SERVICE MANUAL

GPIB DC Power Supplies
Agilent Series 669xA

For instruments with Serial Numbers:

Agilent 6690A: MY41000131

Agilent 6691A: MY41000119

Agilent 6692A: MY41000133

For manual updates, a change page may be included.
For a history of manual updates, see Appendix A.

Agilent Technologies

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CERTIFICATION

Agilent Technologies certifies that this product met its published specifications at time of shipment from the factory. Agilent Technologies further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

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ASSISTANCE

The above statements apply only to the standard product warranty. Warranty options, extended support contracts, product maintenance agreements and customer assistance agreements are also available. Contact your nearest Agilent Technologies Sales and Service office for further information on Agilent Technologies' full line of Support Programs.

SAFETY CONSIDERATIONS

GENERAL. This is a Safety Class 1 instrument (provided with terminal for connection to protective earth ground).

OPERATION. BEFORE APPLYING POWER verify that the product is set to match the available line voltage, the correct line fuse is installed, and all safety precautions (see following warnings) are taken. In addition, note the instrument's external markings described under "Safety Symbols".

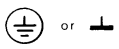
WARNING.

- Servicing instructions are for use by service-trained personnel. To avoid dangerous electrical shock, do not perform any servicing unless you are qualified to do so.
- BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminal of the instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall be inserted only in an outlet socket that is provided with a protective earth contact. This protective action must not be negated by the use of an extension cord (power cable) that is without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.
- If this instrument is to be energized via an auto-transformer (for voltage change), make sure the common terminal is connected to the earth terminal of the power source.
- Any interruption of the protective (grounding) conductor (inside or outside the instrument), or disconnecting of the protective earth terminal will cause a potential shock hazard that could result in personal injury.
- Whenever it is likely that the protective earth connection has been impaired, this instrument must be made inoperative and be secured against any unintended operation.
- Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuseholders. To do so could cause a shock or fire hazard.
- Do not operate this instrument in the presence of flammable gases or fumes.
- Do not install substitute parts or perform any unauthorized modification to this instrument.
- Some procedures described in this manual are performed with power supplied to the instrument while its protective covers are removed. If contacted, the energy available at many points may result in personal injury.
- Any adjustment, maintenance, and repair of this instrument while it is opened and under voltage should be avoided as much as possible. When this is unavoidable, such adjustment, maintenance, and repair should be carried out only by a skilled person who is aware of the hazard involved.
- Capacitors inside this instrument may hold a hazardous electrical charge even if the instrument has been disconnected from its power source.

SAFETY SYMBOLS

Instruction manual symbol. The instrument will be marked with this symbol when it is necessary for you to refer to the instruction manual in order to protect against damage to the instrument.

This sign indicates hazardous voltages.



This sign indicates an earth terminal (sometimes used in the manual to indicate circuit common connected to a ground chassis).

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

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Safety Symbol Definitions			
Symbol	**Description**	**Symbol**	**Description**
	Direct current		Terminal for Line conductor on permanently installed equipment
	Alternating current		Caution, risk of electric shock
	Both direct and alternating current		Caution, hot surface
	Three-phase alternating current		Caution (refer to accompanying documents)
	Earth (ground) terminal		In position of a bi-stable push control
	Protective earth (ground) terminal (Intended for connection to external protective conductor.)		Out position of a bi-stable push control
	Frame or chassis terminal		On (supply)
N	Terminal for Neutral conductor on permanently installed equipment		Off (supply)
	Terminal is at earth potential (Used for measurement and control circuits designed to be operated with one terminal at earth potential.)		Standby (supply) Units with this symbol are not completely disconnected from ac mains when this switch is off. To completely disconnect the unit from ac mains, either disconnect the power cord or have a qualified electrician install an external switch.

Printing History

The edition and current revision of this manual is indicated below. Reprints of this manual containing minor corrections and updates may have the same printing date. Revised editions are identified by a new printing date. A revised edition incorporates all new or corrected material since the previous printing date. Significant changes to the manual occurring between revisions are covered by change sheets shipped with the manual. Note that not all changes made to the power supply affect the content of the manual. Refer to appendix A for a history of manual updates.

Edition 1 November, 2002

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Table of Contents

Introduction **7**

Scope and Organization 7
Instrument Identification 7
Related Documents 8
Manual Revisions 7
Firmware Revisions 8
Safety Considerations 8
Electrostatic Discharge 8

Verification **9**

Introduction 9
Tests 9
Test Equipment Required 9
Equipment List 9
Current-Monitoring Resistor 9
Electronic Load 9
Programming the Tests 10
General Considerations 10
General Measurement Techniques 11
Performance Test Record Sheets 11
Operation Verification Tests 11
Performance Tests 11
Constant Voltage (CV) Tests 12
Constant Current (CC) Tests 15
Averaging the CC Measurements 19

Troubleshooting **25**

Introduction 25
Test Equipment Required 25
Power-On Selftest 26
Troubleshooting Charts 26
Firmware Revisions 42
Test Headers 42
Post-Repair Calibration 43
When Required 43
Inhibit Calibration Jumper 43
Calibration Password 43
Restoring Factory Calibration Constants 44
EEPROM Initialization 44
Transferring Calibration Constants to Factory Preset Locations 44
Disassembly Procedures 48
Tools Required 49
Top Cover 49
Removing Protective RFI Shield (Galvanized Sheet Metal) 49
GPIB Board 49
A4 AC Input Assembly 50
A5 DC RAIL Assembly 50
A6 BIAS Assembly 50
A3 FET Board 50
A10 Control Assembly 50
Front Panel Assembly 51
S1 Line Switch 51
A1 Front Panel Board 51

A1DSP1 LCD Display 51
A1G1 and A1G2 Rotary Controls 51
A1KPD Keypad 51
Output Bus Boards A7, A81 and A9 & Chassis Components 52

Principles of Operation 59

Introduction 59
A2 GPIB Board 59
A1 Front Panel Assembly 60
A10 Control Board 60
A4 AC Input Board 62
A5 DC Rail Board 63
A3 FET Board 63
Output Circuits 64

Replaceable Parts 65

Introduction 65
How to Order Parts 65

Diagrams 69

Introduction 69

Backdating 99

Index 101

1

Introduction

Scope and Organization

This manual contains information for troubleshooting and repairing Agilent Series 669xA, 6.6-kilowatt power supplies to the *assembly* level. The supplied schematics at the back of the manual are not intended for component level repair, only to provide additional information for isolating a problem to a specific assembly. The chapters of this manual are organized as follows:

Chapter	Description
Chapter 2	Verification procedures to determine the performance level of the supply either before or after repair.
Chapter 3	Troubleshooting procedures for isolating a problem, procedures for replacing the defective assembly and, if required, post-repair calibration and EEPROM initialization procedures.
Chapter 4	Principles of power supply operation on a block-diagram level.
Chapter 5	Assembly-level replaceable parts, including parts ordering information.
Chapter 6	Diagrams, including schematics, component location drawings, and troubleshooting test points.

Instrument Identification

Agilent Technologies instruments are identified by a 10-digit serial number. The format is described as follows: first two letters indicate the country of manufacture. The next four digits are a code that identify either the date of manufacture or of a significant design change. The last four digits are a sequential number assigned to each instrument.

Item	Description
MY	The first two letters indicates the country of manufacture, where US = USA; MY = Malaysia.
3648	This is a code that identifies either the date of manufacture or the date of a significant design change.
0101	The last four digits are a unique number assigned to each power supply.

Manual Revisions

The edition and current revision of this manual is indicated on page 4. Reprints of this manual containing minor corrections and updates may have the same printing date. Revised editions are identified by a new printing date. A revised edition incorporates all new or corrected material since the previous printing date. Significant changes to the manual occurring between revisions are covered by change sheets shipped with the manual. Note that not all changes made to the power supply affect the content of the manual. Refer to appendix A for a history of manual updates.

This manual was written for power supplies that have the same serial prefixes (first part) as those listed on the title page and whose serial numbers (second part) are equal to or higher than those listed in the title page.

Note

1) A revised edition incorporates all new or corrected material since the previous printing date.
2) If they are significant to the operation and/or servicing of the power supply, those differences are documented in one or more Manual Changes sheets included with this manual. These changes will also be incorporated at future updates of the manual.
3) A history of changes to this manual that affect previously manufactured units is provided in Appendix A - Manual Backdating.

Firmware Revisions

The power supply's firmware resides in the A10 control board microprocessor chip and in ROM chips on the A2 GPIB and A1 Front Panel boards. You can obtain the firmware revision number by either reading the integrated circuit label, or query the power supply using the GPIB *IDN query command (see Chapter 3 - Troubleshooting). Also, see Chapter 3, Firmware Revisions for the actual Agilent BASIC program that does this.

Related Documents

Operating and Programming Manuals

Each power supply is shipped with an operating and programming manual (see Replaceable Parts, Chapter 5 for part numbers) that covers the following topics:

- Options, accessories, specifications, supplementary characteristics, output characteristic curve, typical output impedance curves.
- Connecting the power cord, load, and remote sensing.
- Connecting power supplies in series or autoparallel.
- Connecting the remote controller and setting the GPIB address.
- Configuring the digital port for remote inhibit, relay link, or digital I/O operation.
- Connecting the analog port for external voltage programming control.
- Turn-on tests, including selftest errors and runtime errors.
- Front panel operation.
- SCPI programming, an introduction to syntax, language dictionary, and status register operation.
- Compatibility-language programming for operation with Agilent Series 603xA power supplies.
- Replacement of line fuse and conversion of line voltage.
- Calibration procedure (front panel and remote).

Safety Considerations

This power supply is a Safety Class I instrument, which means it has a protective earth terminal. This terminal must be connected to earth ground through a power source equipped with a 4-wire, ground receptacle. Refer to the "Safety Summary" page at the beginning of this manual for general safety information. Before operation or repair, check the power supply and review this manual for safety warnings and instructions. Safety warnings for specific procedures are located at appropriate places in the manual.

WARNING Hazardous voltage exist within the power supply chassis, at the output terminals, and at the analog programming terminals.

Electrostatic Discharge Precautions

CAUTION The power supply has components that can be damaged by ESD (electrostatic discharge). Failure to observe standard, antistatic practices can result in serious degradation of performance, even when an actual failure does not occur.

When working on the power supply observe all standard, antistatic work practices. These include, but are not limited to:

- working at a static-free station such as a table covered with static-dissipative laminate or with a conductive table mat (Agilent P/N 9300-0797, or equivalent).
- using a conductive wrist strap, such as Agilent P/N 9300-0969 or 9300-0970.
- grounding all metal equipment at the station to a single common ground.
- connecting low-impedance test equipment to static-sensitive components only when those components have power applied to them.
- removing power from the power supply before removing or installing printed circuit boards.

2

Verification

Introduction

This chapter provides test procedures for checking the operation of Agilent Series 669xA power supplies. The required test equipment is specified and sample performance test record sheets are included. Instructions are given for performing the tests either from the front panel or from a controller over the GPIB.

Tests

Two types of procedures are provided: Operation Verification tests and Performance tests.

Type of Test	Purpose
Operation Verification	These tests do not check all parameters, but comprise a short procedure to verify that the power supply is performing properly.
Performance	These tests verify all the Specifications (not Supplementary Characteristics) listed in Table 1-1 of the Power Supply Operating Manual.

If you encounter failures or out-of-specification test results, see Troubleshooting Procedures (Chapter 3). The procedures will determine if repair and/or calibration is required.

Note The power supply must pass the selftest at power-on before the following tests can be performed. If the power supply fails selftest, go to Chapter 3.

Test Equipment Required

Equipment List

Table 2-1 lists the equipment required to perform the tests given in this chapter. Only the equipment marked with the superscript "[1]" is needed for the Operation Verification test.

Current-Monitoring Resistor

The four-terminal, current-monitoring resistor (current shunt) listed in Table 2-1 is required to eliminate output current measurement error caused by voltage drops in leads and connections. The specified current shunts have special current-monitoring terminals inside the load connection terminals. The accuracy of the current shunt must be 0.04% or better. Connect the current monitor directly to these current-monitoring terminals.

Electronic Load

Many of the test procedures require the use of a variable load capable of dissipating the required power. If a variable resistor is used, switches must be used for connecting, disconnecting, and shorting the load resistor. For most tests, an electronic load (see Table 2-1) is easier to use than a variable resistor. However, an electronic load may not be fast enough for testing transient recovery time or may be too noisy for testing noise (PARD). In these cases, fixed load resistors of suitable power dissipation can be used with minor changes to the test procedures given in this chapter.

Table 2-1. Test Equipment Required

Type	Required Characteristics	Recommended Model
Digital Voltmeter[1]	Resolution: 10 nV @ 1V Readout: 8 1/2 digits Accuracy: 20 ppm	Agilent 3458A
Current Monitor Resistor[1]	Agilent 6691A, 6692A: 0.001Ω ± 0.04%, 300A, 100W Agilent 6690: 0.0001Ω ± 0.05%, 1000A, 100W	Guildline 9230/300 Burster Type 1280
DC Power Supply	DC Power Source with current capability equal to UUT	Agilent 6680A
Electronic Load **Resistor Load**	Range: Voltage and current range must exceed that of supply under test. Power: 7kW minimum or 6.6 Kilowatt minimum Agilent 6690A = 34.1 milliohms 6600W Agilent 6691A = 136 milliohms 6600W Agilent 6692A = 545 milliohms. 6600W	4 each Agilent N3300A, with/3 each Agilent N3306A per mainframe for all units
Oscilloscope	Sensitivity: 1mV Bandwidth Limit: 20MHz Probe: 1:1 with RF tip	Agilent Infinium or equivalent
RMS Voltmeter	True RMS Bandwidth: 20MHz Sensitivity: 100 µV	Rhode & Schwartz Model URE3 RMS-P-P voltmeter
Current Transformer	0.1Volt per ampere: 1Hz to 20MHz	Pearson Model 411
Variable-Voltage Transformer (AC Source)	Power: 3 Phase 24KVA; Range: 180-235V 47 - 63Hz; 360- 440V 47 - 63Hz	Superior Powerstat 1156DT-3Y, 0-280V, 50A, 24.2 KVA or equivalent .
GPIB Controller[2]	Full GPIB capabilities	HP Series 200/300

[1] Required for Operation Verification Tests.
[2] Required for remote testing of 669xA models.

Programming the Tests

General Considerations

Procedures are given for programming these tests either from the front panel keypad or from a GPIB controller. The procedures assume you know how to use the front panel keypad or how to program over the GPIB (see the Power Supply Operating Manual for more information). When using computer-controlled tests, you may have to consider the relatively slow (compared to computer and system voltmeters) settling times and slew rates of the power supply. Suitable WAIT statements can be inserted into the test program to give the power supply time to respond to the test commands.

WARNING This power supply can provide more than 240VA at more than 2 volts. If the output connections touch each other, severe arcing can occur resulting in burns, ignition or welding of parts. DO NOT ATTEMPT TO MAKE CONNECTIONS WHILE OUTPUT POWER IS ON. These connections should be performed only by qualified electronics personnel.

Programming Parameters

Table 2-2 lists the programming voltage and current values for each model. You can enter these values either from the front panel or from a controller over the GPIB.

Table 2-2. Programming Voltage and Current Values

Agilent Model	Full Scale Voltage	Max. Prog. Voltage	Full Scale Current	Max. Prog. Current	Max. Prog. Overvoltage
Agilent 6690A	15V	15.375V	440A	450A	18V
Agilent 6691A	30V	30.75V	220A	225A	36V
Agilent 6692A	60V	60.5V	110A	112A	69V

General Measurement Techniques

Figure 2-1 shows the setup for the Constant Voltage tests. Measure the dc output voltage directly at the sense (+S and -S) terminals. Connect these terminals for local sensing. Be certain to use load leads of sufficient wire gauge to carry the output current (see Chapter 4 of the Power Supply Operating Manual). To avoid noise pickup, use coaxial cable or shielded pairs for the test leads. If you use more than one meter or a meter and an oscilloscope, connect separate leads for each instrument to avoid mutual-coupling effects.

Performance Test Record Sheets

When performing the tests in this chapter, refer to the Performance Test Record sheets supplied at the end of this chapter. Table 2-6 is for recording common information, such as, the test equipment used and the environmental conditions. Tables 2-7 through 2-11 are dedicated to specific models. Each sheet lists the acceptable test ranges for the model and provides a place to record the results of the test.

Note It is recommended that before you perform the tests in either Table 2-4 or Table 2-5, that you first locate the appropriate Performance Test Record sheet from Tables 2-7 through Table 2-11 for your specific model. Make a copy of this sheet, and record the actual observed values in it while performing the tests. Use the sheets in Tables 2-7 through Table 2-11 as master reference sheets to run copies at any time.

Operation Verification Tests

Table 2-3 lists the requirements for operation verification, which is a subset of the performance tests.

Table 2-3. Operation Verification Tests

	Test	Refer To
1	Turn-On Checkout	Power Supply Operating Manual
2	Voltage Programming and Readback Accuracy	Table 2-4
3	Current Programming and Readback Accuracy	Table 2-5

Note: Record the results of Tests 2 and 3 in the appropriate Performance Test Record sheets

Performance Tests

Performance tests check all the specifications of the power supply. The tests are grouped into constant-voltage mode tests (Table 2-4) and constant-current mode tests (Table 2-5).

Constant Voltage (CV) Tests

Test Setup

Connect your dc voltmeter leads to only +S and -S (see Figure 2-1), because the power supply regulates the voltage between these points, not between the + and - output terminals.

Test Procedures

Perform the test procedures in Table 2-4. The CV tests are:

- Voltage Programming and Readback Accuracy
- CV Load Effect
- CV Source Effect
- CV Noise (PARD)
- Transient Recovery Time

Note The tests are independent and may be performed in any order.

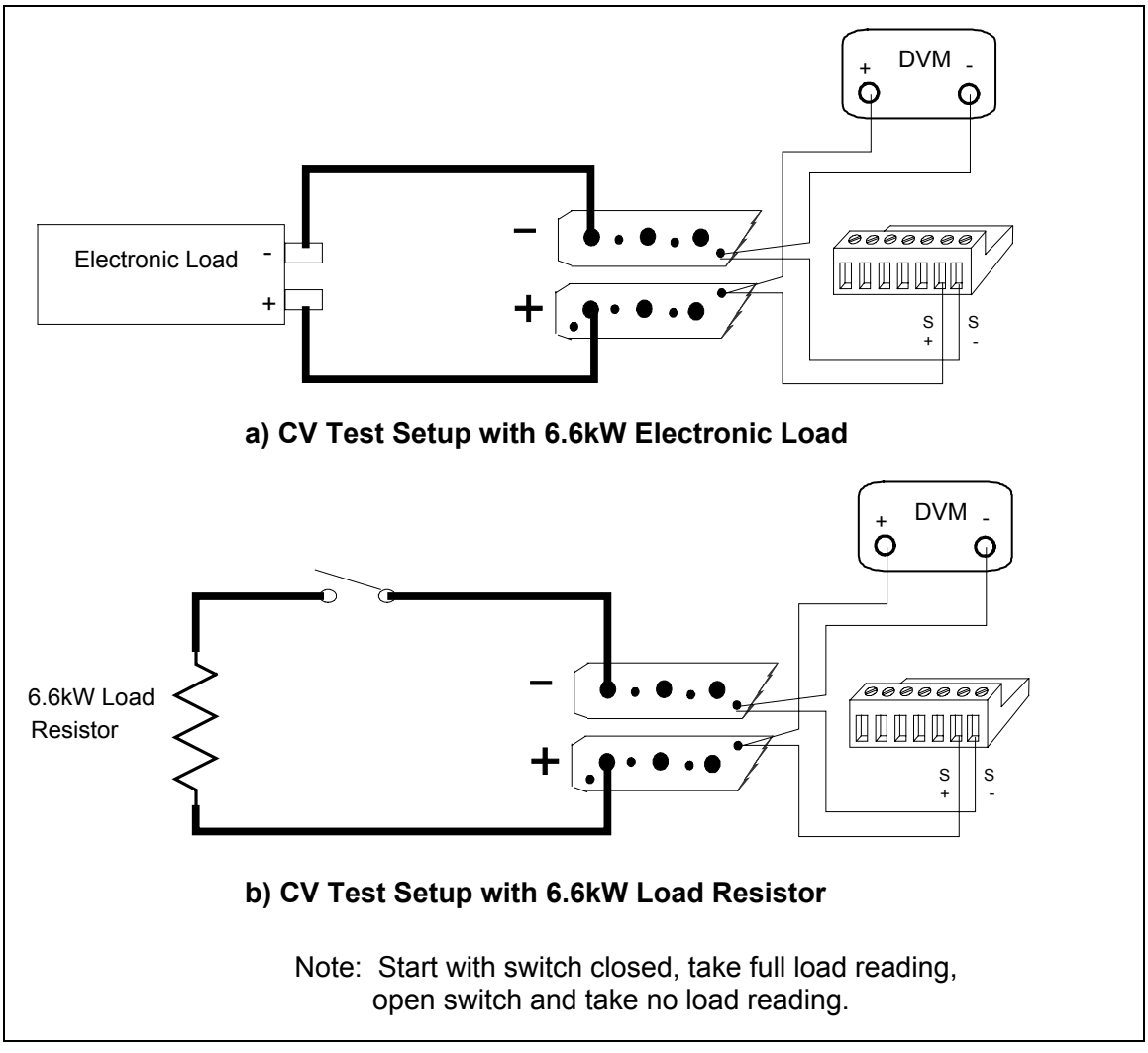


Figure 2-1. Constant Voltage (CV) Test Setup

Table 2-4. Constant Voltage (CV) Tests

	Action	Normal Result
	Voltage Programming and Readback Accuracy This test verifies that the voltage programming, GPIB readback (GPIB system power supplies only), and front panel display functions are within specifications. With system power supplies, values read back over the GPIB should be the same as those displayed on the front panel.	
1	Turn off the power supply and connect a DVM across +S and -S (see Fig. 2-1).	
2	Turn on the power supply with no load and program the output for 0 volts and maximum programmable current (see Table 2-2).	**CV** annunciator on. Output current near 0.
3	Record voltage readings at DVM and on front panel display.	Readings within specified Low Voltage limits.
4	Program voltage to full scale (see Table 2-2).	
5	Record voltage readings of DVM and on front panel display.	Readings within specified High Voltage limits.
	CV Load Effect This test measures the change in output voltage resulting from a change in output current from full-load to no-load.	
1	Turn off the power supply and connect a DVM across **+S** and **-S** (see Fig. 2-1).	
2	Turn on the power supply and program the current to its maximum programmable value and the voltage to its full-scale value (see Table 2-2).	
3	Adjust the load to produce full-scale current (see Table 2-2) as shown on the front panel display.	CV annunciator is on. If it is not, adjust the load to slightly reduce the output current until the annunciator comes on.
4	Record voltage reading of the DVM.	
5	Adjust load to draw 0 amperes (open load). Record voltage reading of the DVM.	
6	Check test result.	The difference between the DVM readings in steps 4 and 5 are within the specified Load Effect limits.
	CV Source Effect This test measures the change in output voltage resulting from a change in ac line voltage from its minimum to maximum value within the line voltage specifications.	
1	Turn off the power supply and connect the ac power input through a variable-voltage transformer.	
2	Set the transformer to the nominal ac line voltage. Connect the DVM across **+S** and **-S** (see Fig. 2-1).	
3	Turn on the power supply and program the current to its maximum programmable value and the voltage to its full-scale value (see Table 2-2).	

Table 2-4. Constant Voltage (CV) Tests (continued)

	Action	Normal Result
	CV Source Effect (cont)	
4	Adjust the load to produce full-scale current (see Table 2-2) as shown on the front panel display.	**CV** annunciator is on. If it is not, adjust the load to slightly reduce the output current until the annunciator comes on.
5	Adjust the transformer to decrease the ac input voltage to the low- line condition (174Vac or 191Vac). Record the output voltage reading of the DVM.	
6	Adjust the transformer to increase the ac input voltage to the high-line condition (220Vac or 250Vac). Record the output voltage reading on the DVM.	
7	Check test result.	The difference between the DVM readings in steps 5 and 6 are within the specified Source Effect limits.
	CV Noise (PARD)	
	Periodic and random deviations (PARD) in the output (ripple and noise) combine to produce a residual ac voltage superimposed on the dc output voltage. This test measures CV PARD, specified as the rms and peak-to-peak output voltages over the frequency range of 20Hz to 20MHz.	
1	Turn off the power supply and connect an a-c coupled oscilloscope across the + and -output terminals (see Fig. 2-1). Set the oscilloscope bandwidth limit to 20MHz (30MHz for the Agilent 54504A) and use an RF tip on the oscilloscope probe.	
2	Turn on the power supply and program the current to its maximum programmable value and the voltage to its full-scale value (see Table 2-2).	
3	Adjust the load to produce full-scale current (see Table 2-2) as shown on the front panel display.	**CV** annunciator is on. If it is not, adjust the load to slightly reduce the output current until the annunciator comes on.
4	Record the amplitude of the waveform.	Amplitude is within the specified PARD Peak-to-Peak limits.
5	Replace the oscilloscope connection with an ac rms voltmeter.	
6	Record the reading obtained in Step 5.	Amplitude is within the specified PARD rms limits.
	Transient Recovery Time	
	This test measures the time required for the output voltage to return to within 100mV of its final value following a 50% change in output load current. Measurements are made on both the unloading transient (from full load to 1/2 load) and the loading transient (from 1/2 load to full load).	
1	Turn off the power supply and connect an oscilloscope across **+S** and **-S** (see Fig. 2-1).	
2	Turn on the power supply and program the current to its maximum programmable value and the voltage to its full-scale value (see Table 2-2).	

Table 2-4. Constant Voltage (CV) Tests (continued)

	Action	Normal Result
	Transient Recovery (cont)	
3	Program the Electronic Load as follows: • Operating mode to constant current. • Input load current to 1/2 the supply's full rated output current. • Transient current level to the supply's full rated output current. • Transient generator frequency = 100Hz. • Transient generator duty cycle = 50%.	
4	Turn on the transient and adjust the oscilloscope to display response waveform.	See Fig. 2-2.
5	Measure both the loading and unloading transients by triggering the oscilloscope on both the negative and positive slopes of the transient. Record the voltage level obtained at the 900-µs interval .	Specified voltage level is reached within 900µs.

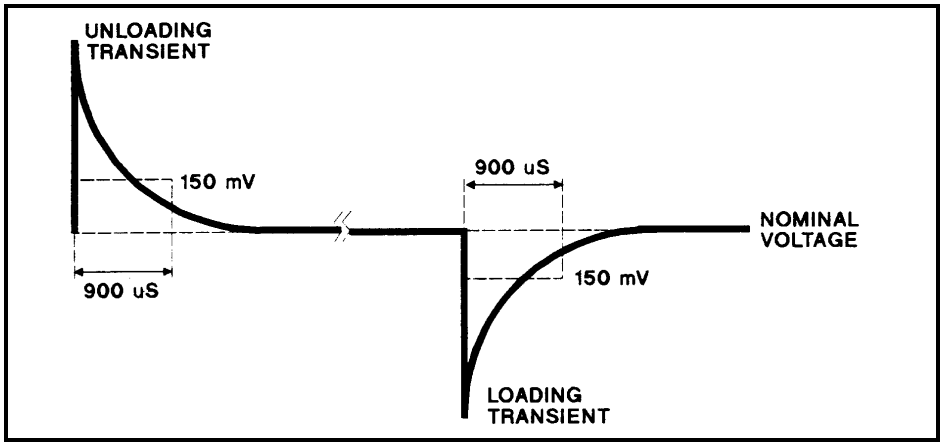


Figure 2-2. Transient Response Waveform

Constant Current (CC) Tests

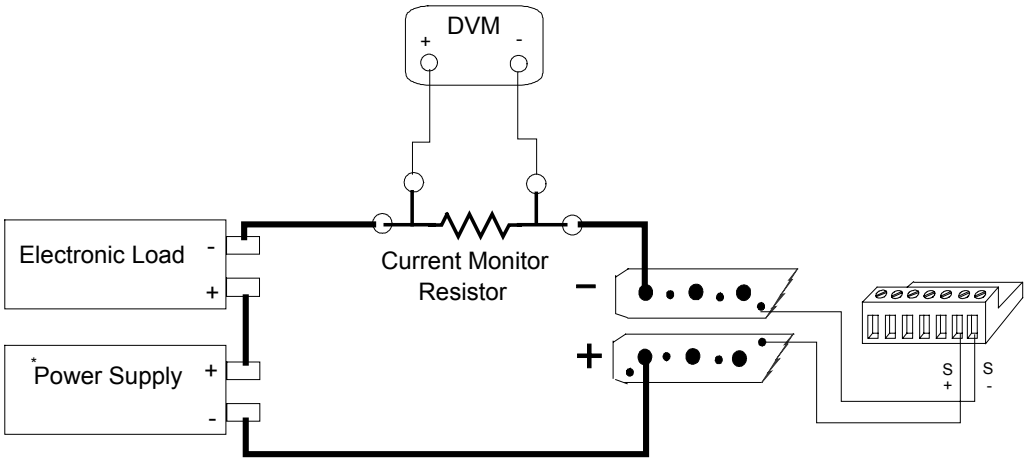
Test Setup

Connect the appropriate current monitoring resistor (see Table 2-l) as shown in Figure 2-3. The accuracy of the resistor must be as specified in the table.

Test Procedures

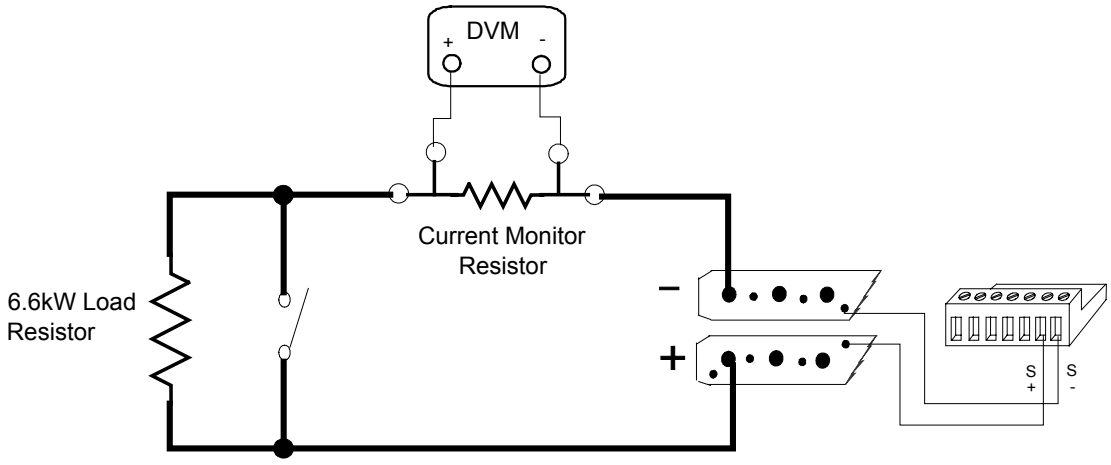
The test procedures are given in Table 2-5. The tests are independent and may be performed in any order. The CC tests are:

- Current Programming and Readback Accuracy.
- CC Load Effect.
- CC Source Effect.



a) CC Test Setup with 6.6kW Electronic Load

* Note: Series power source required for CC Load Regulation Test, allows UUT to operate at 0 volts and electronic load to operate at its minimum input voltage specification. Voltage source must always be in CV mode. UUT must be in CC mode for all CC tests.



b) CC Test Setup with 6.6kW Load Resistor

Note: Start with switch closed, take reading at 0 output voltage.
Open switch and take full load reading.
UUT must be in CC mode for all CC tests.

Figure 2-3. CC Load Effect Test Setup

Table 2-5. Constant Current (CC) Tests

	Action	Normal Result
	Current Programming and Readback Accuracy This test verifies that the current programming and readback are within specification.	
1	Turn off the power supply and connect the current monitoring resistor as shown in Fig. 2-3. Connect a DVM across the resistor .	
2	Turn on the power supply and program the output for 5 volts and 0 amperes.	
3	Short the load.	
4	Observe the DVM voltage reading. Divide this by the resistance of the current monitor resistor. Record the result as the Low Current value.	Value within specified Low Current limits.
5	Record the front panel display readback.	Value within specified readback limits.
6	Program output current to full scale (see Table 2-2).	
7	Repeat Steps 4 and 5.	Both current readings within specified High Current and readback limits.
	CC Load Effect This test measures the change in output current resulting from a change in load from full-load voltage to a short circuit. It is recommended that you use averaged readings for Steps 5 and 6 of this test (see Averaging AC Measurements at the end of this chapter). **Note**: Refer to Figure 2-3. If you are using Agilent N3306A electronic loads, a series DC power source is required to supply the minimum 3 volt input required by the Agilent N3306A electronic loads. The series DC source must be capable of 3VDC ***at a current level that is greater than the output current of the supply being tested***. A switch can be used in place of the series supply if the electronic loads are used in place of a load resistor as shown in Fig. 2-3(b).	
1	Turn off the power supply and connect a DVM across the current monitoring resistor (see Fig. 2-3).	
2	Turn on the power supply and program the current to its full scale value and the voltage to its maximum programmable value (see Table 2-2).	
3	Set the Electronic Load to CV mode and its voltage to full scale as indicated on its front panel display. Set the series supply for 3VDC and a current greater than that being tested. Series source should be in CV mode.	Power supply output current is full scale and its **CC** annunciator is on. If not, reduce the Electronic Load voltage slightly until the annunciator comes on.
4	Observe the DVM reading. Divide this by the resistance of the current monitoring resistor to obtain the output current. Record the result.	You may want to use an averaged reading for this measurement.
5	Program the Electronic Load input to 3 volts or short the Electronic Load input and repeat Step 5.	You may want to use averaged reading for this measurement.
6	Check the result.	The difference between the current readings taken in Step 5 and Step 6 must be within specified "Load Effect" limits (see Table 2-2).

Table 2-5. Constant Current (CC) Tests (continued)

	Action	Normal Result
	CC Source Effect This test measures the change in output current resulting from a change in ac line voltage from its minimum to its maximum value within the line voltage specifications. It is recommended that you use averaged readings for Steps 6 and 8 of this test (see "Averaging AC Measurements" at the end of this chapter) .	
1	Turn off the power supply and connect the ac power input through a variable-voltage transformer.	
2	Set the transformer to the nominal ac line voltage. Connect the DVM across the current monitoring resistor (see Fig. 2-3).	
3	Turn on the power supply and program the current to its full-scale value and the voltage to its maximum programmable value (see Table 2-2).	
4	Set the Electronic Load to CV mode and its voltage to full scale.	The power supply output current is full scale and its **CC** annunciator is on. If not, reduce the Electronic Load voltage slightly until the annunciator comes on.
5	Adjust the transformer to decrease the ac input voltage to the low-line condition (180Vac or 360Vac).	
6	Observe the DVM reading. Divide this voltage by the resistance of the current monitoring resistor to obtain the output current. Record the result.	You may want to use an averaged reading for this measurement.
7	Adjust the transformer to increase the ac input voltage to the high-line condition (235Vac or 440Vac).	
8	Observe the DVM reading. Divide this voltage by the resistance of the current monitoring resistor to obtain the output current. Record the result.	You may want to use an averaged reading for this measurement.
9	Check the test result.	The difference between the current readings found in Step 6 and Step 8 is within the specified current Source Effect limits.

Averaging the CC Measurements

The CC Load Effect and CC Source Effect tests measure the dc regulation of the power supply's output current. When doing these tests, you must be sure that the readings taken are truly dc regulation values and not instantaneous ac peaks of the output current ripple. You can do this by making each measurement several times and then using the average of the measurements as your test value. Voltmeters such as the Agilent 3458A System Voltmeter can be programmed to take just such statistical average readings as required by these tests.

The following steps show how to set up the voltmeter from its front panel to take a statistical average of l00 readings. [ ] represents the unlabeled shift key in the FUNCTION/RANGE group.

1. Program 10 power line cycles per sample by pressing [NPLC] [1] [0] [Enter].
2. Program 100 samples per trigger by pressing [N Rdgs/Trig] [1] [0] [0] [Enter].
3. Set up voltmeter to take measurements in the statistical mode as follows:
   a. Press [ ] [f0] [ ] [N].
   b. Press [▲] until MATH function is selected, then press [▶].
   c. Press [▲] until STAT function is selected, then press [Enter].
4. Now set up voltmeter to read the average of the measurements as follows:
   a. Press [ ] [f1] [ ] [N].
   b. Press [▼] until RMATH function is selected, then press [Enter].
   c. Press [▲] until MEAN function is selected, then press [Enter].
5. Execute the average reading program by pressing [f0] [Enter] [TRIG] [Enter].
6. Wait for 100 readings and then read the average measurement by pressing [f1] [Enter].

Record this as your result.

