

**FLUKE®**

# **5725A**

Amplifier

## Instruction Manual

PN 823435

January 1989

Rev. 7, 6/02

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## **Interference Information**

This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation.

Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

There is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of more of the following measures:

- Reorient the receiving antenna
- Relocate the equipment with respect to the receiver
- Move the equipment away from the receiver
- Plug the equipment into a different outlet so that the computer and receiver are on different branch circuits

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: How to Identify and Resolve Radio-TV Interference Problems. This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402. Stock No. 004-000-00345-4.

## **Declaration of the Manufacturer or Importer**

We hereby certify that the Fluke Model 5725A Amplifier is in compliance with BMPT Vfg 243/1991 and is RFI suppressed. The normal operation of some equipment (e.g. signal generators) may be subject to specific restrictions. Please observe the notices in the users manual. The marketing and sales of the equipment was reported to the Central Office for Telecommunication Permits (BZT). The right to retest this equipment to verify compliance with the regulation was given to the BZT.

## **Bescheinigung des Herstellers/Importeurs**

Hiermit wird bescheinigt, daß Fluke Models 5725A Amplifier in Übereinstimmung mit den Bestimmungen der BMPT-AmtsblVfg 243/1991 funk-entstört ist. Der vorschriftsmäßige Betrieb mancher Geräte (z.B. Meßsender) kann allerdings gewissen Einschränkungen unterliegen. Beachten Sie deshalb die Hinweise in der Bedienungsanleitung. Dem Bundesamt für Zulassungen in der Telekommunikation wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der Seire auf Einhaltung der Bestimmungen eingeräumt.

Fluke Corporation



# OPERATOR SAFETY SUMMARY

 **WARNING**



**HIGH VOLTAGE**

is used in the operation of this equipment

**LETHAL VOLTAGE**

may be present on the terminals, observe all safety precautions!

**To avoid electrical shock hazard, the operator should not electrically contact the output hi or sense hi binding posts. During operation, lethal voltages of up to 1100V ac or dc may be present on these terminals.**

**Whenever the nature of the operation permits, keep one hand away from equipment to reduce the hazard of current flowing through vital organs of the body.**

## **Terms in this Manual**

This instrument has been designed and tested in accordance with IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus. This manual contains information and warnings which have to be followed by the user to ensure safe operation and to retain the instrument in safe condition.

**⚠ Warning** statements identify conditions or practices that could result in personal injury or loss of life.

**⚠ Caution** statements identify conditions or practices that could result in damage to the equipment or other property.

## Symbols Marked on Equipment



DANGER — High Voltage



Protective ground (earth) terminal



Attention — refer to the manual. This symbol indicates that information about the usage of a feature is contained in the manual.

## Power Source

The 5725A is intended to operate from a power source that will not apply more than 264V ac rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

## Use the Proper Fuse

To avoid fire hazard, use only the fuse specified on the line voltage selection switch label, and which is identical in type voltage rating, and current rating.

## Grounding the 5725A

The 5725A is Safety Class I (grounded enclosure) instruments as defined in IEC 348. The enclosure is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired earth grounded receptacle before connecting anything to any of the 5725A or 5700A terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

## Use the Proper Power Cord

Use only the power cord and connector appropriate for proper operation of a 5725A in your country.

Use only a power cord that is in good condition.

Refer cord and connector changes to qualified service personnel.

## Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate the 5725A in an atmosphere of explosive gas.

## Do Not Remove Cover

To avoid personal injury or death, do not remove the 5725A cover. Do not operate the 5725A without the cover properly installed. There are no user-serviceable parts inside the 5725A, so there is no need for the operator to ever remove the cover.

## Do Not Attempt to Operate if Protection May be Impaired

If the 5725A appears damaged or operates abnormally, protection may be impaired. Do not attempt to operate it. When in doubt, have the instrument serviced.

# **SERVICING SAFETY SUMMARY**

## **FOR QUALIFIED SERVICE PERSONNEL ONLY**

Also refer to the preceding Operator Safety Summary

### **Do Not Service Alone**

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

### **Use Care When Servicing With Power On**

Dangerous voltage exist at many points inside this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Whenever the nature of the operation permits, keep one hand away from equipment to reduce the hazard of current flowing through vital organs of the body.

Do not wear a grounded wrist strap while working on this product. A grounded wrist strap increase the risk of current flowing through the body.

Disconnect power before removing protective panels, soldering, or replacing components.

High voltage may still be present even after disconnecting power.



# FIRST AID FOR ELECTRIC SHOCK

## **Free the Victim From the Live Conductor**

Shut off high voltage at once and ground the circuit. If high voltage cannot be turned off quickly, ground the circuit.

If the circuit cannot be broken or grounded, use a board, dry clothing, or other nonconductor to free the victim.

## **Get Help!**

Yell for help. Call an emergency number. Request medical assistance.

## **Never Accept Ordinary and General Tests for Death**

Symptoms of electric shock may include unconsciousness, failure to breathe, absence of pulse, pallor, and stiffness, and well as severe burns.

## **Treat the Victim**

If the victim is not breathing, begin CPR or mouth-to-mouth resuscitation if you are certified.



# **Chapter 1**

## **Introduction and Specifications**

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## 1-1. Introduction

The Fluke 5725A Amplifier enhances the 5700A Calibrator in the ac voltage, ac current, and dc current functions. The 5725A operates under complete control of the 5700A through an interface cable supplied with the 5725A.

A diagram in the specifications tables at the end of this section illustrates the extended ac volt-hertz product achieved by using a 5725A. Increased ac voltage load limits allow using the 5700A Calibrator in systems with long cables.

Voltage output from the 5725A is available at the 5700A Calibrator front or rear binding posts. This eliminates the need to move cables during a procedure that requires amplified as well as standard calibrator outputs.

The 5725A front or rear panel OUTPUT binding posts are only for current output. Extended-range ac and dc current is supplied through them. Since most meters with a high current range use a separate high current input terminal, this configuration normally eliminates the need to move cables during a procedure. If a single-point current output is needed, the 5700A Calibrator can be configured to source all current outputs through the 5725A binding posts.

Enhancements to 5700A ac voltage output capability provided by the 5725A are as follows:

- Frequency limits at higher voltage increase to 100 kHz at 750V, 30 kHz at 1100V.
- Load limits are to 70 mA for frequencies above 5 kHz, and to 50 mA for frequencies less than 5 kHz.
- Capacitive load limits are increased to 1000 pF.

Model 5725A operating functions and ranges are as follows:

- AC voltage: 220 to 1100V rms up to 70 mA (50 mA < 5 kHz), 40 Hz to 30 kHz; 220 to 750V rms up to 70 mA, 30 kHz to 100 kHz
- DC current: 0 to  $\pm 11$ A
- AC current: 1 to 11A rms, 40 Hz to 10 kHz

To contact Fluke, call one of the following telephone numbers:

USA: 1-888-99-FLUKE (1-888-993-5853)  
Canada: 1-800-36-FLUKE (1-800-363-5853)  
Europe: +31 402-678-200  
Japan: +81-3-3434-0181  
Singapore: +65-738-5655  
Anywhere in the world +1-425-446-5500

Or, visit Fluke's web site at [www.fluke.com](http://www.fluke.com).

## **1-2. Where to Go From Here**

This manual is the operator and service manual for the 5725A. However, because the 5725A operates under the control of the 5700A Calibrator, most operating instructions for the 5725A are in the 5700A/5720A Series II manuals. Topics such as selecting output values, connecting to a UUT (Unit Under Test), and self calibration are covered in the 5700A/5720A Series II Operator Manual. The list below gives some specific pointers, and the text further on describes how to use all the manuals to find 5725A information.

**For More Information About:**

- Unpacking and setup
- Installation and rack mounting
- AC line power and interface cabling
- Controls, indicators, and binding posts
- 5725A service information
- Operating the amplifier
- Cabling to a Unit Under Test
- Self calibration
- Full verification
- IEEE-488 or serial remote operation
- 5700A/5725A specifications
- Theory of operation
- Troubleshooting
- Ordering a part

**Refer To:**

- Section 2 of this manual
- Section 2 of this manual and the Y5735/Y5737 Instruction Sheet
- Section 2 of this manual
- Section 3 of this manual
- Sections 4 through 9 of this manual
- Section 3 of this manual and Section 4 of the 5700A/5720A Series II Operator Manual
- Section 4 of the 5700A/5720A Series II Operator Manual
- Section 7 of the 5700A/5720A Series II Operator Manual
- Section 3 of the 5700A/5720A Series II Service Manual
- Section 5 of the 5700A/5720A Series II Operator Manual
- Section 1 of this manual
- Section 4 and 9 of this manual
- Section 6 of this manual
- Section 8 of this manual

### **1-3. How to Use the Manuals**

The following paragraphs describe how each manual addresses the 5725A.

#### **1-4. 5725A Getting Started Manual**

Use this manual for basic getting started information, contacting Fluke, unpacking, and general specifications. This manual also provides setup and operation information for the 5725A Amplifier, descriptions of the 5725A front and rear-panel features, and information about setting up and powering up the 5725A. Please read this information before operating the amplifier.

#### **1-5. 5725A Instruction Manual**

Use the 5725A Instruction Manual for installing the 5725A, learning about its front and rear-panel features, and for all service-related topics such as maintenance, troubleshooting, parts lists, and schematics. (The 5725A Instruction Manual is the service and operator manual for the 5725A.)

Although the instruction manual also contains a section devoted to 5725A operating notes, once the 5725A is up and running you will find that the 5700A/5720A Operator Manual contains most of the information you need to operate the 5725A.

#### **1-6. 5700A/5720A Series II Manual Set**

The 5700A/5720A Series II Manual Set consists of a Getting Started Manual, an Operator Reference Guide, a Remote Programming Reference Guide and a CD-ROM containing an Operators Manual and Service Manual (in addition to all the other manuals provided in printed form).

#### **1-7. 5700A/5720A Series II Operator Manual**

The 5700A/5720A Series II Operator Manual contains the following information pertaining to the 5725A:

- Specifications for both the 5700A and 5725A (these same specifications are in this Instruction Manual)
- Cable connections to a UUT for amplified voltage and current
- Front panel (local) operation
- Remote control operation, IEEE-488 or RS-232
- Self calibration
- Fault codes (these appear on the 5700A Control Display, or are read from the 5700A in remote control operation)
- Calibration constant symbolic names
- Glossary of calibration-related terms

#### **1-8. 5700A/5720A Series II Operator Reference Guide**

The 5700A/5720A Series II Operator Reference Guide contains a summary of operating instructions from the Operator Manual. This booklet contains information needed to start up and operate the 5700A, but since the 5700A controls the 5725A, much of this information applies to the 5725A.

**1-9. 5700A/5720A Series II Remote Programming Reference Guide**

The 5700A/5720A Series II Remote Programming Reference Guide contains a summary of remote commands for the 5700A. It also contains information needed to determine system status using the status byte and registers. Remote commands and system status apply to a 5725A under control of the 5700A.

**1-10. 5700A/5720A Series II Service Manual**

The 5700A/5720A Series II Service Manual is a maintenance guide for the 5700A. The following 5725A topics are included in the 5700A/5720A Series II Service Manual:

- Specifications for both the 5700A and 5725A
- Full verification of the 5700A and 5725A (recommended every two years)
- Calibration of the 5700A and 5725A

**1-11. Specifications**

Specifications are valid after allowing a warm-up period of 30 minutes, or if the 5725A has been recently on, twice the time the 5725A has been turned off. For example, if the 5725A has been turned off for five minutes, the warm-up period is ten minutes.

Absolute uncertainty includes stability, temperature coefficient, linearity, line and load regulation, and traceability to external standards. You do not need to add anything to absolute uncertainty to determine the ratios between 5700A/5725A uncertainties and the uncertainties of your calibration workload.

Relative uncertainty specifications are provided for enhanced accuracy applications. These specifications apply when range constants are adjusted (see "Range Calibration" in the 5700A/5720A Series II Operator Manual). To calculate absolute uncertainty, you must combine the uncertainties of your external standards and techniques with relative uncertainty.

Secondary performance specifications and operating characteristics are included in the uncertainty specifications. They are also provided separately for special calibration requirements such as stability or linearity testing.

The specifications for the 5725A are provided in the following tables as subsets to the 5700A and 5720A Series II Calibrators.

## 1-12. DC Voltage Specifications

Table 1-1. 5720A Series II DC Voltage Specifications: 99 % and 95 % Confidence Levels

**5720A**  
**99%** 99 % Confidence Level

Range	Resolution	Absolute Uncertainty ± 5 °C from calibration temperature For fields strengths >1 V/m but ≤3 V/m, add 0.01% of range.				Relative Uncertainty ± 1 °C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		± (ppm output + μV)				± (ppm output + μV)	
220 mV	10 nV	5 + 0.5	7 + 0.5	8 + 0.5	9 + 0.5	2 + 0.4	2.5 + 0.4
2.2 V	100 nV	3.5 + 0.8	4 + 0.8	4.5 + 0.8	6 + 0.8	2 + 0.8	2.5 + 0.8
11 V	1 μV	2.5 + 3	3 + 3	3.5 + 3	4 + 3	1 + 3	1.5 + 3
22 V	1 μV	2.5 + 5	3 + 5	3.5 + 5	4 + 5	1 + 5	1.5 + 5
220 V	10 μV	3.5 + 50	4 + 50	5 + 50	6 + 50	2 + 50	2.5 + 50
1100 V	100 μV	5 + 500	6 + 500	7 + 500	8 + 500	2.5 + 400	3 + 400

**5720A**  
**95%** 95% Confidence Level

Range	Resolution	Absolute Uncertainty ± 5 °C from calibration temperature For fields strengths >1 V/m but ≤3 V/m, add 0.01 % of range.				Relative Uncertainty ± 1 °C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		± (ppm output + μV)				± (ppm output + μV)	
220 mV	10 nV	4 + 0.4	6 + 0.4	6.5 + 0.4	7.5 + 0.4	1.6 + 0.4	2 + 0.4
2.2 V	100 nV	3 + 0.7	3.5 + 0.7	4 + 0.7	5 + 0.7	1.6 + 0.7	2 + 0.7
11 V	1 μV	2 + 2.5	2.5 + 2.5	3 + 2.5	3.5 + 2.5	0.8 + 2.5	1.2 + 2.5
22 V	1 μV	2 + 4	2.5 + 4	3 + 4	3.5 + 4	0.8 + 4	1.2 + 4
220 V	10 μV	3 + 40	3.5 + 40	4 + 40	5 + 40	1.6 + 40	2 + 40
1100 V	100 μV	4 + 400	4.5 + 400	6 + 400	6.5 + 400	2 + 400	2.4 + 400

Table 1-2. 5700A Series II DC Voltage Specifications: 99 % and 95 % Confidence Levels

**5700A**  
**99%**

99 % Confidence Level

Range	Resolution	Absolute Uncertainty ± 5 °C from calibration temperature For fields strengths >1 V/m but ≤3 V/m, add 0.01 % of range.			
		24 Hours	90 Days	180 Days	1 Year
		± (ppm output + μV)			
220 mV	10 nV	6.5 + .75	7 + .75	8 + .75	9 + .8
2.2 V	100 nV	3.5 + 1.2	6 + 1.2	7 + 1.2	8 + 1.2
11 V	1 μV	3.5 + 3	5 + 4	7 + 4	8 + 4
22 V	1 μV	3.5 + 6	5 + 8	7 + 8	8 + 8
220 V	10 μV	5 + 100	6 + 100	8 + 100	9 + 100
1100 V	100 μV	7 + 600	8 + 600	10 + 600	11 + 600

Relative Uncertainty ± 1 °C	
24 Hours	90 Days
± (ppm output + μV)	
2.5 + .5	4 + .5
2.5 + 1.2	4 + 1.2
1.5 + 3	3.5 + 4
1.5 + 6	3.5 + 8
2.5 + 100	4 + 100
3 + 600	4.5 + 600

**5700A**  
**95%**

95 % Confidence Level

Range	Resolution	Absolute Uncertainty ± 5 °C from calibration temperature For fields strengths >1 V/m but ≤3 V/m, add 0.01 % of range.			
		24 Hours	90 Days	180 Days	1 Year
		± (ppm output + μV)			
220 mV	10 nV	5.5 + 0.6	6 + 0.6	7 + 0.6	8 + 0.6
2.2 V	100 nV	3.5 + 1	5 + 1	6 + 1	7 + 1
11 V	1 mV	3 + 3.5	4 + 3.5	6 + 3.5	7 + 3.5
22 V	1 mV	3 + 6.5	4 + 6.5	6 + 6.5	7 + 6.5
220 V	10 mV	4 + 80	5 + 80	7 + 80	8 + 80
1100 V	100 mV	6 + 500	7 + 500	8 + 500	9 + 500

Relative Uncertainty ± 1 °C	
24 Hours	90 Days
± (ppm output + μV)	
2 + 0.4	3.5 + 0.4
2 + 1	3.5 + 1
1.2 + 3	3 + 3.5
1.2 + 6	3 + 7
2 + 80	3.5 + 80
2.4 + 500	4 + 500



**Table 1-3. DC Voltage Secondary Performance Specifications and Operating Characteristics**

Range	Stability [Note 1] ± 1 °C  24 Hours  ± (ppm output + μV)	Temperature Coefficient Adder [Note 2]		Linearity ± 1 °C  ± (ppm output + μV)	Noise	
		10 °-40 °C	0 °-10 °C and 40°-50 °C		Bandwidth 0.1-10 Hz	Bandwidth 10 Hz-10 kHz
		± (ppm output + μV)/°C			pk-pk	RMS
					μV	
220 mV	0.3 + 0.3	0.4 + 0.1	1.5 + 0.5	1 + 0.2	0.15 + 0.1	5
2.2 V	0.3 + 1	0.3 + 0.1	1.5 + 2	1 + 0.6	0.15 + 0.4	15
11 V	0.3 + 2.5	0.15 + 0.2	1 + 1.5	0.3 + 2	0.15 + 2	50
22 V	0.4 + 5	0.2 + 0.4	1.5 + 3	0.3 + 4	0.15 + 4	50
220 V	0.5 + 40	0.3 + 5	1.5 + 40	1 + 40	0.15 + 60	150
1100 V	0.5 + 200	0.5 + 10	3 + 200	1 + 200	0.15 + 300	500

**Notes:**

1. Stability specifications are included in the Absolute Uncertainty values in the primary specification tables.
2. Temperature coefficient is an adder to uncertainty specifications that does *not* apply unless operating more than ±5 °C from calibration temperature.

**Minimum output:** 0 V for all ranges, except 100 V for 1100 V range

**Maximum load:** 50 mA for 2.2 V through 220 V ranges; 20 mA for 1100 V range; 50 Ω output impedance on 220 mV range; all ranges <1000 pF, >25 Ω

**Load regulation:** <(0.2 ppm of output + 0.1ppm of range), full load to no load

**Line regulation:** <0.1 ppm change, ± 10 % of selected nominal line

**Settling time:** 3 seconds to full accuracy; + 1 second for range or polarity change; + 1 second for 1100 V range

**Overshoot:** <5 %

**Common mode rejection:** 140 dB, DC to 400 Hz

**Remote sensing:** Available 0 V to ±1100 V, on 2.2 V through 1100 V ranges

### 1-13. AC Voltage Specifications

Table 1-4. 5720A Series II AC Voltage Specifications: 99 % Confidence Level

**5720A**  
**99%**

99 % Confidence Level

Range	Resolution	Frequency	Absolute Uncertainty ± 5 °C from calibration temperature				Relative Uncertainty ± 1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			± (ppm output + μV)					
2.2 mV	1 nV	10 - 20	250 + 5	270 + 5	290 + 5	300 + 5	250 + 5	270 + 5
		20 - 40	100 + 5	105 + 5	110 + 5	115 + 5	100 + 5	105 + 5
		40 - 20 k	85 + 5	90 + 5	95 + 5	100 + 5	60 + 5	65 + 5
		20 k - 50 k	220 + 5	230 + 5	240 + 5	250 + 5	85 + 5	95 + 5
		50 k - 100 k	500 + 6	540 + 6	570 + 6	600 + 6	200 + 6	220 + 6
		100 k - 300 k	1000 + 12	1200 + 12	1250 + 12	1300 + 12	350 + 12	400 + 12
		300 k - 500 k	1400 + 25	1500 + 25	1600 + 25	1700 + 25	800 + 25	1000 + 25
500 k - 1 M	2900 + 25	3100 + 25	3250 + 25	3400 + 25	2700 + 25	3000 + 25		
22 mV	10 nV	10 - 20	250 + 5	270 + 5	290 + 5	300 + 5	250 + 5	270 + 5
		20 - 40	100 + 5	105 + 5	110 + 5	115 + 5	100 + 5	105 + 5
		40 - 20 k	85 + 5	90 + 5	95 + 5	100 + 5	60 + 5	65 + 5
		20 k - 50 k	220 + 5	230 + 5	240 + 5	250 + 5	85 + 5	95 + 5
		50 k - 100 k	500 + 6	540 + 6	570 + 6	600 + 6	200 + 6	220 + 6
		100 k - 300 k	1000 + 12	1200 + 12	1250 + 12	1300 + 12	350 + 12	400 + 12
		300 k - 500 k	1400 + 25	1500 + 25	1600 + 25	1700 + 25	800 + 25	1000 + 25
500 k - 1 M	2900 + 25	3100 + 25	3250 + 25	3400 + 25	2700 + 25	3000 + 25		
220 mV	100 nV	10 - 20	250 + 15	270 + 15	290 + 15	300 + 15	250 + 15	270 + 15
		20 - 40	100 + 8	105 + 8	110 + 8	115 + 8	100 + 8	105 + 8
		40 - 20 k	85 + 8	90 + 8	95 + 8	100 + 8	60 + 8	65 + 8
		20 k - 50 k	220 + 8	230 + 8	240 + 8	250 + 8	85 + 8	95 + 8
		50 k - 100 k	500 + 20	540 + 20	570 + 20	600 + 20	200 + 20	220 + 20
		100 k - 300 k	850 + 25	900 + 25	1000 + 25	1100 + 25	350 + 25	400 + 25
		300 k - 500 k	1400 + 30	1500 + 30	1600 + 30	1700 + 30	800 + 30	1000 + 30
500 k - 1 M	2700 + 60	2900 + 60	3100 + 60	3300 + 60	2600 + 60	2800 + 60		
2.2 V	1 mV	10 - 20	250 + 50	270 + 50	290 + 50	300 + 50	250 + 50	270 + 50
		20 - 40	95 + 20	100 + 20	105 + 20	110 + 20	95 + 20	100 + 20
		40 - 20 k	45 + 10	47 + 10	50 + 10	52 + 10	30 + 10	40 + 10
		20 k - 50 k	80 + 12	85 + 12	87 + 12	90 + 12	70 + 12	75 + 12
		50 k - 100 k	120 + 40	125 + 40	127 + 40	130 + 40	100 + 40	105 + 40
		100 k - 300 k	380 + 100	420 + 100	460 + 100	500 + 100	270 + 100	290 + 100
		300 k - 500 k	1000 + 250	1100 + 250	1150 + 250	1200 + 250	900 + 250	1000 + 250
500 k - 1 M	1600 + 400	1800 + 600	1900 + 400	2000 + 400	1200 + 400	1300 + 400		
22 V	10 mV	10 - 20	250 + 500	270 + 500	290 + 500	300 + 500	250 + 500	270 + 500
		20 - 40	95 + 200	100 + 200	105 + 200	110 + 200	95 + 200	100 + 200
		40 - 20 k	45 + 70	47 + 70	50 + 70	52 + 70	30 + 70	40 + 70
		20 k - 50 k	80 + 120	85 + 120	87 + 120	90 + 120	70 + 120	75 + 120
		50 k - 100 k	110 + 250	115 + 250	117 + 250	120 + 250	100 + 250	105 + 250
		100 k - 300 k	300 + 800	310 + 800	320 + 800	325 + 800	270 + 800	290 + 800
		300 k - 500 k	1000 + 2500	1100 + 2500	1150 + 2500	1200 + 2500	900 + 2500	1000 + 2500
500 k - 1 M	1500 + 4000	1600 + 4000	1700 + 4000	1800 + 4000	1300 + 4000	1400 + 4000		
± (ppm output + mV)							± (ppm output + mV)	
220 V [Note 2]	100 mV	10 - 20	250 + 5	270 + 5	290 + 5	300 + 5	250 + 5	270 + 5
		20 - 40	95 + 2	100 + 2	105 + 2	110 + 2	95 + 2	100 + 2
		40 - 20 k	57 + 0.7	60 + 0.7	62 + 0.7	65 + 0.7	45 + 0.7	50 + 0.7
		20 k - 50 k	90 + 1.2	95 + 1.2	97 + 1.2	100 + 1.2	75 + 1.2	80 + 1.2
		50 k - 100 k	160 + 3	170 + 3	175 + 3	180 + 3	140 + 3	150 + 3
		100 k - 300 k	900 + 20	1000 + 20	1050 + 20	1100 + 20	600 + 20	700 + 20
300 k - 500 k	5000 + 50	5200 + 50	5300 + 50	5400 + 50	4500 + 50	4700 + 50		
500 k - 1 M	8000 + 100	9000 + 100	9500 + 100	10,000 + 100	8000 + 100	8500 + 100		
1100 V	1 mV [Note 1]	15 - 50	300 + 20	320 + 20	340 + 20	360 + 20	300 + 20	320 + 20
		50 - 1 k	70 + 4	75 + 4	80 + 4	85 + 4	50 + 4	55 + 4
<b>5725A Amplifier:</b>								
1100 V	1 mV	40 - 1 k	75 + 4	80 + 4	85 + 4	90 + 4	50 + 4	55 + 4
		1 k - 20 k	105 + 6	125 + 6	135 + 6	165 + 6	85 + 6	105 + 6
		20 k - 30 k	230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11
750 V		30 k - 50 k	230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11
		50 k - 100k	600 + 45	1300 + 45	1600 + 45	2300 + 45	380 + 45	1200 + 45

Notes: 1. Maximum output 250V from 15-50 Hz.  
2. See Volt-Hertz capability in Figure 1-2.

Table 1-5. 5720A Series II AC Voltage Specifications: 95 % Confidence Level

**5720A**  
**95%**

95 % Confidence Level

Range	Resolution	Frequency	Absolute Uncertainty ± 5 °C from calibration temperature				Relative Uncertainty ± 1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			± (ppm output + μV)					
2.2 mV	1 nV	10 - 20	200 + 4	220 + 4	230 + 4	240 + 4	200 + 4	220 + 4
		20 - 40	80 + 4	85 + 4	87 + 4	90 + 4	80 + 4	85 + 4
		40 - 20 k	70 + 4	75 + 4	77 + 4	80 + 4	50 + 4	55 + 4
		20 k - 50 k	170 + 4	180 + 4	190 + 4	200 + 4	70 + 4	80 + 4
		50 k - 100 k	400 + 5	460 + 5	480 + 5	500 + 5	160 + 5	180 + 5
		100 k - 300 k	300 + 10	900 + 10	1000 + 10	1050 + 10	280 + 10	320 + 10
		300 k - 500 k	1100 + 20	1200 + 20	1300 + 20	1400 + 20	650 + 20	800 + 20
		500 k - 1 M	2400 + 20	2500 + 20	2600 + 20	2700 + 20	2100 + 20	2400 + 20
22 mV	10 nV	10 - 20	200 + 4	220 + 4	230 + 4	240 + 4	200 + 4	220 + 4
		20 - 40	80 + 4	85 + 4	87 + 4	90 + 4	80 + 4	85 + 4
		40 - 20 k	70 + 4	75 + 4	77 + 4	80 + 4	50 + 4	55 + 4
		20 k - 50 k	170 + 4	180 + 4	190 + 4	200 + 4	70 + 4	80 + 4
		50 k - 100 k	400 + 5	460 + 5	480 + 5	500 + 5	160 + 5	180 + 5
		100 k - 300 k	300 + 10	900 + 10	1000 + 10	1050 + 10	280 + 10	320 + 10
		300 k - 500 k	1100 + 20	1200 + 20	1300 + 20	1400 + 20	650 + 20	800 + 20
		500 k - 1 M	2400 + 20	2500 + 20	2600 + 20	2700 + 20	2100 + 20	2400 + 20
220 mV	100 nV	10 - 20	200 + 12	220 + 12	230 + 12	240 + 12	200 + 12	220 + 12
		20 - 40	80 + 7	85 + 7	87 + 7	90 + 7	80 + 7	85 + 7
		40 - 20 k	70 + 7	75 + 7	77 + 7	80 + 7	50 + 7	55 + 7
		20 k - 50 k	170 + 7	180 + 7	190 + 7	200 + 7	70 + 7	80 + 7
		50 k - 100 k	400 + 17	420 + 17	440 + 17	460 + 17	160 + 17	180 + 17
		100 k - 300 k	700 + 20	750 + 20	800 + 20	900 + 20	280 + 20	320 + 20
		300 k - 500 k	1100 + 25	1200 + 25	1300 + 25	1400 + 25	650 + 25	800 + 25
		500 k - 1 M	2400 + 45	2500 + 45	2600 + 45	2700 + 45	2100 + 45	2400 + 45
2.2 V	1 mV	10 - 20	200 + 40	220 + 40	230 + 40	240 + 40	200 + 40	220 + 40
		20 - 40	75 + 15	80 + 15	85 + 15	90 + 15	75 + 15	80 + 15
		40 - 20 k	37 + 8	40 + 8	42 + 8	45 + 8	25 + 8	35 + 8
		20 k - 50 k	65 + 10	70 + 10	73 + 10	75 + 10	55 + 10	60 + 10
		50 k - 100 k	100 + 30	105 + 30	107 + 30	110 + 30	80 + 30	85 + 30
		100 k - 300 k	300 + 80	340 + 80	380 + 80	420 + 80	230 + 80	250 + 80
		300 k - 500 k	800 + 200	900 + 200	950 + 200	1000 + 200	700 + 200	800 + 200
		500 k - 1 M	1300 + 300	1500 + 300	1600 + 300	1700 + 300	1000 + 300	1100 + 300
22V	10 mV	10 - 20	200 + 400	220 + 400	230 + 400	240 + 400	200 + 400	220 + 400
		20 - 40	75 + 150	80 + 150	85 + 150	90 + 150	75 + 150	80 + 150
		40 - 20k	37 + 50	40 + 50	42 + 50	45 + 50	25 + 50	35 + 50
		20k - 50k	65 + 100	70 + 100	73 + 100	75 + 100	55 + 100	60 + 100
		50k - 100k	90 + 200	95 + 200	97 + 200	100 + 200	80 + 200	85 + 200
		100k - 300k	250 + 600	260 + 600	270 + 600	275 + 600	250 + 600	270 + 600
		300k - 500k	800 + 2000	900 + 2000	900 + 2000	1000 + 2000	700 + 2000	800 + 2000
		500k - 1M	1200 + 3200	1300 + 3200	1400 + 3200	1500 + 3200	1100 + 3200	1200 + 3200
± (ppm output + mV)							± (ppm output + mV)	
220 V [Note 2]	100 mV	10 - 20	200 + 4	220 + 4	230 + 4	240 + 4	200 + 4	220 + 4
		20 - 40	75 + 1.5	80 + 1.5	85 + 1.5	90 + 1.5	75 + 1.5	80 + 1.5
		40 - 20 k	45 + 0.6	47 + 0.6	50 + 0.6	52 + 0.6	35 + 0.6	40 + 0.6
		20 k - 50 k	70 + 1	75 + 1	77 + 1	80 + 1	60 + 1	65 + 1
		50 k - 100 k	120 + 2.5	130 + 2.5	140 + 2.5	150 + 2.5	110 + 2.5	120 + 2.5
		100 k - 300 k	700 + 16	800 + 16	850 + 16	900 + 16	500 + 16	600 + 16
		300 k - 500 k	4000 + 40	4200 + 40	4300 + 40	4400 + 40	3600 + 40	3800 + 40
		500 k - 1 M	6000 + 80	7000 + 80	7500 + 80	8000 + 80	6500 + 80	7000 + 80
1100 V	1 mV [Note 1]	15 - 50	240 + 16	260 + 16	280 + 16	300 + 16	240 + 16	260 + 16
		50 - 1 k	55 + 3.5	60 + 3.5	65 + 3.5	70 + 3.5	40 + 3.5	45 + 3.5
<b>5725A Amplifier:</b>								
1100 V	1 mV	40 - 1 k	75 + 4	80 + 4	85 + 4	90 + 4	50 + 4	55 + 4
		1 k - 20 k	105 + 6	125 + 6	135 + 6	165 + 6	85 + 6	105 + 6
		20 k - 30 k	230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11
750 V	1 mV	30 k - 50 k	230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11
		50 k - 100 k	600 + 45	1300 + 45	1600 + 45	2300 + 45	380 + 45	1200 + 45

Notes: 1. Maximum output 250V from 15-50 Hz.  
2. See Volt-Hertz capability in Figure 1-2.

Table 1-6. 5700A Series II AC Voltage Specifications: 99 % Confidence Level

Range		Resolution		Frequency		Absolute Uncertainty ± 5 °C from calibration temperature				Relative Uncertainty ± 1 °C	
						24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
				Hz		± (ppm output + μV)				± (ppm output + μV)	
2.2 mV	1 nV	10 - 20		500 + 5	550 + 5	600 + 5	600 + 5	500 + 5	550 + 5		
		20 - 40		200 + 5	220 + 5	230 + 5	240 + 5	200 + 5	220 + 5		
		40 - 20 k		100 + 5	110 + 5	120 + 5	120 + 5	60 + 5	65 + 5		
		20 k - 50 k		340 + 5	370 + 5	390 + 5	410 + 5	100 + 5	110 + 5		
		50 k - 100 k		800 + 8	900 + 8	950 + 8	950 + 8	220 + 8	240 + 8		
		100 k - 300 k		1100 + 15	1200 + 15	1300 + 15	1300 + 15	400 + 15	440 + 15		
		300 k - 500 k		1500 + 30	1700 + 30	1700 + 30	1800 + 30	1000 + 30	1100 + 30		
500 k - 1 M		4000 + 40	4400 + 40	4700 + 40	4800 + 40	400 + 30	4400 + 30				
22 mV	10 nV	10 - 20		500 + 6	550 + 6	600 + 6	600 + 6	500 + 6	550 + 6		
		20 - 40		200 + 6	220 + 6	230 + 6	240 + 6	200 + 6	220 + 6		
		40 - 20 k		100 + 6	110 + 6	120 + 6	120 + 6	60 + 6	65 + 6		
		20 k - 50 k		340 + 6	370 + 6	390 + 6	410 + 6	100 + 6	110 + 6		
		50 k - 100 k		800 + 8	900 + 8	950 + 8	950 + 8	220 + 8	240 + 8		
		100 k - 300 k		1100 + 15	1200 + 15	1300 + 15	1300 + 15	400 + 15	440 + 15		
		300 k - 500 k		1500 + 30	1700 + 30	1700 + 30	1800 + 30	1000 + 30	1100 + 30		
500 k - 1 M		4000 + 40	4400 + 40	4700 + 40	4800 + 40	4000 + 30	4400 + 30				
220 mV	100 nV	10 - 20		500 + 16	550 + 16	600 + 16	600 + 16	500 + 16	550 + 16		
		20 - 40		200 + 10	220 + 10	230 + 10	240 + 10	200 + 10	220 + 10		
		40 - 20 k		95 + 10	100 + 10	110 + 10	110 + 10	60 + 10	65 + 10		
		20 k - 50 k		300 + 10	330 + 10	350 + 10	360 + 10	100 + 10	110 + 10		
		50 k - 100 k		750 + 30	800 + 30	850 + 30	900 + 30	220 + 30	240 + 30		
		100 k - 300 k		940 + 30	1000 + 30	1100 + 30	1100 + 30	400 + 30	440 + 30		
		300 k - 500 k		1500 + 40	1700 + 40	1700 + 40	1800 + 40	1000 + 40	1100 + 40		
500 k - 1 M		3000 + 100	3300 + 100	3500 + 100	3600 + 100	3000 + 100	3300 + 100				
2.2 V	1 mV	10 - 20		500 + 100	550 + 100	600 + 100	600 + 100	500 + 100	550 + 100		
		20 - 40		150 + 30	170 + 30	170 + 30	180 + 30	150 + 30	170 + 30		
		40 - 20 k		70 + 7	75 + 7	80 + 7	85 + 7	40 + 7	45 + 7		
		20 k - 50 k		120 + 20	130 + 20	140 + 20	140 + 20	100 + 20	110 + 20		
		50 k - 100 k		230 + 80	250 + 80	270 + 80	280 + 80	200 + 80	220 + 80		
		100 k - 300 k		400 + 150	440 + 150	470 + 150	480 + 150	400 + 150	440 + 150		
		300 k - 500 k		1000 + 400	1100 + 400	1200 + 400	1200 + 400	1000 + 400	1100 + 400		
500 k - 1 M		2000 + 1000	2200 + 1000	2300 + 1000	2400 + 1000	2000 + 1000	2200 + 1000				
22 V	10 mV	10 - 20		500 + 1000	550 + 1000	600 + 1000	600 + 1000	500 + 1000	550 + 1000		
		20 - 40		150 + 300	170 + 300	170 + 300	180 + 300	150 + 300	170 + 300		
		40 - 20 k		70 + 70	75 + 70	80 + 70	85 + 70	40 + 70	45 + 70		
		20 k - 50 k		120 + 200	130 + 200	140 + 200	140 + 200	100 + 200	110 + 200		
		50 k - 100 k		230 + 400	250 + 400	270 + 400	280 + 400	200 + 400	220 + 400		
		100 k - 300 k		500 + 1700	550 + 1700	550 + 1700	600 + 1700	500 + 1700	550 + 1700		
		300 k - 500 k		1200 + 5000	1300 + 5000	1300 + 5000	1400 + 5000	1200 + 5000	1300 + 5000		
500 k - 1 M		2600 + 9000	2800 + 9000	2900 + 9000	3000 + 9000	2600 + 9000	2800 + 9000				
				± (ppm output + mV)				± (ppm output + mV)			
220 V [Note 2]	100 mV	10 - 20		500 + 10	550 + 10	600 + 10	600 + 10	500 + 10	550 + 10		
		20 - 40		150 + 3	170 + 3	170 + 3	180 + 3	150 + 3	170 + 3		
		40 - 20 k		75 + 1	80 + 1	85 + 1	90 + 1	45 + 1	50 + 1		
		20 k - 50 k		200 + 4	220 + 4	240 + 4	250 + 4	100 + 1	110 + 1		
		50 k - 100 k		500 + 10	550 + 10	600 + 10	600 + 10	300 + 10	330 + 10		
		100 k - 300 k		1500 + 110	1500 + 110	1600 + 110	1600 + 110	1500 + 110	1500 + 100		
		300 k - 500 k		5000 + 110	5200 + 110	5300 + 110	5400 + 110	5000 + 110	5200 + 110		
500 k - 1 M		12,000 + 220	12,500 + 220	12,500 + 220	13,000 + 220	12,000 + 220	12,000 + 220				
1100 V	1 mV [Note 1]	15 - 50		400 + 20	420 + 20	440 + 20	460 + 20	400 + 20	420 + 20		
		50 - 1 k		75 + 4	80 + 4	85 + 4	90 + 4	50 + 4	55 + 4		
<b>5725A Amplifier:</b>											
1100 V	1 mV	40 - 1 k		75 + 4	80 + 4	85 + 4	90 + 4	50 + 4	55 + 4		
		1 k - 20 k		105 + 6	125 + 6	135 + 6	165 + 6	85 + 6	105 + 6		
		20 k - 30 k		230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11		
750 V		30 k - 50 k		230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11		
		50 k - 100 k		600 + 45	1300 + 45	1600 + 45	2300 + 45	380 + 45	1200 + 45		

Notes: 1. Maximum output 250V from 15-50 Hz.  
2. See Volt-Hertz capability in Figure 1-2.

