

TECHNICIAN'S  
**DIGITEL™**  
**Multiple Pump Control  
Component Manual**

Part No. 640707 Rev. J

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Physical Electronics, Inc.  
6509 Flying Cloud Drive  
Eden Prairie, MN 55344

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# PHI Safety Notices

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Physical Electronics' (PHI's) products are designed and manufactured in compliance with accepted worldwide practices and standards to provide protection against electrical and mechanical hazards for the operator and the area surrounding the product. All PHI products are designed and intended for professional use only, by skilled "operators" for their intended purpose and according to all of the instructions, safety notices, and warnings provide by PHI.

Those instructions, notices, and warnings assume that an "operator" will not employ any tool when using PHI products. They further assume that all operators clearly understand that use of PHI products in any manner not specified by PHI may impair the protection provided by the products and expose them to hazards.

A "technician" is a qualified servicing individual who:

- Has received training to work with voltages above 50 V,
- Has read and understood the PHI technician's manual for the equipment,
- Observes and understands all safety notices on PHI equipment.

The safety symbols that PHI uses are defined on the following page.\* To reduce or eliminate hazards, technicians and operators of this equipment must fully understand these symbols.

PHI's products are installed with international-style or ANSI†-style safety notices, according to site requirements. International notices are symbols within triangles (alerts) or circles (mandatory actions). PHI's ANSI-style safety notices contain:

- One of three signal words (in all capitals) preceded by the general danger symbol ();
- One of PHI's safety symbols along with a brief description of the hazard and the risk or injury that could occur;
- Short message that observes ANSI's Hazard Alert Trilogy Rule by identifying the hazard, the possible result of ignoring the notice, and how to avoid the hazard.

The three signal words are defined as follows:

- **DANGER**—imminently hazardous situation that, if not avoided, will result in death or serious injury;
- **WARNING**—potentially hazardous situation that, if not

avoided, could result in death or serious injury;

- **CAUTION**—potentially hazardous situation or unsafe practice that, if not avoided, may result in minor or moderate injury or damage to equipment.

**SEMI**‡ standards require identification of type 3, 4, and 5 electrical maintenance tasks in equipment manuals:

- **Type 3** electrical maintenance tasks involve energized equipment, exposed live circuits, and possible accidental contact; potential exposures are less than 30 V RMS, 42.2 V peak, 240 V-A, and 20 J.
- **Type 4** is the same but potential exposures are greater than 30 V RMS, 42.2 V peak, 240 V-A, and 20 J or radio frequency is present.
- **Type 5** tasks involve energized equipment and measurements and adjustment require physical entry into the equipment, or equipment configuration will not allow the use of clamp-on probes.

Only experienced, trained technicians should attempt to perform type 3, 4, or 5 electrical maintenance tasks.

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\* Many of PHI's safety symbols are provided and copyrighted by Hazard Communication Systems, Inc., Milford, PA.

† American National Standards Institute, 1430 Broadway, New York, NY 10018.

‡ Semiconductor Equipment and Materials International, 805 E. Middlefield Rd., Mountain View, CA 94043-4080.

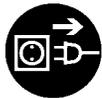
**PHI Safety Notices**



Voltages may be present that could cause death or personal injury.



A risk of death, personal injury, and/or damage to equipment exists (and a more specific label is not available).



Pulling the plug from its power source before servicing is mandatory.



A pinching point is present that could cause personal injury.



A risk of explosion or implosion may be present that could cause personal injury.



Lifting with assistance or equipment could cause personal injury.



An overhead door is present that could cause personal injury. Do not work under door without auxiliary door supports installed.



Visible or invisible radiation may be present that could cause personal injury.



Hot surfaces may be present that could cause personal injury.



Turning off the power switch before servicing is mandatory.



Refer to the manual(s) before proceeding.



Contents are under pressure.



A harmful or irritant material may be present that could cause personal injury.



Extremely low temperatures may be present that could cause personal injury.



A risk of fire may be present that could cause personal injury.



A potentially dangerous magnetic field may be present.



An environment with depleted oxygen may be present that could cause death or personal injury. Open at least 2 doors and wait 2 minutes before entering the enclosure.



Wearing protective gloves is mandatory.



Wearing eye protection is mandatory.



Wearing foot protection is mandatory.



This is the location of the protective grounding conductor terminal.



This is the location of the fuse.



This is the location of an earth (ground) terminal.

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# Limited Warranty

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Except as otherwise provided herein, the Seller warrants to Buyer that the equipment sold hereunder, whether it is new equipment or remanufactured (reconditioned) equipment, is, at the time of shipment to Buyer from Seller, free from defects in material and workmanship. As Buyer's sole exclusive remedy under this warranty Seller agrees either to repair or replace, at Seller's sole option and free of part charge to Buyer, any part or parts of such equipment which, under proper and normal conditions of use prove to be defective within 12 months from the date of receipt by the Buyer. Warranty period for equipment requiring installation by Seller will commence on completion of standard installation services. If customer delays installation beyond 45 days after delivery, the warranty period will commence to run 45 days after delivery. After installation, any realignment, readjustment, recleaning or recalibration, provided it does not relate to a proven defect in material or workmanship, shall be performed only at Seller's then current rates for service.

## **Exclusions and Limitations**

It is recognized that some parts by their nature (expendable items) may not function for one full year; therefore, excluded from the foregoing warranty are filaments, anodes, cathodes, multipliers, retard grids, special ceramics, ionizers, along with other such parts mentioned in the applicable operating manual.

The foregoing warranty excludes certain major items or accessories specifically indicated on applicable price lists or quotations, as to which Seller passes to Buyer whatever warranty is provided to Seller by the manufacturer or the

specific warranty indicated by the price list or quotation.

This warranty does not cover loss, damage, or defects resulting from transportation to the Buyer's facility, improper or inadequate maintenance by Buyer, buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the equipment or improper site preparation and maintenance.

## **Product Service**

All claims must be brought to the attention of Seller within 30 days of the failure to perform.

Seller at his option may require the product to be returned to the factory, transportation prepaid, for repair.

## **Refund of Purchase Price**

In lieu of the foregoing, Seller may at any time elect, in its sole discretion, to discharge its warranty by accepting the return of such equipment and refunding any portion of the purchase price paid by Buyer.

## **Software and Firmware Products**

The sole exclusive warranty applicable to software and firmware products provided by Seller for use with a processor will be as follows: Seller warrants that such software and firmware will conform to Seller's program manuals current at the time of shipment to Buyer when properly installed on that processor. Seller does not warrant that the operation of the processor software or firmware will be uninterrupted or error free.

No other warranty is expressed or implied. Seller expressly disclaims the implied warranties of merchantability and fitness for a particular purpose.

# Customer Service

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## Order Information

Call the order desk at 1-800-237-3603 or 612-828-6466 (FAX: 612-828-6322). When ordering any item, please give the order number and a description.

## Assistance

If you have any questions regarding service, technical questions, or replacement parts, please contact:

**Physical Electronics**  
Customer Service Dept.  
6509 Flying Cloud Drive  
Eden Prairie, MN 55344

Telephone: 1-612-828-6451 or toll free at 1-800-922-4744  
Fax: 1-612-828-6325

## Reconditioning

PHI will recondition your ion pump, usually within two weeks of approval. Call the service department to arrange shipment. Factory reconditioning includes:

1. Complete disassembly down to the basic component level.
2. Replacement of the following components:
  - high voltage feedthrough
  - ceramic standoffs
  - ceramic shields
  - pinch-off flange
  - gaskets and hardware
3. Novamax chemical cleaning of all reusable components.
4. Reassembly in a clean room environment.
5. Vacuum leak check.
6. Electrical checkout and start.
7. Bakeout.
8. Base pressure verification and return shipment under vacuum.

Reconditioning is guaranteed to original pumping specifications and carries a 6-month warranty.

## Equipment

- The service department sells reconditioned high vacuum equipment. For a list of components and prices, contact the service department.
- Loaner electronic units are issued on a priority basis for customers who experience a unit failure within the warranty period.
- Rental electronic units are issued on a priority basis for customers who want to keep their systems on line during non-warranty repairs.

# Section 1: Introduction

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The manual is divided into five sections. Section 1 contains a brief description and specifications of the DIGITEL™ Multiple Pump Control (MPC). Sections 2 and 3 explain the installation and operation procedures, respectively. Section 4 provides information for servicing the unit.

## Description

The DIGITEL™ MPC is a pump power supply and system control. It is designed to operate up to two ion pumps and a titanium sublimation pump (TSP) or non-evaporable getter (NEG) pump, all independently and simultaneously. The MPC can accommodate pump sizes from 10 l/s and up to 1200 l/s. It operates on 115 or 230 Vac, 50 or 60 Hz.

The MPC is a programmable, microprocessor-based unit. It contains a metering circuit, 8 process setpoints, communications interface RS-232/422/485, and up to two independent high voltage modules. The front panel display (shown below) provides direct readout of the ion pump voltage, current, or pressure. Ranging is automatic within the selected display mode.



### ***MPC Configurations***

The DIGITEL MPC comes in the following configurations:

- **635941** base unit plus one medium HV module (200W, 100mA)
- **635942** base unit plus one large HV module (1000W, 500mA)
- **635943** base unit plus two medium HV modules
- **635944** base unit plus two large HV modules
- **635945** base unit plus one medium and one large HV module

## **1: Introduction**

### **RS-232/422/485 Serial Interface**

The DIGITEL MPC can be interfaced and remotely controlled by a computer. All commands entered from the keypad can be performed from the computer.

### **Set Points**

Eight programmable setpoints, four relay and four TTL, can be configured to either supply. Hysteresis and control values can be programmed through the computer interface or keypad. Nonvolatile memory is used to store setpoint data for up to 10 years without power applied to the unit. Bakeout control is designed into the software and setpoints.

### **High Voltage Modules**

The DIGITEL MPC is available with two high-voltage (HV) modules:

- The medium HV module has a starting capacity of 200W, 100 mA. It is intended to fully operate pumps from 10 l/s to 200 l/s and can be used on larger pumps if they are well roughed or if under highvacuum.
- The large HV module has an starting capacity of 1000W, 500 mA. It is intended for pumps from 160 l/s to 1200 l/s.

HV modules are based on transformer design with low noise, high reliability, and overload protection. Each HV module has a standard output of 7000 Vdc. The output voltage can be configured to  $\pm 7000$  or  $\pm 5600$  Vdc for operating different pumps or systems. The modules come with one standard SHV-10 HV connection. For economical operation of more than one pump, an optional 2nd high-voltage output can be added.

### **Analog Outputs**

Four buffered analog outputs are provided independently from each HV module to connect the controller to data-acquisition devices. Two of these outputs provide a 0 to 10 volt signal with a scale factor of 1 volt per 1000V output voltage ( $V_{MON}$ ). The other 2 outputs are proportional to pump current ( $I_{MON}$ ) with selectable scale factors of either

- 1 volt per 100 mA or 100  $\mu$ A on 500 mA HV modules or
- 1 volt per 20 mA or 20  $\mu$ A on 100 mA HV modules.

### **SAFE-CONN™ High-Voltage interlock**

When operated with SAFE-CONN safety interlocked pumps and cables, the DIGITEL MPC automatically shuts off high voltage when the high voltage cable is disconnected at either the pump or controller end. This provides additional protection from possible shock hazard.

### **AUTORUN™**

AUTORUN determines optimum starting and operating conditions based the pump size entered and then starts and monitors the pump down without assistance. In start mode, because an ion pump can draw high currents, the DIGITEL MPC goes through a protected-start process, monitoring current, voltage, power, and time. If the pump starts properly, the MPC *automatically* goes into run protection mode. If the pump does not start properly — the

## 1: Introduction

DIGITEL MPC goes into a cool-down mode. If the pump does not start properly after three tries, it displays PUMP ERROR. The specific error code that identifies the cause of an error can be found in the *Menu* mode.

The DIGITEL MPC *continuously* protects the ion pump during start-up and normal operation. Ion pump parameters are monitored continuously by the microprocessor. If there is a vacuum failure, the MPC shuts down high voltage preventing serious damage. It can also detect power failures and be configured to *automatically* restart high voltage after a power loss, if desired.

### Remote TSP/NEG Control Option

The remote TSP/NEG option allows you to control a TSP (titanium sublimation pump) or NEG (non-evaporable getter). All commands to operate the Remote TSP/NEG Control can be entered using the DIGITEL MPC keypad or a host computer. It can operate in current or power control mode and can be cycled based on time and pressure. In TSP operation the ranges are 0 to 999 seconds for on time and 0 to 999 minutes for off time.

The option consists of:

- Remote TSP/NEG Control unit
- harness inside the DIGITEL MPC
- control cable from the DIGITEL MPC to the Remote TSP/NEG Control
- high-current cable from the Remote TSP/NEG Control to the TSP/NEG
- an AC input power cable

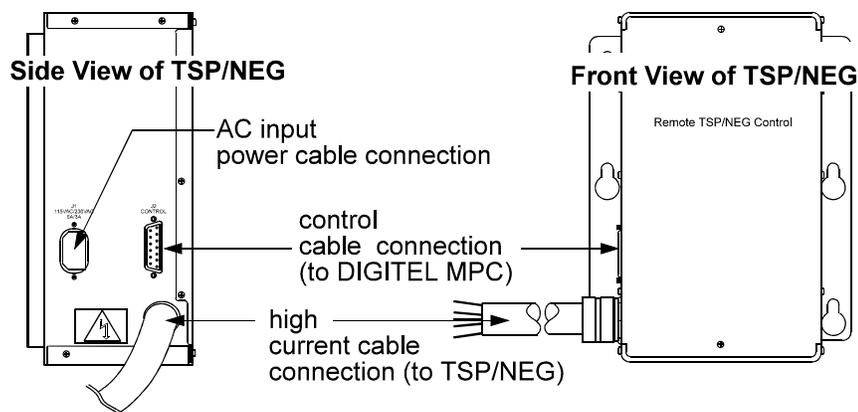


Figure 1-1. Remote TSP/NEG Control Option.

# Specifications

Table 1-1. Specifications DIGITEL MPC.

Parameter	Specification
Operating temperature	0 to 40°C.
Operating humidity	0 to 80% RH (non-condensing).
Storage temperature	-20 to 70°C.
Dimensions: DIGITEL MPC Remote TSP/NEG	WxHxD: 483 mm (19") x 133mm (5.25") x 476 mm (18.75"). WxHxD: 138 mm (5.4") x 292 mm (11.5") x 219 mm (8.6").
Input power	115 Vac, 230 Vac, or 208 Vac selectable.
Serial interface: number of start bits number of stop bits parity number of data bits	one. one. none. eight.
Set points (8):	
type	Set points 1 - 4 are relay; Set points 5 - 8 are TTL.
electrical characteristics	Relay: 500 mA, 28V each, maximum. TTL: 15 mA each, maximum.
response time	All MCP parameters are measured at least every 320 milliseconds. Assuming a set point decision is handled right after measurement is made, response time is 320 milliseconds. Assuming a set point decision is made on the next time through the standard loop response time is 640 milliseconds. Relays take a few milliseconds to operate, so this increases response time slightly.
Line frequency	48 to 62 Hz. No adjustment necessary.
High voltage output: short circuit	+7000 Vdc output standard; ±5600 and -7000 Vdc selectable. Medium HV module: 200W, 100 mA. Large HV module: 1000W, 500 mA.
polarity	Positive or negative (selectable).
Analog outputs:	0 to 10V
Voltage Current (outputs are jumper selectable) Operating Load	1V = 1000V. 1V = 100mA or 100µA on 500mA HV modules; 1V = 20mA or 20µA on 100mA HV modules Lowest resistance = 2kΩ
Pump size	Selectable from the keypad (Menu key).
Filament power ramp-up	5 amps per second.

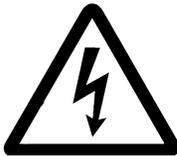
## Section 2: Installation

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This section details the installation requirements for the DIGITEL™ Multiple Pump Control (MPC).



**WARNING:** *Physical Electronics' (PHI's) products are designed and manufactured to provide protection against electrical and mechanical hazards for the operator and the area surrounding the product. The procedures provided in Sections 2 and 5 of this manual and in other PHI product manuals must be followed to ensure that these protections are not impaired in any way.*



**WARNING:** *Installation procedures are for use by qualified and authorized personnel who have experience working with voltages greater than 50 volts. To avoid personal injury, do not perform any installation or service procedures unless qualified to do so.*

*Voltages up to 7000V are present. An interlock is provided to shut off power when the top cover is removed. Do not defeat this interlock.*

*Do not disconnect the high-voltage cable with power on. After turning power off, allow at least one minute before disconnecting electrical equipment*

*Do not operate the control without a proper electrical ground or near water. The control may be damaged and its safety reduced, if it is operated outside of its specifications.*

## **Inspection for Damage**

*NOTE: It is the customer's responsibility to inspect and report any obvious shipping damage to the carrier, typically within 30 days. Before installing PHI equipment, inspect it for damage that may have occurred during shipment.*

## **Installing the DIGITEL MPC**

The DIGITEL MPC can be mounted in a standard 19 in. (48.3 cm) rack or used as a free-standing unit.

*NOTE: This unit can radiate radio frequency energy. Be sure that you install it according to instructions or interference could result.*

*The unit protects against interference in a commercial environment. If operation in a residential area causes interference, it is the user's responsibility to correct this problem.*

### *Required items*

You need the following items to install the MPC:

- 3-wire, detachable AC input power cable (included with DIGITEL)
- high voltage (HV) cable for each pump (ordered separately)
- safety ground cable for each pump (ordered separately)

### *Installation procedure*

Perform the following procedure to install the MPC:

1. Place the unit in its location and secure as necessary.
2. Connect the safety ground cable between the pump and safety ground stud at the DIGITEL rear panel ([Figure 2-1](#)).
3. Connect the high voltage cable to the ion pump and to the appropriate high voltage jack on the DIGITEL rear panel. See [Figure 2-1](#) and [Table 2-1](#).
4. If you have the optional SAFE-CONN feature, an additional connector is part of the HV connector. Connect it to the appropriate SAFE CONN jack. See [Figure 2-1](#) and [Table 2-1](#).
5. Verify correct input voltage requirements. Connect the AC input power cable to input power receptacle on the DIGITEL rear panel.
6. Switch on the DIGITEL and set correct pump size.

## 2: Installation

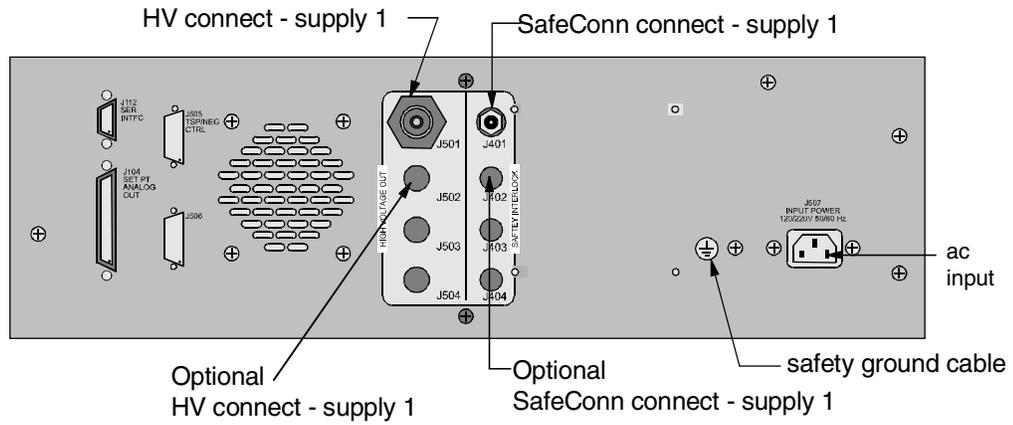


Figure 2-1. MPC Rear Panel HV and SAFECONN Connectors.

Table 2-1. High Voltage and SAFE-CONN Connectors.

HV Connector	SAFE-CONN Connector	Description
J501	J401	HV & SafeConn Connect, Supply 1
J502	J402	Optional Connect, Supply 1
J503	J403	HV & SafeConn Connect, Supply 2
J504	J404	Optional Connect, Supply 2

## Installing the Remote TSP/NEG Control Option



***DANGER: Voltages up to 7000V are present in the DIGITEL MPC. Turn off power and disconnect AC input power cable before installing the Remote TSP/NEG Control option.***

Figure 2-2 shows an overview of the Remote TSP/NEG Control connections in the system.

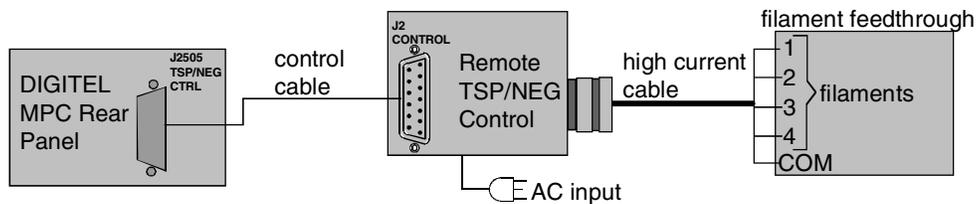


Figure 2-2. Overview: Remote TSP/NEG Control Connections.

To install the Remote TSP/NEG Control, use the following procedure. Figure 2-3 provides an installation diagram.

You need the following components to install the Remote TSP NEG Control:

- control cable
  - Remote TSP/NEG Control unit
  - high current cable
  - AC input power cable
1. Mount the Remote TSP/NEG Control unit using the holes provided on the mounting bracket (see [Figure 2-3](#)).
  2. Turn off power to the DIGITEL MPC and disconnect its AC input power cable.
  3. Connect the control cable to **J505 TSP/NEG CTRL** on the rear panel of the DIGITEL MPC. Connect the other end to **J2 Control** on the Remote TSP/NEG Control unit.

## 2: Installation

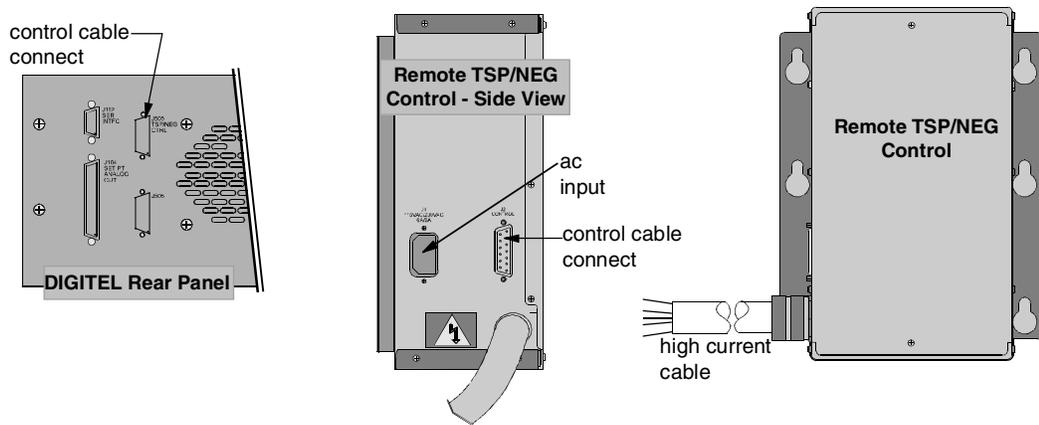


Figure 2-3. Installation Diagram of Remote TSP/NEG Control.

**CAUTION:** Step 4 is a high current connection. Make sure that you have a secure connection, or heating will occur.

4. Connect the high current cable to the filament feedthrough. Filament wires are labeled as shown in Figure 2-4.

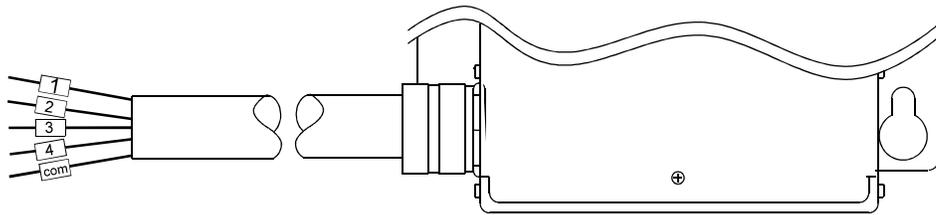


Figure 2-4. High Current Cable.

5. Connect the AC input power cable to the Remote TSP/NEG Control unit.
6. Reconnect the AC input power cable to the DIGITEL MPC.

**NOTE:** If you need to connect a high current cable to the TSP/NEG unit, see Section 4, **Connecting a High Current Cable to TSP/NEG.**

## 2: Installation

# SAFE-CONN™ Installation on an Ion Pump

Use the following procedure to install a SAFE-CONN on the high-voltage feedthrough (HVFT) of your ion pump.

What's needed?

Parts:	Tools:
<ul style="list-style-type: none"><li>• a PEEK cylinder</li><li>• two SS rings</li></ul>	<ul style="list-style-type: none"><li>• two flat-head screwdrivers</li><li>• an SS installation tool and a plastic cylinder</li></ul>

1. Place SS ring #1 on the 10 kV HVFT (Figure 2-2).
2. Install the PEEK cylinder over the 10 kV HVFT with its inner diameter groove facing away from the pump (Figure 2-2).  
The inner diameter groove will locate/lock onto the 10 kV HVFT tabs.

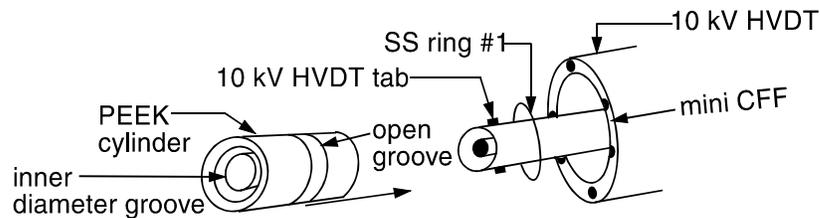


Figure 2-2.

SAFECONN Installation Diagram #1.

3. Use the two flat-headed screwdrivers prying against the mini-CFF — pry SS ring #1 over the PEEK cylinder and into the open groove (Figure 2-3).
4. Using the SS installation tool and plastic cylinder, install SS ring #2 on the PEEK cylinder.
  - a) Place the SS ring on the nose/ramp of the SS installation tool.

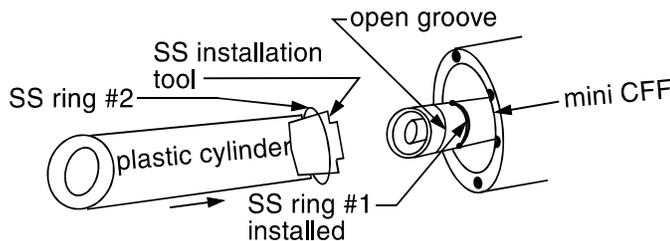


Figure 2-3.

SAFECONN Installation Diagram #2.

- b) Using the plastic cylinder, keep a constant steady pressure on the SS ring — keeping the installation tool, SS ring, and plastic cylinder assembly together.
- c) Raise the assembly to the HVFT, and with a light tap on the plastic cylinder, slide SS ring #2 into the open groove of the PEEK cylinder.

## Section 3: Operation

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Operation of the DIGITEL™ Multiple Pump Control (MPC) can be controlled by the operator through the system computer software. Refer to the system operator's guide for specific operating procedures.

Section 3, *Operation*, contains the following information for manual control of the DIGITEL MPC.

- *Front Panel Description* identifies and describes the front panel controls and indicators.
- *Rear Panel Description* identifies and provides signal pinouts for the rear panel connectors.
- *Operating the Ion Pump* explains how to evacuate and start an ion pump.
- *Using the Keypad* provides a detailed explanation of keypad operation and its associated display information.
- *Display Messages* gives a description in a table format of the status messages that can appear on the display.
- *Analog Outputs* describes the monitor outputs for voltage and current.
- *Serial Interface* provides detailed information concerning the computer communication interface.
- *Menu Structure* provides detailed flow chart on the menu structure.

## Front Panel Description

Figure 3-1 identifies the front panel controls and indicators on the DIGITEL™ MPC, which are described in Table 3-1.

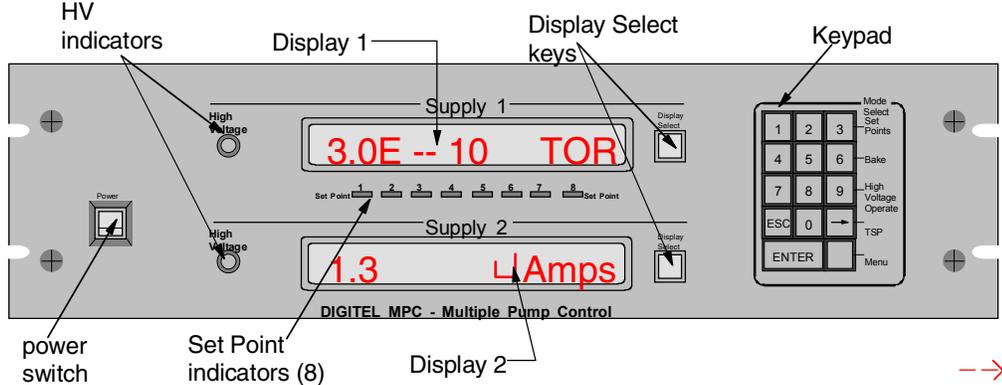


Figure 3-1. Front Panel Controls and Indicators.

Table 3-1. Front Panel Controls and Indicators.

Control	Description
Main <b>Power</b> switch	Turns main power on and off (1 = ON; 0 = OFF).
<b>High Voltage</b> indicators (2)	When high voltage (HV) is enabled to supply 1 or supply 2, the associated indicator on the front panel lights.  To enable HV manually, use the <b>9</b> key on the front panel keypad to select <b>High Voltage Operate</b> .  <i>Note: If SAFE-CONN interlock is not intact, high voltage will not turn on.</i>
<b>Supply 1, Supply 2</b> displays	During normal mode, displays 1 & 2 show voltage, current, or pressure status information, as well as error codes. When in program mode, they display corresponding data.
<b>Display Select</b> (2) keys	During normal mode, press this key to select voltage, current, or pressure for display. During program or menu mode — when an arrow on the display points to a <b>Display Select</b> key, it is active. When active, press it to cycle through setup options.
<b>Set Point</b> indicators (8)	A set point indicator LED lights when its associated output is energized. Set points 1 through 4 are relay. Set points 5 through 8 are TTL.

### 3: Operation

Table 3-1. Front Panel Controls and Indicators (continued).

Control	Description
Keypad:	Used as the primary method for manual control of the MPC.
<b>0</b> key (disable)	To disable the keypad, press <b>0</b> four times in succession during normal mode. All keys except the <b>Display Select</b> keys are disabled.
<b>1</b> key (enable)	To re-enable keypad operation, press <b>1</b> four times in succession.
<b>3, 6, 9</b> or <b>←</b> -key selects one of the following four program modes:	
<b>Set Points</b>	During normal mode, press <b>3</b> to select the <b>Set Points</b> program mode. <i>Press 3 to Select Set Points</i> , following Table 3-2, provides detailed information on this key.
<b>Bake</b>	During normal mode, press <b>6</b> to select the <b>Bake</b> program mode. <i>Press 6 to Select Bake</i> , following Table 3-2, provides detailed information on this key.
<b>High Voltage Operate</b>	During normal mode, press <b>9</b> to select <b>High Voltage Operate</b> , to allow the high voltage on/off function. <i>Press 9 to Select High Voltage Operate</i> , following Table 3-2, provides detailed information on this key.
<b>TSP</b>	During normal mode, press the <b>←</b> (backspace) key to select the <b>TSP</b> program mode. <i>Press ←to Select TSP</i> , following this Table 3-2, provides detailed information on this key.
<b>Menu</b> (blank key)	During normal mode, press the blank key to select the menu mode, which is a hierarchical system for setting unit parameters and preferences. When in the menu mode, use it to scroll through the menu options. Refer to Table 3-3.
<b>0</b> through <b>9</b> keys	When you select one of the program modes or the menu mode, use the numerical keys to enter the desired data. Press <b>ENTER</b> to save or <b>ESC</b> to exit without saving. Refer to Table 3-2 and 3-3.
<b>←</b> -key	When in program or menu mode, use the <b>←</b> (backspace) key to correct errors when keying in data.
<b>ESC</b> key	While in menu or program mode, use this key to escape without saving changes. When in a submenu, use it to move back up a level in the menu structure.
<b>ENTER</b> key	Press this key to save setup data. It is also used in menu mode to step down to the submenu.

## Rear Panel Description

Figure 3-2 identifies the rear panel connectors on the DIGITEL™ MPC. Connector pinouts are given in the tables below.

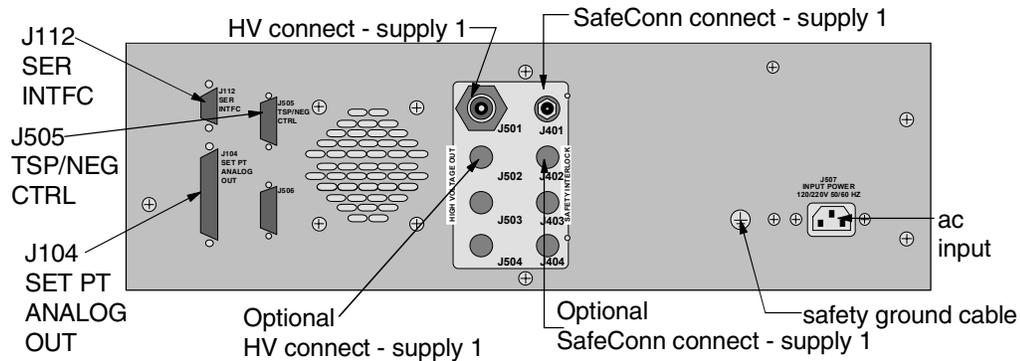


Figure 3-2. Rear Panel Connectors.

**J104 SET PT ANALOG OUT** (a 37-pin, female Sub-D connector) provides 8 set point signals, and 4 voltage/current analog output signals.

Pin	Setpoint Signal	
1	Set Point 1 (Relay)	Common
2	500 mA, 28V, max.	NC
3		NO
4	Set Point 2 (Relay)	Common
5	500 mA, 28V, max.	NC
6		NO
7	Set Point 3 (Relay)	Common
8	500 mA, 28V, max.	NC
9		NO
10	Set Point 4 (Relay)	Common
11	500 mA, 28V, max.	NC
12		NO
13, 14, 16, 18	GND1	
15	Set Point 5 (TTL), 15 mA max.	
17	Set Point 6 (TTL), 15 mA max.	
19	Set Point 7 (TTL), 15 mA max.	
37	Set Point 8 (TTL), 15 mA max.	

Pin	Analog Output Signal
20 ... 28	Unused
29	GND2
30	Analog HV Supply 1 Output
31	GND2
32	Analog Current Output 1*
33	GND2
34	Analog Current Output 2*
35	GND2
36	Analog HV Supply 2 Output

\* Can be configured for Supply 1 or Supply 2 current (I) output – See Analog Outputs.

**J505 TSP/NEG CTRL** (a 15-pin, female Sub-D connector) provides the control signals for the Remote TSP/NEG Control.

Pin	Signal
1	Current Sense COM
2	SCR Trig Pull-up
3	K4 Coil
4	+15V to TSP
5	Voltage Sense

Pin	Signal
6	SCR Trig Out
7	K3 Coil
8	+15V Return
9	Current XFMR –
10	Sync Signal from TSP

Pin	Signal
11	K2 Coil
12	Not Used
13	Current XFMR +
14	Sync Signal GND
15	K1 Coil

### 3: Operation

**J112 SER INTFC** (a 9-pin, female Sub-D connector) routes the serial interface signals for the four serial interface protocols – RS-232, PHI, RS-485, and RS-422.

RS-232 Operation	
DCD	1
RXD	2
TXD	3
GND	5
DSR	6
RTS	7
CTS	8

PHI Operation	
+TX	2
-TX	8
GND	5
+RX	3
-RX	7

RS-485 Operation	
+TX	2
-TX	8
GND	5

RS-422 Operation	
+RX	3
-RX	7
GND	5

## Operating the Ion Pump

Ensure that the pump has been installed according to instructions supplied with it. Install the DIGITEL MPC according to its instructions.

- The DIGITEL MPC and pump must be grounded and have a safety ground strap connecting them to each other.
- The high voltage cable must be attached to the MPC and the pump.
- The proper pump size must be selected from the menu mode.
- The MPC must have the correct output polarity/voltage for the pump.

*Note: More power and current are required to start larger ion pumps or pumps started at higher pressures. Use the full extent of your rough pumping before starting a pump to reduce pump wear and time to UHV, to improve system ultimate pressure, and to give the most accurate readings.*

### To Evacuate the Pump

Before you run an ion pump, it must be evacuated to a minimum vacuum of  $1 \times 10^{-3}$  Torr. Details are best obtained from the pump manual, but in general, use the following procedure.

1. Rough pump down to  $1 \times 10^{-3}$  Torr or less (the lower the better).
2. Ensure that contaminants do not backstream into the ion pump. If you use a mechanical pump, it must be well trapped to prevent oil back-streaming from the mechanical pump to the ion pump.
3. If an ion pump is used or has been at atmospheric pressure, it may be necessary to bakeout the pump into the roughing pump to achieve the best pressure. To do this, heat the ion pump ( $<300^{\circ}\text{C}$  with magnets) for a period of several hours until heat soaked.

### 3: Operation

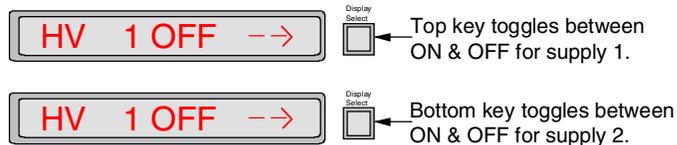
#### To Start the Pump

Use the following procedure to start the pump. If your DIGITEL MPC is configured for POWER LOSS restart, high voltage starts automatically when your turn on the DIGITEL.

1. Turn on main power to the DIGITEL MPC. If in POWER LOSS restart, go to Step 4. If in manual restart, go to Step 2.
2. Press **9** to select *High Voltage Operate*.

To turn supply 1 on (or off), press the top **Display Select** key to toggle to the desired value.

To turn supply 2 on (or off), press the bottom **Display Select** key to toggle to the desired value.



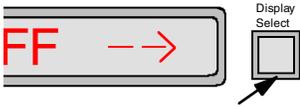
3. Press the **ENTER** key.

*NOTE: If you turn a supply ON and have not set the pump size for that supply, the display automatically goes to PUMP SIZE menu to allow you to set the value.*

4. When voltage starts to rise above 700V, the pump starts. The roughing pump should be valved off at this point. If the pump starts to stall when the roughing pump is valved off (as indicated by a decrease in voltage), the roughing pump should be valved back into the system. After voltage has increased above 3000V, the display may be switched to current or pressure display (when starting the pump, the voltage display mode is more sensitive to pressure changes).

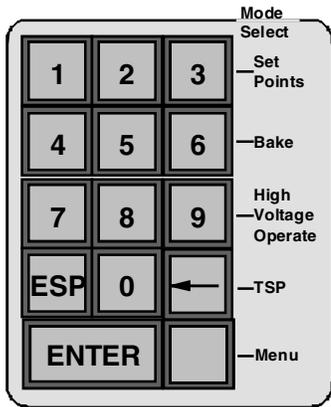
## Using the Keypad

### Display selection



During normal mode, **Supply 1** and **Supply 2** displays show either voltage, current, or pressure. Press the **Display Select** key next to each supply to cycle through these choices. Voltage is the default upon power-up, but you can change it in the *Preferences* menu. Refer to the pump display information in section 3, *Setting Preferences*.

### Keypad



The keypad consists of the following keys and are labeled:

**0-9**

←(backspace)

**ESC**

**ENTER**

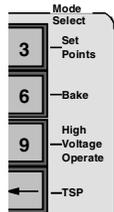
The **3** (*Set Points*), **6** (*Bake*), **9** (*High Voltage Operate*), and ←(*TSP*) keys have program modes (Table 3-2).

The **0** key disables keypad operation.

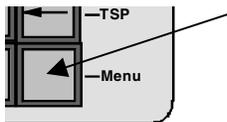
The **1** key enables keypad operation.

The blank key is the *Menu* mode key (Table 3-3).

### Program Mode Select keys



During normal mode, you can press the **3**, **6**, **9**, or ←(backspace) key to select their program mode — *Set Points*, *Bake*, *High Voltage Operate*, and *TSP*, respectively. Refer to section 3, *Program Mode Keys* for information on how to use these keys.



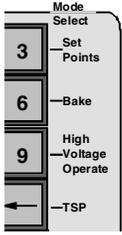
The *Menu* key, which is the blank key, is a hierarchical system for setting unit parameters and preferences. Refer to section 3, *Menu Key* for information on how to use these keys.

To disable and enable the keypad

If you want to disable the keypad, press the **0** key four times in succession during normal mode. All keys except the **Display Select** keys are disabled. Press the **1** key four times in succession to re-enable operation.

### 3: Operation

#### Program Mode Keys



During normal operation, you can press the **3**, **6**, **9**, or **←**key to select their program mode — *Set Points*, *Bake*, *High Voltage Operate*, and *TSP*, respectively. Press the **ESC** key anytime you want to exit a program mode without saving changes, or press **ENTER** to save the changes..

Table 3-2.

Program Mode Select Keys.

Mode	Description
Press the <b>3</b> key to select <i>Set Points</i>	With this key, you select several parameters — the set point number, what supply it should monitor (whether it should monitor a bakeout), and the on/off pressure values. With each set point parameter, if the set point has been used before, the present values are displayed. <i>Press 3 to Select Set Points</i> , following this table, provides detailed information on this key.
Press the <b>6</b> key to select <i>Bake</i>	With this key, you can set up your bakeout, find out how long the heaters for a current bakeout have been on, and disable a current bake. <i>Press 6 to Select Bake</i> , following this table, provides detailed information on this key.
Press the <b>9</b> key to select <i>High Voltage Operate</i>	This key turns high voltage to Supply 1 or Supply 2, ON or OFF using the <b>Display Select</b> key. <i>Press 9 to Select High Voltage Operate</i> , following this table, provides detailed information on this key.
Press the <b>←</b> key to select TSP  Press <b>←</b> to select TSP, following this table, provides detailed information on this key.	Use the <b>Menu</b> key to cycle through modes of operation and parameters.  <b>Four modes of operation:</b> <u>TIMED</u> sets the time between cycles, the number of cycles, and pressure above which the TSP operates. Once you set it up, the TSP fires immediately if pressure is above the preset value. <u>CONTINUOUS</u> turns on the TSP and leaves it on, until you manually turn it off. <u>OFF</u> turns off the TSP and disables all modes. <u>DEGAS</u> is a maintenance tool. Use it to outgas your filaments if they are new or have been brought up to atmosphere.  <b>Five setup parameters:</b> <u>ACTIVE</u> has two functions. As an information tool, the display indicates the filament number and the total amount of logged time on that filament. As a setup tool for TIMED and CONTINUOUS modes of operation, it allows you to select which filament you want to use. <u>CLR FILMNT</u> allows you to reset the logged time of all filaments to zero. You can do this if you DEGAS or replace a filament. This command also resets ACTIVE to the number one filament. <u>ON TIME</u> allows you to specify the firing time of a filament for TIMED and DEGAS operating modes. <u>SUB LEVEL</u> allows you to select current or power control of the TSP and specify its value. <u>AUTO--ADVNC</u> , if enabled, automatically switches to the next filament if an open one is detected.

