INSTRUCTION MANUAL FOR

LC1202 HIGH VOLTAGE POWER SUPPLY

83494001 Revision J

TDK-Lambda Americas Inc.

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TDK-Lambda

MANUFACTURER'S PRODUCT DECLARATION

INTENDED PURPOSE (USE)

The Power Supplies described by this manual are defined by TDK-Lambda Americas Inc. as a component for use in the composition of an apparatus as defined in Article 1 (1) of the EMC Directive (89/336/EEC). These products, as individual components, do not perform in themselves a direct function for the user of the end product. They are not intended to be placed on the market with a direct function to a final user! As such, the products described by this manual are not subject to the provisions of the EMC Directive (89/336/EEC, with amendment 92/31/EEC).

The products described by this manual are intended for incorporation into a final product by a professional assembler. It is the responsibility of the assembler to ensure that the final apparatus or system incorporating our products complies with all relevant EMC standards for that final product.

OPERATING ENVIRONMENT

The operating environment as defined by TDK-Lambda Americas Inc., for the products described by this manual is stated as follows:

The Power Supplies described by this manual are intended for use in a protected industrial environment or in proximity to industrial power installations. These locations are often referred to as industrial locations containing establishments that are not connected to the low voltage public mains network.

Industrial locations are characterized by the existence of one or more of the following conditions:

1) industrial, scientific and medical (ISM) apparatus are present;
2) heavy inductive or capacitive loads are frequently switched;
3) currents and associated magnetic fields are high;
4) location supplied by their own transformer.

These components are not intended for connection to a public mains network, but are intended to be connected to a power network supplied from a high or medium-voltage transformer dedicated for the supply of an installation feeding manufacturing or similar operations. They are suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

ONE YEAR WARRANTY

TDK-Lambda Americas, Inc. (405 Essex Road, Neptune, N.J. 07753), warrants that the unit is free from defects in material or workmanship for a period of ONE YEAR from the date of initial shipment. TDK-Lambda Americas Inc. will service and, at its option, repair or replace parts which prove to be defective. This will be done free of charge during the stated warranty period. This warranty excludes defects resulting from misuse, unauthorized modification, operation outside the environmental or safety specifications of the power supply, or improper site preparation or maintenance. The customer shall contact TDK-Lambda Americas Inc., for warranty service or repair as described in the RETURNING EQUIPMENT section. The customer shall prepay shipping charges. If the unit is covered under the foregoing warranty, then TDK-Lambda Americas Inc. shall pay the return shipping charges.

The “WARRANTY”, “CLAIM FOR DAMAGE IN SHIPMENT”, and “RETURNING EQUIPMENT” information applies to equipment purchased directly from TDK-Lambda Americas Inc. End users receiving equipment from a third party should consult the appropriate service organization for assistance with these issues.

THIS LIMITED WARRANTY IS IN LIEU OF, AND TDK-LAMBDA AMERICAS INC. DISCLAIMS AND EXCLUDES, ALL OTHER WARRANTIES, STATUTORY, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR OF CONFORMITY TO MODELS OR SAMPLES.

CERTIFICATION

All test and measuring equipment used by TDK-Lambda Americas Inc. for Final Acceptance Testing are traceable to primary standards certified by the National Institute of Standards and Technology.

LETHAL VOLTAGES PRESENT!

All power supplies contain hazardous voltage and energy. The power supply must only be operated by qualified personnel who have read this operator’s manual and are familiar with the operation, hazards and application of the power supply. Proper care and judgment must always be observed.

1. Before connecting input AC power, ensure all covers are in place and securely fastened. Ensure the required safety ground to chassis is installed and sufficient cooling is supplied.
2. Proper grounding from the input AC power is required to reduce the risk of electric shock, and to comply with safety agency and code requirements.
3. Use extreme caution when connecting input AC power. Only apply the input voltage specified on the rating label.
4. Use extreme caution when connecting any high voltage cables. Never handle any output cables when the power supply is operating.
5. After a power supply is switched OFF, its output section will retain a charge which may be lethal. Allow sufficient time for self-discharge before handling anything connected to the output. The discharge time specified in the Safety Notes does *NOT* include extra time required to discharge the energy stored in the user’s load.
6. When user serviceable fuses are present, always replace fuses with the same type and Volt/Amp rating.
7. Never attempt to operate the power supply in any manner not described in this manual.
8. Never remove DANGER or WARNING labels from the power supply. Replace lost or damaged labels immediately. Contact TDK-Lambda Americas Customer Service for replacement labels.
9. The power supply may be serviced only by TDK-Lambda Americas Inc. factory qualified service personnel. Breaking the warranty seal will void the warranty. Prior to opening the power supply, contact TDK-Lambda Americas Inc. Customer Service for a written Service Waiver and a replacement warranty seal.

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Description of symbols used in product labeling

SYMBOL	PUBLICATION	DESCRIPTION
	EC Council Directive 93/68/EEC	European Community Conformity Assessment Product Mark
	IEC 348	Attention, consult Accompanying documents
	IEC 60417-1-5036	Dangerous voltage
	IEC 60417-1-5019	Protective earth (e.g. power line earth ground)
	IEC 60417-1-5017	Functional earth (e.g. chassis ground)
	IEC 60417-1-5134	Electrostatic Discharge (ESD) Sensitive Device

ELECTRICAL STANDARDS

All company primary standards are either certified or are traceable to certification by the National Institute of Standards and Technology.

CLAIM FOR DAMAGE IN SHIPMENT

This instrument received comprehensive mechanical and electrical inspection before shipment. Immediately upon receipt from the carrier, and before operation, this instrument should be inspected visually for damage caused in shipment. If such inspection reveals damage in any way, a claim should be filed with the carrier. A full report of damage should be obtained by the claim agent and this report should be forwarded to us. We will then provide a disposition of the equipment and arrange for repair or replacement.

When referring to this equipment, always include the model and serial numbers.

The "WARRANTY", "CLAIM FOR DAMAGE IN SHIPMENT", and "RETURNING EQUIPMENT" information applies to equipment purchased directly from TDK-Lambda Americas Inc. End users receiving equipment from a third party should consult the appropriate service organization for assistance with these issues.

RETURNING EQUIPMENT

Before returning any equipment to the factory, the following steps shall be taken.

1. Notify TDK-Lambda Americas Inc. at (732) 795-4100 or follow the instructions at US.TDK-Lambda.com/HP/service.htm. Give a full description of the difficulty including the model and serial number of the unit in question. Upon receipt of this information, we will assign a Return Material Authorization (RMA) number and provide shipping instructions.
2. The customer shall prepay shipping charges. Equipment returned to us must be packed in a manner to reach us without damage. The shipping container must be marked with the RMA number in an area approximate to the shipping label with numbers that are easy to read. All returned units that do not show the RMA number on the outside of the container will be refused.

   If the equipment is repaired within the warranty agreement, than TDK-Lambda Americas Inc. shall pay for the return shipping to the customer.
3. For non-warranty repairs, we will submit a cost estimate for your approval prior to proceeding. The customer shall pay return shipping charges.

MECHANICAL INSTALLATION

Most power supplies are heavy and, when rack mounted, they should be supported by rails along the sides of the supply from front to rear. The rails must adequately support the unit and not block airflow. Do not support the power supply from the front panel only.

Table of Contents

Description	Page
1 GENERAL	1
1.1 INTRODUCTION	1
2 SPECIFICATIONS	2
2.1 AVERAGE CHARGING RATE	2
2.2 PEAK CHARGING RATE	2
2.3 STANDARD OUTPUT VOLTAGES/CURRENTS	2
2.3.1 LINEARITY	2
2.3.2 ACCURACY	2
2.4 POLARITY	2
2.5 HV INSULATING MEDIUM	2
2.6 INPUT CONNECTIONS	2
2.7 INPUT REQUIREMENTS	2
2.8 POWER FACTOR	2
2.9 EFFICIENCY	2
2.10 STORED ENERGY	2
2.11 STABILITY	3
2.12 PULSE REPEATABILITY	3
2.13 PHYSICAL DIMENSIONS	3
2.14 WEIGHT	3
2.15 MOUNTING	3
2.16 WATER FITTINGS	3
2.17 COOLING WATER	3
2.18 AIR COOLING	3
2.19 AMBIENT TEMPERATURE	3
2.19.1 STORAGE	3
2.19.2 OPERATING	3
2.20 HUMIDITY	3
2.21 FAULT PROTECTION	3
2.22 PROTECTION	3

2.23 VIBRATION 4
2.24 SHOCK 4
2.25 FRONT PANEL DISPLAY 4
3 INSTALLATION 6
3.1 INITIAL INSPECTION 6
3.2 MOUNTING AND COOLING REQUIREMENTS 6
3.3 GROUNDING AND INPUT AC POWER 6
3.4 POWER CORD SPECIFICATION 7
3.5 CONNECTING HIGH VOLTAGE OUTPUT 7
3.6 GROUNDING THE PRODUCT 8
3.6.1 GROUNDING OF INPUT LINE 8
3.6.2 OUTPUT GROUND CONNECTION 8
4 OPERATION 10
4.1 L, S, OEM MODELS 10
4.2 REAR PANEL 11
4.3 FRONT PANEL CONTROL (L MODEL ONLY) 12
4.3.1 POWER SWITCH 12
4.3.2 CONTROL SWITCH 12
4.3.3 HV ON SWITCH 12
4.3.4 HV OFF SWITCH 12
4.3.5 VOLTAGE ADJUST 12
4.3.6 VIEW SET 12
4.4 REMOTE CONTROL (L, S, OEM MODELS) 13
4.5 INITIAL CHECK-OUT PROCEDURE 16
5 APPLICATIONS 17
5.1 DETERMINING CAPACITOR CHARGE TIME 17
5.2 VOLTAGE REVERSAL 17
5.3 PARALLELING UNITS 18
5.4 MEASURING HIGH VOLTAGES 18
5.5 DETERMINING AC LINE CURRENT 19

5.6 OPERATION AS A DC POWER SUPPLY 19
5.7 OPERATION WITH REMOTE VOLTAGE SENSE 19
6 MAINTENANCE AND TROUBLESHOOTING 20
6.1 SAFETY PRECAUTIONS 20
6.2 CALIBRATION 20
6.2.1 OUTPUT VOLTAGE LEVEL 20
6.2.2 OVERVOLTAGE TRIP POINT 20
6.3 MAINTENANCE 20
6.4 TROUBLESHOOTING 20
7 INPUT VOLTAGE CONVERSION PROCEDURE 22
7.1 OVERVIEW 22
7.2 CONVERSION PROCEDURE 22
7.2.1 CHANGE SELECTOR BOARD 22
7.2.2 CHANGE FUSE 22
7.2.3 SELECTOR SWITCHES ON AUX POWER BOARD 23
7.2.4 CORRECTING THE INPUT LABEL 23

List of Figures

Description		Page
Figure 1	LC1202 Block Diagram	1
Figure 2	Mechanical Details	5
Figure 3	Input AC Power Connections	7
Figure 4	Output Ground Connection	9
Figure 5	Model LC1202L	10
Figure 6	Model LC1202S	10
Figure 7	Model LC1202 OEM	11
Figure 8	Rear Panel	12
Figure 10	Suggested Interface	15
Figure 11	Power Supply Top View	24
Figure 12	Power Supply Bottom View	25
Figure 13	Aux Board	26
Figure 14	Fuse Assembly	27

1 GENERAL

1.1 INTRODUCTION

The LC1202 is a liquid cooled high voltage switching power supply designed for charging capacitors in laser systems and modulated applications. They are specifically designed for operation in any position or orientation with very high pulse to pulse repeatability at high rep rates. The LC1202 provides 12kW average power and 13.5kJ/s peak power at the rated output voltage.

The LC1202 incorporates high frequency IGBT based resonant inverter topology for generation of the output power. The control scheme provides excellent regulation of the output voltage and automatically compensates for line, load and temp variations. The latest development resonant inverter topology which improves pulse to pulse repeatability by reducing the ripple or “bucket effect” even at very high pulse repetition frequencies. The high voltage tank has been specially designed with liquid cooling and forced convection cooling. This allows the power supply to be operated in any orientation. The output voltages of the LC1202 supply are fully adjustable over each range.

This product is NOT protected against external load voltage reversal events. Load voltage reversal may result in damage to the unit which is not covered by the standard product warranty. See our online App Note 517 for details.

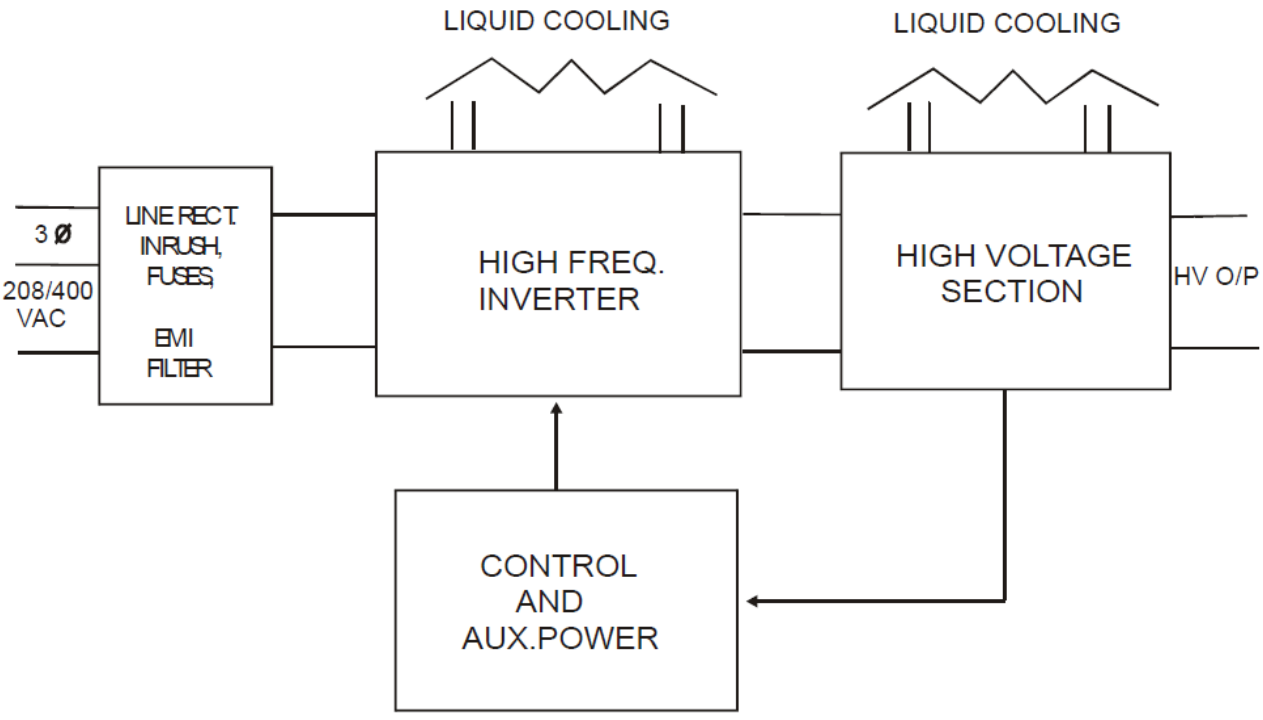


Figure 1 LC1202 Block Diagram

2 SPECIFICATIONS

2.1 AVERAGE CHARGING RATE

12,000J/sec at rated output voltage

2.2 PEAK CHARGING RATE

13,500J/sec at rated output voltage

2.3 STANDARD OUTPUT VOLTAGES/CURRENTS

Voltage	Current at 100% of rated V
1KV	27A
2KV	13.5A
4KV	6.75A
5KV	5.4A
10KV	2.7A
20KV	1.35A
30KV	0.9A

2.3.1 LINEARITY:

To within ±1% of full scale

2.3.2 ACCURACY:

To within ±1% of rated output

2.4 POLARITY

Available as fixed positive or negative.

2.5 HV INSULATING MEDIUM

Silicone oil

2.6 INPUT CONNECTIONS

Via 4 position VDE/IEC approved terminal block. Connections are Ø1, Ø2, Ø3, and ground.

2.7 INPUT REQUIREMENTS

3P208 - 180 - 250V, 50/60Hz, 50A max.

3P400 - 340 - 460V, 50/60Hz, 26A max.

3P480 – 432 - 528V, 50/60Hz, 20A max.

2.8 POWER FACTOR

>0.90

2.9 EFFICIENCY

>90%

2.10 STORED ENERGY

<0.3J in output stage

2.11 STABILITY

<0.2%/hr after 1 hr warm up

2.12 PULSE REPEATABILITY

±0.1% to 300Hz - Standard
±0.3% to 1000Hz - Standard
±0.1% to 1000Hz - Available

2.13 PHYSICAL DIMENSIONS

8.75”/222mm H (5U) x 19”/483mm W x 17”/432mm D. Depth of handles over panel 7/8”/20mm.

2.14 WEIGHT

Approximately 100 pounds/46 kg

2.15 MOUNTING

Chassis support rails or brackets required.

