PRICE $12.00

SERVICE BULLETIN 8804-5
June, 1986

SQUARE D®

# omegapak®
## Adjustable Frequency Controller

RAMSEY™

## 1-10 Horsepower

1000, 1500, 2000, 3000

TYPE PT

CONTROLLERS

## CONTENTS

**NOTE: This service bulletin covers the installation, start-up and servicing of standard controllers and controllers with pre-engineered options. Controllers having variations or special options will be furnished with a set of record drawings which must be consulted to properly and safely install, start-up or service the controller.**

# 1.0 GENERAL

This service bulletin covers OMEGAPAK Type PT 1000, 1500, 2000 and 3000 adjustable frequency controllers. Basic OMEGAPAK Type PT controllers are covered in Service Bulletin 8804-4.

## 1.1 PRECAUTIONS

The following list of "PRECAUTIONS" must be studied and followed during the installation, operation, and servicing of the equipment.

1. Read this service bulletin prior to installing or operating the equipment.
2. Service work should be performed only after becoming familiar with all listed danger and caution statements.
3. If OMEGAPAK controllers are to be stored prior to installation, they must be protected from the weather and kept free of condensation and dust.
4. Use extreme care when moving or positioning controllers (even if crated) as they contain devices and mechanisms which may be damaged by rough handling.
5. Only authorized personnel should be permitted to operate or service the controller.
6. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

**DANGER**
**HAZARD OF ELECTRICAL SHOCK OR BURN**
**BEFORE SERVICING, TURN OFF POWER SUPPLY(S) TO THIS EQUIPMENT. WAIT 5 MINUTES. MEASURE CAPACITOR VOLTAGES TO VERIFY THAT THEY ARE ZERO. DO *NOT* SHORT ACROSS CAPACITORS WITH VOLTAGE PRESENT.**

The dc bus capacitors are discharged slowly when input power is removed from the OMEGAPAK controller. To ensure the capacitors are fully discharged, always test with a dc voltmeter (1000V dc scale) before doing any wiring, troubleshooting or work inside the controller enclosure. If no reading is shown on the voltmeter, reduce scale and test again.

If the capacitors are not fully discharged in 5 minutes, contact your Square D/Ramsey representative — *Do not operate the controller.*

## 1.2 PRELIMINARY INSPECTION

Inspect for shipping damage upon receiving the OMEGAPAK controller. If any shipping damage is found, immediately notify the freight carrier and your Square D or Ramsey Controls representative. Open the door on the controller and check inside for any visual damage. DO NOT ATTEMPT TO OPERATE THE CONTROLLER IF ANY VISUAL DAMAGE IS NOTED. All printed wiring boards should be in place and secure. Check all connectors to be sure they are locked and securely in place.

**DANGER**
**HAZARD OF ELECTRICAL SHOCK OR BURN**
**MANY PARTS, INCLUDING ELECTRONIC PRINTED WIRING BOARDS, IN THIS CONTROLLER OPERATE AT LINE VOLTAGE. DO NOT TOUCH. USE ONLY ELECTRICALLY INSULATED TOOLS WHILE MAKING ADJUSTMENTS.**

## 1.3 STORAGE

After the preliminary inspection repack and store the OMEGAPAK controller in a clean dry location. DO NOT store this equipment in any area where the ambient temperature will rise above 60°C (140°F) or go below −17°C (0°F). DO NOT store this equipment in high condensation or corrosive atmospheres. Proper storage is required to prevent equipment damage.

## 1.4 CONTROLLER IDENTIFICATION

The basic OMEGAPAK Type PT controller is used to construct an open OMEGAPAK Type PT 1000 controller by adding a door, a left side and a rear panel. Refer to Section 4, controller photos. The OMEGAPAK Type PT 1000 controller is a non combination device (without a disconnecting means). Open OMEGAPAK Type 1000 controllers can be inserted into a compact wall mounted enclosure, (OMEGA-

PAK Type PT 1000 enclosed) a modular wall mounted enclosure (OMEGAPAK Type PT 2000 controller) or a motor control center enclosure (OMEGAPAK Type PT 3000 controller). The open OMEGAPAK Type PT 1000 controller can also be field installed in a standard Square D Model 4 motor control center.

The basic OMEGAPAK Type PT controller is also used to construct a combination (with fusible disconnect switch) wall mounted controller (OMEGAPAK Type PT 1500 controller).

OMEGAPAK Type PT 1000 and 1500 controller nameplates are located on the inside left side wall of the structure. Refer to Section 4, controller photos. The Type and MOD numbers listed on the 1000 or 1500 controller nameplate properly identify the controller and options and should be used when corresponding with Square D. Figure 1.1 illustrates a typical nameplate for 1000 and 1500 controllers and identifies the information. Figure 1.3 decodes the controller type and MOD numbers into a description of the controller and options.

The OMEGAPAK Type PT 2000 and 3000 adjustable frequency controllers are non-combination (without disconnect device) or combination (with disconnect device) controllers depending on the MOD (option) selected.

The Type PT 2000 controller consists of a modular wall mounted enclosure with space available for the open Type PT 1000 controller and selected MOD's (options).

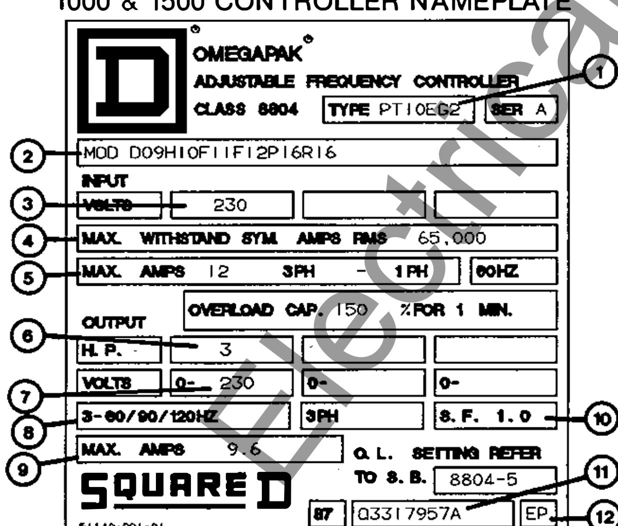
The Type PT 3000 controller consists of a MODEL 4 Motor Control Center vertical section with space for one or more open Type PT 1000 controllers and selected MOD's (options).

The nameplate for the 2000 and 3000 controller is located on the outside of the vertical wireway door of the controller enclosure. Refer to Section 4, Controller Photos. This nameplate is described in Figure 1.2 and carries the 2000 or 3000 controller class, type and MOD (options) listing. When identifying 2000 and 3000 controllers use the data from this nameplate.

To aid in identifying the controller, refer to Figure 1.3.

Note: Whenever contacting Square D in reference to this controller or ordering replacement parts, the complete nameplate information *must* be provided.

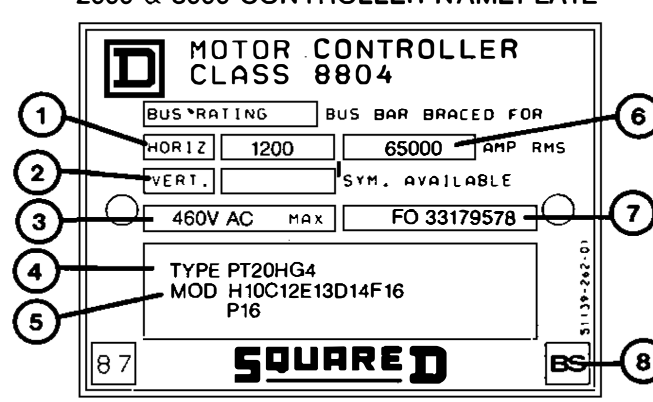
**FIGURE 1.1**
1000 & 1500 CONTROLLER NAMEPLATE




1. CONTROLLER TYPE CODE*
2. OPTIONS (MOD) CODE*
3. PERMISSIBLE INPUT VOLTAGE
4. MAX. WITHSTAND SYM. AMPS. RMS
5. MAX. INPUT RATED CURRENT**
6. HORSEPOWER RATING
7. OUTPUT VOLTAGE
8. OUTPUT FREQUENCY
9. MAX. OUTPUT RATED CURRENT
10. SERVICE FACTOR OF CONTROLLER
11. FACTORY ORDER NUMBER
12. DATE CODE

* SEE FIGURE 1.3
**SEE SECTION 3.0 FIGURE 3.1

**FIGURE 1.2**
2000 & 3000 CONTROLLER NAMEPLATE




1. HORIZONTAL BUS RATING (3000 CONTROLLERS ONLY)
2. VERTICAL BUS RATING (3000 CONTROLLERS ONLY)
3. PERMISSIBLE MAXIMUM INPUT
4. CONTROLLER TYPE CODE*
5. OPTIONS (MOD) CODE*
6. HORIZONTAL BUS BAR SHORT CIRCUIT RATING (3000 CONTROLLERS ONLY)
7. FACTORY ORDER NUMBER
8. DATE CODE

**FIGURE 1.3**

CLASS — TYPE — MODIFICATIONS

8804 PT10EG2 D09 H10 F11 F12 P16 R16

TYPE

STYLE
- 10 = 1000
- 15 = 1500
- 20 = 2000

(1) HORSEPOWER
- C = 1
- D = 2
- E = 3
- F = 5
- G = 7.5
- H = 10

ENCLOSURE
- S = OPEN SADDLE
- G = NEMA-1
- A = NEMA-12

(2) VOLTAGE/PHASE
- 1 = 200/230, 1PH.
- 2 = 200/230, 3PH.
- 4 = 380/460, 3PH.

OPTIONS
- D09 = DYNAMIC BRAKING
- S10 = START-STOP PUSHBUTTONS & MANUAL SPEED POT.
- H10 = HAND-OFF-AUTO SELECTOR SW.& MANUAL SPEED POT.
- F11 = FORWARD-REVERSE SELECTOR SW.
- J11 = RUN-JOG SELECTOR SW.
- C12 = CIRCUIT BREAKER DISCONNECT SWITCHES
- D12 = FUSIBLE DISCONNECT SWITCHES
- F12 = TYPE "KTK" FUSES MOUNTED ON PANEL
- J12 = TYPE "RK-5" FUSES INSTALLED IN STYLE 1500
- E13 = INVERTER/BYPASS CONTACTORS
- A14 = ANALOG SPEED METER
- D14 = DIGITAL SPEED METER
- T15 = ELAPSED TIME METER
- L16 = OVERLOAD RELAY
- P16 = POWER ON PILOT LIGHT
- R16 = RUN PILOT LIGHT
- F16 = DRIVE FAIL PILOT LIGHT
- U16 = GASKETED OPEN CONTROLLER

(1) 7.5 AND 10 HP ARE NOT AVAILABLE IN 200/230V RATING.
(2) SINGLE PHASE UNITS AVAILABLE IN 1-3 HP @ 200/230V ONLY.

SAMPLE
STYLE 1000, 3PH., NEMA-1 ENCLOSED, WITH DYNAMIC BRAKING,HAND-OFF-AUTO SELECTOR SWITCH, MANUAL SPEED POT., FORWARD-REVERSE SELECTOR SWITCH, TYPE "KTK" FUSES MTD. ON PANEL, POWER ON, AND RUN PILOT LIGHTS.

## 2.0 INSTALLATION

### 2.1 MECHANICAL INSTALLATION

Open OMEGAPAK Type PT 1000 controllers are intended to be mounted in modular Square D enclosures. Either a modular wall mounted enclosure (OMEGAPAK Type PT 2000 controller) or a Model 4 motor control center enclosure. The open OMEGAPAK Type PT 1000 controller should be installed in the modular cabinet using hardware furnished.

Enclosed OMEGAPAK Type PT 1000 controllers and OMEGAPAK Type PT 1500 and 2000 controllers are intended for wall mounting. Insure that the controller is securely attached to the mounting surface and that the mounting surface is capable of supporting the controller weight.

OMEGAPAK Type PT 3000 controllers are standard motor control center devices. Refer to Service Bulletin PE-1089 for installation instructions.

Do not mount controllers in direct sunlight or on a hot surface or on a surface subject to excessive vibration. The controller must be mounted vertically to allow for proper ventilation. Mounting dimensions and weights are located in Section 8, controller drawings. Controllers equipped with fans must not have the air flow obstructed.

Controllers must be installed in an area where environmental conditions are within the ratings detailed in Section 3.4.

### 2.2 ELECTRICAL INSTALLATION

#### 2.2.1 INPUT POWER

> **DANGER**
> **HAZARD OF ELECTRICAL SHOCK OR BURN**
> **MAKE CERTAIN THAT ALL SUPPLIES (MAIN AND REMOTE) ARE DEENERGIZED PRIOR TO INSTALLING THIS EQUIPMENT**

The OMEGAPAK Type PT controller is designed to operate from 200/230V or 380/460V, 50/60 Hz input power as indicated on the controller nameplate. Both single and three phase versions are available from 1 to 3 horsepower at 200/230V only. Five (5) hp 200/230V units and all 380/460V units are available with three phase input only. Note: Controllers in the 1 to 3 hp range must be specifically ordered either for single phase or three phase input. Three phase input controllers cannot be applied to a single phase power system. **All** controllers are designed to operate only with a three phase motor.

Controllers designed for 200/230V operation are factory set for 230V, 60 Hz input power. Controllers designed for 380/460V operation are factory set for 460V, 60 Hz input power. If the controller is to be operated from a different power source, consult Section 5, Start-up Procedure for instructions.

National and local electrical codes require that a disconnect device (circuit breaker or disconnect switch) and branch circuit protection (circuit breaker or fuses) be installed ahead of the controller. If a disconnect/branch circuit protective means is not furnished as part of the controller, it is the responsibility of the user to provide and install a disconnect/branch circuit protective device in accordance with national and local electrical codes based on the maximum input current listed in Section 3, Figure 3.1. The controller is coordinated for fault withstand ratings described in Section 3 **only** if fusing as listed in Figure 3.2 is installed ahead of the controller. Use of a circuit breaker is not recommended unless used in conjunction with current limiting fuses.

#### 2.2.2 INPUT WIRING

The ampacity of power conductors feeding the OMEGAPAK controller should be sized for the maximum input currents listed in Section 3, Figure 3.1 the National Electrical Code and applicable local electrical codes.

The controller must be grounded. OMEGAPAK Type PT 1000 and 1500 controllers are provided with a grounding terminal located on the power terminal board on the controller rear panel. OMEGAPAK Type PT 2000 controllers are provided with a pressure type grounding lug installed in the bottom of the enclosure. OMEGAPAK Type PT 3000 controllers are equipped with ground bus.

> **DANGER**
> **HAZARD OF ELECTRICAL SHOCK OR BURN**
> **CONTROLLER PANEL MUST BE PROPERLY GROUNDED BEFORE APPLYING POWER.**

OMEGAPAK Type PT controllers operate from input voltage as detailed on the controller nameplate. Input power leads are to be connected to power terminals provided. Refer to Figure 2.1 to determine the range of wire sizes that the terminals will accept and recommended tightening torques. Wires must be sized based on the maximum input current as shown on the nameplate and listed in Section 3, Figure 3.1.

**FIGURE 2.1**
**TERMINAL, WIRE SIZE AND TIGHTENING TORQUE TABLE**

| TERMINAL DESCRIPTION | WIRE SIZE MIN | WIRE SIZE MAX | TIGHTENING TORQUE |
|---|---|---|---|
| Controller Power Terminal Board① | 22 AWG | 8 AWG | 22 lb-in |
| Panel Mounted Fuses● | 18 AWG | 10 AWG | 20 lb-in |
| Fusible Disconnect Switch③ | 14 AWG | 6 AWG | |
| | 14 AWG<br>8 AWG | 10 AWG<br>6 AWG | 35 lb-in<br>40 lb-in |
| Circuit Breaker④ | 14 AWG | 4 AWG | 35 lb-in |
| Main Lugs⑤ | 14 AWG | 2/0 AWG | |
| | 6 AWG<br>8 AWG<br>14 AWG | 2/0 AWG<br><br>10 AWG | 120 lb-in<br>40 lb-in<br>35 lb-in |
| Overload Relay | 14 AWG | 8 AWG | 35 lb-in |
| Power Interface Board | FACTORY INSTALLED | | 12 lb-in |
| Main Control Board | 22 AWG | 14 AWG | 6 lb-in |

① Located on back panel of Type PT 1000 enclosed controller or open controller installed in a Type PT 2000 or 3000 enclosure.
② If the panel mounted fuse option is selected for Type PT 1000 controllers, L1, L2 and L3 terminals on the power terminal strip are replaced with fuse clips with fuses installed.
● Standard equipment with Type PT 1500 controllers, optional with Type PT 2000 and 3000 controllers.
● Optional with Type PT 2000 and 3000 controllers.
● Used only on Type PT 2000 controllers with optional bypass contactors.

**CAUTION**
***DO NOT* CONNECT INPUT POWER LEADS TO THE CONTROLLER OUTPUT TERMINALS (T1, T2, T3). DOING SO WILL DAMAGE THE CONTROLLER AND VOID THE WARRANTY.**

**OMEGAPAK TYPE PT 1000 CONTROLLERS** — These controllers are furnished with a power terminal strip located on the back panel. Refer to Section 8, Controller drawings and Section 4, Controller Photos for additional information.

**OMEGAPAK TYPE PT 1500 CONTROLLERS** — A fusible disconnect switch is furnished as standard equipment. Input power wiring should be terminated on lugs provided at the top of the switch.

**OMEGAPAK TYPE PT 2000 CONTROLLERS** — Two possible conditions exist for terminating input power wiring.

1. Controller with optional disconnect means and no controller bypass option — Terminate the input wires at the top of the disconnect device. Refer to Section 8, Controller Drawings.
2. Controller with optional disconnect means and controller bypass option — Terminate the input wires on the main lugs located in the vertical wire way. Refer to Section 8, Controller Drawings.

**OMEGAPAK TYPE PT 3000 CONTROLLERS** — Since these are standard motor control center enclosures equipped with horizontal and vertical power bus, incoming power is provided by one of two means:

1. Connecting splice bars (one set is furnished with each vertical section which does not include a main lug compartment) to adjacent vertical sections. Refer to Service Bulletin PE-1089 for splicing instructions.
2. Terminating input power wiring on lugs provided in an optional main lugs compartment. Note: At least one section in each line-up must have a main lugs compartment.

## 2.2.3 OUTPUT WIRING

The ampacity of motor power conductors should be sized according to the motor full load current, National Electrical Code and applicable local electrical codes.

**OMEGAPAK Type PT 1000 and 1500 Controllers** — If an optional overload relay is furnished, connect motor wiring to the load terminals of the overload relay. Refer to Section 8, Controller Drawings. Otherwise, connect motor leads to terminals T1, T2, T3 on the power terminal strip on the back panel. Refer to Section 8, Controller Drawings and Section 4, Controller Photos.

**OMEGAPAK Type PT 2000 and 3000 Controllers** — If optional controller bypass contactors are furnished, connect motor wiring to the load terminals of the overload relay located in the bypass contactor compartment. Refer to Section 8, Controller Photos. Otherwise, see above for OMEGAPAK Type PT 1000 and 1500 controllers.

In either case, refer to Figure 2.1 to determine the range of acceptable wire sizes and the torque requirements.

Electrical Codes require that an overload protection device responsive to motor current be installed in each motor lead or that a thermal sensor be built into or attached to the motor windings to provide motor running overload protection. These two methods of protection are described in more detail.

1. Motor thermal protector or switch —

   The motor thermal switch will protect the motor but may not protect the motor feeder or motor control equipment since motor currents higher than 1.25 times nameplate motor current may be required to cause excessive temperature rise on the motor windings.

2. Overload relay —

   A relay responsive to motor current will protect the motor feeder and motor control apparatus. However, since most motors lose ventilation when operated at speeds lower than base speed, an overload relay will not provide adequate protection against motor overheating on motors utilized in adjustable speed drives.

Recommended overload protection for single motor drives can be achieved two ways.

1. A thermal switch in the motor will protect the motor, motor feeder, and motor control apparatus provided that the motor thermal switch is sized to operated at less than 1.25 times motor full load current with the motor located in a 40° ambient.

2. A thermal switch in the motor **and** an overload relay must be provided for motor, motor feeder, and motor control apparatus overload protection if the current/temperature characteristics of the motor thermal switch are not known.

Both cases assume that the motor feeder conductors are sized according to National Electric Code and that the motor nameplate current is less than or equal to the controller maximum rated continuous output current. OMEGAPAK Type PT controllers have terminals available to wire an overload relay or motor temperature switch. The controller will shut down and the overtemperature LED will illuminate if the circuit between these terminals is broken. Refer to Section 8, Drawing 8.4.1 to determine which terminals are to be used. The protective device must have a normally closed contact which opens upon the occurrence of excessive temperature or load. If the factory installed overload relay option is selected, the normally closed contact will have been factory wired to the proper terminals. If a motor thermal switch is also used, it must be wired in series with the overload relay contact.

The recommended overload relay for protecting Class 8804 OMEGAPAK Type PT controllers is the Square D Class 9065, Type TR bi-metal overload relay. The relay should be selected per Figure 2.2 if the factory installed overload relay option was not selected.

### FIGURE 2.2
### OVERLOAD RELAY SELECTION

| OVERLOAD RELAY CLASS 9065 TYPE* | HORSEPOWER | | |
|---|---|---|---|
| | 460V | 230V | 200V |
| TR 1.4 | 1 HP | 1/2 HP | 1/2 HP |
| TR 2.8 | 2 HP | 1 HP | 1 HP |
| TR 4 | 3 HP | 1-1/2 HP | 1-1/2 HP |
| TR 5.5 | 5 HP | 2 HP | 2 HP |
| TR 8 | 7-1/2 HP | 3 HP | 3 HP |
| TR 11 | 10 HP | 5 HP | 5 HP |

*Since overload time-current characteristics are not well defined by NEMA, NEC, or UL/CSA, the interchangeability of other manufacturers overload relays is not guaranteed.

**Do not** connect the output terminals of the controller (T1, T2, or T3) to the L1, L2, or L3 controller terminals or to any other source of voltage. To do so will cause controller damage. Should it become necessary to bypass a controller not equipped with a controller bypass option, the customer connections to the controller T1, T2, and T3 terminals must be disconnected to prevent backfeeding the controller.

If a customer supplied isolating device is installed between the controller output and the motor (e.g. isolation contactor), the isolating device must not be switched to the open position and then back to the closed position, unless sufficient time is allowed for the motor open-circuit voltage to decay to less than 10% of the motor nameplate rated voltage. Re-connecting the motor to the operating controller without allowing the motor terminal voltage to decay may cause controller damage.

When multiple motors are operated from one controller, several critical requirements must be met to assure proper controller and motor operation.

1. Individual motor overload protection must be provided in accordance with the National Electrical Code or applicable local codes.
2. The total of the connected motor nameplate load currents, as seen by the controller, must not exceed the controller rated output current.
3. If one or more of the motors are to be connected or disconnected from the controller while the controller is operating, the following conditions **must be met**.

   A) The motor isolating device must not allow reconnection of the motor to the controller without first allowing the motor open-circuit voltage to decay to less than 10% of the motor nameplate rated voltage.

   B) The summation of the running currents of the connected motors and the locked rotor current of the motor(s) being reconnected to the controller must be less than 130% of the controller rated output current.

### 2.2.4 CONTROL WIRING

If the OMEGAPAK Type PT controller does not have pilot devices mounted on the door, refer to Section 8, controller drawings to determine the proper connection of the remote control station.

NOTE: All remote manual speed potentiometers must be wired with insulated shielded cable. One end of the shield must be grounded at the controller per the wiring diagram. The other end must be insulated from ground and unconnected.

When wiring external control devices to the controller's sequencing circuitry the following guidelines should be considered:

Pilot Devices (push buttons, selector switches, relay contacts, etc.) — The maximum distance from the controller to an external pilot device is limited by the dc resistance of the wiring plus the remote device contact resistance. Wire size must be selected such that the maximum circuit resistance (wire plus remote contact) does not exceed 50 ohms. Higher resistance may result in failure to deliver sufficient voltage to pick up the controller sequencing relay.

Solid State Contacts — Many solid state control devices, such as programmable controllers, use solid state switches (triacs or transistors) as output contacts. The control relay circuits in the OMEGAPAK Type PT controller operate from filtered, unregulated dc voltage (approximately 25V dc). Triac devices will not turn off when used in a filtered dc circuit. Transistor switches can be used if proper voltage polarity is observed. Refer to Section 8, Controller Drawings. In addition, the off state resistance of the solid state contact must limit leakage current, with 25V dc applied, to 3 madc or less.

OMEGAPAK Controller Relays — The controller is furnished with a run command relay (RCR) and drive failure relay (DFR). The drive fail relay has one extra form c contact available for customer use. Relay contacts are rated as shown in Section 3.2, Application Data.

NOTE: To avoid electrical noise problems and nuisance tripping of the adjustable frequency controller, all remote controlled inductive loads (relay coils, contactor coils, solenoids, etc.) must be transient suppressed.

### 2.2.5 WIRING PRACTICE

Good wiring practice requires that control circuit wiring be separated from all power wiring (whether from the same controller, or other controllers). This minimizes the possibility of electrical transients being electrostatically or electromagnetically coupled into the control circuits from the power circuits. The following general wiring practice is recommended in addition to that already prescribed in National Electrical Code and applicable local electrical codes.

Controllers are intended to be wired using conduit. Metallic conduit is preferred. Control and power wiring should never be run in the same conduit. Metallic conduits carrying power wiring and metallic conduits carrying low level control wiring should be separated by at least three inches. Non-metallic conduits or cable trays carrying power wiring and non-metallic conduits or cable trays carrying low level control wiring should be separated by at least twelve inches. If it is necessary to cross power and control wiring, the above spacing recommendations should be observed and conduits or trays should cross at right angles.

Refer to Section 8, Controller Drawings for outline drawings which show recommended conduit entry areas.

All low level control wiring (start-stop circuits, manual speed potentiometer, etc.) may be run in the same conduit or tray. Remote mounted manual speed potentiometers must be wired using shielded cable. The shielded cable must be jacketed and the shield terminated only where shown on the connection diagram. Refer to Section 8, Controller Drawings for connection diagrams of remote pilot devices.

Stranded control wiring is recommended as it is necessary to wire to the main control board terminal strip located on the controller door. Wires should be routed as shown on the appropriate connection diagram in Section 8, Controller Drawings. If wiring across a hinge point is not desirable, a kit consisting of a twelve point terminal strip and multiconductor, color coded cable are available (Class 8804 Type TK-12) and can be installed so that all remote control wiring terminates on the back panel.

**2.2.6 Transformer Sizing**

Controllers described in this service bulletin are designed for operation from a 200/230V or a 380/460V, 50/60 Hz supply. If these voltages are not available, a transformer will be required. Transformers must be sized based on the maximum controller input current listed in Section 3, Figure 3.1. Transformers listed in Section 3, Figure 3.2 have been selected to meet this criteria.

# 3.0 APPLICATION DATA

## 3.1 INPUT

**Power**

| | |
|---|---|
| Voltage | 1-3 HP — 200/230V ac +10%, −5% Single or three phase. Note: Three phase units cannot be used with a single phase supply<br>5 HP — 200/230V ac +10%, −5% three phase only<br>1-10 HP — 380/460V ac +10%, −5% three phase only |
| Current | See Figure 3.1 |
| Fault Withstand Rating | 1 Phase Input — 10,000 RMS Symmetrical Amps with Class R or Class K fuse per Figure 3.2<br>3 Phase Input — 65,000 RMS Symmetrical Amps with Class R or Class K fuse per Figure 3.2 |
| Frequency | 50/60 Hertz ± 3 Hertz |
| Displacement Power Factor | .95 Lagging |
| Control Power | 28V ac/25V dc provided by self contained transformer isolated power supply |

**Control**

| | |
|---|---|
| Manual Speed Potentiometer | 5000 ohm, 1/4 watt minimum |
| Analog Follower Signal | 0-5V dc or 0-10V dc, 49.4K ohm minimum input impedance<br>4-20 ma dc, 635 ohms maximum input impedance |
| Run Command | Refer to Section 8, Controller Drawings for wiring. Maximum resistance (contact plus wiring) 50 ohms |
| External Fault Reset | Refer to Section 8, Controller Drawings, for wiring. Maximum resistance (contact plus wiring) 50 ohms. |

## 3.2 OUTPUT

**Power**

| | |
|---|---|
| Voltage | 0-200V/230V ac or 0-380/460V ac three phase |
| Maximum Continuous Output Current | Refer to Figure 3.1 |
| Frequency | Selectable 1.75 Hertz to 60, 90 or 120 Hertz |
| Frequency Stability @ 25°C | Open — ±.1 Hertz Typical, Enclosed — ±.34 Hertz Typical |
| Frequency Shift With Ambient Temperature | 0.014 Hertz/°C |
| Controller Linearity (Typical) Versus Reference Signal | ±.04 Hertz @ F Max = 60 Hertz<br>±.11 Hertz @ F Max = 90 Hertz<br>±.11 Hertz @ F Max = 120 Hertz |
| Waveform | Sine coded PWM (Pulse Width Modulated) |
| Short Time Overload Capacity | 150% of maximum continuous output current for 60 seconds |
| Continuous Overload Capacity | Refer to Figure 3.1 |
| Instantaneous Overcurrent Trip | 155% of maximum continuous output current |

**Control**

| | |
|---|---|
| Frequency Follower | 0-5.0V dc proportional to output frequency (2.5V dc = 60 Hz, 5.0 V dc = 120 Hz) Minimum load impedance 5.0K ohms |
| Frequency Meter | 0-5V dc proportional to output frequency (5V dc = 120 Hz) |
| Drive Fail Relay | One Form C contact rated 1.0A @ 28V dc or 0.5A @ 120V ac, resistive — signals that an abnormal shutdown has occurred |

## 3.3 ADJUSTMENTS

| | |
|---|---|
| Acceleration Time | 1.5 to 20 seconds |
| Deceleration Time | 1.5 to 20 seconds |

| | |
|---|---|
| Voltage Boost | 0-400% of nominal volts per Hertz ratio at 1.75 Hertz, decreasing to 0% at 20 Hertz |
| Minimum Frequency | 1.5 ± .25 Hertz to 50% of adjusted maximum frequency |
| Maximum Frequency | 43 Hertz to 60, 90 or 120 Hertz +10%, −0% |

## 3.4 ENVIRONMENTAL CONDITIONS

| | |
|---|---|
| Storage Temperature | −17°C to 60°C (0°F to 140°F) |
| Operating (Ambient) Temperature | Enclosed 0°C to 40°C (32°F to 104°F) Open 0°C to 60°C (32°F to 144°F) |
| Altitude | To 1,000 meters (3,300 feet) w/o derating |
| Relative Humidity | To 95% maximum non-condensing |

## 3.5 PROTECTION

| | |
|---|---|
| Instantaneous Overcurrent Trip | Non-adjustable trip setting of 150% of rated maximum continuous output current |
| Ground Fault | Non-adjustable trip setting |
| Overtemperature | Thermostat mounted on heatsink on 5 hp 200/230V (7.5 & 10 hp 380/460V) controllers only. Also accepts N.C. contact from motor mounted temperature sensor |
| Overvoltage | Protects the controller against excessive dc bus voltage. Trips at 416V ± 21V dc (200/230V controllers) or 832 V ± 21V dc (380/460V controllers) |
| Undervoltage | Trips at 87.5% of rated input voltage. Automatically resets at 95% of rated input voltage. |
| Overfrequency | Non-adjustable clamp limits output frequency to not more than 26% above maximum selected operating frequency |

## 3.6 DIAGNOSTIC AND STATUS INDICATORS

Light Emitting Diodes (LEDs) are provided as indicated below. All LEDs except the bus capacitors charged LED are located on the main control board. Refer to Figure 5.3. The bus capacitor charged LED is located on the power interface board. Refer to Section 4, Controller Photos.

Undervoltage (UV)
Overvoltage (OV)
Ground Fault (GF)
Instantaneous Overcurrent (IOC)
Overtemperature (OT)
Power Up Delay (PUD)/Reset
Drive Enabled (DE)
Bus Capacitors Charged

**FIGURE 3.1**
**INPUT/OUTPUT CURRENTS**

| Controller Horsepower | Output Current① 230V | Output Current① 460V | Input Current Single Phase 230V | Input Current Three Phase 230V | Input Current Three Phase 460V |
|---|---|---|---|---|---|
| 1 | 3.6A | 1.8A | 11.6A | 5.0A | 3.6A |
| 2 | 6.8A | 3.4A | 18.6A | 9.2A | 5.6A |
| 3 | 9.6A | 4.8A | 24.8A | 12.0A | 7.3A |
| 5 | 15.2A | 7.6A | — | 17.0A | 12.0A |
| 7.5 | | 11.0A | | | 16.3A |
| 10 | | 14.0A | | | 19.8A |

① Controller can deliver 115% of this current continuously at rated ambient temperature. When the controller is operated at above listed output current, the input current will increase proportionately.

**FIGURE 3.2**
**TRANSFORMER/INPUT FUSE SELECTION**

| Controller Horsepower | Input Fuse① Single Phase | Input Fuse① Three Phase | Transformer② Single Phase | Transformer② Three Phase |
|---|---|---|---|---|
| 1 | 30A | 20A | 3KVA | 3KVA |
| 2 | 30A | 20A | 5KVA | 6KVA |
| 3 | 30A | 20A | 7.5KVA | 6KVA |
| 5 | | 20A | | 9KVA |
| 7.5 | | 20A | | 15KVA |
| 10 | | 30A | | 30KVA |

① Maximum fuse rating. Must be Class R or Class K current limiting fuse or fault withstand ratings are invalid.
② To prevent imbalanced currents, all three phase transformer connections must maintain balanced output impedance. Two winding connections are not suitable for use with these controllers.

## 3.7 OPTIONS

There are a number of factory and/or field installed options for OMEGAPAK Type PT 1000, 1500, 2000 and 3000 controllers. To determine which options (if any) were factory installed, refer to the controller nameplate(s) for the MOD (option) listing. Figure 1.1 shows a typical nameplate and Figure 1.3 breaks down the controller type and MOD numbers into a description of the controller and options.

### 3.7.1 BRAKING OPTIONS

MOD D09 (Kit Type DB-01, DB-02) Dynamic Braking.
Dynamic braking provides a means of rapid deceleration or quick stopping by dissipating motor rotational energy as heat in the braking resistor. Dynamic braking may be required to avoid overvoltage trips when stopping or decelerating a high inertia load. Included in the dynamic braking option is a solid state switch and a resistor.

### 3.7.2 DOOR MOUNTED PILOT DEVICES①

| | |
|---|---|
| MOD S10 | |
| Start Push Button | Class 9001, Type KR1B-H13 |
| | Class 9001, Type KN-301 Legend Plate |
| Stop Push Button | Class 9001, Type KR1R-H13 |
| | Class 9001, Type KN-302 Legend Plate |
| Manual Speed Potentiometer | Class 9001, Type K2107 |
| MOD H10 | |
| Hand-Off-Auto Selector Switch | Class 9001, Type KS43B-H1 plus one 9001 Type KA-41 Logic Reed Contact Block |
| | Class 9001, Type KN-360 Legend Plate |
| Manual Speed Potentiometer | Class 9001, Type K2107 |
| MOD F11 | |
| Forward-Reverse Selector Switch | Class 9001, Type KS11B-H1 |
| | Class 9001, Type KN339 Legend Plate |
| MOD J11 | |
| Run-Jog Selector Switch | Class 9001, Type KS11B-H1 |
| | Class 9001, KN-348 Legend Plate |
| MOD F16 | |
| Drive Fail Pilot Light | Class 9001, Type KT35<br>Class 9001, Type KN399 Legend Plate (DRIVE FAIL) |
| MOD P16 | |
| Power On Pilot Light | Class 9001, Type KP35<br>Class 9001 KN338 Legend Plate |
| MOD R16 | |
| Run Pilot Light | Class 9001, Type KT35<br>Class 9001, Type KN324 Legend Plate |

Kit Class 8804, Type CK-12
This kit includes a length of multiconductor, color coded cable to ease field installation of door mounted pilot devices listed above. It is not intended for remote mounted devices.

Kit Class 8804, Type TK-12
This kit includes a 12 point terminal strip and multiconductor, color coded cable. Its purpose is to provide terminals for external control wiring on the back panel of the controller and thereby avoid the necessity of running external wiring across the door hinge to the main control board terminals. Up to two Type TK-12 kits may be installed per controller.

① Refer to Section 8, Controller Drawings for connection diagrams for various combinations of pilot devices.

### 3.7.3 POWER CIRCUIT OPTIONS

MOD C12 (Type PT 2000 and 3000 controllers only) circuit breaker disconnect. Note: Requires MOD F12, Panel Mounted Fuses.

MOD D12 (Type PT 2000 and 3000 controllers only)① Fusible Disconnect Switch

MOD F12 (Type PT 1000 controllers only)
Line terminals L1, L2, L3 are replaced with fuse clips and Type KTK current limiting fuses are installed. This option is required if fusing as listed in Figure 3.2 is not installed at some other point in the branch circuit feeding the controller.

MOD J12 (Type PT 1500 controllers only)
Type PT 1500 controllers are combination (Fusible Switch) devices. This option provides fuses factory installed in the disconnect switch.

MOD E13 (Type PT 2000 and 3000 only)
Controller bypass contactors. This option includes a contactor to disconnect the motor from the Type PT controller and an additional electrically and mechanically interlocked contactor to connect the motor across-the-line. An overload relay is provided and in addition, a disconnecting means (breaker or switch) is provided to agree with the disconnecting means selected for the controller.

L16
Overload relay — A bimetallic, ambient compensated overload relay selected based on the controller rated current. Refer to Section 2.2.3 and Figure 2.2.

① This option does not include fuses. Refer to Figure 3.2 to determine the proper fuse rating.

### 3.7.4 METERS

The meters described below are available in kit form for remote mounting only when used with OMEGAPAK Type PT 1000 controllers. They are available factory installed in the controller when used with OMEGAPAK Type PT 1500, 2000 or 3000 controllers.

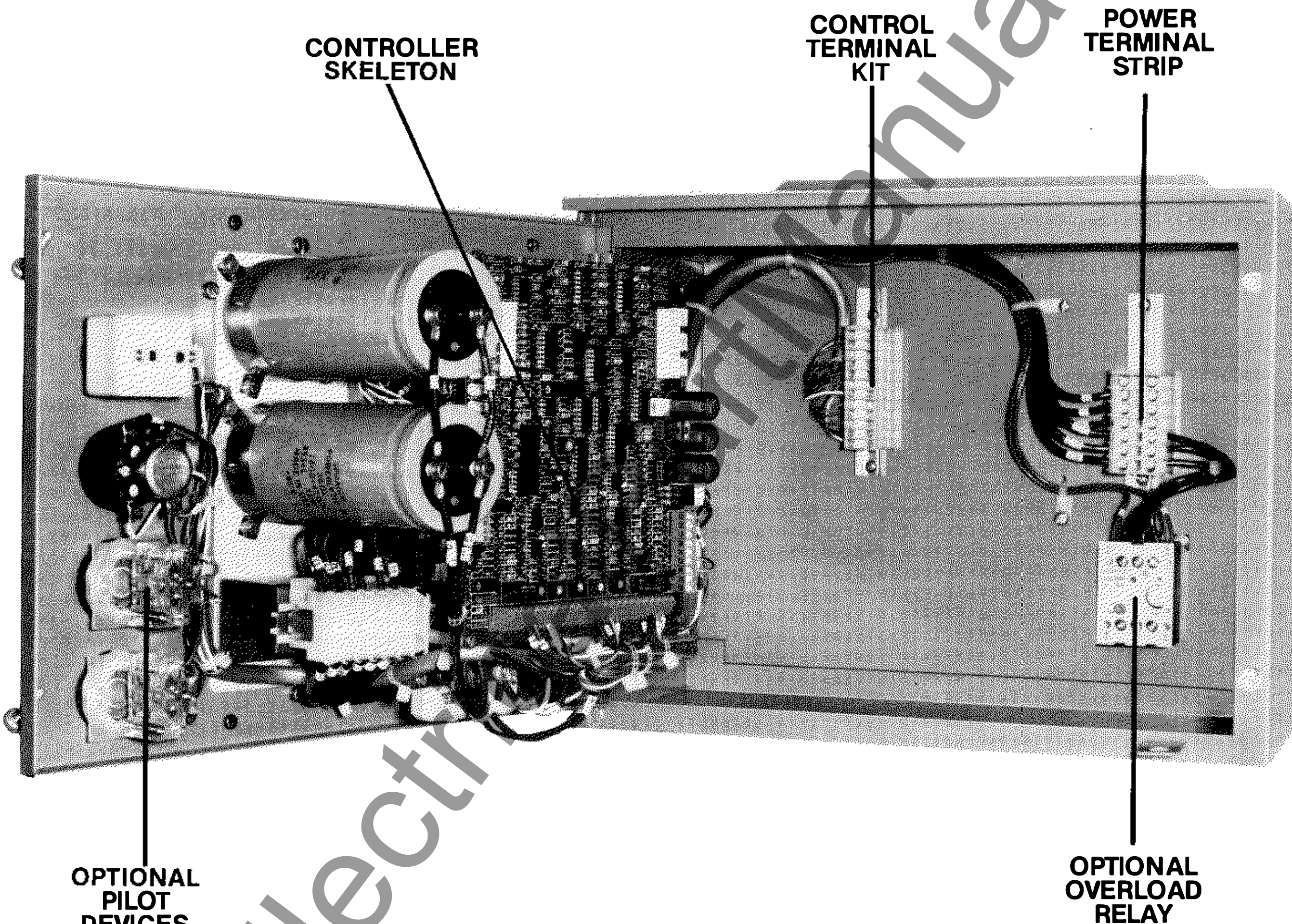
MOD A14 (Kit Class 8804, Type AM-1)
Analog Speed Meter — 3½ inch meter with indicating scale of 0-100% speed. A 2.5V dc output signal that equals 60 Hertz/motor base (rated) speed is used to drive this meter. Refer to Section 8, Controller Drawings for meter connections.

MOD D14 (Kit Class 8804, Type DM-1)
Digital Speed Meter — 3½ inch meter selectable to indicate 0-100% speed or 0-1999 RPM (Maximum RPM indication is 1999). Refer to Section 8, Controller Drawings for meter connections.

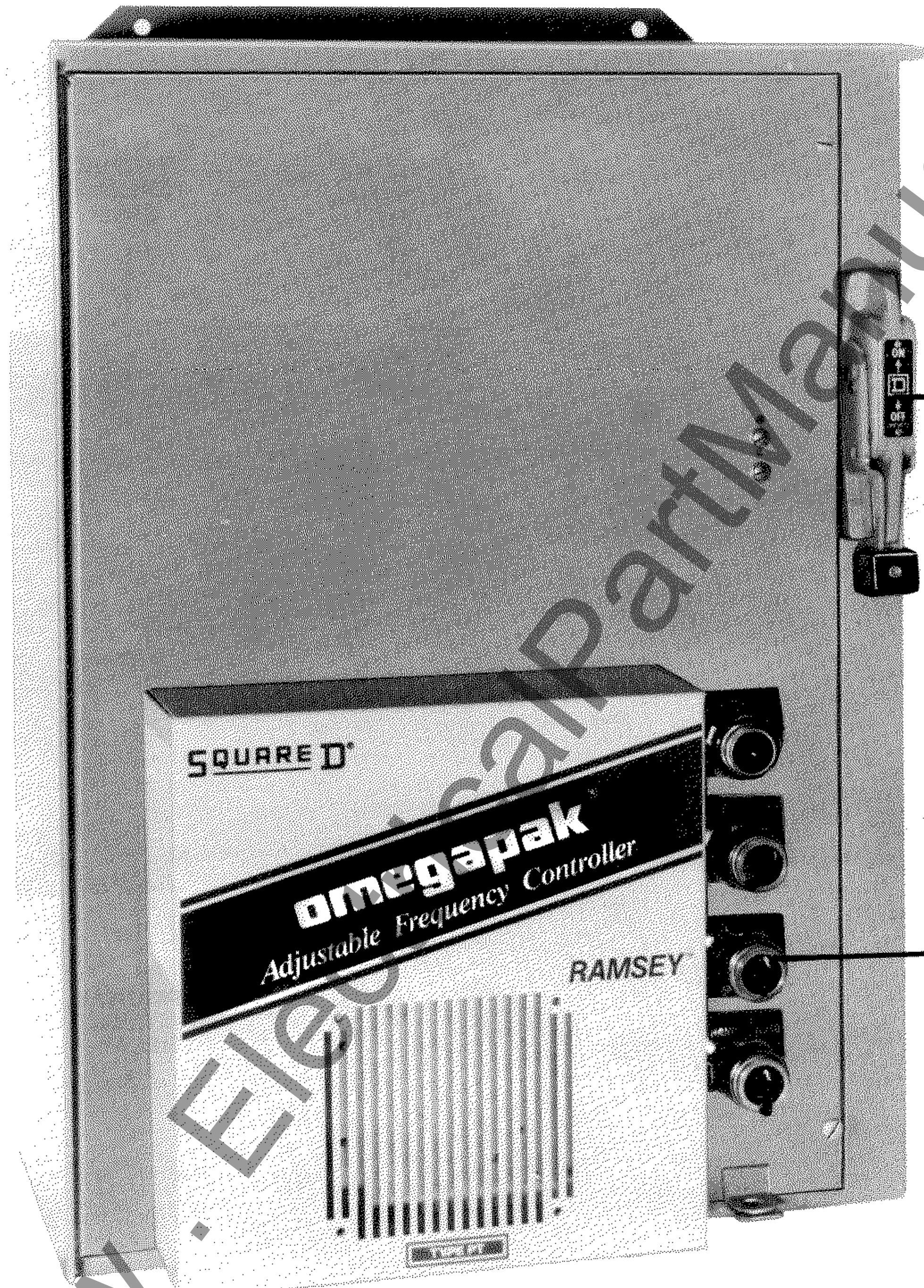
MOD T15
Elapsed Time Meter — 3½ inch meter with indicating scale of 99999.9 hours maximum. Refer to Section 8, Controller Drawings for meter connections.