Table 2-6. Performance Test Record Form

Test Facility:

_____ Report No._____
_____ Date_____
_____ Customer_____
Model_____ Tested By_____
Serial No _____ Ambient Temperature (°C)_____
Options _____ Relative Humidity (%)_____
Firmware Revision _____ Nominal Line Frequency (Hz)_____

Special Notes:

_____
_____
_____
_____
_____
_____
_____
_____

Test Equipment Used:

Description	**Model No.**	**Trace No.**	**Cal. Due Date**
1. AC Source	_____	_____	_____
2. DC Voltmeter	_____	_____	_____
3. RMS Voltmeter	_____	_____	_____
4. Oscilloscope	_____	_____	_____
5. Electronic Load	_____	_____	_____
6. Current Monitoring Shunt	_____	_____	_____

Table 2-7. Performance Test Record for Agilent Model 6690A

MODEL Agilent_____	Report No._____	Date_____	
Test Description	**Minimum Spec.**	**Results ***	**Maximum Spec.**
Constant Voltage Tests			
Voltage Programming and Readback			
Low Voltage (0V) V_{out}	-15mV	_____mV	+15mV
Front Panel Display Readback	V_{out} - 22.5mV	_____mV	V_{out} + 22.5mV
High Voltage (15V) V_{out}	14.979V	_____V	15.021V
Front Panel Display Readback	V_{out} -30mV	_____mV	V_{out} + 30mV
Load Effect	V_{out} - 0.95mV	_____mV	V_{out} + 0.95mV
Source Effect	V_{out} - 0.95mV	_____mV	V_{out} + 0.95mV
PARD (Ripple and Noise)			
Peak-to-Peak	0	_____mV	15mV
RMS	0	_____mV	2.5 mV
Transient Response Time (at 900 μs)	0	_____mV	150mV
Constant Current Tests			
Current Programming and Readback			
Low Current (0A) I_{out}	-230mA	_____mA	+230mA
Front Panel Display Readback	I_{out} - 300mA	_____mA	I_{out} + 300mA
High Current (440A) I_{out}	439.33A	_____A	440.67A
Front Panel Display Readback	I_{out} - 740mA	_____mA	I_{out} + 740mA
Load Effect	I_{out} - 62mA	_____mA	I_{out} + 62mA
Source Effect	I_{out} - 62.5mA	_____mA	I_{out} + 62.5mA

*Enter your test results in this column.

Table 2-8. Performance Test Record for Agilent Model 6691A

MODEL Agilent_____	Report No._____	Date_____	
Test Description	**Minimum Spec.**	**Results** *	**Maximum Spec.**
Constant Voltage Tests			
Voltage Programming and Readback			
Low Voltage (0V) V_{out}	-30mV	_____mV	+30mV
Front Panel Display Readback	V_{out} - 45mV	_____mV	V_{out} + 45mV
High Voltage (30V) V_{out}	29.958V	_____V	30.042V
Front Panel Display Readback	V_{out} - 60mV	_____mV	V_{out} + 60mV
Load Effect	V_{out} - 1.7mV	_____mV	V_{out} + 1.7mV
Source Effect	V_{out} - 1.25mV	_____mV	V_{out} + 1.25mV
PARD (Ripple and Noise)			
Peak-to-Peak	0	_____mV	25mV
RMS	0	_____mV	2.5mV
Transient Response Time (at 900 µs)	0	_____mV	150mV
Constant Current Tests			
Current Programming and Readback			
Low Current (0A) I_{out}	-125mA	_____mA	+125mA
Front Panel Display Readback	I_{out} - 165mA	_____mA	I_{out} + 165mA
High Current (220A) I_{out}	219.655A	_____A	220.345A
Front Panel Display Readback	I_{out} - 385mA	_____mA	I_{out} + 385mA
Load Effect	I_{out} - 28mA	_____mA	I_{out} + 28mA
Source Effect	I_{out} - 28mA	_____mA	I_{out} + 28mA

*Enter your test results in this column.

Table 2-9. Performance Test Record for Agilent Model 6692A

MODEL Agilent_____	Report No._____	Date_____	
Test Description	**Minimum Spec.**	**Results ***	**Maximum Spec.**
Constant Voltage Tests			
Voltage Programming and Readback			
Low Voltage (0V) V_{out}	-60mV	_____mV	+60mV
Front Panel Display Readback	V_{out} - 90mV	_____mV	V_{out} + 90mV
High Voltage (60V) V_{out}	59.916V	_____V	60.084V
Front Panel Display Readback	V_{out} - 120mV	_____mV	V_{out} + 120mV
Load Effect	V_{out} - 3.4mV	_____mV	V_{out} + 3.3mV
Source Effect	V_{out} -1.85mV	_____mV	V_{out} + 1.85mV
PARD (Ripple and Noise)			
Peak-to-Peak	0	_____mV	25mV
RMS	0	_____mV	2.5mV
Transient Response Time (at 900 μs)	0	_____mV	150mV
Constant Current Tests			
Current Programming and Readback			
Low Current (0A) I_{out}	-65mA	_____mA	+65mA
Front Panel Display Readback	I_{out} - 80mA	_____mA	I_{out} + 80mA
High Current (110A) I_{out}	109.825A	_____A	+110.175A
Front Panel Display Readback	I_{out} - 190mA	_____mA	I_{out} + 190mA
Load Effect	I_{out} - 14.5mA	_____mA	I_{out} + 14.5mA
Source Effect	I_{out} - 14.5mA	_____mA	I_{out} + 14.5mA

*Enter your test results in this column.

3

Troubleshooting

Introduction

WARNING **Shock Hazard**: Most of the procedures in this chapter must be performed with power applied and protective covers removed. These procedures should be done only by trained service personnel aware of the hazard from electrical shock.

CAUTION This instrument uses components that can be damaged or suffer serious performance degradation due to ESD (electrostatic discharge). Observe standard antistatic precautions to avoid damage to the components (see Chapter 1).

This chapter provides troubleshooting and repair information for the power supply. Before beginning troubleshooting procedures, make certain the problem is in the power supply and not with an associated circuit, the GPIB controller (for GPIB system power supplies), or ac input line. Without removing the covers, you can use the Verification tests in Chapter 2 to determine if the power supply is operating normally.

The information in this chapter is organized as follows:

Topic	Information Given
Test Equipment Required	Equipment required for completing all the tests in this chapter.
Troubleshooting Procedures	An explanation of the error codes and messages generated during the power-on selftest.
	A series of flow charts for systematic location of defective boards, circuits, and components.
Post-Repair Adjustments	Calibration and EEPROM initialization procedures required after the replacement of certain critical components.
Disassembly Procedures	Gaining access to and/or replacing components.

Test Equipment Required

Table 3-1. Test Equipment Required

Equipment	Purpose	Recommended Model
Test Clips	To gain access to IC pins.	AP Products No. LTC
Ammeter/Current Shunt	To measure output current.	Agilent 6690A: Burster 1280 Agilent 6691A, 6692A: Guildline 9230/300
Oscilloscope	To check waveforms and signal levels.	Agilent 54504A
GPIB Controller	To communicate with power supply via the GPIB (for system units).	Agilent BASIC series
DC Voltmeter	To measure output voltage and current, bias and references.	Agilent 3458A

Power-On Selftest

Description

The procedures in the troubleshooting charts make use of the power-on selftest. The power-on selftest tests the front panel, GPIB interface (for GPIB system power supplies), and secondary interface circuits. If the power supply fails the selftest, the output remains disabled (turned off) and the front panel normally displays an error code or message (see Table 3-2). The message is displayed indefinitely and the power supply will not accept GPIB or front panel commands.

Disabling The Power-On Selftest

In order to perform troubleshooting procedures that require programming of the power supply, you must disable the power-on self test. Do this as follows:

1. Turn off the power supply.
2. Hold down the 7 key and turn on the supply.
3. Continue holding down the 7 for 2 seconds and wait until the **PWR ON INIT** indicator goes off.
4. The power supply is now on without executing power-on selftest.

Using the *TST? Query

You can get the power supply to execute a partial selftest by sending it the GPIB ***TST?** query command. Table 3-2 shows the tests that are performed in response to this command. These tests do not interfere with normal operation or cause the output to change. The command returns a value of "0" if all tests pass. Otherwise, the command returns the error code of the first test that failed. No error codes are displayed on the front panel and the power supply will attempt to continue normal operation.

Troubleshooting Charts

Figure 3-1 gives overall troubleshooting procedures to isolate the fault to a circuit board or particular circuit (see Figure 3-20 for the location of the circuit boards). Some results of Figure 3-1 lead to more detailed troubleshooting charts that guide you to specific components.

Many of the following troubleshooting procedures begin by checking the bias and/or reference voltages. Table 6-3 of chapter 6 lists the test points for these voltages and gives the correct reading for each. Test points are identified by an encircled number such as ⑤ in schematic diagrams and component location drawings. The circuit board component location diagrams identify these points on each board.

The troubleshooting charts are organized as follows:

Chart	Trouble or Circuit
Figure 3-1	Overall procedure checks selftest errors, calibration errors, ac input circuit, fan, readback circuits, A10 Control Board, GPIB cable, digital port, serial link, rotary controls, current amplifier.
Figure 3-2	No display (from Figure 3-1).
Figure 3-3	OV circuit not firing (from Figure 3-1).
Figure 3-4	OV circuit is on at turn on (from Figure 3-1).
Figure 3-5	Output level is held low (from Figure 3-1).
Figure 3-6	Output level is held high (from Figure 3-1).
Figure 3-7	DAC circuits (from Figure 3-1).
Figure 3-8	Serial Down circuit (from Figure 3-1).
Figure 3-9	Secondary interface circuit (from Figure 3-1).
Figure 3-10	Slow downprogramming circuit (from Figure 3-1).
Figure 3-11	FET troubleshooting (from table 3-2).

Table 3-2. Selftest Error Codes/Messages

Code and/or Message	Description	Probable Cause Selftest Error Codes/Messages
El FP RAM	Front panel RAM test failed (power-on).	A1 board probably defective.*
E2 FP ROM	Front panel ROM test failed (power-on and *TST?).	A1 board probably defective.*
E3 EE CHKSM	Front panel EEPROM checksum test failed (power-on and *TST?).	EEPROM U6 on the A1 board probably defective.*
E4 PRI XRAM	Primary interface external RAM test failed (power-on).	A2 board probably defective.
E5 PRI IRAM	Primary interface internal RAM test failed (power-on).	A2 board probably defective.
E6 PRI ROM	Primary interface ROM test failed (power-on and *TST?).	A2 board probably defective.
E7 GPIB	GPIB interface test failed (power-on).	A2 board probably defective.
E8 SEC RAM	Secondary interface RAM test failed (power-on).	A10 board probably defective.*
E9 SEC ROM	Secondary interface ROM test failed (power-on and *TST?).	A10 board probably defective.*
E10 SEC 5V	Secondary interface 5 volt readback test failed (power-on and *TST?).	A10 board probably defective,* or A6 bias board defective
E11 TEMP	Ambient temperature readback test failed (power-on and *TST?).	A10 board probably defective.*
E12 DACS	CV or CC DAC tests failed (power-on).	A10 board probably defective,* or A6 bias board defective (see Figure 3-7).
NOTE: The following error messages can appear because of a failure while the unit is operating or during selftest.		
SERIAL TIMOUT	Serial data line failure on A2 board.	See Figure 3-8.
SERIAL DOWN	Serial data line failure on A2 board.	See Figure 3-8.
UART PARITY	UART failed.	A2 board probably defective.
UART FRAMING	UART failed.	A2 board probably defective.
UART OVERRUN	UART failed.	A2 board probably defective.
SBUF OVERRUN	Serial buffer failure UART.	A2 board probably defective or A2 board is in SA mode (see Figure 3-12).
SBUF FULL	Serial buffer failure.	A2 board probably defective or A2 board is in SA mode (see Figure 3-12).
EE WRITE ERR	EEPROM write failure.	EEPROM U6 on the A1 board probably defective or calibration error.*
SECONDARY DN	Serial data line failure on Main board.	See Figure 3-9.

* If you replace either the Al or A10 board, the power supply must be reinitialized and calibrated.

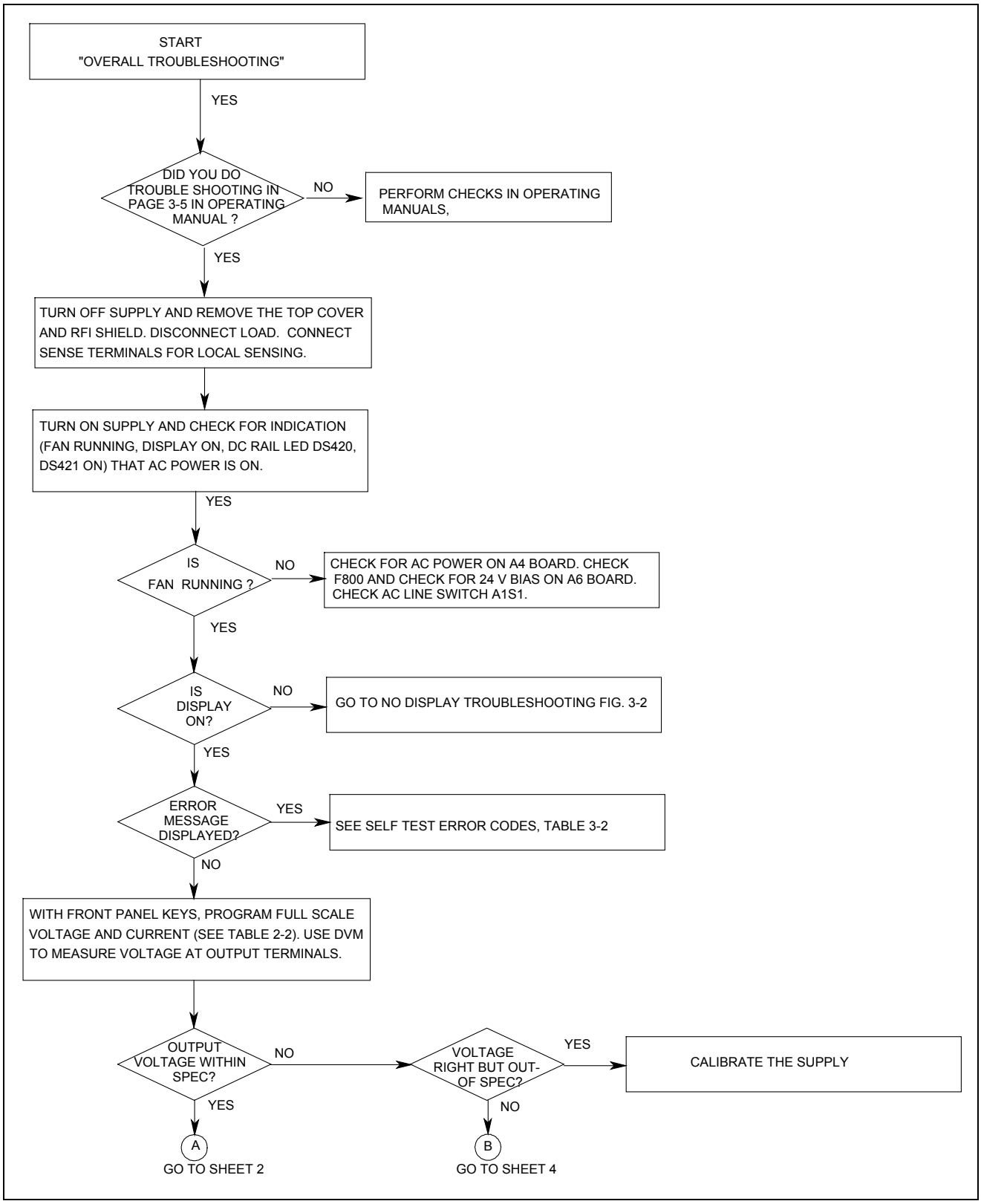


Figure 3-1. Overall Troubleshooting (Sheet 1 of 4)

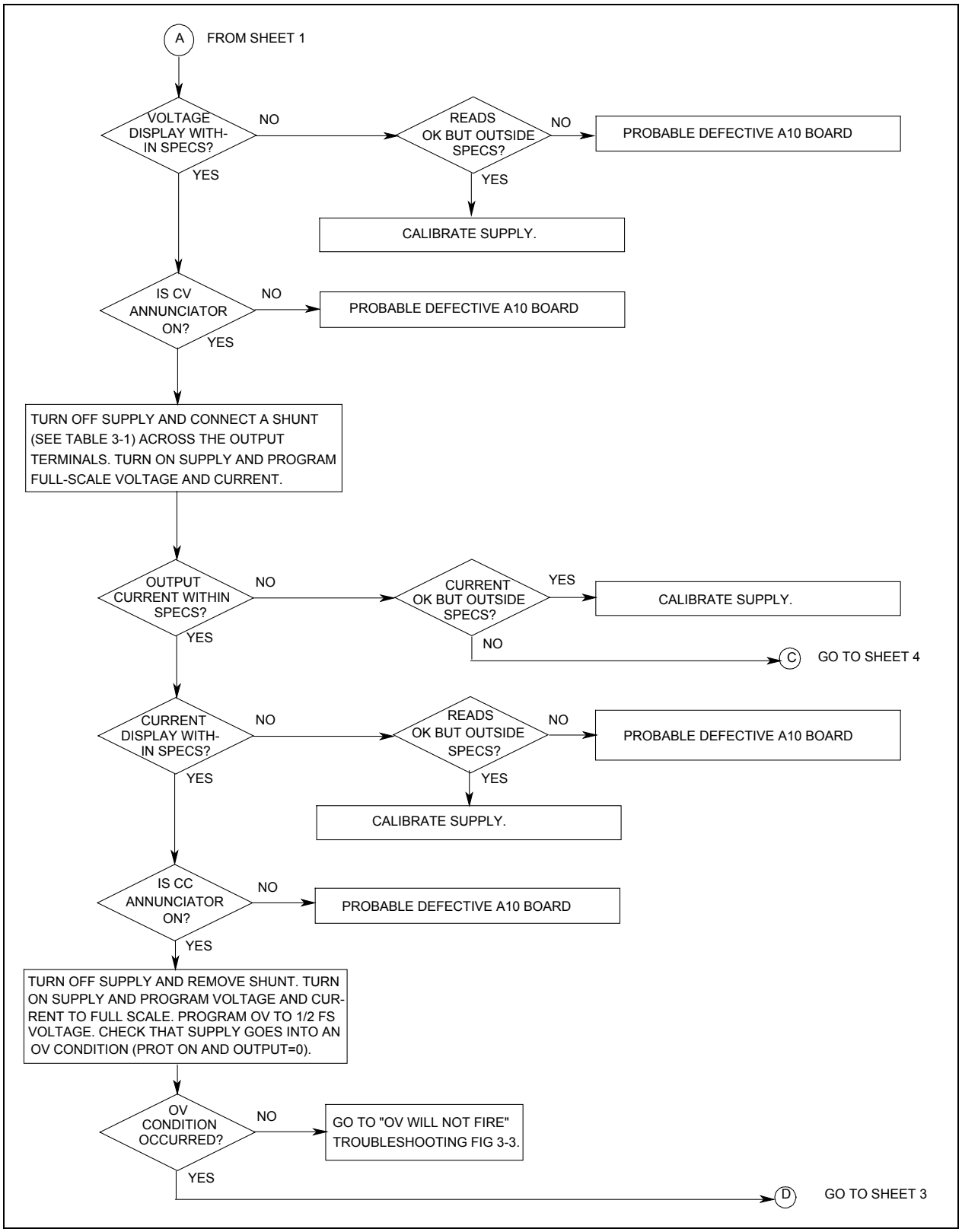


Figure 3-1. Overall Troubleshooting (Sheet 2 of 4)

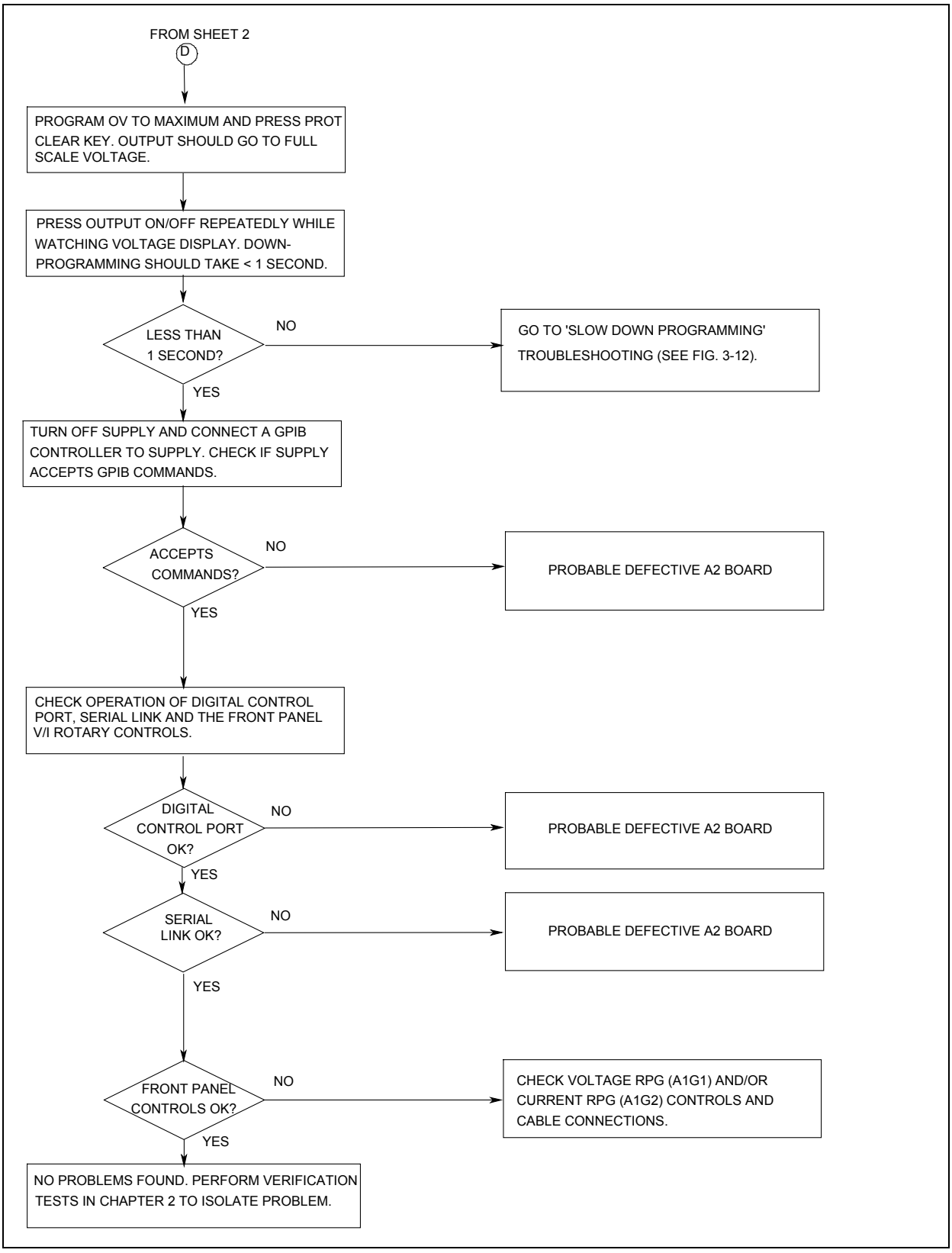


Figure 3-1. Overall Troubleshooting (Sheet 3 of 4)

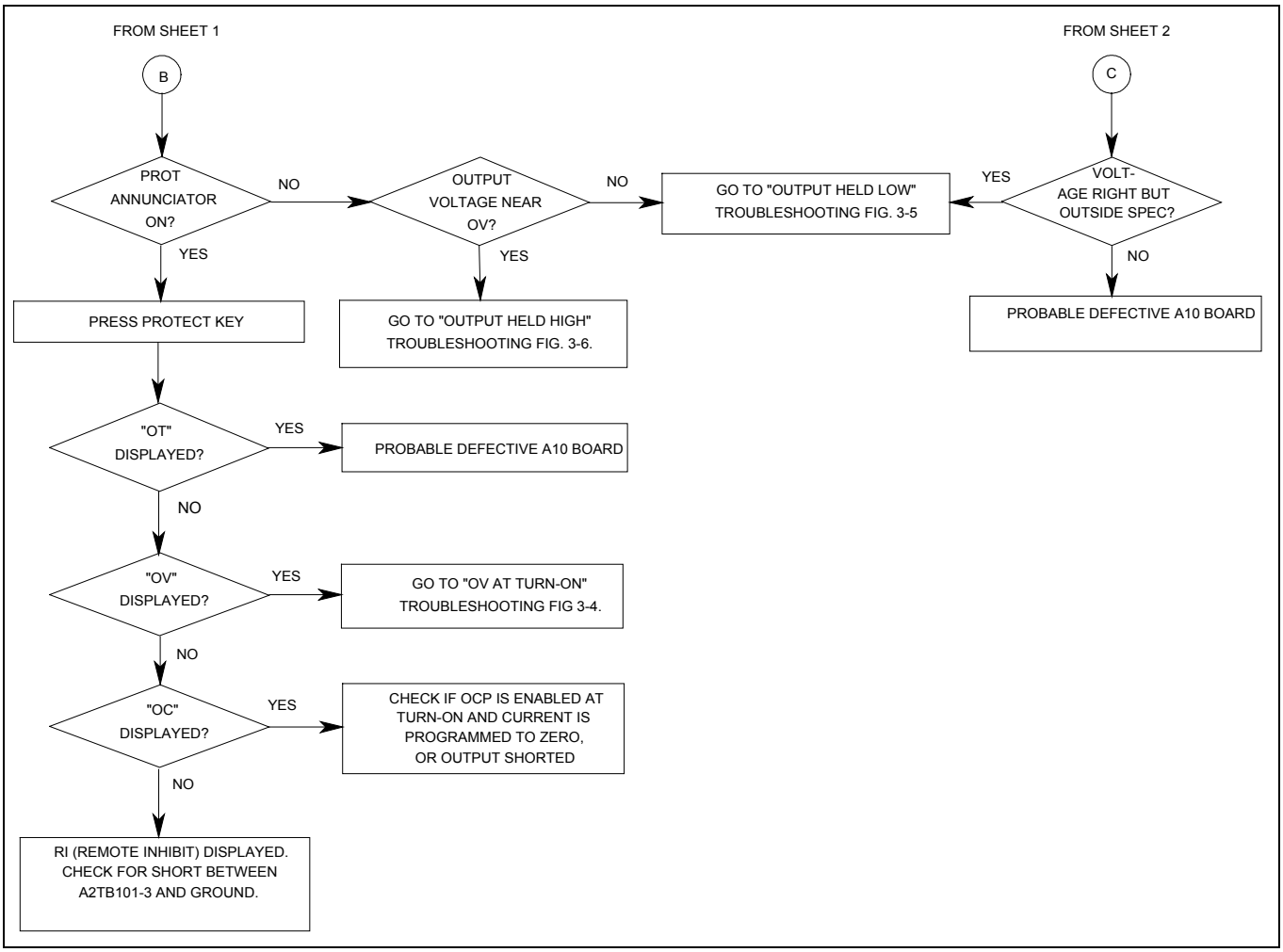


Figure 3-1. Overall Troubleshooting (Sheet 4 of 4)

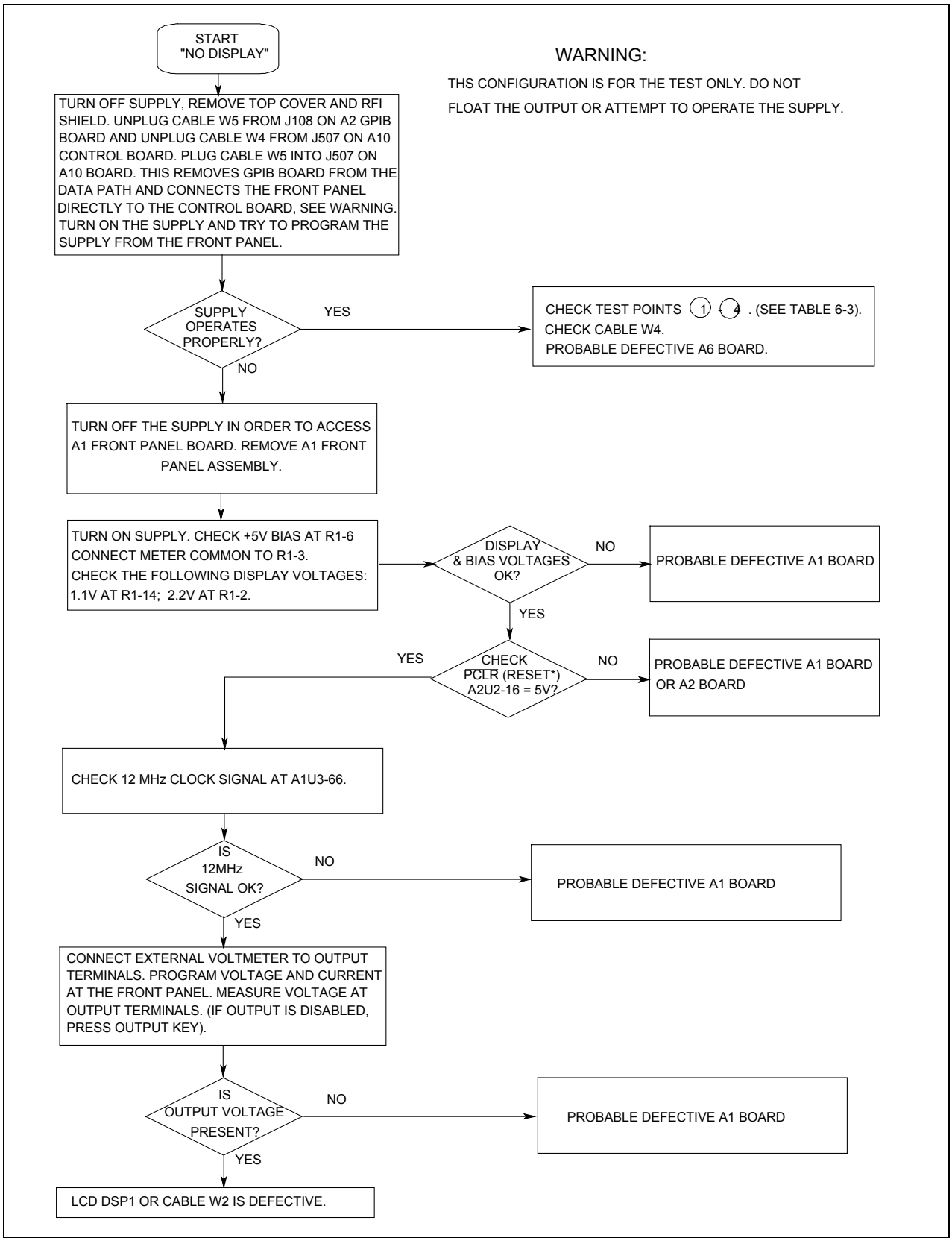


Figure 3-2. No Display Troubleshooting)

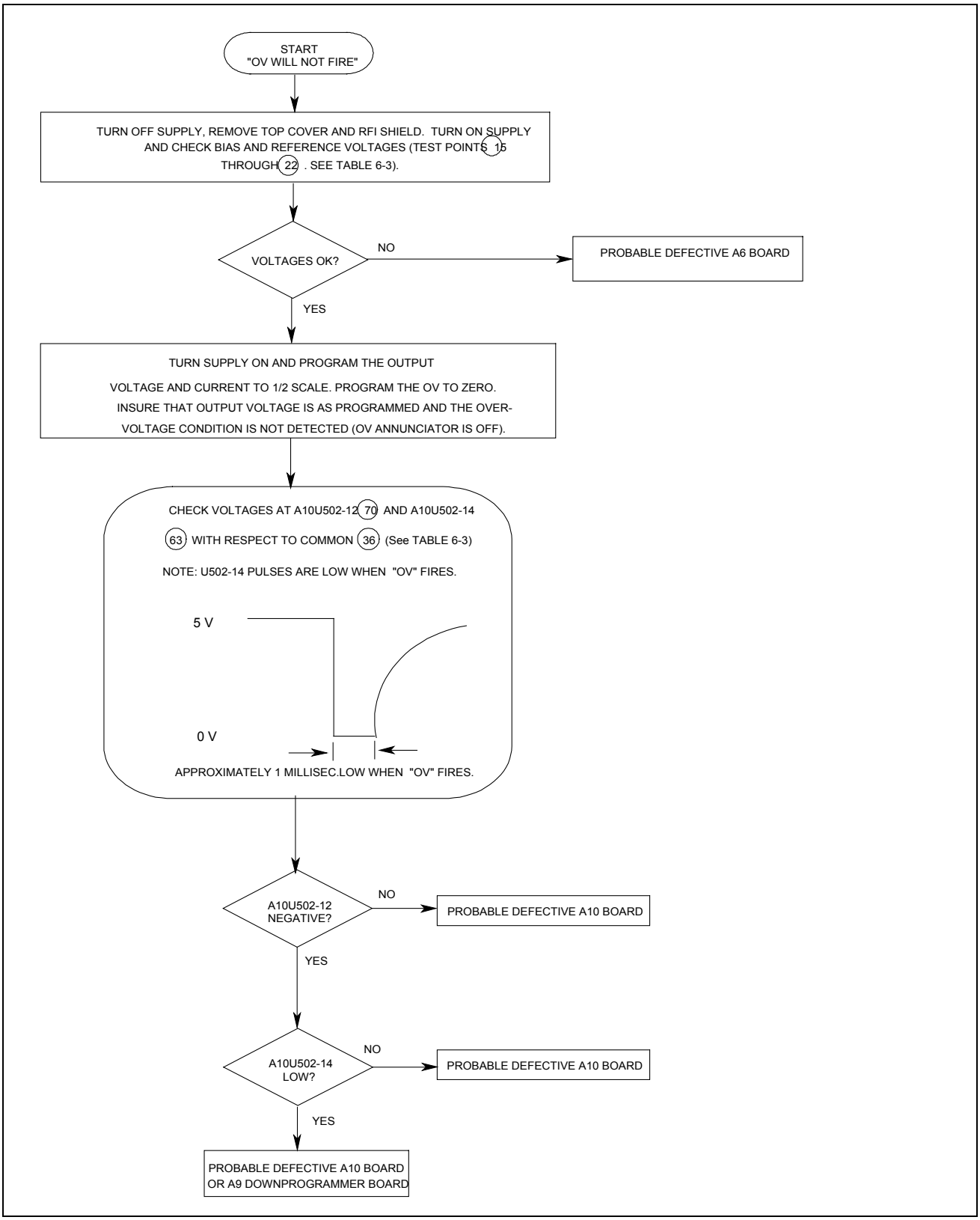


Figure 3-3. OV Will Not Fire Troubleshooting)

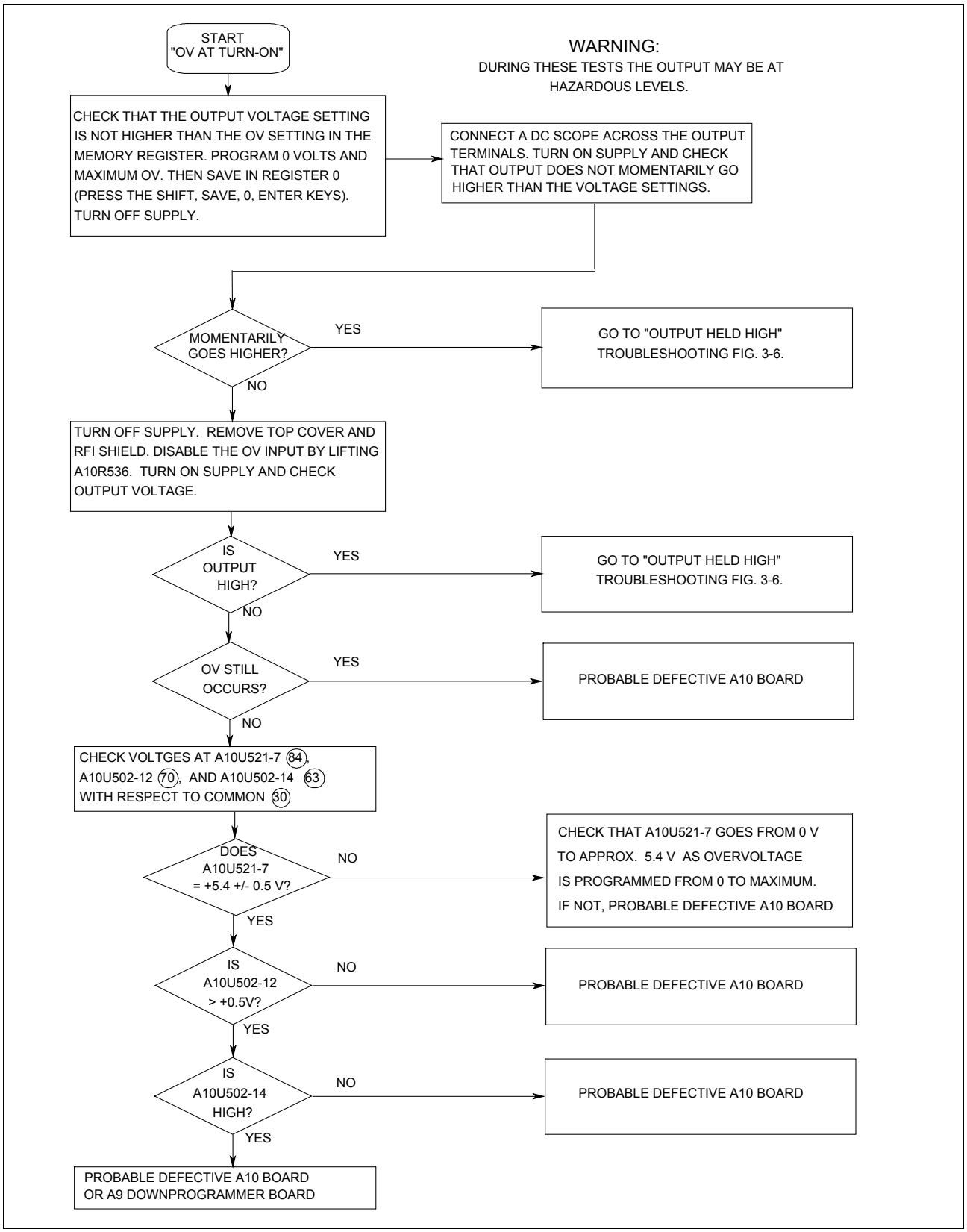


Figure 3-4. OV At Turn-On Troubleshooting)