2.16 WATER FITTINGS

Swagelok 12mm

2.17 COOLING WATER

2GPM/7.6 liters/min, max supply temp 35°C. All water paths are at ground potential and are copper or brass. An analog temp signal, 0-10VDC, is provided for a heat sink temp of 10°-60°±3°C at the DB-25 remote connector.

2.18 AIR COOLING

Internal, 100CFM. Supply makeup air not required.

2.19 AMBIENT TEMPERATURE

2.19.1 STORAGE:
–20°C to +70°C

2.19.2 OPERATING:
+5°C to +45°C

2.20 HUMIDITY

<90%, non-condensing

2.21 FAULT PROTECTION

Three line fuses, accessible through rear panel of power supply.

2.22 PROTECTION

The power supply is protected against open and short circuit operation, current over-loads, and arcs.

2.23 VIBRATION

Meets MIL-STD-810E, Method 514.4. Basic Transportation Common Carrier 10-500Hz, 0.015g^2/Hz. Duration = 1 hour

2.24 SHOCK

25Gpk, half sinewave 11ms.

2.25 FRONT PANEL DISPLAY

Voltage and current 3½ character indicators, 10 segment voltage and current trend graphs, HV ON push button, HV ON indicator, power supply status signals. 3 Position Key SW. Local/Remote/OFF. Key is removable in all positions.

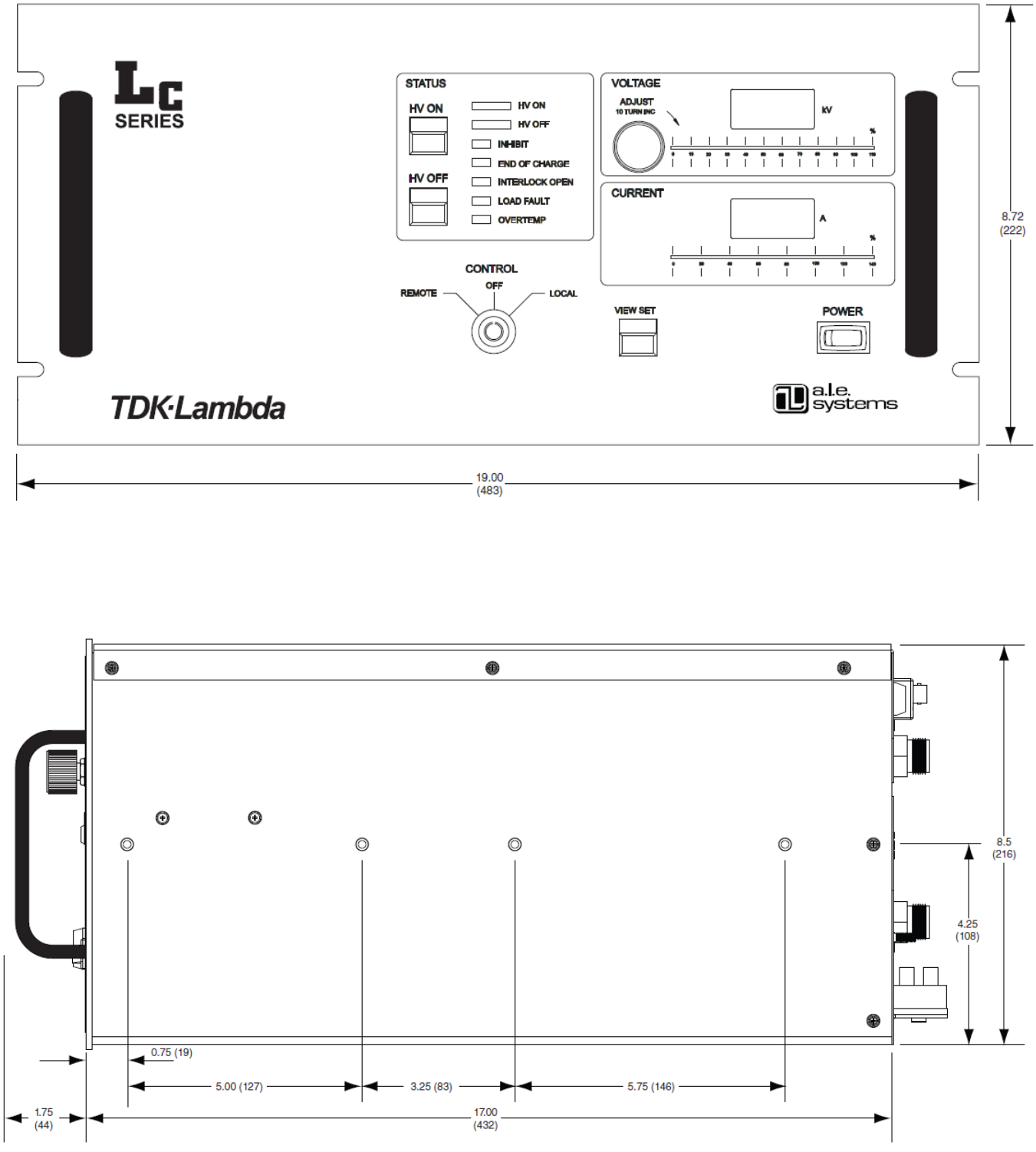


Figure 2 Mechanical Details

3 INSTALLATION

3.1 INITIAL INSPECTION

The shipping container should contain the following items: power supply, HV output cable, test data sheets and operator's manual. Examine the items immediately for damage. Locate the serial number labels on the power supply and verify the model number, the input voltage rating and the output voltage rating and polarity. In the event of any damage promptly notify the transportation company and the TDK-Lambda Americas Inc. customer service manager.

3.2 MOUNTING AND COOLING REQUIREMENTS

The power supply can be mounted in a standard 19" EIA enclosure or equivalent. Chassis support brackets or rails must be added to the bottom of the power supply for proper weight distribution. The power supply can also operate on a bench or table top. In all cases adequate clearances must be provided for cable bends. Generally, at least 4" (161.6mm) of clearance should be allowed at the rear of the power supply.

When operating in an enclosed system, care must be taken to ensure the ambient air to the power supply does not exceed the maximum ambient operating temperature of 45°C, this may require addition of a system heat exchanger.

The power supply requires a cooling water supply with a minimum 2GPM (7.6 l/m) flow and a maximum inlet temp of 35°C. The water connection is at the rear of the supply. The connection is SWAGELOK 12mm. The water flow direction must be as marked on the rear panel. All water connections are at ground potential. The power supply can be operated in any orientation/position.

3.3 GROUNDING AND INPUT AC POWER

Proper grounding of the input AC power is required to reduce the risk of electric shock. The metal chassis of the power supply is grounded through the green ear thing wire at the input AC power terminal block. Use extreme caution when connecting AC input power and never apply the incorrect input power. Connect the three lines of the input power to the L1, L2, L3 terminals and the earth ground to the terminal marked with the protective earth symbol. No neutral connection is required for the 200V and 400V configurations. Verify the input voltage configuration (208 or 400VAC) is on the nameplate on the rear panel before applying the correct voltage. Applying incorrect voltage will immediately cause major damage and void the warranty. The input voltage change should only be performed by qualified technical personnel equipped with proper parts and detailed instructions from the factory. Refer to Section 5 "Applications", to calculate line currents for various operating conditions such as reduced power or charging very large capacitor banks.

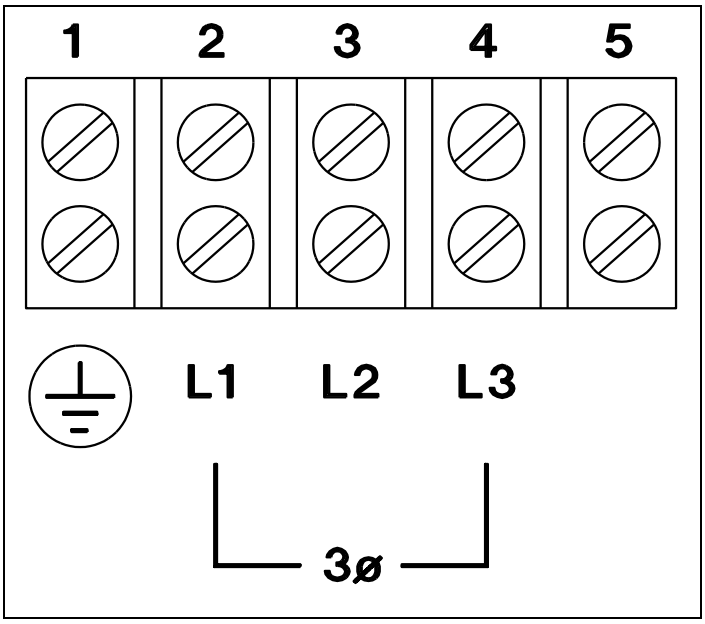


Figure 3: Input AC Power Connections

3.4 POWER CORD SPECIFICATION

Use wire with a minimum of 8 AWG. (diameter = 0.147” (3.73mm)) and 600V insulation.

3.5 CONNECTING HIGH VOLTAGE OUTPUT

Ensure that the power supply is off and disconnected from the input power and that all load capacitors are discharged and shorted to ground before making any connections. Never handle the HV cable during operation.

Always use the HV connector and cable provided with the power supply or an equivalent substitute provided by TDK-Lambda Americas Inc. Fully insert the connector end of the HV cable and tighten the locking nut only "hand tight".

When operating above 20kV or 200 Hz rep rate it is recommended that a silicone grease (such as Dow Corning DC-4) be used on the HV cable before insertion into the HV connector. This displaces the air in the connector and reduces long term corona effects.

The HV cable shield is connected to the power supply chassis and should be used as the HV return. An additional grounding stud is provided adjacent to the HV connector and should also be connected to the HV return. The standard shielded HV cable can contact earth ground without consequence. The optional unshielded silicone HV cable can also contact ground, but isolating it will minimize the effects of corona in the system.

Keep the minimum HV cable bend radius greater than 4" (101.6mm) to minimize stress on the insulation. Keep the HV cable as distant as possible from the input power and the input control signals.

To connect the HV cable to the load it is necessary to remove the cable jacket, shield, and any semiconducting layer that remains on the cable insulation after removing the shield.

The cable outer jacket should be removed to reveal the cable shield. At least 12” or 300mm of outer jacket should be removed for suitable voltage hold-off. The exposed shield should be trimmed to an appropriate length and terminated with a ground connection.

With the shield removed, the black semiconducting layer is exposed. This layer should be very carefully removed using a sharp craft knife, and a peeling action. Once the semiconducting layer is removed the exposed EPR insulation should be cleaned with IPA or an equivalent solvent. If any of the semiconducting layer remains on the HV cable insulation it may cause the cable termination to fail.

Some peak current will flow out of the power supply during discharge and return through the HV return and system chassis. This current comes from voltage reversal in underdamped systems and from normal discharge of filter and cable capacitance. The path for this current should not parallel control signal returns since the resulting voltages could interfere with normal system operation. When due to voltage reversal at high rep rates, this current could damage the power supply. Generally a resistor in series with the HV output can be added to limit this current to an acceptable level. Refer to Section 5.2 "Applications" for more information.

The oil-filled HV assembly should not be opened. The oil and components have been specially cleaned and vacuum impregnated at the factory and the assembly hermetically sealed. Opening the assembly will compromise performance.

3.6 GROUNDING THE PRODUCT

3.6.1 GROUNDING OF INPUT LINE:

The supply is grounded through the ground terminal of the input connector. A protective ground connection by the way of the grounding conductor in the input terminal is essential for safe operation.

3.6.2 OUTPUT GROUND CONNECTION:

It is important that there be a ground connecting the supply to the load as shown in Figure 4.

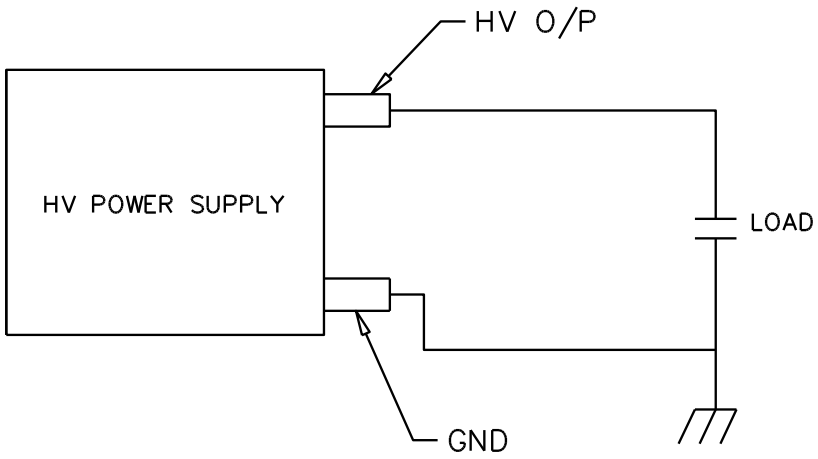


Figure 4 Output Ground Connection

This product is NOT protected against external load voltage reversal events. Load voltage reversal may result in damage to the unit which is not covered by the standard product warranty. See our online App Note 517 for details.

4 OPERATION

4.1 L, S, OEM MODELS

Model LC1202L: This model has full front panel instrumentation for use in laboratory, prototype or OEM systems. The LC1202L can be operated either from the front panel or from the rear panel remote control connector. The front panel includes power on/off, remote/local and HV on/off switches, output voltage adjust, view set switch, digital voltage and current meters, quick reference bar graphs and status indicators. An internal AC contactor is included which is controlled by the front panel power switch. The model LC1202L can be operated as a "master" unit in parallel with several model LC1202S "slave" units for increased output power. Refer to Section 5.3 "Paralleling Units".

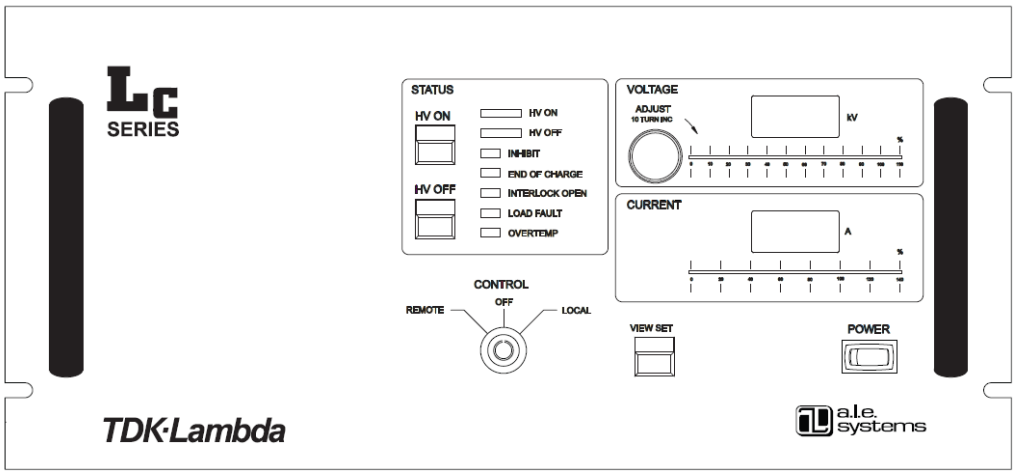


Figure 5 Model LC1202L

Model LC1202S: This model has only a power switch and status indicators on the front panel. It must be operated through its remote control connector and can function as a standalone unit or in parallel with other units. Several model LC1202S units can be paralleled as "slaves" controlled by either a "master" LC1202L or a single remote control circuit. An internal AC contactor is included which is controlled by the front panel power switch.

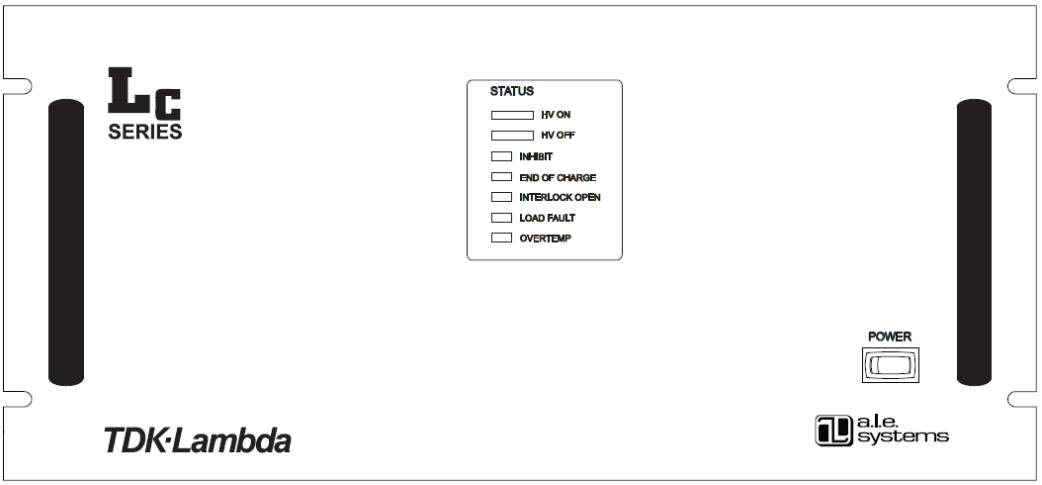


Figure 6 Model LC1202S

<u>Model LC1202 OEM</u>: This model has a blank front panel and is operated the same as an LC1202S, from the remote control connector only. It can function as a stand alone unit or in parallel for increased output power. The basic model LC1202 OEM is supplied by externally controlled AC power. It can also be configured with either an internal AC contactor or front panel circuit breaker option.

