Xantrex XKW Series DC Power Supply

1000 Watt Models

Technical Manual

Release 5.2 (96/12)

TM-1000-XN

Xantrex Technology Inc.
8999 Nelson Way
Burnaby BC
CANADA V5A 4B5
TEL: (604) 422-8595
FAX: (604) 420-1591
Customer Service: 1-800-667-8422

E-mail: info@xantrex.com
Home Page: http://www.xantrex.com

About This Manual

This manual contains user information for the XKW Series DC Power Supply, 1000 Watt models. It provides information about features and specifications, installation procedures, and basic functions testing, as well as operating procedures. It also includes a complete set of schematics, circuit descriptions, and parts lists for the assemblies used in the system supply.

This manual is designed for the user who is familiar with basic electrical laws especially as they apply to the operation of power supplies. This implies a recognition of Constant Voltage and Constant Current operating modes and the control of input and output power, as well as the observance of safe techniques while effecting supply or pin connections and any changes in switch and jumper settings. The more knowledgeable user will find that the detailed schematics and circuit descriptions supplied will enable a greater flexibility in troubleshooting and in configuring new applications.

Section 1 Features and Specifications — Describes the power supply, lists its features, and provides tables of specifications for all of the models.

Section 2 Installation and Operation — Reviews safety and inspection procedures, then goes through the basic installation procedures. Directions for the input voltage selection, for the testing of basic functions, for remote programming and for connecting the load are included.

Section 3 Theory of Operation — Describes the operation of the A2 assembly switching regulator power circuit and the A1 assembly meter circuit. Covers basic switching regulator theory, a simplified description of the full bridge converter, and a more detailed circuit description intended for troubleshooting purposes.

Section 4 Maintenance, Troubleshooting, and Calibration — Covers service precautions and procedures including calibration.

Section 5 Schematics and Parts Lists — Provides schematic drawings and parts lists for the A1 Front Panel PCB assembly and the A2 Power PCB assembly, in addition to the chassis and cover.

Appendix A: Application Note — Contains application note about battery charging.

Warnings, Cautions, and Notes

Warnings, cautions, and notes are defined and formatted as presented below.

WARNING
Describes a potential hazard which could result in injury or death, or, a procedure which, if not performed correctly, could result in injury or death.

CAUTION
Describes a procedure which, if not performed correctly, could result in damage to data, equipment, or systems.

Note: Describes additional operating information which may affect the performance of the equipment.

MANUAL CORRECTIONS

CONTENTS

1. FEATURES AND SPECIFICATIONS

1.1 Description 1-1
1.2 Power Supply Features 1-1
1.3 Operating Modes 1-2
1.4 Specifications 1-2
1.4.1 Electrical Specifications 1-2
1.4.2 Mechanical Specifications 1-4

2. INSTALLATION AND OPERATION

2.1 General 2-1
2.2 Initial Inspection 2-1
2.3 Installation 2-1
2.3.1 AC Input Voltage Selection 2-1
2.3.2 Input Line Impedance 2-2
2.3.3 Ventilation Requirements 2-2
2.3.4 Output Voltage Biasing 2-2
2.3.5 Rack Mounting 2-3
2.4 Functional Tests 2-3
2.4.1 Voltage Mode Operation 2-3
2.4.2 Current Mode Operation 2-4
2.5 Controls, Connectors, and Indicators 2-4
2.6 Load Connection 2-8
2.6.1 Load Conductor Ratings 2-8
2.6.2 Load Connection and Grounding 2-8
2.6.3 Output Cord Strain Relief 2-9
2.7 Local and Remote Sensing 2-10
2.8 Single Supply Operation (Local Mode) 2-11
2.8.1 Setup 2-11
2.8.2 Voltage Mode Operation 2-11
2.8.3 Current Mode Operation 2-11
2.9 Multiple Supplies 2-12
2.9.1 Series Operation 2-12
2.9.2 Parallel Operation 2-12
2.9.3 Split Supply Operation 2-13
2.10 Over Voltage Protection (OVP) 2-14
2.10.1 Front Panel OVP Operation 2-14
2.10.2 Remote Programming of OVP With External Voltage Sources 2-15
2.10.3 Remote Programming of OVP with an External Resistance 2-16
2.10.4 Remote Programming of OVP with External Current Sources 2-17
2.10.5 Remote OVP Sensing 2-18
2.11 Remote ON/OFF 2-18
2.11.1 Remote ON/OFF by Contact Closure 2-18
2.12 Remote Programming of Output Voltage and Current Limit 2-19
2.12.1 Remote Programming Switch SW1 2-19
2.12.2 Programming With External Voltage Sources 2-20
2.12.3 Programming With an External Resistance 2-21
2.12.4 Programming With an External Current Source 2-22
2.13 Remote Monitoring and Status Indicators 2-23
2.14 Using Over Temperature Protection (OTP) 2-24
2.14.1 Resetting the OTP circuit 2-24

CONTENTS

3. THEORY OF OPERATION

3.1 Power Circuit (A2 Assembly) 3-1
3.1.1 Basic Off-Line Switching Regulator Theory 3-1
3.1.2 Simplified Full Bridge Converter Theory 3-1
3.1.3 Detailed Circuit Description 3-2
3.2 Meter Circuit (A1 Assembly) 3-7
3.2.1 Voltmeter 3-7
3.2.2 Current Meter 3-7

4. MAINTENANCE, TROUBLESHOOTING, AND CALIBRATION

4.1 General 4-1
4.2 Periodic Service 4-1
4.3 Servicing Precautions 4-1
4.4 Troubleshooting 4-1
4.4.1 Preliminary Checks 4-1
4.4.2 Internal Troubleshooting 4-1
4.5 Calibration 4-2

5. SCHEMATICS AND PARTS LISTS

5.1 General 5-1
5.2 Parts Ordering 5-1
5.3 A1 Front Panel Assembly Replacement Parts 5-1
5.4 A2 Power Assembly Replacement Parts 5-2
5.4.1 A2 PCB Common Parts 5-2
5.4.2 A2 PCB Differential Parts 5-6
5.5 Chassis and Cover Assembly Replacement Parts 5-17

APPENDIX A: APPLICATION NOTE

Battery Charging A-1

LIST OF ILLUSTRATIONS

Figure 2.4-1 Connector J3 Configuration for Local Operation 2-3
Figure 2.5-1 Front Panel 2-5
Figure 2.5-2 Rear Panel 2-6
Figure 2.5-3 J3 Program, Sense, and Monitor Connector Description 2-7
Figure 2.6-1 Strain Relief 2-9
Figure 2.6-2 Strain Relief Assembly 2-9
Figure 2.8-1 Switch SW1 and Connector J3 Configuration for Local Operation 2-11
Figure 2.10-1 Switch SW1 and Connector J3 Configuration for 0-5Vdc OVP Programming 2-15
Figure 2.10-2 Switch SW1 and Connector J3 Configuration for 0-10Vdc OVP Programming 2-15
Figure 2.10-3 Switch SW1 and Connector J3 Configuration for 0-5k OVP Programming 2-16
Figure 2.10-4 Switch SW1 and Connector J3 Configuration for 0-1mA Current Source OVP Programming 2-17
Figure 2.12-1 Switch SW1 Functions 2-19
Figure 2.12-2 Switch SW1 and Connector J3 Configuration for 0-5V Programming of the Output Voltage 2-20
Figure 2.12-3 Switch SW1 and Connector J3 Configuration for 0-10V Programming of the Output Voltage 2-20
Figure 2.12-4 Connector J3 Configuration for Remote Programming of the Output Current Limit 2-21
Figure 2.12-5 Switch SW1 and Connector J3 Configuration for Resistive Programming of the Output Voltage 2-21
Figure 2.12-6 Switch SW1 and Connector J3 Configuration for Resistive Programming of the Output Current Limit 2-22
Figure 2.12-7 Switch SW1 and Connector J3 Configuration for 0-1mA Current Programming of the Output Voltage 2-22
Figure 2.12-8 Switch SW1 and Connector J3 Configuration for 0-1mA Current Programming of the Output Current Limit 2-23
Figure 3.1-1 Simplified Full Bridge Converter 3-2A
Figure 4.4-1 Troubleshooting Guide 4-2A
Figure 4.5-1 Calibration Adjustment Locations 4-2
Figure 5.3-1 1kW A1 Assembly Schematic 5-2A
Figure 5.4-1 1kW A2 Assembly Schematic 5-16A

LIST OF TABLES

Table 1.4-1 Electrical Specifications 1-2
Table 1.4-2 Additional Characteristics 1-3
Table 1.4-3 Remote Analog Programming Scales 1-3
Table 2.6-1 Load Conductor Ratings 2-8
Table 2.12-1 Program Voltage Selection 2-20
Table 2.13-1 Status Indicators 2-23
Table 4.5-1 Circuit Designation 4-2
Table 5.3-1 A1 Front Panel Assembly Replacement Parts 5-1
Table 5.4-1 A2 PCB Common Parts 5-2
Table 5.4-2 Output Bus Bar Common Parts (8V to 80V Models) 5-6
Table 5.4-3 A2 PCB Differential Parts (All Models) 5-6
Table 5.5-1 Chassis And Cover Assembly Replacement Parts 5-17
Table A-1 Output Diode Selection Criteria A-2

1. FEATURES AND SPECIFICATIONS

1.1 Description

The XKW Series power supply is a 1000 Watt supply designed to provide highly stable, variable output voltage and current for a broad range of development, system, and burn-in applications. The series consists of nine models designated by the XKW prefix, followed by the output voltage and current ratings. For example, the model number XKW 60-18 indicates that the unit is rated at 0 -60 Vdc and 0 -18 Amps while a model XKW 20-50 is rated at 0 -20 Vdc and 0 -50 Amps. The XKW Series employs high frequency switching regulator technology to achieve high power density and small package size.

1.2 Power Supply Features

- Nine models with voltage ranges from 0-8Vdc to 0-600Vdc and current outputs from 1.7A to 125A.
- 115/230Vac selectable input voltage, 47-63Hz single phase.
- Simultaneous digital display of both voltage and current.
- Ten turn potentiometer voltage and current controls permit high resolution setting of the output voltage and current from zero to the rated output.
- Automatic mode crossover into current or voltage mode.
- Flexible output configuration: multiple units can be connected in parallel or series to provide increased current or voltage.
- High frequency switching technology allows high power density, providing increased power output in a small, light package.
- Remote sensing to compensate for losses in power leads up to 1V/lead (0.5V/lead for XKW 8-125 model).
- Adjustable Over Voltage Protection (OVP).
- External TTL, AC, or DC shutdown.
- Remote voltage, current limit and OVP programming with selectable programming constants.
- External indicator signals for remote monitoring of OVP status, local/remote programming status, thermal shutdown, and output voltage and current.
- Optional IEEE-488 interface for complete remote programming and readback capability.
- Optional ISOL interface for isolated programming.

1.3 Operating Modes

The XKW Series supply has two basic operating modes: Constant Voltage and Constant Current. In constant voltage mode the output voltage is regulated at the selected value while the output current varies with the load requirements. In constant current mode the output current is regulated at the selected value while the output voltage varies with the load requirements.

An **automatic crossover** system enables the unit to switch operating modes in response to varying load requirements. If, for example, the unit is operating in voltage mode and the load current attempts to increase above the setting of the current control, the unit will switch automatically from voltage mode to current mode. If the load current is subsequently reduced below the setting of the current control the unit will return to voltage mode automatically.

1.4 Specifications

1.4.1 Electrical Specifications

TABLE 1.4-1 ELECTRICAL SPECIFICATIONS

MODELS	8-125	20-50	33-33	40-25	60-18	80-13	150-7	300-3.5	600-1.7
Output Ratings:									
Output Voltage	0-8V	0-20V	0-33V	0-40V	0-60V	0-80V	0-150V	0-300V	0-600V
Output Current	0-125A	0-50A	0-33A	0-25A	0-18A	0-13A	0-7A	0-3.5A	0-1.7A
Output Power	1000W	1000W	1089W	1000W	1080W	1040W	1050W	1050W	1020W
Line Regulation[1]:									
Voltage	8mV	20mV	33mV	40mV	60mV	80mV	150mV	300mV	600mV
Current	125mA	50mA	33mA	25mA	18mA	13mA	7mA	3.5mA	1.7mA
Load Regulation[2]:									
Voltage	8mV	20mV	33mV	40mV	60mV	80mV	150mV	300mV	600mV
Current	125mA	50mA	33mA	25mA	18mA	13mA	7mA	3.5mA	1.7mA
Meter Accuracy:									
Voltage	0.09V	0.3V	0.43V	0.5V	0.7V	0.9V	1.6V	4.0V	7.0V
Current	1.35A	0.6A	0.43A	0.35A	0.28A	0.23A	0.08A	0.045A	0.018A
OVP Adjustment Range	0.4-8.8V	1.0-22V	1.65-36.3V	2-44V	3-66V	4-88V	7.5-165V	15-330V	30-660V
Output Noise and Ripple (V) (20Hz-20MHz) :									
rms	10mV	10mV	10mV	10mV	20mV	20mV	30mV	40mV	100mV
p-p	50mV	50mV	100mV	100mV	150mV	150mV	200mV	200mV	500mV

Specifications are warranted over a temperature range of 0-50°C with default local sensing. From 50-70°C, derate output 2% per °C.

[1] For input voltage variation over the AC input voltage range, with constant rated load

[2] For 0-100% load variation, with constant nominal line voltage

AC Input: 200-250Vac at 10Arms or 100-130Vac at 20Arms, 47-63Hz
Maximum Voltage Differential from output to safety ground: 600Vdc

1.4 Specifications

1.4.1 Electrical Specifications (continued)

Additional Characteristics

TABLE 1.4-2 ADDITIONAL CHARACTERISTICS									
MODELS	**8-125**	**20-50**	**33-33**	**40-25**	**60-18**	**80-13**	**150-7**	**300-3.5**	**600-1.7**
Stability[1]:									
Voltage	4mV	10mV	16.5mV	20mV	30mV	40mV	75mV	150mV	300mV
Current	62.5mA	25mA	16.5mA	12.5mA	9mA	6.5mA	3.5mA	1.75mA	0.85mA
Temperature Coefficient[2]:									
Voltage	1.6mV	4mV	6.6mV	8mV	12mV	16mV	30mV	60mV	120mV
Current	37.5mA	15mA	9.9mA	7.5mA	5.4mA	3.9mA	2.1mA	1.05mA	0.51mA
Maximum Remote Sense Line Drop Compensation (/line)	0.5V	1V	1V	1V	1V	1V	1V	1V	1V
Nominal Output Capacitance	66,000μF	30,000μF	10,000μF	10,000μF	10,000μF	3,000μF	440μF	440μF	4.7μF
Nominal Capacitance from Output to Chassis	200nF	270nF	300nF	250nF	250nF	250nF	250nF	270nF	220nF

[1] Maximum drift over 8 hours with constant line, load, and temperature, after 90 minute warmup

[2] Change in output per °C change in ambient temperature, with constant line and load

Storage Temperature Range: -55 to +85°C
Humidity Range: 0 to 80% Non-condensing
Time Delay from power on until output stable: 2 seconds maximum
Voltage Mode Transient Response Time: 1ms recovery to 1% band for 30% step load change from 70% to 100% or 100% to 70%
Remote Start/Stop and Interlock: TTL compatible input, Contact Closure, 12-250Vac or 12-130Vdc
Switching Frequency: Nominal 100kHz, 200kHz output ripple (>80V models = 80kHz, 160 kHz output ripple.
Analog Programming Linearity: Typical error is less than 0.5% setting. Maximum error is 1% of rated output.
Agency Approvals: CSA, UL, CE marked units comply with the general protection requirements of the European Council Directive 89/336/EEC: EN55011 Group 1 Class A 1990, EN50081 -2 1992, EN50082-1 1992 and with the European LV Directive 73/23/EEC: IEC 1010-1, IEC 1010-2.

Remote Analog Programming (Full Scale Input)

Scales are selectable via an internally-mounted switch.

TABLE 1.4-1 REMOTE ANALOG PROGRAMMING SCALES			
PARAMETER	**RESISTANCE**	**VOLTAGE**	**CURRENT**
Voltage	5kΩ	5V, 10V	1mA
Current	5kΩ	0.1V, 5V, 10V	1mA
OVP	5kΩ	5V, 10V	1mA

1.4 Specifications

1.4.2 Mechanical Specifications

Dimensions: 41.635mm (1.71in) H x 482.6mm (19in) W x 443.865mm (17.475in) D
Weight: 8.2kg (18lbs)

J3 Program, Sense, and Monitor Connector: D-subminiature 25 Pin Female (Mating connector - 25 pin male ITT Cannon DB25P or equivalent)

Models XKW 8-125 through XKW 80-13 Connector: Nickel plated copper bus bars. Approximate dimensions: 1.365" x 0.8" x 0.125". Distance between positive and negative bus bar centers: 2.2". Load wiring mounting holes: Two 0.257" diameter holes on 0.5" centers (1/4" hardware); Two 0.191" diameter holes on 0.4" centers (#10 hardware)

Models XKW 150-7 through XKW 600-1.7 Connector: Six pin Amp Universal Mate-N-Lok connector (Eight Socket pins and one mating connector housing are supplied in a ziplock bag packaged with each 150V through 600V unit.)

2. INSTALLATION AND OPERATION

2.1 General

After unpacking, perform an initial inspection and function test to ensure that the unit is in good working order. If the unit was damaged in shipment, notify the carrier immediately. Direct repair problems to the Service Department.

2.2 Initial Inspection

Inspect the equipment for damage as follows:

- Inspect for obvious signs of physical damage.
- Turn front panel controls from stop to stop. Rotation should be smooth.
- Test the action of the power switch. Switching action should be positive.
- If internal damage is suspected, remove the cover and check for printed circuit board and/or component damage. Reinstall cover.

2.3 Installation

2.3.1 AC Input Voltage Selection

WARNING

Exercise caution when using and servicing power supplies. High energy levels can be stored at the output voltage terminals on all power supplies in normal operation. In addition, potentially lethal voltages exist in the power circuit and the output connector of power supplies which are rated at 40V and over. Filter capacitors store potentially dangerous energy for some time after power is removed.

WARNING

To provide protection for personnel in the case of unit failure and to ensure proper power supply operation, the safety ground wire of the AC input line cord must **ALWAYS** be connected to the ground screw provided.

WARNING

Attempted operation of the XKW power supply with the incorrect input voltage may result in internal damage to the unit.

Before using the XKW power supply, the correct AC input voltage must be selected and an appropriate line cord and plug attached. All units are shipped in a configuration requiring a 200 -250Vac 10 Amp input. The unit can also be converted for use with a 100-130Vac 20A input.

200-250Vac Input

Connect a 250Vac 15Amp plug and cord to the rear panel AC connector and the safety ground screw. (Note that the NEUT. and LINE designations above the AC connector apply to the 100-130Vac 20A input but do not apply to 200-250V operation.)

2.3 Installation

2.3.1 Input Voltage Selection (continued)

100-130Vac 20A Input

To convert the unit for use with a 100-130Vac 20A input, perform the following steps:

1. Ensure that the unit is switched off and disconnected from any power source.
2. Remove the Phillips head screws which secure the cover and then remove the cover from the unit.
3. Remove the 230Vac voltage selector jumper located at the front center of the PCB from its mating header (designated P1 on the PCB) and install the attached 115Vac jumper in its place.
4. Reinstall the cover and replace the screws.
5. Use the adhesive backed 115Vac 20A label supplied with the unit to cover the 230Vac 10A input specification above the rear panel AC connector.
6. Install a 130Vac 25Amp plug and cord ensuring that the neutral (white) wire and line (black) wire are connected in the correct positions and that the safety ground wire is connected to the ground screw.

2.3.2 Input Line Impedance

The maximum input line impedance for operation at full rated output is 1 ohm. Higher source impedances can be tolerated by raising the input line voltage or by reducing the output voltage and/or current.

2.3.3 Ventilation Requirements

The XKW power supply may be used in rack mounted or benchtop applications. In either case, sufficient space must be allowed for cooling air to reach the ventilation inputs on each side of the unit and for the fan exhaust air to exit from the rear of the unit.

2.3.4 Output Voltage Biasing

WARNING
Use extreme caution when biasing the output relative to the chassis due to potential high voltage levels at the output terminals and J3 connector pins.

If the output voltage is to be biased relative to safety ground, the power supply outputs may be biased up to a maximum of 600Vdc with respect to the chassis.

2.3 Installation

2.3.5 Rack Mounting

The XKW power supply is designed to fit in a standard 19" equipment rack. Use the rack mount brackets at either side of the front panel to install the power supply in a rack. Use adjustable support angles such as Hammond RASA22WH2, or a support bar such as Hammond RASB19WH2. To install with rack mount slides, use a typical slide kit such as the ZERO C-300 S-18.

2.4 Functional Tests

Before connecting the unit to an AC outlet, make sure that the power switch is in the OFF position and that the voltage and current controls are turned fully counter clockwise. Check that the J3 mating connector on the rear of the unit is in place with jumpers connected for local operation as shown below. (This is the default configuration as shipped from the factory). Connect the unit to a 230Vac grounded outlet (115Vac outlet if previously configured for 115Vac operation as per instructions in **Section 2.3.1**) and switch the unit on. After a short power on delay the front panel meters should light up with both displays reading zero.

