

CONTROL SYSTEMS, INC.

P.O. Box 4852, Jackson, Mississippi 39296-4852
PHONE (601) 355-8594 FAX (601) 355-8774

WELL CONTROL PANELS

MIZE, MS

2014

**CUSTOMER: KENNETH FORD - MIZE
P.O. # 188184**

NOTICE: THIS CONTROL SYSTEM DESIGN IS THE PROPERTY OF CONTROL SYSTEMS, INC., AND IS LOANED SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LOANED, OR OTHERWISE DISPOSED OF, DIRECTLY OR INDIRECTLY. IT SHALL BE USED AS A MEANS OF REFERENCE TO CONTROLS FURNISHED BY CONTROL SYSTEMS, INC., AND IS NOT TO BE SUBMITTED TO OUTSIDE PARTIES FOR EXAMINATION WITHOUT OUR CONSENT.

JOB NO.: 46133

DATE: July 16, 2014

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WARRANTY STATEMENT

Warranties to distributors and other commercial customers. Control Systems, Inc. warrants equipment manufactured by it to be free from defects in materials and workmanship for a period of one (1) year from date of acceptance. If within such period any such equipment shall be proved to Control Systems, Inc. satisfaction to be defective, such equipment shall be repaired or replaced at the option of Control Systems, Inc. Repair parts may be new parts, used parts, rebuilt parts, or exchange parts, at the option of Control Systems, Inc. This warranty shall not apply (a) to equipment not manufactured by Control Systems, Inc., (b) to equipment which shall have been repaired or altered by others than Control Systems, Inc. so as, in its judgement, to affect the equipment adversely, or (c) to equipment which shall have been subjected to negligence, accident or damage by circumstances beyond the control of Control Systems, Inc. or to improper operation, maintenance or storage, or to other than normal use or service. With respect to equipment not manufactured by Control Systems, Inc., the warranty obligations of Control Systems, Inc. shall in all respects conform to and be limited to the warranty actually extended to Control Systems, Inc. by its supplier. The foregoing warranties do no cover reimbursement for transportation, removal, installation, or other expenses which may be incurred in connection with repair or replacement.

This warranty is expressly in lieu of any other warranties, expressed or implied, including, but not limited to, any warranty of merchantability or fitness for a particular purpose. Remedies under this or any warranty are expressly limited to repair or replacement as specified above, and such repair or replacement constitutes the sole and exclusive remedy. Under no circumstances shall Control Systems, Inc. be liable for any claims for loss or damage of any kind, for injuries to any person or property caused either directly or indirectly by the equipment. Any and all claims for direct special, indirect or consequential damage for any person or property or for any other economic loss are expressly excluded, whether arising out of failure of the equipment to operate for any period of time or out of any defects of the equipment or for any other reason. Except as may be expressly provided in an authorized writing by Control Systems, Inc., Control Systems, Inc. shall not be subject to any other obligations or liabilities whatsoever with respect to equipment manufactured by Control Systems, Inc. or services rendered by Control Systems, Inc.

ALL PANELS
ELECTRICAL SYMBOLS

<u>SYMBOL</u>	<u>DESCRIPTION</u>
—	— FACTORY WIRING
- - -	— FIELD WIRING
Ø	— TERMINAL
CR1 (RELAY DESIGNATION)	
—	— NORMALLY OPEN INSTANTANEOUS CONTACT
22 (LINE NO. LOCATION OF COIL)	
—	— NORMALLY CLOSED INSTANTANEOUS CONTACT
TR1 (TIMER DESIGNATION)	
—	— NORMALLY OPEN TIMED CLOSED CONTACT
10S. (TIME SETTING)	
—	— NORMALLY CLOSED TIMED OPEN CONTACT
—	— NORMALLY OPEN TIMED OPEN CONTACT
—	— NORMALLY CLOSED TIMED CLOSED CONTACT
(DEVICE DESIGNATION)	
CR1	— DEVICE COIL
—	— LINE NO. LOCATION (OF N.O. CONTACT)
—	— LINE NO. LOCATION (OF N.C. CONTACT)
—	— NORMALLY OPEN FLOAT SWITCH
—	— NORMALLY CLOSED FLOAT SWITCH
—	— NORMALLY OPEN PRESSURE SWITCH
—	— NORMALLY CLOSED PRESSURE SWITCH
PL (COLOR INSERT)	
—	— PILOT LIGHT
—	— PUSH-TO-TEST PILOT LIGHT
OFF ON	
OFF	— TWO POSITION SELECTOR SWITCH
ON	
(X-DENOTES SWITCH CLOSED)	
MAN OFF AUTO	
MAN OFF AUTO	— THREE POSITION SELECTOR SWITCH
—	
—	
20/1 (AMPERE AND NO. OF POLES)	
—	— CIRCUIT BREAKER
FH37 (HEATER SIZE)	
—	— OVERLOAD RELAY

PROOF OF U.L. LABEL AVAILABILITY

NITW January 14, 1983
Industrial Control Panels

CONTROL SYSTEMS INC, JACKSON MS 39216 **E84696 (N)**

Industrial control panels for general use. _____

P O BOX 4852

LOOK FOR LISTING MARK ON PRODUCT

Replaces E84696 dated Dec. 2, 1982.
457833001 Underwriters Laboratories Inc.® F11/0092917

PRE START-UP REQUIREMENTS/INSTRUCTIONS**1. GROUNDING REQUIREMENTS**

Has CSI equipment been properly grounded per NEC article 250? Resistance to ground measurements of twenty-five (25) ohms or less is acceptable, however five (5) ohms or less is recommended for the ground system to function as intended. CSI's warranty could be voided if ground system is **NOT** installed per current National Electric Code requirements.

2. CONDUIT SEALING INSTRUCTIONS

- A. The contractor is responsible for all conduit entrances to enclosures to be temporarily sealed during construction, even before contractor pulls cables, to protect enclosure components from corrosive gasses and/or moisture during construction.
- B. Once the cables have been pulled through the conduits into the enclosure the conduits must be sealed immediately. CSI recommends using 3M Scotchcast 2112C re-enterable compound for this purpose. This does not replace conduit seal for hazardous/explosion-proof applications. Explosion-proof applications require KWIKO cement or equal.
- C. If corrosive gasses have been allowed to enter the enclosure and components have become damaged, consequently CSI will **NOT** provide warranty replacement.

3. EQUIPMENT SETTINGS

- A. Have the adjustable circuit breakers been set to CSI drawing value?
- B. Have overload relays, variable frequency drives, and solid state starters been set per motor nameplate Full Load Amperes (FLA) data?
- C. Have all timer settings been adjusted to CSI drawing values?
- D. Motor Monitors MUST BE FIELD SET based on actual motor full load amps. Please refer to catalog cut sheet page C231B for instructions on setting to running amps setpoint and the high amps setpoint. Set the high amps setpoint to 20% below actual full load amps. Set the high amps setpoint to 10% above the actual full load amps. (DO NOT set the motor monitor using the motor nameplate full load amps.) If applicable.

4. VERIFICATION

- A. Verify proper torque on all terminals and/or lugs; i.e. main lugs, all circuit breakers, line and load side or starters and overload relays.
- B. Verify proper connection of power and control wiring.

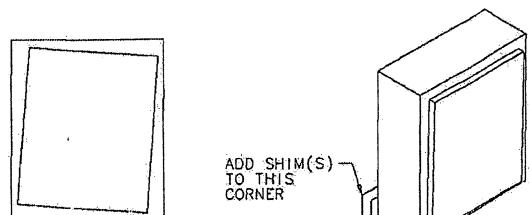
5. WIRING NOTES

- A. D Prefix = DC Low Voltage = Blue Wire
- B. All other = 120 VAC Minimum
- C. DC Low Voltage conductors shall be installed in separate conduit from AC conductors per National Electric Code.

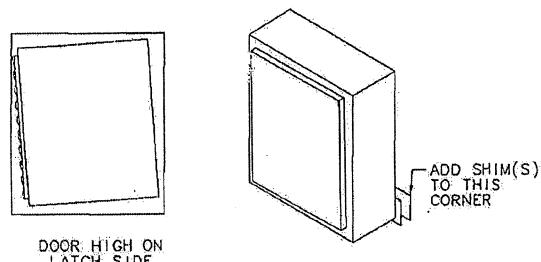
WALL MOUNTED ENCLOSURE GUIDELINE

It is of the utmost importance that all electrical enclosures are mounted and squared correctly per manufacturer's recommendations. This will provide years of reliable service when properly mounted, leveled, squared, and maintained. The use of conduits and conduit entry points to level and square the enclosure is **not** an ACCEPTABLE means of mounting the enclosure.

Wall-Mount enclosures are designed for mounting on rigid, flat surfaces, or walls. After mounting, add shims to enclosure as required to ensure the sealing contact surface and the enclosure are square. This is necessary for the door to close properly and provide a reliable seal. To square wall mounted enclosures, add shims as shown below. Shims should be made of a material such as stainless steel, aluminum, nylon, or plastic to limit or eliminate corrosion.



DOOR LOW ON LATCH SIDE

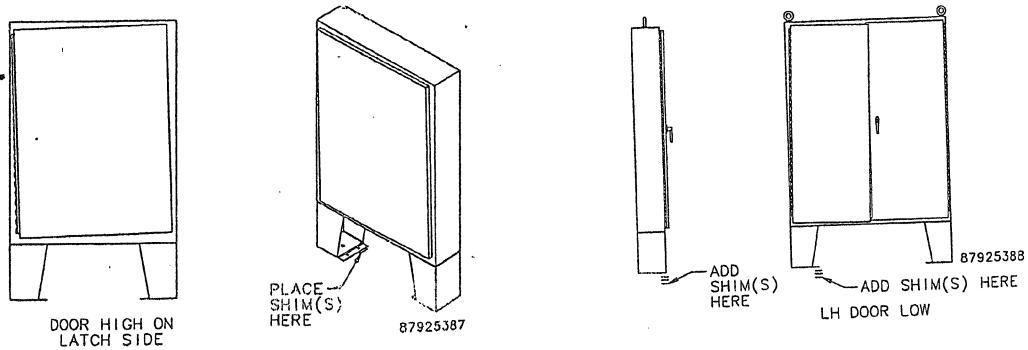
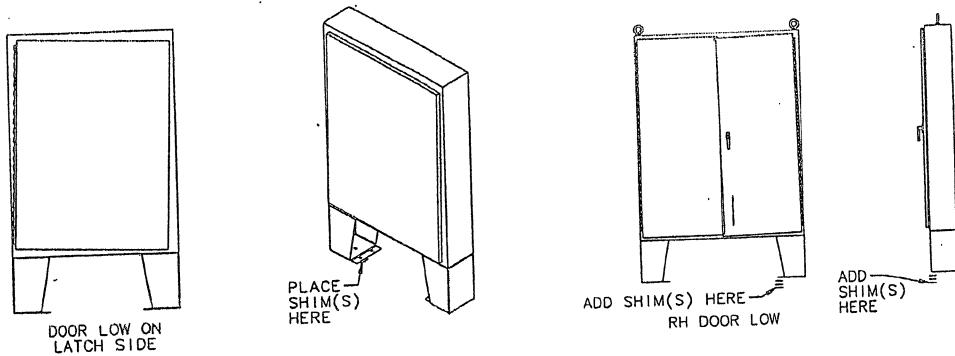


DOOR HIGH ON LATCH SIDE

MOUNTING GUIDELINE FOR DOUBLE DOOR FREE STANDING ENCLOSURES

It is of the utmost importance that all electrical enclosures are mounted and squared correctly per manufacturer's recommendations. This will provide years of reliable service when properly mounted, leveled, squared, and maintained. The use of conduits and conduit entry points to level and square the enclosure is **not** an ACCEPTABLE means of mounting the enclosure.

Enclosures' door sealing contact surface and the enclosure itself **must** be square and level in order to provide a reliable seal. To ensure such a seal, shims should be used as shown below to square the enclosure as needed. Shims should be made of stainless steel or aluminum to reduce corrosion and withstand the weight of the enclosure. Anchor points are provided in each leg for anchoring enclosure to the floor surface. Whether anchoring in concrete or steel, the appropriate anchor style and size should be utilized to prevent enclosure from tipping. All anchor points provided with the panel should be utilized after squaring and leveling to prevent damage to the enclosure or personnel from the effects of wind or manmade disturbances. Each leg or leg kit has pre-punched holes to allow for anchoring. All anchoring shall be accomplished with all stainless steel hardware.

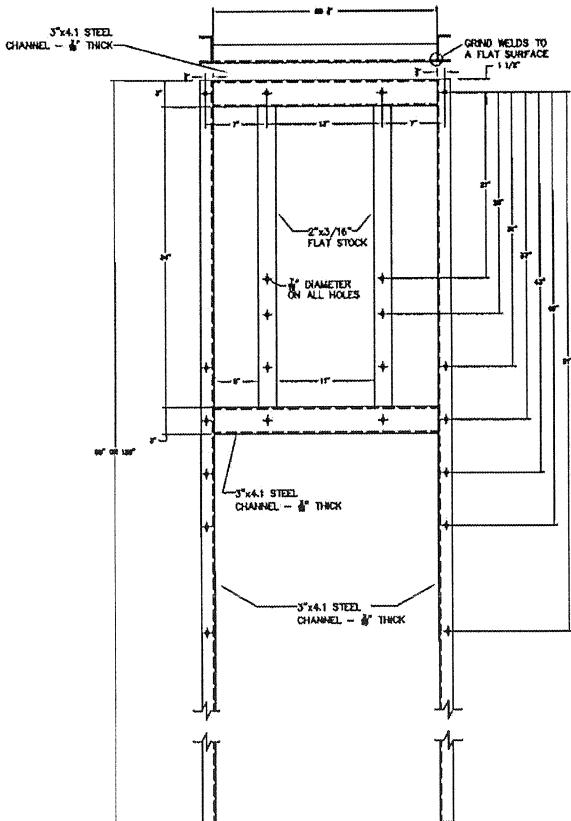


ENCLOSURE RACK MOUNTING GUIDELINE

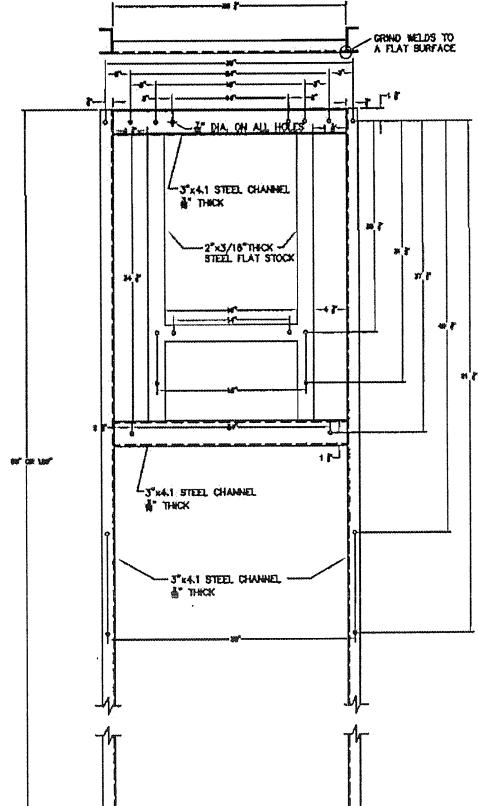
Control Systems, Inc. recommends the use of a suitable aluminum, stainless steel, or hot-dipped galvanized mounting rack be utilized. Construction material utilized must be able to properly support the weight of the enclosure. Rack legs should be a minimum of two-feet (2') below grade in eight-inch (8") diameter holes with 3,000 pound test concrete. Rack should be a minimum of three-inch (3") channel material for the uprights and two-inch (2") channel for cross members and mounting points. Shims of suitable material should be added to properly square the enclosure. **The use of treated lumber or "Unistrut" shall not be approved.** Taking proper actions to ensure the enclosure is squarely mounted will provide years of reliable service. The use of conduits and conduit entry points to level and square the enclosure is **not** an acceptable means of mounting the enclosure.

For your convenience, Control Systems Inc. stocks two (2) different styles of racks utilized in the proper mounting of Hoffman brand NEMA 3R & NEMA 4X enclosures. These racks are hot dip galvanized steel and come pre-drilled to accommodate from a 20”H x 20”W up thru a 60”H x 36”W NEMA 3R & NEMA 4X Hoffman enclosure.

CONTROL PANEL
GALVANIZED RACK DETAIL
FOR NEMA 3R ENCLOSURES



CONTROL PANEL
GALVANIZED RACK DETAIL
FOR NEMA 4X STAINLESS STEEL ENCLOSURES

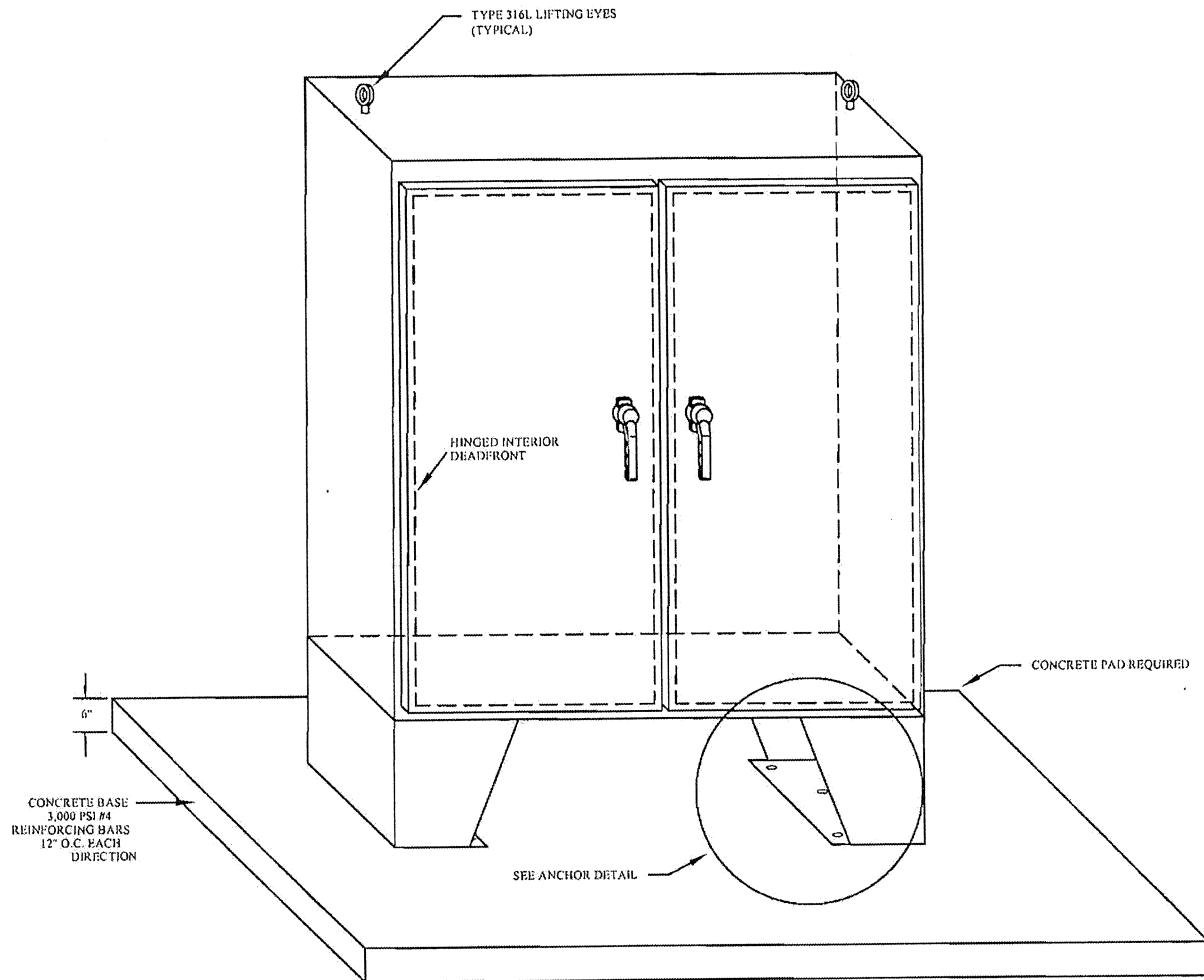


CONSTRUCTION AND INSTALLATION NOTES:

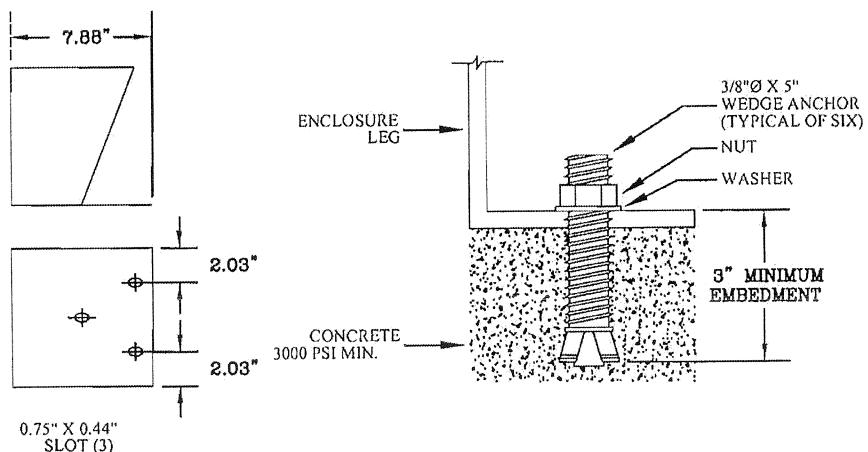
1. ALL HOLES SHALL BE 7/16" AND DRILLED BEFORE HOT DIP GALVANIZED.
 2. AFTER FABRICATION, RACK SHALL BE HOT DIP GALV.
 3. LEGS WILL BE SET IN 8" MIN. DIAMETER HOLES WITH MIN. 3,000 POUND TEST CONCRETE.
 4. WHEN RACK IS INSTALLED ON EXISTING CONCRETE PAD MODIFY RACK TO HAVE: 8"X8"X3/8" FEET WITH TWO "GUSSETS" BACK & OUTSIDE OF 3/16" METAL. BOLT TO CONCRETE WITH 4-3/8" STAINLESS STEEL QUICK BOLTS PER FOOT. RACK WILL BE 6' TO 8' TALL FROM CONCRETE.
 5. CONCRETE PAD SHOULD BE AT LEAST 1' MIN. ON EITHER SIDE OF ENCLOSURE AND AT LEAST 3' MIN. FROM FRONT OF ENCLOSURE THE FRONT OF THE PAD.
 6. MOUNT PANEL WITH 3/8" BOLTS, NUTS, & LOCK WASHERS (S.S.).
 7. A 96" LENGTH RACK IS SUITABLE FOR ENCLOSURES UP TO 48" TALL UNLESS RACK IS TO BE PLACED IN SANDY SOIL. FOR ENCLOSURES TALLER THAN 48" OR LOCATIONS WITH SANDY SOIL USE A 120" LENGTH RACK.

FREE STANDING ENCLOSURE DETAIL

PAGE G8



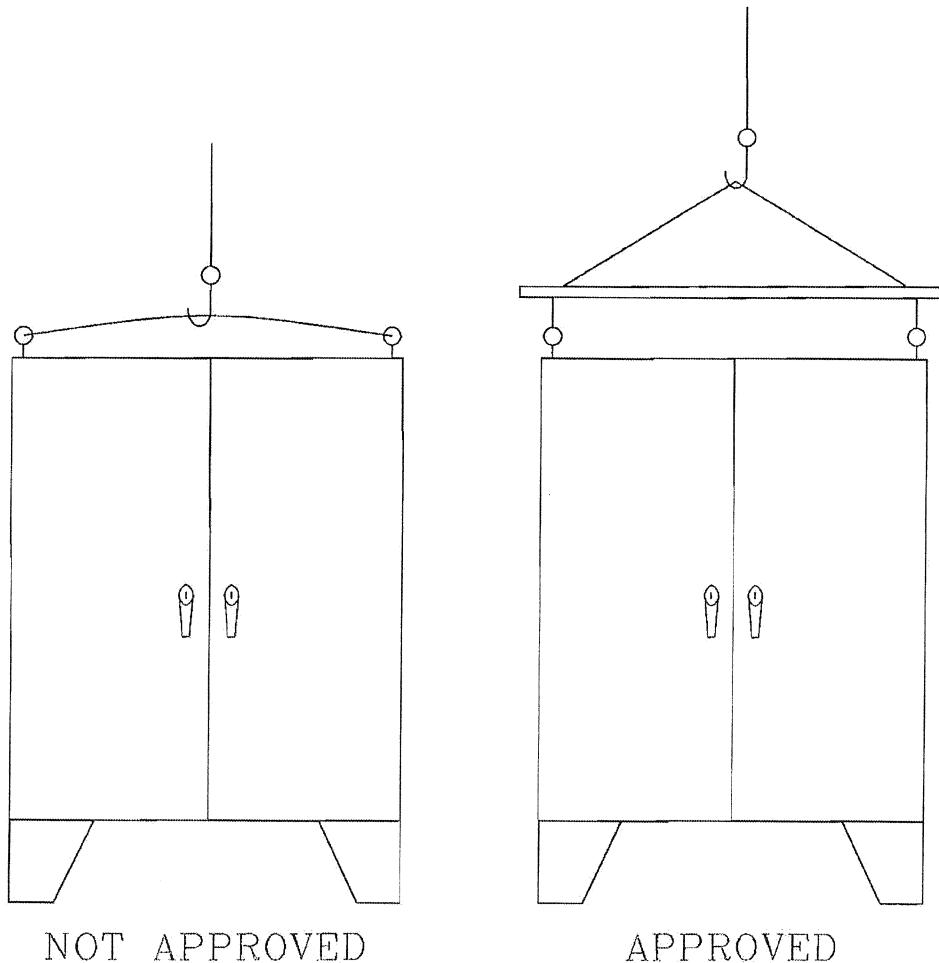
ANCHOR DETAIL



DOUBLE DOOR ENCLOSURES SHALL BE SECURELY FASTENED TO CONCRETE BASE WITH WEDGE ANCHOR, SLEEVE ANCHOR, DROP-IN ANCHOR OR EQUIVALENT. ALL MOUNTING HARDWARE SHALL BE STAINLESS STEEL, ZINC PLATED MATERIAL SHALL NOT BE ACCEPTED. ANCHOR EMBEDMENT SHALL BE MIN. OF THREE INCHES (3"). CONTROL PANEL(S) SHALL BE ACCURATELY LEVELED FOLLOWING MANUFACTURE'S INSTRUCTIONS. THE LEVELING SHALL BE CHECKED IN THE PRESENCE OF THE PROJECT ENGINEER AND SHALL BE TO THE ENGINEER'S SATISFACTION.

CONTROL SYSTEMS, INC RECOMMENDATIONS FOR LIFTING LARGE DOUBLE DOOR ENCLOSURES

Control Systems, Inc. requires the use of a "SPREADER BAR" sized to the enclosure lifting eye "GAP" to be utilized when lifting an enclosure supplied with these "Lifting Eyes". Any damage, warping, bending of any enclosure derived from any improper lifting technique is not covered under any Control Systems, Inc. or enclosure manufacturer's warranty.



GND

CSI EQUIPMENT GROUNDING REQUIREMENTS

The electrical equipment (panel(s) or motor control center) are to be effectively and permanently grounded to a ground grid system. Feeder conduits shall provide a good path to system ground. The ground grid shall consists of a minimum of three (3) - 5/8" x 10 copperweld ground rods by exothermic-welded type connection.

Grounding system resistance to ground of twenty-five (25) Ohms or less shall be considered as the **minimum** and a resistance of five (5) Ohms or less shall be the **goal** for maximum protection of equipment. Final tests shall ensure that this requirement is met.

Approved testing methods shall be: Four Point - Wenner Method, Three or Four Point - Fall of Potential Method. Hand-held multi-meter and megger are **NOT** approved testing methods. If twenty-five (25) Ohms cannot be attained with ten-feet (10') rod lengths, up to thirty-feet (30') rods may be required, along with increased number of rods.

Any equipment that is electrically connected to the CSI main gear should also be electrically connected to this ground grid. Separate ground rods with no common connection to the main ground grid will not provide the intended protection.

Please complete the attached project ground grid report and email to billw@controlsysinc.com or FAX to 601.355.8774 to the attention of Bill Weathers. Certified ground test report will be required prior to CSI attending start-up and to activate equipment warranty period.



CONTROL SYSTEMS, INC.

909 Quinn Street • Jackson, Mississippi 39202
 P.O. Box 4852 • Jackson, Mississippi 39296-4852
 Phone 601.355.8594 • FAX 601.355.8774

CSI Equipment Grounding Report

CSI Job # _____	General Contractor: _____
Job Name: _____	Ground Grid installed by: _____
Job Location: _____	Test Performed by: _____
	Employer: _____
	Test Witnessed by: _____

Ground Grid Information

Main Equipment Ground Grid	List all other ground rods used		
# of Rods: _____	Location:	Length:	Bonded to Main Grid?
Rod Lengths: _____			
Formation (i.e. 6' triangle): _____			

Ground Grid Test Report

Date Test Performed: _____	List Ohm readings of other ground rods tested	
Weather Conditions: _____	Location:	Ohm Reading:
Soil Condition (i.e. dry, damp, wet): _____		
Main Ground Grid Ohm reading: _____		

COMMENTS: _____

SIGNED: _____ DATE: _____

PRINT NAME: _____

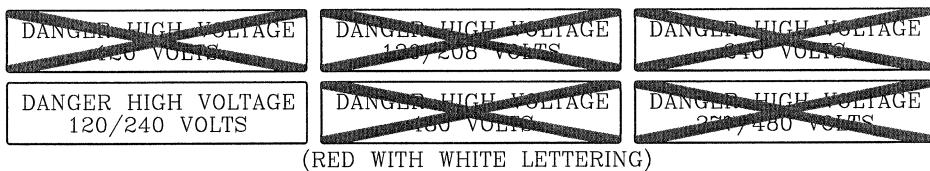
WELL CONTROL PANEL #1

20HP, 240V, 3 PHASE

WELL NO.1 CONTROL PANEL
STANDARD NAMEPLATE LEGEND DETAIL

PAGE 1P1

NP1. VOLTAGE LABEL -



(RED WITH WHITE LETTERING)

NP2. AUTHORIZED PERSONNEL LABEL -

AUTHORIZED PERSONNEL ONLY

(RED WITH WHITE LETTERING)

NP3. ARC FLASH LABEL -



NP4. CSI LOGO LABEL -



NP5. SERVICE ENTRANCE LABEL -

SUITABLE FOR USE AS SERVICE ENTRANCE
CONTROL SYSTEMS, INC.

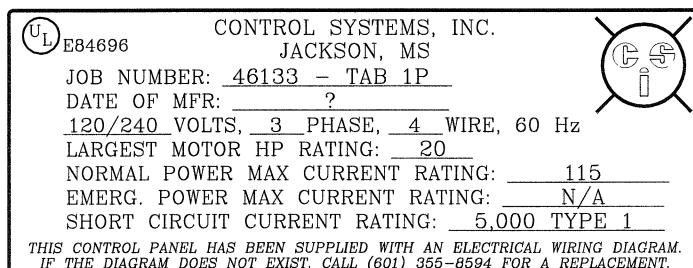
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NP6. STATION NAME OR NUMBER LABEL -

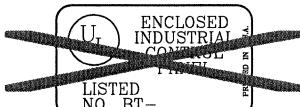
WELL NO.1

(BLACK WITH WHITE LETTERING)

NP7. CSI JOB NUMBER LABEL -



NP8. UL LABEL -



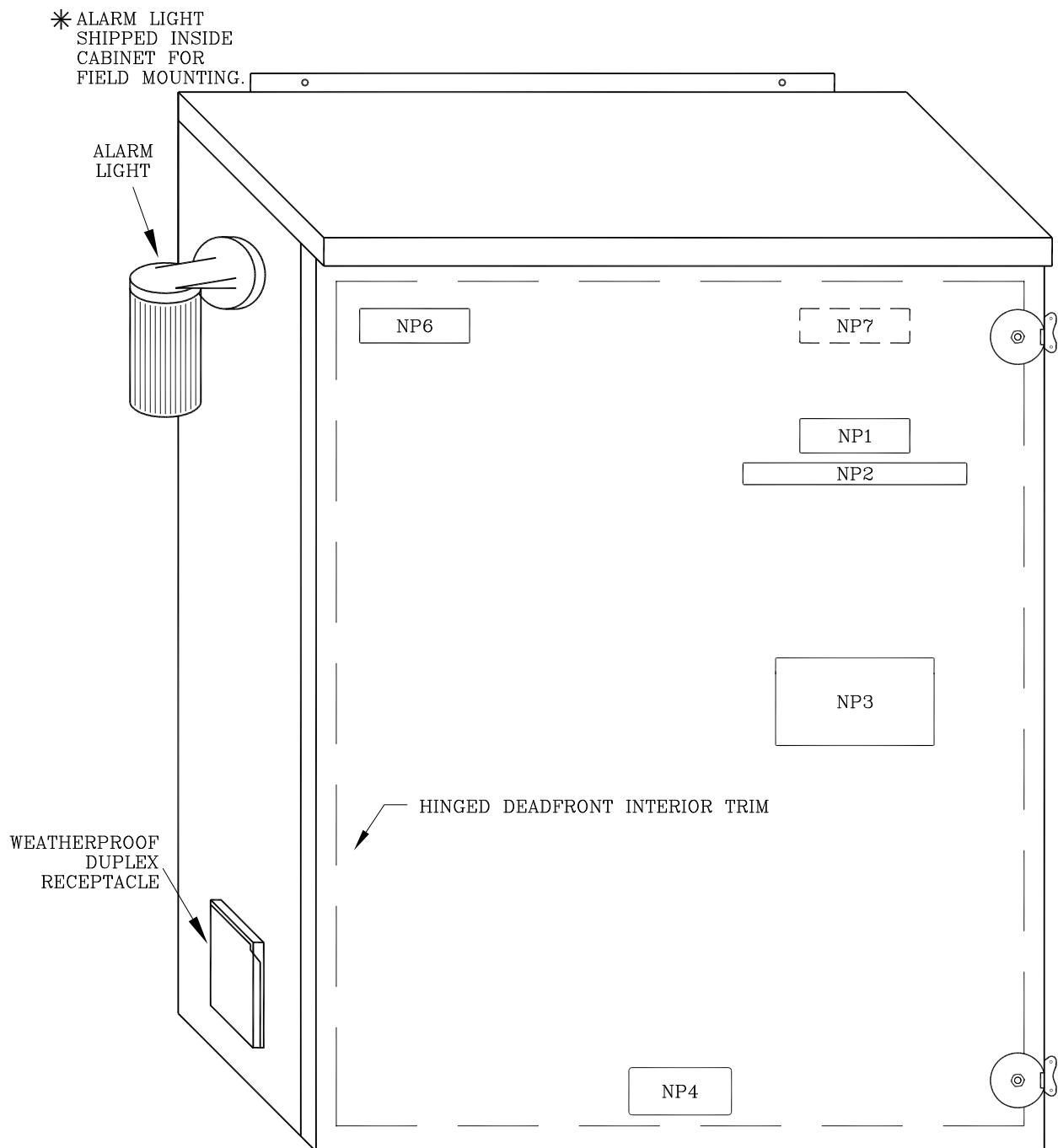
NP9. DE-ENERGIZATION LABEL -

NORMAL MAIN AND EMERGENCY MAIN
BREAKERS HAVE TO BE IN THE "OFF"
POSITION TO DE-ENERGIZE THE EQUIPMENT

(RED WITH WHITE LETTERING)

WELL NO.1 CONTROL PANEL
PHYSICAL LAYOUT

PAGE 1P2

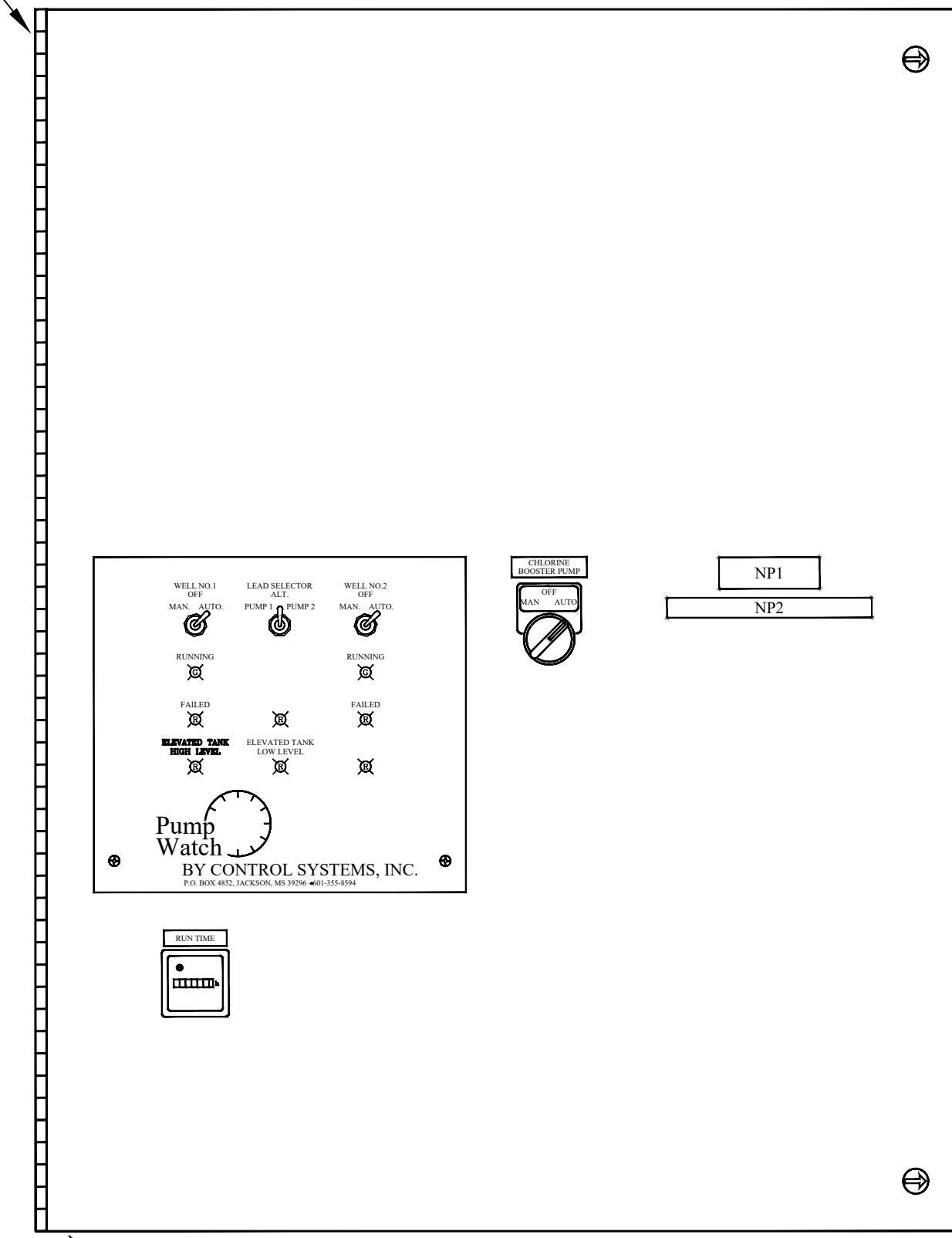


NEMA 3R ENCLOSURE
(36"H X 30"W X 12"D)

