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# H7228 Power Conditioning System (50/60 Hz) Technical Manual

Prepared by Educational Services  
of  
Digital Equipment Corporation

1st Edition, August 1985  
2nd Edition, May 1986  
3rd Edition, January 1987

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## PREFACE

This technical manual is intended for use by personnel who have been trained in the operation, installation, and maintenance of the H7228 power conditioning system.

The manual covers the following topics for the H7228 (50/60 Hz) power conditioning system (PCS):

- Chapter 1, "Introduction," gives an overview of the PCS and provides detailed information on system controls and operator functions.
- Chapter 2, "Operation," provides operator power-up, power-down, and checkout procedures. This chapter also provides an operator troubleshooting guide.
- Chapter 3, "Installation," provides site preparation, unpacking, inspection, and installation procedures.
- Chapter 4, "Service," provides troubleshooting, switch setting, and calibration procedures.
- Chapter 5, "Technical Description," provides a detailed technical description of the PCS for the technical person.
- Appendix A, "Glossary of Terms," lists the mnemonics used in this manual.
- Appendix B, "Remote Emergency Power-Off Option," describes how to install and connect the remote emergency power off (REPO) station(s).
- Appendix C, "Input Power Junction Box," describes the junction box (J-Box) and provides installation procedures.
- Appendix D, "PCS Specifications," provides environmental and physical specifications.
- Appendix E, "Parts Location," provides four illustrations that identify parts.
- Appendix F, "Remote Interface Alarm (RIA) Option," provides a detailed description of the RIA option.

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## RELATED DOCUMENTS

### Title

### Part Number

DIGITAL Site Preparation Guide

EK-CORP-SP

Power and Packaging Catalog

EK-PWRPK-CL



## CHAPTER 1 INTRODUCTION

### 1.1 SAFETY

The H7228 power conditioning system contains HIGH VOLTAGE. Formal training on this unit is required for all maintenance personnel and all appropriate safety precautions must be taken to ensure the safety of personnel installing, operating, and maintaining this equipment.

The maintenance philosophy on this equipment is to replace the field replaceable unit and repair it at the factory. The field engineer may calibrate, troubleshoot, and repair the low voltage sections of the PCS. Work on the high voltage section must be done by a trained specialist.

To power down the PCS for troubleshooting and repair, use the following procedure:

1. Turn OFF the attached equipment using the appropriate sequence,
2. Turn OFF the output main circuit breaker(s),
3. Turn OFF the input main circuit breaker, and
4. Unplug the power cable from the J-Box.

During power-on troubleshooting and testing, keep all panels and protective devices in place whenever possible. Remove all rings and jewelry, and wear safety glasses at all times when conducting power-on tests.

### IMPORTANT

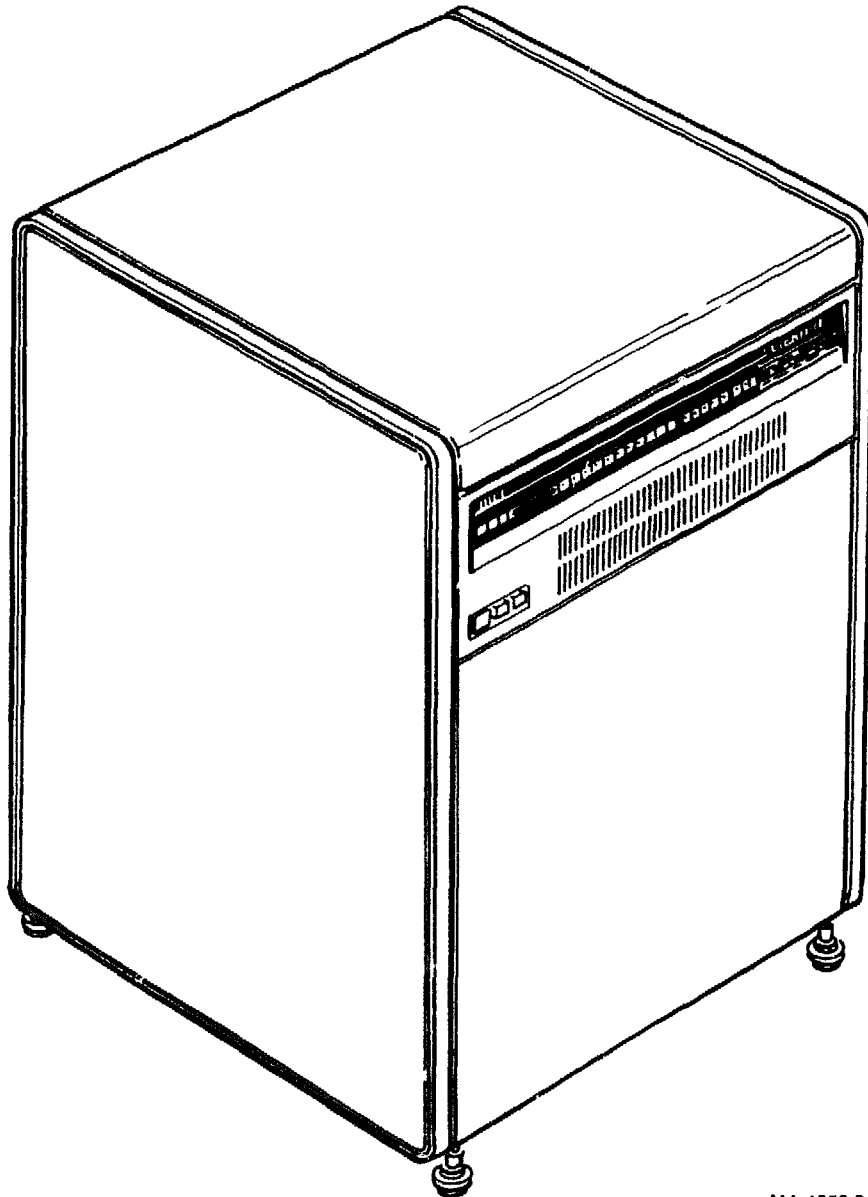
The voltage regulation portion of the H7228 PCS contains HIGH VOLTAGE and formal training of maintenance personnel is mandatory.

## 1.2 GENERAL

The H7228 power conditioning system (PCS) provides voltage regulation, power conditioning, and distribution of ac power for small- to medium-sized computer systems (Figure 1-1). The input voltages can be from 208 Vac to 480 Vac and may be either 50 or 60 Hz. The H7228 PCS is available in 15, 30, 50, and 75 kilo volt ampere (kVA) configurations.

The PCS can be configured to accept and display external failure or status information, which also can cause an alarm and/or emergency shutdown of the system.

The internal functions of the PCS are displayed for operator use, while critical situations cause system shunt trip and an alarm to sound.



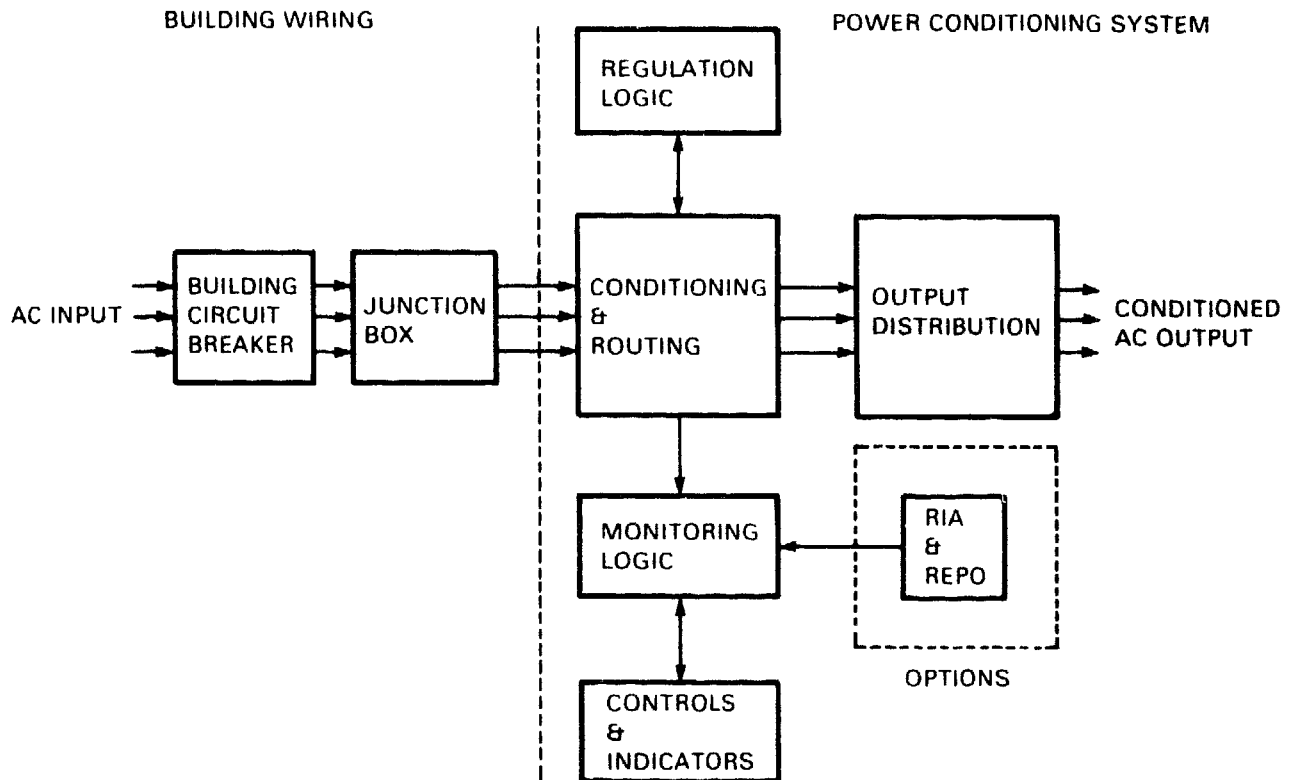
MA-1373-84

Figure 1-1 Power Conditioning System

### 1.3 SYSTEM DESCRIPTION

The functions of the H7228 PCS are divided into seven categories (Figure 1-2):

- External ac input (external to the main unit)
- Input filtering and routing (internal to the PCS)
- Monitoring logic
- Regulating logic
- Controls and indicators
- Output power distribution and filtering
- Options.



MKV86-0138

Figure 1-2 System Components



### 1.3.1 Input Power and Junction Box

The three-phase input branch power ranges from 208 to 480 Vac at 60 Hz and from 380 to 415 Vac at 50 Hz.

The input power junction box (J-Box) connects the building source power (using the input power cable) to the PCS. The J-Box is included with the PCS, but is installed and wired by an electrician supplied by the customer.

### 1.3.2 Input Filtering and Protection

The ac input is applied to the input main circuit breaker (IMCB), which disconnects the PCS from the power source. The IMCB may be tripped by hand to serve as an ON/OFF switch, or tripped automatically by the monitoring logic. The input ac is filtered by three capacitors and then applied to the isolation transformer.

### 1.3.3 Monitoring Logic

The PCS has extensive logic circuits to monitor the input and output voltage and current. The alarm circuitry is included in the monitoring logic. The monitoring logic is separated into 11 modules:

- |                            |                                 |
|----------------------------|---------------------------------|
| ● Unregulated Power Supply | -- Internal ac and dc power     |
| ● Power Block Interface    | -- DC power distribution        |
| ● DC Power Supply          | -- Internal dc power            |
| ● Main Logic               | -- Sensing and control logic    |
| ● Lamp Driver              | -- Display control and drivers  |
| ● Internal Monitor         | -- Temperature/failure logic    |
| ● Internal Alarm Driver    | -- Audible alarm logic          |
| ● LED Display Driver       | -- Control panel                |
| ● Phase Error Detector     | -- Phase rotation or loss logic |
| ● Ground Current Detector  | -- Erroneous ground current     |
| ● Remote Interface Alarm   | -- Optional status input        |

#### 1.3.4 Regulating Logic

The PCS regulates each phase separately by automatically selecting the appropriate taps on the input side of the isolation transformer. The tap selection is accomplished by the control logic modules. The control logic modules sense the line voltage changes and select the SCR driver modules, which select the actual taps.

The regulation circuits are contained on the following modules:

- Control logic modules (3) -- One for each phase
- SCR driver modules (21) -- Seven for each phase

#### 1.3.5 Output Distribution Circuits

The surge suppression network ensures clean power and the output main circuit breaker(s) provide overcurrent protection. The output distribution panelboard holds the output distribution circuit breakers. The output power cables provide output power to the system peripherals.

#### 1.3.6 Options

Remote emergency power off (REPO) switches are optional on the H7228 PCS. The REPO(s) provide emergency power off capabilities for the entire computer system from a point removed from the PCS (for example, near the entrance/exit door). See Appendix B.

#### 1.4 OPERATOR CONTROLS AND INDICATORS

The system status panel and local control panel (Figures 1-3 and 1-4) provides a central location to monitor the status of the PCS. Summaries of the controls and indicators are given in Tables 1-1 and 1-2.

The local control panel (Figure 1-3) contains controls and associated indicators to change the status of the PCS. The input main circuit breaker serves as the ON/OFF switch. The function selector switch, located internally, bypasses the regulation circuits in the event of a failure.

When a malfunction occurs, an audible alarm sounds and the appropriate light-emitting diode (LED) indicator on the system status panel (SSP) comes on. Any alarm stops the digital clock on the SSP. The clock displays the time the malfunction occurred until you press the SYSTEM RESET switch.

##### 1.4.1 System Status Panel (SSP) Indicators -- Figure 1-4

The square LEDs in the corner of the VOLTAGE, CURRENT, KVA, TIME SET, HOURS, MINUTES, ALARM, BATTERY, and SYSTEM switches come on to show which readout is presently on the digital display.

##### MAIN AC:

This indicator comes on and the alarm sounds if the PCS output power fails. The PCS also trips its IMCB.

##### INTERNAL DC:

Indicates a battery charger or dc power supply failure. The alarm also sounds.

##### REPO TRIPPED:

Indicates power was shut down from one of the remote emergency power off wall switches. See Appendix B for more information.

##### VOLTAGE CHECK (HIGH):

Output ac power has exceeded the +7% of nominal line voltage.

##### VOLTAGE CHECK (LOW):

Output ac power has dropped below the -13% of nominal line voltage.

##### GROUND CURRENT MONITOR:

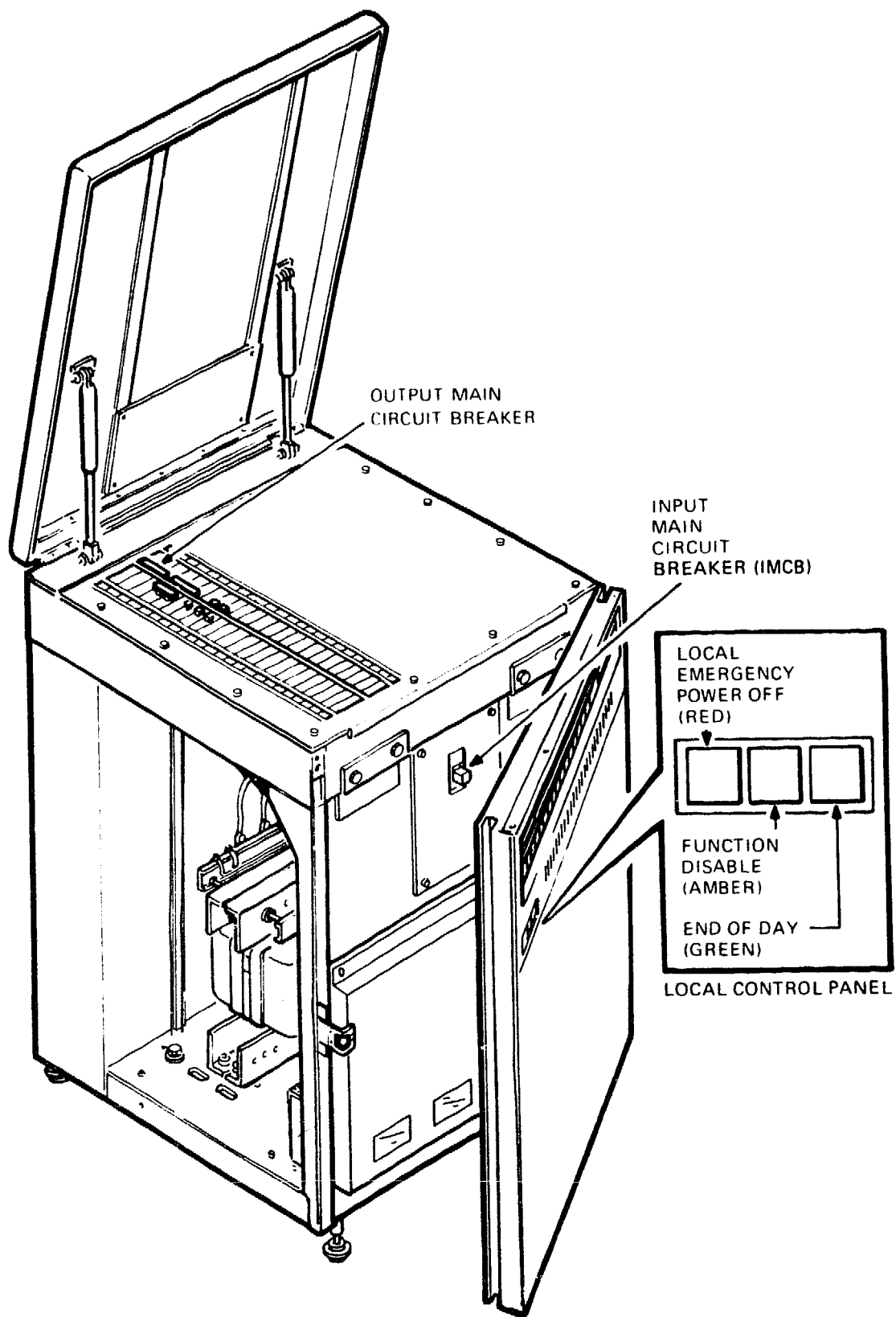
The ground current has exceeded 5 amperes.

##### PHASE ERROR:

Indicates the loss of an output voltage phase or incorrect rotation of the input 3-phase power.

##### TEMPERATURE CHECK:

The temperature in the PCS is above normal.



MKV86-0139

Figure 1-3 Local Control Panel

## Power Conditioning System

Hours

Minutes

Time Set

Voltage  
Current  
kVA  
Time

12  
23  
31  
N1  
N2  
N3

Operating Voltage

Operating Current

Phase 1

Phase 2

Phase 3

Neutral

Ground

kV/L

Alarm

Battery

System

Silence  
Test

Repair

Power Factor

Max AC

Min AC

Max T-Load

Voltage Check

High

Low

Ground Current Monitor

Phase Error

Temperature Check

Warning

Remote Interface Alarm

1

2

3

4

5

6

7

8

MR VBE-0140

Figure 1-4 System Status Panel (SSP)

**OVERTEMP:**

The temperature in the PCS cabinet has exceeded a predetermined level, indicating that a malfunction or overload has occurred. The H7228 PCS automatically shuts down.

**REMOTE INTERFACE ALARMS (1 TO 8):**

One of eight remote safety or security devices has been activated. The alarm sounds and the PCS shuts down, if the PCS is so programmed. Remote devices include fire alarm systems, air conditioners, humidity measuring equipment, and so forth.

**DIGITAL DISPLAY:**

The digital display shows the 24-hour time of day until one of the monitoring switches (OPERATING VOLTAGE or OPERATING CURRENT) is pressed.

When you press any monitoring switch, the selected voltage, current, or power appears on the digital display.

**1.4.2 System Status Panel (SSP) Clock and Controls -- Figure 1-4****TIME SET:**

Use this switch with either the HOURS switch or the MINUTES switch to set the time of day.

**HOURS:**

Use this switch with the TIME SET switch to update the hours and minutes display at a rapid pace.

**MINUTES:**

Use this switch with the TIME SET switch to update the minutes and hours display at a slow pace.

**ALARM SILENCE:**

Silences the audible alarm for up to 15 minutes.

If an alarm condition still exists, the alarm sounds again.

If another malfunction occurs after the alarm is silenced, the system overrides the ALARM SILENCE, and the alarm sounds again.

**BATTERY TEST:**

The PCS has battery backup of the dc power for the system status panel. BATTERY TEST does the following:

- Displays the battery voltage
- Sounds the alarm
- Turns on all indicators.

**NOTE**

Press SYSTEM RESET to clear the alarm.

#### SYSTEM RESET:

Clears a corrected alarm condition. SYSTEM RESET also clears the digital display and activates the clock with the correct time.

If an alarm condition still exists, the system does not reset and the alarm sounds again.

#### OPERATING VOLTAGE:

Selects the phase-to-phase and phase-to-neutral voltages of the transformer output. The voltages appear on the digital display.

#### OPERATING CURRENT:

Allows the operator to monitor the output current flowing in neutral, each of the three secondary phases, and the groundcircuit.

#### KVA:

Displays the present power consumption of the PCS in kVA.

### 1.4.3 Local Control Panel -- Figure 1-3

#### EMR PWR OFF (RED):

The local emergency power off switch (labeled EMR PWR OFF and protected by a guard cover) trips the IMCB, disconnecting the PCS from input power in an emergency. During normal operation, the red indicator is on. Pressing this switch trips the IMCB and turns off the red indicator.

#### FUNC DISABLE (Amber):

Prevents a shunt trip of the PCS by the monitoring logic. Use during operator checks and to prevent trips caused by logic failure. (The alarm still sounds.)

When you press FUNC DISABLE, the amber indicator comes on and the IMCB will not trip during the following alarm conditions:

- VOLTAGE CHECK (high or low)
- REMOTE INTERFACE ALARMS (RIA)
- PHASE ERROR
- GROUND CURRENT.

When you release FUNC DISABLE, the amber indicator goes off and the IMCB is allowed to trip.

#### EOD (Green):

Pressing the end-of-day (EOD) switch when powering down the PCS disconnects the back-up battery from its charging circuits and load (except the clock), preventing battery discharge. The green indicator goes out when the battery is disconnected. When the operator releases EOD, the indicator comes on and the battery is reconnected.

#### 1.4.4 Internal Controls and Indicators -- Figure 1-5

##### INPUT MAIN CIRCUIT BREAKER (IMCB):

The input main circuit breaker disconnects input power to the PCS. The IMCB, located behind the cabinet door, can be tripped:

- Manually,
- By its shunt trip (controlled by the monitoring logic) or
- By an overload.

##### FUNCTION SELECTOR:

Place this switch in the ISOLATION ONLY position to bypass the regulation logic in the event of a regulator failure. The function selector is normally in the REGULATION/ISOLATION position. The function selector switch is located behind the cabinet door.

##### WARNING

The IMCB must be OFF to operate the FUNCTION SELECTOR switch; otherwise, a shunt trip could occur.

##### MOV FUSE INDICATORS:

Located on the inside panel, these lamps indicate a defective surge suppressor.

#### 1.4.5 Output Distribution Circuits

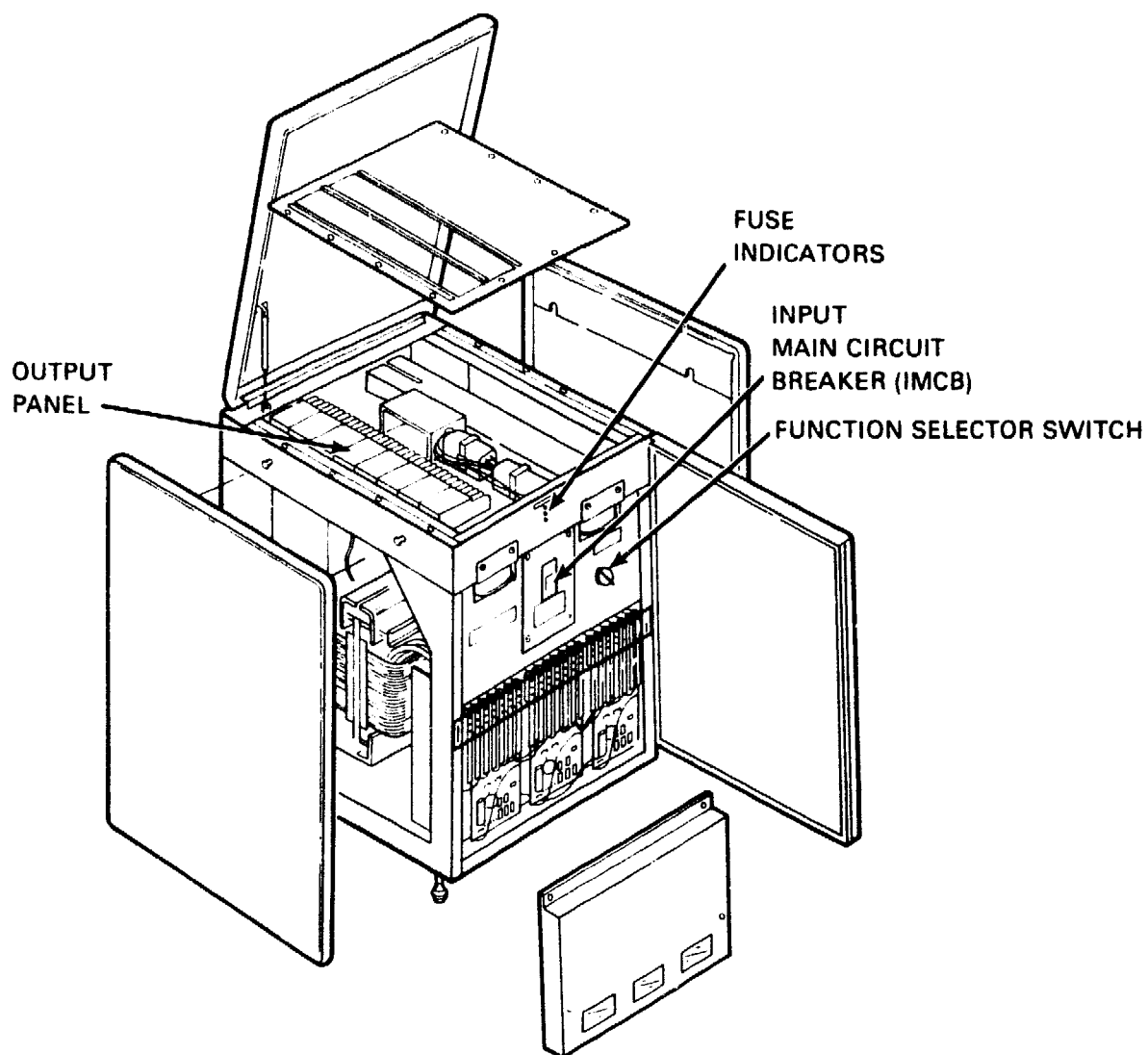
##### OUTPUT MAIN CIRCUIT BREAKER(s):

The output main circuit breaker(s) limit the total output current and switch all the individual circuit breakers on the panelboard. This circuit breaker is on the output panelboard under the top panel. A PCS with two output panelboards has an output main circuit breaker for each panelboard.

##### OUTPUT DISTRIBUTION CIRCUIT BREAKERS:

The output distribution circuit breakers control and protect the output circuits that supply conditioned voltages to the computer system. The output circuit breakers are under the top panel.





MKV86-0141

Figure 1-5 PCS Controls

**Table 1-1 Summary of Operator Controls**

| Control                       | Function               | Location     | Normal Operating State |
|-------------------------------|------------------------|--------------|------------------------|
| Input Main Circuit Breaker    | Main Power ON/OFF      | Inside Panel | ON                     |
| Function Selector             | Regulation Bypass      | Inside Panel | Regulation/Isolation   |
| Local Emergency Power Off     | Emergency Power Off    | LCP          | Red Indicator ON       |
| FUNC DISABLE                  | Shutdown Disable       | LCP          | Amber Indicator OFF    |
| EOD                           | Battery Disconnect     | LCP          | Green Indicator ON     |
| Output Main Circuit Breaker   | Overcurrent Protection | Top Panel    | ON                     |
| Distribution Circuit Breakers | Control & Protection   | Top Panel    | ON                     |
| TIME SET                      | Set Time on Display    | SSP          | (Momentary)            |
| HOURS                         | Time Set for Hours     | SSP          | (Momentary)            |
| MINUTES                       | Time Set for Minutes   | SSP          | (Momentary)            |
| ALARM SILENCE                 | Turns OFF Alarm        | SSP          | (Momentary)            |
| BATTERY TEST                  | Check Battery Voltage  | SSP          | (Momentary)            |
| SYSTEM RESET                  | Clears Alarm Status    | SSP          | (Momentary)            |
| OPERATING VOLTAGE             | Check Output Voltages  | SSP          | (Momentary)            |
| OPERATING CURRENT             | Check Current Use      | SSP          | (Momentary)            |
| KVA                           | Check Power Usage      | SSP          | (Momentary)            |

**Table 1-2 Summary of Operator Indicators**

| Control                | Indication                                    | Location | Normal Operating State                          | Alarm | Shunt Trip |
|------------------------|-----------------------------------------------|----------|-------------------------------------------------|-------|------------|
| EM PWR OFF             | Emergency Power Off                           | LCP      | Red Indicator ON<br>(No Emergency Situation)    | Yes   | Yes        |
| FUNC DISABLE           | Shutdown Disabled                             | LCP      | Amber Indicator OFF<br>(Auto Shutdown Disabled) | No    | No         |
| EOD                    | PCS Deactivated                               | LCP      | Green Indicator ON<br>(Battery Backup Enabled)  | No    | No         |
| (Digital Display)      | Time or Readout                               | SSP      | 24 Hour Time                                    | No    | No         |
| MAIN AC                | AC Input Interrupted                          | SSP      | OFF                                             | Yes   | No         |
| INTERNAL DC            | DC Power Failure                              | SSP      | OFF                                             | Yes   | Yes        |
| REPO TRIPPED           | Remote Emergency Power<br>Off Switch Shutdown | SSP      | OFF                                             | Yes   | Yes        |
| Voltage Check - HIGH   | Input Voltage Over                            | SSP      | OFF                                             | Yes   | Opt*       |
| Voltage Check - LOW    | Input Voltage Under                           | SSP      | OFF                                             | Yes   | Opt*       |
| GROUND CURRENT MONITOR | Excessive Gnd Current                         | SSP      | OFF                                             | Yes   | Opt*       |
| PHASE ERROR            | Output Phase Failure                          | SSP      | OFF                                             | Yes   | Opt*       |
| TEMPERATURE CHECK      | Temperature Too High                          | SSP      | OFF                                             | Yes   | Yes        |
| OVERTEMP               | Critical Temperature                          | SSP      | OFF                                             | Yes   | Yes        |
| REMOTE INTERFACE ALARM | 1 of 8 Inputs Active                          | SSP      | OFF                                             | Yes   | Opt*       |

\* Shunt trip is optional for these alarms and depends on the programming.



## 2.1 GENERAL

This chapter contains the the following procedures:

- Unpacking,
- Inspection,
- Checkout, and
- Initialization.

These procedures let you verify correct PCS operation before you connect the unit to a computer system. See Figures 2-1 and 2-2 during inspection for part locations.

Before installing the PCS, inspect the following items:

1. Check that the input power junction box (J-Box) is installed.
2. Check the input voltage at the J-Box.
3. Check that the power-handling capacity (kVA) of the PCS is correct.
4. Check that the output distribution configuration of the PCS is correct.

Make sure that these checks meet the needs of the computer system being installed. See Appendix C when you inspect the site before installation.

See Appendix D for environmental and physical specifications, including information on circuits, current ratings, branch power, and power capacities.

## 2.2 UNPACKING THE PCS

1. Position the shipping crate to allow 4 meters (12 feet) of space behind the pallet so the PCS can safely roll off the ramp without hitting a wall or other obstruction.
2. Carefully unband the carton.

### CAUTION

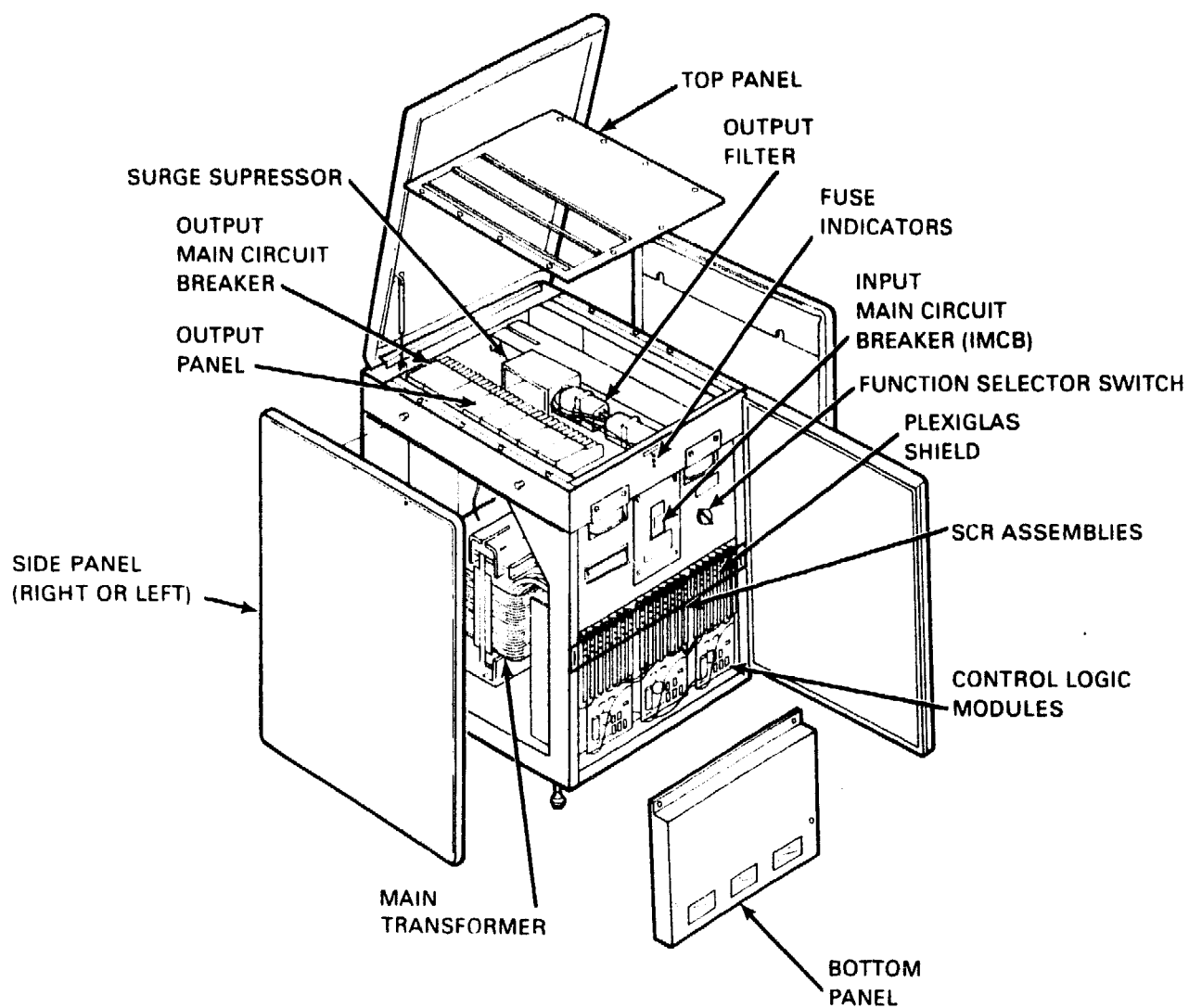
The steel bands can cause injury if incorrectly cut. Use an unbanding tool or take special care when you cut the bands.

3. Lift the cover off the pallet and remove the cardboard box that contains the rear panel.
4. Remove the ramp, taking care not to misplace the loose bolts in the ends.
5. Remove the cardboard protectors around the sides of the PCS.
6. Unband the unit from the pallet and remove the clear plastic cover.
7. Remove the blocking boards around the bottom of the PCS unit using a 9/16-inch wrench.
8. Attach the ramp to the back of the pallet using the 9/16-inch bolts as pegs in the holes at end of the ramp and at the back of the pallet.

### WARNING

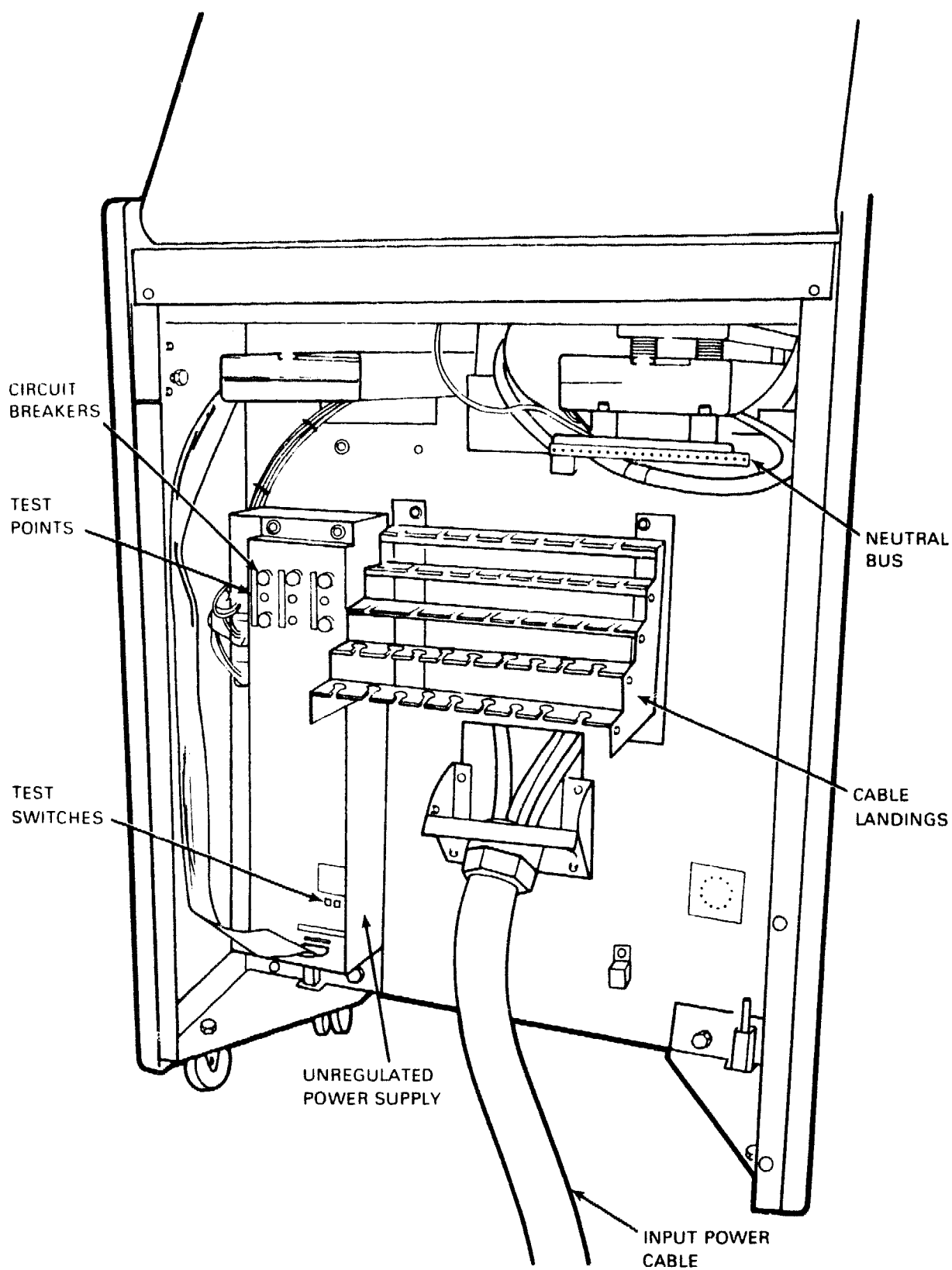
Make sure that the bolts securely attach the ramp to the pallet.

9. Raise the four leveling feet on the PCS as high as they can go.
10. Using an adequate number of people, roll the PCS down the ramp to the floor.



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Figure 2-1 H7228 PCS Components (Front View)



MKV85-0186

Figure 2-2 PCS Components (Rear View)



## 2.3 INSPECTING THE PCS

Sections 2.3.1 through 2.3.7 are checklists to help you detect obvious damage or safety hazards that may have occurred during shipment or handling of the equipment.

### WARNING

DO NOT connect the PCS to the building's power at this time.

#### 2.3.1 Enclosure

- [ ] Check all external surfaces for scratches, dents, or other obvious damage.

#### 2.3.2 Transformer

### WARNING

Make sure that the input power connector is NOT connected to the input J-Box. This ensures that the building's power is NOT connected.

- [ ] 1. Open the cabinet door.
- [ ] 2. Unlock and remove the side panels by lifting up.
- [ ] 3. Check the transformer for shifting, broken, or loose mountings. The transformer coils and terminal lugs must not touch any part of the internal enclosure or other grounded metal surface.
- [ ] 4. Make sure that the terminal lugs and connectors used to hold terminal-to-bus connections and wire-to-terminal connections are tight.
- [ ] 5. Ensure that the wires to the function selector switch are properly connected.
- [ ] 6. Check all the wire insulation for damage.
- [ ] 7. Make sure that the ground lugs are firmly mounted.
- [ ] 8. Replace the side panels.

### 2.3.3 Input Wiring

#### WARNING

Make sure that the input power connector is NOT connected to the input J-Box. This ensures that building power is NOT connected.

- [ ] 1. Remove the four bolts on the IMCB cover (Figure 2-1).
- [ ] 2. Make sure that the three output wire connections to the IMCB are tight.
- [ ] 3. Replace the IMCB cover.

### 2.3.4 Output Wiring

- [ ] 1. Make sure that the input cable-to-grounding bus connections on the back of the PCS are tight.
- [ ] 2. Check the individual distribution circuit ground wire connections (green/yellow wires).
- [ ] 3. Remove the panelboard cover and check the wiring to the following components:
  - a. Neutral bus (white wires)
  - b. Output main circuit breaker (black, red, and blue wires).
- [ ] 4. Make sure that each circuit breaker is firmly seated.
- [ ] 5. Replace the output panelboard cover.

### 2.3.5 Logic Modules

- [ ] 1. Check the cabinet door logic area (behind the plastic cover) for any defects or broken parts.
- [ ] 2. Make sure that all the cables and module boards are firmly seated.
- [ ] 3. Leave the red battery lead disconnected.

### 2.3.6 Regulation Circuits

- ☐ 1. Open the cabinet door and remove the bottom panel.
- ☐ 2. Remove the plexiglas shield covering the SCRs.
- ☐ 3. Ensure that the SCR driver module mounting screws and the SCRs are tight.
- ☐ 4. Confirm that no ICs are missing on the control logic modules and that each board is properly seated.
- ☐ 5. Remove the output panelboard cover.
- ☐ 6. Ensure that the wires to the surge suppressor and the output filter are properly connected.
- ☐ 7. Reinstall all panels and covers.