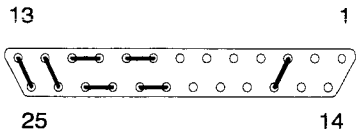


Figure 2.4-1 Connector J3 Configuration for Local Operation

2.4.1 Voltage Mode Operation

To check voltage mode operation, proceed as follows:

- Connect a DVM, rated better than 0.5% accuracy, to the rear output terminals, observing correct polarity.
- Rotate the CURRENT control 1/2 turn clockwise. Slowly rotate the VOLTAGE control clockwise and observe both the internal and external meters. Minimum control range should be from zero to the maximum rated output. Compare the test meter reading with the front panel voltmeter reading. Check that the green voltage mode indicator led is ON.
- Set the POWER switch to OFF.

2.4 Functional Tests

2.4.2 Current Mode Operation

To check current mode operation. proceed as follows:

- Rotate the VOLTAGE and CURRENT controls fully counterclockwise.
- Rotate the VOLTAGE control 1/2 turn clockwise.
- Connect a high current DC ammeter across the rear output terminals. observing correct polarity. Select leads of sufficient current carrying capacity and an ammeter range compatible with the unit's rated current output. The ammeter should have an accuracy of better than 0.5%.
- Set the POWER switch to ON.
- Rotate the CURRENT control slowly clockwise. The control range should be from zero to the maximum rated output. Compare the test meter reading with the reading on the front panel ammeter. Check that the red current mode indicator led is ON.
- Set the POWER switch to OFF.

2.5 Controls, Connectors, and Indicators

CAUTION

All remote programming input and monitoring lines are internally referenced to the supply's negative output. Do not reference remote programming or monitor lines to the supply's positive output. J3 pin 6 (ground) is directly connected to the supply's negative output. Do not connect this pin to the positive output or to the chassis.

Please refer to **Figure 2.5-1** for front panel controls and indicators. **Figure 2.5-2** for rear panel connectors and switch details. and to **Figure 2.5-3** for a description of the J3 Program. Sense. and Monitor Connector.

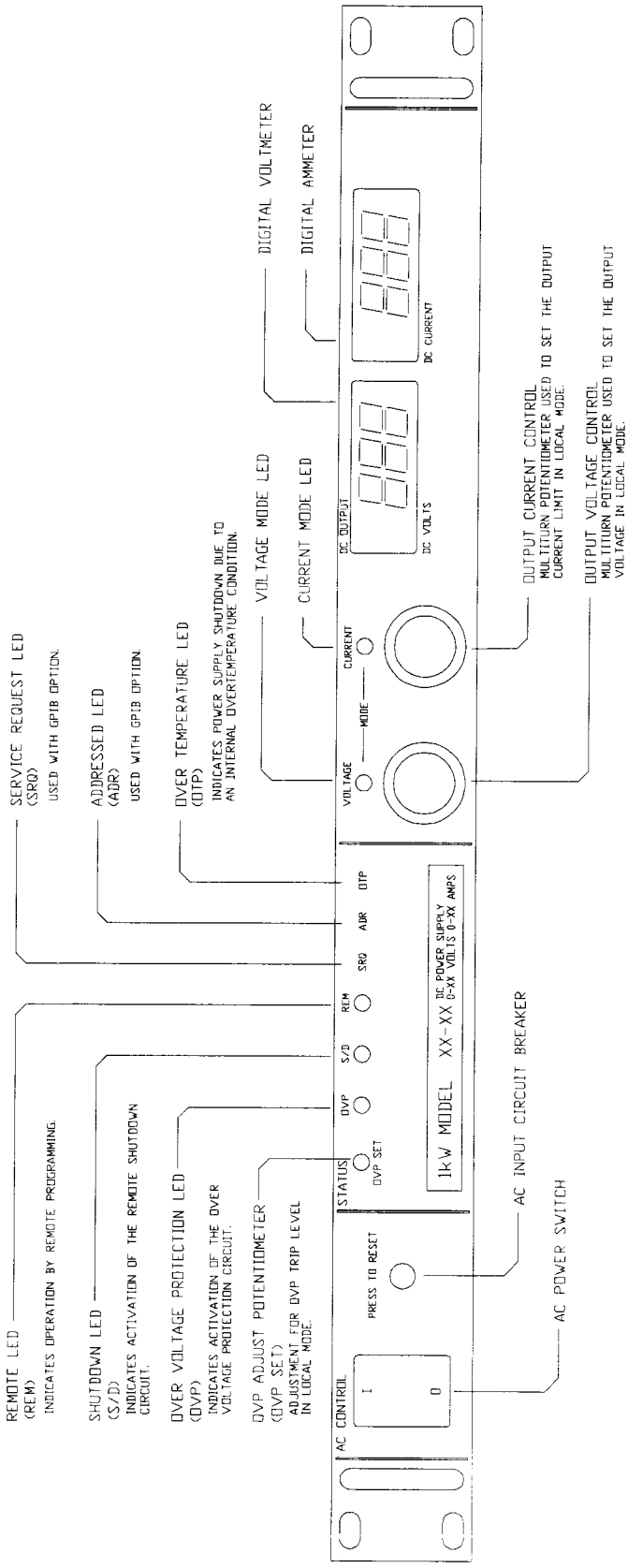


Figure 2.5-1 Front Panel

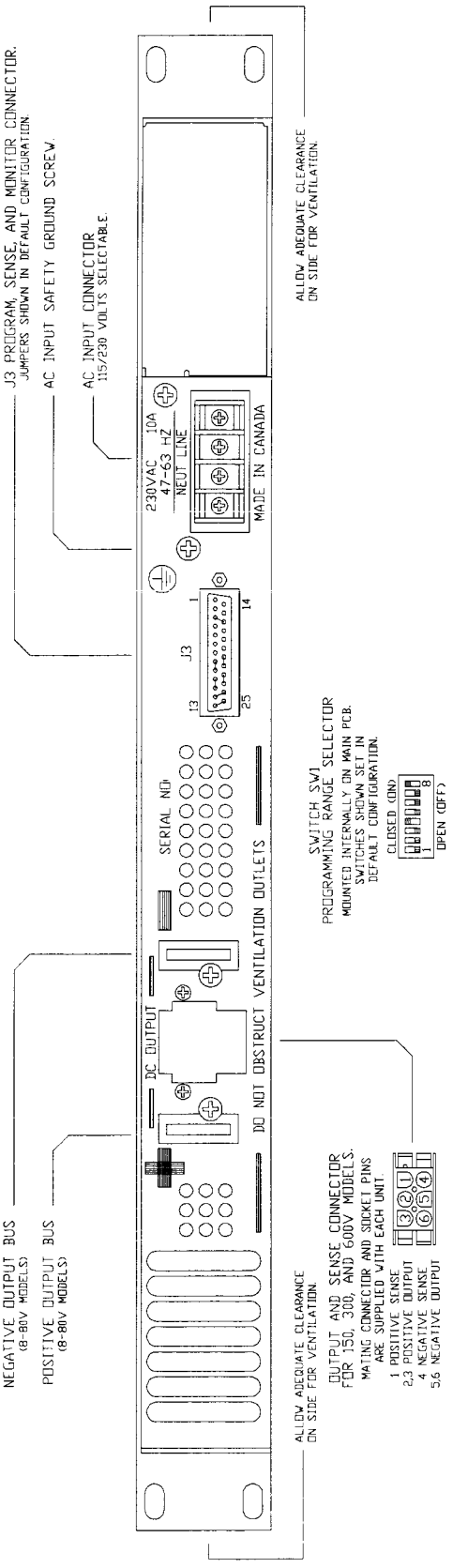


Figure 2.5-2 Rear Panel

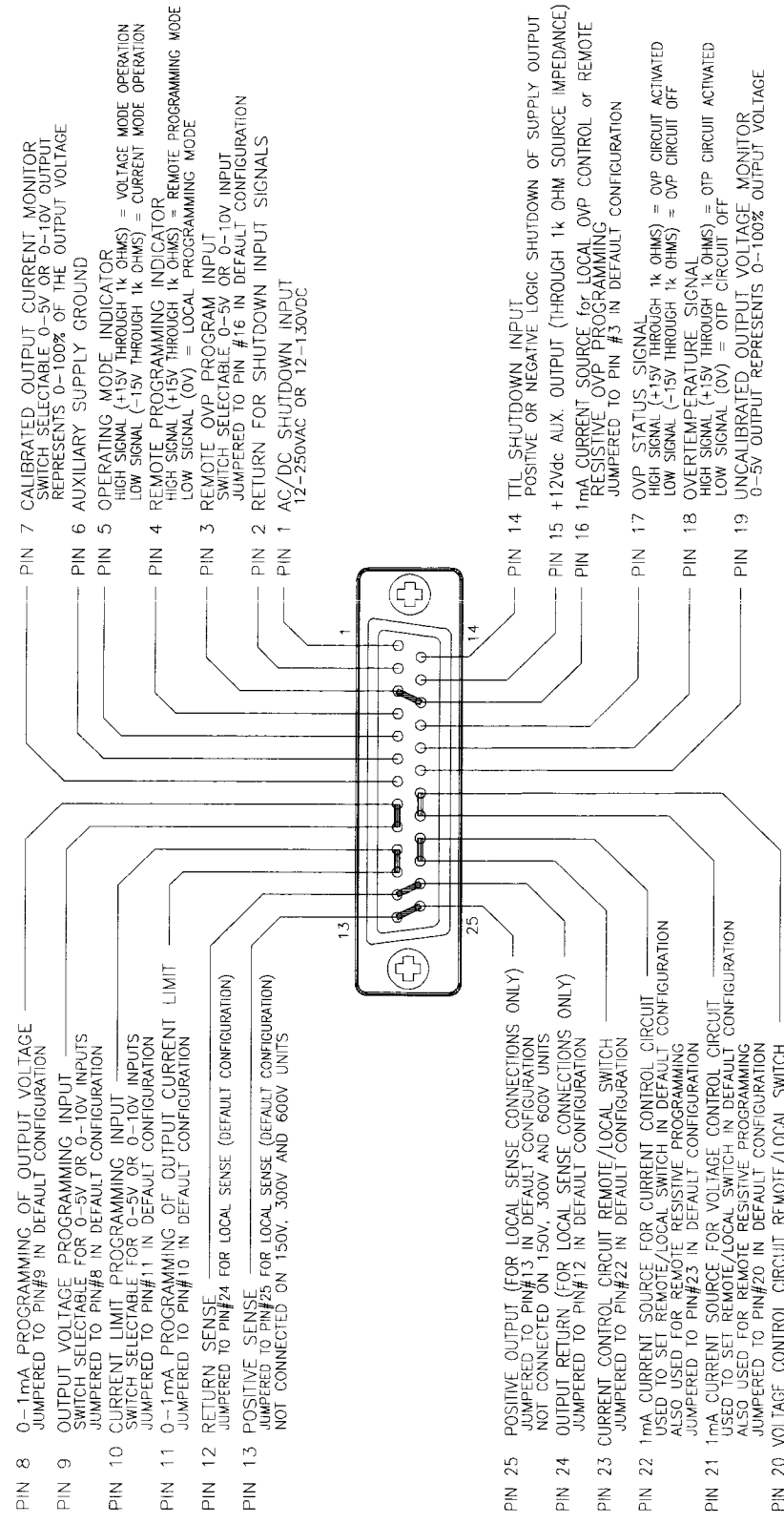


Figure 2.5-3 J3 Program, Sense, and Monitor Connector Description

Note: J3 pins 1. 2. and 14 form an isolated control function and may be biased relative to the supply output.

2.6 Load Connection

Reliable performance of the XKW power supply can be obtained if certain basic precautions are taken when connecting it for use on the lab bench or installing it in a system.

To obtain a stable, low noise output, careful attention should be paid to factors such as conductor ratings, system grounding techniques and the way in which the load and remote sensing connections are made.

2.6.1 Load Conductor Ratings

The table below lists the maximum allowable load wiring length (in feet) for a specified wire gauge and power supply model operating at full rated output. The lengths indicated are based on PVC insulated wire with a maximum operating temperature of 105 ° C. To overcome impedance and coupling effects which can degrade the power supply performance, the use of leads of the largest gauge and shortest length possible is recommended.

	WIRE SIZE (AWG)								
MODEL	2	4	6	8	10	12	14	16	18
8-125	19	12	-	-	-	-	-	-	-
20-50	30	30	30	23	-	-	-	-	-
33-33	30	30	30	30	22	14	-	-	-
40-25	30	30	30	30	30	18	-	-	-
60-18	30	30	30	30	30	26	16	10	-
80-13	30	30	30	30	30	30	22	20	-
150-7	30	30	30	30	30	30	28	26	-
300-3.5	30	30	30	30	30	30	30	30	-
600-1.7	30	30	30	30	30	30	30	30	30

TABLE 2.6-1 LOAD CONDUCTOR RATINGS

2.6.2 Load Connection and Grounding

WARNING
Use extreme caution when biasing the output relative to the chassis due to potential high voltage levels at the output terminals and J3 connector pins.

WARNING
Exercise caution when using and servicing power supplies. High energy levels can be stored at the output voltage terminals on all power supplies in normal operation. In addition, potentially lethal voltages exist in the power circuit and the output connector of power supplies which are rated at 40V and over. Filter capacitors store potentially dangerous energy for some time after power is removed.

Proper connection of distributed loads is an important aspect of power supply application. A common mistake is to connect leads from the power supply to one load, from that load to the next load, and so on for each load in the system. In this **parallel power distribution** method, the voltage at each load depends on the current drawn by the other loads and DC ground loops are developed. Except for low current applications, this method should not be used.

The preferred way to distribute power is by the **radial distribution** method in which power is connected to each load individually from a single pair of terminals designated as the positive and negative distribution terminals. The pair of terminals may be the power supply output terminals, the terminals of one of the loads or a distinct set of terminals especially established for distribution. Connecting the sense leads to these terminals will compensate for losses and minimize the effect of one load upon another.

2.6 Load Connection

2.6.2 Load Connection and Grounding (continued)

Inductive Loads

To prevent damage to the power supply from inductive kickback, connect a diode (rated at greater than the supply's output voltage and with a current surge rating greater than or equal to the supply's output current rating) across the output. Connect the cathode to the positive output and the anode to return. Where positive load transients such as back EMF from a motor may occur, connect a transorb or a varistor (with a breakdown voltage approximately 10% higher than the rated supply output) across the output to protect the power supply.

2.6.3 Output Cord Strain Relief

Assemble the strain relief from supplied pieces and attach it to the DC output connector on 150V, 300V, and 600V models to provide support for the output cord.

Parts Supplied

- Two (2) pieces of 6 position, cap housing strain relief (part number MI-6407-210)
- Two (2) #6-32 x 5/8" screws (part number MS-6P12-10)

Assembly Instructions

1. Snap off the rectangular bushing attached to each piece of the strain relief. See **Figure 2.6-1**.

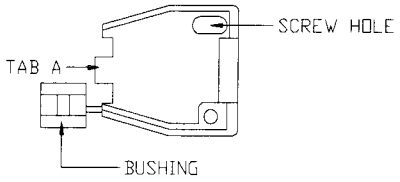


Figure 2.6-1 Strain Relief
(One piece, inside view)

2. Install bushings on strain relief pieces, as required. Cable diameter must be between 0.120" and 0.650".
3. Insert strain relief tab A into DC output connector slot A. Insert strain relief tab B into DC output connector slot B. See **Figure 2.6-2**.
4. Install screws in holes provided on outside of strain relief pieces. Thread through to screw standoff inside opposite piece. Tighten to clamp outer jacket of output cord securely, ensuring that the side of the strain relief slips into the corresponding rabbet on the opposite piece.

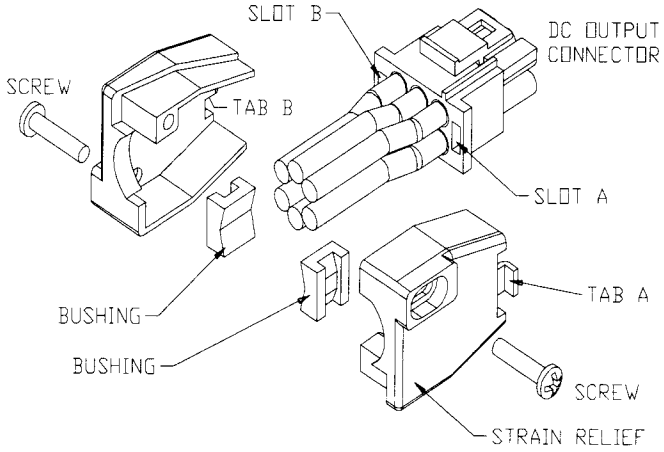


Figure 2.6-2 Strain Relief Assembly

2.7 Local and Remote Sensing

The use of remote sensing permits the regulation point of the power supply to be shifted from the output terminals (local sensing) to the load or other distribution terminals, thereby automatically compensating for the voltage losses in the leads supplying the load (provided these losses do not exceed 0.5V/line for the 8V model or 1V/line for all other models). For example, with the voltmeter reading 10.0 volts and the sense lines connected directly to the load, the load voltage will remain regulated at 10.0 volts regardless of the voltage drops in the power leads and variations in the load current.

On 8V, 20V, 33V, 40V, 60V, and 80V models, the positive sense connection is available at pin 13 of connector J3 and the return sense connection is available at pin 12. For local sensing (regulation at the power supply output terminals), the sense pins are connected to pins 25 (positive output) and 24 (return) of connector J3. For remote sensing, the local operation jumpers are removed and pins 13 and 12 are connected directly to the positive and negative terminals of the load.

On 150V, 300V, and 600V models, the sense connections are available through the output connector. (See **Figure 2.5-3** for the exact pin out.) On these models, no sense line jumpers are required for local operation.

Sense wires can be any size (24AWG or larger) but in high noise environments or when the lowest possible power supply ripple is required, sense wires must be twisted and/or shielded.

Note: On 8V to 80V models the sense leads must always be connected, either for remote or local sensing. Operation of the supply with the sense leads disconnected will cause the output to fall to zero or to be unregulated.

NEVER use the sense connections without the normal power lead connections to the output terminals. Avoid reversing positive and negative sense lead connections.

2.8 Single Supply Operation (Local Mode)

To operate the XKW power supply in local mode, first install the unit and connect the load following the instructions in **Sections 2.1** to **2.7**. For further information see **Section 2.12** for complete description of switch SW1 functions. See **Figure 2.5-3** for J3 connector pinouts.

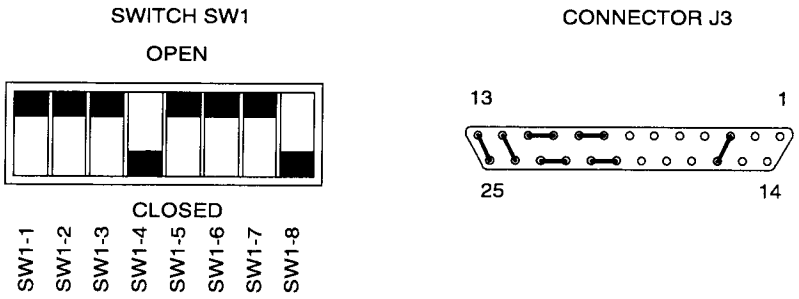


Figure 2.8-1 Switch SW1 and Connector J3 Configuration for Local Operation
(Default factory settings)

2.8.1 Setup

Check that switch SW1 (mounted internally on the main printed circuit board) is set for local operation (the factory default) and that the J3 mating connector on the rear of the unit is in place with jumpers connected for local operation (also the factory default). See **Figure 2.8-1**. Set both the current and voltage controls fully counterclockwise.

2.8.2 Voltage Mode Operation

For voltage mode operation, turn the current control fully clockwise and then adjust the voltage control to obtain the desired output voltage.

2.8.3 Current Mode Operation

For current mode operation, turn the voltage control 1/2 turn clockwise, the current control fully counterclockwise and connect an appropriately-sized shorting jumper across the output terminals. Turn the current control clockwise until the desired output current is obtained. Turn the power supply off, remove the shorting jumper, turn the voltage control fully clockwise and turn the power supply on.

Note that for a short period (less than 2 seconds) after power on, the power supply output is disabled and the current mode LED is illuminated while the main filter capacitors charge through the inrush limiter.

2.9 Multiple Supplies

CAUTION
All remote programming input and monitoring lines are internally referenced to the supply's negative output. Do not reference remote programming or monitor lines to the supply's positive output. J3 pin 6 (ground) is directly connected to the supply's negative output. Do not connect this pin to the positive output or to the chassis.

XKW Series power supplies of the SAME MODEL may be operated with outputs in series or parallel to obtain increased load voltage or current. Split supply operation allows two positive or a positive and negative output to be obtained.

Note: If your application requires the use of isolated programming inputs, contact the factory about the optional ISOL interface.

2.9.1 Series Operation

CAUTION
Do not use remote sensing during series operation.

Series operation is used to obtain a higher voltage single output supply using two or more single units. Connect the negative terminal (-) of one supply to the positive terminal (+) of the next supply. The total voltage available is the sum of the maximum voltages of each supply (add voltmeter readings). The maximum allowable current for a series string of power supplies is the rated output current of a single supply in the string.

Note: The maximum allowable sum of the output voltages is 600V. This is limited by the voltage rating of certain internal components.

2.9.2 Parallel Operation

Parallel operation is used to obtain a higher current single output supply using two or more single units. Set all of the outputs to the same voltage before connecting the positive terminals (+) and negative terminals (-) in parallel. The total current available is the sum of the maximum currents of each supply.

Sensing for Parallel Operation

Use default local sensing to enhance power sharing between units, as the impedance of the load lines will tend to correct for current imbalance. If you use remote sensing at the load for better voltage regulation, one supply always operates in current limit mode and supplies most of the power.

2.9 Multiple Supplies

2.9.2 Parallel Operation (continued)

OVP for Parallel Operation

> **CAUTION**
> To prevent internal damage, ensure that the OVP trip level of all supplies is set to maximum.

