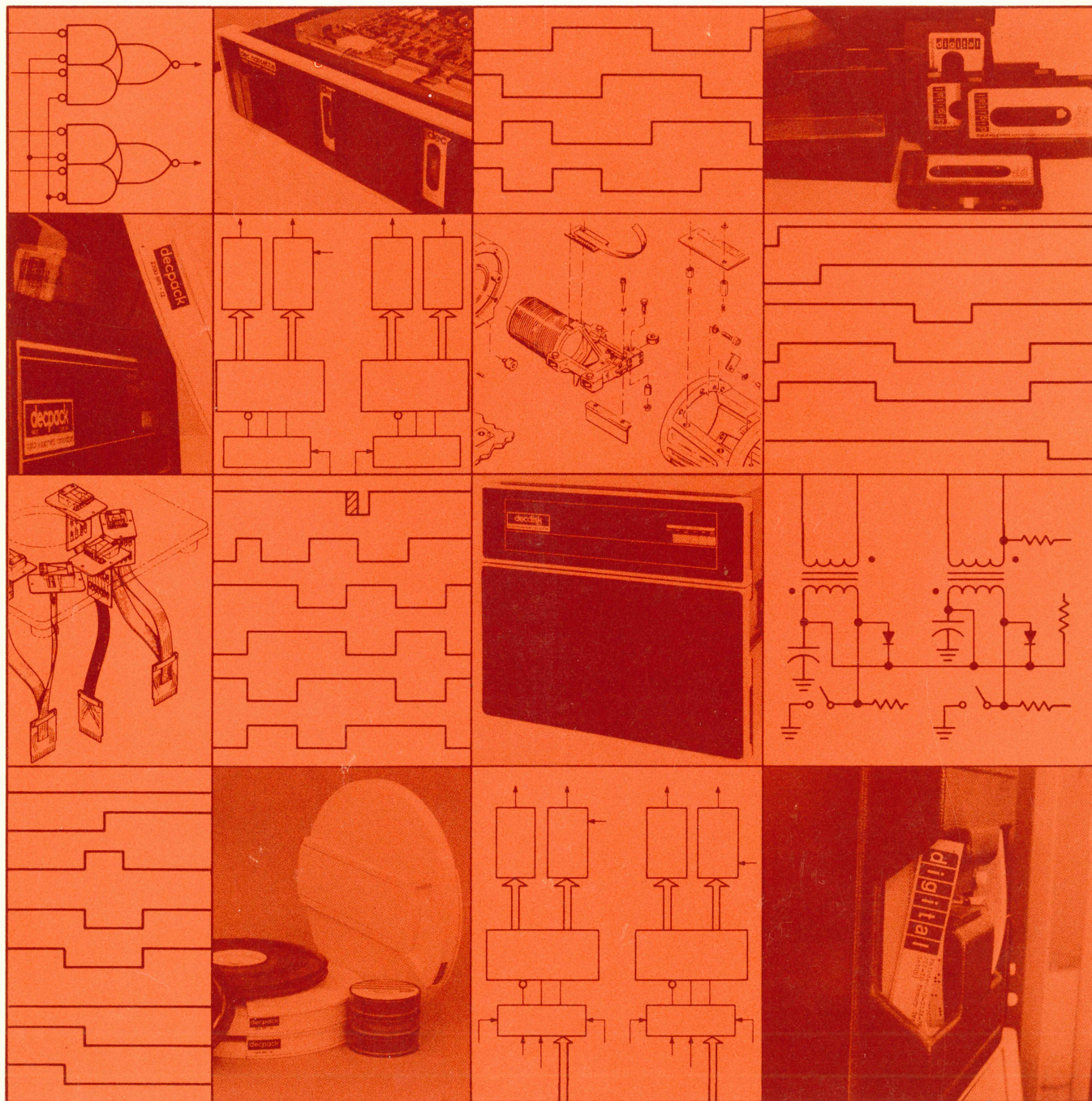
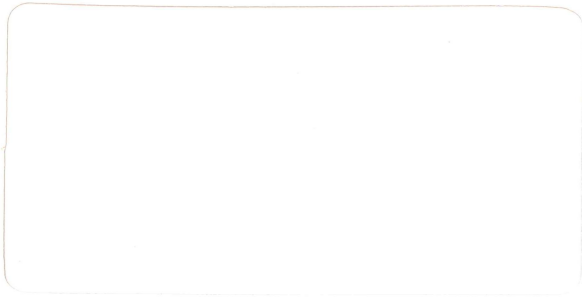


# digital

## 861-A,B,C,D,E,F power controller maintenance manual







**861-A,B,C,D,E,F  
power controller  
maintenance manual**

**EK-861AB-MM-002**

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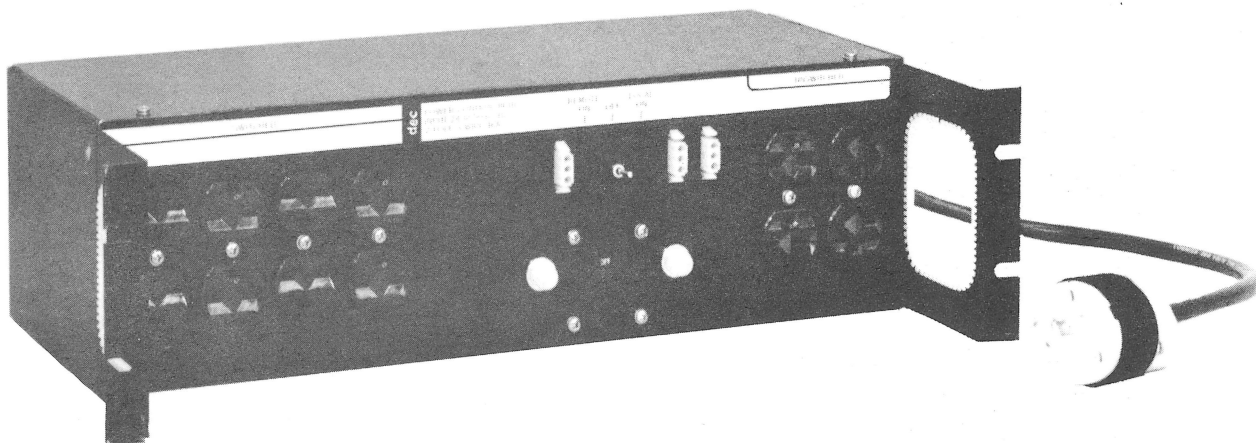
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**861-A,-B,-C,-D,-E,-F POWER CONTROLLER**





6496-5

861-A,-B,-C,-F Power Controller



7570-1

861-D,-E Power Controller

# CHAPTER 1

## INTRODUCTION

This manual provides information for installing, operating, and maintaining the 861-A, 861-B, 861-C, 861-D, 861-E, and 861-F Power Controllers, designed and manufactured by Digital Equipment Corporation.

### 1.1 GENERAL DESCRIPTION

The 861 Power Controllers provide a means for controlling and distributing power to data processing equipment.

All versions are contained on panels intended for mounting in racks or cabinets that accept standard 19-inch panels. Each power controller requires 5-3/16 inches of vertical mounting space. The 861-A, -B, -C, -F extends 8-1/4 inches into the mounting rack or cabinet and the 861-D, -E extends 11 inches into the mounting rack or cabinet.

The following versions are available to provide for a variety of input power configurations:

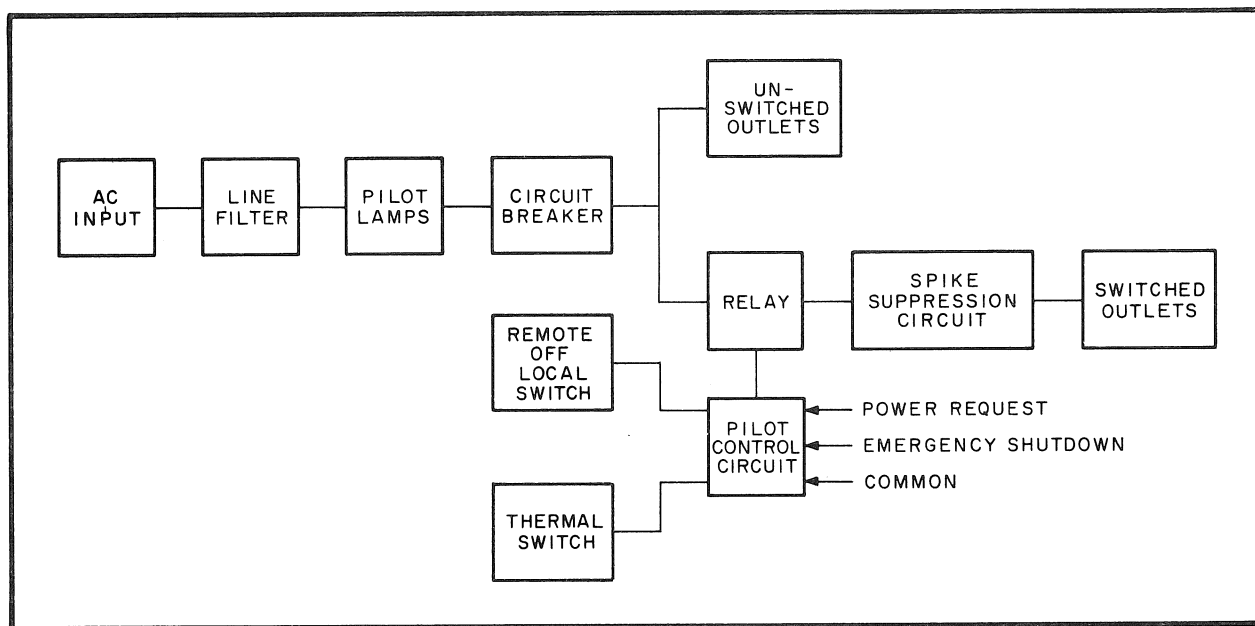
Figures 1-1 and 1-2 are simplified block diagrams of the 861 Power Controllers. Four basic functions are performed:

- a. Control of large amounts of power by control signals of small power content.
- b. Convenient distribution of primary power to controlled devices.
- c. Filtering of primary power to controlled devices.
- d. Automatic removal of primary power from controlled devices in case of overload or overtemperature conditions.

### 1.2 SPECIFICATIONS

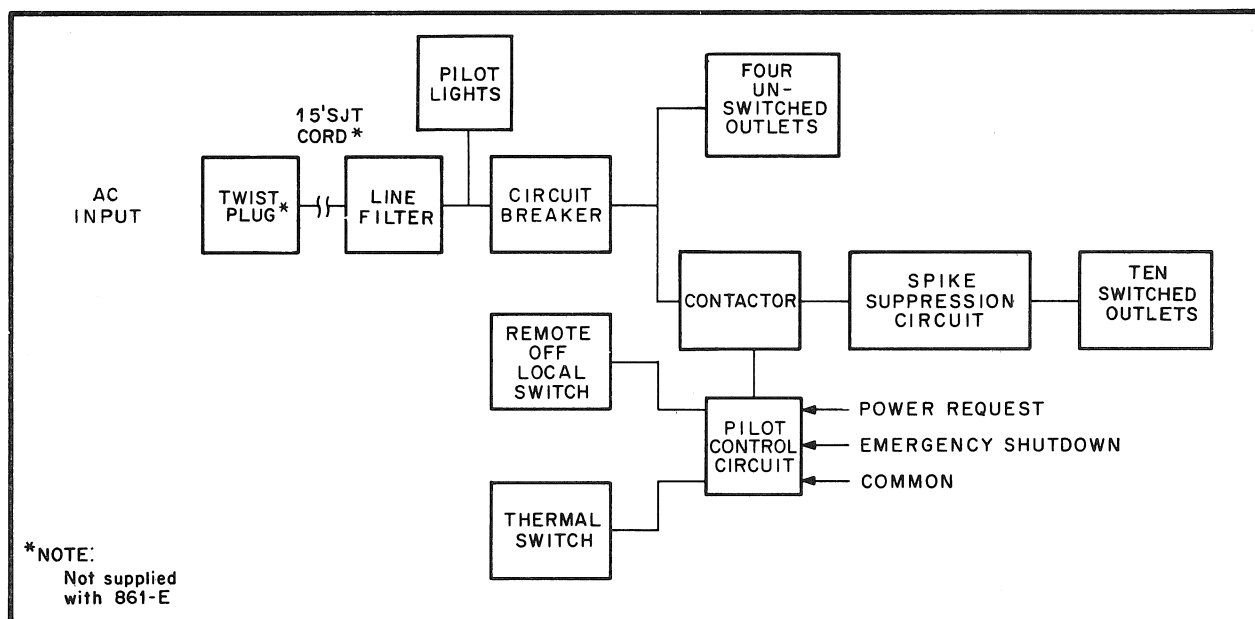
The following specifications are included here for reference purposes only and are subject to change without notice.

