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Hubbell Type 4271 E-Mag
230 Volt Solid State Magnet Controller

Setup and Operating Instructions

KEEP WITH CONTROLLER

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Introduction

The Hubbell Type 4271 Magnet Controller incorporates solid state components arranged to provide a new concept in magnet controller design and operation with over four years of testing and field applications in generator field control. Hubbell again leads the magnet controller industry with the latest technology.

Type 4271 Magnet Controllers include all necessary power and reverse current connections. Discharge path is electronically controlled without use of power resistors or varistors. There is no need for contactors to carry the power to the magnet. The reverse current or “Drop” cycle is controlled by a dynamic closed loop system that uses PLC Logic. The PLC algorithm compares the magnet voltage, generator speed, and shunt field current. It always knows the generator speed, field current, direction of the field, and magnet current and voltage. This gives very fast lift times and accurate dropping or dribbling the load. This cycles the magnet with little delay from Lift to Drop. Most non-Hubbell field controllers have a long delay between lift and drop because they use a stepped-field control or open loop system, utilizing plug in relays. The e-mag controller quickly discharges the magnet energy through the generator “shaft”. Again, requires no relays or external resistors.

Since the Generator absorbs the highly inductive magnet load, the e-mag is rated at 100% duty cycle. We are not limited on contactor size rating, resistor, or varistor ampacity. Because we electronically ramp up and down the charge and discharge voltages, the voltage is “smoothly and quickly” applied to the magnet for soft field charging. Typical previous technology “shocks” the field coil (Internal shift of coil). The e-mag with the dynamic loop system smoothly charges and discharges the magnet which eliminates field shocking and increases magnet life. The maximum voltage permitted by the e-mag is between 275-325 volts depending on generator speed. This feature assures extra protection of the magnet and cable system insulation.

NOTICE: Read these instructions thoroughly before installing and operating the controller. If there are still questions, contact your Hubbell factory representative for assistance.

Receiving, Handling, and Storage

1. Immediately upon receipt, carefully unpack and inspect the Controller for damage that may have occurred in shipment. If damage or rough handling is evident, file a damage claim with the transportation carrier.
2. If the Controller must be stored, cover it and then place it in a clean, dry location. Avoid unheated locations where condensation can result in damage to the insulation or corrosion of metal parts.
3. **To store long term, (periods over 3 months), periodic system charging will be required. Failure to do so may require factory recalibration of unit.**

Operation of Ground Fault Circuit / GFCI protection:

If the ground level of leakage is below 50,000 ohms at 250 VDC applied, the controller will shut off as long as the ground is detected. The controller does not go through a drop cycle, nor does it disable the controller, instead it drives the voltage down to a level where the leakage is acceptable.

If, for example, there is an intermittent ground (as in a bare spot in the cable touching the case), the voltage will only be retarded when the cable is touching the case, it will return as soon as it the ground source is cleared automatically. Unless you push the drop button, it will stay “on”. The voltage applied is directly proportional to the ground present, in real time. It recovers instantly once ground is removed.

Recommended Ground Resistance: 1 megohm @ 1000 Volts.

Before Connecting Controller:

- All system cables should be clearly identified and marked as well as properly sized. This is especially true for existing controller replacement. Continuity and ground tests should then also be performed.
- **!! Important Step**: Load resistance and ground insulation tests should be performed on magnet circuit. With the (2) main magnet cables in isolation:

  a) Measure between the cables with a resistance meter on its lowest scale. Resistance should be commensurate with magnet size. For example: Voltage/Resistance = Amperage ie, 2.0 ohms @ 230VDC will require approx. 115 Amps. Check your magnet to verify required ampacity to determine proper load resistance. Substantially lower than required resistance indicates a short in the circuit.

  b) Measure between either cable and magnet case with a megohm insulation tester (megger) set at 1000V. 500.000 ohms or more should be measured. Lower than required resistance indicates a ground in the circuit.

Mounting Considerations:

- Ambient outdoor temperature maximum 150°F (65°C)
- Beware of exhaust, turbos, oil coolers, radiators, etc.
- Controller must be mounted vertical
- Rigid / Flat surface
- Recommended mounting bolt size 5/16” with flat and lock washers
- Door switch must be readily accessible
- Able to open door (90° minimum)
- Recommend cord grip connections with strain relief

Cable Entrance Positions:

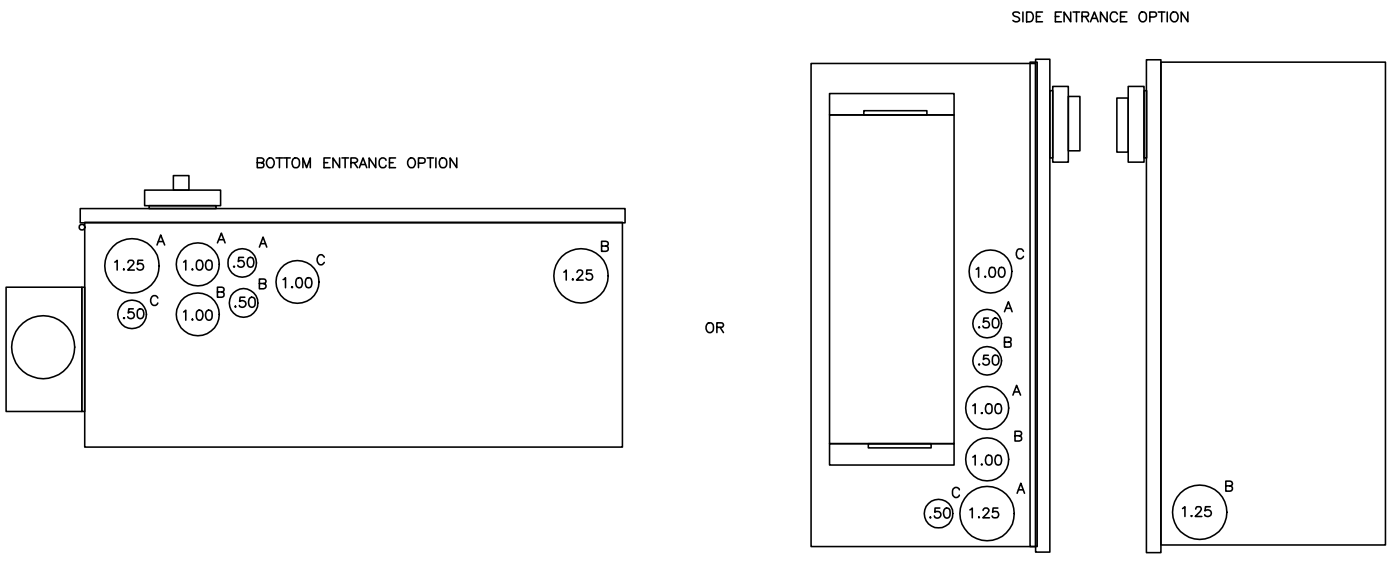
- There are a possible (8) separate entrances required for controller installation. Choose “Bottom” or “Side” as per Figure below. Care should be taken not to allow metallic debris to come in contact with controller internals.

  Entrance schedule is as follows:

  (2) 1.25” Minimum Size Conduit: ‘A’ Magnet Cable; ‘B’ Generator Main Cable

  (3) 1.00” Minimum Conduit Size: ‘A’ 12/24VDC Power Feed Cable; ‘B’ Field Cable; ‘C’ Meter Package (if used)

  (3) .50” Minimum Size Conduit: ‘A’ Pushbutton Cable; ‘B’ Generator On/Off Solenoid Cable (If used); ‘C’ Potentiometer Cable (If remotely cab mounted)



Generator Connection

Baldor Field and Power Wire Connections Procedure:

1. Determine generator direction of rotation.
2. The following wires will be coming out of the generator frame into the junction box and labeled with white tags A1, A2, S1, S2, F1, F2, F3, F4.
3. Install correct capacity 2 conductor (Black and White; refer to Figure 7.1) magnet cable into generator junction box. Install correct size 1/4” ring terminals to cable after cut to correct size (approx. 6”).
4. Connect S1 from generator to Black magnet cable.
5. For CW Shaft End rotation connect as follows: Connect A1 from generator to white magnet cable, Connect A2 from generator to S2 from generator.

   For CCW Shaft End rotation connect as follows: Connect A2 from generator to white magnet cable, Connect A1 from generator to S2 from generator.
6. Figure 5.1 Illustrates CW Shaft End Connection. Figure 5.2 Illustrates CCW Shaft End Connection.
7. Install correct capacity 3 conductor (Black, White and Green; refer to Figure 5.1) field cable into generator junction box. Install correct size 1/4” ring terminals to cable after cut to correct size (approx. 6”).
8. Connect F4 from generator to Black field cable. Connect F1 to White field cable. Connect green to generator case ground. Connect F2 from generator to F3 from generator. This applies to either rotation. See Figure 5.3.
9. Tape all splices separately with insulative tape.

ALL GENERATOR LEADS ARE NOW CONNECTED.

CW Shaft End Rotation

Figure 5.1

CCW Shaft End Rotation

Figure 5.2

Either Rotation

Figure 5.3

Generator Connection

Ohio Field and Power Connections Procedure:

1. Determine generator direction of rotation.
2. The following wires will be coming out of the generator frame into generator junction box, labeled with the following tags: A1, A2, C1, C2, S1, S2, F1, F2.
3. Install correct capacity 2 conductor (Black and White; refer to Figure 7.1) magnet cable into generator junction box. Install correct size 1/4” ring terminals to cable after cut to correct size (approx. 6”).
4. Connect S1 from generator to Black magnet cable.
5. For CW shaft end rotation connect as follows: connect A1 from generator to white magnet cable, connect A2 from generator to S2 from generator, connect C1 from generator to C2 from generator.

   For CCW shaft end rotation connect as follows: connect A2 from generator to white magnet cable, connect A1 from generator to S2 from generator, Connect C1 from generator to C2 from generator.
6. Figure 6.2 Illustrates CW Shaft End Connection. Figure 6.3 Illustrates CCW Shaft End Connection.
7. Install correct capacity 3 conductor (Figure 6.1) field cable into generator junction box. Install correct size 1/4” ring terminals to cable after cut to correct size (aprox. 6”).
8. Connect F2 from generator to Black field cable. Connect F1 to White field cable. Connect green to generator case ground. This applies to either rotation. See Figure 6.3.
9. Tape all splices separately with insulative tape.