> **CAUTION**
> Dis abling the OVP circuit will not allow for protection of the load in the event of a remote programming error, incorrect voltage control adjustment, or power supply failure.

If you should have a problem with external transients tripping the OVP circuit, you have two solutions. One is to add a diode in series with the output line or the return line. This diode must have a reverse voltage and current rating greater than the power supply output. The second solution is to disable the OVP circuit by removing transistor R93 from the A2 PCB.

2.9.3 Split Supply Operation

Split supply operation is used to obtain two positive voltages with a common ground, or a positive -negative supply.

To obtain **two positive voltages**, connect the negative terminals of both supplies together. The positive terminals will supply the required voltages with respect to the common connection.

To obtain a **positive-negative supply**, connect the negative terminal of one supply to the positive terminal of the second supply. The positive terminal of the first supply then provides a positive voltage relative to the common connection while the negative terminal of the second supply provides a negative voltage. The current limits can be set independently. The maximum current available in split operation is equal to the rated output of the supplies used.

2.10 Over Voltage Protection (OVP)

The OVP circuit allows for protection of the load in the event of a remote programming error, incorrect voltage control adjustment, or power supply failure. The protection circuit monitors the output and reduces the output voltage and current to zero whenever a preset voltage limit is exceeded. A red LED on the front panel indicates when the OVP circuit has been activated. Resetting the OVP circuit after activation requires removal of the overvoltage condition and powering the unit OFF and back ON or momentarily activating the remote shut down circuit. See **Section 2.11** for information on shutdown circuit operation. The OVP trip level can be set using either the front panel potentiometer or by using one of three remote programming methods (voltage, resistance or current) through the J3 connector at the rear of the unit. Please see **Section 2.9.2** for how to disable OVP for parallel operation.

2.10.1 Front Panel OVP Operation

To set the trip level from the front panel use the following procedure:

1. With the unit off and disconnected from its AC source remove the cover and check that switches SW1-4 and SW1-8 are closed (factory default setting). Also check that the jumper between pins 3 and 16 of connector J3 is in place.
2. Using a small, flat-bladed screwdriver through the OVP ADJUST hole in the front panel, turn the adjusting screw fully clockwise (until audible clicking is heard or 20 turns maximum).
3. Turn the unit on and adjust the output to the desired trip voltage.
4. Slowly turn the adjusting screw counterclockwise until the red OVP indicator lamp lights.
5. Turn the POWER switch to OFF.
6. Turn the voltage control knob to minimum.
7. Turn the POWER switch back ON and increase the voltage to check that the power supply shuts off the output at the desired voltage.

2.10 Over Voltage Protection (OVP)

2.10.2 Remote Programming of OVP With External Voltage Sources

To remotely program the OVP trip level using a 0 -5V or 0 -10V DC voltage source use the following procedure.

1. With the unit off and disconnected from its AC source. remove the cover and set switch SW1-4 closed (default factory setting) for 0 -5V programming or open for 0 -10V programming. Also check that switch SW1-8 is closed (default factory setting). Set the front panel OVP adjusting potentiometer fully clockwise (until audible clicking is heard or 20 turns maximum).

2. Remove the default jumper connecting pins 16 and 3 of connector J3 and connect the voltage source between pins 3 (positive) and 12 (negative). Set the programming source voltage to maximum.

3. Turn the unit on and adjust the output to the desired trip voltage.

4. Slowly reduce the programming voltage until the red OVP indicator lamp lights and the power supply shuts down.

5. Turn the POWER switch to OFF.

6. Turn the voltage control knob to minimum.

7. Turn the POWER switch back ON and increase the voltage to check that the power supply shuts off the output at the desired voltage.

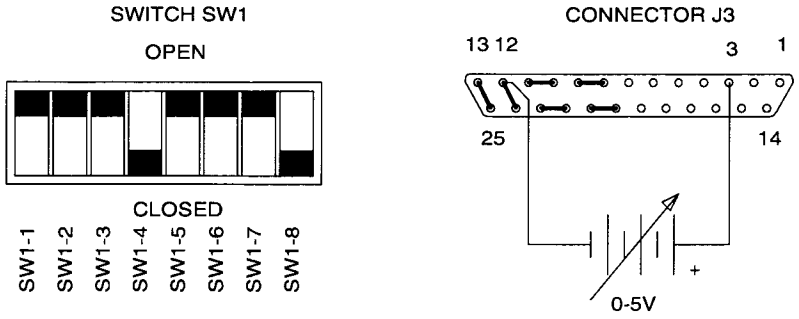


Figure 2.10-1 Switch SW1 and Connector J3 Configuration for 0-5Vdc OVP Programming
(J3 sense line, voltage control and current control jumpers shown set for local operation)

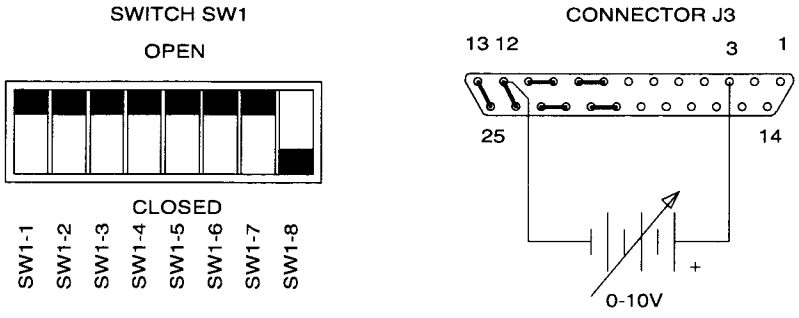


Figure 2.10-2 Switch SW1 and Connector J3 Configuration for 0-10Vdc OVP Programming
(J3 sense line, voltage control and current control jumpers shown set for local operation)

2.10 Over Voltage Protection (OVP)

2.10.3 Remote Programming of OVP with an External Resistance

To remotely program the OVP trip level using a 5k ohm external potentiometer, use the following procedure.

1. With the unit off and disconnected from its AC source remove, the cover, set switch SW1 -8 open and check that switch SW1-4 is closed (default factory setting for switch SW1-4).
2. Connect the counterclockwise end of the 5k potentiometer to pins 3 and 16 of connector J3. Connect the tap and the clockwise end of the potentiometer to pin 12. Set the potentiometer fully clockwise.
3. Turn the unit on and adjust the output to the desired trip voltage.
4. Slowly turn the potentiometer counterclockwise until the red OVP indicator lamp lights and the power supply shuts down.
5. Turn the POWER switch to OFF.
6. Turn the voltage control knob to minimum.
7. Turn the POWER switch back ON and increase the voltage to check that the power supply shuts off the output at the desired voltage.

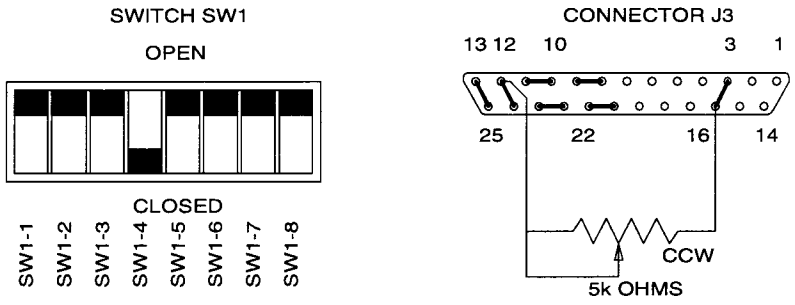


Figure 2.10-3 Switch SW1 and Connector J3 Configuration for 0-5k OVP Programming
(J3 sense line, voltage control and current control jumpers shown set for local operation)

2.10 Over Voltage Protection (OVP)

2.10.4 Remote Programming of OVP with External Current Sources

To remotely program the OVP trip level using a 0-1mA current source, use the following procedure.

1. With the unit off and disconnected from its AC source, remove the cover and set switches SW1 -4 and SW1-8 closed (default factory setting).
2. Using a small, flat-bladed screwdriver through the OVP ADJUST hole in the front panel, turn the adjusting screw fully clockwise (until audible clicking is heard or 20 turns maximum).
3. Remove the default jumper connecting pins 16 and 3 of connector J3 and connect the current source between pins 3 (positive) and 12 (negative). Set the programming source to 1mA.
4. Turn the unit on and adjust the output to the desired trip voltage.
5. Slowly reduce the programming current until the red OVP indicator lamp lights and the power supply shuts down.
6. Turn the POWER switch to OFF.
7. Turn the voltage control knob to minimum.
8. Turn the POWER switch back ON and increase the voltage to check that the power supply shuts off the output at the desired voltage.

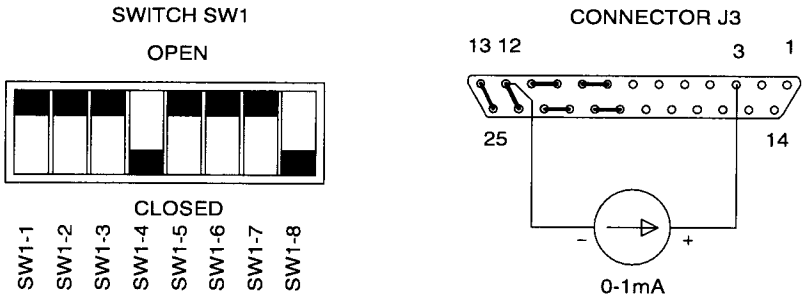


Figure 2.10-4 Switch SW1 and Connector J3 Configuration for 0-1mA Current Source OVP Programming

(J3 sense line, voltage control and current control jumpers shown set for local operation)

2.10 Over Voltage Protection (OVP)

2.10.5 Remote OVP Sensing

The default configuration for the OVP circuit senses the output voltage at the power supply output terminals. For applications using remote sensing where there is a need to accurately monitor the actual load voltage, the following procedure allows the OVP sense point to be shifted from the power supply output to the sense line connection points.

1. Shut the unit off and disconnect it from its power source. Remove the cover from the unit.
2. Using a sharp exacto knife, cut the component side trace connecting the right hand side of resistor R89 to the via marked OVP-LOC.
3. Install a piece of insulated #22 AWG wire from the via marked OVP -RMT C (near the trace cut just made) to the via marked OVP-RMT C1 (near capacitor C51).
4. Reinstall the cover and reconnect the unit to its power source.

To return to local OVP sensing, remove the jumper installed in step 3 above and install a jumper across the trace cut made in step 2.

2.11 Remote ON/OFF

CAUTION
The external voltage applied to pins 1 and 2 (Shutdown input and return) cannot exceed 250V rms with respect to the supply's negative output or the supply may be damaged.

This feature is useful in test applications requiring remote ON-OFF control of the output. The remote ON-OFF control circuit uses either a TTL compatible or a 12-250Vac (or 12-130Vdc) input to remotely control (disable or enable) the power supply output. For TTL operation, a logic level signal between pins 14 (positive) and 2 (return) of connector J3 determines the output conditions:

TTL LOW = OUTPUT ON
TTL HIGH = OUTPUT OFF

For AC or DC operation, an input of 12-250Vac (or 12-130Vdc) between pins 1 (positive for DC input) and 2 (return) of connector J3 will disable the output of the supply.

A red LED on the front panel indicates when the shutdown circuit is activated. The input lines are optically isolated and can therefore be accessed by circuits with a voltage differential of up to 600Vdc.

2.11.1 Remote ON/OFF by Contact Closure

An external relay may be used to operate the ON/OFF control circuit as follows. Connect one side of a normally open relay to pin 15 of connector J3 (+12V). Connect the other side of the relay to pin 14 (TTL Shutdown). Also connect J3 pin 2 (Shutdown return) to pin 6 (Ground). Using this configuration, the power supply will be OFF when the relay coil is energized and ON when the relay is de-energized.

If a normally closed relay is substituted for the normally open relay in the configuration described above, the power supply will be ON when the relay coil is energized and OFF when the relay is de-energized.

2.12 Remote Programming of Output Voltage and Current Limit

2.12.1 Remote Programming Switch SW1

CAUTION
The remote programming input is internally referenced to the s upply's negative output. Do not connect remote programming input lines (J3 pins 9 and 10) to the supply's positive output.

The output voltage and current limit of the power supply can be remotely programmed through the rear panel J3 connector (**Figure 2.5-3**) using external voltage sources. current sources. and resistances. Switch SW1 on the A2 printed circuit board controls the programming as diagrammed below. When the supply is controlled by remote programming. the green REMOTE led on the front panel is illuminated.

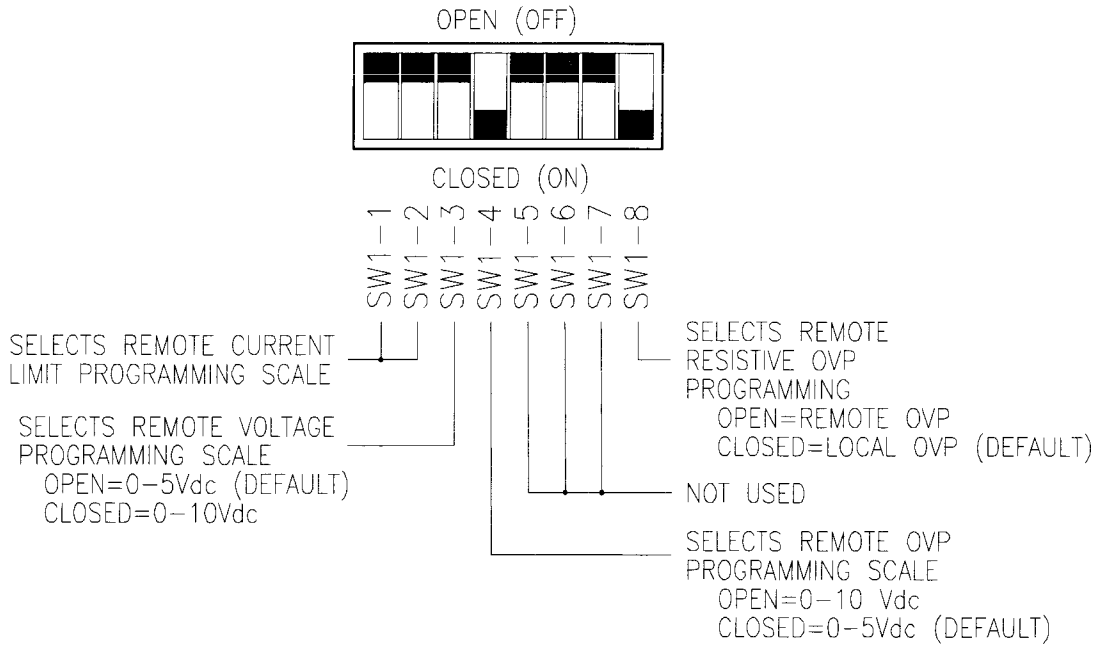


Figure 2.12-1 Switch SW1 Functions
(Default Settings Shown)

Notes:

1. SW-1 and SW-2 are used in combination to sel ect 0-5Vdc. 0-10Vdc. and 0-100mA. See **Table 2.12-1** for settings.

2. To set switch SW1 shut the unit off. disconnect it from its AC source and remove the cover. Make the appropriate switch settings then reinstall the cover and reconnect the unit to its AC source.

2.12 Remote Programming of Output Voltage and Current Limit

2.12.2 Programming With External Voltage Sources

The **ou tpu t voltage**can be programmed using either a 0 -5Vdc or 0 -10Vdc external vol tage source. To program the output voltage with a 0 -5Vdc source, set switch SW1 -3 open (default factory setting) and remove the jumpers connecting pins 8 to 9 and 20 to 21 on connector J3. Connect the external source between pins 9 (positive) and 12 (return). Varying the external voltage from 0 -5V will cause the output to vary from 0 -100% of rated output.

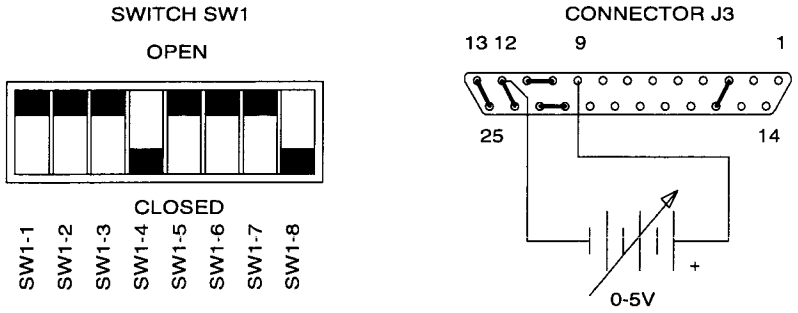


Figure 2.12-2 Switch SW1 and Connector J3 Configuration for 0-5V Programming of the Output Voltage
(J3 sense line, OVP and current control jumpers shown set for local operation)

For programming with a 0 -10Vdc source, cl ose switch SW1 -3 and repl ace the 0 -5V source with a 0 -10V source.

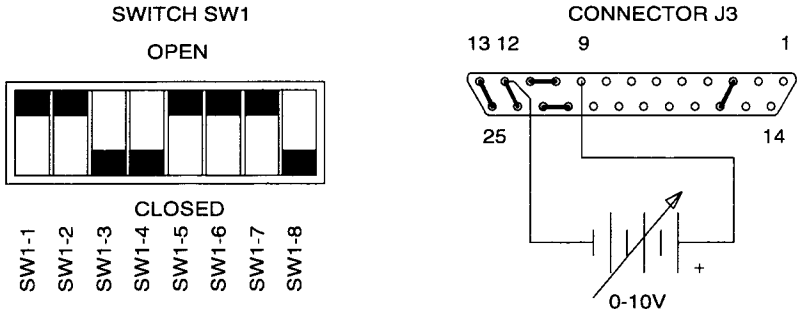


Figure 2.12-3 Switch SW1 and Connector J3 Configuration for 0-10V Programming of the Output Voltage
(J3 sense line, OVP and current control jumpers shown set for local operation)

The **ou tpu t cu rrent limit**can be programmed using a 0 -100mVdc, 0 -5Vdc or 0 -10Vdc external vol tage source. Selection of the programming voltage is done using switches SW1-1 and SW1-2 as indicated below.

TABLE 2.12-1 PROGRAM VOLTAGE SELECTION		
SW1-1	**SW1-2**	**PROGRAMMING VOLTAGE**
OPEN	OPEN	0-5Vdc and Local Mode
OPEN	CLOSED	0-100mVdc
CLOSED	CLOSED	Not Used
CLOSED	OPEN	0-10Vdc

2.12 Remote Programming of Output Voltage and Current Limit

2.12.2 Programming With External Voltage Sources (continued)

To remotely program the output current limit, set switches SW1 -1 and SW1 -2 as shown above, remove the jumpers connecting pins 10 to 11 and 22 to 23 of connector J3 and connect the external voltage source between pins 10 (positive) and 12 (return). Varying the voltage source from 0-100% causes the current limit to vary from 0-100% of the rated maximum.

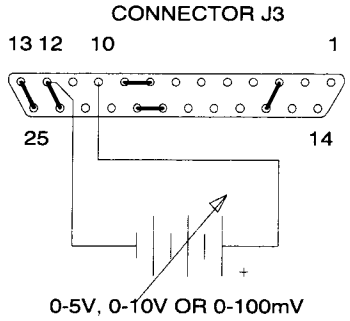


Figure 2.12-4 Connector J3 Configuration for Remote Programming of the Output Current Limit
(J3 sense line, OVP and voltage control jumpers shown set for local operation)

2.12.3 Programming With an External Resistance

The output voltage and current limit can be programmed using a 5k ohm external potentiometer.

To program the **output voltage** set switch SW1 -3 open (default factory setting) and remove the jumpers connecting pins 8 to 9 and 20 to 21 on connector J3. Connect pins 9 and 21 to the counterclockwise end of the 5k potentiometer and connect the tap and clockwise end of the potentiometer to pin 12. Adjusting the tapped resistance from 0-5k will vary the output voltage from 0-100% of the rated output.

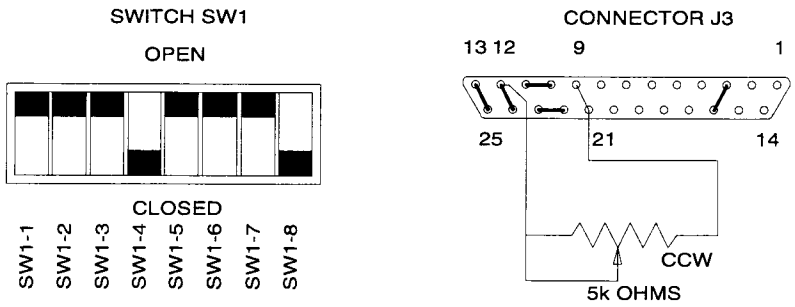


Figure 2.12-5 Switch SW1 and Connector J3 Configuration for Resistive Programming of the Output Voltage
(J3 sense line, OVP and current control jumpers shown set for local operation)

2.12 Remote Programming of Output Voltage and Current Limit

2.12.3 Programming With an External Resistance (continued)

To program the **output current limit** set switches SW1-1 and SW1-2 open (default factory setting) and remove the jumpers connecting pins 10 to 11 and 22 to 23 on connector J3. Connect pins 10 and 22 to the counterclockwise end of the 5k potentiometer and connect the tap and clockwise end of the potentiometer to pin 12. Adjusting the tapped resistance from 0-5k will vary the current limit from 0-100% of the rated output.