WELL NO.1 CONTROL PANEL
DEADFRONT DETAIL

PAGE 1P3

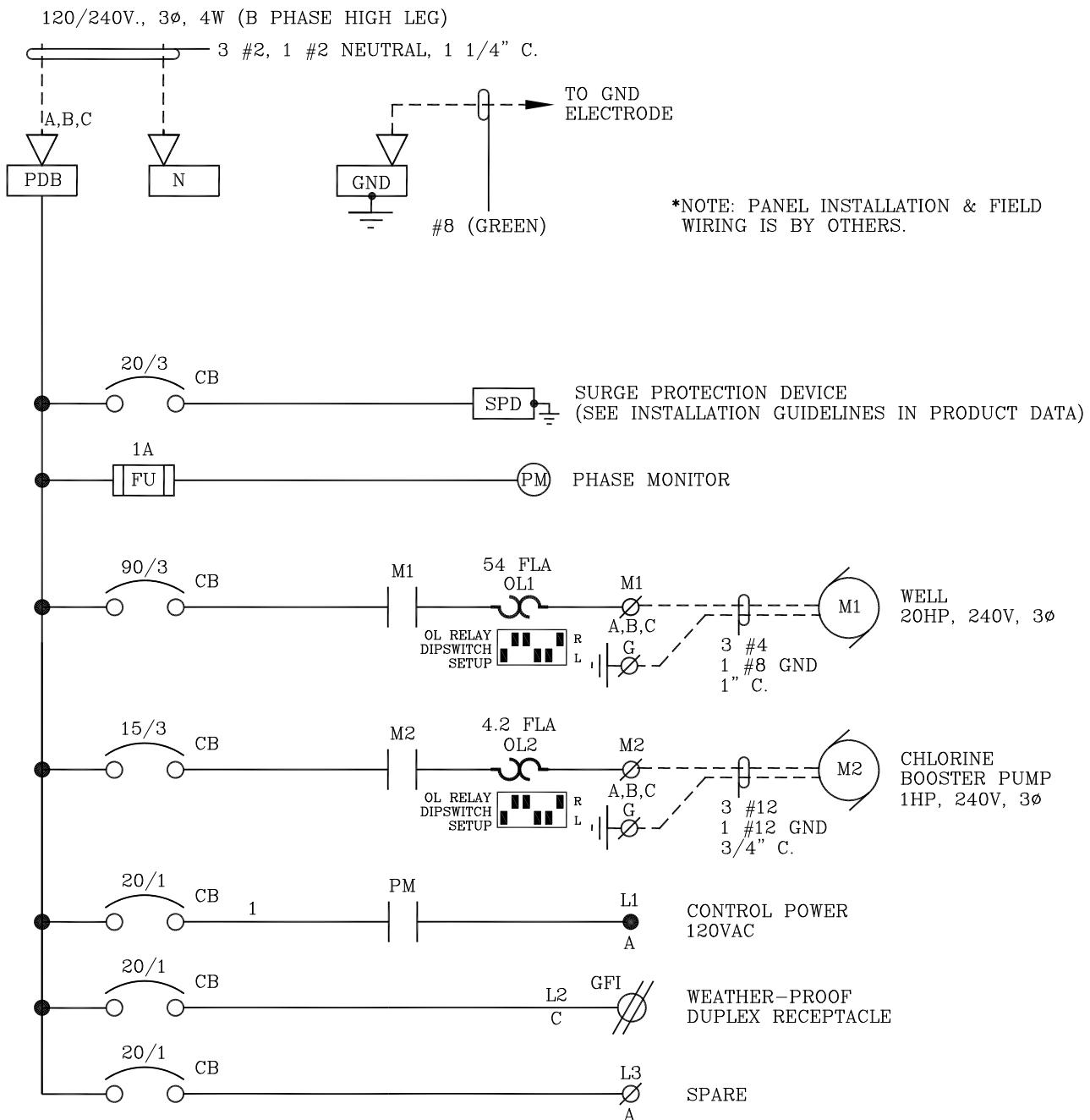
CONTINUOUS HINGE



ANODIZED ALUMINUM DEADFRONT

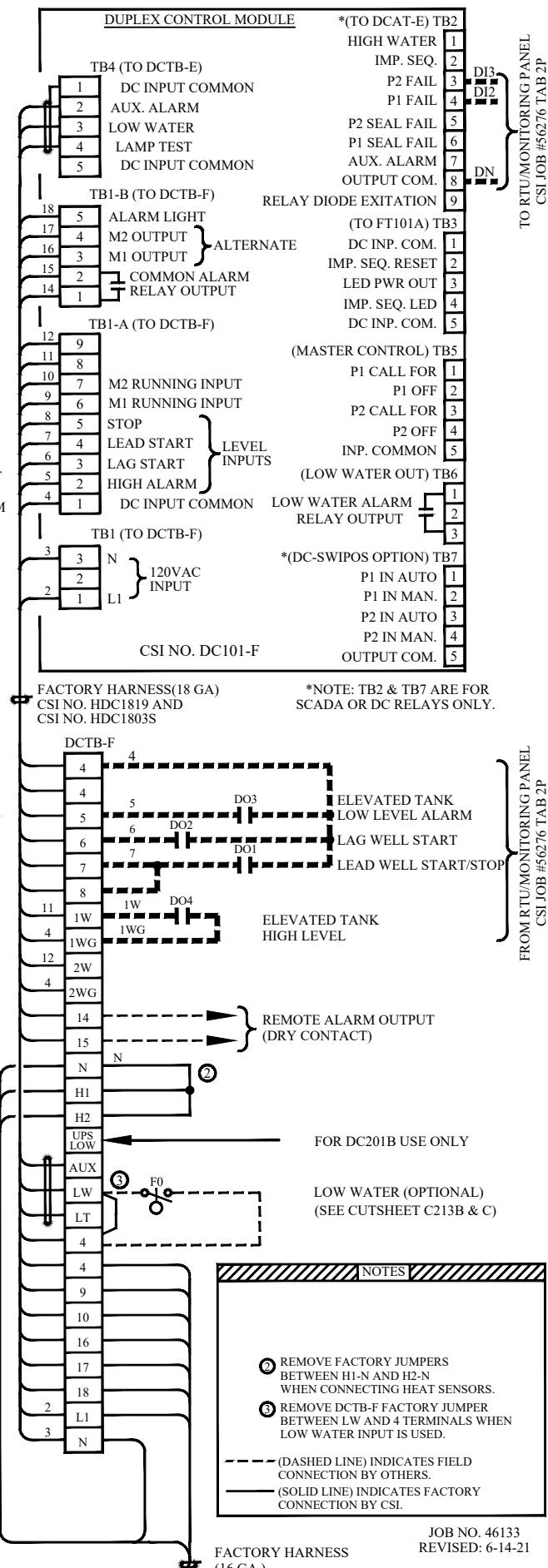
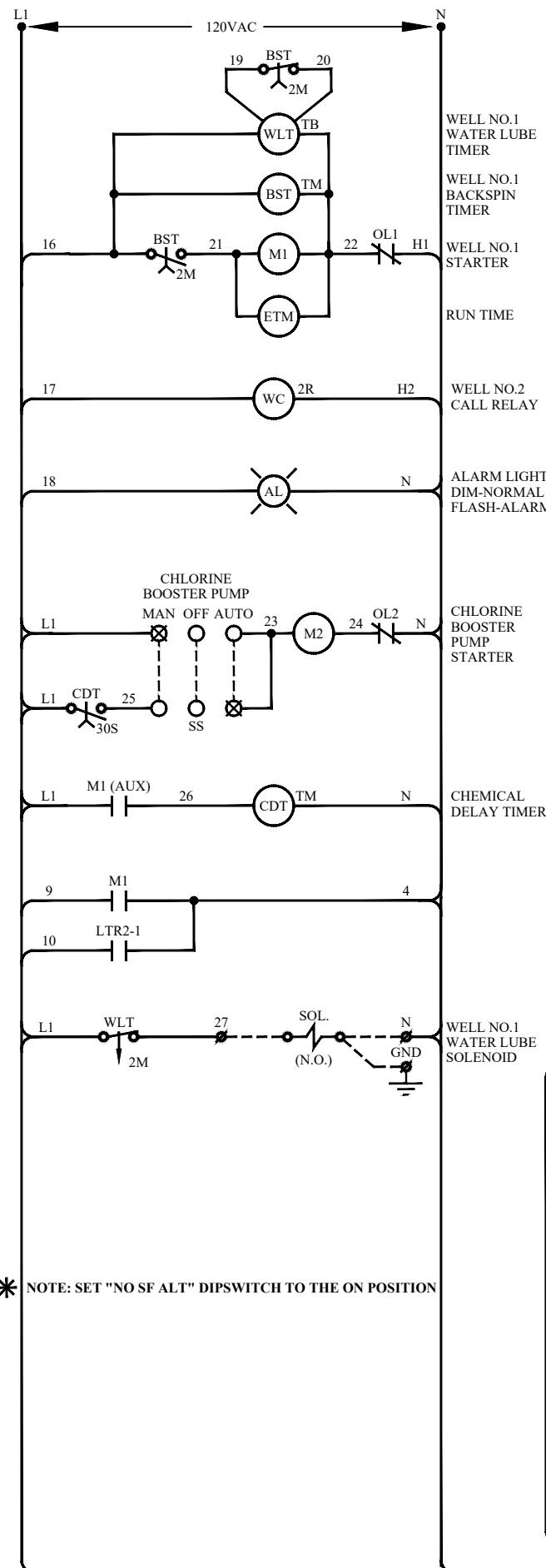
WELL NO.1 CONTROL PANEL
ONE LINE POWER SCHEMATIC

PAGE 1P4



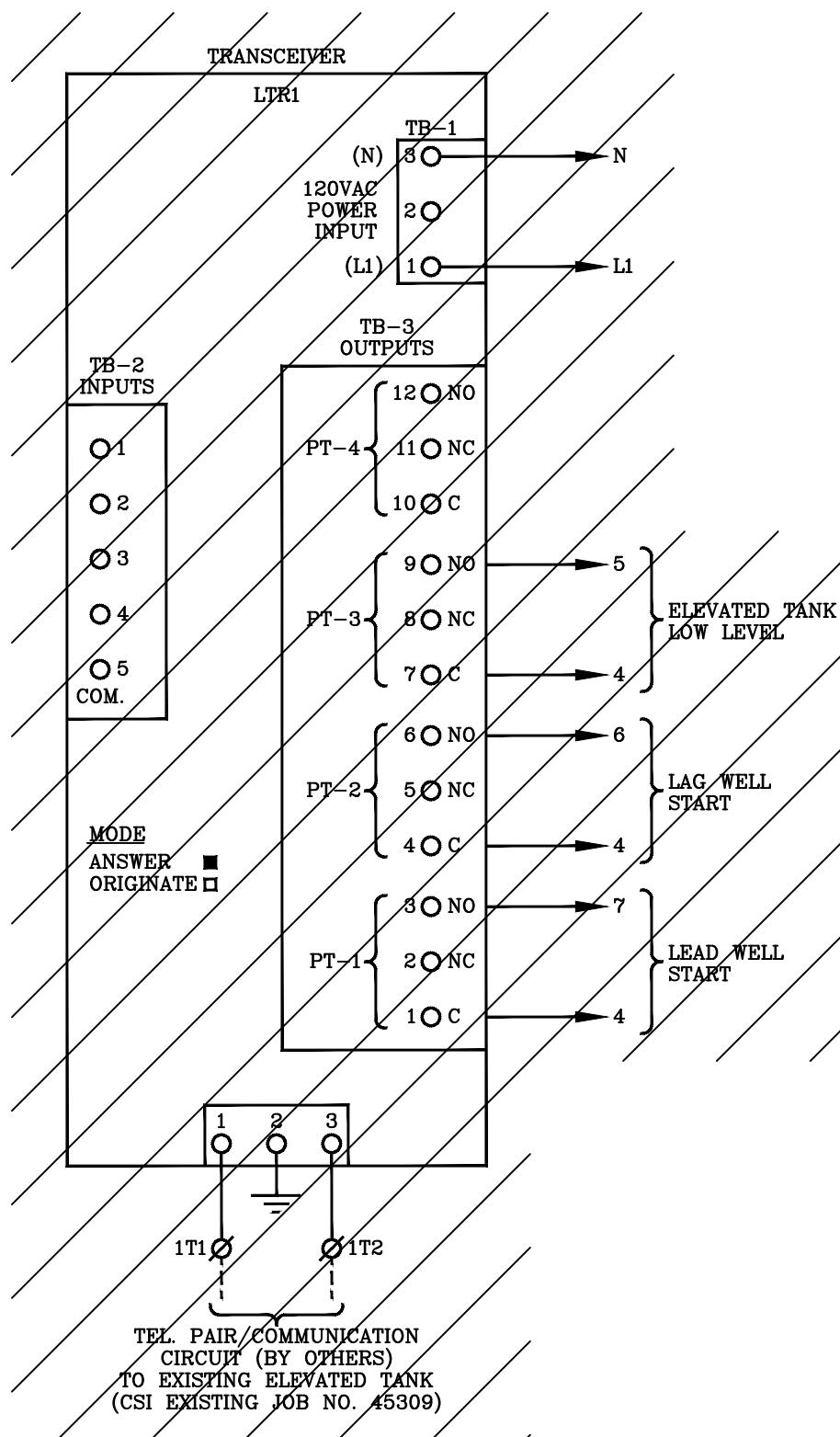
WELL NO.1 CONTROL PANEL
CONTROL SCHEMATIC

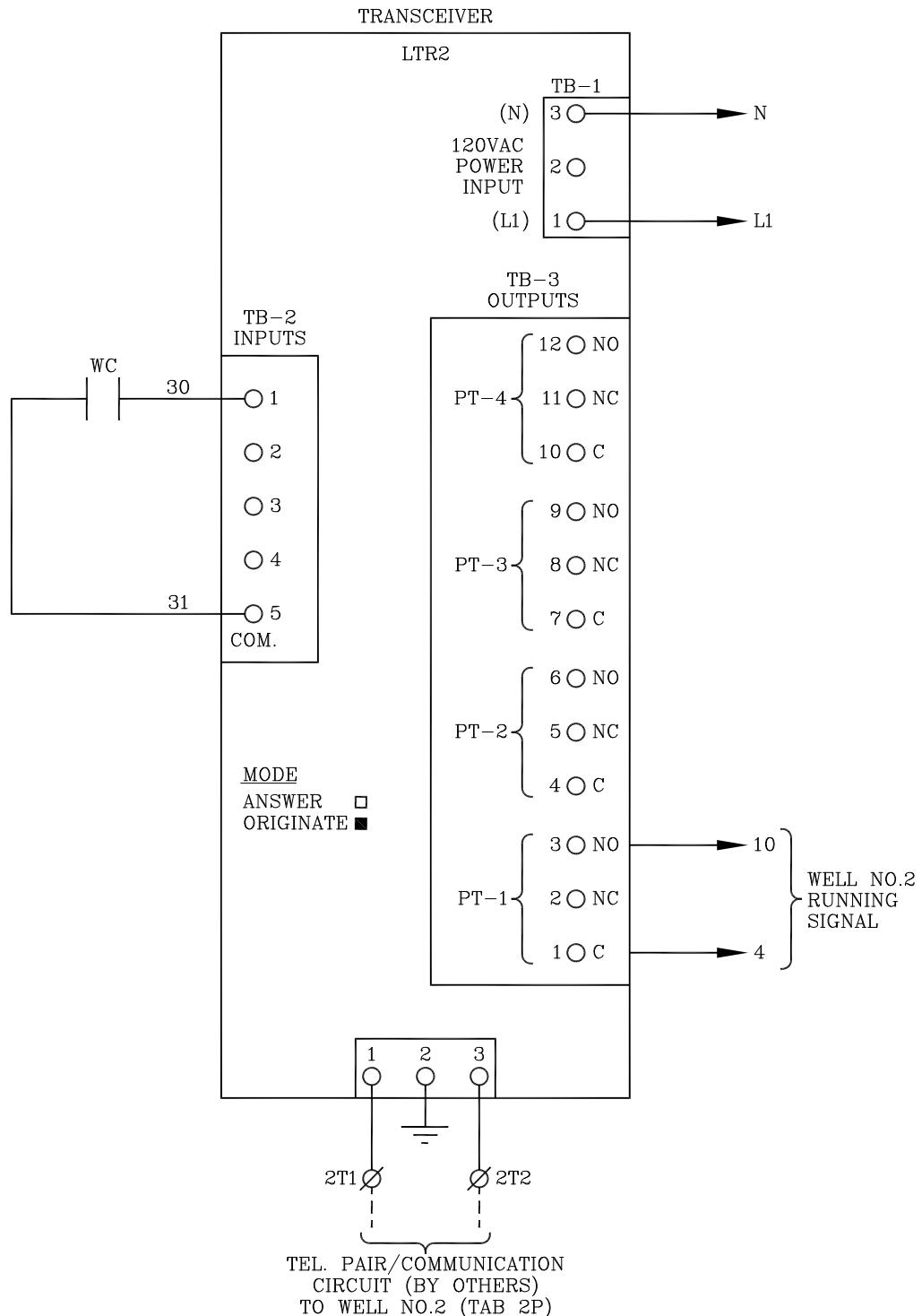
PAGE 1P5



WELL NO.1 CONTROL PANEL
CONTROL SCHEMATIC

PAGE 1P6





QTY	SYM	MFR	CAT #	DESC	PAGE #
2	LTR1-2	CSI	TR401	Long Distance Tone Relay	C203-C203B
1	TB	CSI	TBS-120-A-S	Off-Delay Timer 1 - 1,023 Seconds	C255-C255A
2	TM	CSI	TMS-120-A-S	On-Delay Timer 1 - 1,023 Seconds	C256-C256A
1	DC	CSI	DC101F	Duplex Controller	C213-C213S
1	DCTB	CSI	DCTBF-101	Duplex Controller Terminal Board	C213G,C213Q
1	2R	CSI	2RB-120VAC	DPDT Relay, 120VAC With Indicating Light	C292-C292A
3	FU	Gould	ATQ-1	1 Amp 500V, Fuse	C440
1	ETM	Grasslin	UWZ 48E-120	Elapsed Time Meter 120VAC, 60HZ	C470
1		Hoffman	A-36R3012HCR	NEMA 3R Enclosure 36X30X12	C483 - C484
1	SPD	Joslyn	TK-TT100-3D240	Transient Voltage Surge Suppressor	TAB 1E
1	N	Marathon	1421570	Power Distribution Block 1pole(Service Neutral)	C579
1	PDB	Marathon	1433553	Power Distribution Block 3pole(Internal Distribution)	C578
1	PM	MPE, Inc.	002-230-123	Phase Monitor	C626
1	GFI	P & S	1595-I/S2968	GFI Duplex Receptacle Weatherproof	C637
1	AL	RAB	VBR1 / GL100PGR	Wall Mounted Alarm Light With Red Lexan Globe	C718, C718A
3	CB	Siemens	BQ1B020QLD	Circuit Breaker 20 Amp, 1 Pole, 120V	C732
1	CB	Siemens	BQ3B015L	Circuit Breaker 15 Amp, 3 Pole, 240V	C733
1	CB	Siemens	BQ3B020L	Circuit Breaker 20 Amp, 3 Pole, 240V	C733
1	CB	Siemens	BQ3B090L	Circuit Breaker 90 Amp, 3 Pole, 240V	C733
1	M2	Furnas	14BUC32AA	NEMA Size 00 Starter 3 - 12 Amps	C742
1	M1	Furnas	14HUG32AA	NEMA Size 3 Starter 25 - 100 Amps	C742

QTY	SYM	MFR	CAT #	DESC	PAGE #
1		Furnas	49AB10	Auxiliary Contacts for NEMA Cont. 1 NO	C748
1	SS	Square D	ZB4BD3/(2) ZBE101 ZB4BZ009	3 Position Selector Switch N.O. Contact/Body Collar	C777, C781A
1	GND	Square D	PK15GTAL	Equipment Ground Bar	C823

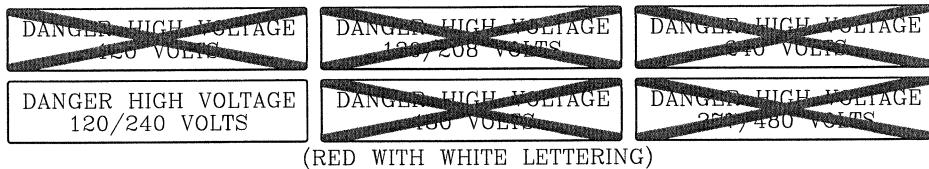
WELL CONTROL PANEL #2

20HP, 240V, 3 PHASE

WELL NO.2 CONTROL PANEL
STANDARD NAMEPLATE LEGEND DETAIL

PAGE 2P1

NP1. VOLTAGE LABEL -



(RED WITH WHITE LETTERING)

NP2. AUTHORIZED PERSONNEL LABEL -

AUTHORIZED PERSONNEL ONLY

(RED WITH WHITE LETTERING)

NP3. ARC FLASH LABEL -



NP4. CSI LOGO LABEL -



NP5. SERVICE ENTRANCE LABEL -

SUITABLE FOR USE AS SERVICE ENTRANCE
CONTROL SYSTEMS, INC.

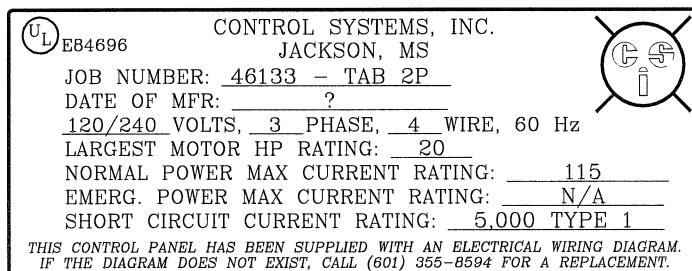
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NP6. STATION NAME OR NUMBER LABEL -

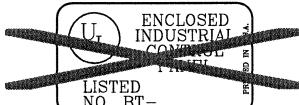
WELL NO.2

(BLACK WITH WHITE LETTERING)

NP7. CSI JOB NUMBER LABEL -



NP8. UL LABEL -



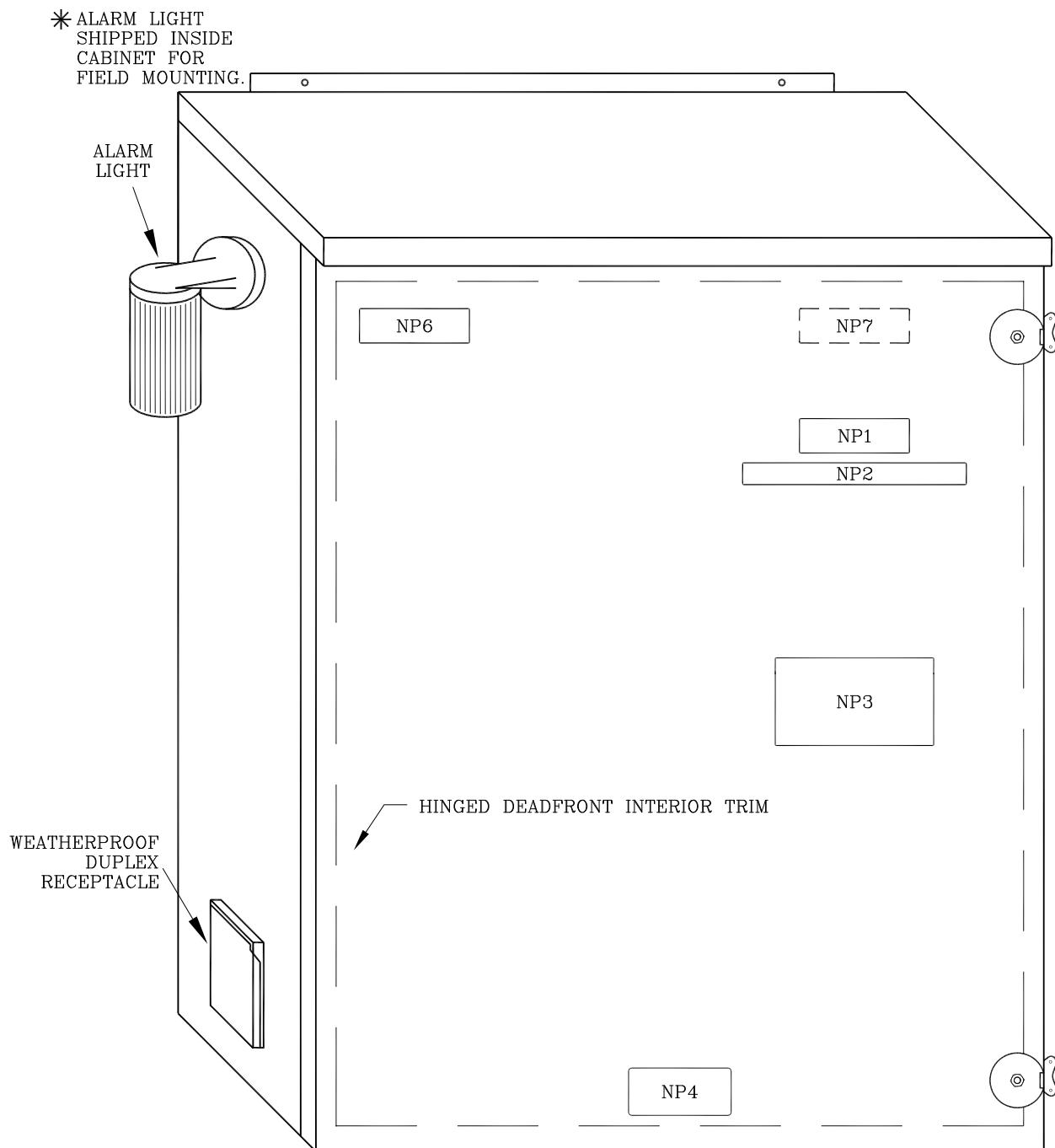
NP9. DE-ENERGIZATION LABEL -

NORMAL MAIN AND EMERGENCY MAIN
BREAKERS HAVE TO BE IN THE "OFF"
POSITION TO DE-ENERGIZE THE EQUIPMENT

(RED WITH WHITE LETTERING)

WELL NO.2 CONTROL PANEL
PHYSICAL LAYOUT

PAGE 2P2

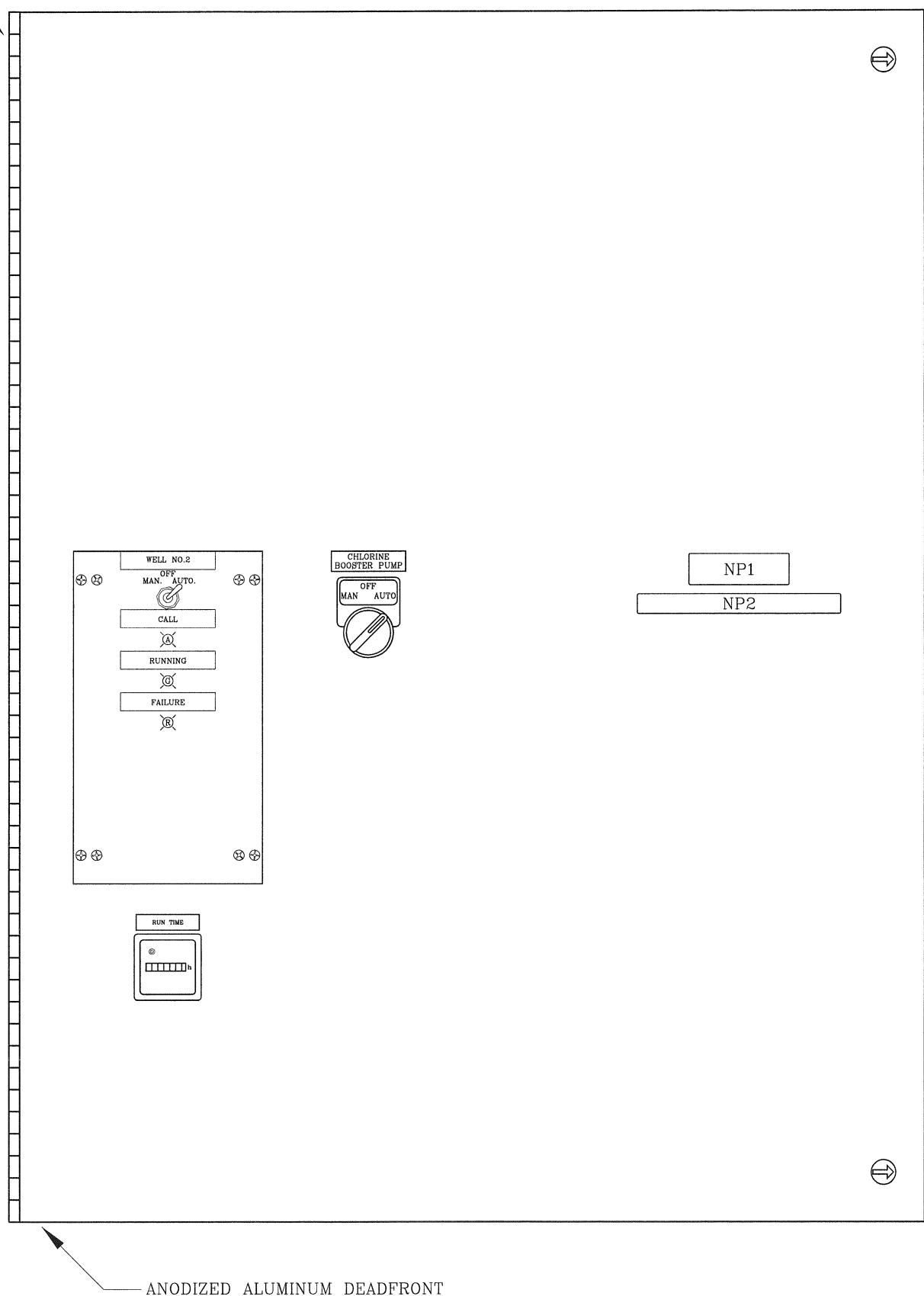


NEMA 3R ENCLOSURE
(36''H X 30''W X 12''D)

WELL NO.2 CONTROL PANEL
DEADFRONT DETAIL

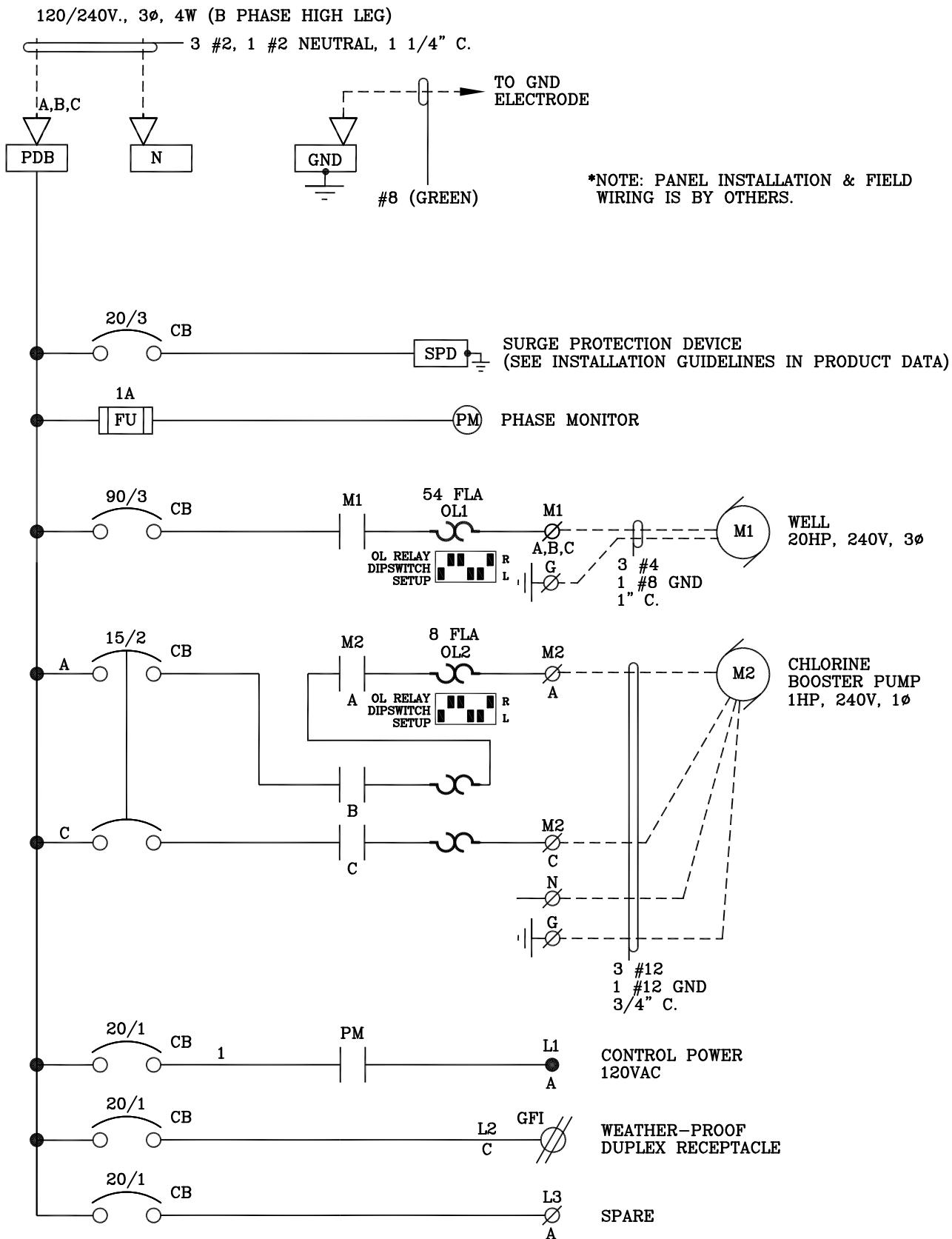
PAGE 2P3

CONTINUOUS HINGE



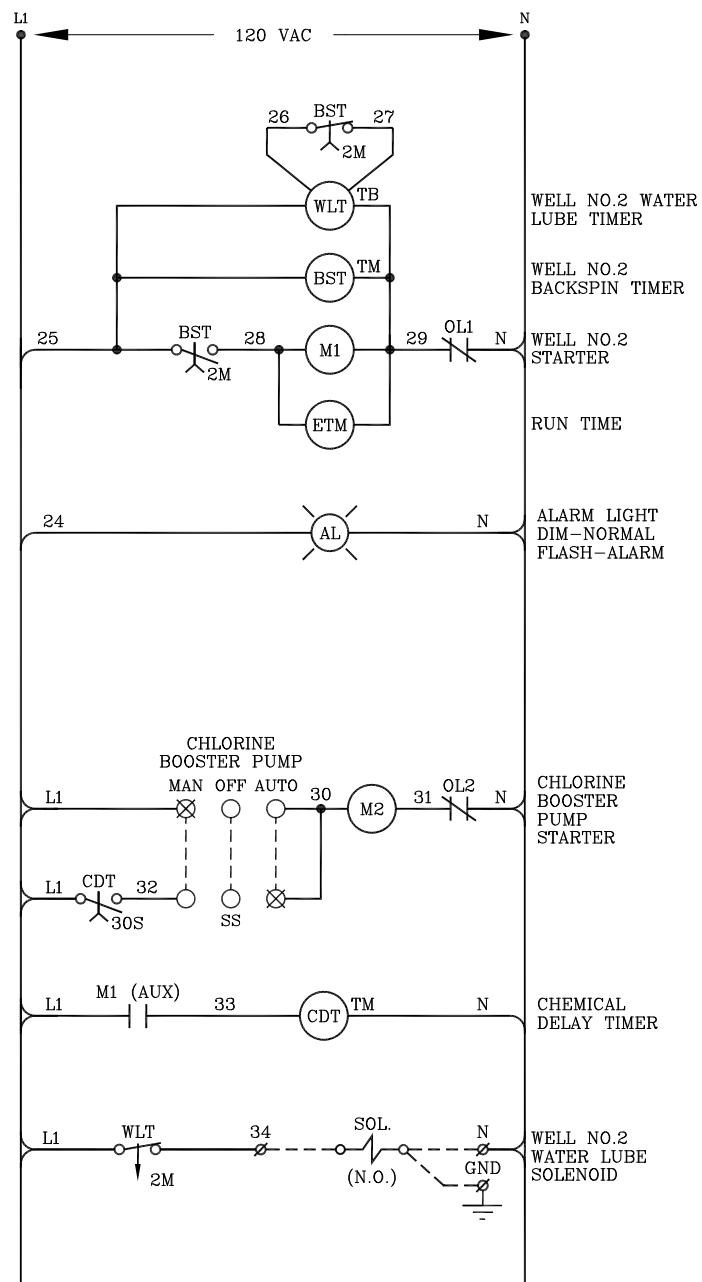
WELL NO.2 CONTROL PANEL
ONE LINE POWER SCHEMATIC

PAGE 2P4



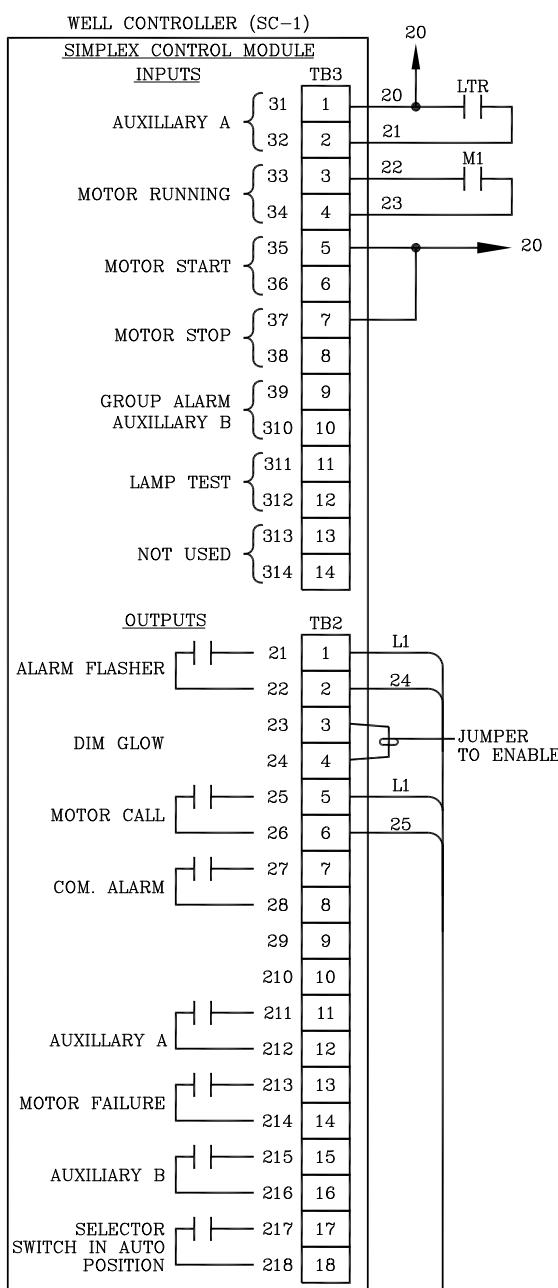
WELL NO.2 CONTROL PANEL
CONTROL SCHEMATIC

PAGE 2P5



NOTES

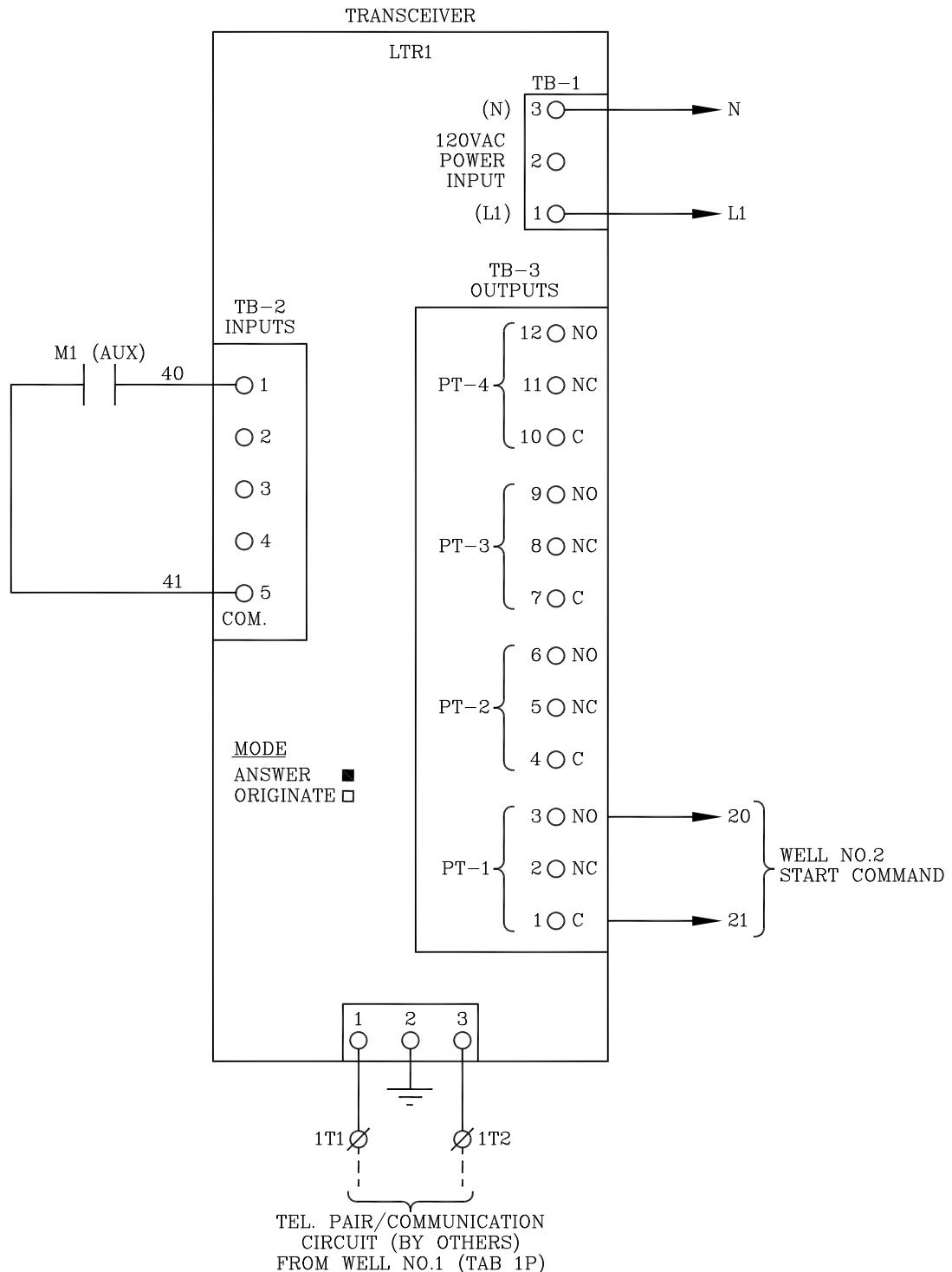
--- (DASHED LINE) INDICATES FIELD CONNECTION BY OTHERS.
— (SOLID LINE) INDICATES FACTORY CONNECTION BY CSI.