Table 1-7. 5700A Series II AC Voltage Specifications: 95 % Confidence Level

**5700A**  
**95%**

95% Confidence Level

Range	Resolution	Frequency	Absolute Uncertainty ± 5 °C from calibration temperature				Relative Uncertainty ± 1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			± (ppm output + μV)				± (ppm output + μV)	
2.2 mV	1 nV	10 - 20	400 + 4.5	500 + 4.5	530 + 4.5	550 + 4.5	400 + 4.5	500 + 4.5
		20 - 40	170 + 4.5	190 + 4.5	200 + 4.5	210 + 4.5	170 + 4.5	190 + 4.5
		40 - 20 k	85 + 4.5	95 + 4.5	100 + 4.5	105 + 4.5	55 + 4.5	60 + 4.5
		20 k - 50 k	300 + 4.5	330 + 4.5	350 + 4.5	370 + 4.5	90 + 4.5	100 + 4.5
		50 k - 100 k	700 + 7	750 + 7	800 + 7	850 + 7	210 + 7	230 + 7
		100 k - 300 k	900 + 13	1000 + 13	1050 + 13	1100 + 13	380 + 13	420 + 13
		300 k - 500 k 500 k - 1 M	1300 + 25 2800 + 25	1500 + 25 3100 + 25	1600 + 25 3300 + 25	1700 + 25 3400 + 25	900 + 25 2900 + 25	1000 + 25 3200 + 25
22 mV	10 nV	10 - 20	400 + 5	500 + 5	530 + 5	550 + 5	400 + 5	500 + 5
		20 - 40	170 + 5	190 + 5	200 + 5	210 + 5	170 + 5	190 + 5
		40 - 20 k	85 + 5	95 + 5	100 + 5	105 + 5	55 + 5	60 + 5
		20 k - 50 k	300 + 5	330 + 5	350 + 5	370 + 5	90 + 5	100 + 5
		50 k - 100 k	700 + 7	750 + 7	800 + 7	850 + 7	210 + 7	230 + 7
		100 k - 300 k	900 + 12	1000 + 12	1050 + 12	1100 + 12	380 + 12	420 + 12
		300 k - 500 k 500 k - 1 M	1300 + 25 2800 + 25	1500 + 25 3100 + 25	1600 + 25 3300 + 25	1700 + 25 3400 + 25	900 + 25 2900 + 25	1000 + 25 3200 + 25
220 mV	100 nV	10 - 20	400 + 13	500 + 13	530 + 13	550 + 13	400 + 13	500 + 13
		20 - 40	170 + 8	190 + 8	200 + 8	210 + 8	170 + 8	190 + 8
		40 - 20 k	85 + 8	95 + 8	100 + 8	105 + 8	55 + 8	60 + 8
		20 k - 50 k	250 + 8	280 + 8	300 + 8	320 + 8	90 + 8	100 + 8
		50 k - 100 k	700 + 25	750 + 25	800 + 25	850 + 25	210 + 25	230 + 25
		100 k - 300 k	900 + 25	1000 + 25	1050 + 25	1100 + 25	380 + 25	420 + 25
		300 k - 500 k 500 k - 1 M	1300 + 35 2800 + 80	1500 + 35 3100 + 80	1600 + 35 3300 + 80	1700 + 35 3400 + 80	900 + 35 2900 + 80	1000 + 35 3200 + 80
2.2 V	1 mV	10 - 20	400 + 80	450 + 80	480 + 80	500 + 80	400 + 80	450 + 80
		20 - 40	130 + 25	140 + 25	150 + 25	160 + 25	130 + 25	140 + 25
		40 - 20 k	60 + 6	65 + 6	70 + 6	75 + 6	35 + 6	40 + 6
		20 k - 50 k	105 + 16	110 + 16	115 + 16	120 + 16	85 + 16	95 + 16
		50 k - 100 k	190 + 70	210 + 70	230 + 70	250 + 70	170 + 70	190 + 70
		100 k - 300 k	350 + 130	390 + 130	420 + 130	430 + 130	340 + 130	380 + 130
		300 k - 500 k 500 k - 1 M	850 + 350 1700 + 850	950 + 350 1900 + 850	1000 + 350 2100 + 850	1050 + 350 2200 + 850	850 + 350 1700 + 850	950 + 350 1900 + 850
22 V	10 mV	10 - 20	400 + 800	450 + 800	480 + 800	500 + 800	400 + 800	450 + 800
		20 - 40	130 + 250	140 + 250	150 + 250	160 + 250	130 + 250	140 + 250
		40 - 20 k	60 + 60	65 + 60	70 + 60	75 + 60	35 + 60	40 + 60
		20 k - 50 k	105 + 160	110 + 160	115 + 160	120 + 160	85 + 160	95 + 160
		50 k - 100 k	190 + 350	210 + 350	230 + 350	250 + 350	170 + 350	190 + 350
		100 k - 300 k	400 + 1500	450 + 1500	470 + 1500	500 + 1500	400 + 1500	450 + 1500
		300 k - 500 k 500 k - 1 M	1050 + 4300 2300 + 8500	1150 + 4300 2500 + 8500	1200 + 4300 2600 + 8500	1250 + 4300 2700 + 8500	1000 + 4300 2200 + 8500	1100 + 4300 2400 + 8500
± (ppm output + mV)				± (ppm output + mV)				
220 V [Note 2]	100 mV	10 - 20	400 + 8	450 + 8	480 + 8	500 + 8	400 + 8	450 + 8
		20 - 40	130 + 2.5	140 + 2.5	150 + 2.5	160 + 2.5	130 + 2.5	140 + 2.5
		40 - 20 k	65 + 0.8	70 + 0.8	75 + 0.8	80 + 0.8	40 + 0.8	45 + 0.8
		20 k - 50 k	170 + 3.5	190 + 3.5	210 + 3.5	220 + 3.5	85 + 3.5	95 + 3.5
		50 k - 100 k	400 + 8	450 + 8	480 + 8	500 + 8	270 + 8	300 + 8
		100 k - 300 k	1300 + 90	1400 + 90	1450 + 90	1500 + 90	1200 + 90	1300 + 90
		300 k - 500 k 500 k - 1 M	4300 + 90 10,500 + 190	4500 + 90 11,000 + 190	4600 + 90 11,300 + 190	4700 + 90 11,500 + 190	4200 + 90 10,500 + 190	4500 + 90 11,000 + 190
1100 V	1 mV [Note 1]	15 - 50	340 + 16	360 + 16	380 + 16	400 + 16	340 + 16	360 + 16
		50 - 1 k	65 + 3.5	70 + 3.5	75 + 3.5	80 + 3.5	45 + 3.5	50 + 3.5
<b>5725A Amplifier:</b>								
1100 V	1 mV	40 - 1 k	75 + 4	80 + 4	85 + 4	90 + 4	50 + 4	55 + 4
		1 k - 20 k	105 + 6	125 + 6	135 + 6	165 + 6	85 + 6	105 + 6
		20 k - 30 k	230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11
750 V	1 mV	30 k - 50 k	230 + 11	360 + 11	440 + 11	600 + 11	160 + 11	320 + 11
		50 k - 100 k	600 + 45	1300 + 45	1600 + 45	2300 + 45	380 + 45	1200 + 45

Notes: 1. Maximum output 250V from 15-50 Hz.  
2. See Volt-Hertz capability in Figure 1-2.

Table 1-8. AC Voltage Secondary Performance Specifications and Operating Characteristics

Range	Frequency	Stability ± 1 °C [Note 1] 24 Hours	Temperature Coefficient		Output Impedance	Maximum Distortion Bandwidth 10 Hz-10 MHz
			10°-40 °C	0°-10 °C and 40°-50 °C		
	Hz	± μV	±μV/°C		Ω	± (% output + μV)
2.2 mV	10 - 20	5	0.05	0.05	50	0.05 + 10
	20 - 40	5	0.05	0.05		0.035 + 10
	40 - 20 k	2	0.05	0.05		0.035 + 10
	20 k - 50 k	2	0.1	0.1		0.035 + 10
	50 k - 100 k	3	0.2	0.2		0.035 + 10
	100 k - 300 k	3	0.3	0.3		0.3 + 30
	300 k - 500 k	5	0.4	0.4		0.3 + 30
500 k - 1 M	5	0.5	0.5	1 + 30		
22 mV	10 - 20	5	0.2	0.3	50	0.05 + 11
	20 - 40	5	0.2	0.3		0.035 + 11
	40 - 20 k	2	0.2	0.3		0.035 + 11
	20 k - 50 k	2	0.4	0.5		0.035 + 11
	50 k - 100 k	3	0.5	0.5		0.035 + 11
	100 k - 300 k	5	0.6	0.6		0.3 + 30
	300 k - 500 k	10	1	1		0.3 + 30
500 k - 1 M	15	1	1	1 + 30		
		± (ppm output + μV)	± (ppm output μV)/°C			
220 mV	10 - 20	150 + 20	2 + 1	2 + 1	50	0.05 + 16
	20 - 40	80 + 15	2 + 1	2 + 1		0.035 + 16
	40 - 20 k	12 + 2	2 + 1	2 + 1		0.035 + 16
	20 k - 50 k	10 + 2	15 + 2	15 + 2		0.035 + 16
	50 k - 100 k	10 + 2	15 + 4	15 + 4		0.035 + 16
	100 k - 300 k	20 + 4	80 + 5	80 + 5		0.3 + 30
	300 k - 500 k	100 + 10	80 + 5	80 + 5		0.3 + 30
500 k - 1 M	200 + 20	80 + 5	80 + 5	1 + 30		
				<b>Load Regulation</b> ±(ppm output+ μV)		
2.2 V	10 - 20	150 + 20	50 + 10	50 + 10	10 + 2	0.05 + 80
	20 - 40	80 + 15	15 + 5	15 + 5	10 + 2	0.035 + 80
	40 - 20 k	12 + 4	2 + 1	5 + 2	10 + 4	0.035 + 80
	20 k - 50 k	15 + 5	10 + 2	15 + 4	30 + 10	0.035 + 80
	50 k - 100 k	15 + 5	10 + 4	20 + 4	120 + 16	0.035 + 80
	100 k - 300 k	30 + 10	80 + 15	80 + 15	300 ppm	0.3 + 110
	300 k - 500 k	70 + 20	80 + 40	80 + 40	600 ppm	0.3 + 110
500 k - 1 M	150 + 50	80 + 100	80 + 100	1200 ppm	1 + 110	
22 V	10 - 20	150 + 20	50 + 100	50 + 100	10 + 20	0.05 + 700
	20 - 40	80 + 15	15 + 30	15 + 40	10 + 20	0.035 + 700
	40 - 20 k	12 + 8	2 + 10	4 + 15	10 + 30	0.035 + 700
	20 k - 50 k	15 + 10	10 + 20	20 + 20	30 + 50	0.035 + 700
	50 k - 100 k	15 + 10	10 + 40	20 + 40	80 + 80	0.035 + 700
	100 k - 300 k	30 + 15	80 + 150	80 + 150	100 + 700	0.3 + 800
	300 k - 500 k	70 + 100	80 + 300	80 + 300	200 + 1100	0.3 + 800
500 k - 1 M	150 + 100	80 + 500	80 + 500	600 + 3000	2 + 800	
220 V	10 - 20	150 + 200	50 + 1000	50 + 1000	10 + 200	0.05 + 10,000
	20 - 40	80 + 150	15 + 300	15 + 300	10 + 200	0.05 + 10,000
	40 - 20 k	12 + 80	2 + 80	4 + 80	10 + 300	0.05 + 10,000
	20 k - 50 k	15 + 100	10 + 100	20 + 100	30 + .600	0.05 + 10,000
	50 k - 100 k	15 + 100	10 + 500	20 + 500	80 + 3,000	0.1 + 13,000
	100 k - 300 k	30 + 400	80 + 600	80 + 600	250 + 25,000	1.5 + 50,000
	300 k - 500 k	100 + 10,000	80 + 800	80 + 800	500 + 50,000	1.5 + 50,000
500 k - 1 M	200 + 20,000	80 + 1000	80 + 1000	1000 + 110,000	3.5 + 100,000	
		±(ppm output + mV)	±(ppm output)/°C			±(% output)
1100 V	15 - 50	150 + 0.5	50	50	10 + 2	0.15
	50 - 1 k	20 + 0.5	2	5	10 + 1	0.07

Note: 1. Stability specifications are included in Absolute Uncertainty values for the primary specifications.

**Table 1-8. AC Voltage Secondary Performance and Operating Characteristics (continued)**

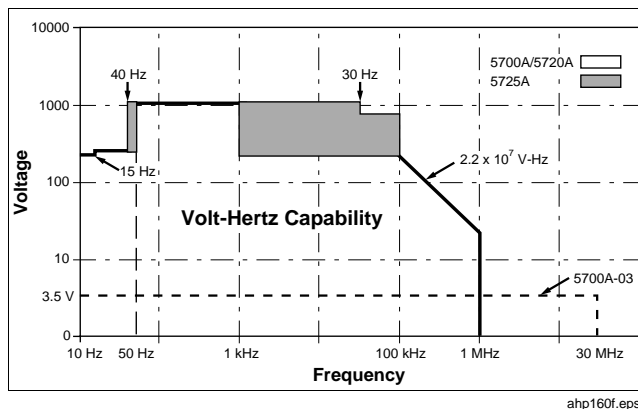
**5725A Amplifier:**

Range	Frequency	Stability ±1 °C [Note 1]  24 Hours	Temperature Coefficient Adder		Load Regulation [Note 2]	Distortion Bandwidth 10 Hz-10 MHz ±(% output)	
			10°-40 °C	0°-10 °C and 40°-50 °C		150 pF	1000 pF
	Hz	±(ppm output + mV)	±(ppm output)/°C		±(ppm output + mV)		
1100 V	40 - 1 k	10 + .5	5	5	10 + 1	0.10	0.10
	1 k - 20 k	15 + 2	5	5	90 + 6	0.10	0.15
	20 k - 50 k	40 + 2	10	10	275 + 11	0.30	0.30
	50 k - 100 k	130 + 2	30	30	500 + 30	0.40	0.40

Voltage Range	Maximum Current Limits	Load Limits
2.2 V [Note 3] 22 V 220 V	50 mA, 0 °C-40 °C 20 mA, 40 °C-50 °C	>50 Ω, 1000 pF
1100 V	6 mA	600 pF
<b>5725A Amplifier:</b>		1000 pF [Note 2]
1100 V	40 Hz-5 kHz	50 mA
	5 kHz-30 kHz	70 mA
	30 kHz-100 kHz	70 mA [Note 4]

**Notes:**

- Stability specifications are included in Absolute Uncertainty values for the primary specifications.
- The 5725A will drive up to 1000 pF of load capacitance. Uncertainty specifications include loads to 300 pF and 150 pF as shown under "Load Limits." For capacitances up to the maximum of 1000 pF, add "Load Regulation."
- 2.2 V Range, 100 kHz-1.2 MHz only: uncertainty specifications cover loads to 10 mA or 1000 pF. For higher loads, load regulation is added.
- Applies from 0 °C to 40 °C



**Figure 1-1. Volt-Hertz Capability**

**Output display formats:** Voltage or dBm, dBm reference 600 Ω.

**Minimum output::** 10 % on each range

**External sense:** Selectable for 2.2 V, 22 V, 220 V, and 1100 V ranges; 5700A/5720A <100 kHz, 5725A <30 kHz

**Settling time to full accuracy:**

Frequency (Hz)	Settling time (seconds)
<20	7
120-120 k	5
>120 k	2

- + 1 second for amplitude or frequency range change;
- + 2 seconds for 5700A/5720A 1100 V range;
- + 4 seconds for 5725A 1100 V range

**Overshoot::** <10%

Common mode rejection: 140 dB, DC to 400 Hz

**Frequency:**

Ranges (Hz):

- 10.000-119.99
- 0.1200 k-1.1999 k, 1.200 k-11.999 k
- 12.00 k-119.99 k, 120.0 k-1.1999

Uncertainty: ±0.01 %

Resolution: 11.999 counts

**Phase lock:** Selectable rear panel BNC input

Phase uncertainty (except 1100 V range):

- >30 Hz: ±1° + 0.05°/kHz, <30 Hz: ±3°

Input voltage: 1 V to 10 V rms sine wave (do not exceed 1 V for mV ranges)

Frequency range: 10 Hz to 1.1999 MHz

Lock range: ±2 % of frequency

Lock-in time: Larger of 10/frequency or 10 msec

**Phase reference:** Selectable, rear panel BNC output

Range: ±180°

Phase Uncertainty (except 1100 V range):

- ±1° at quadrature points (0°, ±90°, ±180°) elsewhere ±2°

Stability: ±0.1°

Resolution: 1°

Output level: 2.5 V rms ±0.2 V

Frequency range:

- 50 kHz to 1 kHz, usable 10 Hz to 1.1999 MHz

## 1-14. Resistance Specifications

Table 1-9. 5720A Series II Resistance Specifications: 99 % and 95 % Confidence Levels

<b>5720A 99%</b>		<b>99% Confidence Level</b>				<b>Relative Uncertainty ±1 °C</b>	
Nominal Value	Absolute Uncertainty of Characterized Value ±5 °C from calibration temperature [Note 1]				24 Hours	90 Days	
	24 Hours	90 Days	180 Days	1 Year			
Ω	±ppm				±ppm		
0	50 μΩ	50 μΩ	50 μΩ	50 μΩ	50 μΩ	50 μΩ	
1	85	95	100	110	32	40	
1.9	85	95	100	110	25	33	
10	23	25	26	27	5	8	
19	23	25	26	27	4	7	
100	10	11	11.5	12	2	4	
190	10	11	11.5	12	2	4	
1 k	8	9	9.5	10	2	3	
1.9 k	8	9	9.5	10	2	3	
10 k	8	9	9.5	10	2	3	
19 k	9	9	9.5	10	2	3	
100 k	9	11	12	13	2	3	
190 k	9	11	12	13	2	3	
1 M	16	18	20	23	2.5	5	
1.9 M	17	19	21	24	3	6	
10 M	33	37	40	46	10	14	
19 M	43	47	50	55	20	24	
100 M	100	110	115	120	50	60	

<b>5720A 95%</b>		<b>95 % Confidence Level</b>				<b>Relative Uncertainty ±1 °C</b>	
Nominal Value	Absolute Uncertainty of Characterized Value ±5 °C from calibration temperature [Note 1]				24 Hours	90 Days	
	24 Hours	90 Days	180 Days	1 Year			
Ω	±ppm				±ppm		
0	40 μΩ	40 μΩ	40 μΩ	40 μΩ	40 μΩ	40 μΩ	
1	70	80	85	95	27	35	
1.9	70	80	85	95	20	26	
10	20	21	22	23	4	7	
19	20	21	22	23	3.5	6	
100	8	9	9.5	10	1.6	3.5	
190	8	9	9.5	10	1.6	3.5	
1 k	6.5	7.5	8	8.5	1.6	2.5	
1.9 k	6.5	7.5	8	8.5	1.6	2.5	
10 k	6.5	7.5	8	8.5	1.6	2.5	
19 k	7.5	7.5	8	8.5	1.6	2.5	
100 k	7.5	9	10	11	1.6	2.5	
190 k	7.5	9	10	11	1.6	2.5	
1 M	13	15	17	20	2	4	
1.9 M	14	16	18	21	2.5	4	
10 M	27	31	34	40	8	12	
19 M	35	39	42	57	16	20	
100 M	85	95	100	100	40	50	

Note: 1. Specifications apply to displayed value. 4-wire connections, except 100 MΩ.



**Table 1-10. 5700A Series II Resistance Specifications: 99 % and 95 % Confidence Levels**

**5700A**  
**99%**

**99 % Confidence Level**

Nominal Value	Absolute Uncertainty of Characterized Value ±5 °C from calibration temperature [Note 1]			
	24 Hours	90 Days	180 Days	1 Year
Ω	±ppm			
0	50 μΩ	50 μΩ	50 μΩ	50 μΩ
1	85	95	100	110
1.9	85	95	100	110
10	26	28	30	33
19	24	26	28	31
100	15	17	18	20
190	15	17	18	20
1 k	11	12	13	15
1.9 k	11	12	13	15
10 k	9	11	12	14
19 k	9	11	12	14
100 k	11	13	14	16
190 k	11	13	14	16
1 M	16	18	20	23
1.9 M	17	19	21	24
10 M	33	37	40	46
19 M	43	47	50	55
100 M	110	120	125	130

Relative Uncertainty ±1 °C	
24 Hours	90 Days
±ppm	
50 μΩ	50 μΩ
32	40
25	33
5	8
4	7
2	4
2	4
2	3.5
2	3.5
2	3.5
2	3.5
2	3.5
2.5	5
3.5	6
10	14
20	24
50	60

**5700A**  
**95%**

**95 % Confidence Level**

Nominal Value	Absolute Uncertainty of Characterized Value ±5 °C from calibration temperature [Note 1]			
	24 Hours	90 Days	180 Days	1 Year
Ω	±ppm			
0	50 μΩ	50 μΩ	50 μΩ	50 μΩ
1	70	80	85	95
1.9	70	80	85	95
10	21	23	27	28
19	20	22	24	27
100	13	14	15	17
190	13	14	15	17
1 k	9	10	11	13
1.9 k	9	10	11	13
10 k	7.5	9.5	10.5	12
19 k	7.5	9.5	10.5	12
100 k	9	11	12	14
190 k	9	11	12	14
1 M	13	15	17	20
1.9 M	14	16	18	21
10 M	27	31	34	40
19 M	35	39	42	47
100 M	90	100	105	110

Relative Uncertainty ±1 °C	
24 Hours	90 Days
±ppm	
50 μΩ	50 μΩ
32	40
25	33
5	8
4	7
2	4
2	4
2	3.5
2	3.5
2	3.5
2	3.5
2	3.5
2.5	5
3	6
10	14
20	24
50	60

**Note:** 1. Specifications apply to displayed value. 4-wire connections, except 100 MΩ.

Table 1-11. Resistance Secondary Performance Specifications and Operating Characteristics

Nominal Value	Stability ±1 °C [Note 1]  24 Hours	Temperature Coefficient Adder [Note 2]		Full Spec Load Range  [Note 3]	Maximum Peak Current	Maximum Difference of Characterized to Nominal Value	Two-Wire Adder active compensation [Note 4]	
		10°-40 °C	0°-10 °C and 40°-50 °C				Lead Resistance	
							0.1Ω	1Ω
Ω	±ppm	±ppm/°C		mA	mA	±ppm	±mΩ	
0	—	—	—	8 - 500	500	—	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
1	32	4	5	8 - 100	700	500	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
1.9	25	6	7	8 - 100	500	500	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
10	5	2	3	8 - 11	220	300	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
19	4	2	3	8 - 11	160	300	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
100	2	2	3	8 - 11	70	150	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
190	2	2	3	8 - 11	50	150	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
1 k	2	2	3	1 - 2	22	150	10	15
1.9 k	2	2	3	1 - 1.5	16	150	10	15
10 k	2	2	3	100 - 500 μA	7	150	50	60
19 k	2	2	3	50 - 250 μA	5	150	100	120
100 k	2	2	3	10 - 100 μA	1	150	I <sub>m</sub> = Current produced by Ohmmeter	
190 k	2	2	3	5 - 50 μA	500 μA	150		
1 M	2.5	2.5	6	5 - 20 μA	100 μA	200		
1.9 M	3.5	3	10	2.5 - 10 μA	50 μA	200		
10 M	10	5	20	0.5 - 2 μA	10 μA	300		
19 M	20	8	40	0.25 - 1 μA	5 μA	300		
100 M	50	12	100	50 - 200 nA	1 μA	500		

**Notes:**

- Stability specifications are included in the Absolute Uncertainty values in the primary specification tables.
- Temperature coefficient is an adder to uncertainty specifications that does not apply unless operated more than 5 °C from calibration temperature, or calibrated outside the range 19 °C to 24 °C. Two examples:
  - Calibrate at 20 °C: Temperature coefficient adder is not required unless operated below 15 °C or above 25 °C.
  - Calibrate at 26 °C: Add 2 °C temperature coefficient adder. Additional temperature coefficient adder is not required unless operated below 21 °C or above 31 °C.
- Refer to current derating factors table for loads outside of this range.
- Active two-wire compensation may be selected for values less than 100 kΩ, with either the front panel or the meter input terminals as reference plane. Active compensation is limited to 11 mA load, and to 2 V burden. Two-wire compensation can be used only with Ω-meters that source continuous (not pulsed) dc current.

**Table 1-12. Current Derating Factors**

Nominal Value	Value of Derating Factor K for Over or Under Current		
	Two-Wire Comp $I < I_L$ [Note 1]	Four-Wire $I < I_L$ [Note 1]	Four-Wire $I_U < I < I_{max}$ [Note 2]
SHORT	4.4	0.3	—
1	4.4	300	$4 \times 10^{-5}$
1.9	4.4	160	$1.5 \times 10^{-4}$
10	4.4	30	$1.6 \times 10^{-3}$
19	4.4	16	$3 \times 10^{-3}$
100	4.4	3.5	$1 \times 10^{-2}$
190	4.4	2.5	$1.9 \times 10^{-2}$
1 k	4.4	0.4	0.1
1.9 k	4.4	0.4	0.19
10 k	5000	50	2.0
19 k	5000	50	3.8
100 k	—	7.5	$2 \times 10^{-5}$
190 k	—	4.0	$3.8 \times 10^{-5}$
1 M	—	1.0	$1.5 \times 10^{-4}$
1.9 M	—	0.53	$2.9 \times 10^{-4}$
10 M	—	0.2	$1 \times 10^{-3}$
19 M	—	0.53	$1.9 \times 10^{-3}$
100 M	—	0.1	—

Notes:

- For  $I < I_L$ , errors occur due to thermally generated voltages within the 5720A. Use the following equation to determine the error, and add this error to the corresponding uncertainty or stability specification.

$$\text{Error} = K(I_L - I)/(I_L \times I)$$

Where: Error is in mΩ for all two-wire comp values and four-wire short, and in ppm for the remaining four-wire values.

K is the constant from the above table;

I and  $I_L$  are expressed in mA for short to 1.9 kΩ;

I and  $I_L$  are expressed in μA for 10 kΩ to 100 MΩ

- For  $I_U < I < I_{MAX}$  errors occur due to self-heating of the resistors in the calibrator. Use the following equation to determine the error in ppm and add this error to the corresponding uncertainty or stability specification.

$$\text{Error in ppm} = K(I^2 - I_U^2)$$

Where: K is the constant from the above table;

I and  $I_U$  are expressed in mA for short to 19 kΩ;

I and  $I_U$  are expressed in μA for 100 kΩ to 100 MΩ

## 1-15. DC Current Specifications

Table 1-13. 5720A Series II DC Current Specifications: 99 % and 95 % Confidence Levels

**5720A**  
**99%**

99 % Confidence Level

Range	Resolution	Absolute Uncertainty ±5 °C from calibration temperature. For fields strengths >0.4 V/m but ≤3 V/m, add 1 % of range.				Relative Uncertainty ±1 °C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		± (ppm output + nA)					
220 µA	0.1	40 + 7	42 + 7	45 + 7	50 + 7	24 + 7	26 + 7
2.2 mA	1	30 + 8	35 + 8	37 + 8	40 + 8	24 + 8	26 + 8
22 mA	10	30 + 50	35 + 50	37 + 50	40 + 50	24 + 50	26 + 50
	µA	± (ppm output + µA)				± (ppm output + µA)	
220 mA	0.1	40 + 0.8	45 + 0.8	47 + 0.8	50 + 0.8	26 + 0.5	30 + 0.5
2.2 A	1	60 + 15	70 + 15	80 + 15	90 + 15	40 + 12	45 + 12
[Note 1]							
<b>5725A Amplifier:</b>							
11 A	10	330 + 470	340 + 480	350 + 480	360 + 480	100 + 130	110 + 130

**5720A**  
**95%**

95 % Confidence Level

Range	Resolution	Absolute Uncertainty ±5 °C from calibration temperature For fields strengths >0.4 V/m but ≤3 V/m, add 1 % of range.				Relative Uncertainty ±1 °C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		± (ppm output + nA)					
220 µA	0.1	32 + 6	35 + 6	37 + 6	40 + 6	20 + 6	22 + 6
2.2 mA	1	25 + 7	30 + 7	33 + 7	35 + 7	20 + 7	22 + 7
22 mA	10	25 + 40	30 + 40	33 + 40	35 + 40	20 + 40	22 + 40
	µA	± (ppm output + µA)				± (ppm output + µA)	
220 mA	0.1	35 + 0.7	40 + 0.7	42 + 0.7	45 + 0.7	20 + 0.7	25 + 0.7
2.2 A	1	50 + 12	60 + 12	70 + 12	80 + 12	32 + 12	40 + 12
[Note 1]							
<b>5725A Amplifier:</b>							
11 A	10	330 + 470	340 + 480	350 + 480	360 + 480	100 + 130	110 + 130

**Note:** Maximum output from calibrator terminals is 2.2 A. Uncertainty specifications for 220 mA and 2.2 mA ranges are increased by a factor of 1.3 when supplied through 5725A terminals.

Specifications are otherwise identical for all output locations.

1. Add to uncertainty specifications:

$$\pm 200 \times I^2 \text{ ppm for } >100 \text{ mA on } 220 \text{ mA range}$$

$$\pm 10 \times I^2 \text{ ppm for } >1 \text{ A on } 2.2 \text{ A range}$$

**Table 1-14. 5700A Series II DC Current Specifications: 99 % and 95 % Confidence Levels**

**5700A**  
**99%**

**99 % Confidence Level**

Range	Resolution	Absolute Uncertainty ±5 °C from calibration temperature For fields strengths >0.4 V/m but ≤3 V/m, add 1% of range.				Relative Uncertainty ±1 °C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
	nA	± (ppm output + nA)				± (ppm output + nA)	
220 µA	0.1	45 + 10	50 + 10	55 + 10	60 + 10	24 + 2	26 + 2
2.2 mA	1	45 + 10	50 + 10	55 + 10	60 + 10	24 + 5	26 + 5
22 mA	10	45 + 100	50 + 100	55 + 100	60 + 100	24 + 50	26 + 50
	µA	± (ppm output + µA)				± (ppm output + µA)	
220 mA	0.1	55 + 1	60 + 1	65 + 1	70 + 1	26 + .3	30 + .3
2.2 A	1	75 + 30	80 + 30	90 + 30	95 + 30	40 + 7	45 + 7
[Note 1]							
<b>5725A Amplifier:</b>							
11 A	10	330 + 470	340 + 480	350 + 480	360 + 480	100 + 130	110 + 130

**5700A**  
**95%**

**95 % Confidence Level**

Range	Resolution	Absolute Uncertainty ±5 °C from calibration temperature For fields strengths >0.4 V/m but ≤3 V/m, add 1 % of range.				Relative Uncertainty ±1 °C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
	nA	± (ppm output + nA)				± (ppm output + nA)	
220 µA	0.1	35 + 8	40 + 8	45 + 8	50 + 8	20 + 1.6	22 + 1.6
2.2 mA	1	35 + 8	40 + 8	45 + 8	50 + 8	20 + 4	22 + 4
22 mA	10	35 + 80	40 + 80	45 + 80	50 + 80	20 + 80	22 + 80
	µA	± (ppm output + µA)				± (ppm output + µA)	
220 mA	0.1	45 + 0.8	50 + 0.8	55 + 0.8	60 + 0.8	22 + 0.25	25 + 0.25
2.2 A	1	60 + 25	65 + 25	75 + 25	80 + 25	35 + 6	40 + 6
[Note 1]							
<b>5725A Amplifier:</b>							
11 A	10	330 + 470	340 + 480	350 + 480	360 + 480	100 + 130	110 + 130

**Note:** Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 mA and 2.2 mA ranges are increased by a factor of 1.3 when supplied through 5725A terminals.

Specifications are otherwise identical for all output locations.

- Add to uncertainty specifications:

$\pm 200 \times I^2$  ppm for >100 mA on 220 mA range

$\pm 10 \times I^2$  ppm for >1A on 2.2A range

Table 1-15. DC Current Secondary Performance Specifications and Operating Characteristics

Range	Stability $\pm 1$ °C [Note 1]  24 Hours	Temperature Coefficient [Note 2]		Compliance Limits	Burden Voltage Adder [Note 3]	Maximum Load for Full Accuracy [Note 4]	Noise	
		10 °-40 °C	0 °-10 °C and 40 °-50 °C				Bandwidth 0.1-10 Hz	Bandwidth 10 Hz-10 kHz
		$\pm$ (ppm output + nA) / °C					pk-pk	RMS
	$\pm$ (ppm output + nA)				$\pm$ nA/V	$\Omega$	ppm output + nA	nA
220 $\mu$ A	5 + 1	1 + 0.40	3 + 1	10	0.2	20k	6 + .9	10
2.2 mA	5 + 5	1 + 2	3 + 10	10	0.2	2k	6 + 5	10
22 mA	5 + 50	1 + 20	3 + 100	10	10	200	6 + 50	50
220 mA	8 + 300	1 + 200	3 + 1 $\mu$ A	10	100	20	9 + 300	500
2.2 A	9 + 7 $\mu$ A	1 + 2.5 $\mu$ A	3 + 10 $\mu$ A	3 [Note 5]	2 $\mu$ A	2	12 + 1.5 $\mu$ A	20 $\mu$ A
<b>5725A</b>	$\pm$ (ppm output + $\mu$ A)	$\pm$ (ppm output + $\mu$ A) / °C					ppm output + $\mu$ A	$\mu$ A
11 A	25 + 100	20 + 75	30 + 120	4		4	15 + 70	175

**Notes:**

Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 mA and 2.2 mA ranges are increased by a factor of 1.3 when supplied through 5725A terminals.

1. Stability specifications are included in the Absolute Uncertainty values for the primary specifications.
2. Temperature coefficient is an adder to uncertainty specifications. It does not apply unless operating more than  $\pm 5$  °C from calibration temperature.
3. Burden voltage adder is an adder to uncertainty specifications that does not apply unless burden voltage is greater than 0.5 V.
4. For higher loads, multiply uncertainty specification by:  $1 + \frac{0.1 \times \text{actual load}}{\text{maximum load for full accuracy}}$
5. The calibrator's compliance limit is 2 V for outputs from 1 A to 2.2 A. 5725A Amplifier may be used in range-lock mode down to 0 A.

**Minimum output:** 0 for all ranges, including 5725A.

**Settling time to full accuracy:** 1 second for mA and mA ranges; 3 seconds for 2.2 A range; 6 seconds for 11 A range; + 1 second for range or polarity change

**Overshoot:** <5 %

## 1-16. AC Current Specifications

Table 1-16. 5720A Series II AC Current Specifications: 99 % Confidence Level

**5720A**  
**99%**

99 % Confidence Level

Range	Resolution	Frequency	Absolute Uncertainty ±5 °C from calibration temperature For fields strengths >0.4 V/m but ≤3 V/m, add 1 % of range.				Relative Uncertainty ±1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			Hz	± (ppm output + nA)				± (ppm output + nA)
220 µA	1 nA	10 - 20	260 + 20	280 + 20	290 + 20	300 + 20	260 + 20	280 + 20
		20 - 40	170 + 12	180 + 12	190 + 12	200 + 12	130 + 12	150 + 12
		40 - 1 k	120 + 10	130 + 10	135 + 10	140 + 10	100 + 10	110 + 10
		1k - 5 k	300 + 15	320 + 15	340 + 15	350 + 15	250 + 15	280 + 15
		5k - 10 k	1000 + 80	1100 + 80	1200 + 80	1300 + 80	900 + 80	1000 + 80
2.2 mA	10 nA	10 - 20	260 + 50	280 + 50	290 + 50	300 + 50	260 + 50	280 + 50
		20 - 40	170 + 40	180 + 40	190 + 40	200 + 40	130 + 40	150 + 40
		40 - 1 k	120 + 40	130 + 40	135 + 40	140 + 40	100 + 40	110 + 40
		1k - 5 k	210 + 130	220 + 130	230 + 130	240 + 130	250 + 130	280 + 130
		5k - 10 k	1000 + 800	1100 + 800	1200 + 800	1300 + 800	900 + 800	1000 + 800
22 mA	100 nA	10 - 20	260 + 500	280 + 500	290 + 500	300 + 500	260 + 500	280 + 500
		20 - 40	170 + 400	180 + 400	190 + 400	200 + 400	130 + 400	150 + 400
		40 - 1 k	120 + 400	130 + 400	135 + 400	140 + 400	100 + 400	110 + 400
		1k - 5 k	210 + 700	220 + 700	230 + 700	240 + 700	250 + 700	280 + 700
		5k - 10 k	1000 + 6000	1100 + 6000	1200 + 6000	1300 + 6000	900 + 6000	1000 + 6000
		Hz	± (ppm output + µA)				± (ppm output + µA)	
220 mA	1 µA	10 - 20	260 + 5	280 + 5	290 + 5	300 + 5	260 + 5	280 + 5
		20 - 40	170 + 4	180 + 4	190 + 4	200 + 4	130 + 4	150 + 4
		40 - 1 k	120 + 3	130 + 3	135 + 3	140 + 3	100 + 3	110 + 3
		1k - 5 k	210 + 4	220 + 4	230 + 4	240 + 4	250 + 4	280 + 4
		5k - 10 k	1000 + 12	1100 + 12	1200 + 12	1300 + 12	900 + 12	1000 + 12
2.2 A	10 µA	20 - 1 k	290 + 40	300 + 40	310 + 40	320 + 40	300 + 40	350 + 40
		1 k - 5 k	440 + 100	460 + 100	480 + 100	500 + 100	500 + 100	520 + 100
		5 k - 10 k	6000 + 200	7000 + 200	7500 + 200	8000 + 200	6000 + 200	7000 + 200
<b>5725A Amplifier:</b>								
11 A	100 µA	40 - 1 k	370 + 170	400 + 170	440 + 170	460 + 170	300 + 170	330 + 170
		1 k - 5 k	800 + 380	850 + 380	900 + 380	950 + 380	700 + 380	800 + 380
		5 k - 10 k	3000 + 750	3300 + 750	3500 + 750	3600 + 750	2800 + 750	3200 + 750

**Note:** Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 µA and 2.2 mA ranges are increased by a factor of 1.3 plus 2 µA when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.

Table 1-17. 5720A Series II AC Current Specifications: 95 % Confidence Level

<b>5720A</b>		<b>95 % Confidence Level</b>					<b>Relative Uncertainty</b>	
Range	Resolution	Frequency	Absolute Uncertainty ±5 °C from calibration temperature For fields strengths >0.4 V/m but ≤3 V/m, add 1 % of range.				±1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		Hz	± (ppm output + nA)				± (ppm output + nA)	
220 μA	1 nA	10 - 20	210 + 16	230 + 16	240 + 16	250 + 16	210 + 16	230 + 16
		20 - 40	130 + 10	140 + 10	150 + 10	160 + 10	110 + 10	130 + 10
		40 - 1 k	100 + 8	110 + 8	115 + 8	120 + 8	80 + 8	90 + 8
		1k - 5 k	240 + 12	250 + 12	270 + 12	280 + 12	200 + 12	230 + 12
		5k - 10 k	800 + 65	900 + 65	1000 + 65	1100 + 65	700 + 65	800 + 65
2.2 mA	10 nA	10 - 20	210 + 40	230 + 40	240 + 40	250 + 40	210 + 40	230 + 40
		20 - 40	140 + 35	140 + 35	150 + 35	160 + 35	110 + 35	130 + 35
		40 - 1 k	100 + 35	110 + 35	115 + 35	120 + 35	80 + 35	90 + 35
		1k - 5 k	170 + 110	180 + 110	190 + 110	200 + 110	200 + 110	230 + 110
		5k - 10 k	800 + 650	900 + 650	1000 + 650	1100 + 650	700 + 650	800 + 650
22 mA	100 nA	10 - 20	210 + 400	230 + 400	240 + 400	250 + 400	210 + 400	230 + 400
		20 - 40	130 + 350	140 + 350	150 + 350	160 + 350	110 + 350	130 + 350
		40 - 1 k	100 + 350	110 + 350	115 + 350	120 + 350	80 + 350	90 + 350
		1k - 5 k	170 + 550	180 + 550	190 + 550	200 + 550	200 + 550	230 + 550
		5k - 10 k	800 + 5000	900 + 5000	1000 + 5000	1100 + 5000	700 + 5000	800 + 5000
		Hz	± (ppm output + μA)				± (ppm output + μA)	
220 mA	1 μA	10 - 20	210 + 4	230 + 4	240 + 4	250 + 4	210 + 4	230 + 4
		20 - 40	130 + 3.5	140 + 3.5	150 + 3.5	160 + 3.5	110 + 3.5	130 + 3.5
		40 - 1 k	100 + 2.5	110 + 2.5	115 + 2.5	120 + 2.5	80 + 2.5	90 + 2.5
		1k - 5 k	170 + 3.5	180 + 3.5	190 + 3.5	200 + 3.5	200 + 3.5	230 + 3.5
		5k - 10 k	800 + 10	900 + 10	1000 + 10	1100 + 10	700 + 10	800 + 10
2.2 A	10 μA	20 - 1 k	230 + 35	240 + 35	250 + 35	260 + 35	250 + 35	300 + 35
		1 k - 5 k	350 + 80	390 + 80	420 + 80	450 + 80	400 + 80	440 + 80
		5 k - 10 k	5000 + 160	6000 + 160	6500 + 160	7000 + 160	5000 + 160	6000 + 160
<b>5725A Amplifier:</b>								
11 A	100 μA	40 - 1 k	370 + 170	400 + 170	440 + 170	460 + 170	300 + 170	330 + 170
		1 k - 5 k	800 + 380	850 + 380	900 + 380	950 + 380	700 + 380	800 + 380
		5 k - 10 k	3000 + 750	3300 + 750	3500 + 750	3600 + 750	2800 + 750	3200 + 750

**Note:** Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 μA and 2.2 mA ranges are increased by 1.3 x plus 2 μA when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.



