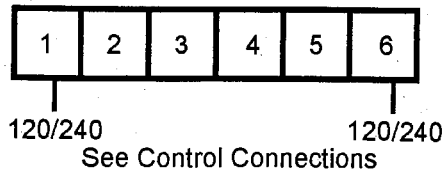


Figure 4.2

4.2.2 – Two-wire connection

An alternate connection for unattended operation replaces start/stop buttons by connecting a maintained contact closure between pins 3 and 5 on TB1 (see Figure 4.3). When the maintained contact is used for start/stop it is necessary to set the overload relay to the manual reset position. This will prevent a restart of the motor that would occur if the thermal overload trips and then cools off (refer to Figure 4.3 for 120 VAC connections and interlocks).

Note: When two-wire connection method is used, the start circuit must be interlocked to prevent automatic restart when either of the two protective devices (overload or thermostat) reset. Thermostats always automatically reset on cool down.

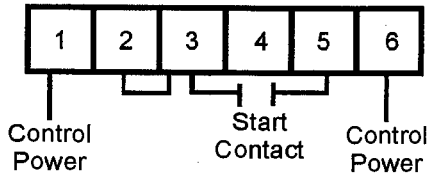


Figure 4.3 – Two-wire connection

4.2.3 – Three-wire connection

For standard 3-wire control connect 120VAC (or 240VAC for 415V and 380V units) to TB1 pins 1 and 6. Connect N.C. (normally closed) stop button between pins 3 and 4 of TB1. Connect N.O. (normally open) start button between pins 4 and 5 of terminal block TB1.
(See Figure 4.4)

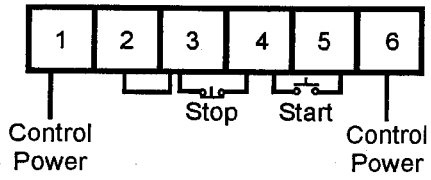


Figure 4.4 – Three-wire connection

4.2.4 Resetting faults

To reset phase loss, overcurrent, or other faults, remove control power for two seconds to clear the fault condition. Check unit to ensure that the fault has been corrected before reenergizing unit. An external reset can be accomplished by sending a closed signal to terminals 1 and 2 on TB5.

4.2.5 – Relay contacts

All the relay contacts are FORM C common, normal open, normal closed. ABB recommends fusing all contacts with external fuses. TB2 is the terminal block for all external contacts. Refer to Figure 4.5. Each contact is explained in the following sections.

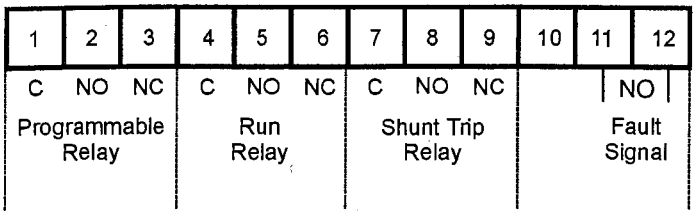
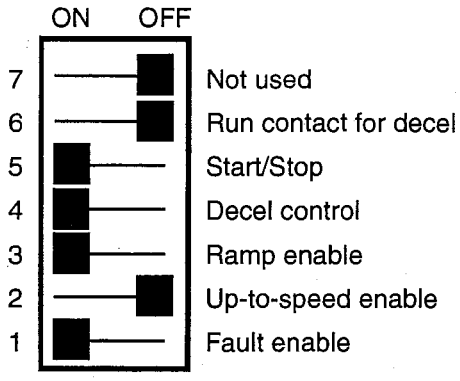


Figure 4.5 – TB4



4.2.6 – Run contacts

Auxiliary N.O. and N.C. FORM C contacts are available on TB2. These contacts are rated 5 amps, 240 VAC maximum (1200 VA maximum) for external use. Auxiliary contacts on the control board energize (change state) when the start command is given and de-energize (change back) when stop or fault condition occurs. In decel mode, the run contact can be modified to drop out at the stop command or can stay latched until the end of the decel command. Dip switch 5 is on and dip switch 6 is off for normal start/stop mode. To keep the run contact latched until the end of decel, turn dip switch 6 on and dip switch 5 off.

4.2.7 – Programmable relay

The SSA also includes a programmable relay on TB4. The relay is rated for 240 VAC, 5A, 1200VA. The relay responds to either a fault condition or an up-to-speed condition. For the relay to act as a fault relay, turn dip switch 1 on and dip switch 2 off (Factory Setting). For an up-to-speed contact turn dip switch 1 off and dip switch 2 on. In the up-to-speed mode, the programmable relay can be used to control a bypass contactor

4.2.8 – Emergency shunt trip relay

The shunt trip relay at TB4 on the main circuit board will also activate when a shunt trip signal is received. This relay is rated for 240VAC, 5 Amps, 1200VA. This relay can be used in your external shunt trip circuit. Check inrush rating on shunt trip breaker. This relay is not programmable. This relay only operates if current is flowing in an off condition.

4.2.9 – Fault signal (solid state)

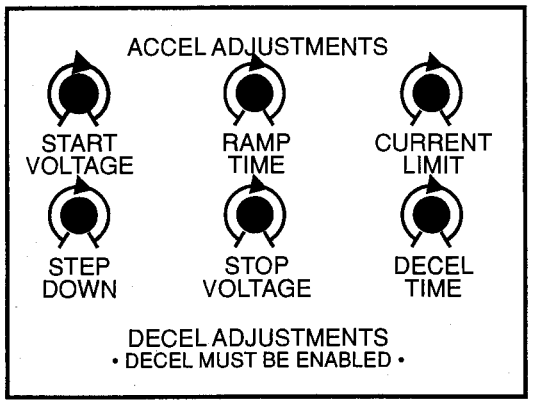
Optical AC switch triac driver that is used for fault indication. This signal energizes with the fault LED, 50 mA maximum output.

5.1 – Introduction

It is best to operate the motor at its full load starting condition to achieve the proper time, torque and ramp settings. Note that the potentiometers have a turning range of 3/4 revolution. Forcing the potentiometer beyond this range will damage the unit. Initial settings are set to accommodate most motor conditions. **TRY INITIAL SETTINGS FIRST.**

5.1.1 – Initial settings (factory set)

Starting Voltage = 60% of line voltage
Ramp Time = 10 seconds
Current Limit = 350% of unit full load amps



5.2 – Acceleration adjustments

The unit is set at the factory with typical starting characteristics that perform well in most applications. When the system is ready to start, try the initial unit settings. If the motor does not come up to speed, increase the current limit setting. If the motor does not start to turn as soon as desired, raise the starting torque adjustment. The unit has three accel adjustments. Adjustment description and procedures are described as follows:

5.2.1 – Starting voltage adjustment/rotation check

Turn dip switch 3 to the OFF position, disabling the ramp function, to allow starting voltage adjustment. Starting voltage adjustment changes the initial starting voltage level to the motor. This voltage level is adjustable from 0 to 100% of line voltage. Start voltage is increased by rotating the start voltage potentiometer clockwise.

5.2.2 – Ramp time adjustment

Ramp time adjustment changes the amount of time it takes to reach the current limit point or full voltage if the current limit point was not reached. Acceleration time (ramp) can be increased by rotating the ramp potentiometer in a clockwise direction. The ramp time adjustment is made after the starting torque has been set. Set the ramp time potentiometer by slowly rotating it until the desired ramp time is reached. The unit should be stopped and restarted to see if the desired acceleration time has been achieved.

Note: Refer to your motor manual for the maximum number of starts allowed by the manufacturer and do not exceed the recommended number.

5.2.3 – Current limit adjustment

Current limit adjustment is factory set for 350% of the unit's rating. The range of adjustment is 200% to 500%. The main function of current limit is to cap the peak current. It may also be used to extend the ramping time if desired. The interaction between the voltage ramp and the current limit will allow the soft start to ramp the motor until the maximum current is reached and the current limit will hold the current at that level. Current limit must be set high enough to allow the motor to reach full speed. The factory setting of 350% is a good starting point. Caution should be taken not to set the current limit too low on variable starting loads as this will cause the motor to stall and eventually cause the system overloads to trip. Note: if the motor does stall, refer to the motor manufacturer for the proper cooling time.

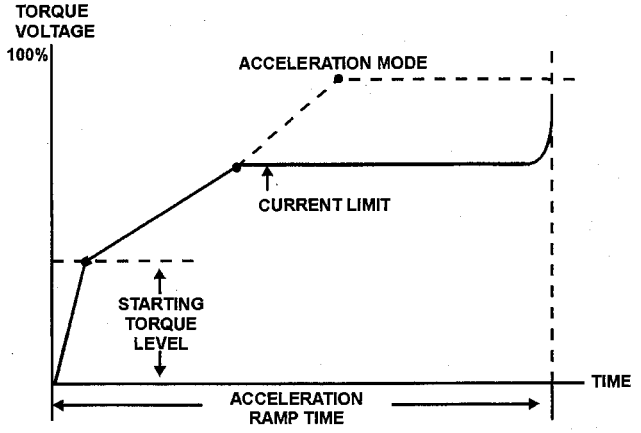


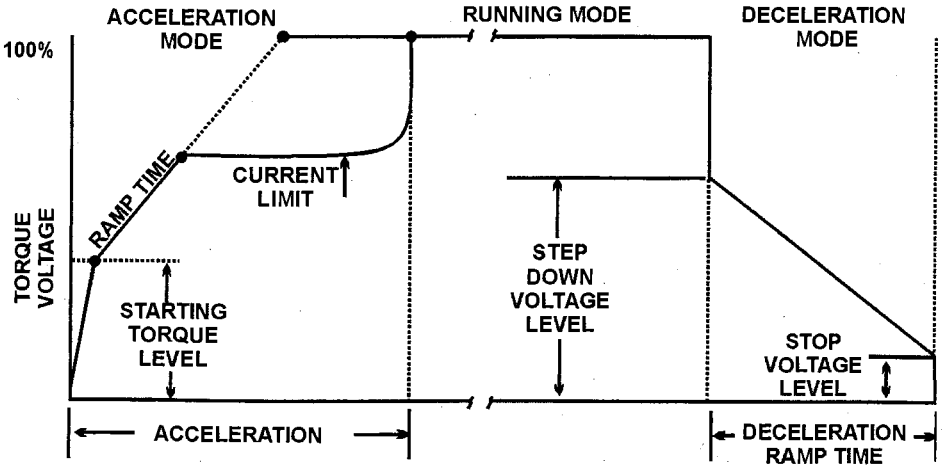
Figure 5.2 – Ramp characteristics

5.3 – Deceleration adjustments

The soft starter is shipped from the factory with the decel feature disabled. Turn off dip switch 4 to enable decel control feature. (See page 6 for dip switch drawing.)

5.3.1 – Deceleration control (pumping application)

Decel extends the stopping time on loads that stop too quickly [illegible] will provide smooth deceleration until the load stops. Three adjustments optimize the deceleration curve to meet the most demanding requirements.



- The step down voltage adjustment eliminates the dead band in the deceleration mode that is experienced while the voltage drops to a level where the motor deceleration is responsive to decreased voltage. This feature allows for an instantaneous drop in voltage when deceleration is initiated.
- The stop voltage level set point is where the deceleration voltage drops to zero.
- The deceleration ramp time is adjustable from 0 to 30 seconds and adjusts the time it takes to reach the stop voltage level set point.

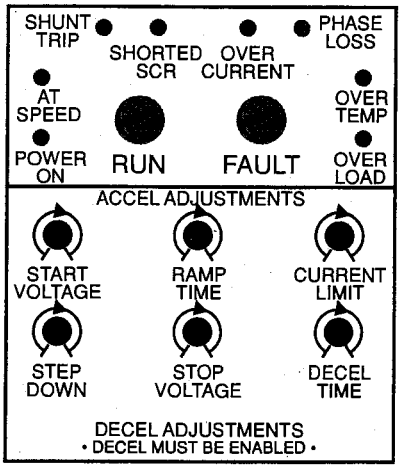
5.3.2 – Adjustments

1. Verify that the soft start adjustments are made as recommended in Section 5.2.

2. Verify that the deceleration board settings are set as listed below. **Try factory settings before adjusting.**

- Step down — 70% voltage
- Stop voltage — 20% voltage
- Decel time — 10 seconds

3. Apply power and adjust the soft start before modifying the deceleration adjustments. Both acceleration and deceleration adjustments should be made under normal load conditions.



Softstarter operator panel

6.1 – Start-up check list

- Supply voltage matches the rated supply voltage of the unit.
- Horsepower and current ratings of the motor and unit match or the unit has a higher rating.
- Initial ramp time and torque adjustments have been checked.
- Power lines are attached to the unit input terminals marked L1, L2 and L3.
- Motor leads are connected to the unit load terminals marked T1, T2, and T3.
- Appropriate control power is applied and/or control connections have been made.
- The motor area and equipment are clear of people and parts before start-up.
- The thermal overload is set to motor rating.

6.2 – Sequence of operation

First, check all power connections on the unit with all power removed; second, apply control power and check that the "Power On" LED comes on. Apply three phase power to the unit. The motor should run only when the start command is applied.

Apply start command. The "Run" LED should light up and the motor should begin to accelerate. When the motor reaches full speed, the "At Speed" LED comes on. If the motor decelerates or stops during the acceleration period, hit the stop button immediately and open the disconnect line.

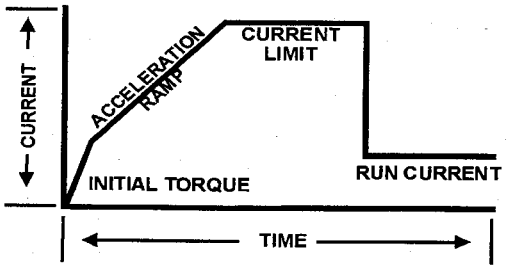
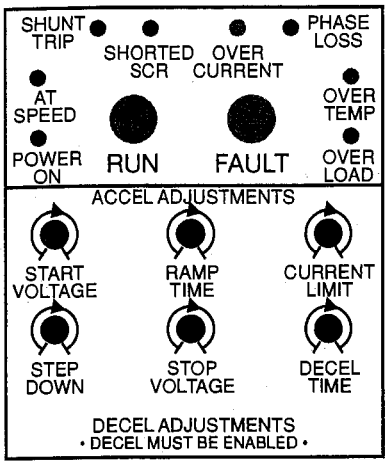


Figure 6.1 – Sequence of Operation

6

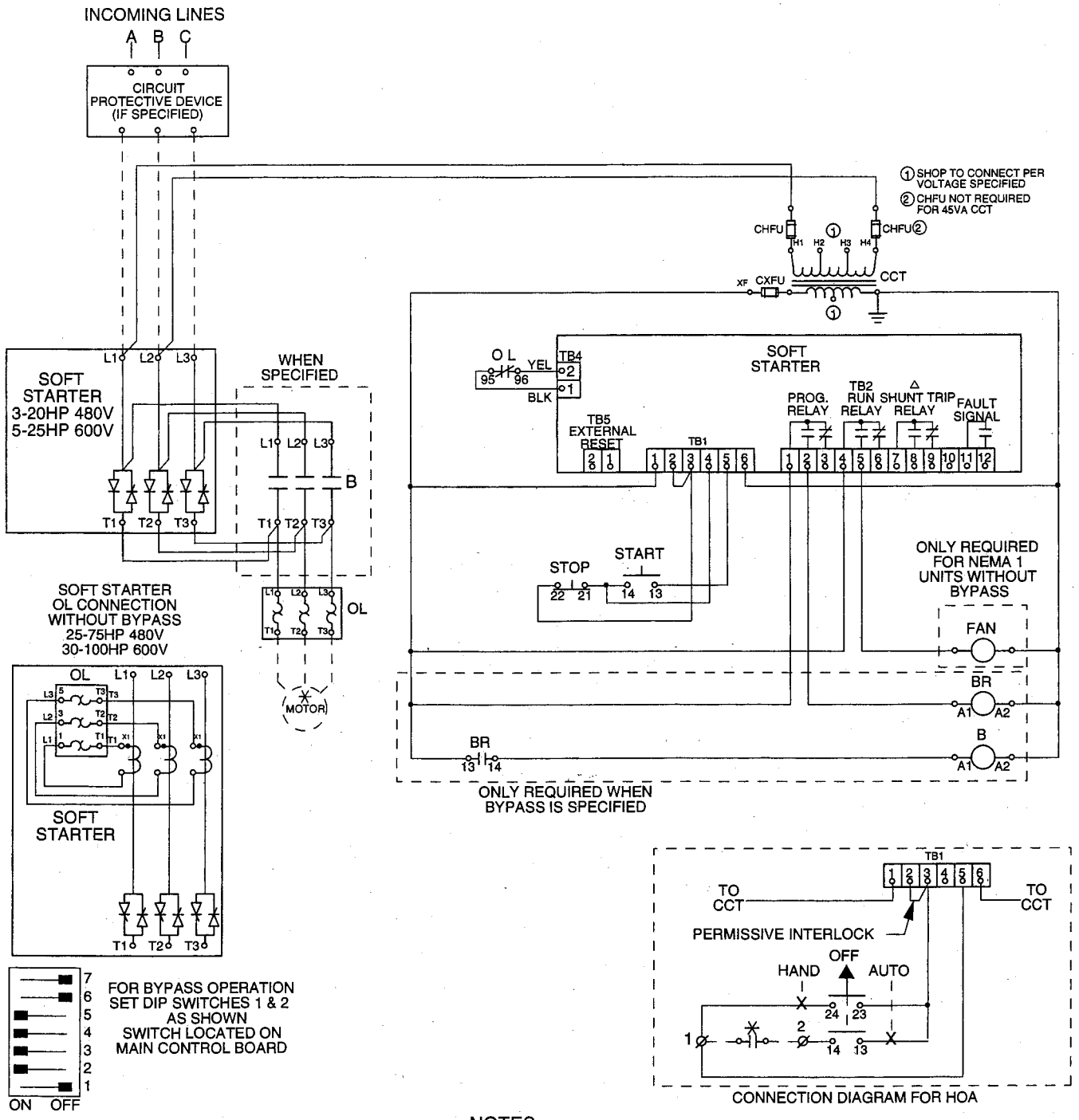
7.1 – LED functions

The unit has 10 LEDs on the status display.



LED		STATUS
Green	Power On	Indicates control power is present
	Run	Indicates the unit is accelerating after acknowledging the start command.
	At Speed	Indicates the unit is running.
Yellow	Over Temperature	This LED indicates the motor starter has tripped due to over temperature.
	Overload	Indicates the starter's motor overload has tripped. The overload must be reset before the fault can be cleared.
	Phase Loss	This LED indicates that one of the incoming phases were lost while the motor was running.
	Shorted SCR	Indicates a shorted SCR was detected in the unit. Refer to 8.2 for checking SCRs. This fault will prevent a start command.
Red	Fault	This is a general indication of a fault occurring in the system. This LED illuminates when another yellow LED comes on to indicate the type of fault.
	Overcurrent	Indicates the unit experienced approximately ten times the FLA (Full Load Amps) and has shut down from a load failure of some type such as a phase to ground failure or a phase to phase short. The overcurrent trip is fixed at 10 times full load motor current and is not adjustable. Check for load faults before a restart. Verify SCRs are not damaged from the fault before restart.
	Shunt Trip	Indicates the starter has two or more power poles shorted and is passing current to the motor while in the off mode. For positive motor protection the "Shunt Trip" relay on the main circuit board must be interlocked with a shunt trip breaker or contactor in front of the unit. Do not re-power the unit without repairing the power poles.

7.2 – Wiring diagram — 25 to 75HP @480V



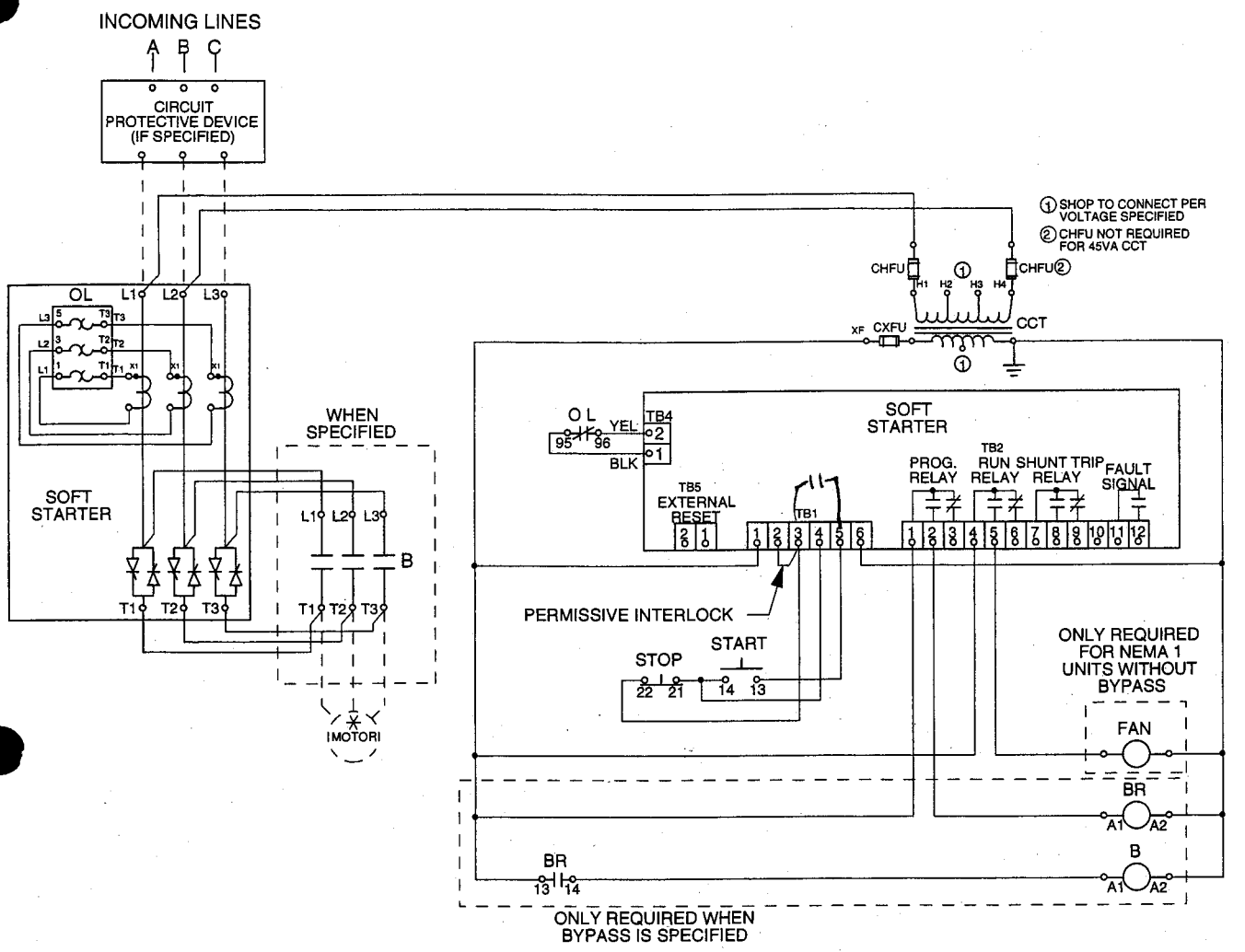
△ SHUNT TRIP RELAY PROVIDED ONLY FOR 25-75HP 480V & 30-100HP 600V SOFT STARTERS.

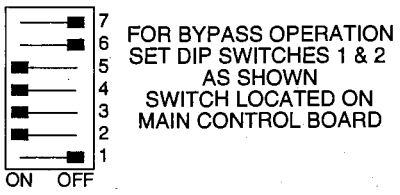
LEGEND	
CCT	CONTROL CIRCUIT TRANSFORMER
CHFU	CCT PRIMARY FUSE
CXFU	CCT SECONDARY FUSE
B	BYPASS CONTACTOR
BR	BYPASS CONTROL RELAY, (31)
OL	OVERLOAD RELAY
°13	CONN POINT ON DEVICE WITH NUMBER
⚹	REMOTE DEVICE
⌀	CONN POINT AT TERMINAL BLOCK

NOTES

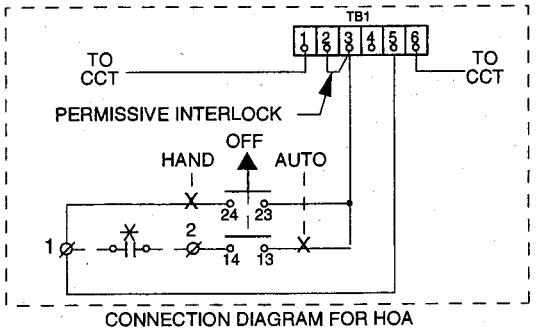
1. ALL CONTROL WIRING TO BE 18GA. COLOR OF CONTROL WIRE SHALL BE PER VOLTAGE OF CONTACTOR COILS:
   RED - ALL AC VOLTAGES
   WHITE MAY BE USED ON THE GROUNDED SIDE OF THE AC CIRCUIT IF SPECIFIED.
   BLUE - ALL DC VOLTAGES
2. ALL DEVICES ARE SHOWN DE-ENERGIZED.
3. DO NOT USE SELECTOR SWITCHES WITH AUTO-RESET OVERLOAD RELAYS

7.3 – Wiring diagram — 100HP and larger @480V





FOR BYPASS OPERATION SET DIP SWITCHES 1 & 2 AS SHOWN SWITCH LOCATED ON MAIN CONTROL BOARD



CONNECTION DIAGRAM FOR HOA

LEGEND	
CCT	CONTROL CIRCUIT TRANSFORMER
CHFU	CCT PRIMARY FUSE
CXFU	CCT SECONDARY FUSE
B	BYPASS CONTACTOR
BR	BYPASS CONTROL RELAY, (31)
OL	OVERLOAD RELAY
°13	CONN POINT ON DEVICE WITH NUMBER
✳	REMOTE DEVICE
Ø	CONN POINT AT TERMINAL BLOCK

NOTES

1. COLOR OF CONTROL WIRE SHALL BE PER VOLTAGE OF CONTACTOR COILS:
   RED - ALL AC VOLTAGES
   WHITE MAY BE USED ON THE GROUNDED SIDE OF THE AC CIRCUIT IF SPECIFIED.
   BLUE - ALL DC VOLTAGES
2. ALL DEVICES ARE SHOWN DE-ENERGIZED.
3. DO NOT USE SELECTOR SWITCHES WITH AUTO-RESET OVERLOAD RELAYS

8.1 – Failure analysis

Problem	Possible LED Display	Possible Causes	Solution
One of the main fuses blows or circuit breaker opens when the power is applied	Fault and Shunt Trip LEDs: ON	Short circuit between line inputs	Locate and remove short
		Faulty SCR(s)	Remove power and test SCR(s). Refer to section 8.2 for SCR testing procedure
One of the main fuses blows or circuit breaker opens when start command is given	Fault and Overcurrent LEDs: ON Fault and Phase Loss LEDs: ON	Short circuit or ground fault in motor or cabling	Locate and remove short or ground
		Phase loss	Repair cause of phase loss
		Branch circuit protection not correctly sized	Verify correct sizing of branch circuit protection
		Faulty SCR(s)	Remove power and test SCR(s). Refer to section 8.2 for SCR testing procedure
		Single phase incoming power	Correct problem with incoming power
		Faulty main circuit board	Remove power and replace main circuit board. Refer to section 8.4 for board replacement procedure
Motor overload trips during start	Fault and Overload LEDs: ON	Overload improperly adjusted	Adjust O.L.
		Excessive load on motor	Lighten load on motor
		Current limit set too low	Increase current limit set point
		Incorrect start adjustment	Readjust starting parameters. Refer to Chapter 5
Motor overload trips during run	Fault and Overload LEDs: ON	Excessive load on motor (measure motor current at full speed)	Lighten load on motor
		Overload improperly adjusted	Readjust overload
Thermostat trips during run	Fault and Over Temp LEDs: ON	Fan(s) not functioning	If fans have power, remove power and replace fan(s). If fans do not have power, find cause of loss of power and repair
		Heatsink coated with dirt	Remove power and clean heatsink with high pressure air (80-100 PSI max clean and dry air)
		Over-current on unit	Verify that running current does not exceed unit rating.
		Environment temperature over 120F (ambient temperature for panel version) or over 104F (ambient temperature for enclosed version)	Place unit in environment temperature less than 120F for panel version or less than 104F for enclosed version

8.1 – Failure analysis

Problem	Possible LED Displays	Possible Reasons	Solution
Motor will not start	All LEDs: OFF Power On LED: OFF Start LED: OFF Fault and Phase Loss LEDs: ON Fault and Shorted SCR LEDs: ON	No control voltage applied to logic board	Apply control voltage to TB1 pins 1 and 6 on control board
		Control power transformer failure or CPT fuse failure	Remove power and replace control power transformer or CPT fuse
		Start circuit wired incorrectly	Remove power and correct start circuit wiring
		No start command	Apply start command
		No 3 phase line voltage	Apply 3 phase line voltage to unit
		Failure of main circuit board	Replace main circuit board
		Faulty control logic	Remove power and repair control logic
		Faulty control logic	Check logic board for faults and replace blown fuses
		Shorted SCR in starter	Refer to section 8.2 for SCR testing procedure and replace faulty (shorted) SCR(s)
Motor vibrates/Motor growls	Fault and Phase Loss LEDs: ON	Faulty motor	Check motor and motor connections
		Faulty SCR(s)	Remove power, perform SCR device checks
		Faulty gate/cathode on SCR(s)	Refer to section 8.2 for SCR testing procedure and replace faulty (shorted) SCR(s)
		Faulty main circuit board	Replace main circuit board
Extremely unbalanced motor currents during start or run mode	Fault and Phase Loss LEDs: ON	Faulty motor/wiring	Troubleshoot and repair
		Faulty wiring	Troubleshoot and repair/replace wiring
		Faulty main circuit board	Replace main circuit board
Motor stopped during run	Fault and Overcurrent LEDs: ON	Warning: This is a serious fault condition. Ensure that the fault condition is cleared on the load before attempting to restart the motor.	
		Load shorted/grounded/faulted	Remove power and repair
		Faulty main circuit board	Replace main circuit board
Control circuit fuses blow after control power is applied	All LEDs: OFF	Short in control circuit	Remove power, locate and remove short
		Wrong control voltage	Apply correct voltage to logic board

8

8.2 – SCR testing procedure

Remove line power and control power from the unit and lock out. Disconnect any two motor load leads and any two line leads. Disconnect SCR connections to main circuit board J1, J2 and J3. Note the type of color coding of the wires connected to J1, J2 and J3. ABB uses two possible configurations. Both configurations have 4 wires going to each plug. The first configuration consists of 4 wires color coded black, yellow, grey and white. The second configuration consists of 4 wires color coded red, white, red, white.