# 4.0 CONTROLLER PHOTOS

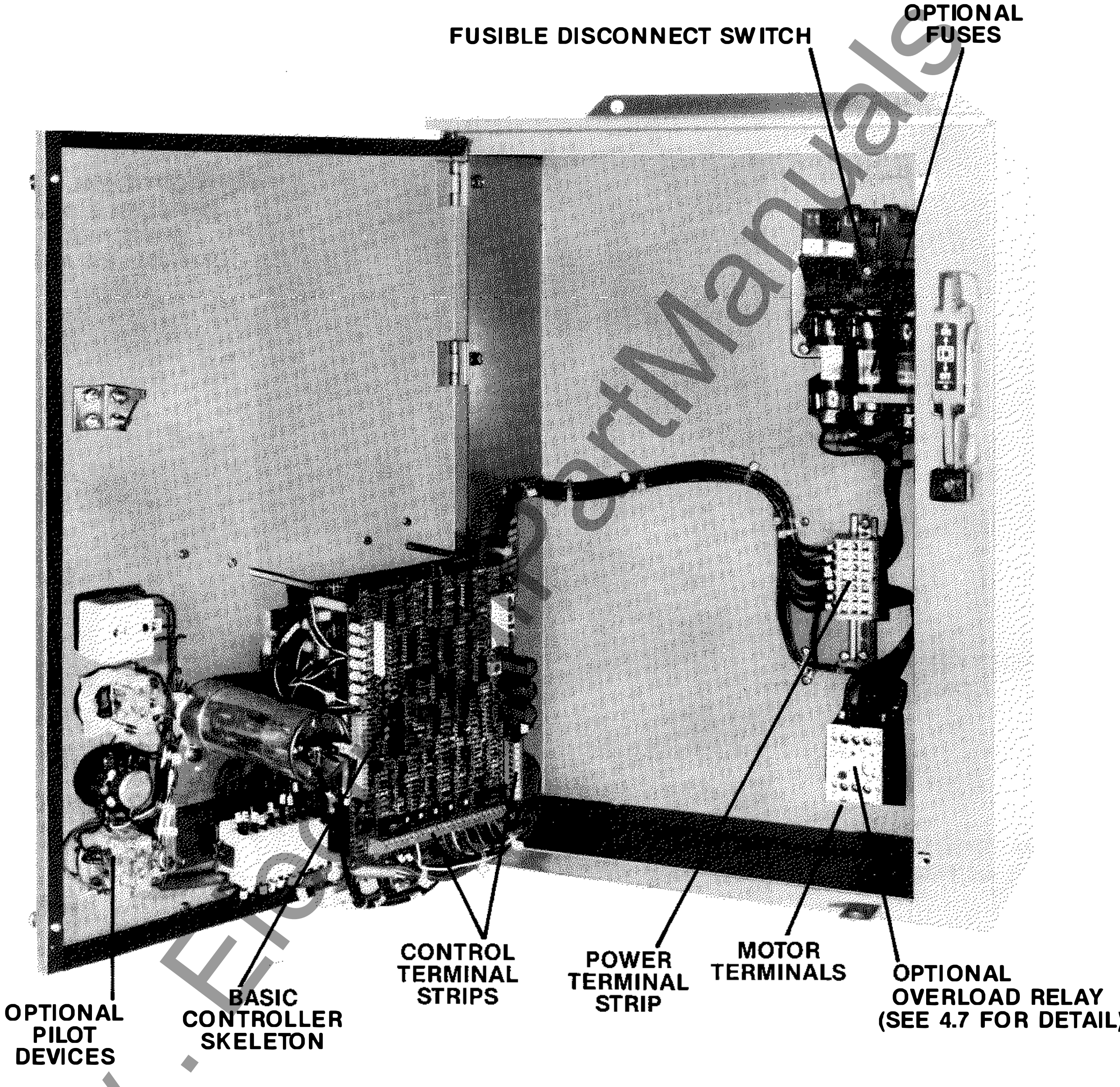
## 4.1 OPEN TYPE PT 1000 CONTROLLERS



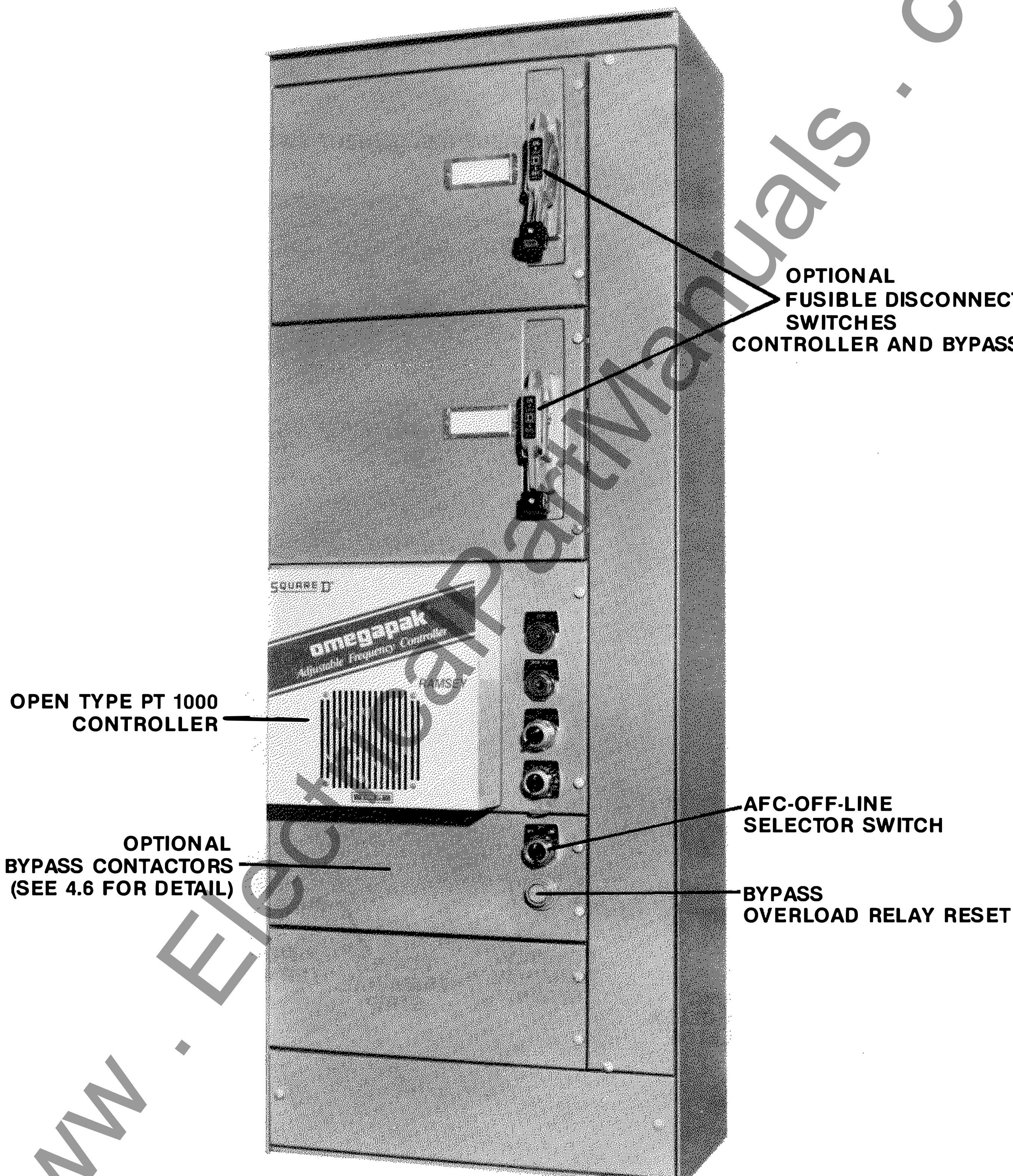
## 4.2 ENCLOSED TYPE PT 1500 CONTROLLER



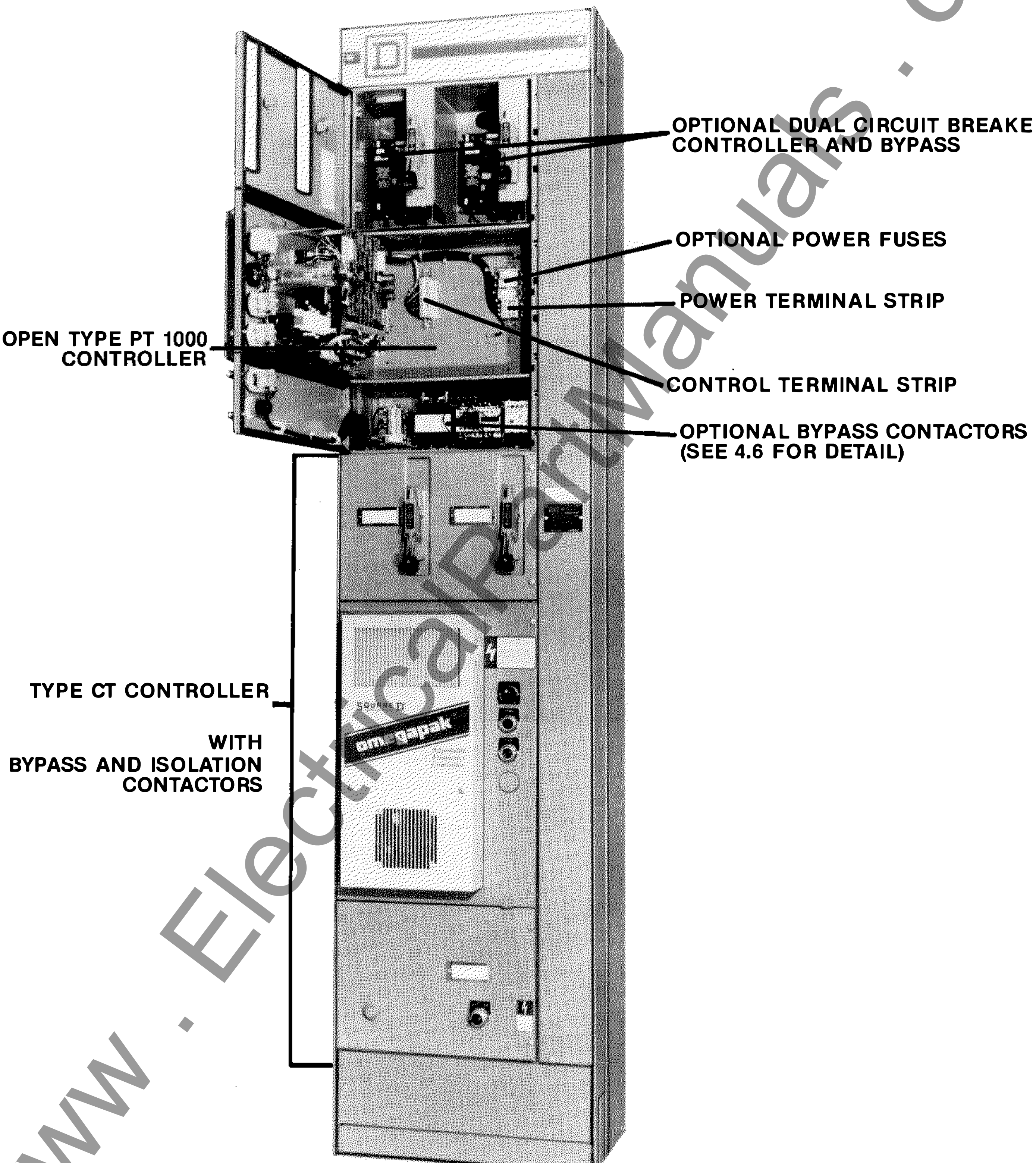
## 4.3 TYPE PT 1500 CONTROLLER



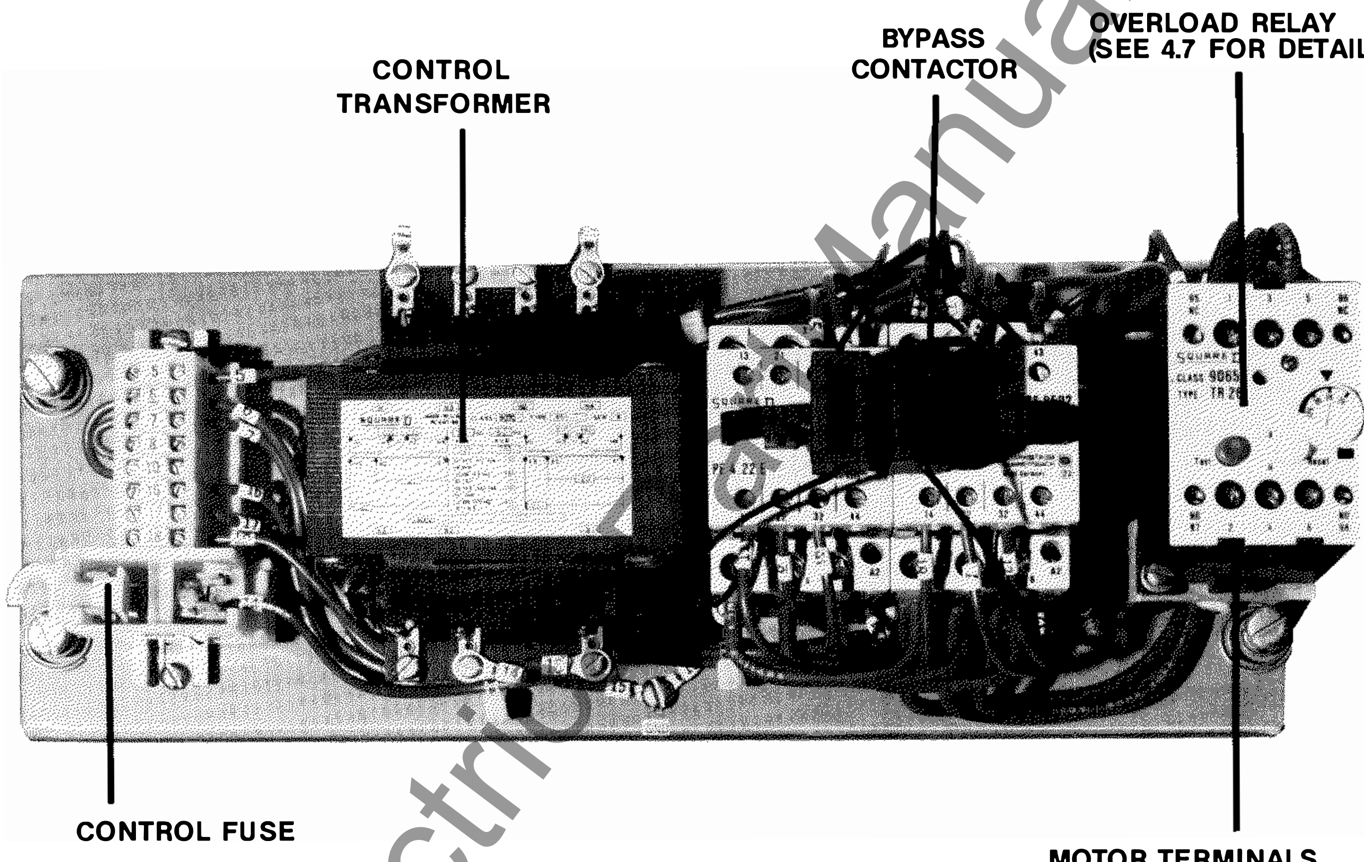
## 4.4 TYPE PT 2000 CONTROLLER



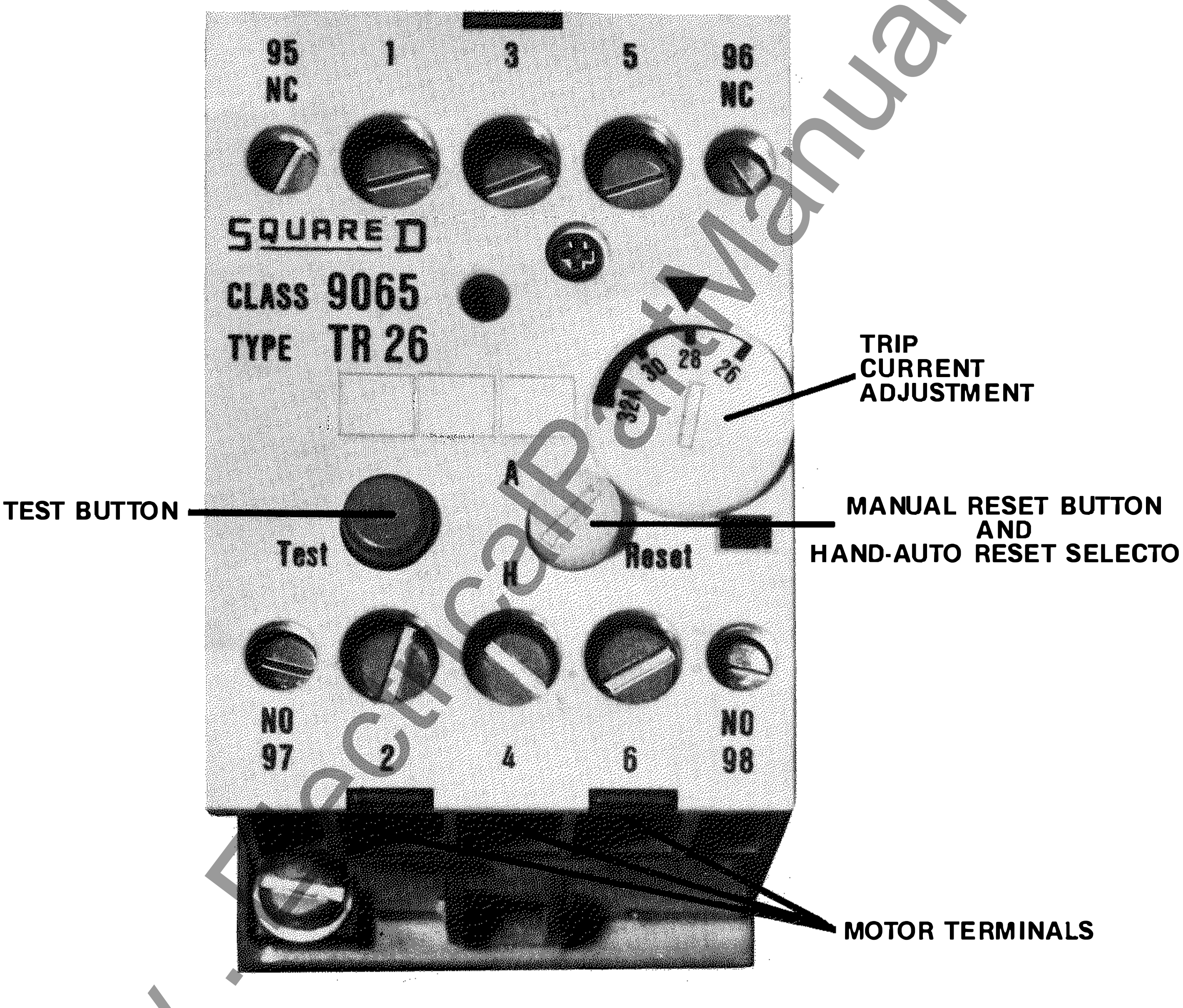
## 4.5 TYPE PT 3000 CONTROLLER



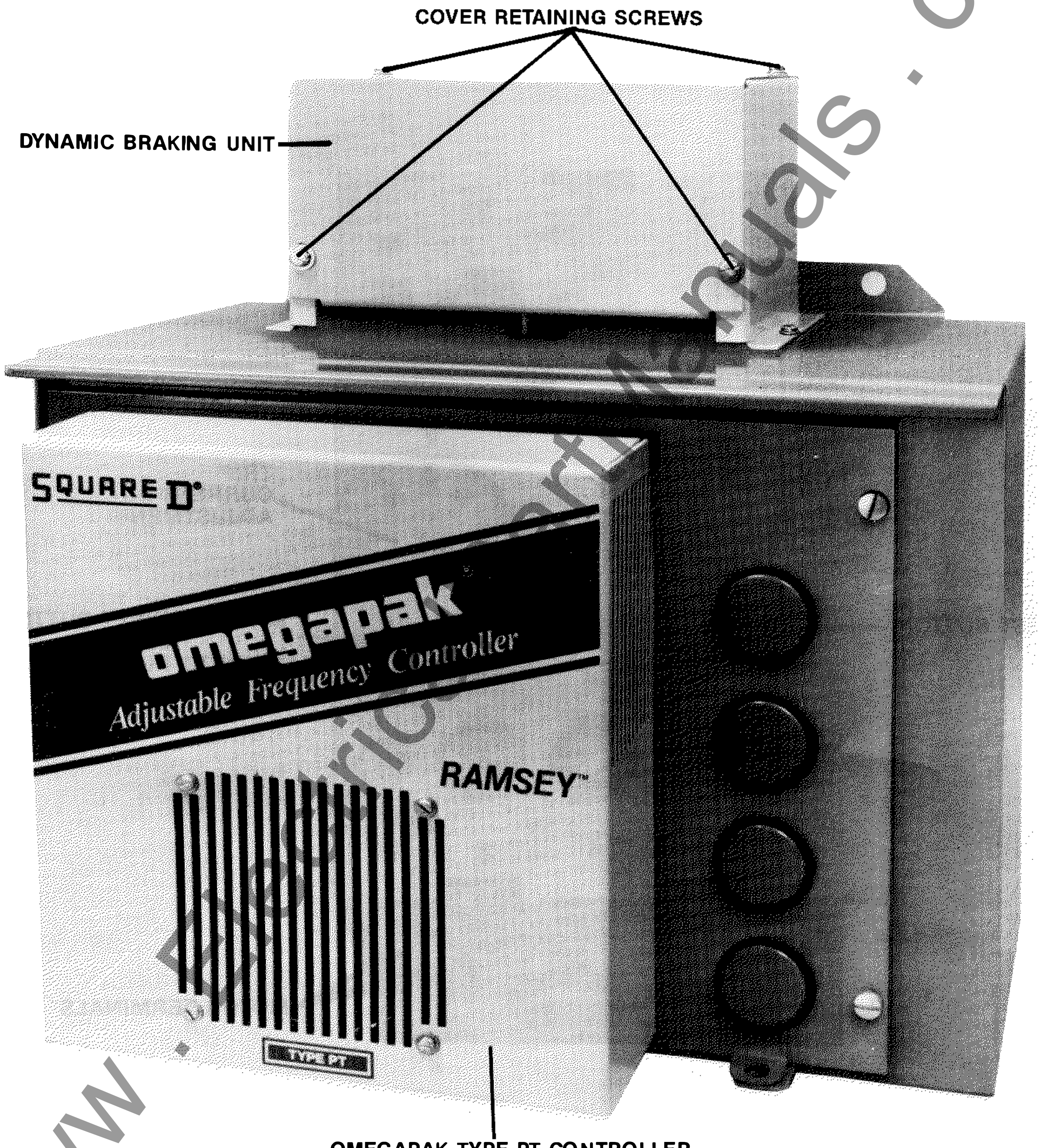
## 4.6 CONTROLLER BYPASS OPTION



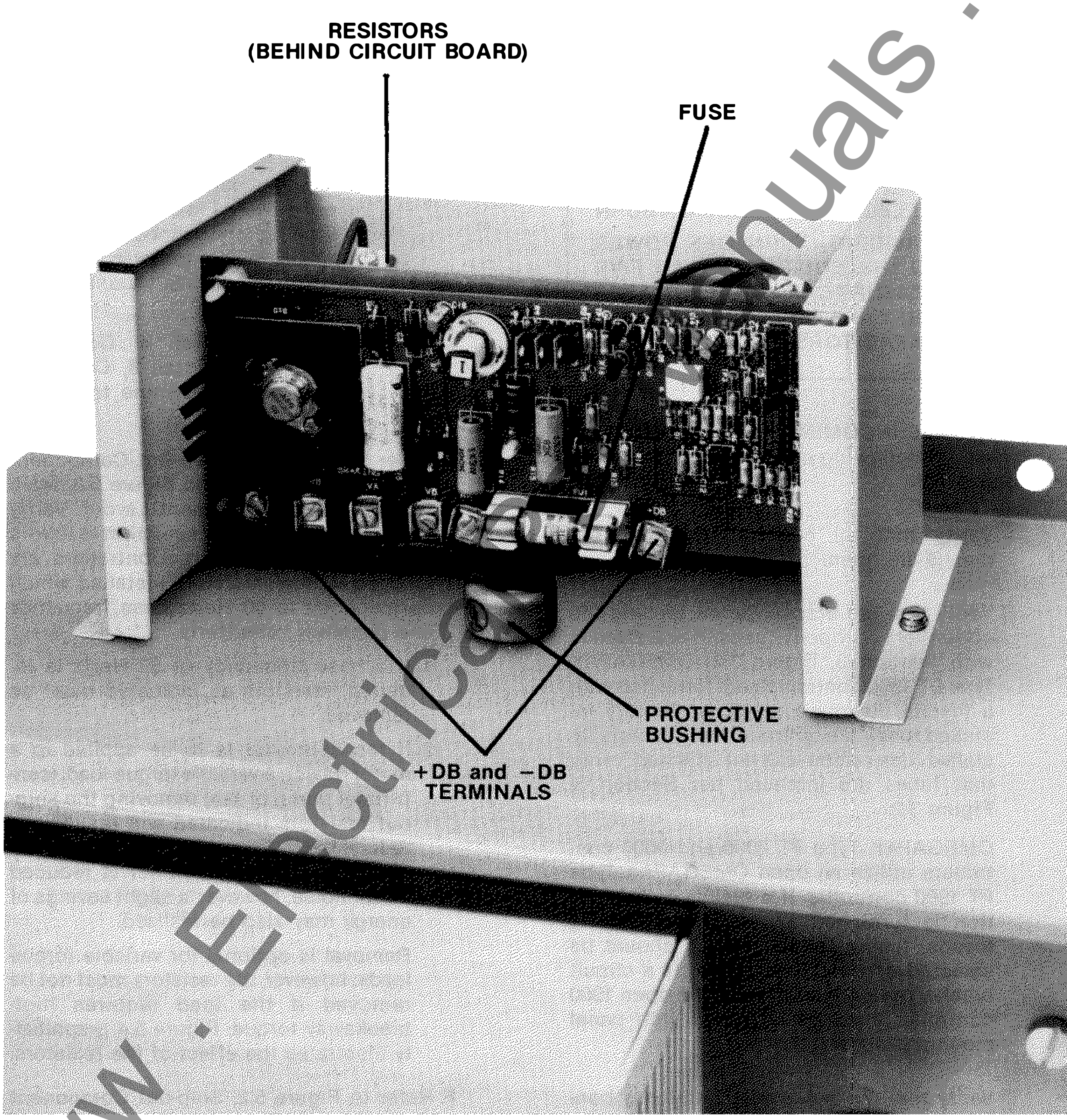
## 4.7 OVERLOAD RELAY OPTION



## 4.8 CONTROLLER WITH DYNAMIC BRAKING



## 4.9 DYNAMIC BRAKING UNIT (COVER REMOVED)



# 5.0 START-UP AND ADJUSTMENT PROCEDURE

## 5.1 INITIAL START-UP PROCEDURE

The OMEGAPAK Type PT controller has been tested at the factory and should require only minor adjustments to complete the field installation. This start-up procedure should be followed step by step. In case of difficulty refer to the TROUBLESHOOTING section of this service bulletin.

> **DANGER**
> **HAZARD OF ELECTRICAL SHOCK OR BURN**
> **BEFORE SERVICING, TURN OFF POWER SUPPLY(S) TO THIS EQUIPMENT. WAIT FIVE MINUTES. MEASURE CAPACITOR VOLTAGES TO VERIFY THEY ARE ZERO. DO *NOT* SHORT ACROSS CAPACITORS WITH VOLTAGE PRESENT.**

**WITH ALL INCOMING POWER REMOVED,** make the following equipment settings and adjustment:

A. Verify that all equipment disconnect means are open.

B. Verify that the branch circuit feeding the controller is properly fused in accordance with Section 3, Figure 3.2. OMEGAPAK Type PT 1500 controllers are furnished with a fusible disconnect switch. Factory installed fuses are optional. If the factory installed fuse option was not selected, verify that fuses are installed per Section 3, Figure 3.2.

OMEGAPAK Type PT 2000 and 3000 controllers utilize an open OMEGAPAK Type PT 1000 controller. If a fusible switch option is furnished as the disconnecting means, fusing for the switch should be selected as described above. If a circuit breaker option is furnished, the open 1000 controller must be equipped with panel mounted fuses.

C. Verify that the adjustable frequency controller control power transformer is connected for the proper input voltage per Figure 5.1. Refer to Section 4, Controller Photos and Section 8, Controller drawings to determine the transformer location.

NOTE: 200/230V rated controllers are factory set for 230 volt operation and 380/460V rated controllers are factory set for 460 volt operation.

D. If the controller is not an OMEGAPAK 2000 or 3000 controller with the bypass option, skip to step E. If bypass is included, verify that the bypass contactors control power transformer is properly connected for the input voltage to be used. Refer to Figure 5.1.B to determine the proper connection.

NOTE: 200/230/460 volt operation may be selected. Operation from 380 volts is not provided for. The transformer will be factory connected for 230V if a 200/230V controller is furnished or 460V if a 380/460V controller is furnished.

Refer to Section 4, Controller Photos and Section 8, Controller Drawings to determine the transformer location.

E. Refer to Figure 5.2, Snip-Out Component Configuration Chart and Figure 5.3, Main Control Board Component Layout. Verify that the volts per Hertz selection resistors are configured properly. Controllers are shipped with all resistors installed which corresponds to 60 Hertz base frequency and constant volts/Hertz.

1. If a base frequency of 50 Hertz is required, resistors as indicated must be removed.

2. If the controller is to be applied to a motor driving a variable torque load, (centrifugal pump or fan) removing the snip-out resistors indicated will result in a reduced volts/Hertz ratio at reduced frequencies. The major effect is reduced motor noise; however, a slight savings of energy may also be realized.

   Removal is optional for variable torque loads; however, the resistors **must not** be removed if the load requires high breakaway torque. Figure 5.4 graphically illustrates the effect of the resistors.

F. Refer to Figure 5.2, Snip-out Component Configuration Chart and Figure 5.3, Main Control Board Component Layout. Verify that the input frequency selection resistor configuration corresponds to the actual input frequency (50 or 60 Hz). The controller

## FIGURE 5.1

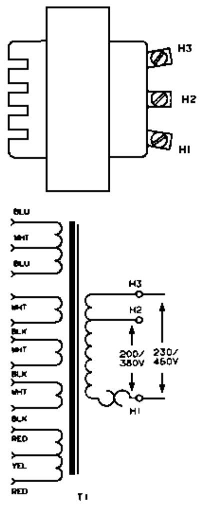
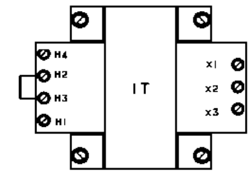
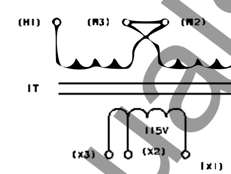



FIGURE 5.1A
CONTROL TRANSFORMER-CONTROLLER




TERMINAL AND JUMPER LOCATIONS
460V OPERATION




CONNECTION DIAGRAM
460V OPERATION

FIGURE 5.1B
CONTROL TRANSFORMER-BYPASS CONTACTORS

## FIGURE 5.2
## SNIP-OUT COMPONENT CONFIGURATION CHART① ②

| Snip-Out Components | FUNCTION | | | |
|---|---|---|---|---|
| | VOLTAGE/FREQUENCY SELECTION | | | |
| | INPUT | | BASE OUTPUT | |
| | VOLTAGE | FREQUENCY | VOLTAGE | FREQUENCY |
| None | 230V | 60 Hz | 230V | 60 Hz |
| R136 | 230V | 60 Hz | 200V | 60 Hz |
| R136, R35 | 230V | 60 Hz | 200V | 50 Hz |
| R136, R74 | 230V | 50 Hz | 200V | 60 Hz |
| R35, R74, R82 | 230V | 50 Hz | 230V | 50 Hz |
| R136, R35, R74 | 230V | 50 Hz | 200V | 50 Hz |
| R136 | 200V | 60 Hz | 200V | 60 Hz |
| R136, R35, R82 | 200V | 60 Hz | 200V | 50 Hz |
| R136, R74 | 200V | 50 Hz | 200V | 60 Hz |
| R136, R35, R74 R82 | 200V | 50 Hz | 200V | 50 Hz |
| None | 460V | 60 Hz | 460V | 60 Hz |
| R136 | 460V | 60 Hz | 400V | 60 Hz |
| R136, R35 | 460V | 60 Hz | 400V | 50 Hz |
| R136, R74 | 460V | 50 Hz | 400V | 60 Hz |
| R35, R74, R82 | 460V | 50 Hz | 460V | 50 Hz |
| R136, R35, R74 | 460V | 50 Hz | 400V | 50 Hz |
| R74, R82 | 380V | 50 Hz | 380V | 50 Hz |
| R38, R135, R138, R141 | CONSTANT OR VARIABLE TORQUE (See Figure 5.4)<br>Installed: Constant V/Hz ratio is maintained over a 1.75 Hz to 60 Hz range permitting constant torque at reduced speeds.<br>Removed: Reduced V/Hz ratio at reduced output frequency for variable torque loads. | | | |
| R86, R87 | OUTPUT FREQUENCY CLAMP<br>Installed: Maximum output frequency is clamped to base frequency (50 or 60 Hz) +26%, −0%.<br>Removed: R86 only.<br>Maximum output frequency is clamped to base frequency times 1.5, +26%, −0%.<br>Removed: R86 **and** R87.<br>Maximum output frequency is clamped to base frequency times 2.0, +26%, −0%. | | | |
| R21 | FOLLOWER SIGNAL LEVEL SELECT<br>Installed: Analog follower signals of 0-10 vdc or 4-20 ma dc are permissible.<br>Removed: Analog follower signal of 0-5 vdc is accepted.<br>Note: R21 must be removed on slave controllers of master-slave arrangement. | | | |
| C37 | ACCEL/DECEL RAMP DISABLE<br>Installed: Acceleration and deceleration ramps are adjustable over the normal range.<br>Removed: Acceleration and deceleration ramps are disabled. Output frequency follows input signal directly.<br>Note: This function is used when it is desired to have slave units directly track a master with accel/decel controlled by the master. | | | |

① Controllers are shipped with all snip-out components installed.
② If a component is to be removed, it is suggested that one lead be snipped and required operation confirmed before completely removing the component.

**FIGURE 5.3**
**MAIN CONTROL BOARD**

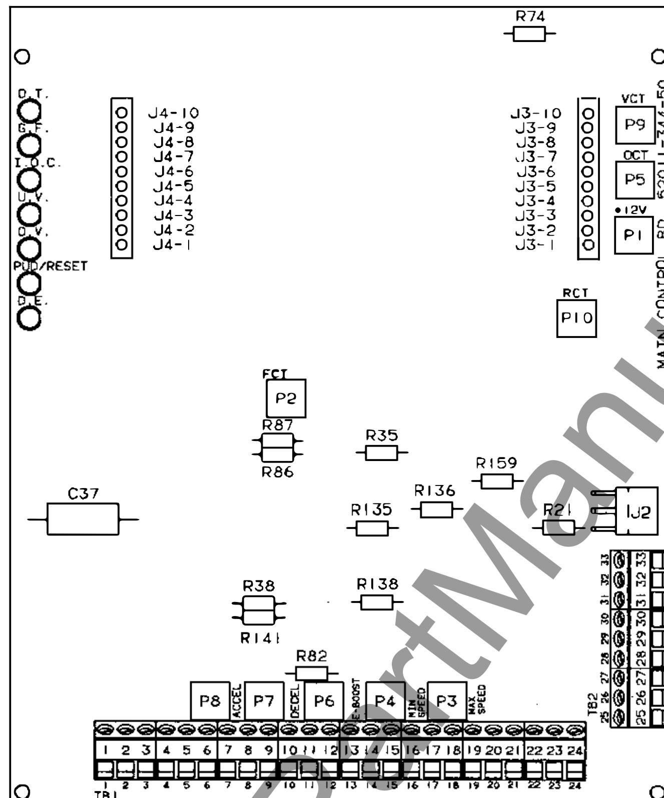
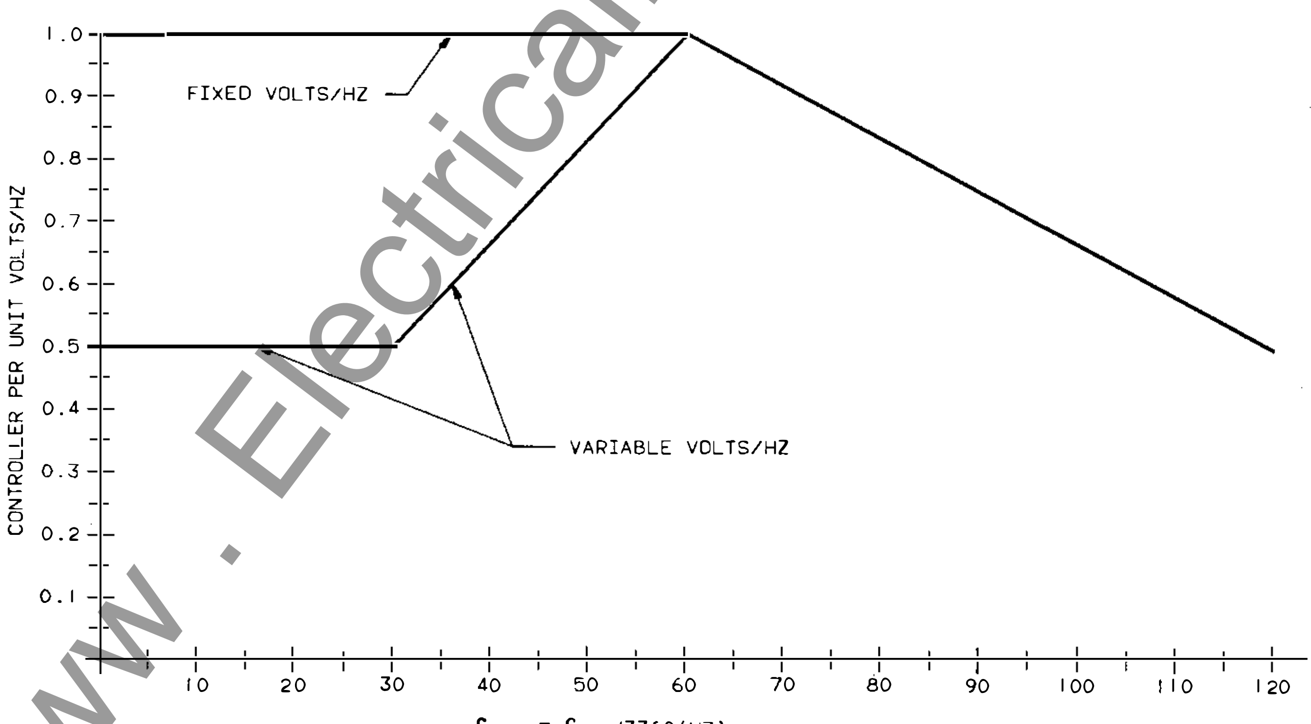



**FIGURE 5.4**




VOLTS/HZ VS. OUTPUT FREQUENCY (THEORETICAL) is shipped for 60 Hz input. Remove the indicated resistor if the controller is to be operated from a 50 Hz supply.

G. Refer to Figure 5.2, Snip-out Component Configuration Chart and Figure 5.3, Main Control Board Component Layout. Verify that the input voltage selection resistor configuration agrees with the intended controller input voltage. The controller is shipped for either 230V or 460V input. Remove the indicated resistor if the controller is to be operated from a 200V or 380V supply.

H. Refer to Figure 5.2, Snip-out Component Configuration Chart and Figure 5.3, Main Control Board Component Layout. Verify that the output frequency clamp resistor configuration corresponds to the desired maximum operating frequency. The controller is shipped set for 60 Hz maximum output frequency. If 90 Hz or 120 Hz output is required, one or both of the indicated resistors must be removed.

**CAUTION**
**SOME MOTORS AND/OR LOADS MAY NOT BE SUITED FOR OPERATION AT HIGHER THAN NAMEPLATE MOTOR SPEED AND FREQUENCY. TO AVOID DANGER OF OVERSPEED, CONSULT THE MOTOR MANUFACTURER AND EQUIPMENT MANUFACTURER BEFORE OPERATING THE MOTOR ABOVE 60 HERTZ.**

I. This step sets the signal level of analog follower inputs. If automatic operation is not desired (speed control via manual speed potentiometer only) skip to step J. Refer to Figure 5.2, Snip-out Component Configuration Chart and Figure 5.3, Main Control Board Component Layout. Verify that the follower signal level select resistor configuration corresponds to the intended input signal range. The controller as shipped will accept 0-10vdc or 4-20 madc for automatic speed control. If speed control from a 0-5vdc signal is required, the indicated resistor must be removed.

NOTE: The resistor must be removed on all slave units in a master-slave arrangement.

If operation from a 4-20 ma signal is required, a jumper must be installed from Main Control Board terminal TB1-11 to TB1-12. Refer to Section 8, Drawing 8.4.1.

J. This step allows the controller's acceleration/deceleration ramps to be disabled. If adjustable acceleration/deceleration times are desired, skip to step K. Refer to Figure 5.2, Snip-out Component Configuration Chart and Figure 5.3, Main Control Board Component Layout. Verify that the accel/decel ramp capacitor configuration corresponds to the desired operation of the controller. The controller is shipped with accel/decel ramps adjustable over the range described in Section 3, Application Data. If it is desired to have the controller ramp function disabled, the designated capacitor must be removed.

**CAUTION**
**IF THE CONTROLLER RAMPS ARE DISABLED AS DESCRIBED ABOVE, THE ACCEL/DECEL RAMP FUNCTION MUST BE PROVIDED EXTERNALLY, EITHER BY THE MASTER CONTROLLER IN A MASTER-SLAVE CONFIGURATION OR BY THE PROCESS CONTROLLER PROVIDING THE FOLLOWER SIGNAL.**

K. Potentiometers located on the main control board were adjusted as shown in Figure 5.5. The function of each potentiometer is described in Figure 5.6. Certain potentiometers indicated as factory adjusted and sealed **must not be adjusted**. Doing so will break the factory seal and **void the warranty**. Other potentiometers are user adjustable to tailor the controller performance to the application. Adjust these, if desired, **only** when directed by the start-up procedure.

**FIGURE 5.5**
**FACTORY SETTINGS OF USER ADJUSTABLE POTENTIOMETERS**

| FUNCTION ① | POTENTIOMETER | FACTORY SETTING |
|---|---|---|
| MAX SPEED | P3 | 60 Hz Max Frequency |
| MIN SPEED | P4 | 1.75 Hz Min Frequency |
| E-BOOST | P6 | Full CCW (Zero Boost) |
| DECEL | P7 | Full CW (20 sec) |
| ACCEL | P8 | Full CW (20 sec) |

● Refer to Figure 5.6 for a complete description of potentiometer functions.

L. Place the start switch (controller mounted or remote mounted) to the off position.

M. Set the Manual Speed adjustment potentiometer (controller mounted or remote mounted) to minimum (full counterclockwise).

**FIGURE 5.6**
**POTENTIOMETER FUNCTIONAL DESCRIPTION**

| POT | DESCRIPTION | FUNCTION |
|---|---|---|
| P1* | +12V TRIM | Trims positive (+) 12 vdc power supply to compensate for component tolerances. |
| P1 | VOLTAGE TRIM (On DB Unit If Used) | Trims voltage at which the DB unit operates. |
| P2* | FCT TRIM (Frequency Clock Trigger) | Permits trimming of the voltage controlled oscillator that controls output frequency to compensate for component tolerances. |
| P3 | MAX SPEED | Permits adjustment of the maximum output frequency produced by the controller when the speed reference signal (either manual potentiometer or automatic follower) is at maximum. |
| P4 | MIN SPEED | Permits adjustment of the minimum output frequency produced by the controller when the manual speed potentiometer is fully counterclockwise. NOTE: Min speed has no effect on the automatic follower input. |
| P5* | OCT TRIM (Output Clock Trigger) | Permits trimming of the oscillator which controls the interlock delay of the output transistors to compensate for component tolerances. |
| P6 | E-BOOST (Voltage Boost) | Permits an increase in the volts per Hertz ratio at low frequencies to compensate for voltage drops due to internal winding resistance of the motor and long lead length. E-Boost has maximum effect at 1.75 Hz and tapers to zero at about 20 Hz. |
| P7 | DECEL (Deceleration Time) | Permits adjustment of the time required to ramp the output frequency from a higher to a lower value. |
| P8 | ACCEL (Acceleration Time) | Permits adjustment of the time required to ramp the output frequency from a lower to a higher value. |
| P9* | VCT TRIM (Voltage Clock Trigger) | Permits the volts per Hertz ratio to be trimmed to compensate for component tolerances. |
| P10* | RCT TRIM (Reference Clock Trigger) | Permits adjustment of the maximum switching rate of the inverter transistors. |

*These potentiometers are factory adjusted and sealed and must not be adjusted. Any attempt to adjust these potentiometers will break the factory seal and void the warranty.

N. Check wiring of input power, ground, motor, manual speed potentiometer (if remote) and start-stop circuit connections (if remote). Refer to Section 8 for controller connection diagrams and wiring diagrams for remote control operators stations.

O. Verify that the incoming line voltage at the line side of the disconnecting means is within +10% to −5% of the controller nameplate input voltage.

> **DANGER**
> **HAZARD OF ELECTRICAL SHOCK OR BURN**
> **CONTROLLER PANEL MUST BE PROPERLY GROUNDED BEFORE APPLYING POWER. ATTACH AND SECURE CONTROLLER COVER OR CLOSE AND SECURE CONTROLLER DOOR BEFORE APPLYING POWER.**

P. Insure that a normally closed control circuit contact from an overload relay and/or the motor thermal switch is wired between terminals TB1-4 and TB1-5 as shown on drawing 8.4.1. If the overload relay option was factory installed, the connections to TB1-4 and TB1-5 will have been made. If it is also desired to use a motor thermal switch, the thermal switch should be wired in series with the overload relay contact. Refer to Section 2.2.3 for further information on overload protection.

Q. If the overload relay option was not furnished, skip to Step R.

The overload relay trip setting must be adjusted to correspond with the motor full load current as shown on the motor nameplate. Refer to Section 4, Controller Photos. Verify that the overload relay is set up for automatic reset (the overload relay will cause an overtemperature trip in the controller which will require manual reset). Refer to Section 4, Controller Photos.

R. If the bypass option was not furnished, skip to Step S.

The bypass option includes an overload relay which must be adjusted as described in Step Q above. Verify that the overload relay located in the bypass contactor compartment is set for hand reset. Refer to Section 4, Controller Photos.

S. Close and secure the enclosure door. Close the equipment disconnect means.

> **DANGER**
> **HAZARD OF ELECTRICAL SHOCK OR BURN**
> **CERTAIN ADJUSTMENTS AND TEST PROCEDURES REQUIRE THAT POWER BE APPLIED TO THIS CONTROLLER. WHEN WORKING WITH ENERGIZED EQUIPMENT, EXTREME CAUTION MUST BE EXERCISED AS HAZARDOUS VOLTAGES EXIST. THE CONTROLLER DOOR MUST BE CLOSED AND SECURED WHILE TURNING ON POWER, OR STARTING AND STOPPING THIS CONTROLLER.**

T. If bypass contactors are not used, proceed to Step X.

U. If the Isolation-Bypass unit is used, turn the AFC-OFF-Line selector switch to the Line position. If necessary, adjust the disconnect means trip setting to the lowest value that will not result in nuisance tripping. The motor should accelerate to full speed. Check the motor rotation. If it is incorrect, stop the drive by turning the AFC-Off-Line selector switch to Off. REMOVE ALL POWER!

V. Correct the phase sequence of the motor by reversing motor leads T1 and T2 at the output of the Bypass contactor unit. Close and secure the enclosure door. Reapply power.

W. Turn the Bypass contactor unit AFC-Off-Line selector switch to AFC.

X. Start the controller. If hand or auto operation is possible, use the hand mode. Slowly turn the Manual Speed adjustment potentiometer clockwise to accelerate the motor. Check the direction of motor rotation. If correct, proceed to Step AA. If incorrect, stop the drive, REMOVE ALL POWER!

**DANGER**
**HAZARD OF ELECTRICAL SHOCK OR BURN**
**BEFORE SERVICING, TURN OFF POWER SUPPLY(S) TO THIS EQUIPMENT. WAIT FIVE MINUTES. MEASURE CAPACITOR VOLTAGES TO VERIFY THAT THEY ARE ZERO. DO NOT SHORT ACROSS CAPACITORS WITH VOLTAGE PRESENT.**

Y. Correct the direction of motor rotation by one of the following methods:
   1. If a Forward-Reverse selector switch is not used, place a jumper from TB1-18 to TB1-19 on the main control board. Proceed to Step Z.
   2. If a Forward-Reverse selector switch is used, change the contact arrangement on the Forward-Reverse selector switch. Refer to Section 8, Controller Drawings for controller mounted or remote pilot devices.

Z. Reset the Manual Speed adjustment potentiometer setting to minimum speed (full counterclockwise). Close and secure the enclosure door. Then, reapply power and restart the controller.

AA. Slowly increase the manual speed adjustment potentiometer setting to maximum (full clockwise). The motor speed should follow. If the motor will not accelerate or if the controller trips refer to Section 7 Troubleshooting.

BB. The controller was shipped set for a maximum output frequency of 60 Hertz. If 60 Hertz is the desired output frequency, no adjustment is necessary. If a maximum frequency of other than 60 Hertz is required, potentiometer P3, Maximum Speed (MAX SPEED), must be adjusted. Refer to Figure 5.3, Main Control Board Component Layout for the location of P3. Turn P3 counter-clockwise to reduce the maximum output frequency or clockwise to increase maximum output frequency.

NOTE: If the required maximum output frequency exceeds about 66 Hertz, output frequency clamp resistors must be reconfigured as described in Step G of the start-up procedure.

**CAUTION**
**SOME MOTORS AND/OR LOADS MAY NOT BE SUITED FOR OPERATION AT HIGHER THAN NAMEPLATE MOTOR SPEED AND FREQUENCY. TO AVOID DANGER OF OVERSPEED, CONSULT THE MOTOR MANUFACTURER AND EQUIPMENT MANUFACTURER BEFORE OPERATING THE MOTOR ABOVE 60 HERTZ.**

CC. Return the manual speed adjustment potentiometer to minimum setting (full counterclockwise). The motor speed should follow.
NOTE: If the controller trips during deceleration, refer to Section 7, Troubleshooting.

DD. The controller was shipped set for a minimum output frequency of approximately 1.75 Hertz. If this is the desired minimum frequency, no adjustment is necessary. If a higher minimum frequency is desired, potentiometer P4, Minimum Speed (**MIN SPEED**), must be adjusted. Refer to Figure 5.3, Main Control Board Component Layout for the location of P4. Turn P4 clockwise to increase the minimum output frequency.