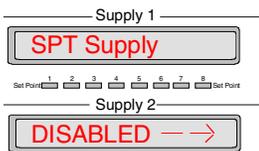
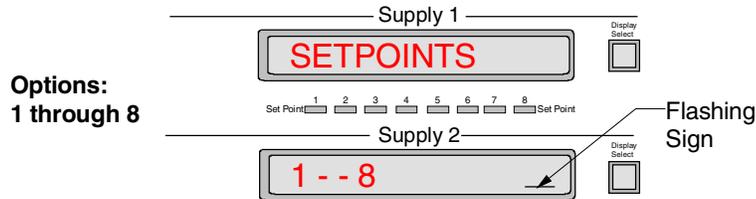
### 3: Operation

#### Press 3 to Select Set Points

With this feature, you can establish set point parameters — the set point number, what supply it should monitor (whether it should monitor a bakeout), and the on/off pressure values. With each set point parameter, if the set point has been used before, the present values are displayed.

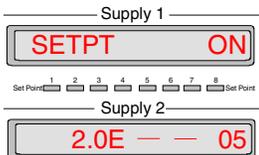
#### Procedure

1. Press **Set Points** (the 3 key). The bottom display shows 1 – 8 followed by a flashing sign to indicate that you may use the numerical keys to enter the desired set point.
2. Key in the set point number and press **ENTER**.



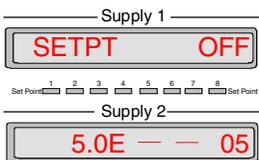
3. The next parameter is SPT SUPPLY. An arrow points to the bottom **Display Select** key to show it is active. Press it to cycle through the options — DISABLED, SUPPLY 1, SUPPLY 2, BAKE S1, and BAKE S2.

4. When you reach the desired option, press **ENTER**.



5. The next parameter is SETPT ON. The bottom display shows the current ON pressure with the number flashing to indicate that you can use the numerical keys to enter a new value.

6. Key in the desired ON pressure value and press **ENTER**.  
If you change the ON pressure, OFF pressure default is reset to:  
 $ON\ pressure * 1.2$  (20% hysteresis)



7. The next parameter is SETPT OFF. Key in the desired OFF pressure value and press **ENTER**. Or press **ENTER** for 20% hysteresis.

8. When the display asks you to CONFIRM, press **ENTER** to save your set point parameters or **ESC** to exit without saving changes.

#### After you have finished

Once the set point parameters have been saved, they are immediately applied. When pressure goes below the specified set point pressure, the set point is energized lighting the associated front panel LED. If it is above the pressure, the set point is de-energized (LED off).

#### How do I disable a set point?

- If you want to disable a set point, press the **Set Points** key,
- key in the set point number, press **ENTER**,
  - press the **Display Select** key to toggle to DISABLED,
  - press **ENTER**, and press **ENTER** again to confirm.

### 3: Operation

#### **Press 6 to Select Bake**

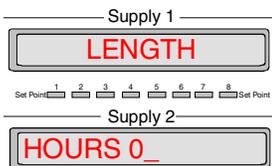
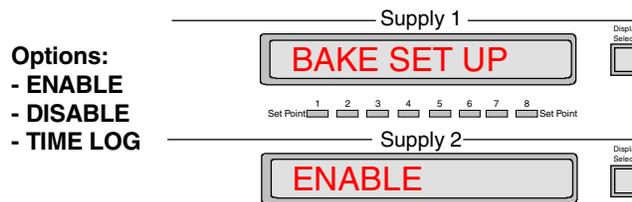
*Is the set point established?*

Before you setup the bake, make sure that your set point parameters for the bakeout have been established. Once established, they are retained in memory and do not need to be re-entered.

Using the **Set Points** (3 key), select the set point number (1-8), what supply it should monitor (BAKE S1 or BAKE S2), and the on/off pressure values. For more information, refer to *Press 3 to Select Set Points*.

**Bake setup procedure**

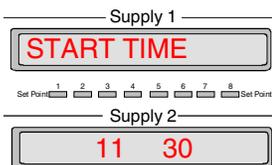
1. Press **Bake** (the 6 key).
2. Press the **Menu** key to toggle between ENABLE, DISABLE, and TIME LOG. Select ENABLE and press **ENTER**.



3. The next parameter is LENGTH. The bottom display shows HOURS 0, followed by a flashing sign to indicate that you may set the duration of the bake (between 0 and 255 hours).

First use the backspace (←) key to overwrite, and then enter the desired duration with the numerical keys.

4. Press **ENTER**.



5. The next parameter is START TIME. At this point you can start the bake immediately when you press **ENTER**. Or you can change the start time, just key in all four numbers and press the **ENTER** key.
6. When the display asks you to CONFIRM, press **ENTER** to save your bake parameters or **ESC** to exit without saving changes.

*After you have finished*

Once the bake is enabled, the display flashes "BAKE ARMED" for 1 second every 5 seconds. Once the bake is started, the display flashes "BAKE nn.nH" where nn.nH indicates how many hours are left in the bake. When pressure is exceeded, the bake is suspended.

*How long have the heaters been on?*

Once your bake has started, the actual on time for the heaters is logged and can be retrieved at any time. To do this, press the **Bake** key,

- select TIME LOG with the **Menu** key, and
- press **ENTER**. The bottom display shows the actual on time for the heaters.

*How do I cancel my bake?*

Once your bake has been enabled, if you want to cancel it, press the **Bake** key,

- press the **Menu** key to toggle to DISABLE,
- press **ENTER**, and press **ENTER** again to confirm.

### 3: Operation

#### *Press 9 to Select High Voltage Operate*

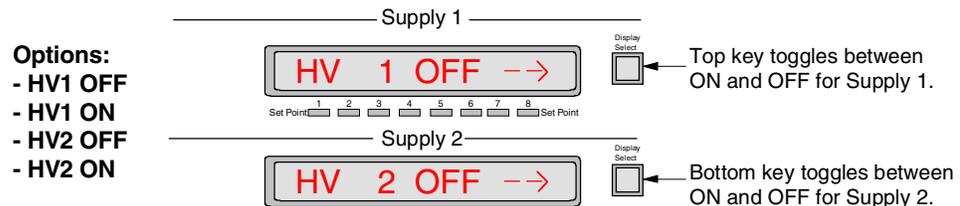
If the MPC is in manual restart, *High Voltage Operate* (the **9** key) allows you to enable high voltage to one or both supplies.

To apply high voltage

To apply high voltage, the following steps must be performed:

*Note: If the DIGITEL MPC is in Autostart, do not perform Steps 3, 4, and 5.*

1. Ensure that the high voltage cable is connected to both the pump and the MPC.  
Ensure that the pump size (refer to Section 3, *Setting Pump Size*) has been specified.
2. Press the front panel main **Power** switch to 1 (1=ON).
3. If the MPC is in manual restart, press **9** to select *High Voltage Operate*.  
The top display shows the state of HV 1 (ON or OFF), and the bottom display shows the state of HV 2.



4. To turn supply 1 on (or off), press the top **Display Select** key to toggle to the desired value.  
To turn supply 2 on (or off), press the bottom **Display Select** key to toggle to the desired value.
5. Press the **ENTER** key.

*NOTE: If you turn a supply ON and have not set the pump size for that supply, the display automatically goes to PUMP SIZE menu to allow you to set the value.*

When you are finished

The **High Voltage Enable** indicator on the front panel lights when high voltage is applied for the corresponding supply.

### 3: Operation

#### Press ← to Select TSP

When you press the **TSP** (←) key, TSP SETUP provides:

- operation modes — four options
- setup parameters — five options

Use the **Menu** key to cycle through the following options.

#### Operation Modes

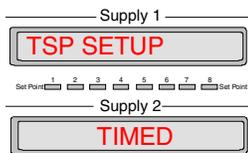
<b>TIMED</b>	TIMED is the main operating mode. You can set the amount of time between cycles, the number of cycles, and minimum pressure value.
<b>CONTINUOUS</b>	CONTINUOUS turns the TSP on and leaves it on. Use caution when selecting this operating mode, it could blow a fuse in the Remote TSP/NEG Control unit.
<b>OFF</b>	OFF mode turns the TSP off. It is the default operating mode when the MPC powers up.
<b>DEGAS</b>	DEGAS is a maintenance tool. If your filaments are new or have been brought up to air, the DEGAS operating mode conditions them.

#### Setup Parameters

<b>ACTIVE</b>	ACTIVE provides two functions. As an information tool, the display indicates the filament number and total amount of logged time it has used. As a setup tool for TIMED mode, it allows you to select which filament to use.
<b>CLR FILMNT</b>	If you degas or install new filaments, CLR FILMNT parameter resets logged time to zero.
<b>ONTIME</b>	This parameter specifies filament on firing time for TIMED and DEGAS operating modes.
<b>SUBLEVEL</b>	With this parameter, you can select current or power and specify its value.
<b>AUTO--ADVNC</b>	If set to YES, it automatically switches to the next filament if an open one is detected

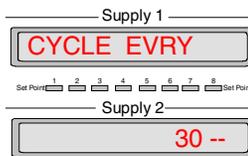
#### Operation Modes:

##### 1 TIMED

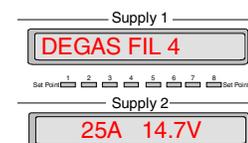


TIMED is the main operating mode. Sets the amount of time between cycles, the number of cycles, and the minimum pressure value. To get there, press the **TSP**(←) key. It is the first display in TSP SETUP.

1. Before enabling TIMED mode, make sure these parameters are setup.
  - ⇒ ACTIVE. Go to setup parameter 1 to specify the filament you want to fire first.
  - ⇒ ON TIME. Go to setup parameter 3 to specify amounts of time the TSP fires.
  - ⇒ SUBLEVEL. Go to setup parameter 4 to select watts/amps and specify its value.



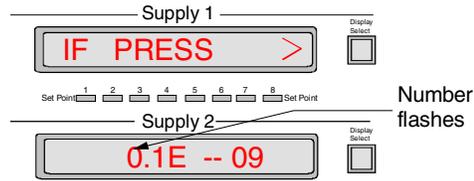
2. Once parameters are setup, press **Menu** to cycle to TIMED. Press **ENTER** to display MINUTS, followed by a cursor to indicate that you may enter the number of minutes.
3. Use the backspace (←) key to overwrite, and enter the desired number of minutes with the numerical keys.



4. Press **ENTER** to display CYCLES. Key in the number of cycles

### 3: Operation

- Press **ENTER** to display the TSP interlock pressure, the first number will flash. Key in the desired value, the TSP will operate in the TIMED mode when the ion pump pressure is above this value.

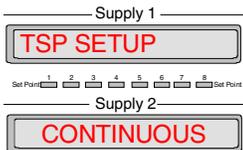


- Press **ENTER** to enable TIMED mode.

Could I have an example?

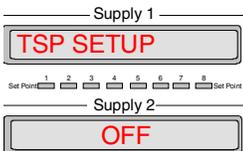
If TIMED is set at 3 minutes, 8 cycles, and a minimum pressure. If SUBLEVEL is 50 amps, ON TIME is 30 sec, and ACTIVE specifies filament 2 — then FIL 2 fires immediately for 30 sec, and then fires every 3 minutes thereafter for 7 additional times, but only if pressure is above the setup value.

### 2 CONTINUOUS



CONTINUOUS mode *turns the TSP on and leaves it on, until you manually turn it off*. When in TSP SETUP, press *Menu* to cycle to CONTINUOUS. Press **ENTER** to display TSP ON, and press **ENTER** again to enable this mode.

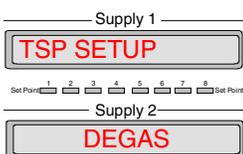
### 3 OFF



If TIMED mode is enabled and you press the *TSP*( $\leftrightarrow$ ) key, the bottom display reads ARMED, indicating the TSP is ON. A number follows to indicate the number of cycles left. For example, if the display reads *ARMED 4*, there are four cycles left and once a cycle is completed, the number decreases to three.

To turn the TSP OFF, press *Menu* to cycle to OFF. Then press **ENTER**.

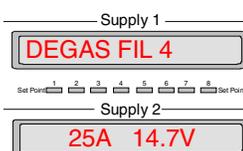
### 4 DEGAS



Use DEGAS to outgas filaments that are new or have been brought up to atmosphere. During DEGAS mode, each filament is fired once. It uses the specified ON TIME and SUBLEVEL setup parameters, but starts its firing at half the value. For example, if current is specified at 50 amps and time at 30 seconds, then the TSP (when enabled) ramps up to 25A for the first 15 sec and then ramps up to 50A for the remaining 15-sec.

When in TSP SETUP, press *Menu* to cycle to DEGAS and press **ENTER** to enable degassing.

**ATTENTION:** *Degas pressure should be less than  $1 \times 10^{-2}$  Torr.*

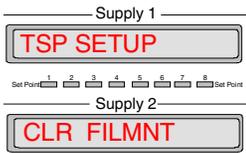


While in degas mode, the display shows which filament is degassing and at what value. When DEGAS is complete, the display returns to TSP SETUP. You need to reset the filament-logged time to zero. Go to setup parameter 2, *CLR FILMNT*.

### 3: Operation

#### Setup parameters:

#### 1 ACTIVE

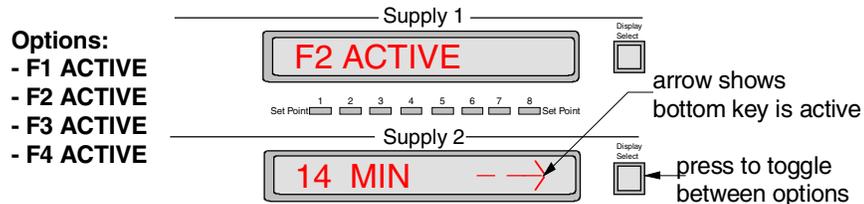


The ACTIVE parameter provides two functions:

- As an information tool, the display indicates the filament number and the total amount of operating logged time.
- As a setup tool, it allows you to select which filament you want to use.

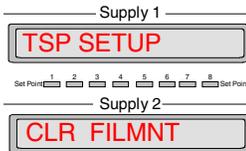
When in TSP SETUP, press *Menu* to cycle to ACTIVE.

1. Press **ENTER** to display the filament number and its total logged time.



2. An arrow points to the bottom **Display Select** key to show it is active. Press it to cycle through the options: F1 ACTIVE, F2 ACTIVE, F3 ACTIVE, F4 ACTIVE.
3. When you reach the desired filament, press **ENTER** to save your selection or press **ESC** to exit without saving changes.

#### 2 CLR FILMNT

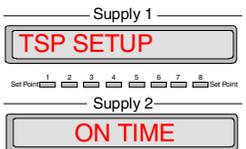


If you degas filaments or install new ones, use CLR FILMNT to reset their operating logged time to zero. Resets all four filaments to zero.

When in TSP SETUP, press *Menu* to cycle to CLR FILMNT.

Press **ENTER**. When the display asks you to confirm, press **ENTER** to clear the filaments or press **ESC** to exit without clearing filaments.

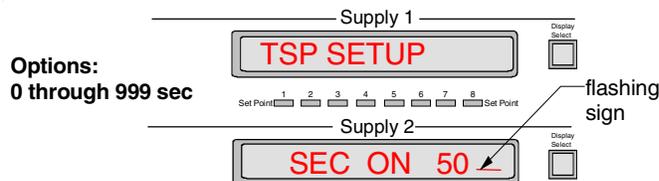
#### 3 ON TIME



This parameter specifies the on firing time of a filament for TIMED and DEGAS operating modes. For example, if you specify 30 sec ON TIME (in TIMED mode), then the TSP operates for 30 sec before it shuts off.

When in TSP SETUP, press *Menu* to cycle to ON TIME.

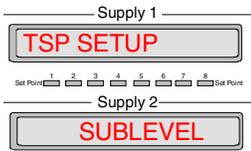
1. Press **ENTER**. The bottom display shows the on time in seconds followed by a flashing sign.



2. Use the backspace (←) key to overwrite, and enter the desired value (0-999) with the numerical keys. Press **ENTER** to save the changes.

### 3: Operation

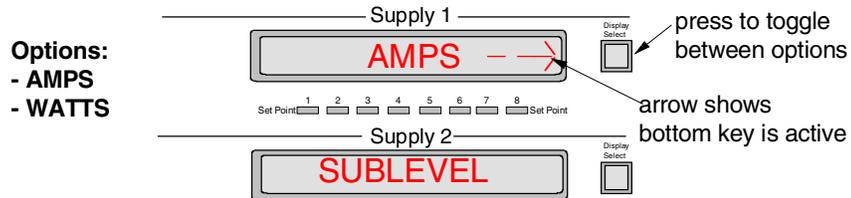
#### 4 SUB LEVEL



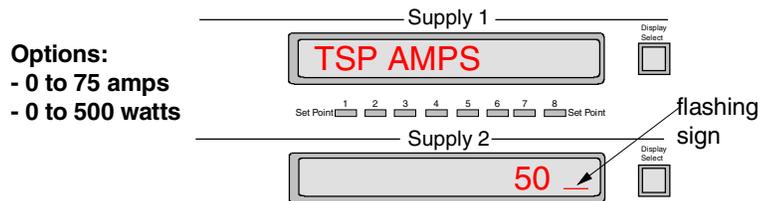
For TSP control, you need to select constant current (amps) or constant power (watts) and specify its value.

When in TSP SETUP, press the **Menu** key to cycle to SUB LEVEL.

1. Press **ENTER**. An arrow points to the top **Display Select** key to show it is active. Press it to toggle between AMPS and WATTS.

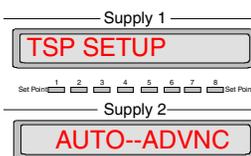


2. When you reach the desired option, press **ENTER**.
3. The bottom display shows the value followed by a flashing sign. Use the backspace ( $\leftarrow$ ) key to overwrite, and enter the desired value (0-75 for amps or 0-500 for watts) with the numerical keys.



4. Press **ENTER** to save your changes.

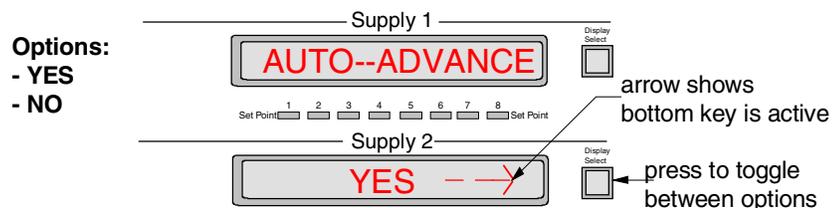
#### 5 AUTO--ADVNC



AUTO--ADVNC, when set to YES, automatically switches to the next filament if an open filament is detected.

When in TSP SETUP, press the **Menu** key to cycle to AUTO--ADVNC.

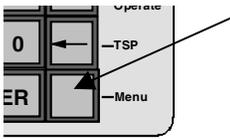
1. Press **ENTER**. An arrow points to the bottom **Display Select** key to show it is active.



2. Press it to toggle between YES and NO.
3. When you reach the desired option, press **ENTER**.

### 3: Operation

#### Menu Key



The **Menu** key (blank key) is a hierarchical system (Table 3-3) for setting unit parameters. After you press **Menu**, the top display shows the first menu selection.

- Press **Menu** to step through each top menu selection.
- Use the **ENTER** key to step to a sub menu.
- Then use **Menu** to step through each submenu selection.
- Press **ESC** to step back up to the top menu.

Table 3-3. Menu Hierarchical System.

Menu Structure	Description
PUMP1 SIZE PUMP2 SIZE	Specifies pump size in liters per second that is connected to each supply. This value must be either 0 (no pump connected) or between 10 and 1200. Default is 0.
PREFERENCES:	The following sub-menus are available in the PREFERENCES menu.
PRES UNITS	Selects pressure units to use: Torr, mBar, or Pascal. Default is Torr.
PUMP DSPLY	Selects voltage, current or pressure for each display. Default is voltage.
CONFIG:	The following sub-menus are available in the CONFIG menu.
FAN ON/OFF	You can set the fan to off or full speed.
POWER LOSS	If yes is chosen, both pumps start up automatically upon power up.
SERIAL ADR	Specifies which serial address to use for the Physical Electronics Serial Communications Protocol. Default is 5.
BAUD RATE	Selects baud rate to use: 9600, 4800, 2400, 1200, or 300. Default is 9600.
SET CLOCK	Allows you to set the time and date of the real time clock.
SPLY1 SIZE SPLY2 SIZE	Indicates what supply option is installed for supply 1 and supply 2: medium, large, or none.
PUMP 1 CAL PUMP 2 CAL	Pumps have a calibration factor that is multiplied by pressure to increase or decrease it. Acceptable factors are between 0.00 and 9.99. Default, 1.00.
SUPPLY1 KV SUPPLY2 KV	Indicates what output voltage the high voltage transformer is set to (for supply 1 and 2), 5600 or 7000.
PRM FACTOR	Informs the firmware of line voltage setting, 120 or 240.
DIAGNOSTCS:	Most of the following diagnostics can be used in the field.
REVISION	Displays the current firmware revision.
ERROR CODE	Display 1 shows last error code for pump 1 and display 2, pump 2.
DISPLY/KEY	Tests all displays, LEDs, and keys.
CALIBRATION	A self-calibration of the current offset for both supplies.
RST DFLT	Resets most options to their default values.
LINE FREQ	Indicates the present line frequency.

### 3: Operation

#### Setting Pump Size

In order to start the pump, you need to specify the pump size (between 10 and 1200 in liters per second). Use the following procedure

*Note: If an attempt is made to start a pump and the pump size is not specified, this menu option is automatically brought up and displayed. You must then set the pump size in order to start the pump.*

1. After you press **Menu**, the top display shows PUMP1 SIZE.
2. Press the **ENTER** key. The bottom display shows the current pump size in liters per second (l/s), followed by a flashing sign to indicate that you may use the numerical keys to enter the pump size.
3. First use the backspace ( $\leftrightarrow$ ) key to overwrite, and then enter the desired pump size with the numerical keys.
4. Press **ENTER** to save the changes.
5. Press the **Menu** key to select PUMP2 SIZE.
6. Repeat Steps 2, 3, and 4.

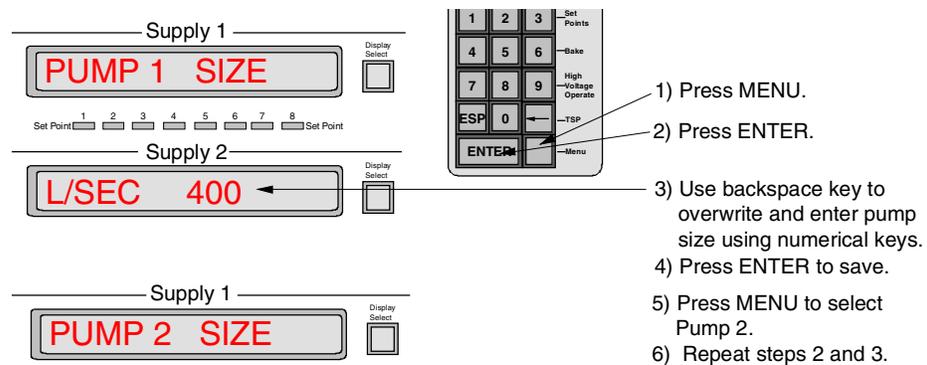


Figure 3-3.

How to Set Pump Size.

### 3: Operation

#### Setting Preferences

PREFERENCES  
overview

Press the **Menu** key to cycle through the top menu selections until you reach PREFERENCES. Press **ENTER** to step to its submenu. Press the **Menu** key to cycle through the following submenu selections:

- PRES UNITS
- PUMP DSPLY DFAULT VAL

Press **ESC** to exit the submenu and return to PREFERENCES.

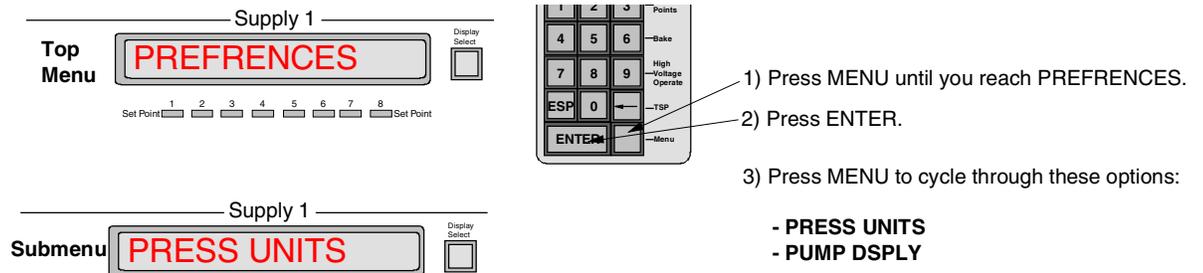


Figure 3-4.

How to Reach PREFERENCES Submenu.

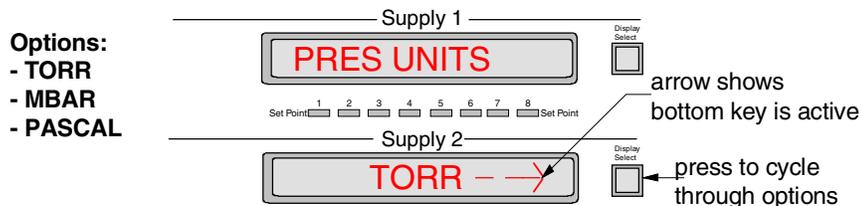
### 3: Operation

#### PRES UNITS

You can specify the default pressure units to display: Torr, mbar, or Pascal. The bottom display shows the units presently in use.

*NOTE: This procedure does not change set point or TSP pressure values. For example, if you have 1.5 mbar and change to Torr, then you have 1.5 Torr.*

1. Press the **Menu** key to cycle through the menu until you reach PREFERENCES.
2. Press **ENTER** to step to the submenu selection PRES UNITS.
3. Press **ENTER** again to display the units.
4. An arrow points to the bottom **Display Select** key to show it is active. Press it to cycle through the unit options — TORR, MBAR, and PASCAL.

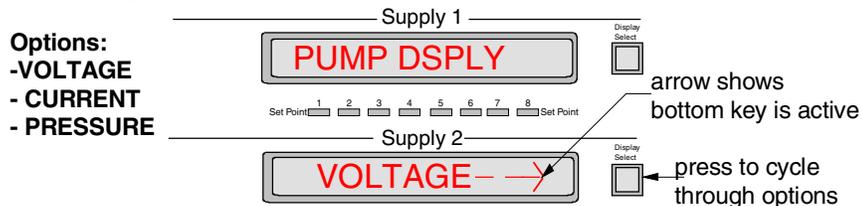


5. When you reach the desired option, press **ENTER** to save the your selection.

#### PUMP DSPLY DFAULT VAL

You can specify the default display in voltage, current or pressure for **Supply 1** and **Supply 2** displays.

1. Press the **Menu** key to cycle through the menu until you reach PREFERENCES.
2. Press **ENTER** to step to the submenu, and press the **Menu** key to cycle to PUMP DSPLY.
3. Press **ENTER**.
4. An arrow points to the bottom **Display Select** key to show it is active. Press it to cycle through the unit options — VOLTAGE, CURRENT, and PRESSURE.



5. When you reach the desired option, press **ENTER** to save the your selection.

### 3: Operation

#### Setting Configurations

CONFIG  
overview

Press the **Menu** key to cycle through the top menu selections until you reach CONFIG. Press **ENTER** to step to its submenu. Press the **Menu** key to cycle through the following 12 submenu selections:

- FAN ON/OFF
- POWER LOSS RESTART
- SERIAL ADR
- BAUD RATE
- SET CLOCK
- SPLY1 SIZE
- SPLY2 SIZE
- PUMP1 CAL FACTOR
- PUMP2 CAL FACTOR
- SUPPLY1 KV
- SUPPLY2 KV
- PRM FACTOR

Press **ESC** to exit the submenu and return to CONFIG.

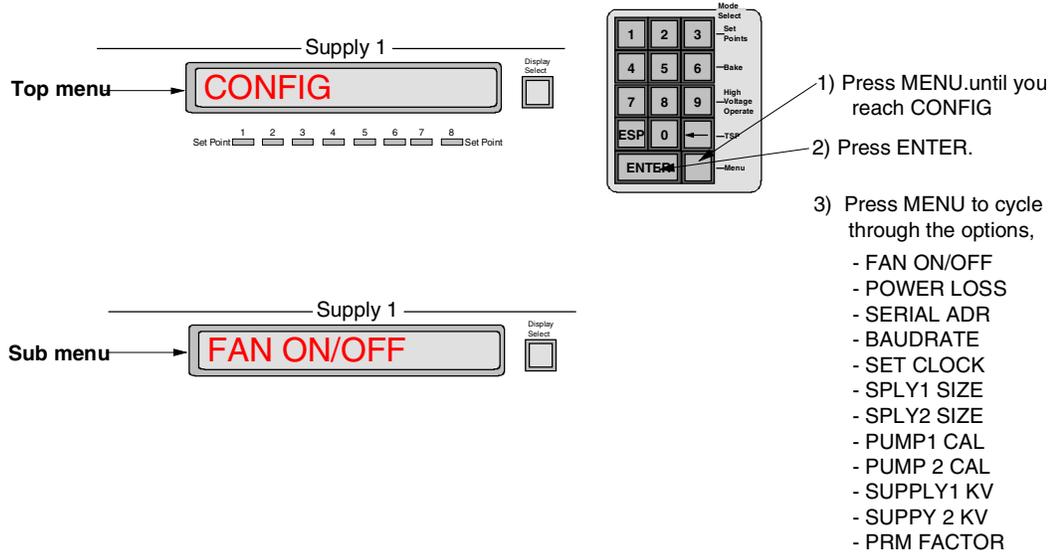


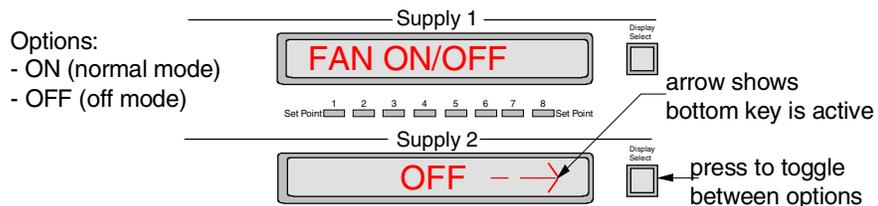
Figure 3-5. How to Reach Configuration Submenu.

### 3: Operation

#### FAN ON/OFF

Use the following procedure to set the fan to off or full speed. If you set the fan to off, the next pump start-up sequence turns it back on. If the pump draws high current, the fan automatically restarts.

1. Press the **Menu** key to cycle through the menu until you reach CONFIG.
2. Press **ENTER** to step to the submenu selection FAN ON/OFF.
3. Press **ENTER** again
4. An arrow points to the bottom **Display Select** key to show it is active. Press it to toggle between ON and OFF.

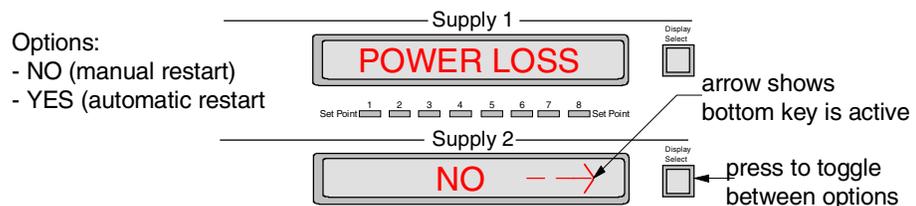


5. When you reach the desired option, press **ENTER** to save the your selection.

#### POWER LOSS RESTART

You can choose yes or no to have both pumps start automatically after a power loss.

1. Press the **Menu** key to cycle through the menu until you reach CONFIG.
2. Press **ENTER** to step to the submenu and press the **Menu** key to cycle to POWER LOSS.
3. Press **ENTER**.
4. An arrow points to the bottom **Display Select** key to show it is active. Press it to toggle between Yes and No.



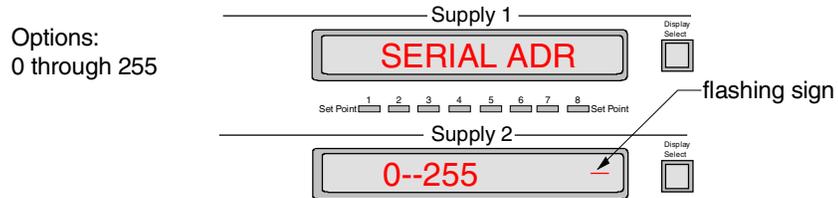
5. When you reach the desired option, press **ENTER** to save the your selection.

### 3: Operation

#### SERIAL ADR

You can choose which serial address to use for the Physical Electronics Serial Communications Protocol. Default is 5.

1. Press the **Menu** key to cycle through the menu until you reach CONFIG.
2. Press **ENTER** to step to the submenu and press the **Menu** key to cycle to SERIAL ADR.
3. Press **ENTER**. The bottom display shows the current address followed by a flashing sign to indicate that you may key in a new address (0 – 255).

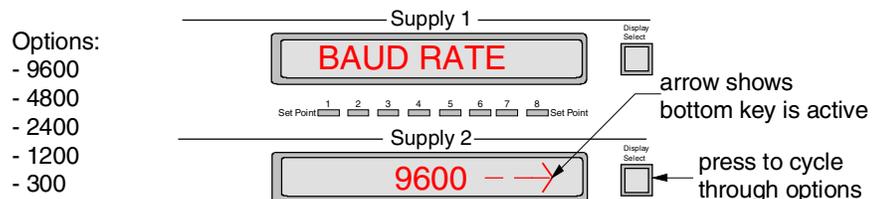


4. First use the backspace (←) key to overwrite, and then enter the desired address with the numerical keys.
5. Press **ENTER** to save the changes.

#### BAUD RATE

You can select the baud rate to use: 9600, 4800, 2400, 1200, or 300.

1. Press the **Menu** key to cycle through the menu until you reach CONFIG.
2. Press **ENTER** to step to the submenu and press the Menu key to cycle to BAUD RATE.
3. Press **ENTER** again to display the rate.
4. An arrow points to the bottom **Display Select** key to show it is active. Press it to cycle through the baud rate options — 9600, 4800, 2400, 1200, or 300.



5. When you reach the desired option, press **ENTER** to save the your selection.

### 3: Operation

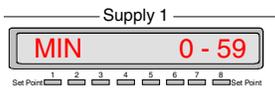
#### SET CLOCK

You can set the time and date of the clock. The values must be stepped through one at a time: hours, minutes, day, and date. For each value, the current data is displayed along with a flashing sign. Press **ENTER** to accept these values, or use the backspace (←) and numerical keys to key in a new value and then press **ENTER**.

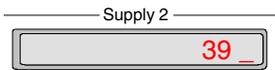
1. Press the *Menu* key to cycle through the menu until you reach CONFIG.
2. Press **ENTER** to step to the submenu and press the *Menu* key to cycle to SET CLOCK.

*NOTE: When you press ENTER in step 3 the display will momentarily flash the battery status.*

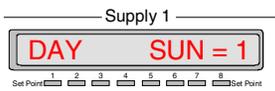
3. Press **ENTER**. The bottom display shows the hour setting followed by a flashing sign to indicate that you may enter the desired hour (0-23) using the backspace and numerical keys.



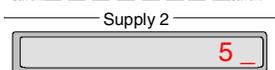
4. Press **ENTER** to save the hour value. The bottom display now shows the current minute setting.



5. Use the backspace and numerical keys to enter the minute value (0-59).



6. Press **ENTER** to save the minute value. The bottom display now shows the current day setting.



7. Key in the day: 1 through 7 where Sunday=1, Monday =2, and so on. Press **ENTER** to save.

8. You can now set the correct date:

- Key in the **day** of the month and press **ENTER** to save.
- Key in the **month** and press **ENTER** to save.
- Key in the **year** and press **ENTER** to save.

*Save changes?*

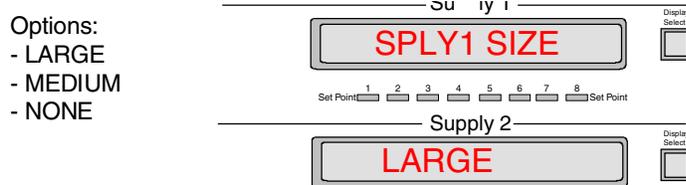
Press the top **Display Select** key (YES) to save changes, or the bottom **Display Select** (NO) to exit without saving changes.

### 3: Operation

SPLY1 SIZE  
SPLY2 SIZE

To display the supply option installed (large, medium or none) for supply 1 and supply 2, use the following procedure.

1. Press the **Menu** key to cycle through the menu until you reach CONFIG.
2. Press **ENTER** to step to the submenu and press the **Menu** key to cycle to SPLY1 SIZE.
3. Press the **ENTER** key. The bottom display shows the pump option installed for supply 1.



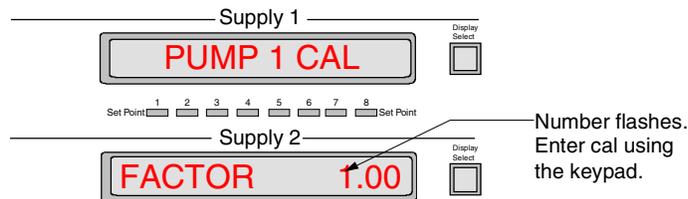
4. Press the **Menu** key twice to select SPLY2 SIZE, and press **ENTER**. The bottom display shows the pump option installed for supply 2.

PUMP 1 CAL  
FACTOR

Each pump has a calibration factor. This factor is multiplied by pressure to increase or decrease it. You need to specify an acceptable factor between 0.00 and 9.99. Use the following procedure.

PUMP 2 CAL  
FACTOR

1. Press the **Menu** key to cycle through the menu until you reach CONFIG.
2. Press **ENTER** to step to the submenu and press the **Menu** key to cycle to PUMP 1 CAL FACTOR.
3. Press the **ENTER** key. The bottom display shows the calibration factor with the first number flashing.



4. Key in a new value and press **ENTER** to save the changes.
5. Press the **Menu** key to select PUMP 2 CAL FACTOR.
6. Repeat Steps 3 and 4.

### 3: Operation

SUPPLY1 KV  
SUPPLY2 KV

To display what voltage is strapped to the high voltage transformer for supply 1 and 2 (5600 or 7000), use the following procedure.

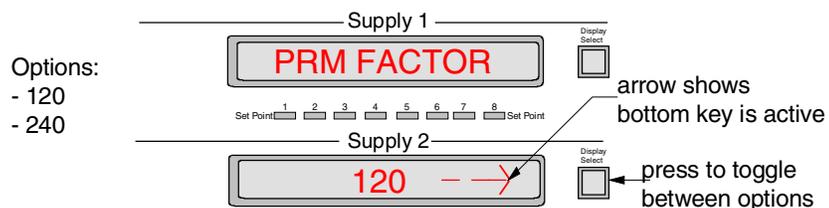
1. Press the **Menu** key to cycle through the menu until you reach CONFIG.
2. Press **ENTER** to step to the submenu and press the **Menu** key to cycle to SUPPLY1 KV.
3. Press the **ENTER** key. The bottom display shows the voltage strapped to supply 1.
4. Press the **Menu** key twice to select SUPPLY2 KV, and press **ENTER**. The bottom display shows the voltage strapped to supply 2.

PRM FACTOR

To display what line voltage the DIGITEL MPC is set to, you need to specify it — 120 or 240. Use the following procedure.

**ATTENTION:** *Setting the PRM FACTOR merely informs the software how the MPC is configured, it does not configure it.*

1. Press the **Menu** key to cycle through the menu until you reach CONFIG.
2. Press **ENTER** to step to the submenu and press the **Menu** key to cycle to PRM FACTOR.
3. Press the **ENTER** key.
4. An arrow points to the bottom **Display Select** key to show it is active. Press it to toggle between 120 and 240.



5. When you reach the desired option, press **ENTER** to save the your selection.

### 3: Operation

#### Running Diagnostics

DIAGNOSTCS  
overview

Press the **Menu** key to cycle through the top menu selections until you reach DIAGNOSTCS. Press **ENTER** to step to its submenu. Press the **Menu** key to cycle through the following 6 submenu selections:

- REVISION
- CALIBRATION
- ERROR CODE
- RST DFLTS
- DISPLY/KEY
- LINE FREQ

Press **ESC** to exit the submenu and return to DIAGNOSTCS.

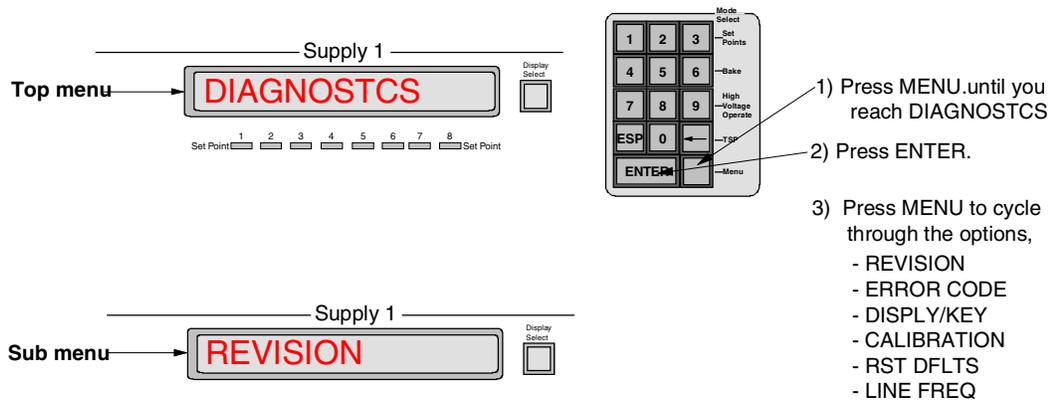
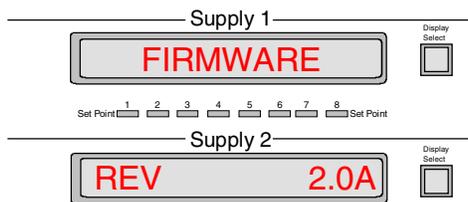


Figure 3-6. How to Reach DIAGNOSTCS Submenu.

REVISION

The first diagnostic submenu item is REVISION. Press **ENTER**, the bottom display shows the revision level of the firmware/software.



### 3: Operation

**ERROR CODE** Table 3-4 provides a list of error codes and their meanings. Here is how you get there.

1. From DIAGNOSTCS, press **ENTER** to step to its submenu.
2. Press the *Menu* key to cycle to ERROR CODE.
3. Press **ENTER**.  
 Display 1 shows the last error code for pump 1.  
 Display 2 shows the last error code for pump 2.

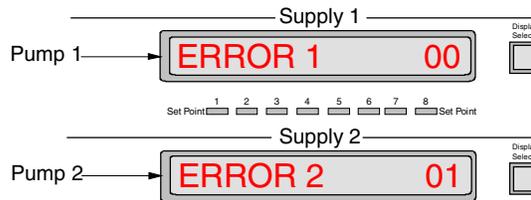


Table 3-4. Error messages.

