PESA Switching Systems

RCP-2416

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1.1 Manual Overview

This manual provides detailed instructions for installing and operating the PESA RCP–2416. This manual is divided into five sections as shown.

Section 1, **INTRODUCTION**, summarizes the manual, describes the RCP–2416, presents a list of terms, and provides the panel specifications.

Section 2, **INSTALLATION**, provides installation and setup instructions.

Section 3, **OPERATION**, describes operation procedures.

Section 4, **FUNCTIONAL DESCRIPTIONS**, presents an in-depth description of each RCP–2416 component.

Section 5, **MAINTENANCE**, explains procedures for maintenance.

1.2 General Description

The RCP–2416 (24X16) pushbutton control panel allows fast intuitive control of 16 destinations. This button-per-source panel features direct take operation for applications requiring minimum keystrokes and access to a limited number of sources.

The sources assigned to the 24 pushbuttons are user-selectable. An LED is incorporated into each pushbutton for display of status. Up to 16 independent levels of control are available.

There are two control pushbuttons on the far right. One allows the operator to PROTECT or LOCK the selected output while the other allows the operator to select breakaway levels and to display the panel address.

This panel comes packaged in a standard 19 inch, one rack unit (1RU) chassis requiring only 1 1/2 inches of depth, making it suitable for tight locations. The unit is powered by a 7.5 Vdc Plug-in-the-Wall type power pack and communicates with the System Controller via Standard RS485 Interface.

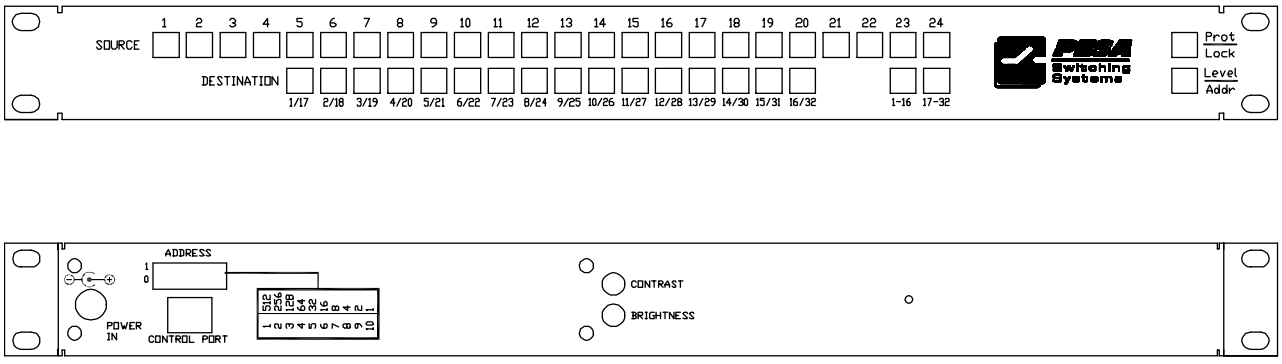


Figure 1–1 RCP–2416 Front and Rear Views

1.3 Specifications

GENERAL	
Mounting	Standard 19" Rack
Pushbuttons	LED Illuminated
INPUT	
Input Type	RS485
POWER	
Voltage Requirements	+7.5 VDC @ 800 mA
MECHANICAL	
One Rack Unit	19"W x 1 1/2"D x 1 3/4"H (482.6mmx38.1mmx44.45mm)
ENVIRONMENTAL	
Temperature	0°C to 40°C
Humidity	20% to 90% Non-Condensing

2.1 Introduction

This section details RCP–2416 installation procedures. The following topics are discussed:

- Receipt Inspection
- Location and Mounting
- Polling Address
- Control Panel/Controller Interconnection
- Power Connections

2.2 Receipt Inspection

The RCP–2416 was inspected and tested prior to leaving the PESA factory. Upon receipt, please inspect the unit for shipping damage. If damage is detected, notify the carrier immediately and hold all packing material for inspection. If assistance is required, please contact PESA Customer Service at the telephone number listed in the front of this manual.

After unpacking, compare all parts received against the packing list. If the unit is undamaged and all components have been received, proceed with installation.

2.3 Location and Mounting

The RCP–2416 has been designed to fit in a standard E.I.A. 19" equipment rack and uses 1 rack unit of space (1 3/4"). An area should be selected where temperature does not exceed 40°C inside the equipment rack, and where air can circulate freely. The unit should be mounted in an area convenient to control and power connections. Sufficient space must be provided behind the rack to allow for the control and power cables. All mounting holes should be utilized and hardware tightened securely. All cables should be strained relieved and secured to racks or other supporting structures. Failure to provide adequate cable support can result in cables separating from connectors. If cable runs are to be stored under an elevated floor, they should be tied to the racks as a guide. If cables are run along the floor, do not allow them to lay in the work area behind the racks. Stepping or tripping on the cables may result in connections being pulled free or wire breakage inside the insulation.

Location and Mounting Continued:

Figure 2–1 illustrates chassis installation.

To install the RCP–2416 chassis follow these steps:

1. Align the chassis with the slotted opening in the rack.
2. Install the bottom screws first.
3. Install the two top screws
4. Tighten all four screws securely.

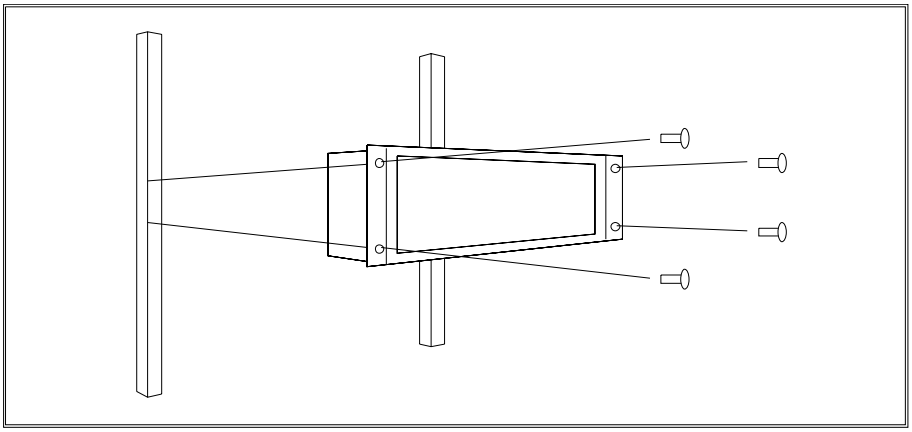


Figure 2–1 RCP–2416 Chassis Installation

2.4 Polling Address

For the controller to identify a particular control panel, a specific device number or polling address must be assigned to each panel. Valid polling addresses are in the range of 1 to 255. The appropriate binary number is entered into the control panel by setting a 10-position DIP switch to the binary number. The DIP switch is located on the remote CPU board and is accessible from the rear of the unit. The panel address is normally assigned and entered at the factory if the panel is purchased as part of a system and a design guide has been completed by the user. If the panel is purchased separately, the user may be required to set the panel address.