NOTE: P4 affects the minimum frequency only when speed control is via a manual speed potentiometer. It has no effect when speed control is via an analog follower signal. Minimum speed in this mode must be set by adjusting the minimum level of the follower signal.

**CAUTION**

**THIS CONTROLLER DOES NOT PROVIDE OVERTEMPERATURE PROTECTION FOR THE MOTOR AT ALL SPEEDS OR LOADING CONDITIONS. A MOTOR THERMAL SENSOR IS RECOMMENDED.**

EE. The controller is shipped factory set for an acceleration time of 20 seconds. If this acceleration time is satisfactory, no adjustment is necessary. If a shorter acceleration time is required, potentiometer P8, Acceleration time (ACCEL), must be adjusted. Refer to Figure 5.3, Main Control Board Component Layout for the location of P8. Turn P8 counterclockwise to decrease the acceleration time.

**CAUTION**

**SETTING ACCELERATION TIME TOO SHORT MAY NOT ALLOW A LOAD SUFFICIENT TIME TO ACCELERATE. IF THIS CONDITION EXISTS, THE CONTROLLER WILL TRIP DUE TO INSTANTANEOUS OVER CURRENT (IOC). REFER TO SECTION 7, TROUBLESHOOTING FOR A DESCRIPTION OF CONTROLLER FAULT INDICATORS. INCREASE THE ACCELERATION TIME UNTIL IOC TRIPS DURING ACCELERATION CEASE. THIS WILL BE THE SHORTEST PERMISSIBLE ACCELERATION TIME FOR THIS LOAD CONDITION. IF IOC TRIPS OCCUR DURING ACCELERATION WITH P8 SET FULLY CLOCKWISE, REFER TO SECTION 7, TROUBLESHOOTING.**

FF. The controller is shipped factory set for a deceleration time of 20 seconds. If this deceleration time is satisfactory, no adjustment is necessary. If a shorter deceleration time is desired, Potentiometer P7, Deceleration time (DECEL), must be adjusted. Refer to Figure 5.3, Main Control Board Component Layout for the location of P7. Turn P7 counterclockwise to decrease the deceleration time. If Overvoltage (OV) trips occur during deceleration, it will be necessary to increase the deceleration time or install the dynamic braking option.

NOTE: If the dynamic braking option is installed and deceleration time is set too short, an instantaneous overcurrent trip may result.

GG. The controller is shipped factory set for zero (0) voltage boost at 1.75 Hertz. If the load starts and accelerates normally, no adjustment is required. If a load will not break-away, starting torque can be increased by boosting output voltage (increasing the V/Hz ratio). This is accomplished by Potentiometer P6, Voltage Boost (E-BOOST). Refer to Figure 5.3, Main Control Board Component Layout for the location of P6. Turn P6 fully clockwise. If the load starts and accelerates normally, no further adjustment of P6 is necessary. If an instantaneous overcurrent (IOC) trip occurs during starting, rotate P6 counterclockwise slightly and again try to start the controller. Repeat the above procedure, if necessary, until the load breaks away and accelerates normally.

NOTE: Both insufficient and excessive voltage boost can result in an IOC trip. If the above procedure does not result in break-away and acceleration of the load without IOC trips, refer to Section 7, Troubleshooting.

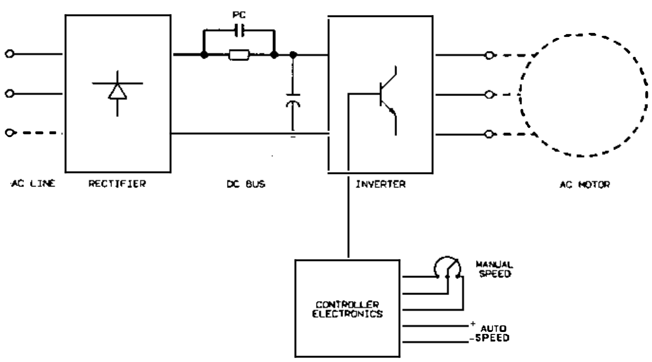
HH. The start-up procedure is now complete.

## 6.0 CONTROLLER OPERATION

### 6.1 POWER CIRCUIT

The simplified power circuit shown in Figure 6.1 consists of two basic blocks connected by a dc bus. The detailed power circuit is shown in Section 8, Controller Drawings.

**Figure 6.1**
**Simplified Power Circuit**




1. **Rectifier** — A diode rectifier power block makes up a full wave bridge circuit which changes fixed voltage ac to fixed voltage dc.
2. **DC Bus** — The dc bus couples the rectifier output to the inverter input. One or more capacitors are used to filter the rectifier output. Three phase input controllers use polypropylene bus capacitors and, single phase input controllers use electrolytic bus capacitors. In either case, a precharge circuit consisting of a resistor and relay is used to limit capacitor charging current during power-up of the controller.
3. **Inverter** — A transistorized inverter stage changes the dc bus voltage back to a three phase ac output voltage. Under control of electronic circuitry, the inverter produces a sine coded, Pulse Width Modulated (PWM) output waveform. Reverse parallel diodes protect the inverter transistors from reverse voltages and provide a path of current flow during periods of regeneration.

### 6.2 ELECTRONICS

The controller electronic circuitry is contained on two printed wiring boards. A main control board (MCB) holds the logic and control circuits necessary to control the output voltage and frequency in response to an input speed reference. A power interface board (PIB) amplifies and isolates the signals generated on the MCB into base drive signals for the inverter transistors.

Main Control Board (MCB) General Operation (Refer to Section 8, Drawing 8.4.1 for the control block diagram.)

The Main Control Board (MCB) contains the circuits necessary to provide the transistor base drivers of a 3-phase inverter with PWM signals. By controlling the fundamental frequency and modulation of the PWM signal, the output voltage and frequency of the inverter power stage is controlled. The MCB is also the means for controlling functions such as start-stop, acceleration-deceleration, and output voltage programming. It monitors bus voltage, fault current and overtemperature conditions, and responds to overvalues.

External connections to the MCB are made from switches such as start-stop, run-jog and forward-reverse. Other connections are the manual speed potentiometer, thermal switches, metering, bus voltage and bus current inputs, indicator lamps, fan, and the transistor base drivers.

A. A major circuit on the MCB is the Pulse-Width Modulation Generator IC which requires four clock inputs and two control inputs to control the waveforms to the base drivers. The control inputs are an enable signal obtained from the control logic circuits, and a rotation signal to establish the direction of motor rotation.

Two of the clock inputs are the constant frequency outputs of stable oscillators. These clocks are labeled the Output Clock Trigger (OCT) and the Reference Clock Trigger (RCT). The RCT determines the maximum inverter switching frequency, and the OCT sets the interlock delay (time between periods of conduction of transistors in the same leg of the inverter).

A third clock input is the Frequency Clock Trigger (FCT) which is the output of a voltage controlled oscillator whose input voltage is the frequency reference input signal after modification by the acceleration/deceleration ramp circuit.

The FCT determines the inverter's output frequency and therefore, the motor speed. The frequency reference signal, set by the external Manual Speed Potentiometer is limited by potentiometers P4 (Minimum Speed) and P3 (Maximum Speed).

Acceleration and deceleration ramp times are set by potentiometers P8 (Acceleration) and P7 (Deceleration) and the resulting output is applied to the FCT oscillator.

There is a frequency clamp circuit connected to the input of the FCT oscillator. The clamp frequency is controlled by resistors R86 and R87 which can be removed (snipped out) to change the clamp frequency. With no resistors snipped from the circuit, the nominal output frequency is 60 Hertz. With R86 snipped out it is 90 Hertz, and with R86 and R87 snipped out it is 120 Hertz.

The final clock input to the PWM controller is the voltage clock trigger (VCT). The VCT is a voltage controlled oscillator (VCO) which controls the modulation of the carrier frequency to the motor in order to control the average inverter output voltage for a particular output frequency. This VCO receives its input from the Bus Voltage Detector and a Volts/Hertz Generator circuit that modifies the VCO output in accordance with E-Boost, 50 Hertz, or Pump/Fan service requirements as appropriate.

B. The output of the Accel/Decel circuit, in addition to driving the FCT VCO is provided, through a buffer, as a frequency follower. This allows multiple controllers to be operated in a master/slave arrangement. When used in this mode, R21 on slave units only should be snipped out to allow for proper scaling of the drive controller input when operated from the frequency follower output of the master drive controller. In addition, the Accel/Decel circuit can be bypassed in the slave drive controllers by snipping out C37, thus allowing master ramp operation from the master controller.

C. There are three circuit blocks shown that function in relation to the starting and stopping of the drive. They are the Start/Stop Logic and Minimum Frequency Detector, Power Up Delay and Reset circuits, and the Forward/Reverse Logic and Reference Suicide circuits. During power up there is a 1.5-second signal that is applied to fault latch circuits to ensure reset of the latches when the drive is energized. In addition, this Power Up Delay or Reset signal is OR-ed with fault signals and applied to the Run Command Relay circuit to prevent energizing of that relay until power up is complete. During operation, if an AC Undervoltage condition occurs, there will also be a power up reset signal when voltage recovers. An external Reset button can produce the same effect as the Power Up Delay.

The Start/Stop logic circuits provide the Enable signal to the PWM Generator. This Enable signal can be reset by the instantaneous trip signal from the bus overvoltage detector, by the fault or power-up reset signals, or by the Minimum Frequency Signal. The Run command input to the block is an active low signal.

The Ramp Reference output is applied to a Minimum Frequency Detector, which is a comparator whose output switches at frequencies less than 1.75 Hertz. This Minimum Frequency signal is applied to the Start/Stop Logic and to the Forward/Reverse Logic. In the Start/Stop circuit, Minimum Frequency causes the Drive Enable signal to go low, if the Run Command has been removed, once the frequency is ramped to minimum frequency. In the Forward/Reverse circuit, the minimum frequency signal allows the rotation latch to be switched once minimum frequency output is obtained, provided that the Forward/Reverse input has been changed.

The Forward/Reverse function has three inputs: Run Command, Forward/Reverse, and Minimum Frequency. The output of this block is the signal to the PWM Generator that determines direction of motor rotation. Additionally, there is an output from the reference suicide circuit that clamps the Frequency Reference signal low during a change in the Forward/Reverse Command input. A loss of the Run Command input to this block of circuits also causes the Frequency Reference suicide circuit to clamp the frequency reference low.

D. Five circuit blocks are involved directly in the processing of fault signals. The Undervoltage block is divided into two functions. It receives a dc Undervoltage instantaneous trip signal from the Bus Undervoltage and Phase-Loss Detector circuit. This signal causes the drive to stop and latches an undervoltage condition. The Undervoltage block also receives a rectified ac input from the 28V ac input to the

MCB. An ac undervoltage occurrence will also cause a trip and an undervoltage latch. However, the ac undervoltage signal is also applied to the Power Up Delay circuit where it initiates a power up reset cycle upon recovery of the ac undervoltage. Once the ac voltage recovers, the Undervoltage latch will be reset by the power up delay and the Drive Enable signal will be restored.

All fault conditions, such as Instantaneous Overcurrent and Ground Fault current will activate fault latches and LEDs. The latched faults provide a signal to the Drive Fault Relay allowing it to drop out. External connections to the relay contacts can provide indication of drive fault.

There is a dc Bus Overvoltage Detector and Ride-through circuit that provides a latched fault trip condition after a 7-millisecond delay allowing transient ride-through, as well as an instantaneous reset of the Start/Stop logic to allow for protection of the power transistors. The power transistors are shut off for 7 milliseconds and then enabled again if a bus overvoltage transient has subsided within that time. Otherwise, an overvoltage trip occurs. The Delayed Trip shown in the block occurs if there are two occurrences of Bus Overvoltage within 28 seconds of each other. The Delayed Trip causes a latched fault signal. This ride-through feature requires that the dynamic braking option be installed to bleed off excess dc bus energy.

E. Another feature depicted on the block diagram is the control circuit for the Pre-Charge (PC) Relay located external from the main control board. From the time that the regulated −12V dc and the −V unregulated voltages are available, there is a 50 millisecond delay before the PC relay is energized. This delay allows the bus capacitors to charge through a limiting resistor that is shunted by a normally open contact of the PC Relay.

F. Controller power supplies are fed from a 200/230-28V (or 380/460-28V) center tapped control transformer. The transformer output is applied to a bridge rectifier which provides positive (+) and negative (−) unregulated voltages for control relays located on the main control board. These voltages are also applied to voltage regulators which provide the regulated +12V dc and −12V dc for the MCB electronics and +10V dc for a manual speed potentiometer.

# 7.0 TROUBLESHOOTING AND MAINTENANCE GUIDE

## 7.0.1 MAINTENANCE

During normal use, the drive controller will require minimum maintenance; however, good maintenance practice requires periodic inspection of the controller. The maintenance periods should be scheduled based on the particular operating environment of the controller, but should not exceed one year.

**CAUTION**
**ONLY AUTHORIZED SERVICE PERSONNEL FAMILIAR WITH THIS EQUIPMENT SHOULD BE ALLOWED TO SERVICE THE CONTROLLER.**

General maintenance procedures for Square D control gear are covered in Square D publication 30072-200-50. Refer to Service Bulletin PE-1089 for maintenance of motor control center equipment. Procedures specific to this controller are as follows.

1) Drive controller operation should be observed. Any deviations from normal operation may be an indication of a controller malfunction. A thorough investigation should be made to determine the cause.
2) REMOVE ALL POWER.

**DANGER**
**HAZARD OF ELECTRICAL SHOCK OR BURN**
**BEFORE SERVICING, TURN OFF POWER SUPPLY(S) TO THIS EQUIPMENT. WAIT 5 MINUTES. MEASURE CAPACITOR VOLTAGES TO VERIFY THAT THEY ARE ZERO. DO NOT SHORT ACROSS CAPACITORS WITH VOLTAGE PRESENT.**

3) Inspect and clean all air passageways in controller using a vacuum cleaner. **Do not** use a compressed air source.
4) Inspect and clean all insulation systems within the controller using a vacuum cleaner. **Do not** use a compressed air source. **Do not "megger" controller**!
5) Check integrity of all mechanical fasteners.
6) Check integrity of all electrical fasteners and joints.
7) Check controller grounding means.
8) Check capacitor bank for damaged, leaky or bulging cans. Replace as required.

## 7.0.2 TROUBLESHOOTING

A number of diagnostic and status indicating lights have been included on the Main Control Board and Power Interface Board. The intent of these lights is to provide visual indication of a number of controller operating and protective circuit functions to assist in maintenance and troubleshooting.

The following troubleshooting guide can best be utilized by observing the status of the lights and reviewing the symptoms listed to determine which possible problems could cause the observed light pattern. To view the lights, the controller electronics must be exposed with power applied to the controller. If the controller trips while operating, the lights must be viewed before power is removed because removing and re-applying power resets the fault indicators.

**CAUTION**
**ONLY AUTHORIZED SERVICE PERSONNEL FAMILIAR WITH THIS EQUIPMENT SHOULD BE ALLOWED TO SERVICE THE CONTROLLER.**

**DANGER**
**HAZARD OF ELECTRICAL SHOCK OR BURN**
**MANY PARTS INCLUDING ELECTRONIC PRINTED WIRING BOARDS IN THIS CONTROLLER OPERATE AT LINE VOLTAGE. DO NOT TOUCH. USE ONLY ELECTRICALLY INSULATED TOOLS WHILE MAKING ADJUSTMENTS.**

**DANGER**
**CERTAIN ADJUSTMENTS AND TEST PROCEDURES REQUIRE THAT POWER BE APPLIED TO THIS CONTROLLER. WHEN WORKING WITH ENERGIZED EQUIPMENT, EXTREME CAUTION MUST BE EXERCISED AS HAZARDOUS VOLTAGES EXIST. THE CONTROLLER DOOR MUST BE CLOSED AND SECURED WHILE TURNING ON POWER, OR STARTING AND STOPPING THIS CONTROLLER.**

When used in conjunction with the diagnostic and status indicating lights, this guide facilitates troubleshooting to the individual printed wiring board level.

The troubleshooting procedure is organized into three basic sections. The first section, Section 7.1, covers general problems which are identified by symptoms such as "controller/motor will not operate". The second section, Section 7.2, consists of LED annunciated faults such as overvoltage, instantaneous overcurrent, etc. The third section, Section 7.3 is a reference section for the first two sections and contains troubleshooting techniques which require a more detailed description.

If troubleshooting indicates the necessity of component replacement observe all precautions. Refer to Section 7.4 for replacement procedures of major components.

**DANGER**
**HAZARD OF ELECTRICAL SHOCK OR BURN**
**BEFORE SERVICING, TURN OFF POWER SUPPLY(S) TO THIS EQUIPMENT. WAIT 5 MINUTES. MEASURE CAPACITOR VOLTAGES TO VERIFY THAT THEY ARE ZERO. DO *NOT* SHORT ACROSS CAPACITORS WITH VOLTAGE PRESENT.**

### 7.0.3 TROUBLESHOOTING ASSISTANCE, SERVICE REQUESTS, RETURNS

When contacting your local Square D/Ramsey representative for troubleshooting assistance or requesting service, it is necessary to have available the information requested on the troubleshooting data sheet in Section 7.5. If the controller is to be returned for repair, a copy of the return material authorization or the return material authorization number (obtained from your local Square D/Ramsey representative) plus a completed copy of the troubleshooting data sheet must accompany the controller.

## 7.1 TROUBLESHOOTING FLOW CHARTS — GENERAL SYMPTOMS

### 7.1.1 MOTOR CONTROLLER WILL NOT START

### 7.1.2 MOTOR WILL NOT ACCELERATE

## 7.2 TROUBLESHOOTING FLOW CHARTS — LED ANNUNCIATED FAULTS

### 7.2.1 INSTANTANEOUS OVER CURRENT (IOC) LED ILLUMINATED

### 7.2.2 OVERVOLTAGE (OV) LED ILLUMINATED
### 7.2.3 GROUND FAULT (GF) LED ILLUMINATED

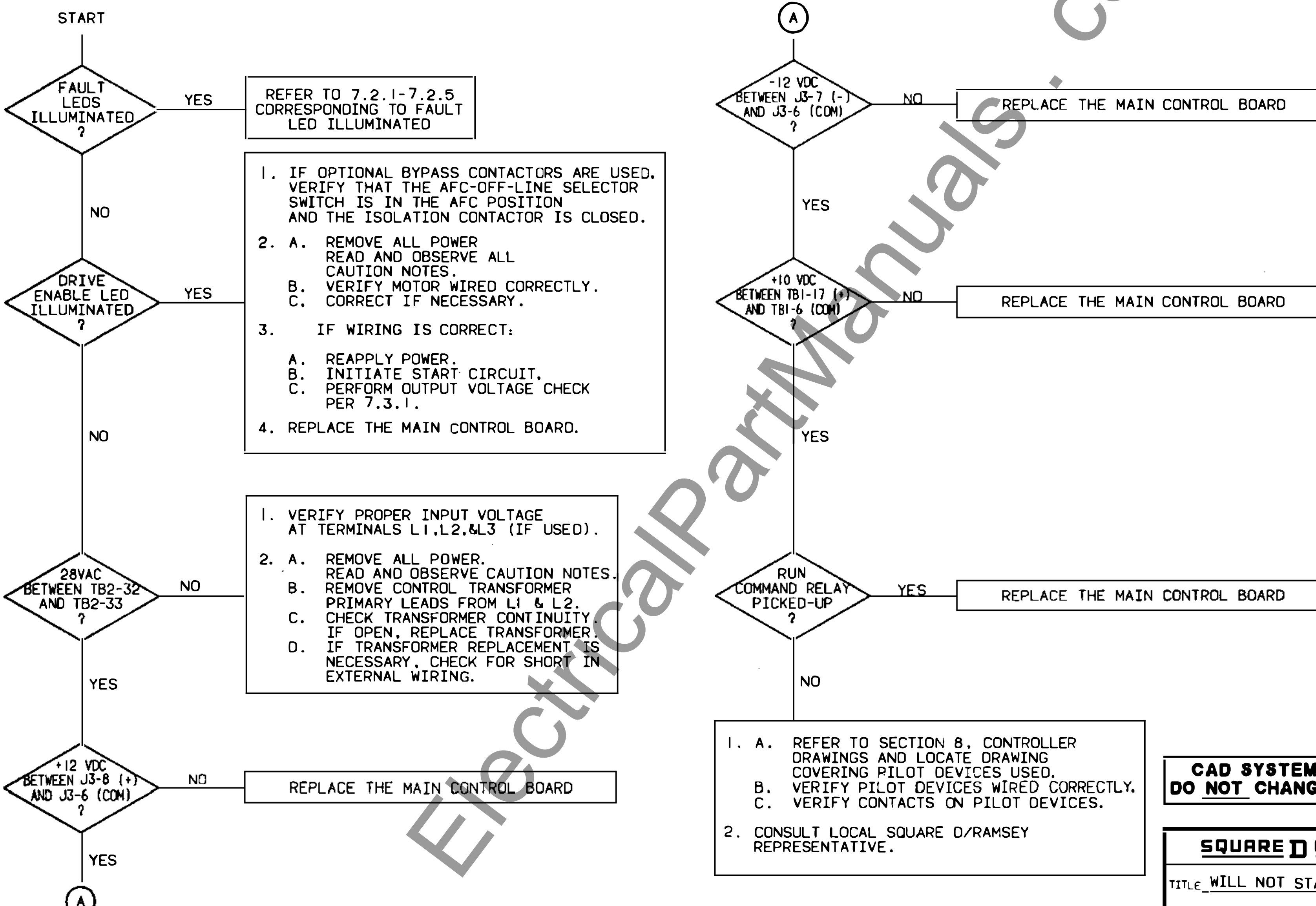
### 7.2.4 UNDERVOLTAGE (UV) LED ILLUMINATED

### 7.2.5 OVERTEMPERATURE (OT) LED ILLUMINATED

## 7.3 TROUBLESHOOTING REFERENCE

### 7.3.1 OUTPUT VOLTAGE CHECK

1. REMOVE ALL POWER.
   Read and observe caution notes concerning controller servicing.
2. Remove the motor leads from terminals T1, T2 and T3.
3. Start the controller and adjust the output frequency to approximately 60 Hertz. Note: Manual operation should be used if both manual and automatic operation is possible.
4. Measure the line to line output voltages from T1 to T2, T2 to T3, and T1 to T3. These voltages should be within 5% of each other. The actual voltage reading is not important. Because of the complex output waveform, different voltmeters may read different values. The major concern is that all three readings indicate balanced voltages.
5. If balanced voltages are measured in step 4, skip to step 7.
6. Unbalanced voltages indicate a possible problem with the inverter transistor module(s) base drive signals to the inverter transistor module(s) or poor connections in the wiring from the power interface board to the inverter transistor modules.
   A. Verify that all fast-on connectors are securely attached to the proper points on the inverter transistor module(s). Refer to the proper connection diagram in Section 8, Controller Drawings.
   B. Check the transistor module(s) per 7.3.3.
   C. If steps 6A and 6B indicate no problems, replace the power interface board per 7.4.2.

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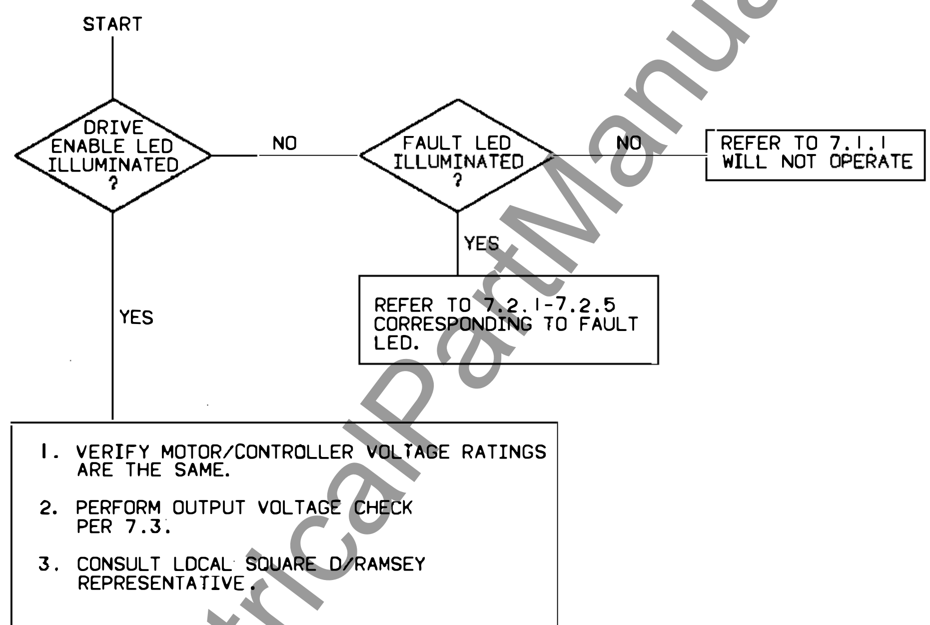
TITLE WILL NOT START

CLASS____ TYPE ____ FORM ________ SER.___

| REV | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|

REF. NEXT ASSEM PROJ.NO.

DATE DRN. 1-86 | DATE REL. | DRN. | CKD. | APP'D | DWG. NO. 7.1.1 | MASTER | SHEET OF

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TITLE WILL NOT ACCELERATE

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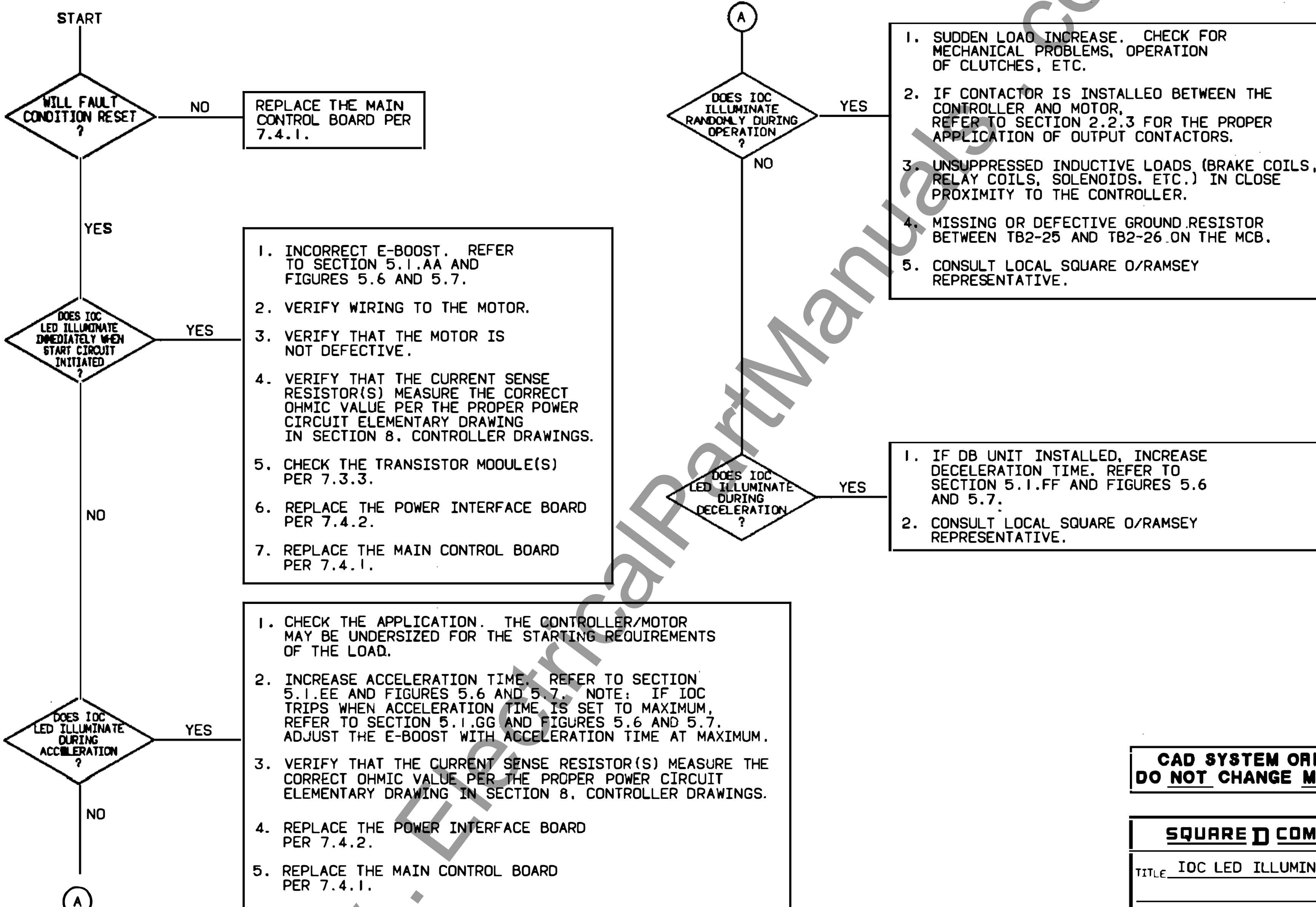


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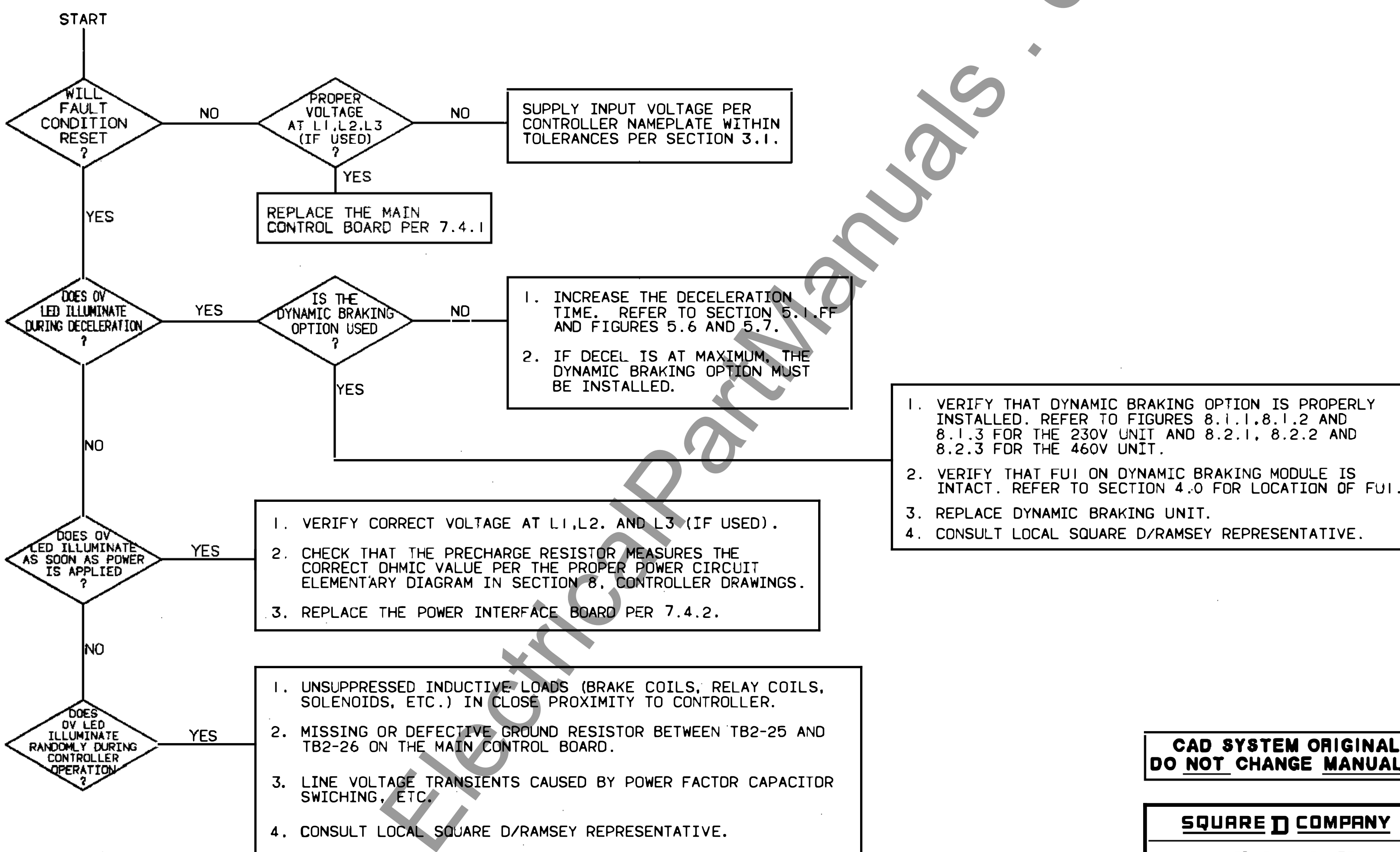


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TITLE OV LED ILLUMINATES

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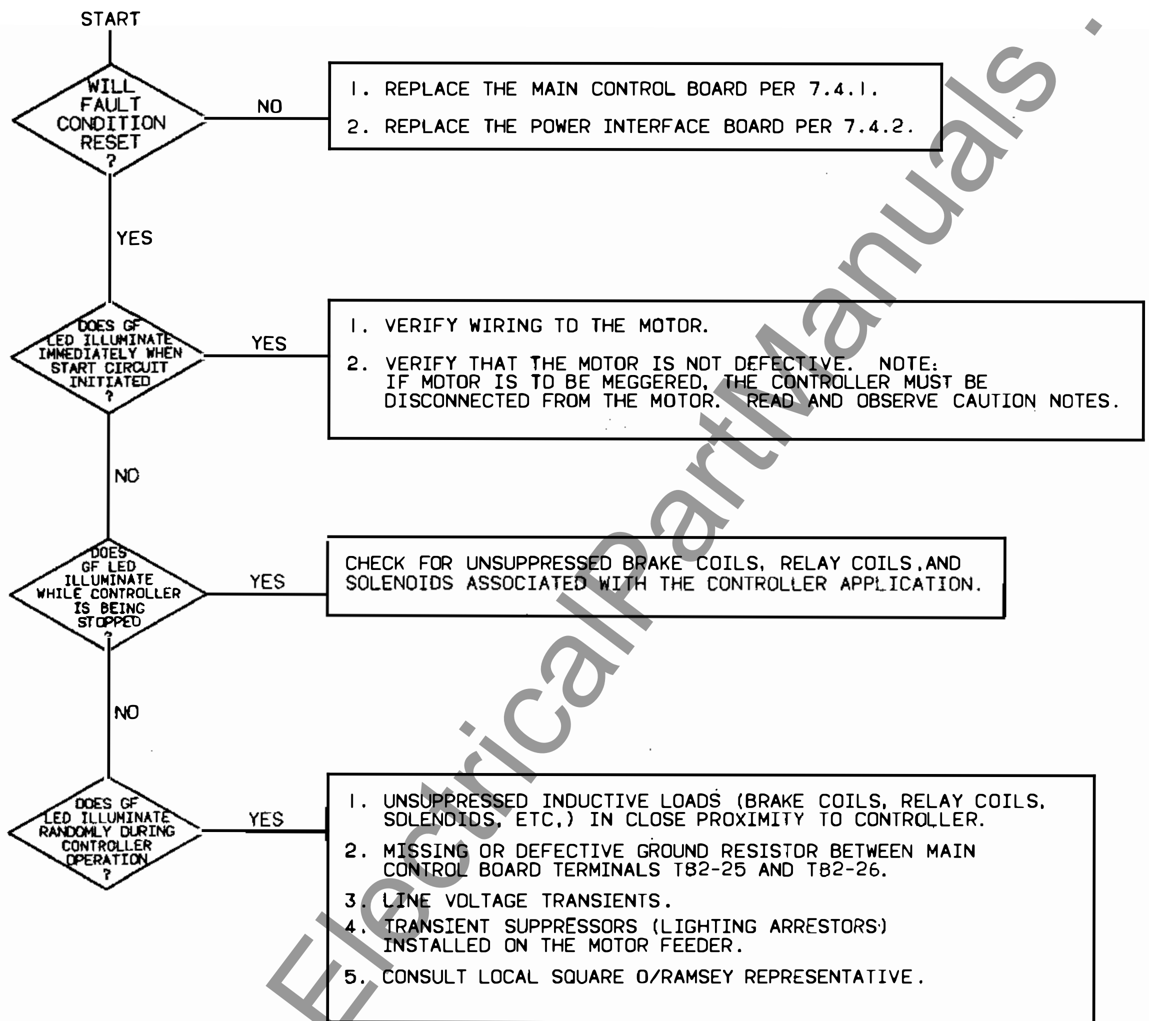


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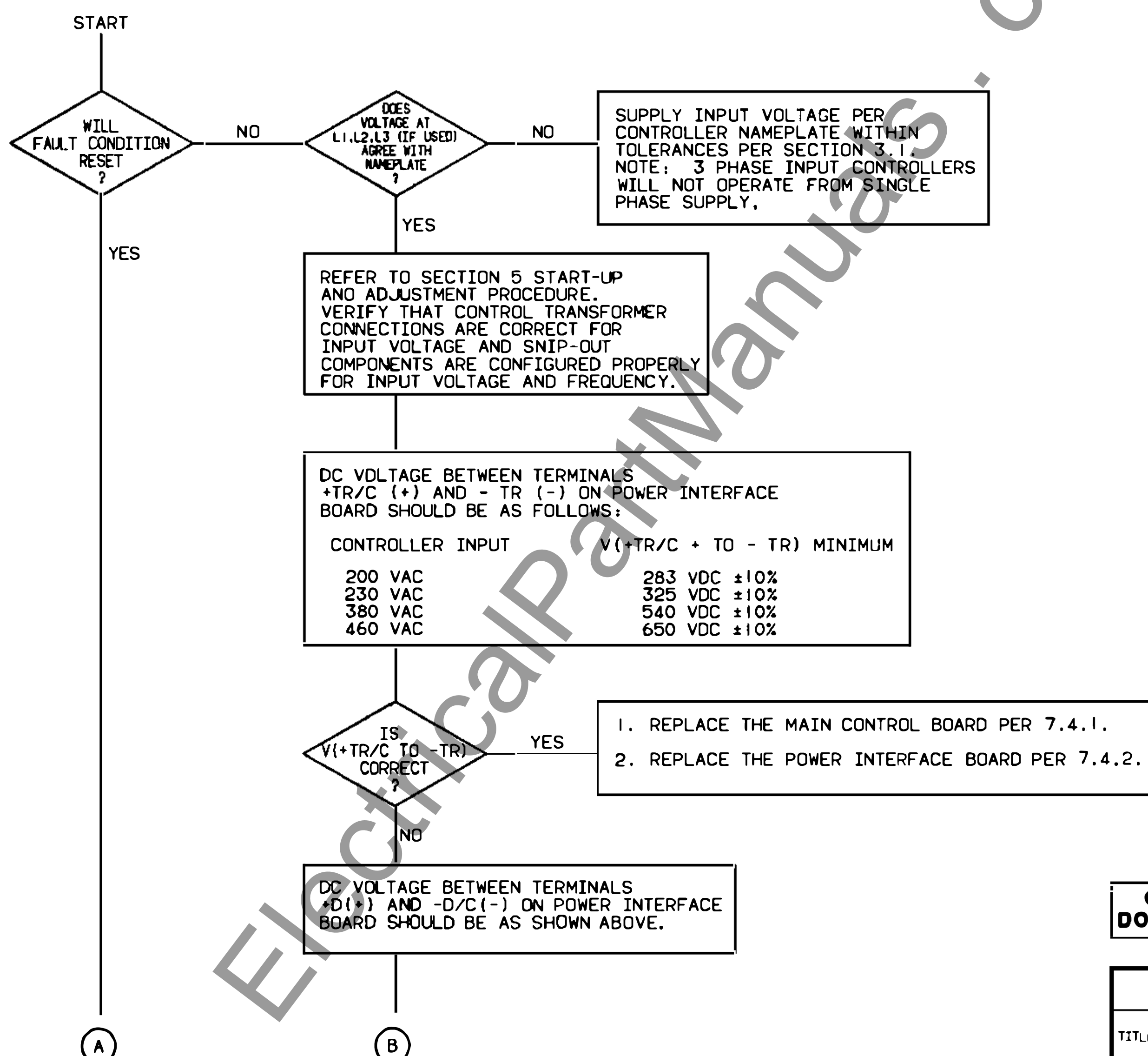


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TITLE UV LED ILLUMINATES

CLASS ____ TYPE ____ FORM ____ SER. ____

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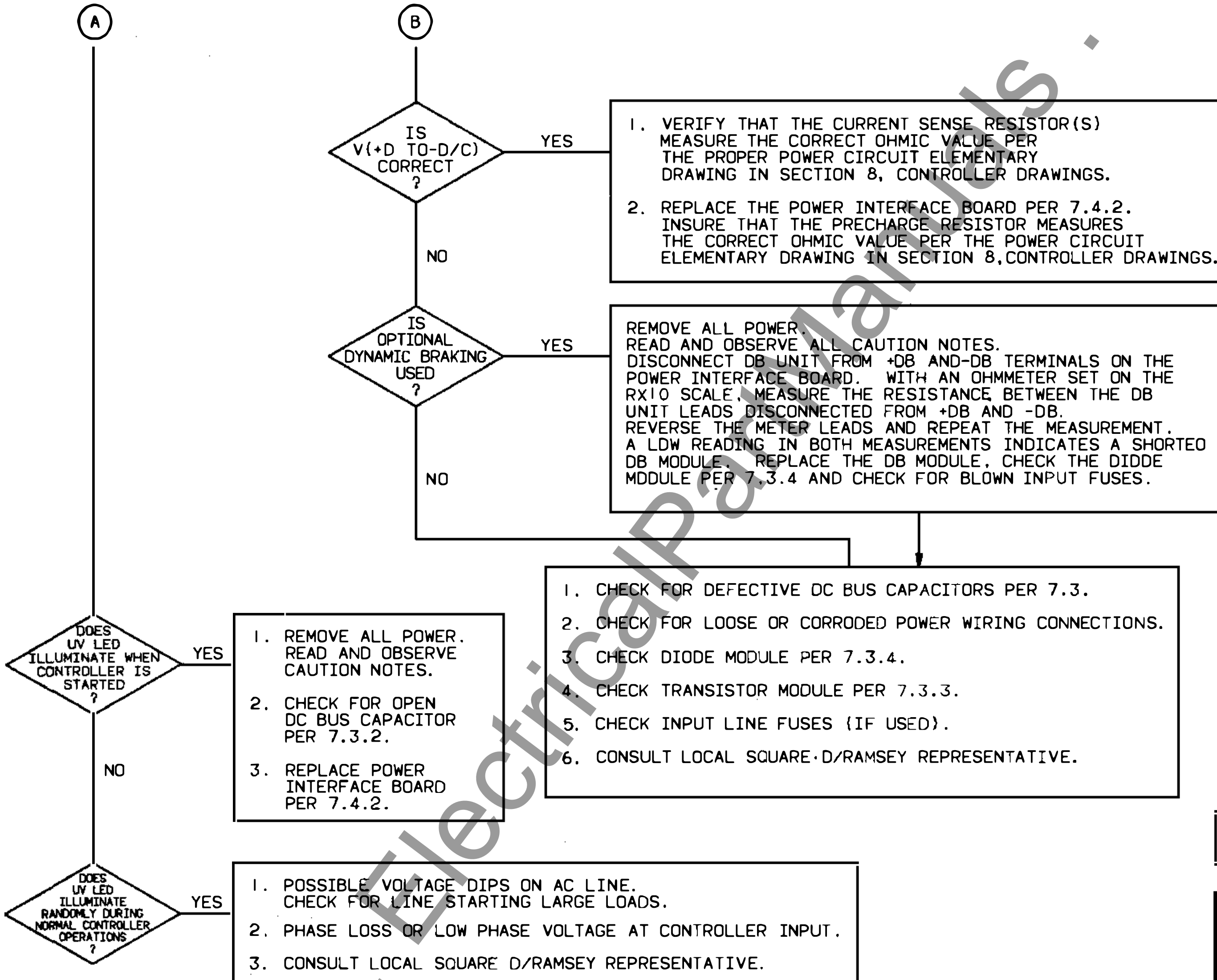


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SQUARE D COMPANY

TITLE UV LED ILLUMINATES

CLASS____ TYPE ____ FORM ____ SER.____

| REV | DATE | REVISION DESCRIPTION | BY | REF. | NEXT ASSEM | PROJ.NO. | DATE DRN. 1-86 | DRN. | DATE REL. | CKD. | APP'D | DRG. NO. 7.2.4 | MASTER | SHEET 2 OF 2 |
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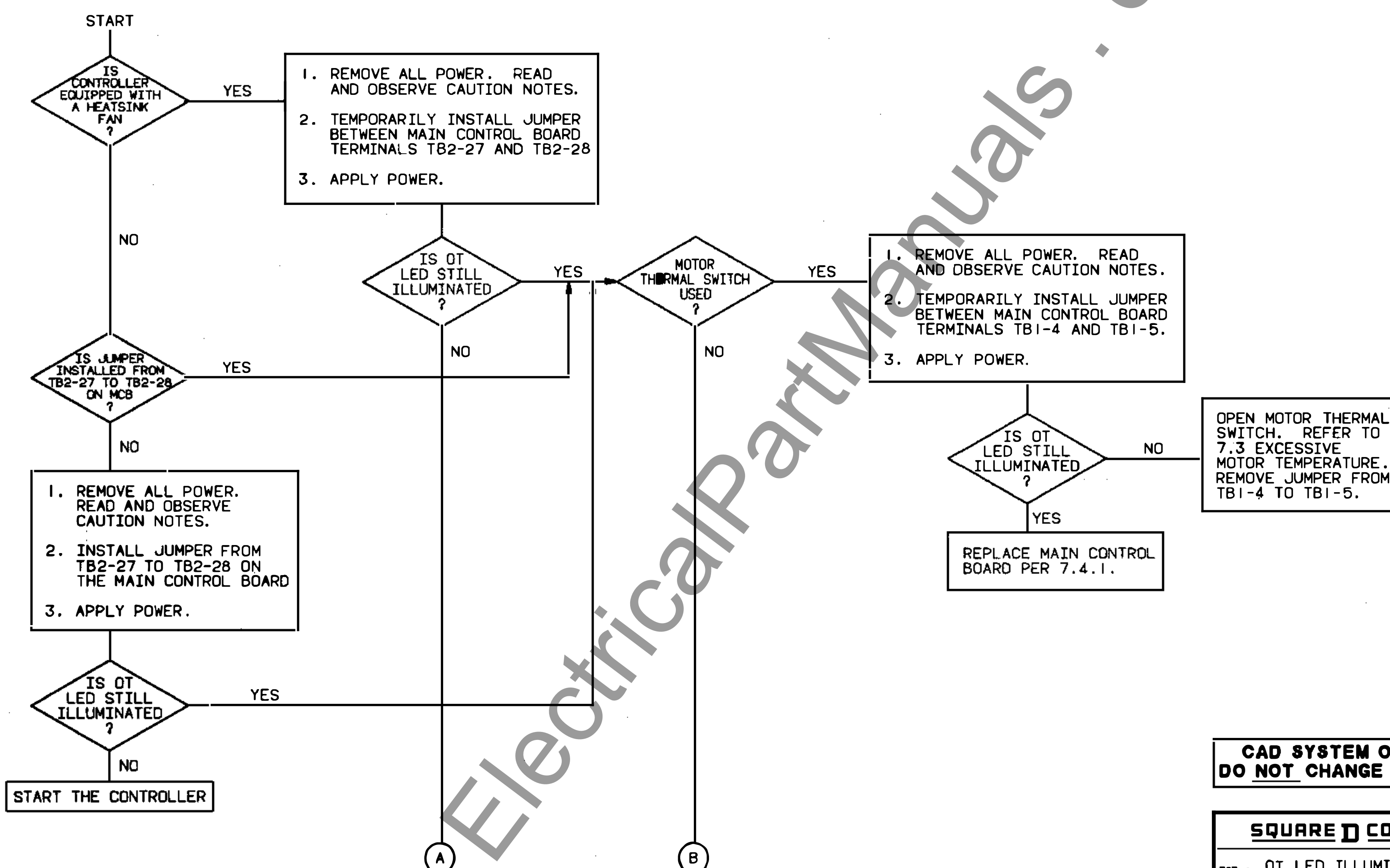


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TITLE OT LED ILLUMINATES

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY | REF. | NEXT ASSEM | PROJ.NO. | DATE DRN. 1-86 | DATE REL. | DRN. | CKD. | APP'D | DWG. NO. MASTER 7.2.5 | SHEET 1 OF 2 |
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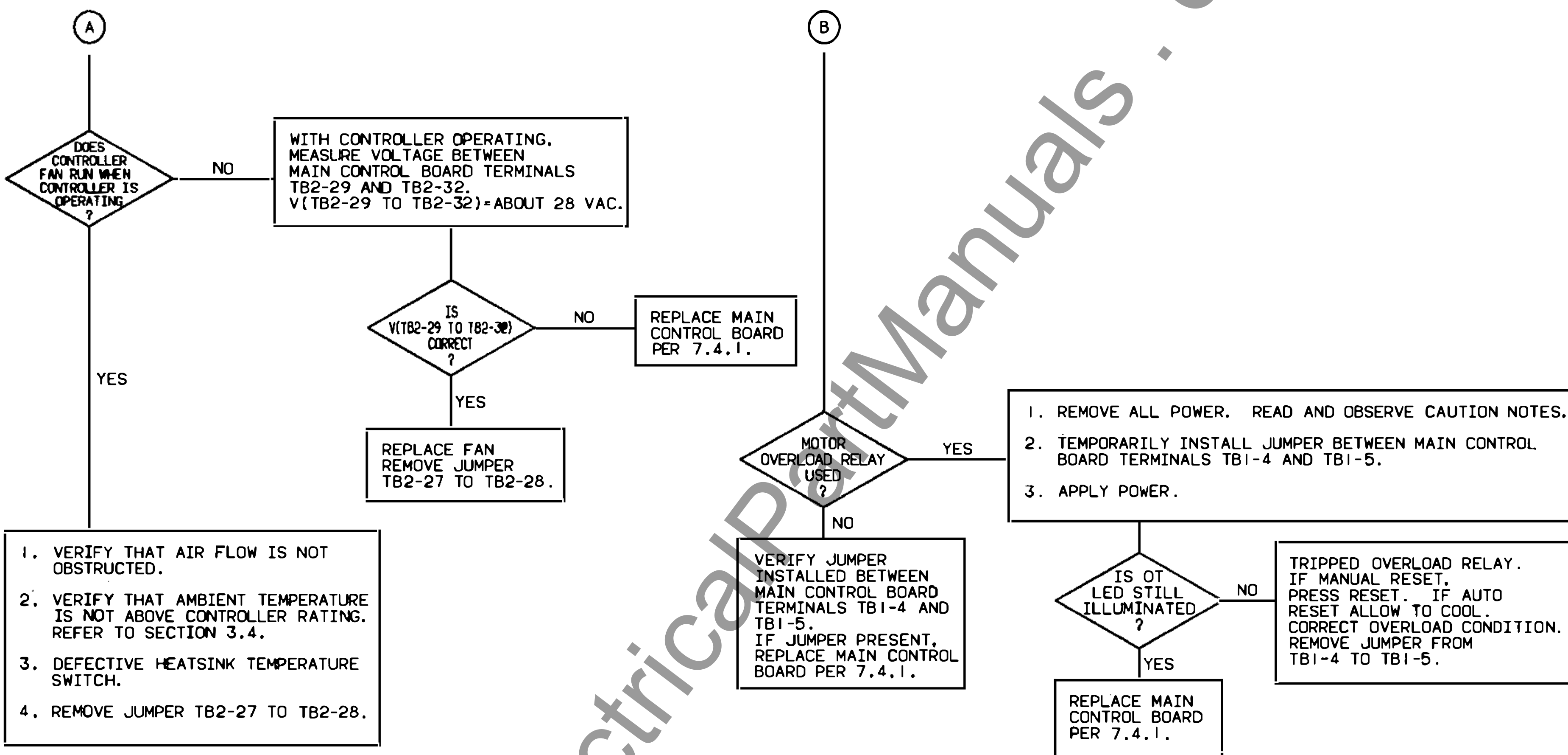


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D. If the problem persists after step 6C, replace the main control board per 7.4.1.