The testing procedure for SCRs is comprised of two separate tests. The first one tests the anode to cathode integrity of the SCR by performing the following ohm checks:

+ LEAD	- LEAD	GOOD	CONSULT FACTORY
L1 LUG	T1 LUG	Greater than 10K ohm	Less than 10K ohm
L2 LUG	T2 LUG	Greater than 10K ohm	Less than 10K ohm
L3 LUG	T3 LUG	Greater than 10K ohm	Less than 10K ohm

The second tests the gate to cathode integrity of the SCR. Place the leads of an ohm meter into the receptacle that was unplugged from the main circuit board. Ohm the pair of wires on one end of the plug. Then ohm the pair of wires on the other end of the plug. The chart below indicates good versus bad readings.

For wire that is color coded black, yellow, grey and white:			
+ LEAD	**- LEAD**	**GOOD**	**BAD**
BLACK	YELLOW	Between 5 and 90 ohms	Less than 5 or greater 90 ohms
GREY	WHITE	Between 5 and 90 ohms	Less than 5 or greater than 90 ohms
For wire that is color coded red, white, red and white:			
+ LEAD	**- LEAD**	**GOOD**	**BAD**
RED	WHITE	Between 5 and 90 ohms	Less than 5 or greater than 90 ohms
RED	WHITE	Between 5 and 90 ohms	Less than 5 or greater than 90 ohms

Note: If any of the above readings are out of specifications, replace the faulty SCR.

8.3 – Replacing SCR devices

Two types of SCRs are used in ABB SSA Series depending on the horsepower/amperage rating of the unit. Isolated SCRs are used in smaller units and "hockey puck" type SCRs are used in larger units.

8.3.1 – Changing an isolated SCR

- Remove both line and control power from unit, tag and lock out.

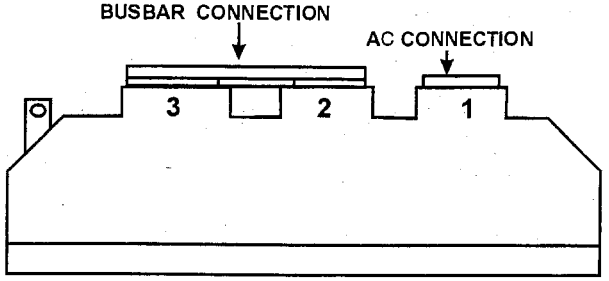
WARNING: Failure to remove both line and control power before starting this procedure may cause personal injury or death.

- Label location of wires connected to the SCR.
- Remove mounting screws, lugs and associated wiring from the existing SCR.
- Make sure the surface to which the power module mounts is clean and free from dirt, nicks and scratches.
- Apply thermal grease uniformly along the grooved area. Spread the grease thinly (3 mil thick) to completely cover the base of the power module and minimize air pockets. Grease must be free of contamination.
- Replace the screws and tighten down firmly. The following chart shows recommended torque values for various SCRs.

VOLTAGE	HP	MOUNTING SCREW	BUSBAR AND POWER LUG
208 VAC	1 – 10	44 lbs/in	26 lbs/in
208 VAC	15 – 20		44 lbs/in
240 VAC	1 – 15		26 lbs/in
240 VAC	20 – 25		44 lbs/in
380 VAC	1 – 25		26 lbs/in
380 VAC	30 – 40		44 lbs/in
415 VAC	1 – 25		26 lbs/in
415 VAC	30 – 40		44 lbs/in
480 VAC	1 – 30		26 lbs/in
480 VAC	40 – 50		44 lbs/in
575 VAC	1 – 40		26 lbs/in
575 VAC	50 – 75		44 lbs/in

- Reconnect all busbars, lugs, and wires. Check to make sure gate and cathode are wired correctly. Use the following chart to verify wiring of J1, J2, and J3:
- After verifying that all wiring is correctly connected test the SCR.

Main Circuit Board Pin#	DESTINATION
Pin 1	Load Gate
Pin 2	Load Cathode (Output Load Lug)
Pin 5	Line Gate
Pin 6	Line Cathode (Input Line Lug)



Isolated SCR Configuration

8.3.2 – Changing a hockey puck type SCR

- Remove both line and control power from unit, tag and lock out.

WARNING: Failure to remove both line and control power before starting this procedure may cause personal injury or death.

- ABB uses two types of clamps with gauges for reading the amount of force on the device. The first type of force gauge uses a spin washer. When the proper force is applied, the washer will be free to spin. The second type of gauge uses a step indicator on the end of the lever. Before proceeding, note the type of clamp used and, if the clamp has a step indicator, document the position of the indicator before removing the clamp to facilitate proper mounting of the new SCR device.
- Label location of wires connected to the SCR.
- Remove any lugs, snubbers, printed circuit boards (refer to section 8.4) and associated wiring that may get in the way of reaching the faulty SCR. Document the location and wiring of all parts before removing them to facilitate the re-installation of the devices later.
- Document the position of the indicator on the SCR clamp. Then remove the top clamp holding the SCR stack together. Remove the top heatsink. Use extreme caution when handling the heat sink so it does not become dented or damaged.
- Remove the faulty SCR device, noting the direction in which the SCR is oriented. The new SCR puck **must be** inserted in the same direction.
- Make sure the SCR mounting surface, tools, and hands are clean and free from dirt, nicks, and scratches. Do not sand or scrape SCR mounting surface. If necessary, super fine Scotch Brite pads can be used to clean the heatsink before installing the new SCR.
- Apply a thin (3 mil thick) layer of thermal grease uniformly along both sides of the SCR. Spread the grease to cover the entire surface of both sides of the SCR in a manner that minimizes air pockets. The grease must be free of contamination.
- Locate the centering pin in the bottom and top of the heatsink and center it in the SCR hole (making sure that the SCR is pointed in the same direction as the SCR that was removed in step 6). Locate the centering pin in the top heatsink and center it in the SCR hole. **Caution: If center pin is not placed correctly it will damage the SCR and the heat sink.** Hand tighten the clamps evenly so that the same number of threads appear at both ends of the U-clamp. Tighten the clamp 1/4 turn at a time alternating sides of the U-clamp until the correct force is reached. Check the gauge or spin washer every time the clamp nuts are tightened 1/4 turn to ensure that the SCR is not over torqued. The gauge reading should be similar to the initial reading taken in step 2. If the clamp uses the spin washer gauge, verify that the washer spins freely after clamping. Once proper force is reached make sure that the SCR pucks are securely held between the heatsinks and aligned evenly.
- Replace any lugs, MOVs, snubbers, power straps, printed circuit boards and associated wiring that was removed in step 4. Use the following chart to verify wiring of J5, J6 and J7:
- After verifying that all wiring is correctly connected, test the SCR and then test the unit.

Main Circuit Board Pin#	DESTINATION
Pin 1	Load Gate
Pin 2	Load Cathode (Output Load Lug)
Pin 5	Line Gate
Pin 6	Line Cathode (Input Line Lug)

8.4 – Replacing printed circuit boards.

The printed circuit boards are not intended to be field repaired. If the board is faulty, the entire board should be replaced using the following procedure:

- Remove three phase power and control power from the unit and lock out.
- Remove plugs and tag plugs with connector numbers.
- Remove control wires from terminals and tag wires with terminal numbers.
- Note the settings of all potentiometers and dip switches
- Remove mounting screws.
- Remove old printed circuit board.
- Mount new printed circuit board.
- Install mounting screws.
- Set the potentiometers and dip switches on the new board to the same positions as on the old board (if applicable).
- Install control wires from terminals and tag wires with terminal numbers.
- Install plugs.
- Apply power to the unit and test.

8

803/327-5005

MIGHTY MODULE

133 ohms - 85°C - Ebara

INSTRUCTIONS FOR
MM1410-1414 RTD INPUT
LATCHING SINGLE ALARM TRIPS

FUNCTION

The MM1410-1414 modules are RTD input limit alarms that provide a DPDT relay closure when the input signal exceeds a preset level. The unit can be supplied to alarm on increasing or decreasing signals.

Once the alarm limit has been reached the relay latches and power must be momentarily interrupted to the module to reset the relay. (The input must also be below the alarm level).

DESCRIPTION

The limit alarm modules monitor an input and trip a latching relay when the input exceeds the preset value.

Normal operation has the relay energized and it de-energizes for an alarm condition. This provides an alarm condition for loss of power to the alarm. A two-color LED indicates alarm status, green for normal, and red for alarm.

MODEL NUMBERS

Five styles of setpoint controls are available for the alarms. These are listed below by model number:

MM1410 RTD Input Single Alarm (25 Turn Screwdriver Adjust)
MM1411 RTD Input Single Alarm (Dial-Single Turn)
MM1412 RTD Input Single Alarm (Remote Pot Setpoint)
MM1413 RTD Input Single Alarm (0 to 1V DC Programmed)
MM1414 RTD Input Single Alarm (Dial-Ten Turn Precision)

PIN 1,3 AC
PIN 9,11 RTD

OPTIONS

The following options are available for the alarms.

H/L H = High Alarm. Alarm occurs on an increasing signal.
L = Low Alarm. Alarm occurs on a decreasing signal.
Specify H or L. (H supplied if not specified)

R Reverse sense. Normal condition for the relay is energized. It de-energizes for an alarm condition. Option R reverses this logic.

100 OHMS = 0
119 = 50°C
138 = 100°C
138.5 ohms

WILKERSON INSTRUMENT CO., INC.
2915 PARKWAY ST
LAKELAND, FL 33811 ● USA
800-234-1343
TEL: 941-647-2000 FAX: 941-644-5318

Ronnie

38.5 = 100 .385
x.85

	2000 ohm 0.2mA
Deadband	Latching. Interrupt power to reset
Setpoint	0 to 100% of span
Response Time	100 msec
Temperature Stability	±0.04% of span per deg C
Common Mode Rejection	120db, DC to 60Hz
Temperature, Operating	0 deg C to 60 deg C
	32 deg F to 140 deg F
Relay	DPDT, 5A contacts
Power	115V ±10%, 50 or 60Hz
	230V, 50 or 60Hz available
	12V and 24V DC available
Option V	open collector NPN transistor
	sinks 100mA from 30V max external supply
	Internal 16V unregulated supply, 50mA max provided
Option T	0 to 1V, 2mA max

MOUNTING

MM1410, MM1411 and MM1414 are designed to plug into a standard 11-pin relay socket. MM1412 and MM1413, and all modules with T option, require a 20-pin socket. Part number MP011 is an 11-pin socket suitable for mounting on a flat surface or in a piece of PVC track. Part number MP020 is a 20-pin socket suitable for mounting on a flat surface.

WARRANTY

For any warranty repair or return, please contact the factory at 1-800-234-1343.

MINCO RESISTANCE/TEMPERATURE TABLE

PE Platinum: 100 Ω at 0°C 0.00385 Ω/Ω/°C

DEG. C P.2

T (°C)	R (Ω)	T (°C)	R (Ω)	T (°C)	R (Ω)	T (°C)	R (Ω)
0.0	100.000	50.0	119.397	100.0	138.506	150.0	157.325
1.0	100.391	51.0	119.782	101.0	138.885	151.0	157.699
2.0	100.781	52.0	120.167	102.0	139.264	152.0	158.072
3.0	101.172	53.0	120.552	103.0	139.643	153.0	158.445
4.0	101.562	54.0	120.936	104.0	140.022	154.0	158.818
5.0	101.953	55.0	121.321	105.0	140.400	155.0	159.191
6.0	102.343	56.0	121.705	106.0	140.779	156.0	159.564
7.0	102.733	57.0	122.090	107.0	141.158	157.0	159.937
8.0	103.123	58.0	122.474	108.0	141.536	158.0	160.309
9.0	103.513	59.0	122.858	109.0	141.914	159.0	160.682
10.0	103.903	60.0	123.242	110.0	142.293	160.0	161.054
11.0	104.292	61.0	123.626	111.0	142.671	161.0	161.427
12.0	104.682	62.0	124.009	112.0	143.049	162.0	161.799
13.0	105.071	63.0	124.393	113.0	143.426	163.0	162.171
14.0	105.460	64.0	124.777	114.0	143.804	164.0	162.543
15.0	105.849	65.0	125.160	115.0	144.182	165.0	162.915
16.0	106.238	66.0	125.543	116.0	144.559	166.0	163.286
17.0	106.627	67.0	125.926	117.0	144.937	167.0	163.658
18.0	107.016	68.0	126.309	118.0	145.314	168.0	164.030
19.0	107.405	69.0	126.692	119.0	145.691	169.0	164.401
20.0	107.793	70.0	127.075	120.0	146.068	170.0	164.772
21.0	108.182	71.0	127.458	121.0	146.445	171.0	165.143
22.0	108.570	72.0	127.840	122.0	146.822	172.0	165.514
23.0	108.959	73.0	128.223	123.0	147.198	173.0	165.885
24.0	109.347	74.0	128.605	124.0	147.575	174.0	166.256
25.0	109.735	75.0	128.987	125.0	147.951	175.0	166.627
26.0	110.123	76.0	129.370	126.0	148.328	176.0	166.997
27.0	110.510	77.0	129.752	127.0	148.704	177.0	167.368
28.0	110.898	78.0	130.133	128.0	149.080	178.0	167.738
29.0	111.286	79.0	130.515	129.0	149.456	179.0	168.108
30.0	111.673	80.0	130.897	130.0	149.832	180.0	168.478
31.0	112.060	81.0	131.278	131.0	150.208	181.0	168.848
32.0	112.447	82.0	131.660	132.0	150.583	182.0	169.218
33.0	112.835	83.0	132.041	133.0	150.959	183.0	169.588
34.0	113.221	84.0	132.422	134.0	151.334	184.0	169.958
35.0	113.608	85.0	132.803	135.0	151.710	185.0	170.327
36.0	113.995	86.0	133.184	136.0	152.085	186.0	170.696
37.0	114.382	87.0	133.565	137.0	152.460	187.0	171.066
38.0	114.768	88.0	133.946	138.0	152.835	188.0	171.435
39.0	115.155	89.0	134.326	139.0	153.210	189.0	171.804
40.0	115.541	90.0	134.707	140.0	153.584	190.0	172.173
41.0	115.927	91.0	135.087	141.0	153.959	191.0	172.542
42.0	116.313	92.0	135.468	142.0	154.333	192.0	172.910
43.0	116.699	93.0	135.848	143.0	154.708	193.0	173.279
44.0	117.085	94.0	136.228	144.0	155.082	194.0	173.648
45.0	117.470	95.0	136.608	145.0	155.456	195.0	174.016
46.0	117.856	96.0	136.987	146.0	155.830	196.0	174.384
47.0	118.241	97.0	137.367	147.0	156.204	197.0	174.752
48.0	118.627	98.0	137.747	148.0	156.578	198.0	175.120
49.0	119.012	99.0	138.126	149.0	156.952	199.0	175.488

WILKERSON INSTRUMENT CO., INC.

2915 Parkway St.
Lakeland, FL 33811-1391
Internet: http://www.wici.com

TEL: 863-647-2000

FAX MESSAGE

FROM

☐ JOE WILKERSON - President
FAX: 863-644-2028
Email: joewilk@wici.com

☐ RICK HUFFMAN - VP / Gen. Manager
FAX: 863-644-2028
Email: rhuffman@wici.com

☐ ENGINEERING DEPT.
FAX: 863-646-7558

☐ PURCHASING DEPT.
FAX: 863-646-7558

☐ ACCOUNTING DEPT.
FAX: 863-644-2028

☒ SALES DEPT.
FAX: 863-644-5318
Email: sales@wici.com

TO: Richard FAX NO. 972-620-0973

ATTENTION: _____ DATE: 12-21-00

FROM: Ronnie PAGE 1 OF 2

YOUR REF: _____ OUR REF: _____

RE: Resistance / Temp. Table

MESSAGE:

MM1400 Copy This Page and Fax to Place Order.

ORDERING INFORMATION

POWER
- ☐ 115 VAC, 50/60 Hz Power
- ☐ 230 VAC, 50/60 Hz Power
- ☐ 12 VDC, Power, Transformer Isolated
- ☐ 24 VDC, Power, Transformer Isolated

ALARMS

Specify Alarm Header Option
- ☐ 11-Pin ☐ 20-Pin

Alarm Selection - Output
- ☐ Relay
- ☐ Transistor, O.C.

Alarm Type
- ☐ High
- ☐ Low

Alarm Logic
- ☐ Normal - Energize On Alarm
- ☐ Reverse - De-Energize On Alarm

Enter Setpoint Input Level

☐ Setpoint 1

INPUT

Select Units

☐ Deg C ☐ Deg F

Enter Input

☐ Zero Scale

☐ Full Scale

Select Sensor
- ☐ 100 ohm Pt., .00385 Alpha
- ☐ 100 ohm Pt., .00392 Alpha
- ☐ 100 ohm Pt., .00375 Alpha
- ☐ 1000 ohm Pt., .00385 Alpha
- ☐ 1000 ohm Pt., .00392 Alpha
- ☐ 10 ohm Cu.
- ☐ Other - Specify in Notes

OPTIONS
- ☐ Conformal Coating

TAGS

Specify Tag Numbers

Tag number is typed on product label at no charge.

Enter Tag Number(s)

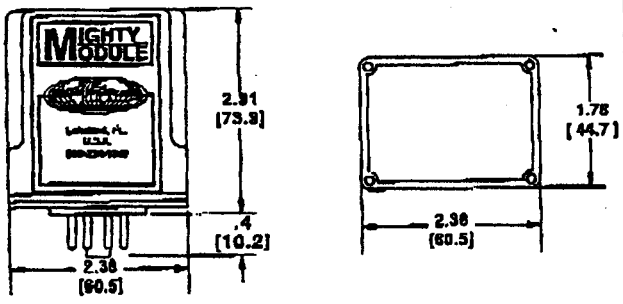
ACCESSORIES

MM1400

DR1	DIN Rail, 35mm Symmetrical, 39 inches (1 meter)	QTY ____
MP011	Plastic Socket, 11-pin or Flat Surface PVC Track	QTY ____
MP020	Plastic Socket, 20-pin or Flat Surface PVC Track	QTY ____
TRK48	PVC Snap-track, 4 ft. for MP008, MP011 & DMP8500	QTY ____
DMP011	DIN Rail Mounting Socket, 11-pin, 35mm Symmetrical Rail	QTY ____
CLP1	Holddown clip for MP008 and MP011	QTY ____
HKB-HK2D-11	Explosion-proof Housing with MP011 Installed	QTY ____

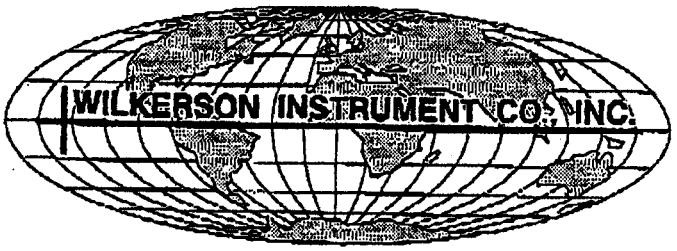
DIMENSIONS

Inches [mm]



CONNECTIONS

PIN 1	Power AC L1 or DC +
PIN 3	Power AC L2 or DC -
PIN 9, 11	RTD
PIN 13	Relay Set 1 NO
PIN 14	Relay Set 1 C
PIN 15	Relay Set 1 NC
PIN 17	Relay Set 2 NO
PIN 18	Relay Set 2 C
PIN 19	Relay Set 2 NC
PIN 20	RTD Compensating Lead



2915 Parkway St.
Lakeland, FL 33811-1391
Internet: http://www.wici.com

TEL: 863-647-2000

FAX MESSAGE

FROM

☐ JOE WILKERSON - President
FAX: 863-644-2028
Email: joewilk@wici.com
☐ RICK HUFFMAN - VP / Gen. Manager
FAX: 863-644-2028
Email: rhuffman@wici.com

☐ ENGINEERING DEPT.
FAX: 863-646-7558
☐ PURCHASING DEPT.
FAX: 863-646-7558

☐ ACCOUNTING DEPT.
FAX: 863-644-2028
☒ SALES DEPT.
FAX: 863-644-5318
Email: sales@wici.com

TO: Sunbelt FAX NO. 972-620-0973

ATTENTION: Rich Kreekon DATE: 12/22/00

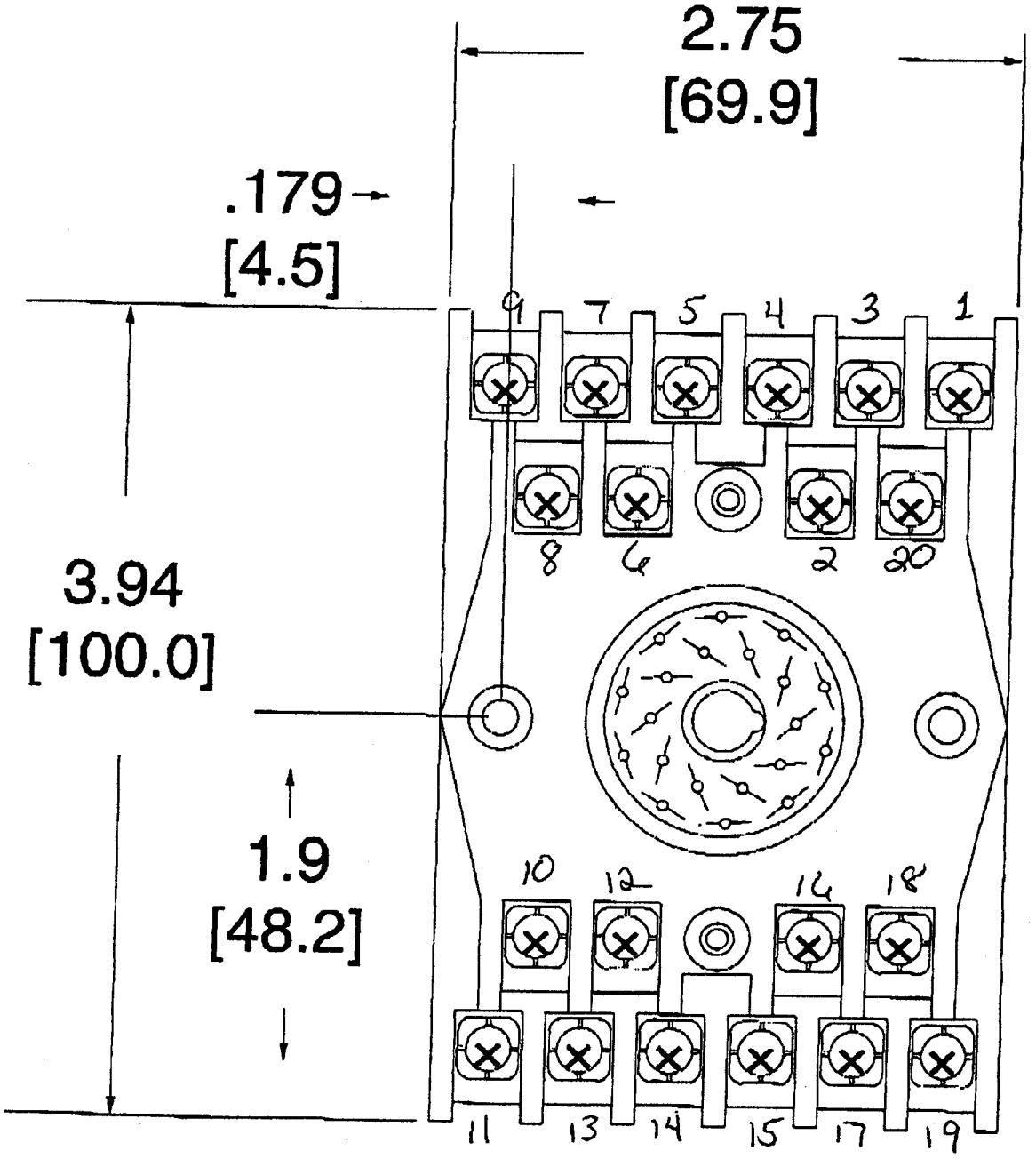
FROM: Cecil Johnson PAGE 1 OF 3

YOUR REF: _____ OUR REF: _____

RE: mm1410 Socket & Pin Out

MESSAGE:

MP020
20-PIN SOCKET



anchor scientific inc.

Box 378, Long Lake, MN 55356 / 612-473-7115

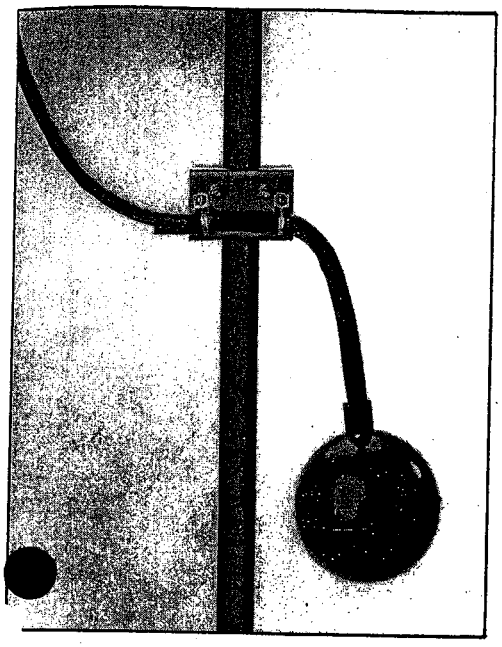
roto·float-SST

~~Type P—Pipe Mounted~~

Form 2900-C

Specification Section
16415-2.12.6

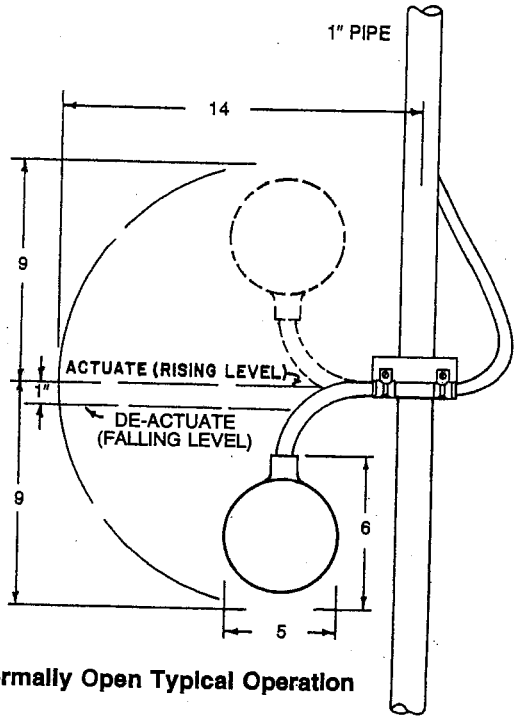
TYPE W - WIRE ROPE MOUNTED



ROTO-FLOAT SST
(Teflon® coated)

APPLICATIONS:

- Chemical Wash Tanks
- High Pressure Tanks
- Long Life Applications
- Severe Environments
- Sewage Lift Stations



Normally Open Typical Operation

GENERAL DESCRIPTION

The Roto-Float SST is a direct acting float switch. It has been designed and constructed for extemely long life in the most demanding applications. Each Roto-Float-SST contains a single pole mercury switch in a normally open or normally closed circuit configuration, which actuates or deactuates with changes in fluid level.