Example: To select polling address 21, set switches 6,8, and 10 in the "ON" or "1" position. See Figure 2–2.

2.4 Polling Address (Device Number) Continued:

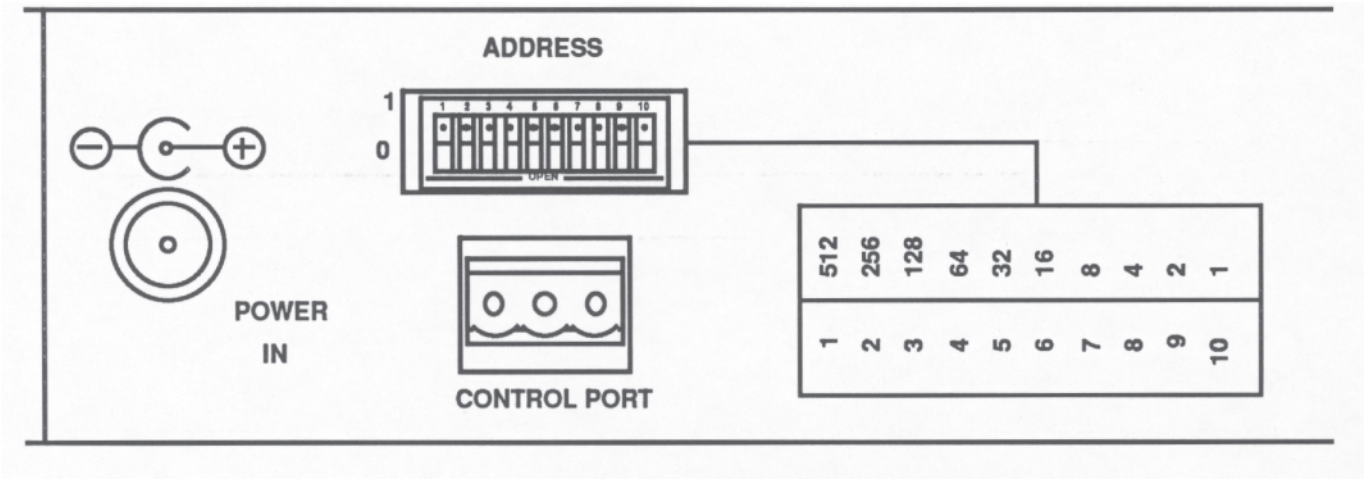


Figure 2-2 DIP Switch Location

2.5 Control Panel/Controller Interconnection

Each panel has a single 3-pin MTA connector located on the rear panel. Control panels are daisy chained to a port on the rear of the Controller. Use shielded twisted pair cable. See Figure 2–3.

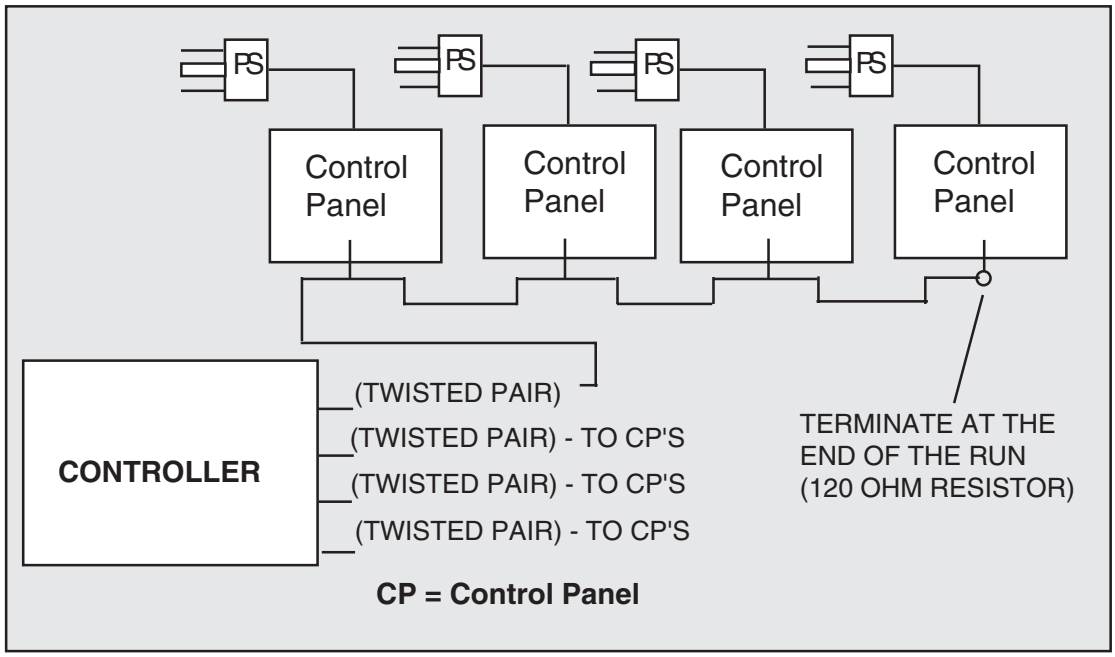


Figure 2-3 Typical Control Panel Controller Interconnection

2.6 Wiring the Control Panel Connector

Should an additional control panel be added to your system, it will be necessary to wire the connector using shielded twisted pair cable and a 3-pin MTA connector. See Figure 2–4.

1. Remove approximately 1 1/2" of insulating jacket from each of the two wires.
2. Remove approximately 1/2" of wire insulation from the black and red wires.
3. Twist together and insert the two black wire ends into positon 1. Crimp down using a screw driver.
4. Twist together and insert the two shield wires into position 2. Crimp down using a screwdriver.
5. Twist together and insert the two red wire ends into position 3. Crimp down using a screwdriver.