**Table 1-18. 5700A Series II AC Current Specifications: 99 % Confidence Level**

**5700A**  
**99%**

**99 % Confidence Level**

Range	Resolution	Frequency	Absolute Uncertainty ±5 °C from calibration temperature For fields strengths >0.4 V/m but ≤3 V/m, add 1 % of range.				Relative Uncertainty ±1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		Hz	± (ppm output + nA)				± (ppm output + nA)	
220 µA	1 nA	10 - 20	650 + 30	700 + 30	750 + 30	800 + 30	450 + 30	500 + 30
		20 - 40	350 + 25	380 + 25	410 + 25	420 + 25	270 + 25	300 + 25
		40 - 1 k	120 + 20	140 + 20	150 + 20	160 + 20	110 + 20	120 + 20
		1k - 5 k	500 + 50	600 + 50	650 + 50	700 + 50	450 + 50	500 + 50
		5k - 10 k	1500 + 100	1600 + 100	1700 + 100	1800 + 100	1400 + 100	1500 + 100
2.2 mA	10 nA	10 - 20	650 + 50	700 + 50	750 + 50	800 + 50	450 + 50	500 + 50
		20 - 40	350 + 40	380 + 40	410 + 40	420 + 40	270 + 40	300 + 40
		40 - 1 k	120 + 40	140 + 40	150 + 40	160 + 40	110 + 40	120 + 40
		1k - 5 k	500 + 500	600 + 500	650 + 500	700 + 500	450 + 500	500 + 500
		5k - 10 k	1500 + 1000	1600 + 1000	1700 + 1000	1800 + 1000	1400 + 1000	1500 + 1000
22 mA	100 nA	10 - 20	650 + 500	700 + 500	750 + 500	800 + 500	450 + 500	500 + 500
		20 - 40	350 + 400	380 + 400	410 + 400	420 + 400	270 + 400	300 + 400
		40 - 1 k	120 + 400	140 + 400	150 + 400	160 + 400	110 + 400	120 + 400
		1k - 5 k	500 + 5000	600 + 5000	650 + 5000	700 + 5000	450 + 5000	500 + 5000
		5k - 10 k	1500 + 10,000	1600 + 10,000	1700 + 10,000	1800 + 10,000	1400 + 10,000	1500 + 10,000
		<b>Hz</b>	<b>± (ppm output + µA)</b>				<b>± (ppm output + µA)</b>	
220 mA	1 µA	10 - 20	650 + 5	700 + 5	750 + 5	800 + 5	450 + 5	500 + 5
		20 - 40	350 + 4	380 + 4	410 + 4	420 + 4	280 + 4	300 + 4
		40 - 1 k	120 + 4	150 + 4	170 + 4	180 + 4	110 + 4	130 + 4
		1k - 5 k	500 + 50	600 + 50	650 + 50	700 + 50	450 + 50	500 + 50
		5k - 10 k	1500 + 100	1600 + 100	1700 + 100	1800 + 100	1400 + 100	1500 + 100
2.2 A	10 µA	20 - 1 k	600 + 40	650 + 40	700 + 40	750 + 40	600 + 40	650 + 40
		1 k - 5 k	700 + 100	750 + 100	800 + 100	850 + 100	650 + 100	750 + 100
		5 k - 10 k	8000 + 200	9000 + 200	9500 + 200	10,000 + 200	7500 + 200	8500 + 200
<b>5725A Amplifier:</b>								
11 A	100 µA	40 - 1 k	370 + 170	400 + 170	440 + 170	460 + 170	300 + 170	330 + 170
		1 k - 5 k	800 + 380	850 + 380	900 + 380	950 + 380	700 + 380	800 + 380
		5 k - 10 k	3000 + 750	3300 + 750	3500 + 750	3600 + 750	2800 + 750	3200 + 750

**Note:** Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 µA and 2.2 mA ranges are increased by 1.3 x plus 2 µA when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.

Table 1-19. 5700A Series II AC Current Specifications: 95 % Confidence Level

<b>5700A 95%</b>		<b>95 % Confidence Level</b>					<b>Relative Uncertainty ±1 °C</b>	
Range	Resolution	Frequency	Absolute Uncertainty ±5 °C from calibration temperature For fields strengths >0.4 V/m but ≤3 V/m, add 1 % of range.				24 Hours	90 Days
			24 Hours	90 Days	180 Days	1 Year		
		Hz	± (ppm output + nA)				± (ppm output + nA)	
220 µA	1 nA	10 - 20	550 + 25	600 + 25	650 + 25	700 + 25	375 + 25	400 + 25
		20 - 40	280 + 20	310 + 20	330 + 20	350 + 20	220 + 20	250 + 20
		40 - 1 k	100 + 16	120 + 16	130 + 16	140 + 16	90 + 16	100 + 16
		1k - 5 k	400 + 40	500 + 40	550 + 40	600 + 40	375 + 40	400 + 40
		5k - 10 k	1300 + 80	1400 + 80	1500 + 80	1600 + 80	1200 + 80	1200 + 80
2.2 mA	10 nA	10 - 20	550 + 40	600 + 40	650 + 40	700 + 40	375 + 40	400 + 40
		20 - 40	280 + 35	310 + 35	330 + 35	350 + 35	220 + 35	250 + 35
		40 - 1 k	100 + 35	120 + 35	130 + 35	140 + 35	90 + 35	100 + 35
		1k - 5 k	400 + 400	500 + 400	550 + 400	600 + 400	375 + 400	400 + 400
		5k - 10 k	1300 + 800	1400 + 800	1500 + 800	1600 + 800	1200 + 800	1200 + 800
22 mA	100 nA	10 - 20	550 + 400	600 + 400	650 + 400	700 + 400	375 + 400	400 + 400
		20 - 40	280 + 350	310 + 350	330 + 350	350 + 350	220 + 350	250 + 350
		40 - 1 k	100 + 350	120 + 350	130 + 350	140 + 350	90 + 350	100 + 350
		1k - 5 k	400 + 4000	500 + 4000	550 + 4000	600 + 4000	375 + 4000	400 + 4000
		5k - 10 k	1300 + 8000	1400 + 8000	1500 + 8000	1600 + 8000	1200 + 8000	1200 + 8000
		Hz	± (ppm output + µA)				± (ppm output + µA)	
220 mA	1 µA	10 - 20	550 + 4	600 + 4	650 + 4	700 + 4	375 + 4	400 + 4
		20 - 40	280 + 3.5	310 + 3.5	330 + 3.5	350 + 3.5	220 + 3.5	250 + 3.5
		40 - 1 k	100 + 3.5	120 + 3.5	130 + 3.5	140 + 3.5	90 + 3.5	100 + 3.5
		1k - 5 k	400 + 40	500 + 40	550 + 40	600 + 40	375 + 40	400 + 40
		5k - 10 k	1300 + 80	1400 + 80	1500 + 80	1600 + 80	1200 + 80	1200 + 80
2.2 A	10 µA	20 - 1 k	500 + 35	550 + 35	600 + 35	650 + 35	500 + 35	550 + 35
		1 k - 5 k	600 + 80	650 + 80	700 + 80	750 + 80	550 + 80	650 + 80
		5 k - 10 k	6500 + 160	7500 + 160	8000 + 1600	8500 + 160	6000 + 160	7000 + 160
<b>5725A Amplifier:</b>								
11 A	100 µA	40 - 1 k	370 + 170	400 + 170	440 + 170	460 + 170	300 + 170	330 + 170
		1 k - 5 k	800 + 380	850 + 380	900 + 380	950 + 380	700 + 380	800 + 380
		5 k - 10 k	3000 + 750	3300 + 750	3500 + 750	3600 + 750	2800 + 750	3200 + 750

**Note:** Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 µA and 2.2 mA ranges are increased by a factor of 1.3 plus 2 µA when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.

**Table 1-20. AC Current Secondary Performance Specifications and Operating Characteristics**

Range	Frequency	Stability ±1 °C [Note 1]	Temperature Coefficient [Note 2]		Compliance Limits	Maximum Resistive Load For Full Accuracy [Note 3]	Noise and Distortion
		24 Hours	10°-40 °C	0°-10 °C and 40°-50 °C			Bandwidth 10 Hz-50 kHz <0.5V Burden
			± (ppm output + nA)	± (ppm output + nA)/°C			
Hz	± (ppm output + µA)	± (ppm output + µA)/°C		V rms	Ω	± (% output + µA)	
220 µA	10 - 20	150 + 5	50 + 5	50 + 5	7	2k [Note 6]	0.05 + 0.1
	20 - 40	80 + 5	20 + 5	20 + 5			0.05 + 0.1
	40 - 1 k	30 + 3	4 + 0.5	10 + 0.5			0.05 + 0.1
	1k - 5 k	50 + 20	10 + 1	20 + 1			0.25 + 0.5
	5k - 10 k	400 + 100	20 + 100	20 + 100			0.5 + 1
2.2 mA	10 - 20	150 + 5	50 + 5	50 + 5	7	500	0.05 + 0.1
	20 - 40	80 + 5	20 + 4	20 + 4			0.05 + 0.1
	40 - 1 k	30 + 3	4 + 1	10 + 2			0.05 + 0.1
	1k - 5 k	50 + 20	10 + 100	20 + 100			0.25 + 0.5
	5k - 10 k	400 + 100	50 + 400	50 + 400			0.5 + 1
22 mA	10 - 20	150 + 50	50 + 10	50 + 10	7	150	0.05 + 0.1
	20 - 40	80 + 50	20 + 10	20 + 10			0.05 + 0.1
	40 - 1 k	30 + 30	4 + 10	10 + 20			0.05 + 0.1
	1k - 5 k	50 + 500	10 + 500	20 + 400			0.25 + 0.5
	5k - 10 k	400 + 1000	50 + 1000	50 + 1000			0.5 + 1
	<b>Hz</b>	<b>± (ppm output + µA)</b>	<b>± (ppm output + µA)/°C</b>				
220 mA	10 - 20	150 + 0.5	50 + 0.05	50 + 0.05	7	15	0.05 + 10
	20 - 40	80 + 0.5	20 + 0.05	20 + 0.05			0.05 + 10
	40 - 1 k	30 + 0.3	4 + 0.1	10 + 0.1			0.05 + 10
	1k - 5 k	50 + 3	10 + 2	20 + 2			0.25 + 50
	5k - 10 k	400 + 5	50 + 5	50 + 5			0.5 + 100
2.2 A	20 - 1 k	50 + 5	4 + 1	10 + 1	1.4 [Note 4]	0.5	0.5 + 100
	1 k - 5 k	80 + 20	10 + 5	20 + 5			0.3 + 500
	5 k - 10 k	800 + 50	50 + 10	50 + 10			1 + 1 mA
<b>5725A Amplifier:</b>							<b>± (% output)</b>
11 A	40 - 1 k	75 + 100	20 + 75	30 + 75	3	3	0.05
	1 k - 5 k	100 + 150	40 + 75	50 + 75			0.12
	5 k - 10 k	200 + 300	100 + 75	100 + 75			0.5
							[Note 5]

**Notes:**

Maximum output from 5720A terminals is 2.2 A. Uncertainty specifications for 220 µA and 2.2 mA ranges are increased by a factor of 1.3, plus 2 µA when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.

1. Stability specifications are included in the Absolute Uncertainty values for the primary specifications.
2. Temperature coefficient is an adder to uncertainty specifications that does not apply unless operating more than ±5 °C from calibration temperature.

3. For larger resistive loads multiply uncertainty specifications by:  $\left( \frac{\text{actual load}}{\text{maximum load for full accuracy}} \right)^2$

4. 1.5 V compliance limit above 1 A. 5725A Amplifier may be used in range-lock mode down to 1 A.

5. For resistive loads within rated compliance voltage limits.

6. For outputs from the Aux Current terminals, the maximum resistive load for full accuracy is 1 kΩ. For larger resistive loads, multiply the uncertainty as described in Note 3.

**Minimum output:** 9 µA for 220 µA range, 10 % on all other ranges. 1 A minimum for 5725A.

**Inductive load limits:** 400 µH (5700A/5720A, or 5725A). 20 µH for 5700A/5720A output >1 A.

**Power factors:** 5700A/5720A, 0.9 to 1; 5725A, 0.1 to 1. Subject to compliance voltage limits.

**Frequency:**

**Range (Hz):** 10.000-11.999, 12.00-119.99, 120.0-1199.9, 1.200 k-10.000 k

**Uncertainty:** ±0.01 %

**Resolution:** 11,999 counts

**Settling time to full accuracy:** 5 seconds for 5700A/5720A ranges; 6 seconds for 5725A 11 A range; +1 second for amplitude or frequency range change.

**Overshoot:** <10 %

## 1-17. Wideband AC Voltage (Option 5700-03) Specifications

Table 1-21. Wideband AC Voltage (Option 5700-03) Specifications

Specifications apply to the end of the cable and 50 Ω termination used for calibration

Range		Resolution	Absolute Uncertainty ±5 °C from calibration temperature 30 Hz-500 kHz			
			24 Hours	90 Days	180 Days	1 Year
Volts	dBm		± (% output + μV)			
1.1 mV	-46	10 nV	0.4 + 0.4	0.5 + 0.4	0.6 + 0.4	0.8 + 2
3 mV	-37	10 nV	0.4 + 1	0.45 + 1	0.5 + 1	0.7 + 3
11 mV	-26	100 nV	0.2 + 4	0.35 + 4	0.5 + 4	0.7 + 8
33 mV	-17	100 nV	0.2 + 10	0.3 + 10	0.45 + 10	0.6 + 16
110 mV	-6.2	1 μV	0.2 + 40	0.3 + 40	0.45 + 40	0.6 + 40
330 mV	+3.4	1 μV	0.2 + 100	2.5 + 100	0.35 + 100	0.5 + 100
1.1 V	+14	10 μV	0.2 + 400	0.25 + 400	0.35 + 400	0.5 + 400
3.5 V	+24	10 μV	0.15 + 500	0.2 + 500	0.3 + 500	0.4 + 500

Frequency	Frequency Resolution	Amplitude Flatness, 1 kHz Reference Voltage Range			Temperature Coefficient	Settling Time To Full Accuracy	Harmonic Distortion
		1.1 mV	3 mV	>3 mV			
Hz	Hz	± (% output + floor indicated)			±ppm/°C	Seconds	dB
10 - 30	0.01	0.3	0.3	0.3	100	7	-40
30 - 120	0.01	0.1	0.1	0.1	100	7	-40
120 - 1.2 k	0.1	0.1	0.1	0.1	100	5	-40
1.2 k - 12 k	1	0.1	0.1	0.1	100	5	-40
12 k - 120 k	10	0.1	0.1	0.1	100	5	-40
120 k - 1.2 M	100	0.2 + 3 μV	0.1 + 3 μV	0.1 + 3 μV	100	5	-40
1.2 M - 2 M	100 k	0.2 + 3 μV	0.1 + 3 μV	0.1 + 3 μV	100	0.5	-40
2 M - 10 M	100 k	0.4 + 3 μV	0.3 + 3 μV	0.2 + 3 μV	100	0.5	-40
10 M - 20 M	1 M	0.6 + 3 μV	0.5 + 3 μV	0.4 + 3 μV	150	0.5	-34
20 M - 30 M	1 M	10.5 + 15 μV	10.5 + 3 μV	1 + 3 μV	300	0.5	-34

**Additional Operating Information:**

dBm reference = 50 Ω

Range boundaries are at voltage points, dBm levels are approximate.

$$\text{dBm} = 10 \log \left( \frac{\text{Power}}{1 \text{ mW}} \right); 0.22361 \text{ V across } 50 \Omega = 1 \text{ mW or } 0 \text{ dBm}$$

**Minimum output:** 300 μV (-57 dBm)

**Frequency uncertainty:** ±0.01 %

**Frequency resolution:** 11,999 counts to 1.1999 MHz, 119 counts to 30 MHz.

**Overload protection:** A short circuit on the wideband output will not result in damage. After settling time, normal operation is restored upon removal.

## 1-18. General Specifications

**Warm-Up Time:** Twice the time since last warmed up, to a maximum of 30 minutes.

**System installation:** Rear output configuration and rack-mount kit available.

**Standard interfaces:** IEEE-488, RS-232, 5725A, 5205A or 5215A, 5220A, phase lock in (BNC), phase reference out (BNC).

**Temperature performance:** Operating: 0 °C to 50 °C. Calibration: 15 °C to 35 °C. Storage: -40 °C to 75 °C; DC Zeros calibration required every 30 days.

**Relative humidity:** Operating: <80 % to 30 °C, <70 % to 40 °C, <40 % to 50 °C. Storage: <95 %, non-condensing. A power stabilization period of four days may be required after extended storage at high temperature and humidity.

**Safety:** Designed to comply with UL3111; EN61010; CSA C22.2 No. 1010; ANSI/ISA S82.01-1994

**Guard isolation:** 20 V

**EMI/RFI:** Designed to comply with FCC Rules Part 15, Subpart B, Class B; EN50081-1, EN50082-1

**Electro Static Discharge:** This instrument meets criteria C for ESD requirements per EN61326

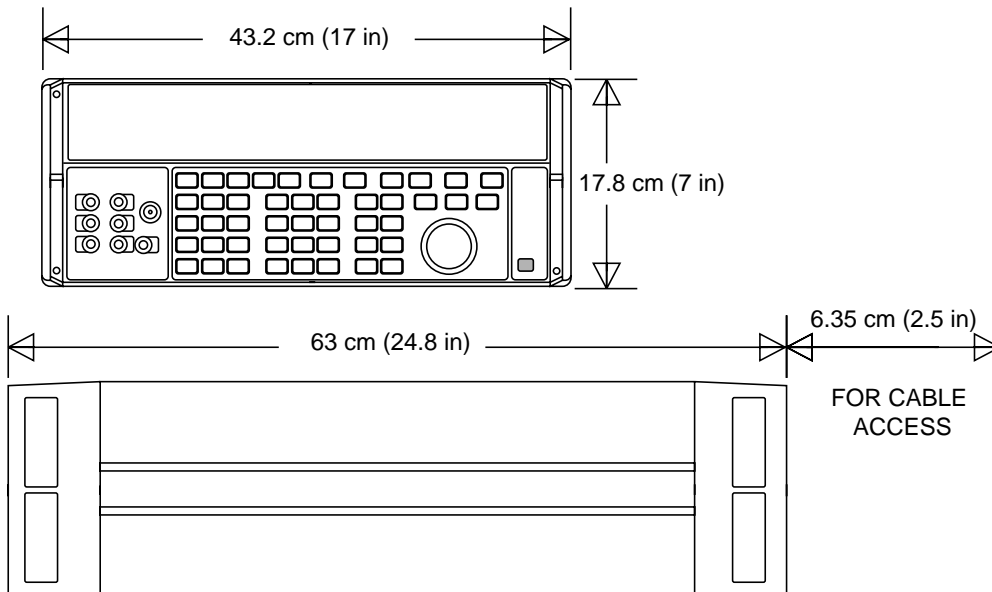
**Line Power:** 47 to 63 Hz;  $\pm 10$  % allowed about selectable nominal line voltage: 100 V, 110 V, 115 V, 120 V, 200 V, 220 V, 230 V, 240 V. Maximum power: 5700A/5720A, 300 VA; 5725A, 750 VA.

**Size:**

5700A/5720A: Height 17.8 cm (7 in), standard rack increment, plus 1.5 cm (0.6 in) for feet; Width 43.2 cm (17 in), standard rack width; Depth 63.0 cm (24.8 in), overall; 57.8 cm (22.7 in), rack depth.

5725A: Height 13.3 cm, (5.25 in); Width and depth same as 5700A/5720A. Both units project 5.1 cm, (2 in) from rack front.

**Weight:** 5700A/5720A: 27kg (62 lbs); 5725A: 32kg (70 lbs).



## 1-19. Auxiliary Amplifier Specifications

For complete specifications, see the 5205A and 5220A Operators Manuals.

### 5205A (220V - 1100 V ac, 0 V - 1100 V dc)

**Overshoot:** < 10 %

#### Distortion (bandwidth 10 Hz - 1 MHz):

10 Hz - 20 kHz	0.07 %
20 kHz - 50 kHz	0.2 %
50 kHz - 100 kHz	0.25 %

Frequency (Hz)	90 Day Accuracy at 23° ±5 °C ± (% output + % range)	Temperature Coefficient for 0°-18 °C and 28°-50 °C ± (ppm output + ppm range)/ °C
dc	0.05 + 0.005	15 + 3
10 - 40	0.15 + 0.005	45 + 3
40 - 20 k	0.04 + 0.004	15 + 3
20 k - 50 k	0.08 + 0.006	50 + 10
50 k - 100 k	0.1 + 0.01	70 + 20

### 5220A (AC Current, 180-day specifications):

#### Accuracy:

20 Hz - 1 kHz	0.07% + 1 mA
1 kHz - 5 kHz	(0.07% + 1mA) x frequency in kHz

**Temperature Coefficient (0° - 18 °C and 28° - 50 °C):** (0.003 % + 100 μA)/°C

#### Distortion (bandwidth 300 kHz):

20 Hz - 1 kHz	0.1% + 1 mA
1 kHz - 5 kHz	(0.1% + 1 mA) x frequency in kHz

**Note:** 5700A/5720A combined with 5220A is not specified for inductive loads.

# **Chapter 2**

## **Installation**

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**⚠ Warning**

**The 5725A amplifier is capable of supplying lethal voltages. Do not touch the 5700A output terminals. Read this section before operating the 5725A.**

**2-1. Introduction**

This section provides instructions for unpacking and installing the 5725A. Procedures for line voltage selection, fuse replacement, and connection to line power and the 5700A Calibrator are provided here. Read this section before operating the 5725A.

Instructions for connecting cables to a UUT (Unit Under Test) are in Section 4 of the 5700A/5720A Series II Operator Manual.

**2-2. Unpacking and Inspection**

The 5725A is shipped in a container that is specially designed to prevent damage during shipping. Inspect the 5725A carefully for damage, and immediately report any damage to the shipper. Instructions for inspection and claims are included in the shipping container.

If you need to reship the 5725A, use the original container. If it is not available, you can order a new container from Fluke by identifying the amplifier's model and serial number.

When you unpack the 5725A, check for all the standard equipment listed in Table 2-1. Report any shortage to the place of purchase or to the nearest Technical Service Center. If performance tests are required for your acceptance procedures, refer to Section 3 of the 5700A/5720A Series II Service Manual for instructions.

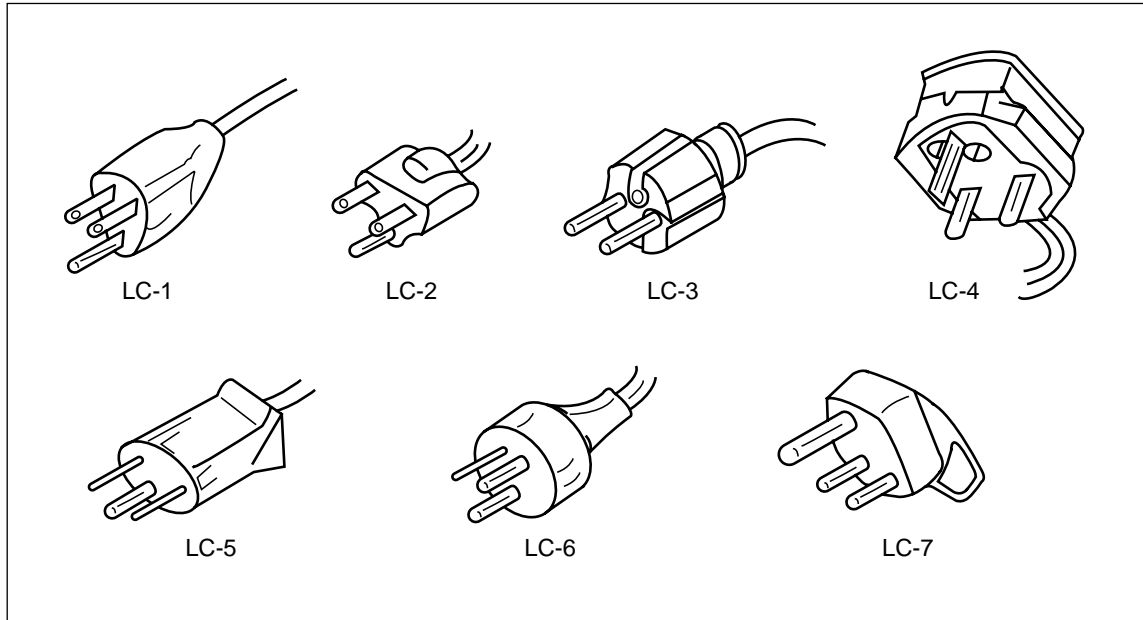
Line power cords available from Fluke are listed in Table 2-2 and illustrated in Figure 2-1.

**Table 2-1. Standard Equipment**

Item	Model or Part Number
Amplifier	5725A
Line Power Cord	(See Table 2-2 and Figure 2-1)
Shielded 5700A/5725A Interface Cable	842901
5725A Getting Started Manual	1780175
5725A CD-ROM (contains Instruction Manual)	1780182
Spare 4A, 250V Fuse	216846
Certificate of Calibration	(No Part Number)

**Table 2-2. Line Power Cord Types Available from Fluke**

<b>TYPE</b>	<b>VOLTAGE/CURRENT</b>	<b>FLUKE OPTION NUMBER</b>
North America	120V/15A	LC-1
North America	240V/15A	LC-2
Universal Euro	220V/16A	LC-3
United Kingdom	240V/13A	LC-4
Switzerland	220V/10A	LC-5
Australia	240V/10A	LC-6
South Africa	240V/5A	LC-7



**Figure 2-1. Line Power Cords Available for Fluke Instruments**

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### 2-3. Service Information

Each 5725A Amplifier is warranted to the original purchaser for a period of one year beginning on the date received. The warranty is located at the front of this manual.

Factory-authorized service and technical advice for the 5725A is available at Fluke Service Centers. A complete list of service centers is available at [www.fluke.com](http://www.fluke.com).

#### Warning

**Servicing described in this manual is to be done by qualified service personnel only. To avoid electrical shock, do not service the 5725A unless you are qualified to do so.**

The owner may choose to repair a 5725A using the troubleshooting information in Section 7 to isolate a faulty module, then use the Module Exchange Program. Refer to the Fluke catalog or contact a Service Center representative for the module exchange procedure.

### 2-4. Placement and Rack Mounting

You can stack the 5725A on top of or below the 5700A Calibrator. (Choose the configuration that provides the easiest access to the 5700A Calibrator controls.) Or, you can mount the 5725A in a standard-width, 24-inch (61-cm) deep equipment rack. For bench-top stacking, the 5725A is equipped with non-skid feet. To mount the 5725A in an equipment rack, order the accessory 5725A Rack Mount Kit, Model Y5735. An instruction sheet is packed with the kit.

#### Caution

**Use only the rack mount slides included in the Y5735 kit. Rack mount slides intended for other instruments can block the side ventilation holes on the 5725A and cause overheating.**

### 2-5. Cooling Considerations

#### Caution

**Damage caused by overheating may occur if the area around the air intake is restricted, the intake air is too warm, or the fan filter becomes clogged.**

Accuracy and dependability of all internal parts of the 5725A are enhanced by maintaining the coolest possible internal temperature. By observing the following rules you can lengthen the life of the 5725A:

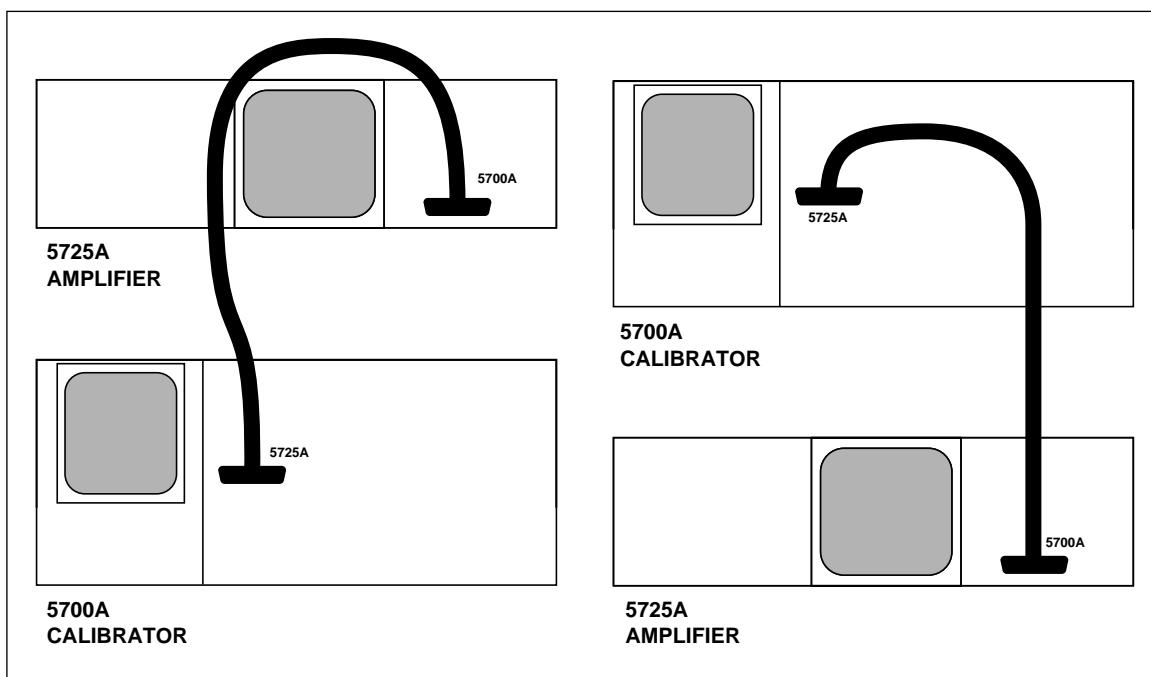
- The area around the fan filter must be at least 3 inches from nearby walls or rack enclosures.
- Exhaust perforations on the sides of the 5725A must be clear of obstructions. Most of the heat exits from the side vents near the front.
- Air entering the instrument must be room temperature. Make sure that exhaust from another instrument is not directed into the fan inlet.
- Clean the fan filter every 30 days, or more frequently if the 5725A is operated in a dusty environment. (Instructions for cleaning the fan filter are in Section 6.)

## 2-6. Connecting to the 5700A Calibrator

Proceed as follows to connect the 5725A to the 5700A:

1. Turn the power off for both instruments and disconnect their line power cords.
2. Connect either end of the interface cable to the 5725A connector labeled 5700A. Dress the cable only as Figure 2-2 shows. The figure shows how to dress the cable in installation arrangements with the 5725A on top or bottom.
3. Connect the other end to the 5700A connector labeled 5725A.

The 5700A/5725A interface cable provides all the digital and analog control signals for the amplifier, and it provides conductors to route amplified voltage to the 5700A OUTPUT binding posts.



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Figure 2-2. Correct Way to Dress Interface Cable

## 2-7. Selecting Line Voltage

The 5725A arrives from the factory configured for the line voltage normally appropriate for the country of purchase, or as specified at the time of purchase. Check the line power label on the rear panel of the 5725A to verify that the line voltage matches local line power. Figure 2-3 shows the location of the line power label and switches, and the switch settings for each line voltage.

The 5725A can be set to operate from eight different nominal line voltages; each voltage setting has a voltage tolerance of  $\pm 10\%$  and a frequency range of 47 to 63 Hz. The line voltage switches are located on the bottom left side of the rear panel.

To change the line voltage setting, set the line voltage selection switches to the correct setting shown in Figure 2-3.

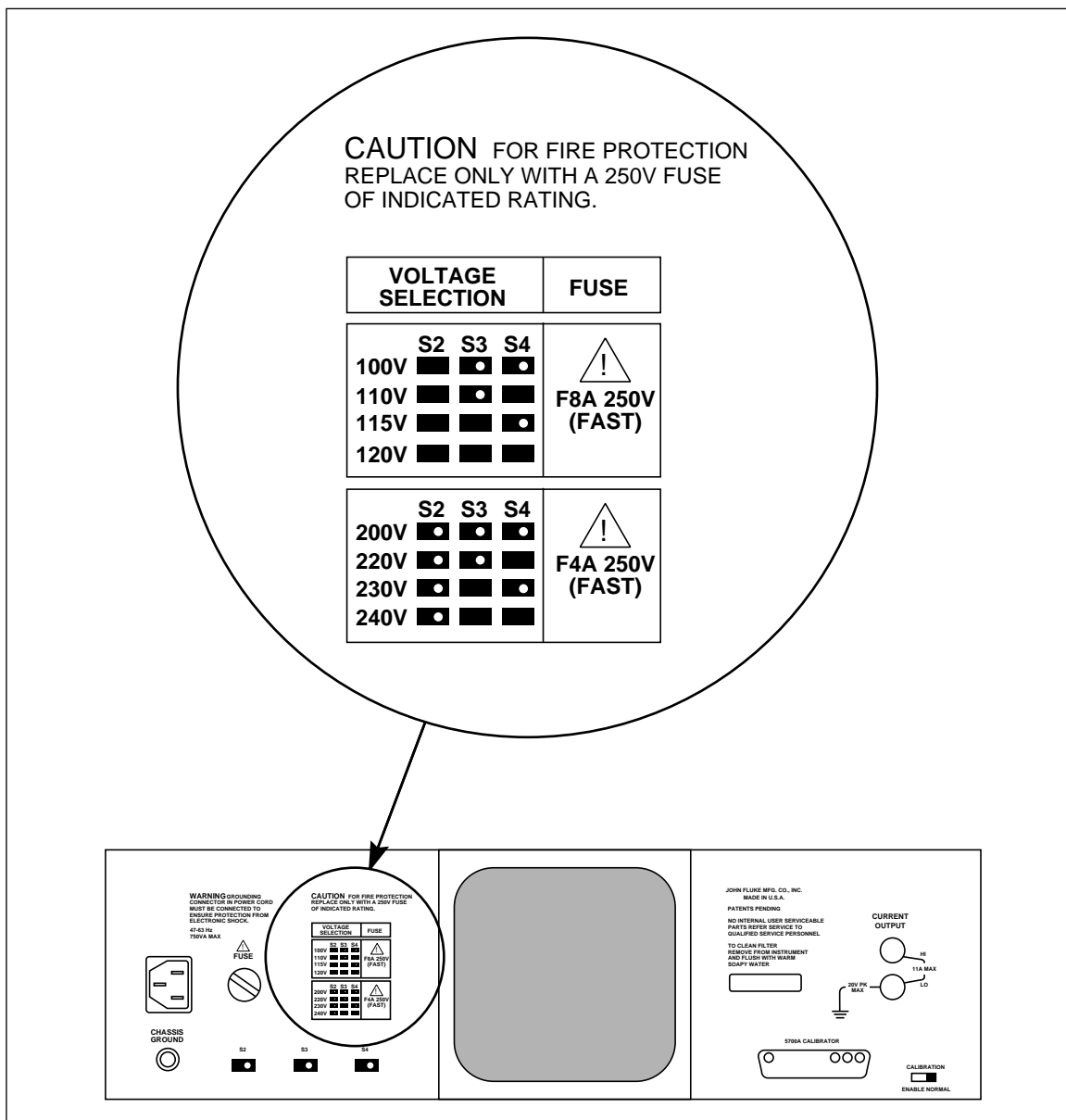


Figure 2-3. Line Power Label and Switch Location

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## 2-8. Accessing the Fuse

### Caution

To prevent instrument damage, verify that the correct fuse is installed for the line voltage setting. Acceptable fuse types are Bussman type MTH or Littelfuse type 312 or equivalent, of the appropriate amperage rating. Use only a 4A, 250V fast-blow fuse when the line voltage selection switches are set in the range 200-240V.

### Note

A spare 4A, 250V fuse is shipped with the 5725A to ensure that one is available for use on the 200-240V range.

The line power fuse is accessible on the rear panel. The fuse rating label to the right of the fuse holder (labeled FUSE) shows the correct replacement fuse rating for each line voltage setting. To check or replace the fuse, refer to Figure 2-4 and proceed as follows:

1. Turn off the POWER switch and disconnect the line power cord from ac line power.
2. Insert the blade of a standard screwdriver in the slot of the fuse holder labeled FUSE.
3. Turn the screwdriver counterclockwise until the cap and fuse pop free.
4. To reinstall the fuse, reverse this procedure.

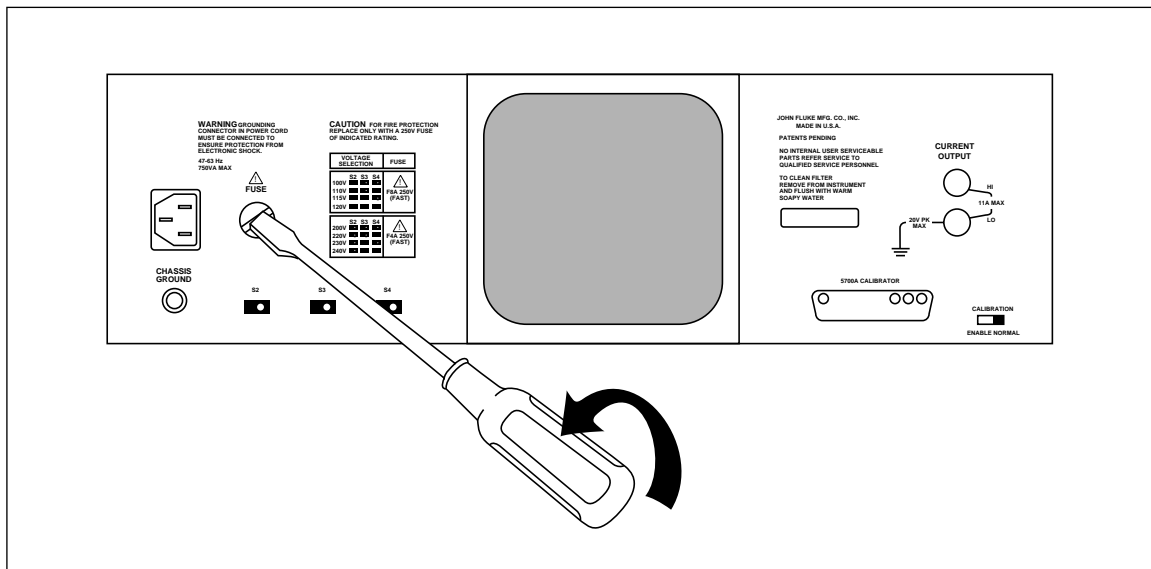


Figure 2-4. Accessing the Fuse

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## **2-9. Connecting to Line Power**

### **Warning**

**To avoid shock hazard, connect the factory-supplied, three-conductor line power cord to a properly grounded power outlet. Do not use a two-conductor adapter or extension cord; this will break the protective ground connection.**

After verifying that the line voltage selection switches are correctly set, verify that the correct fuse is installed. Connect the 5725A to a properly grounded three-prong outlet.





# **Chapter 3**

## **Operating Notes**

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### **3-1. Introduction**

This section provides setup and operation information for the 5725A Amplifier. This section begins with a reference for the 5725A front and rear panel features. Information about setting up and powering up the 5725A follows. Please read this information before operating the amplifier. Also contained in this section is a description of all 5725A operating functions and modes. Because the amplifier operates under complete control of the 5700A Calibrator, operating instructions such as how to call up a specific output value are contained in Section 4 of the 5700A/5720A Series II Operator Manual. Operating the 5725A in remote control is covered in Section 5 of the 5700A/5720A Series II Operator Manual.

### 3-2. Front Panel Features

Front panel features are called out in Figure 3-1. Each front panel feature is described in Table 3-1.