Error	Description
00	No errors.
01	Too many cool down cycles. The MPC makes three attempts to start a pump. Cool down can be reached for various reasons. See codes 05, 06, and 07.
02	Running pressure too high. Pressure of a started pump climbed above 1.0 E-04 Torr for more than 1 second.
03	Running primary current too high. Current of a started pump climbed to a level that was too high for either the pump or the supply.
04	Running pressure too high. Pump pressure that is in the process of starting, climbed above 1.0 E-04 Torr.
While in cool down, the code will be either 05, 06, or 07 to let you know the reason for cool down.	
05	Pump power. Cool down was entered because pump power exceeded a safe value.
06	Supply current. Cool down was entered because the current from the supply exceeded a safe value.
07	Short circuit. Cool down was entered because the supply output was a short circuit.
08	Supply malfunction. Possibly a blown fuse.
09	Voltage too low. HV was shut down because HV dropped below 1200V.

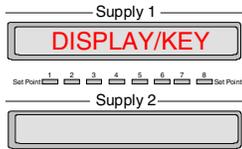
**LINE FREQ** From DIAGNOSTCS, press **ENTER** to step to its submenu. Press *Menu* to cycle to LINE FREQ. Press **ENTER** to display the line frequency.

**RST DFLTS** RST DFLTS allows you to clear supply calibration, disable all setpoints, and reset pump cal factor to zero.

1. From DIAGNOSTCS, press **ENTER** to step to its submenu.
2. Press *Menu* to cycle to RST DFLTS.
3. Press **ENTER** to display RESET DEFAULTS. Press **ENTER** again. Press **ENTER** a third time to confirm, or **ESC** to exit without resetting defaults.

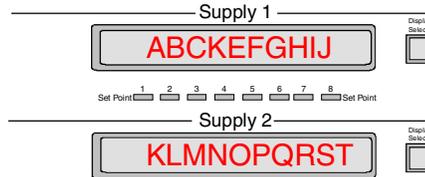
### 3: Operation

#### DISPLY/KEY

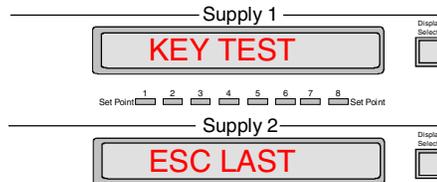


This submenu selection allows you to test the display, keypad, and LEDs.

1. From DIAGNOSTCS, press **ENTER** to step to its submenu.
2. Press **Menu** to cycle to DISPLY/KEY.
3. Press **ENTER** to test the display. Both displays show alpha-numeric characters. Press **ENTER** again to test the remaining characters.



4. Press **ENTER** to test the keypad.



5. As you press each key to test it (press the **ESC** key last), the key is displayed on the bottom display. Some keys are displayed as they are. Other keys (the **ENTER** key for example) are displayed as symbols. The keys are displayed as follows:

Keys	Displayed As
1, 2, 3, 4, 5, 6, 7, 8, 9, 0	1, 2, 3, 4, 5, 6, 7, 8, 9, 0
Backspace (←) key	←
ENTER	→
Menu (blank) key	M
Display Select 1 key	A
Display Select 2 key	B

6. Press **ESC** to exit the keypad test and enter the LED test. The MPC first tests the ODD LEDs.

Leds flash as they are tested.



Press **ENTER** again test ALL LEDs.

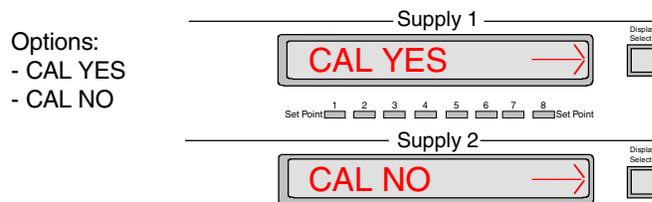
Press **ENTER** again test EVEN LEDs.

7. Press **ESC** to return to the DISPLY/KEY submenu. Press **ESC** again to step up to DIAGNOSTICS.

### 3: Operation

**CALIBRATION** For the calibration procedure remove the HV cables from the rear panel of the DIGITEL MPC.

1. From DIAGNOSTCS, press **ENTER** to step to its submenu. Press **Menu** to cycle to CALIBRATION.
2. Press **ENTER** to start calibrating the MPC. A momentary message "TURNING SUPLYS OFF" appears to let you know that the MPC is turning off the supplies.
3. Press **ENTER** to display the first instruction, which reminds you to remove the HV cables.
4. Press **ENTER** to display next instruction.



5. Press the top **Display Select** key to calibrate the MPC. If you don't wish to calibrate at this time, press the bottom **Display Select** key to exit.

## Display Messages

Status messages that appear on a display assist you in the operation of the DIGITEL MPC. Most of these messages occur immediately after a function key is pressed. Table 3-5 provides a description these messages.

Table 3-5. Display Messages.

Status	Description
STANDBY	STBY command received from computer interface or keypad (High Voltage Operate key) was placed into standby by the remote STBY input on the set point option. High voltage is shut off.
SAFE-CONN	The SAFE-CON cable is not connected properly.
COOL DOWN	The DIGITEL MPC has entered cool-down mode. As long as it is in cool-down, this message remains on the display. After 3 cool-downs, the DIGITEL goes into STANDBY.
PUMP ERROR	The pump has shut down. Go to the DIAGNOSTCS submenu, ERROR CODE.

### 3: Operation

## Analog Outputs

Two analog outputs (voltage and current) from each high voltage (HV) supply are provided at **J104 SET PT ANALOG OUT**, a 37-pin SUB-D connector on the rear panel of the DIGITEL MPC.

#### Voltage measuring

HV supply outputs 1 and 2 provide 0 to 10 volt signals with a scale factor of 1V/1000V output voltage. To obtain ion pump voltage, measure voltage at **J104** located on the rear panel of the DIGITEL MPC. Use the following table.

#### HV Supply Outputs 1 and 2

Measure Pins	Output	Scale Factor
+30, 29 (Gnd) at <b>J104</b>	HV Supply 1	1V/1000V
+36, 35 (Gnd) at <b>J104</b>	HV Supply 2	1V/1000V

#### Current measuring

Analog current outputs 1 and 2 are proportional to pump current with jumper selectable (at connector J106 on the CPU board) scale factors of either:

- 1 volt per 100mA ( $I_{HIGH}$ ) or 100uA ( $I_{LOW}$ ) on a Large HV supply
- 1 volt per 20mA ( $I_{HIGH}$ ) or 20uA ( $I_{LOW}$ ) on a Medium HV supply

To obtain ion pump current, measure voltage at **J104** located on the rear panel of the DIGITEL MPC. Use the following tables.

#### Analog Current Output 1

J104 Pins	Jumpers, J106*	Current	Scale Factor
+32, 31 (Gnd)	3-4	Sply1 $I_{LOW}$	1V/100 $\mu$ A (large) or 1V/20 $\mu$ A (medium)
	5-6	Sply1 $I_{HIGH}$	1V/100mA (large) or 1V/20mA (medium)
	1-2	Sply2 $I_{LOW}$	1V/100 $\mu$ A (large) or 1V/20 $\mu$ A (medium)
	7-8	Sply2 $I_{HIGH}$	1V/100mA (large) or 1V/20mA (medium)

\* Pins are jumpered at connector J106 located on the CPU board.

#### Analog Current Output 2

J104 Pins	Jumpers, J106*	Current	Scale Factor
+34, 33 (Gnd)	15-16	Sply1 $I_{LOW}$	1V/100 $\mu$ A (large) or 1V/20 $\mu$ A (medium)
	17-18	Sply1 $I_{HIGH}$	1V/100mA (large) or 1V/20mA (medium)
	13-14	Sply2 $I_{LOW}$	1V/100 $\mu$ A (large) or 1V/20 $\mu$ A (medium)
	19-20	Sply2 $I_{HIGH}$	1V/100mA (large) or 1V/20mA (medium)

\* Pins are jumpered at connector J106 located on the CPU board.

## Serial Interface

RS - 232/422/485 is an electrical standard specifying *hardware* requirements for a serial communications interface. The standard specifies a bi-directional (half duplex), multi-point interface, allowing multiple devices to be connected to the same serial port on a computer. The standard *does not set up or address any software protocols*. A carefully planned protocol for use between the remote devices and the controlling computer allows devices manufactured by different companies to function on the same port, even if they do not use the same protocol. This section lays out a standard protocol for use on any future PHI instruments that use the standard, and makes recommendations regarding hardware design in areas where software performance may be affected.

### Standard

The interface consists of a differential (balanced) twisted wire pair that is connected to all devices on that serial port. This makes the interface fairly immune to electrical and radio frequency noise generated in the vicinity. All units on the same port must be configured for the same baud rate.

Devices cannot send data until they have been addressed by the controlling computer. A typical command exchange for a device would be:

1. The computer sends a command.
2. Devices read the address.
3. When a device recognizes its address, it decodes the message and returns an acknowledge to the computer, along with any data that was requested.

### Specifics

Every communications exchange between the controlling computer and a PHI unit using the standard interface consists of a command packet (sent by the controlling computer), and a response packet (returned by the remote unit). All characters in these packets are ASCII. All fields are separated by a space (not required between the checksum and terminator). Hexadecimal numbers can be represented in either upper or lower case.

*Command  
packet*

The command packet (Table 3-6) is made up of at least five fields and contains information needed for a remote unit to perform a command. The minimum command packet (single command with no data) is 11 bytes long and consists of the following fields.

:START CHAR>	<space>	<ADDRESS>	<space>	<COMMAND>	<space>	<CHECKSUM>	<TERMINATOR>
1 byte	1 byte	2 byte	1 byte	2 byte	1 byte	2 byte	1 byte

### 3: Operation

Table 3-6. Command Packet.

Field	Size	Comment
1. START character	1 character (byte)	ASCII character is '~' (TILDA)
Start is the first byte in the command packet and tells remote units to start decoding a message. It should be implemented as a #define, so that it can be changed if necessary. As a #define, the character is rarely changed because it is hard coded into PHI remote units. <SPACE>		
2. ADDRESS	2 hex characters	Range 00 through FF
This field should be filled in with the hexadecimal representation of the integer address of the unit. The range provides 255 unique addresses for PHI controls. Only 32 devices may reside on the same serial port due to hardware loading limitations. <SPACE>		
3. COMMAND CODE	2 hex characters	Range 00 through FF
This field is one of 255 possible hexadecimal numbers, which is typically an index into a table of functions on the remote unit. Commands should be implemented as #defines with integers between 0 and 255. The integer value must be converted into ASCII hex before placement into the command packet character array. The command code must be two hex digits, even if the first is a zero. See Table 3-8. <SPACE>		
4. DATA field(s), optional	as needed	ASCII printable characters only
Data field(s) are for any commands that have a data value. For instance, a command to set a beam voltage in some unit would probably consist of a command to set the beam voltage, along with a value of beam voltage. If the command had more than one data value associated with it, such as setting an X and a Y value in a unit, the command field could be followed by two data fields (X and Y) separated by a space between them. All data must be sent in ASCII printable format (no binary or "control" characters). There is no limit on the number or size of data fields. It is up to the remote unit designer to keep practicality in mind when determining these fields. A data field is not required for all commands. <SPACE>		
5. CHECKSUM	2 hex characters	Computed checksum of packet
The calculated checksum must have its value in ASCII hexadecimal notation. It is calculated by adding the decimal value of all characters in the packet (excluding start, checksum, and terminator), and then dividing the result by 256. The integer remainder converted to two ASCII hex digits is the checksum. When a remote device receives a packet, the passed checksum is compared with a computed checksum and if they do not match, the device discards the packet.		
6. Terminator character	2 hex characters	ASCII carriage return
This field is an ASCII carriage return placed at the end of a command packet. This character is not the newline character "\n", but can be used in string assign statements as "\r". There is not a space between the checksum and terminator field.		

#### Decoding the command packet

A PHI remote unit operates in one of three modes. Receipt of data is interrupt driven or otherwise multiplexed so that other tasks are performed by the unit's microprocessor. When the unit receives a command packet, it continues monitoring for new commands while the current one is carried out.

1. **MONITOR.** The PHI unit monitors serial data traffic. When a PHI "start" character is detected, the PHI unit changes to the RECEIVE MODE.
2. **RECEIVE.** After receiving start, the unit tests subsequent characters for a valid PHI command packet. This mode must have a count down timer associated with it, which is a predetermined time for a valid command packet to be received. Furthermore if another PHI start character is received while in this mode, (i.e. the first PHI start character was actually part of a command packet for a non-PHI device) the unit responds by going back to the beginning of the RECEIVE mode, with a fresh timer setting. If a command packet is not received within the allowed time frame or if the

### 3: Operation

checksum does not match, the timer is disabled, the packet is discarded, and the mode is reset back to MONITOR. Once a command packet is received, the mode changes to RESPOND. The only way the unit can get to a RESPOND is by receiving

- a valid PHI start character followed by a space,
- a 2-byte hex value matching the unit's address followed by a space,
- at least one 2-character hex value command followed by a space,
- a 2-byte hex checksum matching the command packet's actual checksum,
- and a carriage return terminator.

3. RESPOND. The controlling computer is in count-down timer mode waiting for a response from the PHI unit. *All PHI units must respond within 500 milliseconds once a valid command has been received.* A valid response could be an error code indicating that the unit is BUSY with a previous command or an acknowledging response packet. After returning a response packet, the unit returns to MONITOR and executes the command. If the controlling computer needs to verify that the last command was successful, it sends a command to the unit requesting status feedback.

#### *Response packet*

The response packet is made up of at least five fields, and contains information to let the controlling computer know that the command requested was either recognized and accepted (STATUS = "OK"), or that an error condition occurred (STATUS = "ER"). The minimum packet also contains a RESPONSE CODE that is used either to pass an error code (if STATUS = "ER"), or is available for each unit to use as needed for a STATUS return of "OK". The minimum response packet (simple acknowledgment with no data) would consist of the following fields, and would be 12 bytes long.

: ADDRESS > <space> <STATUS> <space> <RESPONSE CODE> <space> <CHECKSUM> <TERMINATOR>  
2 byte      1 byte      2 byte      1 byte      2 byte      1 byte      2 byte      1 byte

*NOTE: When a device responds to the controlling computer, that response has been requested and is expected by the computer. For this reason, a specific "start" character is not required in the response packet. The address of the responding unit is included in the packet so the controlling computer can verify it to make the data exchange easier to view on an ASCII terminal.*

### 3: Operation

Table 3-7. Response Packet.

Field	Size	Comment
1. ADDRESS of unit	2 hex characters	Range 00 through FF
<p>This field is filled in with the hexadecimal representation of the integer address of the unit. The range provides 255 unique addresses for PHI controls. The controlling computer will use this field to determine that the correct remote unit is responding.</p> <p>&lt;SPACE&gt;</p>		
2. STATUS MNEMONIC	2 ASCII characters	Either OK or ER
<p>This field is made up of two ASCII characters and is either OK or ER. OK indicates success in recognizing the command. ER indicates an error condition which can mean that the command is invalid, or that the remote unit received the command but is still busy with a previous command. Specific information about ER is reported in the RESPONSE CODE field.</p> <p>&lt;SPACE&gt;</p>		
3. RESPONSE CODE	2 hex characters	Range 00 through FF
<p>For an error condition with an incoming command, this field returns an error number to the controlling computer. For non-error conditions, this field returns a status byte/word to the controlling computer, which is definable by the PHI unit, and can vary with the needs of individual commands within a unit, as well as varying from unit to unit. Data must be in ASCII printable format.</p> <p>&lt;SPACE&gt;</p>		
4. DATA field(s), optional	as needed	ASCII printable characters only
<p>Data field(s) are used to respond to commands requesting data. For example, a command requesting the current voltage setting in a unit would have the reading placed in a data field. Data must be in ASCII printable format. There is no limit on the number or size of data fields. Data is not required for all responses.</p> <p>&lt;SPACE&gt;</p>		
5. CHECKSUM	2 hex characters	Computed checksum of packet
<p>Checksum contains a simple computed checksum of the command packet. The value must be in ASCII hexadecimal notation. The checksum is calculated by adding the decimal value of all characters in this packet (including the space before the checksum field) and then dividing the result by 256. The integer remainder converted to two ASCII hex digits is the packet checksum. When the controlling computer receives a response packet, the passed checksum is converted from the hex value to a binary integer and compared with a computed checksum. If they are not the same, considers it an error, and repeats the last command. When qualified technicians are testing the remote unit using a dumb terminal this returned checksum value can be ignored.</p>		
6. Terminator character	2 hex characters	ASCII carriage return
<p>This field is an ASCII carriage return placed at the end of a packet. This character is not the newline character “\n” which is actually an ASCII linefeed, but can be assigned using the “\r” designation in a string. There is not a space between the checksum and terminator field.</p>		

### 3: Operation

Table 3-8. RS-232/422/485 Commands — PHI Standard Serial Interface.

Hex Cmd	Description
01	MODEL NUMBER. A description of the unit. Response: <i>DIGITEL MPC</i> .
02	VERSION. Firmware revision level. Response: <i>FIRMWARE X.X.n</i> where X.X is the numerical revision level for major changes and n is an alpha character for minor changes.
03	FIRMWARE. Request to download new firmware.
04	S-RECORD. Download a Motorola S-Record.
05	SET EXTERNAL INIT. Record unit initialization done.
06	GET EXTERNAL INIT. Check status of unit initialization.
0A	READ CURRENT. Reads pump current. Parameters: <b>1</b> or <b>2*</b> . Response: <i>X.XE-X AMPS</i> .
0B	READ PRESSURE. Reads pump pressure. Parameters: <b>1</b> or <b>2*</b> . Response: <i>X.XE-XX UUU</i> where UUU is pressure units (Torr, MBR, or PA).
0C	READ VOLTAGE. Reads pump voltage. Parameters: <b>1</b> or <b>2*</b> . Response: <i>XXXX</i> in volts.
0D	GET SUPPLY STATUS. Reads present status of the specified supply. Parameters: <b>1</b> or <b>2*</b> . Status response: <i>WAITING TO START, STANDBY, SAFE-CONN, RUNNING, COOL DOWN XX, PUMP ERROR XX, or HV SWITCH IS OFF XX</i> , where XX is the pump error code.
0E	SET PRESS UNITS. Specifies the default pressure units. Parameters: <b>UUU</b> where <b>UUU</b> is pressure units — Torr, MBR, or PA.
0F	GET DATE/TIME. Reads the date and time. Response: <i>w dd/yy hh:mm</i> , where <i>w</i> is day of the week (1=Sunday); <i>dd</i> is date; <i>mm</i> is month; <i>yy</i> is year; <i>hh</i> is hour, and <i>mm</i> is minute.
10	SET DATE/TIME. Sets the date and time. Response: <i>w dd/yy hh:mm</i> , where <i>w</i> is day of the week (1=Sunday); <i>dd</i> is date; <i>mm</i> is month; <i>yy</i> is year; <i>hh</i> is hour, and <i>mm</i> is minute.
11	GET PUMP SIZE. Reads pump size in liters per second. Parameters: <b>1</b> or <b>2<sup>1</sup></b> . Response: <i>ssss L/S</i> , where <i>ssss</i> is pump size.
12	SET PUMP SIZE. Parameters: <b>1, size</b> or <b>2*, size</b> . Response: <i>ssss L/S</i> . Size = 0 or 10 – 1200.
1C	SET SUPPLY SIZE. Parameters: <b>1, size</b> or <b>2*, size</b> . <b>Size</b> is large or medium.
1D	GET CAL FACTOR. Reads the calibration factor that modifies pressure. Parameters: <b>1</b> or <b>2*</b> . Response: <b>n.nn</b> . <b>n.nn</b> is 0.00 – 9.99.
1E	SET CAL FACTOR. Sets calibration factor. Parameters: <b>1, n.nn</b> or <b>2*, n.nn</b> . <b>n.nn</b> is 0.00 – 9.99.
20	GET HV STRAPPING. Reads the supplies' high voltage strapping. Parameters: <b>1</b> or <b>2<sup>1</sup></b> . Response: <i>5600</i> or <i>7000</i> .
22	READ PARM FACTOR. Informs the firmware (but does not reconfigure the unit) which line voltage the MPC is strapped for. Parameters: <b>120</b> or <b>240</b> .
23	SET PARM FACTOR. Reads the line voltage that the unit is strapped for. Response: <i>120</i> or <i>240</i> .
24	GET LINE FREQUENCY. Reads the line frequency. Response: <i>50HZ</i> or <i>60HZ</i> .
25	SET DISPLAY. Changes the display parameter. Parameters: <b>1, parameter</b> or <b>2*, parameter</b> . <b>Parameter</b> is volts, current, or pressure.

\* Parameters 1 or 2 allow you to select which supply.

### 3: Operation

Table 3-8. RS-232/422/485 Commands — PHI Standard Serial Interface (continued).

Hex Cmd	Description
27	TSP TIMED. Sets TSP mode of operation to TIMED. Cycles TSP once every <b>X</b> minutes, for <b>Y</b> seconds, <b>Z</b> number of cycles, but only if pressure is above specified amount. Parameters: <b>XXX</b> (000 – 999), <b>YYY</b> (000 – 999), <b>ZZZ</b> (000 – 999), and <b>X.XE-XX</b> is specified pressure units (Torr, MBar, or PA).
28	TSP OFF. Disables the TSP. Sets values: <b>ZZZ</b> = 0, <b>X.XE-XX</b> = 0.1E-9.
29	FILAMENT ACTIVE. Sets which filament is active during TSP Timed. Parameters: <b>N</b> (filament number).
2A	TSP STATUS. Reports how many cycles left and minutes each filament has been used. Response: <b>CCC</b> , <b>N- MMMM</b> , <b>N- MMMM</b> , <b>N- MMMM</b> , and <b>N- MMMM</b> . <b>CCC</b> (number of cycles left to execute), <b>N</b> (filament number), and <b>MMMM</b> (total amount of logged time in minutes that the filament has been used).
2B	FILAMENT CLEAR. Executed after degassing. Resets logged time of all filaments to zero.
2C	FILAMENT AUTO. Automatically advances to the next filament if the one being used is open. Parameters: <b>YES</b> or <b>NO</b> .
2D	TSP CONTINUOUS. Sets the TSP mode of operation to continuous.
2E	SUBLIMATION LEVEL. For TSP Timed mode of operation, sets the TSP controlling parameter (watts or amps) and its value. Parameters: <b>XXX,P, N</b> . <b>XXX</b> = value; <b>P</b> = W for watts or A for amps; <b>N</b> = number of seconds of on time (0 - 255).
2F	DEGAS. A maintenance tool. that conditions your filaments. Each filament is fired once. DEGAS uses the specified ON TIME and SUBLEVEL setup parameters, but starts its firing at half the value. For example, if current is specified at 50 amps and time at 30 seconds, then the TSP fires at 25A for the first 15 sec and then steps up to 50A for the remaining 15 sec.
32	CONTROL FAN. Parameters: <b>ON</b> or <b>OFF</b> .
33	SET AUTO-RESTART. Sets pump to automatically restart on power up. Parameters: <b>YES</b> or <b>NO</b> .
34	GET AUTO RESTART. Response: <b>YES</b> or <b>NO</b> .
37	START PUMP. Starts specified pump. Parameters: <b>1</b> or <b>2*</b> .
38	STOP PUMP. Stops specified pump. Parameters: <b>1</b> or <b>2*</b> .
3C	GET SETPOINT. Reads configuration of specified set point. Response: <i>n, s, X.XE-XX, Y.YE-YY</i> . <i>n</i> = set point number (1-8); <i>s</i> = supply driving it; <i>X.XE-XX</i> = on pressure; <i>Y.YE-YY</i> = off pressure.
3D	SET SETPOINT. Configures a specified set point. Parameters: <b>n, s, X.XE-XX, Y.YE-YY</b> . <b>n</b> = set point number (1-8); <b>s</b> = supply driving it (0=inactive, 1=supply 1, 2=supply 2, 3=bake supply 1, and 4=bake supply 2); <b>X.XE-XX</b> = on pressure; <b>Y.YE-YY</b> = off pressure.
3E	SETUP BAKE. Arms the bake. Parameters: <b>hhh, HH:MM</b> . <b>hhh</b> is bake duration (0 –255 hours); <b>HH:MM</b> is the start time in hours and minutes.
3F	BAKE TIME LOG. Response: <i>nnn.nH</i> . <i>nnn.nH</i> is the total time the set points have been on.
40	DISABLE BAKE.
44	LOCK KEYPAD.
45	UNLOCK KEYPAD.

\* Parameters 1 or 2 allow you to select which supply.

### 3: Operation

## CRC Checksum Error

The following is an example of the CRC checksum calculation.

The response from the DIGITEL MPC to command 01 is:

00 OK 00 DIGITEL MPC DC

1. Table 3-8 gives the values of the response.

Add all values in Table 3-8 to get 4DC.

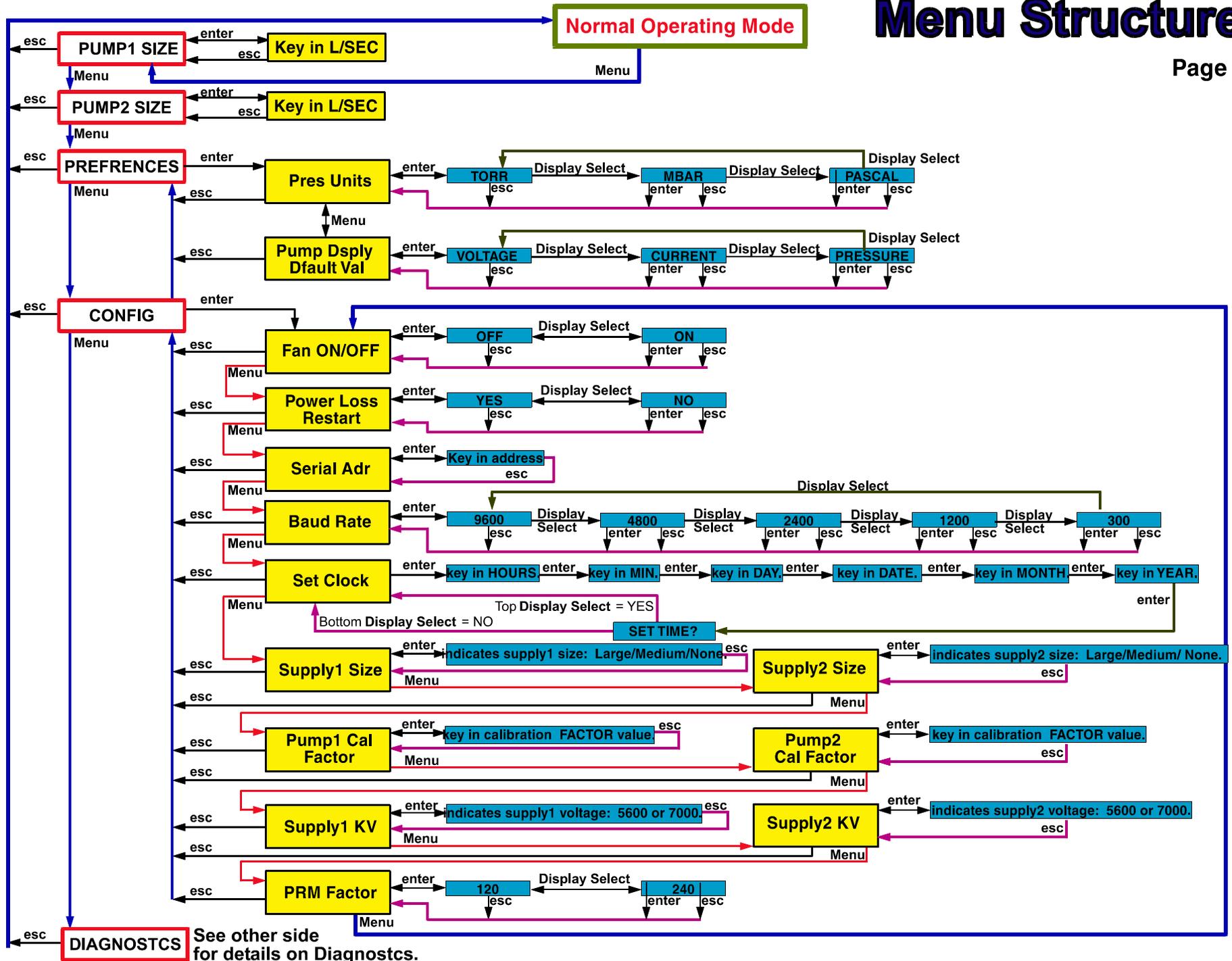
2. Divide by 100 (256).  $4DC \div 100 = 4$  with a remainder of DC.

The remainder, DC, is the CRC.

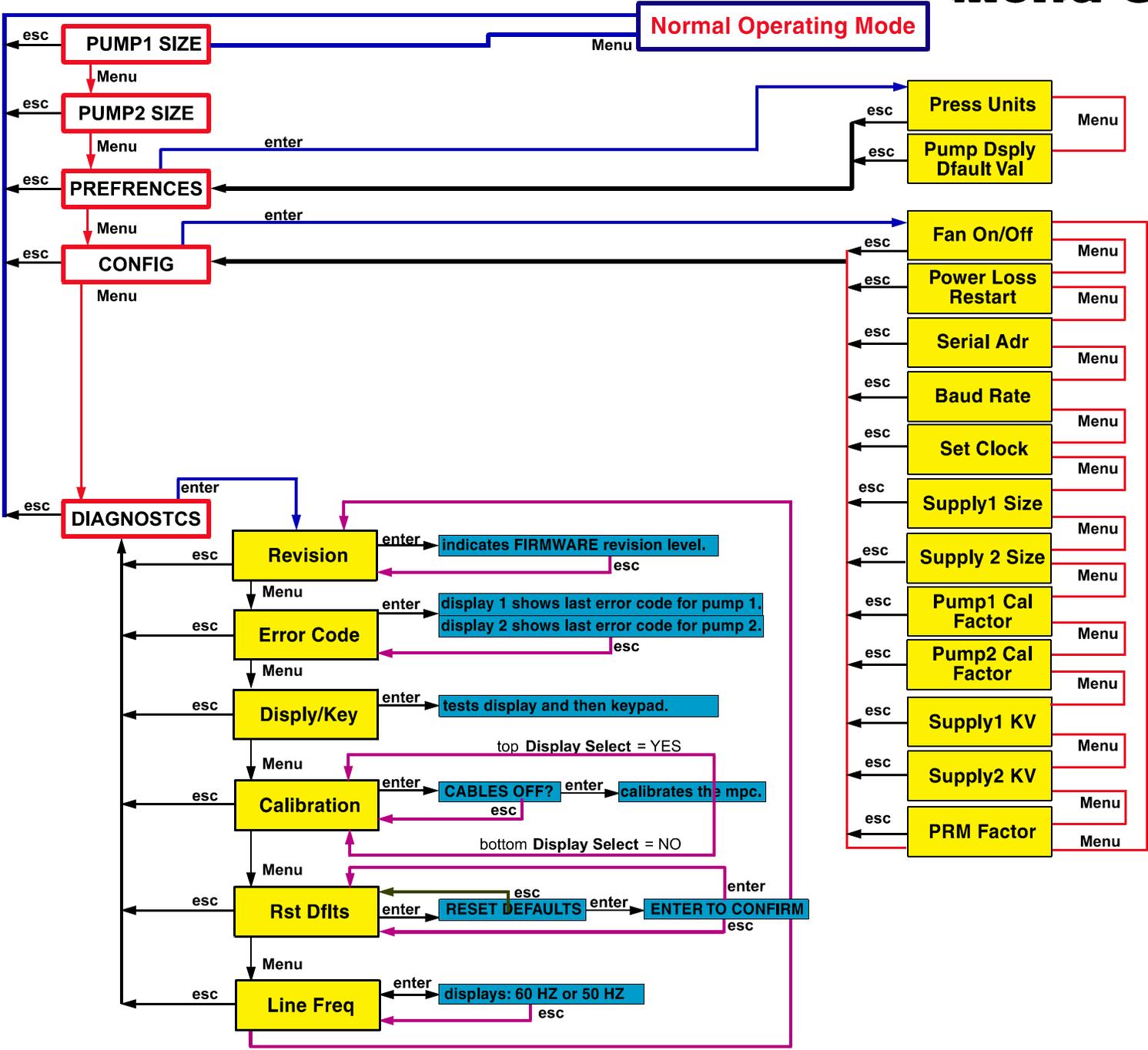
Table 3-9. CRC Checksum Calculation.

Response	Value
0	30
0	30
space	20
O	4F
K	4B
space	20
0	30
0	30
space	20
D	44
I	49
G	47
I	49
T	54
E	45
L	4C
space	20
M	4D
P	50
C	43
space	20

# Menu Structure



# Menu Structure



# Section 4:

## Service

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If the DIGITEL™ Multiple Pump Control (MPC) fails to perform specified functions, either seek the services of qualified personnel or contact PHI Customer Service as follows:

**By mail:**

Physical Electronics, Inc.  
PHI Customer Service, M/S G11  
6509 Flying Cloud Drive  
Eden Prairie, MN 55344  
USA

**By e-mail:**

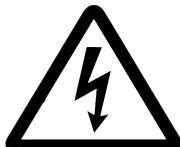
service@phi.com

**By telephone or fax:**

Region	Telephone	Fax
U.S.	1-800-922-4744	1-612-828-6325
Outside U.S.	1-612-828-5831	1-612-828-6325
Japan	81-46-785-6522	81-46-785-4411
Europe	49-89-96275-0	49-89-96275-50



***WARNING: Performing any service tasks other than those described in this section without the assistance of PHI Customer Service could result in serious injury, could damage equipment, and may nullify applicable equipment warranties.***



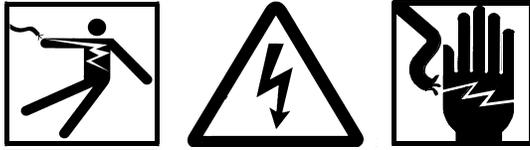
***WARNING: Service procedures are for use by qualified and authorized personnel who have experience working with voltages greater than 50 volts.***

***To avoid personal injury, do not perform any installation or service procedures unless qualified to do so.***



***WARNING: Voltages up to 7000V are present. An interlock is provided to shut off power when the cover is removed. Do not defeat this interlock.***

#### 4: Service



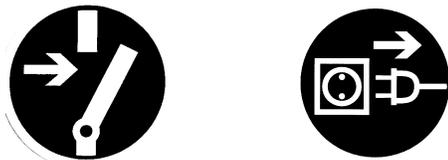
**WARNING:** Do not disconnect the high voltage cable with power on. After turning power off, allow at least one minute before disconnecting electrical equipment.



*Do not operate the control without a proper electrical ground or near water. The control may be damaged and its safety reduced, if operated outside of its specifications.*

*Circuit boards may be destroyed by a small static discharge. To avoid damaging the boards, use the following precautions:*

- *Handle boards at approved ESD workstation.*
- *Do not touch any electrical contacts.*
- *Do not rub boards against any insulator that may build up a static charge.*
- *When shipping boards, use approved ESD containers and packaging.*



**WARNING:** Voltages up to 7000V are present in the DIGITEL MPC. Turn off power and disconnect power cord before performing any service procedures in this section.

## MPC Components

The location of MPC components are found in Figure 4-1. Table 4-1 provides their part numbers.

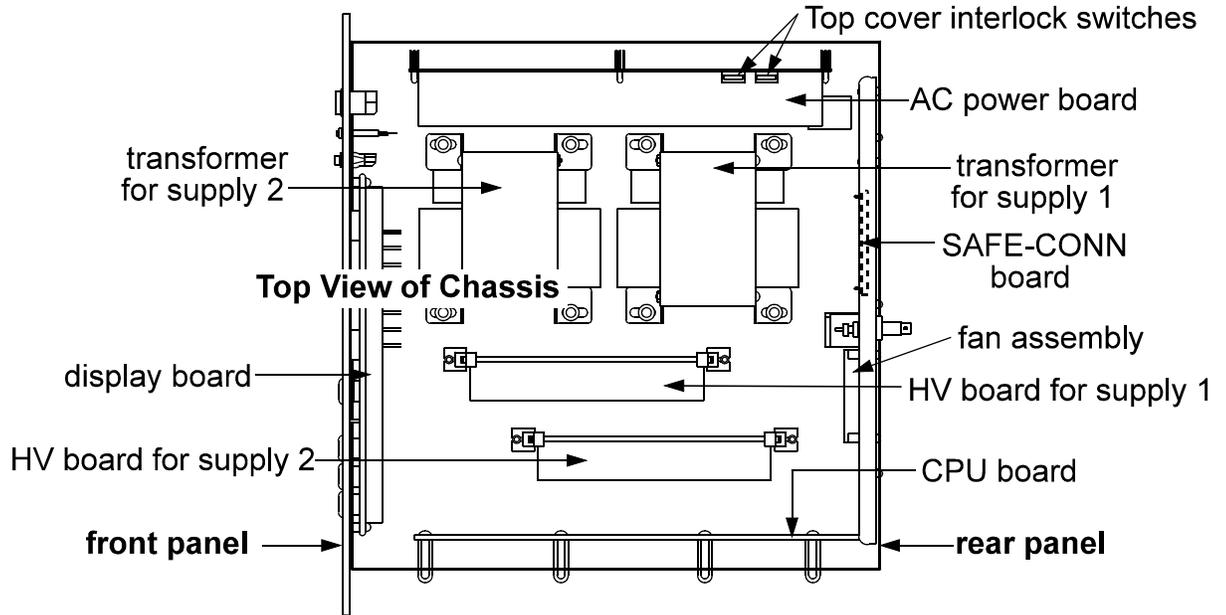


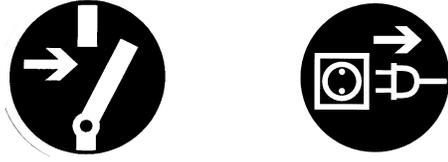
Figure 4-1. Location of MPC Components.

Table 4-1. MPC Component Parts List.

Component	Part Number	Component	Part Number
Display Board	635347	100 mA transformer	635452
HV amber lamps	611716	500 mA transformer	635451
Rear Panel Assembly	638757	100 mA HV Board	640574
SAFECONN Board	640728	500 mA HV Board	635465
Fan Filter	622775	<b>Cable Assemblies</b>	<b>Part Number</b>
Fan	635932	SAFECONN to CPU	636051
AC Power Board	640690	CPU to HV Board	636052
Fuses	see Table 4-3	AC Power to Display and CPU	636053
Interlock Switches	635805	SAFECONN to AC Power	636054
CPU Board	641539	CPU to Display	635934
		CPU to Rear Panel (TSP Opt)	635931

## Maintenance Procedures

Table 4-2 lists maintenance procedures that need to be performed on the MPC.



**WARNING:** Voltages up to 7000V are present in the DIGITEL MPC. Turn off power and disconnect power cord before performing any maintenance procedures.

Table 4-2.

Routine Maintenance Schedule.

Maintenance	How often?
Clean the chassis interior	every six months
Clean the air filter	every six months
Replace lamps	as necessary
Replace fuses	as necessary

### Removing the Top Cover

Turn off power and disconnect power cord from the DIGITEL MPC. To gain access to the unit interior, remove the nine screws securing the top cover to the chassis.

### Cleaning the Chassis

1. Turn off power and disconnect power cord from the DIGITEL MPC.
2. Remove the top cover.
3. Clean the interior of the chassis with clean, oil-free, compressed air at 50 psi maximum.
4. Clean all high voltage wiring and connections; they are susceptible to arcing.
5. Inspect the HV insulation for cracks. If you find any, contact your service representative.

#### 4: Service

##### **Cleaning the Fan Filter**

The fan filter is located on the rear panel.

1. To remove the filter, gently compress it and pull the filter out of the frame.
2. Clean filter with warm water to remove dust and dirt that restricts air flow.
3. After the filter is completely dry, gently compress and insert it into the frame.

*NOTE: If the fan filter is worn, replace it (part number 622775).*

##### **Replacing Fuses**

MPC fuses are located on the AC Power board (Figure 4-2). Replace the fuses according to Table 4-3.

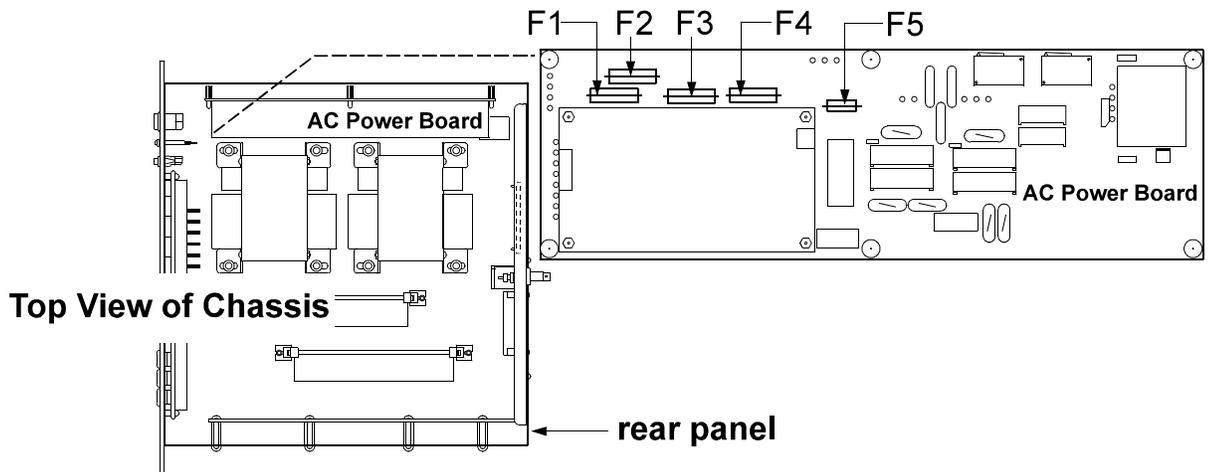


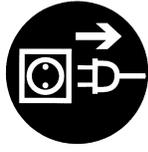
Figure 4-2. Location of Fuses on the AC Power Board.

Table 4-3. Part Numbers (p/n) — Fuses on the AC Power Board.

		F3 – Supply 1	F4 – Supply 2	F1 and F2 – Main Power	F5 – Aux Power
<b>100 mA</b>	<b>100/120</b>	2.5A, 250V, slo-blo, IEC, sheet 5		10A, 250V, slo-blo	2.5A, 250V, slo-blo
<b>HV Card</b>	<b>Vac</b>	p/n 639627			
	<b>200/240</b>	1.25A, 250V, slo-blo, IEC, sheet 5		sheet 5, IEC	pigtail
	<b>Vac</b>	p/n 636475			
<b>500 mA</b>	<b>100/120</b>	6.3A, 250V, slo-blo, IEC, sheet 5		p/n 636478	p/n 639638
<b>HV Card</b>	<b>Vac</b>	p/n 636477			
	<b>200/240</b>	4.0A, 250V, slo-blo, IEC, sheet 5			
	<b>Vac</b>	p/n 639623			
Fuse cover for F1 through F4 is p/n 638170					

## Input and Output Voltage Selection

Use the following [Input Voltage Selection](#) Procedure to change input voltage to 115 or 230 Vac. The voltage shown on the rear panel indicates the present configuration. Use the [Output Voltage Selection](#) Procedure to change output voltage to 7000 or 5600 Vdc.