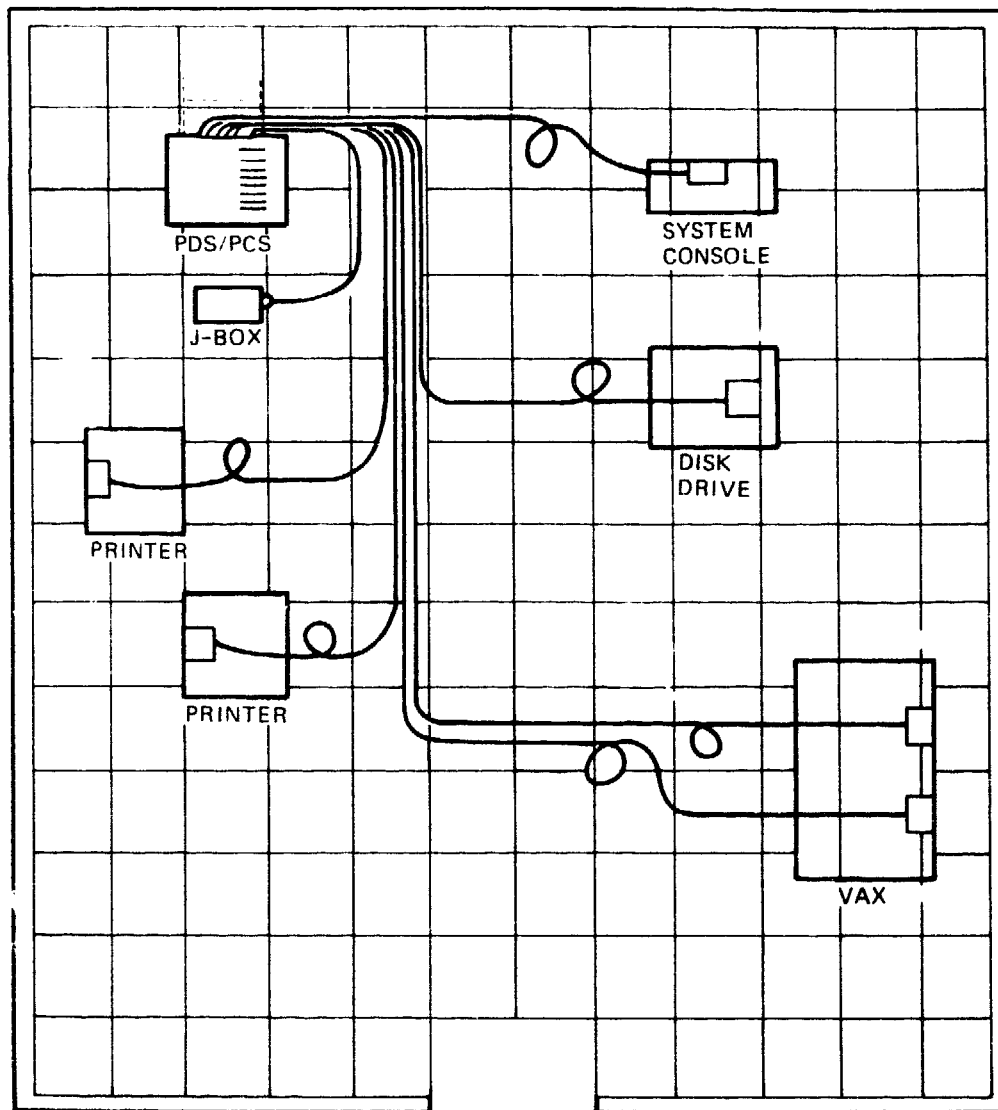
### 2.3.7 Unregulated Power Supply

- ☐ 1. Remove the back panel.
- ☐ 2. Make sure that all the switches are in their normal positions.
- ☐ 3. Reset any tripped circuit breakers.
- ☐ 4. Reinstall the back panel.

## 2.4 INSTALLING THE PCS

The installation of the H7228 power conditioning system (Figure 2-3) is separated into two parts:

- **CUSTOMER RESPONSIBILITIES** -- The customer is responsible for installing the junction box and the associated wiring, and also mounting and wiring any optional remote interface alarms. See Appendix B, Appendix C, and Appendix F for detailed instructions.
- **DIGITAL RESPONSIBILITIES** -- Digital Equipment Corporation will unpack, inspect, install, connect, and check out the H7228 PCS.



WKV86-0142

Figure 2-3 Typical PCS Installation

#### 2.4.1 J-Box Location

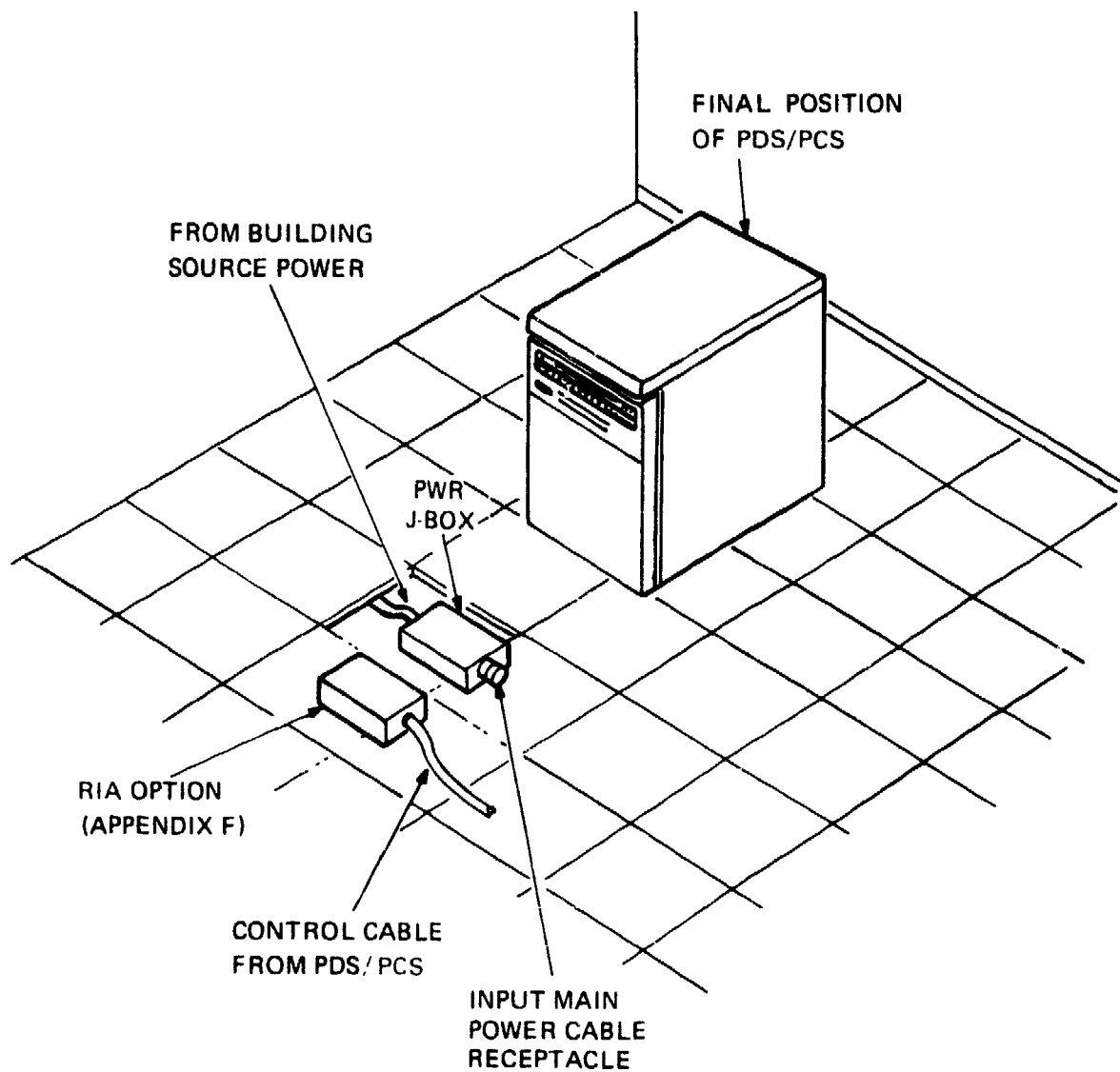
Before the PCS can be installed, the J-Box must be installed by the customer's electrical contractor according to the procedures in Appendix C, Section C.2.

##### NOTE

Before placing the J-Box, plan the clearance for the PCS. The PCS needs 1 meter (3 feet) clearance front and back, and 1.2 meters (4 feet) clearance on each side to allow transformer replacement.

The J-Box is located as follows:

1. At least 1 meter (3 feet) from any wall.
2. Within 1.5 meters (5 feet) of the PCS.
3. The J-Box must always be accessible. No equipment can be on the floor tile covering the J-Box.
4. The J-Box must be positioned to allow routing the input cable to the PCS through the same floor tile opening as the output distribution cables (Figure 2-4).

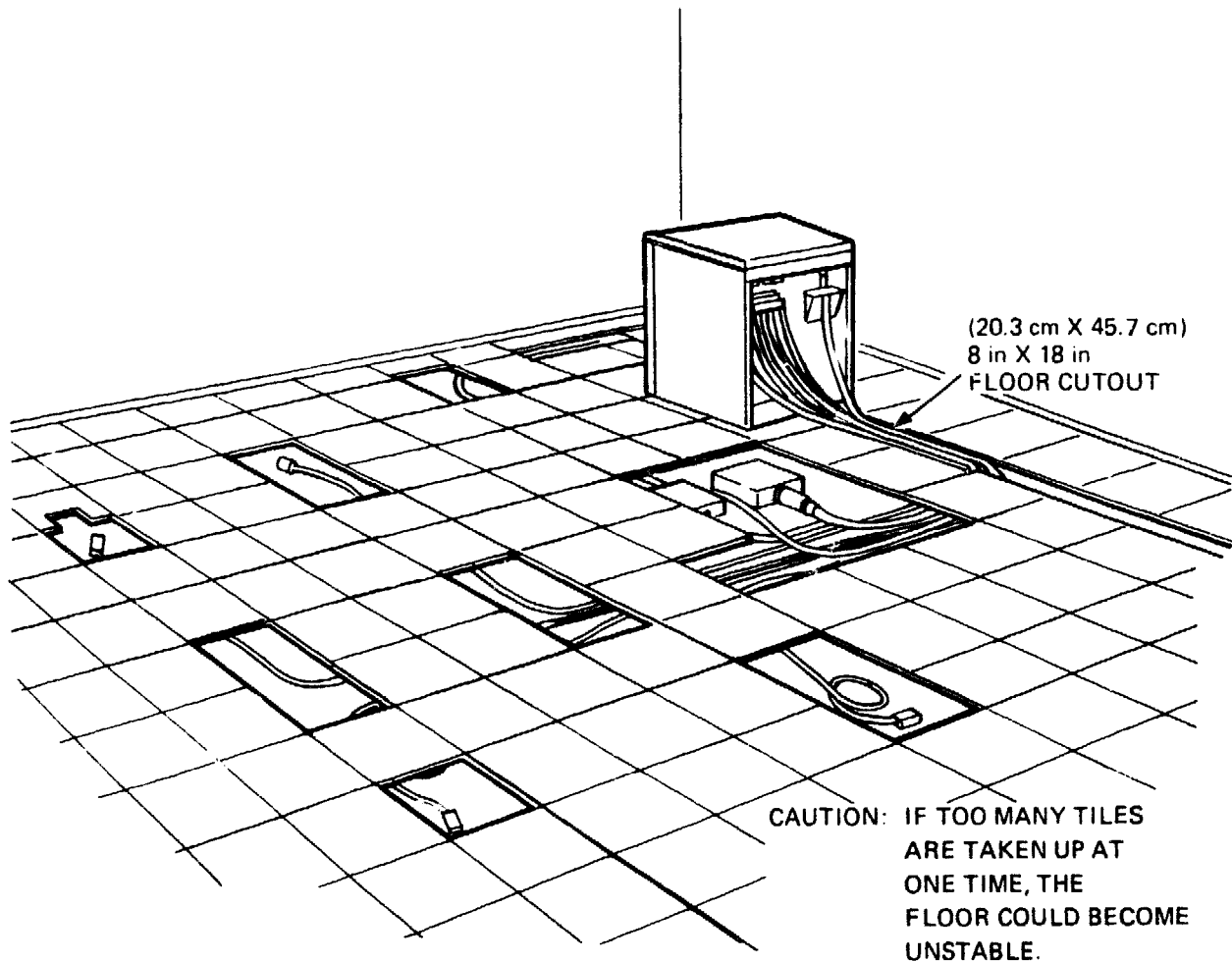


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Figure 2-4 Typical J-Box and RIA Installation

#### 2.4.2 Floor Tile Cutouts

The floor tile under the PCS must have a large enough cutout for the power distribution cables to run under the floor (Figure 2-5). This cutout should be 20.3 cm X 45.7 cm (8 X 18 inches), centered on the rear edge of the tile, and have no sharp edges. The PCS may use subfloor air circulation to back up its own cooling system.



MA-9003A

Figure 2-5 Output Cable Distribution

### 2.4.3 Installing and Adding Cable Assemblies

The PCS load center varies with the line frequency:

|            |   |                                         |
|------------|---|-----------------------------------------|
| 60 Hz Unit | = | Bryant Load Center -- Figure 2-6        |
| 50 Hz Unit | = | Merlin Gerin Load Center -- Figure 2-9. |

A 60 Hz PCS comes with the Bryant load center. The 60 Hz cable assemblies are packed separately and consist of a distribution circuit breaker and the power cable terminated with the outlet plug specified by the customer.

A 50 Hz PCS comes with a Merlin Gerin load center. The 50 Hz cable assemblies are packed separately and consist of a distribution circuit breaker, a circuit breaker power feed cable, and the power cable terminated with the outlet plug or terminal strip junction box specified by the customer.

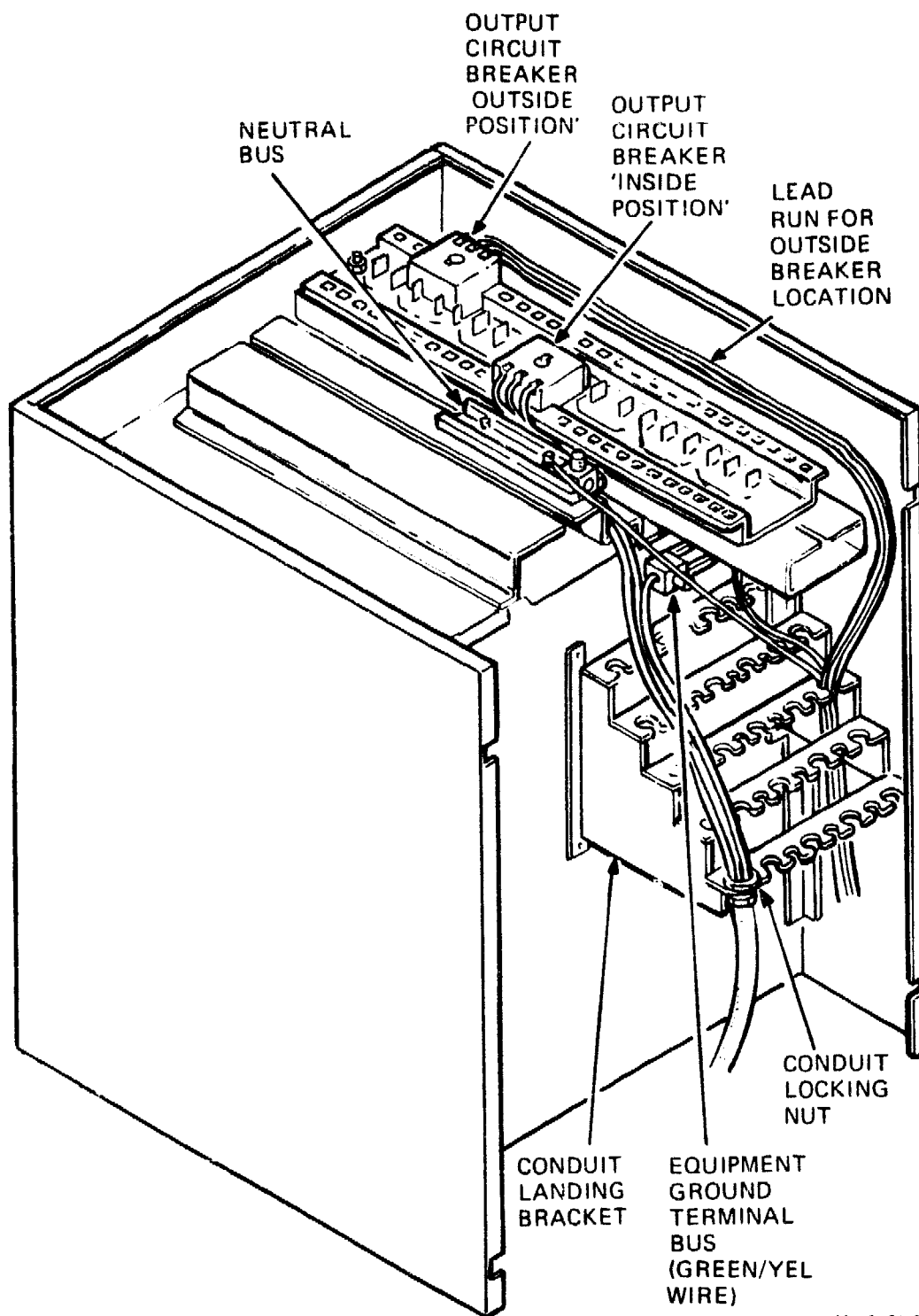
If a circuit is being added to the PCS after installation, make sure that the capacity of the PCS will not be exceeded.

#### WARNING

Ensure that power to the PCS is OFF.

Figure 2-3 shows a typical installation of the PCS.





MA-0127-85

Figure 2-6 Output Cable Installation (Bryant Load Center -- 60 Hz)

To install the cable assemblies:

1. Place the PCS to allow access for attaching the cables.
2. Remove the output cables from the shipping carton.
3. Uncoil the cables carefully.

**CAUTION**

Pulling a coiled cable by its end may break the inner core of the conduit. Bending the conduit below the diameters shown in Table D-1 may also damage the inner core of the conduit.

4. Match the cables with the associated device and place them under the floor panels (Figure 2-5).

The output cable assembly length will be determined by customer needs.

5. Raise the top cover and remove the output panelboard cover by disengaging the fasteners.
6. Remove the upper trim plate at the back of the PCS by disengaging the fasteners.
7. Find the appropriate size conduit mounting hole landing bracket (midline or outside) to the side of the load center where the circuit breaker will be mounted.
8. Remove the lock nut from the conduit on the PCS termination end. Then insert the threaded conduit fitting through the selected mounting hole, and secure it with the locking nut (Figure 2-6).

Table 2-1 Input Power Wiring Color Codes

| Input Power  | Ground       | Neutral | Phase 1 | Phase 2 | Phase 3 |
|--------------|--------------|---------|---------|---------|---------|
| <b>60 Hz</b> |              |         |         |         |         |
| 1-Phase      | Green/yellow | White   | Black   | --      | --      |
| 3-Phase      | Green/yellow | White   | Black   | Red     | Blue    |
| <b>50 Hz</b> |              |         |         |         |         |
| 1-Phase      | Green/yellow | Blue    | Black   | --      | --      |
| 3-Phase      | Green/yellow | Blue    | Black   | Brown   | Brown   |

9. Trim the power leads as follows:
  - a. With the cable secured in the landing bracket, lay the power leads over the front of the PCS.
  - b. Trim the power leads evenly with the front of the PCS.

NOTE

Trimming the power leads so that they will reach the farthest circuit breaker position allows for later configuration changes.

10. Trim the ground and neutral circuits so that the leads extend 1.2 meters (48 inches) from the conduit.

NOTE

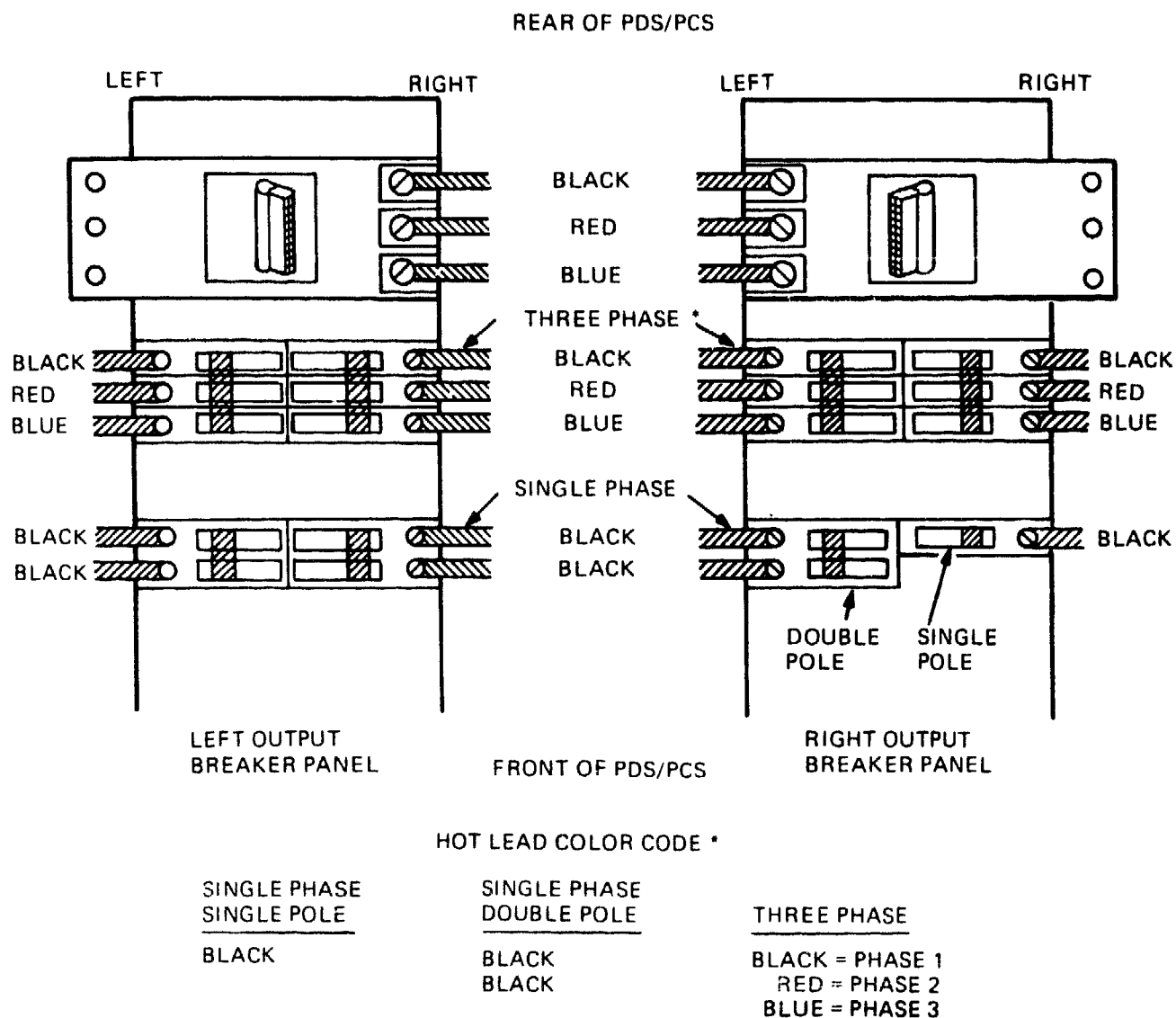
Before you connect a wire lead, strip the insulation to equal the depth of the lug hole or slot.

11. Connect the ground (green/yellow) wires from the cable conduit to the equipment ground terminal bus (Figure 2-6 or 2-9) after you select the appropriate lug hole based on wire size. Then tighten the lug screw.
12. Connect the neutral leads (white on 60 Hz units, blue on 50 Hz units) to the neutral terminal bus (Figure 2-6 or 2-9) after you select the appropriate lug hole based on wire size. Then tighten the lug screw.

CAUTION

When you tighten the bus bar or circuit breaker lug screws, torque the lug screw as tightly as possible. Then grasp the lead firmly and move it from side to side several times. Now torque the lug screw again to securely fasten the lead.

13. Before you install circuit breakers, cut slots from the protective paper that covers the circuit breaker position to be used.



NOTE: \*

THIS COLOR CODE APPLIES TO THE THREE PHASES. WHEN WIRING THE THREE PHASE CIRCUIT BREAKER, VERIFY WHICH PHASE OF THE LOAD CENTER MATES WITH WHICH CIRCUIT BREAKER LUG AND CONNECT THE LEADS PER THE LOAD CENTER PHASE COLOR CODE.

MKV86-0159

Figure 2-7 60 Hz Distribution Circuit Breaker Connection

14A. The 60 Hz distribution circuit breaker connection follows:

**SINGLE-PHASE (60 Hz)**

- a. Attach the circuit breaker to the appropriate cable.  
(See Figure 2-7.)

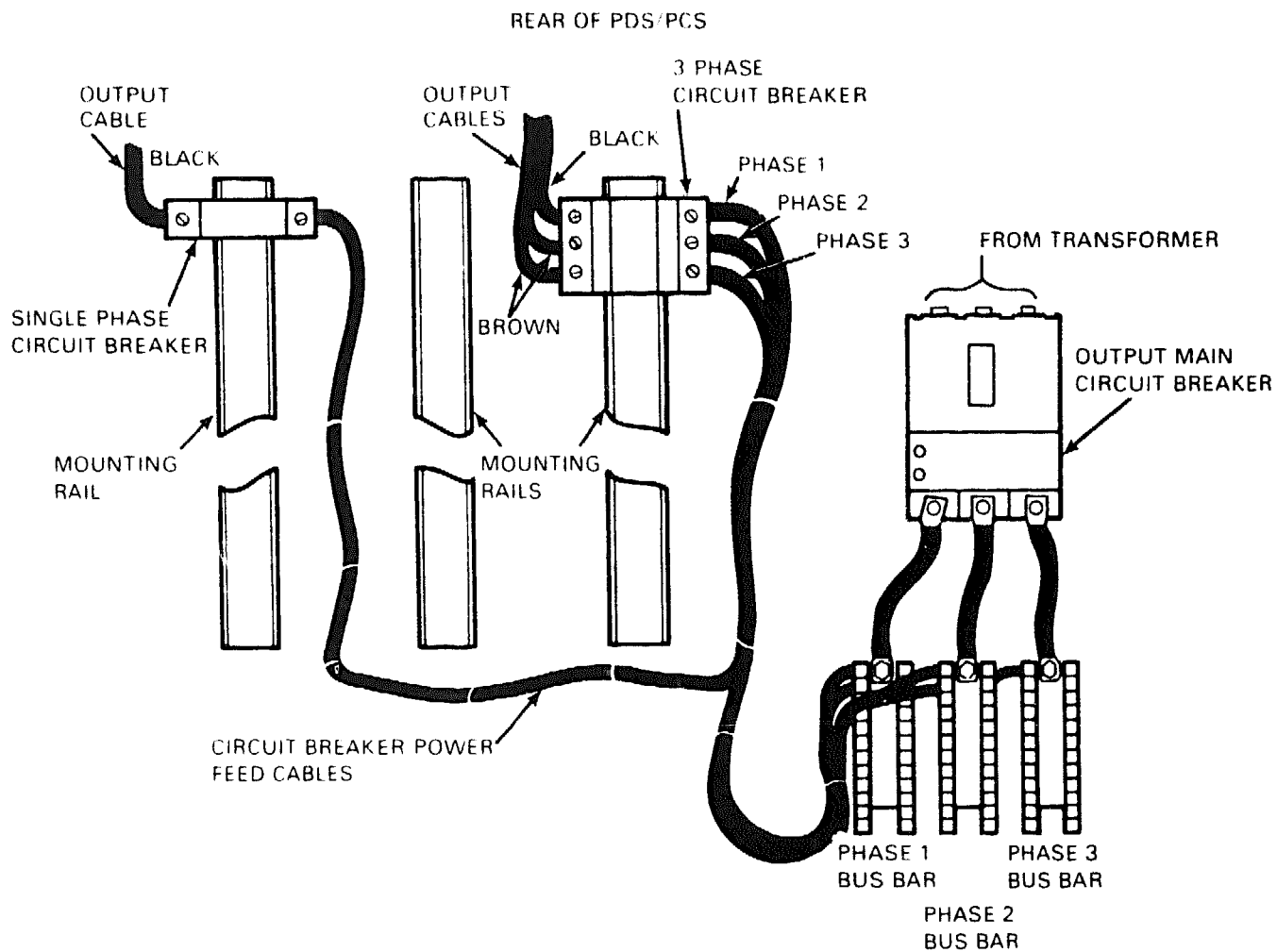
**NOTE**

When installing multiple single-phase lines, balance the loads as equally as possible between the phases.

- b. Run the black hot lead (with the circuit breaker attached) along the appropriate side of the load center (Figure 2-7: inside or outside, based on the desired circuit breaker location).
- c. Snap the circuit breaker into position and make sure that the circuit breaker lug screw(s) are securely tightened.

**3-PHASE CONNECTION (60 Hz)**

- a. Attach the circuit breaker to the appropriate cable.  
(See Figure 2-7.)
- b. Run the three black, red, and blue hot leads (with the circuit breaker attached) along the appropriate side of the load center (Figure 2-6: inside or outside, based on the desired circuit breaker location).
- c. Snap the circuit breaker into position and verify the correct color coding of the attached wires (Figure 2-7) to maintain correct phase relationship.
- d. Make sure that the circuit breaker lug screws are securely tightened.



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Figure 2-8 50 Hz Distribution Circuit Breaker Connection

14B. The 50 Hz distribution circuit breaker connection follows:

SINGLE-PHASE (50 Hz)

- a. Slide the circuit breaker onto the selected rail.

NOTE

Install the circuits located on the left rails and left bus bars first. Balance the loads equally between the phases.

- b. Strip the insulation on the power leads back to a length equal to the depth of the lug hole on the circuit breaker.
- c. Run the power lead (black) along the left side of the selected rail (Figure 2-9, based on the selected circuit breaker location).
- d. Insert the power lead into the terminal on the left side of the circuit breaker and tighten. (See Figure 2-8.)
- e. After stripping the ends of the supplied circuit breaker power feed cable, connect the cable between the phase bus bar and the right side of the installed circuit breaker.

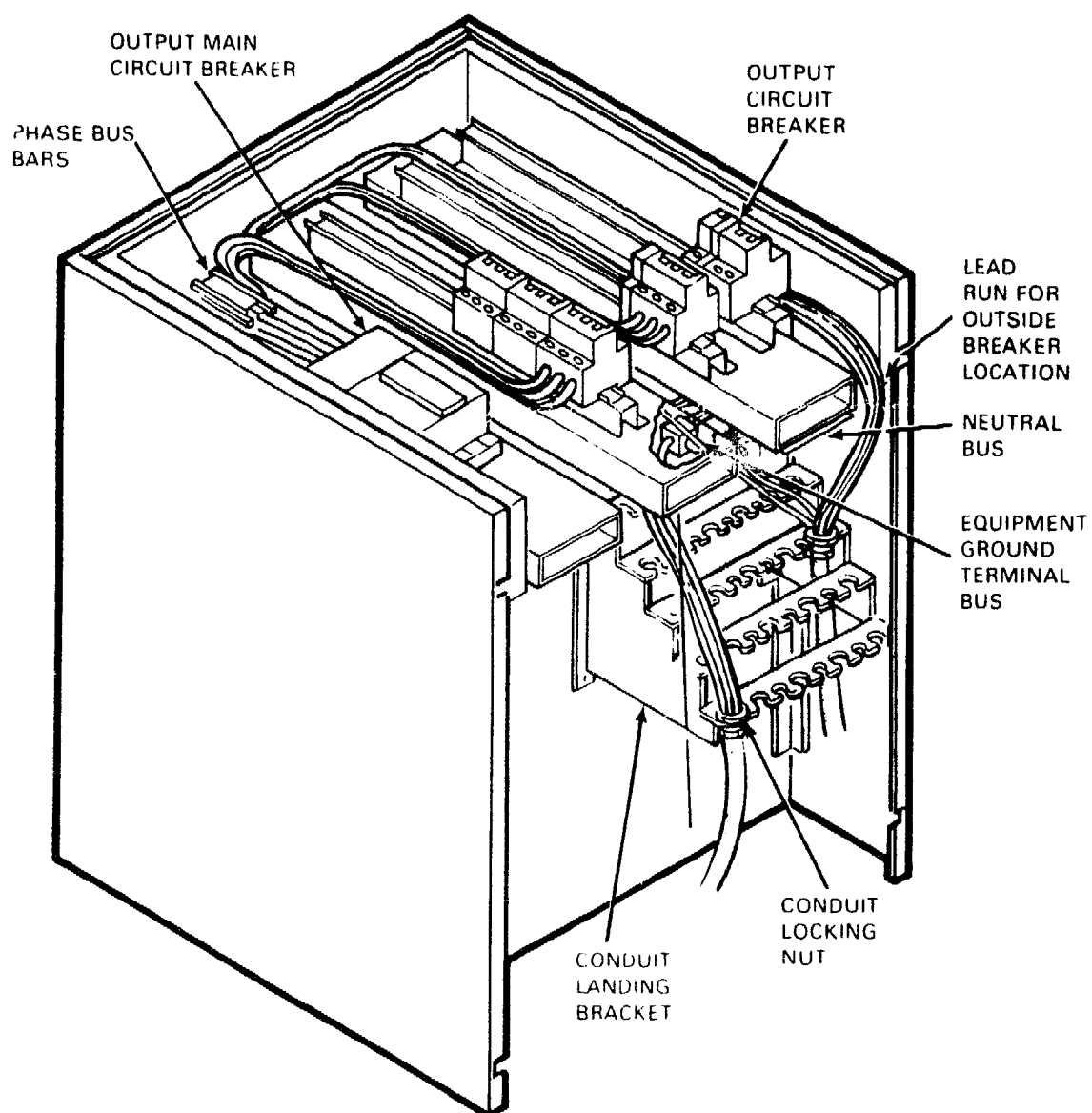
3-PHASE CONNECTION (50 Hz)

- a. Slide the 3-phase circuit breaker onto the selected rail.

NOTE

Install the circuits located on the left rails and left bus bars first. Balance the loads equally between the phases.

- b. Strip the insulation on the power leads back to a length equal to the depth of the lug hole on the circuit breaker.
- c. Run the power leads (black, brown, and brown) along the left side of the selected rail (Figure 2-9), based on the selected circuit breaker location.
- d. Insert the power leads into the terminals on the left side of the circuit breaker and tighten. (See Figure 2-8.)
- e. After stripping the ends of the supplied circuit breaker power feed cables, connect the cables between the phase bus bar and the right side of the installed circuit breaker. (See Figure 2-8.)



MKV86-0144

Figure 2-9 Output Cable Installation (Merlin Gerin Load Center -- 50 Hz)



15. Remove the appropriate plastic fillers from the output panelboard cover.
16. Reattach the upper trim plate on the back of the PCS.
17. Reattach the output panelboard cover on top of the PCS.
18. Label the circuit breaker(s).
19. Close the top cover.
20. After all cables are installed and the trim plates are reattached, rotate the PCS to its correct position, then lower and lock its leveling feet.

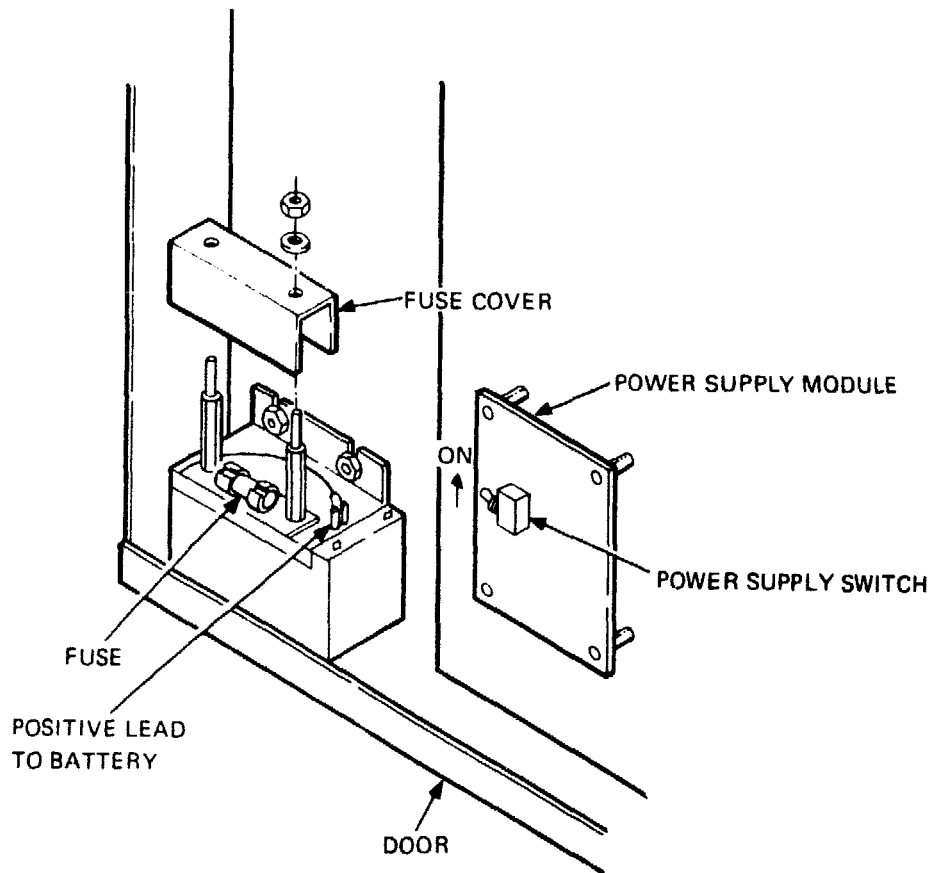
## 2.5 INITIALIZING THE PCS (FIRST POWERUP)

Follow this procedure when you first power up the PCS. After you complete the initial powerup, follow the normal power-up procedure (Section 3.2).

### WARNING

DO NOT attach the PCS to the J-Box or attach the PCS output cables to the computer system until directed.

- [ ] 1. Open the cabinet door and remove the protective cover inside.
- [ ] 2. Turn OFF the dc power supply switch on the power supply module (Figure 2-10).
- [ ] 3. Connect the red lead to the battery located on the cabinet door.
- [ ] 4. Set the local control panel switches as follows:
  - a. Release END OF DAY. (Indicator comes on.)
  - b. Press FUNC DISABLE. (Indicator comes on.)



MKV86-0147

Figure 2-10 Battery Connection

- [ ] 5. At the J-Box output connector, measure the phase-to-phase voltage. Make sure that the voltage matches the voltage rating listed on the nameplate above the IMCB.

**CAUTION**

An error in system input voltage could cause permanent damage to the isolation transformer.

- [ ] 6. Have the customer set the building power circuit breaker that supplies power to the J-Box to the OFF position.
- [ ] 7. Set the IMCB and all PCS output circuit breakers to the OFF position.
- [ ] 8. Connect the PCS input power cable to the J-Box.

**CAUTION**

The input main circuit breaker must be OFF when the input cable is connected to or disconnected from the J-Box.

- [ ] 9. Have the customer set the building power circuit breaker that supplies power to the J-Box to the ON position.
- [ ] 10. With the IMCB OFF, ensure that the FUNCTION SELECTOR switch is set to ISOLATION/REGULATION.

**CAUTION**

Never operate the FUNCTION SELECTOR switch when the input main circuit breaker is in the ON position.

- [ ] 11. Ensure that the attached computer equipment, the output circuit breakers, and the output main circuit breaker(s) are turned OFF.
- [ ] 12. Set the IMCB to the ON position. Allow five seconds for the H7228 PCS to stabilize.

**CAUTION**

If the IMCB trips, press System Reset (on the SSP) and reset the IMCB. If the IMCB fails to stay reset, set the building power circuit breaker to the OFF position and see Chapter 4.

- [ ] 13. Check the circuit breakers on the unregulated power supply (Figure 2-2). Reset any circuit breakers that tripped. If any circuit breaker fails to stay reset, set the building power circuit breaker to the OFF position and see Chapter 4.

- [ ] 14. Turn ON the DC POWER SUPPLY switch on the dc power supply board. To silence a possible alarm condition, press ALARM SILENCE and then press SYSTEM RESET on the system status panel.

If a phase error occurs, power down the PCS. Contact the customer and have any two input power phase wires in the J-Box reversed.

- [ ] 15. Confirm that the local control panel on the front of the PCS appears as follows:

- a. EMR PWR OFF -- Red indicator on
- b. FUNC DISABLE -- Amber indicator on
- c. END OF DAY -- Green indicator on.

- [ ] 16. Open the cabinet door and locate the three windows in the bottom panel.

- [ ] 17. Confirm that the three green LEDs on each of the control logic modules is displaying a binary code between one and seven. (See Figure 2-11.) Record this number in the system log.

| 4 | 2 | 1 |   |   |
|---|---|---|---|---|
| o | o | ● | = | 1 |
| o | ● | o | = | 2 |
| o | ● | ● | = | 3 |
| ● | o | o | = | 4 |
| ● | o | ● | = | 5 |
| ● | ● | o | = | 6 |
| ● | ● | ● | = | 7 |

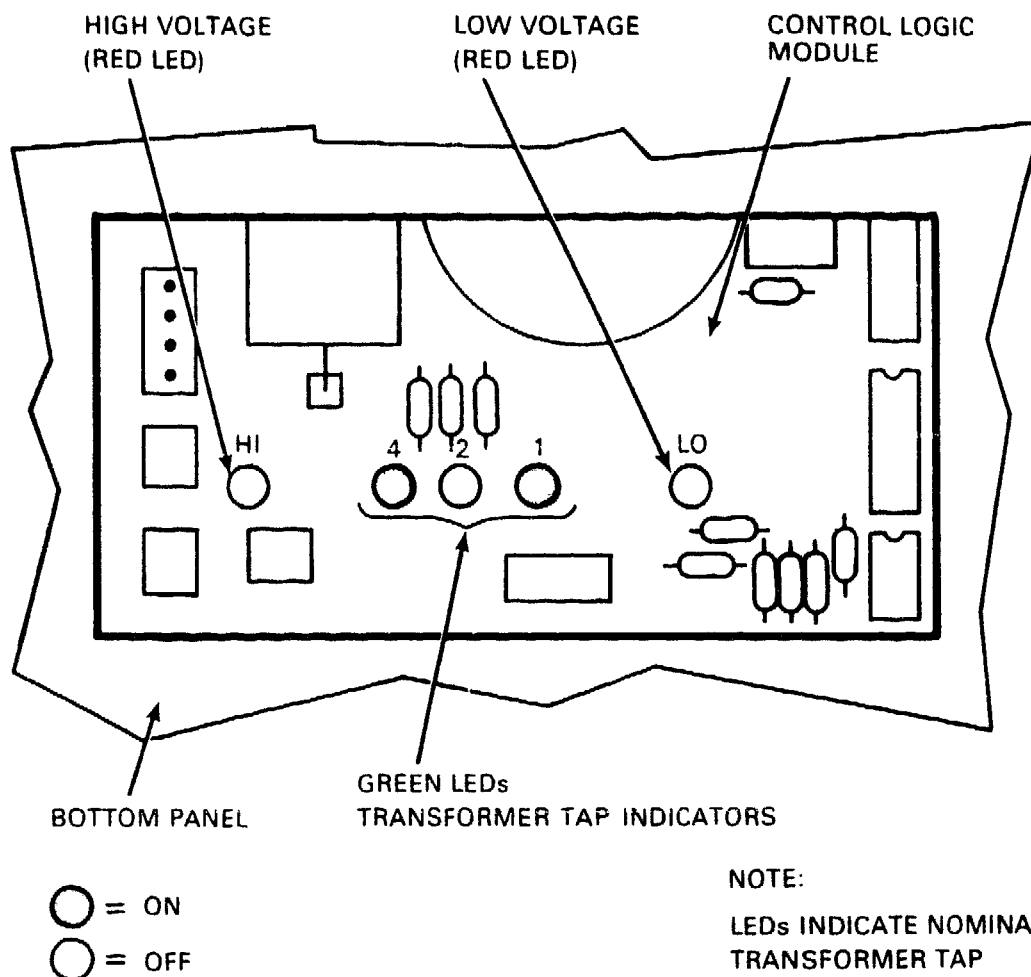
o = LED Off  
● = LED On

-- Nominal Voltage Tap

#### NOTE

The LED's binary code corresponds to the transformer tap (from one through seven) that is presently selected to regulate the output voltage. Since the three phases are regulated independently, each binary code may be different.

- [ ] 18. Confirm that neither the red HI nor red LO LED is lit. If either LED is lit, a high or low output voltage condition exists. Refer to Section 4.9.
- [ ] 19. Perform the nominal transformer tap set-up procedure detailed in Section 4.6.12 of this manual, if necessary.



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Figure 2-11 Transformer Tap Indicators

- [ ] 20. Press each of the operating voltage switches on the system status panel and verify that the voltages are within the follow ranges:

| <u>Input Voltage</u> | <u>Operating Voltages</u>                |
|----------------------|------------------------------------------|
| 208 Vac, 60 Hz       | 116.4 to 123.6 Vac<br>201.8 to 214.2 Vac |
| 380 Vac, 50 Hz       | 213.4 to 226.6 Vac<br>368.6 to 391.4 Vac |
| 415 Vac, 50 Hz       | 232.8 to 247.2 Vac<br>402.6 to 427.5 Vac |

- [ ] 21. Set the PCS output main circuit breaker(s) to the ON position.
- [ ] 22. Set the output circuit breakers to ON.
- [ ] 23. Turn ON the power switches on the attached equipment.

