

**Division 8400
Control Technologies**

**Control Technologies
121 Park Ave., Suite 10
Williston, VT 05495**

Christian Jenkins

Tel: 802-764-2200 Fax: 802-764-2299

Information Includes:

**Personnel Access List
Altonrox Rechargeable Battery
Installig the HD Maxiprox for Optimum Read Range
Maxiprox Reader
Maxiprox DFM Reader 5375 Installation Guide
Prox Key 11
Prox Pro Reader
Prox Pro Wiegand
SEC-ENC-MED and SEC-ENC-LRG
Security JACE- Mounting and Wiring Guide
Remote Z Reader Module- Mounting and Wiring Guide
Functional Devices- Enclosed Relays 10 AMP
Wizard II SMR Set-up Guide
Horton Interlock Module for Multiple Door Applications
Wizard II SMR User's Guide
C2150 Control
Laboratory Door Control Drawings V008100**

**Division 7000
Roofing/ Flashing and Trim**

**Evergreen Roofing
43 Briggs Street
Burlington, VT 05401**

Ian

Tel: 802-865-2264 Fax: 802-660-0860

Information Includes:

Warranty

**Division 7900
Joint Sealant**

**Trowel Trade Supply
206 Hegeman
Colchester, VT 05446**

Bernie Metivier

Tel: 802-655-3166 Fax: 802-655-3166

Information Includes:

Coverage of sealants

**Division 8100
Doors, Frames and Hardware**

**Kelly Brothers
87 Holly Court
Williston, VT 05495**

Harry Black

Tel: 802-865-5133 Fax: 802-865-7833

Information Includes:

**Warranty- Wood Doors
Warranty- Metal Doors**

**Warranty-Hardware
Warranty- Closers**

**Division 8400
Automatic Sliding Entrance Doors
Glazing**

**The Glass Connection
24 New England Dr.
Essex Jct., VT 05495**

Bob Sicard/ Kim Robare

Tel: 802-879-3600 Fax: 802-879-9336

Information Includes:

**Warranty- Automatic Sliding Entrance Doors
Automatic Sliding Entrance Doors Maintenance
Warranty- Sealed Glass**

**Division 9300/ 9600
Floor Tile and Vinyl Base**

**New England Floor Coverings
257 Pine Street
Burlington, VT 05401**

Nigel Mucklow

Tel: 802-658-9336 Fax: 802-658-6194

Information Includes:

**Johnsonite Warranty
Johnsonite Granit Acoustiflor Maintenance Instructions
Interface Flor
Interface Flor Commercial Maintenance Specification Guide
Rubber and Vinyl Wall Base Installation and Maintenance Instructions
Johnsonite Limited Warranty**

Division 9900

Painting

**Spectrum Finishes
34 Jasper Mine Rd.
Colchester, VT 05446**

Eric Johnson

Tel: 802-893-0003 Fax: 802-893-0004

Information Includes:

Paint Schedule

**Division 10100
Specialty Furnishings**

**Lajeunesse Interiors
6 Waterman Street
PO Box 10
East Barre, VT 05649**

Kristine Martel

Tel: 802-479-3173 Fax: 802-479-9462

Information Includes:

**Visual Display Boards- Warranty
Fire Extinguisher- Test/ Fill Exchange Schedule
Fire Extinguisher- Recertification
Grilles/ Mats- Warranty
Grilles/ Mats- Cleaning and maintenance**

**Division 12300
Laboratory Casework and Equipment/ Fumehoods**

**Gibson Associates
325 Boston Post Rd.
Sudbury, MA 01776**

Frank Nykiel

Tel: 978-443-8160 Fax: 978-443-0928

Information Includes:

**Fumehoods- Factory Certification
Warranty**

**Division 13930
Sprinkler**

**North Country Fire Protection
PO Box 224
Colchester, VT 05446**

Lane Esden

Tel: 802-864-6594 Fax: 802-878-2186

Information Includes:

**Wet Pipe Sprinkler Inspection
Operation and Maintenance of Sprinklers
Final Calculations
Training**

**Also
Record Drawings
Spare Parts**

**Division 15000
Mechanical**

**New England Air Systems
43 Krupp Drive
PO Box 525
Williston, VT 05495**

Randy Chicoine

Tel: 802-264-1239 Fax: 802-864-3904

Information Includes:

**See Table of Contents on the following page
for a full list of items included**

**Division 16000
Electrical**

**Benoit Electric
254 Industrial Lane
Barre, VT 05641**

DJ Stricker

Tel: 802-229-1955 Fax: 802-229-4946

Information Includes:

**See Table of Contents on the following page
for a full list of items included**

RECEIVED

JAN 23 2008

CH2MHILL #GH

BENOIT ELECTRIC, INC.
254 INDUSTRIAL LANE
BARRE, VT 05641
Phone (802) 229-1955
Fax (802) 229-4946

Submittal Cover Sheet

Project Name: UVM Delehanty Lab

Date:

Architect: IDC Architects

Engineer: Same

Specification Section: 16011

Revision:

Submitted per Specification Section: 2.23

Drawing #/Detail Reference: E-1

Supplier: CED Twinstare, Burlington

Items Submitted: Light Fixtures

Types - A
A1
B
C
EM

ReArch Company

Submittal and Shop Drawings

Received 1/23/08

Reviewed

Bob Pro
Signature, Title

1/23/08
Date

<input checked="" type="checkbox"/> NO EXCEPTIONS NOTED
<input type="checkbox"/> MAKE CORRECTIONS NOTED
<input type="checkbox"/> REVISE AND RESUBMIT
<input type="checkbox"/> SUBMIT ITEMS AS NOTED
Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any Action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: dimensions which shall be confirmed and correlated at the jobsite, fabrication processes and techniques of construction, coordination of the work with that of all other trades and the satisfactory performance of the work.
By: <u>[Signature]</u>
Dated: <u>1/24/08</u>
CH2MHILL



FEATURES & SPECIFICATIONS

INTENDED USE

Recessed Frame-In rated Non-IC for New Construction only. Approved for all ceiling types (including air handling plenums), and wiring types.

CONSTRUCTION

Rugged, galvanized steel frame.

Galvanized steel junction box with (4) romex, (2) 3/4" and (4) 1/2" nominal conduit knock outs with pryout slots. Removable door for easy access.

Rated for 90°C supply wire. Ground wire provided.

Galvanized bar hangers span up to 24" o.c. and feature built-in T-bar clips and rollers.

ELECTRICAL SYSTEM

Socket attaches to reflector with pre-mounted screws to ensure proper and consistent lamp position.

Encased and potted, high power factor (HPF) electromagnetic ballast is standard.¹

Multi-volt, 120V through 277V, electronic ballast with end of life protection standard for TRT lamps. Requires four-pin lamp.

Class P thermally protected ballast protects against improper contact with insulation. Rated for through branch circuit wiring.

INSTALLATION

T bar or wood joist installation.

Expandable bar hangers allow for off-center mounting in T-bar ceilings or wood joists.

Bar hangers expand to a length of 25-1/4" maximum 13-1/4" minimum.

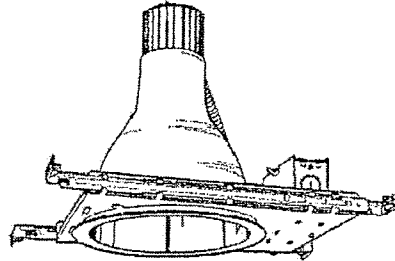
Reflectors accommodate ceilings up to 1-1/2" thick.

LISTING

UL listed in US and Canadian safety standards.

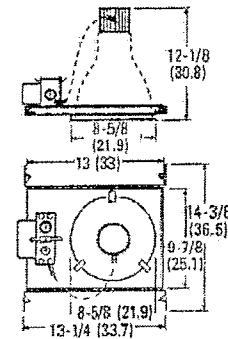
Damp location listed. (See trim selection for wet location.)

Catalog Number	LPBF 42TRT 802 120 GEB10	
Notes	Job: UVM Delahanty Hall	Submitted By: Visible Light, Inc.
Type	A	



8" Frame-In
LP8F

FLUORESCENT
Vertical
Non-IC
New Construction



Specifications

Height: 12-1/8 (30.8)
 Length: 13-1/4 (33.7)
 Width: 14-3/8 (36.5)
 Ceiling Opening: 8-7/8 (22.5)

All dimensions are inches (centimeters).

ORDERING INFORMATION

For shortest lead times, configure product using standard options (shown in bold).

Example: LPBF 26-42TRT MVOLT 802AZ

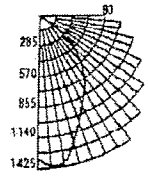
LPBF	42TRT	120	GEB10			802
Series	Lamps	Volt	Options			Reflector
LP8F	180TT 260TT 18TRT ² 26-42TRT^{2,3} 26TRT ² 32TRT ² 42TRT ² 57TRT ^{4*}	MVOLT⁵ 120 277 347	ADEZ Advance Mark 10™ electronic dimming ballast, 120V or 277V. Requires 4-pin lamp. Minimum dimming level 5%.	EL Emergency battery pack with integral test switch. ⁶	802 White open	
			DMHL Lutron Compact SET™ electronic dimming ballast, 120V or 277V. Requires 4-pin lamp. Minimum dimming level 5%.	ELR Emergency battery pack with remote test switch. ⁶	802A Clear diffuse low iridescence open	
			GEB10 <10% THD Ballast	GMF Single slow-blow fuse.	802AZ Clear specular low iridescence open	
				BOP Ballast disconnect plug (meets codes that require in-fixture disconnect).	802G2 Gold specular open	
				WLP 35K Lamp (shipped separately).	802WT2 Wheat specular open	
				TRW White flange.	883 Black baffle	
					883W White baffle	
					8W1 White wallwash	
					8W1A Clear diffuse wallwash	
					8W1AZ Clear specular wallwash	
					8W1GZ Gold specular wallwash	
					8W1WT2 Wheat specular wallwash	
					8LF1 White splay flat clear lens ⁷	
					8LFB1 Black baffle flat clear lens ⁷	
					8L4 White splay fresnel lens ⁷	
					8LB4 Black baffle fresnel lens ⁷	
					8LF73 White splay T73 tempered prismatic lens ⁷	
					8LFB73 Black baffle T73 tempered prismatic lens ⁷	

NOTES:

- Not recommended for use with occupancy sensors, device may cause reduced lamp life or premature failure. Consult lamp manufacturer.
 - Not available with a magnetic ballast.
 - Not available with WLP or DMHL.
 - Open, non-lensed trims only. Not available with DMHL.
 - MVOLT- Electronic multi-volt ballast capable of operating any line voltage from 120-277, 50 or 60Hz.
 - Not available with magnetic ballast or 57TRT. For dimensional changes, refer to accessories tab. For two-lamp operation, consult factory.
 - Lens removal required before EL testing.
- See trim specification sheets for maximum wattages.

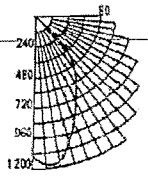
8" Fluorescent LP8F Frame-in

802AZ, (1) 42W TRT lamp, .96 s/mh, 3200 rated lumens, test no. LTL9815



From 0°	cp.	Zone	Lumens	% lamp	rf rc nv	Coefficient of utilization						Mount height	Initial fc at beam center	50%		10%		
						80%		70%		50%				Beam angle 51.2°	Beam angle 92.6°			
						50%	30%	50%	30%	50%	30%			Beam diameter	Beam diameter	Beam diameter	Beam diameter	
0°	1328	0°-30°	900	28.1	0	.66	.66	.65	.66	.62	.62							
5°	1393	0°-40°	1339	41.8	1	.87	.60	.60	.59	.58	.57							
15°	1224	0°-60°	1783	55.7	2	.66	.53	.55	.53	.53	.51	8'	43.9	5.3'	22.0	11.5'	4.4	
25°	919	0°-90°	1767	55.3	4	.47	.44	.46	.43	.45	.42	10'	23.6	7.2'	11.8	15.7'	2.4	
35°	799	90°-180°	0	0.0	5	.46	.40	.43	.39	.42	.39	12'	14.7	9.1'	7.4	19.9'	1.5	
45°	435	0°-180°	1787	55.8*	6	.40	.36	.40	.36	.39	.35	14'	10.0	11.0'	5.0	21.1'	1.0	
55°	111	* Efficiency			7	.37	.33	.37	.33	.36	.33	16'	7.3	12.9'	3.6	28.3'	0.7	
65°	2				8	.34	.31	.34	.30	.33	.30							
75°	0				9	.32	.28	.32	.28	.31	.28							
85°	0				10	.30	.26	.30	.26	.29	.26							
90°	0																	

BB3, (1) 32W TRT lamp, .93 s/mh, 2400 rated lumens, test no. LTL9954



From 0°	cp.	Zone	Lumens	% lamp	rf rc nv	Coefficient of utilization						Mount height	Initial fc at beam center	50%		10%		
						80%		70%		50%				Beam angle 49.7°	Beam angle 87.1°			
						50%	30%	50%	30%	50%	30%			Beam diameter	Beam diameter	Beam diameter	Beam diameter	
0°	1101	0°-30°	734	30.6	0	.62	.62	.60	.60	.67	.57							
5°	1167	0°-40°	1053.1	43.9	1	.57	.56	.56	.55	.54	.53							
15°	1026	0°-60°	1237.5	51.6	2	.53	.50	.52	.50	.50	.48	8'	36.4	5.1'	18.2	10.5'	3.6	
25°	733	0°-90°	1241.7	51.7	3	.49	.46	.46	.45	.47	.45	10'	19.5	6.9'	9.8	14.3'	2.0	
35°	513	90°-180°	0	0.0	4	.45	.42	.45	.42	.43	.41	12'	12.2	8.8'	6.1	18.1'	1.2	
45°	235	0°-180°	1241.7	51.7*	5	.42	.39	.44	.38	.41	.38	14'	8.3	10.7'	4.2	21.9'	0.8	
55°	5	* Efficiency			6	.39	.36	.39	.36	.36	.35							
65°	2				7	.36	.33	.36	.33	.35	.33							
75°	1				8	.34	.31	.34	.31	.33	.30	16'	6.0	12.5'	3.0	25.7'	0.6	
85°	0				9	.32	.29	.32	.29	.31	.28							
90°	0				10	.30	.27	.30	.27	.29	.26							





FEATURES & SPECIFICATIONS

INTENDED USE

Recessed Frame-In rated Non-IC for New Construction only. Approved for all ceiling types (including air handling plenums), and wiring types.

CONSTRUCTION

Rugged, galvanized steel frame.

Galvanized steel junction box with (4) romex, (2) 3/4" and (4) 1/2" nominal conduit knock outs with pryout slots. Removable door for easy access.

Rated for 90°C supply wire. Ground wire provided.

Galvanized bar hangers span up to 24" o.c. and feature built-in T-bar clips and nailers.

ELECTRICAL SYSTEM

Socket attaches to reflector with pre-mounted screws to ensure proper and consistent lamp position.

Encased-and-potted, high power factor (HPF) electromagnetic ballast is standard.¹

Multi-volt, 120V through 277V, electronic ballast with end of life protection standard for TRT lamps. Requires four-pin lamp.

Class P thermally protected ballast protects against improper contact with insulation. Rated for through branch circuit wiring.

INSTALLATION

T-bar or wood joist installation.

Expandable bar hangers allow for off-center mounting in T-bar ceilings or wood joists.

Bar hangers expand to a length of 25-1/4" maximum 13-1/4" minimum.

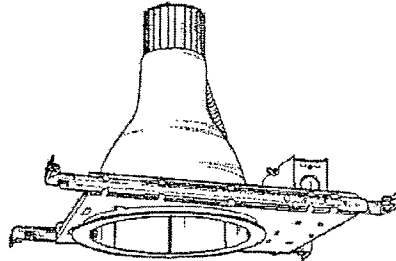
Reflectors accommodate ceilings up to 1-1/2" thick.

LISTING

UL listed to US and Canadian safety standards.

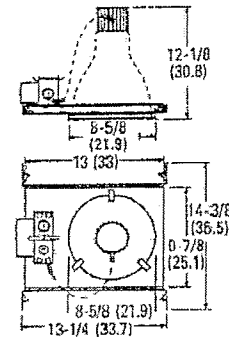
Damp location listed. (See trim selection for wet location.)

Catalog Number	LP8F 42TRT 802 120 ADEZ	
Notes	Type	
Job: UVM Delehanty Hall	Submitted By: Visible Light, Inc.	A1



8" Frame-In
LP8F

FLUORESCENT
Vertical
Non-IC
New Construction



Specifications

Height: 12-1/8 (30.8)
 Length: 13-1/4 (33.7)
 Width: 14-3/8 (36.5)
 Ceiling Opening: 8-7/8 (22.5)

All dimensions are inches (centimeters).

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold)**.

Example: LP8F 26-42TRT MVOLT 802AZ

LPBF	42TRT	120	ADEZ		802
Series	Lamps	Volt	Options		Reflector
LPBF	18DTT	MVOLT ¹	ADEZ	Advance Mark 10™ ¹ electronic dimming ballast, 120V or 277V. Requires 4-pin lamp. Minimum dimming level 5%.	802 White open
	26DTT	120		EL Emergency battery pack with integral test switch. ⁶	802A Clear diffuse low iridescence open
	18TRT ²	277		ELR Emergency battery pack with remote test switch. ⁶	802AZ Clear specular low iridescence open
	26-42TRT^{2,3}	347	DMHL	GMF Single slow-blow fuse.	802GZ Gold specular open
	26TRT ²			BDP Ballast disconnect plug (meets codes that require in-fixture disconnect).	802WTZ Wheat specular open
	321RT ²			WLP 35K Lamp (shipped separately).	8B3 Black baffle
	42TRT ²			TRW White flange.	8B3W White baffle
	57TRT ^{2,4}				8W1 White wallwash
					8W1A Clear diffuse wallwash
					8W1AZ Clear specular wallwash
					8W1GZ Gold specular wallwash
					8W1WTZ Wheat specular wallwash
					8LF1 White splay flat clear lens ⁷
					8LFB1 Black baffle flat clear lens ⁷
					8LA White splay fresnel lens ⁷
					8LB4 Black baffle fresnel lens ⁷
					8LF73 White splay T73 tempered prismatic lens ⁷
					8LFB73 Black baffle T73 tempered prismatic lens ⁷

NOTES:

- Not recommended for use with occupancy sensors, device may cause reduced lamp life or premature failure. Consult lamp manufacturer.
 - Not available with a magnetic ballast.
 - Not available with WLP or DMHL.
 - Open, non-lensed trims only. Not available with DMHL.
 - MVOLT- Electronic multi-volt ballast capable of operating any line voltage from 120-277, 50 or 60Hz.
 - Not available with magnetic ballast or 57TRT. For dimensional changes, refer to accessories tab. For two-lamp operation, consult factory.
 - Lens removal required before EL testing.
- See trim specification sheets for maximum wattages.

8" Fluorescent LP8F Frame-in

802AZ, (1) 42W TRT lamp, .96 s/mh, 3200 rated lumens, test no. LTL9815

Distribution curve	Distribution data	Output data	Coefficient of utilization						Single luminaire data 30" above floor										
			Zone	Lumens	%lamp	rc	80%		90%		50%		Mount height	Initial fc at beam center	50% Beam angle 51.2°		10% Beam angle 92.8°		
							50%	30%	50%	30%	50%	30%			fc at beam diameter	fc at beam edge	Beam diameter	Beam diameter	
	From 0°	cp.																	
	0°	1328	0°-30°	900	28.1	0	.66	.66	.65	.65	.62	.62							
	5°	1359	0°-40°	1339	41.8	1	.61	.60	.60	.59	.58	.57							
	15°	1224	0°-60°	1783	55.7	2	.56	.53	.55	.53	.53	.51	8'	43.9	5.3'	22.0	11.5'	4.4	
	25°	919	0°-90°	1787	55.8	3	.51	.46	.51	.48	.49	.47	10'	23.6	7.2'	11.8	15.7'	2.4	
	35°	709	90°-180°	0	0.0	4	.47	.44	.46	.43	.45	.42	12'	14.7	9.1'	7.4	19.9'	1.5	
	45°	435	0°-180°	1787	55.8*	5	.46	.40	.43	.39	.42	.39	14'	10.0	11.0'	5.0	21.1'	1.0	
	55°	111	* Efficiency			6	.40	.36	.40	.36	.39	.36							
	65°	2				7	.37	.33	.37	.33	.36	.33							
	75°	0				8	.34	.31	.34	.30	.33	.30	16'	7.3	12.9'	3.6	28.3'	0.7	
85°	0				9	.32	.28	.32	.28	.31	.28								
90°	0				10	.30	.26	.30	.26	.29	.26								

8B3, (1) 32W TRT lamp, .93 s/mh, 2400 rated lumens, test no. LTL9954

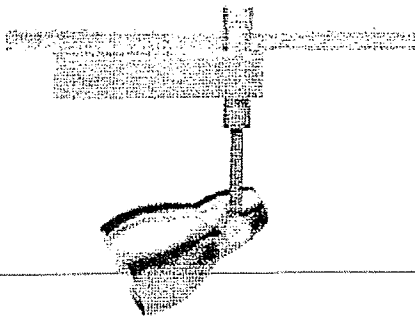
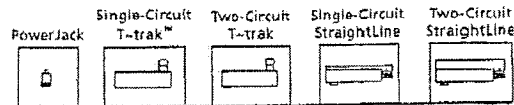
Distribution curve	Distribution data	Output data	Coefficient of utilization						Single luminaire data 30" above floor										
			Zone	Lumens	%lamp	rc	80%		90%		50%		Mount height	Initial fc at beam center	50% Beam angle 49.7°		10% Beam angle 87.1°		
							50%	30%	50%	30%	50%	30%			fc at beam diameter	fc at beam edge	Beam diameter	Beam diameter	
	From 0°	cp.																	
	0°	1101	0°-30°	734	30.6	0	.62	.62	.60	.60	.57	.57							
	5°	1167	0°-40°	1053.1	43.9	1	.57	.55	.56	.55	.54	.53							
	15°	1026	0°-60°	1237.5	51.6	2	.53	.50	.52	.50	.50	.49	8'	36.4	5.1'	18.2	10.5'	3.6	
	25°	733	0°-90°	1241.7	51.7	3	.49	.46	.48	.45	.47	.45	10'	19.6	6.9'	9.8	14.3'	2.0	
	35°	513	90°-180°	0	0.0	4	.45	.42	.45	.42	.43	.41	12'	12.2	8.8'	6.1	18.1'	1.2	
	45°	235	0°-180°	1241.7	51.7*	5	.42	.39	.42	.38	.41	.38	14'	8.3	10.7'	4.2	21.9'	0.8	
	55°	5	* Efficiency			6	.39	.36	.39	.36	.38	.35							
	65°	2				7	.36	.33	.36	.33	.35	.33							
	75°	1				8	.34	.31	.34	.31	.33	.30	16'	6.0	12.5'	3.0	25.7'	0.6	
85°	1				9	.32	.29	.32	.29	.31	.28								
90°	0				10	.30	.27	.30	.27	.29	.26								



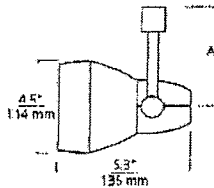
LINE-VOLTAGE ELEMENTS

Om with Ceramic Metal Halide PAR

ARCHITECTURAL HEAD

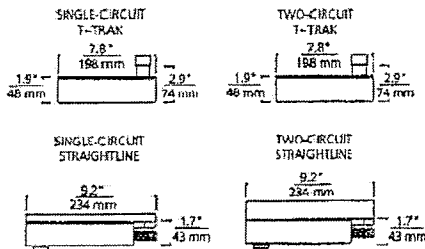


OM, PAR30 LONG, SOLID LENS RING
Shown approximately 15% actual size.

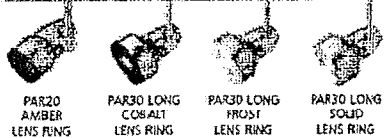


System Connectors

Elements ordered with a system prefix include a connector for that system.



Lens Ring Options



DESCRIPTION

Versatile die cast aluminum head, pivots vertically 180°, rotates horizontally 350°. Features vertical and horizontal locking mechanisms and optional glass lens ring. Four beam spread options with specular reflector.

SYSTEM/FINISH

Single-Circuit T-trak, Two-Circuit T-trak and Power Jack:
Satin Nickel: satin nickel connector with satin nickel head.
White: white connector with white head.
Single-Circuit StraightLine and Two-Circuit StraightLine:
Black/Satin Nickel: black connector with satin nickel head.
White/Satin Nickel: white connector with satin nickel head.
White/White: white connector with white head.

BALLAST

Includes energy-saving electronic ballast in slim aluminum die cast housing. Input voltage 120v 50/60 hertz, THD <10%. Power Jack version is compatible with Power Jack Canopy with Ballast (sold separately).

LAMP

120 volt ceramic metal halide PAR20 lamp with E26 medium base, up to 39 watts; PAR30 long lamp up to 70 watts (lamp not included).

LENS RING

Satin nickel or white body with amber, cobalt, frost or solid (to match finish selection) lens ring.

OPTICAL CONTROLS

Holds up to two, sold separately: Eggcrate Louver, Glass Lens, UV Filter.

WEIGHT

PAR20: 3.10 lb/1.40 kg. ±
PAR30: 4.65 lb/2.10 kg. ±

ORDERING INFORMATION

700 SYSTEM	OMC TYPE	WATTAGE	LENGTH (A)	LENS RING	PJ, TT + TT2 FINISH
PJ POWER JACK	20 PAR20	3 38 WATT	03 2.1"	A AMBER	S SATIN NICKEL
TT SINGLE-CIRCUIT T-TRAK	20L PAR20 LONG	7 70 WATT (PAR30 ONLY)	06 5.1"	B FROST	W WHITE
TT2 TWO-CIRCUIT T-TRAK			12 11.1"	F FROST	
SL SINGLE-CIRCUIT STRAIGHTLINE			18 17.1"	S SOLID	
S2 TWO-CIRCUIT STRAIGHTLINE					

SL + SL2 COUPLER FINISH
BS BLACK SATIN NICKEL
WS WHITE SATIN NICKEL
WW WHITE/WHITE

T~trak

a brand of TECH LIGHTING

7400 Linder Avenue T 847.410.4400
Skokie, Illinois 60077 F 847.410.4500

www.ttraklighting.com

700 PJ OMC 20 3 12 S S

Catalog Number		700PJOMC20312SS	
Notes	Job: LVM Delahanty Hall		Type
Submitted By: Visible Light, Inc.		B	

tt_hds_om_CMH_PAR_spec.pdf

January 2007 Specifications subject to change without notice.





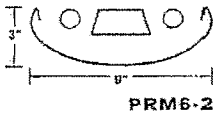
PRIMA[®]

TB LAMP

9X3 FULLY PERFORATED

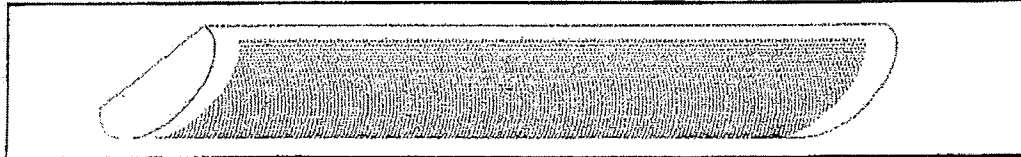
MODULAR

AVAILABLE FIXTURES



Catalog Number	
PRM6 2 32 4FT R4 120 GEB10 SCT L/LP F1/12 ACG	
Notes	Type
Job: UVM Delahanty Hall Submitted By: Visible Light, Inc.	C

SPECIFICATIONS



CONSTRUCTION
Housing one-piece cold-rolled steel with flat endplate forming a 6" x 3" oval channel.

REFLECTORS
Reflecting surfaces have white finish (nominal 90% reflectance).

SHIELDING
Die-punched perforations on housing.

FINISH
Fine textured white paint is standard.

ELECTRICAL
Specify 120 volt or 277 volt. Pre-wired with prescribed circuits as specified. UL listed. Listed and labeled to comply with Canadian standards. For special circuiting, consult factory. T5 high-output lamps are included.

FIXTURE LENGTH
4', 8', and 12' sections form row lengths. Sections are attached using internal joiners.

ORDERING GUIDE

Use guide below to order complete fixture run(s) of any length.

Fixture	# of Lamps in Cross Section	Lamp Type	Reflector	Nominal Row Length	Minimum Section Length	Voltage	Ballast Type	# of Emergency/Night Light Sections	Emergency/Night Light Type(s)	Switching	Lamp Color	Mounting Type	Feed/Suspension Lengths	Options
PRM6	2	32	WHR	4FT	R4	120	GEB10		SCT	L/LP	F1/12	ACG		
					R4	120			SCT - Single Circuit DCT - Dual Circuit				12-12" overall suspension 15-15" overall suspension 18-18" overall suspension 21-21" overall suspension 24-24" overall suspension XX-XX" overall suspension	ACG - Adjustable Cable Grippers APF - Alternate Power Feed CMG - Cord Manager DC - Dust Cover ELH - EM through wire/w/ separate lead ELS - EM through wire/w/ single lead GLR - Gusing (last row) GMF - Gusing (slow blow)
					R8	277			Blank - No Emergency or Night Light EL - Emergency Battery Pack EC - Emergency/Night Light Circuit EN - Emergency/Battery Pack with Night Light Circuit				F1 - T-Bar Ceiling (Universal Mounting Bracket) F2 - Hard Ceiling (Universal Mounting Bracket)	
					R12	347			L/LP - No Ballast LP730 - 3000°K, 70+CRI LP735 - 3500°K, 70+CRI Standard LP741 - 4100°K, 70+CRI LP830 - 3000°K, 80+CRI LP835 - 3500°K, 80+CRI LP841 - 4100°K, 80+CRI				F4A - E30 Cap 1/16" Tee F4B - R05 Cap 1/16" Tee F4C - R05 Cap Screw Slot	
									Blank - No Emergency 1SE - 1 Section 2SE - 2 Sections XSE - X Sections					
									GEB - Generic Electronic Ballast GEB10 - <1.0% THD Ballast (consult factory for dimming options)					
									WHR - White Reflector Standard EPR - Specular Reflector					

Notes: 1. All units are in 4" increments.
2. Optional.
3. EL and EC are installed in last 4' of fixture sections and are not available concurrently with each other. Separate lead required for each EL or EC unless L/LP is specified.

EXAMPLE:
Qty Fixture section
2 PRM6 2 32 4FT R12 347 GEB SCT LP735 F1/12
1 PRM6 2 32 12FT R8 277 GEB 1SE EC SCT L/LP F2/16 ACG

ITEM #:



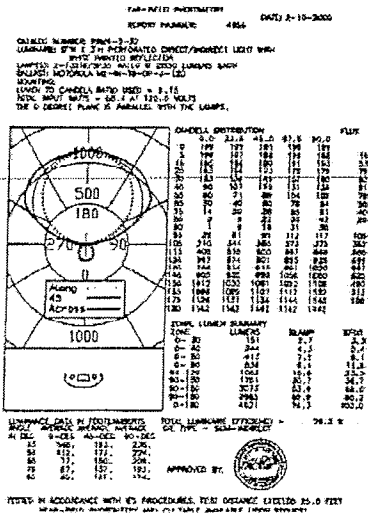
PRIMA®

T8 LAMP

3X3 FULLY PERFORATED

2 LAMP T8 PHOTOMETRIC REPORT PR16-7

PERFORMANCE SUMMARY



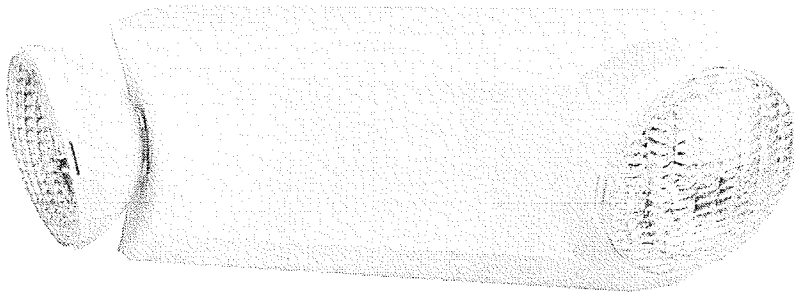
2 LAMP

% Luminaire	0°-90°	12%
Lumens from	90°-130°	39%
	90°-180°	88%
Maximum Direct Flux Location	30°-40°	
Maximum Indirect Flux Location	120°-130°	
Luminaire Efficiency	79%	

DUAL LITE

CV Series

Emergency Lighting Units



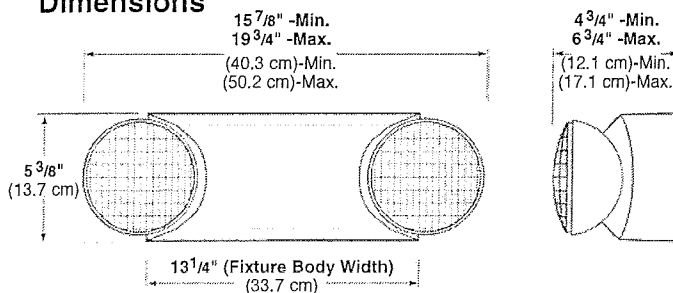
"EM"



Standard Features

- Fast, easy installation
- Snap-together design
- Compact, low-profile style
- High impact, UV stabilized thermoplastic
- Fully adjustable lighting heads
- White or black finishes offered
- Standard and damp location models
- Remote capacity models
- High output incandescent lamps
- Maintenance-free battery
- Dual voltage – 120/277VAC
- Fully automatic charger
- Automatic low-voltage battery disconnect and transformer isolation protection
- Universal mounting plate
- Test switch and LED AC-On light
- Temperature range: 20°C to 30°C (68°F to 86°F)
Damp location models: 10°C to 40°C (50°F to 104°F)
- Optional Spectron® self-diagnostic/self-testing electronics
- UL 924 Listed
- UL Damp Location Listed (Damp Location models only)
- NFPA 101/NEC

Dimensions



Featuring a contemporary appearance, the CV Series adds style to a reliable and technologically advanced unit. Available with remote capability, the CV Series is ideally suited for commercial or institutional facilities where performance, appearance and ease of installation are concerns.

Model Numbers

Standard Models	Damp Location Models	NiCad Battery Models
CV2 (6V, 12W)	CV2D (6V, 11W)	CV2N (6V, 15W)
CV3 (6V, 18W)	CV3D (6V, 17W)	CV5N (6V, 30W)
CV5 (6V, 30W)	CV5D (6V, 27W)	

Options (Add suffix to catalog number)

I	Spectron self-testing/self-diagnostic electronics ⁽¹⁾
-B	Black housing
-V	Voltmeter
-24K	220-240VAC, 60Hz operation ⁽¹⁾
-A21	Auxiliary 2-conductor AC line cord (120V only) ⁽²⁾
-A31	Auxiliary 3-conductor AC line cord (120V only) ⁽³⁾

⁽¹⁾ Not available with NiCad (CV2N, CV5N) models.

⁽²⁾ For use with CV2, CV2D and CV2N models.

⁽³⁾ For use with CV3, CV3D, CV5, CV5D and CV5N models.

Accessories (Order Separately)

SRHSW	Matching remote head - single (white) ^{(a)(b)}
SRHDW	Matching remote head - twin (white) ^{(a)(b)}
OMSSB	Single outdoor lighting head (black) ^{(a)(b)}
OMSDB	Twin outdoor lighting head (black) ^{(a)(b)}
PMLZTW	Pendant mounting kit (white) ^(c)
PMLZTB	Pendant mounting kit (black) ^(c)
WGEL	Wire guard

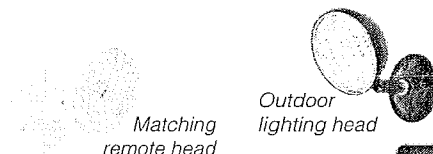
^(a) Supplied with mounting plate. Specify voltage and wattage when ordering. Example: SRHDW0607.

^(b) Replace "W" with "B" for black finish. Example: OMSDB0607.

^(c) Not available for use with CV5, CV5D and CV5N models.

Optional Lamps

To order two nonstandard lamps on the fixture, suffix the catalog number. See the "Remote Heads and Fixtures" catalog section for available lamps. Example: CV5-SRHSW0612



Matching remote head

Outdoor lighting head



Hubbell Lighting, Inc.

Construction

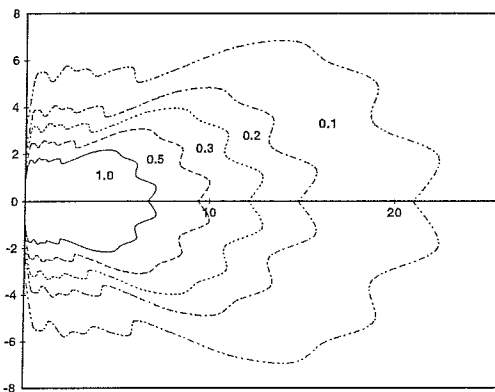
Unit and Lamp Housings: All housings and back plate constructed of flame-rated, UV stable, ABS thermoplastic
Finish: Textured bright white or black

Illumination

Lamp Type: Incandescent
Lamp Voltage: 6 volts
Lamp Wattage: 5.4 watts
Rated lamp life: 100 hours

Photometrics

High Output 6 Volt, 5.4 Watt Incandescent Lamp
Horizontal Distribution



Installation

Unit Wall Mounting: Unit mounts to 3 1/2", 4" octagon, or 4" square outlet boxes and standard plaster rings. Back plate provides a universal knockout pattern for mounting to outlet box. Keyholes provided for securing unit housing to wall surface.
Wiring: Pre-stripped AC input leads provided. All AC connections made inside unit housing.

Operating Temperature Range

Standard models: 20°C to 30°C (68°F to 86°F)
Damp location models: 10°C to 40°C (50°F to 104°F)

Product Selector Guide

Base Catalog Number	Electrical										
	Output Volts	Output Watts				Input Amps		Input Watts		Standard Lamp	Remote Capability
		1.5 Hrs.	2 Hrs.	3Hrs.	4Hrs.	120V	277V	120V	277V		
CV2	6	12	--	--	--	.040	.020	4.0	4.0	5.4W	No
CV3	6	18	13	--	--	.040	.020	4.0	4.0	5.4W	Yes
CV5	6	30	22	15	12	.130	.060	14.0	14.0	5.4W	Yes
CV2D	6	11	--	--	--	.040	.020	4.0	4.0	5.4W	No
CV3D	6	17	12	--	--	.040	.020	4.0	4.0	5.4W	Yes
CV5D	6	27	20	13	--	.130	.060	14.0	14.0	5.4W	Yes
CV2N	6	15	11	--	--	.070	.030	9.0	9.0	5.4W	No
CV5N	6	30	22	15	12	.120	.050	14.0	14.0	5.4W	Yes

Dual-Lite • www.dual-lite.com

A Hubbell Lighting, Inc. brand with representatives' offices in principal cities throughout North America.
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Electronics

Input: 120/277VAC, 60 Hz. (standard)
Built-in Protection: Transformer isolation and low battery voltage disconnect
Charger: Solid-state, constant voltage, current limited type
Transfer: Solid-state design (Relay transfer on Remote Capacity models)
Battery Recharge Cycle: Per UL time standards
Test Means: Integral test switch
Indicators: LED AC-On indicator

Battery

Type: Maintenance-free lead-acid

Compliances

UL 924 (all models)
NFPA-101 (all models)

Warranty

	Unit and Electronics	Battery	
		Full	Pro-Rata
Standard Models	3 years	2 years	8 years
Nicad Models	3 years	3 years	7 years
Spectron Models	5 years	3 years	7 years

Suggested Specifications

Unit housing construction will be flame-rated, UV stable, ABS thermoplastic in textured (white) (black) finish. Unit design will allow universal 120/277VAC, 60 Hz operation standard. Emergency illumination will be provided by two integral [and (one)(two)(three) remote] 5.4-watt high-output lighting heads. A universal knockout pattern shall be provided in the unit back plate for mounting to 4" square or 3 1/2" and 4" octagon outlet boxes as well as standard plaster rings. Emergency components will include a solid-state, constant voltage, current limited type battery charger; a maintenance-free, (lead-acid)(NiCad) battery; an AC-On LED indicator light; and a test switch. The unit charger will be capable of recharging the battery within acceptable UL time standards. Emergency operation must be provided for a minimum of 90 minutes. During emergency operation, the battery shall be protected from deep discharge by a low-voltage battery disconnect circuit. Upon return of normal utility power the unit shall begin a recharge cycle. The charger will bring the battery to full capacity within acceptable UL time standards. A manual test switch will allow a user-activated test at any time. Units must comply with all UL 924 and NFPA 101 Life Safety Code requirements. Optional equipment will include:
Dimensions to be 5 3/8" (137 mm) high x 19 3/4" (502 mm) wide (max.) x 6 3/4" (171 mm) deep (max.).

RECEIVED

JAN 10 2008

CRISM HILL PGM

BENOIT ELECTRIC, INC.
254 INDUSTRIAL LANE
BARRE, VT 05641
Phone (802) 229-1955
Fax (802) 229-4946

Submittal Cover Sheet

Project Name: UVM Delehanty Lab

Date: 1/09/2008

Architect: IDC Architects

Engineer: Same

Specification Section: 16011

Revision:

Submitted per Specification Section: 2.21 Panelboards

Drawing #/Detail Reference: E-3

Supplier: Twinstate CED Burlington

Items Submitted: Panel PP-1

- NO EXCEPTIONS NOTED
- MAKE CORRECTIONS NOTED
- REVISE AND RESUBMIT
- SUBMIT ITEMS AS NOTED

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any Action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: dimensions which shall be confirmed and correlated at the jobsite, fabrication processes and techniques of construction, coordination of the work with that of all other trades and the satisfactory performance of the work.

By: [Signature]

Dated: 1/17/08



ReArch Company

Submittal and Shop Drawings

Received 1/09/08

Reviewed

ReArch Prep

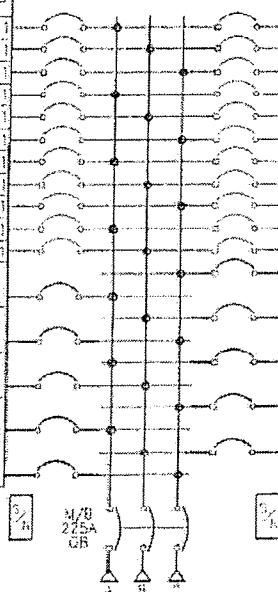
Signature, Title

1/10/08

Date

REV	DESCRIPTION	BY	DATE	---	---	---	---
---	---	---	---	---	---	---	---

CKT NO	ACCESSORIES	TYPE	RATING AMP/P			RATING AMP/P	TYPE	ACCESSORIES	CKT NO
1		QOB	30/1			20/1	QOB		2
2		QOB	20/1			20/1	QOB		4
3		QOB	20/1			20/1	QOB		6
4		QOB	20/1			20/1	QOB		8
5		QOB	20/1			20/1	QOB		10
6		QOB	20/1			20/1	QOB		12
7		QOB	20/1			20/1	QOB		14
8		QOB	20/1			20/1	QOB		16
9		QOB	20/1			20/1	QOB		18
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11		QOB	20/1			20/1	QOB		22
12		QOB	20/1			20/1	QOB		24
13		QOB	20/1			20/1	QOB		26
14		QOB	20/1			20/1	QOB		28
15		QOB	20/1			20/1	QOB		30
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18		QOB	20/1			20/1	QOB		36
19		QOB	20/1			20/1	QOB		38
20		QOB	20/1			20/1	QOB		40
21		QOB	20/1			20/1	QOB		42
22		QOB	20/1			20/1	QOB		44
23		QOB	20/1			20/1	QOB		46
24		QOB	20/1			20/1	QOB		48
25	SHUNT TRIP 120 VAC	QOB	30/1			30/1	QOB	SHUNT TRIP 120 VAC	26
26	SHUNT TRIP 120 VAC	QOB	30/1			30/1	QOB	SHUNT TRIP 120 VAC	28
27	SHUNT TRIP 120 VAC	QOB	30/1			30/1	QOB	SHUNT TRIP 120 VAC	30
28	SHUNT TRIP 120 VAC	QOB	30/1			30/1	QOB	SHUNT TRIP 120 VAC	32
29	SHUNT TRIP 120 VAC	QOB	30/1			30/1	QOB	SHUNT TRIP 120 VAC	34
30	SHUNT TRIP 120 VAC	QOB	30/1			30/1	QOB	SHUNT TRIP 120 VAC	36
31	SHUNT TRIP 120 VAC	QOB	30/1			30/1	QOB	SHUNT TRIP 120 VAC	38
32	SHUNT TRIP 120 VAC	QOB	30/1			30/1	QOB	SHUNT TRIP 120 VAC	40
33	SHUNT TRIP 120 VAC	QOB	30/1			30/1	QOB	SHUNT TRIP 120 VAC	42



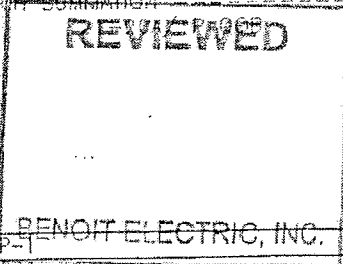
PHYSICAL DATA

- o ENCLOSURE: TYPE 1
SURFACE WITH DOOR FRONT
FRONT CAT#: MHC50S
BOX CAT#: MH50BE
DIMENSIONS:
50"H X 20"W X 5.75"D
WIRE BENDING SPACE:
TOP 5.0"
BOTTOM 12.1"
SIDE 6.1"
PBA 507A
- o BUSSING: ALUMINUM BUS
STANDARD PLATING
- o SPECIAL:
STANDARD SOLID NEUTRAL
BLANK ENDWALLS
GROUND BAR

ELECTRICAL DATA

- o SYSTEM: 208Y/120 VAC 3PH 4W 60 HZ
10,000 AMPS SYMS. SCOR
- o MAIN: MAIN BREAKER: QB 225A
BOTTOM FEED
10K AIC
INCOMING CONDUCTOR(S) PER PHASE:
(1)#4-300 kcmil Al/Cu (PER NEC)
- o BRANCH MOUNTING TYPE: BOLT-ON
BRANCH TERMINATION

3
1-30A/1P QOB
10-30A/1P QOB S/T

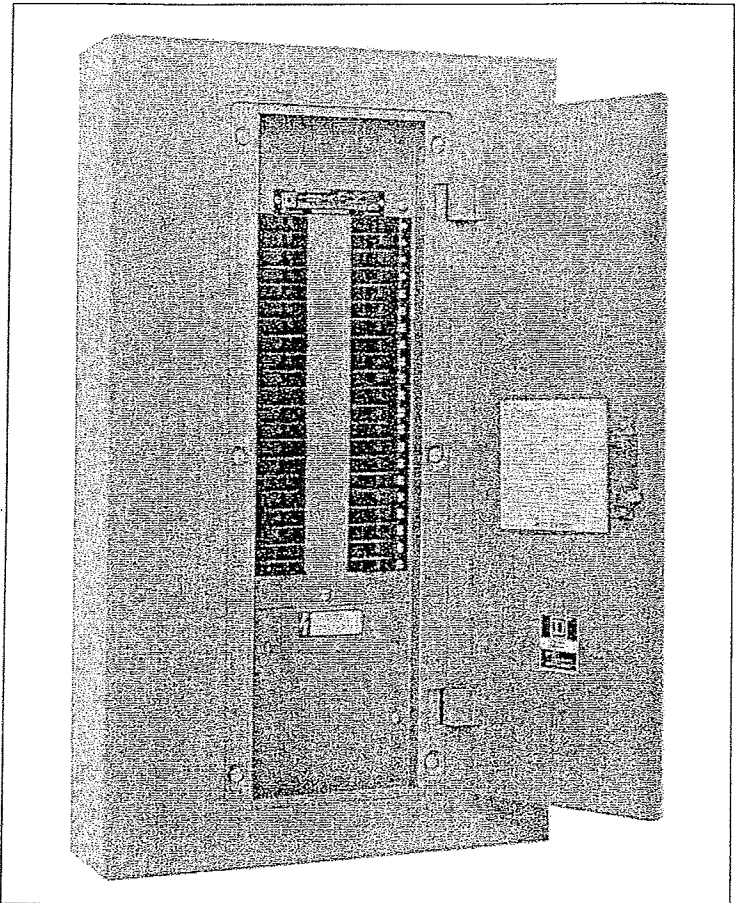


JOB NAME:	SPJ DWG DELAHANTY TB	EQUIPMENT DESIGNATION:	PP-1
JOB LOCATION:	SOUTH BURLINGTON VT	EQUIPMENT TYPE:	NUOD
DRAWN BY:	(070)	DRAWING TYPE:	ONE LINE DIAGRAM
DATE:	JANUARY 3 2008		
DRAWING STATUS:	QUOTE NOT FOR CONSTRUCTION	DWG# 024483540	PG 1 OF 1 REV 001

NQOD Circuit Breaker Panelboards

Catalog
2005

Class 1630

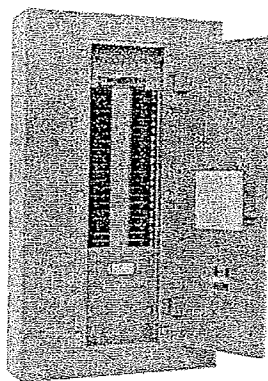


CONTENTS

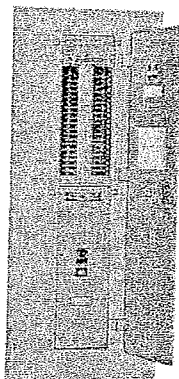
Description	Page
APPLICATION DATA	3
TYPICAL WIRING DIAGRAMS	12
DIMENSIONS	13
REPLACEMENT PARTS	22



NQOD Circuit Breaker Panelboards Application Data



225 A Main Lugs



225 A Main Circuit Breaker

APPLICATION DATA

Type

NQOD circuit breaker panelboards are for use on ac systems and are Underwriters Laboratories (UL) Listed under File E33139. NQOD circuit breaker panelboards accept QO® and QOB branch circuit breakers.

Standards

NQOD circuit breaker panelboards are designed, manufactured, and tested to comply with the following standards:

UL 67—Standard for Panelboards
UL 50—Enclosures for Electrical Equipment
CSA C22.2, No. 29-M1988—Panelboards and Enclosed Panelboards
CSA C22.2, No. 94-M91—Special Purpose Enclosures
NEMA PB 1—Panelboards
NFPA 70—National Electrical Code® (NEC®)
Federal Specification W-P-115C Type I Class 1—Circuit Breaker Panelboards

Ratings

Main Lugs 100–600 A Main Circuit Breaker 100–600 A

Branch Circuit Breakers (Plug-on or Bolt-on)

10 k AIR	22 k AIR	65 k AIR	10 k AIR (240 Vac)	42 k AIR
QO, QOB	QO-VH, QOB-VH	QH, QHB	QO-H, QOB-H	QOH
1-Pole 10–70 A	1-Pole 15–30 A	1-Pole 15–30 A	2-Pole 15–100 A	2-Pole 35–125 A
2-Pole 10–125 A	2-Pole 15–150 A	2-Pole 15–30 A		
3-Pole 10–100 A	3-Pole 15–150 A	3-Pole 15–30 A		

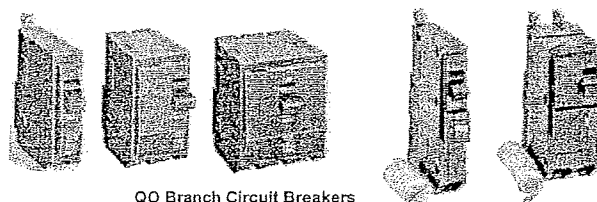
NQOD Panelboard 240 Vac Short-Circuit Current Ratings (SCCR)

SCCR	Fully Rated or Series Rated	Integral Mains (Main Circuit Breaker) Maximum Amperage	Remote Mains Maximum Amperage	Branch Circuit Breakers
10,000 A	Fully Rated	FAL (100 A), QOB (125 A), QBL (225 A)	FAL (100 A), QOB (125 A), QBL (225 A)	QO(B)
22,000 A	Fully Rated	QOB-VH (150 A)	ED (125 A), QO(B)-VH (150 A), QD (225 A)	QO(B)-VH
	Series Rated	QOB-VH (150 A)	QO(B)-VH (150 A)	QO(B)
25,000 A	Series Rated	HDL (150 A), QDL (225 A), JDL (250 A)	ED (125 A), HD (150 A), QD (225 A), JD (250 A)	QO(B)
42,000 A	Fully Rated	LAL (400 A)	LA (400 A), MA (600 A)	QHB
	Fully Rated	HGL (150 A), QGL (225 A), JGL (250 A), LHL (400 A)	EG (125 A), HG (150 A), QG (225 A), JG (250 A), LH (400 A), MH (600 A)	QHB
65,000 A	Series Rated	HGL (150 A), QGL (225 A), JGL (250 A), LCL (600 A)	EG (125 A), HG (150 A), QG (225 A), JG (250 A), LC (600 A), Class J/T6 fuses (400 A)	QO(B), QO(B)-VH
100,000 A	Series Rated	QJL★ (225 A)	EJ (125 A), QJ★ (225 A)	QO(B)
200,000 A	Series Rated	FIL (100 A), KIL (250 A)	FI (100 A), KI (250 A), Class J/T6 fuses (200 A), Class T3 fuse (400 A)	QO(B)

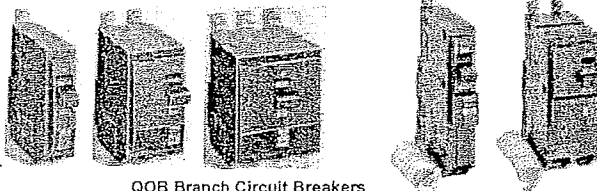
★ QJL/QJ 100 kA rating is at 208Y/120 Vac for 3-phase applications and 240 Vac for one-phase applications.

Service

Voltage	System	System Diagram
120/240 Vac	1 ϕ 3W	
208Y/120 Vac	3 ϕ 4W	
240/120 Vac	3 ϕ 4W Delta	
240 Vac	3 ϕ 3W Delta	
240 Vac	3 ϕ 3W Grd. B ϕ Delta	



QO Branch Circuit Breakers



QOB Branch Circuit Breakers

NQOD Circuit Breaker Panelboards Application Data

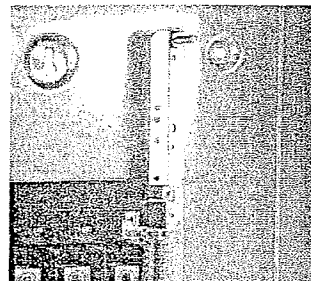
Indoor Enclosures (Types 1 and 2)

Boxes (NQB or MH):

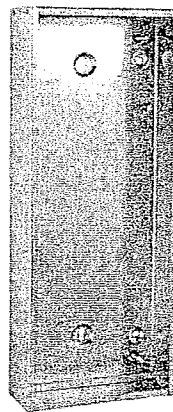
- Galvanized steel with removable endwalls. One endwall is provided with knockouts and the other endwall is blank.
- Box sizes:
 - NQB: 14 in. (356 mm) wide x 5.75 in. (146 mm) deep, 225 A interior maximum.
 - MH: 20 in. (508 mm) wide x 5.75 in. (146 mm) deep, 600 A main lug interior max. or 400 A main circuit breaker max.
 - MH: 20 in. (508 mm) wide x 6.75 in. (171 mm) deep, 600 A main circuit breaker interior, factory-assembled only.
- Box and interior mounting instructions are found in the information manual shipped with the interior.
- Interiors mount directly to studs in the MH or NQB boxes. Interior mounting brackets are not required.
- Type 2 enclosure includes a driphood.
 - Surface-mounted trim only.

Fronts:

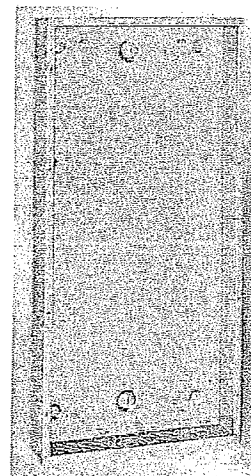
- Finished with gray baked enamel electrodeposited over cleaned phosphatized steel (ANSI 49).
- Flush or surface mounted.
- Door has flush lock. Uses NSR-251 key.
- Directory card is located on the inside of the door.
- MONO-FLAT® fronts on 100–225 A interiors mount to the interior trim with trim screws. Both trim screws and door hinges are concealed. Fronts are not removable with the door closed and locked.
- Fronts for 400–600 A interiors are vented and mount to the enclosure with trim screws (Catalog No. LP9502). Door hinges are concealed.



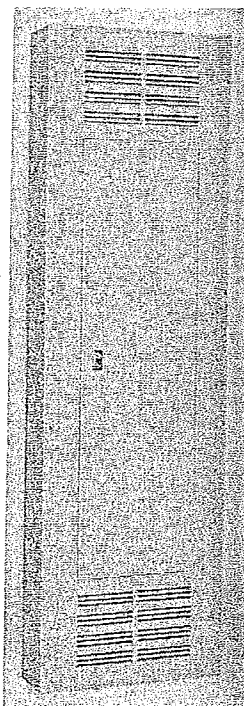
Interiors Mount Directly to Box Studs



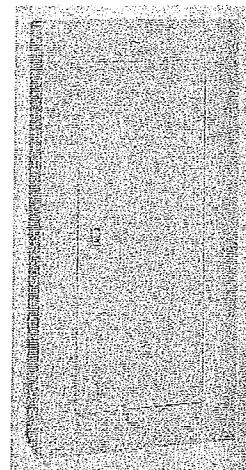
NQB Box



MH Box



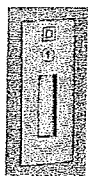
Front (Type 1 Enclosure) for 400–600 A Interiors with Trim Screws



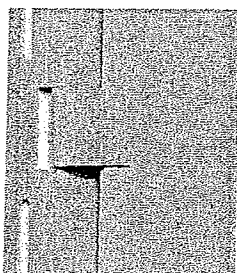
MONO-FLAT Front (Type 1 Enclosure) for 100–250 A Interiors



Flush Lock (Catalog No. PK4FL)



Sliding Vault Lock (Catalog No. PK5FL)



Concealed Hinge Used on 100–600 A Fronts



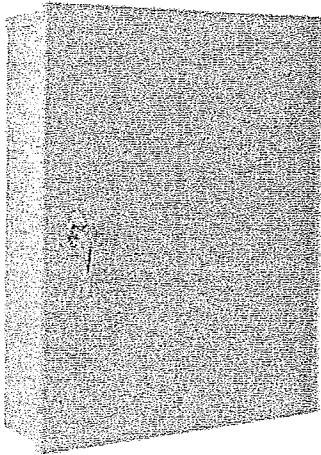
Key NSR-251 (Catalog No. LP9618)

NQOD Circuit Breaker Panelboards Application Data

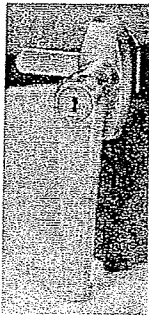
Rainproof (Type 3R Enclosures)

Dusttight (Type 5 and 12 Enclosures)

- Finished with gray-baked enamel electrodeposited over cleaned phosphatized galvanized steel (ANSI 49).
- Gasketed door has vault handle with lock (uses NSR-251 key).
- Two additional trunk latches.
- Directory card located on inside of door.
- No knockouts.
- Removable drain screw for Type 3R enclosure rating.
- Trim kit (ordered separately) is required for end and side gutters.
- Provisions for two ground bars.



Type 3R, 5, and 12 Enclosures



Vault Handle with Lock
(Catalog No. PK4NVL)

Stainless Steel (Type 4 and 4X Enclosures)

- Watertight and dusttight.
- Gasketed door with optional locking handle.
- Directory card holders on inside of door.

Enclosure Options

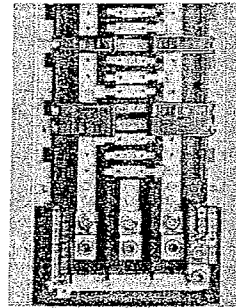
Types	Environment	Provides Protection Against
Type 1	Indoor	Contact with the enclosed equipment
Type 2	Indoor	Falling water and dust
Type 3R	Outdoor	Falling rain, sleet, undamaged by ice
Type 4X	Indoor/Outdoor	Resists corrosion, hose-directed water, dust
Type 5	Indoor	Settling dust, falling dirt, dripping liquids
Type 12	Indoor	Circulating dust, falling dirt, dripping liquids

Class CTL

UL Listed, Class CTL panelboard. Meets paragraph 408.15 of the NEC.

Phasing

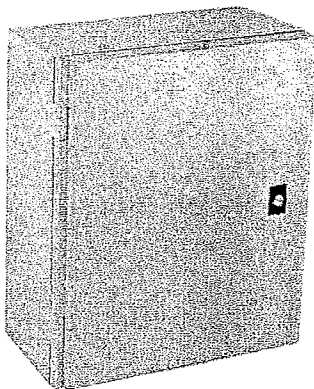
Distributed phase bussing. Branch circuit breakers may be mounted in any position.



Distributed Phase
Bussing

Corrosion-Resistant Fiberglass-Reinforced Polyester (Type 4X Enclosure)

- Watertight and dusttight.
- Gasketed door with optional locking handle.
- Directory card holders on inside of door.

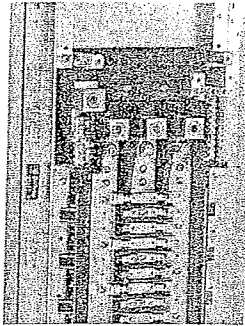


Type 4X Enclosure

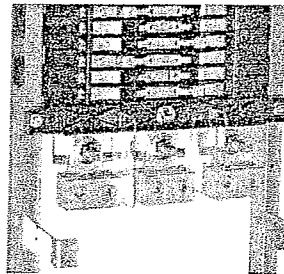
NQOD Circuit Breaker Panelboards Application Data

Line Lugs

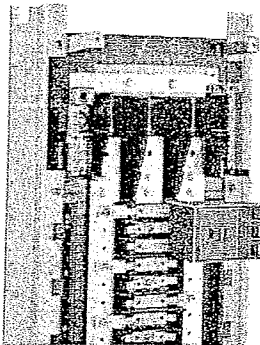
All lugs are suitable for 75 °C copper or aluminum wire.



100–225 A Main Lugs



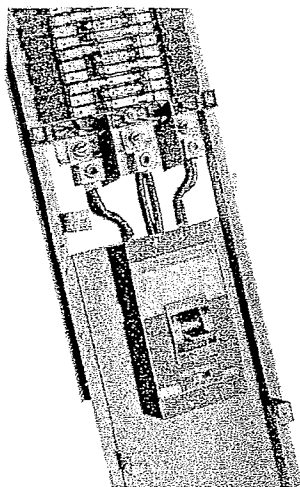
600 A Main Lugs



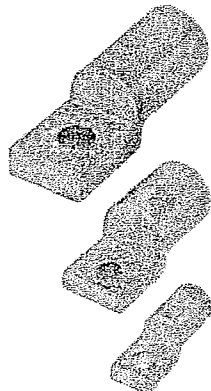
100 A QOB Main Circuit Breaker



225 A QBL Main Circuit Breaker



400 A LAL Main Circuit Breaker



Type VCEL VERSAtile™
Compression Equipment
Terminals

VERSA-CRIMP® Compression Lugs

- Compression lugs are available for 100–600 A main lug interiors and 100–400 A main circuit breaker interiors.
- Compression lugs are not available on QOB or QBL-type main circuit breakers.

Main Lugs Terminal Data

Standard Mechanical Lugs

Panelboard Type	Ampere Rating	Wire Range— Wire Bending Space per NEC Table 373-6	Lug Wire Range
NQOD	100	(1) #10-#1 Cu or (1) #6-#1 Al	(1) #10-2/0 Cu or (1) #6-2/0 Al
	225	(1) #6-300 kcmil Al/Cu	(1) #6-300 kcmil Al/Cu
	400	(2) 1/0-300 kcmil Al/Cu or (1) 1/0-750 kcmil Al/Cu	(2) 1/0-300 kcmil Al/Cu or (1) 1/0-750 kcmil Al/Cu
	600	(2) 1/0-500 kcmil Al/Cu or (4) 1/0-300 kcmil Al/Cu	(2) 1/0-750 kcmil Al/Cu or (4) 1/0-300 kcmil Al/Cu

VCEL Compression Lugs

Panelboard Type	Ampere Rating	Lugs per Phase	Catalog No.	Lug Wire Range
NQOD	100	1	VCEL021-14S1	#8-1/0 Al/Cu
	225	1	VCEL030-516H	#4-300 kcmil Al/Cu
	400–600	2 ▲	VCEL050-12H1	2/0-500 kcmil Al/Cu
			VCEL050-12H1	400-600 kcmil Al or 400-500 kcmil Cu
		or 1	VCEL075-12H1	500-750 kcmil Al or 500 kcmil Cu

▲ When two wires are terminated per phase, anti-turn kit NQOD5VC must be used.

Main Circuit Breaker Terminal Data

Standard Mechanical Lugs

Panelboard Type	Ampere Rating	Circuit Breaker Type	Wire Range— Wire Bending Space per NEC Table 373-6	Lug Wire Range
NQOD	100	QOB	(1) #4-#1 Al/Cu	(1) #4-2/0 Al/Cu
		FA, FH, FI ▲	(1) #14-#1 Al/Cu	(1) #14-1/0 Al/Cu
	150	HD, HG, HJ, HL	(1) #14-3/0 Al/Cu	(1) #14-3/0 Al/Cu
	225	QB, QD, QG, QJ	(1) #4-300 kcmil Al/Cu	(1) #4-300 kcmil Al/Cu
	250	KI	(1) #4-300 kcmil Al/Cu	(1) #6-350 kcmil Al/Cu
		JD, JG, JJ, JL	(1) #4-300 kcmil Al/Cu	(1) #3/0-350 kcmil Al/Cu
	400	Q4, LA, LH	(1) #4-500 kcmil Al/Cu or (2) #1-250 kcmil Al/Cu	(1) #1-600 kcmil Al/Cu or (2) #1-250 kcmil Al/Cu

▲ Circuit breaker Types FA, FH, FI are factory assembled only.