**WARNING:** Voltages up to 7000V are present in the DIGITEL MPC. Turn off power and disconnect the power cord before servicing the unit.

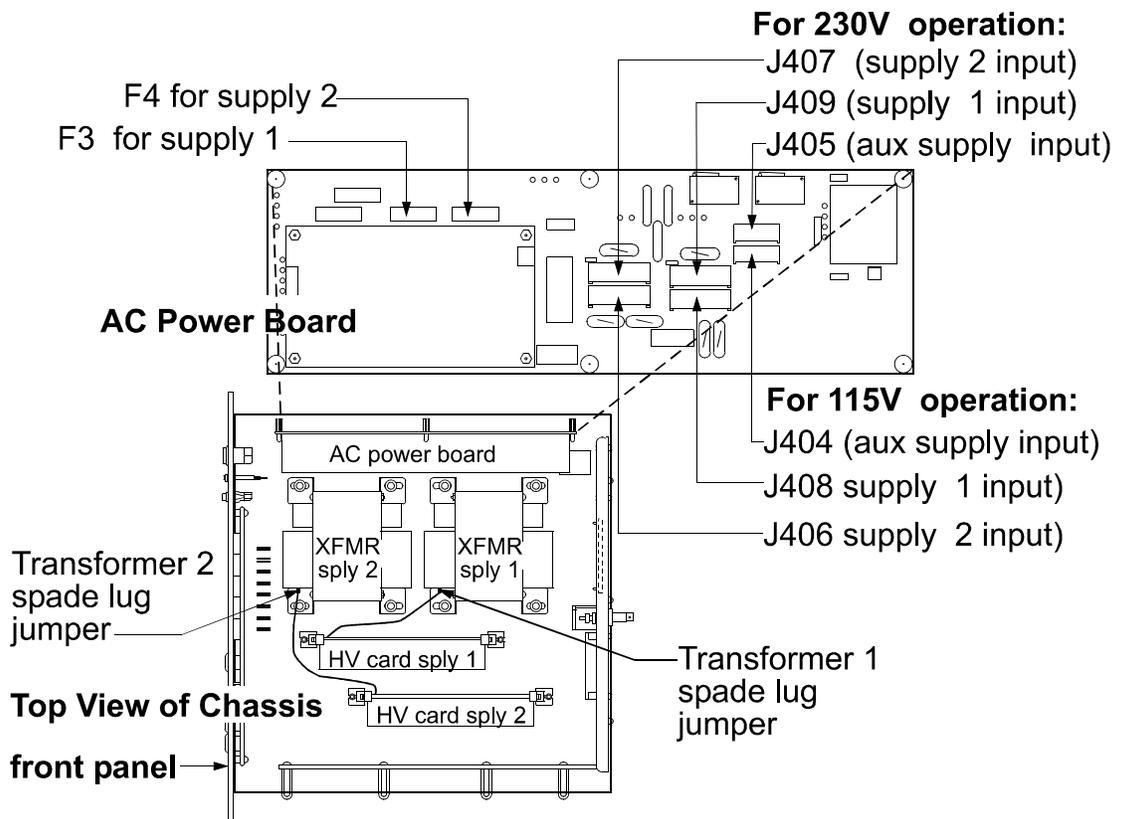


Figure 4-3. Input and Output Voltage Conversion — Location of Components.

#### 4: Service

##### **Input Voltage Selection Procedure**

1. Disconnect power and remove the top cover.
2. On the AC Power board (Figure 4-3), remove the cover from the two fuses (F3 for supply 1 and F4 for supply 2) and replace the fuses according to the table below.

Table 4-4. *Input Voltage Conversion Fuse Values for the DIGITEL MPC.*

	F3/F4 — 100/120 V		F3/F4 — 200/240 V	
100 mA HV Card	2.5A, 250V, slo-blo, IEC	p/n 639627	1.25A, 250V, slo-blo, IEC	p/n 636475
500 mA HV Card	6.3A, 250V, slo-blo, IEC	p/n 636477	4.0A, 250V, slo-blo, IEC	p/n 639623

3. Replace the cover on each fuse.
4. On the AC Power board (Figure 4-3), pull out the input voltage connectors and reconnect them to appropriate voltage according to the table below.

Table 4-5. *Input Voltage Conversion Connectors for the DIGITEL MPC.*

	100/120 V	200/240 V
supply 2 input	J406	J407
supply 1 input	J408	J409
aux supply input	J404	J405

5. Replace the top cover of the MPC and reconnect power.

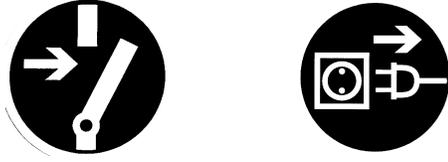
##### **Output Voltage Selection Procedure**

1. Disconnect power and remove the top cover.
2. Move the spade lug jumper (Figure 4-3) located on the secondary tap of the high voltage transformer to appropriate connection.
  - 5600 Vdc for the upper connection
  - 7000 Vdc for the lower connection
3. Replace the top cover and plug in the DIGITEL.
4. Remove the high voltage cables.
5. Turn on the DIGITEL.
6. Go to the DIAGNOSTICS menu and select CALIBRATION to calibrate the unit.

*NOTE: Calibration calibrates the output current and automatically informs the DIGITEL what output voltage the high voltage transformer is set to (for supply 1 and 2).*

## Voltage Polarity Configuration

The DIGITEL MPC can be configured for positive or negative voltage polarity. Use the following procedure to change the voltage polarity.



**WARNING:** Voltages up to 7000V are present in the DIGITEL MPC. Turn off power and disconnect power cord before performing any service procedures.

1. Turn off power to the MPC and remove its power cord.
2. Remove the chassis top cover.
3. Disconnect any cables connected to the High Voltage (HV) board and remove it from its slot.

**NOTE:** Each HV board can be independently configured for positive or negative polarity.

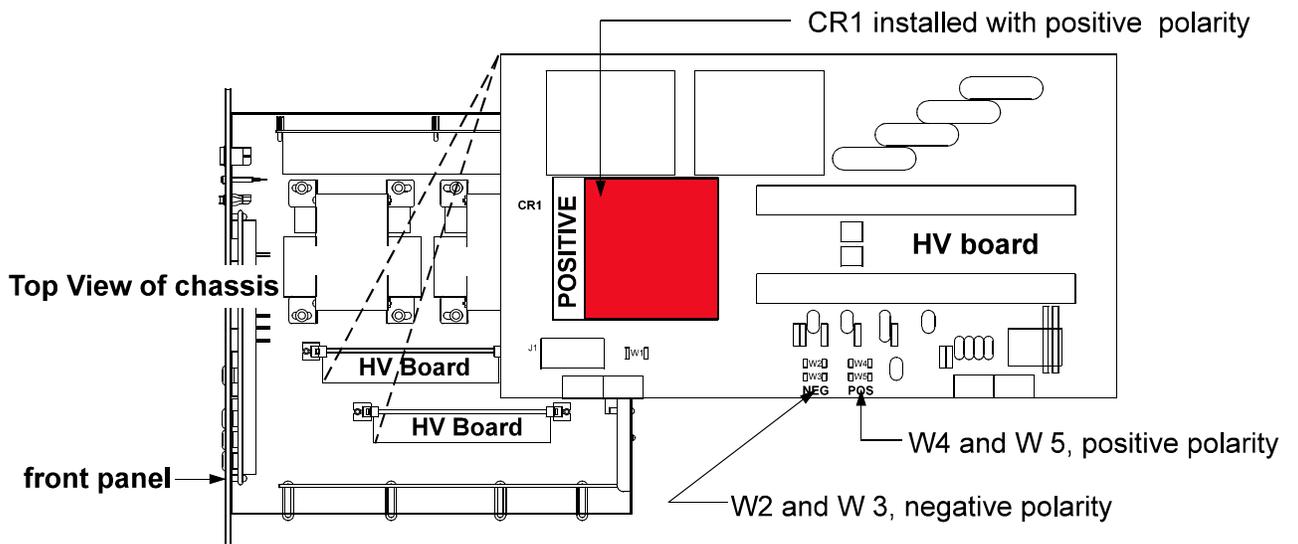


Figure 4-4. Voltage Polarity — Location of Components.

#### 4: Service

4. Locate component CR1 (the diode bridge). Along one side, CR1 will read:
  - If the MPC is configured for positive polarity, the word POSITIVE is shown to the left of CR1 as shown in Figure 4-4.
  - If configured for negative polarity, the word NEGATIVE is shown to the right of CR1.
5. If a polarity change is desired, unsolder the four pins of CR1.
6. Rotate CR1 180° and shift it to the next series of holes so that CR1 exposes the desired polarity.
7. Re-solder CR1 at the desired location.
8. Next, unsolder the two polarity jumpers on the bottom-center of the HV board (Figure 4-4), and re-solder the jumpers according to the table below.

W4 and W5	configures positive polarity
W2 and W3	configures negative polarity

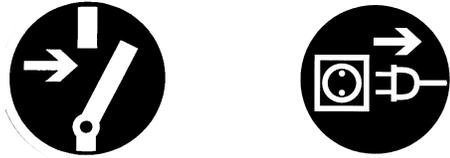
9. Reinstall the HV board and reconnect the cables.
10. Replace the MPC top cover and reconnect power.
11. Re-calibrate the unit. See Section 3, *Running Diagnostics*, the Calibration portion.

## PROM Change Procedure

The CPU board, located inside the DIGITEL MPC chassis, houses the PROM (Programmable Read Only Memory), which contains the programmable commands for the DIGITEL MPC.

[Figure 4-5](#) shows the PROM's location.

If you need to update the revision level of the MPC, you need to change this PROM. Use the following procedure.



***WARNING: Voltages up to 7000V are present in the DIGITEL MPC. Turn off power and disconnect power cord before performing any service procedures.***

1. Make sure that you have an ESD grounding strap on your wrist.
2. Turn off power to the MPC and remove its power cord.
3. Remove the chassis top cover.
4. Disconnect any cables connected to the CPU board and remove the CPU board from its slot.
5. Remove the old PROM.

***NOTE: Each PROM contains a label indicating its revision level. Do not use this label to position the new PROM (the label does not always face the same direction).***

#### 4: Service

**Make sure the groove is facing towards the rear panel.**

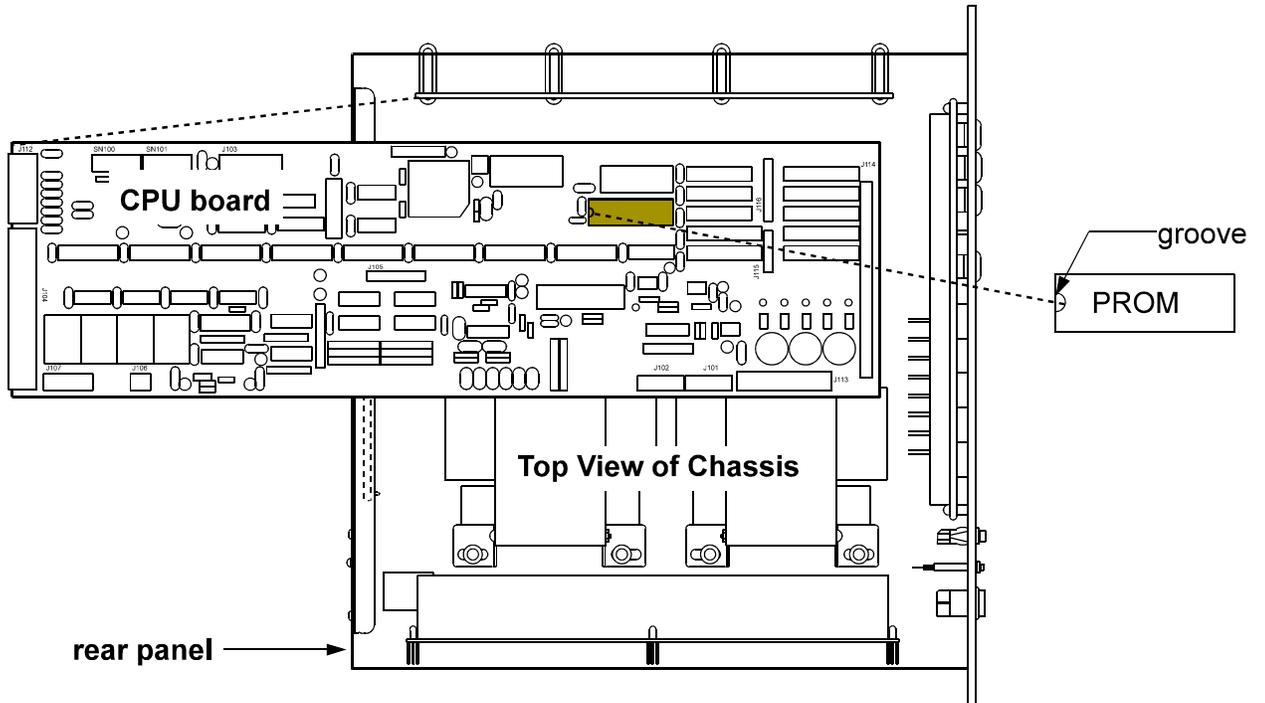


Figure 4-5.

*CPU Board — Location of PROM.*

6. Carefully insert the new PROM, making sure the small groove on the PROM (denoting pin 1) is positioned correctly. See Figure 4-5.
7. Reinstall the CPU board and reconnect the cables.
8. Replace the MPC top cover and plug in the power cable.

## Rear Panel Connector Pinouts

The location of the rear panel connectors on the DIGITEL MPC are shown in the Figure 4-6.

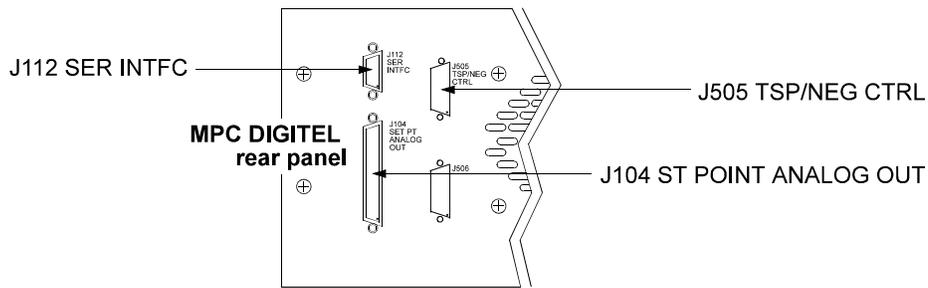


Figure 4-6. Rear Panel Connectors.

Connector pinouts and signal designations are provided in the following tables:

- **J104 SET PT ANALOG OUT** — Table 4-6
- **J505 TSP/NEG CTRL** — Table 4-7
- **J112 SER INTFC** — Table 4-8.

### Connector J104 — Set Point and Analog Output Signals

**J104 SET PT ANALOG OUT** (a 37-pin, female Sub-D connector) provides 8 set point signals, and 4 voltage/current analog output signals.

Table 4-6. Connector J104 Pinouts.

Pin	Setpoint Signal	
1	Set Point 1 (Relay)	Common
2		NC
3		NO
4	Set Point 2 (Relay)	Common
5		NC
6		NO
7	Set Point 3 (Relay)	Common
8		NC
9		NO
10	Set Point 4 (Relay)	Common
11		NC
12		NO
13, 14, 16, 18	GND1	
15	Set Point 5 (TTL)	
17	Set Point 6 (TTL)	
19	Set Point 7 (TTL)	
37	Set Point 8 (TTL)	

Pin	Analog Output Signal
20 ... 28	Unused
29	GND2
30	Analog HV Supply 1 Output
31	GND2
32	Analog Current Output 1*
33	GND2
34	Analog Current Output 2*
35	GND2
36	Analog HV Supply 2 Output

\* Can be configured for Supply 1 or Supply 2 current (I) output - See Analog Outputs.

#### 4: Service

### Connector J505 — Remote TSP/NEG Control Signals

**J505 TSP/NEG CTRL** (a 15-pin, female Sub-D connector) provides the control signals for the Remote TSP/NEG Control.

Table 4-7. Connector J505 Pinouts.

Pin	Signal
1	Current Sense COM
2	SCR Trig Pull-up
3	K4 Coil
4	+15V to TSP
5	Voltage Sense

Pin	Signal
6	SCR Trig Out
7	K3 Coil
8	+15V Return
9	Current XFMR –
10	Sync Signal from TSP

Pin	Signal
11	K2 Coil
12	Not Used
13	Current XFMR +
14	Sync Signal GND
15	K1 Coil

### Connector J112 — Serial Interface Signals

**J112 SER INTFC** (a 9-pin, female Sub-D connector) routes the serial interface signals for the four serial interface protocols – RS-232, PHI, RS-485, and RS-422.

Table 4-8. Connector J112 Pinouts.

RS-232 Operation	
DCD	1
RXD	2
TXD	3
GND	5
DSR	6
RTS	7
CTS	8

PHI Operation	
+TX	2
–TX	8
GND	5
+RX	3
–RX	7

RS-485 Operation	
+TX	2
–TX	8
GND	5

RS-422 Operation	
+RX	3
–RX	7
GND	5

## Serial Communication Protocol Selection

Four serial interface protocols are available on the MPC — RS-232 Operation, RS-485 Operation, RS-422 Operation, and PHI Operation. Set DIP switches SN100 and SN101 on the CPU board (Figure 4-7) to select a serial interface. [Table 4-9 shows the DIP switch settings.](#)

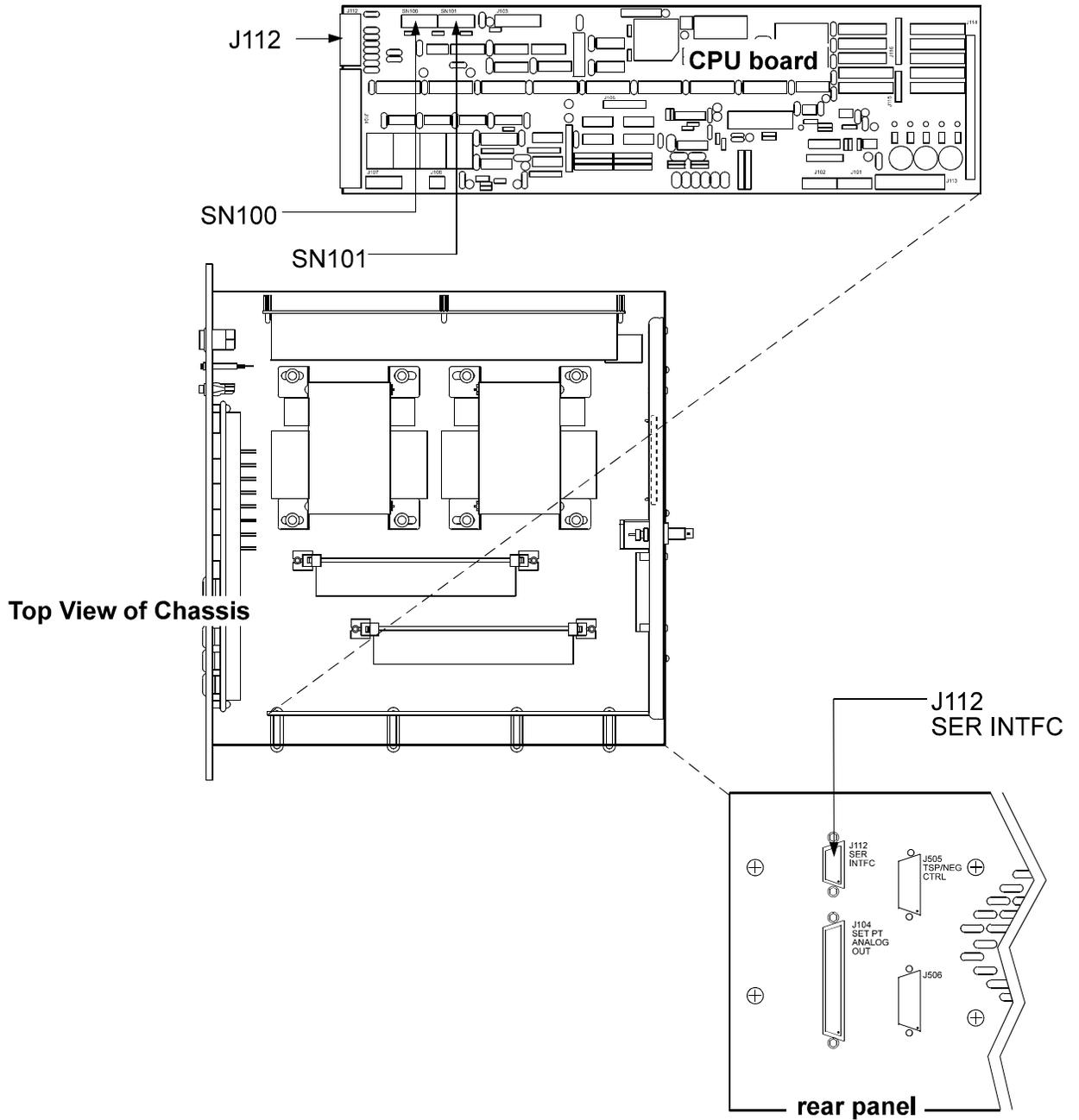


Figure 4-7. *Selecting the Serial Interface Protocol.*

#### 4: Service

Table 4-9. Serial Interface DIP Switch Setting.

RS-232	SN100	SN101	J112 SER INTFC			
	Close 5 thru 8 Open 1 thru 4	Close 6 Open all others	Signal	Pin No.	Signal	Pin No.
			DCD	1	DSR	6
			RXD	2	RTS	7
			TXD	3	CTS	8
			GND	5		

RS-485	SN100	SN101	J112 SER INTFC	
	Close 1, 2, and 4 Open all others For terminator close 7.	Open all	Signal	Pin No.
			+ TX	2
			-TX	8
			GND	5

RS-422	SN100	SN101	J112 SER INTFC	
	Close 1, 3, and 4 Open all others For terminator close 8.	Close 1 and 2 Open all others	Signal	Pin No.
			+ RX	3
			-RX	7
			GND	5

PHI	SN100	SN101	J112 SER INTFC			
	Close 1, 3, and 4 Open all others For terminator close 8.	Close 1 and 2 Open all others	Signal	Pin No.	Signal	Pin No.
			+ TX	2	+ RX	3
			-TX	8	-RX	7
			GND	5		

# Remote TSP/NEG Control Option



**WARNING:** High voltages are present in the Remote TSP/NEG Control and DIGITEL. Turn off power and disconnect power cords from both units before servicing.

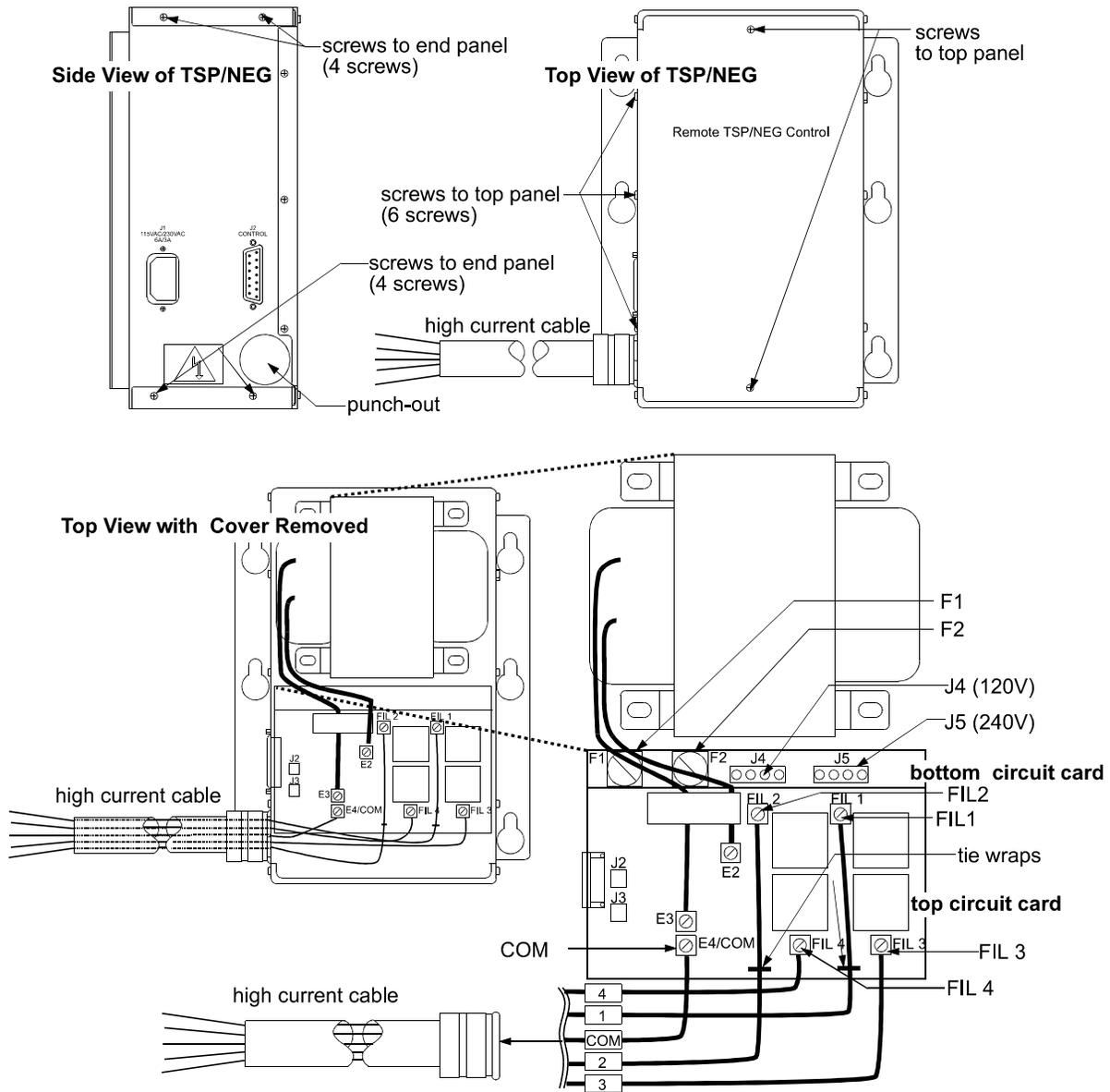


Figure 4-8. Remote TSP/NEG Control — Location of Components.

#### **4: Service**

##### ***Removing the Panels of the Remote TSP/NEG Control***

The Remote TSP/NEG Control has a top panel and two end panels

- Remove the top panel:

Remove the eight screws (two on the front and three on each side) from the top panel and pull it away from the unit.

- Remove the end panels:

Remove the four screws (two on each side) from the end panel and pull it away from the unit.

##### ***Input Voltage Selection of the Remote TSP/NEG Control***

To change input voltage on the Remote TSP/NEG, you need to access the bottom circuit card inside the unit. [Refer to Figure 4-8 for its location.](#)

1. Turn off power and disconnect the power cord from the unit.
2. Remove the top panel.
3. On the bottom circuit card ([Figure 4-8](#)), pull out the input voltage connector and reconnect it to appropriate voltage:
  - For 120 Vac, connect to J4
  - For 240 Vac, connect to J5
4. Replace the panel and install the appropriate power cord.

##### ***Connecting a High Current Cable to the Remote TSP/NEG Control***

1. Remove the top panel and end panel.
2. Tap the punch-out on the end panel to make a hole for the high current cable connector ([Figure 4-8](#)). Install the cable connector.
3. On the top circuit card, connect high current cable wires 1 and 2 to FIL 1 and FIL 2, respectively. Install tie wraps to these wires. See [Figure 4-8](#).

***ATTENTION: This is a high current connection. Make sure that you have a secure connection, or heating will occur.***

4. Connect wires 3, 4, and COM to FIL 3, FIL 4, and COM, respectively.
5. Replace the panels.

## Accessory Equipment

Table 4-11. Optional Accessory Equipment.

Order No.	High Voltage Modules
640574	medium HV module (200W, 100mA), transformer, and fuse.
635465	large HV module (1000W, 500mA), transformer, and fuse.
<b>Remote TSP/NEG Control Unit</b>	
640697	Remote TSP. (Order TSP control and power cables separately.)
<b>Ion Pump High Voltage Cables for use with 3-Million Series Captorr Pumps</b>	
642453	3 m bakeable (200°), SAFE-CONN ion pump HV cable.
642454	6 m bakeable (200°), SAFE-CONN ion pump HV cable.
642455	10 m bakeable (200°), SAFE-CONN ion pump HV cable.
642456	15 m bakeable (200°), SAFE-CONN ion pump HV cable.
642457	20 m bakeable (200°), SAFE-CONN ion pump HV.
642458	30 m bakeable (200°), SAFE-CONN ion pump HV.
643506	40 m bakeable (200°), SAFE-CONN ion pump HV.
643507	50 m bakeable (200°), SAFE-CONN ion pump HV.
643508	75 m bakeable (200°), SAFE-CONN ion pump HV.
643509	100 m bakeable (200°), SAFE-CONN ion pump HV.
<b>Ion Pump High Voltage Cables for use with 2-Million Series and older Pumps</b>	
1001514	10' bakeable (200°) ion pump HV cable .
1000438	15' bakeable (200°) ion pump HV cable .
1001515	20' bakeable (200°) ion pump HV cable .
1001516	30' bakeable (200°) ion pump HV cable .
1001518	50' bakeable (200°) ion pump HV cable .
1001517	75' bakeable (200°) ion pump HV cable .
1006169	100' bakeable (200°) ion pump HV cable .
<b>TSP Control Cables (MPC to Remote TSP Unit)</b>	
638108	3 m (10') TSP control cable (MPC to remote TSP unit).
638109	6 m (20') TSP control cable (MPC to remote TSP unit).
638110	10 m (30') TSP control cable (MPC to remote TSP unit).
638111	15 m (50') TSP control cable (MPC to remote TSP unit).
638112	20 m (65') TSP control cable (MPC to remote TSP unit).
<b>High Current Cables (Remote TSP/NEG Unit to TSP or NEG)</b>	
638106	1.5 m (5') bakeable (250°) cable (remote TSP unit to TSP/NEG).
638107	3 m (10') bakeable (200°) cable (remote TSP unit to TSP/NEG).
<b>Main AC Power Cable (MPC Base Unit, TSP/NEG Remote Units)</b>	
639643	Power Cord, IEC / Stripped 230V, 2m
1004936	Power Cord, IEC / US 110V, 2m
633150	Power Cord, IEC / US 220V, 2.5m
638644	Power Cord, IEC / UK 240V, 10A, 2.5m
638645	Power Cord, IEC / EC 230V, 2.5m
<b>2<sup>nd</sup> High Voltage Output Options</b>	
641784	DIGITEL MPC high voltage output

# Appendix A:

This appendix contains drawings/parts lists and schematics for the DIGITEL™ Multiple Pump Control (MPC) to assist qualified and authorized service technician's with on-site troubleshooting. Table A-1 lists assembly drawings (each drawing is followed by its parts list). Table A-2 lists schematics.

Table A-1. *Drawings and Parts Lists.*

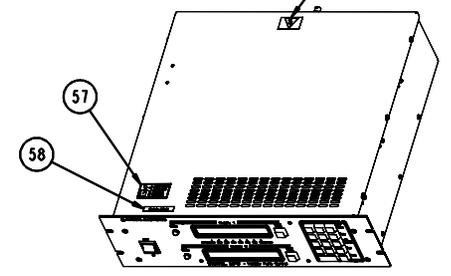
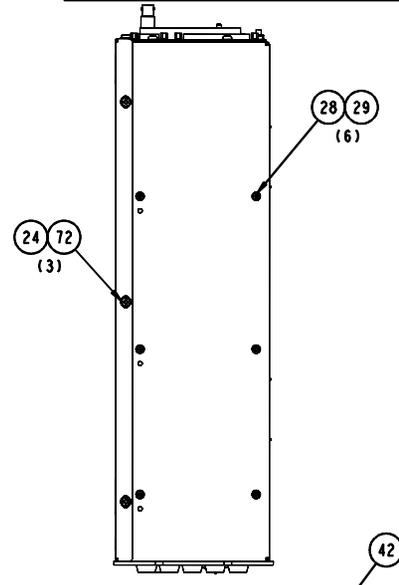
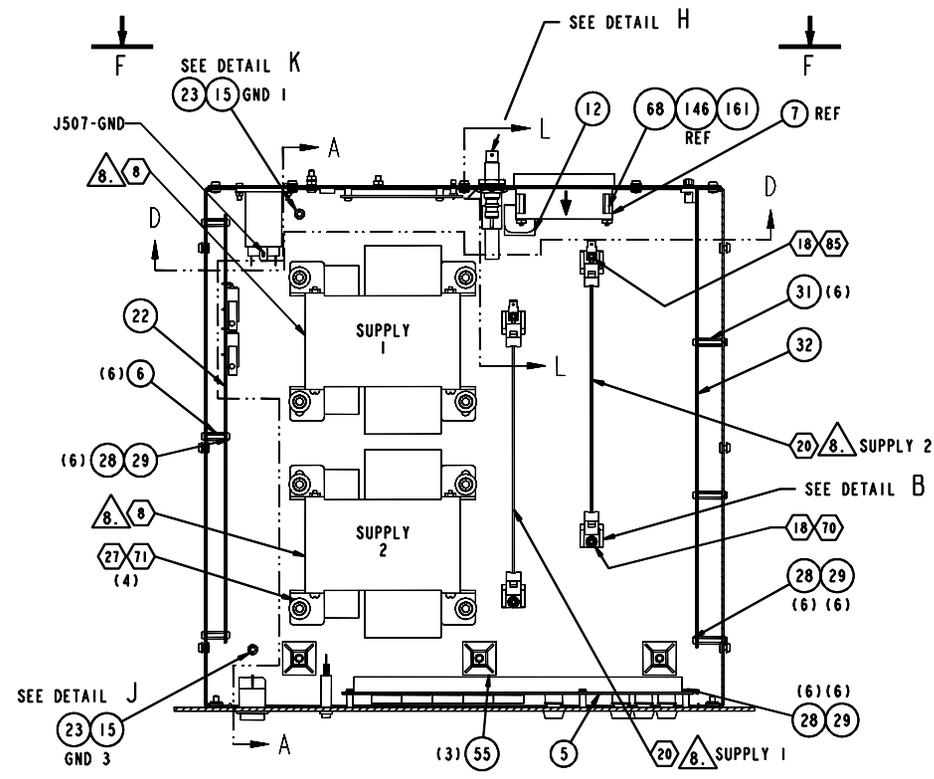
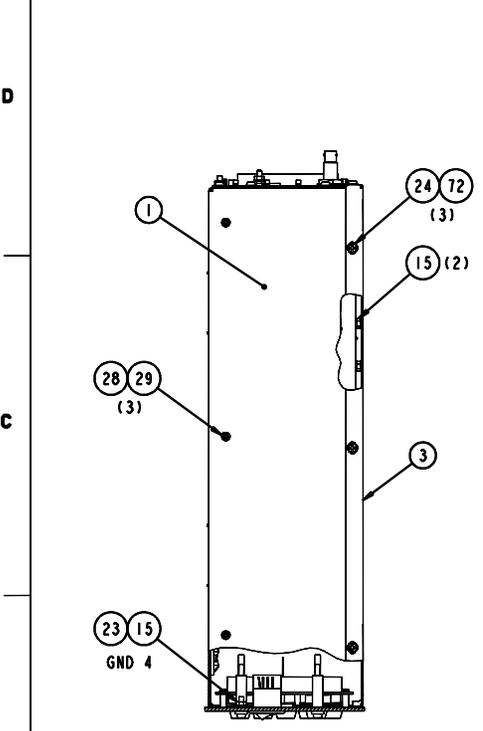
Order of Appearance	Part Number	Description
1	<a href="#">643325</a>	top level assembly drawing followed by parts lists.
2	<a href="#">643181</a>	CPU circuit card drawing followed by parts lists.
3	<a href="#">640690</a>	AC Power circuit card drawing followed by parts lists.
4	<a href="#">641458</a>	HV (100 mA) circuit card drawing followed by parts lists.
5	<a href="#">641459</a>	HV (500 mA) circuit card drawing followed by parts lists.
6	<a href="#">635464</a>	High Voltage PCB drawing.
7	<a href="#">635347</a>	Display circuit card drawing followed by parts lists.
8	<a href="#">640728</a>	SAFECOMM circuit card drawing followed by parts lists.
9	<a href="#">640697</a>	TSP Control assembly drawing followed by parts lists.
10	<a href="#">635460</a>	Remote TSP circuit card drawing followed by parts lists.

Table A-2. *Schematics.*

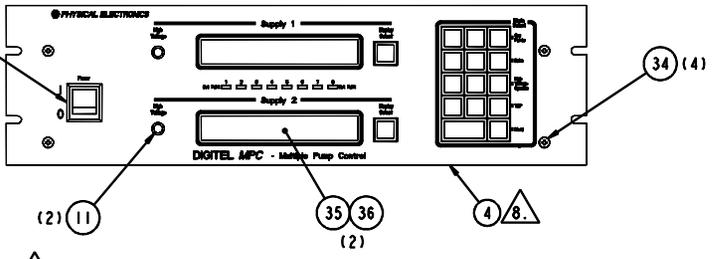
Order of Appearance	Part Number	Description
1	<a href="#">635344</a>	CPU circuit card
2	<a href="#">640691</a>	AC Power circuit card
3	<a href="#">635466</a>	HV (500 mA) circuit card
4	<a href="#">635348</a>	Display circuit card
5	<a href="#">640729</a>	SAFECOMM circuit card
6	<a href="#">635461</a>	TSP/NEG Control assembly

REV. NO. 643325		REV. H		
REV	CD #	DESCRIPTION	DATE	APPROVED
C	17711	SEE CO	1-28-99	K.JT
D	17872	CHANGE P/N FOR ITEM 67	3-19-99	DDD
E	17996	ITEM 33 QTY WAS 4	7-21-99	DDM/K.JT
F	18318	CHG ITEMS 15, 68; ADD ITEM 161	8-23-99	DDD
G	18401	DELETE NOTE 10 & ITEM 146 - SEE CO	9-8-99	DDD
H	19038	CHANGE ITEM 56	4-10-00	C.JB

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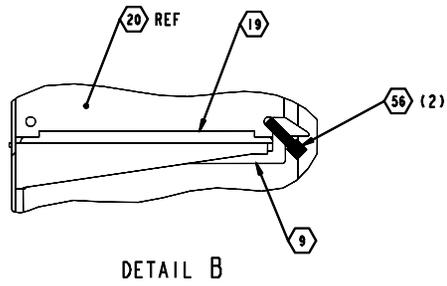


- NOTES:
1. MARK ID LABEL, ITEM 40, WITH APPLICABLE INFORMATION AND AFFIX APPROXIMATELY AS SHOWN.
  2. CRIMP BOTH INNER CONDUCTOR AND BRAIDED SHIELD OF COAXIAL CABLE, ITEM 46, INTO LUG, ITEM 47. USE 140 MM LONG PIECE OF ITEM 46.
  3. ALL DIGITELS ARE TO BE CONFIGURED FOR 120VAC OPERATION UNLESS OTHERWISE SPECIFIED.
  4. IDENTIFY INTERNAL COMPONENTS (XFMR'S, SWITCHES, ETC) USING LABELS, ITEM 74. LOCATE LABELS PER SPEC 638528.
  5. LABEL TO BE POSITIONED AS NOT TO BE OBSCURED BY TOP COVER.
  6. PACKAGE LINE CORD (SEE CUSTOMER ORDER), GND CABLE (ITEM 66) AND MANUAL (ITEM 110) IN ZIPLOCK BAG (ITEM 67) FOR SHIPMENT WITH EACH UNIT.
  7. REFER TO PARTS LIST(S) 643298, 643299, 641784, 641785, AND/OR 643336 FOR ITEMS IDENTIFIED WITH "HEX" (◻) SHAPED BALLOONS.

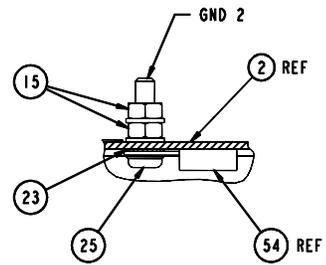


8. THIS ITEM IS SPECIFIED BY THE CUSTOMER. REFER TO CUSTOMER ORDER FOR ACTUAL UNIT CONFIGURATION.
  9. ATTACH THE HIGH VOLTAGE BOARD GROUND BRAID TO THE GROUND TAB LOCATED AT THE BASE OF THE REAR CARD GUIDE.
- NOTES CONTINUED ON SHEET 4.