CSI NO. SC101E

FACTORY HARNESS
(16 GA.)

JOB NO. 46133



QTY	SYM	MFR	CAT #	DESC	PAGE #
1	LTR1	CSI	TR401	Long Distance Tone Relay	C203-C203B
1	TB	CSI	TBS-120-A-S	Off-Delay Timer 1 - 1,023 Seconds	C255-C255A
2	TM	CSI	TMS-120-A-S	On-Delay Timer 1 - 1,023 Seconds	C256-C256A
1	SC	CSI	SC101E	Simplex Controller	C210-C210D
3	FU	Gould	ATQ-1	1 Amp 500V, Fuse	C440
1	ETM	Grasslin	UWZ 48E-120	Elapsed Time Meter 120VAC, 60HZ	C470
1		Hoffman	A-36R3012HCR	NEMA 3R Enclosure 36X30X12	C483 - C484
1	SPD	Joslyn	TK-TT100-3D240	Transient Voltage Surge Suppressor	TAB 1E
1	N	Marathon	1421570	Power Distribution Block 1pole(Service Neutral)	C579
1	PDB	Marathon	1433553	Power Distribution Block 3pole(Internal Distribution)	C578
1	PM	MPE, Inc.	002-230-123	Phase Monitor	C626
1	GFI	P & S	1595-I/S2968	GFI Duplex Receptacle Weatherproof	C637
1	AL	RAB	VBR1 / GL100PGR	Wall Mounted Alarm Light With Red Lexan Globe	C718, C718A
3	CB	Siemens	BQ1B020QLD	Circuit Breaker 20 Amp, 1 Pole, 120V	C732
1	CB	Siemens	BQ2B015L	Circuit Breaker 15 Amp, 2 Pole, 240V	C733
1	CB	Siemens	BQ3B020L	Circuit Breaker 20 Amp, 3 Pole, 240V	C733
1	CB	Siemens	BQ3B090L	Circuit Breaker 90 Amp, 3 Pole, 240V	C733
1	M2	Furnas	14BUC32AA	NEMA Size 00 Starter 3 - 12 Amps	C742
1	M1	Furnas	14HUG32AA	NEMA Size 3 Starter 25 - 100 Amps	C742
1		Furnas	49AB20	Auxiliary Contacts for NEMA Cont. 2 NO	C748
1	SS	Square D	ZB4BD3/(2) ZBE101 ZB4BZ009	3 Position Selector Switch N.O. Contact/Body Collar	C777, C781A

QTY	SYM	MFR	CAT #	DESC	PAGE #
1	GND	Square D	PK15GTAL	Equipment Ground Bar	C823

SURGE PROTECTION DEVICE (SPD) DATA



TransTrack™ TT100

SYSTEM FEATURES



- Protects facilities and equipment against the harmful effects of lightning strikes and internally generated electrical transients
- Includes pre-wired pigtail conductors to streamline installation
- Internal copper bus conduction path to minimize system impedances, reducing let-through voltage and increasing reliability
- Status indicating lights and Form "C" dry relay contacts for remote monitoring
- Single pulse tested at independent 3rd party lab
- Hybrid design using MOV and Tracking Filter
- UL 1283 Tracking Filter
- Small, Compact Footprint – makes installation flexible
- 25-Year Unlimited Free Replacement Warranty
- Enhanced Transient Filter option on certain models

PRODUCT SPECIFICATIONS

GENERAL SPECIFICATIONS

Maximum Rated Surge Current: 100kA per phase; 50kA per mode

Nominal Discharge Surge Current In: 20kA

Application: ANSI/IEEE C62.41 Location C, B & A. Ideal for distribution panels, branch panels and critical loads

Design: Compact design for easy installation

Warranty: 25-Year Unlimited Free Replacement

Safety Listing: UL 1449 3rd Ed., Type 2, and UL 1283

ELECTRICAL SPECIFICATIONS

Modes of Protection: All Modes. L-N, L-L, L-G, & N-G

Input Power Frequency: 40-440Hz (47-64 Hz with enhanced filter option)

Response Time: < 1 nanosecond

Standard Monitoring: Status indicator lights (one per phase); Form C dry relay contacts for suppressor status

Short Circuit Current Rating: 65 kAIC using a 20A max breaker

MECHANICAL SPECIFICATIONS

Dimensions (approx.): 7"H x 7"W x 5"D
(186 mm H x 186 mm W x 125 mm D)

Enclosure: High-impact non-metallic, NEMA 4X (IP 56)

Connection: Pre-wired with 24" (610 mm) #10 AWG conductor (5.26 mm²)

Mounting: Multi-point mounting feet

Operating Environment: -40° C to 70° C (-40° F to 160° F)
5% to 95% non-condensing humidity

Weight: 12.7 lbs. (5.8 kg)



UL 1449

AVAILABLE CONFIGURATIONS

Model Number	Description
TK-TT100-1P120	120VAC, 1Ø, 2-wire + grd
TK-TT100-1P240	240VAC, 1Ø, 2-wire + grd
TK-TT100-1S240	120/240VAC, 1Ø SPLIT-PHASE, 3-wire + grd
TK-TT100-3Y208	120/208VAC, 3Ø WYE, 4-wire + grd
TK-TT100-3Y380	220/380VAC, 3Ø WYE, 4-wire + grd
TK-TT100-3Y600	347/600VAC, 3Ø WYE, 4-wire + grd
TK-TT100-3Y415	240/415VAC, 3Ø WYE, 4-wire + grd
TK-TT100-3Y480	277/480VAC, 3Ø WYE, 4-wire + grd
TK-TT100-3D240	120/240VAC, 3Ø high-leg DELTA, 4-wire + grd (B phase must be 208V)
TK-TT100-240NN	240VAC, 3Ø DELTA, 3-wire + grd
TK-TT100-380NN	380VAC, 3Ø DELTA, 3 wire + grd
TK-TT100-480NN	480VAC, 3Ø DELTA, 3-wire + grd

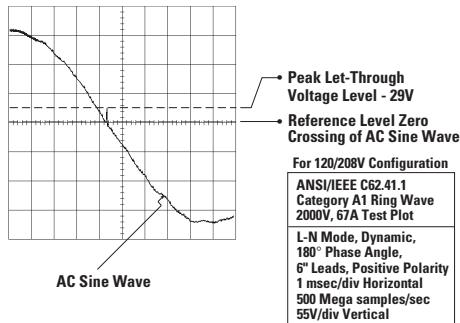
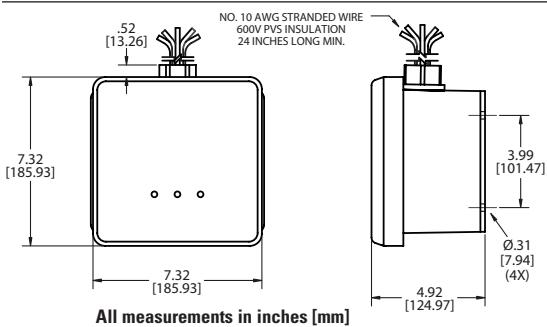
AVAILABLE OPTIONS

- Enhanced Transient Filter (ETF): add suffix "-F" to the standard part number: Example: TK-TT100-3Y208-F. Not available for 3Y600; 3Y480; 3Y415; 3Y380, 240NN, 380NN and 480NN models.

EMI / RFI FILTER ATTENUATION – MIL STANDARD 220B

Frequency	Attenuation
1kHz	1 dB
10kHz	14 dB
100kHz	35 dB
1MHz	18 dB
10MHz	3 dB
100MHz	2 dB
Max. Attenuation Frequency	57 dB @ 153 kHz

TransTrack™ TT100



ANSI/IEEE C62.41.1-2002, C62.41.2-2002, & C62.45-2002

Measured Limited Voltage

Model Number	System Voltage	System Configuration	Protection Mode	MCOV	ETF Models		All Models		UL Voltage Ratings	
					A1 Ring Wave	2kV, 67A 180° Phase Angle	B3/C1 Impulse Wave	6kV, 3kA 90° Phase Angle	C3 Impulse Wave	UL 1449 2nd Edition/ UL 1449 3rd Edition Voltage Protection Ratings
TK-TT100-1P120	120V	1-Phase 2-wire+grnd	L-N	150V	29V		881V		770V	400/600
			L-G	150V	311V		942V		993V	400/600
			N-G	150V	303V		978V		990V	400/600
TK-TT100-1P240	240V TT Ground	1-Phase 2-wire+grnd	L-N	320V	31V		881V		1280V	900/900
			L-G	320V	760V		940V		1570V	900/1000
			N-G	320V	765V		992V		1605V	900/1000
TK-TT100-1S240	120/240V	1-Phase 3-wire+grnd	L-N	150V	29V		522V		770V	400/600
			L-G	150V	311V		566V		993V	400/600
			L-L	300V	31V		951V		1230V	700/1000
			N-G	150V	303V		588V		990V	400/600
TK-TT100-3Y208	120/208V	3-Phase WYE 4-wire+grnd	L-N	150V	29V		522V		770V	400/600
			L-G	150V	311V		566V		993V	400/600
			L-L	300V	31V		951V		1230V	700/1000
			N-G	150V	303V		588V		990V	400/600
TK-TT100-3Y380	220/380V	3-Phase WYE 4-wire+grnd	L-N	275V	31V		857V		1293V	900/900
			L-G	275V	747V		836V		1369V	900/900
			L-L	550V	37V		1485V		2377V	1800/1500
			N-G	275V	769V		890V		1650V	800/900
TK-TT100-3Y600	347/600V	3-Phase WYE 4-wire+grnd	L-N	400V	N.A.		1574V		1429V	900/1800
			L-G	400V	N.A.		1598V		1269V	900/1800
			L-L	690V	N.A.		2477V		2341V	1800/2500
			N-G	400V	N.A.		1391V		1820V	900/1500
TK-TT100-3Y415	240/415V	3-Phase WYE 4-wire+grnd	L-N	320V	N.A.		888V		1293V	900/900
			L-G	320V	N.A.		941V		1369V	900/1000
			L-L	550V	N.A.		1696V		2377V	1800/1800
			N-G	320V	N.A.		971V		1650V	800/1000
TK-TT100-3Y480	277/480V	3-Phase WYE 4-wire+grnd	L-N	320V	N.A.		888V		1293V	900/900
			L-G	320V	N.A.		941V		1369V	900/1000
			L-L	550V	N.A.		1696V		2377V	1800/1800
			N-G	320V	N.A.		971V		1650V	800/1000
TK-TT100-3D240	120/240V	High-Leg DELTA 4-wire+grnd	L-N	150V	29V		559V		770V	400/600
			H-N	275V	31V		858V		1293V	800/900
			L-G	150V	311V		588V		993V	400/600
			H-G	275V	747V		847V		1369V	800/900
			L-L	300V	31V		944V		1230V	700/1000
TK-TT100-240NN	240V	3-Phase DELTA 3-wire+grnd	H-L	425V	63V		1295V		1640V	1500/1500
			N-G	150V	303V		594V		990V	400/800
TK-TT100-240NN	240V	3-Phase DELTA 3-wire+grnd	L-G	275V	N.A.		848V		1237V	800/900
TK-TT100-380NN	380V	3-Phase DELTA 3-wire+grnd	L-L	300V	N.A.		849V		1403V	800/1000
TK-TT100-480NN	480V	3-Phase DELTA 3-wire+grnd	L-G	550V	N.A.		1263V		1937V	1200/1500
			L-L	640V	N.A.		1515V		2473V	1500/1800
							1513V		1937V	1500/1800
							1798V		2473V	1800/1800

EFT = Enhanced Transient Filter (-F suffix). All tests performed with 6" (152 mm) lead length, positive polarity.

All voltages are peak values ($\pm 10\%$) measured from the zero reference point at the phase angles referenced above using a 10 μ s/div display rate and 500 Mega samples/sec sampling rate. Specifications subject to change without notice. See web site www.TPSurge.com for latest revisions.



**Surge
Protective
Devices**

**TransTrack Series:
50, 100, 160 and 200**

Installation,
Operation and
Maintenance
Manual



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INTRODUCTION

Today's sophisticated electronic equipment requires reliable surge protective devices. By selecting Joslyn® Total Protection Solutions™, TransTrack™ devices, you have taken a critical step toward decreasing downtime and ensuring longer product life for your equipment.

TransTrack is designed to protect facilities and sensitive electrical and electronic equipment against the harmful effects of lightning strikes and internally generated electrical transients. These reliable surge protection devices fulfill the single-pulse surge current capacity testing recommendations per NEMA LS-1, 1992, sections 2.2.9 and 3.9.

TransTrack combines easy installation with many special features to deliver more performance than any other device in its class.

TransTrack is conveniently pre-wired with 24-inch, stranded #10 AWG pigtail conductors. To ensure optimum product performance, install your TransTrack system in a location that minimizes wire lengths and wire bends. This positioning maximizes surge suppression and filtering while providing added protection for the connected loads.



WARNING: HAZARDOUS VOLTAGES PRESENT Improper installation or misapplication may result in serious personnel injury and/or damage to electrical system. Read the complete installation instructions before proceeding with installation. Remove all power to the electrical panel before installing or servicing the suppressor.

IMPORTANT SAFETY INSTRUCTIONS All work must be performed by licensed and qualified personnel. The electrical system must be properly grounded in accordance with the U.S. National Electrical Code, state and local codes or other applicable codes for this suppressor to function properly. Do not connect TransTrack to the line side of the main service breaker or disconnecting means. This device is suitable for installation where the available short circuit current is 100,000 RMS symmetrical amperes at 480VAC or less.

BEFORE INSTALLATION

1. System Configuration Verification:

Confirm that the voltage(s) and service configuration shown on TransTrack product label are consistent with the voltage and service configuration of the facility. A model number is on the bottom side of TransTrack. Each model number corresponds to the configurations printed in the table below:

Example of a suppressor model number: TK-TT200-3Y208-F

MODEL NUMBER	NOMINAL VOLTAGE	L-N VOLTAGE RANGE	L-L VOLTAGE RANGE	CONFIGURATION
TK-TTxxx-1P240	240	204-264	N/A	Single-Phase, 2-wire+ground
TK-TTxxx-1S240	120/240	102-132	204-264	Split-Phase, 3-wire+ground
TK-TTxxx-3Y208	120/208	102-132	177-229	Three-Phase WYE 4-wire+ground
TK-TTxxx-3Y380	220/380	187-264	323-460	Three-Phase WYE 4-wire+ground
TK-TTxxx-3Y415	240/415	204-264	353-457	Three-Phase WYE 4-wire+ground
TK-TTxxx-3Y480	277/480	236-305	408-528	Three-Phase WYE 4-wire+ground
TK-TTxxx-3D240	120/240	102-132 (A & C PHASES) 177-229 (B PHASE)	204-264	Three-Phase high-leg DELTA 4-wire+ground
TK-TTxxx-240NN	240	N/A	204-264	Three-Phase DELTA 3-wire+ground
TK-TTxxx-380NN	380	N/A	323-460	Three-Phase DELTA 3-wire+ground
TK-TTxxx-480NN	480	N/A	408-528	Three-Phase DELTA 3-wire+ground

-F suffix denotes enhanced transient filter (ETF) option.

The ETF option is not recommended for applications employing a Ground Fault Current Interrupting (GFCI) breaker.



WARNING: Check to ensure that a proper bond is installed between neutral and ground at the transformer upstream from all 3-phase WYE, 3-phase high-leg DELTA, split-phase or single-phase TransTrack device (see NEC article 250). If the transformer is not accessible, check the main service disconnect/panel for the N-G bond. Lack of a proper bond will damage TransTrack and void the warranty.

2. Wiring Connection Diagrams

Figures 1-5 show the electrical relationship between TransTrack and these five basic service configurations: Single-phase, 2-wire, Split-phase, 3-wire; Three-phase, 4-wire WYE, Three-phase, 3-wire DELTA and Three-phase, 4-wire high-leg DELTA.

Fig. 1: 1-Phase, 2-Wire

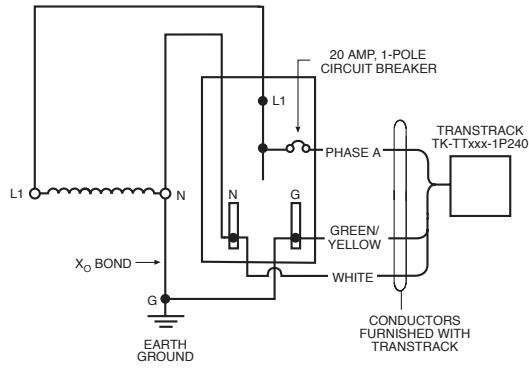


Fig. 2: Split Phase, 3-Wire

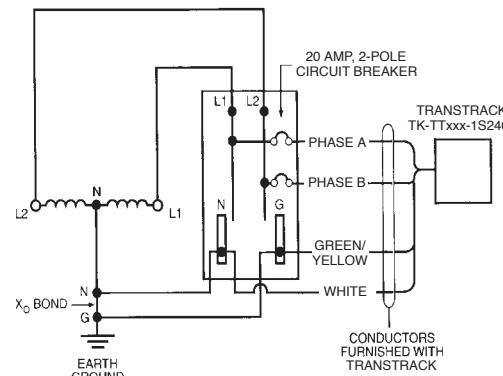


Fig. 3: 3-Phase, 4-Wire WYE

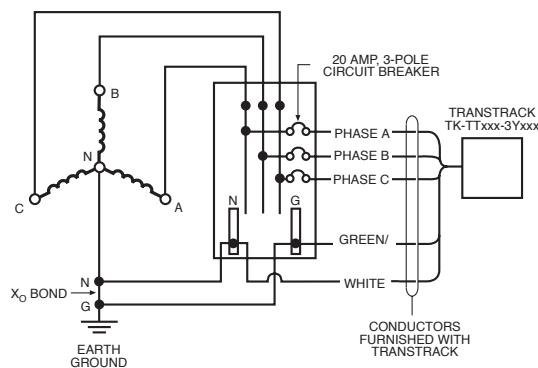


Fig. 4: 3-Phase, 3-Wire DELTA

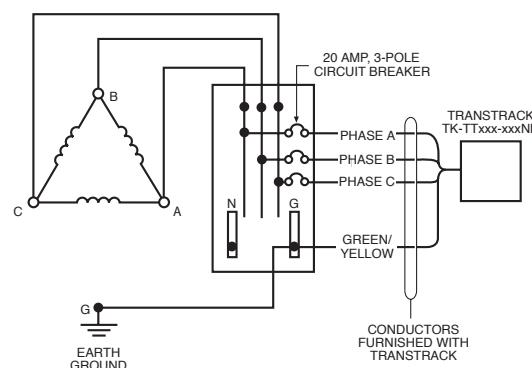
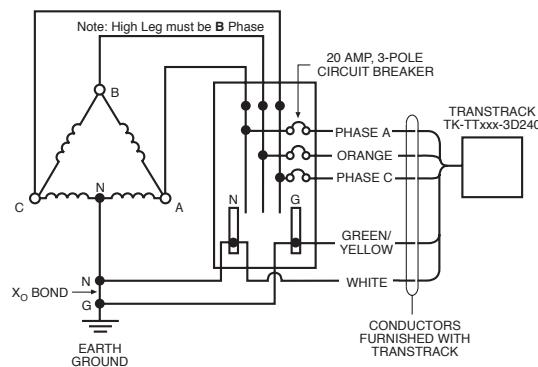


Fig. 5: 3-Phase, 4-Wire DELTA



Connections to the SPD are clearly identified. Connections are made via pigtail leads supplied with the unit. For 3 phase units phases A, B and C are black wires, which are marked "PHASE A", "PHASE B" and "PHASE C" respectively. For split phase units, the phase connections are marked "PHASE A" and "PHASE B". For single phase units, the phase connection is marked "PHASE A". The neutral is a white wire and the ground is a green/yellow wire.

3. Upstream Over-Current Protection Device

TransTrack must be connected in parallel with the electrical system. It must be connected to an overcurrent protection device (circuit breaker or fused switch) rated 20A maximum. The advantage of using a dedicated overcurrent protection device for the suppressor is that it allows the suppressor to be de-energized during service without disturbing the electrical service to the rest of the facility.

4. Raceway

To route TransTrack conductors to the panel being protected, choose from any of these materials: (1) non-metallic flexible conduit, (2) metallic flexible conduit, (3) rigid conduit or (4) a nipple. The TransTrack enclosure is provided standard with a 3/4-inch hub which will accept rigid or IMC conduit. A plastic flexible conduit with fitting and a 3-inch nipple are available as options.

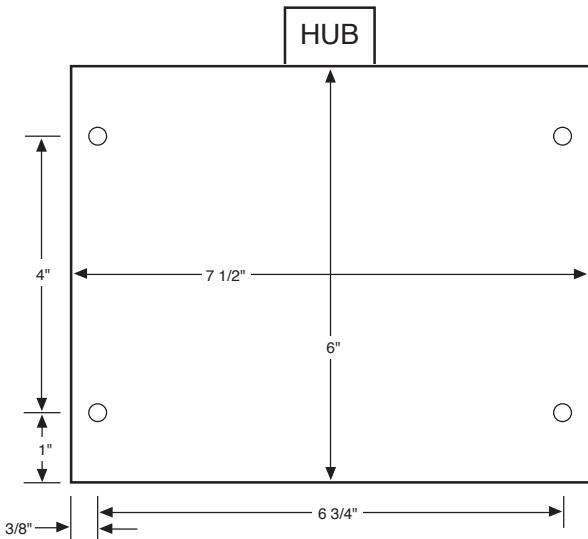
5. Wire Length and Conductor Routing

Use the supplied 24-inch, #10 AWG leads. Trim leads to suit the application but do NOT splice to add length to the leads. Refer to Figures 1 through 4 for the color code of the TransTrack leads. Terminate the leads as shown. TransTrack's performance will be severely limited if the conductors are (a) too long, (b) are of too small a wire gauge, (c) have too many bends or (d) have sharp bends. The factors listed above should be addressed during the design of an installation to reserve a suitable place for TransTrack next to its point of connection to the electrical system. The selected mounting location should allow for the shortest possible conductor runs and a direct route with a minimum of bends. If bends are required, they should be *sweeping* bends. Do not make sharp 90° bends for appearance purposes because they will severely decrease the effectiveness of TransTrack. Binding or twisting conductors together using tie-wraps or electrical tape increases the protection performance of the device.

6. Mounting

Four 5/16-inch holes are provided for mounting the TransTrack.

FIG. 6
Mounting Hole Detail



CONNECTION AND WIRING INSTRUCTIONS

1. Phase, Neutral, and Ground Connections

Phase, Neutral* and **Ground**: Following all applicable National Electrical Code standards as well as state and local codes, connect the phase, neutral* and ground conductors from upstream overcurrent protection device to TransTrack. Ensure that the conductor lengths are kept as short and straight as possible. On all high-leg delta systems, the Phase B conductor of the suppressor (color-coded orange according to NEC) must be connected to the high-leg.

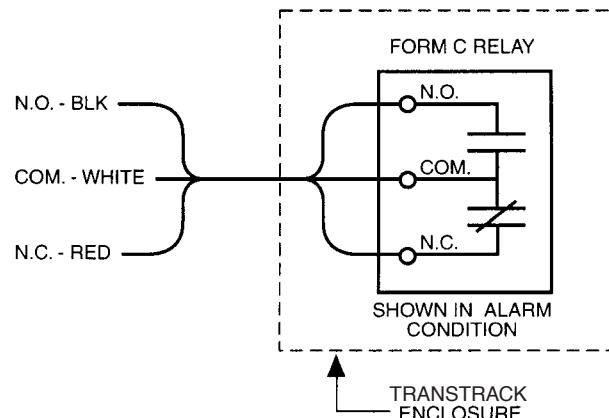
**DELTA-connected* TransTrack does not have a neutral conductor.

2. Connecting Form C Dry Contacts

TransTrack units come standard with Form "C" dry contacts. The relay contacts are rated 110V DC/125V AC with maximum switching power of 30W DC/62.5VA AC. Use butt splices within the panelboard to connect the Form "C" leads to the user's monitoring circuits. Alternatively, install a junction box between the TransTrack and the panelboard to connect Form "C" leads to user's monitoring circuits. If the Form "C" contacts are not used, user has the option of either cutting off the leads or coiling up the leads and saving them for potential future use. Consult applicable local codes to ensure proper installation.

FIG. 7

Detail of Form "C" contacts



3. Verification and Power Up

Apply power to TransTrack by closing the circuit breaker or molded-case switch feeding the suppressor. Verify that all "Phase Protection Status" indicating lights are illuminated.

TROUBLESHOOTING

Call Joslyn Technical Support if you experience either of these conditions:

- Circuit breaker trips and cannot be reset
- One or more lights on TransTrack are not illuminated

*No user-serviceable parts inside.

TECHNICAL ASSISTANCE

Our staff is ready to support you and answer any questions.

Monday through Friday, 8:00 a.m. to 5:00 p.m. (EST) 800-647-1911.

RETURNS AND WARRANTY PROCEDURES

TransTrack products are warranted for a period of 25 years from date of purchase. In the event that any module or subassembly within the suppressor fails to perform as specified during the warranty period, call our Technical Support at 800-647-1911 to obtain a Return Material Authorization number. We will immediately ship a replacement for the defective parts free of charge (installation labor and site preparations excluded). Return the defective parts to Joslyn within 30 days of receiving the replacement. Failure to return the defective parts will result in billing for the replacement parts. To help expedite the return procedures, please have the following information at hand when you contact Joslyn:

INFORMATION	EXAMPLE
Model Number	TK-TT200-3Y208-F
Serial Number	23115-4103-001
Date of Purchase	October 17, 2003 (41st week)
Sales Order Number	23115
Description of Failure	Phase A light is off
Desired Action from Joslyn	Replace

WARRANTY STATEMENT

During the applicable warranty period, any Total Protection Solutions™ surge protector device which fails due to defect in materials, workmanship, or any electrical anomaly, including lightning, shall be repaired or replaced at Joslyn's discretion.

Prior to shipment of any suspect or known defective product to Joslyn a Return Material Authorization (RMA) number must be obtained. An official Joslyn RMA number and shipping instructions can be obtained from the distributor where the product was originally purchased. Distributors can obtain the official Joslyn RMA number by contacting the Joslyn Customer Service Department at 800-647-1911. Products arriving at Joslyn without an official RMA number will not be accepted and will be returned freight collect to the original point of shipment.

Products being returned with an official Joslyn RMA number should be shipped by prepaid freight to the nominated point of return as shown on the RMA documentation.

The Company shall have no liability under this warranty for problems or defects directly or indirectly caused by misuse of the Product, alteration of the Product (including removal of any warning labels), accidents, improper installation, application, operation or improper repair of the Product.

THIS WARRANTY REPRESENTS THE ENTIRE WARRANTY OF THE COMPANY. ALL OTHER WARRANTIES EXPRESS OR IMPLIED, ORAL OR WRITTEN, INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

THE LIABILITY OF THE COMPANY, AT ITS SOLE OPTION, UNDER THIS WARRANTY IS EXPRESSLY LIMITED TO THE REPLACEMENT OR REPAIR OF THE DEFECTIVE PART THEREOF. IN NO EVENT SHALL THE COMPANY BE LIABLE OR RESPONSIBLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND OR CHARACTER, NOR SHALL ITS LIABILITY EVER EXCEED THE PURCHASE PRICE PAID TO JOSLYN FOR SUCH DEFECTIVE PRODUCT.

This warranty is not transferable and may only be enforced by the original purchaser. Claims under this warranty must be submitted to Joslyn within thirty (30) days of discovery of any suspected product defect.

Warranty Period

TransTrack™ 25 Years from original date of purchase



5900 Eastport Boulevard Richmond, VA 23231-4453 USA
TEL: 800.647.1911
www.tpsjostlyn.com



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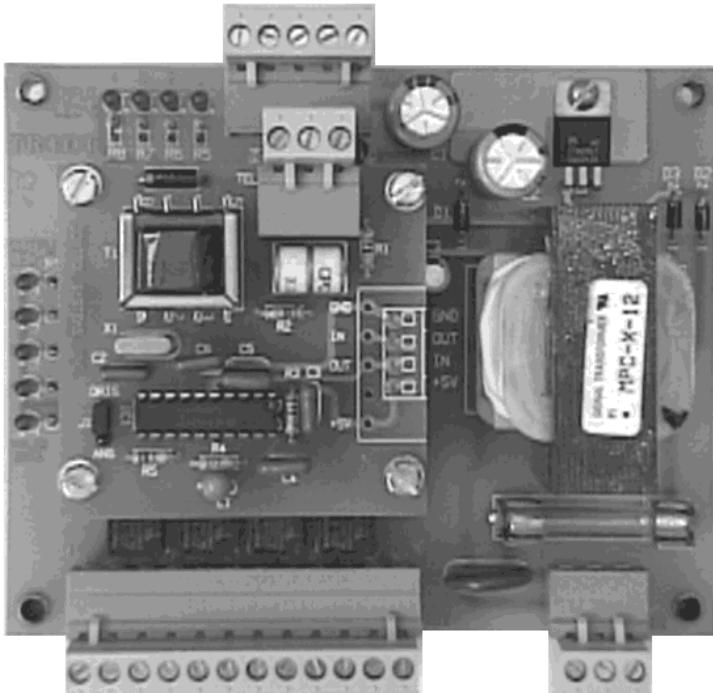
CATALOG DATA



Control Systems, Inc.

PRODUCT DATA BULLETIN

BULLETIN
TR401
TELEMETRY
TRANSCEIVER



STANDARD FEATURES

- | VOICE GRADE, LEASED LINE OPERATION
- | FULL DUPLEX OPERATION
- | BELL 103 COMPATIBLE
- | FOUR (4) DRY CONTACT INPUTS
- | INPUTS ARE OPTICALLY ISOLATED
- | FOUR (4) DRY CONTACT RELAY OUTPUTS
- | I/O LED STATUS INDICATORS
- | BUILT-IN SURGE PROTECTION
- | BACK-PLATE MOUNTING
- | 115/120 VAC @ 50/60 Hz POWER

DESCRIPTION

The model TR401 Telemetry Relay Board is a 4-channel digital transceiver intended for use over leased, voice-grade telephone lines. Two units are required for operation, providing four optically isolated inputs and relay outputs at each location. Inputs are dry-contact type. Communication is accomplished with a built in, full-duplex, Bell 103 compatible modem operating at 300 Baud. Signals are FSK (Frequency-Shift-Keyed) and transmitted at -9dBm into a 600 ohm load. Normally open and normally closed relay contact outputs are provided for each of the four channels. The board contains status LED's for all inputs, outputs and Valid Data received.

SUGGESTED SPECIFICATIONS

Provide a four (4) channel transceiver for use over leased, voice-grade telephone lines. The transceiver shall be compatible with an identical transceiver at a remote location. Provide the transceiver with the following features: A) The transceiver shall have four dry-contact inputs. The maximum current produced at each input shall be 12 mAdc. All four inputs shall be optically isolated and be provided with a separate LED status indicator which lights when its respective input contact is closed. B) Provide four (4) output relays with contacts rated for 8 amps, 120 VAC resistive. Normally open and normally closed output contacts shall be provided for each relay. LED status indicators shall be provided to indicate when each output relay is energized. C) Communications shall be made over "leased-line", voice-grade Bell 103 telephone lines. The signals sent shall be 300 Baud, FSK (Frequency-Shift-Keyed), transmitted at a level of -9 dBm into a 600 ohm load. Provide an LED status indicator to indicate "Valid Data Received". If communications are lost for any reason, this LED shall be turned off. D) The transceiver shall be protected from AC transient surges by a metal oxide varistor which can operate with up to 130 VAC RMS continuously, has a maximum voltage clamp rating of 340 volts and can handle up to 4500 amps and 38 joules of energy. The telephone line shall be protected by an on-board two-stage hybrid system. The first stage shall be a three element gas tube for heavy duty surges, having a breakdown rating between 200 and 350 volts. Impulse breakdown at 100 volts per microsecond shall equal 600 volts. The second stage shall be a solid state system consisting of two current limiting resistors and a transient voltage suppressor connected across the telephone line to limit the voltage to 6.8 nominal volts. The transceiver shall also be optically isolated from the field inputs by a photo-transistor optoisolator which has an isolation rating of 5000 volts. E) The transceiver shall operate from 115/120 VAC, 50/60 Hz. power.

SPECIFICATIONS

M SUPPLY VOLTAGE: 115/120 VAC, 50/60 Hz

M SUPPLY CURRENT: 80 ma

M POWER CONSUMPTION: 10 Watts

M INPUT CONTROL VOLTAGE: 30 VDC @ 12 m adc

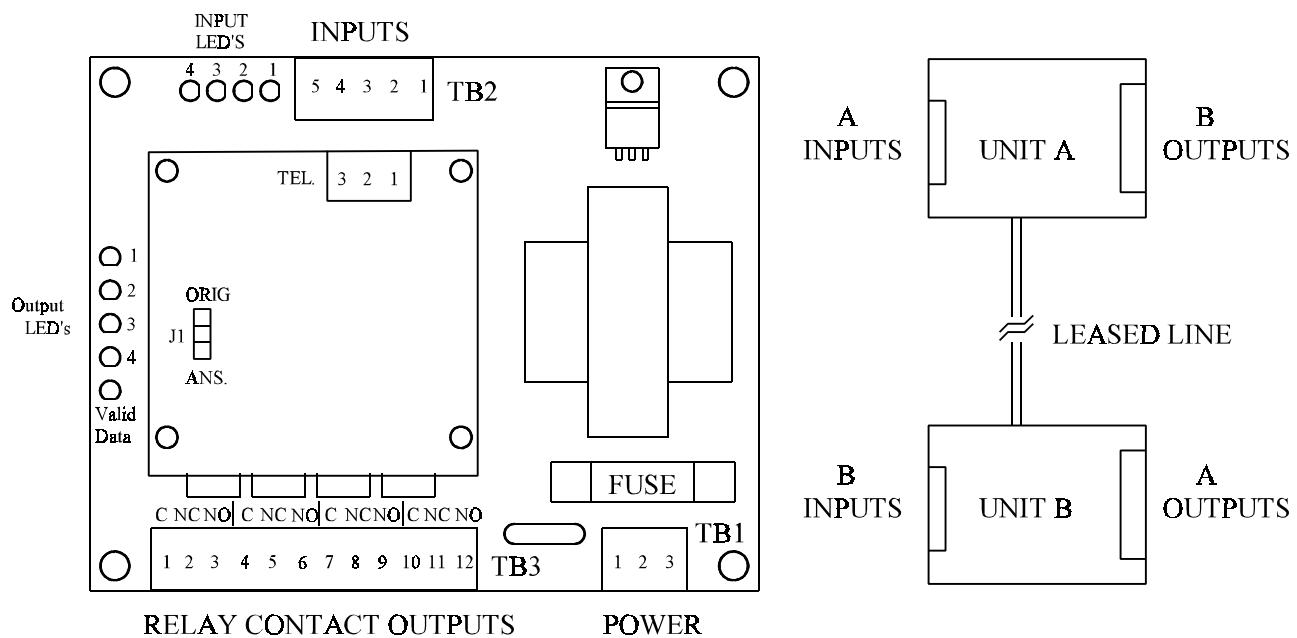
M OUTPUT CONTACT RATING: 8 Amps @ 120 VAC, Resistive

M DUTY CYCLE: Continuous

M CIRCUIT BOARD DIMENSIONS: 5" Wide X 4" High

*Note: Leave about 1" extra space, top and bottom, when mounting to allow room for unplugging the connectors.

TR401 FEATURES



ORDERING INFORMATION

Telemetry Transceiver: TR401

NOTE: Two units are required for new installations.

WARRANTY: Control Systems, Inc. (CSI) warrants equipment of its own manufacture to be free from defects in material and workmanship, under normal conditions of use and service, and will replace any component found to be defective on its return to CSI, transportation charges prepaid, within one year of its original purchase. CSI will extend the same warranty protection on accessories which is extended to CSI by the original manufacturer. CSI also assumes no liability, express or implied, beyond its obligation to replace any component involved. Such warranty is in lieu of all other warranties express or implied.



CONTROL SYSTEMS, INC.
P.O. Box 4852, Jackson, MS 39296-4852
Telephone: (601) 355-8594
FAX: (601) 355-8774

Document Revision: C

TELEMETRY RELAY BOARD (TR401) OPERATIONAL FEATURES

GENERAL DESCRIPTION:

The TR401 Telemetry Relay board is a 4-channel digital transceiver for use over leased, voice-grade telephone lines. Two units are required for operation, providing four inputs and outputs at each location. Communication is accomplished with a built in, full-duplex, Bell 103 compatible modem. Relay outputs are provided for each of the four channels. The board contains status LED's for all inputs, outputs and Valid Data Received.

DIGITAL INPUTS:

Four inputs are provided on TB2 for dry-contacts only. Terminals 1-4 on the connector are the individual inputs and terminal 5 is the return for all four inputs. Maximum current produced at each input is about 12ma/dc. All four inputs are optically isolated from the rest of the circuitry on board. External resistance should not exceed 1000 ohms for each input. Separate status LED indicators are provided for each input. Each LED will light when an input contact closure is received. The LED's are located to the left of the input connector. NOTE: the system continually scans each input and under dark conditions, each LED in turn will "pulse" very faintly. This is a normal condition.

RELAY OUTPUTS:

Connections for each relay output are made to the 12-pin connector (TB3) which is located at the bottom of the circuit board. Each relay is rated for 8 Amps, 120 Vac resistive. Normally-open and normally-closed contacts are provided. On-board labels are located above the connector to indicate each terminal function. LED status indicators are provided on the left side of the board to indicate when each output relay is energized.

COMMUNICATIONS:

Communication is made over voice-grade, Bell 103 telephone lines. The TR401 does not dial a phone number, so "leased-line" service must be used. The signals sent are 300 baud FSK (Frequency-Shift-Keyed). Transmit level at the TEL connector is -9dBm into a 600 ohm load. The TEL connector is located above the input connector. Terminals 1 and 3 are for the telephone line. Terminal 2 (center) should be connected to an Earth Ground to enable the on-board surge arrester. In order for the set of boards to communicate properly, one board must be set to Answer mode and the other to Originate. There is a 3-pin jumper plug (J1), located on the "piggy-back" board that is used to make the selection. There is one LED status indicator located on the left side of the board under the output relay LED's that indicates Valid Data Received. Under steady conditions, this LED should be on. When any remote input (over telephone lines) changes state, the LED will go off for a moment and then come back on. The output relay status indicators will also change at this point. If communications are lost for any reason, the Valid Data LED will be turned off.

POWER REQUIREMENTS:

The circuit board is powered by 115/120 VAC, 50/60 Hz. Power is terminated on TB1, located at the bottom right of the board. Terminal 1 is Hot and terminal 3 is Neutral. No connection is made to terminal 2.