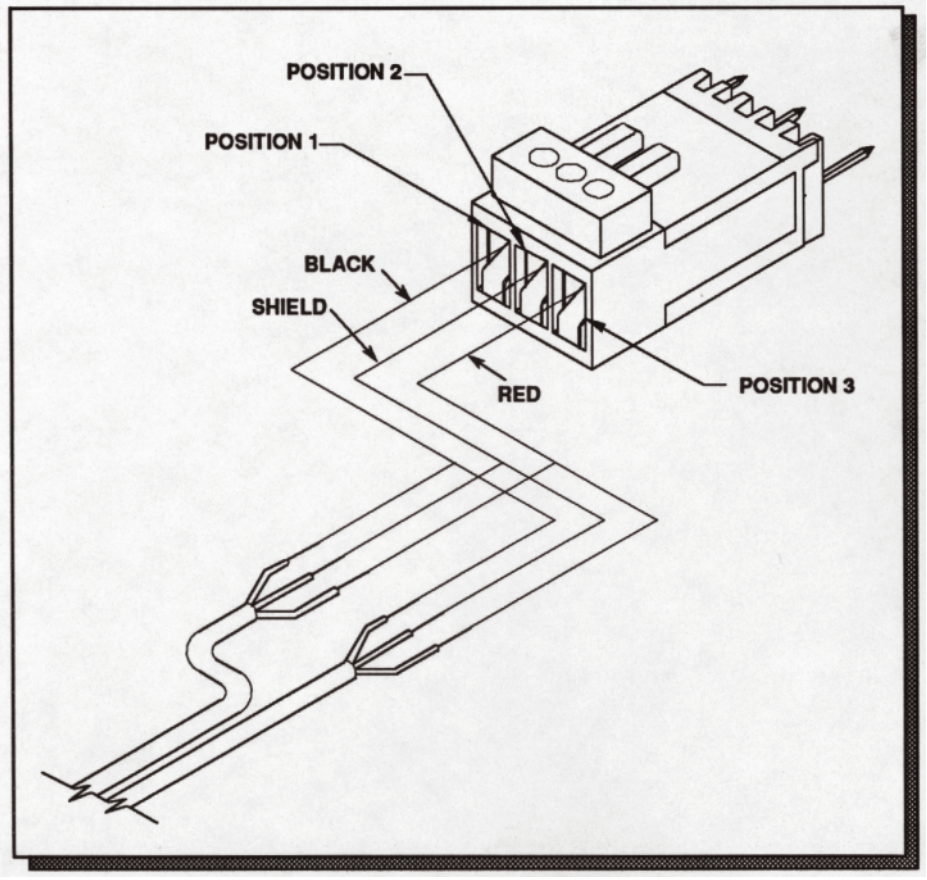


Figure 2-4 Wiring the Control Panel Connector

2.7 Terminating Cable Runs

Each cable run should be terminated at the end of the run with a 120ý, 1/4 watt 5% resistor. The cable is terminated internally at the controller. See Figure 2–5.

1. Uncrimp the black and red leads in position 1 and 3.
2. Insert the resistor ends into position 1 and position 3 along with the black and red leads.
3. Crimp down using a screwdriver.
4. The shield wire remains in position 2.

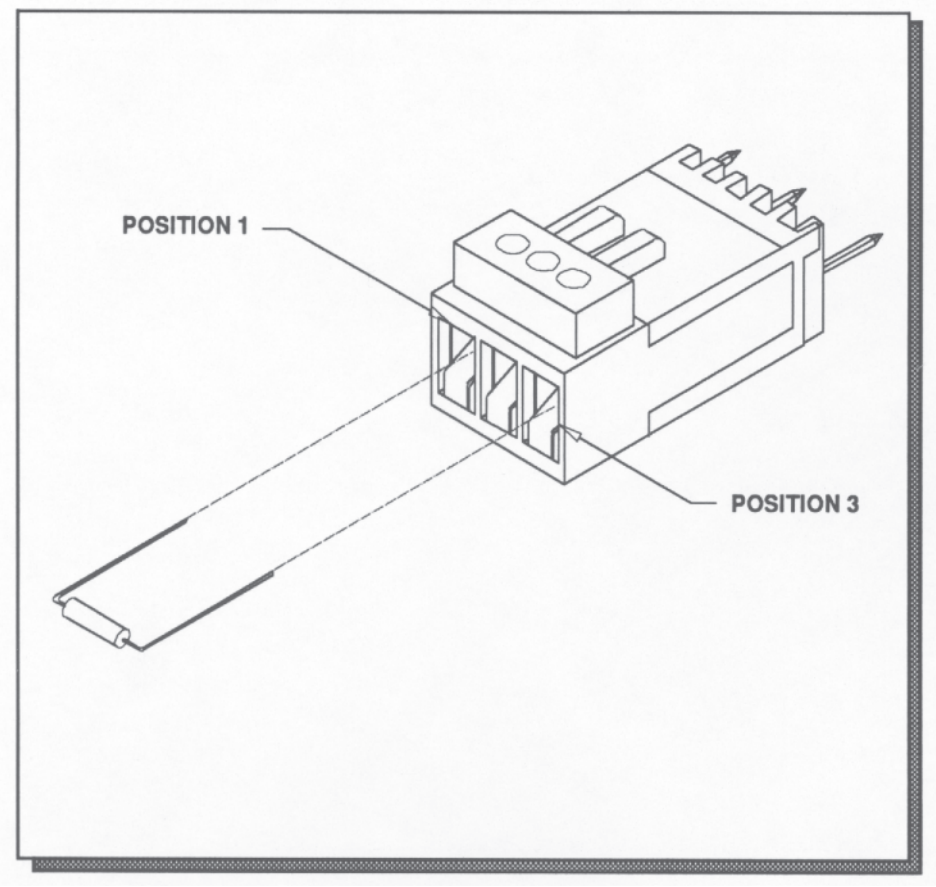


Figure 2–5 Terminating Cable Runs

2.8 Power Connections

Power for the RCP–2416 is supplied by an external 7.5 Vdc, 800 mA power supply.