**CAUTION**

The attached computer equipment may require a sequential powerup; turn the equipment ON according to instructions.

- [ ] 24. Set each output distribution circuit breaker to the OFF position.
- [ ] 25. Set the output main circuit breaker(s) to the OFF position.
- [ ] 26. Turn off each computer system device switch.
- [ ] 27. Connect the output power cables from the PCS to the corresponding computer system devices.
- [ ] 28. Set the output main circuit breaker(s) to the ON position.
- [ ] 29. Set all the output distribution circuit breakers in use to the ON position.

If the ground current alarm sounds, see Table 4-9.

- [ ] 30. Power up the computer system devices (one at a time).

**CAUTION**

The attached computer equipment may require a sequential powerup; turn the equipment ON according to instructions.

- [ ] 31. Take a kVA reading to make sure that the system is working within its capacity (15, 30, 50, or 75 kVA).

**NOTE**

If the ground current is excessive, or if an alarm sounds, turn off the individual output distribution circuit breakers to find the fault.

- [ ] 32. Release FUNC DISABLE (indicator goes off). If the IMCB does not trip, you have a successful installation. If any circuit breakers trip, see Chapter 4.
- [ ] 33. Set the system status panel clock (Section 1.4.2).
- [ ] 34. Connect the remote emergency power off (REPO) stations (if installed) as specified in Appendix B.
- [ ] 35. Connect the remote interface alarm (RIA) unit (if installed) as specified in Appendix F.
- [ ] 36. Digital Equipment Corporation recommends that you record the computer system kVA loading, operating voltage, and current readings while the system is supplied with a defined power load (that is, CPU and memory on, and disks spinning but not seeking). This establishes a reference point to estimate leakage current and to calibrate future current. Record these readings when the PCS is installed.
- [ ] 37. Complete and return all quality or product survey forms.
- [ ] 38. Complete the configuration table (Tables 4-2 and 4-3) found in Section 4.5.3.

## 2.6 CHECKING OUT THE PCS

This section describes the checkout tests that you perform after installation to make sure the PCS is working correctly. Remove the load from the PCS by turning off all output circuit breakers.

See Chapter 4 for switch locations and functions.

### 2.6.1 Delayed Trip Check

#### NOTE

The IMCB will trip during this test.

1. The FUNC DISABLE indicator should be OFF.
2. Set switch 6 of S2 on the main logic board to the closed position. (See Figure 4-4.)
3. Set all S1 switches on the main logic board to the closed position.
4. Produce a phase error condition by placing the PHASE ERROR test switch on the unregulated power supply to the TEST position. (See Figure 4-3.)
5. Verify the following conditions:
  - a. The audible alarm sounds.
  - b. The main circuit breaker trips about ten (10) seconds after the alarm sounds.
  - c. The following system status panel indicators come on:
    - 1) MAIN AC POWER FAILURE
    - 2) INTERNAL DC POWER FAILURE
    - 3) PHASE ERROR
    - 4) LOW VOLTAGE.
5. Reset the PHASE ERROR test switch to the NORMAL position.
6. Reset S1 and S2 on the main logic board to the desired configuration.
7. Reset the IMCB.
8. Press SYSTEM RESET on the system status panel.



## 2.6.2 Function Disable Check

### NOTE

The IMCB will trip during this test.

1. Press FUNC DISABLE (the indicator comes on).
2. Set all S2 switches on the main logic board to the closed position.
3. Set the PHASE ERROR switch (SW2) on the unregulated power supply to the TEST position. (See Figure 4-3.)
4. Check that the IMCB does not trip.
5. Release FUNC DISABLE (the indicator goes off). Check that the IMCB trips.
6. Reset the PHASE ERROR switch to the NORMAL position.
7. Reset S2 on the main logic board to the desired configuration.
8. Reset the IMCB.
9. Press SYSTEM RESET on the system status panel.

## 2.6.3 Direct Trip Check

### NOTE

The IMCB will trip during this test.

1. Make sure that the FUNC DISABLE indicator is OFF.
2. Set switch S2 on the main logic board to the closed position.
3. Place the PHASE ERROR switch on the unregulated power supply to the TEST position.
4. Verify the following conditions:
  - a. The IMCB trips immediately.
  - b. The alarm sounds.
  - c. The following system status panel indicators come on:
    - 1) MAIN AC POWER FAILURE
    - 2) INTERNAL DC POWER FAILURE
    - 3) PHASE ERROR
    - 4) LOW VOLTAGE.
5. Reset the PHASE ERROR switch to the NORMAL position.

6. Reset the IMCB.
7. Press SYSTEM RESET on the system status panel.
8. Set the PHASE LOSS TEST switch on the unregulated power supply to the TEST position, producing a phase loss error.
9. Verify the following conditions:
  - a. The IMCB trips immediately.
  - b. The alarm sounds.
  - c. The following system status panel indicators come on:
    - 1) MAIN AC POWER FAILURE
    - 2) INTERNAL DC POWER FAILURE
    - 3) PHASE ERROR
    - 4) LOW VOLTAGE.
10. Reset the PHASE LOSS TEST switch on the unregulated power supply to the NORMAL position.
11. Reset S2 on the main logic board to the desired configuration.
12. Reset the IMCB.
13. Press SYSTEM RESET on the system status panel.

The system checkout is complete.



### 3.1 GENERAL

This chapter provides complete operating instructions for the H7228 power conditioning system (PCS). Five types of operation are covered:

- Normal powerup (Section 3.2)
- System checkout and log procedures (Section 3.3)
- Normal power off (Section 3.4)
- Resetting the PCS from a trip condition (Section 3.5)
- EMERGENCY POWER OFF (Section 3.6).

An Operator's Troubleshooting Guide (Table 3-1) is located at the end of the chapter to help you isolate the cause of an alarm or malfunction during normal PCS operation.

### 3.2 POWERUP (NORMAL USE)

Operating the PCS consists of turning ON or OFF power to the main transformer, and applying or removing power to the attached computer equipment. Usually the PCS is left on, which keeps the transformer energized; however, you will not damage the PCS if you turn power ON and OFF on a daily basis.

#### CAUTION

Do not use the local emergency power off (labeled EMR PWR OFF) or remote emergency power off (REPO) switches, except under emergency conditions.

Apply power to the system as follows (Figures 1-3, 1-4, and 1-5):

1. Place the FUNCTION SELECTOR switch to the REGULATION/ISOLATION position.
2. Set the IMCB on the PCS to the ON position.
3. Press ALARM SILENCE on the system status panel.
4. Press SYSTEM RESET on the system status panel.

5. Release the END OF DAY switch on the local control panel.  
(Green indicator comes on.)
6. Set the PCS output main circuit breaker(s) to the ON position.

NOTE

The computer equipment attached to the PCS may require a sequential order for applying power; turn ON all equipment according to instructions.

7. Turn ON the attached computer equipment.

### 3.3 OPERATIONAL CHECKOUT AND SYSTEM LOG PROCEDURES

During normal use, record the following readings in the system log once a week:

- Operating voltages
- Battery voltage
- Operating current
- kVA.

A digital display is located on the system status panel. If an alarm condition occurs, record the time, the alarm condition, and the following readings in the system log.

NOTE

The battery test will sound an alarm.  
Press SYSTEM RESET to silence the alarm.

#### References

- Figure 1-4 System Status Panel (SSP)
- Figure 2-1 H7228 PCS Components (Front View)
- Figure 3-1 Transformer Tap Indicators

#### OPERATING VOLTAGES:

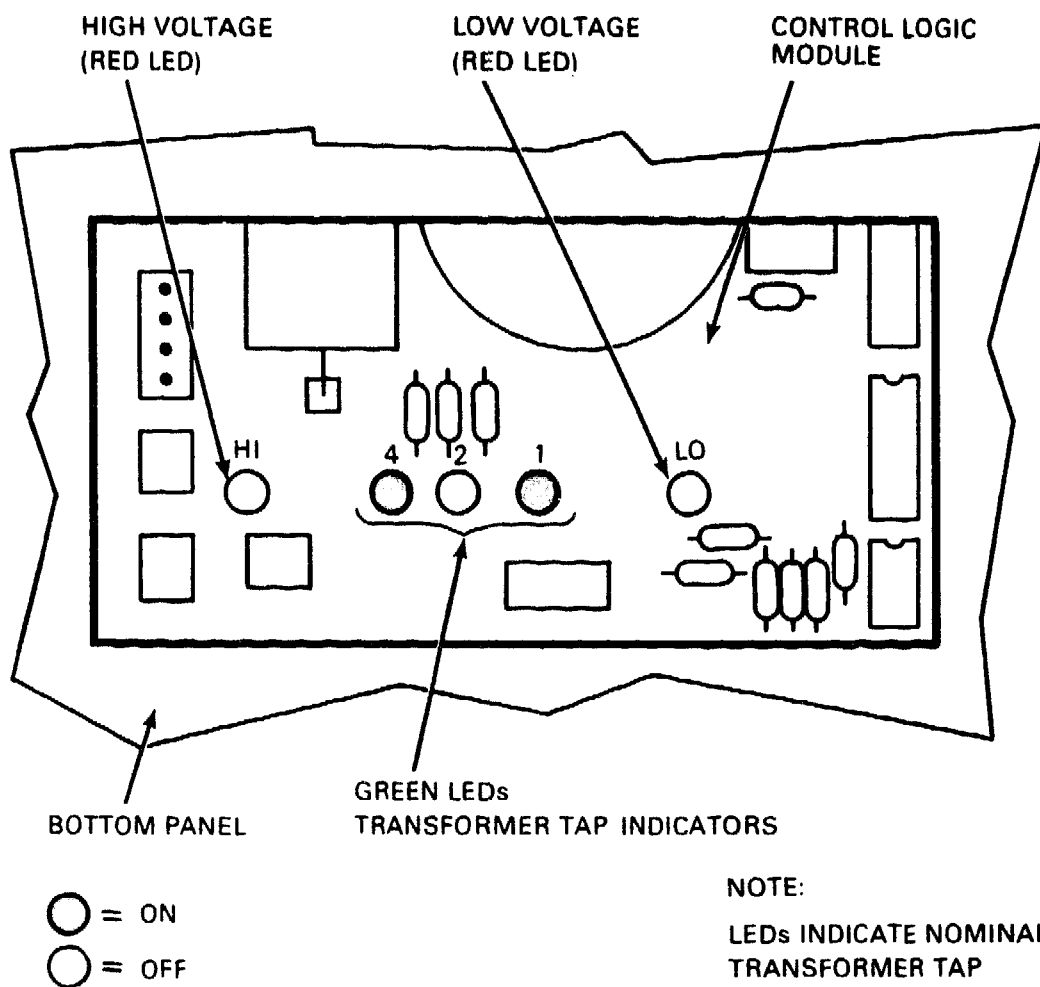
Press the OPERATING VOLTAGE buttons 1-2, 2-3, 3-1, N-1, N-2, and N-3. Record the voltages that correspond to each button.

#### BATTERY VOLTAGE:

Press the BATTERY TEST switch and record the displayed voltage in the system log. Reset the PCS after the test by pressing SYSTEM RESET.

#### GROUND:

Press the GND button on the system status panel and record the reading in the system log.



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Figure 3-1 Transformer Tap Indicators

#### KVA:

Press the KVA switch on the system status panel and record the display reading in the system log.

#### TRANSFORMER TAP CHECK:

Open the cabinet door and locate the three windows in the bottom panel, revealing the control logic modules. Confirm that the green LEDs on the three control logic modules are displaying a binary code. (See Figure 3-1.) Record these codes in the system log. A binary 5 is nominal.

| <u>4</u>    | <u>2</u> | <u>1</u> |   |                          |
|-------------|----------|----------|---|--------------------------|
| o           | o        | ●        | = | 1                        |
| o           | ●        | o        | = | 2                        |
| o           | ●        | ●        | = | 3                        |
| ●           | o        | o        | = | 4                        |
| ●           | o        | ●        | = | 5 -- Nominal Voltage Tap |
| ●           | ●        | o        | = | 6                        |
| ●           | ●        | ●        | = | 7                        |
|             |          |          |   |                          |
| o = LED Off |          |          |   |                          |
| ● = LED On  |          |          |   |                          |

#### HIGH/LOW VOLTAGE:

Confirm that neither the red HI nor the red LO LED on the control logic module is ON.

#### FUNCTION DISABLE CHECK:

Release the FUNCTION DISABLE button and confirm that its amber indicator goes out.

If any circuit breakers trip, press the SYSTEM RESET button to reset them.

#### NOTE

If any of the readings are out of specification, refer to the troubleshooting chapter of this manual.

### 3.4 POWER DOWN (NORMAL USE)

1. Turn OFF the attached computer equipment.

#### CAUTION

The attached equipment may require a sequential power-down; turn the equipment OFF according to instructions.

2. Set the PCS output main circuit breaker to OFF.
3. If desired, set the IMCB to the OFF position and press END OF DAY. (Green indicator goes off.)



### 3.5 RESETTING THE INPUT MAIN CIRCUIT BREAKER (IMCB)

You must follow this sequence or the IMCB will trip when you try to reset the PCS. Do the following steps to reset the PCS (from the tripped status) after an automatic shutdown or emergency trip.

1. Set the PCS output main circuit breaker(s) to OFF.
2. Press FUNC DISABLE. (Amber indicator comes on.)
3. Reset the IMCB as follows:
  - a. Push the IMCB on the PCS to OFF.
  - b. Pull the IMCB to the ON position.

If the IMCB does not stay in the ON position (if it trips OFF), there is still a problem in the system.

#### CAUTION

Damage may result if the IMCB is continually reset.

4. Press SYSTEM RESET.
  - a. All alarm indicators go off.
  - b. The red local emergency power off indicator comes on.
5. Release FUNC DISABLE. (Amber indicator goes off.)
6. Turn off the attached computer equipment.
7. Set the PCS output main breaker(s) to the ON position.
8. Power on the attached equipment according to instructions for the computer system.

### 3.6 EMERGENCY POWER OFF

In an emergency, shut OFF the power to the PCS at one of the following locations:

- The local emergency power off switch (labeled EM PWR OFF) on the front of the PCS,
- The optional remote emergency power off switch (labeled REPO) at a customer-specified location,
- The input main circuit breaker (IMCB), or
- The building circuit breaker for the junction box (J-Box).

### 3.7 OPERATOR TROUBLESHOOTING GUIDE

Table 3-1 is a guide to help the operator troubleshoot PCS malfunctions and alarms. See Appendix A for definitions of the abbreviations used in Table 3-1.

**Table 3-1 Operator's Troubleshooting Guide**

| Symptom                                                                                         | Probable Cause                                                                   | Corrective Action                                                     |
|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| SSP is blank                                                                                    | EOD switch engaged and battery is dead                                           | Released EOD switch                                                   |
| PCS is dead                                                                                     | PCS is turned OFF                                                                | Power up PCS, referring to Section 3.2                                |
|                                                                                                 | No power from building is going to the junction box (J-Box)                      | Call building maintenance to restore power                            |
| Specific output circuit is dead                                                                 | Output circuit breaker is off                                                    | Reset circuit breaker                                                 |
|                                                                                                 | Output circuit is not connected to a computer device                             | Call DIGITAL Field Service                                            |
| No output from PCS, but SSP is on                                                               | IMCB, output main circuit breaker, or output distribution circuit breaker is off | See Section 3.2 or 3.4                                                |
| PCS is shutdown, some SSP indicators are on and alarm is sounding, and LEPO indicator is not on | A shunt trip of IMCB occurred for one of the following reasons:                  |                                                                       |
|                                                                                                 | • LEPO switch was pressed                                                        | Turn LEPO on and reset IMCB (Section 3.5)                             |
|                                                                                                 | • External signal was received from building wiring through RIA option           | Correct the alarm condition repeated by RIA. Reset IMCB (Section 3.5) |
|                                                                                                 | • Overtemp shutdown has occurred                                                 | See Overtemp indicator symptom in this table                          |
|                                                                                                 | • Ground current monitor phase error occurred                                    | Record SSP indicators and reset IMCB (Section 3.5)                    |
|                                                                                                 | • IMCB is defective                                                              | Call DIGITAL Field Service                                            |

**Table 3-1 Operator's Troubleshooting Guide (Cont)**

| Symptom                                                                               | Probable Cause                               | Corrective Action                                                                                                |
|---------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| IMCB keeps tripping when turned on                                                    | PCS is still in shunt trip status            | Correct indicated alarm condition and reset IMCB (Section 3.5)                                                   |
|                                                                                       | IMCB defective                               | Call DIGITAL Field Service                                                                                       |
|                                                                                       | Short circuit occurred in PCS                | Call DIGITAL Field Service                                                                                       |
| IMCB or output main circuit breaker periodically trips without alarms                 | PCS overloaded and is operating above rating | Read and record kVA, then call DIGITAL Field Service                                                             |
|                                                                                       | Phase currents are not balanced              | Read and record operating current, then call DIGITAL Field Service                                               |
|                                                                                       | IMCB is defective                            | Call DIGITAL Field Service                                                                                       |
| One or more output circuits periodically trip secondary breakers in output panelboard | Individual circuit has overloaded            | Call DIGITAL Field Service                                                                                       |
|                                                                                       | Circuit breaker is defective                 | Call DIGITAL Field Service                                                                                       |
| Continuous buzzing or humming from lower part of PCS                                  | Transformer may be vibrating                 | Problem does not indicate a component failure. Condition can exist until DIGITAL Field Service evaluates problem |
| Overtemp indicator is on and alarm sounds                                             | Unit is overloaded                           | Read and record kVA, then call DIGITAL Field Service                                                             |
|                                                                                       | Air conditioner has failed                   | Repair air conditioner                                                                                           |
|                                                                                       | Air intake vents are blocked                 | Clean area around bottom air vents                                                                               |

**Table 3-1 Operator's Troubleshooting Guide (Cont)**

| <b>Symptom</b>                                                              | <b>Probable Cause</b>                                            | <b>Corrective Action</b>                                                                                                                    |
|-----------------------------------------------------------------------------|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Overtemp indicator is on and alarm sounds                                   | Fan circuit breaker (CB5) tripped                                | Reset circuit breaker CB5 on unregulated power supply. Press SYSTEM RESET                                                                   |
|                                                                             | Fan is defective                                                 | Call DIGITAL Field Service                                                                                                                  |
| Burning odor comes from PCS or J-Box                                        | High temperature is causing possible burning of cable insulation | Power down PCS and related equipment as a safety precaution. Call DIGITAL Field Service                                                     |
| PCS alarm is sounding                                                       | Alarm condition or faulty signal is causing alarm to sound       | Press ALARM SILENCE. Record time on display and alarm condition. If no problems are evident, press SYSTEM RESET. Call DIGITAL Field Service |
| PCS tripped, shutdown indicator is on, and alarm sounds                     | Prolonged or extensive heating occurred in main transformer      | Call DIGITAL Field Service                                                                                                                  |
| One or more output phases show low voltage on display                       | Circuit breakers (CB1 through CB3) are open                      | Reset circuit breakers (CB1 through CB3) on the unregulated power supply                                                                    |
|                                                                             |                                                                  | Call DIGITAL Field Service if condition still exists                                                                                        |
| Unresettable phase alarm and phase-sensitive equipment (disks) are affected | Phase rotation is reversed                                       | Have electrician reverse two input phase leads in J-Box                                                                                     |
| Unresettable phase alarm and no phase-sensitive equipment are affected      | Phase switches on the unregulated power supply are set to TEST   | Reset phase switches to NORMAL                                                                                                              |

**Table 3-1 Operator's Troubleshooting Guide (Cont)**

| Symptom                                          | Probable Cause                                                                                                               | Corrective Action                                                                                                                   |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Unresettable alarm and no indicators turn on     | SCR disable switches on main logic board are set to MAINT (Figure 4-4)                                                       | Press upper side of switch to NORMAL. Nearby indicator shows an impending trip                                                      |
| LEPO does not turn on and no trips are possible  | Shunt trip harness (single wire from the unregulated power supply to the power block interface) is disconnected (Figure E-3) | Reconnect shunt trip harness                                                                                                        |
| BATTERY TEST switch indicates less than 11.5 Vdc | END OF DAY indicator not on                                                                                                  | Power up PCS (Section 3.2)                                                                                                          |
|                                                  | Battery is not charged due to recent power outage                                                                            | Allow battery to charge                                                                                                             |
|                                                  | Excessive battery charge current has tripped CB4 on the unregulated power supply                                             | Reset CB4                                                                                                                           |
|                                                  | Battery is defective                                                                                                         | Replace battery                                                                                                                     |
| Low voltage alarm                                | Defective regulation circuit                                                                                                 | Change the function selector switch (with IMCB in the OFF position) to the ISOLATION ONLY position, then call DIGITAL Field Service |
| MOV indicator ON                                 | Defective surge suppressor circuit                                                                                           | Call DIGITAL Field Service                                                                                                          |



#### **4.1 SAFETY**

The H7228 power conditioning system contains HIGH VOLTAGE. The procedures outlined in this chapter are intended for trained maintenance personnel only.

To power down the PCS for troubleshooting and repair, proceed as follows:

1. Turn OFF attached equipment, using the proper sequences
2. Turn OFF the output main circuit breaker(s)
3. Turn OFF the input main circuit breaker
4. Unplug the power cable from the J-Box.

During power-on troubleshooting and testing, keep all panels and protective devices in place whenever possible. Wear safety glasses at all times when conducting power-on tests.

#### **4.2 GENERAL**

All testing, maintenance, and calibration procedures are done with no load on the PCS and with the FUNCTION SELECTOR switch in the ISOLATION/REGULATION position.

This chapter is divided into the following sections:

- Safety -- Section 4.1
- General -- Section 4.2
- Fuses and Circuit Breakers -- Section 4.3
- Maintenance Switches and Test Points -- Section 4.4
- PCS Configuration -- Section 4.5
- Calibration -- Section 4.6
- SCR Service -- Section 4.7
- Unregulated Power Supply Replacement -- Section 4.8
- Field Service Troubleshooting -- Section 4.9.



### 4.3 FUSES AND CIRCUIT BREAKERS

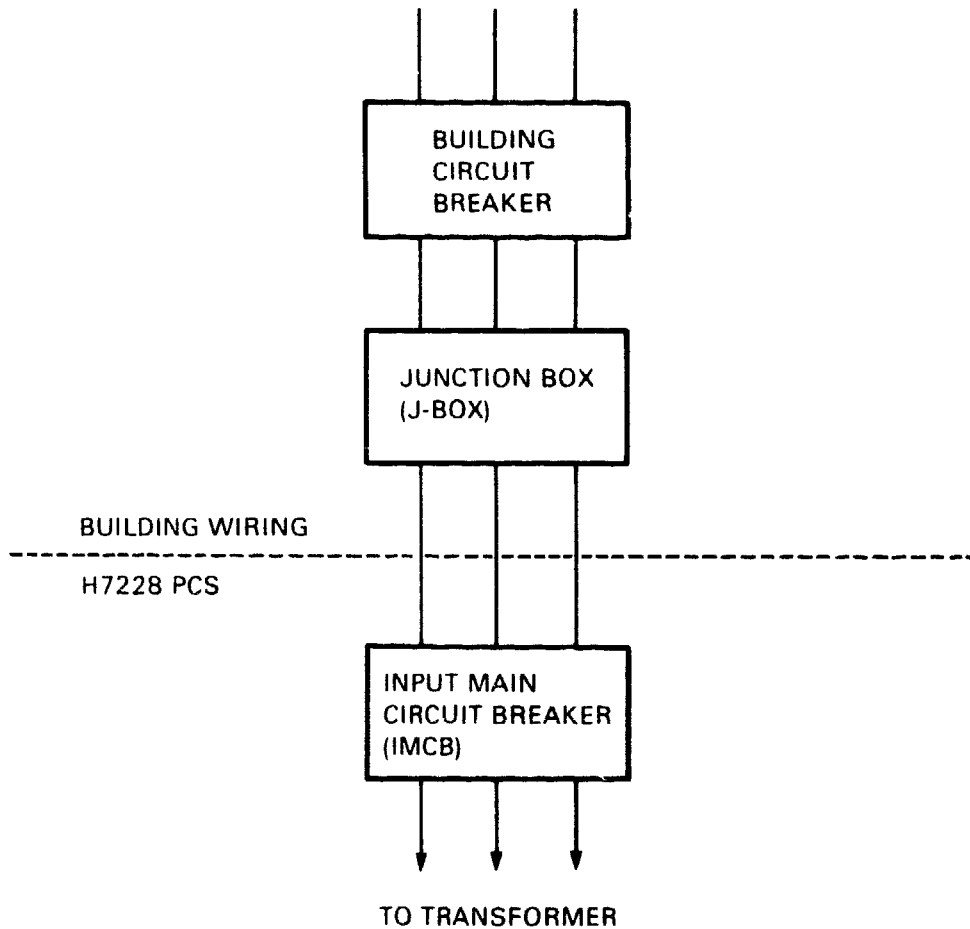
The H7228 power conditioning system has extensive circuit protection. This section contains a summary of the protection devices.

#### 4.3.1 Input AC Protection

Input ac protection is provided by the IMCB (input main circuit breaker). See Figure 4-1. A complete shutdown of the PCS indicates that the IMCB has been shunt tripped or tripped by an overcurrent condition.

#### Reference

- Figure 2-1 PCS Components



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Figure 4-1 Input Protection

### 4.3.2 Internal Protection

#### References

- Figure 2-1 H7228 PCS Components (Front View)
- Figure 2-10 Battery Connection
- Figure 4-16 Control Logic Module
- Figure 4-17 Voltage Regulation Components

| Device    | Circuit               | Symptom                                                |
|-----------|-----------------------|--------------------------------------------------------|
| CB1       | Unregulated P/S       | Internal dc alarm                                      |
| CB2       | Unregulated P/S       | Internal dc alarm                                      |
| CB3       | Unregulated P/S       | Internal dc alarm                                      |
| CB4       | Unregulated P/S       | Internal dc alarm                                      |
| CB5       | Fan power             | Temperature check (overtemp or shutdown), no fan noise |
| F1(Batt)  | Battery               | Clock display blank                                    |
| F1(CLMS)  | Control logic modules | Phase loss, low voltage alarm                          |
| Fusewires | SCR banks             | Phase loss, low voltage alarm                          |

### 4.3.3 Output Protection

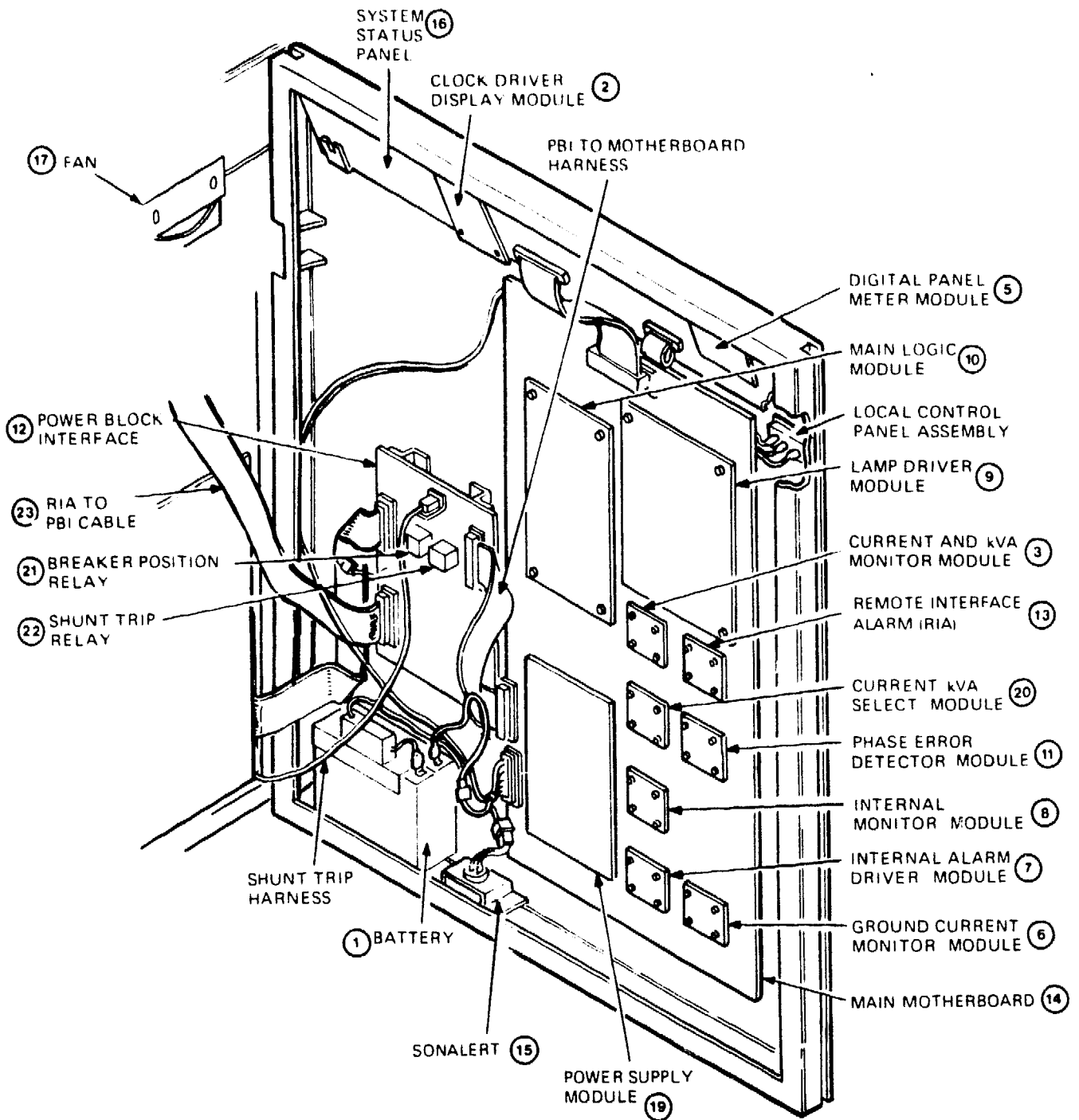
#### Reference:

- Figure 1-5 PCS Controls

| Device                      | Circuit                   | Symptom                                |
|-----------------------------|---------------------------|----------------------------------------|
| MOV Fuses                   | Surge suppressor          | Fuse indicator light on                |
| Output Main Circuit Breaker | Output distribution       | All or half of attached equipment dead |
| Output Circuit Breaker(s)   | Individual output circuit | Single device dead                     |

#### 4.4 MAINTENANCE SWITCHES AND TEST POINTS

The H7228 power conditioning system has many switches and test points that are used during troubleshooting and checkout procedures. This section contains a summary of all the maintenance switches and test points.



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Figure 4-2 Monitoring Logic Parts Location

#### 4.4.1 Unregulated Power Supply

##### References

- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-3 Unregulated Power Supply

##### PHASE LOSS SWITCHES:

The phase loss switches found on the unregulated power supply are used during maintenance to simulate a phase loss alarm and a shunt trip.

SW2 assignments are as follows:

SW2-1 = Phase 1  
SW2-2 = Phase 2  
SW2-3 = Phase 3.

##### PHASE ERROR SWITCH:

- Labeled SW1
- Simulates phase rotation errors, providing a phase error alarm and a possible shunt trip for test purposes
- With the switch set to the NORMAL position, the rotation is 1, 2, 3
- Single pole

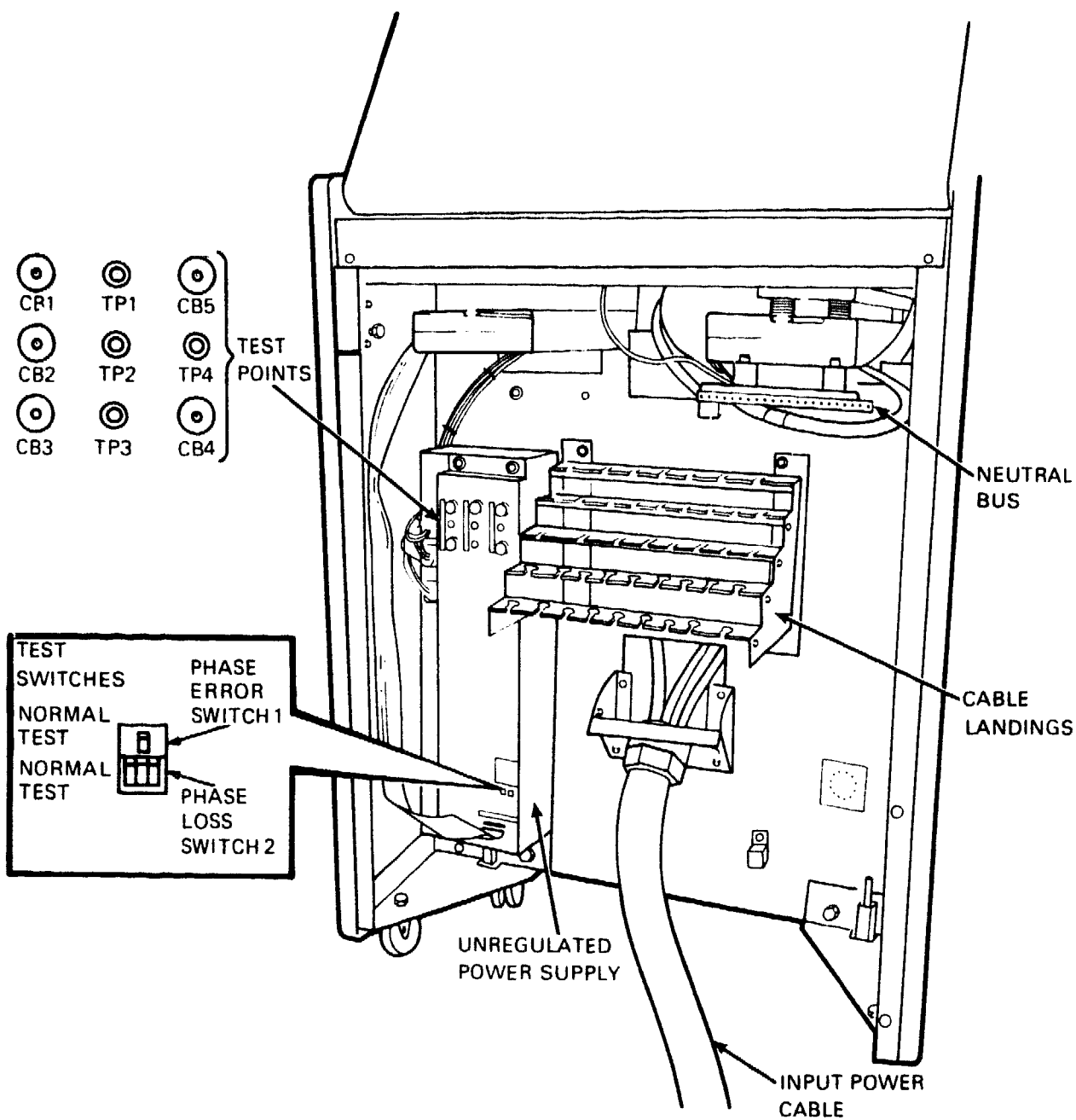
##### NOTE

The normal position for these switches is with the top half of the rocker switches pushed in.

##### TEST POINTS:

The unregulated power supply has four colored test points for monitoring the secondary transformer output.

| Point | Color | Function |
|-------|-------|----------|
| TP1   | Black | Phase 1  |
| TP2   | Red   | Phase 2  |
| TP3   | Blue  | Phase 3  |
| TP4   | White | Neutral  |



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Figure 4-3 Unregulated Power Supply

#### 4.4.2 Main Logic Module

##### References

- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-4 Main Logic Module

##### SWITCH S3:

With switch S3 in the MAINT position, any trip signals that normally produce a trip alarm are not allowed. The clock colon "freezes" and an alarm sounds.

When on, the red DS-1 indicator shows that the PCS will trip if S3 is set to NORMAL.

If S3 is left open (in the MAINT position), an alarm sounds and the system status panel shows no errors.

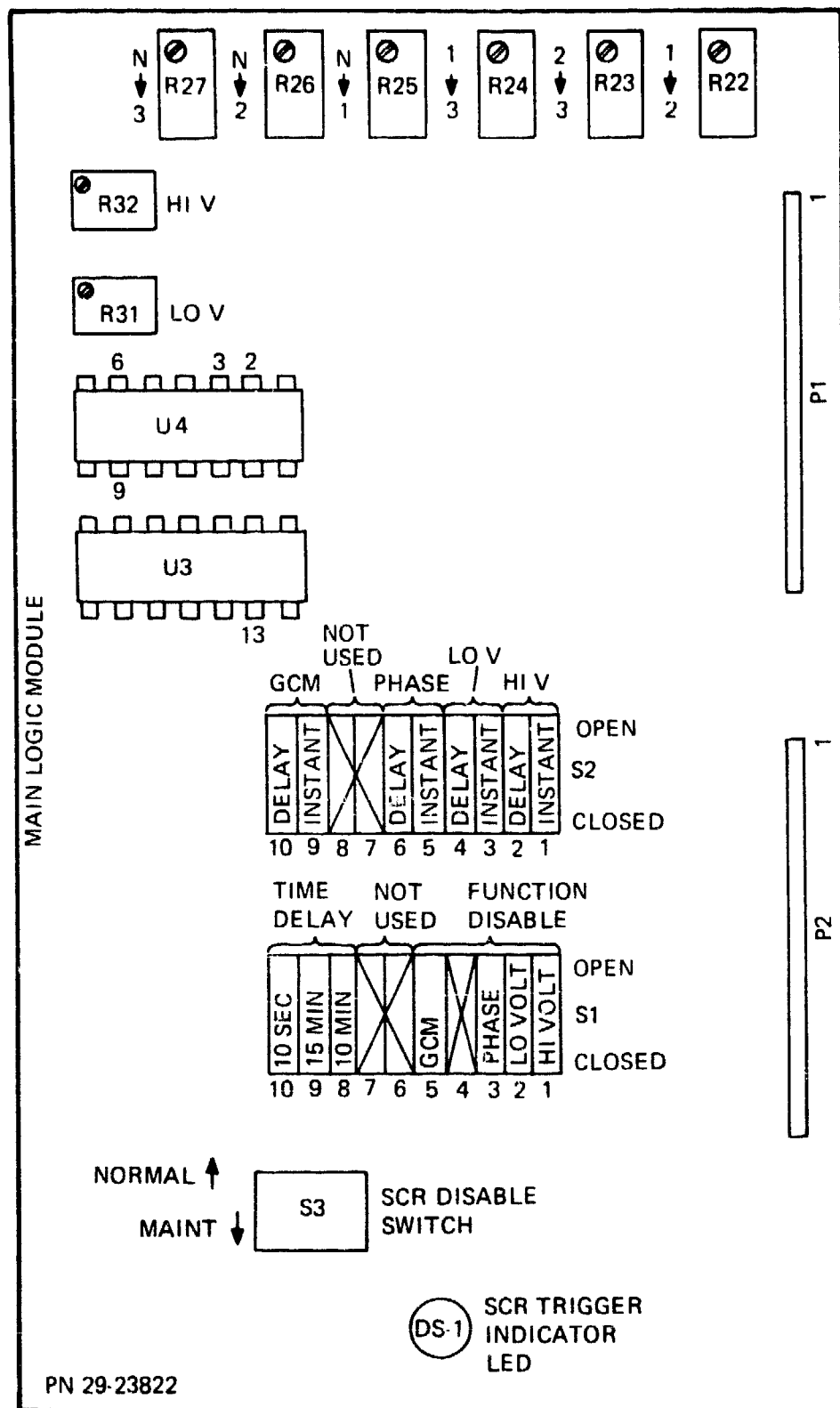


Figure 4-4 Main Logic Module

### 4.4.3 Control Logic Module

#### Reference

- Figure 4-5 Control Logic Module

#### SWITCH S2:

The ENABLE/DISABLE switch (S2) on the control logic modules prevents the regulation SCRs from being enabled while troubleshooting. The control logic module still performs all its logic functions, but the SCR enable signal is inhibited.

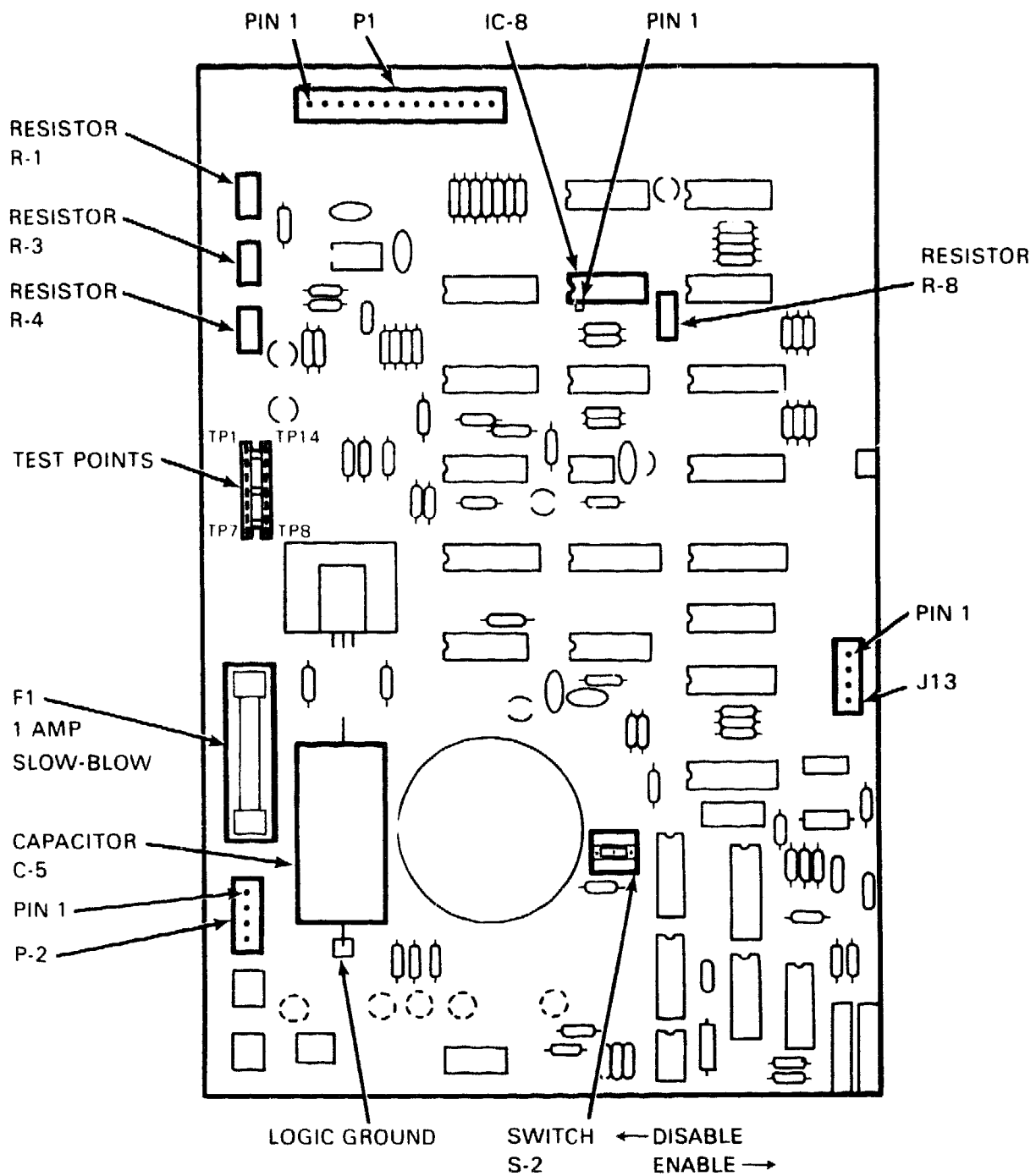
S2 is left in the ENABLE position (to the right) for normal PCS operation.

#### TEST POINTS:

The control logic module has several test points used for maintenance and calibration:

| Test Point        | Function                 |
|-------------------|--------------------------|
| TP1               | Voltage range setting.   |
| TP2               | Voltage range setting    |
| TP9               | Clock waveform           |
| P1-Pin 1          | SCR driver select signal |
| Bottom lead of C5 | Logic ground             |





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Figure 4-5 Control Logic Module

#### 4.5 PCS CONFIGURATION

The configuration of the H7228 power conditioning system may be changed to fit the customer's needs. The functions that can be changed are limited to the following:

- Alarm silence delay -- Section 4.5.1
- Shunt trip delay -- Section 4.5.2
- Enable/disable of alarm functions -- Section 4.5.3
- Alarm function delay times -- Section 4.5.3
- Instant/delayed alarm function -- Section 4.5.3.