Version	Voltage	Hertz	Phase
861-A	90-135	47-63	Two (120° or 180° displaced)
861-B	180-270	47-63	Single
861-C	90-135	47-63	Single
861-D	90-132	47-63	Three (120° displaced)
861-E	180-264	47-63	Three (120° displaced)
861-F	90-135	47-63	Single



CP-0354

Figure 1-1 Simplified Block Diagram - 861-A,-B,-C,-F



CP-1735

Figure 1-2 Simplified Block Diagram - 861-D,-E



## 1.2.1 Mechanical And Environmental

### Dimensions

861-A,-B,-C,-F: 5 in. h x 19-1/8 in. w x 8 in. d (12.7 cm h x 48.5 cm w x 20.3 cm d)

861-D,-E: 5 in. h x 19-1/8 in. w x 11 in. d (12.7 cm h x 48.5 cm w x 27.9 cm d)

### Weight

861-A,-B,-C,-F: 10 lb (4.54 kg) (approx)

861-D,-E: 27 lb (12.26 kg) (approx)

### Cooling Method

Convection

### Mounting

Rack (standard 19 in.)

### Ambient Temperature

#### Operating

861-A,-B,-C,-F: 0° to +60° C

861-D,-E: 0° to +70° C

#### Storage

-40° to 71° C

### Relative Humidity

95% max (no condensation)

### Altitude

861-A,-B,-C,-F: 10,000 ft (max)

861-D,-E: 8000 ft (max)

## 1.2.2 Electrical

### Input Power

#### Voltage

861-A,-C,-F: 90 Vac – 135 Vac; 861-B: 180 Vac – 270 Vac; 861-D: 90 Vac – 132 Vac; 861-E: 180 Vac – 264 Vac

#### Phase

861-A: Two (120° or 180° displaced); 861-B,-C,-F: Single; 861-D,-E: Three (120° displaced)

### Frequency

47 Hz – 63 Hz

### Current

861-A: 16A per pole; 861-B: 16A per pole; 861-C: 24A per pole; 861-D: 24A per pole; 861-E: 15A per pole; 861-F: 12A per pole.

### Power Requirements

#### Full Load

861-A: 3830 VA; 861-B: 3830 VA; 861-C: 2870 VA; 861-D: 8640 VA; 861-E: 10,800 VA; 861-F: 1435 VA

#### No Load

861-A,-B,-C,-D,-E,-F: 10 VA

### Inrush Current Capability

240 A peak, 1 cycle

### Leakage Current

861-D: 1.75 mA max. 861-E: 3.5 mA max.

### Input Overvoltage Transient

180/360 V, 1 sec (power controller alone)

### Activate Time

20 ms (from switch closing to power out)

### Deactivate Time

10 ms (from switch opening to power out)

### Input Breaker

861-A,-B,-C: 20 A delayed action, manual reset, magnetic  
861-D: 30 A delayed action, manual reset, magnetic  
861-E: 15 A delayed action, manual reset, magnetic  
861-F: 10 A delayed action, manual reset, magnetic

### Thermoswitch

Opens at 160°F, automatically resets at 120°F, 49° C (exposed to ambient air external to controller)

#### Input Power Connector

861-A: 4-prong twist plug, NEMA\* L14-20P;  
861-B: 3-prong twist plug NEMA L6-20P;  
861-C: 3-prong twist plug NEMA L5-30P;  
861-D: 5-prong twist plug, NEMA L21-30P;  
861-E: pressure fit terminal block;  
861-F: 3-prong standard plug NEMA L5-15P.

#### Hipot

2.1 kVdc for 60 sec (input and output to chassis).

#### Remote Switching Control Connectors

3 each: Female, AMP 1-480304-0 (DEC-12 09350-03) with AMP 61117-4 (DEC-12-09379) pins or equivalent that mate with AMP 1-480305-0 (DEC-12-09351) with AMP 61118-4 (DEC-12-09378) pins or equivalent

#### Input Signal Current Levels

861-A,-B,-C,-F: 0.5 mA (min), 10 mA (max);  
861-D,-E: 0.5 mA (min), 40 mA (max) load worst case to each bus signal line when connected to pin 3.

#### Input Signal Voltage Levels

861-A,-B,-C,-F: 3.0 V max = low; +35 V min = high (open circuit = high); 861-D,-E: +3.0 V max = low; +32 V min = high. Worst case to each bus signal line in relation to pin 3.

#### Bus Signal Line Overload Capability

125 Vac rms @ 60 Hz, 13 k $\Omega$  impedance in relation to pin 3 for two seconds with no damage

#### Power Control Impedance

Inductive (diode suppressed)

#### Capacitance

200 pF (max)

#### Output (861-A,-B,-C,-F)

##### Outlets (power)

Twelve (8 switched, 4 unswitched)

##### Outlet Current Ratings

861-A: 12 A per outlet, 16 A per branch circuit, 32 A total; 861-B: 12 A per outlet, 16 A total; 861-C: 12 A per outlet, 16 A per branch circuit, 24 A total; 861-F: 6 A per outlet, 8 A per branch circuit, 12 A total.

##### Outlet Inrush Current

861-A: 240 A peak per branch circuit (1 cycle), 480 A peak total (1 cycle); 861-B: 240 A peak total (1 cycle); 861-C: 240 A peak per branch circuit (1 cycle), 360 A peak total (1 cycle); 861-F: 120 A peak per branch circuit (1 cycle), 180 A peak total (1 cycle).

#### Output (861-D,-E)

##### Outlets (power)

Fourteen (10 switched, 4 unswitched)

##### Outlet Current Ratings

861-D: 15 A per outlet, 24 A per phase, 72 A total; 861-E: 12 A per outlet, 15 A per phase, 45 A total.

##### Outlet Inrush Current

240 A peak per branch circuit (1 cycle)

All provisions of Underwriters Laboratories Specification UL-478 have been met in the design and manufacture of the 861-A, 861-B, 861-C, 861-D, 861-E and 861-F Power Controllers.

---

\*National Electrical Manufacturer's Association

## CHAPTER 2 INSTALLATION

### 2.1 SITE CONSIDERATIONS

The dimensions of the 861-A,-B,-C, and -F Power Controllers are identical. Each is contained on a 19-inch panel intended for mounting on a rack or in a cabinet that accepts standard 19-inch panels. Each power controller requires 5-1/4 inches of vertical mounting space and extends approximately 8 inches into the mounting rack or cabinet. For convenience, the power controller should be mounted as close as feasible to the units it controls.

The dimensions of the 861-D and -E Power Controllers are identical. Each is contained on a 19-inch panel intended for mounting on a rack or in a cabinet that accepts standard 19-inch panels. Each power controller requires 5-1/4 inches of vertical mounting space and extends approximately 11 inches into the mounting rack or cabinet. For convenience, the power controller should be mounted as close as feasible to the units it controls.

Ambient temperature at the installation site should not exceed +60°C; for the 861-A,-B,-C,-F or +70°C for the 861-D,-E; relative humidity should remain below 95 percent, with no condensation. For other environmental particulars, refer to Paragraph 1.2.

### 2.2 CABLES

Each power controller requires the following cables:

- a. Input Power (provided with 861-A,-B,-C,-D,-F only)
- b. Remote Switching Control, DEC No. 70-08288, 70-10695, or equivalent (not provided)
- c. Output Power (provided with controlled units)

These cable assemblies are described in the following paragraphs.

#### 2.2.1 Input Power

The type of input power cable depends on which version of the power controller is being installed. Table 2-1 describes the input power cables. Cables supplied are 15 feet in length and are composed of insulated stranded conductors. (Cables with a grounded shield braid are recommended for EMI/RFI protection.)

The power cable connector types provided also differ depending upon which 861 version is being installed. Table 2-2 lists the plug and receptacle types with NEMA and DEC designations. Figure 2-1 shows the power connector outlines and provides color coding information.

The input power cable connects to the 4-terminal block at the side of the line filter. In 861-A installations, the following connections must be made:

- a. Green - N (Earth Ground)
- b. Black - C (Phase 2)
- c. White - B (Neutral)
- d. Red - A (Phase 1)

In 861-B installations the following connections must be made:

- a. Green - N (Earth Ground)
- b. White - B (Phase or Neutral)
- c. Black - C (Phase or Neutral)
- d. No Connection - A