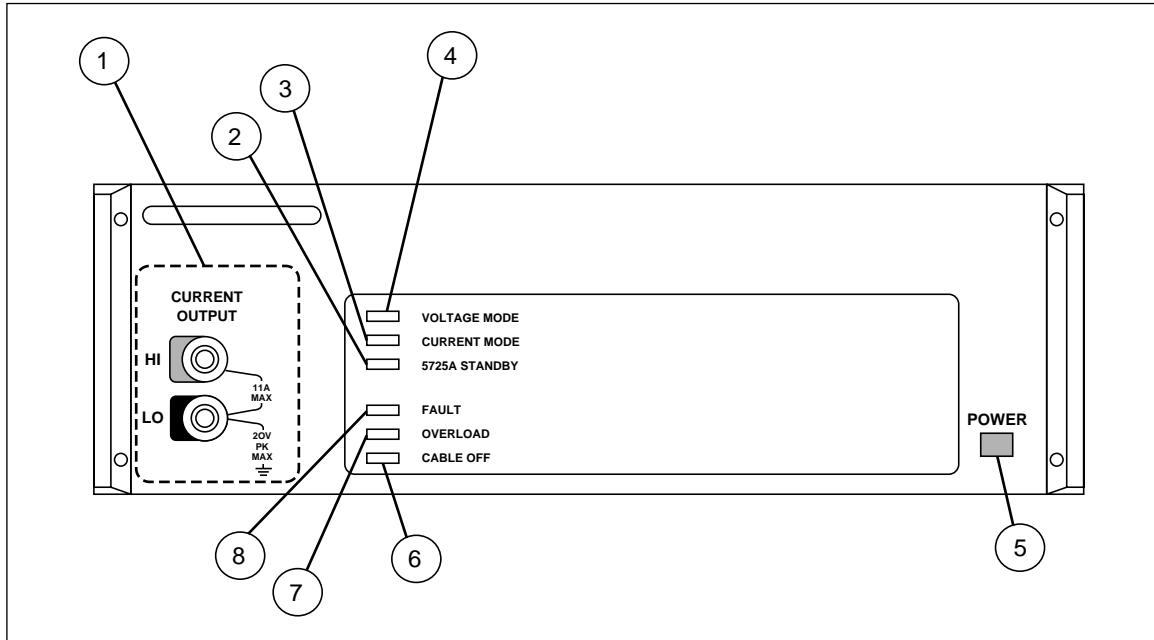


Figure 3-1. Front Panel Features

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**Table 3-1. Front Panel Features**

①	<p><b>CURRENT OUTPUT Binding Posts</b></p> <p>The source of all amplified current if the 5725A is configured for front output. You can set the 5700A to source all unamplified as well as amplified current through these binding posts. The LO binding post is isolated from ground when in the current function, and is open-circuited at other times. Cable and connection recommendations are made in Section 4 of the 5700A/5720A Series II Operator Manual.</p>
②	<p><b>5725A STANDBY Indicator</b></p> <p>Lit whenever the 5725A is in any of three standby modes. This indicator is lit alone in standby mode; it is lit at the same time as VOLTAGE MODE in voltage standby mode; and it is lit at the same time as CURRENT MODE in current standby mode. (See "5725A Operating Functions and Modes," further on in this section.)</p>
③	<p><b>CURRENT MODE Indicator</b></p> <p>Lit when the 5725A is in current standby or current operate mode. In current standby mode, the STANDBY indicator is also lit. (See "5725A Operating Functions and Modes," further on in this section.)</p>
④	<p><b>VOLTAGE MODE Indicator</b></p> <p>Lit when the 5725A is in voltage standby or voltage operate mode. In voltage standby mode, the STANDBY indicator is also lit. (See "5725A Operating Functions and Modes," further on in this section.)</p>
⑤	<p><b>POWER Switch</b></p> <p>Turns the power on and off. The switch is a push-push type; the first push turns the power on and locks the switch in, and the second push turns the power off and releases the switch.</p>
⑥	<p><b>CABLE OFF Indicator</b></p> <p>Lit when the 5700A/5725A interface cable is not connected, or when the 5700A power is turned off. This condition also lights the FAULT indicator.</p>
⑦	<p><b>OVERLOAD Indicator</b></p> <p>Lights on entering current operate mode in overcompliance conditions (load not connected to the proper binding posts, or load resistance too high). The OVERLOAD indicator also lights on entering voltage operate mode if the load resistance is too low.</p>
⑧	<p><b>FAULT Indicator</b></p> <p>Lit whenever any fault condition is detected. Normally, a fault code and message appears on the 5700A Control Display when this happens. The FAULT indicator also comes on with the CABLE OFF indicator when the 5700A/5725A interface cable is not connected. In case of a FAULT indication, check the 5700A/5725A interface cable connections, make sure the 5700A power is on, and check that the load is appropriate and connected to the correct binding posts. Refer to "Service Information" in Section 2, or to Section 7, Troubleshooting, in case of a FAULT indication that appears to be a malfunction.</p>

### 3-3. Rear Panel Features

Rear panel features are called out in Figure 3-2. Each rear panel feature is briefly described in Table 3-2.

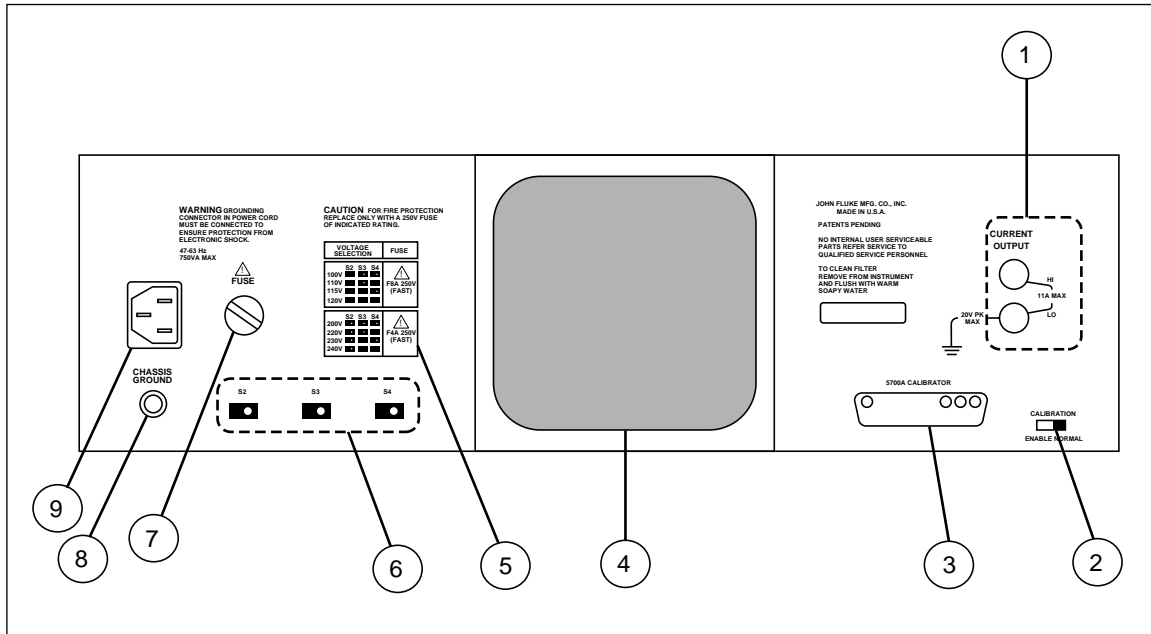


Figure 3-2. Rear Panel Features

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**Table 3-2. Rear Panel Features**

①	<p><b>CURRENT OUTPUT Binding Posts</b></p> <p>The source of all amplified current if the 5725A is configured for rear output. You can set the 5700A to source all its unamplified as well as amplified current through these binding posts. The LO binding post is isolated from ground when in the current function, and is open-circuited at other times. Cable and connection recommendations are made in Section 4 of the 5700A/5720A Series II Operator Manual.</p>
②	<p><b>CALIBRATION Switch</b></p> <p>A slide switch that enables and disables writing to the nonvolatile memory that stores 5725A calibration constants. Switching to ENABLE allows writing to the memory, and switching to NORMAL protects data in memory from being overwritten. The switch must be in the ENABLE position to store corrections generated during calibration. The switch is recessed to allow a metrologist to cover it with a calibration seal to guarantee calibrator integrity.</p>
③	<p><b>5700A CALIBRATOR Connector</b></p> <p>Provides the analog and digital interface to the 5700A Calibrator. After connecting to the 5700A, you control the 5725A from the 5700A front panel or by sending remote commands to the 5700A. Refer to "Using an Auxiliary Amplifier" in Section 4, or for remote operation to Section 5, of the 5700A/5720A Series II Operator Manual for details.</p>
④	<p><b>Fan Filter</b></p> <p>Covers the air intake to keep dust and debris out of the instrument. The fan directs a constant cooling air flow throughout the chassis.</p>
⑤	<p><b>Line Voltage/Fuse Rating Label</b></p> <p>Shows the various settings of the line voltage switches, and the correct replacement fuse for operating voltages of 110 (90 to 132) and 220 (180 to 264) volts ac. Refer to "Accessing the Fuse" in Section 2 for the fuse replacement procedure.</p>
⑥	<p><b>Line Voltage Selection Switches</b></p> <p>Select the operating line voltage. Refer to "Selecting Line Voltage" in Section 2 for instructions on how to select operating line voltage.</p>
⑦	<p><b>Fuse Holder</b></p> <p>The line power fuse. Refer to "Accessing the Fuse" in Section 2 for fuse rating information and the fuse replacement procedure.</p>
⑧	<p><b>CHASSIS GROUND Connector</b></p> <p>If the 5725A is the location of the ground reference point in a system, the CHASSIS GROUND binding post can be used for connecting other instruments to earth ground. (The chassis is connected to earth ground through the three-conductor line cord.)</p>
⑨	<p><b>Line Power Input</b></p> <p>A grounded male three-prong connector that accepts the line power cord.</p>

### **3-4. Turning on the 5725A Amplifier**

#### **Warning**

To avoid electric shock, make sure the 5725A is safely grounded as described in section 2.

#### **Caution**

**Before turning the 5725A on, make sure that the line voltage selection switches are set properly for your line voltage. Refer to Figure 2-3 or the line voltage switch label and check the line voltage setting now if you have not already done so.**

When you turn on the 5725A, all six front panel indicators light briefly and the 5725A undergoes a self test. If the self test fails, a fault message on the 5700A Control Display identifies the failure, indicating that you should service the 5725A.

After the 5725A passes its self test, it transfers its calibration constants to the 5700A. During the transfer, the BOOST indicator on the 5700A flashes. For the few seconds that the BOOST indicator is flashing, the 5725A is not usable. After the transfer is complete, the 5725A is in standby mode. (See "5725A Operating Functions and Modes" for more information about standby mode.)

### **3-5. Warm Up**

When you turn on a cold 5725A, warm it up for 30 minutes to allow the components inside to stabilize. This ensures that the 5725A meets or exceeds the specifications listed in Section 1.

If you turn off the 5725A after it has warmed up, allow it to warm up again for at least twice the length of time it was turned off (up to a maximum of 30 minutes of warm-up). For example, if the 5725A is turned off for 10 minutes, allow it to warm up again for at least 20 minutes.



### 3-6. 5725A Operating Functions and Modes

#### ⚠ Warning

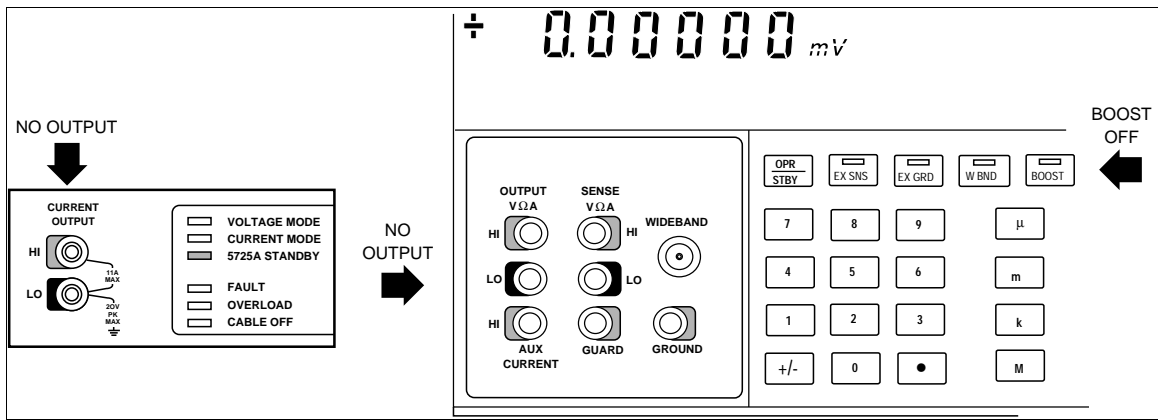
**Both the 5700A and 5725A can produce fatal voltages. Boosted voltage operation produces high voltage at higher current levels than normally available from the 5700A. During 5725A voltage operation, the potential risk of injury or fatal accident is greater than during unamplified 5700A voltage operation.**

The 5725A has five normal modes of operation, including active output in its three output functions: ac voltage, dc current, and ac current. The five normal operating modes are:

- Standby (also referred to as "dormant" on the schematics)
- Voltage Standby
- Current Standby
- Voltage Operate
- Current Operate

Each normal operating mode is described in the following paragraphs. For the meaning of FAULT, OVERLOAD, or CABLE OFF indications, refer to Table 3-1.

### 3-7. Standby



**Figure 3-3. Standby Mode Indicator**

Standby mode is when only the 5725A STANDBY indicator is lit. In standby mode, the 5725A is not supplying an output. However, the 5700A, depending on how it is set, can be supplying up to 1100V or 2.2A. Standby occurs under any of the following conditions:

- At power-up with no pending 5725A entry on the 5700A.
- When the 5725A is not selected in a 5700A setup menu as the amplifier for the 5700A output function in use, and the 5725A is not selected as the output location for all 5700A current.

### 3-8. Voltage Standby

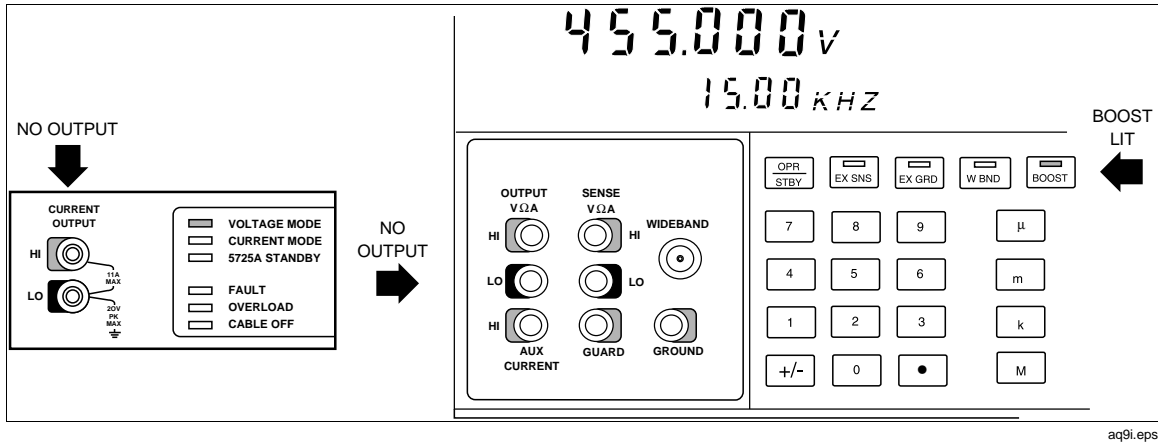


Figure 3-4. Voltage Standby Mode

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Voltage standby mode is when both VOLTAGE MODE and 5725A STANDBY indicators are lit. In voltage standby mode, the 5725A is not supplying an output. Voltage standby occurs if "5725A" is selected in a 5700A setup menu as the voltage amplifier, and the next two conditions are true:

- An ac voltage 220V or above is showing on the 5700A Output Display with the STANDBY annunciator lit.
- The BOOST indicator on the 5700A is lit.

*Note*

*If condition 1 is true, the BOOST indicator can be toggled on and off by pressing the 5700A BOOST key. If the BOOST indicator is off, the 5725A is in standby mode, not voltage standby.*

### 3-9. Current Standby

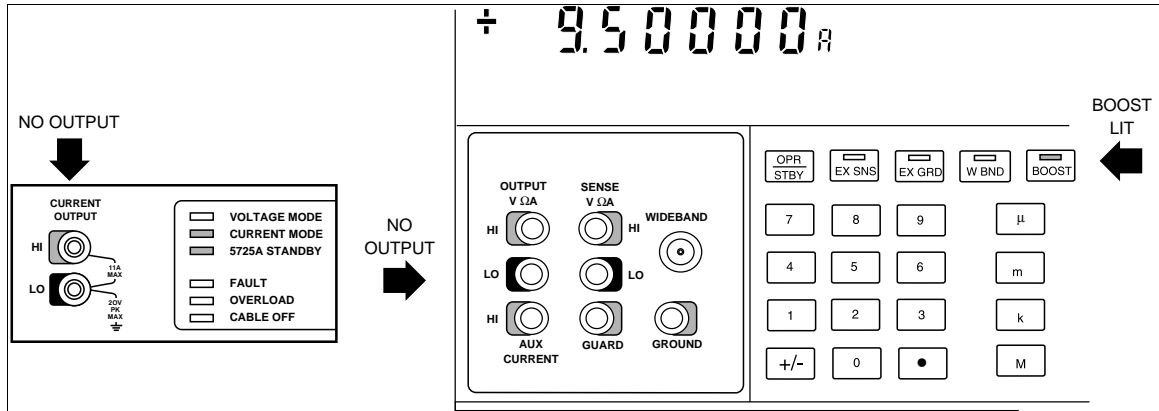


Figure 3-5. Current Standby Mode

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Current standby mode is when both CURRENT MODE and 5725A STANDBY indicators are lit. In current standby mode, the 5725A is not supplying an output. Current standby occurs under any of the following conditions:

- When the 5700A current output location is set to "5725A", and any ac or dc current level is showing on the 5700A Output Display with the STANDBY annunciator lit.
- If "5725A" is selected in a 5700A setup menu as the current amplifier, and any of the following conditions are true:
  1. An ac or dc current 2.2A or above is showing on the 5700A Output Display with the STANDBY annunciator lit.
  2. Any level of dc current is showing on the 5700A Output Display with the STANDBY annunciator lit, and the BOOST key on the 5700A is pressed so that the BOOST indicator is lit.
  3. An ac current 1A or above is showing on the 5700A Output Display with the STANDBY annunciator lit, and the BOOST key on the 5700A is pressed so that the BOOST indicator is lit.
  4. The 5700A is ranged locked on the 11A range, and any dc current or an ac current 1A or above is showing on the Output Display with the STANDBY annunciator lit.

### 3-10. Voltage Operate

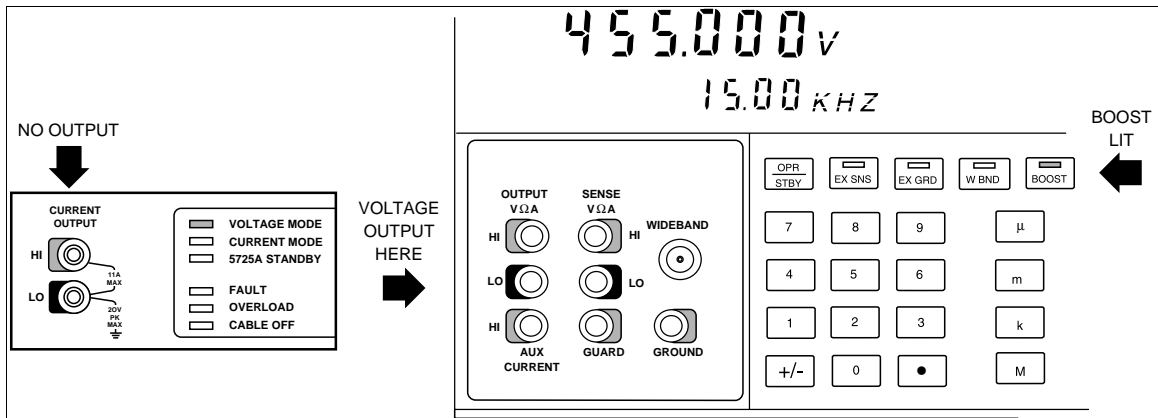


Figure 3-6. Voltage Operate Mode

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#### **⚠ Warning**

**Both the 5700A and 5725A can produce fatal voltages. boosted voltage operation produces high voltage at higher current levels than normally available from the 5700A. during voltage operation, the potential risk of injury or fatal accident is greater than during normal operation.**

Voltage operate mode is when only the VOLTAGE MODE indicator is lit. In voltage operate mode, amplified voltage output is available at the 5700A binding posts. Voltage operate occurs if "5725A" is selected in a 5700A setup menu as the voltage amplifier, and the next two conditions are true:

- An ac voltage 220V or above is showing on the 5700A Output Display with the OPERATE annunciator lit.
- The BOOST indicator on the 5700A is lit.

#### *Note*

*If condition 1 is true, the BOOST indicator can be toggled on and off by pressing the 5700A BOOST key. If the BOOST indicator is off, then the 5725A is in standby mode.*

#### *Note*

*Under certain settings of ac voltage, especially high voltage between 1 to 5 kHz, a whine from the 5725A is audible. This originates from the output transformer, and is normal.*

### 3-11. Current Operate

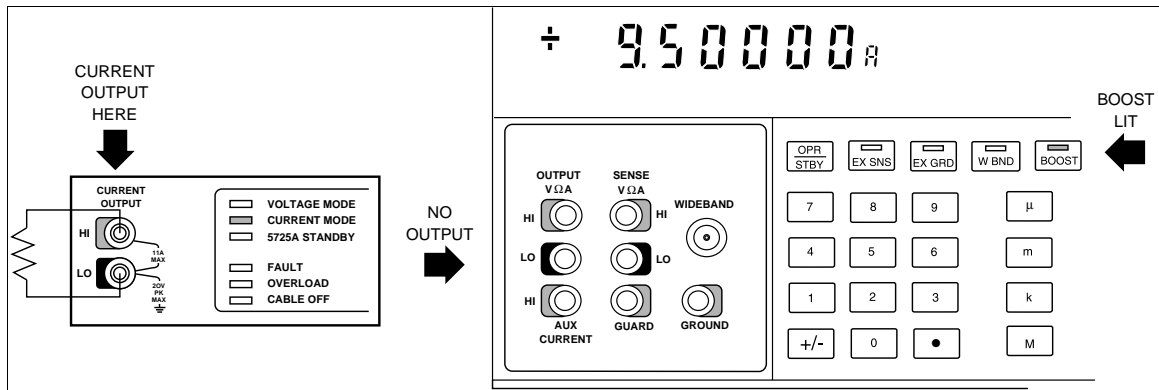


Figure 3-7. Current Operate Mode

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*Note*

*An overcompliance fault occurs if a low-resistance load is not connected to the enabled 5725A binding posts when entering current operate mode.*

Current operate mode is when only the CURRENT MODE indicator is lit. In current operate mode, current output (either 5725A amplified current or redirected 5700A current) is available at the 5725A binding posts. Current operate occurs under the following conditions:

- When, on the 5700A, the current output location is set to "5725A", and any ac or dc current level is showing on the 5700A Output Display with the OPERATE annunciator lit.
- If "5725A" is selected in a 5700A setup menu as the current amplifier, and any of the following conditions are true:
  1. An ac or dc current 2.2A or above is showing on the 5700A Output Display with the OPERATE annunciator lit.
  2. Any level of dc current is showing on the 5700A Output Display with the OPERATE annunciator lit, and the BOOST key on the 5700A is pressed so that the BOOST indicator is lit.
  3. An ac current 1A or above is showing on the 5700A Output Display with the OPERATE annunciator lit, and the BOOST key on the 5700A is pressed so that the BOOST indicator is lit.
  4. The 5700A is ranged locked on the 11A range, and any dc current or an ac current 1A or above is showing on the Output Display with the OPERATE annunciator lit.

*Note*

*Under certain settings of ac current, especially high current at frequencies above 1 kHz, a whine from the 5725A is audible. This is caused by a piezo effect in the current output transistors, and is normal.*

### **3-12. Conditions That Activate the 5725A**

When the 5725A is connected to the 5700A, and is selected as the amplifier for the active output function, it supplies an output under the conditions shown in the following list. (These conditions are the same as VOLTAGE OPERATE and CURRENT OPERATE as previously described.)

- Whenever current above 2.2A is selected and the 5700A is set to operate. (Output available at the 5725A binding posts.)
- Whenever ac voltage in the 220-1100V range is selected and the 5700A is set to operate. Note that the 5725A takes over the 1100V ac range of the 5700A if the 5725A is selected as the voltage amplifier in a setup menu. (Output available at the 5700A binding posts.)
- Whenever the 5700A BOOST key is toggled on while the 5700A output setting is in the operating range of the 5725A, voltage or current. (Output location is 5725A for current, 5700A for voltage.)
- If the "Range" softkey is set to "LOCKED" while supplying a current greater than 2.2A, then the 5725A stays active if the 5700A output setting is adjusted down to 0A dc, or down to 1A ac. (Output available at the 5725A binding posts.)

Regardless of the "BOOST AMP TYPES" setting in the 5700A setup menus, all unamplified 5700A current is supplied through the 5725A binding posts when, on the 5700A, the current output location is set to "5725A"; the 5700A output is set to any ac or dc current level; and the 5700A OPERATE annunciator is lit.

## **Chapter 4**

# **Theory of Operation**

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## 4-1. Introduction

This section presents theory of operation in increasing level of detail. The 5725A Amplifier is first broadly defined in an overall functional description and block diagram. The overall functional description continues in more detail with functional descriptions by function (ac V, dc I, ac I, and standby). The overall picture is completed with a detailed discussion of how the 5700A and 5725A communicate. The largest part of this section is devoted to detailed component-level circuit descriptions, grouped by assembly.

### Warning

**Lethal voltage ( $\pm 500\text{V}$ ) appears on the internal heat sink assemblies, and at many other points inside the 5725A chassis. Do not open the 5725A cover without referring to the access procedures and warnings in section 6. Theory text in this section is here strictly for the purpose of describing how circuits work, and contains no access procedures.**

## 4-2. Overall Functional Description

The 5725A provides three primary functions for the 5700A Calibrator:

- Extended frequency range for high ac voltage
- High-range dc current
- High-range ac current

The 5725A also has a secondary function of sourcing all 5700A current outputs (without the 5700A Current guard) through its own binding posts, if so selected at the 5700A front panel controls. Refer to Figure 4-1, the overall block diagram of the 5725A, for this discussion. Each 5725A function is described briefly next.

- 1100V AC Function:

The 1100V ac function can output 220 to 1100V, 40 Hz to 30 kHz; and 220 to 750V, 30 kHz to 100 kHz. The 1100V ac function is implemented with a gain of -100 amplifier. Input for the ac voltage function comes from the 5700A Oscillator, spanning the range of 2.2 to 11V. The 5725A returns an oscillator sense voltage of precisely -1/100 of the output voltage to the 5700A. Voltage outputs go through the 5725A/5700A interconnect cable to either the 5700A front or rear panel OUTPUT binding posts.

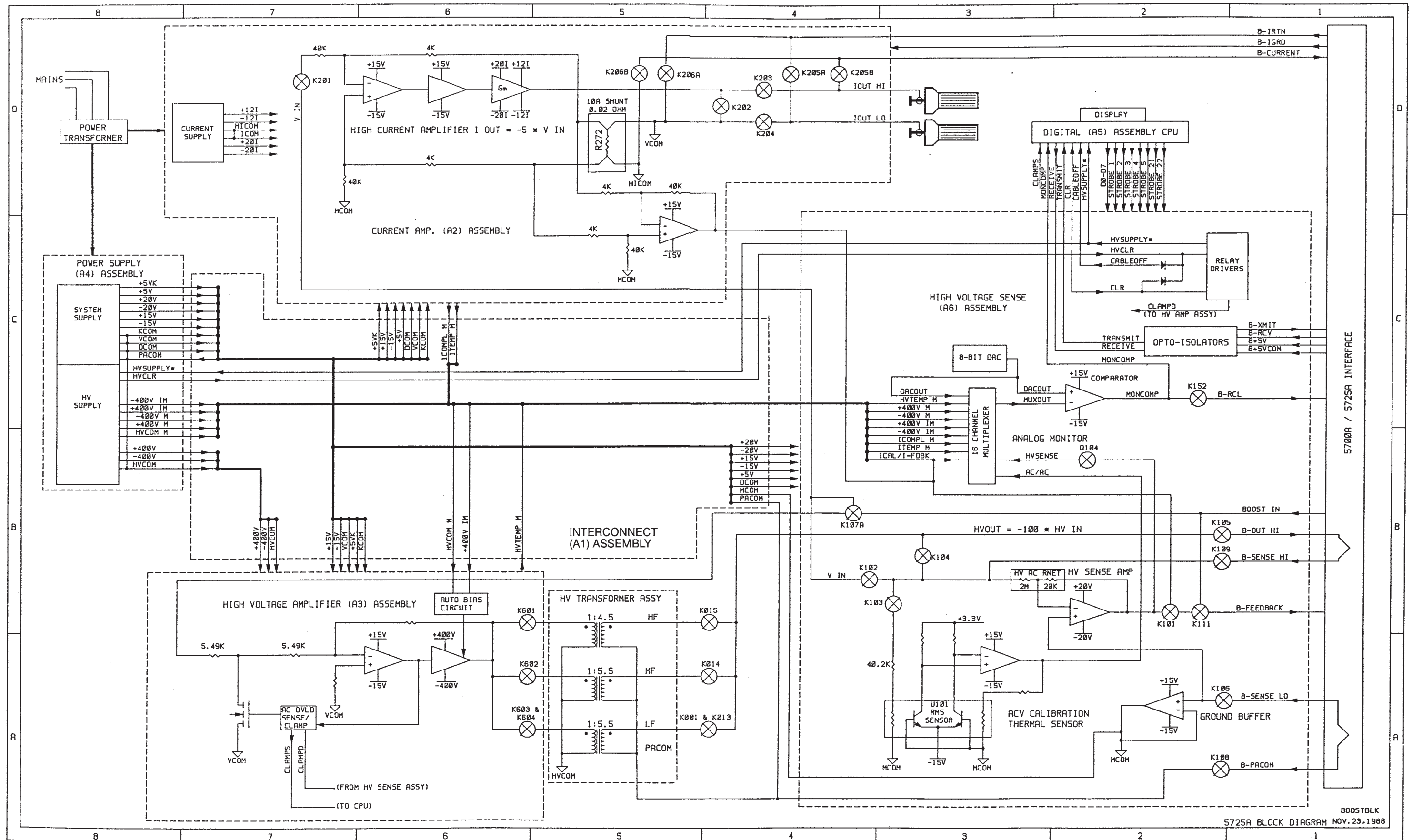


Figure 4-1. 5725A Overall Block Diagram

- 11A DC Function:

The 11A dc function is implemented with a transconductance (voltage in/current out) amplifier with a gain of -5. If the 5700A outputs -2V into the 5725A, the 5725A output is 10A. (This is transparent to the user.) The output range is 0 to 11A. The 5725A delivers amplified current to either the front or rear panel binding posts of the 5725A, depending on an internal hardware setup. Reconfiguration requires removing the covers, and is described in Section 6.

- 11A AC Function

The 11A ac function is similar to the 11A dc function. The frequency range is 40 Hz to 10 kHz. The output range is 1 to 11A rms. As in the dc current function, all outputs from the 5725A either go through the front or rear panel of the 5725A. Input to the 5725A comes from the 5700A Oscillator assembly.

### **4-3. 1100V AC Range Functional Description**

The 5700A Oscillator assembly generates the driving ac voltage, then sends it to the 5725A Power Amplifier for amplification. The 5725A returns an attenuated feedback voltage for output correction. The final output voltage is kept accurate by the high voltage sense amplifier and a real-time, software-controlled feedback loop within the 5700A, incorporating a 5700A ac/dc thermal rms converter. The 5700A Oscillator, DAC (digital-to-analog converter), and ac/dc thermal rms converter work together with the 5725A Power Amplifier and high voltage attenuator circuits to produce the desired output.

Active assemblies in the 5725A ac voltage function are as follows:

- In the 5700A: CPU, DAC, Oscillator, Oscillator Control, High-Resolution Oscillator, Switch Matrix, Motherboard, Rear Panel assemblies.
- In the 5725A: CPU, High Voltage Amplifier, High Voltage Sense, Signal Transformer, Power Supply, Digital, and Interconnect assemblies.

When an ac voltage in the 220 to 1100V range is selected, the 5700A calls the 5725A amplifier and leaves its own high voltage amplifier dormant. The 5725A takes over the 1100V ac range automatically. The 5725A produces ac voltage in the following sequence:

1. The 5700A sets the Oscillator assembly to the proper frequency and amplitude. The 5700A sets the initial amplitude using an 8-bit resistive hybrid dac located on the Oscillator amplifier assembly, yielding an Oscillator output accuracy of about 0.5%.
2. Next, the 5725A Power Amplifier amplifies this signal by -100 and returns an accurately attenuated signal to the 5700A.
3. The 5700A thermal sensor and adc (analog-to-digital converter) monitoring system fine tune the Oscillator amplitude. The DAC assembly output is switched directly to the Oscillator assembly, controlling the dac output amplitude. AC voltage calibration constants stored in the 5725A determine the 5700A DAC voltage setting.

The 5700A/5725A system uses the following method for ac amplitude control:

1. An rms thermal sensor alternately measures two signals: an unknown but adjustable ac signal, and a known calibrated dc signal.
2. The output of the thermal sensor is measured by the adc, allowing settling time for the sensor each time its input is changed. The ac signal is adjusted until the thermal sensor output is the same for both signals. Thus, the dc voltage at the output of the thermal sensor is not important, but differences in the dc voltage when the sensor input is switched between the ac variable and dc reference are important.

To ensure safe, reliable operation, the High Voltage Amplifier is turned on in the following sequence:

1. The 5700A Oscillator is set to the 22V range and its output is channeled to the 5725A High Voltage Amplifier on line BOOST IN.
2. Then the output of the High Voltage Amplifier is connected to the appropriate high voltage step-up transformer (one of three).

#### **4-4. 11A Range Functional Description**

The 5725A Current Amplifier is a transconductance amplifier that has a compliance voltage of 3.0V rms for the ac current function and 4.0V for the dc current function. The transconductance amplifier has a gain of -5 (e.g., 1V in gives -5A out). Either the 5700A 2V range for dc operation, or the Oscillator for ac operation, drives the transconductance amplifier. Input voltage to the transconductance amplifier comes in on BOOST IN (for ac current) or B-FEEDBACK (for dc current) and enters the High Voltage Sense assembly. From there it is routed to the error amplifier on the Current assembly whenever the 5725A is in the current function. The B-FEEDBACK line returns the current calibration amplifier output to OSC SENSE HI during ac current operation.

The following assemblies are active in the 5725A current function:

- In the 5700A: CPU, DAC, Oscillator, Switch Matrix, Motherboard, Rear Panel assemblies. (Plus the Oscillator assembly in the ac current function.)
- In the 5725A: CPU, Current, High Voltage Sense, Digital, and Power Supply.

#### 4-5. *Operation in the 11A DC Range*

For the dc current function, the 5700A is configured for the dc 2.2V range. The 5700A 2V dc range drives an error amplifier with an input impedance of 40 k $\Omega$ . The gain of this amplifier is determined by this 40 k $\Omega$  resistor with a 4 k $\Omega$  feedback resistor, and the value of the precision shunt. The 5725A uses a 0.02 $\Omega$  shunt for the 11A function. There is no feedback to the 5700A.

The 5725A monitors the error amplifier output voltage using the 16-channel multiplexer. One channel of the multiplexer, ICOMPL M, is scanned every 30 milliseconds or faster, with its output compared to -2V from the DAC. If the peak error amplifier output is more negative than the dac voltage, MONCOMP goes LOW and is read by bit 6 of port 5 of U507, the CPU. This indicates an overload condition, and lights the OVERLOAD LED. If a later scan shows the same result, the CPU trips the Current Amplifier into standby and reports this condition to the 5700A.

A soft-start from standby to operate transitions reduces sudden current changes. This allows the 5725A to drive inductive loads such as power meters and clamp-on type current probes.

#### 4-6. *Operation in the 11A AC Range*

For ac current operation, input to the 5725A comes from the 5700A Oscillator. The 5700A Oscillator is configured for the 2.2V ac range, with sensing back to the 5700A Oscillator coming from the current shunt through the calibration amplifier circuit (on the Current Assembly).

#### 4-7. ***Voltage and Current Standby Modes***

When a change in output function is selected, the 5725A goes through voltage or current standby mode before connecting the output to the 5725A binding posts, or to the 5700A. Voltage or current standby allows for local sensing within the 5725A, and for establishment of a known input condition in current and ac voltage.

#### 4-8. *Voltage Standby*

In voltage standby, the 5700A binding posts are completely disconnected from the rest of the instrument circuitry, and the 5725A high voltage output and sense lines (B-OUT HI and B-SENSE HI) are disconnected from the 5725A/5700A connector. The High Voltage Amplifier remains powered from the high voltage supply, but its input is grounded by pulling CLAMPD, and its output (MV OUT) is disconnected from the output transformers. Analog monitor circuitry continues to check the voltage and current on the high voltage supplies as well as the heat sink temperatures and cable integrity. It prevents the 5725A from switching to operate if a fault is present.

#### 4-9. *Current Standby*

In current standby, the binding posts are disconnected from the instrument circuitry, but all 5725A/5700A connections are made as in the operate mode. In dc current standby, the 5700A DAC supplies a voltage that corresponds to the dc current selected. In ac current standby, 5725A relay settings are identical to those for dc current standby. The 5700A Oscillator supplies an ac voltage level that corresponds to the selected output current and frequency.

#### **4-10. How the 5700A and 5725A Communicate**

The 5725A and 5700A maintain all analog and digital communication over an external cable connected to subminiature D-type connectors on the back of each instrument. All in-guard (analog) signals, except B-VGRD, connect to relays that isolate the 5725A and 5700A whenever the 5725A is not in use.

Digital communication occurs over five out-guard (digital) 5700A lines, B-SCT, B-SCR, B+5V, B+5VCOM, and B-CINT\*. The B+5V and B+5VCOM lines power the 5725A guard crossing and allow the 5725A to detect when the cable is disconnected. Lines B-SCT and B-SCR provide serial communication of data over an RS-232 type line. Optoisolators on the 5725A maintain the integrity of the guard. Line B-CINT\* is a hardwire loop that allows the 5700A to detect a cable off or 5725A power off condition.

#### **4-11. Description of the Out-Guard Lines (5725A Side)**

The following list describes the five 5725A out-guard lines:

- B-RCV (Serial Communication Receive)  
Receives serial data from the 5700A; connects to the B-SCT line of the 5700A.
- B-XMIT (Serial Communication Transmit)  
Transmits serial data to the 5700A; connects to the B-SCR line of the 5700A.
- B+5V  
5700A out-guard supply that powers optoisolators and 5725A CABLEOFF relay.
- B+5VCOM  
5700A out-guard supply common for above.
- B-CINT\* (Boost Cable Interlock)  
Hardwire "loop around system" on the 5725A that is polled at least every 100 ms by the 5700A to determine if the 5700A/5725A cable is connected and if the 5725A is turned on. Returns a low to the 5700A if above is true. A pull-up resistor on the 5700A leaves this line high if the interconnect cable is open or if the 5725A is turned off.

#### 4-12. Description of the In-Guard Lines

The following list describes the 11 5725A in-guard lines:

- **B-RCL**  
High-quality analog line from the 5725A which carries critical signals to be measured by the 5700A adc during either 5725A calibration or 5725A self diagnostics. During calibration, these signals are ICAL (output of the current calibration amplifier), HVSENSE (DC output of the sense amplifier during dc gain ac characterization), AC/AC (buffered output of the 5725A thermal rms sensor that does frequency characterization).
- **B-OUT HI**  
High voltage output from the 5725A step-up transformers, to be routed to either the 5700A front or rear panel terminals.
- **B-SENSE HI**  
High voltage sense line from the 5700A output terminals. This signal is then attenuated -100:1 by the High Voltage Sense assembly.
- **BOOST IN**  
During normal 5725A ac operation, carries the 5700A DAC outputs, which in turn drives either the High Voltage Amplifier or Current Amplifier. During 5725A calibration, BOOST IN drives the High Voltage Sense assembly with up to -260V from the 5700A Power Amplifier.
- **B-CURRENT**  
Analog line that carries the current high output from the 5700A. When the user sets the current output location to "5725A" in a 5700A menu, this signal is routed to the 5725A binding posts. Under this operating condition, all 5700A/5725A current ranges are available from the same binding posts. Line B-CURRENT carries up to 2.2A in normal operation. During current calibration, this line carries 1.3A to measure the value of the 0.02Ω 5725A current shunt.
- **B-IRTN**  
Current return for B-CURRENT; carries up to 2.2A. Line B-IRTN eventually ties to the same node as SCOM on the 5700A.
- **B-IGRD**  
Current guard voltage from the 5700A; enables internal guarding within the 5725A only.
- **B-VGRD**  
5700A guard. Enables discrete guarding/shielding within the 5725A.
- **B-PACOM**  
System common from the 5700A. Once inside the 5725A, it becomes VCOM, HVCOM, DCOM, and KCOM. B-PACOM is the current return for signals from the 5700A, including source current for driving the 5725A in the ac voltage function. Current output from the 5700A, when "5725A" is selected as the current output location, returns via B-IRTN.
- **B-SENSE LO**  
High quality ground from the 5700A that is the reference point for the 5700A DAC and Oscillator assemblies.