7. Stop the controller.
REMOVE ALL POWER
Read and observe caution notes concerning controller servicing.

8. Reconnect the motor leads removed in step 2. Tighten screws to torque ratings specified in Section 2, Figure 2.1.

### 7.3.2 DC BUS CAPACITOR CHECK

The normal failure mode of a dc bus capacitor is a short circuit. This will normally result in a blown input fuse and possibly a blown input rectifier diode. The polypropylene capacitors used on three-phase input controllers have a built-in Interrupter which opens the capacitor terminals upon a build-up of pressure inside the can. This condition can be detected by examining the top of the capacitor. The top of the capacitor will be bulged outward creating a dome shape.

All dc bus capacitors, whether electrolytic (used on single phase input controllers) or polypropylene, can be checked by the following procedure.

1. REMOVE ALL POWER.
Read and observe caution notes concerning controller servicing. Be absolutely sure that the bus capacitors are completely discharged before proceeding.

2. Remove the insulated boot (if used) and disconnect one wire from the capacitor to be checked.

3. With an analog VOM set on the RX1000 resistance scale, connect the meter across the capacitor terminals.

4. The meter should deflect momentarily to a low resistance and quickly return to near infinity.

   A. No deflection — The capacitor may be charged to higher than the VOM battery voltage. Reverse the meter leads and repeat the measurement. If the meter does not deflect, the capacitor is open and must be replaced. See Step 6.

   B. Deflects and remains at low resistance reading — shorted capacitor. Replace per Step 6.

5. Repeat Step 3 for each capacitor in the controller.

6. If readings in Step 3 or 4 indicate a faulty bus capacitor the following procedure must be followed to replace the capacitor:

   A. If electrolytic capacitors are used, mark the wires to Insure that they can be reconnected to the capacitor with the proper polarity. Polypropylene capacitors are not polarity sensitive.

   B. Remove the remaining wire from the capacitor, loosen the mounting hardware and remove the capacitor.

   C. Install the new capacitor and tighten the mounting hardware.

   D. Reconnect wires being careful to observe the polarity if electrolytic capacitors are used.

   E. Replace the Insulated boots on the capacitor terminals (if used).

### 7.3.3 INVERTER TRANSISTOR MODULE(S) CHECK

The following procedure checks for a shorted transistor in the inverter output.

NOTE: Failure of an inverter transistor module may result in the application of damaging voltages to the power interface board. If a faulty transistor module is detected the power interface board should be replaced during the replacement of the transistor module(s). Refer to Section 7.4.2 and 7.4.3.

1. REMOVE ALL POWER
Read and observe caution notes concerning controller servicing. Be absolutely sure that the bus capacitors are completely discharged before proceeding.

2. Disconnect motor leads from terminals T1, T2 and T3.

3. With a VOM set on the RX10 resistance scale, perform the measurements listed In Table 7.1.
NOTE: Terminals +TR/C and −TR are located on the power interface board.

**TABLE 7.1**

| VOM +LEAD | VOM −LEAD | RESISTANCE READING* |
|---|---|---|
| +TR/C | T1 | High |
| +TR/C | T2 | High |
| +TR/C | T3 | High |
| T1 | +TR/C | Low |
| T2 | +TR/C | Low |
| T3 | +TR/C | Low |
| −TR | T1 | Low |
| −TR | T2 | Low |
| −TR | T3 | Low |
| T1 | −TR | High |
| T2 | −TR | High |
| T3 | −TR | High |

*The actual ohmic value is not important. The high reading should be at least several times higher than the low reading.

4. If a low resistance measurement is encountered where a high resistance measurement is expected, a shorted transistor is indicated.
5. If the controller is rated for 200/230V, all transistors are contained in the same module. Replace the module per 7.4.3.
6. If the controller is rated for 380/460V, three modules, each containing two transistors may be used. Isolate the defective module by studying the power elementary drawing and the connection diagram, refer to Section 8, Controller Drawings, to determine which transistor pair feeds the output terminal where the improper reading occurred. Replace that module per 7.4.3.
7. Reconnect the motor leads removed in Step 2. Tighten screws to torque ratings specified in Section 2, Figure 2.1

### 7.3.4 DIODE MODULE CHECK

The following procedure checks for a shorted diode in the diode module.

1. REMOVE ALL POWER
   Read and observe caution notes concerning controller servicing. Be absolutely sure that the bus capacitors are completely discharged before proceeding.
2. Disconnect the control transformer primary leads from terminals **L1** and L2.
3. With a VOM set on the RX10 resistance scale perform the measurements listed in table 7.2.
   **NOTE:** Terminals +D and −D/C are located on the power interface board.

**TABLE 7.2**

| VOM +LEAD | VOM −LEAD | RESISTANCE READING* |
|---|---|---|
| L1 | +D | Low |
| L2 | +D | Low |
| L3** | +D | Low |
| +D | L1 | High |
| +D | L2 | High |
| +D | L3** | High |
| −D/C | L1 | Low |
| −D/C | L2 | Low |
| −D/C | L3** | Low |
| L1 | −D/C | High |
| L2 | −D/C | High |
| L3** | −D/C | High |

*The actual ohmic value is not important. The high reading should be at least several times higher than the low reading.

**Single phase input controllers do not have an L3 terminal, therefore, this measurement cannot be made.

4. If a low resistance is encountered where a high resistance measurement is expected, a shorted diode is indicated.
5. All six diodes are contained in a single module. Replace the diode module per 7.4.4.
6. Be sure to reconnect the control transformer leads removed in step 2. Tighten screws to torque ratings specified in Section 2, Figure 2.1.

### 7.3.5 EXCESSIVE MOTOR TEMPERATURE

Motor overheating can result form the following items:

1. Motor incorrectly sized for the load. Measure motor current and compare to nameplate rating.
2. Insufficient motor ventilation. Since most motors are cooled by shaft-mounted fans, the motor rated current capacity will decrease with speed due to decreased fan speed. If substantial motor torque is required at low speed, motor overtemperature may occur. The motor manufacturer should be consulted to determine the correct motor selection for such applications.
3. Unbalanced output voltage/current. Verify that voltage output is correct per 7.3.1.

   NOTE: With the advent of modern insulation materials, many motors are capable of operating at relatively high winding temperatures. Therefore, motors which seem hot to the touch may be operating well within their temperature limits. The motor nameplate should be consulted as to the class of the motor's insulation system. To properly determine a motor's temperature, the procedures described in NEMA MG-1 may be followed.

### 7.4 COMPONENT REPLACEMENT GUIDE

When replacing a controller component, procedures detailed in the following sections must be followed to insure personnel safety and prevent damage to the controller. It is suggested that the procedure and any required drawings be studied before starting. The procedures should be followed in a step-by-step manner.

**CAUTION**
**ONLY AUTHORIZED SERVICE PERSONNEL FAMILIAR WITH THIS EQUIPMENT SHOULD BE ALLOWED TO SERVICE THE CONTROLLER.**

**DANGER**
**HAZARD OF ELECTRICAL SHOCK OR BURN**

**BEFORE SERVICING, TURN OFF POWER SUPPLY(S) TO THIS EQUIPMENT. WAIT 5 MINUTES. MEASURE CAPACITOR VOLTAGES TO VERIFY THAT THEY ARE ZERO. DO *NOT* SHORT ACROSS CAPACITORS WITH VOLTAGE PRESENT.**

### 7.4.1 MAIN CONTROL BOARD REMOVAL/ REPLACEMENT PROCEDURE

If troubleshooting indicates the necessity of removal or replacement of the main control board, the following procedure must be followed to insure that the task is accomplished safely and without damage to the controller.

A. MAIN CONTROL BOARD REMOVAL

1. REMOVE ALL POWER
   Read and observe caution notes concerning controller servicing.
2. Mark all wiring to the main control board terminal strips so that the wires can be reconnected properly. It is suggested that the terminal number silk screened on the board be used.
3. Remove all wiring from the main control board terminal strips.
4. Disconnect the control power transformer plug. Refer to Section 4, Controller photos for the plug location.
5. Remove the four screws holding the board to the nylon stand-offs.

   NOTE: It will be necessary to hold the stand-off to prevent its turning.
6. Grasp the main control board at the top and bottom and lift with a rocking motion. This will ease separation of the main control board and power interface board connector.

**DANGER**
**HAZARD OF ELECTRICAL SHOCK OR BURN**
**DO *NOT* ENERGIZE THE CONTROLLER WITH ANY PRINTED WIRING BOARD REMOVED.**

B. MAIN CONTROL BOARD INSTALLATION

1. If the main control board is to be replaced with a different unit, insure that all terminal strip jumpers on the removed board are duplicated on the replacement board and that a ground resistor (1K ohm, 1/4 watt) is installed between terminals TB2-25 and TB2-26. Also configure snip-out components on the replacement board to match the removed board. Refer to Section 5, start-up procedure for additional information.
2. Carefully line-up the long pins on the left side of the power interface board with the connector on the main control board.

   NOTE: The component side of the board must face outward.
3. Gently press the connector until all pins show through the top side about 1/4 inch.
4. Install and tighten the four mounting screws that secure the main control board to the nylon stand-offs.

   NOTE: It will be necessary to hold the stand-off to prevent its turning.
5. Connect the control power transformer plug. Refer to Section 4, Controller Photos for the plug location.

6. Install wiring removed from the main control board terminal strips using care to insure that wires are routed to the proper terminal. Recommended tightening torque is listed in Section 2, Figure 2.1.

### 7.4.2 POWER INTERFACE BOARD REMOVAL/ REPLACEMENT PROCEDURE

If troubleshooting indicates the necessity of removal or replacement of the power interface board, the following procedure must be followed to insure that the task is accomplished safely and without damage to the controller.

A. POWER INTERFACE BOARD REMOVAL

1. REMOVE ALL POWER
   Read and observe all caution notes concerning controller servicing. Be absolutely sure that the bus capacitors are completely discharged before proceeding.
2. Remove the main control board per 7.4.1.
3. Mark all wiring to the power interface board terminals so that the wires can be reconnected properly. It is suggested that the terminal designation silk screened onto the board be used.
4. Remove all wiring from the power interface board terminals.
5. Disconnect the four control power transformer plugs. Refer to Section 4, Controller Photos for the plug locations.
6. Remove the four screws holding the board to the metal stand-offs.
7. Gently lift the board away from the heatsink assembly until the two wires (+D and −D/C) can be pulled through the board mounted current transformer.
8. Continue to lift the board away from the heatsink assembly until the fast-on connectors attaching the power interface board to the inverter transistor module(s) are accessible.
9. Insure that factory installed wire markers are in place on the wires from the power interface board to the transistor module(s). Refer to the proper connection diagram in Section 8, Controller Drawings.
10. Remove the wires for the power interface board to the transistor module(s) by pulling on the connector at the transistor module(s).

    NOTE: Rocking the connector back and forth will ease removal. **Do not** pull on the wire.

**DANGER**
**HAZARD OF ELECTRICAL SHOCK OR BURN**
**DO *NOT* ENERGIZE THE CONTROLLER WITH ANY PRINTED WIRING BOARD REMOVED.**

B. POWER INTERFACE BOARD INSTALLATION

1. If the power interface board is to be replaced with a different unit, a precharge resistor must be installed between terminals RA and RB on the lower left hand portion of the board. Refer to the proper connection diagram in Section 8.

   NOTE: The precharge resistor from the removed board may be used if it is not damaged.
2. If the power interface board is to be replaced with a different unit, the four nylon stand-offs must be installed to support the main control board.

   NOTE: The stand-offs from the removed board may be used.
3. Hold the power interface board near enough to the heat sink assembly so that the black and white wires can be connected to the transistor module(s).
4. Insert the fast-on connectors onto the pins provided using the proper controller connection diagram (Refer to Section 8, Controller Drawings) and the designations marked on the wires. Use care to avoid bending the pins.

   NOTE: The proper connection drawing based on the controller horsepower and voltage **must** be used. Each connection diagram shows different transistor module terminal details based on the module manufacturer. Be absolutely sure that the correct terminal detail is used.

**CAUTION**
**IMPROPER OPERATION AND POSSIBLE CONTROLLER DAMAGE MAY RESULT FROM INCORRECT CONNECTION OF WIRING FROM THE POWER INTERFACE BOARD TO THE INVERTER TRANSISTOR MODULE(S).**

5. Hold the power interface board component side facing outward. Carefully route the black and white wires over the upper left edge of the board between the top left nylon stand-off and the main control board connector pins.

6. Insert the +D and −D/C leads through the power interface board current transformer and pull until slack is removed. Be sure that both leads enter the current transformer from the solder side of the power interface board.

7. Rest the power interface board on the metal stand-offs. Verify that wiring to the transistor module(s) is not pinched. Insert all four mounting screws and tighten securely. Be certain that the lower left screw is installed. This is the power interface board grounding point.

8. Insert the control power transformer plugs in the jacks on the power interface board.

   NOTE: Plugs with black and white wires are connected to J100, J200 and J300 in any order. the plug with blue and white wires must go to J400. Refer to the proper connection diagram in Section 8, Controller Drawings and Section 4, Controller Photos.

9. Reconnect other wiring to the power interface board terminals using care to insure that wires are routed to the proper terminals. Tighten the terminal screws to the torque specifications in Section 2, Figure 2.1.

10. Replace the main control board per 7.4.1.

### 7.4.3 INVERTER TRANSISTOR MODULE REPLACEMENT PROCEDURE

If troubleshooting indicates the necessity of replacing an inverter transistor module, the procedure below must be followed to insure that the task is accomplished safely and without damage to the controller.

1. REMOVE ALL POWER
   Read and observe caution notes concerning controller servicing. Be absolutely sure that the bus capacitors are completely discharged before proceeding.
2. Remove the main control board per 7.4.1.
3. Remove the power interface board per 7.4.2.
4. Refer to the proper controller component layout and connection diagram in Section 8, Controller Drawings based on the controller horsepower and voltage. Locate the transistor module. Determine the manufacturer of the transistor module(s) installed in the controller and select the proper detail from the connection diagram.
5. Mark the wires remaining on the transistor module(s) to agree with the connection drawing detail.
6. Remove the wires from the transistor module(s) to be replaced.
7. Remove the mounting screws from the transistor module to be replaced and remove the module.
8. Thoroughly clean the heatsink surface. All dust, dirt and thermal joint compound must be removed. Verify that no nicks, scratches or other irregularities are present.
9. With a solid applicator, apply a light film of thermal joint compound, Square D Corporate number 1619-100011 (Thermacote) or equivalent. Spread evenly over the heatsink contact area of the transistor module. Do not allow the compound to be contaminated by dust or grit. When properly applied, the film should evenly cover the entire contact area but be thin enough so that the contact surface is visible.
10. Carefully place the transistor module on the heatsink surface so that the mounting holes line up with those in the heatsink.

11. Install mounting screws and tighten until just snug. Torque the screws to 25 lb-in.
12. Reconnect power wiring removed in Step 6, using care to insure that the wires are routed to the proper terminals. Refer to the proper connection diagram in Section 8 and the detail corresponding to the transistor module manufacturer to determine the terminal locations. Torque the connections to 17 lb-in.
13. Install the power interface board per 7.4.2.
14. Install the main control board per 7.4.1.

## 7.5 TROUBLESHOOTING DATA SHEET

PLACE THE TROUBLE SHEET WITH THE AUTHORIZED RETURN PAPER RECEIVED FROM LOCAL SQUARE D/RAMSEY REPRESENTATIVE

The purpose of the "Trouble Sheet" is to obtain as much pertinent information about the controller as possible. By fully filling out the form the time to repair the controller, and the cost of troubleshooting the controller are reduced. The following is an explanation of the type of information we need on this form.

USER NAME AND ADDRESS: Where the controller is installed

PERSON TO CONTACT: Someone at the user who is familiar with the problem and application. Contact for additional information may be required.

CONTROLLER DATA: Completely fill in the sample nameplate given on the form.

MOTOR DATA: Fill in the requested information. If you have multiple motors give the information for all the motors controlled by the AFC.

APPLICATION DATA:

- Ambient temperature
- Basic power flow from supply to motor. Indicate if any contactors or circuit breakers are installed before the motor, or between the controller and motor. Is there any line bypass or across-the-line start capabilities?
- Is this a multiple motor scheme? Are the motors started all at the same time or sequenced?
- Type of speed control
  Hand pot, analog input signal (4-20 ma, 0-10V dc, etc.)
- Braking options installed
- If remote control wiring is installed detail the functions (start-stop, run-jog, etc.) and the terminals to which your wiring is connected.

PROBLEM INFORMATION:

Description of Symptoms:

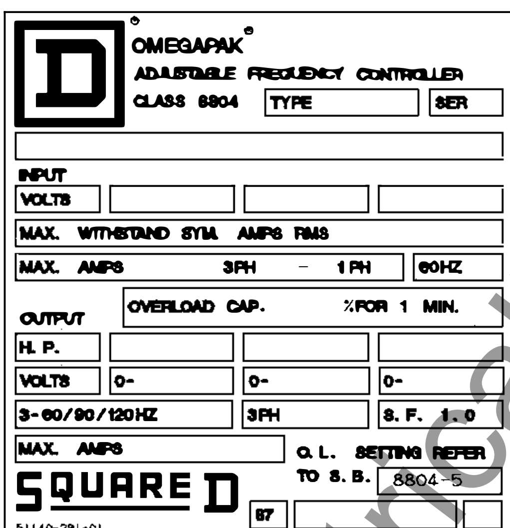
- Does fault occur
  - When only power is on the controller
  - When start button is pushed
  - When changing speeds
  - When running at constant speed
  - When stopping
  - When motor load changes
- Does problem have a pattern (I.E. does problem occur at same time during day?) or is the problem random?
- Visible signs of damage (bulging capacitor cans, blown fuses, discoloration on boards)

## CONTROLLER TROUBLE SHEET

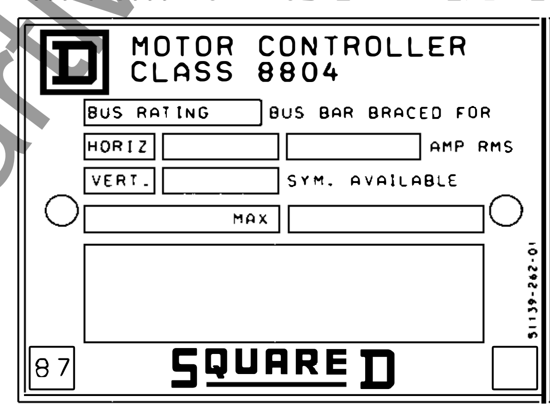
DETAIL TROUBLESHOOTING STEPS TAKEN
In the service bulletins there are a number of troubleshooting steps to be taken. List the steps taken and the results of those steps. If you have done any troubleshooting on associated equipment detail those steps and results also.

USER NAME ____________________
ADDRESS ____________________
CITY, STATE, ZIP ____________________
PERSON TO CONTACT ____________________
PHONE ____________________
PURCHASER (DISTRIBUTOR) ____________ P.O. # IF AVAILABLE ____________
**CONTROLLER DATA:** (FILL IN NAMEPLATE INFORMATION)

1000 & 1500 CONTROLLER NAMEPLATE




2000 & 3000 CONTROLLER NAMEPLATE




**MOTOR DATA:**

HP __________ VOLTAGE __________ FULL LOAD CURRENT __________
SERVICE FACTOR __________ NEMA DESIGN TYPE __________ SPEED __________

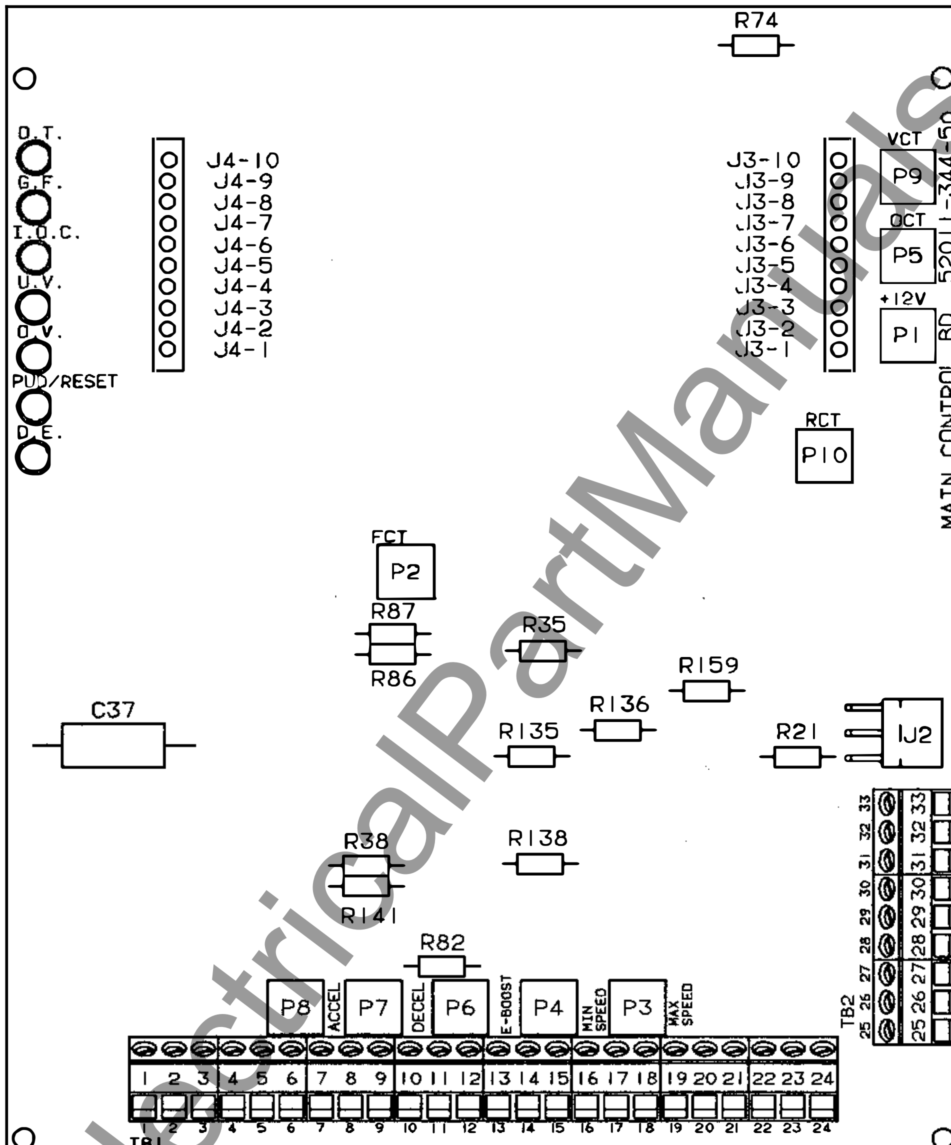
**APPLICATION DATA:**

APPLICATION (DESCRIBE) ____________________
____________________
____________________

**SPEED RANGE:** MAX. SPEED __________ MIN. SPEED __________ DUTY CYCLE __________

## CONTROLLER TROUBLE SHEET (CONTINUED)

**PROBLEM INFORMATION:**
**LED'S THAT ARE ILLUMINATED (MARK DRAWING)**




MAIN CONTROL BOARD

**LENGTH OF TIME CONTROLLER HAS OPERATED PROPERLY:**

________ **MONTHS, OR PROBLEM OCCURRED AT START-UP** ________

**DESCRIPTION OF SYMPTOMS** ________

________

**DETAIL TROUBLESHOOTING STEPS TAKEN** ________

________

________

________

________

## CONTROLLER TROUBLE SHEET

DETAIL TROUBLESHOOTING STEPS TAKEN
In the service bulletins there are a number of troubleshooting steps to be taken. List the steps taken and the results of those steps. If you have done any troubleshooting on associated equipment detail those steps and results also.

USER NAME________________________________________

ADDRESS________________________________________

CITY, STATE, ZIP____________________________________

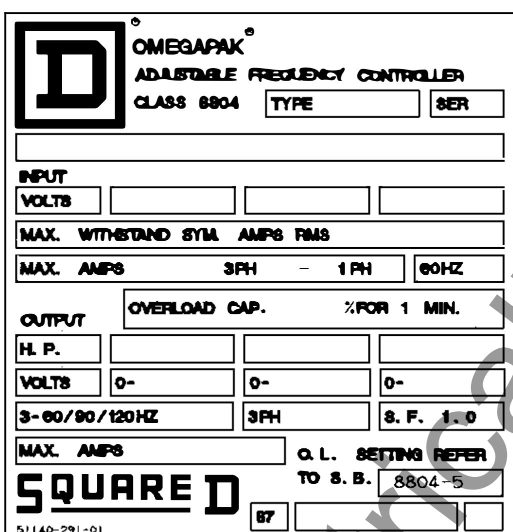
PERSON TO CONTACT__________________________________

PHONE__________________________________________

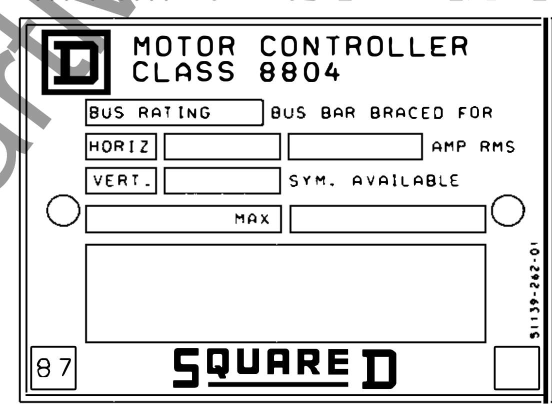
PURCHASER (DISTRIBUTOR)__________________ P.O. # IF AVAILABLE________________

**CONTROLLER DATA:** (FILL IN NAMEPLATE INFORMATION)

1000 & 1500 CONTROLLER NAMEPLATE




2000 & 3000 CONTROLLER NAMEPLATE




**MOTOR DATA:**

HP______________ VOLTAGE______________ FULL LOAD CURRENT____________

SERVICE FACTOR____________ NEMA DESIGN TYPE____________ SPEED____________

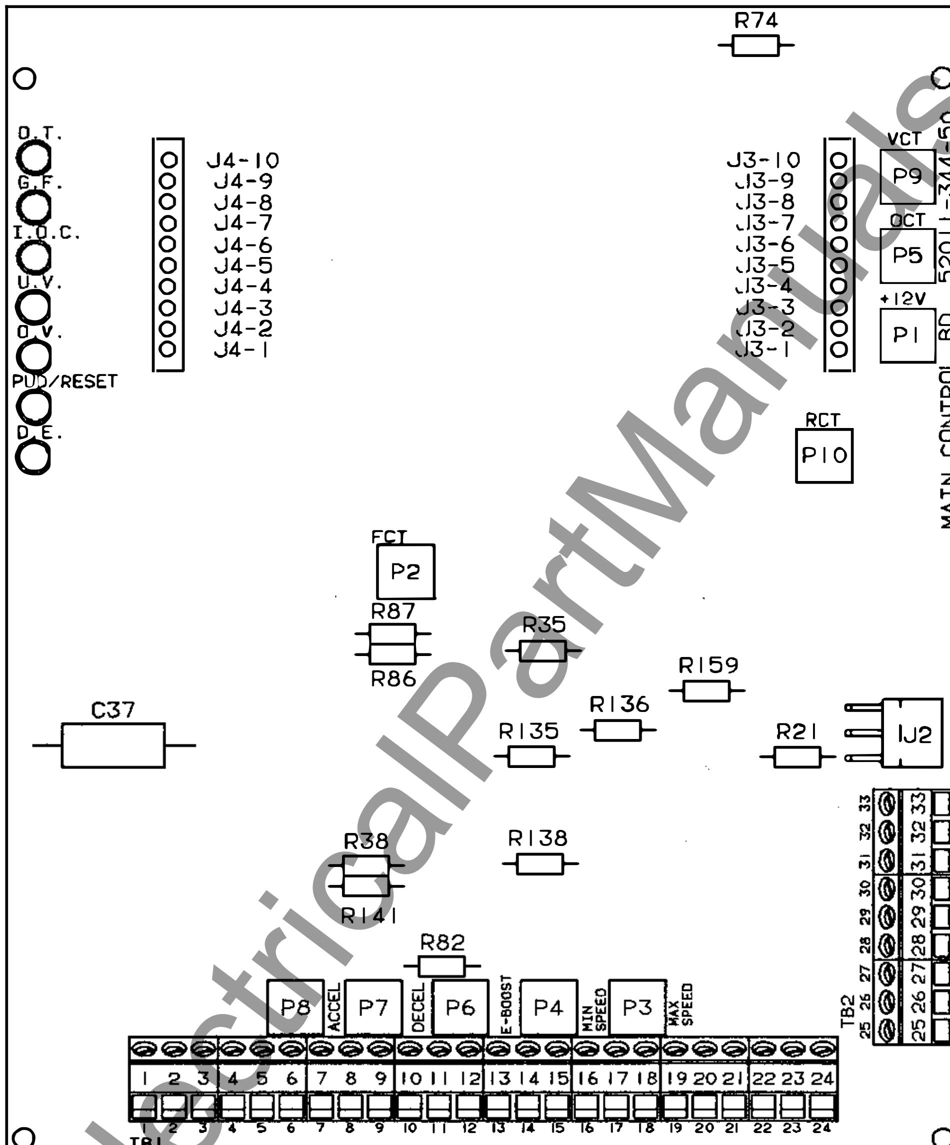
**APPLICATION DATA:**

APPLICATION (DESCRIBE)____________________________________

**SPEED RANGE:** MAX. SPEED____________ MIN. SPEED____________ DUTY CYCLE____________

## CONTROLLER TROUBLE SHEET (CONTINUED)

**PROBLEM INFORMATION:**
**LED'S THAT ARE ILLUMINATED (MARK DRAWING)**




MAIN CONTROL BOARD

**LENGTH OF TIME CONTROLLER HAS OPERATED PROPERLY:**

________________ **MONTHS, OR PROBLEM OCCURRED AT START-UP** ________________

**DESCRIPTION OF SYMPTOMS**________________________________

**DETAIL TROUBLESHOOTING STEPS TAKEN**____________________________

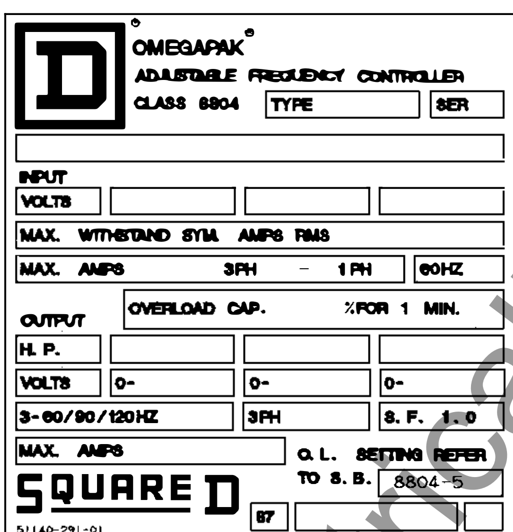
## CONTROLLER TROUBLE SHEET

DETAIL TROUBLESHOOTING STEPS TAKEN
In the service bulletins there are a number of troubleshooting steps to be taken. List the steps taken and the results of those steps. If you have done any troubleshooting on associated equipment detail those steps and results also.

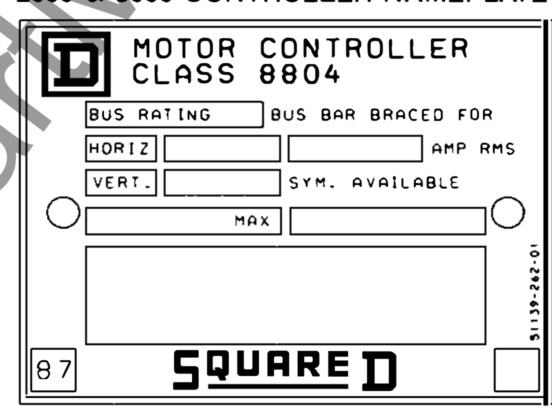
USER NAME______________________________
ADDRESS______________________________
CITY, STATE, ZIP______________________________
PERSON TO CONTACT______________________________
PHONE______________________________
PURCHASER (DISTRIBUTOR)________________ P.O. # IF AVAILABLE________________

**CONTROLLER DATA:** (FILL IN NAMEPLATE INFORMATION)

1000 & 1500 CONTROLLER NAMEPLATE




2000 & 3000 CONTROLLER NAMEPLATE




**MOTOR DATA:**

HP__________ VOLTAGE__________ FULL LOAD CURRENT__________
SERVICE FACTOR__________ NEMA DESIGN TYPE__________ SPEED__________

**APPLICATION DATA:**

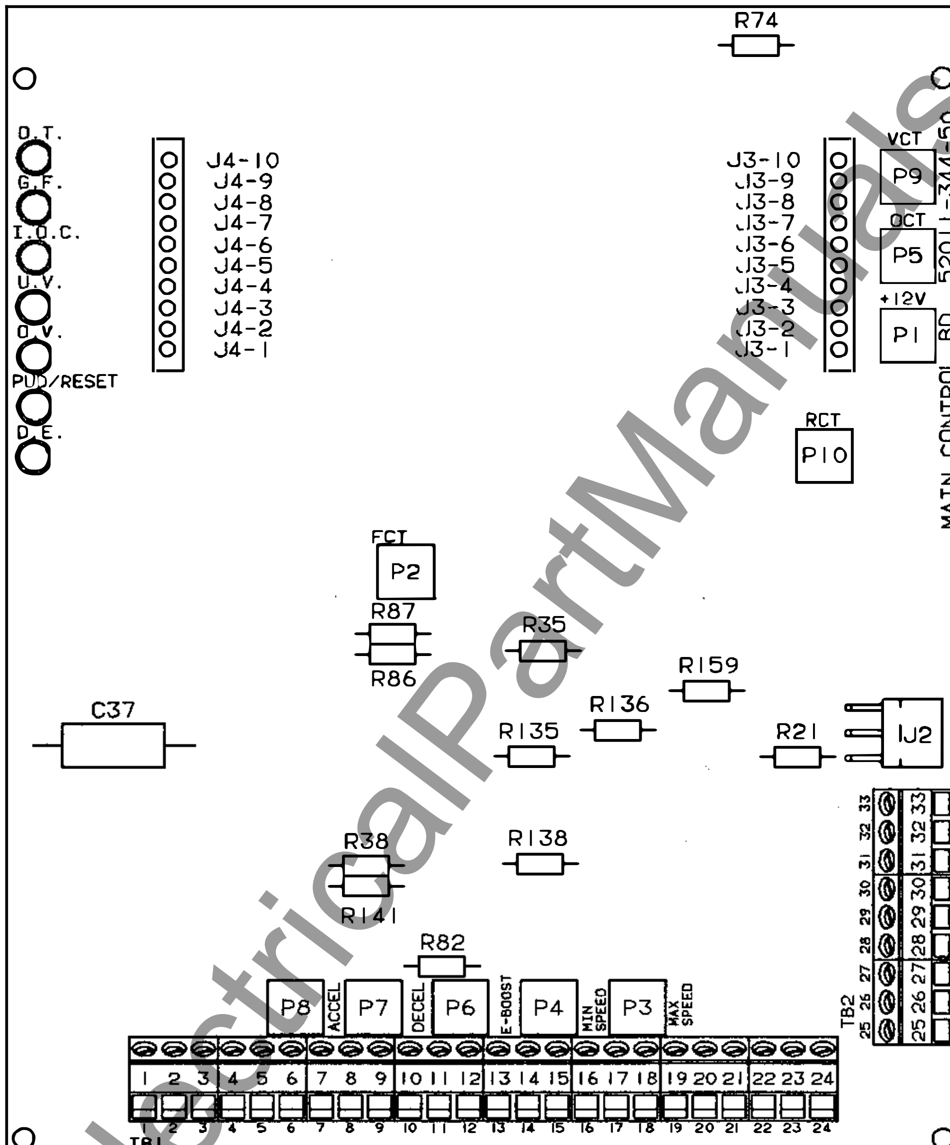
APPLICATION (DESCRIBE)______________________________

**SPEED RANGE:** MAX. SPEED__________ MIN. SPEED__________ DUTY CYCLE__________

## CONTROLLER TROUBLE SHEET (CONTINUED)

**PROBLEM INFORMATION:**

**LED'S THAT ARE ILLUMINATED (MARK DRAWING)**



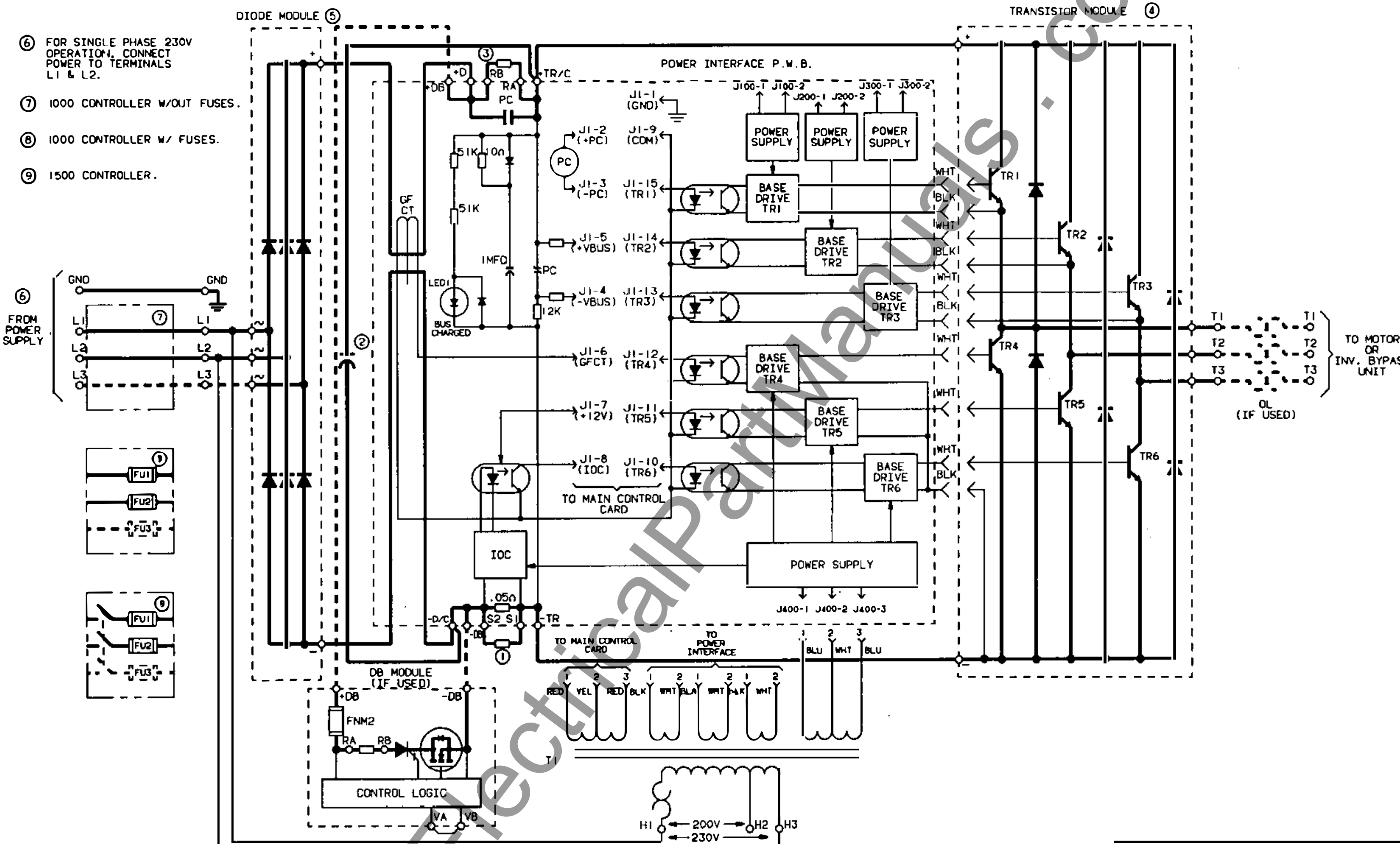

MAIN CONTROL BOARD

**LENGTH OF TIME CONTROLLER HAS OPERATED PROPERLY:**

__________ **MONTHS, OR PROBLEM OCCURRED AT START-UP** __________

**DESCRIPTION OF SYMPTOMS** __________

**DETAIL TROUBLESHOOTING STEPS TAKEN** __________




| HP@ 230V | TRANSISTOR MODULE ④ | CURRENT SENSE ① RESISTOR | POWER INTERFACE 52011-390 | SINGLE PHASE INPUT: DIODE MODULE ⑤ | BUS CAPACITORS ② | PRECHARGE RESISTORS ③ | POWER FUSES FU1, FU2: TYPE KTK ⑧ | TYPE RK-5 ⑨ | THREE PHASE INPUT: DIODE MODULE ⑤ | BUS CAPACITORS ② | PRECHARGE RESISTORS ③ | POWER FUSES FU1, FU2, FU3: TYPE KTK ⑧ | TYPE RK-5 ⑨ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15A, 600V | NOT USED | -50 | 30A, 600V | 1-860MFD 450VDC | 2Ω, 30W | 30A. 600V. | 30A. 250V. | 20A, 600V | 1-80MFD 240VAC | 10Ω, 30W | 20A. 600V. | 20A. 250V. |
| 2 | 20A, 600V | .12Ω, 5% | -50 | 30A, 600V | 2-860MFD 450VDC | 2Ω, 30W | 30A. 600V. | 30A. 250V. | 20A, 600V | 2-80MFD 240VAC | 10Ω, 30W | 20A. 600V. | 20A. 250V. |
| 3 | 30A, 600V | .05Ω, 5% | -51 | 50A, 600V | 2-1400MFD 450VDC | 2Ω, 30W | 30A. 600V. | 30A. 250V. | 30A, 600V | 2-80MFD 240VAC | 10Ω, 30W | 20A. 600V. | 20A. 250V. |
| 5 | 50A, 600V | .022Ω, 5% | -52 | ——— | ——— | ——— | ——— | ——— | 50A, 600V | 2-80MFD 240VAC | 10Ω, 30W | 20A. 600V. | 20A. 250V. |

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE OMEGAPAK TYPE PT 1000&1500 CONT'LR

POWER ELEM DIAGRAM (1-5 HP@200/230V)

CLASS____ TYPE ____ FORM ____ SER.____

| REV. | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 3-20-86 | | |

REFERENCE 8804-5

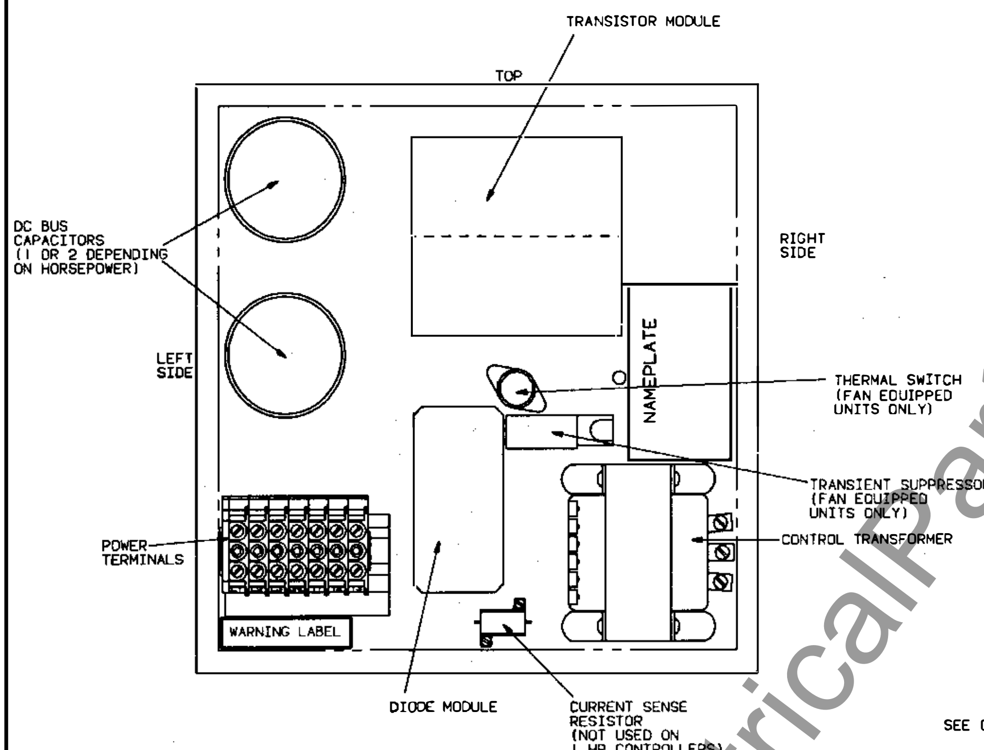
NEXT ASSEM.

PROJ. NO.