Remove the Power Supply from the box it was shipped in and check to insure that no damage has occurred in shipping. Verify that the Power Supply is rated for the proper AC voltage (i.e. 115 VAC or 230 VAC) before connection to the AC voltage. The power connector can now be plugged into the **POWER IN** position on the RCP–2416. The Power Pack will immediately power the unit upon connections to AC Voltage. See Figure 2–6.

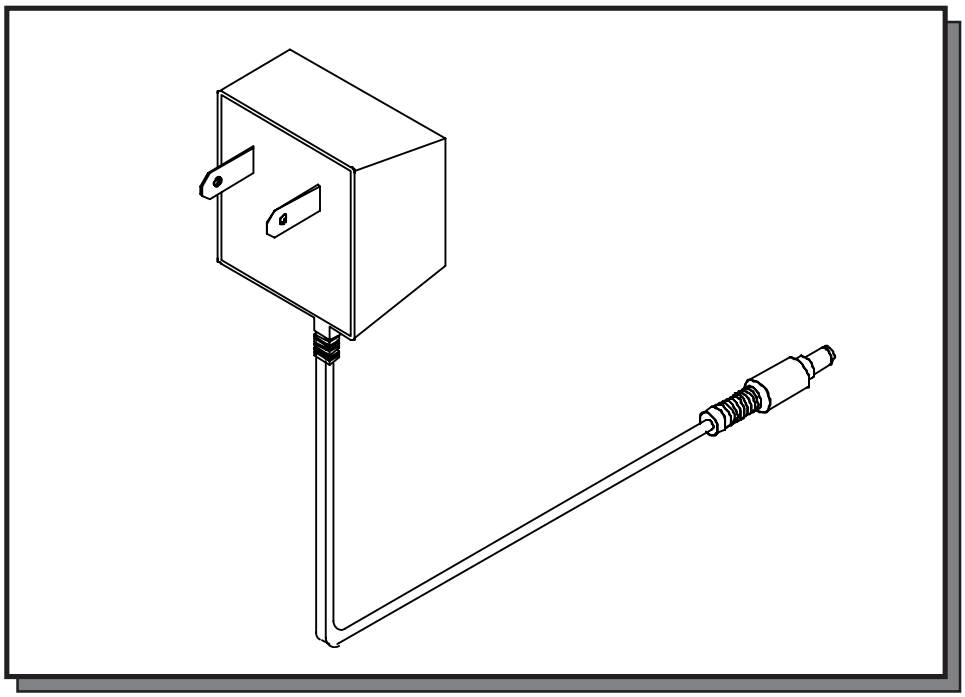


Figure 2-6 Typical Panel Power Supply

3.1 Operations of the RCP–2416

Introduction

The RCP–2416 can be controlled by the 2400E family of Controllers. Operations of the RCP–2416 require that it be configured at the controller and have the appropriate polling address assigned. Connections and power up procedures should be performed on each panel controlled.

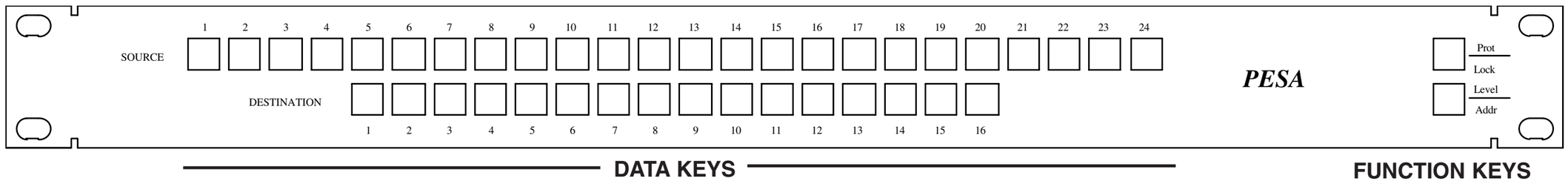
General

All RCP–2416 panels in a routing switcher system are custom configured at the factory prior to shipment. The information needed to configure the panels comes from the System Design Guide filled out by the customer.

Breakaway Operation

Breakaway operation allows you to select an input to be switched to an output on one or more specific levels. **Assumptions:** Panel is currently in Direct Take mode (default mode) and no level has been selected for breakaway (Level/Disp. LED is not illuminated or blinking).

To Make a Breakaway Switch:	**Results:**
Depress Level/Address Key	Level/Address Key lights. Panel enters Level Select Mode. Source Data Keys represent Levels.
Depress Data Key associated with level you wish to breakaway (2400E operation allows only 1 level breakaway at a time)	Data Key selected light to show level selection
Depress Level/Address Key again	Level/Address key blinks. Panel returns to Direct Take Mode but with Level selected for breakaway. Data Key whose associated input matches the current status on the selected level will be illuminated.
Depress the Data Key associated with the input you desire on the level selected	The destination controlled by the panel will be switched to the input assigned to the Data Key pressed for each level selected.
To Return to Follow Operation:	**Results:**
Depress the Level/Address Key again	Level/Address Key lights. Panel enters Level Select Mode again. Data Keys associated with currently selected level light.
Depress Data Key currently lit Data Key	LEDs are extinguished and associated levels are no longer selected for breakaway operation.
Depress Level/Address Key again	Level/Address Key LED is extinguished Panel returns to Direct Take Mode but with no levels broken away (Follow operation). Data Key whose source matches the current status is illuminated.



The RCP–2416 has 2 Modes of Operation:

Direct Take - Selects sources to be switched to the destination controlled by the panel by depressing associated Source Keys. Switch requests are sent immediately. Direct Take is the default mode; deselecting the Level Select mode will always return the you to the Direct Take mode. The Level/Address Key will not be illuminated if the panel is in Follow or blinking if you have selected Breakaway level(s).

Level Select - Selects which levels are to be affected when selecting switches in Direct Take mode. Enter the Level Select mode by depressing the Level/Address key for less than 2 seconds. The Levels/Address illuminates.