VCEL Compression Lugs

Panelboard Type	Ampere Rating	Circuit Breaker Type	Lugs per Phase	Catalog No.	Lug Wire Range
NQOD	100	FA, FH, FC, FI	1	VC100FA	#8-1/0 Al/Cu
		HD, HG, HJ, HL	1	YA060HD	#6-#2 Al/Cu
	150	HD, HG, HJ, HL	1	YA150HD	#1-4/0 Al/Cu
		JD, JG, JJ, JL	1	YA150JD	#1-3/0 Al/Cu
	225	JD, JG, JJ, JL	1	YA250J35	#3/0-350 kcmil Al/Cu
		KA, KH, KC, KI	1	VC250KA3	#4-300 kcmil Al/Cu
		KA, KH, KC, KI	1	VC250KA35	250-350 kcmil Al/Cu
		LA, LH, Q4	2	VC400LA35	250-350 kcmil Al/Cu
	400	LA, LH, Q4	2	VC400LA3	#4-300 kcmil Al/Cu
		LA, LH, Q4	1	VC400LA5	2/0-500 kcmil Al/Cu
		LA, LH, Q4	1	VC400LA7	500-750 kcmil Al or 500 kcmil Cu

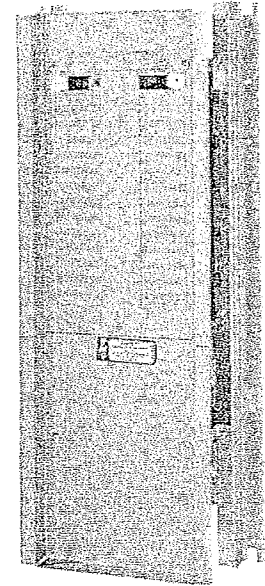
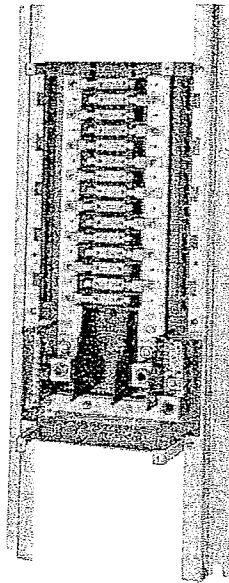
NQOD Circuit Breaker Panelboards Application Data

Main Lugs Interiors

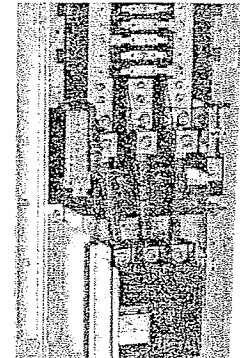
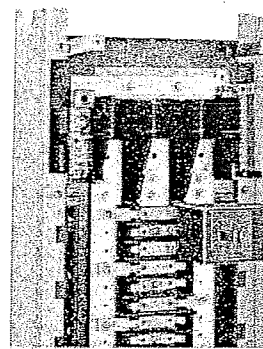
- Will accept plug-on or bolt-on branch circuit breakers.
- Suitable for use as service entrance (USA only); meets local electrical codes.
- Top or bottom feed.
- 65k AIR maximum branch circuit breakers (fully rated).
- 200k AIR maximum when supplied by remote I-LIMITER® circuit breaker (series rated).
- 100 A and 225 A are suitable for use as service entrance with back-fed QOB circuit breaker (USA only).
- Field-installable sub-feed lug kits for 100–225 A interiors.
- Factory installed main lugs on all interiors.
- 225–400 A main lug interiors are convertible to main circuit breaker by adding a main circuit breaker and adapter kit.
- Available with silver-plated copper or tin-plated aluminum bus (aluminum is standard). Tin-plated copper bus is available as an option. Branch connector fingers are all tin-plated copper; silver-plated branch connector fingers are optional.

Main Circuit Breaker Interiors

- Will accept plug-on or bolt-on branch circuit breakers.
- Suitable for use as service entrance; meets local electrical codes.
- Top or bottom feed.
- 65k AIR maximum branch circuit breakers (fully rated).
- 200k AIR maximum when supplied by I-LIMITER circuit breaker (series rated).
- Available with silver-plated copper or tin-plated aluminum bus (aluminum is standard). Tin-plated copper bus is available as an option. Branch connector fingers are all tin-plated copper; silver-plated branch connector fingers are optional.
- 100 A main circuit breaker interiors consist of factory installed back-fed QOB main circuit breaker.
- 225 A main circuit breaker interiors use:
 - Standard main lug interiors.
 - Main circuit breaker adaptor kit.
 - Appropriate QBL, QDL, QGL, QJL, JDL, JGL, JLL, JLL, or KIL circuit breaker.
 - 250 A main circuit breaker interiors are factory assembled only.

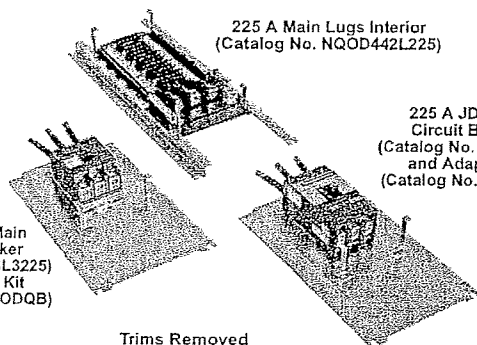


225 A Maximum Main Lugs



100 A QOB Main Circuit Breaker

225 A QBL Main Circuit Breaker

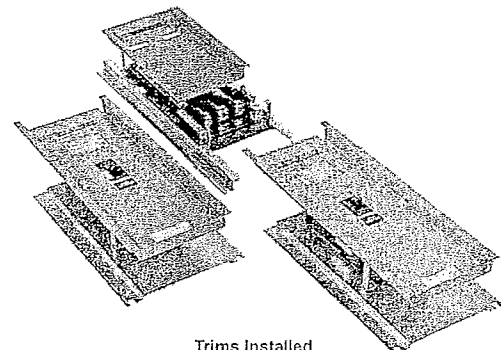


225 A Main Lugs Interior
(Catalog No. NQOD442L225)

225 A QBL Main
Circuit Breaker
(Catalog No. JDL36225)
and Adapter Kit
(Catalog No. NQODQB)

225 A QBL Main
Circuit Breaker
(Catalog No. QBL3225)
and Adapter Kit
(Catalog No. NQODQB)

Trims Removed

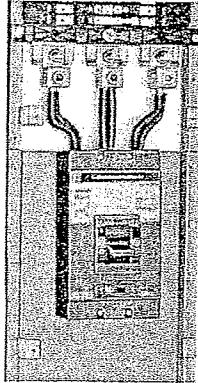


Trims Installed

NQOD Circuit Breaker Panelboards Application Data

Main Circuit Breaker Interiors (continued)

- 400 A main circuit breaker interiors use:
 - Standard main lug interior.
 - Main circuit breaker adapter kit (Catalog No. NQOD4).
 - Appropriate LAL or LHL circuit breaker.

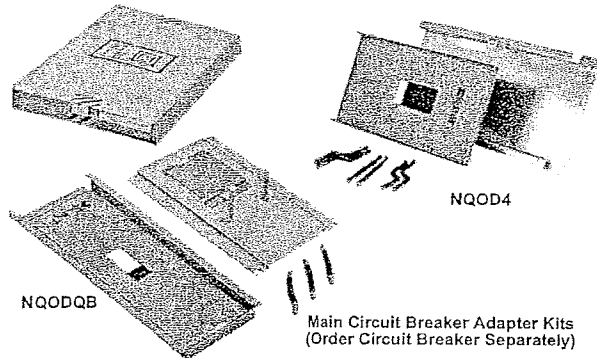


400 A Main Circuit Breaker Interior

Main Circuit Breaker Adapter Kits

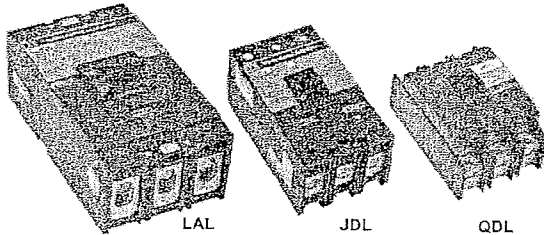
Adapter Kit Catalog No.	Ampere Rating	Main Circuit Breaker
NQODQB	100–225 A	QBL, QDL, QGL, QJL
NQODJK	150–225 A	JDL, JGL, JLL, JLL, KIL
NQOD4	125–400 A	LAL, LHL

Note: Main circuit breakers are not included in the adapter kits. They should be ordered separately.



Main Circuit Breakers

- 100 A max. factory-installed QOB, FAL, FHL, or FIL
- 150 A max. factory-installed HDL, HGL, HJL, or HLL
- 225 A max. field-installable QBL, QDL, QGL, QJL, JDL, JGL, JLL, JLL, or KIL
- 250 A max. factory-installed JDL, JGL, JLL, JLL, or KIL
- 400 A max. field-installable LAL or LHL



Field-Installable Main Circuit Breakers

Branch Circuit Breaker Interrupting Capacity

Circuit Breaker Catalog Prefix	Max. Vac Rating	No. of Poles	Ampere Rating	UL Listed Interrupting Rating—RMS Symmetrical Amperes		
				Vac		
				120	120/240	240
QO, QOB	120/240	1	10-70	—	10k	—
	120/240	2	10-125	—	10k	—
	240	3	10-100	—	—	10k
QO-H, QOB-H	240	2	15-125	—	—	10k
QO-VH	120/240	1	15-30	—	22k	—
	120/240	2	15-125	—	22k	—
	240	3	15-100	—	—	22k
QOB-VH	120/240	1	15-30	—	22k	—
	120/240	2	15-150	—	22k	—
	240	3	15-150	—	—	22k
QOH-QOHB	120/240	2	35-125	—	42k	—
QH QHB	120/240	1	15-30	—	65k	—
	120/240	2	15-30	—	65k	—
	240	3	15-30	—	—	65k

Branch Terminal Lug Data

Ampere Rating	Circuit Breaker Type	Wire Size	
		Aluminum	Copper
10-30	QO, QOB	(2) #12-#8	(2) #14-#8
35-50	QO, QOB	(1) #8-#4	(1) #8-#4
60-70	QO, QOB	(1) #6-#2	(2) #6-#2
80-125	QO, QOB	(1) #4-2/0	(1) #4-2/0
150	QOB-VH	(1) #4-300 kcmil	(1) #4-300 kcmil

Notes:

- Lugs suitable for 75 °C wire.
- Torque QOB connector mounting screws to 18–21 lb-in.
- Torque labels are included on the circuit breakers with load side lug torque requirements.

Additional Main Circuit Breaker Information

Ampere Rating	Circuit Breaker Type	Circuit Breaker Catalog Section Class
100	QOB	730
	FAL, FCL, FHL	650
	FIL	820
150	HDL, HGL, HJL, HLL	611
	QBL, QDL, QGL, QJL	734
225	JDL, JGL, JLL, JLL	611
	KIL	825
	LAL, LHL	660

Additional Branch Circuit Breaker Information

Circuit Breaker Type	Circuit Breaker Catalog Class
QO, QOB	730
QO-GFI, QOB-GFI	910

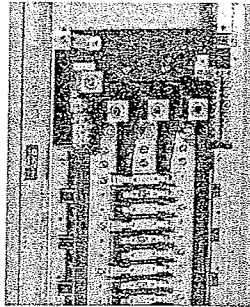
Field-Installable Circuit Breaker Accessories

Field-installable shunt trip, alarm switch, and auxiliary contacts are available for LAL 400 A main circuit breaker interiors. Refer to the Square D Digest for additional information.

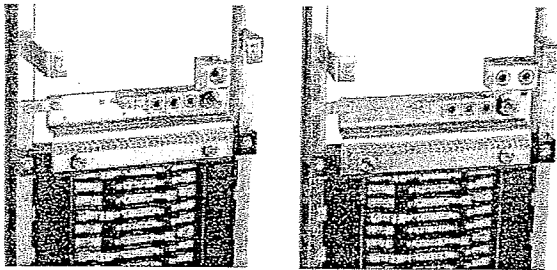
NQOD Circuit Breaker Panelboards Application Data

Neutral Assembly

- All lugs suitable for copper or aluminum wire. 100–225 A interiors have split neutral located on same end as mains.
- 400–600 A interior have the neutral located on the end opposite mains.
- Bondable for use as service entrance (in Canada, available as factory-assembled only).
- Branch terminals suitable for #12-#4 aluminum and #14-#4 copper.
- Provisions for larger branch terminal lugs with use of auxiliary neutral lugs.
- Suitable lug provided on neutrals for termination of grounding conductor.
- All unused neutral terminals may be used to terminate equipment grounding conductors when panelboard is used as service entrance.
- 100% rated neutrals. One neutral termination provided per circuit in panelboard.
- 200% rated neutrals optional.



100–225 A

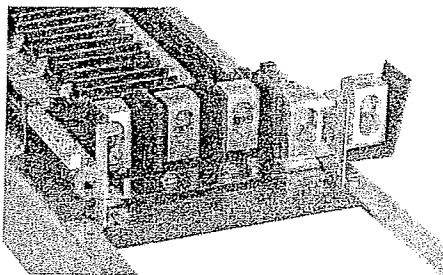


400 A 600 A
Typical Neutral Assemblies

200% Neutral Restrictions

225 A, 200% Neutral:

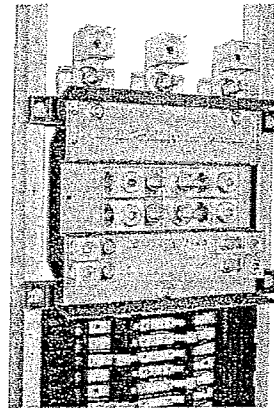
- 225 A main circuit breakers are available using J-frame only.
- Integral lighting contactors are not available.
- Crimp neutral line lugs are not available.
- Panelboards are only available factory assembled when equipped with sub-feed lugs, feed-thru lugs, or sub-feed circuit breakers and 200% neutrals.



225 A Interior with Sub-Feed Lugs

400 A, 200% Neutral:

- Type 3R, 5, and 12 enclosures require copper-bussed interiors.
- Sub-feed branch circuit breakers are available with main lug interiors in Type 1 enclosures only. Sub-feed branch circuit breakers are not available in Type 3R, 5, and 12 enclosures. Using a sub-feed branch circuit breaker restricts standard QO and QOB branches to a maximum of 125 A.
- Integral lighting contactors are not available.
- Crimp neutral line lugs are not available.
- Panelboards are only available factory assembled when equipped with sub-feed lugs, feed-thru lugs, or sub-feed circuit breakers and 200% neutrals.



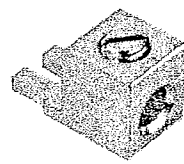
400 A Interior with Feed-Thru Lugs

200% Rated Feed-Thru Neutral Lug Data

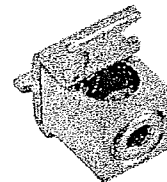
Ampere Rating	Lug Type (Quantity)	Lug Wire Range	Wire Range Wire Bending Space per NEC Table 373-6
225	Line Lug (2)	(2) #4-300 kcmil Al/Cu	(2) 300 kcmil Al/Cu
	Sub-Feed Circuit Breaker Lug	(1) #4-300 kcmil Al/Cu	300 kcmil Al/Cu
	Branch Lugs	(42) #14-#4 Al/Cu	#4 Al/Cu
400	Line Lug (4)	(1) 750 kcmil Al/Cu or (2) #6-300 kcmil Al/Cu	(2) 250 kcmil Al/Cu
	Sub-Feed Circuit Breaker Lug (4)	(1) #6-300 kcmil Al/Cu	350 kcmil Al/Cu
	Branch Lugs	(4) 2/0 Al/Cu	(4) 2/0 Al/Cu
		(22) #14-#4 Al/Cu	#2 Al/Cu
		(17) #14-#6 Al/Cu	#6 Al/Cu

Auxiliary Neutral Lugs

Lugs are UL Listed for copper or aluminum wire and are field-installable on neutral assembly.



#10-#4 AWG
(Catalog No. QO70AN)

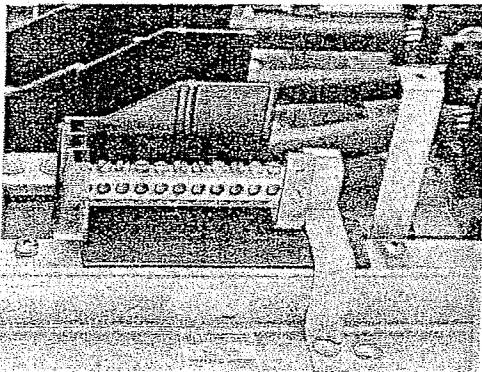


#1-4/0 AWG
(Catalog No. Q1150AN)

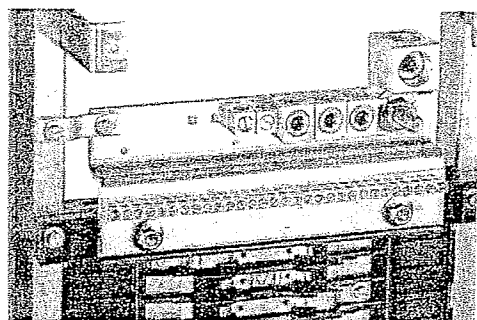
NQOD Circuit Breaker Panelboards Application Data

Neutral Bonding Provisions

Bonding strap may be field-installed for UL service equipment requirements on 100–400 A interiors (in Canada, available as factory-assembled only).



100–225 A Neutral Bonding Provision



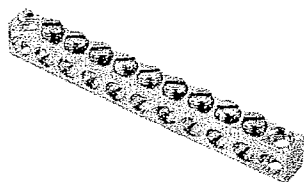
400 A Neutral Bonding Provision

Ground Bar Kits

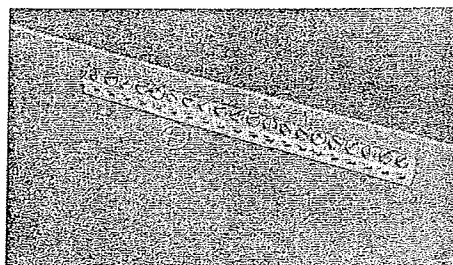
- Field-installable in all panelboards.
- Suitable for copper or aluminum wire.

Ground Bar Kit Catalog Numbers

No. of Circuits	Ampere Rating	Catalog No.
12	225	PK9GTA
20	225	PK12GTA
24	225	PK15GTA
30	225	PK18GTA
54	225	PK23GTA
54	600	PK27GTA



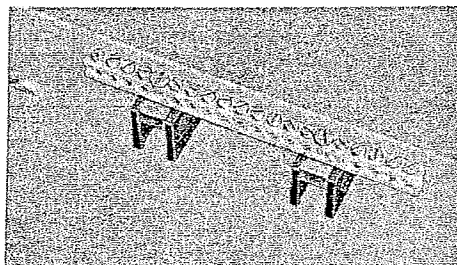
Equipment Ground Bar



Box with Equipment Ground Bar

Ground Bar Insulator Kit (Catalog No. PKGTAB)

- The insulator kit is for use with standard panelboard ground bar kits to isolate the ground bar from the panelboard.
- The insulator kit is field installable. Also may be used with equipment ground since panelboard enclosures have ground bar mounting provisions in all four corners.



Ground Bar with Insulator Kit

Ground Bar Kit Technical Information

All PK equipment grounding kits are supplied with mounting screws, necessary installation instructions, and an "Equipment Grounding Terminal" self-adhesive label.

Catalog Number	Total Qty	Terminals		Approximate Overall Length in (mm)	Distance Between Mounting Holes in (mm)
		Qty Each Size (see wire range below)			
		I	II		
PK9GTA	9	9	—	3.125 (79)	3.125 (79)
PK12GTA	12	12	—	4.5 (114)	3.125 (79)
PK15GTA	15	15	—	5.3125 (135)	3.125 (79)
PK15GTA-L	16	15	1	7.25 (184)	3.125 (79)
PK18GTA	18	18	—	6.375 (162)	3.125 (79)
PK18GTA-L	19	18	1	8.5 (216)	3.125 (79)
PK23GTA	23	23	—	7.875 (200)	3.125 (79)
PK23GTA-L	24	23	1	9.125 (232)	3.125 (79)
PK27GTA	27	27	—	9.125 (232)	3.125 (79)

Wire Range

Size	Cu	Al
I	(1) #14 to #4 or (2) #14 or #12	(1) #12 to #4 or (2) #12 or #10
II	(1) #1 to 4/0	(1) #1 to 4/0

NQOD Circuit Breaker Panelboards Application Data

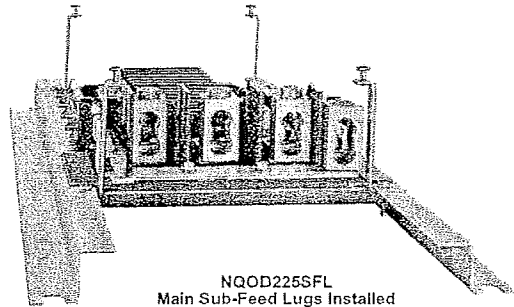
UL Recognized Component Branch Sub-Feed Lug Kits, 240 Vac

2-Pole Sub-Feed Lugs

Rating Amperes	Spaces	Type of Connection	Catalog No.	Main Wire Size
125	2	Plug-On	QO2125SL	#4-2/0 Al or Cu
	2	Bolt-On	QOB2125SL	

3-Pole Sub-Feed Lugs

Rating Amperes	Spaces	Type of Connection	Catalog No.	Main Wire Size
125	3	Plug-On	QO3125SL	#4-2/0 Al or Cu
	3	Bolt-On	QOB3125SL	



Field-Installable Sub-Feed Main Lugs

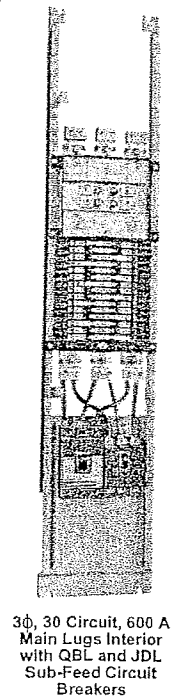
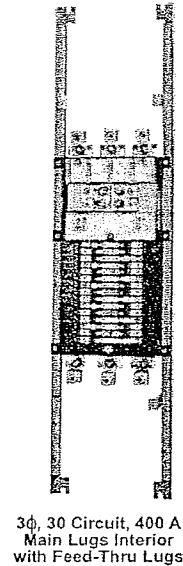
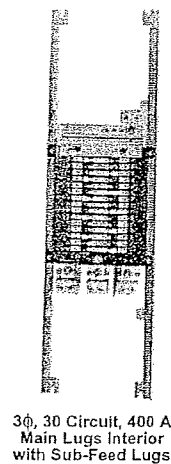
Field-installable sub-feed main lugs 100 A (NQOD100SFL) or 225 A (NQOD225SFL) are available for use on 1 ϕ or 3 ϕ main lug 100–225 A. Refer to the Digest for the correct box size.

Factory-Installed Options

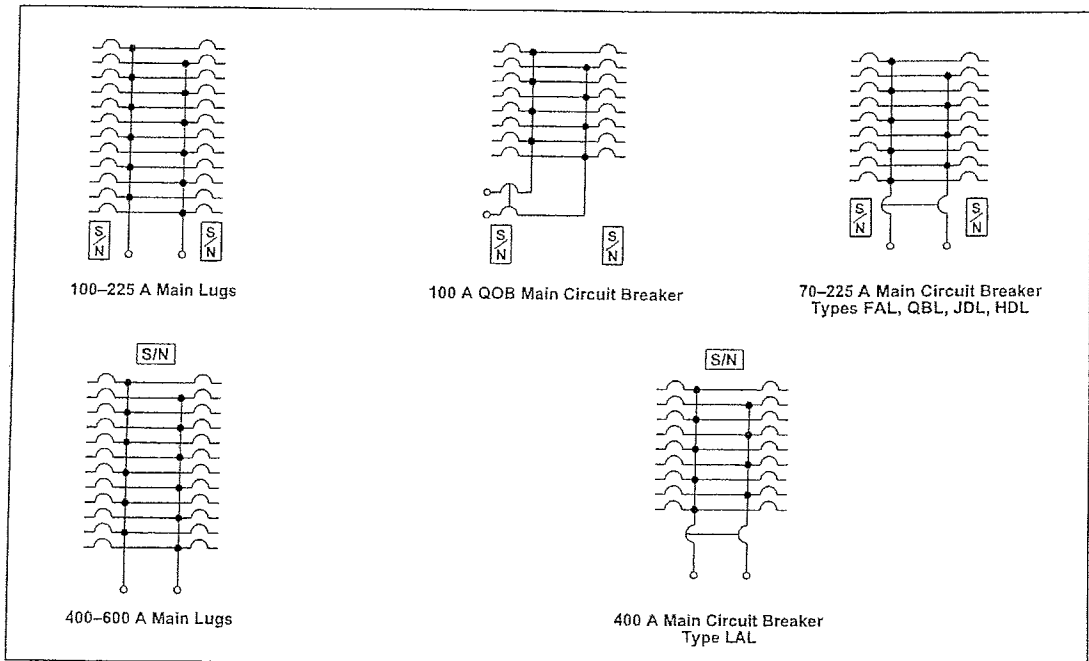
- Sub-Feed Lugs (on the main) are available on 1 ϕ or 3 ϕ , 100–400 A main lug interiors only.
- Box size changes are as follows:
 - 100–225 A interiors with 30 circuits maximum—no change required.
 - 225 A interiors with 42 circuits: 38 in. (965 mm) high by 20 in. (508 mm) wide or 14 in. (356 mm) wide.
 - 225 A interiors with 54 circuits: 44 in. (1118 mm) high by 20 in. (508 mm) wide or 14 in. (356 mm) wide.
 - 225 A interiors with 72 circuits: 50 in. (1270 mm) high by 20 in. (508 mm) wide (Canada only).
 - 225 A interiors with 84 circuits: 53 in. (1346 mm) high by 20 in. (508 mm) wide (Canada only).
 - 400 A interiors: add 3 in. (76 mm) to standard box height.
- Feed-Thru Lugs are available on 1 ϕ or 3 ϕ 225–600 A main lug, or 225–600 A main circuit breaker interiors.
- Sub-Feed Circuit Breakers
 - Available on 1 ϕ or 3 ϕ main lugs 225–600 A, or main circuit breaker interiors 225–600 A.
 - One sub-feed circuit breaker for each 225 A panelboard.
 - Two sub-feed circuit breakers for each 400–600 A panelboard.
 - Sub-feed circuit breakers may be type HDL, HGL, HJL, HLL, QBL, QDL, QGL, QJL, JDL, JGL, JLL, OR JLL circuit breakers.

Other Accessories Available

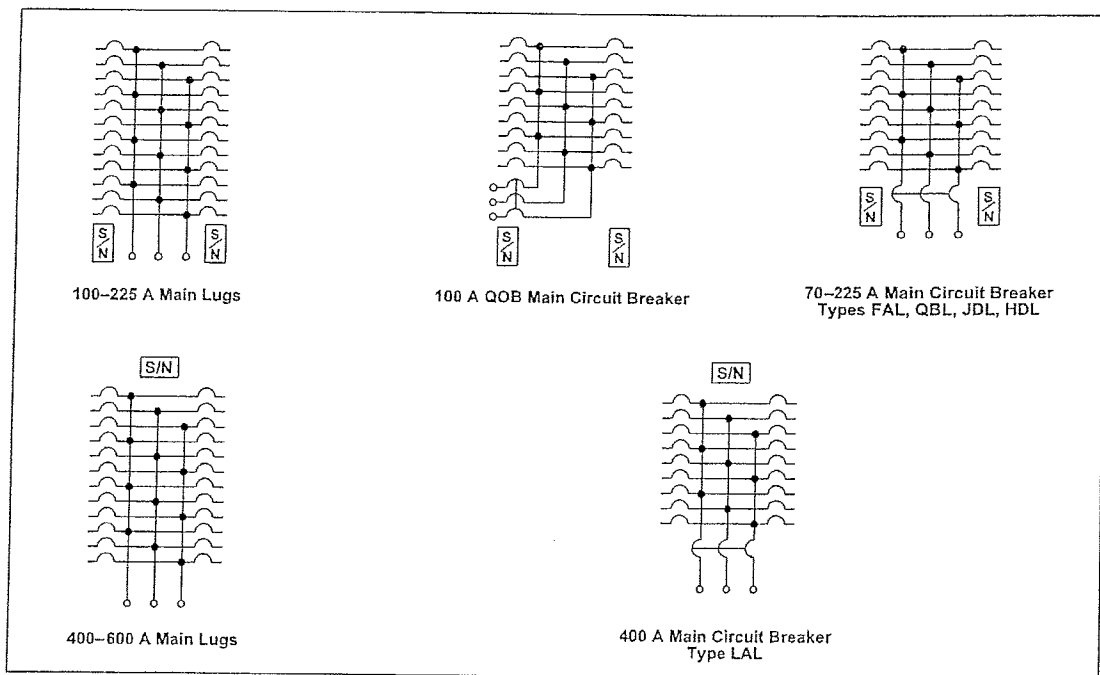
- Split bus
- Lighting contactors
- Compression lugs
- Copper bus
- Phenolic nameplates



NQOD Circuit Breaker Panelboards Typical Wiring Diagrams

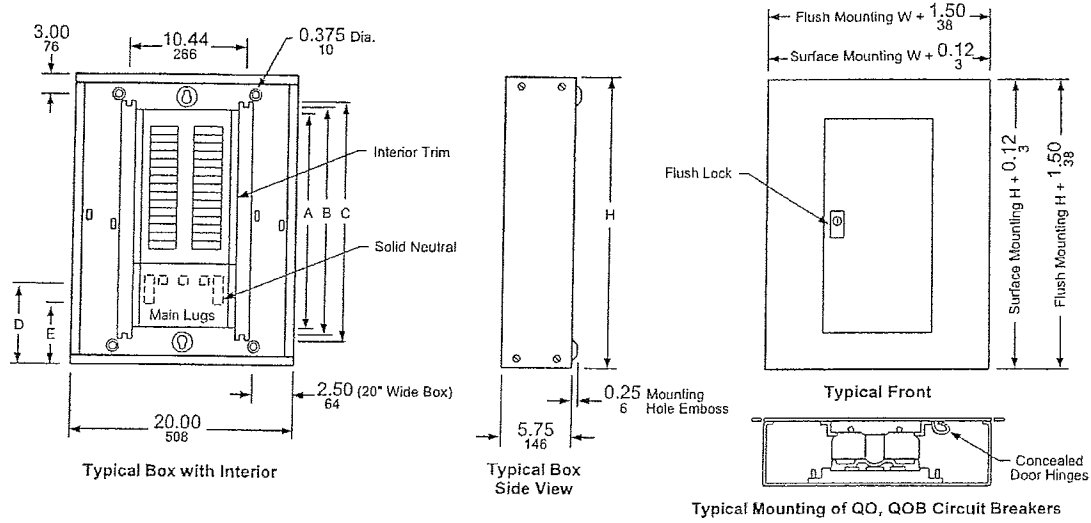


1-Phase, 3-Wire

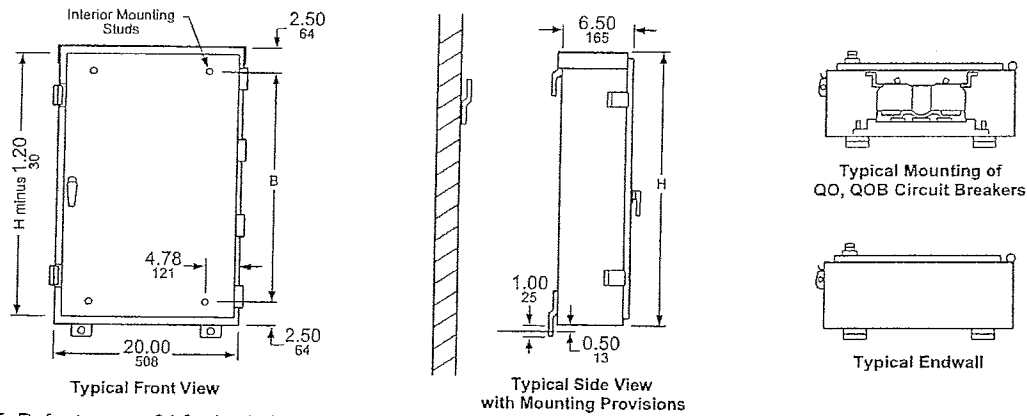


3-Phase, 4-Wire

NQOD Circuit Breaker Panelboards Dimensions



Indoor—Type 1 Enclosure
Outdoor—Type 3R Enclosure



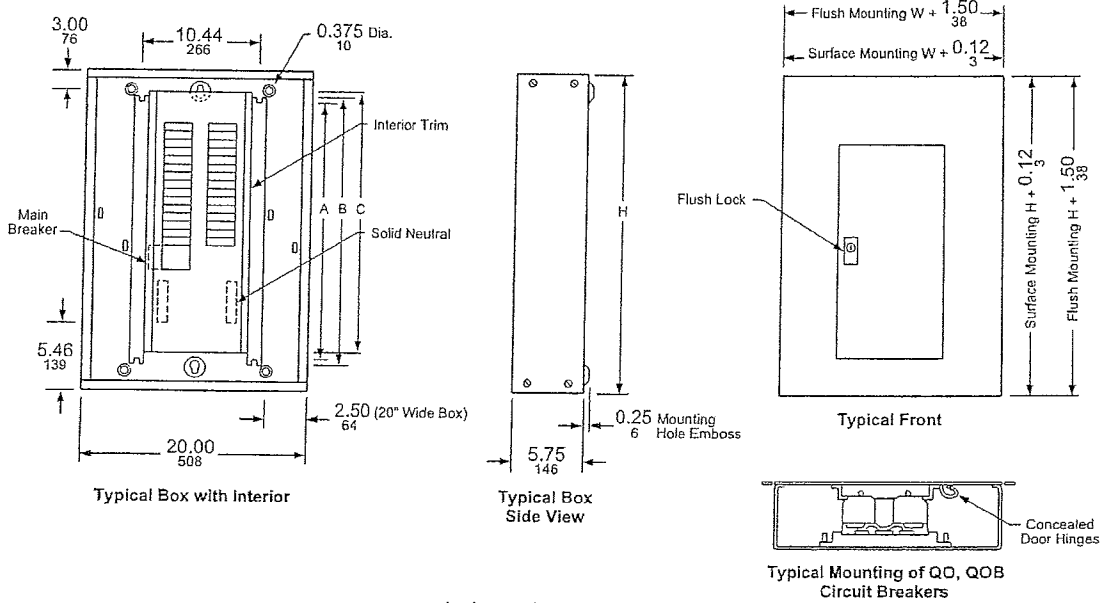
NOTE: Refer to page 21 for keyhole and endwall detail.

dimensions: INCHES
mm

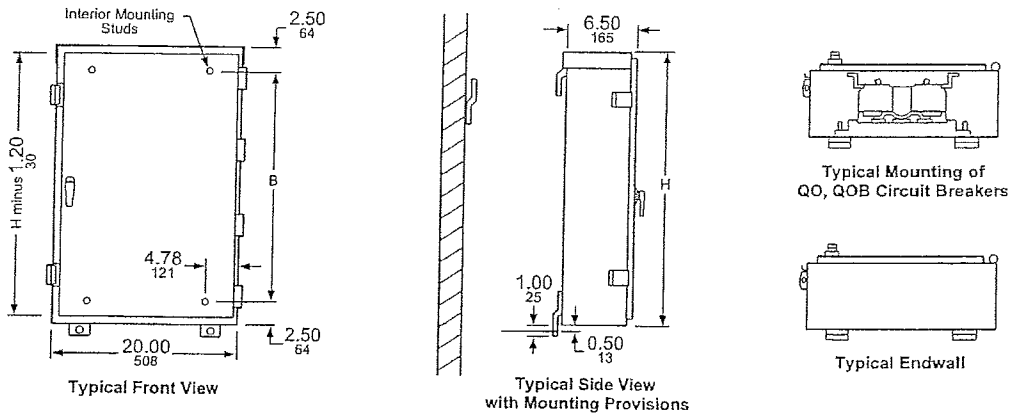
Maximum Main Lug Ampere Rating	Maximum Number of Circuits	H Box Height		A Length of Deadfront		B Stud Dimension		C Rail Length		D MLO Wire Bending		E S/N Wire Bending	
		IN	mm	IN	mm	IN	mm	IN	mm	IN	mm	IN	mm
100	12	20.00	508	14.90	378	15.00	381	15.88	403	6.89	175	5.46	139
	20 ▲	23.00	584	17.90	455	18.00	457	18.88	480	6.89	175	5.46	139
	24 ■	23.00	584	17.90	455	18.00	457	18.88	480	6.89	175	5.46	139
	30 ■	26.00	660	20.90	531	21.00	533	21.88	556	6.89	175	5.46	139
225	30	32.00	813	26.90	683	27.00	686	27.88	708	11.43	290	10.00	254
	42	35.00	889	29.80	759	30.00	762	30.88	784	8.43	214	7.00	178
	54	41.00	1041	35.90	912	36.00	914	36.88	937	8.43	214	7.00	178
	72 ★	47.00	1194	41.90	1064	42.00	1067	42.88	1089	8.43	214	7.00	178
	84 ★	50.00	1270	44.90	1140	45.00	1143	45.88	1165	8.43	214	7.00	178

▲ 1Ø3W only.
■ 3Ø4W only.
★ Canada only.

NQOD Circuit Breaker Panelboards Dimensions



Outdoor—Type 3R Enclosure



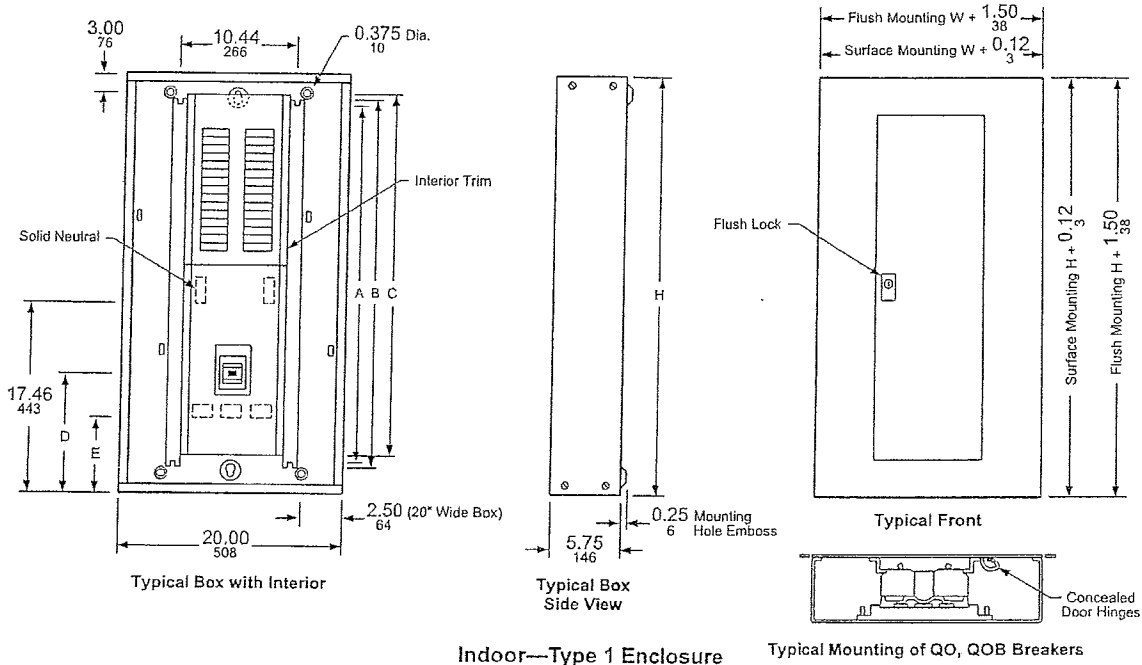
NOTE: Refer to page 21 for keyhole and endwall detail.

dimensions: INCHES
mm

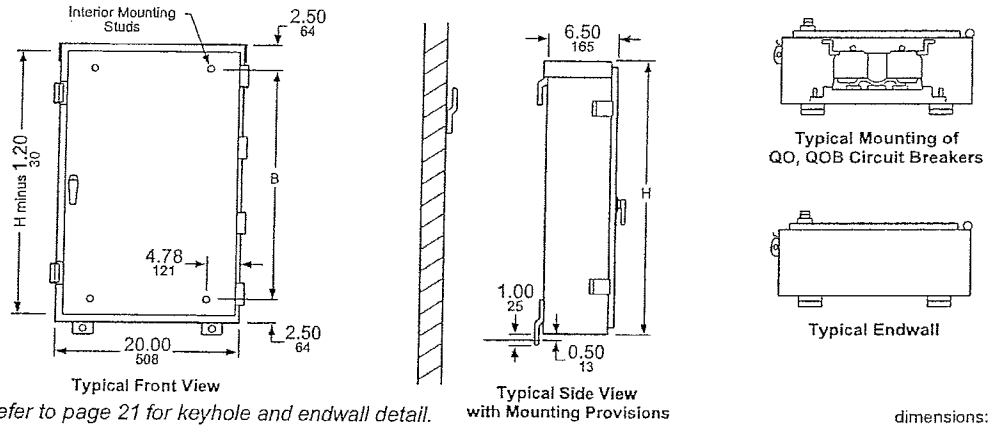
Maximum Main Circuit Breaker Ampere Rating	Maximum Number of Circuits	H Box Height		A Stud Dimension		B Rail Length		C Length of Deadfront	
		IN	mm	IN	mm	IN	mm	IN	mm
100	12	23.00	584	18.00	457	18.88	480	17.90	455
	20 ▲	26.00	660	21.00	533	21.88	556	20.90	531
	24 ■	26.00	660	21.00	533	21.88	556	20.90	531
	30 ■	29.00	737	24.00	610	24.88	632	23.90	607

▲ 1φ3W only.
■ 3φ4W only.

NQOD Circuit Breaker Panelboards Dimensions



Indoor--Type 1 Enclosure
Outdoor--Type 3R Enclosure



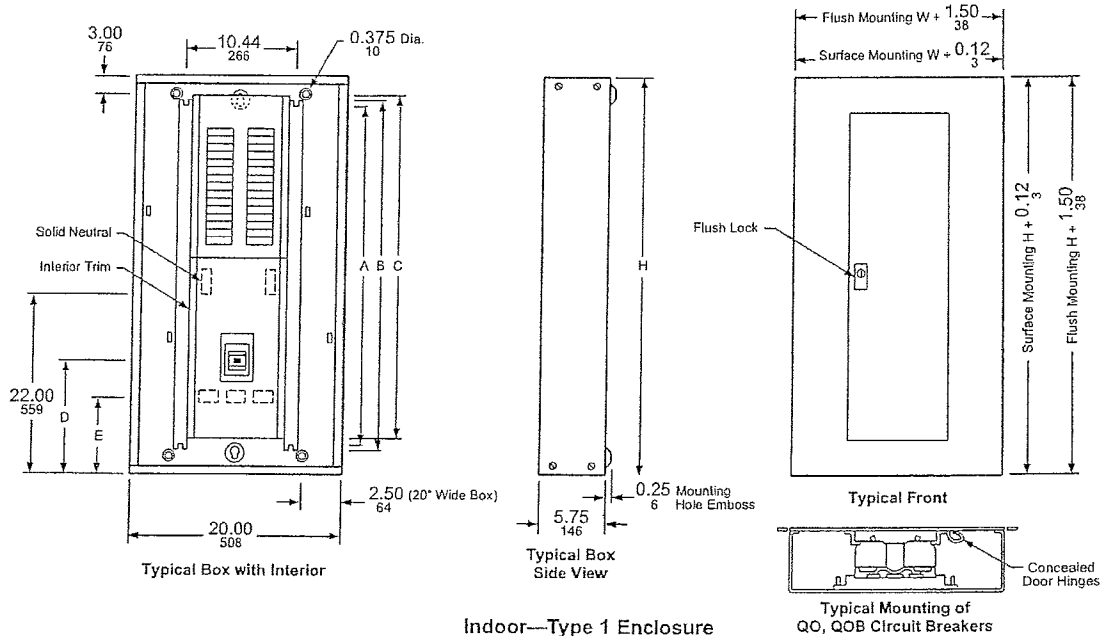
NOTE: Refer to page 21 for keyhole and endwall detail.

dimensions: INCHES
mm

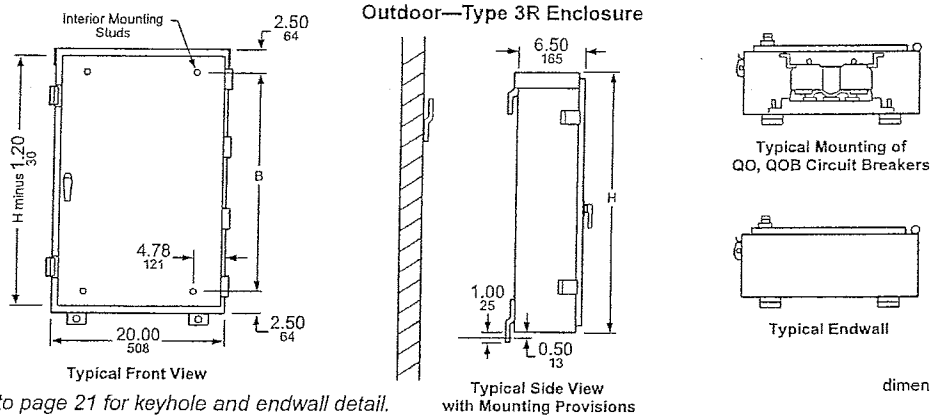
Maximum Main Circuit Breaker Ampere Rating	Maximum Number of Circuits	H Box Height		A Stud Dimension		B Rail Length		C Length of Deadfront		D (from Center Line of CB)		E (from Line Lugs of CB)					
		IN	mm	IN	mm	IN	mm	IN	mm	Top Feed		Bottom Feed					
										IN	mm	IN	mm	IN	mm	IN	mm
100 FAL ★, FHL ★	12	32.00	813	27.00	686	27.88	708	26.90	683	11.82	300	10.06	256	8.08	205	8.08	205
	20 ▲	35.00	889	30.00	762	30.88	784	29.90	759								
	24 ■	35.00	889	30.00	762	30.88	784	29.90	759								
	30 ■	38.00	965	33.00	838	33.88	860	32.90	836								
100 FIL ★	12	32.00	813	27.00	680	27.88	708	26.90	683	10.08	256	10.08	256	7.08	180	7.08	180
	20 ▲	35.00	889	30.00	762	30.88	784	29.90	759								
	24 ■	35.00	889	30.00	762	30.88	784	29.90	759								
	30 ■	38.00	965	33.00	838	33.88	860	32.90	836								

▲ 1φ3W only. ■ 3φ4W only. ★ Factory assembled only.

NQOD Circuit Breaker Panelboards Dimensions



Indoor—Type 1 Enclosure



Outdoor—Type 3R Enclosure

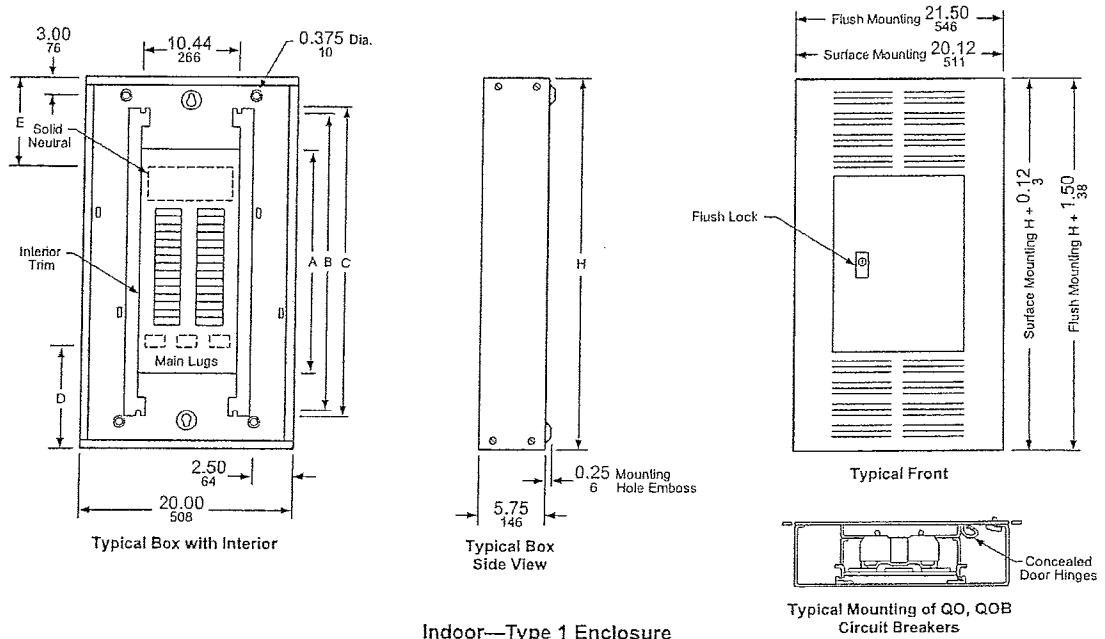
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NOTE: Refer to page 21 for keyhole and endwall detail.

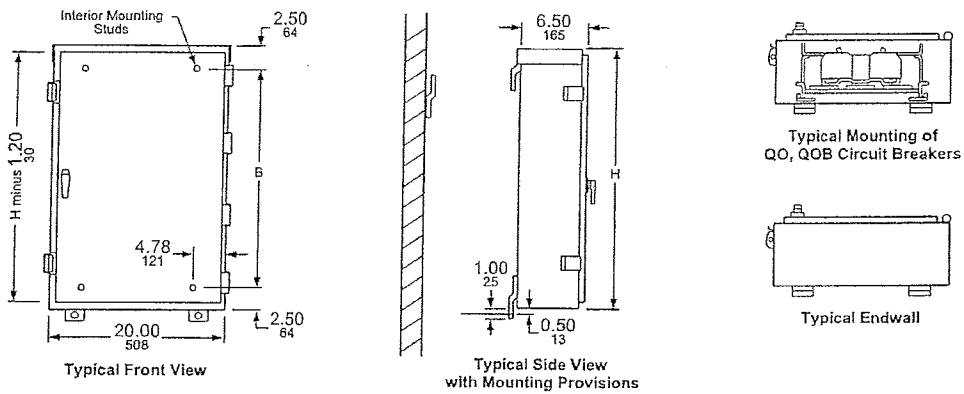
Maximum Main Circuit Breaker Ampere Rating	Maximum Number of Circuits	H Box Height		A Stud Dimension		B Rail Length		C Length of Deadfront		D (from Center Line of CB)		E (from Line Lugs of CB)					
		IN	mm	IN	mm	IN	mm	IN	mm	Top Feed	Bottom Feed	Top Feed	Bottom Feed				
		IN	mm	IN	mm	IN	mm	IN	mm	IN	mm	IN	mm				
150 ● HDL, HGL, HJL, HLL	30	44.00	1118	39.00	991	39.88	1013	39.90	1013	14.30	363	14.30	363	11.25	286	11.25	286
	42	50.00	1270	45.00	1143	45.88	1165	44.75	1137	14.30	363	14.30	363	11.25	286	11.25	286
	54	56.00	1422	51.00	1295	51.88	1318	50.75	1289	14.30	363	14.30	363	11.25	286	11.25	286
	72 ★	62.00	1575	57.00	1448	57.88	1470	56.75	1441	14.30	363	14.30	363	11.25	286	11.25	286
225 ○BL, ○DL, ○QL, ○JL	30	44.00	1118	39.00	991	39.88	1013	39.90	1013	16.99	432	15.48	393	13.66	347	12.79	325
	42	50.00	1270	45.00	1143	45.88	1165	44.75	1137								
	54	56.00	1422	51.00	1295	51.88	1318	50.75	1289								
	72 ★	62.00	1575	57.00	1448	57.88	1470	56.75	1441								
225/250 ▲ JDL, JGL, JLL, JLL	30	44.00	1118	39.00	991	39.88	1013	39.90	1013	16.30	414	16.30	414	12.70	323	12.70	323
	42	50.00	1270	45.00	1143	45.88	1165	44.75	1137								
	54	56.00	1422	51.00	1295	51.88	1318	50.75	1289								
	72 ★	62.00	1575	57.00	1448	57.88	1470	56.75	1441								
	84 ★	65.00	1651	60.00	1524	60.88	1546	59.75	1518								

● 150 A available in a 225 A interior. ★ Canada only. ▲ 250 A available factory-assembled only.

NQOD Circuit Breaker Panelboards Dimensions



Indoor—Type 1 Enclosure
Outdoor—Type 3R Enclosure



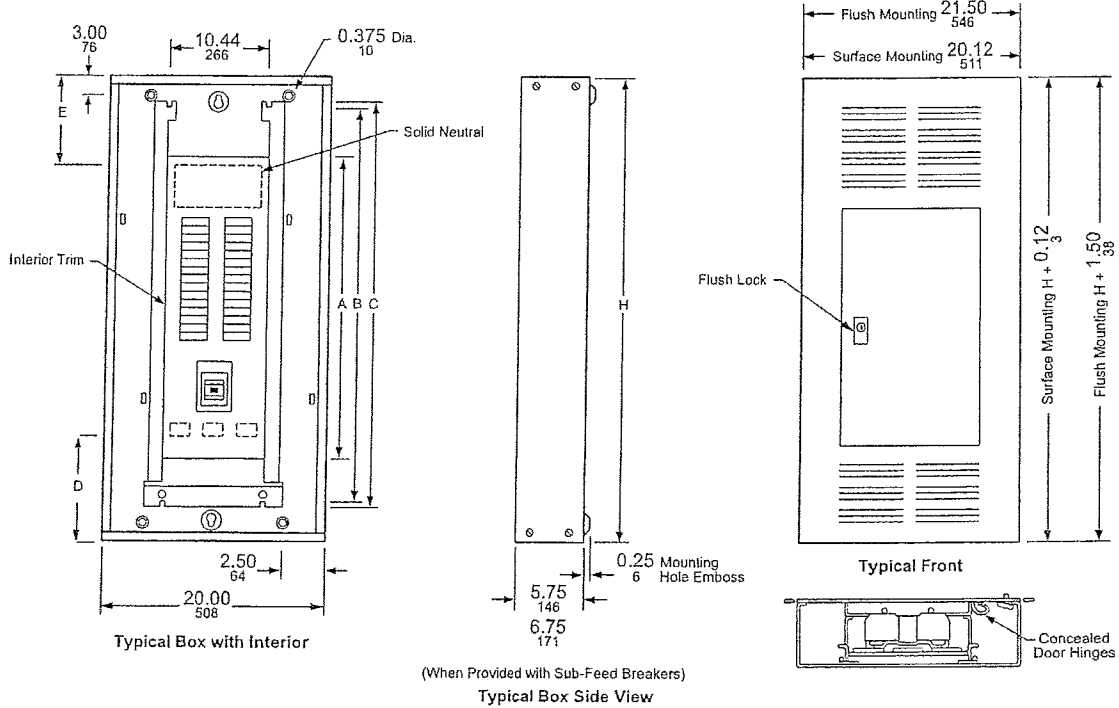
NOTE: Refer to page 21 for keyhole and endwall detail.

dimensions: INCHES
mm

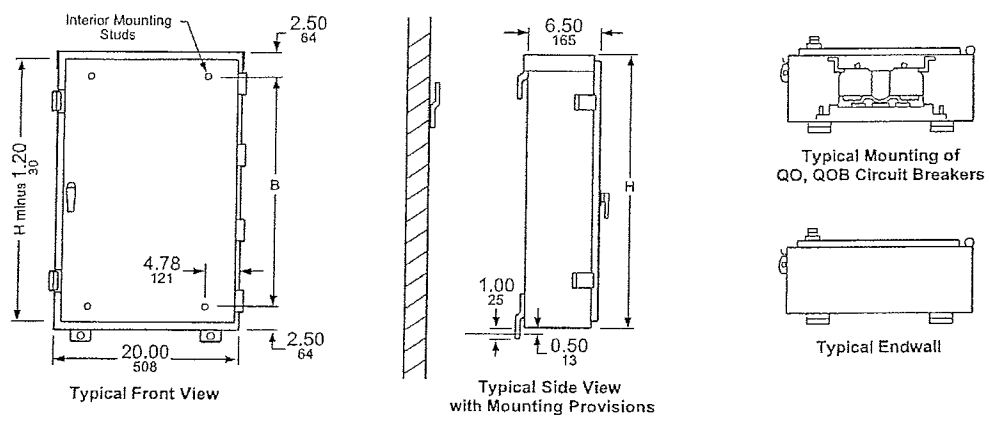
Maximum Main Lug Ampere Rating	Maximum Number of Circuits	H Box Height		A Length of Deadfront		B Stud Dimension		C Rail Length		D MLO Wire Bending		E S/N Wire Bending	
		IN	mm	IN	mm	IN	mm	IN	mm	IN	mm	IN	mm
400	30	50.00	1270	30.75	781	45.00	1143	46.00	1163	15.14	385	14.03	356
	42	53.00	1346	34.50	875	48.00	1219	49.00	1245	14.39	366	13.28	337
	54	59.00	1499	39.75	1010	54.00	1372	55.00	1397	15.14	385	14.03	356
	72 ★	65.00	1651	42.75	1086	60.00	1524	61.00	1549	14.74	374	13.63	346
600	84 ★	68.00	1727	47.50	1207	63.00	1600	64.00	1626	14.74	374	13.63	346
	30	53.00	1346	33.75	857	48.00	1219	49.00	1245	16.43	417	15.32	389
	42	56.00	1422	37.50	953	51.00	1295	52.00	1321	15.63	398	14.57	370
	54	62.00	1575	42.75	1086	57.00	1448	58.00	1473	16.45	417	15.32	389
	72 ★	65.00	1651	42.75	1086	60.00	1524	61.00	1549	14.74	374	13.63	346
	84 ★	68.00	1727	47.50	1207	63.00	1600	64.00	1626	14.74	374	13.63	346

★ Canada only.

NQOD Circuit Breaker Panelboards Dimensions



Indoor—Type 1 Enclosure
Outdoor—Type 3R Enclosure



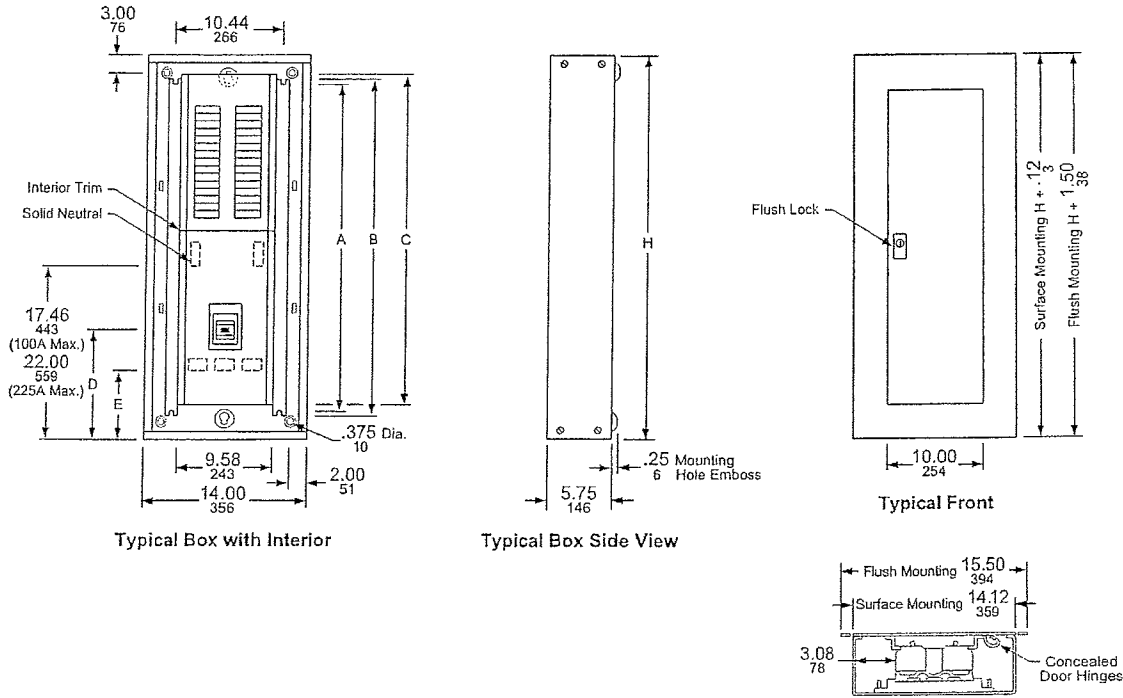
NOTE: Refer to page 21 for keyhole and endwall detail.

dimensions: INCHES
mm

Maximum Main Circuit Breaker Ampere Rating	Maximum Number of Circuits	H Box Height		A Length of Deadfront		B Stud Dimension		C Rail Length		D MLO Wire Bending		E S/N Wire Bending	
		IN	mm	IN	mm	IN	mm	IN	mm	IN	mm	IN	mm
400	30	65.00	1651	42.67	1084	60.00	1524	61.00	1549	15.26	388	14.03	356
	42	68.00	1727	46.42	1179	63.00	1600	64.00	1626	14.51	369	13.28	337
	54	74.00	1880	51.67	1312	69.00	1753	70.00	1778	15.26	388	14.03	356
	72 *	80.00	2032	51.67	1312	75.00	1905	76.00	1930	13.55	344	13.63	346

* Canada only.

NQOD Circuit Breaker Panelboards Dimensions



NOTE: Refer to page 21 for keyhole and endwall detail.

Typical Mounting of QO or QOB Circuit Breakers

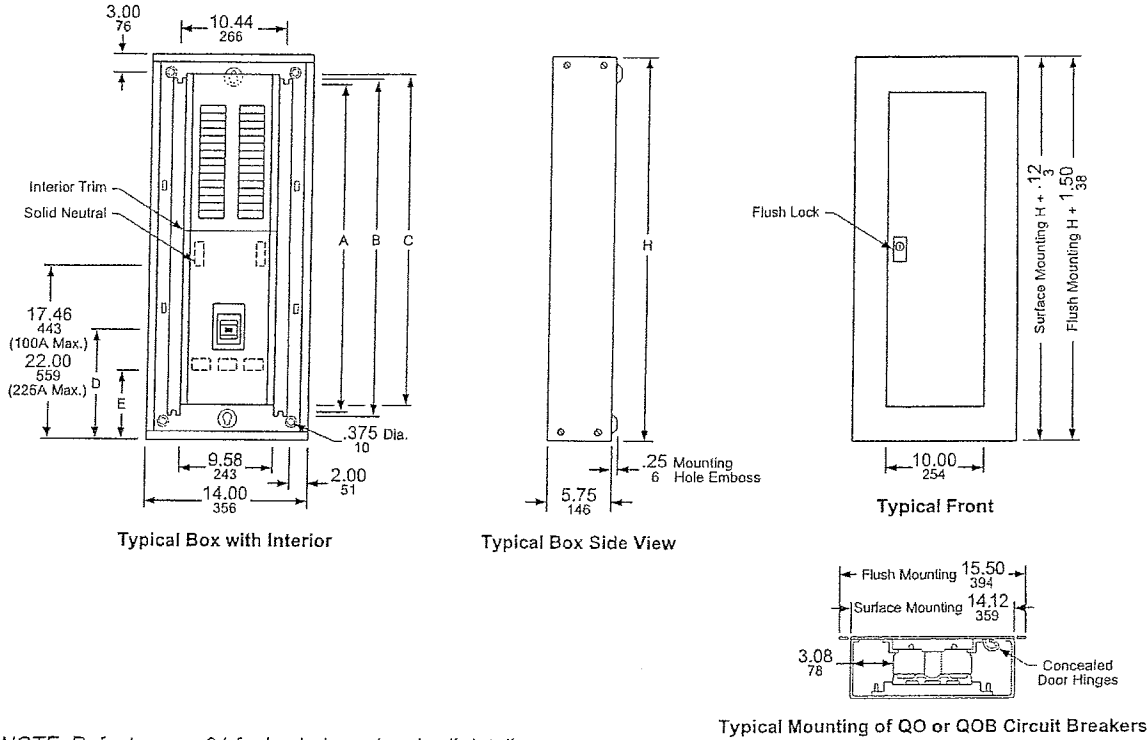
dimensions: INCHES
mm

Indoor—Type 1 Enclosure

Maximum Main Circuit Breaker Ampere Rating	Maximum Number of Circuits	H Box Height		A Length of Deadfront		B Stud Dimension		C Rail Length		D (from Center Line of CB)		E (from Line Lugs of CB)					
		IN	mm	IN	mm	IN	mm	IN	mm	Top Feed		Bottom Feed					
										IN	mm	IN	mm	IN	mm		
100 FAL ★, FHL ★	12	32.00	813	27.00	686	27.88	708	26.90	683	11.82	300	10.06	256	8.08	205	8.08	205
	20 ▲	35.00	889	30.00	762	30.88	784	29.90	759								
	24 ■	35.00	889	30.00	762	30.88	784	29.90	759								
100 FIL ★	12	32.00	813	27.00	686	27.88	708	26.90	683	10.08	256	10.08	256	7.08	180	7.08	180
	20 ▲	35.00	889	30.00	762	30.88	784	29.90	759								
	24 ■	35.00	889	30.00	762	30.88	784	29.90	759								
150 HDL, HGL, HJL, HLL ★	30	44.00	1118	39.00	991	39.88	1013	39.90	1013	14.30	363	14.30	363	11.25	286	11.25	286
	42	50.00	1270	45.00	1143	45.88	1165	44.75	1137	14.30	363	14.30	363	11.25	286	11.25	286
	54	56.00	1422	51.00	1295	51.88	1318	50.75	1289	14.30	363	14.30	363	11.25	286	11.25	286
225 QBL, QDL, QGL, QJL	30	44.00	1118	39.00	991	39.88	1013	39.90	1013	16.99	432	15.48	393	13.66	347	12.79	325
	42	50.00	1270	45.00	1143	45.88	1165	44.75	1137								
	54	56.00	1422	51.00	1295	51.88	1318	50.75	1289								
225 JDL, JGL, JJL, JLL	30	44.00	1118	39.00	991	39.88	1013	39.90	1013	16.30	414	16.30	414	12.70	323	12.70	323
	42	50.00	1270	45.00	1143	45.88	1165	44.75	1137								
	54	56.00	1422	51.00	1295	51.88	1318	50.75	1289								

▲ 1Φ3W only.
■ 3Φ4W only.
★ Factory-assembled only.

NQOD Circuit Breaker Panelboards Dimensions



NOTE: Refer to page 21 for keyhole and endwall detail.

Typical Mounting of QO or QOB Circuit Breakers

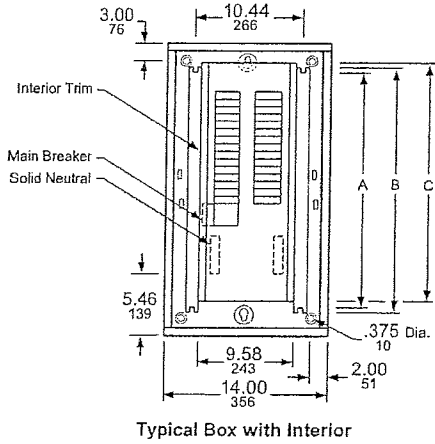
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mm

Indoor—Type 1 Enclosure

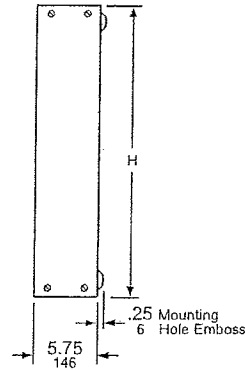
Maximum Main Lug Ampere Rating	Maximum Number of Circuits	H Box Height		A Length of Deadfront		B Stud Dimension		C Rail Length		D MLO Wire Bending		E S/N Wire Bending	
		IN	mm	IN	mm	IN	mm	IN	mm	IN	mm	IN	mm
100	12	20.00	508	14.90	378	15.00	381	15.88	403	6.89	175	5.46	139
	20 ▲	23.00	584	17.90	455	18.00	457	18.88	480	6.89	175	5.46	139
	24 ■	23.00	584	17.90	455	18.00	457	18.88	480	6.89	175	5.46	139
	30 ■	26.00	660	20.90	531	21.00	533	21.88	556	6.89	175	5.46	139
225	30	32.00	813	26.90	683	27.00	686	27.88	708	11.43	290	10.00	254
	42	35.00	889	29.90	759	30.00	762	30.88	784	8.43	214	7.00	178
	54	41.00	1041	35.90	912	36.00	914	36.88	937	8.43	214	7.00	178

▲ 1Ø3W only.
■ 3Ø4W only.