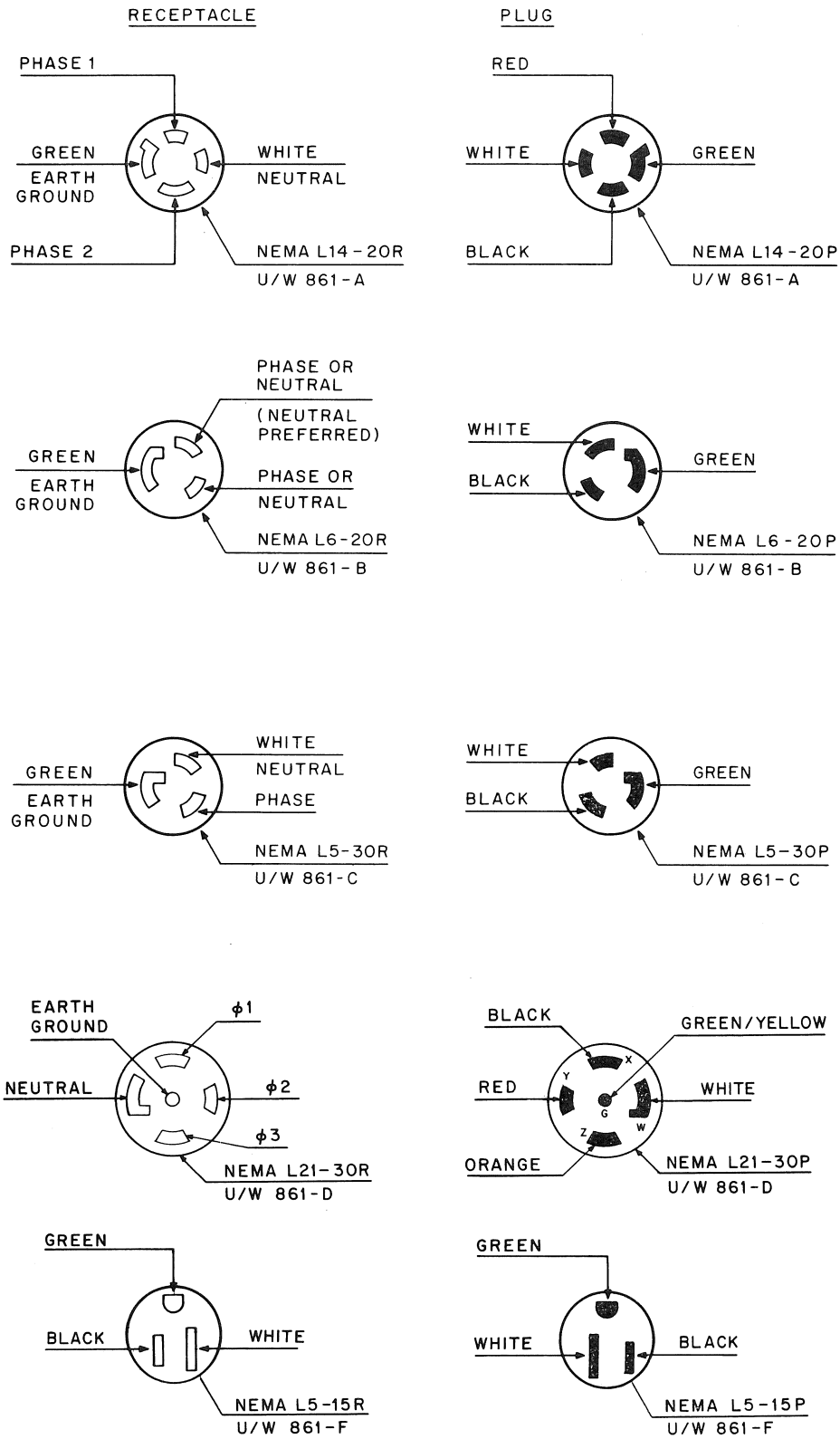


**Table 2-1**  
**Input Power Cables**

Controller	Conductors	Size	Coding
861-A	4	#12 AWG	Green, black, white, red
861-B	3	#14 AWG	Green, black, white
861-C	3	#12 AWG	Green, black, white
861-D	5	#10 AWG	Green/yellow, black, white, red, orange
861-E	5	#14 AWG (Shielded)	Green/Yellow, black, black, brown, blue (not provided)
861-F	3	#14 AWG	Green, black, white

**Table 2-2**  
**Input Power Cable Connectors**

		NEMA No.	DEC No.
861-A	4-Prong Twist Plug	L14-20P	12-11045
	4-Prong Twist Receptacle	L14-20R	12-11046
861-B	3-Prong Twist Plug	L6-20P	12-11192
	3-Prong Twist Receptacle	L6-20R	12-11191
861-C	3-Prong Twist Plug	L5-30P	12-11193
	3-Prong Twist Receptacle	L5-30R	12-11194
861-D	5-Prong Twist Plug	L21-30P	12-12314
	5-Prong Twist Receptacle	L21-30R	12-12315
861-E	(Not provided)		
861-F	3-Prong Plug	L5-15P	90-08938
	3-Prong Receptacle	L5-15R	12-05351



11-3202

Figure 2-1 Connector Wiring

In 861-C,-F installations, the following connections must be made:

- a. Green – N (Earth Ground)
- b. White – A (Neutral)
- c. Black – B (Phase)

In 861-D installations, the following connections must be made:

- a. Green/yellow – N (Earth Ground)
- b. Black – (Phase 1)
- c. White – (Neutral)
- d. Red – (Phase 2)
- e. Orange – (Phase 3)

#### NOTE

**The 861-E Power Controller is not supplied with an ac power cord and connector. It is shipped with a strain relief installed. Local electrical codes should be referenced for the size and type of power cord and connector used.**

#### 2.2.2 Remote Switching Control

Three female bus connectors, wired in parallel, are provided on the front panel for accepting and re-routing the Remote Switching Control Bus. Each is an AMP Mate-N-Lok type AMP 1-480304-0 (DEC-12-0-350-3) with AMP G117-4 (DEC-12-09379) pins or equivalent.

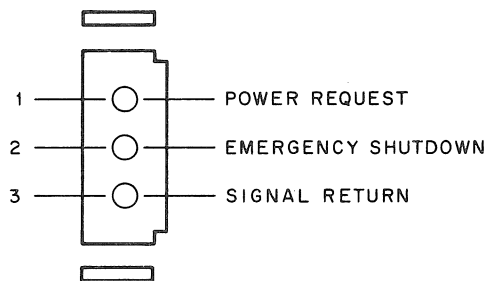
Connections between units are effected with from one to three cable assemblies of 3-conductor stranded #22 AWG cable terminated at each end with male connectors. These are AMP 1-480305 (DEC-12-09351) with AMP 61118-4 (DEC-12-09378) pins or equivalent. Cable assembly details are shown on drawing DEC-70-08288. Color coding is as follows:

- a. Pin 1 – Red
- b. Pin 2 – Black
- c. Pin 3 – Green

Remote Switching Control Bus lines connect the Signal Return, Power Request, and Emergency Shutdown lines from the processor and system devices to the power controller in systems employing compatible automatic control features. These lines are low for assertion. Figure 2-2 shows one female connector viewed from the front.

#### 2.2.3 Output Power

Power for the 861-A,-B,-C,-F is provided to controlled units from the 12 convenience outlets (8



CP-0355

Figure 2-2 Signal Bus Connector

switched, 4 unswitched). Power cables must be terminated with standard 3-prong male connectors (NEMA 5-15P for the 861-A,-C,-F and NEMA 6-15P for 861-B) to mate with the female connectors (NEMA 5-15R for the 861-A,-C,-F and NEMA 6-15R for 861-B) on the panel.

Power for the 861-D,-E is provided to controlled units from the 14 convenience outlets (10 switched, 4 unswitched). Power cables must be terminated with standard 3-prong male connectors (NEMA 5-15P or 5-20P for the 861-D and NEMA 6-15P for the 861-E) to mate with the female connectors (NEMA 5-15R or 5-20R for the 861-D and NEMA 6-15R for the 861-E) on the panel.

#### 2.3 GROUNDING

A good return ground is essential to proper power controller operation. A secure electrical connection must exist between the controller and the frame of the associated rack or cabinet. To accomplish this, (861-A,-B,-C,-F) use a 10-32 nut with serrated washer and a 10-32 bolt with serrated washer in at least one of the four mounting holes. For the 861-D,-E, use a serrated washer and a 10-32 bolt with serrated washer in a 10-32 press nut on the rear of the controller.

#### 2.4 INITIAL OPERATION

Before applying primary power to the power controller, determine that the power at the mains is of the correct value for the particular 861 version being installed and that all cables are connected correctly.

#### NOTE

**If the controller is being installed in a system where the Emergency Shutdown and Power Request lines are not in use, the LOCAL/OFF/REMOTE switch must be in the LOCAL position.**



In systems where the Emergency Shutdown and Power Request lines (or their equivalents) are to be used, provisions must exist for connecting pin 1 to pin 3 when normal operation is desired (power is supplied to the controlled devices through the switched outlets). Provision must also exist for connecting pin 3 to pin 2 if an Emergency Shutdown feature is to be implemented.

Once it has been determined that correct power exists at the mains and that all cabling is correct, and before connecting any devices to the power outlets, connect the controller power plug to the appropriate receptacle. All pilot lamps on the panel should light. The circuit breaker(s) on the panel should be thrown to the ON position and the LOCAL/OFF/REMOTE switch to the LOCAL position. Measure the voltage at the switched and unswitched outlets. If the measured values are cor-

rect for the power controller in use, the power controller should be shut down, the loads connected to the switched and unswitched outlets\*, and the circuit breaker(s) thrown ON again. The system should now operate. If the circuit breaker trips, or other abnormality exists, refer to the maintenance information in Chapter 5.

If the Emergency Shutdown feature is in use, check that the power controller responds properly to shutdown requests from each external device.

Also, if required, the operation of the thermally-activated overtemperature switch can be checked by holding a match in proximity to the sensing element and observing that the switched outlets are disabled. The thermal switch should reset automatically after a brief period, once the flame is removed.

---

\*Loads should be balanced between circuits.



## CHAPTER 3 OPERATION

### 3.1 CONTROLS AND INDICATORS

Figure 3-1 shows the front panels for the 861-A, 861-B and 861-C Power Controllers. Each version has two pilot lamps, a circuit breaker, a 3-position toggle switch, and several power outlets. Their functions are discussed in the following paragraphs.

Figure 3-2 shows the front and back panels for the 861-D and 861-E Power Controllers. Each version has three pilot lamps, a main circuit breaker, a 3-position toggle switch, and several power outlets. In addition, the 861-D has six branch circuit breakers. Their functions are discussed in the following paragraphs.

Figure 3-3 shows the front panel for the 861-F Power Controller. Controls, indicators and outlets are the same as for the 861-C.

#### 3.1.1 Pilot Lamps

In all 861 Power Controller versions, all pilot lamps are lighted whenever the controller input power cable is connected to the live mains, regardless of the position of the power controller circuit breaker or LOCAL/OFF/REMOTE switch.

#### 3.1.2 Circuit Breaker

Circuit breaker CB1, when ON, provides power to the unswitched outlets, and to the switched outlets when the LOCAL/OFF/REMOTE switch is in the LOCAL position (or in the REMOTE position and a connection exists between pins 1 and 3 of a Remote Switching Control Bus connector\*). The circuit breaker opens automatically when an overload condition exists at a power outlet or within the power controller.

\*A connection between pins 2 and 3 of the Remote Switching Control Bus disables the switched outlets, regardless of the position of the LOCAL/OFF/REMOTE switch.

The following are the outlet current ratings:

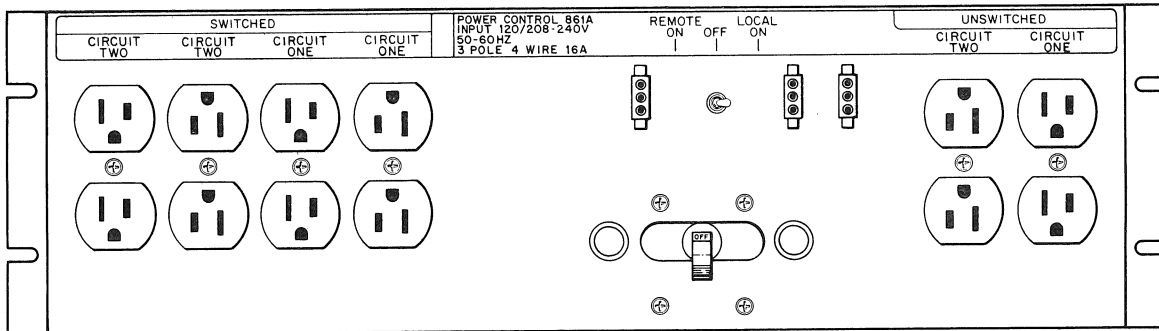
Version	Per Outlet	Per Branch/Phase	Total
681-A	12A	16A	32A
681-B	12A	16A	16A
861-C	12A	16A	24A
861-D	15A	24A	72A
861-E	12A	15A	45A
861-F	6A	8A	12A

#### 3.1.3 LOCAL/OFF/REMOTE Switch

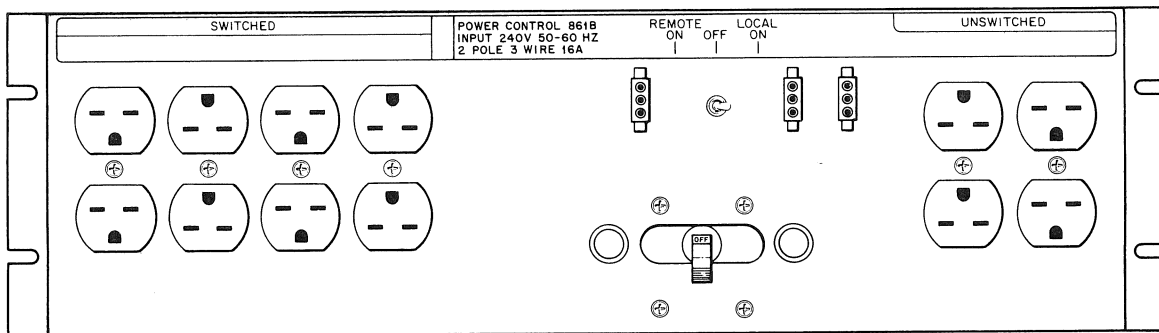
The LOCAL/OFF/REMOTE switch provides the Remote Switching Bus with the means to control the power to the switched outlets. When the power controller is energized and the switch is in the OFF position, the switched outlets are disabled. When in the REMOTE position and connected to a bus where Power Request and Emergency Shutdown are in use (or a means of effecting connection between pin 3 and pins 1 or 2 exists), the switched outlets are enabled or disabled in accordance with conditions on the bus. When in the LOCAL position, the switched outlets are enabled only when the Emergency Shutdown signal is not asserted.