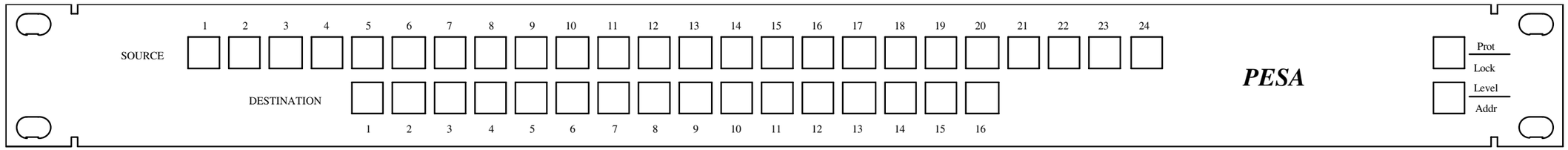
Source Keys: 24 Source Keys are located towards the left of the panel. Source Keys are associated with sources in Direct Take mode and with levels in the Level Select mode. The sources assigned to each Source Key are configurable from the controller and based upon the panel's address.

Destination Keys:
The panel has 16 Destination Keys located below the Source Keys. The Destination Keys are associated with destinations in the Direct Take mode. The outputs assigned to each Destination Key are configurable based upon the panel's address. The Destination Keys are unused in the Level Select mode.

Function Keys: Two function keys are located to the far right of the panel: **Protect / Lock** and **Level / Display Address.** Each function key works as a toggle; the primary function is listed first, followed by the secondary function. **NOTE: The primary function is executed when the key is held down less than 2 seconds. The secondary function is executed when the key is held down more than 2 seconds.**

STATUS METHOD:

The panel will always display the status of the Default Status Level, which is the first level where the output is defined (usually Level 1). If the panel is in Follow, the source key corresponding to the input selected on the Default Status Level will be illuminated. If the status of all other levels matches the status of level 1, the key will be illuminated solid. If the status of any other level is different, the data key will blink. If the panel is in Breakaway, the source key corresponding to the input on the level selected will be illuminated. The Destination Key corresponding to the output currently controlled by the RCP–2416 will always be fully illuminated during Direct Take mode.



MODE 1 –DIRECT TAKE

In this mode, Source Keys are associated with sources. Pressing a Source Key will switch the source(s) assigned to the Source Key on all selected levels to the destination controlled by the panel. Follow operation is indicated when the Level/Address LED is off. Breakaway operation is indicated when the Level/Address LED is blinking. The method of statusing used by the panel is the same for both Follow and Breakaway operation.

BREAKAWAY AND FOLLOW OPERATION

Source Key LED Illuminated Solid (not blinking) – For Follow operation the current status matches the source assigned to the Source Key for the Default Status Level, and the source(s) assigned to the Source Key for all other levels matches the status on the Default Status Level. If in Breakaway operation, the illuminated LED matches the source selected on the breakaway level.

Source Key LED Blinking – The current status matches the source assigned to the Source Key for the Default Status Level, but the source switched to the current output for at least one other selected level does not match the current source assigned to the Source Key that is blinking.

No Source Key LED Illuminated – The current status does not match the source assigned to anySource Key on the Default Status Level.

DESTINATIONS KEYS:

Destination Keys are associated with destinations in Direct Take mode. Pressing a Destination Key will change the current destination controlled by the panel. The Destination Key representing the current destination will always have its LED fully illuminated (not blinking). All other Destination Key LEDs will be off. The correct status for that output will be displayed on the Source Keys for either Follow or Breakaway operation.

PROTECT/LOCK CONTROL KEY:

PROTect – Protects the destination controlled by the panel. Any switch request attempting to affect this destination made at any location other than this panel will be disallowed. Protect/Lock LED is illuminated to show the destination controlled by the panel is protected.

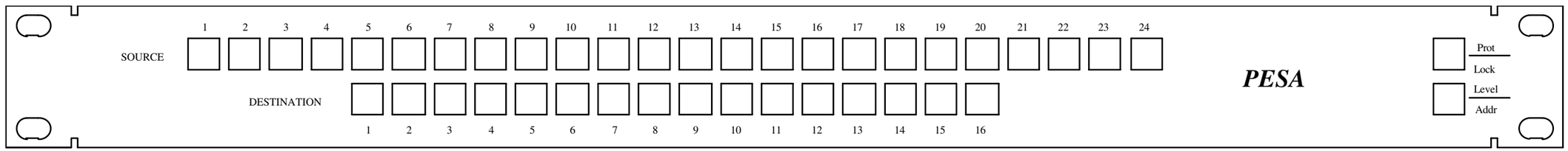
LOCK – Locks the destination controlled by the panel. Any switch request attempting to affect this destination will be disallowed. Protect /Lock LED blinks to show the destination controlled by the panel is locked.

When the panel is unlocked, pressing the PROTect/LOCK key quickly will take the panel into PROTECT. Pressing the PROTect/LOCK key for > 2 seconds will take the panel into LOCK. When the panel is already protected or locked, pressing the PROTect/LOCK key quickly will clear PROTECT or LOCK.

LEVEL/ADDRESS KEY:

LEVEL – Activates the Level Select Mode. Illuminates the Level/Address LED. Displays the currently selected level(s) by lighting the associated Data Key LEDs, with the first Data Key on the top row corresponding to level 1 and proceeding left to right, top to bottom. If no level is selected, no Data Key will be illuminated (refer to the Level Select Mode description).

ADDR – Displays the panel address on the row of Source Key LEDs while key is depressed. The address displayed will be a binary representation of the panel address with the MSB = Source Key 15 and the LSB = Source Key 24.



MODE 2 –LEVEL SELECT

In this mode, Source Keys are associated with levels, with the top left Source Key corresponding to level 1 and proceeding left to right. If the panel is in Follow (no Breakaway level[s] selected), no Source Key will be illuminated. If a Source Key is illuminated, the corresponding level is selected. Pressing a Source Key will toggle the selection of the corresponding level (if level is controllable by this panel) by either deselecting it if the Source Key was already illuminated or selecting it and illuminating its associated Source Key if not.

DESTINATION KEYS:

Destination Keys are not operational in Level Select Mode. All Destination Key LEDs will be off.

PROTECT/LOCK CONTROL KEY:

PROTect – Protects the destination controlled by the panel. Any switch request attempting to affect this destination made at any location other that this panel will be disallowed. Protect/Lock LED is illuminated to show the destination controlled by the panel is protected.

LOCK - Locks the destination controlled by the panel. Any switch request attempting to affect this destination will be disallowed. Protect/Lock LED blinks to show the destination controlled by the panel is locked.