The mercury switch has been inserted into the #316 stainless steel, Teflon® coated housing, then encapsulated in epoxy, forming an impact and corrosion resistant unit. The cable used is a 14-3 conductor, SO type hypalon jacketed, with each conductor having 105 strands of copper for extra flexibility. Each float has a green wire as an internal ground and THIS MUST BE RUN TO A SUITABLE EXTERNAL GROUND, per N.E.C. The Roto-Float SST comes with a mounting clamp, which attaches to a 1" mounting pipe, (supplied by others). #316 stainless steel pipe stabilizing brackets for mounting the pipe are available and designated 'WSTB'.

SPECIFICATION DATA

Cable
105°C., SO type, 14-3 105 strand, hypalon jacketed. Oil and water resistant.

Float Housing
#316 stainless steel. 5" diameter, grounded. Teflon® coated.

Potting Material
Moisture resistant epoxy.

Electrical Data
Contact rating: 20A., 120 VAC
10A., 230 VAC
Specify normally open or normally closed.

ORDERING INFORMATION

Specify mounting style W, cable length (~~20, 30, and~~ 40 feet are in stock), circuit configuration, (NO for normally open, NC for normally closed). Add the suffix '-SST' to indicate stainless steel, Teflon® coated.

	List Price
~~Model P20NO-SST~~	.....
~~Model P30NO-SST~~	.....
Model W40NO-SST	.....

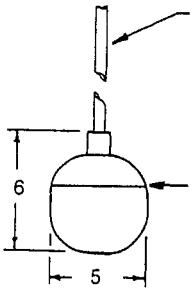
GENERAL DESCRIPTION

The Roto-Float-SST is a direct acting float switch. Each Roto-Float-SST contains a single pole mercury switch which actuates when the longitudinal axis of the float is horizontal, and deactuates when the liquid falls 1" below the actuation elevation.

The Float is a chemical resistant, Teflon® coated, 316 stainless casing, with a firmly bonded electrical cable protruding. One end of the cable is permanently connected to the glass enclosed mercury switch and the entire assembly is encapsulated to form a completely water tight and impact resistant unit.

Roto-Float-SST can be mounted on a 1" support pipe, (Type P). Advantages of the Roto-Float-SST are low cost, simplicity and reliability. Various circuit configurations, other than the ones listed below, are available.

SPECIFICATIONS:



Hypalon Type SO3 – #14 AWG 105 Strand 600 V, 105°C
Conductors 20', 30', 40' lengths standard.
Other lengths available.
Cable Diameter: .56
Temperature Limit: 90°C (water)

Teflon® coated, 316 Stainless Casing Contains Hermetically Sealed Mercury Switch.

- Electrical Rating:
  20 A @ 115 VAC
  10 A @ 230 VAC
- Mounting Arrangement
  Type P — Pipe Mounted Model

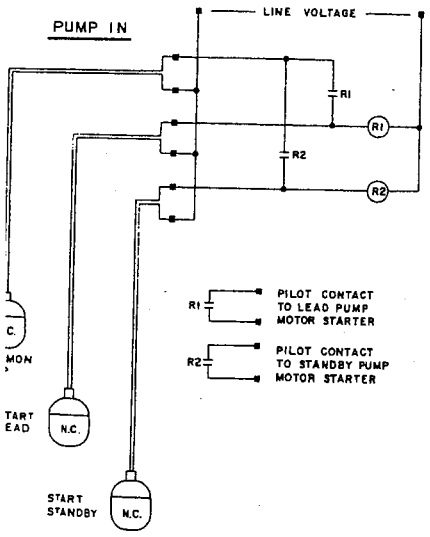
MODELS:

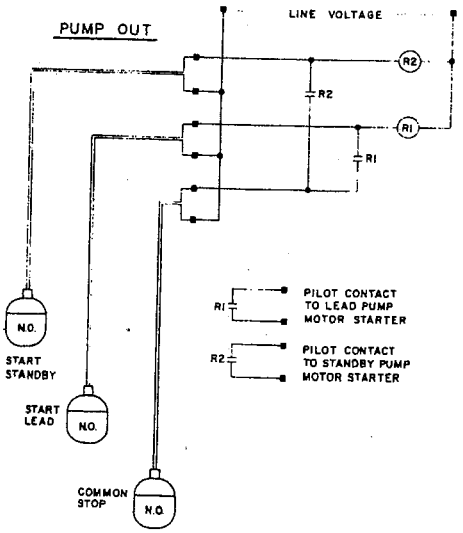
NORMALLY OPEN	20 30 40	P20NO-SST P30NO-SST P40NO-SST	5.00 6.25 7.50
NORMALLY CLOSED	20 30 40	P20NC-SST P30NC-SST P40NC-SST	5.00 6.25 7.50

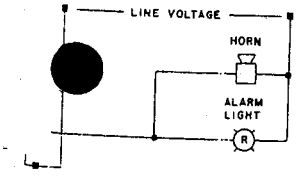
APPLICATIONS:

For use in controlling pumps or other machines and measuring alarm levels in water, sewage and many other liquids. Roto-Floats may be used for pump in or pump out control, for low level cutout, or for low and high level alarms.

TYPICAL 2 PUMP CIRCUITS

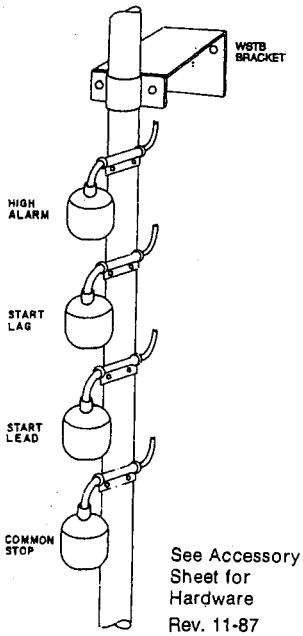






Important Note: Green wire should be properly grounded per NEC. Use in accordance with local electrical code and authority having jurisdiction. Do not use Roto-Floats in gasoline, volatiles or other combustibles. Roto-Floats are compatible with intrinsically safe relays.

TYPICAL MOUNTING TYPE P



See Accessory Sheet for Hardware

Rev. 11-87

SUBMITTAL APPROVAL

NAME

DWN BY	DATE
PD	9-9-80
CKD BY	DATE
JA	9-9-80
APPD BY	DATE
DS	9-9-80

PROJECT NAME

LETTER	REVISIONS	DATE

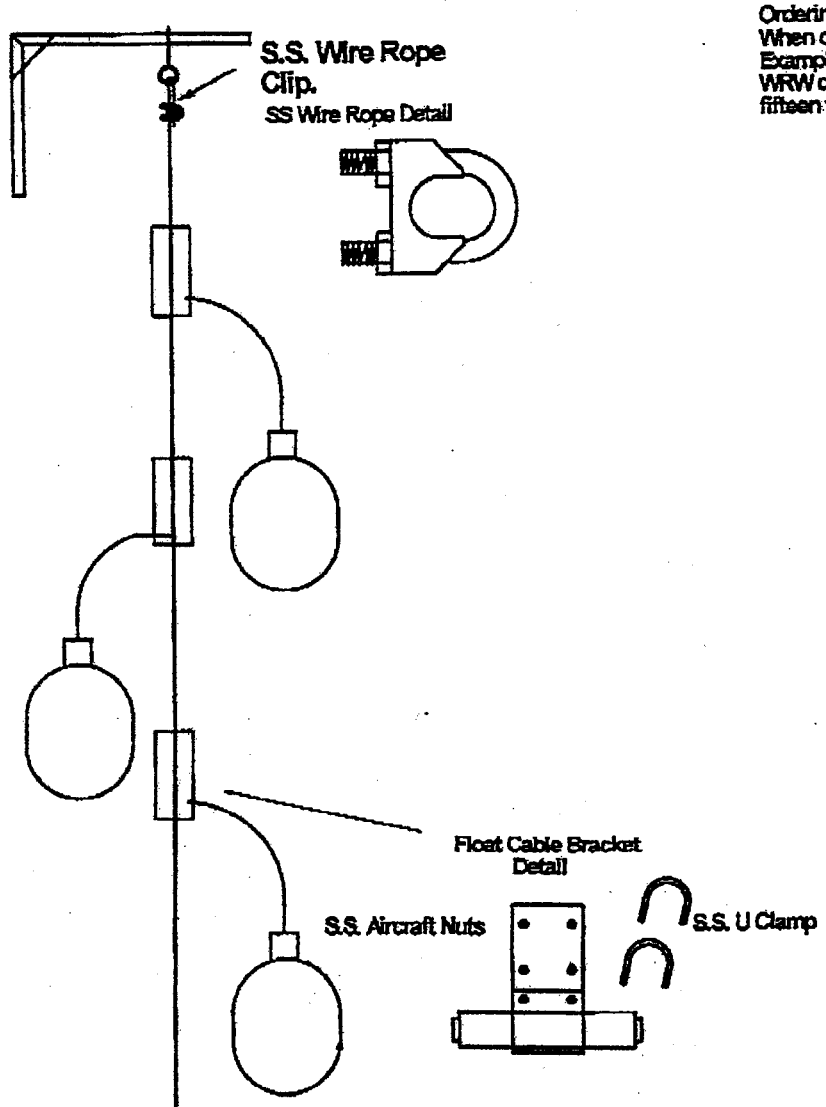
anchor scientific inc.
Industrial Park, Long Lake, Mn. 55356

ROTO-FLOAT-SST
SPECIFICATION DATA AND INSTRUCTION SHEET

HIGH ALARM

Type W

Type WRW Bracket
with S.S. Eyebolt



Ordering Information:
When ordering, specify "WRW- (length of SS wire rope)'
Example: WRW-15
WRW calls out bracket, eyebolt and anchor, 15 calls out fifteen ft of vinyl coated 316 SS wire rope.

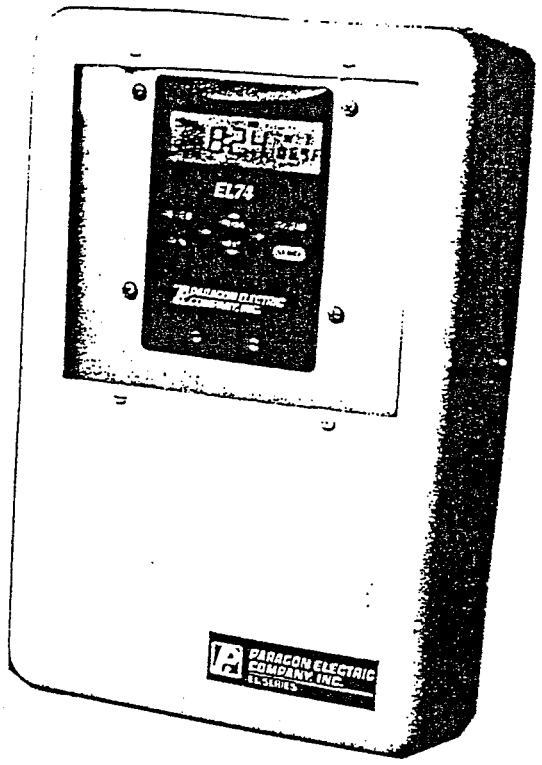
SUBMITTED _____

APPROVED _____

anchor scientific, inc.
Box 378 Fx: 612-473-6002
Long Lake, MN 55356 Ph: 612-473-7115

Drwn by: jp 1/09/97	Chkd by: JP 1/10/97	TYPICAL INSTALLATION: Type W- Roto-Float, Roto-Float SST Mini-Float, Eco-Float, Solo-Float
		Rev.
		DWG. 2975-1

EL74 Series



E145941

LR8376

SPEC DATA SHEET

Paragon EL74
Electronic Time Control

Description

The EL74 is a four channel, electronic time control that provides simple, inexpensive control of lighting, HVAC, motors, pumps, bell-ringing or any electrical load with a time-of-day schedule. The control may be utilized as a 24 hour, 7 day, full year (365 day), or SunTracker control.

The EL74 allows for the programming of 128 events. An event could be an ON, an OFF, one of four user defined durations or one of four user defined duty cycle patterns. In addition, up to 32 sensor events can be programmed to allow control based on temperature & light level.

The EL74 is one member of the EL series of time controls that also includes the EL71, EL[illegible]EL78 and EL712. The EL series of tim[illegible]ntrols are versatile, yet easy to pro-ram. A simple keypad combined with a [illegible]rge, user friendly display takes the frustration out of programming.

Features & Benefits

- 128 Events - An event can be an ON, an OFF, one of four user defined durations or one of four user defined duty cycle patterns.
- 32 Sensor Events - A sensor event will control a channel based on programmable on/off sensor levels. Each sensor event can be assigned to any day or combination of days, including the three holiday schedules.
- Computer Interface - The controls can be programmed and reviewed by a local personal computer using Pecosoft.EL software (sold separately).
- Easy programming - A simple keypad with large user friendly display makes programming easy.
- Remote overrides make local time control available to after hour maintenance or cleaning personnel.
- One model offers five input power voltages: 24V, 120V, 208V, 240V, or 277V
- Automatic Daylight Savings Adjustment
- Additional features and benefits included in the following pages.

Applications

- Indoor/Outdoor Lighting
- Heating/Ventilating Systems
- Air Conditioning
- Security Systems
- School Flashers
- Bell Ringing
- Motors
- Security Lights
- Traffic Lights
- Process Equipment

SIEBE

Features & Benefits (continued)

Programming Capabilities

Duty Cycle Patterns - Each duty cycle pattern can be programmed with ON durations and OFF durations from 1 second to 23 hours, 59 minutes and 59 seconds.

4 User Defined Inputs - Each input can be independently defined as one of two override types, an enable input or as one of four sensor types.

ON With Off Delay Override Input - Provides a retriggerable override input that is assignable to any output(s). The affected output(s) will be overridden ON with the closing of the input and remain ON as long as the input is closed. When the input is opened, the output(s) will remain ON for the length of the off delay. The off delay is programmable from 0 seconds to 23 hours, 59 minutes and 59 seconds. Closing the input during the off delay will retrigger the override.

Toggle Type Override Input - Provides a toggle type override input that is assignable to any output(s). Closing the input causes the affected output(s) to be toggled to the opposite state and remain in that state until the occurrence of the next programmed event. An optional timed-on from 1 second to 23 hours, 59 minutes and 59 seconds can be programmed. Upon completion of this timed-on, the affected output(s) will return to the programmed state unless toggled off.

Enable Input - The enable input is assignable to any output(s). The enable input acts as a switch which opens and closes in series with the output. When open, the loads will remain off. When closed, the output(s) follow the scheduled events.

Sensor Input - The inputs can be configured as one of four sensor types:

- F = degrees Fahrenheit (-40 to 215)
- C = degrees Celsius (-40 to 102)
- L = light level (0 to 100)
- U = user defined (0 to 255)

4 Durations - Each duration can be programmed from 1 second to 23 hours, 59 minutes and 59 seconds.

Optional Daylight Savings Correction - Programmable as a day of the month (e.g. 1st Sunday in April / last Sunday in October)

Leap Year Correction to the Year 2100

10 Single Day Holidays - (e.g. July 4th)

10 Day of Month Type Holidays - (e.g. last Monday in May)

10 Holiday Durations - Programmable from 1 to 366 days (e.g. June 9th to August 27th)

6 Specific Holidays - Each holiday can be optionally selected: Good Friday, Easter Sunday, Easter Monday, Boxing Day, Victoria Day, Thanksgiving Thursday and Friday

3 Holiday Schedules - Each of these 36 holidays can be assigned to one of three holiday schedules (A,B or C). For example if July 4th is assigned to holiday schedule A, then on July 4th only those events and sensor events containing holiday A in their day fields will be executed.

Keyboard Override - Toggles the current output state; begins immediately when initiated and remains in effect until overridden again or until the next programmed event occurs.

Astro - Optional Astro feature assignable to any channel(s). Astro will automatically keep track of the changing sunrise and sunset times throughout the year without the need of a photocell. Astro feature will keep assigned outputs off during daylight hours.

Selectable Clock Format - 12 hour (am/pm) or 24 hour clock format.

Stagger Up - Optional stagger up after a power outage. Stagger up time between channels selectable from 5 seconds, 15 seconds, 30 seconds, 1 minute, 5 minutes, 10 minutes, and 15 minutes.

Momentary - The EL74 can be configured for either maintained or momentary operation. The momentary option is intended for use with latching relays. When configured for momentary the EL74 will have only two channels; relays #1 & #3 will provide a 1 second latching ON pulse and relays #2 & #4 will provide a 1 second latching OFF pulse.

Electrical

Power Requirements

One model (EL74) offers five power input voltages: 24, 120, 208, 240 and 277VAC

Frequency: 50/60 Hz

Power Consumption: 4 VA Max

Wiring terminals: Relay contact terminals can accommodate 10-16 AWG

- Sensor/override input terminals can accommodate 18-22 AWG
- Power input terminals can accomodate 12-18 AWG

UL listed, CSA Certified, and complies with FCC, part 15 rules.

Output Switch Ratings

Four SPDT relays with contacts rated as follows:

Normally Open Contacts:
20 amp resistive or inductive at 24-277 Vac
1 HP at 120 Vac
2 HP at 208-277 Vac
5 amp tungsten at 120-240 Vac
20 amp ballast at 120 Vac
10 amp ballast at 208-277 Vac
470 VA at 120-240 Vac

Normally Closed Contacts:
10 amp resistive or inductive at 24-277 Vac
1/4 HP at 120 Vac
1/2 HP at 208-277 Vac
3 amp ballast at 120-277 Vac
275 VA at 120-240 Vac

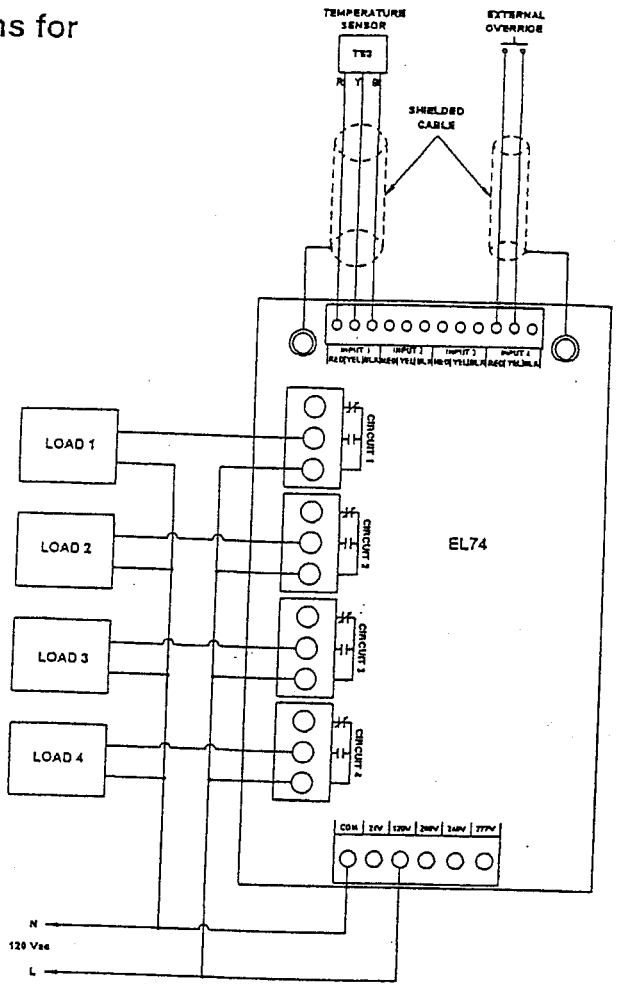
Power Outage Carry-Over

The program and time of day are maintained during a power outage for a minimum of 2 days by means of a capacitor. After two days, a lithium battery takes over and provides a minimum accumulated carryover of 1 year. The lithium battery should provide over 10 years of carryover protection.

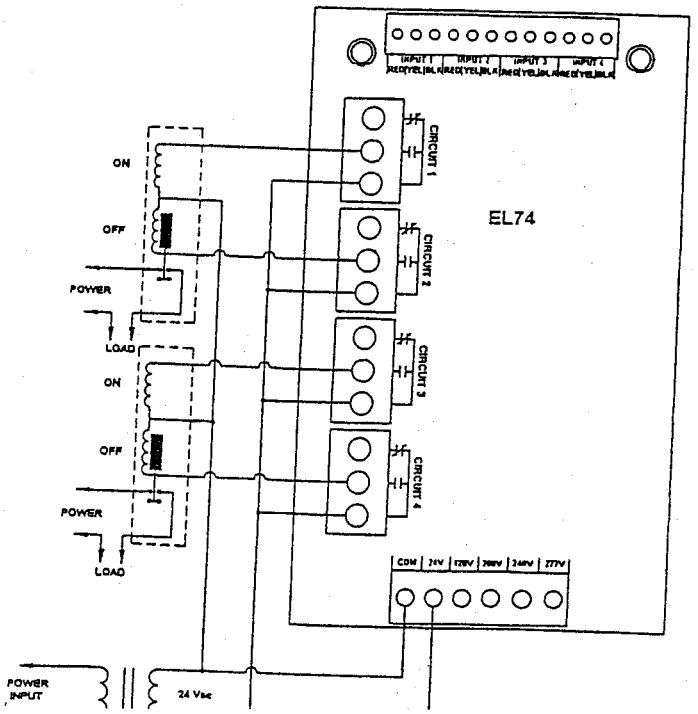
Environmental

Operating Temperature range: -20° F (-29° C) to 140° F (60°C)
Operating Humidity: 10-90%RH non-condensing.
The EL74 should be mounted indoors in an environment that is free of excessive contaminants such as oil, moisture and dirt.

Typical Wiring Diagrams for Maintained Contacts



Typical wiring diagram for controlling Latching Relays (Momentary Contacts)



Physical: Enclosure Dimensions

Enclosure: NEMA 1 drawn steel with lockable hasp. Weight: Approximately 7 lbs. (3.2 kg)

Dimensions: Width 18.8 cm (7.4"), Height 27.7 cm (10.9"), Depth 8.9 cm (3.5"), Display Size 6.7 cm x 1.9 cm (2-5/8" x 3/4")

Optional Accessories

Computer Software

The Pecosoft.EL software program provides a quick and easy method of programming and reviewing the EL74 from a personal computer. Programs can be written and stored on the PC and then loaded into the time control. Programs can also be copied from the time control into the PC to allow easy review and verification.

Temperature Sensors and Light Sensor

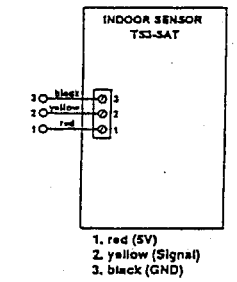
Model No.	Description	Wiring Diagram	
TS3/SAT	Solid-state temperature sensor for indoor use designed to interface directly with the EL74. Operating temperature -40°F to 140°F (-40°C to 60°C), resolution 1.5F (1C). Dimensions: 4.5" H x 2.75" W x 1.25" D.	See below	
TS3/OAT	Solid-state temperature sensor, sealed for outdoor use, designed to interface directly with the EL74. Operating temperature -40°F to 167°F (-40°C to 75°C) resolution 1.5F (1C) Dimensions 6.25" H x 1.25" W x 4" D. This sensor comes complete with a 3.5" D x 1.75 H non-metallic electrical box.		
LS-R	Solid-state light sensor designed to interface directly with the EL74. It provides a relative light level to the control (0-88 L). The light sensor's range (0-300 foot candles) is adjustable to accommodate a wide variety of light sensing requirements. Dimensions: 2.5" L x 1.28" D. (Electrical box not included.)		

How to Specify

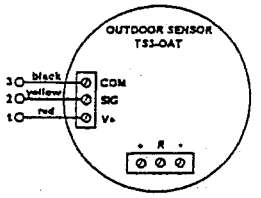
EL74

Installer shall furnish and install Paragon EL74 Electronic Time Control. The 7-channel control shall have 24-hour, 7-day, 365 day or SunTracker capability with 128 events available. It shall also have 4 user-definable durations and duty cycle lengths plus automatic daylight saving time and leap year adjustments. Control shall have remote override capabilities (Timed, toggle or enable type). Control shall have keyboard override until overridden again or until next event is reached. It shall be capable of switching loads based on user-definable temperature and light levels with 32 events available. Control shall have momentary (latching relay) capability and shall have Astro features plus 30 definable holidays and 6 pre-programmed holidays. Control shall provide 2 days of power outage carry-over without a battery. Control shall provide 1 year of power outage carry-over with a battery. The digital time display shall be 3/4" in height. Clock format shall be selectable, allowing a choice of 12 hour (AM/PM) or 24 hour format. Control shall be capable of interfacing (sending and receiving data) with a personal computer. Power input terminals shall have the capability to accommodate #12 to #18 AWG wire. Control shall be housed in a NEMA 1, lockable steel enclosure, to guard against vandalism or tampering.

Wiring Diagrams for Temperature Sensors and Light Sensor.



1. red (5V)
2. yellow (Signal)
3. black (GND)

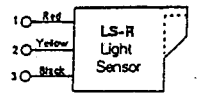


To the EL Series Time Control:

V+	red (5V)
SIG	yellow (Signal)
COM	black (GND)

To the TS3-OAT Sensor:

+	red
R	yellow
-	black



Paragon Electric Company, Inc.
606 Parkway Boulevard, P.O. Box 28
Rivers, Wisconsin 54241-0028
United States of America

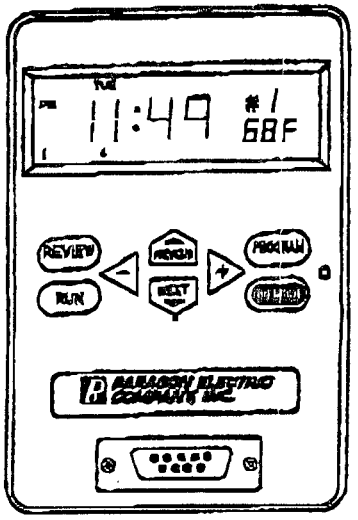
Telephone 1 920 793 1161
Facsimile 1 920 793 3736

IN CANADA:
Paragon Electric Canada Ltd.
5785 Kennedy Road
Mississauga, Ontario L4Z 2G3

IN EUROPE:
Robertshaw International
2809 Emerywood Pkwy, Ste.400
Richmond, VA 23294-3743

EL78 - Eight Channel Electronic Time Control

General Instructions



PARAGON ELECTRIC COMPANY, INC.

CONTENTS

Introduction

The EL78 is an eight channel, electronic time control that provides simple, inexpensive control of lighting, HVAC, motors, pumps, bell-ringing or any electrical load with a time-of-day schedule. The control may be utilized as a 24 hour, 7 day or full year (365 day) control.

The EL78 allows for the programming of 128 events. An event could be an ON, an OFF, one of four user defined durations or one of four user defined duty cycle patterns. In addition, up to 32 sensor events can be programmed to allow control based on temperature & light level. Other parameters can be used; contact the factory for information.

The EL78 is a member of the EL series of time controls, that also includes the EL71, EL72, EL74, and EL712 (1, 2, 4 and 12 channel, respectively). All are versatile, yet easy to program. A simple keypad combined with a large, user friendly display takes the frustration out of programming.