ALL GENERATOR LEADS ARE NOW CONNECTED.

Figure 6.1

Figure 6.2

Figure 6.3

Cabling-Fusing Charts

Figure 7.1

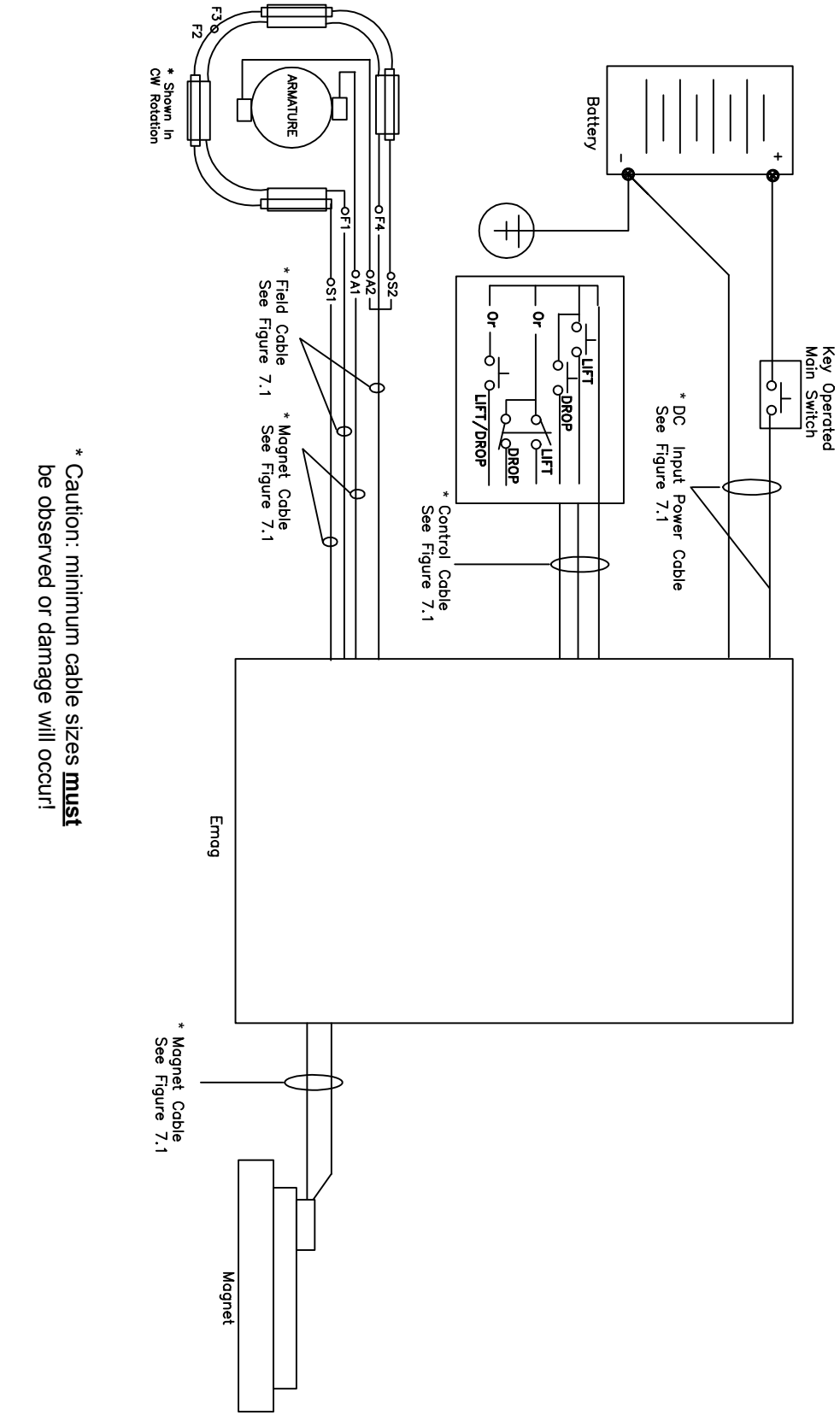
CHART 1 - 12V SOURCE			
UNIT SIZE	MINIMUM WIRE SIZE	CBI	DSW
5 KW	10 AWG	40 AMP	63 AMP
7.5 KW	8 AWG	60 AMP	63 AMP
10 KW	8 AWG	60 AMP	63 AMP
15 KW	8 AWG	60 AMP	63 AMP
20 KW	6 AWG	80 AMP	80 AMP
25 KW	6 AWG	80 AMP	80 AMP
33 KW	6 AWG	80 AMP	80 AMP

CHART 1 - 24V SOURCE			
UNIT SIZE	MINIMUM WIRE SIZE	CBI	DSW
5 KW	10 AWG	40 AMP	63 AMP
7.5 KW	10 AWG	40 AMP	63 AMP
10 KW	10 AWG	40 AMP	63 AMP
15 KW	10 AWG	40 AMP	63 AMP
20 KW	10 AWG	40 AMP	63 AMP
25 KW	10 AWG	40 AMP	63 AMP
33 KW	10 AWG	40 AMP	63 AMP
40 KW	6 AWG	80 AMP	80 AMP

CHART 2 - MAGNET FUSE & SHUNT			
UNIT SIZE	MINIMUM WIRE SIZE	FUSE SIZE	SHUNT SIZE 50mv
5 KW	10 AWG	25 AMP	30 AMP
7.5 KW	8 AWG	40 AMP	50 AMP
10 KW	8 AWG	50 AMP	50 AMP
15 KW	4 AWG	80 AMP	75 AMP
20 KW	2 AWG	100 AMP	100 AMP
25 KW	2 AWG	125 AMP	125 AMP
33 KW	1/0 AWG	175 AMP	175 AMP
40 KW	2/0 AWG	200 AMP	200 AMP

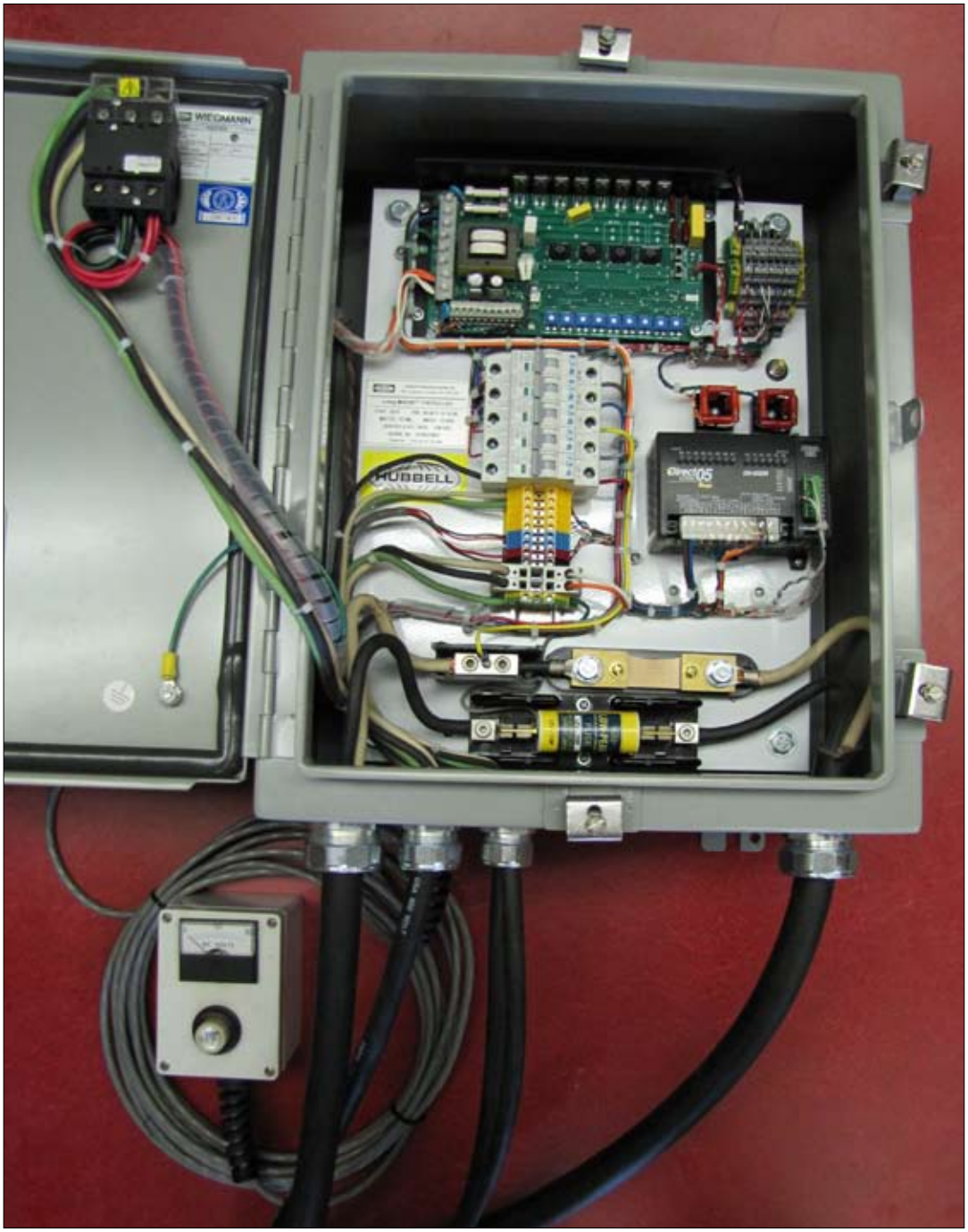
System Layout

Figure 8.1



* Caution: minimum cable sizes **must** be observed or damage will occur!