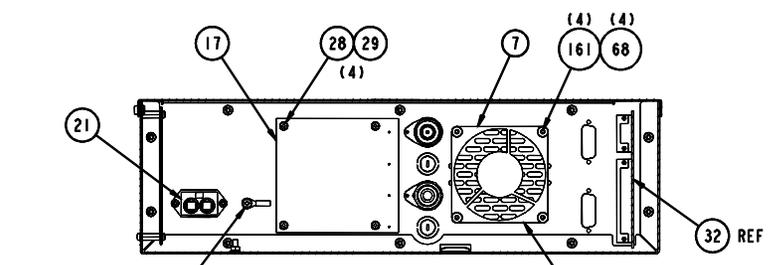
<b>METRIC</b> THIRD ANGLE PROJECTION 	UNLESS OTHERWISE SPECIFIED SURFACE FINISH: 10 MICROMETERS SURFACE ROUGHNESS: 10 MICROMETERS TOLERANCES: LENGTH: 0.13 HOLES: 0.13 ANGULAR: C/D MACHINES: 0.1 FORMING: 0.1 CHAMFER: 0.1 MACHINED SURFACES: <input checked="" type="checkbox"/> BREAK SHARP EDGES: 0.2 OR 0.5 R. R. MAX. INTERNAL RICK CORNER: 0.4 MAX.	DIM: DDS DATE: 10-15-98 CHK: GAT DATE: 10-30-98 APPV: GAT DATE: 10-30-98 BY: G. TAYLOR TOLERANCING AND DIMENSIONING PER ANSI Y14.2M - 1982 THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION, DISCLOSURE OR USE OF THIS DRAWING IS EXPRESSLY PROHIBITED EXCEPT AS PHYSICAL ELECTRONICS MAY OTHERWISE AGREE TO IN WRITING.	<b>PHYSICAL ELECTRONICS</b> 6509 Flying Cloud Drive • Eden Prairie, MN TITLE: ASSY-DIGITEL MPC, BASIC DRAWING NO. 643325 SCALE: 0.500 DETACHED <input type="checkbox"/> PL <input type="checkbox"/> SPEC (SHEET 1) OF 4
	REV. H DATE: 4-10-00 APPROVED: C.JB		



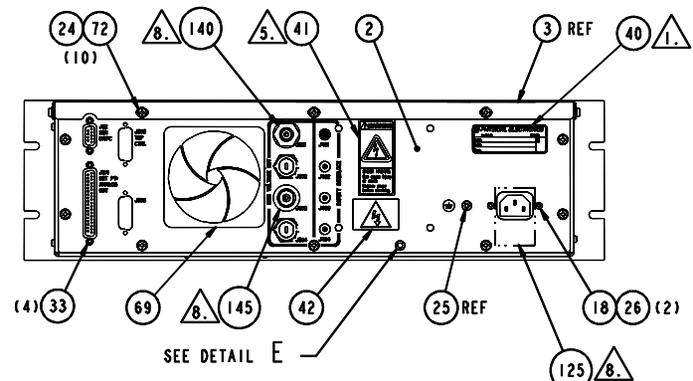
DETAIL B



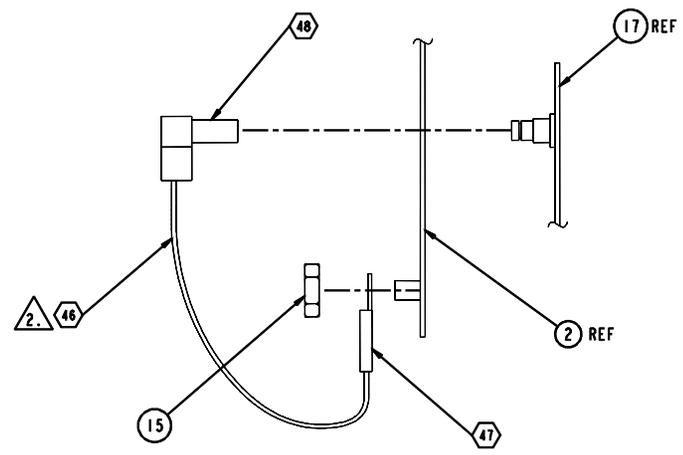
DETAIL C



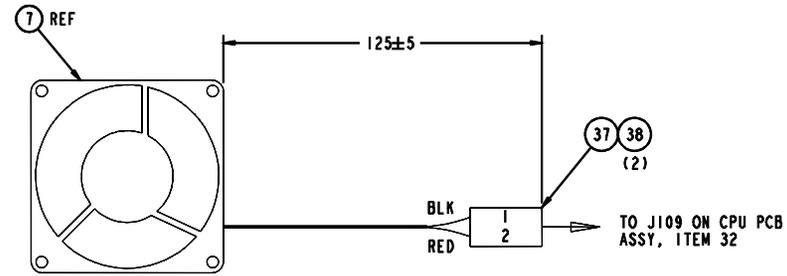
SECTION D-D



VIEW F-F

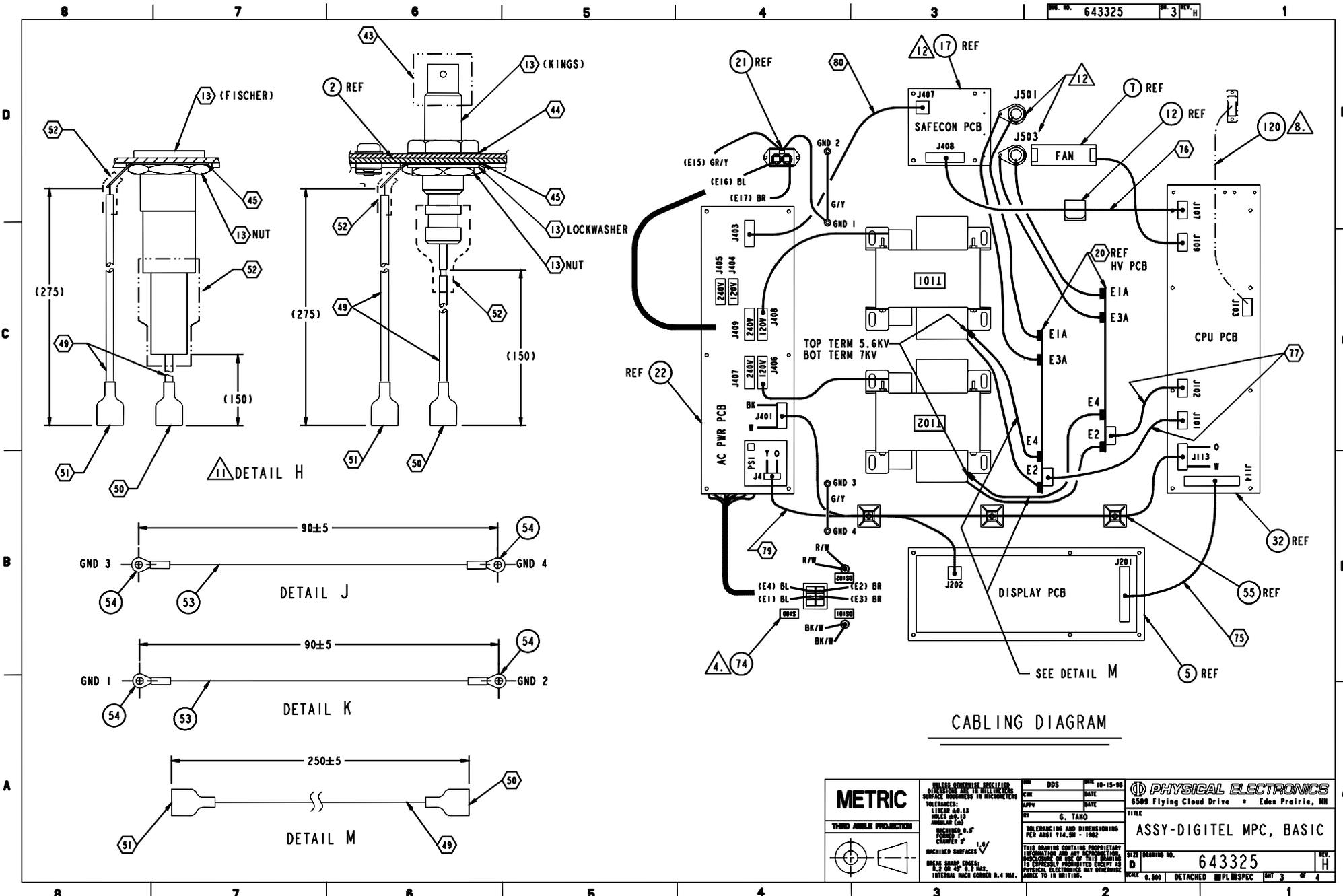


DETAIL E



DETAIL G

<p><b>METRIC</b></p> <p>THIRD ANGLE PROJECTION</p>	<p>UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MILLIMETERS. SURFACE FINISHES IN MICROMETERS.</p> <p>TOLERANCES:          LENGTH .05-.13          DIA'S .00-.13          ANGULAR C/D          HOLE POSITION .08          HOLE CHAMFER .08</p> <p>RADIUSES, R. .08          FORMS &amp; CHAMFERS .08          MACHINED SURFACES <math>\sqrt{\text{V}}</math>          BREAKS SHARP EDGES:          0.2 OR 45° R. 0.2 DIA.          INTERNAL RICKS CORNER R. 4 DIA.</p>	<p>REV. DDS DATE 10-15-90</p> <p>CHK DATE</p> <p>APPV DATE</p> <p>BY G. TABO</p> <p>TOLERANCING AND DIMENSIONING PER ANSI Y14.2M - 1982</p> <p>THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION, DISCLOSURE OR USE OF THIS DRAWING IS EXPRESSLY PROHIBITED EXCEPT AS PHYSICAL ELECTRONICS MAY OTHERWISE AGREE TO IN WRITING.</p>	<p><b>PHYSICAL ELECTRONICS</b>          6509 Flying Cloud Drive • Eden Prairie, MN</p> <p>TITLE  <b>ASSY-DIGITEL MPC, BASIC</b></p> <p>SIZE DRAWING NO. <b>643325</b></p> <p>SCALE 0.500 DETACHED <math>\square</math> PLMSPEC SHEET 2 OF 4</p>
	<p>REV. H</p>	<p>REV. H</p>	



CABLING DIAGRAM

<p><b>METRIC</b></p> <p>THIRD ANGLE PROJECTION</p>	<p>UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE TO BE IN MILLIMETERS.</p> <p>SURFACE FINISHES TO BE MICROMETERS.</p> <p>TOLERANCES:</p> <p>LENGTH .00-13</p> <p>DIALES .00-13</p> <p>ANGLES (C)</p> <p>MACHINED SURFACES</p> <p>FINISHES</p> <p>UNLESS SHOWN OTHERWISE</p> <p>ALL DIMENSIONS TO BE TO CENTER UNLESS OTHERWISE SPECIFIED</p> <p>ALL DIMENSIONS TO BE TO CENTER UNLESS OTHERWISE SPECIFIED</p> <p>ALL DIMENSIONS TO BE TO CENTER UNLESS OTHERWISE SPECIFIED</p>	<p>FORM: DDS</p> <p>DATE: 10-15-98</p> <p>APPV: DATE</p> <p>BY: G. TARD</p> <p>TOLERANCING AND DIMENSIONING PER ANSI Y14.5M - 1992</p> <p>THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION, DISCLOSURE OR USE OF THIS DRAWING IS EXPRESSLY PROHIBITED EXCEPT AS AUTHORIZED BY PHYSICAL ELECTRONICS. PHYSICAL ELECTRONICS MAY OBTAIN RIGHTS TO INVENTION.</p>	<p><b>PHYSICAL ELECTRONICS</b></p> <p>6509 Flying Cloud Drive • Eden Prairie, MN</p> <p>TITLE: ASSY-DIGITEL MPC, BASIC</p> <p>REV. H</p> <p>SCALE: 0.500 DETACHED PLSPEC SH. 3 OF 4</p>
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## 643325 Rev. H

Item	Part No.	Description	Rev	Status	Qty	UM	Notes	From	To
	643325	DIGITEL MPC-BASIC	H		.	EA			
1	639407	CHASSIS-DIGITEL MPC	B		1	EA		1/1/91	12/31/10
2	643278	PANEL-REAR,DIGITEL MPC	B		1	EA		2/3/99	12/31/50
3	638138	COVER-TOP,DIGITEL MPC	B		1	EA		1/1/91	12/31/10
4	639973	PANEL-FRNT,BRN DIGITEL MPC	A		.	EA		1/1/91	12/31/10
4	639974	PANEL-FRNT,WHT DIGITEL MPC	C		.	EA		4/29/99	12/31/50
4	640565	PANEL-FRNT,BLK DIGITEL MPC	A		.	EA		1/1/91	12/31/10
5	635347	ASSY-PCB,DISPLAY,DIGITEL MPC	E		1	EA		1/1/91	12/31/10
6	638252	STDF-15MML, M3,F/F,5.5MMHEX,BR	A		6	EA		1/1/91	12/31/10
7	635932	FAN-6-14VDC,27CFM,3.15SQ,1.0T	A		1	EA		1/1/91	12/31/10
10	634533	SW-RKR,DPST,250/15A,VDE,0-1			1	EA		1/1/91	12/31/10
11	611716	LAMP-NEON,125V,.31DI,AMBER,QC	A		2	EA		1/1/91	12/31/10
12	1003498	CABLE CLIP-FLAT CABLE	-		1	EA		1/1/91	12/31/10
15	578501	NUT-KEPS, M4,ZINC PLTD STEEL	B		8	EA		7/12/99	12/31/50
17	640728	ASSY-PCB,SAFECONN,DIGITEL MPC	D		1	EA		10/22/97	12/31/10
18	578500	NUT-KEPS, M3,ZINC PLTD STEEL	B		2	EA		1/1/91	12/31/10
21	635928	FILTER-LINE,10A	A		1	EA		1/1/91	12/31/10
22	640690	ASSY-PCB,AC PWR,DIGITEL MPC	F		1	EA		10/10/98	12/31/50
23	576702	WSHR-EXT TOOTH LOCK,M 4 SST	A		4	EA		1/1/91	12/31/10
24	573631	SCR-PAN,M4X 6,PHIL,SS	A		1	6 EA		1/1/91	12/31/10
25	573635	SCR-PAN,M4X 16,PHIL,SS	A		1	EA		1/1/91	12/31/10
26	573625	SCR-PAN,M3X 12,PHIL,SS	A		2	EA		1/1/91	12/31/10
28	512104	WSHR-INT TOOTH LOCK,# 4, SST	A		3	1 EA		1/1/91	12/31/10
29	573622	SCR-PAN,M3X 6,PHIL,SS	A		3	1 EA		1/1/91	12/31/10
31	636155	STDF-20MML, M3,F/F,5.5MMHX,SST	A		6	EA		1/1/91	12/31/10
32	643181	ASSY-PCB,CPU,DIGITEL MPC	B		1	EA		12/14/98	12/31/10
33	609107	SCREWLOCK-SUB D,F/M,4-40,.312L	C		2	EA		3/29/99	12/31/50
34	546408	SCR-FLAT, 8-32X .500,PHIL,SST	-		4	EA		1/1/91	12/31/10
35	635933	FILTER-DISPLAY,DIGITEL MPC,GRY	A		2	EA		1/1/91	12/31/10
36	516101	TAPE-DBL SIDED,FOAM, 1/4" WIDE	C		2	8 IN		8/21/98	12/31/50
37	624801	CONN-.100C, 2S,CA ,HSG,LATCHNG	A		1	EA		1/1/91	12/31/10
38	624535	CONTACT-.100C,F,26-22GA,LATCHG	A		2	EA		1/1/91	12/31/10
40	639837	LABEL-SYSTEM/UNIT ID	E		1	EA		3/31/99	12/31/50
41	638458	LABEL-ANSI/ISO,SHOCK:REM PWR	C		1	EA		4/24/98	12/31/10
42	636009	LABEL-CE,HI VOLT	A		2	EA		1/1/91	12/31/10
53	1000738	WIRE-STRD,16GA,IPVC,300V,GN/YL	D		1	FT		1/1/91	12/31/10
54	546108	LUG-RING,16-14GA, #8,INS,.343W	C		4	EA		1/1/91	12/31/10

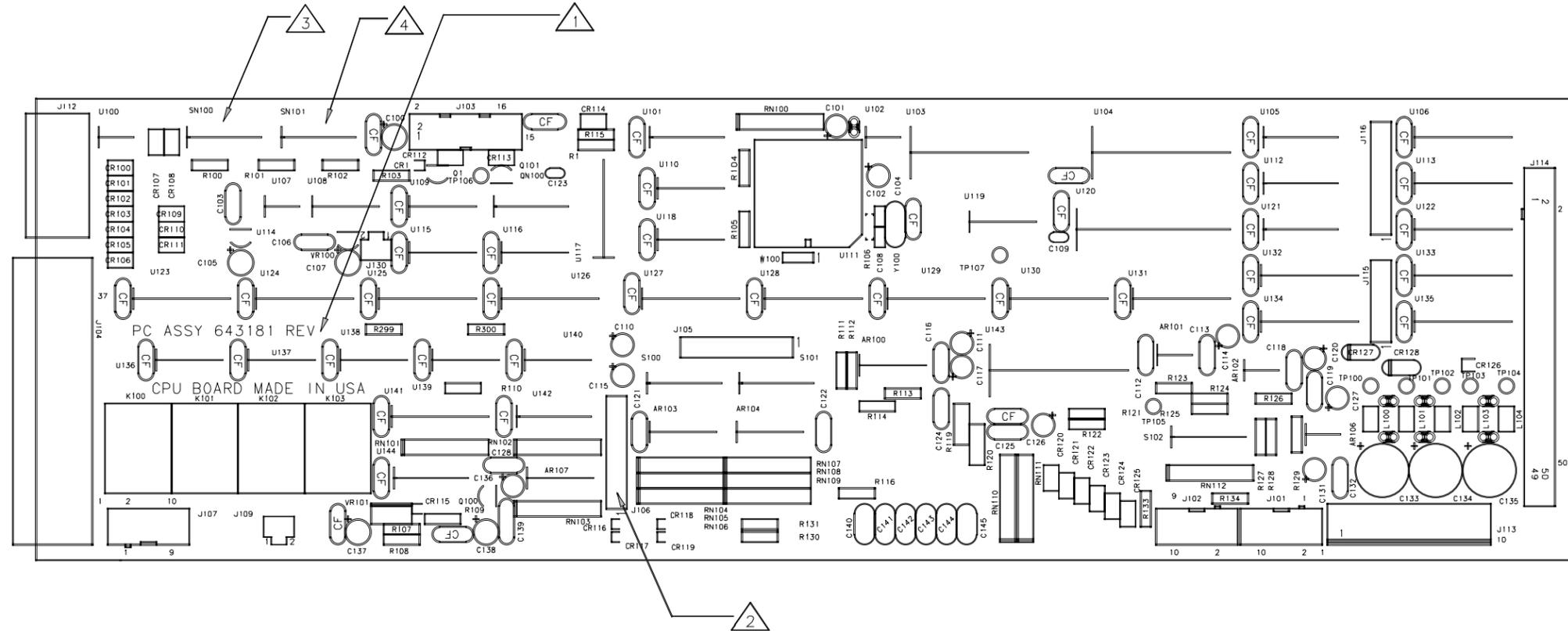
## 643325 Rev. H

55	506400	CABLE TIE MNT-ADH BK,NYL,1.0"	B		3	EA		1/1/91	12/31/10
56	506000	CABLE TIE-.750 BDL OD,NYL,NAT	C		6	EA		2/29/00	12/31/50
57	636303	LABEL-ANSI,2 MAN LIFT,HTEMP	A		1	EA		1/1/91	12/31/10
58	638456	LABEL-25.4KG (56LB)	C		1	EA		10/2/97	12/31/10
66	643336	KIT-CABLE,DIGITEL MPC	B		1	EA		10/26/98	12/31/50
67	643580	BAG-15"Wx18"L,4 MIL,ZIP	A		1	EA		3/12/99	12/31/50
68	546324	SCR-FLAT, 6-32X1.500,PHIL,SST	-		4	EA		7/19/99	12/31/50
69	622775	FAN FILTER ASSEMBLY-3.125"	A		1	EA		1/1/91	12/31/10
72	512108	WSHR-INT TOOTH LOCK,# 8, SST	A	1	6	EA		1/1/91	12/31/10
73	638528	SPEC SHEET-DIGITEL MPC IDENTS	B		.	EA		1/1/91	12/31/10
74	628966	MARKER-LASER TAB,.375SQ,HITEMP	A		7	EA		1/1/91	12/31/10
100	635344	SCHEM DIAG-CPU,DIGITEL MPC	L		.	EA		1/1/91	12/31/10
101	635348	SCHEM DIAG-DISPLAY,DIGITEL MPC	B		.	EA		1/1/91	12/31/10
102	640691	SCHEM DIAG-AC PWR,DIGITEL MPC	B		.	EA		1/1/91	12/31/10
103	640729	SCHEM DIAG-SAFECONN,DIG MPC	C		.	EA		11/3/97	12/31/10
104	635466	SCHEM DIAG-HV BD,DIGITEL MPC	H		.	EA		1/1/91	12/31/10
106	635424	ASSY-BURN IN,TEST/CAL,DIG MPC		PR	.	EA		1/1/91	12/31/10
110	640707	MANUAL-DIGITEL MPC	H		1	EA		12/8/99	12/31/50
111	634160	DEC OF CONFORM-DIGITEL MPC/TSP	A		1	EA		1/1/91	12/31/10
125	622792	LABEL-STRAPPED FOR 120VAC	A		.	EA		1/1/91	12/31/10
125	629358	LABEL-STRAPPED FOR 220VAC	B		.	EA		1/1/91	12/31/10
130	639627	FUSE-2.5A,250V,S/B,5X20MM,SHT5	A		.	EA		1/1/91	12/31/10
130	636475	FUSE-1.25A,250,S/B,5X20,SHT5	A		.	EA		1/1/91	12/31/10
130	636477	FUSE-6.3A,250V,S/B,5X20,SHT5	A		.	EA		1/1/91	12/31/10
130	639623	FUSE-4A,250V,S/B,5X20,IEC,SHT5	A		.	EA		1/1/91	12/31/10
140	641784	ASSY-MPC HV OUTPUT,KINGS	D		.	EA		10/2/98	12/31/10
145	641785	ASSY-MPC HV OUTPUT,FISHER	D		.	EA		1/1/91	12/31/10
150	643326	SPEC-MPC STD OUTPUT CONFIGS	A		.	EA		10/5/98	12/31/50
160	643337	FLOWCHART-DIGITEL MPC/TSP	B		.	EA		12/8/99	12/31/50
161	533203	NUT-KEPS,# 6-32,SST304	B		4	EA		7/19/99	12/31/50

DRAWING NO. 643181		SH 1	REV C	1
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	ADD PARTS & TSP OPTION C017237	08-98	
	B	ADD ASSEMBLY INST CO # 19039	04-00	DJM
	C	EPROM PROG CHANGE CO # 19586	09-00	DJM

NOTES:

- 1 MARK REVISION OF THIS DOCUMENT IN SPACE PROVIDED.
- 2 INSTALL JUMPER PLUGS IN J106 PINS 3-4 AND 13-14.
- 3 CLOSE SWITCHES ON SN100 POSITIONS 1,3, AND 4 THE REMAINING SWITCHES MUST BE SET TO OPEN.
- 4 CLOSE SWITCHES ON SN101 POSITIONS 1,2, AND 8 THE REMAINING SWITCHES MUST BE SET TO OPEN.



SEE DETACHED PARTS LIST

COMPUTER GENERATED MENTOR CAD SYSTEM VERSION 8	DRN MCNEIL	DATE 08-98	<b>PHYSICAL ELECTRONICS</b> 6509 FLYING CLOUD DRIVE, EDEN PRAIRIE, MN, 55344
TOLERANCES AND DIMENSIONS SHALL BE INTERPRETED PER ANSI Y14.5M-1982	CKD MCNEIL	DATE 08-98	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	APPD MCNEIL	DATE 08-98	
TOLERANCES •X +/-0.030 ANGLES •XX +/-0.010 +/- 1 DEG •XXX +/-0.005	THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION IS EXPRESSLY PROHIBITED EXCEPT AS PHYSICAL ELECTRONICS MAY OTHERWISE AGREE TO IN WRITING		TITLE PRINTED CIRCUIT BOARD ASSEMBLY MPC CPU BOARD
	APPD	DATE	SIZE D DRAWING NUMBER 643181 REV C
			SCALE NONE SHEET 1 OF 1

## 643181 Rev. C

Item	Part No	Description	Rev	Status	Quantity	Notes	From	To
	643181	ASSY-PCB,CPU,DIGITEL MPC	C		0 EA			
1	643180	PCB-CPU,DIGITEL MPC	A		1 EA		11/19/98	12/31/50
2	115-00159	IC-75188,QUAD LN DRVR,(MC1488)	A		1 EA	U108	01/01/91	12/31/10
3	115-00160	IC-75189,QUAD LIN RCVR(MC1489)	A		1 EA	U109	01/01/91	12/31/10
4	608428	IC-574AJ,ADC,12B,HI SPD,	A		1 EA	U143	01/01/91	12/31/10
5	608639	V REG,-12V,.1A,TO92,MC79L12ACP	-		1 EA	U114	01/01/91	12/31/10
6	612259	IC-74HC00,QUAD 2 INP NAND	B		2 EA		04/17/00	12/31/50
7	613580	IC-74HCT02,QUAD 2 INP NOR	-		1 EA	U116	01/01/91	12/31/10
8	614219	IC-74HC138,3-8 DECODER/DEMUX	B		3 EA	U105,112,	01/01/91	12/31/10
9	614672	IC-74HC08,QUAD 2 INP NAND	-		3 EA	U136,138,	01/01/91	12/31/10
10	614676	IC-74HC74,DUAL D F/F	-		2 EA	U115,140	01/01/91	12/31/10
11	616405	(OBS)IC-43256C-15L,SRAM,32K X8	-	DU	1 EA	U104	01/01/91	12/31/10
12	620068	IC-74HC244,OCTAL 3ST BFR	-		2 EA	U123,129	01/01/91	12/31/10
13	623017	IC-75176B,DIFF BUS XCVR,RS422	A		2 EA	U100,107	01/01/91	12/31/10
14	625921	IC-74HCT245,OCTAL BIDIR BUFFER	A		1 EA	U131	01/01/91	12/31/10
15	626415	IC-2068B,DARL SW,50VCEX,DIP	A		2 EA	U142,144	01/01/91	12/31/10
16	629650	(OBS)IC-68HC11A0,8B MICRO	A	DU	1 EA	U111	01/01/91	12/31/10
17	629656	IC-MAX694CPA,MICRO SUPERVISOR	A		1 EA	U102	01/01/91	12/31/10
18	647767	IC-PRGM,EPRM,DIG MPC	A		1 EA	U120	08/15/00	12/31/50
19	635340	IC-BQ3287MT,REAL TIME CLK MOD	A		1 EA	U103	01/01/91	12/31/10
20	635650	IC-74HC374	A		15 EA	U106,113,	01/01/91	12/31/10
21	635651	IC-74HC85,4B MAGNITUDE COMPARA	B		1 EA		04/17/00	12/31/50
22	635652	IC-74HC04	A		2 EA	U119,137	01/01/91	12/31/10
23	472038	IC-301AN,OP AMP	-		1 EA	AR101	01/01/91	12/31/10
24	641237	IC-148,QUAD 741 OP AMP			4 EA	AR100,103	01/01/91	12/31/10
25	608638	IC-07EP,OP AMP,LO OFFSET V	B		2 EA	AR102,106	01/01/91	12/31/10
26	1003302	XSTR-MC1413 ,ARRAY,NPN	C		1 EA		04/17/00	12/31/50
27	1003382	V REG,+12V,.1A,TO92, 78L12A	-	NP	1 EA	VR100	01/01/91	12/31/10
28	478126	XSTR-2N3904 ,NPN, 40V, .3W	A		3 EA	Q1,100,10	05/28/97	12/31/10
29	603902	V REG,+1.2-37V,1.5A, LM317T	-		1 EA	VR101	01/01/91	12/31/10
30	171423	DIO-RECT,400V,1A,1N4004	B		2 EA	CR1,115	01/01/91	12/31/10
31	638756	DIO-ZENER,8.2V,.4W,1N756A	A		4 EA	CR116-116	05/28/97	12/31/10
32	635817	DIO-TVS,20V,.5W,BI,SA20CA	A		19 EA	CR100-114	01/01/91	12/31/10
34	278002	CAP-0.01 UF,50V,20%,.25LS,CER	B		52 EA	C103,106,	05/28/97	12/31/10
35	371076	CAP-47 PF,1KV,10%,CER DISC,RDL	-		1 EA	C112	01/01/91	12/31/10
36	472043	CAP-1 UF,50V,20%,CER ML,RDL	A		6 EA	C140-145	06/12/97	12/31/10
37	601279	CAP-10 UF,25V,20%,TANT,RDL	A		5 EA	C100,105,	01/01/91	12/31/10
38	603951	CAP-1 UF,35V,10%,TANT,RDL	A		12 EA	C101,102,	01/01/91	12/31/10
39	617886	CAP-0.1 UF,50V,20%,.3",CER ML	-		1 EA	C139	03/03/00	12/31/50

Item	Part No	Description	Rev	Status	Quantity	Notes	From	To
40	623444	CAP-0.01 UF,100V,20%,.1",CER M	C		9 EA	C109,123,	07/18/97	12/31/10
42	629978	CAP-22 PF,50VDC,5%,.1C,CER ML	A		2 EA	C104,108	01/01/91	12/31/10
43	1000684	CAP-100 UF,50V,20%,ELECT,RDL	E		3 EA	C133-135	01/01/91	12/31/10
44	635926	RLY-PCB,SPDT,12V,30MA	B		4 EA		04/17/00	12/31/50
45	635919	RES NTWK-1M, SIP, 4I,.25W,2%	A		10 EA	RN102-111	01/01/91	12/31/10
46	608584	RES NTWK-10K ,SIP, 4I,.25W,2%	-		3 EA	RN100,101	01/01/91	12/31/10
47	173027	RES-75 OHM,.25W, 1%,RN60D	-		2 EA	R119,120	05/28/97	12/31/10
48	602949	RES-301 OHM,.12W, 1%,RN55D	-		1 EA	R103	01/01/91	12/31/10
49	603132	RES-1K OHM,.12W, 1%,RN55D	-		3 EA	R105,133,	01/01/91	12/31/10
50	603133	RES-2K OHM,.12W, 1%,RN55D	-		2 EA	R101,102	01/01/91	12/31/10
51	603140	RES-10K OHM,.12W, 1%,RN55D	-		5 EA	R1,100,104	09/08/97	12/31/10
53	603936	RES-243 OHM,.12W, 1%,RN55D	-		1 EA	R108	01/01/91	12/31/10
54	603941	RES-2.1K OHM,.12W, 1%,RN55D	-		1 EA	R107	01/01/91	12/31/10
55	604290	RES-12.4K OHM,.12W, 1%,RN55D	-		2 EA	R113,114	01/01/91	12/31/10
56	604347	RES-49.9K OHM, .12W, 1%,RN55D	-		2 EA	R111,112	01/01/91	12/31/10
57	604967	RES-9.76K OHM,.12W, 1%,RN55D	-		1 EA	R127	01/01/91	12/31/10
58	608257	RES-1.69K OHM,.12W, 1%,RN55D	-		1 EA	R109	01/01/91	12/31/10
59	608433	RES-49.9 OHM, .12W, 1%,RN55D	-		2 EA	R121,122	01/01/91	12/31/10
60	609150	RES-3.32K OHM,.12W, 1%,RN55D	-		2 EA	R115,116	07/18/97	12/31/10
61	610980	RES-10.2K OHM,.12W, 1%,RN55D	-		2 EA	R123,128	01/01/91	12/31/10
62	612798	RES-11.3K OHM,.12W, 1%,RN55D	A		1 EA	R125	01/01/91	12/31/10
63	613673	RES-6.98K OHM, .12W, 1%,RN55D	-		1 EA	R126	01/01/91	12/31/10
64	614664	RES-102K OHM,.12W, 1%,RN55D	-		1 EA	R124	01/01/91	12/31/10
65	625004	RES-61.9K OHM, .12W, 1%,RN55D	A		1 EA	R129	01/01/91	12/31/10
66	631584	RES-10M OHM,.25W, 1%,SM MF	A		1 EA	R106	01/01/91	12/31/10
67	177260	SW-RKR,DIP,SPST,8RKR,125MA@30V	B		2 EA	SN100,101	01/01/91	12/31/10
68	603605	IC-13331N,QUADR SPST ANLG SW	-		3 EA	S100-102	01/01/91	12/31/10
69	177050	CONN-.156C,10P,PCB,STR,1R,T,RD	C	NP	1 EA	J113	01/01/91	12/31/10
70	378052	CONN-.100C,50P,PCB,STR,2ROW	-		1 EA	J114	01/01/91	12/31/10
71	614659	CONN-.100C,10P,PCB,STR,2ROW	B		3 EA	J101,102,101	01/01/91	12/31/10
72	619773	CONN-.100C,16P,PCB,STR,2R,UNSH	-		1 EA	J115	01/01/91	12/31/10
73	619774	CONN-.100C,22P,PCB,STR,2ROW	-		3 EA	J105,106,101	01/01/91	12/31/10
74	624800	CONN-.100C, 2P,PCB,STR,LATCHNG	A		2 EA	J109,130	01/01/91	12/31/10
75	625936	CONN-SUB D, 9S,F,PCB,RA,THDINS	A		1 EA	J112	01/01/91	12/31/10
76	627328	CONN-SUB D,37S,F,PCB,RA,THDINS	A		1 EA	J104	01/01/91	12/31/10
77	634756	CONN-.100C,16P,PCB,STR,2R,LONG	B		1 EA	J103	01/01/91	12/31/10
78	617856	TEST POINT-PCB,LOOP,BLACK	-		2 EA	TP101,104	01/01/91	12/31/10
79	617857	TEST POINT-PCB,LOOP,RED	-		6 EA	TP100,102	05/28/97	12/31/10
80	619992	FERRITE SHIELD BEAD-AXIAL	A		5 EA	L100-104	01/01/91	12/31/10

## 643181 Rev. C

Item	Part No	Description	Rev	Status	Quantity	Notes	From	To
81	629657	CRYSTAL-8.0 MHZ, 2 LEADED	A		1 EA	Y100	01/01/91	12/31/10
82	627077	CONN-.100C,50P,PCB,STR,BRKAWAY	A		3 PC	W100	01/01/91	12/31/10
83	541806	SCR-PAN, 4-40X .375,PHIL,SST	-		4 EA	XJ104,112	01/01/91	12/31/10
86	623436	CONN-.100C, 2S,SHUNT JUMPER,AU	A		2 EA	XJ106	01/01/91	12/31/10
87	634773	SKT-IC,DIP,32P,.6W,MACH PINS	A		1 EA	XU120	01/01/91	12/31/10
88	126-00005	SKT-CARRIER,52 PIN,SOLDER TAB	-		1 EA	XU111	01/01/91	12/31/10
89	1000843	NUT-KEPS,# 4-40,SST304	C		4 EA	XJ104,112	01/01/91	12/31/10
90	609442	RES-2M OHM,.12W, 1%,RN55D	-		2 EA	R130,131	06/12/97	12/31/10
91	634785	DIO-TVS,5V,500W,UNI,SA5.0A			1 EA	CR126	01/01/91	12/31/10
92	641265	DIO-TVS,15V,500W,UNI,SA15A	A		2 EA	CR127,12E	04/10/98	12/31/10
93	635816	DIO-TVS,10V,.5W,BI,SA10CA	A		2 EA	CR122,12E	01/01/91	12/31/10
94	603131	RES-100 OHM,.12W, 1%,RN55D	-		1 EA	R300	01/01/91	12/31/50

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	RELEASE CO 16032	09-97	
	B	FUSE 2.5A CO 16177	11-97	
	C	CHANGE WIRING CO 17429	11-98	
	D	CHANGE TRANS CO 17604	12-98	
	E	CORRECT ASSY CO 18726	11-99	DJM
	F	CORRECT ASSY CO 19039	4-00	DJM
	G	ASSY CHANGE CO 19416	8-26-00	DJM

NOTES:  
 1. MARK REVISION OF THIS DOCUMENT IN SPACE PROVIDED.  
 2. SEE SHEET TWO FOR WIRING INFORMATION.

TO BE DONE AT CHASSIS ASSY

3. COVER FUSES F1 F2 F3 F4 WITH ITEM 53.

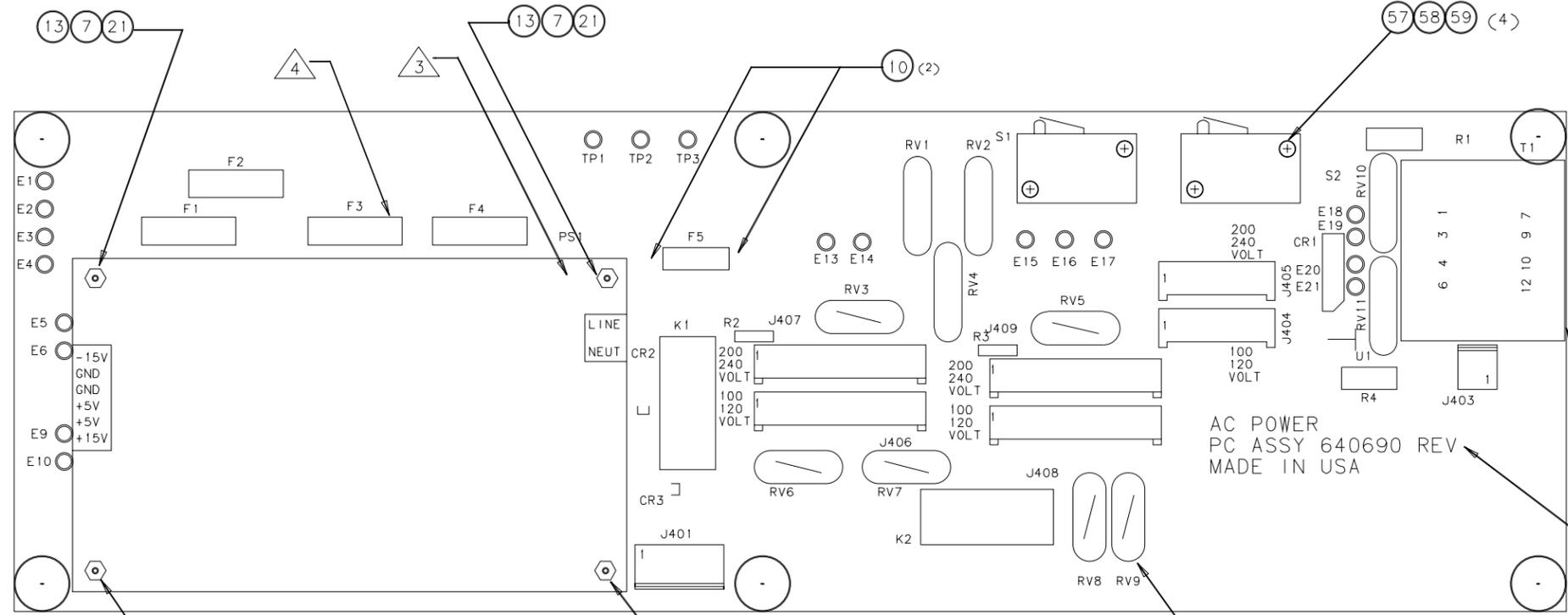
4. FUSE VALUES FOR F3 AND F4

	120V	208/230V
500ma XFMR	6.30 AMP	4.00 AMP
100 ma XFMR	2.50 AMP	1.25 AMP

F1 THRU F4 ARE ALL IEC 127, TYPE T SHEET V TIME LAG, HIGH BREAKING CAPACITY

5. IF BOARD IS ALTERED TO INSTALL VARISTORS IN LOCATIONS RV3, RV5-RV9, THE VARISTORS MUST BE SPACED OFF THE BOARD WITH CERAMIC BEADS.