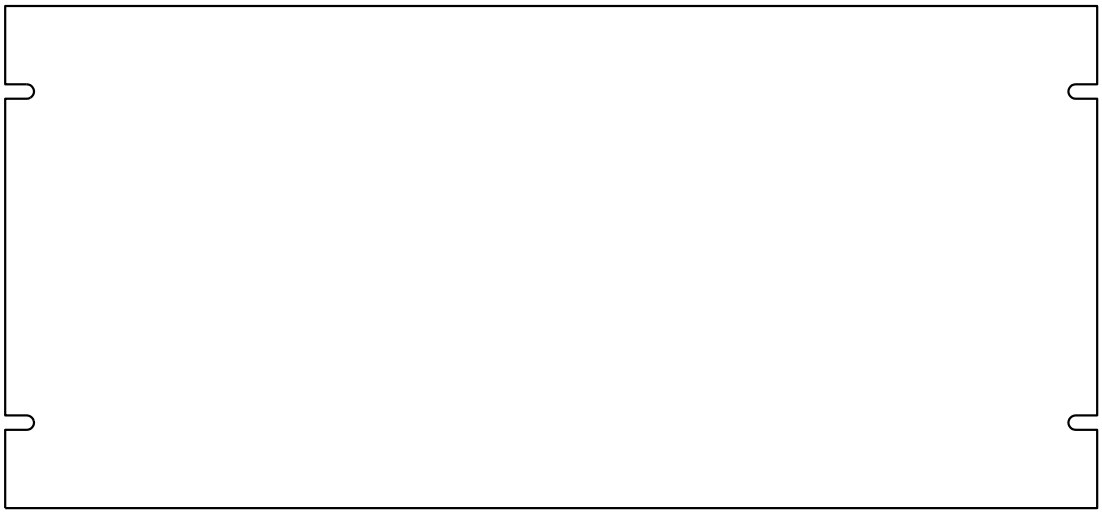


Figure 7 Model LC1202 OEM

4.2 REAR PANEL

Figure 8 shows the rear panel of the model LC1202L. The REMOTE connector is used to control the power supply when the CONTROL KEY SWITCH on the front panel is in the REMOTE position. The INTERLOCK terminal block (internal 24 DC) can be connected to system interlocks to disable the power supply when opened. Jumper the two terminals together allows the power supply to operate. The INHIBIT connector allows for easily connecting a pulsed INHIBIT signal when operating from the front panel. The INHIBIT signal in the REMOTE connector can be used when operating in remote control mode. The SLAVE connector is used to control model LC1202S power supplies operating in parallel with an LC1202L "master" unit. The model LC1202S and model LC1202 OEM do not have the INHIBIT and SLAVE connectors.

Note: The Inter-lock terminals are connected to internal 24 VDC circuits and should never be connected to ground.

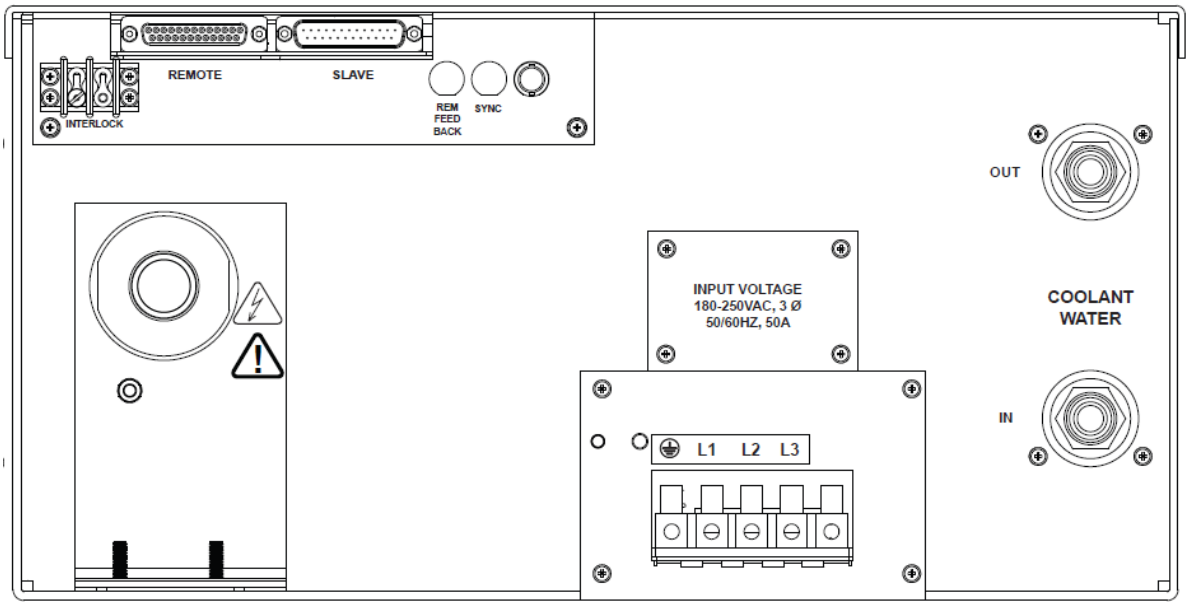


Figure 8 Rear Panel

4.3 FRONT PANEL CONTROL (L MODEL ONLY)

4.3.1 POWER SWITCH:

Connects AC input power to the control circuitry and closes the internal AC contactor if the interlock is closed.

4.3.2 CONTROL SWITCH:

Directs the power supply to take on/off and voltage program commands from either the front panel (LOCAL position) or the remote control connector (REMOTE position). The OFF position disables the power supply regardless of other commands.

4.3.3 HV ON SWITCH:

Turns on the high voltage output to the level set by the HV adjust knob. Also used with HV OFF to reset latched fault conditions: overvoltage, open circuit, over-temp, AC undervoltage, interlock open, overload and inverter current.

4.3.4 HV OFF SWITCH:

Turns off the high voltage output.

4.3.5 VOLTAGE ADJUST:

Clockwise increases the output from zero to maximum, 10 turns full scale.

4.3.6 VIEW SET:

Previews the voltage adjust set point before HV ON. Also displays set point during operation to indicate whether a load condition is affecting the desired HV output level.

4.4 REMOTE CONTROL (L, S, OEM MODELS)

All three models are easily controlled through their remote connector on the rear of the unit. Only the HV ON/OFF, V PROGRAM and GND signals are required for operation. The remaining signals are provided for status monitoring and fault diagnosis. A schematic diagram showing the suggested interface circuit appears after the following description of control signals. Pins 2, 4, 6, 11 and 24 are internal connections and should not be used.

Pin	Signal Name	Function
1	Analog Out	0-10V (±1%) Analog of output voltage waveform. Impedance 1kΩ. If the 5V option is installed the voltage level is 0-5V.
3	Inhibit LED	Open collector through 100Ω. Low impedance when output current is inhibited. See Note 1.
5	End of Charge LED	Open collector through 100Ω. Low impedance when power supply reaches End of Charge. See Note 1.
7	Inhibit Input	5-15V Inhibits unit, open or ground allows operation. Input impedance >10kΩ. Note use either INHIBIT or $\overline{\text{INHIBIT}}$, never both signals. Do not use the INHIBIT BNC as well as the INHIBIT signal.
8	HV ON/OFF	15V=On, ground or open =Off. Also used to reset latching faults by cycling from On to Off. Input impedance >1MΩ. If the EN option is installed 15V=Off, Ground or open = On
9	Peak output volts	0-10V (±1%) Peak detector of output voltage waveform. Can be used to drive a meter displaying peak charging voltage. Impedance 1kΩ. If the 5V option is installed the voltage level is 0-5V.
10	HV ON LED	Open collector through 100Ω. Low impedance when HV output is enabled. See Note 1.
12	GROUND	Control circuit return. Also chassis/earth ground.
13	Charge current	0-10V Analog of output current waveform. Impedance 1kΩ
14	+15VDC	+15V fused at 250mA
15	Plate Temp Sense	0-10V = 10 to 60°C +/-3°C through 1k
16	Overtemp LED	Open collector through 100Ω. Low impedance when inverter overtemperature condition occurs. See Note 1.
17	Interlock LED	Open collector through 100Ω. Low impedance when external interlock circuit is open. Interlock is a **latching** fault that must be RESET with an HV ON to HV OFF transition before the supply can be restarted. See Note 1.
18	Load fault LED	Open collector through 100Ω. Low impedance when load fault condition occurs. Load fault is normally a non-latching fault and will self reset after approximately 500ms (for models without LP option), unless caused by an output overvoltage where the supply will latch off. See Note 1.
19	Summary Fault LED	Open collector through 100Ω. Low impedance indicated a summary fault condition. Summary fault is a logical or of Overvoltage, Overtemp, AC Line, and Open Interlock conditions. See Note 1.
20	NOT Inhibit Input	0V Inhibits unit, 15V or open allows operation. Input impedance >10kΩ
21	Phase Loss LED	Open collector through 100Ω. Low impedance when an AC phase is not connected. See Note 1.
22	Vprogram	0-10V = 0-100% of rated output voltage. Input impedance >1MΩ. If the 5V option is installed the voltage level is 0-5V.

Remote Control Interface (Continued)		
23	HV Off LED	Open collector through 100Ω. Low impedance when HV output is off/disabled. See Note 1.
25	GND	Control circuit return. Also chassis/earth ground.

<u>Note 1</u>. For LC1202L or LC1202S models, the front panel LEDs are driven by open collector drivers that are common to the remote control interface indicator signals. A pullup resistor is not required to sense the remote interface voltage on these signals. The user should expect the Active Logic level (low) to be between 2 and 4V. If an external pullup resistor is added, the Active Logic level (low) voltage will be higher.

For LC1202-OEM models, a pullup resistor is required to sense voltage levels at these outputs.

For applications that require logic level inputs the use of an opto-isolation device is recommended.

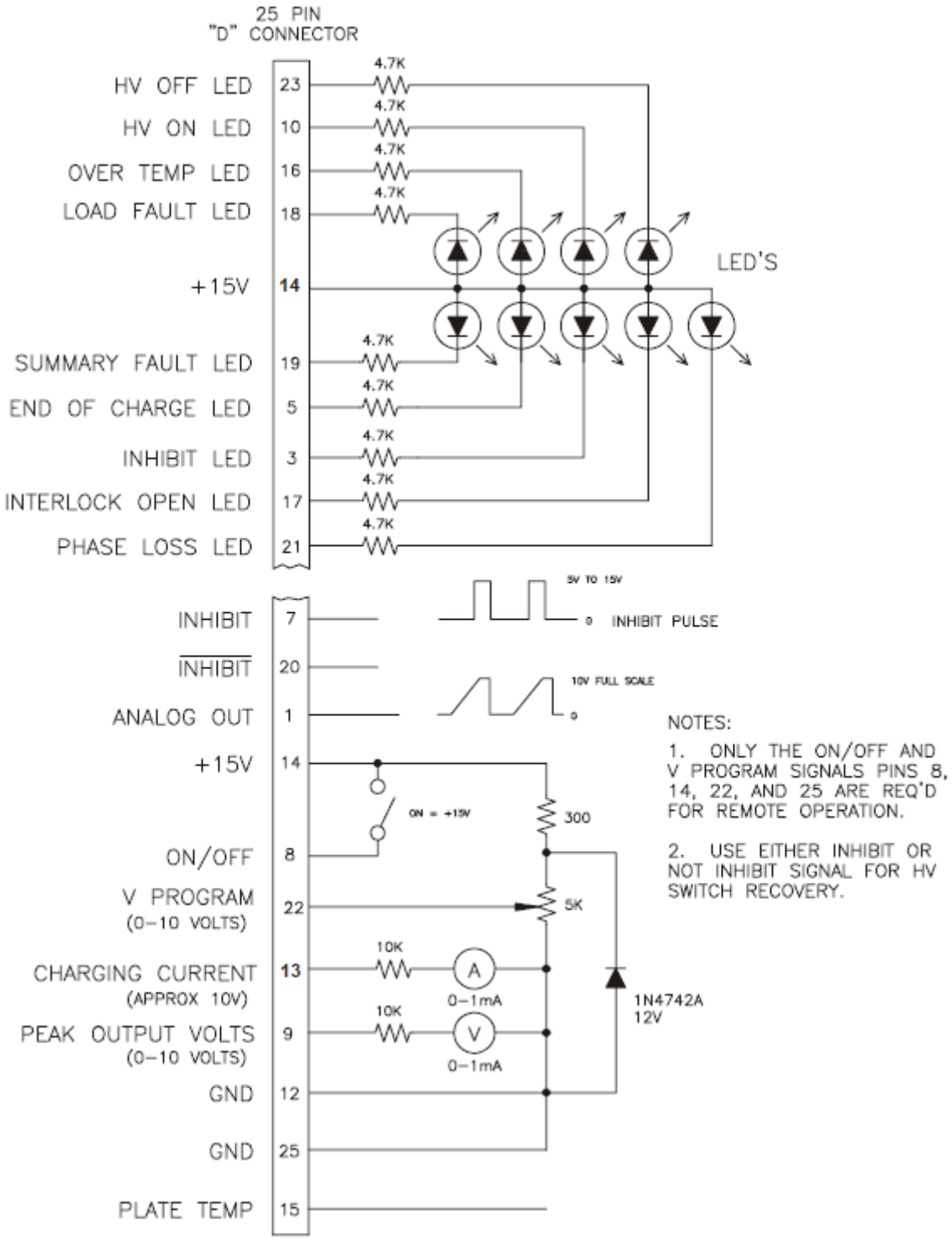


Figure 10 Suggested Interface

4.5 INITIAL CHECK-OUT PROCEDURE

The power supply should have no visible damage or defects and the cover should be securely fastened. Properly connect the input power, control connector and HV output. If there is no load connected, the power supply will sense an open circuit and immediately shut down indicating a LOAD FAULT. If there is a short circuit or overload condition on the output, the power supply will operate in a 50% duty cycle protection mode and indicate a LOAD FAULT. An overload condition can occur if the INHIBIT signal is missing and the discharge rep rate is too high to allow the capacitor to fully charge to V PROGRAM. Double check all connections and ensure that all personnel are protected from the HV output. With the HV adjust at zero volts, turn the power supply on in the following sequence:

LC1202L Front Panel Control:

1. Turn HV ADJUST knob fully counterclockwise.
2. Turn POWER switch to ON.
3. Turn CONTROL key switch to LOCAL.
4. Push HV ON switch.
5. Verify the HV output is at approx. zero volts.
6. Increase HV output slowly and verify adjustability.

LC1202L Remote Control:

7. V PROGRAM signal (pin 22) at zero volts.
8. ON/OFF signal (pin 8) at zero volts.
9. Turn POWER switch to ON.
10. Turn CONTROL key switch to REMOTE position.
11. Assert ON/OFF signal to 15V.
12. Verify HV output is at approx. zero volts.
13. Increase HV output slowly and verify adjustability.

LC1202S Remote Control:

14. V PROGRAM signal (pin 22) at zero volts.
15. ON/OFF signal (pin 8) at zero volts.
16. Turn POWER switch to ON.
17. Assert ON/OFF signal to 15V.
18. Verify HV output is at approx. zero volts.
19. Increase HV output slowly and verify adjustability.

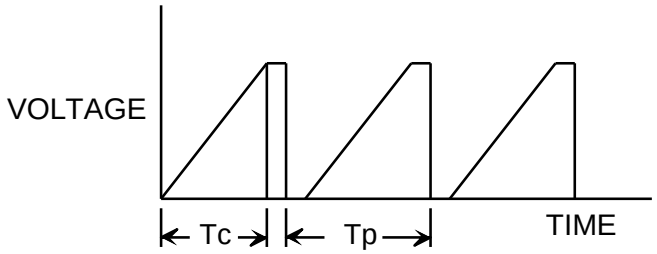
LC1202 OEM Remote Control:

20. V PROGRAM signal (pin 22) at zero volts.
21. ON/OFF signal (pin 8) at zero volts.
22. Assert ON/OFF signal to 15V.
23. Verify HV output is at approx. zero volts.
24. Increase HV output slowly and verify adjustability.

5 APPLICATIONS

5.1 DETERMINING CAPACITOR CHARGE TIME

The LC1202 Series is rated at 13500 J/sec peak and 12000 J/sec average charge rate. Although the measure of Joules/sec equates to Watts, it is more convenient when working with energy storage capacitors. The peak charge rate determines the capacitor charge time. The average charge rate determines the total power delivered from the power supply. It is possible to charge a capacitor at a rate of 13500 J/sec, but to discharge it at a low rep rate amounting to only 100 J/sec.