#### 3.1.4 Remote Switching Control Bus Connectors

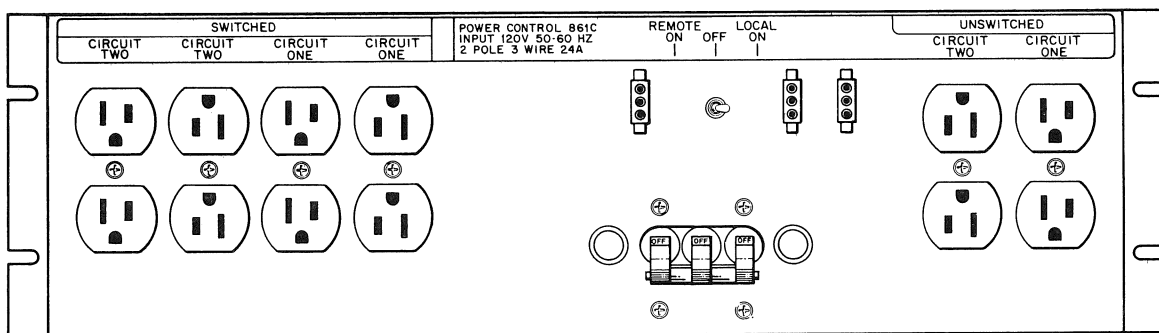
The three female Signal Bus connectors, adjacent to the LOCAL/OFF/REMOTE switch, are wired in parallel. These connectors provide a means of daisy-chaining the Remote Switching Control Bus between the controller and system devices.



861-A

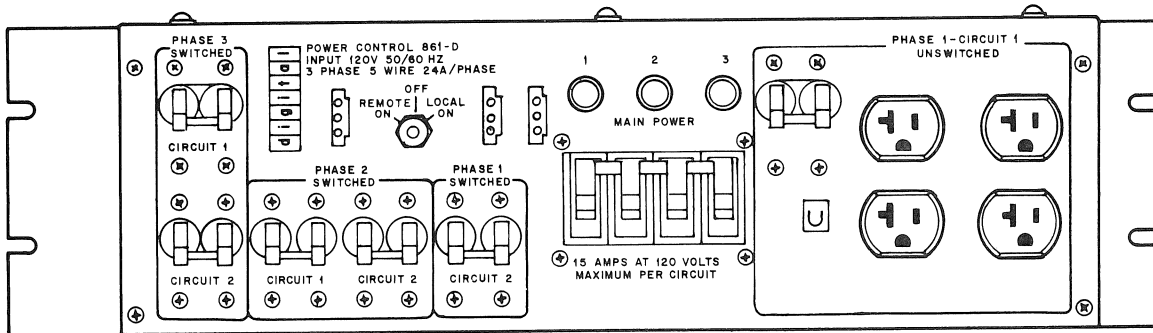


861-B

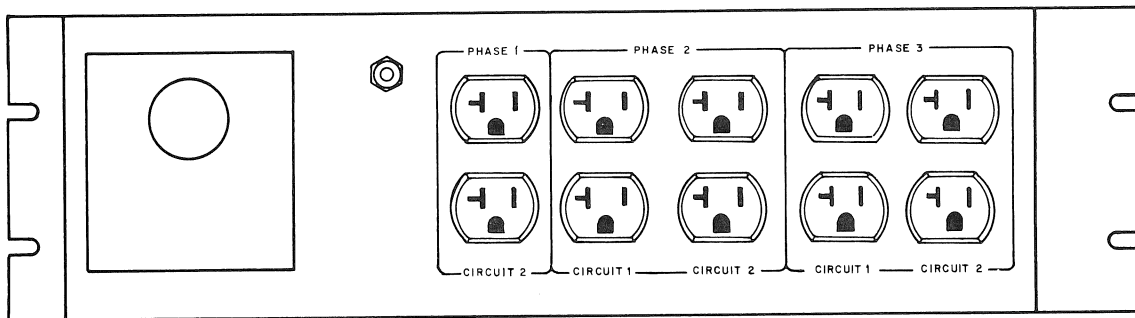


861-C

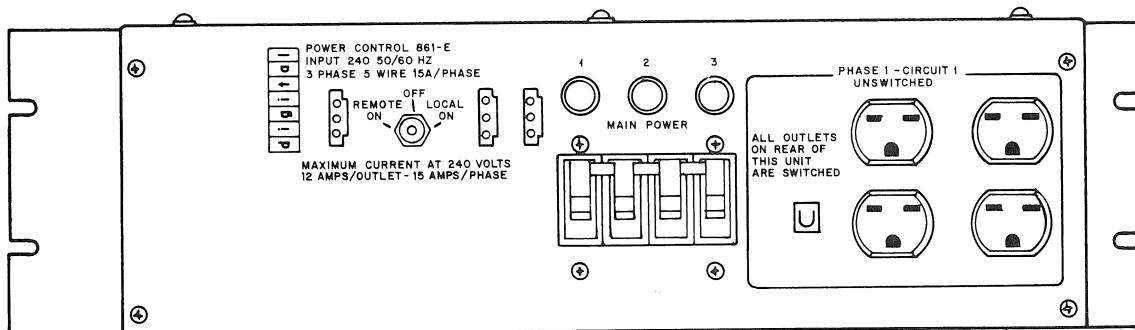
Figure 3-1 Type 861-A,-B,-C Power Controller Panels



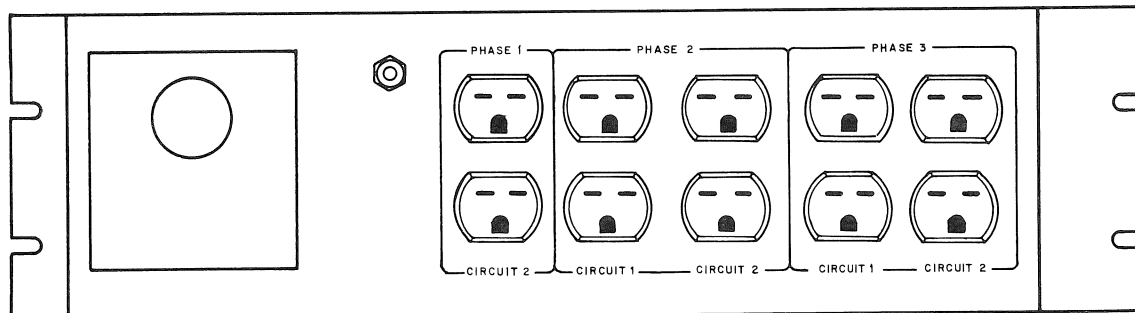
861-D (Front Panel)



861-D (Back Panel)



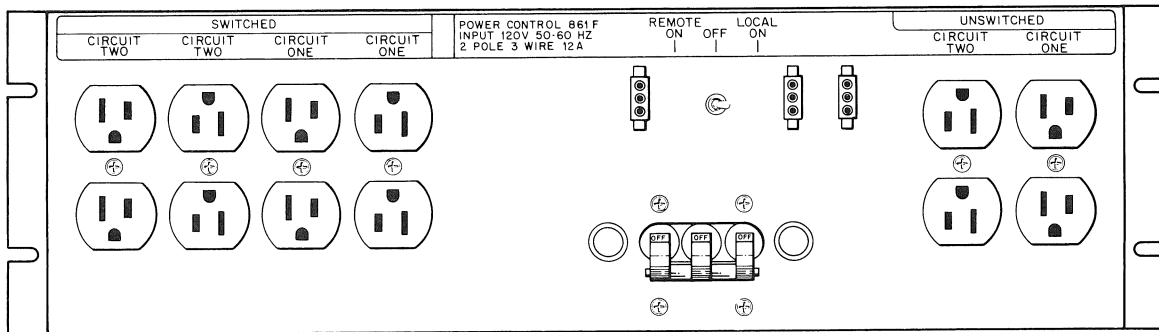
861-E (Front Panel)



861-E (Back Panel)

CP-1730

Figure 3-2 Type 861-D,-E Power Controller Panels



CP-1731

Figure 3-3 Type 861-F Power Controller Panel

### 3.1.5 Power Outlets

Two groups of power outlets are provided on the panel. The group containing eight (861-A,-B,-C,-F) or ten (861-D,-E) receptacles is the switched group. Under normal conditions, power is available at these outlets when the LOCAL/OFF/REMOTE switch is in the LOCAL position, or when in the REMOTE position and a connection exists between pins 1 and 3 of the Remote Switching Control Bus connector. Power is removed from these outlets by any of the following:

- Main circuit breaker in OFF position, (or branch circuit breakers OFF if 861-D.)
- LOCAL/OFF/REMOTE switch in the OFF position.
- LOCAL/OFF/REMOTE switch in the REMOTE position and no connection exists between the lines associated with pins 1 and 3 of the Remote Switching Control Bus Connectors.

- LOCAL/OFF/REMOTE switch in the REMOTE or LOCAL position and a connection exists between the lines associated with pins 3 and 2 of the Remote Switching Control Bus connectors (Emergency Shutdown signal asserted).

- Overtemperature switch closed.

The group containing four power outlets is not controlled by the Remote Switching Control Bus. Power is available at these outlets when the main circuit breaker is closed and the power controller is connected to the live mains. (861-D: branch circuit breaker also closed.)

### 3.1.6 Overtemperature Switch

A thermally-activated switch is provided to disable the controlled outlets in the event of an over-temperature condition at the power controller. The switch opens at 160° F and resets automatically when the ambient temperature at the power controller drops below 120° F.

## CHAPTER 4

### THEORY OF OPERATION

#### 4.1 GENERAL

Although the six versions of the 861 Power Controller are quite similar, they are discussed separately in the following paragraphs to maintain clarity. The pilot control board is identical in each version and is therefore described once.

#### 4.2 TYPE 861-A CIRCUIT DESCRIPTION

Figure 4-1 is an 861-A simplified circuit schematic. The 861-A is the 90 – 135 Vac, 47 – 63 Hz, two-phase version of the power controller.

Power is applied to the terminal block mounted on the power line filter. This filter contains 0.1  $\mu$ F capacitors, which connect between neutral and each of the two phase lines and ground. Also contained in the filter are four chokes, connected in series with each of the three lines and ground. The capacitors provide low impedance paths to ground for high frequency line components. The chokes present a high impedance to these components. If 90 – 135 Vac exists between phase 2 and neutral, I1 lights. Similarly, if 90 – 135 Vac is present between phase 1 and neutral, I2 lights. All three lines are connected to 20 A elements at the circuit breaker, CB1. All loads connected to the power controller (both switched and unswitched) are controlled by CB1.