Figure 9.1



Controller Connection

Generator Main Connections:

1. Secure generator main cable in 1.25” entrance A per Figure 11.1.
2. Connect A+ to Terminal ‘A’ , Figure 13.2 (shown as white cable)
3. Connect S- to Terminal ‘S’ , Figure 13.3 (shown as black cable)

Figure 11.1

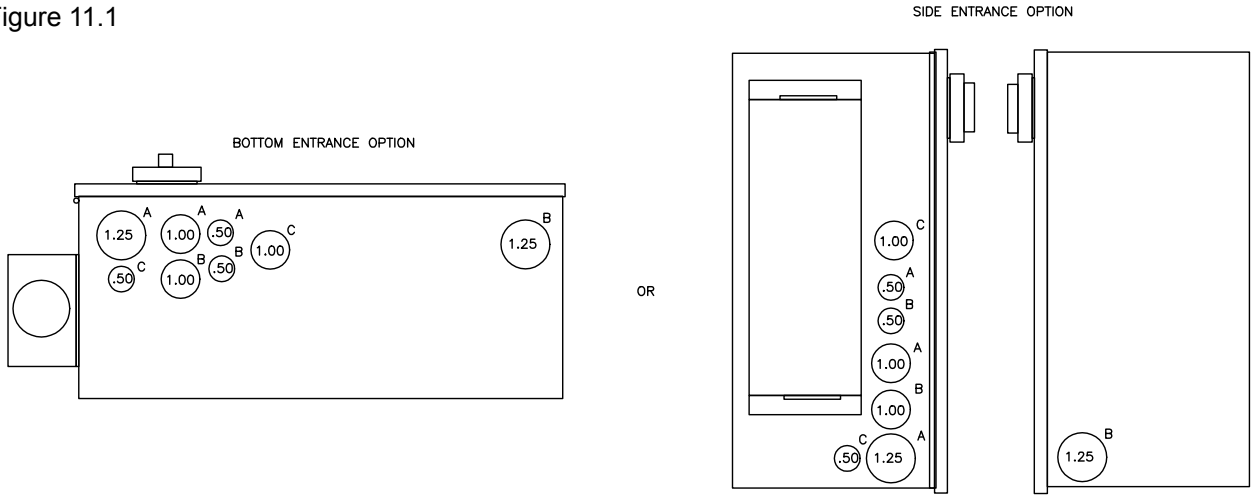
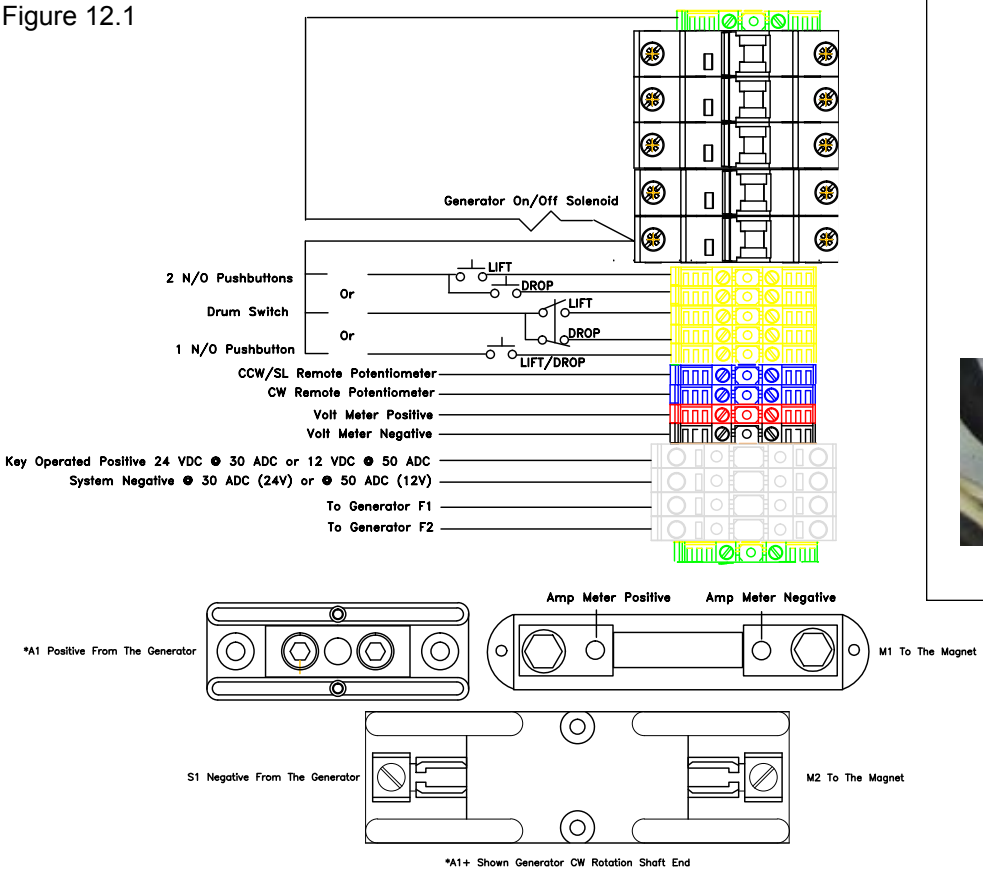


Figure 12.1



Terminal ‘A’

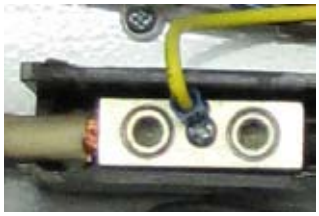


Figure 13.2

Terminal ‘S’

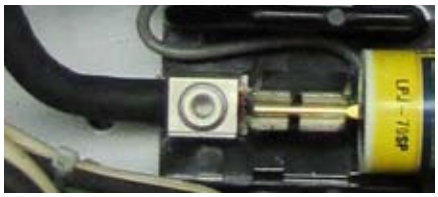


Figure 13.3

Controller Connection

Magnet Power Connections:

1. Secure magnet cable in 1.25” entrance B per Figure 11.1.
2. Connect either of the pair of cables leading to the magnet to Terminal ‘M1’, Figure 13.4 (shown as white cable).
3. Connect the remaining cable from the pair of cables leading to the magnet to Terminal ‘M2’, Figure 13.5 (shown as black cable).

Figure 11.1

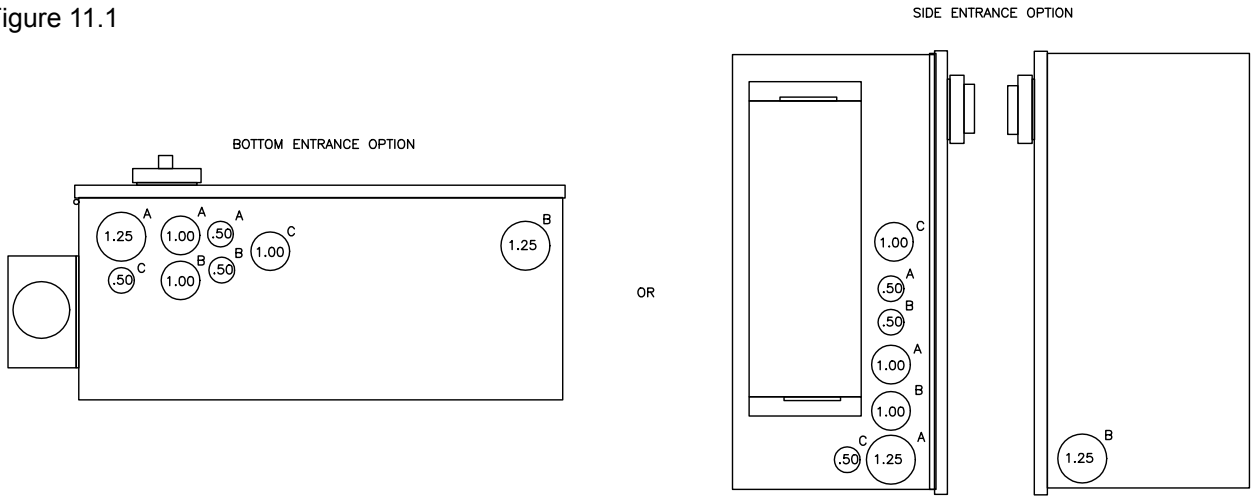
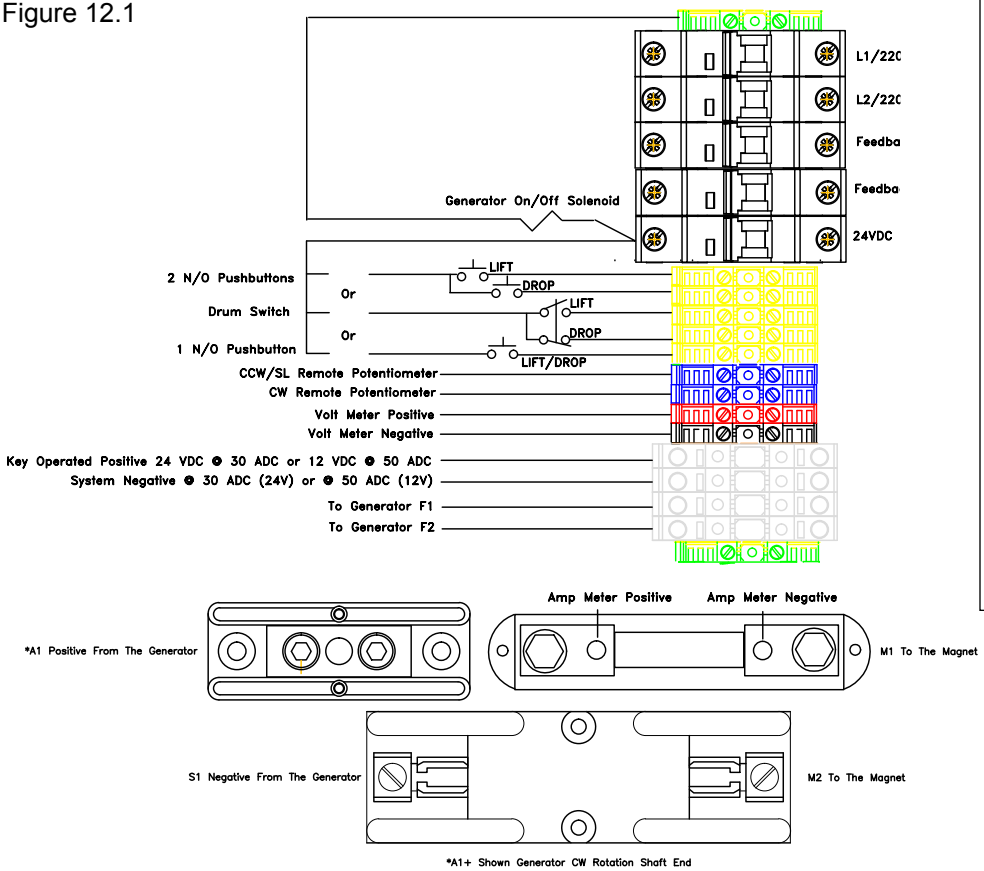


Figure 12.1



Terminal ‘M1’

Figure 13.4

Terminal ‘M2’

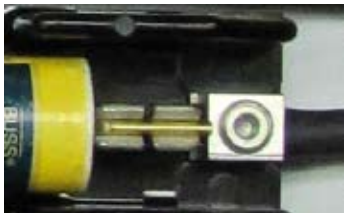


Figure 13.5

Controller Connection

Field Power Connections:

1. Secure field cable in 1.00” entrance B per Figure 11.1.
2. Connect F1 from generator to top field connection terminal (shown as white cable).
3. Connect F2 (or F4 depending on generator manufacturer) from generator to bottom field connection terminal (shown as black cable).