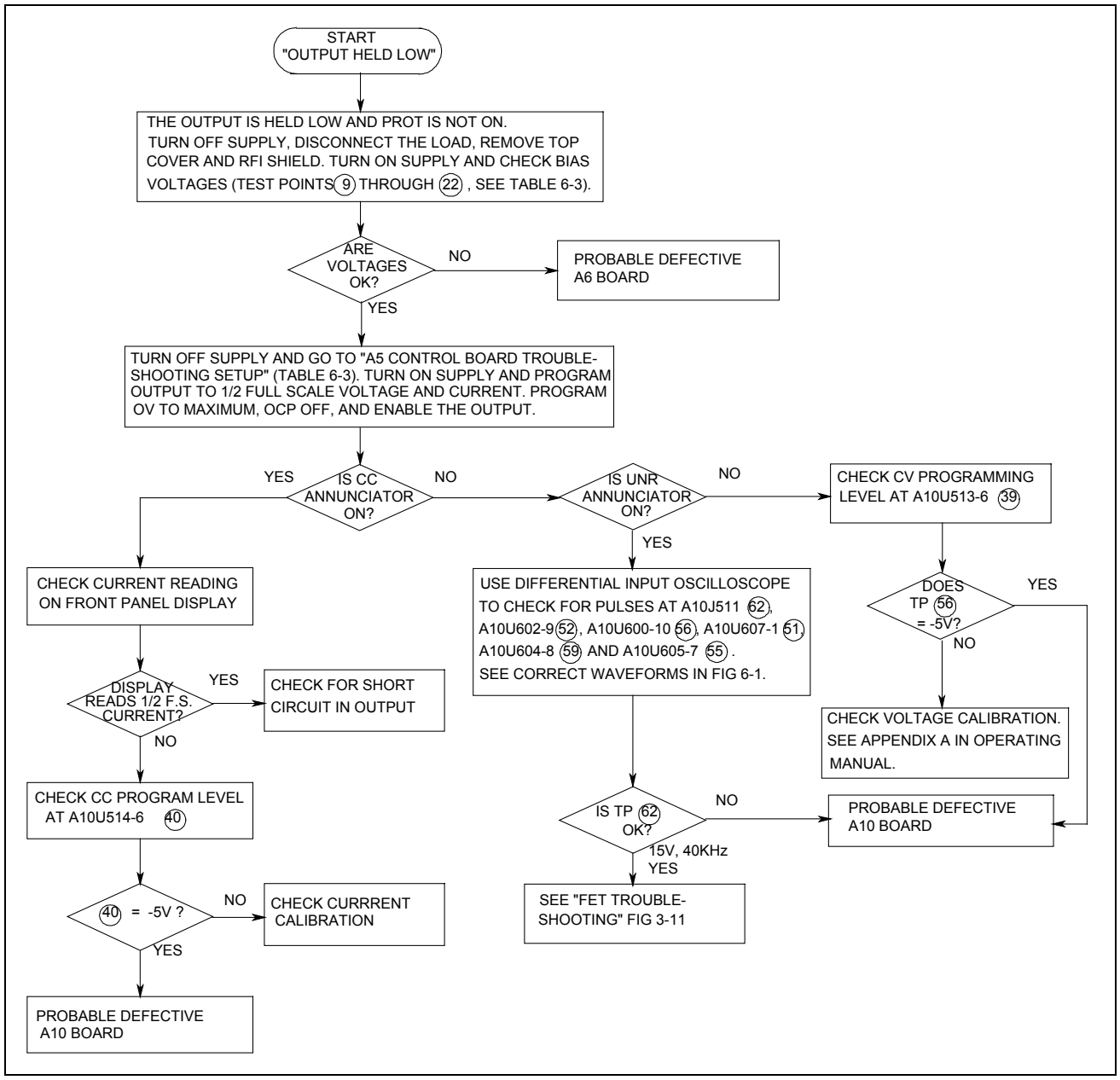


Figure 3-5. Output Held Low Troubleshooting)

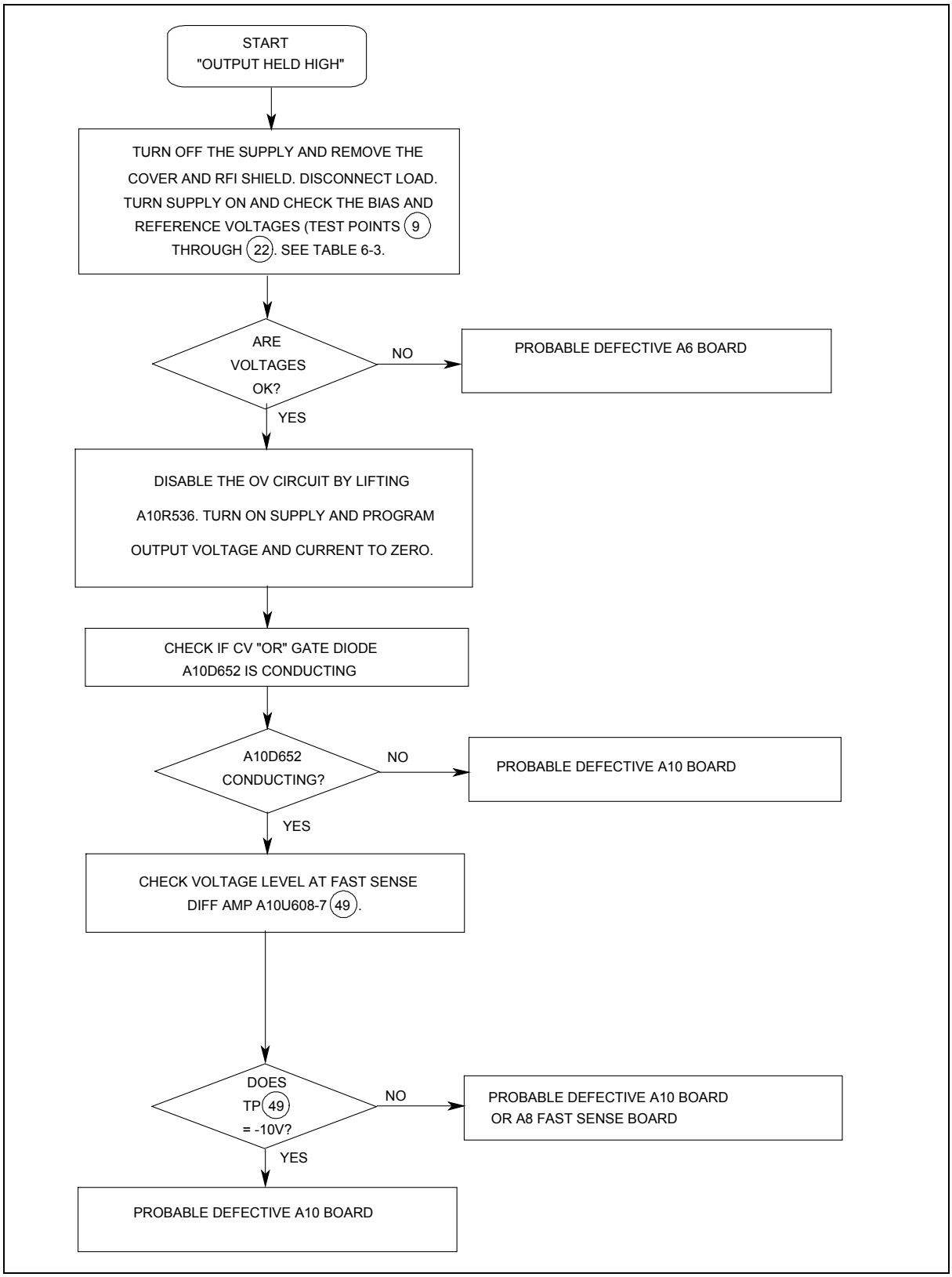


Figure 3-6. Output Held High Troubleshooting)

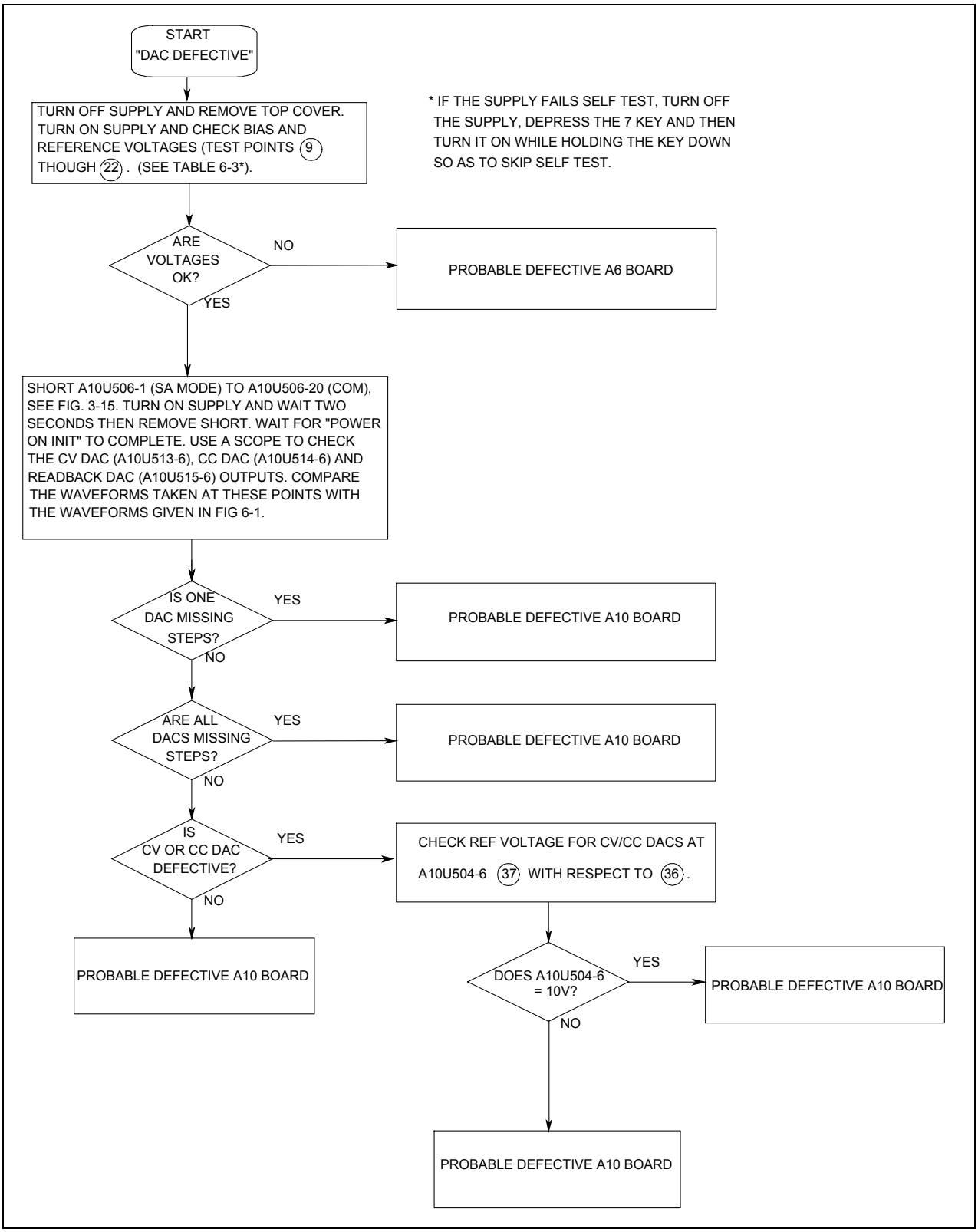


Figure 3-7. DAC Circuits Troubleshooting)

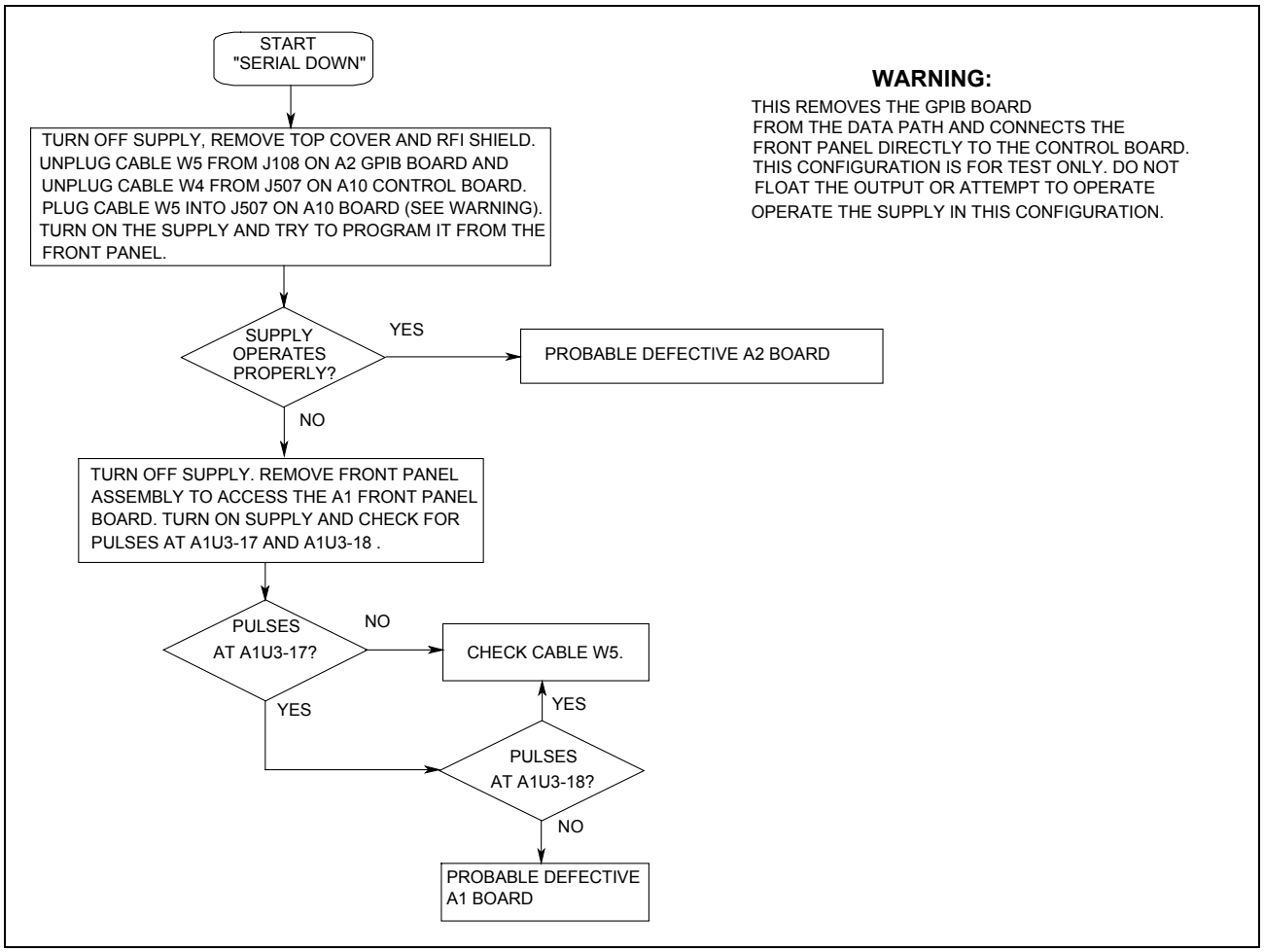


Figure 3-8. Serial Down Troubleshooting)

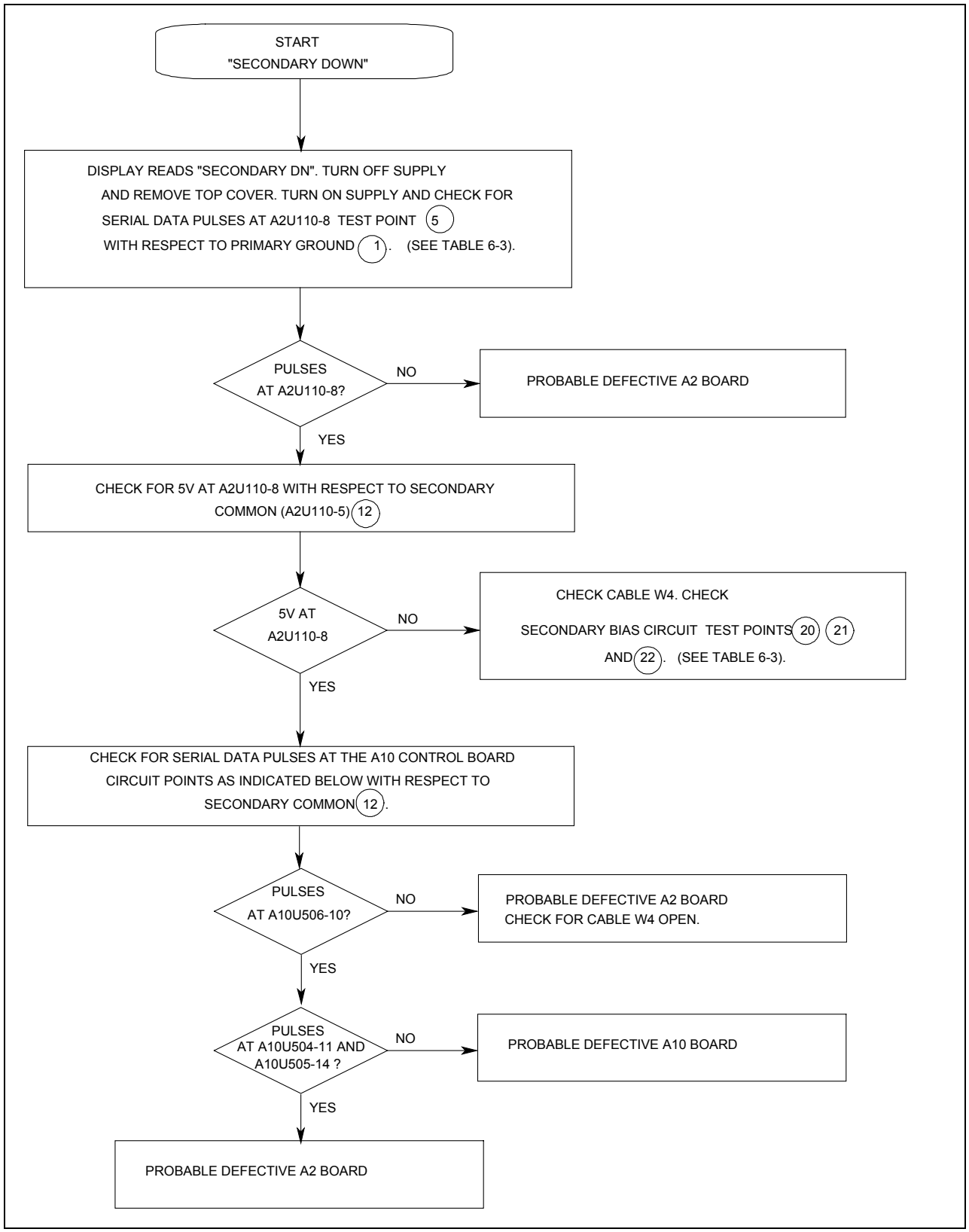


Figure 3-9. Secondary Interface Down)

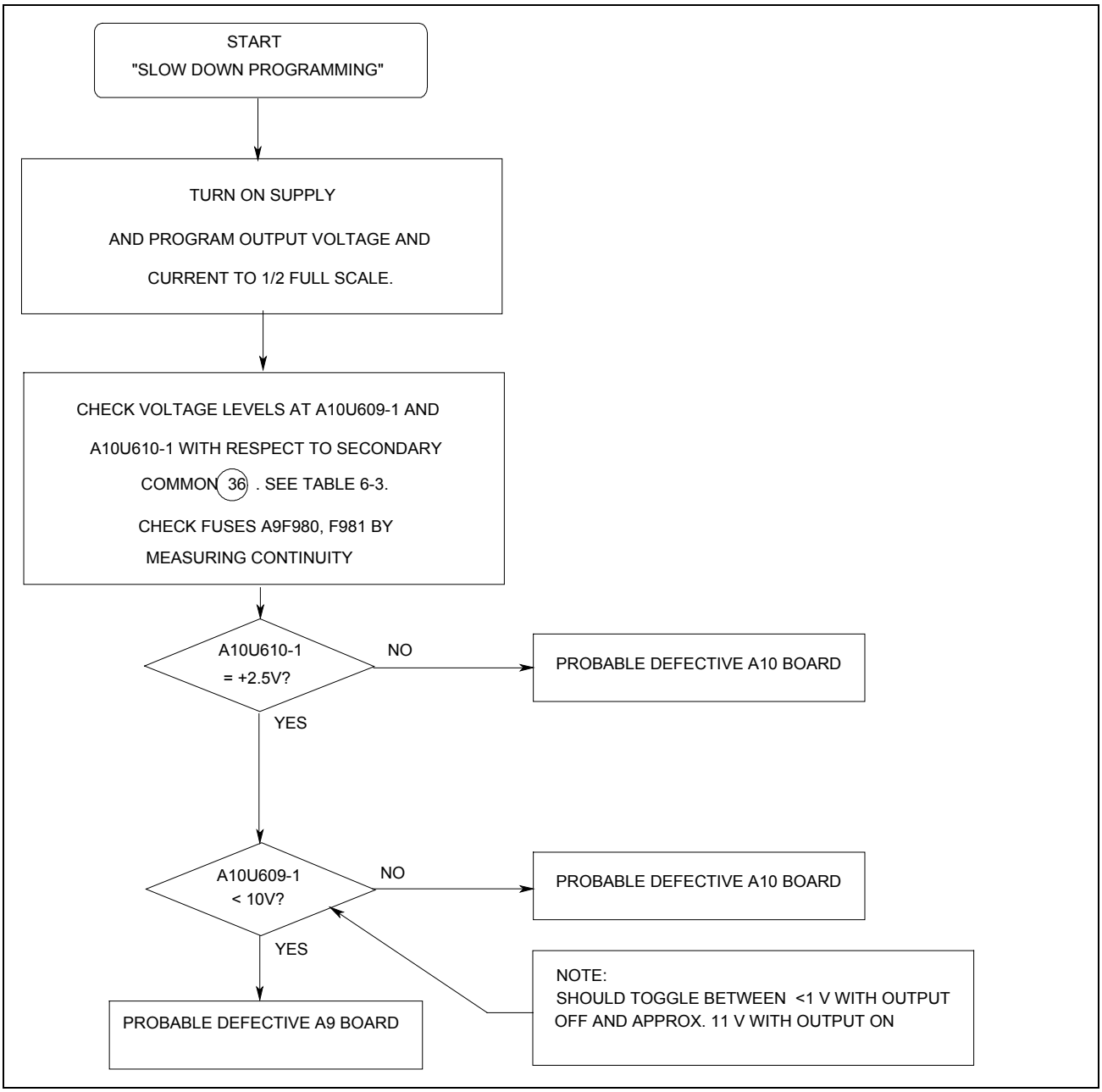


Figure 3-10. Slow Downprogramming Troubleshooting)

Note Because test points on the FET board are not accessible when the board is installed, troubleshooting must be performed with the board removed from the power supply (refer to the disassembly procedures at the back of this chapter

If any power FET (Q201-204, Q301-304, Q211, Q311, Q222, Q322, Q233, Q333, Q244, Q344) is defective, you must replace all eight with a matched set.

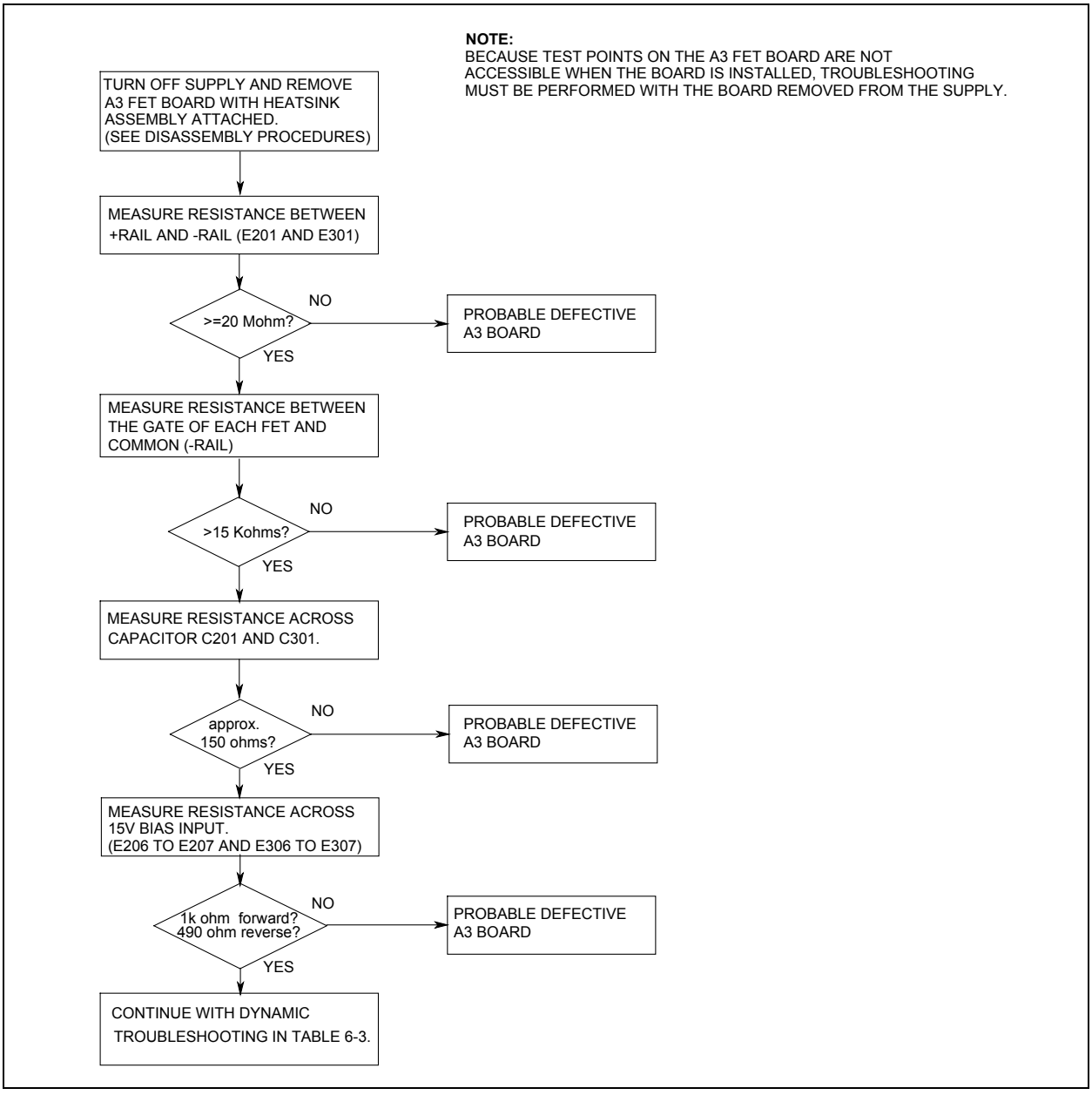


Figure 3-11. FET Troubleshooting Chart)

Firmware Revisions

Firmware revision labels are located on the Front panel ROM, AlU3, and on the Secondary microprocessor, A5U504. You can obtain the revisions with the GPIB ***IDN?** query command. The following sample Agilent BASIC program does this:

```
10 ALLOCATE L$[52]
20 OUTPUT 705;"*IDN?"
30 ENTER 705;L$
40 DISP L$
50 END
```

For a typical Model 6691A, the controller will return a string with four comma-separated fields, as follows:

"Hewlett-Packard ,6691A,O,fA.01.05sA.01.04pA.0l.02"

The first three fields are the manufacturer, model number and 0. The last field gives the firmware information as follows:

f= front panel firmware revision (A.01.05).
s= secondary interface firmware revision (A.01.04).
p= primary interface firmware revision (A.01.02).

Note The firmware revisions numbers shown here may not match the firmware revision of your instrument. Firmware revision numbers are subject to change whenever the firmware is updated.

Test Headers

The power supply has two test headers as shown in Figure 3-12, each with a jumper that can be moved to different positions for various functions. To gain access to the headers, remove the power supply top cover.

Pins	Description
Primary Interface Test Connector A2J106	
7 and 8 (FLT/INH)	Normal operating (and storage) position. DIG CNTL port** is configured for fault indicator (FLT) output and remote inhibit (RI) input .
1 and 2 (SA Mode)	NOT AVAILABLE
3 and 4 (DIG I/O)	Install jumper here to configure DIG CNTL port** for digital I/O operation .
5 and 6 (RELAY LINK)	Install jumper here to configure DIG CNTL port** for control of external relay accessories. ** See Appendix D in power supply Operating Manual for information about the digital control port.
Front Panel Test Connector A1J3	
7 and 8 (NORM)	Normal operating (and storage) position of jumper.
1 and 2 (SA Mode)	NOT AVAILABLE
3 and 4 (INHIBIT CAL)	Install jumper here to disable calibration commands and prohibit calibration.
5 and 6 (FACTORY PRESET CAL)	Install jumper here to restore original factory calibration constants.

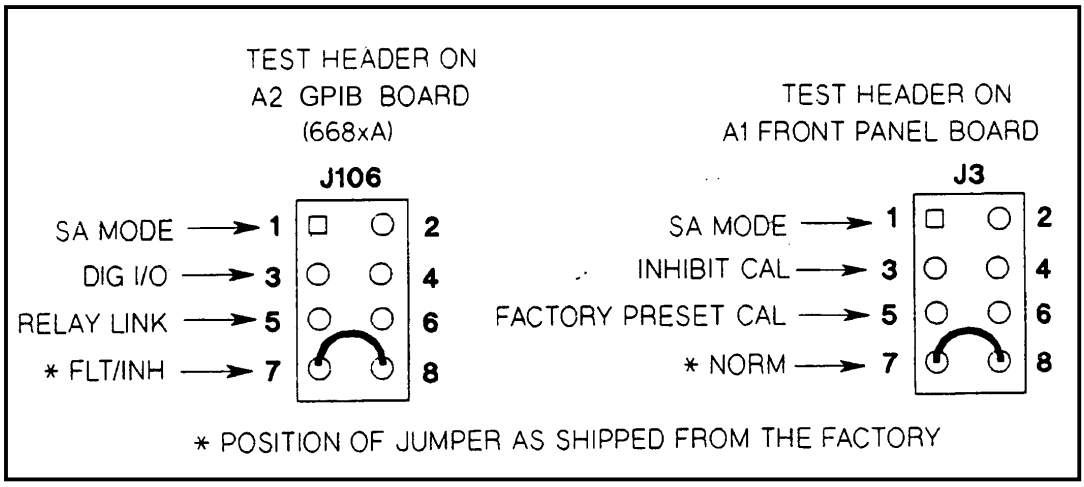


Figure 3-12. Test Header Jumper Positions

Post-Repair Calibration

When Required

Calibration is required annually and also whenever certain components are replaced. If components in any of the circuits listed below are replaced, the supply must be recalibrated.

Note For calibration procedures, see Appendix A of the Operating Manual.

Location	Component
A10 Control Board	CV/CC DACs/operational amplifiers, CV/CC control circuit amplifiers, readback DAC/operational amplifier, readback comparators.
A1 Front Panel Assy	A1 Front Panel Board or EEPROM AlU6. **Note**: If either of these front panel components is replaced, the power supply must first be reinitialized before calibration (see "EEPROM Initialization") .

Inhibit Calibration Jumper

If **CAL DENIED** appears on the display when front panel calibration is attempted (or error code 1 occurs when GPIB calibration is attempted on a Systems Supply), the INHIBIT CAL jumper (see Figure 3-15) is installed. This prevents the power supply calibration from being changed. To calibrate the power supply first move this jumper from the INHIBIT CAL position to the NORM position.

Calibration Password

In order to enter the calibration mode, you must use the correct password as described in Appendix A of the Operating Manual. As shipped from the factory, the supply's model number (e.g., "6681") is the password. If you use an incorrect password, **PASSWD ERROR** appears on the display during front panel calibration, or error code 2 occurs during GPIB calibration, and the calibration mode is disabled. If you do not know the password, you can recover the calibration function by restoring the preset factory calibration constants as described below.

Restoring Factory Calibration Constants

This procedure allows you to recover the factory calibration constants. The ability to do this allows you to operate the power supply for troubleshooting and/or to recalibrate it as required. To restore the original factory calibration constants, proceed as follows:

1. Turn off the supply and remove the top cover.
2. Move the jumper in test header J3 on the A1 Front Panel Board from the **NORM** to the **FACTORY PRESET CAL** position (see Figure 3-15).
3. Turn on the power supply and note that **ADDR 5** and then **PWR ON INIT** appear briefly on the front panel display.
4. When **PWR ON INIT** no longer appears, the supply's factory calibration constants have been restored and the password has been changed to 0. There is no longer any password protection. You can now turn off the supply and restore the calibration jumper to the **NORM** position (see Figure 3-15).
5. Turn on the supply. You may now set a new password (if desired) and recalibrate the power supply.

EEPROM Initialization

EEPROM AlU6 on the A1 Front Panel Board stores the supply's GPIB address, model number, and constants required to program and calibrate the power supply. If either the front panel board or the EEPROM is replaced, the power supply must be reinitialized with the proper constants by running the program listed in Figure 3-18.

When the program pauses and asks you to make a selection, respond as follows:

Initialization (I) or Factory Preset Replacement (F)? I

After the power supply has been initialized, it must be calibrated as described in Appendix A of the Operating Manual. After calibration, transfer the new calibration constants to the EEPROM's "Factory Cal" locations as described next.

Transferring Calibration Constants to Factory Preset Locations

A newly initialized and calibrated power supply has calibration constants in operating locations but does not have the new factory calibration constants stored in EEPROM. This procedure transfers the calibration constants into the EEPROM FACTORY PRESET CAL locations by running the program listed in Figure 3-13.

When the initialization program pauses and asks you to make a selection, respond as follows:

Initialization (I) or Factory Preset Replacement (F)? F

The new calibration constants will then be stored. Pre-initialized and tested A1 Front Panel boards are available for Analog Programmable "bench" series supplies. (See Chapter 5, Table 5-4 for part numbers.)

A Bench Series Supply can be initialized and the new Factory Preset calibration constants loaded by temporarily replacing the A2 Isolator board with an A2 GPIB board. Then follow the instructions above for "EEPROM INITIALIZATION" and also "TRANSFERRING CALIBRATION CONSTANTS TO THE FACTORY PRESET LOCATIONS" described above.