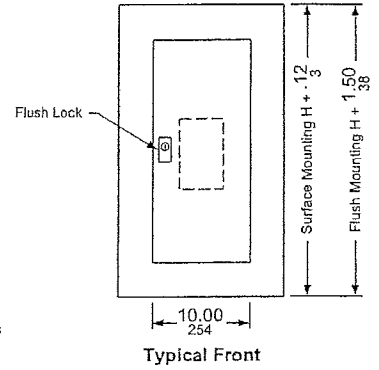
NQOD Circuit Breaker Panelboards Dimensions



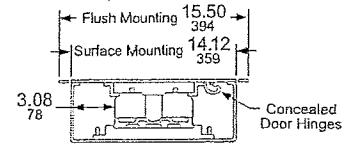
Typical Box with Interior



Typical Box Side View



Typical Front



Typical Mounting of
QO or QOB Circuit Breakers

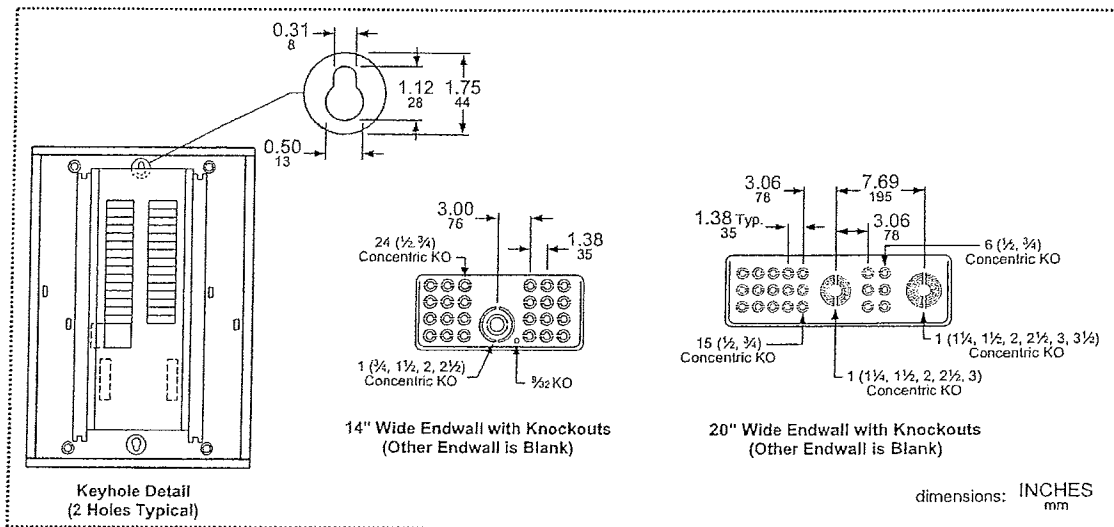
dimensions: INCHES
mm

NOTE: Refer to page 21 for keyhole and endwall detail.

Indoor—Type 1 Enclosure

Maximum Main Circuit Breaker Ampere Rating	Maximum Number of Circuits	H Box Height		A Length of Deadfront		B Stud Dimension		C Rail Length	
		IN	mm	IN	mm	IN	mm	IN	mm
100	12	23.00	584	18.00	457	18.88	480	17.90	455
	20 ▲	26.00	660	21.00	533	21.88	556	20.90	531
	24 ■	26.00	660	21.00	533	21.88	556	20.90	531
	30 ■	29.00	737	24.00	610	24.88	632	23.90	607

▲ 1Ø3W only.
■ 3Ø4W only.



Keyhole and Endwall Detail

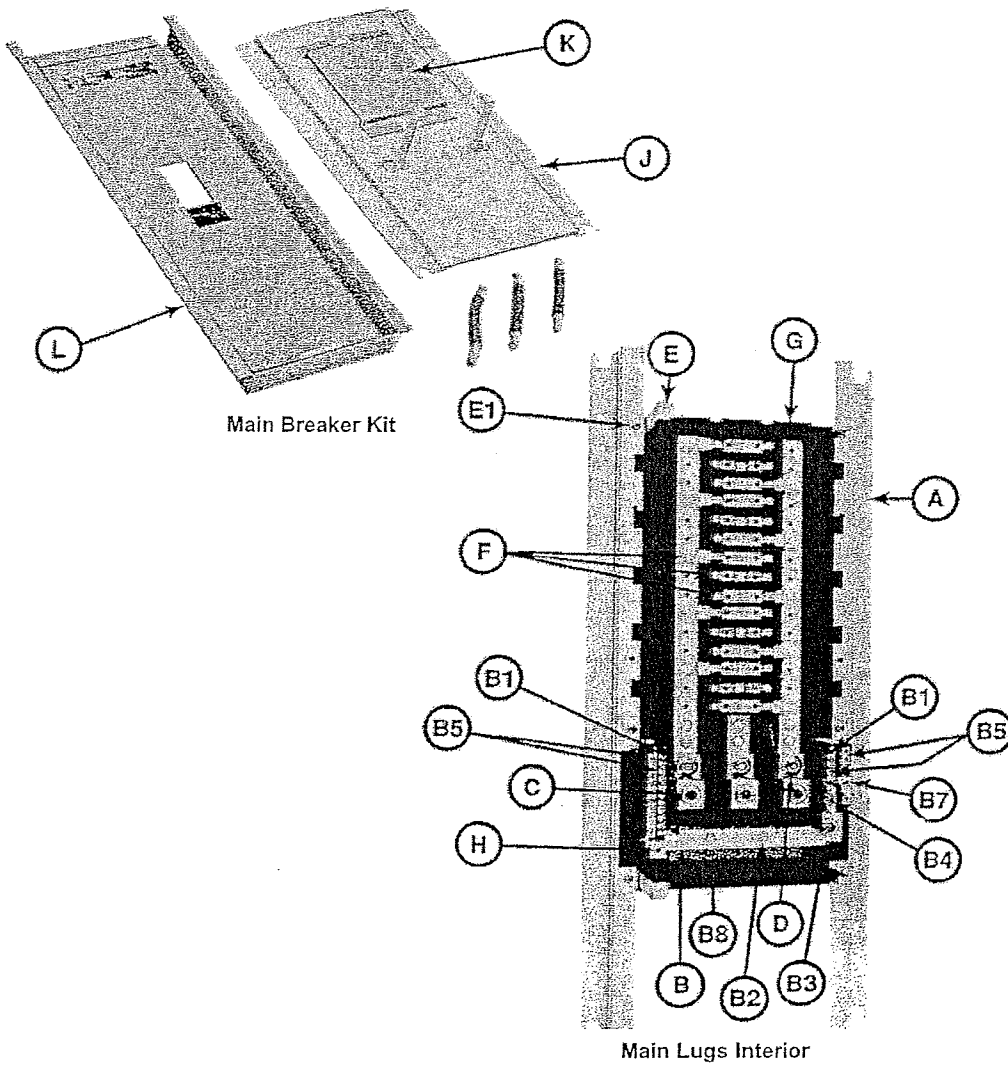
dimensions: INCHES
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NQOD Circuit Breaker Panelboards
Replacement Parts

REPLACEMENT PARTS

Main Lugs and Main Breaker—225 A Maximum

CLOSING PLATE FOR 10 FRAME HOLE
 (1) 8011032002 PLATE
 (4) 8002506701 SCREW



NQOD Circuit Breaker Panelboards Replacement Parts

Ordering Instructions: Specify quantity, part number, description of part; copy catalog number from panelboard nameplate.
For example: (1)80110-201-50 Neutral Assembly for NQOD interior catalog number NQOD12L100CU.

Letter Code	Description	Part Number
A	Interior Catalog Number	See Table Below
⊕	Elevating Screws (10-32 x .875)	(4) 80114-005-01
B	Neutral Assembly:	See Table Below
B1	Screw for Mounting Neutral to Insulator (6-18 x 3/4)	(2) 21533-08240
B2	Screw for Mounting Neutral to Insulator (8-32 x .44)	(2) 80110-233-01
B3	Neutral Lug 100 A (#6-2/0 Al, 10-2/0Cu) 225 A (#6-300 kcmil)	80110-194-01
		40251-162-51
B4	Keps Nuts, Neutral Lug Mounting 100 A (5/16-18) 225 A (5/16-18)	23427-02200
		23427-02200
B5	Neutral Bars	3 Circuit Al 80120-805-62
		6 Circuit Al 80120-805-79
		10 Circuit Al 80120-805-80
		13 Circuit Al 80120-805-83
B7	Screw for Mounting Neutral Bar to Neutral (6-32 x 5/8)	21590-00001
B8	Neutral Insulator	80110-095-01

Letter Code	Description	Part Number
C	Main Lug/Wire Binding Screw: 100 A (6-2/0 Al, 10-2/0 Cu) 225 A (#6-300 kcmil)	40251-194-01
		40251-162-51
D	Keps Nut, Main Lug Mounting: 100 A (5/16-18) 225 A (5/16-18)	23427-02200
		23427-02200
⊕	Interior Trim Screw, Trim Jointing/Mounting (10-32 x 7/16)	See Table Below
		80025-067-01
E	Trim Mounting Bracket E-1 Screw, Trim Bracket Mounting	(4) 80110-007-01
		(2) 21962-10280
F	Branch Connectors, 3-Pole	SKNQOD225
G	Endcap Insulator	80110-004-02
H	Neutral Bonding Strap Assembly	80116-121-50
⊕	Circuit Number Strips	See page 25
⊕	Trim Mounting Screws	40205-130-01

Interiors, Solid Neutrals, Interior Trims

Letter Code	Description	Part Number								
		1-12 Circuits	13-20 Circuits	21-24 Circuits	25-30 Circuits	31-42 Circuits	43-54 Circuits	55-72 Circuits ★	73-84 Circuits ★	
A	Interior Catalog Number	1Ø3W; 100 A	—	NQOD20L100/ NQOD20M100	—	—	—	—	—	
			NQOD12L100CU NQOD12M100CU	NQOD20L100CU/ NQOD20M100CU	—	—	—	—	—	
			—	—	—	NQOD30L225 NQOD30L225CU	NQOD42L225 NQOD42L225CU	—	NQOD72L225 NQOD72L225CU	NQOD84L225 NQOD84L225CU
			—	—	—	—	—	—	—	—
	3Ø4W; 100 A	—	—	NQOD424L100 NQOD424M100	NQOD430L100 NQOD430M100	—	—	—	—	
		NQOD412L100CU NQOD412M100CU	—	NQOD424L100CU NQOD424M100CU	NQOD430L100CU NQOD430M100CU	—	—	—	—	
		—	—	—	—	—	—	—	—	
		—	—	—	—	—	—	—	—	
B	Solid Neutral Assembly (S/N Lug Not Included)	100 A	80110-201-75	80110-201-75	80110-201-75	80110-201-75	—	—	—	
		225 A	—	—	—	80110-201-75	80110-201-78	80110-201-78 80116-169-50	80110-201-78 80116-169-50	
⊕	Interior Deadfront Trim:	Main Breaker ⊕	100 A 1Ø	80110-059-01	80110-059-02	—	—	—	—	
			100 A 3Ø	80110-059-05	—	80110-059-03	80110-059-04	—	—	
			100 A	80110-042-01	80110-042-01	80110-042-01	80110-042-01	—	—	
			225 A	—	—	—	80110-045-02	80110-045-01	80110-045-01	
		Main Lugs End	100 A	80110-041-01	80110-041-02	80110-041-03	80110-041-04	—	—	
			225 A	—	—	—	80110-044-01	80110-044-02	80110-044-01	
			Branch End	100 A	80110-041-01	80110-041-02	80110-041-03	80110-041-04	—	—
				225 A	—	—	—	80110-044-01	80110-044-02	80110-044-01

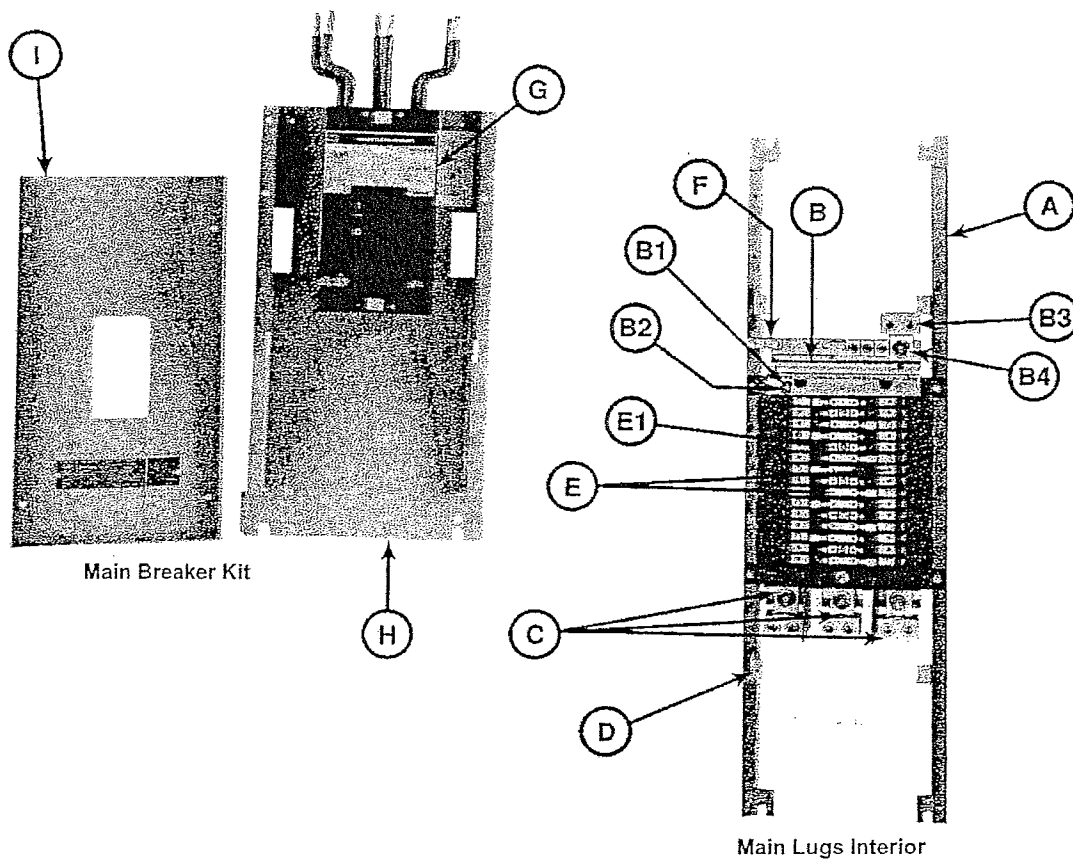
Main Breaker

Letter Code	Description	Part Number
⊕	Main Breaker Kit	100 A Breaker ⊕
	Main Breakers	Factory-Assembled, QOB
J	Main Breaker Mounting Pan	80110-013-01
K	Main Breaker Subpan Assembly	80110-092-50
L	Main Breaker Trim	80110-046-01
	Mounting Bracket, Trim	(2) 80110-007-02
	Mounting Screw, Trim	(2) 80025-067-01
⊕	Replacement Hardware Kit (Bolts, Nuts, Washers)	80110-236-50
		80110-235-50

- ⊕ Not shown.
- ⊕ 100 A main breaker panels require only one trim. Main lug panels require two trims; mains end and branch end.
- ⊕ 100 A main breaker is backfed.
- ★ Canada only.
- Note: Number in parentheses, (e.g., (2)) indicates quantity required.

NQOD Circuit Breaker Panelboards Replacement Parts

Main Breaker—400 A Maximum; Main Lugs—600 A Maximum



NQOD Circuit Breaker Panelboards Replacement Parts

Ordering Instructions: Specify quantity, part number, description of part; copy catalog number from panelboard nameplate. For example: (1)80110-808-51 Neutral Assembly for NQOD interior catalog number NQOD30L400.

400 A and 600 A Maximum

Letter Code	Description	Part Number
A	Interior Catalog Number	See Table Below
Ⓞ	Keps Nut (5/16-18), Interior Mounting	(4) 23220-00003
B	Neutral Assembly:	See Table Below
B1	Bolt, 5/16-18 x 2; Neutral Mounting	21401-22640
B2	Keps Nut, (5/16-18), Neutral Mounting	23427-02200
B3	S/N Lug Assembly	
400 A (750 kcmil)		40251-136-50
600 A (750 kcmil)		80116-122-50
B4	Keps Nut, S/N Lug Assembly (1/2-13)	23427-02800
C	Main Lug Assemblies	
400 A (750 kcmil)		42051-136-50
600 A (750 kcmil)		80116-122-50
Ⓞ	Interior Trim, Branch End	See Table Below
Main Lugs End		80110-630-01
Screw, Trim Joint/Mounting		80025-067-01
D	Mounting Bracket, Interior Trim	80110-604-01
Screw, Bracket Mounting (10-32 x 7/16)		80025-067-01
E	Branch Connector, AⓄ and CⓄ	80110-600-01
E1	Branch Connector, BⓄ	80110-601-01
Screw, Branch Connector		80110-802-01
F	Neutral Bonding Strap Assembly	80110-605-01
Ⓞ	Circuit Number Strips	See Miscellaneous Table Below

Main Lug Panelboards

Letter Code	Description	Part Number					
		1-30 Circuits	31-42 Circuits	43-54 Circuits	55-72 Circuits *	73-84 Circuits *	
A	Interior Catalog Numbers	1Ⓞ3W; 400 A	NQOD30L400	NQOD42L400	NQOD54L400	NQOD72L400	NQOD84L400
			NQOD30L400CU	NQOD42L400CU	NQOD54L400CU	NQOD72L400CU	NQOD84L400CU
		3Ⓞ4W; 400 A	NQOD30L600	NQOD42L600	NQOD54L600	NQOD72L600	NQOD84L600
			NQOD430L400	NQOD442L400	NQOD454L400	NQOD472L400	NQOD484L400
		400/600 A	NQOD430L400CU	NQOD442L400CU	NQOD454L400CU	NQOD472L400CU	NQOD484L400CU
			NQOD430L600	NQOD442L600	NQOD454L600	NQOD472L600	NQOD484L600
B	Solid Neutral Assembly (Lugs Not Included)	80110-808-51	80110-808-50	80110-808-50	80110-411-50	80110-411-50	
Ⓞ	Interior Deadfront Trim						
	Branch End	400 A	80110-633-02	80110-634-02	80110-635-02	80116-128-01	80110-406-02
	Branch End	600 A	80110-646-02	80110-647-02	80110-648-02	80116-128-01	80110-406-02
	Main Lugs End	400/600 A	80110-630-01	80110-630-01	80110-630-01	80110-630-01	—

Main Breaker Kit

Letter Code	Description	Part Number
	Main Breaker Kit	NQOD
G	Main Breaker	Select Q4, LA, or LH Breaker from Digest
H	Main Breaker Mounting Pan	80110-632-01
I	Main Breaker Trim	80110-631-02
Ⓞ	Replacement Hardware Kit	80110-863-50

Miscellaneous

Letter Code	Description	Part Number
Ⓞ	Endwalls (Type MH):	
	Blank	80110-105-01
	With Knockouts	80110-104-01
Ⓞ	Circuit Directory Cards (5-2/3 in. Wide)	80031-158-01
	Numbers (1-54)	80031-158-02
	Numbers (43-96)	
Ⓞ	Plastic Stick-On Pouch (5-2/3 in. Wide)	80031-159-01
Ⓞ	Circuit Number Description	
	1-96	80043-295-03

Ⓞ Not shown.
* Canada only.
Note: Number in parentheses, (e.g., (4)) indicates quantity required.

Schneider Electric USA
252 North Tippecanoe
Peru, IN 46970 USA
1-888-SquareD
(1-888-778-2733)
www.us.SquareD.com

Schneider Electric Canada
19 Waterman Avenue,
M4B 1 Y2
Toronto, Ontario
1-800-565-6699
www.schneider-electric.ca

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BENOIT ELECTRIC, INC.
254 INDUSTRIAL LANE
BARRE, VT 05641
Phone (802) 229-1955
Fax (802) 229-4946

Submittal Cover Sheet

Project Name: UVM Delehanty Lab

Date: 2/14/2008

Architect: IDC Architects

Engineer: Same

Specification Section: 16011

Revision:

Submitted per Specification Section: 2.19, 2.22

Drawing #/Detail Reference: E-2

Supplier: Square D

Items Submitted: Disconnects & Combo Starters

Nema 3R Disconnects - 30&100 amps

Nema 1 Combo Starters - 15 hp

Customer Quotation

CED TWIN STATE ELECTRIC
4 CALKINS COURT



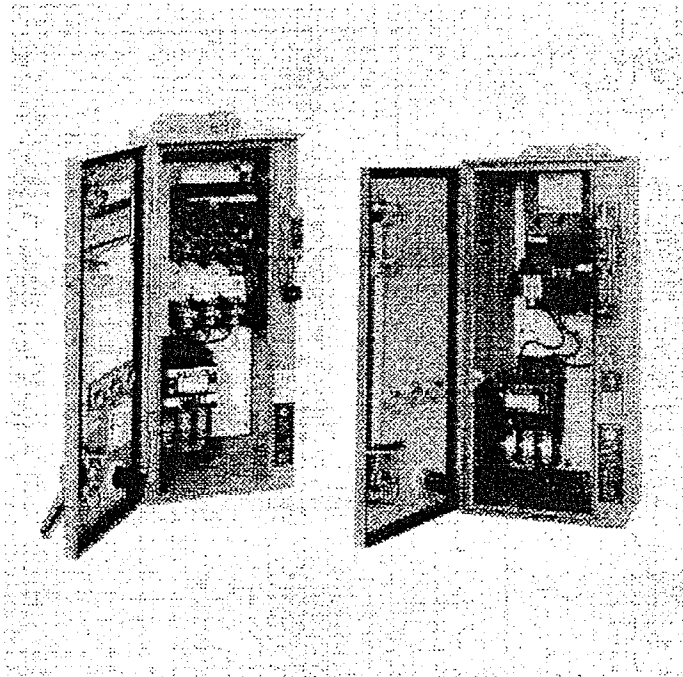
SOUTH BURLINGTON, VT 05403
Phone: (802)864-0186 Fax: (802)865-2635

Project Name: SPJ UVM DELAHANTY COMBO & DISC TB Project Location: SOUTH BURLINGTON Customer Name: BENOIT ELECTRIC INC Q2C Number: 24907535 Quote Number: 1	Accessories Fuses Are Included Overloads Are Included Lamps NOT Included Lug Kits NOT Included
--	---

Item Number	Quantity	Catalog Number / Details	Unit Price	Extended Price
001-00	2	8538SEG35V08CSY74 Class 8538 Fused Combination Starter 8538SEG35V08CSY74 NEMA Size 3 Fused combination starter Non-reversing 3 phase with Class R fuse clips (Fuses not included) 3 pole device Y74 - SPDT auxiliary contact on disconnect Selected for 15 HP @ 200V 3Ph Type 1 Enclosure Melting alloy overload Starter will require 3 thermal units Standard with NC overload contact Separate control source selected with 208V 60Hz coil Auxiliary contacts - None Control units supplied C - HAND-OFF-AUTO selector switch Pilot lights supplied None Revision: 080123 - (8010271003)		
		Estimated Ship Days (ARO): 3 Working Days		
004-00	2	DU321RB SWITCH NOT FUSIBLE GD 240V 30A 3P NEMA3R		
005-00	4	PK3GTA1 LOAD CENTER GROUND BAR ASSY		
007-00	2	DU323RB SWITCH NONFUSIBLE GD 240V 100A 3P NEMA3R		
008-00	2	QOB370VH MINIATURE CIRCUIT BREAKER 240V 70A		

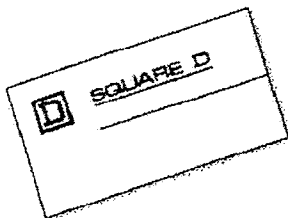
Combination Starters

Class 8538/8539, 8738/8739



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Application Data	27
Approximate Dimensions	28
Panel Layout Drawings	29
Factory Modifications	30
Replacement Parts Kits	38
Coils and Accessories	Refer to Catalog 9999CT9701



General Information

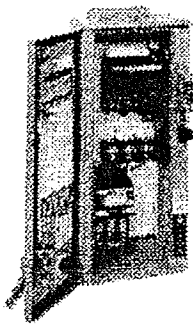
Class 8538 and 8539 Type S combination starters combine the requirements of motor overload and short circuit protection into one package. These starters are manufactured in accordance with NEMA standards and are UL Listed (although some FORM numbers may not be listed – contact your local Square D representative for information). Class 8538 and 8539 combination starters are designed to operate at 600 Vac maximum, 50 to 60 Hz – and are supplied with melting alloy overload relays as standard.

Type 2 Coordination

Square D is one of the leaders in North America and Europe in providing starters that are verified by UL to comply with IEC 947-4-1 and Type 2 coordination. This means that the components of a motor branch circuit protective device (fuses and circuit breaker), contactor, and overload relay will be suitable for further use following a short circuit fault (even though contact welding is recognized but can be easily broken) allowing for replacement of components during normal scheduled maintenance.

Square D starters and specified fuses have been tested by UL and CSA (at 100,000 Amps fault current) for operation at 600 volts AC. Class 8538 Type S Combination Starters, NEMA size 0 through 5, with fusible disconnect switches have tested to Type 2 performance criteria.

Class 8538 Disconnect Switch Type



Class 8538 combination starters can be supplied with either a fusible or non-fusible disconnect switch. Class 8538 combination starters are available in NEMA Sizes 0-6.

The fusible disconnect switch type combination starter design utilizes a flange operated visible blade switch. Interchangeable fuse clips, straight through wiring, space for a fused control transformer with additional capacity, and provisions for adding a disconnect switch electrical interlock are key features of the combination starters.

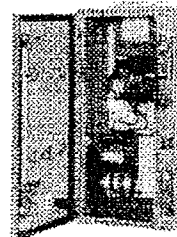
The fusible disconnect switch type can be supplied with Class R fuse clips increasing the short-circuit rating to 100,000A.

Size 0-2 non-fusible combination starters can be converted to a fusible type. See Catalog 999CT9701 for fuse block kits and fuse clips.

Class 8539 MAG-GARD® Motor Circuit Protector or Thermal Magnetic Circuit Breaker

Class 8539 combination starters can be supplied with either a MAG-GARD® motor circuit protector (MCP) or a thermal magnetic circuit breaker. Class 8539 combination starters are available in NEMA Sizes 0-7.

The circuit breakers in Class 8539 combination starters can be supplied with a factory installed auxiliary switch for remote indication of an open and/or tripped or closed breaker. For one auxiliary switch, specify Form Y74. For two auxiliary switches, specify Form Y75. The switches are supplied with normally open and normally closed circuits with a common connection. Contacts must be used on the same polarity and are rated 15 Amps at 240 Volts AC.



An alarm switch can be factory supplied only, specify Form Y742. The alarm switch only operates when the breaker is tripped. It is used to actuate bell alarms and warning lights. The alarm switch consists of a normally open single pole single throw switch. The contacts are rated 4 Amps at 240 Volts AC.

Enclosures – Class 8538 and 8539 combination starters are available in the following enclosures:

NEMA Type 1 General Purpose

NEMA Type 4 & 4X Watertight and Dusttight Stainless Steel

NEMA Type 4X Watertight, Dusttight, and Corrosion Resistant Glass-Polyester

NEMA Type 7 & 9 Bolted and Spin-Top® for Hazardous Locations (Class 8539 only).

NEMA Type 12 Dusttight and Driptight for Industrial Use

The NEMA Type 4 & 4X stainless steel enclosure (Sizes 0 - 5) has a brushed finish. Sizes 6 & 7 are painted sheet steel enclosures and are rated NEMA Type 4 only. For an electropolished finish, specify Form G16 and add 15% to the price of the standard device. Hubs are supplied as standard on NEMA Type 4 & 4X enclosures.

Hubs are supplied as standard on NEMA Type 4X enclosures.

NEMA Type 12 enclosures may be field modified for outdoor applications. Specify Form G26 for NEMA Type 3R (no additional charge). See Catalog 999CT9701 for additional information. Also, NEMA Type 12 devices are available UL Listed for use in Class II, Division 2, Group G and Class III, Divisions 1 and 2 locations. Request Form G21 (no additional charge).

Oversized Enclosures – Class 8538 disconnect switch type and Class 8539 MAG-GARD® MCP (Sizes 0-2) are available in NEMA Type 1, 4 & 4X and 12 enclosures. The oversized enclosures provide additional panel

space for customer installation of control transformers, fuse blocks, terminal blocks, relays, and other auxiliary equipment. These enclosures have three Class 9001 Type "K" holes as standard for installation of push buttons, pilot lights, and other cover mounted control units.

Coil Voltages – AC coils are available for application on 50-60 Hz. NEMA Sizes 00 - 5 are supplied with coils that are designed to operate satisfactorily on line voltages of 85% - 110% of rated voltage. NEMA Size 6 and 7 contactors are supplied with a DC coil operated by a solid state rectifier circuit that is powered by an AC source and is designed to operate satisfactorily on line voltages of 90-110% of rated voltage.

Please note that Voltage Codes have been added to the Type designations in order to improve customer service. It is necessary to include the Voltage Code when ordering combination starters. Also, 120 Volt polyphase combination starters will be wired for separate control.

Auxiliary Contacts – Additional auxiliary contacts may be added to Type S starters. Refer to Page 14 for maximum number of auxiliary units and Form designations for factory installed auxiliary contacts. See Catalog 999CT9701 for auxiliary contact kits for field installation.

Type S Accessories – Additional accessories such as fuse blocks, fuse clip kits, disconnect switch and circuit breaker interlocks, and cover mounted control stations are available for field modifications, see Catalog 999CT9701. For factory modifications (Forms), see Pages 30-34.



Combination Starters – NEMA Rated Class 8538 – Fusible Disconnect Switch Type with Class R Fuse Clips

3-POLE POLYPHASE – 600 VOLTS AC MAXIMUM – 50-60 HZ

Devices require 3 thermal units. See Catalog 8065CT9701 for selection information.

**Fusible (with Class R Fuse Clips) Full Voltage Type, Non-Reversing,
with Melting Alloy Overload Relays — (100,000 AIC Rated)**

RATINGS					NEMA Type 1 General Purpose Enclosure	NEMA Type 4 & 4X Watertight and Dusttight Enclosure Stainless Steel (304) (Sizes 0-6)	NEMA Type 4X Watertight, Dusttight and Corrosion Resistant Polyester Enclosure	NEMA Type 123RA Dusttight and Driptight Industrial Enclosure	
Motor Voltage (Starter Voltage)	Max. HP Poly- phase	Coil Voltage *	NEMA Size	Fuse Clip Size Amperes	Type	Type	Type	With External Reset	Without External Reset
200 (208)	3	7½	208-60	0	SBG32V08	SBW32V08	SBW42V08	SBA42V08	SBA32V08
	5			SCG32V08	SCW32V08	SCW42V08	SCA42V08	SCA32V08	
	10			SDG32V08	SDW32V08	SDW42V08	SDA42V08	SDA32V08	
	20			SEG32V08	SEW32V08	SEW42V08	SEA42V08	SEA32V08	
	25			SFG32V08	SFW32V08	SFW42V08	SFA42V08	SFA32V08	
	40			SGG32V08	SGW32V08	SGW42V08	SGA42V08	SGA32V08	
230 (240)	3	7½	240-60	0	SBG32V03	SBW32V03	SBW42V03	SBA42V03	SBA32V03
	5			SCG32V03	SCW32V03	SCW42V03	SCA42V03	SCA32V03	
	10			SDG32V03	SDW32V03	SDW42V03	SDA42V03	SDA32V03	
	20			SEG32V03	SEW32V03	SEW42V03	SEA42V03	SEA32V03	
	25			SFG32V03	SFW32V03	SFW42V03	SFA42V03	SFA32V03	
	40			SGG32V03	SGW32V03	SGW42V03	SGA42V03	SGA32V03	
480 (480)	5	480-60	440-50	0	SBG33V06	SBW33V06	SBW43V06	SBA43V06	SBA33V06
	10			SCG33V06	SCW33V06	SCW43V06	SCA43V06	SCA33V06	
	15			SDG33V06	SDW33V06	SDW43V06	SDA43V06	SDA33V06	
	25			SEG33V06	SEW33V06	SEW43V06	SEA43V06	SEA33V06	
	50			SFG33V06	SFW33V06	SFW43V06	SFA43V06	SFA33V06	
	100			SGG33V06	SGW33V06	SGW43V06	SGA43V06	SGA33V06	
575 (600)	5	600-60	550-50	0	SBG33V07	SBW33V07	SBW43V07	SBA43V07	SBA33V07
	10			SCG33V07	SCW33V07	SCW43V07	SCA43V07	SCA33V07	
	15			SDG33V07	SDW33V07	SDW43V07	SDA43V07	SDA33V07	
	25			SEG33V07	SEW33V07	SEW43V07	SEA43V07	SEA33V07	
	50			SFG33V07	SFW33V07	SFW43V07	SFA43V07	SFA33V07	
	100			SGG33V07	SGW33V07	SGW43V07	SGA43V07	SGA33V07	

▲ NEMA Type 12 enclosures may be field modified for outdoor non-corrosive and non-service-entrance-rated applications; see Page 17 for more information.
 * Coil voltage code must be specified to order this product. Refer to standard coil voltage codes listed in selection table above or additional standard voltage codes shown below.
 † NEMA Size 6 starters are NEMA Type 4 painted sheet steel enclosures.

NOTE: Some control transformers may require the use of oversized enclosures. Refer to the control transformer selection table on Page 35.

Coil Voltage Codes

Voltage	Code
86 Hz	
241▲	V01
120†	V02
238	V08
240	V03
480	V06
600	V07
Specify	V99

▲ 24V coils are not available on Sizes 4-7. On Sizes 00-3, where 24V coils are available, Form 8 (separate control) must be specified.
 † These voltage codes must include Form 8 (supplied at No Charge). When specifying Form 8, please supply motor voltage when ordering.



Combination Starters — NEMA Rated Approximate Dimensions, Shipping Weights — Class 8538, 8539

NEMA Type 1 Enclosure — Figure 1

NEMA Size	Class	Type	Dimensions in Inches*													Top & Bottom			Sides	Wt. (Lbs.)		
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P			W	X	Y
0-1	8538 & 8539	SBG SCG	9 1/4	22 1/2	8 1/2	5 3/4	20 1/4	14 7/8	1 1/4	1 1/4	3	2 3/4	1 1/4	3 1/4	2 3/4	1 1/4	7/8	...	7/8-3/4	7/8-3/4	1/2	38
2	8538 & 8539	SDG	10 1/4	26	9 3/4	7 3/4	24	16 3/4	2 1/4	2	4	2 3/4	1 1/4	3 1/4	2 3/4	1 1/4	7/8	...	1-1/4	7/8-3/4	1/2	54

* Above dimensions include space for control circuit transformers.

NEMA Type 1 Enclosure — Figure 2

NEMA Size	Class	Type	Dimensions in Inches*													Top & Bottom			Sides	Wt. (Lbs.)		
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P			W	X	Y
3	8538 & 8539	BEG	16 1/4	42	10 3/4	9 1/4	3	22 3/4	4 1/4	1/2	...	2 3/4	3 1/4	5	2 1/4	5 1/4	1 3/4	7 3/4	1-1/4 2-2 1/2	7/8-3/4	1/2	102
4	8538	SFG	16	52 1/2	10 1/2	10	3	23 1/2	5 1/2	1/2	...	2 3/4	3 1/2	5	2 1/4	5 1/4	1 3/4	7 3/4	2 1/2	7/8-3/4	1/2	163
	8539	SFG	16	52 1/2	10 1/2	10	3	23 1/2	5 1/2	1/2	...	2 3/4	3 1/2	5	2 1/4	5 1/4	1 3/4	7 3/4	2 1/2	7/8-3/4	1/2	163
6	8538	SGG	20	78	15 1/4	12	4	28 1/2	7 1/2	1/2	...	3 3/4	4 3/4	8 1/4	3 1/4	...	...	7 3/4	3	...	...	450
	8539	SGG	20	86	13 3/4	12	4	29 3/4	8 5/8	1/2	...	3 3/4	4 3/4	8 1/4	3 1/4	...	...	7 3/4	3	...	...	420
6A	8538 & 8539	BHG	36	90	21 1/4	...	...	41 3/4	...	...	...	...	...	5	...	...	...	...	...	...	...	...

T Left side only

A Size 6 enclosures are floor mounting.

* Above dimensions include space for control circuit transformers.

† Class 8538 Size 3 devices with 200 Amp fuse class use dimensions for Class 8538 Size 4.

NEMA Type 12 Enclosure — Figure 3

NEMA Size	Class	Type	Dimensions in Inches*										Wt. (Lbs.)
			A	B	C	D	E	F	G	H	I	J	
0-1	8538 & 8539	SBA SCA	9 1/4	8 1/2	24	3 1/4	2 1/2	4 1/4	23 1/4	1 3/4	4 1/4	14 1/4	40
2	8538 & 8539	SDA	10 1/4	9 3/4	27 3/4	3 1/4	2 1/2	5 1/4	27	3 1/4	16 1/4	55	
3	8538 & 8539	SEA	15 1/4	10 3/4	42	5	5	9 1/4	41	1/2	22 1/4	111	
	8538	SFA	16	10 1/2	42 1/2	5	5	10	41 1/2	1/2	22 1/2	170	
4	8538	SFA	16	10 1/2	42 1/2	5	5	10	41 1/2	1/2	22 1/2	170	
	8539	SFA	16	10 1/2	42 1/2	5	5	10	41 1/2	1/2	22 1/2	170	
6	8538	SGA	20	13 3/4	78	8 1/4	4	12	77	1/2	29 1/2	...	
	8539	SGA	20	13 3/4	86	5	4	12	85	1/2	27 3/4	440	
6A	8538 & 8539	SHA	36	17	90	5	...	...	...	...	47 3/4	...

A Size 6 enclosures are floor mounting.

* Above dimensions include space for control circuit transformers.

† Class 8538 Size 3 devices with 200 Amp fuse class use dimensions for Class 8538 Size 4.

NOTE: Illustrations may not represent the actual enclosure, they are intended for dimensional information only.

NEMA Type 12 Enclosures Modified for Outdoor Applications (not to be used in salt air or corrosive environments)

Field Modifications for NEMA Type 3 dusttight, raintight and steel resistant outdoor applications are as follows:
Watertight conduit hubs or equivalent provision for watertight connection at the conduit entrance shall be used.

Field Modifications for NEMA Type 3R rainproof and steel resistant outdoor applications are as follows:

1. Watertight conduit hubs or equivalent provision for watertight connection at the conduit entrance, when the conduit enters at a level higher than the lowest live part, shall be used.
2. Drain holes of 1/8 inch diameter shall be added to the bottom of the enclosure.

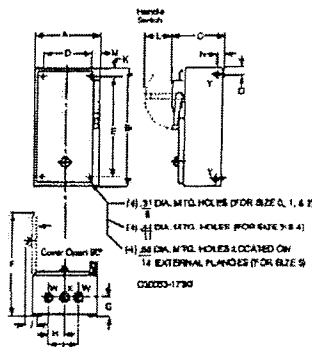


Figure 1
NEMA Type 1 Enclosure

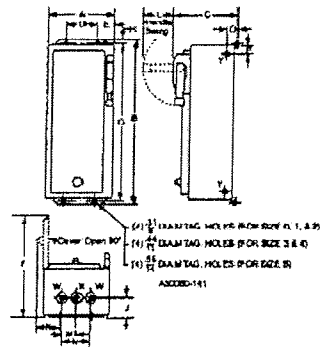


Figure 2
NEMA Type 1 Enclosure

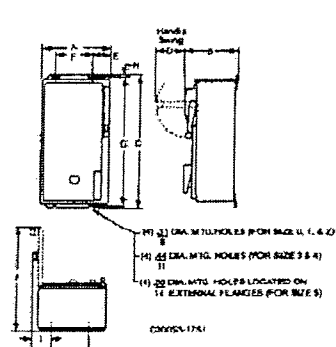


Figure 3
NEMA Type 12 Enclosure



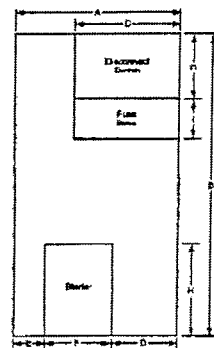
Combination Starters — NEMA Rated Panel Layout Drawings – Class 8538, 8539

Standard NEMA Type 1, 4 & 4X Stainless, 12

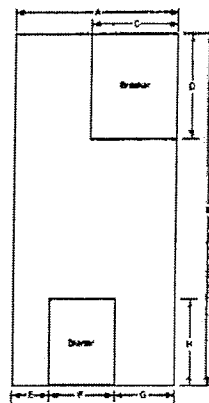
The following table is provided to identify open panel space on standard NEMA Type 1, 4 & 4X stainless steel and 12 combination starters. Space and mounting holes are provided in all combination starters (except NEMA type 7 & 9 SPIN TOP®) for the field addition of a control transformer – see Page 35 for control transformer selection.

Class	NEMA Size	Dimensions in inches								
		A	B	C	D	E	F	G	H	I
8538	0, 1	8.9	18.5	8.8	6.5	0	3.5	3.4	6.9	4.0
8539				8.5	7.9					—
8538	2	7.9	22.0	7.5	7.0	3.1	4.8	0	7.7	8.0
8539				6.5	8.4					—
8538	3	12.0	29.5	9.0	7.7	0	5.6	6.4	12.9	5.3
8539				FAL: 6.5 KAL: 6.8	FAL: 6.5 KAL: 10.5					—
8538	4	13.0	39.0	11.0	11.5	0	7.0	8.0	13.0	9.0
8539				8.8	12.5					—
8538	5*	17.3	50.0	13.5	25.0	0	10.8	6.5	20.5	—
8539				KAL: 8.8 LAL: 9.0	KAL: 23.0 LAL: 24.6					—
8538	6	32.0	82.0	32.0	40.0	0	13.0	18.0	35.0	—
8539				LAL: 9.0 MAL: 12.5	LAL: 25.5 MAL: 40.5					—

* Size 5 combination starter does not contain a full size panel. No usable panel space is available.



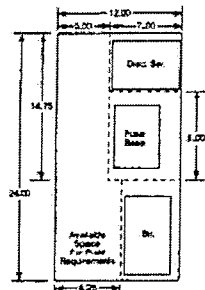
Class 8538



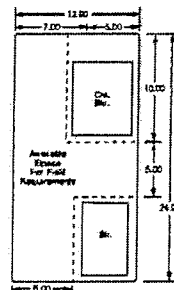
Class 8539

Overize Enclosures, NEMA Type 1, 4 & 4X Stainless, 12

Combination starters in oversized enclosures provide additional panel space for field addition of control relays, timing relays, terminal blocks or other auxiliary equipment. Disconnect type devices offer over 130 square inches of available panel space. Circuit breaker type devices offer over 180 square inches of available panel space.



Class 8538



Class 8539



Factory Modifications (Forms) For Full Voltage Contactors and Starters

Factory installed modifications are available for the classes of control equipment listed in the respective tables. Prices shown are **additions** to standard equipment prices and are **not** to be used as separate selling prices. Kits are also available for many field modifications and normal parts replacement on most control items. Refer to Classes 9998 and 9999 for complete listings.

Standard equipment dimensions and enclosure construction may not apply when certain special features are added. Such cases should be referred to the factory with complete description when accurate dimensions are required. **Note:** If UL label is required, consult local Square D Field Sales Office. Some forms are not UL Listed.

Full Voltage Starters

	Factory Modifications	Enclosure Type	Form Letters
PILOT DEVICES IN COVER Full Voltage Non-Reversing Controllers Only Classes 8538 8539	Push Buttons *		
	"Start-Stop"	1 3R, 4, 4X, 12 7 & 9	A A A
	"Start-Stop" (maintained contact)†	1, 3R, 4, 4X, 12	A16
	"Start-Stop" push button and "Hand-Off-Auto" selector switch	1, 3R, 4, 4X, 12	AC
	"On-Off"	1 3R, 4, 4X, 12	A3 A3
	Single Onlight Pushbutton (specify marking)	1, 3R, 4, 4X, 12	A11
	Selector Switches		
	"Hand-Off-Auto"	1 3R, 4, 4X, 12 7 & 9	C C C
	"On-Off"	1 3R, 4, 4X, 12 7 & 9	C6 C6 C6
	Key Operated Selector Switch (specify marking and Key withdrawal position code)	1, 3R, 4, 12	C33
	NON-STANDARD markings for Pilot Devices	1, 3R, 4, 12	G12W
	Addition of padlock attachment to Class 8001 operators	1, 3R, 4, 12	G12Z
	Pilot Lights (specify color/type) ‡		
	Without Operating Interlock: Per light Per light Push-to-test (each)	1, 3R, 4, 4X, 12 7 & 9 1, 3R, 4, 4X, 12	PA PA PA
With Operating Interlock; Add price of each interlock per light	1, 3R, 4, 4X, 12	X*	
PILOT DEVICES IN COVER Full Voltage Reversing and Multi-Speed Controllers Only Classes 8736 8739	Push Buttons *		
	"Forward-Reverse-Stop"	1, 4, 4X, 12	A1
	"High-Low-Stop"	1, 4, 12	A2
	"Fast-Off-Slow"	1, 4, 12	A9
	"High-Low" push button and "Hand-Off-Auto" selector	1, 4, 12	A10C
	Single Onlight Pushbutton (specify marking)	1, 4, 4X, 12	A11
	Selector Switches		
	"Hand-Off-Auto"	1, 4, 4X, 12 7 & 9	C C
	"On-Off"	1, 4, 4X, 12 7 & 9	C6 C6
	"High-Off-Low"	1, 4, 12	C7
	"Forward-Off-Reverse"	1, 4, 4X, 7, 9, 12	C14
	"High-Low" and "Hand-Off-Auto"	1, 4, 12	C17
	"Slow-Fast"	1, 4, 4X, 12	C18
	"Forward-Reverse"	1, 4, 4X, 12	C20
	"High-Low-Off-Auto"	1, 4, 12	C26
	NON-STANDARD markings for Pilot Devices	Any	G12W
	Pilot Lights (specify color/type) ‡		
	One Pilot Light; one light with two electrical interlocks. Two Pilot Lights; each light is wired in parallel, no interlocks used		
	Without Operating Interlock: Per light Per light Push-to-test (each)	1, 4, 4X, 12 7 & 9 1, 4, 4X, 12	PA PA PA
	With Operating Interlock; Add price of each interlock per light	1, 4, 4X, 12	X*

* All push buttons are momentary contact unless specified otherwise.
 † This article, used with a NEMA Type 4X enclosure, applies to Classes 8538, 8539, 8736, 8739.
 ‡ Indicate pilot light color as Form P1 (red) or Form P2 (green), etc. as shown in the table below. Unless otherwise requested, standard practice is to wire red pilot light to indicate device is energized. No additional auxiliary contact is required. Also, standard practice is to wire green pilot light to indicate device is de-energized. An additional normally-closed auxiliary contact is required. A wiring diagram must be supplied for other pilot light colors and/or arrangements.
 * Pilot lights available at 120 to 600 volt only.
 † Specify marking and/or Class 8001 Type KN or Type SKN legend plate required.
 ‡ Specify appropriate Class 8001 Type K or SK operator required.
 * To determine the maximum number of auxiliary contacts which can be added to each Type S device and for the appropriate "X" Form, refer to the tables in the Class 8736 section on Page 12, 81 (for reversing or two-speed devices).

Standard Pilot Light Form	Push-to-Test Pilot Light Form	LED Pilot Light	Color
P1	P21	P51	Red
P2	P22	P62	Green
P3	P23	—	Amber
P4	P24	—	Clear
—	P26	P66	Yellow



Factory Modifications (Forms) For Full Voltage Contactors and Starters

Full Voltage Controllers Only

Classes 8536, 8538, 8736 and 8739

Factory Modifications		Enclosure Type	Form Letters
Separate Control Circuit — (specify voltage and frequency)		Any	B*
Fused Control Circuit (without control transformer)			F
One fuse		1, 3R, 4, 4X, 12	F4
Two fuses		1, 3R, 4, 4X, 7, 8, 12	
Control Circuit Transformers†			
Standard capacity (50 or 60 Hz)			
NOTE: All orders requesting Form FT will be supplied as Form F4T.			
FUSES			
CONTROL CIRCUIT	Primary	Secondary	
	2	0	1, 4, 4X, 12
FULL VOLTAGE AND MULTISPEED CONTROLLERS ONLY	1	1†	7 & 9
	2	1†	1, 4, 4X, 12
CLASSES 8538 8539 8736 8739	2	1	1, 4, 4X, 12
	1	2†	7 & 9
CLASSES 8538 8539 8736 8739	2	2	1, 4, 4X, 12
	Additional Capacity (50 or 60 Hz)		
Two fuses in primary			
100 VA additional capacity		1, 4, 4X, 12	F4T11*
100 VA additional capacity		7 & 9	F4T11*
200 VA additional capacity		1, 4, 4X, 12	F4T12*
Two fuses in primary and one fuse in secondary			
100 VA additional capacity		1, 4, 4X, 12	FF4T11
100 VA additional capacity		7 & 9	FF4T11
200 VA additional capacity		1, 4, 4X, 12	FF4T12
300 VA additional capacity		1, 4, 4X, 12	FF4T13
400 VA additional capacity		1, 4, 4X, 12	FF4T14
500 VA additional capacity		1, 4, 4X, 12	FF4T15
Substitute non-standard single primary, and/or single secondary voltage rating on control transformer		Any	T1†
Substitute dual-voltage magnet coil		Any	Y6†

* All combination style devices such as 8538, 8539, 8736, 8739, that use Form S should also use Form Y74 (auxiliary contact installed on disconnected switch) per NEC Article 430-74.

† Table at right.

‡ Single primary voltage must be specified.

§ Must be used with another form of F4T. (Ex. Standard capacity transformer required, 208-24V. Order as Form F4TT1, 208-24V.)

¶ Not available on Size 2 or Size 3 devices with 4 or 5 poles.

|| Not available on this Size. Select appropriate transformer with secondary fuse protection.

⊞ Not available with 24V secondary on Size 3. Select appropriate transformer with secondary fuse protection. See Table at right for 24V secondary restrictions.

⊟ Single phase with one leg grounded or grounded B phase applications ONLY.

Selection of Control Circuit Transformers

The standard primary/secondary voltages for control circuit transformers are indicated in the following table.

AC-OPERATED DEVICES With Control Transformers	
Voltage	Code
60Hz (Primary-Secondary)	
120-12*	V88
120-24*	V88
208-120	V84
240-24*	V82
240-120	V80
277-120	V85
480-24*	V83
480-120	V81
480-240	V87
600-120	V86
Specify	V98

* 12V coils are not available on Sizes 3-7. 24V coils are not available on Sizes 4-7.

To order, select the desired device with the appropriate transformer form designation. Then convert the previously selected voltage code (V_) to reflect the desired primary/secondary voltage for the transformer. The secondary voltage should equal the previously selected coil voltage of the device.

Example:

You have previously selected a Class 8536SDG1V02S. V02S means that you need a coil voltage of 120-60/110-50 wired for separate control. You would like to add form FF4T with the transformer voltages being 48 volt primary, 120 volt secondary with Solid State Overload Relay Protection Class 20 Trip Class (H20).

The new and complete class, type, voltage code and form number will be:

Class	Type	Voltage Code	Form*
8536	SDG1	V81	FF4TH20

* Form numbers should always be shown in alphabetical order.

Marine Control

Class	Factory Modification	Enclosure Type	Form
8538	Modification of standard device for use as marine control per UL508	1273R	M10
8538		4/4X (S.S. only)	
8738	Modification of standard device for use as marine control like Form 1D standards in addition to IEEE45.	1273R	M11
8739		4/4X (S.S. only)	



Factory Modifications (Forms) For Full and Reduced Voltage Contactors & Starters

Full Voltage and Reduced Voltage Controllers*

CLASSES 8530, 8536, 8736 and 8739		Enclosure Type	Form Letters
Factory Modifications			
Auxiliary Relays	Control relay (1 thru 4 poles) — specify pole arrangement, voltage and type required†	1, 12 4, 4X*, 9	R17† R17†
	Pneumatic Timing Relay — specify Class 9080 Type A or B, "On" or "Off" delay and wiring instructions	1, 12 4, 4X*, 7, 9	K K
	0.2 Sec. to 1.0 Min.	1, 12	K16
	1.0 Min. to 3.0 Min.	4, 4X*, 7, 9	K16
	Solid State Timing Relay (specify timing range) and timer (120V control req'd.)	1, 4, 4X, 7, 9, 12	K1
	Pneumatic Timing Attachment — 0.2 sec. to 1.0 min.	1, 4, 4X*, 12	K36
	Addition of Class 9999 Type SK3 (on delay) attachment.	1, 4, 4X*, 12	K35
	Motor driven timing relay††	1, 4, 12	K5
	Phase Failure and Reverse Phase Relay††	1, 4, 12	Y444
	Under-voltage Relay††	1, 4, 12	Y447
	Over-voltage Relay††	1, 4, 12	Y448
Under and Over-voltage Relay††	1, 4, 12	Y448	
Meters And Metering†	Ammeter in cover (includes current transformer if req'd.)	1, 12	G61
	Ammeter and switch with two current transformers	1, 12	G62
	Ammeter and switch with three current transformers	1, 12	G63
	Voltsmeter mounted	1, 12	G94
	Voltsmeter and switch mounted	1, 12	G96
	Elapsed time meter	1, 12	G97
	Operation counter	1, 12	G99
	Wattmeter	1, 12	G811
	Varmeter	1, 12	G813
Power factor meter	1, 12	G814	
Auxiliary Contacts	Additional starter (contactor) auxiliary contacts (Specify number of additional normally open or closed contacts required per contactor.) Each	Any	X†
	Auxiliary contacts installed on disconnect switch or circuit breaker operating mechanism.	1, 4, 4X, 12	Y74
	SPDT	1, 4, 4X, 12	Y75
	DPT (Note: Above contacts do not switch with automatic tripping of circuit breaker. If such operation is required, consult your local Square D field office.)	1, 4, 4X, 12	Y75
Enclosures	Space heater with N.C. auxiliary contact	1, 4, 4X, 12	G61
	Function identification plate, with marking as specified	Any	G11
	Convenience receptacle (2-wire) mounted in side of enclosure	1, 12	Y31
	Drain and breather installed	7 & 9	Y41
	Cover panels added to NEMA Type 1 enclosures:	1	Y47
	For Classes 8536 and 8639	1	Y47
For other full voltage controllers	1	Y47	
For reduced voltage controllers	1	Y47	

* If controller has a control transformer, price that transformer with additional capacity for the relay provided.
 † This adder, used with a NEMA Type 4X enclosure, applies only to Classes 8536, 8539, 8738, 8739 and 8810 non-reversing.
 †† Specify control and line voltage.
 ‡ Motor HP and voltage required when placing order. Meters will be panel mounted in NEMA Type 12 enclosures.
 † To determine the maximum number of auxiliary contacts which can be added to each Type 6 device and for the appropriate "X Form", refer to the tables in the Class 8536 section on Page 12-29 (for non-reversing single-speed devices) or the Class 8736 section on Page 12-81 (for reversing or two-speed devices). For Class 8600 Reduced Voltage controllers, consult local Square D field office.
 † Addition of control relay one (1) thru eight (8) poles. Number of poles is same as ending of form number. (Ex: R174 = 4 pole relay).
 * NEMA Type 7 & 9 enclosures not available with Class 8600 devices.
 † For single phase applications only.

Selection of Control Circuit Transformers

The standard primary/secondary voltages for control circuit transformers are indicated in the following table.

Voltage 60 Hz (Primary-Secondary)	Code
120-12	V88
120-24	V89
208-120	V94
240-24	V82
240-120	V90
277-120	V85
480-24	V83
480-120	V81
480-240	V87
600-120	V86
Specify	V99

To order, select the desired device with the appropriate transformer form designation. Then convert the previously selected voltage code (V__) to reflect the desired primary/secondary voltage for the transformer. The secondary voltage should equal the previously selected coil voltage of the device. (24Vac coils for NEMA Sizes 4-7 are not available).

Example:

You have previously selected a Class 8606SDG1V02S. V02S means that you need a coil voltage of 120-60/110-50 wired for separate control. You would like to add Form FF4T with the transformer voltages being 480 volt primary, 120 volt secondary.

The new and complete class, type, voltage code and form number will be:

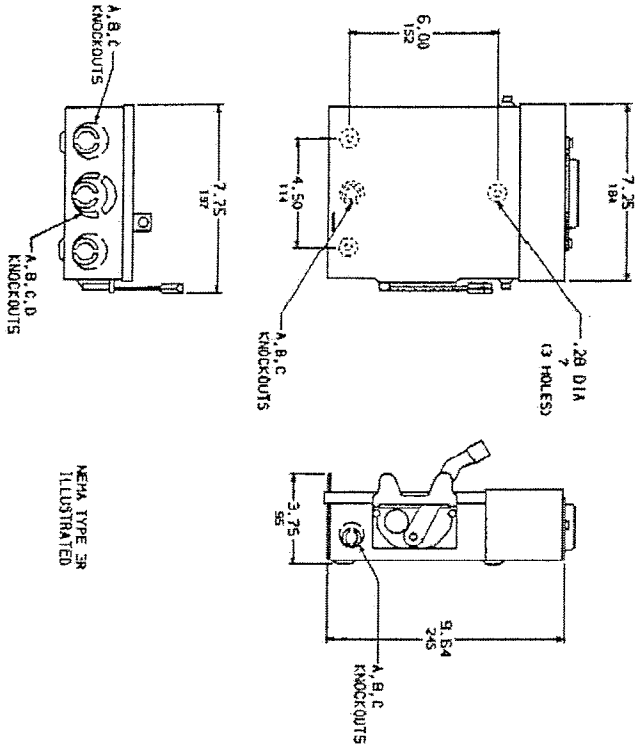
Class	Type	Voltage Code	Form
8606	SDG1	V81	FF4T

* Form numbers should always be shown in alphabetical order.



MAY 1959

NOTES: FINISH - GRAY BAKED ENAMEL, ELECTRODEPOSITED OVER CLEANED PHOSPHATIZED STEEL.
 UL LISTED - FILE E-2675
 ALL NEUTRALS - INSULATED GROUNDABLE
 SUITABLE FOR USE AS SERVICE EQUIPMENT
 TOP OF MAIN TYPE OR SWITCHES HAVE PROVISIONS FOR MAXIMUM 2 1/2" BOLT-ON TAB.
 SEE 10,000 AMPERE RATING RATINGS.
 * 10,000 AMPERES WHEN USED WITH OR PROTECTED BY CLASS H OR K FUSES.
 † FOR CORNER MOUNTED DELTA SYSTEM.
 ‡ LUGS SUITABLE FOR 60°C OR 75°C CONDUCTORS.



NEHA TYPE 3R ILLUSTRATED

GENERAL DUTY SAFETY SWITCHES
 VISIBLE BLADE TYPE
 ENCLOSURE - MAIN TYPE OR RAIN-PROOF

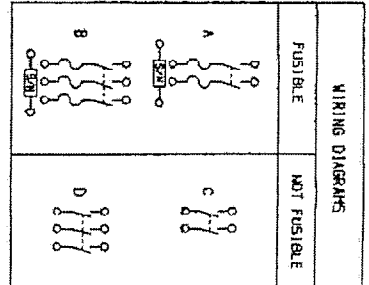
SQUARE D COMPANY
 MODEL NO. 1852

CATALOG NUMBER	VOLTAGE RATINGS	WIRING DIA.	OPERATING RATINGS			
			120VAC STD.	MAX.	240VAC STD.	MAX.
021188 ●	240VAC	A	1/2	2	1 1/2	3
022188	240VAC	A	-	-	1 1/2	3
023188	240VAC	B	-	-	1 1/2	3
024188	240VAC	C	-	-	1 1/2	3
025188	240VAC	D	-	-	1 1/2	3

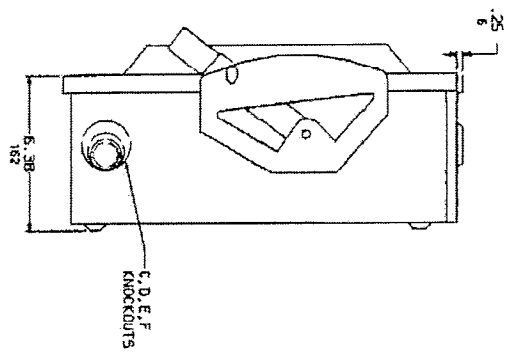
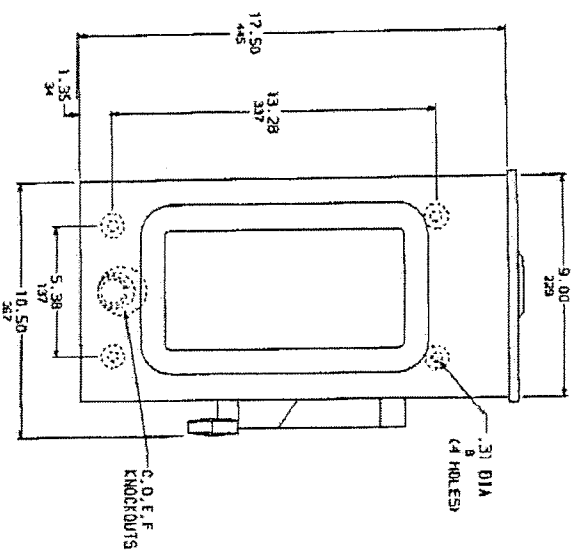
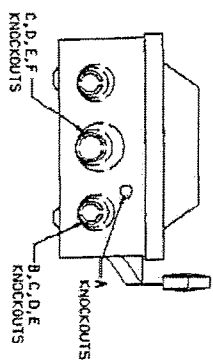
DUAL DIMENSIONS, INCHES
 MILLIMETERS

ENCLOSURE	
SYMBOL	A B C D
CONDUIT SIZE	.50 .75 1 1.25

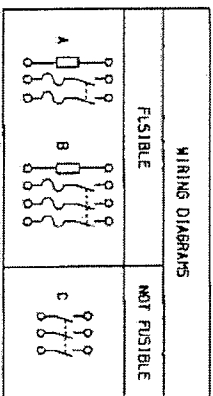
TERMINAL CUBES			
AMPERES	MAX.	MIN.	WIRE TYPE
30	# 5 AWG	# 12 AWG	AL
	# 8 AWG	# 14 AWG	CU



NOTES:
 1. SWITCH - 400Y RATED MODEL.
 2. LISTED - 4 TIE-BACKS GROUNDED.
 3. SWITCHES FOR USE AS SERVICE EQUIPMENT.
 4. 10,000 AMPERES WITH CLASS M FUSES MAY BE CLASS N REJECTION KIITS INSTALLED.
 5. TOP OF MAIN TYPE 3R DEVICES HAVE PROVIDED FOR MATHIN 2.50 IN / 64 IN 90-1-04 IN. HIG.
 6. FOR CORNER GROUNDED DELTA SYSTEMS ONLY.
 7. REQUIRES FIELD INSTALLATION OF EQUIPMENT.
 8. USED AS SERVICE EQUIPMENT.
 9. LISTS SUITABLE FOR 60°C OR 75°C CONDITIONS.



NEHA TYPE 3R ILLUSTRATED



TERMINAL LISTS

AMPERES	MAX. WIRE MIN. WIRE TYPE
100	1/0 AWG #12 AWG AL
	1/0 AWG #14 AWG CU

KNOCKOUTS

SYMBOL	CONDUIT SIZE	1 INCHETER	1 1/2 INCHETER	2 INCHETER
A	.50	1 1/2	1.68	2.2
B	.75	1 1/2	1.73	2.2
C	1.00	2 1/2	1.78	2.2
D	1.25	3 1/2	1.75	2.2
E	1.50	3 1/2	2.00	2.5
F	2.00	5 1/2	2.50	3 1/4

DUAL DIMENSIONS INCHES MILLIMETERS

CATALOG NUMBER	VOLTAGE RATINGS	WIRING DIA.	CORNER RATINGS		
			STD.	ZONAL	MAX.
002298	240VAC	A	7 1/2	15 K	15
002299	240VAC	B	7 1/2	15	20 K
002298	240VAC	C	-	-	15

GENERAL DUTY SAFETY SWITCHES
 VISIBLE BLADE TYPE
 ENCL. 3R - NEHA TYPE 3R MAINPANEL

1865
SQUARE D COMPANY



by Honeywell

Velociti[®] Series

ADPF and ADPRF

Description

The Gamewell-FCI Velociti[®] Series, low-flow photoelectric air duct smoke sensors are capable of sensing smoke in air velocities from 100 to 4,000 feet per minute (0.5 to 20.32 m/sec.).

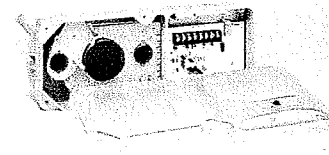
ADPF sensors feature low-flow technology that enables duct smoke detection throughout a broad range of airflow environments. Many difficult to solve HVAC applications occur in low airflow duct applications where reliable smoke detection is critical. ADPF low-flow technology can detect smoke at air speed velocities of 100 feet per minute or greater, while continuing the same reliable performance to 4,000 feet per minute.

The ADPF sensor samples air currents passing through a duct and gives dependable performance for shutdown of fans, blowers, and air conditioning systems, preventing the spread of toxic smoke and fire gases through the protected area.

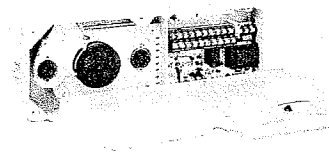
The Velociti[®] Series use a communication protocol that substantially increases the speed of communication between the sensors and certain Gamewell-FCI analog addressable fire alarm controls. These devices operate in a grouped fashion. If one of the devices in the group has a status change, the panel's microprocessor stops the group poll and concentrates on the single device. The net effect is a response speed up to five times greater than earlier designs.

These intelligent sensors communicate and are continuously monitored through the signaling line circuit. Sensor sensitivity changes caused by dirt, temperature, or humidity are reported to the panel, allowing compensation algorithms to maintain the sensor's set sensitivity. An advance indication at the panel specifies the sensor address, allowing for selected maintenance to be performed as needed.

Analog Addressable Low-Flow Duct Sensor



ADPF



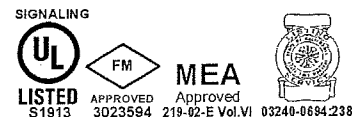
ADPRF

Features

- Air velocity rating from 100 to 4,000 feet per minute (0.5 to 20.32 m/sec.)
- Patented telescopic sampling tube
- Easily accessible code switches
- Outside mounting tabs
- Easy and quick mounting to round or rectangular ducts from 1'-12' (0.3-3.7 meters) wide
- Easy to clean
- UL recognized field-replaceable power and sensor boards
- Transparent cover for convenient visual inspection. Bi-color LEDs flash green whenever the sensor is addressed, and light steady red on alarm

*Note: Only the red LED is operative in panels that do not operate in Velociti mode.

An ISO 9000-2000 Company



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GAMEWELL-FCI

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Description (continued)

Remote alarm annunciation can be accomplished by using the RA400Z remote annunciator or the RTS451 or RTS451KEY remote test station. Both these devices allow testing of the sensor from a remote location.

ADPF low-flow duct sensors are designed for simplified installation and easy maintenance. The modular construction allows for easy cleaning and uncomplicated field replacement of the UL recognized power and sensor boards.

The ADPF (non-relay) has outputs for a remote LED display and remote test switch. It incorporates zener diodes to conserve power for communications to other devices. The ADPF is a 2-wire device that requires signaling line circuit power only.