Inside the 5725A, B-SENSE LO is buffered by the 5725A, with the equivalent voltage called MCOM.

- B-FEEDBACK

During ac voltage operation, B-FEEDBACK is the output of the High Voltage Sense assembly; this signal represents B-SENSE HI divided by -100, and drives the 5700A ac/dc thermal sensor. During low-frequency ac voltage calibration, this is the sense path for the -260V dc from the 5700A Power Amplifier.

During ac current operation, B-FEEDBACK is the output of the current calibration amplifier. It represents the output current divided by -5 and drives the 5700A Oscillator feedback.

During dc current operation, voltage from the 5700A 2V dc range is fed to the 5725A on B-FEEDBACK.

If B-FEEDBACK is out of tolerance during 5725A ac voltage or current operation but no other faults are reported, the 5700A sends a message to the 5725A asking for a sequenced shutdown into standby, and displays a fault message on its Control Display. The 5725A FAULT indicator lights. A faulty 5700A/5725A interface connection could cause this problem.

#### **4-13. Functional Summaries by Assembly**

For an overview of all the assemblies in the 5725A and the functions contained on each, refer to Figure 4-1, the overall block diagram, and the following list:

- Interconnect Assembly (A1):
  - Connectors and traces to link other assemblies and fan
  - High voltage transformer secondary switching circuitry
- Power Supply Assembly (A4):
  - Rectifiers for high voltage supplies
  - Filters for high voltage supplies
  - High voltage current-limit circuitry
  - High voltage supply-monitoring circuitry
  - Rectifiers for system supplies
  - Filters for system supplies
  - Regulators for system supplies
  - Rectifiers for fan supply
  - Filter for fan supply
- Digital Assembly (A5)
  - LED front panel status annunciators
  - CPU, RAM, ROM, EEROM, watchdog timer, logic
- Current Amplifier Assembly (A2):
  - Transconductance amplifier
  - Current shunt
  - Heat sink and current power devices
  - 5700A current routing circuits
  - Filters for high current supply
  - Rectifier bridge for high current supply
  - Regulators for low current supply
  - Current heat sink temperature monitor



- High Voltage Power Amplifier Assembly (A3)
  - Power amplifier
  - Harness to heat sink and its high voltage power devices
  - Connections to the output transformers
  - High voltage heat sink temperature monitoring circuitry
- High Voltage Sense Assembly (A6):
  - High voltage sense (attenuator) and calibration circuits
  - 5725A input and output switching relays, relay drivers
  - Analog monitor, an 8-bit dac, latch for mux, latch for dac
  - Subminiature D-type connector to the 5700A
  - 5700A current routing circuits
  - Guard crossing
  - AC line power selection circuitry
  - AC line inrush current limiting circuitry

#### **4-14. Detailed Circuit Description**

Detailed circuit descriptions for each pca (printed circuit assembly) are provided next. Individual block diagrams are provided for the Current Amplifier (A2), High Voltage Amplifier (A3), High Voltage Sense (A6), and Digital (A5) assemblies. You may also find it helpful to refer to the schematic diagrams (Section 9) while reading theory for each assembly.

#### **4-15. Interconnect Assembly (A1)**

The Interconnect assembly (A1) links the other five assemblies in the 5725A. The interconnect assembly contains the following parts:

- Connectors and traces to interconnect the other assemblies and the fan. There are three 32-pin DIN connectors on the Interconnect pca which connect the Power Supply assembly (A4), High Voltage Amplifier assembly (A3), and Current Amplifier assembly (A2). A 64-pin DIN connector links the Interconnect assembly to the High Voltage Sense assembly (A6). A 34-pin ribbon cable connector links the Interconnect assembly to the Digital assembly (A5). Other cable assemblies attached to the Interconnect assembly go to the fan, High Voltage assembly output, and high voltage transformers.
- High voltage transformer secondary-switching circuitry. Three high voltage reed relays (K013, K014, and K015) select one of three ac voltage output transformers. A fourth relay (K001) is a high voltage armature type that connects the secondaries of the low-frequency transformer in either a series or parallel fashion.

The circuit board has four layers. Most connections are done on the inner two layers. One outer layer is an earth ground plane; the other outer layer is tied to the signal VCOM.

#### 4-16. Power Supply Assembly (A4)

The Power Supply assembly (A4) provides regulated system supplies for all 5725A assemblies except as noted below, as well as unregulated fan supply and high voltage supplies for the High Voltage Amplifier. The assembly also includes microprocessor-controlled switching and an independent current-limit circuit.

*Note*

*Other power supplies are contained on the Current Amplifier assembly (A2). The A2 assembly includes a high-current supply and a local  $\pm 20V$  supply.*

The Power Supply assembly has four sections: high voltage supply, switching, current limit, and system supply section. Each section is first briefly described, then described in detail.

- High Voltage Supply Section

The high voltage supply section consists of a simple unregulated power supply with the additional capability of being run at  $\pm 400V$  dc for normal instrument operation, or at  $\pm 50V$  dc for troubleshooting.

- Switching Section

The switching section behaves like an electronic DPST switch, which by command of the microprocessor or the current-limit section, shuts down the high voltage supplies. Microprocessor control alone can turn on the high voltage supplies in normal operation. At the board level, manual control of the switch is possible to enable stand-alone turn on of the Power Supply assembly (A4) and the High Voltage Amplifier assembly (A3).

- Current-Limit Section

The current-limit section shuts down the high voltage supply in a latching mode if excessive current is drawn by the High Voltage Amplifier or if the  $\pm 15V$  or  $+5V$  supplies fail. This section of the Power Supply assembly consists of a pair of shunts, a pair of comparators, and a system supply monitor.

- System Supply Section

The system supply section contains various regulated power supplies, and is comprised of five linear regulators. In addition, the system supply section contains an unregulated supply for the fan.

#### 4-17. High Voltage Supply Section

The high voltage supply allows normal operation from a pair of nominal 400V dc supplies, or troubleshooting operation in a reduced voltage mode with a pair of nominal 50V dc supplies. Switching between normal and reduced-voltage operation is done by removing the plug from J301 and inserting it into J303. See Section 7 for the procedure to do this. (Plug P301 is wired with both 400V and 50V transformer taps so that the 400V taps are connected in the circuit when P301 is plugged into J301, and the 50V taps are connected in the circuit when P301 is plugged into J303.)

Two sets of high voltage rectifiers, CR301 through CR304 and CR310 through CR313, form bridge rectifiers for the positive and negative supplies, respectively. The output from these bridges is filtered by C301/C321 and C320/C322. The capacitor pairs are configured in series to obtain the necessary working voltage. Bleeder resistors R303, R314, R315, and R 308 discharge C301/C321 when power is removed and form a voltage divider that equalizes the voltage across halves of C301. Resistors R335, R337, R336, and R339 do the same function for C302/C322.

#### **Warning**

**Do not rely on the power supply LEDs as an indication of the presence of high voltage. Always use a voltmeter to check for high voltage between TP307 and TP301, and between TP307 and TP304.**

Components CR317 and CR318 are high intensity red LEDs that provide visual indication of the presence of high voltage. These LEDs have high luminosity at low current levels. They are located in series with the bleeders for the positive and negative supplies, using about 1 mA of current for bias. Under average lighting conditions, these LEDs are visibly lit with as little as 40V on C301/C321 and C320/C322. Zeners VR306 and VR307 are normally off, as their zener voltages are greater than the forward voltage of the LEDs. However, should an LED fail, these zeners carry enough current to allow the bleeder resistors to function.

Fuses F301 and F302 protect the transformer against overload in case the 400V supplies are shorted. Without these internal fuses, a short-circuit would cause excessive power dissipation in the power transformer, even though ac line current would be insufficient to blow the main fuse. Table 4-1 lists data for fuses F301 and F302, and the other internal fuses in the 5725A.

#### **Caution**

**For safety, replace internal fuses only with fuses of the rating and type specified in Table 4-1.**

Surge arrester E302 fires if the secondary voltage of the +400V supply exceeds 600V. This should only occur if the 5725A is plugged into an ac line voltage of 200V or more when it is set to 100-120V. E302 would then draw enough current to blow the main fuse, thereby protecting the 5725A.

**Table 4-1. Internal Fuse Data**

REF DES.	ASSEMBLY	RATING	TYPE
F301	Power Supply (A4)	2A, 600V	Littelfuse BLS or equivalent
F302	Power Supply (A4)	2A, 600V	Littelfuse BLS or equivalent
F201	Current Amplifier (A2)	20A, 32V	Bussman AGC or equivalent
F202	Current Amplifier (A2)	20A, 32V	Bussman AGC or equivalent

#### 4-18. Switching Section

MOSFETs Q301/Q317 and Q302/Q318 (each in parallel) are series-switch elements for the +400V supply. Similarly, Q312/Q319 and Q313/Q320 are series-switch elements for the -400V supply. Resistor pairs R301/R302 and R342/R343 equalize the voltage across the transistors in their "off" state. Series transistors guarantee operation within the MOSFET 500V absolute rating.

The MOSFET switches are controlled by the signal at TP305. When this point is at +5V, the series connected base-emitter junctions of Q305/Q307 and Q304/Q306 are zero biased. In this condition, only leakage current flows through Q305/Q307 and Q304/Q306, which is insufficient to develop enough source-gate voltage to turn on Q301/Q317, Q302/Q318, Q312/Q319, or Q313/Q320. When TP305 is taken low, the series base-emitter junctions are now forward biased sufficiently so that the Q305/Q307 and Q304/Q306 pairs conduct with about 0.5 mA collector current. This current flows through the source-gate resistor and zener diode bias networks of Q301/Q317, Q302/Q318, Q312/Q319, and Q313/Q320. The zener diodes limit the source-gate voltage to near 15V, which is enough to turn on the MOSFETs completely without exceeding their source-gate voltage ratings.

Transistors Q303/Q321, Q311/Q323, Q315/Q322, and Q316/Q324 are emitter followers that prevent Q305 and Q307 from experiencing excessive collector-emitter voltages in their "off" state. The networks of resistors, capacitors, and diodes formed by R344/C305/CR305, R327/C304/CR316 and R345/C306/CR309 are included to slow supply turn-on to prevent a transient current-limiting condition, while still allowing rapid supply turn-off.

Resistors R310/R311/R306 provide a divided voltage for low-level monitoring of the +400V supply by the analog monitor on the High Voltage Sense assembly (A6). Resistors R332/R346/R347 do the same for the -400V supply. Diodes CR314, CR315, CR319, and CR320 prevent damage to the series-switches from inductive kickback during shutdown.

Control over the potential at TP305 is controlled in one of the two following ways:

1. In normal operation (P301 plugged onto the E301 header where the label SYS appears, pins 1 and 2), the microprocessor strobes the control data HVSUPPLY\* into U302 by pulsing HVSTROBE. This action occurs in parallel with writing HVSUPPLY\* information into a latch on the High Voltage Sense assembly (A6), but there the sense of the HVSTROBE line is inverted.

Transistor Q304 provides correct polarity to the clock of U302. At any time, the supply can be switched off (i.e., TP305 brought to +5V) independent of the processor by the current-limit circuitry or by SW301 pulling the "set" line of U302 high (TP306).

2. To turn on a Power Supply assembly (A4) by itself for troubleshooting, you can plug P301 onto the E302 header where the label MAN appears (pins 2 and 3). This allows momentary-contact pushbutton switch SW302 to generate a strobe signal for U302, turning the supplies on. You turn the supplies off by pressing switch SW301. You may wish to troubleshoot in the low-voltage mode by plugging the high voltage secondary plug into J303. Section 7 contains the procedures to do this.

#### 4-19. Current-Limit Section

Resistors R313 and R329 are current shunts for the high voltage supplies. These are connected in series with the bridge rectifiers, with the common point between the shunts being the high voltage supply common, HVCOM. The voltage developed across the +400V shunt is negative; the voltage across the -400V shunt is positive.

The shunt voltages, +400V IMON and -400V IMON, in addition to being monitored by comparators in the current-limit section, are routed via the Interconnect assembly (A1) to the High Voltage Sense assembly (A6), where they are scanned by the analog monitor, and to the High Voltage Amplifier assembly (A3) to control the autobias circuitry. The negative current monitor signal is clamped by CR307 and filtered by R328 and C308 before being directly compared to 0.36V by U301B. The positive current monitor is more complicated because of its negative value. To stay within the common-mode operating range of U301A, the shunt signal is first summed with a reference voltage via the R319/R318 network, after which it is clamped by CR306 and filtered by C308. The comparator switching level is 0.18V. The summing network scales the shunt signal for equal supply trip currents.

The outputs of U301A and U301B are open collector, which allows them to be wire-OR'ed with the open drain output of Q309. The output of this logic drives Q308, resetting the high voltage supply switches and signaling the processor via HVCLR. Transistor Q310 monitors the presence of the  $\pm 15$ V supplies. If either of these supplies fail, the high voltage supplies are switched off.

#### 4-20. System Supply Section

The digital/relay power supply tap (+5V) is routed via J350 through RT350 and bridge rectifier CR351. A positive temperature-coefficient thermistor protects the instrument from the secondary supply short circuits. This prevents them from thermally stressing the power transformer. Three-terminal regulator U350 regulates the digital/relay supply with 1% initial tolerance and about 2% accuracy over temperature. Capacitor C350 filters the input of U350; C351 filters the output.

The +5V digital supply powers both logic and relays. The power for each routes away from the +5V regulator separately, via lines +5V and +5VK. This prevents relay drive currents from causing drops in the logic supply voltage.

Because the  $\pm 20$ V supplies draw little current, they can share power transformer secondary windings with the  $\pm 15$ V supply with little efficiency lost. This center-tapped winding is brought to the Power Supply assembly via J350, where each half of the winding is protected from short circuits by a thermistor. Bridge rectifier CR355, as well as filter capacitors C353 and C356 again serve both supplies. The center tap of this transformer winding forms VCOM, to which PACOM and HVCOM are tied to provide a common reference for the instrument.

An accurate +15V supply is obtained by using U351. Regulator U352 regulates the -15V supply.

An accurate +20V supply is obtained by regulating with U353, a 5V regulator, but referencing it to the accurate +15V supply. VR351 forces U353 to be forward biased as the +15V supply comes into regulation. This avoids powering up the +20V supply through CR359 (at the improper voltage), reverse biasing U353.

A discrete regulator makes the negative -20V supply accurate. U354 is an error amplifier that forces the junction of R352 and R350 to be 0V. In doing so, the -20V supply is forced to be the inverse of the +20V supply within the matching of R350 and R352. Transistor Q350 provides a pass element for the negative regulator; VR352 provides level shifting so that the drive required from U354 is within its output swing range.

#### 4-21. Fan Supply Section

The fan supply uses the same transformer secondary windings as the  $\pm 15$  and  $\pm 20$ V supplies. Its own full-wave bridge rectifier diodes create a supply voltage of +25V. Transistor Q351 is operated near saturation, and provides the measurement point to tell the CPU whether the fan is running. The output of Q351 is sent to the analog multiplexer on line -FAN to accomplish this.

#### 4-22. Digital Assembly (A5)

From a software standpoint, digital circuitry functions as a subset of the 5700A in-guard CPU. Digital circuitry resides on three assemblies within the 5725A: the Digital assembly (A5), the High Voltage Sense assembly (A6), and the Current Amplifier assembly (A2). All the 5725A hardware, including digital, is in-guard, except for the guard crossing and the CABLEOFF detection circuit.

Figure 4-2 is a block diagram of the Digital assembly. The Digital assembly contains most of the digital circuitry, including the following:

- Microcomputer (Hitachi 6303Y CMOS)
- External RAM (CMOS static)
- External ROM
- EEROM (2Kb X 8)
- Break-detect circuitry
- Power up and reset circuitry
- Watchdog timer circuitry
- Front panel LEDs
- LED decoder and driver

The High Voltage Sense assembly (A6) contains the optoisolator link (guard crossing) to the 5700A Main CPU and the CABLEOFF circuit.

The Current Amplifier assembly (A2) contains the interface to the digital bus (two latches and three relay drivers) and a relay driver chip.

#### 4-23. Microcomputer

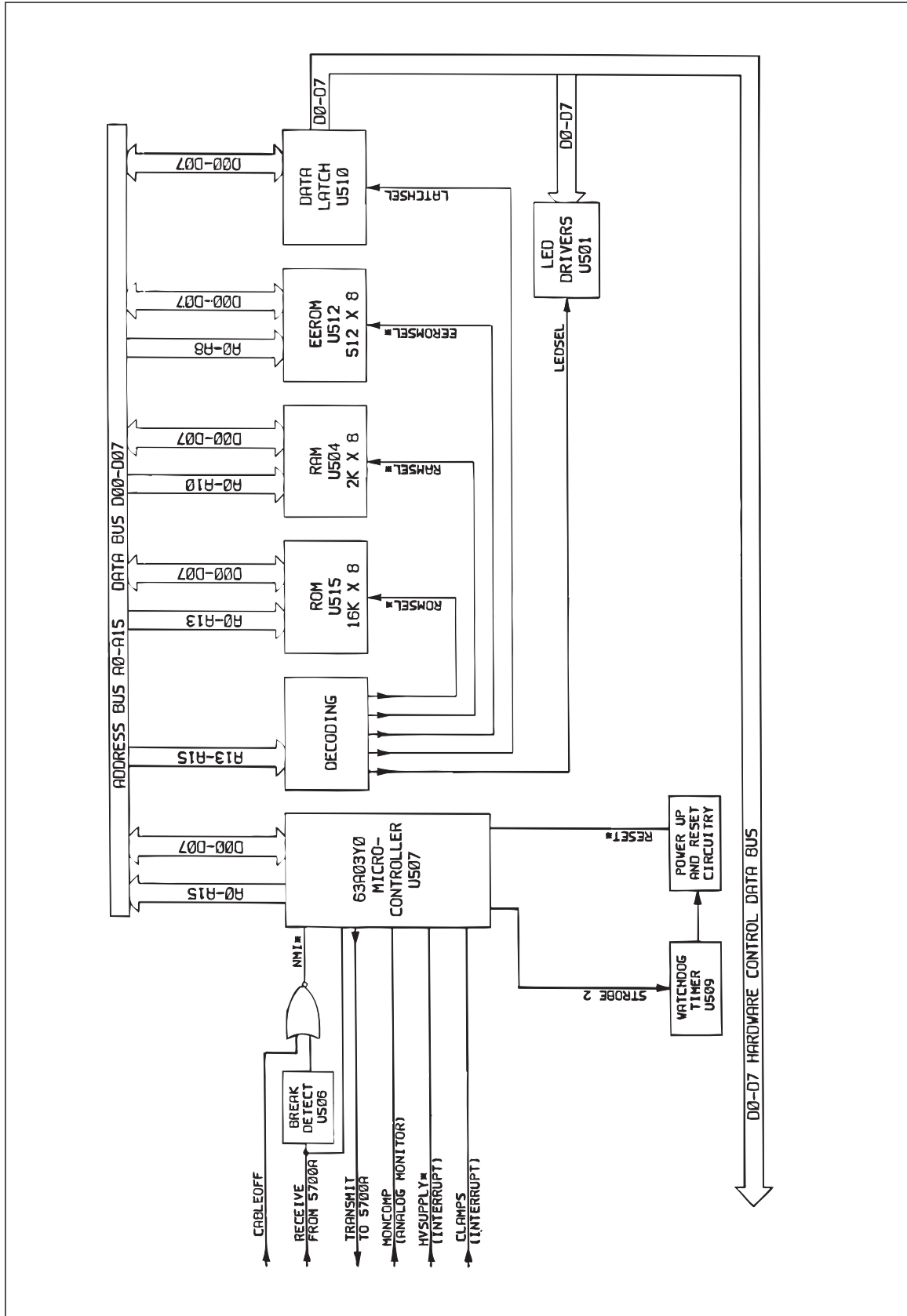
The 6303Y CMOS microcomputer is configured for Mode 1 operation, with external RAM and external ROM. Port 3 provides a common data bus (D00-D07), while port 1 and bits 0 through 5 of port 4 provide the address bus (A0-A13). Bits 6 and 7 of port 4 are address lines A14 and A15.

#### 4-24. External RAM.

External RAM is enabled whenever A15 is high, A14 is low (hex 8000-BFFF), and either RD\* or WR\* is true. Reading and writing is controlled by bit 2 of port 7.

#### 4-25. External ROM

The external ROM (U515) is enabled via ROMSEL\* whenever A15 and A14 are high (hex C000-FFFF). Bit 0 of Port 7 (RD\*) is OUTPUT ENABLE\*.



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Figure 4-2. Digital Assembly Block Diagram

#### 4-26. EEROM

A 2Kb X 8 EEROM (U512) stores 5725A calibration constants plus the date and temperature of calibration. If the rear panel CALIBRATION switch is in the NORMAL position, the EEROM is software write disabled. The 6303Y reads the CALIBRATION switch via bit 1 of port 5 and enables the EEROM when the switch is in the ENABLE position. The EEROM is selected when A15 and A14 are low, A13 is high (2000 through 3FFF), and either RD\* or WR\* is TRUE. Writing is controlled by bit 2 of port 7 and the RESET\* line.

The 5725A does not automatically format its own EEROM. The 5725A informs the 5700A Calibrator if a problem has been encountered at power-up. The 5700A assumes responsibility for formatting the 5725A EEROM.

#### 4-27. Data Latch

The Data Latch (U510) is enabled via LATCHSEL when three conditions are met: address bit A15 is 0, A14 is 1 (hex 4000-7FFF), and WR\* is 0 (true). Data Latch U510 (a 74HCT373) latches information on the external data bus (D0-D7) and sends this information to the LED latch (U501), Current Amplifier assembly (A2), and the High Voltage Sense assembly (A6).

#### 4-28. Strobe Lines

The Current Amplifier (A2) and High Voltage Sense (A6) assemblies tie to the Data Latch external data bus output with latching relay drivers and/or latches. Information is strobed into the respective relay drivers/latches by the state of any of the seven strobe lines. The seven strobe lines (STROBE 1-5,21,22) and a clear line (CLR), all asserted high, are buffered (U503) outputs on port 6. An additional strobe line called HVSTROBE, for use by the High Voltage Sense and Power Supply assemblies, is created from STROBE 2 combined with STROBE 2 ENABLE\* and HVSUPPLY\*.

Line HVSUPPLY\* is generated on the High Voltage Sense assembly. The strobe rate varies from 50 ms for STROBE 2 to over 100 ms for the other strobe lines. The CLR line opens all relays except K202.

#### 4-29. Led Driver

Front panel LEDs are driven by U501, a 74HCT373 latch, which is capable of sinking 35 mA of LED operating current. An output LOW turns an LED on. The LED driver is selected by bit 7 of port 5, LEDSEL.

#### 4-30. Optoisolator Link

An optoisolator circuit links the two-channel guard crossing. This guard crossing circuit and the related 5725A/5700A interconnection reside on the High Voltage Sense assembly (A6). Serial communication to and from this guard crossing uses the RECEIVE and TRANSMIT lines, respectively.

When the 5725A is not being used, all cable inputs into the 5700A are tied to the 5700A guard to shunt noise currents away.



#### 4-31. Break-Detect Circuitry

The 6303Y divides the 4.9152-MHz crystal frequency by four to create the 1.2288-MHz ECLK. This signal serves as the clock for the 74HC4020 counter (U506), which is configured as a divide-by-16384. The RECEIVE line is usually high, except for the brief interval when characters are being transmitted. As long as the low state is less than 13.34 ms, RECEIVE holds the CLR of the 74HC4020 TRUE. However, if communication between the 5725A Amplifier and the 5700A Calibrator fails, the 5700A attempts to reset the 5725A by sending a break (holding RECEIVE low for greater than 26.7 ms). This action causes the 74HC4020 counter output (BREAK) to go high. Signal BREAK is NOR'ed with CABLEOFF from the High Voltage Sense assembly (A6); either signal causes a NON-MASKABLE INTERRUPT to the 6303Y. The 5700A also uses BREAK to reset the 5725A.

#### 4-32. Power Up and Reset Circuitry

Reset and glitch-detection circuitry primarily consists of U508, a TL7705A. This chip detects if the power supply falls below 4.5V, if a reset input from a momentary contact switch occurs, or if there is an output from the watchdog timer. Any combination of these conditions resets the board via RESET\* for 130 ms.

#### 4-33. Watchdog Timer

Watchdog circuitry contains a 4538 Dual Monostable Multivibrator. The first multivibrator (U509A) is configured as a 300 ms retriggerable one-shot that can fire a second 3 ms one-shot (U509B). Control line STROBE 2 of the 6303 (bit 1, port 6) retriggers the first one-shot every 50 ms and refreshes the high voltage relay driver. If STROBE 2 is stuck high or low during operation, the first one-shot is no longer retriggered, and its output transitions low. The second one-shot, configured to trigger on a falling edge, now sends a pulse via RESIN\* to the TL7705A reset IC U508. This action forces the reset circuit to pull a hard reset on the 6303Y for 130 ms.

The first trigger to the 4538 occurs when the 7705A RESET\* line makes a transition from low to high. During normal operation, STROBE 2 prevents another reset by retriggering the first one-shot well before the 300 ms timeout. The watchdog fires only if the CPU is executing erroneous code which does not activate STROBE 2.

#### 4-34. Current Amplifier Assembly (A2)

The Current Amplifier assembly enables the 5725A to extend the current output range of the 5700A Calibrator to  $\pm 11$ A dc or 11A ac. The 5700A drives the Current Amplifier assembly input through the 5725A interface cable. There are no user input terminals. Output current is available at binding posts on the 5725A front or rear panel. Selection of front or rear 5725A binding posts is done by unplugging one cable and plugging in another cable on the Current Amplifier assembly inside the 5725A chassis. Additionally, relays on the Current Amplifier assembly can route the 5700A current source to the 5725A output terminals, if so selected at the 5700A front panel (or by remote command).

The Current Amplifier assembly has five distinct sections: the error amplifier, output, control, monitor, and power supply. Each section is first briefly described, then described in detail in the following paragraphs. Refer to Figure 4-3, a block diagram of the Current Amplifier assembly, to see the interrelationship of the following function blocks.

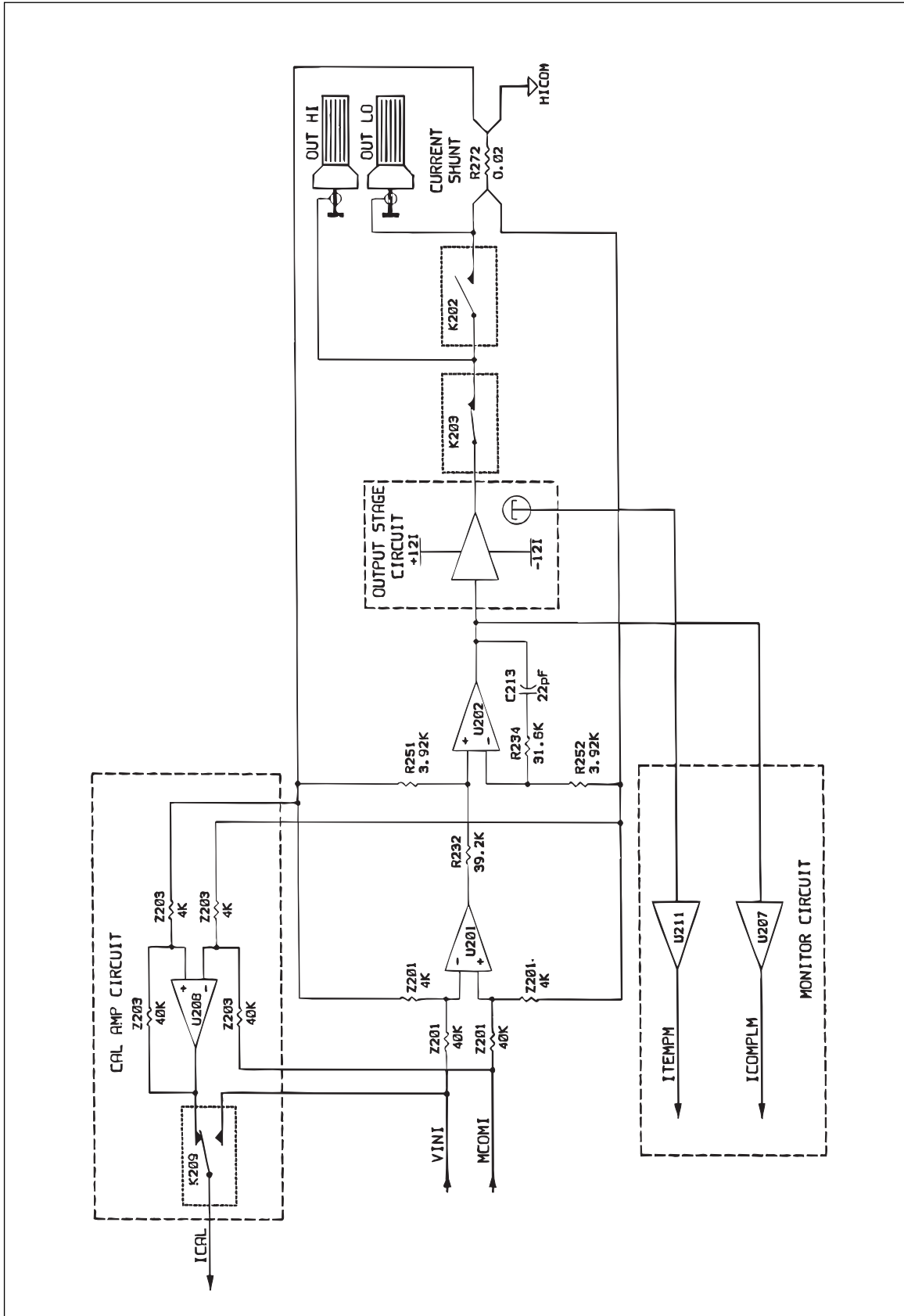


Figure 4-3. Current Amplifier Assembly Block Diagram

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- Error Amplifier Section

The error amplifier section contains three differential amplifiers and a precision high-current shunt resistor. Two differential amplifiers set the gain and uncorrected frequency response of the current amplifier. The remaining differential amplifier is used during the internal portion of 5700A/5725A calibration and during ac current operation.

- Output Section

The output section contains several power transistors, a heat sink, two operational amplifiers, a current buffer amplifier, two current sensing resistors and related components. The output stage is driven by the error amplifier section, converting a  $\pm 3V$  signal into a  $\pm 15A$  signal. The output section is powered by floating supplies that are referenced to the ICOM current common. The output stage is designed to drive inductive loads.

- Monitor Section

The monitor section contains several op amps and comparators, and a thermistor. A temperature monitor circuit observes the temperature of the voltage output transistors. Excessive output compliance voltage is detected by the drive monitor circuit. Both monitor circuits send scaled voltages to a multiplexed comparator on the High Voltage Sense assembly (A6), where abnormal operating conditions are detected.

- Control Section

The control section contains nine relays, a latched relay driver, several transistors, and a quad comparator. The relays and transistors switch the Current Amplifier into ac current and dc current operating states, a standby state, and several self calibration and diagnostics states during which 5725A operation is monitored and characterized by measurement circuitry and software residing in the 5700A.

- Power Supply Section

The power supply section contains two bipolar power supplies. Regulated  $\pm 20V$  supplies and unregulated  $\pm 12V$  supplies are referenced to ICOM and power only the output section. The error amplifier section and control section are powered from the  $\pm 15V$  and  $+5V$  5725A system supplies.

#### 4-35. Error Amplifier Section

Refer to page 1 of the Current Amplifier schematic. Components U201, Z201, R235, C230, and Q211 make up the "outer loop error amplifier," a differential amplifier with high common-mode rejection ratio. The outer loop error amplifier controls a first-order feedback loop that determines the dc accuracy and uncorrected ac frequency response of the current amplifier. Q211 shuts off the outer loop error amplifier during standby and, through modulation of its channel resistance by R255 and C210, yields a soft-start transition into the operate modes.

Components U202, R232, R241, R251, R252, R234, C213, and Q213 comprise the inner loop error amplifier. The inner loop error amplifier works with the outer loop amplifier in a second-order feedback loop that significantly diminishes the effects of output stage non-linearities. Q213 reduces the inner loop gain during standby.

Refer to page 2 of the Current Amplifier schematic. Resistor R272 is a specially constructed  $0.02\Omega$  shunt resistor that senses the Current Amplifier output. U208 and Z203 comprise a gain of ten differential amplifier called the calibration amplifier (Cal Amp). The calibration amplifier scales the voltage dropped across R272, creating a signal

(ICAL, TP208) with the same amplitude and polarity as the current amplifier input voltage. The calibration amplifier output is measured by circuitry within the 5700A during calibration of the 5725A current amplifier. The calibration amplifier output is fed back to the 5700A Oscillator during ac current operation.

The feedback signal from the precision shunt is applied to both the inner and outer loop error amplifiers (ISENSE HI, ISENSE LO , pages 1 and 2). The error amplifier section drives the output stage (TP204) so that the voltage across R272 is one-tenth of the Current Amplifier input voltage (VINI). Thus, the Current Amplifier is a transconductance amplifier: output current is proportional to input voltage. This transconductance is  $-5\text{A/V}$ .

#### 4-36. Output Stage Section

Refer to page 1 of the Current Amplifier schematic. Components U203, R203, R204, and R209 convert the bipolar ground-referenced output signal from the error amplifier section into two unipolar supply-referenced waveforms at the inputs to U204A and U204B. IC U203 also isolates the output stage, which is referenced to a floating common (ICOM), from the rest of the circuitry, which is referenced to circuit common (VCOM). The operation of the positive and negative output halves are similar. Only the positive output section is described below.

In response to a positive polarity error amplifier output (TP204), the current through R209 increases. This same current flows into pin 2 of U203, causing the voltage drop across R203 to increase. The voltage across R203 is applied to the positive input of U204A. U204A drives Q203, Q205, and Q207 until the voltage at the emitter of Q207 is identical to the voltage at the non-inverting input of U204A. Test point TP204 is a test input for the output stage when in standby mode. The resulting output stage current can be monitored at TP208 with a scaling of 200 mV/A.

The quiescent operating point of the output devices is fixed by the bias current of U203 and current source CR205 at about 1A. There is no output stage bias adjustment.

Capacitor C235 and resistors R256 through R260 provide a tertiary feedback path that guarantees stability when the 5725A is driving the specified inductive loads.

#### 4-37. Monitor Section

Refer to page 1 of the Current Amplifier schematic. Components U211C and D, U210C, RT203, CR207, and associated resistors and capacitors make up the temperature-monitoring circuit. Heat sink temperatures above approximately 85°C signal the ITEMPM fault condition.

Components U207, R280 through 284, and C234 generate a negative voltage at TP207 (DRIVE MONITOR) that remains less than 3.1V in magnitude when the output compliance voltage is within the linear operating range of the output stage. The output compliance voltage is not measured by the drive monitor circuit; an overcompliance condition is inferred from excessive error amplifier output.

#### 4-38. Control and Switching Section

Refer to page 2 of the Current Amplifier schematic. Relays K201 through 209, Q214 through 216, and U209 through 210 configure the Current Amplifier circuitry for the following six modes:

- **Current Standby**  
Current Amplifier input is active through K201. Current Amplifier output is disconnected from instrument output terminals but is routed through the sense path through K202.
- **Operate1**  
Input is connected to BOOST IN and MCOM. Output is connected to front or rear output terminals. FET switches Q211 and Q213 are off, enabling the error amplifier circuitry. Operate1 is the active mode for delivering up to 11A (ac or dc) to a UUT.
- **Operate2**  
The Current Amplifier is configured as in standby mode, except K201 is off. 5700A current source is routed to the 5725A current output terminals through K205. Operate2 is the active mode for delivering 2.2A or less to the 5725A terminals unless the 5725A 11A current range has been explicitly enabled from the 5700A front panel or by remote command.
- **Calibrate1 (Shunt Calibration)**  
Input is shorted. Error amplifiers are disabled with Q211 and Q213. Output is routed directly to current return path through K207, bypassing sense circuits. 5700A current source is routed through K206 to the 5725A current sense path. Procedures performed during Calibrate1 determine the value of R272. This is one of the factors in the dc gain and the only factor in the ac gain of the Current Amplifier.
- **Calibrate2 (Offset Calibration)**  
The amplifier is configured as in Calibrate1, except with its output routed by K208 to the 5700A. Procedures performed during Calibrate2 determine the dc offset of the Current Amplifier.
- **Calibrate3 (Gain Calibration)**  
Input is connected to BOOST IN, B-FEEDBACK, and MCOM as in Operate1, but Output is routed through the current sense path through K202. Output is not connected to output terminals. Procedures performed during Calibrate3 determine the gain of the error amplifier, the other factor in the dc gain of the Current Amplifier.

#### 4-39. Power Supply Section

Refer to page 3 of the Current Amplifier schematic. The unregulated, high-current supply is made from K208 through 209, F201 through 202, CR206, and C218 through C221.

The regulated  $\pm 20\text{V}$  supplies are composed of RT201 through 202, U205, U206, CR212 through 215, C222, C223, and associated components. Thermistors RT201 and RT202 are PTC thermistors for current limiting and transformer protection.

#### **4-40. High Voltage Amplifier (A3)**

The High Voltage Amplifier assembly, operating with the step-up signal transformers, constitutes an amplifier with an inverting gain of 100. It amplifies 2.2V to 11V signals from the 5700A Oscillator and returns 220V to 1100V to the 5700A where they go to the 5700A OUTPUT HI/OUTPUT LO binding posts. The signals to and from the 5700A come through the High Voltage Sense assembly (A6) where they are switched.

The High Voltage Amplifier assembly consists of an input amplifier, integrator, window comparator, input clamp, transconductance and cascode stage, midstage, midstage -400V filter, high voltage heat sink assemblies, autobias current source, autobias sense circuit, high voltage amplifier feedback, and temperature monitoring circuits.

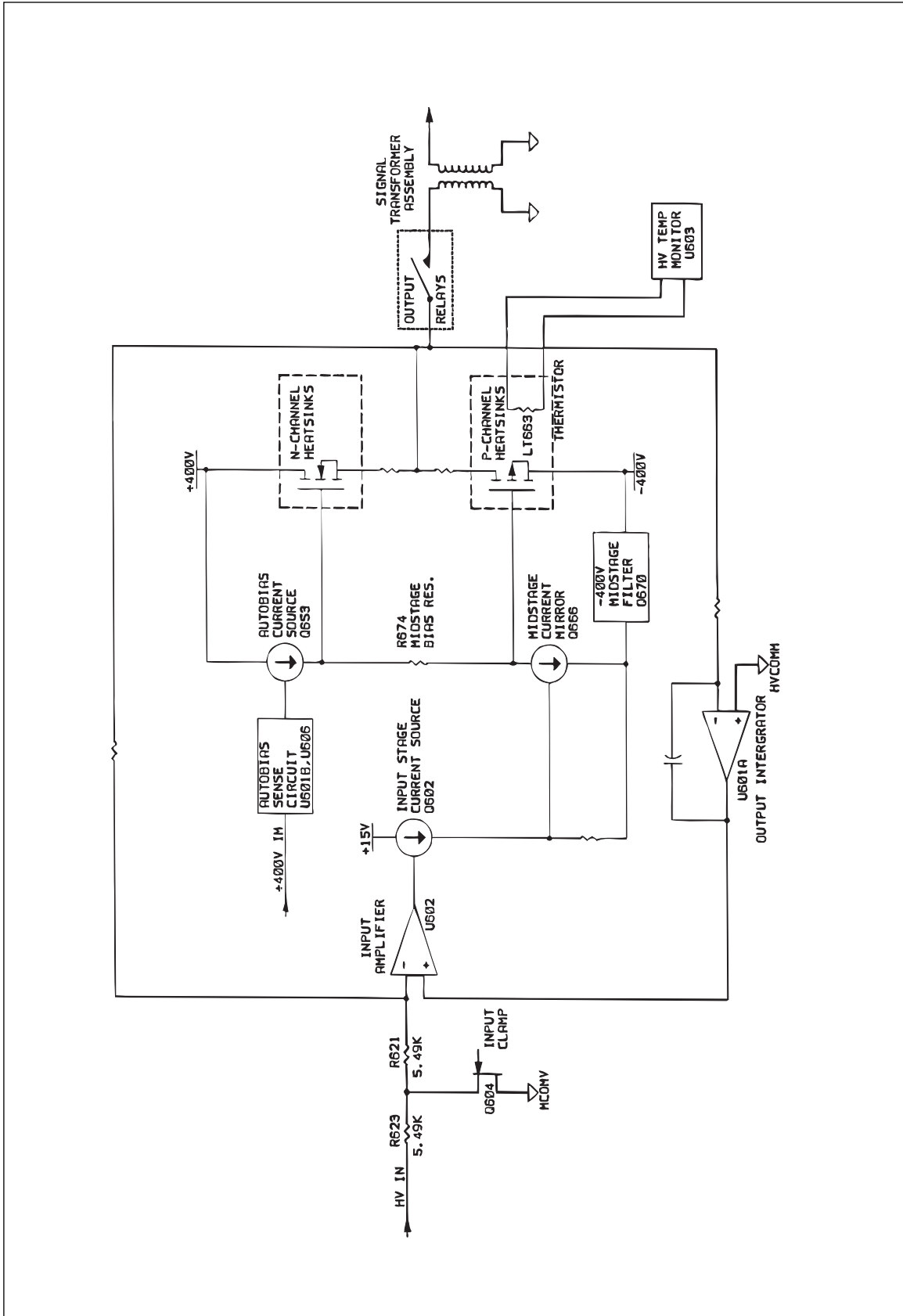
The High Voltage Amplifier drives the primary winding of the appropriate signal transformer depending on the frequency of operation. Signal transformers are interfaced to the High Voltage Amplifier via connector J604. Relays that select signal transformers are mentioned under the heading "Signal Transformers" further on.