Figure 11.1

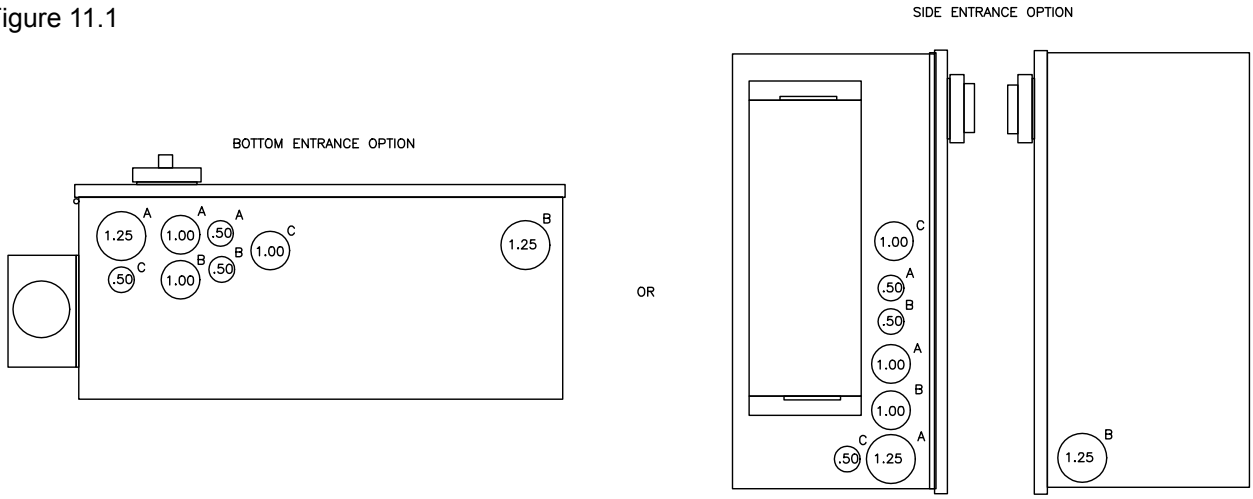


Figure 12.1

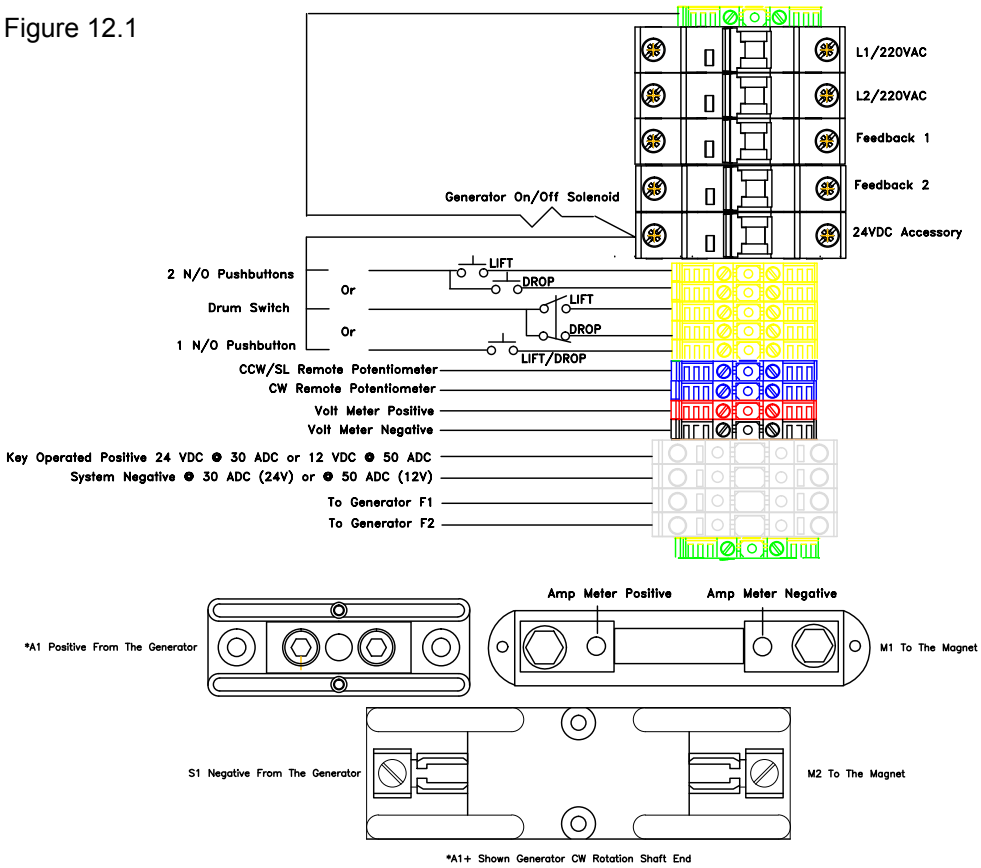


Figure 13.6

Controller Connection

System Input Power Connections:

1. Secure input power cable in 1.00” entrance A per Figure 11.1.
2. Connect POSITIVE input cable to top terminal (shown as white cable/red cable controller side).
3. Connect NEGATIVE input voltage to top terminal (shown as black cable/black cable controller side).

Figure 11.1

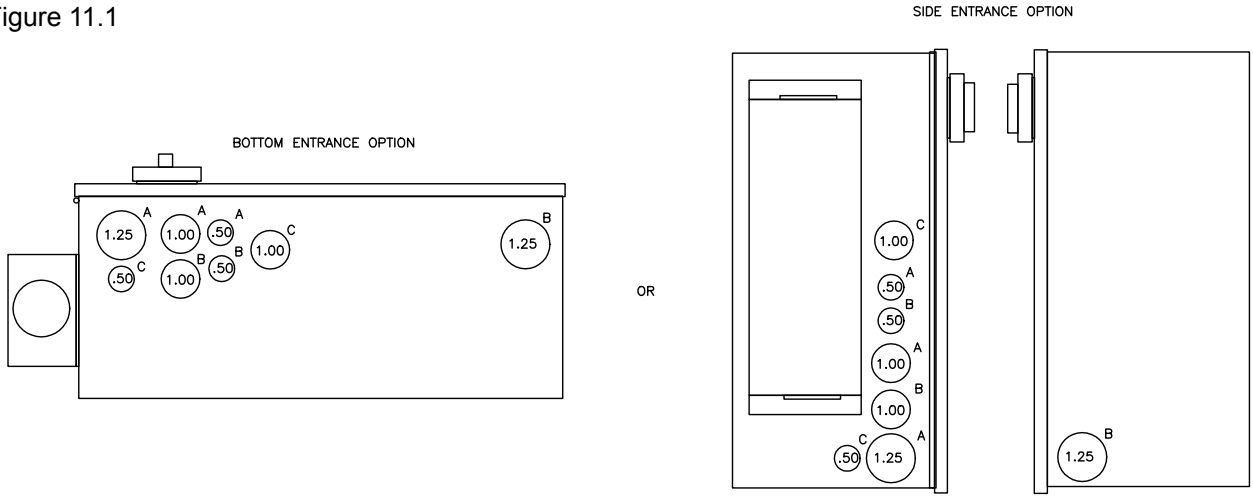
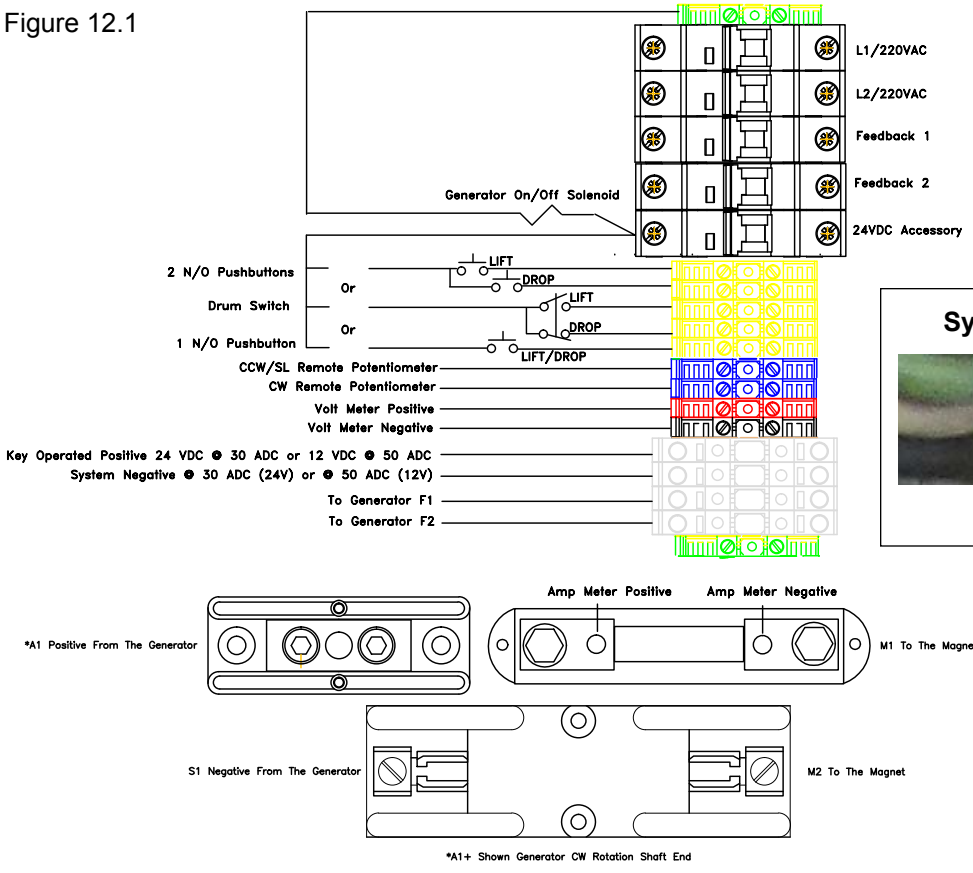


Figure 12.1



System Input Power Connection

Figure 13.1

Controller Connection

Operator Controls Connections:

1. Secure operator control cable in .50” entrance A per Figure 11.1.
2. Connect POSITIVE input cable to top terminal (shown as white cable/red cable controller side).
3. Connect NEGATIVE input voltage to top terminal (shown as black cable/black cable controller side).