If the current through any of the three lines exceeds 20 A, CB1 trips, removing power from the loads. Power outlets P1 and P2 connect across the circuit breaker output. These outlets are energized (90–135 Vac) whenever the circuit breaker is closed. Each outlet line from CB1 is connected to a normally open contact on relay K1. The field coil associated

with K1 is energized by 90–135 Vac from the output of CB1 if a relay on the pilot control board is closed (see Paragraph 4.8 for a description of the pilot control board).

When K1 is closed, 90–135 Vac is applied across outlets P3, P4, P5, and P6. The two 0.1  $\mu$ F capacitors (C1), connected across the lines at the relay, reduce the amplitude of voltage spikes at the output of the controller when switching inductive loads, thereby preventing interference to nearby electronic data processing equipment.

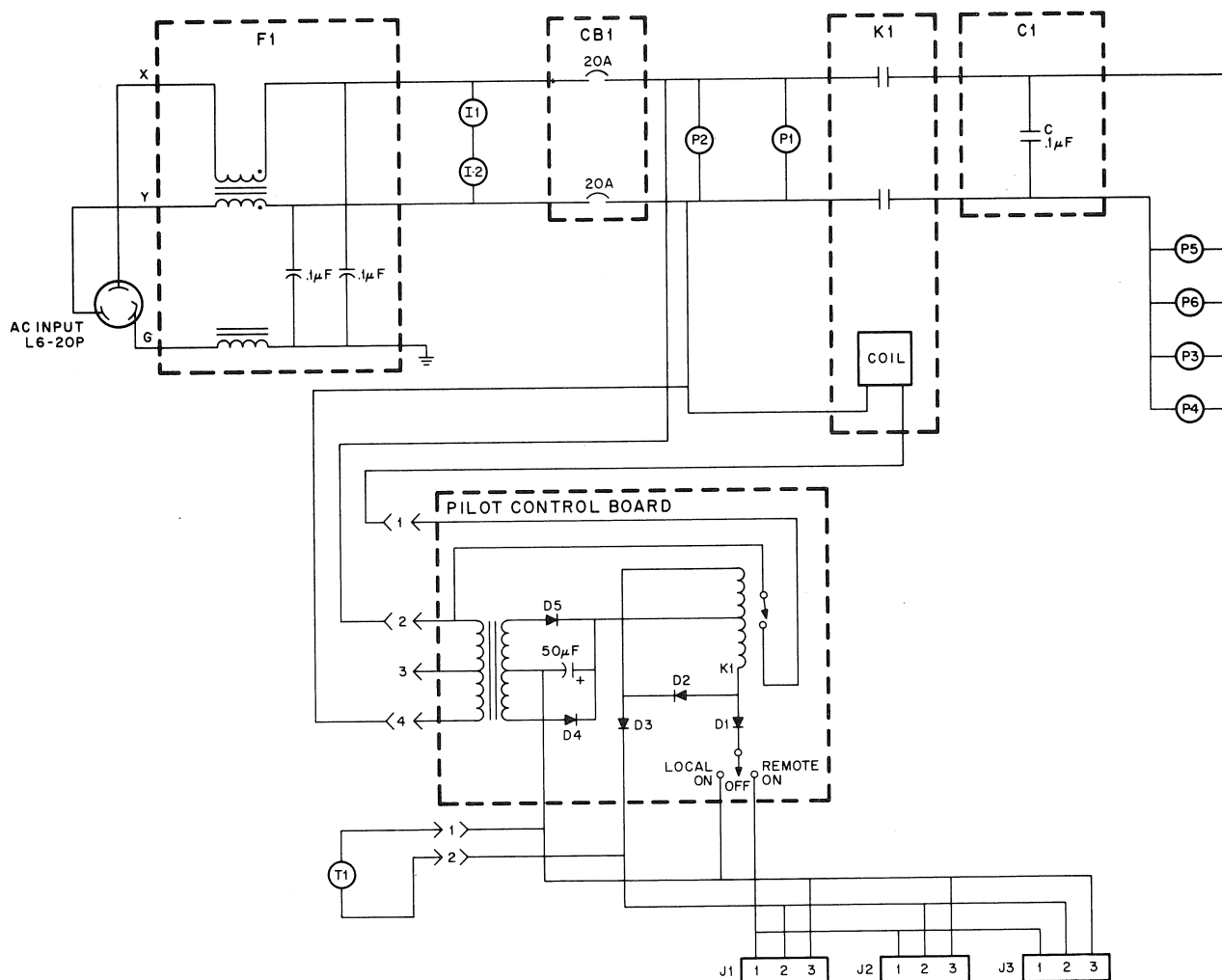
#### 4.3 TYPE 861-B CIRCUIT DESCRIPTION

Figure 4-2 is a simplified circuit schematic of the 861-B, the 180–270 Vac, 47–63 Hz, single-phase version of the power controller.

Power is applied to the terminal block mounted on the power line filter. This filter contains 0.1  $\mu$ F capacitors which connect between each side of the 180–270 Vac line and ground. Also contained in the filter are three chokes connected in series with each of the two lines and ground. The capacitors provide low impedance paths to ground for high frequency line components. The chokes present a high impedance to these components. If 180–270 Vac is present across the lines at the output of the line filter, both I1 and I2 (connected in series) light. Each side of the line connects to a 20 A element of circuit breaker CB1. All loads connected to the power controller (both switched and unswitched) are controlled by CB1. If the current through either line exceeds 20 A, CB1 trips, removing power from the load. Power outlets P2 and P1 connect across the output of CB1. These outlets are energized







CP-0358

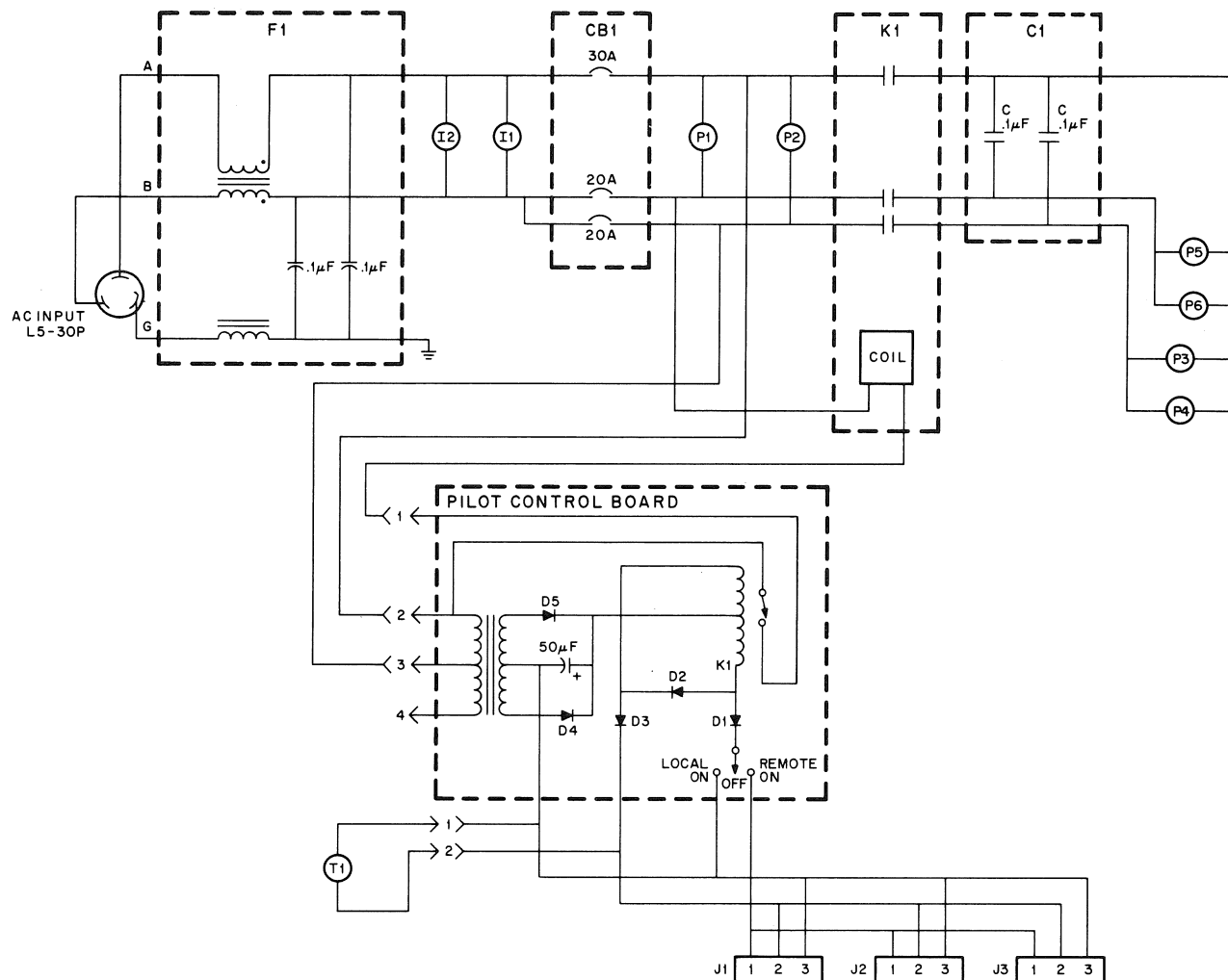
Figure 4-2 861-B Simplified Circuit Schematic Diagram

to these components. If 90–135 Vac exists across the output of the line filter, pilot lamps I2 and I1 (connected in parallel) light. The neutral line is connected to a 30 A element at circuit breaker CB1. The phase line is branched; each resulting line connects to a separate 20 A element at CB1. All loads connected to the power controller (both switched and unswitched) are controlled by CB1. If the current through the upper (shared) line exceeds 30 A, or if the current in either of the remaining lines exceeds 20 A, the circuit breaker trips, removing power from the load. Power outlets P1 and P2 connect across the output of CB1. These outlets are energized (95–130 Vac) whenever the circuit breaker is closed.

Each output line from CB1 connects to a normally open contact on relay K1. The field coil associated with K1 is energized by 90–135 Vac from the output of CB1 if a relay on the pilot control board (Paragraph 4.8) is closed. When K1 is closed, 90–135 Vac is applied across outlets P3, P4, P5, and P6. The two 0.1 μF capacitors, connected across the lines at the relay, reduce the amplitude of voltage spikes when switching inductive loads, thereby preventing interference to nearby electronic data processing equipment.

#### 4.5 TYPE 861-D CIRCUIT DESCRIPTION

Figure 4-4 is an 861-D simplified circuit schematic. The 861-D is a 90–132 Vac, 47–63 Hz, three-phase Power Controller.