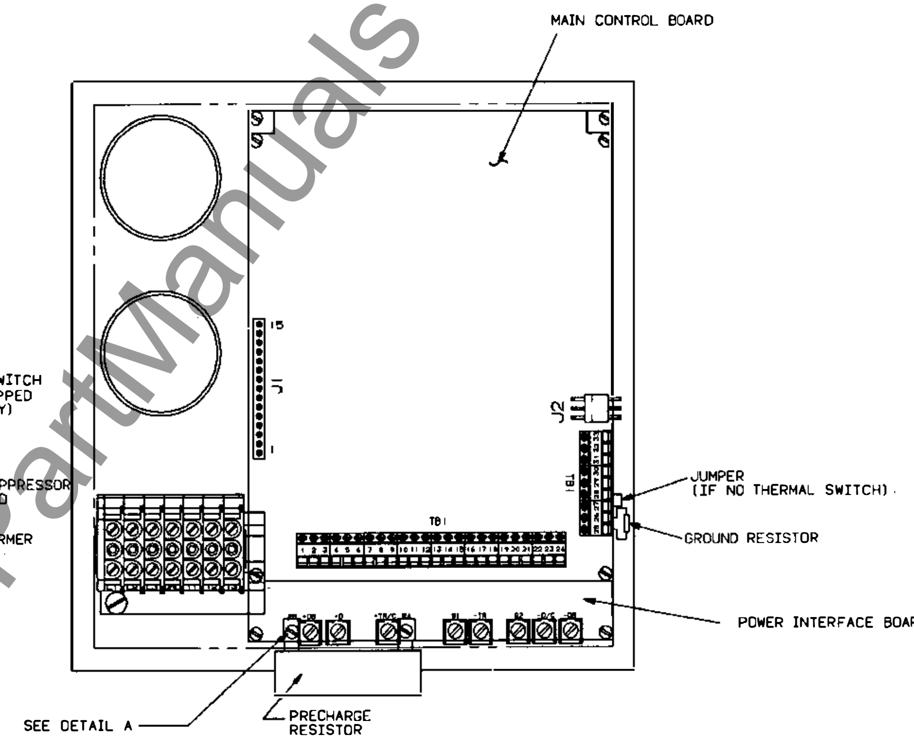
DATE DRN. 1-86 | DATE REL. | DRN. | CKD. | APP'D

ORD. NO. ORD FILE 8.1.1

SHEET OF

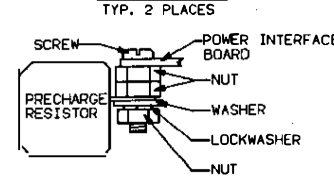



POWER COMPONENTS, CONTROLLER SKELETON




FRONT VIEW, CONTROLLER SKELETON

DETAIL A
TYP. 2 PLACES




CONTROLLER COMPONENT LOCATION

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

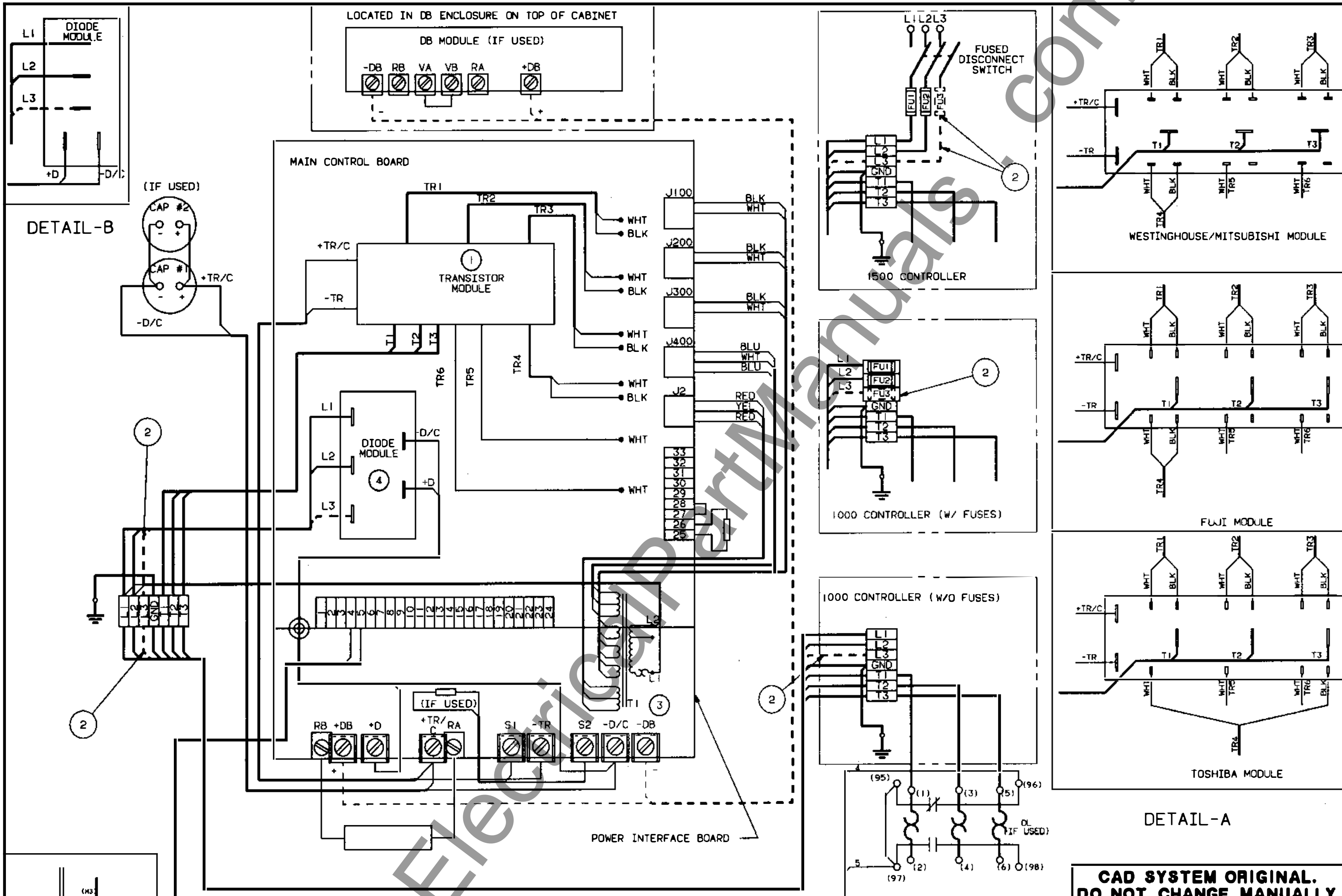
**SQUARE D COMPANY**

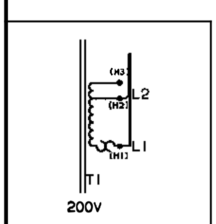
TITLE CONTROLLER COMPONENT LAYOUT
(1-5 HP, 200/230V)

CLASS____ TYPE ____ FORM ____ SER.____

REV. | DATE | REVISION DESCRIPTION | BY | REFERENCE | ASSEM. | PROJ. NO.

DATE DRN. 12-85 | DATE REL. | DRG. NO. 8.1.2 | MASTER | SHEET OF
DRN. | CKD. | APP'D




DETAIL-C

① FOR CONNECTIONS TO TRANSISTOR MODULE SEE DETAIL-A.

② FU3, L3 CABLE, AND L3 TERMINALS ARE NOT PRESENT ON SINGLE PHASE CONTROLLERS.

③ CONNECTIONS FOR 230V SHOWN. SEE DETAIL C FOR 200V CONNECTIONS.

④ FOR ALTERNATE DIODE CONNECTION SEE DETAIL B.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE OMEGAPAK TYPE PT 1000&1500 CONT'LR

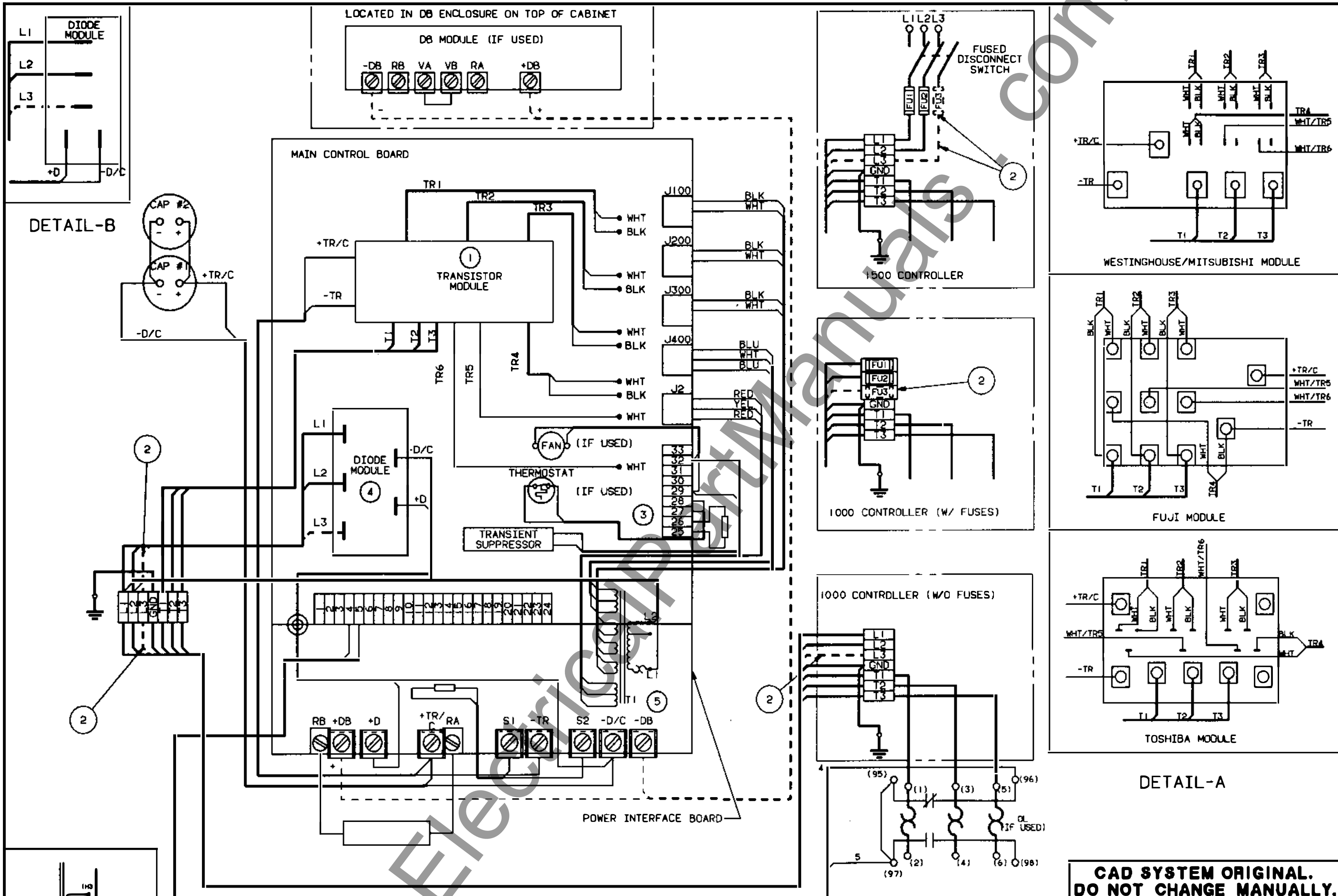
CONNECTION DIAGRAM (1&2HP@200/230V)

CLASS ____ TYPE ____ FORM ____ SER. ____

| | | | | | |
|---|---|---|---|---|---|
| A | 3-20-86 | | | REFERENCE | 8804-5 |
| REV. | DATE | REVISION DESCRIPTION | BY | NEXT ASSEM. | |
| | | | | PROJ. NO. | |

DATE DRN. 1-86 | DATE REL. | DRG. NO. 8.1.3 | ORD FILE | SHEET OF

DRN. | CKD. | APP'D




1. FOR CONNECTIONS TO TRANSISTOR MODULE SEE DETAIL-A.
2. FU3, L3 CABLE, AND L3 TERMINALS ARE NOT PRESENT ON SINGLE PHASE CONTROLLERS.
3. TERMINALS 27 AND 28 MUST BE JUMPERED WHEN THERMOSTAT NOT USED.
4. FOR ALTERNATE DIODE BLOCK CONNECTION SEE DETAIL-B.
5. CONNECTIONS FOR 230V SHOWN. SEE DETAIL C FOR 200V CONNECTIONS.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

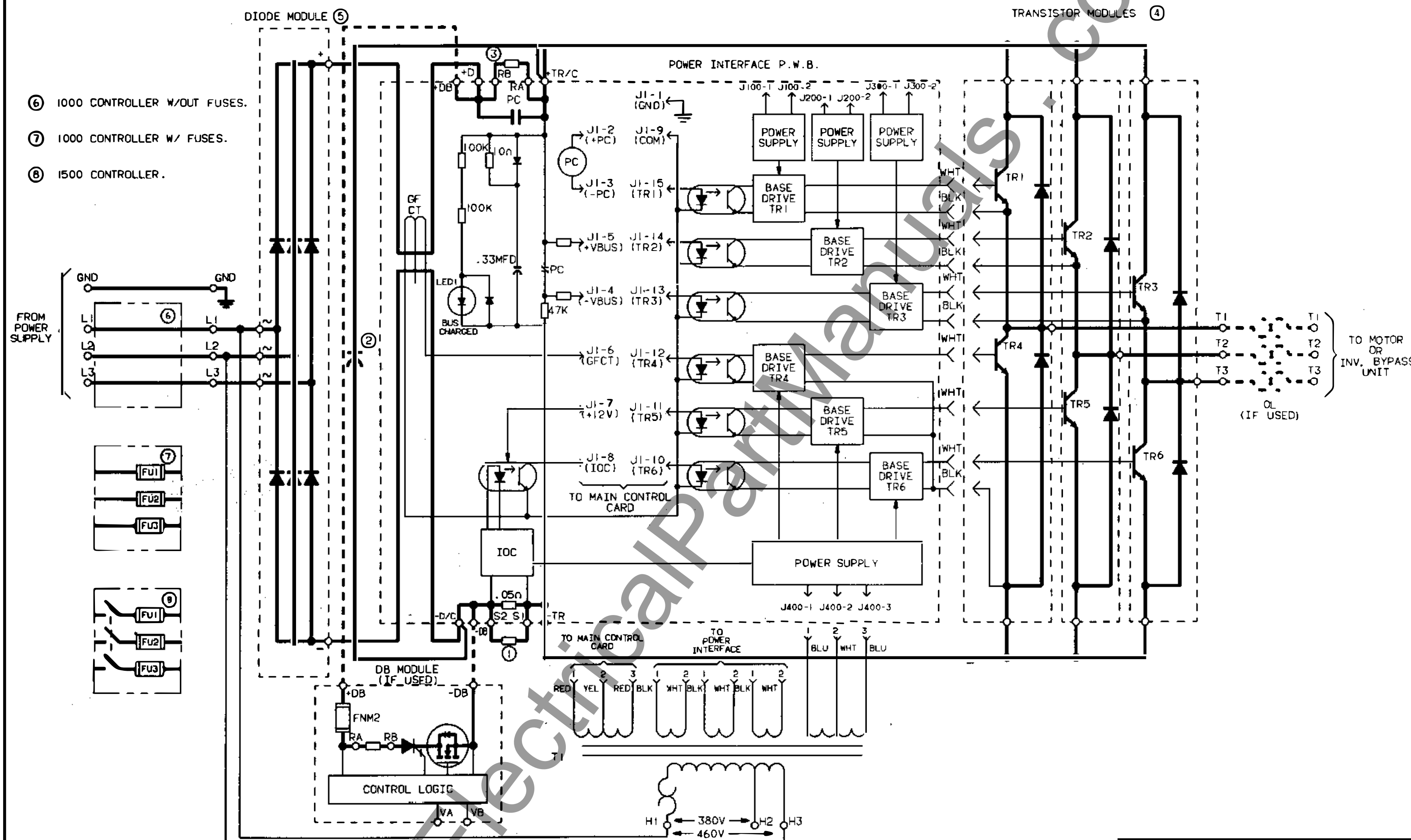
**SQUARE D COMPANY**

TITLE OMEGAPAK TYPE PT 1000&1500 CONT'LR CONNECTION DIAGRAM (3&5HP@200/230V)

CLASS ____ TYPE ____ FORM ____ SER. ____

| | | | | | |
|---|---|---|---|---|---|
| REFERENCE | 8804-5 | DATE DRN. 1-86 | DATE REL. | DRD. NO. 8.1.4 | ORD FILE SHEET OF |
| NEXT ASSEM. | | DRN. | CKD. | APP'D | |
| PROJ. NO. | | | | | |

| REV. | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 3-20-86 | | |




|  | | | | THREE PHASE INPUT | | | | |
|---|---|---|---|---|---|---|---|---|
| HP@ 460V | TRANSISTOR MODULE ④ | CURRENT SENSE RESISTOR ① | POWER INTERFACE 52011-390 | DIODE MODULE ⑤ | BUS CAPACITORS ② | PRECHARGE RESISTORS ③ | POWER FUSES FU1,FU2,FU3 TYPE KTK ⑦ | TYPE RK-5 ⑧ |
| 1-3 | 30A, 1200V | 1.0Ω,5% | -53 | 30A, 1200V | 1-90MFD 480VAC | 10Ω,30W | 20A. 600V. | 20A. 600V. |
| 5 | 30A, 1200V | .05Ω,5% | -53 | 30A, 1200V | 2-90MFD 480VAC | 10Ω,30W | 20A. 600V. | 20A. 600V. |
| 7.5 | 50A, 1200V | .022Ω,5% | -54 | 50A, 1200V | 2-90MFD 480VAC | 10Ω,30W | 20A. 600V. | 20A. 600V. |
| 10 | 50A, 1200V | .022Ω,5% | -54 | 50A, 1200V | 2-90MFD 480VAC | 10Ω,30W | 30A. 600V. | 30A. 600V. |

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

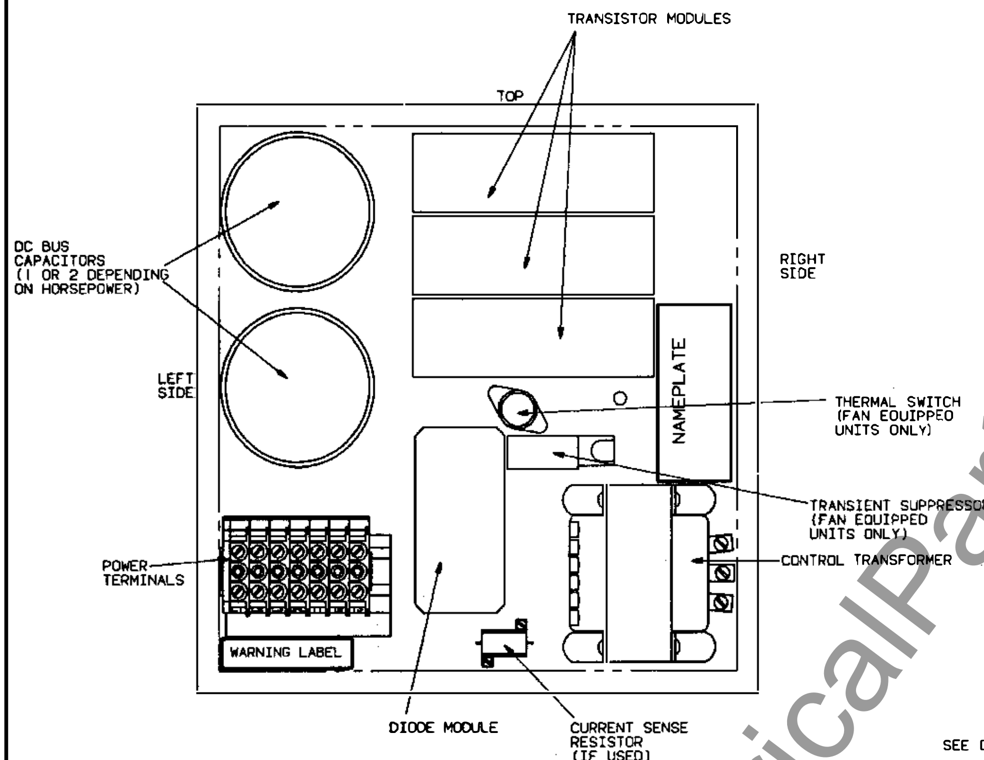
TITLE OMEGAPAK TYPE PT 1000&1500 CONT'LR
POWER ELEM DIAGRAM (1-10 HP@ 460V)

CLASS ____ TYPE ____ FORM ________ SER. ___

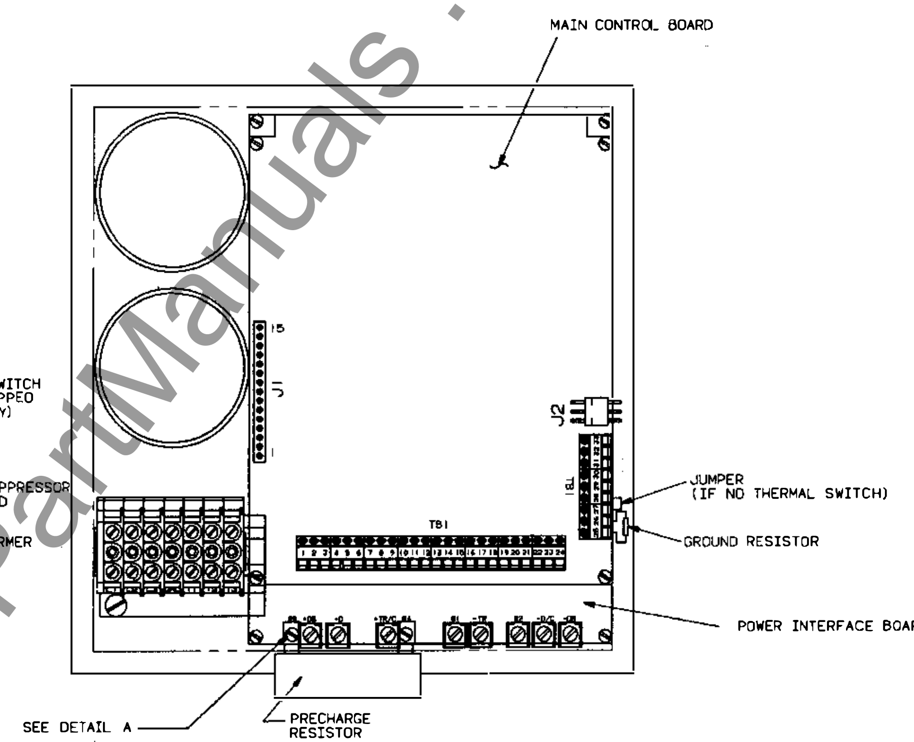
| REV. | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 3-20-86 | | |

REFERENCE 8804-5
NEXT ASSEM.
PROJ. NO.
DATE DRN. 1-86
DATE REL.
DRN.
CKD.
APP'D
DRG. NO. 8.2.1
ORD FILE
SHEET OF

A 3-20-86



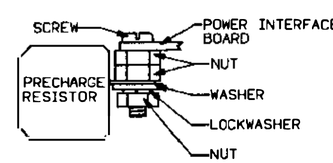

POWER COMPONENTS, CONTROLLER SKELETON




FRONT VIEW, CONTROLLER SKELETON

DETAIL A

TYP. 2 PLACES




460V CONTROLLER COMPONENT LOCATION

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE CONTROLLER COMPONENT LAYOUT

1-10HP @ 460V

CLASS____ TYPE ____ FORM ____ SER.____

REV. | DATE | REVISION DESCRIPTION | BY

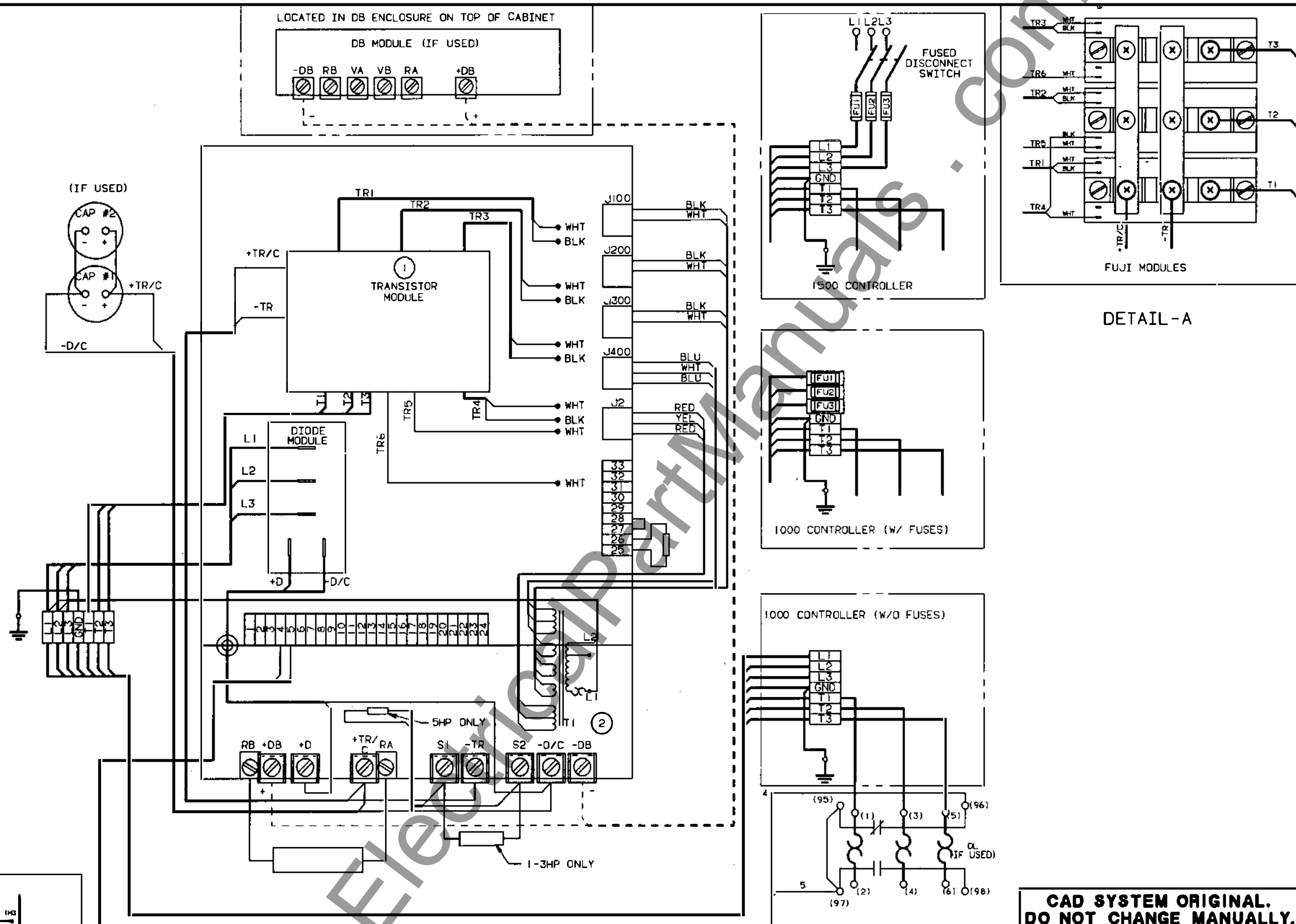
REFERENCE

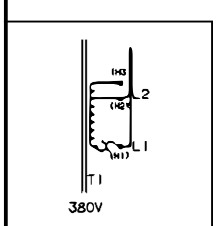
ASSEM.

PROJ. NO.

DATE DRN. 12-85 | DATE REL. | DRG. NO. 8.2.2 | MASTER | SHEET OF

DRN. | CKD. | APP'D




DETAIL-B

1. FOR CONNECTIONS TO TRANSISTOR MODULE SEE DETAIL-A.
2. CONNECTIONS FOR 460V SHOWN SEE DETAIL B FOR 380V CONNECTIONS.

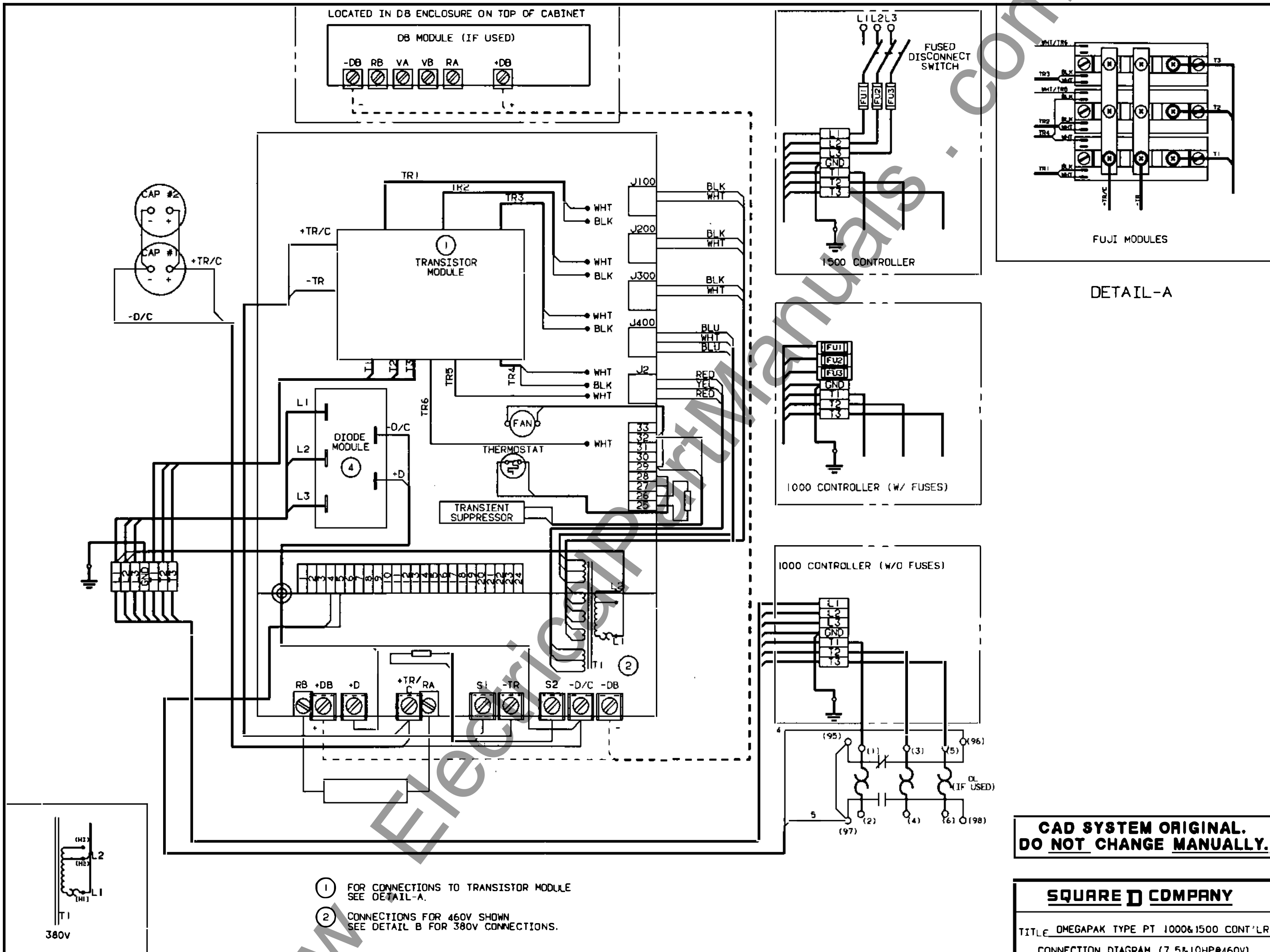
**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE OMEGAPAK TYPE PT 1000&1500 CONT'LR CONNECTION DIAGRAM (1-5HP@460V)

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV. | DATE | REVISION DESCRIPTION | BY | REFERENCE | NEXT ASSEM. | PROJ. NO. | DATE DRN. | DATE REL. | DRG. NO. | ORD FILE | SHEET |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 3-20-86 | | | 8804-5 | | | 1-86 | | | 8.2.3 | OF |




1. FOR CONNECTIONS TO TRANSISTOR MODULE SEE DETAIL-A.
2. CONNECTIONS FOR 460V SHOWN SEE DETAIL B FOR 380V CONNECTIONS.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

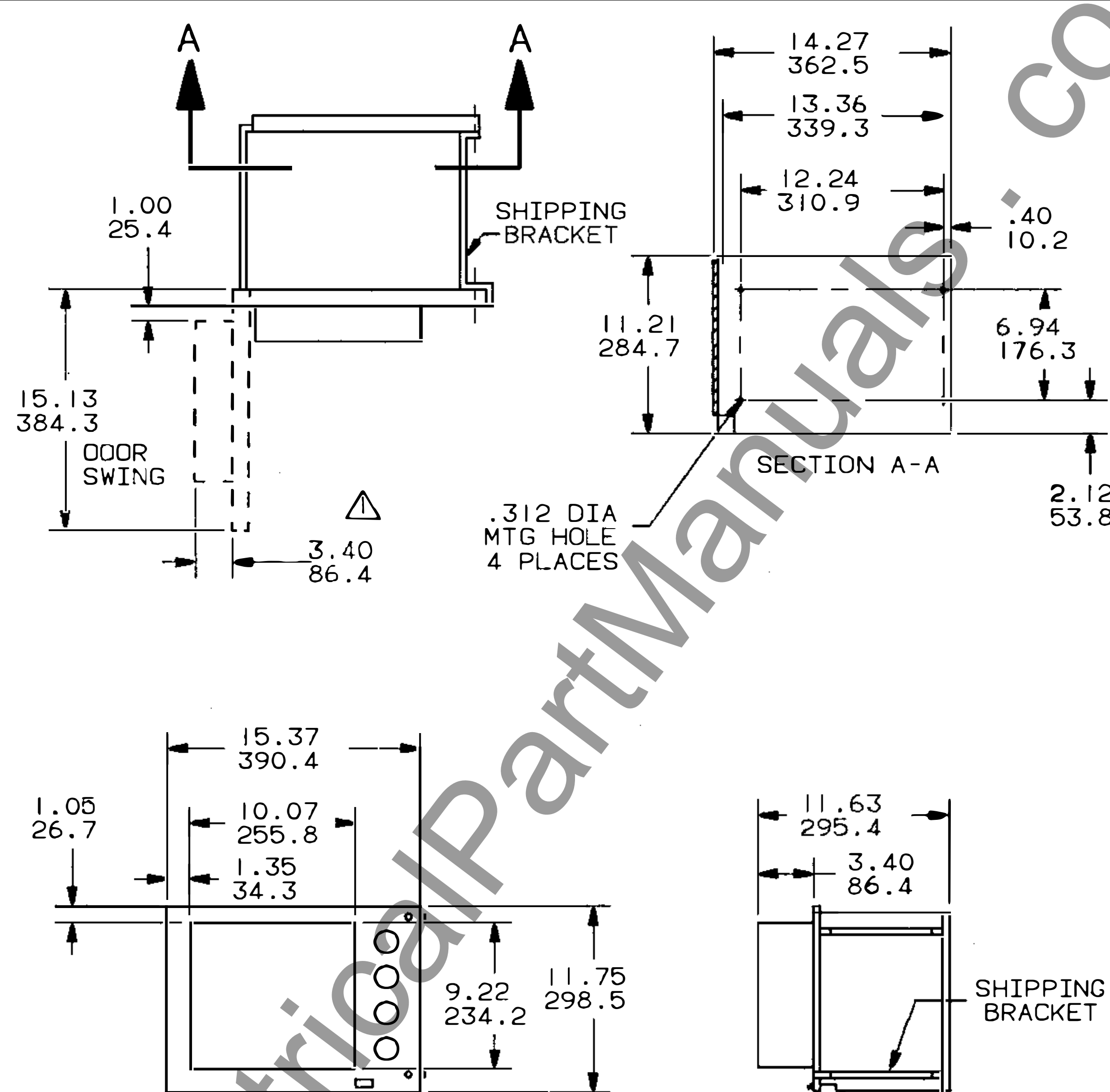
**SQUARE D COMPANY**

TITLE OMEGAPAK TYPE PT 1000&1500 CONT'LR CONNECTION DIAGRAM (7.5&10HP@460V)

CLASS ____ TYPE ____ FORM ____ SER. ____

| | | | | | |
|---|---|---|---|---|---|
| REFERENCE | 8804-5 | DATE DRN. 1-86 | DATE REL. | DRG. NO. | ORD FILE / SHEET OF |
| NEXT ASSEM. | | DRN. | CKD. | APP'D | 8.2.4 |
| PROJ. NO. | | | | | |

| REV. | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 3-20-86 | | |




NOTES:

1. SHROUD PROJECTION WITH DOOR OPEN MUST BE CONSIDERED WHEN MOUNTING CONTROLLER NEAR ADJACENT SURFACES.

2. THE OPEN OMEGAPAK TYPE PT 1000 CONTROLLER IS DESIGNED TO OCCUPY 1 SPACE FACTOR IN A SQUARE D MODEL 4 MOTOR CONTROL CENTER STRUCTURE.

APPROXIMATE WEIGHT=37LBS.(16.8KG)

DUAL DIM. INCHES
MILLIMETERS

**CAD SYSTEM ORIGINAL**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

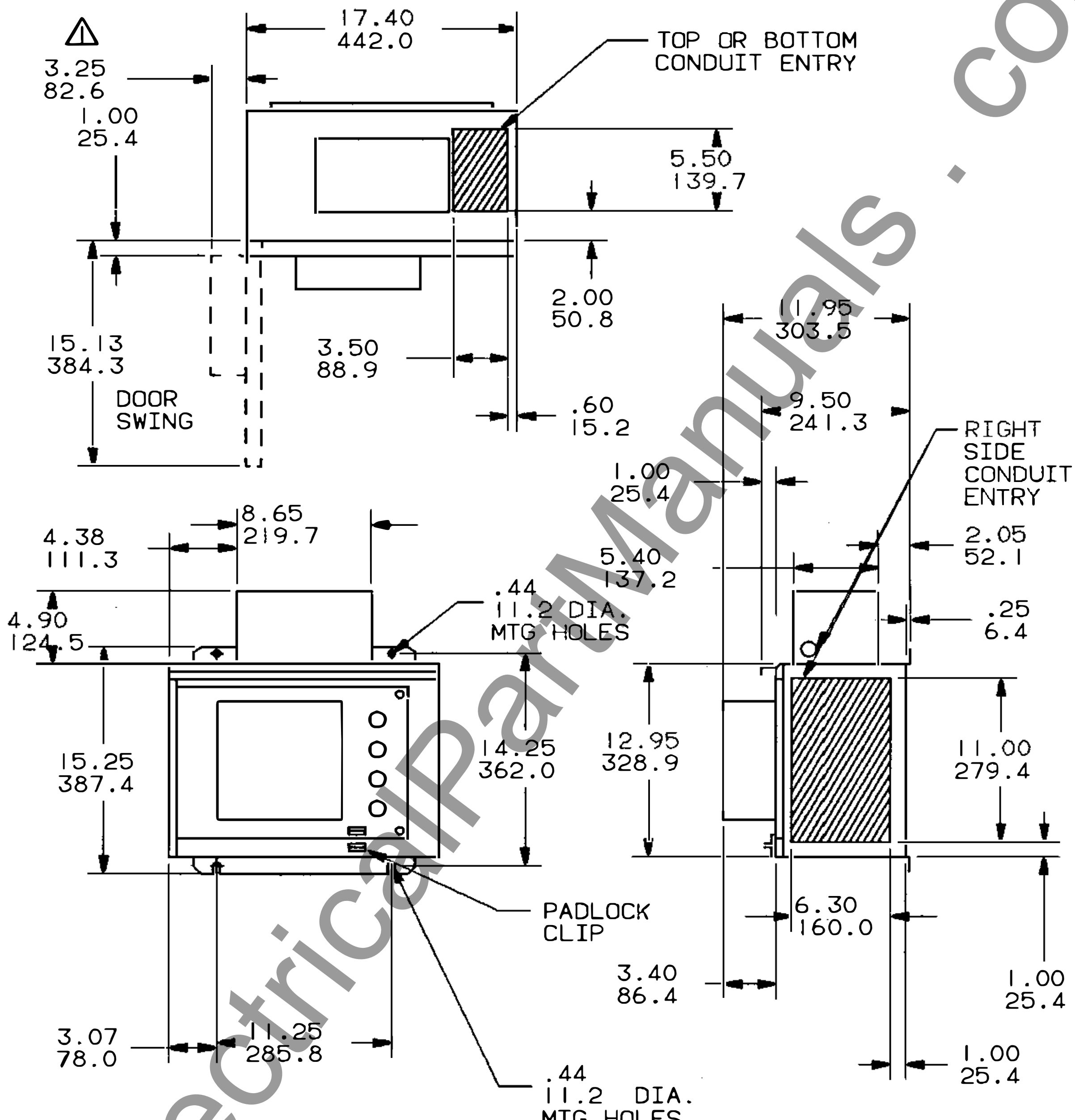
TITLE OPEN OMEGAPAK TYPE PT 1000 OUTLINE DRAWING

CLASS ____ TYPE ____ FORM ____ SER. ____

| REF. | DATE DRN. 1-86 | DATE REL. | DRG. NO. 8.3.1 | MASTER | SHEET |
|---|---|---|---|---|---|
| NEXT ASSEM | DRN. | CKD. | APP'D | | OF |
| PROJ. NO. | | | | | |

REV. | DATE | REVISION DESCRIPTION | BY

SHEET OF DRG. NO. 8.3.1




NOTE:

⚠ SHROUD PROJECTION WITH DOOR OPEN MUST BE CONSIDERED WHEN MOUNTING CONTROLLER NEAR ADJACENT SURFACES.

APPROXIMATE WEIGHT= 53LBS.(24.1KG)

DUAL DIM. INCHES / MILLIMETERS

**CAD SYSTEM ORIGINAL**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE ENCLOSED OMEGAPAK TYPE PT 1000 OUTLINE DRAWING

CLASS____ TYPE____ FORM________ SER.___

| REF. | 8804-5 | DATE DRN. 1-86 | DATE REL. | DRG. NO. 8.3.2 | ORD FILE | SHEET |
|---|---|---|---|---|---|---|
| NEXT ASSEM | | DRN. | CKD. | APP'D | | OF |
| PROJ. NO. | | | | | | |

| REV. | DATE | REVISION DESCRIPTION | BY |
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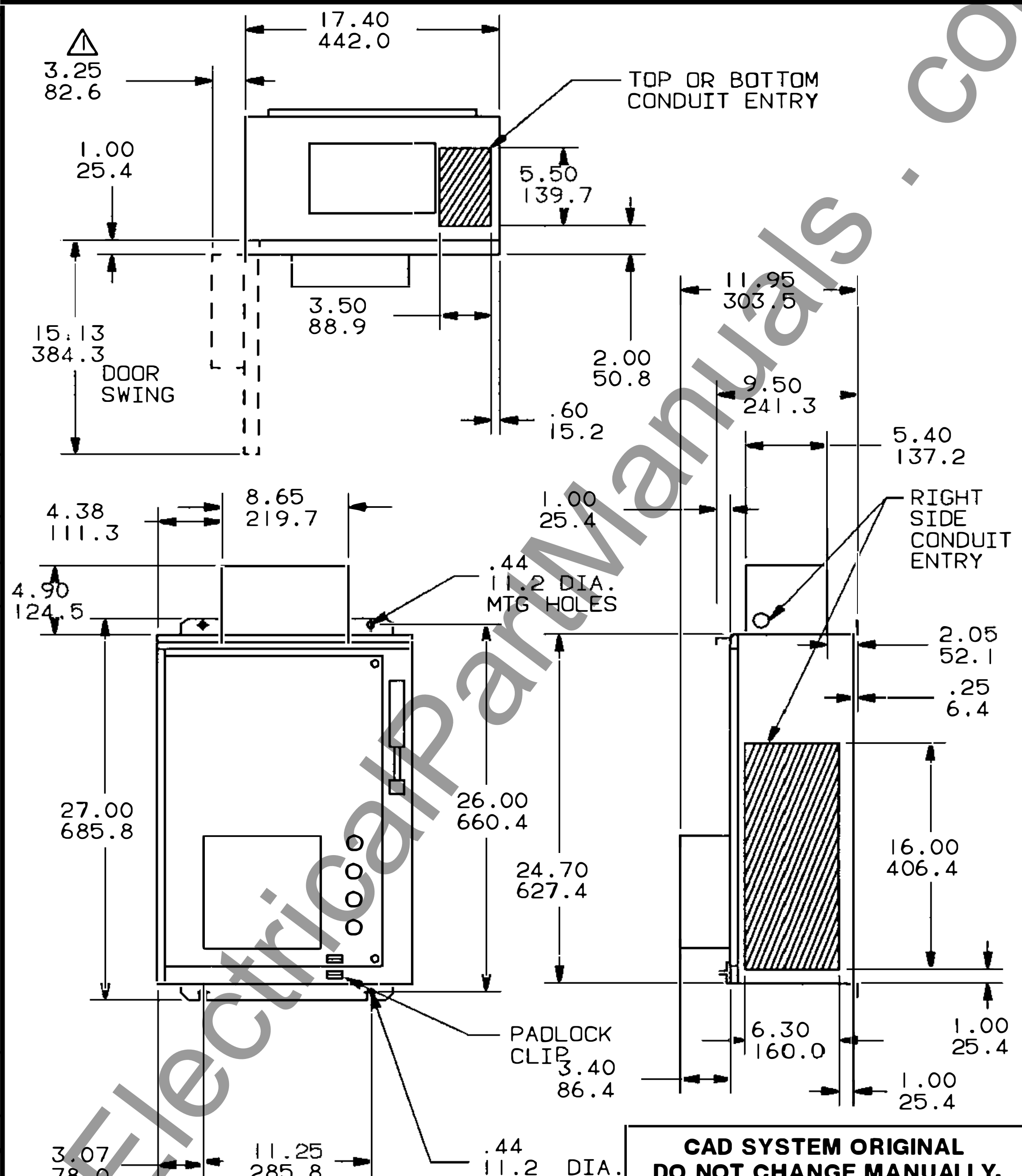
| A | 3-26-86 | | |

SHEET OF DRG. NO. 8.3.2




⚠ SHROUD PROJECTION WITH DOOR OPEN MUST BE CONSIDERED WHEN MOUNTING CONTROLLER NEAR ADJACENT SURFACES.