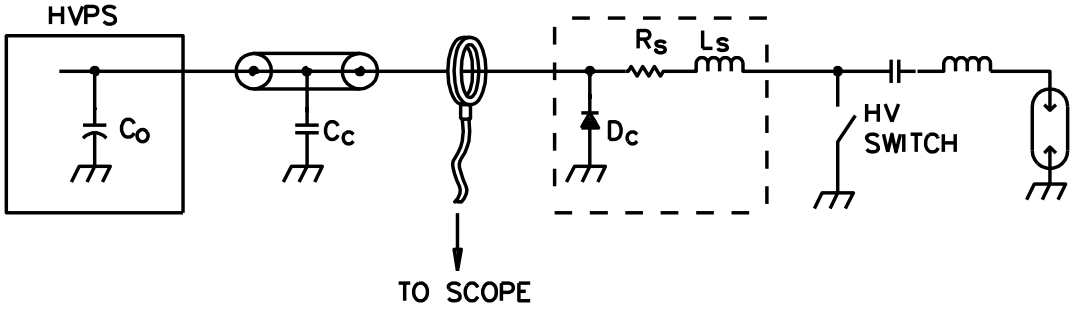


$$\textit{Peak Charge Rage} = \frac{\frac{1}{2} CV^2}{T_c}$$

$$\textit{Average Charge Rate} = \frac{\frac{1}{2} CV^2}{T_p}$$

5.2 VOLTAGE REVERSAL *(SEE ONLINE APP NOTE 517 FOR MORE DETAILS)*

When the capacitor or PFN is discharged, a high peak current may flow out of the power supply as a result of voltage reversal. This occurs in a system which is under damped in order to clear the high voltage switch after each pulse. The average value of this peak current added to the normal output current may exceed the rating of the HV diodes in the power supply. This current can be measured with a current transformer as shown.



A series terminating resistor (or series inductor or clamp diode) must be added as shown if the average value of the peak current exceeds 10% of the normal output current.

When choosing Rs, ensure it can withstand the full output voltage across it as well as the power dissipation caused by discharging Co (460pF) and Cc (20pF/ft) each cycle as well as conducting the normal output current. Its power dissipation can be calculated as,

$$P_D = Io^2 R_S + \tfrac{1}{2}(C_O + C_C)V^2(F_{REP\ RATE})$$

5.3 PARALLELING UNITS

The LC1202 power supply is designed for simple parallel operation. Any model (L, S, OEM) can be paralleled with any other model. The input power and HV output should be connected directly together. The REMOTE connectors on the rear panel can also be connected directly together using a "daisy chain" ribbon cable from the system controller. Each of the power supplies operate at the same time with the total charge rate equal to the sum of each.

When operating an LC1202L as a master with either one or more LC1202S's as slaves, connect the SLAVE connector on the LC1202L to the REMOTE connector on each of the LC1202S's. This allows control of the entire system from the LC1202L front panel when in local mode, or the LC1202L REMOTE connector when in remote mode. The status of each individual LC1202L and LC1202S is displayed on its front panel.

Sometimes when operating several units in parallel, the high total power generates noise which interferes with the power supply control. This is usually due to the many interconnecting control cables acting as an antenna picking up noise. The problem usually appears as one or more of the power supplies shuts down when the output voltage increases beyond a certain level. Dressing the control cables as short as possible and close to ground or using shielded cables should help. In severe cases, it is necessary to wrap the cables several times through large ferrite cores at the rear panel of each unit.

5.4 MEASURING HIGH VOLTAGES

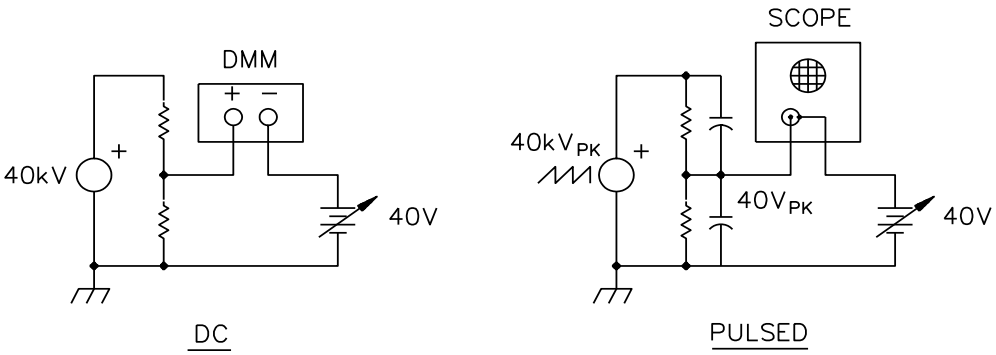
A sample of the output voltage is available in the REMOTE connector. If it desired to measure the HV output externally, care must be taken to understand the accuracy of the measurement.

When making a DC measurement, such as when the power supply is holding voltage on a capacitor, any HV probe and DMM combination can be used. The Fluke 80k - 40 probe with any 10MW input resistance DMM is adequate up to 40kV. Building a simple resistor divider using appropriate HV resistors is also very straightforward. Keep in mind that all HV resistors, including the one in the Fluke probe, exhibit a negative voltage coefficient, changing by up to 4% from zero to max voltage. Derating the resistors and calibrating at the operating point solves this problem.

Making a pulsed measurement with an oscilloscope requires a compensated HV probe having a wide bandwidth. Simply connecting a DC probe, through the proper resistance, into a scope yields a slow response adequate for only low rep rate systems. As with DC probes, the pulsed probe resistor voltage coefficient is a problem. In addition, damage to the resistors can occur during pulsing due to high electric field gradients. Also, stray capacitance to nearby objects can significantly alter the pulse response. The Tektronix P6015 is a high-performance, shielded probe and a good choice up to 40kV.

Measurements accurate to better than 0.1% can be achieved using a bias technique. For example, if a 40V signal (40kV divided by 1000) is to be measured accurately, the minus input of the DMM would be biased up 40V. The original signal, with respect to ground, is fed to the plus input of the DMM. The bias can be measured accurately for

absolute measurements, or relative measurements read directly as the line or load is varied. In the same manner, an oscilloscope return can be biased for accurate peak measurements during pulsing.



5.5 DETERMINING AC LINE CURRENT

$$I_L = \frac{P}{\sqrt{3} V_L P_F \pi}$$

I_L = Line current
P = Average output power
V_L = Line voltage
P_F = Power factor (0.9 min)
π = Efficiency (0.9min)

EX: An LC1202 operating from 208V - 10% and delivering 12000W average.

$$I_L = \frac{12000}{\sqrt{3}(.9 \times 208)(0.9)(0.9)} = 45.7A$$

When charging very large capacitor banks requiring many seconds or minutes to reach end-of-charge, the power supply will display a load fault and go into a 50% duty cycle protection mode. If this feature is defeated and the power supply is allowed to charge for an extended period, then the peak output power rather than the average must be used to determine line current.

5.6 OPERATION AS A DC POWER SUPPLY

The LC1202 can provide a regulated voltage to a DC load such as an electron beam. The output current will be preset at the factory in order to limit the average output power to 12000W, while making full rated HV steady state. The voltage ripple can be easily filtered to any desired level with an external capacitor across the load.

For more details refer to App Note 505 available from TDK-Lambda web site (http://us.tdk-lambda.com/hp/).

5.7 OPERATION WITH REMOTE VOLTAGE SENSE

Only factory configured LC1202 power supplies with the “RS” option will operate with an external voltage sense. The Remote Voltage Sense is connected to the LC1202 supply via the “REM FEED BACK” BNC connector on the rear panel (Figure 8). The signal must be a linear scaled voltage signal provided by the system with a range of 0 to 200 VDC equal to 0-100% of the supplies’ rated voltage. The input impedance characteristic of the REM FEED BACK connection is 1M Ohm at 750pf.

6 MAINTENANCE AND TROUBLESHOOTING

6.1 SAFETY PRECAUTIONS

The calibration and troubleshooting steps described in this section require operation of the power supply with the top cover removed. Proceed with extreme caution as hazardous voltages are exposed throughout the unit. Safety glasses must be worn to prevent serious injury in the event of a component failure (e.g., power transistors readily explode during fault conditions).

6.2 CALIBRATION

Calibration of the output is accomplished with trim pots located on the Control Board. This pc board is horizontally mounted on top of the high voltage output assembly on the right side of the unit as you face the front panel.

6.2.1 OUTPUT VOLTAGE LEVEL:

RP14. Slowly adjust clockwise to increase output voltage for a given V PROGRAM level. Factory set for 10V = rated voltage.

6.2.2 OVERVOLTAGE TRIP POINT:

PP17 (12 turns). Slowly adjust clockwise to increase trip point. Factory set at 10% above rated voltage.

6.3 MAINTENANCE

No maintenance is required under normal operating conditions. Occasional vacuum or blowout of the chassis may be required when operated in extremely dirty environments. The oil-filled HV assembly must not be opened. The oil and components have been specially cleaned and vacuum impregnated at the factory and the assembly hermetically sealed. Opening the assembly may compromise performance.

6.4 TROUBLESHOOTING

First check for obvious trouble such as input power, output connections, control connections and signal levels. In particular, the interlock, the INHIBIT and the ON/OFF signals. If there is no load connected, the power supply will sense an open circuit and immediately shut down indicating a LOAD FAULT. If there is a short circuit or overload condition on the output, the power supply will operate in a 50% duty cycle protection mode and indicate a LOAD FAULT. An overload condition can occur if the INHIBIT signal is missing and the discharge rep rate is too high to allow the capacitor to fully charge to V PROGRAM.

- If the power supply is making high voltage but does not appear to be functioning properly in a specific application, the problem may be application related. Consult the TDK-Lambda Americas Inc. customer service department.
- If the power supply is not making high voltage, the problem is usually either failed HV output diodes or a problem on a pc board. Refer to the schematics provided in this manual.
  - Check the DC bus voltage on the SWG C1 - C2 and SWG C3 - C4 on Inverter Board. Should be 250-350 V.
  - Check for failed power transistors or diodes on the Inverter Board.
  - Check the +15V and -5V on the Control Board.
  - Check the output and inputs of the main OR-gate U2-2, 3, 4, 5 and u11 pins 3 and 4. A high level will disable the power supply.
  - Check the output of the latches U28-1, U31-1, U37-1, U12-1 and U41-1.

- Check the V PROGRAM input at U1-12.
- Check the clock at “Drain” Q4.
- Check the transistor gate drives at Q4, Q5, Q8, Q10

7 INPUT VOLTAGE CONVERSION PROCEDURE

7.1 OVERVIEW

The 1202 power supply was designed so that the input line voltage can be easily changed from 208VAC to a 400VAC (and vice versa) in the field by ***technically qualified person***. Each supply will be shipped configured to the voltage shown on the input label on the rear panel of the supply.

- A conversion kit will be included in the shipping package of each supply. Kit will be labeled clearly.
  - Kit part number 12494001 - Conversion kit for converting 208VAC to 400VAC
  - Kit part number 12494002 - Conversion kit for converting 400VAC to 208VAC
  - Kit part number 12494005 - Conversion kit new for converting 208 to 400VAC
  - Kit part number 12494004 - Conversion kit new for converting 400VAC to 208VAC

	12494001	12494002	12494005	12494004
Fuses Qty 3	24A	50A	30A	60A
Fuses Qty 3	0.125A	0.25A	–	–
Selector Board Qty 1	20008100	20007900	20008100	20007900

7.2 CONVERSION PROCEDURE

7.2.1 CHANGE SELECTOR BOARD

Make sure the power supply is disconnected from the line and load and all caps must be discharged.

Take the cover off.

On the inverter board (Figure 11) discharge the bus capacitor by shorting SWGC1 - SWGC2 and SWGC3 - SWGC4 with a 10Ω 10W resistor.

Remove the Selector Board (Figure 11) by unscrewing the 7 #10 x 3/8 screws. Be careful not to drop any screws in the supply as it is not easy to retrieve them.

Replace the Selector Board in the supply with the one provided in the kit. The #10 screws must be tightened and torqued to 25 in-lbs. Loose screws will damage the board and will cause the supply to fail.

7.2.2 CHANGE FUSE

To access the fuses, unscrew the four screws in the rear panel (Figure 8) and two screws on the bottom of the supply (Figure 12). Pull the fuse assembly out.

Note the revision level of the fuse PCB assembly. (Figure 14). Depending on the PCB revision level go to a) or b).

a) For fuse PCB assembly Rev. D or lower use kits 12494001 or 12494002. Six fuses need to be replaced for the conversion. These fuses are all located on the fuse assembly (Figure 14). Replace the fuses. F4, F5 and F6 are 50A for 208 VAC and 24A for 400VAC supply. F1, F2 and F3 are 0.25A for 208VAC and 0.125A for the 400VAC power supply.

b) For fuse PCB assembly Rev. E or higher, use kits 12494004 or 12494005. Three fuses need to be replaced for the conversion. These fuses are all located on the fuse assembly (Fig 14). Replace the fuses F4, F5, and F6 are 60A for the 208VAC and 30A for the 400VAC supply. Fuse F1, F2, F3 do not need replacement.

After replacing the fuses slide the fuse assembly back into the supply.

First use a 6 x 1¼ (74-011-011) screw (supplied in the kit to locate fuse assembly in place by screwing the long screw in the bottom of the supply. Screw in the 4 screws on the rear panel of the power supply. Then go back and replace the 6 x 1¼ long screws in the bottom of the screw with the correct 6 x ¾“ (74-039-008) screws.

7.2.3 SELECTOR SWITCHES ON AUX POWER BOARD

There are 3 selector slide switches on the Aux Board which have to be correctly selected. For 208VAC line operation the position of the slide switches should be so that 110VAC is visible. For 400V line 220VAC should be visible.

The Aux Board is located on the front right hand corner (standing in front of the supply). Figure 13 shows the location of the slide switches on the Aux Board. The slide switches can be selected with a flat head screw driver.

7.2.4 CORRECTING THE INPUT LABEL

The input label is located on the rear panel and is screwed to the chassis with 4 6 x .312 screws. The input label plate is silk screened on both sides. One side is for the 208VAC line and the other side is for the 400VAC line.

Unscrew the silk screened input label plate and reverse it for the changed input voltage.

The supply is tested for both input voltages prior to being shipped. On completion of the above steps, the supply is ready for operation with the changed input voltage.