The ADPRF (with relay) has powered outputs for remote LED indication with a remote test switch and audible sounder. Two form "C" auxiliary contacts can be configured as a relay version or jumpered to mimic the non-relay version. It has a patented cover tamper trouble signal. The ADPRF is a 4-wire device that requires both signaling line circuit power and either 24VAC/DC or 120/240VAC for proper operation.

Specifications

Operating Temperature	32° to 131° F (0° to 55° C)
Operating Humidity	10 to 93% relative humidity
Range:	(non-condensing)
Storage Temperature	-22° to 158° F
Range:	(-30° to +70° C)
Duct Air Velocity:	100-4000 ft./min. (0.5—20.32 m/s)
Shipping Weight:	ADPF: 3.35 lbs. (1.5 kg) ADPRF: 3.90 lbs. (1.8 kg)
Dimensions	
Length:	14 3/4" (37 cm)
Width:	5 1/2" (14 cm)
Depth:	2 3/4" (7 cm)

Model ADPF (Non-relay)

Voltage Range:	15 to 32 VDC
Standby Current:	300 µA @ 24 VDC (one communication every 5 seconds with LED flash enabled)

Model ADPRF (with Relay)

Current Requirements (using no accessories)

Power				
Supply Voltage:	20-30 VDC	30 VAC,	120 VAC,	22/240 VAC,
		50-60 Hz	50-60 Hz	50-60 Hz
Max. Standby				
Current:	26 mA	65 mA RMS	44 mA RMS	25 mA RMS
Max. Alarm				
Current:	87 mA	182 mA RMS	52 mA RMS	30 mA RMS
Alarm Response				
Time:	3 to 10 sec.	3 to 10 sec.	3 to 10 sec.	3 to 10 sec.

Auxiliary Relay Contact Ratings

Alarm auxiliary contacts* (DPDT):

10 A @ 30 VDC
10 A @ 277 VAC (0.75 power factor)
240 VA @ 249 VAC (0.4 power factor)
1/8 HP @ 120 VAC
1/4 HP @ 240 VAC

Supervisory contact (SPST):

2.0 A @ 30 VDC (resistive)

Minimum switching current for auxiliary contact must be 100 mA DC minimum @ 5 VDC.

Accessory Current Loads at 24 VDC

Device	Standby	Alarm
PA400	0 mA	15 mA Max.
RA400Z	0 mA	12 mA Max.
RTS451/	0 mA	10 mA Max.
RTS451KEY		

Ordering Information

Part Number Description

ADPF	Analog addressable low-flow photoelectric non-relay duct smoke sensor
ADPRF	Analog addressable low-flow photoelectric with relay duct smoke sensor
ST-1.5	Sampling tube duct widths 1'-2'
ST-3	Sampling tube duct widths 2'-4'
ST-5	Sampling tube duct widths 4'-8'
ST-10	Sampling tube duct widths 8'-12'
A5060	Replacement power board for ADPF-RF (w/relay)
A5067	Replacement power board for ADPF (w/o relay)

Accessories Description

RTS451	Remote test station
RTS451KEY	Remote test station w/key
RA400Z	Remote LED
F36-09-11	Replacement filters
M02-04-00	Test magnet
P48-21-00	End cap of metal sampling tube
P48-61-00	End cap for plastic sampling tube
S08-39-01	Replacement photo insect screen

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by Honeywell

Velociti™ Series ASD-PL2F and ASD-PTL2F

Description

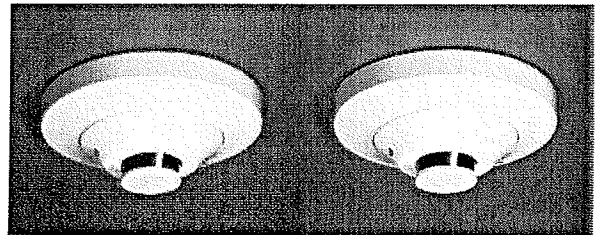
The FCI Velociti™ Series, analog addressable plug-in smoke sensors with integral communication provide features that surpass conventional sensors. Sensitivity can be programmed in the control panel software, and is continuously monitored and reported to the panel. Point ID capability allows each sensor's address to be set, providing exact locations for selective maintenance when the chamber contamination reaches an unacceptable level. The ASD-PL2F photoelectric sensor's unique optical sensing chamber is engineered to sense smoke produced by a wide range of combustion sources. Dual electronic thermistors add 135°F (57°C) fixed-temperature thermal sensing on the ASD-PTL2F model.

The Velociti™ Series use a communication protocol that substantially increases the speed of communication between the sensors and certain FCI analog addressable fire alarm controls. These devices operate in a grouped fashion. If one of the devices in the group has a status change, the panel's microprocessor stops the group poll and concentrates on the single device. The net effect is a response speed up to five times greater than earlier designs.

Ordering Information

Model	Description
ASD-PL2F	Analog, addressable photoelectric smoke sensor
ASD-PTL2F	Analog, addressable photoelectric smoke sensor with thermal sensing

Analog, Addressable
Photoelectric
Smoke Sensor



ASD-PL2F

ASD-PTL2F

Features

- Sleek, low-profile design.
- Visual rotary switch addressing.
- Built-in functional test switch activated by an external magnet.
- Bicolor LEDs flash green whenever the sensor is addressed, and light steady red on alarm*.
- Optional relay, isolator, or sounder bases.
- Low standby current.
- Analog addressable communication.
- Stable communication technique with noise Immunity.
- Optional remote, single-gang LED Indicator (RA400Z).
- Suitable for installation in ducts.

Note: *Only the red LED is operative in panels that do not operate in Velociti™ mode.

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SIGNALING



LISTED
S1913



APPROVED
3023594

ME A

Approved
219-02-E Vol. VI



07272-0694;263

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Installation

ASD-PL2F plug-in sensors use a separate base to simplify installation, service, and maintenance. A special tool allows maintenance personnel to plug-in and remove sensors without using a ladder.

Mount the base on a box which is at least 1.5" (3.8 cm) deep. Suitable mounting base boxes include:

- 4.0" (10.2 cm) square box.
- 3.5" (8.9 cm) or 4.0" (10.2 cm) octagonal box.
- Single-gang box (except relay or isolator bases).
- With B501BH or B501BHT base, use a 4.0" (10.2 cm) square box.
- With B224RB or B224BI base, use a 3.5" (8.9 cm) octagonal box, or a 4.0" (10.2 cm) octagonal or square box.

NOTE: Because of the inherent supervision provided by the SLC, end-of-line resistors are not required. Wiring "T-taps" or branches are permitted for Style 4 (Class "B") wiring.

Sensor Spacing

FCI recommends spacing sensors in compliance with NFPA 72. In low airflow applications with smooth ceilings, space sensors 30 feet (9.1 m). For specific information regarding sensor spacing, placement and special applications, refer to NFPA 72.

Specifications

Size:	2.1" (5.1 cm) high x 4.1" (10.4 cm) diameter installed in B501 base, 6.1" (15.5 cm) diameter installed in ADB-FL base.
Shipping Weight:	5.2 oz. (147 g)
Operating Temperature:	ASD-PL2F: 32° F to 120° F (0° C to 49° C) ASD-PTL2F: 32° F to 100° F (0° C to 38° C) Low-temperature signal for ASD-PTL2F: at 45° F (7.22° C) +/- 10° F (5.54° C)
UL-Listed Velocity Range:	0-4000 ft./min. (1,219.2 m/min.), suitable for installation in ducts.
Relative Humidity:	10-93% (non-condensing)
Thermal Ratings:	Fixed-temperature setpoint 135° F (57° C)

Electrical Specifications

Voltage Range:	15 – 32 volts DC peak
Standby Current:	(max. avg.): 300 µA @ 24 VDC (one communication every 5 seconds with LED enabled)
Maximum Alarm Current:	6.5 mA @ 24 VDC (LED) lit).

Bases and Options

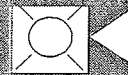
ADB-FL:	6.1" (15.5 cm) diameter
B501:	4.1" (10.4 cm) diameter
B501BH or B501BHT:	Sounder base assembly (B501BHT produces a temporal pattern). Includes B501 base.
B224RB Relay Base:	Screw terminals: Up to 14 AWG (2.0 mm ²) Relay type: Form-C Rating: 2.0A @ 30 VDC resistive; 0.3 A @ 110 VDC inductive; 1.0 A @ 30 VDC inductive. Dimensions: 6.2": (15.7 cm) x 1.2" (3.0 cm)
B524BI Isolator Base:	Dimensions: 6.2" (15.7 cm) x 1.2" (3.0 cm) Maximum: 25 devices between isolator bases.
ra400Z	Remote alarm indicator, LED.
bck-200	Black detector covers (box of 10).

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FIRE ALARM SYSTEMS

Helping People Take Action™

FEATURING

SPEC 1 FIRE™

A Family of Multi-Candela Appliances**

SERIES AS SINGLE & MULTI-CANDELA AUDIBLE STROBE APPLIANCES SERIES AH AUDIBLES

Description

Wheelock's patented 2-wire Series AS Audible Strobe Appliances and Series AH Audibles offer more features with less current draw and Zero Inrush.

Strobe options for wall mount models include 15/75cd or Wheelock's patented Multi-Candela strobe with field selectable candela settings of: 15, 30, 75 or 110cd.

Ceiling mount models are available in 15, 30, 75 or 100cd intensities.

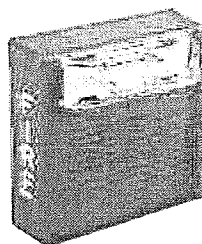
The audible provides a selectable choice of either a continuous horn or temporal pattern (Code 3) when constant voltage from a Fire Alarm Panel (FACP) is applied. Each tone has 3 dBA settings to choose from. Additionally, the audible may be silenced while maintaining strobe activation.

All models may be synchronized when used in conjunction with the Wheelock SM, DSM Sync Modules or the PS-12/24-8 Power Supply with Wheelock's Patented Sync Protocol.

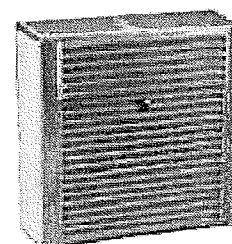
Synchronization of the continuous horn tone provides the temporal (Code 3) tone as mandated by NFPA-72 for all audible appliances. This ensures a distinct temporal (Code 3) pattern when 2 or more audibles are within hearing distance. If not synchronized, the temporal sound may overlap and not be distinctive. At the same time, the strobes will also be synchronized. This provides the ability to comply with ADA recommendations concerning photosensitive epilepsy and NFPA and UFC standards when installing two or more visual appliances within the field of view.

All of this, plus the ability to silence the audible is achieved by using only 2 WIRES.

For Weatherproof Series AS, See Datasheet S9004



SERIES AS




SERIES AH




Multi-Candela Indicator
(bottom of lens)

Features

- Approvals include: UL Standard 1971, UL Standard 464, California State Fire Marshal (CSFM), New York City (MEA), and Factory Mutual (FM) Pending; Chicago (BFP).
- ADA/NFPA/UFC/ANSI Compliant.
- Wall mount models are available with Field Selectable Candela Settings of 15, 30, 75 or 110cd (Multi-Candela models) or 15/75cd.
- Weatherproof wall mount UL Listed for outdoor use (ASWP)
- Ceiling mount models are available in 15, 30, 75 or 100cd.
- Selectable Continuous Horn or Temporal (Code 3).
- 3 Selectable dBA settings (99, 95 and 90 dBA) in both tones.
- Patented 2-Wire Audible Strobe Appliance.
- Patented Universal Mounting Plate.
- Strobes produce 1 flash per second over the regulated voltage range.
- 12 and 24 VDC models with wide UL "Regulated Voltage" using filtered DC or unfiltered VRMS input voltage.
- Wall Mount or Ceiling Mount models.
- Synchronize with Wheelock SM, DSM or PS-12/24-8 Power Supply with Wheelock's built-in sync protocol.
- ZERO Inrush above Peak.
- Compatible with all Wheelock 2-Wire products.
- Fast installation with IN / OUT screw terminals using #12 to #18 AWG wires.

NOTE: All CAUTIONS and WARNINGS are identified by the symbol . All warnings are printed in bold capital letters.

 **WARNING:** PLEASE READ THESE SPECIFICATIONS AND ASSOCIATED INSTALLATION INSTRUCTIONS CAREFULLY BEFORE USING, SPECIFYING OR APPLYING THIS PRODUCT. FAILURE TO COMPLY WITH ANY OF THESE INSTRUCTIONS, CAUTIONS OR WARNINGS COULD RESULT IN IMPROPER APPLICATION, INSTALLATION AND/OR OPERATION OF THESE PRODUCTS IN AN EMERGENCY SITUATION, WHICH COULD RESULT IN PROPERTY DAMAGE, AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.

General Notes

- Strobes are designed to flash at 1 flash per second minimum over the Regulated Voltage Range. Note that NFPA-72 (1999) specifies a flash rate of 1 to 2 flashes per second and ADA Guidelines specify a flash rate of 1 to 3 flashes per second.
- All candela ratings represent minimum effective Strobe intensity based on UL Standard 1971.
- Series AS Strobe products are listed under UL Standard 1971 for indoor use with a temperature range of 32° F to 120° F (0° C to 49° C) and maximum humidity of 93% (± 2%).
- Series AH-24 horns are listed under UL Standard 464 for audible signal appliances (Indoor use only).
- Series AH-24WP audible appliances are listed under UL Standard 464 for indoor/outdoor use with a temperature range of -31°F to 150°F (-35°C to 66°C) and maximum humidity of 95%.
- “Regulated Voltage Range” is the newest terminology used by UL to identify the voltage range. Prior to this change, UL used the terminology “Listed Voltage Range”.

Table 1: Ratings Per UL 1971

Model	Input Voltage VDC	Regulated Voltage Range VDC/FWR	Strobe Candela (cd)
AS-24MCW-FR	24	16.0 - 33.0	15/30/75/110
AS-241575W-FR	24	16.0 - 33.0	15 (75 on Axis)
AS-121575W-FR	12	8.0 - 17.5	15 (75 on Axis)
AS-2415C-FW	24	16.0 - 33.0	15
AS-2430C-FW	24	16.0 - 33.0	30
AS-2475C-FW	24	16.0 - 33.0	75
AS-24100C-FW	24	16.0 - 33.0	100
ASWP-2475W-FR	24	16.0 - 33.0	75 @ -31°F

Table 5: dBA Ratings for 12 VDC and 24 VDC Series AS/AH 12 and 24 VDC Audible

Description	Volume	Reverberant dBA Per UL 464 @ 10 ft.	Anechoic dBA @ 10 ft.
Continuous Horn	High	91	99
	Medium	88	95
	Low	83	90
Code 3 Horn	High	87	99
	Medium	84	95
	Low	79	90

Table 2: Average Current * (AMPS) for AS-24 MC Wall Models @ Each Candela Setting

Average Current-with High dBA Setting (99 dBA)				
Voltage	15cd	30cd	75cd	110cd
16.0 VDC	.095	.142	.242	.308
24.0 VDC	.088	.120	.174	.224
33.0 VDC	.099	.120	.152	.190
Average Current-with Medium dBA Setting (95 dBA)				
16.0 VDC	.081	.128	.225	.296
24.0 VDC	.068	.105	.157	.207
33.0 VDC	.068	.090	.119	.157
Average Current-with Low dBA Setting (90 dBA)				
16.0 VDC	.077	.119	.222	.294
24.0 VDC	.060	.090	.142	.200
33.0 VDC	.055	.081	.109	.147

Table 6: Average Current * (AMPS) for Ceiling Mount 24 V Audible Strobe

At the 3 Audible Settings @ 16, 24, and 33 VDC				
dBA Levels	Models	Voltage		
		16.0 VDC	24.0 VDC	33.0 VDC
Average Current with High dBA Setting (99 dBA)	AS-2415C	.130	.106	.102
	AS-2430C	.178	.135	.131
	AS-2475C	.357	.248	.200
	AS-24100C	.404	.277	.245
Average Current with Medium dBA Setting (95 dBA)	AS-2415C	.116	.091	.079
	AS-2430C	.164	.120	.103
	AS-2475C	.339	.226	.179
	AS-24100C	.389	.258	.217
Average Current with Low dBA Setting (90 dBA)	AS-2415C	.112	.082	.069
	AS-2430C	.160	.113	.095
	AS-2475C	.332	.219	.164
	AS-24100C	.382	.252	.207

Table 3: Average Current * (AMPS) Series AH-24-R/W & AH-12-R/W & WP (Horn only)

VOLTAGE	High	Medium	Low
16.0 VDC	.033	.019	.013
24.0 VDC	.047	.025	.016
33.0 VDC	.066	.033	.020
8.0 VDC	.089	.035	.029
12.0 VDC	.103	.047	.033
17.5 VDC	.122	.066	.040

Table 4: Average Current * (AMPS) Series AS-241575

VOLTAGE	High	Medium	Low
16.0 VDC	.124	.108	.103
24.0 VDC	.102	.083	.077
33.0 VDC	.100	.077	.067

Table 7: Average Current * (AMPS) for Wall 15/75 cd 12 V Audible Strobe

At the 3 Audible Settings @ 8, 12, & 17.5				
dBA Level	Model	Voltage		
		8.0 VDC	12.0 VDC	17.5 VDC
Average Current with High dBA (99 dBA)	AS-121575W	.408	.256	.251
Average Current with Medium dBA (95 dBA)	AS-121575W	.354	.217	.182
Average Current with Low dBA (90 dBA)	AS-121575W	.348	.194	.162

SYNC MODULES / POWER SUPPLY

Model Number	Order Code	Input Voltage (VDC)	Average Current (AMPS) @ 24 VDC	Mounting Options**
SM-12/24-R ¹	6369	24	.028	W
DSM-12/24-R ²	6374	24	.035	W
PS-12/24-8 ³	8114	120 VAC	-	-

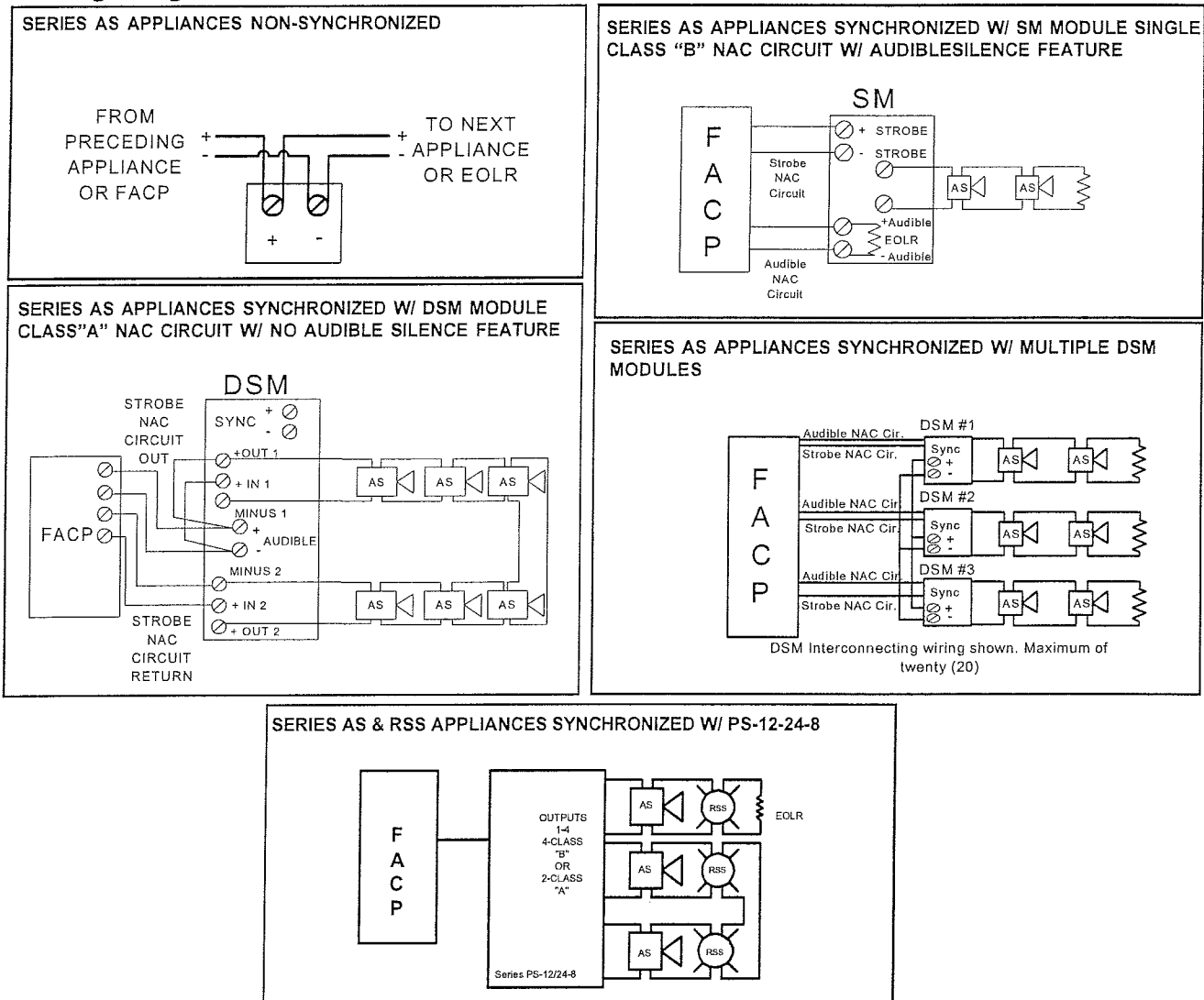
#SM Sync Module is rated for 3.0 amperes @ 24 VDC.
 ##DSM Sync Module is rated for 3.0 amperes per circuit. The maximum number of interconnected DSM modules is twenty (20). Refer to Data Sheet S3000 or Installation Instructions P83123 for SM and P83177 for DSM.
 ###Refer to Data Sheet S9001 or Installation Instructions P83862 for PS-12/24-8 Power Supply.

* Average Current per actual Wheelock Production Testing at listed VDC. For Rated Average and Peak current across UL Regulated Voltage Range for both Filtered DC and Unfiltered VRMS, see Installation Instructions.
 ** Refer to Data Sheet S7000 for Mounting Options.

WARNING: CONTACT WHELOCK FOR THE CURRENT "INSTALLATION INSTRUCTIONS" (P83947) SERIES AS-24MCW, (P84023 AND P84024) SERIES AS SINGLE CANDELA, (P83519) Series AH, (P83641) Series AH-WP AND "GENERAL INFORMATION" SHEET (P82380) ON THESE PRODUCTS. THESE DOCUMENTS UNDERGO PERIODIC CHANGES. IT IS IMPORTANT THAT YOU HAVE CURRENT INFORMATION ON THESE PRODUCTS. THESE MATERIALS CONTAIN IMPORTANT INFORMATION THAT SHOULD BE READ PRIOR TO SPECIFYING OR INSTALLING THESE PRODUCTS, INCLUDING:

- TOTAL CURRENT REQUIRED BY ALL APPLIANCES CONNECTED TO SYSTEM SECONDARY POWER SOURCES.
- FUSE RATINGS ON NOTIFICATION APPLIANCE CIRCUITS TO HANDLE PEAK CURRENTS FROM ALL APPLIANCES ON THOSE CIRCUITS.
- ADDING, REPLACING OR CHANGING APPLIANCES OR CHANGING CANDELA SETTINGS WILL EFFECT CURRENT DRAW. RECALCULATE CURRENT DRAW TO INSURE THAT THE TOTAL AVERAGE CURRENT AND TOTAL PEAK REQUIRED BY ALL APPLIANCES DO NOT EXCEED THE RATED CAPACITY OF THE POWER SOURCE OR FUSES.
- COMPOSITE FLASH RATE FROM MULTIPLE STROBES WITHIN A PERSON'S FIELD OF VIEW.
- THE VOLTAGE APPLIED TO THESE PRODUCTS MUST BE WITHIN THEIR "REGULATED VOLTAGE RANGE".
- INSTALLATION OF 110 CANDELA STROBE PRODUCTS IN SLEEPING AREAS.
- INSTALLATION IN OFFICE AREAS AND OTHER SPECIFICATION AND INSTALLATION ISSUES.
- THESE APPLIANCES ARE NOT DESIGNED TO BE USED ON CODED SYSTEMS IN WHICH THE APPLIED VOLTAGE IS CYCLED ON AND OFF.
- FAILURE TO COMPLY WITH THE INSTALLATION INSTRUCTIONS OR GENERAL INFORMATION SHEETS COULD RESULT IN IMPROPER INSTALLATION, APPLICATION, AND/OR OPERATION OF THESE PRODUCTS IN AN EMERGENCY SITUATION, WHICH COULD RESULT IN PROPERTY DAMAGE AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.
- CONDUCTOR SIZE (AWG), LENGTH AND AMPACITY SHOULD BE TAKEN INTO CONSIDERATION PRIOR TO DESIGN AND INSTALLATION OF THESE PRODUCTS, PARTICULARLY IN RETROFIT INSTALLATIONS.

Wiring Diagrams



For detail using SM or DSM Sync Module refer to Data Sheet S3000 or Installation Instructions P83123 for SM and P83177 for DSM. For wiring information on the PS-12/24-8 Power Supply refer to Installation Instructions P83862.

Wheelock products must be used within their published specifications and must be PROPERLY specified, applied, installed, operated, maintained and operationally tested in accordance with their installation instructions at the time of installation and at least twice a year or more often and in accordance with local, state and federal codes, regulations and laws. Specification, application, installation, operation, maintenance and testing must be performed by qualified personnel for proper operation in accordance with all of the latest National Fire Protection Association (NFPA), Underwriters' Laboratories (UL), National Electrical Code (NEC), Occupational Safety and Health Administration (OSHA), local, state, county, province, district, federal and other applicable building and fire standards, guidelines, regulations, laws and codes including, but not limited to, all appendices and amendments and the requirements of the local authority having jurisdiction (AHJ).

Architects and Engineers Specifications

The notification appliances shall be Wheelock Series AS Audible Strobe appliances and Series AH Audible appliances or approved equals. The Series AS Audible Strobe shall meet and be listed for UL Standard 1971 (Emergency Devices for the Hearing-Impaired) for Indoor Fire Protection Service. The Series AH Audible shall be UL Listed under Standard 464 (Fire Protective Signaling). The audible/strobe shall be listed for indoor use and both shall meet the requirements of FCC Part 15 Class B. All inputs shall be compatible with standard reverse polarity supervision of circuit wiring by a Fire Alarm Control Panel (FACP).

The audible portion of the appliance shall have a minimum of three (3) field selectable settings for dBA levels and shall have a choice of continuous or temporal (Code 3) audible outputs.

The strobe portion of the appliance shall produce a flash rate of one (1) flash per second over the Regulated Voltage Range and shall incorporate a Xenon flashtube enclosed in a rugged Lexan® lens. The Series AS shall be of low current design and shall have Zero Inrush. Where wall mount, Multi-Candela appliances are specified, the strobe intensity shall have a minimum of four (4) field selectable settings and shall be rated per UL Standard 1971 for: 15, 30, 75 or 110 candela. The selector switch for selecting the candela shall be tamper resistant and not accessible from the front of the appliance. The 15/75 candela strobe shall be specified when 15 candela UL Standard 1971 Listing with 75 candela on-axis is required (e.g. ADA compliance). For ceiling mount applications, the strobe intensity shall be 15, 30, 75 or 100 candela.

When synchronization is required, the appliance shall be compatible with Wheelock's SM, DSM Sync Modules or Wheelock's PS-12/24-8 Power Supply with built-in Patented Sync Protocol. The strobes shall not drift out of synchronization at any time during operation. If the sync module or Power Supply fails to operate, (i.e., contacts remain closed), the strobe shall revert to a non-synchronized flash-rate. The appliance shall also be designed so that the audible signal may be silenced while maintaining strobe activation.

The Series AS Audible Strobe and Series AH Audible shall incorporate a Patented Universal Mounting Plate that shall allow mounting to a single-gang, double-gang, 4-inch square, 100mm European type backboxes, or the SHBB Surface Backbox. If required, an NATP (Notification Appliance Trimplate) shall be provided.

All notification appliances shall be backward compatible.

Specifications and Ordering Information

Model	Order Code	Strobe Candela	Non-Sync	Sync w/SM, DSM or PS-12/24-8	24 VDC	12 VDC	Wall Mount	Ceiling Mount	Mounting Options*
AS-24MCW-FR	9024	15/30/75/110	X	X	X	-	X	-	AB,D,E,F,G,H,J,N,O,R,X
AS-24MCW-FW	9025	15/30/75/110	X	X	X	-	X	-	AB,D,E,F,G,H,J,N,O,R,X
AS-241575W-FR	7405	15 (75 on Axis)	X	X	X	-	X	-	AB,D,E,F,G,H,J,N,O,R,X
AS-121575W-FR	7410	15 (75 on Axis)	X	X	-	X	X	-	AB,D,E,F,G,H,J,N,O,R,X
AS-2415C-FW	7411	15	X	X	X	-	-	X	AB,D,E,F,G,H,J,N,O,R,X
AS-2430C-FW	7412	30	X	X	X	-	-	X	AB,D,E,F,G,H,J,N,O,R,X
AS-2475C-FW	7413	75	X	X	X	-	-	X	AB,D,E,F,G,H,J,N,O,R,X
AS-24100C-FW	7414	100	X	X	X	-	-	X	AB,D,E,F,G,H,J,N,O,R,X
ASWP-2475W-FR**	9012	75 @ -31°F	X	X	X	-	X	-	I (see Data Sheet S9004)
AH-24-R	7892	-	X	X	X	-	X	X	AB,D,E,F,G,H,J,N,O,R,X
AH-12-R	7891	-	X	X	-	X	X	X	AB,D,E,F,G,H,J,N,O,R,X
AH-24WP-R**	7416	-	X	X	X	-	X	X	K
AH-12WP-R**	7415	-	X	X	-	X	X	X	K

*Refer to Data Sheet S7000 for Mounting Options.

**For Weatherproof Series AS/AH specifications see data sheet S9004.

Note: Models are available in either Red or White. Contact Customer Service for Order Code and Delivery.

NOTE: Due to continuous development of our products, specifications and offerings are subject to change without notice in accordance with Wheelock Inc. standard terms and conditions.

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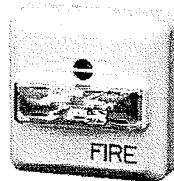
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Distributed By:

Series ZRS Strobes, ZNS Horn Strobes and Series ZNH Horns



Series ZNS



Series ZNH



Series ZRS



Series ZRS

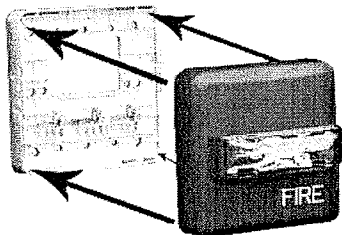
Description:

The Wheelock Series Z notification appliances feature an easy snap on base that is designed to simplify the installation and testing of horns, strobes, and horn/strobes. The separate Series Z snap on base can be pre-wired so circuit wiring can be fully tested before the appliance is installed and before the walls are covered. Once all surrounding work is complete, the appliance can be simply installed by snapping it on the base. Shorting contacts in the base, which provide continuity for circuit testing, are permanently opened when the appliance is installed so any subsequent removal of the appliance will indicate a trouble condition on that circuit at the control panel when circuit supervision is enabled. The same base is used for all Series Z horns, strobes and horn/strobes to provide consistent installation and easy replacement of appliances if required. A locking screw is also included for the appliance to provide extra secure installation.

The Wheelock Series Z appliances incorporate the same dependable circuitry and high efficiency optics that are used in Wheelock RSS strobes, NS horn/strobes and NH horns and have the same high performance ratings. The Series Z appliances are compatible with all UL listed "Regulated" panels and all panels that are compatibility listed with Wheelock RSS, NS and NH appliances.

Features:

- Approvals include: UL Standard 1971, UL Standard 464, New York City (MEA), California State Fire Marshal (CSFM), Factory Mutual (FM) and Chicago (BFP). See approvals by model number in Specifications and Ordering Information
- ADA/NFPA/UFC/ANSI and OSHA 29, Part 1910, 165 compliant
- EZ Mount SNAP design, with separate base plate, provides ability to pre-wire the base and test the circuit wiring before the walls are covered
- The base plate is protected by a disposable cover and the appliances can quickly snap onto the base after the walls are painted.
- Patented EZ Mount Universal Mounting Plate (ZBASE) – uses single plate for ceiling and wall mount installations
- Wall Mount models feature field selectable candela settings of 15/30/75/110cd and 135/185cd
- Ceiling Mount models feature field selectable candela settings of 15/30/75/95cd and 115/177cd
- Strobes can be synchronized using the Wheelock sync modules or power supplies with built-in sync protocol
- 12 and 24 VDC models with UL "Regulated Voltage" using filtered DC or unfiltered VRMS input voltage
- Strobes produce 1 flash per second over the "Regulated Voltage" range (ZNS, ZRS models)
- Selectable Continuous Horn or Temporal (Code-3) Tones with selectable 90 or 95 dBA setting (ZNH, ZNS models)
- Selectable 12 or 24VDC in 1 appliance (ZNH model)



ZNS, ZNH and ZRS appliances go onto the base plate in a SNAP.



NOTE: All CAUTIONS and WARNINGS are identified by the symbol **▲**. All warnings are printed in bold capital letters.

▲ WARNING: PLEASE READ THESE SPECIFICATIONS AND ASSOCIATED INSTALLATION INSTRUCTIONS CAREFULLY BEFORE USING, SPECIFYING OR APPLYING THIS PRODUCT. VISIT WWW.COOPERWHEELLOCK.COM OR CONTACT COOPER WHEELLOCK FOR THE CURRENT INSTALLATION INSTRUCTIONS. FAILURE TO COMPLY WITH ANY OF THESE INSTRUCTIONS, CAUTIONS OR WARNINGS COULD RESULT IN IMPROPER APPLICATION, INSTALLATION AND/OR OPERATION OF THESE PRODUCTS IN AN EMERGENCY SITUATION, WHICH COULD RESULT IN PROPERTY DAMAGE, AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.

General Notes:

- Strobes are designed to flash at 1 flash per second minimum over their "Regulated Voltage Range".
- All candela ratings represent minimum effective strobe intensity based on UL Standard 1971.
- Series ZNS Strobe products are listed under UL Standards 1971 and 464 for indoor use with a temperature range of 32°F to 120°F (0°C to 49°C) and maximum humidity of 93% (± 2%).
- Series ZNH horns are listed under UL Standard 464 for audible signal appliances (Indoor use only).
- "Regulated Voltage Range" is the newest terminology used by UL to identify the voltage range. Prior to this change UL used the terminology "Listed Voltage Range".

Table 1: Series ZNS Ratings Per UL Standard 1971

Model	Input Voltage VDC	Regulated Voltage Range VDC/FWR	Strobe Candela (CD)
ZNS-MCW	24	16.0 - 33.0	15/30/75/110
ZNS-MCWH	24	16.0 - 33.0	135/185
ZNS-MCC	24	16.0 - 33.0	15/30/75/95
ZNS-MCCH	24	16.0 - 33.0	115/177

Table 2: Series ZNS/ZNH Horn dBA Ratings

Description	Volume	Reverberant dBA @ 10ft per UL 464		Anechoic dBA @ 10 ft	
		12 VDC	24 VDC	12 VDC	24 VDC
Continuous Horn	High	83	87	89	95
	Low	76	81	84	90
Code 3 Horn	High	79	82	89	95
	Low	72	76	84	90

Table 3: Series ZNS UL Max. Current*

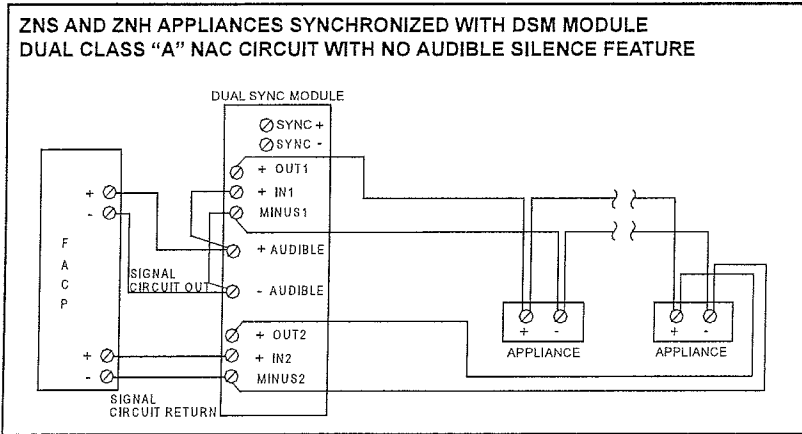
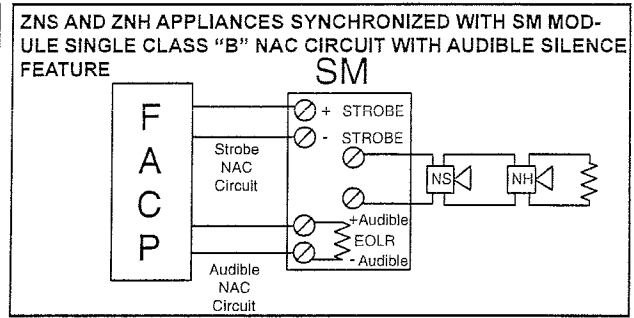
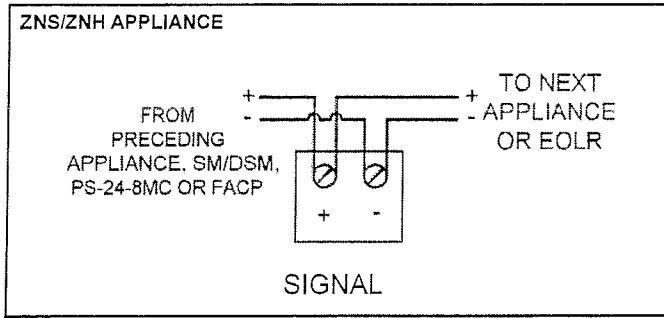
Series ZNS/ZNH 24 VDC		Audible ZNH-12/24	Wall Mount Strobe Models						Ceiling Mount Strobe Models							
			ZNS-MCW				ZNS-MCWH		ZNS-MCC				ZNS-MCCH			
			15cd	30cd	75cd	110cd	135cd	185cd	15cd	30cd	75cd	95cd	115cd	177cd		
High (95) dBA	16-33 VDC	0.044	0.074	0.107	0.184	0.244	0.350	0.477	0.082	0.124	0.209	0.275	0.350	0.477		
Low (90) dBA		0.018	0.066	0.101	0.177	0.232	0.306	0.429	0.071	0.114	0.201	0.261	0.306	0.429		
Series ZNS/ZNH 12VDC		Audible ZNH-12/24														
			High (89) dBA	8-17.5 VDC	0.021											
			Low (84) dBA		0.012											

Table 4: Series ZRS UL Max. Current*

ZRS 24VDC Models	ZRS - Wall Mount						ZRS - Ceiling Mount					
	MCW				MCWH		MCC				MCCH	
	15cd	30cd	75cd	110cd	135cd	185cd	15cd	30cd	75cd	95cd	115cd	177cd
16-33 vdc	0.060	0.092	0.165	0.220	0.300	0.420	0.065	0.105	0.189	0.249	0.300	0.420

* UL max current rating is the maximum RMS current within the listed voltage range (16-33v for 24v units). For strobes the UL max current is usually at the minimum listed voltage (16v for 24v units). For audibles the max current is usually at the maximum listed voltage (33v for 24v units). For unfiltered FWR ratings, see installation instructions.

Wiring Diagrams#



NOTE: ZNS/ZNH must be set on Code-3 horn tone to achieve synchronized temporal (Code-3) tone. Refer to installation instruction (P83983, P83600 respectively).

* For detail using SM or DSM Sync Module refer to Data Sheet S3000 or Installation Instructions P83123 for SM and P83177 for DSM. For wiring information on the power supplies refer to Installation Instructions P84662 for PS-24-8MC.

SPECIFICATION & ORDERING INFORMATION

Model Number	Order Code	Strobe Candela	Sync w/ SM, DSM or PS-24-8MC	24 VDC	12 VDC	Mounting Options#	Agency Approvals				
							UL	MEA	CSFM	FM	BFP
ZNS-MCW-FR	0304	15/30/75/110	X	X	-	B, D, E, F	X	*	X	*	*
ZNS-MCW-FW	0305	15/30/75/110	X	X	-	B, D, E, F	X	*	X	*	*
ZNS-MCWH-FR	0306	135/185	X	X	-	B, D, E, F	X	*	X	*	*
ZNS-MCWH-FW	0307	135/185	X	X	-	B, D, E, F	X	*	X	*	*
ZNH-R	0300	-	X	X	X	B, D, E, F	X	*	X	*	*
ZNH-W	0301	-	X	X	X	B, D, E, F	X	*	X	*	*
ZNS-MCC-FR	0310	15/30/75/95	X	X	-	B, D, E, F	X	*	X	*	*
ZNS-MCC-FW	0311	15/30/75/95	X	X	-	B, D, E, F	X	*	X	*	*
ZNS-MCCH-FR	0312	115/177	X	X	-	B, D, E, F	X	*	X	*	*
ZNS-MCCH-FW	0313	115/177	X	X	-	B, D, E, F	X	*	X	*	*
ZRS-MCW-FR	4085	15/30/75/110	X	X	-	B, D, E, F	X	*	X	*	*
ZRS-MCW-FW	0302	15/30/75/110	X	X	-	B, D, E, F	X	*	X	*	*
ZRS-MCWH-FR	5242	135/185	X	X	-	B, D, E, F	X	*	X	*	*
ZRS-MCWH-FW	0303	135/185	X	X	-	B, D, E, F	X	*	X	*	*
ZRS-MCC-FW	0309	15/30/75/95	X	X	-	B, D, E, F	X	*	X	*	*
ZRS-MCC-FR	0308	15/30/75/95	X	X	-	B, D, E, F	X	*	X	*	*
ZRS-MCCH-FR	5240	115/177	X	X	-	B, D, E, F	X	*	X	*	*
ZRS-MCCH-FW	0314	115/177	X	X	-	B, D, E, F	X	*	X	*	*
ZBASE	5268	Accessory - Includes base, dust cover, mounting screws and installation sheet									

*Pending

#The ZRS, ZNS and ZNH will mount to single-gang, double-gang, 4" octal, 4" square and 3-1/2" octal back boxes.

NOTE: Due to continuous development of our products, specifications and offerings are subject to change without notice in accordance with Wheelock Inc. standard terms and conditions.

ARCHITECTS AND ENGINEERS SPECIFICATIONS

General

Audible/visual notification appliances shall be listed for indoor use and shall meet the requirements of FCC Part 15 Class B. These appliances shall be listed under UL Standard 1971, (Standard for Safety Signaling Devices for Hearing Impaired) and UL Standard 464 (Fire Protective Signaling). The appliances shall use a Patented Universal EZMount backplate that shall allow mounting to a single-gang, double-gang, 4-inch square, 4" octal, or a 3-1/2" octal backbox. Two wire appliance wiring shall be capable of directly connecting to the mounting back plate. Continuity checking of the entire NAC circuit prior to attaching any audible/visual notification appliances shall be allowed. A dust cover shall fit and protect the mounting plate. The dust cover shall be easily removed when the appliance is installed over the backplate. Removal of an appliance shall result in an alarm condition by the Fire Alarm Control Panel (FACP).

Strobes

Strobe appliances shall produce a minimum flash rate of 60 flashes per minute (1 flash per second) over the Regulated Voltage Range of 16 to 33 VDC and shall incorporate a Xenon flashtube enclosed in a rugged Lexan lens. The strobes shall be available with two or four field selectable settings in one unit and shall be rated, per UL 1971, for up to 185 cd for wall mounting and 177 cd for ceiling mounting. The strobes shall operate over an extended temperature range of 32°F to 120°F (0°C to 49°C) and be listed for maximum humidity of 95% RH. Strobe inputs shall be polarized for compatibility with standard reverse polarity supervision of circuit wiring by a Fire Alarm Control Panel (FACP).

Audibles and Audible/Strobe Combinations

Horns and horn/strobes shall be listed for Indoor use under UL Standard 464. The horns shall be able to produce a continuous output or a temporal code-3 output that can be synchronized. The horns shall have at least 2 sound level settings of 90 and 95 dBA.

Synchronization Modules

When synchronization of strobes or temporal Code-3 audibles is required, the appliances shall be compatible with the Wheelock Series SM and DSM Sync Modules or the Wheelock PS-24-8MC Power Supply with built-in, patented sync protocol. The strobes shall not drift out of synchronization at any time during operation. Audibles and strobes shall be able to be synchronized on a 2-wire circuit with the capability to silence the audible if required. If the sync module or power supply fails to operate (i.e., contacts remain closed), the strobes shall revert to a non-synchronized flashrate



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Thank you for using our products.

**INSTALLATION INSTRUCTIONS
 SERIES Z 2-WIRE FIELD SELECTABLE HORN,
 STROBE, AND HORN/STROBE APPLIANCES
 (WALL AND CEILING MOUNT)**

Use this product according to this instruction manual. Please keep this instruction manual for future reference.

GENERAL:

The Cooper Wheelock Series Z horn, strobe, and horn/strobe appliances are designed for easy installation. The ZNS horn/strobes and ZRS strobes are for 24V operation and the ZNH horn is for 12V or 24V operation. The appliance comes in two main parts. The universal mounting back plate allows the appliance to be mounted to a single-gang, double-gang, four square backbox, 4" octagon backbox, or a 3 1/2" octagon backbox. Two wire appliance wiring is then connected to the mounting back plate. This allows a continuity check of the entire NAC circuit before any appliances are attached. It also allows the appliances to be installed after all finish work has been completed. The installer can snap or install the appliances when all other work is complete.

⚠ WARNING: PLEASE READ THESE INSTRUCTIONS CAREFULLY BEFORE USING THIS PRODUCT. FAILURE TO COMPLY WITH ANY OF THE FOLLOWING INSTRUCTIONS, CAUTIONS AND WARNINGS COULD RESULT IN IMPROPER APPLICATION, CANDELA SETTING, INSTALLATION AND/OR OPERATION OF THESE PRODUCTS IN AN EMERGENCY SITUATION, WHICH COULD RESULT IN PROPERTY DAMAGE AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.

SPECIFICATIONS:

Table 1: Models and Settings

Model	Regulated Voltage (VDC/VRMS)	Voltage Range Limit per UL 1971 (VDC/VRMS)	Strobe (cd)	Horn	Current Draw See Table	Mounting
ZRS-MCW	24	16-33	15/30/75/110	-	3	Wall
ZRS-MCWH	24	16-33	135/185	-	3	Wall
ZRS-MCC	24	16-33	15/30/75/95	-	3	Wall
ZRS-MCCH	24	16-33	115/177	-	3	Wall
ZNS-MCW	24	16-33	15/30/75/110	X	4	Ceiling
ZNS-MCWH	24	16-33	135/185	X	4	Ceiling
ZNS-MCC	24	16-33	15/30/75/95	X	4	Ceiling
ZNS-MCCH	24	16-33	115/177	X	4	Ceiling
ZNH	12 24	8-17.5 16-33	-	X	5	Wall or Ceiling

Strobe and Horn Strobe Appliances

Cooper Wheelock's Series Horn Appliances provide a selectable Continuous or Code 3 Horn tone when connected directly to the Fire Alarm Control Panel (FACP). They can also provide a synchronized Code 3 Horn tone when used in conjunction with an FACP that incorporates the Wheelock sync protocol, a Wheelock Sync Module, or the Wheelock Power Supply. The Horn Appliances can be field set for High (HI) or Low (LO) dBA sound output. The Horn Appliances are UL Listed under Standard 464 for Audible Signal Appliances. They are listed for indoor use only. These models are designed for use with either filtered DC (VDC) or unfiltered Full-Wave-Rectified (VRMS) input voltage. All inputs are polarized for compatibility with standard reverse polarity supervision of circuit wiring by a FACP. The ZNS Horn/Strobe is for 24V operation only. The ZNH Horn is for 12V or 24V operation.

NOTE: The Code 3 temporal pattern (1/2 second on, 1/2 second off, 1/2 second on, 1/2 second off, 1/2 second on, 1-1/2 off and repeat) is specified by ANSI and NFPA 72 for standard emergency evacuation signaling. The Code 3 Horn should be used only for fire evacuation signaling and not for any other purpose.

Table 2: ZNH and ZNS Horn Reverberant dBA per UL464

		ZNH at 12V			ZNS and ZNH at 24V		
		8.0V	12V	17.5V	16.0V	24V	33.0V
Continuous Horn	High	78	83	86	83	87	90
	Low	72	76	80	77	81	83
Code 3 Horn	High	75	79	82	79	82	86
	Low	67	72	74	72	76	79

CURRENT DRAW:

Table 3: ZRS Strobe Current Draw (Amps) at 16-33 Volts

	Strobe Setting (cd)											
	MCW				MCWH		MCC				MCCH	
	15	30	75	110	135	185	15	30	75	95	115	177
DC	0.060	0.092	0.165	0.220	0.300	0.420	0.065	0.105	0.189	0.249	0.300	0.420
FWR	0.102	0.155	0.253	0.347	0.455	0.645	0.110	0.170	0.280	0.375	0.455	0.645

Table 4: ZNS Horn/Strobe Current Draw (Amps) at 16-33 Volts

	Horn Setting	Strobe Setting (cd)											
		MCW				MCWH		MCC				MCCH	
		15	30	75	110	135	185	15	30	75	95	115	177
DC	High*	0.074	0.107	0.184	0.244	0.350	0.477	0.082	0.124	0.209	0.275	0.350	0.477
	Low*	0.066	0.101	0.177	0.232	0.306	0.429	0.071	0.114	0.201	0.261	0.306	0.429
FWR	High*	0.133	0.189	0.285	0.383	0.491	0.681	0.141	0.204	0.312	0.411	0.491	0.681
	Low*	0.116	0.169	0.274	0.369	0.469	0.659	0.124	0.184	0.301	0.397	0.469	0.659

* Current Draw is the same for the Continuous Horn and Code 3 Horn Settings.

Table 5: ZNH Horn Current Draw (Amps)

	Horn Setting	8-17.5 Volts	16-33 Volts
DC	High*	0.021	0.044
	Low*	0.012	0.018
FWR	High*	0.054	0.075
	Low*	0.030	0.045

* Current Draw is the same for the Continuous Horn and Code 3 Horn Settings.

NOTE: Candela and Horn Setting will determine the current draw of the product.

When calculating the total currents use Tables 3-5 to determine the highest value of RMS current for an individual appliance, then multiply these values by the total number of appliances. Be sure to add the currents for any other appliances, including audible signaling appliances powered by the same source, and to include any required safety factors.

NOTE: The maximum number of strobes on a single notification appliance circuit shall not exceed 50.

NOTE: These notification appliances are UL Listed as “Regulated”. They are intended to be used with FACP’s whose notification circuits are UL Listed as “Regulated.” These appliances shall not be used on UL Listed “Special Application” notification circuits unless the appliances are identified to be compatible in the installation instructions of the FACP or unless the FACP is identified to be compatible in this instruction manual.

NOTE: THESE APPLIANCES WERE TESTED TO THE REGULATED VOLTAGE LIMITS OF 16.0-33.0 VOLTS FOR 24V MODELS AND 8-17.5 VOLTS FOR 12V MODELS USING FILTERED DC OR UNFILTERED FULL-WAVE-RECTIFIED VOLTAGE. DO NOT APPLY VOLTAGE OUTSIDE OF THIS RANGE.

NOTE: CHECK THE MINIMUM AND MAXIMUM OUTPUT OF THE POWER SUPPLY AND STANDBY BATTERY AND SUBTRACT THE VOLTAGE DROP FROM THE CIRCUIT WIRING RESISTANCE TO DETERMINE THE APPLIED VOLTAGE TO THE STROBES. THE MAXIMUM WIRE IMPEDANCE BETWEEN STROBES SHALL NOT EXCEED 35 OHMS.

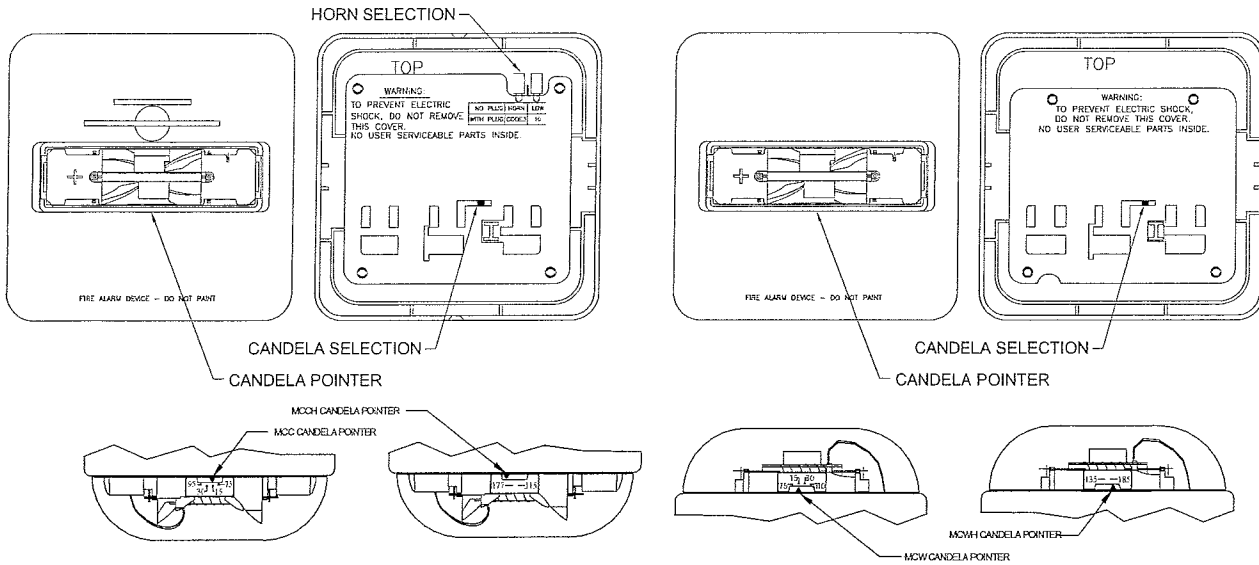
NOTE: Strobes are not designed to be used on coded systems in which the applied voltage is cycled on and off.

NOTE: MAKE SURE THAT THE TOTAL RMS CURRENT REQUIRED BY ALL APPLIANCES THAT ARE CONNECTED TO THE SYSTEM’S PRIMARY AND SECONDARY POWER SOURCES, NOTIFICATION APPLIANCE CIRCUITS, SM, DSM SYNC MODULES, OR COOPER WHELOCK POWER SUPPLIES DOES NOT EXCEED THE POWER SOURCES’ RATED CAPACITY OR THE CURRENT RATINGS OF ANY FUSES ON THE CIRCUITS TO WHICH THESE APPLIANCES ARE WIRED. OVERLOADING POWER SOURCES OR EXCEEDING FUSE RATINGS COULD RESULT IN LOSS OF POWER AND FAILURE TO ALERT OCCUPANTS DURING AN EMERGENCY, WHICH COULD RESULT IN PROPERTY DAMAGE AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.

WIRING AND MOUNTING INFORMATION:

Note: The ZNS and ZNH are factory set for the most common application of High dB and Code 3.

Jumper Plug and Candela Selectors

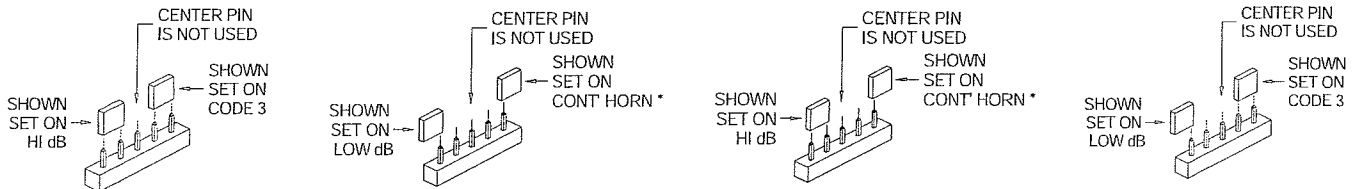


Jumper plug settings for High dB and Code 3.

Jumper plug settings for Low dB and Continuous Horn.

Jumper plug settings for High dB and Continuous Horn.

Jumper plug settings for Low dB and Code 3.



NOTE: Use needle nose pliers to pull and properly set the jumper plugs. No jumper plugs are needed for Continuous Horn and low dB settings. However, it is recommended that the jumper plug be retained in the unit for future use (if needed) as shown.

CAUTION: Check that the installed product will have sufficient clearance and wiring room prior to installing backboxes and conduit, especially if sheathed multiconductor cable or 3/4" conduit fittings are used.

Although the limits shown for each mounting option comply with the National Electrical Code (NEC), Cooper Wheelock recommends use of the largest backbox option shown and the use of approved stranded field wires, whenever possible, to provide additional wiring room for easy installation and minimum stress on the product from wiring.

CAUTION: DO NOT OVER TIGHTEN MOUNTING SCREWS. EXCESSIVE TORQUE CAN DISTORT THE BASE AND MAY AFFECT OPERATION.

Mounting Options:

<p>Figure 1:</p>	<ol style="list-style-type: none"> 1. Install mounting plate as shown in figure 1 to a single-gang, double-gang, 4" square, 4" octagon, or a 3 1/2" octagon backbox with the provided pan head screws. 2. Connect field wiring per figures 2 and 3. 3. Address wires back into backbox. 4. Place dust cover over mounting plate to protect the terminals while performing wiring continuity check. 5. Remove dust cover before snapping or installing the appliance onto the mounting plate per fig 1. 6. Important: Device only has one mounting orientation. Match the top of the base to the top of the device. 7. If it is desired to further secure the device to the base, then two optional screws are provided. To install these screws punch out the screw holes located at the top and bottom of the device. 8. To remove the appliance, press flat screwdriver 1/8" max, into side opening to release snap.
<p>Figure 2:</p>	<p>Figure 3:</p> <ul style="list-style-type: none"> • All strobe appliances have in-out wiring terminals that accepts two #12 to #18 American Wire Gauge (AWG) wires at each screw terminal. Strip leads 3/8 inches and connect to screw terminals. • Break all in-out wire runs on supervised circuits to ensure integrity of circuit supervision as shown in Figure 2. The polarity shown in the wiring diagrams is for the operation of the appliances. The polarity is reversed by the FACP during supervision.

⚠ WARNING: THESE APPLIANCES are a "FIRE ALARM DEVICE - DO NOT PAINT."

⚠ WARNING: WHEN INSTALLING STROBES IN AN OPEN OFFICE OR OTHER AREAS CONTAINING PARTITIONS OR OTHER VIEWING OBSTRUCTIONS, SPECIAL ATTENTION SHOULD BE GIVEN TO THE LOCATION OF THE STROBES SO THAT THEIR OPERATING EFFECT CAN BE SEEN BY ALL INTENDED VIEWERS, WITH THE INTENSITY, NUMBER, AND TYPE OF STROBES BEING SUFFICIENT TO MAKE SURE THAT THE INTENDED VIEWER IS ALERTED BY PROPER ILLUMINATION, REGARDLESS OF THE VIEWER'S ORIENTATION.

⚠ WARNING: INSTALLATION OF COOPER WHEELOCK 135/185 and 115/177 CANDELA STROBE PRODUCTS IN SLEEPING AREAS SHOULD BE WALL MOUNTED AT LEAST 24" BELOW THE CEILING AS FOLLOWS: (1) THE ON-AXIS (DIRECTLY IN FRONT OF LENS) LIGHT OUTPUT SHOULD BE DIRECTED AT THE EYE-LIDS OF THE SLEEPING PERSON, E.G. PILLOW END OF BED, BED HEAD; (2) NO PART OF THE BED SHALL BE MORE THAN SIXTEEN (16) FEET FROM THE STROBE NOTIFICATION APPLIANCE. INSTALLERS MUST ADVISE OWNERS AND OPERATORS OF BUILDINGS WITH SLEEPING OCCUPANTS, E.G. HOTELS AND MOTELS, TO WARN GUESTS, RESIDENTS AND EMPLOYEES TO NOT MOVE THE BED LOCATION TO A POSITION VIOLATING POINTS (1) AND (2) ABOVE OR SERIOUS INJURY AND/OR LOSS OF LIFE MAY OCCUR DURING A FIRE EMERGENCY.

⚠ WARNING: A SMALL POSSIBILITY EXISTS THAT THE USE OF MULTIPLE STROBES WITHIN A PERSON'S FIELD OF VIEW, UNDER CERTAIN CIRCUMSTANCES, MIGHT INDUCE A PHOTO-SENSITIVE RESPONSE IN PERSONS WITH EPILEPSY. STROBE REFLECTIONS IN A GLASS OR MIRRORED SURFACE MIGHT ALSO INDUCE SUCH A RESPONSE. TO MINIMIZE THIS POSSIBLE HAZARD, COOPER WHEELOCK STRONGLY RECOMMENDS THAT THE STROBES INSTALLED SHOULD NOT PRESENT A COMPOSITE FLASH RATE IN THE FIELD OF VIEW WHICH EXCEEDS FIVE (5) Hz AT THE OPERATING VOLTAGE OF THE STROBES. COOPER WHEELOCK ALSO STRONGLY RECOMMENDS THAT THE INTENSITY AND COMPOSITE FLASH RATE OF INSTALLED STROBES COMPLY WITH LEVELS ESTABLISHED BY APPLICABLE LAWS, STANDARDS, REGULATIONS, CODES AND GUIDELINES.

NOTE: NFPA 72/ANSI 117.1 conform to ADAAG Equivalent Facilitation Guidelines in using fewer, higher intensity strobes within the same protected area.

NOTE: Final acceptance is subject to Authorities Having Jurisdiction.

⚠ CAUTION: Check the installation instructions of the manufacturers of other equipment used in the system for any guidelines or restrictions on wiring and/or locating Notification Appliance Circuits (NAC) and notification appliances. Some system communication circuits and/or audio circuits, for example, may require special precautions to assure immunity from electrical noise (e.g. audio crosstalk).

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: 1) Reorient or relocate the receiving antenna, 2) Increase the separation between the equipment and receiver, 3) Connect the equipment into an outlet on a circuit different from that to which the receiver is connected, and 4) Consult the dealer or an experienced radio/TV technician for help.

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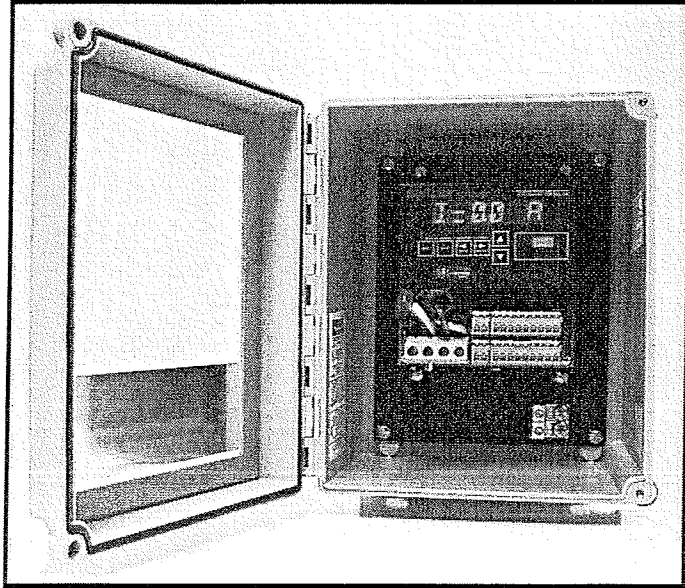
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9/06



DigiTrace™ **910 Series Single Point** **Heat Trace Controller**



FULLY FEATURED

- Compact, fully featured single point Heat-trace Controller
- Compatible with ALL types of heating equipment and cables
- Computer monitoring eliminates need for preventative maintenance
- Full GFI protection - independent Alarm and Trip settings

COST EFFECTIVE

- Per point costs similar to larger multi-point panels
- No need for additional GFI protection devices

VERSATILITY

- Double pole Solid-state or Electro-mechanical relay switching
- Supports both single and 2 pole configurations to a full 30 Amps

RELIABILITY

- Excellent corrosion protection (conformally coated circuitry)
- State of the art surface mount technology

DigiTrace™

Proven performance
and technology for
all of your heat
trace control
applications.

DigiTrace™ 910 Series Heat Trace Controller

HIGHLIGHTS

EVERYTHING YOU NEED IN A SINGLE POINT CONTROLLER:

Each 910 Controller supports one individual heat trace circuit. Terminals are included for low-level signals such as RTDs, alarming and communications, as well as for power wiring.

CHOICE OF OUTPUT DEVICES:

The 910 Series HTC is available in two output types:

- electro-mechanical relay (EMR) output for use in ordinary (non-hazardous) areas, and
- solid-state relay (SSR) output for use in either ordinary or Class I, Div. 2 / Zone 2 hazardous locations.

Ratings of 30A, 120 to 277Vac are standard for both types.

UNIVERSAL DESIGN:

The Controller incorporates a universal power supply (100-277Vac), 50/60Hz support, voltage, current, and ground fault sensing. No other components are required.

INTEGRAL CONSOLE:

Large, easy to read alpha-numeric characters and menu-driven interface eases configuration and eliminates the need for an external programmer. All monitored parameters, programmed values and alarming information are available to the user.

OPTIONAL COMMUNICATIONS:

Communications modules are available for remote monitoring and configuration. A modem version maintaining compatibility with all existing Pyrotenax heat trace controls and upstream devices (GCCs, HHPs, and PyroMaster™ software) may be chosen, or other industry-standard interfaces such as RS-485 and RS-232 may be specified.

VERSATILE MONITORING AND ALARMING:

The Controller monitors and alarms on high or low temperature, voltage, resistance, or load current at user defined levels. Two separate temperature inputs are standard, and both are monitored for open or shorted sensors. The 910 Series Controller also monitors ground fault currents and is suitable for meeting the latest NEC, CEC, and IEEE equipment protection requirements. The user may program separate ground fault alarm and trip levels.

RESISTANCE MONITORING:

This feature provides enhanced functionality over the standard low current alarming when using tracing with constant resistance. The Controller calculates trace resistance in real-time, minimizing nuisance low current alarms when the line voltage fluctuates. This makes for more reliable detection of heating zone loss for constant wattage heating cables.

AUTO-CYCLE™:

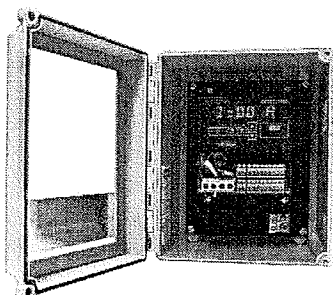
The controller will momentarily energize the circuit at a user defined interval. Circuit alarms will be generated at the time of auto-cycle, rather than only when heat is required. This feature essentially eliminates the requirement for preventative maintenance checks.

REMOTE ENABLE/DISABLE:

In applications where the designer wishes to disable individual or grouped Controllers directly, a remote contact can force the unit(s) into an idle state, where temperature control is disabled, but trace monitoring and alarming functions remain active.

HARSH ENVIRONMENT OPERATION:

Wide temperature range operation plus conformally coated circuitry permits installation in almost any environment. Suitable for use in Class I, Division 2 and Zone 2 hazardous areas (Solid-state output versions only) as well as ordinary (non-hazardous) locations.