APPROXIMATE WEIGHT=90LBS.(40.9KG)

DUAL DIM. INCHES / MILLIMETERS

**CAD SYSTEM ORIGINAL**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE OMEGAPAK TYPE PT 1500
OUTLINE DRAWING

CLASS ____ TYPE ____ FORM ____ SER. ____

| REF. | 8804-5 | DATE DRN. 1-86 | DATE REL. | DRG. NO. | ORD FILE | SHEET |
|---|---|---|---|---|---|---|
| NEXT ASSEM | | DRN. | CKD. | APP'D | 8.3.3 | OF |
| PROJ. NO. | | | | | | |

| REV. | DATE | REVISION DESCRIPTION | BY |
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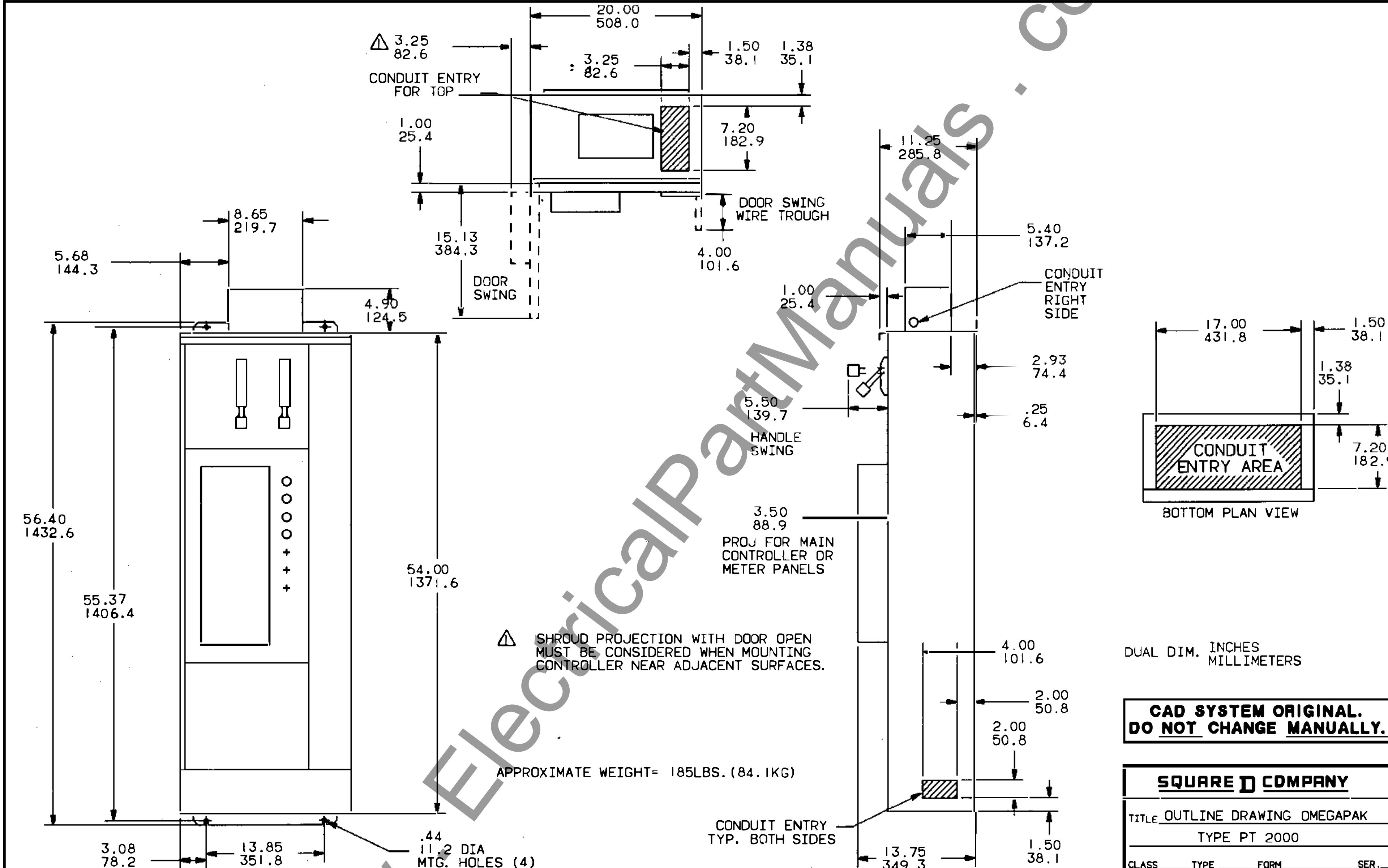
| A | 3-26-86 | | |

SHEET OF — DRG. NO. 8.3.3




**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

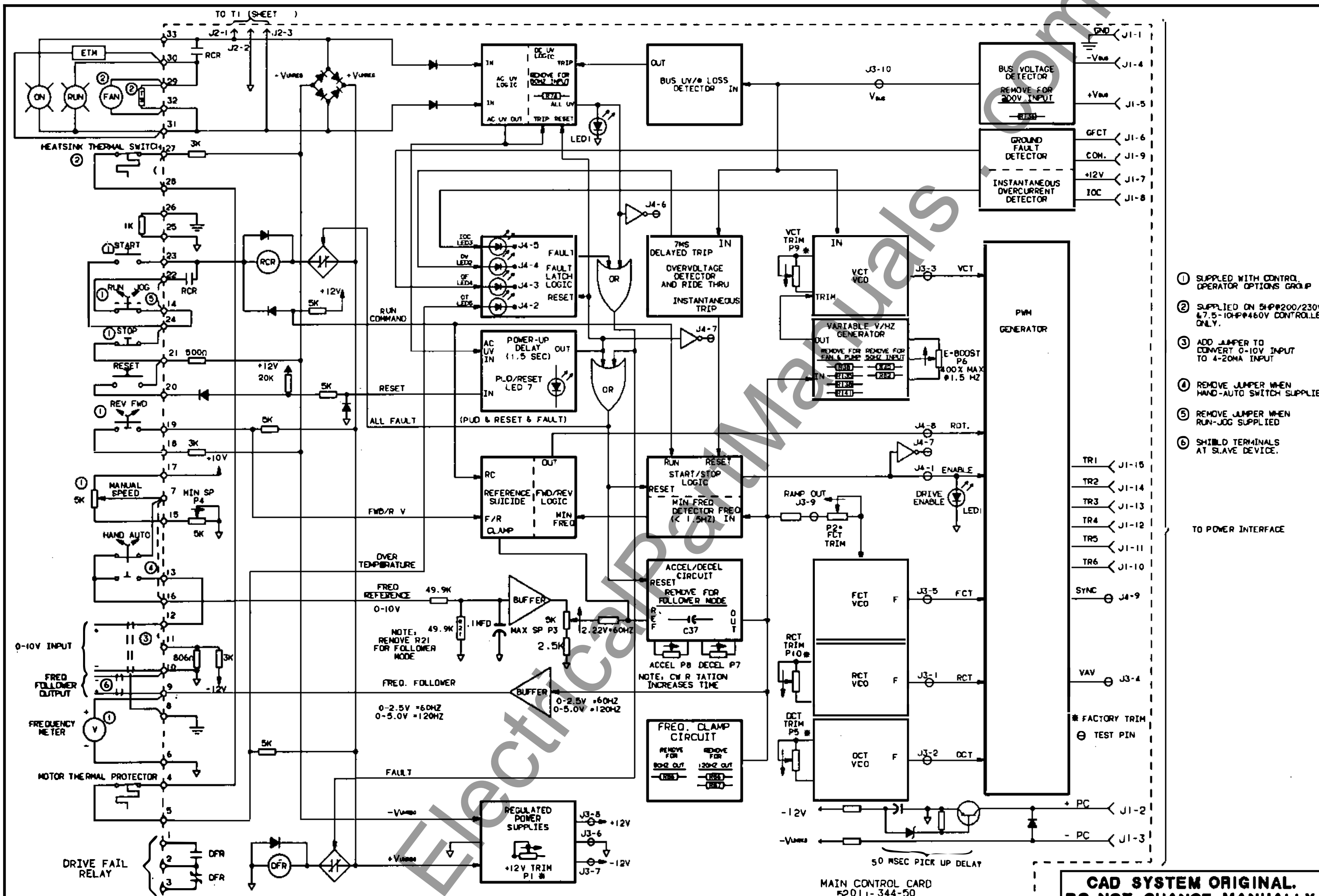
**SQUARE D COMPANY**

TITLE OUTLINE DRAWING OMEGAPAK
TYPE PT 2000

CLASS ____ TYPE ____ FORM ____ SER. ____

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| REFERENCE | 8804-5 | DATE DRN. 1-86 | DATE REL. | DRG. NO. | ORD FILE | SHEET |
| NEXT ASSEM. | | DRN. | CKD. | APP'D | 8.3.4 | OF |
| PROJ. NO. | | | | | | |

| REV. | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 3-20-86 | | |




**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE OMEGAPAK ADJ. FREQ. CONTROLLER (1-10HP 460V)
CONTROL BLOCK DIAGRAM (1-5HP 200/230V)

CLASS____ TYPE____ FORM____ SER.____

| REV. | DATE | REVISION DESCRIPTION | BY | REFERENCE | 8804-5 | DATE DRAWN 12-85 | DATE REL. | DWG. NO. 8.4.1 | MASTER | SHEET OF |
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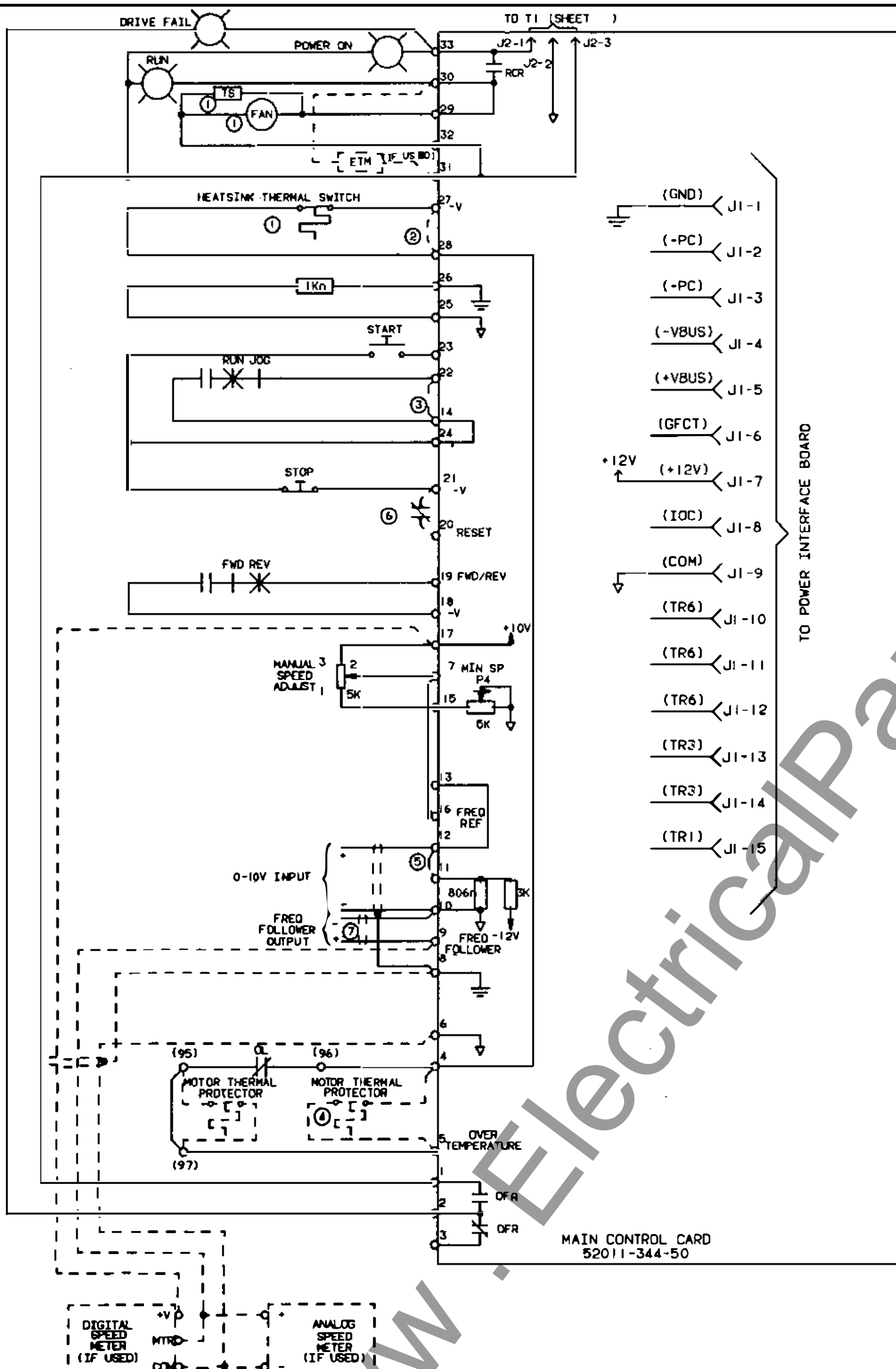
| | | | | NEXT ASSEM. | | DRN. | CKD. | APP'D | | |
| | | | | PROJ. NO. | | | | | | |




NOTES:

1. SUPPLIED ON 5 HP@200/230 V. AND 7.5-10 HP@460V CONTROLLERS ONLY.
2. ADD JUMPER WHEN THERMAL SWITCH NOT SUPPLIED.
3. ADD JUMPER WHEN RUN-JOG NOT SUPPLIED.
4. CONNECT MOTOR THERMAL PROTECTOR HERE IF OVERLOAD RELAY NOT SUPPLIED
5. ADD JUMPER TO CONVERT 0-10V INPUT TO 4-20MA INPUT.
5. LOCATED IN INV-BYPASS UNIT (IF USED). CONTACT OPENS FOR PERMISSIVE TO RUN.
7. SHIELD TERMINATED AT SLAVE DEVICE (IF USED).

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

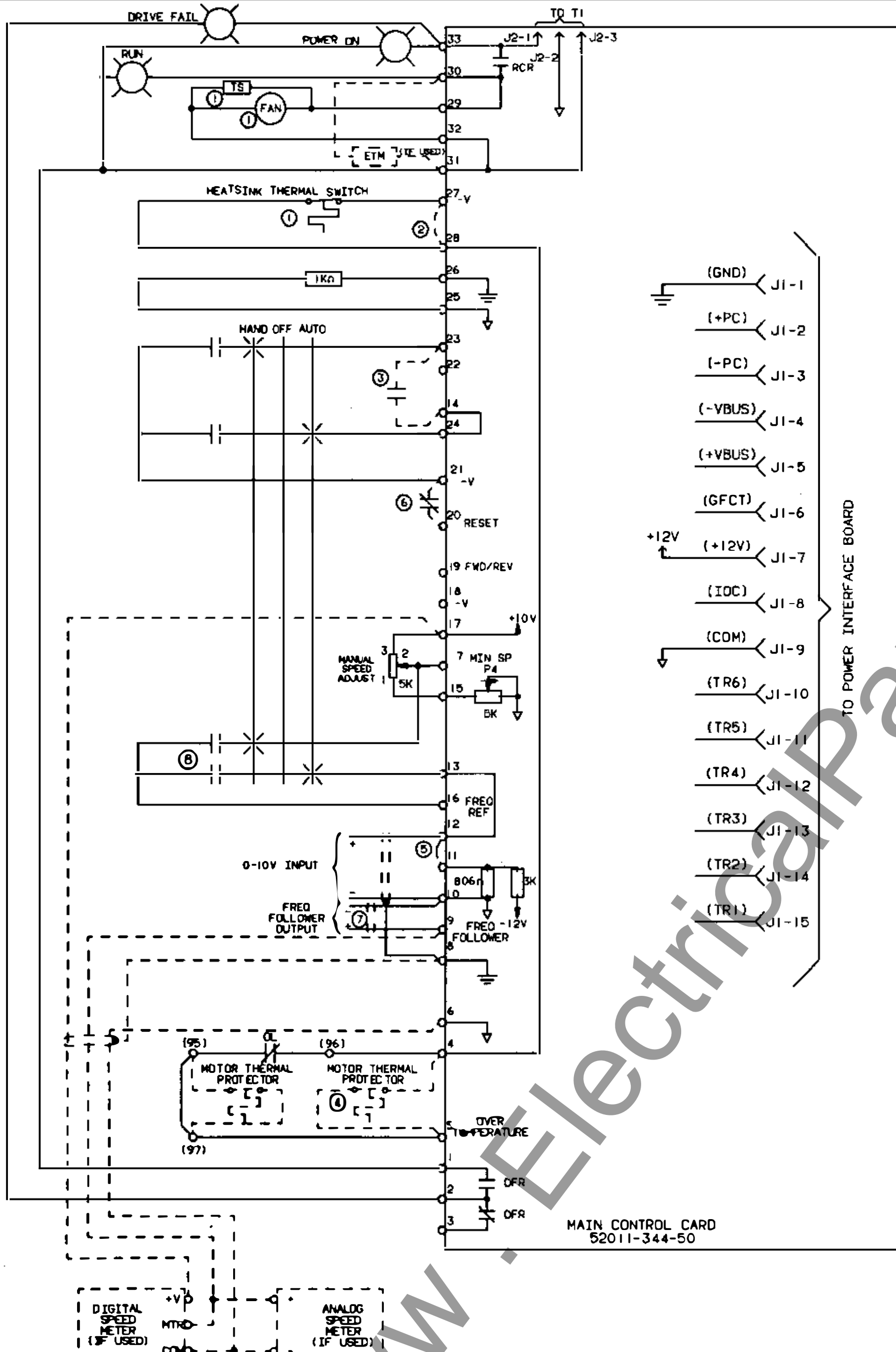
**SQUARE D COMPANY**

TITLE OMEGAPAK TYPE PT CONTROLLER

CONTROL ELEMENTARY DIAGRAM

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV. | DATE | REVISION DESCRIPTION | BY | REFERENCE | NEXT ASSEM. | PROJ. NO. | DATE DRN. 1-86 | DATE REL. | DRN. | CKD. | APP'D | DRG. NO. 8.4.2 | MASTER | SHEET OF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|




NOTES:

1. SUPPLIED ON 5HP@200/230V, AND 7.5-10HP@460V CONTROLLERS ONLY.
2. ADD JUMPER WHEN THERMAL SWITCH NOT SUPPLIED.
3. SUPPLIED BY OTHERS. CLOSES TO RUN IN AUTO MODE.
4. CONNECT MOTOR THERMAL PROTECTOR HERE IF OVERLOAD RELAY NOT SUPPLIED.
5. ADD JUMPER TO CONVERT 0-10V INPUT TO 4-20MA INPUT.
6. LOCATED IN INV-BYPASS UNIT (IF USED). CONTACT OPENS FOR PERMISSIVE TO RUN.
7. SHIELD TERMINATED AT SLAVE DEVICE (IF USED).
8. REFERENCE SELECT CONTACTS MUST BE SQUARE D CLASS 9001 TYPE KA-41, LOGIC REED CONTACT BLOCK OR EQUIVALENT.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE OMEGAPAK TYPE PT CONTROLLER

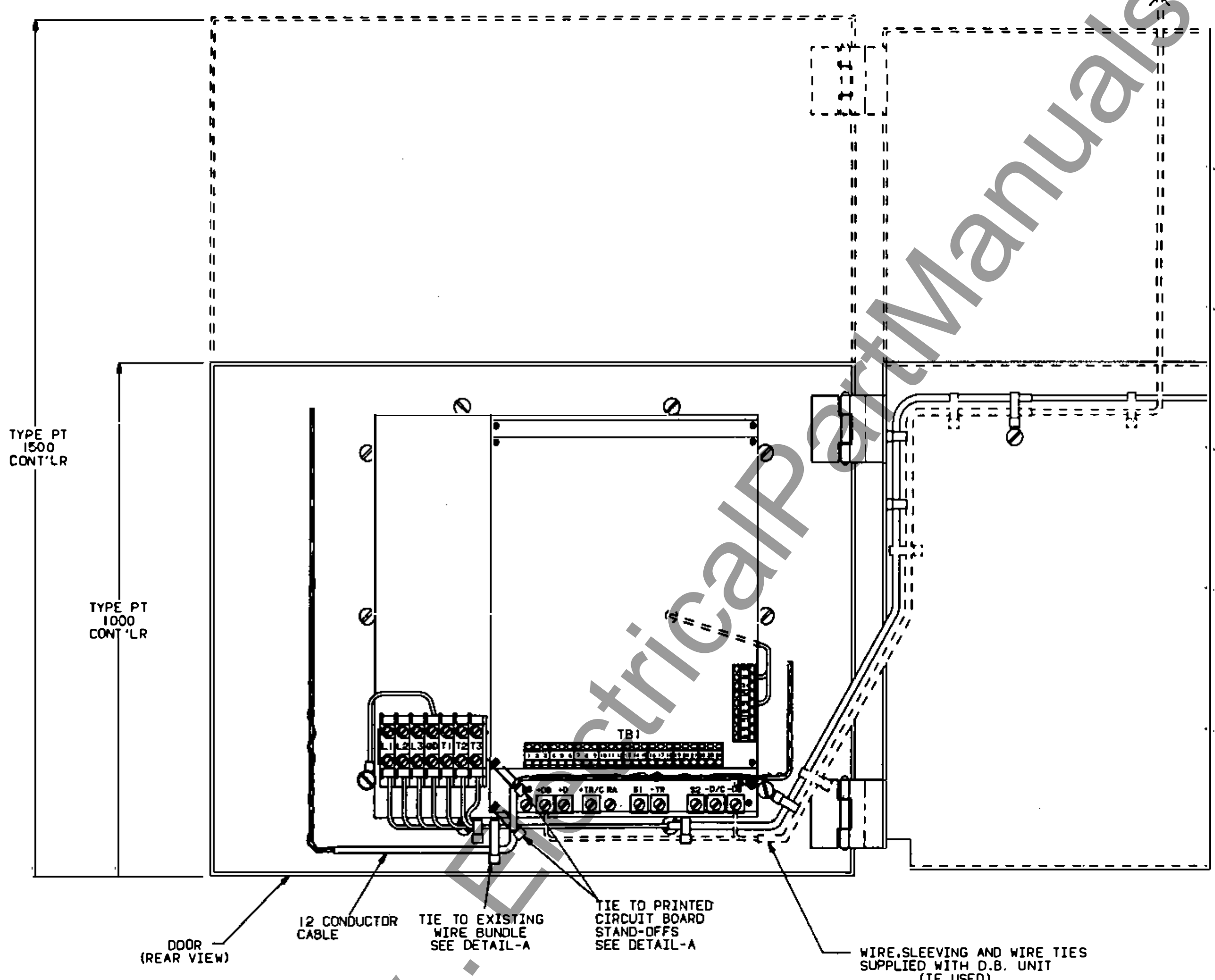
CONTROL ELEMENTARY DIAGRAM

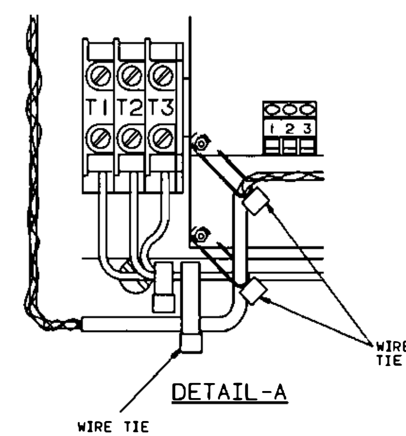
CLASS ____ TYPE ____ FORM ____ SER. ____

| REV. | DATE | REVISION DESCRIPTION | BY | REFERENCE / NEXT ASSEM. / PROJ. NO. | DATE DRN. | DATE REL. | DRG. NO. | SHEET OF |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1-86 | | ORD FILE 8.4.3 | |

## GENERAL NOTES:

1. PUSHBUTTONS, SELECTOR SWITCHES & PILOT LIGHTS ARE TO BE ARRANGED AND WIRED AS SHOWN ON DRAWINGS 8.5.4-8.5.16. WITH THE UNUSED POSITIONS BEING AT THE BOTTOM OF THE DOOR.
2. TWELVE (12) CONDUCTOR UNSHIELDED CABLE USED ON ALL CONFIGURATIONS.
3. ALL SELECTOR SWITCH AND PUSHBUTTONS ARE TO BE ORIENTED WITH LOCATING NIBS TO THE RIGHT (REAR VIEW OF DOOR) WITH CONTACT BLOCKS MOUNTED ON TOP SIDE OF OPERATOR.
4. WHERE MULTI-BLOCKS ARE USED ON OPERATORS. THEY MUST BE STACKED-NOT SIDE BY SIDE.
5. DO NOT CUT OR SHORTEN ANY CONDUCTORS OF THE 12-CONDUCTOR CABLE. ANY UNUSED OR EXCESS CONDUCTOR SHOULD BE NEATLY COILED AND TIED AGAINST THE 12-CONDUCTOR CABLE USING A WIRE TIE.




DETAIL-A

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE CABLE ROUTING DOOR

MTO PILOT DEVICES & D.B. OPTION

CLASS_____ TYPE _____ FORM _____ SER. _____

| REV. | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| B | 4-11-86 | | |
| A | 4-4-86 | | |

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| REFERENCE | 8804-5 |
| ASSEM. | |
| PROJ. NO. | |
| DATE DRN. | 1-86 |
| DATE REL. | |
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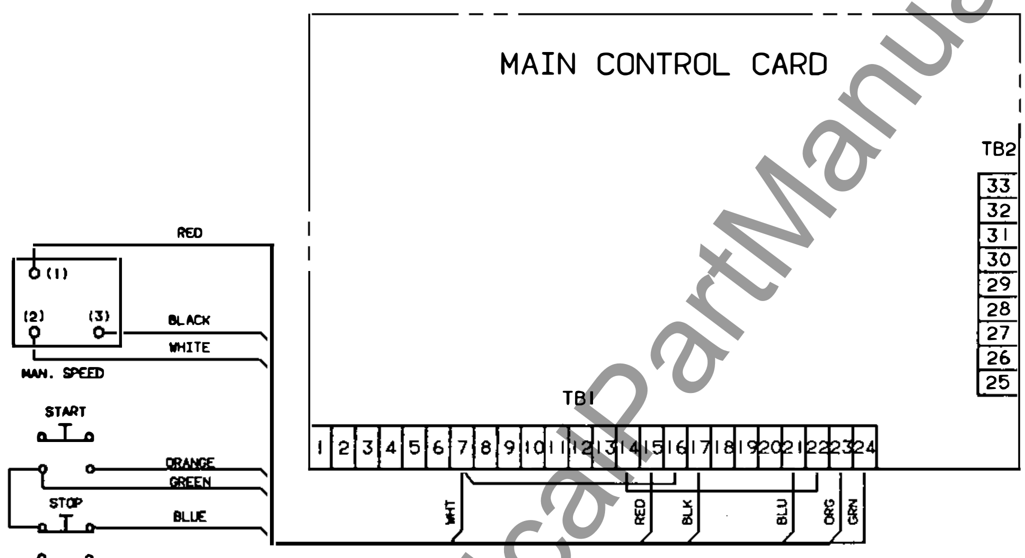
| APP'D | |
| DRD. NO. | 8.5.1 |
| ORD FILE | |
| SHEET OF | |




START-STOP PUSHBUTTONS

MANUAL SPEED POTENTIOMETER

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

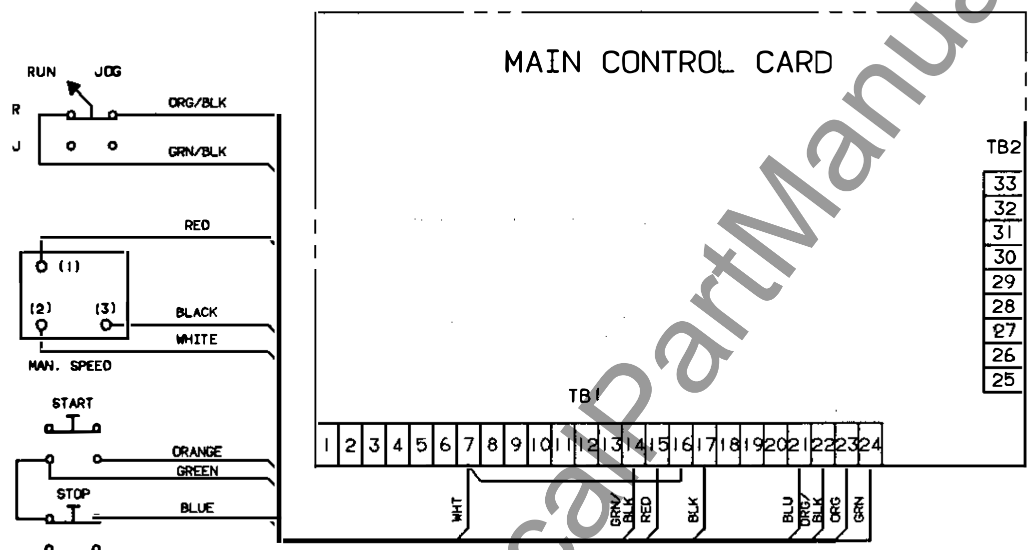
TITLE MOD 510 PILOT DEVICE
CONNECTION DIAGRAM

CLASS____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|

REF.
NEXT ASSEM
PROJ. NO.

DATE DRN. 1-86 | DATE REL. | DRG. NO. 8.5.2 | MASTER | SHEET OF
DRN. | CKD. | APP'D




START-STOP PUSHBUTTONS

MANUAL SPEED POTENTIOMETER

RUN-JOG SELECTOR SWITCH

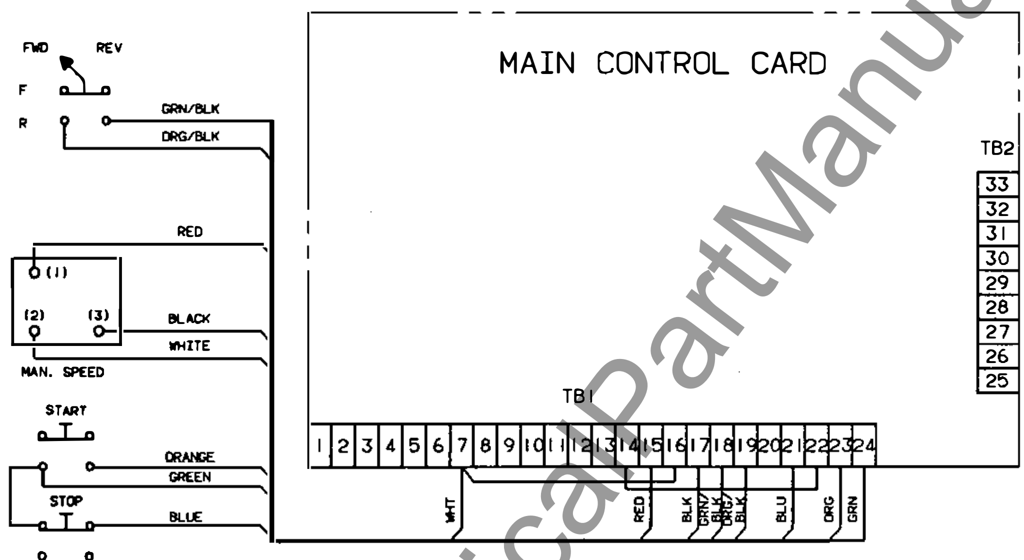
**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE MOD S10 & J11 PILOT DEVICE
CONNECTION DIAGRAM

CLASS_____ TYPE ______ FORM____________ SER.___

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REV | DATE | REVISION DESCRIPTION | BY | REF. | | DATE DRN. 1-86 | DATE REL. | DRG. NO. | MASTER | SHEET | | | | | | |
| | | | | NEXT ASSEM | | DRN. | CKD. | APP'D | 8.5.3 | OF | | | | | | |
| | | | | PROJ.NO. | | | | | | | | | | | | |




START-STOP PUSHBUTTONS

MANUAL SPEED POTENTIOMETER

FOR-REV SELECTOR SWITCH



**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE MOD SIO & F11 PILOT DEVICE
CONNECTION DIAGRAM

CLASS ____ TYPE ____ FORM ____ SER. ____

| | | REV | DATE | REVISION DESCRIPTION | BY | REF. | NEXT ASSEM | PROJ.NO. | DATE DRN. | DATE REL. | DRN. | CKD. | APP'D | DRG. NO. | SHEET |
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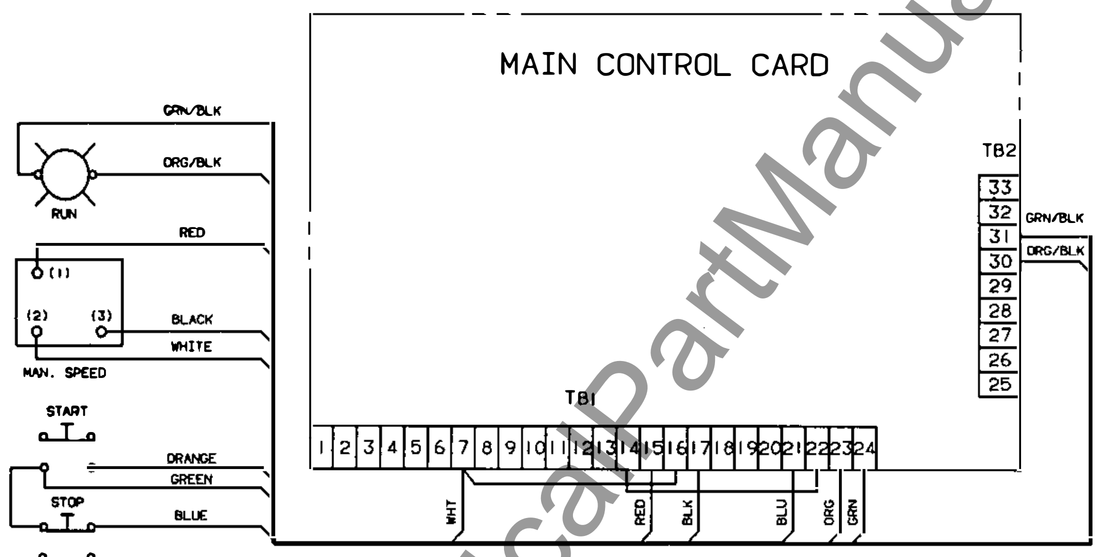



START-STOP PUSHBUTTONS

MANUAL SPEED POTENTIOMETER

RUN PILOT LIGHT

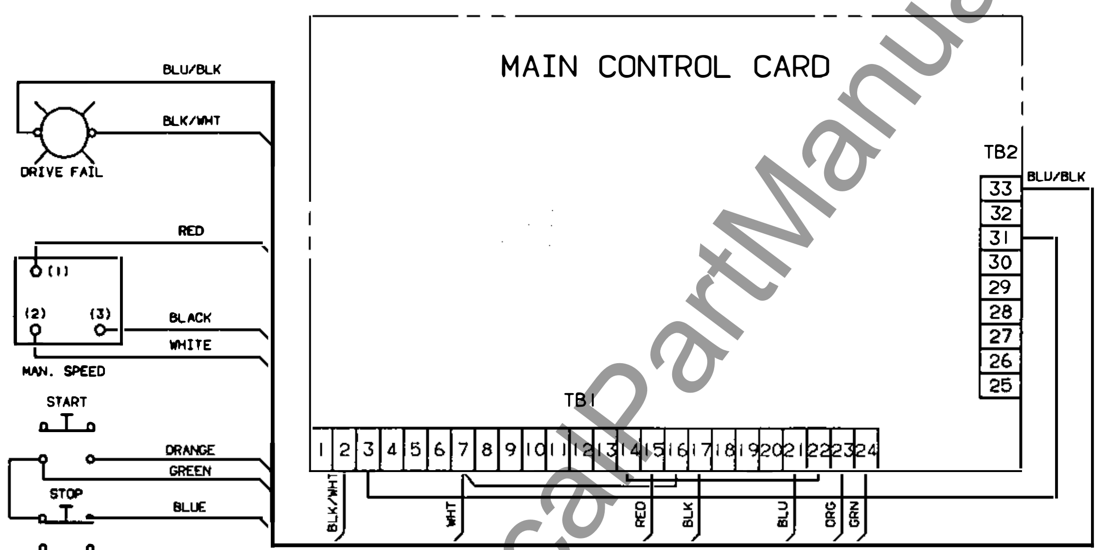
**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE MOD S10 & R16 PILOT DEVICE CONNECTION DIAGRAM

CLASS____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY | REF. / NEXT ASSEM / PROJ.NO. | DATE DRN. 1-86 | DATE REL. | DRG. NO. MASTER | SHEET OF |
|---|---|---|---|---|---|---|---|---|
| | | | | | DRN. | CKD. / APP'D | 8.5.5 | |




START-STOP PUSHBUTTONS

MANUAL SPEED POTENTIOMETER

DRIVE FAIL PILOT LIGHT

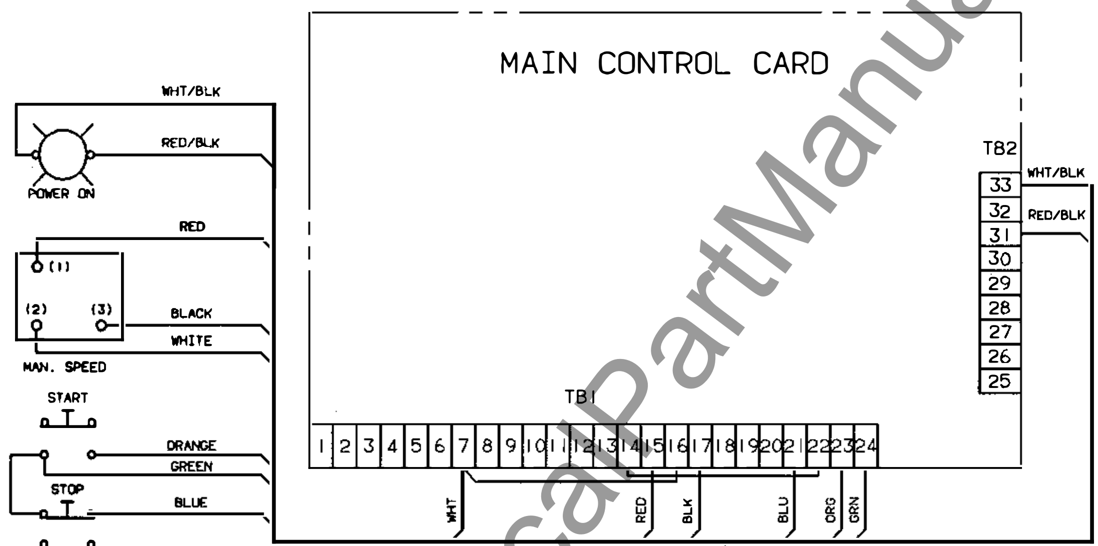
**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE MOD S10 & F16 PILOT DEVICE
CONNECTION DIAGRAM

CLASS____ TYPE ____ FORM ________ SER. ___

| REV | DATE | REVISION DESCRIPTION | BY | REF. / NEXT ASSEM / PROJ.NO. | DATE DRN. 1-86 | DATE REL. | DRG. NO. MASTER 8.5.6 | SHEET OF |
|---|---|---|---|---|---|---|---|---|
| | | | | | DRN. | CKD. | APP'D | |




START-STOP PUSHBUTTONS

MANUAL SPEED POTENTIOMETER

POWER ON PILOT LIGHT

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

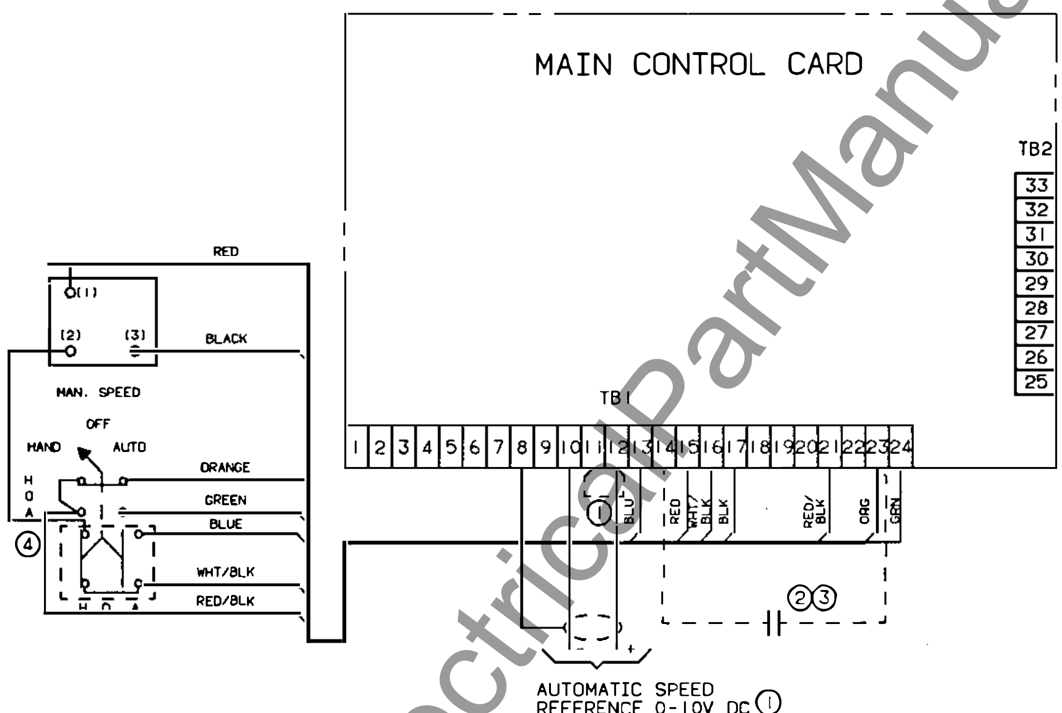
TITLE MOD S10 & P16 PILOT DEVICE CONNECTION DIAGRAM

CLASS ___ TYPE ___ FORM ___ SER. ___

| REV | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|

REF.
NEXT ASSEM
PROJ. NO.

DATE DRN. 1-86 | DATE REL. | DRG. NO. 8.5.7 | MASTER | SHEET OF
DRN. | CKD. | APP'D




MANUAL SPEED POTENTIOMETER

HAND-OFF-AUTO SELECTOR SWITCH

NOTES:

1. ADD JUMPER TB1-11 TO TB1-12 IF AUTOMATIC SPEED REFERENCE IS 4-20 MA DC.
2. AUTOMATIC START CONTACT (USER FURNISHED).
3. IF IT IS DESIRED TO HAVE THE CONTROLLER OPERATE CONTINUOUSLY WHEN THE HAND-OFF-AUTO SELECTOR SWITCH IS IN THE AUTO POSITION, JUMPER TB1-14 TO TB1-23.
4. CONTACTS FOR THE HAND-AUTO REFERENCE SELECTION MUST BE LOGIC LEVEL REED CONTACTS, SQUARE D CLASS 9001, TYPE KA-41 OR EQUIVALENT.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE MOD H10 PILOT DEVICE CONNECTION DIAGRAM

CLASS____ TYPE____ FORM____ SER.____

| REV | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 4-7-86 | | |

REF. 8804-5
NEXT ASSEM
PROJ. NO.
DATE DRN. 1-86
DATE REL.
DRN. CKD. APP'D
DRG. NO. 8.5.8
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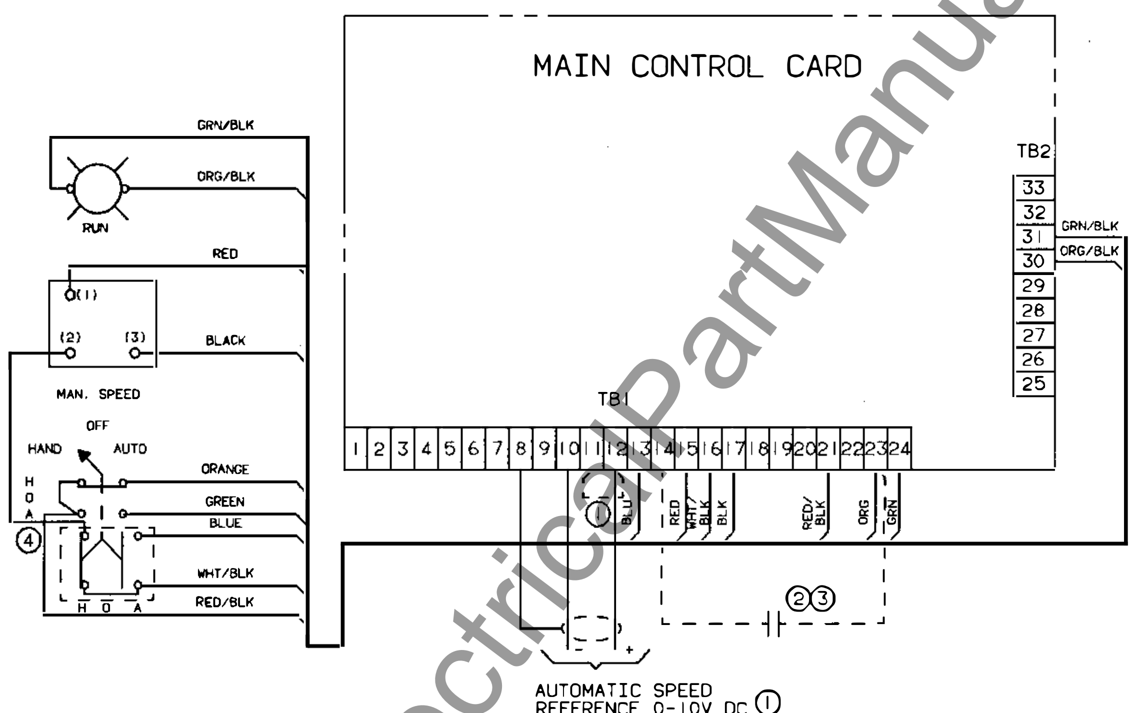


MANUAL SPEED POTENTIOMETER

HAND-OFF-AUTO SELECTOR SWITCH

RUN PILOT LIGHT

NOTES:

1. ADD JUMPER TB1-11 TO TB1-12 IF AUTOMATIC SPEED REFERENCE IS 4-20 MA DC.
2. AUTOMATIC START CONTACT (USER FURNISHED).
3. IF IT IS DESIRED TO HAVE THE CONTROLLER OPERATE CONTINUOUSLY WHEN THE HAND-OFF-AUTO SELECTOR SWITCH IS IN THE AUTO POSITION, JUMPER TB1-14 TO TB1-23.
4. CONTACTS FOR THE HAND-AUTO REFERENCE SELECTION MUST BE LOGIC LEVEL REED CONTACTS, SQUARE D CLASS 9001, TYPE KA-41 OR EQUIVALENT.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE MOD H10 & R16 PILOT DEVICE CONNECTION DIAGRAM

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 4-7-86 | | |

| REF. | 8804-5 |
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| NEXT ASSEM | |
| PROJ.NO. | |

| DATE DRN. | DATE REL. | DRG. NO. | ORD FILE | SHEET |
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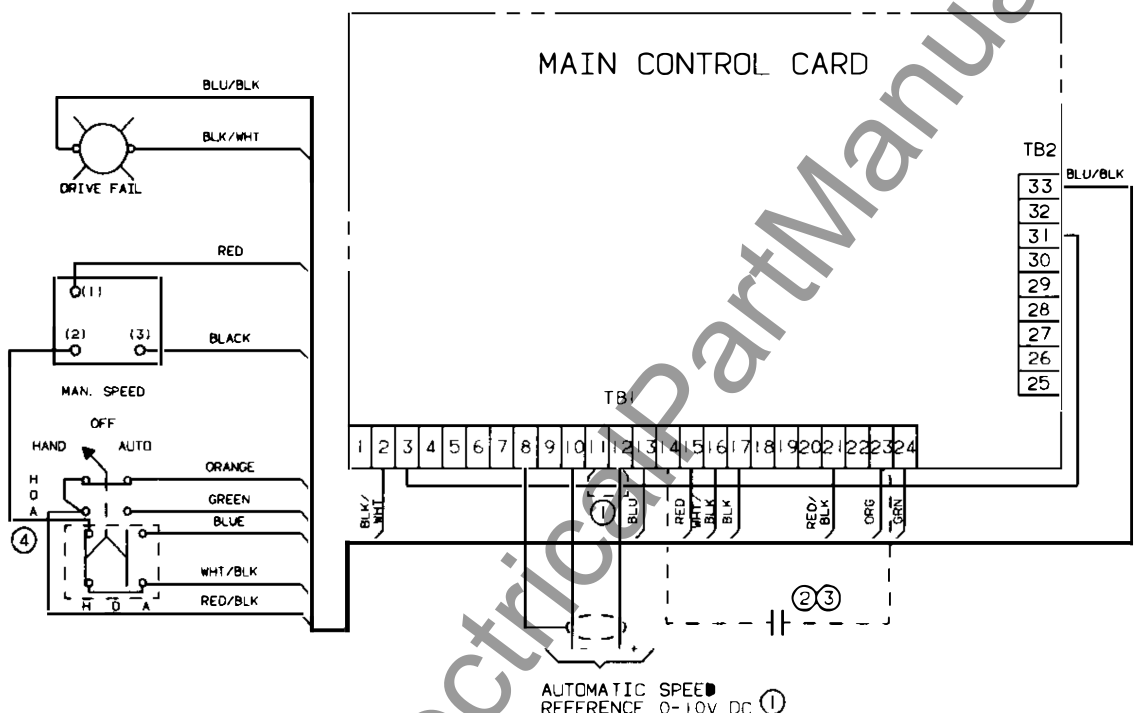
| 1-86 | | 8.5.9 | | OF |
| DRN. | CKD. | APP'D | | |




NOTES:

1. ADD JUMPER TB1-11 TO TB1-12 IF AUTOMATIC SPEED REFERENCE IS 4-20 MA DC.

2. AUTOMATIC START CONTACT (USER FURNISHED).

3. IF IT IS DESIRED TO HAVE THE CONTROLLER OPERATE CONTINUOUSLY WHEN THE HAND-OFF-AUTO SELECTOR SWITCH IS IN THE AUTO POSITION, JUMPER TB1-14 TO TB1-23.

4. CONTACTS FOR THE HAND-AUTO REFERENCE SELECTION MUST BE LOGIC LEVEL REED CONTACTS, SQUARE D CLASS 9001, TYPE KA-41 OR EQUIVALENT.