Specifications

Programming Capabilities

- 128 Events - An event can be an ON, an OFF, one of four user defined durations or one of four user defined duty cycle patterns. Each event can be assigned to any channel. Each event can be assigned to any day or any combination of days, including the three holiday schedules.
- 4 Durations - Each duration can be programmed from 1 second to 23 hours,59 minutes and 59 seconds.
- 4 Duty Cycle Patterns - Each duty cycle pattern can be programmed with ON durations and OFF durations from 1 second to 23 hours, 59 minutes and 59 seconds.
- 8 User Defined Inputs - Each input can be independently defined as one of two override types, an enable input or as one of four sensor types.
- ON With Off Delay Override Input - Provides a retriggerable override input that is assignable to any combination of outputs. The affected output(s) will be overridden ON with the closing of the input and remain ON as long as the input is closed. When the input is opened, the output(s) will remain ON for the length of the off delay. The off delay is programmable from 0 seconds to 23 hours, 59 minutes and 59 seconds. Closing the input during the off delay will retrigger the override.
- Toggle Type Override Input - Provides a toggle type override input that is assignable to any combination of outputs. Closing the input causes the affected output(s) to be toggled to the opposite state and remain in that state until the occurrence of the next programmed event. An optional timed-on from 1 second to 23 hours, 59 minutes and 59 seconds can be programmed. Upon completion of this timed-on, the affected output(s) will return to the programmed state unless toggled off.
- Enable Input - The enable input is assignable to any combination of outputs. The enable input acts as a switch which opens and closes in series with the output(s). When open, the load(s) will remain off. When closed, the output(s) follow the scheduled events.
- Sensor Input - The inputs can be configured as one of four sensor types:
  F = degrees Fahrenheit (-40 to 215)
  C = degrees Celsius (-40 to 102)
  L = light level (0 to 100)
  U = undefined (0 to 255)
- 32 Sensor Events - A sensor event will control a channel based on programmable on/off sensor levels. Each sensor event can be assigned to any day or combination of days, including the three holiday schedules.
- Optional Daylight Savings Correction - Programmable as a day of the month (i.e. 1st Sunday in April / last Sunday in October)
- Leap Year Correction to the Year 2100
- 10 Single Day Holidays - (e.g. July 4th)
- 10 Day of Month Type Holidays - (e.g. last Monday in May)
- 10 Holiday Durations - Programmable from 1 to 366 days (e.g. June 9th to August 27th)
- 6 Specific Holidays - Each holiday can be optionally selected

Good Friday	Easter Sunday	Easter Monday
Boxing Day	Victoria Day	Thanksgiving Thursday and Friday

- 3 Holiday Schedules - Each of these 36 holidays can be assigned to one of three holiday schedules (A,B or C). For example if July 4th is assigned to holiday schedule A, then on July 4th only those events and sensor events containing holiday A in their day fields will be executed.
- Keyboard Override - Toggles the current output state; begins immediately when initiated and remains in effect until overridden again or until the next programmed event occurs.
- Astro - Optional Astro feature assignable to any combination of channels. Astro will automatically keep track of the changing sunrise and sunset times throughout the year without the need of a photocell. The Astro feature will keep assigned output(s) off during daylight hours.
- Selectable Clock Format - 12 hour (am/pm) or 24 hour clock format
- Stagger Up - Optional stagger up time between channels, after a power outage; selectable from 5 seconds, 15 seconds, 30 seconds, 1 minute, 5 minutes, 10 minutes, and 15 minutes
- Momentary - The EL78 will normally be configured as maintained. The momentary option is intended for use with latching relays. An EL78 configured as momentary will only have 4 channels. Relays 1, 3, 5, and 7 will provide a one second ON pulse for channels 1, 2, 3, and 4 respectively. Relays 2, 4, 6, and 8 will provide a one second OFF pulse for channels 1, 2, 3, and 4 respectively. See example 2 on page 16 for more details.
- Computer Interface - The controls can be programmed and reviewed by a local personal computer using Pecosoft.EL software (sold separately).

Electrical:

1. **Power Requirements** -

   Input Voltage 24, 120, 208, 240 or 277 Vac, 50/60 Hz

2. **Outputs** - Eight SPDT relays with contacts rated as follows:

Normally Open Contacts: 20 amp resistive or inductive at 120-277 Vac
1 HP at 120 Vac
2 HP at 208-277 Vac
5 amp tungsten at 120-240 Vac
20 amp ballast at 120 Vac
10 amp ballast at 208-277 Vac
470 VA at 120-240 Vac

Normally Closed Contacts: 10 amp resistive or inductive at 120-277 Vac
1/4 HP at 120 Vac
1/2 HP at 208-277 Vac
3 amp ballast at 120-277 Vac
275 VA at 120-240 Vac

3. **Wiring** - Relay contact terminals can accommodate 10-16 AWG
   - Power input terminals can accomodate 12-18 AWG
   - Sensor/override input terminals can accommodate 18-22 AWG

4. **Power Outage Carryover** - The program and time of day are maintained during a power outage for a minimum of 2 days by means of a capacitor. After two days, a lithium battery takes over and provides a minimum accumulated carryover of 1 year. The lithium battery should provide over 10 years of carryover protection.

Environmental:

1. Temperature - Operating: -20 F (-29 C) to 140 F (60 C)
2. Relative Humidity - 10 to 90% RH (non-condensing)
3. The EL78 should be mounted indoors in an environment that is free from excessive contaminants such as oil, moisture and dirt.

Physical: Enclosure Dimensions

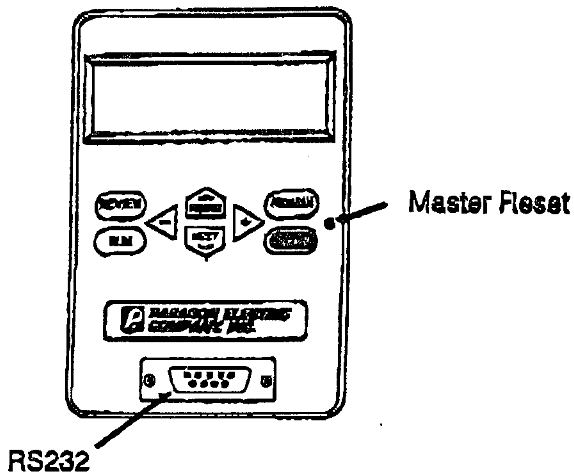
Enclosure: NEMA 1 drawn steel with lockable hasp

W = 14.3" (36.4cm) H = 16.1" (40.9 cm) D = 6.1" (15.6 cm) Weight Approx. 17.3 lbs. (7.8 kg)

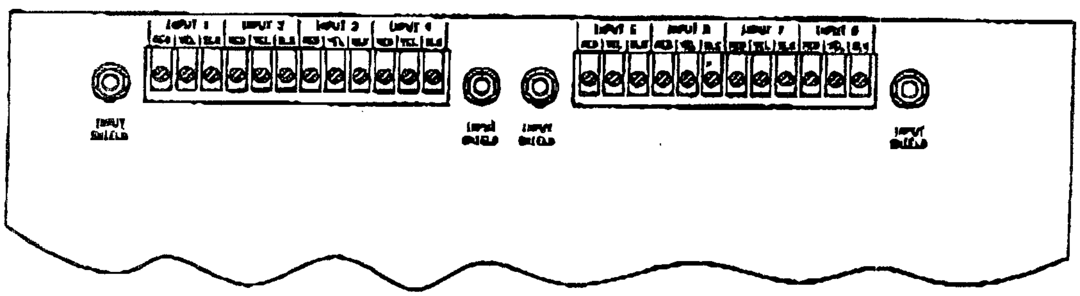
FUNCTIONAL DESCRIPTION

Front Panel Layout

Program Header Menu
- TIME
- CONF
- ASTR
- EVNT
- INPT
- EVNT SENS
- HOL



Input Connections



Sensor Connection: 1. red
2. yellow
3. black

External Override: use RED + YEL (Use manual switch or isolated contacts.)

CAUTION: Do not apply voltage to sensor inputs. To do so will damage control.

NOTE: It is highly recommended that shielded cable be used for sensor and override input wiring. The shield should be tied to earth ground at the control using the "INPUT SHIELD" screw terminals. The shield should be left floating (unconnected) at the sensor end. It is also recommended that shielded cable not be placed in metal conduit.

Keypad Description

Master Reset - Clears time and program. Display will show "MEM CLR". The reset switch is accessed by inserting a pointed object, such as a paper clip, into the reset hole to the right of the keypad.

PROGRAM - This key allows the user to add, delete or change parameters (events, time, holidays, etc).

When pressed from the RUN mode, the programming menu is displayed starting with the TIME menu header.

When pressed from a menu header, the control will advance to the next menu header.

When pressed from a programming step, the control returns to that menu header.

When pressed during review, the control will go to the appropriate programming display.

REVIEW - This key allows the user to review all the programmed steps using displays condensed to show as much information as possible on one display. The user will not be able to change the program in the Review mode.

When pressed from the RUN mode or any programming step within a menu header, the control will return to the TIME menu header.

When pressed from any menu header during review, the control will move to the next menu header.

When pressed from a review step, the control returns to that menu header.

RUN - This key will return the control to the RUN mode.

From all programming steps (excluding the override menu), the control will perform a status update and return to the RUN mode.

From all review steps, the control will go straight to the RUN mode without updating. If the REVIEW key was pressed while in a programming step the control will perform a status update and return to the run mode.

When in the override menu, this key will return the selected channel from an override to the current event status shown and return the control to the RUN mode.

OVERRIDE - This key will take the user to the override header.

From the RUN mode, this key will jump to the override header.

From the override header, the selected channel's state is toggled and the control returns to the RUN mode.

PREVIOUS/NEXT - Moves the display selection to the previous or next program step. While in a programming step, the current item (to be modified) will be flashing.

+/- -These keys will change (increment or decrement) the current (flashing) item. The +/- keys will not work during review, except to allow a faster step through of events, inputs and holidays.

Hierarchy of Control

Priority Level 1 - Stagger Up

Priority Level 2 - Timed External Override

Priority Level 3 - Toggle Override (keyboard and external)

Priority Level 4 - External Enable

Priority Level 5 - Astro

Priority Level 6 - Programmed events (on, off, duration, duty cycle, sensor control)

NOTES:

1. A keyboard override cannot be performed during stagger up.
2. An external override can be done during stagger up, but the stagger up sequence is still observed.
3. Status update will cancel a keyboard override or an external toggle override, but will not cancel an external timed override.
4. All programmed events have the same priority. The most recent event is the one that is active.

As an example of hierarchy, consider a simple lighting control application. It is desired to turn parking lot lights on at sunset and off at 11:00pm. Programming an ON event at 1:00pm, an OFF event at 11:00pm and using the astro feature will provide the desired control. The ON and OFF events (at priority level 6) would energize the lights from 1:00pm to 11:00pm. However, because the astro function has higher priority, the lights will be held off during daylight hours - thus achieving the desired control.

Programming

Programming Overview:

After pressing the PROGRAM key, the EL78 will continue to control the outputs based on the events that were operating at the time the PROGRAM key was pressed. The control will not check for new events until it has gone through a status update.

The control remains fully functional after pressing the REVIEW key, provided the REVIEW key wasn't pressed while in the programming mode.

During operation the control will be in the RUN mode. When programming (or reviewing), the order of the program headers and steps is as follows:

TIME - set time, date, daylight savings time
CONF - 12/24, stagger up, durations 1-4, duty cycles 1-4
ASTR - sunrise, sunset, latitude, hemisphere
EVNT - on, off, durations 1-4, duty cycles 1-4
INPT - configure inputs
EVNT SENS - sensor events
HOL - set holidays

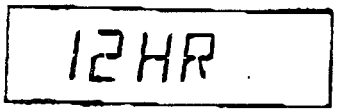
From the HOL header, the control will loop around to the TIME header. The OVER (over-ride) mode is only accessible from the RUN mode. The following is a detailed explanation of each mode.

In all modes use the NEXT key to advance to the next item to be programmed or reviewed and the PREVIOUS key to go back to the previous item. Use the + and - keys to modify the current (flashing) item.

Memory Clear

Indicates that the memory has been cleared. Use the NEXT key to begin programming.
After initial power up or a reset, the control will be in MEM CLR (memory clear) mode. This mode is only accessible once.

Toggle between MAINtAin (maintained) or MOMNtARY (momentary) operation using the +/- key. When configured for momentary, relays 1, 3, 5, & 7 will provide the ON pulses, and relays 2, 4, 6, & 8 will provide the OFF pulses. An EL78 configured for momentary operation will become a four channel control. Use the NEXT key to continue programming.



Toggle between 12 hour (AM/PM) or 24 hour (00:00-23:59) clock format using the +/- key.

NOTE: After selecting relay operation and clock format, press the PROGRAM key to begin programming steps in the TIME header.

Set Time

Set Time header. This mode is used for setting time, date and daylight savings time. Use the NEXT key to begin programming.

Program hours, minutes, seconds and day of week using the +/- key. A PM indicator is used in the 12 hour format. AM begins with midnight and PM begins with noon. NOTE: Only the pm indicator will appear in the 12 hr format.

Program month, date and year.

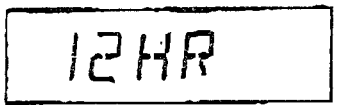
To disable daylight savings time operation, select NO.

Program the day that daylight savings time begins. The control defaults to the first Sunday in April. At 2:00 AM on this day, the control's time will advance one hour.

Program the day that daylight savings time ends. The control defaults to the last Sunday in October. At 2:00 AM on this day, the control's time will go back one hour.

Configuration

Configuration header. This mode is used for changing the clock format, selecting stagger up, setting the lengths of the 4 durations and for programming the on/off times of the 4 duty cycle patterns. Use the NEXT key to begin programming.



Select 12 hour or 24 hour clock format using the +/- key.

Select the stagger up time between channels. This stagger up occurs after a power outage and after a status update.
The following stagger up selections are available:

NO = not used	01.00 = 1 minute
00.05 = 5 seconds	05.00 = 5 minutes
00.15 = 15 seconds	10.00 = 10 minutes
00.30 = 30 seconds	15.00 = 15 minutes

Programs the duration length for dUR1-dUR4, which are event types (see Events). These durations are programmable from 1 second to 23 hours, 59 minutes and 59 seconds. The control will not allow a duration of 0:00.00.

Programs the duty cycle off time for CYC1-CYC4, which are event types (see Events). The off cycle is programmable from 1 second to 23 hours, 59 minutes and 59 seconds. The control will not allow an off cycle of 0:00.00. A duty cycle event will always start with the off cycle.

Programs the duty cycle on time for CYC1-CYC4. The on cycle is programmable from 1 second to 23 hours, 59 minutes and 59 seconds. The control will not allow an on cycle of 0:00.00.

Astro

Astro header. The Astro function provides a means for controlling lights based on the changing sunrise and sunset times throughout the year without use of a photocontrol. The Astro feature does not turn loads on or off. Between sunrise and sunset the load(s) are not allowed to be on. An event must be programmed to allow the load(s) assigned to Astro to turn on. Use the NEXT key to begin programming.

Program today's sunrise time using the +/- key. The control will automatically update the sunrise time each day.
Offset Feature - program today's sunrise time with the desired offset figured in. The control will automatically update the desired offset time each day.

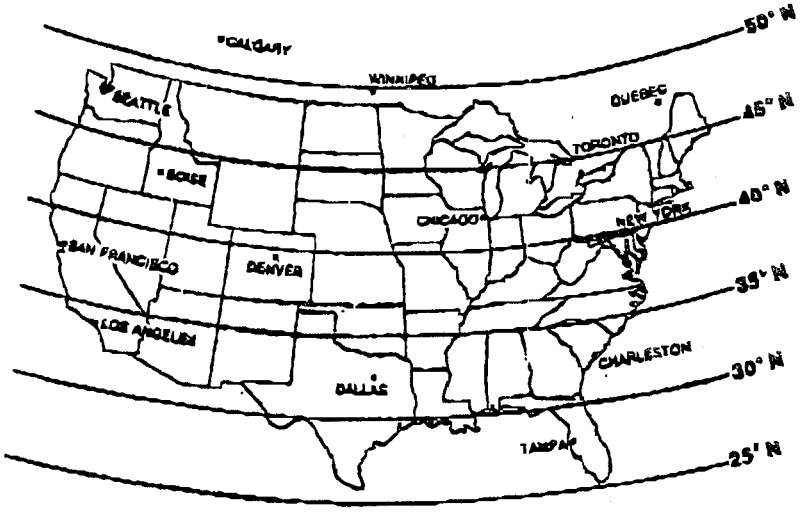
Program today's sunset time. The control will automatically update the sunset time each day.
Offset Feature - program today's sunset time with the desired offset figured in. The control will automatically update the desired offset time each day.

Program the latitude. The allowable ranges are 10 - 70 North and 10 - 70 South. Use the following maps or consult an atlas to obtain your latitude to the nearest degree.

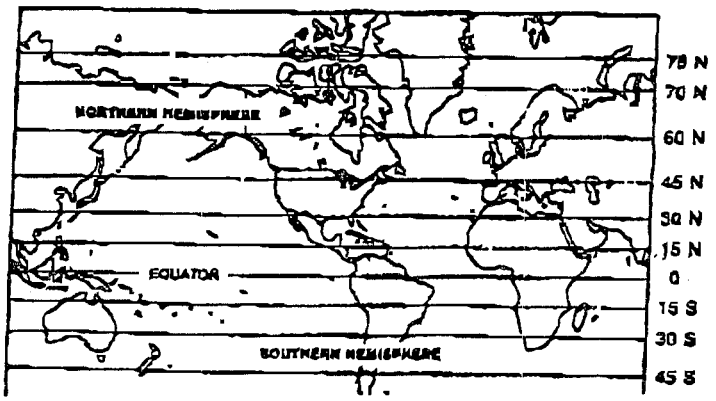
To assign the Astro function to a channel, select YES.

U.S. LATITUDE CHART

ALBANY, NY	43 N	DULUTH, MN	47 N	NASHVILLE, TN	36 N	TOLEDO, OH	42 N
ALBUQUERQUE	35 N	ERIE, PA	42 N	NEWARK, NJ	41 N	TOPEKA, KS	39 N
AMARILLO, TX	35 N	FAIRBANKS, AK	65 N	NEW ORLEANS, LA	30 N	TRENTON, NJ	40 N
ANCHORAGE, AK	61 N	FARGO, ND	47 N	NEW YORK, NY	41 N	TUCSON, AZ	32 N
APPLETON, WI	44 N	FORT SMITH, AR	35 N	OKLAHOMA CITY	35 N	TULSA, OK	36 N
ATLANTA, GA	34 N	FORT WORTH, TX	33 N	OMAHA, NE	41 N	TWO RIVERS, WI	44 N
AUSTIN, TX	30 N	GREAT FALLS, MT	47 N	PHILADELPHIA, PA	40 N	WASHINGTON, DC	39 N
BALTIMORE, MD	39 N	GREEN BAY, WI	44 N	PHOENIX, AZ	33 N	WAUSAU, WI	45 N
BILOXI, MS	30 N	HONOLULU, HI	21 N	PITTSBURGH, PA	40 N	WILMINGTON, DE	40 N
BIRMINGHAM, AL	34 N	HOUSTON, TX	30 N	PORTLAND, ME	44 N	WICHITA, KS	38 N
BOISE, ID	44 N	INDIANAPOLIS	40 N	PORTLAND, OR	46 N		
BOSTON, MA	42 N	JACKSON, MS	32 N	PROVIDENCE, RI	42 N		
BRIDGEPORT, CN	41 N	JACKSONVILLE, FL	30 N	RACINE, WI	43 N		
BUFFALO, NY	43 N	KANSAS CITY, MO	39 N	RALEIGH, NC	36 N		
CHARLESTON, SC	33 N	LA CROSSE, WI	44 N	RICHMOND, VA	37 N		
CHARLESTON, WV	38 N	LAS VEGAS, NV	36 N	RICHPORT, CT	41 N		
CHEYENNE, WY	41 N	LITTLE ROCK, AR	35 N	ROCHESTER, NY	43 N		
CHICAGO, IL	42 N	LOS ANGELES, CA	34 N	ST LOUIS, MO	39 N		
CINCINNATI, OH	39 N	LOUISVILLE, KY	38 N	ST PAUL, MN	45 N		
CLEVELAND, OH	41 N	MADISON, WI	43 N	SALT LAKE CITY	41 N		
COLUMBIA, SC	34 N	MANITOWOC, WI	44 N	SAN ANTONIO, TX	30 N		
COLUMBUS, OH	40 N	MARINETTE, WI	45 N	SAN DIEGO, CA	33 N		
CONCORD, NH	43 N	MARQUETTE, MI	47 N	SAN FRANCISCO	38 N		
CORPUS CHRISTI	28 N	MEMPHIS, TN	35 N	SANTA ANA, CA	34 N		
DALLAS, TX	33 N	MIAMI, FL	26 N	SEATTLE, WA	48 N		
DENVER, CO	40 N	MILWAUKEE, WI	43 N	SIOUX FALLS, SD	44 N		
DES MOINES, IA	42 N	MINNEAPOLIS, MN	45 N	SPRINGFIELD, IL	40 N		
DETROIT, MI	42 N	MOBILE, AL	31 N	SUPERIOR, WI	47 N		
DUBUQUE, IA	42 N	MONTPELIER, VT	44 N	TAMPA, FL	28 N		



World Latitude Chart



Events

Events header. Up to 128 events can be programmed. Events can be an ON, an OFF, dUR1(duration), dUR2, dUR3, dUR4, CYC1 (duty cycle), CYC2, CYC3 or CYC4. An event can be assigned to any channel. Each event can be assigned to any day or combination of days including the 3 holiday schedules (A, B and C). Use the NEXT key to begin programming.

The +/- keys will quickly step thru the events when the event # is flashing. Select the event type, select the channel and program the hours and minutes while each of these parameters are flashing using the +/- key.

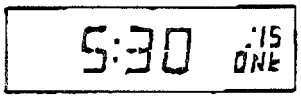
Select YES for each day that is to be included in this event.

Input Configuration

Input header. Each input can be individually configured as a retriggerable override, a toggle override, an enabler or as one of four sensor types. Use the NEXT key to begin programming.

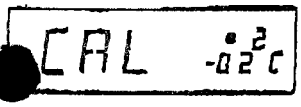
Choose the desired input type.
- NONE: not used
- On\d: On with off delay override
- OVr: Toggle override
- ENb: Enabler input
- F: Fahrenheit temperature sensor
- C: Celsius temperature sensor
- L: Light level sensor
- U: User defined sensor

This screen is used for setting the off delay time when the input is configured as an On\d override type. The off delay is programmable from 0 seconds to 23 hours, 59 minutes and 59 seconds.



This screen is used for setting the on time when the input is configured as an OVr (toggle) override type. The on time is programmable from 0 seconds to 23 hours, 59 minutes and 59 seconds. When this on time is set to 0:00.00, the override functions as a toggle on/toggle off override. When a non-zero value is programmed, the override functions as a timed on/toggle off override.

This screen is used for assigning channels to the inputs. This applies only to the On\d, OVr and ENb input types.



This screen is used for calibrating the sensors.
The following calibration options are provided:
F: -12,-11,-9,-8,-6,-5,-3,-2,0,2,3,5,6,8,9,11
C: -8,-7,-6,-5,-4,-3,-2,-1,0,1,2,3,4,5,6,7
L: -4,-3,-2,-1,0,1,2,3
U: -8,-7,-6,-5,-4,-3,-2,-1,0,1,2,3,4,5,6,7

Sensor Events

Sensor Events header. Up to 32 sensor events can be programmed. A sensor event can be assigned to any channel. Each sensor event can be assigned to any day or combination of days including the 3 holiday schedules (A, B and C). Use the NEXT key to begin programming.

The +/- keys will quickly step thru the sensor events when the event # is flashing. Select the sensor number, select the channel and program the hours and minutes while each of these parameters are flashing. When a sensor no. is shown, its sensor type (F,C,L or U) is also shown. If the input is not configured as a sensor a question mark (?) is shown.

Select YES for each day that is to be included in this sensor event.

Program the turn on setpoint.

Program the turn off setpoint.

Holiday

Holiday header. The four holiday types with their priorities are as follows:

SPEC (special) - highest priority
DATE (month/date) - 2nd highest priority
D/WK (day of week) - 3rd highest priority
SPAN (duration) - lowest priority

To demonstrate the use of priorities assume that Thanksgiving Break (SPEC) is programmed as a holiday schedule B. Also assume that Nov. 1st to Nov. 30th (SPAN) is programmed as a holiday schedule A. Then on Thanksgiving Day and the Friday after, the control will execute the events that include HOLIDAY B in their day field since SPEC is a higher priority than SPAN. The rest of November the control will use events that include HOLIDAY A in their day fields. The other 11 months (assuming no other holidays) will be controlled according to the events programmed for the normal days (SUN - SAT).
Use the NEXT key to begin programming

Special Holiday type. Each of 6 special holidays can either be assigned as one of the 3 holiday schedules A, B or C or not selected. Press the NEXT key to program the special holidays (starting with Good Friday) or press the +/- keys to move to a different holiday type (e.g. Date).

Good Friday

Easter Sunday

Easter Monday

Thanksgiving Break (Thursday and Friday)

Boxing Day

Victoria Day

Holiday Date type. Up to 10 date type holidays can be programmed. Press the NEXT key to program the date type holidays or press the +/- keys to move to a different holiday type (e.g. day of week).

NONE indicates that this holiday (date) number (1-10) is not used (no holiday schedule has been selected). Press the NEXT key to program this holiday (date) or press the +/- keys to move to other holiday (date) number(s).

Program the month, date and holiday schedule while each of these parameters are flashing.

Day of Week Holiday type. Up to 10 day of week type holidays can be programmed. Examples of day of week type holidays are:
1st Monday in September
Last Monday in May
Press the NEXT key to program the day of week type holidays or press the +/- keys to move to a different holiday type (e.g. SPAN).

NONE indicates that this holiday (day of week) number (1-10) is not used (no holiday schedule has been selected). Press the NEXT key to program this holiday (day of week) or press the +/- keys to move to other holiday (day of week) numbers.

This screen shows holiday #2 is programmed as the 1st Sunday in January with holiday schedule A assigned. Program the month, week no.(1st, 2nd, 3rd, 4th or last), day and holiday schedule while each of these parameters are flashing.

Holiday Span type. Up to 10 holiday durations can be programmed. A holiday duration is defined with a beginning date and an ending date. A holiday duration can be programmed as a single day holiday by making the ending date the same as the beginning date. It is OK to have the holiday duration extend into the next year. Press the NEXT key to program the span type holidays or press the +/- keys to move to a different holiday type (e.g. SPEC).

NONE indicates that this holiday (span) number (1-10) is not used (no holiday schedule has been selected). Press the NEXT key to program this holiday (span) or press the +/- keys to move to other holiday (span) numbers.

Program the beginning month and date for holiday duration #1.

Program the ending month and date for holiday duration #1. Then select a holiday schedule A, B or C. To remove a holiday duration, select none of the schedules.

Override

Keyboard Override header. This mode is reached by pressing the OVERRIDE key from the RUN mode. Press the NEXT key to continue in this mode or press the RUN key to exit this mode without affecting a change to the load status.

This screen shows the status of all channels on the bottom line of the display. If the channel no. is flashing, the channel is currently overridden. If it is flashing mostly on, the channel is overridden on. If it is flashing mostly off, the channel is overridden off. The channel # currently pointed to will be flashing in the upper right hand corner of the display. The current event for this channel is shown below the channel # (e.g. ON, OFF, dUR2, CYC4, SC03, NONE). Press the OVERRIDE key to toggle the channel status until the next event. Press the RUN key to cancel an override (will not work for timed external overrides). Press the +/- keys to select the next/previous channel. To exit the override mode without making a change, press the PREVIOUS or NEXT key to return to the override header, then press the RUN key.

RUN

The RUN mode is the normal operating mode. In the RUN mode the current time and day are shown. If today is a holiday, the active holiday schedule is also shown. Channel status is shown on the bottom line. The channel no. is shown if that channel is on. If the channel no. is flashing, that channel is currently overridden. If it is flashing mostly on, the channel is overridden on. If it is flashing mostly off, the channel is overridden off. The input # is also shown along with the status of that input. The following is a list of the possible input status messages:

Message	Input Config.	Status
NONE	not config	–
On\d	On\d	input closed
OFFd	On\d	input open, in delay
-N-	On\d	not active
OVd	OVR	overridden on w/delay
?-V-	OVR	not active or overridden on or off without delay
ENb	ENb	input closed (enabled)
dISb	ENb	input open (disabled)
072F	sensor,F	sensor value
LO F	sensor,F	sensor value below range
025C	sensor,C	sensor value
HI C	sensor,C	sensor value above range
055L	sensor,L	sensor value
175U	sensor,U	sensor value

The display will show the status of all inputs, one at a time, by automatically looping to the next input every 5 seconds. To lock on one input, press the NEXT key. To return to the automatic sequencing of inputs, press the NEXT key again.

Accessories (each sold separately)

Temperature Sensor

Model TS3/CAT is a sealed, outdoor solid-state temperature sensor designed to interface directly with the EL78.

Specifications: Operating temperature: -40 F to 167 F (-40 C to 75 C), Resolution: 1.5F (1C)

Model TS3/SAT is an unsealed, indoor solid-state temperature sensor designed to interface directly with the EL78.

Specifications: Operating temperature: -40 F to 140 F (-40 C to 60 C), Resolution: 1.5F (1C)

Light Sensor

Model LS-R is a solid-state light sensor designed to interface directly with the EL78. It provides a relative light level to the control (0-100 L).

Computer Software

The Pecosoft.EL software program provides a quick and easy method of programming and reviewing the EL78 from a personal computer. Programs can be written and stored on the PC and then loaded into the time control. Programs can also be copied from the time control into the PC to allow easy review and verification.