Use Tables 4-1 or 4-2 at end of this section to record any changes in configuration.

### 4.5.1 Lamp Driver Module

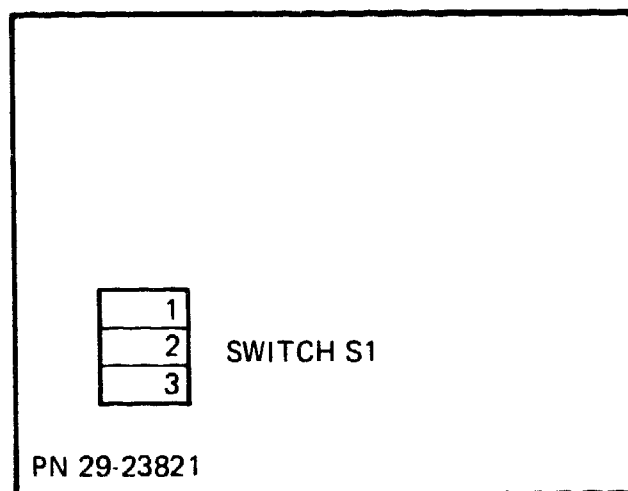
#### References

- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-6 Lamp Driver Module

#### SWITCH S1:

Switch S1 on the lamp driver module controls the delay time of the alarm after you press ALARM SILENCE on the system status panel. The delay times and corresponding switch positions are listed as follows:

| Delay Time | S1-1   | S1-2   | S1-3   |
|------------|--------|--------|--------|
| 10 seconds | Closed | Closed | Closed |
| 5 minutes  | Open   | Closed | Closed |
| 10 minutes | Open   | Open   | Closed |
| 15 minutes | Open   | Open   | Open   |



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Figure 4-6 Lamp Driver Module

## 4.5.2 Shunt Trip Delay and Time Settings

### References

- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-7 Power Block Interface

### SWITCHES:

The shunt trip delay times are controlled by circuits on the power block interface. The following switches are used to change the configuration of the shunt trip circuits:

- S1 -- Selects instant trip
- S2 -- Selects delayed trip
- S9 -- Selects delayed trip time.

### RELAYS:

| Name             | Relay | Function                                   |
|------------------|-------|--------------------------------------------|
| Shunt trip relay | K2    | Trips IMCB via shunt trip coil when closed |
| Breaker position | K1    | Senses IMCB position relay for logic use   |

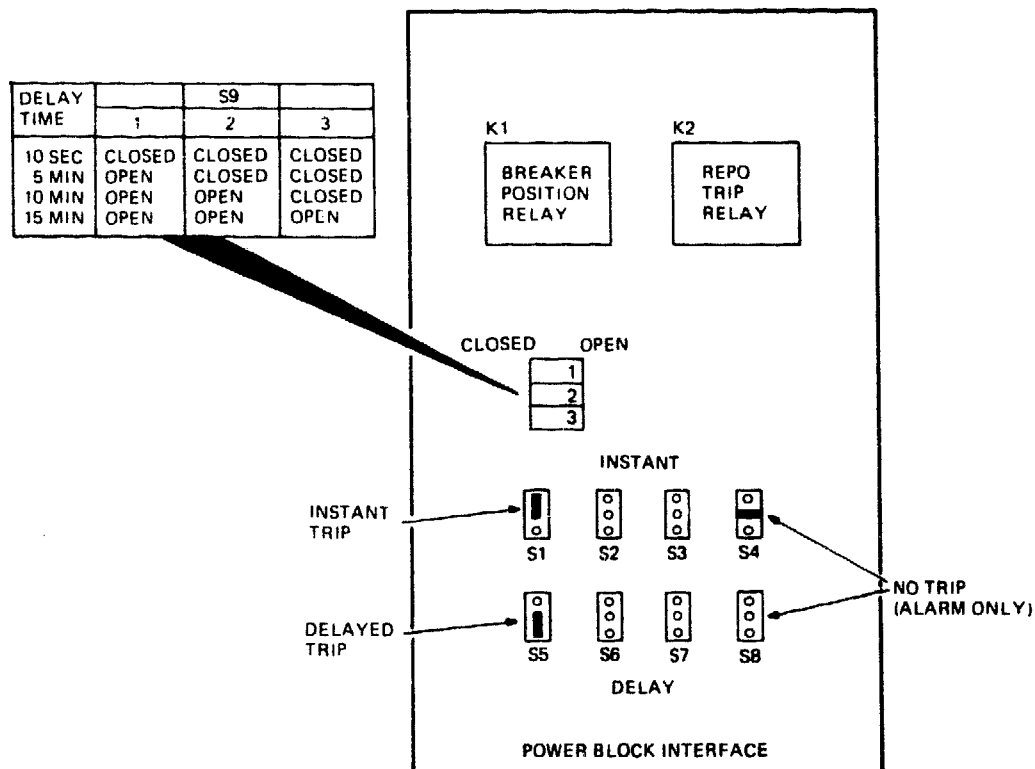


Figure 4-7 Power Block Interface

MA-8088

### 4.5.3 Main Logic Module

#### References

- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-4 Main Logic Module

The main logic module switches control the function disable and trip time functions of the internal monitors. There are four internal monitors:

- High volts -- HI V
- Low volts -- LO V
- Phase error -- PHASE
- Ground current -- GCM.

#### SWITCH S1:

Switch S1 controls the alarm disable (trip or no trip), and has the following settings:

| Switch | Alarm          | Disable | Enable |
|--------|----------------|---------|--------|
| S1-1   | High volts     | Open    | Closed |
| S1-2   | Low volts      | Open    | Closed |
| S1-3   | Phase error    | Open    | Closed |
| S1-4   | Not used       | --      | --     |
| S1-5   | Ground current | Open    | Closed |

Switches S1-8 through S1-10 provide delay timing as follows:

| Time   | S1-8   | S1-9   | S1-10  |
|--------|--------|--------|--------|
| 10 s   | Closed | Closed | Closed |
| 5 min  | Closed | Closed | Open   |
| 10 min | Closed | Open   | Open   |
| 15 min | Open   | Open   | Open   |

#### NOTE

Switches S1-4, S1-6, and S1-7 are not used.

SWITCH S2:

Switch S2 controls either delay trip or instant trip functions and has the following settings:

| Function       | Delay Trip |        | Instant Trip |        | No Trip |      |
|----------------|------------|--------|--------------|--------|---------|------|
| High volts     | S2-1       | Open   | S2-1         | Closed | S2-1    | Open |
|                | S2-2       | Closed | S2-2         | Open   | S2-2    | Open |
| Low volts      | S2-3       | Open   | S2-3         | Closed | S2-3    | Open |
|                | S2-4       | Closed | S2-4         | Open   | S2-4    | Open |
| Phase error    | S2-5       | Open   | S2-5         | Closed | S2-5    | Open |
|                | S2-6       | Closed | S2-6         | Open   | S2-5    | Open |
| Ground current | S2-9       | Open   | S2-9         | Closed | S2-9    | Open |
|                | S2-10      | Closed | S2-10        | Open   | S2-10   | Open |

NOTES

For any function, both switch positions closed also produces an instant trip.

Switches S2-7 and S2-8 are not used.

**Table 4-1 Configuration Table (60 Hz)**

| Function        | Adjustable Range | Factory Setting     | Adjusted Setting | Trip Status* |
|-----------------|------------------|---------------------|------------------|--------------|
| High voltage    | +5% to +15%      | +7%<br>128 V, Ph-N  | AO _____         | _____        |
| Low voltage     | -5% to -20%      | -13%<br>105 V, Ph-N | AO _____         | _____        |
| Phase error     | NA†              | 132 V, Ph-Ph        | IT <u>132 V</u>  | _____        |
| Main ac failure | NA               | 75 V, Ph-Ph         | IT <u>75 V</u>   | IT           |
| DC failure      | NA               | 104 V, Ph-Ph        | AO <u>104 V</u>  | AO           |
| Ground current  | 0.5 A to 20 A    | 5 A                 | AO _____         | _____        |
| Alarm silence   | 10 s to 15 min   | 15 min              | NA _____         | _____        |
| Trip delay      | 10 s to 15 min   | 15 min              | NA _____         | _____        |
| Overtemp        | NA               | 140° F              | AO <u>140° F</u> | AO           |
| Shutdown        | NA               | 160° F              | IT <u>160° F</u> | IT           |

| RIA Channel | Input | Trip Status* | REPO Station | Location |
|-------------|-------|--------------|--------------|----------|
| 1           | _____ | _____        | 1            | _____    |
| 2           | _____ | _____        | 2            | _____    |
| 3           | _____ | _____        | 3            | _____    |
| 4           | _____ | _____        | 4            | _____    |
| 5           | _____ | _____        | 5            | _____    |
| 6           | _____ | _____        | 6            | _____    |
| 7           | _____ | _____        |              | _____    |
| 8           | _____ | _____        |              | _____    |
| Output      | _____ | _____        |              | _____    |

\* AO = alarm only, DT = delay trip, IT = instant trip, NA = not applicable

† 1-2-3 rotation with PHASE ERROR switch set to the NORMAL position

#### NOTES

If you change factory settings, record new values in last two columns.

Record remote interface alarm channels as applicable, and the number and location of any remote emergency power off stations.

Table 4-2 Configuration Table (380 Vac, 50 Hz Input)

| Function        | Adjustable Range | Factory Setting     | Adjusted Setting | Trip Status* |
|-----------------|------------------|---------------------|------------------|--------------|
| High voltage    | +5% to +15%      | +7%<br>235 V, Ph-N  | AO               | _____        |
| Low voltage     | -5% to -20%      | -13%<br>191 V, Ph-N | AO               | _____        |
| Phase error     | NA†              | 140 V, Ph-Ph        | IT               | _____        |
| Main ac failure | NA               | 79 V, Ph-Ph         | IT               | IT           |
| DC failure      | NA               | 110 V, Ph-Ph        | AO               | AO           |
| Ground current  | 0.5 A to 20 A    | 5 A                 | AO               | _____        |
| Alarm silence   | 10 s to 15 min   | 15 min              | NA               | _____        |
| Trip delay      | 10 s to 15 min   | 15 min              | NA               | _____        |
| Overtemp        | NA               | 60° C               | AO               | AO           |
| Shutdown        | NA               | 72° C               | IT               | IT           |

| RIA Channel | Input | Trip Status* | Station | REPO Location |
|-------------|-------|--------------|---------|---------------|
| 1           | _____ | _____        | 1       | _____         |
| 2           | _____ | _____        | 2       | _____         |
| 3           | _____ | _____        | 3       | _____         |
| 4           | _____ | _____        | 4       | _____         |
| 5           | _____ | _____        | 5       | _____         |
| 6           | _____ | _____        | 6       | _____         |
| 7           | _____ | _____        |         | _____         |
| 8           | _____ | _____        |         |               |
| Output      | _____ | _____        |         |               |

\* AO = alarm only, DT = delay trip, IT = instant trip, NA = not applicable

† 1-2-3 rotation with PHASE ERROR switch set to the NORMAL position

#### NOTES

If you change factory settings, record new values in last two columns.

Record remote interface alarm channels as applicable, and the number and location of any remote emergency power off stations.



## 4.6 CALIBRATION

This section contains the calibration procedures needed to operate the PCS within specified tolerances. Each procedure lists the tools and test equipment needed to perform that adjustment.

### 4.6.1 Calibration Jumpers

#### References

- Figure 4-2 Monitoring Logic Parts Location
- Table 4-3 Calibration Jumpers
- Table 4-4 Calibration Potentiometers
- Figure 4-8 Digital Display Assembly

Use the supplied jumper plug to simulate pressing a switch. The jumper plug is used between T1 and T2 on the back of the display panel daughterboard.

Table 4-5 identifies the potentiometers by module. If a jumper plug is not available, you can use one from the power block interface module.

#### NOTE

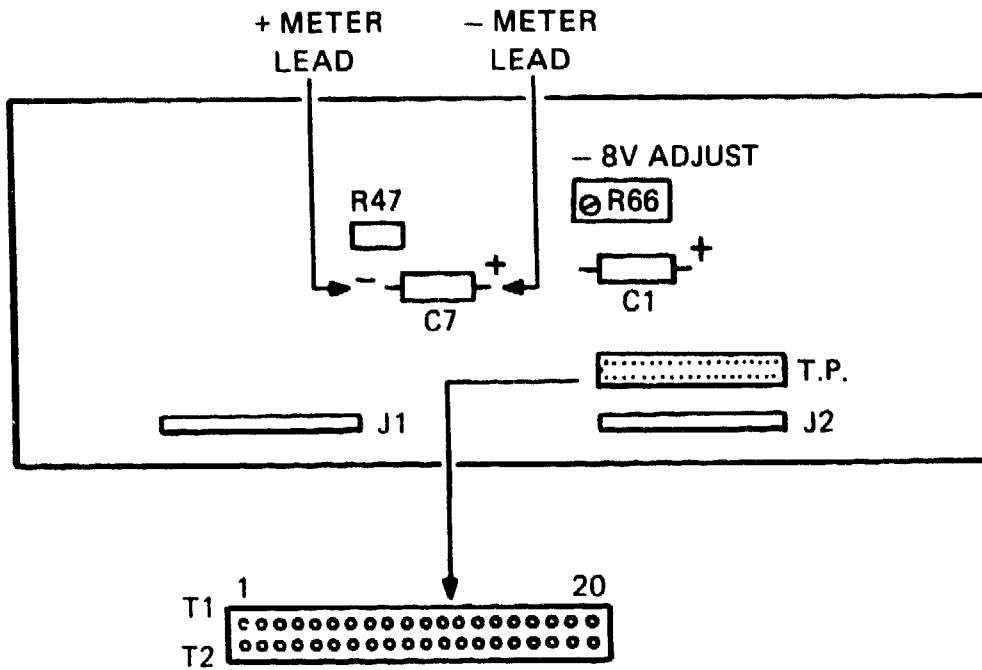
Press FUNC DISABLE (indicator comes on) to make sure that the system does not shut down accidentally. Figure 2-1 shows the switches and circuit breakers.

Table 4-3 Calibration Jumpers

| Position | Jumper         | Function                 |
|----------|----------------|--------------------------|
| 1        | T1-1 to T2-1   | Phase 2 to neutral volts |
| 2        | T1-2 to T2-2   | Phase 3 to neutral volts |
| 3        | T1-3 to T2-3   | Phase 1 current          |
| 4        | T1-4 to T2-4   | Phase 2 current          |
| 5        | T1-5 to T2-5   | Phase 3 current          |
| 6        | T1-6 to T2-6   | Neutral current          |
| 7        | T1-7 to T2-7   | Ground current           |
| 8        | T1-8 to T2-8   | kVA                      |
| 9        | T1-9 to T2-9   | Phase 1 to neutral volts |
| 10       | T1-10 to T2-10 | Phase 1 to phase 3 volts |
| 11       | T1-11 to T2-11 | Phase 2 to phase 3 volts |
| 12       | T1-12 to T2-12 | Phase 1 to phase 2 volts |
| 13       | T1-13 to T2-13 | System reset             |
| 14       | T1-14 to T2-14 | Battery test             |
| 15       | T1-15 to T2-15 | Alarm silence            |
| 16       | T1-16 to T2-16 | Set time                 |
| 17       | T1-17 to T2-17 | Not used                 |
| 18       | T1-18 to T2-18 | Minutes                  |
| 19       | T1-19 to T2-19 | Hours                    |
| 20       | T1-20 to T2-20 | Not used                 |

**Table 4-4 Calibration Potentiometers**

| <b>Display</b>                        | <b>Potentiometer</b> |
|---------------------------------------|----------------------|
| <b>Ground Current Monitor Module</b>  |                      |
| Ground current meter                  | R4                   |
| Ground current alarm                  | R1                   |
| <b>Current and kVA Monitor Module</b> |                      |
| kVA                                   | R13                  |
| Neutral current                       | R4                   |
| Phase 1 current                       | R1                   |
| Phase 2 current                       | R2                   |
| Phase 3 current                       | R3                   |
| <b>Main Logic Module</b>              |                      |
| High volts                            | R32                  |
| Low volts                             | R31                  |
| N-3 volts                             | R27                  |
| N-2 volts                             | R26                  |
| N-1 volts                             | R25                  |
| 3-1 volts                             | R24                  |
| 2-3 volts                             | R23                  |
| 1-2 volts                             | R22                  |
| <b>Control Logic Modules</b>          |                      |
| Voltage range                         | R1                   |
| Voltage range                         | R8                   |
| Tap select                            | R4                   |
| Clock adjust                          | R3                   |



MA-1371-84

Figure 4-8 Digital Display Assembly

## 4.6.2 +12V, -12 V Power Supply

### References

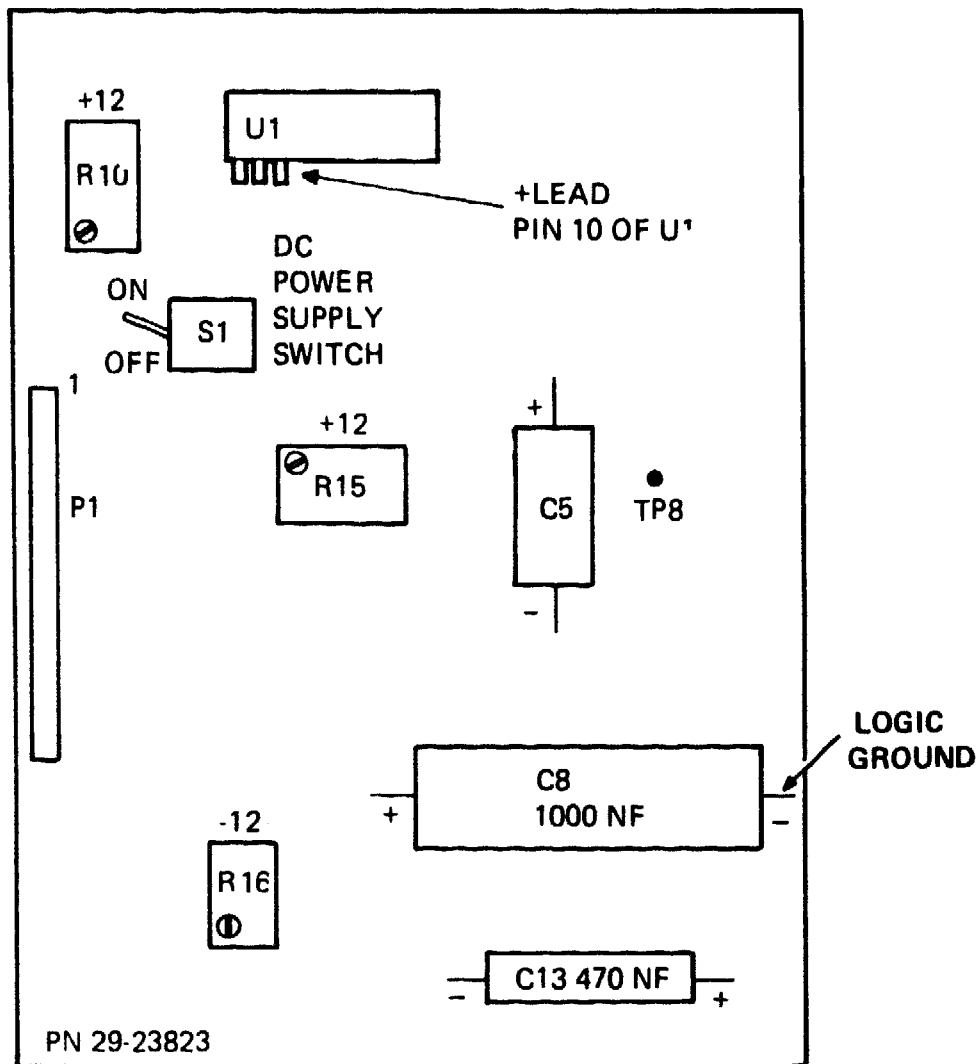
- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-9 Power Supply Module

### Tools Needed

- Digital multimeter (DMM)
- Trim potentiometer adjusting tool

### Calibration Procedure

1. Disconnect the plus (+) battery lead.
2. Connect the DMM positive lead to TP8 and connect the negative lead to the negative side of C8.
3. Adjust R10 for  $+15.20 \text{ Vdc} \pm 0.30 \text{ Vdc}$ . Press BATTERY TEST and verify that greater than 10 V is shown on the meter.
4. Move the DMM positive lead to the negative side of C13.
5. Adjust R16 for  $-11.50 \text{ Vdc} \pm 0.70 \text{ Vdc}$ .
6. Reconnect the plus (+) battery lead.
7. Refer to Section 4.6.3 and calibrate the -8 volt supply.
8. Connect the DMM leads to the battery terminals. Press BATTERY TEST and record the meter reading.
9. Press BATTERY TEST and adjust R15 until the digital display reading matches the reading obtained in step 8.
10. Refer to Section 4.6.4 and calibrate the voltage meter.



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Figure 4-9 Power Supply Module

### 4.6.3 -8 V Power Supply (LED Display)

#### References

- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-8 Digital Display Assembly

#### Tools Needed

- Digital multimeter (DMM)
- Trim potentiometer adjusting tool

#### Calibration Procedure

1. Connect the DMM leads across C7 as shown in Figure 4-8.
2. Adjust R66 to read  $-7.50 \text{ V} \pm 0.3 \text{ V}$  on the meter.

#### 4.6.4 Voltage Meter

##### References

- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-3 Unregulated Power Supply
- Figure 4-4 Main Logic Module
- Table 4-3 Calibration Jumpers
- Figure 4-8 Digital Display Assembly

##### Tools Needed

- Digital multimeter (DMM) set for line ac
- Trim potentiometer adjusting tool
- Jumper plug

##### Calibration Procedure

1. Use the DMM to measure and record phase-to-phase and phase-to-neutral voltages at TP1 through TP4, using the following combinations:
  - a. TP1 and TP2 = Phase 1 to 2
  - b. TP2 and TP3 = Phase 2 to 3
  - c. TP1 and TP3 = Phase 1 to 3
  - d. TP1 and TP4 = Phase 1 to neutral
  - e. TP2 and TP4 = Phase 2 to neutral
  - f. TP3 and TP4 = Phase 3 to neutral.

Test points for measuring the output voltages are on the unregulated power supply in the back of the PCS.

2. Install the jumper plug in position 12. This shorts the pins at jumper positions T1 and T2.

If a jumper plug is not available, press the phase 1-2 voltage switch on the system status panel.

3. Adjust R22 on the main logic module until the digital display reads the value recorded in Step 1a.
4. Repeat Step 2 for each voltage pair (Steps 1b through 1f). Move the jumper plug as indicated for each pair and adjust the corresponding trim potentiometer.
5. Remove the jumper plug.

#### 4.6.5 -8 V (Current and kVA Select)

##### References

- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-10 Current and KVA Select Module

##### Tools Needed

- Digital multimeter (DMM)
- Trim potentiometer adjusting tool

##### Calibration Procedure

1. Connect the DMM leads across C7.
2. Adjust R5 for  $-7.50 \text{ Vdc} \pm 0.30 \text{ Vdc}$ .

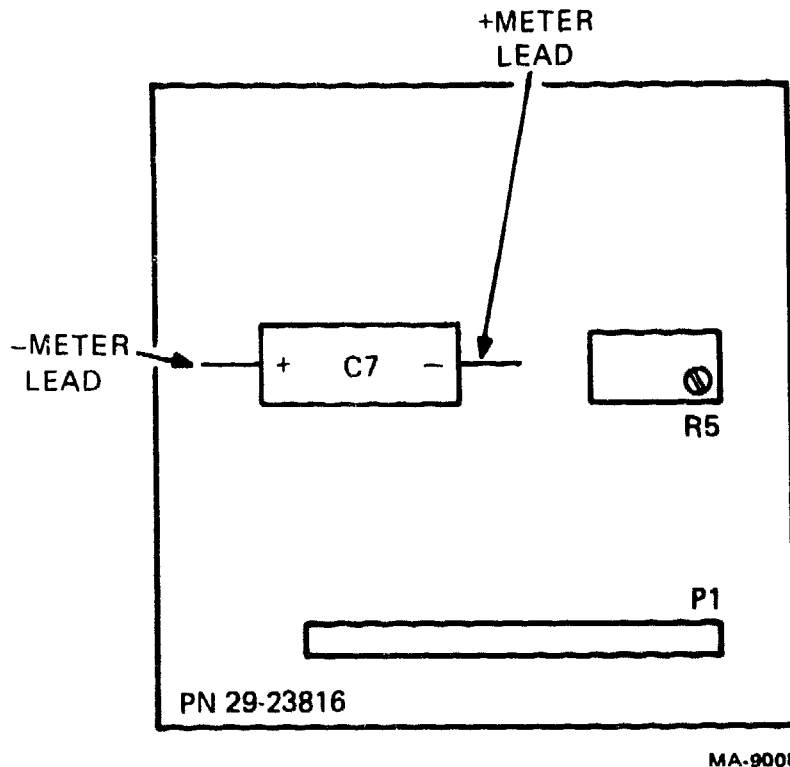


Figure 4-10 Current and kVA Select Module



#### 4.6.6 Current Meter

##### References

- Figure 4-2 Monitoring Logic Parts Location
- Table 4-3 Calibration Jumpers
- Table 4-5 Phase Designator and Relationship Chart
- Figure 4-11 Current and kVA Monitor

##### Tools Needed

- Clamp-on ammeter (Fluke Type 801-600 and DMM) or use the calibrated current system load readings
- Screwdriver
- Trim potentiometer adjusting tool
- Jumper plug

##### Calibration Procedure

1. Check the operating current on the system status panel to make sure that the PCS has a steady load above 10 A on each secondary phase line.

2. Find the transformer secondary wires:

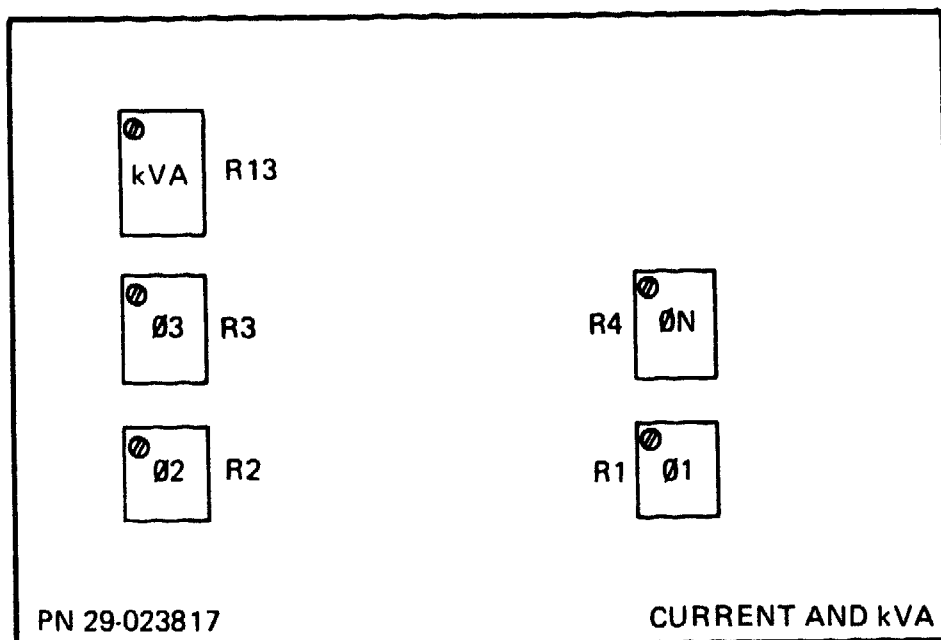
Phase 1 -- Black  
Phase 2 -- Red  
Phase 3 -- Blue  
Neutral -- White.

The neutral wire is at the back of the unit (from the output panelboard).

3. Use the ammeter to measure and record the current flowing in each phase of the transformer secondary.
4. Press the PHASE 1 switch on the system status panel, or place the shorting plug on the appropriate connection for phase 1.
5. Adjust R1 until the DMM reads the value recorded for phase 1  $\pm$  2 percent.
6. Repeat Steps 1 through 5 for phases 2 and 3 and neutral.

Table 4-5 Phase Designator and Relationship Chart

| Description | Transformer<br>Lug Location | Input<br>(Primary) | Output<br>(Secondary) | Power<br>Conductor<br>Wire Color |
|-------------|-----------------------------|--------------------|-----------------------|----------------------------------|
| Phase X     | H <sub>1</sub>              | X                  |                       | Brown                            |
| Phase Y     | H <sub>2</sub>              | X                  |                       | Orange                           |
| Phase Z     | H <sub>3</sub>              | X                  |                       | Yellow                           |
| Phase 1     | X <sub>1</sub>              |                    | X                     | Black                            |
| Phase 2     | X <sub>2</sub>              |                    | X                     | Red                              |
| Phase 3     | X <sub>3</sub>              |                    | X                     | Blue                             |
| Neutral     | X <sub>0</sub>              |                    | X                     | White                            |



MA-9004

Figure 4-11 Current and kVA Monitor

#### 4.6.7 kVA Meter

##### References

- Figure 1-4 System Status Panel (SSP)
- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-11 Current and kVA Monitor

##### Tools Needed

- Trim potentiometer adjusting tool
- Pocket calculator (optional)

##### Calibration Procedure

1. Press the appropriate system status panel switches to obtain the following voltages and current readings:

I1 = Phase 1 current  
I2 = Phase 2 current  
I3 = Phase 3 current  
VN.1 = Voltage Phase 1  
VN.2 = Voltage Phase 2  
VN.3 = Voltage Phase 3

2. Calculate the kVA using the following formula:

$$\frac{(I_1 \times V_{N.1}) + (I_2 \times V_{N.2}) + (I_3 \times V_{N.3})}{1000} = \text{kVA (in watts)}$$

3. Press and hold the kVA switch on the system status panel.
4. Adjust R13 on the current and kVA monitor until the value from Step 2 appears on the digital display.

#### 4.6.8 Voltage Alarm Thresholds

##### References

- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-4 Main Logic Module

##### Tools Needed

- Digital multimeter (DMM)
- Trim potentiometer adjustment tool

##### Calibration Procedure

1. Connect the negative lead of the DMM to ground on the main logic module.
2. With the positive lead of the DMM, measure and record the readings at the following points on the main logic module:

a. U4 pin 2 (Phase X) = \_\_\_\_\_  
b. U4 pin 9 (Phase Y) = \_\_\_\_\_  
c. U3 pin 13 (Phase Z) = \_\_\_\_\_

The differences between the phase-to-phase reference voltages should be .20 volts or less.

2. Adjust the high voltage threshold as follows:
  - a. Add .5 volts to the highest reading.
  - b. Connect the positive lead of the DMM to U4 pin 3.
  - c. Adjust R32 for value determined in Step 2a.

Example: U4 pin 2 (Phase X) = 2.46 Vdc  
U4 pin 9 (Phase Y) = 2.53 Vdc  
U3 pin 13 (Phase Z) = 2.39 Vdc

The reading at U4 pin 9 is the highest. Adding .5 volts = 3.03 volts. Adjust R32 until 3.03 volts is read on the DMM.

3. Adjust the low voltage threshold as follows:
  - a. Subtract .18 volts from the lowest reading.
  - b. Connect the positive lead of the DMM to U4 pin 6.
  - c. Adjust R31 for value determined in step 3a.

Example: U4 pin 2 (Phase X) = 2.46 Vdc  
U4 pin 9 (Phase Y) = 2.53 Vdc  
U3 pin 13 (Phase Z) = 2.39 Vdc

The reading at U3 pin 13 is the lowest. Subtracting .18 volts = 2.21 volts. Adjust R31 until 2.21 volts is read on the DMM.

4. Perform the calibration procedures in Sections 4.6.6, 4.6.7, and 4.6.9.

#### 4.6.9 Ground Current Meter and Alarm

##### References

- Figure 4-2 Monitoring Logic Parts Location
- Figure 4-12 Example of a Ground Current Load Adapter
- Figure 4-13 Ground Current Monitor

##### Tools Needed

- Digital multimeter (DMM)
- Clamp-on ammeter
- Ground current load adapter
- Trim potentiometer adjusting tool

##### NOTE

This procedure assumes no existing fault conditions. If a fault condition exists, the calibrated levels may be incorrect by the amount of existing ground current.

##### Calibration Procedure

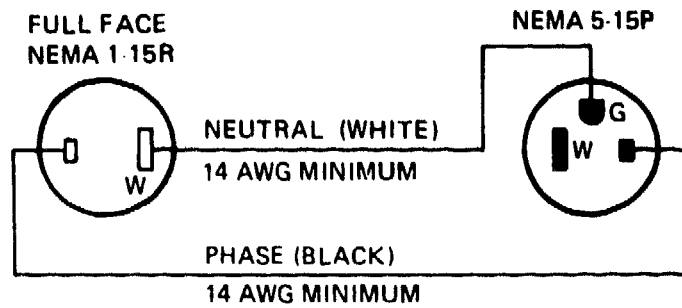
1. Power down the PCS (Section 3.4).
2. Turn off all branch circuits except one single phase output power cable.
3. Plug the ground current load adapter into the output power cable. Remove a computer device, if necessary.
4. Plug a double-insulated noncomputer device that draws more than 5 amperes (an electric heater, for example) into the ground current load adapter. This level of current becomes the alarm setting.

##### CAUTION

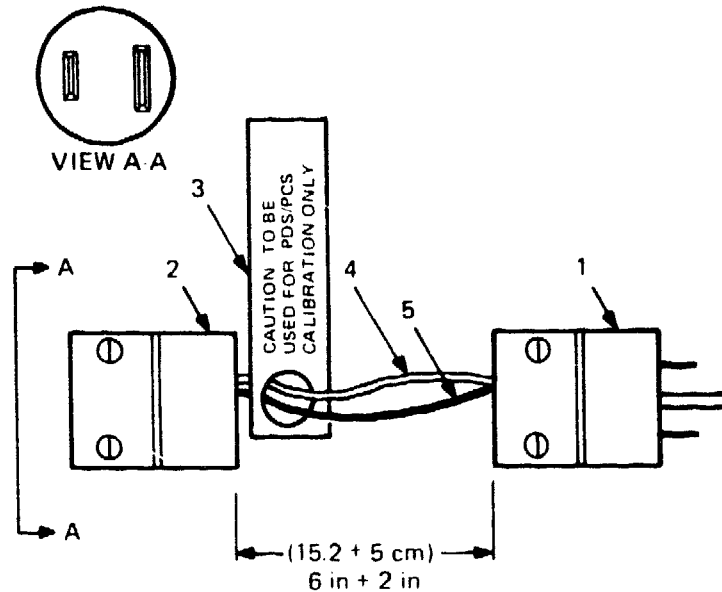
The device must be a 2-wire, double-insulated type device. Do not use a 2-to 3-wire adapter.

5. Power up the PCS (Section 3.2).
6. Use the clamp-on ammeter to measure and record the current flowing through the white conductor on the ground current load cord.

7. Adjust R1 on the ground current monitor until the alarm sounds. This adjustment ensures that the alarm will sound when this current is faulting to ground.
8. Adjust R7 on the ground current monitor until the current reading from Step 6 appears on the digital display when you press GROUND (operating current) on the SSP.
9. Power down the PCS (Section 3.4).
10. Remove the load adapter and noncomputer device connected to the output cable.  
  
If necessary, reconnect the removed computer device.
11. Power up the PCS (Section 3.2).
12. Release the FUNC DISABLE switch. (Indicator goes off.)



ELECTRICAL DRAWING



MECHANICAL DRAWING

| MATERIALS |                                                                                                 |     |
|-----------|-------------------------------------------------------------------------------------------------|-----|
| ITEM      | DESCRIPTION                                                                                     | QTY |
| 1.        | NEMA 5-15P (PLASTIC SHELL TYPE).                                                                | 1   |
| 2.        | NEMA 1-15R (FULLFACE) PLASTIC SHELL TYPE)                                                       | 1   |
| 3.        | PLASTIC CAUTION TAG<br>PERMANENT INK: "CAUTION:<br>TO BE USED FOR PDS/PCS<br>CALIBRATION ONLY". | 1   |
| 4.        | NEUTRAL WIRE (WHITE)<br>14 AWG - 8 in (20.3 cm) LONG                                            | 1   |
| 5.        | PHASE CONDUCTOR (BLACK)<br>14 AWG - 8 in (20.3 cm) LONG                                         | 1   |

MA-8610B

Figure 4-12 Example of a Ground Current Load Adapter

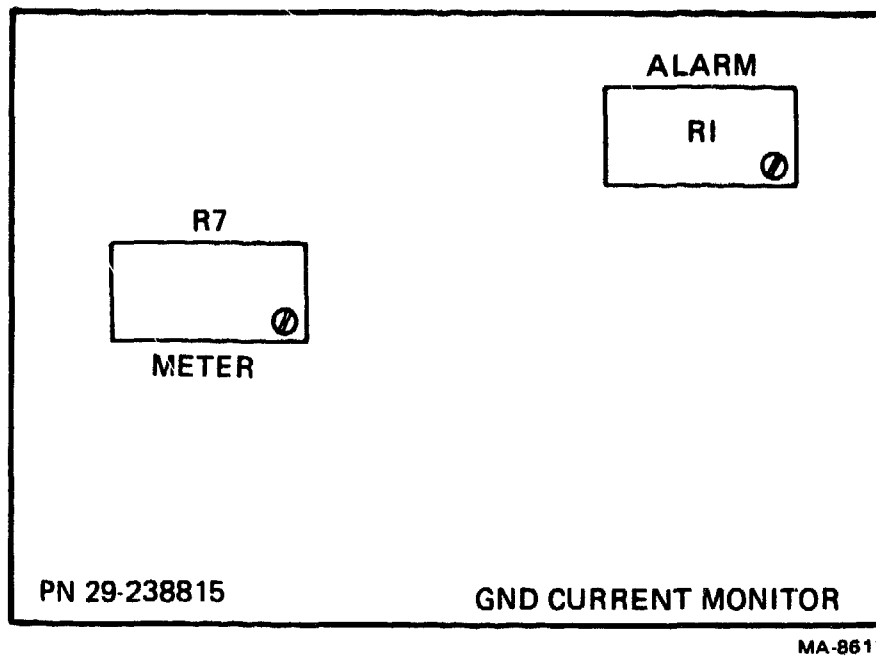


Figure 4-13 Ground Current Monitor



#### 4.6.10 Control Logic Module Clock

##### References

- Figure 4-14 Clock Waveform
- Figure 4-15 Control Logic Module

##### Tools Needed

- Oscilloscope with a triggered mode
- Trim potentiometer adjusting tool

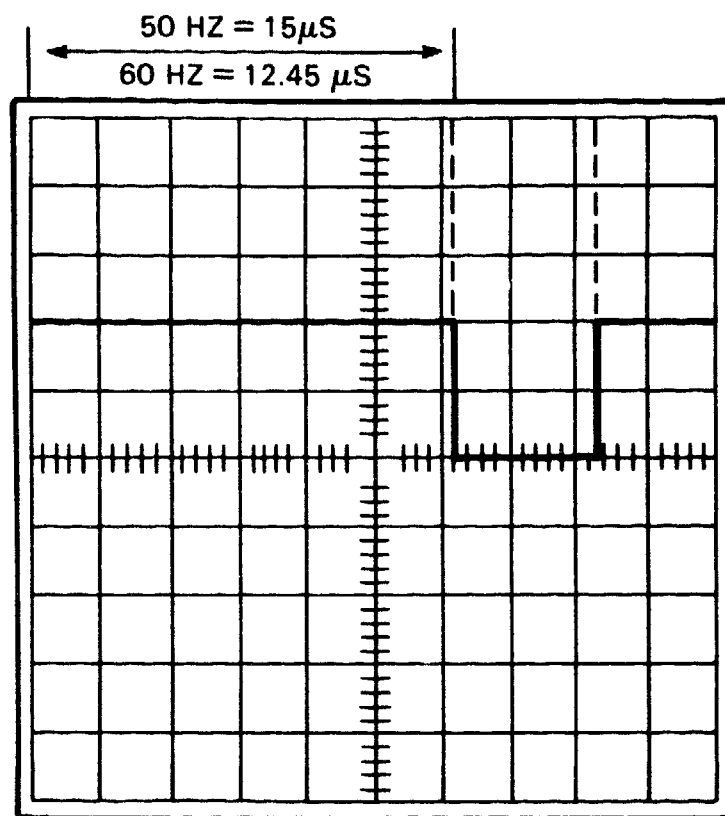
##### Calibration Procedure

1. With the H7228 PCS powered OFF, open the cabinet door and remove the bottom panel.
2. Do not remove the plexiglas shield.
3. Ensure that the ENABLE/DISABLE switch (S2) is in the DISABLE position on all control logic modules.
4. Power up the H7228 PCS with no load.
5. Set the oscilloscope as follows:  
Vertical: 5.0 volts per centimeter  
Timing: 2.0 milliseconds per centimeter  
Trigger: Internal, ac coupled
6. Connect the scope ground to the bottom lead of capacitor C5.
7. Connect the scope probe to test point TP9. The measured portion of the waveform should be as shown as in Figure 4-14.

| 50 Hz    | 60 Hz    |
|----------|----------|
| 15.00 ms | 12.45 ms |

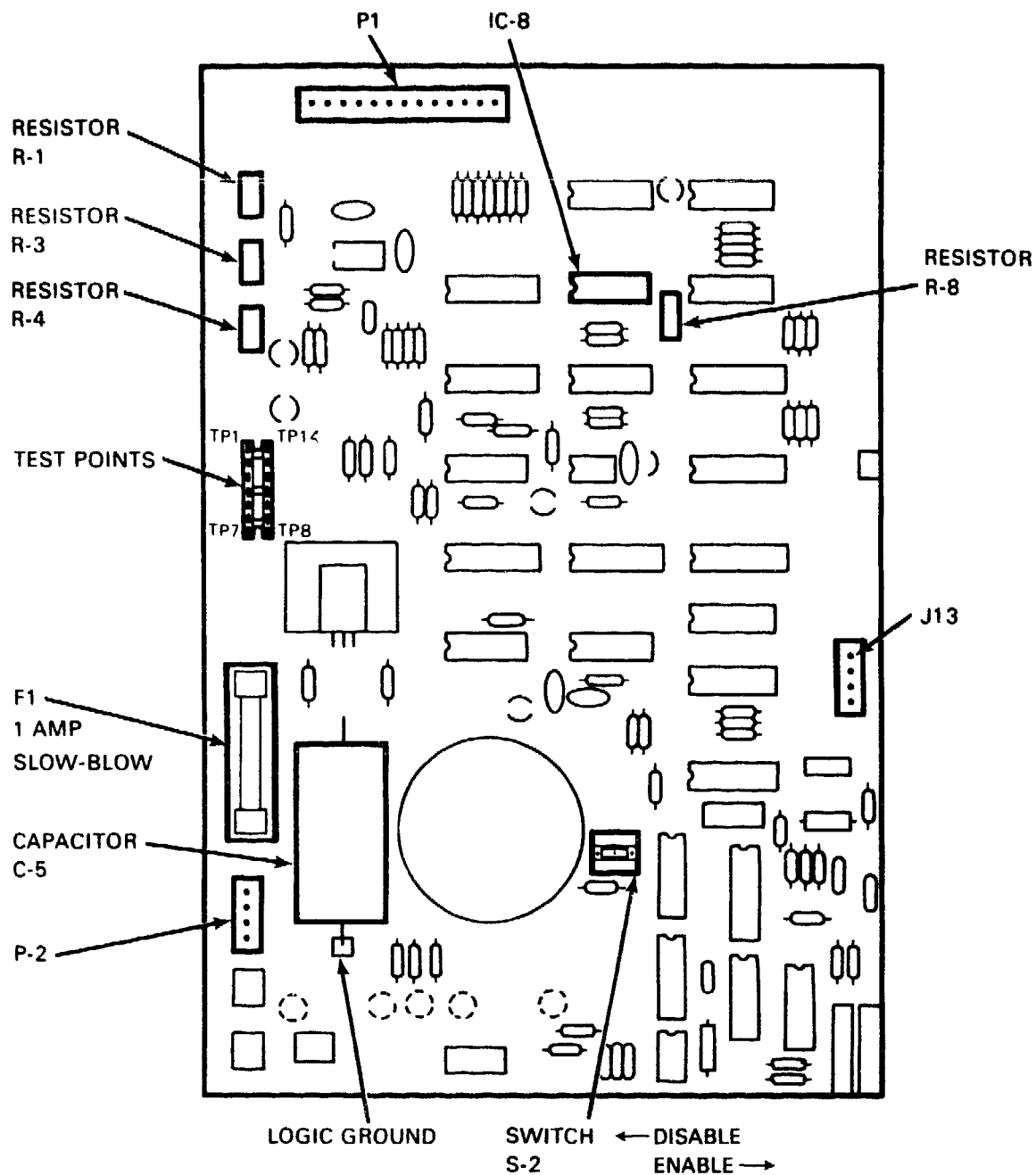
8. Adjust R3 until the waveform matches Figure 4-15, if necessary.