The High Voltage Amplifier assembly uses the  $\pm 400\text{V}$  supplies from the Power Supply assembly. Lethal voltage appears on the heat sink assemblies. Do not open the 5725A cover without referring to the access procedures and warnings in Section 6.

Figure 4-4 is a block diagram of the High Voltage Amplifier assembly. Refer to the block diagram or the schematic to better understand theory of operation.

#### **4-41. Input Amplifier**

The input amplifier, U602, is an op amp whose input comes from HV IN on J653 through R623 and R621. HV IN is the 2.2V to 11V ac signal generated by the 5700A and routed through the High Voltage Sense assembly. The input amplifier has a high-frequency gain of 5.5, but because feedback resistor R622 is ac-coupled through C615, the gain is much higher at low frequencies. The inverting input of U602 is buffered with Q601. The nominal output of the input amplifier, LVAMP TP602, is about 6V dc.



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Figure 4-4. High Voltage Amplifier Assembly Block Diagram

#### 4-42. Integrator

Op amp U601A is configured as an integrator to reduce the output offset of the input amplifier circuit. This integrator senses the output voltage of the amplifier (MVOU) through R604 and R605 and forces it to be zero with respect to HVCOMM.

#### 4-43. Window Comparator

Comparators U604A and U604B form a window comparator that monitors the output of the input amplifier, U602. The window is set to about +2.2V to +9V by R626, VR602, and R636. If the output of U602 exceeds the window limits, the appropriate comparator turns on the clamp, Q604, shorting the input to ground. The comparator also pulls control line CLAMPS high via U604D, where the comparator routes to the Digital Assembly (A5) through the Interconnect assembly (A1). Comparator U604D is a level shifter to translate the window comparator output to a TTL level.

Exceeding the limits of the window comparator is an indication that the loop is in an abnormal condition when the instrument is in the ac voltage standby or ac voltage operate states. In current standby or current operate states, the comparator causes CLAMPS to be asserted, which turns off the +400V and -400V supplies.

#### 4-44. Input Clamp

A FET clamp, Q604, is turned on until the output of U602 returns to the region within the window. When this occurs, the comparator turns off Q603. To avoid a large transient at the output of the High Voltage Amplifier assembly (A6), the clamp must be turned off slowly. Resistor R637 and C618 slow the clamp drive signal to accomplish this. Though Q604 can be turned off slowly by removing its gate drive slowly, it clamps asymmetrically in the transition region. The body of the FET is held at -7.5V. This keeps the FET from turning on at the negative peaks of the input waveform. The asymmetrical clamping appears as a dc shift in the waveform, which can cause the transformer to saturate. To alleviate this problem, a second clamp is placed in parallel with Q604.

This second clamp is the photoresistor portion of the optical isolator, U605. It has a considerably higher on resistance than Q604, so the two are used together. When the clamp is to be turned off, Q603 is turned off and the voltage on C618 begins its transition from nearly +15V to -15V. At +15V, Q604 is turned on but because Q605 is also on, shunting current from the input of U605, the photoresistor is in the high impedance state. When the voltage on C618 reaches about +9V, Q605 turns off and the optoisolator is turned on, putting the photoresistor into its low resistance state. This has little effect on the input signal because the photoresistor is a higher impedance than the FET. As the control voltage approaches zero, Q604 turns off and the input is clamped only by the photoresistor. As the control voltage continues toward -15V, the photoresistor makes the transition to its off, or high impedance state. The photoresistor clamps symmetrically, eliminating the dc transient on the input. A similar transition takes place when light turns on the clamp but it happens much faster, as the turn-on transition is controlled by the time constant  $R631 * C618$  which is about an order of magnitude faster than the  $R637 * C618$  turn-off time constant.

The microprocessor on the Digital assembly can also pull the clamp via control line CLAMPD, which is latched into a driver on the High Voltage Sense assembly (A6). Line CLAMPD is asserted during a sequenced turn on, power down of the High Voltage Amplifier assembly (A3), or during a transition to another frequency range. Comparator U604C level shifts CLAMPD and provides an OR function with the window comparator output.



#### 4-45. *Transconductance and Cascode Stage*

The output voltage of the input amplifier U602, LVAMP, is transformed into a current by Q602. The nominal current is about 8.5 mA. This implies that the nominal output voltage of the input amplifier is about 6V;  $15V - (.0085 * 1000) - .6 = 5.9V$ .

The current is passed through a cascode FET Q661, which can stand off the voltage required, about 400V. A zener diode similar to VR656 protects most of the power MOSFETs from damage to their gate oxide layer by excessive gate voltage (approximately  $\pm 20V$ ). A gate resistor similar to R675 suppresses high frequency oscillations.

#### 4-46. *Midstage*

The current from Q661 generates a voltage of about 8.5V across R698. The ac voltage gain from TP602, the LVAMP output, to R698 is unity. Transistor Q666 mirrors the current into the midstage with an ac gain of 5. The dc midstage current is about 28 mA.

The midstage current passes through two cascode FETs, Q662 and Q665, to bias resistor R674. Transistor Q660, VR658, and R678 form a 21 mA current source that, along with R674 establishes the midstage bias current at about 28 mA. FET Q653 is a current source from the +400V supply controlled by the auto-bias circuitry. The bias for Q654 and Q662 comes from the high voltage heat sink assemblies and is maintained about halfway between the output voltage and the +400V supply or -400V supply, respectively. The bias for Q665 comes from zener VR665, FET Q667, and its associated parts, which form a 3 mA current source to bias the zener.

Zener VR661 provides some additional protection for Q665 and Q666. Capacitor C660 and R612 provide the dominant pole to stabilize the midstage amplifier. Gain-bandwidth is set to about 7 MHz.

#### 4-47. *Midstage -400V Filter*

FET Q670 is a filter to reduce the 120 Hz and output signal ripple on the -400V supply. Zener VR663, acting as a normal diode, clamps the gate of Q670 at the positive peak of the ripple on the -400V supply. As soon as the -400V supply moves away from the positive peak, the gate voltage is heavily filtered by R695 and C663. The zener action of VR663 and VR664 prevents Q670 from being damaged by excessive gate voltage as the -400V supply is turned on.

#### 4-48. *High Voltage Heat Sink Assemblies*

The output power MOSFET devices are mounted in pairs on the four high voltage heat sink assemblies. Each pair is driven with the same gate voltage. To ensure they equally divide the current, the MOSFETs are matched for gate-source voltage at 0.5A and have  $3.9\Omega$  source resistors. The push-pull output stage consists of Q655 and Q656 on the N-channel heat sink assembly #2 and Q663 and Q664 on the P-channel heat sink assembly #2. Their gates are driven with the voltage on R674. Resistors R670 through R673 sense the output current, while Q658 and Q659 limit the current to about 2.4A. Diodes CR652 and CR654 help to reduce the amount of stored charge in the power MOSFETs that must be driven when they are turned on and off.

The power MOSFETs on the #1 heat sink assemblies are driven cascode to share the voltage drop between the output (MVOUT) and their respective 400V supply. This also balances their power dissipation with the #2 heat sink assemblies. Their gates are driven from the voltage divider R654 and R661 or R684 and R692. Capacitors C654 and C661

compensate for the capacitance seen at the gates of the power MOSFETs on the #1 heat sink assemblies. Their sources establish the voltage on the gates of the cascode FETs in the midstage, Q654 and Q662.

The power MOSFETs are in the TO3 package and are mounted to the heat sinks using a heat conductive pad (electrically conductive as well) to minimize thermal resistance to the heat sink. This means that the heat sinks can have  $\pm 400\text{V}$  on them during normal operation. Do not open the 5725A cover without referring to the access procedures and warnings in Section 6.

Lower voltage supplies of about  $\pm 50\text{V}$  are available on the board to replace the  $\pm 400\text{V}$  supplies during test and troubleshooting. How to power up in the reduced-voltage troubleshooting mode is described in Section 7.

The four heat sink assemblies are attached to the High Voltage Amplifier assembly (A3) via connectors P661-664. A thermistor is stud mounted to the P-channel heat sink assembly #2 and attaches to the High Voltage Amplifier Assembly through J603. The temperature monitoring circuit, described further on, uses this thermistor.

#### 4-49. *Autobias Current Source*

FET Q653 is a current mirror that provides a dc current to bias the midstage. FET Q654 is a cascode stage to share the voltage and power. Since the loop forces the dc output of the amplifier back to zero if the midstage current is increased, the effect of increasing the midstage current is to increase the voltage drop across R674. Midstage current is increased until the gates of the output devices (connected to either end of R674) are driven just hard enough to establish the desired idle current in the output stage.

The current that Q653 mirrors comes from Q657, which is driven by BIAS from the Autobias Sense Circuit. FET Q657 stands off the high voltage to the +400V supply and makes the autobias circuit less sensitive to its ripple.

#### 4-50. *Autobias Sense Circuit*

The autobias sense circuit senses the +400V IM from the Power Supply assembly (A4). Signal +400V IM is a voltage developed across a R313 in the low side of the +400V supply, which provides a voltage proportional to the current in the 400V supply. If the High Voltage Amplifier were operating Class B, the +400V IM waveform would be half sines for a sinusoidal output current waveform.

The autobias sense circuit forces the average current in the +400V supply to be greater than the average of a half sine to produce Class A-B operation. This results in Class A operation for small output currents and for high output currents, a +400V IM waveform that looks like a half sine at the peak but is more rounded at the base. The autobias sense circuit does this by measuring the average of +400V IM and comparing it to the peak of +400V IM / pi (the average that would have been obtained for Class B operation), plus an offset.

Op amp U606A and C621 are configured as a peak detector. Resistors R647 and R648 divide the peak by pi. Resistor R643 and the 15V supply provide the offset:  $(15\text{V} * 10\text{K}) / (4.3\text{M} * 0.39) = 90\text{ mA}$ .

These signals are summed into integrator U601B. The integrator is an error amplifier that drives the autobias current source circuitry, via BIAS, to achieve the desired relationship between the peak and average values of the current delivered by the +400V supply.

Op amp U606B senses the -400V supply and forces the autobias to the minimum bias condition when the  $\pm 400V$  supplies are turned off. Transistor Q606 forces the minimum bias condition when the window comparator is activated.

#### 4-51. High Voltage Amplifier Feedback

Feedback for the High Voltage Amplifier is provided by R606, R607, and R608 from the output signal MVOOUT. This means that the high voltage signal transformers are driven open loop by the High Voltage Amplifier. Feedback for amplitude leveling is provided on the High Voltage Sense Assembly (A6).

The turns ratio of the hf transformer is less than the other transformers. Resistor R608 compensates for the difference in turns ratio so the overall gain of the High Voltage Amplifier, plus the signal transformers, is -100 independent of frequency range. Resistor R608 is switched in by K601 only in standby mode and in hf operation.

#### 4-52. Signal Transformers

Three transformers cover the four frequency ranges as shown in Table 4-2. The lf transformer is a C-core. The mf and hf transformers are toroids. All three signal transformers are located in the transformer box on the left side of the instrument when viewed from the front.

**Table 4-2. Signal Transformer Usage**

FREQUENCY RANGE	TRANSFORMER	TURNS RATIO	HIGH VOLTAGE AMPLIFIER OUTPUT(MVOOUT)	HIGH VOLTAGE TRANSFORMER OUTPUT
40 Hz to 120 Hz	LF (Series)	1:5.5	40 to 200V	220 to 1100V
120 Hz to 3.4 kHz	LF (Parallel)	1:5.5	40 to 200V	220 to 1100V
3.4 kHz to 30 kHz	MF	1:5.5	40 to 200V	220 to 1100V
30 kHz to 100 kHz	H F	1:4.5	49 to 167V	220 to 750V

Four control lines: HFPD, MFPD, LFPD, and VLFPD, control the frequency ranges. The control lines are generated on the High Voltage Sense assembly. These lines control relays K601 to K604, which direct the High Voltage Amplifier output to the primary of the appropriate transformer and switch in feedback resistor R608 to compensate for the hf transformer turns ratio. Relay K604 switches the primary windings of the lf transformer into a series connected configuration for 40 to 120 Hz operation, and into a parallel connected configuration for 120 Hz to 3.5 kHz operation.

Relays on the Interconnect assembly (A1) switch the secondary transformer windings. These Interconnect relays are driven by the same control lines as the High Voltage Amplifier assembly. These lines originate from latch/driver U157 on the High Voltage Sense assembly (A6).

#### 4-53. Temperature Monitoring

The temperature monitoring circuit estimates the junction temperature of the power MOSFETs by measuring the temperature of one of the high voltage heat sinks and adding a calculated temperature rise from heat sink to junction, based on the current in the +400V supply.

The heat sink temperature is sensed with a stud-mounted thermistor mounted into the P-channel heat sink #2 via connector J603. Its negative temperature coefficient is linearized

to approximately  $33\Omega/^\circ\text{C}$  by R615. Op amp U603A provides a reference voltage of about  $-0.77\text{V}$ . This reference voltage is applied to the circuit containing summing amplifier U603B, R611, and the linearized thermistor. The output of U603B is signal HV TEMP M, equal to  $10\text{ mV}/^\circ\text{C}$ .

A voltage proportional to the temperature rise from the heat sink to the junction of the transistor is added to HV TEMP M through R610. This is done via  $+400\text{V IM}$  from the Power Supply assembly. Resistor R610 is selected to properly scale this contribution to the  $10\text{ mV}/^\circ\text{C}$  output of U603B. Capacitor C610 provides averaging for the ripple on the current-sensing resistor, and CR604 prevents C610, an electrolytic capacitor from being reverse charged.

#### **4-54. High Voltage Sense Assembly (A6)**

In addition to ac voltage sensing for which it is named, the High Voltage Sense assembly provides four major functions for the 5725A. These additional functions are the following:

- Analog monitoring of the 5725A status
- Interface with the 5700A controller
- Switching input signals from the 5700A
- AC Line Power switching

Because it performs all the above functions, the High Voltage Sense assembly plays a primary role in controlling the instrument, attaining ac voltage specifications, performing 5725A calibration, and maintaining instrument safety.

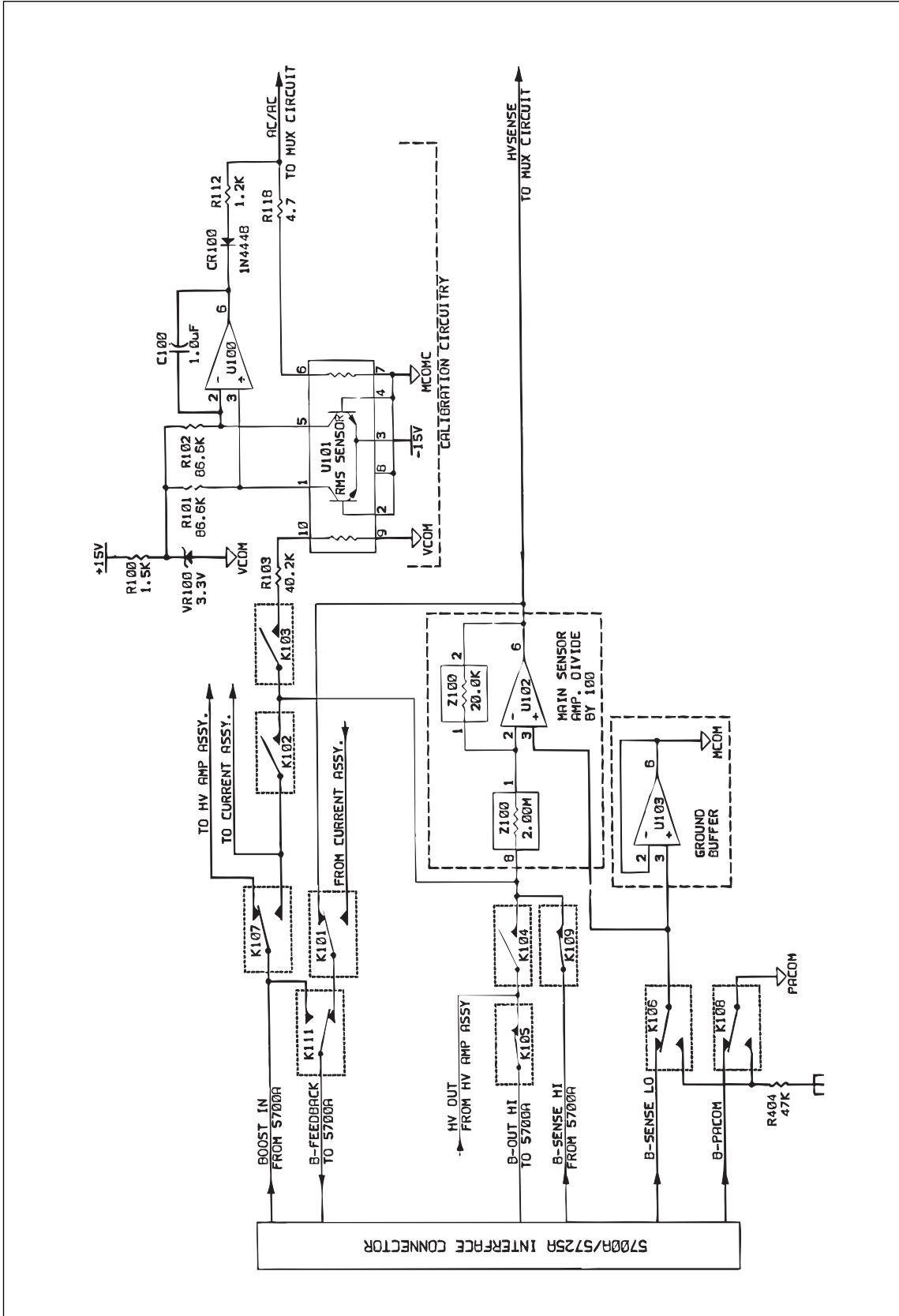
The High Voltage Sense assembly has the following six sections: sense amplifier, analog monitor, serial interface/guard crossing, analog input switching, control, and mains switching. Each section is first briefly described, then described in detail. For reference, see Figure 4-5, the block diagram for the High Voltage Sense assembly.

- Sense Amplifier Section

The sense amplifier section consists of a precision ac amplifier configured as an active attenuator, a buffer amplifier that isolates the 5725A high quality ground from the 5700A ground reference, and a precision true rms converter circuit for 5725A calibration. Together, these circuits accurately attenuate the output of the 5725A in ac voltage function to drive the 5700A Oscillator control circuitry. The sense amplifier section is essentially a gain-determining feedback element of a loop whose forward path consists of the 5700A Oscillator and the High Voltage Amplifier assembly (A3).

- Analog Monitor Section

The analog monitor section is comprised of a bipolar output dac, a comparator, and a 16-channel multiplexer. The inputs to the multiplexer are scaled voltages representing critical parameters in the other 5725A assemblies, particularly those involving high voltage and/or current. Each input can be compared to programmed limits set by the dac under microprocessor control. The comparator gives simple go/no go decisions, which are then acted on in a more sophisticated way by the software. An additional function of the analog monitor section is to provide access to the B-RCL line used by the 5700A during 5725A calibration.



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Figure 4-5. High Voltage Sense Assembly Block Diagram

- Serial Interface/Guard Crossing Section

The serial interface/guard crossing section consists of an RS-232 interface integrated circuit that provides the hardware for 5700A/5725A communication within the 5725A. Two optoisolators provide the serial guard crossing to the Digital assembly (A5), and two more provide integrity checks for the interface. A relay remotely powered by the 5700A provides a software independent path to guarantee 5725A shutdown if the 5700A/5725A cable is disconnected.

- Analog Input Switching Section

The analog input switching section consists of a bank of relays that route ac and dc voltages and dc currents from the 5700A to various functional blocks inside the 5725A. Assemblies that receive inputs from the Analog Input Switching Section are the High Voltage Amplifier assembly (A3); the Current Amplifier assembly (A2); and the sense amplifier section of the High Voltage Sense assembly.

- Control Section

The control section is implemented with a bank of four latches connected to the microprocessor data bus. A pair of latches with their integral drivers control relays, a pair of latches control the 16-channel multiplexer and the bipolar output dac in the analog monitor section.

- AC Line Voltage Switching Section

The ac line voltage switching section is independent of the other five sections of the High Voltage Sense assembly. The ac line voltage section contains three switches (labeled S2, S3, and S4 on the rear panel) that configure the input to the transformer to accept one of eight nominal line voltage levels. Also included in this section are a simple unregulated power supply and a time delayed relay driver circuit. These circuits control a shunt switch around a pair of surge current-limiting NTC thermistors.



**Caution**

**To avoid meter damage, do not measure the ac line voltage section unregulated supply with a meter tied to earth ground.**

#### 4-55. Sense Amplifier Section

Op amp U102, transistors Q100 through Q103, and their associated parts comprise the forward gain elements of a precision ac amplifier. Since this monolithic device does not accept supply voltages large enough to accommodate output swings of  $\pm 15.6\text{V}$ , a quartet of discrete transistors is configured as an output stage with voltage gain. This provides the necessary output swing of 11V rms as well as limits the additional forward gain of the overall amplifier to simplify frequency compensation.

Inputs to the output voltage stage are derived from deviations of the supply current of U102 from its quiescent value. This topology depends on the increase in current from a particular power supply as the output of the monolithic op amp moves toward the value of that power supply. This increasing current develops a drop across R108 for positive output voltages or a drop across R116 for negative output voltages. These drops are amplified by Q100 and Q103. Transistors Q101 and Q102 buffer the output signal to present a low source impedance to the load.

Overall gain at low frequencies is controlled by Z100, a resistor network designed for good ac frequency response, low power coefficient, and low thermal settling time. This network provides a feedback ratio of 0.99, or a closed-loop gain of 0.01. As a result, the entire sense amplifier is running in a virtual unity gain configuration. Zeners VR103 and

VR105 reduce apparent supply voltage seen by U102. Transistors Q105 and Q106 along with R131/C117 and R132/C118 filter the supply to reduce common mode errors at high frequency.

Capacitor C108 provides ac tuning for the sense amplifier. This capacitor balances most of the parasitic capacitance picked up across the input resistor portion of Z100. Capacitor C109, in parallel, provides fine adjustment of response if needed.

Components L105 and R130 isolate capacitive loads from the output of the sense amplifier to aid in achieving stability. Transistor Q104 is necessary to route the output of the sense amplifier to the 5700A during calibration. The signal routes to the B-RCL line (the high-quality dc line to the 5700A calibration circuitry) through the analog monitor section's 16-channel multiplexer. This device cannot handle the output swing of the sense amplifier ( $\pm 15.6V$ ) without risking inadvertent functional failure because of its  $\pm 15V$  supply limits. The result is to isolate the multiplexer from the sense amplifier output during normal operation with the JFET switch Q104, which is then also turned on during calibration. This is possible because the output of the sense amplifier is nominally  $\pm 3.2V$  during calibration.

During ac voltage operation, the input of the sense amplifier is either locally driven via K104, or remotely driven via K105 and K109, by the High Voltage Amplifier assembly (A3).

Op amp U103 forms a simple low offset voltage, low input current buffer to isolate the B-SENSE LO line from the rest of the 5725A circuitry. B-SENSE LO is the reference sense signal from the load provided through the 5700A and 5700A/5725A cable. Buffering B-SENSE LO ensures that the current flowing between the load and the 5700A Switch Matrix assembly along this reference sense line is minimized, and as a result, the series voltage drop is minimized.

The buffered B-SENSE LO line is distributed throughout the 5725A as MCOM, MCOMI, MCOMV, and MCOMC. These lines are all at the same potential, but they have different names corresponding to different paths taken to control the flow of ground currents. These names correspond to destinations as shown in Table 4-3.

**Table 4-3. High-Quality Reference Name Destination**

REFERENCE NAME	DESTINATION (ASSEMBLY)
MCOM	High Voltage Sense (A6)
MCOMI	Current (A2)
MCOMV	Reference for high voltage input to calibration circuit, High Voltage Sense (A6)
MCOMC	Calibration circuit section of the High Voltage Sense (A6)

The ac calibration circuit is also in the sense amplifier section. This circuit provides an extremely flat ac response for 5725A calibration of the sense amplifier. This flat ac response is made possible by the use of U101, the Fluke rms sensor, and a low-impedance ranging resistor, R103. The value of this resistor is 50 times less than the input resistor within Z100; as a result, the effect of parasitic capacitances is reduced by 2500. A protection circuit made up of CR101, CR102, VR101, and VR102 clamp input voltages.

Op amp U100 is a forward gain block, configured as an integrator with U101. A feedback circuit results, whose output at TP106 is a dc voltage proportional to the rms value of the signal applied to R103 and the input sensing resistor of U101. Resistor R112 provides a simple means of protecting the output half of U101, while CR100 prevents

latch up by eliminating positive feedback resulting from positive output voltages from U100. Op amp U105 is simply a low-noise inverting amplifier that scales the sensor output to 10 dB below the 5700A Oscillator output level. The output of the calibration circuit, AC/AC, goes to the 5700A during calibration through the analog monitor section.

#### 4-56. Analog Monitor Section

The 16-channel multiplexer, U151, takes a variety of inputs from all analog assemblies and provides a means of switching them to either a comparator, U154A, or to the B-RCL line via K152. During normal operation, the multiplexer output is routed exclusively to the comparator. Calibration requires routing the multiplexer output to the B-RCL line, which is routed back to the 5700A. The B-RCL line is measured by the precision add circuit on the 5700A DAC assembly. All inputs to the multiplexer are scaled so that inputs are within its  $\pm 15\text{V}$  power supply range. Table 4-4 shows the signal name of the multiplexer input, its description, origin, and purpose.

The state of the multiplexer is controlled by the microprocessor via data latched into U152.

**Table 4-4. Signals Monitored by the Analog Monitor Section**

STANDBY VOLTAGE LIMITS(1)	SIGNAL NAME	PHYSICAL PARAMETER	SOURCE	PURPOSE
-0.125V	+400V IM	Supply Current	Power Supply	Monitoring
+0.125V	-400V IM	Supply Current	Power Supply	Monitoring
0.26V	+400V M	Supply Voltage	Power Supply	Monitoring
-0.26V	-400V M	Supply Voltage	Power Supply	Monitoring
—	VCOM	System Supply Common	Power Supply	Monitoring
—	HVCOM M	High Voltage Supply Common	Power Supply	Monitoring
1.7V	HVTEMP M	Voltage Amp Heat Sink Temp.	High Voltage Amplifier	Monitoring
2.0V	ITEMP M	Current Amp Heat Sink Temp.	Current Amplifier	Monitoring
-2.2V	ICOMPL M	Current Output Stage Drive Level	Current Amplifier	Monitoring
—	I CAL/I FB	Shunt Voltage	Current Amplifier	Calibration, AC I Operation
—	AC/AC	Calibrator Output	High Voltage Sense	Calibration
—	HVSENSE	Sense Amp Output	High Voltage Sense	Calibration
—	DAC OUT	DAC Output	High Voltage Sense	Monitoring
0.08, 2.0V	FAN M	Fan is On or Off	Power Supply	Monitoring

Note 1: For single limit values, the limit is equal to, or smaller in magnitude to, the value shown.



IC U156 is a dac whose digital input is under microprocessor control via data latch U155. The +15V supply is the dac's reference voltage. Op amp U153A acts as a current-to-voltage converter, providing outputs between 0V and -6.375V. The desired output for the analog monitor function ranges from -2.56V to +2.56V. Level shifting and scaling is accomplished by U153B, by summing the output of U153A and the reference voltage for U156. Op amp U153B also forms an active two-pole filter to reduce wideband noise. The output of the dac is routed to both the multiplexer, U151, and the analog monitor comparator, U154A.

Resistors R171 and R170 provide a small amount of positive feedback around U154A to ensure noise-free operation for small input voltages. Q150 forms a simple inverter that converts the comparator output to 5V logic levels. This output, MONCOMP, is routed back to the 5725A Digital assembly (A5), where it is acted on by the microprocessor.

#### 4-57. *Serial Interface/Guard Crossing Section*

The control link between the 5700A and the 5725A consists of a serial interface at the hardware level. Serial data signals arrive via B-RCV and leave via B-XMIT. These are translated to and from standard 5V logic levels by U160, an RS-232 interface chip that runs from a single 5V supply. Internal charge pumps use C158 through C161 to generate RS-232 compatible supply levels of  $\pm 10V$ .

A pair of dual optoisolators, U159 and U161, isolate the serial interface signals from the remainder of the 5725A circuitry. The serial interface uses half of each pair. The other half of U161 signals the status of the 5700A/5725A interface cable to the microprocessor.

A 5V supply is available from the 5700A via pins 19 and 20 of J101. This supply drives the optoisolator LED when the cable connections are intact. The 5V supply also provides coil drive for K153. This relay's contacts are in series with the coils of the other relays on the High Voltage Sense assembly. Thus, if the cable becomes disconnected, all relays on the High Voltage Sense assembly automatically open. The relays are configured so that safety is maximized when they are open.

The remaining half of U159 signals to the 5700A when the 5725A is powered up. The 5725A +5V supply powers the LED of the optoisolator, whose output pulls B-CINT\* (pin 21 of J101) toward the 5700A supply common, B+5VCOM. This system is a complement to the CABLEOFF signal provided to the 5725A processor.

#### 4-58. *Analog Input Switching Section*

The analog input switching section is the primary analog interface with the 5700A output functions. Relay K108 serves exclusively to connect the output low lead of the 5725A to the load. Relay K106 does the same for the low sense line. Line MCOM, when switched to B-SENSE LO, serves as the low sense lead for the 5725A. Similarly, PACOM, which ties to the 5725A system ground VCOM at the power supply, is switched to B-PACOM, serving as the 5725A output low lead.

Signal BOOST IN is the input high lead from the 5700A signal sources, and is switched from the inputs to the High Voltage Amplifier or Current Amplifier and sense amplifier by K107. Relay K101 also selects the proper source for the B-FEEDBACK signal. Signal B-FEEDBACK corresponds to the input high sense lead. Relay K111 provides the capability to provide local sensing directly by the 5700A on the 5725A High Voltage Sense assembly. Local sensing is used during ac voltage standby mode. This prevents the 5700A Oscillator from running without feedback when the 5725A High Voltage Amplifier assembly is in standby.

Relays K102 and K103 provide switching that allows direct drive of the sense amplifier and its calibration circuitry by the 5700A. These switches are used only during calibration.

Relays K105 and K109 are high voltage reed relays that provide output to the 5700A binding posts and remote sensing from the binding posts, respectively, during ac voltage operation. These connections are accomplished by connecting the output of the High Voltage Amplifier to B-OUT HI and the input of the sense amplifier to B-SENSE HI. Local sensing for standby and calibration is accomplished by K104, which enables the High Voltage Amplifier to drive the sense amplifier and its calibration circuitry directly.

While 5700A current is sourced through the 5725A OUTPUT binding posts of the 5725A, relay K151 is energized to provide current guarding within the 5725A. 5700A output current comes to the High Voltage Sense assembly via J101 and is routed to a guarded coaxial cable through J152. The current return path is via E155. While 5700A current is sourced at its own binding posts, relay K151 is de-energized to prevent compromising of the 5700A internal guard.

#### 4-59. Control Section

The relay and switch control section consists simply of a pair of latched relay drivers, U157 and U158. Each of these latches receives its input from the microprocessor bus and drives a bank of relays. Additionally, the microprocessor has a ready means to quickly open all relays via a CLR signal that synchronously clears the driver latches. The outputs of relay driver U157 control six relays on the High Voltage Sense assembly (A6), four relays on the Interconnect assembly (A1), and four relays on the High Voltage Amplifier assembly (A3). Relays on the Interconnect and High Voltage Amplifier assemblies are controlled via HFPD, VLFPD, LFPD, and MFPD. Relay driver U158 is unique because all the high voltage relays connected directly to the outside world are driven from this latch. This provides a way for hardware to clear the instrument to a safe state independently of the microprocessor. This can happen in the following two ways:

- Via the CABLEOFF signal that is asserted when the 5700A/5725A link is physically disabled as described under "Serial Interface/Guard Crossing Section".
- By detecting an overcurrent condition in the high voltage power supply, which not only shuts down the high voltage supply, but also clears latch U158 via the signal HVCLR. Note that HVCLR, CABLEOFF, and CLR are diode-OR'ed to provide the composite clear function for U158.

In addition to controlling all the high voltage relays, U158 also generates control line CLAMPD for the High Voltage Amplifier assembly, and HVSUPPLY\* for the Power Supply and Digital assemblies.

Comparator U150A provides level shifting of the output of the latch U158 so that the JFET switch Q104 can be controlled.

Switch SW150 is simply a contact closure that indicates to the processor whether 5725A calibration is enabled.

#### *4-60. AC Line Voltage Selection Section*

In addition to the primary power switch, S401, this section contains three line-voltage selection switches, S402 through S404. These three switches allow the 5725A to be set to eight nominal ac line voltage levels, each with a 10% tolerance.

Thermistors RT401 and RT402 have negative temperature coefficients, and limit inrush current at power-up. Relay K401 provides a pair of shunt switches to bypass thermistors after about a half second. This allows greater efficiency than with thermistors alone, and the use of thermistors allows operation if the relay fails. CR401 through CR404 and C401 form an unregulated power supply that is not isolated from ac line power for controlling K401. R401, R402, and C402 provide a time delay that prevents Q401, and hence K401 from switching before the effective power supply capacitance is sufficiently charged.

Metal Oxide Varistor RV401 prevents high voltage transients on the ac line from reaching the transformer by clamping voltages above 275V ac.



# **Chapter 5**

## ***Calibration and Verification***

	<b>Title</b>	<b>Page</b>
5-1.	Introduction .....	5-3
5-2.	Where to Find Further Information.....	5-3



### **5-1. Introduction**

The 5725A is calibrated at the factory before shipping. Calibration is traceable to the U.S. National Bureau of Standards. All that is required to maintain traceability is to run 5700A calibration to external standards at the beginning of the calibration cycle and do performance verification every two years. Calibration check and range calibration are optional procedures that are available for special needs. The 5725A is calibrated whenever an attached 5700A is calibrated.

### **5-2. Where to Find Further Information**

Information about 5700A calibration, and therefore 5725A calibration, is contained in the following sections of the 5700A/5720A Series II manual set:

- Section 7 of the 5700A/5720A Series II Operator Manual presents procedures for calibration, calibration check, and range calibration.
- Section 1 of the 5700A/5720A Series II Operator Manual describes the calibration process and the theory behind its use to establish traceability to national standards. The same section includes a description of the calibration check feature, and suggests using it to develop a performance history for your 5700A. (This applies equally to a 5725A.)
- Section 3 of the 5700A/5720A Series II Service Manual contains a performance verification procedure recommended every two years to maintain traceability.



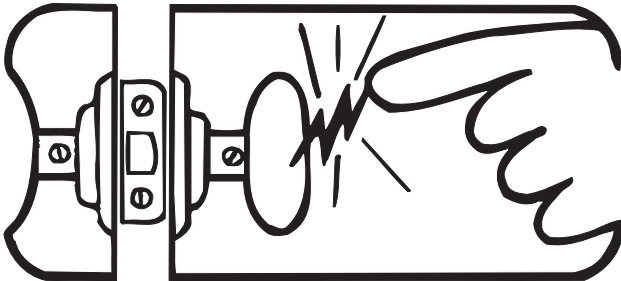




# static awareness



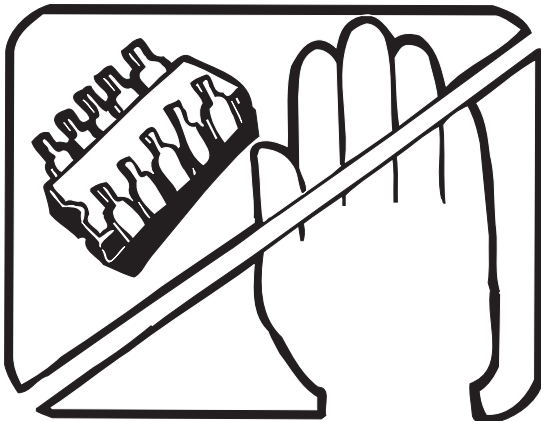
A Message From  
Fluke Corporation



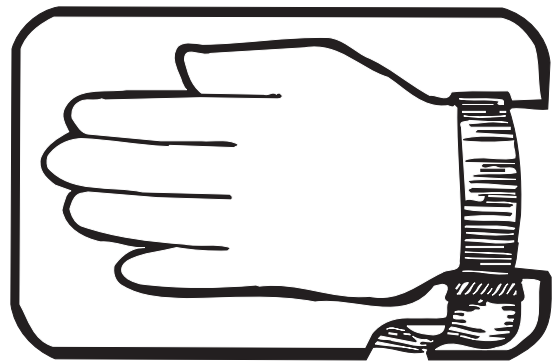
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, packaging, and bench techniques that are recommended.

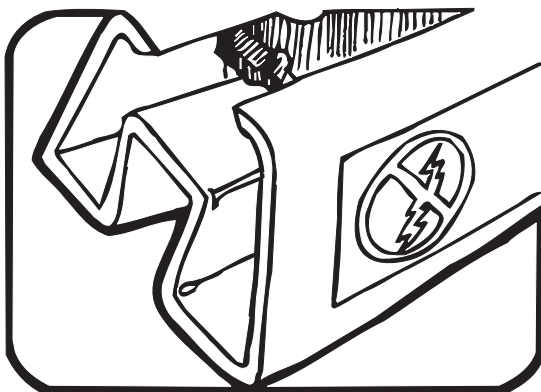
The following practices should be followed to minimize damage to S.S. (static sensitive) devices.



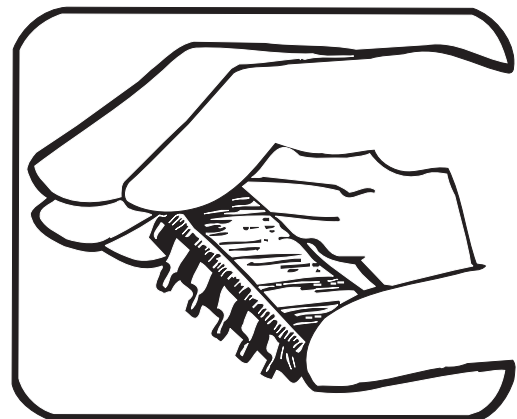
1. MINIMIZE HANDLING



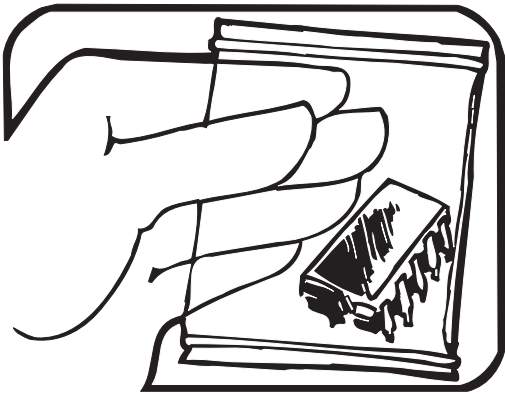
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES. USE A HIGH RESISTANCE GROUNDING WRIST STRAP.