User Options:

- 2 Normally Open Momentary Pushbuttons: Connect to top yellow terminal for Lift; Connect to second from top yellow terminal for Drop.
- Drum Switch: Connect to third from top yellow terminal for Lift; Connect fourth from top yellow terminal for Drop”
- 1 Normally open Momentary Pushbutton: Connect to bottom yellow terminal.
- For correct operator control verification see Figure 15.1
- Connect power to operator controls to Breaker 5, Figure 13.8.

Figure 11.1

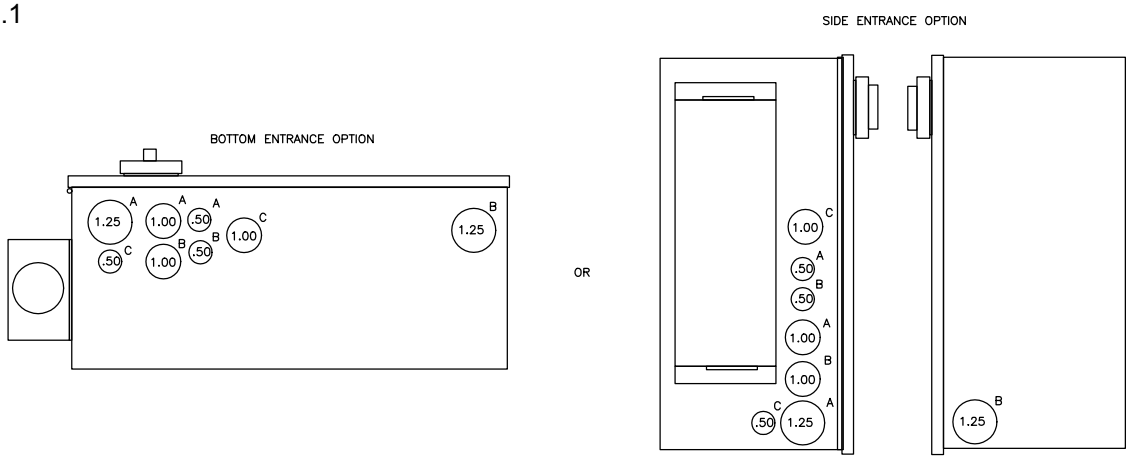
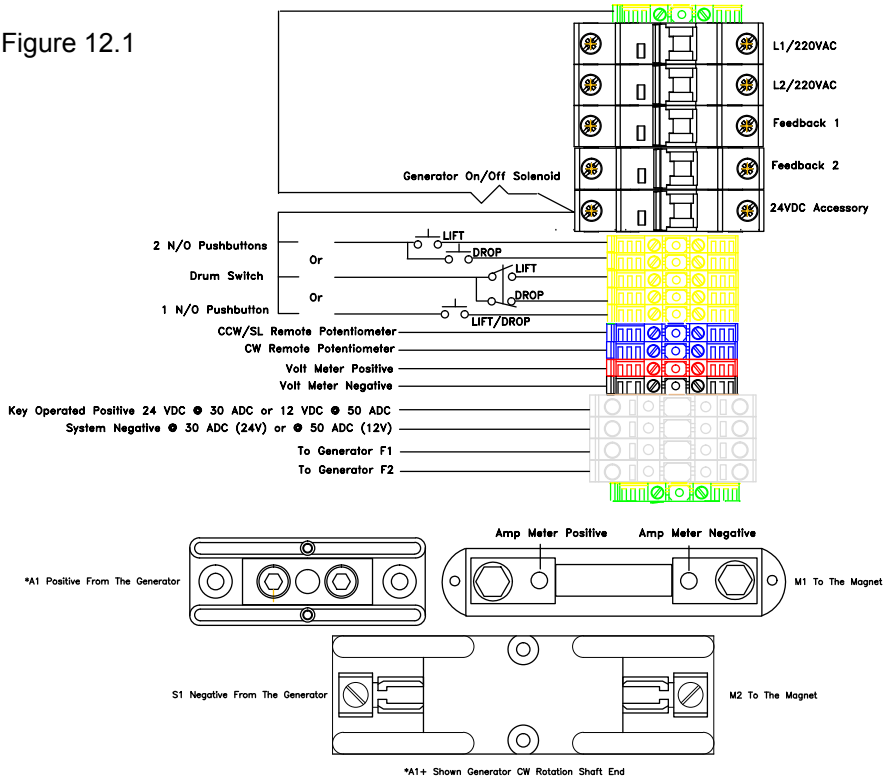


Figure 12.1



Operator Control Terminals

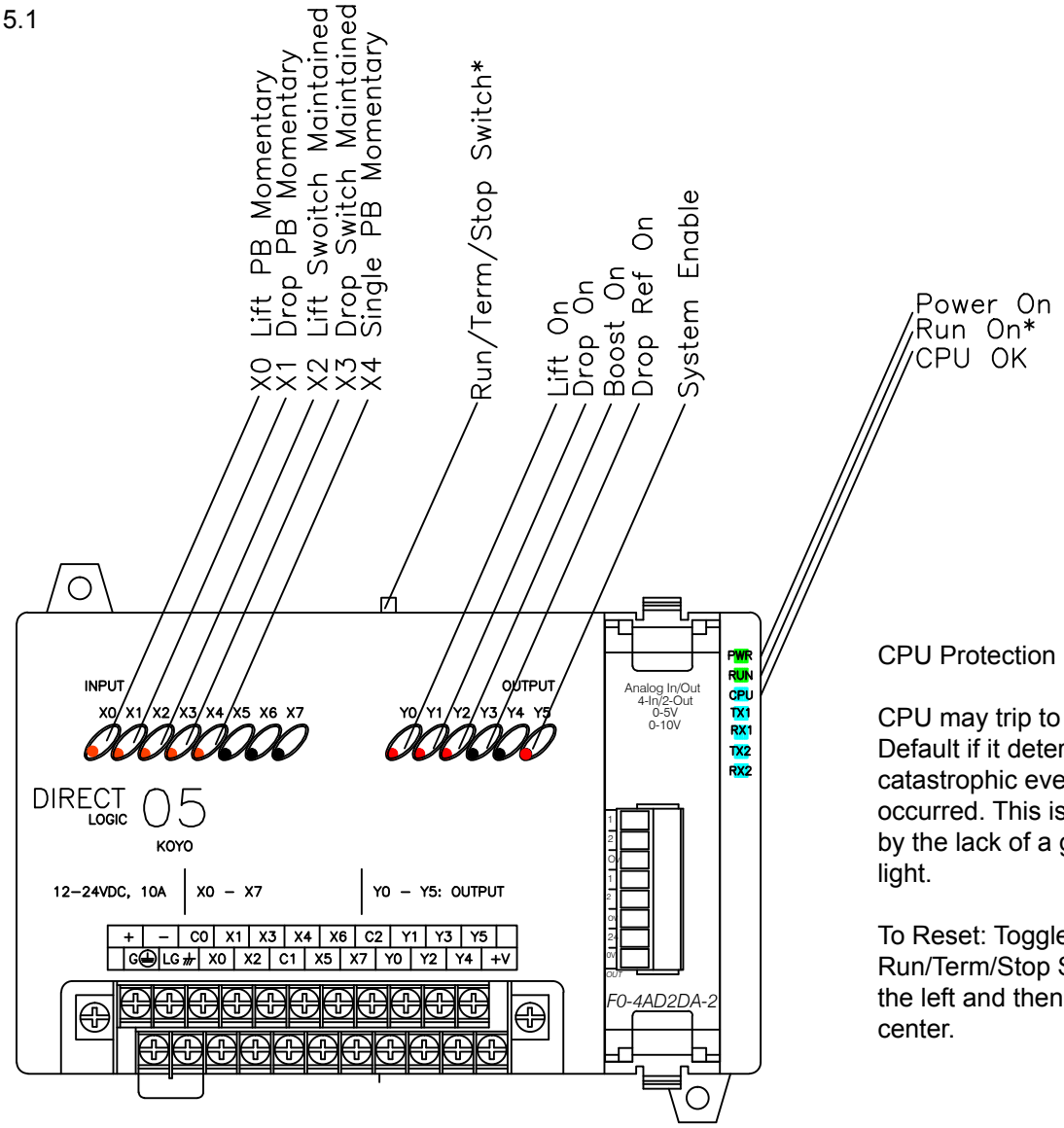
Figure 13.7

System Control Power

Figure 13.8

Operator Control Connections

Figure 15.1



CPU Protection Reset*

CPU may trip to Program Default if it determines a catastrophic event has occurred. This is indicated by the lack of a green Run light.

To Reset: Toggle the Run/Term/Stop Switch to the left and then back to center.

Controller Connection

Remote Drop Adjust:

1. Secure remote potentiometer cable (if remotely cab mounted, suggested) in .50” entrance C per Figure 11.1.
2. Connect CCW of Drop Adjustment Potentiometer to top blue terminal.
3. Connect CW and SL of Drop Adjustment Potentiometer to bottom blue terminal.