9. Check the clock settings on the other two CLMs, using the same procedure.
10. Power down the H7228 PCS.
11. Place the ENABLE/DISABLE switch in the ENABLE position on all the control logic modules.
12. The PCS is ready for use.



MKV86-0151

Figure 4-14 Clock Waveform



MKV85-0188

Figure 4-15 Control Logic Module

#### 4.6.11 Control Logic Module Voltage Range Setting

The control logic modules require configuration for the input (primary) voltage as follows:

- 208-240 Vac (60 Hz),
- 440-480 Vac (60 Hz), or
- 380-415 Vac (50 Hz).

Use this procedure when changing control logic modules.

#### Reference

- Figure 4-15 Control Logic Module

#### Tools Needed

- Digital multimeter (DMM)
- Trim potentiometer adjusting tool

#### Procedure

1. Remove IC-8 from the CLM.
2. Set the DMM to the resistance scale.
3. Connect the negative lead to the bottom lead of C5.
4. Connect the positive lead to test point TP2.
5. Confirm that the resistance is 7.9K ohms.

If the resistance does not correspond to one of the above values, adjust R8 until the correct value is obtained.

6. Replace IC-8, being careful that pin 1 is in the proper location and that all IC legs are correctly inserted.
7. Install the CLM at this time.
8. Ensure that the ENABLE/DISABLE switch (S2) is in the DISABLE position on all CLMs.
9. Power up the H7228 PCS at this time.
10. Set the DMM to dc volts.
11. Connect the negative lead to the bottom of capacitor C5.
12. Connect the positive lead to TP1 on the CLM.
13. Adjust R1 for a reading of 8.1 Vdc.
14. Power down the PCS.

15. Verify operation of the CLM, referring to Section 4.7.3.
16. Place the ENABLE/DISABLE switch on all the CLMs in the ENABLE position.

#### 4.6.12 Nominal Transformer Tap Setup

The H7228 PCS should be left with transformer tap 5 selected, after any maintenance or troubleshooting has been performed. Follow this procedure with power ON, but with no load. The input power must be within the limits specified in Tables D-13 and D-14.

#### References

- Figure 4-3 Unregulated Power Supply
- Figure 4-15 Control Logic Module
- Figure 4-16 Voltage Regulation Components
- Table D-13 Input Branch Power (60 Hz)
- Table D-14 Input Branch Power (50 Hz)

#### Tools Needed

- Digital multimeter (DMM)
- Trim potentiometer adjusting tool

#### Procedure

1. Power OFF the H7228 PCS (Section 4.1).
2. Remove the back panel to the PCS.
3. Remove the bottom panel and disable the SCRs by placing the ENABLE/DISABLE switch (S2) on each control logic module in the DISABLE position.
4. Power up the PCS with no load.
5. Set the DMM to the ac volts scale.
6. With the DMM, monitor the voltage between TP1 and TP4 on the unregulated power supply, while adjusting R4 on the right-hand control logic module (phase X).
7. Adjust for a voltage within one of the following ranges:

| <u>50 Hz(220 Vac)</u> | <u>50 Hz(240 Vac)</u> | <u>60 Hz(120 Vac)</u> |
|-----------------------|-----------------------|-----------------------|
| 213-227 Vac           | 233-247 Vac           | 116-124 Vac           |

The readings will move in steps as the taps are selected.

8. With the DMM, monitor the voltage between TP2 and TP4 on the unregulated power supply, while adjusting R4 on the center control logic module (phase Y).

9. Adjust for a voltage within one of the following ranges:

|                       |                       |                       |
|-----------------------|-----------------------|-----------------------|
| <u>50 Hz(220 Vac)</u> | <u>50 Hz(240 Vac)</u> | <u>60 Hz(120 Vac)</u> |
| 213-227 Vac           | 233-247 Vac           | 116-124 Vac           |

The readings will move in steps as the taps are selected.

10. With the DMM, monitor the voltage between TP3 and TP4 on the unregulated power supply, while adjusting R4 on the left-hand control logic module (phase Z).

11. Adjust for a voltage within one of the following ranges:

|                       |                       |                       |
|-----------------------|-----------------------|-----------------------|
| <u>50 Hz(220 Vac)</u> | <u>50 Hz(240 Vac)</u> | <u>60 Hz(120 Vac)</u> |
| 213-227 Vac           | 233-247 Vac           | 116-124 Vac           |

The readings will move in steps as the taps are selected.

12. Verify that phase X and phase Y have not changed. Adjust, if necessary.

13. Record all settings in the system log.

14. Power OFF the H7228 PCS (Section 4.1).

15. Enable the SCRs by placing the ENABLE/DISABLE switch (S2) on each control logic module in the ENABLE position.

16. Replace all panels.

## 4.7 SCR SERVICE

### FAILURE TYPES:

- Open or Discolored Fuselink Wires -- Indicates a shorted SCR or that multiple SCRs have been turned on by erroneous triggers or a logic failure.
- Low Voltage Alarm -- Caused by SCRs not turning on or a bank of SCRs not being selected.

#### NOTE

The PCS will operate with an open or nonconducting SCR until the associated tap is selected, then the system will detect the problem.

The failure of one SCR can stress other assemblies. If there is reason to believe a part has been stressed, it should be DISCARDED immediately and replaced with a new one.

#### WARNING

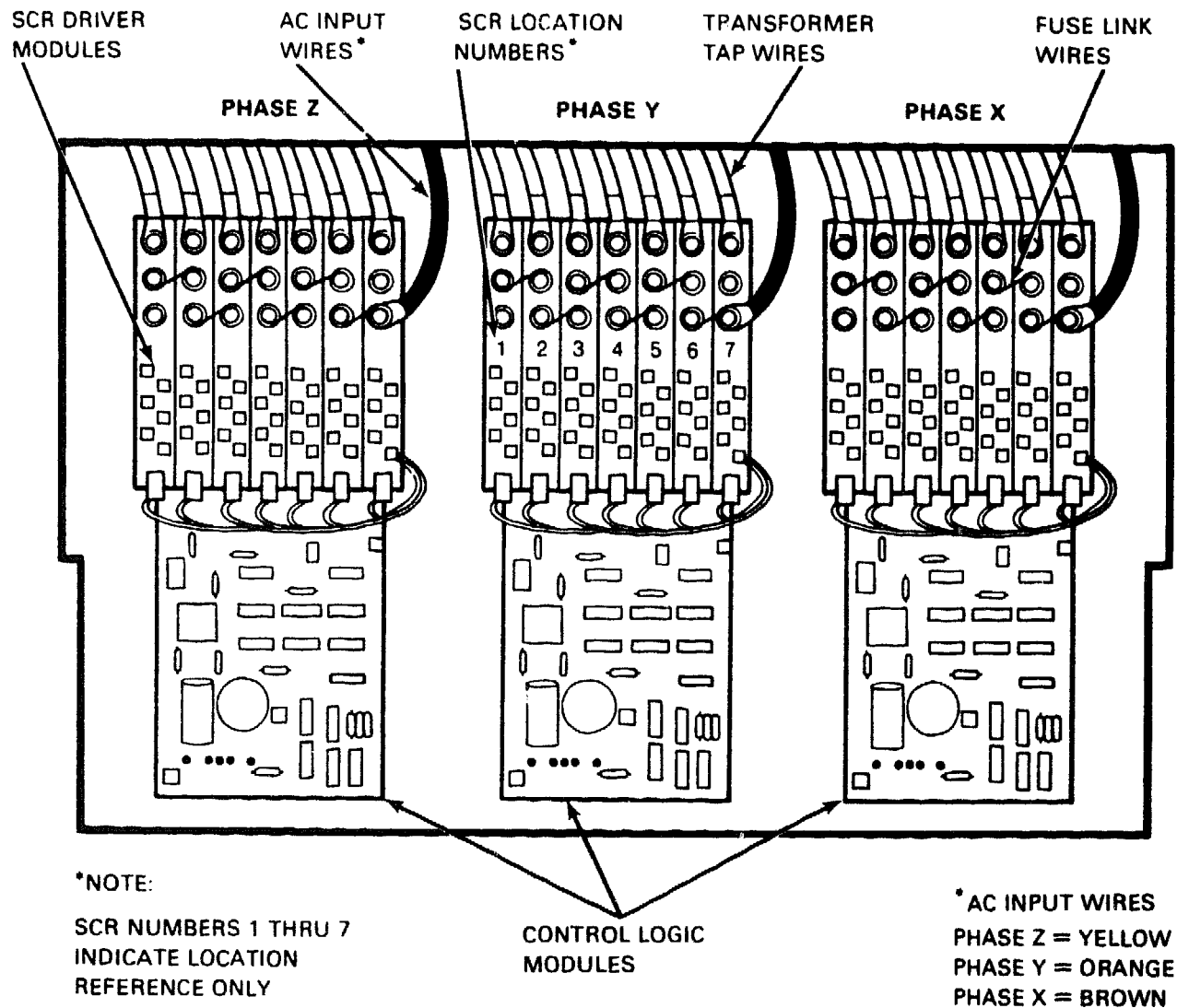
The fuselink wires, which act as fuses, can present a hazard to the technician when they blow open. The wires vaporize and splatter molten copper, making it necessary that you keep the plexiglas safety shield in place and that you wear safety glasses while the system is live.

After any failure and subsequent replacement of parts, completely check the SCRs for proper operation, using the procedures outlined in Section 4.7.3.

#### 4.7.1 Isolating a Shorted SCR and the Cause

The SCRs are high current, high voltage devices and are subject to short circuit failure. An SCR shorting causes a fuselink wire to open, resulting in a loss of ac power to the attached equipment. Isolate the shorted SCR as follows:

- Determine in which bank the shorted SCR(s) is located (Section 4.7.1.1)
- Isolate the failed device(s) (Section 4.7.1.2)
- Remove and replace the failed device(s) (Section 4.7.4)
- Verify proper operation of all the SCRs after the repair has been made (Section 4.7.3).



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Figure 4-16 Voltage Regulation Components



#### 4.7.1.1 Determining in Which Bank the Failed SCR Is Located

##### References

- Figure 4-16 Voltage Regulation Components
- Figure 4-17 SCR Driver Module

##### Tools Needed

- Digital multimeter (DMM)
- Phillips screwdriver
- Safety glasses

##### Procedure

1. This procedure is done with power off. Take all the safety precautions outlined in Section 4.1.
2. Open the cabinet door and remove the bottom panel.
3. Remove the plexiglas shield covering the SCR driver modules.
4. Visually examine the SCR banks for an open or discolored fuselink wire. The problem bank will have an open or discolored fuselink wire.

#### 4.7.1.2 Isolating the Shorted SCR

##### References

- Figure 4-16 Voltage Regulation Components
- Figure 4-17 SCR Driver Module

##### Tools Needed

- Digital multimeter (DMM)
- Phillips screwdriver
- Safety glasses

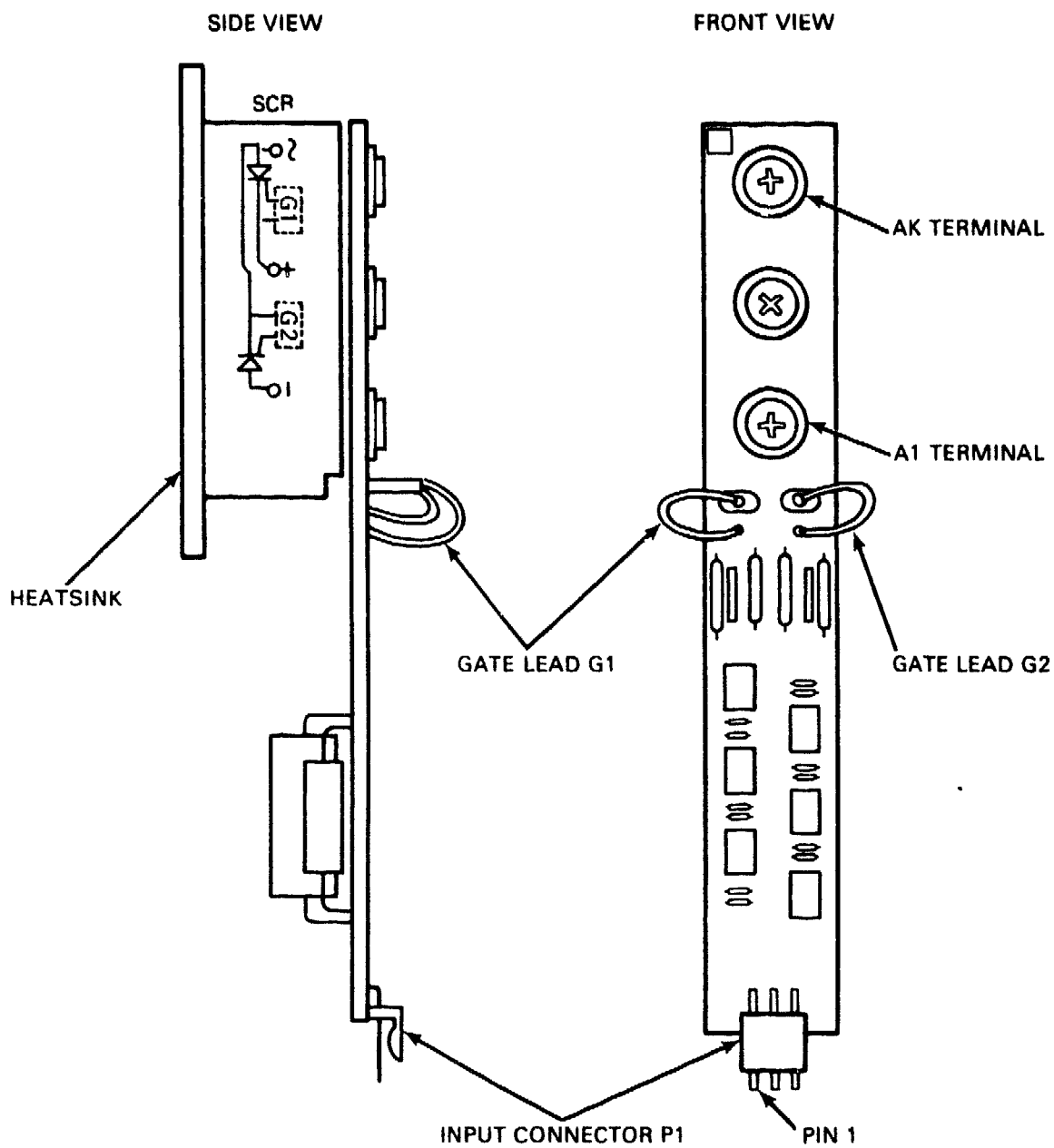
##### Procedure

1. If one fuselink wire opens or becomes discolored, replace the SCR and SCR driver module on each side of the fuselink wire. Refer to Section 4.7.4 of this manual.
2. If multiple fuselink wires open or become discolored, change the two SCRs and SCR driver modules to the outside and adjacent to the open fuselink wires.

Example: If fuselink wires between taps 2 and 3 and taps 4 and 5 are open or discolored, change the SCRs and SCR driver modules in the 2 and 5 positions. Refer to Section 4.7.4 of this manual.

3. Remove all the transformer tap wires on the defective bank, ensuring that they are properly labeled for reconnection.
4. Remove the SCR driver module PCBs for proper readings.
5. Using the DMM, measure the resistance of both legs of each SCR, verifying that there are no other shorted SCRs in the bank.
  - a. Place one lead on the top terminal (N).
  - b. Place the other lead on the bottom terminal (-).
  - c. Read the resistance on the DMM.
  - d. Move the lead on the bottom terminal (-) to the middle terminal (+).
  - e. Read the resistance on the DMM.
  - f. A good SCR will read more than one megohm (typically, two to three megohms) on both legs.
  - g. A reading of five ohms or less on either leg of the SCR indicates a shorted SCR.

If the SCR reads less than one megohm, replace the SCR and its driver module. Refer to Section 4.7.4.
6. Reinstall and tighten the screws removed in Steps 3 and 4.
7. After the replacement of a defective part, perform the verification procedure in Section 4.7.3.



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Figure 4-17 SCR Driver Module

#### 4.7.2 SCR Not Turning On Properly

A low voltage alarm condition indicates that a phase has been lost or that the ac power to the PCS is out of specification. The alarm is probably caused by an SCR that is not turning on. Determine the cause of the problem as follows:

- Ensure that the input ac power is within specification at the J-Box (Tables D-13 and D-14)
- Determine which phase (bank) has been lost (Section 4.7.2.1)
- Locate the SCR that is not turning on (Section 4.7.2.2)
- Determine if the SCR driver module is selected (Section 4.7.2.3)
- Remove and replace the failed part (Section 4.7.4)
- Verify proper operation of all SCRs (Section 4.7.3).

##### 4.7.2.1 Determining Which Phase Caused the Low Voltage Alarm

###### References

- Figure 4-16 Voltage Regulation Components
- Figure 4-17 SCR Driver Module

###### Tools Needed

- Digital multimeter (DMM)
- Phillips screwdriver
- Safety glasses

###### Procedure

1. This procedure is done with the power ON.
2. Ensure that the plexiglas SCR shield and bottom panel are in place.
3. Look at the control logic modules through the windows in the bottom panel.
4. The bank causing the alarm will have the L0 voltage LED on the control logic module illuminated.
5. Troubleshoot the appropriate bank with the procedure described in Section 4.7.1.2.

#### 4.7.2.2 Isolating Which SCR Is Not Turning On

Select each SCR in each bank and determine that it is conducting properly.

#### WARNING

Use EXTREME CAUTION. The SCRs are at line potential.

#### References

- Figure 3-1 Transformer Tap Indicators
- Figure 4-15 Control Logic Module
- Figure 4-16 Voltage Regulation Components
- Figure 4-17 SCR Driver Module

#### Tools Needed

- Digital multimeter (DMM)
- Trim potentiometer adjusting tool
- Safety glasses

#### Procedure

1. Power down the H7228 PCS (Section 4.1).
2. Open the cabinet door and remove the bottom panel.
3. Remove the plexiglas shield covering the SCR driver modules.
4. Visually examine the SCR banks for any problem.
5. Ensure that the three screws securing each SCR driver module are tight.
6. Put on your safety glasses.
7. Power up the H7228 PCS with no load.
8. Adjust R4 on each control logic module to select transformer tap 7. The selected transformer tap is displayed on the green LEDs on each CLM.

| 4 | 2 | 1 |     |
|---|---|---|-----|
| o | o | ● | = 1 |
| o | ● | o | = 2 |
| o | ● | ● | = 3 |
| ● | o | o | = 4 |
| ● | o | ● | = 5 |
| ● | ● | o | = 6 |
| ● | ● | ● | = 7 |

o = LED Off  
 ● = LED On

Binary codes 1 to 7 refer to transformer taps 1 to 7.

#### CAUTION

Do not allow the taps to be more than two positions apart between control logic modules. Excessive circulating current can cause damage.

#### WARNING

If an SCR fails to pass the tests in Steps 9c or 9d, STOP IMMEDIATELY and change the suspect SCR (Section 4.7.4) before continuing.

9. Set the DMM to the ac volts scale and measure across the SCR in the number 7 position (left-most) on each SCR bank as follows:
  - a. Place one lead on the top screw terminal (AK).
  - b. Place the other lead on the bottom screw terminal (Al).
  - c. The proper conducting voltage drop should be between .5 Vac and 1.5 Vac on the selected SCR.
  - d. A reading of more than 1.5 Vac indicates that the SCR is not turning on fully.
10. Adjust R4 on the three control logic modules to the next successive, lower tap setting and repeat Step 9 for the SCRs in the next successive positions.
11. After all SCRs in the PCS are checked in this manner, restore the unit to its nominal transformer tap setting using the procedure outlined in Section 4.6.
12. When the problem circuit is found, determine if the SCR/SCR driver module or the control logic module has failed. Refer to Section 4.4.3.

#### 4.7.2.3 SCR Driver Module Selection

The SCR driver module selection check determines if the SCR driver module is receiving the dc select signal from the control logic module. Only the SCR/SCR driver module not turning ON will be checked.

#### References

- Figure 4-15 Control Logic Module
- Figure 4-16 Voltage Regulation Components
- Figure 4-17 SCR Driver Module

#### Tools Needed

- Digital multimeter (DMM)
- Trim potentiometer adjusting tool
- Safety glasses

#### Procedure

1. With the power OFF (Section 4.1), remove the bottom panel.
2. DO NOT remove the plexiglas shield covering the SCR driver modules.
3. Visually examine the SCR driver modules and control logic modules for loose connectors or any other problems.
4. Power up the PCS without a load.
5. Ensure that the control logic module for the bank being checked is displaying the correct transformer tap number.
6. Set the DMM to the dc volts scale and measure the dc select signal to the selected SCR in each bank:
  - a. Place the negative meter lead on the bottom lead of capacitor C5 on the control logic module.
  - b. Place the positive meter lead on pin 1 of connector P1 on the SCR driver module.
  - c. The proper dc select voltage should be between 5 Vdc and 9 Vdc, indicating that the control logic module is selecting the SCR driver module. Replace the SCR and SCR driver module as described in Section 4.7.4.
  - d. A reading of approximately 12 Vdc indicates that the SCR driver module is not being selected. Replace the control logic module.
  - e. A reading of 1 Vdc or less means that the SCR driver module is bad. Replace the SCR and SCR driver module as described in Section 4.7.4.

### 4.7.3 Verifying Proper SCR Operation

After the removal of any parts, wires, or connectors, check all the SCRs for proper operation.

#### References

- Figure 4-15 Control Logic Module
- Figure 4-16 Voltage Regulation Components
- Figure 4-17 SCR Driver Module

#### Tools Needed

- Digital multimeter (DMM)
- Trim potentiometer adjusting tool
- Safety glasses

#### Procedure

1. With power off (Section 4.1), check each bank of SCRs for shorts, using the resistance scale of the DMM.
  - a. Remove the color-coded ac input wire for phase X.
  - b. Place one lead on the top screw terminal (AK) of any SCR.
  - c. Place the other lead on the bottom screw terminal (AI) of any SCR.
  - d. A reading of less than 10 kilohms means that there is a shorted SCR in this bank. Go to Section 4.7.1.
  - e. A reading of greater than 10 kilohms indicates that the SCRs in this bank are all good.
  - f. Reattach the ac input wire removed in Step 1a.
  - g. Repeat this procedure for phases Y and Z.
2. Check each of the SCRs in each bank for leakage with power ON and no load.
  - a. Power down the PCS (Section 4.1).
  - b. Place the ENABLE/DISABLE switch (S2) on the control logic modules in the DISABLE position.
  - c. Replace the plexiglas shield and put on your safety glasses.
  - d. Power up the H7228 PCS and let it operate five minutes.
  - e. Power down the H7228 PCS (Section 4.1).



- f. Remove the plexiglas shield and power up.
- g. Set the DMM to the appropriate ac volts scale and measure the voltage drop across each SCR.

**WARNING**

Use **EXTREME CAUTION**. The SCRs are at line potential.

- 1) Place one lead on the top screw terminal (AK).
  - 2) Place the other lead on the bottom screw terminal (A1).
  - 3) A good SCR will measure very close to line potential.
  - 4) An SCR is considered leaky if it measures 80% or less of line voltage. Replace SCR, referring to Section 4.7.4.
- h. Power down the H7228 PCS (Section 4.1).
  - i. Return the ENABLE/DISABLE switch (S2) on all three control logic modules to the ENABLE position.
3. Check each SCR for proper turn on as follows:
- a. Ensure that the H7228 PCS is OFF (Section 4.1).
  - b. Remove the bottom panel and plexiglass shield, and put on your safety glasses.
  - c. Ensure that the ENABLE/DISABLE switch (S2) on each control logic module is set to the ENABLE position.
  - d. Turn the output main circuit breaker OFF (no load).
  - e. Power up the H7228 PCS.

- f. Adjust R4 on each control logic module to select transformer tap 7. The selected transformer tap is displayed on the green LEDs on each control logic module.

**CAUTION**

Do not allow the taps to be more than two positions apart between control logic modules. Excessive circulating current can cause damage.

| 4 | 2 | 1 |     |
|---|---|---|-----|
| o | o | ● | = 1 |
| o | ● | o | = 2 |
| o | ● | ● | = 3 |
| ● | o | o | = 4 |
| ● | o | ● | = 5 |
| ● | ● | o | = 6 |
| ● | ● | ● | = 7 |

o = LED Off

● = LED On

Binary codes 1 to 7 refer to transformer taps 1 to 7.

**WARNING**

If an SCR fails to pass the tests in Step g, STOP IMMEDIATELY and change the suspect SCR (Section 4.7.4) before continuing.

- g. Set the DMM to the ac volts scale and measure across the SCR in the number 7 position (right-most) on each SCR bank as follows:
- 1) Place one lead on the top SCR screw terminal (AK).
  - 2) Place the other lead on the bottom SCR screw terminal (Al).
  - 3) The proper conducting voltage drop should be between .5 Vac and 1.5 Vac on the selected SCR.
  - 4) A voltage of less than .5 Vac indicates a shorted SCR and will cause the fuselink wire to open. Replace the SCR and the SCR driver module, referring to Section 4.7.4.
  - 5) A reading of more than 1.5 Vac indicates that the SCR is not turning on fully. The problem can be with the SCR, the SCR driver module, or the control logic module.

- h. Adjust R4 on the three control logic modules to the next successive, lower tap setting and repeat Step 3g for the SCRs in the next successive positions.
- i. After all SCRs are checked in this manner, restore the unit to its nominal transformer tap setting, using the procedure outlined in Section 4.6.12.
- j. Power down the H7228 PCS (Section 4.1).
- 4. Reinstall the plexiglas shield and bottom panel.

#### 4.7.4 SCR and SCR Driver Module Replacement

The SCR and SCR driver module are always replaced together. A failure in one device will stress the other, increasing the chances of early failure. The defective SCR(s) and SCR driver module(s) should be disposed of immediately to prevent possible reuse.

#### References

- Figure 2-1 H7228 PCS Components (Front View)
- Figure 4-15 Control Logic Module
- Figure 4-16 Voltage Regulation Components
- Figure 4-17 SCR Driver Module

#### Tools Needed

- Phillips screwdriver

#### Removal Procedure

1. Turn power OFF to the H7228 PCS (Section 4.1).
2. Open the cabinet door and remove the bottom panel.
3. Remove the plexiglas shield covering the SCR banks.
4. Remove the transformer tap wire by removing the top screw on the SCR. Make sure that the wire is marked.
5. Remove the two screws securing the fuselink wires.
6. Unplug the red and white gate leads to G1 and G2.
7. Unplug the connector (P1) from the bottom of the SCR driver module.
8. Lift the SCR driver module away from the SCR.
9. Remove the two SCR mounting screws and remove the SCR.

## Replacement Procedure

1. Before installing the replacement SCR, check its resistance as detailed in Section 4.7.1.2 (Steps 3, 4, and 5).
2. Apply heatsink compound or pad to the SCR and position the SCR with the gate tabs down.
3. Secure the SCR to the heatsink with the two mounting screws, ensuring that the locking hardware is in place.
4. Reconnect the transformer tap wire to the top terminal of the SCR and the SCR driver module, ensuring that the locking hardware is in place.
5. Reconnect the two fuselink wires to the other two SCR screw terminals, ensuring that the locking hardware is in place.

Replace the fuselink wires (if necessary), referring to Table 4-6 for the proper sizes.

### CAUTION

DO NOT cross the red and white leads.

6. Connect the two gate leads to G1 and G2.  
  
If the SCR has four tab terminals, connect the gate leads to the outside pair.
7. Reconnect the connector (P1).
8. Check that the SCR and the SCR driver module operate properly, referring to Section 4.7.3 for the verification procedure.
9. Reinstall the plexiglas shield and the bottom panel.

Table 4-6 Fuselink Wire Sizes

| Input Voltage | 15 kVA   | 30 kVA   | 50 kVA   | 75 kVA   | 100 kVA  |
|---------------|----------|----------|----------|----------|----------|
| 208           | 20 Gauge | 16 Gauge | 16 Gauge | --       | --       |
| 220           | 20 Gauge | 16 Gauge | 16 Gauge | --       | --       |
| 240           | 20 Gauge | 16 Gauge | 16 Gauge | --       | --       |
| 380*          | 22 Gauge | 20 Gauge | 16 Gauge | 16 Gauge | --       |
| 415*          | 22 Gauge | 20 Gauge | 16 Gauge | 16 Gauge | --       |
| 440           | 22 Gauge | 20 Gauge | 16 Gauge | 16 Gauge | 16 Gauge |
| 460           | 22 Gauge | 20 Gauge | 16 Gauge | 16 Gauge | 16 Gauge |
| 480           | 22 Gauge | 20 Gauge | 16 Gauge | 16 Gauge | 16 Gauge |

\* 50 Hz units

## 4.8 UNREGULATED POWER SUPPLY REPLACEMENT

### References

- Figure 2-2 PCS Components (Rear View)
- Figure 4-3 Unregulated Power Supply

### Tools Needed

- Phillips screwdriver

### Removal Procedure

1. Power down the PCS.
2. Set the IMCB to the OFF position and disconnect the input power cable from the J-Box.
3. Open the backpanel at the rear of the PCS.
4. Disconnect the harness connectors at the back of the unregulated power supply.
5. Disconnect the ribbon and single-wire connector from the front of the unregulated power supply.
6. Remove the unregulated power supply.

### Replacement Procedure

1. Install the new unregulated power supply.
2. Connect the front and rear cables to the unregulated power supply.
3. Replace the PCS backpanel.
4. Connect the input power cable to the J-Box.
5. Calibrate all the logic functions. See Section 4.6.

#### **4.9 FIELD SERVICE TROUBLESHOOTING**

The voltage regulation portion of the H7228 PCS contains HIGH VOLTAGE and formal training of maintenance personnel is mandatory.

Tables 4-7 and 4-8 are guides to help you correct basic malfunctions and alarm conditions.

Before you troubleshoot the PCS, record (in the system log) the malfunction and time shown on the system status panel indicators and digital display. Also record all operating currents and voltages.

##### **NOTES**

The PCS may be operated without regulation or monitoring functions to the attached equipment during a service delay. See Table 4-7 for information about disabling.

Make sure that all logic functions are enabled before you leave the site.

##### **CAUTION**

Turn off the DC POWER SUPPLY switch (Figure 4-9) when you replace modules.

See Table 4-9 to determine the source of possible ground currents.

##### **NOTE**

See Appendix A for definitions of the abbreviations used in Tables 4-7, 4-8, and 4-9.

**Table 4-7 Preventing an Accidental Trip**

| <b>Probable Cause</b>                      | <b>Remedy</b>                                                                                                                                |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Individual alarm/monitoring circuit inputs | Press the S1 FUNCTION DISABLE switches on main logic module (S1-1, S1-2, S1-3, and S1-5: Figure 4-4).                                        |
| All alarm/monitoring circuit inputs        | Press FUNC DISABLE on the local control panel (amber indicator on, Figure 1-3).                                                              |
| Defective alarm circuits                   | Set the MAINTENANCE switch on the main logic module to the MAINT position (Figure 4-4) or turn off the DC POWER SUPPLY switch (Figure 2-10). |
| LEPO, REPO, or Temp Check (Shutdown)       | Remove the shunt trip harness connected to the unregulated power supply (single-wire harness).                                               |



**Table 4-8 Field Service Troubleshooting Guide**

| <b>Symptom</b>                                                                    | <b>Probable Cause</b>                                                                       | <b>Corrective Action</b>                                                                                         |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Display is blank,<br>and volts kVA and<br>current are correct                     | Discharged<br>battery                                                                       | Reset IMCB and let<br>battery recharge.<br>If battery does not take<br>charge (below 11.5 V),<br>replace battery |
|                                                                                   | Open battery fuse<br>or disconnected<br>battery                                             | Replace battery fuse F1<br>or reconnect battery                                                                  |
|                                                                                   | J6 connection on<br>motherboard                                                             | Reconnect J6                                                                                                     |
|                                                                                   | Clock/driver<br>display module                                                              | Replace clock/driver<br>display module                                                                           |
| Display is blank<br>for all functions                                             | J1 connection on<br>motherboard                                                             | Reconnect J1                                                                                                     |
|                                                                                   | Display panel<br>daughterboard                                                              | Replace display panel<br>daughterboard                                                                           |
| DPM is erratic and<br>clock is working                                            | DPM module                                                                                  | Replace DPM module                                                                                               |
| One select switch<br>(volts or current,<br>for example) is<br>active all the time | Program shorting<br>plug left on T1<br>to T2 terminal<br>strip on back of<br>display module | Remove jumper plug                                                                                               |
|                                                                                   | Display panel<br>daughterboard                                                              | Replace display panel<br>daughterboard                                                                           |
|                                                                                   | Shorted switch                                                                              | Replace SSP                                                                                                      |
| Indicators do not<br>turn on during<br>battery test                               | Lamp driver<br>module                                                                       | Replace lamp driver<br>module                                                                                    |

**Table 4-8 Field Service Troubleshooting Guide (Cont)**

| Symptom                                                                    | Probable Cause                                          | Corrective Action                                  |
|----------------------------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------|
| Audible alarm does not sound                                               | Alarm                                                   | Replace alarm                                      |
|                                                                            | Driver on lamp driver module                            | Replace lamp driver module                         |
|                                                                            | Cable (J3)                                              | Replace cable (J3)                                 |
|                                                                            | Power block interface (PBI) module                      | Replace PBI module                                 |
| LEPO indicator is off, and PCS is on (no shunt trip)                       | LEPO indicator                                          | Replace indicator                                  |
|                                                                            | Connector or cable to the unregulated power supply (P3) | Replace unregulated power supply cable (P3)        |
|                                                                            | Shunt trip                                              | Replace IMCB                                       |
| Ground current monitor alarm sounds when computer equipment is powered on  | Ground current leakage in computer equipment on powerup | Repair unit causing alarm. (See Table 4-9)         |
| Phase alarm is on all the time, and all phase voltage readings are correct | Unregulated power supply maintenance switches           | Set maintenance switches to NORMAL position        |
|                                                                            | Incorrect phase in J-Box                                | Contact building engineer or electrical contractor |
|                                                                            | Phase error detector module                             | Replace phase error detector module                |

**Table 4-8 Field Service Troubleshooting Guide (Cont)**

| <b>Symptom</b>                                   | <b>Probable Cause</b>              | <b>Corrective Action</b>                                                                                     |
|--------------------------------------------------|------------------------------------|--------------------------------------------------------------------------------------------------------------|
| No regulation on one phase                       | SCR shorted and fuselink wire open | Replace SCR and SCR driver module and fuselink wires                                                         |
|                                                  | SCR driver module defective        | Replace SCR and SCR driver module                                                                            |
|                                                  | Fuse on the control logic module   | Replace fuse                                                                                                 |
|                                                  | Control logic module               | Replace control logic module                                                                                 |
|                                                  | Loose connections                  | Tighten SCR driver modules and FUNCTION SELECTOR switch screws<br><br>Check connections on SCR driver module |
| No output on one phase                           | Control logic module               | Replace control logic module                                                                                 |
|                                                  | SCR driver module                  | Replace SCR and SCR driver module                                                                            |
| Low voltage alarm                                | SCR                                | Replace SCR and SCR driver module                                                                            |
|                                                  | SCR driver module                  | Replace SCR and SCR driver module                                                                            |
|                                                  | Control logic module               | Replace control logic module                                                                                 |
| SCR fuselink wire blown                          | SCR                                | Replace SCR and SCR driver module on each side and fuselink wire                                             |
|                                                  | SCR driver module                  | Replace SCR and SCR driver module on each side and fuselink wire                                             |
| LEPO trips, but no REPO or monitor circuit trips | Relay K1 on PBI module             | Plug K1 on PBI securely<br><br>Replace PBI module                                                            |

**Table 4-8 Field Service Troubleshooting Guide (Cont)**

| Symptom                                                                        | Probable Cause                                                | Corrective Action                                                           |
|--------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------|
| No shunt trip occurs from RIA alarm (delay or immediate), and alarm is working | FUNC DISABLE switch on local control panel                    | Release FUNC DISABLE (amber indicator OFF)                                  |
|                                                                                | No jumper plug on PBI                                         | Install jumper plug on PBI module                                           |
|                                                                                | PBI module                                                    | Replace PBI module                                                          |
| No shunt trip occurs from internal errors, and RIA, REPO, and LEPO are correct | FUNCTION DISABLE switches on main logic module                | Set FUNCTION DISABLE switches on main logic module (Section 4.5.3)          |
|                                                                                | Maintenance switch on main logic module set to MAINT position | Set maintenance switch to NORMAL position                                   |
|                                                                                | FUNC DISABLE switch                                           | Release FUNC DISABLE on the local control panel. (Amber indicator goes off) |
|                                                                                | Main logic module                                             | Replace main logic module                                                   |
| Continuous shunt trip occurs                                                   | K1 relay                                                      | Replace K1                                                                  |
|                                                                                | PBI module                                                    | Replace PBI module                                                          |
|                                                                                | Shorted REPO switch                                           | Replace REPO switch                                                         |
|                                                                                | Shorted LEPO switch                                           | Replace LEPO switch                                                         |
|                                                                                | Overheated shunt trip mechanism                               | Wait five (5) minutes and then reset IMCB                                   |
| No readings for current or kVA appear and voltage readings are correct         | Current and kVA select module                                 | Replace current and kVA select module                                       |
|                                                                                | Current and kVA monitor module                                | Replace current and kVA monitor module                                      |

**Table 4-8 Field Service Troubleshooting Guide (Cont)**

| <b>Symptom</b>                                                                                                    | <b>Probable Cause</b>                                         | <b>Corrective Action</b>                                                     |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------------------------|
| SSP is dead or partially up after powerdown                                                                       | Disconnected battery                                          | Reconnect battery                                                            |
|                                                                                                                   | Open battery fuse (F1) or unregulated power supply breakers   | Replace fuse F1 if open, and reset unregulated power supply circuit breakers |
| Computer devices do not power up, and PCS phase rotation is correct                                               | Incorrect wiring connection in computer equipment             | Have computer device checked for correct phase rotation sequence             |
| Computer devices do not power up, PCS phase rotation is correct, and voltage is present on output cables          | Incorrect wiring connection in computer equipment             | Have computer device checked for correct phase rotation sequence             |
|                                                                                                                   | Computer device                                               | Repair computer device                                                       |
| Alarm sounds with no error indication                                                                             | MAINTENANCE switch on main logic module set to MAINT position | Set MAINTENANCE switch to NORMAL position                                    |
| Some voltage or current readings indicate zero, while others indicate correct voltage or current. No alarm sounds | Loose connection from main logic module to DPM                | Tighten connections on both modules                                          |
|                                                                                                                   | Main logic module                                             | Replace main logic module                                                    |
| Output circuit breaker trips                                                                                      | Short circuit on output or faulty circuit breaker             | Clear short circuit condition or replace faulty circuit breaker              |
| MOV light on                                                                                                      | Fuse in surge suppressor                                      | Replace fuse                                                                 |
|                                                                                                                   | Defective MOV                                                 | Replace surge suppressor assembly                                            |

Table 4-9 Probable Sources of Measured Ground Current

| Measurement Location                              | Probable Source                                       |
|---------------------------------------------------|-------------------------------------------------------|
| SSP operating ground current switch               | Ground fault in computer or PCS                       |
| Input power cable green/yellow wire               | External fault to computer or PCS                     |
| Green taped output distribution green/yellow wire | Ground fault internal or external to flexible conduit |
| Untaped output distribution green/yellow wire     | Ground fault internal or external to computer         |



### 5.1 GENERAL

The H7228 power conditioning system (PCS) automatically monitors, conditions, and distributes ac power for electronic data processing (EDP) equipment. The PCS can be programmed to automatically shutdown in emergency and alarm situations. The PCS ensures noise-free ac power with 90 dB common mode and 60 dB normal mode noise attenuation (Figures 5-2, 5-3, and 5-4).

### 5.2 INPUT POWER

The PCS input voltage must be within -27 to +15 percent of the specified PCS input voltage for proper regulation. (See Tables D-12 and D-13.) The input voltage may be at a frequency of 50 or 60 Hz. This voltage is a 3-phase Delta-connected voltage with a separate ground (3-wire plus ground). Neutral is not used if a wye source is used. The wire size of this ground is the same as the wire size for each of the 3-phase wires.

#### NOTE

An error in the system input voltage may cause permanent damage to the isolation transformer. To prevent this, measure the input voltage available at the site when configuring a power system.

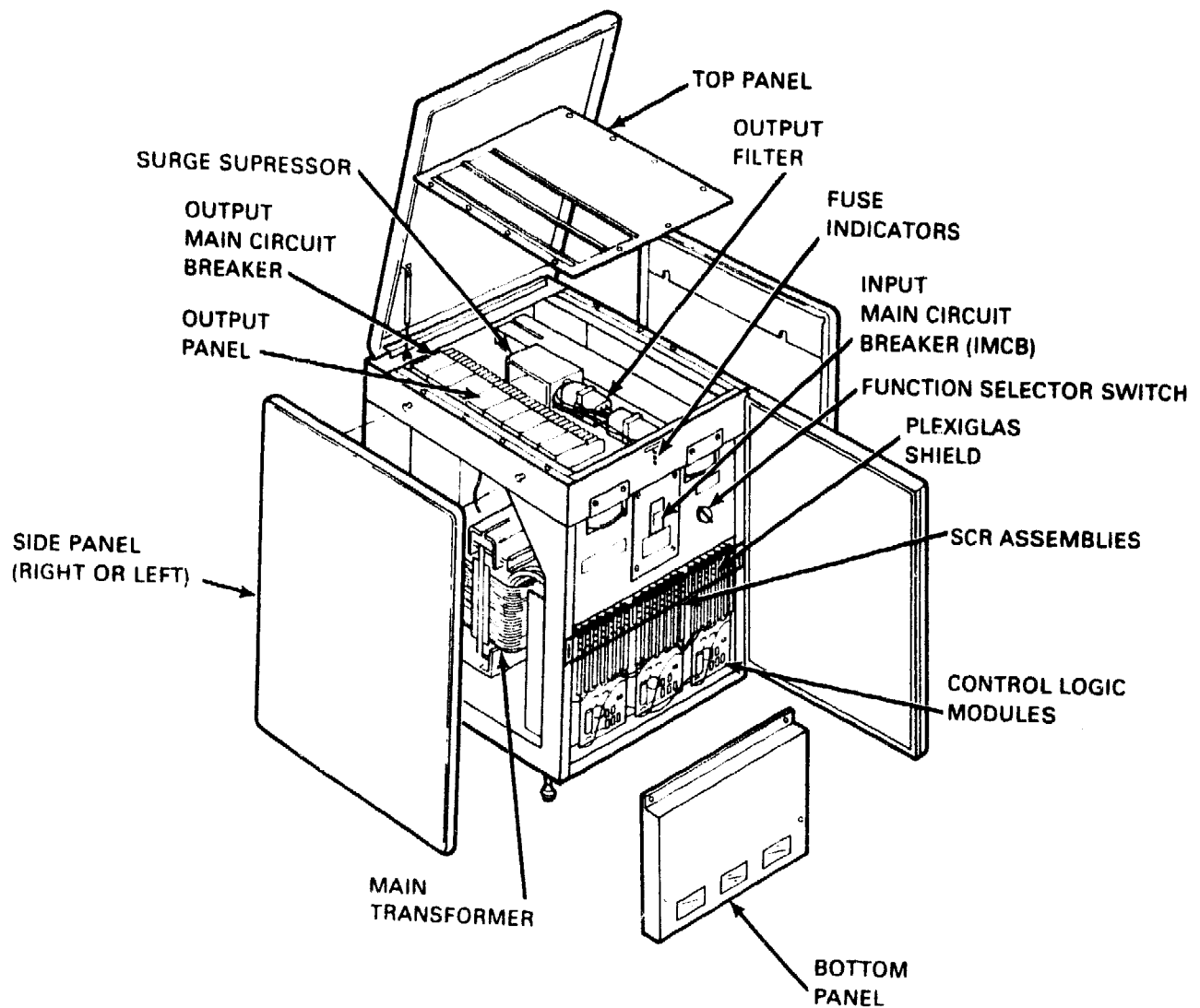
#### 5.2.1 Input Power Circuitry

The three-phase, four-wire (three hot leads and one ground) input voltage is provided through the junction box and terminates at the input main circuit breaker (IMCB). The IMCB provides overcurrent protection for the H7228 PCS and all main circuitry (Figure 5-1). The rating of the circuit breaker is determined by the capacity of the unit.