DigiTrace™

**Proven performance
and technology for
all of your heat
trace control
applications.**

SPECIFICATIONS AND FEATURES

GENERAL:

Operating Ambient: -40 to +60°C (-40 to +140°F)
Universal 100-277Vac 50/60Hz operation

APPROVALS:



Indicates certification of products meeting both U.S. and Canadian standards

Ordinary locations (SSR and EMR versions)

Class I, Div. 2, Groups A,B,C,D and Ex nA IIA,IIB,IIC (SSR version only) , T-code: T4

TEMPERATURE CONTROL:

(2) 3-wire 100 ohm Platinum ($\alpha=0.00385\Omega/\Omega/^{\circ}C$) RTD inputs

Also supports 2- or 3-wire 100 ohm Nickel-Iron RTD

Open/shorted sensor alarm, lead resistance compensated to 20 ohms per lead

-60 to +570°C (-76 to +1058°F) measurement range

Proportional / Deadband, adjustable from 1 to 50°C (2 to 122°F)

8 Temperature Control Modes

Remote Inhibit/Override Operation

OUTPUT CONTROL:

SSR: 2-pole, 30A @ 120 to 277Vac nominal., 80A 1sec. in-rush, 625A 1 cycle in-rush

EMR: 2-pole, 30A @ 120 to 277Vac nominal.

Adaptive Soft-Starting™ (In-rush current-Limit), Breaker Trip, Output Switch Protection

Programmable Power Limiting, Overcurrent Trip Feature

Adjustable Ground Fault Trip

4 Switch Control Modes including Proportional Ambient Control

AC MEASUREMENTS:

Voltage measurement range: 80 to 295Vac

Current measurement range: 0.3 to 100A (limited by output device)

Ground Fault Current range: 20 to 250ma

ALARMING:

Adjustable HI/LO Temperature, Current, Voltage, and Resistance Alarms

Adjustable HI Ground Fault Alarm

Temperature Sensor, Output Switch, and Communications Failure Alarms

Overcurrent Alarm

Alarm Filtering

Low voltage and Line voltage alarm outputs

OTHER FEATURES:

Power Accumulator (kW-h)

Programmable Alarm Output Contact

Programmable Auto-Cycle™

Random Startup Delay

OPTIONAL COMMUNICATIONS:

HTCBus™ / Modbus (RTU or ASCII)

Optional RS-232 / Isolated Modem / Isolated RS-485 (2-wire)

STANDARD CONSOLE:

Output, Alarm, Communications Status Indicators

Degrees C or F Indication

6 digit Alpha-numeric Display

Wide Temperature Operation

Programming Keypad



ORDERING INFORMATION

910 Series Controller Assemblies are ordered as complete units.

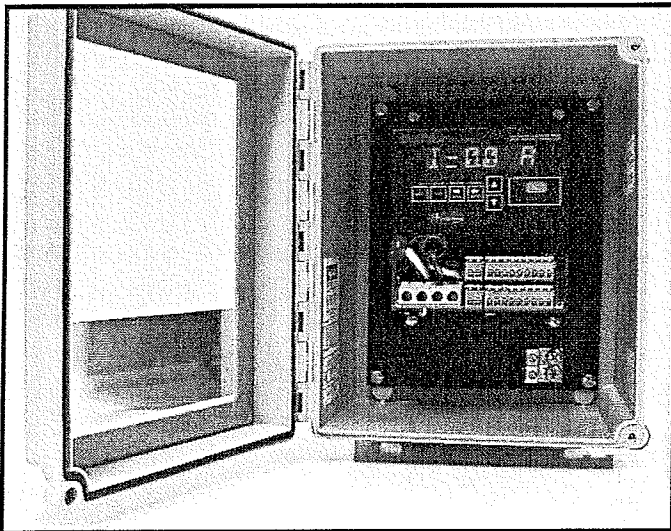
Contact your local representative for other available configurations that are not listed below.

STOCK ENCLOSURE ASSEMBLIES

DESCRIPTION	MODEL CODE
Controller in an 8"x10" FRP Enclosure with window. 2 pole 30A 277V EMR. Controls a single circuit with a 2-pole electro-mechanical relay.	910*E1FWL*EMR2
Controller in an 8"x10" FRP Enclosure with window. 2 pole 30A 277V SSR. Controls a single circuit with a 2-pole solid-state relay.	910*E1FWL*SSR2

AVAILABLE OPTIONS

DESCRIPTION	MODEL CODE
100 ohm Platinum RTD with 10 foot S/S corrugated sheath.	*RTD10CS
Modem communications option	*MDM
Isolated 2-wire RS-485 communications option	*485
RS-232 communications option	*232
Red or Green Pilot Light	*ALR or *ALG
Stainless Steel 8"x10" Enclosure with Window	replace *E1FWL with *E1SW



DigiTrace™

Proven performance
and technology for
all of your heat
trace control
applications.



WORLDWIDE HEADQUARTERS

Tyco Thermal Controls
300 Constitution Drive
Menlo Park, CA 94025-1164
USA
Tel: (800) 545-6258
Fax: (650) 474-7517

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FOR OVER 50 YEARS

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CANADA

Tyco Thermal Controls
250 West St.
Trenton, Ontario
K8V 5S2
Tel: (800) 545-6258
Fax: (650) 474-7517

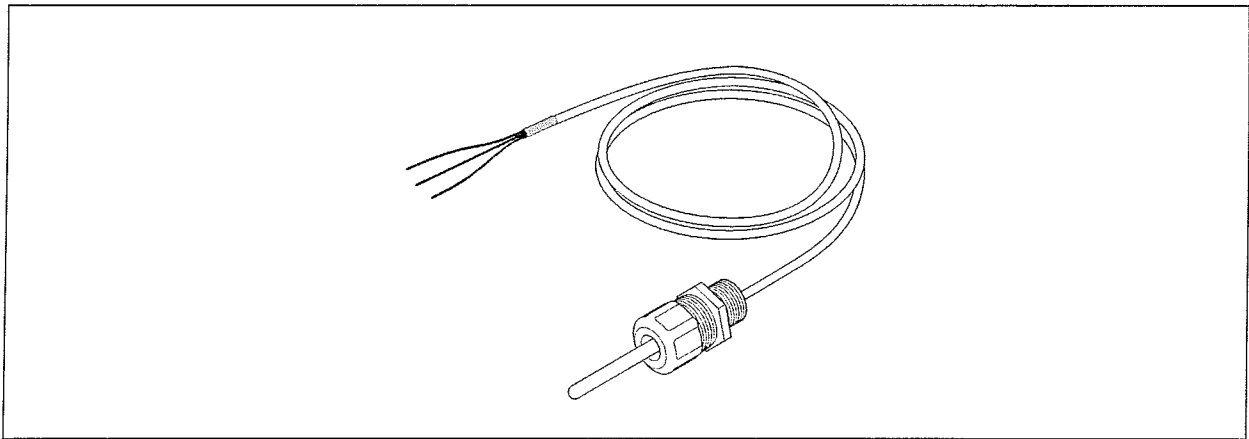


RTD temperature sensor for ambient sensing

The RTD-200 is a three-wire platinum RTD (resistance temperature detector) typically used with electronic control systems that require accurate ambient temperature

sensing. The RTD-200 comes with a 1/2" NPT fitting that installs to the appropriate conduit box. This allows mounting of the

RTD in a typical ambient location. This also allows for splicing of RTD extension wire back to the controller.



Specifications	
Sensor	
Housing	316 stainless steel
Dimensions	3-in (7.6 mm) length, 1/4-in (6 mm) diameter
Accuracy	± 0.3°F (± 0.2°C)
Range	-100°F to 300°F (-73°C to 149°C)
Resistance	100 ohms ± 0.25 ohm at 0°C $\alpha=0.00385$ ohms/ohm/°C
Extension wire	
Wire size (each of three)	22 AWG
Wire dielectric strength	600 V
Length	6 ft (1.8 m)
Outer jacket	Fluoropolymer
Maximum exposure temperature	300°F (149°C)
Sensor fitting	1/2-in (12.7 mm) NPT with sealing washer and nut

Approvals Approvals associated with control device. Not to be used in Division 1 areas.

Installation, Operating, and Maintenance Instructions

Firmware versions up to V3.1X
Document H56873

Please read all instructional literature carefully and thoroughly before starting.

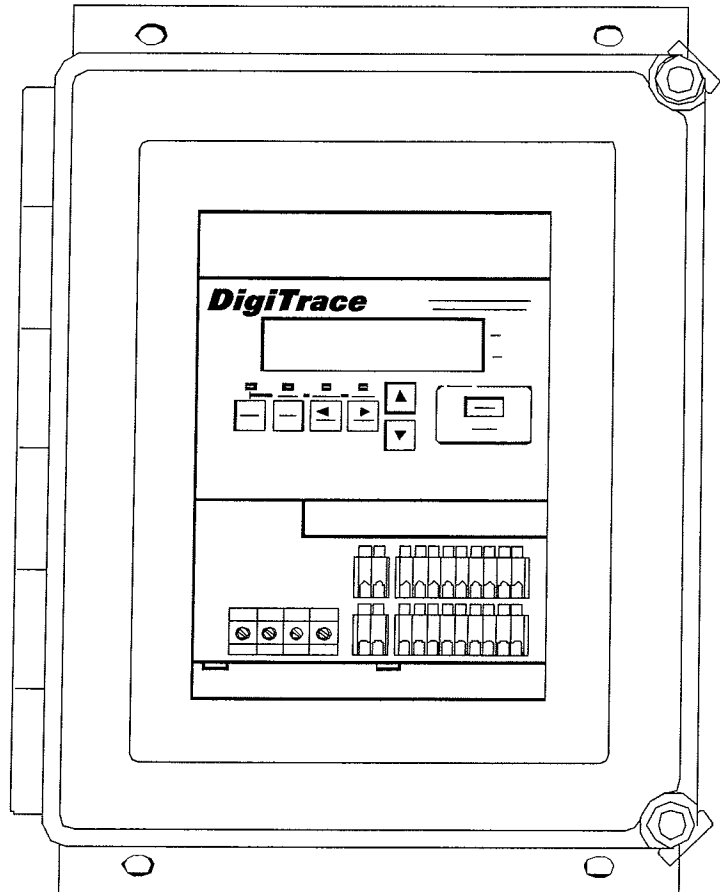




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DigiTrace® 910 Series Heat Trace Controller

Installation and Maintenance Instructions for Firmware Versions up to and Including V3.1X

Notice: The information contained in this document is subject to change without notice.

Certification

Tyco Thermal Controls certifies that this product met its published specifications at the time of shipment from the Factory.

Limited Warranty

This Tyco Thermal Controls product is warranted against defects in material and workmanship for a period of 18 months from the date of installation or 24 months from the date of purchase, whichever occurs first. During the warranty period, Tyco Thermal Controls will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Tyco Thermal Controls. The Buyer shall prepay shipping charges to Tyco Thermal Controls and Tyco Thermal Controls shall pay shipping charges to return the product to the Buyer. However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to Tyco Thermal Controls from another country.

Tyco Thermal Controls warrants that the software and firmware designated by Tyco Thermal Controls for use with the DigiTrace 910 Controller will execute its programming instructions properly. Tyco Thermal Controls does not warrant that the operation of the hardware, or software, or firmware will be uninterrupted or error-free.

Warranty Exclusion/Disclaimer

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the specifications for the product, or improper installation.

No other warranty is expressed or implied. Tyco Thermal Controls disclaims the implied warranties of merchantability and fitness for a particular purpose.

Exclusive Remedies

The remedies provided herein are the buyer's sole and exclusive remedies. Tyco Thermal Controls shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

Conducted and Radiated Emissions—FCC/DOC Statement of Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

This equipment does not exceed Class A limits for radio emissions as set out in Schedule V to VIII of the Radio Interference Regulations of Communication Canada.

Cet appareil respecte les limites de bruits radioélectriques applicables aux appareils numériques de Classe A prescrites dans la norme sur le matériel brouilleur: "Appareils Numériques," NMB-003 édictée par le Ministre des Communications.

Section 1—Overview

1.1 Introduction

This manual provides information pertaining to the installation, operation, testing, adjustment, and maintenance of the Tyco Thermal Controls DigiTrace™ Model 910 Series Heat Tracing Controller.

Additional copies of this user manual may be ordered separately through your Tyco Thermal Controls representative or online at www.tycothermal.com using the document number H56873.

1.2 Controllers Covered by this Manual

This document covers the 910 Series Heat Trace Controllers and its available options. The information coincides with the specific releases of firmware for the 910 product which are listed on the front page. As Tyco Thermal Controls releases new firmware to modify or enhance the product significantly, new documentation will accompany these releases. To ensure that you are using the correct documentation for your particular version of controller, please check the firmware version number of the 910 against the version number listed on the front of this manual. This may be displayed using the Operator Console or a communicating device. As subsequent changes are made, supplements to this document will be issued and included in manuals shipped after the firmware is released. Supplements will make specific reference to the operational or functional changes, and are available at www.tycothermal.com.

1.3 Product Overview

1.3.1 DESCRIPTION

The 910 Series electronic Heat Tracing Controller controls, monitors, and communicates alarms and data for one heating circuit. The ability to install the units in Class 1, Division 2 areas supports direct field installation, if desired. It is available with a solid-state relay (SSR) output for use in hazardous areas or with electro-mechanical relay (EMR) output for use in ordinary (non-hazardous) areas.

1.3.2 FEATURES

A detailed description of available features may be found in Section V of this manual. Highlights of specific features follow.

Keypad and Alphanumeric Display

A six character alphanumeric LED display provides the operator with large easy to read messages and prompts, eliminating complex and cryptic programming. Six individual keys are provided to quickly access alarming and operational information.

–40°F to 140°F (–40°C to 60°C) Operation

Extended temperature operation permits installation in all but the harshest environments.

Single or Dual Temperature Sensor Inputs

The ability to utilize one or two temperature sensor (TS) inputs allows the selection of one of eight control modes and programming of all temperature parameters.

High and Low Temperature Alarms

High and low temperature alarms are offered for both temperature sensor inputs of each control point.

High and Low Current Alarms

The 910 offers full adjustment of both the high and low alarm points over the entire current measurement range.

Solid State or Electromechanical Relay (EMR) Output

The 910 is available with either a solid-state relay (SSR) or an electromechanical relay (EMR) output switch. With the SSR option, the user may select a time-proportional control algorithm, a simple deadband control mode, or one of two ambient control algorithms. The EMR version always uses either the deadband mode or the proportional ambient contactor mode. Switching device failure alarms are supported for both types of output devices.

Ground Fault Alarm and Trip

Ground Fault (GF) current levels are monitored and may be displayed in milliamps. The availability of the actual ground fault level gives the user the choice of both alarm and trip levels suitable for the particular installation.

Overcurrent Protection

A unique overcurrent protection algorithm greatly reduces the possibility of damage to the circuit or the controller in the event of a temporary overload while allowing for initially high in-rush currents (SSR options only).

Soft Starting

Given the circuit breaker size, the 910 will limit the energy let-through to help prevent nuisance breaker trips due to cable in-rush. This feature makes the controller particularly attractive for use with self-regulating cables (SSR options only).

Minimum/Maximum Temperature Tracking

The controller maintains the minimum and maximum temperature values it has measured since the last reset of these values. This is helpful in determining causes of temperature alarms.

Latching/Non-Latching Temperature Alarms

User selectable non-latching temperature alarms allow the controller to automatically clear the alarm when the condition no longer exists.

High and Low Voltage Alarms

Operating at voltages less than design can cause serious loss of heater output. The alarming of preset voltage deviations ensures availability of sufficient wattage output.

Power-Limiting

The 910 will control the maximum output wattage if the full load power exceeds the specified Maximum Power Setpoint. This feature eliminates the need for low voltage transformers in many applications and can assist in standardization of heating cable types (SSR options only).

Autocycling

The controller will momentarily energize the circuit (for 10 seconds) at a programmable interval. Circuit alarms will be generated at the time of autocycle instead of when the heat is required. This feature eliminates the need for a preventive maintenance program as these tests are performed at regular intervals by the controller.

Temperature Sensor Failure Alarm

Both open and shorted sensors are detected and alarmed by the controller.

Random Start

A startup delay between 0 and 9 seconds ensures that all units do not come on line at the same time.

Full Digital Communications

An optional internal communications interface allows the communication of alarms and analog data to a monitoring system. Industry-standard RS-232 or RS-485 serial communications are available for applications requiring direct interfacing to other devices. The modem version maintains compatibility with legacy products, including the Group Communications Controller (Model 780/GCC-9000). With heat trace data at the user's fingertips, historical trending of temperatures, power consumption, or other parameters are available for analysis and system optimization.

CSA C/US

The 910 Series of controllers are approved for Class I, Division 2, Groups A, B, C, D hazardous locations making them ideal for direct installation in the field. This may save the significant expense of wiring back to a centrally located electrical distribution center.

1.4 Modular Components

The 910 Series controller is made up of two components. Each component's primary function is described below.

1.4.1 CONTROL MODULE

The 910 Control Module forms the heart of a single heat trace control solution. Each Control Module provides all of the intelligence required to control and monitor one heat trace circuit. It includes indicators for alarm and output status and an integral Operator Console. An internal connector is provided to plug in an optional communications interface.

The Control Module packaging provides a rugged, vibration-proof design.

Temperature sensor, communications, and alarm control wiring are connected to the lever-operated spring terminals, providing gas-tight, vibration-resistant connections.

A large, easy-to-read alphanumeric display and menu-driven interface eases controller configuration and eliminates the need for an external programmer. Access is available for all monitored parameters, programmed values, and alarm information. Enhanced security is provided by password protection.

Single phase current monitoring, ground fault detection, and voltage monitoring are provided. The 910 Control Module also incorporates a universal power supply, allowing operation directly from 100 to 277 Vac.

1.4.2 COMMUNICATIONS INTERFACE

In applications where the user wishes remote configuration capability, or wants to communicate trace information and/or alarms to another device such as a Group Communications Controller (780 Series/GCC-9000), an optional communications interface may be installed in the Control Module.

A modem version that maintains compatibility with legacy products is available, or other industry-standard interfaces such as RS-232 and RS-485 may be specified.

1.5 Controller Assemblies

Two standard assemblies are available and stocked at the Factory:

1. An SSR version for use in ordinary or Class I, Division 2 areas
2. An EMR version for use in ordinary locations only

1.6 Ordering and Configuration Guide

DIGITRACE 910 CONTROLLERS – FACTORY INVENTORY

Description	Catalog Number	Part Number	Weight
DigiTrace 910 controller in an 8" x 10" FRP enclosure with window. 2-pole 30 A EMR. Controls a single circuit with a 2-pole electromechanical relay. (Approved for ordinary areas only)	910*E1FWL*EMR2	10170-001	15
DigiTrace 910 controller in an 8" x 10" FRP enclosure with window. 2-pole 30 A EMR. Controls a single circuit with a 2-pole electromechanical relay. Includes an isolated 2-wire RS-485 communication option. (Approved for ordinary areas only)	910*E1FWL*EMR2*485	10170-015	15
DigiTrace 910 controller in an 8" x 10" FRP enclosure with window. 2-pole 30 A 277 V SSR. Controls a single circuit with a 2-pole solid-state relay. (Approved for Class I, Div. 2 areas)	910*E1FWL*SSR2	10170-002	20
DigiTrace 910 controller in an 8" x 10" FRP enclosure with window. 2-pole 30 A 277 V SSR. Controls a single circuit with a 2-pole solid-state relay. Includes an isolated 2-wire RS-485 communication option. (Approved for Class I, Div. 2 areas)	910*E1FWL*SSR2*485	10170-016	20
DigiTrace-DigiTrace Supervisor Software	DigiTrace Supervisor	10391-002	1

DIGITRACE 910 CONTROLLERS – MADE-TO-ORDER (Contact factory for lead time)

DigiTrace 910 controller in an 8" x 10" stainless-steel enclosure with window. 2-pole 30 A EMR. Controls a single circuit with a 2-pole electromechanical relay. (Approved for ordinary areas only)	910*E1SW*EMR2	10170-003	20
DigiTrace 910 controller in an 8" x 10" stainless-steel enclosure with window. 2-pole 30 A EMR. Controls a single circuit with a 2-pole electromechanical relay. Includes an isolated 2-wire RS-485 communication option. (Approved for ordinary areas only)	910*E1SW*EMR2*485	10170-017	20
DigiTrace 910 controller in an 8" x 10" stainless-steel enclosure with window. 2-pole 30 A 277 V SSR. Controls a single circuit with a 2-pole solid-state relay. (Approved for Class I, Div. 2 areas)	910*E1SW*SSR2	10170-004	25
DigiTrace 910 controller in an 8" x 10" stainless-steel enclosure with window. 2-pole 30 A 277 V SSR. Controls a single circuit with a 2-pole electromechanical relay. Includes an isolated 2-wire RS-485 communication option. (Approved for Class I, Div. 2 areas)	910*E1SW*SSR2*485	10170-018	25

RTD SENSORS

100-ohm platinum RTD with 10' stainless-steel corrugated sheath	RTD10CS	RTD10CS	1.0
RTD, ambient, cable style	MONI-RTD-200	254741	0.1
C1D1 RTD, -100°F to 900°F, pipe mounted	RTD7AL	RTD7AL	2.0
RTD, -100°F to 900°F, pipe mounted	RTD4AL	RTD4AL	1.2

OPTIONS

Append the following code(s) to the end of the standard Model Code to have the option included at the factory.

Option Code	Description
*232	RS-232 communications option (replace *485 with *232)
*MDM	Modem communications option (replace *485 with *MDM)
*ALR	Red LED pilot light
*ALG	Green LED pilot light

Contact your local representative for configurations not listed here.

Section 2—Installation and Wiring



Caution: Be sure all personnel involved in installation, servicing, and programming are qualified and familiar with electrical equipment, their ratings and proper practices and codes. Multiple voltages and signal levels may be present during the installation, operation, and servicing of this product. **Do not** power the product until the safety provisions outlined in this section have been observed.

2.1 Introduction

This section includes information regarding the initial inspection, preparation for use, and storage instructions for the 910 Series Heat Trace Controller.

2.2 Initial Inspection

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been verified for completeness and the equipment has been checked mechanically and electrically. Procedures for configuring and operating the heat trace controller are given in Sections III, IV, and V. If the shipment is incomplete, there is mechanical damage, a defect, or the controller does not pass the electrical performance tests, notify the nearest Tyco Thermal Controls representative. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as your Tyco Thermal Controls representative. Keep the shipping materials for the carrier's inspection.

2.3 Operator Safety Considerations

The standard 910 controller using solid-state relays is suitable for Class 1, Division 2, Groups A, B, C, and D hazardous areas. Hazardous areas are defined by Article 500 of the National Electrical Code and Section 18 of the Canadian Electrical Code. Electromechanical relay (EMR) based assemblies are suitable for use in ordinary (non-hazardous) areas only.



Caution: Some wiring configurations will use more than one power source and all must be de-energized prior to performing any maintenance on a controller circuit.

2.4 Operating Environment

The operating environment should be within the limitations specified in the 910 Heat Trace Controller Specifications outlined in Appendix A.

2.5 Installation Location

The wide ambient operating temperature range of the controller permits installation in most any convenient location. Considerations should include expected atmospheric conditions, accessibility for maintenance and testing, the location of existing conduits and hazardous area rating. Ambient temperature conditions may affect load current ratings.



Caution: Always be sure that the intended location is classified as an area that the product is approved for as defined by Article 500 of the National Electrical Code and/or Part I, Section 18 of the Canadian Electrical Code.

2.6 Mounting Procedures

Mounting hole dimensions for the standard enclosures are shown in Appendix B. Conduit entries should be made in the bottom of the enclosure if possible to reduce the possibility of water entry or leakage. Conduit entries must be drilled/punched following the enclosure manufacturers' recommendations. Use bushings suitable for the enclosure type and install such that the completed installation remains waterproof. For nonmetallic enclosures, grounding hubs and conductors must be installed in accordance with Article 501-4(b) of the National Electrical Code and Part I of the Canadian Electrical Code.

The user may want to consider enclosure drain holes in applications where moisture is a problem; drill 0.125" holes in the bottom of the enclosure on both the left and right sides. Two holes reduce the possibility that one will plug and ensures drainage if the enclosure is not perfectly level. Note that drilling holes in the enclosure compromises the NEMA 4 rating.

2.6.1 Controller Installation and Removal



Caution: Always ensure that the power to the unit is turned off during installation or removal to avoid the risk of injury and damage to the controllers.



Warning—Explosion Hazard! Do not install or remove the control module while the unit is powered.

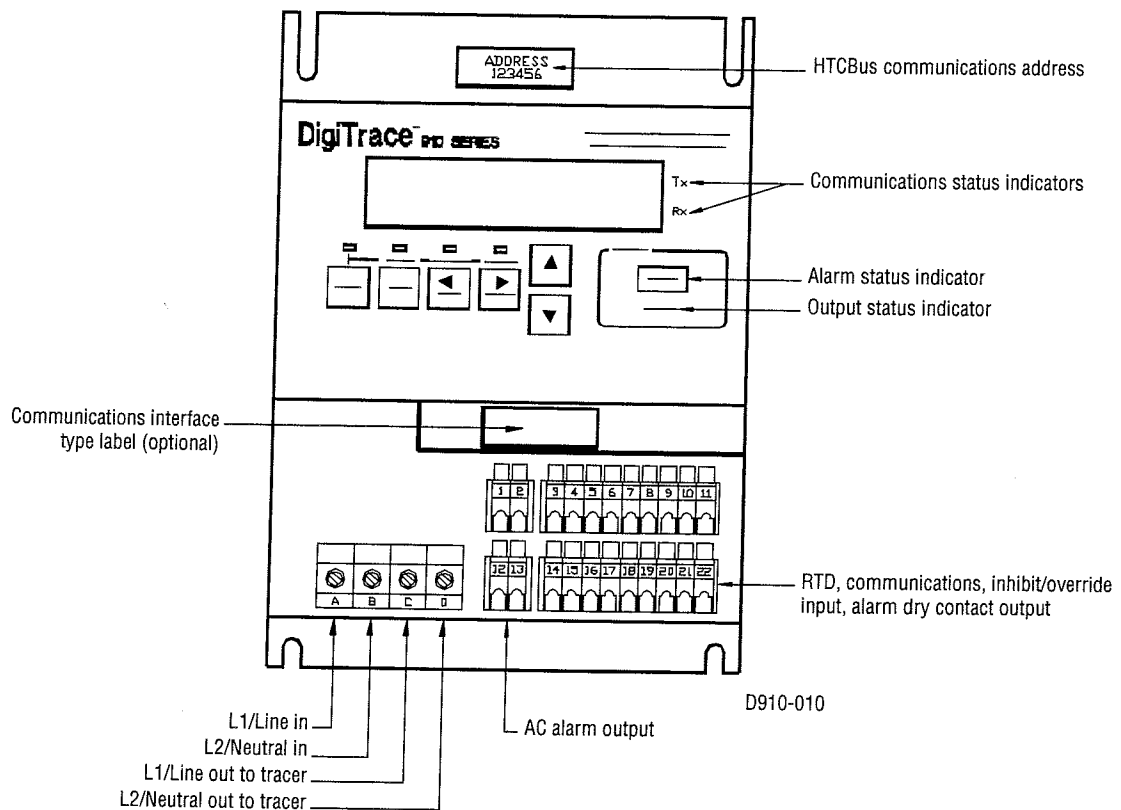


Fig. 2.1 Control module face

2.7 Wiring

Wiring diagrams for typical configurations are included in Appendix C of this manual.



Caution: Always verify wiring connections before applying power to the controller or connected circuits. To avoid injury or equipment damage, do not install or remove wiring while controller power is on.

To minimize the chance of loose connections, the 910 uses lever-operated, spring-loaded terminals for signal wiring. See Appendix A for allowable wire sizes and recommended insulation strip lengths.

2.7.1 TEMPERATURE SENSOR CONNECTIONS

Use shielded, twisted, three-conductor wire for the extension of RTD leads. The wire size should ensure that the maximum allowable lead resistance is not exceeded. Shields on RTD wiring should be grounded at the controller end only, using the terminals provided.

Temperature Sensors	Terminal No.
Shield	19
TS 1 Source (WHT)	20
TS 1 Sense (WHT)	21
TS 1 Common (RED)	22
Shield	8
TS 2 Source (WHT)	9
TS 2 Sense (WHT)	10
TS 2 Common (RED)	11

2.7.2 ALARM RELAY CONNECTIONS

Two types of alarm relays are provided: one is a programmable dry contact output relay and the other is a line voltage AC relay (Triac). Both may be programmed for N.O., N.C., steady or flashing operation, and are typically used to annunciate an alarm to an external device such as a DCS, PLC, etc.

Notes:

- Both alarm relays are controlled by the 910 using the same signal. The N.O., N.C., and flashing parameter settings affect both the dry contact and the AC alarm relays.
- The dry contact alarm relay is intended to be used for switching low-voltage, low-current signals. **Do not use this relay to directly switch line voltages.** Ensure that your application stays within the ratings of the relay contacts as defined in Appendix A.

The AC alarm relay is typically used to drive a local, external, line-voltage pilot light, etc. Refer to the wiring diagrams in Appendix C for example connection details.

Dry Contact Alarm and Control Signals	Terminal No.
Alarm relay dry contact output	14
Alarm relay dry contact output	15
Ground	4
+12Vdc nom. Out	3

AC Alarm and Control Signals	Terminal No.
L1/Line out	1
L2/Neutral out	2
AC alarm relay	12
AC alarm relay	13

2.7.3 EXTERNAL CONTACT INPUT/OUTPUT

These input terminals are used to implement the inhibit and override features. Refer to Section V of this manual for programming details, and Appendix C for example wiring diagrams.

Miscellaneous Signals	Terminal No.
External input (+)	6
External input (-)	7

2.7.4 COMMUNICATION SIGNAL CONNECTIONS

The communications terminal assignments change based on the type of option installed. If present in a 910 Control Module, the type of communications interface will be identified by a label located on the front of the control module (Figure 2.1).

Communications wiring should use twisted pair, shielded cable. Shields on communications wiring should be grounded at one end only, using the terminals provided.

The following tables define the appropriate signal connections for the various types of interfaces:

RS-485 (2-Wire) Connections

Communication Signal	Terminal No.
Receive/transmit data (+)	16
Receive/transmit data (-)	17
Shield	18

RS-232 (3-Wire) Connections

Communication Signal	Terminal No.
Receive data	16
Transmit data	17
Common	18

Modem Interface Connections

Communication Signal	Terminal No.
Modem	16
Modem	17
Shield	18

2.7.5 POWER CONNECTIONS

All of the power terminals are labeled for easy identification. Do not attempt to use wire sizes that exceed the marked terminal ratings and avoid terminating two wires on the same terminal whenever possible.

Always be sure that all terminals are adequately tightened according to the terminal manufacturer's specification. See Appendix A for allowable wire sizes, recommended insulation strip lengths, and tightening torque. A loose terminal can cause arcing and damage to the terminal or incorrect operation of the controller.

Note: Make sure that power terminals are retightened several days after installation. Stranded wire will tend to compress when initially installed; therefore, these terminals should be checked for tightness several times after the system is installed to ensure that a good connection is maintained. Be certain to use the proper size screwdriver for the terminal blocks to minimize the chance of damage to the terminals.

If the controllers are installed in either a metallic or non-metallic enclosure, follow the enclosure manufacturer's recommendations for proper grounding. Do not rely on conduit connections to provide a suitable ground.

Grounding terminals/screws are provided for connection of system ground leads. Proper system grounding is required for safe and correct operation of the controller's protection features.

2.7.6 INPUT POWER

The 910 controller may be powered directly from a 100 to 277 Vac circuit. The wiring terminal assignments are defined below.

Power Connections	Terminal No.
Line/L1 power input	A
Neutral/L2 power input	B
Line/L1 output to trace	C
Neutral/L2 output to trace	D

Wiring diagrams for typical configurations are included in Appendix C.



Caution: Many wiring configurations will use more than one power source and all must be de-energized prior to performing any maintenance on a controller circuit.

2.8 Initial Power-up



Caution: Before applying power to the controller, ensure that powering the circuit will not damage it if power limiting or the setpoint temperature have not been set correctly. If there is any doubt, the load should be disconnected until the 910 has been suitably programmed for correct and safe operation.

2.8.1 INITIAL CABLE TEST

To minimize the risk of damage to the controller due to a cable fault, the integrity of the heating cable should be verified by:

1. Performing a high voltage insulation test using a "Megger"
2. Using an ohmmeter to ensure that the heating cable is not shorted

These tests must be performed with the controller output disconnected.

Once the cable has been checked, it may be reconnected to the controller and power applied.

2.8.2 RANDOM START DELAY

All 910 Series Control Modules incorporate a RANDOM START-UP DELAY feature, ensuring that all units do not power on at the same time. When power is first applied to a controller, it will hold its output off for a random time (0 to 9 seconds), equal to the last digit of the HTCBUS™ communications address (see Section 5.6.2). Once the start-up delay has timed out, the controller will begin normal operation.

2.9 Setup for the 910

The 910 may be programmed using the Operator Console, or if a communications option is installed, with an external communicating device. For instructions on the operation of these devices, refer to the corresponding operating manuals. For complete instructions on programming the 910, see the Programming and Configuration Section of this manual.

Section 3—Operator Console and Operation

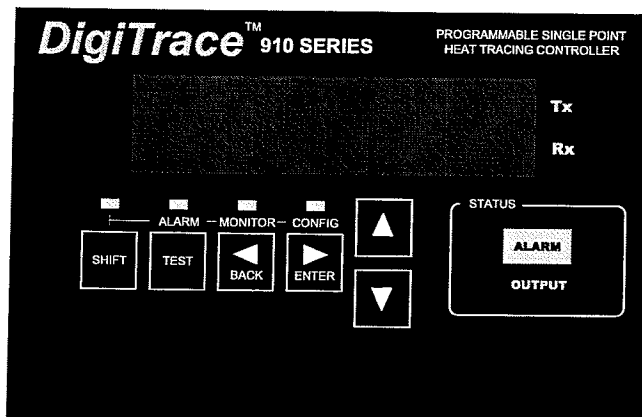
3.1 Alphanumeric Display

The console incorporates a six character, fourteen segment plus decimal LED display. Messages and prompts that are greater than six characters long are scrolled, allowing more meaningful, non-cryptic messages to be used.

3.2 Keypad

The local keypad consists of six keys that allow you to select the console mode function that you are interested in. For certain keys, the SHIFT key selects an alternate function, as shown by the text above that key.

Key	Function
SHIFT	<ul style="list-style-type: none"> Press to activate a SHIFTed function; the next key pressed uses the alternate (shifted) function The SHIFT LED illuminates, indicating the next key uses the alternate (shifted) function Pressing SHIFT again cancels the alternate (shifted) function
TEST [shift ALARM]	<ul style="list-style-type: none"> Turns on tracing for 30 seconds When prefixed by the SHIFT key, this key switches the console to the Alarm mode
◀ BACK [shift MONITOR]	<ul style="list-style-type: none"> Exits the current menu (or cancels the new setting when editing a parameter) Moves the cursor to the left when editing an alphanumeric parameter When prefixed by the SHIFT key, this key switches the console to the Monitor mode
▶ ENTER [shift CONFIG]	<ul style="list-style-type: none"> Selects the item in the display (or accepts the setting when editing a parameter) Moves the cursor to the right when editing an alphanumeric parameter When prefixed by the SHIFT key, this key switches the console to the Configure mode
△	<ul style="list-style-type: none"> Moves to the previous item in a menu Increments the value when editing
▽	<ul style="list-style-type: none"> Moves to the next item in a menu Decrements the value when editing



3.3 LED Indicators

The console includes eight LED indicators:

Four LEDs indicate the console operating mode (SHIFTed function, ALARM, MONITOR, or CONFIGure modes).

There are two status LEDs which indicate the alarm and control output status of the controller:

1. The output LED, when illuminated steadily, indicates that the output of the controller is turned on and is allowing current to flow into the loadtrace circuit. For SSR versions programmed for proportional modes, a flashing LED indicates that the controller is pulsing its output on and off to maintain the setpoint temperature and/or control the average amount of current/power the tracer uses.
2. The alarm LED will flash (approximately once per second) when the controller has detected an alarm condition.

The two additional LEDs are used to indicate external communications activity and are only used when an optional communications interface is installed. The "Rx" LED flashes to show that the Controller is receiving information via its communications port. The "Tx" LED flashes when the Controller is transmitting information via its communications port.

3.4 Operational Basics

3.4.1 OPERATING MODES

The console operates in one of four modes and is related to the basic function the operator selects.

Mode	Function
Scan	This is the default mode. In this mode, the console sequentially displays load current, temperature, and setpoint readings.
Alarm	Invoked when you press the SHIFT key followed by the ALARM key. This mode allows you to examine or reset any alarms that may exist. The LED above the ALARM key is illuminated while in this mode.
Monitor	Invoked when you press the SHIFT key followed by MONITOR key. In this mode, you may examine any of the controller readings such as temperature, load current, etc. The LED above the MONITOR key is illuminated while in this mode.
Configure	Invoked when you press the SHIFT key followed by CONFIG key. In this mode, you may examine or alter the controller configuration. The LED above the CONFIG key is illuminated while in this mode.

3.4.2 MENUS

Each of the operating modes has a list of data items associated with it. For example, in the Monitor mode you may view temperatures, load current, resistance, ground fault current, voltage, or power information. This collection of data items is referred to as a menu.

Only one menu item may be viewed at a time. The ∇ (\triangle) keys move to the next (previous) item in the menu. When you reach the end of the menu (indicated by ---- END ---), ∇ wraps you to the first item in the menu; conversely, \triangle wraps you to the last item in the menu.

Some of the items within a menu are actually entry points to sub-menus—these entries are indicated with "..." at the end of the message. To enter a sub-menu, press the \triangleright key. To move around in the menu, use the ∇ and \triangle keys move to the next and previous items respectively. The \triangleleft key exits the current menu and returns to the previous menu.

After approximately five minutes of keypad inactivity, the current menu and mode will be exited and the console will revert to the Scan mode.

Note: Some menus are dynamic; that is, some items appear or disappear depending on the configuration. For example, if you disable the Low Voltage Alarm, then the corresponding Low Voltage Setpoint is not available and will not be displayed.

3.4.3 CHANGING THE CONFIGURATION

To change the Controller configuration, follow the directions listed below.

- Position the desired parameter (menu item) in the display.
- Press the \triangleright key to initiate an edit session.
- If the console is “locked” you are prompted to enter the passcode.
- The present setting will flash on the display to indicate that you are editing the parameter.
- Use the \triangle and ∇ keys to change the value.
- The operation of the \triangleright and \triangleleft varies depends on the type of data being editing. See the following sections for details.

Note: Once you have initiated an edit session, you must end it before switching to another mode or invoking another function. An edit session ends when you enter a new value (using the \triangleright key) or you back out of it (using the \triangleleft key).

3.4.4 CHANGING A NON-NUMERIC PARAMETER

To change a non-numeric parameter (e.g.: an alarm mask setting), follow the directions below.

- Position the appropriate parameter in the display.
- Press the \triangleleft key to initiate the edit session.
- If the console is “locked” you are prompted to enter the passcode.
- The present setting will flash on the display to indicate that you are editing the parameter.
- Use \triangle or ∇ until the desired value appears in the display.
- Pressing \triangleright saves the new value.
- Pressing \triangleleft ends the edit session without altering the parameter.

3.4.5 CHANGING A NUMERIC PARAMETER

To change a numeric parameter (e.g. the control setpoint), follow the directions below.

- Position the appropriate parameter in the display.
- Press the \triangleright key to initiate the edit session.
- If the console is “locked” you are prompted to enter the passcode.
- The present value is displayed and the last (rightmost) digit blinks.
- The blinking digit identifies the digit that you are editing.
- Use \triangle or ∇ to set the desired value.
- Use \triangleleft or \triangleright to move to a different digit.
- To enter a negative value, scroll to the first (leftmost) digit until a “-” appears in the display.
- Pressing \triangleright while on the last (rightmost) digit saves the new value.
- Pressing \triangleleft while on the first (leftmost) digit ends the edit session without altering the parameter.

3.4.6 PASSCODE PROTECTION

The 910 Series Controller provides a passcode for protection of its configuration. You may view any portion of the configuration with the console “locked”; however, when you attempt to initiate an edit session by pressing \triangleright , you are prompted to enter the passcode. Entering the passcode is just like entering any other numeric value; see Section 3.4.5 “Changing a Numeric Parameter.”

Once the console is “unlocked,” you may edit any configuration parameter. The console will automatically re-lock after approximately five minutes of keypad inactivity, or until the user explicitly locks it.

Notes:

- Setting the programmed passcode to “0” disables passcode protection.

-
- The console does not have to be unlocked to reset alarms.

3.4.7 FEATURE MODES

There are two types Configuration Menus in the 910 Series Controller.

1. A “Basic” Configuration Menu which only contains seven parameters
2. An “Advanced” Configuration Menu which contains all of the parameters

Both types of Configuration Menu contain a “Feature Mode” parameter which allows the user to select which type of Configuration Menu is most desirable.

3.4.8 QUICK NOTES ON OPERATION

Remember the following basic rules for efficient Console use:

- Use the SHIFT key followed by the appropriate function key—ALARM, MONITOR, or CONFIG—to select the operating mode
- Use \triangle and ∇ to move around in the menu
- Use \triangleright to enter a new menu, enter a new value, or select a menu item
- Use \triangleleft to exit the current menu or cancel an edit

Section 4—Operator Console Modes

4.1 Alarm Mode

The Alarm mode is invoked when you press the SHIFT key followed by the ALARM key. This mode allows you to examine and reset any alarms that may exist. Use \triangle (∇) to examine the next (previous) active alarm.

4.1.1 RESETTING ONE ALARM

To reset an alarm, press \triangleright . You are prompted for confirmation; answering YES resets the alarm and advances you to the next alarm.

4.1.2 RESETTING ALL ALARMS

To reset all active alarms, press \triangleright . You are prompted for confirmation; press \triangle to select ALL and press \triangleright to accept.

4.1.3 MONITOR MODE TRACKING

The Monitor mode “tracks” the Alarm mode. If the Monitor mode is selected while viewing an alarm, the controller will enter the MONITOR menu and display an appropriate reading.

For example, if you are examining a High Load Current Alarm and then select the Monitor mode, the starting point within the MONITOR menu will be the load current reading. Once the Monitor mode has been selected, you may move around in the menu using ∇ and \triangle .

4.1.4 ALARM MESSAGES

Table 4.1 lists sample alarms and the corresponding starting point in the Monitor mode menu, if it is invoked from the Alarm mode.

Table 4.1 Alarm Messages

Sample Alarm	Message	Monitor Mode Starting Point
LO TS 1	= -2°C	TS 1 temperature
HI TS 1	= 102°C	TS 1 temperature
TS 1 FAIL	= ALARM	TS 1 temperature
LO TS 2	= -4°C	TS 2 temperature
HI TS 2	= 105°C	TS 2 temperature
TS 2 FAIL	= ALARM	TS 2 temperature
CTL TS FAIL	= ALARM	Control temperature
LO LOAD	= 0.5 A	Load current
HI LOAD	= 21.0 A	Load current
HI GFI	= 52 mA	Ground fault current
GFI TRIP	= 77 mA	Ground fault current
LO VOLT	= 85 V	Voltage
HI VOLT	= 140 V	Voltage
LO RESIST	= 3.38 Ω	Resistance
HI RESIST	= 9.24 Ω	Resistance
OVERCURRENT TRIP	= ALARM	Load current
SWITCH FAIL	= ALARM	Load current
HTC RESET	= ALARM	Time since last reset
SWITCH LIMITING	= ALARM	Load current
C.B. LIMITING	= ALARM	Load current
POWER LIMITING	= ALARM	Power
EEROM DATA FAIL	= ALARM	n/a
CONTACTOR COUNT	= 200000	Contactor cycle count

4.2 Monitor Mode

The Monitor mode is invoked when you press the SHIFT key followed by the MONITOR key.

This mode allows you to test the heat tracing and examine any of the analog readings. The data is updated in real-time, providing the user with a method of viewing tracer information as it occurs.

4.2.1 MAIN MENU

Table 4.2 Monitor Mode Main Menu

CONTROL MODE	=	4°C	
TS 1 TEMP	=	4°C	
TS 2 TEMP	=	7°C	(only if TS2 is being used)
LOAD	=	8.9 A	
RESIST	=	13.26 Ω	
GFI	=	0 mA	
VOLT	=	118 V	
POWER	=	1050 W	(or POWER = 10.4 kW)
TEST TRACING	=		(Turn on tracing for 30 seconds)
DISPLAY TEST	=		(To abort DISPLAY TEST, press any key)
MAINTENANCE DATA...	=		Note the "..." indicating a sub-menu
---	END	----	

4.2.2 "MAINTENANCE DATA..." SUB-MENU

This sub-menu is used to view minimum and maximum temperatures, total accumulated power, hours in use, and the number of hours since the last time the Controller was reset.

These parameters may be reset by the user.

CONTROL TEMP = 4°C
TS 1 TEMP = 4°C
TS 2 TEMP = 7°C
LOAD = 8.9 A
RESIST = 13.26 Ω
GFI = 0 mA
VOLT = 118 V
POWER = 1050 W
TEST TRACING
DISPLAY TEST
MAINTENANCE DATA...
---- END ----

Table 4.3 Maintenance Data Sub-Menu

MIN CTL TEMP = -2°C	
MAX CTL TEMP = 65°C	
TS 1 MIN TEMP = -2°C	
TS 1 MAX TEMP = 65°C	
TS 2 MIN TEMP = -1°C	
TS 2 MAX TEMP = 61°C	
POWER ACCUM = 145.9 kW-h	
CONTACTOR CYCLE COUNT = 1234	(only if Deadband or Prop. Amb. Contactor modes are being used)
IN USE = 2896 h	
TIME SINCE LAST RESET = 675 h	
---- END ----	

4.3 Configure Mode

The Configure mode is selected when the operator presses the SHIFT key followed by the CONFIG key. This mode allows you to examine or alter the Controller's configuration. There are two types of configuration modes each presenting different features: Basic and Advanced.

The Basic Configuration Mode will limit the display to seven of the most commonly modified parameters, while the Advanced Configuration Mode presents all of the available parameters. Both Configure mode menus contain a parameter called FEATURE MODE which allows the user to specify which Configure mode is to be used.

Note: All parameters that are enabled are active with their corresponding settings even if the Basic Configuration Mode is currently active. Selecting the Basic Configure mode of operation simply hides the display of certain parameters, but does not disable them.

4.3.1 Basic Configure Mode Menu

Table 4.4 Basic Configure Mode Menu

CONTROL SETPOINT	=	{-60 to 570}°C
LO TS 1	=	{-60 to 570}°C
LO LOAD	=	{0.3 to 100.0} A
SWITCH CONTROL MODE	=	{Proportional, Prop. Amb., SSR, Deadband, or Prop. Amb. Contactor}
CIRCUIT BREAKER	=	{0.3 TO 100.0} A (only if SSR is being used)
TEMP UNITS	=	{°C or °F}
FEATURE MODE	=	{Basic or Advanced}
LOCK DATABASE	=	(Only if passcode is not 0 and database is unlocked)
UNLOCK DATABASE	=	(Only if passcode is not 0 and database is locked)
---- END ----		

4.3.2 ADVANCED CONFIGURE MODE MAIN MENU

Menu items with a trailing “...” indicate an entry point to a sub-menu. To enter a sub-menu, use ▽ and △ to position the menu item in the display and then press ▷. Note that the controller “remembers” where you are in the Configure mode if you temporarily switch to a different mode (such as the Monitor mode). Switching back to the Configure mode will return you to the same menu item.

Note: A few of the controller parameters that are often used have been duplicated in the Advanced Configure mode main menu for quick access. These parameters (Lo TS 1, Lo Load, Hi GFI, GFI Trip) may also be accessed using their respective sub-menus.

Table 4.5 Advanced Configure Mode Main Menu

CONTROL SETPOINT	=	{-60 to 570}°C
LO TS 1	=	{-60 to 570}°C
LO LOAD	=	{0.3 to 100.0} A
HI GFI	=	{20 to 250} mA
GFI TRIP	=	{20 to 250} mA
FEATURE MODE	=	{Basic or Advanced}
TS ALARMS CONFIG...		Note that the menu items with a trailing “...” indicate the entry point to a sub-menu
OTHER ALARMS CONFIG...		
POINT SETUP...		
MISC SETUP...		
COMMUNICATIONS SETUP...		
LOCK DATABASE		(Only if passcode is not 0 and database is unlocked)
UNLOCK DATABASE		(Only if passcode is not 0 and database is locked)
---- END ----		

This sub-menu is used to set up alarms that relate to any of the temperature sensors. Each alarm may be ENabled or DISabled, and if the alarm is ENabled, an alarm setting may be entered.

4.3.3 “TS ALARMS CONFIG...” SUB-MENU

This sub-menu is used to set up alarms that relate to any of the temperature sensors. Each alarm may be ENabled or DISabled, and if the alarm is ENabled, an alarm setting may be entered.

CONTROL SETPOINT = 20°C
LO TS 1 = -10°C
LO LOAD = 1.0 A
HI GFI = 50 mA
GFI TRIP = 75 mA
TS ALARMS CONFIG...
OTHER ALARMS CONFIG...
POINT SETUP...
MISC SETUP...
COMMUNICATIONS SETUP...
---- END ----

Table 4.6 TS Alarms Configuration Sub-Menu

TS 1 FAIL	=	{ENA or DIS}
LO TS 1	=	{ENA or DIS}
LO TS 1	=	{-60 TO 570}°C
HI TS 1	=	{ENA or DIS}
HI TS 1	=	{-60 TO 570}°C
TS 2 FAIL	=	{ENA or DIS}
LO TS 2	=	{ENA or DIS}
LO TS 2	=	{-60 TO 570}°C
HI TS 2	=	{ENA or DIS}
HI TS 2	=	{-60 TO 570}°C
LO TS FILTERS	=	{0 to 999} MIN (only if LO TS 1 or 2 are enabled)
HI TS FILTERS	=	{0 to 999} MIN (only if HI TS 1 or 2 are enabled)
LATCH TS ALARMS	=	{YES or NO}
CTL TS FAIL	=	{ENA or DIS}
---- END ----		

4.3.4 "OTHER ALARMS CONFIG..." SUB-MENU

This sub-menu allows the user to set up all alarms that do not directly relate to the temperature sensors. These include all AC alarms (voltage, current, ground fault, etc.) as well as protection settings such as power limiting, etc.

Each alarm may be ENabled or DISabled. If the alarm is ENabled, an alarm setting and filter setting may be entered.

CONTROL SETPOINT = 20°C
LO TS 1 = -10°C
LO LOAD = 1.0 A
HI GFI = 50 mA
GFI TRIP = 75 mA
TS ALARMS CONFIG...
OTHER ALARMS CONFIG...
POINT SETUP...
MISC SETUP...
COMMUNICATIONS SETUP...
---- END ----



Table 4.7 Other Alarms Configuration Sub-Menu

LO LOAD	=	{ENA or DIS}	
LO LOAD	=	{0.3 to 100.0} A	
LO LOAD FILTER	=	{0 to 12} S	
HI LOAD	=	{ENA or DIS}	
HI LOAD	=	{0.3 to 100.0} A	
HI LOAD FILTER	=	{0 TO 12} S	
HI GFI	=	{ENA or DIS}	
HI GFI	=	{20 to 250} mA	
HI GFI FILTER	=	{0 to 12} S	
GFI TRIP	=	{ENA or DIS}	
GFI TRIP	=	{20 to 250} mA	
LO VOLT	=	{ENA or DIS}	
LO VOLT	=	{10 to 330} V	
LO VOLT FILTER	=	{0 to 12} S	
HI VOLT	=	{ENA or DIS}	
HI VOLT	=	{10 to 330} V	
HI VOLT FILTER	=	{0 to 12} S	
LO RESIST	=	{ENA or DIS}	
LO RESIST	=	{1 to 100} %	
LO RESIST FILTER	=	{0 to 12} S	
HI RESIST	=	{ENA or DIS}	
HI RESIST	=	{1 To 250} %	
HI RESIST FILTER	=	{0 to 12} S	
NOMINAL RESIST	=	{2.00 to 2000.00} Ω	(only if LO or HI is enabled)
OVERCURRENT TRIP	=	{ENA or DIS}	(only if SSR is being used)
SWITCH FAIL	=	{ENA or DIS}	
HTC RESET	=	{ENA or DIS}	
C.B. LIMITING	=	{ENA or DIS}	(only if SSR is being used)
POWER LIMITING	=	{ENA or DIS}	(only if SSR is being used)
SWITCH LIMITING	=	{ENA or DIS}	(only if SSR is being used)
CONTACTOR COUNT	=	{ENA or DIS}	(only if Deadband or Prop Amb Contactor are being used)
CONTACTOR COUNT	=	{0 to 999999}	(only if Deadband or Prop Amb Contactor are being used)
EEROM DATA FAIL	=	{ENA or DIS}	
---- END ----			

4.3.5 "POINT SETUP..." SUB-MENU

The "Point Setup" sub-menu is used to configure parameters that relate directly to the specific control point. Included in this menu are control mode settings, circuit breaker and switch ratings, autcycle set-up parameters, etc.

CONTROL SETPOINT = 20°C
LO TS 1 = -10°C
LO LOAD = 1.0 A
HI GFI = 50 mA
GFI TRIP = 75 mA
TS ALARMS CONFIG...
OTHER ALARMS CONFIG...
POINT SETUP...
MISC SETUP...
COMMUNICATIONS SETUP...
---- END ----

Table 4.8 Point Setup Sub-Menu

TAG	=	{19 ALPHANUMERIC CHARACTERS}	
SWITCH CONTROL MODE	=	{PROPORTIONAL, PROP AMB SSR, DEADBAND, or PROP AMB CONTACTOR}	
DEADBAND	=	{1 to 50}°C	(only if SWITCH CONTROL MODE is DEADBAND)
PROP BAND	=	{1 to 50}°C	(only if SWITCH CONTROL MODE is not DEADBAND)
CYCLE TIME	=	{10 to 255} MIN	(only if SWITCH CONTROL MODE is not PROP AMB CONTACTOR)
SWITCH RATING	=	{0.3 to 100.0} A	(only if SSR is being used)
CIRCUIT BREAKER	=	{0.3 to 100.00} A	(only if SSR is being used)
MAX POWER	=	{3 W to 33,000} W	(only if SSR is being used)
TS FAIL MODE	=	{OFF or ON}	
TS CTL MODE	=	{TS 1-FAIL OFF (ON) or TS 1-FAIL TO TS 2 or TS 2-FAIL OFF (ON) or TS 2-FAIL TO TS 1 or AVERAGE-FAIL OFF (ON) or AVERAGE-FAIL TO GOOD or LOWEST-FAIL OFF (ON) or LOWEST-FAIL TO GOOD}	
TS 1 TYPE	=	{100 Ω PLAT or NI-FE}	
TS 1 LEAD RESIST	=	{1 to 20.000} Ω	(only if TS 1 TYPE = NI-FE)
TS 1 HI LIMIT	=	{ENA or DIS}	
TS 2 TYPE	=	{100 Ω PLAT or NI-FE}	
TS 2 LEAD RESIST	=	{0 TO 20.000} Ω	(only if TS 2 TYPE = NI-FE)
TS 2 HI LIMIT	=	{ENA or DIS}	
AUTO-CYCLE	=	{ENA or DIS}	
AUTO-CYCLE INTERVAL	=	{1 to 240}	(only if AUTO-CYCLE=ENA)
AUTO-CYCLE UNITS	=	{HOURS or MINUTES}	(only if AUTO-CYCLE=ENA)
OVERRIDE SOURCE	=	{REMOTE or EXT INPUT}	
LOAD SHEDDING	=	{ENA or DIS}	
		---- END ----	

4.3.6 "MISC. SETUP..." SUB-MENU

The "Misc. Setup" sub-menu is used to configure miscellaneous parameters.

CONTROL SETPOINT = 20°C
LO TS 1 = -10°C
LO LOAD = 1.0 A
HI GFI = 50 mA
GFI TRIP = 75 mA
TS ALARMS CONFIG...
OTHER ALARMS CONFIG...
POINT SETUP...
MISC SETUP...
COMMUNICATIONS SETUP...
---- END ----

Table 4.9 Misc. Setup Sub-Menu

TEMP UNITS	=	{°C or °F}
VERSION	=	V3.16.3
EXT. INPUT	=	{NOT USED, INHIBIT or FORCE ON}
FLASH ALARM OUTPUT	=	{YES or NO}
ALARM OUTPUT	=	{N.C. or N.O.}
LANGUAGE	=	{ENGLISH or FRANCAIS}
PASSCODE	=	{0000 to 9999} (only if 0 or database is unlocked)
SCROLL DELAY	=	{0.07 to 0.25} S
LOAD DEFAULTS		
---- END ----		

4.3.7 "COMMUNICATIONS SETUP..." SUB-MENU

The settings found in this sub-menu must be configured whenever an optional communications board is installed in the Control Module.

CONTROL SETPOINT = 20°C
LO TS 1 = -10°C
LO LOAD = 1.0 A
HI GFI = 50 mA
GFI TRIP = 75 mA
TS ALARMS CONFIG...
OTHER ALARMS CONFIG...
POINT SETUP...
MISC SETUP...
COMMUNICATIONS SETUP...
---- END ----

Table 4.10 Communications Setup

PROTOCOL	= {HTCBUS or MODBUS ASCII or MODBUS RTU}	
HTCBUS ADDR	= {1 to 16777215}	(only if PROTOCOL=HTCBUS)
MODBUS ADDR	= {1 to 247}	(only if PROTOCOL≠HTCBUS)
MODBUS SUB ADDR	= {0 to 31}	(only if PROTOCOL≠HTCBUS)
BAUD RATE	= {AUTO or 9600 or 4800 or 2400 or 1200 or 600 or 300}	
PARITY	= {NONE or ODD or EVEN}	(only if PROTOCOL≠HTCBUS)
HARDWARE	= {NONE OR MODEM OR RS-232 or RS-485}	
DRIVER	= {AUTO or RS-485 or RS-232 or MODEM}	
PROFILE	= {AUTO or 3-WIRE RS-232 or RS-485 or 1200 BAUD MODEM or 300 BAUD MODEM}	
Tx DELAY	= {0.00 to 2.50} S	
---- END ----		

Section 5—Configuration Parameter Details

5.1 Introduction

The sections that follow explain the various functions of the 910 controller and how they may be accessed. The first line of each section identifies the function to be described. Each section goes on to explain the **purpose** of the function, the **range** over which it may be set, the **procedure** for setting or enabling the feature, and finally any **Notes** or **Cautions** that pertain to the particular function.

Setting and using the alarming functions of the 910 controller is a two step procedure:

1. The alarm must be enabled or disabled as desired. When using the Operator Console, access to all alarming functions is available using the ADVANCED CONFIGURE mode sub-menus. When using either the Model 780/GCC-9000 Group Communications Controller, the alarm masks may be found in the HTC SET-UP Section. Please see the appropriate operating manual for instructions on accessing controller parameters using these devices.
2. The corresponding alarm point value may be modified appropriately for the application. When using the Operator Console, access to the alarm points is also available using the ADVANCED CONFIGURE mode sub-menus. Modification of the alarm setpoint values is found in the HTC SETPOINTS Section of the Model 780/GCC-9000 Group Communications Controller. Please see the appropriate operating manual for instructions on accessing controller parameters using these devices.

Note: The Operator Console and the Model 780/GCC-9000 will NOT allow modification of an alarm point value if the alarm has been disabled (DIS) with the exception of the HIGH TS ALARM temperature settings. These may still be modified if the corresponding HIGH LIMIT CUTOFF has been enabled (ENA) to incorrect design or factors outside those considered by the design.

5.2 Point Setup Parameters

This section describes the setup parameters that relate to the 910.

5.2.1 CONTROL SETPOINT TEMPERATURE

Purpose: The CONTROL SETPOINT temperature is the value at which the heat trace controller maintains the circuit temperature through either proportional, proportional ambient SSR, proportional ambient contactor, or deadband control, depending on the controllers' configuration. The CONTROL SETPOINT temperature is compared to the temperature measured by the control temperature sensor (TS). A decision is then made to turn on or turn off the output to control power to the tracer.

Range: -76°F to 1058°F (-60°C to 570°C)

Procedure: Adjust the CONTROL SETPOINT temperature value to the desired maintain temperature. The HTC will switch the output ON and OFF in an attempt to maintain this temperature.

Notes:

- See Section 7.2 of this manual for an explanation of Proportional, Proportional Ambient SSR, Proportional Ambient Contactor, and Deadband Control algorithms.
- When using the Operator Console, the CONTROL SETPOINT temperature range may be limited by the CONSOLE SETPOINT MAXIMUM and MINIMUM values (see Sections 5.2.23 and 5.2.24). This is a safety feature to prevent users in the field from modifying the CONTROL SETPOINT temperature setting to a dangerous level.

5.2.2 ALPHANUMERIC TAG ASSIGNMENT

Purpose: A 19 character alphanumeric TAG may be assigned to a control point to allow it to be easily associated with a pipe, vessel, process, circuit, drawing name, or number.

Setting: Any combination of 19 characters from A–Z, 0–9, /, -, ., (,), or #.

Procedure: Using the Operator Console, enter the desired text.

5.2.3 SWITCH CONTROL MODE

Purpose: This allows selection of the type of algorithm to be used by the HTC to maintain the CONTROL SETPOINT temperature. There are four different control algorithms available in the HTC—proportional, proportional ambient SSR, proportional ambient contactor, and deadband. See Section 7.2 for a complete explanation of these controlling techniques as implemented in the HTC.

Setting: PROPORTIONAL, PROPORTIONAL AMBIENT SSR, PROPORTIONAL AMBIENT CONTACTOR, or DEADBAND

Procedure: Select the desired control technique. Note that deadband control and proportional ambient contactor should be selected when using contactors or when precise control and advanced current handling functions are not required.

Note: If deadband is selected, a DEADBAND setting will be available in the HTC configuration menu; otherwise, a PROPORTIONAL BAND setting will be available. No MAXIMUM POWER, SWITCH CURRENT RATING, or CIRCUIT BREAKER CURRENT RATING settings are available when the controller is set to operate in either contactor mode. If proportional ambient contactor is selected, the CYCLE TIME setting will also be available.

5.2.4 PROPORTIONAL BAND SETTING

(For use with the three proportional control modes only).

Purpose: When an HTC equipped with SSRs is used to control a heating circuit, proportional or proportional ambient SSR modes are normally used, allowing for more precise temperature control. When using contactors, the proportional ambient contactor mode should be selected.

This programmable proportional band acts to vary the on to off time of the output based on the difference between the measured control temperature and the desired CONTROL SETPOINT temperature.

Range: 2°F to 90°F (1°C to 50°C)

Procedure: Adjust the PROPORTIONAL BAND setting to the desired differential from the CONTROL SETPOINT temperature.

Notes:

- See Section 7.2 of this manual for an explanation of how the three proportional modes use the PROPORTIONAL BAND setting.
- When using Series-type, constant wattage, or self-regulating tracers in an ambient temperature control application, significant energy savings may be realized by setting the PROPORTIONAL BAND to match the expected range of operating ambient temperatures. Tracer design is normally done assuming worst-case conditions, where 100% of the design output power is required to maintain the desired minimum temperature. When the ambient temperature is above the design minimum, but some heat is still required, adjusting the PROPORTIONAL BAND width accordingly will allow only the amount of power required by the application to be consumed, while maintaining the minimum required temperature.

Example: A water line must be protected from freezing when the ambient temperature falls below 10°C. Either the proportional ambient SSR or proportional ambient contactor mode is selected as the control method (depending on the type of switch being used). The heater and insulation combination are chosen to impart enough heat to the line to keep it from freezing at a worst-case ambient temperature of -40°C. At 10°C, the heater should be completely off, since no heat is required at this temperature to guarantee that the product will not freeze. It follows that the amount of heat required by the water line decreases as the ambient temperature increases from -40°C to 10°C (theoretically, at -15°C the heater output should be approximately 50%). Setting the CONTROL SETPOINT temperature to 10°C, and the PROPORTIONAL BAND to 50°C, will force the controller's output to be 100% on at -40°C, 50% on at -15°C, and off at 10°C.

5.2.5 DEADBAND SETTING

(Deadband control mode only)

Purpose: When an HTC equipped with a contactor is used to control a heating circuit, it is necessary to use deadband rather than proportional control. This is done to prevent the contactor from switching on and off rapidly and being worn out prematurely. This deadband acts as an on/off control where the decision to turn the output off or on is based upon a window of difference between the measured control temperature and the desired CONTROL SETPOINT temperature.

Range: 2°F to 90°F (1°C to 50°C)

Procedure: Adjust the DEADBAND setting to the desired differential from the desired CONTROL SETPOINT temperature. When the control temperature is above the setpoint + deadband value, the controller will turn off the output to the tracer. If the control temperature drops down below the setpoint, the output will be turned back on. Note that the smaller the DEADBAND setting, the more often the contactor will cycle on and off, decreasing its operational life.

Note: See Section 7.2 of this manual for an explanation of Deadband Control. Note that the MAXIMUM POWER, SWITCH CURRENT RATING, and CIRCUIT BREAKER CURRENT RATING settings are not available when the HTC is set to Deadband mode (typically when switching a contactor).

5.2.6 CYCLE TIME SETTING

(For proportional ambient contactor control mode only).

Purpose: This parameter determines the minimum amount of time it will take for a complete contactor ON-OFF-ON cycle.

Range: 10 to 255 minutes

Procedure: Adjust the CYCLE TIME setting to yield the desired contactor ON+OFF time for a particular duty cycle. For instance, if the contactor should remain on for five minutes with a 50% duty cycle, then the CYCLE TIME should be 10 minutes. A new duty cycle (based on measured control temperature, PROPORTIONAL BAND, and CONTROL SETPOINT) is calculated every time the contactor is required to change state.

Notes:

- If the calculated duty cycle is 0% or 100%, then the contactor will not change state and the duty cycle will not be calculated again for a time period = CYCLE TIME/30.
- The minimum cycle time setting is 10 minutes, and the minimum controller output duty cycle is 3%. This results in a minimum contactor ON time of 18 seconds.

5.2.7 SWITCH CURRENT RATING SETTING (SSR ONLY)

Purpose: The SWITCH CURRENT RATING setting defines the current rating of the output switch. It is used by the controller to limit the maximum average current that will be allowed to flow to the load before it begins to adjust the output duty cycle, limiting the amount of current to an acceptable level.

Range: 0.3 to 100.0 Amps

Procedure: Adjust the SWITCH CURRENT RATING setting to match the current rating of the output device (i.e. 30.0 Amps).

5.2.8 CIRCUIT BREAKER CURRENT RATING SETTING (SSR ONLY)

Purpose: The CIRCUIT BREAKER CURRENT RATING setting helps prevent in-rush induced nuisance tripping of the circuit breaker immediately upstream of the controller. The HTC evaluates the square of the current related to time (I^2t) and adjusts the output duty cycle accordingly, limiting the amount of current to an acceptable level.

Range: 0.3 to 100.0 Amps

Procedure: Adjust the CIRCUIT BREAKER CURRENT RATING setting to the heating circuit breaker size (i.e. 30.0 Amps).

Note: This feature should NOT be used to reduce the size of a circuit breaker or increase the maximum heating cable length. It can be quite effective in preventing nuisance trips due to incorrect design or factors outside those considered by the design.