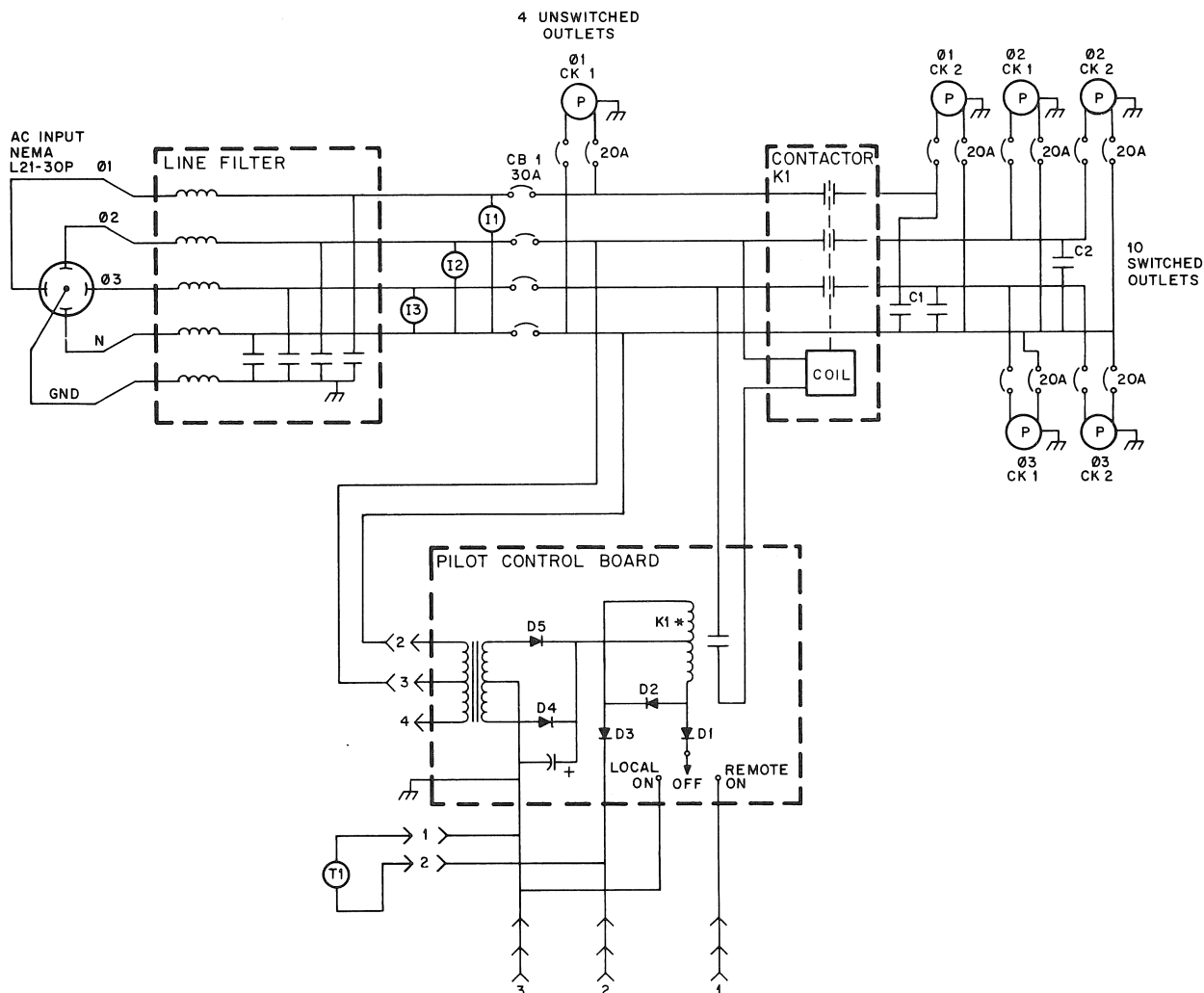
CP-0357

Figure 4-3 861-C Simplified Circuit Schematic Diagram

Power is applied to the terminal block mounted on the power line filter via a 15-foot line cord. This filter contains  $.03 \mu\text{F}$  capacitors which connect between neutral and each of the three phase lines and ground. Also contained in the filter are nine chokes, two connected in series with each of the four lines and one to ground. The capacitors provide low impedance paths to ground for high frequency line components. The chokes present a high impedance to these components. If 90-132 Vac exists between phase 1 and neutral, I1 lights. If 90-132 Vac is present between phase 2 and neutral, I2 lights. Similarly, if 90-132 Vac is present between phase 3 and neutral, I3 lights.

All three lines are connected to 30 A elements at the circuit breaker CB1. All loads connected to the power controller (both switched and unswitched) are controlled by individual 20 A circuit breakers.

If the current through any of the lines exceeds 20 A, the respective circuit breaker trips, removing power from the loads. Phase 1, circuit 1 outlets connect across the main circuit breaker output. These outlets are energized (90-132 Vac) whenever the circuit breaker is closed. All outlet lines from CB1 are connected to a normally open contact on contactor K1. The field coil associated with K1 is energized by 156-229 Vac from the output of CB1 if a relay



CP-1732

Figure 4-4 861-D Simplified Circuit Schematic Diagram

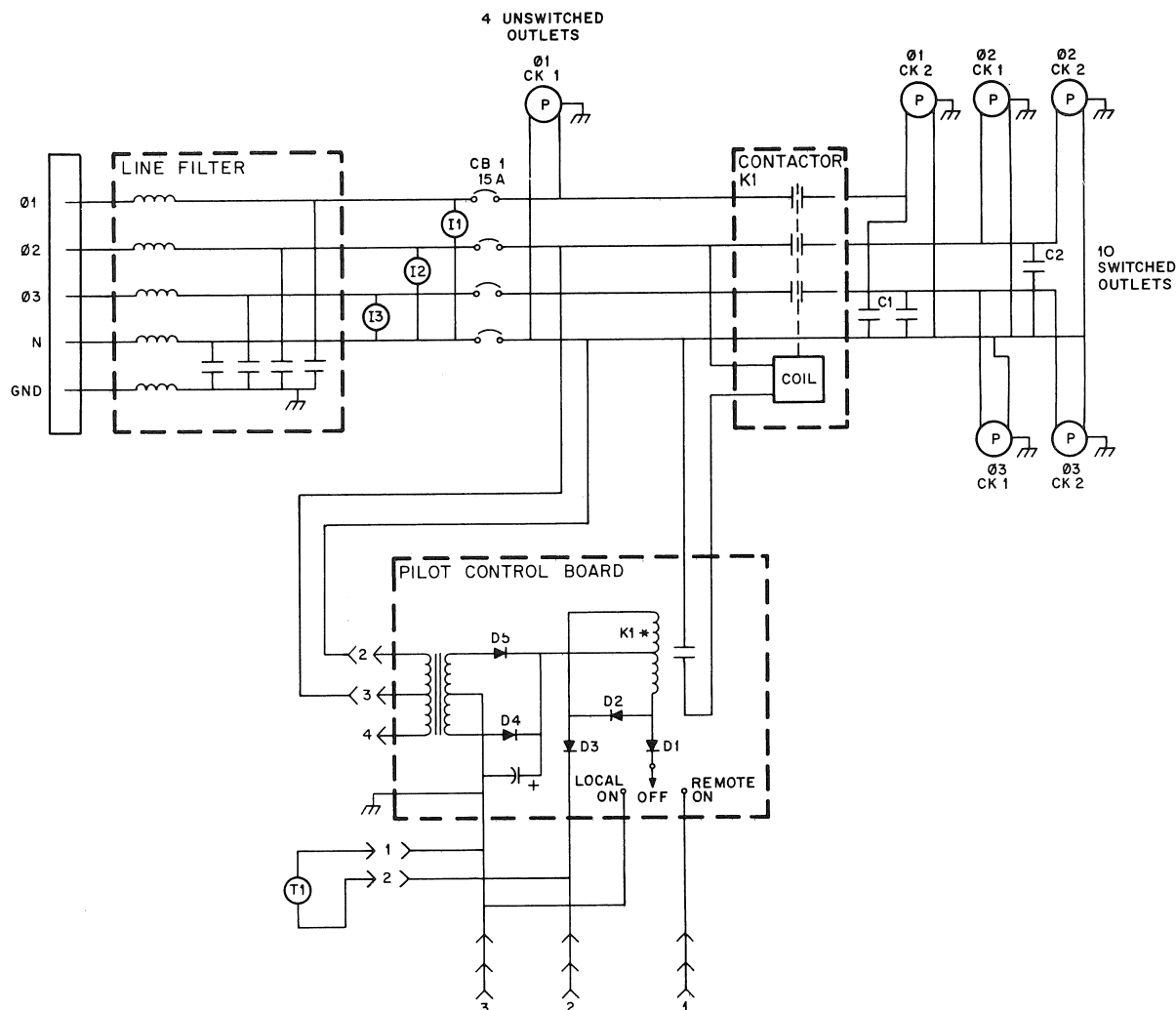
(K1\*) on the pilot control board is closed (see Paragraph 4.8 for a description of the pilot control board).

When K1 is closed, 90–132 Vac is applied across Phase 1, circuit 2, Phase 2, circuits 1 and 2, and Phase 3, circuits 1 and 2. The three 0.1  $\mu$ F capacitors (C1 and C2), connected across the lines at the output of the controller when switching inductive loads, thereby preventing interference to nearby electronic data processing equipment.

#### 4.6 TYPE 861-E CIRCUIT DESCRIPTION

Figure 4-5 is a simplified circuit schematic of the 861-E, the 180–264 Vac, 47–63 Hz, three-phase version of the Power Controller.

Power is applied to the terminal block mounted on the power line filter. This filter contains .03  $\mu$ F capacitors which connect between neutral and each of the 3-phase, 180–264 Vac line and ground. Also contained in the filter are nine chokes, two connected in series with each of the four lines and one to ground. The capacitors provide low impedance paths to ground for high frequency line components. The chokes present a high impedance to these components. If 180–264 Vac is present across each line at the output of the line filter, I1, I2 and I3 light. Each side of the line connects to a 15 A element of circuit breaker CB1. All loads connected to the power controller (both switched and unswitched) are controlled by CB1. If the current through either line exceeds 15 A, CB1 trips, removing power from the load. Phase 1, circuit 1 connects across the output of CB1. These outlets are



CP-1733

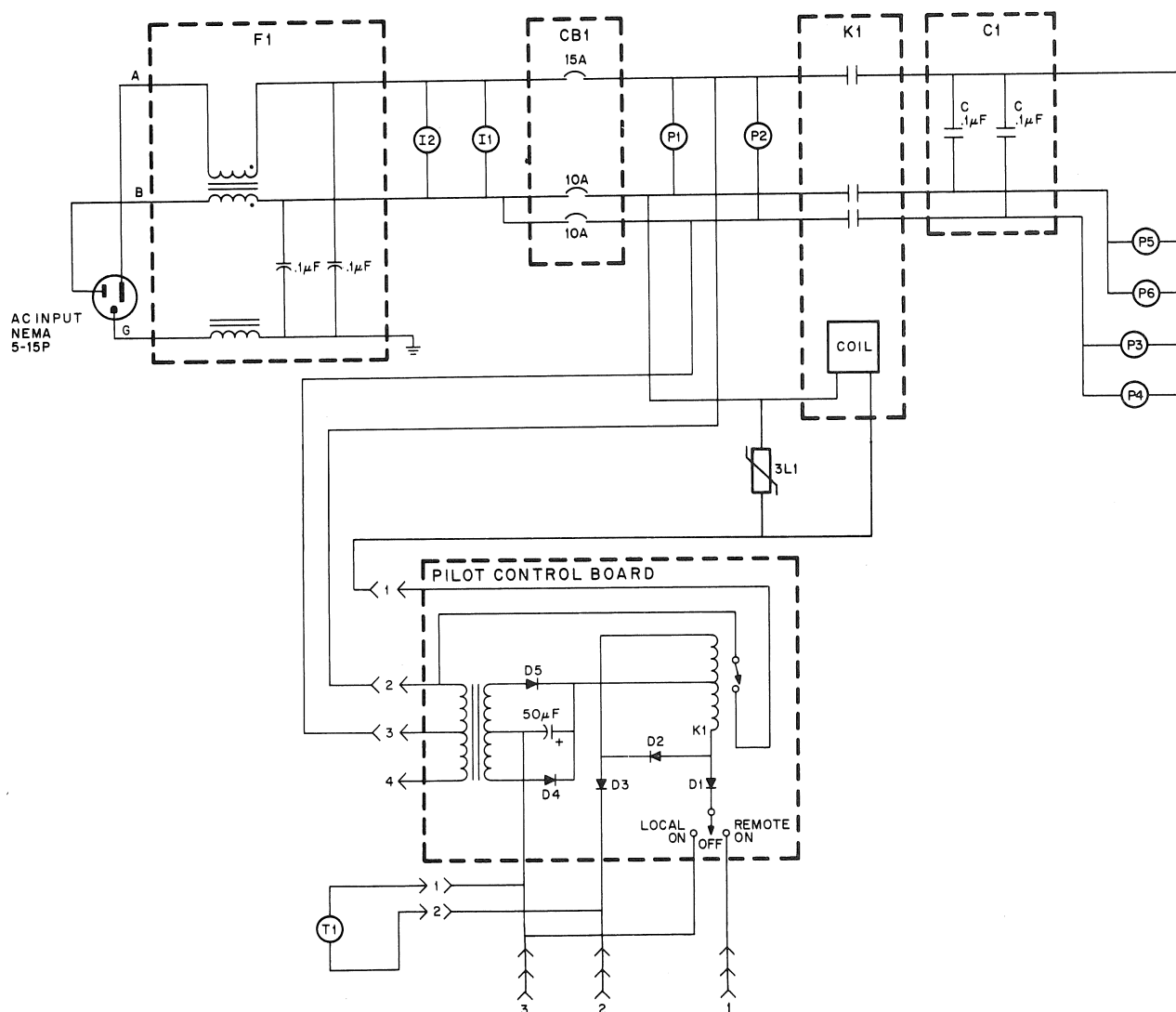
Figure 4-5 861-E Simplified Circuit Schematic Diagram