TRANSIENT PROTECTION:

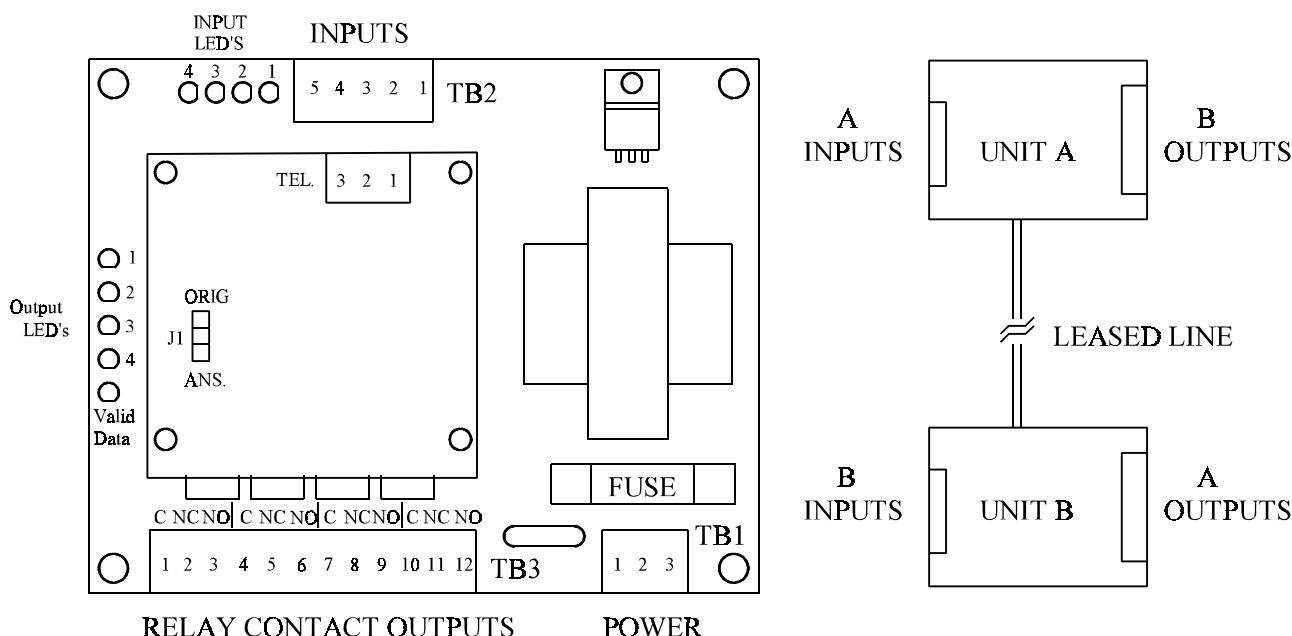
The TR401 transceiver is protected from AC transient surges by a G.E. V130LA10A metal oxide varistor which can operate with up to 130 VAC RMS continuously, has a maximum voltage clamp rating of 340 volts and can handle up to 4500 amps and 38 joules of energy. The power transformer is fused by an AGC 1/2 amp fast-blow fuse.

The telephone line is protected by a two-stage hybrid system: The first stage is a three element gas tube (connected to earth ground) for heavy duty surges, that has a breakdown rating between 200 and 350 volts. Impulse breakdown at 100 volts per microsecond = 600 volts. The second stage is a solid state system consisting of two current limiting resistors and a transient voltage suppressor connected across the telephone line to limit the voltage to 6.8 nominal volts.

The circuit board also is optically isolated from the field inputs by a Photo-transistor optoisolator which has an isolation rating of 5000 volts.

DIMENSIONS:

Circuit Board Dimensions: 5"W X 4"H NOTE: Because the connectors on top and bottom of the board extend out from the board, a little extra room (about 1" top and bottom) should be provided when mounting in order for the connectors to be unplugged.





Control Systems, Inc.

PRODUCT DATA BULLETIN

BULLETIN
SC101E
SIMPLEX
CONTROLLER



STANDARD FEATURES

- MANUAL-OFF-AUTO SELECTOR SWITCH
- RUNNING AND FAILURE PILOT LIGHTS
- SEAL FAILURE PILOT LIGHT
- LEVEL INPUT PILOT LIGHTS
- HIGH/LOW LEVEL ALARM PILOT LIGHT
- COMMON ALARM LIGHT WITH DIM GLOW
- COMMON ALARM DRY CONTACT OUTPUT
- ADJUSTABLE MOTOR FAILURE DELAY
- ADJUSTABLE POWER ON DELAY TIMER
- ADJUSTABLE PUMP START DELAY
- ADJUSTABLE SEAL FAILURE DELAY
- ADJUSTABLE SHORT CYCLE DELAY
- LAMP TEST
- 120VAC POWER

DESCRIPTION

The model SC101E board is a 115 VAC powered solid-state instrument that controls one fixed speed motor. The board is panel mounted with integral terminals for field contacts. Front panel indicators are provided for seal failure, motor failure and high level. The seal failure and high level inputs can be used as auxiliary inputs in the event the default functions are not needed. Variable rate delays are provided for motor failure, seal failure, power-on, motor start and short cycle. A Manual/Off/Auto switch allows either fully automatic or manual operation. There is a relay output that closes when this switch is in the 'Automatic' position. This feature is useful in SCADA systems. Alarm indicators and outputs are provided for motor failure, seal failure and high level.

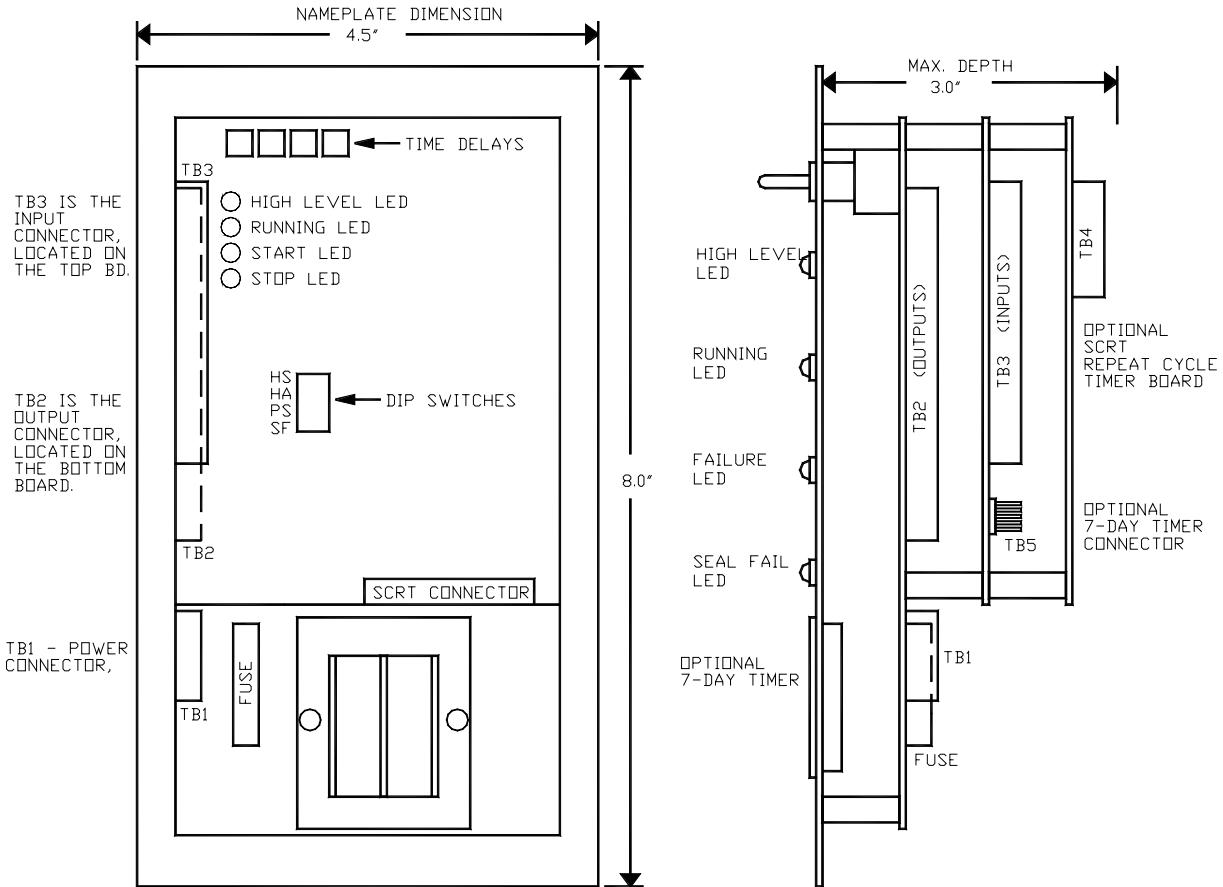
All inputs are operated on 30 vdc or less. CSI's Master Controller (MC101) board can be tied into this unit for remote operation over a multiplexer system. An optional Repeat Cycle Timer (SCRT) board and Seven Day Programmable Timer (SC7DP) version of the board add to its functionality.

SUGGESTED SPECIFICATIONS

Provide a simplex motor controller with a panel mounted Man-Off-Auto switch, green running pilot light, red motor failure pilot light and red seal failure pilot light. Inputs shall be provided for motor stop, start, running and high level with pilot light indications as well as a seal failure input which may be used for an auxiliary input. All of the electronic controls shall be bypassed when the Man-Off-Auto switch is placed in the Manual or Off position to allow motor control even in the event of a circuit failure. Provide a relay output that closes only when the Man-Off-Auto switch is in the 'Automatic' position. Level input power should be limited to 30 Vdc with a maximum current of less than 14madc. All outputs shall activate dry type contacts. A common alarm dry contact output will be activated under any alarm condition including board power failure. Individual dry-contact outputs shall be provided for each alarm. A field adjustable motor failure delay shall be provided in the range of 5 seconds to 6 minutes. The motor failure alarm will be held energized until manually reset by the operator. A motor start delay shall also be supplied which will delay pump start during initial startup, after a power failure and, optionally, during every motor call-for. The motor start delay shall have a range of 5 seconds to 4 minutes. Provide a Seal Failure alarm delay range of 3 seconds to 2 minutes. There shall also be a short-cycle (pump off) delay adjustable from 0 to 4 minutes. Each alarm function shall flash individual red pilot lights as well as activate the common alarm and common alarm light. In addition, when not used in their default modes, the seal failure and high level pilot lights can be made to indicate an auxiliary condition by flashing or steady operation without interfering with the simplex controller operation. Provide an exterior alarm light output which allows the light to dim glow under normal conditions to indicate power on and lamp good. The light shall flash brightly (on and off) during any alarm condition. Provide a lamp test feature to light all front panel pilot lights.

SPECIFICATIONS

- SUPPLY VOLTAGE: 115/120 VAC, 50/60 Hz
- SUPPLY CURRENT: 190 ma
- POWER CONSUMPTION: 23 Watts
- INPUT CONTROL VOLTAGE: 30vdc @ 12 madc and 12vdc @ 4madc
- OUTPUT CONTACT RATING: 5 Amps @ 120 VAC, Resistive
- DUTY CYCLE: Continuous
- NAMEPLATE DIMENSIONS: 4 1/2" Wide X 8" High



ORDERING INFORMATION

Simplex Controller: SC101E
with 7-day timer: SC101E-7DT

OPTIONAL BOARDS

Repeat Cycle Timer : SCRT

WARRANTY: Control Systems, Inc. (CSI) warrants equipment of its own manufacture to be free from defects in material and workmanship, under normal conditions of use and service, and will replace any component found to be defective on its return to CSI, transportation charges prepaid, within one year of its original purchase. CSI will extend the same warranty protection on accessories which is extended to CSI by the original manufacturer. CSI also assumes no liability, express or implied, beyond its obligation to replace any component involved. Such warranty is in lieu of all other warranties express or implied.



CONTROL SYSTEMS, INC.
P.O. Box 4852, Jackson, MS 39296-4852
Telephone: (601) 355-8594
FAX: (601) 355-8774

Document Revision: B

SIMPLEX BOARD (SC101E) OPERATIONAL FEATURES

GENERAL DESCRIPTION:

The SC101E board is a 115 VAC powered solid-state instrument that controls one fixed-speed motor. The board is panel mounted with integral terminals for field connections. Front panel indicators are provided for seal failure, motor failure, motor running and high level. The seal failure and high level inputs can be used as auxiliary inputs in the event the default functions are not needed. Variable delays are provided for motor failure, seal failure, power-on, motor start and short cycle. A Manual/Off/Auto switch allows either fully automatic or manual operation. Alarm indicators and outputs are provided for motor failure, seal failure and high level.

Level inputs are provided for Stop, Call-For, High Level and motor Running, that operate on 30 Vdc with a maximum current of less than 14 mAdc and are optically isolated. CSI's Master Controller (MC101) board can be tied into this unit for remote operation over a multiplexer system. An optional Repeat Cycle Timer (SCRT) board and Seven Day Programmable Timer (SC7DP) version of the board add to its functionality.

MAN/OFF/AUTO SWITCH:

Located on the front of the SC101E board, this toggle switch permits either automatic or manual motor control. In the AUTO position, the motor is controlled by the logic circuitry. In the MAN position, the motor will run continuously until the switch is either placed in the OFF or AUTO position. While in the MAN position, the motor call-for output is closed through the switch contacts, bypassing all of the SC101E circuitry and disabling the motor failure alarm. The failure alarm will only work in the AUTO position. There is a relay output on the board that closes when this switch is in the 'Automatic' position. This feature is useful in SCADA systems. Terminals 17 and 18 of TB4 are the contacts for this output.

INPUT STATUS LED'S:

The SC101E provides LED indicators for High Level, Motor Running, Motor Failure and Seal Failure, which are located on the front (nameplate) side of the circuit board. The Motor-Failure indicator and alarm only work when the MAN/OFF/AUTO switch is placed in the AUTO position. The alarm LED's can be set to flash on alarm or remain steady to indicate a status condition that does not require an alarm condition. This feature is discussed in greater detail in later paragraphs.

On the rear of the board there are four LED input status indicators which are primarily used for troubleshooting. The LEDs functions are: High Level, Motor Running, Motor Start and Motor Stop. When any of these inputs are closed, its corresponding LED will be lit.

LAMP-TEST:

The SC101E has a lamp test add-on feature that will turn on all of the front LED indicators for testing. An externally mounted, normally open, momentary action, push-button switch is needed to add this feature. The switch should be connected to the SC101E's TB3 terminals 11 and 12.

SEAL FAILURE:

The SC101E has a seal failure input feature that will alarm in the event of a motor seal failure. This input can be used for other types of status inputs and can be set to operate in two ways by using the SF DIP Switch located on the rear of the circuit board:

- (1) When the SF switch is set to the OFF position, a Seal Failure input will flash the front panel Seal Failure LED, close the Seal Failure Alarm Relay output, Common Alarm Relay and flash the Common Alarm Light output.
- (2) When the SF switch is set to the ON position, a Seal Failure input will light the front panel LED steadily and the Seal Failure Alarm output will be energized. It will not energize the Common Alarm Circuitry.

There is an adjustable Seal Failure Delay for this option which adjusts the time between the seal failure input and the Seal Failure Alarm. The delay range is Approx. 3 seconds to 2 minutes (120 seconds). The factory default setting is 3 seconds. Turn the potentiometer clockwise to increase the delay time. The pot only has a 3/4 turn span -- don't force it past the stop. Connect the Seal Failure input to terminals 9 and 10 of connector TB3.

HIGH LEVEL ALARM:

The High Level alarm input can be operated in several ways. By setting the HA (High Alarm) DIP Switch to the OFF position, a high level input will cause the front panel High Level LED to flash, close the High Level Alarm relay, Common Alarm relay and energize the Common Alarm Light output.

By setting the HA DIP Switch to the ON position, a high level input will cause the front panel High Level LED to light steadily and close the High Level alarm relay output. The Common Alarm circuitry will not be energized.

The SC101E can also be set to turn on the motor during a high level condition. This is an added safety feature in the event that one or more float inputs fail. Setting the HS DIP Switch to the ON position will enable this feature.

When the HS switch is set to the OFF position, a high-level condition will still turn on the high-level and common alarms, but no further action will be taken to turn on the motor even if it is not currently being called for due to a float input failure.

NOTE: The HA and HS DIP switches are completely independent of each other. Any combination of the two switches settings are valid. Connect the high level input to terminals 1 and 2 of TB3.

MOTOR FAILURE:

On receipt of a motor failure, the SC101E will energize the Common alarm and Motor Failure alarm outputs as well as the Common alarm light. This alarm condition must be manually reset after the condition is cleared by switching the MAN/OFF/AUTO switch to OFF and back to AUTO. The motor will continue to be called for during the failure condition.

The motor-failure delay sets the delay time before a motor-failure alarm occurs. The range is from 5 seconds to 6 minutes (360 seconds). Turn the potentiometer clockwise to increase the time. The pot has only a 3/4 turn span -- don't force it past the stop. The factory setting is 5 seconds.

SIMPLEX BOARD (SC101E) OPERATIONAL FEATURES

SHORT CYCLE DELAY:

To prevent short-cycling of the motor if an input level contact or float fails, the SC101E provides a Short Cycle delay that is only activated if the stop level input fails. The range of the delay is 1 second to 4 minutes (240 seconds). If the stop level input fails, and the lead start float drops out, the delay increases the time before the motor is stopped. Turn the potentiometer clockwise to increase the delay time. The pot has only a 3/4 turn span -- don't force it past the stop. The factory default setting is 1 second.

MOTOR START DELAY:

The Motor Start Delay has a dual function depending on the position of the PS (Motor Start) DIP Switch. When the PS switch is set to the OFF position, the Motor Start delay acts as a Power-On delay only. When the PS switch is set to the ON position, the Motor Start delay is always active. The delay time is adjustable between 5 seconds and 4 minutes (240 seconds). Turn the potentiometer clockwise to increase the delay time. The pot has only a 3/4 turn span. Don't force it past the stop. The factory default setting is 5 seconds.

ALARM OUTPUTS:

There are four (4) dry-contact relay alarm outputs on the SC101E: Common Alarm, Alarm Light, High Level, Motor Failure and Seal Failure. In the event that there is no need for High Level or Seal Failure, these inputs and alarm outputs can be configured for use as other status indication as needed by the end user. All of the relays are rated for 5 Amps @ 120 VAC resistive.

The Common Alarm output is a Normally Closed contact which closes on alarm. The output will energize on high level, motor failure or seal failure, depending on the configuration of the controller. The Common Alarm will also be energized on a power failure to the board. Please refer to the other sections of this manual for more complete descriptions of each alarm.

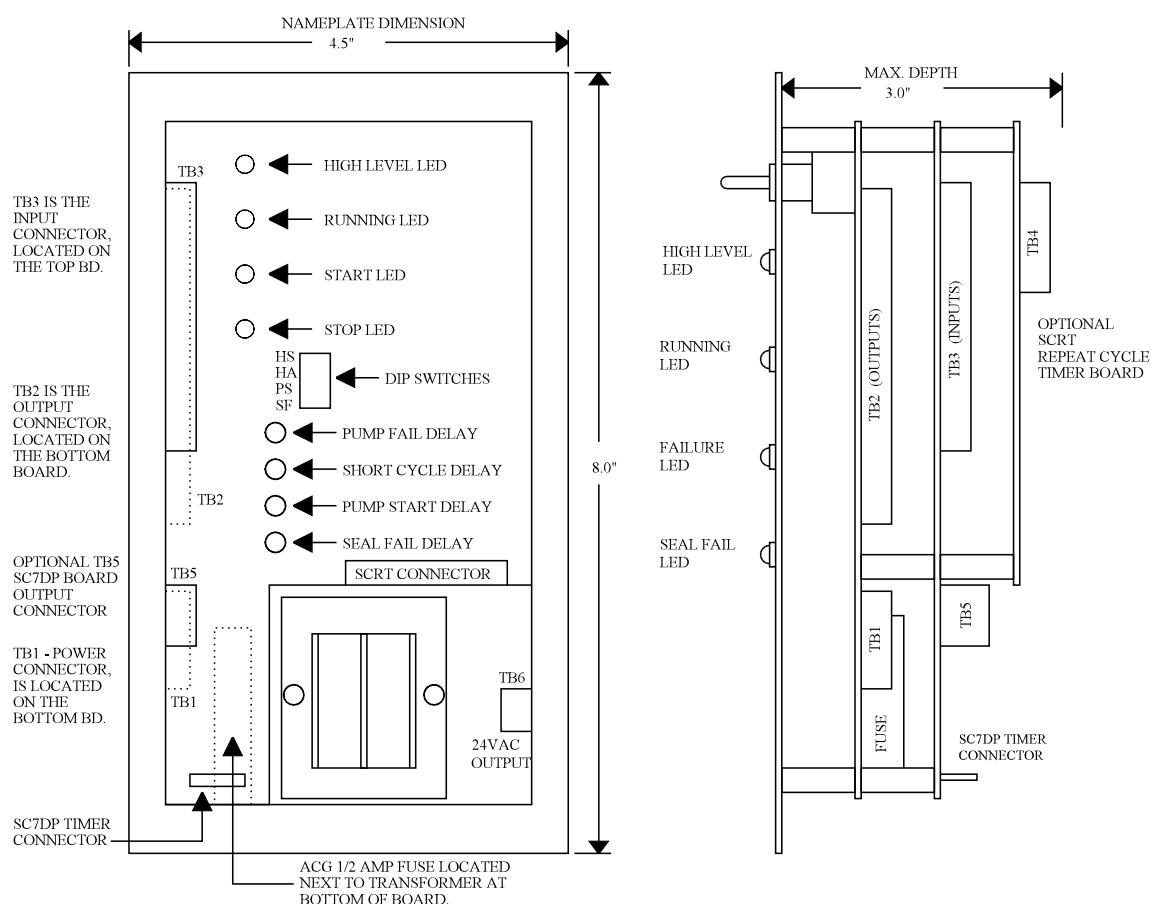
The Alarm Light output is a Normally Open contact which pulses closed and open during an alarm condition. Power for the alarm light should be tied into terminal one (1) of TB2 while terminal two (2) should be tied to the alarm light. The other side of the light should then be connected to the negative side of the alarm light power source. This will allow the alarm light to flash on and off during an alarm condition. If terminals three (3) and four (4) of TB3 are jumped together, the Dim Glow feature will be enabled causing the light to glow slightly even when there is no alarm. During an alarm condition, the light will still flash completely on and off. This feature will allow operators to check the condition of the light even when no alarm exists.

INPUT POWER REQUIREMENTS:

The SC101E is powered by 115 VAC 60 HZ. and protected by an AGC 1/2 Amp fuse and a 130 volt MOV. Maximum supply current is 190 ma (23 Watts @ 120 VAC). Terminal Strip TB1 is the input power connector. Pin 1 is Hot, pin 3 is Neutral and pin 5 is Earth Ground.

DIMENSIONS:

The nameplate is 4 1/2" Wide and 8" High. The circuit board is 3 3/4" Wide X 7" High X 2 1/2" Deep (3" deep when the SCRT option is used).



SIMPLEX BOARD (SC101E) FIELD TERMINAL CONNECTIONS

(INPUTS)

TB3

01	High Water
02	Common
03	Motor Running
04	Common
05	Motor Start
06	Common
07	Motor Stop
08	Common
09	Seal Failure
10	Common
11	Lamp Test
12	Common
13	not used
14	not used

(POWER)

TB1

01	115 VAC Hot
02	115 VAC Hot
03	115 VAC Neutral
04	Earth Ground Input
05	Earth Ground Input

(OUTPUTS)

TB4

01	Alarm Light
02	Alarm Light
03	Dim Glow Jumper
04	Dim Glow Jumper
05	Motor Call-For
06	Motor Call-For
07	Common Alarm
08	Common Alarm
09	not used
10	not used
11	High Level Alarm
12	High Level Alarm
13	Motor Failure Alarm
14	Motor Failure Alarm
15	Seal Failure Alarm
16	Seal Failure Alarm
17	Man/Off/Auto Switch 'In-Auto'
18	Man/Off/Auto Switch 'In-Auto'

SIMPLEX REPEAT CYCLE TIMER (SC-RCT) OPTION BOARD

REPEAT-CYCLE MODE:

The SC-RCT-E option board enables automatic on/off control of a motor attached to the simplex board (SC101E). Both on and off times can be set in either seconds or minutes. To operate in Repeat Cycle mode, set the Auto Reset jumper to ON, the Run jumper to OUT and the Relay Action jumper to the N.O. position. Connect the Normally Open relay contact from terminals 5 and 6 of TB4 to the motor start input on the SC101E board TB3 terminals 5 and 6. Then jumper terminals 5 and 7 of TB3. This ties both the start and stop inputs together. Select either Seconds or Minutes with the On and Off jumpers and set the corresponding DIP switches to the desired on and off times. NOTE: Please be careful when setting the times! The switches can be set to fast for the SC101E to respond and fast enough to short-cycle a motor.

SETTING CYCLE TIME:

The two DIP switches on the board set the desired time in either seconds or minutes. The numbers printed on the circuit board beside each switch indicate the time increments. The switches add the numbers together that are set to the On position. Each switch can be set independent of the other in seconds or minutes by simply switching the corresponding On or Off jumper to the SEC or MIN position. Please refer to the SCRT Operational Features Diagram for the location of all jumpers, terminals and DIP switches on this board.

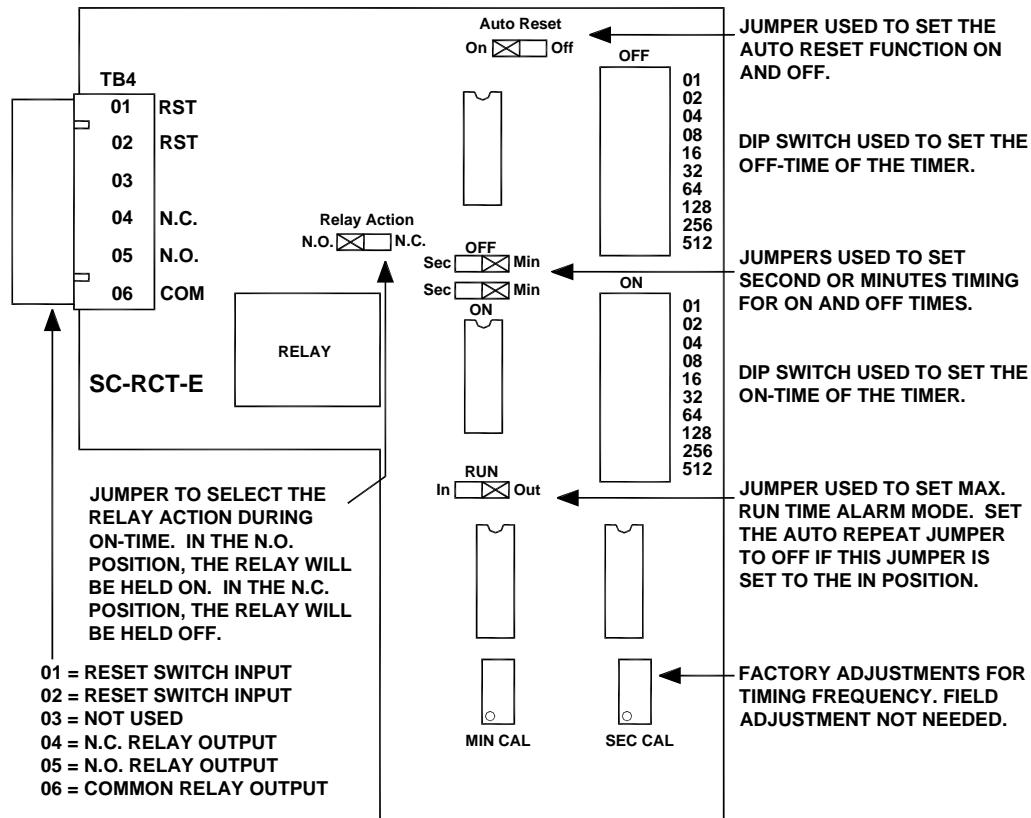
MAXIMUM RUN TIME MODE:

The SC-RCT-E board can also be used as a Maximum Run Time Alarm. In this mode, the output relay will switch if the motor continues to run past the time set by the On time DIP switch. There are terminals for an external, normally open, momentary push-button switch to reset the timer. Simply connect the switch to TB4 terminals 1 and 2. If an alarm occurs and the switch is pressed, the alarm timer will be reset to zero and will start timing again if the motor is still running. The motor will not be affected by this action. The timer will automatically reset when the motor turns off. During this operation, the Relay Action jumper should be set to the N.C. position in order for the relay to be de-energized during the on-time and only energize on alarm.

To set up the SC-RCT-E board for max. run timing operation, set the Auto Reset jumper to OFF, the Run jumper to IN and the Relay Action jumper to the N.C. position. Then set the desired On-time with the On DIP switch. Remember to select either SEC or MIN with the ON jumper. The Off timer has no affect in this mode.

FREQUENCY ADJUSTMENT:

These adjustments are preset at Control Systems Inc. to the correct frequency and should never be adjusted by operators in the field. There are two potentiometers at the bottom of the circuit board that are used only in setting the on-board clock circuitry. They are labeled as MIN CAL and SEC CAL. The Seconds frequency is 16 Hz (62.5 ms) and the Minutes frequency is 0.27 Hz (3.75 sec.).



SIMPLEX ELECTRONIC 7-DAY PROGRAMMABLE TIMER (SC7DP) OPTION:

DESCRIPTION:

The SC101E-7DP module is a solid state, quartz controlled timer with a 7-segment, 9mm LCD display. It can be used to automatically control a motor attached to the SC101E board by using programmed on and off times. The timer has a battery backup to prevent program loss in case of a power failure. The rechargeable Ni-Cad battery will maintain the timer memory for at least 30 days. The quartz time base is accurate to within 5 minutes per year.

Twelve (12) programs are available: six On and six Off times. However, four selectable block program variations allow these 12 programs to be expanded to 84 weekly events or six on and off commands per day. A manual override switch is also provided for easy control. This switch does not affect the program settings. Please see the SC7DP Programming Instructions page for a detailed description of timer program functions.

CONNECTIONS:

The timer connections have been integrated into the SC101e board so that no special user wiring is required.

After proper programming, put the MAN OFF AUTO switch into the AUTO position and the timer will take over control. If there are no level contact inputs wired into the SC101e board, the timer will turn on and off the motor (in normal mode). If the Stop input is connected to a float or other level control, the timer may call for the motor, but the motor will continue to operate even if the timer function times off, until the Stop input is de-energized.

NOTE: Be careful when programming since times can be entered that could short-cycle a pump or motor.

MODE DESCRIPTION / SELECTION:

The SC7DP timer has a few customizable features that may be set using the DIP switches on the back of the SC101E board. These options affect the way the timer and front panel LED's operate. These modes are stored in non-volatile memory and will be in effect even after a power failure.

NORMAL MODE:

This is the default mode, in effect on new boards without any setup. Operation is as follows...

- When the clock timer is ON (energized), the pump will be turned on when the Man/Off/Auto switch is in Automatic.
- The Stop, Start and High Water inputs function normally.
- If the Stop float is energized and the timer turns ON, the pump will run, but not stop if the timer turns OFF, until the Stop float de-energizes.

PERMISSIVE MODE:

In this mode, the timer sets times that the pump is allowed to run. It does not directly start the pump. In this mode, when the timer is ON, the Start and Stop inputs may operate the pump. When the timer turns OFF, the pump will stop and not be allowed to run.

Initialization:

The Permissive Mode must be initialized by the following method...

- Turn all four DIP switches to the OFF position and turn the Man/Off/Auto switch to the Off position.
- Manually turn ON the timer so that 'ON' is displayed on the LCD screen.
- switch the 2nd DIP switch (labeled 'HA') On and Off *twice*.
- Manually turn OFF the timer so that 'OFF' is displayed on the LCD screen.

NOTE: After the timer is turned ON, you have 10 seconds to complete the setup or you must start over.

LOCAL/REMOTE MODE:

This mode is used for local/remote control of the pump, using the 7-Day clock for local control and an external control circuit for remote control. It may also be used to enable a 'lock-out' input. The High Level LED may be used for local indication of the clock call-for.

Local Operation:

The Stop input is used to select either Local or Remote operation. For Local operation, the Stop input must be Closed. During this mode, the 7-Day clock will operate the pump and the Start input is ignored.

Remote Operation:

When the Stop input is Open the 7-Day clock will not operate the pump. Pump operation is controlled from the Start input. An external contact must be applied to the Start input to start and stop the pump. Any desired off delay must be controlled externally since the Stop input is not used here.

Lockout Operation:

The Local/Remote mode may be used for a low-level lockout circuit. Place the board into the Local/Remote mode without local indication and use the Stop input with a normally-closed contact for a low-level lockout. You may also use a normally-open contact into the High Level input, with the HA DIP switch ON, for a local Low-Level Lockout indication. In this way, the 7-Day clock will operate the pump unless the low level lockout contact opens, causing the pump to stop. The Start input should not be used in this setup.

Initialization:

The Local/Remote Mode must be initialized by the following method...

- Turn all four DIP switches to the OFF position and turn the Man/Off/Auto switch to the Off position.
- Manually turn ON the timer so that 'ON' is displayed on the LCD screen.
- switch the 4th DIP switch (labeled 'SF') On and Off *twice*.
- Manually turn OFF the timer so that 'OFF' is displayed on the LCD screen.

NOTE: After the timer is turned ON, you have 10 seconds to complete the setup or you must start over.

TIMER CALL-FOR INDICATION OPTION:

The High Water input may be re-assigned and used for a ‘Timer Call-For’ indication, in addition to the ‘On’ and ‘Off’ indication on the LCD screen. When this option is engaged, the High Water input is disabled. This option may be selected in the Normal, Permissive or Local/Remote modes of operation. The operating mode must be selected first and then this option may be set.

Initialization:

This option must be initialized by the following method...

- a. Turn all four DIP switches to the OFF position and turn the Man/Off/Auto switch to the Off position.
- b. Manually turn ON the timer so that ‘ON’ is displayed on the LCD screen.
- c. switch the 3rd DIP switch (labeled ‘PS’) On and Off *twice*.
- d. Manually turn OFF the timer so that ‘OFF’ is displayed on the LCD screen.

NOTE: After the timer is turned ON, you have 10 seconds to complete the setup or you must start over.

RESET TO NORMAL MODE:

This is used to reset all modes back to the normal mode described above.

Reset Method:

- a. Turn all four DIP switches to the OFF position and turn the Man/Off/Auto switch to the Off position.
- b. Manually turn ON the timer so that ‘ON’ is displayed on the LCD screen.
- c. switch the 1st DIP switch (labeled ‘HS’) On and Off *twice*.
- d. Manually turn OFF the timer so that ‘OFF’ is displayed on the LCD screen.

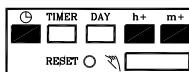
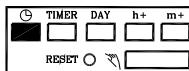
NOTE: After the timer is turned ON, you have 10 seconds to complete the setup or you must start over.

SC7DP PROGRAMMING INSTRUCTIONS

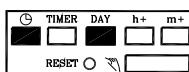
A. SETTING THE DAY OF WEEK AND TIME OF DAY.

KEEP KEY  DEPRESSED DURING THE WHOLE SETTING OPERATION.

2. USE KEYS h+ AND m+ TO SET ACTUAL TIME OF DAY. (h+ = HOURS/m+ = MINUTES)



3. IF KEYS h+ AND m+ ARE DEPRESSED CONTINUOUSLY FOR LONGER THAN 1 SECOND, THE DISPLAY WILL AUTOMATICALLY CONTINUE COUNTING.

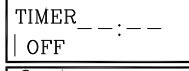
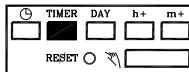


4. USE KEY DAY TO BRING THE ACTUAL DAY OF THE WEEK INTO THE DISPLAY.

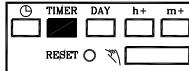
5. RELEASE KEY  . TIME IN OPERATION. (EXACT START OF SET TIME OF DAY POSSIBLE USING, FOR INSTANCE, OFFICIAL TIME SIGNALS.)

B. PROGRAMMING ON/OFF TIMES

1. OPERATE KEY TIMER ONCE. THE SET TIME OF DAY DISAPPEARS FROM THE DISPLAY. TIMER "1" ON --:-- WILL APPEAR. NOW INSERT THE TIME AT WHICH AN "ON" COMMAND IS TO BE CARRIED OUT AS DESCRIBED UNDER A 2 AND 3 (SETTING TIME OF DAY). PRESS KEY TIMER TO ENTER PROGRAM. SYMBOL "1" OFF --:-- WILL APPEAR.



2. PROGRAMMING "OFF" TIME. THE DISPLAY SHOWS SYMBOL "TIMER 1 OFF" --:--. NOW INSERT THE TIME AS DESCRIBED UNDER 1 A 2 AND 3 (SETTING OF TIME OF DAY). AFTER INPUT PRESS KEY TIMER.



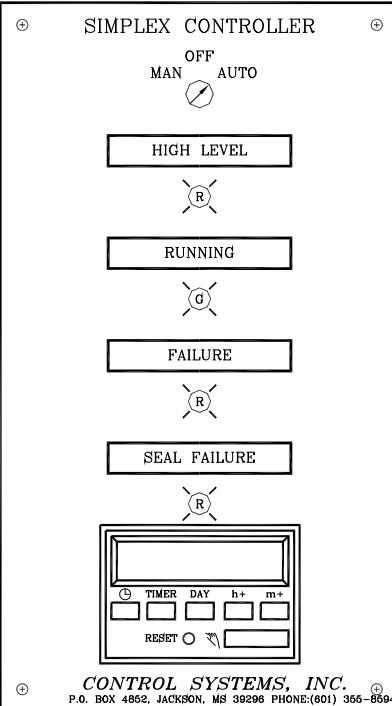
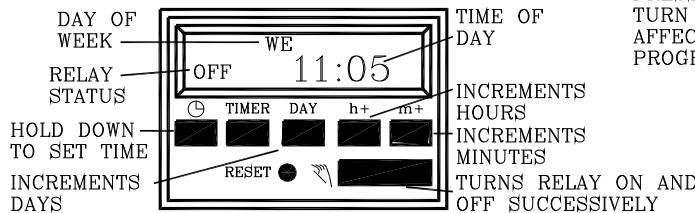
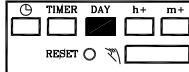
3. SIX "ON" AND SIX "OFF" COMMANDS CAN BE PROGRAMMED.

4. IF NO WEEKDAY IS ADDED TO THE SWITCH COMMANDS, THEY WILL BE EXECUTED DAILY.

C. BLOCK PROGRAMMING

APART FROM INDIVIDUAL DAYS OF THE WEEK, KEY DAY ALSO SERVES TO OPERATE MULTIPLE DAY COMBINATIONS.

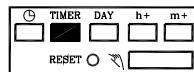
1. MONDAY - FRIDAY
2. SATURDAY + SUNDAY
3. MONDAY - SATURDAY



IF AN INDIVIDUAL DAY OR ONE OF THESE MULTIPLE DAY COMBINATIONS IS INCORPORATED IN A PROGRAM, THE LOAD WILL BE TURNED ON OR OFF ON EACH OF THESE DAYS AT THE PROGRAMMED TIME.

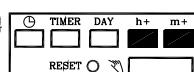
D. CHANGING OR CHECKING OF PROGRAMS.

BY OPERATING KEY TIMER, THE INDIVIDUAL COMMANDS AS PROGRAMMED CAN, AT ANY TIME, BE BROUGHT CONSECUTIVELY INTO THE DISPLAY FOR CHECKING. ALTERATIONS ARE CARRIED OUT BY WRITING OVER THE EXISTING PROGRAMS USING THE STEPS OUTLINED IN A. AND B.



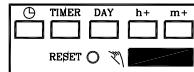
E. CANCELLING PROGRAMS.

USE PROCEDURE ABOVE TO BRING PROGRAM TO BE CANCELLED INTO DISPLAY. USE h+ AND m+ KEYS TO SET HOURS AND MINUTES TO ZERO, SYMBOL --:-- WILL BE IN DISPLAY.



F. MANUAL SWITCH.

PRESS OVERRIDE SWITCH TO TURN LOAD ON OR OFF WITHOUT AFFECTING THE STORED PROGRAMS.





Control Systems, Inc.

PRODUCT DATA BULLETIN

DC101-F
DUPLEX PUMP
CONTROLLER



CONTROL SYSTEMS, INC., P.O. BOX 4852, JACKSON, MS 39296

STANDARD FEATURES

- MAN-OFF-AUTO SELECTOR SWITCHES
- MOTOR LEAD / LAG SELECTOR SWITCH
- PILOT LIGHTS FOR RUNNING, FAILURE, SEAL FAILURE, HIGH/LOW LEVEL AND AUXILIARY ALARM
- PILOT LIGHTS FOR EACH LEVEL INPUT
- COMMON ALARM LIGHT WITH DIM GLOW
- COMMON ALARM DRY CONTACT OUTPUT
- AUTOMATIC MOTOR ALTERNATION
- 14VDC OPTICALLY ISOLATED INPUTS WITH MAX CURRENT OF 12 madc.
- LAG MOTOR START IF LEAD FAILS
- ADJUSTABLE MOTOR FAILURE DELAYS
- ADJUSTABLE POWER-ON DELAYS
- ADJUSTABLE PUMP OFF-DELAYS
- ALARM TELEMETRY OUTPUTS ARE OPTICALLY ISOLATED, OPEN-COLLECTOR TRANSISTOR TYPE
- FLOAT TEST / IMPROPER SEQUENCE ALARM OPTION
- LAMP TEST INPUT
- REPEAT-CYCLE TIMER OPTION BOARD
- 7-DAY PROGRAMMABLE TIMER OPTION
- SWITCH POSITION OUTPUT OPTION
- SERIAL PORT (RS232 OR RS485) OUTPUT OPTIONS
- UL RECOGNIZED FOR USE IN INDUSTRIAL CONTROL PANELS
- 120 VAC POWER SUPPLY

DESCRIPTION

The DC101-F board is a 120 VAC powered unit that controls two fixed-speed pumps. The board will automatically alternate the pumps and provide variable delays for Power-On, Pump Failure and Improper Sequence Pump Off delays. Each pump has its own Manual/Off/Auto switch. The Manual position will operate the pumps, bypassing all of the on-board circuitry, including the delays and failure timers. A Lead Selector switch allows automatic alternation each cycle, or one pump may be set to always be the Lead pump. Level inputs are provided for Low Level, Stop, Lead, Lag and High Level that operate at 14vdc with a current of 12madc for intrinsic safety and are optically isolated. The board is panel mounted with a backplate mounted terminal board (DCTB-F) for field contacts. Optional Float Test , Alarm Telemetry, Repeat-Cycle Timer, 7-Day Timer, Man/Off/Auto Switch position, RS232 and RS485 Serial output boards add to its functionality. The DC101-F has been UL recognized for use in industrial control panels.