5.2.9 MAXIMUM POWER SETTING (SSR ONLY)

Purpose: This user selectable level limits the maximum amount of power applied to a heat trace circuit. This is an average power calculated by the controller using the average current and applied voltage. The HTC switches the output on and off rapidly to limit the average current to an appropriate level. The MAXIMUM POWER level may be adjusted to eliminate step-down transformers, lower the effective output wattage of a cable, or implement energy management of the heat trace circuit.

Range: 3 to 33,000 Watts

Procedure: Adjust the MAXIMUM POWER level to the desired value (watts). Use the TEST TRACING function to observe the power limiting operation.

Notes:

- This function may be set within reasonable limits for the particular tracer being powered. The effective resolution of the setting is limited to 1/30th of the calculated full on power.
- Do not set the MAXIMUM POWER below full output for applications that do not require power limiting.

5.2.10 TS FAIL MODE

Purpose: This parameter determines whether the HTC turns the output switch ON or OFF if all selected temperature sensors fail to provide a valid control temperature.

Setting: OFF or ON

Procedure: If the HTC should turn the output switch off when it cannot read a valid control temperature, then select OFF, otherwise if the output switch should turn on, then select ON.

Note: This parameter is part of the TS CONTROL MODE.

5.2.11 TEMPERATURE SENSOR CONTROL MODE

Purpose: The TS CONTROL MODE allows the selection of one of eight possible temperature control modes for the controller. The different modes allow redundant fail-safe temperature sensing, averaging, or minimum maintain temperature control.

Setting: Select one of the following eight possible modes:

CONTROL TS AND DESCRIPTION

CONTROL USING TS 1, FAIL OFF/ON
CONTROL USING TS 1, FAIL TO TS 2
CONTROL USING TS 2, FAIL OFF/ON
CONTROL USING TS 2, FAIL TO TS 1
CONTROL ON AVERAGE, FAIL OFF/ON
CONTROL ON AVERAGE, FAIL TO GOOD
CONTROL ON LOWEST, FAIL OFF/ON
CONTROL ON LOWEST, FAIL TO GOOD

Where OFF/ON = Controllers' output switch turned OFF or ON as determined by the TS FAIL MODE.

Example: With a TS CONTROL MODE of CONTROL ON AVERAGE, FAIL TO GOOD, the controller will measure both sensors (TS 1 and TS 2), averaging the two temperature values, display the results, and cycle the heater ON or OFF to maintain the CONTROL SETPOINT temperature. This is the primary control mode. If either sensor should fail, the controller will transfer control to the remaining "good" sensor and generate the appropriate TS 1 or TS 2 FAILURE ALARM (assuming that the alarm is enabled). The temperature will now be maintained based on this measured value. If the remaining "good" sensor fails, the controller will turn the heater OFF or ON as determined by the TS FAIL MODE setting. The appropriate TS 1 or TS 2 FAILURE ALARM will be also be generated.

Procedure: Select the control mode that best suits the application.

Note: Ensure that TS FAILURE ALARMS are enabled. See Sections 5.4.1, 5.4.4, and 5.4.10 for a complete explanation of RTD failure detection in the HTC.

5.2.12 TS 1 TYPE

Purpose: This parameter specifies the type of RTD that is connected to the HTC's TS 1 input.

Setting: 3 wire 100 Ω Platinum or 2 (or 3) wire 100 Ω Nickel Iron (NI-FE).

Procedure: Select the type of RTD that is connected to the TS 1 input.

Note: If a 2 wire 100 Ω Nickel Iron (NI-FE) RTD is selected then the TS 1 LEAD RESISTANCE must be entered manually (see Section 5.2.13).

5.2.13 TS 1 LEAD RESISTANCE

(For NI-FE RTDs only.)

Purpose: This parameter specifies the lead resistance of a 2 wire Nickel Iron RTD connected to the HTC's TS 1 input.

Range: 0 to 20.00 Ω

Procedure: Measure the resistance of one of the Nickel Iron RTD leads (from the RTD to the HTC's TS 1 input) and use this value as the TS 1 LEAD RESISTANCE.

5.2.14 TS 1 HIGH LIMIT CUTOUT

Purpose: When enabled, the TS 1 high limit cutout feature will override the CONTROL SETPOINT temperature and force the controller output off if the TS 1 reading exceeds the HIGH TS 1 ALARM temperature setting. This is a non-latching condition, so once the TS 1 reading drops below the HIGH TS 1 ALARM temperature setting, the controller will resume normal operation.

Setting: ENABLE or DISABLE

Procedure: Enable or disable the cutout feature as desired.

Notes:

- The TS 1 HIGH LIMIT CUTOUT feature overrides an autocycle test. A pending autocycle will be initiated immediately after the TS 1 temperature drops below the HIGH TS 1 ALARM temperature setting.

- If a TS 1 failure occurs and the TS 1 HIGH LIMIT CUTOFF feature is enabled, the switch output will latch off regardless of the TS CONTROL MODE setting or the TS FAIL MODE setting.
- If the TS 1 HIGH LIMIT CUTOFF feature is enabled, then the HIGH TS 1 ALARM temperature setting can be set, regardless of whether the HIGH TS 1 ALARM is enabled.

5.2.15 TS 2 TYPE

Purpose: This parameter specifies the type of RTD that is connected to the HTC's TS 2 input.

Setting: 3 wire 100 Ω Platinum or 2 (or 3) wire 100 Ω Nickel Iron (NI-FE).

Procedure: Select the type of RTD that is connected to the TS 2 input.

Note: If a 2 wire 100 Ω Nickel Iron (NI-FE) RTD is selected then the TS 2 LEAD RESISTANCE must be entered (see Section 5.2.16).

5.2.16 TS 2 LEAD RESISTANCE

(For NI-FE RTDs only.)

Purpose: This parameter specifies the lead resistance of a 2 wire Nickel Iron RTD connected to the HTC's TS 2 input.

Range: 0 to 20.00 Ω

Procedure: Measure the resistance of one of the Nickel Iron RTD leads (from the RTD to the HTC's TS 2 input) and use this value as the TS 2 LEAD RESISTANCE.

5.2.17 TS 2 HIGH LIMIT CUTOFF

Purpose: When enabled, the TS 2 high limit cutoff feature will override the CONTROL SETPOINT temperature and force the controller output off if the TS 2 reading exceeds the HIGH TS 2 ALARM temperature setting. This is a non-latching condition, so once the TS 2 reading drops below the HIGH TS 2 ALARM temperature setting, the controller will resume normal operation.

Setting: ENABLE or DISABLE

Procedure: Enable or disable the cutoff feature as desired.

Notes:

- The TS 2 HIGH LIMIT CUTOFF feature overrides an autocycle test. A pending autocycle will be initiated immediately after the TS 2 temperature drops below the HIGH TS 2 ALARM temperature setting.
- If a TS 2 failure occurs and the TS 2 HIGH LIMIT CUTOFF feature is enabled, the switch output will latch off regardless of the TS CONTROL MODE setting or the TS FAIL MODE setting.
- If the TS 2 HIGH LIMIT CUTOFF feature is enabled, then the HIGH TS 2 ALARM temperature setting can be set, regardless of whether the HIGH TS 2 ALARM is enabled.

5.2.18 AUTOCYCLE ENABLING

Purpose: The autocycle function momentarily (approximately 10 seconds) applies power to the heating circuit at the selected interval. It is used to test the integrity of the heating circuit. Alarms present at the time of autocycle then become latched and remain active after the completion of the autocycle function. Autocycling effectively eliminates the need for preventive maintenance by automatically verifying the heating circuit integrity.

Setting: ENABLE or DISABLE

Procedure: Enable or disable the autocycling feature as desired. If the feature is disabled, you will not be prompted to enter the AUTOCYCLE INTERVAL or AUTOCYCLE UNITS.

Notes:

- Autocycling should always be enabled for normal operation. Disabling this feature should

only be required where the HTC system is monitoring a circuit exercised by some other device or means. Although this function defeats temperature control and forces output on, the controller will continue to adjust the output for protection purposes or power limiting (SSR option only).

- Autocycling is inhibited if the controller is in the load shedding mode. See Section 7.3.
- If autocycling is enabled, the HTC will always autocycle for 10 seconds when power is initially applied.
- If autocycling is enabled, and TS FAIL MODE = OFF and all the control temperature sensors have failed, the HTC will still perform an autocycle.
- If an alarm condition with an alarm filter time greater than 0 appears during the autocycling, then the autocycle will be extended (past the 10 seconds) until the alarm filter time has expired.

5.2.19 AUTOCYCLE TIME INTERVAL

Purpose: AUTOCYCLE INTERVAL is the number of hours/minutes between successive heating circuit integrity tests depending on the AUTOCYCLE UNITS specified.

Range: 1 to 240

Procedure: Set the AUTOCYCLE INTERVAL to the desired time period.

Notes:

- When using proportional ambient contactor mode, the CYCLE TIME setting should be less than the AUTOCYCLE INTERVAL; otherwise, autocycling could affect the duty-cycle.
- If an AC ALARM becomes active during an autocycle, but the AUTOCYCLE INTERVAL expires prior to the corresponding ALARM FILTER time, then autocycling will continue until the ALARM FILTER time has elapsed.
- For the earliest possible alarming of heating circuit problems, the AUTOCYCLE INTERVAL should be set to a small value.

5.2.20 AUTOCYCLE TIME UNITS

Purpose: The autocycle time units parameter allows selection of minutes or hours for the AUTOCYCLE INTERVAL setting.

Setting: HOURS or MINUTES

Procedure: Set the AUTOCYCLE UNITS to the desired time units.

5.2.21 OVERRIDE SOURCE

Purpose: An override signal can be sent to the HTC from one of two sources. This override signal can be used to override the controller's temperature control and force the output switch off or on. This is especially useful when the user wishes to turn a controller or a group of controllers off over the summer months, during maintenance, or when a line is flowing and does not require heating.

Setting: REMOTE or EXT. INPUT

Procedure: If the override signal will be generated remotely and received by the HTC via the optional communications interface, select REMOTE as the OVERRIDE SOURCE. If the override signal will be received by the HTC via the external input, select EXTERNAL INPUT as the OVERRIDE SOURCE.

Notes:

- If the EXTERNAL INPUT is not configured as either INHIBIT or FORCE ON then OVERRIDE SOURCE will always automatically be set to REMOTE. See Section 5-3-3 for further details.
- If the autocycle feature is enabled, it will continue to function even when an INHIBIT override signal is being received as long as load shedding is not active.
- Fail safe mode is inactive if an INHIBIT override signal is being received.
- Load shedding and fail safe modes are inactive if a FORCE ON override signal is being received.

-
- Only the LOW TS ALARMS for temperature sensors used by the TS CONTROL MODE are inactive if an INHIBIT override signal is being received.

5.2.22 LOAD SHEDDING ENABLING

Purpose: The load shedding function allows the controller output to be forced OFF by way of a remote contact input on the 780 Group Communications Controller or using the communications port and an upstream device. It may be used to turn OFF the output of one or more controllers in order to reduce energy consumption to avoid peak demand surcharges, remove power from unused circuits, or remove power from circuits which may be subjected to steam cleaning.

Setting: ENABLE or DISABLE

Procedure: Enable or disable the load shedding control mode as desired.

Note: To completely configure the HTC for load shedding operation, the following additional parameters must be set up using the Model 780/GCC-9000:

- Fail Safe Mode
- Load Shedding GCC Contact Association

These additional parameters may only be accessed using the Group Communications Controller. See the appropriate Section of the GCC manual for further details.

Notes:

- Fail safe mode is not supported when using proportional ambient SSR or proportional ambient contactor modes.
- For fail safe mode to function, at least one LOW TS ALARM of the controlling temperature sensor(s) must be enabled and the corresponding LOW TS ALARM temperature setting must be less than the CONTROL SETPOINT temperature.

5.2.23 CONSOLE SETPOINT MAXIMUM

Purpose: When using the Operator Console the maximum setting of the CONTROL SETPOINT temperature may be limited to the CONSOLE SETPOINT MAXIMUM value. This is a safety feature to prevent users in the field from modifying the CONTROL SETPOINT temperature setting to a dangerous level.

Range: -76°F to 1058°F (-60°C to 570°C)

Procedure: Adjust the CONSOLE SETPOINT MAXIMUM temperature value to limit the maximum allowable CONTROL SETPOINT TEMPERATURE that may be set using the Operator Console. The CONSOLE SETPOINT MAXIMUM may only be set using a communicating device such as the Model 780/GCC-9000. See the 780/GCC-9000 user manual for the proper procedure.

Note: The CONSOLE SETPOINT MAXIMUM is not displayed on the Operator Console.

5.2.24 CONSOLE SETPOINT MINIMUM

Purpose: When using the Operator Console the minimum setting of the CONTROL SETPOINT temperature may be limited to the CONSOLE SETPOINT MINIMUM value. This is a safety feature to prevent users in the field from modifying the CONTROL SETPOINT temperature setting to a dangerous level.

Range: -76°F to 1058°F (-60°C to 570°C)

Procedure: Adjust the CONSOLE SETPOINT MINIMUM temperature value to limit the minimum allowable CONTROL SETPOINT TEMPERATURE that may be set using the Operator Console. The CONSOLE SETPOINT MINIMUM may only be set using a communicating device such as the Model 780/GCC-9000. See the 780/GCC-9000 manual for the proper procedure.

Note: The CONSOLE SETPOINT MINIMUM is not displayed on the Operator Console.

5.3 Miscellaneous Setup Parameters

The following section describes miscellaneous the setup parameters.

5.3.1 TEMPERATURE DISPLAY UNITS

Purpose: This allows selection of the type of temperature units to display on the Operator Console. All temperature related values will be displayed in the selected units.

Note: This setting will not affect the temperature units displayed at a 780/GCC-9000 Group Communications Controller. The GCC may be set independently.

Setting: DEGREES F or DEGREES C

Procedure: Adjust the setting to the desired temperature units (°F or °C).

Note: To minimize possible confusion, it is recommended that the temperature units be set the same on the HTC and any other communicating devices.

5.3.2 VERSION OF FIRMWARE AND HARDWARE

Purpose: The first three digits indicate the revision level of the firmware programmed into the controller. As new features are added to the HTC, the firmware revision level is incremented to allow the user to determine which features are available for the particular unit being used.

5.3.3 EXTERNAL INPUT PORT

Purpose: This input port may be used as an OVERRIDE SOURCE to sense a remote dry contact closure. This will override the controller's temperature control and force its output switch off or on.

Setting: NOT USED, INHIBIT, or FORCE ON

Procedure: If the EXTERNAL INPUT is not being used, select NOT USED. If a remote dry contact closure should force the output switch off then select INHIBIT. If a remote dry contact closure should force the output switch on, then select FORCE ON.

If the EXTERNAL INPUT is set to INHIBIT or FORCE ON, then OVERRIDE SOURCE must be set to EXT. INPUT.

Notes:

- When used with the INHIBIT/FORCE ON feature, a contact closure sensed by the EXTERNAL INPUT will initiate the INHIBIT/FORCE ON mode. An open input will cause the controller to revert to normal temperature control operation.
One possible use of the INHIBIT feature is to use an external device (such as a flow meter) to provide a contact closure if there is flow in a line. As long as the line has adequate flow, the heating will be off (INHIBITED from operating). See Appendix C for typical connection diagrams when using this input.
- EXTERNAL INPUT must be set to INHIBIT or FORCE ON before OVERRIDE SOURCE can be set to EXT. INPUT. Setting EXTERNAL INPUT to NOT USED or TEMPBUS™ will *automatically* set OVERRIDE SOURCE to REMOTE.

5.3.4 FLASH ALARM OUTPUT SETTING

Purpose: Programs both the alarm output relays (dry contact and AC alarm) for flashing or steady output in case of an alarm condition.

Setting: YES (Flash) or NO (Steady)

Procedure: Set the alarm output relays to flash or not to flash on an alarm condition, whichever suits the application.

Notes:

- If the alarm output is used to drive a pilot light, it is recommended that YES be selected to enable flashing operation. When the output is also configured for normally closed operation, the pilot light will be on steady for normal operation, flash in case of alarm,

and be extinguished due to a bulb failure or loss of power.

- If multiple alarm outputs from different controllers are wired in series (i.e.: multi-point panels), set this parameter to NO (steady).

5.3.5 ALARM OUTPUT NORMAL STATE

Purpose: Configures both the alarm output relays (dry contact and AC alarm) for normally open or normally closed operation. The normal condition is assumed to be when the HTC is powered and no alarms exist.

Setting: N.O. (Normally Open) or N.C. (Normally Closed)

Procedure: Set the alarm output relays to normally open or normally closed to suit the application.

Note: If a pilot light is used for indication of alarms, normally closed operation provides a steady illumination of the lamp when the circuit is operating correctly. A light that is flashing or out indicates a fault condition. A burned out lamp is readily identified if the HTC is set to flash the dry contact alarm output relay and the AC Alarm Relay output in case of alarm. See the Section 5.3.4.

5.3.6 LANGUAGE

Purpose: Defines which language the Operator Console is to use when prompting the user for input and/or displaying messages and status.

Setting: ENGLISH or FRANCAIS

Procedure: Select the language of choice: ENGLISH for English prompts and messages, or FRANCAIS for French prompts and messages.

5.3.7 PASSCODE

See Section 5.7.1.

5.3.8 SCROLL DELAY SETTING

Purpose: Allows the user to modify the speed at which information is scrolled on the Operator Console for ease of viewing.

Range: 0.07 to 0.25 seconds

Procedure: Decreasing the scroll delay value will cause the information on the display to scroll by faster. Increasing the scroll delay value will cause the information on the display to scroll by slower.

5.4 Temperature Sensor Alarms Configuration

This section defines the temperature related alarming functions of the 910 controller.

5.4.1 TEMPERATURE SENSOR 1 FAILURE ALARM

Purpose: Enabling TS 1 FAILURE will provide indication of an open or shorted failure of TS 1.

Alarm Mask: ENABLE or DISABLE

Procedure: Enable or disable alarming of a failed temperature sensor connected to the TS 1 input as required.

Notes:

- This failure alarm should be enabled if a temperature sensor is connected to the TS 1 input.
- This alarm is always latched and must be reset by the user.

5.4.2 LOW TEMPERATURE SENSOR 1 ALARM

Purpose: If enabled, the LOW TS 1 ALARM allows for alarming of low temperature conditions as sensed by the first temperature sensor (TS 1).

Alarm Mask: ENABLE or DISABLE

Range: -76°F to 1058°F (-60°C to 570°C)

Procedure: Adjust the LOW TS 1 ALARM temperature setpoint to the desired value. Note that the LOW TS 1 ALARM must be enabled in order to adjust the LOW TS 1 ALARM temperature setpoint.

Notes:

- This alarm should normally be enabled and the setpoint should be appropriate for the heating application. Maintaining a minimum 5°C differential between low temperature alarming and the CONTROL SETPOINT temperature will minimize nuisance alarming due to momentary dips in temperature. Another alternative to this is to configure the controller for non-latching temperature alarms.
- This alarm must be enabled and its setpoint must be below the CONTROL SETPOINT temperature if fail safe mode uses the temperature reading from TS 1.

5.4.3 HIGH TEMPERATURE SENSOR 1 ALARM

Purpose: If enabled, the HIGH TS 1 ALARM allows for alarming of high temperature conditions as sensed by the first temperature sensor (TS 1).

Alarm Mask: ENABLE or DISABLE

Range: -76°F to 1058°F (-60°C to 570°C)

Procedure: Adjust the HIGH TS 1 ALARM temperature setpoint to the desired value. Note that the HIGH TS 1 ALARM must be enabled in order to adjust the HIGH TS 1 ALARM temperature setpoint unless the TS 1 high limit cutout feature is enabled.

Note: This alarm should only be used for applications where a product that is sensitive to over temperature is involved. General usage may result in nuisance alarms due to the flow of hot product or steam out. This may be a case where the alarm should be enabled and non-latching temperature alarming should be used. A high temperature condition resulting from a forced on failure of the heating circuit should first be alarmed by the SWITCH FAILURE ALARM. See Section 5.5.18 for more information.

5.4.4 TEMPERATURE SENSOR 2 FAILURE ALARM

Purpose: Enabling TS 2 FAILURE will provide indication of an open or shorted failure of TS 2.

Alarm Mask: ENABLE or DISABLE

Procedure: Enable or disable alarming of a failed temperature sensor connected to the TS 2 input as required.

Notes:

- If no second sensor is installed, this alarm should be disabled. This failure alarm should be enabled if a second temperature sensor is connected to the TS 2 input.
- This alarm is always latched and must be reset by the user.

5.4.5 LOW TEMPERATURE SENSOR 2 ALARM

Purpose: If enabled, the LOW TS 2 ALARM allows for alarming of low temperature conditions as sensed by the second temperature sensor (TS 2).

Alarm Mask: ENABLE or DISABLE

Range: -76°F to 1058°F (-60°C to 570°C)

Procedure: Adjust LOW TS 2 ALARM temperature setpoint to the desired value. Note that the LOW TS 2 ALARM must be enabled in order to adjust the LOW TS 2 ALARM temperature setpoint.

Notes:

- If no second sensor is installed this alarm should be disabled. This alarm should be enabled and the setpoint should be appropriate for the heating application. Maintaining a

minimum 5°C differential between low temperature alarming and the CONTROL SET-POINT temperature will minimize nuisance alarming due to momentary dips in temperature. Another alternative to this is to configure the controller for non-latching temperature alarms.

- This alarm must be enabled and its setpoint must be below the CONTROL SETPOINT temperature if fail safe mode uses the temperature from TS 2.

5.4.6 HIGH TEMPERATURE SENSOR 2 ALARM

Purpose: If enabled, the HIGH TS 2 ALARM allows for alarming of high temperature conditions as sensed by the second temperature sensor (TS 2).

Alarm Mask: ENABLE or DISABLE

Range: -76°F to 1058°F (-60°C to 570°C)

Procedure: Adjust the HIGH TS 2 ALARM temperature setpoint to the desired value. Note that the HIGH TS 2 ALARM must be enabled in order to adjust the HIGH TS 2 ALARM temperature setpoint unless the TS 2 high limit cutout feature is enabled.

Note: If no second sensor is installed this alarm should be disabled. This alarm may be used for applications where a product that is sensitive to over temperature is involved. General usage could result in nuisance alarms due to the flow of hot product or steam out. This may be a case where the alarm could be enabled and non-latching temperature alarming used. A high temperature condition resulting from a forced on failure of the heating circuit should first be alarmed by the SWITCH FAILURE ALARM. See Section 5.5.18 for more information.

5.4.7 LOW TEMPERATURE SENSOR ALARM FILTER TIME SETTING

Purpose: The LOW TS ALARM FILTER will prevent LOW TS 1 and/or LOW TS 2 ALARMS from being indicated until their corresponding alarm condition has existed for the duration of the LOW TS ALARM FILTER time.

Range: 0 to 999 minutes

Procedure: Adjust the LOW TS ALARM FILTER time to the desired value. Note that either the LOW TS 1 ALARM and/or the LOW TS 2 ALARM must be enabled in order to adjust the LOW TS ALARM FILTER time.

Notes:

- If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.
- If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5.4.8 HIGH TEMPERATURE SENSOR ALARM FILTER TIME SETTING

Purpose: The HIGH TS ALARM FILTER will prevent HIGH TS 1 and/or HIGH TS 2 ALARMS from being indicated until their corresponding alarm condition has existed for the duration of the HIGH TS ALARM FILTER time.

Range: 0 to 999 minutes

Procedure: Adjust the HIGH TS ALARM FILTER time to the desired value. Note that either the HIGH TS 1 ALARM and/or the HIGH TS 2 ALARM must be enabled in order to adjust the HIGH TS ALARM FILTER time.

Notes:

- If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.
- If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

- The HIGH TS ALARM FILTER time setting will not affect the cutout time when the HIGH LIMIT CUTOFF feature is enabled.

5.4.9 LATCH TEMPERATURE SENSOR ALARMS SETTING

Purpose: This allows for the selection of automatic clearing of all HIGH and LOW TS ALARMS (non-latching) when a temperature alarm condition no longer exists or permanent alarming of such a condition (latching) until the alarm is manually reset.

Setting: YES (LATCHING) or NO (NON-LATCHING)

Procedure: Adjust the LATCH TS ALARMS setting to the desired mode (latching or non-latching).

Notes:

- If your application is subject to periodic situations where cold or hot product is part of the process, it may be appropriate to configure the HTC for non-latching temperature alarms to avoid nuisance alarms. If it is important to be aware of any temperature alarm conditions that may have existed in a pipe, then the HTC should be configured for latching temperature alarms.
- This setting does not affect the TS FAILURE ALARMS—these are always latching.

5.4.10 CONTROL TEMPERATURE SENSOR FAILURE ALARM

Purpose: Control TS FAILURE ALARM indicates a failure of the temperature sensor designated as the control sensor.

One of eight TS CONTROL MODES may be selected. These modes determine which TS input(s) is(are) designated to provide the control temperature. See Section 5-2-11 for a full description of the temperature sensor control designations.

Alarm Mask: ENABLE or DISABLE

Procedure: Enable or disable the alarming of a failure of the designated control temperature sensor as required.

Note: This alarm should always be enabled. If the controller experiences a Control TS Failure it will turn the output off or on (as specified by TS FAIL MODE) until this alarm is cleared.

5.5 Other Alarms Configuration

This section defines the non-temperature-related alarming functions of the 910 controller (current, ground fault, voltage and resistance).

5.5.1 LOW LOAD CURRENT ALARM

Purpose: Alarms current levels which are lower than a preset limit for the application. Monitoring for lower than expected current levels may be an effective means of continuity monitoring. See also HIGH RESISTANCE ALARM in Section 5.5.14.

Alarm Mask: ENABLE or DISABLE

Range: 0.3 to 100.0 Amps

Procedure: Adjust the LOW CURRENT ALARM level to the desired value. Note that the LOW CURRENT ALARM must be enabled in order to adjust the LOW CURRENT ALARM level.

Notes:

- For series type heating cables, adjusting the LOW CURRENT ALARM to 50% of full load current will properly alarm a problem and reduce nuisance alarms due to voltage dips. Parallel heaters should be adjusted to a level as close as possible to full load current but lower than the current at worst case voltage. The low current setting as a percentage of full load current will vary depending on the facility and its power system.
- A LOW CURRENT ALARM may also result from a switch failed open. The controller can-

not detect a switch failure due to no current. A no current condition would be identified by a LOW CURRENT ALARM (if enabled) and the analog value reported with the alarm will be 0.0 A.

- It may be advantageous to consider using the HIGH RESISTANCE ALARM to indicate a cable fault when using certain types of heaters. See Sections 5.5.12 and 5.5.14 for an explanation of the resistance alarming feature.

5.5.2 LOW LOAD CURRENT ALARM FILTER TIME SETTING

Purpose: The LOW CURRENT ALARM FILTER will prevent LOW LOAD CURRENT ALARMS from being indicated until a low current condition has existed for the duration of the LOW CURRENT ALARM FILTER time.

Range: 0 to 12 seconds

Procedure: Adjust the LOW CURRENT ALARM FILTER time to the desired value. Note that the LOW CURRENT ALARM must be enabled in order to adjust the LOW CURRENT ALARM FILTER time.

Notes:

- If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.
- If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5.5.3 HIGH LOAD CURRENT ALARM

Purpose: Alarms current levels which are higher than a preset limit for the application.

Alarm Mask: ENABLE or DISABLE

Range: 0.3 to 100.0 Amps

Procedure: Adjust the HIGH CURRENT ALARM level to the desired value. Note that the HIGH CURRENT ALARM must be enabled in order to adjust the HIGH CURRENT ALARM level.

Note: As the HTC automatically protects itself from overload, it would not normally be necessary to enable this alarm. This automatic protection can be used effectively to guard against accidental paralleling of heating circuits. In-rush, or cold start currents typically associated with self-regulating cables, may cause nuisance HIGH CURRENT ALARMS. If this is undesirable this alarm should be disabled.

5.5.4 HIGH LOAD CURRENT ALARM FILTER TIME SETTING

Purpose: The HIGH CURRENT ALARM FILTER will prevent HIGH LOAD CURRENT ALARMS from being indicated until a high current condition has existed for the duration of the HIGH CURRENT ALARM FILTER time.

Range: 0 to 12 seconds

Procedure: Adjust the HIGH CURRENT ALARM FILTER time to the desired value. Note that the HIGH CURRENT ALARM must be enabled in order to adjust the HIGH CURRENT ALARM FILTER time.

Notes:

- If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.
- If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5.5.5 HIGH GROUND FAULT CURRENT ALARM

Purpose: Alarms ground fault current levels which are higher than a preset limit for the application.

Alarm Mask: ENABLE or DISABLE

Range: 20 to 250 mAmps

Procedure: Adjust the HIGH GFI ALARM level to the desired value. Note that the HIGH GFI ALARM must be enabled in order to adjust the HIGH GFI level.

5.5.6 HIGH GROUND FAULT CURRENT ALARM FILTER TIME SETTING

Purpose: The HIGH GFI ALARM FILTER will prevent HIGH GFI ALARMS from being indicated until a high GFI condition has existed for the duration of the HIGH GFI ALARM FILTER time.

Range: 0 to 12 seconds

Procedure: Adjust the HIGH GFI ALARM FILTER time to the desired value. Note that the HIGH GFI ALARM must be enabled in order to adjust the HIGH GFI ALARM FILTER time.

Notes:

- If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.
- If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5.5.7 GROUND FAULT TRIP ALARM

Purpose: This value sets the upper limit of allowable ground fault leakage current. Exceeding this limit will result in the output switch being latched off and the GFI TRIP ALARM activated to indicate a ground fault condition.

Alarm Mask: ENABLE or DISABLE

Range: 20 to 250 mAmps

Procedure: If ground fault tripping is desired, enable the GFI TRIP ALARM and adjust the G.F. TRIP CURRENT to the desired value. To disable ground fault tripping, disable the alarm. Note that the GFI TRIP ALARM must be enabled in order to adjust the G.F. TRIP CURRENT level.



Caution: In order to implement a ground fault trip function, ALL NON-GROUNDED power conductors must be opened upon detection of a ground fault condition.

Note: National Electrical Codes may require that all legs of non-neutral based power sources be opened upon detection of a Ground Fault. Multi-pole switch configurations should be used on non-neutral based power systems. Check the requirements with your local Electrical Authority.

5.5.8 LOW VOLTAGE ALARM

Purpose: Alarms voltage levels that are lower than a preset limit for the application.

Alarm Mask: ENABLE or DISABLE

Range: 10 to 330 Volts

Procedure: Adjust the LOW VOLTAGE ALARM level to the desired value. Note that the LOW VOLTAGE ALARM must be enabled in order to adjust the LOW VOLTAGE ALARM level.

Note: It is recommended that the LOW VOLTAGE ALARM always be enabled.

5.5.9 LOW VOLTAGE ALARM FILTER TIME SETTING

Purpose: The LOW VOLTAGE ALARM FILTER will prevent LOW VOLTAGE ALARMS from being indicated until a low voltage condition has existed for the duration of the LOW VOLTAGE ALARM FILTER time.

Range: 0 to 12 seconds

Procedure: Adjust the LOW VOLTAGE ALARM FILTER time to the desired value. Note that

the LOW VOLTAGE ALARM must be enabled in order to adjust the LOW VOLTAGE ALARM FILTER time.

Notes:

- If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.
- If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5.5.10 HIGH VOLTAGE ALARM

Purpose: Alarms voltage levels that are higher than a preset limit for the application. Serves as a monitor of the voltage used to power the tracing circuit.

Alarm Mask: ENABLE or DISABLE

Range: 10 to 330 Volts

Procedure: Adjust the HIGH VOLTAGE ALARM level to the desired value. Note that the HIGH VOLTAGE ALARM must be enabled in order to adjust the HIGH VOLTAGE ALARM level.

5.5.11 HIGH VOLTAGE ALARM FILTER TIME SETTING

Purpose: The HIGH VOLTAGE ALARM FILTER will prevent HIGH VOLTAGE ALARMS from being indicated until a high voltage condition has existed for the duration of the HIGH VOLTAGE ALARM FILTER time.

Range: 0 to 12 seconds

Procedure: Adjust the HIGH VOLTAGE ALARM FILTER time to the desired value. Note that the HIGH VOLTAGE ALARM must be enabled in order to adjust the HIGH VOLTAGE ALARM FILTER time.

Notes:

- If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.
- If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5.5.12 LOW RESISTANCE ALARM

Purpose: Alarms heater resistance levels that have decreased from the NOMINAL RESISTANCE setting by more than the selected amount.

Alarm Mask: ENABLE or DISABLE

Range: 1% to 100% (deviation from NOMINAL RESISTANCE)

Procedure: Adjust the LOW RESISTANCE ALARM deviation to the desired value. Note that the LOW RESISTANCE ALARM must be enabled in order to adjust the LOW RESISTANCE deviation.

Notes:

- This feature would not normally be enabled. It can be used effectively to guard against accidental paralleling of heating circuits. Care must be taken when using this alarm feature with heating cables that exhibit a variable resistance with temperature. Low resistance alarming may not be practical when the load has an increasing resistance with temperature (such as self-regulating cables).
- Use of the LOW RESISTANCE ALARM assumes that the controller power is derived from the same circuit as the tracing power (either by direct connection or through a step-down transformer).
- No LOW RESISTANCE ALARMS will be generated if the measured voltage is below the LOW VOLTAGE ALARM setpoint, regardless if the LOW VOLTAGE ALARM is enabled. This stops an alarm from being generated when the circuit power is turned off. If the LOW

VOLTAGE ALARM is disabled, ensure that the LOW VOLTAGE setpoint is set to a relevant level otherwise no LOW RESISTANCE ALARMS will occur.

- LOW RESISTANCE ALARMS will only be generated if the output switch is on.

5.5.13 LOW RESISTANCE ALARM FILTER TIME SETTING

Purpose: The LOW RESISTANCE ALARM FILTER will prevent LOW RESISTANCE ALARMS from being indicated until a low resistance condition has existed for the duration of the LOW RESISTANCE ALARM FILTER time.

Range: 0 to 12 seconds

Procedure: Adjust the LOW RESISTANCE ALARM FILTER time to the desired value. Note that the LOW RESISTANCE ALARM must be enabled in order to adjust the LOW RESISTANCE ALARM FILTER time.

Notes:

- If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.
- If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5.5.14 HIGH RESISTANCE ALARM

Purpose: Alarms heater resistance levels that have increased from the NOMINAL RESISTANCE setting by more than the selected amount. The HIGH RESISTANCE ALARM may be used to indicate an open or a high resistance connection or, when using constant wattage parallel cables, may indicate the failure of one or more heating zones. It may also be used to monitor a failed series-type cable or connection in three-phase applications while minimizing nuisance alarms created by voltage fluctuations.

Alarm Mask: ENABLE or DISABLE

Range: 1% to 250% (deviation from NOMINAL RESISTANCE)

Procedure: Adjust the HIGH RESISTANCE ALARM level to the desired value. Note that the HIGH RESISTANCE ALARM must be enabled in order to adjust the HIGH RESISTANCE deviation.

Notes:

- Using the LOW CURRENT ALARM feature to ensure that unexpected decreases in current consumption by the heating cable are alarmed is a reliable method of monitoring the integrity of series-type heating cables. When using parallel-type heaters (zoned constant-wattage or self-regulating) or in three-phase installations, the LOW CURRENT ALARM setting must be chosen as close to the lowest expected current as possible to detect failed zones, or cable degradation, or a lost phase. The problem with such a close setting is that it inevitably leads to nuisance alarms, particularly when voltage fluctuations are present. By using the HIGH RESISTANCE ALARM, nuisance alarms due to voltage dips may be minimized.
- Use of the HIGH RESISTANCE ALARM assumes that the controller power is derived from the same circuit as the tracing power.
- No HIGH RESISTANCE ALARMS will be generated if the measured voltage is below the LOW VOLTAGE ALARM setpoint, regardless of whether the LOW VOLTAGE ALARM is enabled. This stops an alarm from being generated when the circuit power is turned off. If the LOW VOLTAGE ALARM is disabled ensure that the LOW VOLTAGE setpoint is set to a relevant level otherwise no HIGH RESISTANCE ALARMS will occur.
- HIGH RESISTANCE ALARMS will only be generated if the output switch is on.

5.5.15 HIGH RESISTANCE ALARM FILTER TIME SETTING

Purpose: The HIGH RESISTANCE ALARM FILTER will prevent HIGH RESISTANCE ALARMS from being indicated until a high resistance condition has existed for the duration of the HIGH RESISTANCE ALARM FILTER time.

Range: 0 to 12 seconds

Procedure: Adjust the HIGH RESISTANCE ALARM FILTER time to the desired value. Note that the HIGH RESISTANCE ALARM must be enabled in order to adjust the HIGH RESISTANCE ALARM FILTER time.

Notes:

- If an alarm condition appears and then disappears before the alarm filter time has expired, the filter timer is reset and the alarm condition must exist again for the entire alarm filter time before the corresponding alarm will be indicated.
- If the user resets an alarm while the alarm condition is still exists, then the alarm will not be indicated again until the entire alarm filter time has expired.

5.5.16 NOMINAL RESISTANCE SETTING

Purpose: This parameter defines the nominal expected heater resistance. A value must be entered by the user to allow the HIGH and LOW RESISTANCE ALARMS to be used. In installations where the power source may experience periodic fluctuations (surges and/or brown-out conditions), alarming on resistance deviation offers an improved method of monitoring tracer integrity than simple LOW and HIGH CURRENT ALARMS. Since the ratio of voltage to current is monitored, the HIGH and LOW RESISTANCE ALARMS offer cable monitoring that is relatively immune to voltage fluctuations.

Range: 2.00 to 2000.00 Ω

Procedure: The NOMINAL RESISTANCE value can only be set if either the LOW RESISTANCE and/or the HIGH RESISTANCE ALARMS are enabled. Once the controller and the heating cable have been installed, the following procedure should be used to determine the NOMINAL RESISTANCE setting:

- Adjust the CONTROL SETPOINT temperature to turn on the output switch.
- Allow the load to come up to design temperature and its power consumption to stabilize.
- Using the 920 Operator Console, access the RESISTANCE reading and record its value. Return the CONTROL SETPOINT temperature to its proper setting.
- Enter the recorded resistance value as the NOMINAL RESISTANCE setting.

Note: The setup procedure outlined above may have to be repeated a number of times to arrive at a correct nominal resistance setting. This value will be affected by the heating cable temperature, which in turn is affected by ambient temperature, insulation level, a full or empty pipe or vessel, etc.

5.5.17 OVERCURRENT TRIP ALARM (SSR ONLY)

Purpose: The overcurrent trip feature is always enabled when using an SSR output switch and is used to provide protection for the output switch. Enabling this alarm will only inform the user of an excessively high current condition and that the output switch has been latched off. During a high current condition, the controller attempts to soft start a heating cable using a technique involving measured in-rush current and the SWITCH CURRENT RATING. If the controller is unable to start the cable, it will eventually trip its output switch off and will not retry or pulse its output switch again. At this point the OVERCURRENT TRIP ALARM is latched on.

Notes:

- The controller is NOT a safety cutout or an overcurrent protective device as defined by the National and Canadian Electrical Codes (NEC and CEC). A protective device such as a circuit breaker or fuse must be included as part of a proper design and be selected in accordance with the requirements defined in the National Electrical Code (NEC) and/or the Canadian Electrical Code (CEC).
- The controller cannot protect the SSR from short circuits or excessive overcurrent conditions. Always ensure that the power is off prior to performing any maintenance or troubleshooting of the heating circuit. Verify that no damage has occurred to the cable or the controller prior to re-energizing the circuit.

Alarm Mask: ENABLE or DISABLE

Procedure: Adjust the SWITCH CURRENT RATING setting to the actual current rating of the

SSR. Enable or disable the alarm as required. Note that the OVERCURRENT TRIP ALARM does not have to be enabled in order to adjust the SWITCH CURRENT RATING setting.

Note: It is highly recommended that this alarm be left enabled since an overcurrent trip condition would normally represent a serious problem. Note that this is a factory set alarm value and disabling the alarm does not disable the overcurrent trip function. In some applications the use of self-regulating cable will produce very high in-rush currents during cold startup. These currents may exceed the overcurrent trip limit and the controller will not be able to soft start the trace circuit. If this condition persists please contact your nearest sales office for recommendations and solutions to this problem.

5.5.18 SWITCH FAILURE ALARM

Purpose: The purpose of the SWITCH FAILURE ALARM is to indicate that an output switch failure has occurred. The controller determines that if the output switch is turned off and there is load current present, then the output switch has failed closed and the alarm is latched on.

Alarm Mask: ENABLE or DISABLE

Procedure: Enable or disable the alarming of an output switch that has failed in the closed position.

Note: The SWITCH FAILURE ALARM SHOULD ALWAYS BE ENABLED. A high temperature condition as a result of a failed circuit can only be caused if the output switch fails closed. When an output switch fails closed, the controller cannot turn the tracer off; therefore, no protection features are available (ground fault trip, power limiting, etc.). If a SWITCH FAILURE ALARM is detected, the unit should be serviced immediately.

5.5.19 HTC RESET ALARM

Purpose: The HTC RESET ALARM is used to indicate:

1. Power to the HTC has been interrupted and subsequently restored.
2. A transient has caused the HTC's microprocessor to restart.
3. An internal condition has caused the HTC's microprocessor to restart its program.

Alarm Mask: ENABLE or DISABLE

Procedure: Enable or disable alarming on reset as desired.

Note: Normally the HTC RESET ALARM is left disabled since powering the controller off and on for maintenance or trouble-shooting would require the user to reset this alarm every time. If the particular installation includes a Model 780/GCC-9000, this alarm may be left enabled since resets are not considered normal occurrences and the Model 780/GCC-9000 provides the capability to easily log and reset alarms such as these. The difference in time between when a COMMUNICATIONS FAIL ALARM and an HTC RESET ALARM are logged provide an indication of how long the circuit has been "OFF."

5.5.20 CIRCUIT BREAKER LIMITING STATUS (SSR ONLY)

Purpose: The circuit breaker limiting feature is always enabled when using an SSR output switch and is intended to prevent the circuit breaker immediately upstream of the controller from tripping during a temporary overcurrent condition. Enabling this alarm will only inform the user that circuit breaker limiting is currently active.

Alarm Mask: ENABLE or DISABLE

Procedure: Adjust the CIRCUIT BREAKER CURRENT RATING setting to the heating circuit breaker size (i.e. 15.0 or 20.0 Amps). Enable or disable the alarm as required. Note that the CIRCUIT BREAKER LIMITING ALARM does not have to be enabled in order to adjust the CIRCUIT BREAKER CURRENT RATING setting.

Notes:

- This is a non-latching alarm.
- This alarm may be considered an advisory alarm. If the measured current exceeds the

level that would cause the upstream circuit breaker to release, the HTC will begin to switch the SSR ON and OFF rapidly to limit the average current to an acceptable level.

5-5-21 POWER LIMITING STATUS (SSR ONLY)

Purpose: The power limiting feature is always enabled when using an SSR output switch and is intended to limit the average amount of power that is applied to the trace circuit. The controller measures the voltage and current of the tracing circuit and will vary its output switch to limit the amount of power applied to the trace to the value set by the MAXIMUM POWER setting. Enabling this alarm will only inform the user that power limiting is currently active.

Alarm Mask: ENABLE or DISABLE

Procedure: Adjust the MAXIMUM POWER setting to the desired value. Enable or disable the alarm as required. Note that the POWER LIMITING ALARM does not have to be enabled in order to adjust the MAXIMUM POWER setting.

Notes:

- This is a non-latching alarm.
- This alarm may be considered more appropriately an advisory alarm and is normally disabled. It will be active if the MAXIMUM POWER setting is set below the power output level required for temperature maintenance. In other words, if the circuit demands the maximum power allowed and the alarm is enabled, then this alarm will be indicated and the output switch will pulse ON and OFF to limit the average power output to a value approximately equal to the MAXIMUM POWER setting.

5.5.22 SWITCH LIMITING STATUS (SSR ONLY)

Purpose: The switch limiting feature is always enabled when using an SSR output switch and is intended to provide protection for the output switch. Enabling this alarm will only inform the user that switch limiting is currently active and an excessively high current condition is present. The controller pulses its output switch for a small number of cycles and reads the resulting current. If the measured current exceeds the SWITCH RATING setting, then the duty-cycle of its output switch will be varied so that an average current not exceeding the SWITCH RATING setting is maintained.

Alarm Mask: ENABLE or DISABLE

Procedure: Adjust the SWITCH CURRENT RATING setting to the actual current rating of the SSR. Enable or disable the alarm as required. Note that the SWITCH LIMITING ALARM does not have to be enabled in order to adjust the SWITCH CURRENT RATING setting.

Notes:

- This is a non-latching alarm.
- This alarm should normally be enabled. Currents in this range cannot be considered normal and should be investigated.

5.5.23 CONTACTOR COUNT ALARM

Purpose: Generates an alarm if the number of off-to-on transitions of a contactor reaches or exceeds the CONTACTOR COUNT ALARM setting. This serves as a method to perform preventative maintenance on the contactor before a failure is likely to occur.

Alarm Mask: ENABLE or DISABLE

Range: 0 to 999999 off-to-on transitions

Procedure: Adjust the CONTACTOR ALARM setting to the desired value. Note that the CONTACTOR ALARM must be enabled in order to adjust the CONTACTOR ALARM setting.

Note: The CONTACTOR ALARM is only available if the SWITCH CONTROL MODE is set to either DEADBAND or PROPORTIONAL AMBIENT CONTACTOR.

5.5.24 EEROM DATA FAILURE ALARM

Purpose: The EEROM DATA FAILURE ALARM indicates that the controller has detected a failure in its nonvolatile memory.

Alarm Mask: ENABLE or DISABLE

Procedure: Enable or disable alarming of a nonvolatile memory failure as desired.

Note: The EEROM DATA FAILURE ALARM should always be enabled. This memory stores all of the controller's configuration and calibration settings and the alarm will only be generated if the microprocessor cannot bypass the failed area of its memory. This indicates an internal problem and the 910 should be replaced and returned to the factory for repair.

5.6 Communications Setup

The following section describes the setup parameters that relate to the way in which the controller is to communicate with another device. If the optional communications interface is not installed in the 910 Control Module, these parameters need not be configured.

5.6.1 PROTOCOL

Purpose: Defines the communications language used by the controller to communicate with other devices.

Setting: HTCBUS™ or MODBUS ASCII or MODBUS RTU

Procedure: Select the HTCBUS™ protocol when communicating with existing Pyrotenax Heat Trace Control products, including the Model 780/GCC-9000 Group Communications Controller.

If you are communicating directly with the controller using a different device, select the MODBUS protocol. For a detailed description of the controller's MODBUS mapping please refer to *910 Series Heat Trace Controller—Modbus Protocol Interface* document.

5.6.2 HTCBUS™ ADDRESS

Purpose: Defines the communications address to be used by the controller when using the HTCBUS™ protocol to communicate with a Model 780/GCC-9000.

Range: 1 to 16,777,215

Procedure: Set the communications address as desired. This must be an address unique to the entire communications network to avoid messaging conflicts. The HTCBUS™ protocol must be selected in order to set the HTCBUS™ ADDRESS.

Note: A unique HTCBus™ communications address is always assigned by the Factory and identified by the label on the top of the controller module (see Fig. 2.1). It is recommended that the pre-assigned address be used whenever possible to minimize the chances of an address being duplicated in the user's system.

5.6.3 MODBUS ADDRESS

Purpose: The MODBUS ADDRESS along with the MODBUS SUB ADDRESS define the communications address to be used by the controller when using either MODBUS protocol to communicate with a MODBUS compatible device.

Range: 1 to 247

Procedure: Set the communications address as desired. Together with the MODBUS SUB ADDRESS, this combination must be unique to the entire communications network to avoid messaging conflicts. Either MODBUS protocol must be selected in order to set the MODBUS ADDRESS.

5.6.4 MODBUS SUB ADDRESS

Purpose: The MODBUS SUB ADDRESS along with the MODBUS ADDRESS define the communications address to be used by the controller when using either MODBUS protocol to communicate with a MODBUS compatible device.

Range: 0 to 31

Procedure: Set the communications sub address as desired. Together with the MODBUS ADDRESS, this combination must be unique to the entire communications network to avoid messaging conflicts. Either MODBUS protocol must be selected in order to set the MODBUS SUB ADDRESS.

Note: Since a 910 HTC does not use all 65,535 data registers that are available for each MODBUS ADDRESS, the data register range is subdivided to allow up to 32 HTCs to share the same MODBUS ADDRESS. This increases the number of HTCs allowed on a single Modbus port from 247 to 7,904 (= 247 x 32). This requires that any HTC sharing the same MODBUS ADDRESS as another HTC must have its own unique MODBUS SUB ADDRESS.

5.6.5 BAUD RATE

Purpose: Defines the data rate at which communications occur.

Setting: AUTO or 9600 or 4800 or 2400 or 1200 or 600 or 300

Procedure: Select the data rate to be compatible with other devices that will be connected to the controller for communications purposes.

Note: Not all communications interfaces will support the various data rates—it is recommended that the setting be set to AUTO. The controller will automatically select a BAUD RATE that is compatible with the communications interface installed. If BAUD RATE = AUTO and a MODEM communication interface is used then a data rate of 300 will always be used. Otherwise, if BAUD RATE = AUTO and a non-MODEM communication interface is used the PROTOCOL is either MODBUS protocol then a data rate of 9600 is used.

5.6.6 PARITY (MODBUS)

Purpose: Defines the type of parity bit to be used with MODBUS communications.

Setting: NONE or ODD or EVEN

Procedure: Select the desired type of parity. Note that PARITY can only be selected when using either MODBUS protocol.

5.6.7 HARDWARE

Purpose: Identifies the type of communications interface installed in the 910. The controller will automatically determine and display which communications interface type is available.

Values: NONE, MODEM or RS-232 or RS-485

5.6.8 DRIVER

Purpose: Defines the way in which the controller's program communicates with the communications interface.

Setting: AUTO or RS-232 or RS-485 or MODEM

Procedure: It is recommended that the setting be set to AUTO—this will allow the controller to automatically choose the setting to match the type of communications interface installed.

5.6.9 PROFILE

Purpose: Defines the way in which the controller's program supports communications handshaking and communication interface signals.

Setting: AUTO or
3-WIRE RS-232 or
RS-485 or
1200 BAUD MODEM or
300 BAUD MODEM

Procedure: Select the PROFILE to be compatible with other devices that will be connected to the controller for communications purposes. It is recommended that the setting be set to AUTO. The controller will automatically select a profile based on the type of communica-

tions interface installed in the 910.

Notes:

- **AUTO:** Selects a communications profile based on the data rate and the type of communications interface installed in the 910.
- **3-WIRE RS-232:** Continuously asserts the internal RTS signal. Internal CTS and DCD signals are ignored. The Tx Delay timer is active. This is the profile used when PROFILE = AUTO and an RS-232 communication interface is used with the 910.
- **RS-485:** Uses the internal RTS signal and the Tx Delay timer. Internal CTS and DCD signals are ignored. This is the profile used when PROFILE = AUTO and an RS-485 communication interface is used.
- **1200 BAUD MODEM:** Uses the internal RTS signal with a fixed 10 msec Tx Delay time, ignores the internal CTS signal. Uses the internal DCD signal to qualify each receive data character. This is the profile used when PROFILE = AUTO, BAUD RATE = 1200 and a MODEM communication interface is used.
- **300 BAUD MODEM:** Uses the internal RTS signal with a fixed 30 msec Tx Delay time, ignores the internal CTS signal, uses the internal DCD signal to qualify each receive data character. This is the profile used when PROFILE = AUTO, BAUD RATE is not 1200 and a MODEM communication interface is used.

5.6.10 TX DELAY

Purpose: Allows a programmable delay between the receipt of a communications message and the controller's reply. In some applications, it may be necessary to delay the controller's response to an inquiry for a short period of time to allow external devices to start up, stabilize and/or synchronize.

Range: 0.00 to 2.50 seconds

Procedure: Set the amount of delay between the receipt of a message and the controller's response as required.

Note: This selectable TX DELAY is only used if the PROFILE is set to either RS-485 or AUTO and an RS-485 interface is installed.

5.7 Operator Console Functions

The following features are part of the controller's programming, but are only used in conjunction with the Operator Console.

5.7.1 PASSCODE

Purpose: The four digit, numeric PASSCODE feature stops unauthorized users from modifying the controller's configuration parameters using the Operator Console.

Range: 0000 to 9999

Procedure: Enter the desired PASSCODE (in the "Miscellaneous Common Setup" submenu) using the Operator Console keypad. A PASSCODE of 0000 disables the lockout feature and allows all configuration parameters to be modified using the Operator Console without requiring a PASSCODE. Setting the PASSCODE to any other value will require the database to be unlocked by entering the correct PASSCODE prior to modifying any of the controller's configuration parameters using the Operator Console.

Note: The PASSCODE can be edited only if it is set to 0 or the database has been unlocked by entering the proper PASSCODE.

5.7.2 LOCK DATABASE

Purpose: If the PASSCODE has been enabled (PASSCODE is not set to 0) and the user has unlocked console modification access to the controller's configuration parameters, the LOCK DATABASE feature allows the user to re-lock this modification access once programming has been completed.

Procedure: Select the LOCK DATABASE function (at the end of the “Configuration Mode Main Menu”) to lock out Operator Console configuration modification access. The display will confirm the operation by displaying a “DATABASE LOCKED” message.

Note: Operator Console configuration modification access will automatically re-lock after approximately 5 minutes of keypad inactivity.

5.7.3 UNLOCK DATABASE

Purpose: If a PASSCODE has been enabled (PASSCODE is not set to 0) and the user wants to modify any of the controller’s configuration parameters using a the Operator Console, then the database must first be unlocked.

Procedure: Try modifying any configuration parameter, or select the UNLOCK DATABASE function (at the end of the “Configuration Mode Main Menu”), and a prompt for the PASSCODE will appear. If the correct PASSCODE is entered then the display will confirm the operation by displaying a DATABASE UNLOCKED message.

5.7.4 TEST TRACING

Purpose: The TEST TRACING feature provides an easy method of temporarily overriding the temperature control, without having to modify the CONTROL SETPOINT temperature or any other configuration parameter.

Procedure: Press the TEST key on the Operator Console or select the TEST TRACING function to force the output switch on for approximately 30 seconds. After the test time has expired, the unit will automatically revert back to normal operation.

Notes:

- This feature only overrides temperature control; it does not override other control parameters such as power limiting.
- If load shedding is active then TEST TRACING is inhibited.

5.7.5 DISPLAY TEST

Purpose: The DISPLAY TEST feature provides an easy method of illuminating each display segment and all the LEDs of the Operator Console to ensure that they are functioning properly.

Procedure: Select DISPLAY TEST and watch the Operator Console to verify that each display segment and each LED is illuminated during the test sequence.

Note: Pressing any key on the Operator Console keypad during the DISPLAY TEST will cause the DISPLAY TEST to abort.

5.7.6 LOAD DEFAULTS

Purpose: To provide a quick method of setting all of the controller’s configuration parameters to the factory default configuration parameters, as defined in Appendix G. In addition, all of the maintenance data parameters are reset. Note that all load shedding parameters (including fail safe) are configured with default values. The CONSOLE SETPOINT MAXIMUM and MINIMUM are also configured with default values.

Procedure: Select the LOAD DEFAULTS function (in the “Miscellaneous Setup” sub-menu) using the Operator Console keypad.

Note: This function will also overwrite the communication configuration parameters, which could affect existing communications to the controller.

5.7.7 FEATURE MODE

Purpose: Provides two types of menus on the Operator Console for configuring the 910.

Setting: BASIC or ADVANCED

Procedure: Select BASIC if access to only the seven most common parameters is required. Select ADVANCED if access to all of the 910 parameters is required.

Section 6—Monitored Parameter Details

6.1 Introduction

The following text provides a brief summary of each of the measured and calculated parameters that the 910 Series Control Module provides to the user. Detailed information regarding settings, alarms limits, etc. may be found in Section 5 of this manual.

Detailed information regarding the display of these variables using the Operator Console may be found in Section 4.2 of this manual.

For detailed information regarding the display of these variables using the Model 780/GCC-9000, refer to the GCC user manual.

6.2 Analog Readings

6.2.1 CONTROL TEMPERATURE

Purpose: This is the temperature that the controller uses to determine whether its output switch should be on or off. Depending on the TS CONTROL MODE setting and whether one or two RTDs are installed, the CONTROL TEMPERATURE may be derived from TS 1 or TS 2, or a combination of the two temperatures. See Section 5.2.11 of this manual for further details regarding the TS CONTROL MODE settings.

6.2.2 TS 1 TEMPERATURE

Purpose: This temperature is the value that the controller is reading from the RTD connected to its TS 1 input. Depending on the TS CONTROL MODE, it may be used to determine the CONTROL TEMPERATURE (see Section 6.2.1 above).

Note: If the TS 1 input is not being used by the controller, the TS 1 TEMPERATURE is not displayed.

6.2.3 TS 2 TEMPERATURE

Purpose: This temperature is the value that the controller is reading from the RTD connected to its TS 2 input. Depending on the TS CONTROL MODE, it may be used to determine the CONTROL TEMPERATURE (see Section 6.2.1 above).

Note: If the TS 2 input is not being used then by the controller then the TS 2 TEMPERATURE is not displayed.

6.2.4 LOAD CURRENT

Purpose: The LOAD CURRENT reading indicates the average current being drawn by the heating cable.

6.2.5 RESISTANCE

Purpose: Resistance is calculated using the average adjusted voltage reading divided by the average adjusted current reading to yield a load resistance in ohms. If the controller's output switch is on, but no current is present, the RESISTANCE will read "open circuit."

Note: If the controller's output switch is off, the RESISTANCE will always display the last resistance which was calculated while the output switch was last on.

6.2.6 GROUND FAULT CURRENT

Purpose: If the controller detects any leakage current in the output circuit, it will indicate the level in milliamps.

Note: To minimize nuisance alarms, the controller will not report a leakage current of less than 20 mAmps.

6.2.7 VOLTAGE

Purpose: The voltage reading indicates the average circuit voltage being measured by the 910.

6.2.8 POWER

Purpose: Load power provides an indication of the average power being consumed by the heat trace cable .

Note: The controller calculates load power by multiplying the average adjusted voltage reading by the average adjusted current reading.

6.3 Maintenance Data

6.3.1 MAX / MIN TEMPERATURE VALUES

MAX CONTROL TEMP

MIN CONTROL TEMP

TS 1 MAX TEMP

TS 1 MIN TEMP

TS 2 MAX TEMP

TS 2 MIN TEMP

Purpose: This feature indicates the maximum and minimum temperatures recorded by the HTC since the last time the values were reset. It may be useful to log the maximum/minimum temperatures experienced on a particular tracing circuit for the purposes of troubleshooting or gathering data for future design criteria. The temperature values are written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user. Max/min temperatures are recorded for TS 1, TS 2 and the CONTROL TS.

Range: Can only be reset (cleared) by the operator.

Procedure: The max/min temperatures may be reset using the Operator Console or a communicating device. Resetting any one of the temperatures will reset all of them.

6.3.2 POWER ACCUMULATOR

Purpose: This feature indicates the total power consumption of the trace circuit since the last time the POWER ACCUMULATOR was reset. It may be useful to log the amount of power consumed on a particular trace circuit for the purposes of energy management or gathering of data for future design criteria. The value of this accumulator is written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user.

Procedure: The POWER ACCUMULATOR may be reset to zero using the Operator Console or a communicating device.

Note: The POWER ACCUMULATOR value will roll over to zero when the upper limit of the POWER ACCUMULATOR has been exceeded. This upper limit is 214,748,364.7 kW-hours.

6.3.3 CONTACTOR CYCLE COUNTER

Purpose: This feature indicates the total number of off-to-on transitions a contactor has made since the last time the CONTACTOR CYCLE COUNTER was reset. This serves as a method to perform preventative maintenance on the contactor according to the manufacturer's specifications. This count value is written to the controller's nonvolatile memory once every 24 hours or whenever any maintenance data is reset by the user.

Procedure: The CONTACTOR CYCLE COUNTER may be reset to zero using the Operator Console or a communicating device.

Note:

- Once the CONTACTOR CYCLE COUNTER reaches 999,999,999 it will stop counting.
- The CONTACTOR CYCLE COUNTER is only indicated if the SWITCH CONTROL MODE is set to either DEADBAND or PROPORTIONAL AMBIENT CONTACTOR.

6.3.4 TIME IN USE

Purpose: The purpose of this feature is to indicate the total hours in use of the controller since its initial operation. It may be useful to log the amount of time a particular controller has been in operation for the purposes of maintenance planning or reliability testing. The value of this accumulator is written to the controller's nonvolatile memory once every 24 hours or whenever any maintenance data is reset by the user.

Procedure: The IN USE hours accumulator can be reset to zero using the Operator Console or a communicating device.

Note: The IN USE hours accumulator value will roll over to zero when the upper limit of the accumulator has been exceeded. This limit is 999,999,999 hours.

6.3.5 TIME SINCE LAST RESET

Purpose: This feature indicates the total hours in use of the controller since the last reset. It may be useful to log the amount of time a particular controller has been in operation since the last time the controller's power was cycled for trouble-shooting purposes.

Procedure: The TIME SINCE LAST RESET hours accumulator can only be reset by cycling the controller's power.

Note: The TIME SINCE LAST RESET will roll over to zero when the upper limit of 65,535 hours has been exceeded.

6.3.6 PEAK LOAD CURRENT

Note: The PEAK LOAD CURRENT is not displayed on the Operator Console.

Purpose: This feature indicates the highest instantaneous load current measured since the last time the PEAK LOAD CURRENT was reset. This value is written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user.

Procedure: The PEAK LOAD CURRENT may only be reset to zero using a communicating device.

6.3.7 PEAK GROUND FAULT CURRENT

Note: The PEAK GROUND FAULT CURRENT is not displayed on the Operator Console.

Purpose: This feature indicates the highest instantaneous ground fault current measured since the last time the PEAK GROUND FAULT CURRENT was reset. This current value is written to the controller's non-volatile memory once every 24 hours or whenever any maintenance data is reset by the user.

Procedure: The PEAK LOAD CURRENT may only be reset to zero using a communicating device.

6.3.8 EXTERNAL INPUT STATUS

Note: The EXTERNAL INPUT STATUS is not displayed on the optional Operator Console.

Purpose: This feature indicates the actual status of the external input regardless of the controller's configuration. This may be useful if the user wishes to use the controller's external input to monitor the status of an external dry contact and pass this on to another device.

Procedure: The EXTERNAL INPUT STATUS may only be viewed using a communicating device.

Section 7—Control Modes

7.1 Introduction

There are several different types of control modes in the controller. Some of these modes require further explanation in order to fully understand and implement their operation.

This section describes the control modes available in the HTC and how to set their associated parameters.

7.2 Switch Control Modes

There are four different SWITCH CONTROL modes associated with the HTC. The following is an explanation of their implementation in the controller and the differences between them.

7.2.1 PROPORTIONAL CONTROL (FOR USE WITH SSRS ONLY)

Proportional control on the HTC is implemented as follows:

- When using SSRs to directly control the power applied to a trace circuit, the output may be switched on/off very rapidly. The controller implements proportional temperature control on a cycle by cycle basis (50 or 60 Hz power line cycle).
- This algorithm monitors the temperature of the heating circuit and compares it to the CONTROL SETPOINT temperature. If the temperature of the control sensor is at or below the CONTROL SETPOINT temperature, then power is applied to the trace with a duty cycle of 100%—the controller output is full on.
- If the temperature sensed by the control sensor is equal to or greater than the CONTROL SETPOINT temperature + the PROPORTIONAL BAND setting, then the controller output will have a duty cycle of 0%—the output will be off.
- The temperature of the control sensor is constantly monitored and the output duty cycle is adjusted proportionally according to where the temperature falls within the 0%–100% band.

Proportional Control Temperature Band

Control Sensor Temperature	Duty Cycle
Setpoint + proportional band	0%
Setpoint + proportional band/2	50%
Setpoint	100%

7.2.2 DEADBAND CONTROL (FOR USE WITH EXTERNAL CONTACTORS)

Deadband control on the HTC is implemented as follows:

- When using the HTC in an application where the controller is used to open and close a contactor, proportional control cannot be used since this would cycle the contactor too quickly. In these situations, a deadband control algorithm is used. The output duty cycle is not controlled, instead the output is either fully on or completely off. The user may set the DEADBAND value.
- The controller monitors the temperature of the trace circuit and compares it to the CONTROL SETPOINT temperature as in the proportional control mode. If the control sensor temperature is above the CONTROL SETPOINT temperature by more than the DEADBAND value, the output is turned off.
- If the control sensor temperature falls below the CONTROL SETPOINT temperature the output is turned on.

This is a very simple control algorithm but it works very effectively in heat trace applications where the temperature of a traced system changes relatively slowly.

Deadband Control Temperature Band

Control Sensor Temperature	Output State
Setpoint + deadband	Off
Setpoint	On

When the control sensor temperature is within the deadband, the output does not change its state. Also, when using deadband control, a contactor is not allowed to toggle faster than every two seconds. If an AC alarm with an alarm filter time greater than 0 is detected, the contactor will not toggle until the alarm filter time has expired.

7.2.3 PROPORTIONAL AMBIENT SSR CONTROL (FOR USE WITH SSRS ONLY)

When an HTC using an SSR is used to control the output using the ambient temperature, this control mode should be used.

Proportional ambient SSR control on the HTC is implemented as follows:

- When using SSRs to directly control the power applied to a heating circuit, the output may be switched on/off very rapidly. The controller implements proportional temperature control on a cycle by cycle basis (50 or 60 Hz power line cycle).
- This algorithm monitors ambient temperature and compares it to the CONTROL SETPOINT temperature. If the temperature of the control sensor is at or below the CONTROL SETPOINT temperature minus the PROPORTIONAL BAND setting, then power is applied to the trace with a duty cycle of 100%—the controller output is fully on.
- If the temperature sensed by the control sensor is equal to or greater than the CONTROL SETPOINT temperature, then the output will have a duty cycle of 0%—the controller output will be off.
- The temperature of the control sensor is constantly monitored and the output duty cycle is adjusted proportionally according to where the temperature falls within the 0%–100% band.

Proportional Ambient SSR Control Temperature Band

Control Sensor Temperature	Duty Cycle
Setpoint	0%
Setpoint - proportional band/2	50%
Setpoint - proportional band	100%

Note: The load shedding “fail safe mode” is not supported when using proportional ambient SSR control, since ambient temperature is being monitored rather than pipe temperature.

7.2.4 PROPORTIONAL AMBIENT CONTACTOR CONTROL (FOR USE WITH CONTACTORS)

When an HTC using a contactor is used to control the output based on the ambient temperature, this control mode should be used.

Proportional ambient contactor control on the HTC is implemented as follows:

- The output may not be switched on/off rapidly when using a contactor, so proportional temperature control is implemented by applying the required duty cycle over the selected CYCLE TIME.
- The output is fully on for a portion of the CYCLE TIME as determined by the calculated duty cycle, and it will be completely off for the remainder of the CYCLE TIME.
- The duty cycle is calculated each time the output toggles, based on the ambient temperature, PROPORTIONAL BAND setting, and the CONTROL SETPOINT temperature setting.
- The controller monitors the ambient temperature and compares it to the CONTROL SETPOINT temperature as in proportional ambient SSR control. If the temperature of the control sensor is at or below the CONTROL SETPOINT temperature minus the PROPORTIONAL BAND setting, then power is applied to the trace with a duty cycle of 100%. The controller output will be fully on for 1/30 of the CYCLE TIME setting before the duty cycle is calculated again.
- If the temperature sensed by the control sensor is equal or greater than the CONTROL SETPOINT temperature, then the output will have a duty cycle of 0%. The controller out-

put will be off for 1/30 of the CYCLE TIME setting before the duty cycle is calculated again.