Figure 11.1

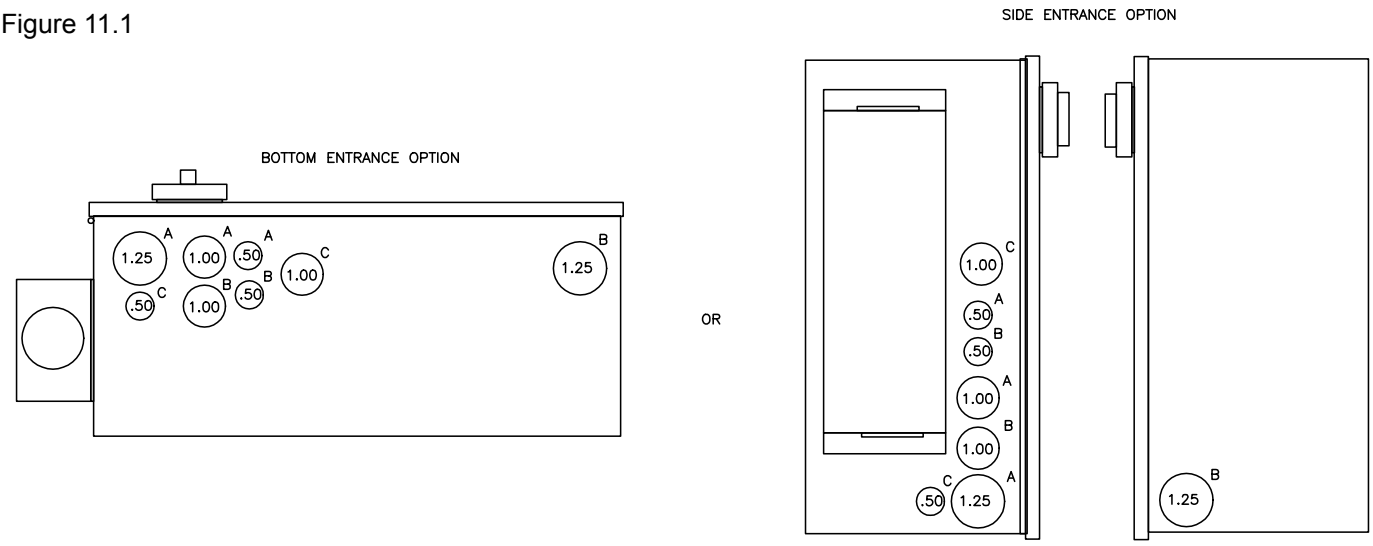
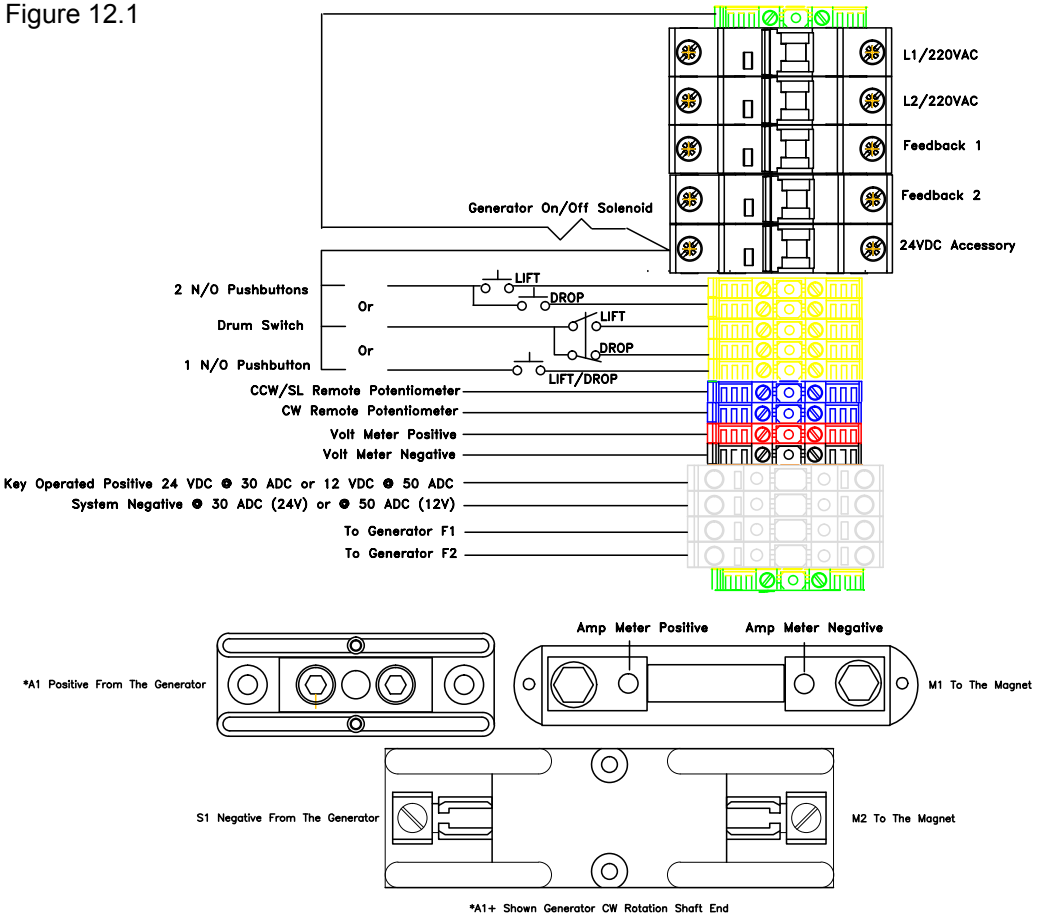


Figure 12.1



Drop Adjust Connection

Figure 13.9

Drop Adjustment Potentiometer (Remotely Mounted)

Figure 14.3

Controller Connection

Meter Package:

1. Secure meter package cable (if used) in 1.00” entrance C per Figure 11.1.
2. Connect POSITIVE of volt meter to red terminal see Figure 13.10.
3. Connect NEGATIVE of volt meter to black terminal, see Figure 13.10.
4. Connect POSITIVE of amp meter to left hand screw terminal, see figure 13.11.
5. Connect NEGATIVE of amp meter to right screw terminal, see Figure 13.11.

   !! NOTE: METERS MUST BE PURCHASED FROM HUBBELL !!

Generator Hydraulic Motor Solenoid On/Off:

1. Secure generator hydraulic solenoid cable (if used) in .50” entrance B per Figure 11.1.
2. Connect solenoid cable to ‘System Control Power’ , see Figure 13.8.
3. Connect solenoid common cable to any ground terminal, see Figure 12.1.

   !! WARNING: SAFETY SYSTEM DISCONNECT REQUIRES THIS OPTION, DIRECT DRIVE SYSTEMS REQUIRE MAIN SAFETY DISCONNECT !!

Figure 11.1

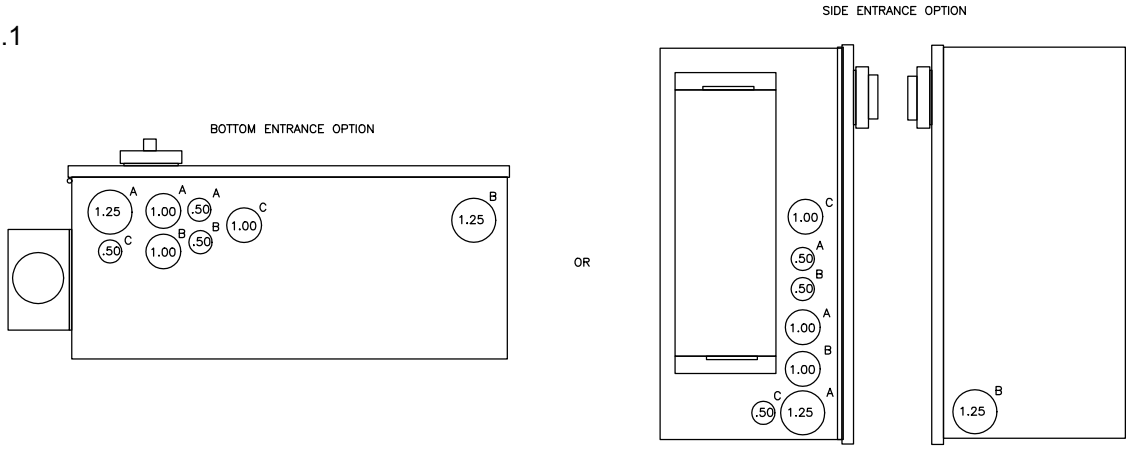
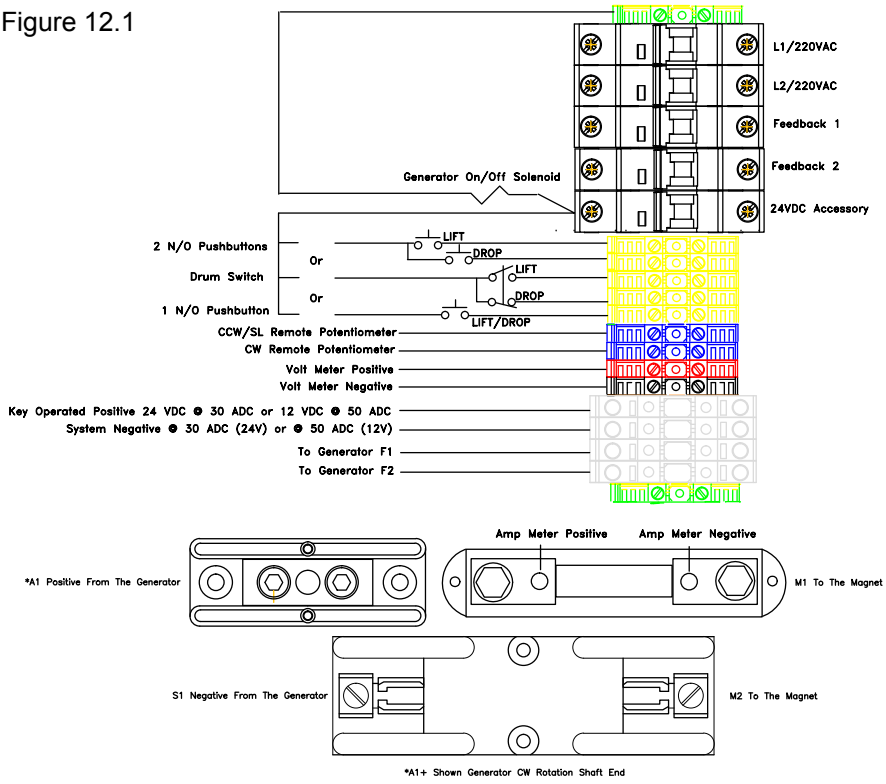


Figure 12.1



Volt Meter Connection

Figure 13.10

Amp Meter Connection

Figure 13.11

System Control Power

Figure 13.8

Quick Start Instructions

1. Check that all terminations are correct.
2. Turn on five E-Mag circuit breakers.
3. Turn E-Mag door mounted switch to “ON” position.
4. Start crane, if E-Mag controlled by key switch, skip to step 6.
5. Engage magnet system.
6. Ensure generator is rotating in the rotational direction chosen by the connection on page 8, step 5 of this manual
7. Connect a DC voltmeter across top of breaker 3 and breaker 4 (Figure 14.2)

   a) Breaker 3 POSITIVE; Breaker 4 NEGATIVE when Lift engaged.
8. Increase machine RPM to generator nameplate RPM.
9. Operate lift pilot device and observe voltage which should climb to 260-270 VDC before setting at 230 VDC. Adjust to desired lift voltage level using ‘Voltage Adjust Potentiometer’ (Figure 14.1)
10. Operate drop pilot device and observe voltage which should reverse polarity for drop time interval.
11. Adjust drop potentiometer for efficient magnet cleaning (Figure 14.3)

    a) Observe material dropping from magnet. Increase drop time if not clean. Decrease drop time if material re-picks.