6. ALL WIRES ARE 16GA EXCEPT AS NOTED.



7. AFTER TRANSFORMER IS MOUNTED ON BOARD JUMPER PINS 9 TO 10 OF TRANSFORMER WITH 20-22 AWG BUS WIRE

SEE DETACHED PARTS LIST

COMPUTER GENERATED MENTOR CAD SYSTEM VERSION 8	DRN ROGER	DATE 09-97	 6509 FLYING CLOUD DRIVE, EDEN PRAIRIE, MN, 55344
TOLERANCES AND DIMENSIONS SHALL BE INTERPRETED PER ANSI Y14.5M-1982	CKD D.MCNEIL	DATE 09-97	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	APPD D.MCNEIL	DATE 09-97	
TOLERANCES .X +/-0.030 ANGLES .XX +/-0.010 +/- 1 DEG .XXX +/-0.005	APPD	DATE	TITLE PRINTED CIRCUIT BOARD ASSEMBLY AC POWER
THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION IS EXPRESSLY PROHIBITED EXCEPT AS OTHERWISE AGREE TO IN WRITING			SIZE D DRAWING NUMBER 640690 REV G
SCALE NONE SHEET 1 OF 2			

D

C

B

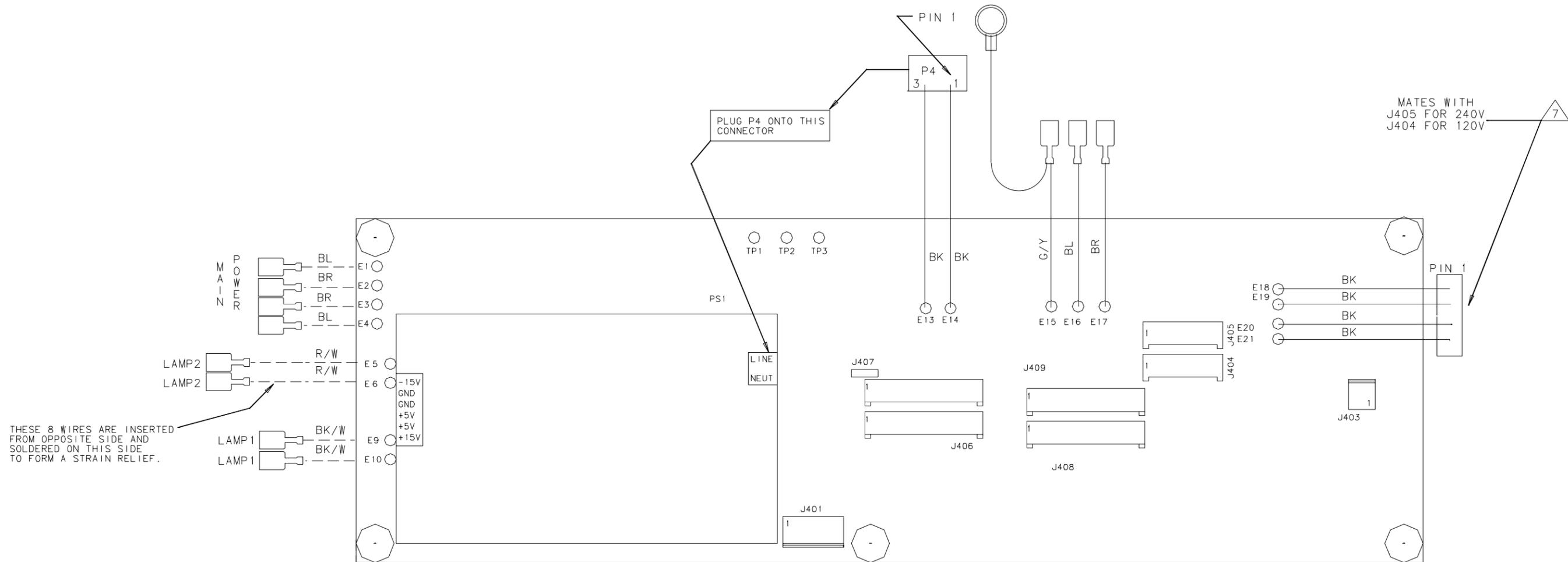
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WIRING DIAGRAM

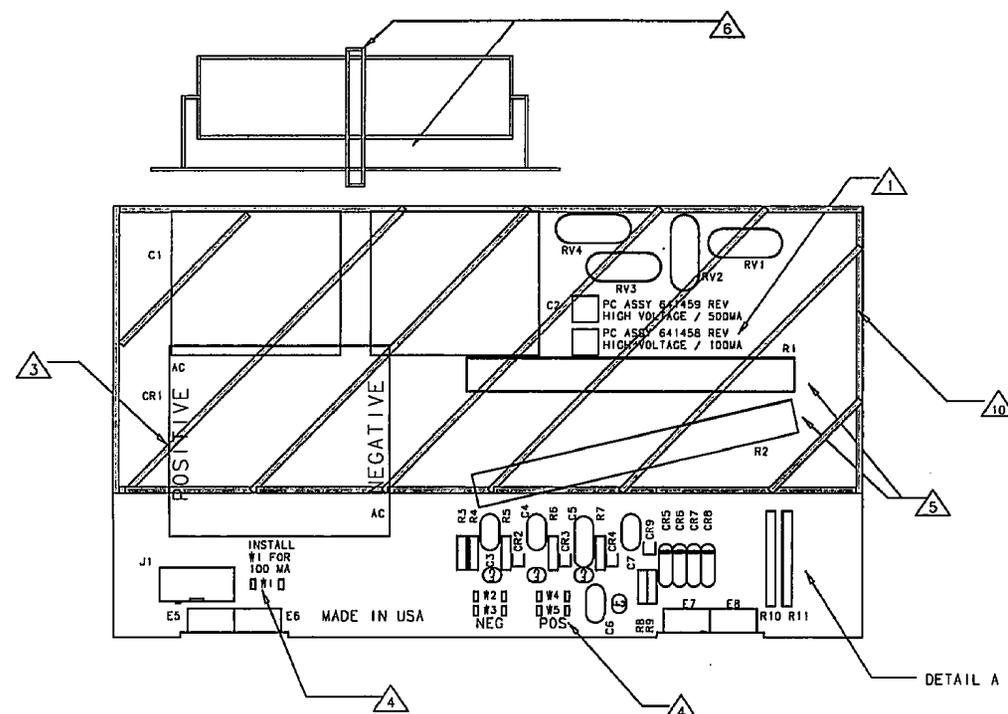
## 640690 Rev G

Item	Part No	Description	Rev	Status	Quantity	Notes	From	To
	640690	ASSY-PCB,AC PWR,DIGITEL MPC	G		0 EA			
1	640689	PCB-AC POWER,DIGITEL MPC	A		1 EA		01/01/91	12/31/10
3	279179	BRIDGE-RECT,600V,1A,KBP06	A		1 EA	CR1	01/01/91	12/31/10
4	472030	RES-30.1K OHM,.25W, 1%,RN60D	-		2 EA	R2,3	01/01/91	12/31/10
6	531304	STDF-0.25L, 6-32,F/F,.25HEX,BR	B		2 EA		01/01/91	12/31/10
7	541912	SCR-PAN, 6-32X .750,PHIL,SST	-		4 EA		01/01/91	12/31/10
10	606102	SKT-.020-.032 PIN,PS-30-805	A		2 EA	XF5	01/01/91	12/31/10
12	607846	CONN-MATE-N-LOK, 4P,HDR,PCB	B		2 EA	J404,405	01/01/91	12/31/10
13	608792	STDF-0.25L, 6-32,F/F,.25HEX,NY	-		2 EA		01/01/91	12/31/10
14	610662	CONN-.156C, 5P,PCB,STR,1R,G,SQ	A		1 EA	J401	01/01/91	12/31/10
15	611669	FUSE HOLDER-PCB CLIP,5MM SIZE	-		8 EA	XF1-4	01/01/91	12/31/10
16	611672	CONN-MATE-N-LOK, 6P,HDR,IN-LIN	-		4 EA	J406-409	01/01/91	12/31/10
19	626692	OPTOISOL-4N35,7.5KV,H CTR	A		1 EA	U1	01/01/91	12/31/10
21	628642	NUT-KEPS,# 6-32,SML PATTRN,STL	A		4 EA		01/01/91	12/31/10
22	630822	VARISTOR-300 VOLT; V300LA40	A		3 EA	RV1,2,4	01/01/91	12/31/10
23	631932	PS-90-264VAC:+5,+/-15V,SWITCHR	B		1 EA		07/08/98	12/31/50
25	610633	CONN-.156C, 2P,PCB,STR,1R,G,SQ	A		1 EA	J403	01/01/91	12/31/10
26	643535	XFMR-PWR,2.5VA,PCB,IEC	A		1 EA	T1	12/03/98	12/31/50
27	635805	SW-SNAP ACTION,LH,PCB,(MICRO)			2 EA	S1,2	01/01/91	12/31/10
29	636455	RES-4.7K OHM,2W,5%,MET OX	A		2 EA	R1,4	01/01/91	12/31/10
33	647855	KIT-WIRE MPC AC PWR	A		1 EA		06/19/00	12/31/50
49	639638	FUSE-2.5A,250V,S/B,PIGTL,2AG	A		1 EA	F5	10/15/97	12/31/10
50	636478	FUSE-10A,250V,S/B,5X20,SHT5	A		2 EA	F1,2	01/01/91	12/31/10
51	636498	RLY-PCB,SPST,12VDC,16A/240V	A		2 EA	K1,2	01/01/91	12/31/10
52	603955	DIO-HS SW,75V,1N914	A		2 EA	CR2,3	01/01/91	12/31/10
53	638170	COVER-FUSE,5 X 20MM	A		4 EA	XF1-4	01/01/91	12/31/10
55	617856	TEST POINT-PCB,LOOP,BLACK	-		3 EA	TP1-3	01/01/91	12/31/10
57	573627	SCR-PAN,M3X 20,PHIL,SS	A		4 EA	XS1,2	01/01/91	12/31/10
58	1002325	WSHR-FLAT,# 4,.253X.115, NYL	-		4 EA	XS1,2	01/01/91	12/31/10
59	578500	NUT-KEPS, M3,ZINC PLTD STEEL	B		4 EA	XS1,2	01/01/91	12/31/10
60	640691	SCHEM DIAG-AC PWR,DIGITEL MPC	B		0 EA		01/01/91	12/31/10
63	374039	VARISTOR-150VRMS,6.5KA,150LA20	B		2 EA	RV10,11	01/01/91	12/31/10

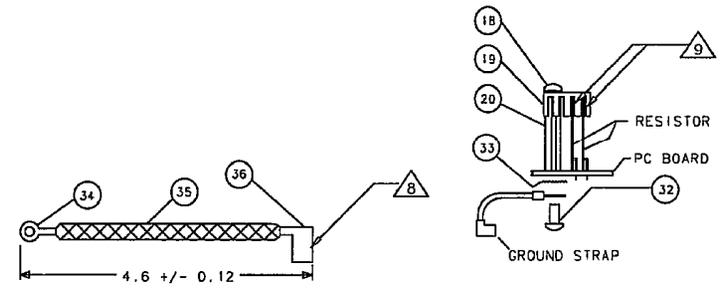
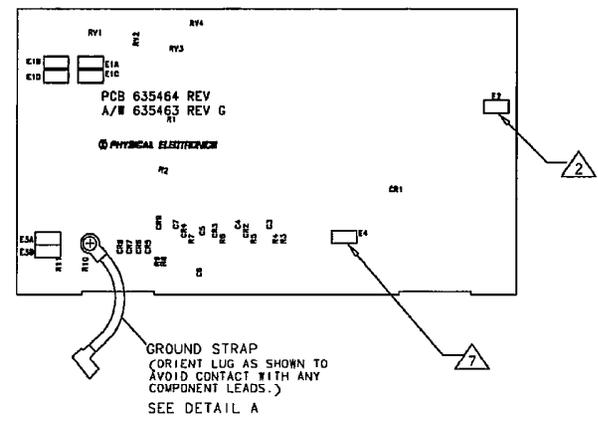
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DRAWING NO		641458		REV	DATE	APPROVED
ZONE	REV	DESCRIPTION	DATE	APPROVED		
	A	RELEASE CO 16523	03-98	BBB		
	B	UPDATE ASSEMBLY CO# 17009	05-98	BBB		
	C	ADD TAPE TO RES CO# 17198	07-98	BBB		
	D	ADD COATING CO# 17706	01-99	BBB		
	E	CHANGE DIODE CO # 17922	04-99	BBB		

D  
C  
B  
A



- NOTES:
- 1 MARK REVISION OF THIS DOCUMENT IN SPACE PROVIDED. MARK AN X IN BOX IN FRONT OF PART NUMBER.
  - 2 ASSEMBLE E1A B C D, E2, E3A, E3B, E4 ON BACK OF BOARD.
  - 3 INSTALL CR1 SO THE WORD POSITIVE SHOWS.
  - 4 INSTALL JUMPERS IN W1, W4, W5 POSITIONS.
  - 5 COVER LEAD OF RESISTORS R1 AND R2 WITH TEFLON TUBING. ITEM 31.
  - 6 SECURE CAPS TO BOARD WITH CABLE TIE PN 506003
  - 7 AFTER SOLDERING CONNECTOR 'E4' IN PLACE, TRIM LEADS FLUSH WITH BOARD, COAT TRIMMED LEADS WITH A SMALL AMOUNT OF HOT MELT GLUE.
  - 8 ASSEMBLE GROUND STRAP AS SHOWN.
  - 9 ADD TAPE P/N 643002 TO RESISTORS TO INSULATE THEM FROM HEATSINK
  - 10 APPLY ITEM 28 TO AREA SHOWN



DETAIL A  
SEE DETACHED PARTS LIST

COMPUTER GENERATED VECTOR CAD SYSTEM VERSION 8	DWG ROGER	DATE 03-97	 5509 FLYING CLOUD DRIVE, EDEN PRAIRIE, MN, 55344
TOLERANCES AND DIMENSIONS SHALL BE INTERPRETED PER ANSI Y14.5M-1982	APPD	DATE	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	APPD	DATE	TITLE PRINTED CIRCUIT BOARD ASSEMBLY HIGH VOLTAGE POSITIVE 100 MA
TOLERANCES .XX +/-0.030 ANGLES .XX +/-0.010 +/-1 DEG .XXX +/-0.005	THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION OR USE OF THIS DRAWING IS EXPRESSLY PROHIBITED EXCEPT AS PHYSICAL ELECTRONICS MAY OTHERWISE AGREE TO IN WRITING		SIZE D DRAWING NUMBER 641458 REV E
SCALE NONE			SHEET 1 OF 1

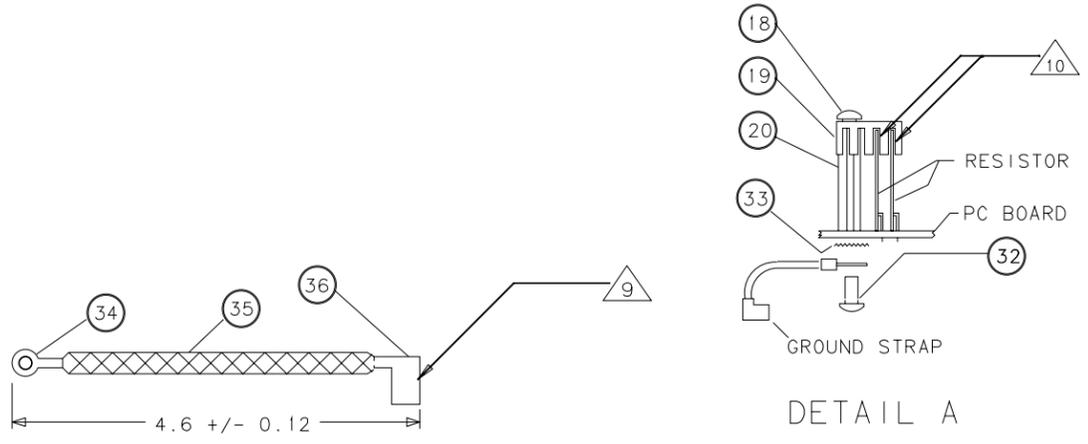
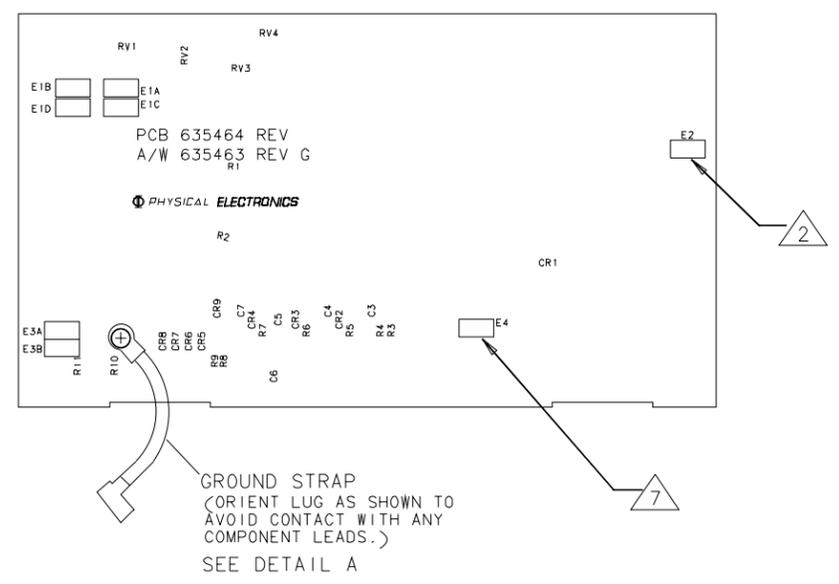
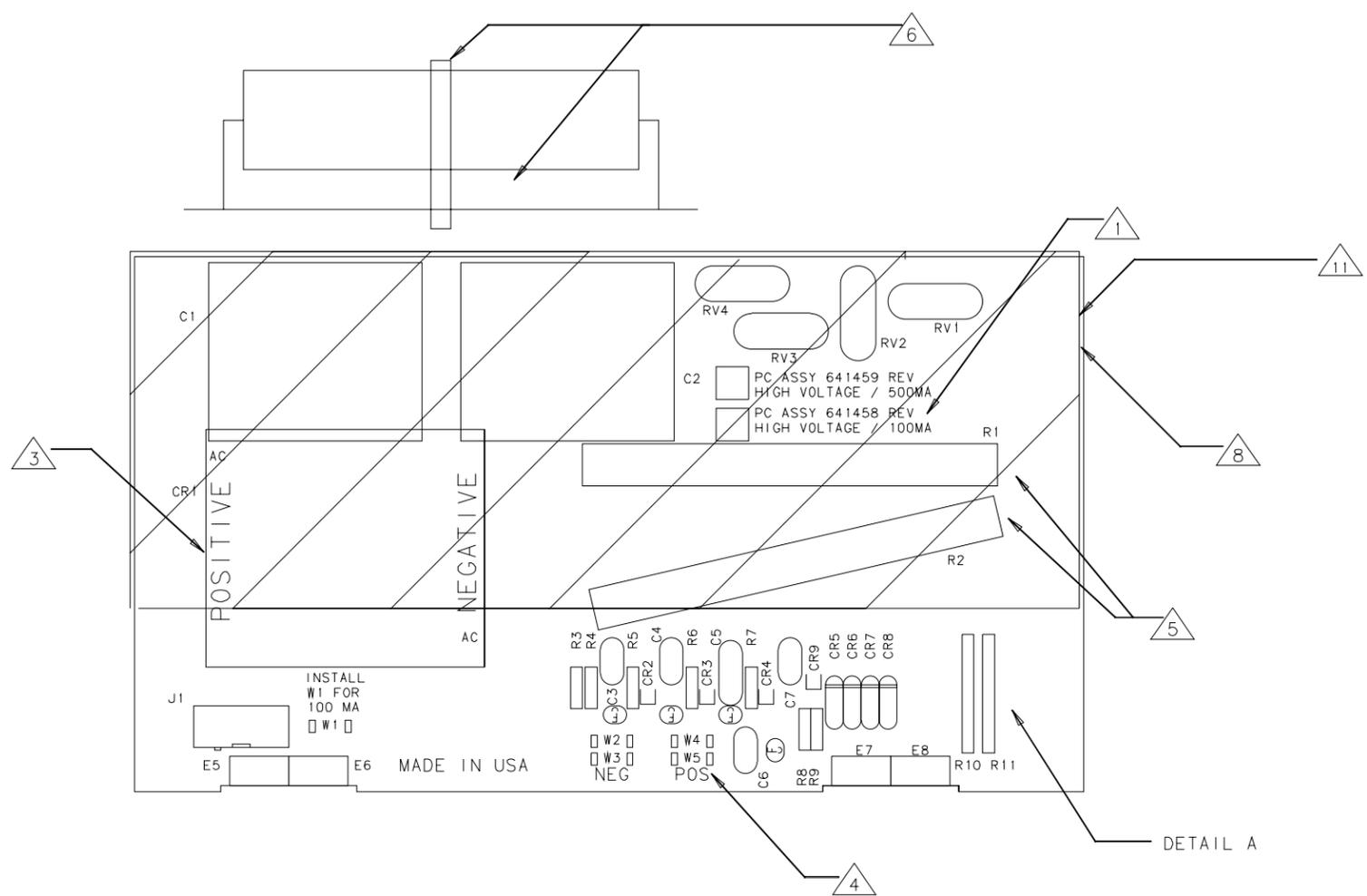
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## 641458 Rev. E

Item	Part No.	Description	Rev	Status	Qty	UM	Notes	From	To
	641458	ASSY-PCB,100MA HV,DIGITEL MPC	E			EA			
1	635464	PCB-HIGH VOLTAGE,DIGITEL MPC	G		1	0 EA		1/1/91	12/31/10
2	643002	TAPE-KAPTON,.75"W,.002THK,500F	A			3 IN		8/3/98	12/31/50
3	639622	CAP-0.1 UF,4KV,5%,FILM,AXIAL	A			2 EA	C1,2	10/17/97	12/31/10
4	644255	BRIDGE-RECT,16KV,1A,JH836	A			1 EA	CR1	4/1/99	12/31/50
5	636470	HT SK-TO220,LT WT,.750H,.750W	A			1 EA	XR10,11	1/1/91	12/31/10
6	531318	STDF-1.12L, 6-32,F/F,.25HEX,BR	B			1 EA	XR10,11	1/1/91	12/31/10
7	546804	SCR-SEMS,PAN,EXT, 6-32X.250,SS	A			1 EA	XR10,11	1/1/91	12/31/10
8	373035	CAP-0.1 UF,100V,20%,.1",CER ML	-			4 EA	CX	1/1/91	12/31/10
9	378079	RES-ZEROHM,MOLDED JUMPER WIRE	A			3 EA	W1,4,5	1/1/91	12/31/10
10	603597	RES-20K OHM,.12W, 1%,RN55D	-			2 EA	R3,4	1/1/91	12/31/10
11	603598	RES-100K OHM,.12W, 1%,RN55D	A			2 EA	R8,9	1/1/91	12/31/10
12	528000	INSUL-CER,FISH,SPINE BEAD,99%	-			8 EA	XRV1-4	1/1/91	12/31/10
13	274053	CAP-4.7 UF,50V,20%,CER ML,RDL	A	NP		1 EA	C5	1/1/91	12/31/10
14	472043	CAP-1 UF,50V,20%,CER ML,RDL	A			4 EA	C3,4,6,7	1/1/91	12/31/10
15	604966	RES-4.75K OHM, .12W, 1%,RN55D	-			2 EA	R5,6	1/1/91	12/31/10
16	635802	RES-10M OHM,10W,1%,15KV,MG780	A			2 EA	R1,2	1/1/91	12/31/10
17	635816	DIO-TVS,10V,500W,BI,SA10CA	A			1 EA	CR4	1/1/91	12/31/10
18	635817	DIO-TVS,20V,500W,BI,SA20CA	A			3 EA	CR2,3,9	1/1/91	12/31/10
19	614659	CONN-.100C,10P,PCB,STR,2ROW	B			1 EA	J1	1/1/91	12/31/10
20	107-00067	DIO-ZENER,5.6V,5W,1N5339B	-			4 EA	CR5-8	1/1/91	12/31/10
21	635818	LUG-QC,BD MT,.187X.020,PCB	A			3 EA	E3A,3B,4	1/1/91	12/31/10
22	531800	LUG-QC,BD PCB,.25X.032,SOLDER	-			3 EA	E1A,1B,2	1/1/91	12/31/10
23	620196	RES-47.5K OHM, .12W, 1%,RN55D	-			1 EA	R7	1/1/91	12/31/10
24	635474	CURRENT LIMITER-INRUSH,2A MAX	A			4 EA	RV1-4	1/1/91	12/31/10
25	636485	RES-100 OHM,10W,1%,POWER CHIP	A			2 EA	R10,11	1/1/91	12/31/10
26	638266	GROUND STRIP-CLIP ON	A			EA	E5,6	1/1/91	12/31/10
27	506003	CABLE TIE-1.250 BDL OD,5.6"L	C			2 EA	XC1,2	10/17/97	12/31/10
28	643538	COATING-CONFORMAL,HUMISEAL1B73	-			EA		1/4/99	12/31/50
30	635466	SCHEM DIAG-HV BD,DIGITEL MPC	H			1 EA		4/1/99	12/31/50
31	521518	TUBING-TEF,NAT,.042ID,.012THK	C			3 IN	XR1,2	11/6/97	12/31/10
32	546806	SCR-SEMS,PAN,EXT, 6-32X.375,SS	A			1 EA		2/2/98	12/31/10
33	546506	WSHR-EXT TOOTH LOCK,# 6, SST	A			1 EA		2/1/98	12/31/10
34	500506	LUG-RING,12-10GA, #6,INS,.292W	B			1 EA		2/2/98	12/31/10
35	520000	CA-BRAID,TUBULAR,COPPER,.203ID	A			FT		2/2/98	12/31/10
36	641600	LUG-QC,FLAG,F,10-12GA,.25W,UN				1 EA		2/2/98	12/31/10

ZONE	REV	DESCRIPTION	DATE	APPROVED
		DRAWING NO. 641459	SH 1	REV E 1
A		RELEASE C0# 16523	03-98	BBB
B		UPDATE ASSEMBLY C0#17009	05-98	BBB
C		ADD TAPE TO RES C0#17198	07-98	BBB
D		ADD COATING C0# 17706	01-99	BBB
E		CHANGE CR1 C0# 18320	09-99	BBB

- NOTES:
- 1 MARK REVISION OF THIS DOCUMENT IN SPACE PROVIDED. MARK AN X IN BOX IN FRONT OF PART NUMBER.
  - 2 ASSEMBLE E1A B C D, E2, E3A, E3B, E4 ON BACK OF BOARD.
  - 3 INSTALL CR1 SO THE WORD POSITIVE SHOWS.
  - 4 INSTALL JUMPERS IN W4, W5 POSITIONS.
  - 5 COVER LEAD OF RESISTORS R1 AND R2 WITH TEFLON TUBING. ITEM 31.
  - 6 SECURE CAPS TO BOARD WITH CABLE TIE PN 506003
  - 7 AFTER SOLDERING CONNECTOR 'E4' IN PLACE, TRIM LEADS FLUSH WITH BOARD. COAT TRIMMED LEADS WITH A SMALL AMOUNT OF HOT MELT GLUE.
  - 8 SPRAYING PROCEDURE COVER J1 CONN E1A, 1B, 1C, 1D, E2, E3A, E3B, E4-E8 SPRAY 3 COATS OF KOLOID (ITEM 28) ON THE FRONT AND BACK OF BOARD.
  - 9 ASSEMBLE GROUND STRAP AS SHOWN.
  - 10 ADD TAPE P/N 643002 TO RESISTORS TO INSULATE THEM FROM HEATSINK
  - 11 APPLY ITEM 28 TO AREA SHOWN



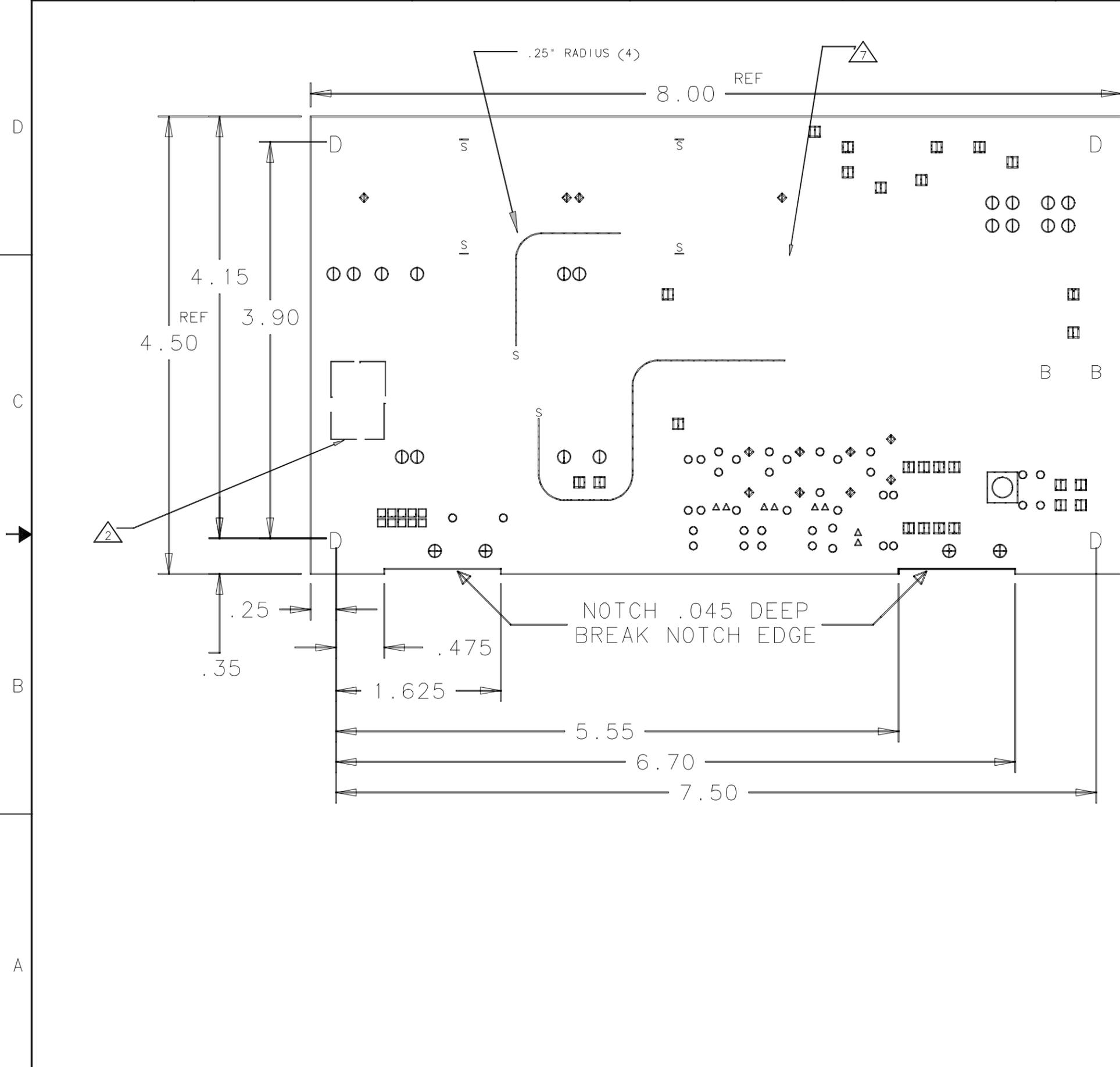
SEE DETACHED PARTS LIST

COMPUTER GENERATED MENTOR CAD SYSTEM VERSION 8	DRN D.MCNEIL	DATE 07/98	<b>PHYSICAL ELECTRONICS</b> 6509 FLYING CLOUD DRIVE, EDEN PRAIRIE, MN, 55344	
TOLERANCES AND DIMENSIONS SHALL BE INTERPRETED PER ANSI Y14.5M-1982	CKD	DATE		TITLE PRINTED CIRCUIT BOARD ASSEMBLY
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	APPD	DATE		TITLE HIGH VOLTAGE POSITIVE 500MA
TOLERANCES .X +/-0.030 ANGLES .XX +/-0.010 +/- 1 DEG .XXX +/-0.005	THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION IS EXPRESSLY PROHIBITED EXCEPT AS OTHERWISE AGREE TO IN WRITING		SIZE D DRAWING NUMBER 641459 REV E	
SCALE NONE		SHEET 1 OF 1		

Item	Part No.	Description	Rev	Status	Qty	UM	Notes	From	delete col
	641459	ASSY-PCB,500MA HV,DIGITEL MPC	E			EA			641459
1	635464	PCB-HIGH VOLTAGE,DIGITEL MPC	G		1	EA		1/1/91	641459
2	373035	CAP-0.1 UF,100V,20%,.1",CER ML	-		4	EA	CX	1/1/91	641459
3	528000	INSUL-CER,FISH,SPINE BEAD,99%	-		8	EA	XRV1-4	1/1/91	641459
4	531800	LUG-QC,BD PCB,.25X.032,SOLDER	-		3	EA	E2,E1A,1B	1/1/91	641459
5	274053	CAP-4.7 UF,50V,20%,CER ML,RDL	A	NP	1	EA	C5	1/1/91	641459
6	603597	RES-20K OHM,.12W, 1%,RN55D	-		4	EA	R3,4,8,9	1/1/91	641459
7	614659	CONN-.100C,10P,PCB,STR,2ROW	B		1	EA	J1	1/1/91	641459
8	472043	CAP-1 UF,50V,20%,CER ML,RDL	A		4	EA	C3,4,6,7	1/1/91	641459
9	604966	RES-4.75K OHM, .12W, 1%,RN55D	-		2	EA	R5,6	1/1/91	641459
10	635472	CAP-0.33 UF,4KV,FILM,AXIAL	A		2	EA	C1,2	1/1/91	641459
11	644255	BRIDGE-RECT,16KV,1A,JH836	A		1	EA	CR1	7/16/99	641459
12	635802	RES-10M OHM,10W,1%,15KV,MG780	A		2	EA	R1,2	1/1/91	641459
13	635816	DIO-TVS,10V,500W,BI,SA10CA	A		1	EA	CR4	1/1/91	641459
14	635817	DIO-TVS,20V,500W,BI,SA20CA	A		3	EA	CR2,3,9	1/1/91	641459
15	635981	RES-20 OHM,10W,1%,POWER CHIP	A		2	EA	R10,11	1/1/91	641459
16	635818	LUG-QC,BD MT,.187X.020,PCB	A		3	EA	E3A,3B,4	1/1/91	641459
17	107-00067	DIO-ZENER,5.6V,5W,1N5339B	-		4	EA	CR5-8	1/1/91	641459
18	546804	SCR-SEMS,PAN,EXT, 6-32X.250,SS	A		1	EA	XR10,11	1/1/91	641459
19	636470	HT SK-TO220,LT WT,.750H,.750W	A		1	EA	XR10,11	1/1/91	641459
20	531318	STDF-1.12L, 6-32,F/F,.25HEX,BR	B		1	EA	XR10,11	1/1/91	641459
21	643002	TAPE-KAPTON,.75"W,.002THK,500F	A		3	IN		8/3/98	641459
22	620196	RES-47.5K OHM, .12W, 1%,RN55D	-		1	EA	R7	1/1/91	641459
23	635474	CURRENT LIMITER-INRUSH,2A MAX	A		4	EA	RV1-4	1/1/91	641459
24	378079	RES-ZEROHM,MOLDED JUMPER WIRE	A		2	EA	W4,5	1/1/91	641459
25	638266	GROUND STRIP-CLIP ON	A			EA	E5,6	1/1/91	641459
27	506003	CABLE TIE-1.250 BDL OD,5.6"L	C		2	EA	XC1,2	1/1/91	641459
28	643538	COATING-CONFORMAL,HUMISEAL1B73	-			EA		1/4/99	641459
30	635466	SCHEM DIAG-HV BD,DIGITEL MPC	H		1	EA		1/1/91	641459
31	521518	TUBING-TEF,NAT,.042ID,.012THK	C		3	IN	XR1,2	1/1/91	641459
32	546806	SCR-SEMS,PAN,EXT, 6-32X.375,SS	A		1	EA		1/1/91	641459
33	546506	WSHR-EXT TOOTH LOCK,# 6, SST	A		1	EA		1/1/91	641459
34	500506	LUG-RING,12-10GA, #6,INS,.292W	B		1	EA		1/1/91	641459
35	520000	CA-BRAID,TUBULAR,COPPER,.203ID	A			FT		1/1/91	641459
36	641600	LUG-QC,FLAG,F,10-12GA,.25W,UN			1	EA		1/1/91	641459

8 7 6 5 4 3

DRAWING NO.		635464	SH 1	REV G	1
ZONE	REV	DESCRIPTION	DATE	APPROVED	
	A	PROTO	08-96	BBB	
	B	PROTO	12-96	BBB	
	C	RELEASE CO# 15380	03-97	BBB	
	D	GND PLANE/CLIP CO 15658	05-97	BBB	
	E	ADD CR9 CO# 15935	08-97	BBB	
	F	FASTON NEW ASSY MOVE VARS # CO 16038	09-97		
	G	ASSY #s CHANGE CO 16523			03-98



- NOTES:
- FABRICATE PER PHYSICAL ELECTRONICS SPEC 602531
  - VENDOR U.L. IDENTIFICATION, DATE CODE, AND U.L. FLAMMABILITY RATING MUST APPEAR ON OPPOSITE SIDE SILKSCREEN WITHIN DASHED AREA.
  - MATERIAL: 0.062 INCH THICK LAMINATE WITH ONE OUNCE COPPER BOTH SIDES. (FLGFN 062 1/1 A/A)
  - PLATING: COPPER 0.001 SOLDER 0.0003
  - APPLY SILKSCREEN LEGEND BOTH SIDES. COLOR WHITE
  - APPLY LPI SOLDER MASK BOTH SIDES.
  - MARK REVISION LEVEL OF THIS DRAWING IN SPACE PROVIDED ON THE OPPOSITE SIDE SILKSCREEN FOLLOWING THE PCB NUMBER
  - USE PHYSICAL ELECTRONICS ARTWORK 635463 REV G
  - SHEAR/ROUTE PER DIMENSIONS.

BOARD'S DRILL SCHEDULE

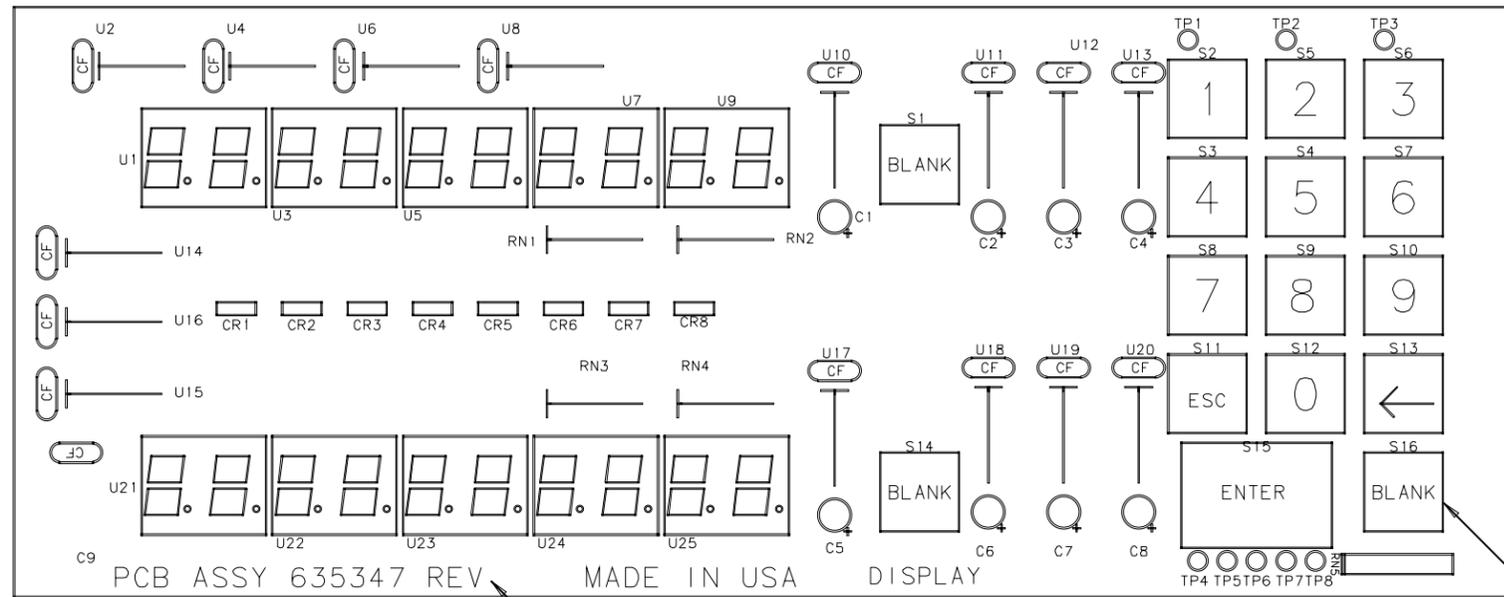
DRILL SYMBOL	DRILL SIZE	COUNT	PLATED	Min/Max
▲	.028	8	YES	+/- .003
○	.033	38	YES	+/- .003
□	.039	10	YES	+/- .003
◆	.045	14	YES	+/- .003
■	.055	26	YES	+/- .005
⊙	.065	14	YES	+/- .005
⊕	.083	4	YES	+/- .003
B	.125	2	NO	+/- .005
D	.156	5	NO	+/- .01
S	.125	6	SLOT NO PLATE	+/- .01

COMPUTER GENERATED MENTOR CAD SYSTEM VERSION 8	DRN ROGER	DATE 08-96	<b>PHYSICAL ELECTRONICS</b> 6509 FLYING CLOUD DRIVE, EDEN PRAIRIE, MN, 55344
TOLERANCES AND DIMENSIONS SHALL BE INTERPRETED PER ANSI Y14.5M-1982	CKD	DATE	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	APPD	DATE	
TOLERANCES .X +/-0.030 ANGLES .XX +/-0.010 +/- 1 DEG .XXX +/-0.005	THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION IS EXPRESSLY PROHIBITED EXCEPT AS OTHERWISE AGREE TO IN WRITING.		TITLE <b>PCB FABRICATION HIGH VOLTAGE</b>
SIZE D DRAWING NUMBER 635464 REV G		SCALE NONE	SHEET 1 OF 1

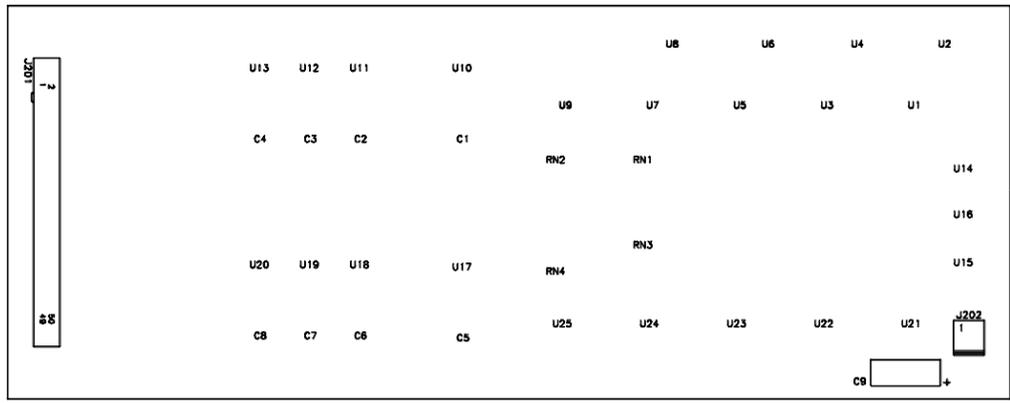
8 7 6 5 4 3 2 1

8 7 6 5 4 3

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	RELEASE BOM CO# 15198	11-96	T.SUTERA
	B	PROD RELEASE CO# 15274	02-97	T.SUTERA
	C	KEY CAP SWAP CO 15618	07-97	T.SUTERA
	D	ENTER KEY HDW CO 15878	08-97	GAT DDM
	E	RE SPACE BAR HDW 16255	11-97	



- NOTES:
- 1 MARK REVISION OF THIS DOCUMENT IN SPACE PROVIDED.
  - 2 INSTALL C9, J201, AND J202 ON BACK OF BOARD.
  - 3 INSTALL S1 THRU S16 AFTER FLOW SOLDERING AND HAND SOLDER.



SEE DETACHED PARTS LIST

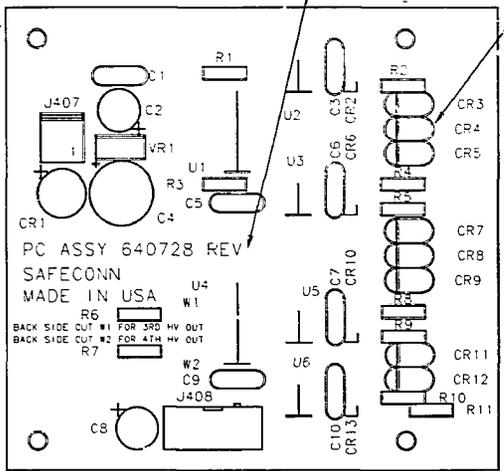
COMPUTER GENERATED MENTOR CAD SYSTEM VERSION 8	DRN D MCNEIL	DATE 11-96	<b>PHYSICAL ELECTRONICS</b> 6509 FLYING CLOUD DRIVE, EDEN PRAIRIE, MN, 55344
TOLERANCES AND DIMENSIONS SHALL BE INTERPRETED PER ANSI Y14.5M-1982	CKD	DATE	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	APPD	DATE	
TOLERANCES •X +/-0.030 ANGLES •XX +/-0.010 +/- 1 DEG •XXX +/-0.005	THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION IS EXPRESSLY PROHIBITED EXCEPT AS PHYSICAL ELECTRONICS MAY OTHERWISE AGREE TO IN WRITING		TITLE PRINTED CIRCUIT BOARD ASSEMBLY DISPLAY BOARD
SCALE NONE		SHEET 1 OF 1	SIZE D DRAWING NUMBER 635347 REV E

8 7 6 5 4 3 2 1

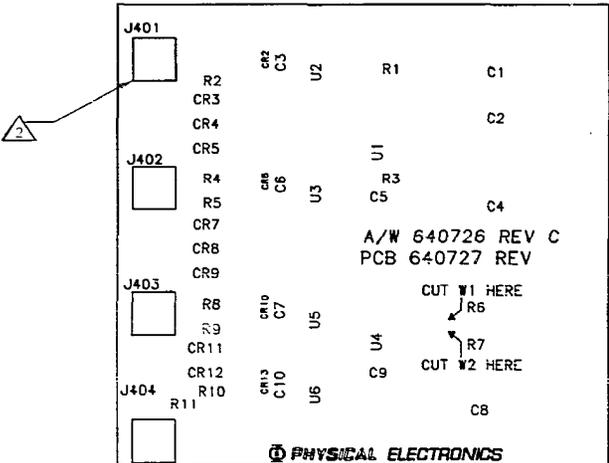
## 635437 Rev. E

Item	Part No.	Description	Rev	Status	Qty	UM	Notes	From	To
	635347	ASSY-PCB,DISPLAY,DIGITEL MPC	E						
1	635346	PCB-DISPLAY,DIGITEL MPC	B		1	EA		2/28/97	12/31/10
2	274061	CAP-100 UF,10V,10%,TANT,AXL	-		1	EA	C9	1/1/91	12/31/10
3	635387	LED-ALPHANUMERICX2,13.8MM,GRN	A		10	EA	U1,3,5,7,9,21-25	1/1/91	12/31/10
4	278002	CAP-0.01 UF,50V,20%,.25LS,CER	B		16	EA	CF'S	1/1/91	12/31/10
5	378052	CONN-.100C,50P,PCB,STR,2ROW	-		1	EA	J201	1/1/91	12/31/10
6	636157	SW-KYBD,LOW PROFILE,CHERRY MX	A		16	EA	S1-16	2/28/97	12/31/10
7	601279	CAP-10 UF,25V,20%,TANT,RDL	A		8	EA	C1-8	1/1/91	12/31/10
8	608584	RES NTKW-10K ,SIP, 4I,.25W,2%	-		1	EA	RN5	1/1/91	12/31/10
9	610633	CONN-.156C, 2P,PCB,STR,1R,G,SQ	A		1	EA	J202	1/1/91	12/31/10
10	614219	IC-74HC138,3-8 DECODER/DEMUX	B		2	EA	U6,8	1/1/91	12/31/10
11	617857	TEST POINT-PCB,LOOP,RED	-		8	EA	TP1-8	1/1/91	12/31/10
12	624748	IC-293,QUADRUPLE HALF-H DRVR			8	EA	U10-13,17-20	1/1/91	12/31/10
13	626415	IC-2068B,DARL SW,50VCEX,DIP	A		3	EA	U14-16	1/1/91	12/31/10
16	635652	IC-74HC04	A		2	EA	U2,4	1/1/91	12/31/10
17	1003253	LED-GRN,RECT,2V/20MA,HLMP-0504	A		8	EA	CR1-8	1/1/91	12/31/10
18	1003254	RES NTKW-22 ,DIP, 8I,.25W,2%	-		4	EA	RN1-4	1/1/91	12/31/10
19	636172	KEYCAP SET-DIGITEL MPC			1	EA	XS1-16	1/1/91	12/31/10
20	638280	SPACER-LED,.24L,T-1.75,NYLON	A		8	EA	XCR1-8	5/28/97	12/31/10

ZONE	REV	DESCRIPTION	DATE	APPROVED
A		RELEASE CO 16095	09-97	
B		JUMFERS CO 16224	10-97	
C		FLIP C2 CO 18391	01-98	
D		SAFECONN CONFIG CO 17355	11-98	GAT



- NOTES:
- 1 MARK REVISION OF THIS DOCUMENT IN SPACE PROVIDED.
  - 2 J401 IS MOUNTED ON THE OPPOSITE SIDE OF THE BOARD. J402, J403 AND J404 ARE MOUNTED PER OPTION ONLY.
  - 3 CR4, CR5, CR9, CR12 ARE MOUNTED PER OPTION ONLY.