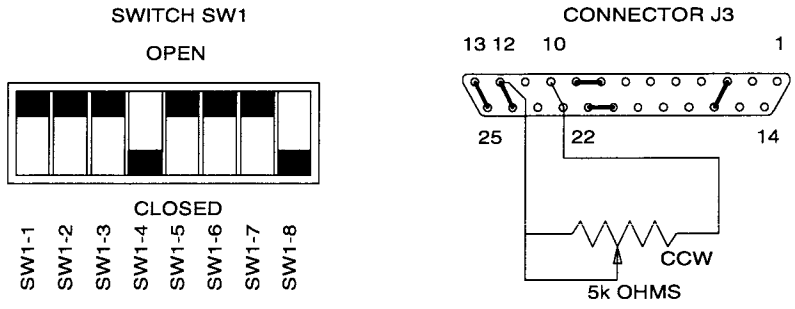


Figure 2.12-6 Switch SW1 and Connector J3 Configuration for Resistive Programming of the Output Current Limit
(J3 sense line, OVP and voltage control jumpers shown set for local operation)

2.12.4 Programming With an External Current Source

The output voltage and current limit can be programmed using an external 0-1mA current source.

To program the **output voltage** set the front panel voltage control to maximum, set switch SW1-3 open (default factory setting) and remove the jumper between pins 20 and 21 of connector J3. Connect the external current source between pins 8 (positive) and 12 (return) of connector J3. Varying the current source from 0-1mA will vary the output voltage from 0-100% of the rated output.

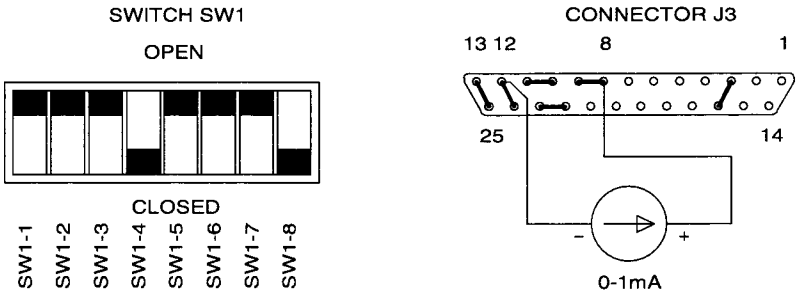


Figure 2.12-7 Switch SW1 and Connector J3 Configuration for 0-1mA Current Programming of the Output Voltage
(J3 sense line, OVP and current control jumpers shown set for local operation)

2.12 Remote Programming of Output Voltage and Current Limit

2.12.4 Programming With an External Current Source (continued

To program the **output current limit**, set the current control to maximum, set switches SW1 -1 and SW1 -2 open (factory setting) and remove the jumper between pins 22 and 23 of connector J3. Connect the external current source between pins 11 (positive) and 12 (return). Varying the current source from 0 -1mA causes the current limit to vary from 0-100% of rated maximum.

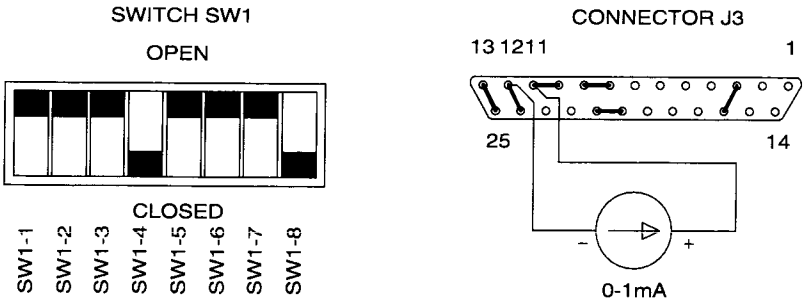


Figure 2.12-8 Switch SW1 and Connector J3 Configuration for 0-1mA Current Programming of the Output Current Limit
(J3 sense line, OVP and voltage control jumpers shown set for local operation)

2.13 Remote Monitoring and Status Indicators

Readback signals for remote monitoring of the output voltage and current are available at connector J3 on the rear of the unit. A 0 -5V (uncalibrated) signal between pins 19 (positive) and 12 (negative) represents 0 -100% of the rated output voltage. A 0 -5V (calibrated) signal between pins 7 (positive) and 12 (negative) represents 0-100% of the rated output current. The offset and gain of the current readback signal may be adjusted through holes in the cover of the unit. See **Section 4.4 Calibration** for location of adjusting holes.

Status indicators for thermal shutdown, OVP operation, remote programming and operating mode are al so available through the J3 connector. **Table 2.13-1** lists the various signals, the J3 connector pins where they are available, the approximate magnitude of the signal (measured with respect to pin 6 of connector J3) and the source impedance through which the signal is fed.

TABLE 2.13-1 STATUS INDICATORS			
INDICATOR SIGNAL	J3 CONNECTOR PIN	SIGNAL VOLTAGE	SOURCE IMPEDANCE
Thermal Shutdown	18	+10V	750Ω
OVP Circuit Activated	17	+9V	750Ω
Remote Programming	4	+10V	750Ω
Voltage Mode Operation	5	+10V	750Ω
Current Mode Operation	5	-3V	750Ω

Note: To use a 0-10V readback signal, you must use an external instrumentation amplifier.

2.14 Using Over Temperature Protection (OTP)

The OTP circuit protects the power suppl y in the event of excessive temperature. The protection circuit monitors the temperature of a suppl y heatsink using a temperature sensor. and wil l activate the internal shutdown circuit whenever the maximum temperature is exceeded.

The red OTP LED on the front panel lights up when an OTP shutdown occurs.

2.14.1 Resetting the OTP circuit

To reset the OTP after it activates:

1. The supply recovers to normal operation when the over temperature condition no longer exists.

OR

1. Turn the AC power switch OFF.
2. Correct the situation causing the over temperature condition.
3. Turn the AC power switch ON.

3. THEORY OF OPERATION

3.1 Power Circuit (A2 Assembly)

WARNING

Potentially lethal voltages exist on the A2 circuit board on the primary side of the isolation barrier and on the secondary side of the high voltage units. Troubleshoot with care, preferably with power off and recognizing that filter capacitors s tore potentially lethal and des tructive energy even for s ome time after power is removed. Always us e an is olation trans former connected only to the power supply input when making test measurements on the primary side circuits.

This section describes the operation of the A2 assembly switching regulator power circuit. Three subsections cover basic switching regul ator theory, a simpl ified description of the ful l bridge converter, and a more detailed circuit description intended for troubleshooting purposes.

3.1.1 Basic Off-Line Switching Regulator Theory

An off-l ine switching power suppl y first converts the AC input l ine vol tage to high vol tage DC by diode rectification and then chops the DC at a high frequency. This high frequency waveform is appl ied to the primary of a power transformer which provides a step-up or step-down in voltage and electrical isolation on its secondary. The secondary waveform is rectified and fil tered, giving a smooth DC output vol tage. Feedback from the secondary circuit is applied to a pulse width modulator (PWM) control circuit which controls the on-time of the primary circuit switching waveform. This increases or decreases the vol tage on the secondary of the power transformer so that output regulation is obtained.

The use of high frequency transformers in switching power suppl ies has the advantage of requiring l ess vol ume, l ess weight, and dissipating l ess heat than the l ower frequency transformers in conventional l inear power supplies.

3.1.2 Simplified Full Bridge Converter Theory

Figure 3-1 illustrates the circuit description in this section.

The input AC l ine vol tage is rectified and fil tered by CR35, C71, and C72 to a raw DC vol tage which is suppl ied to the power FETs Q13 -Q16 on the primary of power transformer T1. Resistor R116 and rel ay K1 form an input surge current l imiter which reduces the inrush current to the fil ter capacitors C71 and C72 during power-up. The power FETs and the primary winding of T1 form a bridge which is driven at 80-100kHz (depending on the model) by pulse width modulator (PWM) U6 through FETs Q7 -Q12 and drive transformer T2. A current sense transformer T3 in the primary of the power transformer provides a feedback signal to the PWM which is compared to a limited error signal derived from the output current and voltage control circuits. The output of the comparator control s the on time of the PWM output drive waveforms on a cycl e by cycl e basis thereby control l ing the primary current and the output of the power transformer. Diodes CR301 and CR302 (CR301 -CR304 on model s XKW 150 -7 and XKW 300 -3.5 and CR300 -CR307 on model XKW 600-1.7) rectify the output of power transformer T1 and inductor L3 and capacitors C51, C5 2, and C53 filter the rectified signal to provide the DC output.

3.1 Power Circuit (A2 Assembly)

3.1.2 Simplified Full Bridge Converter Theory (continued)

A current shunt (R91) in the output return line develops a voltage dependent on the output current. This current information is compared to the setting of the front panel current limit control in the current control circuit (U4-2, U4-3, and U4-4). The output voltage is also monitored and compared to the front panel voltage control setting in the voltage control circuit (U5). The outputs of the voltage and current control circuits are ORed and this signal is fed into the PWM error amplifier inverting input providing the negative feedback required to produce a regulated output. The output voltage and current information from the current and voltage control circuits is also fed to the front panel A1 assembly where it is displayed on the digital voltage and current readouts.

Transformer T4, rectifier CR42, and regulators U9-U11 provide the necessary auxiliary supply voltages for the PWM circuit, the voltage and current control circuits, the A1 metering board and the raw DC supply for drive transformer T2. A 6.2 volt reference is also derived from the 12V supply for use in metering circuits by diode CR1 and resistor R2.

Transformers T1, T3, and T4 provide output isolation from the line potentials in the primary circuit, the PWM circuit and the auxiliary supply circuits respectively.

3.1.3 Detailed Circuit Description

This section is intended to provide further detail for troubleshooting purposes. Please read the previous section as an overview and then refer to the detailed A2 assembly schematic (**Figure 5.4-1**) in **Section 5**.

Input Rectifier and Inrush Limiting

Input AC power passes from the rear panel AC connector (TB1) through an RFI filter consisting of C1 -6, R125, L1, and L2 to the front panel power switch. Both input lines are switched with one line (the neutral line of a 115Vac input) returning to the A2 PCB and the input rectifier CR35 via fuse F1. The other input line (the hot line of a 115Vac input) is connected to the remaining input of rectifier CR35 via front panel circuit breaker CB1, fuse F2, and the inrush limiter formed by resistor R116 and relay K1. Resistor R116 limits the power-on inrush current to the main filter capacitors C71 and C72 until it is shorted by K1 relay contacts. The time delay for K1 contact closure is determined by the time constant formed by capacitor C12, resistor R118, and the gate threshold of FET Q6. Diode CR38 discharges C12 when the 12V auxiliary supply collapses and CR39 provides an inductive kickback path for the relay coil. During the inrush period, diode CR33 holds the PWM shutdown line high, disabling the power supply output until Q6 turns on. Resistors R114 and R115 are bleeder resistors for the main filter capacitors. The rectified high voltage DC from CR35 is supplied to the main switching FETs Q13-Q16 on the primary of the power transformer T1 via fuse F3.

For 230Vac operation, rectifier CR35 and filter capacitors C71 and C72 are configured as a full wave bridge. For 115Vac operation, the input voltage selector P1 is switched so that CR35, C71, and C72 form a voltage doubler. In addition to determining the input rectifier configuration, P1 also switches the connections to the primary of auxiliary transformer T4.

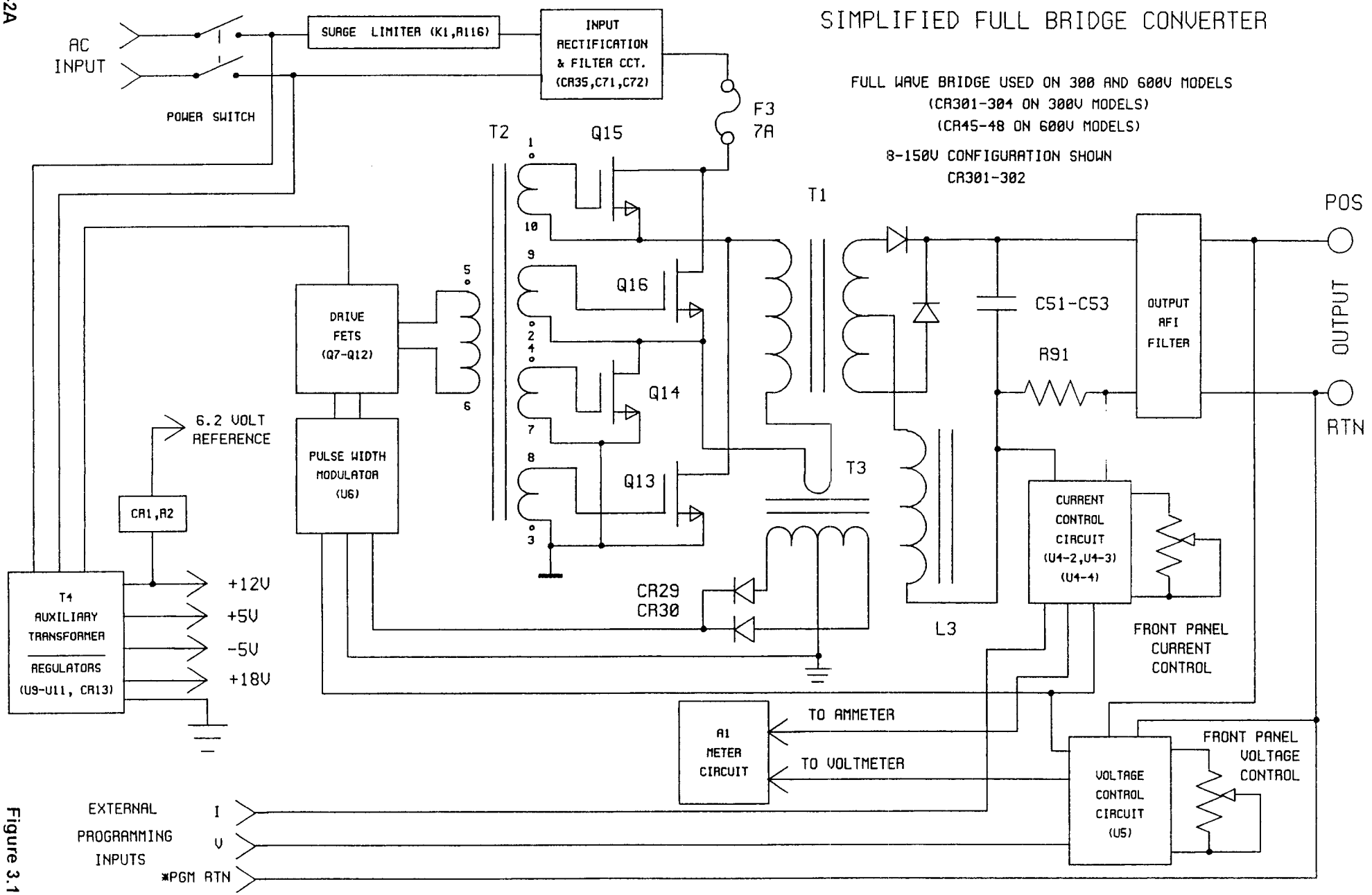


Figure 3.1-1

*NOTE THAT PGM RTN IS TIED TO OUTPUT RETURN VIA THE SENSE CIRCUIT.
IN APPLICATIONS REQUIRING PGM RTN CONNECTION TO POSITIVE OUTPUT, AN ISOLATION AMP IS REQUIRED (OPTION M15)

3.1 Power Circuit (A2 Assembly)

3.1.2 Detailed Circuit Description (continued)

Pulse Width Modulator

Pulse width modulator U6 is a current mode controller which drives the main switching FETs Q13 -Q16 through drive FETs Q7 -Q12 and drive transformer T2. Capacitor C69 and resistors R111 -R113 form a snubber on the primary of transformer T1 limiting switching transients. Transformer T3 is used to monitor T1 primary current and provide a feedback signal for the current sense amplifier of U6. Diodes CR29 and CR30 rectify T3 output while resistors R66 and R95 -R97 and capacitors C60-C62 and C64A scale and condition the signal before it is input to the PWM. An internal PWM comparator compares the output of the current sense amplifier with a limited error signal derived from the output voltage and current control circuits. The output of the PWM comparator controls the pulse duration of the drive signals from pins 11 and 14 of the PWM thereby controlling the primary current in T1 and the output power. Resistor R100 and capacitor C63 set the internal oscillator of U6 to approximately 200kHz for 8V to 80V models, resulting in a 100kHz output switching frequency, or to approximately 160kHz for 150V to 600V models, resulting in a 100kHz or 80kHz output switching frequency. A 5.1V reference developed at pin 2 of the PWM is divided down by resistors R64 and R67 to provide a reference at the non -inverting input of the PWM error amplifier (pin 5). The 5.1V reference voltage is also divided by resistors R65 and R68 to provide a reference at pin 1 of the PWM which limits the swing of the error amplifier output placing an upper limit on the primary current in transformer T1.

Output Rectifier Circuit and Output Filter

The XKW Series uses two different configurations for the output rectifier. The 8V to 80V models use a full wave center tap configuration while the 150 to 600V models employ a full wave bridge. On 8V and 20V models the output rectifiers are one piece power tap units mounted on the rectifier heatsink with the secondary snubber components connected directly to the rectifier input terminals. The 33V to 600V models have their rectifier and snubber components on a separate printed circuit board which is mounted on a rectifier heatsink. Capacitors C51-C53, power inductor L3 and common mode inductor L4 form the main output filter on all models. On 8V to 80V models the secondary filter capacitors C401 -C407 are on a separate PCB which is mounted on the output busbar assembly. On 150V to 600V models the secondary filter capacitors C50, C50A, C50B, C50C, C48, C48A, C48B, C49, C49A, and C49B are mounted directly on the A2 PCB. Resistor R90 is an output pre-load which allows the unit to operate under no load or light load conditions.

Models XKW 8-125 to XKW 80-13

On these models, diodes CR301 and CR302 rectify the output of power transformer T1. Resistors R301 -R304 and capacitors C301 and C302 form snubbers on the secondary of T1 to limit switching transients while resistors R305, R305A, R306, and R306A and capacitors C303 and C304 are used to provide additional rectifier snubbing on some models.

Models XKW 150-7, XKW 300-3.5, and XKW 600-1.7

On XKW 150-7 and XKW 300-3.5, diodes CR301-CR304 form the rectifier bridge with resistors R301-R304 and capacitors C301 -C304 providing snubbing for the diodes. Resistor R305 and capacitor C305 form the snubber on the secondary of transformer T1. Capacitor C306 provides bypassing on the output of the bridge.

On XKW 600-1.7, diodes CR300 -CR307 form the rectifier bridge with resistors R302 -R305 and capacitors C1, C2, and C4 -13 providing snubbing for the diodes. Resistor R300 and R301 and capacitor C303 form the snubber on the secondary of transformer T1. Capacitor C300 provides bypassing on the output of the bridge.

3.1 Power Circuit (A2 Assembly)

3.1.3 Detailed Circuit Description (continued)

Voltage Control Circuit

The output voltage is monitored by the voltage control op amp U5 at pin 3 via the positive sense line (pin 13 of connector J3 on 8V to 80V models) and the resistor divider formed by R21, R22, R53, and R85. This feedback voltage is compared with a 0-5V reference voltage gated from the front panel voltage control to pin 2 of U5 by U7-2 to provide an error signal for the PWM. If the output voltage tries to rise above the selected level, the voltage at pin 3 rises and the output of U5 becomes more positive. This increase is applied to the inverting input of the PWM error amplifier through diode CR18 and resistor R69 causing the amplifier output to decrease. This reduces the PWM output drive waveform pulse width, lowering the output voltage and regulating the output at the desired level. Similarly, if the output voltage tries to fall below the selected level the voltage at pin 3 decreases, U5 output decreases, the output from the PWM error amplifier increases, and the drive waveform pulse width increases which raises the output voltage to the desired level. During voltage mode operation, the output of the current control circuit at U4-2 pin 7 remains low. Resistor R70 and capacitors C54, C55, and C45 provide compensation for the op amp and diodes CR21 and CR21A limits saturation. Capacitor C20, resistor R54, and CMOS gate U7-3 provide a soft start for the power supply during initial startup and recovery from shut down conditions by delaying the voltage rise at pin 2 of U5. Resistor R21 supplies the front panel voltmeter with a voltage proportional to the output voltage through pin 6 of the J1 connector while a 0-5V signal (uncalibrated) for remote monitoring of the output voltage is provided at pin 19 of connector J3. Potentiometer R53 is used to adjust the full scale output of the power supply and potentiometer R52 is used to adjust the offset on op amp U5.

Current Control Circuit

The output current is monitored by current shunt resistor R91 which develops a voltage across it proportional to the output current. This voltage is amplified and conditioned by the differential op amp formed by U4-3, U4-4, and their associated components to provide a control ground referenced 0-5V signal at pin 5 of the current control op amp U4-2. This signal is compared to a reference signal gated from the front panel current control to pin 6 of U4-2 by U7-1. As the output current increases, the voltage at pin 5 rises until it reaches the reference level set at pin 6 at which time the output of U4-2 goes high and the unit switches from voltage mode to current mode operation. The output current is maintained at the desired level by providing negative feedback to the PWM error amplifier as described in the voltage control circuit description above. Resistor R27 and capacitor C27 provide compensation for U4-2. Op amp U4-1 and related components scale the current feedback signal to provide a calibrated 0-5V output at pin 7 of connector J3 for external monitoring of the output current. The shunt voltage is also fed to the front panel ammeter via pins 8 and 9 of connector J1.

Operating Mode Indicator Circuit

Op amp U8-2 takes advantage of the fact that diode CR18 is forward biased during voltage mode and reverse biased during current mode to provide a mode indication signal at pin 7. This output is used to drive the back to back mode LEDs on the front panel through pin 1 of connector J1. In voltage mode U8-2 pin 7 is high and the green voltage mode LED is illuminated. In current mode pin 7 is low and the red current mode LED is illuminated.