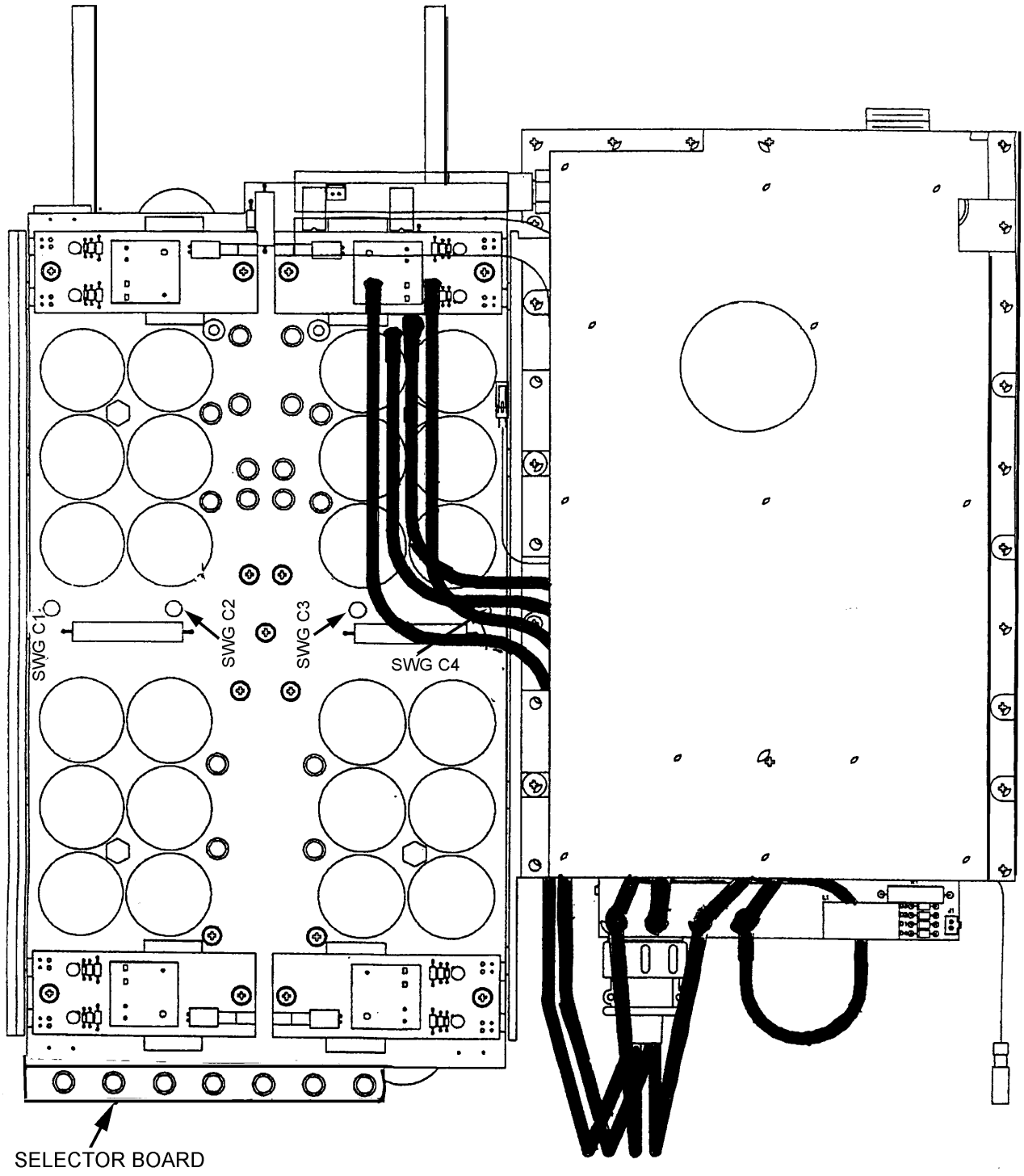


Figure 11 Power Supply Top View

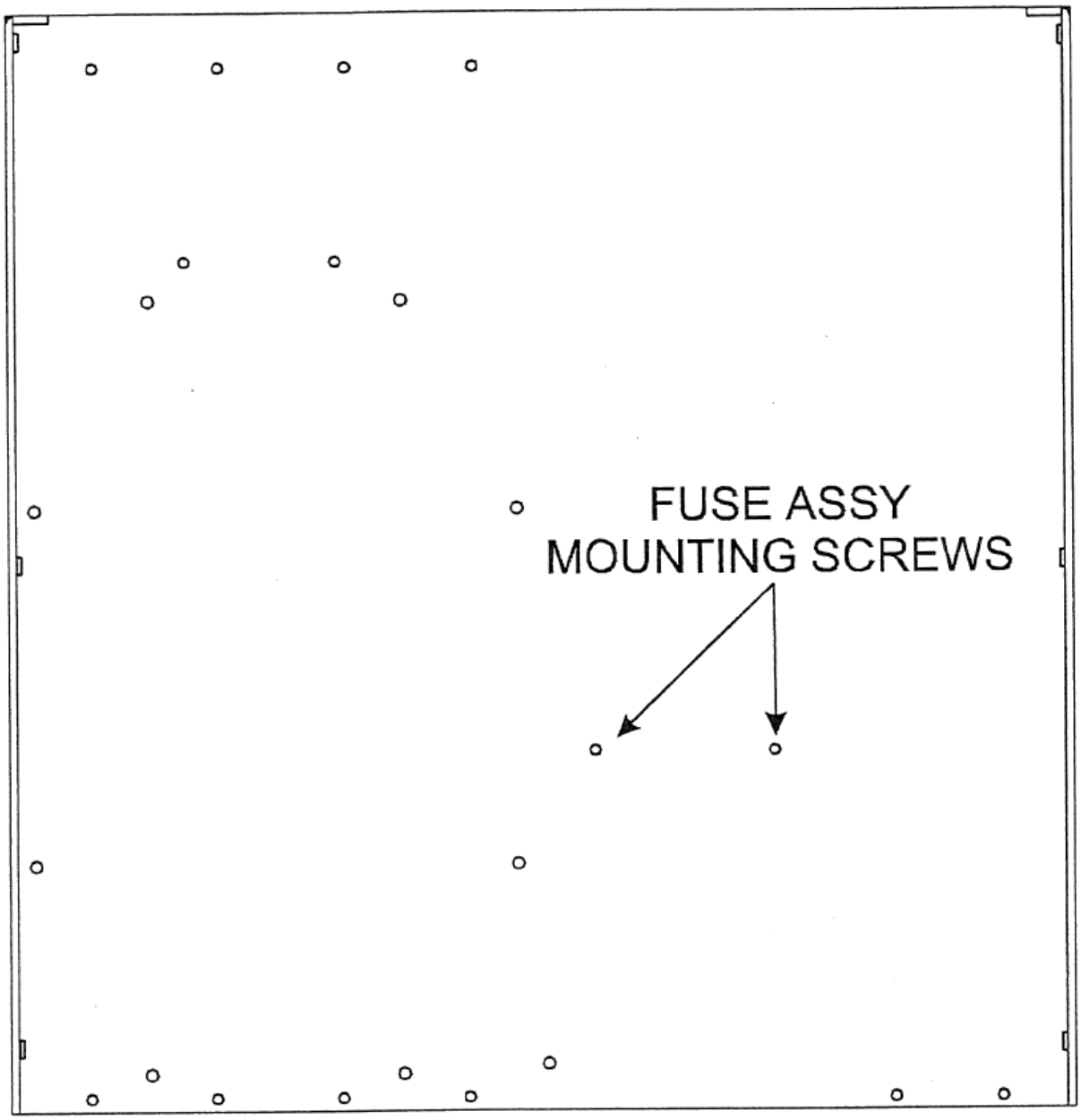


Figure 12 Power Supply Bottom View

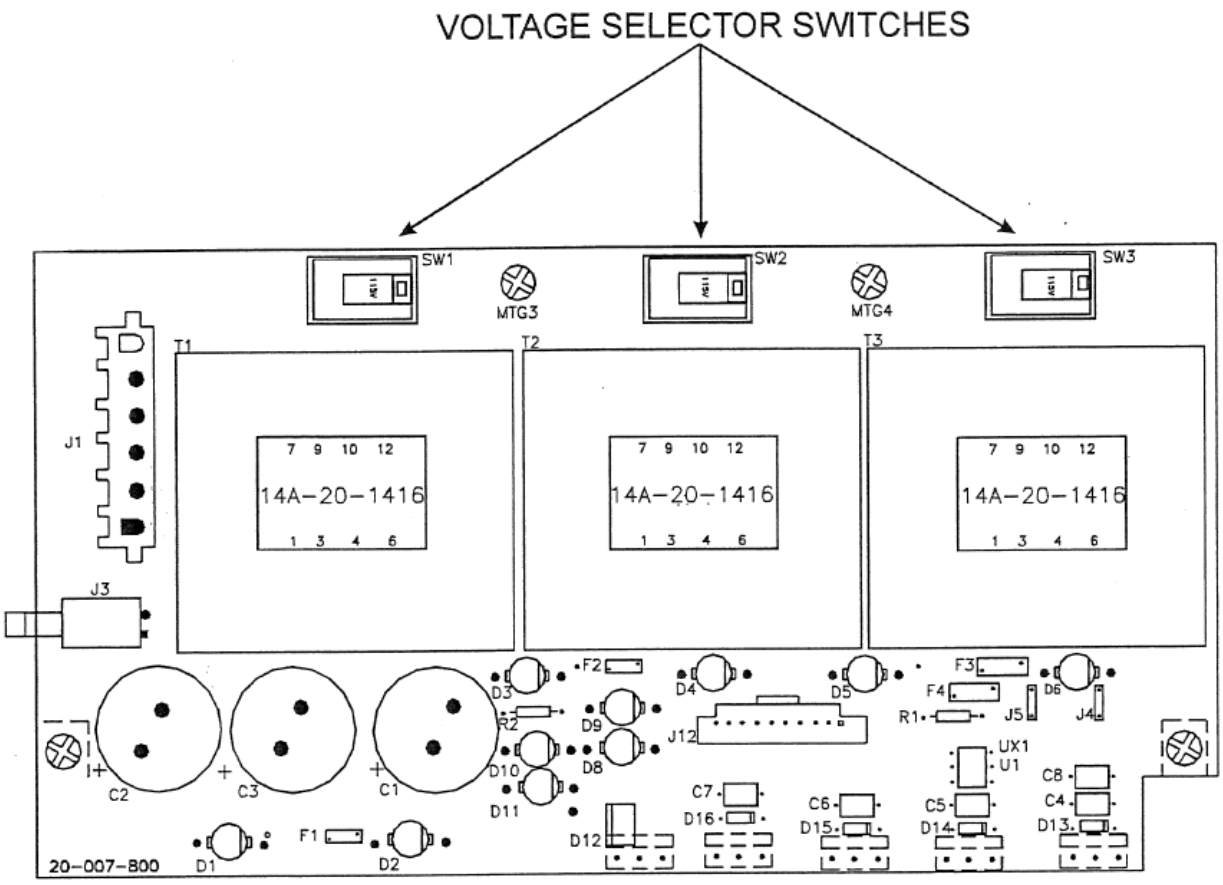


Figure 13 Aux Board

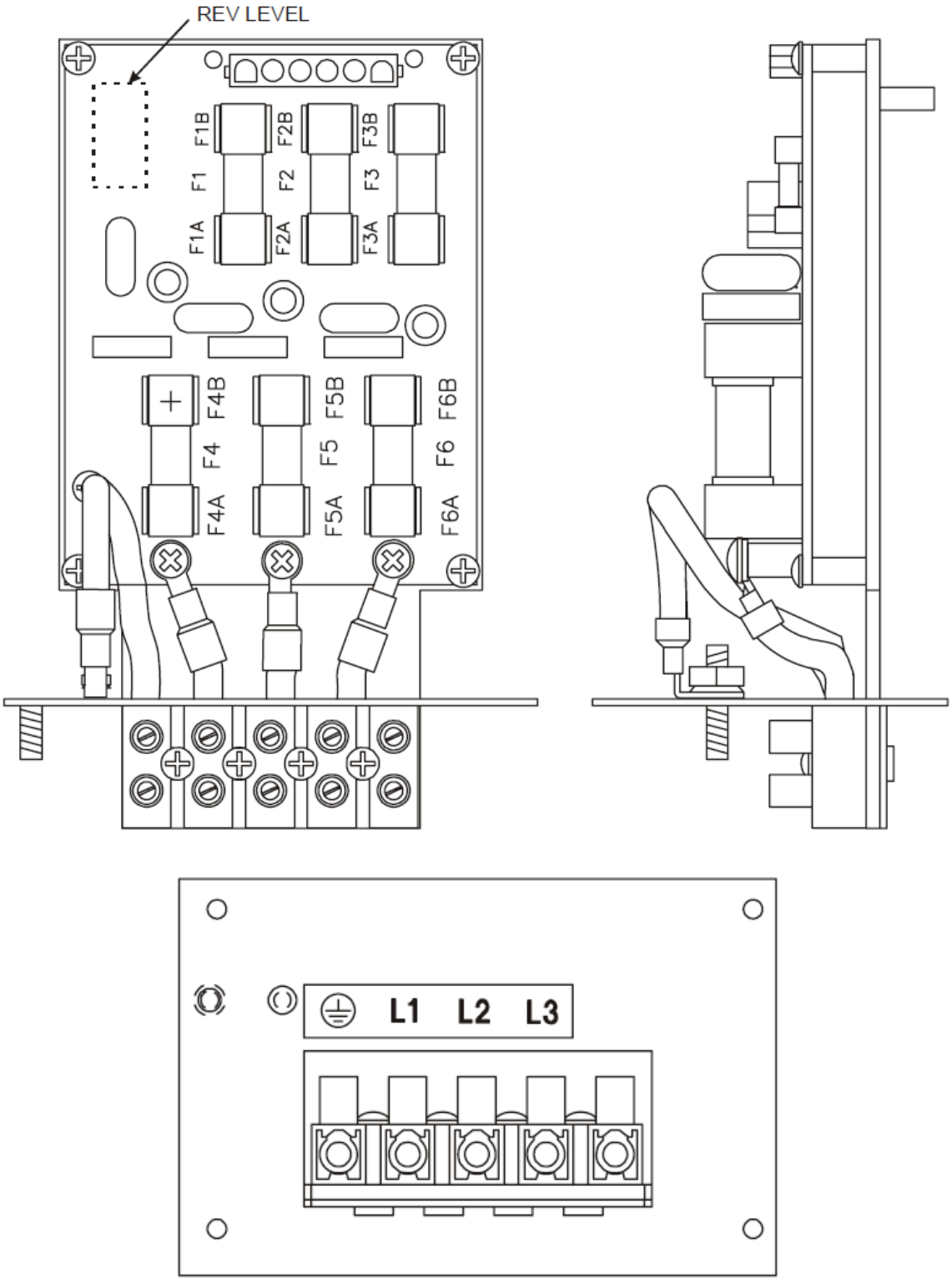
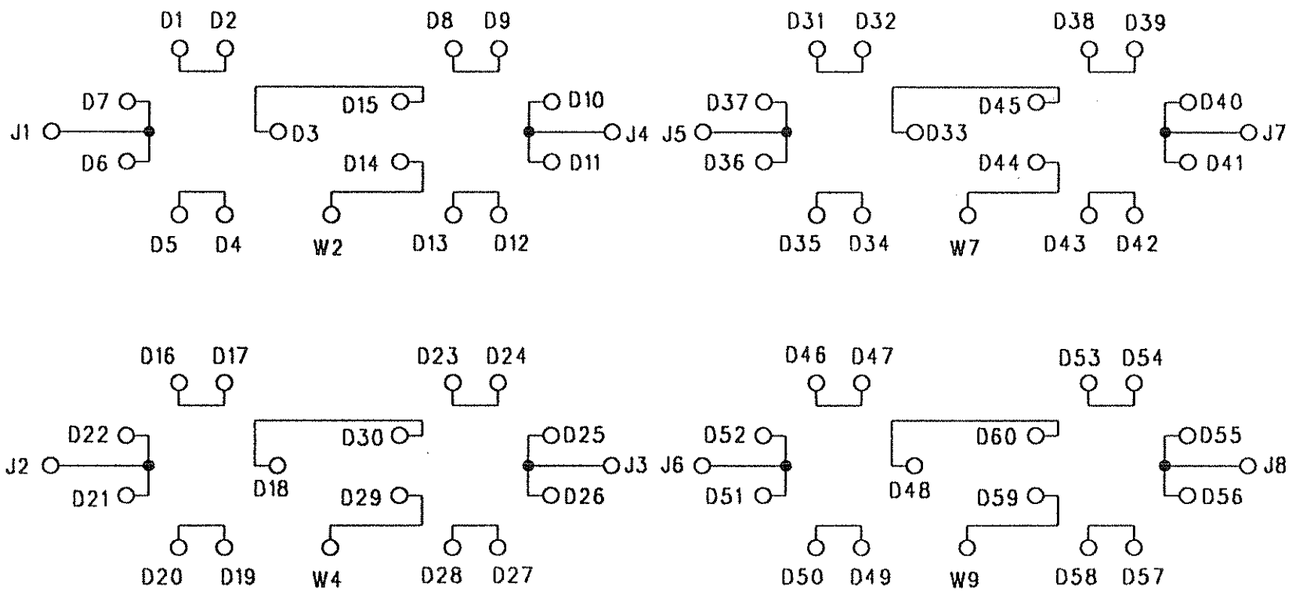
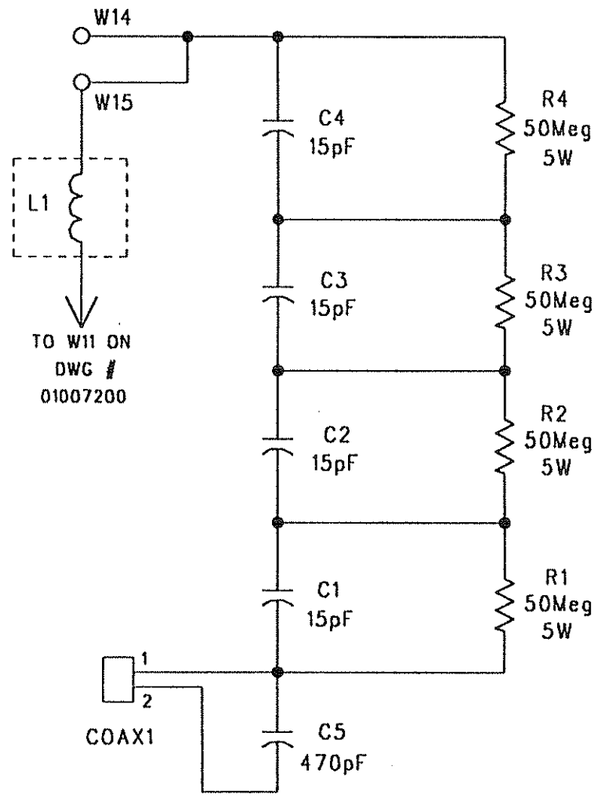


Figure 14 Fuse Assembly

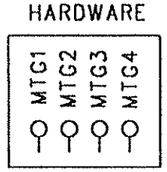
APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE
			1	PROTO RELEASE	GB 6/23/97	GB 6/23/97
			2	TG UPDATES	GB 8//97	S.A.
			A	TG RELEASE	LPN 9/11/97	GFS





PQ20R3
S010R2

HARDWARE

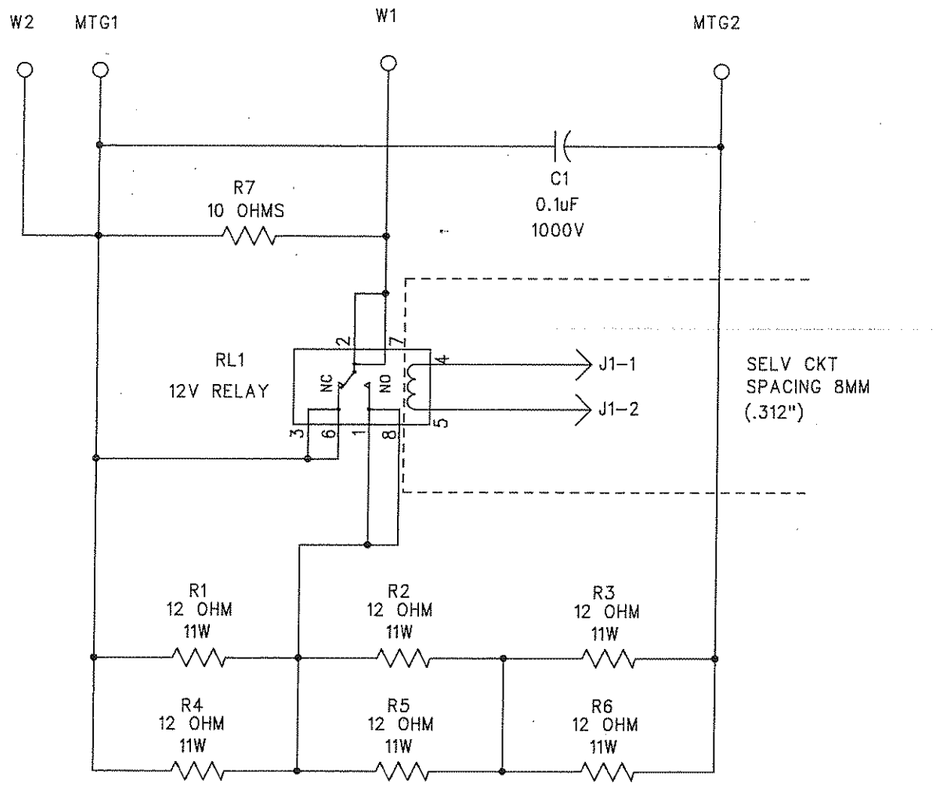


NOTES:

1. UNLESS SPECIFIED, ALL RESISTORS ARE IN OHMS, ALL CAPACITORS ARE IN MICROFARADS. K = 1,000 AND M = 1,000,000.
2. REF. ASSEMBLY 20-007-100.