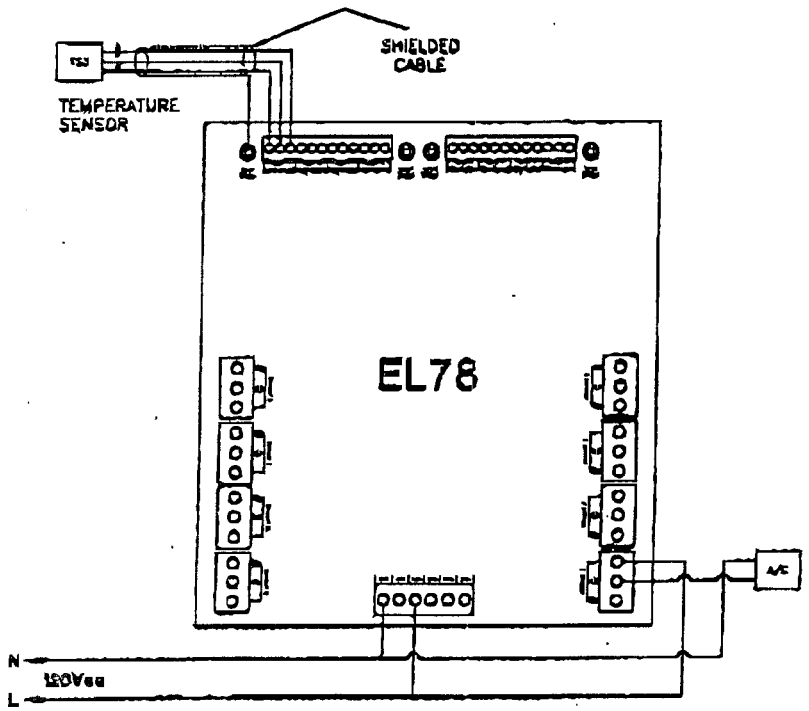
Contact Paragon for further information.

Application Examples

Example No. 1:

Objective: To control an air conditioner to operate at 73 F from 8:00 AM to 12:00 PM and to operate at 77 F from 12:00 PM to 5:00 PM on Monday through Friday. On nights and weekends the air conditioner will be off. The air conditioner will also be off from October 1st to April 30th. Temperature setpoints are to have a +/- 1 F deadband.

Wiring Diagram:



Programming:

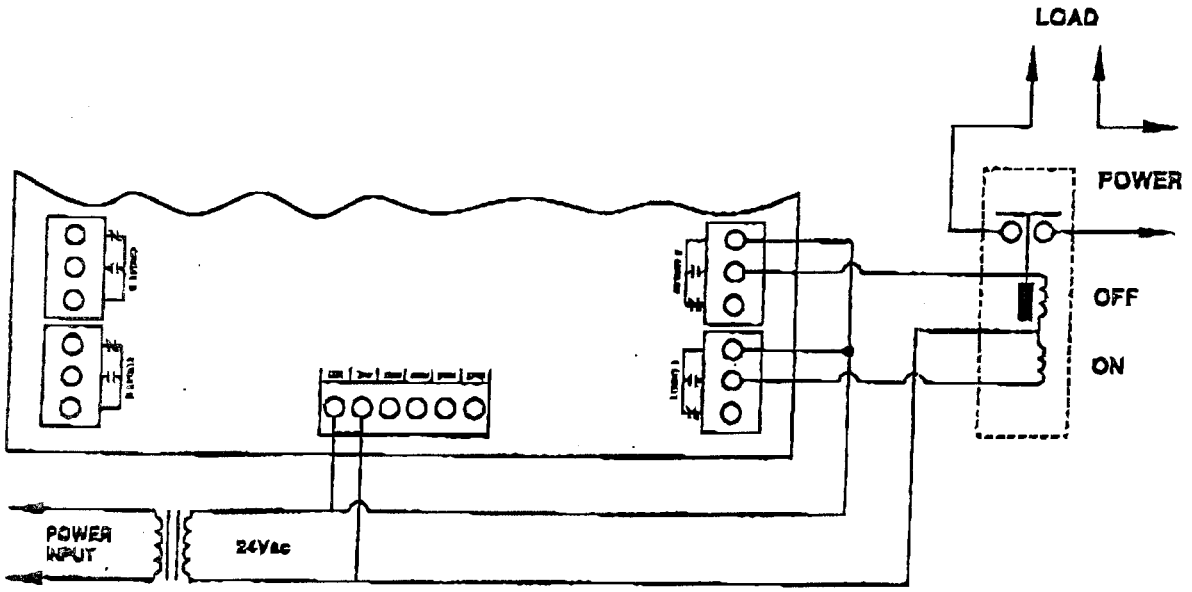
STEP	KEY	DESCRIPTION
1.	RESET	Clears control's memory. Control is finished initializing when # stops flashing (about 6 seconds).
2.	NEXT	Display shows MAINtAIn (maintained relay operation).
3.	PROGRAM	Display shows TIME header.
4.	NEXT,+,-	Use these keys to set time, date and daylight savings time information.
5.	PROGRAM	Press PROGRAM key to step through headers until EVNT (event header) is reached.
6.	NEXT	First event is shown with event # flashing.
7.	NEXT	Event type is flashing.
8.	+	Select OFF event type.
9.	NEXT	Channel no.1 is flashing. This is the desired channel.
10.	NEXT	Hours are flashing.
11.	-	Roll backward to select 5 PM.
12.	NEXT	Minutes are flashing. 00 is desired value.
13.	NEXT	SUN is flashing. NO is displayed.
14.	NEXT	MON is flashing. NO is displayed.
15.	+	Change NO to YES. Step through remaining days and select YES for TUE, WED, THU, FRI and HOLIDAY A.
16.	PROGRAM	Advance to INPT (configure inputs) header.
17.	NEXT	1st input is shown with input # flashing.
18.	NEXT	Input type is flashing.
19.	+/-	Select F (Fahrenheit).
20.	NEXT	CAL (calibration) offset is shown.
21.	+/-	Calibrate sensor if necessary.
22.	PROGRAM	Advance to EVNT SENS (sensor event) header.
23.	NEXT	First sensor event is shown with event # flashing.
24.	NEXT	Sensor no. is flashing. NONE indicates that a sensor has not yet been selected.
25.	+	Select sensor 1. 1- F is displayed.
26.	NEXT	Channel no. 1 is flashing. This is the desired channel.
27.	NEXT	Hours are flashing.
28.	+	Roll hours to 8 AM (PM indicator is not displayed).
29.	NEXT	Minutes are flashing. 00 is desired value.
30.	NEXT	SUN is flashing. NO is displayed. Step through the days to select YES for MON, TUE, WED, THU and FRI.
31.	NEXT	ON is displayed with the on setpoint flashing.
32.	+	Roll to 074F.
33.	NEXT	OFF is displayed with off setpoint flashing. Default value of 072F is what we want. If another value is desired, use the +/- keys to roll to that value. NOTE: Because the resolution is 1.5 F, not all values of F will be possible.
34.	NEXT	Sensor event # 02 is shown. Repeat the above steps to select sensor 1, channel 1, 12:00 PM, MON thru FRI, an ON setpoint of 077F and an OFF setpoint of 075F.
35.	PROGRAM	Advance to HOL (holiday) header.
36.	NEXT	Displays SPEC (special holiday) header.
37.	-	Select SPAN (holiday [illegible]

38.	NEXT	First holiday duration is shown with holiday # flashing.
39.	NEXT	Holiday start is shown with month flashing.
40.	-	Roll to OCT (October).
41.	NEXT	Holiday start date is flashing. 01 is the desired date.
42.	NEXT	Holiday end month is flashing.
43.	+	Roll to APR (April).
44.	NEXT	Holiday end date is flashing.
45.	-	Roll to 30.
46.	NEXT	HOLIDAY (holiday schedule) is flashing. No schedule is currently selected (not used).
47.	+	Select A (holiday schedule A).
48.	RUN	Programming is complete. The control will do a status update and then go to the RUN mode.

Example No. 2

Objective: To control lighting circuits using latching relays. The lights are to turn on at sunset and turn off at 11:00 PM. The lights are also to turn on at 4:00 AM and turn off at sunrise. This is to occur seven days a week. This example will use channel 1 (relays 1 & 2).

Wiring Diagram:

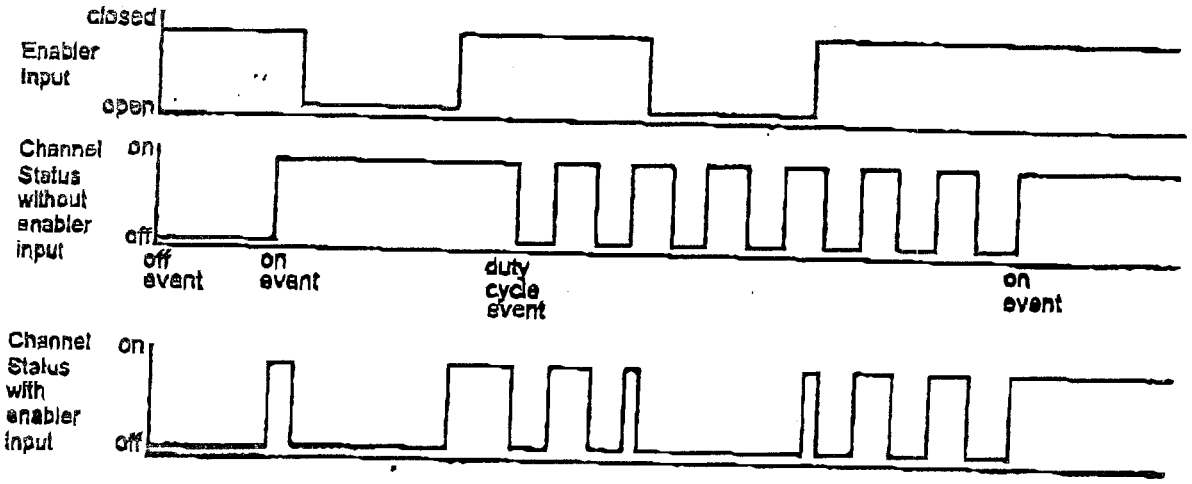


Programming:

STEP	KEY	DESCRIPTION
1.	RESET	Clears control's memory. Control is finished initializing when # stops flashing (about 6 seconds).
2.	NEXT	Display shows MAINtAin (maintained relay operation).
3.	+	Toggle to MOMNtARY (momentary relay operation).
4.	PROGRAM	Display shows TIME header.

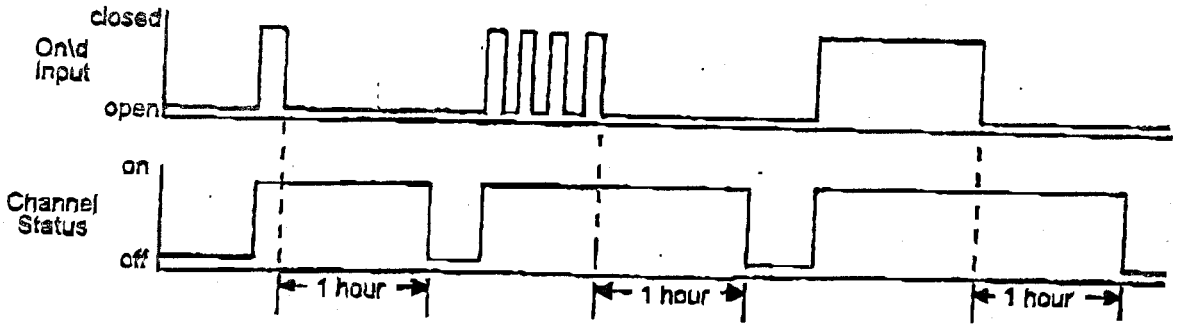
5.	NEXT,+,-	Use these keys to set time, date and daylight savings time information.
6.	PROGRAM	Press PROGRAM key to step through headers until ASTR (astro header) is reached.
7.	NEXT	Sunrise time is displayed with hours flashing.
8.	+/-	Set to today's sunrise hour.
9.	NEXT	Sunrise minutes are flashing.
10.	+/-	Set to today's sunrise minutes.
11.	NEXT	Sunset time is displayed with hours flashing.
12.	+/-	Set to today's sunset hour.
13.	NEXT	Sunset minutes are flashing.
14.	+/-	Set to today's sunset minutes.
15.	NEXT	LATT N-10° is displayed (latitude 10° north).
16.	+/-	Roll to the desired latitude.
17.	NEXT	Displays CHAN 1 NO.
18.	+	Change NO to YES to assign astro to channel 1.
19.	PROGRAM	Press PROGRAM key to step through headers until EVNT (event header) is reached.
20.	NEXT	First event is shown with event # flashing.
21.	NEXT	Event type is flashing.
22.	+	Select ON event type.
23.	NEXT	Hours are flashing.
24.	+	Roll hours to 4 AM.
25.	NEXT	Minutes are flashing. 00 is desired value.
26.	NEXT	SUN is flashing. NO is displayed.
27.	+	Change NO to YES to assign this ON event to Sunday.
28.	NEXT,+	Assign this ON event to MON - SAT.
29.	NEXT,+,-	Second event is shown with event # flashing. Program this second event as an OFF at 11:00 PM for SUN - SAT.
30.	RUN	Programming is complete. The control will perform a status update before going into the RUN mode.

Example No. 3 Operation of Enabler Input



Example No. 4 **Operation of On\d (On with off delay) override input**

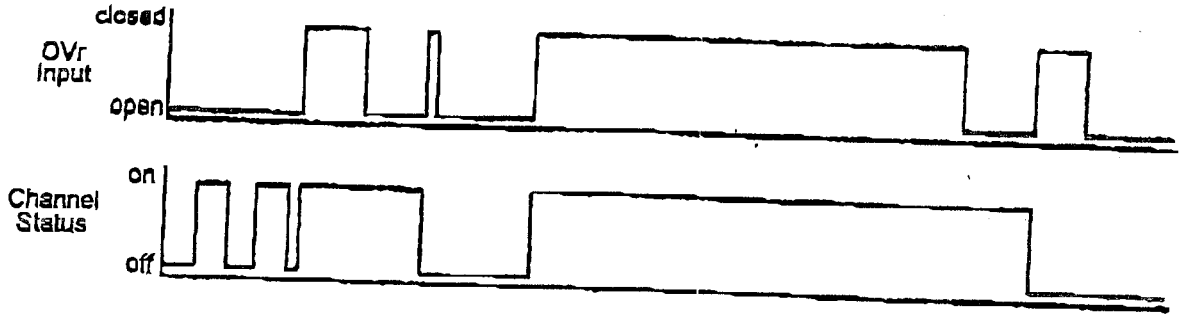
Assume that off delay time is programmed for 1 hour. Also assume that the channel's programmed state is off.



Example No. 5 Operation of OVr (toggle) override input

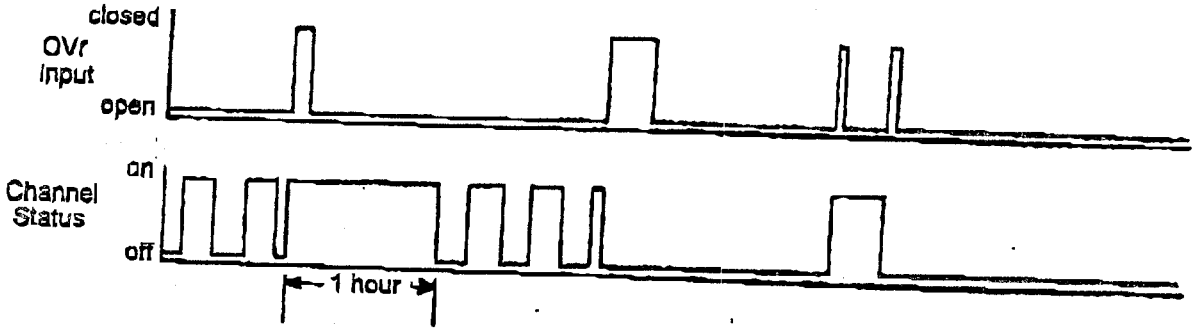
Assume that the channel is currently under control of a duty cycle event.

Case 1: No programmed ON time (ONt = 0:00.00)



NOTES: 1. OVr can be canceled from the keyboard override mode.
2. Toggle override will end when the next programmed event is reached.
3. OVr input is active with the closing of the input. Opening the input has no effect.

Case 2: Programmed ON time = 1 hour



NOTES: 1. OVr ON cancels after 1 hour, unless OVr input is closed again which will force an override OFF.
2. OVr OFF can be canceled from the keyboard override mode.
3. OVr input is active with the closing of the input. Opening the input has no effect.

Programming Worksheets

Configuration

Relay Operation: maintained / momentary

Clock Format: 12 hr / 24 hr

Stagger up: No/5 second/15 second/30 second/1 minute/5minute/10 minute/15 minute.

Duration 1: ___:___.___ (hours:minutes.seconds)
Duration 2: ___:___.___ (hours:minutes.seconds)
Duration 3: ___:___.___ (hours:minutes.seconds)
Duration 4: ___:___.___ (hours:minutes.seconds)

Duty Cycle OFF 1: ___:___.___ (hours:minutes.seconds)
Duty Cycle ON 1: ___:___.___ (hours:minutes.seconds)
Duty Cycle OFF 2: ___:___.___ (hours:minutes.seconds)
Duty Cycle ON 2: ___:___.___ (hours:minutes.seconds)
Duty Cycle OFF 3: ___:___.___ (hours:minutes.seconds)
Duty Cycle ON 3: ___:___.___ (hours:minutes.seconds)
Duty Cycle OFF 4: ___:___.___ (hours:minutes.seconds)
Duty Cycle ON 4: ___:___.___ (hours:minutes.seconds)

Daylight Savings Time: yes / no
(if yes) Spring (start DST): ____ ____ in ____ (i.e. 1st SUN in APR)

Fall (end DST): ____ ____ in ____ (i.e. last SUN in OCT)

Astro

Latitude: ___ north / south
Channel 1 Assignment: yes / no
Channel 2 Assignment: yes / no
Channel 3 Assignment: yes / no
Channel 4 Assignment: yes / no
Channel 5 Assignment: yes / no
Channel 6 Assignment: yes / no
Channel 7 Assignment: yes / no
Channel 8 Assignment: yes / no

Events

#	Event Type	Channel 1-5	Time	Day(s)
			: am/pm	SU MO TU WE TH FR SA HA HB HC
			: am/pm	SU MO TU WE TH FR SA HA HB HC
			: am/pm	SU MO TU WE TH FR SA HA HB HC
			: am/pm	SU MO TU WE TH FR SA HA HB HC
			: am/pm	SU MO TU WE TH FR SA HA HB HC
			: am/pm	SU MO TU WE TH FR SA HA HB HC
			: am/pm	SU MO TU WE TH FR SA HA HB HC
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			: am/pm	SU MO TU WE TH FR SA HA HB HC
			: am/pm	SU MO TU WE TH FR SA HA HB HC

Input Configuration

Input # 1 (choose one of the following):

NONE

On\d OFFd = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

OVr ONt = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

ENb chan 1 = yes/no chan 2 = yes/no chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no chan 7 = yes/no chan 8 = yes/no

F calibration = ___

C calibration = ___

L calibration = ___

U calibration = ___

Input # 2 (choose one of the following):

NONE

On\d OFFd = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

OVr ONt = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

ENb chan 1 = yes/no chan 2 = yes/no chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no chan 7 = yes/no chan 8 = yes/no

F calibration = ___

C calibration = ___

L calibration = ___

U calibration = ___

Input Configuration

Input # 3 (choose one of the following):

NONE

On\d OFFd = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

OVr ONt = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

ENb chan 1 = yes/no chan 2 = yes/no chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no chan 7 = yes/no chan 8 = yes/no

F calibration = ___

C calibration = ___

L calibration = ___

U calibration = ___

Input # 4 (choose one of the following):

NONE

On\d OFFd = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

OVr ONt = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

ENb chan 1 = yes/no chan 2 = yes/no chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no chan 7 = yes/no chan 8 = yes/no

F calibration = ___

C calibration = ___

L calibration = ___

U calibration = ___

Input Configuration

Input # 5 (choose one of the following):

NONE

On\d OFFd = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

OVr ONt = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

ENb chan 1 = yes/no chan 2 = yes/no chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no chan 7 = yes/no chan 8 = yes/no

F calibration = ___

C calibration = ___

L calibration = ___

U calibration = ___

Input # 6 (choose one of the following):

NONE

On\d OFFd = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

OVr ONt = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

ENb chan 1 = yes/no chan 2 = yes/no chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no chan 7 = yes/no chan 8 = yes/no

F calibration = ___

C calibration = ___

L calibration = ___

U calibration = ___

Input Configuration

Input # 7 (choose one of the following):

NONE

On\d OFFd = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

OVr ONt = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

ENb chan 1 = yes/no chan 2 = yes/no chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no chan 7 = yes/no chan 8 = yes/no

F calibration = ___

C calibration = ___

L calibration = ___

U calibration = ___

Input # 8 (choose one of the following):

NONE

On\d OFFd = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

OVr ONt = __:__.__ (hr:min.sec) chan 1 = yes/no chan 2 = yes/no
chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no
chan 7 = yes/no chan 8 = yes/no

ENb chan 1 = yes/no chan 2 = yes/no chan 3 = yes/no chan 4 = yes/no
chan 5 = yes/no chan 6 = yes/no chan 7 = yes/no chan 8 = yes/no

F calibration = ___

C calibration = ___

L calibration = ___

U calibration = ___

Sensor Events

#	Sens. #	Channel (1-8)	Time	Day(s)	Setpoints	
					ON	OFF
01			: am/pm	SU MO TU WE TH FR SA HA HB HC		
02			: am/pm	SU MO TU WE TH FR SA HA HB HC		
03			: am/pm	SU MO TU WE TH FR SA HA HB HC		
04			: am/pm	SU MO TU WE TH FR SA HA HB HC		
05			: am/pm	SU MO TU WE TH FR SA HA HB HC		
06			: am/pm	SU MO TU WE TH FR SA HA HB HC		
07			: am/pm	SU MO TU WE TH FR SA HA HB HC		
08			: am/pm	SU MO TU WE TH FR SA HA HB HC		
09			: am/pm	SU MO TU WE TH FR SA HA HB HC		
10			: am/pm	SU MO TU WE TH FR SA HA HB HC		
11			: am/pm	SU MO TU WE TH FR SA HA HB HC		
12			: am/pm	SU MO TU WE TH FR SA HA HB HC		
13			: am/pm	SU MO TU WE TH FR SA HA HB HC		
14			: am/pm	SU MO TU WE TH FR SA HA HB HC		
15			: am/pm	SU MO TU WE TH FR SA HA HB HC		
16			: am/pm	SU MO TU WE TH FR SA HA HB HC		
17			: am/pm	SU MO TU WE TH FR SA HA HB HC		
18			: am/pm	SU MO TU WE TH FR SA HA HB HC		
19			: am/pm	SU MO TU WE TH FR SA HA HB HC		
20			: am/pm	SU MO TU WE TH FR SA HA HB HC		
21			: am/pm	SU MO TU WE TH FR SA HA HB HC		
22			: am/pm	SU MO TU WE TH FR SA HA HB HC		
23			: am/pm	SU MO TU WE TH FR SA HA HB HC		
24			: am/pm	SU MO TU WE TH FR SA HA HB HC		
25			: am/pm	SU MO TU WE TH FR SA HA HB HC		
26			: am/pm	SU MO TU WE TH FR SA HA HB HC		
27			: am/pm	SU MO TU WE TH FR SA HA HB HC		
28			: am/pm	SU MO TU WE TH FR SA HA HB HC		
29			: am/pm	SU MO TU WE TH FR SA HA HB HC		
30			: am/pm	SU MO TU WE TH FR SA HA HB HC		
31			: am/pm	SU MO TU WE TH FR SA HA HB HC		
32			: am/pm	SU MO TU WE TH FR SA HA HB HC		

Holidays (special)

Good Friday:	HOL A	HOL B	HOL C	not used
Easter Sunday:	HOL A	HOL B	HOL C	not used
Easter Monday:	HOL A	HOL B	HOL C	not used
Thanksgiving Thu + Fri:	HOL A	HOL B	HOL C	not used
Boxing Day:	HOL A	HOL B	HOL C	not used
Victoria Day:	HOL A	HOL B	HOL C	not used

Holidays (date)

#	Month	Date	Holiday Schedule HOLIDAY A, B, C, or NONE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Holidays (Day of week)

#	Week 1st, 2nd, 3rd, 4th or last	Day	Month	Holiday Schedule HOLIDAY A, B, C, or NONE
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Holidays (duration)

#	Begin		End		Holiday Schedule HOLIDAY A, B, C, or NONE
	Month	Date	Month	Date	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Note: This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareill numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Commercial / Industrial Warranty

The products manufactured by Paragon Electric Company, Inc. and used in commercial, industrial or institutional applications are warranted to be free from defects in workmanship or material under normal use and service, for a period of one (1) year from the date of purchase by the end user (whether separately or as a component of other products), or eighteen (18) months from the date of manufacture of the Paragon products, whichever is less.

Paragon's obligation under this warranty is limited to replacing or repairing, free of charge, any product returned to Paragon with transportation charges prepaid, providing that Paragon's examination discloses to its satisfaction that such product is defective.

This warranty does not apply to damage caused by misuse, neglect, accident or mishandling, or to products which have been subject to repair by anyone other than Paragon, opened or taken apart, or which have not been properly installed or have been used other than in accordance with Paragon's instructions.

THIS WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OR MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

IN NO EVENT SHALL PARAGON BE LIABLE TO PURCHASER OR ANY THIRD PARTY FOR ANY LOSS OF PROFITS OR OTHER INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES WHATSOEVER.

PARAGON ELECTRIC COMPANY, INC.

IN U.S.
Paragon Electric Co., Inc.
608 Parkway Blvd., P.O. Box 28
Two Rivers, WI 54241-0028
920/793-1161 FAX 920/793-3736

IN CANADA:
Paragon Electric Canada Ltd.
5785 Kennedy Road
Mississauga, Ontario L4Z 2G3
905/890-5956 FAX 905/890-6098

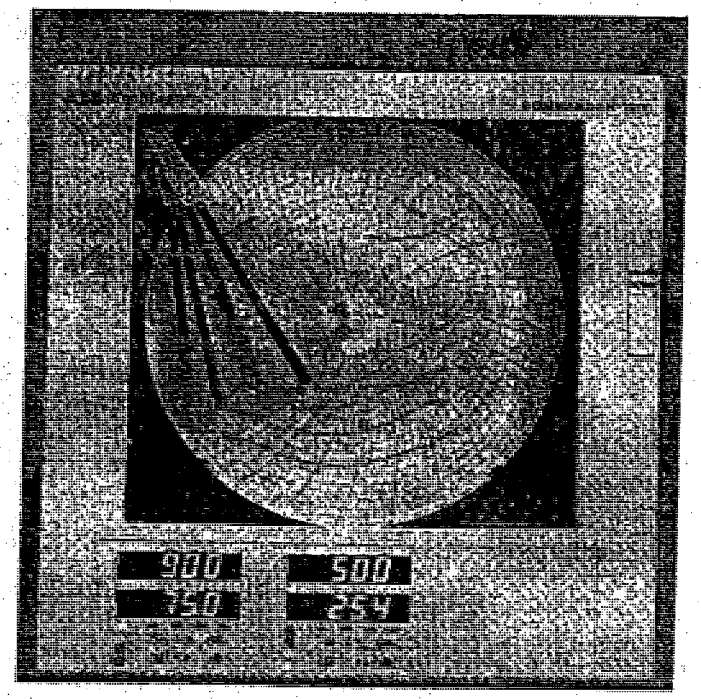
IN EUROPE:
Robertshaw International
2809 Emerywood Parkway, Ste. 400
Richmond, VA 23294-3743
804/756-6500 FAX 804/756-6361

Part No. 949395 Made in USA Printed in USA

Specifications

COMMANDER 1900
Circular Chart Recorder

- **1 to 4 pens –** full application flexibility
- **NEMA 4X/IP66 construction –** Hose-down protection
- **Multiple 6-digit indicator panels –** continuous display of all signal values
- **0.1% measurement accuracy –** precise process information
- **High noise immunity –** robust, dependable operation
- **RS485 MODBUS serial communications –** open systems compatibility
- **Totalizers and math functions built-in –** fully integrated solutions



COMMANDER 1900 – a rugged, reliable recorder with the full capability to meet your application needs

ABB Instrumentation

SS C1900R

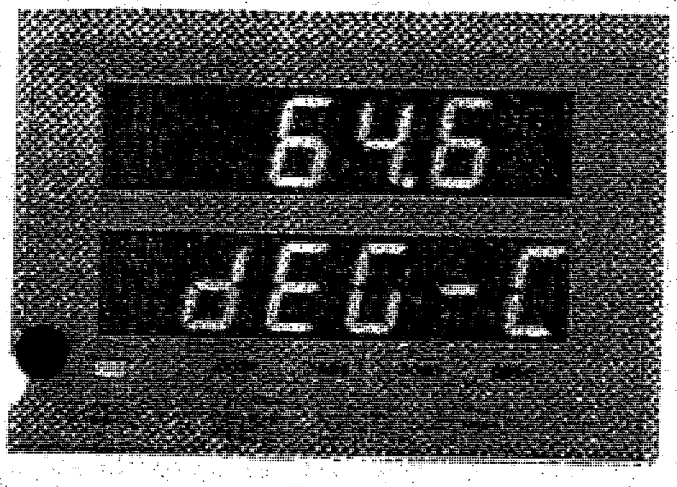
CP-67

COMMANDER 1900

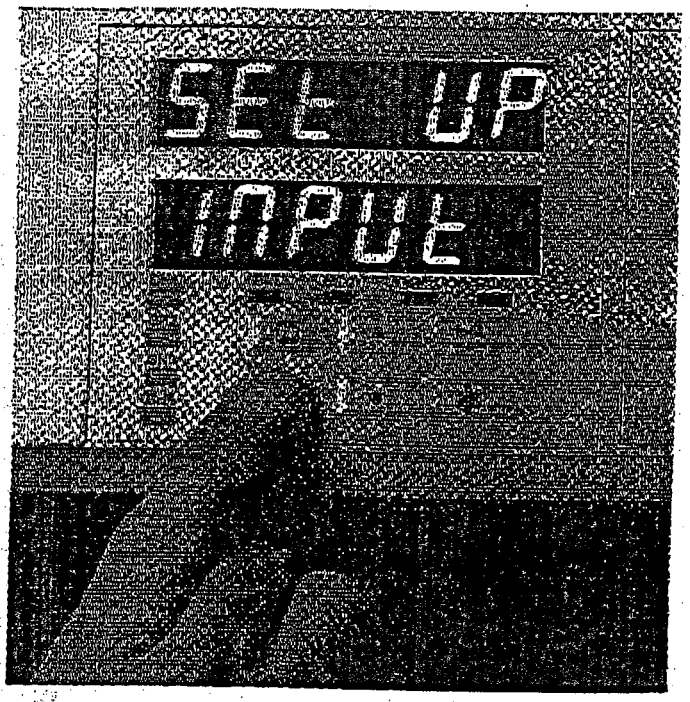
The COMMANDER 1900 is a fully programmable circular chart recorder for up to four process signals. The COMMANDER's straightforward operator controls and robust construction make it suitable for a variety of industrial environments. Excellent standard facilities are complemented by a powerful range of options to give the flexibility to match your application.