3.1 Power Circuit (A2 Assembly)

3.1.3 Detailed Circuit Description (continued)

Auxiliary Supply and 6.2V Reference Circuit

Transformer T4, rectifier CR42 and capacitors C9 and C10 provide the raw DC supply voltages from which the +12V and +5V auxiliary supplies are derived by three terminal regulators U10 and U11 respectively. Resistor R98 and zener diode CR31 provide a +18V supply to the drive FETs Q7 -Q12 on the primary of transformer T2. Diodes CR40 and CR41 with capacitors C7 and C11 provide the negative input to three terminal regulator U9 which supplies the -5V auxiliary output. Resistor R2 and zener diode CR1 are used to derive a stable 6.2V reference from the +12V auxiliary supply for use on the front panel meters (via pin 5 of connector J1) and the A2 PCB. Transistor Q5, diode CR32, resistors R60 -62, and zener diode CR20 form a low voltage lock out which disables the power supply output by shutting down the PWM should the auxiliary raw supply fall below the threshold set by CR20.

Voltage and Current Control Current Sources

Op amps U2 -1 and U2 -2, transistors Q1 and Q2, and related components are used to provide 1mA current sources for the front panel voltage and current controls. These current sources are also used for remote resistive programming of the output voltage and current limit.

Over Voltage Protection Circuit

Op amp U3-1, transistor Q4, and related components provide a 1mA current source which is fed to the front panel OVP adjusting pot via the external jumper connecting pins 3 and 16 of connector J3, switch SW1-8, and pin 17 of connector J1. This current source and the OVP adjusting pot provide a 0 -5V reference at pin 6 of U3-2, the OVP control op amp. The power supply output voltage is monitored at pin 5 of U3-2 through the resistor divider formed by R80 and R89. When the output voltage increases such that the voltage at pin 5 becomes higher than that at pin 6 the output of U3-2 goes high activating MOSFET Q17 (via drive FET Q2A) which clamps the power supply output off through resistor R93. Diode CR25 latches U3 -2 on while diodes CR23 and CR24 gate the high signal to the shutdown pin of the PWM. The OVP indicator on the front panel is biased on via pin 15 of connector J1 when the OVP is activated. The OVP may be reset by cycling the power switch off and then back on to release the latch provided by CR25 or by momentarily activating the remote shutdown circuit which causes pin 6 to be pulled high through diode CR10.

During remote voltage programming of the OVP trip level, the internal 1mA current source is disconnected by removing the jumper connecting pins 3 and 16 of connector J3 and the reference voltage at pin 6 of U3-2 is provided directly by the external voltage source. Switch SW1-4 is used to select the programming range; 0-5V (with the switch closed), or 0-10V (with the switch open). For current programming, the internal 1mA current source is replaced with a 0 -1mA external source to provide the required 0 -5V reference signal. For resistive programming, switch SW1-8 is opened to disconnect the front panel adjusting potentiometer and the internal 1mA current source is connected to the external 0-5k ohm potentiometer to provide the 0-5V reference.

Remote ON/OFF Circuit

A TTL high signal applied between pins 14 (positive) and 2 (negative) of connector J3 activates opto coupler U1 which turns on transistor switch Q3 by pulling its base low. This applies 12V through diode CR11 to the shutdown pin of the PWM thereby shutting down the power supply output. A 12 -250Vac or 12-130Vdc signal applied between pins 1 (positive) and 2 (negative) of connector J3 will also activate U1 and disable the power supply output. Diode CR14 rectifies AC inputs while resistors R37 and R38 limit the current through the opto coupler. Diode CR13 provides protection against reverse polarity TTL signals.

3.1 Power Circuit (A2 Assembly)

3.1.3 Detailed Circuit Description (continued)

Remote Programming of the Output Voltage

During remote programming of the output voltage with an external voltage source (0 -5V or 0-10V) the local operation jumpers connecting J3 pins 8 to 9 and 20 to 21 are removed and the external source is connected between pins 9 (positive) and 12 (negative) of connector J3. When using a 0 -5V source the reference at pin 2 of U5 (voltage control op amp) is provided directly by the external source. When using a 0 -10V source switch SW1-3 is closed to provide the necessary voltage divider to scale the reference voltage to 0-5V.

For remote programming with an external 5k resistance, the jumpers connecting J3 pins 8 to 9 and 20 to 21 are removed, pins 9 and 21 are connected to the counterclockwise end of the external 5k ohm potentiometer and the tap and clockwise end are connected to pin 12. The internal 1mA current source at pin 21 develops a 0-5V potential across the potentiometer, depending on the potentiometer setting, which is fed to pin 2 of U5.

During remote programming of the output voltage with an external 0 -1mA current source, the jumper connecting J3 pins 20 and 21 is removed, the front panel voltage control is set fully clockwise, and the external current source is connected between pins 8 (positive) and 12 (return). Varying the current source from 0-1mA causes 0-5V to develop at the reference pin of the voltage control circuit.

The front panel remote programming indicator is controlled by op amp U8 -4. Resistors R55 and R56 form a voltage divider with the 6.2V reference which develops a nominal 0.3V at pin 12 (the non-inverting input) of the op amp. During local operation, current flow through diode CR15 and the front panel voltage control provides a higher voltage at pin 13 (the inverting input) keeping U8 -4 output low. During remote programming, there is no current flow through diode CR15 and the output of U8-4 goes high, illuminating the remote programming indicator through diode CR4, resistor R13, and pin 13 of connector J1. The high signal is also provided at pin 4 of connector J3 for remote monitoring purposes.

Remote Programming of the Output Current Limit

During remote programming of the output current limit with an external voltage source, the local operation jumpers connecting J3 pins 10 to 11 and 22 to 23 are removed and the external source (0 -5V, 0-10V, or 0-100mV) is connected between pins 10 (positive) and 12 (negative). When using a 0-5V source, the reference at pin 2 of U6 (current control op amp) is provided directly by the external source. Use of a 0 -10V source requires that switch SW1 -1 be closed to provide the necessary voltage divider to limit the control circuit reference voltage to 0-5V. For 0-100mV programming, switch SW1-1 is opened, and SW1-2 is closed so that the feedback voltage is scaled to 0-100mV.

3.1 Power Circuit (A2 Assembly)

3.1.3 Detailed Circuit Description

Remote Programming of the Output Current Limit (continued)

For remote programming with an external 5k resistance, the jumpers connecting J3 pins 10 to 11 and 22 to 23 are removed, pins 10 and 22 are connected to the counterclockwise end of the external 5k ohm potentiometer and the tap and clockwise end are connected to pin 12. The internal 1mA current source at pin 22 develops a 0-5V potential across the potentiometer, depending on the potentiometer setting, which is fed to pin 6 of U4-2.

During remote programming of the output voltage with an external 0 -1mA current source the jumper connecting J3 pins 22 and 23 is removed, the front panel voltage control is set fully clockwise and the external current source is connected between pins 11 (positive) and 12 (return). Varying the current source from 0-1mA causes 0-5V to develop at the reference pin of the current control circuit.

The front panel remote programming indicator is controlled by op amp U8 -1 during remote current limit programming. Operation is the same as that described above in the remote voltage programming section except that diode CR15 is replaced by diode CR16.

Over Temperature Shutdown Circuit

The Over Temperature Shutdown circuit monitors the temperature of the bridge heatsink and the output heatsink, using temperature sensor RT1. When the heatsink temperature reaches approximately 100 °C, the output of U8-3 goes positive. This activates the PWM shutdown lines through diode CR27. The front panel OTP LED is illuminated through resistor R17. The Shutdown Circuit resets automatically when the heatsink temperature falls to a safe value. The output of U8-3 goes negative, deactivating the PWM shutdown lines.

3.2 Meter Circuit (A1 Assembly)

The A1 assembly is comprised of the voltmeter and ammeter displays, the output voltage and current limit controls, the local operation OVP adjusting potentiometer and the indicator LEDs. The operation of the voltage and current controls, the OVP potentiometer and the indicator LEDs is covered in the A2 description in **Section 3.1**. Refer to the A1 schematic assembly in **Figure 5.3-1** for the following discussion.

3.2.1 Voltmeter

U2 is a 3 1/2 digit analog to digital converter which converts the analog input from the A2 board voltage control circuit to a digital display on seven segment displays DS5-DS8 (maximum display is 1999). The 6.2V reference from pin 5 of connector J1 is divided down by resistors R16 and R17 and potentiometer R18 to provide the reference for the converter. The analog input from the voltage control circuit (via pin 6 of connector J1) is filtered by resistor R9 and capacitor C14 before it is input to pin 31 of the converter. Capacitor C12 and resistor R7 set the conversion frequency to approximately 3 times per second. Resistors R8, R11, and R12 are used to select the appropriate decimal point position depending on the model of the power supply.

3.2.2 Current Meter

The current meter circuit operates in the same manner as the voltage meter circuit with U1 performing the conversion for display on DS1-DS4. Capacitors C4 and C6 provide additional filtering on the meter analog input. Resistors R2, R5, and R6 are used to select the appropriate decimal point.

4. MAINTENANCE, TROUBLESHOOTING, AND CALIBRATION

4.1 General

> **WARNING**
> **POTENTIALLY LETHAL VOLTAGES EXIST IN THE POWER CIRCUIT AND THE OUTPUT OF HIGH VOLTAGE MODELS.** Filter capacitors store potentially dangerous energy for some time after power is removed. Repairs should be attempted by experienced technical personnel only. Be sure to isolate the power supply from the input line with an isolation transformer when using grounded test equipment such as an oscilloscope in the power circuit.

This section provides maintenance, calibration and troubleshooting information.

4.2 Periodic Service

No routine service except for periodic cleaning is required. Whenever a unit is removed from service, it should be cleaned, using naphtha or an equivalent solvent on the metal surfaces, and a weak solution of soap and water for the front panel. Low pressure compressed air may be used to blow dust from in and around components on the printed circuit boards.

4.3 Servicing Precautions

Always disconnect power, discharge circuits, and remove external voltage sources before making internal adjustments or replacing components. When performing internal adjustments or servicing the power supply, ensure another person with first aid and resuscitation certification is present. Repairs must be made by experienced technical personnel only.

4.4 Troubleshooting

Units requiring repair during their warranty period should be returned to the manufacturer for service. Unauthorized repairs performed by anyone other than Xantrex during the warranty period may void the warranty. Any questions regarding repair should be directed to the Service Department.

4.4.1 Preliminary Checks

If the power supply displays any unusual or erratic operation, shut the power supply off immediately and disconnect it from the AC power source. Check all load, programming, and monitoring connections and circuits. Check the AC input for correct voltage and frequency. Correct any problems found and retest the system. If no problems are found or the unit fails to operate correctly upon retesting, proceed with internal troubleshooting as described below.

4.4.2 Internal Troubleshooting

After reading the cautions in **Section 4.3** and completing the preliminary checks described in **Section 4.4.1**, remove the cover and proceed with internal troubleshooting, using the information contained in **Figure 4.4-1** as a guide, to isolate the problem to a specific area of the circuit. Refer to the schematics in **Section 5** and the theory of operation in **Section 3** for additional information.

4.5 Calibration

Calibration on both the A1 and A2 assemblies is accomplished using multiturn trimpots. The list below gives the circuit designation of the trimpot and the parameter affected by that part. Calibration is performed at the factory during testing and recalibration should be unnecessary unless major repairs are required. Calibration should be done with the cover on through the access holes in the cover. See **Figure 4.5-1** below.

TABLE 4.5-1 CIRCUIT DESIGNATION		
CIRCUIT DESIGNATION	ASSEMBLY	PARAMETER AFFECTED
R7	A2	Output Current Monitor Calibration
R46	A2	Output Current Monitor Offset
R47	A2	Current Control Circuit Offset
R48	A2	Output Current Range
R52	A2	Voltage Control Circuit Offset
R53	A2	Output Voltage Range
R18	A1	Front Panel Voltmeter Calibration
R15	A1	Front Panel Ammeter Calibration

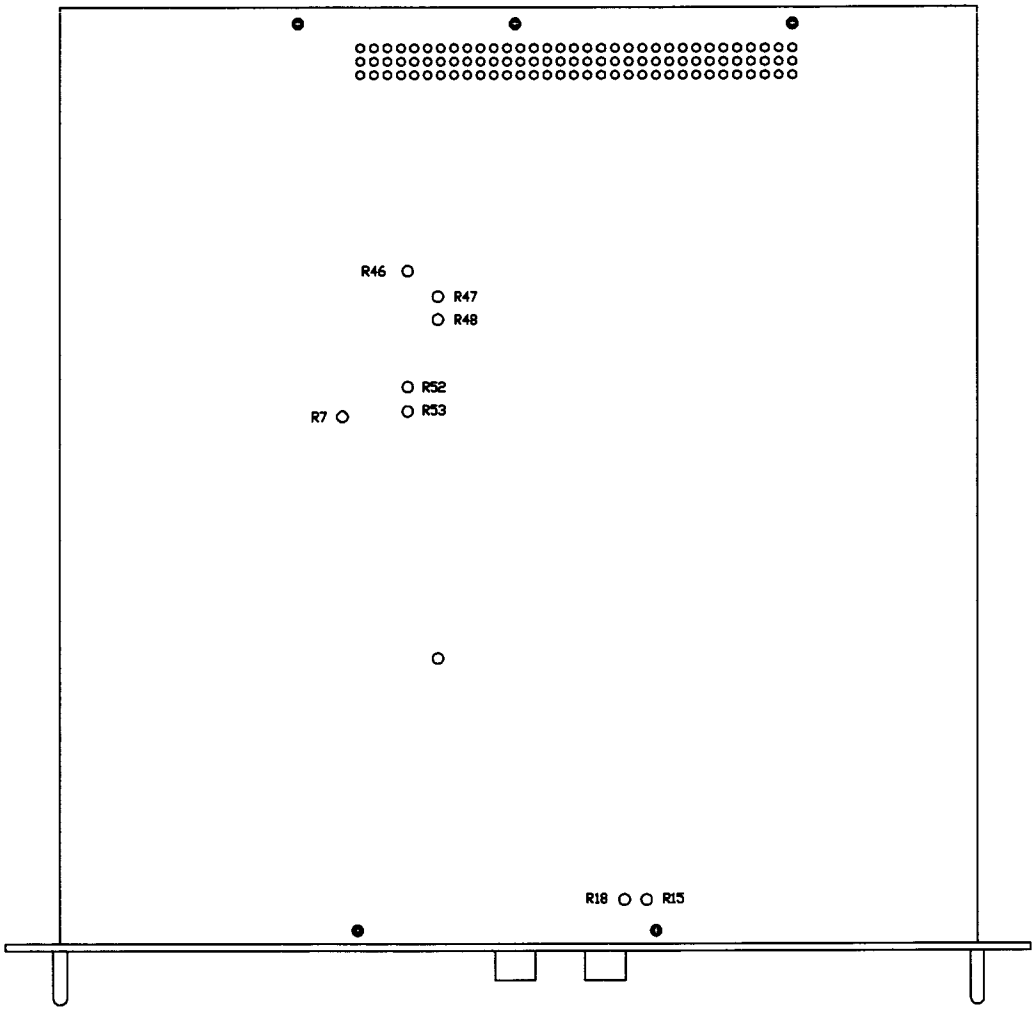


Figure 4.5-1 Calibration Adjustment Locations

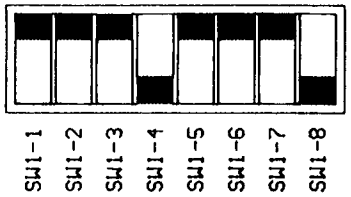
TROUBLESHOOTING GUIDE

CAUTION

READ SECTION 4.3 BEFORE PROCEEDING AND PERFORM
THE PRELIMINARY CHECKS IN SECTION 4.3.1

SWITCH SW1

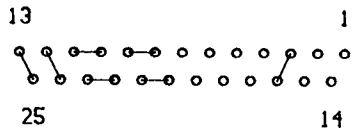
OFF



ON

SETUP
TURN THE POWER SWITCH OFF
DISCONNECT THE UNIT FROM THE AC SOURCE
DISCONNECT THE LOAD FROM THE OUTPUT TERMINALS
DISCONNECT ANY PROGRAMMING OR MONITOR LINES
CONFIGURE SWITCH SW1 AND CONNECTOR J3 FOR LOCAL CONTROL
(SEE DIAGRAMS AT LEFT AND RIGHT FOR SETTINGS AND CONNECTIONS)
SET VOLTAGE AND CURRENT CONTROLS FULLY CLOCKWISE
CONNECT THE UNIT TO THE AC SOURCE THROUGH AN ISOLATION TRANSFORMER
TURN UNIT ON

CONNECTOR J3



CONNECTIONS FOR LOCAL
CONTROL AND SENSING

SWITCH POSITIONS FOR

CHECK DC VOLTAGE AT U6 PIN 16

HIGH → CHECK ANODE CR24

- HIGH → OVP SHUTDOWN CHECK U3-2
- LOW → CHECK ANODE CR11
  - HIGH → REMOTE SHUTDOWN CHECK U1
  - LOW → CHECK ANODE CR27
    - HIGH → THERMAL SHUTDOWN CHECK RT1, U8-3
    - LOW → CHECK ANODE CR32
      - HIGH → AC AUXILIARY INPUT LOW CHECK CR20, Q5, T4
      - LOW → CHECK ANODE CR33
        - HIGH → +12V LOCKOUT CHECK Q6
        - LOW → CHECK ANODE CR 26
          - HIGH → CURRENT PROGRAM ERROR SHUTDOWN CHECK U4-1

LOW → CHECK THE DC VOLTAGE AT THE CATHODE OF DIODE CR18

- LOW → REPLACE U6
- HIGH → CHECK THE DC VOLTAGE AT CONNECTOR J3 PINS 9 AND 11
  - LESS THAN 5V → CHECK 1mA CURRENT SOURCES U2-1,U2-2,Q1,Q2
  - APPROX. 5V → CHECK THE VOLTAGE AT THE ANODE OF DIODE CR18
    - LOW → CHECK VOLTAGE CONTROL CIRCUIT U5,U7-2
    - HIGH → CHECK CURRENT CONTROL CIRCUIT U4-2,U4-3,U4-4,U7-1

Figure 4.4-1

5. SCHEMATICS AND PARTS LISTS

5.1 General

WARNING

Exercis e caution when us ing and s ervicing power s upplies . High energy levels can be stored at the output voltage terminals on all power supplies in normal operation. In addition, potentially lethal voltages exist in the power circuit and the output connector of power s upplies which are rated at 40V and over. Filter capacitors store potentially dangerous energy for some time after power is removed.

This section provides schematic drawings and parts lists for the following assemblies:

- A1 Front panel assembly
- A2 Power assembly
- Chassis and cover

Most assembl ies consist of parts common to al l series model s as wel l as parts which are model -specific. or differential.

5.2 Parts Ordering

Do not substitute parts without first checking with the manufacturer. Order parts from the factory using the information in the fol l owing sections. When ordering parts. pl ease incl ude the model number and serial number of the unit with your order.

5.3 A1 Front Panel Assembly Replacement Parts

TABLE 5.3-1 A1 FRONT PANEL ASSEMBLY REPLACEMENT PARTS

Designation	Description	Part #
C1,9	10µF 25V 20% 2.5mm Tantalum Cap	CJ-100D-25
C2,12	100pF 100V Z5F 10% 5mm Ceramic Radial Cap	CB-101F-16
C3-7,10,11,13-15,17, 18-22	0.33µF 50V Z5U -20% to +80% 5mm Ceramic Cap	CC-334F-09
C8,16	0.1µF 100V MF 10% 10mm Radial Cap	CD-104J-16
CB1	125/250Vac 20A Circuit Breaker, Button Reset	SB-1205-ACBQ
CR1,7,8	T-1 3/4 20mcd @ 20mA Red round LED	DS-5103-R2
For CR1-8	0.25" x 0.2" insulating standoff	MR-625I-03
CR2,6	T-1 3/4 3.0mcd @ 10mA Green round LED	DS-5173-G2
CR3,5	Red Rectangular LED 2.5 x 5mm	DS-5556-R6
CR4	Green Rectangular LED 2.5 x 5mm	DS-0394-G6
DS1,2,3,4,5,6,7,8	Orange 7 segment display (DS4 and DS8 not installed on some models)	DS-1131-O7
For DS1,2,3,5,6,7,8	20 posn socket strip, 0.1" single row	MC-2001-IC
PCB	A1 PCB	PC-1001-D
For PCB	6-32 x 3/16" Nylon Allen Socket Head Screw	MS-6A37-03
	8-32 x 1/2" Philips Flathead	MS-8P18-08
P1	20 Pin Male MTA Pin header 0.1" Friction Lock	MC-2003-MC
P2	9 Pin MTA Pin header 0.1" Friction Lock	MC-0903-MC
R1,3,7,9	100kΩ 1% 1/4W MF	R-1003-41
R2,5,6,8,11,12	365Ω 1% 1/4W CF Decimal point resistors (Not all installed)	R-3650-41

Continued on next page.