SUGGESTED SPECIFICATIONS

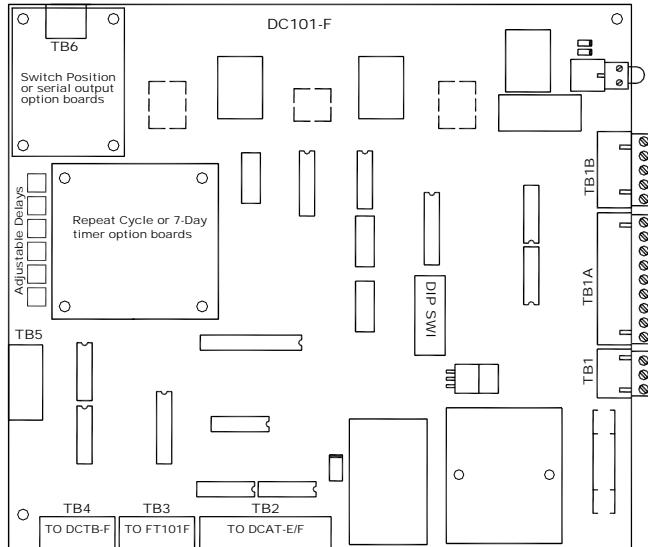
Provide a duplex motor controller with panel mounted Man-Off-Auto switches, green running pilot lights, red motor failure and seal failure pilot lights for each motor. Each motor can be selected for Lead operation or fully automatic alternation on each call-for cycle. All of the electronic controls shall be bypassed when the Man-Off-Auto switches are in the Manual or Off positions to allow motor control even in the event of a circuit failure. Level inputs shall be provided for low level, stop, lead start, lag start and high level with pilot light indications. Level inputs shall be optically isolated , operate at 14Vdc with a current 12madc for intrinsic safety. Field adjustable motor failure delays shall be provided in the range of 5 seconds to 8 minutes. Upon motor failure, the remaining functional motor shall be made Lead until the failure is corrected and manually reset. The failed motor shall only be called to operate at the lag pump operating level. Individual, adjustable power-on delays shall also be supplied which delay pump start during initial startup or after a power failure. A soft start and stop feature shall be included to prevent water hammer. In the event that both motors are called for at the same time, there shall be a minimum of 5 seconds between motor starts and stops. Motor failure, seal failure and high level alarms will flash the red pilot lights. In addition, when not used as seal failures, the seal failure pilot lights can be made to indicate an auxiliary condition by flashing or steady operation without interfering with the duplex controller operation. Provide an exterior alarm light output which allows the light to dim glow under normal conditions to indicate power on and lamp good. The light shall flash brightly during any alarm condition. Provide a lamp test feature to light all front panel pilot lights. Provide rear panel LED indications of all level inputs and all auxiliary alarm outputs. Also provide 'master controller' inputs with LED indications for manual Pump On/Off controls from an external source.

Provide the capability of using integrated repeat-cycle timer or 7-day programmable timer options. The repeat-cycle timer board shall have DIP switch time settings for On and Off times in the range of 15 seconds to 34.05 hours. The 7-day timer shall mount through the controller nameplate and include an LCD display and keypad for settings and manual override. Provide the capability of providing solid-state, open-collector transistor outputs to indicate the position of each pump's Manual/Off/Automatic switch. The board shall have the capability of an optional RS232 or RS485 serial board to communicate the level input positions, manual/off/automatic switch positions and all detected failures.

OPERATING SPECIFICATIONS

- SUPPLY VOLTAGE: 115/120 VAC, 50/60 Hz
- OUTPUT CONTACT RATING: 3 Amps @ 120 VAC, Resistive (limited by 10amp fuse on DCTB)
- SUPPLY CURRENT: 100 ma
- DUTY CYCLE: Continuous
- POWER CONSUMPTION: 12 Watts
- NAMEPLATE DIMENSIONS: 8 7/8" Wide X 8" High
- INPUT CONTROL VOLTAGE: 14VDC @ 12madc
- DCTB-F Terminal Board Dimensions: .5" W x 6.75" L x 1" H

DC101-F
DUPLEX PUMP
CONTROLLER



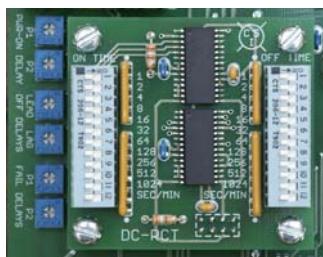
DC101-F FEATURES

1. TB1, TB1A and TB1B: DCTB-F wiring harness connectors
2. TB2: Optional DCATe Alarm Relay Output connector
3. TB3: Optional FT101-F float test board connector
4. TB4: Optional Auxiliary alarm, Low Level input and Lamp Test
5. TB5: Optional 'Master' Pump control connections
6. TB6: Optional Low Level output relay connector
7. Field adjustable delay potentiometers are located on the left edge.
8. DC-RCT or DC-7Day Timer option boards plug onto the board just beside the delay adjustment potentiometers
9. DC-SwiPos or RS232 option boards plug onto the board at the upper left corner.
10. The Logic Running LED, located near the center of the board, normally blinks on every second and off every second.
11. The diodes located near the upper right corner control the Common Alarm dim glow feature: Remove the two-pin jumper plug to disable this feature.
(Caution: 120vac on this connector)
12. DIP switch settings:

1. No HiLo Call	6. Lag-Stop on Lead-Start
2. No Imp. Seq.	7. 1 Pmp Call on Lag/Hi Lvl
3. SF Steady	8. P1 Long Fail Delay
4. No SF Alt	9. P2 Long Fail Delay
5. No SF Alarm	10. Pmp Dwn/Up (controls High & Low Level operation)

'Piggyback' Option Boards:

DC-RCT
Repeat-Cycle Timer Board



DC-7DAY
7-Day Timer Interface
To Clock module



DC-SWPOS
Switch Positions
Output Board



DC-RS232
Communications



DC-RS485A
Communications



Note: Can only use one or the other between DC-RCT and DC-7Day boards and between DC-SwPos, DC-RS232 and DC-RS485A boards.

ORDERING INFORMATION:

Duplex Controller: DC101-F (Terminal Board is required for new installations)

Auxiliary Boards:

Terminal Board: DCTB-F; Float Test Board: FT101-F; Alarm Telemetry Board: DCAT-E; Repeat-Cycle Timer: DC-RCT; 7-Day Timer: DC-7DAY
Switch Positions: DC-SWIPOS; Serial Communications: DC-RS232 or DC-RS485A

WARRANTY: Control Systems, Inc. (CSI) warrants equipment of its own manufacture to be free from defects in material and workmanship, under normal conditions of use and service, and will replace any component found to be defective on its return to CSI, transportation charges prepaid, within one year of its original purchase. CSI will extend the same warranty protection on accessories which is extended to CSI by the original manufacturer. CSI also assumes no liability, express or implied, beyond its obligation to replace any component involved. Such warranty is in lieu of all other warranties express or implied.



CONTROL SYSTEMS, INC.
P.O. Box 4852, Jackson, MS 39296-4852
Telephone: (601) 355-8594
FAX: (601) 355-8774

Document Revision: B

DUPLEX BOARD (DC101-F) OPERATIONAL FEATURES

GENERAL DESCRIPTION:

The DC101-F board is a 120 VAC powered unit that controls two fixed-speed pumps. The board will automatically alternate the pumps and provide variable delays for Power-On, Pump Failure and Improper Sequence Pump Off delays. Each pump has its own Manual/Off/Auto switch. The Manual position will operate the pumps, bypassing all of the on-board circuitry, including the delays and failure timers. A Lead Selector switch allows automatic alternation each cycle, or one pump may be set to always be the Lead pump. Level inputs are provided for Low Level, Stop, Lead, Lag and High Level that operate on 14 Vdc with a current of 12ma/dc for intrinsic safety and are optically isolated. Optional Float Test, Alarm Telemetry, Repeat-Cycle Timer, 7-Day Timer, MOA Switch position and RS232 Serial output boards add to its functionality.

MAN/OFF/AUTO SWITCHES:

Located on the front of the board, these toggle switches permit either automatic or manual pump control. In the AUTO position, the pumps are controlled by the logic circuitry. In the MAN position, the pumps will run continuously until the switch is either placed in the OFF position or the AUTO position. While a pump is in the MAN position, power is applied to the call-for output through the switch contacts, bypassing all of the on-board circuitry and disabling the pump failure alarms which only work in the AUTO position.

LEAD SELECTOR SWITCH:

The lead pump can be selected using the Lead Selector switch on the front of the board. Either pump #1 or pump #2 can be selected to be the lead pump all of the time. When the switch is placed in the ALT position, the Lead pump will automatically alternate every cycle.

When one pump is selected to be the Lead pump, there are a few features that need to be kept in mind:

1. If the Lead pump fails, the controller will automatically alternate to the other pump if possible. It will continue to call for the other pump first until the failure has been reset. If the Lag level is reached, the DC101 will call for the failed pump anyway, in case it will operate.
2. Forcing a Lead pump off while it is running alone, using the 'Master Control' input, will also alternate to the other pump. If the Lead pump is still being called for when the 'force' is removed, the controller will immediately alternate back to the Lead pump.
3. A Seal Failure of the Lead pump, when it is running alone, will cause the controller to alternate to the other pump if possible, unless the 'No Alt on S.F.' DIP switch is enabled. It will immediately alternate back to the Lead pump when the seal failure goes off. There is a 5 second on-delay on the seal failure inputs to help eliminate adverse affects of very fast seal failure input switching. Switching the 'No Alt on S.F.' DIP switch ON will prevent alternation for this alarm.

LED STATUS INDICATORS:

LED indicators are provided for Pump Running, Pump Failure, Seal Failure, High Water and Low Water on the front (nameplate) side of the board. The failure indicators flash during alarm conditions for extra clarity. The Pump-Failure alarms only work when the MAN/OFF/AUTO switches are in the AUTO position. The Seal Failure LED's may be used for auxiliary indication if they are not needed for Seal Failure operation.

On the rear of the board there are 6 LED input status indicators which are used for troubleshooting purposes. The LED functions are: Stop, Lead Call-For, Lag Call-For, High-Level, M1 Running and M2 Running. Each LED is clearly labeled on the circuit board.

In addition to the input LED's there are a 16 other status LED's on the rear of the board. Indications are for Master Pump#1 and #2 Start and Stop, Auxiliary Alarm input, Low Level input, Lamp Test and all outputs to the optional Alarm Telemetry board (DCATe) as well as a 'logic running' indication, which also serves as an improper sequence indication.

LAMP-TEST (TB4):

The lamp test option turns on all of the front LED indicators for testing. An externally mounted, normally open, momentary action, push-button switch is needed for this feature. The lamp test connection is made to pins 4 and 5 of TB4, located at the bottom left of the circuit board as viewed from the rear.

LEVEL INPUTS (TB1A and TB4):

Level inputs available are: Low Level, All Stop, Lead Start, Lag Start and High Level. All inputs require dry-contact type inputs with 14vdc potential.

AUXILIARY ALARM (TB4):

The auxiliary alarm input will energize the common alarm and be output through the optional RS232 serial port and DCATe alarm output board. Normally open dry-contact input is used for this input between the AUX and '4' (common) terminals on the DCTB-F terminal board.. There is an LED for the input status on the back of the board above TB4 and above TB2 for the DCATe output. This alarm does NOT have any indication on the front of the DC101-F board. It is most commonly used for another device to energize the external common alarm circuitry.

DUPLEX BOARD (DC101-F) OPERATIONAL FEATURES

HIGH LEVEL / LOW LEVEL:

Either one or both pumps can be turned on during a high-water condition (or an optional low-water condition, depending on the position of the 'Pmp Dwn/Up' DIP switch). This is an added safety feature in the event that one or more float inputs fail to call for a pump at the correct time. There is a 'No HiLo Call' DIP switch which will allow an optional feature in which no action will be taken to turn on any pump not currently running, but still allow the High Water (or Low Water) alarm and Common Alarm outputs to be energized. The '1 Pmp Call on Lag/Hi Lvl' DIP switch allows either one or both of the pumps to be called for on Lag level, High Level (or Low Level) only conditions.

The addition of the Low Level input made it necessary to select how the unit operates on High and Low levels. The 'Pmp Dwn/Up' DIP switch selects which one of these inputs turns pumps on and which turns them off. In the 'Pump Down' mode (normal operation with the DIP switch in the Off position), the High Level input can turn on pumps and the optional Low Level input turns them off as an extra safety measure past the Stop level. In the 'Pump Up' mode the Low Level input turns on pumps and the High Level is used as the extra safety level to turn pumps off, past the Stop level.

This paragraph addresses the Low Level Stop feature, in the 'Pump Down mode , but can equally apply to the High Level in the 'Pump Up' mode: The Low Level input activates when opened, as does the Stop Level input. When the Low Level is reached, any pump that is running is turned off in order to prevent damaging the pump by running it without water. This level should always be placed below the Stop level and should not be reached unless some other level input has failed. To prevent burning up motors, a default 10 minute timing period has been implemented. This time can be optionally changed to either 5 or 15 minutes. The timing period begins when the alarm condition is activated. The pumps will not run until both the lockout period has expired and the alarm condition has cleared. If the condition persists, the pumps will not run until the condition is cleared or the High Level is activated. If the condition has cleared and the operator wants to manually reset this time so that the pumps can run, simply switch both pump's Man/Off/Auto switches to the Off position for a couple of seconds. The lockout time may also be reset by the 'Master' inputs that force the pumps off. The lockout time starts only when the input is activated and the Lead or Lag levels were reached. If this level is reached without a pump running, the lockout time is not started. The 'Logic Running' LED on the back of the board blinks very fast during the timing period, as it does when there is an improper sequence. Also, the Low Level indicator LED on the front panel will blink on and off every second while the input is active. If the Low Level condition clears, this LED will blink rapidly during the timing period for a visual indication that the pumps are locked out during this time. The Low Level Lockout Output Relay will remain energized until the timing period is finished or reset.

IMPORTANT LOW LEVEL INPUT NOTE: When the Low Level feature is not needed, the input must be connected to input common (DCTB terminal 4) to prevent the alarm from being activated and to allow the pumps to operate. If this input is not closed the pumps will not be allowed to run.

The High Level input will override and reset this 'lockout' time period in the extremely rare event that during the 'lockout' the levels rise to that point. The 'Master' pump Force-On's will also work even during the lockout period.

If the new low level input is not needed, the 'High Level' input may still be used as a 'Low Level' input to turn on pumps on 'pump-up' installations like our older DC101 models have been used, by simply renaming the indicator on the nameplate. However, the Low Level input may not be used for an 'auxiliary' indication when the low level feature is not needed. It is dedicated to this feature.

LOCKOUT TIME SETTING:

The default timing period for the low level lockout is 10 minutes. There are actually three timing period that may be used: 5, 10 or 15 minutes. Using the DIP switches on the back of the DC101-F board, you can select another timing period if necessary. The setting is stored in nonvolatile EEPROM storage so that after a power failure the setting will be restored. If you don't set the desired feature within a 20 second time period, you will have to reset the trigger and try again.

Setting Procedure:

- a. Routine started when both pumps MOA switches are in the Off position, all DIP switches are in the Off positions and the Auxiliary Alarm input (pins 1&2 of TB4) is closed the entire time. After these things are done, to trigger the start of the routine, open the Low Level alarm input (the alarm will energize) and switch the desired DIP switch for the time period desired as shown here...
- b. The default time period is 10 minutes if this routine has never been entered to change it.
- c. Set 5 minutes: switch DIP switch #1 on/off twice
- d. Set 10 minutes: switch DIP switch #2 on/off twice
- e. Set 15 minutes: switch DIP switch #3 on/off twice
- g. End routine by de-energizing the Low level (close the input) and putting other switches (including DIP switches) in their operating positions.

SEAL FAILURE:

The seal failure input feature will alarm in the event of a pump seal failure. If the Lead Selector switch is in the ALT. position when a seal failure occurs, that pump will be used as the lag pump. If the pump was running when the alarm was activated, it will be turned off and the other pump turned on. If both pumps are running, they will continue to run. The common alarm output and alarm light will be activated on seal failure. Also, the seal failure output to the DCATe alarm board will be activated. This alarm feature is always active and has a built in, non-adjustable delay of about five seconds. The alarm will automatically reset when the input failure condition is corrected.

The seal failure inputs can be used for auxiliary inputs when seal failure alarm are not required. The indicators may be set to come on steady instead of flashing on alarm by using the 'SF Steady' DIP switch. Also, they can be set with the 'No SF Alt' and 'No SF Alarm' DIP switches so that the pumps will not alternate and no common alarm occurs. Note: On the older DC101D boards, these options were set individually for each seal failure input. On the DC101-F board, the options apply to both seal failure inputs.

DUPLEX BOARD (DC101-F) OPERATIONAL FEATURES

PUMP FAILURE:

The pump failure alarms will activate the common alarm alarm light outputs as well as the pump failure output to the DCATe alarm board. This alarm is only active when in the Auto mode. If a pump is placed in Manual, no failure alarm will occur. The DC101-F determines if a pump has failed by looking at the pump running input when a pump is being called for. When the Lead Selector switch is in ALT and a pump failure occurs, that pump will be turned off and the other pump called for. If both pumps are being called for, they will continue to be called for. The pump failure alarm has to be manually reset by switching the failed pump's MAN/OFF/AUTO switch to the Off position. It can also be reset by an external input on the Master Control terminals TB5.

The pump failure delays (one for each pump) set the delay time before a pump failure alarm occurs. Each timer has two ranges: the short delay is adjustable between 5 seconds and 60 seconds; the long delay multiplies this range by eight, so the adjustments are between 40 seconds and 480 seconds (8 minutes). Each pump can be selected individually to use the long delay by setting the 'P1 Long Fail Delay' and 'P2 Long Fail Delay' DIP switches On. Each delay potentiometer is turned clockwise to increase the delay time. The pots have only a 3/4 turn span -- don't force them past the stops.

LAG STOP LEVEL:

The Lag pump can be set to stop at either the Stop level or the Lead Start level as determined by the 'Lag-Stop on Lead-Start' DIP switch on the back of the board. When this DIP switch is OFF, the Lag pump will turn off at the same Stop level as the Lead pump after a short delay of approximately 6 seconds. When the DIP switch is ON, the Lag pump will operate between the Lag Start and Lead Start levels. The Lead pump will operate between the Lead Start and Stop levels.

In order to maintain compatibility with the older DC101D boards in special circumstances, the Lag pump may turn off after a delay period when the Lag input turns off, without an improper sequence alarm. It will only do this when the Stop input is not activated, the 'Lag-Stop on Lead-Start' DIP switch is OFF and the 'No Improper Sequence' Alarm DIP switch is ON. In this case, there will be no improper sequence when only the Lead and Lag inputs are used to operate the pumps (no Stop input). The pump outputs will be energized at the Lead and Lag levels, the Lag output will de-energize after a delay when the Lag input turns off and the Lead output will de-energize when the Lead input is turned off. The delay time is adjustable with the Improper Sequence off-delays on the board, even though the improper sequence alarm is not energized. (this feature added in firmware revision 1.46 and later)

ONE PUMP CALL ON LAG / HIGH LEVEL:

When the 'No HiLo Call' DIP switch is OFF, both pumps will be called for when either the lag start level or High level is reached. This is a safety feature in case the lead pump call-for fails to energize. Under normal conditions the pumps will already be running at these levels.

When the '1 Pmp Call on Lag/Hi Lvl' DIP switch is set to the ON position, only the lag pump is called for at the lag start level if the lead float input fails to energize. If the 'No HiLo Call' DIP switch is OFF, the lag pump will also be called for during a high-water only condition.

POWER-ON DELAYS:

There are two Power-On delay potentiometers on the board. One for the Lead pump and one for the Lag pump. These adjustable delays, located on the back of the board, increase or decrease the time between circuit board power-on and allowing each pump to run for the first time. The Lead Power On range is from 15 to 90 seconds. The Lag Power On range is 5 to 60 seconds after the Lead power on delay has timed out. These settings do not affect the normal operation of the pumps. Turn the potentiometers clockwise to increase the delay time. The pots have only a 3/4 turn span -- don't force them past the stops.

PUMP OFF DELAYS (Improper Sequence):

To prevent short-cycling of the pumps if a level input fails, the DC101-F provides Lead and Lag Off-delays that are only activated on improper sequence. The range of the delays are 10 to 120 seconds, with the Lag delay starting after the Lead has finished. If the stop level input fails, and the lead start float drops out, the Pump Off delay increases the time before the lead pump is stopped, in order to minimize short-cycling. Turn the potentiometers clockwise to increase the delay time. The pots have only a 3/4 turn span -- don't force them past the stops.

STAGGER START / STOP DELAYS:

There is a built-in, non-adjustable delay time between starting and stopping each pump which will prevent the pumps from starting or stopping at exactly the same time. This feature is designed to prevent water hammer. In the event that both pumps are called for at the same time, there will be a minimum of 5 seconds between pump starts. Under normal operating conditions the time delay between the lead and lag pumps turning off will be approximately 7 seconds.

IMPROPER SEQUENCE:

The improper sequence feature is ideally combined with the use of the optional FT101-F float test board. This feature is disabled by switching the 'No Imp Seq' DIP switch On. An improper sequence occurs if the Stop input fails to come in while the Lead or Lag inputs are activated, or the Lead input fails to energize before the Lag input. The improper sequence alarm will activate the common alarm and the LED alarm light on the FT101-F board. The FT101-F board has a built in Improper Sequence Indicator and Reset switch. If the FT101-F board is not used, an improper sequence may be reset by toggling both 'Man/Off/Auto' switches to the Off positions. Without the use of the FT101-F board, the only indication that the common alarm was activated by an improper sequence will be the 'Logic Running' LED on the back of the board. It flashes very fast during this condition. Also a built in delay will be activated to prevent short cycling of the pumps. Please refer to the sections on the Pump Off Delays and the FT101-F board for further details.

DUPLEX BOARD (DC101-F) OPERATIONAL FEATURES

MASTER CONTROLLER INPUT (TB5):

The DC101-F has 'Master Controller' input terminals which can be used to manually override the DC101-F controller. The connector for this option is TB5, which is located on the lower left side of the board (as viewed from the back). Terminal #1 is M1 Call; #2 is M1 Off; #3 is M2 Call; #4 is M2 Off; #5 is Common. These are dry contact inputs that must be switched to terminal #5 (Common) to activate. The inputs are normally biased to +14vdc. If the 'Call' and 'Off' inputs for one pump are both energized, the 'Off' overrides the 'Call'. Please refer to the section on the Master Controller (MC101) board and the MASTER CONTROLLER (MC101) OPERATIONAL FEATURES document for further details.

COMMON ALARM LIGHT DIM-GLOW FEATURE (TB9):

The Common Alarm light has a dim-glow feature that allows the operator to know if the alarm light has burned out. Under normal conditions, the alarm light glows half-bright and during an alarm, will blink full on and full off. If this dim-glow feature is not desired, you may remove the jumper plug from TB9 and the alarm light will remain completely off until an alarm occurs, where it will then blink on and off as long as the alarm is active.

POWER REQUIREMENTS:

The DC101-F operates on standard 115/120 VAC (60 Hertz) and has a maximum power consumption of 23 Watts. The board is fused by an AGC 1 amp fuse. There are two on-board G.E.V130LA10A MOV's to protect the circuitry from AC transient surges. The MOV's can operate with up to 130 VAC RMS continuously, has a maximum voltage clamp rating of 340 volts and can handle up to 4500 amps and 38 joules of energy.

OUTPUT RATINGS:

120vac outputs:

1. Call-For, Low Level and Com. Alarm Relays: 3amps, 120vac, resistive (note: the relays are actually rated for higher contact amperages but the total current capability of the DC101 is limited by a 10amp fuse located on the DCTB board.)
2. Man/Off/Auto Switches: 6 amps, 120vac, resistive
3. Alarm light relay(CR3): We recommend no larger incandescent bulbs than 60watts due to the 1N4007 Diodes used in the dim-glow circuitry. The older DC101D board used one of these diodes, but we now have two in parallel for increased current capacity/safety margins.

dc level solid state outputs:

1. DCATe outputs (DC101-F TB2) and DC-SwiPos outputs (TB7) option:
Normally-open, NPN transistor outputs. Driver chips have a rating of more than 50ma per channel and a voltage limit of 50vdc max, but we never use more than 24vdc and around 22ma on these outputs.
2. FT101-F (TB3): 14vdc inputs and outputs, 15madc max. 120vac wires are 'pass-through' between DC101 and DCTB.

UL APPROVALS:

The DC101-F, DCTB-F, FT101-F , DCATe and all option boards for the DC101-F have been UL approved and may be used in UL marked industrial control panels.

DIMENSIONS:

The circuit board size is 8 5/8" Wide, 7 9/16" High and 2 3/8" Deep. The nameplate size is 8 7/8" Wide X 8" High.

DUPLEX BOARD (DC101-F) OPERATIONAL FEATURES

DIP SWITCH SETTINGS SUMMARY:

Here is a quick list of the DIP switch settings and notes as to their normal usage. They also have some other uses when setting up some of the option boards. For those functions, please refer to the specific option board sections.



<u>Switch Number</u>	<u>Function</u>	<u>Default</u>	<u>Notes</u>
1	No Pump Call on High or Low Level	OFF	ON position prevents calling for either pump at High/Low Levels
2	No Improper Sequence Alarm	OFF	ON position disables the Imp. Sequence Alarm function.
3	Seal Failure Steady LED (no blink)	OFF	ON position prevents the Seal Failure LED from blinking.
4	No Alternation on Seal Failure	OFF	ON position disables the automatic alternation on Seal Failure.
5	No Seal Failure Alarm	OFF	ON position disables the Seal Failure Alarm.
6	Lag Stops on Lead Start level	OFF	ON position stops the Lag pump before the Stop float drops out.
7	One pump call on Lag/High Levels	OFF	ON position will only call for the Lead pump at these levels
8	Pump #1 Long Failure Delay	OFF	OFF: 5-60sec ON: 40 sec to 480 sec (8 minutes).
9	Pump #2 Long Failure Delay	OFF	OFF: 5-60sec ON: 40 sec to 480 sec (8 minutes).
10	Pump Down/UP (Down when OFF)	OFF	ON position reverses the operation of the High & Low Level inputs.

NOTES:

1. DIP1: When OFF, the controller calls for both pumps at the High or Low Level, depending on the position of DIP # 10. When the 'No HiLo Call' DIP switch is set to the ON position, no action will be taken to turn on any pump that is not currently running, but it still allows the high water (or low water) alarm and common alarm outputs to energize on those conditions.
2. DIP 2: When the 'No Imp Seq' DIP switch is set to the ON position, Improper Sequence alarms are disabled.
3. DIPS 3 through 5: The multiple DIP switches for the Seal Failure function allows custom applications where this input is used for another indication other than Seal Failure and you want to disable Alarm, blinking LED, and Alternation when the input is active.
4. DIP 6: Lag Stop on Lead-Start... This switch controls where the Lag pump turns off. Normally it turns off at the same level as the Lead pump, after the Stop Level input drops out. If this switch is ON, the Lag pump operates between the Lag Start and Lead Start inputs. When the Lag Level is reached the Lag pump will be called for and when the level drops to the point where the Lead Call-For input de-energizes, the Lag pump will turn off. The Lead pump will continue to run until the Stop Level input drops out.
5. DIP 7: Normally if the Lag or High Levels are reached in an improper sequence when the Lead call-for fails to energize, the DC101F will continue to call for both the Lead and Lag pumps. In situations where only one pump is allowed to run at a time, this switch will make the controller only call for the Lag pump at the Lag level and when a High level is reached with no other inputs (improper sequence), only the Lead pump will be called for.
6. DIP 10: OFF position is for 'Pump Down' mode and ON is for 'Pump-Up' mode, which selects how the controller operates on High and Low levels. In the 'Pump Down' mode, pumps are stopped at the optional Low Level and called for at the High Level. In the 'Pump-Up' mode the High and Low level actions are reversed.

DUPLEX BOARD (DC101-F) AUXILIARY/OPTION BOARDS

TERMINAL BOARD (DCTB-F):

The DCTB-F board provides field terminals for the duplex board (DC101-F). The wiring harness on the board connects directly to the DC101-F and FT101-F boards. There is an AGC 10 amp fuse on the circuit board for protection against overloads. If the duplex board does not operate, check this fuse and the fuse on the duplex board itself. See the DCTB-F Field Termination diagram for proper connections to this board. This board will work with all versions of the DC101 board.

SERVICE NOTE: The DCTB-F board has a few extra terminals than the older models, but may be used with all versions of the DC101 boards. Some connections may not be used on the older boards. The new board is also slightly narrower than the old boards in order to allow track mounting, if desired. The mounting holes are in the same location as the older boards for compatibility when backplate mounting is used.

FLOAT TEST (FT101-F) OPTION BOARD:

The FT101-F board provides input level monitoring/testing and an improper sequence alarm. The circuit board is panel mounted next to the Duplex Board. Its nameplate matches the DC101's in style and provides LED indications for all available float inputs and improper sequence. There are test switches by each LED indicator which parallel the inputs. These can be used to test the DC101 at each input level simply by pushing the required switches. Next to the improper sequence indicator, there is a push-button switch that is used to reset any improper sequence alarm that might occur. The improper sequence alarm can only be reset after the sequence has been returned to normal. Improper sequence conditions occur when the stop or lead inputs fail to energize in the proper sequence. The common alarm on the DC101-F is also energized during this condition. NOTE: The improper sequence feature is only enabled when the 'No Imp Seq' DIP switch on the DC101-F board is OFF. The FT101-F may be operated without this feature if it is not needed. In this case it would not be necessary to run the 5-wire harness between the bottom of the FT101-F board and the duplex board.

The FT101-F is connected to the duplex board using factory wiring harnesses. The first harness connects where the terminal board (DCTB-F) usually connects to the DC101-F. Then the DCTB-F board's connector is then connected to the FT101-F board. The second harness is used to connect the improper sequence function into the DC101-F board. Five wires connect to the bottom of the FT101-F board and to the mating connector (TB3) on the DC101-F board. This connector provides signals for the Imp. Seq. LED and Reset pushbutton.

ALARM TELEMETRY/AUX. CONTACT (DCATe) OPTION BOARD:

The Duplex Controller Alarm Telemetry (DCATe) board provides auxiliary normally open relay contact outputs for the following duplex board alarms: auxiliary alarm, improper sequence, M1 & M2 failure, M1 & M2 seal failure and high water. LED indicators for each output relay are provided to show when each relay is energized.

This option board is normally mounted on a backplate and has field terminals like those of the DCTB-F terminal board. All of the terminals are labeled on the circuit board. The board is connected to the duplex board via a 9-pin connector and is wired pin to pin (1 to 1, 2 to 2 etc...). 120 VAC power must be connected to this board at the 3-pin connector located above the GMA 1/4 amp fuse on the circuit board. Pin 1 is Hot, pin 2 is Neutral and pin 3 is Earth Ground. Please see the DCATe field termination diagram for the connector locations.

DCATe relay current rating: 6 amps, 120vac, resistive

SERVICE NOTE: The DCATe board is NOT the same as the previous versions. It is compatible with DC201 boards, but not older DC101 boards. If a new DC101-F board is being used to replace an older DC101 board that has a DCAT board, the existing DCAT must be changed to the DCATe version.

DUPLEX BOARD (DC101-F) AUXILIARY/OPTION BOARDS (continued)

TIMER BOARDS:

The DC101-F has two optional timer boards. The DC-RCT (Repeat Cycle Timer) board and the DC-7DAY timer board. Either of these boards may be plugged into the back of the DC101-F board using the common header located next to the adjustment potentiometers. The 7-Day timer interface board also attaches to the electronic timer which mounts on through the front nameplate. When adding or removing any of these option boards, power should be turned off.

DC-RCT REPEAT CYCLE TIMER:

The DC-RCT is a repeat-cycle timer board which attaches to the back of the DC101-F board. It has two rows of DIP switches that are used to set the On-Time and Off Time of the pumps. Each set of switches can be independently set to operate in seconds or minutes, giving two ranges of operation. The seconds range may be set from 15 seconds to 2,043 seconds (34.05 minutes) and the minutes range multiplies this by 60, so the range is from 1 minute to 2043 minutes (34.05 hours). NOTE: The seconds range is limited to a minimum of 15 seconds. Setting the DIP switches anywhere from 1 to 15 gives 15 seconds. This is to give time for the pumps to go on and off. These switches do function when adding up times greater than 15 seconds.

Number of pumps to run:

In the Repeat-Cycle mode, to allow only one pump to be turned on and off, switch the '1 Pmp on Lag/Hi Lvl' DIP switch to the ON position. Otherwise, both pumps will be cycled on and off. During the repeat-cycle mode, the level inputs are still active. If a pump is turned on with the timer and the Stop input is energized, the pump will remain on until the Stop input de-energizes, even if the On-Time has timed out.

Max Runtime mode:

To use the DC-RCT board as a maximum run timer, set the 'On-Time' DIP switches to the desired time and leave all of the 'Off-Time' DIP switches set to OFF. In this mode, the level inputs operate the pumps normally, but if one pump only is energized for a time period longer than the 'On-Time' is set for, it will alternate to the other pump and start the timer over.

Permissive mode:

In the 'Permissive' mode, the timer does not directly call for any pumps. Instead, it allows the pumps to run only during the time that it is ON. When the timer is in the OFF position, either by program or manually, the pumps will not run. In this mode, pumps turn on or off during the timer ON period depending on the level inputs status.

Local/Remote mode:

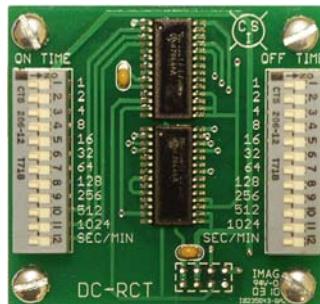
In this mode, the Stop level input is used to determine whether the timer is in Local or Remote. Remote mode is activated when the Stop input is open. Local mode is active when the Stop input is closed. During Local mode, the timer controls the pumps. During Remote mode, the timer is disabled and the Start Lead and Start Lag inputs are used to control the pumps from a remote controller. In this mode, the Lead input will start the Lead pump and stop both pumps. When both inputs are energized, one or two pumps may be called for depending on the position of the 'One pump call on Lag/HL' DIP switch. When both pumps are called for and running, the both pumps will be turned off when the Lead Call-For input opens. Since this mode will stop the timer if the Stop input is de-energized (open), it can be used for a pump lock-out circuit as well.

In the Repeat-Cycle, Permissive and Local/Remote modes, the High Level LED located on the nameplate may be used as a 'timer call-for', 'permissive' or 'Remote' mode indication. An actual High Level condition will override these indications and blink the LED.

NOTE: If both sets of DIP switches are set to all OFF, the timer is disabled.

In order to change or set the desired modes, a setup procedure must be followed. Please refer to the Setup Procedure section for detailed instructions.

DC-RCT Option Board



DC-7DAY TIMER:

The 7-Day Timer option allows the use of the battery-backed, electronic 7-Day timer with LCD display to be used with the DC101-F board. This is the same timer module that is used on our SC101 simplex boards. To initially set the clock and program the time settings, please refer to the 7-Day Timer Option Programming page of this document. The on-board, rechargeable lithium battery will hold the program and clock memory for about 1 month. For long-term storage, please unplug the connector to the option board to disable the battery.

The 7-Day timer can be initialized in several different modes:

Standard mode:

In the Standard (default) mode, if the timer output is ON, one or two pumps will be turned on, depending on the position of the '1 Pmp on Lag/Hi Lvl' DIP switch. The board has a minimum time limit built in: When only one pump is being called for by the timer, it is five (5) seconds. When two pumps are being called for, it is increased to 15 seconds to allow time for both pumps to actually be called for.

Permissive mode:

In the 'Permissive' mode, the timer does not directly call for any pumps. Instead, it allows the pumps to run only during the ON time period. When the timer is in the OFF time period, the pumps will not run. In this mode, pumps turn on or off during the timer ON period depending on the status of the level inputs.

Local/Remote mode:

In this mode, the Stop level input is used to determine whether the timer is in Local or Remote. Remote mode is activated when the Stop input is open. Local mode is active when the Stop input is closed. During Local mode, the timer controls the pumps. During Remote mode, the timer is disabled and the Start Lead and Start Lag inputs are used to control the pumps from a remote controller. In this mode, the Lead input will start the Lead pump and stop both pumps. When both inputs are energized, one or two pumps may be called for depending on the position of the 'One pump call on Lag/HL' DIP switch. When both pumps are called for and running, the both pumps will be turned off when the Lead Call-For input opens. Since this mode will prevent the local timer from calling for pumps when the Stop input is de-energized (open), it can be used for a pump lock-out circuit as well. NOTE: when in Remote, the local timer will not call for the pumps, but the timer keeps running.

In the Standard, Permissive and Local/Remote modes, the High Level LED located on the nameplate may be used as a 'timer call-for', 'permissive' or 'Remote' mode indication. An actual High Level condition will override these indications and blink the LED.

The timer module has a manual override pushbutton. The timer output may be turned on or off with this pushbutton. The setting will be overridden during the next automatic cycle of the timer settings.

In order to change or set the desired modes, a setup procedure must be followed. Please refer to the Setup Procedure section for detailed instructions.

DC-7DAY Option Interface Board



SETUP PROCEDURE (FOR OPTION BOARDS):

The DC-7DAY timer board and the RS232 boards may be utilized in various ways. To accommodate these functions, there is a way to change the features using the DIP switches on the back of the DC101-F board. These settings are stored in nonvolatile EEPROM storage so that after a power failure all settings will be restored. In all cases, there is a 20 second timeout. If you don't set the desired feature in the time period, you will have to reset the trigger and try again.

RS232 Baudrate Setting:

- a. Routine started only when RS232 board is detected (automatically) and both pumps MOA switches are in the Off position, all DIP switches are in the Off positions and the Improper Sequence Reset input (pins 1&2 of TB3) is held energized the entire time.
- b. The default baudrate is 4800 if this routine has never been entered to change it.
- c. Set 1200 baud: switch DIP switch #1 on/off twice
- d. Set 2400 baud: switch DIP switch #2 on/off twice
- e. Set 4800 baud: switch DIP switch #3 on/off twice
- f. Set 9600 baud: switch DIP switch #4 on/off twice
- g. End routine by de-energizing the Improper Sequence Reset input and putting other switches (including DIP switches) in their operating positions.

DC-RCT / DC-7Day Timer mode Settings:

- a. Routine initialized only when either board is detected (automatically) and both pumps MOA switches are in the Off position, all DIP switches are in the Off positions and the Alternate Switch is in the P2-Lead position. To begin the 7-Day timer setup, the 7-Day Input is manually switched to the ON position and held energized the entire time. To begin the DC-RCT setup, the DC-RCT Off Timer DIP switch #12 (sec/min) must be switched ON during the setup procedure. The options in this section must be set one at a time.

The following all refer to the DC101 10-position DIP switch:

- b. Reset to Normal mode: DIP switch #1 on/off twice.
- c. Permissive mode: DIP switch #2 on/off twice.
- d. Indication: DIP switch #3 on/off twice.
Use High Water LED for either 'Call-For', 'Permissive' or 'Remote mode' indication (LED will be on steady):
- e. Local/Remote mode: DIP switch #4 on/off twice.
- f. NOTE: While the High Water LED is being used for timer indication, the High Water input will still work and any timer indications using this LED will be overridden during an alarm condition and blink during the alarm.
- g. Multiple Choice setting note: If it is desired to use the High Water LED as a mode indicator, first set the main mode and then toggle the routine's start trigger again (7-Day timer input off / on, or the RCT DIP #12 off/on) and then set the indication mode using step 'd'.
- h. End routine by de-energizing the 7-Day Timer input or DC-RCT dip switch and putting other switches (including DIP switches) in their operating positions.

DUPLEX BOARD (DC101-F) AUXILIARY/OPTION BOARDS (continued)

STATUS OUTPUT BOARDS:

There are two optional status boards available for the DC101-F in addition to the DCAT board. The DC-SWPOS (Switch Position) board gives solid state, open-collector transistor outputs for indication of the 'Man/Off/Auto' switch positions. The DC-RS232 board gives a standard serial port connection for attaching to remote telemetry units. Currently, the serial port board only gives status outputs. These boards plug into a common header located in the upper left corner of the board (as viewed from the back). Only one board at a time may be used.