When the panel is unlocked, pressing the PROTect/LOCK key quickly will take the panel into PROTECT. Pressing the PROTect/LOCK key for > 2 seconds will take the panel into LOCK. When the panel is already protected or locked, pressing the PROTect/LOCK key quickly will clear PROTECT or LOCK.

LEVEL/ADDRESS KEY:

LEVEL - Deactivates the Level Select mode and returns to Direct Take mode. Turns off the Level/Address LED if in Follow, or the LED begins blinking if a Breakaway condition is selected. Displays the status of the destination controlled by the panel by lighting the associated Source Key's LED (refer to the Direct Take mode description).

ADDRess - Displays the panel address on the row of Source Key LEDs while key is held down. The address displayed will be a binary representation of the panel address with the MSB = Source Key 15 and the LSB = Source Key 24.

4.1 Introduction

The RCP–2416 panel consists of two printed circuit boards. The CPU board contains a microprocessor that controls the panel's operation and communicates with the control system. The Switchcard contains pushbuttons and indicators used by the operator to control the routing switcher. The following is a detailed description of each of these boards.

4.2 CPU Board

The CPU board contains all circuitry necessary to communicate with the system controller and to interface to a front panel switchcard. The circuitry on the CPU board may be divided into the following sections: Power Supply, Microprocessor, Clock, Reset, Memory, LED Driver Support, RS-485 Communications, I/O, and Miscellaneous. The following paragraphs explain each section in detail.

Power Supply

The power supply circuit on the CPU board consists of a 7805 +5V regulator and filter capacitors. Unregulated DC voltage (7.5 to 9 Vdc) is supplied by an external power supply via J3. The voltage regulator U7 reduces the voltage to 5.0 Vdc. C10 and C12 provide filtering for the input and output of the regulator, respectively. Bypass capacitors (.1 uF) are scattered about the board to provide power supply bypassing for individual chips. The regulated voltage is available to external board on both J1 and J2, pins 31 and 32. The unregulated voltage is available to external board on both J1 and J2, pins 29 and 30.

Microprocessor

The heart of the CPU board is the Motorola 68HC11 microprocessor (U1). This IC contains the microprocessor and peripheral circuitry used to operate the panel. In addition, the 68HC11 contains a PROM with the software used to operate the panel. The 68HC11 is operated in the expanded multiplexed mode. In this mode port B (U1 pins 35-42) provides the upper address byte (A8-A15). Port C (U1 pins 9-16) provides both the lower address byte (A0-A7) and the data byte (D0-D7). U2 is used to latch the lower address byte. Figure 4–1 shows an idealized timing diagram for external bus cycles.

CPU Board Continued:

Microprocessor Continued:

During the first half of the bus cycle, port C presents the lower address byte (A0-A7). This information is latched into U2 on the falling edge of address strobe AS (U1 pin 4 to U2 pin 11) and remains stable until the beginning of the next bus cycle when AS is driven high by the processor. During the last half of the bus cycle port C presents data during write cycles and accepts data from an external device during read cycles.

The address bus (A0..A15), the data bus (D0..D7), AS, R/W, and E clock are available to external boards via J1.

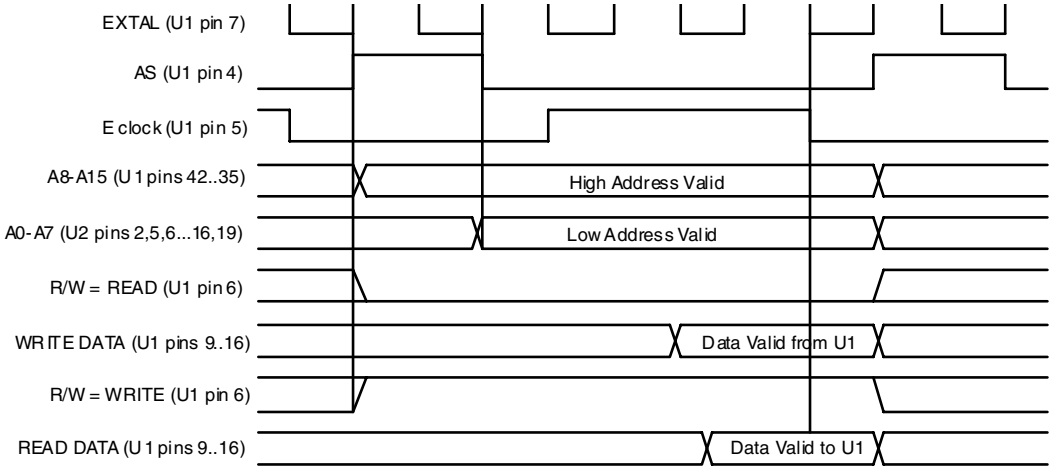


Figure 4-1 Idealized Bus Cycle Timing Diagram

Clock

The master system clock is provided by oscillator U6 pin 8. SYSCLK is available to the processor (U1 pin 7) and to external boards via J2 pin 10. The frequency of SYSCLK is 7.3728 MHz. This value was chosen to provide an appropriate frequency for the baud rate generator inside the 68HC11. The 68HC11 internally divides SYSCLK by four to derive the bus operating frequency. U1 pin 5 is the E clock used to synchronize all external bus cycles. The frequency of the E clock is 1.8432 MHz (SYSCLK/4). The E clock is used to derive control signals on the CPU board and is available to external boards via J1 pin 28.

CPU Board Continued:

Reset

As with all microprocessors, the 68HC11 requires initialization during power-up. The 68HC11 requires that the RESET pin (U1 pin 17) be held low for 4064 cycles of E clock (2.2 mS @ 1.8432 MHz E clock). In addition the RESET pin must be held low while VDD is below legal limits to protect internal EEPROM register contents. A Maxim MAX690 chip (U5) performs the reset function for the 68HC11. The MAX690 monitors the supply voltage and asserts RESET (U5 pin 7) whenever VCC falls below 4.5 Vdc. The RESET signal is guaranteed to be asserted for a minimum of 50 mS after VCC rises above 4.75 Vdc. This is more than adequate to meet the 2.2 mS requirement of the 68HC11. The RESET signal is available to external boards via J2 pin 11.