energized (180–264 Vac) whenever the circuit breaker is closed. Each output line from CB1 connects to a normally open contact on contactor K1. The field coil associated with K1 is energized by 180–264 Vac from the output of CB1 if a relay (K1\*) on the pilot control board (Paragraph 4.8) is closed. When K1 is closed, 180–264 Vac is applied across outlets Phase 1, circuit 2, Phase 2, circuits 1 and 2, and Phase 3, circuit 1 and 2. The 0.1  $\mu$ F capacitor (C1), connected across the lines at the relay, reduces the amplitude of voltage spikes at the output of the control when switching inductive loads, thereby preventing interference to nearby electronic data processing equipment.

#### 4.7 TYPE 861-F CIRCUIT DESCRIPTION

Figure 4-6 is a simplified circuit schematic of the 861-F, a 90–135 Vac, 47–63 Hz, single-phase version of the Power Controller.

Power is applied to the terminal block mounted on the power line filter. This filter contains 0.1  $\mu$ F capacitors which connect between each line and ground. Also contained in the filter are three chokes, connected in series with each of the two lines and ground. The capacitors provide low impedance paths to ground for high frequency line components. The chokes present a high impedance to these components. If 90–135 Vac exists across



CP-1734

Figure 4-6 861-F Simplified Circuit Schematic Diagram

the output of the line filter, pilot lamps I2 and I1 (connected in parallel) light. The neutral line is connected to a 15 A element at circuit breaker CB1. The phase line is branched; each resulting line connects to a separate 10 A element at CB1. All loads connected to the power controller (both switched and unswitched) are controlled by CB1. If the current through the upper (shared) line exceeds 15 A, or if the current in either of the remaining lines exceeds 10 A, the circuit breaker trips, removing power from the load. Power outlets P1 and P2 connect across the output of CB1. These outlets are energized (95–135 Vac) whenever the circuit breaker is closed.

Each output line from CB1 connects to a normally open contact on relay K1. The field coil associated with K1 is energized by 90–135 Vac from the output of CB1 if a relay on the pilot control board (Paragraph 4.8) is closed. When K1 is closed, 90–135 Vac is applied across outlets P3, P4, P5, and P6. The two 0.1  $\mu$ F capacitors, connected across the lines at the relay, reduce the amplitude of voltage spikes when switching inductive loads, thereby preventing interference to nearby electronic data processing equipment.

#### 4.8 PILOT CONTROL BOARD CIRCUIT DESCRIPTION

Figures 4-1 through 4-5 show the pilot control board simplified circuit schematic. The pilot control board contains the circuitry which allows remote turn-on and emergency turn-off of the switched power outlets in all 861 Power Controller versions. These functions are accomplished by controlling the voltage applied to the field coil of relay K1 in the 861 Power Controller.

The circuit consists basically of a full-wave rectifier loaded by the center-tapped field coil of a relay. Three control lines connect to the board. Pin 3 connects to the center-tapped secondary of the full-wave rectifier transformer. (In the case of the 861-D and 861-E, the center is returned to chassis ground through a plug connection.) Pin 2 is the disable (Emergency Shutdown) line from the signal bus, pin 1 is the enable (Power Request) line from the signal bus. Two additional lines (from the thermal switch) are connected to the lines associated with pins 3 and 2.

When the LOCAL/OFF/REMOTE switch is in the REMOTE position and pins 3 and 1 are connected, current flows through the lower portion of the center-tapped relay field coil to the full-wave rectifier transformer. This action closes relay K1\* on the pilot control board and causes an energizing potential to be applied across the field coil associated with K1 in the power controller, thereby energizing the controlled outlets. When pins 3 and 2 are connected (Emergency Shutdown is true), current flows through the lower and upper halves of the center-tapped field coil in different directions, before returning to the power supply transformer. The resultant current through the field coil is less than that required for holding relay K1\* closed. Energizing potential therefore is not present at relay K1 and power is removed from controlled outlets.

Diode D2 provides a current path in the lower section of the coil to prevent closing the relay in instances where pins 3 and 2 are connected but no connection exists between pins 1 and 3.

Closing T1 (the thermal switch) performs the same function as Emergency Shutdown (connects pins 2 and 3 together). This switch is exposed to the ambient air surrounding the power controller. Temperatures above 160° F close the switch (disabling the switched outlets). The switch resets automatically when the temperature drops below 120° F.

Placing the LOCAL/OFF/REMOTE switch in the LOCAL position provides a connection between pin 3 and the lower portion of the coil to energize K1, regardless of the state of the Power Request line on the signal bus. This switch position is normally used for maintenance purposes; operations on the pilot control board are exactly the same for situations where a connection is provided between pins 3 and 1 of the signal bus connector due to closing of a circuit in an external device. A connection between pins 2 and 3 disables the switched outlets, regardless of the position of the LOCAL/OFF/REMOTE switch.

#### NOTE

In the 861-A, -B, -C, -F, the power supply that provides the potential for closing the relay need not be returned to ground. It can be operated in a floating configuration where a connection between pins 3 and 2 (as by the thermal switch or Emergency Shutdown) disables the switched outlets and a connection between pins 1 and 3 (Power Request) enables the switched outlets.

## CHAPTER 5 MAINTENANCE

### 5.1 GENERAL

The 861 Power Controllers are constructed of high quality components (Figures 5-1 and 5-2) and can therefore be expected to provide trouble-free performance for extensive periods. No adjustment or alignment procedures exist. No special tools or equipment are required and no fuses are utilized. A 5000  $\Omega/V$  multimeter is adequate for accomplishing all voltage and resistance measurements.

### 5.2 PREVENTIVE MAINTENANCE

Preventive maintenance procedures for the power controllers consist of periodic cleaning and inspection to detect any mechanical damage to wiring and components or evidence of overheating, etc. The operation of the thermal switch can be checked by holding a flame close to the sensing element, while the controller is operating and observing that the switched outlets become disabled. Emergency Shutdown response to devices on the signal bus can also be checked as a preventive maintenance procedure by connecting pins 3 and 2 of the Remote Switching Control Bus. Should a failure occur, proceed as described in the following paragraphs.

#### NOTE

**Dangerous potentials exist within the power controller. Perform all measurements with properly insulated meter leads. Remove the main power plug before attaching or removing test leads.**

Failures within the power controller occur in one of three failure modes:

- a. No output (circuit breaker trips)
- b. No output (circuit breaker not tripped)
- c. No control (including Emergency Shutdown and overtemperature)

The flow charts in Figures 5-3 through 5-5 present a logical troubleshooting sequence for the three failure modes.

#### 5.2.1 No Output (Circuit Breaker Tripped)

If correct power is available from the mains, a tripped circuit breaker can be caused only by: a faulty circuit breaker, a low resistance load, or a low resistance within the power controller caused by component failure.

#### 5.2.2 No Output (Circuit Breaker Not Tripped)

Failures within this mode are caused by: bad cable connections, open components in the line filter, improper relay operation, or a faulty circuit breaker.

#### 5.2.3 No Control

Control failures are associated only with the switched outlets; the input circuits, line filter, and main circuit breaker are therefore not involved. These failures are caused by bad cable connections, secondary circuit breakers, relays, and diodes. A faulty thermal switch, T1, can cause loss of control. Control problems can be isolated to either the internal or external circuit by use of the LOCAL/OFF/REMOTE switch. With the switch in the LOCAL position, if T1 is operating properly, the switched outlets should be enabled. If not, the problem is within the controller circuitry. If operation is normal when in LOCAL, check the control signals from the external device.

Once the failing component is identified, it should be replaced with one of equal or better quality. Drawing UA-861-0-0 of the Engineering Drawing Set provides a complete list of 861 Power Controller components for the 861-A, -B, -C, and -F. Drawings UA-861D-0-0 and UA-861E-0-0 provide a complete list of 861-D and 861-E Power Controller components.