DC-SWPOS BOARD:

The DC-SWPOS board provides a solid-state, open-collector transistor output for external indication or reporting of the Man/Off/Auto switch positions. The connector TB7 terminals are as follows: 1=Pump 1 in Auto, 2=Pump 1 in Manual, 3=Pump 2 in Auto, 4=Pump 2 in Manual, 5 = output common. These outputs can only switch DC loads. The maximum recommended load is 100 mA on each output. The outputs switch to pin 5 (common) and the other pins will have to be biased properly through resistors to a positive power supply (like inputs to our RTU103 and RTU104 boards are) and the common pin connected to the common of the receiving board's power supply.

DC-RS232 BOARD:

The RS232 option board allows communications using a standard 9-pin serial port. An ASCII format designed for local communications to a laptop PC for troubleshooting is currently included, with Modbus RTU and Bricknet protocols being tested for inclusion at a later date for full communications capabilities.

The ASCII data output is in the form of a string of characters which may be anywhere from 28 to 58 characters in length. The output has been expanded to include pump statistics, formatted as follows:

ASCII OUTPUT FORMAT (Subject to change if more features are added)

Character #	Function	Possible Values
1	String Beginning Character	A
2	Low Water/High Water alarms	0=none 1=LW 2=HW 3= both
3	Lag/Lead/Stop float inputs	0=none 1=stop 2=lead 3=stop & lead 4=lag 5=stop & lag 6=lead & lag 7= stop, lead & lag
4	P1 Failure and Seal Failure	0 = none 1= Pump Fail 2=Seal Fail 3=both
5	P2 Failure and Seal Failure	0 = none 1= Pump Fail 2=Seal Fail 3=both
6	Aux alarm ,Imp. Sequence and Low/High pump Lockout	0 = none 1=Aux 2=Imp Seq 3=Aux & Imp Seq. 4 = Lockout 5 = Aux & Lockout 6 = Imp. Seq and Lockout 7 = Aux, Imp. Seq. And Lockout
7	Which pump is running	0 = none 1= P1 2=P2 3=both
8	P1 Man/Off/Auto	0=off 1=Auto 2=Man 3=both(not possible unless switch bad)
9	P2 Man/Off/Auto	0=off 1=Auto 2=Man 3=both(not possible unless switch bad)
10	P1/P2 Lead or Alt position	0 = ALT 1= P1 Lead 2 = P2 Lead
11	P1 Master On/Off/none	0 = none 1=On 2= Off
12	P2 Master On/Off/none	0 = none 1=On 2= Off
13-61 variable-length	P1 Daily Starts	B0-65535 (over the last 24 hours)
	P1 Daily Runtime average mins.	C0-1440 (Average runtime in minutes over the last 24 hours)
	P2 Daily Starts	D0-65535 (over the last 24 hours)
	P2 Daily Runtime average mins.	E0-1440 (Average runtime in minutes over the last 24 hours)
	P1 Total Run K. Hours	F0-65535 (Total accumulated 1000 hours)
	P1 Total Run Hours	G0-999 (Total accumulated hours)
	P2 Total Run K. Hours	H0-65535 (Total accumulated 1000 hours)
	P2 Total Run Hours	I0-999 (Total accumulated hours)
	Unit Address	J0-999 (Number will be 0 if set to 00 or board is not installed)
	\n (newline character)	LF
	\r (carriage return)	CR
	null	0

DC-RS232 BOARD (continued):

Notes:

1. Data is only printed when one of the first digital inputs or alarms changes state.
2. Baudrates of 1200, 2400, 4800 and 9600 are supported. All have No Parity, 8 data bits, 1 Stop bit and No Flow Control.
3. Each section of data is preceded by a letter to indicate the start of the section. Only the digital section is fixed in length. The pump statistics have variable length numbers.

Example full output:

A00000011000B0C0D0E0F0G0H0I0J0 (Shortest version possible)
A00000011000B65535C1440D65535E1440F65535G999H65535I999J999 (Longest version possible)

A00000011000B13C5D12E6F1G200H1I212J0

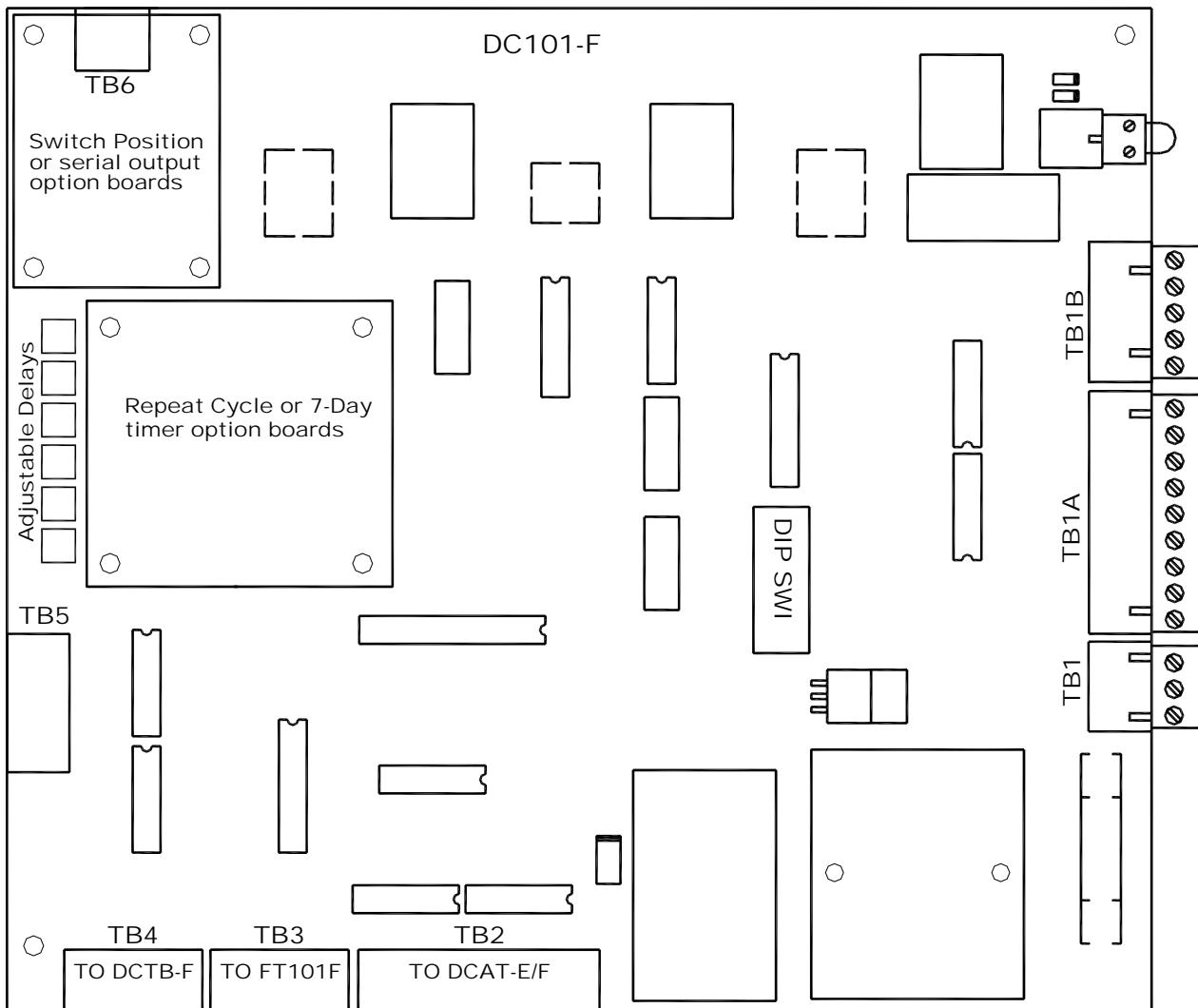
explanation of above example:

- A: both pumps in Auto
- B: P1 ran 13 times over the last 24 hours
- C: P1 had an average runtime of 5 minutes over the last 24 hours
- D: P2 ran 12 times over the last 24 hours
- E: P2 had an average runtime of 6 minutes over the last 24 hours
- F & G: P1 has a total accumulated runtime of 1,200 hours
- H & I: P2 has a total accumulated runtime of 1,212 hours
- J: Unit Address of 0

Detailed example packed digital output section format:

<u>Output</u>	<u>Description</u>
A000000000000	(nothing running, no float inputs or alarms and both pumps switched off)
A00000011000	(Both pumps in Automatic)
A03000111000	(Stop and Lead floats energized, P1 running and both pumps in Auto)
A07000111000	(Stop, Lead and Lag energized, P1 running and pumps in Auto)
A07000311000	(Stop, Lead and Lag energized, both pumps running and in Auto)

DC101-F OPERATIONAL FEATURES DIAGRAM



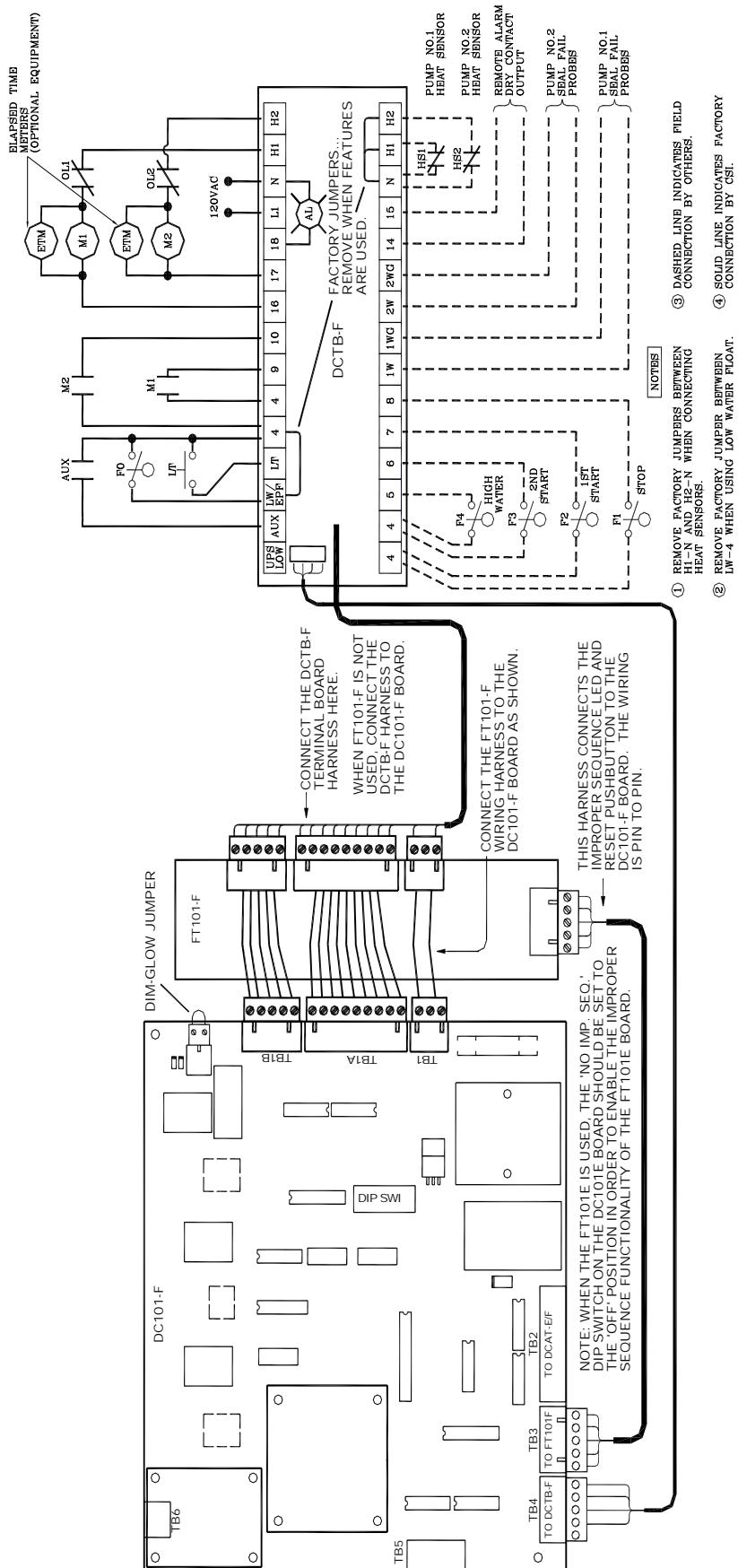
1. TB1: 120vac Power Input connector
2. TB1A: Digital Input connector
3. TB1B: 120vac Outputs (call-for relays, alarm light) connector
4. TB2: Optional DCAT Alarm Relay Output connector
5. TB3: Optional FT101-F float test board connector
6. TB4: Optional Auxiliary alarm, Low Level input and Lamp Test connections
7. TB5: Optional 'Master' Pump control connector
8. TB6: Low Level output relay
9. TB7: (not shown) Optional switch position output connector
10. TB9: Common Alarm Light Dim Glow Jumper Plug. Remove this jumper plug to disable the dim-glow feature.
Caution: this plug has 120vac on it.
11. Field adjustable delay potentiometers are located on the left edge of the board
12. DC-RCT or DC-7Day Timer option boards plug onto the board just beside the delay adjustment potentiometers
13. DC-SwiPos or Serial I/O option board plugs onto the board at the upper left corner.
14. DIP switch settings:

1. No HiLo Call	6. Lag-Stop on Lead-Start
2. No Imp. Seq.	7. 1 Pmp Call on Lag/Hi Lvl
3. SF Steady	8. P1 Long Fail Delay
4. No SF Alt	9. P2 Long Fail Delay
5. No SF Alarm	10. Pmp Dwn/Up (controls High & Low Level operation)

Changes from older DC101's(versions A-D)

1. TB6 is no longer a 24vac output. It is now relay contact output for the Low Level alarm.
2. The DCAT driver outputs are now on the DC101-F board (TB2). Older model DCAT boards will not work with this board.
3. The old DCAA interface board used on older DC101's to connect to TB4 is no longer needed and will not work with this board.
4. All jumpers have been removed from this model and replaced with a single row of DIP switch settings.
5. Older DC101's had only the level input status LED' on the back. This version adds 16 more LED's for I/O status.
6. Due to UL regulations, the older DCTB and FT101 connectors are no longer approved. Therefore new DCTB-F's and FT101-F's must be used with these boards.

DC101-F / FT101-F / DCTB-F CONNECTION DIAGRAM



DC101-F CONNECTOR PINOUTS

TB1-B	DCTB-F Connector
5	Alarm Light output (120 vac)
4	P2 Call output (120 vac)
3	P1 Call output (120 vac)
2	Common Alarm relay contact (closes on alarm or power failure)
1	Common Alarm relay contact

TB3	FT101-F Connector
1	dc Input Common
2	Imp. Seq. Reset input (14vdc bias)
3	power output for Imp. Seq. LED
4	Improper Sequence LED output
5	dc Input Common

TB1-A	
9	P2 Seal Failure input (14vdc bias)
8	P1 Seal Failure input (14vdc bias)
7	P2 Running input (14vdc bias)
6	P1 Running input (14vdc bias)
5	Stop Level input (14vdc bias)
4	Lead Level input (14vdc bias)
3	Lag Level input (14vdc bias)
2	High Water Level input (14vdc bias)
1	dc Input Common

TB4	DCTB-F Auxiliary Input Connector
1	dc Input Common
2	Auxiliary input (14vdc bias) close to energize
3	Low Water input (14vdc bias) open to energize
4	Lamp Test input (14vdc bias) close to energize
5	dc Input common

TB1	
3	Neutral (120vac power)
2	no connection
1	L1 (120vac power)

TB5	'Master' Inputs
1	P1 Call-For (On) (14vdc bias)
2	P1 Stop (Off) (14vdc bias)
3	P2 Call-For (On) (14vdc bias)
4	P2 Stop (Off) (14vdc bias)
5	dc Input common

TB2	DCATe Connector
1	High Water output
2	Improper Sequence output
3	P2 Failure output
4	P1 Failure output
5	P2 Seal Failure output
6	P1 Seal Failure output
7	Auxiliary Alarm output
8	Output common
9	external +12vdc input for relay diodes

TB6	Low Level Relay Connector
1	Common contact
2	Normally Open contact

TB7	DC-SWPOS Option Board Connector (for low-power dc relay or SCADA use only)
1	P1 in Automatic (NPN open-collector output)
2	P1 in Manual (NPN open-collector output)
3	P2 in Automatic (NPN open-collector output)
4	P2 in Manual (NPN open-collector output)
5	transistor output common

DC101-F to DCTB-F WIRING CHART

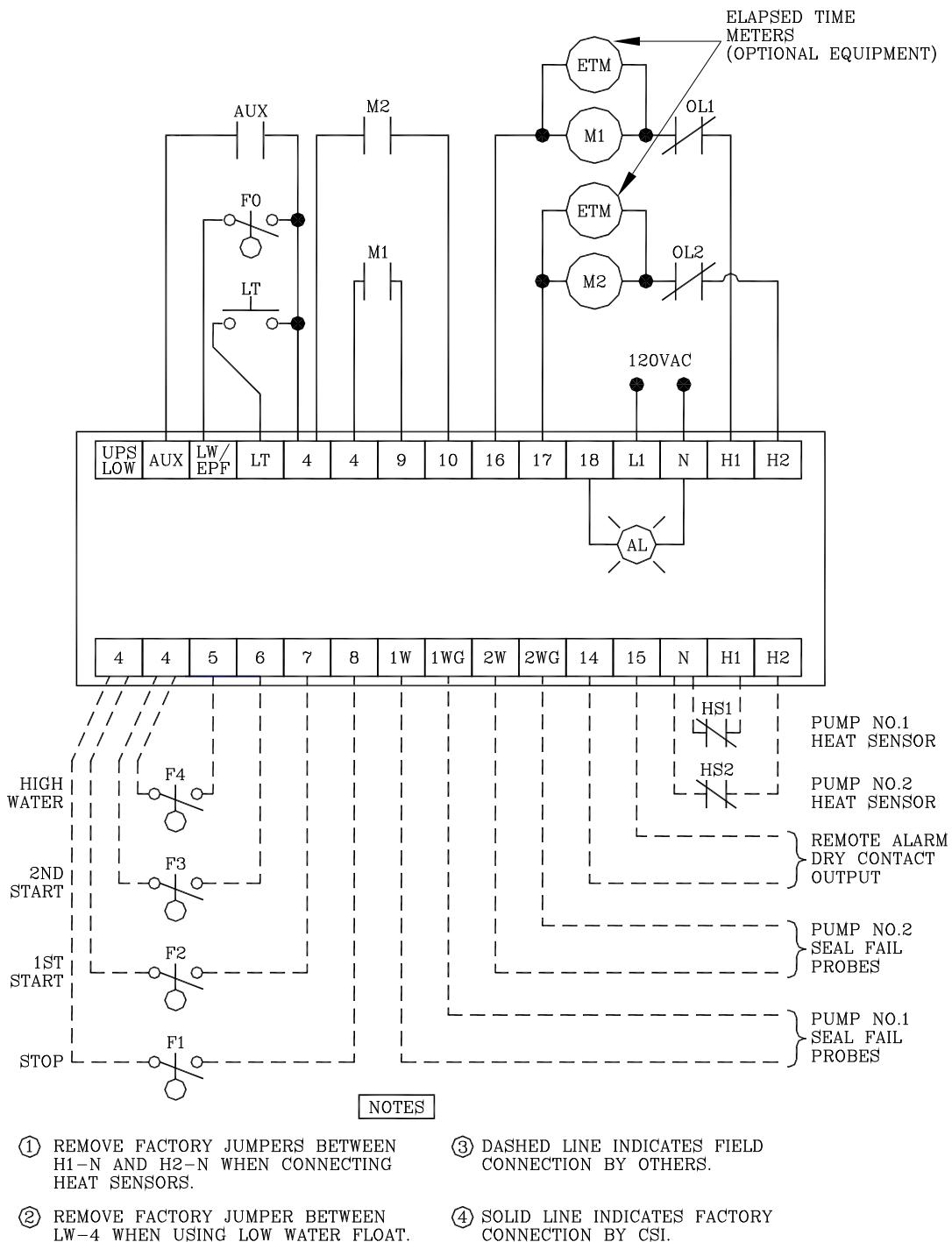
DC101-F	DCTB-E	DCTB-F	DCTB-F	DESCRIPTION
terminal	wire #s	wire #s	terminal	
5	grn/yel	grn/yel	18	alarm light output
4	17	17	17	P2 call-for output
TB1-B	3	16	16	P1 call-for output
	2	15	15	common-alarm relay contact
	1	14	14	common-alarm relay contact

9	12	12	12	P2 seal failure input
8	11	11	11	P1 seal failure input
7	10	10	10	P2 running input
6	9	9	9	P1 running input
TB1-A	5	8	8	Stop level input
	4	7	7	Lead level input
	3	6	6	Lag level input
	2	5	5	High Water level input
	1	4 & 1	4	input common (dc)

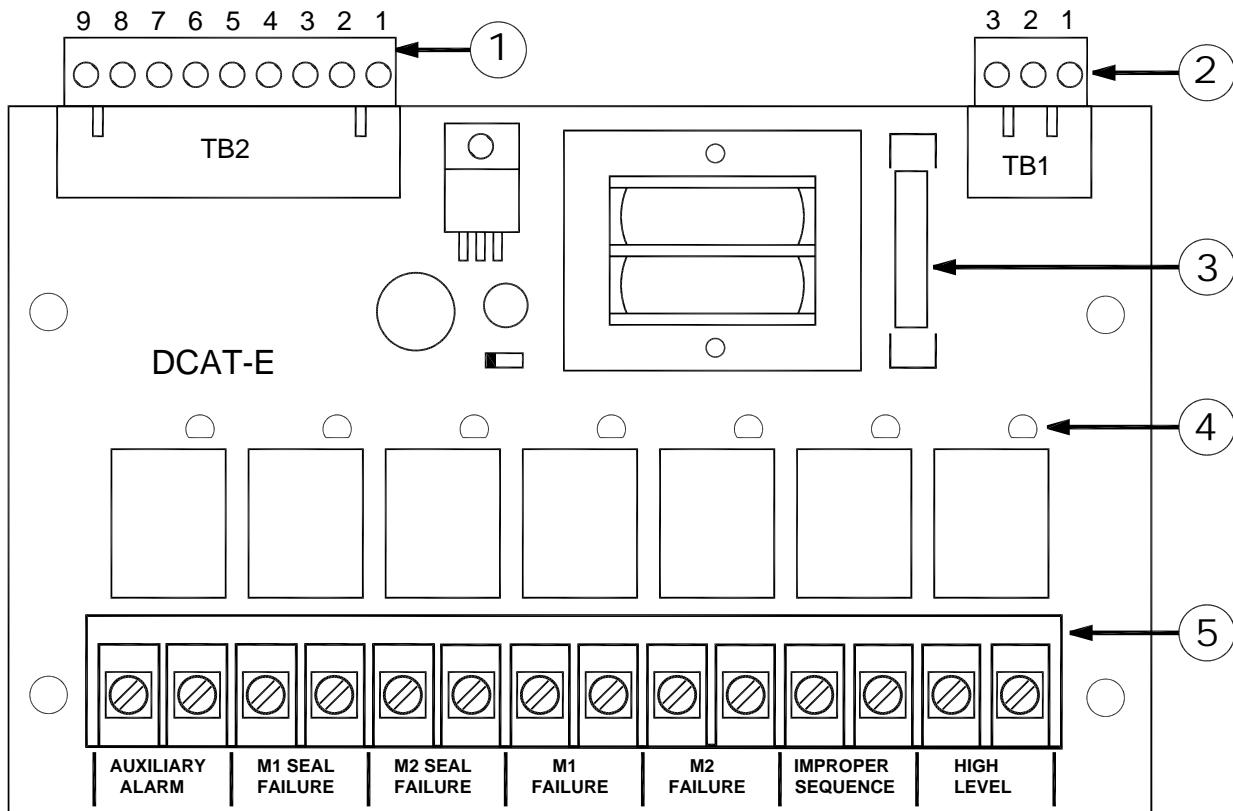
TB1	3	N	3	120vac neutral
	2	---	---	no connection
	1	L1	2	120vac hot

	4-pin screw terminals	4-pin screw terminals	DCTB-F terminals	DESCRIPTION
	---	---	4	input common (dc)
	4	4	LT	Lamp Test input
TB4	3	3	LW/EPF	Low Water input (jump to input common if not used)
	2	2	AUX	Auxiliary input
	---	---	4	input common (dc)

DCTB-F FIELD TERMINATION DIAGRAM



DCATe FIELD TERMINATION DIAGRAM



1. TB2 alarm input connector:
pin 1 = High Level, 2 = Improper Sequence, 3 = M2 Failure, 4 = M1 Failure, 5 = M2 Seal Failure, 6 = M1 Seal Failure, 7 = Auxiliary Alarm, 8 = Signal Common, 9 = +Vdc for relay diode protection that is built into the DC101 board.
2. TB1 board power connector: pin 1 is 120 vac Hot, pin 2 is Neutral
3. AGC ½ amp fuse
4. Relay Energized LED's for visual indication of alarm condition
5. TB3 relay output terminals (normally open contacts only): current rating is 6 amps at 120VAC, resistive.

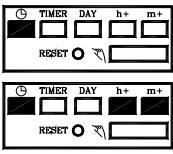
NOTE : This version of the DCAT board is compatible with CSI's DC101-E, DC101-F and DC201 boards. However, it is not compatible with the older DC101 boards before version 'E'. If you have an existing older DC101 system that contains an old DCAT board, it will have to be replaced or modified to match the new DC101-F board.

7-DAY TIMER OPTION PROGRAMMING

A. SETTING THE DAY OF WEEK AND TIME OF DAY.

KEEP KEY  DEPRESSED DURING THE WHOLE SETTING OPERATION.

2. USE KEYS $h+$ AND $m+$ TO SET ACTUAL TIME OF DAY. ($h+$ = HOURS/ $m+$ = MINUTES)



3. IF KEYS $h+$ AND $m+$ ARE DEPRESSED CONTINUOUSLY FOR LONGER THAN 1 SECOND, THE DISPLAY WILL AUTOMATICALLY CONTINUE COUNTING.

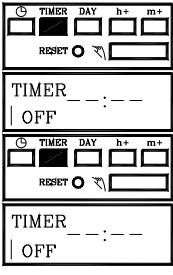


4. USE KEY DAY TO BRING THE ACTUAL DAY OF THE WEEK INTO THE DISPLAY.

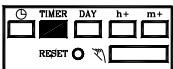
5. RELEASE KEY  TIME IN OPERATION. (EXACT START OF SET TIME OF DAY POSSIBLE USING, FOR INSTANCE, OFFICIAL TIME SIGNALS.)

B. PROGRAMMING ON/OFF TIMES

1. OPERATE KEY TIMER ONCE. THE SET TIME OF DAY DISAPPEARS FROM THE DISPLAY. TIMER "1" ON ---:-- WILL APPEAR. NOW INSERT THE TIME AT WHICH AN "ON" COMMAND IS TO BE CARRIED OUT AS DESCRIBED UNDER A 2 AND 3 (SETTING TIME OF DAY). PRESS KEY TIMER TO ENTER PROGRAM. SYMBOL "1" OFF ---:-- WILL APPEAR.



2. PROGRAMMING "OFF" TIME. THE DISPLAY SHOWS SYMBOL "TIMER 1 OFF" ---:--. NOW INSERT THE TIME AS DESCRIBED UNDER 1 A 2 AND 3 (SETTING OF TIME OF DAY). AFTER INPUT PRESS KEY TIMER.



3. SIX "ON" AND SIX "OFF" COMMANDS CAN BE PROGRAMMED.

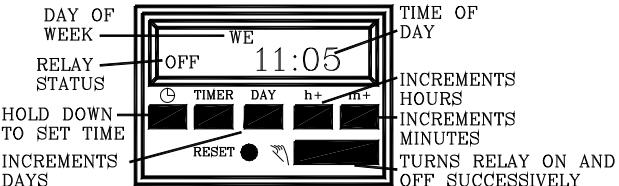
4. IF NO WEEKDAY IS ADDED TO THE SWITCH COMMANDS, THEY WILL BE EXECUTED DAILY.

C. BLOCK PROGRAMMING

APART FROM INDIVIDUAL DAYS OF THE WEEK, KEY DAY ALSO SERVES TO OPERATE MULTIPLE DAY COMBINATIONS.



1. MONDAY - FRIDAY
2. SATURDAY + SUNDAY
3. MONDAY - SATURDAY



IF AN INDIVIDUAL DAY OR ONE OF THESE MULTIPLE DAY COMBINATIONS IS INCORPORATED IN A PROGRAM, THE LOAD WILL BE TURNED ON OR OFF ON EACH OF THESE DAYS AT THE PROGRAMMED TIME.

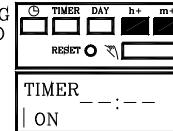
D. CHANGING OR CHECKING OF PROGRAMS.

BY OPERATING KEY TIMER, THE INDIVIDUAL COMMANDS AS PROGRAMMED CAN, AT ANY TIME, BE BROUGHT CONSECUTIVELY INTO THE DISPLAY FOR CHECKING. ALTERATIONS ARE CARRIED OUT BY WRITING OVER THE EXISTING PROGRAMS USING THE STEPS OUTLINED IN A. AND B.



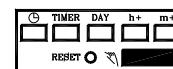
E. CANCELLING PROGRAMS.

USE PROCEDURE ABOVE TO BRING PROGRAM TO BE CANCELLED INTO DISPLAY. USE $h+$ AND $m+$ KEYS TO SET HOURS AND MINUTES TO ZERO, SYMBOL ---:-- WILL BE IN DISPLAY.



F. MANUAL SWITCH.

PRESS OVERRIDE SWITCH TO TURN LOAD ON OR OFF WITHOUT AFFECTING THE STORED PROGRAMS.

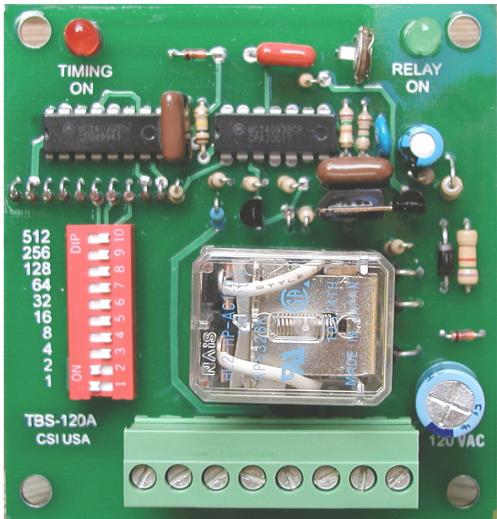




Control Systems, Inc.

PRODUCT DATA BULLETIN

BULLETIN
TB2
OFF-DELAY
TIMER



STANDARD FEATURES

- DIGITAL SOLID-STATE RELIABILITY
- BACK-PLATE OR SNAP-TRACK MOUNTING
- EXACT TIME SETTING
- LED INDICATORS FOR TIMING AND ON
- QUICK-CONNECT TERMINALS
- HEAVY DUTY RATINGS
- SPDT OUTPUT CONTACTS
- EASY INSTALLATION
- ECONOMICAL
- BOARD SIZE: 3.25" HIGH X 3.125" WIDE
- 120 VAC, 60HZ POWER

DESCRIPTION

The snap-track mounted TB electronic timer provides an adjustable off-delay time beginning when the initiate contact is opened. Power must be applied to the input terminals L and N at all times. The output contacts change state and remain in the ON position as long as the initiate contact is closed. When the initiate contact is opened, the off-delay period begins. At the end of the delay period, the output contacts revert to the original de-energized position. The time delay is selected using ten binary switches, allowing exact time setting from 1 to 1023 seconds (TMS version) or from 10 to 10,230 seconds (TML version). A red LED indicates TIMING period and green LED indicates when the output is on (relay energized). This model can either be back-plate mounted, or mounted on 3.25" snap-track.

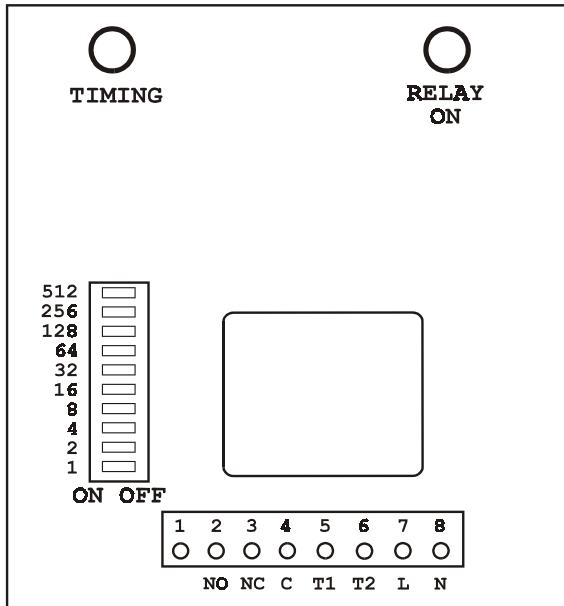
SUGGESTED SPECIFICATIONS

Provide a solid-state off-delay timer with digital time delay settings in one second increments from 1 to 1023 seconds (TMS version) or in ten second increments from 10 to 10,230 seconds (TML version), $\pm 2\%$ accuracy and $\pm .1\%$ repeatability. Reset time shall be 50ms maximum. The timer shall be provided with a red LED to indicate Timing and a green LED to indicate when the relay is energized. The timer shall have quick-connect terminals and be backplate or 3.25" snap-track mounted as required.

SPECIFICATIONS

- SUPPLY VOLTAGE: 120 VAC, 60 Hz
- POWER CONSUMPTION: 2 Watts
- OUTPUT CONTACT RATING: 10 Amps @ 120 VAC, Resistive
- ACCURACY: Setting = \pm 2%: Repeatability = \pm 0.1 %
- RESET TIME: 50 ms
- RECYCLE TIME: 150 ms
- OPERATIONS: Mechanical – 10 million (minimum)
 Electrical – 500,000 @ rated load
- DUTY CYCLE: Continuous
- CIRCUIT BOARD DIMENSIONS: 3.125" Wide X 3.25" High
- MOUNTING: 3.25" Snap-Track preferred

TBS-120-A-S FEATURES



Terminal Functions:

- 1: not used
- 2, 3 & 4: Relay Contact Output
- 5 & 6: Initialization Contact Input
- 7 & 8: 120 VAC power

DIP Switch Selection: The 10 switches select the total time delay before the relay de-energizes. The numbers beside each switch indicate the switch value. If all of the switches are placed in the ON position (TBS version), the time delay will be 1023 seconds (17.05 minutes).

LED Functions: Red indicates Timing. Green indicates the Relay is energized. Before the timing period starts, only the Green LED will be lit. During the timing period, both LED's will be lit and on timeout, both will turn off.

ORDERING INFORMATION

SHORT TIMER for 120VAC: TBS-120-A-S
LONG TIMER for 120VAC: TBL-120-A-S

(For 1 to 1023 seconds or 17.05 minutes)
(For 10 to 10,230 seconds or 2.84 hours)

WARRANTY: Control Systems, Inc. (CSI) warrants equipment of its own manufacture to be free from defects in material and workmanship, under normal conditions of use and service, and will replace any component found to be defective on its return to CSI, transportation charges prepaid, within one year of its original purchase. CSI will extend the same warranty protection on accessories which is extended to CSI by the original manufacturer. CSI also assumes no liability, express or implied, beyond its obligation to replace any component involved. Such warranty is in lieu of all other warranties express or implied.



CONTROL SYSTEMS, INC.
P.O. Box 4852, Jackson, MS 39296-4852
Telephone: (601) 355-8594
FAX: (601) 355-8774

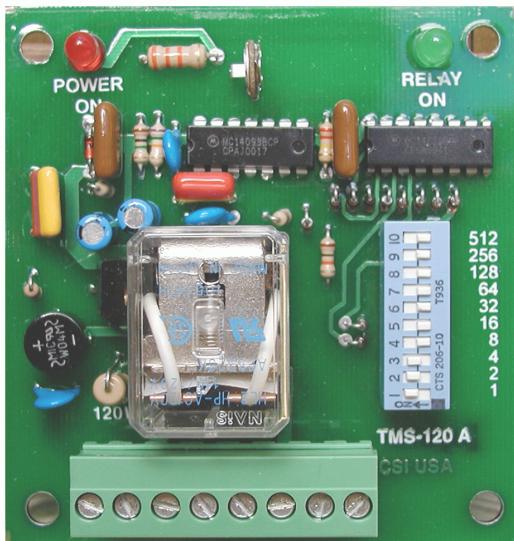
Document Revision: A



Control Systems, Inc.

PRODUCT DATA BULLETIN

BULLETIN
TM2
ON-DELAY
TIMER



STANDARD FEATURES

- DIGITAL SOLID-STATE RELIABILITY
- BACK-PLATE OR SNAP-TRACK MOUNTING
- EXACT TIME SETTING
- LED INDICATORS FOR TIMING AND ON
- QUICK-CONNECT TERMINALS
- HEAVY DUTY RATINGS
- DPDT OUTPUT CONTACTS
- EASY INSTALLATION
- ECONOMICAL
- BOARD SIZE: 3.25" HIGH X 3.125" WIDE
- 120 VAC, 60HZ POWER

DESCRIPTION

The snap-track mounted TM electronic timer provides an adjustable on-delay time initiated when power is applied. At the end of the delay period, the output contacts change state. The timer is reset by removal of input power. Time delay is selected using ten binary switches, allowing exact time setting from 1 to 1023 seconds (TMS) or from 10 to 10,230 seconds (TML) or from 1 to 1023 minutes (TMXL). A red LED indicates power-on and Timing and a green LED indicates that the time period has expired and the output is ON. This model can either be back-plate mounted, or mounted on 3.25" snap-track.

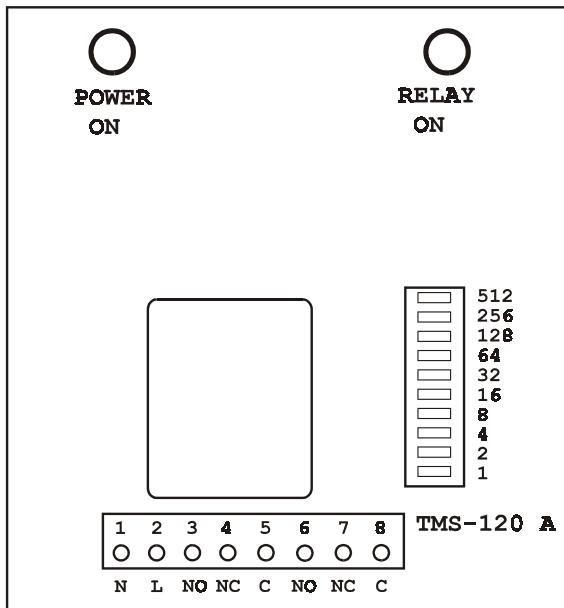
SUGGESTED SPECIFICATIONS

Provide a solid-state timer with digital time delay settings in one second increments from 1 to 1023 seconds (TMS), in ten second increments from 10 to 10,230 seconds (TML) or in 1 minute increments from 1 to 1023 minutes (TMXL), $\pm 2\%$ accuracy and $\pm .1\%$ repeatability. Reset time shall be 50ms maximum. The timer shall be provided with a red LED to indicate Power On and a green LED to indicate ON (timeout). The timer shall have quick-connect terminals and be backplate or 3.25" snap-track mounted as required.

SPECIFICATIONS

- SUPPLY VOLTAGE: 120 VAC, 60 Hz
- POWER CONSUMPTION: 2 Watts
- OUTPUT CONTACT RATING: 10 Amps @ 120 VAC, Resistive
- ACCURACY: Setting = \pm 2%: Repeatability = \pm 0.1 %
- RESET TIME: 50 ms
- RECYCLE TIME: 150 ms
- OPERATIONS: Mechanical – 10 million (minimum)
 Electrical – 500,000 @ rated load
- DUTY CYCLE: Continuous
- CIRCUIT BOARD DIMENSIONS: 3.125" Wide X 3.25" High
- MOUNTING: 3.25" Snap-Track preferred

TMS-120-A-S FEATURES



Terminal Functions:

- 1&2: 120 VAC Input
- 3-5: Relay Contacts # 1
- 6-8: Relay Contacts # 2

DIP Switch Selection: The 10 switches select the total time delay before the relay energizes. The numbers beside each switch indicate the switch value in seconds. If all of the switches are placed in the ON position (TMS version), the time delay will be 1023 seconds (17.05 minutes).