Comprehensive Process Information

The COMMANDER lets you see the status of your process at a glance: **high visibility 6-digit displays** provide a clear indication of up to four process values simultaneously and active alarms are signalled by flashing LED's below the main display.

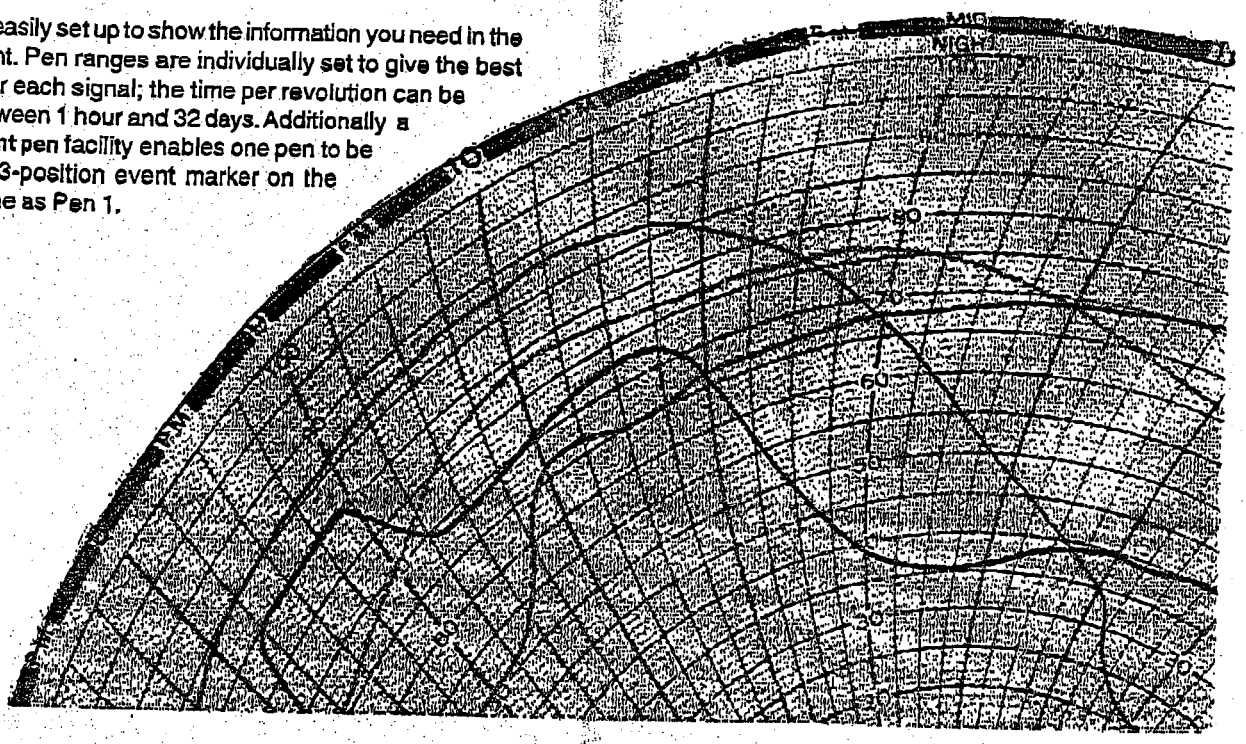


Simple Operation



The clearly-labelled **tactile keypad** gives direct access for operator adjustments and configuration programming, without the need to open the recorder's door. Clear text prompts on the digital displays guide the user around the various menus. A **password-protected security system** prevents unauthorized access to configuration adjustment menus.

The **chart** is easily set up to show the information you need in the way you want. Pen ranges are individually set to give the best resolution for each signal; the time per revolution can be selected between 1 hour and 32 days. Additionally a **true time event pen** facility enables one pen to be set up as a 3-position event marker on the same time line as Pen 1.



Flexibility to Solve Problems

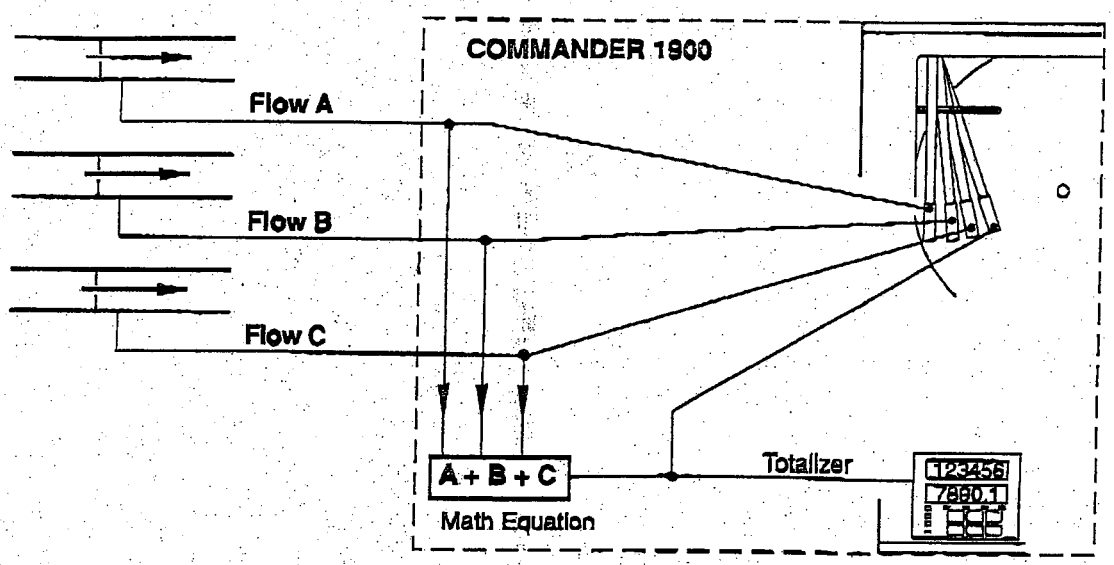
The COMMANDER 1900 offers seamless integration of loop functionality to solve process problems, eliminating the need for auxiliary devices.

Totalizers, Math and Logic

Integrating fluid flow to calculate total volume is performed by the **built-in totalizers** available for each channel. Relays can be assigned to increment or reset external counters to match the recorder's totalizer values.

User configurable **math functions**, mass flow calculations and RH tables are all fully supported.

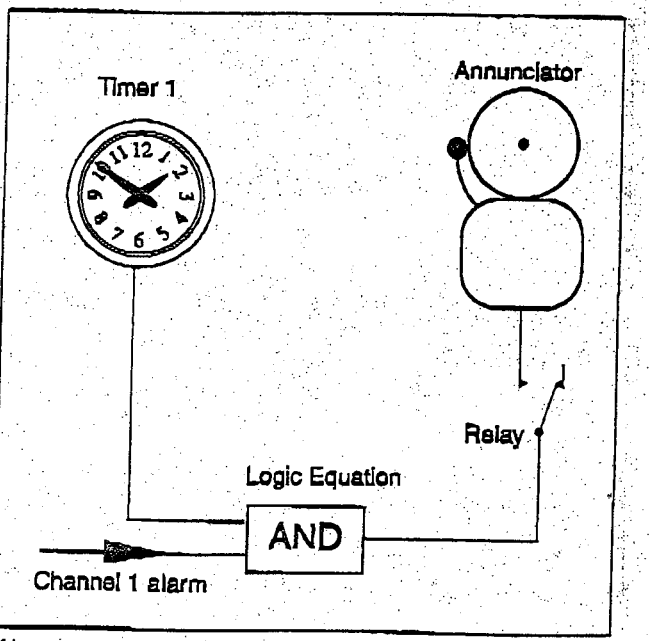
Logic capability allows interlocking and integration of discrete and continuous functions to solve a wide range of process problems.



Summation of Three Flows

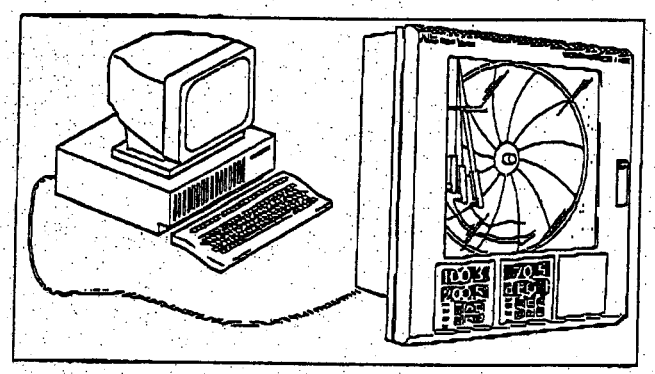
Timers and Clock

The COMMANDER offers two event timers driven by the recorder's **real-time clock**. The timers can be configured to operate relays, start/stop the chart or trigger other actions within the recorder.



Alarm annunciation enabled during night hours only.

MODBUS RS485 Communications



Communications with PCs or PLCs are achieved via the **RS485 serial communications** link, enabling the COMMANDER to serve as the front end of plant-wide data acquisition systems. Using MODBUS RTU protocol all process inputs and other variables can be continuously read by a host PC running any of a wide variety of standard SCADA packages.

Built to Meet Your Needs

COMMANDER's modular architecture gives rise to a high level of hardware choice: up to five I/o modules can be added to the basic instrument.

The **standard input/output module** supplied with every pen comes complete with a fully isolated analog input, a relay output, transmitter power supply, isolated analog retransmission and two digital inputs. Further input and output capability is provided by a **range of plug-in modules:**

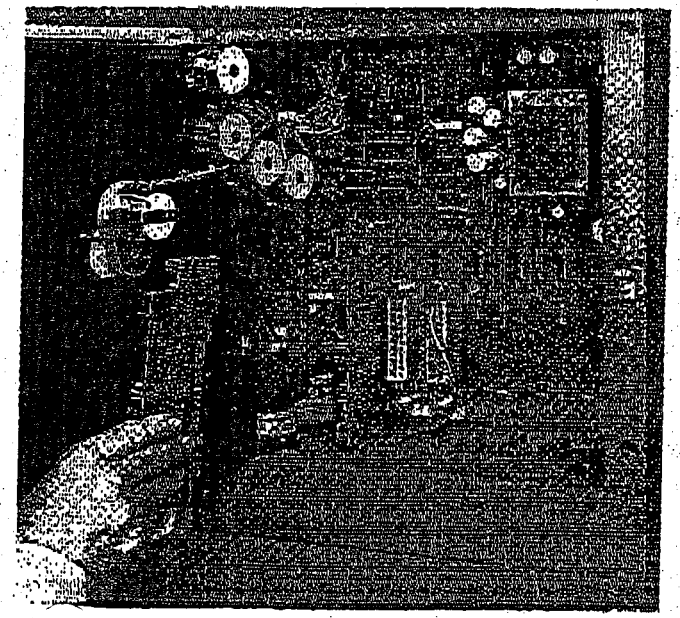
- **Analog input and relay** – for use with math functions
- **Four relays** – channel alarm outputs
- **Eight digital inputs** – linked using logic equations
- **Eight digital outputs** – TTL level alarm outputs
- **MODBUS RS485 communications** – interfaces with P.C.s

Expandable for the Future

The COMMANDER may be quickly upgraded to meet your changing process requirements.

Additional recording channels, math capability or input and output functions can be retrofitted on-site using **plug-in cards** and easily fitted pen arms. Input calibration data is stored on card, allowing quick changes to input cards without the need for recalibration.

Changes to input sensors or recording procedures are accommodated by reconfiguration using the main keypad.

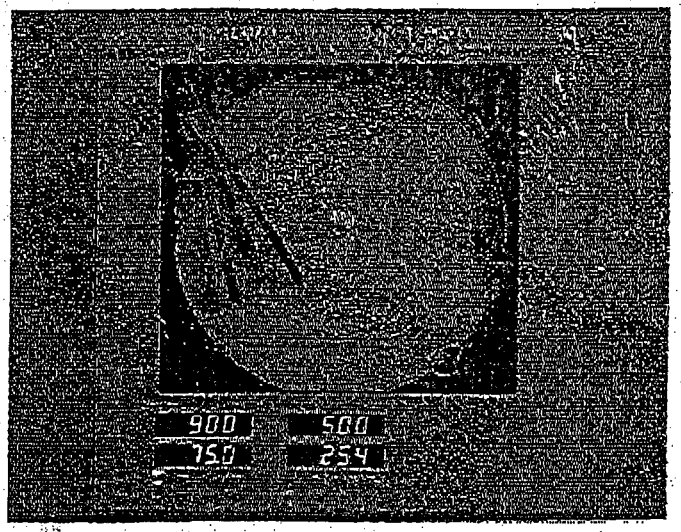


Minimal Maintenance

Excellent long-term stability keeps recalibration to a minimum, cutting the costs of ownership. User-selectable chart speeds and long-life pens combine to limit usage of consumables.

Designed to Survive

NEMA 4X protection ensures the COMMANDER can survive in the harshest environments and makes the recorder ideal for use in panels which are regularly hosed down. The **tough, acid-resistant case** and secure cable-entry glands maintain the NEMA 4X rating for wall-mounted or pipe-mounted instruments.

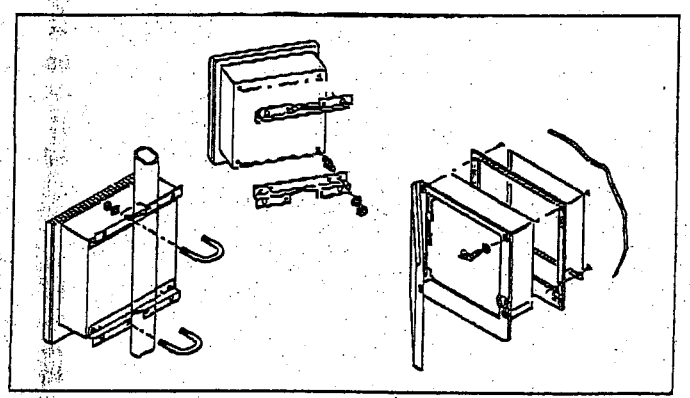


Noise Immunity

Recording accuracy is maintained in noisy industrial environments due to the **advanced EMC shielding** within the recorder. The power supply has been designed to give excellent protection from power spikes and brownouts and all configuration and status information is held in nonvolatile memory to ensure rapid recovery after a power failure.

Easy to Install

A choice of mounting options enables simple installation of the recorder in a panel, on a wall or on a pipe. **Detachable terminal blocks** allow for trouble-free connection of input and output wiring, with mains isolation provided by a power switch within the instrument.



Built-in Quality

The COMMANDER 1900 is designed, manufactured and tested to the highest quality standards, including ISO 9001, and is guaranteed by a 2 year parts and labour warranty.

Commander 1900 Performance Specification

Summary

1, 2, 3 or 4 pens
10" Chart size
Standard i/o with each pen includes:
Analog input, analog output, transmitter power supply, relay output and 2 digital inputs.

General

Construction

Size:	15.23" (h) x 15.04" (w) x 5.57" (d) (386.8 x 128.0 x 141.5mm)
Weight:	18lb (8.2kg)
Case material:	Glassfiber-filled reinforced polyester
Window Material:	Polycarbonate
Door latch:	High-compression with optional lock

Environmental

Operational temperature range:	32° to 130°F (0° to 55°C)
Operational humidity range:	5 to 95%RH (non-condensing) 5 to 80%RH (chart only)
Case sealing:	NEMA 4X (IP66)
Fast transients:	IEC 801-4 Level 3

Installation

Mounting options:	Panel, wall or pipe
Terminal type:	Screw
Wire size (max):	14 AWG (i/o), 12 AWG (power)

Operation and Configuration

Programming method:	Via front panel keys
Security:	Password protected menus

Safety

General safety:	IEC348
Isolation:	500V dc (channel/channel) 2kV dc (channel/ground)
Memory protection:	Nonvolatile EEPROM
Approvals:	CSA (pending)

Power Supply

Voltage:	115/230V ac ±15%, 50/60Hz
Consumption:	< 40 VA (typical for full spec. unit)
Line interruption:	Up to 60ms

Process Inputs and Outputs

General

Noise Rejection:	Common mode > 120dB at 50/60Hz Normal (series) mode > 60dB at 50/60Hz
CJC rejection ratio:	< 0.05°C/°C
Sensor break protection:	Upscale or downscale drive
Out of range detection:	0 to 100% of engineering span
Temperature stability:	< 0.02% of reading/°C or 1µV/°C
Long-term drift:	< 0.01% of reading 10µV annually
Input impedance:	> 10 MΩ (mV and V inputs) 100 Ω (mA input)

Analog Inputs

Signal types:	mV, V, mA, Ω
Thermocouple types:	B, E, J, K, N, R, S, T
Resistance Thermometer:	Pt 100
Other linearizations:	$x^{1/2}$, $x^{3/2}$, $x^{5/2}$, linear
Sample interval:	250ms per channel
Isolation:	500Vdc channel/channel
Digital Filter:	0 to 60s programmable

Transmitter Power Supplies

Number:	1 per channel
Voltage:	24Vdc nominal
Drive:	Up to 25mA
Isolation:	500Vdc channel/channel

Analog Input Performance

Type	Range Lo	Range Hi	Min. Span	Accuracy
mV	0	150	5	±0.1% reading or 10µV
V	0	5	0.1	±0.1% reading or 20µV
mA	0	50	1	±0.2% reading or 0.2µA
Ohms (low)	0	750	20	±0.2% reading or 0.1 ohms
Ohms (high)	0	10k	400	±0.5% reading or 10 ohms

	°C		°F		
Type	Range Lo	Range Hi	Range Lo	Range Hi	Accuracy (excl. CJC)
B	–18	1800	0	3270	±2.0°C (above 200°C)
E	–100	900	–140	1650	±0.5°C
J	–100	900	–140	1650	±0.5°C
K	–100	1300	–140	2350	±0.5°C
N	–200	1300	–325	2350	±0.5°C
R	–18	1700	0	3000	±1.0°C (above 300°)
S	–18	1700	0	3000	±1.0°C (above 200°C)
T	–250	300	–400	550	±0.5°C
PT100	–200	600	–325	1100	±0.5°C

Analogue Outputs

Type:	4 to 20 mA
Accuracy:	±0.1%
Maximum load:	750 Ω
Isolation:	500V dc

Relay Outputs

Type:	SPDT
Rating (with non-inductive load):	5A at 115/230Vac

Digital Inputs

Type:	TTL or volt-free
Minimum pulse:	250ms
Isolation:	500Vdc between modules, no isolation within module

Digital Outputs

Type:	5V TTL
Rating:	5mA per output
Isolation:	500Vdc between modules, no isolation within module

Serial Communications

Connections:	RS485, 4 wire
Protocol:	MODBUS RTU

Pneumatic inputs/outputs

Type:	3 to 15 psig I/P, 3 to 15 psig P/I
Mounting:	External DIN rail on rear of unit

Recording System

Pens

Number:	1, 2 ,3, or 4 (red, blue, green, black)
Response:	7 seconds (full scale)
Resolution:	0.1% steps
Pen lift:	Motor-driven, with optional auto-drop

Event Pens

Standard:	3-position event recording on any channel
Real time:	3-position event recording on the same time line as Pen 1

Chart

Chart size:	10" or 105mm
Chart speed:	1 to 167 hours or 7 to 32 days per revolution

Display and Operator Panels

Displays

Number:	2 (1 or 2 pens) or 4 (3 or 4 pens)
Type:	6-digit red LED, 0.56" (14mm) high
Status indicators:	Indicate channel number on display
Alarm indicators:	Indicate channel with active alarms

Panel keys

Function:	Programming access, increment/ decrement, pen lift and user-defined function key.

Alarms and Logic

Alarms

Number:	4 per channel
Type:	High/low process, fast/slow rate of change
Adjustments:	Hysteresis, time delay

Logic Equations

Number:	4
Function:	OR, AND
Inputs:	Alarm states, digital inputs, totalizers, logic
Outputs:	Relays, digital outputs, chart stop, alarm acknowledge

Advanced Software Functions

Totalizers

Number:	1 per pen
Size:	99,999,999 max.
Output:	External counter driver, "wrap" pulse signal

Math

Number of eqns.:	4
Type:	+, −, x, ÷, low & high select, max, min, average, mass flow, RH

Timers

Number:	2
Type:	Real-time clock driven event, adjustable duration
Output:	Relay, digital output, logic equation

Option Module

Number:	5 plus 1 x standard input/output module
Connection:	Plug in cards with detachable connection blocks

Option Module Types	i/o per module							
	Analog i/p	Analog o/p	Trans. PSU	Relays	Digital i/p	Digital o/p	Comms.	Max. No. per instrmt
Standard i/o	1	1	1	1	2			3
Analog i/p + relay	1			1				5
4 relays				4				2
Digital i/p					8			3
digital o/p						8		3
RS485 comms.							1	1
1901J (non-upgradeable)	1							

Ordering Guide

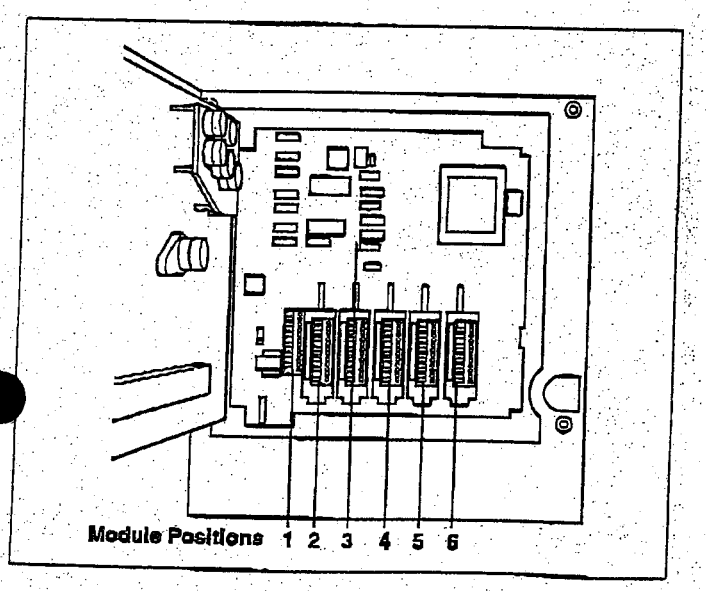
PART 1

COMMANDER 1900 Recorder		19XX	X	X	X	X	X	X	X	X	X	X	X	XXX
Recorders	One Pen (Red) Basic, non-upgradeable	01												
	One Pen (Red)	11												
	Two Pens (Red & Green)	12												
	Three Pens (Red, Green, Blue)	13												
	Four Pens (Red, Green, Blue, Black)	14												
Chart Type	Standard (ER/C type)		J											
	KPC 105 PX and PXR type charts		K											
	Chessell Brand charts		D											
Electrical Code	Standard			A										
Option Module	None				0									
	Additional Modules Ð *Complete PART 2*				A									
Options	None					0								
	Totalizer					3								
	Maths & Timer					A								
	Totalizer, Maths & Timer					B								
Door Lock	Not Fitted						1							
	Fitted						2							
Power Supply	115V A.C.							1						
	230V A.C.							2						
	24V A.C.							3						
	115V A.C. with On/Off Switch							4						
	230V A.C. with On/Off Switch							5						
	24V A.C. with On/Off Switch							6						
Special Settings	Company Standard													STD
	Customer Setting													CUS
	Special													SXX

Each pen fitted has an associated standard Input/Output module comprising Analog input, Analog output, Relay, Transmitter Power Supply and Two Digital Inputs.
Additional Input/Output modules may be fitted in the unused Module Positions as required. These additional modules should be specified in PART 2 of the Ordering Guide

PART 2 Additional Modules

	Module Type
Module Position 2 / Channel 2 Input*	0 1 2
Module Position 3 / Channel 3 Input*	0 1 2
Module Position 4 / Channel 4 Input *	0 1 2 3 4 5 6
Module Position 5	0 1 2 3 4 5
Module Position 6	0 2 4 5 8

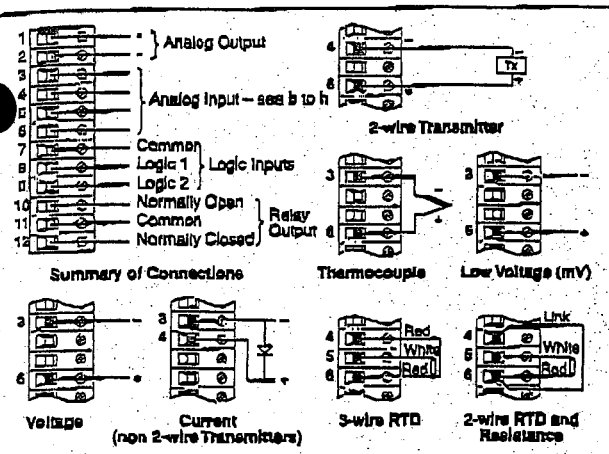


Key to Module Types

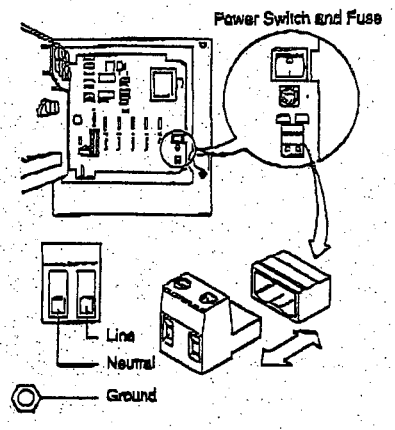
0 No module fitted / Pen input channel *
1 Standard Input/Output
2 Analog Input (Math input) + Relay
3 Four Relays
4 Eight Digital Inputs
5 Eight Digital Outputs
6 True Time Event Pen (Violet)
8 MODBUS RS485 Communications

* On 2, 3 or 4 pen instruments a standard I/O module is always fitted in the corresponding module position (enter '0' in the corresponding order code field).