Voltage Adjustment Potentiometer

Figure 14.1

Generator Voltage Feedback

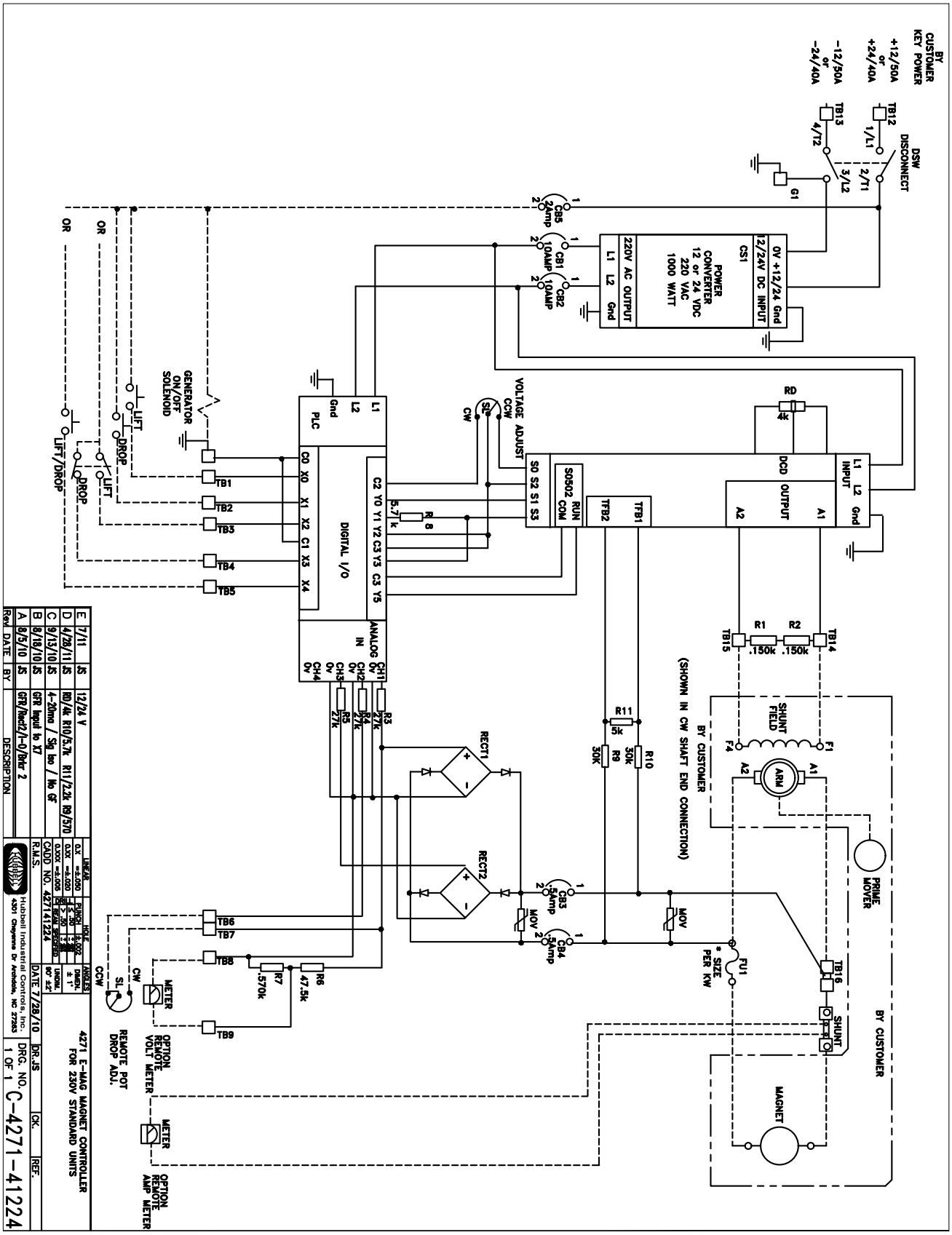
Figure 14.2

Drop Adjustment Potentiometer (Remotely Mounted)

Figure 14.3

12V/24V Schematic

Figure 19.1



Troubleshooting

Tools needed for troubleshooting / testing:

(1) 10 k Ohm / 1 Turn Potentiometer with 8 leads soldered to CW, CCW and SL

(1) N/O Pushbutton with 12 leads connected to either side of switch

(1) Digital Volt Meter-Resistance Tester w/ 0-300VDC and 0-300VAC scale minimum

(1) Insulation Tester (Megger or Megohm Meter)

(1) #16 AWG 6 Wire Jumper

Types of Failures:

No Generator Output:

1. Shut off controller at Main Disconnect Switch on door.
2. Open door of controller.
3. Turn on controller at Main Disconnect on door.
4. Turn crane key on, do not start.
5. Check for input power at power input terminals. See Figure i.2.
6. Check for 220V AC system power at Breaker 1 and Breaker 2. See Figure i.3.
   a. If no voltage measured, replace INV-1.
7. Check for PLC Run function. See Figure i.4.
8. Check for field output voltage:
   a. Connect DC Volt meter across field output terminals. Take care the positive meter lead is connected to the top field terminal See Figure i.5.
   b. Initialize ‘Lift’ command.
   c. Observe PLC indicator lamps: Input X0 or X2 or X4 (Dependent on Operator Option). Output Y0 ; Y2 ; Y5 illuminate with ‘Lift’ command. See Figure i.6.
   d. Observe momentary positive DC to fields. Voltage should be 175-195 VDC.
   e. If field output is 0 with correct PLC output indication, go to No Field Output.
   f. If field output is 0 with no PLC output indication, go to No PLC Output instruction set.
   g. If field voltage cycles on then off with correct corresponding PLC indication, go to Feedback Failure.

Fig. i.2 System Input Power

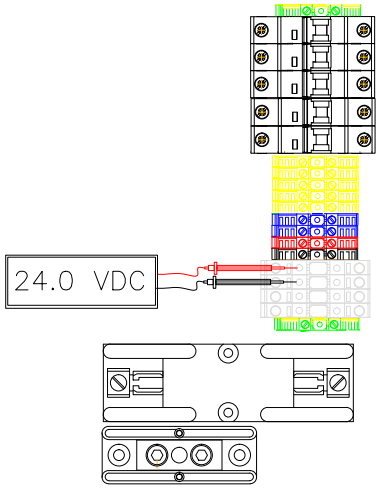


Fig. i.3 System Power Breakers

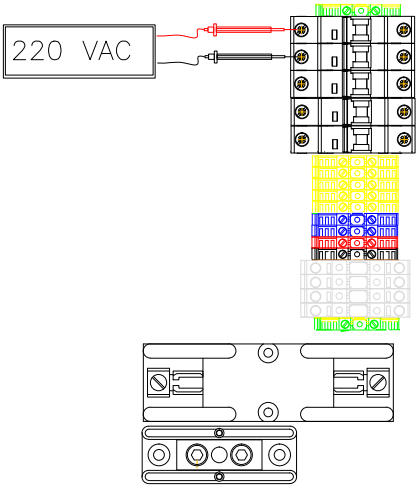


Fig. i.4 PLC Run Indicator

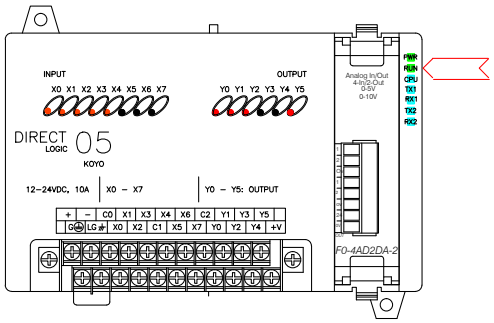


Fig. i.5 Field Output Voltage

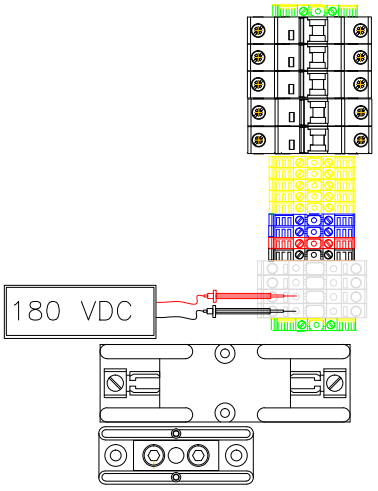
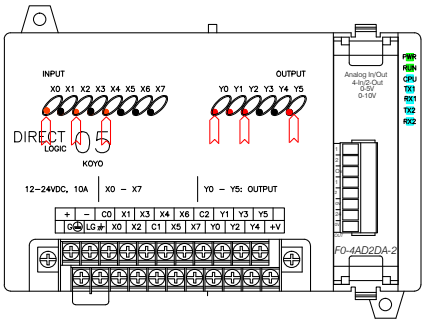


Fig. i.6 PLC Lift Indication



Troubleshooting

Types of Failures:

No Field Output:

1. Shut off controller at Main Disconnect Switch on door.
2. Remove Main Fuse. See Figure ii.1.
3. Disconnect M1 cable at controller. See Figure ii.1.
4. Turn on controller at Main Disconnect on door.
5. Connect DC Volt meter across field output terminals. Take care the positive meter lead is connected to the top field terminal See Figure i.5.
6. Initialize ‘Lift’ command.
7. Observe momentary positive DC to fields. Voltage should be 175-195 VDC.
8. If no output, replace DR-1**.**