LED Functions:

Timing starts when power is applied to the board (the "Power On" LED is on). On timeout, the Green "Relay On" LED will come on as the

ORDERING INFORMATION

SHORT TIMER for 120VAC: TMS-120-A-S



(For 1 to 1023 seconds or 17.05 minutes)

LONG TIMER for 120VAC: TML-120-A-S

(For 10 to 10,230 seconds or 2.84 hours)

EXTRA LONG TIMER for 120VAC: TMXL-120-A-S

(For 1 to 1023 minutes or 17.05 hours)

WARRANTY: Control Systems, Inc. (CSI) warrants equipment of its own manufacture to be free from defects in material and workmanship, under normal conditions of use and service, and will replace any component found to be defective on its return to CSI, transportation charges prepaid, within one year of its original purchase. CSI will extend the same warranty protection on accessories which is extended to CSI by the original manufacturer. CSI also assumes no liability, express or implied, beyond its obligation to replace any component involved. Such warranty is in lieu of all other warranties express or implied.



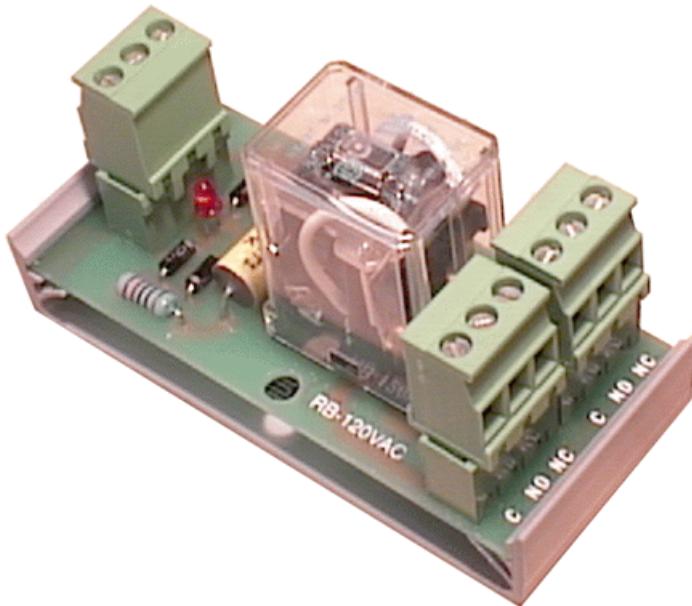
CONTROL SYSTEMS, INC.
P.O. Box 4852, Jackson, MS 39296-4852
Telephone: (601) 355-8594
FAX: (601) 355-8774

Document Revision: B



PRODUCT DATA BULLETIN

2RB
DPDT Relay
Board



STANDARD FEATURES

- 3.25" SNAPTRACK CHANNEL MOUNTING
- 120VAC, 24VAC, 24VDC AND 12VDC MODELS
- INPUT TRANSIENT SURGE PROTECTION
- FORM C, DPDT CONTACTS
- QUICK-RELEASE SCREW TERMINALS
- LED STATUS INDICATOR
- SIZE: 3.25" x 1.50"

DESCRIPTION

The CSI model 2RB relay is a 3.25" SnapTrack channel mounted relay board with input surge protection. Quick-connect terminals are used for the power input as well as individual contact outputs, making it very convenient to use. An LED indicator is included on the board to indicate when the relay has been energized. The unit is available in 120VAC, 24VAC 24VDC and 12VDC models..

SUGGESTED SPECIFICATIONS

Provide a SnapTrack channel mounted relay board with LED status indicator and individual quick-connect terminals. The SnapTrack can be optionally snapped to a DIN rail. The indicator LED shall turn on when the relay is energized. The terminals shall be of the fixed screw cage clamp type, rated for at least 10 amps at 250 volts. Tubular screw clamp types will not be accepted. The relay shall be rated for 10 amps. Surge suppression shall be provided on the coil side of the relay. The board shall include built-in transient protection across the coil. DC powered versions shall include a built-in diode across the coil to protect external devices from coil surges. The relay and connectors shall be UL approved.

OPERATING SPECIFICATIONS

- SUPPLY VOLTAGE: 120VAC, 24VAC, 24VDC OR 12VDC (Model Dependent)
- SUPPLY CURRENT: 13ma @ 120vac; 46ma @ 24vac; 37ma @ 24vdc; 75ma @ 12vdc
- BOARD OUTPUT CONTACT RATING: 8 amps @ 110vac / 24vdc
- CONNECTORS: FIXED SCREW CLAMP TYPE RATED AT 10 AMPS 250V
- DIMENSIONS: 3.25" x 1.50"
- HUMIDITY: 5-95% NON-CONDENSING

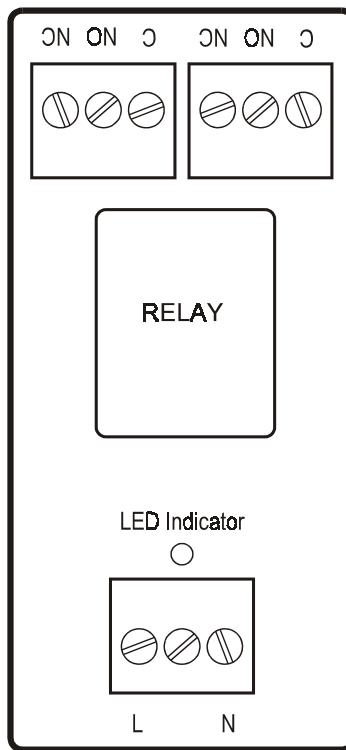
CONTACT OUTPUTS

**All connectors are separate,
unpluggable units for ease of
maintenance and troubleshooting.**

**Different model units will differ
slightly in labeling according to
the voltage input of the relay.**

**The LED status indicator will light
when the input is energized.**

**The middle pin of the input
connector is not used at this time.**



POWER INPUT

ORDERING INFORMATION:

120V MODELS: 2RB-120VAC
24V MODELS: 2RB-24VAC or 2RB-24VDC
12V MODELS: 2RB-12VDC

WARRANTY: Control Systems, Inc. (CSI) warrants equipment of its own manufacture to be free from defects in material and workmanship, under normal conditions of use and service, and will replace any component found to be defective on its return to CSI, transportation charges prepaid, within one year of its original purchase. CSI will extend the same warranty protection on accessories which is extended to CSI by the original manufacturer. CSI also assumes no liability, express or implied, beyond its obligation to replace any component involved. Such warranty is in lieu of all other warranties express or implied.



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Document Revision: A

1-1/2" X 13/32" MIDGET FUSES



Amp-trap ATQ midget time-delay fuses are rated at 500 volts AC with 42 ampere ratings from 1/10 to 30A. They are an excellent choice for supplemental protection of circuits up to 30A where the available short circuit current does not exceed 10,000A. (Not for Branch Circuit Protection).

HIGHLIGHTS:

- Time Delay

APPLICATIONS:

- Supplemental protection of lighting, solenoid, motor, and transformer circuits

Features/Benefits

- **Numerous ratings** for a wide variety of applications up to 500VAC
- **Time Delay** (12 seconds at 200% rating) for circuits with high inrush current
- Can be used with **ULTRASAFE™** Fuseholders

Ratings

- **AC:** 1/10 to 30A 500VAC, 10KA I.R.

Approvals

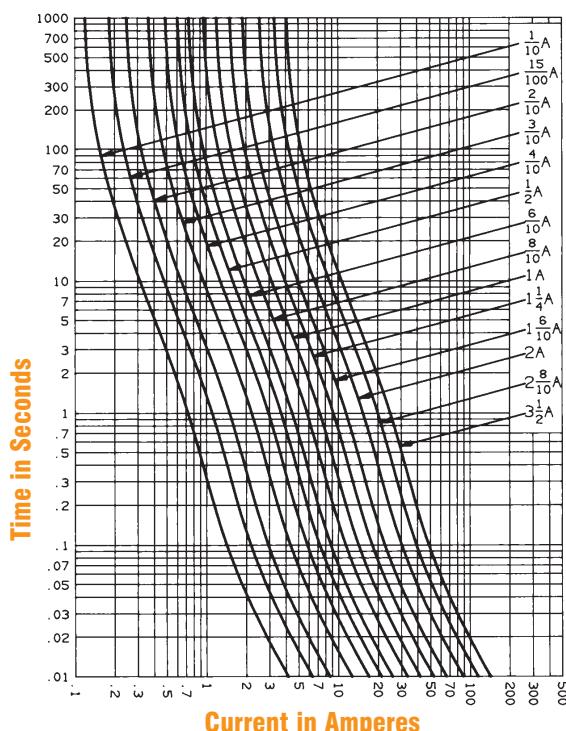
- UL Listed to Standard 248-14
- CSA Certified to Standard C22.2 No. 248.14



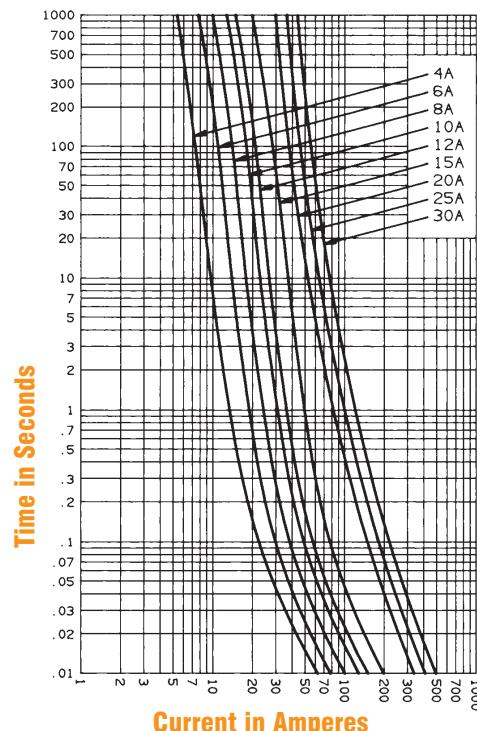
Standard Fuse Ampere Ratings, Catalog Numbers

AMPERE RATING	CATALOG NUMBER												
1/10	ATQ1/10	3/10	ATQ3/10	1-1/8	ATQ1-1/8	2	ATQ2	3-2/10	ATQ3-2/10	6	ATQ6	12	ATQ12
1/8	ATQ1/8	4/10	ATQ4/10	1-1/4	ATQ1-1/4	2-1/8	ATQ2-1/8	3-1/2	ATQ3-1/2	6-1/4	ATQ6-1/4	14	ATQ14
15/100	ATQ15/100	1/2	ATQ1/2	1-4/10	ATQ1-4/10	2-1/4	ATQ2-1/4	4	ATQ4	7	ATQ7	15	ATQ15
3/16	ATQ3/16	6/10	ATQ6/10	1-1/2	ATQ1-1/2	2-1/2	ATQ2-1/2	4-1/2	ATQ4-1/2	8	ATQ8	20	ATQ20
2/10	ATQ2/10	8/10	ATQ8/10	1-6/10	ATQ1-6/10	2-8/10	ATQ2-8/10	5	ATQ5	9	ATQ9	25	ATQ25
1/4	ATQ1/4	1	ATQ1	1-8/10	ATQ1-8/10	3	ATQ3	5-6/10	ATQ5-6/10	10	ATQ10	30	ATQ30

Melting Time – Current Data 1/10 - 3-1/2 Amperes, 500 Volts AC



Melting Time – Current Data 4 - 30 Amperes, 500 Volts AC



UWZ Series AC VOLTAGE

**For within panels or indoor
mounting-non-resetable**

All models are light grey
color with white numerals on
black background. Tents and
hundredths numerals are
yellow. An orange dial
adjacent to the hundredths
digit provides running
indication.

 UL FILE: E86119



 CSA FILE: LR44080

UWZ 48E Flush Mount



- Bezel: 1.89" x 1.89" (48 x 48mm)
- Capacity: 99,999.99 hours
- Mounting: Flush
- Digits: 7 – 0.16" high numerals
- Voltage: 24, 120, 240, 50 or 60Hz
- Power Consumption: 1VA
- Temperature: -40° to 160°F (-40° to 72°C)
- Termination: Combination 1/4" spade and screw clamp
- Weight: 2.1oz.

Flush mounted with bracket. The UWZ 48E unit fits into a 1.79 x 1.79in. (45.5 x 45.5mm) cut-out. The thickness of the panel for flush mounting can be up to 0.35in. (9mm). The unit is secured in position by a plastic slip-on retaining bracket. Also fits square or round openings for 72mm meters with optional 72mm bezel.

Ord. Info.: UWZ 48E – voltage/freq.

UWZ 48 Surface Mount



- Bezel: 1.89" x 1.89" (48 x 48mm)
- Capacity: 99,999.99 hours
- Mounting: Surface
- Digits: 7 – 0.16" high numerals
- Voltage: 24, 120, 240, 50 or 60Hz
- Power Consumption: 1VA
- Temperature: -40° to 160°F (-40° to 72°C)
- Termination: Screw Lugs
- Weight: 2.5oz.

Surface mounted type. The UWZ 48 unit with plug-in base where terminal protection is not necessary. The socket base is easy to install and connect. The meter is simply plugged into the base and secured by one screw.

Ord. Info.: UWZ 48 – voltage/freq.

UWZ 48A Enclosed Surface Mount



- Bezel: 1.89" x 1.89" (48 x 48mm)
- Capacity: 99,999.99 hours
- Mounting: Surface
- Digits: 7 – 0.16" high numerals
- Voltage: 24, 120, 240, 50 or 60Hz
- Power Consumption: 1VA
- Temperature: -40° to 160°F (-40° to 72°C)
- Termination: Screw Lugs
- Weight: 2.5oz.

Wall mounted type. Used in conjunction with a terminal cover for added safety, the UWZ 48A is surface mounted. Installation merely requires fixing the base to wall or panel with two screws, wiring the base, and plugging in the meter with the terminal cover.

Ord. Info.: UWZ 48A – voltage/freq.

UWZ 48V DIN Rail Mount



- Bezel: 1.89" x 1.89" (48 x 48mm)
- Capacity: 99,999.99 hours
- Mounting: DIN Rail
- Digits: 7 – 0.16" high numerals
- Voltage: 24, 120, 240, 50 or 60Hz
- Power Consumption: 1VA
- Temperature: -40° to 160°F (-40° to 72°C)
- Termination: Combination 1/4" spade and screw clamp
- Weight: 2.5oz.

DIN rail mounting. A special snap-on socket base enables the unit to be quickly and simply fitted on DIN rail.

Ord. Info.: UWZ 48V – voltage/freq.

UWZ 52E Flush Mount



- Bezel: 2.28" round (58mm)
- Capacity: 99,999.99 hours
- Mounting: Flush
- Digits: 7 – 0.16" high numerals
- Voltage: 24, 120, 240, 50 or 60Hz
- Power Consumption: 1VA
- Temperature: -40° to 160°F (-40° to 72°C)
- Termination: Combination 1/4" spade and screw clamp
- Weight: 2.1oz.

Flush mounted with bracket. The UWZ 52E with round face is fastened with a plastic slip-on retaining bracket. For larger cutouts up to a 60mm diameter, a slip-on 65mm ø bezel is available.

Ord. Info.: UWZ 52E – voltage/freq.



Application

Designed for use as a wiring box and junction box. Enclosure provides protection in outdoor installations against rain, sleet and snow, or indoors against dripping water.

Construction

- 16 gauge or 14 gauge galvanized steel
- Drip shield top and seam-free sides, front, and back protect from rain, snow, or sleet
- 16 gauge galvanized steel continuous hinge has stainless steel pin
- Cover fastened securely with captive plated steel screws
- Hasp and staple provided for padlocking
- No gasketing or knockouts
- Collar studs provided for mounting optional panels

Finish

ANSI 61 gray polyester powder finish inside and out over galvanized steel. Optional panels are white.

Industry Standards

UL 50, File No. E27567, Type 3R
NEMA/EEMAC Type 3R
CSA, File No. LL42184, Type 3R (See table)
IEC 60529, IP32

Accessories

See General Accessories index.

Corrosion Inhibitors
Electric Heater
Grounding Device
Lock Kit (Keylock) for Type 12
Panel Support Kit
Panels (See table)
Rack Mounting Angle Kit
Terminal Kit Assembly
Touch-Up Paint (A-TPPY61)
Window Kit

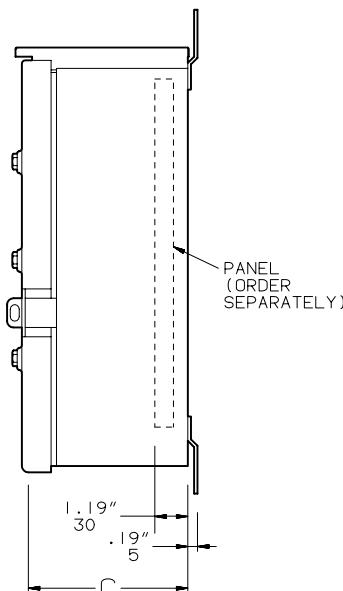
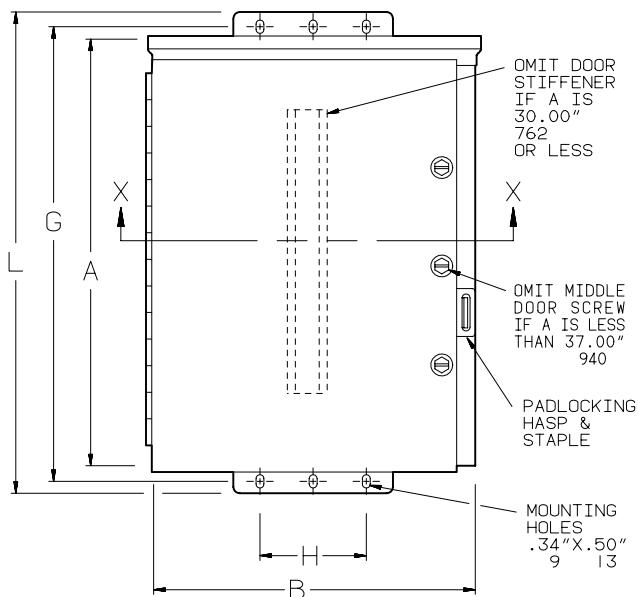
Standard Sizes Hinged Cover Type 3R Medium Enclosures

Enclosure Catalog Number	Enclosure Size A x B x C	* Panel Catalog Number	Panel Size D x E	Mounting G x H	Overall L	Stiffener Door / Body
† A-16R126HCR	16.00 x 12.00 x 6.00 (406 x 305 x 152)	A-16P12	13.00 x 9.00 (330 x 229)	17.00 x 5.00 (432 x 127)	18.00 (457)	0 0
† A-16R166HCR	16.00 x 16.00 x 6.00 (406 x 406 x 152)	A-16P16	13.00 x 13.00 (330 x 330)	17.00 x 13.00 (432 x 330)	18.00 (457)	0 0
† A-20R166HCR	20.00 x 16.00 x 6.00 (508 x 406 x 152)	A-20P16	17.00 x 13.00 (432 x 330)	21.00 x 13.00 (533 x 330)	22.00 (559)	0 0
† A-20R208HCR	20.00 x 20.00 x 8.00 (508 x 508 x 203)	A-20P20	17.00 x 17.00 (432 x 432)	21.00 x 13.00 (533 x 330)	22.00 (559)	0 0
† A-24R208HCR	24.00 x 20.00 x 8.00 (610 x 508 x 203)	A-24P20	21.00 x 17.00 (533 x 432)	25.00 x 13.00 (635 x 330)	26.00 (660)	0 0
† A-24R248HCR	24.00 x 24.00 x 8.00 (610 x 610 x 203)	A-24P24	21.00 x 21.00 (533 x 533)	25.00 x 13.00 (635 x 330)	26.00 (660)	0 0
A-30R248HCR	30.00 x 24.00 x 8.00 (762 x 610 x 203)	A-30P24	27.00 x 21.00 (686 x 533)	31.00 x 13.00 (787 x 330)	32.00 (813)	0 0
A-24R2410HCR	24.00 x 24.00 x 10.00 (610 x 610 x 254)	A-24P24	21.00 x 21.00 (533 x 533)	25.00 x 13.00 (635 x 330)	26.00 (660)	0 0
A-30R2410HCR	30.00 x 24.00 x 10.00 (762 x 610 x 254)	A-30P24	27.00 x 21.00 (686 x 533)	31.00 x 13.00 (787 x 330)	32.00 (813)	0 0
A-30R3012HCR	30.00 x 30.00 x 12.00 (762 x 762 x 305)	A-30P30	27.00 x 27.00 (686 x 686)	31.00 x 27.00 (787 x 686)	32.00 (813)	0 1
A-36R2412HCR	36.00 x 24.00 x 12.00 (914 x 610 x 305)	A-36P24	33.00 x 21.00 (838 x 533)	37.00 x 13.00 (940 x 330)	38.00 (965)	0 1
A-36R3012HCR	36.00 x 30.00 x 12.00 (914 x 914 x 305)	A-36P30	33.00 x 27.00 (838 x 686)	37.00 x 27.00 (940 x 686)	38.00 (965)	0 1
A-42R3012HCR	42.00 x 30.00 x 12.00 (1067 x 914 x 305)	A-42P30	39.00 x 27.00 (991 x 686)	43.00 x 27.00 (1092 x 686)	44.00 (1118)	1 1
A-36R3612HCR	36.00 x 36.00 x 12.00 (914 x 914 x 305)	A-36P36	33.00 x 33.00 (838 x 838)	37.00 x 27.00 (940 x 686)	38.00 (965)	1 1
A-42R3612HCR	42.00 x 36.00 x 12.00 (1067 x 914 x 305)	A-42P36	39.00 x 33.00 (991 x 838)	43.00 x 27.00 (1092 x 686)	44.00 (1118)	1 1
A-48R3612HCR	48.00 x 36.00 x 12.00 (1219 x 914 x 305)	A-48P36	45.00 x 33.00 (1143 x 838)	49.00 x 27.00 (1245 x 686)	50.00 (1270)	1 1
A-60R3612HCR	60.00 x 36.00 x 12.00 (1524 x 914 x 305)	A-60P36	57.00 x 33.00 (1448 x 838)	61.00 x 27.00 (1549 x 686)	62.00 (1575)	1 1
A-30R3016HCR	30.00 x 30.00 x 16.00 (762 x 762 x 406)	A-30P30	27.00 x 27.00 (686 x 686)	31.00 x 27.00 (787 x 686)	32.00 (813)	0 1
A-48R3616HCR	48.00 X 36.00 X 16.00 (1219 X 914 X 406)	A-48P36	45.00 X 33.00 (1143 X 838)	49.00 X 27.00 (1245 X 686)	50.00 (1270)	1 1

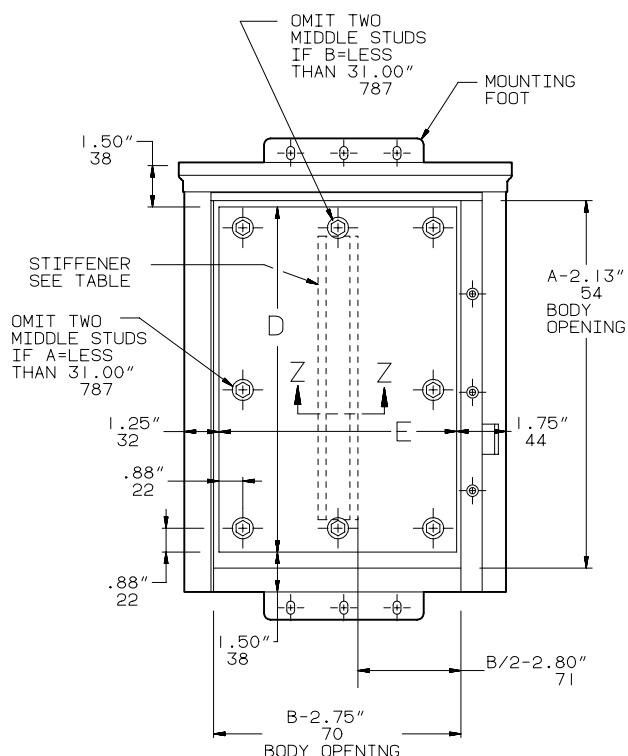
Millimeter dimensions () are for reference only; do not convert metric dimensions to inch.

* Panels must be ordered separately. Optional aluminum panels are available for most sizes. See General Accessories.

† Certified by Canadian Standards Association. Specify CSA label when ordering.

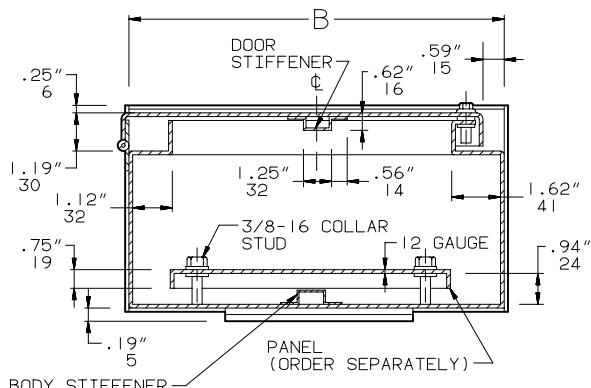


NOTE: Panels have flanges along sides which are more than 21.00 inches (533mm) long, except A-24P20 and A-24P24 which have flanges on two sides.

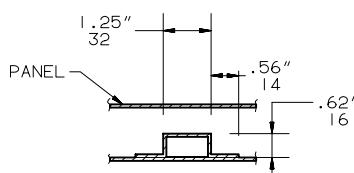


Inch
Millimeter

Door Removed



SECTION X-X



SECTION Z-Z

Power Distribution Blocks

600 Volts AC/DC

Specifications:

- Connector, High Conductive Aluminum, Tin Plated, Rated for Copper and Aluminum Wire
- CU Connector, High Conductive Copper, Tin Plated, Rated for Copper Wire Only
- Multiple wire rating - refer to datasheets for details
- UL Recognized File No. XCFR2.E62806
- CSA Certified File No. LR19766
- Up to 1000 Volts AC/DC
- Flexible Stranded Wire Compliant
- RoHS Compliant



Power Blocks

Replace "X" with # of poles

Catalog #	Hinge Cover	Poles (X)	Amps	MATERIAL		LINE SIDE			LOAD SIDE		
				Insulator	Conn.	Wire Range AWG/kcmil	Openings Per Pole	Connector Configuration	Wire Range AWG/kcmil	Openings Per Pole	Connector Configuration
143X554		1/2/3	310	Phenolic	AL	350 kcmil - #6 AWG	1		2/0 - #14 AWG	2	
144X401		1/2/3	335	Phenolic	AL	400 kcmil - #6 AWG	1		#2 - #14 AWG	6	
143X552		1/2/3	335	Phenolic	AL	400 kcmil - #6 AWG	1		#2 - #14 AWG	4	
143X553		1/2/3	335	Phenolic	AL	400 kcmil - #6 AWG	1		#2 - #14 AWG	6	
144X560		1/2/3	335	Phenolic	AL	400 kcmil - #6 AWG	1		#2 - #14 AWG	8	
133X552	CH	1/2/3	335	Plastic	AL	400 kcmil - #6 AWG	1		#2 - #14 AWG	4	
143X555		1/2/3	350	Phenolic	AL	2/0 - #14 AWG	2		#4 - #14 AWG	6	
133X555	CH	1/2/3	350	Plastic	AL	2/0 - #14 AWG	2		#4 - #14 AWG	6	
143X955		1/2/3	350	Phenolic	CU	2/0 - #14 AWG	2		#4 - #14 AWG	6	
133X955	CH	1/2/3	350	Plastic	CU	2/0 - #14 AWG	2		#4 - #14 AWG	6	
143X953		1/2/3	380	Phenolic	CU	500 kcmil - #4 AWG	1		#2 - #14 AWG	6	

CH = Block is also available with hinge cover attached - include "CH" at end of part number when ordering (not available on Adder blocks) - See page 58 for available covers

See pages 55-57 for dimensional information

Power Distribution Blocks

600 Volts

Power Blocks

Specifications:

- Connector, High Conductive Aluminum, Tin Plated
- Rated for Copper and Aluminum Wire
- Amp Rating Based on NEC Table 310-16 Using 75°C Copper Wire
- UL Recognized File No. XCFR2.E62806
- CSA Certified File No. LR19766
- **CE**
- For detailed SCCR information, please visit www.marathonsp.com



** Openings rated for #4-14 AWG are multiple wire rated:
(2) #10 CU Str, (2 to 4) #12 CU Str, and (2 to 4) #14 CU Str.

*** Openings rated for #2-14 AWG are multiple wire rated:
(2) #8 CU Str, (2) #10 CU Str, (2) #12 CU Str, and
(2) #14 CU Str

Catalog #	Hinge Cover	Poles	Amps	Material	Connector Configuration	Line Wire Range	Openings Per Pole	Connector Configuration	Load Wire Range	Openings Per Pole
1411403		1								
1412403		2								
1413403		3								
1414403		4								
1411400		1								
1412400		2								
1413400		3								
1414400		4								
1320570		Adder								
1321570	CH	1								
1322570	CH	2								
1323570	CH	3								
1421570		1								
1422570		2								
1423570		3								
1320580		Adder								
1321580	CH	1								
1322580	CH	2								
1323580	CH	3								
1402402		2								
1403402		3								
1402401		2								
1403401		3								
1402404		2								
1403404		3								
1331554	CH	1								
1332554	CH	2								
1333554	CH	3								
1441401		1								
1442401		2								
1443401		3								
1431552		1								
1432552		2								
1433552		3								
1431553		1								
1432553		2								
1433553		3								
1441560		1								
1442560		2								
1443560		3								
1331552	CH	1								
1332552	CH	2								
1333552	CH	3								

CH = Available with hinge cover attached

See pages 54-56 for dimensional information



PHASE MONITORS

THREE PHASE MOTOR PROTECTION

MADE IN
THE U.S.A.

BASIC MODELS:

DPDT / Surface Mount

002-230-123
002-480-123



UL FILE #E101681



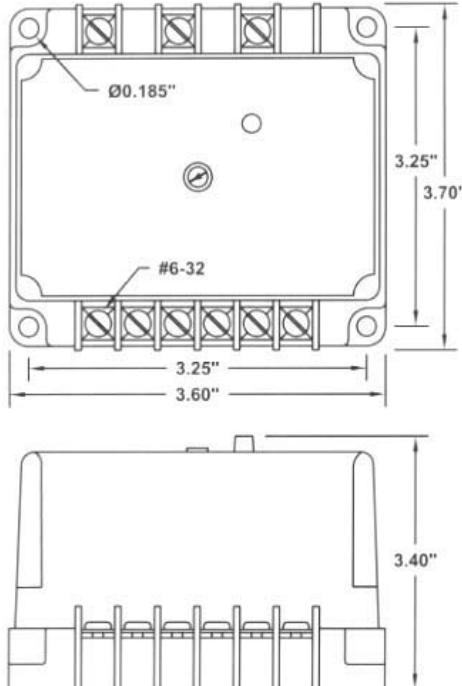
PROTECTS AGAINST:

Under Voltage
Phase Loss
Phase Reversal
Phase Unbalance
(Optional Over Voltage)

OPERATION

When proper voltage is connected to the phase monitor the internal relay will be energized and the LED will come on steady. An abnormal condition will cause the LED to blink during the trip delay. When the trip delay has expired the internal relay will be de-energized. The LED will then provide a series of pulses that indicate which fault condition is present. When conditions return to normal, the LED will blink during the reset delay. When the reset delay has expired, the LED will come on steady and the internal relay will be energized. The reset delay is also active immediately after power is turned on to the unit.

These units can be used on Delta or Wye systems, 50/60 Hz.



SPECIFICATIONS

Under Voltage:

- Trip: - 15% of Setting for 230V (-10% for 480V)
Reset: - 12% of Setting for 230V (-8% for 480V)

Over Voltage:

- Trip: + 15% of Setting for 230V (+10% for 480V)
Reset: + 12% of Setting for 230V (+8% for 480V)

Phase Unbalance:

- Trip: 7% with 5 Second Trip Delay
15% with 1 Second Trip Delay

- Reset: 6%

Trip Delay:

5 Seconds (Delay is Reduced to 1 Second if Phase Unbalance is 15% or Greater)

2 Seconds Standard (See Options)

Voltage Range:

200V to 240V or 425V to 525V

Output Rating:

10A Resistive @ 240VAC

6A Inductive @ 240VAC

Operating Temp:

-40°C to +50 °C

Storage Temp:

-45°C to +85 °C

Enclosure:

White Lexan

LED STATUS	CONDITION	A	B	C
ON STEADY	NORMAL	•	•	•
██████████	TRIP or RESET	1	3	5
████	UNDERVOLTAGE	7	8	9
████	OVERTOWTAGE	10	11	12
████	Ø UNBALANCE			
████	Ø REVERSAL			

ORDERING INFORMATION

002 - XXX - 12 3 - XXXXX

Product Type

Operating Voltage

(230,480)

Relay Type (DPDT)

Base (Surface Mount)

Options:

OV - Over Voltage

G5 - 5 Second Reset Delay

G10 - 10 Second Reset Delay

G20 - 20 Second Reset Delay

G30 - 30 Second Reset Delay

G60 - 60 Second Reset Delay

TradeMaster® & Specification Grade GFCI Receptacles

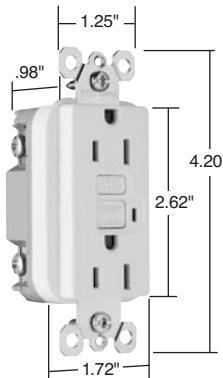
2 Pole, 3 Wire Grounding 15 & 20A, 125VAC

Features

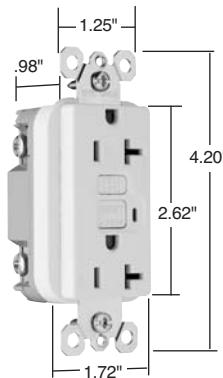
- Meets 2006 UL requirements.
- SafeLock™ Protection: if critical components are damaged and ground fault protection is lost, power to receptacle is disconnected.
- Prevents line-load reversal miswire: no power to the face or downstream receptacles if wired incorrectly.
- Exceeds UL943 voltage surge requirements; survives 100x the required UL 3kA/6kV voltage surge test cycles.
- FSUL Listed (Federal Specification WC596).
- Trip indicator light (red lamp).
- Side or internal screw-pressure-plate back wire with #10 - #14 AWG solid or stranded copper wire.
- Two back wire holes per terminal.
- Ground screw has a back wire clamp for easy installation.
- 1/4" thinner than competitors' GFCIs; leaves more room for wires in the box.
- Mounting screws are shipped captive in the device and wall plate for easier installation.
- High-impact-resistant thermoplastic construction.
- Extra-long strap.
- Button colors match the device face.
- Dual-direction test and reset buttons.
- Class A rated GFCI.
- Supplied with matching TP26 nylon wall plate.
- Tri-drive screws.
- GFCIs with Auto-Ground assure a positive ground to metal box.

Specifications

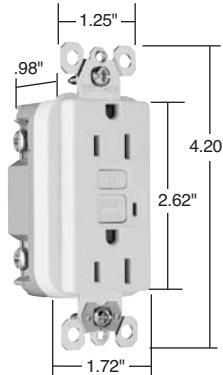
- | | |
|-------------------------------------|--|
| ■ Supply Voltage: 125VAC, 60 Hz | ■ Trip Time: 0.025 sec., nominal per UL Standard |
| ■ Supply Voltage Range: 102-132 VAC | ■ 20 Amp feed-thru capacity |
| ■ Trip Threshold: 5± 1mA | |



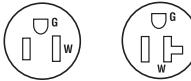
1595-W



2095-W



1595-SW

NEMA
5-15RNEMA
5-20R

Catalog Number	Rating A. VAC	Color	NEMA Config. No.	3rd Party Compliance		
				UL943 C22.2 No. 144	UL498 C22.2 No. 42	FSUL WC596
TradeMaster®/Spec Grade 15 Amp Duplex GFCI						
1595-I	15	Ivory	5-15R	•	•	•
1595-W	15	White	5-15R	•	•	•
1595	15	Brown	5-15R	•	•	•
1595-GRY	15	Gray	5-15R	•	•	•
1595-BK	15	Black	5-15R	•	•	•
1595-RED	15	Red	5-15R	•	•	•
1595-LA	15	Light Almond	5-15R	•	•	•
TradeMaster®/Spec Grade 15 Amp Duplex GFCI with Auto-Ground						
1595-SI	15	Ivory	5-15R	•	•	•
1595-SW	15	White	5-15R	•	•	•
1595-SLA	15	Light Almond	5-15R	•	•	•
Specification Grade 20 Amp Duplex GFCI						
2095-I	20	Ivory	5-20R	•	•	•
2095-W	20	White	5-20R	•	•	•
2095	20	Brown	5-20R	•	•	•
2095-GRY	20	Gray	5-20R	•	•	•
2095-BK	20	Black	5-20R	•	•	•
2095-RED	20	Red	5-20R	•	•	•
2095-LA	20	Light Almond	5-20R	•	•	•
Specification Grade 20 Amp Duplex GFCI with Auto-Ground						
2095-SI	20	Ivory	5-20R	•	•	•
2095-SW	20	White	5-20R	•	•	•
2095-SLA	20	Light Almond	5-20R	•	•	•

Available Spring 2006.

For Configurable Solutions, see Page U-1.

All devices listed on this page conform to NEMA WD-1 and WD-6.

Available in Bulk Packaging,
i.e. 1595-W20 is 20 pack,
1595-W100 is 100 pack.
Please contact Customer
Support at 1-800-223-4189.

VBR- Bracket

Die cast aluminum construction with sturdy wall mounting bracket. Medium base socket and a variety of globes to choose from. Available in incandescent up to 300 watts and 13 or 22 watt fluorescent. Fits 4" box. Lamp not included.

Finish: Natural
 Silver Gray
 White
 Black

New!
Colors!



VBR100DG
shown in silver gray

Product Information

Fixture with:

clear glass & die cast guard	
clear glass & wire clamp guard	
clear glass globe	
clear Permaglobe	
white Permaglobe	
Fixture less globe	
13 watt Fluorescent, 120 Volt	
22 watt Fluorescent, 120 Volt 3/4" tapped hubs	
Finish: <input checked="" type="radio"/> Silver Gray <input type="radio"/> White <input type="radio"/> Black	

Catalog Numbers

100 Series	200 Series
150w Glass	300w Glass
75w Permaglobe	150w Permaglobe
VBR100DG	VBR200DG
VBR100G	VBR200G
VBR100	VBR200
VBR100P	VBR200P
VBR100PW	VBR200PW
VBR1	VBR2
add /F13	
	add /F22
add S	add S
add W	add W
add B	add B
Natural, no suffix	Natural & 1/2" hubs, no suffix

VXBR- Bracket & Box

Die cast aluminum construction. Wall bracket plus junction box with sturdy mounting lugs. Medium base socket, 1/2" or 3/4" NPS hub size and a variety of globes to choose from. Available in incandescent up to 300 watts and 13 or 22 watt fluorescent. Lamp not included.

Finish: Natural
 Silver Gray
 White
 Black

New!
Colors!



VXBR100DG
shown in silver gray

Adjustable Pendant

Universal swivel permits mounting at any angle and locks in place. Die cast aluminum construction. Medium base socket and a variety of globes to choose from. Available in incandescent up to 300 watts and 13 or 22 watt fluorescent. Lamp not included.

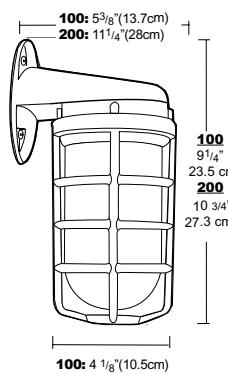
Finish: Natural



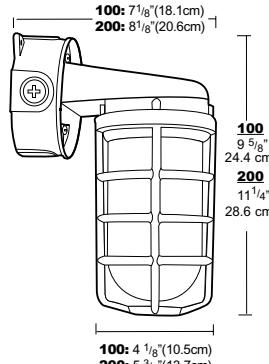
VA100DG
shown in Natural

Dimensions

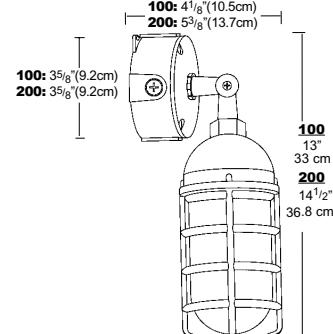
VBR100DG & VBR200DG



VXBR100DG & VXBR200DG



VA100DG & VA200DG



Permaglobes

Unbreakable Polycarbonate threaded globes to fit RAB and other standard Vaporproof fixtures. Lamp base up only. Observe wattage restrictions of 75 watts for 100 series and 150 watts for 200 series

**Prismatic Globes**

Prismatic glass globes hide the light source and allow maximum light output in RAB and other standard Vaporproof fixtures.

**Heat Resistant**

Highly tempered crystal lime glass to withstand high ambient temperatures in RAB and other standard Vaporproof fixtures. Standard threads.

**Ball**

Decorative Ball shaped threaded opal white globes in both glass and unbreakable polycarbonate to fit RAB 100 Series Vaporproof fixtures.