TOL: .X = ±.02, .XX = ± .01, .XXX = ± .005, FRAC = ± 1/64, ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ELECTRONIC MEASUREMENTS, INC. a.l.e. systems division
	ARR'NGR: DATE: 9/15/97	DWN: GWM DATE: 6/23/97	TITLE: SCHEMATIC 1202 HV DIODE VOLTAGE PCB
	MFG: DATE: 9/15/97	CHK: DRB DATE: 6/23/97	
P/L: 494	DOC.REL: GFS DATE: 9-12-97	ENG: GB DATE: 6/27/97	PCB NO: 21-007-100 SHEET 1 OF 1
SCALE: NONE		APP: GFS DATE: 9-12-97	DRAWING NO: 01-007-100 REV. A

APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE
			1	PROT RELEASE	GB 9/24/96	GB 9/24/96
			3	ENG CHNG	GB 8/5/98	GB 8/5/98
			4	ENG 4CHNG	GB 9/4/98	GB 9/4/98
			A	TOL REL	WJW 10/19/98	WJW 10/19/98
			B	ECO 19134	WJW 3/24/00	11/19/03



H1 H2

M M 12 CERAMIC SPACERS
M M 38-032-003
M M
M M

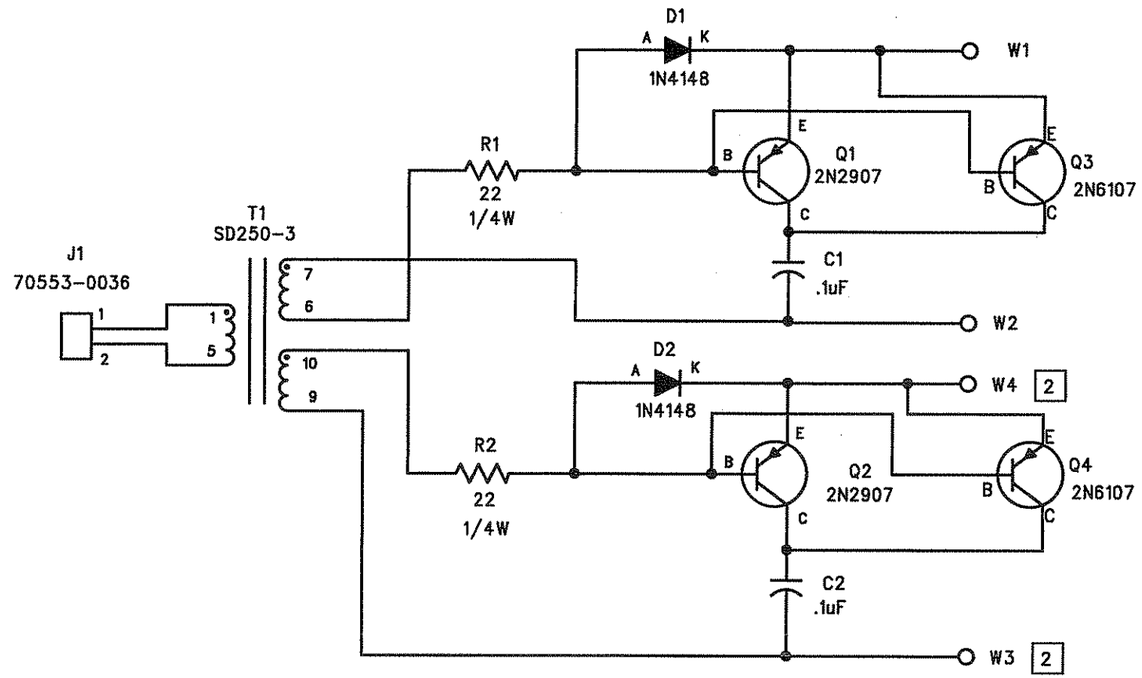
S018R4

TOL: .X = ±.02 .XX = ± .01 .XXX = ± .005 FRAC = ± 1/64 ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	a.i.e systems a division of ELECTRONIC MEASUREMENTS, INC.
	PRJ.MGR: DATE: GB 9/24/96	DWN: DSF 9/24/96 DATE:	TITLE: SCHEMATIC DIAGRAM SCR BOARD LC1202/SX502,1002
	MFG: B. Hahn DATE: 11/19/03	CHK: WJW 10/19/98 DATE:	
P/L: 494	DOC.REL: WJW 10/19/98 DATE:	ENG: GB 9/24/96 DATE:	PCB: 21-007-300 SHEET 1 OF 1
SCALE:		APP: WJW 10/19/98 DATE:	DRAWING NO: 01-007-300 REV. B

03-000-051

THIS IS A COMPUTER GENERATED DWG.
NO MANUAL CHANGES ARE PERMITTED.

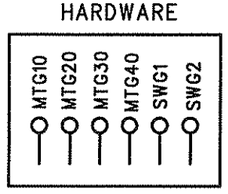
APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE
			1	PROTO RELEASE	GB 9/22/96	GB 9/22/96
			2	TG UPDATES	GB 8/7/97	S.A.
			A	TG RELEASE	LPN 9/11/97	GFS
			B	ECO # 21254	GB 2/24/04	RHL 03-01-04



NOTES:

1. UNLESS SPECIFIED, ALL RESISTORS ARE IN OHMS, ALL CAPACITORS ARE IN MICROFARADS. K = 1,000 AND M = 1,000,000.
2. REF. ASSEMBLY 20-007-400.

HARDWARE



P024R2
S017R2

PADS LOGIC DRAWING.
THIS IS A STANDARD FORMAT.
NOT ALL BOXES APPLY TO EVERY DRAWING AND MAY NOT BE FILLED IN.

TOL: .X = ±.02, .XX = ± .01, .XXX = ± .005, FRAC = ± 1/64, ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ELECTRONIC MEASUREMENTS, INC. a.l.e. systems division
	PRJ.MGR: SAEED 9/15/97 DATE:	DWN: DSF DATE: 9/22/96	TITLE: SCHEMATIC 1202 GATE DRIVE PCB
	MFG: RS 9/16/97 DATE:	CHK: DRB DATE: 9/22/96	
P/L: 494	DOC.REL: GFS 9-12-97 DATE:	ENG: GB DATE: 9/22/96	PCB NO: 21-007-400 / SHEET 1 OF 1
SCALE: NONE		APP: GFS 9-12-97 DATE:	DRAWING NO: 01-007-400 / REV. B

REVISION RECORD			
LTR	ECO NO:	APPROVED:	DATE:
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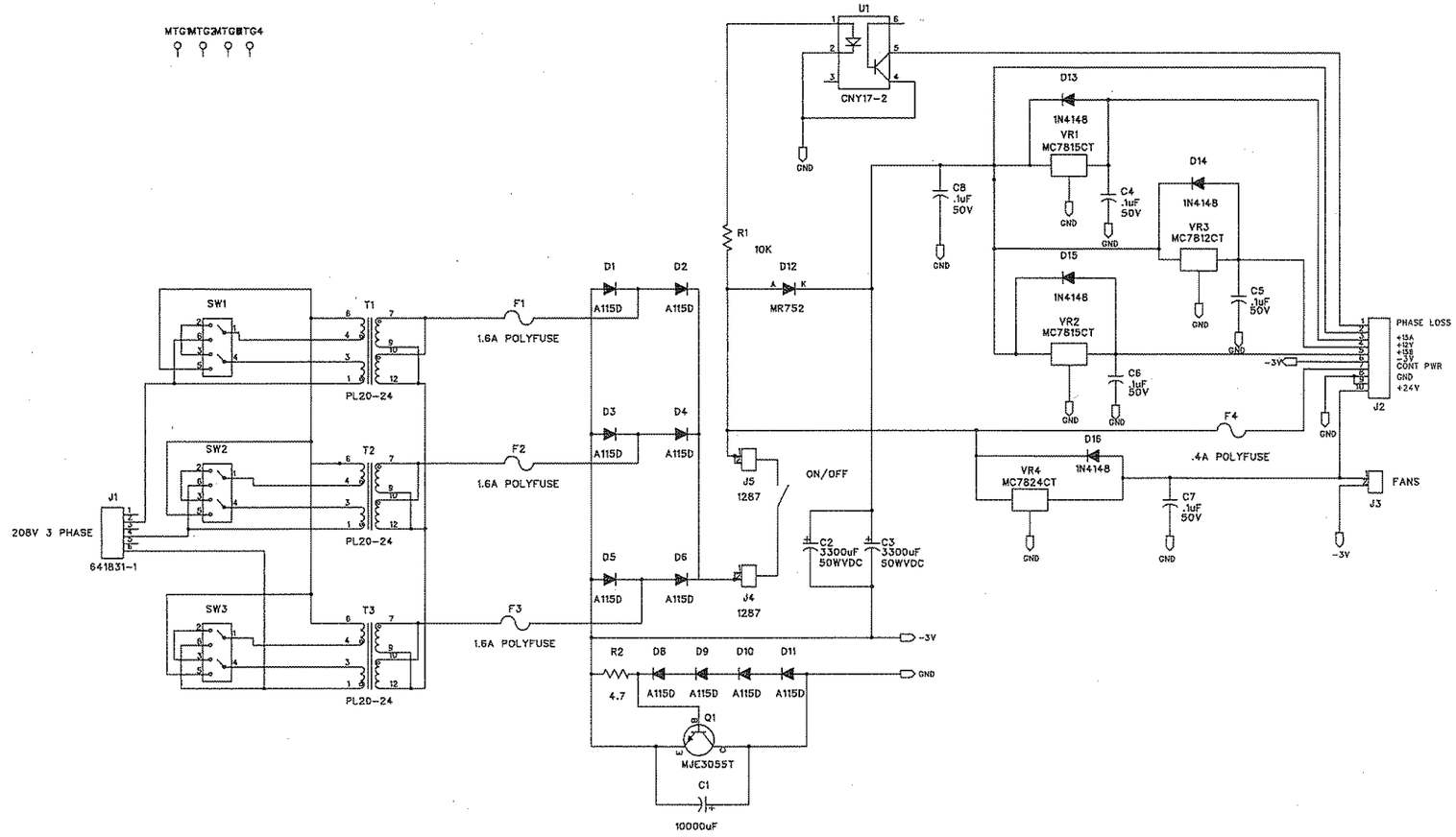
A	TG RELEASE	LPN 9/11/97	LB
B	ECO # 20284	SA 4-10-02	
C	ECO # 23431	GB 6/2/09	



DRAWN: DSF	DATED: 9/23/96	COMPANY: o.i.e. systems a division of ELECTRONIC MEASUREMENTS INC.	
CHECKED:	DATED: 11/8/10	TITLE: 1202 AUX POWER PCB	
ENG: GB	DATED: 9/23/96	CODE:	SIZE: DRAWING NO: 01007800 REV: C
RELEASED:	DATED: 11/8/09	SCALE:	SHEET: OF

THIS IS A COMPUTER GENERATED DWG. NO MANUAL CHANGES ARE PERMITTED. PADS LOGIC DRAWING.
THIS IS A STANDARD FORMAT. NOT ALL BOXES APPLY TO EVERY DRAWING AND MAY NOT BE FILLED IN.

REVISIONS			
LTR	ECO NO.	BY/DATE	APP/DATE
G	ECO # 21192	KHL 02-14-04	RFC 2/17/04
H	ECO # 22267	DSF 04-27-06	GB 04-27-06

REVISIONS			
LTR	ECO NO	BY/DATE	APP/DATE
1	PROTOTYPE RELEASE	EMI MASS	GB 10/14/96
2	TG UPDATES	S.A.	S.A.
3	TG UPDATES	EMI MASS	EMI MASS
4	TG UPDATES	LPN 9/22/97	WJW
A	TG RELEASE	LPN 10/31/97	WJW
B	ECO # 18281	LPN 3/10/99	WJW
C	ECO # 18681	LPN 9/23/99	GFS
D	ECO # 18903	RFC 1/12/00	GFS
E	ECO # 20564	KHL 11-06-02	RFC
F	ECO # 21029	KHL 11-06-03	RFC 11-10-03

P032R4
S016R7

TOL: .X = ±.02, .XX = ±.01, .XXX = ±.005, FRAC = ± 1/64, ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	LAMBDA EMI
	PRJ.MGR: S.AHMED DATE: 1/27/98	DWN: DSF DATE: 10/14/96	TITLE: SCHEMATIC 1202 CONTROL PCB PARALLEL RESONANT
	MFG: R.S. DATE: 10/14/96	CHK: GB DATE: 10/14/96	
P/L: 494	DOC.REL: WJW DATE: 11/6/97	ENG: GB DATE: 10/14/96	PCB: 21-008-300 SHEET 1 OF 3
SCALE:		APP: WJW DATE: 11/6/97	DRAWING NO: 01-008-300 REV H

REVISIONS			
LTR	DESCRIPTION	BY/DATE	APP/DATE
	SEE SHT 1 FOR REVISIONS		

SEC F

+15VDC, RP5 25K 3299-P CW, R33 100K, R52 1K, C37 .1UF, U15-A LM324, IER, R53 2.2K, D24, U15-B LM324, VCONT, D31, D29, D30, R67 10K, R59 TBD, R51 1K, R66 1K 1/4W, C57 .1UF, IFB, VER, D23, D25, D32, D28 1N4742,12V, U15-C LM324, R68 1K 1/4W, D13, U15-D LM324, R70 20K, R71 1K 1/4W, C78 .01uF, C79 TBD, RP2 25K 3299-P, RP1 25K 3299-P, SW1 DIP4SW, R72 1K, R73 100, R74 100, C85 1.0uF, TP5, INV, J9-1, J9-2, J5-2, J1-2, J5-1, J2-2, JMP27, JMP15, INTB, I PROG, R6 1K, D20 1N4742,12V, J2-11, J1-11, JMP14, PARALLEL

SEC A

+15VDC, R88 10K, JMP4, J5-15, J1-8, ON/OFF, JMP29, J5-16, J2-8, R38 10K, 100K R43, C28 .1UF, U10-A, R44 10K, OFF, SUMFAULT, D14, U10-B, U10-C, D15, U10-D, C25 .1UF, R39 1M, U5-B 4071, U3-D, U10-E, U3-E, C5 .1UF, C6 .1UF, R13 100, R14 100, D4, D3, J5-19, J2-10, J1-10, J5-20, J1-23, J2-23, ON, OFF

SEC G

D2, D10, B, JMP6, INTA, REF, IER, VER, U2-A LM324, U2-B LM324, D46, D47, U3-A, U3-G, R10 100, R16 100, C3 .1UF, C8 .1UF, CURRENT REG, VOLTAGE REG, J5-7, J2-4, J2-24, J5-11

SEC E

+15VDC, FBVOLT, U20-A LM324, D27, Q3 2N4400, C64 4.7UF, R76 1M, U20-B LM324, R77 1K 1%, C56 .1UF, J5-17, J2-9

SEC B

+15VDC, R45 100K, C29 .001MF, OLSYN, U6-A 4071, B, R25 10K, D17, U7-A, R30 1M, C19 1.0UF, C12 1.0UF, SW2 DIP4SW, R49 100K, OVERVOLT, D99A XXX, U12-A 4013B, SET, DATA, CLK, RESET, LATCH, POR, A, U3-B, U3-C, U6-B 4071, R4 100K, C108 .1uF, R11 1K, R12 100, C4 .1UF, J2-6, J1-6, J5-10, J2-18, J1-18, OL SYN, LOAD F