Proportional Ambient Contactor Control Temperature Band	
Control Sensor Temperature	Duty Cycle
Setpoint	0%
Setpoint - proportional band/2	50%
Setpoint - proportional band	100%

Note: The load shedding “fail safe mode” is not supported when using proportional ambient contactor control, since ambient temperature is being monitored rather than pipe temperature. Also note that if an AC alarm, with an alarm filter time greater than 0, is detected the contactor will not toggle until the alarm filter time has expired.

7.3 Load Shedding Control Mode

Load shedding is a control mode that may be programmed and initiated only by an external communicating device or by the Model 780/GCC-9000 Group Communications Controller, which overrides temperature control and forces the output of the controller OFF until reset by the 780/GCC-9000. When using a GCC, load shedding is initiated by a contact closure (or opening) on one of the four contact inputs on the GCC. Each contact input initiates a load shedding command for the group of controllers associated with that contact input. Each controller may be associated with one or more groups. Refer to the Load Shedding Section in the GCC manual for details on setting up the load shedding features of the HTC when using a GCC.

When power is applied to the controller, it determines if load shedding mode has been enabled. If enabled, the controller immediately enters load shedding operation (holding its output off) and waits to see if the GCC or an external communicating device has initiated a load shedding command. If no command is present, the controller resumes normal operation. If a load shedding command is present, the controller will continue to hold its output OFF, until one of three conditions occurs:

1. The GCC contact input or zone definition bits of an external communicating device that initiated load shedding clears and the command to terminate load shedding mode is issued.
2. Communications are interrupted between the controller and its communicating device (as in the case of a damaged communications wire). Approximately 30 seconds after communications ceases, the controller will return to normal operation.
3. Communications between the controllers and the external communicating device go off-line for approximately two minutes (as occurs when the 760 Hand Held Programmer is used to communicate with the controller).

Note: The controller will return to normal operation if communications between the GCC or external communicating device and the controller is disrupted in any way. This will return temperature control to the HTC. Also, the HTC does not perform a periodic autocycle test while operating in load shed mode. When using a GCC it must be configured for load shedding operation before the controller may be set up for load shedding control.

There are three parameters that must be set up in the controller to completely configure it for load shedding operation:

1. The load shedding feature must be enabled.
2. The FAIL SAFE MODE parameter must be enabled or disabled depending on the application requirements. If FAIL SAFE MODE is enabled, then at least one LOW TS ALARM (of a TS used in the TS CONTROL MODE) must be enabled and its alarm temperature must be less than the CONTROL SETPOINT temperature; otherwise, fail safe mode will be disabled.
3. The GCC contact input(s) or zone definition bits of an external communicating device that are to be associated with the load shedding action for the controller must be defined.

These parameters may only be configured using an external communicating device or the Model 780/GCC-9000 Group Communications Controller. Refer to the Model 780/GCC-9000 user manual for details on how to set up these options. Note that the Operator Console may be used to enable or disable the load shedding feature but not set any of the other load shedding parameters.

Notes:

- Fail safe mode is always disabled if the SWITCH CONTROL MODE is set to either of the two proportional ambient control modes, or the TS CONTROL MODE = EXT. INPUT, FAIL OFF/ON.
- If the TS CONTROL MODE uses both TS 1 and TS 2 to calculate the control temperature, the HTC will turn on its output if the following conditions are met:
 - load shedding is active
 - fail safe mode is enabled
 - the control temperature falls below either of the LOW TS ALARM settings
 - both TS 1 and TS 2 have their LOW TS ALARMS enabled
- A FORCE ON override signal has higher priority than a load shedding signal. An INHIBIT signal has higher priority than fail safe mode.

Section 8—Troubleshooting

8.1 Operator Checks

Note: If the controller does not operate properly and is being returned to Tyco Thermal Controls for service, information must be provided as to why the unit was removed from service. Contact the Tyco Thermal Controls customer service department for a Return Authorization form and number prior to returning any units for repair.

Upon receipt of the controller, or to check the controller for an indication of normal operation, follow the operational procedures shown below. These procedures are designed to familiarize the operator with the controller and to provide an understanding of its operation.

In order to determine if a fault is associated with the heat tracing, wiring or the controller, it will be necessary to troubleshoot the wiring and tracer circuit. If the fault remains, remove power from the controller and exchange it with another controller. This may require some reprogramming of the new HTC. Refer to the following sections for the appropriate topic.

If the fault clears, exchange the controller on another circuit to determine if the fault moves with the controller. If the fault moves with the controller, verify that the HTC has been configured correctly for the application. If the configuration is correct it may be necessary to return the controller to Tyco Thermal Controls for evaluation.

8.1.1 GETTING STARTED

In order to access the functions of the 910 Series HTC, use the Operator Console. If the modem communications option is installed in the 910, the Model 780/GCC-9000 Group Communications Controller may also be used to access controller parameters. Refer to the GCC User Manual for operational details.

8.2 Common Problem Areas

The HTC may be used as an effective troubleshooting tool to pinpoint problem areas of heat trace circuits. Described below are a few of the more common problem areas, their symptoms, and parameters to check to determine the actual faulty portion of the heat trace circuit.

8.2.1 RTDS

RTD failures after installation can generally be attributed to incorrect wiring or improper installation of the sensor. Troubleshooting of these failures is a very simple procedure if the proper steps are undertaken in the correct order. Some specific RTD problems and the correct methods for troubleshooting are outlined as follows.

1. TS Failure Alarm(s)

If the HTC controller indicates a failure of an RTD:

- Ensure that the RTD is a 3-wire 100 (Platinum Type (for V3.00). For V3.11 and up ensure that the TS TYPE setting matches the RTD being used.
TURN THE POWER TO THE CONTROLLER OFF BEFORE PROCEEDING!!
- Disconnect the RTD wiring from the input terminals.
- Measure the RTD's resistance between the source (WHT) and sense (WHT) leads at the controller (it should not exceed 40 Ω). Excessive lead resistance will cause a TS FAILURE ALARM and must be corrected. Look for loose terminals, excessive lead length, or insufficient wire gauge and correct as necessary.
- Measure the RTD's resistance between the source (WHT) or sense (WHT) lead and the common (RED) lead of the RTD at the controller (should be between 60 and 330 Ω depending on the temperature and the lead resistance. See Appendix E or Appendix F).
- Verify that the RTD is wired correctly—the heat tracing controllers will always be terminated in the order: source (WHT), sense (WHT), common (RED). When wiring to the 910, the terminals are marked as follows:

Terminal No.	Description
19	Shield
20	TS 1 Source (WHT)
21	TS 1 Sense (WHT)
22	TS 1 Common (RED)
8	Shield
9	TS 2 Source (WHT)
10	TS 2 Sense (WHT)
11	TS 2 Common (RED)

The RTD manufacturer will typically color code the leads with the source and sense being the same color, and the common a different color. Ensure that the RTD extension wire shield is terminated at one end only, normally using the terminal block provided at the terminal board.

Note: Some manufacturers use the common Black-White-Red triad color code for the RTD connections. Usually, the RED lead is the common connection (same as the White-White-Red color scheme) and the White and Black connections may be used interchangeably.

2. Seemingly Incorrect Temperature

If you feel that the indicated or displayed temperature is not correct, the controller and the RTD can be quickly checked for correct operation.

To verify the RTD:

TURN THE POWER TO THE CONTROLLER OFF BEFORE PROCEEDING!!

- Disconnect the RTD wiring from the input terminals.
- To calculate the temperature indicated by the RTD, measure the resistance from source (white wire) or sense (white wire) to common (red wire) and subtract the resistance measured between source and sense. This will give a compensated resistance value that can be cross-referenced to one of the RTD tables found in Appendix E or Appendix F. Compare the measured resistance and cross-referenced temperature value obtained from the RTD table to the indicated or displayed value. These should agree to within the accuracy standards of the HTC and the RTD.

Notes:

- Ensure you refer to the correct RTD table for the type of RTD you are using.

- Ensure that the TS TYPE setting matches the type of RTD that you are using.

To verify the Controller:

TURN THE POWER TO THE CONTROLLER OFF BEFORE PROCEEDING!!

- Disconnect the RTD wiring from the input terminals.
- Connect a 100 Ω resistor across the source or sense terminal and common. Insert a jumper between the source and sense terminals.
- Apply power to the controller. The indicated or displayed temperature should be about 32°F (0°C) depending on the actual resistance of the test resistor if TS TYPE is set to 100 Ω Platinum.

3. Unstable or Bouncing Temperature

An erratic indication of temperature can be caused by several factors external to the controller, however a bouncing temperature of a few degrees should not be confused with incorrect operation. The controller's accuracy and resolution will result in an indicated temperature change of a couple of degrees if the measured resistance temperature falls between two discrete values (this is sometimes referred to as quantization error).

If the bounce or instability is excessive, check:

- Wire used for extension of the RTD should be three-wire, twisted and shielded with the shield grounded at the controller only. Each of the three lead wires must be of the same gauge.
- The ideal installation has a separate conduit for the RTD leads (if they have been extended). It is not usually a problem to run low signal levels in the same conduit as the power leads even in high power applications, as long as the RTD wire is a twisted, shielded type with an insulation rating equal to or greater than the highest voltage in the conduit. Follow the proper Electrical Code requirements for your particular installation.
- Terminal connections that are not tight can add resistance to an RTD circuit. Check the tightness of all screw terminal connections at time of installation and during subsequent maintenance checks.
- Check the specifications for the particular cable being used to ensure that it does not have excessive capacitance when used in long lengths. This can cause a temperature offset between what the controller reads and what the RTD actually measures. This again is normally not a problem since the controller compensates for all but the worst cases of this.
- Lastly, it is possible for the RTD itself to fail on an intermittent basis but this failure mode should be considered unusual. This kind of failure is probably the most difficult to find but fortunately it is also the least likely as a failure mechanism.

8.2.2 GROUND FAULT

Ground fault alarms can be due to incorrect installation as well as leakage resulting from wet system components or faulted cables.

The 910 Series Controller detects ground faults by summing the outgoing and return trace currents through an internal current transformer. Under normal operating conditions (no ground fault condition) this current will be zero. When there is a flow of current from one of the trace supply wires to ground, a ground fault condition occurs.

If a ground fault alarm is present on start-up of a new installation it is likely due to a wiring error or damaged cable. To verify this condition:

- Check that the heating circuit neutrals return to the controller and are not connected directly to the distribution panel. This can be a common problem if the installation is a retrofit situation.
- On paralleled circuits, be certain that ALL neutrals return. The late addition of a circuit may not be obvious.

Use the monitoring feature available at the 910 Operator Console or the Model 780/GCC-9000 Group Communications Controller to view the measured ground fault current at the heat trace controller. If this value is at the maximum that the controller can measure, it is usually an indication that the wiring is incorrect. If the value is less than 250 mAmps then

an actual ground fault condition may exist in the cable.

Note: The controller monitors the integrity of the ground fault (GF) detection transformer and associated wiring. If a fault is detected, the controller will report a GF value of 300 mAmps.

8.3 Common Alarms—What to Look for

The 910 has a wide range of alarming features that may be selectively enabled or disabled to allow the monitoring and indication of trouble conditions. Described below are the different alarm conditions available on the 910, their meanings, and possible causes.

8.3.1 High TS 1/ TS 2 Temperature

This alarm appears when the temperature exceeds the HIGH TS ALARM temperature setting.

Cause of Alarm:

- Alarm temperature setting too close to maintain temperature
- Flow of hot product
- Steaming out lines
- Incorrect tracer wiring

8.3.2 LOW TS 1/TS 2 TEMPERATURE

This alarm appears when the temperature decreases below the LOW TS ALARM temperature setting.

Cause of Alarm:

- Alarm temperature setting too close to maintain temperature
- Flow of cold product
- Empty pipe
- Damaged, wet, or missing insulation
- Heating cable not sized properly for the application

8.3.3 TS 1/ TS 2 FAILURE

This alarm indicates a sensor is not operating properly. The temperature sensor may fail due to an “open” or “shorted” condition.

Cause of Alarm:

- Incorrect or damaged field wiring—open leads or excess resistance (either intermittent or continuous) may be due to broken or damaged wires or loose terminals.
- Damaged or inoperative temperature sensors

8.3.4 CONTROL TS FAILURE

This alarms a failure of the temperature sensing element designated as the control element by the TS CONTROL MODE setting. Depending on the chosen TS FAIL MODE and TS CONTROL MODE, the output switch may be latched off or on until this failure is corrected.

Cause of Alarm:

- Incorrect or damaged field wiring—open leads or excess resistance (either intermittent or continuous) may be due to broken or damaged wires or loose terminals.
- Damaged or inoperative temperature sensors

8.3.5 HIGH CURRENT

This alarms current levels that are greater than the HIGH CURRENT ALARM setting for the application.

Cause of Alarm:

- Alarm setting too close to normal operating current
- High in-rush current from “cold start” of self regulating cable
- Damaged or partially shorted heating cable
- “As built” cable length is greater than design value

8.3.6 LOW CURRENT

This alarms current levels which are less than the LOW CURRENT ALARM setting.

Cause of Alarm:

- Alarm setting too close to normal operating current
- Low source voltage
- Damaged or inoperative heating cable
- Open connection—wiring problem
- SSR or contactor failed open

8.3.7 HIGH GFI

This alarms ground fault current levels which are greater than the HIGH GFI ALARM setting.

Cause of Alarm

- Alarm setting too close to normal leakage current
- Damaged cable insulation and/or moisture present
- Moisture in junction box
- Poor splice or termination
- Moisture provides conductive ground path which allows ground fault current

8.3.8 GFI TRIP

This value sets the upper limit of allowable ground fault leakage. Exceeding this limit will result in the output switch being latched off and the alarm activated to indicate a ground fault condition.

Cause of Alarm

- Trip setting too close to normal leakage current
- Damaged cable insulation and/or moisture present
- Moisture in junction box
- Poor splice or termination
- Moisture provides conductive ground path which allows ground fault current

8.3.9 HIGH VOLTAGE

This alarms voltage levels that are greater than the HIGH VOLTAGE ALARM setting.

Cause of Alarm

- Alarm setting too close to normal operating voltage
- Incorrect wiring
- Power surge

8.3.10 LOW VOLTAGE

This alarms voltage levels which are less than the LOW VOLTAGE ALARM setting.

Cause of Alarm

- Alarm setting too close to normal operating voltage
- Damaged power cable
- Incorrect VOLTAGE TURNS RATIO
- “Brown-out” conditions
- Loss of power to the circuit

8.3.11 OVERCURRENT TRIP

If the controller is unable to start the cable due to high current or after attempting to soft start it, the controller will trip its output switch off.

Cause of Alarm

- Excessive in-rush current
- Incorrect wiring
- Damaged cable

8.3.12 SWITCH FAILURE

This alarm indicates that the controller senses current flow when the output switch should be off.

Cause of Alarm

- Some other device energized heat trace
- Output switch has failed “closed”

8.3.13 HTC RESET

This alarm is latched when power is restored after an interruption. Used to identify intermittent power losses.

Cause of Alarm

- Circuit breaker tripped
- Power line transient

8.3.14 POWER LIMITING

This alarm indicates that the solid state relay is limiting the average amount of power that is applied to the trace circuit as defined by the MAXIMUM POWER setting.

Cause of Alarm

- Power applied to trace circuit is being limited to the MAXIMUM POWER setting

8.3.15 C.B. LIMITING

This alarm indicates that the solid state relay is limiting the average current that is applied to the trace circuit to the C.B. CURRENT RATING setting to protect the upstream heater circuit breaker from tripping.

Cause of Alarm

- Excessive current caused by in-rush current
- C.B. CURRENT RATING setting too low for normal heater current draw or not matched to actual circuit breaker size

8.3.16 SWITCH LIMITING

This alarm indicates that the controller is limiting the average current that is applied to the trace circuit based on the SWITCH RATING setting to protect the solid state relay from excess current.

Cause of Alarm

- Excessive current caused by in-rush current
- Excessive ambient temperature

8.3.17 HIGH RESISTANCE

This alarm indicates that the heating cable resistance has deviated from the NOMINAL RESISTANCE setting by more than the HIGH RESISTANCE ALARM setting.

Cause of Alarm

- Alarm setting too close to actual operating resistance
- NOMINAL RESISTANCE not set properly
- Open connection—wiring problem
- Damaged cable

8.3.18 LOW RESISTANCE

This alarm indicates that the heating cable resistance has deviated from the NOMINAL RESISTANCE setting by more than the LOW RESISTANCE ALARM setting.

Cause of Alarm

- Alarm setting too close to actual operating resistance
- NOMINAL RESISTANCE not set properly
- Partial short—wiring problem
- Damaged cable

8.3.19 EEROM DATA FAILURE

This alarm indicates that the controller has detected a failure in its nonvolatile memory (this is where all of the controller's configuration and calibration settings are stored). This indicates an internal problem and the HTC should be replaced and returned to the factory for repair.

Cause of Alarm

- The HTC cannot bypass the failed area of its memory and has loaded factory defaults into this failed area.

8.3.20 CONTACTOR COUNT

This alarm indicates that the number of off-to-on transitions of a contactor has exceeded the CONTACTOR COUNT ALARM setting and the contactor should be replaced.

Cause of Alarm

- Contactor has been controlling the trace circuit for a long time
- Some configuration parameter (i.e. DEADBAND, AUTO CYCLE INTERVAL, load shedding etc.) is causing the contactor to toggle more than usual.

Section 9—Maintenance

9.1 Operator Maintenance

The 910 series controller is designed to be a maintenance-free product. Once installed properly the only maintenance required is retightening of the terminal connections approximately one week after installation and inspection periodically thereafter. Also, alarm pilot lamps (if installed) may need periodic replacement. EMR versions may require periodic contactor replacement.



Caution: Make sure that the power to the controller is OFF when replacing the pilot lamps! Also, be certain power is OFF to the controller before attempting to test or service the heat tracing. Do not rely on the controller as a disconnect device!

9.2 Replaceable Parts

There are no user-serviceable parts in the 910 series controller or accessories (except lamps in optional alarm pilot lights). The unit is designed to be modular and easily changed out in the field in a matter of minutes. A 910 appearing inoperative should be returned to the nearest Tyco Thermal Controls Service Center for service.



Warning: Tampering with the 910 components without approval from Tyco Thermal Controls could result in the product's warranty being void.

Appendix A—Specifications

Specifications are @ 25°C unless otherwise noted and are subject to change without notice.

System Ratings

Storage Ambient	-40°F to 185°F (-40°C to 85°C)
Approvals	CSA C/US
Classification	<ul style="list-style-type: none"> • CI I, Div 2, Grps A,B,C,D and Ex nA IIA, IIB, IIC (Zone 2) • SSR Version T-code: T4 • Ordinary locations (SSR and EMR versions)

Wiring Terminal Ratings

Signal Terminals	28-12 AWG, strip length: 0.2"
Power Terminals	30A: 22-8 AWG, strip length: 0.47", torque: 10.7 in-lb (1.2 N-m)
Ground Lugs	14-6 AWG torque: 12 in-lb (1.35 N-m)

Assembly Ratings

Operating Temperature	-40°F to 140°F (-40°C to 60°C)
Enclosures	FRP: Nema 4X/IP65 SS: Type 304, Nema 4X/IP65
Solid State Relay Rating	<ul style="list-style-type: none"> • 2 pole switching • 30 A continuous @ 40°C, derate linearly to: 15 A max. @ 60°C resistive load • 100-277 Vac nom. max., 80 A 1 sec. in-rush, 625 A 1 cycle in-rush
Electromechanical Relay Rating	<ul style="list-style-type: none"> • 2 pole switching • 30 A continuous @ 40°C derate linearly to: 20 A max. @ 60°C • 100-277 Vac nom. max.

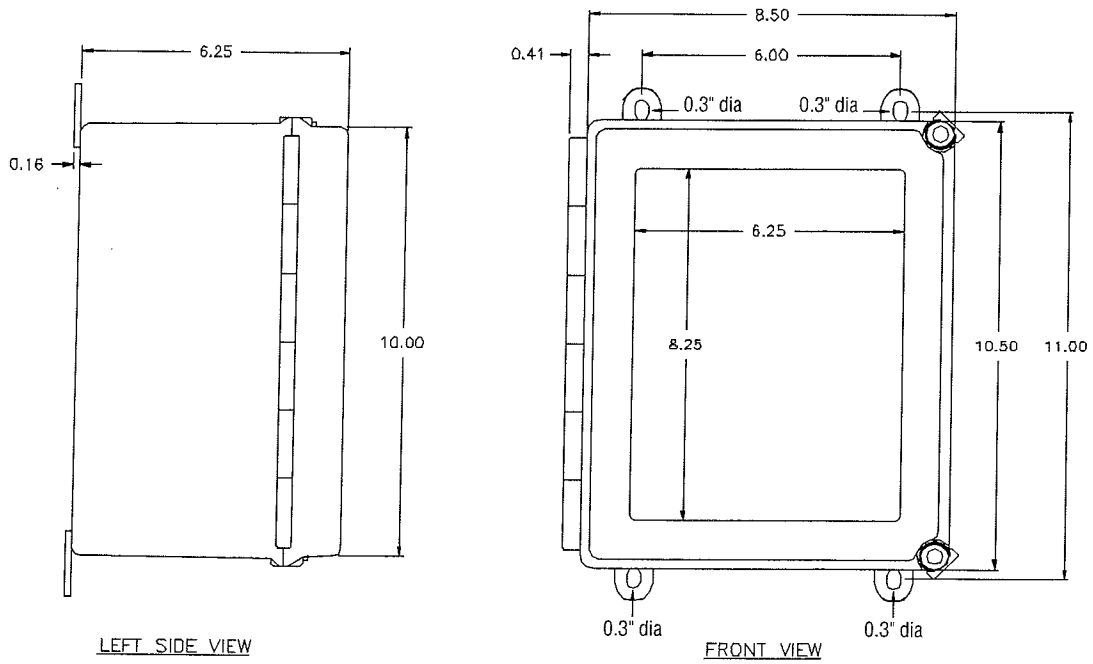
Control Module Ratings

Operating Temperature	-40°F to 140°F (-40°C to 60°C)
Power Requirements	100 to 277 Vac nom., 1PH, 50/60 Hz, 0.2A. max. + 0.75A (Aux. AC output terminals)
Output Power	+12Vdc nom., 250ma. max.
Control Modes	<ul style="list-style-type: none"> • Proportional, Deadband, Proportional Ambient (SSR), Proportional Ambient (Contactor) modes • Adjustable 2°F to 90°F (1°C to 50°C)
Temperature Inputs	(2) RTD inputs: 3-wire 100Ω Platinum (DIN 43760, $\alpha=0.00385\Omega/\Omega/^\circ\text{C}$) or 2/3-wire 100Ω Ni-Fe, open/shorted sensor detection/protection, lead resistance compensated 0 to 20Ω per lead
Temperature Measurement Range	-76°F to 1058°F (-60°C to 570°C), accuracy $\pm 0.5\%$ of span $\pm 1\text{LSD}$
Voltage Measurement Range	80 to 295Vac, accuracy: $\pm 1\%$ of span $\pm 2\text{LSD}$, repeatability: $\pm 1.5\%$ of span
Current Measurement Range	0.3 to 100A, resolution: 0.1A (0.3A to 11A range), 0.3A (11A to 40A range), 0.7A (40A to 100A range), accuracy: $\pm 2.5\%$ of reading \pm resolution
GF Current Measurement Range	20 to 250ma, accuracy: $\pm 2.5\%$ of span $\pm 2\text{LSD}$ at nominal load, repeatability: $\pm 4\%$ of span
Dry Contact Alarm Relay Output	48Vac/dc, 500ma, 10VA switching max.
AC Alarm Relay Output	0.75A, 100-277 Vac nom. max.

Appendix B—Typical Enclosure Dimensions

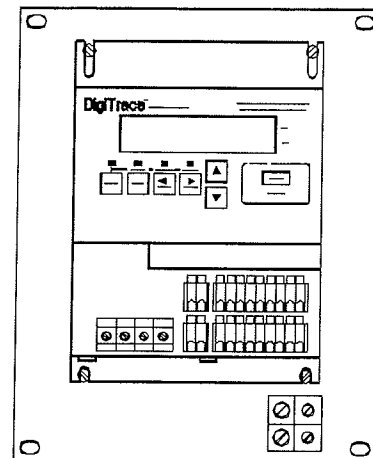
The following drawings provide the user with enclosure size and mounting dimensions for the stock 910 enclosure assemblies. Please contact your local Tyco Thermal Controls representative for information regarding other available sizes and configurations.

B.1 Standard Fiberglass EMR Assembly #10170-001



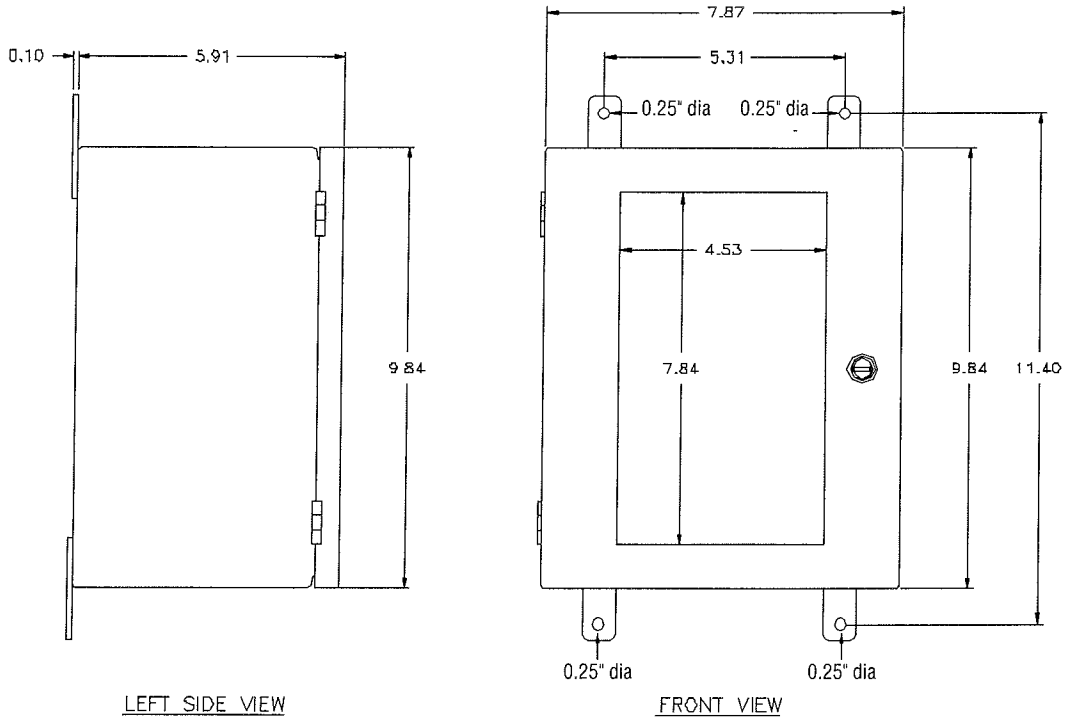
2-pole 30A EMR Assembly
in a Fiberglass
Enclosure with Window.

Model: 910*E1FWL*EMR2



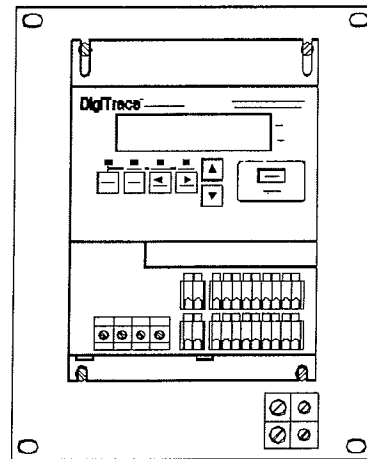
BACKPLANE

B.2 Optional Stainless Steel EMR Assembly #10170-003



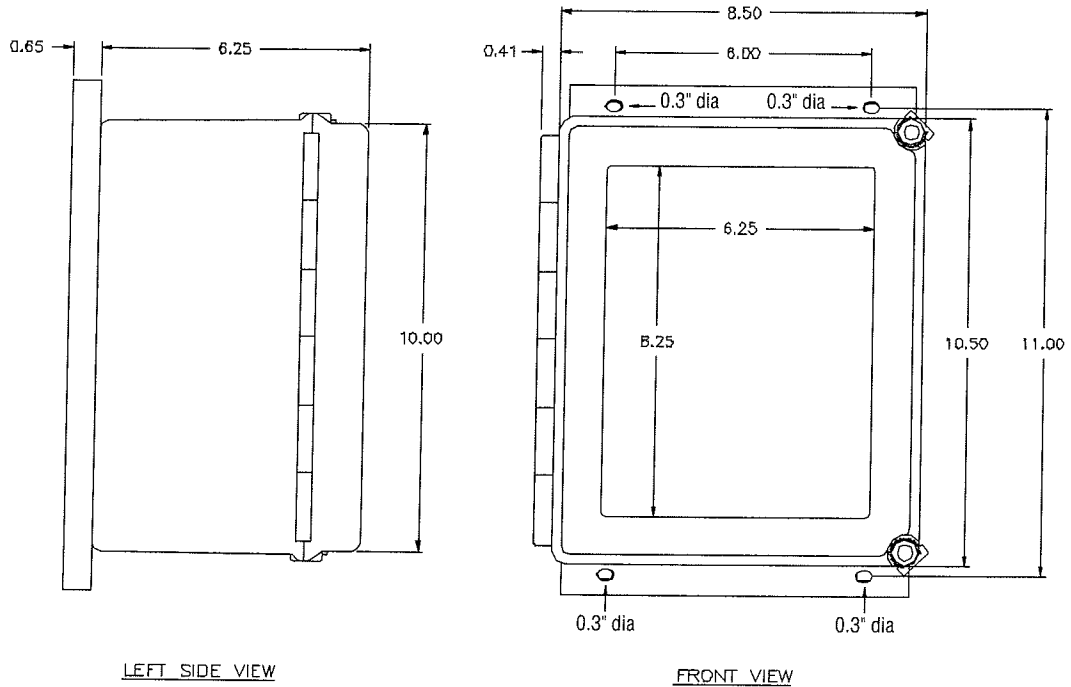
2-pole 30A EMR Assembly
in a Fiberglass
Enclosure with Window.

Model: 910*E1FWL*EMR2

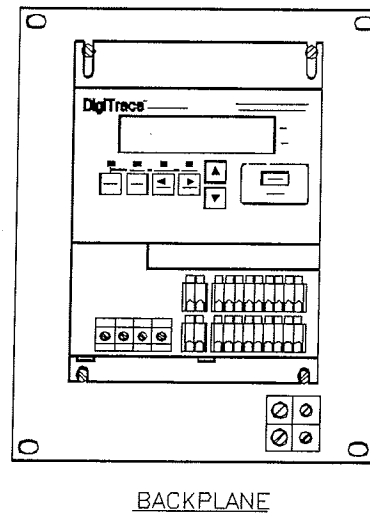


BACKPLANE

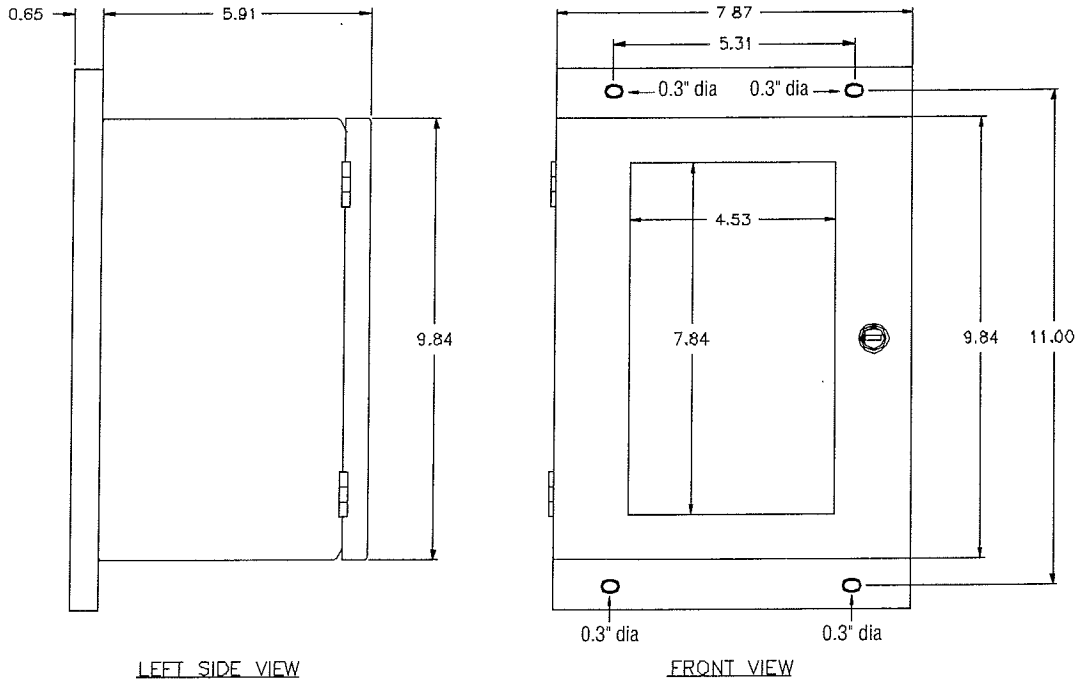
B.3 Standard Fiberglass SSR Assembly #10170-0002



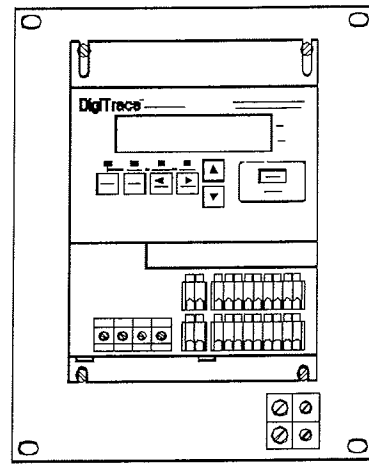
2-pole 30A EMR Assembly
in a Fiberglass
Enclosure with Window.
Model: 910*E1FWL*EMR2



B.4 Optional Stainless Steel SSR Assembly #10170-004

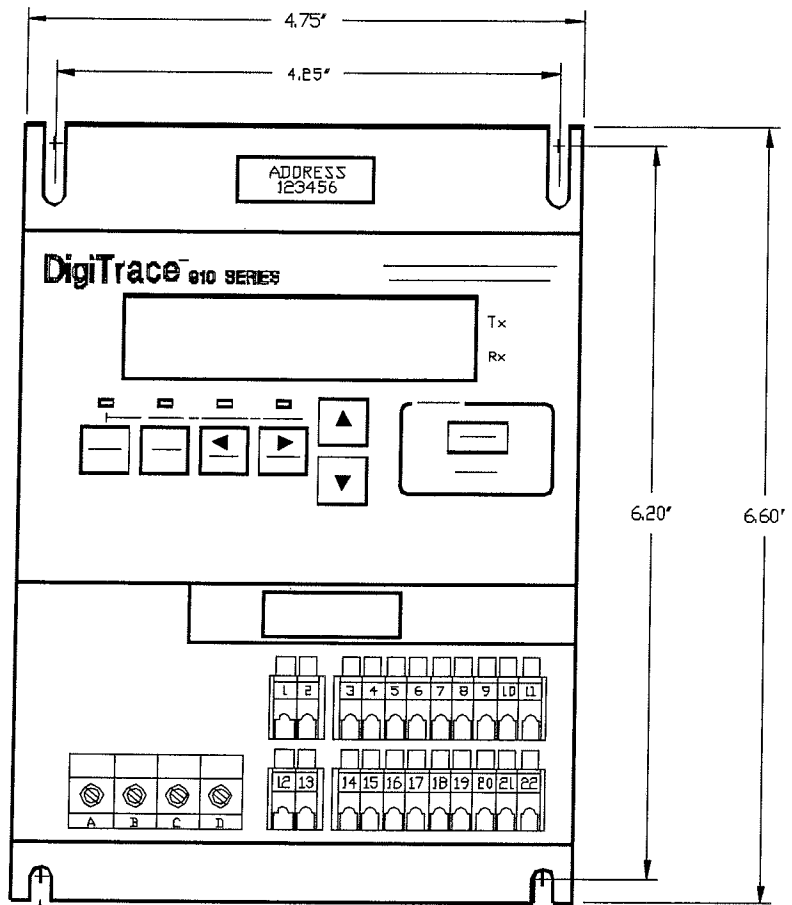


2-pole 30A EMR Assembly
in a Fiberglass
Enclosure with Window.
Model: 910*E1FWL*EMR2



BACKPLANE

B.5 910 Series HTC Control Module Dimensions

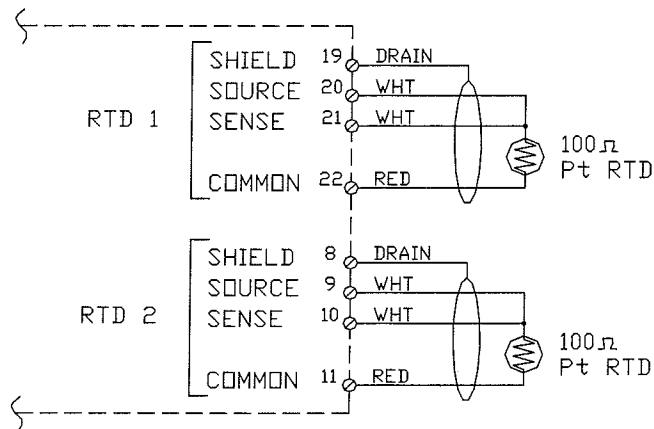


Mounting slots suitable
for a #8 machine screw

Appendix C—Wiring Diagrams

The following drawings provide sample wiring diagrams for the 910 Series control products and optional accessories. Please contact your local Tyco Thermal Controls representative for information regarding other available options.

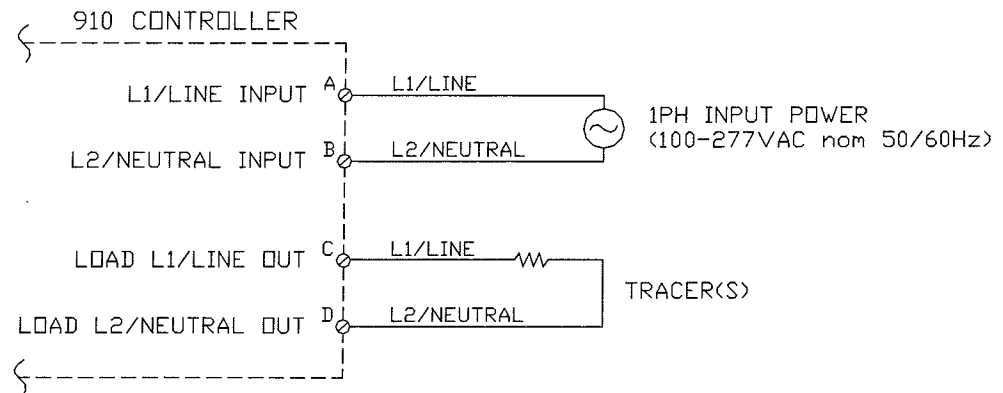
C.1 TS Wiring



Note: Temperature sensor manufacturers may use different lead wire colors than those shown in the diagram above. Some common color combinations are shown in the table below, but others may also be available. See Sections 2.7.1 and 8.2.1 for additional details.

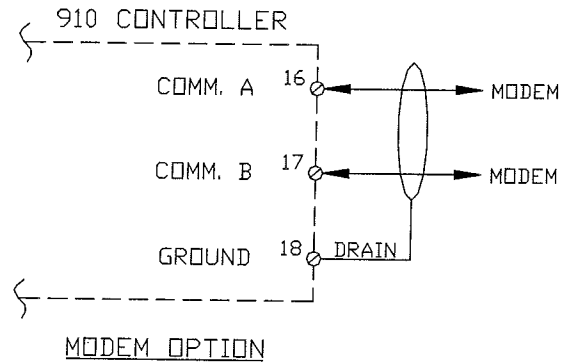
Signal Description	Lead Wire Color Scheme #1	Lead Wire Color Scheme #2	Lead Wire Color Scheme #3 (IEC 751)
Source	White	White	Red
Sense	White	Black	Red
Common	Red	Red	White

C.2 Power Wiring

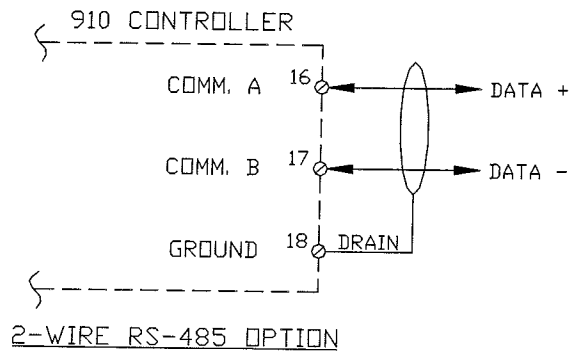


C.3 Communication Wiring

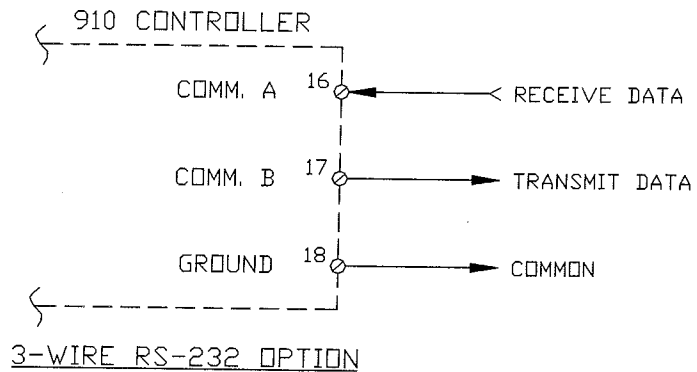
C.3.1 2-WIRE MODEM OPTION



C.3.2 2-WIRE RS-485 OPTION

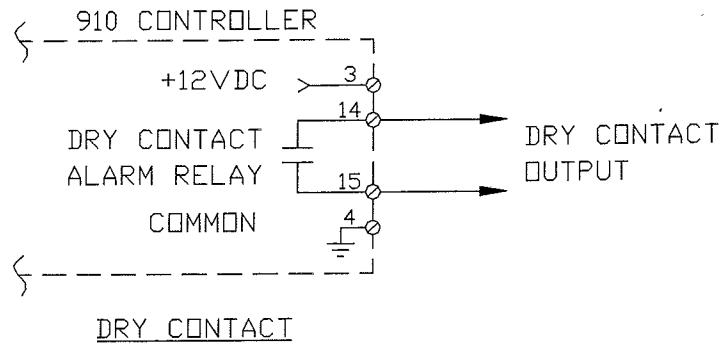


C.3.3 RS-232 OPTION

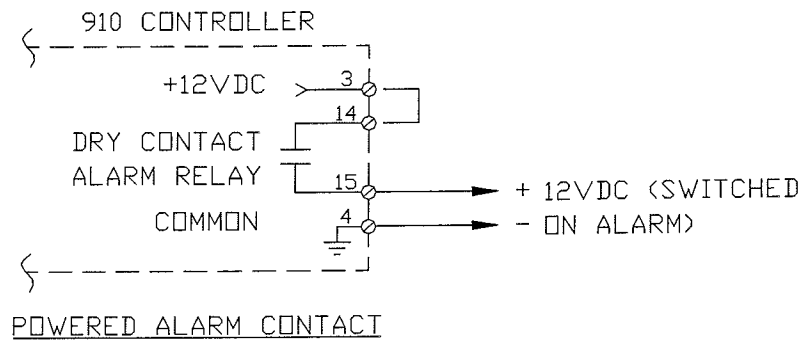


C.4 Alarm Output Wiring

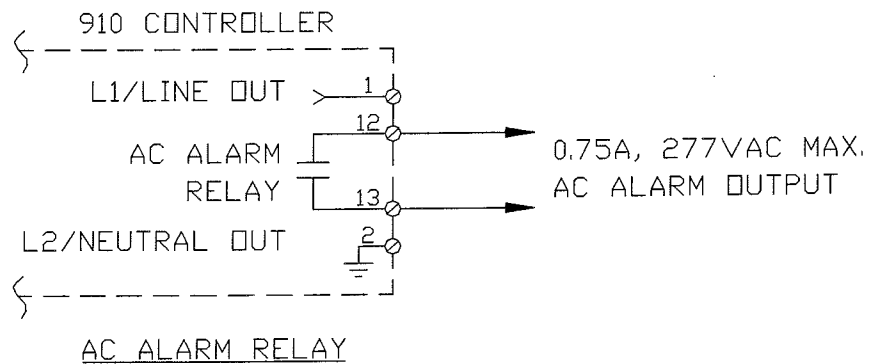
C.4.1 USED AS A DRY CONTACT



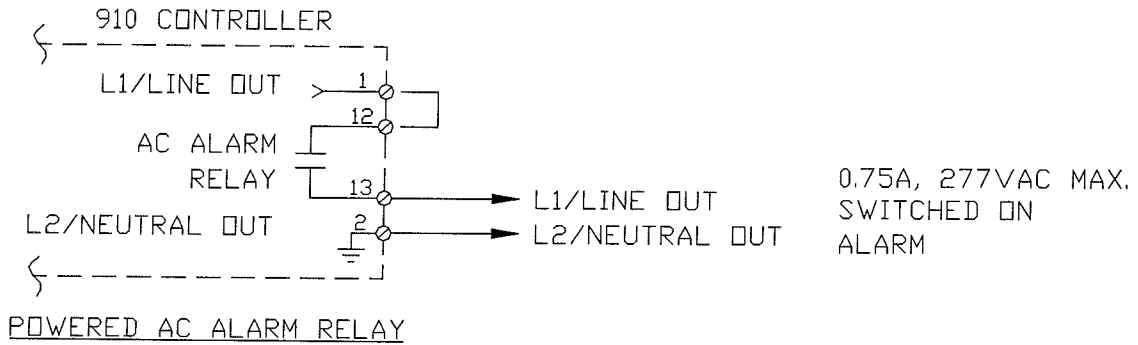
C.4.2 USED AS A SWITCHED DC CONTACT



C.4.3 USED AS AN AC ALARM RELAY

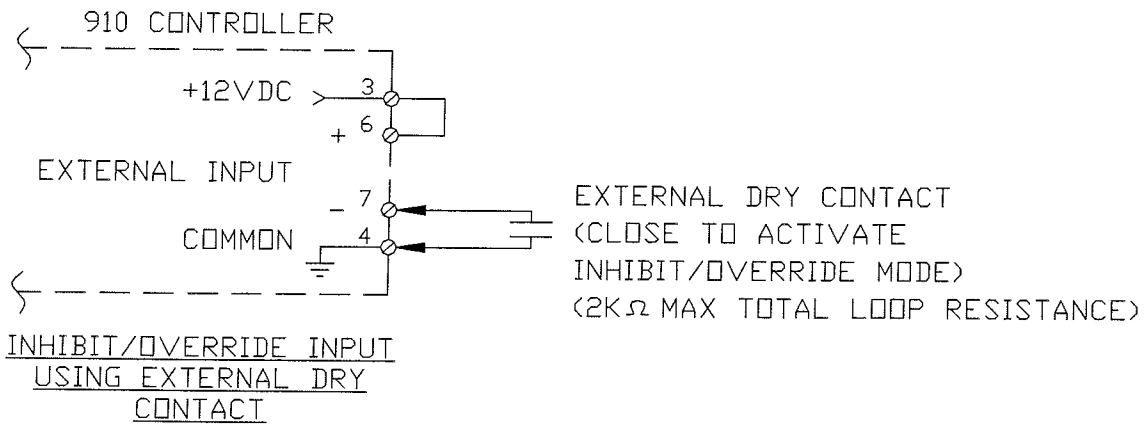


C.4.4 Used as a Powered AC Alarm Relay



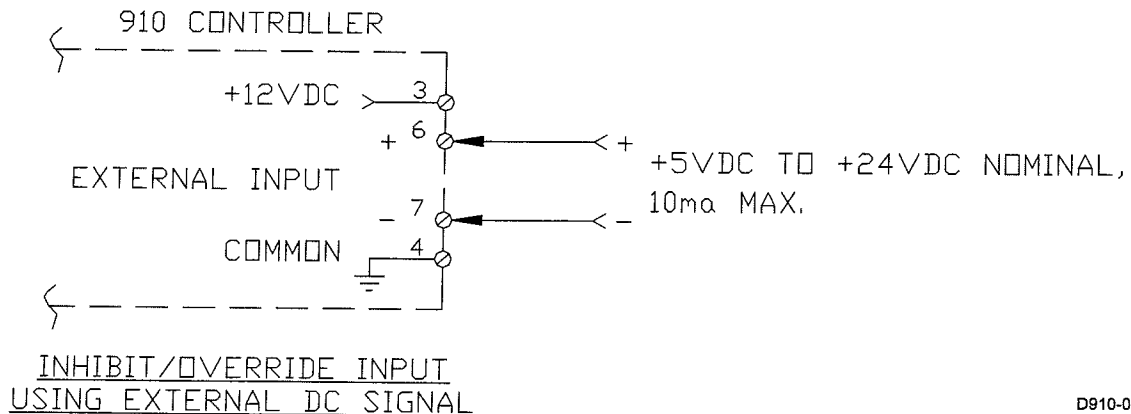
C.5 External Input/Output Port Wiring

C.5.1 EXTERNAL INHIBIT/OVERRIDE USING A DRY CONTACT



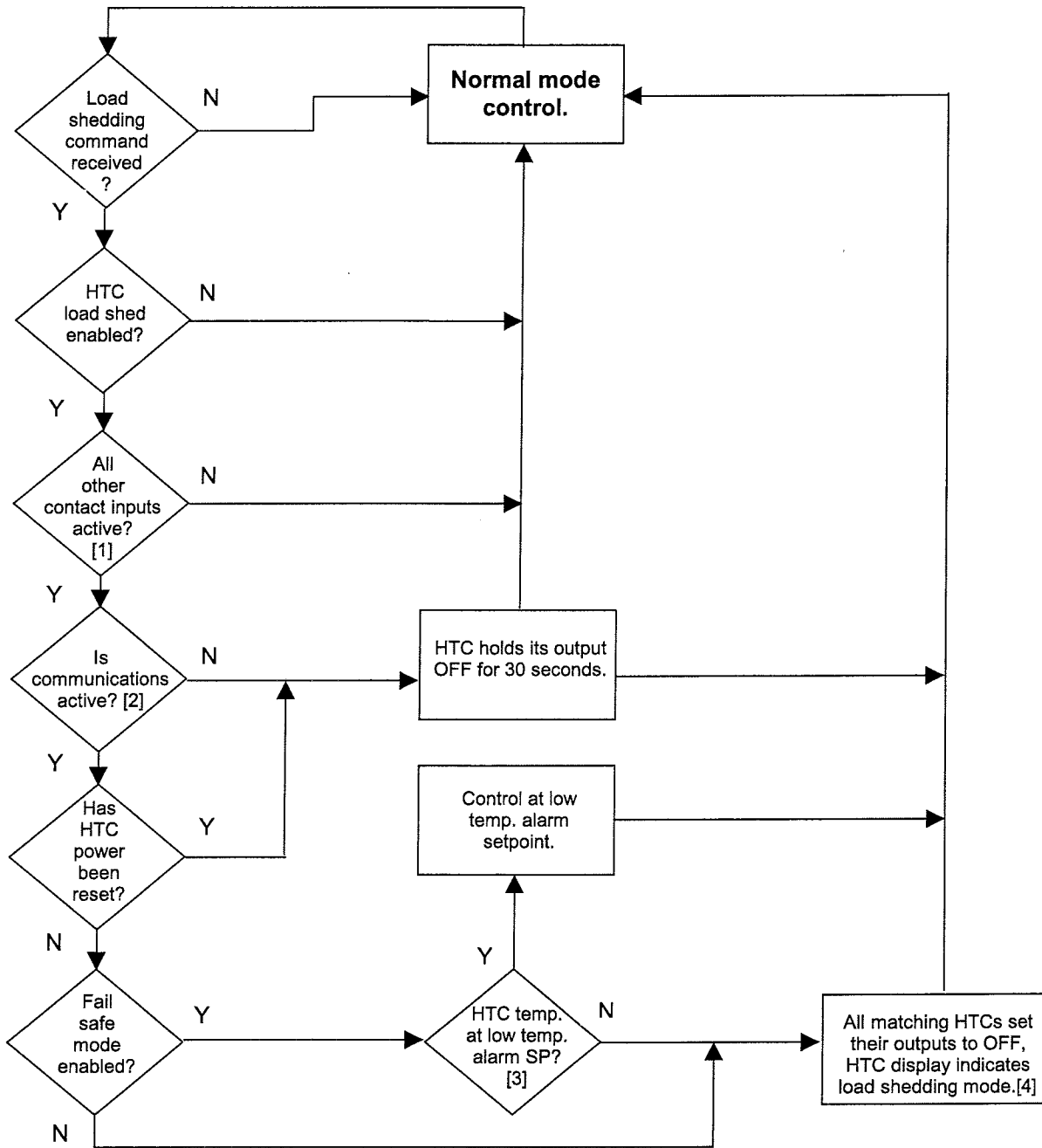
D910-009

C.5.2 EXTERNAL INHIBIT/OVERRIDE USING A DC SIGNAL



D910-009

Appendix D—HTC Load Shedding Sequence



1. If an HTC is associated with more than one contact input, all inputs must be activated before the HTC will go into a Load Shedding mode.
2. If communications between an HTC and an upstream device such as a GCC or supervisory software are interrupted, or if the power has been reset to the HTC, the HTC will hold its output OFF, waiting for a Load Shedding command.
3. Only if the Low Temperature Alarm is ENABLED.
4. For 910 Series controllers, a "<Load Shedding>" message will displayed after the load current reading.

Appendix E—100 Ω Platinum RTD Table

DIN 43760—100 Ω Platinum Resistance Temperature (RTD)—0.00385 Ohms/Ohm/°C

Ohms	°C	°F	Ohms	°C	°F	Ohms	°C	°F
60.25	-100	-148	159.18	155	311	250.48	410	770
62.28	-95	-139	161.04	160	320	252.19	415	779
64.30	-90	-130	162.90	165	329	253.90	420	788
66.31	-85	-121	164.76	170	338	255.61	425	797
68.33	-80	-112	166.61	175	347	257.32	430	806
70.33	-75	-103	168.46	180	356	259.02	435	815
72.33	-70	-94	170.31	185	365	260.72	440	824
74.33	-65	-85	172.16	190	374	262.42	445	833
76.33	-60	-76	174.00	195	383	264.11	450	842
78.32	-55	-67	175.84	200	392	265.80	455	851
80.31	-50	-58	177.68	205	401	267.49	460	860
82.33	-45	-49	179.51	210	410	269.18	465	869
84.27	-40	-40	181.34	215	419	270.86	470	878
86.25	-35	-31	183.17	220	428	272.54	475	887
88.22	-30	-22	184.99	225	437	274.22	480	896
90.19	-25	-13	186.82	230	445	275.89	485	905
92.16	-20	-4	188.63	235	455	277.56	490	914
94.12	-15	5	190.45	240	464	279.23	495	923
96.09	-10	14	192.26	245	473	280.90	500	932
98.04	-5	23	194.07	250	482	282.56	505	941
100.0	0	32	195.88	255	491	284.22	510	950
101.95	5	41	197.69	260	500	285.87	515	959
103.90	10	50	199.49	265	509	287.53	520	968
105.85	15	59	201.29	270	518	289.18	525	977
107.79	20	68	203.08	275	527	290.83	530	986
109.73	25	77	204.88	280	536	292.47	535	995
111.67	30	86	206.67	285	545	294.11	540	1004
113.61	35	95	208.45	290	554	295.75	545	1013
115.54	40	104	210.24	295	563	297.39	550	1022
117.47	45	113	212.02	300	572	299.02	555	1031
119.40	50	122	213.80	305	581	300.65	560	1040
121.32	55	131	215.57	310	590	302.28	565	1049
123.24	60	140	217.35	315	599	303.91	570	1058
125.16	65	149	219.12	320	608	305.53	575	1067
127.07	70	158	220.88	325	617	307.15	580	1076
128.98	75	167	222.65	330	626	308.76	585	1085
130.89	80	176	224.41	335	635	310.38	590	1094
132.80	85	185	226.17	340	644	311.99	595	1103
134.70	90	194	227.92	345	653	313.59	600	1112
136.60	95	203	229.67	350	662	315.20	605	1121
138.50	100	212	231.42	355	671	316.80	610	1130
140.39	105	221	233.17	360	680	318.4	615	1139
142.29	110	230	234.91	365	689	319.99	620	1148
144.17	115	239	236.65	370	698	321.59	625	1157
146.06	120	248	238.39	375	707	323.18	630	1166
147.94	125	257	240.13	380	716	324.76	635	1175
149.82	130	266	241.86	385	725	326.35	640	1184
151.70	135	275	243.59	390	734	327.93	645	1193
153.58	140	284	245.31	395	743	329.51	650	1202
155.45	145	293	247.04	400	752	331.08	655	1211
157.31	150	302	248.76	405	761	332.66	660	1220

Appendix F—100 Ω Nickel-Iron RTD Table

Ohms	°C	°F	Ohms	°C	°F	Ohms	°C	°F
69.8	-73	-100	133.4	68	155	218.2	210	410
71.1	-70	095	134.8	71	160	220.1	212	415
72.3	-67	-90	136.3	73	165	222.0	215	420
73.1	-65	-85	137.8	76	170	223.9	218	425
74.3	-62	-80	139.3	79	175	225.8	221	430
75.5	-59	-75	140.8	82	180	227.7	223	435
76.7	-56	-70	142.3	85	185	229.6	226	440
78.0	-53	-65	143.8	87	190	231.5	229	445
78.8	-51	-60	145.3	90	195	233.5	232	450
80.0	-48	-55	146.8	93	200	235.4	235	455
81.2	-45	-50	148.4	96	205	237.4	237	460
82.2	-42	-45	149.9	98	210	239.3	240	465
82.9	-40	-40	151.5	101	215	241.3	243	470
84.2	-37	-35	153.0	104	220	243.3	246	475
85.7	-34	-30	154.6	107	225	245.3	248	480
86.9	-31	-25	156.2	110	230	247.2	251	485
88.1	-28	-20	157.7	112	235	249.3	254	490
88.9	-26	-15	159.3	115	240	251.2	257	495
90.1	-23	-10	160.9	118	245	253.3	260	500
91.4	-20	-5	162.5	121	250	255.2	262	505
92.2	-17	0	164.2	123	255	257.3	265	510
93.4	-15	5	165.8	126	260	259.3	268	515
94.6	-12	10	167.4	129	265	261.4	271	520
95.8	-9	15	169.0	132	270	263.4	273	525
97.1	-6	20	170.7	135	275	265.5	276	530
98.3	-3	25	172.3	137	280	267.6	279	535
99.5	-1	30	174.0	140	285	269.6	282	540
100.8	1	35	175.7	143	290	271.7	285	545
102.0	4	40	177.4	146	295	273.8	287	550
103.3	7	45	179.1	148	300	275.9	290	555
104.6	10	50	180.8	151	305	278.0	293	560
105.9	12	55	182.5	154	310	280.1	296	565
107.2	15	60	184.2	157	315	282.3	298	570
108.5	18	65	185.9	160	320	284.4	301	575
109.8	21	70	187.6	162	325	286.5	304	580
111.1	23	75	189.	165	330	288.6	307	585
112.5	26	80	191.1	168	335	290.8	310	590
113.8	29	85	192.9	171	340	293.1	312	595
115.2	32	90	194.5	173	345	295.2	315	600
116.5	35	95	196.4	176	350	297.5	318	605
117.9	37	100	198.2	179	355	299.8	321	610
119.2	40	105	199.9	182	360	301.4	323	615
120.6	43	110	201.7	185	365	303.7	326	620
122.0	46	115	203.5	187	370	306.0	329	625
123.4	48	120	205.3	190	375	308.3	332	630
124.8	51	125	207.2	193	380	310.6	335	635
126.2	54	130	109.0	196	385	312.2	337	640
127.6	57	135	210.8	198	390	314.5	340	645
129.0	60	140	212.7	201	395	316.8	343	650
130.5	62	145	214.5	204	400	319.1	346	655
131.9	65	150	216.4	207	405	320.6	348	660

Appendix G—Factory Default Configuration V3.1X

910 Series HTC

BASIC MODE MENU

(All other parameters are set as shown in the Advanced Mode Sub-Menus)

Configuration Mode Menu		
Parameter	Factory	User
Control Setpoint	68°F (20°C)	
Lo TS 1	14°F (-10°C)	
Lo Load	1.0A	
Switch Control Mode	Deadband	
Circuit Breaker	*n/a (30.0A)	
Temperature Units	°F	
Feature Mode	Basic	

ADVANCED MODE MENUS

Configuration Mode Main Menu

Parameter	Factory	User
Control Setpoint	68°F (20°C)	
Lo TS 1	14°F (-10°C)	
Lo Load	1.0 A	
Hi GFI	20 mA	
GFI Trip	30 mA	
Feature Mode	Advanced	

TS Alarms Configuration Sub-Menu

Parameter	Factory	User
TS 1 Fail	Enable	
Lo TS 1	Enable	
Lo TS 1	14°F (-10°C)	
Hi TS 1	Disable	
Hi TS 1	*n/a (212°F (100°C))	
TS 2 Fail	Disable	
Lo TS 2	Disable	
Lo TS 2	*n/a (14°F (-10°C))	
Hi TS 2	Disable	
Hi TS 2	*n/a (212°F (100°C))	
Lo TS Filter	0 min	
Hi TS Filter	*n/a (0 min)	
Latch TS Alarms	Yes	
CTL TS Fail	Enable	

Other Alarms Configuration Sub-Menu

Parameter	Factory	User
Lo Load	Enable	
Lo Load	1.0 A	
Lo Load Filter	0 sec	
Hi Load	Disable	
Hi Load	*n/a (30.0A)	
Hi Load Filter	*n/a (0 sec)	
Hi GFI	Enable	
Hi GFI	20 mA	
Hi GFI Filter	0 sec	
GFI Trip	Enable	
GFI Trip	30 mA	
Lo Volt	Enable	
Lo Volt	90 V	
Lo Volt Filter	0 sec	
Hi Volt	Disable	
Hi Volt	*n/a (270V)	
Hi Volt Filter	*n/a (0 sec)	
Lo Resist	Disable	
Lo Resist	*n/a (50%)	
Lo Resist Filter	*n/a (0 sec)	
Hi Resist	Disable	
Hi Resist	*n/a (50%)	
Hi Resist Filter	*n/a (0 sec)	
Nominal Resist	*n/a (6.00 Ω)	
Overcurrent Trip	*n/a (Enable)	
Switch Fail	Enable	
HTC Reset	Disable	
C.B. Limiting	*n/a (Disable)	
Power Limiting	*n/a (Disable)	
Switch Limiting	*n/a (Disable)	
Contacto Count	Enable	
Contacto Count	200,000	
EEROM Data Fail	Enable	

Point Setup Sub-Menu

Parameter	Factory	User
Tag	TAG -(factory ID)	
Switch Control Mode	Deadband	
Prop Band	*n/a (4°F (2°C))	
Deadband	5°F (3°C)	
Cycle Time	*n/a (10 min)	
Switch Rating	*n/a (30.0 A)	
Circuit Breaker	*n/a (30.0 A)	
Max Power	*n/a (7200 W)	
TS Fail Mode	Off	
TS CTL Mode	TS1-Fail Off	
TS 1 Type	100Ω Plat	
TS 1 Lead Resist	*n/a (0)Ω	
TS 1 Hi Limit	Disable	
TS 2 Type	100Ω Plat	
TS 2 Lead Resist	*n/a (0Ω)	
TS 2 Hi Limit	Disable	
Autocycle	Enable	
Autocycle Interval	8	
Autocycle Units	Hours	
Override Source	Remote	
Load Shedding	Disable	

Miscellaneous Setup Sub-Menu

Parameter	Factory	User
Temperature Units	°F	
Version	V3.1x.xx	n/a
Ext. Input	Not used	
Flash Alarm Output	Yes	
Alarm Output	N.C.	
Language	English	
Passcode	0	
Scroll Delay	0.15 sec	
Load Defaults	(See user manual)	

Communications Setup Sub-Menu

Parameter	Factory	User
Protocol	HTCBUS	
HTCBUS Addr	(factory ID)	
Modbus Addr	*n/a (1)	
Modbus Sub Addr	*n/a (0)	
Baud Rate	Auto	
Parity	*n/a (None)	
Hardware	None, modem, RS-232, RS-485	n/a
Driver	Auto	
Profile	Auto	
Tx Delay	0.06 sec	

*n/a: Parameter may only appear if certain features are enabled. Values shown in brackets are the Factory defaults if the settings are enabled.

This information defines the default 910 Series Control Module configuration as set by the Factory for firmware V3.1X. These settings are subject to change without notice.

It is the user's responsibility to verify that all configuration parameters are chosen appropriately for the intended application.

Tyco Thermal Controls

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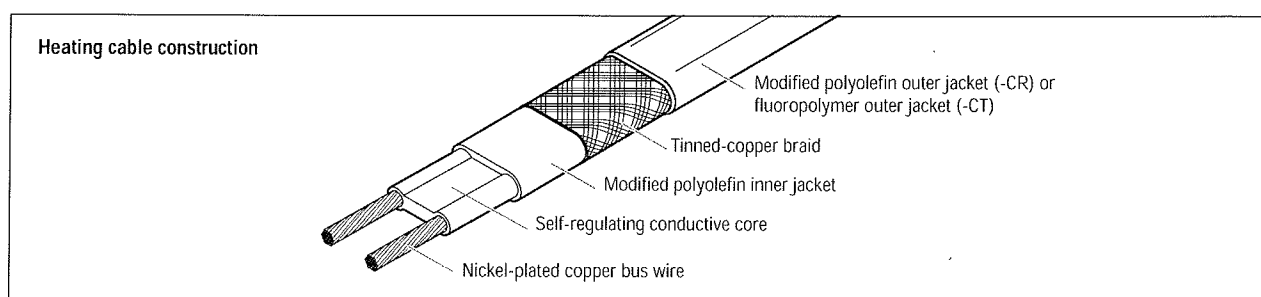
Self-regulating heating cables

Electrical freeze protection for both non-hazardous and hazardous locations.

The BTV family of self-regulating heating cables provides the solution to freeze-protection and process-temperature maintenance applications. BTV heating

cables maintain process temperatures up to 150°F (65°C) and can withstand intermittent exposure to temperatures up to 185°F (85°C). The heating cables are configured for use in nonhazardous and hazardous locations, including areas where corrosives may be present.

Raychem® BTV cables meet the requirements of the U.S. National Electrical Code and the Canadian Electrical Code. For additional information, contact your Tyco Thermal Controls representative or call Tyco Thermal Controls at (800) 545-6258.