OPPOSITE SIDE

SEE DETACHED PARTS LIST

COMPUTER GENERATED MENTOR CAD SYSTEM VERSION 8	DRN ROGER	DATE 09-97	<b>PHYSICAL ELECTRONICS</b> 5529 FAYING CLOUD DRIVE, EDEN PRAIRIE, MN, 55344
TOLERANCES AND DIMENSIONS SHALL BE INTERPRETED PER ANSI Y14.5M-1987	CRD	DATE	FILE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	APPD	DATE	PRINTED CIRCUIT BOARD ASSEMBLY
TOLERANCES - .0005 + .0005 + .0010 + .0015 + .0020 + .0025 + .0030 + .0040 + .0050 + .0060 + .0070 + .0080 + .0090 + .0100 + .0120 + .0150 + .0200 + .0250 + .0300 + .0350 + .0400 + .0500 + .0600 + .0700 + .0800 + .1000 + .1200 + .1500 + .2000 + .2500 + .3000 + .4000 + .5000 + .6000 + .7000 + .8000 + .9000 + 1.0000	APPD	DATE	SAFECONN
THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION HEREOF OR USE OF THIS DRAWING IS EXPRESSLY PROHIBITED EXCEPT AS AUTHORIZED BY PHYSICAL ELECTRONICS, INC. DATE: 11/12/98	SIZE	DRAWING NUMBER	REV
	D	640728	D
	SCALE	NONE	SHEET 1 OF 1

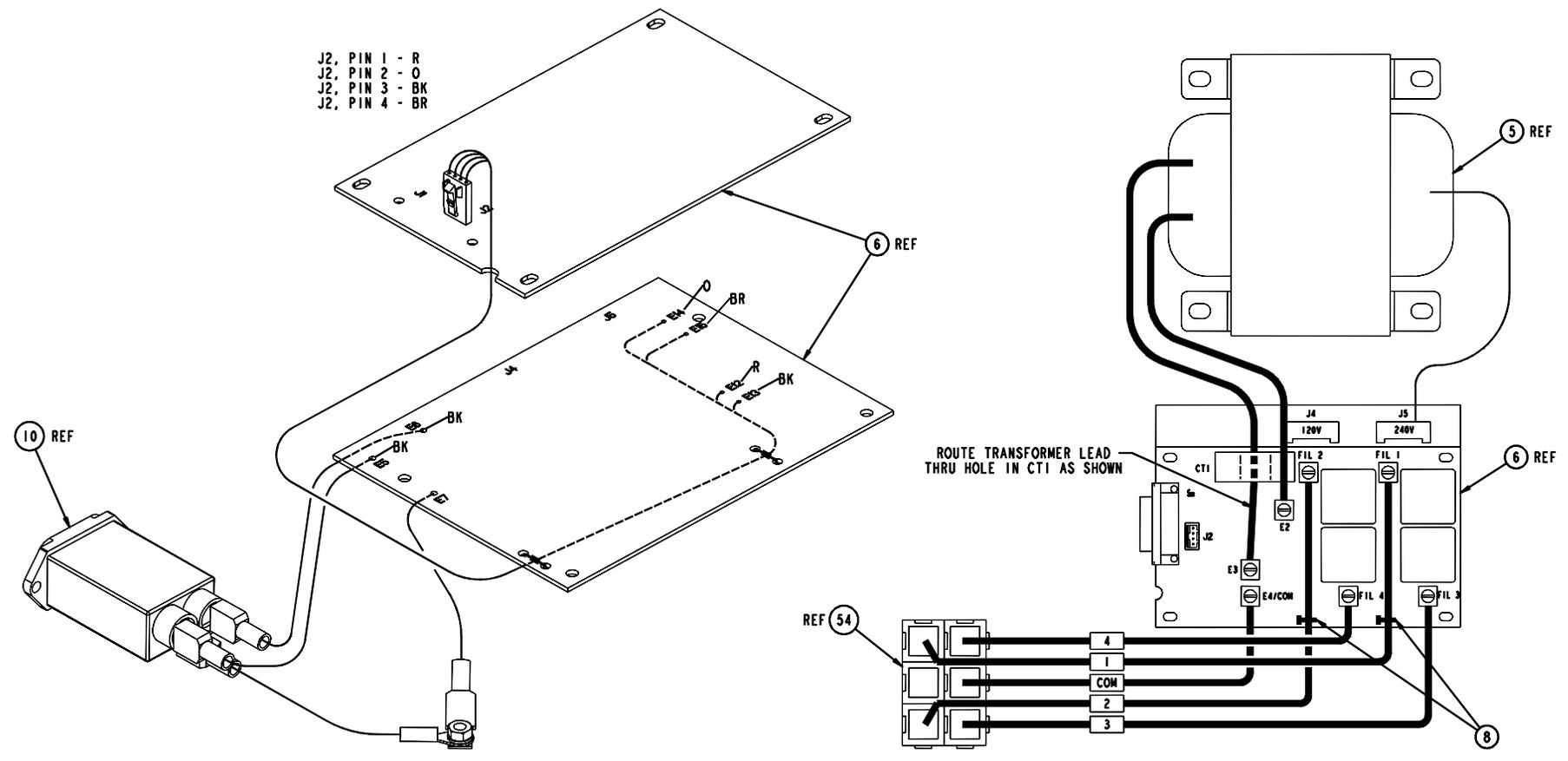
## 640728 Rev. D

Item	Part No.	Description	Rev	Status	Qty	UM	Notes	From	To
	640728	ASSY-PCB,SAFECONN,DIGITEL MPC	D			EA			
1	640727	PCB-SAFECONN,DIGITEL MPC	C		1	EA		1/1/91	12/31/10
2	378079	RES-ZEROHM,MOLDED JUMPER WIRE	A		3	EA	R4,8,10	1/1/91	12/31/10
3	476165	V REG,-5V,1A,TO220, LM7905CT	B		1	EA	VR1	1/1/91	12/31/10
4	1000684	CAP-100 UF,50V,20%,ELECT,RDL	E		1	EA	C4	1/1/91	12/31/10
5	476180	DIO-TVS,5V,5W,MPTE-5	A		4	EA	CR3,7,8,11	1/1/91	12/31/10
6	603955	DIO-HS SW,75V,1N914	A		4	EA	CR2,6,10,13	1/1/91	12/31/10
7	610633	CONN-.156C, 2P,PCB,STR,1R,G,SQ	A		1	EA	J407	1/1/91	12/31/10
8	614659	CONN-.100C,10P,PCB,STR,2ROW	B		1	EA	J408	1/1/91	12/31/10
9	617886	CAP-0.1 UF,50V,20%,.3",CER ML	-		7	EA	C1,3,5-7,9,10	1/1/91	12/31/10
10	602668	CAP-33 UF,10V,10%,TANT,RDL	A	NP	2	EA	C2,8	1/1/91	12/31/10
11	603132	RES-1K OHM,.12W, 1%,RN55D	-		2	EA	R6,7	1/1/91	12/31/10
12	626692	OPTOISOL-4N35,7.5KV,H CTR	A		4	EA	U2,3,5,6	1/1/91	12/31/10
13	630303	CONN-SMB,JACK,GOLD,MIL STYLE	A		1	EA	J401	12/21/98	12/31/50
14	610974	RES-383 OHM,.12W, 1%,RN55D	-		4	EA	R2,5,9,11	1/1/91	12/31/10
15	1000710	BRIDGE-RECT,100V,1A,VE28	-		1	EA	CR1	1/1/91	12/31/10
16	640729	SCHEM DIAG-SAFECONN,DIG MPC	C			EA		1/1/91	12/31/10
17	603140	RES-10K OHM,.12W, 1%,RN55D	-		2	EA	R1,3	1/1/91	12/31/10
18	612259	IC-74HC00,QUAD 2 INP NAND	A		2	EA	U1,4	1/1/91	12/31/10



640697 REV. 2 E  
 THIS DRAWING HAS BEEN GENERATED AND IS MAINTAINED BY PRO/ENGINEER CAD SYSTEM.

J2, PIN 1 - R  
 J2, PIN 2 - O  
 J2, PIN 3 - BK  
 J2, PIN 4 - BR



# WIRING DIAGRAM

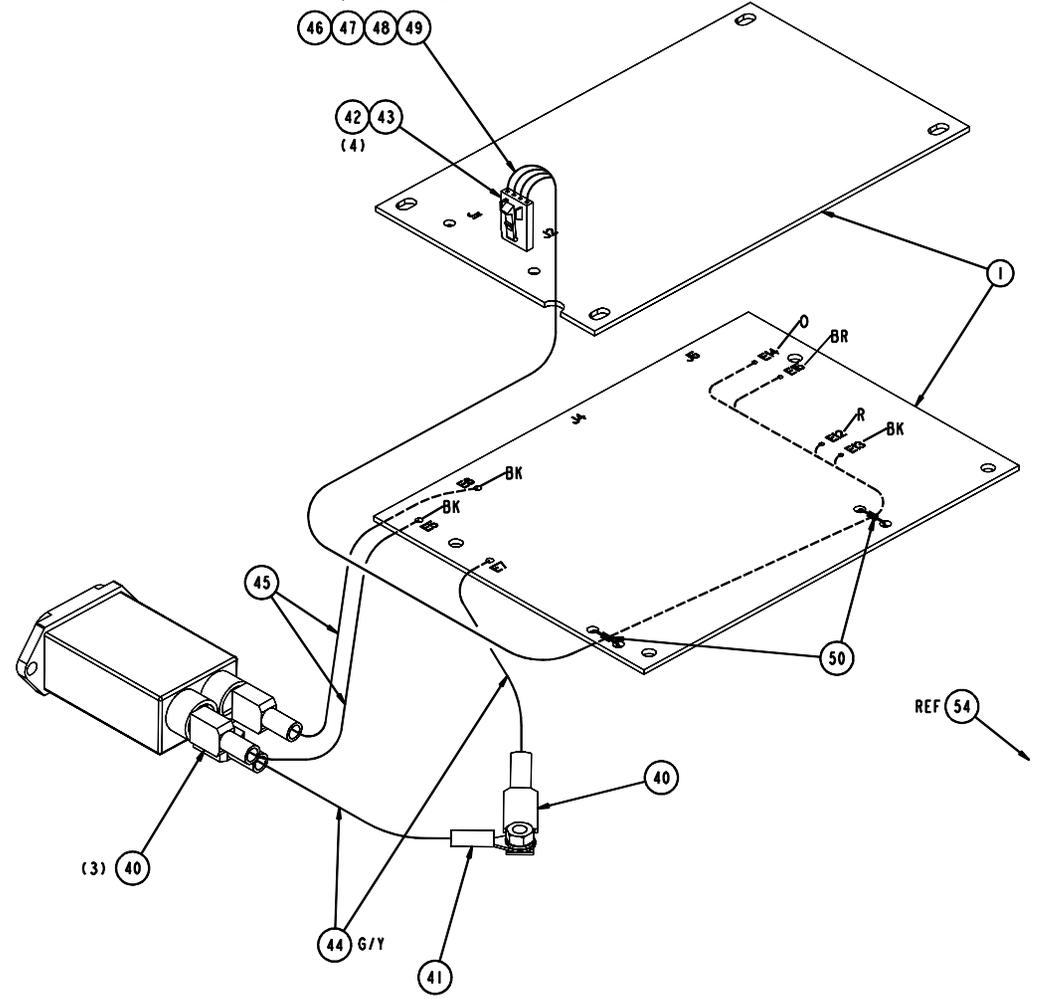
<b>METRIC</b> THIRD ANGLE PROJECTION 	<small>UNLESS OTHERWISE SPECIFIED          DIMENSIONS ARE IN MILLIMETERS          SURFACE FINISHES IN MICROMETERS</small> TOLERANCES: LENGTH .00-13 HOLES .00-13 ANGULAR (C) MACHINES, 0.1° FORMS & CHAMFERS 0° MACHINED SURFACES SQUARE SHARP EDGES: 0.2 OR 0.4 0.2 DIA. INTERNAL RADIUS CORNER 0.4 DIA.	DESIGNED BY: H. NOVDE DATE: 11-Mar-91 CHK: [blank] DATE: [blank] APPV: [blank] DATE: [blank] BY: BRIAN BRADY TOLERANCING AND DIMENSIONING PER ANSI Y14.2M - 1982 <small>THIS DRAWING CONTAINS PROPRIETARY          INFORMATION AND IS CONFIDENTIAL.          REPRODUCTION OR USE OF THIS DRAWING          IS EXPRESSLY PROHIBITED EXCEPT AS          PHYSICAL ELECTRONICS MAY OTHERWISE          AGREE TO IN WRITING.</small>	<b>PHYSICAL ELECTRONICS</b> 6509 Flying Cloud Drive • Eden Prairie, MN TITLE: <b>ASSY - TSP CONTROL</b> DRAWING NO. <b>640697</b> SCALE: 0.750 DETACHED <b>PLMSPEC</b> SHEET 2 OF 2
	METRIC THIRD ANGLE PROJECTION 	DESIGNED BY: H. NOVDE DATE: 11-Mar-91 CHK: [blank] DATE: [blank] APPV: [blank] DATE: [blank] BY: BRIAN BRADY TOLERANCING AND DIMENSIONING PER ANSI Y14.2M - 1982 <small>THIS DRAWING CONTAINS PROPRIETARY          INFORMATION AND IS CONFIDENTIAL.          REPRODUCTION OR USE OF THIS DRAWING          IS EXPRESSLY PROHIBITED EXCEPT AS          PHYSICAL ELECTRONICS MAY OTHERWISE          AGREE TO IN WRITING.</small>	<b>PHYSICAL ELECTRONICS</b> 6509 Flying Cloud Drive • Eden Prairie, MN TITLE: <b>ASSY - TSP CONTROL</b> DRAWING NO. <b>640697</b> SCALE: 0.750 DETACHED <b>PLMSPEC</b> SHEET 2 OF 2

## 640697 Rev. E

Item	Part No.	Description	Rev	Status	Qty	UM	Notes	From	To
	640697	ASSY-TSP CTRL,PHI VER,SIDE OUT	E			EA			
1	638841	CHASSIS-REMOTE TSP/NEG CONTROL	D		1	EA		7/27/99	12/31/50
3	638842	PANEL-ACCESS,REMOTE TSP/NEG	A		1	EA		1/1/91	12/31/10
4	636126	COVER-REMOTE TSP/NEG CONTROL	B		2	EA		1/1/91	12/31/10
5	635462	XFMR-POWER,TSP	D		1	EA		1/7/99	12/31/50
6	635460	ASSY-PCB,REMOTE TSP/NEG CTRL	F		1	EA		1/1/91	12/31/10
7	629270	LUG-QC,BD MNT,M,.25X.032,M4,BT	A		1	EA		1/1/91	12/31/10
8	506000	CABLE TIE-.750 BDL OD,NYL,NAT	C		2	EA		3/22/99	12/31/50
10	635928	FILTER-LINE,10A	A		1	EA		1/1/91	12/31/10
11	578503	NUT-KEPS, M6,ZINC PLTD STEEL	B		4	EA		1/1/91	12/31/10
12	573631	SCR-PAN,M4X 6,PHIL,SS	A		1	6 EA		1/1/91	12/31/10
13	609107	SCREWLOCK-SUB D,F/M,4-40,.312L	C		1	EA		3/29/99	12/31/50
14	636151	STDF-34MML, M3,F/F,6MM HEX,BRS	A		4	EA		1/1/91	12/31/10
15	636150	STDF-40MML, M3,M/F,6MM HEX,BRS	A		4	EA		1/1/91	12/31/10
18	512106	WSHR-INT TOOTH LOCK,# 6, SST	A		4	EA		1/1/91	12/31/10
19	573622	SCR-PAN,M3X 6,PHIL,SS	A		4	EA		1/1/91	12/31/10
20	576702	WSHR-EXT TOOTH LOCK,M 4 SST	A		1	EA		1/1/91	12/31/10
23	578501	NUT-KEPS, M4,ZINC PLTD STEEL	B		1	EA		1/1/91	12/31/10
24	578500	NUT-KEPS, M3,ZINC PLTD STEEL	B		4	EA		1/1/91	12/31/10
25	573625	SCR-PAN,M3X 12,PHIL,SS	A		2	EA		1/1/91	12/31/10
26	573628	SCR-PAN,M3X 25,PHIL,SS	A		2	EA		1/1/91	12/31/10
27	638843	BAR-HEATSINK,REMOTE TSP/NEG	A		1	EA		1/1/91	12/31/10
28	479092	LABEL-CHASSIS (S/N)	D		1	EA		1/1/91	12/31/10
29	636009	LABEL-CE,HI VOLT	A		1	EA		1/1/91	12/31/10
40	635461	SCHEM DIAG-REMOTE TSP/NEG CTRL	E		1	EA		3/31/00	12/31/50
47	629358	LABEL-STRAPPED FOR 220VAC	B		1	EA		1/1/91	12/31/10
48	639827	FUSE-4A,250V,S/B,5X20MM,SHT V	A		2	EA		3/31/00	12/31/50
50	638271	CONDUIT-3/4",LOCKNUT	A		1	EA		1/1/91	12/31/10
53	631951	LABEL-CE, 1.0" X .5",WHITE	A		1	EA		1/1/91	12/31/10
54	644236	ASSY-CA,TSP,PHI	A		1	EA		3/22/99	12/31/50

Dwg. No. 635460		REV. 1	REV. F
REVISIONS			
REV	CD #	DESCRIPTION	DATE
SEE SHT 1 (MAINTAINED WITH MENTOR) FOR REVISION INFO			
THIS SHEET OF THIS DRAWING HAS BEEN GENERATED AND IS MAINTAINED BY PRO/ENGINEER CAD SYSTEM.			

E12 TO J2, PIN 1 - R  
 E14 TO J2, PIN 2 - O  
 E13 TO J2, PIN 3 - BK  
 E15 TO J2, PIN 4 - BR



WIRING DIAGRAM

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES		DATE	17-JUL-98
TOLERANCES:	DECIMAL (±)	DATE	
	.2	DATE	
	.030	DATE	
	.010	DATE	
	.005	DATE	
ANGLE 1:3		DATE	
INCHES 0.30		DATE	
FORMED 1"		DATE	
CHAMFER 0.5"		DATE	
MACHINED SURFACES		DATE	
BIGGEST SHARP CORNER:		DATE	
0.01 ON 0.2, 0.04 MAX.		DATE	
INTERNAL RADIUS CORNER 0.04 MAX.		DATE	

PHYSICAL ELECTRONICS	TITLE
6500 Flying Cloud Drive • Eden Prairie, MN	ASSY-PCB, REMOTE TSP/NEG CTRL
SHEET DRAWING NO.	635460
SCALE	1:1000
DETACHED	PLM SPEC
SHT	2 of 2

## 635460 Rev. F

Item	Part No.	Description	Rev	Status	Qty	UM	Notes	From	To
	635460	ASSY-PCB,REMOTE TSP/NEG CTRL	F			EA			
1	635459	PCB-REMOTE TSP/NEG CTRL	D		1	EA		4/7/97	12/31/10
4	171423	DIO-RECT,400V,1A,1N4004	B		4	EA	CR1-4	1/1/91	12/31/10
5	175041	V REG,+12V,1A,TO220, LM340	B		1	EA	VR1	1/1/91	12/31/10
8	533204	NUT-KEPS,# 8-32, SST	B		1	EA	XL1	1/1/91	12/31/10
10	542016	SCR-PAN, 8-32X1.000,PHIL,SST	-		1	EA	XL1	1/1/91	12/31/10
12	603951	CAP-1 UF,35V,10%,TANT,RDL	A		1	EA	C1	1/1/91	12/31/10
13	608433	RES-49.9 OHM, .12W, 1%,RN55D	-		2	EA	R1,2	1/1/91	12/31/10
15	613672	RES-180 OHM,5W,1%,WW,RS-5	-		1	EA	R3	1/1/91	12/31/10
16	617886	CAP-0.1 UF,50V,20%,.3",CER ML	-		2	EA	C2,3	1/1/91	12/31/10
17	626692	OPTOISOL-4N35,7.5KV,H CTR	A		1	EA	U1	7/23/97	12/31/10
18	624663	CONN-SUB D,15P,M,PCB,RA,THDINS	A		1	EA	J1	1/1/91	12/31/10
19	624533	CONN-.100C, 4P,PCB,STR,LATCHNG	A		1	EA	J2	7/23/97	12/31/10
20	626203	LUG-TERMINAL,#8 BOX	A		7	EA	E2-4,FIL1-4	1/1/91	12/31/10
21	626207	XFMR-CUR,50AMP:50MA,.1V/A,PCB	A		1	EA	CT1	1/1/91	12/31/10
23	629260	FUSEHOLDER-PCB,VERT,5X20MM,BLK	B		2	EA	F1,2	7/23/97	12/31/10
24	630822	VARISTOR-300 VOLT; V300LA40	A		3	EA	RV1-3	1/1/91	12/31/10
25	631823	CHOKE-1.5 MH,5A,AMECON			1	EA	L1	1/1/91	12/31/10
26	631824	CAP-0.47 UF,250VAC,M/MYLAR,VDE	B		1	EA	C5	1/1/91	12/31/10
28	635812	CONN-MATE-N-LOK, 5P,HDR,PCB	A		2	EA	J4,5	7/23/97	12/31/10
29	626206	RLY-PCB,SPST,12VDC	A		4	EA	K1-4	1/1/91	12/31/10
30	542003	SCR-PAN, 8-32X .187,PHIL,SST	-		7	EA	XE2-4,XFIL1-4	1/1/91	12/31/10
31	546508	WSHR-EXT TOOTH LOCK,# 8, SST	A		7	EA	XE2-4,XFIL1-4	1/1/91	12/31/10
32	635461	SCHEM DIAG-REMOTE TSP/NEG CTRL	D		1	EA		1/1/91	12/31/10
33	622807	RES-316 OHM,.25W, 1%,RN60D	A		1	EA	R5	4/7/97	12/31/10
34	638463	SCR-S4020L,400V,20A,TO220	A		2	EA	CR5,6	7/23/97	12/31/10
35	279179	BRIDGE-RECT,600V,1A,KBP06	A		1	EA	CR7	7/23/97	12/31/10
36	638299	OPTOISOL-MOC3023,TRIAC DV,250V	A		1	EA	U2	7/23/97	12/31/10
37	1004153	RES-10K OHM,5W,5%,WW	B		2	EA	R6,7	7/23/97	12/31/10
38	541806	SCR-PAN, 4-40X .375,PHIL,SST	-		2	EA	XJ1	1/13/98	12/31/10
39	1000843	NUT-KEPS,# 4-40,SST304	C		2	EA	XJ1	1/13/98	12/31/10
40	603609	LUG-QC,F,16-14GA,.25X.032,F/I	-		4	EA		3/22/99	12/31/50
41	546108	LUG-RING,16-14GA, #8,INS,.343W	C		1	EA		3/22/99	12/31/50
42	624534	CONN-.100C, 4S,CA ,HSG,LATCHNG	A		1	EA		3/22/99	12/31/50
43	624535	CONTACT-.100C,F,26-22GA,LATCHG	A		4	EA		3/22/99	12/31/50
44	1000738	WIRE-STRD,16GA,IPVC,300V,GN/YL	D		1	FT		3/22/99	12/31/50
45	1000733	WIRE-STRD,16GA,IPVC,300V,BLK	D		1	FT		3/22/99	12/31/50

**635460 Rev. F**

46	502201	WIRE-STRD,22GA,IPVC,150V,BLK	B		1 FT		3/22/99	12/31/50
47	502203	WIRE-STRD,22GA,IPVC,150V,RED	B		1 FT		3/22/99	12/31/50
48	502202	WIRE-STRD,22GA,IPVC,150V,BRN	B		1 FT		3/22/99	12/31/50
49	502204	WIRE-STRD,22GA,IPVC,150V,ORN	B		1 FT		3/22/99	12/31/50
50	506000	CABLE TIE-.750 BDL OD,NYL,NAT	C		2 EA		3/22/99	12/31/50
51	1001067	BAG-ZIP LOCK,4X6X4 MILL	-		1 EA		3/22/99	12/31/50

NOTES:

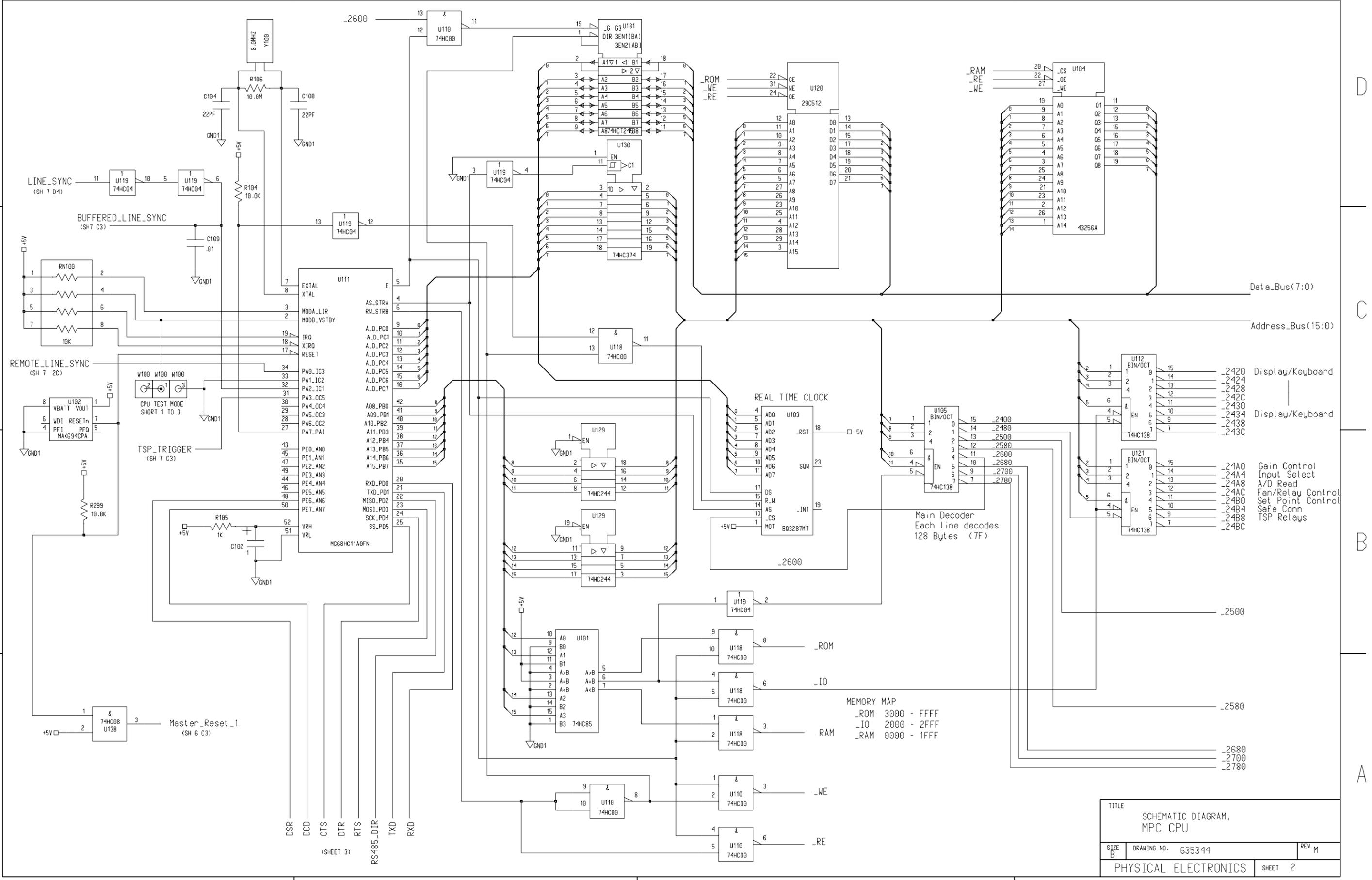
1. UNLESS OTHERWISE SPECIFIED:  
RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS.
2. THE COVER SHEET WILL CARRY THE LATEST REVISION LEVEL.  
ALL REMAINING SHEETS WILL CHANGE REVISION LEVEL WHEN APPLICABLE.  
SEE THE REVISION STATUS LOG FOR THE LATEST REVISION LEVEL OF EACH SHEET.

3. COMMON CIRCUIT RETURN SYMBOLS:



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
C	RELEASE CO# 15429	03-97	
D	CO# 15660	05-97	
E	CO# 15668	06-97	
F	CO# 15749	06-97	
G	CO# 15854	06-97	
K	ADDED 10K PULLUP CO# 16044	09-97	
L	DIODES, OPAMPS, AND RES CO 16527	02-98	
M	TSP OPTION ADDED CO 17237	08-98	DJM

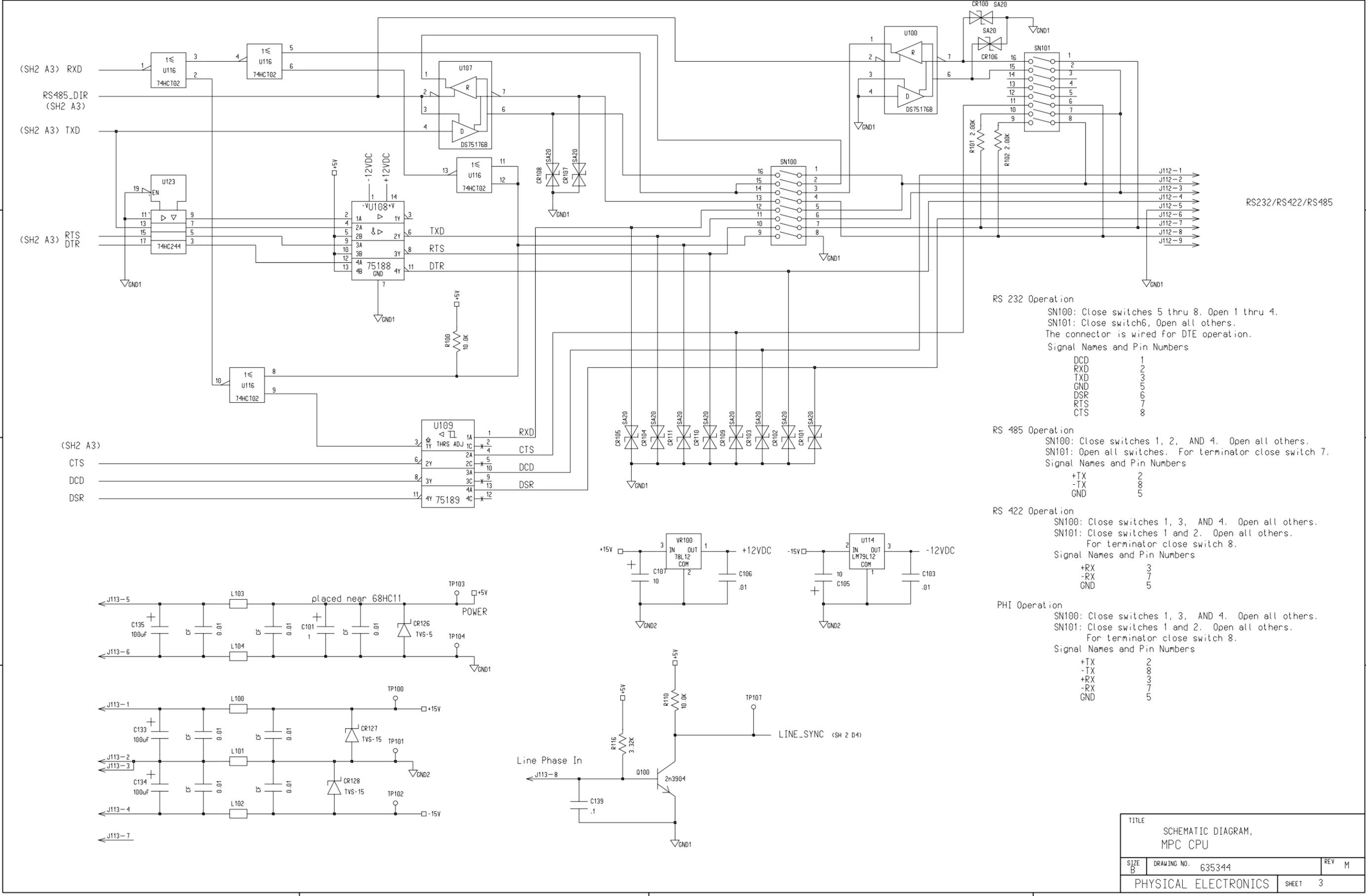
DRN	T SUTERA	DATE	12-96	<p>6509 FLYING CLOUD DRIVE EDEN PRAIRIE, MN</p>					
CKD		DATE							
APPD		DATE							
<p>THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION, DISCLOSURE OR USE OF THIS DRAWING IS EXPRESSLY PROHIBITED EXCEPT AS PHYSICAL ELECTRONICS MAY OTHERWISE AGREE TO IN WRITING</p>				TITLE	SCHEMATIC DIAGRAM, MPC CPU				
				SIZE	B	DRAWING NO.	635344	REV	M
						SHEET	1	OF	7



MEMORY MAP  
 \_ROM 3000 - FFFF  
 \_IO 2000 - 2FFF  
 \_RAM 0000 - 1FFF

TITLE		
SCHEMATIC DIAGRAM, MPC CPU		
SIZE B	DRAWING NO. 635344	REV M
PHYSICAL ELECTRONICS		SHEET 2

(SHEET 3)



RS 232 Operation  
 SN100: Close switches 5 thru 8. Open 1 thru 4.  
 SN101: Close switch 6, Open all others.  
 The connector is wired for DTE operation.  
 Signal Names and Pin Numbers

DCD	1
RXD	2
TXD	3
GND	5
DSR	6
RTS	7
CTS	8

RS 485 Operation  
 SN100: Close switches 1, 2, AND 4. Open all others.  
 SN101: Open all switches. For terminator close switch 7.  
 Signal Names and Pin Numbers

+TX	2
-TX	8
GND	5

RS 422 Operation  
 SN100: Close switches 1, 3, AND 4. Open all others.  
 SN101: Close switches 1 and 2. Open all others.  
 For terminator close switch 8.  
 Signal Names and Pin Numbers

+RX	3
-RX	7
GND	5

PHI Operation  
 SN100: Close switches 1, 3, AND 4. Open all others.  
 SN101: Close switches 1 and 2. Open all others.  
 For terminator close switch 8.  
 Signal Names and Pin Numbers

+TX	2
-TX	8
+RX	3
-RX	7
GND	5

TITLE		
SCHEMATIC DIAGRAM, MPC CPU		
SIZE B	DRAWING NO. 635344	REV M
PHYSICAL ELECTRONICS		SHEET 3

4

3

2

1

D

C

B

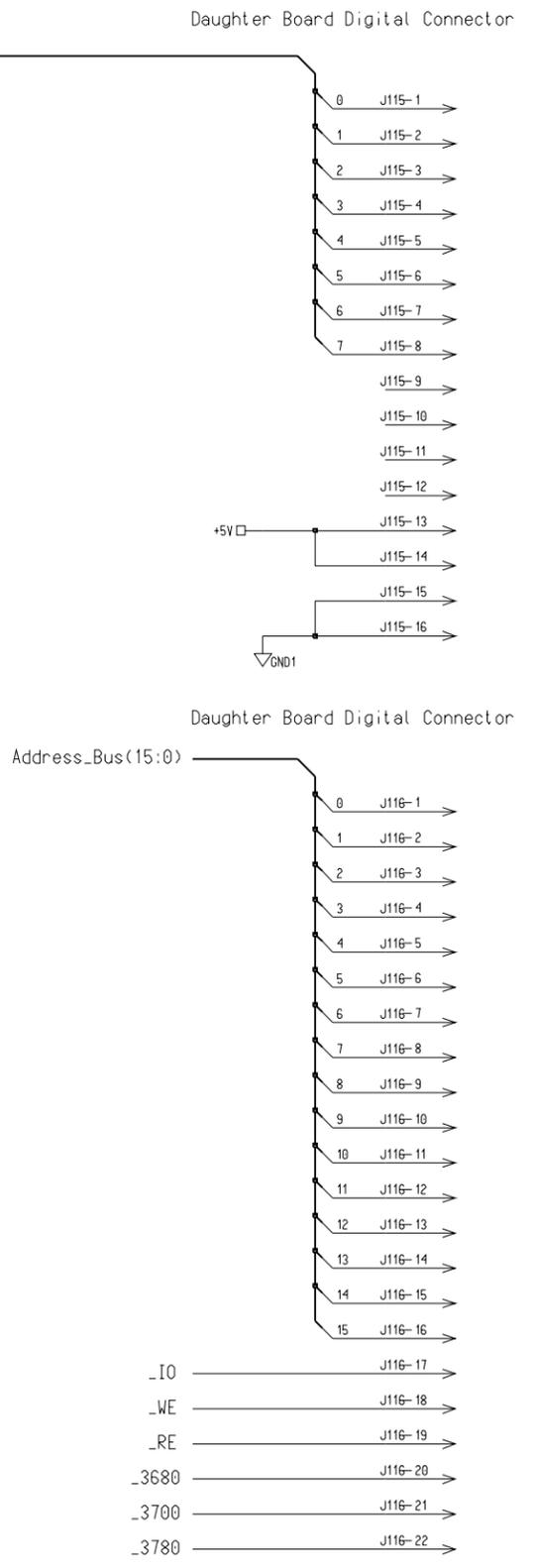
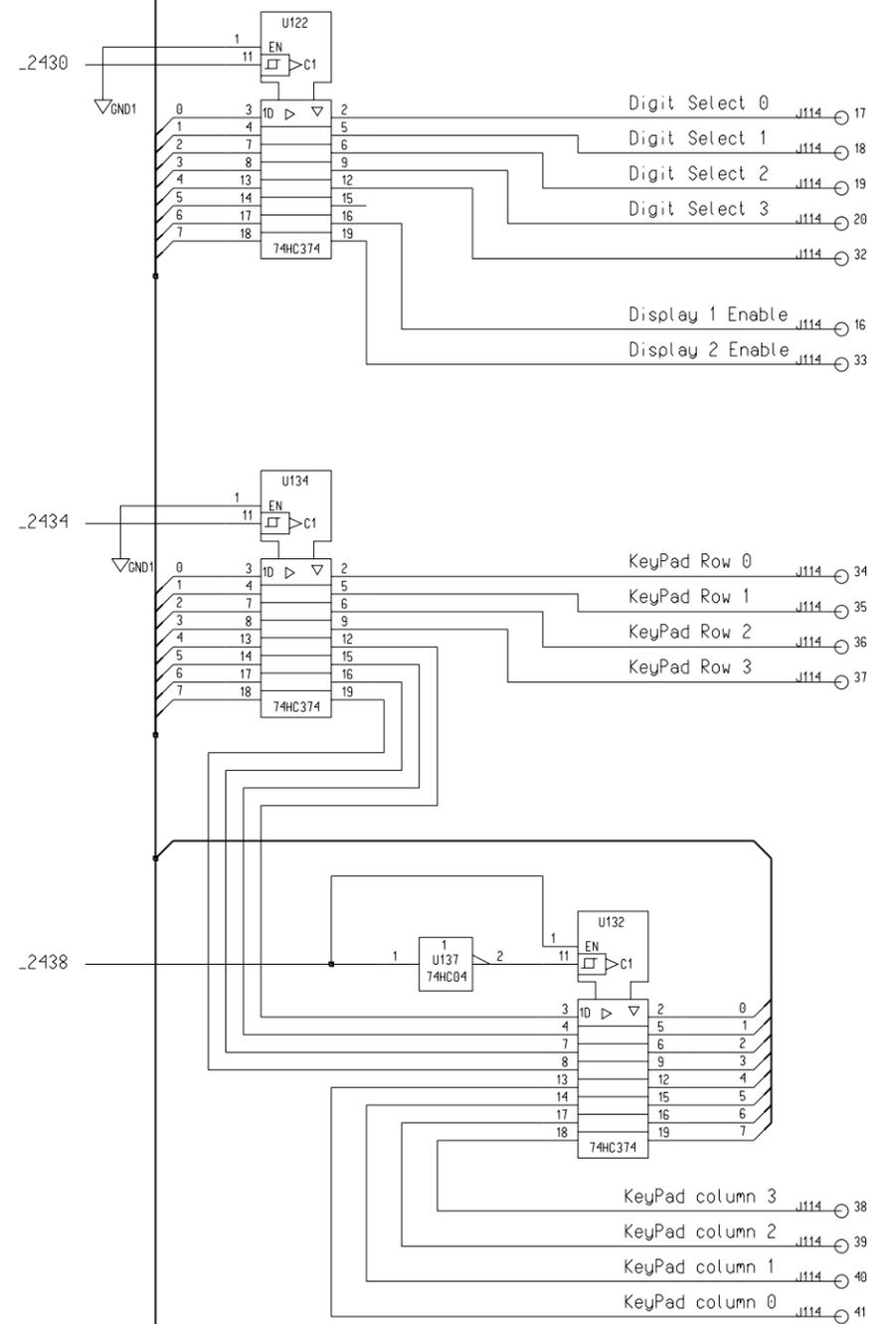
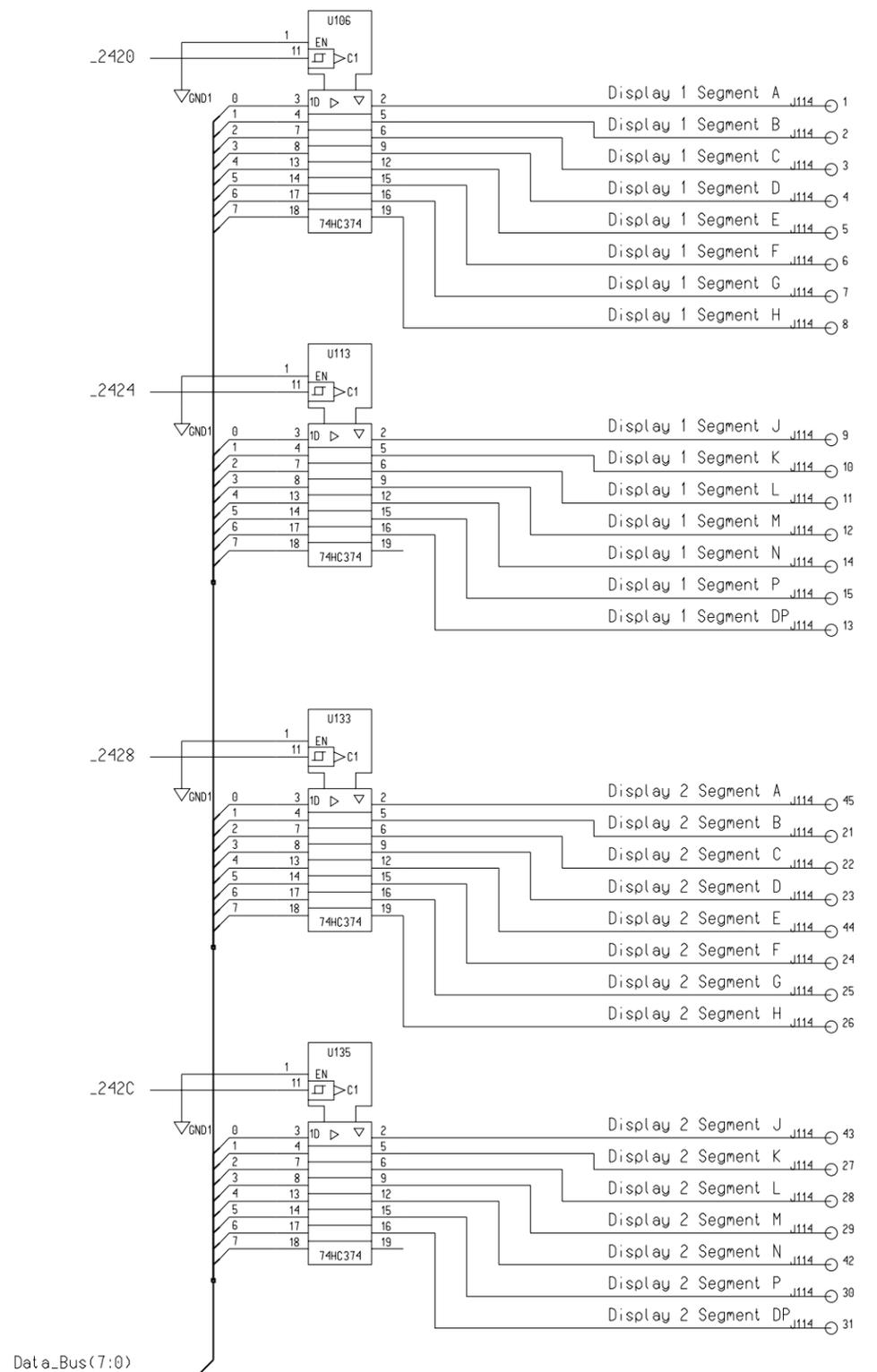
A