#### 5.2.2 Input Filter

The H7228 PCS has input filters on the load side of the input main circuit breaker which suppress high frequency noise and help attenuation. The filters work in conjunction with the main input power wiring inductance to form a low-pass filter.

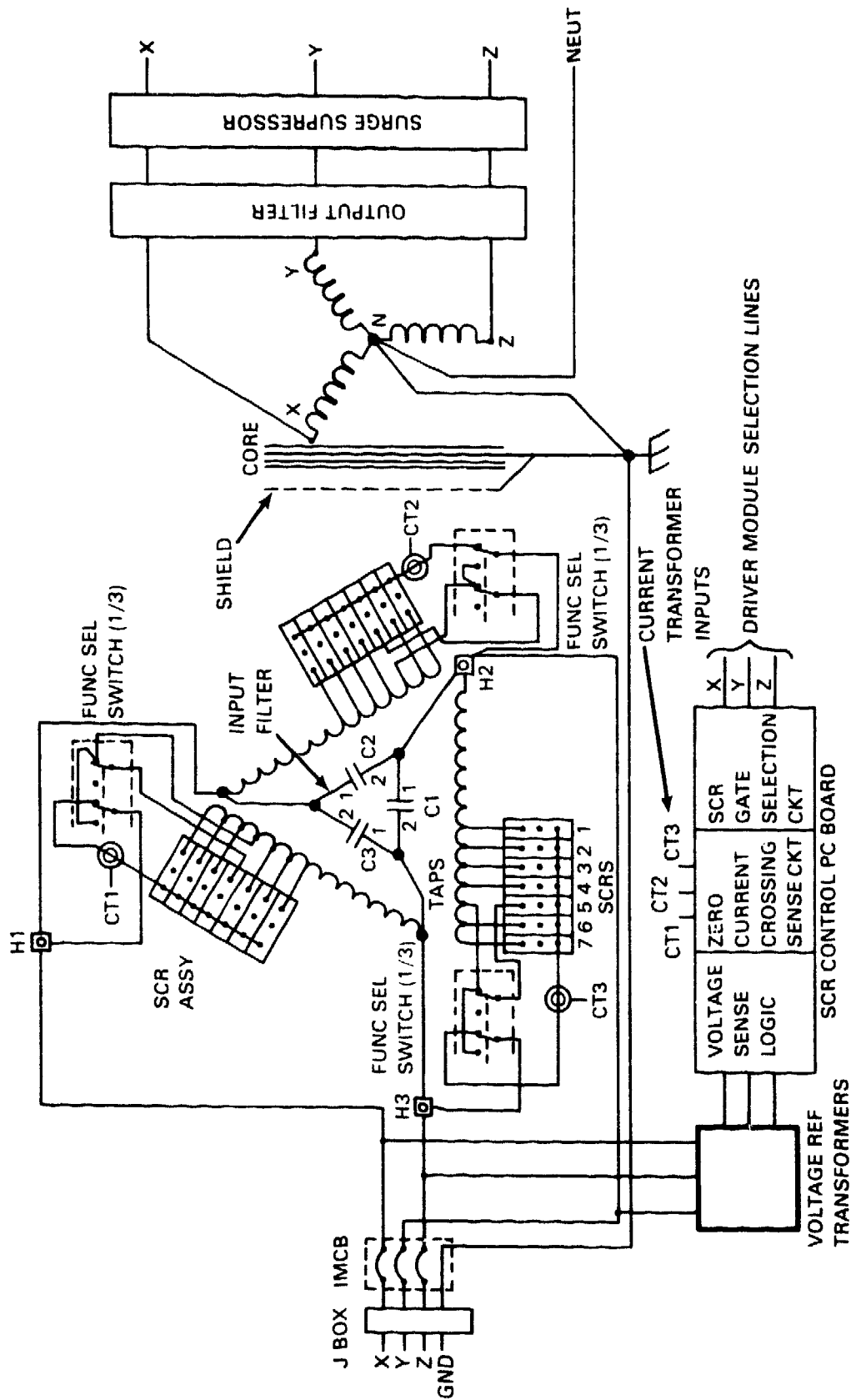




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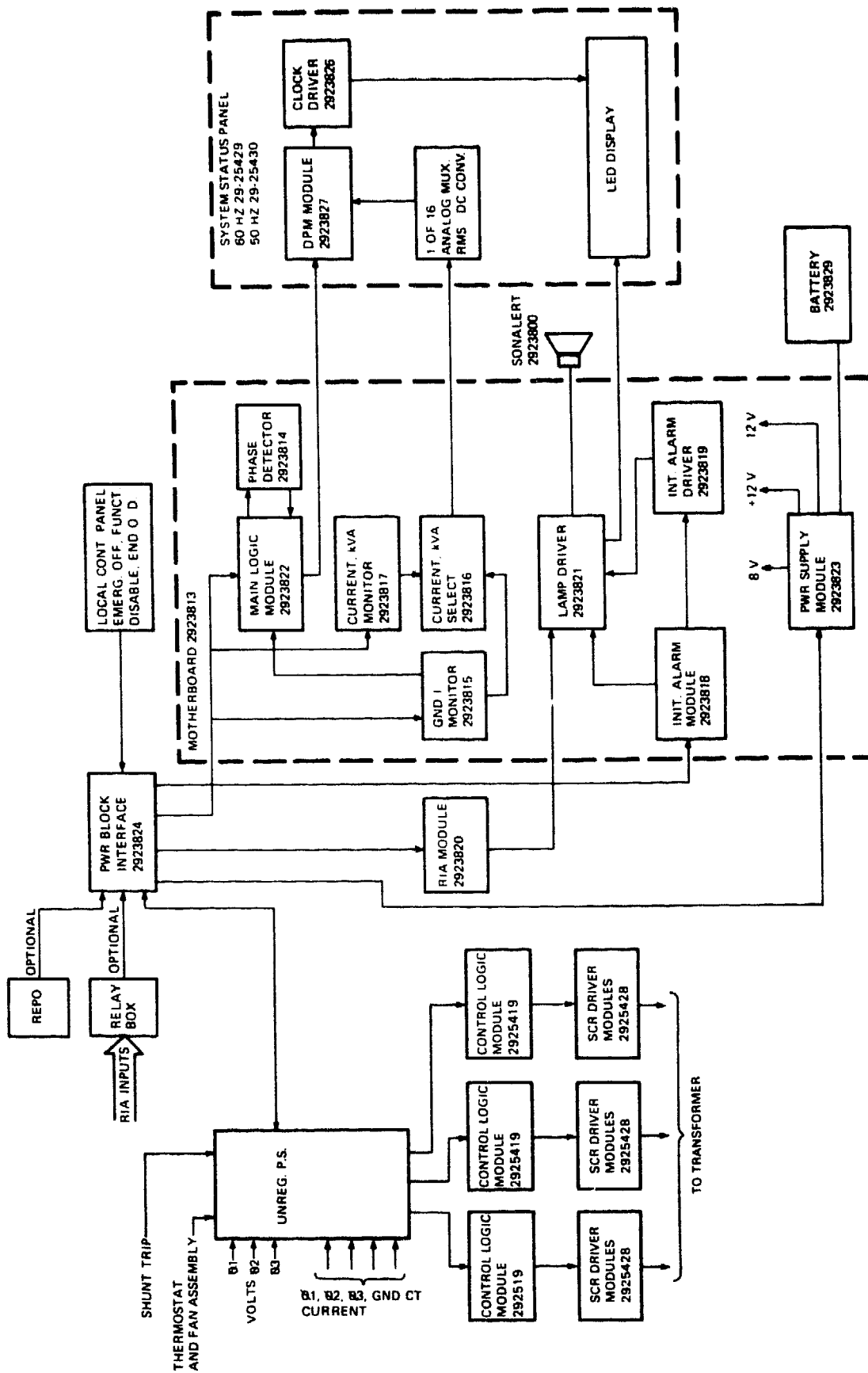
Figure 5-1 PCS Configuration

BLOCK DIAGRAM VOLTAGE REGULATION CKT



MKV85-0182

Figure 5-2 Power Block Diagram



WV88-0152

Figure 5-3 Logic Block Diagram

### 5.2.3 Input Main Circuit Breaker (IMCB)

This circuit breaker removes input power from the PCS in the following ways:

- Manually,
- By the shunt trip mechanism, or
- By overloading.

#### MANUAL TRIP:

The IMCB serves as the power ON/OFF switch for the PCS during normal operation. The IMCB may also be manually tripped in the event of an emergency.

#### SHUNT TRIP MECHANISM:

The IMCB has a shunt mechanism that allows the monitoring logic to shutdown the PCS in an emergency or alarm condition. Input power to the transformer is disconnected by the shunt trip mechanism under the following conditions:

- A local emergency power off (LEPO) activation,
- A remote emergency power off (REPO) activation,
- A TEMP CHECK (overtemperature) occurrence,
- High line voltage,
- Low line voltage,
- A phase error, or
- Excessive ground current.

During normal use, the shunt trip coil is at 18 V, with a small current passing through the shunt trip position relay and the LEPO indicator.

The trip mechanism is activated by the control circuits on the main logic module. These circuits control an SCR, which operates the shunt trip relay that completes the coil-to-ground circuit.

#### OVERLOADING:

If the power capacity of the H7228 PCS is exceeded, the input main circuit breaker will trip. The excessive load must be removed for proper operation.

#### 5.2.4 Main Transformer

The main transformer is a double-shielded, computer-grade isolation transformer with three phases and having seven taps per phase. Its primary is delta-connected and its secondary is wye-connected.

Each winding of the three-phase transformer is double-shielded. The first shield is electrically connected to the primary winding and the second shield is connected to chassis ground. Both shields are between the primary and secondary portions of each isolated winding. The shields greatly reduce interwinding capacitance and help in the attainment of the 90 dB common mode attenuation.

A copper strap provides a high-frequency grounding pad for the main transformer core. The transformer uses a UL-listed 220° Celsius insulation system.

#### 5.2.5 Ground Bus

All grounding is referenced to the ground bus at the back of the PCS. The neutral, the transformer shield, and core are also referenced to this point. Auxiliary grounds can be connected to the ground bus or the auxiliary ground stud on the back of the PCS.

### 5.3 UNREGULATED POWER SUPPLY

Located in the back of the PCS, the unregulated power supply performs the following functions:

- Supplies unregulated dc voltages to the logic modules.
- Provides ac reference voltages to the control logic module.
- Provides maintenance switches for testing and troubleshooting:
  - S1 -- Phase rotation
  - S2 -- Phase loss.
- Provides test points for monitoring output ac.

The two thermostats on the fan bracket have a wiring harness that is routed down the inside of the unit and connected to the unregulated power supply. The thermostat signals are fed directly to the unregulated power supply. A 26-pin ribbon cable connects the unregulated power supply to the power block interface on the cabinet door.

There are three reference and power supply transformers in the unregulated power supply. These center-tap secondary transformers provide 19.5 VRMS to the internal unregulated power supply. The transformers also produce the reference voltage for the main logic module. The wires from the X2, Y2, and Z2 windings of these transformers are routed to the switches S1 and S2 which are maintenance switches for testing the phase loss and phase rotation.

### 5.4 COOLING AND THERMAL PROTECTION

The PCS uses a cooling fan in the exhaust air stream. Thermal sensors are mounted on the fan and thermal switch assembly.

Two stages of thermal alarms provide protection against overheating:

- Overtemp -- The first stage causes an alarm only. Overtemp is set for a 49°C (120°F) trip and 43°C (110°F) reset.
- Shutdown -- The second stage powers down the PCS. Shutdown is set for 71°C (160°F) shunt trip and 65°C (150°F) reset. The IMCB must be manually reset to power up the PCS.

## 5.5 CONTROLS AND INDICATORS

This section describes the use and operation of each control and indicator available to the PCS operator.

### 5.5.1 Local Control Panel

The local control panel is located on the PCS cabinet door and has three switches.

#### LOCAL EMERGENCY POWER OFF (LEPO) SWITCH

This switch trips the IMCB and removes power from the PCS and all attached equipment. The LEPO switch (labeled EMR PWR OFF) is protected by a guard cover. When the indicator is ON, the shunt trip mechanism has continuity, indicating that the IMCB is ON.

#### FUNCTION DISABLE (FUNC DISABLE) SWITCH

When disabled (indicator on), the FUNC DISABLE switch prevents an IMCB trip during the following alarm conditions:

- Voltage check (high or low)
- Remote interface alarm (RIA)
- Phase error
- Ground current monitor.

When enabled (indicator off), this switch allows an IMCB trip. The FUNC DISABLE switch does not prevent a shutdown via the LEPO or REPO switches.

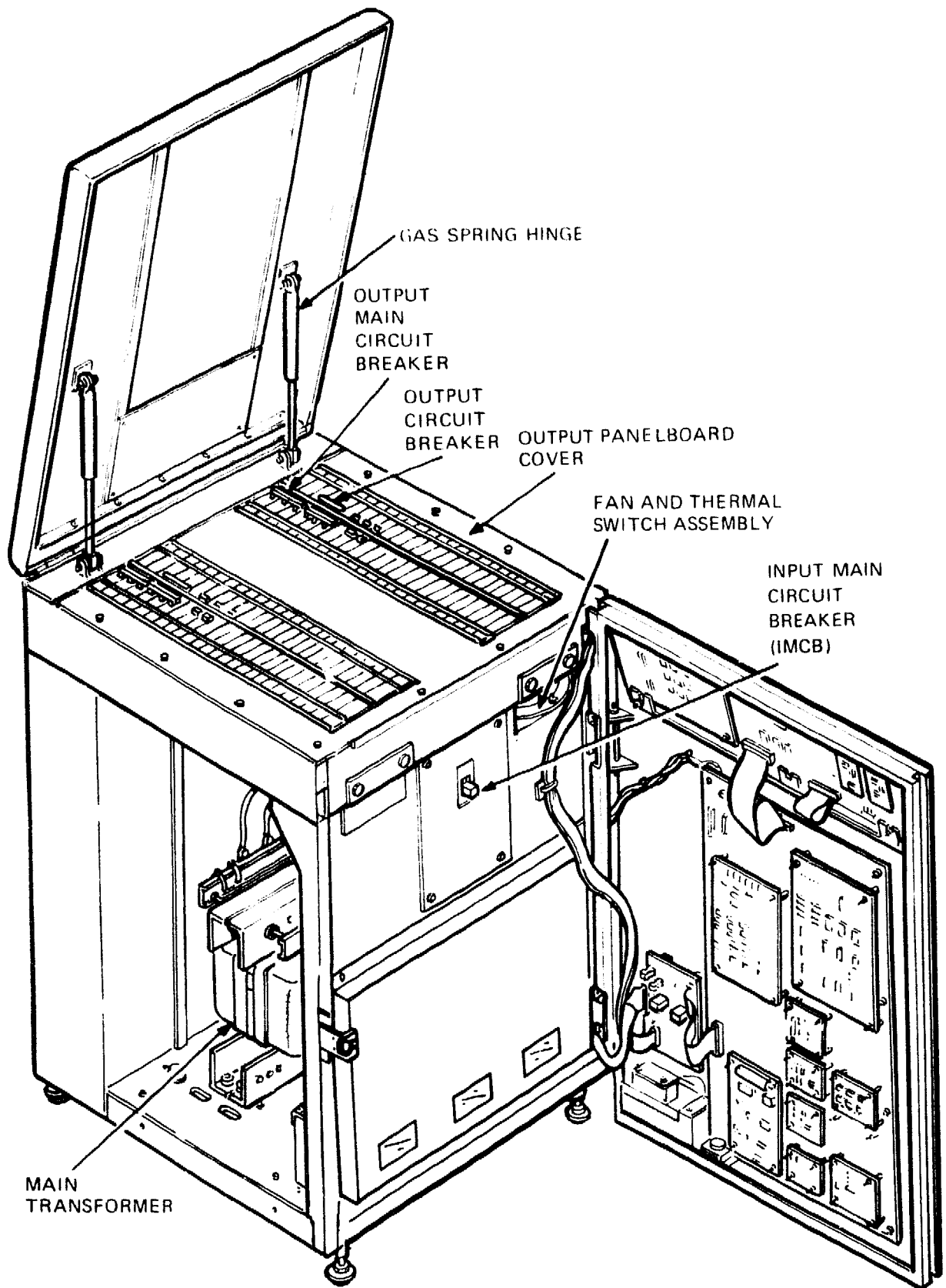
#### END OF DAY SWITCH

This switch (labeled END OF DAY) removes the load from the battery (except the clock), so the battery will not discharge overnight (indicator off).

### 5.5.2 Remote Emergency Power Off (REPO) Switches

The optional remote emergency power off (REPO) switches provide the ability to manually shutdown the PCS from a remote location. The REPO stations are wall-mounted conduit channels with guard-covered power off switches. The stations may be placed at convenient points around the computer room. Each station has one switch and comes with a 15.24 m (50 ft) cable.

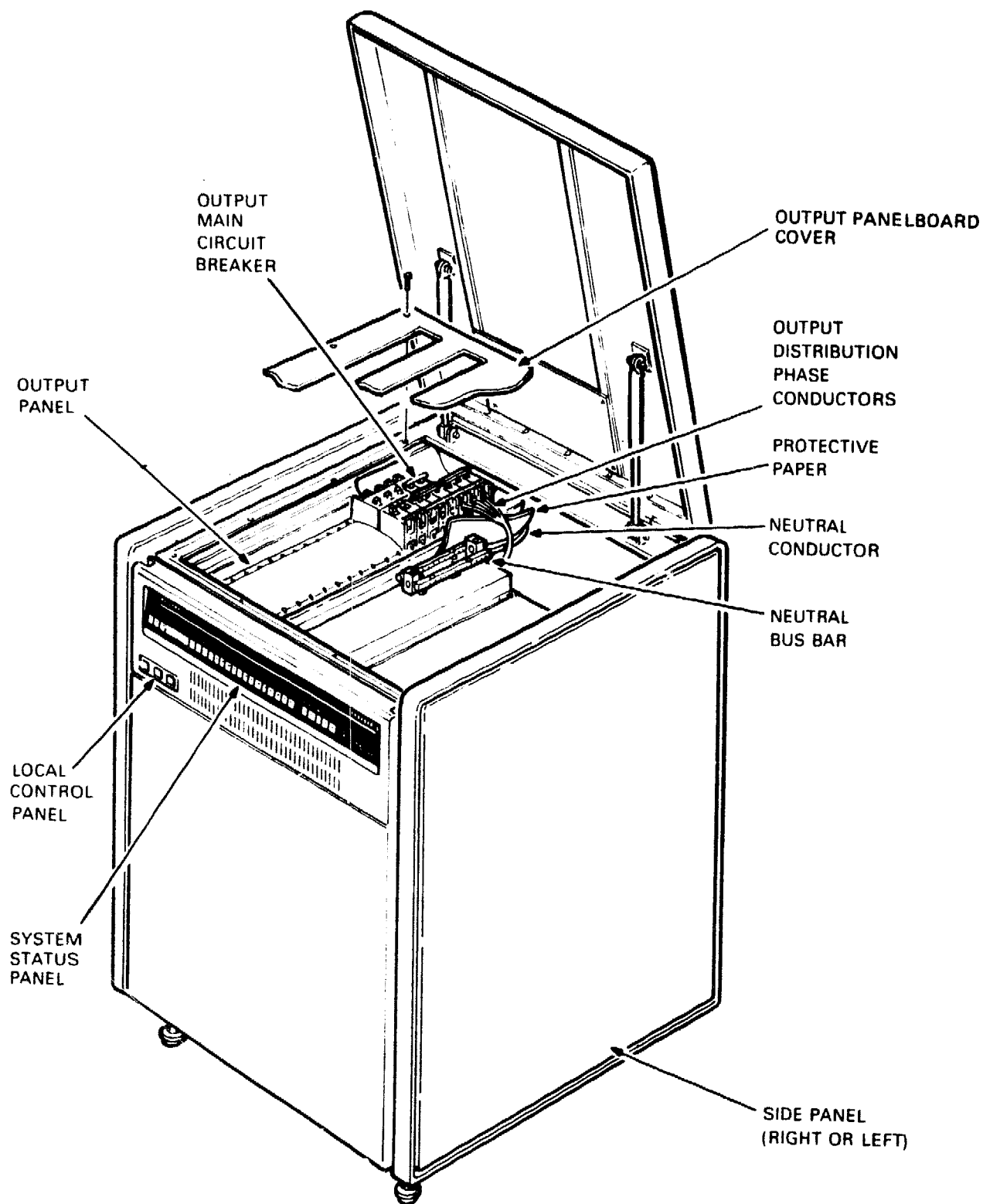
REPO stations may be daisy chained, so that operating any REPO switch immediately trips the IMCB. (See Appendix B.)



MKV86-0153

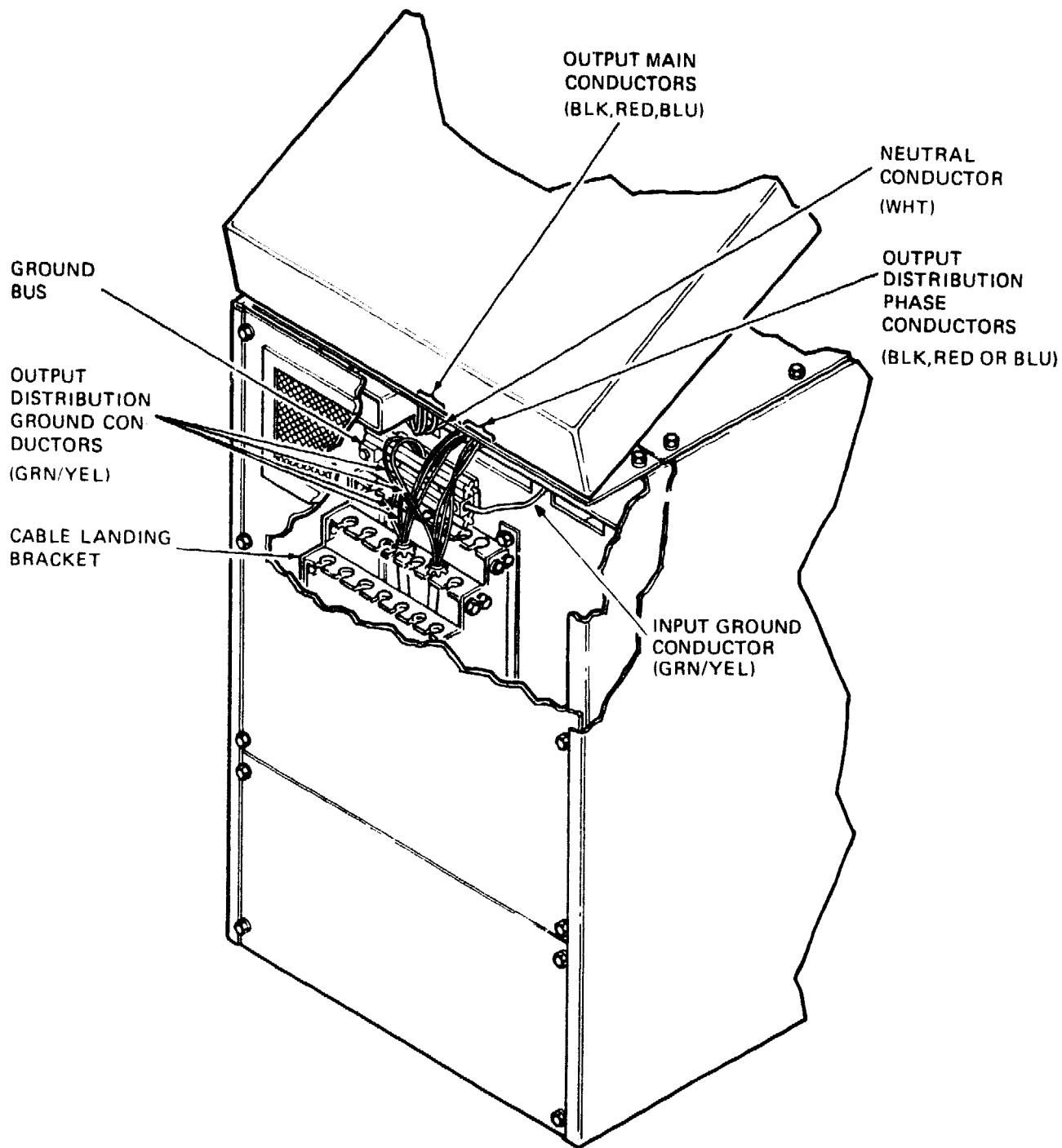
Figure 5-4 PCS Components (Sheet 1 of 3)





MA-1372-84

Figure 5-4 PCS Components (Sheet 2 of 3)



MA-7717A

Figure 5-4 PCS Components (Sheet 3 of 3)

### 5.5.3 FUNCTION SELECTOR

The FUNCTION SELECTOR switch is a two-position, mechanical bypass switch that is used to override the solid state voltage regulation function of the PCS.

In the ISOLATION/REGULATION position, the H7228 PCS automatically isolates, conditions, and regulates the output voltage.

In the ISOLATION only position, the regulating function of the PCS is bypassed to provide isolated, conditioned, and nonregulated output voltage.

#### CAUTION

Never operate the FUNCTION SELECTOR switch when the input main circuit breaker is ON.

### 5.5.4 System Status Panel (SSP)

#### VOLTAGE CHECK (HIGH OR LOW CIRCUIT):

This circuit sounds an alarm and turns on an indicator when the measured output (secondary) voltage is greater than or less than the preset levels (adjustable between -27 and +15 % of the output voltage). You can configure this alarm for immediate trip, delayed trip, or alarm only operation.

#### ALARM SILENCE SWITCH:

The ALARM SILENCE switch silences the audible alarm. If the malfunction is not cleared by the end of the silence delay (selectable for 5, 10, or 15 minutes), the alarm sounds again. A new malfunction will override this switch and sound the alarm again.

#### BATTERY TEST SWITCH:

When the BATTERY TEST switch is activated, the following results:

- The battery voltage is displayed on the digital display
- All system status panel indicators light
- The alarm sounds.

If the battery voltage is less than 11.5 V, replace the battery. The battery load could trigger a dc low warning alarm during this test. Reset the alarm after the test.

#### NOTE

A fully discharged battery may give a bad battery indication (less than 11.5 V). Allow the battery to charge and test it again.

If it still reads low, replace the battery.

#### SYSTEM RESET SWITCH:

The SYSTEM RESET switch clears a corrected alarm condition.

If the alarm condition still exists, the system does not reset and the alarm sounds again.

#### TIME OF DAY CLOCK CIRCUIT:

In normal operation, the clock circuit shows 24-hour time of day. In the event of a PCS shutdown, the clock indicates when the PCS shut down. The clock's colon flashes during normal operation.

When the PCS is on battery backup, the colon does not flash and the clock display freezes at the time when the power tripped. Although not displayed, the clock will keep the correct time and when power is restored, the clock will display the correct time.

#### PHASE ERROR INDICATOR:

The phase error indicator comes on (and an alarm sounds) when the PCS unregulated power supply sees incorrect phase rotation, or when single or multiple phases drop below 50 percent of the nominal monitored voltage for 0.1 seconds or more.

Normal phase rotation is defined as phases that rotate 1-2-3, 2-3-1, or 3-1-2. Any other rotation causes a phase error.

#### GROUND CURRENT MONITOR (GCM):

Input for the GCM circuit comes from a current transformer on the ground return line. When the current on that line exceeds 5 A (adjustable) for 0.1 seconds, the GCM sounds an alarm and turns on the Ground Current Monitor indicator. See Section 4.5.3 for configuration data.

#### REMOTE INTERFACE ALARM (RIA):

The RIA option lets you connect the building alarms, air conditioners, and devices such as smoke detectors, moisture detectors, or humidity detectors to the PCS.

The RIA receives the following alarm signals:

- Fire alarms
- Smoke detectors
- Air conditioners
- Water (flood) detectors
- Other security systems.

The RIA sends out the following signals:

- Shut off air conditioner
- Set any other alarm (optional trip and time delay)
- Alarm signal to the PCS.

When a malfunction occurs, the RIA sends a 12 Vdc signal to the PCS. The PCS sounds an alarm and turns on the system status panel indicator to designate the malfunction.

The PCS may be configured to shut down on the RIA alarm. To configure for a trip, set the programming plugs on the power block interface (PBI). See Section 4.5.2 for configuration data.

#### MAIN AC POWER FAILURE INDICATOR:

The main ac power failure indicator comes on if the main ac supply to the PCS is interrupted for more than 0.1 seconds.

#### INTERNAL DC INDICATOR:

The internal dc indicator comes on when a malfunction causes the PCS to switch to internal dc (battery) power. This malfunction has two possible causes:

- 105 V phase-to-phase on the secondary, or
- A faulty power supply regulator.

#### NOTE

The digital display shows the 24-hour time of day until you press one of the monitoring switches. When you press a monitoring switch, the corresponding indicator comes on and the voltage, current, or power readings appear on the digital display.

#### OPERATING VOLTAGE SWITCHES:

The operating voltage switches cause the selected output voltage to be displayed on the digital display. The voltages displayed are the output (secondary) voltages and are in true RMS. The values are obtained by using the unregulated transformers to step down the secondary voltage.

#### OPERATING CURRENT SWITCHES:

The operating current switches cause the current in the selected circuit to be displayed on the digital display. The reading displayed is the output (secondary) current displayed amps (true RMS). Sensing is done through current transformers, on ground and phase wires, with the burden resistors in the unregulated power supply.

#### KVA SWITCH:

The kVA switch will cause the digital display to show the present power usage in kVA.

## 5.6 MONITORING LOGIC

The PCS monitoring logic is located on the cabinet door.

### 5.6.1 Power Block Interface (PBI) Module

The power block interface (PBI) module includes the following:

- The silicon-controlled rectifier (SCR) activates the K1 breaker position relay and K2 shunt trip relay
- The K1 relay is the breaker position relay
- The K2 relay activates a shunt trip if one of the following conditions exist:
  - Internal monitor module causes a trip
  - Main ac failure is detected
  - REPO or LEPO switch is activated
  - Temp check shutdown indicator is on.

The RIA option connects to the PCS through connector P2 on the PBI. The RIA signals continue to the main motherboard through P7. P1 is the interface for the unregulated power supply and P2 is the connector for the shunt trip coil harness. Eight program plugs for the RIA allow either an alarm condition only or an immediate trip. P8 provides the interface between the local control panel switches and the PBI.

### 5.6.2 Motherboard

This circuit board provides all the signal interfaces. The motherboard does not contain logic; it acts as backplane wiring for the system.

### 5.6.3 Internal Monitor

The internal monitor has several functions:

1. The monitor checks the dc power supply.

If the power supply fails and the logic switches over to the battery, the internal dc power failure indicator comes on and the alarm sounds.
2. The internal monitor checks the output power.

If all three phases fail, the main ac power failure indicator comes on and the alarm sounds.
3. The internal monitor (activated by any REPO switch) controls the repo-tripped alarm.

#### 5.6.4 Lamp Driver Module

The lamp driver module transmits signals from the motherboard to the system status panel (SSP). The lamp driver module contains the drivers for the following SSP indicators:

- VOLTAGE CHECK
- REMOTE INTERFACE ALARM
- PHASE ERROR
- GROUND MONITOR
- TEMP CHECK.

The lamp driver module also contains the logic to control the alarm. Switch S1 on the main logic module sets the alarm silence timer. (See Section 4.5.1 for the switch settings.)

The lamp driver module controls the function disable logic. When you press the FUNC DISABLE switch on the local control panel, the indicator comes on.

#### 5.6.5 Internal Alarm Driver Module

This module drives internal dc power supply failure, main ac power failure, and the repo-tripped indicators.

#### 5.6.6 Main Logic Module

The main logic module contains the following:

- Logic to control the digital display settings when the secondary voltages are monitored.
- Adjustments for the high and low volt settings.
- Logic that controls all error conditions except the internal monitor alarms.

The main logic module has several switches for configuration and calibration. See Sections 4.4.2 and 4.6.8 for their functions and settings.

#### 5.6.7 Ground Current Monitor Module

The ground current monitor module detects excessive ground current in the PCS. The ground current transformer output on the ground wire of the main power transformer is fed through the unregulated power supply to the PBI, the motherboard, and into the ground current monitor. The signal goes to the digital display.

The value displayed is determined by recording the value of the current through the ground current transformer. R7 is then adjusted to read the correct value. R1 adjusts the threshold for the ground current monitor alarm. See Section 4.6.9 for calibration data.

#### 5.6.8 Current and kVA Monitor Module

Current usage is monitored by the output transformers in the unregulated power supply, causing an output voltage proportional to current in the phase lines.

The digital display shows the current usage when you press the OPERATING CURRENT switches. R13 adjusts the calculated kVA value, which is sent to the digital panel meter.

#### 5.6.9 Current and kVA Select Module

The current and kVA module passes the ac signal through the 4016 analog switches to the true RMS meter circuit. The 4016 passes both halves of the ac waveform. (This is the reason for the -8 V and +8 V.)

#### 5.6.10 Phase Error Detector Module

The phase error detector module has two functions:

1. To determine whether or not any input phase has dropped to less than one half of nominal. The monitor is triggered as follows:

| <u>208-240 Vac Input</u> | <u>380/440 Vac Input</u> |
|--------------------------|--------------------------|
| 132 Vac Phase-to-Phase   | 140 Vac Phase-to-Phase   |

2. To determine whether the phasing is correct. The phasing is usually checked at powerup, or when a transformer is replaced after a power failure, and the phasing is reversed.

#### 5.6.11 Remote Interface Alarm (RIA) Module

The remote interface alarm module provides a standard interface between the building safety features and the PCS. The RIA cable from the RIA option box plugs into the back of the power distribution channel. The cable is routed through the side channel into the PBI, then to the motherboard.

The RIA module logic controls the remote interface alarms displayed on the system status panel, along with the circuitry to override the alarms.



#### 5.6.12 DC Power Supply Module

The dc power supply module is a standard dc power supply with an unregulated input. The unregulated input voltage is 19.5 VRMS. The regulator produces about 14.4 V of output to charge the battery.

The dc power supply switch disconnects the power supply from the main logic, which lets you safely remove or replace boards.

#### 5.6.13 DC Battery

The dc battery (12 V) provides power for the clock and digital display during an alarm condition or power supply failure.

#### 5.6.14 Digital Display Assembly

The digital display assembly contains the following:

##### SYSTEM STATUS PANEL/SWITCH MODULE:

The system status panel/switch module consisting of a Mylar<sup>TM</sup> panel and the switch module mounted on an aluminum backing plate. Eighteen pressure switches on the display are used to select information that will appear on the digital display. The clock display appears until you press a switch to select other information.

##### CLOCK/DRIVER DISPLAY MODULE:

The clock/driver display module, which displays the time of day and has the memory to retain the time of an alarm. The 7-segment decoder and the multiplex logic for the clock's four digits are also on this module. Analog switches that control the display of DPM functions also control the logic that allows a choice between the time of day, and the DPM module readings.

##### DIGITAL PANEL METER (DPM) MODULE:

The digital panel meter (DPM) module consisting of a +5 V regulator and the ADD3501 digital display. R20 is the null (0) signal adjustment for the DPM. R19 is used for a full-scale adjustment, which ensures that a 1.999 V input displays 1999 on the 3 1/2 digit DPM. The rest of the circuitry passes information to the display when you press any DPM switch.

The clock and DPM modules are mounted on the back of the digital display assembly. The larger clock module displays a 24-hour clock and the DPM module provides current and voltage readings. Selecting a DPM reading causes the clock display to go off and the selected DPM reading to come on.

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Mylar is a trademark of Dupont de Nemours and Co., Inc.

## 5.7 REGULATION CIRCUITS

### 5.7.1 Reference Transformer

The reference transformers monitor the ac input power and provide signals to the control logic modules, indicating the level of the ac input power. Each phase is monitored individually by a reference transformer.

### 5.7.2 Control Logic Modules

Each of the three phases is independently controlled and regulated by its own control logic module and seven sets of SCR driver PCBs with back-to-back SCRs. The reference transformer provides an ac voltage and the necessary analog signals to regulate each phase independently.

#### REFERENCE VOLTAGES:

The analog regulating signal from the reference transformer is presented to the control logic module by means of pins 3 and 4 of P2. The ac voltage at pins 3 and 4 of P2 is rectified by the RMS approximation circuit. Voltage followers isolate the signals from the voltage comparator circuitry. The 60 Hz ac voltage at pin 4 of P2 is also used in the clock timing circuit.

#### CLOCK SIGNALS:

The output of the oscillator is set for 4.15 milliseconds. This is the clock signal that synchronizes the transferring of information throughout the control logic module. The clock signal triggers the hold and sampling register, and the tap initiation register.

#### ZERO CROSSING TIMING:

The priority encoding chip receives signals from the voltage comparator circuitry. From these signals the priority encoder provides a binary code, which is stored in a sampling register at the fall of the timing pulse. At the next zero crossing of the voltage, the signals are coupled to the tap initiation flip-flop.

When the SCR current goes to zero, the new tap may be selected. The zero sensing circuitry develops the digital signals to inhibit initiating the tap until zero current crossing is sensed.

#### SCR SELECTION:

The control logic module selects the SCR driver module, which in turn selects the tap on the main transformer. The current sensing signal (from the current reference transformer) is brought to J13 pins 1 and 2 on the control logic module by means of a shielded, twisted pair wire.

The differential amplifier converts the signal to a squarewave, which is in phase with the current flowing through the SCRs. The SCR drive signals are removed from the SCRs and the tap change is inhibited until the current sensing amplifier senses that the current has reached a 20 milliampere level. The inhibit is then released and tap initiation is permitted.

#### SOFT-START:

The soft-start timer inhibits the output voltage from being established for approximately five seconds after powerup, allowing the output loads to stabilize before initiation of the first tap.

#### 5.7.3 SCR Driver Assemblies

One of seven SCR driver modules is selected by the control logic module for each phase. The control logic module applies a low voltage level to the appropriate SCR driver assembly. The optical isolators turn on, causing the selected SCR to conduct. The fuselink wires are daisy chained between SCR driver modules, and provide overcurrent protection in case an SCR shorts or multiple SCRs are selected.

#### 5.8 OUTPUT CIRCUITS

The configuration of the output circuits is determined by the attached equipment.

##### 5.8.1 Output Voltage (60 Hz)

The PCS nominal output voltage is 3-phase wye-connected, grounded neutral, 120/208 V. This output voltage may be supplied as single phase or multiphase to the appropriate receptacles.

##### 5.8.2 Output Voltage (50 Hz)

The PCS nominal output voltage is 3-phase wye-connected, grounded neutral, 380/415 V. This output voltage may be supplied as single phase or multiphase to the appropriate receptacles.

### 5.8.3 Surge Suppressor

The output filters are composed of oil-filled capacitors, high-frequency foil wrap capacitors, and metal oxide varistors (MOV). The capacitors are connected line-to-line and line-to-neutral on all three phases, and work in conjunction with the leakage inductance of the transformer to form a low-pass filter helping to achieve 60 dB normal mode attenuation.

The MOVs protect against voltage surges and are in turn protected by fuses connected to indicator lights on the front panel.

### 5.8.4 Output Panelboard (60 Hz)

The output panel assembly consists of a 42-pole position panelboard (2 panelboards, or 84 positions for some 50 kVA and all 75 and 100 kVA units). The panelboard includes the circuit breakers for individual output circuits and the output main circuit breaker. The output panelboard is covered by a trim plate.

### 5.8.5 Output Panelboard (50 Hz)

The output panel assembly consists of a 66-pole position panelboard. The panelboard includes the circuit breakers for individual output circuits and the output main circuit breaker. The output panelboard is covered by a trim plate.

#### WARNING

Unused breaker positions are covered with insulating paper to prevent hazards due to the voltages present.

#### 5.8.6 Output Main Circuit Breaker(s)

This 150, 100, or 50 A 3-pole circuit breaker mounts on the output panelboard and provides a current limit for the total output distribution circuit loading. (See Table D-15.)

The output main (secondary) breaker limits each phase current through the output panelboard to a value within the specified range for the particular PCS unit. The output phase currents must be balanced to fully load the PCS.

#### 5.8.7 Output Distribution Circuit Breakers

These circuit breakers are part of the output circuit. The rating and size of the breakers depend on the system configuration.

#### 5.8.8 Output Circuits

Output circuits provide secondary voltages in single-phase, 2-phase or 3-phase output for the computer system and its peripherals. Each output circuit consists of a standard electrical circuit breaker, wiring, an appropriate length of flexible conduit, and a power receptacle in a grounded outlet box. The size of the circuit breaker and the receptacle are determined as a unit for each peripheral and system as required.

The length of each circuit is determined by the right angle computer room distance between the PCS and the powered device. (See Tables D-7 and D-8.)

#### Secondary Voltages

| 50 Hz             | 60 Hz     |
|-------------------|-----------|
| 220-240/380-415 V | 120/208 V |



**APPENDIX A**  
**ABBREVIATIONS OF TERMS**

|       |       |                            |
|-------|-------|----------------------------|
| CLM   | ..... | Control Logic Module       |
| DMM   | ..... | Digital Multimeter         |
| DPM   | ..... | Digital Panel Meter        |
| EDP   | ..... | Electronic Data Processing |
| EPO   | ..... | Emergency Power Off        |
| GCM   | ..... | Ground Current Monitor     |
| I     | ..... | Current (in amps)          |
| IC    | ..... | Integrated Circuit         |
| IMCB  | ..... | Input Main Circuit Breaker |
| J-Box | ..... | Junction Box               |
| KVA   | ..... | Kilo Volt-Ampere           |
| LCD   | ..... | Liquid Crystal Display     |
| LCP   | ..... | Local Control Panel        |
| LED   | ..... | Light-Emitting Diode       |
| LEPO  | ..... | Local Emergency Power Off  |
| MOV   | ..... | Metal Oxide Varistor       |
| OT    | ..... | Over Temperature           |
| PBI   | ..... | Power Block Interface      |
| PCB   | ..... | Printed Circuit Board      |
| PCS   | ..... | Power Conditioning System  |
| R     | ..... | Resistor (that is, R4)     |
| REPO  | ..... | Remote Emergency Power Off |
| RIA   | ..... | Remote Interface Alarm     |

|     |       |                              |
|-----|-------|------------------------------|
| RMS | ..... | Root Mean Square             |
| SCR | ..... | Silicon-Controlled Rectifier |
| SSP | ..... | System Status Panel          |
| TP  | ..... | Test Point                   |
| V   | ..... | Volts                        |
| Vac | ..... | Volts ac                     |
| Vdc | ..... | Volts dc                     |





APPENDIX B  
REMOTE EMERGENCY POWER OFF

### B.1 GENERAL

The remote emergency power off (REPO) station lets you shut down power to the PCS from remote wall-mounted switches. Each REPO option comes with 15.24 m (50 ft) of cable [additional 15.24 m (50 ft) cables are available]. This option must be installed by the customer's electrical contractor.