5.3 A1 Front Panel Assembly Replacement Parts

TABLE 5.3-1 A1 FRONT PANEL ASSEMBLY REPLACEMENT PARTS		
Designation	**Description**	**Part #**
R4 (8V,20V,40V,60V, 80V Models)	47.5kΩ 1% 1/4W	R-4752-41
R4 (150V,300V,600V Models)	475kΩ 1% 1/4W	R-4753-41
R10	475kΩ 1% 1/4W MF	R-4753-41
R13 (8,20,33,40,60,80 150, 600V Models)	100Ω 1% 1/4W MF	R-1000-41
R13 (300V Model)	1kΩ 1% 1/4W MF	R-1001-41
R13A	Empty Position	R-EMPT
R14 (8V Model)	34.8kΩ 1/4W 1% MF	R-3482-41
R14 (20,33,40,60,80, 150,600V Models)	6.19kΩ 1/4W 1% MF	R-6191-41
R14 (300V Model)	2.37kΩ 1/4W 1% MF	R-2371-41
R15,18	500Ω 25 Turn 10% Cermet Pot Type "Z"	RC-5000-Z8
R16	750Ω 1/4W 1% MF	R-7500-41
R17	4.99kΩ 1% 1/4W MF	R-4991-41
R19,20	5kΩ 10T 2W 5% Panel Mount 1/4" Shaft Potentiometer	RP-5001-0
For R19,20	#24 Bus Wire Tinned Cu	WB-0024-0010
R21,R21A	5kΩ 20 Turn 10% Cermet Pot Type "Y" (one installed)	RC-5001-Y9
R22	200Ω 1% 1/4W	R-2000-41
U1,2	3.5 Digit A/D LED driver 40P 7107 CMOS	UD-7107-C
For U1 and U2	20 posn socket strip, 0.1" single row	MC-2001-IC
	Front panel sheet metal 1.71" x 19"	SM-10FP
Front panel mounting	#8-32 x 1" Hex Standoff Brass/CAD plated	MR-825T-16
	#8 x 5/16" Internal Lockwasher Stainless Steel	MW-8110
F/P to base,subplate	#4-40 x 1/4" Undercut Flathead Philip Stainless Steel	MS-4P30-04
For front panel	#4 Angle bracket	MB-0612-04
For bracket	#4-40 x 1/4" KEP Nut Stainless Steel	MN-440Z-08
	Handle	MH-8125-BA
For handle	#8-32 x 1/2" Philips Flathead Stainless Steel	MS-8P18-08
	Front panel control knobs	MK-4094-SB
AC power switch	20A 250V DPST Rocker Switch	SW-2126-RR2
	Front panel label XKW 8-125	LA-1008-XF
	Front panel label XKW 20-50	LA-1020-XF
	Front panel label XKW 33-33	LA-1033-XF
	Front panel label XKW 40-25	LA-1040-XF
	Front panel label XKW 60-18	LA-1060-XF
	Front panel label XKW 80-13	LA-1080-XF
	Front panel label XKW 150-7	LA-1150-XF
	Front panel label XKW 300-3.5	LA-1300-XF
	Front panel label XKW 600-1.7	LA-1600-XF

5.4 A2 Power Assembly Replacement Parts

5.4.1 A2 PCB Common Parts

TABLE 5.4-1 A2 PCB COMMON PARTS		
Designation	**Description**	**Part #**
C1,4,73	1μF 250Vac 10% 27.5mm MF "X" Radial Cap	CD-105P-36
C2,3,5,6	10nF 250Vac 10% 15mm MF "Y" Radial Cap	CD-103L-36
C7,11	470μF 35V 20% 5mm 13 x 25mm Electrolytic Radial Cap	CL-471F-35
Continued on next page.		

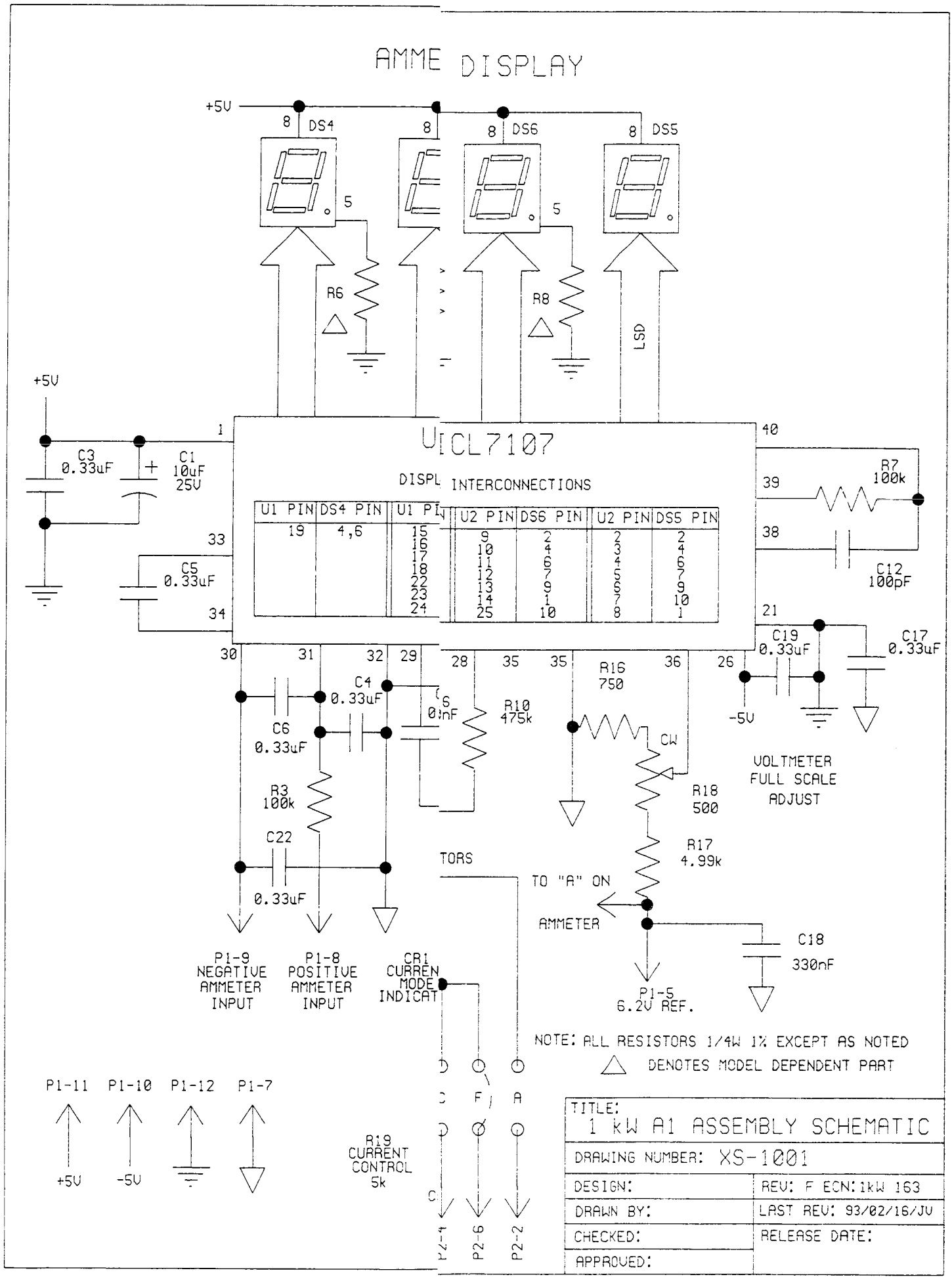


Figure 5.3-1

XS1001F.SCH

5.4 A2 Power Assembly Replacement Parts

5.4.1 A2 PCB Common Parts

TABLE 5.4.1 A2 PCB COMMON PARTS (CONTINUED)

Designation	Description	Part #
C8,16-18,18A,19,20, 20A,20B,20C,23,23A, 24-26,28,29A,30,31, 31A,32,33,35,35B, 36-39,41,56,56A, 57-59,64A,65,67,68,74, 76,77,80	0.33µF 50V Z5U -20% to +80% 5mm Ceramic Cap	CC-334F-09
C9	2200µF 16V 20% 5mm 13 x 25mm Electrolytic Radial Cap	CL-222F-16
C10	1000µF 35V 7.5mm 16 x 2.5mm Electrolytic Radial Cap LS	CL-102H-35
C12-15,66	10µF 50V 2mm Electrolytic Radial Cap	CL-100C-50
C21,22	10nF 100V X7R 10% 5mm Ceramic Radial Cap	CB-103F-16
C22A,26A	0.1µF 50V X7R 10% 5mm Ceramic Cap	CB-104F-06
C29,30A,34,40,42	100pF 100V Z5F 10% 5mm Ceramic Radial Cap	CB-101F-16
C35A,63,63A	1nF 100V X7R 10% 5mm Ceramic Radial Cap	CB-102F-16
C43,44	10µF 25V 20% 2.5mm Tantalum Cap	CJ-100D-25
C46	10nF 1kV Z5U -20% to +80% 10mm Ceramic Cap	CC-103J-69
C47	10µF 63V 2.5mm Electrolytic Cap	CL-100D-63
C61	220pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-221F-16
C69	330pF 1KV Z5F 10% 6.5mm Ceramic Cap	CB-331G-66
C70,70A	0.33µF 400V 10% 22.5mm Ceramic Radial Cap	CD-334N-46
C71,71A,71B,72,72A, 72B	1000µF 200V 10mm 20% 35mm x 30mm Snap-in Cap	CL-102J-8030
C78,79	50nF 1kV Z5U -20% to +80% 10mm Ceramic Cap	CC-503J-69
CR1,17	1N825A 6.2V 400mW VZ DO35 Zener Diode	CR-0825-A
CR1A,1B	0Ω Jumper 1/4W Resistor size	R-0000
CR2-13,3A,9A,15,16, 17A,18,19,21,21A,24, 25,25A,27-30,32-34, 38,39	1N4148 UR D035 75V 300mA Diode	CR-4148
CR14,36,37,40,41,43	1N4004 400V 1A Diode	CR-4004
CR20	1N5242B 12V 5% 0.5W Zener Diode	CR-5242-B
CR23	1N753A 6.2V Zener Diode	CR-0753-A
CR23A	1N5336B 4.3V 5W 5% Zener Diode	CR-5336-B
CR27A	1N4372A 3.0V 400mW Zener Diode	CR-4372-A
CR31	1N5355B 18V 5W Zener Diode	CR-5355-B
CR35	800V 35A Bridge Rectifier Chassis-mounted	CR-B358
For CR35	#6 x 5/16" Flatwasher Stainless Steel	MW-6410-SS
For CR35	Therm.Conduct Insul Adh Back 12" x 125	MI-7403-09
For mntg CR35	#6-32 x 1/4" KEP Nut Stainless Steel	MN-632Z-08
CR42	200V 1A 4 pin DIP Bridge Rectifier	CR-B012
CR44	1N754 6.8V 500mW Zener Diode	CR-0754
DS1	Neon bulb 65Vac 40mA	DS-65NE-29
F1	20A 250V 3AG Fuse (slow)	F2-2000-S
For F1,F2	3AG Fuse clip BeCu PC Mount	MC-3101-FC
F2	0.5A 250V 3AG Fuse (slow)	F2-0050-S
F3	10A 250V 5AG Fuse (fast)	F2-1000-F5
For F3	5AG Tin Plate Brass Fuse clip PC Mount	MC-5011-FC
J1	20 Pin MTA Connector (Female) 0.1" with 7.5" Ribbon cable	WA-2022-15
J2,for J1	20 Pin 0.1" MTA male Header Friction Lock	MC-2003-MC
J3	25 Pin female PCB mount DSUB	MC-2501-D

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.1 A2 PCB Common Parts

TABLE 5.4.1 A2 PCB COMMON PARTS (CONTINUED)		
Designation	**Description**	**Part #**
For J3	DSUB F/M Screwlock Assy #4-40 kit	MA-440D-FS
Mates to J3	25 pin male DSUB Connector, solder cup	MC-2500-D
For mntg DSUB mating connector	#4-40 x 1/4" PPM Head Screw Stainless Steel	MS-4P28-04
For J3 connector jumpers	#22 Bus wire Tinned Cu	WB-0022-0010
K1	T90 Relay 250V 30A SPST 12V Coil	K1-012D-30AP
L1,L2	1mH 20A Common Mode Inductor	L2-0120
L4	ETD34 N27 Ferrite core Gapped in 8V and 20V models	FD-2400-34
L5	Sense Line Common Mode Inductor	X7-1SNS
For L5	0.5" x 0.25" Toroid (Ferrite)	FT-0525
PCB	A2 PCB Rev G	PC-1002-G
P1	4 Pin Mate-N-Lock PCB Header	MC-3502-ML
P2	2 Pin Mate-N-Lock PCB Header	MC-0209-ML
Q1,2,3,4	XX2907A PB 60V 0.5mA 400mW TO92	QN-2907-A
Q2A,5B	2N7000 NM 60V 500mA TO226AA	QJ-7000
Q5	PN2222A NB 40V 500mA 500mW TO92	QM-2222-A
Q6-12	RFD14N05 NFET 14A 50V 0.1Ω TO251	QF-P14N-05
Q13-16	IRFP450 500V 0.4W NMOS FET TO247	QF-450P-IR
For Q13-16	TO247 Insulating Washers	MI-T247-IW
For Q13-16	Heatsink	HS-1000-B
	#6-32 x 5/8" PPM Screw Stainless Steel	MS-6P28-10
	#6-32 x 9/32" W x 0.065" H Captive Nut	MN-632C-09
	#6 x 1/4" Internal Lockwasher Stainless Steel	MW-6108-SS
	#6 x 5/16" Plated Flatwasher Stainless Steel	MW-6410-SS
	#6-32 x 1/4" Pan Head Stainless Steel	MS-6P28-04
	#4-40 x 1/4" Kep Nut Stainless Steel	MN-440Z-08
R1,3,49,51,56,75,77,96	4.99kΩ 1% 1/4W MF	R-4991-41
R2,11-15,17,40,45,82, 123	750Ω 1% 1/4W	R-7500-41
R3A,22A	75kΩ 1% 1/4W MF	R-7502-41
R4,6,19,21,28A,32,39, 61,74,76,97,102	1kΩ 1% 1/4W MF	R-1001-41
R5,8,8A,20,23-25,28, 57,58,60,62,65,69,80, 81,81A,103,105	10kΩ 1% 1/4W MF	R-1002-41
R7,46,48,52	10kΩ Multiturn 10% Cermet trimpot "Y" Type	RC-1002-Y9
R7A,63,66,67	20kΩ 1% 1/4W	R-2002-41
R8B,8C,12A,78	Empty Position	R-EMPT
R9,10,55	100kΩ 1% 1/4W MF	R-1003-41
R16	121Ω 1% 1/4W	R-1210-41
R18,19A,54,119,119A, 120,125	1MΩ 1% 1/4W	R-1004-41
R26,79	2kΩ 1% 1/4W MF	R-2001-41
R29,94	49.9kΩ 1% 1/4W MF	R-4992-41
R30	665kΩ 1% 1/4W	R-6653-41
R31,41,43,84	3.01kΩ 1% 1/4W MF	R-3011-41
R33	20MΩ 5% 1/4W CF	R-2005
R34	787kΩ 1% 1/4W MF	R-7873-41

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.1 A2 PCB Common Parts

TABLE 5.4.1 A2 PCB COMMON PARTS (CONTINUED)		
Designation	**Description**	**Part #**
R35	200kΩ 1% 1/4W MF	R-2003-41
R36,50	100Ω 1% 1/4W MF	R-1000-41
R37	1kΩ 5% 1/2W CF	R-1001-3
R38	5.1kΩ 5% 5W WW	RW-5101-5
R42	3.24kΩ 1% 1/4W MF	R-3241-41
R44	10Ω 1% 1/4W MF	R-10R0-41
R47	500Ω 20T "Y" Trimpot 10%	RC-5000-Y9
R53	5kΩ 20T 10% Cermet Trimpot "Y" Type	RC-5001-Y9
R57A	365kΩ 1% 1/4W	R-3653-41
R59	8.66kΩ 1% 1/4W MF	R-8661-41
R83,124	243Ω 1% 1/4W MF	R-2430-41
R87,88	100Ω 5% 5W WW	RW-1000-5
R98	10Ω 5% 1/2W CF	R-10R0-3
R99,101	47.5Ω 1% 1/4W MF	R-47R5-41
R103A	16Ω 5% 1W MF	R-16R0-1
R104,106	100Ω 5% 1/2W CF	R-1000-3
R111-113	470Ω 5% 5W WW Low inductance	RN-4700-5
R114,115	10kΩ 5% 5W WW	RW-1002-5
R116	39Ω 5% 5W WW	RW-39R0-5
R117,118	301kΩ 1% 1/4W	R-3013-41
RT1	NTC Axial Lead Temp. Sensor 100k @ 25°C TO92	RT-1003-89
For RT1A, for L5	#22 TR64 Stranded Black Wire, Twisted	WI-0122-BK
For RT1B, for L5	#22 TR64 Stranded Red Wire, Twisted	WI-0122-RD
SW1	8PST DIP Rocker Switch 5V 0.06A	SW-8156-RU3
For SW1	16 pin DIL IC Socket	MC-0016-IC
T2	100kHz Bridge drive Transformer 1:1	T2-10DR
T3	Current sense Transformer	T2-10SN
T4	Auxiliary Transformer 110/220 16CT 12VA	T-1612-60
TB1	AC input barrier strip	MC-026R-BS
For TB1	Insulating cover	MI-026R-CR
U1	4N35 Opto-coupler 6 pin DIP 3550V Isolation	UP-4N35
U2	LF353 Dual op amp 8 pin DIP FET	UA-0353-N
For U2,3,5	8 pin DIL IC Socket	MC-0008-IC
U3	LM358 Dual Op amp 8 pin DIP	UA-0358-N
U4,8	LF347N Quad JFET Op amp 14 pin DIP	UA-0347-N
For U4,7,8	14 pin DIL IC Socket	MC-0014-IC
U5	LF351 Op amp 8 pin DIP	UA-0351-N
U6	UC3846N IMODE PWM 16 pin DIP	UR-3846-N
For U6	16 pin DIL IC Socket	MC-0016-IC
U7	4066B Quad analog gate 14 pin DIP	UC-4066-BN
U9	LM337 3T regulator (negative) TO-220 1.5A	UR-0337-T
U10,11	LM2940CT Low saturation 3T regulator TO-220 5V	UR-2940-CT
For U10,11,AC connector	#6-32 x 1/4" KEP Nut Stainless Steel	MN-632Z-08
	#4-40 x 1/4" Phillips PAN Stainless Steel	MS-4P28-04
For U10,11,AC connector	TO220 Heatsink	HS-6021-PB
	Air dam (10 mil Nomex)	SP-10AD

5.4 A2 Power Assembly Replacement Parts

5.4.1 A2 PCB Common Parts

TABLE 5.4-2 OUTPUT BUS BAR COMMON PARTS (8V TO 80V MODELS)		
Designation	**Description**	**Part #**
For bus bar cover	#4 Angle Bracket	MB-0612-04
For PCB to bus bar	#6-32 Right Angle Bracket	MB-0614
For RA bracket	1/8" Copper Rivets	MP-0205
	#6 Nylon Shoulder Washer	MI-0635-SW
Chassis ground to PCB	#4-40 x 7/32" Captive Nut PCB Mount	MN-440C-07
For captive nut	#4 x 0.265" OD Internal Lockwasher Stainless Steel	MW-4108-SS
	#4 x 9/32" Plated Flatwasher Stainless Steel	MW-4409-SS
For chassis ground, bus bar cover	#4-40 x 1/4" Phillips PAN Stainless Steel	MS-4P28-04
For bus bars to RFI PCB and chassis	#6-32 x 3/8" PPM Stainless Steel	MS-6P28-06
For bus bars to chassis	#6-32 x 7/16" PPM Stainless Steel	MS-6P00-07
PCB	Output Bus Bar PCB Rev. C	PC-10RF-C
For mntg PCB	#6-32 x 16" Nylon Allen Socket Head 7/64"	MS-6A37-03
For bus bars to PCB	#6-32 x 5/16" Phillips PAN Stainless Steel	MS-6P28-05
	#6-32 x 1/4" KEP Nut Stainless Steel	MN-632Z-08
For PCB, bus bar	#6 x 1/4" Internal Lockwasher Stainless Steel	MW-6108-SS
	#6 x 5/16" Plated Flatwasher Stainless Steel	MW-6410-SS

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS (ALL MODELS)		
Designation	**Description**	**Part #**
	MODEL XKW 8-125	
C27,54,62	10nF 100V X7R 10% 5mm Ceramic Radial Cap	CB-103F-16
C51-53	22000µF 10V 10mm 30 x 35mm Electrolytic Cap	CE-223J-10
C55	22nF 100V X7R 10% 5mm Ceramic Cap	CB-223F-16
C60,64	330pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-331F-16
C61	220pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-221F-16
C301	10nF 1kV Z5U -20% to +80% 10mm Ceramic Radial Cap	CC-103J-69
C302	1nF 1kV X7R 10% 6.5mm Ceramic Radial Cap	CC-102G-66
C306	0.05µF 1kV Z5U -20% to +80% 10mm Ceramic Disk Cap	CC-503J-69
For C306	#6 Bent, Locking Solder lug	MC-6213-SL
For C306	#6-32 x 1/2" PPM Stainless Steel screw	MS-6P28-08
For C306	#6 x 5/16" Plated Flatwasher Stainless Steel	MW-6410-SS
For C306 and heatsink	#6 Nylon Shoulder Washer 0.25" x 3/8"	MI-0625-SW
CR49-52	Empty Diode Position	CR-EMPT
CR301-302	MBR 30045 300A 45V Dual Schottky Rectifier	CR-3004-PT
For CR301-302	1/4-20 x 3/8" Brass Screw	MS-7S27-06
For CR301-302	1/4-20 x 1/2" Brass Screw	MS-7S27-08
L3	Output Inductor 12.5mH 125A	L2-1008
Q5A	PN2222A 40V 500mA 500mW TO92	QM-2222-A
Q17	IRF640 200V 18A 0.18W NFET TO220	QF-0640-IR
R22	4.53kΩ 1% 1/4W MF	R-4531-41
R27,95A	475Ω 1% 1/4W MF	R-4750-41
R64,107-110	10Ω 1% 1/4W MF	R-10R0-41
R68	90.9kΩ 1% 1/4W MF	R-9092-41
R70	47.5kΩ 1% 1/4W	R-4752-41