After the supply has been Initialized, Calibrated, and the new Factory Presets stored, remove the GPIB board and reinstall the original Isolator board.

```
10    !      Program to initialize EPROM or move factory preset data in 669xA
20    !    power supplies.
30    !    RE-STORE " INIT_669X"
40    !    Rev A.00.00 dated Feb 2002
50    !
60         DIM Init_data(1:49),Model$[5],Idn$[21],Cal_data$[40]
70         INTEGER Addr(1:49),Length(1:49)
80         ASSIGN @Ps TO 705                                   ! Supply must be at address 705
90         CLEAR SCREEN
100        !
110 Eprom_data_addr:                                           ! Data address
120        DATA 2,6,10,14,18,19,20,24,28,32
130        DATA 36,37,38,42,46,50,54,55,56,57
140        DATA 64,68,72,76,80,116,l52,153,154,155
150        DATA l56,158,160,162,163,164,165,166,167,168
160        DATA 169,170,171,172,174,176,180,184,188
170        !
180 Eprom_data_len:                                            ! Data for word length
190        DATA 4,4,4,4,1,1,4,4,4,4
200        DATA 1,1,4,4,4,4,1,1,1,1
210        DATA 4,4,4,4,4,1,1,1,1,1
220        DATA 2,2,2,1,1,1,1,1,1,1
230        DATA 1,1,1,2,1,4,4,4,4
240        !
250 Eprom_data_6690:    !                                      ! EEPROM data for 6690A
260        DATA 175,74,15.375,0,83,0,15,73,450,0
270        DATA 98,21,8.7,10,18.0,0,83,255,20,10
280        DATA 6690,162,96,15,96,128,5,255,0,0
290        DATA 1296,6690,0,20,180,20,180,175,33,98
300        DATA 115,30,20,1,127,.002701,.2,.000307,10.25
310        !
320 Eprom_data_6691:   !                                       ! EPROM data for 6691A
330        DATA 116,74,30.75,0,83,0,23,75,225,0
340        DATA 98,21,5.5,10,36.0,0,83,255,20,10
350        DATA  6691,108,96,23,97,128,5,255,0,0
360        DATA  1296,6691,0,20,180,20,180,175,33,98
370        DATA 115,30,20,1,127,.002701,.2,.00042,10.25
380        !
390 Eprom_data_6692:  !                                        ! EEPROM data for 6692A
400        DATA 93,74,61.5,0,83,0,29,70,112,0
410        DATA 98,21,4.6,10,69,0,83,255,20,10
420        DATA  6692,87,97,28,93,128,5,255,0,0
430        DATA 1296,6692,0,20,180,20,180,175,33,98
440        DATA  115,30,20,1,127,.002701,.2,.000333,10.234375
450        !
460        INPUT “Input Power Supply model number.     Example:""6691A""",Model$
470        CLEAR SCREEN
480        !
490        RESTORE Eprom_data_addr
500        !
510        FOR I=l T0 49
520          READ Addr(I)
530        NEXT I
540        !
```

Figure 3-13. Initialization and Factory Preset Replacement Program Listing (Sheet 1 of 4)

```
550     RESTORE Eprom_data_len
560     !
570     FOR I=l T0 49
580             READ Length(I)
590     NEXT I
600     !
610     SELECT TRIM$(UPC$(Model$))          ! Delete leading/trailing zeros and set to uppercase
620     CASE "6690A"
630       RESTORE Eprom_data_6690
640     CASE "6691A"
650       RESTORE Eprom_data_6691
660     CASE "6692A"
670       RESTORE Eprom_data_6692
680     !
690     CASE ELSE
700       PRINT "Model number not found. Program is for models"
710       PRINT "Agilent 6690A, 6691A, and 6692A only"
720       STOP
730     END SELECT
740     !
750     FOR I=l T0 49                                   ! Read model dependent data
760       READ Init_data(I)
770     NEXT I
780     !
790     OUTPUT @Ps;"*CLS"                               ! Clears power supply registers
800     !
810     OUTPUT @Ps;"CAL;STATE ON,"                      ! Turn on cal mode, "0" passcode
820     !
830  GOSUB Ps_error                                     ! Error if passcode is not "0"!
840  IF Err THEN
850       OUTPUT @Ps;"*IDN?"                            ! Get data from model # location
860    ENTER @Ps;Idn$
870       Model=VAL(Idn$[POS(Idn$,",")+1] )
880     ELSE
890       GOTO Start
900     END IF
910     !
920     OUTPUT @Ps;"CAL:STATE ON,";Model                ! Turn on cal mode, passcode =
930                                                     ! data at model number location
940     !
950  GOSUB Ps_error                                     ! Error if passcode is not same as
960                                                     ! data at model # location
970  IF Err THEN
980       OUTPUT @Ps;"CAL:STATE ON,";Model$[l,4]        ! Turn on cal mode, passcode =
990                                                     ! model #
1000      GOSUB Ps_error
1010      IF Err THEN
1020        PRINT "Change pass code to the power supply model # or zero then restart the program."
1030        STOP
1040      ELSE
1050        GOTO Start
1060      END IF
1070 END IF
1080    !
```

Figure 3-13. Initialization and Factory Preset Replacement Program Listing (Sheet 2 of 4)

```
1090  Start:        !
1100                !
1110     INPUT “Select Initialization (I) or Factory preset replacement (F).”,Sel$
1120     CLEAR SCREEN
1130     SELECT (UPC$(Sel$))
1140     CASE "I"                                                    ! Select Initialization
1150        GOTO Init_eeprom
1160     CASE "F"                                                    ! Select install new factory data
1170        GOTO Fact_preset
1180     CASE ELSE
1190        BEEP
1200        GOTO Start
1210     END SELECT
1220                 !
1230  Init_eeprom:              !
1240     PRINT “Initializing EEPROM”
1250          !
1260     FOR I=1 TO 49
1270        OUTPUT @Ps;"DIAG:EEPR ";Addr(I);",";Length(I);",";Init_data(I)
1280     NEXT I
1290     GOTO Cal_off
1300     !
1310  Fact_preset:              !
1320     CLEAR SCREEN
1330     PRINT "This program should ONLY be completed if your power supply”
1340     PRINT "EEPROM has been replaced or a component that will effect"
1350     PRINT "the calibration AND the alignment of voltage, overvoltage"
1360     PRINT "and current is complete AND unit has passed the performance"
1370     PRINT "test.                    Enter C to continue, any other key to abort.”
1380     INPUT Cont_prog$
1390     IF (UPC$(Cont_prog$))< >"C" THEN GOTO Cal_off
1400     !
1410     CLEAR SCREEN
1420     PRINT "Transferring calibration data to factory preset locations."
1430     !
1440  Fact_cal_sour:            ! Address of factory calibration data source
1450     DATA 2,6,68,72,20,24,76,80,150
1460     !
1470  Fact_cal_dest        :    ! Address of factory calibration data destination
1480     DATA 84,88,92,96,100,104,108,112,116
1490     !
1500  Fact_cal_len:             ! Length of factory calibration data
1510     DATA 4,4,4,4,4,4,4,4,1
1520     !
1530     RESTORE Fact_cal_sour
1540     FOR I=1 TO 9
1550        READ Cal_sour_addr(I)
1560     NEXT I
1570           !
1580     RESTORE Fact_cal_dest
1590     FOR I=1 T0 9
1600        READ Cal_dest_addr(I)
1610     NEXT I
1620           !
```

Figure 3-13. Initialization and Factory Preset Replacement Program Listing (Sheet 3 of 4)

```
1630     RESTORE Fact_cal_len
1640     FOR I=1 T0 9
1650        READ Cal_length(I)
1660     NEXT I
1670     !
1680     FOR I=1 T0 9                                        ! Locations of good data
1690        OUTPUT @Ps;"DIAG:EEPR? ";Cal_sour_addr(I);",";Cal_length(I)      !     Read good data
1700        ENTER @Ps;Cal_data$                              ! Enter good data
1710        OUTPUT @Ps;"DIAG:EEPR";Cal_dest_addr(I);",";Cal_length(I);",";Cal_data$
1720     !  Write good data to factory preset locations
1730     NEXT I
1740     !
1750     !
1760  Cal_off
1770     CLEAR SCREEN
1780     OUTPUT @Ps;"CaL:STATE OFF"                          ! Turn off cal mode
1790     !
1800     GOSUB Ps_error                                      ! Check for errors
1810     IF Err THEN
1820        PRINT "An error occurred during the EEPROM read/write, Check for"
1830        PRINT "programming errors. Initialization data may be incorrect."
1840        STOP
1850     END IF
1860     !
1870     PRINT "Operation complete. Program stopped."
1880     STOP
1890     !
1900  Ps_error:                                              ! Error handling subroutine
1910     OUTPUT @Ps;"SYST:ERR?"                              ! Check for errors
1920     ENTER @Ps;Err
1930     RETURN
1940     !
1950 END
```

Figure 3-13. Initialization and Factory Preset Replacement Program Listing (Sheet 4 of 4)

Disassembly Procedures

WARNING

Shock Hazard: To avoid the possibility of personal injury, remove the power supply from service before removing the top cover. Turn off the ac power and disconnect the line cord, GPIB cable, load leads, and remote sense leads before attempting any disassembly. Any disassembly work must only be performed by a qualified support technician.

Observe that the DC RAIL assembly LEDs (DS420 & DS421) are fully extinguished (no live voltages present) before attempting any disassembly work. Any disassembly work must only be performed by a qualified support technician.

Cable connections are shown in Figure 6-2 of Chapter 6 and component part numbers are given in Chapter 5. Reassembly procedures are essentially the reverse of the corresponding disassembly procedures.

Tools Required

- TORX screwdriver size T-15 (for most all retaining screws).
- TORX screwdriver size T-20 (for power supply carry straps).
- Seven (7) mm metric hex driver (to remove GPIB read connector).
- Pencil, paper, and labels to make notes to aid in the reinstallation of components.
- Work at a static-free station such as a table covered with static-dissipative laminate or with a conductive table mat (Agilent P/N 9300-0797, or equivalent) using a conductive wrist strap where necessary, such as, Agilent P/N 9300-0969 or 9300-0970.

Top Cover

1. Remove the four screws that secure the carrying straps (two TORX 20 screws on each side). These same screws secure the cover to the chassis.
2. Spread the bottom rear of the cover, and then pull the cover backwards towards the rear of the power supply to disengage it from the front panel.

WARNING **Shock Hazard:** Hazardous voltage can exist inside the power supply even after it has been turned off. Check the INPUT RAIL LED (A4CR402) under the RFI shield (see Figure 3-18 end of this section for LED location). If the LED is on, there is still hazardous voltage inside the supply. Wait until the LED goes off (*approximately 7 minutes after power is removed*) before proceeding.

Removing Protective RFI Shield (Galvanized Sheet Metal)

Once you remove the top cover of the power supply, you will see the RFI galvanized sheet metal cover preventing the power supply from emanating RFI fields. The RFI shield covers most components and circuit boards, as well as, many of the chassis-mounted components. You must remove this shield in order to gain access to the inside of the power supply. Remove the shield as follows:

1. There are approximately 21 screws holding the cover to the frame.
2. There are two screws at the top of the shield that secure a retaining clip for the GPIB board. You do not need to remove these screws, simply loosen the screws and slide the GPIB retaining clip backwards free of the GPIB board.
3. Remove all shield securing screws using a TORX T-15 screwdriver and save for later reinstallation .
4. Lift the RF shield out of the chassis.
5. When DC RAIL LEDs are extinguished, it is safe to work inside the power supply. (See Warning note above.)

Note The following procedures describe the removal of most of the circuit boards within the power supply. Once the GPIB board is removed, you will have access to the A4 AC Input Assembly and the A5 DC Rail Assembly. Similarly, once the A10 control board is removed along with the Rectifier HS you will have access to other components and boards within the supply.

It is recommended that when you disconnect any wires and/or cable connectors you should immediately label them to simplify their reinstallation later.

GPIB Board

To remove the GPIB board, disconnect the cables from the following connectors at the GPIB board:

1. Disconnect the cable going to connector P101.
2. Disconnect phone cable going to J107.
3. Disconnect phone cable going to J107.
4. Disconnect phone cable going to J108.
5. Remove two (2) holding screws at read of chassis holding GPIB board in place.
6. Using a 7 mm driver, remove the two (2) screws holding the GPIB connector at rear of chassis.
7. The GPIB board can now be lifted out from the chassis.

A4 AC Input Assembly

To remove the A4 AC Input Board first remove the GPIB board, then disconnect these cables from the following connectors at the GPIB board:

1. Disconnect the cables going to connector J417 and J420.
2. Disconnect the cable going to connector J419.
3. Remove the holding screw at the center of board just to the left of the 3-phase choke.
4. Disconnect phone cable going to J108.
5. Slide the board to the right and lift out.
6. Other wires going to the board can now be removed/unsoldered.

A5 DC RAIL Assembly

Disconnect these cables from the following connectors at the A5 DC RAIL board:

1. Disconnect the cables going to four connectors: J430, J431, J432, and J433.
2. Remove the four (4) holding screws TORX T-15 holding the A5 DC RAIL board in place.
3. Lift the board out and remove/desolder any other wires preventing the board from being removed.

A6 BIAS Assembly

Disconnect the cables from the following connectors at the A6 BIAS Assembly board:

1. Disconnect cables from connectors J809, J821, J830, and J831 on the A6 BIAS Board.
2. Remove two (2) holding screws at top side of board.
3. Slide board upward until board is free of slotted standoffs. There is one of these standoffs at the top of the board and two at the bottom. Wiggle the board slightly to clear all three standoffs then lift the board out.
4. Once the board is free from its restraining standoffs, you can proceed to remove/unsolder any other wires/cables as necessary to remove the A6 BIAS Board entirely.

Note It is recommended that you label any connectors you disconnect from the A6 BIAS Board to facilitate the reinstallation of these cables/wires to their correct locations later. If you have trouble later in determining which cable goes to which connector during reinstallation, refer to the cabling diagram in Chapter 6.

A3 FET Board

Follow this procedure to remove the A3 FET Board:

1. Remove the four (4) holding screws that secure the two black caps over the Rectifier HS assembly.
2. Once these caps are removed, you can remove the Rectifier HS which faces the A3 FET Board.
3. Disconnect two connectors, P430 and P431, at the A5 DC RAIL assembly.
4. Disconnect two connectors P/O cable assemblies P/N 5080-2283, at the A5 DC RAIL assembly.
5. You can now lift out the A3 FET board and remove/unsolder any other wires necessary to fully remove the A3 board.

A10 Control Assembly

Disconnect the cables from the following connectors at the A10 DC RAIL board:

1. Disconnect the ribbon cable going from to the A6 Bias board. This cable connects to J509 on the A10 board but it is easier to disconnect it at the A6 Bias Board.
2. Disconnect cables from connector J507 (phone) and connectors J510, J511, J512, and J513 on the A10 Control Board.
3. At rear of power supply, remove holding screw directly above fan. This screw holds the frame and A10 control board.
4. At rear of power supply unplug connector DIG CNTL from A10 Control Board.
5. Move board to the right and lift board and associated steel frame out of chassis.

Front Panel Assembly

1. Peel off vinyl trim (one strip on each side of front panel) to access the four screws that secure the front panel assembly to the chassis.
2. Remove the four screws (two on each side) using a size T-10 TORX.
3. Disconnect phone cable W5 from J6 on the A1 Front Panel Board.
4. Record the color code and the location of each of the four wires connected to line switch S1.
5. Disconnect the wires from the switch assembly.
6. Remove the front panel assembly.

S1 Line Switch

1. Remove Front Panel Assembly and disconnect switch wires as described in that procedure.
2. Release the switch locking tabs by pressing them inward against the body of the switch and removing the switch.

A1 Front Panel Board

1. Remove the Front Panel Assembly and disconnect the switch as described under "Front Panel Assembly".
2. Disconnect LCD display ribbon cable W2 from J2 on the A1 Front Panel Board.

Note When reinstalling the LCD ribbon cable, be sure to line up the "stripe" of the ribbon cable with pin 1 on J2.

3. Use a small Allen wrench (0.050") to loosen the set screws that are inset in the knobs. (These are the AlG1 and AlG2 Voltage/Current control shafts that extend through the front panel.) Remove knobs and shaft bushings.

Note Be careful not to unscrew the knob set screws too far out as they can easily fall out of the knob and become lost.

4. Remove screw (if installed) that secures board to the Front Panel Assembly. The screw is located near J4 on the Front Panel Board.
5. Lift tab (near J6 on front panel board) and slide left to release board from the A1 Front Panel Assembly and remove board.

A1DSP1 LCD Display

1. Remove the A1 Front Panel Board as described in that procedure.
2. Remove the nuts securing the LCD display to the front panel assembly and remove the LCD and attached ribbon cable (see CAUTION below). (When reinstalling this cable, be sure to line up the cable stripe over the LCD connector pin marked with a square.)

CAUTION The display connector is fragile. When removing the cable from the LCD display, carefully rock the cable connector back and forth while gently pulling it back.

A1G1 and A1G2 Rotary Controls

1. Remove the A1 Front Panel Board as described in that procedure.
2. Remove the AlG1 and AlG2 cables from connectors A1J4 and A1J5.
3. Remove nuts securing the AlG1 AlG2 controls to the board and remove controls.

A1KPD Keypad

1. Remove the A1 Front Panel Board as described in that procedure.
2. With board removed, keypad can easily be lifted out of the Front Panel Assembly.

Output Bus Boards A7, A81 and A9 & Chassis Components

Note To remove the A7 Snubber Board, A8 Fast Sense Assembly, A9 Downprogrammer and other chassis mounted components, first remove the A10 Control Board frame assembly and the two Rectifier Heat Sinks described earlier. Once the heat sinks are removed you will have access to the A7, A8, and A9 boards as well as other chassis mounted components.

Should you have any difficulty in removing power supply components or boards, contact the Agilent Technologies Support Line for help.

WARNING **Shock Hazard**: Hazardous voltage can exist inside the power supply even after it has been turned off. Check the INPUT RAIL LED (A4CR402) under the RFI shield (see Figure 3-14 for LED location). It the LED is on, there is still hazardous voltage inside the supply. Wait until the LED goes off (*approximately 7 minutes after power is removed*) before proceeding.

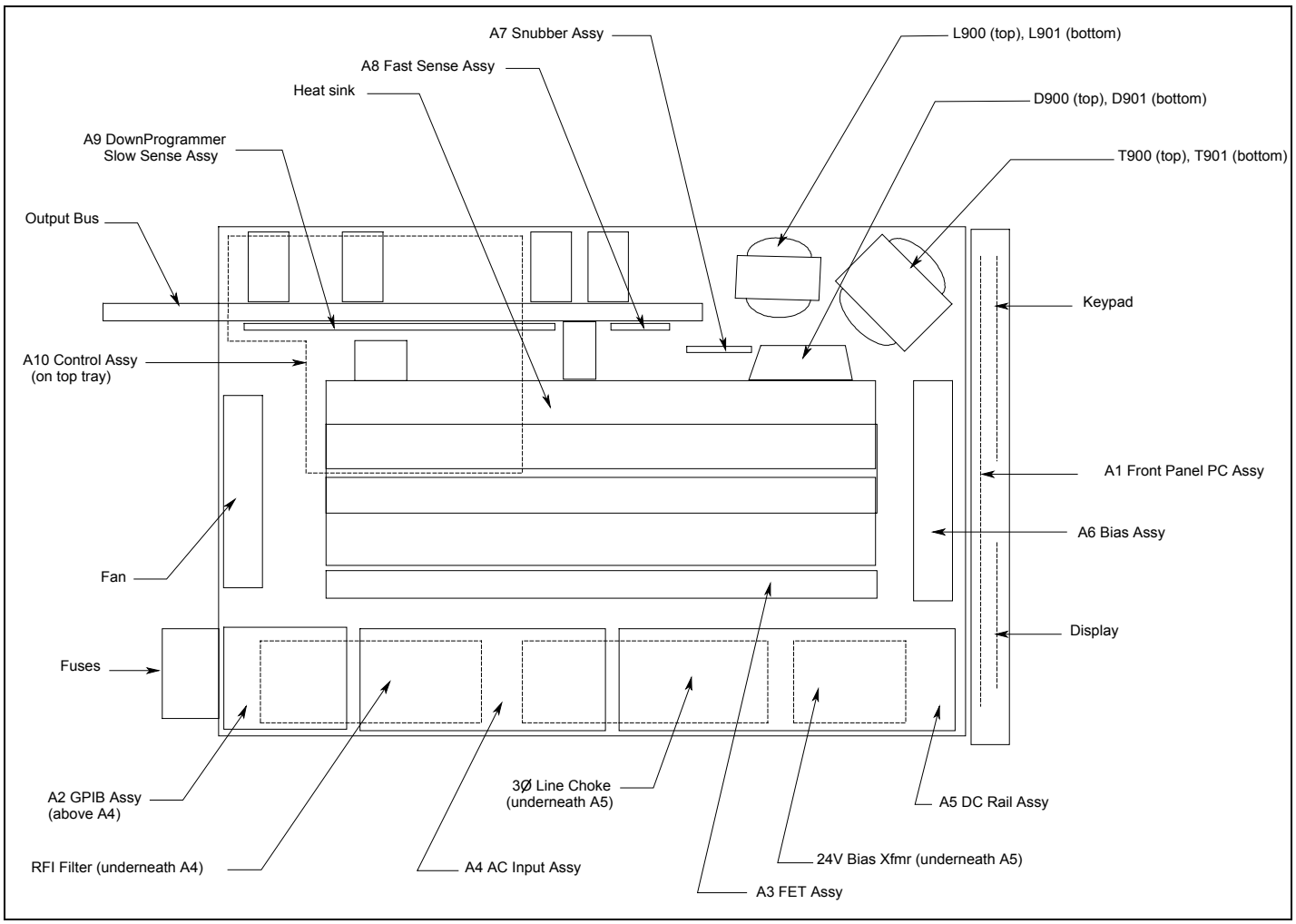


Figure 3-14. Component Locations (Top Cover and RFI Shield Removed)

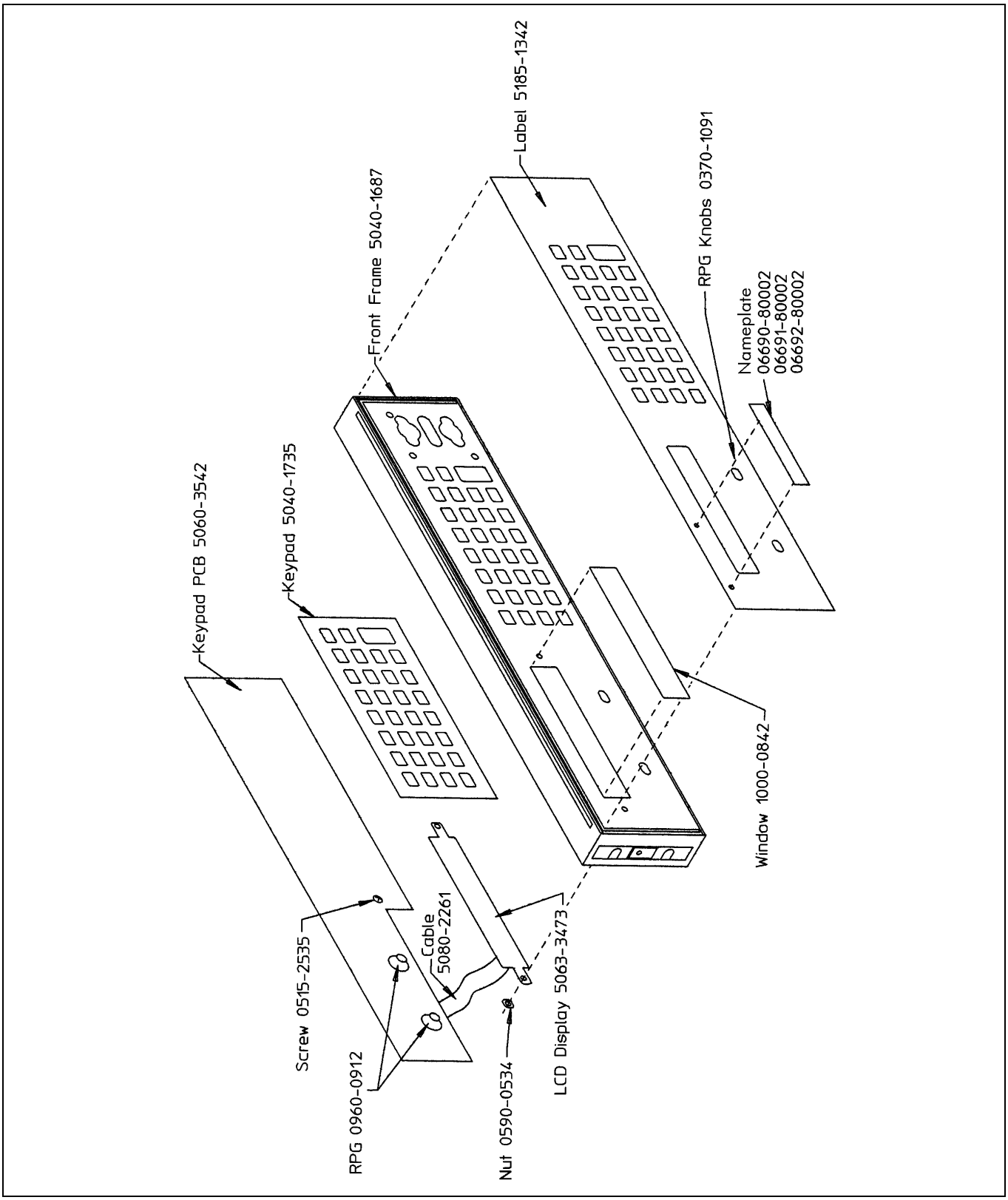


Figure 3-15. 3-Inch Front Panel Frame Assembly

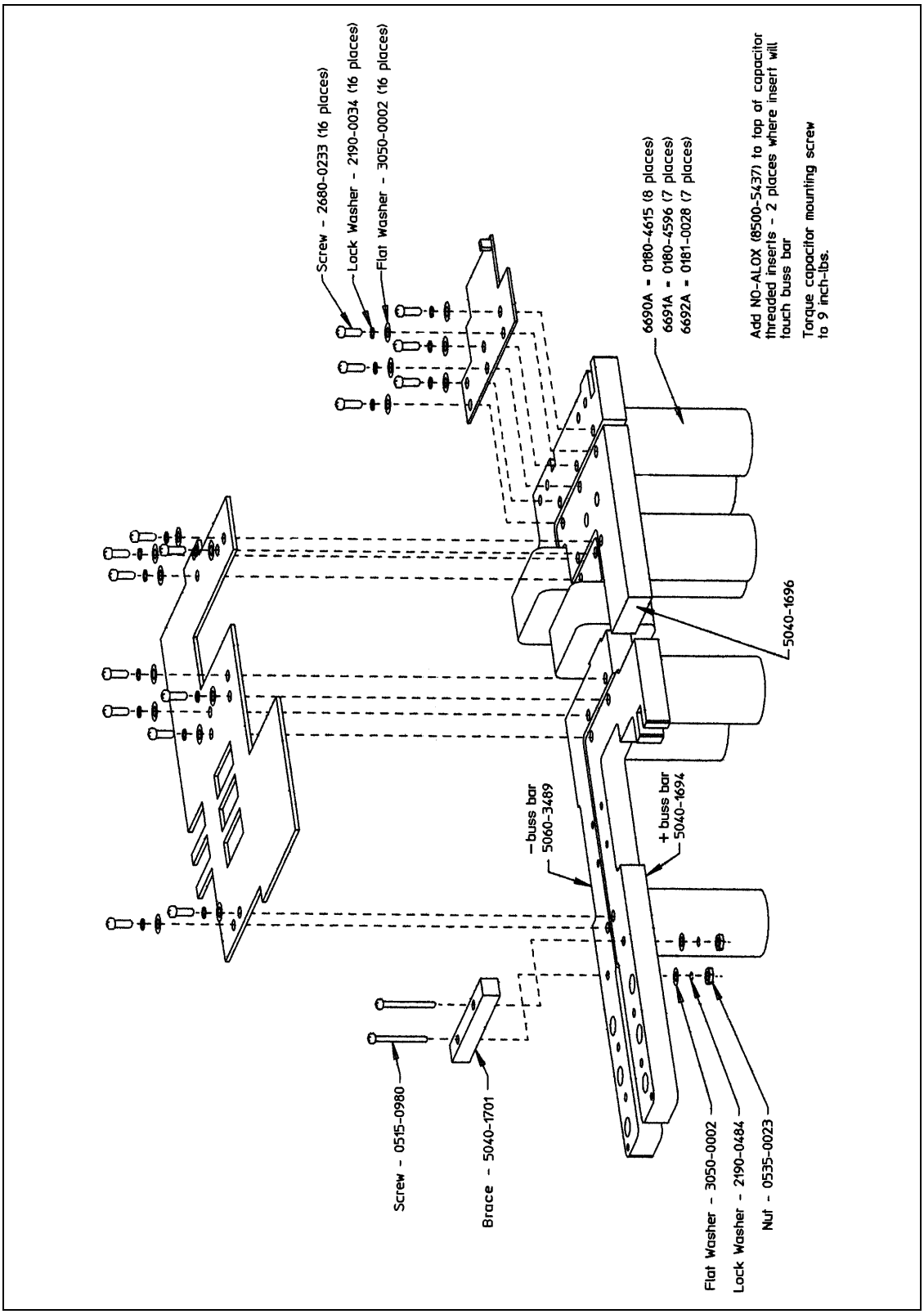


Figure 3-16. Assembly A10, Exploded View

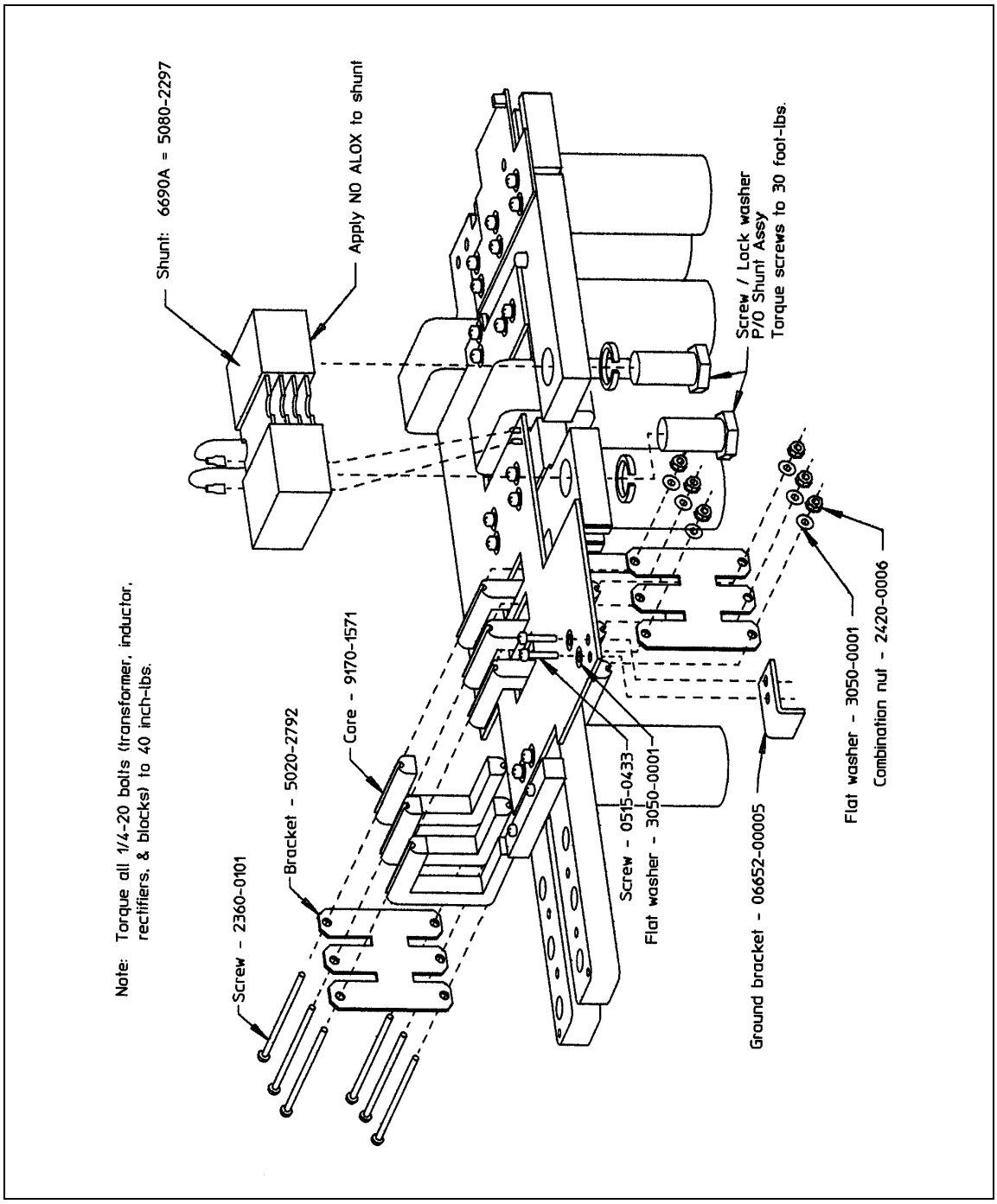


Figure 3-17. Assembly A10, Exploded View (6690A)

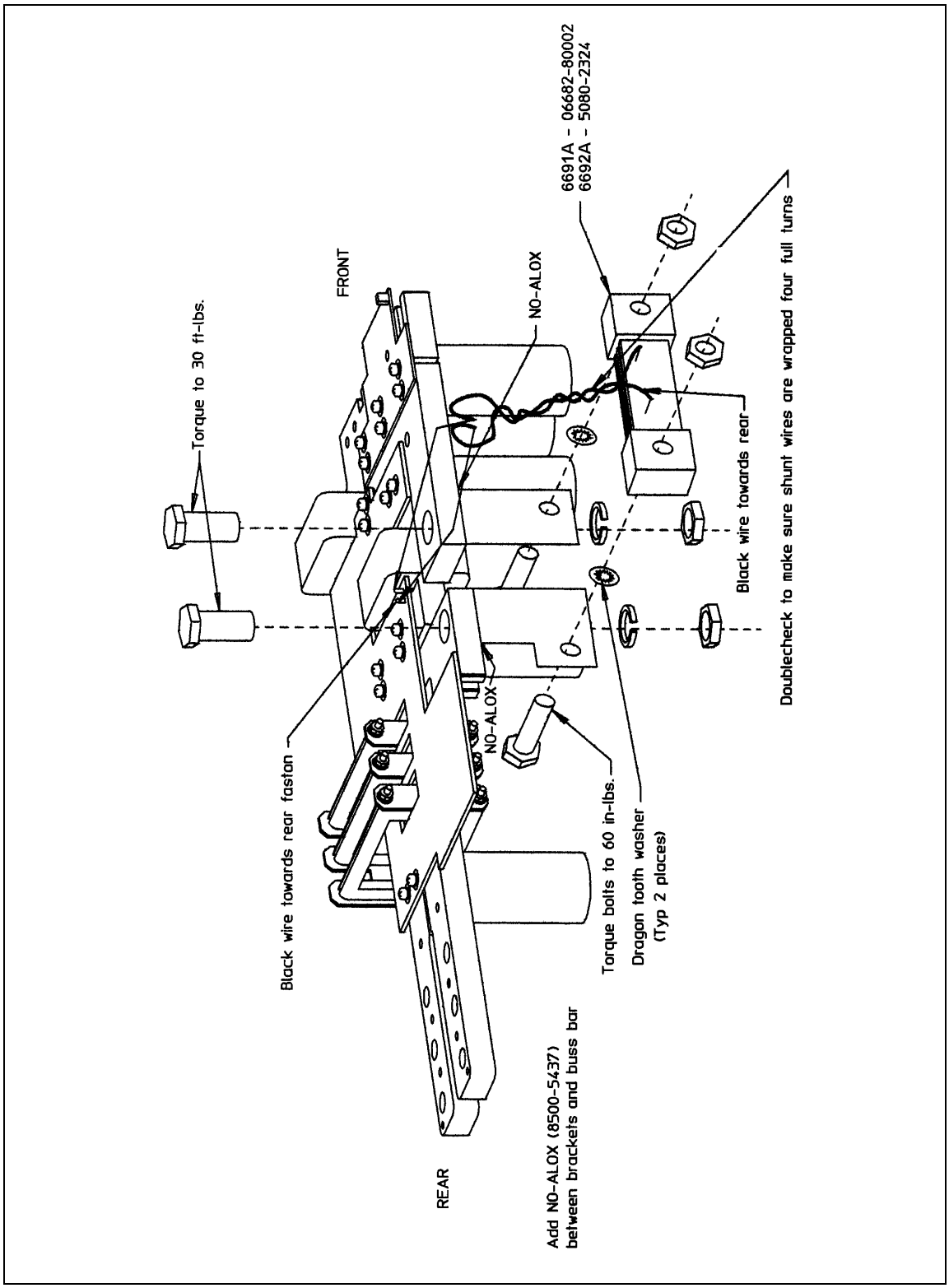


Figure 3-18. Assembly A10, Exploded View (6691A, 6692A)