The remote emergency power off (REPO) stations are available in two configurations:

- Basic remote emergency power off stations:
  - H7227-KA (floor and/or wall mount)
  - H7227-KD (wall mount only)
- Environmental remote emergency power off stations:
  - H7227-KE (with temperature monitor)
  - H7227-KF (with temperature and humidity monitors)

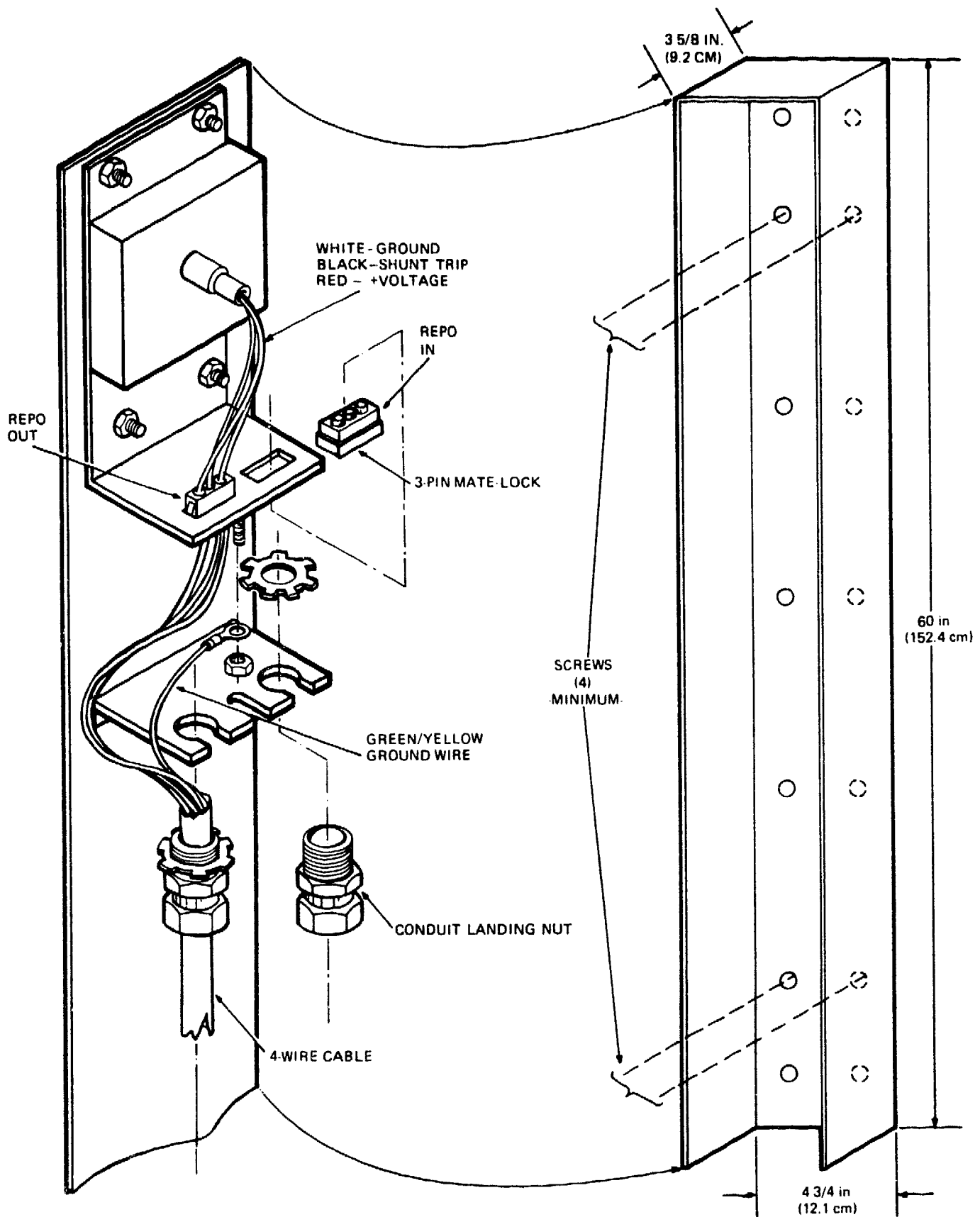
### B.2 INSTALLATION OF THE BASIC REPO

The REPO station is housed in a heavy gauge steel box that weighs 9.5 kilograms (21 pounds). The box's dimensions are 152.4 cm (60 inches) high by 12.1 cm (4 3/4 inches) wide by 9.2 cm (3 5/8 inches) deep.

The box (Figures B-1 and B-2) has a pry-off front panel with a red emergency off pushbutton, two connectors (REPO in and REPO out), two cable landings, and one 4-wire cable (H7227-KA). The second connector (REPO in) lets you daisy chain other REPO stations (Figure B-3).

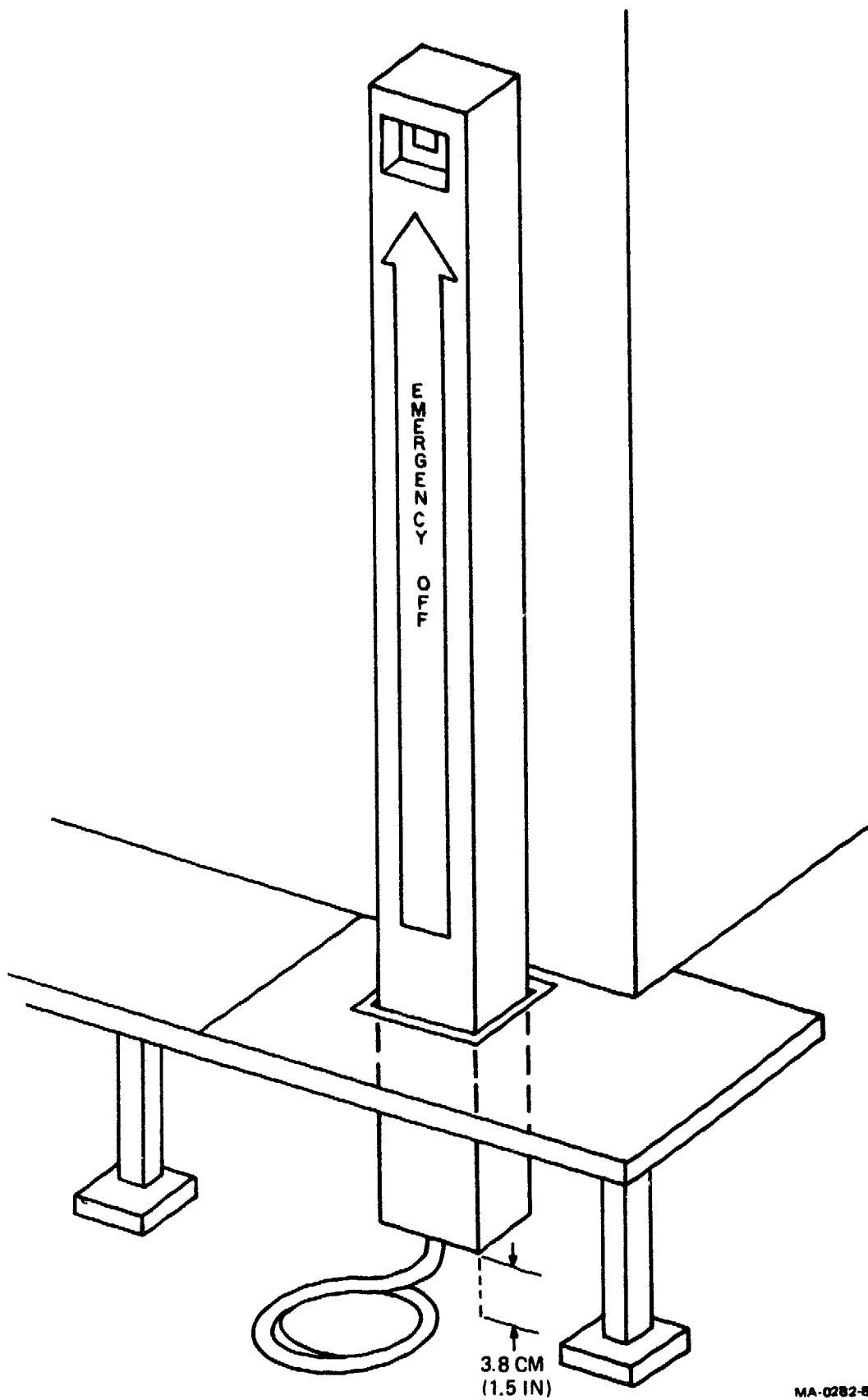
The REPO station should mount vertically so that the red pushbutton is at, or slightly below, eye level. To ease mounting, different sized screw hole knockouts are available on the back of the box. Digital Equipment Corporation recommends that you use at least four screws to mount the station (Figure B-1).

If the REPO station is used with a raised floor, leave a floor opening of 12.4 cm (4 7/8 inches) by 9.5 cm (3 3/4 inches) so that the REPO station can extend through the floor. In all cases, at least 3.8 cm (1 1/2 inch) clearance must be left for cable access at the bottom of the REPO station (Figure B-2).



MA-9011

Figure B-1 Basic REPO Station



MA-0282-82

Figure B-2 Basic REPO Station Installation

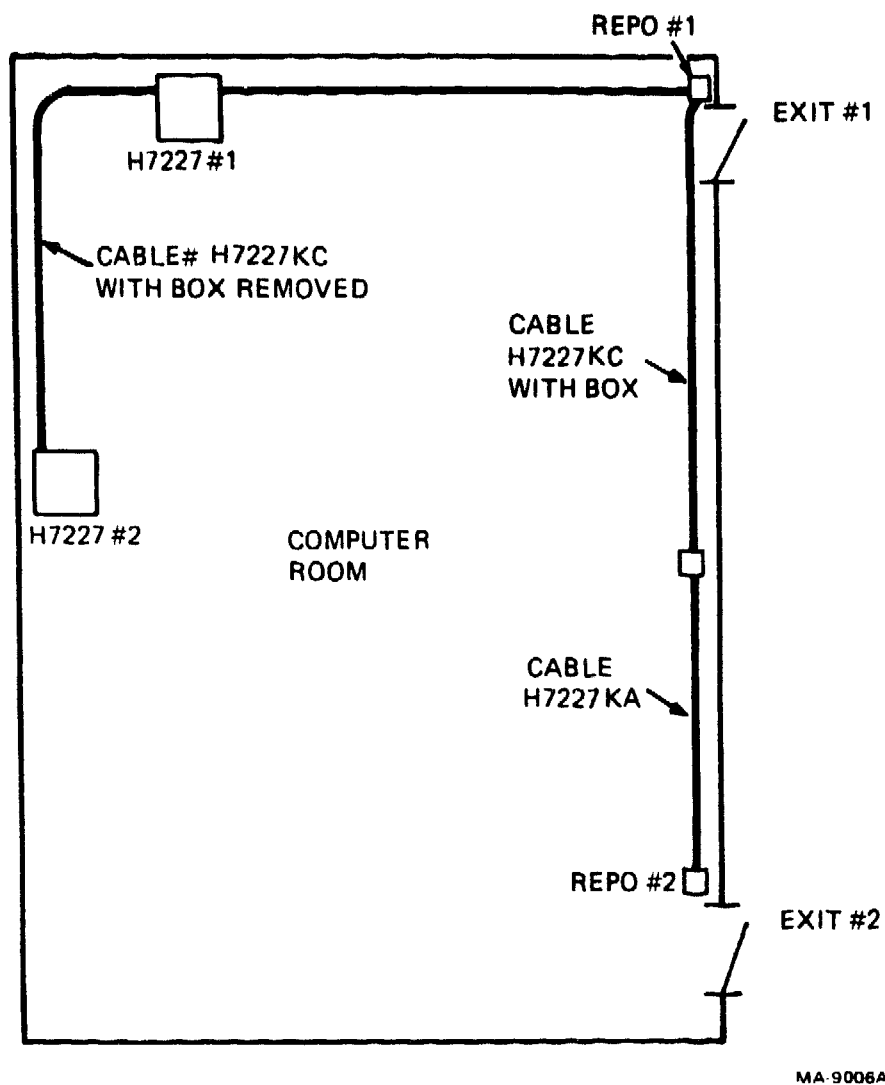
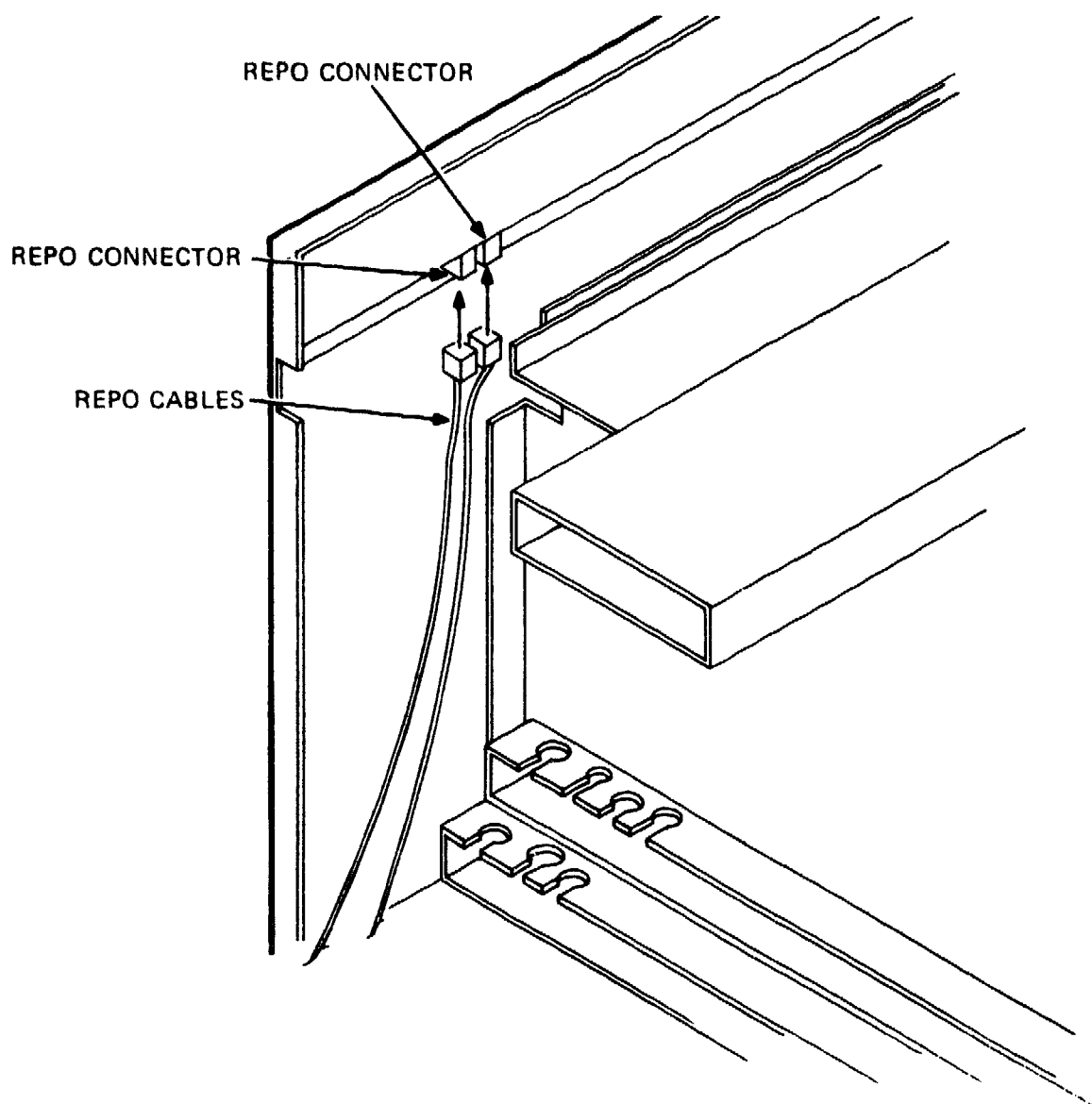


Figure B-3 Basic REPO Daisy Chaining

### B.3 BASIC REPO CONNECTIONS

No hazardous voltages are present in the installation, operation, or servicing of the REPO station. You cannot install more than six REPO units per PCS unit. If the distance between the REPO station and either another REPO station or the PCS unit is more than 15 meters (50 feet), an extension cable assembly (H7227-KC) is needed. The extension cable includes the appropriate connectors.

The REPO connections in the PCS are at the top right rear of the unit. At least 1.2 meters (4 feet) is needed at the PCS end. This lets DIGITAL Field Service personnel connect the REPO cables to the PCS (Figure B-4).



MA-0283-82

Figure B-4 REPO Station Connection

## B.4 ENVIRONMENTAL REPO

### General

The environmental REPO station provides the user with an alternating display of the ambient temperature and humidity. The unit gives an audible alarm if the preselected temperature and humidity ranges are exceeded. The environmental REPO unit can also be programmed to shut down the PCS when a predetermined temperature is reached.

In the event of an alarm condition (first stage temperature alarm, low humidity limit, and high humidity limit), the audible alarm sounds continuously, but no alarm signal is sent to the PCS. If the reset push button on the environmental monitor is pressed, the audible alarm is stopped and the display will flash rapidly.

When the temperature shutdown setting is reached, the environmental REPO will automatically trip the input main circuit breaker on the PCS while sounding its alarm until reset.

The environmental REPO station has a large red push button for EMERGENCY POWER OFF on the front of the unit. A small push button located on the bottom of the unit silences the audible alarm.

The environmental REPO station is housed in a heavy gauge steel box, specified as follows:

Weight: 2.2 kg (4.75 lbs)  
Height: 23 cm (9 inches)  
Width: 18.4 cm (7.25 inches)  
Depth: 6.4 cm (2.5 inches)

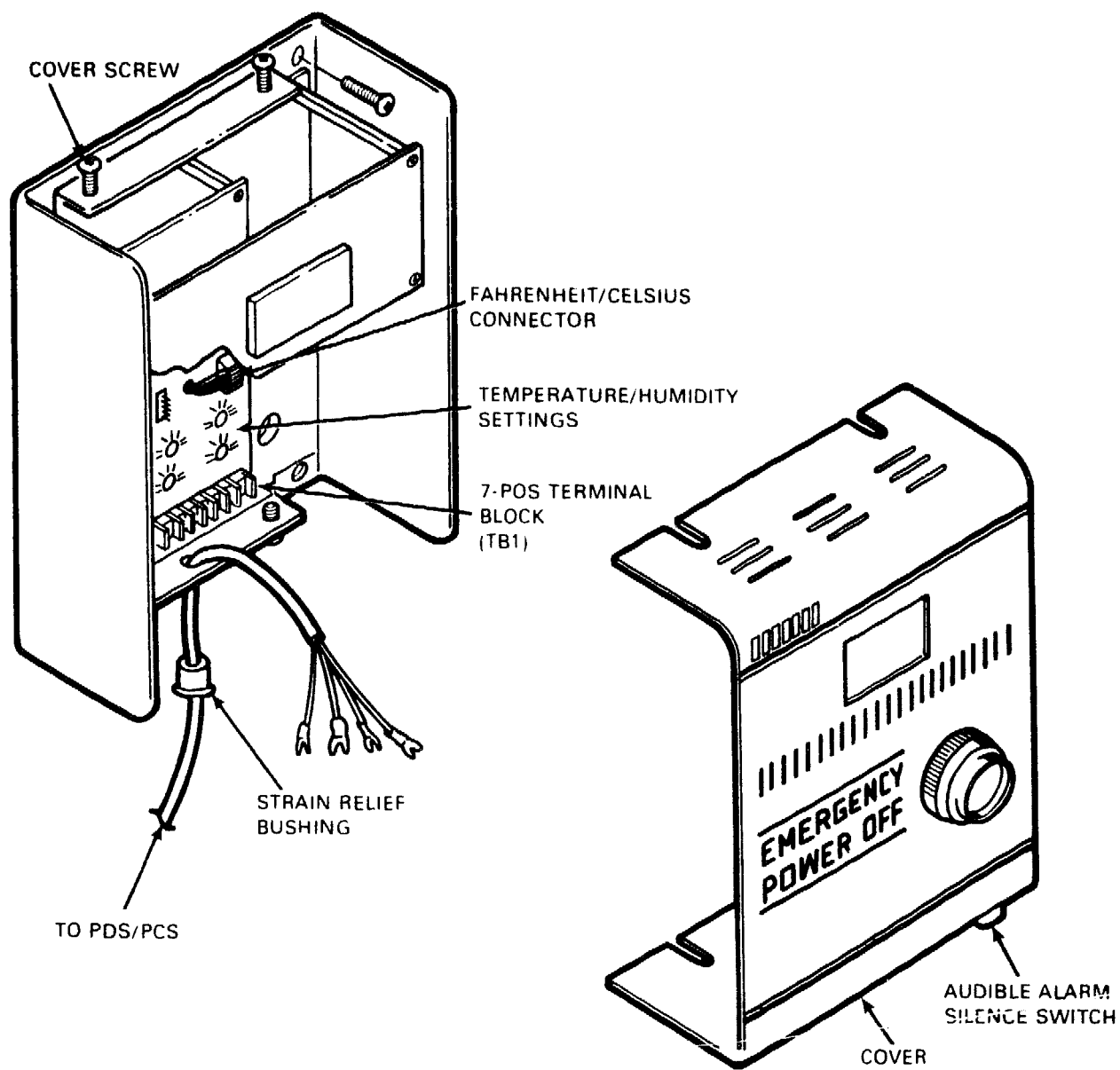
Relay Contact Rating: 5 amps @ 125 Vac (normally closed)  
3 amps @ 250 Vac (normally closed)

Temperature Accuracy:  $\pm 2\%$   
Humidity Accuracy:  $\pm 3\%$

Display: Liquid crystal display (LCD)  
Two 7-segment digits plus "C," "F," or "H"

The box (see Figure B-5) has a front panel that is secured with four (4) screws. The front panel has a 3-character LCD display and a red emergency off push button. Electrical connections to the REPO unit are made internally.

The environmental REPO station is designed to wall-mount and should mount vertically so that the LCD display is at, or slightly below, eye level.



MKV86-0154

Figure B-5 Environmental REPO Unit



## Installation Procedure

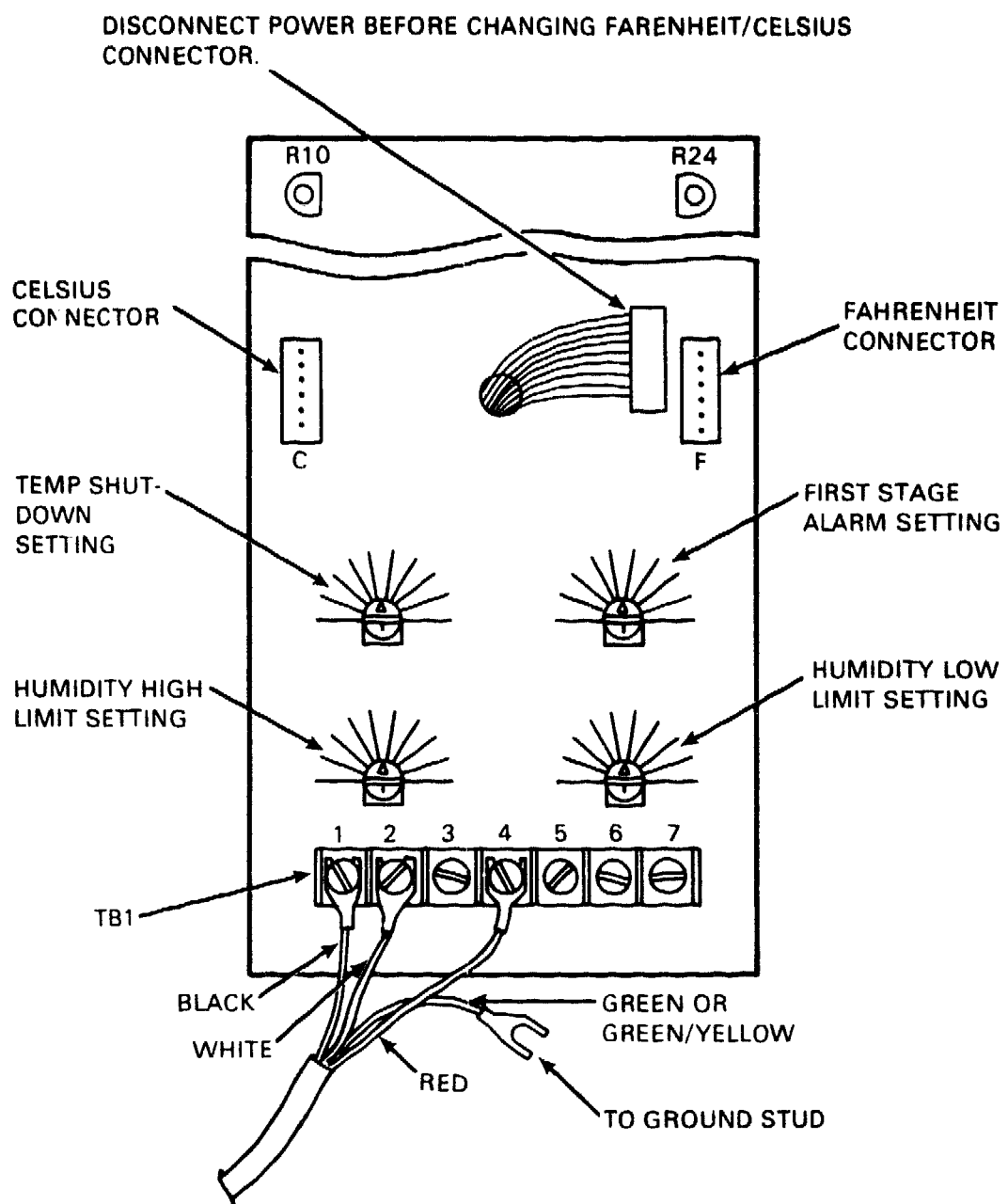
1. Unpack and ensure that you have the correct environmental REPO station and cable assembly.
2. Loosen the four cover screws and remove the cover.
3. Attach the REPO station to the wall using two #10 screws appropriate for the wall material.
4. Route the cable from the PCS (DO NOT connect at this time) to the REPO station.
5. Feed the cable through the access hole on the bottom of the unit.

If the cable is run through the wall, feed cable through the entry hole in the back of the unit.

6. Connect the wires as follows:

| Wire         | Function    | Connection Point |
|--------------|-------------|------------------|
| White        | Ground      | TB1-2            |
| Black        | Trip        | TB1-1            |
| Red          | + V         | TB1-4            |
| Green/Yellow | Chassis Gnd | Gnd Stud         |

7. Attach the connector end of the cable to the PCS. (See Figure B-4.)



MKV86-0155

Figure B-6 Environmental REPO Connections and Settings

## Configuration Procedure

1. Connect the 6-position temperature scale connector to the appropriate connector. Observe the keying.

F = Temperature in Fahrenheit  
C = Temperature in Celsius

### NOTE

Some units may have a switch to select Fahrenheit or Celsius. If your REPO has this switch, place it in the desired position.

2. Set the first stage alarm dial to the desired temperature setting for audible/visual alarm only. (See Table B-1.)
3. Set the shutdown temperature dial to the desired temperature setting for PCS shutdown. (See Table B-1.)
4. Set the high humidity alarm dial to the desired humidity setting for audible/visual alarm. (See Table B-1.)
5. Set the low humidity alarm dial to the desired humidity setting for audible/visual alarm. (See Table B-1.)
6. Reattach the front cover.

Table B-1 Environmental REPO Configuration Data

| Function             | Range                        | Increments   |
|----------------------|------------------------------|--------------|
| First Stage Alarm    | 63°F to 99°F<br>17°C to 37°C | 4°F<br>1.1°C |
| Temperature Shutdown | 63°F to 99°F<br>17°C to 37°C | 4°F<br>1.1°C |
| High Humidity Limit  | 23% to 77%                   | 6%           |
| Low Humidity Limit   | 23% to 77%                   | 6%           |

## CALIBRATION

### Tools Needed

- Hygrometer, humidistat, or sling psychrometer
- Accurate thermometer (32°F to 113°F)  
( 0°C to 45°C)

### Procedure

1. Loosen the two (2) top and the two (2) bottom cover screws, and remove the cover.
2. Disconnect the wires going to TB1-1 and TB1-2. (See Figure B-6.)
3. Accurately measure and record the ambient temperature and humidity. Use the instructions supplied with the equipment.
4. Remove the four screws securing the display board and position them out of the way.
5. Rotate the humidity calibration trim-pot R24 (right-hand side) counterclockwise until it stops.
6. Turn R24 clockwise until the LCD displays the value of relative humidity measured in Step 3.
7. Rotate the temperature calibration trim-pot R10 (left-hand side) counterclockwise until it stops.
8. Turn R10 clockwise until the LCD displays the value of the temperature measured in Step 3.
9. Test and set the high/low humidity and first stage/shutdown settings as desired.
10. Reattach the display board.
11. Reconnect the wires to TB1-1 and TB1-2.
12. Replace the front cover.



APPENDIX C  
INPUT POWER JUNCTION BOX

C.1 GENERAL

Every PCS needs an input power junction box (J-Box). This J-Box must be protected by a branch circuit breaker rated at not more than 125% of the full load amps of the PCS.

This J-Box is part of the Underwriter's Laboratory (UL) listing. The electrical contractor must install the J-Box according to the following instructions to maintain its UL listing.

The J-Box must be placed within a 1.5 meter (5 foot) radius of the PCS. Avoid restricting the output cables, and allow easy access for checking connections. Never place the J-Box directly under the PCS.

Access to the J-Box is important. If installing the J-Box under a raised floor, you should center the box under a single floor tile.

NOTE

The input power cable is 3 meters (10 feet) long. Because the cable is very stiff, however, you should assume it is 1.5 meters (5 feet) long for preinstallation planning.

The size of the J-Box depends on the kVA rating of the PCS. See Table C-1 for specifications.

Figure C-1 shows the J-Box with cover removed. The terminal board (TB-1) is the location for the contractor's connections, including the 3-phase input power and the ground wire (Table C-2). All wires must be the same size. The ground must connect to the nearest safety ground that is referenced to the building service entrance, and to the computer facility ground.

NOTE

You can use the auxiliary ground on the back of the PCS to reference the PCS to a ground grid or to other computer power distribution equipment, including more PCS units.

**Table C-1 J-Box and IMCB Specifications**

| kVA | Option Number | 60 Hz Input Voltage | IMCB Ampacity | J-Box Amps | Dimensions (Inches) |        |        |
|-----|---------------|---------------------|---------------|------------|---------------------|--------|--------|
|     |               |                     |               |            | Width               | Length | Height |
| 15  | H7228-AA      | 208                 | 70 A          | 100 A      | 14                  | 16     | 4 1/2  |
| 30  | H7228-AB      | 208                 | 150 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 50  | H7228-AC      | 208                 | 200 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 50  | H7228-AJ      | 208                 | 200 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 15  | H7228-BA      | 220                 | 70 A          | 100 A      | 14                  | 16     | 4 1/2  |
| 30  | H7228-BB      | 220                 | 150 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 50  | H7228-BC      | 220                 | 200 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 50  | H7228-BJ      | 220                 | 200 A         | 200 A      | 14                  | 16     | 4 1/4  |
| 15  | H7228-DA      | 240                 | 60 A          | 60 A       | 8 1/4               | 10 1/4 | 4 1/2  |
| 30  | H7228-DB      | 240                 | 125 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 50  | H7228-DC      | 240                 | 200 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 50  | H7228-DJ      | 240                 | 200 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 15  | H7228-EA      | 440                 | 30 A          | 30 A       | 8 1/4               | 10 1/4 | 4 1/2  |
| 30  | H7228-EB      | 440                 | 70 A          | 100 A      | 14                  | 16     | 4 1/2  |
| 50  | H7228-EC      | 440                 | 125 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 75  | H7228-ED      | 440                 | 175 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 100 | H7228-EE      | 440                 | 200 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 50  | H7228-EJ      | 440                 | 125 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 15  | H7228-FA      | 460                 | 30 A          | 30 A       | 8 1/4               | 10 1/4 | 4 1/2  |
| 30  | H7228-FB      | 460                 | 60 A          | 60 A       | 8 1/4               | 10 1/4 | 4 1/2  |
| 50  | H7228-FC      | 460                 | 100 A         | 100 A      | 14                  | 16     | 4 1/2  |
| 75  | H7228-FD      | 460                 | 175 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 100 | H7228-FE      | 460                 | 200 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 50  | H7228-FJ      | 460                 | 100 A         | 100 A      | 14                  | 16     | 4 1/2  |
| 15  | H7228-HA      | 480                 | 30 A          | 30 A       | 8 1/4               | 10 1/4 | 4 1/2  |
| 30  | H7228-HB      | 480                 | 60 A          | 60 A       | 8 1/4               | 10 1/4 | 4 1/2  |
| 50  | H7228-HC      | 480                 | 100 A         | 100 A      | 14                  | 16     | 4 1/2  |
| 75  | H7228-HD      | 480                 | 150 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 100 | H7228-HE      | 480                 | 200 A         | 200 A      | 14                  | 16     | 4 1/2  |
| 50  | H7228-HJ      | 480                 | 100 A         | 100 A      | 14                  | 16     | 4 1/2  |

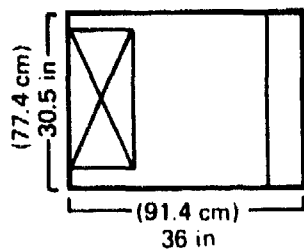
**Table C-1 J-Box and IMCB Specifications (Cont)**

| kVA | Option Number | 50 Hz Input Voltage | IMCB Ampacity | J-Box Amps | Metric Dimensions |        |        |
|-----|---------------|---------------------|---------------|------------|-------------------|--------|--------|
|     |               |                     |               |            | Width             | Length | Height |
| 15  | H7228-LA      | 380/415             | 40 A          | 60 A       | 21 cm             | 26 cm  | 12 cm  |
| 30  | H7228-LB      | 380/415             | 80 A          | 100 A      | 36 cm             | 41 cm  | 12 cm  |
| 50  | H7228-LC      | 380/415             | 125 A         | 200 A      | 36 cm             | 41 cm  | 12 cm  |
| 75  | H7228-LD      | 380/415             | 175 A         | 200 A      | 36 cm             | 41 cm  | 12 cm  |

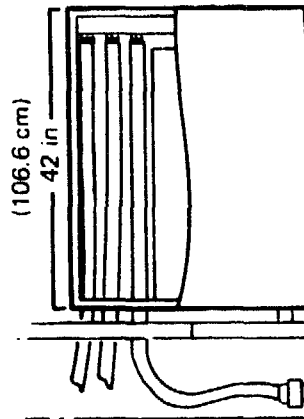
**NOTE**

The input feeder to the junction box conduit is installed by the customer's electrical contractor. The connection must be watertight.





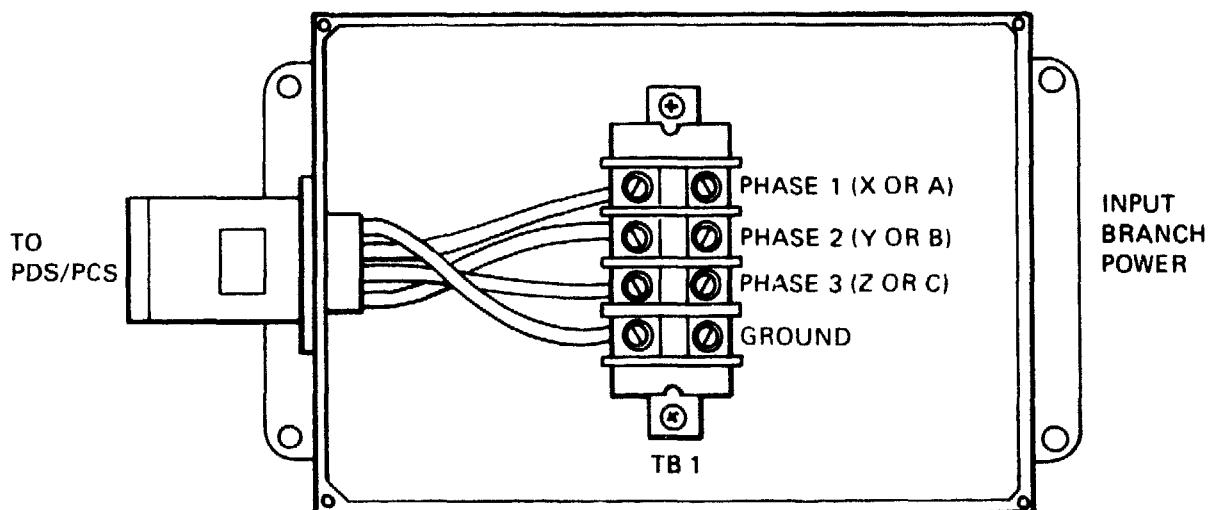
TOP VIEW  
WITH FLOOR CUT OUT 8 in X 18 in (20.3 X 45.7 cm)



SIDE VIEW

| COMPUTER POWER CONDITIONING SYSTEM<br>INPUT POWER J BOX |                            |
|---------------------------------------------------------|----------------------------|
| VOLTS <u>208</u>                                        | CURRENT RATING <u>100A</u> |
| MODEL NO. <u>H7228-AB</u>                               |                            |
| VOLTAGE MEASURED, DATE <u>1-21-84</u>                   |                            |
| Ø1 TO Ø2<br><u>205</u>                                  | Ø2 TO Ø3<br><u>204</u>     |
| Ø3 TO Ø1<br><u>205</u>                                  |                            |

PN 800208 (A)



MKV86-0156

Figure C-1 J-Box and Nameplate

Table C-2 J-Box Wiring

| Conductor | Connector Pin Location | Terminal Location | Conductor Identification |
|-----------|------------------------|-------------------|--------------------------|
| X         | 1                      | 1                 | 1                        |
| Y         | 2                      | 2                 | 2                        |
| Z         | 3                      | 3                 | 3                        |
| Ground    | G (4)                  | Gnd               | Green/Yellow             |

## C.2 INSTALLATION

The electrical contractor should install the J-Box as follows:

1. Place the J-Box under a single tile within 1.5 meters (5 feet) of the PCS and at least 1 meter (3 feet) from any wall.
2. Secure the J-Box by using the mounting flanges provided.
3. Install the conduit and conduit fittings for the branch circuit.
4. Install the branch circuit wiring sized according to the full load amps for the PCS unit (see the nameplate ratings) to be installed, and according to the National Electrical Code (NEC) requirements for branch circuits.

### NOTE

All wiring, including the ground, must be the same size.

5. Install the J-Box cover.
6. Turn on power to the branch circuit, then make sure the correct voltage and correct phasing is present. (See the nameplate ratings.)
7. Record the voltage and date on the nameplate (Figure C-1).

[illegible][illegible]

APPENDIX D  
PCS SPECIFICATIONS

Table D-1 Flexible Conduit Specifications(60 Hz only)

| Electrical Trade<br>Size (Inches) | Inside Bend<br>Diameter (Inches) | Allowable Stresses<br>(Tensile in lbs) |
|-----------------------------------|----------------------------------|----------------------------------------|
| 3/8                               | 6                                | 200                                    |
| 1/2                               | 7                                | 200                                    |
| 3/4                               | 10                               | 200                                    |
| 1                                 | 12                               | 375                                    |
| 1 1/4                             | 14                               | 375                                    |
| 1 1/2                             | 11                               | 450                                    |
| 2                                 | 14                               | 450                                    |

Table D-2 Environmental Specifications

| kVA<br>Rating | Room Temp |       | Relative<br>Humidity<br>No Condensation<br>(Percent) | Air<br>Conditioning<br>Load<br>(BTU/Hr) | Heat<br>Dissipation<br>(Watts) |
|---------------|-----------|-------|------------------------------------------------------|-----------------------------------------|--------------------------------|
|               | F         | C     |                                                      |                                         |                                |
| 15            | 50-104    | 10-40 | 10 -- 90%                                            | 2081                                    | 610                            |
| 30            | 50-104    | 10-40 | 10 -- 90%                                            | 3501                                    | 1026                           |
| 50*           | 50-104    | 10-40 | 10 -- 90%                                            | 5459                                    | 1600                           |
| 75            | 50-104    | 10-40 | 10 -- 90%                                            | 7681                                    | 2260                           |
| 100(60 Hz)*   | 50-104    | 10-40 | 10 -- 90%                                            | 10242                                   | 3000                           |

\* Operation derated to 80% of kVA at 40°C (104°F).

**Table D-3 Physical Specifications**

| kVA<br>Rating | Shipping<br>Weight (Average) |     | Height |       | Width |      | Depth |      |
|---------------|------------------------------|-----|--------|-------|-------|------|-------|------|
|               | lbs                          | kg  | in     | cm    | in    | cm   | in    | cm   |
| 15            | 750                          | 341 | 42     | 106.7 | 30.5  | 77.5 | 36    | 91.4 |
| 30            | 825                          | 376 | 42     | 106.7 | 30.5  | 77.5 | 36    | 91.4 |
| 50            | 948                          | 430 | 42     | 106.7 | 30.5  | 77.5 | 36    | 91.4 |
| 75            | 1090                         | 495 | 42     | 106.7 | 30.5  | 77.5 | 36    | 91.4 |
| 100 (60 Hz)   | 1206                         | 548 | 42     | 106.7 | 30.5  | 77.5 | 36    | 91.4 |

**Table D-4 Unit Weight\***

| kVA<br>Rating | Weight |      | Floor Loading |              |
|---------------|--------|------|---------------|--------------|
|               | kg     | lb   | kg/square m   | lb/square ft |
| 15            | 250    | 550  | 351           | 72           |
| 30            | 284    | 625  | 401           | 82           |
| 50            | 340    | 748  | 479           | 98           |
| 75            | 405    | 890  | 572           | 117          |
| 100           | 457    | 1006 | 645           | 132          |

\* Average shipping weight figures are supplied since the exact shipping weight depends on the particular configuration.

**Table D-5 Distribution Capacity (60 Hz)**

| Electrical<br>kVA Rating | Conduit<br>Pole Positions | Landing Capacity<br>1.3 cm (1/2 inch) Cable |
|--------------------------|---------------------------|---------------------------------------------|
| 15                       | 42                        | 42                                          |
| 30                       | 42                        | 42                                          |
| 50                       | 42                        | 42                                          |
| 50                       | 84*                       | 84*                                         |
| 75                       | 84                        | 84                                          |
| 100                      | 84                        | 84                                          |

\* Optional

**Table D-6 Capacity for Merlin Gerin Load Center (50 Hz)**

| kVA Rating | Maximum Pole Positions | Maximum Landing Capacity |
|------------|------------------------|--------------------------|
| 15         | 66                     | 66                       |
| 30         | 66                     | 66                       |
| 50         | 66                     | 66                       |
| 50         | 66                     | 66                       |
| 75         | 66                     | 66                       |

**Table D-7 Service Clearance (Minimums -- Facing Unit)**

| Front |    | Rear |    | Both Sides* |    |
|-------|----|------|----|-------------|----|
| cm    | in | cm   | in | cm          | in |
| 91.4  | 36 | 91.4 | 36 | 122         | 48 |

**NOTE**

Do not allow obstructions closer than 15 cm (6 inches) from the back of the unit. Restriction of cooling airflow may result.