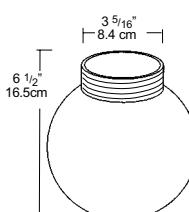
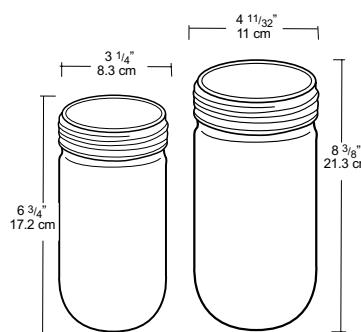
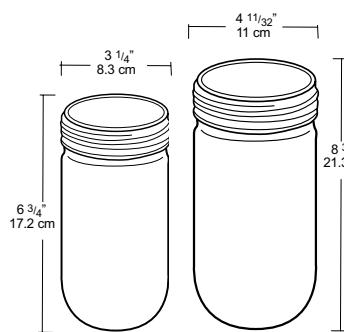
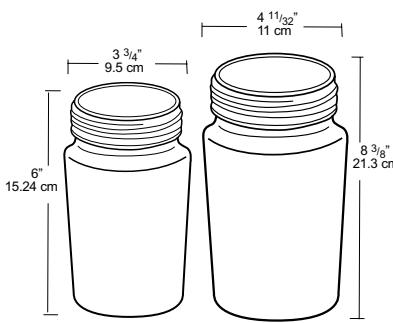


Color	75 watts	150 watts
Clear	GL100PG	GL200PGR
Opal	GL100PGW	GL200PGW
Ruby	GL100PGR	GL200PGR
Blue	GL100PGB	GL200PGB
Green	GL100PGG	GL200PGG
Amber	GL100PGA	GL200PGA

Color	150 watts	300 watts
Prismatic	GL100PRIS	GL200PRIS

Color	150 watts	300 watts
Clear	GL100HR	GL200HR

Shape	Watts	Catalog #:
Ball Glass	150	GL100BO
Ball Poly	75	GL100BPGO



Molded Case Circuit Breakers

DIN Rail Mounted Circuit Breakers

Selection/Dimensions

1-Pole DIN Rail (120V AC)

Breaker Type	Ampere Rating	Catalog Number	Load Side Connector	List Price \$	"Interrupting Ratings (KA) (RMS Symmetrical Amperes)" Volts AC	
					120	120/240
"BQXD 1-Pole 120V DIN Rail"	10	BQ1B010QLD	TC1Q1	33.50	10	
	15	BQ1B015QLD	TC1Q1	33.50	10	
	20	BQ1B020QLD	TC1Q1	33.50	10	
	25	BQ1B025QLD	TC1Q1	33.50	10	
	30	BQ1B030QLD	TC1Q1	33.50	10	
	35	BQ1B035QLD	TC1Q1	33.50	10	
	40	BQ1B040QLD	TC1Q1	33.50	10	
	45	BQ1B045QLD	TA1Q1	33.50	10	
	50	BQ1B050QLD	TA1Q1	33.50	10	
	60	BQ1B060QLD	TA1Q1	33.50	10	
	10	BQ1B010QXD	Quick-Connect	39.50	10	
	15	BQ1B015QXD	Quick-Connect	39.50	10	
	20	BQ1B020QXD	Quick-Connect	39.50	10	
	25	BQ1B025QXD	Quick-Connect	39.50	10	
	30	BQ1B030QXD	Quick-Connect	39.50	10	
	35	BQ1B035QXD	Quick-Connect	39.50	10	
	40	BQ1B040QXD	Quick-Connect	39.50	10	
	45	BQ1B045QXD	Quick-Connect	39.50	10	
	50	BQ1B050QXD	Quick-Connect	39.50	10	
	60	BQ1B060QXD	Quick-Connect	39.50	10	

2-Pole DIN Rail (120/240V AC)

"BQXD 2-Pole 120/240V DIN Rail"	10	BQ2B010QLD	TC1Q1	76.00		10
	15	BQ2B015QLD	TC1Q1	76.00		10
	20	BQ2B020QLD	TC1Q1	76.00		10
	25	BQ2B025QLD	TC1Q1	76.00		10
	30	BQ2B030QLD	TC1Q1	76.00		10
	35	BQ2B035QLD	TC1Q1	76.00		10
	40	BQ2B040QLD	TC1Q1	76.00		10
	45	BQ2B045QLD	TA1Q1	76.00		10
	50	BQ2B050QLD	TA1Q1	76.00		10
	60	BQ2B060QLD	TA1Q1	76.00		10
	10	BQ2B010QXD	Quick-Connect	91.00		10
	15	BQ2B015QXD	Quick-Connect	91.00		10
	20	BQ2B020QXD	Quick-Connect	91.00		10
	25	BQ2B025QXD	Quick-Connect	91.00		10
	30	BQ2B030QXD	Quick-Connect	91.00		10
	35	BQ2B035QXD	Quick-Connect	91.00		10
	40	BQ2B040QXD	Quick-Connect	91.00		10
	45	BQ2B045QXD	Quick-Connect	91.00		10
	50	BQ2B050QXD	Quick-Connect	91.00		10
	60	BQ2B060QXD	Quick-Connect	91.00		10

Lugs-For Use with BQ, BQH, HBO®

Circuit Breaker Amp. Rtg.	Cab. Per Lug	Lug Wire Range AWG	Catalog Number	List Price \$ (Qty. 6)
Line Side				
10-40	1	#16-#6 Cu #12-#6 Al	TC1Q1 ^{①②}	2.60
45-100	1	#8-#1 Cu #6-#1/0 Al	TA1Q1	2.60
Load Side				
10	2	#16 Cu	Connectors are Supplied with Circuit Breaker	
15-20	1	#14-#10 Cu #12-#10 Al		
25-35	1	#14-#6 Cu #12-#10 Al		
40-50	1	#8-#6 Cu #8-#4 Al		
55-70	1	#8-#4 Cu #8-#2 Al		
80-100	1	#4-#1/0 Cu #2-#1/0 Al		
110-125	1	#2-#1/0 Cu #1/0-#2/0 Al		

For inches / millimeters conversion, see Application Data section.

■ Built to order. Allow 2-3 weeks for delivery.

①Terminals are UL Listed for 60°/75°C conductors. Also CSA Listed.

②Connector has steel construction.

③Surface mounted indoor. If flush mounting is required, replace suffix "S" in catalog number with suffix "F".

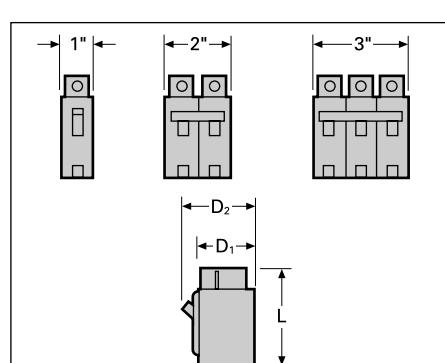
④Discount Schedule B.

⑤Does not include circuit breaker. Order circuit breaker separately.

⑥Neutral included in enclosure.

⑦Enclosure will not accept circuit breakers with shunt trips or auxiliary switches installed.

Discount Schedule MCCB



Breaker Type	Amperes	Dimensions (inches)		
		L	D1	D2
BQ, BQH	15-50	3 1/4	2 1/2	3
BQ, BQH	55-125	4	2 1/2	3
HBO	15-125	4	2 1/2	3
BQXD	15-60	4 1/2	2 1/2	3

Finger Safe Terminal Shield

Protects against accidental contact with lugs-1 per lug. Fits line and load end.

Catalog Number	Qty	List Price \$ each
BQFS2	2	2.10
BQFS1K	1000	1.40

Enclosures

Type	Catalog Number ^{④⑤}	List Price \$ ^{④⑤}
1	EB3100S ^{③⑦}	189.00
3R	WB3100	249.00

④Type BQXD uses TA1Q1 or TC1Q1 lugs on line side of circuit breaker.

Enclosures Section 5
Accessories pages 6-86 to 6-91

Circuit Breakers

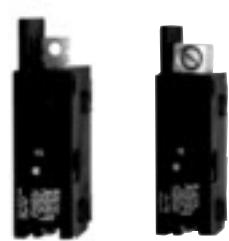
Lug-In/Lug-Out with INSTA-WIRE

Selection

All BQ/BQH/HBQ circuit breakers are supplied with load side lugs. If line side lugs are required, add suffix "L" to catalog number. Consult Siemens for any additional charge. All standard circuit breakers are calibrated for 40°C maximum ambient application.

1-Pole Plug-In (120V AC)^{①⑤}

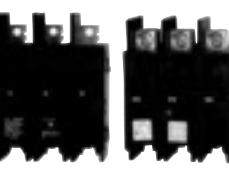
Continuous Current Rating @ 40°C	Type BQ		Type BQH		Type HBQ	
	10,000A IR		22,000A IR		65,000A IR	
	Catalog Number	List Price \$	Catalog Number	List Price \$	Catalog Number	List Price \$
10	BQ1B010	33.50	BQ1B010H	—	HB1B010	—
15	BQ1B015 ^④	33.50	BQ1B015H ^④	66.00	HB1B015 ^④	113.00
20	BQ1B020 ^④	33.50	BQ1B020H ^④	66.00	HB1B020 ^④	113.00
25	BQ1B025	33.50	BQ1B025H■	66.00	HB1B025■	113.00
30	BQ1B030	33.50	BQ1B030H	74.00	HB1B030■	113.00
35	BQ1B035■	33.50	BQ1B035H■	74.00	HB1B035■	113.00
40	BQ1B040	33.50	BQ1B040H	74.00	HB1B040■	132.00
45	BQ1B045■	33.50	BQ1B045H■	74.00	HB1B045■	132.00
50	BQ1B050	33.50	BQ1B050H	74.00	HB1B050■	132.00
60	BQ1B060■	33.50	BQ1B060H■	74.00	HB1B060■	132.00
70	BQ1B070■	33.50	BQ1B070H■	92.00	HB1B070■	142.00



1-Pole



2-Pole



3-Pole

2-Pole Plug-In (Common-Trip 120/240V AC)^{①⑥}

10	BQ2B010	76.00	—	—	HB2B010■	276.00
15	BQ2B015	76.00	BQ2B015H	149.00	HB2B015■	276.00
20	BQ2B020	76.00	BQ2B020H	149.00	HB2B020■	276.00
25	BQ2B025	76.00	BQ2B025H■	149.00	HB2B025■	276.00
30	BQ2B030	76.00	BQ2B030H	149.00	HB2B030■	276.00
35	BQ2B035	76.00	BQ2B035H■	149.00	HB2B035■	276.00
40	BQ2B040	76.00	BQ2B040H	149.00	HB2B040■	276.00
45	BQ2B045	76.00	BQ2B045H■	149.00	HB2B045■	276.00
50	BQ2B050	76.00	BQ2B050H	149.00	HB2B050■	338.00
60	BQ2B060	76.00	BQ2B060H	149.00	HB2B060■	338.00
70	BQ2B070	149.00	BQ2B070H■	224.00	HB2B070■	552.00
80	BQ2B080	203.00	BQ2B080H■	326.00	HB2B080■	624.00
90	BQ2B090	203.00	BQ2B090H■	326.00	HB2B090■	624.00
100	BQ2B100	203.00	BQ2B100H	326.00	HB2B100■	624.00
110	BQ2B110	407.00	BQ2B110H	864.00	HB2B110■	1794.00
125	BQ2B125	431.00	BQ2B125H	1112.00	HB2B125■	1794.00

2-Pole Plug-In (Common-Trip 240V AC)^{①③⑥}

15	BQ2H015	203.00	—	—	—	—
20	BQ2H020	203.00	—	—	—	—
30	BQ2H030	203.00	—	—	—	—
40	BQ2H040■	203.00	—	—	—	—
50	BQ2H050	203.00	—	—	—	—
60	BQ2H060	203.00	—	—	—	—
70	BQ2H070■	269.00	—	—	—	—
80	BQ2H080■	306.00	—	—	—	—
90	BQ2H090■	306.00	—	—	—	—
100	BQ2H100■	306.00	—	—	—	—

3-Pole Plug-In (Common-Trip 240V AC)^{①⑦}

10	BQ3B010	254.00	—	—	HB3B010	480.00
15	BQ3B015	254.00	BQ3B015H	381.00	HB3B015■	480.00
20	BQ3B020	254.00	BQ3B020H	381.00	HB3B020■	480.00
25	BQ3B025■	254.00	BQ3B025H■	381.00	HB3B025■	480.00
30	BQ3B030	254.00	BQ3B030H	381.00	HB3B030	480.00
35	BQ3B035■	254.00	BQ3B035H	381.00	HB3B035	480.00
40	BQ3B040	254.00	BQ3B040H	381.00	HB3B040	584.00
45	BQ3B045■	254.00	BQ3B045H	381.00	HB3B045	584.00
50	BQ3B050	254.00	BQ3B050H	381.00	HB3B050	584.00
60	BQ3B060	254.00	BQ3B060H	381.00	HB3B060	584.00
70	BQ3B070	311.00	BQ3B070H	463.00	HB3B070■	624.00
80	BQ3B080	351.00	BQ3B080H■	543.00	HB3B080■	734.00
90	BQ3B090	351.00	BQ3B090H■	543.00	HB3B090■	734.00
100	BQ3B100	351.00	BQ3B100H	543.00	HB3B100■	734.00

MP-T / MP-HT / MP-MT Accessories

Description	Catalog Number	Field/Factory Installed	List Price \$
120V Shunt Trip	add suffix...00S01■	Factory	141.00(adder)
24V Shunt Trip	add suffix...00S07■	Factory	141.00(adder)
120V Auxiliary Switch	add suffix...01■ ^②	Factory	83.00(adder)
1-Pole Padlocking Device	ECPLD1	Field	10.10
2-Pole Padlocking Device	ECPLD2	Field	10.20
3-Pole Padlocking Device	ECQLD3 (Pkg of 10)	Field	98.00
Handle Block	ECHBD1	Field	9.10

^① UL Listed for use with 60/75° wire through 125 amps, HACR rated.
^② 1A and 1B contacts.
^③ UL Listed for use on 3-phase grounded "B" systems — 10,000 for this application.

^④ UL Listed for frequent switching applications (SWD). 120V AC Fluorescent Lighting.
^⑤ Shipped 12 per sleeve.
^⑥ Shipped 6 per sleeve.
^⑦ Shipped 4 per sleeve.

Factory Modifications

Description	Catalog Number	List Price \$
Line Side Lugs	add suffix...L	Consult Siemens
Quick Connect Lug	add suffix...QX	7.50 (adder per pole)
400Hz Calibration	add suffix...Y ^⑧	8.00 (adder)
415V 50Hz Calibration	add suffix...E ^{⑨⑩}	No adder
Marine 50° C Ambient Calibration	add suffix...M	No adder
Fungus Proofing	add suffix...F	10.50 (adder per pole)

^⑧ UL Listed 5KA IR.
^⑨ Not UL Listed.
^⑩ 1 & 2 Poles only.
[■] Built to order. Allow 2-3 weeks for delivery

Heavy Duty Motor Starters

Solid State Overload with Auto/Manual Reset, Class 14

Selection

NEMA PRODUCTS

ESP200
Starters



Ordering Information

- Replace the (*) with a letter from the coil table. Dual voltage coils are wired on high voltage unless specified on order.
- Field Modification Kits see page 39.
- Factory Modifications see page 46.
- Dimensions see page 51.
- Wiring Diagrams see page 54.

Coil Table

60Hz Voltage	Letter
24 Separate Control	J
120 Separate Control	F
110–120/220–240 ^①	A
200–208	D
220–240	G
277	L
220–240/440–480 ^②	C
440–480	H
575–600	E

For other voltages and frequencies,
see Factory Modifications page 46.

Open Type & Standard Width Enclosure, 3-Phase, 3-Pole

Max Hp		Overload	Enclosure																			
Max Volts	230 Volts		460 Volts	575 Volts	NEMA Size	Half Size	Amp Range	Frame Size	Open Type Standard Auxiliary Contacts ^③	NEMA 1 General Purpose	NEMA 4/4X Stainless Watertight, Dust-tight, Corrosion Resistant 304 Stainless Steel 316 Stainless Steel Optional ^④	NEMA 4X Fiberglass Watertight, Dust-tight Corrosion Resistant	NEMA 7 & 9 NEMA 3 & 4 Div. 1 and Div. 2 Class I Groups C & D Class II Groups E, F & G Class III Bolted Enclosures Indoor/Outdoor Use	NEMA 12 NEMA 3/3R ^⑤ Industrial Use Weatherproof (Field Convertible to 3/3R)								
200	230	—	460	575	00	—	0.25–1	A	14BUA32A*	336.00	14BUA32B*	331.00	Use Size 0	—	Use Size 0	—	Use Size 0	—	Use Size 0	—		
½	½	⅓	½	½	00	—	0.75–3.4	A	14BUB32A*	336.00	14BUB32B*	331.00	Use Size 0	—	Use Size 0	—	Use Size 0	—	Use Size 0	—		
1½	1½	2	—	00	—	—	3–12	A1	14BUC32A*	338.00	14BUC32B*	331.00	Use Size 0	—	Use Size 0	—	Use Size 0	—	Use Size 0	—		
½	½	⅓	½	0	—	—	0.25–1	A	14CUA32A*	405.00	14CUA32B*	399.00	14CUA32W*	746.00	14CUA32F*	820.00	14CUA32H*	1641.00	14CUA320*	518.00		
½	½	⅓	½	2	0	—	0.75–3.4	A	14CUB32A*	405.00	14CUB32B*	399.00	14CUB32W*	746.00	14CUB32F*	820.00	14CUB32H*	1641.00	14CUB320*	518.00		
2	2	5	5	0	—	—	3–12	A1	14CUC32A*	407.00	14CUC32B*	399.00	14CUC32W*	746.00	14CUC32F*	820.00	14CUC32H*	1641.00	14CUC320*	518.00		
3	3	—	—	0	—	—	5.5–22	A1	14CUD32A*	407.00	14CUD32B*	399.00	14CUD32W*	746.00	14CUD32F*	820.00	14CUD32H*	1641.00	14CUD320*	518.00		
½	½	⅓	½	1	—	—	0.25–1	A	14DUA32A*	454.00	14DUA32B*	450.00	14DUA32W*	804.00	14DUA32F*	885.00	14DUA32H*	1691.00	14DUA320*	568.00		
½	½	⅓	½	2	1	—	0.75–3.4	A	14DUB32A*	454.00	14DUB32B*	450.00	14DUB32W*	804.00	14DUB32F*	885.00	14DUB32H*	1691.00	14DUB320*	568.00		
2	2	5	5	1	—	—	3–12	A1	14DUC32A*	456.00	14DUC32B*	450.00	14DUC32W*	804.00	14DUC32F*	885.00	14DUC32H*	1691.00	14DUC320*	568.00		
3	3	10	10	1	—	—	5.5–22	A1	14DUD32A*	456.00	14DUD32B*	450.00	14DUD32W*	804.00	14DUD32F*	885.00	14DUD32H*	1691.00	14DUD320*	568.00		
7½	7½	—	—	1	—	—	10–40	A1	14DUE32A*	456.00	14DUE32B*	450.00	14DUE32W*	804.00	14DUE32F*	885.00	14DUE32H*	1691.00	14DUE320*	568.00		
10	10	15	15	—	—	1½	10–40	A1	14EUE32A*	604.00	14EUE32B*	596.00	14EUE32W*	951.00	14EUE32F*	1046.00	14EUE32H*	1839.00	14EUE320*	716.00		
10	15	25	25	2	—	—	13–52	B	14FUF32A*	786.00	14FUF32B*	844.00	14FUF32W*	1554.00	14FUF32F*	1708.00	14FUF32H*	2323.00	14FUF320*	1060.00		
15	20	30	30	—	—	—	25–100	B	14GUG32A*	1001.00	14GUG32B*	1110.00	14GUG32W*	1968.00	14GUG32F*	2165.00	14GUG32H*	2894.00	14GUG320*	1346.00		
25	30	50	50	3	—	—	25–100	B	14HUG32A*	1218.00	14HUG32B*	1376.00	14HUG32W*	2383.00	14HUG32F*	2620.00	14HUG32H*	4153.00	14HUG320*	1633.00		
30	40	75	75	—	—	—	50–200	B	14IUH32A*	2283.00	14IUH32B*	2659.00	14IUH32W*	4374.00	14IUH32F*	4812.00	14IUH32H*	5173.00	14IUH320*	3506.00		
40	50	100	100	4	—	—	50–200	B	14JUH32A*	2678.00	14JUH32B*	3053.00	14JUH32W*	4769.00	14JUH32F*	5246.00	14JUH32H*	5568.00	14JUH320*	3900.00		
75	100	200	200	5	—	—	55–250	—	14LPU32A*	6380.00	14LPU32B*	7142.00	14LPU32E*	9311.00	—	—	—	—	14LPU32H*	12902.00	14LPU320*	3900.00
150	200	400	400	6	—	—	160–630	—	14MPX32A*	15112.00	14MPX32B*	20043.00	14MPX32E*	24975.00	—	—	—	—	—	—	14MPX320*	9311.00
—	300	600	600	7③	—	—	400–1220	A1+CT	14NUN32A*	22406.00	14NUN32B*	27312.00	14NUN32E*	32242.00	—	—	—	—	—	—	14NUN320*	29975.00
—	450	900	900	8③	—	—	400–1220	A1+CT	14PUN32A*	32489.00	14PUN32B*	38388.00	14PUN32E*	43320.00	—	—	—	—	—	—	14PUN320*	41051.00

Open Type & Standard Width Enclosure, Single Phase, 2-Pole^③

Max Hp		Overload	Enclosure													
Max Volts	208/230 Volts		NEMA Size	Amp Range	Frame Size	Open Type Standard Auxiliary Contacts	NEMA 1 General Purpose	NEMA 4/4X Stainless Watertight, Dust-tight, Corrosion Resistant 304 Stainless Steel 316 Stainless Steel (Optional)	NEMA 4X Fiberglass Watertight, Dust-tight Corrosion Resistant	NEMA 7 & 9 NEMA 3 & 4 Div. 1 and Div. 2 Class I Groups C & D Class II Groups E, F & G Class III Bolted Enclosures Indoor/Outdoor Use	NEMA 12 NEMA 3/3R ^④ Industrial Use Weatherproof (Field Convertible to 3/3R)					
115	208/230 Volts	—	—	—	—	—	—	—	—	—	—	—				
115	208/230 Volts	0	0.75–3.4	A	14CUB12A*	343.00	14CUB12B*	336.00	14CUB12W*	682.00	14CUB12F*	690.00	14CUB12H*	1579.00	14CUB120*	454.00
½	½	0	3–12	A1	14CUC12A*	343.00	14CUC12B*	336.00	14CUC12W*	682.00	14CUC12F*	690.00	14CUC12H*	1579.00	14CUC120*	454.00
1	2	0	5.5–22	A1	14CUD12A*	343.00	14CUD12B*	336.00	14CUD12W*	682.00	14CUD12F*	690.00	14CUD12H*	1579.00	14CUD120*	454.00
½	½	1	0.75–3.4	A	14DUB12A*	389.91	14DUB12B*	385.00	14DUB12W*	740.00	14DUB12F*	814.00	14DUB12H*	1629.00	14DUB120*	504.00
½	½	1	3–12	A1	14DUC12A*	389.91	14DUC12B*	385.00	14DUC12W*	740.00	14DUC12F*	814.00	14DUC12H*	1629.00	14DUC120*	504.00
1	2	1	5.5–22	A1	14DUD12A*	389.91	14DUD12B*	385.00	14DUD12W*	740.00	14DUD12F*	814.00	14DUD12H*	1629.00	14DUD120*	504.00

Note: All starter sizes carry one maximum Hp rating (per the National Electric Code).

① Dual voltage coils not available in size 5–8 starters.

② For conduit hubs and conversion instructions, see page 44.

③ Coils D, F, or G will be wired for incoming voltage. J coil will be wired for separate source. Coils E, H, and L do not apply to single phase starters.

④ Enclosure is NEMA Type 4 (painted steel).

⑤ F coil 100–250V AC 50/60Hz, or DC, H coil 150–500V AC 50/60Hz, or DC

⑥ Only available F coil 100–250V AC 50/60Hz, or DC

⑦ Standard Auxiliary Contacts, Same as Contactors, refer to page 5.

⑧ For 316 Stainless Steel option see page 49.

Field Modification Kits

NEMA, Reduced Voltage and Lighting

Selection

Starter/Contactor Auxiliary Contact Kits

Description	Class	Size	Type	Catalog No	Price \$
	14, 17, 18, 22, 25, 26, 30, 32, 36, 37, 40, 43	00-4	1 NO	49AB10	
			1 NC	49AB01	
			1 NC Early Break	49AB01EB	
			1 NC Late Break	49AB01LB	
			1 NC Extra Late Break	49AB01XLB	
			1 NO Extra Late Make	49AB10XLM	
			1 NO & 1 NC	49AB11	
			2 NO	49AB20	
			4 NO	49AB40	
			3 NO & 1 NC	49AB31	
			2 NO & 2 NC	49AB22	
			2 NO	3RH1921-1EA20 ^③	
			1 NO & 1 NC	3RH1921-1DA11 ^③	
			2 NC	3RH1921-1EA02 ^③	
	14, 17, 18, 22, 25, 26, 36, 37, 40, 43	5, 6	1 NO	49ACR0	
			1 NC	49ACRC	
			2 NO	49ACR7	
			1 NO & 1 NC	49ACR6	
			2 NC	49ACR8	
			1 NO	49D22125001	
			1 NC	49D22125002	
			1 NO/NC SPDT	49CE42SPDT	
			1 NO/NC SPDT	CLM4097291	
			2 NO/NC SPDT	CLM4097292	
			1 NO & 1 NC	CLMFCAK11	
			2 NC	CLMFCAK02	
			2 NO	CLMFCAK20	
	LEN, LED, LEF, LEB	20-60 Amps	1 Coil Clearing NO & NC	CLMFCCK11	
			1 NO & 1 NC	CLMHCAK11	
		100 Amp	2 NC	CLMHCAK02	
			2 NO	CLMHCAK20	
		30-200 Amps	1 Coil Clearing NO & NC	CLMHCCK11	
			1 NO & 1 NC	CLMHCAK11	
		300-400 Amps	2 NC	CLMHCAK02	
			2 NO	CLMHCAK20	
			1 Coil Clearing NO & NC	CLMHCCK11	
			1 NO & 1 NC	CLMHCAK11	
			2 NC	CLMHCAK02	
			2 NO	CLMHCAK20	
			1 Coil Clearing NO & NC	CLMHCCK11	

Disconnect Auxiliary Switch Kits

Description	Class	Disconnect Amp or CB Rating	Type	Catalog No	Price \$
Non-fusible or Fusible Type	17, 25, 32, 37, 71 LED, LEF, CMN, CMF	30A & 60A	2 NO/2 NC DPDT (NEMA A600)	MCSAKR236 ^④	
		100A	2 NO/2 NC DPDT (NEMA A600)	MCSAK216 ^④	
		200A	2 NO/2 NC DPDT (NEMA A600)	MCSAK226 ^④	
MCP	18, 26, 32, 37, 71, LEB, CMB	3A-125A	1 NO/1 NC 240V	A02ED62 ^④	
		250A	1 NO/1 NC 480V	A02FD64 ^④	
		400A-600A	(2) 1 NO/1 NC SPDT-480V	A02JLD64 ^④	

Overload Auxiliary Contact Kit

Description	Class	Size	Type	Catalog No	Price \$
	All ESP100	00-4	1 NO (NEMA A600)	49ASNO	
			1 NC (NEMA A600)	49ASNC	

Control Power Transformer Kits^①

Description	Recommended Transformer Size		VA Rating	Catalog No	Price \$	Transformer Table		
	Control Size	Transformer VA				Primary Volts	Secondary Volts	Code
 Transformer 50/60Hz	0-2½ 3, 3½ 4 5	45 or 50 100 150 300	45 VA 50 VA 100 VA 150 VA 200 VA 300 VA 500 VA	KT*050 ^② KT*050P KT*100 KT*150 KT*200 KT*300 KT*500		120 208 208 240/480 240/480 277 277 600	24 24 120 24 120 24 120 24	1 G H 4 8 5 7 6 9
			Replace * with code from Transformer table					
			Kits used with Class 14 NEMA 1 general purpose lift-off cover type require extra wide enclosures.					

^①Installation of CPT's may require a larger enclosure. Reference page 6/xxx or contact the factory for dimensions.

^②45VA transformer kits will include secondary but not primary fusing. According to NEC 430.72, 450.3, and

U/L 508, primary fuses are not required for control transformers rated less than 50VA which are inherently protected. Sizes 50VA and higher include

2-pole primary fusing and 1-pole secondary fusing.

^③Discount Code: SIRIUS 3R Contactors, OL's, MSP's.

^④Discount Code: F.

Push Buttons—XB4 22 mm

Selector Switches

 Telemecanique

www.SquareD.com

FOR CURRENT INFORMATION

Non-Illuminated Selector Switches ▲



ZB4BD4
Standard Lever



ZB4BJ3
Extended Lever

Color	Number and Type of Positions	Standard Lever	Extended Lever	Price
		Catalog Number	Catalog Number	
Black	2—maintained		ZB4BD2	ZB4BJ2 \$11.60
Black	2—momentary from right to left		ZB4BD4	ZB4BJ4 14.20
Black	3—maintained		ZB4BD3	ZB4BJ3 11.60
Black	3—momentary to center		ZB4BD5	ZB4BJ5 14.20
Black	3—momentary from left to center		ZB4BD7	ZB4BJ7 14.20
Black	3—momentary from right to center		ZB4BD8	ZB4BJ8 14.20

Non-Illuminated Key Switches

Shape of Head	Type of Operator	Number and Type of Positions	Catalog Number ♦	Price
		2—maintained		ZB4BG2
				ZB4BG4
		2—momentary from right to left		ZB4BG6
		3—maintained		ZB4BG0
				ZB4BG3
				ZB4BG5
				ZB4BG9
				ZB4BG09
		3—momentary from left to center		ZB4BG1
				ZB4BG7
				ZB4BG8
		3—momentary from right to center		ZB4BG08
				56.00

The symbol indicates key withdrawal position(s).

- ▲ For actuation of outside contacts only.
- See selector switch sequence charts below.

♦ Other key numbers:

- key No. 421E: add the suffix 12 to the reference.
- key No. 458A: add the suffix 10 to the reference.
- key No. 520E: add the suffix 14 to the reference.
- key No. 3131A: add the suffix 20 to the reference.

Example: The catalog number for a head with key No. 421E for a 2 position maintained, lockable selector switch, with key withdrawal from the left-hand position, becomes: ZB4BG212.

Selector Switch Sequence (using contact block assemblies, page 16-25; or complete bodies, page 16-25.)

2 Position Selector Switch		
		Contact block guide *
O	X	1 N.O. (left or right)
X	O	1 N.C. (left or right)
O	X	1 N.O. and 1 N.C.
X	O	1 N.C.

3 Position Selector Switch			
			Contact block guide *
X	O	O	1 N.O. (left)
O	X	O	2 N.C. wired in SERIES, (side by side)
O	O	X	1 N.O. (right)
X	X	O	1 N.C. (right)
O	X	X	1 N.C. (left)
X	O	X	2 N.O. wired in PARALLEL, (side by side)

* As viewed from the front of the panel.

For additional information, reference Catalog #9001CT0001.



Push Buttons—XB4 22 mm

Electrical Components

 Telemecanique

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FOR CURRENT INFORMATION



ZB4BZ009



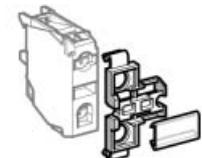
ZBE101



ZBE203



ZBV8



ZBZ001

Body/Mounting Collar

For use with	Catalog Number	Price
Electrical block (contact or light module)	ZB4BZ009	\$ 2.60

Add-On Contact Block (with screw clamp terminal connections) ▲

Description	Type of Contact		Catalog Number	Price
	N.O.	N.C.		
Standard single contact blocks	1	—	ZBE101	\$ 7.90
	—	1	ZBE102	7.90
Standard double contact blocks	2	—	ZBE203	16.00
	—	2	ZBE204	16.00
Special contact blocks (for low power switching and dust protected) ■	1	1	ZBE205	16.00
	—	—	ZBE1016	15.80
	—	1	ZBE1026	15.80

Light Modules (with screw clamp terminal connections)

Description	Supply Voltage	Color of Light Source	Catalog Number	Price
Protected LED 	24 Vac or Vdc	White	ZBVB1	\$25.00
		Green	ZBVB3	
		Red	ZBVB4	
		Yellow	ZBVB5	
		Blue	ZBVB6	
	110-120 Vac	White	ZBVG1	25.00
		Green	ZBVG3	
		Red	ZBVG4	
		Yellow	ZBVG5	
		Blue	ZBVG6	
Protected LED	230-240 Vac	White	ZBVM1	25.00
		Green	ZBVM3	
		Red	ZBVM4	
		Yellow	ZBVM5	
		Blue	ZBVM6	
Direct supply for BA 9s 2.4 W max. bulb Not included	≤ 250 Vac or Vdc	—	ZBV6	16.00

Clip-on Legend Holders for Electrical Blocks (Contact Blocks and Light Modules) (with screw clamp terminal connections)

Description	Catalog Number	Price
Identification of an XB4B control or signalling unit	ZBZ001	\$ 2.00

Sheet of 50 Blank Legends

Description	Catalog Number	Price
Legend holder ZBZ001	ZBY001	\$ 3.00

- ▲ The contact blocks enable variable composition of body sub-assemblies and can be stacked to 3 rows, either: 3 rows of 3 single contacts or 1 row of 3 double contacts + 1 row of 3 single contacts (double contact blocks occupy 2 rows).
- Cannot stack additional contact blocks onto these blocks.

Single Phase Three Wire—120/240 Vac—UL Listed

Main Lugs (Order QO, QOT, QO-GFI, QO-EPD, QO-AFI and QO-PL branch circuit breakers from pages 3 and 4.)

Mains Rating (A)	Spaces	Max. Number Single Pole Circuits ▲	Max. Number of Tandem Circuit Breakers	Total Price (Interior, Box and Cover)	Load Center Box and Interior		Main Wire Size AWG/kcmil		Equipment Ground Bar Kit (Order Separately)		Box No. See page 20					
					Catalog Number	Price	AI	Cu	Catalog No.	Price						
Non-Metallic Enclosure																
Fixed Mains—Factory-installed Main Lugs—10,000 RMS Sym. Amperes Short Circuit Current Rating																
60	2	4	2	\$ 68.00	QO24L60NRNM	\$ 68.00	#14-4	#14-4	Factory-incl.	1NM						
Metallic Enclosure																
Fixed Mains—Factory-installed Main Lugs—10,000 RMS Sym. Amperes Short Circuit Current Rating																
40	2	2	0	\$ 75.00	QO2L40RB■	\$ 75.00	#12-6	#14-6	PK3GTA-1	\$ 7.60	1R					
70	2	4	2	87.00	QO24L70RB■	87.00	#12-3	#14-4	PK4GTA	7.20	1R					
100	6	12	6	95.00	QO612L100RB◆	95.00			PK7GTA	7.80	2R					
6	12	6	105.00	QO612L100TRB◆	105.00	#8-1			Factory-installed	...	2R					
8	16	8	154.00	QO816L100RB◆	154.00				PK7GTA	7.80	2R					
100	6	12	6	116.00	QO612L100RBCU◆★	116.00			PK7GTA	7.80	2R					
8	16	8	186.00	QO816L100RBCU◆★	186.00	#8-1			PK7GTA	7.80	2R					
125	4	8	4	101.00	QO148L125GRB★	101.00	#12-2/0	#14-2/0	PK7GTA Factory-incl.		15R					
Convertible Mains—Factory-installed Main Lugs—65,000 RMS Sym. Amperes Maximum Short Circuit Current ▼ △ □																
QOM1 Main Frame Size—Convertible to Main Circuit Breaker—Copper Bus																
125	12	12	0	\$190.00	QO112L125GRB	\$190.00			PK9GTA Factory-incl.	3R						
12	24	12	243.00	QO11224L125GRB	243.00				PK15GTA Factory-incl.	3R						
16	24	8	290.00	QO11624L125GRB	290.00	#6-2/0			PK15GTA Factory-incl.	4R						
24	24	0	348.00	QO124L125GRB	348.00				PK15GTA Factory-incl.	4R						
Convertible Mains—Factory-installed Main Lugs—65,000 RMS Sym. Amperes Maximum Short Circuit Current ▼ △ □																
QOM2 Main Frame Size—Convertible to Main Circuit Breaker—Copper Bus																
150	30	30	0	\$391.00	QO130L150GRB	\$391.00	#6-250		PK23GTA & LK100AN Factory-incl.	6R						
12	12	0	320.00	QO112L200GRB	320.00				PK9GTA Factory-incl.	5R						
200	30	0	444.00	QO130L200GRB	444.00	#6-250			PK23GTA & LK100AN Factory-incl.	6R						
30	40	10	476.00	QO13040L200GRB	476.00				PK23GTA & LK100AN Factory-incl.	7R						
40	40	0	647.00	QO140L200GRB	647.00				PK23GTA & LK100AN Factory-incl.							
225	42	42	0	873.00	QO142L225GRB	873.00	#6-300		PK23GTA & LK100AN Factory-incl.	8R						

Single Phase Three Wire—120/240 Vac—UL Listed

Main Circuit Breaker Order QO, QOT, QO-GFI, QO-EPD and QO-PL branch circuit breakers from pages 3 and 4.

Mains Rating (A)	Spaces	▲ Max. Number Single Pole Circuits	Max. Number of Tandem Circuit Breakers	Total Price (Interior, Box and Cover)	Load Center Box and Interior		Main Wire Size AWG/kcmil	AI or Cu	Equipment Ground Bar Kit (Order Separately)		Box No. See page 20							
					Catalog Number	Price			Catalog No.	Price								
Convertible Mains —Factory-installed Main Circuit Breaker—22,000 RMS Sym. Amperes Short Circuit Current Rating																		
—Convertible to Main Lugs (see page 8) or Lower Amperage Main Circuit Breaker (see page 7) ◇ □																		
QOM1 Main Circuit Breaker Frame Size—Copper Bus																		
100	12	12	0	\$307.	QO112M100RB	\$307.	#6-2/0		PK9GTA	\$ 8.90	3R							
16	16	0	336.	QO116M100RB	336.				PK12GTA	10.50	4R							
20	20	0	368.	QO120M100RB	368.				PK15GTA	11.40	4R							
125	24	24	0	636.	QO124M125RB	636.	#6-2/0		PK15GTA	11.40	4R							
Convertible Mains —Factory-installed Main Circuit Breaker—22,000 RMS Sym. Amperes Short Circuit Current Rating																		
—Convertible to Main Lugs (see page 8) or Lower Amperage Main Circuit Breaker (see page 7) ◇ □																		
QOM2 Main Circuit Breaker Frame Size—Copper Bus																		
150	20	30	10	\$635.	QO12030M150RB	\$635.	#4-250		PK18GTA	\$12.50	5R							
30	30	0	748.	QO130M150RB	748.				PK18GTA	12.50	6R							
200	20	30	20	636.	QO12040M200RB	636.	#4-250		PK23GTA	14.20	5R							
30	30	0	769.	QO130M200RB	769.				PK18GTA	12.50	6R							
40	40	0	931.	QO140M200RB	931.				PK23GTA	14.20	7R							
Feed Thru Main Circuit Breaker With Feed-Thru Lugs—Copper Bus—22,000 RMS Sym. Amperes Short Circuit Current Rating ◇																		
125	6	12	6	\$413.	QO1612M125FTRB	\$413.	#4-2/0		PK12GTA	\$10.50	3R							
150	8	16	8	575.	QO1816M150FTRB	575.	#4-250		PK15GTA-L	23.30	6R							
200	8	16	8	575.	QO1816M200FTRB	575.	#4-250		PK15GTA-L	23.30	6R							

Above listings thru 200 A mains rating meet Federal Specification W-P-115c as Type 1, Class 2.

▲ Maximum number of single pole branch circuits utilizing QO and/or QOT circuit breakers.

■ Use #10 maximum size wire for GFI circuit breaker.

◆ 70 A max. branch circuit breaker and 70 A max. back fed main circuit breaker.

* Copper bus.

▼ UL short circuit current rating depends on lowest interrupting rating of circuit breakers installed.

△ UL Listed 5000 A short circuit current rating for corner grounded Delta systems. Use QO-H circuit breakers only.

□ Side hinge door device; allow 1 1/4" on left side for door to open.

◊ 22,000 AIR main circuit breaker UL Listed for use ahead of QO, QOT, QO-GFI, QO-EPD and QOPL 10,000 AIR branch circuit breakers to permit their application on systems up to 22,000 A available fault current.

For additional information, reference Catalog #1100CT9901.