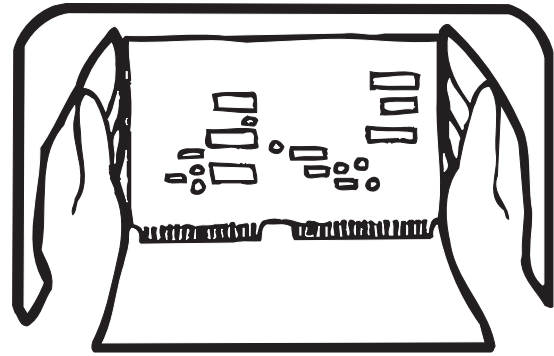
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



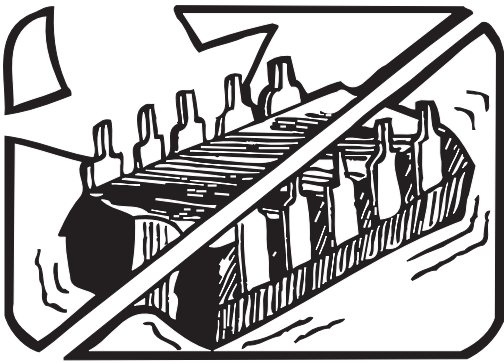
4. HANDLE S.S. DEVICES BY THE BODY.



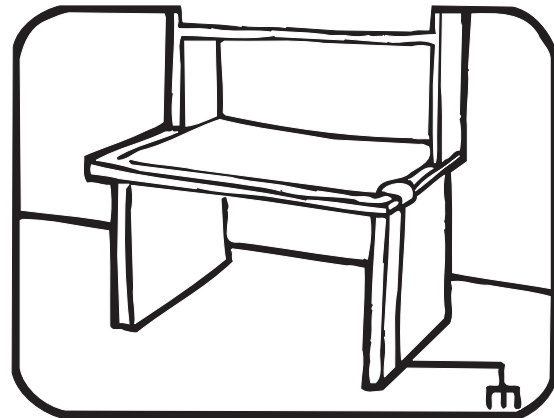
5. USE STATIC SHIELDING CONTAINERS FOR HANDLING AND TRANSPORT.



8. WHEN REMOVING PLUG-IN ASSEMBLIES HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR HELPS PROTECT INSTALLED S.S. DEVICES.



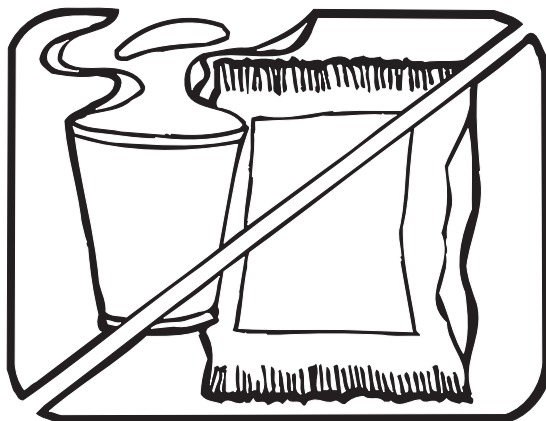
6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION.

10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

11. ONLY GROUNDED-TIP SOLDERING IRONS SHOULD BE USED.



7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA.

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# **Chapter 6**

## **Maintenance**

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 **Warning**

**Servicing described in this section is to be done by qualified service personnel only. To avoid electrical shock, do not service the 5725A unless you are qualified to do so.**

## **6-1. Introduction**

This section explains how to do routine maintenance tasks and how to access internal modules for troubleshooting and repair. This section tells you how to do the following:

- Replace the line power fuse
- Clean the air filter, and how often to do so
- Clean external surfaces and internal pca's
- Access internal modules for servicing

For troubleshooting information, refer to Section 7. For pointers to calibration information, refer to Section 5.

## **6-2. Replacing the Fuse**

 **Caution**

**To prevent instrument damage, verify that the correct fuse is installed for the line voltage setting. Acceptable fuse types are Bussman type MTH or Littelfuse type 312 or equivalent, of the appropriate amperage rating. Use only a 4A, 250V fast-blow fuse when the line voltage selection switches are set in the range 200-240V.**

*Note*

*A spare 4A, 250V fuse is shipped with the 5725A to ensure that one is available for use on the 200 to 240V range.*

The line power fuse is accessible on the rear panel. The fuse rating label to the right of the fuse holder (labeled FUSE) shows the correct replacement fuse rating for each line voltage setting. To replace the fuse, refer to Figure 6-1, and proceed as follows:

1. Turn off the POWER switch and disconnect the line power cord from ac line power.
2. Insert the blade of a standard screwdriver into the slot of the fuse holder labeled FUSE.
3. Turn the screwdriver counterclockwise until the cap and fuse pop free.
4. To install a new fuse, reverse this procedure.

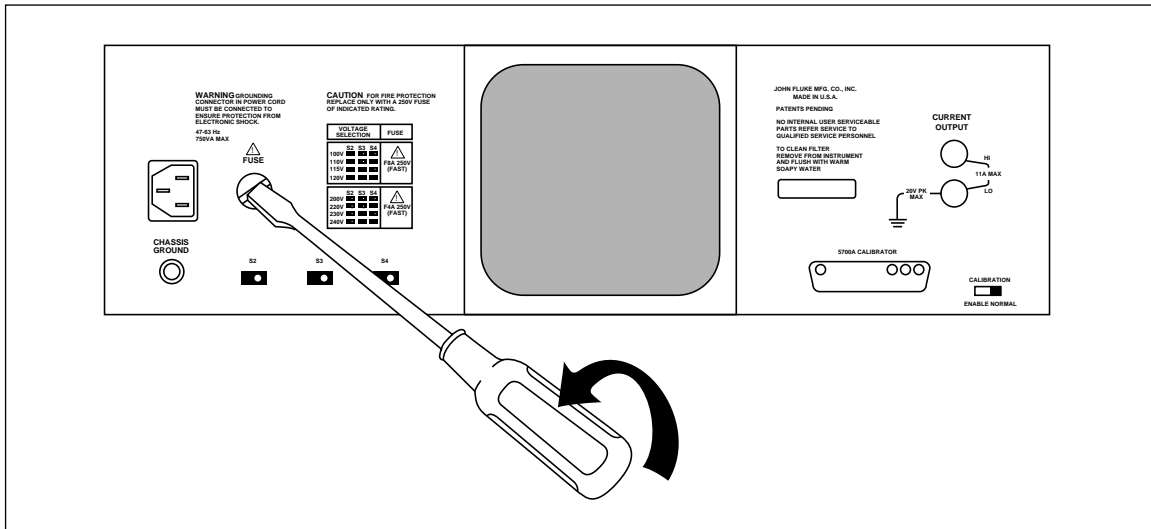


Figure 6-1. Accessing the Fuse

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### 6-3. Cleaning the Air Filter

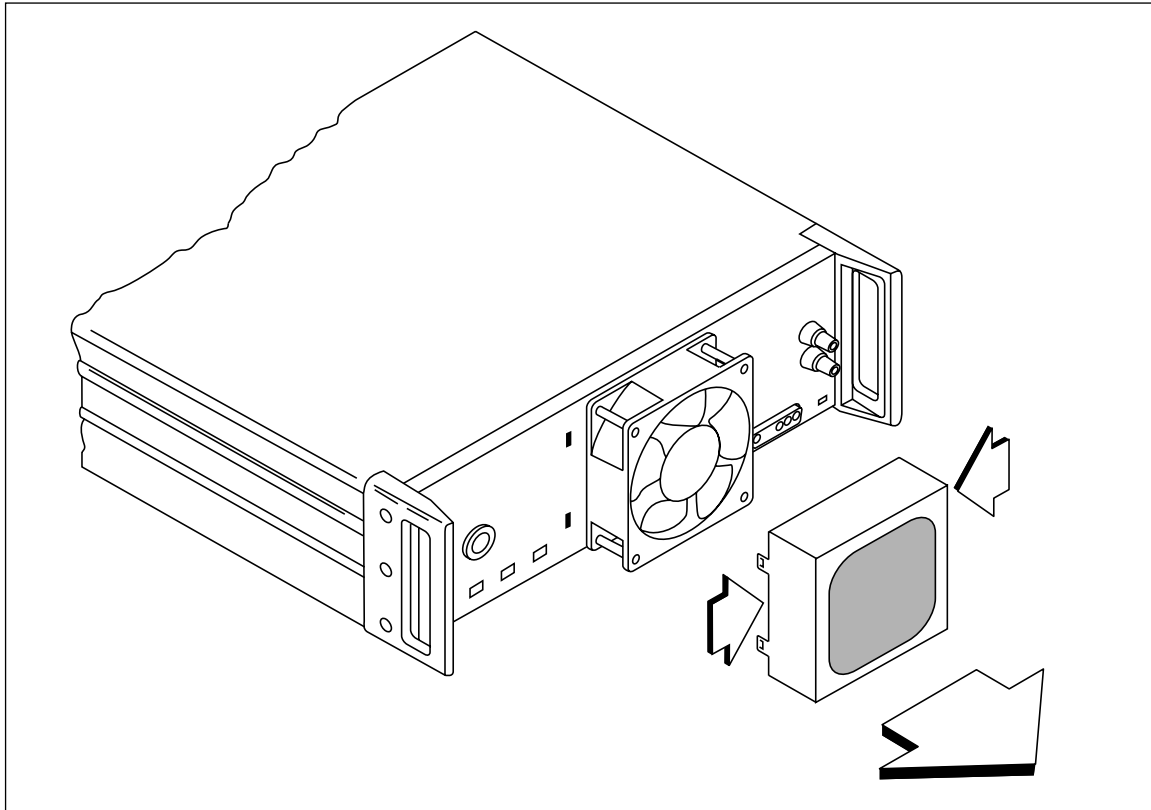
#### Caution

Damage caused by overheating may occur if the area around the fan is restricted, the intake air is too warm, or the air filter becomes clogged.

The air filter must be removed and cleaned every 30 days, or more frequently if the calibrator is operated in a dusty environment. The air filter is accessible from the rear panel of the calibrator.

To clean the air filter, refer to Figure 6-2 and proceed as follows:

1. Turn off the POWER switch and disconnect the line power cord from ac line power.
2. Squeeze together the sides of the air filter housing and pull it off.
3. Wash the filter element and housing in soapy water.
4. Rinse the filter element and housing in fresh running water.
5. Shake out excess water, then allow the filter element to dry thoroughly before reinstalling it.
6. Snap the filter housing back into place.



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Figure 6-2. Accessing the Air Filter

#### 6-4. General Cleaning

To keep the 5725A looking like new, clean the case, front panel, and rear panel using a soft cloth slightly dampened with water or a non-abrasive mild cleaning solution that does not harm plastics.

**⚠ Caution**

**Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. They can damage the plastic materials used in the amplifier.**

#### 6-5. Cleaning PCA's

Printed circuit assemblies only need cleaning after repair work. After soldering on a pca, remove flux residue using isopropyl alcohol and a cotton swab.

## 6-6. Access Procedures

Figure 6-3 shows the location of all major modules in the 5725A. View A is a top view, and view B is a bottom view. Both views show the covers removed. The 5725A is constructed so that two modules are completely accessible from the top, and two modules are completely accessible from the bottom. Each of these four modules can be lifted out of the chassis and locked in a service position by pivoting the assembly and inserting two machined pegs into two machined holes in the chassis towards the center of the instrument. (Figure 6-4 shows the High Voltage Amplifier assembly (A3) in the Service position.) Once in the service position, a module can be removed completely by disconnecting all cables attached to it.

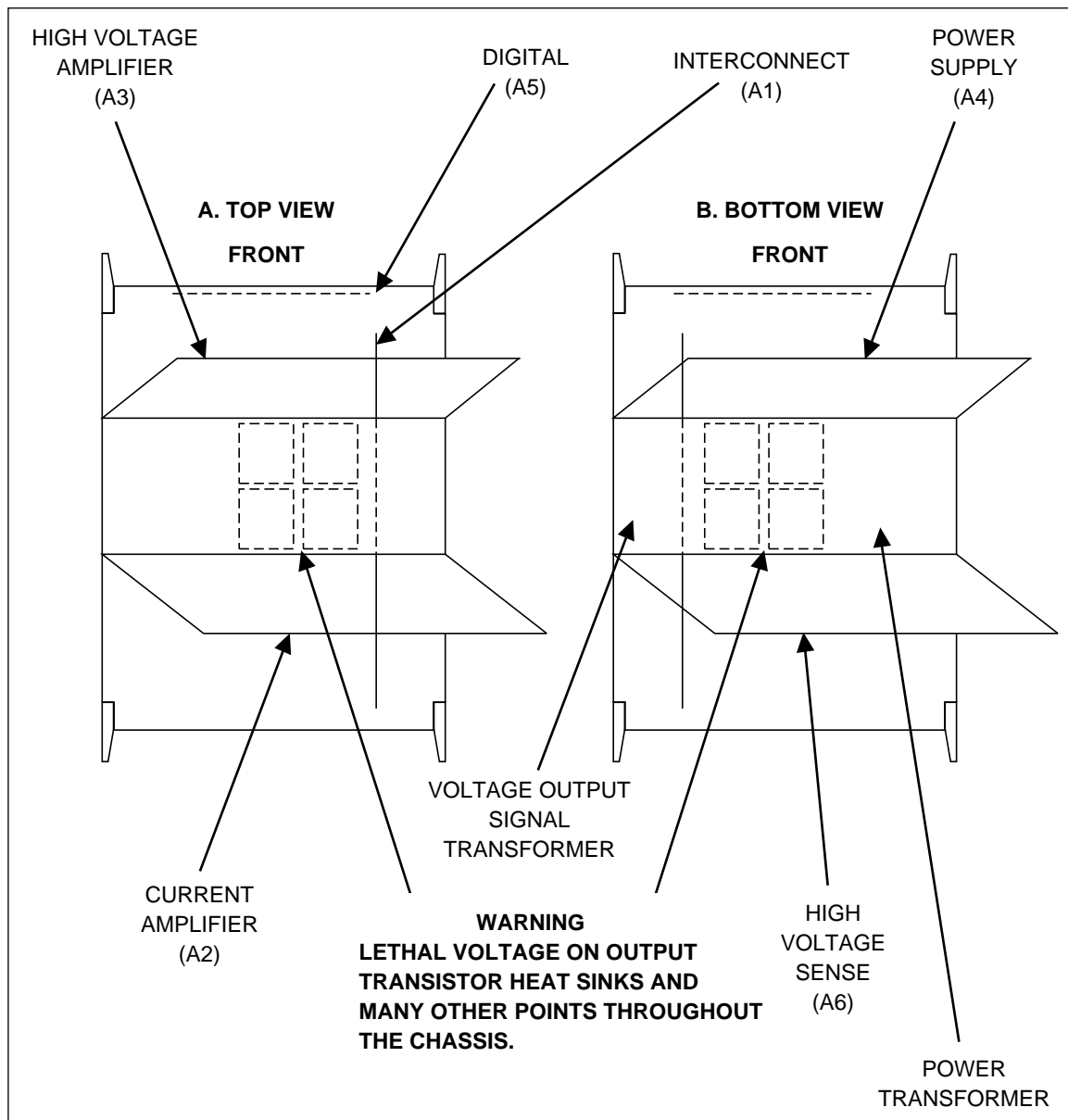


Figure 6-3. Assembly Location Diagram

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**⚠ Warning**

Follow the instructions under "Initial Access Procedure" to make sure high voltage has been bled off before you touch anything inside the 5725A.

If you work on a 5725A with the power cord attached, and/or you are not certain the high voltage has not bled off, do not wear a grounded wrist strap. Wearing a strap increases risk of dangerous electrical shock.

Use extreme caution when you are working inside the 5725A with the power connected. Use only non-conductive tools, and keep one hand behind your back to avoid making a circuit through your body.

The voltage output transistor heat sinks are at lethal voltage potential in ac V standby and ac V operate modes during normal operation, and possibly in any other mode after a failure. The heat sinks are exposed when any assembly is in the service position, and when the heat sink cover is removed.

**6-7. Initial Access Procedure**

Before accessing any module from the top or bottom of the instrument, proceed as follows to remove the top cover and verify that high voltage on the power supply capacitors has been bled off:

1. Turn off the POWER switch.
2. Remove the line power cord from ac line power.
3. Wait three minutes.
4. Remove the top cover by removing the screws accessible on the top surface (three front, three rear).

**⚠ Warning**

**Before touching anything inside the 5725A, do the following steps to make sure high voltage has been bled off.**

5. Refer to Figure 6-4 for the location of items mentioned in this procedure. Remove the five retaining screws on the High Voltage Amplifier assembly (A3). (Two screws secure each side rail, and one seats the board into a mating connector on the Interconnect assembly.) Lift the High Voltage assembly by pulling on the plastic wire-tie loops, pivot it, and insert its metal pegs in the two holes on the chassis as Figure 6-4 shows. This puts the High Voltage Amplifier assembly in the service position.

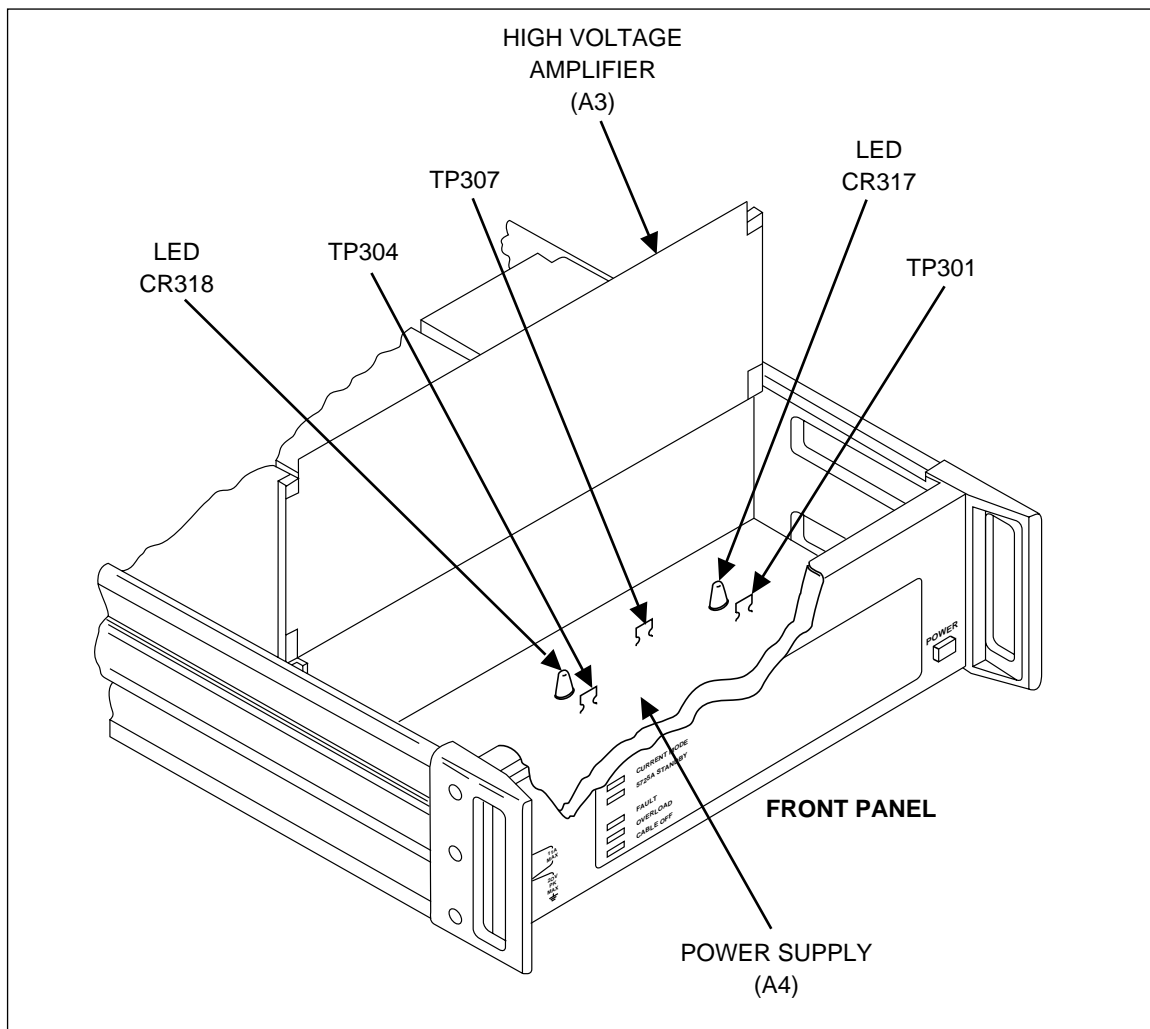


Figure 6-4. Initial Access Procedure

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6. Verify that both LEDs CR317 and CR318 on the Power Supply assembly (A4) are off. If either is lit after three minutes, there is a fault in the high voltage capacitor bleed-off path.

### **⚠ Warning**

**Do not rely on an off condition as an indication that dangerous voltage no longer exists on the filter capacitors. Always use a voltmeter to check for high voltage between TP307 and TP301, and between TP307 and TP304.**

7. To confirm that high voltage has dissipated, set a DMM to the 1000V dc range, and take a reading with the common lead to TP307 and the high lead to TP301 on the Power Supply assembly. This is the +400V filter capacitor test point, and it should be at a safe level near zero.

8. Take another DMM reading with the common lead to TP307 and the high lead to TP304 on the Power Supply assembly. This is the -400V filter capacitor test point, and it should be at a safe level near zero. This completes the initial access procedure.

### 6-8. Accessing the Power Supply Assembly (A4)

#### Warning

**To avoid electrical shock, do not proceed with the following access procedure until you have completed the initial access procedure, which removes line power and checks for high voltage on the power supply.**

The Power Supply assembly lays flat on the bottom of the instrument, toward the front. Proceed as follows to access the Power Supply assembly:

1. Perform the Initial Access Procedure.
2. Return the High Voltage Amplifier assembly (A3) (and the Current Amplifier assembly (A2) if it has been accessed) to the normal position, and reinstall the assembly retaining screws.

#### *Note*

*When reinstalling assemblies, lower them in place squarely to make sure their connectors seat correctly in the Interconnect assembly connectors.*

3. Turn over the 5725A so that the bottom is facing up.
4. Remove the five retaining screws on the Power Supply assembly. Lift the Power Supply assembly by pulling on the plastic wire-tie loops, and place the assembly in the service position.

#### *Note*

*When reinstalling the assembly, lower it into place squarely to make sure its connector seats correctly in the Interconnect assembly connector. Ensure that both J301 and J303 are properly aligned and connected to their respective cables.*

### 6-9. Accessing the Digital Assembly (A5)

#### Warning

**To avoid electrical shock, do not proceed with the following access procedure until you have completed the initial access procedure, which removes line power and checks for high voltage on the power supply.**

The Digital assembly is oriented vertically just behind the front panel. Proceed as follows to access the Digital Assembly:

1. Perform the Initial Access Procedure.
2. Refer to Figure 6-5 for accessing the Digital assembly. Remove the six Allen-head screws from the sides of the front handles, and remove the three screws from the front edge of the bottom cover. (You have already removed the top cover in step 1.)
3. The front panel remains connected by the Digital assembly ribbon cable and the current output cable. Remove the screw in the center of the Digital assembly to free the pca.

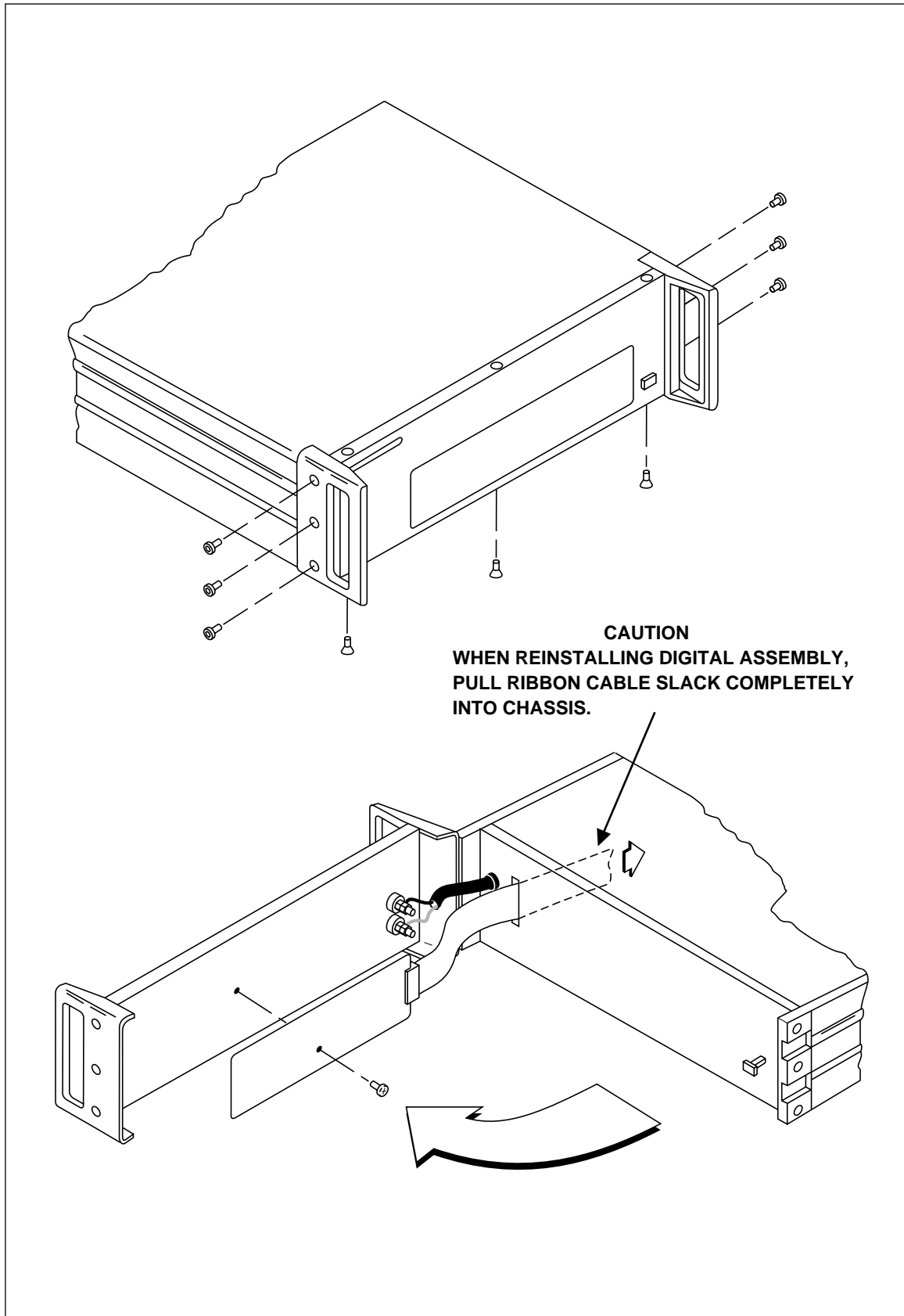


Figure 6-5. Accessing the Digital Assembly

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4. If you want to completely remove the Digital assembly, remove the ribbon cable by releasing the catches on the board-mounted connector.

**⚠ Caution**

**When replacing the Digital assembly, make sure the ribbon cable is pulled fully into the 5725A chassis. Be sure to leave no fold trapped between the back of the pca and the metal panel or else shorting to the component leads can occur.**

### **6-10. Accessing the Current Amplifier Assembly (A2)**

**⚠ Warning**

**To avoid electrical shock, do not proceed with the following access procedure until you have completed the initial access procedure, which removes line power and checks for high voltage on the power supply. This assembly drops into an area of live line voltage.**

The Current Amplifier assembly lays flat on the top of the instrument, toward the rear. Proceed as follows to access the Current Amplifier assembly:

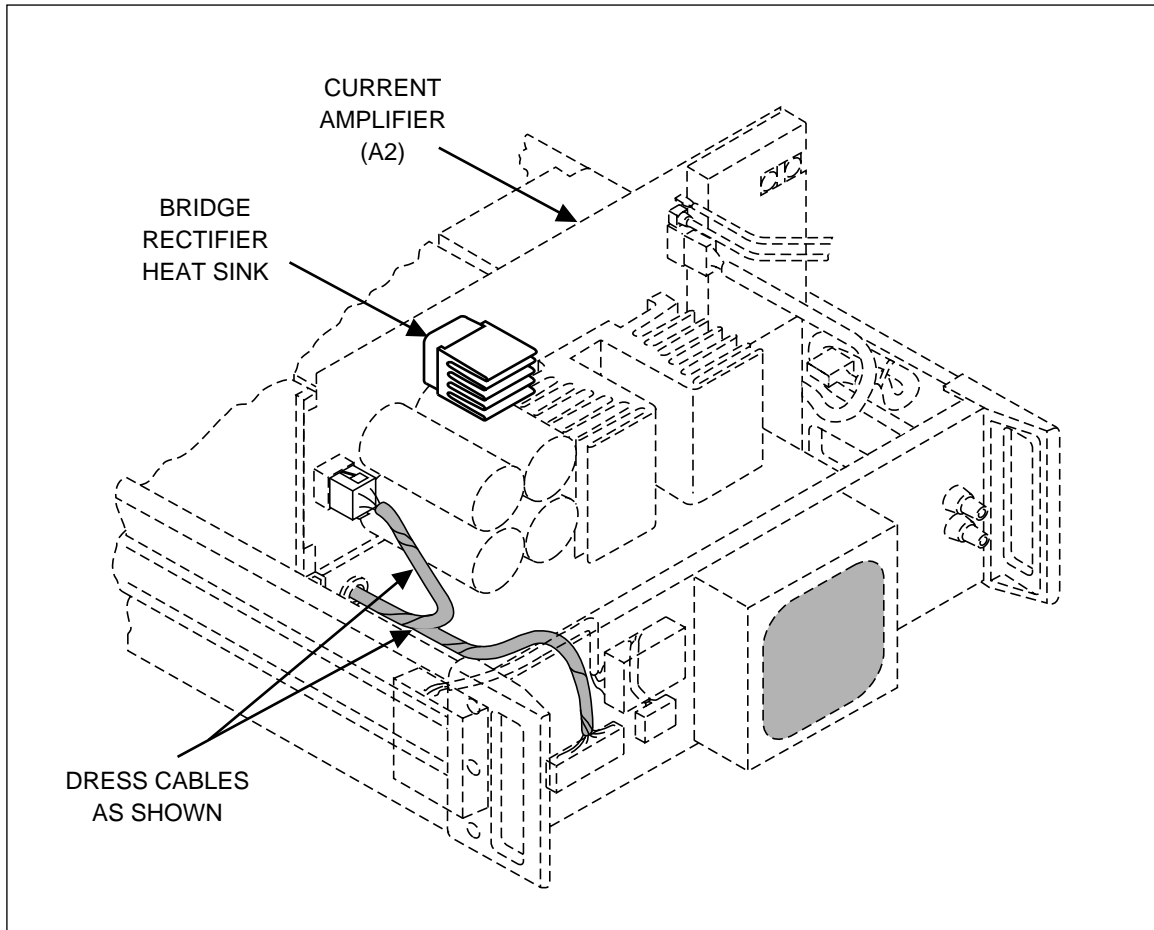
1. Perform the Initial Access Procedure.
2. Turn over the 5725A so that the bottom is facing up.
3. Remove the bottom cover by removing the six screws on the bottom surface.
4. Remove the two screws labeled \_A and \_B and turn the 5725A over again.
5. Remove the five retaining screws on the Current Amplifier assembly. Lift the Current Amplifier assembly by pulling on the plastic wire-tie loops, and place the assembly in the service position.

**⚠ Caution**

**When reinstalling the assembly, refer to Figure 6-6 and make sure cable harnesses are dressed as shown, to avoid shorting wires to the bridge rectifier heat sink or chassis.**

*Note*

*When reinstalling the assembly, lower it into place squarely to make sure its connector seats correctly in the Interconnect assembly connector.*



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Figure 6-6. Correct Way to Dress Cables

### 6-11. Accessing the High Voltage Amplifier (A3)

The High Voltage Amplifier assembly lays flat on the top of the instrument, toward the front. To access the High Voltage Amplifier assembly, simply do the Initial Access Procedure. This leaves the assembly in the service position.

*Note*

*When reinstalling the assembly, lower it into place squarely to make sure its connector seats correctly in the Interconnect assembly connector.*

## 6-12. Accessing the High Voltage Sense Assembly (A6)

### Warning

**To avoid electrical shock, do not proceed with the following access procedure until you have completed the initial access procedure, which removes line power and checks for high voltage on the power supply. Line voltage comes directly to this assembly.**

The High Voltage Sense assembly lays flat on the bottom of the instrument, toward the rear. Proceed as follows to access the High Voltage Sense assembly:

1. Perform the Initial Access Procedure.
2. Follow the Current Amplifier Assembly (A2) access procedure to gain access to the connectors on the High Voltage Sense Assembly (A6). Remove the connectors and secure the Current Amplifier Assembly before proceeding.
3. Return the High Voltage Amplifier assembly (and the Current Amplifier assembly if it has been accessed) to the normal position, and reinstall the assembly retaining screws.

### *Note*

*When reinstalling assemblies, lower them in place squarely to make sure their connectors seat correctly in the Interconnect assembly connectors.*

4. Turn over the 5725A so that the bottom is facing up.
5. Remove the bottom cover by removing the six screws on the bottom surface.
6. Remove the two jack screws from the 5700A subminiature D-connector.
7. Remove the five retaining screws on the High Voltage Sense assembly. Lift the High Voltage Sense assembly by pulling on the plastic wire-tie loops, and place the assembly in the service position.

### Caution

**When reinstalling the assembly, refer to Figure 6-6 and make sure cable harnesses are dressed as shown, to avoid shorting wires to the bridge rectifier heat sink or chassis.**

### 6-13. Accessing the High Voltage Output Transistors

#### Warning

**During normal operation, the high voltage heat sinks are at lethal voltage. To avoid electrical shock, do not proceed with the following access procedure until you have completed the initial access procedure, which removes line power and checks for high voltage on the power supply.**

To access the high voltage output transistors (attached to four separate, large heat sinks in the center of the instrument), proceed as follows:

1. Perform the Initial Access Procedure.
2. Disconnect the heat sinks from the High Voltage Amplifier assembly by unplugging connectors J661, J662, J663, J664. Disconnect the temperature monitor by unplugging connector J603.
3. Remove the four screws that retain the high voltage heat sink assembly at the bottom rails.
4. Lift out the heat sink assembly, being careful to keep the cables clear of obstructions during removal.
5. Each of the four heat sinks is held in place by two screws, one at the top rail and one at the bottom rail. Labels on each heat sink identify it as P1, P2, N1, or N2. To remove a heat sink, remove its two retaining screws, and slide it out of the assembly.

### 6-14. Accessing the Interconnect Assembly (A1)

#### Warning

**To avoid electrical shock, do not proceed with the following access procedure until you have completed the initial access procedure, which removes line power and checks for high voltage on the power supply.**

The Interconnect assembly is a vertical board oriented front-to-rear, and is accessible for test probing by placing any other assembly into the service position. To completely remove the Interconnect assembly, as would be required to replace a relay, proceed as follows:

1. Perform the Initial Access Procedure.
2. Completely remove the High Voltage Amplifier (A3) and the Current Amplifier (A2) assemblies by first placing each in the service position, then disconnecting all cables attached to each of them.
3. Turn over the 5725A so that the bottom is facing up.
4. Remove the bottom cover by removing the six screws on the bottom surface.
5. Completely remove the Power Supply (A4) and the High Voltage Sense assemblies (A6) by first placing each in the service position, then disconnecting all cables attached to each of them.



6. Turn over the 5725A so that the top is facing up.
7. Remove the high voltage heat sink assembly as described under "Accessing the High Voltage Output Transistors", steps 2 through 4.
8. Remove the two screws that secure the Interconnect assembly and pop the assembly free of the two bosses.

### **6-15. Enabling Front or Rear Binding Posts**

The 5725A comes from the factory configured for front or rear current output as requested by the purchaser when the system was ordered. Only one output location can be enabled at a time. You can reconfigure the output location by opening the chassis, detaching a cable and tying it away, and attaching another cable to a jack on the Current Amplifier assembly.

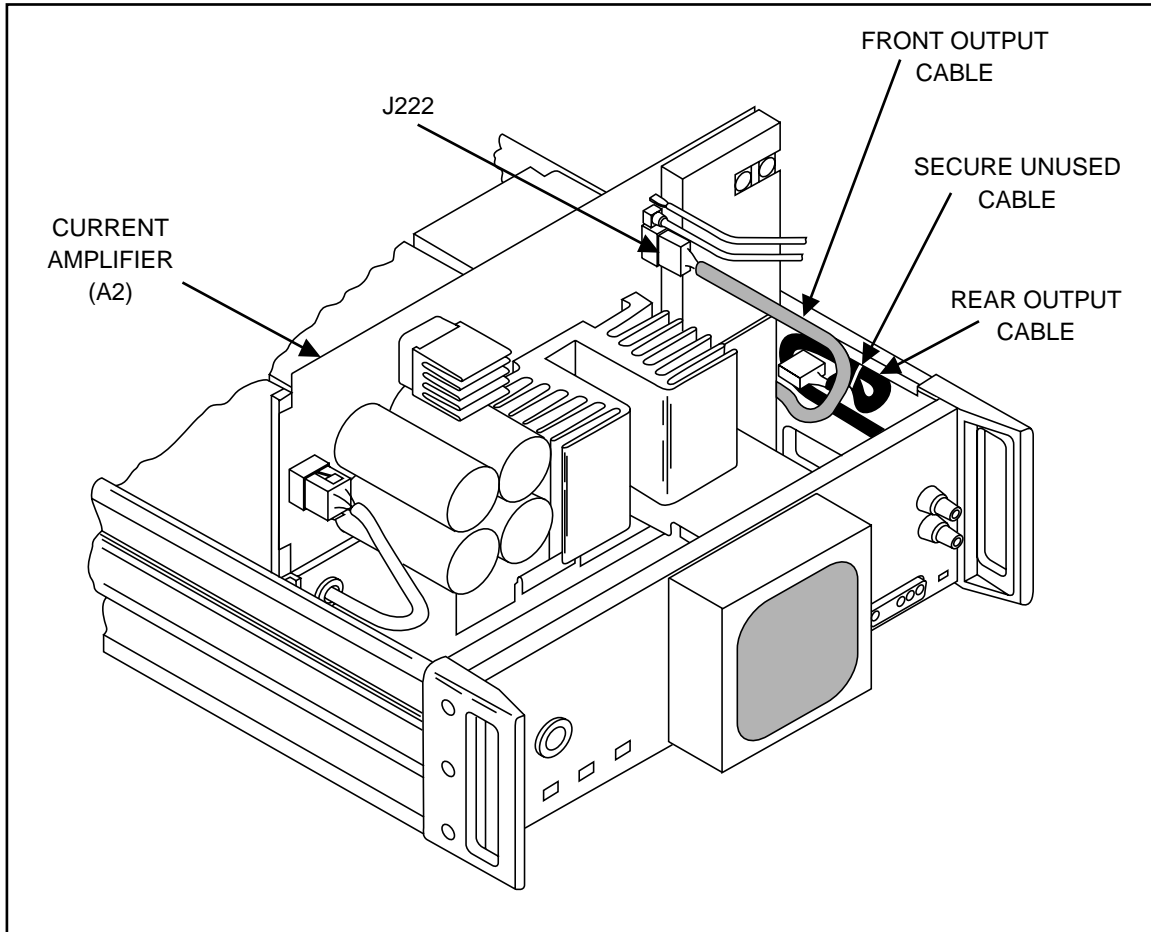
#### **Warning**

**To avoid electrical shock, proceed only after completing the initial access procedure, which removes line power and checks for high voltage on the power supply.**

Proceed as follows to change the current output location:

1. Perform the Initial Access Procedure.
2. Remove the five retaining screws on the Current Amplifier assembly. Lift the current amplifier assembly by pulling on the plastic wire-tie loops, and place the assembly in the service position.
3. Refer to Figure 6-7, and locate J222 on the Current Amplifier assembly.
4. Perform step 5 to change from front to rear, or perform step 6 to change from rear to front.
5. To enable the rear binding posts and disable the front, remove the cable that goes to the front binding posts from J222, and plug the cable that goes to the rear binding posts into J222.
6. To enable the front binding posts and disable the rear, remove the cable that goes to the rear binding posts from J222, and plug the cable that goes to the front binding posts into J222.