MANUAL SPEED POTENTIOMETER

HAND-OFF-AUTO SELECTOR SWITCH

DRIVE FAIL PILOT LIGHT

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE MOD H10 & F16 PILOT DEVICE
CONNECTION DIAGRAM

CLASS____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY |
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| A | 4-7-86 | | |

REF. 8804-5
NEXT ASSEM
PROJ. NO.
DATE DRN. 1-86
DATE REL.
DRN. CKD. APP'D
DWG. NO. 8.5.10
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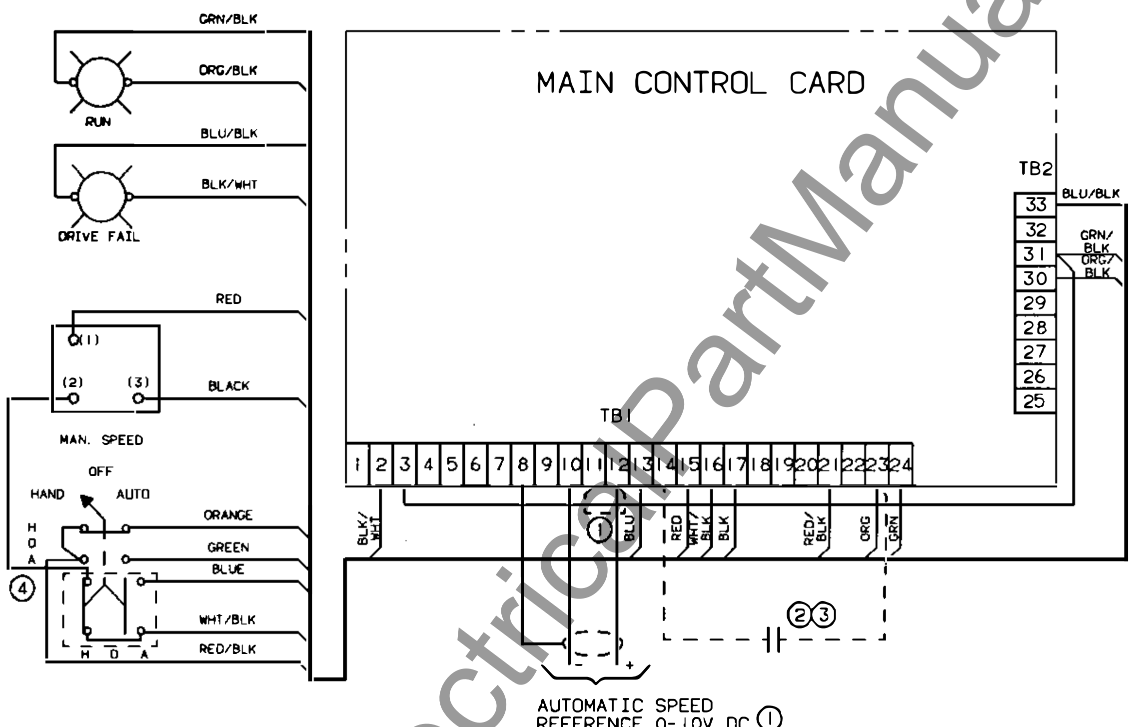


MANUAL SPEED POTENTIOMETER

HAND-OFF-AUTO SELECTOR SWITCH

DRIVE FAIL PILOT LIGHT

RUN PILOT LIGHT

NOTES:

1. ADD JUMPER TB1-11 TO TB1-12 IF AUTOMATIC SPEED REFERENCE IS 4-20 MA DC.
2. AUTOMATIC START CONTACT (USER FURNISHED).
3. IF IT IS DESIRED TO HAVE THE CONTROLLER OPERATE CONTINUOUSLY WHEN THE HAND-OFF-AUTO SELECTOR SWITCH IS IN THE AUTO POSITION, JUMPER TB1-14 TO TB1-23.
4. CONTACTS FOR THE HAND-AUTO REFERENCE SELECTION MUST BE LOGIC LEVEL REED CONTACTS, SQUARE D CLASS 9001, TYPE KA-41 OR EQUIVALENT.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE MOD H10, R16 & F16 PILOT DEVICE CONNECTION DIAGRAM

CLASS____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY |
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| A | 4-7-86 | | |

REF. 8804-5
NEXT ASSEM
PROJ.NO.
DATE DRN. 1-86
DATE REL.
DRN. CKD. APP'D
DRG. NO. 8.5.11
ORD FILE
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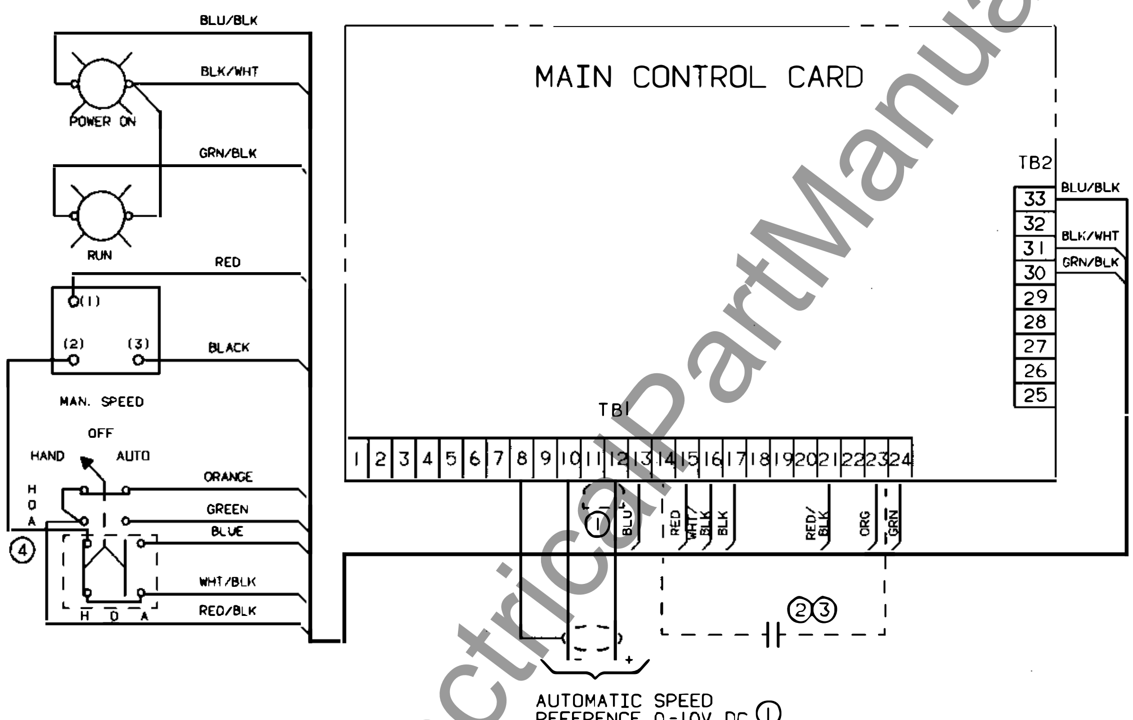


MANUAL SPEED POTENTIOMETER

HAND-OFF-AUTO SELECTOR SWITCH

RUN PILOT LIGHT

POWER ON PILOT LIGHT

NOTES:

1. ADD JUMPER TB1-11 TO TB1-12 IF AUTOMATIC SPEED REFERENCE IS 4-20 MA DC.
2. AUTOMATIC START CONTACT (USER FURNISHED).
3. IF IT IS DESIRED TO HAVE THE CONTROLLER OPERATE CONTINUOUSLY WHEN THE HAND-OFF-AUTO SELECTOR SWITCH IS IN THE AUTO POSITION, JUMPER TB1-14 TO TB1-23.
4. CONTACTS FOR THE HAND-AUTO REFERENCE SELECTION MUST BE LOGIC LEVEL REED CONTACTS, SQUARE D CLASS 9001, TYPE KA-41 OR EQUIVALENT.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE MOD H10, P16 & R16 PILOT DEVICE
CONNECTION DIAGRAM

CLASS_____ TYPE _____ FORM_____ SER.____

| REV | DATE | REVISION DESCRIPTION | BY |
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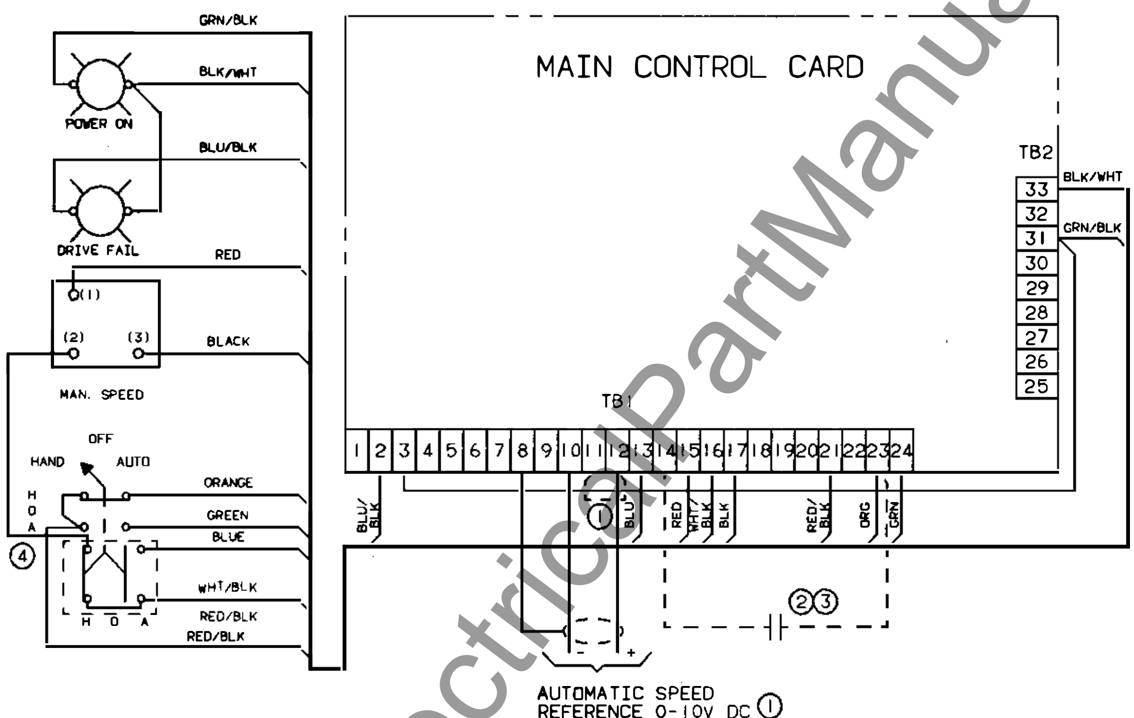
| A | 4-7-86 | | |

REF. 8804-5
NEXT ASSEM
PROJ.NO.

DATE DRN. 1-86 | DATE REL. | DRG. NO. | ORD FILE | SHEET
DRN. | CKD. | APP'D | 8.5.12 | OF




MANUAL SPEED POTENTIOMETER

HAND-OFF-AUTO SELECTOR SWITCH

DRIVE FAIL PILOT LIGHT

POWER ON PILOT LIGHT

## NOTES:

1. ADD JUMPER TB1-11 TO TB1-12 IF AUTOMATIC SPEED REFERENCE IS 4-20 MA DC.
2. AUTOMATIC START CONTACT (USER FURNISHED).
3. IF IT IS DESIRED TO HAVE THE CONTROLLER OPERATE CONTINUOUSLY WHEN THE HAND-OFF-AUTO SELECTOR SWITCH IS IN THE AUTO POSITION, JUMPER TB1-14 TO TB1-23.
4. CONTACTS FOR THE HAND-AUTO REFERENCE SELECTION MUST BE LOGIC LEVEL REED CONTACTS, SQUARE D CLASS 9001, TYPE KA-41 OR EQUIVALENT.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE MOD H10, P16 & F16 PILOT DEVICE CONNECTION DIAGRAM

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY |
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| A | 4-7-86 | | |

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DATE DRN. 1-86 | DATE REL. | DRN. | CKD. | APP'D

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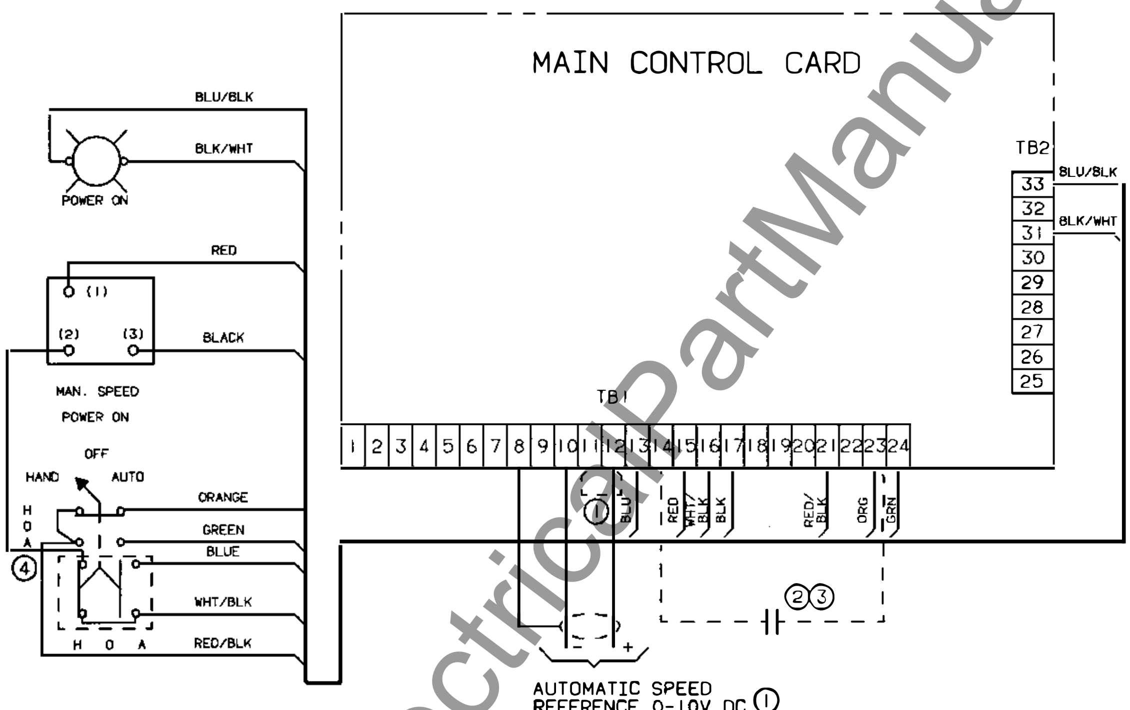


MANUAL SPEED POTENTIOMETER

HAND-OFF-AUTO SELECTOR SWITCH

POWER ON PILOT LIGHT

NOTES:

① ADD JUMPER TB1-11 TO TB1-12 IF AUTOMATIC SPEED REFERENCE IS 4-20 MA DC.

② AUTOMATIC START CONTACT (USER FURNISHED).

③ IF IT IS DESIRED TO HAVE THE CONTROLLER OPERATE CONTINUOUSLY WHEN THE HAND-OFF-AUTO SELECTOR SWITCH IS IN THE AUTO POSITION, JUMPER TB1-14 TO TB1-23.

④ CONTACTS FOR THE HAND-AUTO REFERENCE SELECTION MUST BE LOGIC LEVEL REED CONTACTS, SQUARE D CLASS 9001, TYPE KA-41 OR EQUIVALENT.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE MOD H10 & P16 PILOT DEVICE CONNECTION DIAGRAM

CLASS____ TYPE____ FORM____ SER.____

| REV | DATE | REVISION DESCRIPTION | BY |
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| A | 4-7-86 | | |

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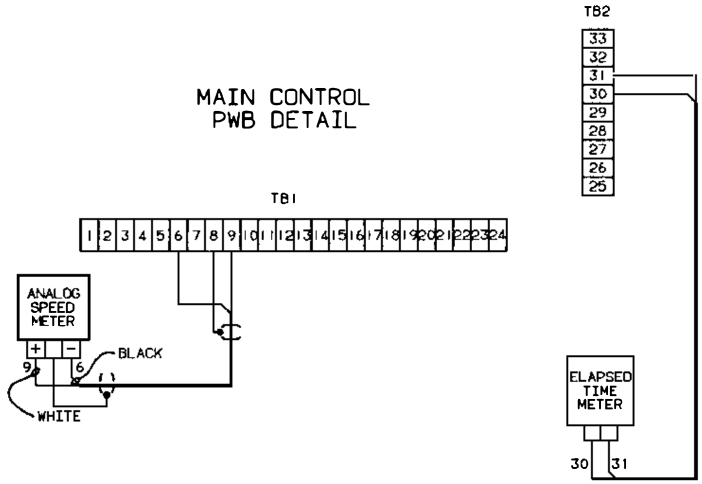


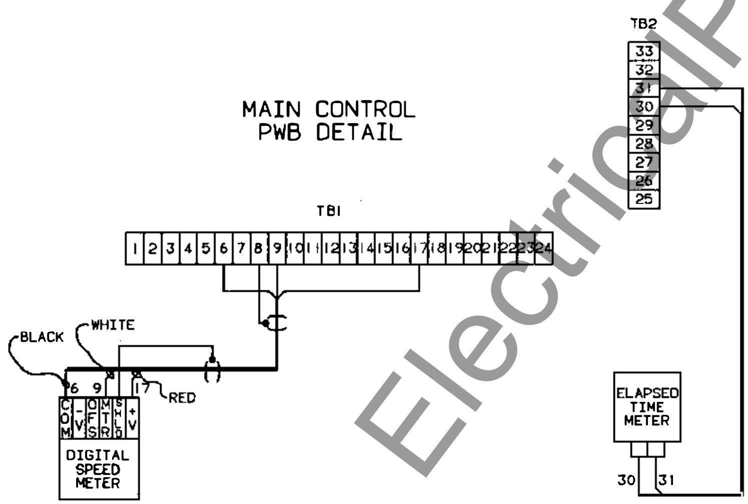


METER WIRING FOR 1-10 HP TYPE PT CONTROLLERS

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE METER CONNECTION DIAGRAM

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV. | DATE | REVISION DESCRIPTION | BY | REFERENCE | NEXT ASSEM. | PROJ. NO. | DATE DRN. 1-86 | DATE REL. | DRN. | CKD. | APP'D | DRG. NO. 8.5.15 | MASTER | SHEET OF |
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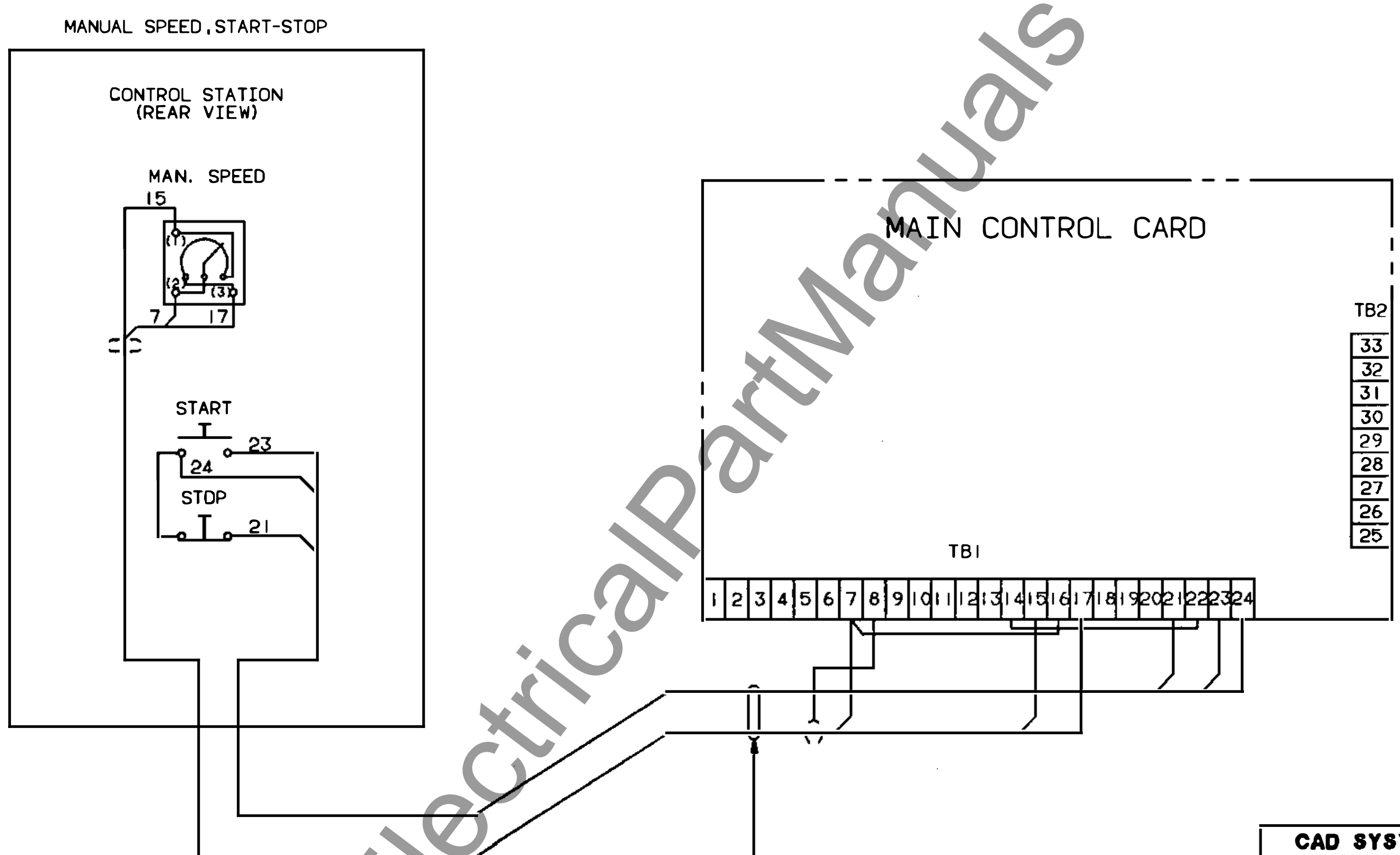


LOW LEVEL CONTROL WIRING. THESE CONDUCTORS MAY BE ROUTED IN THE SAME RACEWAY. MAINTAIN 3" SEPARATION (CONDUIT) OR 12" SEPARATION (TRAY) FROM OTHER TYPES OF POWER OR CONTROL WIRING. ALL CONDUCTORS TO BE #18 AWG MINIMUM. SHIELDED CABLE TO BE JACKETED. GROUND SHIELD ONLY WHERE SHOWN. INSULATE OTHER END OF SHIELDED CABLE.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE CONNECTION DIAGRAM TYPE CA-31
REMOTE OPERATOR STATION

CLASS____ TYPE ____ FORM____ SER.____

| REV | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 4-7-86 | | |

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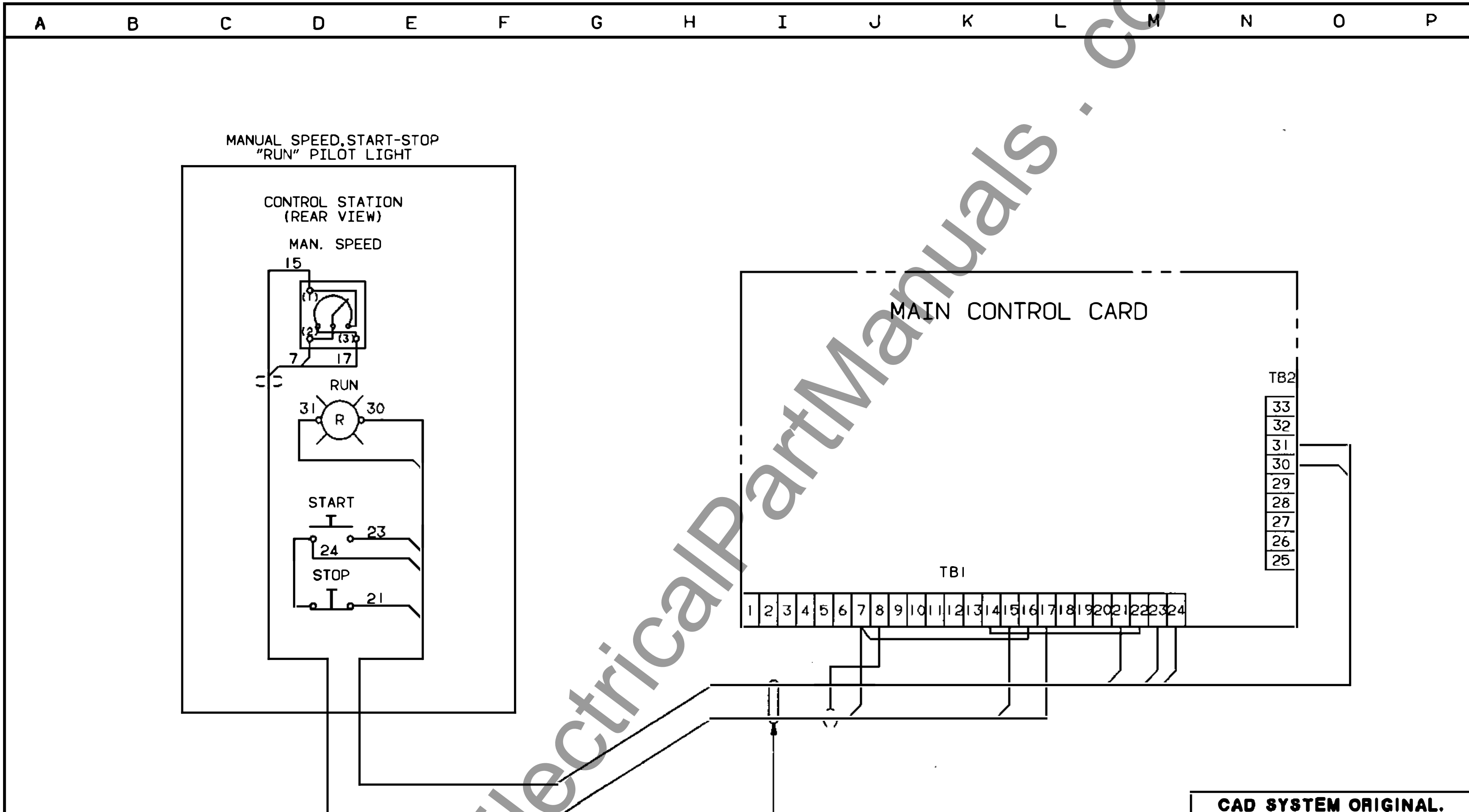
DATE DRN. 12-85 | DATE REL. | DRG. NO. | MASTER | SHEET
DRN. | CKD. | APP'D | 8.6.1 | OF






LOW LEVEL CONTROL WIRING. THESE CONDUCTORS MAY BE ROUTED IN THE SAME RACEWAY. MAINTAIN 3" SEPARATION (CONDUIT) OR 12" SEPARATION (TRAY) FROM OTHER TYPES OF POWER OR CONTROL WIRING. ALL CONDUCTORS TO BE #18 AWG MINIMUM. SHIELDED CABLE TO BE JACKETED. GROUND SHIELD ONLY WHERE SHOWN. INSULATE OTHER END OF SHIELDED CABLE.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE CONNECTION DIAGRAM TYPE CA-41
REMOTE OPERATOR STATION

CLASS____ TYPE ____ FORM ________ SER.____

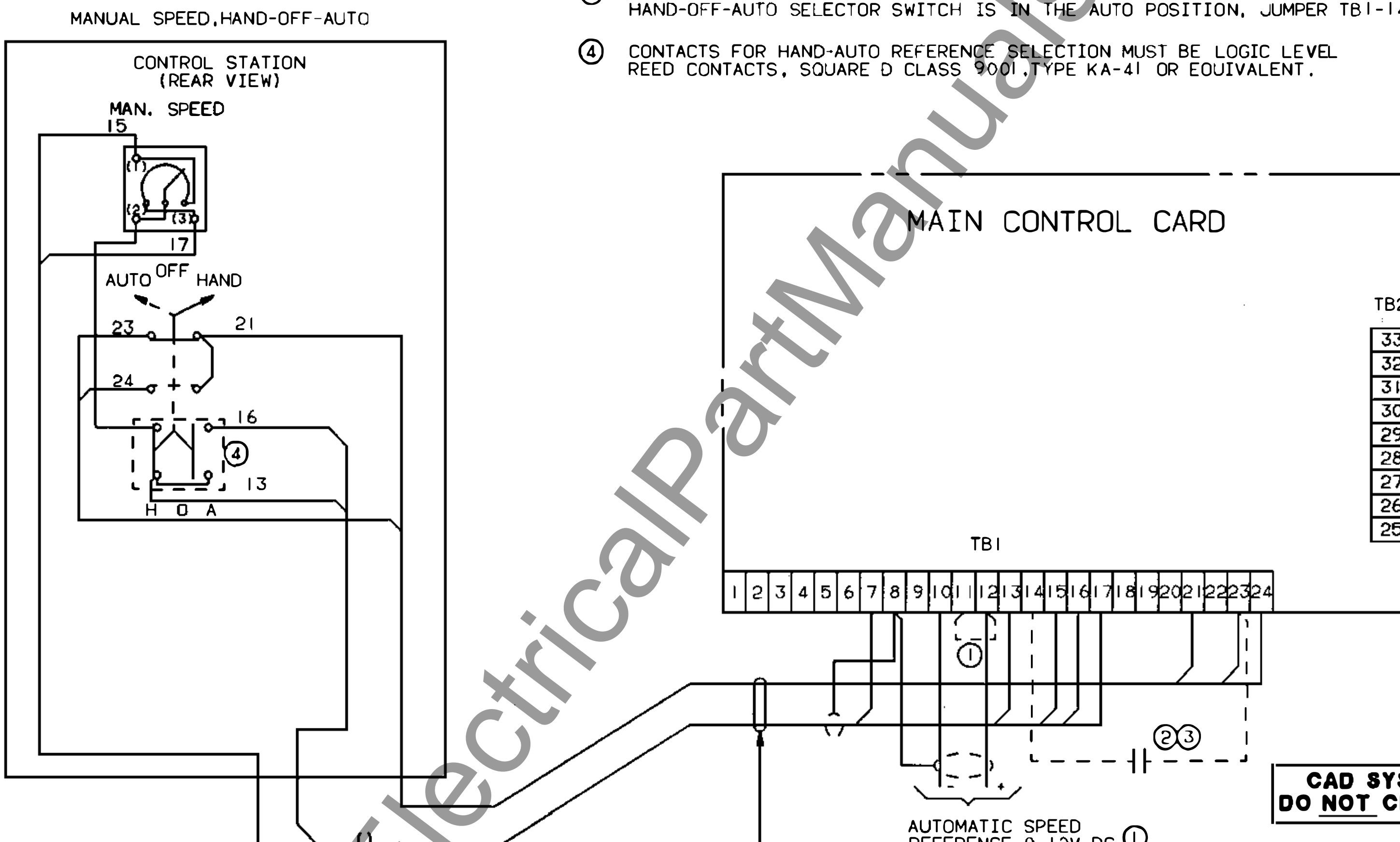
| REV | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 4-7-86 | | |

REF. / NEXT ASSEM / PROJ.NO.

DATE DRN. 12-85 | DATE REL. | DRG. NO. 8.6.2 | MASTER | SHEET OF
DRN. | CKD. | APP'D

NOTES:

1. ADD JUMPER TB1-11 TO TB1-12 IF AUTOMATIC SPEED REFERENCE IS 4-20 MA DC.
2. AUTOMATIC START CONTACT (USER FURNISHED).
3. IF IT IS DESIRED TO HAVE THE CONTROLLER OPERATE CONTINUOUSLY WHEN THE HAND-OFF-AUTO SELECTOR SWITCH IS IN THE AUTO POSITION, JUMPER TB1-14 TO TB1-23.
4. CONTACTS FOR HAND-AUTO REFERENCE SELECTION MUST BE LOGIC LEVEL REED CONTACTS, SQUARE D CLASS 9001, TYPE KA-41 OR EQUIVALENT.




LOW LEVEL CONTROL WIRING. THESE CONDUCTORS MAY BE ROUTED IN THE SAME RACEWAY. MAINTAIN 3" SEPARATION (CONDUIT) OR 12" SEPARATION (TRAY) FROM OTHER TYPES OF POWER OR CONTROL WIRING. ALL CONDUCTORS TO BE #18 AWG MINIMUM. SHIELDED CABLE TO BE JACKETED. GROUND SHIELD ONLY WHERE SHOWN. INSULATE OTHER END OF SHIELDED CABLE.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE CONNECTION DIAGRAM TYPE CA-21
REMOTE OPERATOR STATION

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 4-10-86 | | |

| REF. | NEXT ASSEM | PROJ. NO. | DATE DRN. | DATE REL. | DRN. | CKD. | APP'D | ORD. NO. | ORD FILE | SHEET OF |
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| 8804-4 | | | 12-85 | | | | | | 8.6.3 | |

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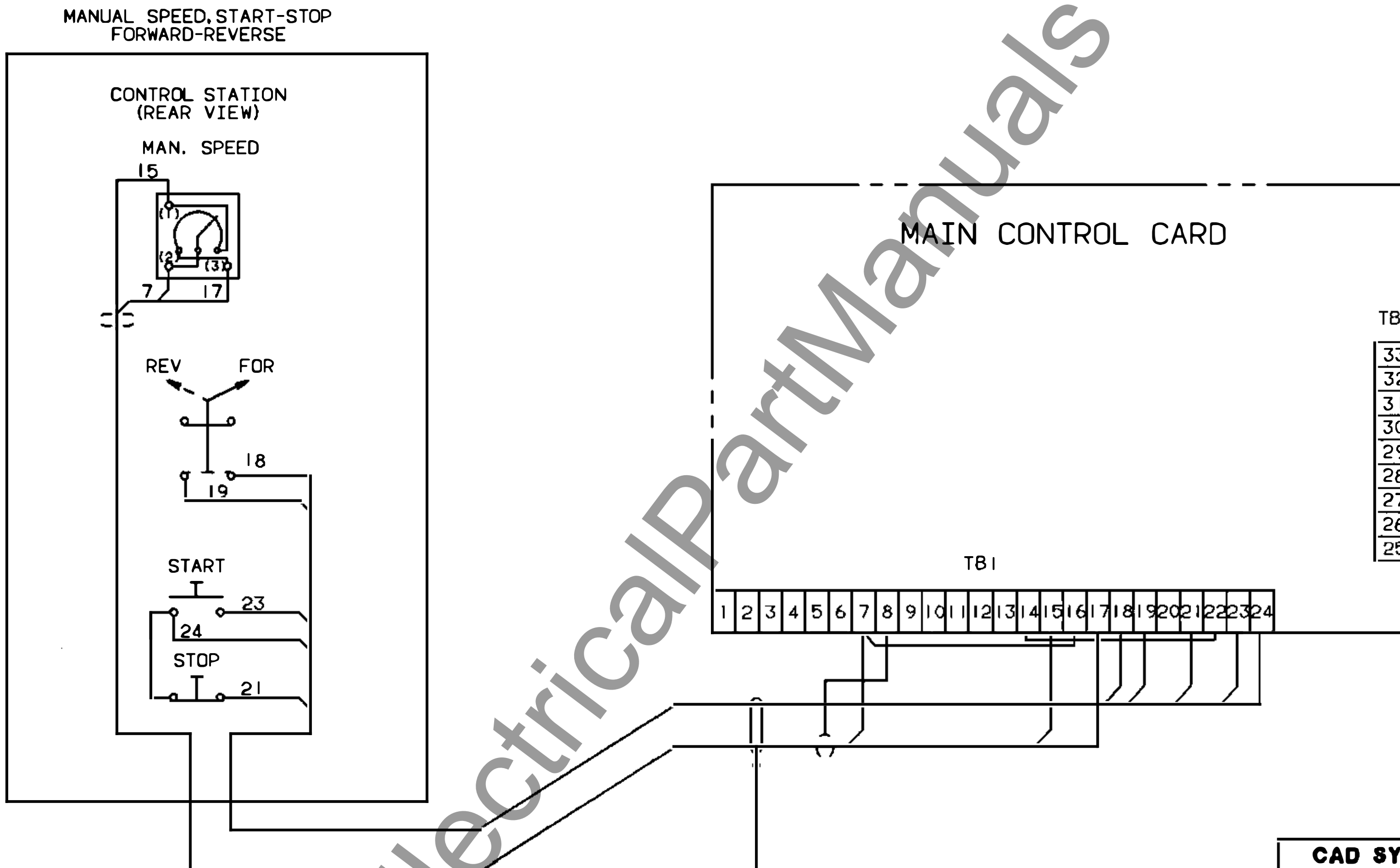


LOW LEVEL CONTROL WIRING. THESE CONDUCTORS MAY BE ROUTED IN THE SAME RACEWAY. MAINTAIN 3" SEPARATION (CONDUIT) OR 12" SEPARATION (TRAY) FROM OTHER TYPES OF POWER OR CONTROL WIRING. ALL CONDUCTORS TO BE #18 AWG MINIMUM. SHIELDED CABLE TO BE JACKETED. GROUND SHIELD ONLY WHERE SHOWN. INSULATE OTHER END OF SHIELDED CABLE.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE CONNECTION DIAGRAM TYPE CA-43
REMOTE OPERATOR STATION

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|

REF.
NEXT ASSEM
PROJ.NO.

| DATE DRN. | DATE REL. | DWG. NO. | MASTER | SHEET |
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| 12-85 | | 8.6.4 | | OF |
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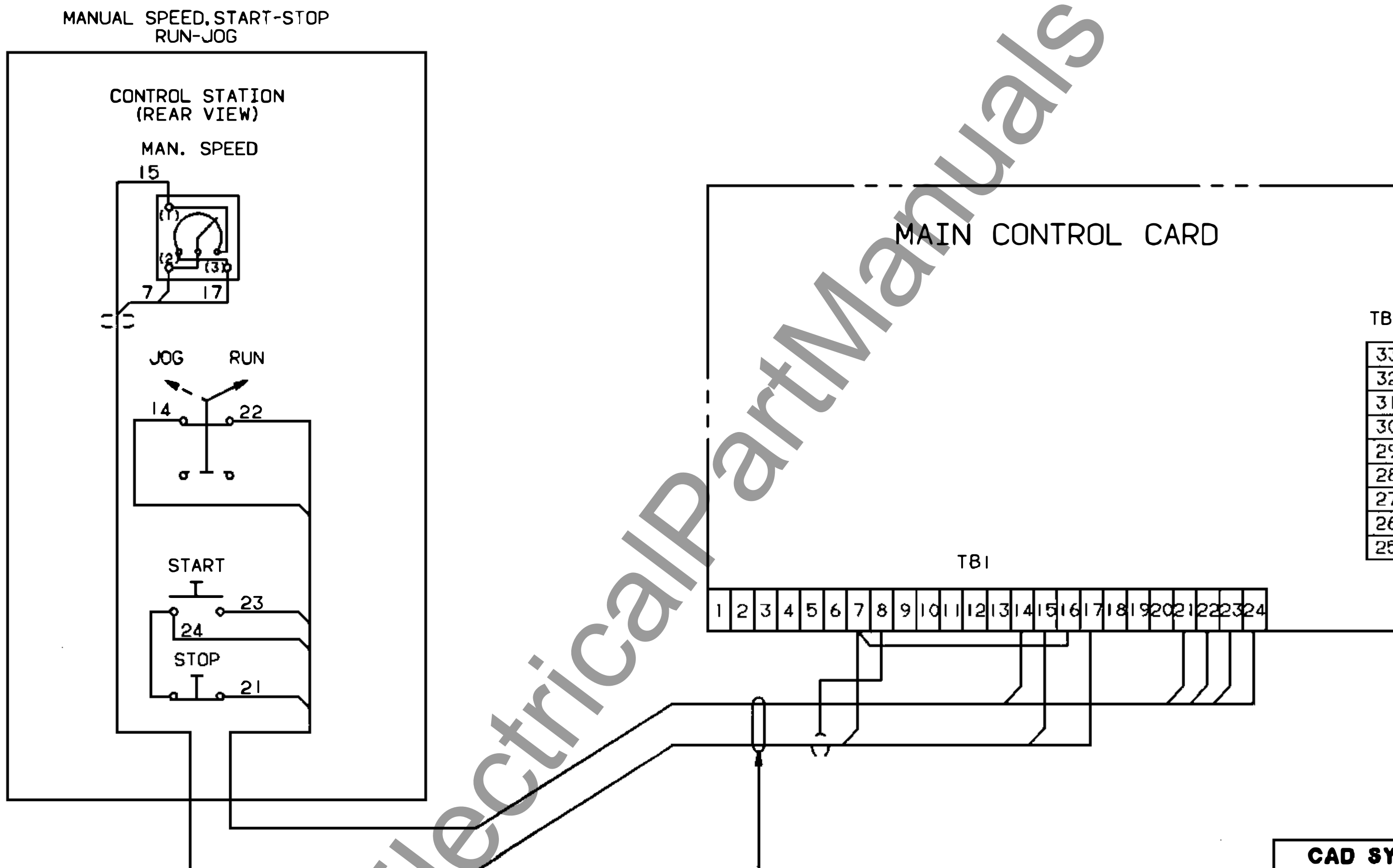


LOW LEVEL CONTROL WIRING. THESE CONDUCTORS MAY BE ROUTED IN THE SAME RACEWAY. MAINTAIN 3" SEPARATION (CONDUIT) OR 12" SEPARATION (TRAY) FROM OTHER TYPES OF POWER OR CONTROL WIRING. ALL CONDUCTORS TO BE #18 AWG MINIMUM. SHIELDED CABLE TO BE JACKETED. GROUND SHIELD ONLY WHERE SHOWN. INSULATE OTHER END OF SHIELDED CABLE.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE CONNECTION DIAGRAM TYPE CA-44
REMOTE OPERATOR STATION

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY | REF. | NEXT ASSEM | PROJ.NO. | DATE DRN. 12-85 | DATE REL. | DRN. | CKD. | APP'D | DWG. NO. 8.6.5 | MASTER | SHEET OF |
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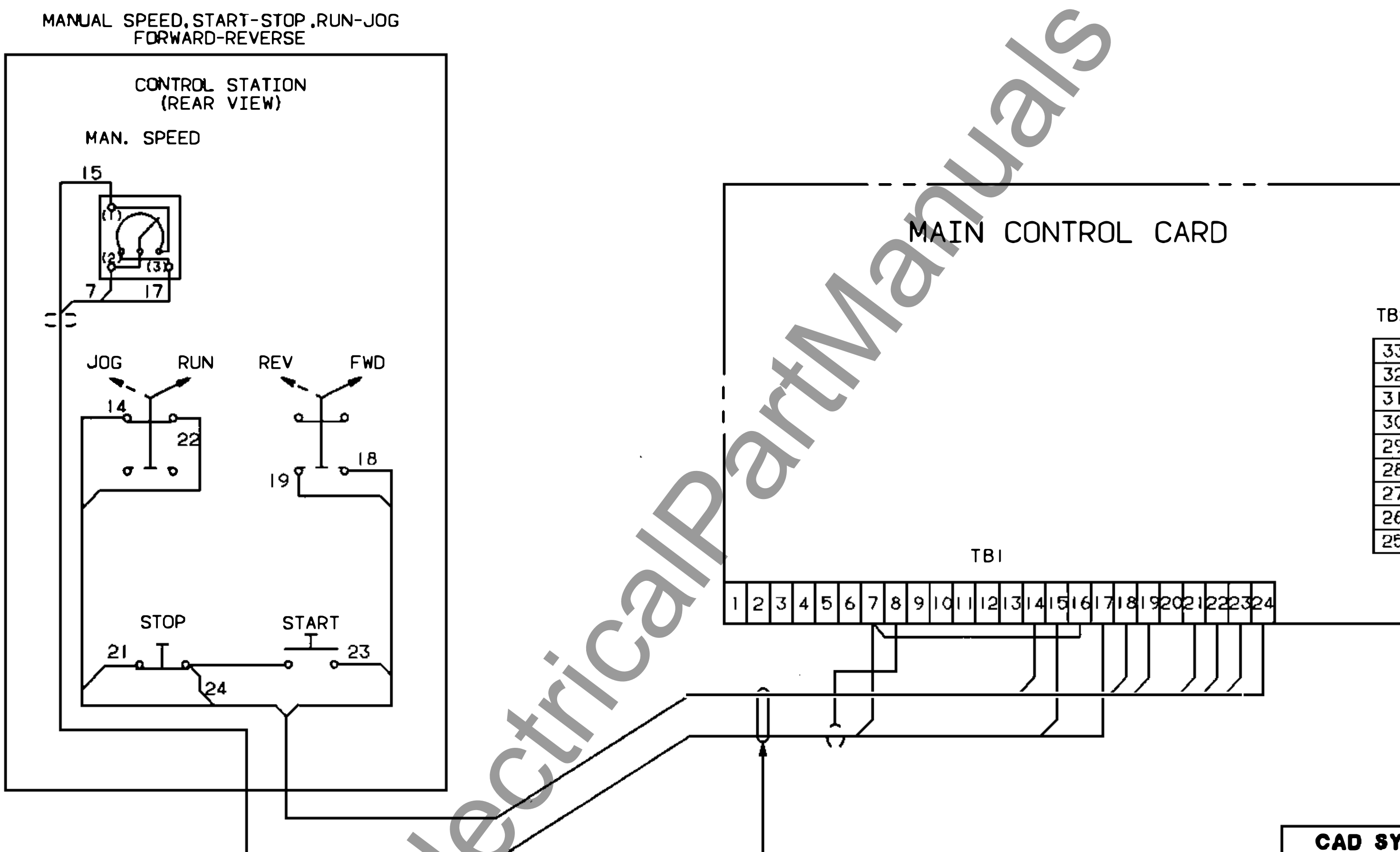


LOW LEVEL CONTROL WIRING. THESE CONDUCTORS MAY BE ROUTED IN THE SAME RACEWAY. MAINTAIN 3" SEPARATION (CONDUIT) OR 12" SEPARATION (TRAY) FROM OTHER TYPES OF POWER OR CONTROL WIRING. ALL CONDUCTORS TO BE #18 AWG MINIMUM. SHIELDED CABLE TO BE JACKETED. GROUND SHIELD ONLY WHERE SHOWN. INSULATE OTHER END OF SHIELDED CABLE.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE CONNECTION DIAGRAM TYPE CA-61
REMOTE OPERATOR STATION

CLASS____TYPE____FORM________SER.___

| | | REV | DATE | REVISION DESCRIPTION | BY | REF. | NEXT ASSEM | PROJ.NO. | DATE DRN. 12-85 | DATE REL. | DRN. | CKD. | APP'D | DRG. NO. 8.6.6 | MASTER | SHEET OF |
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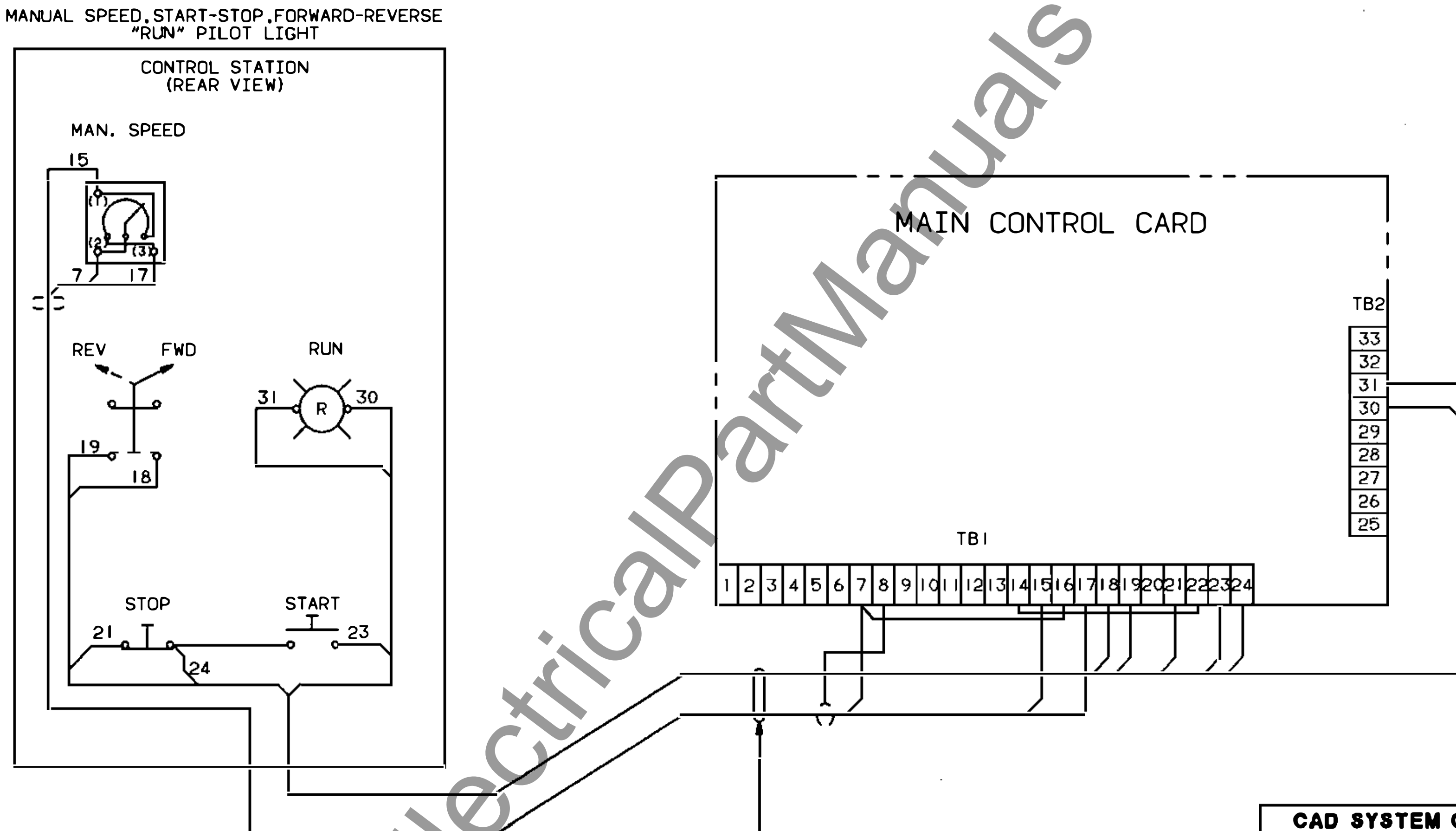


LOW LEVEL CONTROL WIRING. THESE CONDUCTORS MAY BE ROUTED IN THE SAME RACEWAY. MAINTAIN 3" SEPARATION (CONDUIT) OR 12" SEPARATION (TRAY) FROM OTHER TYPES OF POWER OR CONTROL WIRING. ALL CONDUCTORS TO BE #18 AWG MINIMUM. SHIELDED CABLE TO BE JACKETED. GROUND SHIELD ONLY WHERE SHOWN. INSULATE OTHER END OF SHIELDED CABLE.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE CONNECTION DIAGRAM TYPE CA-62
REMOTE OPERATOR STATION

CLASS____ TYPE ____ FORM ________ SER.___

| REV | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|

REF.
NEXT ASSEM
PROJ.NO.