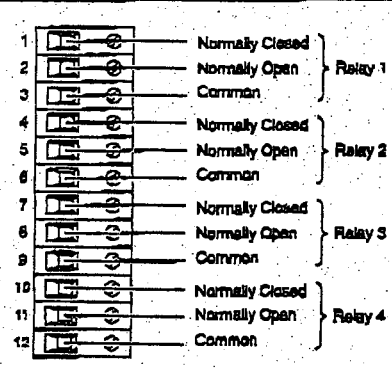
e.g. 1 9 1 3 J A A 0 1 1 0 0 3 0 8 STD
3 pen
4 relays
Modbus RS485 communications



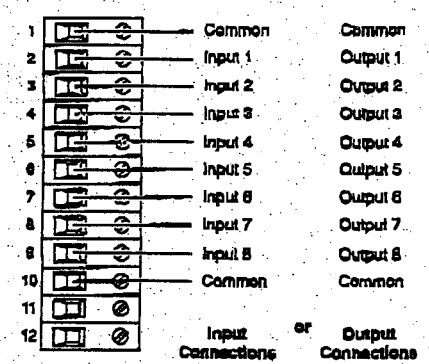
Standard Input/Output Modules



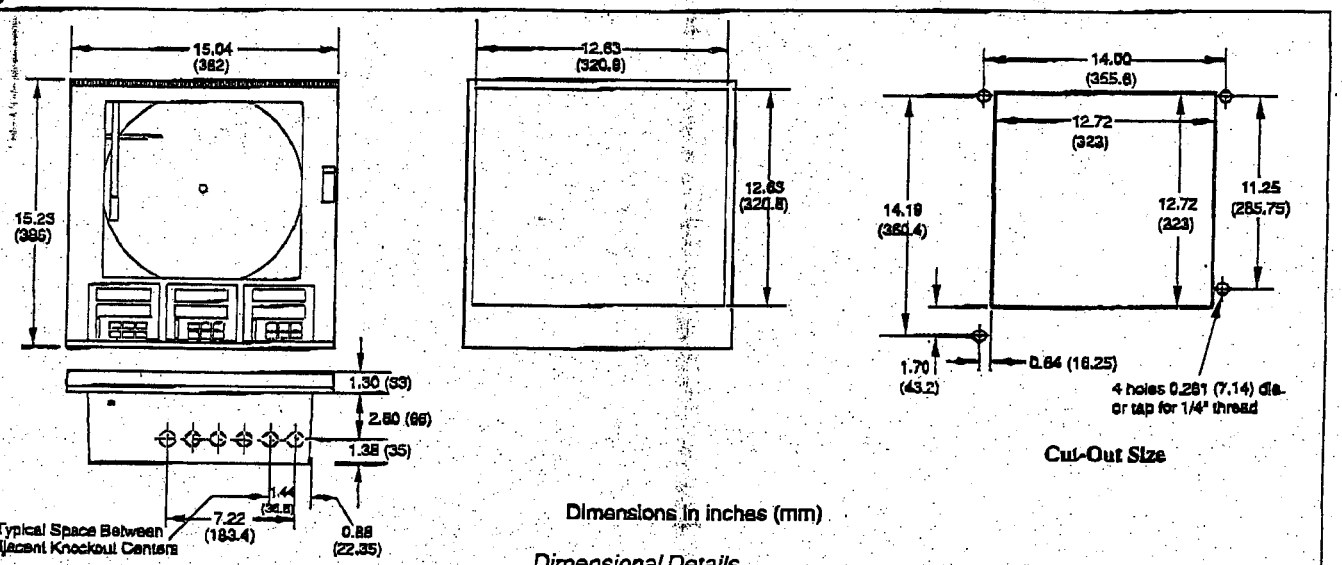
Power Supply Connections



Eight Relay Output Module



Digital Input/Output Module



Dimensional Details

COMMANDER 1900 Series
Circular Chart Recorders

Installation Guide

All Versions

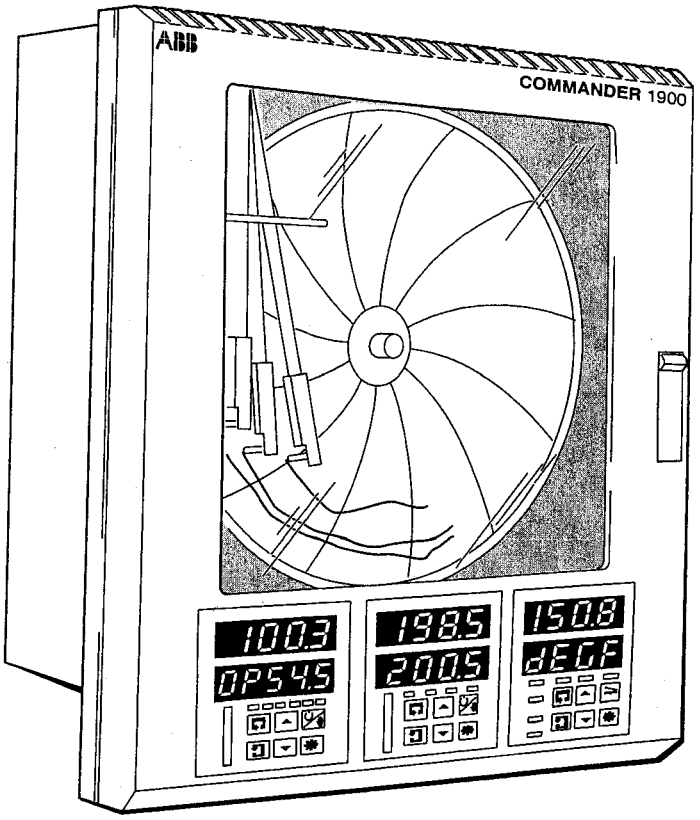


ABB Instrumentation

ABB

ABB INSTRUMENTATION

The Company

ABB Instrumentation is an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

The NAMAS Calibration Laboratory No. 0255(B) is just one of the ten flow calibration plants operated by the Company, and is indicative of ABB Instrumentation's dedication to quality and accuracy.

BS EN ISO 9001

St Neots, U.K. – Cert. No. Q5907
Stonehouse, U.K. – Cert. No. FM 21106

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K. – Cert. No. 0255

Use of Instructions

Warning.
An instruction that draws attention to the risk of injury or death.

Note.
Clarification of an instruction or additional information.

Caution.
An instruction that draws attention to the risk of damage to the product, process or surroundings.

Information.
Further reference for more detailed information or technical details.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it must be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

CONTENTS

1 INTRODUCTION

The series of COMMANDER 1900 instruction manuals is shown in Fig. 1.1. The **Standard Manuals**, including the specification sheet, are supplied with all instruments. The **Supplementary Manuals** supplied depend on the specification of the instrument.

This manual includes an **Installation Record** which should be completed as a log of the electrical installation. The record is useful when carrying out initial instrument programming and can be retained for future reference.

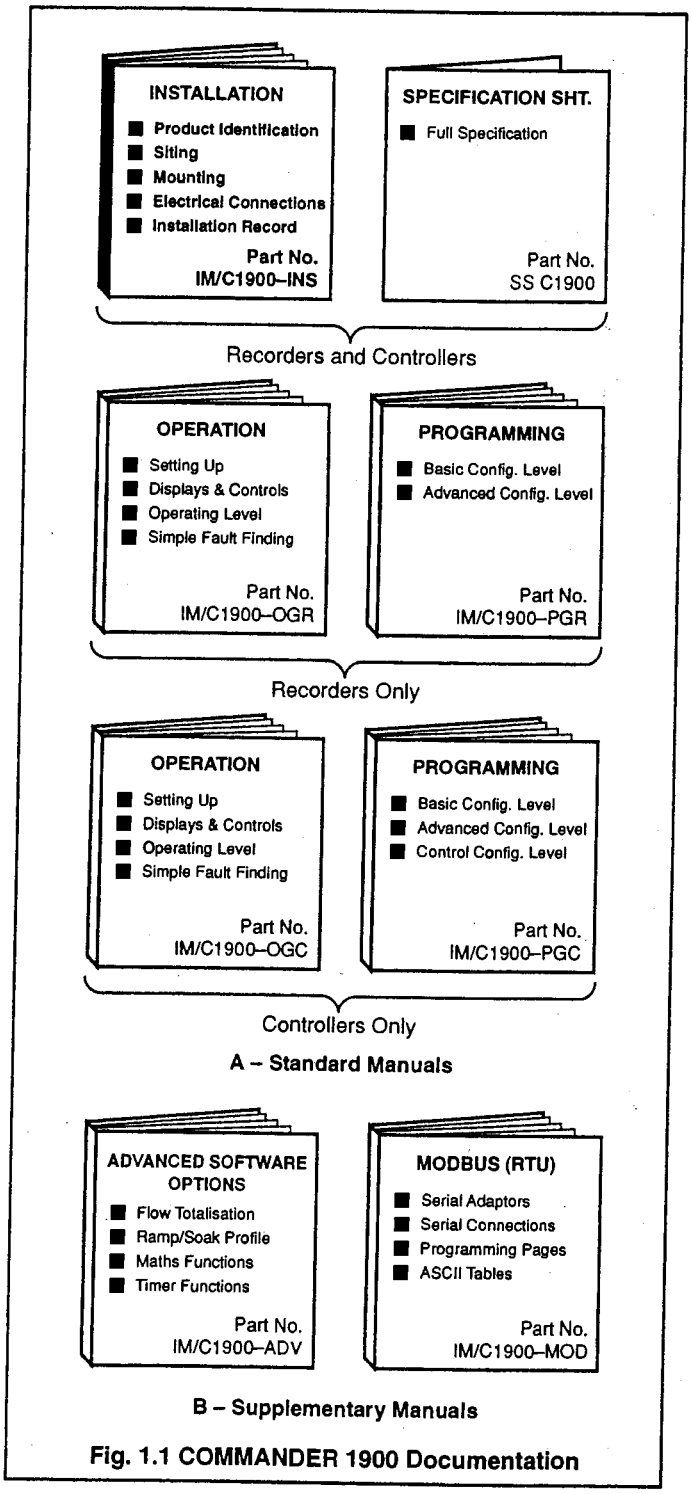
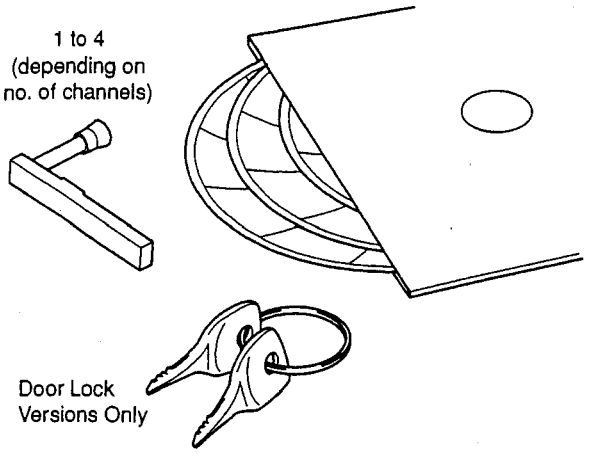


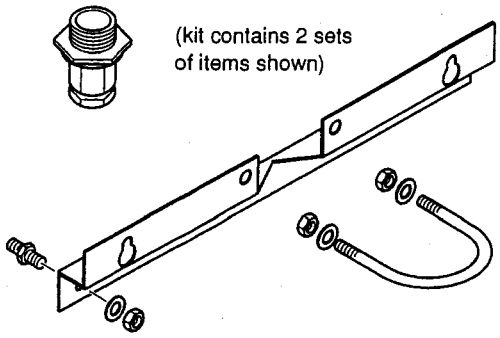
Fig. 1.1 COMMANDER 1900 Documentation

2 PREPARATION

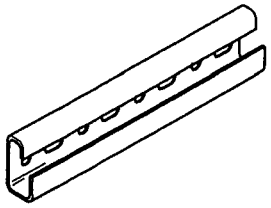
2.1 Accessories – Fig. 2.1



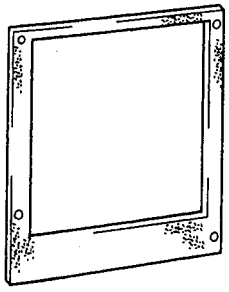
A – Standard Accessories



B – Wall-/Pipe-mounting Accessories (part no. C1900/0712)



C – DIN Rail (part no. C1900/0713)



D – Optional Case-to-Panel Gasket (part no. C1900/0149)

Fig. 2.1 Accessories

2.2 Checking the Code Number – Fig. 2.2

2.1.1 Non-upgradeable Version

> **Information.**
> The 1901J is a basic, non-upgradeable single pen recorder. This version is not fitted with an analog output, relay, transmitter power supply unit or digital inputs and no additional modules can be fitted. The full identification code is shown below.

1901J A 0 0 1 1 00000 STD

- **COMMANDER 1900 single pen recorder**
- Electrical code – **standard**
- Option module – **none**
- Options – **none**
- Door lock – **not fitted**
- Power supply – **115V a.c.**
- Modules fitted in module positions 2 to 6 – **none**
- Special Settings – **company standard**

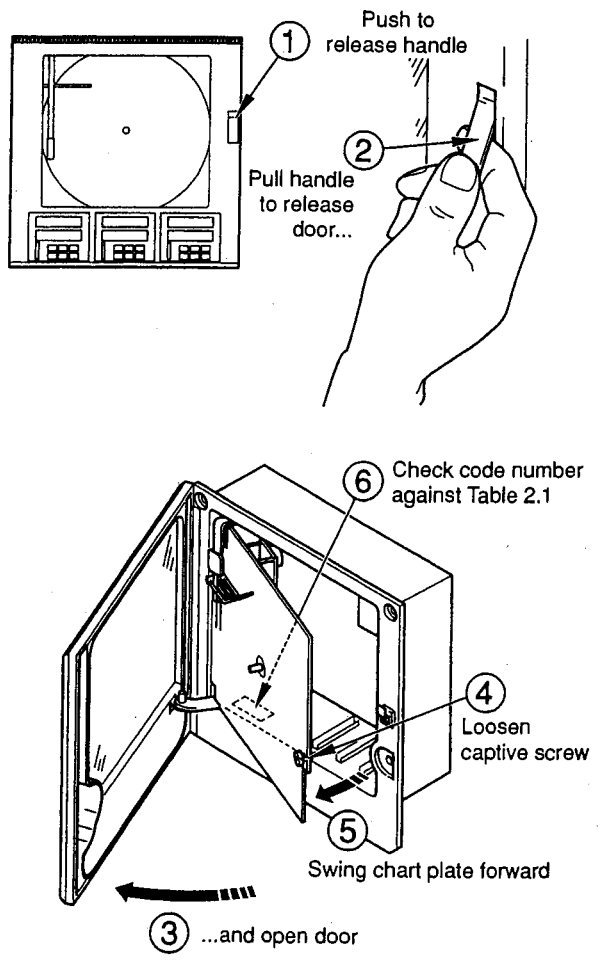


Fig. 2.2 Checking the Code Number

...2.2 Checking the Code Number

1900 Recorder/Controller		19 XX	X	X	X	X	X	X	X	X	X	X	XXX
Recorders	One Pen (Red)	11											
	Two Pens (Red & Green)	12											
	Three Pens (Red, Green, Blue)	13											
	Four Pens (Red, Green, Blue, Black)	14											
Recorder/ Controllers	One Control Unit One Pen (Red)	11											
	One Control Unit, Two Pens (Red & Green)	12											
	One Control Unit, Three Pens (Red, Green, Blue)	13											
	One Control Unit, Four Pens (Red, Green, Blue, Black)	14											
	Two Control Units, Two Pens (Red & Green)	22											
	Two Control Units, Three Pens (Red, Green, Blue)	23											
	Two Control Units, Four Pens (Red, Green, Blue, Black)	24											
Chart Type	Recorder Standard (ER/C Type Chart)		J										
	Recorder KPC (PX105 and PXR105 Type Charts)		K										
	Recorder Special (Special Charts)		C										
	Controller Standard (ER/C Type Chart)		R										
	Controller KPC (PX105 and PXR105 Type Charts)		S										
	Controller Special (Special Charts)		D										
Electrical Code	Standard			A									
	CSA			B									
Option Module	None				0								
	Additional Modules				A								
Options	None					0							
	Totalizer					3							
	Ramp/Soak Profile (Recorder/Controller versions only)					5							
	Maths & Timer					A							
	Totalizer, Maths & Timer					B							
	Totalizer, Ramp/Soak, Profile, Maths & Timer (Recorder/Controller versions only)					C							
Door Lock	Not Fitted						1						
	Fitted						2						
Power Supply	115V A.C.							1					
	230V A.C.							2					
	24V A.C.							3					
	115V A.C. with On/Off Switch							4					
	230V A.C. with On/Off Switch							5					
	24V A.C. with On/Off Switch							6					

Module Position 2*					0	1	2							
Module Position 3**					0	1	2							
Module Position 4***					0	1	2	3	4	5	6			
Module Position 5					0		2	3	4	5				
Module Position 6					0		2		4	5			8	
Special Settings	Company Standard													STD
	Customer Setting													CUS
	Special													SXX

Table 2.1 Code Number Interpretation

Key to Module Types

0 No module fitted
1 Standard Input/Output
2 Analog Input + Relay
3 Four Relays
4 Eight Digital Inputs
5 Eight Digital Outputs
6 True Time Event Pen (Violet)
8 MODBUS RS485 Communications

Refer to Fig. 4.2 on page 6 for module positions and identification.

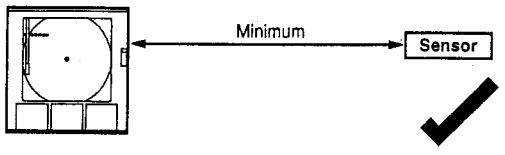
* On 2, 3 and 4 pen instruments standard I/O module is always fitted in this position for the Channel 2 input.

** On 3 and 4 pen instruments standard I/O module is always fitted in this position for the Channel 3 input.

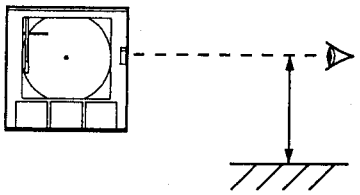
*** On 4 pen instruments standard I/O module is always fitted in this position for the Channel 4 input.

3 MECHANICAL INSTALLATION

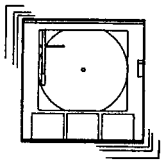
3.1 Siting – Figs 3.1 and 3.2



A – Close to Sensor

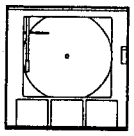


B – At Eye-level Location

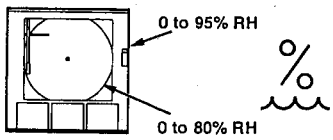


C – Avoid Vibration

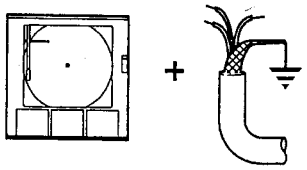
Fig. 3.1 General Requirements



A – Within Temperature Limits



B – Within Humidity Limits



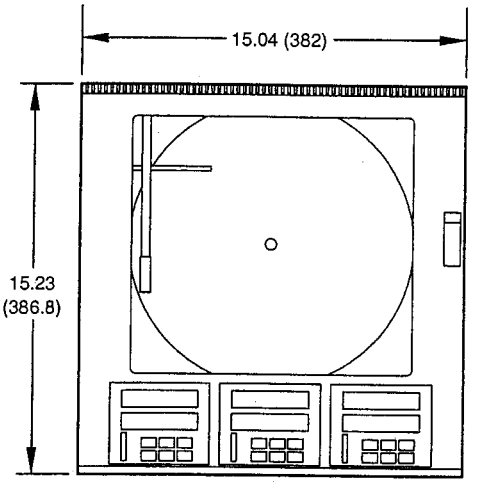
Caution. Select a location away from strong electrical and magnetic fields. If these cannot be avoided, particularly in applications where 'walkie-talkies' are used, connect using screened cables within grounded metal conduit.

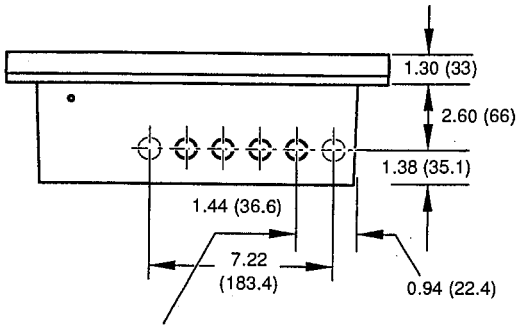
C – Use Screened Cables

Fig. 3.2 Environmental Requirements

3.2 Mounting – Figs. 3.3 to 3.5

Dimensions in inches (mm)





Typical Space Between
Adjacent Knockout Centers

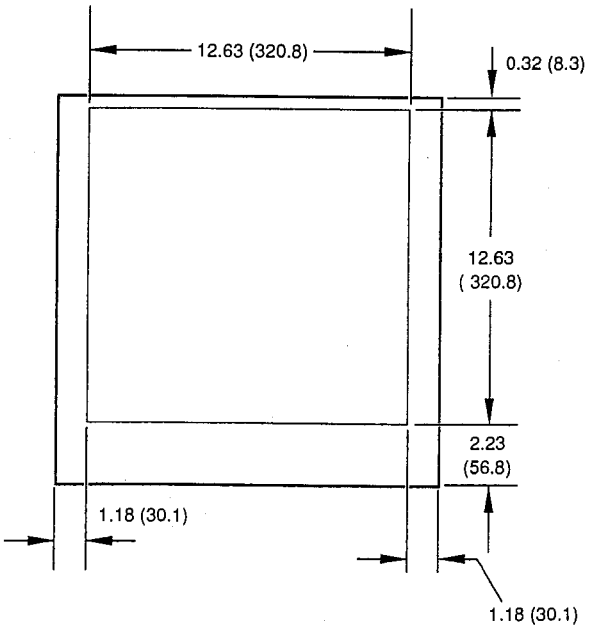
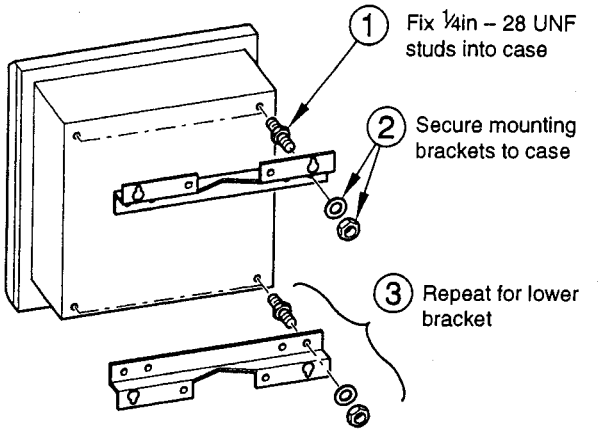
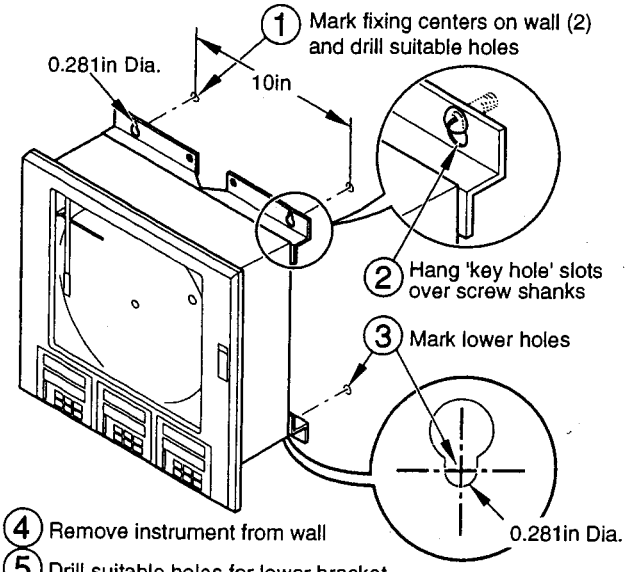


Fig. 3.3 Overall Dimensions

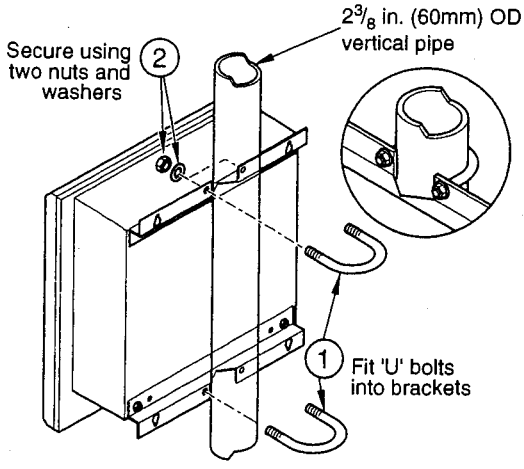
3.2.1 Wall-/Pipe-Mounting – Fig. 3.4



A – Fitting the Mounting Brackets



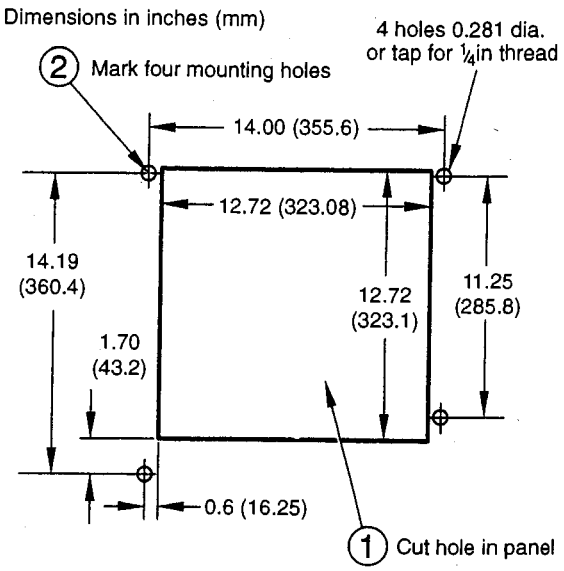
B – Wall Mounting



C – Pipe Mounting

Fig. 3.4 Wall-/Pipe Mounting

3.2.2 Panel Mounting – Fig. 3.5



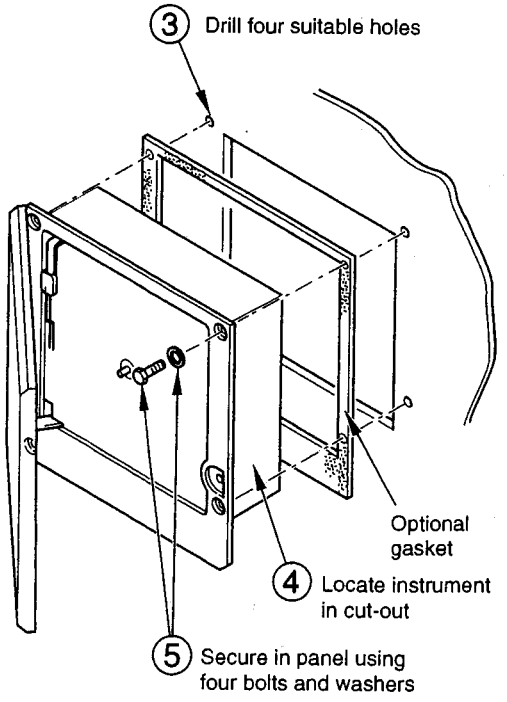


Fig. 3.5 Panel Mounting

4 ELECTRICAL INSTALLATION

Warning. Before making any connections, ensure that the power supply, any high voltage-operated control circuits and high common mode voltages are switched off.

Note.

- To comply with Underwriter Laboritories (UL) certification, use flexible conduit for cable routing (signal and power).
- Always route signal leads and power cables separately, preferably in earthed metal conduit.
- Screened cable must be used for signal inputs and relay connections. Connect the screen to the ground stud.
- The terminal blocks can be removed from the main p.c.b. when making connections. Before removing any module note its position – see Fig. 4.1.

Information. Use cable appropriate for the load currents. The terminals accept cables up 12AWG for power supply connections and 14AWG for all other connections.

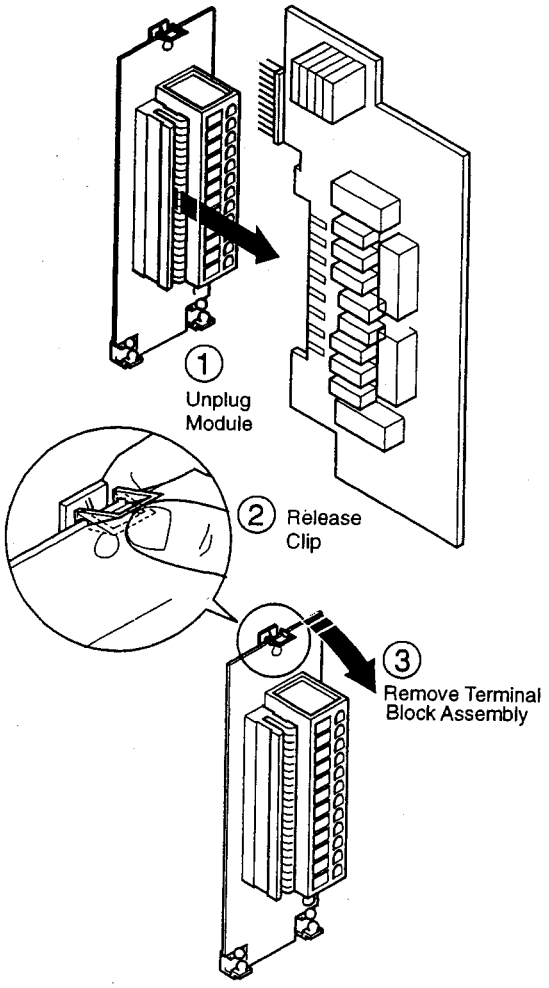


Fig. 4.1 Removing Terminal Block Assembly

4.1 Identifying the Input/Output Modules – Fig. 4.2

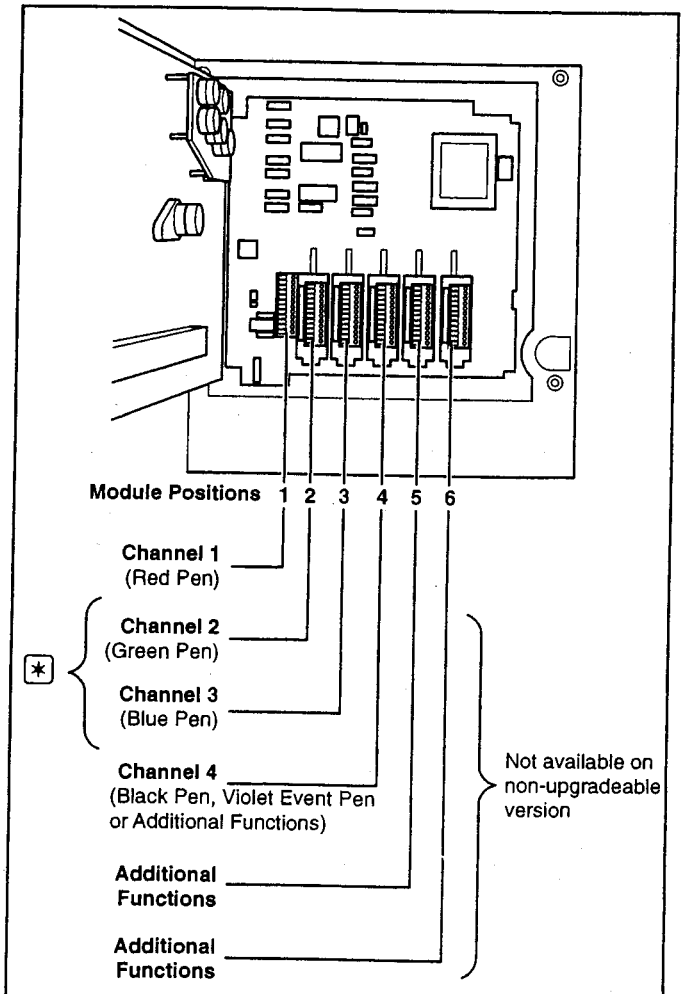
To gain access to the modules, open the door and chassis – see Fig. 2.2. There are six module positions as shown in Fig. 4.2.