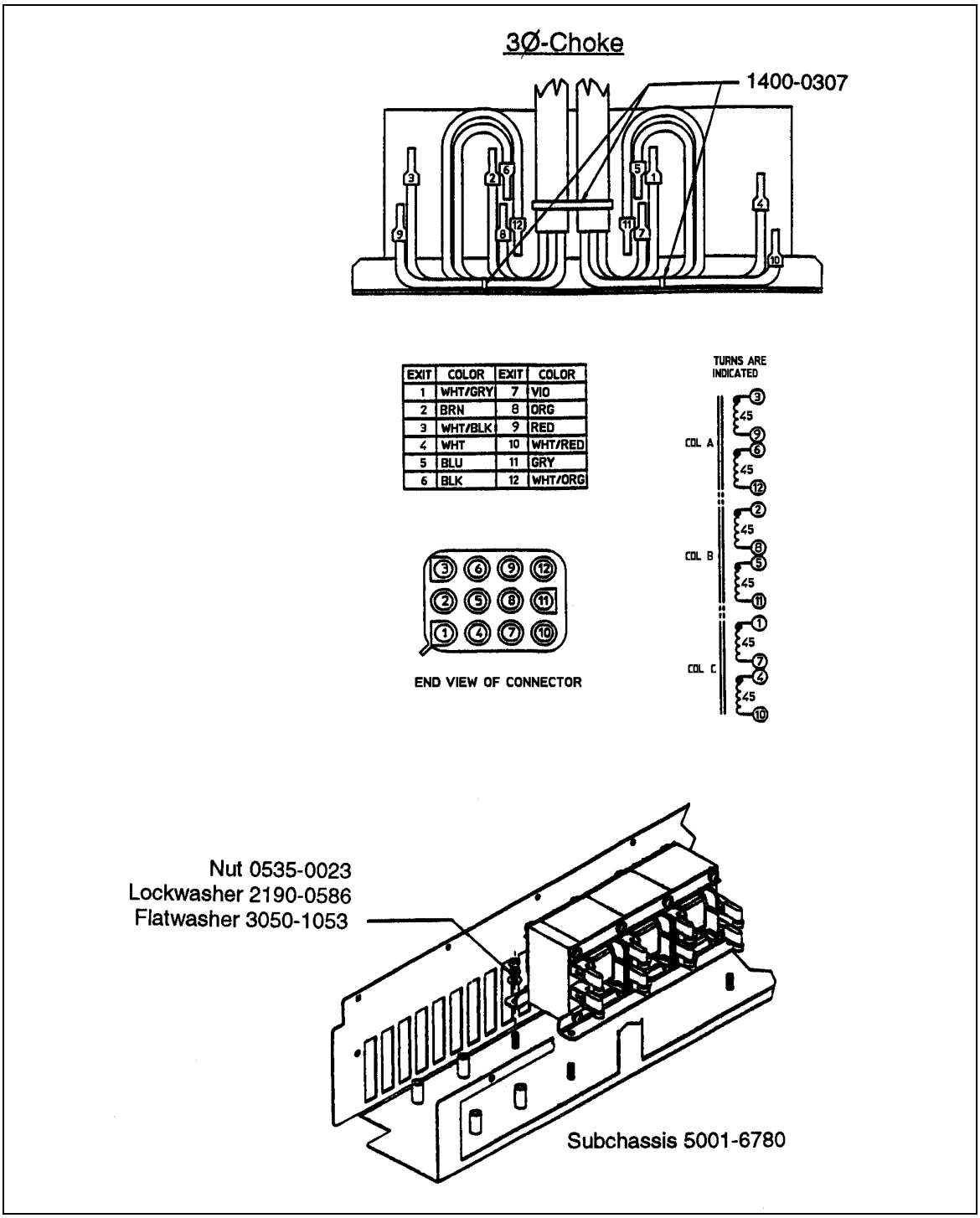


Figure 3-19. Three-Phase Line Choke Subchassis Wiring

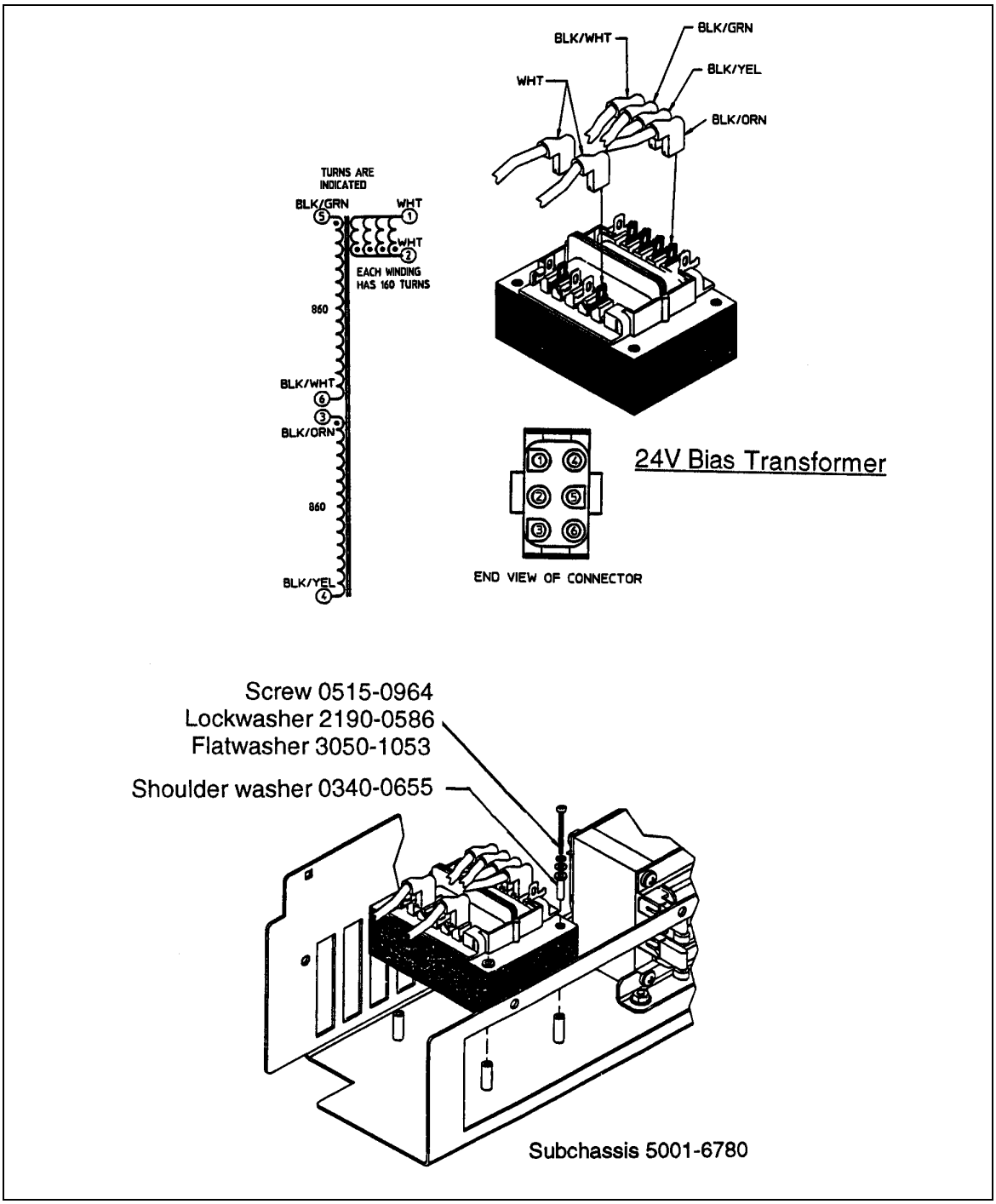


Figure 3-20. 24 Volt Fan Transformer

4

Principles of Operation

Introduction

Figure 4-3 (at the end of this chapter) is a block diagram showing the major circuits within the power supply. The power supply consists of the following circuits:

- A1 Front Panel Board circuits.
- A2 GPIB circuits.
- A10 Control Board including the secondary interface ckts, CV/CC control ckts, switching/downprogramming control circuits.
- Power circuits on the A4 AC Input Board.
- A3 FET Assembly circuits.
- A5 DC Rail Board circuits.
- Output bus circuits which include the A7 Snubber Board, A8 Slow Sense Board, and A9 Downprogrammer Board circuits.
- Output rectifiers and filter capacitors.
- Ferrite cores mounted on the output bus form the output filter inductors.
- A6 Bias Board supply which supplies low-voltage, low-power, bias voltages where required.

Each block in Figure 4-3 identifies a schematic diagram in Chapter 6 where the circuits are shown in detail. You can refer to the component location diagrams in Chapter 6 to locate specific components mentioned in this description. Chapter 6 also has a cabling diagram showing the circuit board interconnections.

A2 GPIB Board

Circuits on the A2 GPIB board provide the interface between the GPIB controller and the power supply. All communications between the power supply and the GPIB controller are processed by the GPIB interface and primary microprocessor circuits on the A2 board.

The primary microprocessor circuits (microprocessor, U114, ROM U106, and RAM U108) decode and execute all instructions and control all data transfers between the GPIB controller and the Secondary Interface on the A10 Control Board. The primary microprocessor also processes measurement and status data received from the Secondary Interface.

A UART (universal asynchronous receive/transmit) IC (U112) on the A2 board converts data between the primary microprocessor's 8-bit, parallel bus and the serial I/O port. The serial data is transferred between the primary interface and the secondary interface via a programmed GAL (gated array logic) IC (U119) and optical isolator ICs (U110/U111). These ICs isolate the primary interface circuits (referenced to earth ground) from the secondary interface circuits (referenced to power supply common). The GAL IC also provides a serial I/O port to the A1 Front Panel Board to enable front panel control of the power supply.

A serial link interface IC (U109) on the A2 GPIB Board allows up to sixteen supplies to be connected together and programmed from one GPIB address. The first supply is the only supply connected directly to the GPIB controller and is set to the primary GPIB address. The remaining supplies are set to secondary addresses and are linked (daisy chained) together via the Jl/J2 phone jacks at the rear of each supply. The serial link configuration is described in the Power Supply Operating Manual.

A digital control interface on the A2 GPIB Board provides the following power supply functions:

- Relay link.
- Digital 1/0.
- Remote inhibit (INH).
- Discrete fault indicator (FLT).

An optical isolator IC (U113) isolates the FLT output signal common from the external fault circuit common. The desired digital interface function is selected by placing a jumper in a header (J106) on the A2 GPIB Board. Appendix D in the Power Supply Operating Manual describes how to select one of these functions and how to make the appropriate external connections to the DIG CNTL connector on the supply's rear panel. Another jumper position on the header selects the SA (signature analysis) mode. Signature analysis troubleshooting is not supported.

The A2 Board has a bias supply regulator IC (U121) that provides +5V (with respect to earth ground) for the primary interface circuits and the bias voltage for the front panel board circuits, the LCD, and the keypad. The A2 Board also has a line or bias voltage detector IC (U101) that generates a power clear signal (PCLR). This signal initializes certain primary interface and front panel circuits when normal ac line voltage is applied, and also shuts these circuits down when the line voltage drops below the required minimum.

A1 Front Panel Assembly

The power supply A1 Front Panel Assembly contains a circuit board, keypad, liquid crystal display (LCD), and the power on/off switch.

The Front Panel Circuit Board A1 contains microprocessor circuits (microprocessor U3 and ROM U4) that decode and execute all front panel keypad commands. These are transferred to the power supply output via the serial I/O port to the A2 board GAL (gated-array logic) IC and isolators, and to the secondary interface circuits on the A10 Control Board. The front panel microprocessor circuits also process power supply measurement and status data received from the serial I/O port. This data is displayed on the LCD.

IC EEPROM, U6, (electrically-erasable, programmable, read-only memory) on the A1 Front Panel Board stores data and configuration information. This information includes calibration constants, GPIB address, the present programming language, and model-dependent data such as the minimum and maximum values of voltage and current.

One of the EEPROM storage locations holds a checksum value used to verify the integrity of this EEPROM data. Access to the calibration data in the EEPROM is controlled by the combination of a password and jumper options on a header (J3) located on the A1 board (see Post-Repair Calibration in Chapter 3).

The power supply can be calibrated manually using the front panel keys, or via the GPIB bus with SCPI (Standard Commands for Programmable Instruments) commands. The calibration procedure is in Appendix A of the Power Supply Operating Manual).

A10 Control Board

The A10 Control Board contains the Secondary Interface, CV/CC Control Circuits, Readback Circuits, PWM Switching Circuits and OV/Downprogramming Circuits. These circuits are shown schematically in the A10 Control Board schematic.

Secondary Interface (P/O A10 board)

These circuits are shown in detail on the A10 Control Board schematic and include the Secondary Microprocessor (U506), Programmed GAL (U505), three DAC/OpAmp circuits (U510-U515), Readback Comparator circuits (U516, U517) and OV/Shunt DAC OpAmp circuit, (U520, U521).

The Secondary Microprocessor translates serial data received from the A2 board into parallel 12 bit data. The data bus is connected directly to the four DAC/OpAmp circuits. Under control of the lip the selected DAC converts the bus data into an analog signal. The DAC reference circuit (U503, U504) provides a +10V reference for the CV and CC DACs and a -11.6V reference for the readback DAC. Zener VR501 provides a-6.2V reference for the OV Shunt DAC.

The CV DAC/OpAmp (U510, U513) converts the programmed voltage value from the bus or front panel into the CVPROG signal. CVPROG is sent to the CV Error Amp and compared with the VMON signal to control the magnitude of the output voltage in the CV mode. The range of CVPROG is 0 volts to -10 volts, which corresponds to the zero-to-full-scale output voltage range of the supply.

The CC DAC/OpAmp (U511, U514) converts the programmed current value from the bus or front panel into the CCPROG signal. CCPROG is sent to the CC Error Amp and is compared with the IMON signal to control the magnitude of the output current in the CC mode. The range of CCPROG is 0 volts to -10 volts, which corresponds to the zero-to-full-scale output current range of the supply.

The Readback Comparators (U516, U517) operate with the Readback DAC/OpAmp (U512, U515) to return the following signals to the µP:

- The monitored output voltage (VMON).
- The monitored output current (IMON).
- The ambient temperature (AMB_SENSE).
- The programmed voltage value (CVPROG).
- The programmed current value (CCPROG).
- The fan detector (FAN_DEW).

The readback DAC circuit is controlled by the µP to successively approximate (to 12-bit resolution) the value of each signal monitored. The CVPROG and CCPROG signals are used during selftest to check DAC/OpAmp operation. The µP monitors the fan speed and ambient temperature and generates the FAN_PWM control signal to adjust fan speed depending upon the ambient temperature measured internally in the power supply.

A dual DAC, Shunt-Trim/OV, Amplifier circuit (U520, U521) performs two functions. One is to convert the programmed overvoltage value from the bus or front panel into the OVREF signal. The OVREF signal is compared by U502 with the output voltage. Second, the Shunt Trim DAC calibrates the IMON signal by sampling the current flowing through current-sense resistor (R900) on the output power bus together with the TRIM input signal.

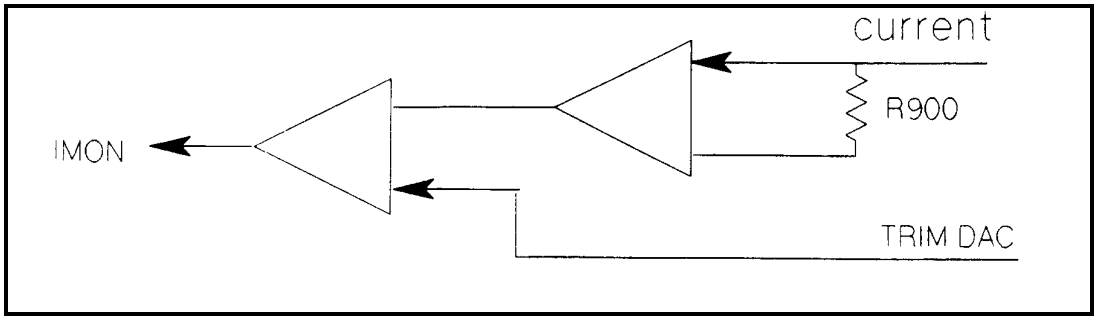


Figure 4-1. AC Calibration of IMON

During power initiation, the secondary processor generates PWM DISABLE to the power supply's output off for 10 seconds. After 10 seconds PWM DISABLE is removed and the supply's output can be programmed.

CV/CC Control (P/O A10 Board) These circuits are shown in detail on the A10 Control Board schematic and include the CV (constant voltage) and CC (constant current) control loops. The power supply must act as either a CV or CC supply for any value of load impedance. Switching between CV and CC is done automatically by the CV/CC control circuits at a value of load impedance equal to the ratio of the programmed voltage value to the programmed current value.

A low-level CV or CC signal is generated by the applicable status comparator (P/O U502) and returned to the secondary processor to indicate that the corresponding mode, CV or CC, is in effect.

In CV mode, an OR gate diode (D652) conducts and the CV loop regulates the output voltage. A CV error amplifier (P/O U621) compares the programmed voltage signal CVPROG to VMON which is the output signal from the V_DIF amplifier(P/O U621). The range of VMON is 0 volts to +10 volts which corresponds to the zero-to-full-scale output voltage of the supply. If the output voltage exceeds the programmed voltage the OR GATE signal goes low causing the output voltage to decrease to the programmed value.

Conversely, if the output voltage is less than the programmed voltage, the OR GATE signal goes high causing the output voltage to increase to the programmed value. An externally applied dc signal, VPROG, can be used to program the output voltage. A 0 volt to -5 volt VP level produces a proportional zero-to-full-scale output voltage.

In CC mode, an OR gate diode (D651) conducts and the CC loop regulates the output voltage. A CC error amplifier (P/O U620) compares the programmed voltage signal CCPROG to IMON which is the output signal of 2nd I_AMP (P/O U620). The range of IMON is 0 volts to +10 volts which corresponds to the zero-to-full-scale output voltage of the supply. If the output current exceeds the programmed current, the OR GATE signal goes low causing the output current to decrease to the programmed value.

Conversely, if the output current is less than the programmed current, the OR GATE signal goes high causing the output current to increase to the programmed value. An externally applied dc signal, IPROG, can be used to program the output current. A 0 volt to -5 volt IP level produces a proportional zero-to-full-scale output current.

Switching/Downprogramming Control (P/O A10) These circuits include a Ramp Generator, Divider /Deadtime Latch, Fast Sense Differential Amplifier, Pulse Width Modulator, Summing Comparator, Down-Programmer Control and OV Comparator circuits.

The Divider/Deadtime Latch (U600, U601, U602) divides the 2-MHz ALE_CK signal from the Secondary µP and supplies 40 KHz pulses to the Ramp Generator (U607) and ON Latch (U604).

The OR-GATE signal (CV or CC control signal as previously described) is summed with the 40 KHz triangular waveform produced by the Ramp Generator. An input from the Fast Sense Differential Amplifier is also summed to compensate for a sudden transient in the rectified output.

The width of the output pulses from the Summing Amplifier vary as the OR-GATE control signal increases or decreases. These pulses are applied to the Pulse-Width Modulator (U603) via the On Latch. The PWM generates the square wave pulses that are applied to the A3 FET assembly to turn the FET switches on and off. The Deadtime Latch resets the ON Latch to provide a minimum off time for the FET switches.

The OV circuit compares the output voltage level with the OVREF signal which represents the programmed overvoltage level. When the output voltage exceeds the programmed OV value, the downprogrammer circuits are activated and the FET switches are turned off

The Downprogrammer control circuit generates control signal DP CONTROL whenever an OV or disable condition has been detected, or when the output voltage exceeds the programmed value. DP CONTROL causes the downprogrammer FETs (Q980, Q981) on the A9 Downprogrammer/Fast Sense board to conduct and conduct current away from the load.

A4 AC Input Board

The A4 Input Board contains the Inrush-Current Limit relay (K401), Main Power Relays (K402, K403), and current-limiting resistors (R407, R408). On power-on, the current-limit relay (K401) closes allowing the dc rail capacitors to charge under a controlled condition. This applies ac voltage to the A6 Bias Board. After the turn-on initialization period (approximately 10 seconds), the main relays (K402, K403) close, shorting out the current-limit resistor.

A5 DC Rail Board

The A5 DC Rail board contains the full-wave, three-phase, rectifiers and the input filter circuits. The ac mains are full-wave rectified by D420-D425 and converted to two, 300-volt dc rails by filter capacitors, C423-C426, and by two range select connectors. In range 1 (180-235Vac), J438 connects the two DC rails, called Rail #1 and Rail #2, in parallel. Each rail supplies 300Vdc to the A3 FET board via J430 and J431. In Range 2 (360-440Vac), J439 connects the two DC rails in series. Each rail still supplies 300 Vdc to the A3 FET board via J430 and J431.

The A5 DC Rail board also contains the bias transformer and primary range select connectors J436 (Range 1) and J437 (Range 2). There are two LEDS (DS420, DS421) which light when more than 40Vdc is present on the dc rails.

WARNING As a precaution always disconnect power supply from ac mains and wait 7 minutes before handling dc rail board. Be certain that the LEDs are completely extinguished.

The +24 auxiliary bias fuse, F420, and the standard bias fuse, F421, are located on the dc rail board.

A3 FET Board

The A3 FET board consists of two power FET stages connected between the +rail and -rail voltages, and connected across the FET stages is a chassis mounted power transformer. The entire circuit represents an H-bridge configuration. A complete stage consists of eight, power FETs and two, bridge-driver ICs. The power FETs are mounted on but isolated from the heat sink assembly. The two power FET stages are isolated from each other.

The DRIVElA, lB and DRIVE2A, 2B pulses, received from the A10 Control board, are used by the bridge drivers (U201, U202, U301, U302) to derive control pulses for the FET switches. The width of the pulses determines the ON time of the FET switches, thereby determining the magnitude of the output voltage or current. DRIVElA pulses turn on one set of +RAIL (Q301, Q311) and -RAIL (Q303, Q333) FETs, causing current to flow through power transformer, T900, in one direction. DRIVE2A pulses turn on the other set of +RAIL (Q304, Q344) and -RAIL (Q302, Q322) FETs causing current to flow through T900 in the opposite direction. The FET on/off periods are controlled by the duty-cycle detect and the peak-current detection circuits. If the output attempts to change, regulation is accomplished by the CV/CC control circuits on the A10 Control board. These circuits vary the width of the drive pulses and the duration of the FET on/off periods.

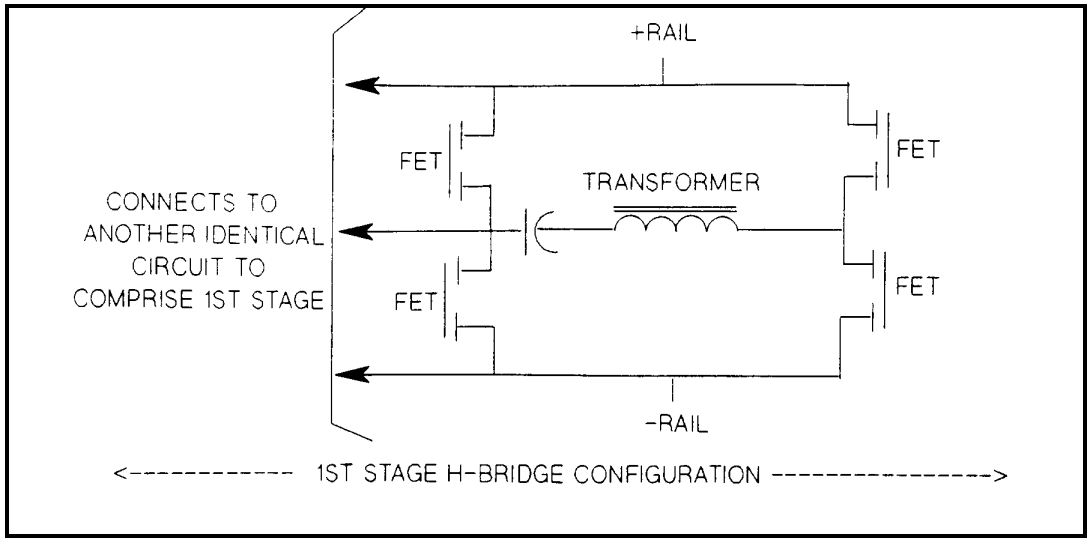


Figure 4-2. 1ST Stage of the FET H-Bridge Configuration

Output Circuits

The output circuits include the following circuits:

- Chassis mounted components.
- Two power transformers, T900/T901.
- Two inductors, L900/L901.
- Two rectifiers, D900/D901.
- Output capacitors.
- A7 Snubber board mounted to the heat sink.
- A8 Fast Sense board.
- A9 Slow/Downprogrammer board and output bus bars.

Each combination of power transformers, T900/T901, and rectifiers, D900/D901, couples the output pulses from the A3 FET board. The output of each transformer/rectifier combination is connected in parallel before being applied to the output filter. The output filter assembly consists of bus bars with the filter capacitors bolted to them. The filter chokes, L902 through L906, consist of ferrite cores enclosing the bus bar. The current-sense resistor, R900, is part of the positive-output bus bar.

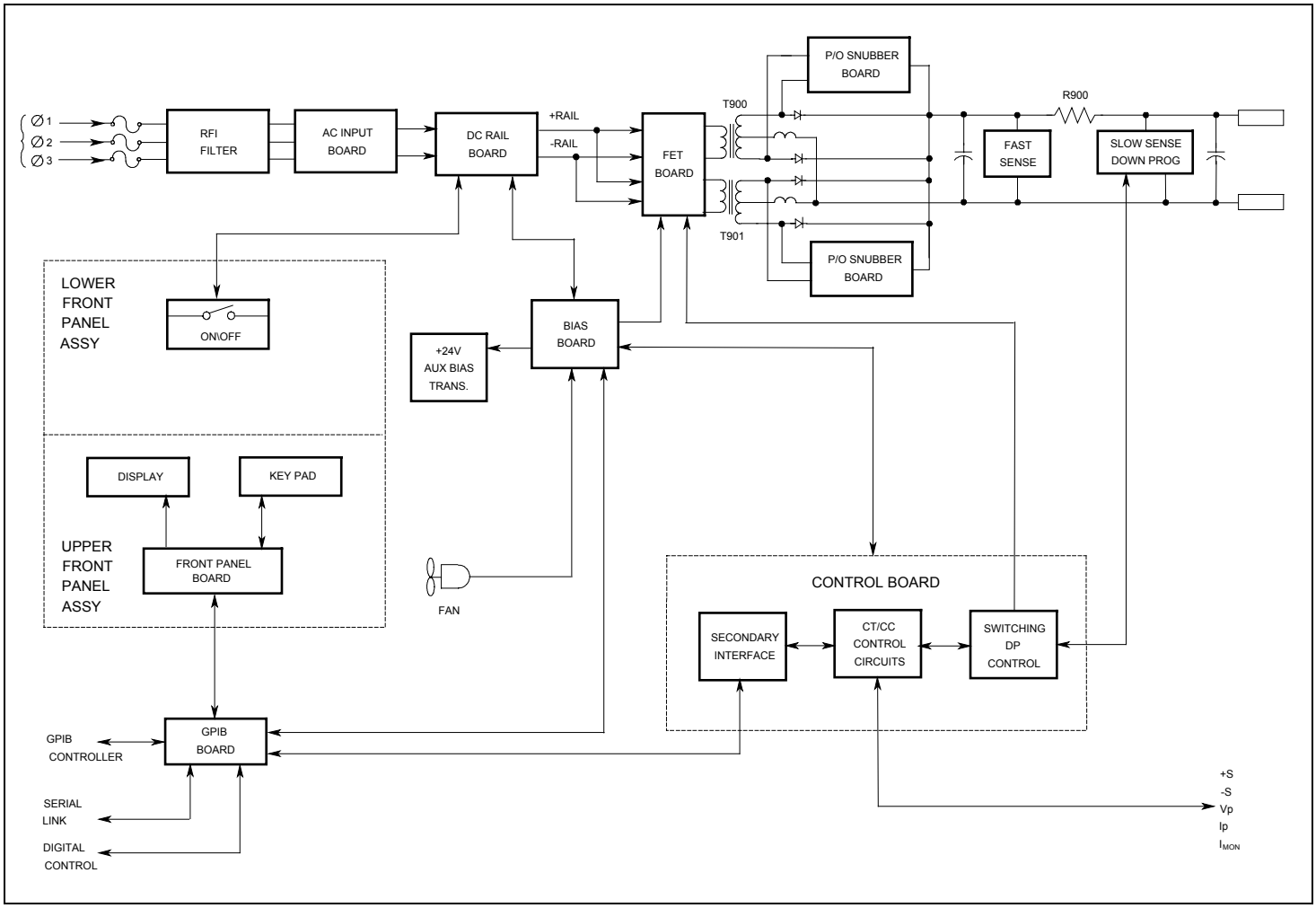


Figure 4-3. Agilent Series 669xA Power Supply, Block Diagram

5

Replaceable Parts

Introduction

This section lists the replaceable electrical and mechanical parts for the Agilent 669xA series power supplies. (Component location diagrams are located in Chapter 6.) The lists consist of tables organized by assemblies as follows:

Assembly	See
Main chassis (see Figure 3-20 for location of all assemblies)	Table 5-1
A1 Front Panel Board	Table 5-2
A2 GPIB Board	Table 5-3
A3 FET Board	Table 5-4
A4 AC Input Board	Table 5-5
A5 DC Rail Board	Table 5-6
A6 Bias Board	Table 5-7
A7 Snubber Board	Table 5-8
A9 Down Programming/Slow Sense Board	Table 5-9

A8 and A10 assemblies contain no user- replaceable parts.

How to Order Parts

You can order parts from your local Agilent Technologies, Inc. Sales and Support Office (see the list of offices in the back of this manual). When ordering a part, please include the following information:

- the Agilent part number
- the part description
- the desired quantity
- the model number of the power supply (for example, Agilent 6692A)

Table 5-1. Main Chassis, Replaceable Parts

Ref. Desig.	Agilent Part No.	Description
	ASSEMBLIES & SUBASSEMBLIES	
	5060-3553	TESTED FRONT FRAME ASSEMBLY
A1	5060-3542	TESTED KEYBOARD PC ASSEMBLY
A2	5063-4851	TESTED GPIB PC ASSEMBLY
A3	5065-0642	TESTED FET PC ASSEMBLY
A4	5065-0644	TESTED AC INPUT PC ASSEMBLY
A5	5065-0645	TESTED DC RAIL PC ASSEMBLY
A6	5065-6937	TESTED BIAS PC ASSEMBLY
A7		
6690A	06682-60021	SNUBBER PC BOARD
6691A	06683-60021	SNUBBER PC BOARD
6692A	06692-60021	SNUBBER PC BOARD
A8	06681-60023	FAST SENSE PC BOARD
A9		
6690A	06690-60024	DOWN PROGRAMMER / SLOW SENSE BOARD
6691A	06691-60022	DOWN PROGRAMMER / SLOW SENSE BOARD
6692A	06692-60022	DOWN PROGRAMMER / SLOW SENSE BOARD
A10		
6690A	06690-61020	TESTED CONTROL PC BOARD
6691A	06691-61020	TESTED CONTROL PC BOARD
6692A	06692-61020	TESTED CONTROL PC BOARD

Table 5-1. Main Chassis, Replaceable Parts (continued)

	ELECTRICAL PARTS	
C900-905		
6690A	0180-4615	CAP 18000uF 28V
6691A	0180-4596	CAP 13000uF 45V
6692A	0181-0028	CAP 4700uF 80V
C906		
6690A	0180-4615	CAP 18000uF 28V
C907		
6690A	0180-4615	CAP 18000uF 28V
6691A	0180-4596	CAP 13000uF 45V
6692A	0181-0028	CAP 4700uF 80V
C920-925	0160-4183	CAP 1000pF 250V
D900A,B		
6690A	1906-0722	RECTIFIER 400A, 100V
6691A	1906-0397	RECTIFIER 20020
6692A	1906-0398	RECTIFIER 20040/20140
D90lA,B		
6690A	1906-0722	RECTIFIER 400A, 100V
6691A	1906-0397	RECTIFIER 20020
6692A	1906-0398	RECTIFIER 20040/20140
L900, 901		
6690A	06690-80001	CHOKE - OUTPUT
6691A	06691-80001	CHOKE - OUTPUT
6692A	06692-80001	CHOKE - OUTPUT
L902, 903	5080-2257	CORE
L904 - 906	9170-1571	CORE
R900		
6690A	5080-2297	SHUNT-CURRENT
6691A	06682-80002	SHUNT-CURRENT
6692A	5080-2324	SHUNT-CURRENT
T900, 901		
6690A	9100-6062	POWER TRANSFORMER
6691A	9100-6063	POWER TRANSFORMER
6692A	9100-6064	POWER TRANSFORMER
	9100-6065	24V BIAS TRANSFORMER
	3160-4116	FAN-TUBEAXIAL
	2110-1077	FUSE 20A 690V (3 required for 400VAC)
	2110-1078	FUSE 40A 690V (3 required for 208VAC)
	5065-6934	FUSE KIT FOR 208VAC (contains 3 fuses)
	5065-6935	FUSE KIT FOR 400VAC (contains 3 fuses)
	5080-2148	CABLE - CHAINING (2 meters)
	5080-2168	CABLE - A2 GPIB/A1 FRONT PANEL
	5080-2280	CABLE - A6 BIAS/A10 CONTROL
	5080-2287	CABLE - A10 CONTROL/A8 FAST SENSE
	5080-2316	CABLE - A10 CONTROL/A9 SLOW SENSE
	MECHANICAL PARTS	
	5040-1694	BUSS BAR, PLUS, output end (large)
	5040-1696	BUSS BAR, PLUS, internal end (small)
	5060-3489	BUSS BAR, MINUS (WITH L902/L903 CORE)
	5040-1688	BUSS BAR BEZEL (ON REAR PANEL)
	5040-1689	SUPPORT-PLASTIC (BUSS BAR PLUS TO CHASSIS)
	5040-1701	BRACE-PLASTIC (ACROSS BUSS BARS)

Table 5-1. Main Chassis, Replaceable Parts (continued)

	06652-00005	GROUND BRACKET (A9 BOARD TO CHASSIS)
	1252-1488	TERM-BLOCK-4 POSITION GPIB)
	1252-3698	TERM-BLOCK-7 POSITION CONTROL)
	3160-4117	FAN FINGER GUARD
	5001-0538	TRIM-SIDES
	5001-0539	TRIM SIDES,FRENCH GRAY
	5001-6776	CHASSIS, BASE
	5002-1591	REAR PANEL
	5182-9192	LABEL - REAR PANEL
	5001-6779	COVER-GREY
	5040-1697	SPACER BLOCK - 2 (COVER TO REAR PANEL)
	5001-6793	GPIB-BRACKET (A2 BOARD TO CHASSIS TOP)
	5020-2783	HEATSINK-DIODE
	5020-2785	HEATSINK-FET
	5020-2797	SHIELD-PLASTIC - 2 (FET/DIODE HEATSINK)
	5040-1691	PLENUM (FAN TO FET/DIODE HEATSINK)
	5002-1592	AC INPUT COVER
	9310-6711	CLAMP- POWER CORD
	5065-6933	KIT (AC INPUT COVER WITH CLAMP)
	2110-1312	FUSEHOLDER 3-PHASE
	5041-8801	FOOT - 4
	5041-8819	CAP-STRAP HANDLE
	5041-8820	CAP-STRAP HANDLE
	5062-3705	STRAP HANDLE
	5080-2545	CARTON (shipping container)
	5080-2418	TRAY (shipping container)
	5080-2414	SKID (shipping container)
	5080-2415	FOAM PAD (shipping container)
	5964-8269	MANUAL-OPERATING

Table 5-2. Front Panel Assembly, Replaceable Parts

Ref. Desig.	Agilent Part No.	Description
A1	5060-3542	A1 KEYPAD PC BOARD (tested)
	0370-3238	KNOB Ref: G1, G2
	0515-2535	SCREW - Ref: keypad PCB to front frame
	1000-0842	WINDOW (3 inch front frame)
	5001-6794	BLINDER (5 inch front frame)
	5040-1735	KEYPAD
	5040-1687	FRONT FRAME - 88.1mm (3.5 inch)
	5040-1698	FRONT FRAME - 132.6mm (5.25 inch)
	5185-1342	LABEL (3.5 inch & 5.25 inch front frame)
	06690-80002	NAMEPLATE front panel model description
	06691-80002	NAMEPLATE front panel model description
	06692-80002	NAMEPLATE front panel model description

Table 5-3. A2 GPIB Board, Replaceable Parts

Ref. Desig.	Agilent Part No.	Description
	1205-0758	HEATSINK (U121)
	0515-0642	SCREW (U121)
	0515-0911	SCREW M3x0 5 (J101)

Table 5-4. A3 FET Assembly, Replaceable Parts

Ref. Desig.	Agilent Part No.	Description
Q201-204, 211, 222, 233, 244	1855-1674	MOSFET 500V 20A (replace as matched set)
Q301-304, 311, 322, 333, 344	1855-1674	MOSFET 500V 20A (replace as matched set)
	5080-2279	CABLE FET CTRL (E208-E209 to CONTROL J511)
	5080-2283	CABLE +15V BIAS (E206-E207 to BIAS J831)

Table 5-5. A4 AC Input Assembly, Replaceable Parts

Ref. Desig.	Agilent Part No.	Description
J419	1251-6832	CONNECTOR
K401	0490-1908	RELAY 24V COIL
	5080-2284	CABLE RELAY CTRL (E411-E413 to BIAS J827)

Table 5-6. A5 DC Rail Assembly, Replaceable Parts

Ref. Desig.	Agilent Part No.	Description
F420	2110-1066	FUSE 1AM, 500V
F421	2110-0934	FUSE .5AM, 500V
J430, 431	1251-7616	CONNECTOR
J432	1251-6832	CONNECTOR
J436, 437, 438, 439	1251-3837	CONNECTOR
J440	1252-0055	CONNECTOR
J441	1252-0056	CONNECTOR
	5080-2286	CABLE BIAS 24V (E440-E443 to BIAS J816)
	5080-2289	CABLE AC BIAS (E430-E434 to AC INPUT J419)
	5080-2293	CABLE LINE SELECT (E444-E447 to J436/J437)
	5080-2294	CABLE LINE SELECT (E448-E451 to J438/J439)

Table 5-7. A6 Bias Assembly, Replaceable Parts

Ref. Desig.	Agilent Part No.	Description
F800	2110-0712	FUSE-SUBMIN 4A
F803, 804, 805, 806	2110-0679	FUSE 1.5AM, 125V
J801	1252-1670	CONNECTOR
J816	1252-0056	CONNECTOR
J827	1251-7070	CONNECTOR
J830, 831	1252-0055	CONNECTOR
	5080-2292	CABLE BIAS (E800-E804 to DC RAIL J432)

Table 5-8. A8 Fast Sense Assembly, Replaceable Parts

Ref. Desig.	Agilent Part No.	Description
	5080-2287	CABLE (El001-El003 to CONTROL J512)

Table 5-9. A9 Down Programmer/Slow Sense, Replaceable Parts

Ref. Desig.	Agilent Part No.	Description
Q981, 982	1855-1003	POWER MOSFET
	0340-1507	INSULATOR - 2 (Q981, 982 TO HEATSINK)
	5080-2212	CABLE (J910 to CONTROL J510)

6

Diagrams

Introduction

This chapter contains drawings and diagrams for troubleshooting and maintaining Agilent Series 669xA Power Supplies. Unless otherwise specified, a drawing or diagram applies to all models of the series. Wiring connections to external equipment are shown in the Power Supply Operating Manual.