DATE ISSUED 12-85 | DATE REL. | DRG. NO. 8.6.7 | MASTER | SHEET OF
DRN. | CKD. | APP'D

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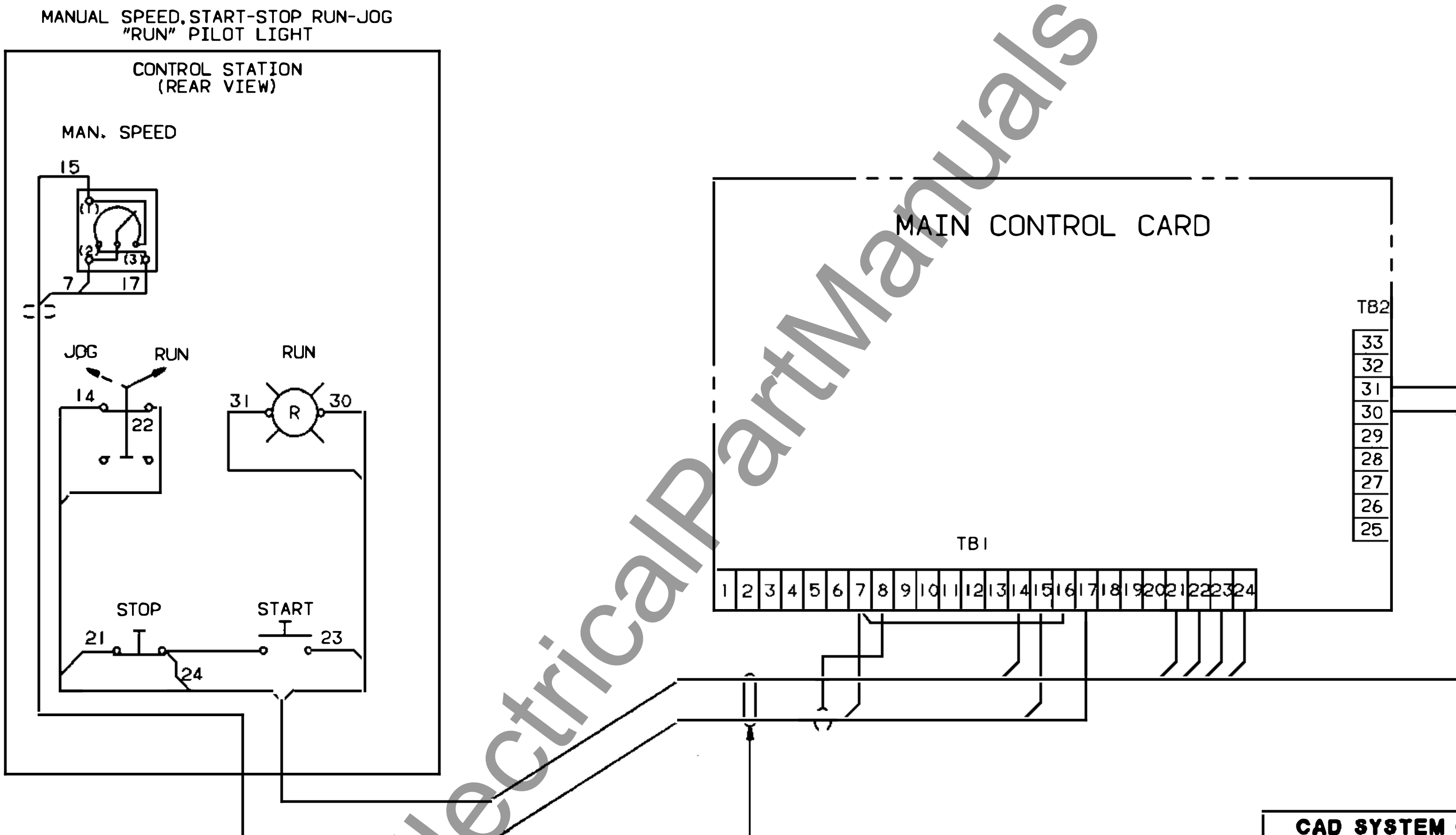


LOW LEVEL CONTROL WIRING. THESE CONDUCTORS MAY BE ROUTED IN THE SAME RACEWAY. MAINTAIN 3" SEPARATION (CONDUIT) OR 12" SEPARATION (TRAY) FROM OTHER TYPES OF POWER OR CONTROL WIRING. ALL CONDUCTORS TO BE #18 AWG MINIMUM. SHIELDED CABLE TO BE JACKETED. GROUND SHIELD ONLY WHERE SHOWN. INSULATE OTHER END OF SHIELDED CABLE.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE CONNECTION DIAGRAM TYPE CA-63
REMOTE OPERATOR STATION

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY | REF. / NEXT ASSEM / PROJ. NO. | DATE DRN. 12-85 | DATE REL. | DRG. NO. 8.6.8 | MASTER | SHEET OF |
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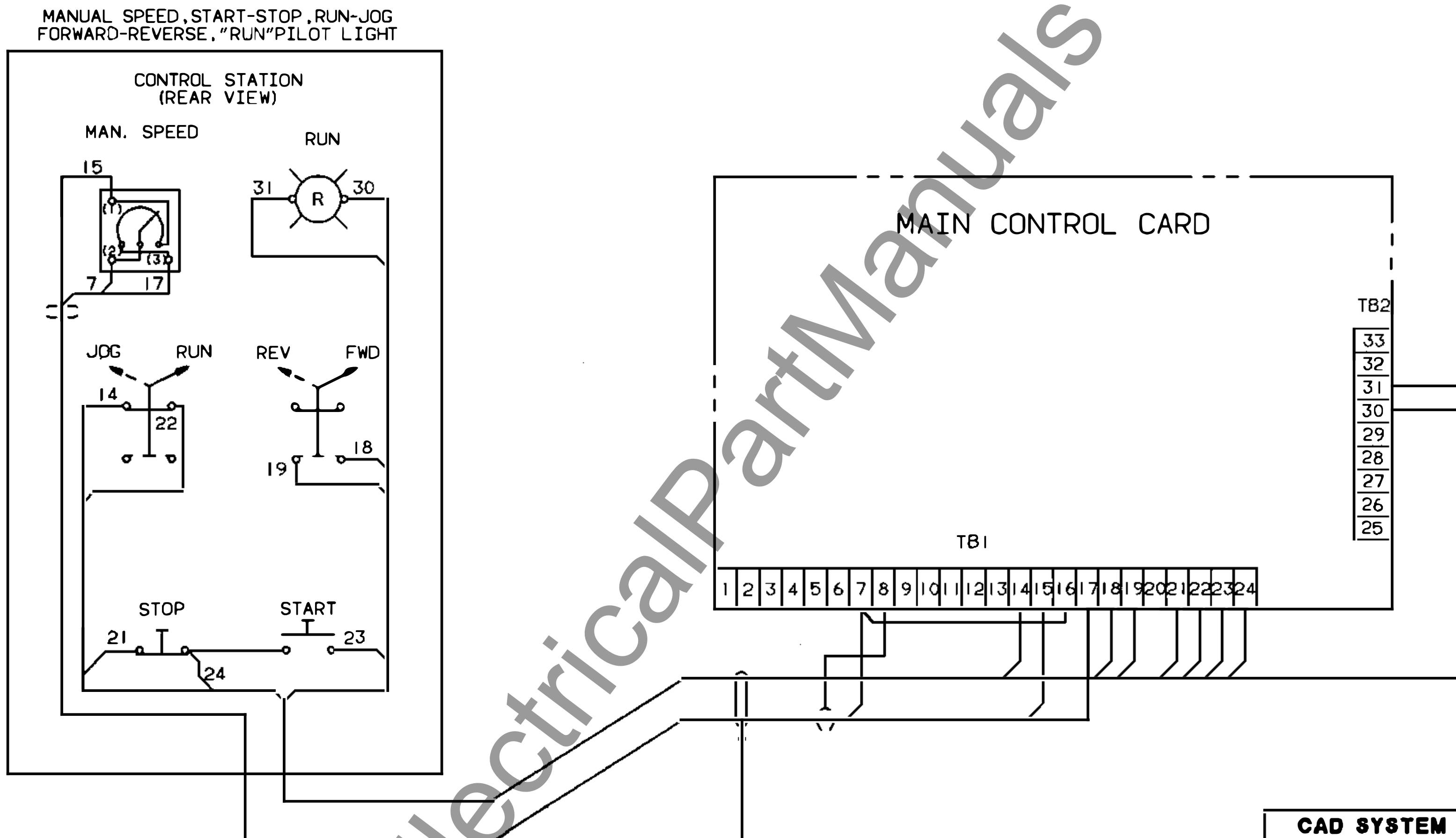
| | | | | | DRN. | CKD. / APP'D | | | |




LOW LEVEL CONTROL WIRING. THESE CONDUCTORS MAY BE ROUTED IN THE SAME RACEWAY. MAINTAIN 3" SEPARATION (CONDUIT) OR 12" SEPARATION (TRAY) FROM OTHER TYPES OF POWER OR CONTROL WIRING. ALL CONDUCTORS TO BE #18 AWG MINIMUM. SHIELDED CABLE TO BE JACKETED. GROUND SHIELD ONLY WHERE SHOWN. INSULATE OTHER END OF SHIELDED CABLE.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

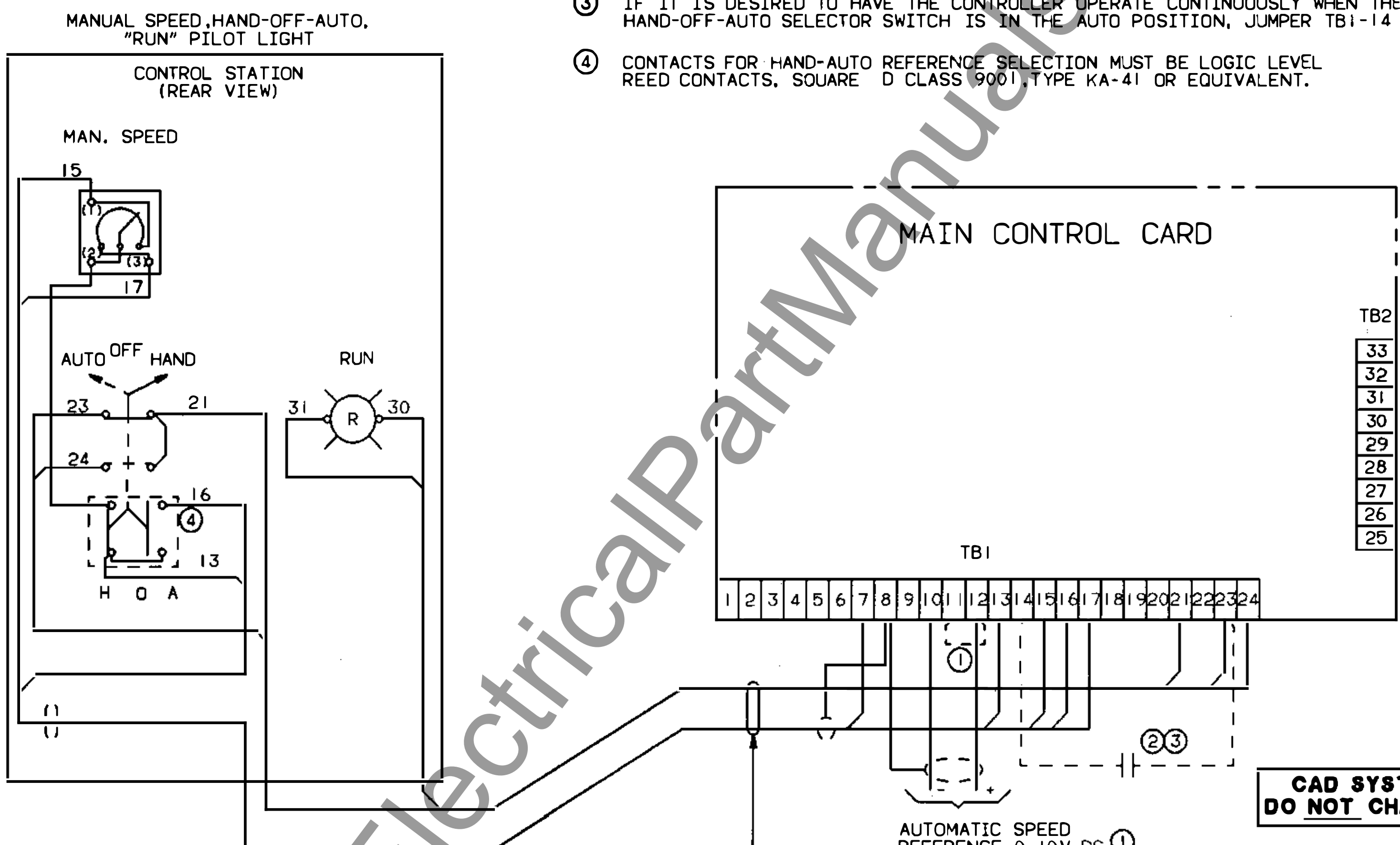
TITLE CONNECTION DIAGRAM TYPE CA-64
REMOTE OPERATOR STATION

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY | REF. / NEXT ASSEM / PROJ.NO. | DATE DRN. 12-85 | DATE REL. | DRG. NO. 8.6.9 | MASTER | SHEET OF |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | DRN. | CKD. / APP'D | | | |

NOTES:

1. ADD JUMPER TB1-11 TO TB1-12 IF AUTOMATIC SPEED REFERENCE IS 4-20 MA DC.
2. AUTOMATIC START CONTACT (USER FURNISHED).
3. IF IT IS DESIRED TO HAVE THE CONTROLLER OPERATE CONTINUOUSLY WHEN THE HAND-OFF-AUTO SELECTOR SWITCH IS IN THE AUTO POSITION, JUMPER TB1-14 TO TB1-23.
4. CONTACTS FOR HAND-AUTO REFERENCE SELECTION MUST BE LOGIC LEVEL REED CONTACTS, SQUARE D CLASS 9001, TYPE KA-41 OR EQUIVALENT.




LOW LEVEL CONTROL WIRING. THESE CONDUCTORS MAY BE ROUTED IN THE SAME RACEWAY. MAINTAIN 3" SEPARATION (CONDUIT) OR 12" SEPARATION (TRAY) FROM OTHER TYPES OF POWER OR CONTROL WIRING. ALL CONDUCTORS TO BE #18 AWG MINIMUM. SHIELDED CABLE TO BE JACKETED. GROUND SHIELD ONLY WHERE SHOWN. INSULATE OTHER END OF SHIELDED CABLE.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE CONNECTION DIAGRAM TYPE CA-32 REMOTE OPERATOR STATION

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV | DATE | REVISION DESCRIPTION | BY |
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| A | 4-10-86 | | |

| REF. | 8804-4 |
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| NEXT ASSEM | |
| PROJ.NO. | |

| DATE DRN. | DATE REL. | DRG. NO. | ORD FILE | SHEET |
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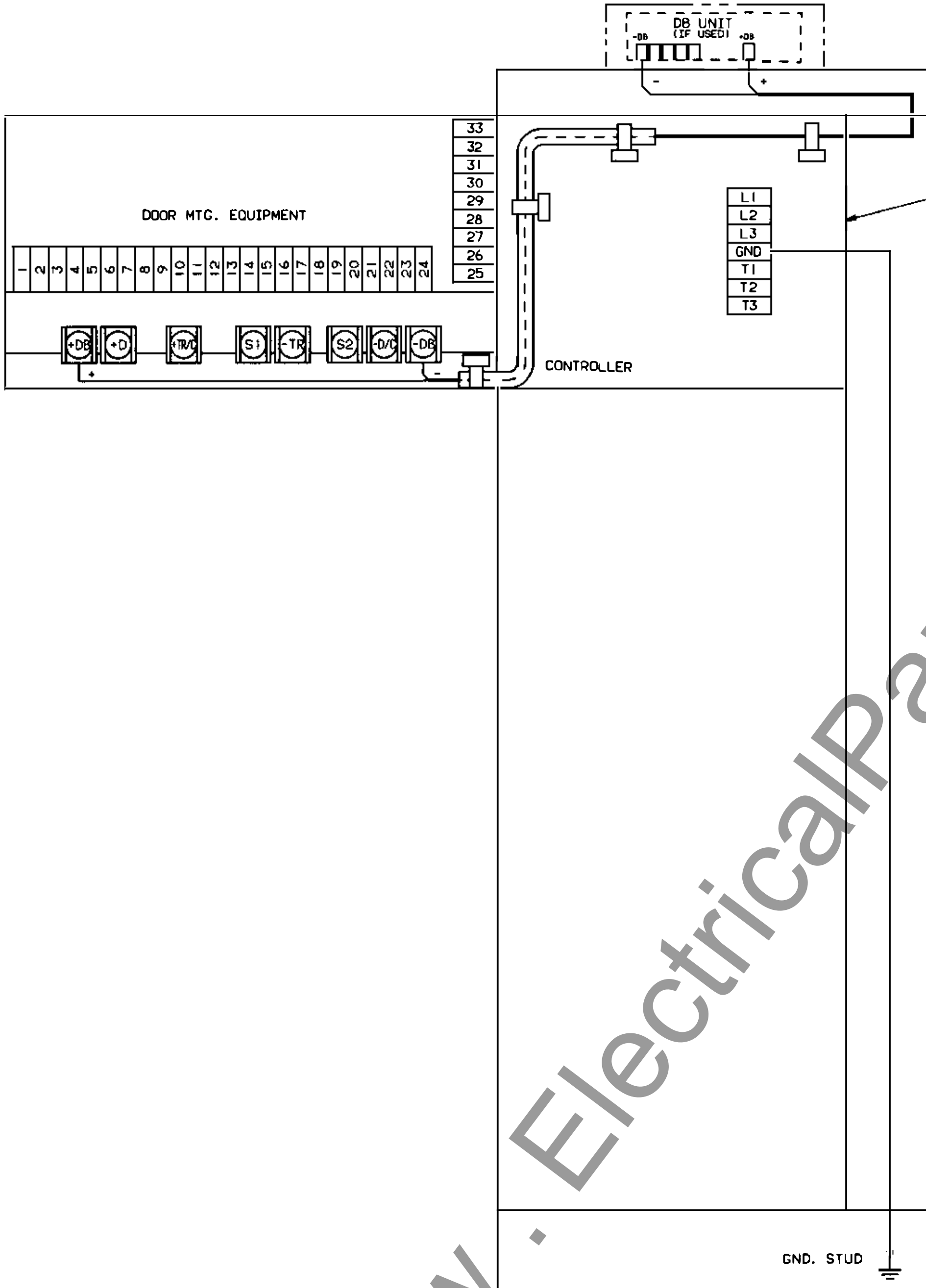
| 12-85 | | | 8.6.10 | OF |
| DRN. | CKD. | APP'D | | |




NOTE:

1. REFER TO SECTION 8.1 OR 8.2 FOR 1000 CONTROLLER DETAIL.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE 1-10HP OMEGAPAK TYPE PT
2000 CONTROLLER ONLY

CLASS____ TYPE ____ FORM ____ SER.____

| REV. | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 4-9-86 | | |

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| REFERENCE | 8804-5 | DATE DRN. 1-86 | DATE REL. | DWG. NO. | ORD FILE |
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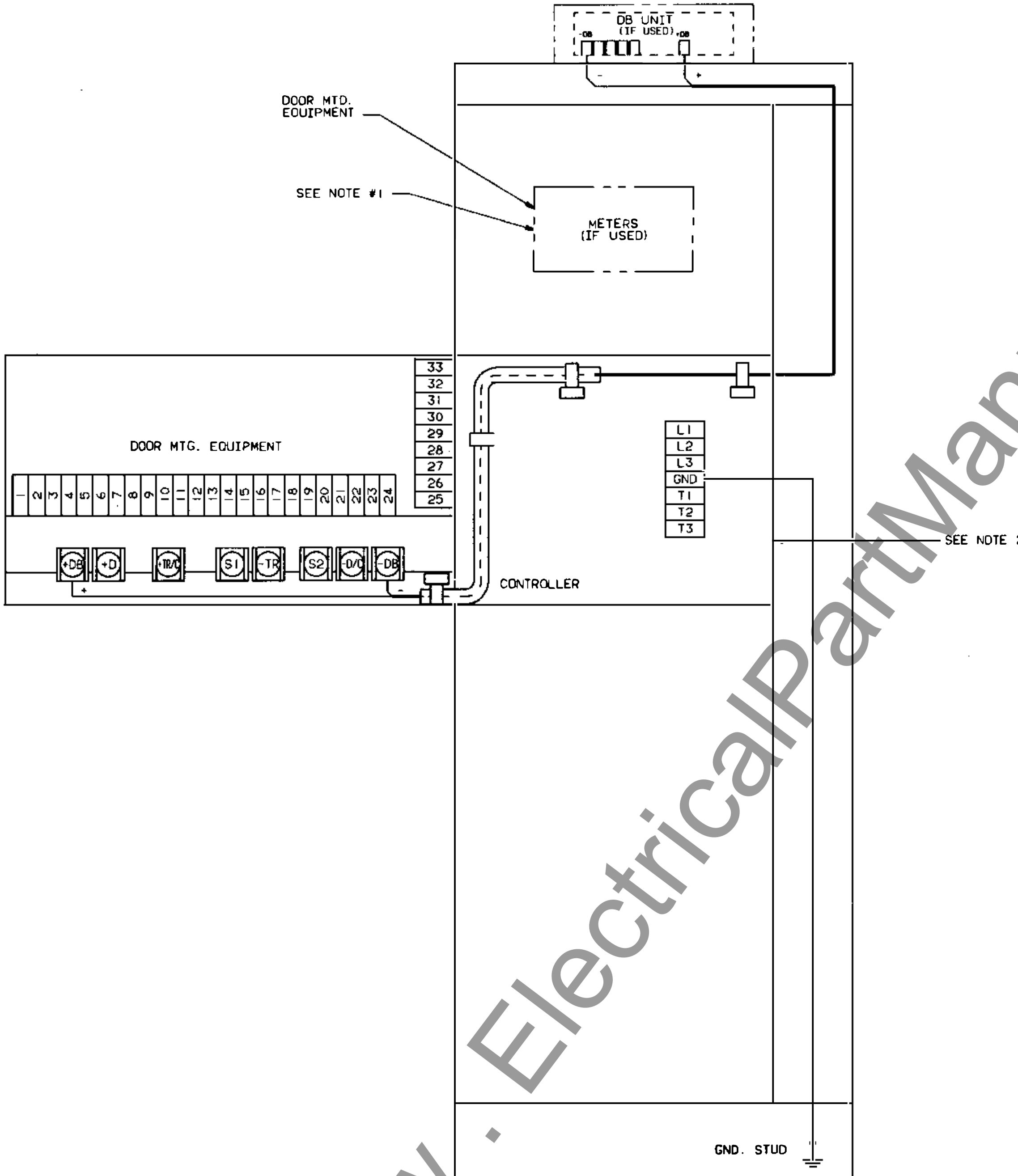
| PROJ. NO. | C0441.73 | | | | SHEET OF |




## NOTES:

1. FOR METER CONNECTIONS REFER TO DRAWING 8.5.15.
2. REFER TO SECTION 8.1 OR 8.2 FOR 1000 CONTROLLER DETAIL.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE 1-10HP OMEGAPAK TYPE PT
2000 CONTROLLER WITH METERS

CLASS ____ TYPE ____ FORM ____ SER. ____

| | | | | |
|---|---|---|---|---|
| A | 4-9-86 | | | |
| REV. | DATE | REVISION DESCRIPTION | BY | |

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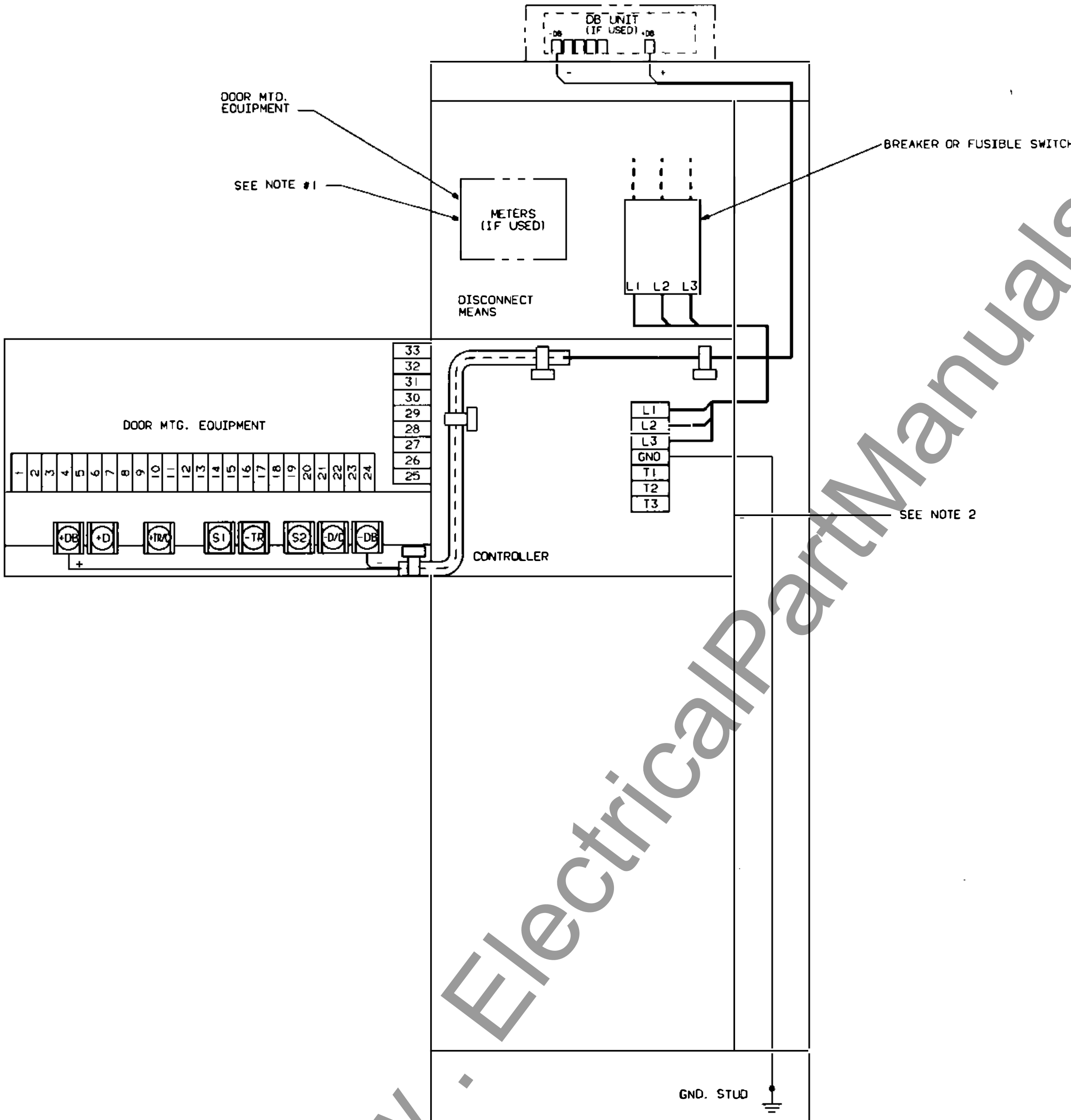
|---|---|---|---|---|
| REFERENCE | 8804-5 | DATE DRN. 1-86 | DATE REL. | DRG. NO. ORD FILE 8.7.2 |
| NEXT ASSEM. | | DRN. | CKD. | APP'D |
| PROJ. NO. | C0441.73 | | | SHEET OF |




NOTES:

1. FOR METER CONNECTIONS REFER TO DRAWING 8.5.15.
2. REFER TO SECTION 8.1 OR 8.2 FOR 1000 CONTROLLER DETAIL.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

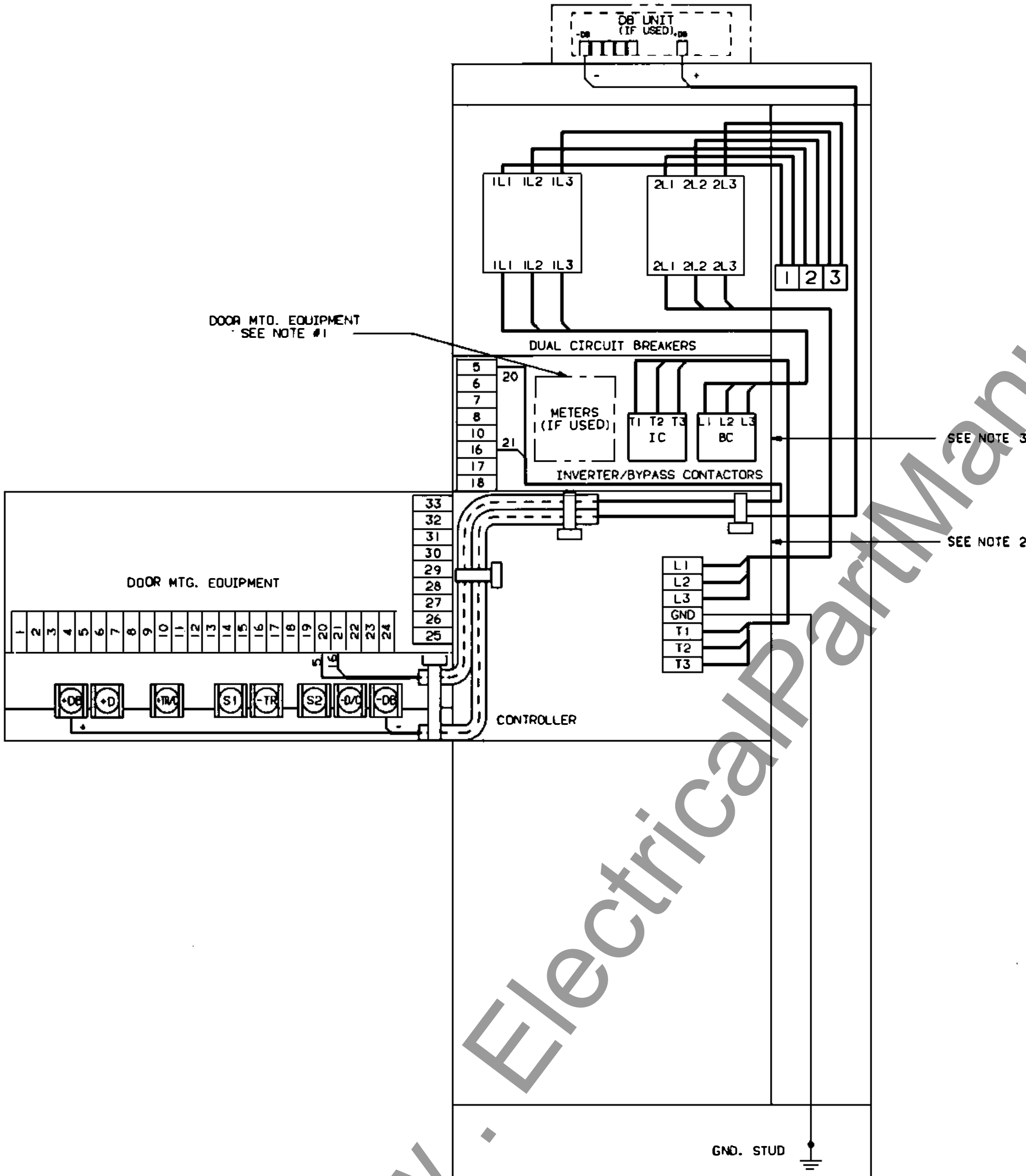
**SQUARE D COMPANY**

TITLE 1-10 HP OMEGAPAK TYPE PT 2000 CONTROLLER WITH SINGLE DISCONNECT

CLASS____ TYPE ____ FORM____ SER.____

| REFERENCE | 8804-5 | DATE DRN. 1-86 | DATE REL. | DRG. NO. | ORD FILE | SHEET |
|---|---|---|---|---|---|---|
| NEXT ASSEM. | | DRN. | CKD. | APP'D | 8.7.3 | OF |
| PROJ. NO. | C0441.73 | | | | | |

| REV. | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 4-9-86 | | |




NOTES:

1. FOR METER CONNECTIONS REFER TO DRAWING 8.5.15.
2. REFER TO SECTION 8.1 OR 8.2 FOR 1000 CONTROLLER DETAIL.
3. REFER TO DRAWING 8.7.6 FOR BYPASS CONTACTOR DETAIL.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

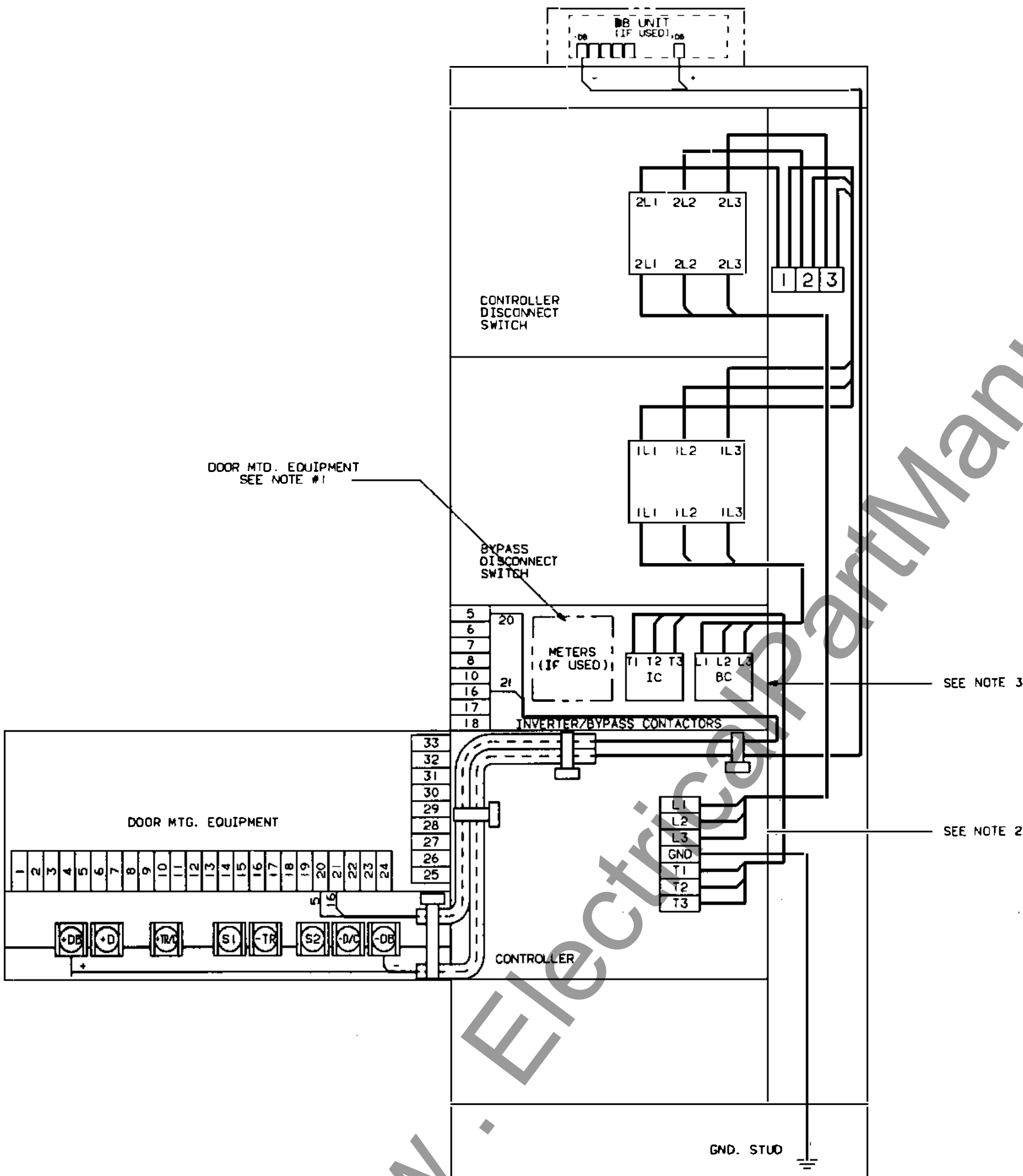
TITLE 1-10 HP OMEGAPAK TYPE PT 2000 CONT'LR, DUAL CIRCUIT BR'KR & BYPASS CONTACTORS

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV. | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 4-9-86 | | |

| | | | |
|---|---|---|---|
| REFERENCE | 8804-5 | DATE DRN. 1-86 | DATE REL. |
| NEXT ASSEM. | | DRN. | CKD. |
| PROJ. NO. | C0441.73 | APP'D | |

DWG. NO. ORD FILE 8.7.4 SHEET OF




NOTES:

1. FOR METER CONNECTIONS REFER TO DRAWING 8.5.15.

2. REFER TO SECTION 8.1 OR 8.2 FOR 1000 CONTROLLER DETAIL.

3. REFER TO DRAWING 8.7.6 FOR BYPASS CONTACTOR DETAIL.

**CAD SYSTEM ORIGINAL.**
**DO NOT CHANGE MANUALLY.**

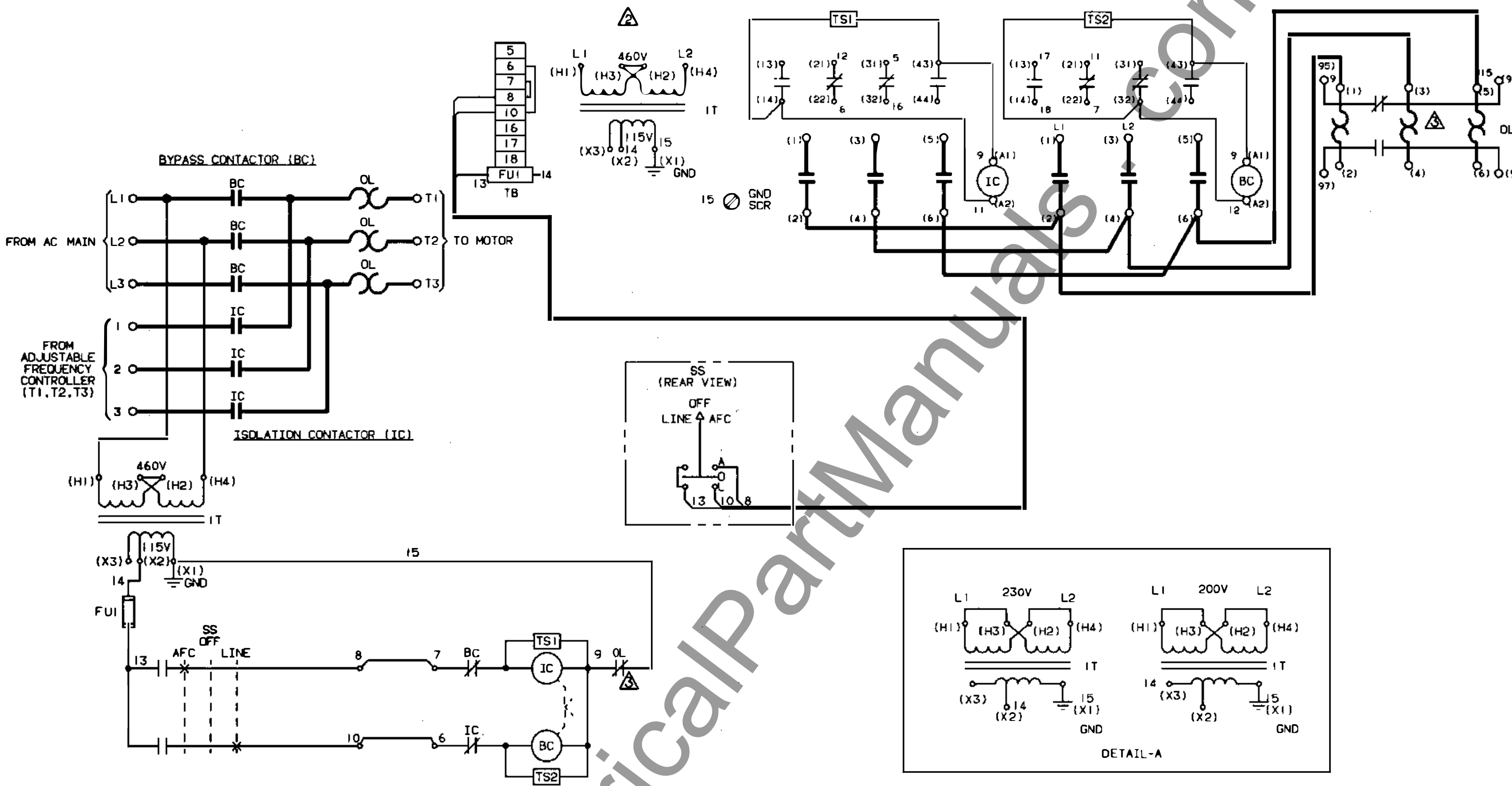
**SQUARE D COMPANY**

TITLE 1-10 HP OMEGAPAK TYPE PT 2000 CONT'LR.
DUAL FUSIBLE DISC & BYPASS CONTACTORS

CLASS____ TYPE ____ FORM ________ SER.___

| REV. | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| A | 4-9-86 | | |

| | | | | |
|---|---|---|---|---|
| REFERENCE | 8804-5 | DATE DRN. 1-86 | DATE REL. | DRG. NO. ORD FILE 8.7.5 |
| NEXT ASSEM. | | DRN. | CKD. | APP'D |
| PROJ. NO. | C0441.73 | | | SHEET OF |




| TRANSFORMER CONNECTIONS | | | |
|---|---|---|---|
| SOURCE VOLTAGE | PRIMARY INPUT | SECONDARY OUTPUT | JUMPER |
| 440/460/480 | H1 TO H4 | X1 TO X2 | H2 TO H3 |
| 220/230/240 | H1 TO H4 | X1 TO X2 | H1 TO H3, H2 TO H4 |
| 192/200/208 | H1 TO H4 | X1 TO X3 | H1 TO H3, H2 TO H4 |



## CONNECTION DIAGRAM

NOTES:

1. ( ) INDICATES TERMINAL # ON DEVICE.
2. 460V TRANSFORMER CONNECTIONS SHOWN. FOR OTHER VOLTAGES,SEE TRANSFORMER CONNECTION TABLE AND DETAIL-A.
3. OVERLOAD RELAY SHOULD BE SET FOR "MANUAL" RESET.

**CAD SYSTEM ORIGINAL. DO NOT CHANGE MANUALLY.**

**SQUARE D COMPANY**

TITLE BYPASS CONTACTORS

ELEMENTARY AND CONNECTION DIAGRAM

CLASS ____ TYPE ____ FORM ____ SER. ____

| REV. | DATE | REVISION DESCRIPTION | BY | REFERENCE | DATE DRN. | DATE REL. | DRG. NO. | SHEET |
|---|---|---|---|---|---|---|---|---|
| | | | | ASSEM. | 1-86 | | ORD FILE 8.7.6 | OF |
| | | | | PROJ. NO. | DRN. | CKD. | APP'D | |

# 9.0 RENEWAL PARTS

## 9.1 NON VOLTAGE DEPENDENT ITEMS (ALL CONTROLLERS)

### 9.1.1 ELECTRONIC BOARDS

| DESCRIPTION | PART NUMBER |
|---|---|
| MAIN CONTROL BOARD | BN457 |

### 9.1.2 CONTROL/MISCELLANEOUS ITEMS

| DESCRIPTION | PART NUMBER |
|---|---|
| GROUND RESISTOR | RB094 |
| MANUAL SPEED POTENTIOMETER | 9001 K2107 |
| HEATSINK FAN① | DT011 |
| HEATSINK THERMOSTAT① | FK014 |
| TRANSIENT SUPPRESSOR① | SV023 |

① USED ON 5 HP, 200/230V AND 7.5-10 HP, 380/460V CONTROLLERS ONLY.

## 9.2 VOLTAGE DEPENDENT ITEMS

### 9.2.1 ELECTRONIC BOARDS

| DESCRIPTION | PART NUMBER |
|---|---|
| POWER INTERFACE BOARD | |
| 1-2 HP, 200/230V | BN463 |
| 3 HP, 200/230V | BN464 |
| 5 HP, 200/230V | BN465 |
| 1-5 HP, 380/460V | BN466 |
| 7.5-10 HP, 380V/460V | BN467 |

### 9.2.2 POWER DEVICES

| DESCRIPTION | PART NUMBER |
|---|---|
| DIODE MODULE | |
| 1-2 HP, 200/230V, 1 PHASE INPUT | SD105 |
| 3 HP, 200/230V, 1 PHASE INPUT | SD106 |
| 1-2 HP, 200/230V, 3 PHASE INPUT | SD077 |
| 3 HP, 200/230V, 3 PHASE INPUT | SD105 |
| 5 HP, 200/230V, 3 PHASE INPUT | SD106 |
| 1-5 HP, 380/460V, 3 PHASE INPUT | SD109 |
| 7.5-10 HP, 380/460V, 3 PHASE INPUT | SD110 |
| TRANSISTOR MODULE | |
| 1 HP, 200/230V | ST078 |
| 2 HP, 200/230V | ST079 |
| 3 HP, 200/230V | ST080 |
| 5 HP, 200/230V | ST081 |
| 1-5 HP, 380/460V | ST082 |
| 7.5-10 HP, 380/460V | ST083 |
| DC BUS CAPACITOR | |
| 1-2 HP, 200/230V, 1 PHASE INPUT | CF027 |
| 3 HP, 200/230V, 1 PHASE INPUT | CF028 |
| 1-5 HP, 200/230V, 3 PHASE INPUT | CK024 |
| 1-10 HP, 380/460V, 3 PHASE INPUT | CK025 |
| PRECHARGE RESISTOR | |
| 1-3 HP, 200/230V, 1 PHASE INPUT | RW066 |
| 1-5 HP, 200/230V, 3 PHASE INPUT | RW067 |
| 1-10 HP, 380/460V, 3 PHASE INPUT | RW067 |
| CURRENT SENSE RESISTOR | |
| 1 HP, 200/230V | NONE USED |
| 2 HP, 200/230V | RZ017 |
| 3 HP, 200/230V | RZ018 |
| 5 HP, 200/230V | RZ019 |
| 1-3 HP, 380/460V | RZ020 |
| 5 HP, 380/460V | RZ018 |
| 7.5-10 HP, 380/460V | RZ019 |

### 9.2.3 CONTROL/MISCELLANEOUS

| DESCRIPTION | PART NUMBER |
|---|---|
| CONTROL POWER TRANSFORMER | |
| 200/230V | TT200 |
| 380/460V | TT202 |

Fuses — Refer to Figure 3.2 for basic controller
Dynamic Braking (            ) FNM-2

### 9.2.4 OPTIONS

Refer to Section 3.7 for part number

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