4.2 Channel Connections

Channel 1 connections are made directly to the terminal block mounted on the motherboard.

Other Channel connections are made to standard I/O modules, fitted in positions 2, 3 or 4 – see Fig. 4.2.

Caution.
The maximum channel to channel voltage (between any 2 channels) must not exceed 500V d.c.



Note. Module positions can also be used for additional I/O modules (module types 1 and 2) for use with maths functions.

Information. The module type is marked on the component side of the p.c.b. Refer to Table 2.1 for the module types and module position options.

Fig. 4.2 Module Positions and Functions

4.2.1 Selecting the Analog Input Type(s) – Figs. 4.3 and 4.4

Plug-in links are used to select the input type:

Channel 1 PL1 & PL8 on the main p.c.b. (Fig. 4.3)
Channels 2 to 4 PL1 & PL3 on the module (Fig. 4.4)

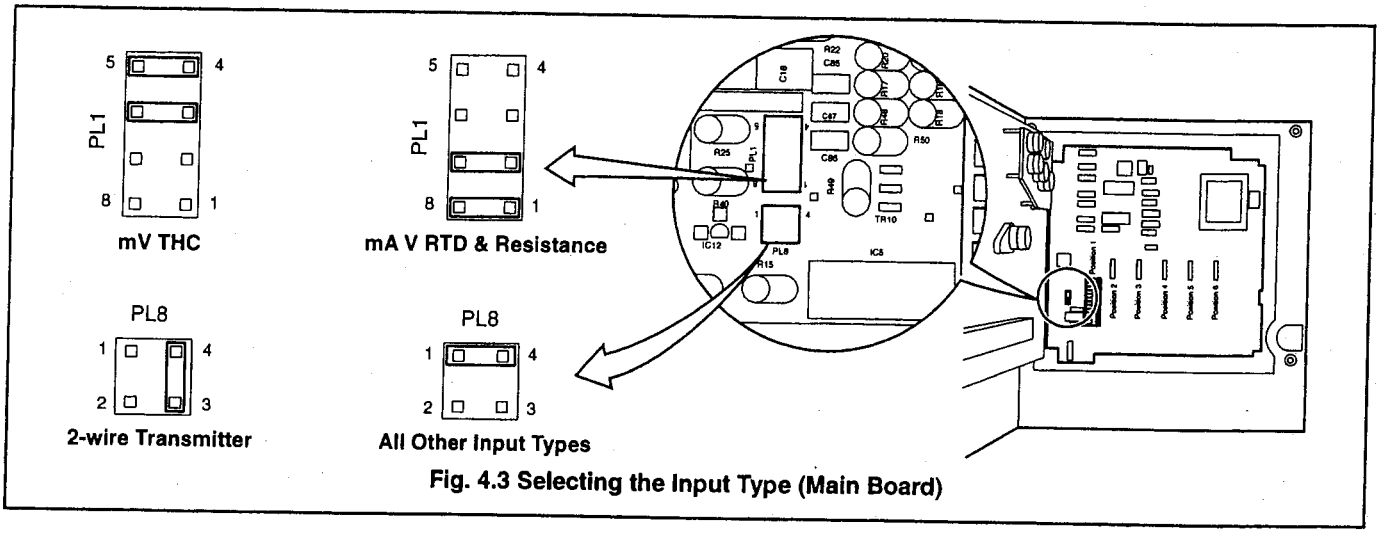


Fig. 4.3 Selecting the Input Type (Main Board)

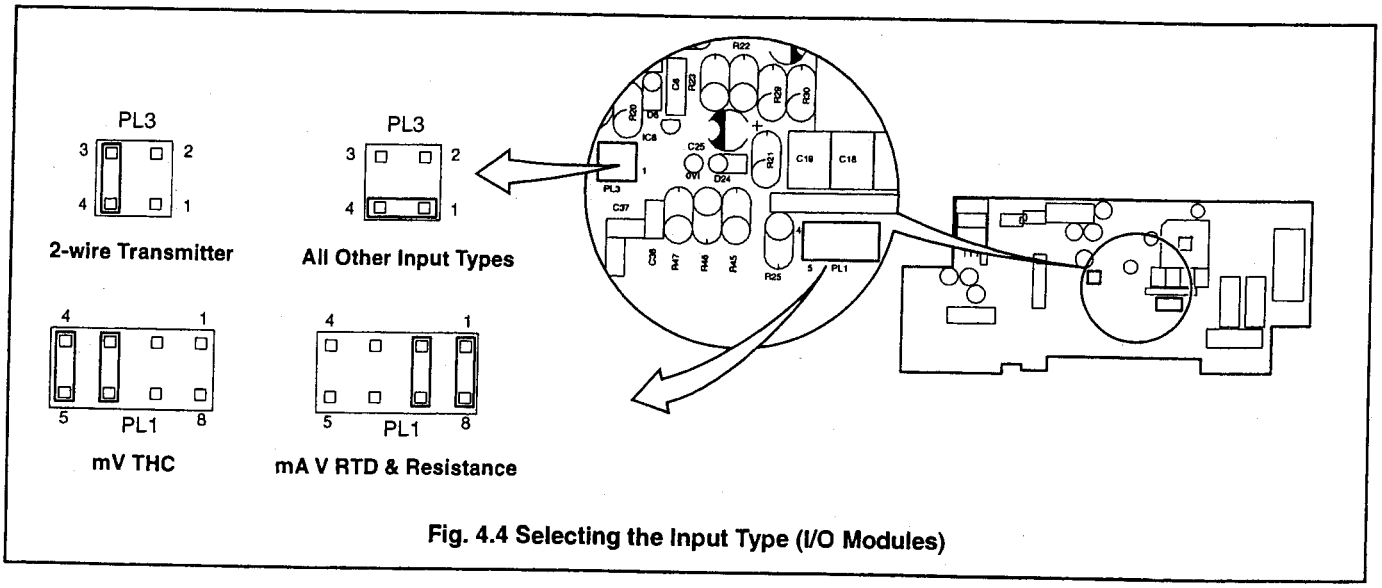


Fig. 4.4 Selecting the Input Type (I/O Modules)

Type of Thermocouple	Compensating Cable											
	BS1843			ANSI MC 96.1			DIN 43714			BS4937 Part No.30		
	+	–	Case	+	–	Case	+	–	Case	+	–	Case
Ni-Cr/Ni-Al (K)	Brown	Red	Blue	Yellow	Red	Yellow	Red	Green	Green	Green	White	Green*
Ni-Cr/Cu-Ni (E)	—	—	—	—	—	—	—	—	—	Violet	White	Violet*
Nicrisil/Nisil (N)	Orange	Blue	Blue	Orange	Red	Orange	—	—	—	Pink	White	Pink
Pt/Pt-Rh (R and S)	White	Blue	Blue	Black	Red	Green	Red	White	White	Orange	White	Orange*
Pt-Rh/Pt-Rh (B)	—	—	—	—	—	—	—	—	—	Grey	White	Grey*
Cu/Cu-Ni (T)	White	Blue	Blue	Blue	Red	Blue	Red	Brown	Brown	Brown	White	Brown*
Fe/Con (J)	Yellow	Blue	Blue	White	Red	Black	Red	Blue	Blue	Black	White	Black*
										* Case Blue for intrinsically safe circuits		
Fe/Con (DIN 43710)							DIN 43710					
							Blue/Red	Blue	Blue			

Table 4.1 Thermocouple Compensating Cable

4.2.2 Voltage and Current – Fig. 4.5

Information. Input impedances:

Low voltage (mV)	>10MΩ
Voltage	>10MΩ
Current (mA)	100Ω

4.2.3 2-wire Transmitter Input – Fig. 4.5

Power for the transmitter is supplied by terminal 6.

Note. The voltage across terminals 4 and 6 is 20V (nominal). This is due to internal voltage drops across a shunt resistor and measurement circuitry.

4.2.4 Thermocouple – Fig. 4.5

Use correct compensating cable between the thermocouple and the terminals – see Table 4.1 (previous page).

Automatic cold junction (ACJC) is incorporated but an independent cold (reference) junction may be used.

4.2.5 Resistance Thermometer (RTD) – Fig. 4.5

If long leads are necessary it is preferable to use a 3-lead resistance thermometer.

If 2-lead resistance thermometers are used each input must be calibrated to take account of the lead resistance.

4.2.6 Logic Inputs – Fig. 4.5

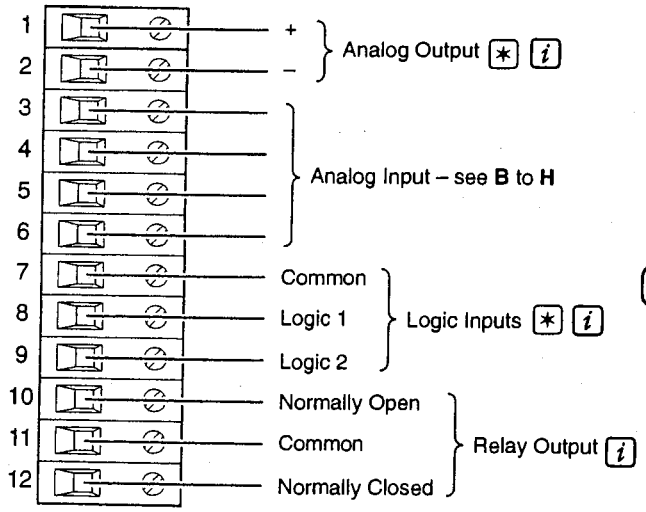
The two logic inputs accept either volt-free (switch) or TTL (5V) input types and can be used for remote switching of many recorder functions, e.g. chart stop/go, alarm acknowledgment, totalizer reset etc. Refer to the **Programming Guide**, IM/C1900–PGR or IM/C1900–PGC.

4.2.7 Analog Output – Fig. 4.5

4.2.8 Relay Output – Fig. 4.5

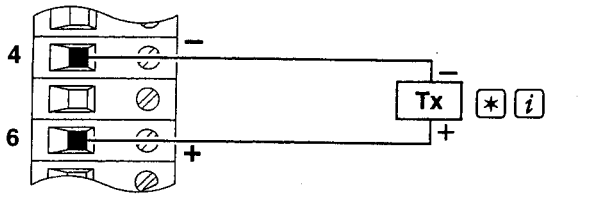
Information. Relay specification:

Type –	single pole changeover	
Voltage	250V a.c.	250V d.c.
Current	5A a.c.	5A d.c.
Loading (non inductive)	1250VA	50W
Isolation, contacts to earth	2kV r.m.s.	



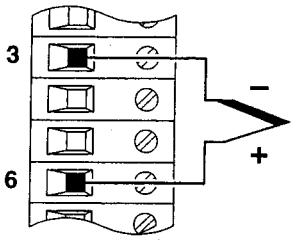
Note. Not applicable on Type 2 Modules.

A – Summary of Connections

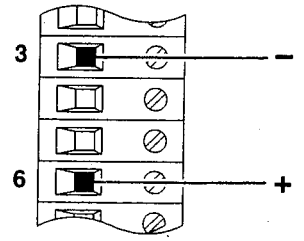


D – 2-wire Transmitter

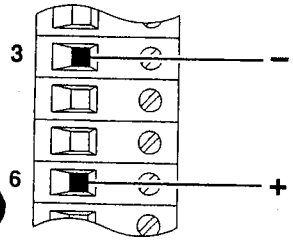
Information. Not available on non-upgradable version



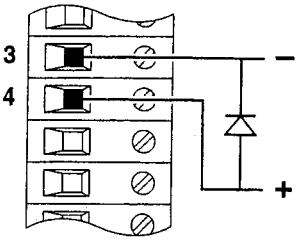
E – Thermocouple



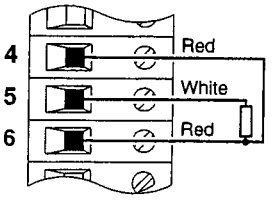
F – Low Voltage (mV)



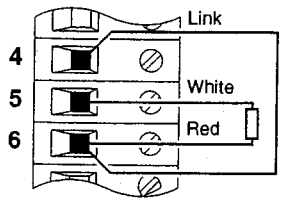
B – Voltage



C – Current (non 2-wire transmitters)



G – 3-wire RTD



H – 2-wire RTD & Resistance

Fig. 4.5 Channel Connections

4.2.9 Motorized Valve – Fig. 4.6

A motorized valve with or without feedback requires 2 relays (common and normally open terminals) to drive the valve in either direction. Any two relays can be allocated for this function. Fig. 4.6 A shows two possible combinations.

4.3 Module Connections

4.3.1 Standard I/O or Analog + Relay (Module Types 1, 2 and 7) – Fig. 4.5

The connections are the same as Channel connections to the main board. Refer to Section 4.2.

4.3.2 Four Relay Module (Module Type 3) – Fig. 4.7

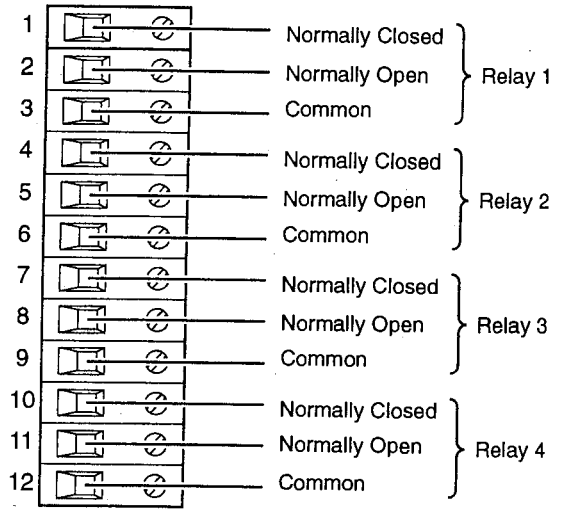
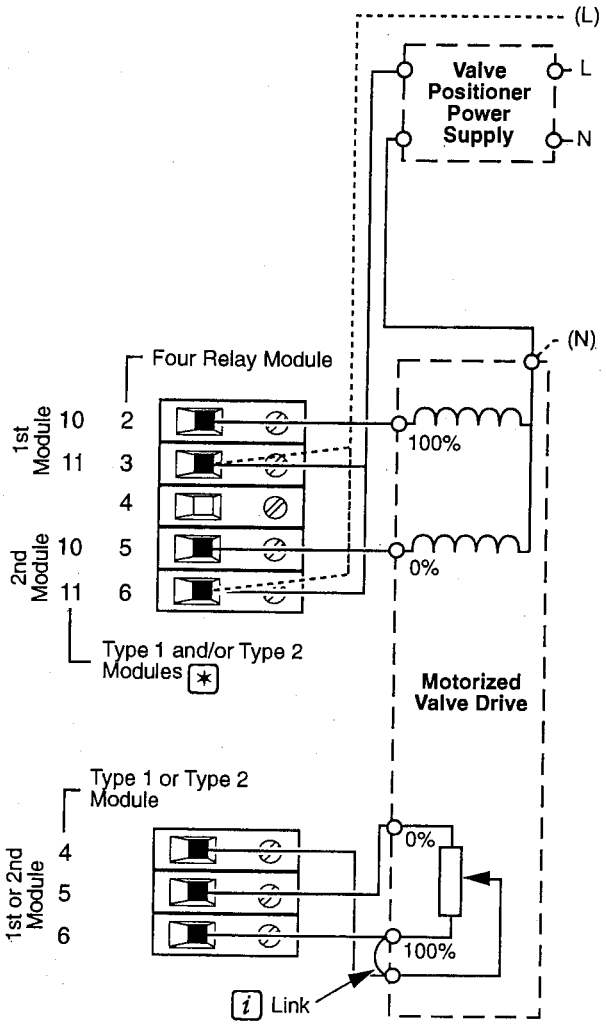
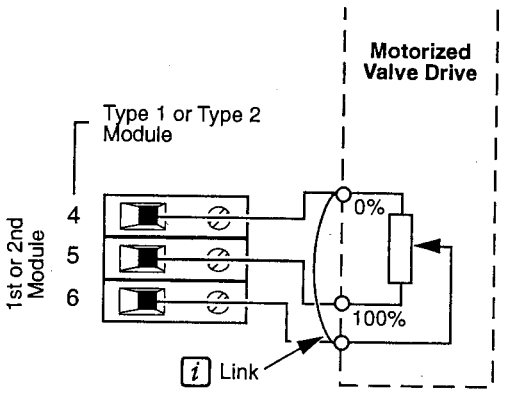


Fig. 4.7 Four Relay Module Connections (Module Type 3)

✶ **Note.** For valves with position feedback using low voltage (mV), voltage (V) or current (C), refer to Fig. 4.5 B, C and F for connections.



A – Standard Feedback Slidewire Configuration



B – Alternative Feedback Slidewire Configuration

✶ **Note.** Type 1 and type 2 modules have one relay output, therefore two modules are required.

i **Information.** Link must be connected at valve drive end, not at the controller terminals.

Fig 4.6 Motorized Valve Connections (using feedback slidewire)

4.3.3 Eight Digital Inputs or Outputs (Module Types 4 and 5 respectively) – Figs. 4.8 and 4.9

A plug-in link is used to select the board's function; digital inputs or digital outputs – see Fig. 4.8. The maximum current drain from each TTL output must not exceed 5mA.

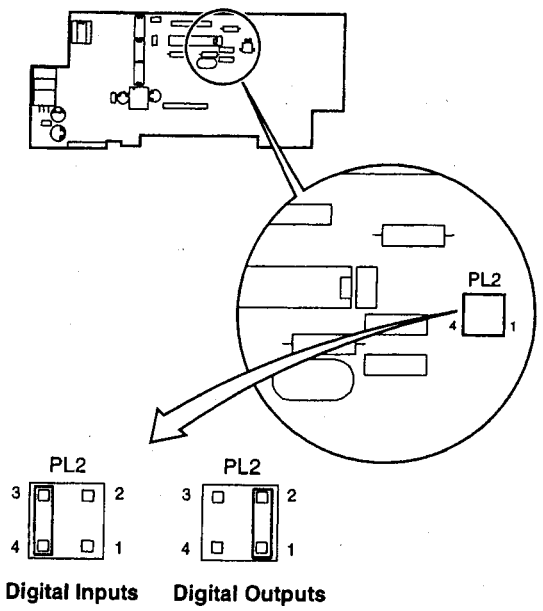


Fig. 4.8 Selecting the Digital Module Function (Module Types 4 and 5)

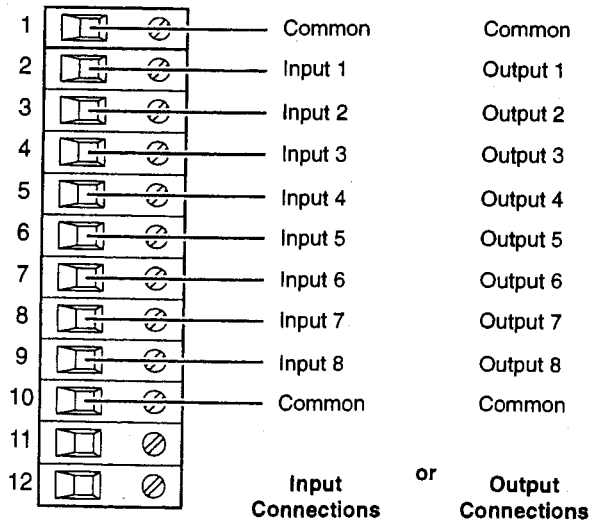
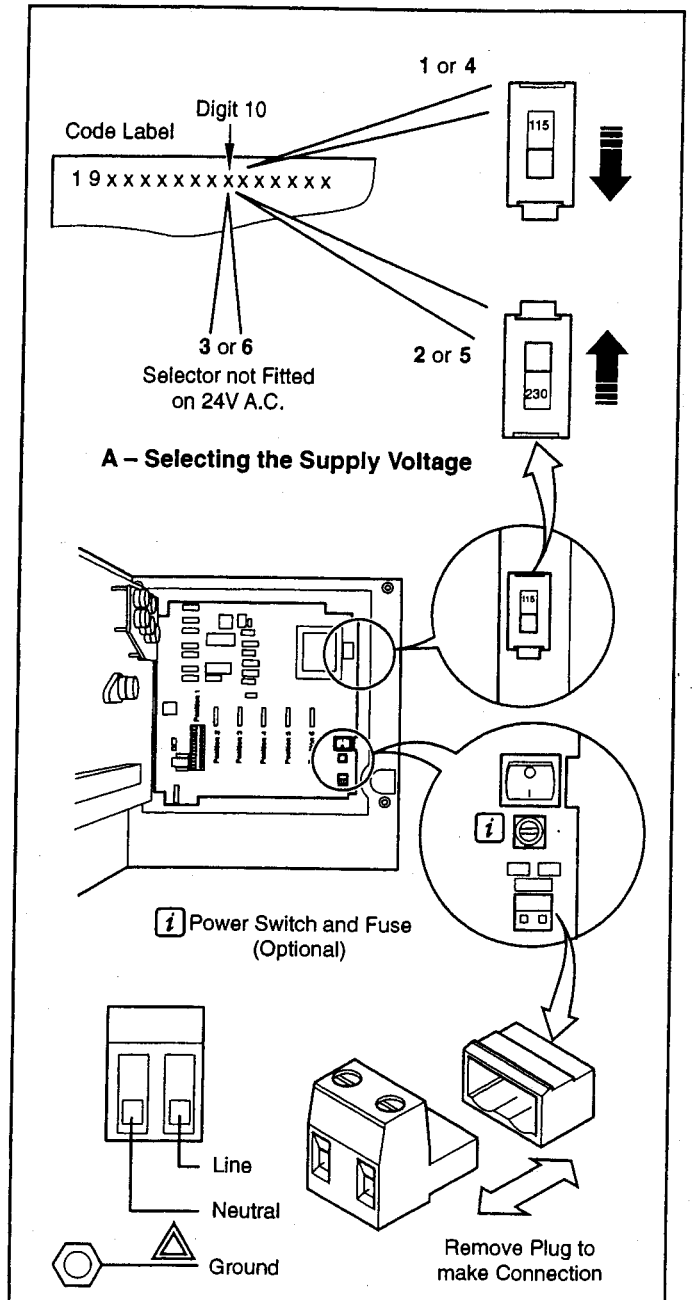


Fig. 4.9 Eight Digital Inputs or Outputs Connections (Module Types 4 and 5)

4.4 Power Supply Selection and A.C. Connections Fig. 4.10



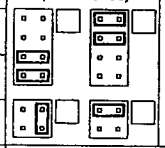
Information. Fuse ratings:
115V Supply – 1A (20 X 5mm) Type T
230V Supply – ½A (20 X 5mm) Type T
24V Supply – 4A (20 X 5mm) Type T

Warning. Ensure that the Ground lead is longer than the Line and Neutral leads.

Fig. 4.10 Power Supply Selection and A.C. Connections

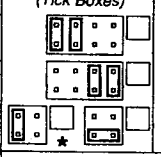
Position 1

Module Type 1☑

Analog Output	1	+	
	2	–	
Analog Input	3		Link Positions (Tick Boxes) 
	4		
	5		
	6		
Logic Inputs	7	C	
	8	L1	
	9	L2	
Relay Output	10	NO	
	11	C	
	12	NC	

Position 2

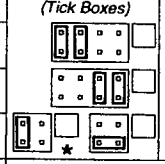
Module Type *(Tick Box)* 1☐ 2☐

* Analog Output	1	+	
	2	–	
Analog Input	3		Link Positions (Tick Boxes) 
	4		
	5		
	6		
* Logic Inputs	7	C	
	8	L1	
	9	L2	
Relay Output	10	NO	
	11	C	
	12	NC	

* Not applicable on Module Type 2

Position 3

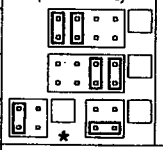
Module Type *(Tick Box)* 1☐ 2☐

* Analog Output	1	+	
	2	–	
Analog Input	3		Link Positions (Tick Boxes) 
	4		
	5		
	6		
* Logic Inputs	7	C	
	8	L1	
	9	L2	
Relay Output	10	NO	
	11	C	
	12	NC	

* Not applicable on Module Type 2

Position 4

Module Type *(Tick Box)* 1☐ 2☐ 6☐ 7☐

* Analog Output	1	+	
	2	–	
Analog Input	3		Link Positions (Tick Boxes) 
	4		
	5		
	6		
* Logic Inputs	7	C	
	8	L1	
	9	L2	
Relay Output	10	NO	
	11	C	
	12	NC	

* Not available on Module Type 2

3☐

Relay Output 1	1	NC	
	2	NO	
	3	C	
Relay Output 2	4	NC	
	5	NO	
	6	C	
Relay Output 3	7	NC	
	8	NO	
	9	C	
Relay Output 4	10	NC	
	11	NO	
	12	C	

4☐ 5☐

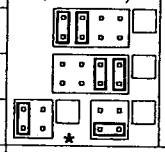
Logic I/Ps (Type 4) or Logic O/Ps (Type 5)	1	C
	2	1
	3	2
	4	3
	5	4
	6	5
	7	6
	8	7
	9	8
	10	C

Link Positions *(Tick Box)*  Type 4  Type 5

5 INSTALLATION RECORD...

Position 5

Module Type *(Tick Box)* 2☐

* Analog Output	1	+	
	2	–	
Analog Input	3		Link Positions *(Tick Boxes)* 
	4		
	5		
	6		
* Logic Inputs	7	C	
	8	L1	
	9	L2	
Relay Output	10	NO	
	11	C	
	12	NC	

* Not available on Module Type 2

3☐

Relay Output 1	1	NC	
	2	NO	
	3	C	
Relay Output 2	4	NC	
	5	NO	
	6	C	
Relay Output 3	7	NC	
	8	NO	
	9	C	
Relay Output 4	10	NC	
	11	NO	
	12	C	

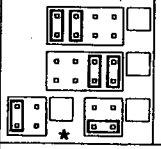
4☐ 5☐

Logic I/Ps (Type 4) or Logic O?ps (Type 5)	1	C
	2	1
	3	2
	4	3
	5	4
	6	5
	7	6
	8	7
	9	8
	10	C

Link Positions *(Tick Box)*  Type 4  Type 5

Position 6

Module Type *(Tick Box)* 2☐

* Analog Output	1	+	
	2	–	
Analog Input	3		Link Positions *(Tick Boxes)* 
	4		
	5		
	6		
* Logic Inputs	7	C	
	8	L1	
	9	L2	
Relay Output	10	NO	
	11	C	
	12	NC	

* Not available on Module Type 2

4☐ 5☐

Logic I/Ps (Type 4) or Logic O/Ps (Type 5)	1	C
	2	1
	3	2
	4	3
	5	4
	6	5
	7	6
	8	7
	9	8
	10	C

Link Positions *(Tick Box)*  Type 4  Type 5

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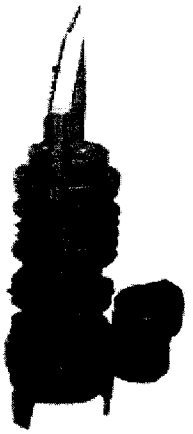

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