D

C

B

A



TITLE		
SCHEMATIC DIAGRAM, MPC CPU		
SIZE B	DRAWING NO. 635344	REV M
PHYSICAL ELECTRONICS		SHEET 4

4

3

2

1

4

3

2

1

D

D

C

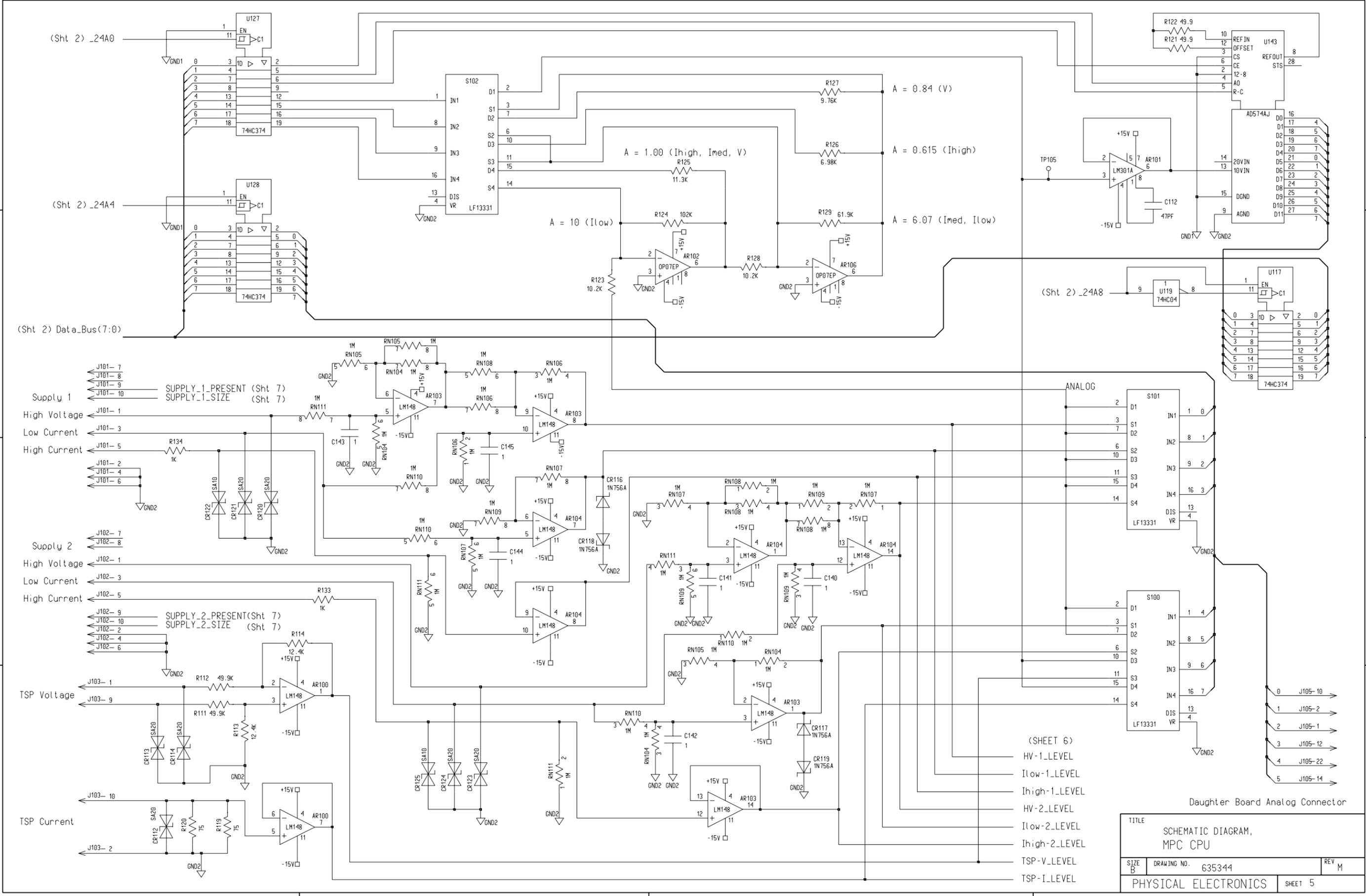
C

B

B

A

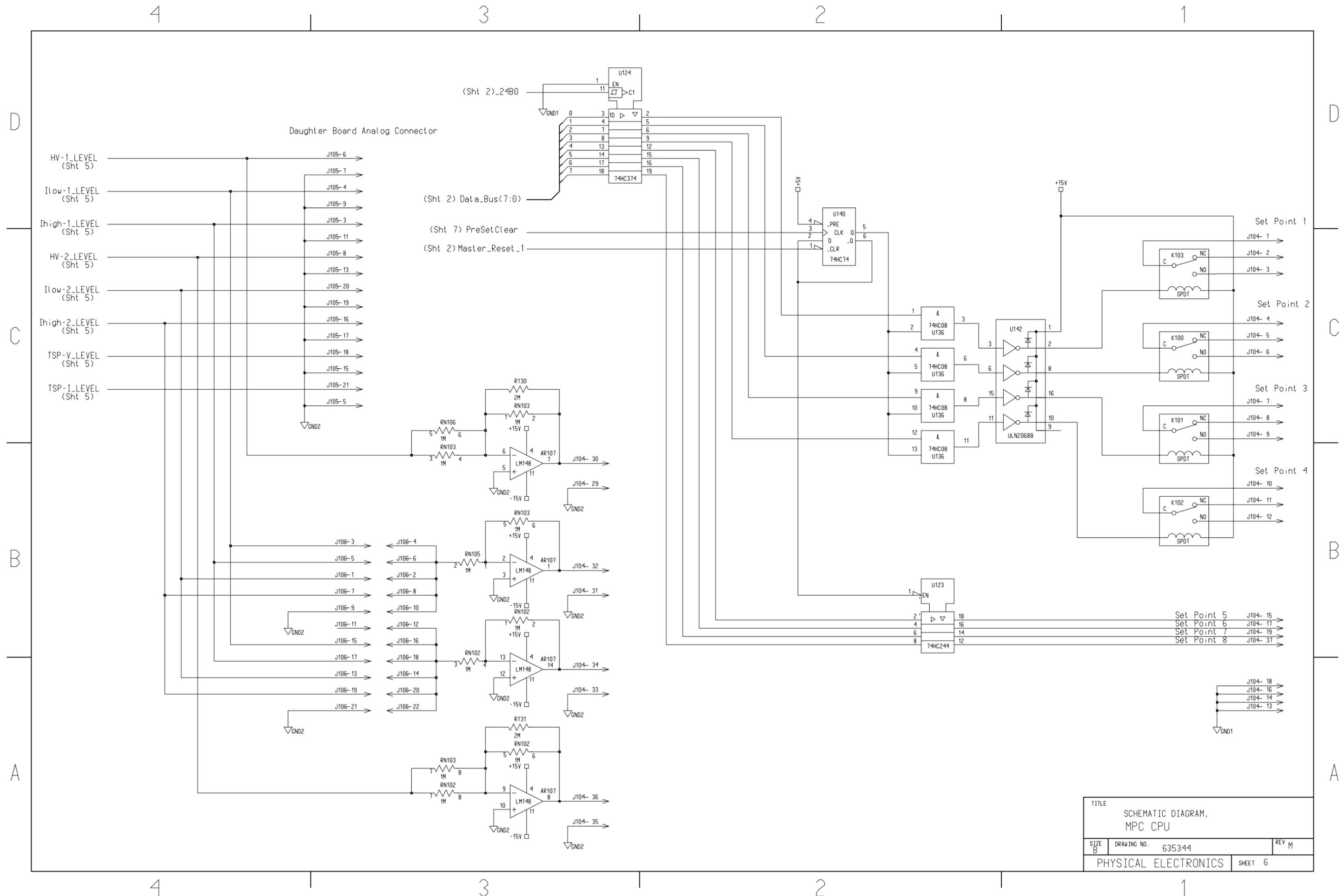
A



- (SHEET 6)
- HV-1\_LEVEL
- Ilow-1\_LEVEL
- Ihigh-1\_LEVEL
- HV-2\_LEVEL
- Ilow-2\_LEVEL
- Ihigh-2\_LEVEL
- TSP-V\_LEVEL
- TSP-I\_LEVEL

Daughter Board Analog Connector

TITLE		
SCHEMATIC DIAGRAM, MPC CPU		
SIZE B	DRAWING NO. 635344	REV M
PHYSICAL ELECTRONICS		SHEET 5



TITLE		
SCHEMATIC DIAGRAM, MPC CPU		
SIZE B	DRAWING NO. 635344	REV M
PHYSICAL ELECTRONICS		SHEET 6



- NOTES: 1. UNLESS OTHERWISE SPECIFIED:  
RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS.
2. THE COVER SHEET WILL CARRY THE LATEST REVISION LEVEL.  
ALL REVISION SHEETS WILL CHANGE REVISION LEVEL WHEN APPLICABLE.  
SEE THE REVISION STATUS LOG FOR THE LATEST REVISION LEVEL OF EACH SHEET.
3. COMMON CIRCUIT RETURN SYMBOLS:



FUSE VALUES FOR F3 AND F4

	120V	208/230V
500 MA XFMR	6.3 AMP	4.00 AMP
100 MA XFMR	2.50 AMP	1.25 AMP

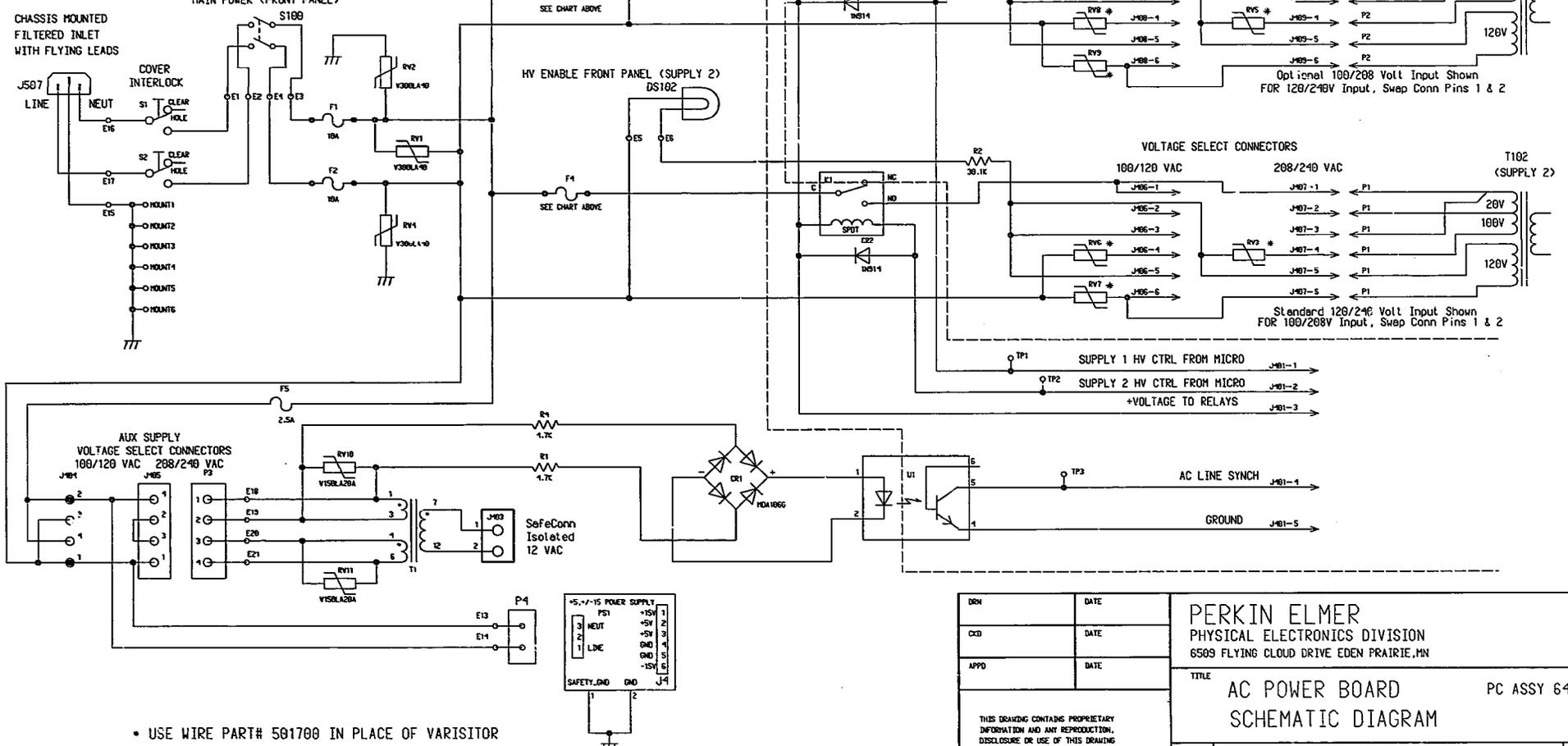
F1 THRU F4 ARE ALL  
IEC 127, TYPE T, SHEET Y  
TIME LAG, HIGH BREAKING CAPACITY

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	RELEASE CD# 16032	09-97	
B	CHANGE FUSE 2.5A CD 16177	11-97	D. McNeil

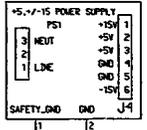
CHASSIS MOUNTED  
FILTERED INLET  
WITH FLYING LEADS

MAIN POWER (FRONT PANEL)

HV ENABLE FRONT PANEL (SUPPLY 2)



\* USE WIRE PART# 501700 IN PLACE OF VARISITOR



futel\_ecpwr1 8/1/96

DRN	DATE
CD	DATE
APPD	DATE

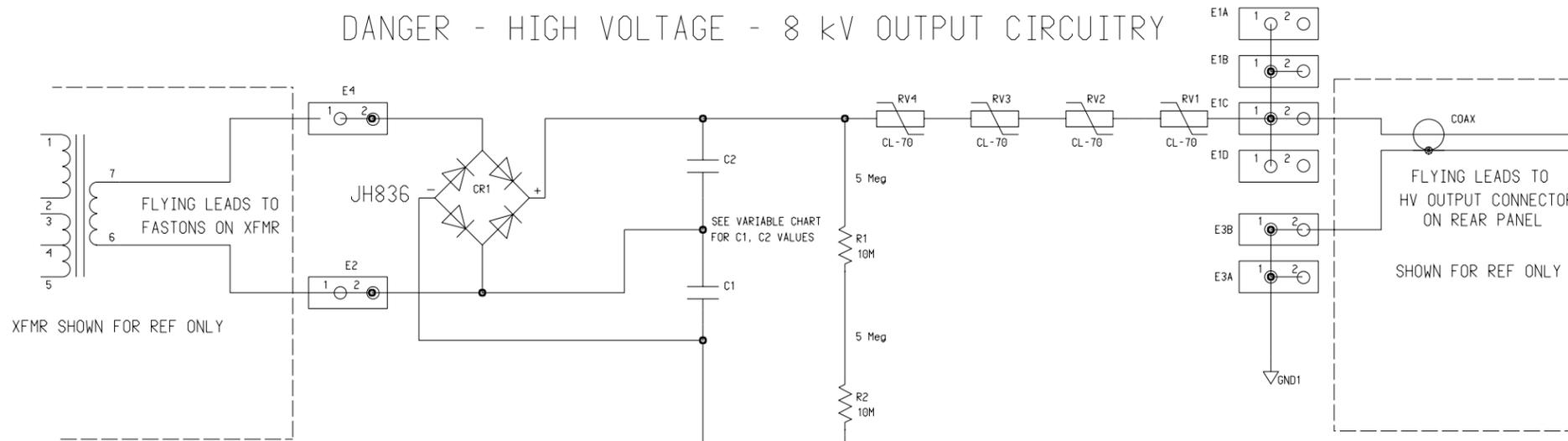
PERKIN ELMER  
PHYSICAL ELECTRONICS DIVISION  
6509 FLYING CLOUD DRIVE EDEN PRAIRIE, MN

TITLE AC POWER BOARD PC ASSY 640690  
SCHEMATIC DIAGRAM

SIZE B	DRAWING NO.	640691	REV B
SHEET 1		OF	

THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION, DISCLOSURE OR USE OF THIS DRAWING IS EXPRESSLY PROHIBITED EXCEPT AS PHYSICAL ELECTRONICS MAY OTHERWISE AGREE TO IN WRITING

# DANGER - HIGH VOLTAGE - 8 kV OUTPUT CIRCUITRY



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
B	PROTO	12-96	BBB
C	RELEASE CO# 15380	03-97	BBB
D	ADD CR9 CO# 15935	08-97	BBB
E	NEW ASSY # C1&C2 FASTON CO# 16038	09-97	BBB
F	CORRECT INSTRUCTIONS CO # 16699	09-98	BBB
G	100 MA DIODE CHANGE CO # 17922	04-99	BBB
H	CHANGE CR1 CO # 18320	09-99	BBB

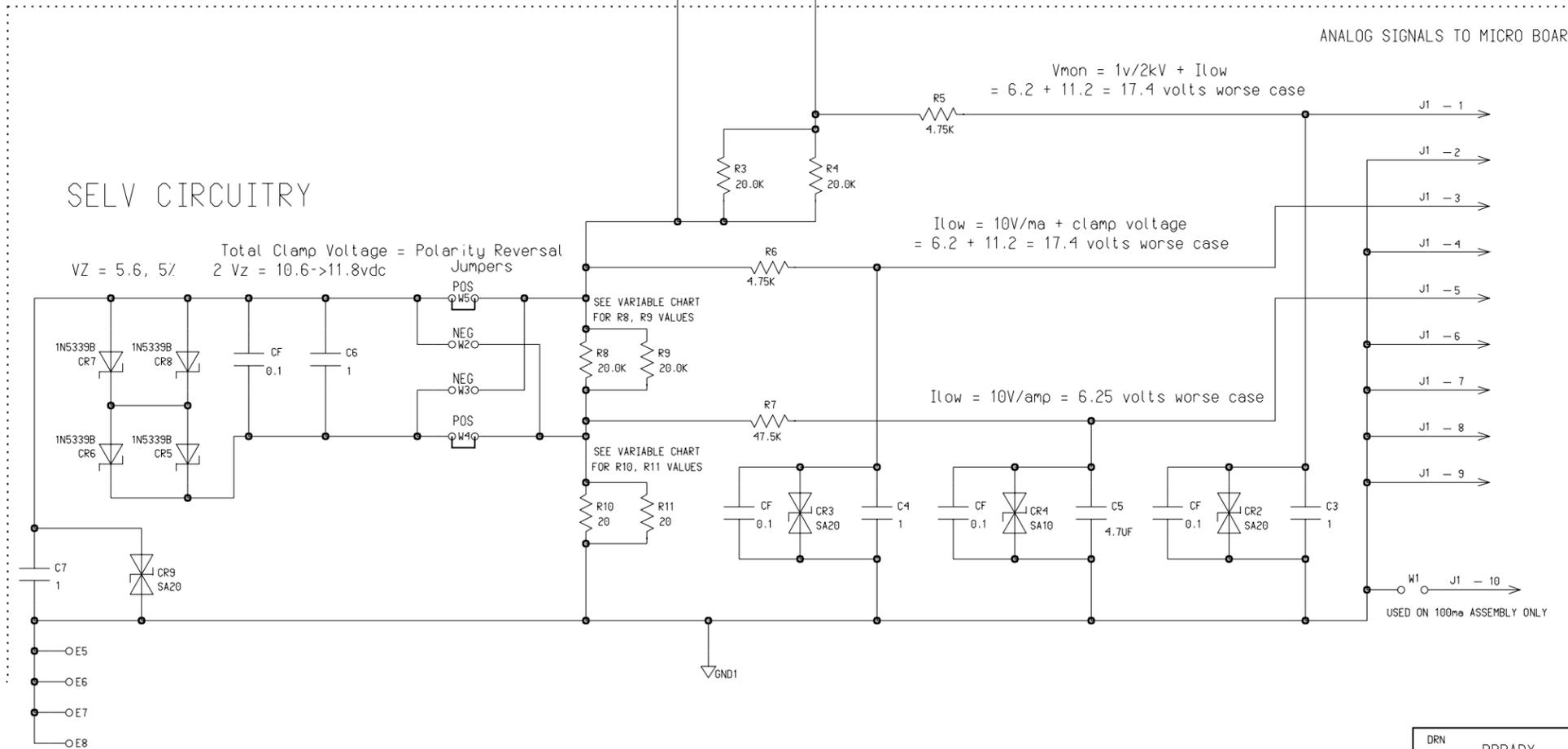
NOTES:

- UNLESS OTHERWISE SPECIFIED: RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS.
- BOARD IS SHOWN STRAPPED FOR POSTIVE OUTPUT.
- FOR NEGATIVE OUTPUT- BRIDGE CR1 INSTALLED SO NEGATIVE SHOWS DIODES CR5 CR6 CR7 CR8 ARE REVERSED JUMPERS ARE CONNECTED AT W2 W3 INSTEAD OF W1 W5
- WORST CASE DESIGN  $I_{out} = 635ma$   $V_{out} = + OR - 8,000$  VOLTS

VARIABLES 100ma/500ma

	R8	R9	R10	R11	C1	C2	W1
BD ASSY 635465 500ma	20K	20K	20	20	.33	.33	NO
BD ASSY 640574 100ma	100K	100K	100	100	.10	.10	YES

## SELV CIRCUITRY



\$BBB/fut\_HVbd

DRN	BBRADY	DATE	12-96
CKD		DATE	
APPD		DATE	

**PHYSICAL ELECTRONICS**

6509 FLYING CLOUD DRIVE EDEN PRAIRIE, MN

TITLE  
SCHEMATIC DIAGRAM,  
HIGH VOLTAGE DIGITEL MPC

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SIZE	DRAWING NO.	REV
B	635466	H

NOTES:

- UNLESS OTHERWISE SPECIFIED:  
RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS.
- THE COVER SHEET WILL CARRY THE LATEST REVISION LEVEL.  
ALL REMAINING SHEETS WILL CHANGE REVISION LEVEL WHEN APPLICABLE.  
SEE THE REVISION STATUS LOG FOR THE LATEST REVISION LEVEL OF EACH SHEET.
- COMMON CIRCUIT RETURN SYMBOLS:



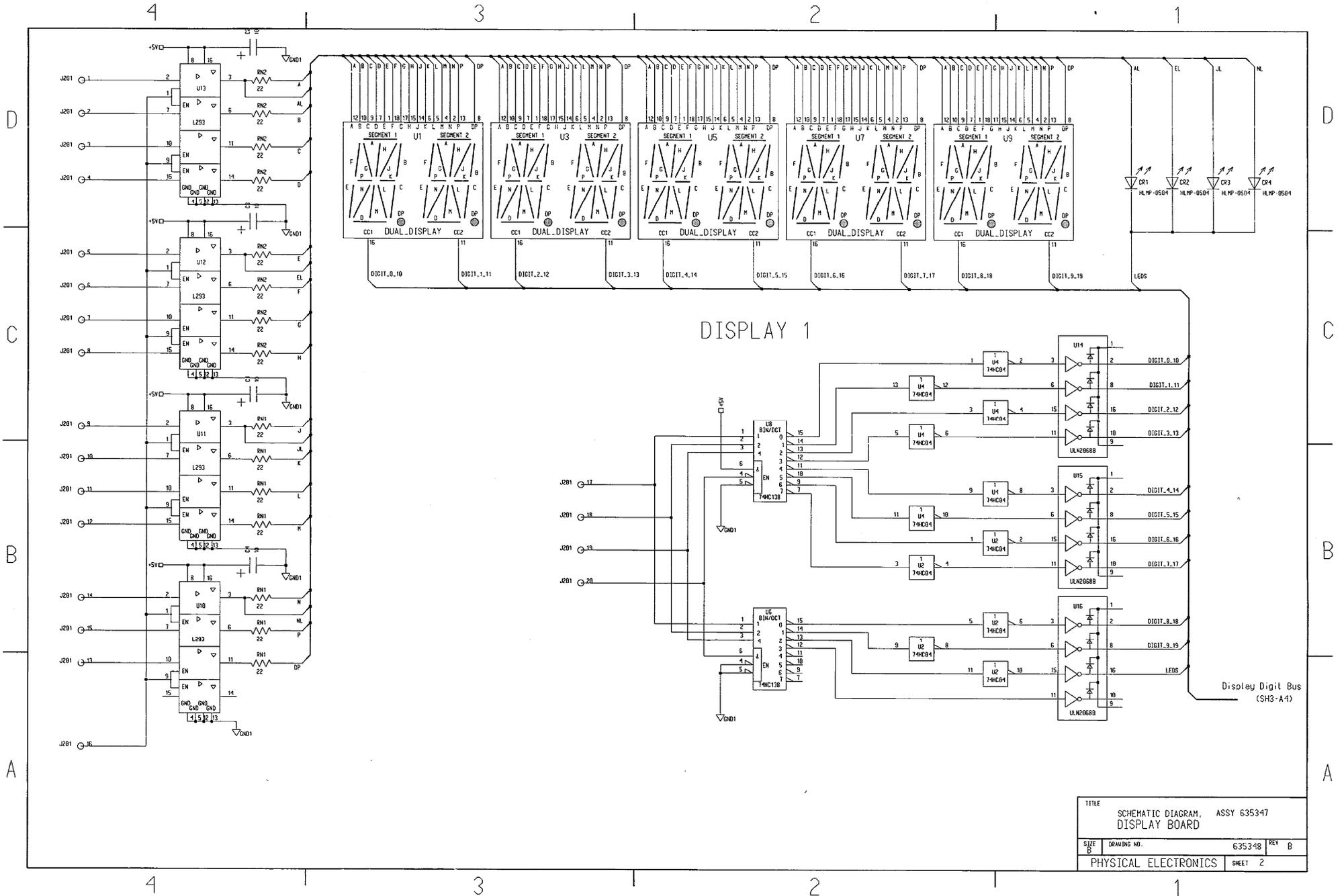
REVISION STATUS LOG

SHEET NUMBERS																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
B	B	B																	

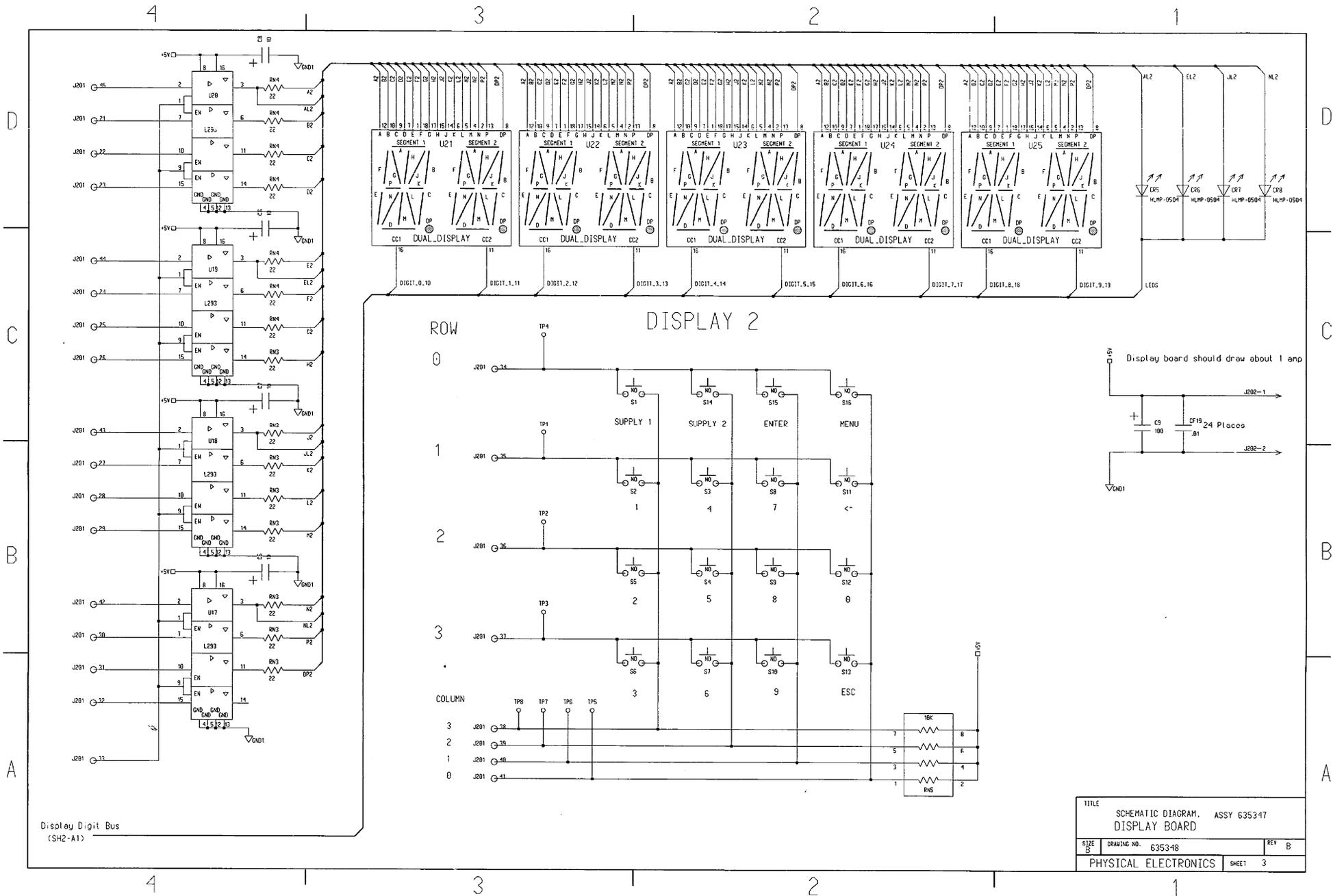
REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	BOM RELEASE CO# 15198	12-96	
B	PROD RELEASE CO# 15274	02-97	

DRN D. MCNEIL	DATE 12-96	 <b>PHYSICAL ELECTRONICS</b> 6509 FLYING CLOUD DRIVE EDEN PRAIRIE, MN
CKD <i>J. Smith</i>	DATE 2/97	
APPD	DATE	
THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION, DISCLOSURE OR USE OF THIS DRAWING IS EXPRESSLY PROHIBITED EXCEPT AS PHYSICAL ELECTRONICS MAY OTHERWISE AGREE TO IN WRITING		TITLE SCHEMATIC DIAGRAM, DISPLAY BOARD PCB ASSY 635347
SIZE B	DRAWING NO. 635348	REV B
SHEET 1 OF 3		



TITLE			
SCHEMATIC DIAGRAM, ASSY 635347			
DISPLAY BOARD			
SIZE	DRAWING NO.	635348	REV B
B			
PHYSICAL ELECTRONICS			SHEET 2



TITLE		
SCHEMATIC DIAGRAM. ASSY 635347		
DISPLAY BOARD		
SIZE	DRAWING NO.	REV
B	6353-48	B
PHYSICAL ELECTRONICS		SHEET 3

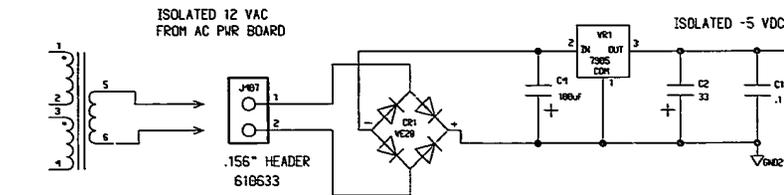
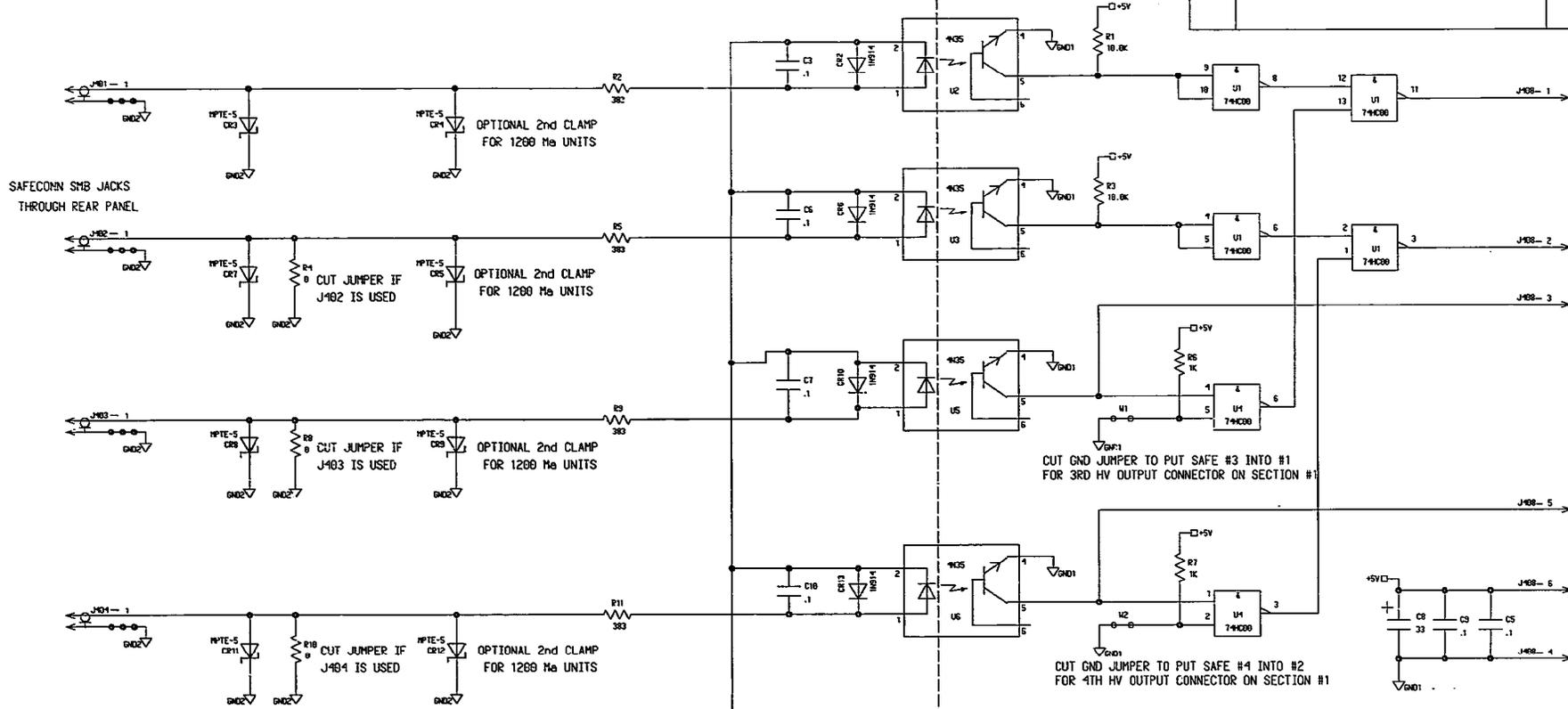
REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	RELEASE CO 16095	09-97	BBB
B	JUMPER CONNECTIONS CO 16224	11-97	BBB
C	FLIP C2 CORRECT + CO 16391	01-98	BBB/ALM

SELV CIRCUITRY

NOTES:

- UNLESS OTHERWISE SPECIFIED:  
RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROFARADS.
- COMMON CIRCUIT RETURN SYMBOLS:



DRN	BBB	DATE	09-97
CD		DATE	
APPD		DATE	

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**PHYSICAL ELECTRONICS**

6509 FLYING CLOUD DRIVE EDEN PRAIRIE, MN

TITLE  
SCHEMATIC DIAGRAM,  
SAFECONN

SIZE	DRAWING NO.	640729	REV	C
B				

NOTES:

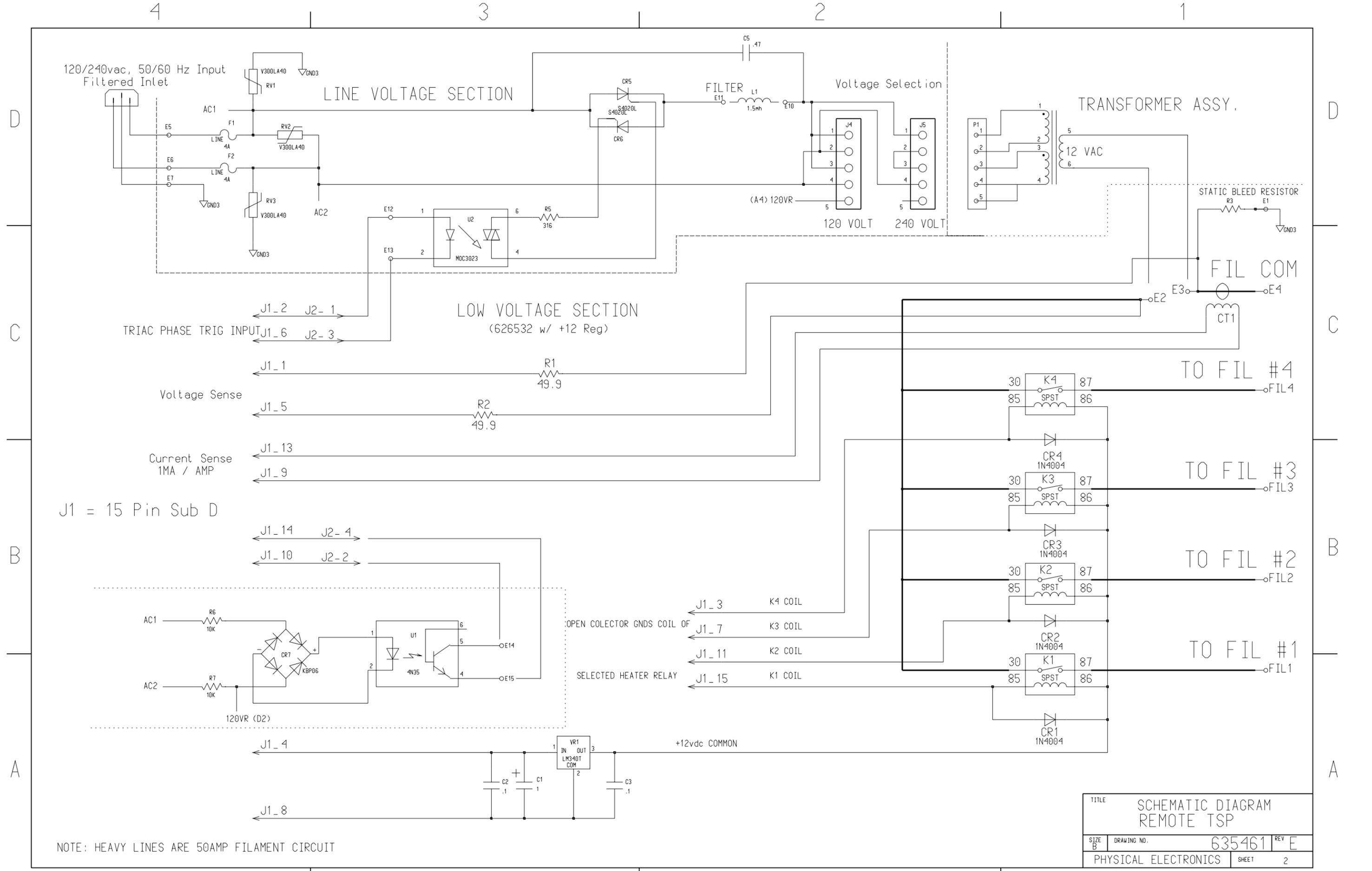
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SEE THE REVISION STATUS LOG FOR THE LATEST REVISION LEVEL OF EACH SHEET.

3. COMMON CIRCUIT RETURN SYMBOLS:



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
C	RELEASE CO# 15438	04-97	
D	CO # 15871	06-97	
E	CO # 19147 CHANGE FUSE	05-00	DJM

DRN	ROGER	DATE	03-97	 <b>PHYSICAL ELECTRONICS</b> 6509 FLYING CLOUD DRIVE EDEN PRAIRIE, MN
CKD		DATE		
APPD		DATE		
THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND ANY REPRODUCTION, DISCLOSURE OR USE OF THIS DRAWING IS EXPRESSLY PROHIBITED EXCEPT AS PHYSICAL ELECTRONICS MAY OTHERWISE AGREE TO IN WRITING				TITLE SCHEMATIC DIAGRAM REMOTE TSP
				SIZE B
			SHEET 1	OF 2



NOTE: HEAVY LINES ARE 50AMP FILAMENT CIRCUIT

TITLE			SCHEMATIC DIAGRAM REMOTE TSP		
SIZE B	DRAWING NO.	635461		REV	E
PHYSICAL ELECTRONICS			SHEET	2	