SEC D

+5VDC, C44 .1UF, JMP9, JMP8, JMP7, JMP10, JMP11, JMP12, U14 LF356, TP2, +15VDC, C45 .1UF, C23 NLXCAP, QV, JMP2, JMP3, COAX1-1, COAX1-2, C13 2000PF, R90 100K, RP12 1M 3299-P, RP14 100K 3299-P, J12, NLXR1 NLXRES, NLXRP3 NLXRP, NLXC1 NLXCAP, INHIBIT, C98 .001uF, RP15 25K 3299-P, C97 .001uF, RP18 25K 3299-P, SW5 DIP4SW, U2-C LM324, R94 1K 1%, R98 1K 1%, R100 10K, R104 10K, C107 TBD, D19, FBVOLT2, FBVOLT, R64 1K 1%, J2-1, D18

SEC C

+15VDC, AUTOINH, JMP5, R26 10K, U7-B, U6-C 4071, INHIBIT, D16, J2-20, J1-20, R27 1K, D11 1N4742,12V, C14 .001MF, R41 100K, INHIBIT_, R46 10K, C26 .01UF, R40 4.7M, U6-D 4071, U3-F, R15 100, C7 .1UF, D6, J5-5, J2-3, J1-3, J2-7, J1-7, R48 4.7K, C76 2200pF, D12 1N4742,12V, R47 10K, J13, Q1 2N4400, INHIBIT

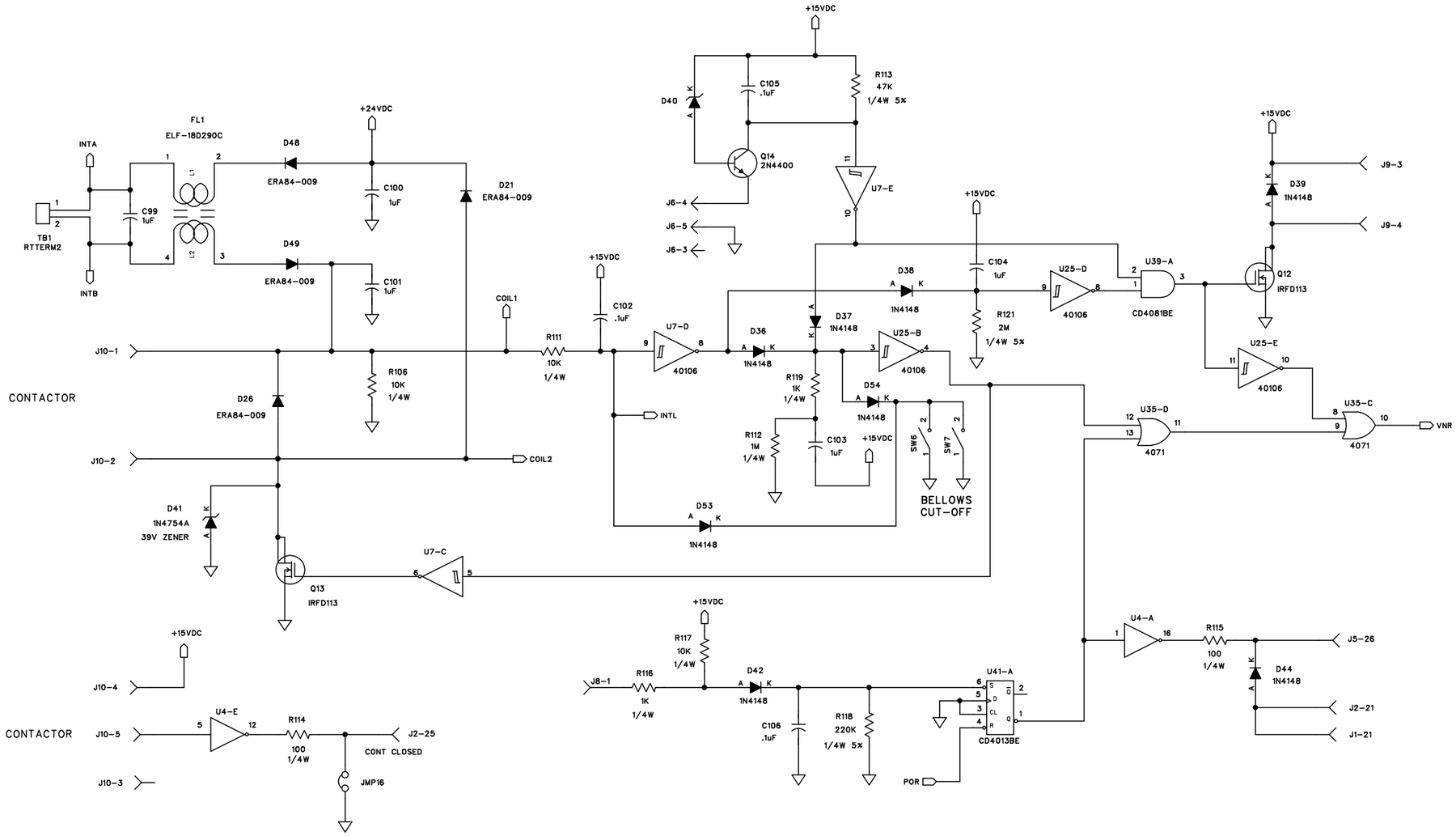
+15VDC, J6-1, J6-2, C150A 1uF, R86 10K, C95 .1uF, R83 10K, U20-C LM324, R79 1K, J2-15, RP20 TBD, C86 .1uF, D96A 1N5817, U33-A LM339, PLATE-TEMP, M8 M9 M10 M11 M12 M13, J1-1 J1-4 J1-9 J1-13 J1-14 J1-15 J1-24 J1-25, R36 3.3K, RP3 5K 25T, D98A 1N4735A, TP7, U20-D LM324, R87 1.21K 1%, R80 22.6K 1%

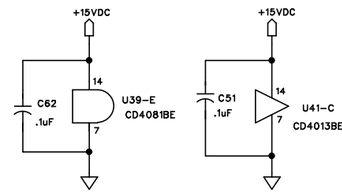
+15VDC, U7-G, C20 .1UF, U10-G, C30 .1UF, U6-E 4071, C18 .1UF, U5-E 4071, C17 .1UF, U35-E 4071, C90 .1UF, U33-D LM339, U2-D LM324, U5-A 4071, U5-C 4071, U5-D 4071

+15VDC, U12-C 4013B, C31 .1UF, -5VDC, U15-E LM324, C46 .1UF, U2-E LM324, C11 .1UF, U20-E LM324, C59 .1UF, U3-H, U7-F, U10-F, U4-F, U34-F, U4-B, 4013B, SET, DATA, CLK, RESET, U12-B

TITLE:	LAMBDA EMI SCHEMATIC 1202 CONTROL PCB PARALLEL RESONANT
PCB.:	SHEET 2 OF 3
DRAWING NO:	01-008-300 REV. H

REVISIONS			
LTR	DESCRIPTION	BY/DATE	APP/DATE
	SEE SHT 1 FOR REVISIONS		





LAMBDA EMI		
TITLE:	SCHEMATIC 1202 CONTROL PCB PARALLEL RESONANT	
PCB.:		SHEET 3 OF 3
DRAWING NO:	01-008-300	REV. H

THIS IS A COMPUTER GENERATED DWG. NO MANUAL CHANGES ARE PERMITTED. PADS LOGIC DRAWING.
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REVISIONS			
LTR	ECO NO	BY/DATE	APP/DATE
1	INITIAL RELEASE	RFC 02/11/00	GFS
A	TG RELEASE	RFC 02/11/00	GFS
B	ECO # 20564	KHL 11-06-02	RFC
C	ECO # 21029	KHL 11-06-03	RFC 11-10-03
D	ECO # 21192	KHL 02-13-04	RFC 2/17/04
E	ECO # 22267	DSF 04-27-06	GB 04-27-06

SUM FAULT

P032R4
S016R7

TOL: .X = ±.02, .XX = ± .01, .XXX = ± .005, FRAC = ± 1/64, ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	LAMBDA EMI
	PRJ.MGR: JB 2/15/00	DWN: RFC 02/11/00	TITLE: SCHEMATIC LC1202-30KV-DC CONTROL PCB PARALLEL RESONANT
	MFG: RS 2/15/00	CHK: GFS 2-14-00	
P/L: 494	DOC.REL: GFS 2-14-00	ENG: JB 2-15-00	PCB: 21-008-300 SHEET 1 OF 3
SCALE:		APP: GFS 2-14-00	DRAWING NO: 01-008-304 REV E

REVISIONS			
LTR	DESCRIPTION	BY/DATE	APP/DATE
	SEE SHT 1 FOR REVISIONS		

SEC F

+15VDC, RP5 25K 3299-P CW, R33 100K, R52 1K, C37 .1UF, U15-A LM324, IER, R53 2.2K, D24, U15-B LM324, VCONT, D31, D29, D30, R67 10K, D25, D32, U15-C LM324, D23, VER, IFB, R51 1K, R66 1K 1/4W, C57 .1UF, R59 TBD, D28 1N4742,12V, D20 1N4742,12V, D13, R68 1K 1/4W, U15-D LM324, R70 20K, C78 .01uF, R71 1K 1/4W, C79 TBD, RP2 25K 3299-P, RP1 25K 3299-P, SW1 DIP4SW, R74 100, R73 100, R72 1K, C85 1.0uF, TP5, INV, I PROG, INTB, JMP15, JMP27, JMP14, PARALLEL, J5-1, J5-2, J1-2, J2-2, J2-11, J1-11, J9-1, J9-2, R6 1K

SEC A

+15VDC, R88 10K, JMP4, OFF, ON/OFF, J5-15, J1-8, JMP29, J5-16, J2-8, R38 10K, R43 100K, C28 .1UF, U10-A, R44 10K, U10-B, SUMFAULT, D14, U10-C, D15, U10-D, C25 .1UF, R39 1M, U5-B 4071, U10-E, U3-D, U3-E, C5 .1UF, C6 .1UF, R13 100, R14 100, D4, D3, J5-19, J2-10, J1-10, J5-20, J1-23, J2-23, ON, OFF

SEC G

D2, D10, B, JMP6, INTA, REF, IER, VER, U2-A LM324, U2-B LM324, D46, D47, U3-A, U3-G, R10 100, R16 100, C3 .1UF, C8 .1UF, CURRENT REG, VOLTAGE REG, J5-7, J2-4, J2-24, J5-11

SEC E

+15VDC, FBVOLT, U20-A LM324, D27, Q3 2N4400, C64 4.7UF, R76 1M, U20-B LM324, R77 1K 1%, C56 .1UF, J5-17, J2-9

SEC B

+15VDC, R45 100K, C29 .001MF, OLSYN, U6-A 4071, B, R25 10K, D17, U7-A, R30 1M, C19 1.0UF, C12 1.0UF, SW2 DIP4SW, R49 100K, OVERVOLT, D99A XXX, U12-A 4013B, SET, DATA, CLK, RESET, LATCH, POR, A, U3-B, U3-C, U6-B 4071, R4 100K, C108 .1uF, R11 1K, R12 100, C4 .1UF, J2-6, J1-6, J5-10, J2-18, J1-18, OL SYN, LOAD F

SEC C

+15VDC, AUTOINH, JMP5, R26 10K, J2-20, J1-20, INHIBIT_, R27 1K, D11 1N4742,12V, C14 .001MF, R41 100K, U7-B, U6-C 4071, INHIBIT, D16, Q1A VN10KM, Q1 2N4400, OFF, R48 4.7K, J2-7, J1-7, INHIBIT, J13, C76 2200pF, D12 1N4742,12V, R47 10K, R46 10K, C26 .01UF, R40 4.7M, U6-D 4071, U3-F, R15 100, C7 .1UF, D6, J5-5, J2-3, J1-3

SEC D

QV, JMP2, JMP3, COAX1-1, COAX1-2, C13 2000PF, R90 100K, RP12 1M 3299-P, RP14 100K 3299-P, C23 NLXCAP, JMP9, JMP8, JMP7, JMP10, JMP11, JMP12, U14 LF356, TP2, C44 .1UF, C45 .1UF, +15VDC, -5VDC, J12, NLXR1 NLXRES, NLXRP3 NLXRP, NLXC1 NLXCAP, INHIBIT, FBVOLT, R64 1K 1%, J2-1, D18, R94 1K 1%, R98 1K 1%, R100 10K, R104 10K, C107 TBD, D19, FBVOLT2, C98 .001uF, C97 .001uF, RP15 25K 3299-P, RP18 25K 3299-P, SW5 DIP4SW, U2-C LM324

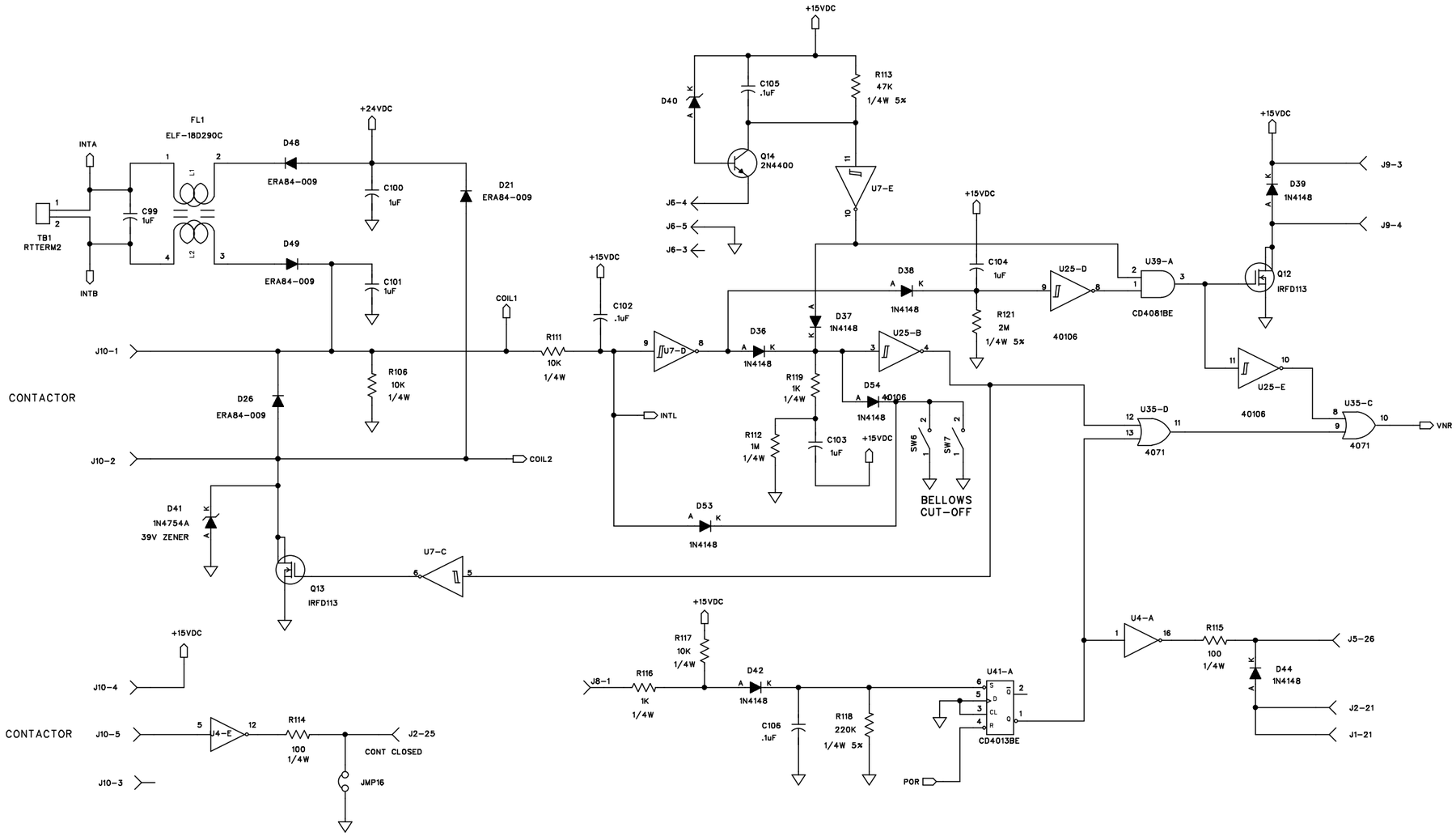
SEC G (lower)

+15VDC, R36 3.3K, D98A 1N4735A, RP3 5K 25T, TP7, C96 .1uF, U20-D LM324, R87 1.21K 1%, C95 .1uF, R83 10K, R86 10K, J6-1, J6-2, C150A 1uF, U20-C LM324, R79 1K, J2-15, RP20 TBD, C86 .1uF, D96A 1N5817, U33-A LM339, PLATE-TEMP, M8 M9 M10 M11 M12 M13, J1-1 J1-4 J1-9 J1-13 J1-14 J1-15 J1-24 J1-25