In the diagrams, the name of a complementary signal is sometimes shown with a bar above the signal mnemonic. In other diagrams and in the text, complementary signals are shown with an asterisk (*) after the mnemonic (such as PCLR*). A mnemonic with a bar over it or an asterisk after it represents the same signal.

Table 6-1 summarizes the contents of this chapter.

Table 6-1. Summary of Chapter Contents

Function	Description	See
Signal names	Table of signal name mnemonics	Table 6-2
Test points	Description of each test point. The location of each test point is shown on the appropriate schematic and its associated parts location drawing.	Table 6-3
Schematic notes	A list of general notes that are applicable to all schematic diagrams. Notes that apply to a specific schematics appear on the schematic sheet.	Table 6-4
Waveforms	Test point waveforms for Table 6-3.	Figure 6-1
Interconnections	Drawing identifying each circuit board, the cables between boards, and schematic diagram for each board.	Figure 6-2
Schematics	Al Front Panel Board. A2 GPIB Board. A3 FET Board. A4 AC Input Power Board. A5 DC Rail Board. A6 Bias Board. A7 Snubber Board. A8 Fast Sense Board. A9 Down Programming/Slow Sense Board. A10 Control Board.	
Assembly and component locations	A diagram that shows the location of components on a circuit board is included with each circuit board schematic. A drawing showing location of each circuit board in the chassis is in Chapter 3.	Figure 3-15

Table 6-2. Signal Name Mnemonics

Mnemonic	Description	Mnemonic	Description
A(0)--A(15)	Address lines	**MSRQ**	Microprocessor service request
AD (O)--AD(7)	Address bus	**NDAC**	Not data accepted (GPIB)
AMB_SENSE	Ambient temperature sense	**NEG_IMON**	Negative current monitor
ANA(0)--ANA(7)	Analog Signal readback bus	**NRFD**	Not ready or data (GPIB)
ATN	Attention (GPIB)	**OV**	Overvoltage
BIAS_OK	±15V bias supplies have stabilized	**OV_CLR**	Overvoltage clear
BOVPROG	BuFfered OV programming	**OVCMP**	Overvoltage comparator
BSTX	BuFfered secondary transmit	**OVP_BIAS**	Overvoltage protection bias
cc	Constant current status	**OVPROG**	Overvoltage programming
CCPROG	Constant current programming	**OVSCR**	Overvoltage SCR (crowbar)
cv	Constant voltage status	**PCLR**	Primary power clear
CVPROG	Constant voltage programming	**PREF**	Primary reference voltage (2.53V)
D(0)_D(7)	Data lines	**PREF_2**	Primary reference voltage (1.0V)
D101--DI08	Data lines (GPIB)	**PREN**	Primary remote enable
DAV	Data valid (GPIB)	**PRX**	Primary receive serial data
DFI	Discrete fault indicator	**PTX**	Primary transmit serial data
DFI-EN	Discrete fault indicator enable	**PWM_EN**	Pulse width modulator enable
DPS	Downprogramming shunt	**RAM**	Random access memory
DN_PGM	Down programming	**RDY**	Ready
DRIVE_A/B	FET drive signals	**REF_PWM**	Reference pulse width modulator
EOI	End or identify (GPIB)	**REN**	Remote enable
FAC_CAL	Factory calibration	**RI**	Remote inhibit
FAN_PWM	Fan pulse width modulation	**ROM**	Read only memory
FPRX	Front panel receive serial data	**SPCLR**	Secondary power clear
FPTX	Front panel transmit serial data	**RX**	Receive serial data
FS	Fast sense	**RxD**	Receive Serial Data
HSRQ	GPIB service request	**SA**	Signature analysis
IFC	Interface clear (GPIB)	**SRQ**	Service request (GPIB)
IMON	Current monitor	**SRX**	Secondary receive serial data
INH_CAL	Inhibit calibration	**STX**	Secondary transmit serial data
IP	External current programming	**TxD**	Transmit Serial Data
IPROG	Current programming	**UART**	Universal asynchronous receive/transmit
ISEN	Current sense	**VMON**	Voltage monitor
ISRQ	Interface service request	**VPROG**	Voltage programming
KO(0)-KO(5)	Keypad output data bus	**WR**	Write
KI(0)--KI(5)	Keypad input data bus		

Table 6-3. Test Points

TEST POINT No. & Loc.	Signal Tested	Measurement and Conditions
	A2 GPIB BOARD	
(1) J106-4	Primary/chassis ground	Connect meter or scope common here. Make measurements at test points 2 through 8.
(2) U101- 1	+ 5V primary bias	+ 5V ± 0.2V
(3) U101-6	**PCLR**	Goes high for approximately 40 ms at power on, then goes low.
(4) U101-8	**PCLR***	Held low for approximately 40 ms at power on, then goes high.
(5) U110-3	**STX**	Toggles between 0 and +5V.
(6) U111-6	**SRX**	Toggles between 0 and +5V.
(7) U119-4	**FPRX**	Toggles between 0 and +5V.
(8) U119-18	**FPTX**	Toggles between 0 and +5V.

Table 6-3. Test Points (continued)

TEST POINT No. & Loc.	Signal Tested	Measurement and Conditions
A4 AC Input Board		
Connect meter between TP 9 and 10, or 9 and 11, or 10 and 11, and measure approximately 220VAC or 440VAC.		
(9) J418-1/J417-7	AC Mains Voltage	
(10) J418-2/J417-8	AC Mains Voltage	
(11) J418-3/J417-9	AC Mains Voltage	
(12) K402 coil	24VDC Coil Voltage	Turns on PS, and after power-on initialization test, reads approximately 24VDC.
A5 DC Rail Board		
(13) J430-1 (+) to J430-2 (-)	Rail #1 Voltage	Measure approximately 290VDC
(14) J431-1 (+) to J431-2 (-)	Rail #2 Voltage	Measure approximately 290VDC
A6 Bias Board		
(15) J801-4 to J801-5	GPIB 5V Bias	+15 ± 0.9V measure approx. 11VAC
(16) J801-1 (+) to J801-2 (-)	Fan voltage	Measure 24Vdc
(17) J827-1 (+) to J827-2 (-)	Inrush relay coil	Measure 24Vdc
(18) J827-1 (+) to J827-3 (-)	Rail relay coil	Measure 24Vdc after power-on initialization test.
(19) J816-3 to J816-4	24V Primary	Measure approximately 34VAC
(20) R813	-15V bias	-15V
(21) R806	+ 5V bias	+5V
(22) R812	+15V bias	+15V
A3 FET Board		
NOTE: Because test points on the FET board are not accessible when the board is installed; troubleshooting must be performed with the board removed from the power supply (refer to the disassembly procedures at the back of chapter 3). 1. Turn off the power supply and remove the A3 FET Board with its heat sink assembly. 2. Short the collectors of Q251 and Q253 or Q351 and Q353 by connecting the collector (case) of each transistor to common (E507) . 3. Connect waveform generator to J200-1 and J200-2. 4. Set generator to produce a 20 kHz, 20V p-p triangular waveform 5. Connect 15V from an external supply to E206 or E306 (positive) and E207 or E307 (common).		
(26) E207/E307	Secondary common (Sheet 1,2)	Connect meter or scope common here. Make measurements at test points 27 through 35.
(27) U203-1/U303-1	Bias voltage (Sheet 1, 2)	+5V
(28) U204-1/U304-1	Bias trip point (Sheet 1, 2)	Voltage goes from low (0V) to high (5V) at an input of ≈ 12V; and from high to low at ≈ 13V.
(29) U201-1/U301-1	Drive 1 waveform (Sheet 1)	See Figure 6-1
(30) U201-12/U301-12	Drive 2 waveform (Sheet 2)	See Figure 6-1
(31) U201-10/U301-10	Drive pulses (Sheet 1, 2)	See Figure 6-1
(32) U201-7/U301-7	Drive pulses (Sheet 1, 2)	See Figure 6-1
(33) U202-1/U302-1	Drive pulses (Sheet 1, 2)	See Figure 6-1
(34) U202-7/U302-7	Drive pulses (Sheet 1, 2)	See Figure 6-1
(35) U205-2	VREF voltage (Sheet 1)	≈ 1.7V

Table 6-3. Test Points (continued)

TEST POINT No. & Loc.	Signal Tested	Measurement and Conditions
	A10 Control Board	
(36) +C500	Secondary common (Sheet 1)	Connect meter or scope common here. Make measurements at test points 37 - 61, and 62 - 70.
(37) U504-6	CC/CC DACs reference (Sheet 1)	+10V ± 0.05V
(38) U503-7	Readback DAC reference (Sheet 1)	-11.6V ± 0.1V
(39) U513-6	**CVPROG** (Sheets 2,4)	See Figure 6-1
(40) U514-6	**CCPROG** (Sheets 2,4)	See Figure 6-1
	NOTE: Measurement and Conditions for test points 41 through 70 are as follows: 1. Voltage = ½ scale 2. Current = ½ scale 3. OV = full scale	a. CV mode measurement is with no load b. CC mode measurement is with output shorted.
(41) U621-1	**VMON** (Sheet 4)	CV mode =+4.6V CC mode = 0V
(42) U621-7	**CV CONTROL** (Sheet 4)	CV mode =+2.4V CC mode = +10V
(43) U502-2	**CV*** (Sheet 4)	CV mode =0V CC mode = 5V
(44) U624-1	CC CLAMP AMP output (Sheet 4)	CV mode =+2.2V CC mode = +2.2V
(45) U622-6	1ST I AMP output (Sheet 4)	CV mode =0V CC mode = -0.4V
(46) U620-7	2ND I AMP output (Sheet 4)	CV mode =0V CC mode = +4.5V
(47) U620-1	**CC CONTROL** (Sheet 4)	CV mode =+10V CC mode = +0.4V
(48) U502-3	**CC*** (Sheet 4)	CV mode =+5V CC mode = 0V
(49) U608-7	FAST SENSE AMP (Sheet 3)	CV mode = -4V CC mode = 0V
(50) U607-7	RAMP GEN (Sheet 3)	See Figure 6-1
(51) U607-1	RAMP GEN (Sheet 3)	See Figure 6-1
(52) U602-9	DIVIDER output (Sheet 3)	See Figure 6-1
(53) U605-3	SUMMING POINT (Sheet 3)	See Figure 6-1
(54) U602-6	DEADTIME LATCH (Sheet 3)	See Figure 6-1
(55) U605-7	SUM COMPARATOR (Sheet 3)	See Figure 6-1
(56) U600-10	DIVIDER CLOCK (Sheet 3)	See Figure 6-1
(57) U601-6	DIVIDER RESET (Sheet 3)	See Figure 6-1
(58) U601-3	ON LATCH CLOCK (Sheet 3)	See Figure 6-1
(59) U604-3	ON LATCH (Sheet 3)	See Figure 6-1
(60) U603-3	**PWM_EN** (Sheet 3)	Held high for approximately 12 seconds at power-on, then goes low.
(61) U603-13	**REF_PWM** (Sheet 3)	+5 ± 0.2V
	NOTE: Temporarily move both scope leads to J511 for TP (62)	
(62) J511-1,2	DRV A, DRV B (Sheet 3)	See Figure 6-1
(63) U502-14	OV COMPARATOR (Sheet 1)	+5V
(64) U521-7	**OVREF** (Sheet 2)	+5.4V
(65) Q610, collector	**DP CONTROL** (Sheet 3)	CV Mode = N/A CC Mode = -0.14V
(66) U609-7	**DP CONTROL** (Sheet 3)	CV Mode = +13V CC Mode = 0V

Table 6-4. General Schematic Notes

1. **Schematic sheets are not intended for component-level troubleshooting. Component values and ratings do not match the values used on all models.**
2. All resistors are in ohms ±1%, 1/8W, unless otherwise specified.
3. All capacitors are in microfarads unless otherwise specified.
4. Signal lines that are terminated by flags continue on other sheets, and may also go to other locations on the same sheet. Example: CVPROG (SH.2 8C); "SH.2 8C" indicates the sheet number and the coordinates on that sheet where the CVPROG signal line goes.
5. Unterminated signal lines go to a least one other location on the same sheet.
6. Unless otherwise noted, bias connections to integrated-circuit packages are as follows:

	Common	**+ 5V**
14-pin packages	pin 7	pin 14
16-pin packages	pin 8	pin 16
20-pin packages	pin 10	pin 20

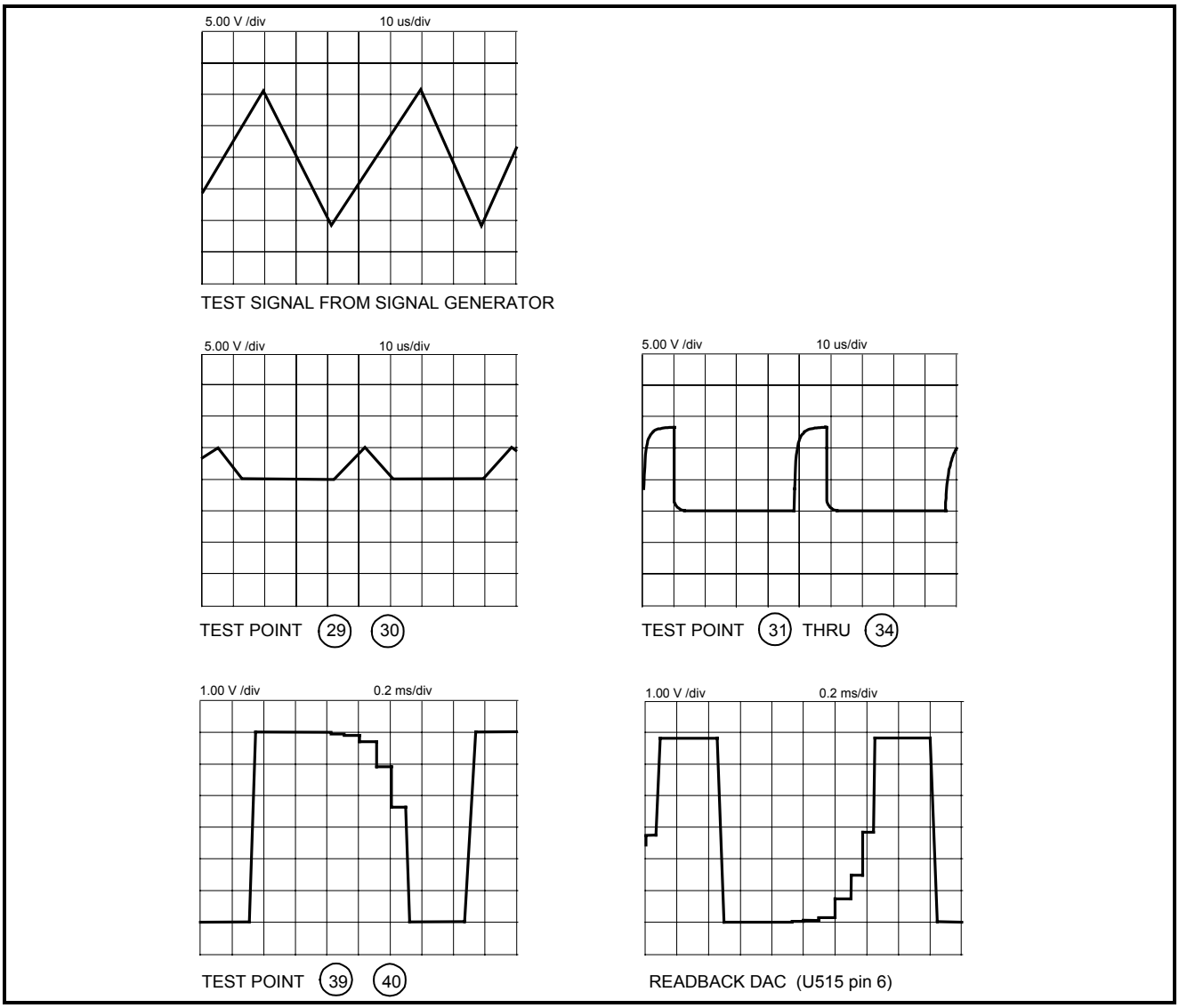


Figure 6-1. Test Point Waveforms for Table 6-3 (sheet 1 of 2)

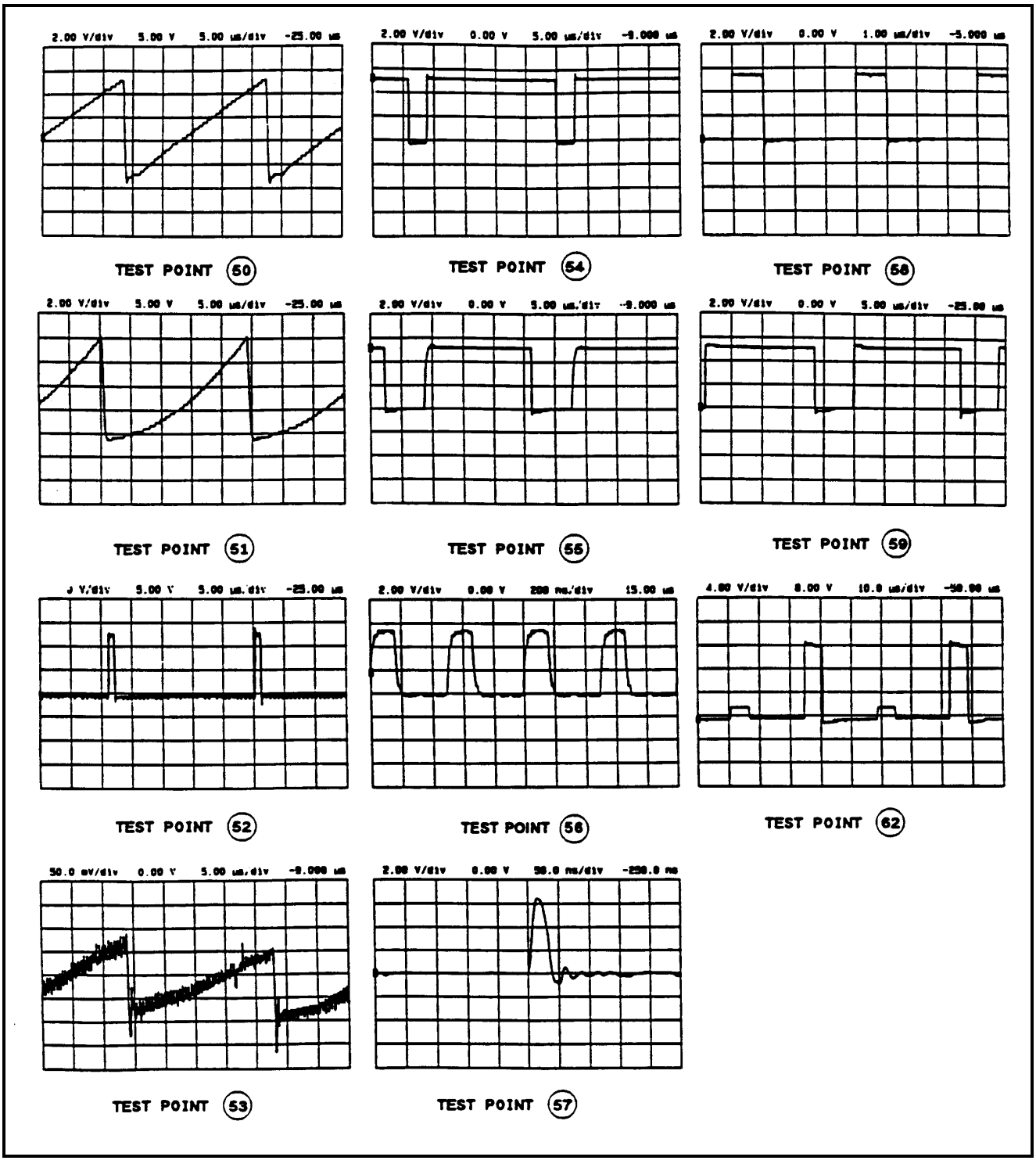


Figure 6-1. Test Point Waveforms for Table 6-3 (sheet 2 of 2)

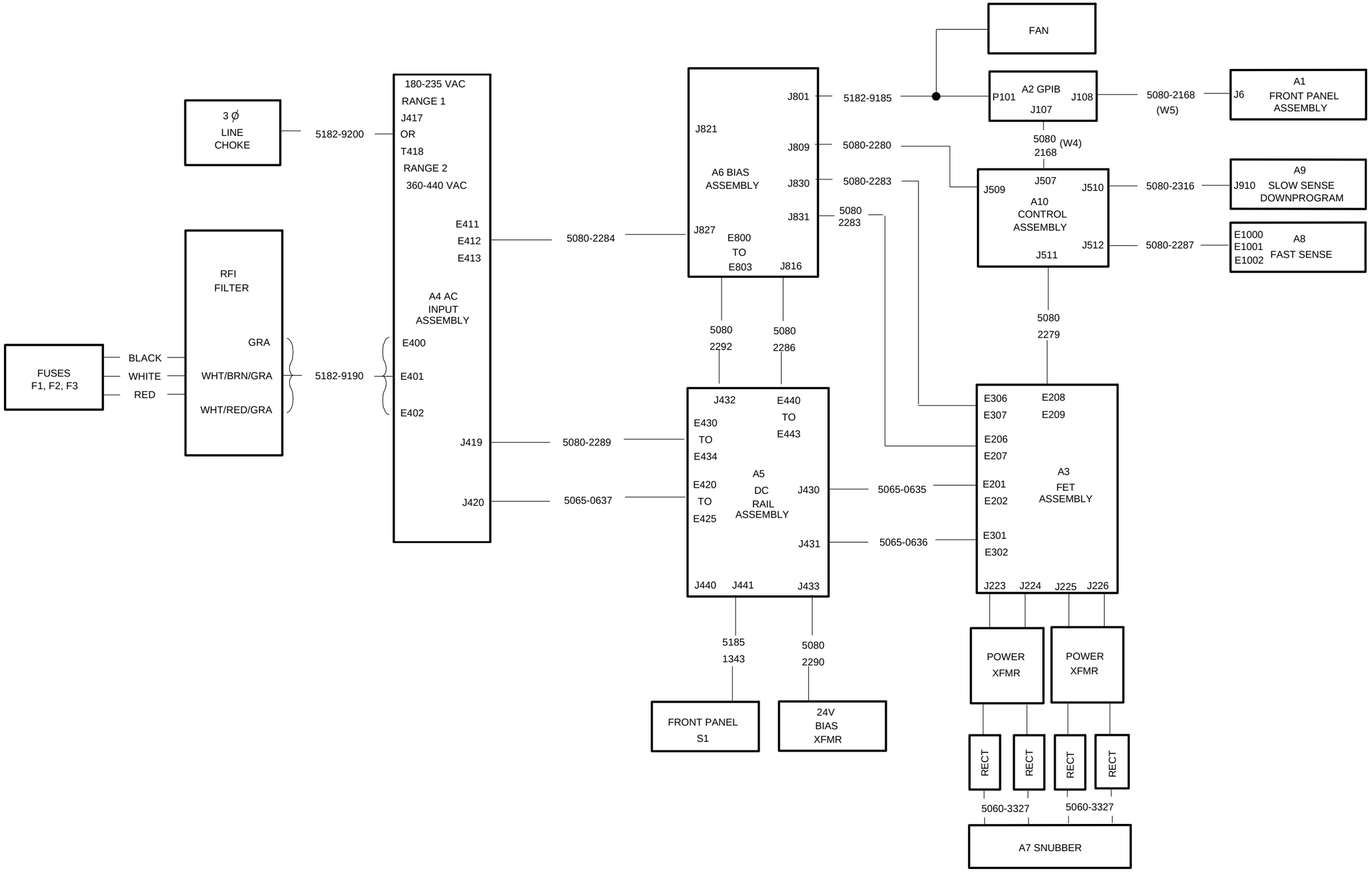


Figure 6-2. Circuit Board Cabling Diagram

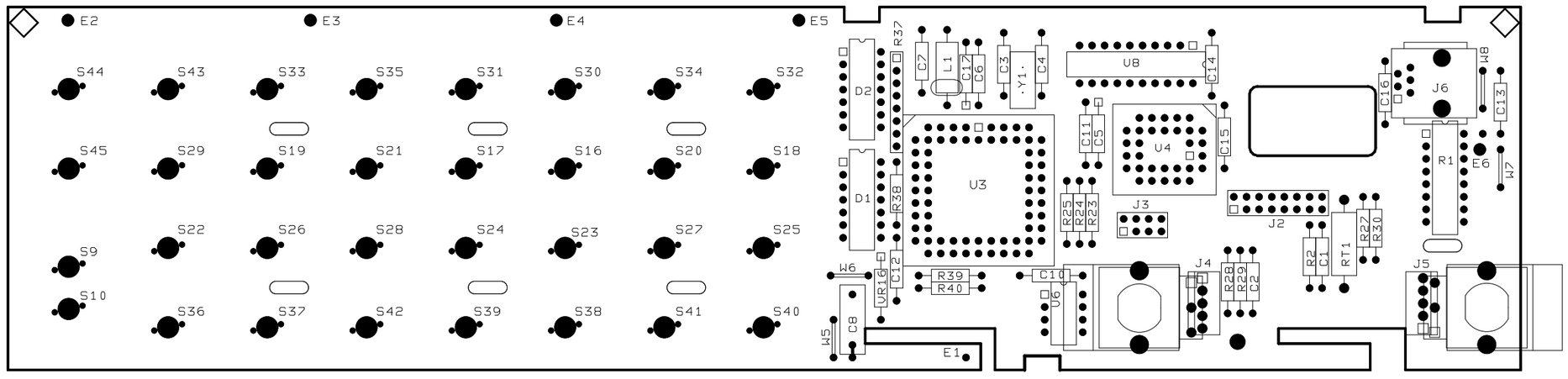


Figure 6-3. A1 Front Panel Board, Assembly Diagram

NOTE:

1. All resistor values are in OHMS +/- 1% 1/8W unless otherwise specified.
2. All capacitor values are in microfarads unless otherwise specified.

Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

Figure 6-4. A1 Front Panel Board, Schematic Diagram

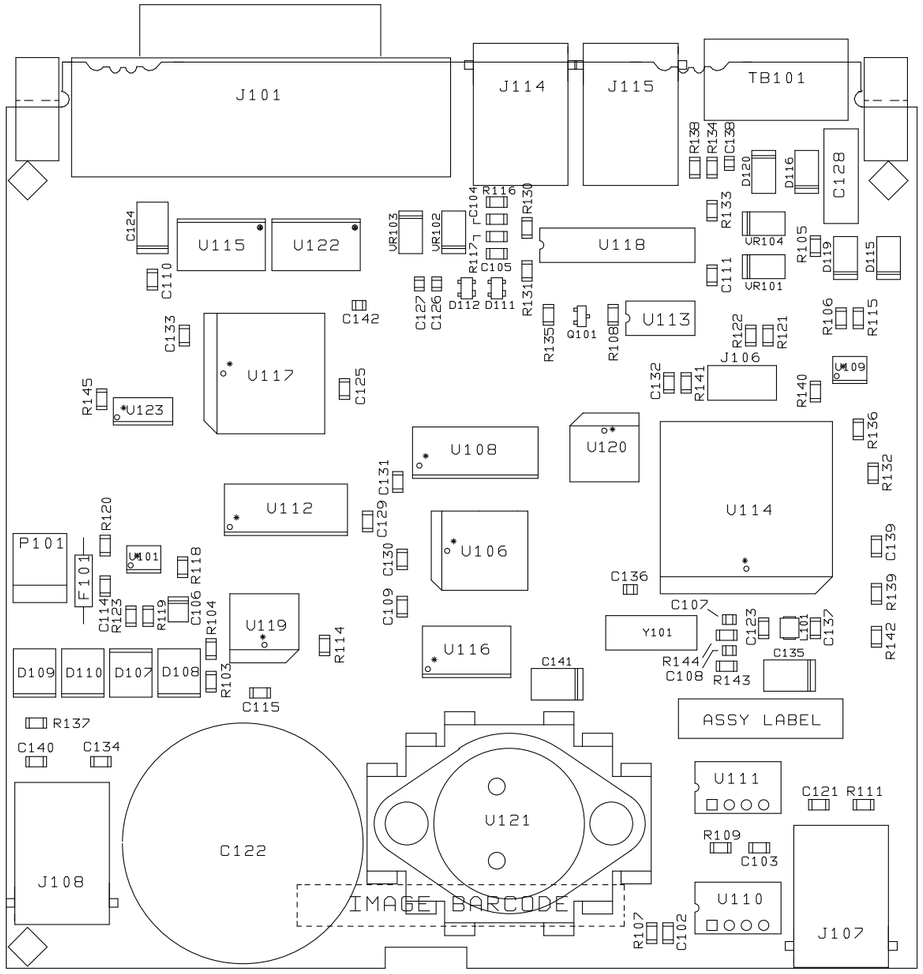


Figure 6-5. A2 GPIB Board, Component Location

Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

Figure 6-6. A2 GPIB Board, Schematic Diagram

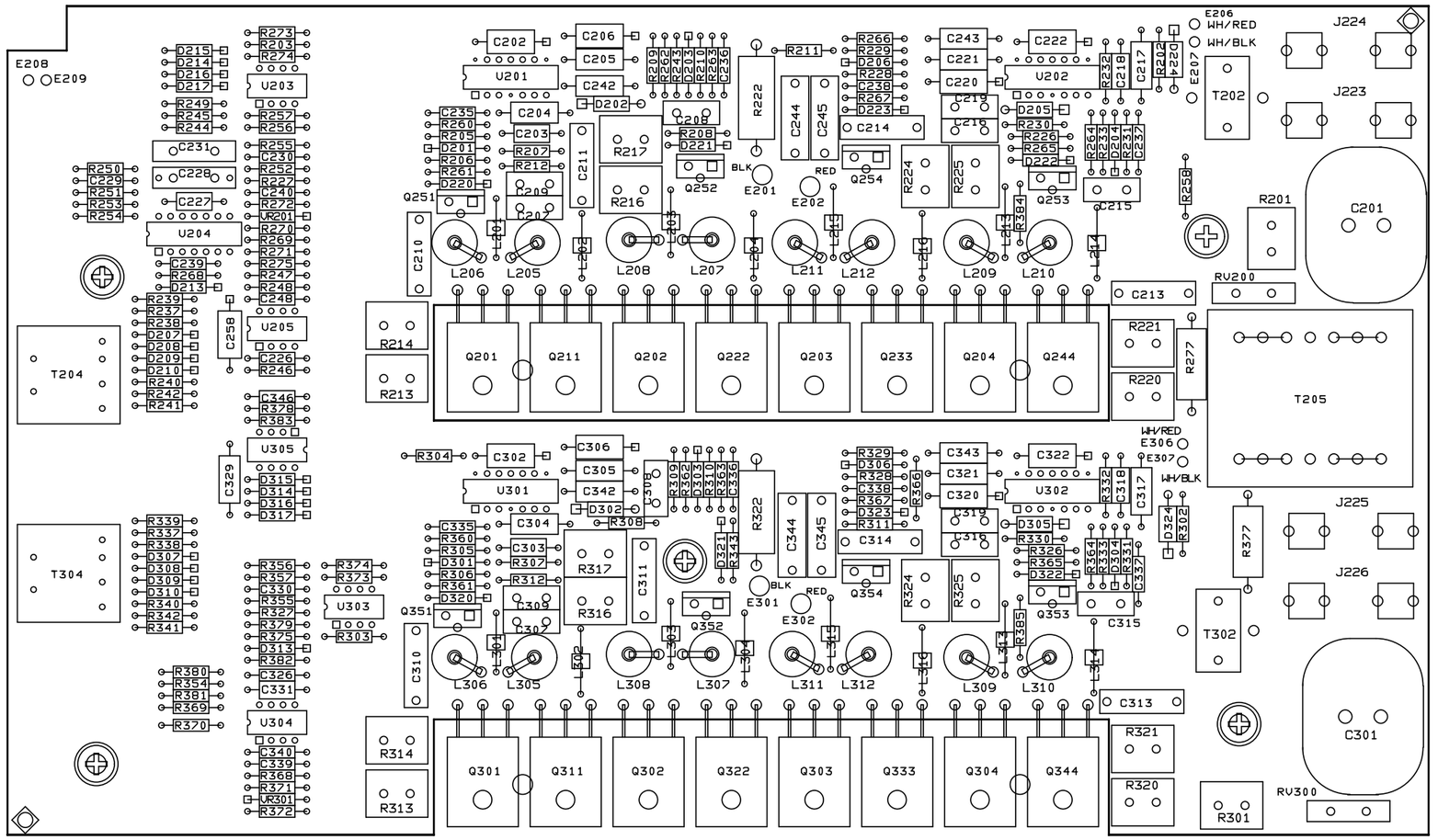
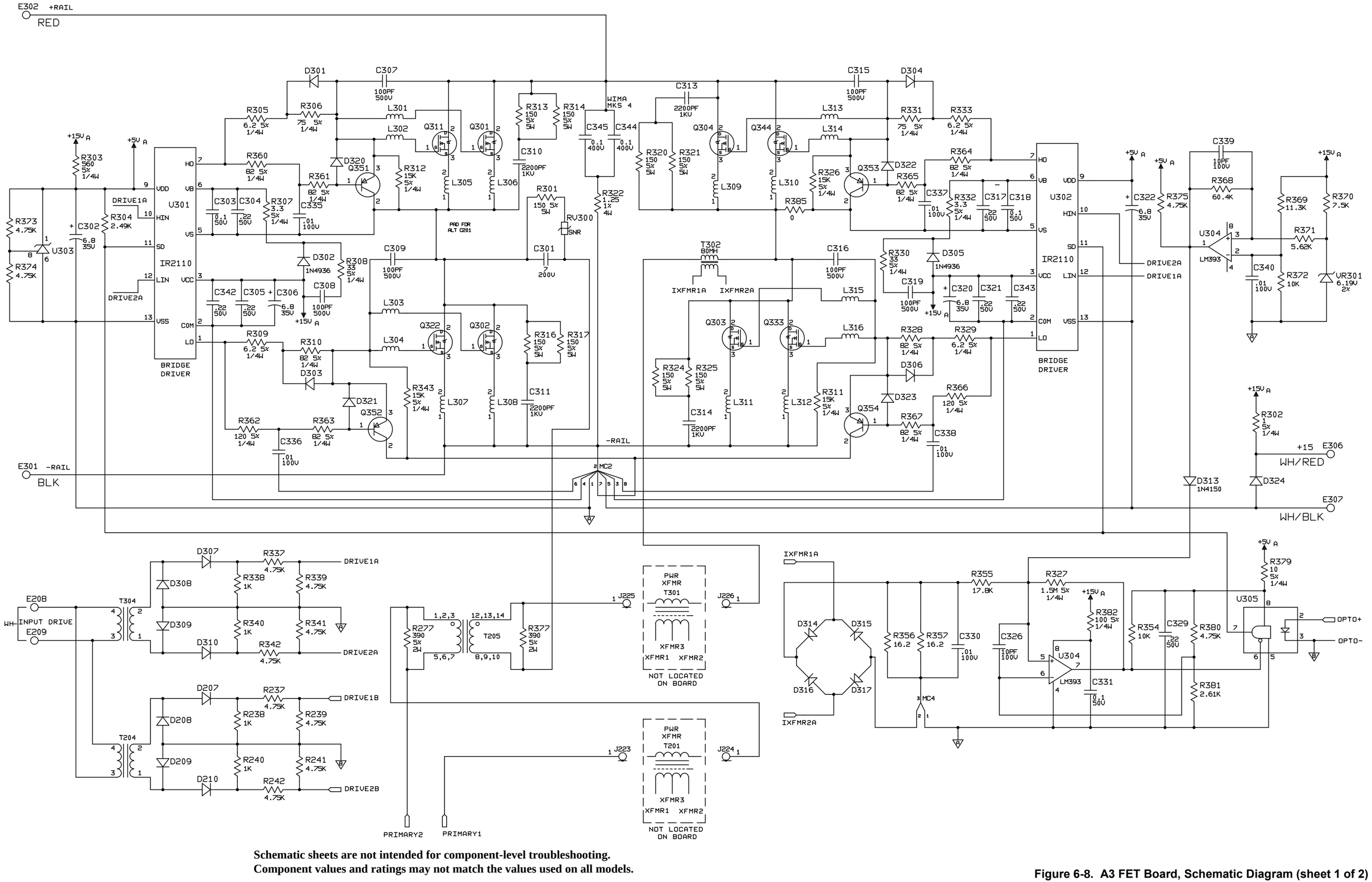
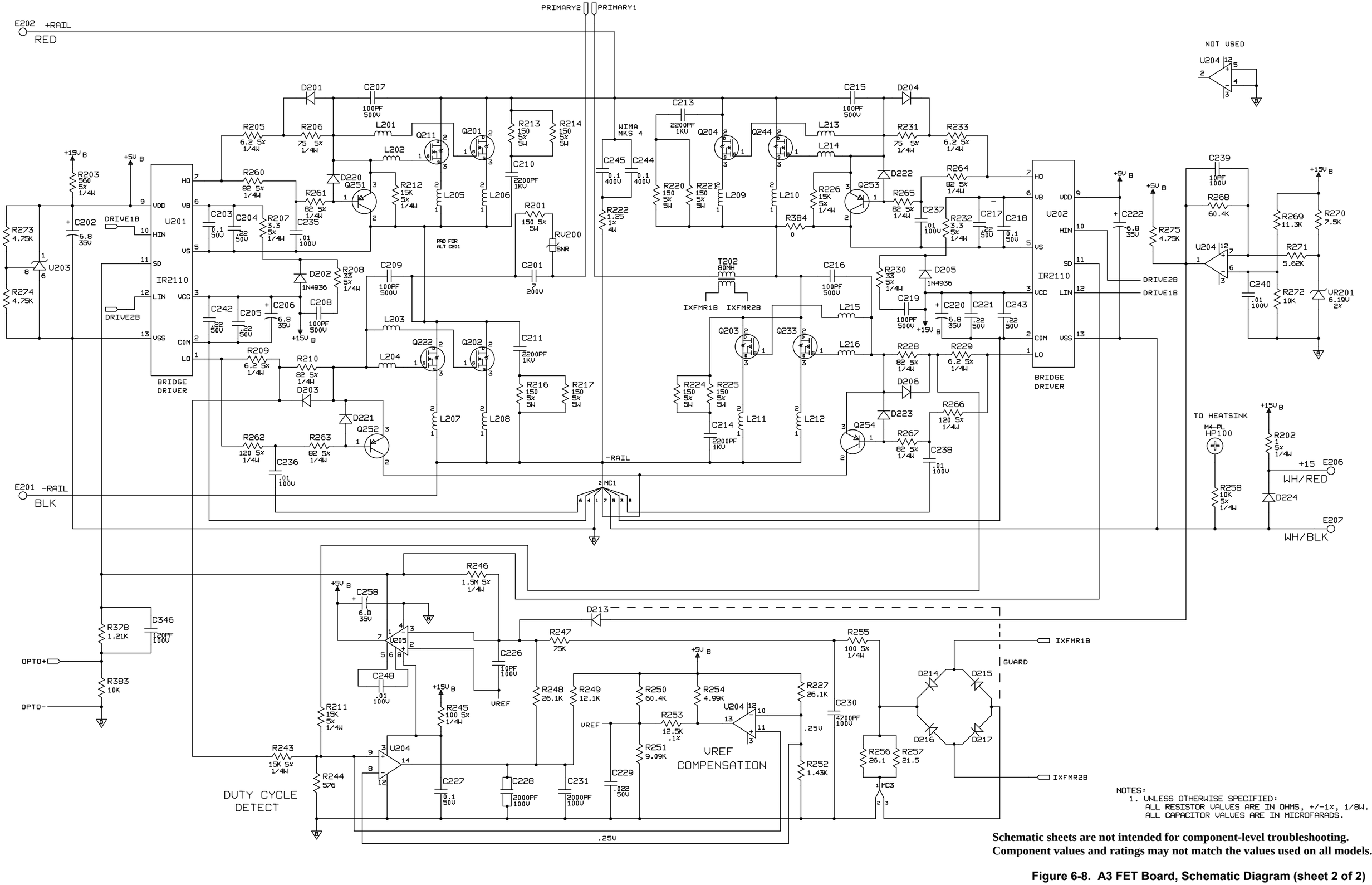


Figure 6-7. A3 FET Board, Component and Test Point Location



Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

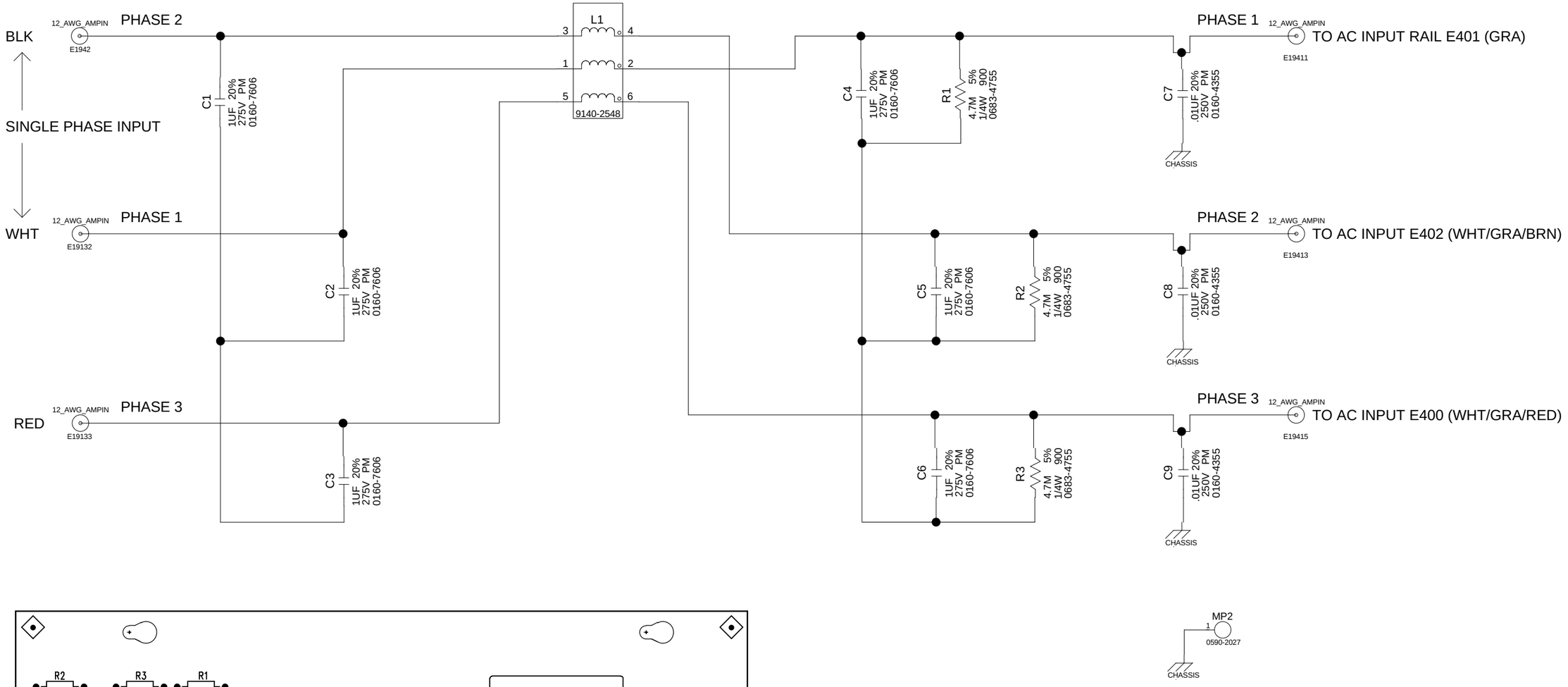
Figure 6-8. A3 FET Board, Schematic Diagram (sheet 1 of 2)



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, +/-1%, 1/8W.
   ALL CAPACITOR VALUES ARE IN MICROFARADS.

Schematic sheets are not intended for component-level troubleshooting. Component values and ratings may not match the values used on all models.

Figure 6-8. A3 FET Board, Schematic Diagram (sheet 2 of 2)



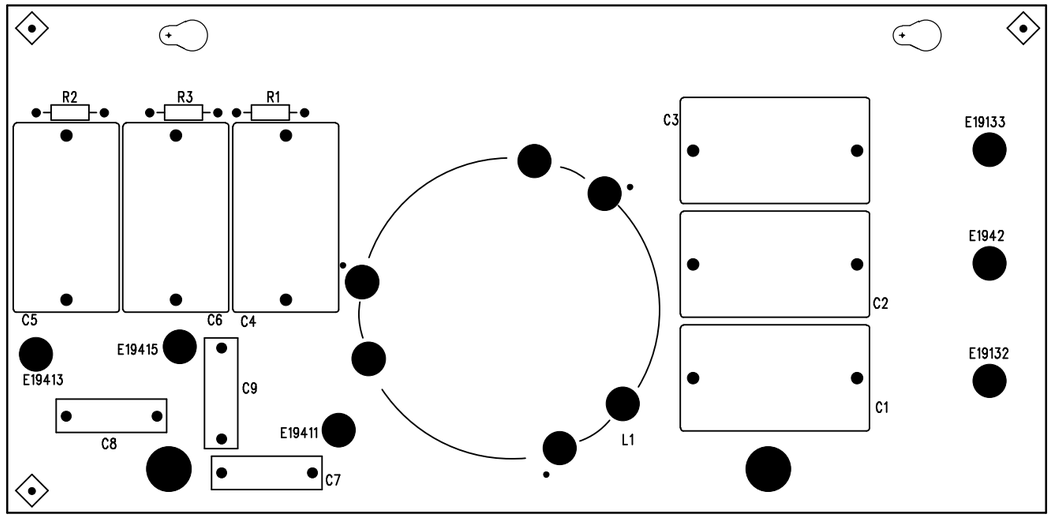


Figure 6-9. RFI Board, Component and Test Point Location

Figure 6-10. RFI Board, Schematic Diagram

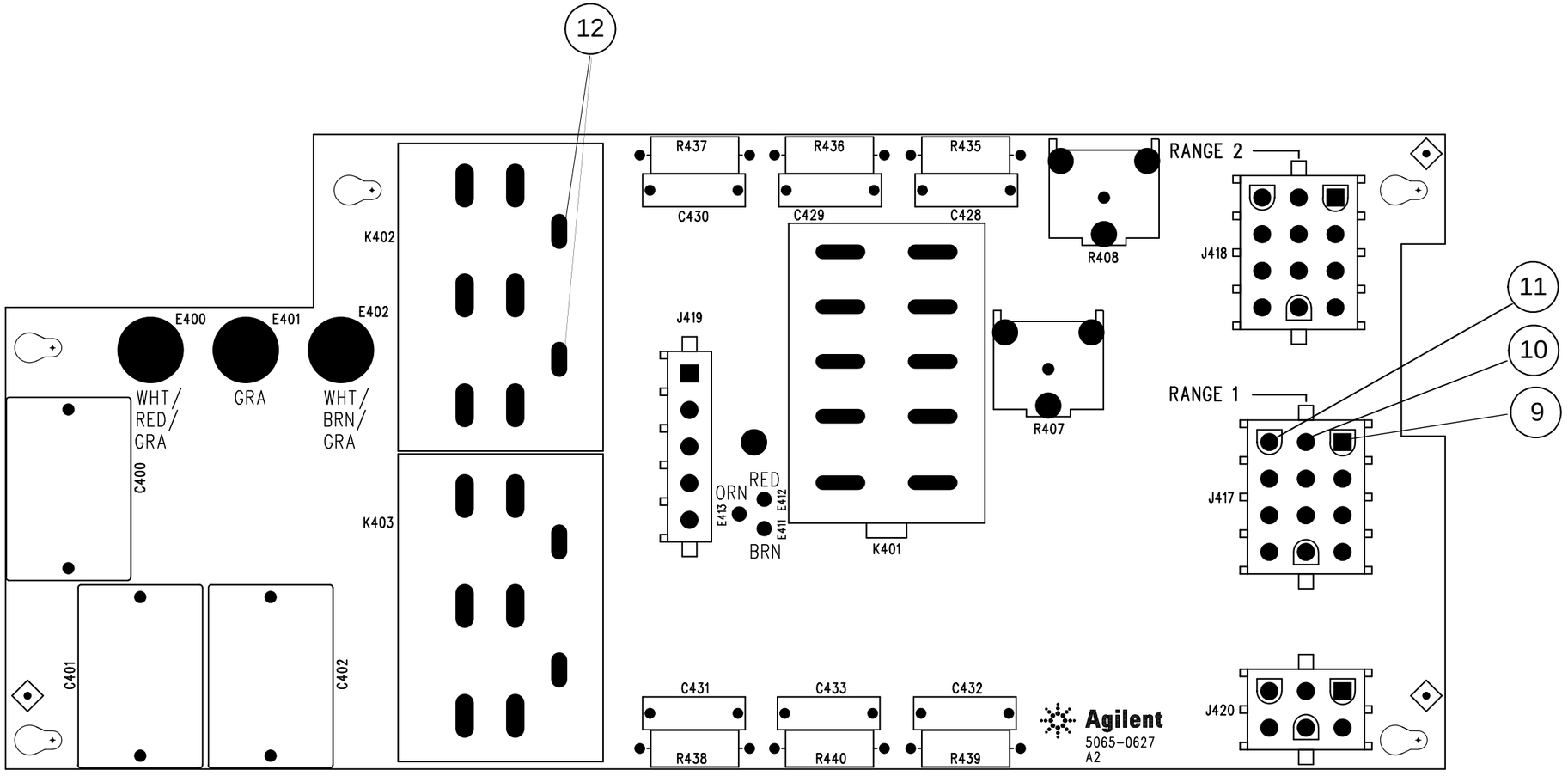
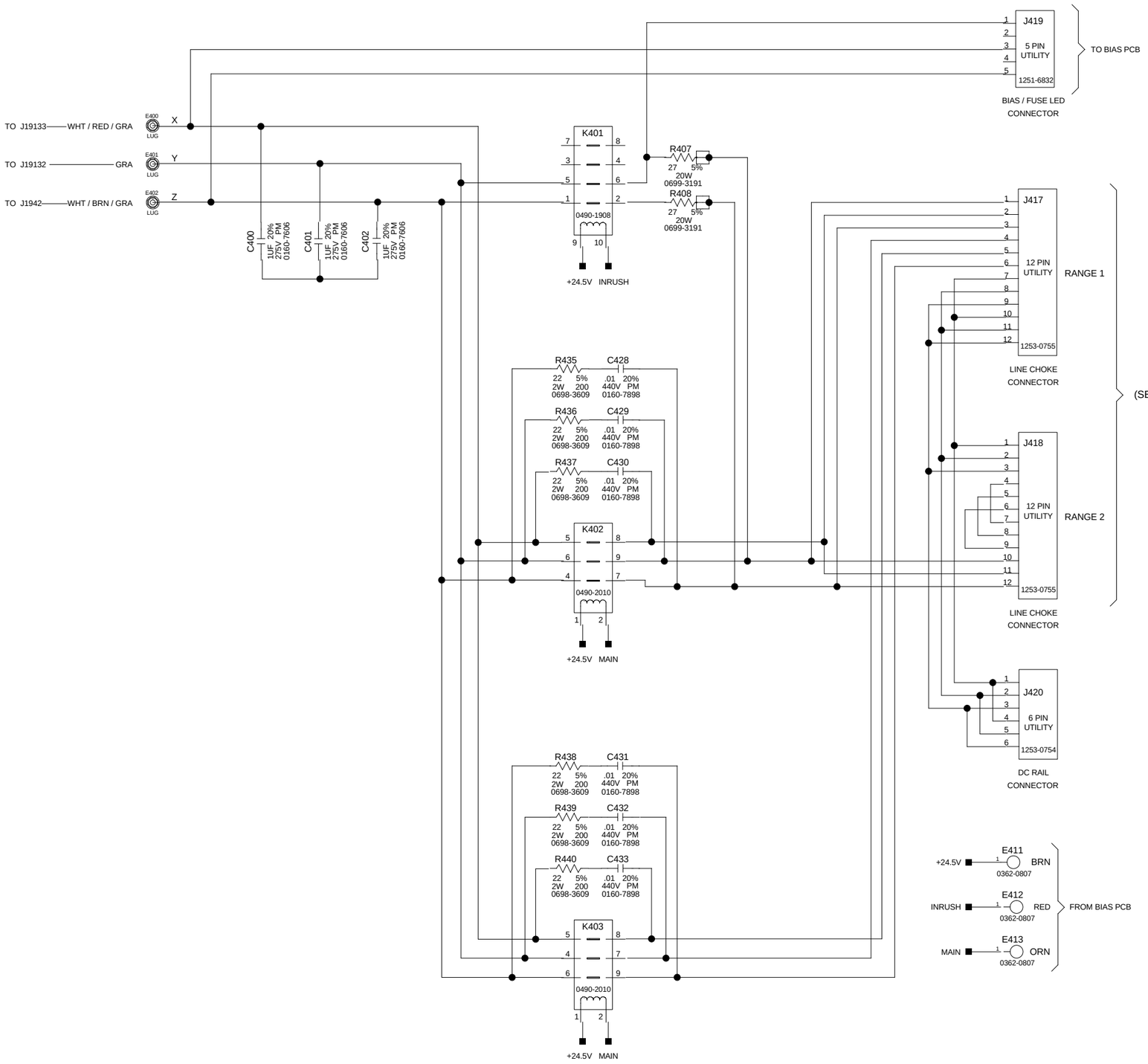
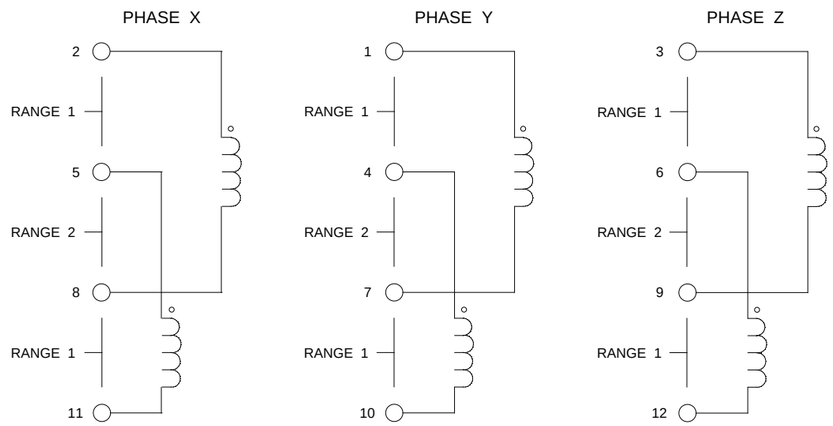


Figure 6-11. A4 AC Input Board, Component and Test Point Location



LINE CHOKE CONNECTION DETAIL



NOTE:

IF RANGE 1 IS SELECTED BY CHOKE PLUG, PIN NUMBERS REFER TO J417

IF RANGE 2 IS SELECTED BY CHOKE PLUG, PIN NUMBERS REFER TO J418

Schematic sheets are not intended for component-level troubleshooting. Component values and ratings may not match the values used on all models.

Figure 6-12. A4 AC Input Board, Schematic Diagram

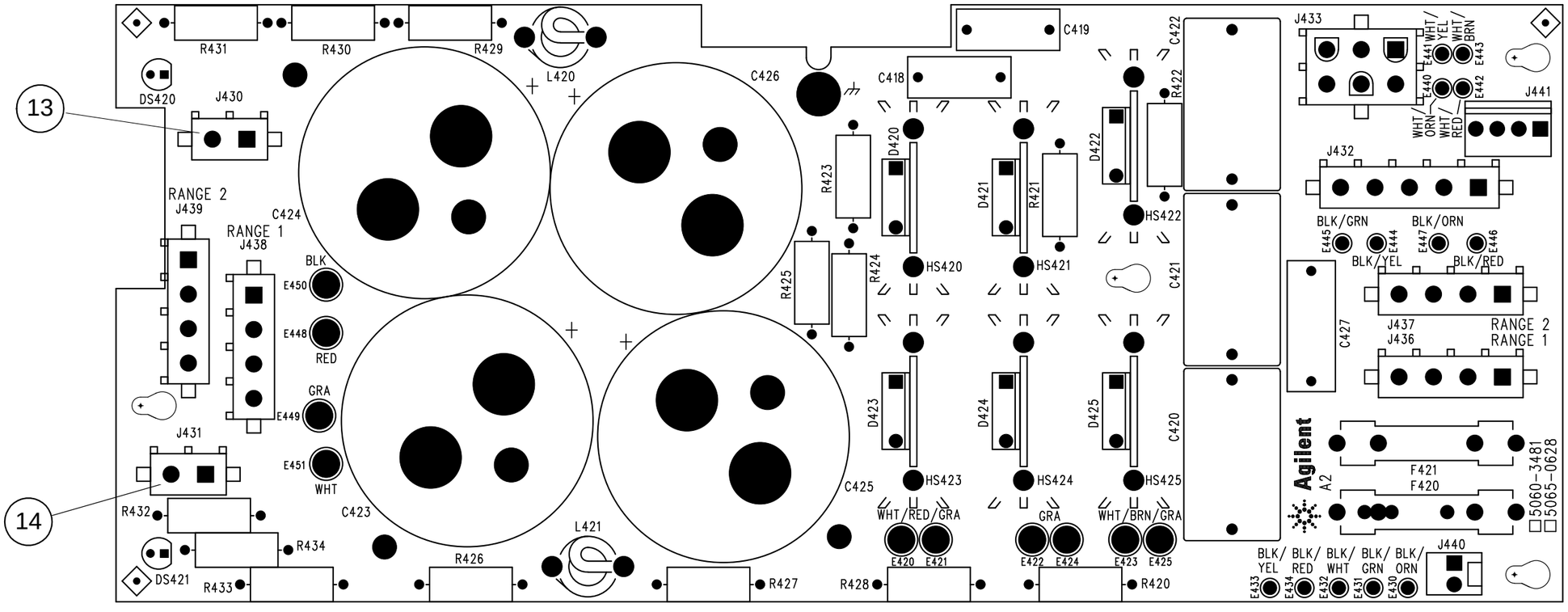


Figure 6-13. A5 DC Rail Board, Component and Test Point Location

AC INPUT

TO DC RAIL CONNECTOR J420 (AC INPUT PCB)

WHT / RED / GRA — E420, E421

GRA — E422, E423

WHT / BRN / GRA — E424, E425

R420, R421, R422: 27 5% 2W 200 0698-3611

C420, C421, C422: 1UF 20% 275V PM 0160-7606

C418, C419: .022 20% 250V PM NL0160-4048

MP8 SCREW_M4_P

D420, D421, D422: 1901-1717 — HS420, HS421, HS422: 1205-0350 — ASSY: 5064-0070

D423, D424, D425: 1901-1717 — HS423, HS424, HS425: 1205-0350 — ASSY: 5064-0070

R423, R424, R425, R426, R427, R428: 8.2K 5% 2W 200 0764-0044

C426, C425: 50-10% 1500 AL 400V 149674

E448 RED, E449 GRA — 1252-1346

RANGE 1 / RANGE 2 — 1251-3837 UTILITY 4 PIN — J438 / J439

L420, L421: 5080-2300 (COIL: 5080-2263 / SLUG: 9170-1575)

E450 BLK, E451 WHT — 1252-1346

C424, C423: 50-10% 1500 AL 400V 149674

R429, R430, R431, R432, R433, R434: 8.2K 5% 2W 200 0764-0044

DS420, DS421: RED 1990-0517

J430, J431: 2 PIN UTILITY 1253-4842 — DC RAIL 1, DC RAIL 2

13, 14

	RANGE 1	RANGE 2
E448 CONNECTS TO	J438-2	J439-2
E449 CONNECTS TO	J438-3	J439-3
E450 CONNECTS TO	J438-1	J439-1
E451 CONNECTS TO	J438-4	J439-4
E444 CONNECTS TO	J436-3	J437-3
E445 CONNECTS TO	J436-4	J437-4
E446 CONNECTS TO	J436-1	J437-1
E447 CONNECTS TO	J436-2	J437-2

NOTE:

Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

J440 HEADER 1252-0055 — BLOWN FUSE DETECT — TO LED PCB

E441 WHT / YEL — TO J816 - 4
E440 WHT / ORN — TO J816 - 3 — 24V REGULATOR — TO BIAS PCB
E442 WHT / RED — TO J816 - 2 — FAN RELAYS
E443 WHT / BRN — TO J816 - 1
0362-0807

J441 4 PIN POST 1252-0056 — DEW LED, FP SWITCH — TO LED PCB (FP)

J433 6 PIN UTILITY 1251-3819 — SECONDARY, PRIMARY, PRIMARY — TO / FROM 24V BIAS XFMR TB03 MOUNTED ON CHASSIS

C427: .047 20% 440V PM 0160-7743

J432 5 PIN UTILITY 1251-6832 — TB01, TB02 — TO BIAS PCB PRIMARY

BIAS INPUT

TO AC INPUT PCB

J419 - 2	BLK / ORN	E430
J419 - 4	BLK / GRN	E431
J419 - 3	BLK / WHT	E432
J419 - 5	BLK / YEL	E433
J419 - 1	BLK / RED	E434

0362-0807

F420 1A 2110-1066 SEE NOTE

F421 .5A 2110-0934 (CLIP: 2110-0726)

RANGE 1 — 1251-3837 UTILITY 4 PIN — J436

RANGE 2 — 1251-3837 UTILITY 4 PIN — J437

E445 BLK / GRN, E444 BLK / YEL, E447 BLK / ORN, E446 BLK / RED — 0362-0807

NOTE: FOR F420	FUSE	CLIP
668X SERIES	2110-0921 (0.5A)	2110-1107
669X SERIES	2110-1066 (1A)	2110-1072

Figure 6-14. A5 DC Rail Board, Schematic Diagram

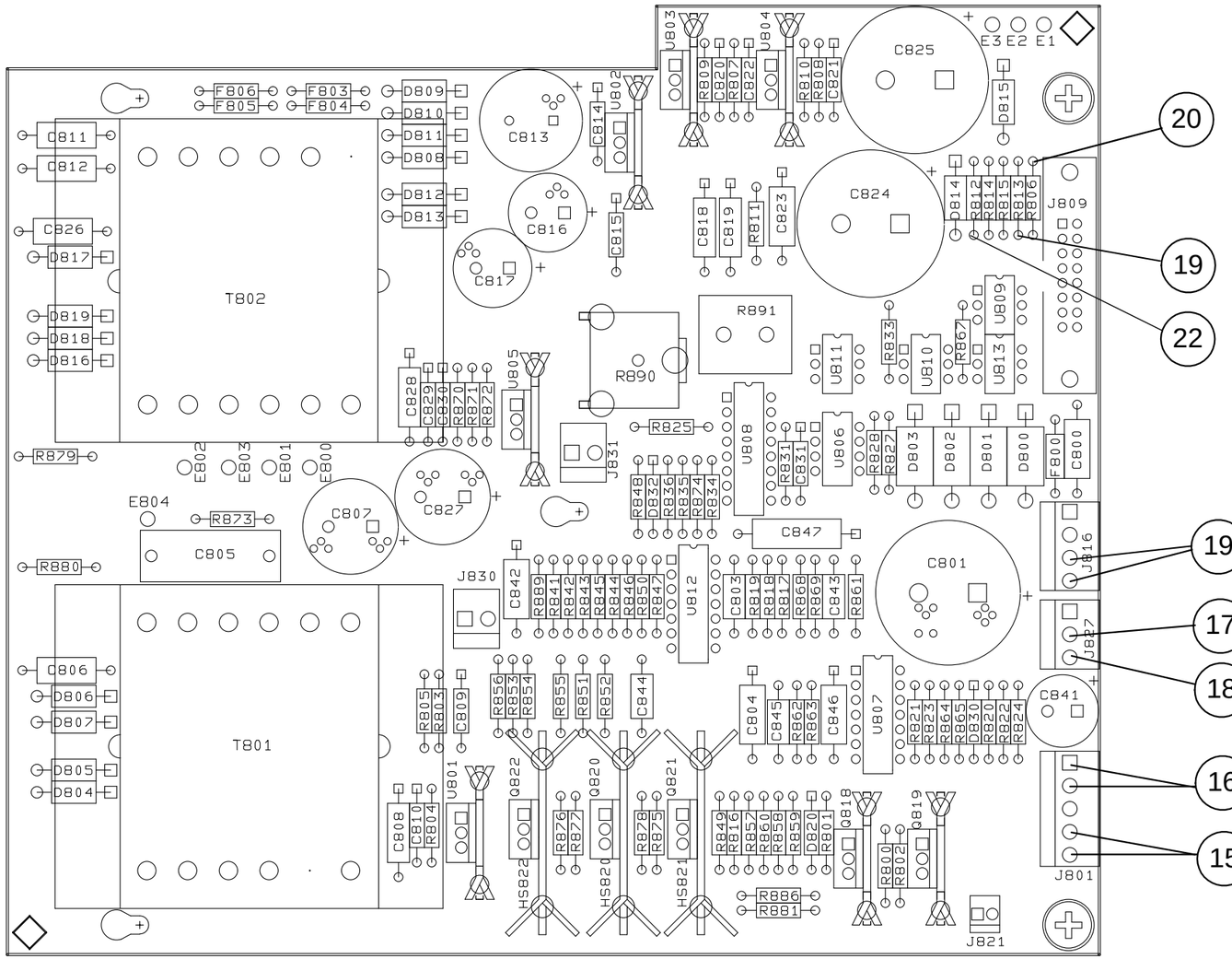
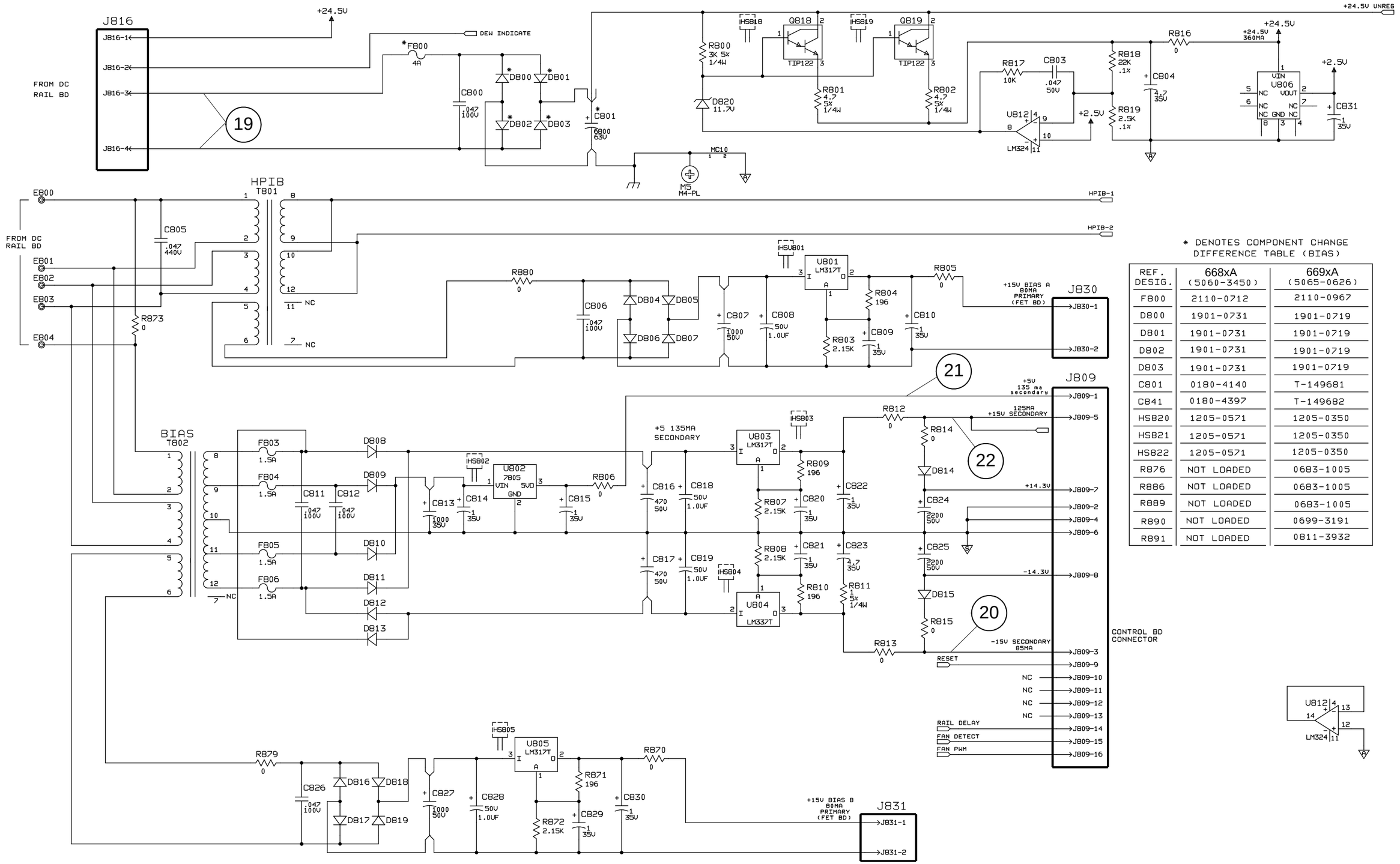