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS (ALL MODELS)

Designation	Description	Part #
	MODEL XKW 8-125 (CONTINUED)	
R71,73	44.2kΩ 1% 1/4W MF	R-4422-41
R72	1kΩ 1% 1/4W MF	R-1001-41
R85	100Ω 1% 1/4W MF	R-1000-41
R86,107A-110A	0Ω Jumper 1/4W Resistor size	R-0000
R89	13.3kΩ 1% 1/4W MF	R-1332-41
R90	20Ω 5% 5W WW	RW-20R0-5
R91	#12 Manganin wire	WR-0012-MN
R93	0.40Ω 5% 5W WW	RW-R400-5
R95	3.32Ω 1% 1/4W	R-3R32-41
R96A	4.99kΩ 1% 1/4W MF	R-4991-41
R100	10kΩ 1% 1/4W MF	R-1002-41
R301,303	1Ω 5% 5W 100PPM/C Non-inductive	RN-1R00-5
T1	1KVA 100kHz 8V 125A Transformer	T2-1008
	O/P PCB Blank Rev. C	PC-10RF-C
	Negative conductor bus	SM-1000-NC
	Positive conductor bus	SM-1000-PC
	Power Tap Rectifier output bus	SM-1000-RO
Shunt bracket	Inductor O/P, Shunt I/P bus	SM-1000-SB
For shunt bracket	#6-32 x 1/4" KEP Nut Stainless Steel	MN-632Z-08
	#6-32 x 5/16" Phillips PAN Stainless Steel Screw	MS-6P28-05
	Output bus bar (negative)	SM-1000-NB
	Output bus bar (positive)	SM-1000-PB
	10 mil NOMEX insulation	IN-2000-10
	50nF 1kV Z5U -20% to +80% 10mm Ceramic Disk Cap	CC-503J-69
	470µF 16V 20% 5mm Electrolytic Radial Cap	CL-471F-16
C406	2.2µF 63V 5% 15mm Metallized Polyester Cap	CD-225L-D5
For +O/P, -O/P, rectifier O/P, shunt bracket	1/8" copper rivets	MP-0205
	Differential heatsink (tapped)	HS-100T-A2
For rectifier/snubber	1/4" Straight, plain solder lug 12/16"	MC-1312-SL
For snubber parts	#6-32 Insulated solder turret	MR-625C-06
For solder turret	#6-32 x 1/2" PPM Stainless Steel screw	MS-6P28-08
For solder turret, heatsink	#6-32 x 5/8" PPM Stainless Steel screw	MS-6P28-10
	#6 x 1/4" Internal Lockwasher Stainless Steel	MW-6108-SS
	#6 x 5/16" Plated Flatwasher Stainless Steel	MW-6410-SS
	MODEL XKW 20-50	
C27,54,62	10nF 100V X7R 10% 5mm Ceramic Cap	CB-103F-16
C51,52,53	10,000µF 25V 10mm 35 x 30mm Electrolytic Rad Cap	CE-103J-25
C55,60,64	330pF 100V X7R 10% 5mm Ceramic Cap	CB-331F-16
C61	220pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-221F-16
C301	1nF 1kV X7R 10% 6.5mm Ceramic Disk Cap	CB-102G-66
C302	4.7nF 400V 10% 10mm MF Polyester Cap	CD-472J-46
C305,306	50nF 1kV Z5U -20% to +80% 10mm Ceramic Cap	CC-503J-69
For C305,306	#6 Bent, Locking Solder Lug	MC-6213-SL
For C305,306	#6 Nylon Shoulder Washer	MI-0625-SW
For C305,306	#6-32 x 5/8" PPM Stainless Steel screw	MS-6P28-10
CR49-52	Empty Diode Position	CR-EMPT

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS (ALL MODELS)		
Designation	**Description**	**Part #**
	MODEL XKW 20-50 (CONTINUED)	
CR301,302	100A 150V Dual UFR Power Tap Rectifier	CR-UI00-PT
For CR301,302	1/4" - 20 x 3/8" Brass Screw	MS-7S27-06
For CR301,302	1/4" - 20 x 1/2" Brass Screw	MS-7S27-08
For CR301,302	1/4" Straight, plain solder lug	MC-1312-SL
L3	Output Inductor 25mH 50A	L2-1020
Q5A	PN2222A NB 40V 500mA 500mW TO92	QM-2222-A
Q17	IRF640 NM 200V 0.18W 18A NFET TO-220	QF-0640-IR
R22	21kΩ 1% 1/4W MF	R-2102-41
R27,95A	475Ω 1% 1/4W	R-4750-41
R64,107-110	10Ω 1% 1/4W MF	R-10R0-41
R68	90.9kΩ 1% 1/4W MF	R-9092-41
R70	100kΩ 1% 1/4W MF	R-1003-41
R71,73	44.2kΩ 1% 1/4W MF	R-4422-41
R72	1kΩ 1% 1/4W MF	R-1001-41
R85	73.2kΩ 1% 1/4W MF	R-7322-41
R86,107A-110A	0Ω Jumper 1/4W Resistor size	R-0000
R89	47.5kΩ 1% 1/4W MF	R-4752-41
R90	100Ω 5% 5W WW	RW-1000-5
R91	#12 Manganin wire	WR-0012-MN
R93	0.40Ω 5% 5W WW	RW-R400-5
R95	3.32Ω 1% 1/4W	R-3R32-41
R96A	4.99kΩ1% 1/4W MF	R-4991-41
R100	10kΩ 1% 1/4W MF	R-1002-41
R301,303,304	33Ω 5% 3W MF	RA-33R0-6
T1	1KVA 100kHz 20V 50A Transformer	T2-1020
	O/P PCB Blank Rev.C	PC-10RF-C
	Differential heatsink (tapped)	HS-100T-A2
For busbars	10 mil NOMEX insulation	IN-2000-10
	Output bus bar (negative)	SM-1000-NB
	Output bus bar (positive)	SM-1000-PB
For O/P bus bar C401,405	50nF 1kV Z5U -20% to +80% 10mm Ceramic Disk Cap	CC-503J-69
C402,404	10nF 1kV Z5U -20% to +80% 10mm Ceramic Disk Cap	CC-103J-69
C403	100µF 63V 20% 5mm Electrolytic Radial Cap	CL-101F-63
C406	2.2µF 63V 5% 15mm Metallized Polyester Cap	CD-225L-D5
	Negative conductor bus	SM-1000-NC
	Positive conductor bus	SM-1000-PC
	Rectifier output bus	SM-1000-RO
For +O/P, -O/P, rectifier O/P, shunt bracket	1/8" copper rivets	MP-0205
Shunt bracket	Inductor O/P, Shunt I/P bus	SM-1000-SB
For shunt bracket	#6-32 x 1/4" Kep Nut	MN-632Z-08
	#6-32 x 5/16" Philips Pan Stainless Steel	MS-6P28-05
For snubber parts	#6-32 Insulated solder turret	MR-625C-06
For solder turret	#6-32 x 1/2" PPM Stainless Steel Screw	MS-6P28-08
For solder turret, heatsink	#6-32 x 5/8" PPM Stainless Steel Screw	MS-6P28-10
	#6 x 1/4" Internal Lockwasher Stainless Steel	MW-6108-SS
	#6 x 5/16" Plated Flatwasher Stainless Steel	MW-6410-SS

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS (CONTINUED)

Designation	Description	Part #
	MODEL XKW 33-33	
C27,62	10nF 100V X7R 10% 5mm Ceramic Cap	CB-103F-16
C45	100pF 100V Z5F 10% 5mm Ceramic Cap	CB-101F-16
C51,52,53	3300µF 63V 10mm Electrolytic Cap	CE-332J-63
C54	4.7nF 100V X7R 10% 5mm Ceramic Cap	CB-472F-16
C55,60,64	330pF 100V X7R 10% 5mm Ceramic Cap	CB-331F-16
C61	220pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-221F-16
C87	50nF 1kV Z5U -20% to +80% 10mm Ceramic Radial Cap	CC-503J-69
CR49-52	Empty Diode Position	CR-EMPT
L3	Output inductor 45mH 33A	L2-1033
Q5A	PN2222A NB 40V 500mA 500mW TO92	QM-2222-A
Q17	IRF640 NM 200V 0.18W 18A NFET TO220	QF-0640-IR
R22	12.7kΩ 1% 1/4W MF	R-1272-41
R27,95A	475Ω 1% 1/4W MF	R-4750-41
R64,107-110	10Ω 1% 1/4W MF	R-10R0-41
R68	90.9kΩ 1% 1/4W MF	R-9092-41
R70	100kΩ 1% 1/4W MF	R-1003-41
R71,73	44.2kΩ 1% 1/4W MF	R-4422-41
R72	1kΩ 1% 1/4W MF	R-1001-41
R85,89	80.6kΩ 1% 1/4W MF	R-8062-41
R86,107A-110A	0Ω Jumper 1/4W Resistor size	R-0000
R90	390Ω 5% 5W WW	RW-3900-5
R91	#12 Manganin wire	WR-0012-MN
R93	1Ω 5% 5W WW	RW-1R00-5
R95	3.32Ω 1% 1/4W CF	R-3R32-41
R96A	4.99kΩ 1% 1/4W MF	R-4991-41
R100	10kΩ 1% 1/4W	R-1002-41
T1	1KVA 100kHz 33V 33A Transformer	T2-1033
	Differential heatsink (tapped)	HS-100T-A2
	Output bus bar (negative)	SM-1000-NB
	Output bus bar (positive)	SM-1000-PB
For O/P bus bar C401,405	50nF 1kV Z5U -20% to +80% 10mm Ceramic Disk Cap	CC-503J-69
C403	100µF 63V 20% 5mm Electrolytic Cap	CL-101F-63
C406	1µF 250V 10% 15mm Metal Film Cap	CD-105L-26
	Negative conductor bus	SM-1000-NC
	Positive conductor bus	SM-1000-PC
For +O/P, -O/P, rectifier O/P, shunt bracket	1/8" copper rivets	MP-0205
Shunt bracket	Inductor O/P, Shunt I/P bus	SM-1000-SB
For shunt bracket	#6-32 x 1/4" Kep Nut Stainless Steel	MN-632Z-08
	#6-32 x 5/16" Philips Pan Stainless Steel screw	MS-6P28-05
	Rectifier/snubber PCB Rev D	PC-100R-D1
For rectifier PCB	9 mil Thermally conductive insulating sheet	MI-7403-09
	#6-32 x 0.125" PCB Mount Captive standoff	MR-632R-02
	#6-32 x 5/8" PPM Stainless Steel Screw	MS-6P28-10
	#6 x 1/4" Internal Lockwasher Stainless Steel	MW-6108-SS
	#6 x 5/16" Plated Flatwasher Stainless Steel	MW-6410-SS
	O/P PCB Blank Rev.C	PC-10RF-C

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS

Designation	Description	Part #
	MODEL XKW 33-33 (CONTINUED)	
C301	1nF 1kV X7R 10% 6.5mm Ceramic Cap	CB-102G-66
C303,304	330pF 1kV Z5F 10% 6.5mm Ceramic Cap	CB-331G-66
C305	50nF 1kV Z5U -20% to +80% 10mm Cer Rad Cap	CC-503J-69
For mounting C305	#6 x 3/16" Bent Locking Solder Lug	MC-6213-SL
	#6 x 3/8" Nylon Shoulder Washer	MI-0625-SW
CR301,302	600V 30A MUR3060PT DUR TO218	CR-3060-UD
R301-306	33Ω 5% 3W MF	RA-33R0-6
	MODEL XKW 40-25	
C27,62	10nF 100V X7R 10% 5mm Ceramic Cap	CB-103F-16
C45	470pF 100V X7R 10% 5mm Ceramic Cap	CB-471F-16
C51,52,53	3300µF 63V 10mm Electrolytic Cap	CE-332J-63
C54	4.7nF 100V X7R 10% 5mm Ceramic Cap	CB-472F-16
C55,60	330pF 100V X7R 10% 5mm Ceramic Cap	CB-331F-16
C61	220pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-221F-16
C64	1nF 100V X7R 10% 5mm Ceramic Cap	CB-102F-16
C78A,87 (+C53 to safety ground)	50nF 1kV Z5U -20% to +80% 10mm Ceramic Radial Cap	CC-503J-69
CR49-52	Empty Diode Position	CR-EMPT
L3	Output inductor 100mH 25A	L2-1040
Q5A	PN2222A NB 40V 500mA 500mW TO92	QM-2222-A
Q17	IRF640 NM 200V 0.18W 18A NFET TO-220	QF-0640-IR
R22,100	10kΩ 1% 1/4 MF	R-1002-41
R27,95A	475Ω 1% 1/4W MF	R-4750-41
R64,107-110	10Ω 1% 1/4W MF	R-10R0-41
R68	90.9kΩ 1% 1/4W MF	R-9092-41
R70	200kΩ 1% 1/4W MF	R-2003-41
R71,73	44.2kΩ 1% 1/4W MF	R-4422-41
R72	1kΩ 1% 1/4W MF	R-1001-41
R85	84.5kΩ 1% 1/4W MF	R-8452-41
R86,107A, 110A	0Ω Jumper 1/4W Resistor size	R-0000
R89	100kΩ 1% 1/4W MF	R-1003-41
R90	390Ω 5% 5W WW	RW-3900-5
R91	#12 Manganin wire	WR-0012-MN
R93	1Ω 5% 5W WW	RW-1R00-5
R95	3.32Ω 1% 1/4W	R-3R32-41
R96A	4.99kΩ 1% 1/4W MF	R-4991-41
T1	1KVA 100kHz 40V 25A Transformer	T2-1040
	Differential heatsink (tapped)	HS-100T-A2
	Output bus bar (negative)	SM-1000-NB
	Output bus bar (positive)	SM-1000-PB
For O/P bus bar C401,405	50nF 1kV Z5U -20% to +80% 10mm Ceramic Disk Cap	CC-503J-69
C403	100µF 63V 20% 5mm Electrolytic Radial Cap	CL-101F-63
C406	1µF 250V 10% 15mm Radial Cap	CD-105L-26
	Rectifier/snubber PCB Rev D	PC-100R-D1
For rectifier PCB	9 mil Thermally conductive insulating sheet	MI-7403-09
	#6-32 x 0.125" PCB Mount Captive standoff	MR-632R-02
	#6-32 x 5/8" PPM Stainless Steel Screw	MS-6P28-10

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS

Designation	Description	Part #
	MODEL XKW 40-25 (CONTINUED)	
	#6 x 1/4" Internal Lockwasher Stainless Steel	MW-6108-SS
	#6 x 5/16" Plated Flatwasher Stainless Steel	MW-6410-SS
C301	1nF 1kV X7R 10% 6.5mm Ceramic Radial Cap	CB-102G-66
C305	50nF 1kV Z5U -20% to +80% 10mm Ceramic Cap	CC-503J-69
For C305	#6 Bent Locking Solder Lug 3/16"	MC-6213-SL
	O/P PCB Blank Rev.C	PC-10RF-C
CR301,302	600V 30A MUR3060PT DUR TO218	CR-3060-UD
R301-R304	68Ω 5% 3W MF	RA-68R0-6
	MODEL XKW 60-18	
C20B	0.33µF 50V Z5U +80% to -20% 5mm Cer Rad Cap	CC-334F-09
C27,62	10nF 100V X7R 10% 5mm Ceramic Cap	CB-103F-16
C45	1nF 100V X7R 10% 5mm Ceramic Cap	CB-102F-16
C51,52,53	3300µF 63V 10mm Electrolytic Cap	CE-332J-63
C54	4.7nF 100V X7R 10% 5mm Ceramic Cap	CB-472F-16
C55,60,64	330pF 100V X7R 10% 5mm Ceramic Cap	CB-331F-16
C61	220pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-221F-16
C78A,87 (+C53 to safety ground)	50nF 1kV Z5U +80% to -20% 10mm Ceramic Rad Cap	CC-503J-69
CR49-52	Empty Diode Position	CR-EMPT
L3	Output inductor 193mH 18A	L2-1060
Q5A	PN2222A NB 40V 500mA 500mW TO92	QM-2222-A
Q17	IRF640 NM 200V 0.18W 18A NFET TO-220	QF-0640-IR
R22	6.34kΩ 1% 1/4W MF	R-6341-41
R27,95A	475Ω 1% 1/4W MF	R-4750-41
R64	10Ω 1% 1/4W MF	R-10R0-41
R68	90.9kΩ 1% 1/4W MF	R-9092-41
R70	100kΩ 1% 1/4W MF	R-1003-41
R71,73	44.2kΩ 1% 1/4W MF	R-4422-41
R72	1kΩ 1% 1/4W MF	R-1001-41
R85	88.7kΩ 1% 1/4W MF	R-8872-41
R86,107A-110A	0Ω Jumper 1/4W Resistor size	R-0000
R89	150kΩ 1% 1/4W MF	R-1503-41
R90	910Ω 5% 5W WW	RW-9100-5
R91	#12 Manganin wire	WR-0012-MN
R93	2Ω 5% 5W WW	RW-2R00-5
R95	3.32Ω 1% 1/4W	R-3R32-41
R96A	4.99kΩ 1% 1/4W MF	R-4991-41
R100	10kΩ 1% 1/4W MF	R-1002-41
R107-110	24.3Ω 1/4W 1% MF	R-24R3-41
T1	1KVA 100kHz 60V 18A Transformer	T2-1060
	Differential heatsink (tapped)	HS-100T-A2
	Output bus bar (negative)	SM-1000-NB
	Output bus bar (positive)	SM-1000-PB
For O/P bus bar	50nF 1kV Z5U -20% to +80% 10mm Ceramic Disk Cap	CC-503J-69
C401,405		
C403	100µF 63V 20% 5mm Electrolytic Radial Cap	CL-101F-63
C406	1µF 250V 10% 15mm Radial Cap	CD-105L-26
	Rectifier/snubber PCB Rev D	PC-100R-D

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS

Designation	Description	Part #
	MODEL XKW 60-18 (CONTINUED)	
	O/P PCB Blank Rev.C	PC-10RF-C
For rectifier PCB	9 mil Thermally conductive insulating sheet	MI-7403-09
	#6-32 x 0.125" PCB Mount Captive standoff	MR-632R-02
	#6-32 x 5/8" PPM Stainless Steel Screw	MS-6P28-10
	#6 x 1/4" Internal Lockwasher Stainless Steel	MW-6108-SS
	#6 x 5/16" Plated Flatwasher Stainless Steel	MW-6410-SS
C301,303,304	330pF 1kV Z5F 10% 6.5mm Ceramic Cap	CB-331G-66
C305,306	50nF 1kV Z5U -20% to +80% 10mm Ceramic Rad Cap	CC-503J-69
For C305,306	#6 x 13/16" Bent Locking Solder Lug	MC-6213-SL
	#6 Nylon Shoulder Washer 0.25 x 3/8"	MI-0625-SW
	#6 x 5/16" Plated Flat Washer Stainless Steel	MW-6410-SS
	#6-32 x 5/8" PPM Stainless Steel Screw	MS-6P28-10
CR301,302	600V 30A MUR3060PT DUR TO218	CR-3060-UD
R301-305,305A,306, 306A	330Ω5% 3W MF	RA-3300-6
	MODEL XKW 80-13	
C27,62	10nF 100V X7R 10% 5mm Ceramic Cap	CB-103F-16
C45	1nF 100V X7R 10% 5mm Ceramic Cap	CB-102F-16
C51,52,53	1000µF 100V 10mm Electrolytic Cap	CE-102J-76
C54	2.2nF 100V X7R 10% 5mm Ceramic Cap	CB-222F-16
C55,60,64	330pF 100V X7R 10% 5mm Ceramic Cap	CB-331F-16
C61	220pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-221F-16
C87	50nF 1kV Z5U -20% to +80% 10mm Ceramic Radial Cap	CC-503J-69
CR49-52	Empty Diode Position	CR-EMPT
L3	Output Inductor 370mH 13A	L2-1080
Q5A	PN2222A NB 40V 500mA 500mW TO92	QM-2222-A
Q17	IRF640 NM 200V 0.18W 18A NFET TO-220	QF-0640-IR
R22	4.53kΩ 1% 1/4W MF	R-4531-41
R27,95A	475Ω 1% 1/4W MF	R-4750-41
R64,107-110	10Ω 1% 1/4W MF	R-10R0-41
R68,85	90.9kΩ 1% 1/4W	R-9092-41
R70	200kΩ 1% 1/4W MF	R-2003-41
R71,73	44.2kΩ 1% 1/4W MF	R-4422-41
R72	1kΩ 1% 1/4W MF	R-1001-41
R86,107A-110A	0Ω Jumper 1/4W Resistor size	R-0000
R89	205kΩ 1% 1/4W MF	R-2053-41
R90	1.6kΩ 5% 5W WW	RW-1601-5
R91	#12 Manganin wire	WR-0012-MN
R93	2Ω 5% 5W WW	RW-2R00-5
R95	3.32Ω 1% 1/4W MF	R-3R32-41
R96A	4.99kΩ 1% 1/4W MF	R-4991-41
R100	10kΩ 1% 1/4W MF	R-1002-41
T1	1KVA 100kHz 80V 13A Transformer	T2-1080
	Differential heatsink (tapped)	HS-100T-A2
	Output bus bar (negative)	SM-1000-NB
	Output bus bar (positive)	SM-1000-PB