U7-G C20 .1UF; U10-G C30 .1UF; U6-E C18 .1UF; U5-E C17 .1UF; U35-E C90 .1UF; U33-D LM339; U2-D LM324; U5-A U5-C U5-D 4071; U12-C C31 .1UF 4013B; U15-E C46 .1UF LM324; U2-E C11 .1UF LM324; U20-E C59 .1UF LM324; -5VDC; U3-H; U7-F U10-F; U4-F U34-F U4-B; 4013B SET DATA CLK RESET U12-B

TITLE:	LAMBDA EMI SCHEMATIC LC1202-30KV-DC CONTROL PCB PARALLEL RESONANT
PCB.:	SHEET 2 OF 3
DRAWING NO:	01-008-304
REV.	E

REVISIONS			
LTR	DESCRIPTION	BY/DATE	APP/DATE
	SEE SHT 1 FOR REVISIONS		



LAMBDA EMI		
TITLE: SCHEMATIC LC1202-30KV-DC CONTROL PCB PARALLEL RESONANT		
PCB.:	SHEET 3 OF 3	
DRAWING NO: 01-008-304	REV. E	

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REVISIONS			
LTR	ECO NO	BY/DATE	APP/DATE
H	ECO # 28018	PAW 8/15/17	JB 8/15/17

REVISIONS			
LTR	ECO NO	BY/DATE	APP/DATE
1	INITIAL RELEASE	DRB 3/17/98	GB 3/17/98
2	ENG CHGS	CJS 7/20/98	WJW
A	RELEASE TO PROD	CJS 7/20/98	WJW
B	ECO # 18281	LPN 3/10/99	WJW
C	ECO # 18681	LPN 9/23/99	GFS
D	ECO # 18903	RFC 1/12/00	GFS
E	ECO # 20564	KHL 11-08-02	RFC
F	ECO # 21029	KHL 11-06-03	RFC 11-10-03
G	ECO # 21192	KHL 02-13-04	RFC 2-17-04

P054R1
S042R1

TOL: .X = ±.02, .XX = ± .01, .XXX = ± .005, FRAC = ± 1/64, ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	LAMBDA EMI
	PRJ.MGR: B HUHN 1-24-00	DWN: DSF 3/17/98	TITLE: SCHEMATIC, 1202 SERIES RESONANT CONTROL PCB
	MFG: GS 8/16/2017	CHK: BHuhn 8/16/17	
P/L: 494	DOC.REL: GFS 1-24-00	ENG: GB 3/17/98	PCB: # 21-013-700 SHEET 1 OF 3
SCALE:		APP: A Hague 8/16/17	DRAWING NO: 01-013-700 REV H

REVISIONS			
LTR	DESCRIPTION	BY/DATE	APP/DATE
	SEE SHT 1 FOR REVISIONS		

SEC F

SEC A

SEC G

SEC B

SEC E

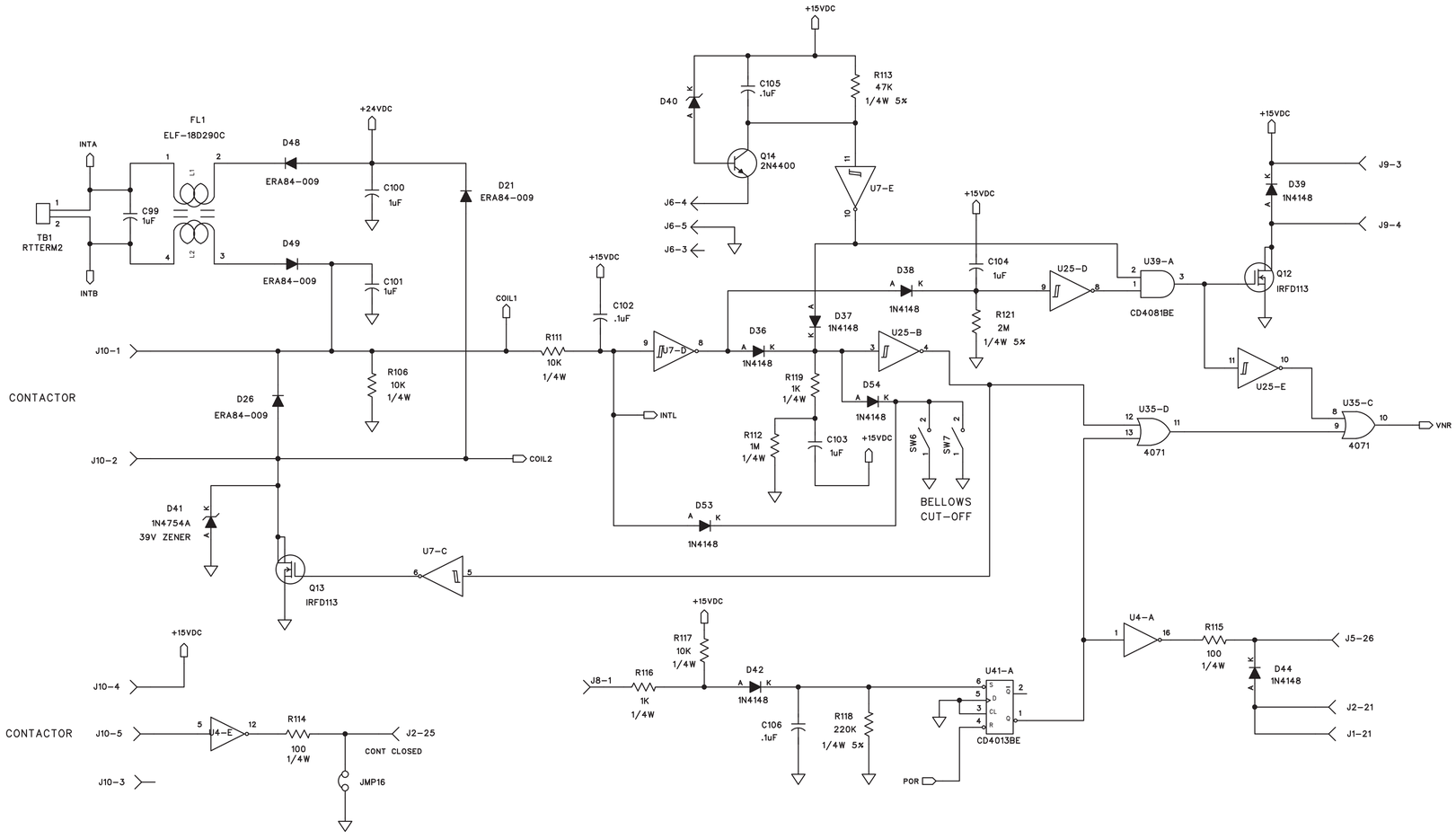
SEC C

SEC D

LOAD F

LAMBDA	EMI
TITLE:	SCHEMATIC, 1202 SERIES RESONANT CONTROL PCB
PCB.:	SHEET 2 OF 3
DRAWING NO:	01-013-700
REV.	H

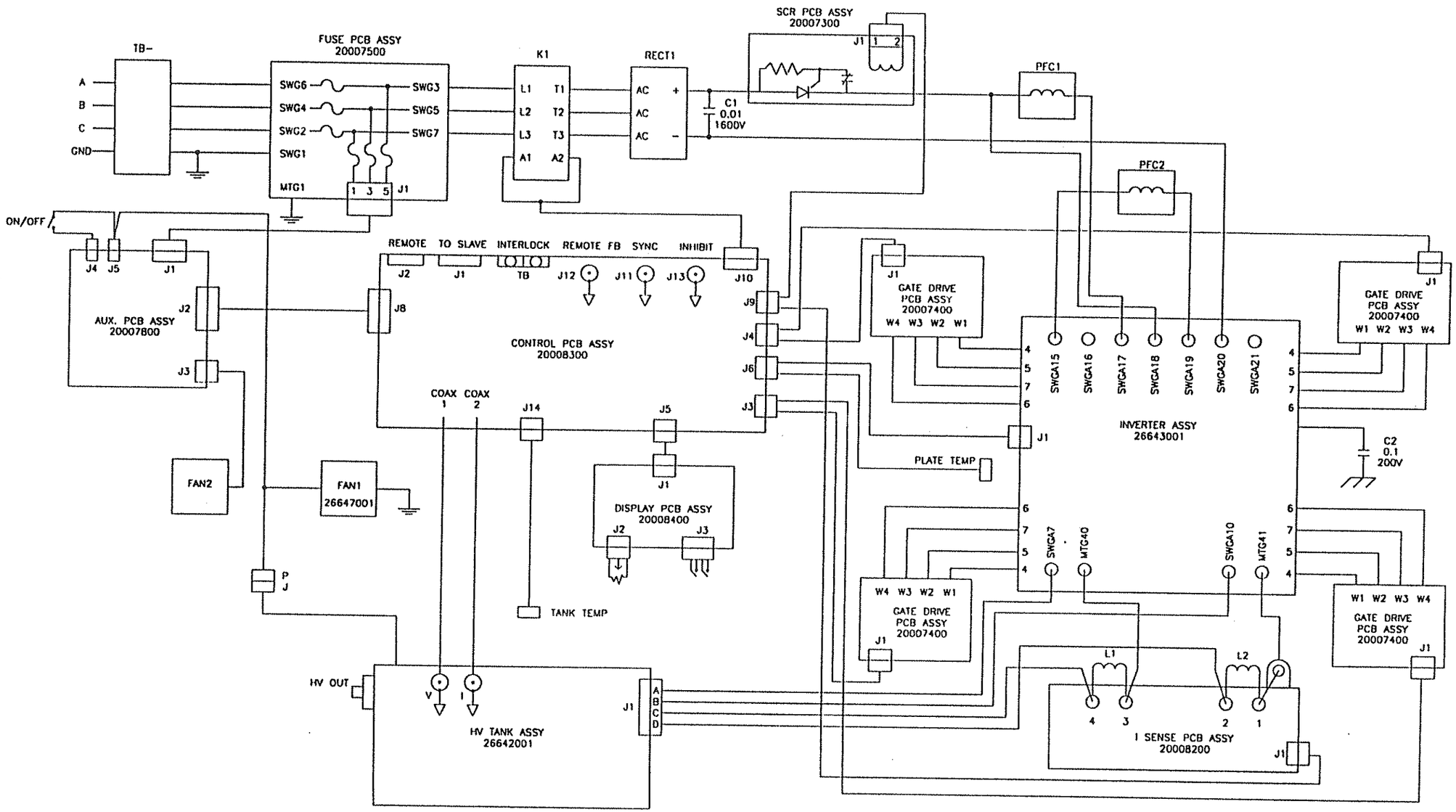
REVISIONS			
LTR	DESCRIPTION	BY/DATE	APP/DATE
	SEE SHT 1 FOR REVISIONS		



LAMBDA EMI	
TITLE: SCHEMATIC, 1202 SERIES RESONANT CONTROL PCB	
PCB.:	SHEET 3 OF 3
DRAWING NO: 01-013-700	REV. H

THIS IS A COMPUTER GENERATED DWG.
NO MANUAL REVISIONS ARE PERMITTED.

APPLICATION			REVISIONS			
USED ON	NEXT ASSY.	QTY.	LTR	ECO NO.	BY	APP
			01	PROTOTYPE 8/7/97	GB	GFS
			02	TG CHANGES	S.A.	S.A.
			A	TG RELEASE	LPN	GFS
			B	ECO #12420 4/20/98	CJS	GFS

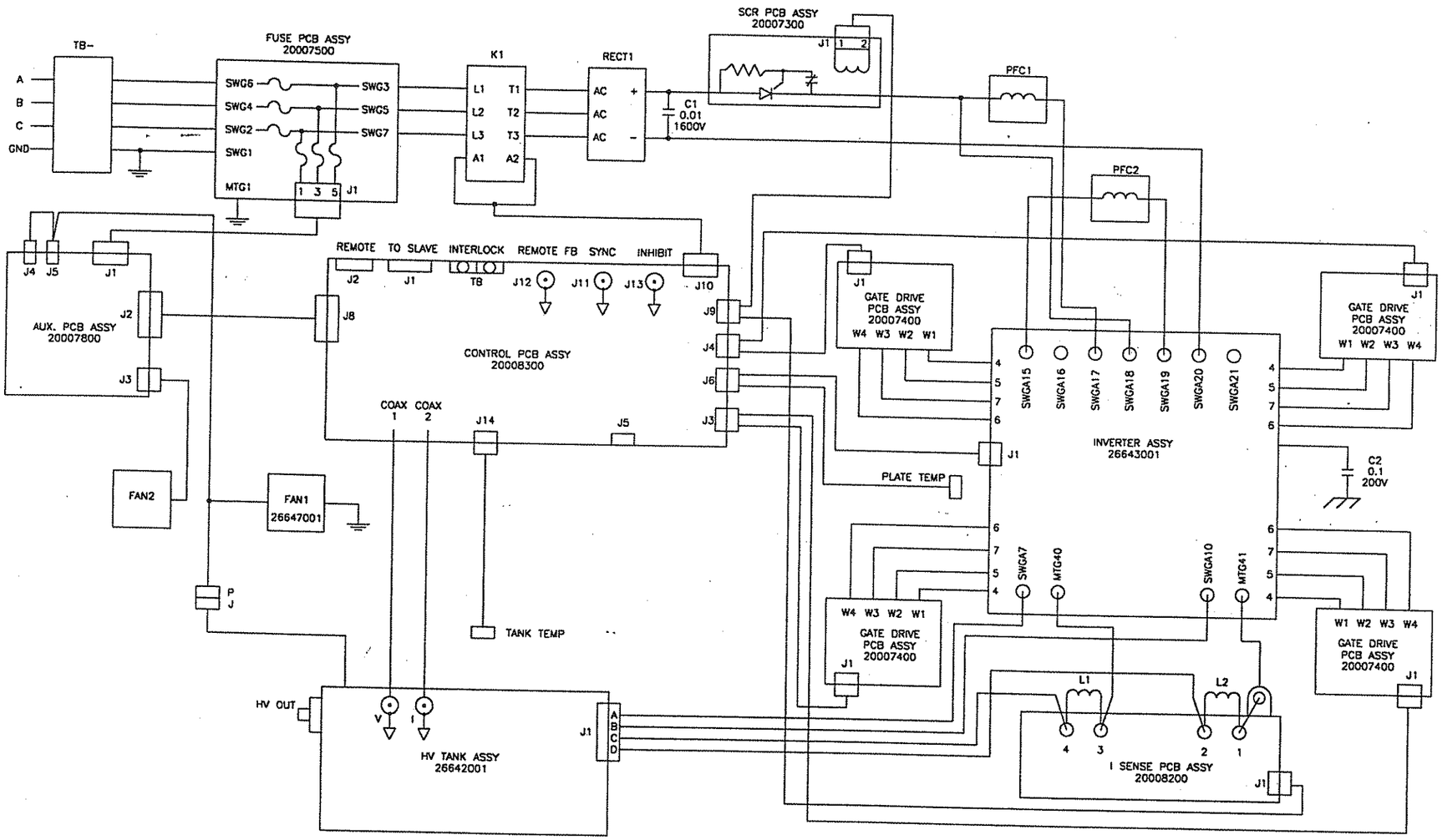


MTL. FIN.	TOL: .X = ± .02" .XX = ± .01" .XXX = ± .005" FRAC. = ± 1/64 ANGLES = ± 1/2° P/L: 494 SCALE: ———	REL. TO MFG. ENG: DATE: 9/15/97 MFG: DATE: 9/17/97 DOC. REL: DATE: GFS 9/12/97	ENG. CTL. DWN: DATE: GWM 7/30/97 CHK: DATE: DRB 8/7/97 ENG: DATE: GB 8/7/97 APP: DATE: GFS 9/12/97	ELECTRONIC MEASUREMENTS, INC.	SHEET 1 OF 1 TITLE: 1202 SYSTEM SCHEMATIC DWG. NO. 01-494-001 REV B

M404R2

THIS IS A COMPUTER GENERATED DWG.
NO MANUAL REVISIONS ARE PERMITTED.

APPLICATION			REVISIONS			
USED ON	NEXT ASSY.	QTY.	LTR	E.C.O. NO.	BY	APP.
			1	INITIAL RELEASE 02/09/00	RFC	GFS
			A	TG RELEASE 02/09/00	RFC	GFS



M404R2

SHEET 1 OF 1

MFG.	TOL: x = ± .02", .xx = ± .01", .xxx = ± .005", FRAC. = ± 1/64", ANGLES = ± 1/2°	REL. TO MFG. PRJ. ENG. DATE:	ENG. CTL. DWN. DATE: RFC 02/09/00	LAMBDA EMI
FIN.	P/L: 494	MFG. DATE:	CHK. DATE: GFS 2-14-00	TITLE: LC1202 SYSTEM SCHEMATIC OEM W/CONTACTOR
	SCALE: ——	DOC. REL. DATE: GFS 2-14-00	ENG. DATE:	DWG. NO. 01-494-003 REV. A
			APP. DATE: GFS 2-14-00	