Application	
Area classification	Nonhazardous and hazardous locations
Traced surface type	Metal and plastic
Chemical resistance	Exposure to aqueous inorganic chemicals: Use -CR (modified polyolefin outer jacket) Exposure to organic chemicals or corrosives: Use -CT (fluoropolymer outer jacket) For aggressive organics and corrosives: Consult your Tyco Thermal Controls representative.
Supply Voltage	
BTV1	100–130 Vac
BTV2	200–277 Vac
Temperature Rating	
Maximum maintain or continuous exposure temperature (power on)	150°F (65°C)
Maximum intermittent exposure temperature, 1000 hours (power on)	185°F (85°C)
Temperature ID Number (T-Rating)	T6: 185°F (85°C) Temperature ID numbers are consistent with North America national electrical codes.

Approvals

Hazardous Locations



Class I, Div. 2, Groups A, B, C, D
Class II, Div. 2, Groups F, G
Class III⁽¹⁾



Class I, Div. 1 & 2⁽²⁾, Groups A, B, C, D
Class II, Div. 1 & 2⁽²⁾, Groups E, F, G
Class III

Zone Approvals



CLI, ZN1, AEx e II T6⁽³⁾



Ex e II T6⁽³⁾

(1) FM Approved only
(2) BTV-CR is CSA Certified for Division 2 only
(3) BTV-CT only

BTV heating cables also have many other approvals, including Baseefa (2001) Ltd., PTB, DNV, and ABS.

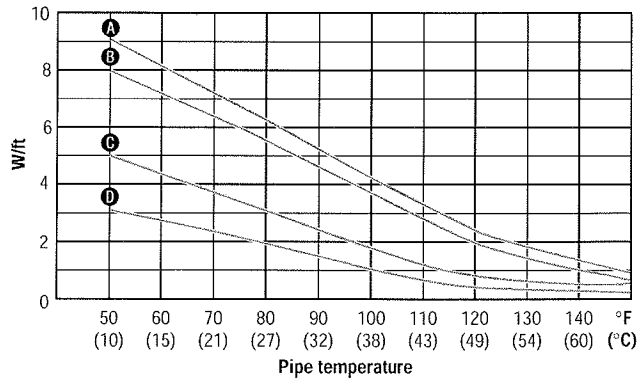
Design and Installation

For proper design and installation, use TraceCalc® Pro design software or the Design section of the *Industrial Product Selection and Design Guide* (H56550). Also, refer to the *Industrial Heat-Tracing Installation and Maintenance Manual* (H57274). Literature is available via the Tyco Thermal Controls Web site, www.tycothermal.com.

Nominal Power Output Rating on Metal Pipes at 120 V/240 V

	Adjustment factors	
	Power output	Circuit length
208 V		
3BTV2-CR/CT	0.82	0.96
5BTV2-CR/CT	0.85	0.94
8BTV2-CR/CT	0.89	0.92
10BTV2-CR/CT	0.89	0.92
277 V		
3BTV2-CR/CT	1.13	1.08
5BTV2-CR/CT	1.12	1.09
8BTV2-CR/CT	1.08	1.11
10BTV2-CR/CT	1.08	1.11

- Ⓐ 10BTV-CR/CT
- Ⓑ 8BTV-CR/CT
- Ⓒ 5BTV-CR/CT
- Ⓓ 3BTV-CR/CT



Note: To choose the correct heating cable for your application, use the Design section of the *Industrial Product Selection and Design Guide* (H56550). For more detailed information, use TraceCalc Pro design software.

Maximum Circuit Lengths Based on Circuit Breaker Sizes

	Ambient temperature at start-up	Maximum continuous circuit length (in feet) per circuit breaker							
		120 V				240 V			
		15 A	20 A	30 A	40 A	15 A	20 A	30 A	40 A
3BTV-CR/CT	50°F (10°C)	330	330	330	330	660	660	660	660
	0°F (-18°C)	200	265	330	330	395	530	660	660
	-20°F (-29°C)	175	235	330	330	350	465	660	660
	-40°F (-40°C)	155	205	310	330	310	410	620	660
5BTV-CR/CT	50°F (10°C)	230	270	270	270	460	540	540	540
	0°F (-18°C)	140	190	270	270	285	380	540	540
	-20°F (-29°C)	125	165	250	270	250	330	500	540
	-40°F (-40°C)	110	145	220	270	220	295	440	540
8BTV-CR/CT	50°F (10°C)	150	200	210	210	300	400	420	420
	0°F (-18°C)	100	130	200	210	200	265	400	420
	-20°F (-29°C)	85	115	175	210	175	235	350	420
	-40°F (-40°C)	80	105	155	210	155	210	315	420
10BTV-CR/CT	50°F (10°C)	120	160	180	180	240	315	360	360
	0°F (-18°C)	80	110	160	180	160	215	325	360
	-20°F (-29°C)	70	95	140	180	145	190	285	360
	-40°F (-40°C)	65	85	125	170	125	170	255	340

Ground-Fault Protection

Tyco Thermal Controls and national electrical codes require both ground-fault protection of equipment and a grounded metallic covering on all heating cables. Following are some of the ground-fault breakers that satisfy this equipment protection requirement: Square D Type QOB-EPD or QO-EPD; TraceGuard 277[®]; Cutler Hammer (Westinghouse) Type QBGFEP.

Product Characteristics	3BTV, 5BTV	8BTV, 10BTV
Minimum bend radius	@68°F (20°C): 0.5 in (12.7 mm)	@68°F (20°C): 0.5 in (12.7 mm)
Weight (lb per 10 ft, nominal)	0.7	1.0
Bus wire size	16 AWG	16 AWG
Outer jacket color	Black	Black
Heating cable dimensions	0.46 in x 0.25 in (11.7 mm x 6.35 mm)	0.65 in x 0.26 in (16.5 mm x 6.6 mm)

Components Tyco Thermal Controls offers a full range of components for power connections, splices, and end seals. These components must be used to ensure proper functioning of the product and compliance with warranty, code, and approvals requirements.



Visit www.tycothermal.com for more information on our ten-year extended warranty.

Single-entry power connection with junction box

The JBS-100 kit is designed to connect power to a single Raychem® brand BTV, QTVR, XTV, KTV, or VPL heating cable. It is approved by FM, CSA, and PTB for use in hazardous locations.

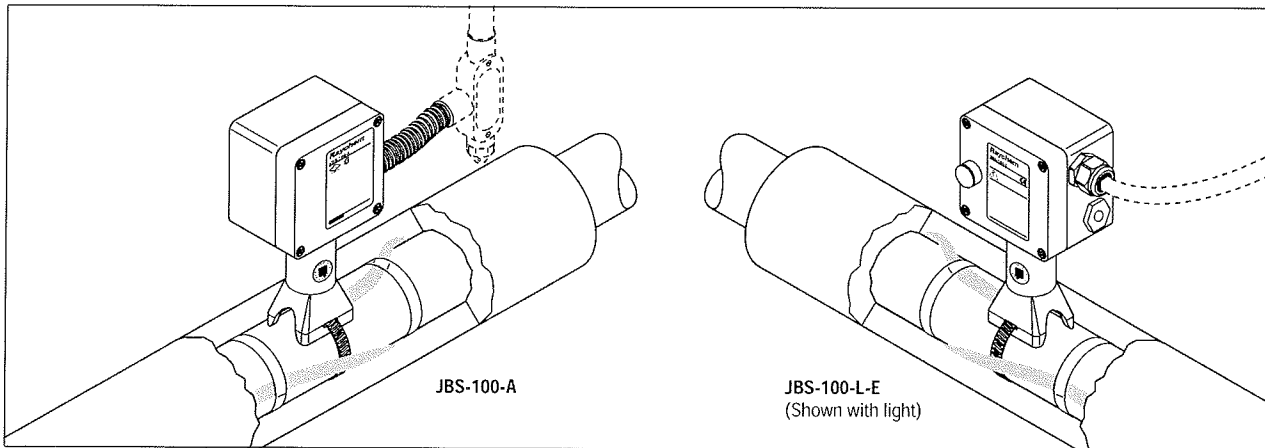
The JBS-100 integrates the functions of connection kits and insulation entries. The rugged stand protects the heating cable and allows for up to four inches (100 mm) of thermal insulation.

The cold-applied core sealer does not require a heat gun or torch for installation, so no hot work permit is necessary. The silicone-free, noncuring sealant allows easy installation and re-entry for maintenance.

Innovative spring clamp terminals provide fast installation and safe, reliable, maintenance-free operation.

Compared with other systems, this connection kit significantly reduces installation time. The kit is offered in three versions, customized for local installation practices, and is also available with a plug-in LED light (-L) that indicates when power is supplied to the heating cable circuit.

The kit contains all the necessary materials for a complete installation except for one pipe strap, which must be ordered separately.



	JBS-100-A, A6 JBS-100-L-A	JBS-100-E JBS-100-L-E	JBS-100-EP JBS-100-L-EP
Description	For use with conduit; has one 3/4-in through hole for use with 3/4-in conduit	For use with power cable; has two M25 threaded entries, one stopping plug, and one plastic power cable gland	For use with armored power cable; has two M25 threaded entries, an earthing plate, and an external earthing stud
Kit Contents	1 junction box with terminals 1 stand assembly 1 core sealer 1 green/yellow tube 1 light module (for -L only)	1 junction box with terminals 1 stand assembly 1 core sealer 1 green/yellow tube 1 M25 gland for power cable 8–17 mm in diameter 1 M25 stopping plug 1 light module (for -L only)	1 junction box with terminals, earth continuity plate, and stud 1 stand assembly 1 core sealer 1 green/yellow tube 1 M25 stopping plug 1 light module (for -L only)

Approvals

Hazardous Locations

FM APPROVED Class I, Div. 2, Groups A, B, C, D
Class II, Div. 1 & 2, Groups E, F, G
Class III

FM APPROVED (1) CLI, ZN1, AEx e II T⁽²⁾
CLI, ZN1, AEx em II T⁽²⁾ (for -L only)

CSA Ex e II T⁽²⁾
Ex em II T⁽²⁾ (for -L only)

Ex II 2 G EEx e II
II 2 G EEx em II (for -L only)
PTB 97 ATEX 1058 U

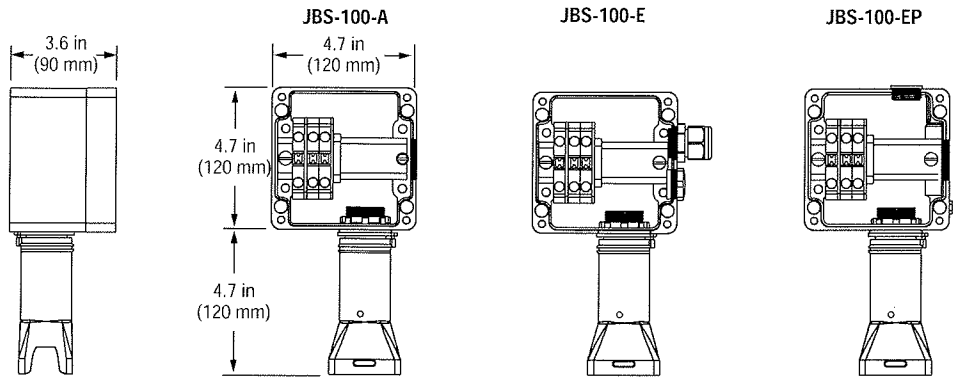
CSA Ex e II T⁽²⁾
Ex em II T⁽²⁾ (for -L only)

Ex II 2 G EEx e II
II 2 G EEx em II (for -L only)
PTB 97 ATEX 1058 U

CSA Ex e II T⁽²⁾
Ex em II T⁽²⁾ (for -L only)

(1) Except VPL
(2) For T-rating, see heating cable or design documentation

Dimensions



	JBS-100-A, A6	JBS-100-E	JBS-100-EP
Product Specifications			
Heating cable capability	BTV-CR, BTV-CT, QTVR-CT, XTV-CT, KTV-CT and VPL-CT		
Ingress protection	NEMA 4X	IP66/IP67	IP66/IP67
Entries	1 x 3/4 in	2 x M25	2 x M25
Minimum installation temperature	-40°F (-40°C)	-40°F (-40°C)	-40°F (-40°C)
Minimum usage temperature	-60°F (-50°C)	-60°F (-50°C)	-60°F (-50°C)
Maximum pipe temperature	482°F (250°C)	420°F (215°C)	420°F (215°C)
Terminals	Spring clamp EEx e 2 line, 1 ground	Spring clamp EEx e 1 phase, 1 neutral, 1 earth	Spring clamp EEx e 1 phase, 1 neutral, 1 earth
Maximum conductor size	8 AWG (A6 to 6 AWG)	10 mm ²	10 mm ²
Maximum operating voltage	277 Vac	254 Vac	254 Vac
Maximum circuit breaker rating	50 A	40 A	40 A
Materials			
Enclosure	Electrostatic charge-resistant glass-filled engineered polymer, black	Electrostatic charge-resistant glass-filled engineered polymer, black	Electrostatic charge-resistant glass-filled engineered polymer, black
Lid screws	Stainless steel	Stainless steel	Stainless steel
Lid gasket	Silicone rubber	Silicone rubber	Silicone rubber
Earth continuity plate	n/a	n/a	Steel, zinc-plated and yellow-chromated
Optional LED Indicator Light			
Color	Red	Green	Green
Voltage rating	100-277 Vac	100-277 Vac	100-277 Vac
Power consumption	< 1 W	< 1 W	< 1 W
Ordering Details			
Power connection			
Catalog number	JBS-100-A / JBS-100-A6	JBS-100-E	JBS-100-EP
Part number	085947-000 / C26470	829939-000	158251-000
Weight	2.5 lb (1.1 kg)	1.2 kg (2.6 lb)	1.3 kg (2.9 lb)
Power connection with light			
Catalog number	JBS-100-L-A	JBS-100-L-E	JBS-100-L-EP
Part number	944699-000	054363-000	075249-000
Weight	3.5 lb (1.6 kg)	1.6 kg (3.5 lb)	1.7 kg (3.7 lb)



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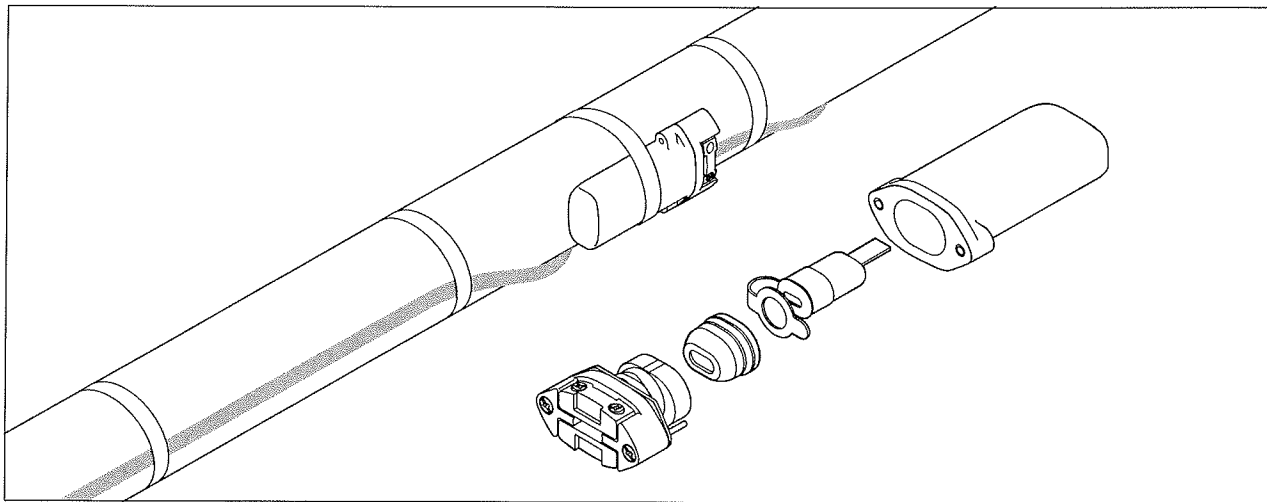
Low-profile end seal kit

The E-150 is a cold-applied low-profile end seal. It is designed for use with the following Raychem® brand heating cables: BTV, QTVR, XTV, and KTV. Use the E-150 in applications with temperatures ranging from -60°F to 420°F (-50°C to 215°C). It is approved by FM, CSA, and PTB for use in hazardous locations.

The unique design of the E-150 suits the demanding requirements of the industrial environment. The low-profile housing can be installed on pipes and other surfaces. A spring-loaded grommet makes a first seal to maintain a watertight connection, while the silicone-free, noncuring sealant used in the Raychem sealing boot adds a second seal, providing additional protection.

The rugged construction makes the E-150 resistant to impact and suitable for high-temperature and chemical exposure.

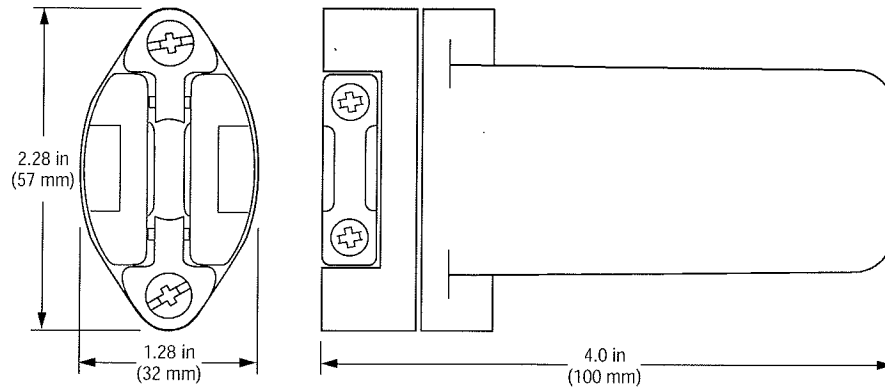
The end seal requires no heat source for installation and it is re-enterable, making maintenance fast and easy. Each kit contains all the necessary materials to do one end termination.



Description	Cold-applied end seal for use with BTV, QTVR, XTV, and KTV heating cables
Kit Contents	1 end seal enclosure housing 1 sealing grommet assembly 1 sealing boot 1 identification label

Approvals	Hazardous Locations	
		Class I, Div. 2, Groups A, B, C, D Class II, Div. 2, Groups F, G Class III
		II 2 G EEx e II PTB 98 ATEX 1121 U
		CLI, ZN2, AEx e II T ⁽¹⁾
		Ex e II T ⁽¹⁾
	⁽¹⁾ For T-rating, see heating cable or design documentation	

Dimensions



Product Specifications

Heating cable capability	BTV-CR, BTV-CT, QTVR-CT, XTV-CT, KTV-CT
Ingress protection	NEMA 4X (IP66)
Minimum installation temperature	-40°F (-40°C)
Minimum usage temperature	-60°F (-50°C)
Maximum pipe temperature	420°F (215°C)
Operating voltage	277 Vac for FM, CSA; 254 Vac for PTB

Materials of Construction

Enclosure, end plate, and shim	Engineered polymer, black
Sealing grommet and core sealer	Silicone rubber
Screws, compression spring, reinforcement plate	Stainless steel

Ordering Details

Catalog number	E-150
Part number	979099-000
Weight	0.6 lb (0.3 kg)



Visit www.tycothermal.com
for more information on our
ten-year extended warranty.

Splice or tee connection kit

The T-100 serves as an above-insulation splice or tee for up to three Raychem® brand BTV, QTVR, XTV, KTV, or VPL heating cables. It is approved by FM, CSA, and PTB⁽¹⁾ for use in hazardous locations.

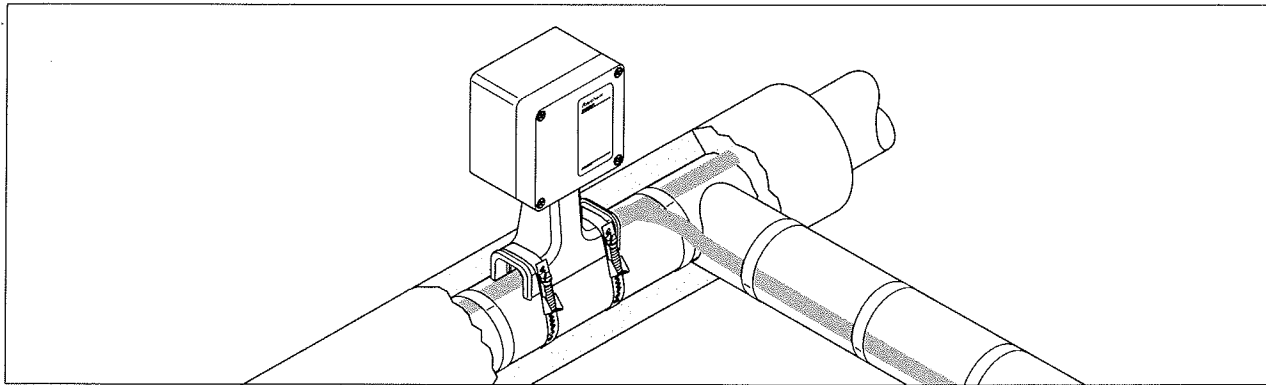
The T-100 integrates the functions of connection kits and insulation entries. The rugged stand protects the heating cable

and allows for up to four inches (100 mm) of thermal insulation.






The cold-applied core sealer does not require a heat gun or torch for installation, so no hot work permit is necessary. The silicone-free, noncuring sealant in the core sealer allows easy installation and re-entry for maintenance.

The electrical connections in the T-100 are made with insulated crimps. For a splice or tee connection with terminal blocks, use the JBM-100.

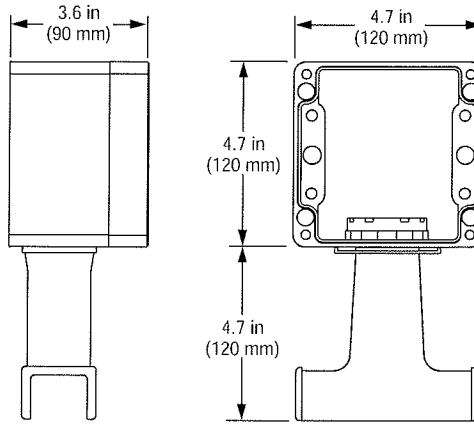
Each kit contains all the necessary materials for a complete installation except for the pipe straps, which must be ordered separately.



Description	Above-insulation splice/tee kit appropriate for use in hazardous locations
Kit Contents	1 splice/tee enclosure and lid 1 stand assembly 3 core sealers 3 green/yellow tubes 3 compression crimps 3 crimp insulating tubes 3 crimp insulating boots Note: Order appropriate pipe straps separately (two straps per kit).

Approvals	<p>Hazardous Locations</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p> Class I, Div. 2, Groups A, B, C, D Class II, Div. 1 and 2, Groups E, F, G Class III</p> <p></p> </div> <div style="width: 45%;"> <p> CLI, ZN1, AEx e II T⁽²⁾</p> <p> Ex e II T⁽²⁾</p> <p> II 2 G EEx e II PTB 98 ATEX 1020 U</p> <p>⁽¹⁾ Except VPL ⁽²⁾ For T-rating, see heating cable or design documentation</p> </div> </div>
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Dimensions (nominal)



Product Specifications

Heating cable capability	BTV-CR, BTV-CT, QTVR-CT, XTV-CT, KTV-CT, and VPL-CT
Ingress protection	NEMA 4X/IP66/IP67
Minimum installation temperature	-40°F (-40°C)
Minimum usage temperature	-60°F (-50°C)
Maximum pipe temperature	482°F (250°C) for FM, CSA; 420°F (215°C) for PTB
Maximum operating voltage	277 Vac for FM, CSA; 254 Vac for PTB
Maximum circuit breaker rating	50 A for FM, CSA; 40 A for PTB

Materials

Enclosure	Electrostatic charge-resistant glass-filled engineered polymer, black
Lid screws	Stainless steel
Lid gasket	Silicone rubber

Ordering Details

Catalog number	T-100
Part number	447379-000
Weight	2.5 lb (1.2 kg)
Crimp tool	T-100-CRIMP-TOOL (not included in kit; equivalent to Panduit CT-1570)
Spare crimps and insulating tubes	T-100-CRIMP-KIT

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BENOIT ELECTRIC, INC.
254 INDUSTRIAL LANE
BARRE, VT 05641
Phone (802) 229-1955
Fax (802) 229-4946

Submittal Cover Sheet

Project Name: UVM Delehanty Lab

Date: 2/07/2008

Architect: IDC Architects

Engineer: Same

Specification Section: 16011

Revision:

Submitted per Specification Section: 2, 12, 2.13, 2.15 / B

Drawing #/Detail Reference: E-1

Supplier: Pass & Seymour

Items Submitted: Devices and Plates

Switches - PS20AC1-I

Duplex Outlet - PT5362-I

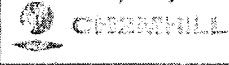
GFCI Outlet - PT2095-I

Wall Plates - TP Nylon series

- NO EXCEPTIONS NOTED
- NAME CORRECTIONS NOTED
- REVISE AND RESUBMIT
- SUBMIT ITEMS AS NOTED

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any Action shown is subject to the requirements of the plans and specifications. Contractor is responsible for dimensions which shall be confirmed and correlated at the jobsite, fabrication processes and technique of construction, coordination of the work with that of all other trades and the satisfactory performance of the work.

Dated: 2/17/08



ReArch Company

Submittal and Shop Drawings

Received 2/8/08

Reviewed

Bob Pass
Signature, Title

2/8/08
Date

Pass & Seymour

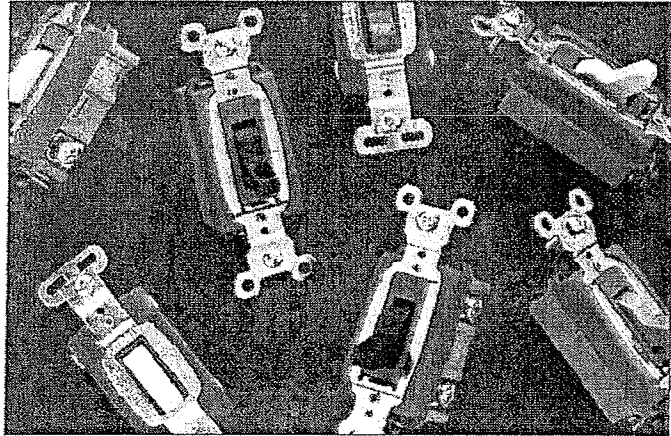


Switches Extra Heavy-Duty 15, 20 & 30A, 120/277VAC

PS15AC1, PS15AC2, PS15AC3, PS15AC4, PS20AC1, PS20AC2, PS20AC3, PS20AC4, PS30AC1, PS30AC2, PS30AC3

Extra heavy-duty switches with quiet operation and a smooth feel.

Designed to withstand abuse and constant use in demanding applications, these durable switches virtually eliminate contact bounce and arcing. Featuring auto-ground and external, screw-pressure-plate back wiring on all terminals for fast, easy installation and excellent electrical connection. Oversize silver alloy contacts help ensure long life and better heat dissipation.



Features & Benefits

One-piece nickel-plated brass strap for superior corrosion-resistance.

Cam control and spring actuator for positive "makes and breaks" with a minimum of arcing.

Heavy-duty bumpers for quiet, smooth operation.

Oversized silver-alloy contacts for long life and better heat dissipation.

Heavy-duty, brass alloy, one-piece contact arm virtually eliminates contact bounce.

Shallow design for easier installation.

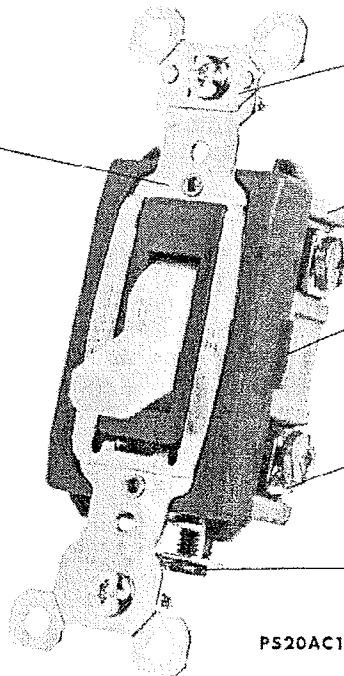
Auto-ground clip assures positive ground.

Glass-reinforced nylon back body for durability and strength.

Locking support provides resistance to face and back body separation.

Side and external screw-pressure-plate back wire with #14 - #10 AWG copper or copper-clad wire.

Grounding terminal is standard with screw-pressure-plate back wire.



PS20AC1-I

Field Uses/Venture Markets

Industrial

Health Care

Education

Institutional

Pass & Seymour



**Switches
Extra Heavy-Duty
15, 20 & 30A, 120/277VAC**

Ordering Information

Catalog Number				Rating		Color
Single Pole	Double Pole	Three-Way	Four-Way	A.	VAC	
Toggle Switches Back & Side Wire						
PS15AC1-I	PS15AC2-I	PS15AC3-I	PS15AC4-I	15	120/277	Ivory
PS15AC1-W	PS15AC2-W	PS15AC3-W	PS15AC4-W	15	120/277	White
PS15AC1	PS15AC2	PS15AC3	PS15AC4	15	120/277	Brown
PS15AC1-GRY	PS15AC2-GRY	PS15AC3-GRY	PS15AC4-GRY	15	120/277	Gray
PS15AC1-LA	PS15AC2-LA	PS15AC3-LA	PS15AC4-LA	15	120/277	Light Almond
PS20AC1-I	PS20AC2-I	PS20AC3-I	PS20AC4-I	20	120/277	Ivory
PS20AC1-W	PS20AC2-W	PS20AC3-W	PS20AC4-W	20	120/277	White
PS20AC1	PS20AC2	PS20AC3	PS20AC4	20	120/277	Brown
PS20AC1-GRY	PS20AC2-GRY	PS20AC3-GRY	PS20AC4-GRY	20	120/277	Gray
PS20AC1-BK	PS20AC2-BK	PS20AC3-BK	PS20AC4-BK	20	120/277	Black
PS20AC1-RED	PS20AC2-RED	PS20AC3-RED	PS20AC4-RED	20	120/277	Red
PS20AC1-LA	PS20AC2-LA	PS20AC3-LA	PS20AC4-LA	20	120/277	Light Almond
PS30AC1-I	PS30AC2-I	PS30AC3-I		30	120/277	Ivory
	PS30AC2-W			30	120/277	White
PS30AC1	PS30AC2	PS30AC3		30	120/277	Brown

For more information on these and other P&S products refer to our Catalog or visit our web site.

Switches Extra Heavy-Duty 15, 20 & 30A, 120/277VAC

Pass & Seymour



Technical Specifications

3rd Party Compliance

UL Listed, File Number E140597, Standard UL20, General Use Snap Switches.
Federal Specification WS896.
cULus Listed, File Number LR17446, Standard CSA-C22.2 No. 111, General Use Snap Switches.
Conforms to NEMA WD-1 and WD-6.

Performance

Electrical	
Dielectric Withstand Voltage	1500V Minimum
Maximum Working Voltage	277VAC
Overload	Minimum 4.8 times rated current for 100 cycles
Temperature Rise	30°C maximum at rated current
Maximum Continuous Current	277VAC
Endurance	50,000 cycles minimum, resistive, inductive, tungsten filament lamp load (Fed Spec)
Mechanical	
Terminal Accommodations	#14 AWG – #10 AWG
Environmental	
Flammability	UL94 V2
Operating Temperature	Maximum continuous +115°C, minimum -40°C

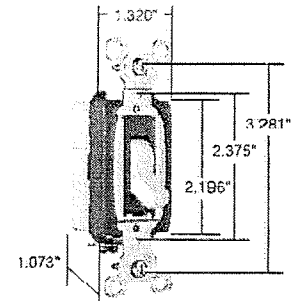
Materials

Back Body	Glass-Reinforced Nylon	Contacts	Silver Cadmium Oxide
Front Body	Nylon	Spring Arm	Brass
Toggle	Thermoplastic Polycarbonate	Bumper	Rubber
Terminals	Brass	Spring	Zinc-Plated Steel
Terminal Screws	Tri-Drive Brass	Ground Terminal	Brass
Strap	Nickel-Plated Brass	Ground Screw	Tri-Drive Zinc-Plated Steel
Pressure Plate	Brass	Auto-Ground Clip	Nickel-Plated Brass

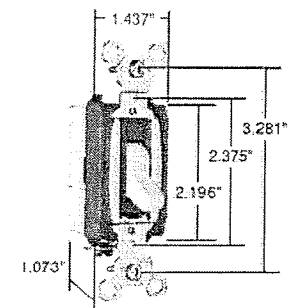
15 Amp Cover	Blue
20 Amp Cover	Red
30 Amp Cover	Green

Warranty

1 Year

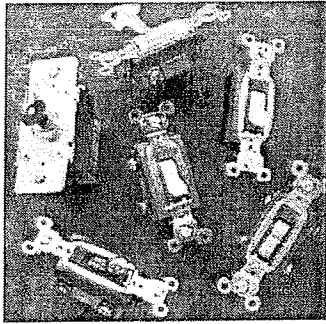


Dimensions for
15 & 20 Amp



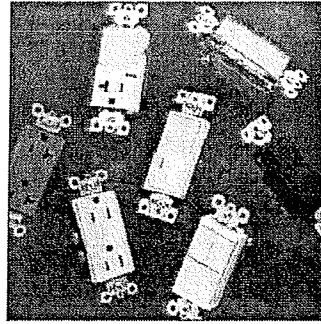
Dimensions for
30 Amp

Complimentary Devices & Accessories



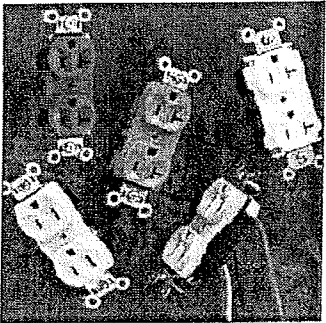
SWITCHES

- Heavy-Duty Lighted Toggle
- Heavy-Duty Security
- Heavy-Duty Locking
- Construction Grade Toggle
- Commercial Grade Toggle



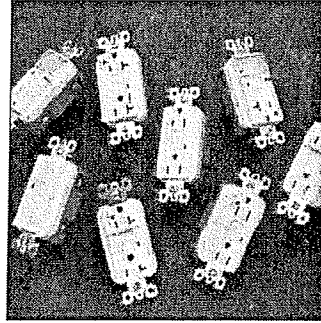
DECORATOR DEVICES

- Construction Grade Switches
- Specification Grade Combo Switches
- Construction Grade Receptacles
- Commercial Grade Receptacles
- Specification Grade Hallway Lights



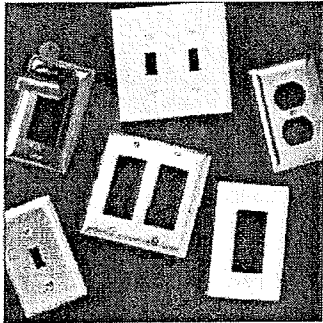
STRAIGHT BLADE RECEPTACLES

- Extra Heavy-Duty
- Heavy-Duty
- Hard Use
- Construction Grade
- Construction Grade Leaded
- Commercial Grade



GFCIs

- Specification Grade
- Hospital Grade
- Dead Front



WALL PLATES

- TradeMaster® Thermoplastic Nylon
- Screwless Polycarbonate
- Stainless Steel
- Brass
- Aluminum
- Dustproof Stainless Steel Covers

Also available...

- | | | | |
|--------------------------|--------------------------------------|-------------------------------|-------------------------------|
| ■ Light Almond Devices | ■ TVSS & Isolated Ground Devices | ■ Turnlok® Locking Devices | ■ IEC 309 Industrial Products |
| ■ Hospital Grade Devices | ■ Ground Continuity Monitoring (GCM) | ■ Weatherproof Boxes & Covers | ■ Flexcor® Wire Mesh Grips |
| ■ PlugTail™ Devices | ■ Straight Blade Plugs & Connectors | | ■ Configurable Solutions |

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800-611-7277

Canada
570 Applewood Crescent
Vaughan, ON, L4K 4B4
905-738-9195

SR 101R2 — Updated April 2006 — For latest specs visit www.passandseymour.com

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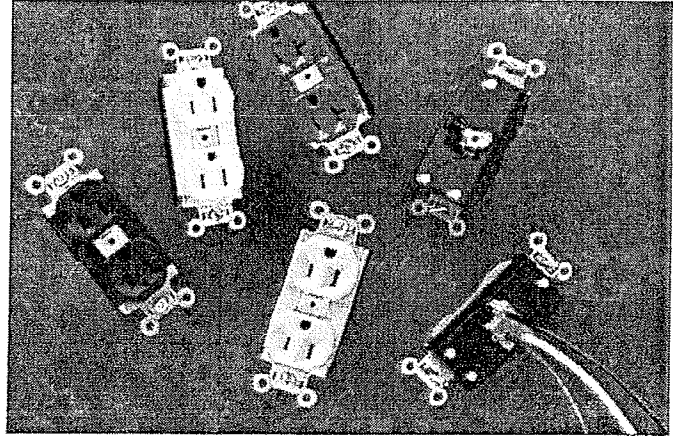
LEgrand®

PlugTail™ Devices Receptacles Spec Grade 15 & 20A, 125V

PT5262, PT5362

PlugTail™. The fastest, most consistent and reliable wiring devices — ever.

Factory-terminated devices and connectors mean that device installation is the same regardless of skill level of the installer. The UL-Listed connectors are keyed to ensure proper wiring installation into each receptacle. The connector simply snaps into the back of the device — no fussing with wires, stripping, or tightening screws. PlugTail devices are finger safe with no exposed terminals, so taping is not required. Now device installation is a snap!



Features & Benefits

Auto-ground clip assures positive ground.

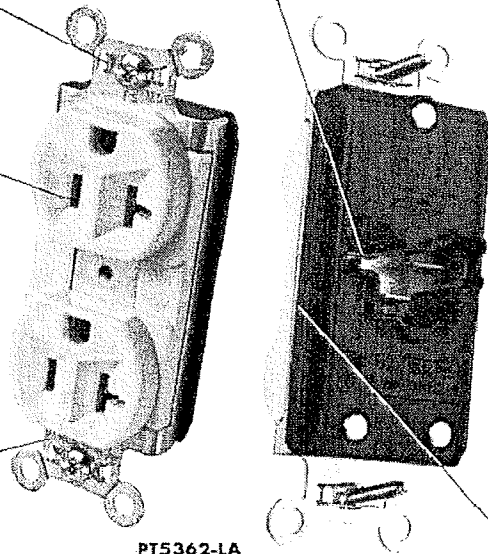
Built-in connector features large brass terminal blades to ensure consistent, reliable electrical connections.

Large brass contacts snugly terminate on device blade terminals. Audible snapping latch assures connection, allows release.

.036 inch thick, brass, triple-wipe power contacts for lasting retention.

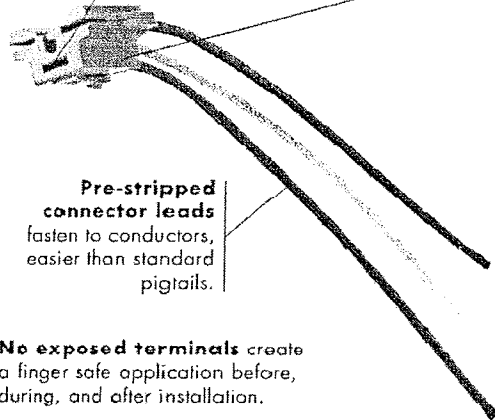
Three drive screws anchor strap to back body and face.

Plated steel wrap strap design for maximum durability and corrosion resistance.



PT5362-LA

Ultrasonically welded polycarbonate connector housing secures terminations and conductors in a UL Listed, finger safe housing.



Pre-stripped connector leads fasten to conductors, easier than standard pigtails.

No exposed terminals create a finger safe application before, during, and after installation.

Field Uses/Vertical Markets

■ Education

■ Institutional

■ Retail

■ Office

■ Hospitality/Lodging

■ Multiple Dwelling

SF1505K1 — Updated May 2005 — For lead specs visit www.passandseymour.com

Pass & Seymour

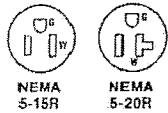


**PlugTail™ Devices
Receptacles
Spec Grade 15 & 20A, 125V**

Ordering Information

Catalog Number	Rating A. V.	Color	NEMA Config. No.
Duplex Receptacles			
PT5262-I	15 125	Ivory	5-15R
PT5262-W	15 125	White	5-15R
PT5262	15 125	Brown	5-15R
PT5262-GRY	15 125	Gray	5-15R
PT5262-BL	15 125	Blue	5-15R
PT5262-RED	15 125	Red	5-15R
PT5262-LA	15 125	Light Almond	5-15R
PT5362-I	20 125	Ivory	5-20R
PT5362-W	20 125	White	5-20R
PT5362	20 125	Brown	5-20R
PT5362-GRY	20 125	Gray	5-20R
PT5362-BL	20 125	Blue	5-20R
PT5362-RED	20 125	Red	5-20R
PT5362-LA	20 125	Light Almond	5-20R

Catalog Number	Wire Type	Wire Length
PlugTail Connectors		
PT6STR	Stranded	6"
PT6SOL	Solid	6"
PT6STRB25	Stranded	25"
PT6SOLB25	Solid	25"



For more information on these and other P&S products refer to our Product Guide or visit our web site.

PlugTail™ Devices Receptacles

Spec Grade 15 & 20A, 125V

Pass & Seymour

legrand®

Technical Specifications

3rd Party Compliance

cULus Listed, File Number E140596, Standard UL498.
Federal Specification WC596.

Performance

Electrical

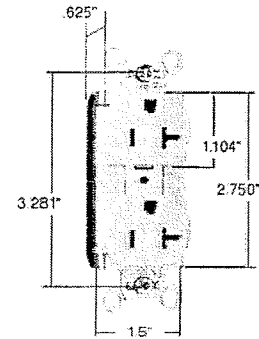
Dielectric Voltage	Withstands 2000V minimum
Maximum Working Voltage	125V
Current Interrupting	Certified for current interrupting at full-rated current (receptacle only)
Temperature Rise	Maximum 30°C temperature rise at full-rated current after 50 cycles of overload at 150% of rated current with direct current

Mechanical

PlugTail Connector Identification	#12 AWG, THHN, copper conductor, 6" or 25" leads, stripped, solid or stranded, for use with PlugTail Receptacles only
Product Identification	Ratings are a permanent part of the device

Environmental

Flammability	UL94 V2
Operating Temperature	Maximum continuous +60°C, minimum -40°C without impact



Dimensions for
15 & 20 Amp

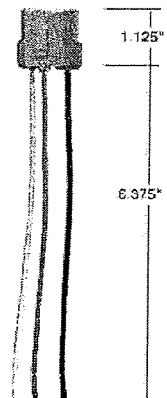


Plug Tail Receptacle Materials

Face	Nylon	Integral Ground System	.036 260 Brass
Back Body	PVC	Assembly Drive Screw	Zinc-Plated Steel
Line Contacts	.036 688 Brass	Auto-Ground Clip	Steel
Mounting Strap	.042 Zinc-Plated Steel	Mounting Screws	Tri-Drive Steel

Plug Tail Connector Materials

Housing	Polycarbonate	Contacts	.030 Brass
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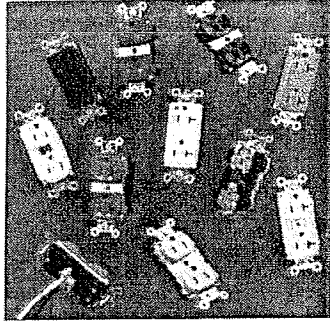


PT6STR

Warranty

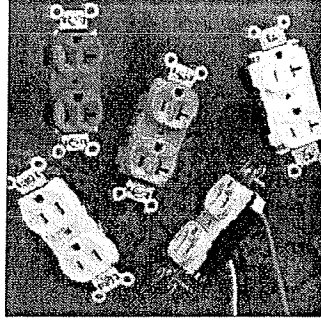
1 Year

Complimentary Devices & Accessories



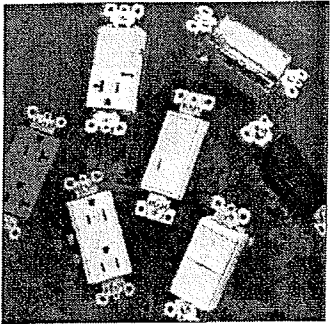
PLUGTAIL™ DEVICES

- Spec Grade
- Decorator
- Hospital Grade
- Tamper-Resistant
- Isolated Ground



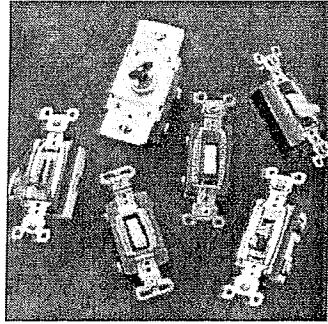
STRAIGHT BLADE RECEPTACLES

- Extra Heavy-Duty
- Heavy-Duty
- Construction Grade
- Construction Grade Leaded
- Commercial Grade



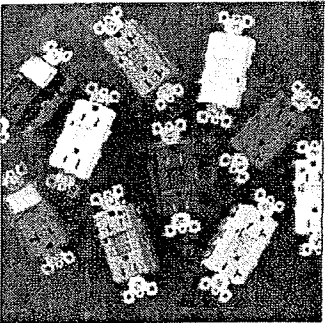
DECORATOR DEVICES

- Construction Grade Switches
- Specification Grade Combo Switches
- Construction Grade Receptacles
- Commercial Grade Receptacles
- Specification Grade Hallway Lights



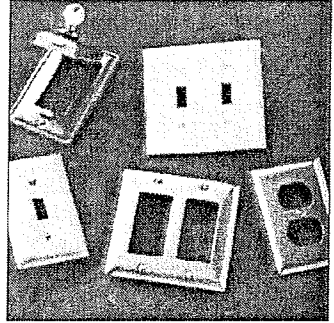
SWITCHES

- Heavy-Duty Toggle
- Heavy-Duty Lighted Toggle
- Heavy-Duty Security
- Heavy-Duty Locking
- Construction Grade Toggle
- Commercial Grade Toggle



GFCIs

- Specification Grade
- Hospital Grade
- Dead Front



WALL PLATES

- TradeMaster® Thermoplastic Nylon
- Stainless Steel
- Brass
- Aluminum
- Dustproof Stainless Steel Covers

Also available...

- Light Almond Devices
- Hospital Grade Devices
- TVSS & Isolated Ground Devices
- Ground Continuity Monitoring (GCM)
- Straight Blade Plugs & Connectors
- Turnlok® Locking Devices
- Weatherproof Boxes & Covers
- IEC 309 Industrial Products
- Flexcar® Wire Mesh Grips
- Configurable Solutions

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Canada
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Vaughan, ON, L4K 4B4
905-738-9195

575 BOSTON — Updated May 2005 — For latest specs visit www.passandseymour.com

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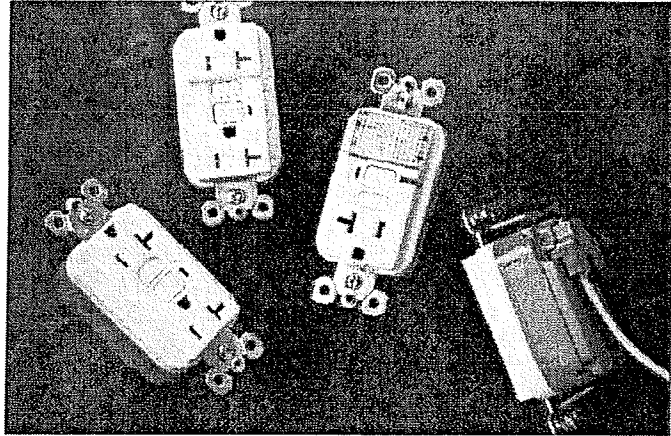
GFCIs PlugTail™ Specification Grade 15 & 20A, 125VAC

PT1595, PT2095, PT1595-NTL, PT2095-NTL, PT1595-TR, PT2095-TR

PlugTail™ GFCIs — reliability and consistency that meets the 2006 UL standard.

P&S PlugTail™ wiring devices offer unique installation speed and no call-back accuracy in every type of receptacle you'll need for any commercial job. The revolutionary PlugTail GFCIs work with the existing 3 wire PlugTail connector creating a finger safe application. At rough-in just install the same right angle connector for the GFCI and receptacles.

For Hospital Grade PlugTail GFCIs, refer to SF721R1.



Features & Benefits

Nickel-plated mounting strap for superior corrosion resistance.

Trip indicator light (red lamp) makes it easy to identify tripped condition.

The most durable GFCI available. Exceeds UL943 voltage surge requirements; survives 100x the required UL 3kA/6kV voltage surge test cycles.

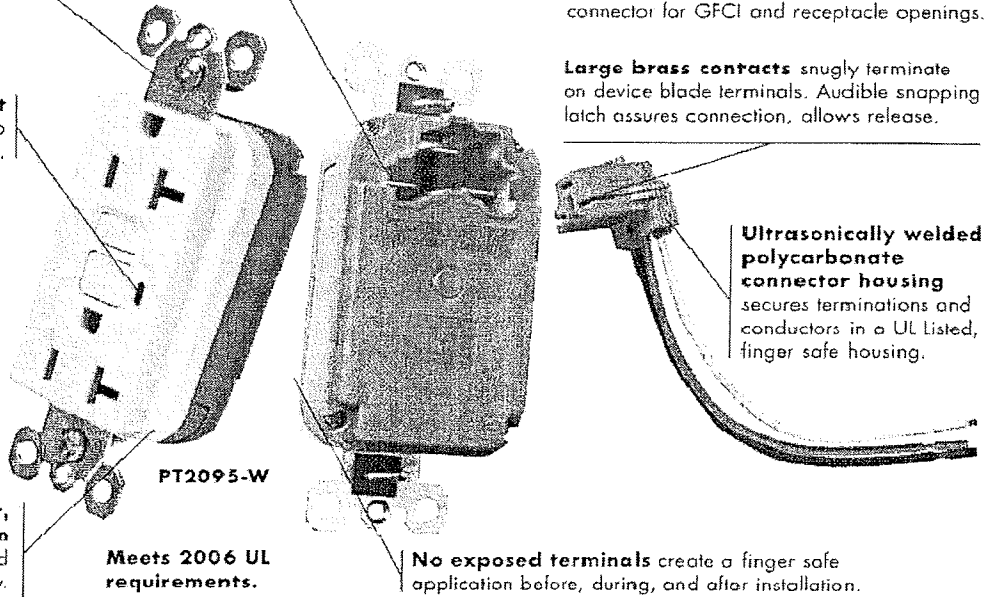
High-impact-resistant, nylon construction for superior strength and durability.

Built-in connector features large brass terminal blades to ensure consistent, reliable electrical connections.

GFCI works with the existing three wire PlugTail connectors creating a non-feed thru application for facility owners. At rough in just install the same right angle connector for GFCI and receptacle openings.

Large brass contacts snugly terminate on device blade terminals. Audible snapping latch assures connection, allows release.

Ultrasonically welded polycarbonate connector housing secures terminations and conductors in a UL Listed, finger safe housing.



Meets 2006 UL requirements.

No exposed terminals create a finger safe application before, during, and after installation.

Field Uses/Vertical Markets

- | | | | |
|--------------|---------------|-----------------------|---------------------|
| ■ Industrial | ■ Health Care | ■ Education | ■ Institutional |
| ■ Retail | ■ Office | ■ Hospitality/Lodging | ■ Multiple Dwelling |

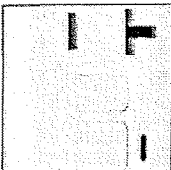
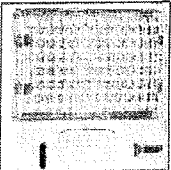
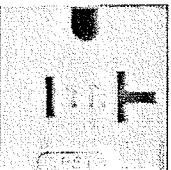
SF1104R1 — Updated November 2006 — For latest specs visit www.passandseymour.com

Pass & Seymour



GFCIs PlugTail™ Specification Grade 15 & 20A, 125VAC

Ordering Information

Additional Features & Benefits	Catalog Number	Rating A. VAC	Color	NEMA Config. No.
PlugTail™ GFCI Receptacles				
 <p>Patented SafeLock™ Protection is standard on all P&S Specification Grade GFCIs.</p>	PT1595-*	15 125	I, W, Brown, GRY, BK, RED, LA	5-15H
	PT2095-*	20 125	I, W, Brown, GRY, BK, RED, LA	5-20R
PlugTail™ Combination Nightlight/GFCI Receptacles				
 <p>High impact-resistant lens made of Lexan®. Energy-efficient LED has average 20-year life expectancy, eliminating bulb replacement. Photocell turns nightlight ON in dark, OFF in daylight.</p>	PT1595-NTL*	15 125	I, W, GRY, BK, RED, LA	5-15R
	PT2095-NTL*	20 125	I, W, GRY, BK, RED, LA	5-20R
PlugTail™ Tamper-Resistant GFCI Receptacles				
 <p>Dual mechanical shutter system to help prevent insertion of foreign objects. Patented UL Listed shutter system.</p>	PT1595-TR*	15 125	I, W, Brown, GRY, BK, RED, LA	5-15R
	PT2095-TR*	20 125	I, W, Brown, GRY, BK, RED, LA	5-20R

Catalog Number	Wire Type	Wire Length
Plugtail Connectors — Right Angle		
PTRA6STR	Stranded	6"
PTRA6SOL	Solid	6"

***Color Designation**

I Ivory GRY Gray RED Red
W White BK Black LA Light Almond
- Brown



GFCI - Specific Additional Features & Benefits:

Fits all electrical box and raceway applications. Right angle (90°) connector creates an easy mounting application.

Supplied with TP26 Decorator nylon wall plate.

For more information on these and other P&S products refer to our Catalog or visit our web site.

GFCIs PlugTail™ Specification Grade 15 & 20A, 125VAC

Pass & Seymour



Technical Specifications

3rd Party Compliance

cULus Listed File Number E42190 and E140596. Standard UL498 Attachment Plugs and Receptacles. UL943 GFCIs. Federal Specification WC596. Standard CSA C22.2 No. 42 General Use Receptacles, CSA C22.2 No. 144 GFCIs. Conforms to NEMA WD-1 and WD-6.

Performance

Electrical

Dielectric Voltage	Withstands 1500V minimum
Trip Level	4 to 6 mA
Trip Time	.025 Second Nominal
Frequency	60 Hz
Maximum Working Voltage	125VAC
Voltage Range	102-132VAC

Mechanical

PlugTail Connector Identification	#12 AWG, THHN, copper conductor, 6" leads, stripped, solid or stranded, for use with PlugTail Receptacles only
Product Identification	Ratings are a permanent part of the device

Environmental

Operating Temperature	-35°C to +66°C
Maximum Humidity	95%
Flammability	UL94 V2

PlugTail™ GFCI Receptacle Materials

Face	Nylon	Test/Reset Buttons	Nylon
Body	Nylon	Nightlight Lens	* Lexan*
Contacts	.03" Brass (.8)	Tamper-Resistant Shutter	** Thermoplastic
Mounting Straps	.05" Nickel-Plated Steel (1.3)		

Plug Tail Connector Materials

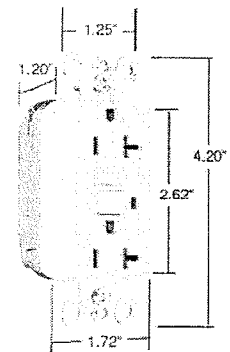
Housing	Polycarbonate	Contacts	.030 Brass
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* For PT1595-NTL and PT2095-NTL Nightlight versions only.

**For PT1595-TR and PT2095-TR Tamper-Resistant versions only.

Warranty

1 Year



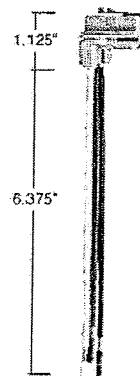
Dimensions for
15 & 20 Amp



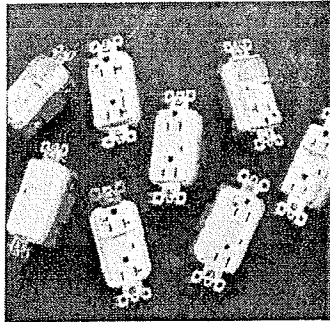
Nightlight/GFCI



Tamper-Resistant

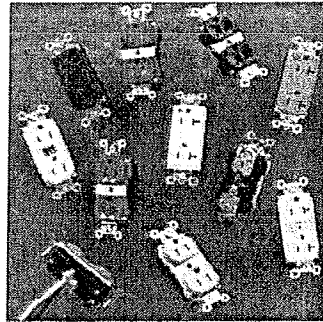


PTRA6STR



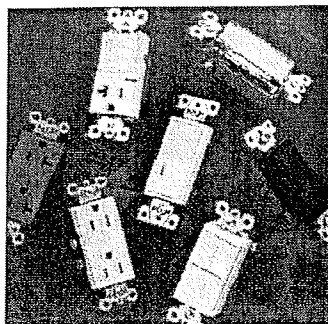
GFCIs

- Specification Grade



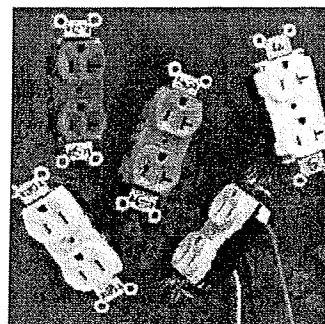
PLUGTAIL™ DEVICES

- Spec Grade
- Decorator
- Hospital Grade
- Tamper-Resistant
- Isolated Ground



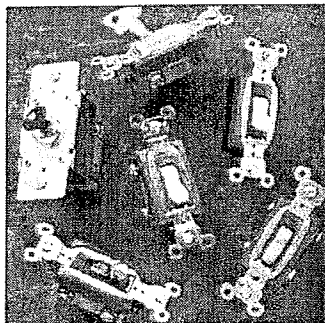
DECORATOR DEVICES

- Construction Grade Switches
- Specification Grade Combo Switches
- Construction Grade Receptacles
- Commercial Grade Receptacles
- Specification Grade Hallway Lights



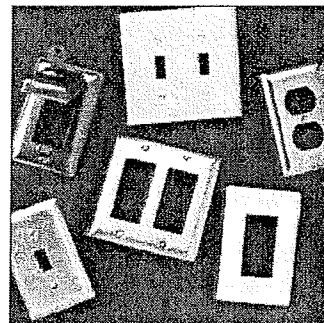
STRAIGHT BLADE RECEPTACLES

- Extra Heavy-Duty
- Heavy-Duty
- Hard Use
- Construction Grade
- Construction Grade Leaded
- Commercial Grade



SWITCHES

- Heavy-Duty Toggle
- Heavy-Duty Lighted Toggle
- Heavy-Duty Security
- Heavy-Duty Locking
- Construction Grade Toggle
- Commercial Grade Toggle



WALL PLATES

- TradeMaster® Thermoplastic Nylon
- Screwless Polycarbonate
- Stainless Steel
- Brass
- Aluminum
- Dustproof Stainless Steel Covers

Also available...

- Light Almond Devices
- Hospital Grade Devices
- TVSS & Isolated Ground Devices

- Ground Continuity Monitoring (GCM)
- Straight Blade Plugs & Connectors

- Turnlok® Locking Devices
- Weatherproof Boxes & Covers

- IEC 309 Industrial Products
- Flexcor® Wire Mesh Grips
- Configurable Solutions

Pass & Seymour



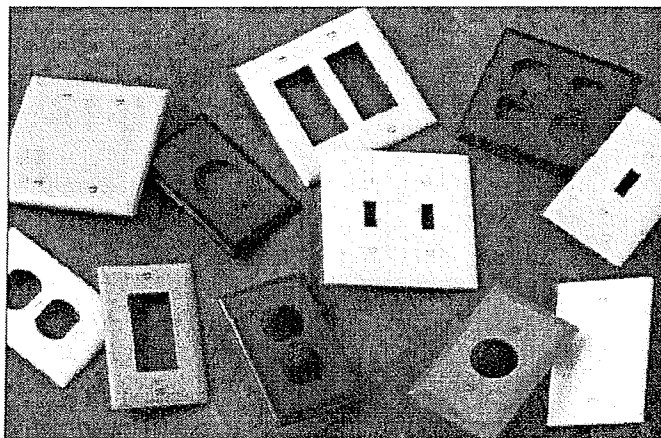
USA
 P.O. Box 4822
 Syracuse, NY 13221-4822
 800-611-7277

Canada
 570 Applewood Crescent
 Vaughan, ON, L4K 4B4
 905-738-9195

TP1, TP2, TP8, TP82, TP26, TP262, TP13, TP23, TP7, TP720

**Maximum durability
in plastic wall plates.**

Self-extinguishing nylon construction makes these TradeMaster® wall plates virtually unbreakable. They will not crack if excessive torque is applied to installation screws. They are 3/16" higher and wider than typical plastic wall plates – not enough to be apparent to the eye, but the extra size cuts costs by reducing dry wall rework.



Features & Benefits

An extra 3/16" width and height than standard size wall plates for more tolerance in covering ragged sheet rock openings.

Molded of rugged, virtually unbreakable self-extinguishing .070 inch thick thermoplastic Nylon 6.

Aesthetically pleasing contour design.

TP26-W, TP2-I, TP8-LA

Pre-installed mounting screws on single gang toggle, duplex receptacle and decorator openings.

Field Uses/Vertical Markets







- Health Care
- Education
- Institutional
- Retail
- Office
- Hospitality/Lodging
- Multiple Dwelling





Wall Plates

TradeMaster® Thermoplastic Nylon

One & Two Gang

Ordering Information

Description	Catalog Number	Color
TradeMaster Toggle Switch Openings		
One Gang 	TP1-I TP1-W TP1 TP1-GRY TP1-BK TP1-RED TP1-LA	Ivory White Brown Gray Black Red Light Almond
Two Gang 	TP2-I TP2-W TP2 TP2-GRY TP2-BK TP2-RED TP2-LA	Ivory White Brown Gray Black Red Light Almond
TradeMaster Duplex Receptacle Openings		
One Gang 	TP8-I TP8-W TP8 TP8-GRY TP8-BK TP8-RED TP8-LA TP8-BL TP8-OR	Ivory White Brown Gray Black Red Light Almond Blue Orange
Two Gang 	TP82-I TP82-W TP82 TP82-GRY TP82-BK TP82-RED TP82-LA TP82-OR	Ivory White Brown Gray Black Red Light Almond Orange
TradeMaster Decorator Openings		
One Gang 	TP26-I TP26-W TP26 TP26-GRY TP26-BK TP26-RED TP26-LA TP26-BL TP26-OR	Ivory White Brown Gray Black Red Light Almond Blue Orange
Two Gang 	TP262-I TP262-W TP262 TP262-GRY TP262-BK TP262-RED TP262-LA TP262-BL TP262-OR	Ivory White Brown Gray Black Red Light Almond Blue Orange

Description	Catalog Number	Color
TradeMaster Blank Plates — Box Mounted		
One Gang 	TP13-I TP13-W TP13 TP13-GRY TP13-BK TP13-RED TP13-LA	Ivory White Brown Gray Black Red Light Almond
Two Gang 	TP23-I TP23-W TP23 TP23-GRY TP23-BK TP23-LA	Ivory White Brown Gray Black Light Almond
TradeMaster Single Receptacle Openings		
One Gang 	TP7-I TP7-W TP7 TP7-GRY TP7-BK TP7-RED TP7-LA	Ivory White Brown Gray Black Red Light Almond
TradeMaster Power Outlet Receptacle Openings		
One Gang 	TP720-I TP720-W TP720 TP720-GRY TP720-LA	Ivory White Brown Gray Light Almond

For more information on these and other P&S products refer to our Product Guide or visit our web site.

TradeMaster® Thermoplastic Nylon One & Two Gang

Pass & Seymour
LeGrand®
*The one that works
for you.™*

Technical Specifications

3rd Party Compliance

UL Listed, Standard UL514. Cover Plates for Flush Mounted Wiring Devices.
CSA Certified.

Performance

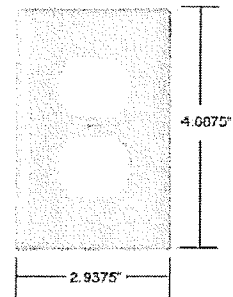
Environmental	Chemical-Resistant
Flammability	UL94 V2

Materials

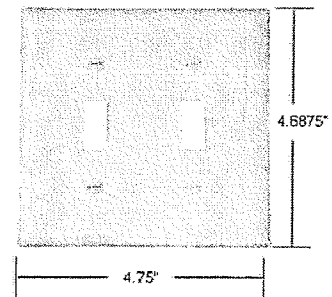
Plate Material	.070" Nylon 6
Plate Finish	Matte
Screws	Steel, Heads Painted to Match Plate Color

Warranty

1 Year

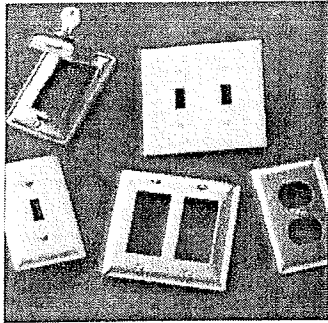


Dimensions for
TradeMaster One Gang



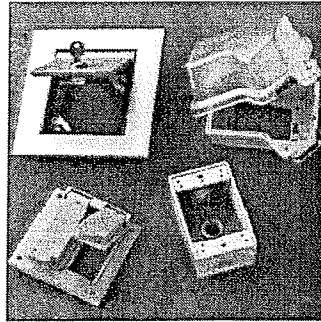
Dimensions for
TradeMaster Two Gang

Complimentary Devices & Accessories



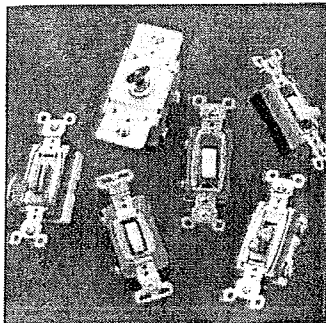
WALL PLATES

- Stainless Steel
- Brass
- Aluminum
- Dustproof Stainless Steel Covers



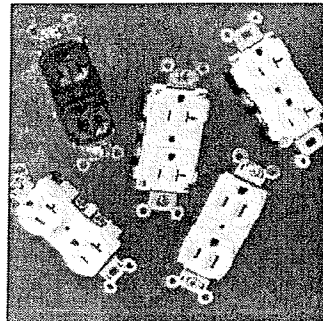
WEATHERPROOF BOXES & COVERS

- While-In-Use Covers
- Heavy Cast Aluminum Covers
- Cast Covers
- Boxes



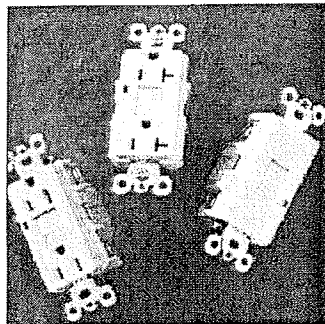
SWITCHES

- Heavy-Duty Toggle
- Heavy-Duty Lighted Toggle
- Heavy-Duty Security
- Heavy-Duty Locking
- Construction Grade Toggle
- Commercial Grade Toggle



STRAIGHT BLADE RECEPTACLES

- Extra Heavy-Duty
- Heavy-Duty
- Construction Grade
- Commercial Grade



GFCIs

- Construction Grade with Auto-Ground
- Construction Grade
- Construction Grade Dead Front

Also available...

- Light Almond Devices
- Decorator Devices
- Hospital Grade Devices
- PlugTail™ Devices
- TVSS & Isolated Ground Devices
- Ground Continuity Monitoring (GCM)
- Straight Blade Plugs & Connectors
- Turnlok® Locking Devices
- IEC 309 Industrial Products
- Flexcor® Wire Mesh Grips
- Configurable Solutions

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Legrand
The one that works for you.™

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 Syracuse, NY 13221-4822
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 905-738-9195

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