Figure 6-15. A6 Bias Board, Component and Test Point Location

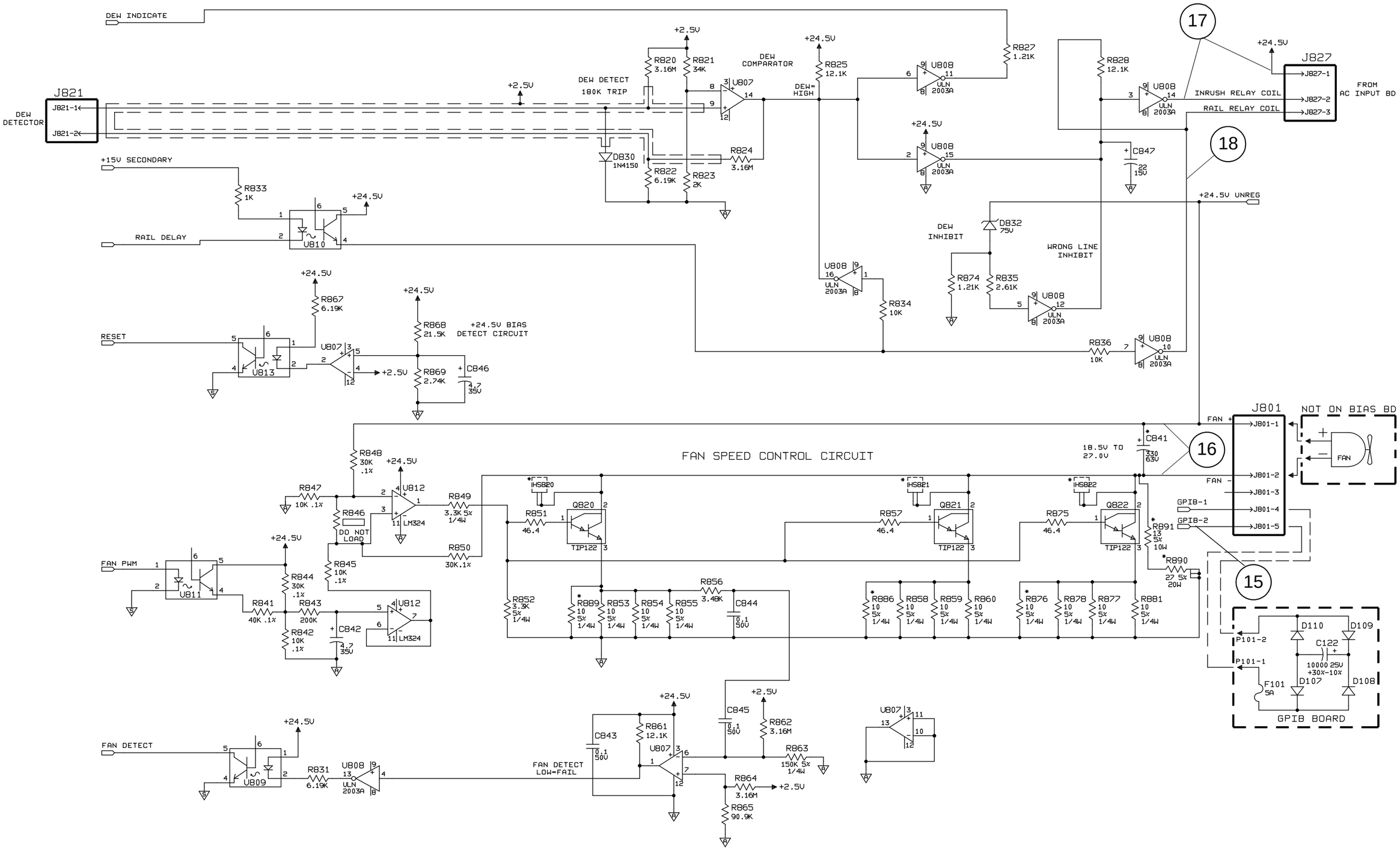


* DENOTES COMPONENT CHANGE DIFFERENCE TABLE (BIAS)

REF. DESIG.	668xA (5060-3450)	669xA (5065-0626)
F800	2110-0712	2110-0967
D800	1901-0731	1901-0719
D801	1901-0731	1901-0719
D802	1901-0731	1901-0719
D803	1901-0731	1901-0719
C801	0180-4140	T-149681
C841	0180-4397	T-149682
HS820	1205-0571	1205-0350
HS821	1205-0571	1205-0350
HS822	1205-0571	1205-0350
R876	NOT LOADED	0683-1005
R886	NOT LOADED	0683-1005
R889	NOT LOADED	0683-1005
R890	NOT LOADED	0699-3191
R891	NOT LOADED	0811-3932

Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

Figure 6-16. A6 Bias Board, Schematic Diagram (Sheet 1of 2)



Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

Figure 6-16. A6 Bias Board, Schematic Diagram (Sheet 2 of 2)

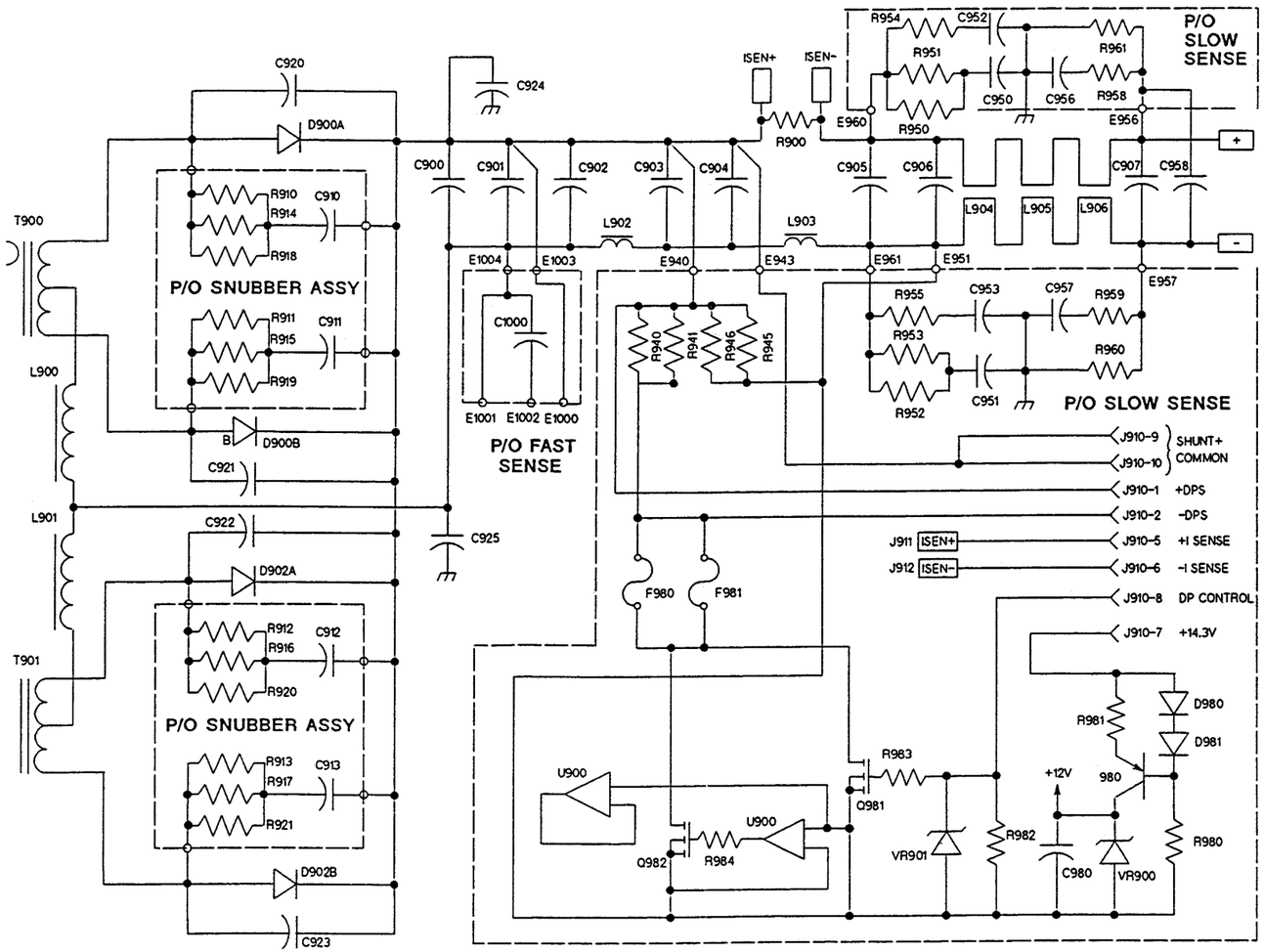
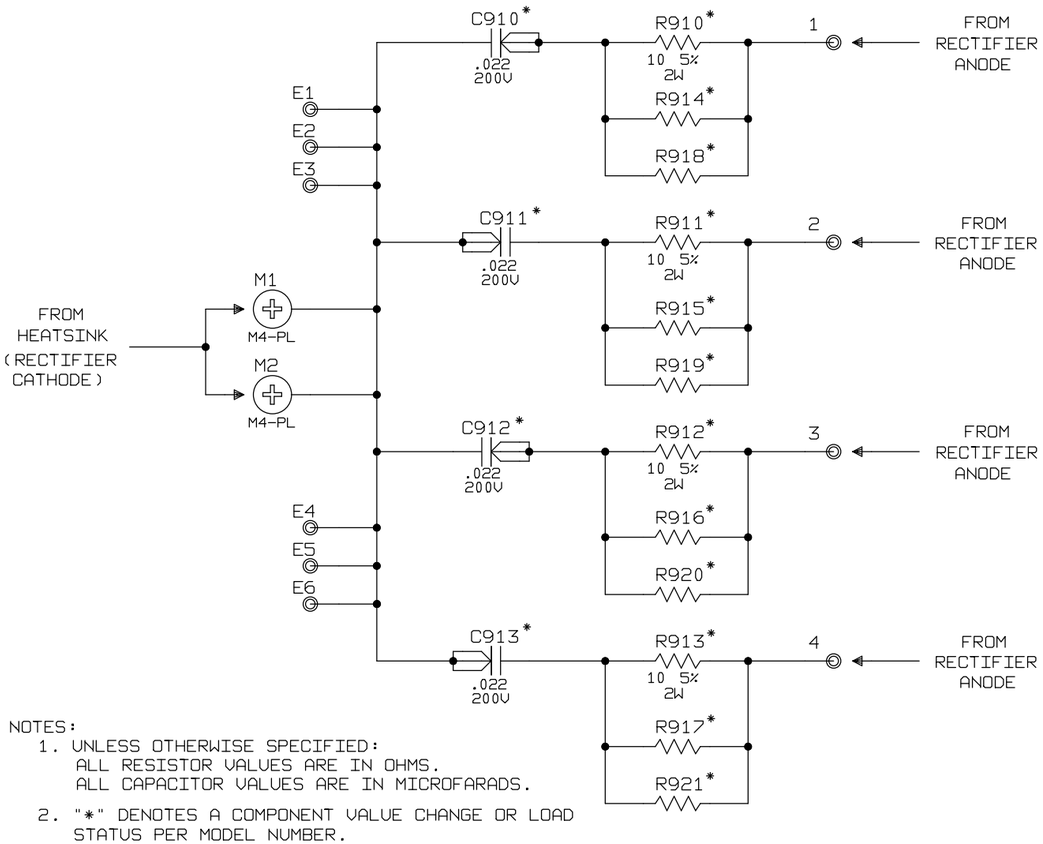


Figure 6-17. Power Mesh, Schematic Diagram, All Models



Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

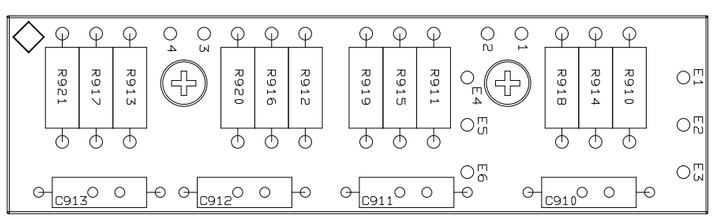


Figure 6-18. A7 Snubber Board, Component Location and Schematic Diagram

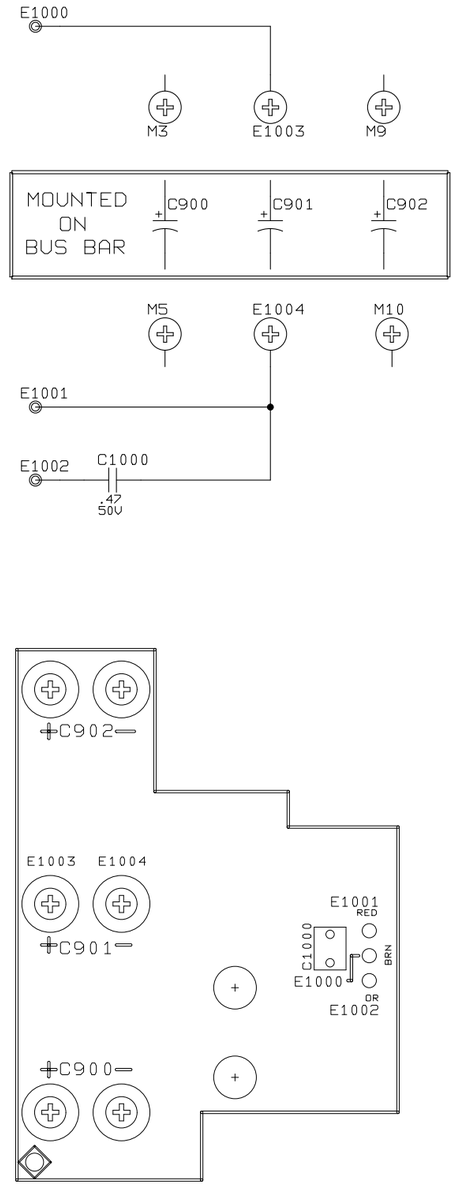
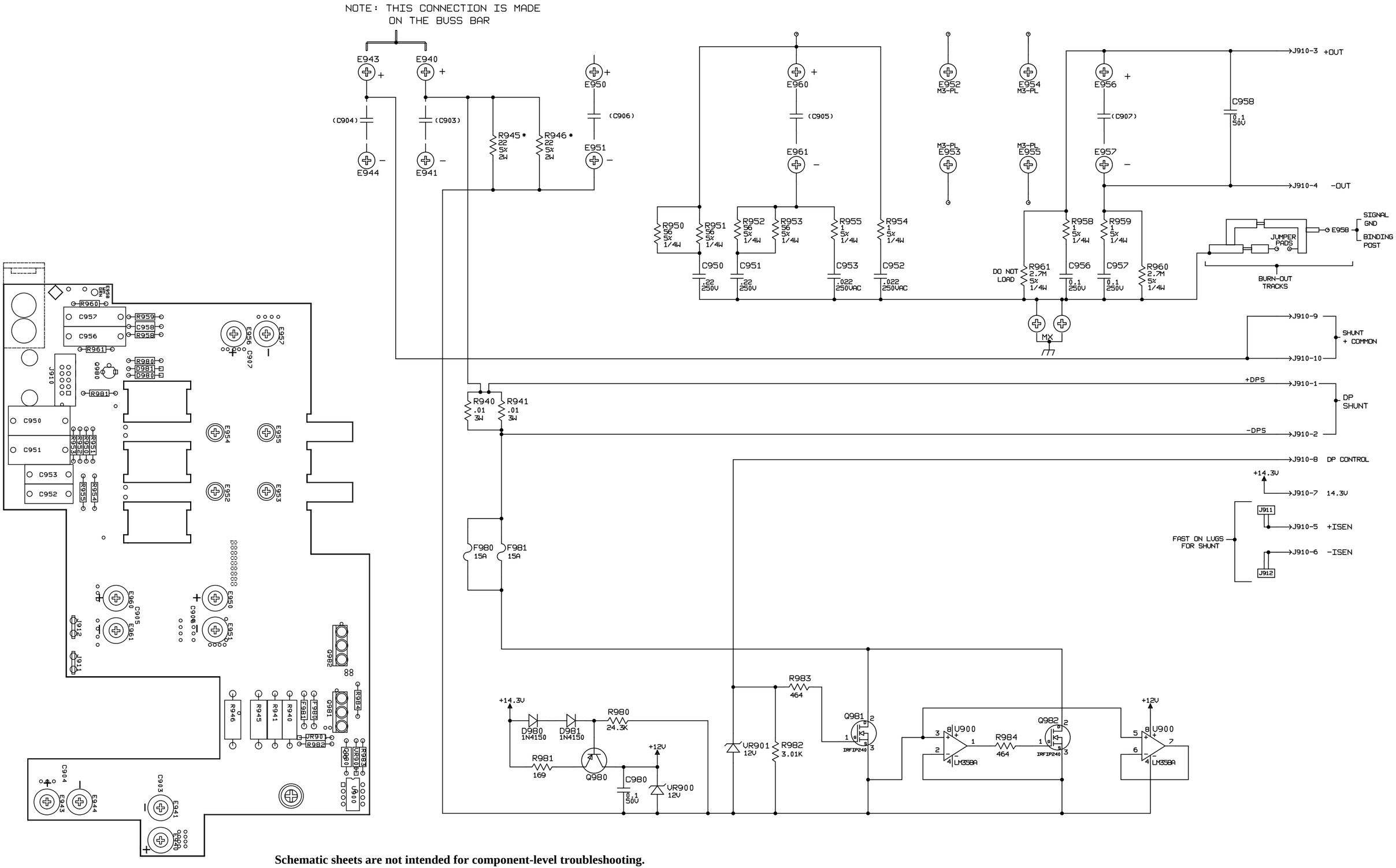


Figure 6-19. A8 Fast Sense Board, Component Location and Schematic Diagram



Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

Figure 6-20. A9 Down Programming/Slow Sense, Component Location and Schematic Diagram

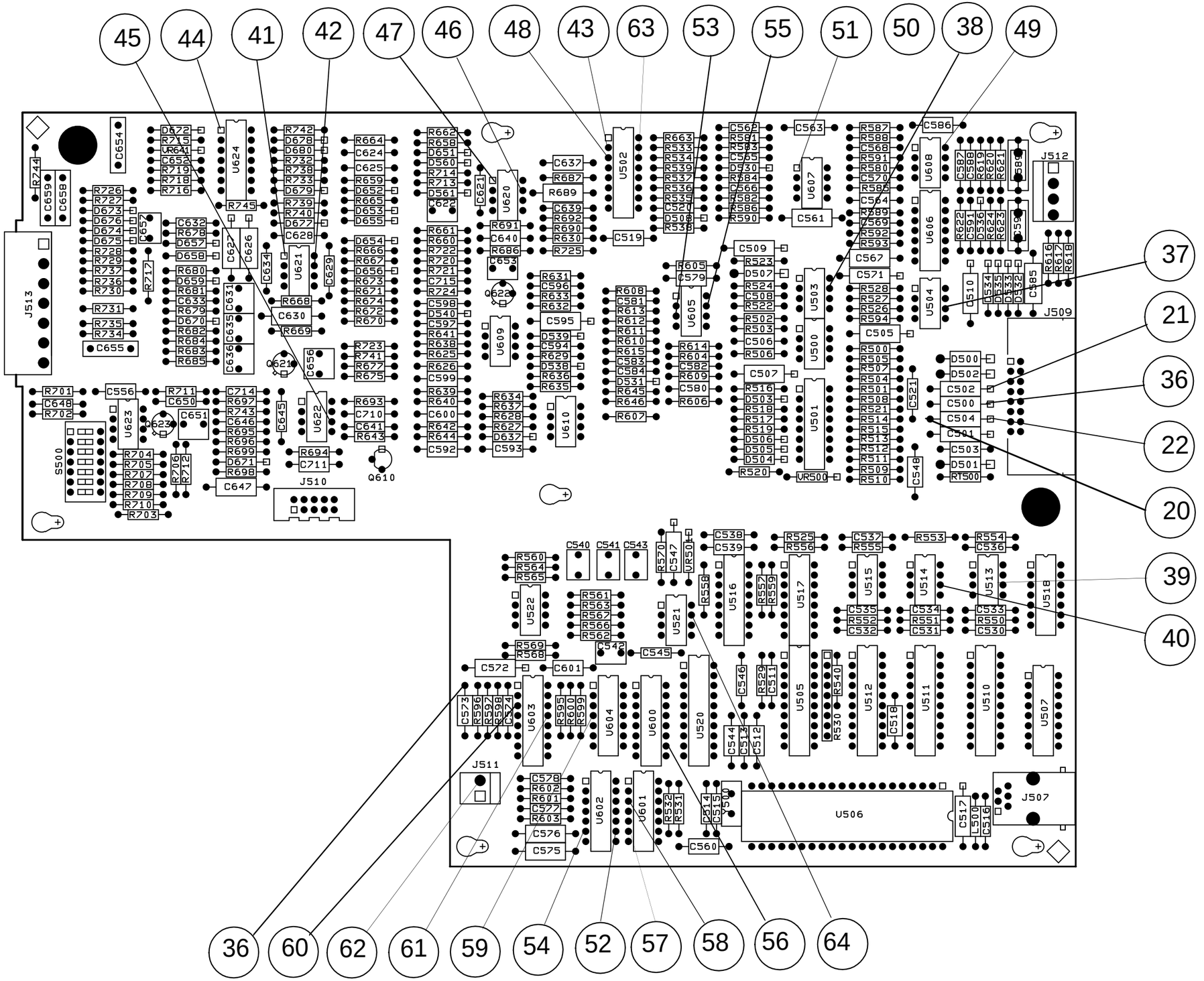
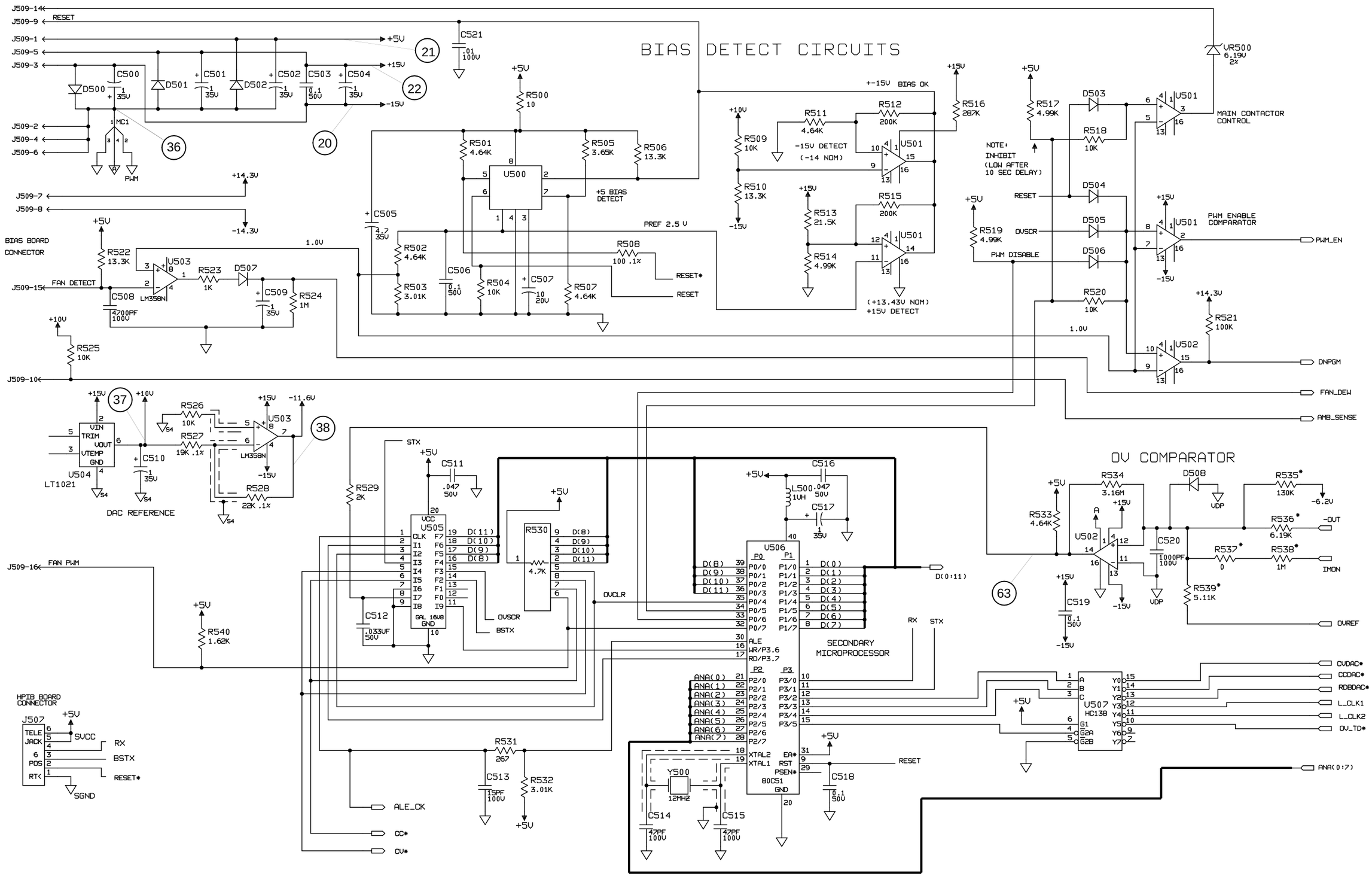


Figure 6-21. A10 Control Board, Component and Test Point Location



Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

Figure 6-22. A10 Control Board, Schematic Diagram (Sheet 1 of 4)

CONSTANT VOLTAGE D/A

CONSTANT CURRENT D/A

SUCCESSIVE APPROXIMATION A/D

READBACK COMPARATORS

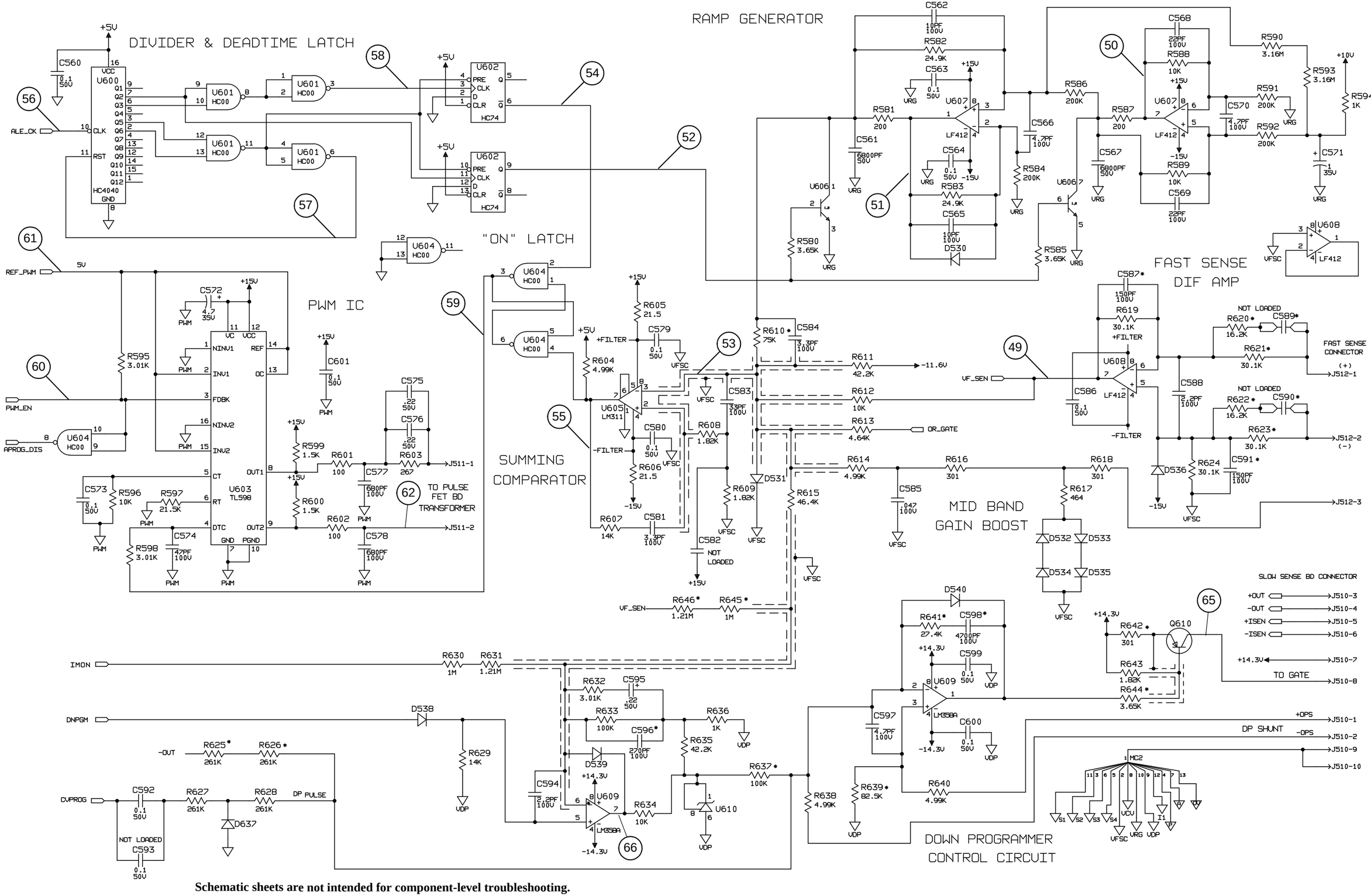
-IMON AMP

-VMON AMP

SHUNT TRIM / OV DACS

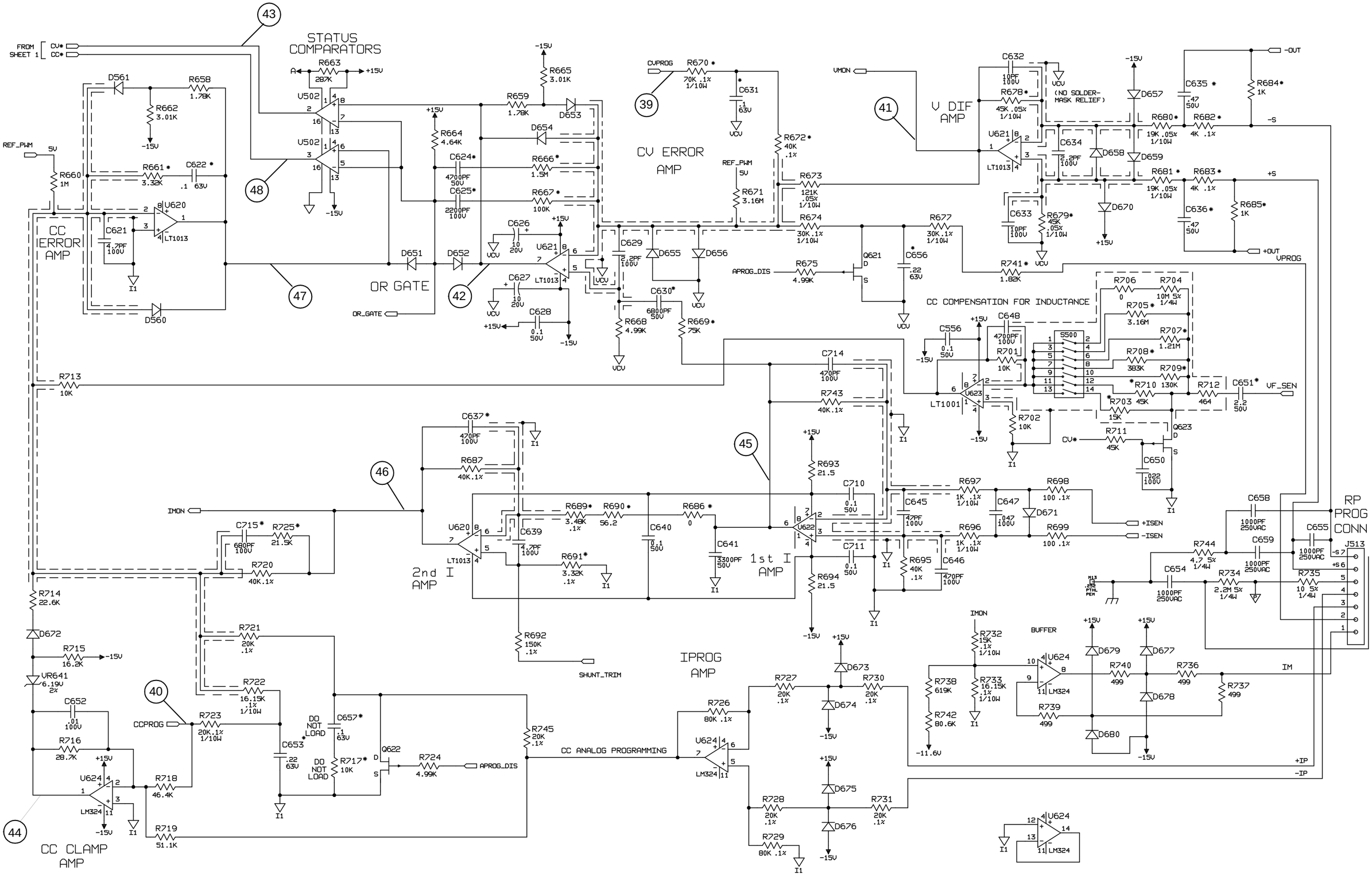
Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

Figure 6-22. A10 Control Board, Schematic Diagram (Sheet 2 of 4)



Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

Figure 6-22. A10 Control Board, Schematic Diagram (Sheet 3 of 4)



Schematic sheets are not intended for component-level troubleshooting.
Component values and ratings may not match the values used on all models.

Figure 6-22. A10 Control Board, Schematic Diagram (Sheet 4 of 4)

A

Backdating

Manual backdating describes changes that must be made to this manual for power supplies whose serial numbers predate the latest revision of this manual.

Look in the following table and locate your Agilent model. Then look at each serial number listed for this group. If the serial number of your power supply is **prior** to any of the serial number(s) listed, perform the change indicated in the **Change** column. Note that several changes can apply to your supply.

Serial Numbers	Change
Model 6690A	
MY41000131	1
Model 6691A	
MY41000119	1
Model 6692A	
MY41000133	1

Change 1

In Table 5-1 Main Chassis

DELETE CABLE, PN 5185-1343.

ADD LED BOARD, P/N 5060-3483.
CABLE, P/N 5080-2281
CABLE, P/N 5080-2283
CABLE, P/N 5080-2286

CHANGE BIAS BOARD, from P/N 5065-6937, to 5065-0643.

In Table 5-2 Front Panel,

CHANGE LABEL from PN 5185-1342, to P/N 5182-9191.

Index

A

averaging
  constant current measurements, 19

B

backdating, 99
block diagram, 64

C

cabling diagram, 75
CAL DENIED, 43
calibration
  inhibit, 43
  jumper, 43
  post-repair, 43
constant current load effect test, 17
constant current source effect test, 18
constant voltage load effect test, 13
constant voltage noise test, 14
constant voltage source effect test, 13
current programming and readback accuracy test, 17

D

disassembly
  A10 assembly, 54
  component locations, 52
  fan transformer, 58
  front frame, 53
  line choke, 57
  procedures, 48
  tools required, 49

E

E1 FP RAM, 27
E10 SEC 5 V, 27
E11 TEMP, 27
E12 DACS, 27
E2 FP ROM, 27
E3 EE CHKSM, 27
E4 PRI XRAM, 27
E5 PRI IRAM, 27
E6 PRI ROM, 27
E7 GPIB, 27
E8 SEC RAM, 27
E9 SEC ROM, 27
EE WRITE ERR, 27
EEPROM initialization, 44
electrostatic discharge
  precautions, 8
error messages
  E1 FP RAM, 27
  E10 SEC 5V, 27
  E11 TEMP, 27
  E12 DACS, 27
  E2 FP ROM, 27
  E3 EE CHKSM, 27
  E4 PRI XRAM, 27
  E5 PRI IRAM, 27
  E6 PRI ROM, 27
  E7 GPIB, 27
  E8 SEC RAM, 27
  E9 SEC ROM, 27
  EE WRITE ERR, 27
  SBUF FULL, 27
  SECONDARY DN, 27
  SERIAL DOWN, 27
  SERIAL TIMOUT, 27
  SUBF OVERRUN, 27
  UART FRAMING, 27
  UART OVERRUN, 27
  UART PARITY, 27

F

firmware revision, 8
firmware revisions, 42
flowchart
  troubleshooting, 26

I

identification, 7
inhibit calibration, 43
initialization, 44
  program, 45
  transferring CAL constants, 44

J

jumper
  DIG I/O, 42
  FACTORY PRESET CAL, 42
  FLT/INH, 42
  INHIBIT CAL, 42
  NORM, 42
  RELAY LINK, 42
  SA Mode, 42

M

manual
  revision, 7
manual backdating, 99
mnemonics, 70

O

operation
  ac calibration, 61
  control board, 60

dc rail board, 63
FET board, 63
front panel, 60
GPIB board, 59
H bridge, 63
input board, 62
output circuits, 64
principles of, 59

P

performance
tests, 9, 11
power-on selftest, 26
disabling, 26

R

replaceable parts
ac input assembly, 68
bias assembly, 68
chassis, 65
dc rail assembly, 68
down programmer/slow sense, 68
fast sense assembly, 68
FET assembly, 68
front panel, 67
GPIB board, 67

S

safety
symbols, 4
SBUF FULL, 27
schematic
ac input board, 85
bias board, 89
cabling diagram, 75
control board, 95
dc rail board, 87
down programming/fast sense, 93
fast sense board, 92
FET board, 81
front panel board, 77
GPIB board, 79
notes, 73
power mesh, 91
RFI board, 83
snubber board, 92
SECONDARY DN, 27
selftest
error messages, 27
SERIAL DOWN, 27
serial number, 7
SERIAL TIMOUT, 27
signal names, 70
SUBF OVERRUN, 27

T

test equipment
troubleshooting, 25
test header, 42
test points, 70
waveforms, 73
test record form
6690A, 21
6691A, 22
6692A, 23
tests
constant current, 15
constant voltage, 12
equipment required, 10
performance, 9, 11
selftest, 26
verification, 9, 11
transient recovery time test, 14
troubleshooting
DAC circuits, 37
FETs, 41
no display, 32
output held high, 36
output held low, 35
OV at turn on, 34
OV will not fire, 33
overall, 28
secondary interface down, 39
serial down, 38
slow downprogramming, 40
TST? query, 26

U

UART OVERRUN, 27
UART FRAMING, 27
UART PARITY, 27

V

verification
tests, 9, 11
voltage programming and readback accuracy test, 13

W

warranty, 2