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS

Designation	Description	Part #
	MODEL XKW 80-13 (continued)	
For O/P bus bar C401,405	50nF 1kV Z5U -20% to +80% 10mm Ceramic Radial Cap	CC-503J-69
C403	47µF 100V 20% 5mm Electrolytic Cap	CL-470F-76
C406	1µF 250V 10% 15mm Metal Film Cap	CD-105L-26
	Rectifier/snubber PCB Rev D	PC-100R-D1
For rectifier PCB	9 mil Thermally conductive insulating sheet	MI-7403-09
	#6-32 x 0.125" PCB Mount Captive standoff	MR-632R-02
	#6-32 x 5/8" PPM Stainless Steel Screw	MS-6P28-10
	#6 x 0.288" Internal Lockwasher Stainless Steel	MW-6108-SS
	#6 x 5/16" Plated Flatwasher Stainless Steel	MW-6410-SS
C301,303,304	220pF 1kV 10% Z5F 6.5mm Ceramic Radial Cap	CB-221G-66
C305	50nF 1kV Z5U -20% to +80% 10mm Ceramic Radial Cap	CC-503J-69
For C305	#6 x 13/16" Bent Locking Solder Lug	MC-6213-SL
	#6 Nylon Shoulder Washer 0.25 x 3/8"	MI-0625-SW
	#6 x 5/16" Plated Flat Washer Stainless Steel	MW-6410-SS
	#6-32 x 5/8" PPM Stainless Steel Screw	MS-6P28-10
CR301,302	600V 30A MUR3060PT DUR TO218	CR-3060-UD
R301-305,305A,306, 306A	330Ω 5% 3W MF	RA-3300-6
	MODEL XKW 150-7	
C27,62	10nF 100V X7R 10% 5mm Ceramic Radial Cap	CB-103F-16
C45	1nF 1kV X7R 10% 6.5mm Ceramic Radial Cap	CB-102G-66
C48,49,50,87	50nF 1kV Z5U -20% to +80% 10mm Ceramic Disk Cap	CC-503J-69
C50C	1µF 250V 10% 15mm Radial Cap	CD-105L-26
C52,53	220µF 350V 10mm Electrolytic Cap	CC-221J-83
C54	4.7nF 100V X7R 10% 5mm Ceramic Cap	CB-472F-16
C55	2.2nF 100V X7R 10% 5mm Ceramic Cap	CB-222F-16
C60	180pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-181F-16
C61	220pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-221F-16
C64	1nF 100V X7R 10% 5mm Ceramic Cap	CB-102F-16
L3	Output Inductor 150V 7A	L2-1150-FWB
Q5A	PN2222A NB 40V 500mA 500mW TO92	QM-2222-A
Q17	IRF640 NM 200V 0.18W 18A NFET TO-220	QF-0640-IR
R22	1.96kΩ 1% 1/4W	R-1961-41
R27,95A	475Ω 1% 1/4W	R-4750-41
R64	4.53kΩ 1% 1/4W MF	R-4531-41
R68	16.2kΩ 1% 1/4W	R-1622-41
R70	100kΩ 1% 1/4W MF	R-1003-41
R71,73	8.87kΩ 1% 1/4W MF	R-8871-41
R72	2kΩ 1% 1/4W MF	R-2001-41
R85	93.1kΩ 1% 1/2W MF	R-9312-31
R86	Empty Position	R-EMPT
R89	348kΩ 1% 1/4W MF	R-3483-41
R90	5.6kΩ 5% 5W WW	RW-5601-5
R91	0.05Ω 1% 5W Non inductive	RN-R050-51
R93	10Ω 5% 5W WW	RW-10R0-5
R95	1.82Ω 1% 1/4W	R-1R82-41
R96A	4.99kΩ 1% 1/4W MF	R-4991-41

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS

Designation	Description	Part #
	MODEL XKW 150-7 (CONTINUED)	
R100	11.8kΩ 1% 1/4W MF	R-1182-41
R107-110	10Ω 1% 1/4W MF	R-10R0-41
R107A-110A	0Ω Jumper 1/4W Resistor size	R-0000
T1	1KVA 100kHz 150V 7A Transformer	T2-1150-FWB
	Differential heatsink (tapped)	HS-100T-A2
Chassis mounted part	Output connector Universal Mate N Lock	MI-4875-UM
For chassis mounted part	Output connector pin	MC-3547-ML
Supplied to customer	Output connector Universal Mate N Lock	MI-4874-UM
Supplied to customer	Output connector socket pin	MC-3550-ML
	Rectifier/snubber PCB	PC-103R-A
For rectifier PCB	9 mil Thermally conductive insulating sheet	MI-7403-09
	Stiffener plate	SM-103R
	NOMEX Insulator	SM-103R-IN
	#6-32 x 1" PPM Stainless Steel Screw	MS-6P00-16
	#6 x 1/4" Internal Lockwasher Stainless Steel	MW-6108-SS
For PCB mntg	#6-32 x 5/16" Phil Pan Head Stainless Steel	MS-6P28-05
	300V Insulator	IN-1300-RS
C301-304	180pF 1kV Z5F 10% 6.5mm Ceramic Radial Cap	CB-181G-66
C305	100pF 1kV Z5U 10% 6.5mm Ceramic Radial Cap	CB-101G-66
C306	50nF 1kV Z5U -20% to +80% 10mm Ceramic Radial Cap	CC-503J-69
For C306 mounting	#6-32 x 5/8" PPM Stainless Steel	MS-6P28-10
	#6 Nylon Shoulder Washer 0.25 x 3/8"	MI-0625-SW
	#6 x 5/16" Plated Flat Washer Stainless Steel	MW-6410-SS
	#6 x 3/16" Bent Locking Solder Lug	MC-6213-SL
	#6-32 x 9/32" W x 0.065" H Captive Nut	MN-632C-09
CR301-304	30A 600V single UF Fred Rect. TO247AD	CR-3060-US
For CR301-304	#6 NATVAR Sleeving	IS-1151-06
R301-304	330Ω 5% 3W MF	RA-3300-6
R305	470Ω 5% 5W WW Low inductance	RN-4700-5
	MODEL XKW 300-3.5	
C27,62	10nF 100V X7R 10% 5mm Ceramic Radial Cap	CB-103F-16
C45	220pF 1kV Z5F 10% 6.5mm Ceramic Cap	CB-221G-66
C48,49,50,50A,87	50nF 1kV Z5U -20% to +80% 10mm Ceramic Cap	CC-503J-69
C48A,49A	10nF 1kV Z5U -20% to +80% 10mm Ceramic Radial Cap	CC-103J-69
C50C	0.1μF 250V 10% 15mm Metal Film Cap	CD-104L-36
C52,53	220μF 350V 10mm Snap-in Electrolytic Cap	CE-221J-83
C54	4.7nF 100V X7R 10% 5mm Ceramic Cap	CB-472F-16
C55	2.2nF 100V X7R 10% 5mm Ceramic Cap	CB-222F-16
C60	180pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-181F-16
C61	220pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-221F-16
C64	1nF 100V X7R 10% 5mm Ceramic Radial Cap	CB-102F-16
L3	8.5 μH 3.5A Output Inductor	L2-1300
Q5A	PN2222A NB 40V 500mA 500mW TO92	QM-2222-A
Q17	MTP4N90 NM 900V 4.0A 4Ω 75W TO-220	QF-P04N-90
R22	13.7kΩ 1% 1/4W MF	R-1372-41
R27,95A	475Ω 1% 1/4W MF	R-4750-41
R64,96A	4.99kΩ 1% 1/4W MF	R-4991-41

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS

Designation	Description	Part #
	MODEL XKW 300-3.5 (CONTINUED)	
R68	16.2kΩ 1% 1/4W MF	R-1622-41
R70	100kΩ 1% 1/4W MF	R-1003-41
R71,73	4.02kΩ 1% 1/4W MF	R-4021-41
R72	2kΩ 1% 1/4W MF	R-2001-41
R85	976kΩ 1% 1/2W MF	R-9763-31
R86	Empty Position	R-EMPT
R89	787kΩ 1% 1/4W MF	R-7873-41
R90	22kΩ 5% 5W WW	RW-2202-5
R91	0.2Ω 1% 5W Low inductance	RN-R200-51
R93	27Ω 5% 5W WW	RW-27R0-5
R95	1.82Ω 1% 1/4W	R-1R82-41
R100	11.8kΩ 1% 1/4W MF	R-1182-41
R107-110	10Ω 1% 1/4W MF	R-10R0-41
R107A-110A	0Ω Jumper 1/4W Resistor size	R-0000
T1	1KVA 100kHz 300V 3.5A Transformer	T2-1300
	Differential heatsink (tapped)	HS-100T-A2
Chassis mounted part	Output connector Universal Mate N Lock	MI-4875-UM
For chassis mounted part	Output connector pin	MC-3547-ML
Supplied to customer	Output connector Universal Mate N Lock	MI-4874-UM
Supplied to customer	Output connector socket pin	MC-3550-ML
	Rectifier/snubber PCB	PC-103R-A
For rectifier PCB	9 mil Thermally conductive insulating sheet	MI-7403-09
	Stiffener plate	SM-103R
	NOMEX Insulator	SP-103R-IN
	#6-32 x 1" PPM Stainless Steel	MS-6P00-16
	#6 x 1/4" Internal Lockwasher Stainless Steel	MW-6108-SS
	#6-32 x 5/16" Phil Pan Head Stainless Steel	MS-6P28-05
	300V Insulator	IN-1300-RS
C301-304	180pF 1kV 10% Z5F 6.5mm Ceramic Radial Cap	CB-181G-66
C305	100pF 1kV Z5U 10% 6.5mm Ceramic Radial Cap	CB-101G-66
C306	50nF 1kV Z5U -20% to +80% 10mm Ceramic Disk Cap	CC-503J-69
For C306 mounting	#6 x 13/16" Bent Locking Solder Lug	MC-6213-SL
	#6 Nylon Shoulder Washer	MI-0625-SW
	#6-32 x 5/8" PPM Stainless Steel	MS-6P28-10
	#6-32 x 9/32" W x 0.065" H Captive Nut	MN-632C-09
For PCB & C306	#6 x 5/16" Plated Flatwasher Stainless Steel	MW-6410-SS
CR301-304	30A 600V single UF Fred Rect. TO247AD	CR-3060-US
For CR301-304	#6 NATVAR Sleeving	IS-1151-06
R301-304	330Ω 5% 3W MF	RA-3300-6
R305	470Ω 5% 5W WW Low inductance	RN-4700-5
	MODEL XKW 600-1.7	
C27,55,62A	10nF 100V X7R 10% 5mm Ceramic Cap	CB-103F-16
C45	47pF 1kV X7R 10% 6.5mm Ceramic Radial Cap	CB-470G-66
C48,50,50A,87	50nF 1kV Z5U -20% to +80% 10mm Ceramic Cap	CC-503J-69
C48A,49	10nF 1kV Z5U -20% to +80% 10mm Ceramic Cap	CC-103J-69
C50B,50C	10nF 250Vac "Y" 10% 15mm Metal Film Cap	CD-103L-36
C52,53,53A	1.5μF 630V 10% Axial 32mm Metal Film Cap	CD-155A-B6

Continued on next page.

5.4 A2 Power Assembly Replacement Parts

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS

Designation	Description	Part #
	MODEL XKW 600-1.7 (CONTINUED)	
C54	47nF 50V X7R 10% 5mm Ceramic Cap	CB-473F-06
C60	680pF 100V X7R 10% 5mm Ceramic Cap	CB-681F-16
C61,64	470pF 100V X7R 10% 5mm Ceramic Cap	CB-471F-16
C64B	100pF 100V Z5F 10% 5mm Ceramic Radial Cap	CB-101F-16
CR27A	IN4372A Z Case 3 3.0V 400mW Diode	CR-4372-A
CR49-52	1N4148 UR D035 75V 300mA Diode	CR-4148
L3	Output Inductor 36mH 1.7A	L2-1600
Q5	PN2222A NB 40V 500mA 500mW TO92	QM-2222-A
Q17	MTP4N90 NM 900V 4W 4A 75W NFET TO220	QF-PO4N-90
R22	6.34kΩ 1% 1/4W MF	R-6341-41
R27	475Ω 1% 1/4W MF	R-4750-41
R64,70	4.75kΩ 1% 1/4W	R-4751-41
R68	16.2kΩ 1% 1/4W	R-1622-41
R72	2kΩ 1% 1/4W MF	R-2001-41
R71,73	8.87kΩ 1% 1/4W	R-8871-41
R85	976kΩ 1% 1/2W MF	R-9763-31
R86	Empty Position	R-EMPT
R89	1.6MΩ 5% 1/2W	R-1604-3
R90	91kΩ 5% 5W WW	RW-9102-5
R91	0.2Ω 1% 5W Non inductive	RN-R200-51
R93	47Ω 5% 5W WW	RW-47R0-5
R95	1.82Ω 1% 1/4W	R-1R82-41
R100	10.5kΩ 1% 1/4W MF	R-1052-41
R103A	16Ω 5% 1W Film Resistor	R-16RO-1
R107-110	10Ω 1% 1/4W MF	R-10RO-41
R107A-110A	36.5Ω 1% 1/4W	R-36R5-41
T1	1KVA 100kHz 600V 1.7A Transformer	T2-1600-1
Complete Assy	Complete 600-1.7 Rectifier Assembly	X7-106R
Bare PCB	Rectifier PCB	PC-106R
Rectifier heatsink	Heatsink plate 600-1.7 Rectifier Assembly	SM-106R-HS
For rectifiers	Clamp plate 600-1.7 Rectifier Assembly	SM-106R-CP
For heatsink	#6 Nylon Shoulder Washer, 0.25" SD x 3/8"	MI-0625-SW
For rectifiers	Thermal Insulation	MI-106R-HS
For heatsink	Nomex Insulation	MI-106R-PC
For heatsink and rectifier clamp	#6 - 32 x 1/2" PPM Stainless Steel	MS-6P28-08
	#6 x 0.288" Internal Lockwasher Stainless Steel	MW-6108-SS
	#6 x 5/16" Plated Flatwasher Stainless Steel	MW-6410-SS
	#6-32 x 5/16" Phil Pan Head Stainless Steel	MS-6P28-05
Chassis mounted part	Output connector Universal Mate N Lock	MI-4875-UM
For O/P connector	Output connector pin	MC-3547-ML
Supplied to customer	Output connector Universal Mate N Lock	MI-4874-UM
Supplied to customer	Output connector socket pin	MC-3550-ML
C300	50nF 1kV Z5U -20% to +80% 10mm Ceramic Cap	CC-503J-69
For C300 to chassis	#6.x.13/16" Bent Locking Solder Lug	MC-6213-SL
C301-305	100pF 3kV Z5U -20% to +80% 6.5mm Ceramic Cap	CC-101G-99
C306-313	22pF 1kV S2L 10% 0.2" Ceramic Cap	CB-220F-66
CR300-307	12A 1kV 50nS DSEI 12-10A UR TO220AC	CR-1210-AUF

Continued on next page.

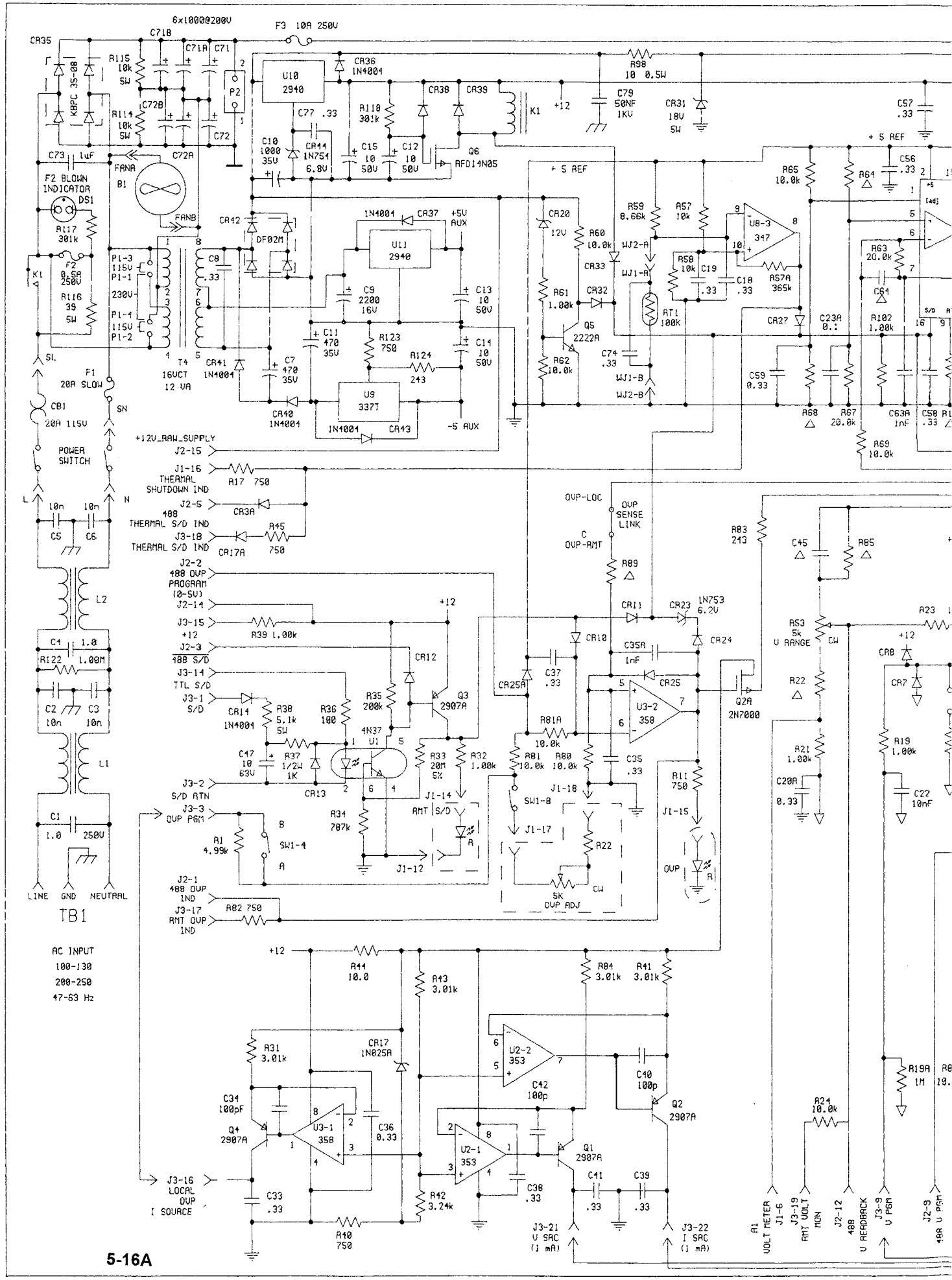
5.4 A2 Power Assembly Replacement Parts

5.4.2 A2 PCB Differential Parts

TABLE 5.4-3 A2 PCB DIFFERENTIAL PARTS		
Designation	**Description**	**Part #**
	MODEL XKW 600-1.7 (CONTINUED)	
R300,301	470Ω 5% 5W WW Low Inductance	RN-4700-5
R302-305	1kΩ 5% 5W WW Low Inductance	RN-1001-5
For +O/P to A2 PCB	#18 TEW Stranded Red, 12.5"	WT-0118-RD

5.5 Chassis and Cover Assembly Replacement Parts

TABLE 5.5-1 CHASSIS AND COVER ASSEMBLY REPLACEMENT PARTS		
Designation	**Description**	**Part #**
B1	Cooling fan (radial) 115V ac 50/60Hz 22CFM 1.6" H x 4.75" SQ	BR-0115-22
For cooling fan	Vinyl bumper (adhesive backed)	MF-RB12-06V
For fan mounting	#6-32 5/8" x 1/4" Hex Standoff	MR-632H-10
For fan mounting	#6-32 x 1" PPM Stainless Steel	MS-6P00-16
For fan,ground screw	#6 x 0.288" Internal Lockwasher Stainless Steel	MW-6108-SS
	Chassis (and rear panel)	SM-10BS-M
For chassis	Nomex Insulator	IN-10BS-05
	Subplate Blank	SM-10SP-K
For rear panel subplate	#6-32 x 5/16" Phil Pan Head Stainless Steel	MS-6P28-05
Ground screw	#6-32 x 1/2" Slot Pan Head Stainless Steel	MS-6S00-08
Ground screw,subplate	#6 x 5/16" Flatwasher Stainless Steel	MW-6410-SS
	Cover	SM-10CR
For cover	Nomex Insulator	IN-10CR-05



5-16A

APPENDIX A: Application Note

Battery Charging

When using the XKW Series (1000 Watt) power supply to charge a battery, take the following precautions to prevent damage to the supply and/or the battery **in case the overvoltage protection (OVP) circuit is activated**.

1. Select a diode rated to handle the required charging current and voltage. Use the following table as a reference.

TABLE A-1 OUTPUT DIODE SELECTION CRITERIA		
Peak Charging Current	**Maximum Voltage**	**Diode Type**
250-350A	40V	Two (2) parallel MBR30045CT
60-249A	40V	One (1) MBR30045CT
25-59A	100V	One (1) MUR7015
10-24A	300V	One (1) MUR3040PT
5-9A	500V	One (1) MUR1560
<5A	600V	One (1) MUR758

2. Connect the diode in series with either supply output to prevent the battery from discharging through the internal OVP crowbar transistor. The diode must be mounted on a suitably -rated heatsink to prevent its case temperature from exceeding the manufacturer's maximum limits.