Memory

The CPU board contains 8K of static RAM (U3). The RAM is selected when both CS1 (U3 pin 20) and CS2 (U3 pin 26) are asserted. CS1 is low active and is driven by address bit A15. Whenever A15 is low, CS1 is asserted. This occurs for addresses in the range of 0000h to 7FFFh. CS2 is high active and is asserted when address bit A14 is high and E clock is high (note the AND gate formed by U8 pins 1, 2, and 3 followed by inverter stage U8 pins 4, 5, and 6). CS2 is active for addresses in the range of 4000h to 7FFFh and C000h to FFFFh. U3 is selected when both CS1 and CS2 are asserted. This occurs for addresses in the range of 4000h to 7FFFh. This encloses an address space of 16K. Since U3 is only 8K in length, it is dually mapped at base addresses of 4000h and 6000h. This means that the same location in the RAM may be accessed either at 4000h or at 6000h. The write enable pin WE (U3 pin 27) is driven low during the last half of write cycles by the U8 pin 8. This WE signal is also availably to external boards via J1 pin 25.

LED Driver Support

The 68HC11 processor uses the internal synchronous peripheral interface (SPI) under software control to drive external LED circuitry. LED_DATA is presented as a serial bitstream on U1 pin 23 and is available to external boards via J2 pin 7. LED_CLOCK is presented on U1 pin 24 and is available to external boards via J2 pin 8. External circuitry should accept LED_DATA on the rising edge of LED_CLOCK. To allow multiple LED drivers to be serviced, the CPU board provides four select lines labelled LED_SEL0..LED_SEL3. These low-active signals are presented at U1 pins 30..27 and are available to external boards via J2 pins 1..4. The data stream generated is compatible with that required by National MM5450 LED driver chips.

CPU Board Continued:

RS-485 Communications

Communication between the panel and the system controller is accomplished by the 68HC11 internal Serial Communication Interface (SCI). The SCI is an asynchronous receiver/transmitter, sometimes referred to as a UART. The RS-485 standard is used for the electrical interface between panels and the system controller. A 75ALS176 (U4) chip is used to convert between RS-485 and the levels required by the SCI. Transmit data (TXD) is presented by the SCI on U1 pin 21. This signal drives the input to the RS-485 transceiver on U4 pin 4. Data received from the system controller is converted to the appropriate levels by the RS-485 transceiver and presented on U4 pin 1. This received data (RXD) signal is then fed to the SCI receiver at U1 pin 20. Since the RS-485 interface requires the transmitter to be tri-stated when not in use, a third signal is required to enable/disable the RS-485 transmitter. The processor provides the TX_ENABLE signal under software control at U1 pin 25. This signal is connected to the RS-485 transceiver at U4 pin 3. When TX_ENABLE is asserted (high), U4 drives the RS-485 bus (U4 pins 6 and 7 to J4 pins 1 and 3). When TX_ENABLE is negated (low), U4 ceases driving the bus and allows other devices to drive the bus. During reset, the TX_ENABLE signal from the processor is initialized to an input and is not driven to a particular state. A pull-down resistor R2 has been added to ensure that U4 does not drive the RS-485 bus during power-up or other reset conditions. A shield connection is provides for the RS-485 bus on J4 pin 2. The shield is connected to ground through R1.

I/O

Circuitry is included on the CPU board to support I/O expansion via J1 and J2. Decoder U9 provides eight chip select signals SEL0..SEL7 for use by I/O devices. U9 is selected when A14 and A15 are both low and E is high. This occurs during the last half of each external bus cycle addressing in the range of 0000h to 3FFFh. Table 4-1 lists active address range for each select signal. Currently, the CPU board uses two of these eight signals for on-board circuitry. SEL6 is used to select eight bits of the address dip switch S1. When SEL6 is asserted, U10 places the state of signals SWX3..SWX10 on the data bus. If the corresponding switch for each bit is closed, a logic low is presented. If the switch is open, pullup resistor RP1 presents a logic high. SEL7 is used to select the remaining two bits of the address switch and the six bit ID field from an external board. The ID field should be driven by an external board. A logic low is generated by grounding the ID pin. A logic high is generated by leaving the ID pin floating. Pullup resistor RP3 generates the high logic when a pin is floating.

CPU Board Continued:

Signal	Start	End
SEL0	0000h	07FFh
SEL1	0800h	0FFFh
SEL2	1000h	17FFh
SEL3	1800h	1FFFh
SEL4	2000h	27FFh
SEL5	2800h	2FFFh
SEL6	3000h	37FFh
SEL7	3800h	3FFFh

Table 4–1 Decoder Addressing

Miscellaneous

The CPU board provides some special function signals for use by external boards. R3/R4 provide a contrast adjustment for LCD displays. The CONTRAST signal is available for use by external boards on J2 pin 13. Likewise, R5 provides a brightness control signal for use by external boards. It is available on J2 pin 14. J2 pin 9 is a signal named DSP_RS. This signal is a register select signal for external LCD displays. The processor interrupt request line IRQ is not currently used, but is available for use by external board on J2 pin 12. The CPU board accepts input from a rotary encoder in the form of two signals named KNOB0 and KNOB1. The CPU software expects quadrature-encoded signals to indicate direction of travel from the rotary encoder. These two signals are present on J2 pins 5 and 6.

4.3 Switchcard

RCP–2416 Switchcard

The switchcard for the RCP–2416 panel contains circuitry to provide a switchcard ID for the CPU board, scan a keyboard, light the keyboard LEDs, and interface to an optional I/O board. The following is a description of each of these circuits.

Switchcard ID

The RCP–2416 switchcard provides a six-bit ID available to be read by the CPU board. This ID is available on J2, pins 23-28. The least significant bit (ID0) is provided by the optional I/O board on J3 pin 5. If the I/O board is not installed, then ID0 is pulled high by a pullup resistor on the CPU board. If the I/O board is installed, then the ID0 pin is grounded. The CPU may use this bit to detect the presence or absence of the I/O board. The

Switchcard Continued:

remainder of the ID bits (ID1-ID5) are either floating or grounded by the switchcard. Floating pins are pulled high by pullup resistors on the CPU board. The CPU may use these bits to detect what switchcard is attached.