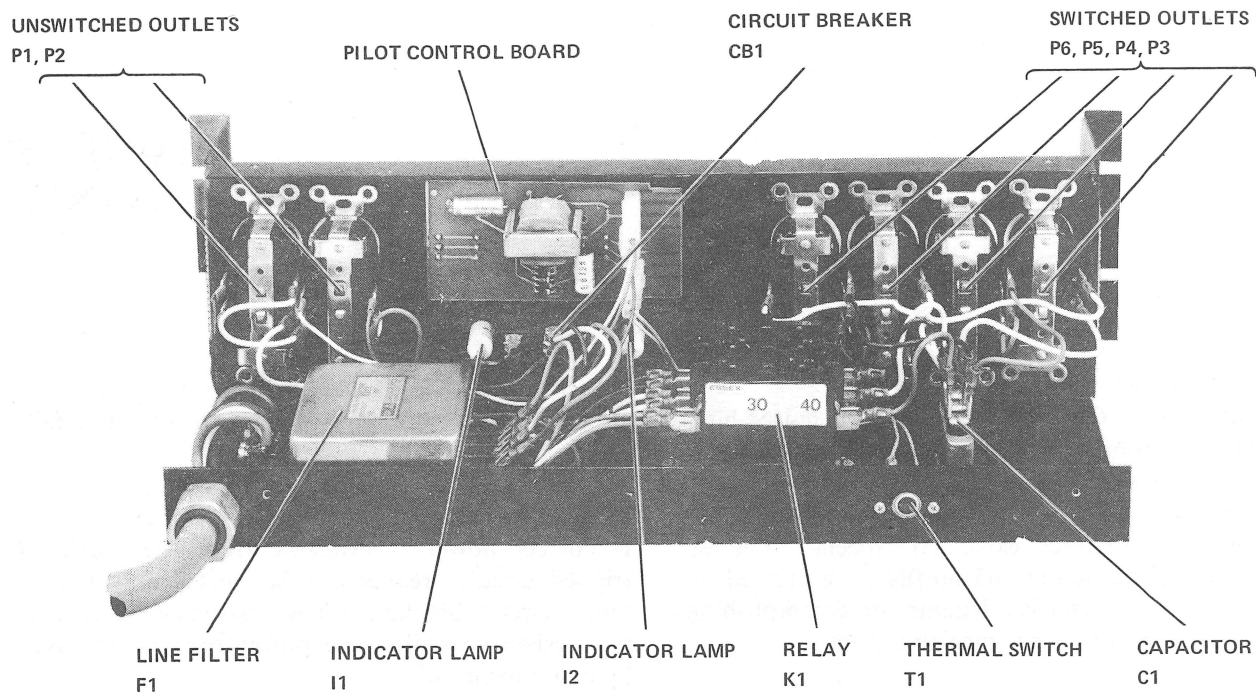


Figure 5-1 861-A,-B,-C,-F Power Controller Component Identification

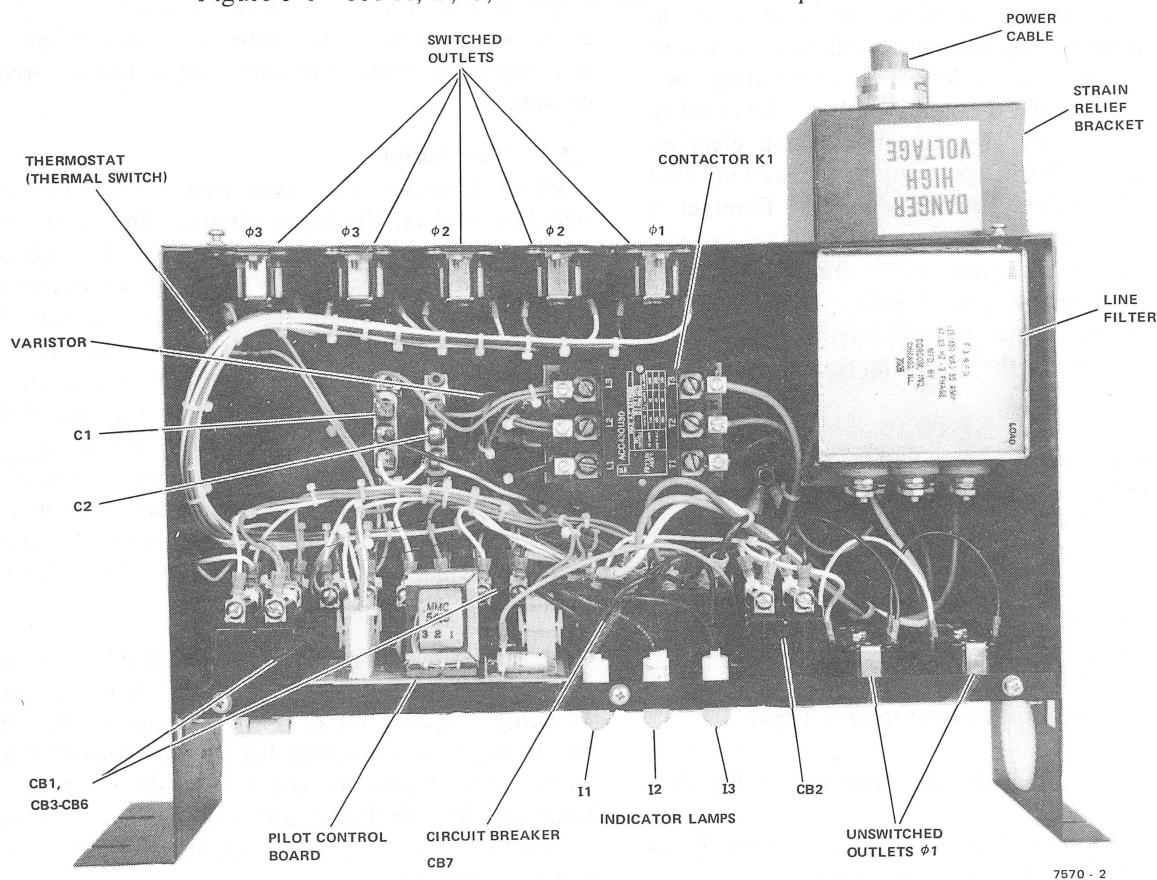


Figure 5-2 861-D Power Controller Component Identification



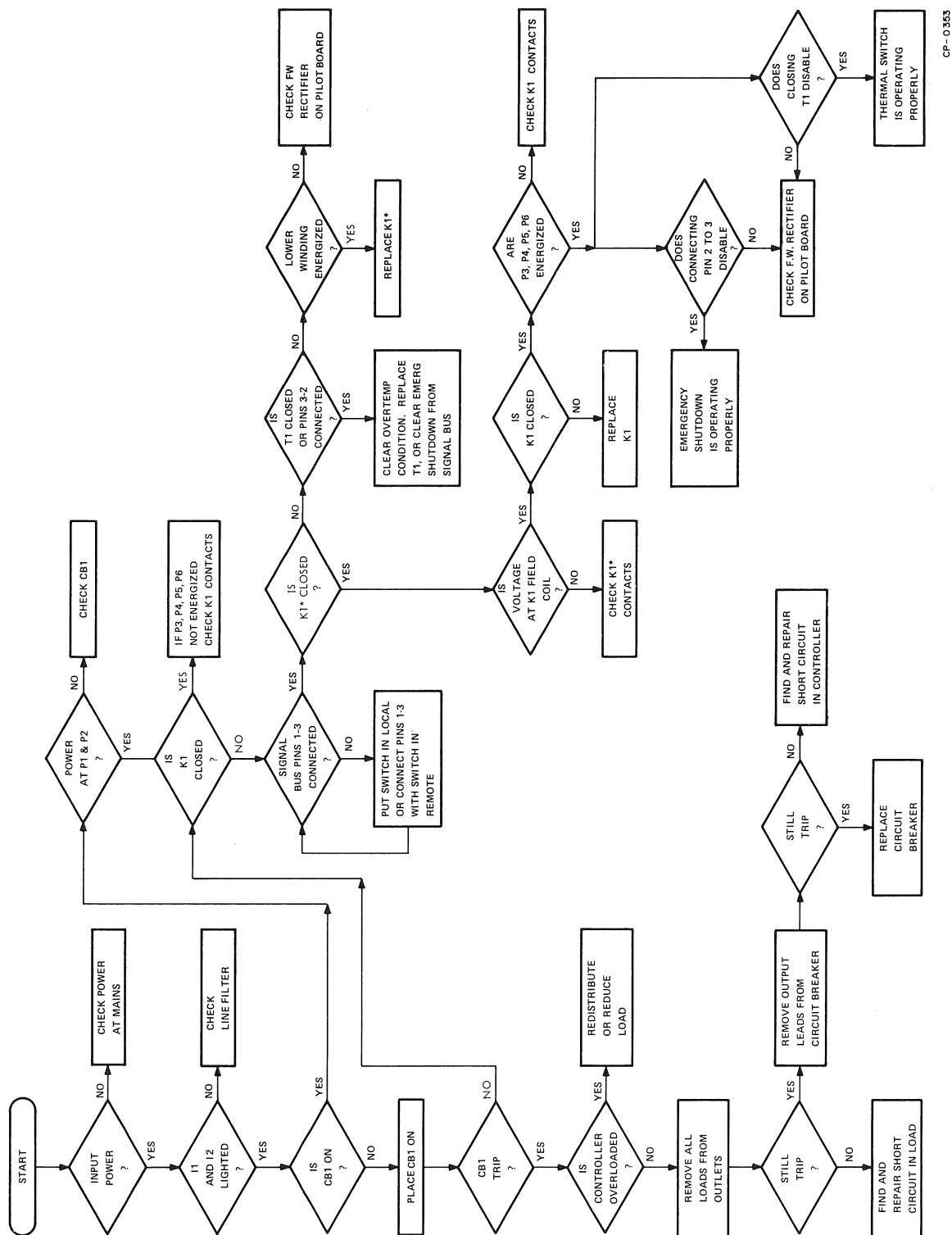
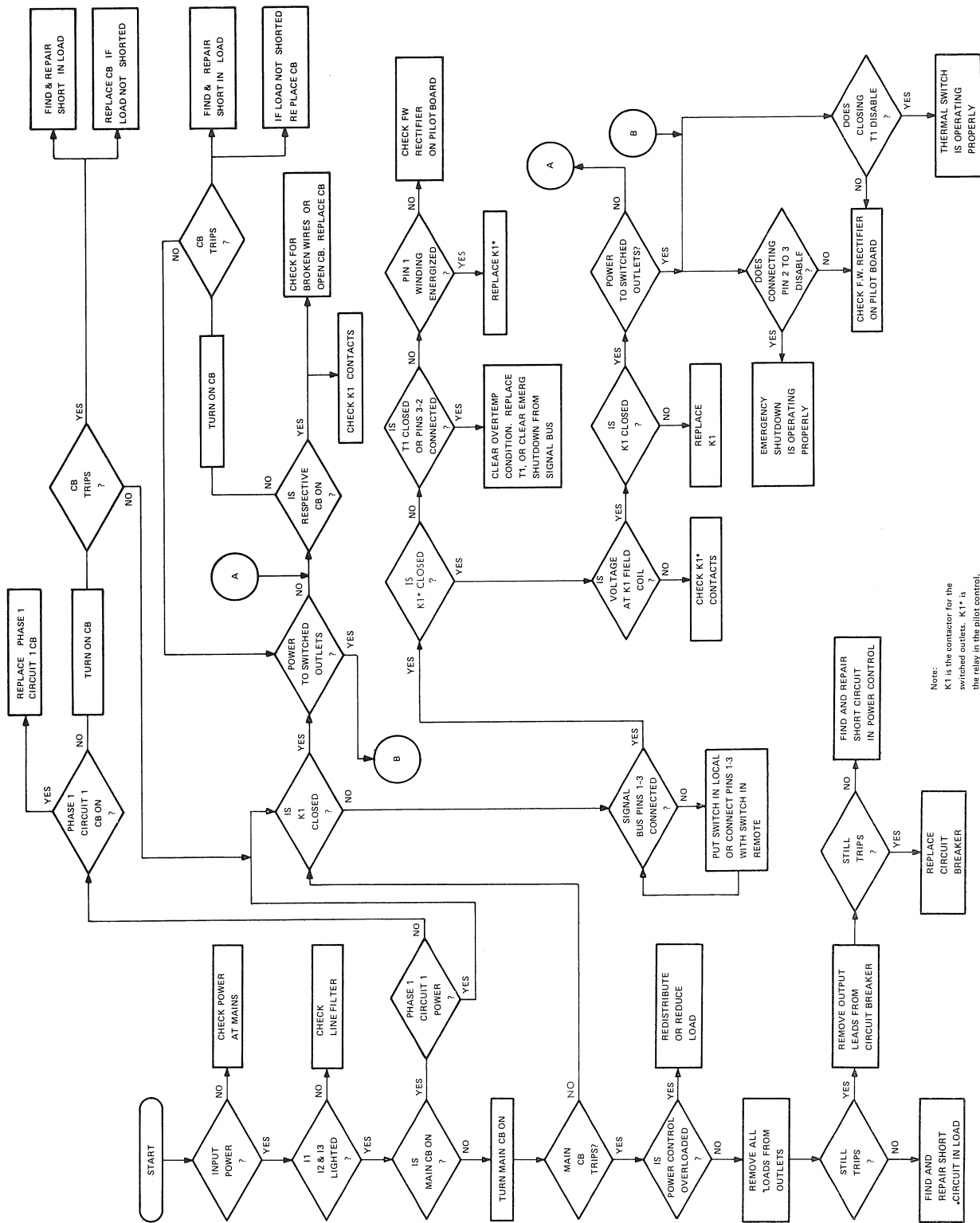


Figure 5-3 Troubleshooting Flow Diagram – 861-A,-B,-C,-F

CP-0353



CP-1736

Figure 5-4 Troubleshooting Flow Diagram - 861-D





861-A,B,C,D,E,F POWER CONTROLLER  
MAINTENANCE MANUAL  
EK-861AB-MM-002

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