Fig. ii.1 Disconnect Load

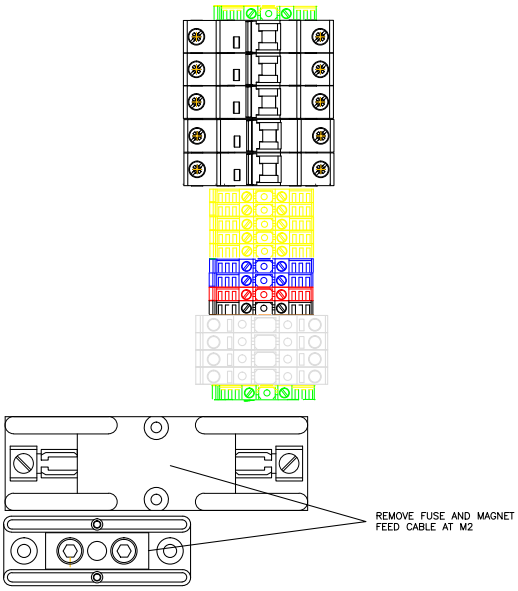
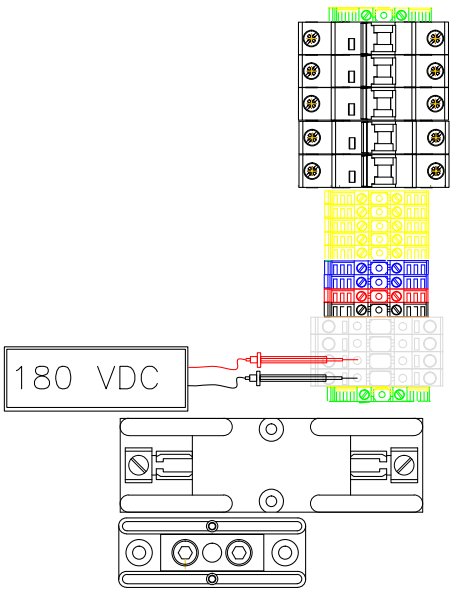


Fig. i.5 Field Output Voltage



No PLC Indication:

1. Check Input Assignment.
   a. Inputs must be assigned as follows:
      - X0 Momentary ‘Lift’ with X1 Momentary ‘Drop’

        OR

      - X2 Maintained ‘Lift’ with X3 Maintained ‘Drop’

        OR

      - X4 Momentary ‘Lift/Drop’
2. Initialize ‘Lift’ command, if no output occurs replace CPU-1.

Types of Failures:

Generator Output Turns 'On' the turns 'Off' upon 'Lift' Command:

1. Shut off controller at Main Disconnect Switch on door.
2. Remove Main Fuse. See Figure ii.1.
3. Disconnect M1 cable at controller. See Figure ii.1.
4. Turn on controller at Main Disconnect on door.
5. Turn on generator and magnet controller.
6. Place meter on Breaker 3 and Breaker 4. See Figure iv.1

Steps 7 & 8 Continued on next page...

Fig. ii.1 Disconnect Load

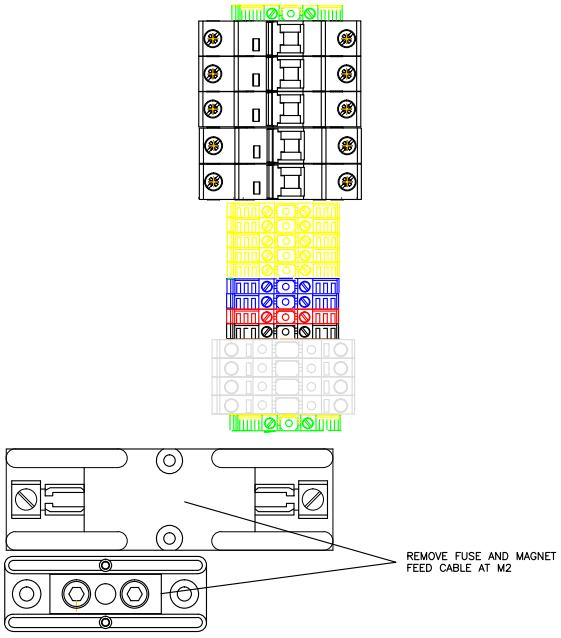
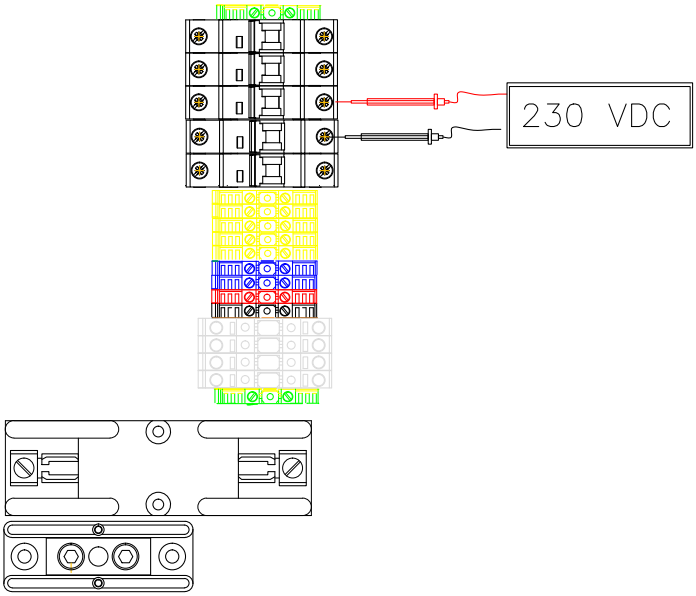


Fig. iv.1 Generator Output Check



7. Initialize a ‘Lift’ command. Voltage should go to desired level and stabilize. If no voltage is measured, repair of generator required.
8. If ‘Failure Symptom’ occurs, begin feedback loop testing. Each voltage test is performed with a ‘Lift’ command.

   a. Check Feedback Breakers. See Figure iv.2. If voltage measured not equal to voltage measured in step 6., replace breaker/MOV assemblies.

   b. Check Feedback Polarity Alignment Diodes. See Figure iv.3. If voltage measured not equal to voltage measured in step 6., replace terminal assemblies DO-1 and DO-2.

   c. Check Feedback Rectifiers. See Figure iv.4. If voltage measured not equal to voltage measured in step 6, replace RECT-1 and RECT-2.

   d. Check Analog Input Resistors. See Figure iv.5. If voltage measured is not 1-3 VDC, replace terminal assemblies AR-1 and AR-2.

   e. If all tests pass, replace CPU-1.

Fig. iv.2 Feedback Breaker Check

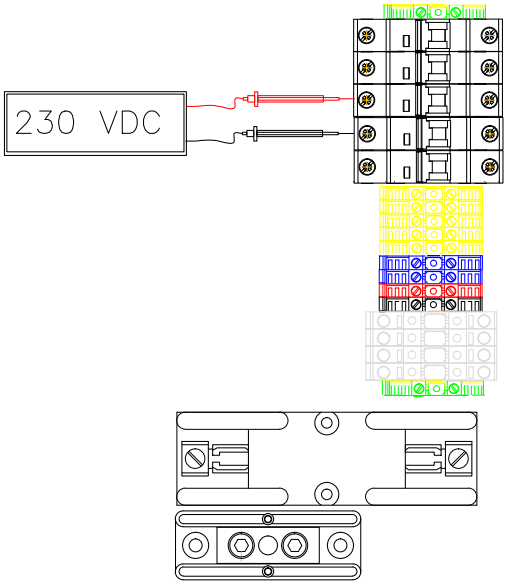


Fig. iv.3 Polarity Alignment Diode Check

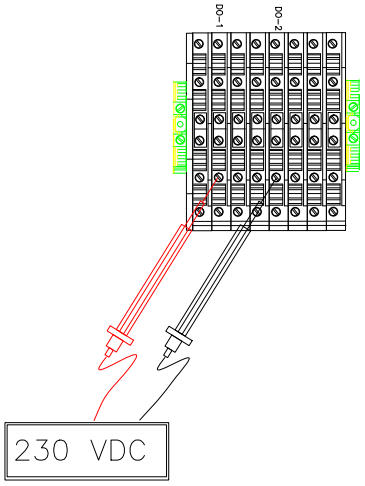


Fig. iv.4 Feedback Rectifier Check

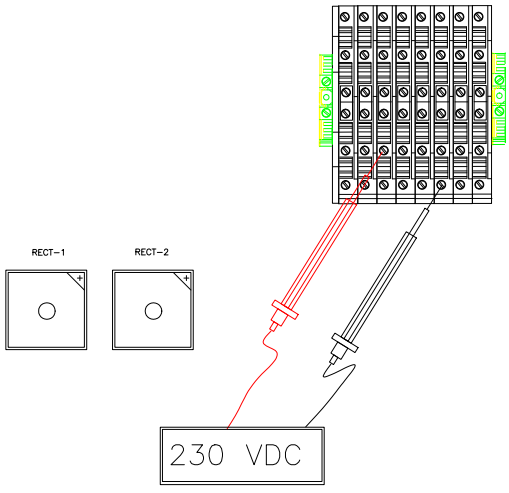
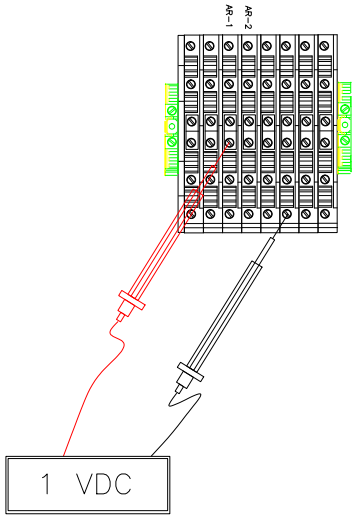


Fig. iv.5 Analog Resistor Check



The main power circuit can be damaged if ran outside the correct parameters. These include the following:

1) Incorrect feed cable size or feed source (see Figure 7.1.)

2) Generator RPM at loaded condition (less than 80% of generator nameplate RPM)

3) Incorrect use of operator interface terminals (ie: Utilizing a maintained switch in the single pushbutton position)

4) Incorrect generator field voltage (Using a 4271 in place of a 4272)

5) Incorrect initial field connection (ie: Connecting for constant potential, connecting to the series field, connecting in parallel, connecting in the armature circuit, etc.) then reconnecting correctly.

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