Keyboard Scan

The RCP–2416 switchcard contains circuitry capable of scanning up to 64 pushbuttons. The scan circuit is arranged as an eight row by eight column array. While the circuitry is capable of serving 64 pushbuttons, the RCP-2416 uses only 42 pushbuttons. To scan the keyboard, the microprocessor on the CPU board performs read cycles that enable SEL1. This occurs for addresses in the range of 800h to FFFh. SEL1 provides a low-active chip select for a 3 to 8 line decoder (U3 pin 5). A second low-active chip select is provided by address bit A3 at U3 pin 4. The three least significant address bits (A0-A2) are connected to the input of the decoder (U3 pins 1, 2, and 3). One of the eight low-active outputs of the decoder is selected by placing the appropriate address on the input of the decoder. Since partial decoding is used, the keyboard circuitry is mapped to several addresses within the SEL1 address range. The software in the CPU only uses the lowest available addresses to access the keyboard. Table 4–2 contains the addresses used to access each row of the keyboard circuit.

Address	Row	U3 pin #
800h	KB_ROW0	15
801h	KB_ROW1	14
802h	KB_ROW2	13
803h	KB_ROW3	12
804h	KB_ROW4	11
805h	KB_ROW5	10
806h	KB_ROW6	9
807h	KB_ROW7	7

Table 4–2 Keyboard Memory Map

The CPU scans all eight rows of the keyboard. Each row of pushbuttons contains up to eight individual switches. Example: KB_ROW0 will simultaneously enable pushbuttons S1-S8. If any of these switches is pressed, the low-active signal will be passed through the pushbutton contacts to one of the eight column signals (KB_COL0-KB_COL7). If the pushbutton is not pressed, the switch contacts are broken and the column signal will be pulled high by resistor pack RP1. The SEL1 signal also enables U4 to place the KB_COL signals on the data bus. Thus, by performing a read

Switchcard Continued:

cycle at address 800h, the CPU can determine the state of pushbuttons S1-S8 by looking at the state of data bits D0-D7. If S1 is pressed, then D0 will be low. Likewise, if S2 is pressed, D1 will be low. The status of the entire keyboard array may be determined by performing successive reads of each row of the array.

LED Driver

The RCP–2416 switchcard contains circuitry capable of lighting up to 68 LEDs. The RCP–2416 uses only 42 of these LEDs, one per pushbutton. The drive for each LED is provided by U1or U2. The CPU sends a serial data stream to U1 and U2 by using the LED_DATA (pin 25) and LED_CLOCK (pin 24) signals. LED_SEL0 (U1 pin 26) must be asserted (low active) to update LEDs 1-34. Likewise, LED_SEL1 (U2 pin 26) must be asserted to update LEDs 35-50. The output current used to drive each LED is enabled by the brightness pin of the LED driver (pin 21). The LED_DATA line is latched into U1 and U2 on the rising edge of LED_CLOCK while LED_SEL0 or LED_SEL1 is asserted.

I/O Board Interface

Connector J3 provides the signals necessary to interface to an optional I/O board. The connector provides +5 Vdc (pin 1) and ground (pin 6) to power the external board. In addition, data bit D0 (pin 2), address bit A0 (pin 3), and chip select SEL5 (pin 4) are present on the connector. Pin 5 of the connector is connected to ID0, and is used to detect the presence or absence of the external board (see Switchcard ID, above).

5.1 General

THE RCP–2416 Control Panel is a solid state electro-mechanical device designed to give long, trouble free service with minimum maintenance requirements. If problems do occur, follow the troubleshooting procedure provided. If additional technical assistance is required, refer to the General Assistance and Service information in the front of the manual.

5.2 Preventive Maintenance

There is little need for preventive maintenance on the RCP–2416 other than the normal care which should be given to any quality electronic equipment.

5.3 Test Equipment

The test equipment recommended for servicing the RCP–2416 is listed below. Equivalent test equipment may be used.

EQUIPMENT	FUNCTION
Oscilloscope - 20 MHz or higher	Waveform Monitoring and Tracing
VOM - 20,000 ohms per volt or higher	Voltage and Resistance Measurements

5.4 Corrective Maintenance

The following paragraphs provide information to assist the servicing technician in maintenance of the RCP–2416. The functional description (Section 4) contains board/circuit level information to help identifying specific problems.

5.4 Corrective Maintenance Continued:

Factory Repair Service

If desired, equipment or boards may be returned to the factory (transportation prepaid) for repair. Refer to the General Assistance and Service information sheet in the front of this manual.

> **NOTE:** Pack the equipment securely and label with the correct address. Proper packaging saves money. The small amount of extra care and time it takes to cushion a part or unit properly may prevent costly damage while in transit. Make certain that the address is both legible and complete. Failure to do so often results in delay or even loss.

NOTE: Contact PESA Switching Sytems' Service Department (listed on the General Assistance and Service information sheet in the front of this manual) for a RMA# prior to shipping.

Adjustment/Alignment

The RCP–2416 has no adjustments.

Troubleshooting

Troubleshooting an RCP–2416 requires the routing switcher system to be used as a test fixture. The Panel does not function except as part of the system. The only troubleshooting which can be accomplished without opening the Control Panel is to check input power (from plug-in power module).

To open the Control Panel for troubleshooting, remove the front cover and disassemble the unit as far as required to gain access to the component side of the circuit boards. Place the disassembled panel on a non-conducting surface and arrange the parts so the unit can be operated. You must be able to operate the pushbuttons and observe the resulting status indicators. You must also have sufficient access to the boards to measure voltage or observe waveforms.

Procedure: Put the RCP–2416 through the operating sequence described in the operation section. Refer to Section 3.

5.4 Corrective Maintenance Continued:

Troubleshooting Continued:

If the Panel is nonresponsive, there may be a power problem or the CPU is not operating.

1. Refer to the POWER DISTRIBUTION discussion in Section 4. Refer to the CPU Board functional description in Section 4.

2. If power is functioning properly, the CPU is not operating. The CPU requires a clock, a power-up reset, communications from the Controller. Refer to the CPU Board functional description in Section 4.

For partial failures:

1. Pushbutton switches fail to initiate desired operation. Refer to the PUSHBUTTON SWITCH MATRIX discussion, in Section 4.

> **NOTE:** If a source input fails to function it may be a blocked input. Check the system configuration at the controller.

2. Control indicators fail to light. Refer to the LED Driver discussion in the functional description section.

3. Almost any type of functional failure can be caused by a memory failure. This type of failure can easily be checked if a substitute chip is available.