\* For transformer access

**Table D-8 60 Hz Output Distribution Circuits (Single-Phase)**

| <b>Output<br/>Voltage<br/>(Nominal)</b> | <b>Output<br/>Circuit<br/>Breaker</b> | <b>Output<br/>Poles<br/>Required</b> | <b>NEMA<br/>Receptacle<br/>Number</b> | <b>DIGITAL<br/>Cable<br/>P/N</b> | <b>Receptacle<br/>Supplied</b>    | <b>Length<br/>(Max)</b> |
|-----------------------------------------|---------------------------------------|--------------------------------------|---------------------------------------|----------------------------------|-----------------------------------|-------------------------|
| 120                                     | 15 A                                  | 1                                    | 5-15R                                 | BC24J-XX                         | Single                            | 100 ft                  |
| 120                                     | 15 A                                  | 1                                    | 5-15R                                 | BC24K-XX                         | Double                            | 100 ft                  |
| 120                                     | 15 A                                  | 1                                    | 5-15R                                 | BC24L-XX                         | Quad                              | 100 ft                  |
| 120                                     | 20 A                                  | 1                                    | 5-20R                                 | BC24M-XX                         | Single                            | 75 ft                   |
| 120                                     | 20 A                                  | 1                                    | 5-20R                                 | BC24N-XX                         | Double                            | 75 ft                   |
| 120                                     | 20 A                                  | 1                                    | 5-20R                                 | BC24P-XX                         | Quad                              | 75 ft                   |
| 120                                     | 20 A                                  | 1                                    | 5-20R                                 | BC24R-XX                         | Two quad<br>boxes,<br>10 ft apart | 75 ft                   |
| 120                                     | 15 A                                  | 1                                    | L5-15R                                | BC26F-XX                         | Single                            | 100 ft                  |
| 120                                     | 30 A                                  | 1                                    | L5-30R                                | BC24S-XX                         | Single                            | 75 ft                   |
| 120                                     | 20 A                                  | 1                                    | 5-20R*                                | BC28D-XX                         | Single                            | 75 ft                   |
| 120                                     | 20 A                                  | 1                                    | 5-20R*                                | BC28E-XX                         | Double                            | 75 ft                   |
| 120                                     | 20 A                                  | 1                                    | 5-20R*                                | BC28F-XX                         | Quad                              | 75 ft                   |
| 120                                     | 20 A                                  | 1                                    | 5-20R*                                | BC28G-XX                         | Two quad<br>boxes                 | 75 ft                   |

\* Canada Only

Table D-9 50 Hz Output Distribution Circuits (Single-Phase)

| Output<br>Voltage | Current | Poles | DIGITAL<br>Cable P/N | Supplied<br>Receptacle            | Where Used                                 |
|-------------------|---------|-------|----------------------|-----------------------------------|--------------------------------------------|
| 220               | 10 A    | 1     | BN29A-**-            | Duplex                            | Switzerland                                |
| 220               | 10 A    | 1     | BN29D-**-            | Duplex                            | UK, Ireland                                |
| 220               | 10 A    | 1     | BN29E-**-            | Quad                              | UK, Ireland                                |
| 220               | 10 A    | 1     | BN29F-**-            | Junction Box<br>Terminal<br>Strip | Europe                                     |
| 220               | 15 A    | 1     | BN29H-**-            | Shuko Duplex                      | Continental Europe<br>(except Switzerland) |
| 220               | 15 A    | 1     | BN29J-**-            | Shuko Quad                        | Continental Europe<br>(except Switzerland) |
| 220               | 15 A    | 1     | BN29K-**-            | Junction Box<br>Terminal<br>Strip | Continental Europe<br>(except Switzerland) |
| 220               | 20 A    | 1     | BN29M-**-            | Junction Box<br>Terminal<br>Strip | Europe                                     |

\*\* The last two digits denote the length of the cable:

-03 = 3 meters  
 -06 = 6 meters  
 -09 = 9 meters  
 -12 = 12 meters  
 -15 = 15 meters  
 -18 = 18 meters  
 -23 = 23 meters  
 -30 = 30 meters



Table D-10 60 Hz Output Distribution Circuits (Multiphase)

| Output Voltage (Nominal) | Output Circuit Breaker | Output Poles Required | NEMA Receptacle Number | DIGITAL Cable PN | Receptacle Supplied | Length (Max) |
|--------------------------|------------------------|-----------------------|------------------------|------------------|---------------------|--------------|
| 208                      | 20 A                   | 2                     | L6-20R                 | BC24T-XX         | Single              | 75 ft        |
| 208                      | 30 A                   | 2                     | L6-30R                 | BC26E-XX         | Single              | 75 ft        |
| 120/208                  | 20 A                   | 2                     | L14-20R                | BC24U-XX         | Single              | 75 ft        |
| 120/208                  | 20 A                   | 3                     | L21-20R                | BC24V-XX         | Single              | 75 ft        |
| 120/208                  | 30 A                   | 3                     | L21-30R                | BC24W-XX         | Single              | 75 ft        |
| 120/208                  | 60 A                   | 3                     | 560C9W                 | BC29F-XX         | Single              | 75 ft        |
| 120/208                  | 100 A                  | 3                     | ZRLT-6C24-49 SR*       | BC24X-XX         | Single              | 75 ft        |
| 120/208                  | 30 A                   | 2                     | L14-30R                | BC28Z-XX         | Single              | 75 ft        |
| 120/208                  | 60 A                   | 3                     | DF6516FP               | BC29A-XX         | Single              | 50 ft        |
| 120/208                  | 60 A                   | 3                     | 560C9W                 | BC29B-XX         | Single              | 75 ft        |
| 208                      | 60 A                   | 3                     | RS7428-78 (TX02)       | BC26D-XX         | Single              | 75 ft        |
| 208                      | 20 A                   | 2                     | RS3913                 | BC28S-XX         | Single              | 75 ft        |
| 120                      | 20 A                   | 1                     | RS3913U1               | BC28T-XX         | Single              | 75 ft        |
| 208                      | 15 A                   | 2                     | RS3913U2               | BC28U-XX         | Single              | 75 ft        |
| 208                      | 15 A                   | 3                     | RS3914                 | BC28V-XX         | Single              | 75 ft        |
| 208                      | 30 A                   | 2                     | RS3933                 | BC28W-XX         | Single              | 75 ft        |
| 208                      | 30 A                   | 3                     | RS3934                 | BC28X-XX         | Single              | 75 ft        |
| 208                      | 100 A                  | 3                     | JCS1034                | BC28Y-XX         | Single              | 75 ft        |

NOTE

Output cables rated 30 A and below use isolated ground (IG) receptacles. Because of this, two ground conductors (green/yellow) are used in the output cable assembly. The green taped conductor is an auxiliary ground. This conductor grounds the flexible conduit only. The untaped conductor is connected to the receptacle ground pin.

\* For DECsystem-10

Table D-11 50 Hz Output Distribution Circuits (Multiphase)

| Output Voltage     | Current | Poles | Wires | DIGITAL Cable PN | Supplied Receptacle                 | Where Used |
|--------------------|---------|-------|-------|------------------|-------------------------------------|------------|
| 380/220<br>415/240 | 10      | 3     | 5     | BN29N-**         | Junction Box<br>Terminal Strip      | Europe     |
| 380/220<br>415/240 | 15      | 3     | 5     | BN29P-**         | Junction Box<br>Terminal Strip      | Europe     |
| 380/220<br>415/240 | 20      | 3     | 5     | BN29R-**         | Junction Box<br>Terminal Strip      | Europe     |
| 380/220<br>415/240 | 32      | 3     | 5     | BN29S-**         | Junction Box<br>Terminal Strip      | Europe     |
| 380/220<br>415/240 | 32      | 3     | 5     | BN29W-**         | Hubbell 532C6W+<br>or IEC309 Equiv. | Europe     |
| 380/220<br>415/240 | 16      | 3     | 5     | BN29X-**         | Hubbell 516C6W+<br>or IEC309 Equiv. | Europe     |
| 380/220<br>415/240 | 15      | 3     | 5     | BN29Z-**         | Russellstoll<br>#DF34962            | Europe     |

\*\* The last two digits denote the length of the cable:

-03 = 3 meters  
 -06 = 6 meters  
 -09 = 9 meters  
 -12 = 12 meters  
 -15 = 15 meters  
 -18 = 18 meters  
 -23 = 23 meters

+Hubbell 516C6W is a trademark of Harvey Hubbell, Inc.

**Table D-12 Input Branch Power (60 Hz)**

| PCS<br>Option<br>Number | Voltage<br>(Nominal) | Input<br>Voltage<br>Range* |
|-------------------------|----------------------|----------------------------|
| H7228-AX                | 208                  | 151.8 -- 239.2             |
| H7228-BX                | 220                  | 160.6 -- 253.0             |
| H7228-DX                | 240                  | 175.2 -- 276.0             |
| H7228-EX                | 440                  | 321.2 -- 506.0             |
| H7228-FX                | 460                  | 335.8 -- 529.0             |
| H7228-HX                | 480                  | 350.4 -- 552.0             |

\* The input voltage frequency is 60 Hz  $\pm 1$  Hz.

**Table D-13 Input Branch Power (50 Hz)**

| PCS<br>Option<br>Number | Voltage*<br>(Nominal) | Input<br>Voltage<br>Range† |
|-------------------------|-----------------------|----------------------------|
| H7228-LX                | 380/415 Vac           | 277.4 to 477.2 Vac         |

\* The input voltage frequency is 50 Hz  $\pm 1$  Hz.

† See Section 4.6.11.

**Table D-14 PCS Breaker Rating and Power Capacity (60 Hz)**

| PCS<br>Option<br>Number | Output Main<br>(Secondary)<br>Breaker Rating | kVA<br>Capacity |
|-------------------------|----------------------------------------------|-----------------|
| H7228-XA                | 50 A per phase                               | 15              |
| H7228-XB                | 100 A per phase                              | 30              |
| H7228-XC                | 150 A per phase                              | 50*             |
| H7228-XD                | 225 A per phase                              | 75              |
| H7228-XE                | 225 A per phase                              | 100             |
| H7228-XJ                | 150 A per phase                              | 50†             |

\* Above 32°C (95°F), operation is derated to 80% kVA at 40°C (104°F)

† Two circuit breakers

**Table D-15 PCS Breaker Rating and Power Capacity (50 Hz)**

| PCS<br>Option<br>Number | Output Main<br>(Secondary)<br>Breaker Rating | kVA<br>Capacity | Maximum Output<br>Phase Current |
|-------------------------|----------------------------------------------|-----------------|---------------------------------|
| H7228-LA                | 160 A per phase                              | 15              | 23 A                            |
| H7228-LB                | 160 A per phase                              | 30              | 45 A                            |
| H7228-LC                | 160 A per phase                              | 50*             | 76 A                            |
| H7228-LD                | 250 A per phase†                             | 75              | 114 A                           |

\* Above 32°C (95°F), operation is derated to 80% kVA at 40°C (104°F)

† Two circuit breakers

**Table D-15 PCS Breaker Rating and Power Capacity (60 Hz)**

| PCS<br>Option<br>Number | Output Main<br>(Secondary)<br>Breaker Rating | kVA<br>Capacity |
|-------------------------|----------------------------------------------|-----------------|
| H7228-XA                | 50 A per phase                               | 15              |
| H7228-XB                | 100 A per phase                              | 30              |
| H7228-XC                | 150 A per phase                              | 50*             |
| H7228-XD                | 225 A per phase                              | 75              |
| H7228-XE                | 225 A per phase                              | 100             |
| H7228-XJ                | 150 A per phase                              | 50†             |

\* Above 32°C (95°F), operation is derated to 80% kVA at 40°C (104°F)

† Two circuit breakers

**Table D-16 PCS Breaker Rating and Power Capacity (50 Hz)**

| PCS<br>Option<br>Number | Output Main<br>(Secondary)<br>Breaker Rating | kVA<br>Capacity | Maximum Output<br>Phase Current |
|-------------------------|----------------------------------------------|-----------------|---------------------------------|
| H7228-LA                | 160 A per phase                              | 15              | 23 A                            |
| H7228-LB                | 160 A per phase                              | 30              | 45 A                            |
| H7228-LC                | 160 A per phase                              | 50*             | 76 A                            |
| H7228-LD                | 250 A per phase†                             | 75              | 114 A                           |

\* Above 32°C (95°F), operation is derated to 80% kVA at 40°C (104°F)

† Two circuit breakers

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APPENDIX E  
PARTS LOCATION

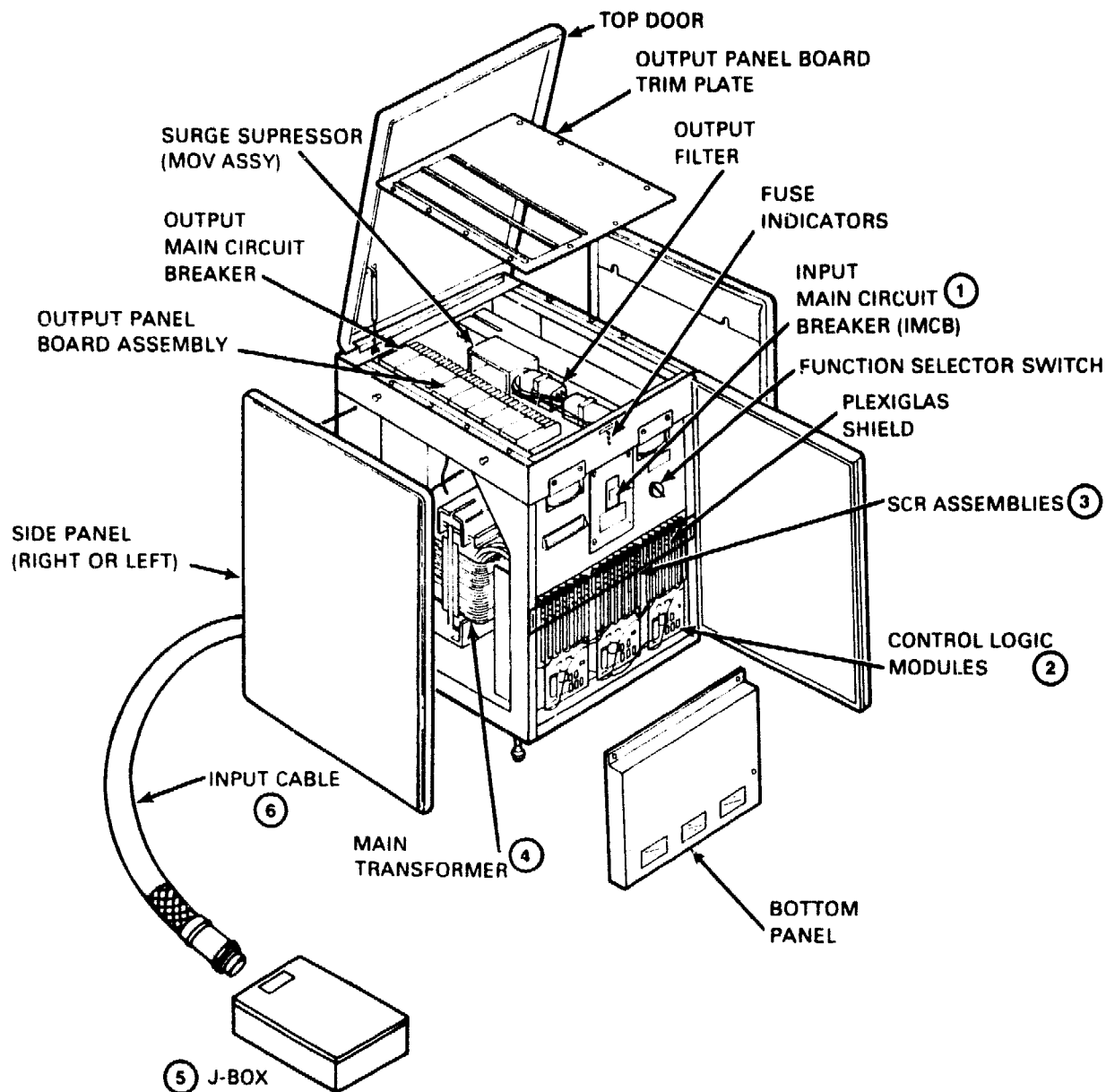
Figures E-1, E-2, and E-3 show the various parts of a functioning PCS. Use these drawings to help identify parts.

Order parts through normal channels using the supplied part numbers. Parts without DIGITAL part numbers are available on special order.

**Table E-1 PCS Parts List (Reference Figure E-1)**

| <b>Item</b>      | <b>Description</b>                         | <b>Part Number</b> |
|------------------|--------------------------------------------|--------------------|
| 1                | Input Main Circuit Breakers                |                    |
|                  | 30 Amp                                     | 29-23790           |
|                  | 50 Amp                                     | 29-23791           |
|                  | 100 Amp                                    | 29-23793           |
|                  | 125 Amp                                    | 29-24351           |
|                  | 150 Amp                                    | 29-23794           |
|                  | 175 Amp                                    | 29-23795           |
|                  | 200 Amp                                    | 29-24352           |
|                  | Conditioning Logic                         |                    |
| 2                | Control Logic Module                       | 29-25419           |
| 3                | SCR Driver Module (without SCR)            | 29-25428           |
| 5                | J-Boxes                                    |                    |
|                  | 30 Amp                                     | 29-23782           |
|                  | 60 Amp                                     | 29-23783           |
|                  | 100 Amp                                    | 29-23784           |
|                  | 200 Amp                                    | 29-23785           |
| 6                | Input Cable                                |                    |
|                  | 30 Amp                                     | 29-23786           |
|                  | 60 Amp                                     | 29-23787           |
|                  | 100 Amp                                    | 29-23788           |
|                  | 200 Amp                                    | 29-23789           |
| Items Not Shown: |                                            |                    |
|                  | IC-8, Resistor Pack (Control Logic Module) | 29-25424           |
|                  | Cables (see Appendix B)                    |                    |
|                  | REPO extension (50 feet)                   | 29-23835           |
|                  | REPO to PCS (50 feet)                      | 29-23836           |
|                  | SCRs                                       |                    |
|                  | 300 V input or less                        | 29-25425           |
|                  | 300 V input or more                        | 29-25504           |
|                  | Heatsink Pads (for SCRs)                   | 29-25431           |
|                  | Fuselink Wires                             |                    |
|                  | 16-gauge                                   | 29-25420           |
|                  | 18-gauge                                   | 29-25421           |
|                  | 20-gauge                                   | 29-25422           |
|                  | 22-gauge                                   | 29-25423           |



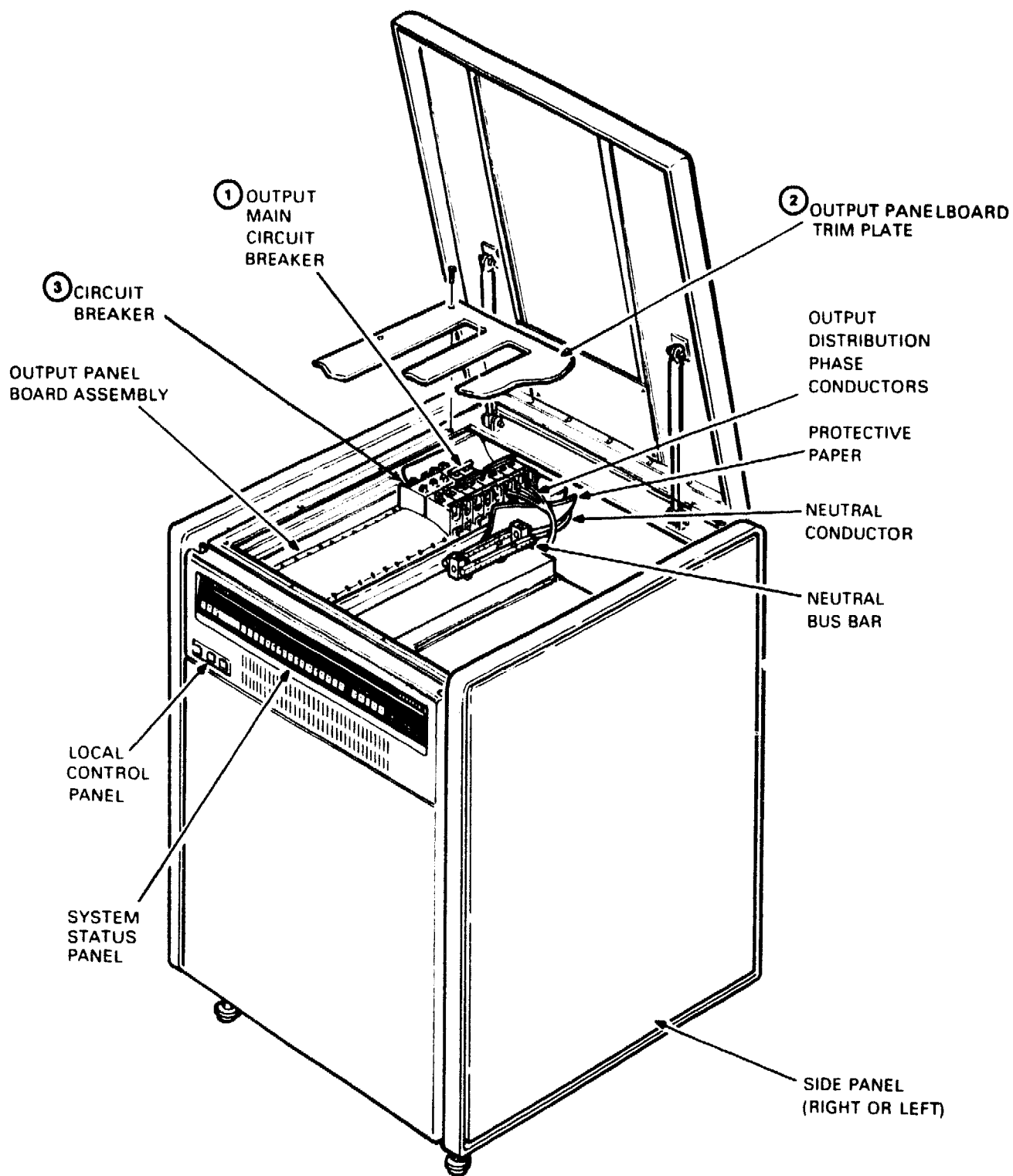


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Figure E-1 PCS Parts Location

**Table E-2 PCS Parts List (Reference Figure E-2)**

| <b>Item</b>      | <b>Description</b>                 | <b>Part Number</b> |
|------------------|------------------------------------|--------------------|
| 1                | Output Main Circuit Breakers       |                    |
|                  | 50 Amp                             | 29-23803           |
|                  | 100 Amp 240 V                      | 29-23804           |
|                  | 150 Amp                            | 29-23805           |
| 2                | Output Panel Board Assembly        | 29-23801           |
| Items Not Shown: |                                    |                    |
|                  | Brackets (Back of PCS)             |                    |
|                  | Conduit landing (for DECsystem 10) | 29-23802           |
|                  | Output heavy duty, no holes        | 29-23802-01        |
|                  | Local Control Panel Parts          |                    |
|                  | Lamp, 18 V                         | 29-23810           |
|                  | Lens, green                        | 29-23809           |
|                  | Lens, red                          | 29-23807           |
|                  | Lens, yellow                       | 29-23808           |
|                  | Switch, harness, bracket assembly  | 29-23812           |
|                  | Cover, guard (for LEPO switch)     | 29-23811           |

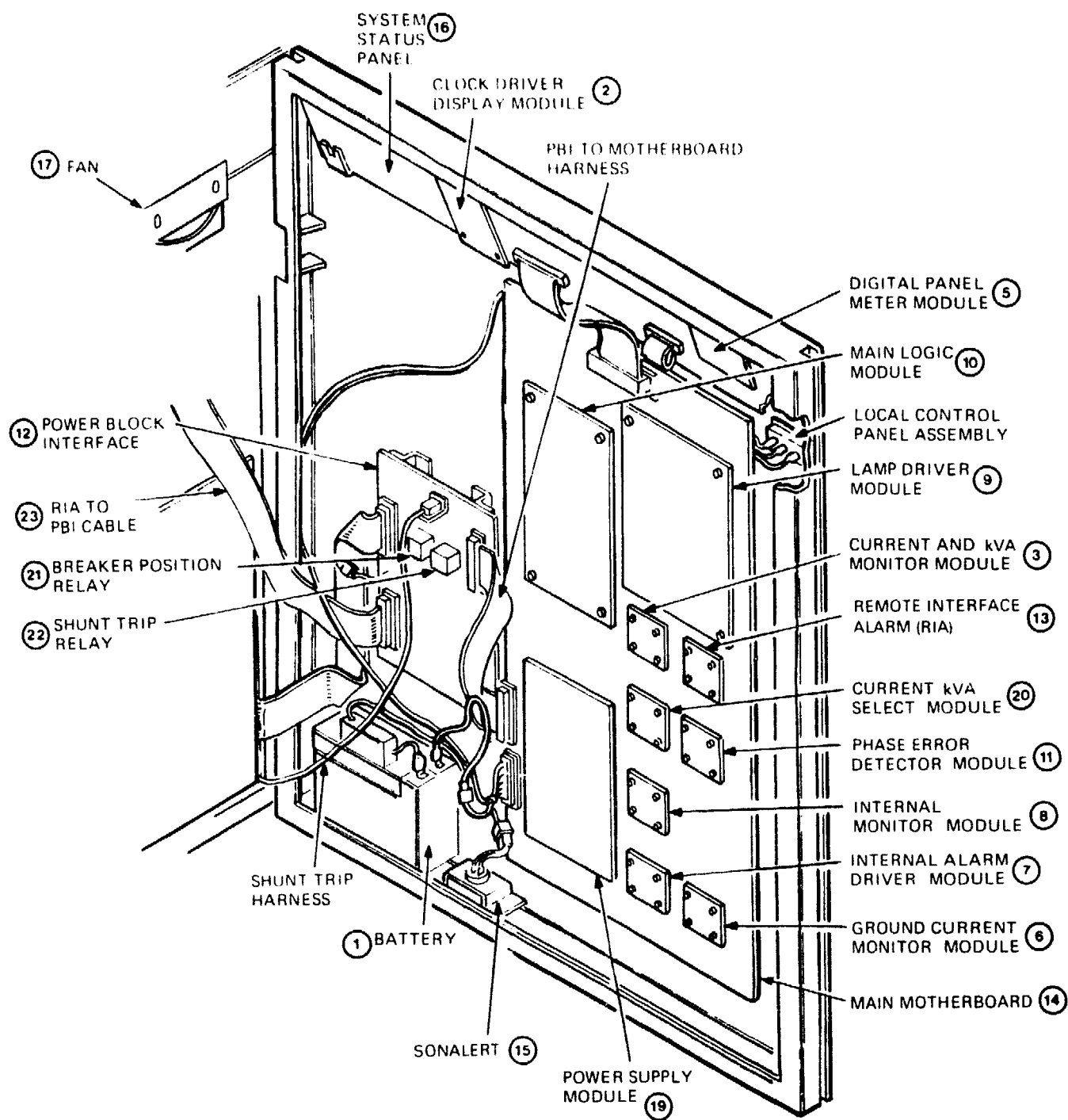


MKV86-0158

Figure E-2 PCS Parts Location

**Table E-3 PCS Parts List (Reference Figure E-3)**

| <b>Item</b>             | <b>Description</b>                 | <b>Part Number</b> |
|-------------------------|------------------------------------|--------------------|
| 1                       | Battery, 12 Volt, 6 Amp Modules    | 29-23829           |
| 2                       | Clock Driver Display               | 29-23826           |
| 3                       | Current & kVA Monitor              | 29-23817           |
| 5                       | Digital Panel Meter                | 29-23827           |
| 6                       | Ground Current Monitor             | 29-23815           |
| 7                       | Internal Alarm Driver              | 29-23819           |
| 8                       | Internal Alarm Monitor             | 29-23818           |
| 9                       | Lamp Driver                        | 29-23821           |
| 10                      | Main Logic (60 Hz)                 | 29-23822           |
| 11                      | Phase Error Detector               | 29-23814           |
| 12                      | Power Block Interface              | 29-23824           |
| 19                      | Power Supply (Module)              | 29-23823           |
| 13                      | Remote Interface Alarm (ESI)       | 29-23820           |
| 20                      | Current & kVA Select               | 29-23816           |
| 14                      | Motherboard, Front Door            | 29-23813           |
| 15                      | Sonalert                           | 29-23800           |
| 16                      | System Status Panels               |                    |
|                         | 50 Hz                              | 29-25430           |
|                         | 60 Hz                              | 29-25429           |
| 17                      | Fan and Fan Assemblies             |                    |
|                         | Fan and thermo-switch 50 Hz        | 29-24353           |
|                         | Fan and thermo-switch 60 Hz, 120 V | 29-23799           |
|                         | Fan, 120 Vac, 60 Hz                | 29-23837           |
|                         | Fan, assembly 230 Vac, 50 Hz       | 29-24343           |
| 21&22                   | Relay, PBI 12 V (on PBI Module)    | 29-23833           |
| 23                      | Cable, RIA to PBI (Internal)       | 29-23831           |
| <b>Items Not Shown:</b> |                                    |                    |
|                         | Cable, REPO to PBI (Internal)      | 29-23832           |
|                         | Harness, Main Power Block          | 29-23830           |
|                         | REPO switch and harness assembly   | 29-23834           |



MKV86-0160

Figure E-3 PCS Parts Location

[illegible][illegible]

APPENDIX F  
REMOTE INTERFACE ALARM  
(RIA) OPTION

**F.1 GENERAL**

The RIA option lets you connect the building alarms, air conditioners, and devices such as smoke detectors, moisture detectors, and humidity detectors to the PCS. The RIA option is housed in a customer installed heavy gauge steel box located within 3 meters (10 feet) of the PCS, usually under the raised floor of the computer room.

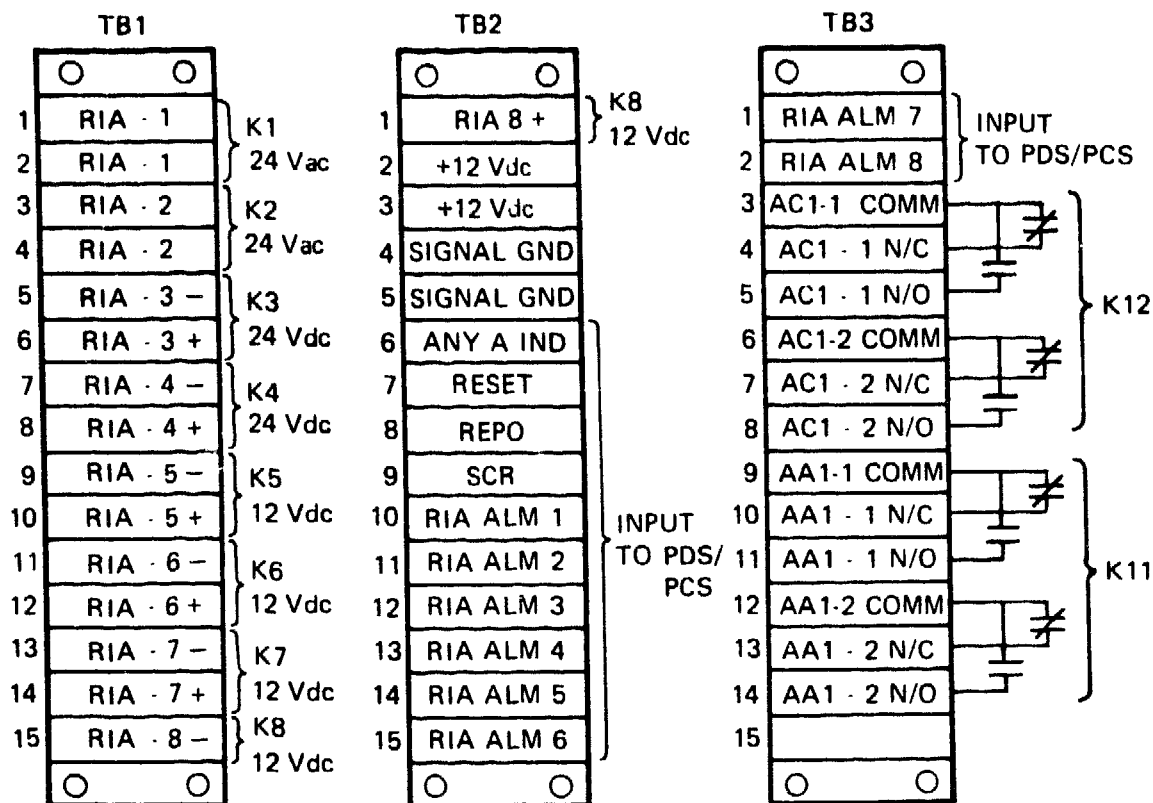
The RIA can send and receive alarm signals through the auxiliary contacts (Figure F-1).

**Incoming Signals**

- Fire alarms and smoke detectors
- Air conditioners
- Water (flood) detectors
- Other security systems

**Outgoing Signals (Contact Closures)**

- Shut off air conditioner, etc
- Set any other alarm (optional trip and time delay)



MKV86-0511

Figure F-1 Terminal Board Wiring



## F.2 THEORY OF OPERATION

This section describes RIA incoming and outgoing signals, operating modes, and wiring.

### F.2.1 Incoming Signals

Incoming signals enter the RIA box by means of RIA relays K1 through K8. Eight indicators located on the PCS system status panel (Figure F-2) show individual RIA inputs such as fire alarms, or other building security alarms. These indicators correspond to the relays in the RIA box.

When an alarm occurs, these relays (K1 through K8) send a 12 V signal to the PCS. The PCS sounds an alarm and turns on the system status panel indicator to designate the malfunction.

The PCS can be programmed to shunt trip with or without a variable time delay. To program a shunt trip, set the programming plugs on the power block interface (Figure F-3).

#### RIA RELAYS RATINGS (ENERGIZING COILS)

K1 to K2 = 24 Vac  
K3 to K4 = 24 Vdc  
K5 to K8 = 12 Vdc.

12345678

910111213141516

## Power Conditioning System

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Phase 1
Phase 2
Phase 3

Voltage
Current
Power

120V
10A
1200W

Figure F-2 System Status Panel (SSP)

REV 01-00

F-4

### F.2.2 RIA Time Delay and Trip Program Plugs

The RIA has three operating modes available, depending on how the program plugs are set on the PBI (Figure F-4).

1. ALARM ONLY -- The program plug is usually installed on the center pin of the 3-pin connector.
2. ALARM AND IMMEDIATE SHUNT TRIP -- If the program plug is installed on the two pins closest to the PBI relays, an alarm will trip the PCS.
3. ALARM AND DELAYED SHUNT TRIP -- If the plug is installed on the two pins farthest from the PBI relays, an alarm may cause a delayed trip.

The delayed trip occurs if the alarm continues for as long as the S9 switch-selected time period.

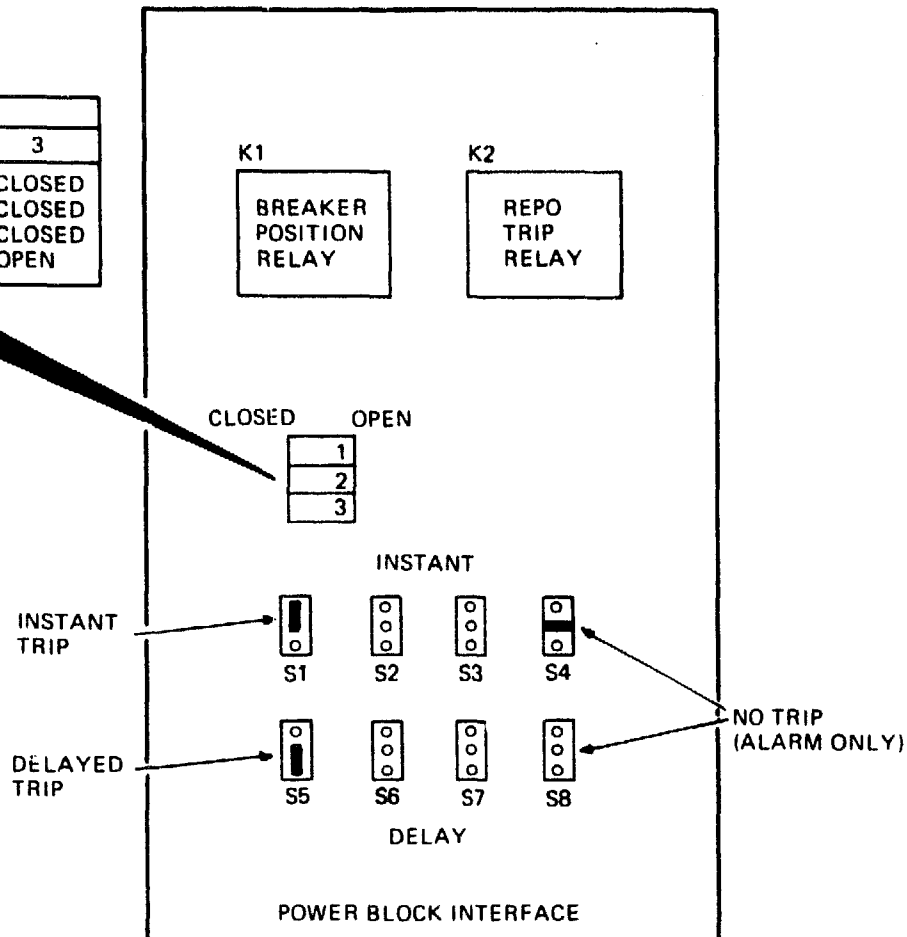
The FUNC DISABLE switch on the local control panel disables all RIA trips when pressed.

Set S9 delay times on the PBI as follows:

| Delay<br>Time | S9-1   | S9-2   | S9-3   |
|---------------|--------|--------|--------|
| 10 seconds    | Closed | Closed | Closed |
| 5 minutes     | Open   | Closed | Closed |
| 10 minutes    | Open   | Open   | Closed |
| 15 minutes    | Open   | Open   | Open   |

Switch 9 of the PBI must be set, along with the programming plugs, to ensure correct RIA operation (Figure F-3).

| DELAY TIME | S9     |        |        |
|------------|--------|--------|--------|
|            | 1      | 2      | 3      |
| 10 SEC     | CLOSED | CLOSED | CLOSED |
| 5 MIN      | OPEN   | CLOSED | CLOSED |
| 10 MIN     | OPEN   | OPEN   | CLOSED |
| 15 MIN     | OPEN   | OPEN   | OPEN   |



MA-8098

Figure F-3 Power Block Interface (PBI)

### F.2.3 Outgoing Signals

Outgoing signals let the RIA connect to any external device. Outgoing signals are received in the RIA box through relays K9 through K12 (Figure F-1).

#### RELAY RATINGS (ENERGIZING COIL)

K9 through K12 = 12 Vdc.

#### Relay K9

Relay K9 is a latching relay. Relay K9 holds relay K12 picked at the desired signal.

#### Relay K10

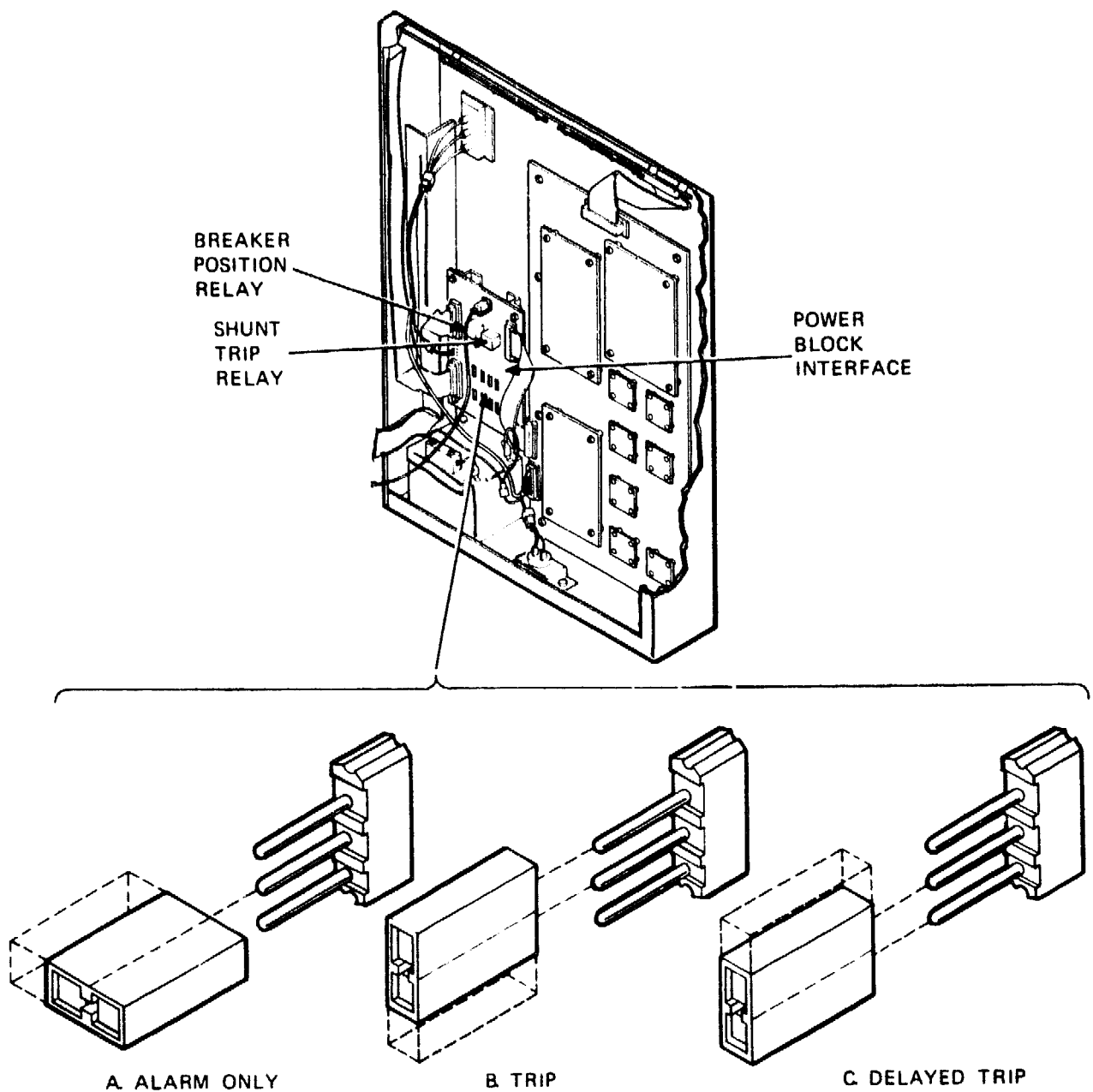
Relay K10 is the reset relay. Pressing the RESET switch on the system status panel (Figure F-2) picks K10, and resets K9 and K12.

#### Relay K11

Relay K11 lets the customer connect an external alarm system or device to the PCS. Relay K11 provides a 12 Vdc signal, a normally open (N/O) set of contacts, and a normally closed (N/C) set of contacts for customer use.

Select an outgoing 12 Vdc signal by connecting a jumper from the 12 Vdc common terminal (TB2-2 and TB2-3) to the AA1-1 common terminal (TB3-9) and/or AA1-2 common terminal (TB3-12). When the relay picks (receives an alarm), 12 Vdc is sent across the N/O contacts and is removed from the N/C contacts.

Any RIA alarm activates this circuit.



MA-0281-82

Figure F-4 Program Plug Installation

### Relay K12

Relay K12 lets you shut down external devices (such as air conditioning units) and activate other security systems when the PCS is shunt tripped.

K12 will be picked only as follows:

- If you press the LEPO or REPO switch,
- If the PCS is shunt tripped, or
- If relay K11 is wired to pick K12 (described above).

Relay K12 is locked by K9 and remains picked until reset by K10. K12 can provide a 12 Vdc output signal or N/O and N/C contacts for customer use.

You can select an outgoing 12 Vdc signal by connecting a jumper from the 12 Vdc common terminal (TB2-2 or TB2-3) to the AC1-1 common terminal (TB3-3) and/or AC1-2 common terminal (TB3-6). When the relay picks, 12 Vdc is sent across the N/O contacts and is removed from the N/C contacts.

### Preprogrammed Trip

When you select this feature, any alarm signal from the PCS can pick relay K12 and trip the PCS.

To select a preprogrammed trip, connect the N/O contacts TB2-4 (SIG GND) to pin 7 of K12 in the RIA box.

The preprogrammed shunt trip will occur after every RIA alarm signal or internal alarm received by the PCS, and may not be a desired feature.

### F.3 RIA WIRING

See Figure F-1 and use the following information to wire the RIA.

#### K1 to K4 (RIA Alarms 1 to 4)

Energizing one of these relays initiates a remote interface alarm. These four relays are energized by providing a 24 Vac (K1 and K2) or a 24 Vdc signal (K3 and K4).

#### K5 to K8 (RIA Alarms 5 to 8)

Energizing one of these relays also initiates a remote interface alarm. These four relays can be initiated in two ways.

- Provide a 12 Vdc signal to energize relays K5, K6, K7, or K8.
- Provide a dry contact N/O closure. The 12 V signal can be derived within the RIA from terminal 2 or 3 on TB2-2 and TB2-3 (12 Vdc). Connect a jumper from this terminal (TB2-2 or TB2-3) to the selected relay (K5, K6, K7, or K8). Then connect one terminal of your N/O dry contact to ground (TB2-4 or TB2-5), and the other terminal of your N/O dry contact to the selected relay (K5, K6, K7, or K8).

#### NOTES

Relays K3 through K8 have arc suppression diodes across their coils. Figure F-1 (terminal board wiring) shows the proper relay polarity. (Polarity must be observed.)

Octal mount DPDT enclosed relays in the RIA have a 120 V, 5 A maximum contact rating.





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