Use a non-conductive plastic wire tie to secure the unused cable to the right side ventilation slots.



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Figure 6-7. Enabling Front or Rear Binding Posts

**⚠ Caution**

**Make sure that the unused connector is neatly secured in the recessed area of the chassis side, away from the High Voltage Sense assembly as Figure 6-7 shows. If it is allowed to hang down, shorting can occur.**

8. Reconfiguration is complete. Reinstall the Current Amplifier and High Voltage Amplifier assemblies, being careful to correctly seat each assembly into the connector on the Interconnect assembly.
9. Reinstall the top cover.

# Chapter 7

## Troubleshooting

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## 7-1. Introduction

This section provides troubleshooting information in three parts. First a listing of all 5725A fault codes is provided for reference in Table 7-1. Following that is a description of 5725A automated self-diagnostics that you run from the 5700A. Finally, some manual tests are provided that can help you isolate a fault.

## 7-2. 5725A Fault Codes

Table 7-1 lists all 5725A fault codes. Fault codes and descriptions appear on the 5700A Control Display in fault conditions. The codes and descriptions can also be transferred from the 5700A in remote control operation. Where fault messages are not self-explanatory, additional explanation is given in the table.

## 7-3. Self Diagnostics

The best way to begin looking for the source of a fault is to run self diagnostics from the 5700A diagnostics menu. To run self diagnostics, proceed as follows:

1. Press the "Setup Menus" softkey. (If "Setup Menus" is not showing on the Control Display, press RESET first to return to the 5700A power-up state.)
2. Press the "Self Test & Diags" softkey.
3. Press the "5725A Self Diags" softkey.
4. Begin testing with the voltage function. Press the "Voltage" softkey. A sequence of self tests is run. A brief description of each test follows:
  - a. 5725A ACV Sense Amp: Checks for proper operation of the high voltage sense amplifier on the High Voltage Sense Assembly (A6).
  - b. 5725A ACV Standby: Puts the 5725A into voltage standby mode, and causes the analog monitor circuit on the High Voltage Sense Assembly (A6) to cycle through the continuous tests it does during normal operation.
  - c. 5725A ACV Operate: Puts the 5725A into voltage operate mode, but disconnects the output from the 5700A binding posts. This test makes sure that the High Voltage Amplifier (A3) works correctly, and checks the analog monitor circuit on the High Voltage Sense Assembly (A6) for correct operation.
  - d. 5725A Cal Sensor: Verifies that the calibration circuitry on the High Voltage Sense Assembly (A6) is working correctly.
5. This completes voltage function testing. If any of the self tests fail, a fault code and message is displayed.

**Table 7-1. 5725A Fault Codes**

<b>FAULT NO.</b>	<b>MESSAGE</b>	<b>EXPLANATION</b>
201	5725 Self-Test ROM Failure	Requires service
202	5725 Self-Test RAM Failure	Requires service
203	5725 Self-Test EEPROM Failure	Requires service
204	5725 Self-Test Data Bus Failure	Requires service
205	5725 Self-Test CLAMPS Circuit Failure	Requires service
206	5725 Self-Test HVCLR Circuit Failure	Requires service
207	5725 Self-Test DAC Failure	Requires service
208	5725 Self-Test Watchdog Timer Failure	Requires service
209	5725 Current Heatsink Too Hot	Requires service
210	Output Tripped To Standby	Current heat sink too hot in operate
211	5725 Current Compliance Voltage Too High	Internal fault, requires service
212	5725 Current Compliance Voltage Too High	Most likely an external fault
213	5725 +400V Supply Did Not Shut Off	Requires service
214	5725 -400V Supply Did Not Shut Off	Requires service
215	5725 Voltage Heatsink Too Hot	Requires service
216	5725 Voltage Heatsink Too Hot	Voltage heat sink too hot in operate
217	5725 +400V Supply Too Small	Requires service, or improper line voltage selected
218	5725 +400V Supply Too Large	Requires service, or improper line voltage selected
219	5725 -400V Supply Too Large	Requires service, or improper line voltage selected
220	5725 -400V Supply Too Small	Requires service, or improper line voltage selected
221	5725 +400V Supply Current Too High	Internal fault, requires service
222	Output Tripped To Standby	+400V supply too high in operate, most likely an external fault
223	5725 -400V Supply Current Too High	Internal fault, requires service
224	Output Tripped To Standby	-400V supply magnitude too high in operate, most likely an external fault
225	5725 Fan Not Working	Requires service
226	5725 CLAMPS Fault	Internal fault, requires service
227	Output Tripped To Standby	CLAMPS circuit activated most likely because of external transient condition

Table 7-1. 5725A Fault Codes (cont)

FAULT NO.	MESSAGE	EXPLANATION
228	5725 Software TRAP	—
229	5725 Cable Was Off	—
230	5725 RESET (power-up or watchdog timer)	—
231	5725 Guard-Crossing Timeout	—
232	5725 Illegal/Unexecutable Command	—
233	5725 Non-Maskable Interrupt Occurred	Either internal fault or external transient condition
234	5725 HVCLEAR Circuit Activated	Internal fault, requires service
235	Output Tripped To Standby	HVCLEAR circuit activated most likely because of external transient condition
841	No 5725 Available For Selected Output	—
850	Can't Store, 5725 Switch In NORMAL	—
851	Can't Format, 5725 Switch In NORMAL	—
3202	5725 ACV Sense Amp Fault	Requires service
3203	5725 ACV Standby 5725 Fault	Requires service
3204	5725 ACV Operate Wouldn't Converge	Requires service
3205	5725 ACV Operate 5725 Fault	Requires service
3206	5725 ACV Cal Sensor Test Died	Requires service
3207	5725 ACV Cal Sensor Fault	Requires service
3208	5725 Current Path To Shunt Open	Requires service
3209	5725 Shunt Sense Open	Requires service
3210	5725 Shunt Measurement Out Of Tolerance	Requires service
3211	5725 Current Amplifier Offset Too Large	Requires service
3212	5725 Current Drive Path Open	Requires service
3213	5725 Current Error Amplifier Failure	Requires service

6. To test the current function, press the "Current" softkey. A sequence of self tests is run. A brief description of each test follows:
  - a. 5725A Current Shunt: Checks the current cabling and the calibration amplifier on the Current Amplifier assembly (A2).
  - b. 5725A Current Zero: Grounds the input and shorts the output of the Current Amplifier, and verifies that the output is close to 0A.
  - c. 5725A Current Gain: Shorts the output of the Current Amplifier, applies a voltage input, and verifies the output current. This confirms integrity of the error amplifier circuit in the Current Amplifier assembly.
  - d. 5725A Current Monitor: Runs the analog monitor circuit on the High Voltage Sense Assembly (A6) in the current function and verifies that it operates correctly.

## 7-4. Manual Tests for Fault Isolation

### Warning

The following servicing is to be done by qualified service personnel only. To avoid electrical shock, do not service the 5725A unless you are qualified to do so.

Follow the access procedures and warnings in section 6 to open the 5725A covers.

The voltage output transistor heat sinks are at lethal voltage potential in ac v standby and ac v operate modes during normal operation, and possibly in any other mode after a failure. The heat sinks are exposed when any assembly is in the service position, and when the heat sink cover is removed.

Use only non-conductive tools, and keep one hand behind your back to avoid making a circuit through your body. If you work on a 5725A with the power cord attached, and/or you are not certain the high voltage has not bled off, do not wear a grounded wrist strap. Wearing a strap increases risk of dangerous electrical shock.

If self-diagnostics does not identify a faulty module, you can perform these manual tests. Five different fault conditions are addressed. The following numbered list describes each type of fault condition. Following that are troubleshooting tests to do for each type of condition.

1. Fault at power-up (STANDBY and FAULT indicators lit).
2. Normal at power-up (STANDBY indicator ON), but trips out when trying to enter voltage standby mode. (VOLTAGE MODE indicator momentarily lights, then STANDBY and FAULT indicators light.)
3. Normal at power-up (STANDBY indicator ON) and ACV STANDBY (ACV and STANDBY indicator ON), but trips out when trying to enter ACV OPERATE.
4. Normal at power-up, but trips out when entering current standby
5. Normal at power-up and CURRENT STANDBY, but trips out when entering current operate.



**7-5. Problems 1 or 2: Fault at Power-Up or When Entering Voltage Standby**

Proceed as follows to isolate the problem in these conditions:

1. If the 5700A is reporting a fault, determine if it is an analog monitor fault from Table 7-2. If the fault is not in Table 7-2, skip to step 2. (See Table 7-1 for explanations of fault codes.)

**Table 7-2. Analog Monitor Faults**

FAULT NO.	MESSAGE
209	5725 Current Heatsink Too Hot
210	Output Tripped To Standby
211	5725 Current Compliance Voltage Too High
212	5725 Current Compliance Voltage Too High
213	5725 +400V Supply Did Not Shut Off
214	5725 -400V Supply Did Not Shut Off
215	5725 Voltage Heatsink Too Hot
216	Output Tripped To Standby
217	5725 +400V Supply Too Low
218	5725 +400V Supply Too High
219	5725 -400V Supply Too Negative
220	5725 -400V Supply Too Positive
221	5725 +400V Supply Current Too High
222	Output Tripped To Standby
223	5725 -400V Supply Current Too High
224	Output Tripped To Standby
225	5725 Fan Not Working

- a. With an oscilloscope, check TP152 (DAC OUT) for the waveform shown facing Section 9 with the High Voltage Sense Assembly (A6) schematic.
  - b. If the waveform is present, suspect an abnormal analog input into U151 on the High Voltage Sense Assembly (A6). See Table 4-3 for voltage limits of the analog inputs for standby operation.
  - c. If the waveform is not present, short TP510 to DCOM on the Digital assembly. This tells the CPU to ignore all analog monitor faults and run all other tests. Check for any new fault codes that indicate the problem.
  - d. If the waveform is still not present, the High Voltage Sense Assembly (A6) is likely to be at fault, specifically, the circuitry that includes U151, U155, U156, U153, and U154.
2. If not an analog monitor fault, is it a high voltage supply (Fault 234) or CLAMPS\* (Fault 226) fault? If yes and in standby mode, suspect the Power Supply assembly (A4). If yes and in voltage standby mode, suspect the High Voltage Amplifier (A3) and the high voltage output transistors.
  3. If the error on the 5700A is not an analog monitor fault, high voltage supply (Fault 234), or CLAMPS\* (Fault 226) fault, or if no fault is reported by the 5700A, check for communications activity at pins 12 and 13 of U507 on the Digital assembly (A5). The waveform should appear as shown facing the Digital schematic as waveform 4. If there is no activity, suspect the communication circuitry on the High Voltage Sense Assembly or the Digital assembly.

### **7-6. Problem 3: Fault When Entering Voltage Operate**

Proceed as follows to isolate the problem in this condition:

1. Suspect the 5700A/5725A interface cable.
2. Check the analog monitor circuit on the High Voltage Sense Assembly as in step 1 on conditions 1 and 2.
3. Suspect the High Voltage Amplifier assembly and the output transistor heat sink assemblies.

### **7-7. Problem 4: Fault When Entering Current Standby**

Proceed as follows to isolate a problem in this condition:

1. If an overcompliance error is showing (fault 211), check for proper closing of the standby relay on the Current assembly (K202).
2. Check the analog monitor circuit on the High Voltage Sense Assembly as in step 1 on conditions 1 and 2.

### **7-8. Problem 5: Fault When Entering Current Operate**

Proceed as follows to isolate a problem in this condition:

1. If an overcompliance error is showing (fault 212):
  - a. Check for an open or too high resistance load.
  - b. Suspect an open internal current output cable, or the Current Amplifier assembly.
2. Check the analog monitor circuit on the High Voltage Sense Assembly as in step 1 on conditions 1 and 2.

### **7-9. Reduced-Voltage Troubleshooting Mode**

The high voltage supply on the Power Supply assembly (A4) allows normal operation from a pair of nominal 400V dc supplies, or troubleshooting operation in a reduced voltage mode with a pair of nominal 50V dc supplies. To switch between normal and reduced-voltage operation, proceed as follows:

1. Turn off the POWER switch and disconnect the line power cord from ac line power.

#### **Warning**

**Follow the instructions under "Initial Access Procedure" in section 6 to make sure high voltage has been bled off before you touch anything inside the 5725A.**

**The power supply assembly generates lethal voltages. Use extreme caution when you are working inside the 5725A with the power connected. Use only non-conductive tools, and keep one hand behind your back to avoid making a circuit through your body. If you work on a 5725A with the power cord attached, and/or you are not certain the high voltage has not bled off, do not wear a grounded wrist strap. Wearing a strap increases risk of dangerous electrical shock.**

2. Place the Power Supply assembly in the service position as described in the access procedures in Section 6.

3. Remove plug P301 from J301 and inserting it into J303. Now the high voltage power supply will power up in the  $\pm 50\text{V}$  mode. The high voltage amplifier may also be serviced in the  $\pm 50\text{V}$  mode.

### **7-10. Testing the Power Supply By Itself**

To turn on a Power Supply assembly (A4) by itself for troubleshooting, proceed as follows:

1. Turn off the POWER switch and disconnect the line power cord from ac line power.

#### **Warning**

**Follow the instructions under "initial access procedure" in section 6 to make sure high voltage has been bled off before you touch anything inside the 5725A.**

**The power supply assembly generates lethal voltages. Use extreme caution when you are working inside the 5725A with the power connected. Use only non-conductive tools, and keep one hand behind your back to avoid making a circuit through your body. If you work on a 5725A with the power cord attached, and/or you are not certain the high voltage has not bled off, do not wear a grounded wrist strap. Wearing a strap increases risk of dangerous electrical shock.**

2. Place the Power Supply assembly in the service position as described in the access procedures in Section 6.
3. Plug P301 onto the E302 header where the label MAN appears (pins 2 and 3).
4. This allows momentary-contact pushbutton switch SW302 to generate a strobe signal for U302, turning the supplies on. You turn the supplies off by pressing switch SW301.
5. You may want to troubleshoot in the low-voltage mode by plugging the high voltage secondary plug into J303. The previous procedure describes how to do this.



# **Chapter 8**

## ***List of Replaceable Parts***

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## 8-1. Introduction

This chapter contains an illustrated list of replaceable parts for the 7-300, 7-600, 12B, and 18 Meters. Parts are listed by assembly; alphabetized by reference designator. Each assembly is accompanied by an illustration showing the location of each part and its reference designator. The parts lists give the following information:

- Reference designator
- An indication if the part is subject to damage by static discharge
- Description
- Fluke stock number
- Total quantity
- Any special notes (i.e., factory-selected part)

### Caution

**A \* symbol indicates a device that may be damaged by static discharge.**

## 8-2. How to Obtain Parts

Electrical components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the Fluke Corporation and its authorized representatives by using the part number under the heading FLUKE STOCK NO. In the U.S., order directly from the Fluke Parts Dept. by calling 1-800-526-4731. Parts price information is available from the Fluke Corporation or its representatives. Prices are also available in a Fluke Replacement Parts Catalog which is available on request.

In the event that the part ordered has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

To ensure prompt delivery of the correct part, include the following information when you place an order:

- Instrument model and serial number
- Part number and revision level of the pca containing the part.
- Reference designator
- Fluke stock number
- Description (as given under the DESCRIPTION heading)
- Quantity

## 8-3. Manual Status Information

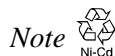
The Manual Status Information table that precedes the parts list defines the assembly revision levels that are documented in the manual. Revision levels are printed on the component side of each pca.

## 8-4. Newer Instruments

Changes and improvements made to the instrument are identified by incrementing the revision letter marked on the affected pca. These changes are documented on a manual supplement which, when applicable, is included with the product.

## 8-5. Service Centers

A list of service centers is available on the Fluke web sit at [www.fluke.com](http://www.fluke.com).



*This instrument may contain a Nickel-Cadmium battery. Do not mix with the sold waste stream. Spent batteries should be disposed of by a qualified recycler or hazardous materials handler. Contact your authorized Fluke service center for recycling information.*

**Table 8-1. Manual Status Information**

Ref or Option No.	Assembly Name	Fluke Part No.	Revision Level
A1	Interconnect PCA	843065	101
A2	Current Amplifier PCA	843073	102
A3	High Voltage Amplifier PCA	843086	101
A4	Power Supply PCA	843078	101
A5	Digital PCA	843081	101
A6	High Voltage Sense PCA	843060	105
A30	Inductor PCA	860119	A

## 8-6. Parts Lists

**Table 8-2. Final Assembly**

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
A1	* INTERCONNECT PCA	843065	1	
A2	* CURRENT AMPLIFIER PCA	843073	1	
A3	* HIGH VOLTAGE AMPLIFIER PCA	843086	1	
A4	* POWER SUPPLY PCA	843078	1	
A5	* DIGITAL PCA	843081	1	
A6	* HIGH VOLTAGE SENSE PCA	843060	1	
A12	TRANSFORMER ENCLOSURE ASSEMBLY	842984	1	
A30	INDUCTOR PCA	890116	1	
F501	FUSE,.25X1.25,8A,250V,FAST	561506	1	
F502	FUSE,.25X1.25,4A,250V,FAST	216846	1	
H1	SCREW,PH,P,SEMS,STL,6-32,.375	177022	22	
H30	SCREW,PH,P,LOCK,STL,6-32,.500	152173	8	
H301	SCREW,PH,P,LOCK,MAG SS,6-32,.2	772236	30	
H302	WASHER,FLAT,BRASS,#8,0.032 THK	631606	4	
H304	NUT, #8 LOW THERMAL	850334	8	
H308	WASHER,FLAT,COPPER,#8,.020	721688	4	
H331	SCREW,CAP,SCKT,SS,8-32,.375	295105	24	
H424	SCREW,PH,P,LOCK,SS,6-32,.375	334458	2	
H425	SCREW,FHU,P,LOCK,SS,6-32,.250	320093	12	

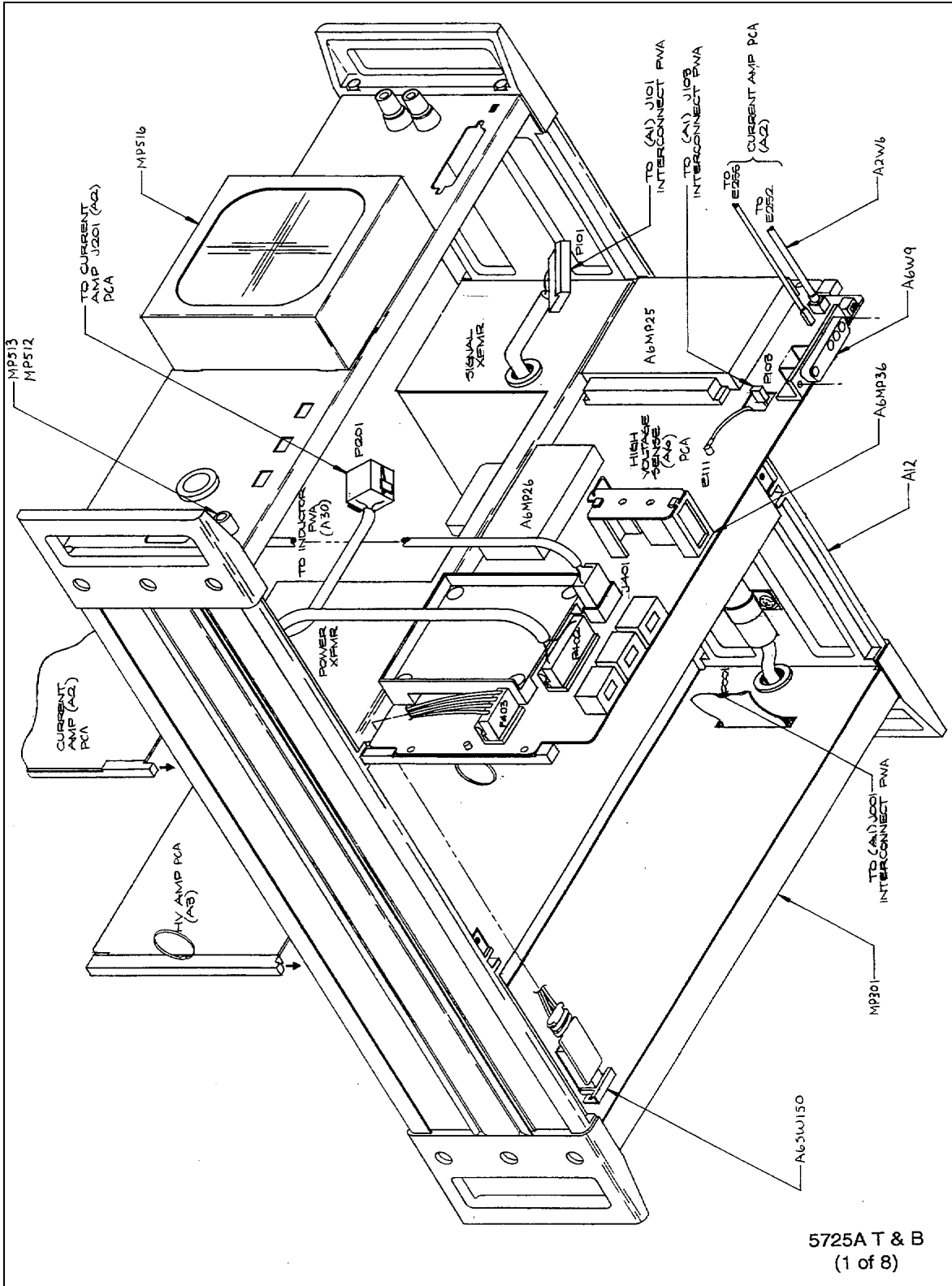


Table 8-2. Final Assembly (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
H437	SCREW,PH,P,LOCK,SS,6-32,.750	376822	2	
H439	SCREW,TH,P,LOCK,STL,8-32,.250	853622	4	
H443	SCREW,PH,P,LOCK,STL,6-32,.625	152181	4	
H505	NUT,HEX,BR,1/4-28	110619	1	
H506	WASHER,LOCK,INTRNL,STL,.267ID	110817	1	
H513	WASHER,FLAT,SS,.119,.187,.010	853296	2	
H545	NUT,EXT LOCK,STL,6-32,.344OD	152819	1	
L3-6	CORE,TOROID,FERRITE,.047X.138X	321182	4	
MP1	TRANSISTOR SET	842880	2	
MP2	LABEL, CE MARK, BLACK	600707	1	
MP3	TRANSISTOR SET	842992	2	
MP5	HEATSINK, HIGH VOLTAGE	843115	4	
MP9	DECAL,HEATSINK	850230	4	
MP15	ASSY, THERMISTOR	843032	1	
MP16	CABLE ACCESS,TIE,4.00L,.10W,.7	172080	24	
MP39	HEAT DIS,ACC,AL FOIL,TO-3	838169	8	
MP47	SLEEV,POLYOL,SHRINK,.187-.093I	113852	1	
MP302	HANDLE,INSTRUMENT, GRAY #7	886341	4	
MP304	INSULATOR,BINDING POST,FRONT,G	885459	4	
MP306	REAR INSULATOR GRAY #3	894183	4	
MP308	BINDING POST-RED	886382	2	
MP309	BINDING POST-BLACK	886379	2	
MP310	DECAL,FRONT	886317	1	
MP311	NAMEPLATE,TITTLE	850164	1	
MP312	POWER BUTTON, ON/OFF	775338	1	
MP405	DECAL,WARNING	850243	2	
MP410	SIDE EXTRUSION	886288	2	
MP412	INSERT EXTRUSION	886283	2	
MP414	ADHESIVE SIDE TRIM	698316	2	
MP416	BOTTOM FOOT, MOLDED, GRAY #7	868786	4	
MP501	DECAL, CSA	864470	1	
MP510	LINE FILTER ASSEMBLY	850172	1	
MP511	FAN ASSEMBLY	843029	1	
MP512	BINDING HEAD, PLATED	102889	1	
MP513	BINDING POST, STUD, PLATED	102707	1	
MP514	LABEL,VINYL,1.500,.312	844712	1	
MP516	FAN GUARD AND AIR FILTER	886416	1	
MP600	FRONT PANEL	886408	1	
MP601	REAR PANEL	886411	1	
MP602	HOUSING, AIR FILTER	886416	1	
MP603	COVER, TOP	660951	1	
MP604	COVER, BOTTOM	660958	1	
MP605	DIVIDER, HIGH VOLTAGE MODULE	860176	1	
MP606	TOP INSULATOR ASSY, HIGH VOLTAGE MODULE	860192	1	
MP607	BOTTOM INSULATOR ASSY, HIGH VOLTAGE MODULE	860197	1	

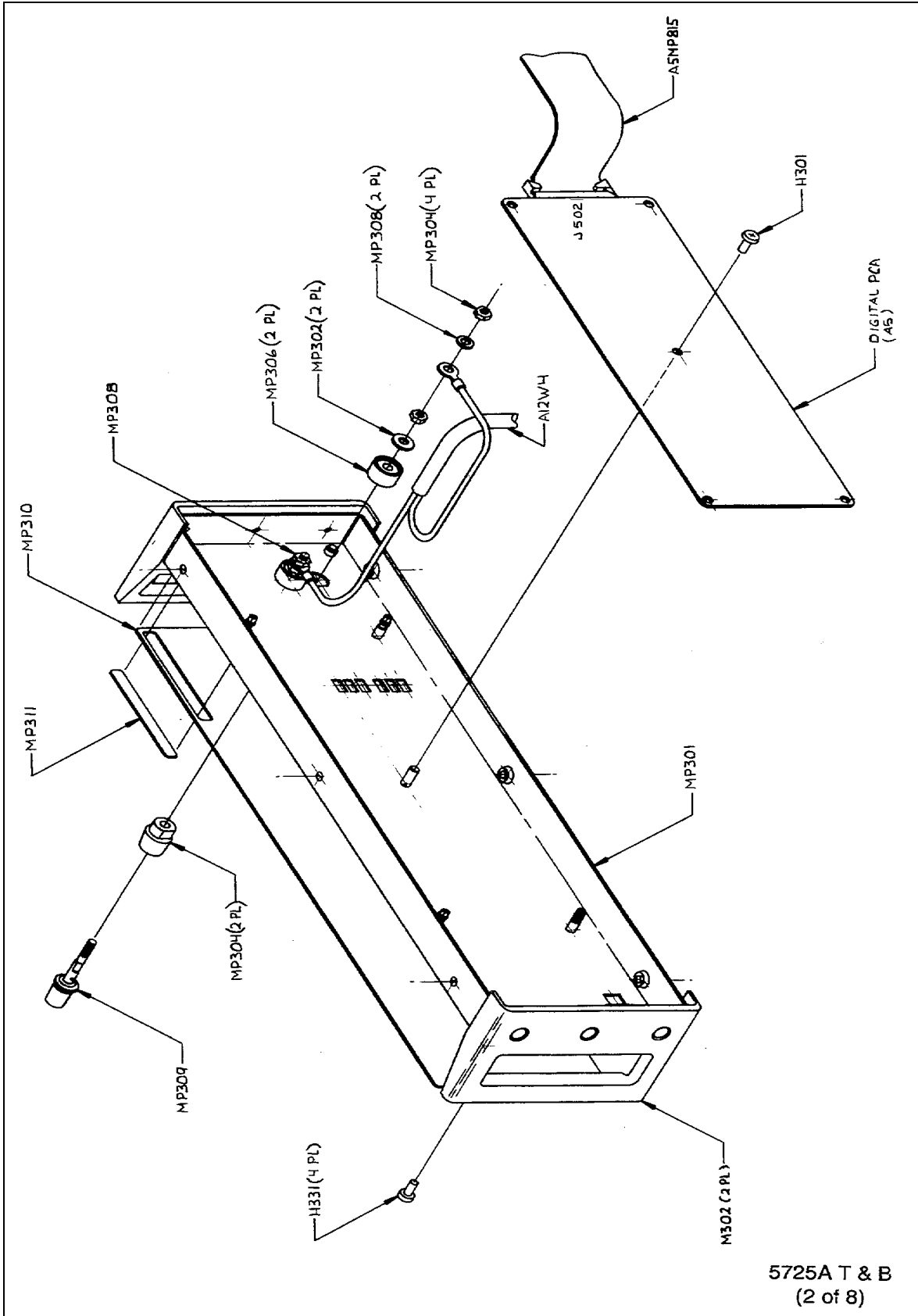
Table 8-2. Final Assembly (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
TM1	5725 INSTRUCTION MANUAL	823435	1	
W1	CORD,LINE,5-15/IEC,3-18AWG,SVT	284174	1	
W13	HARNESS, TRANSISTOR P661	843040	1	
W14	HARNESS, TRANSISTOR P662	843045	1	
W15	HARNESS, TRANSISTOR P663	843052	1	
W16	HARNESS, TRANSISTOR P664	843057	1	
W44	CABLE ASSY, 5700A/5725A I/F	859897	1	
XF501	HLDR,FUSE,1/4 X 1-1/4,LOPROFIL	424416	1	



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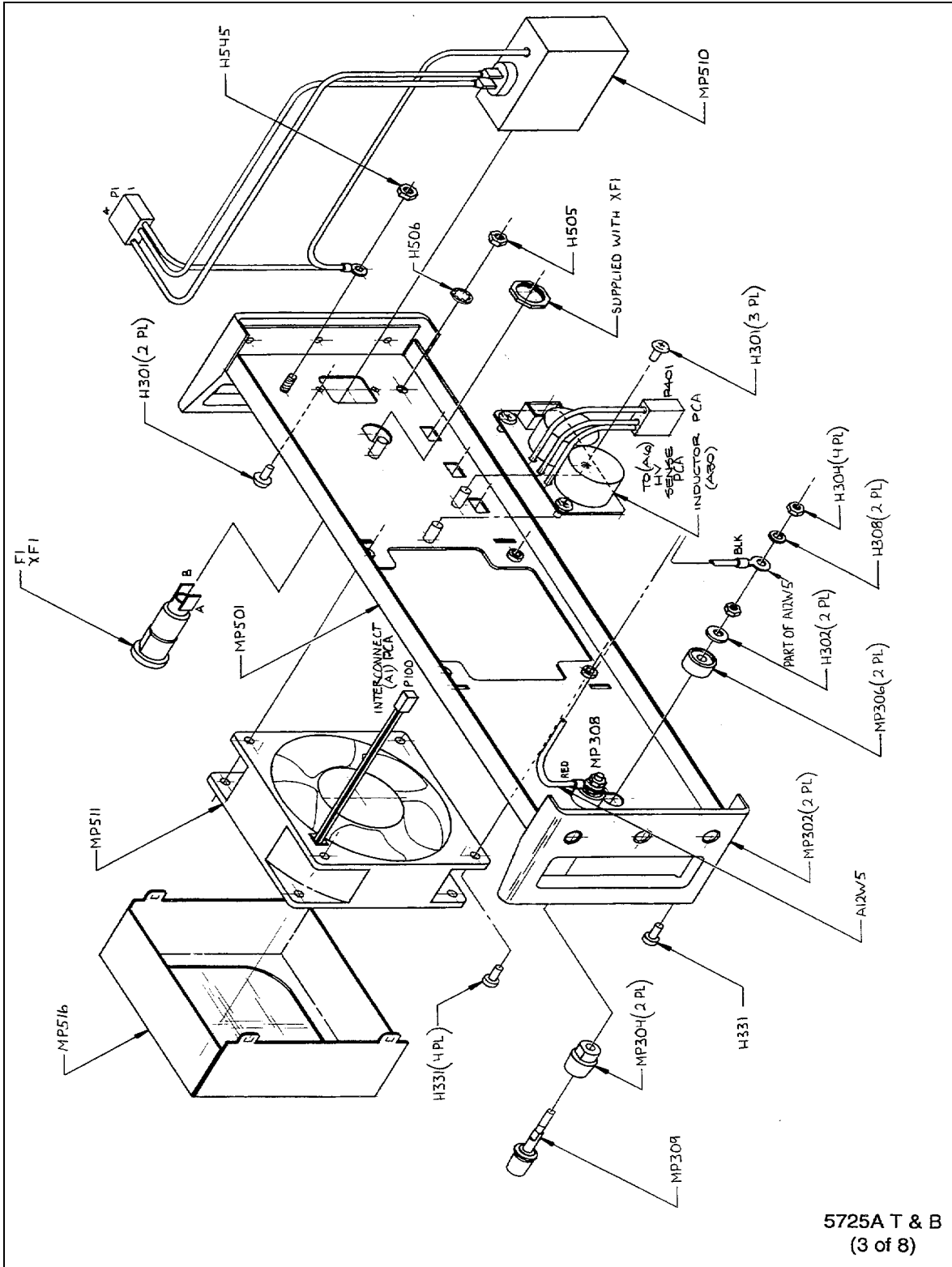
Figure 8-1. Final Assembly



5725A T & B  
(2 of 8)

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Figure 8-1. Final Assembly (cont)



5725A T & B  
(3 of 8)

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Figure 8-1. Final Assembly (cont)

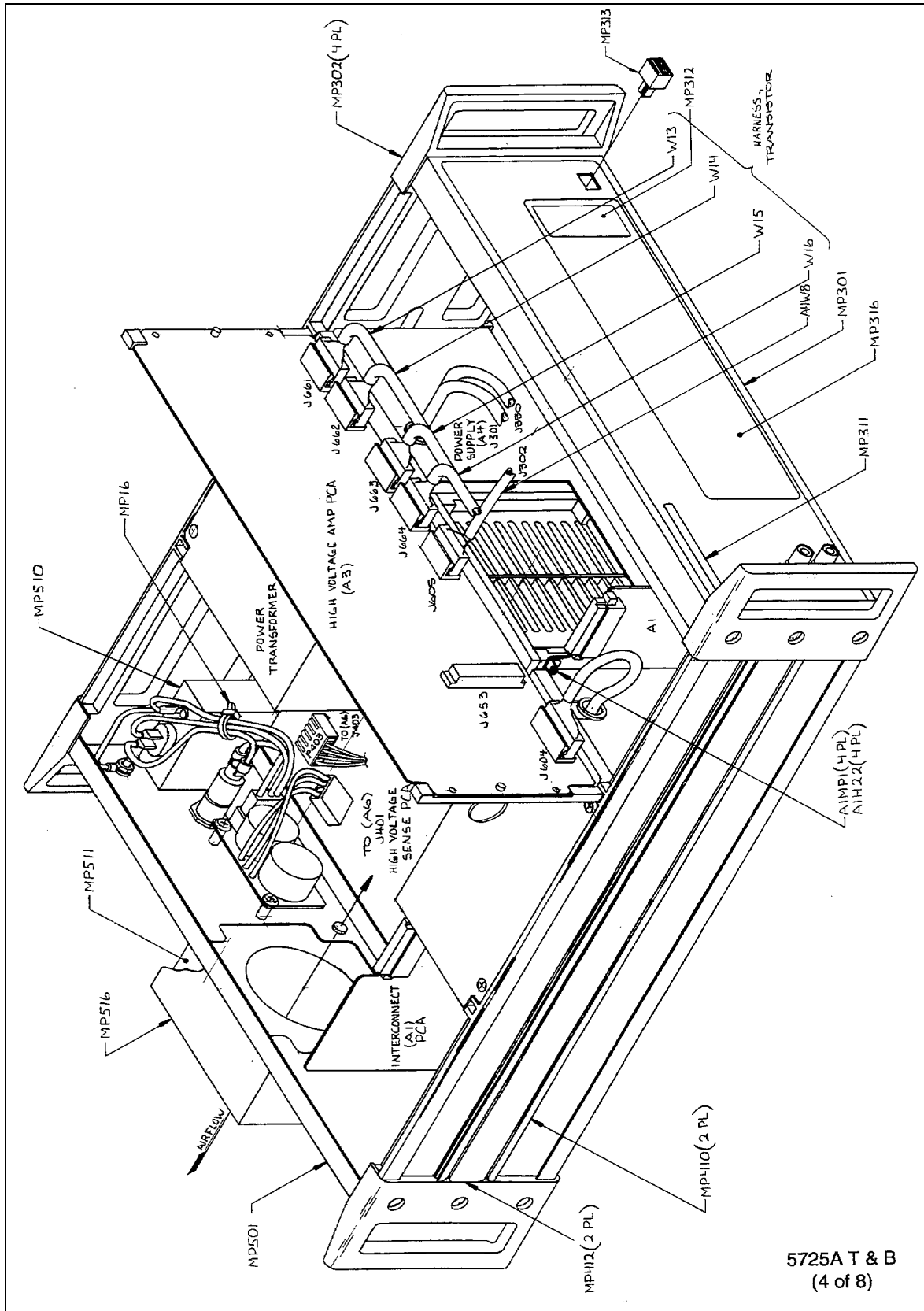
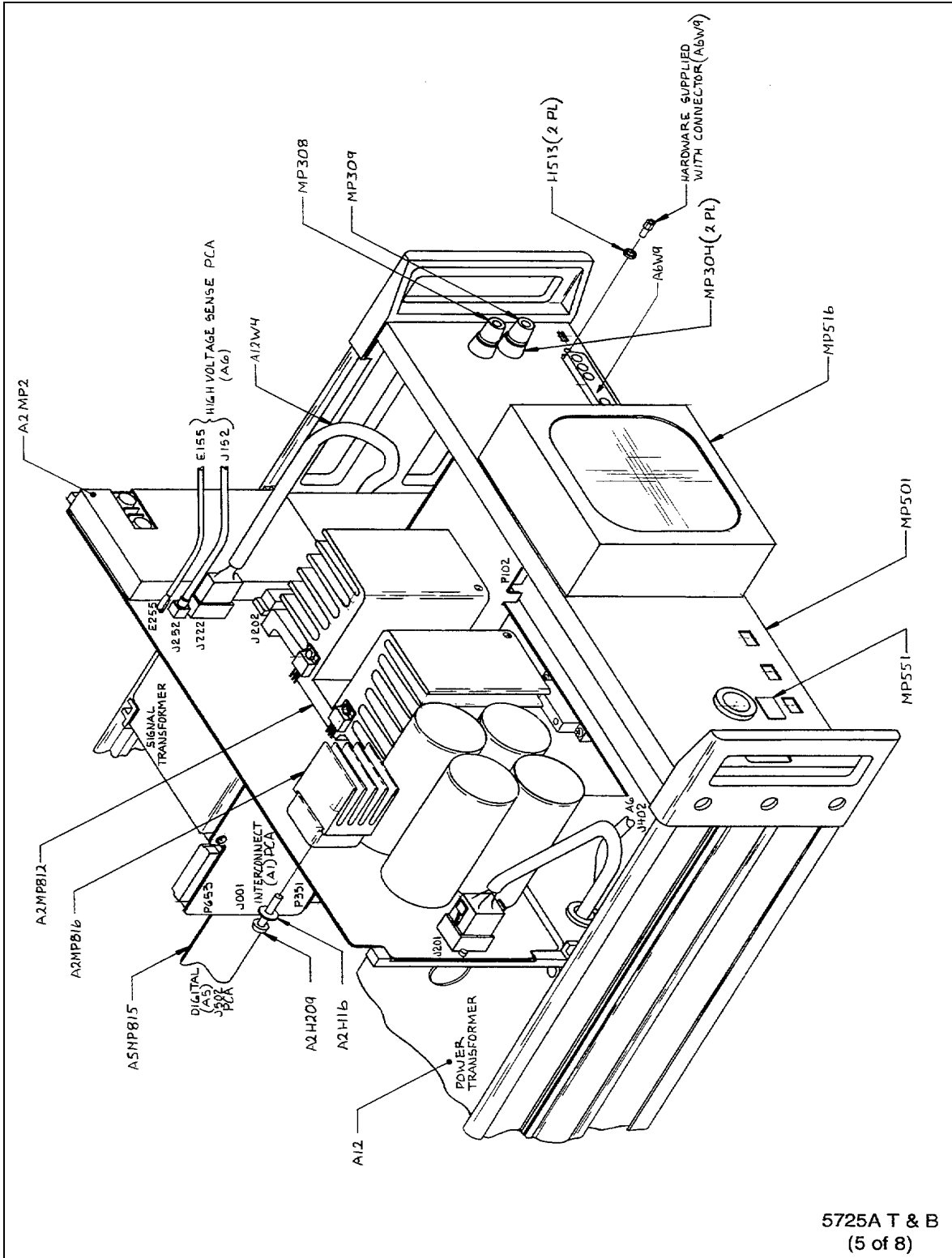


Figure 8-1. Final Assembly (cont)



5725A T & B  
(5 of 8)

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Figure 8-1. Final Assembly (cont)

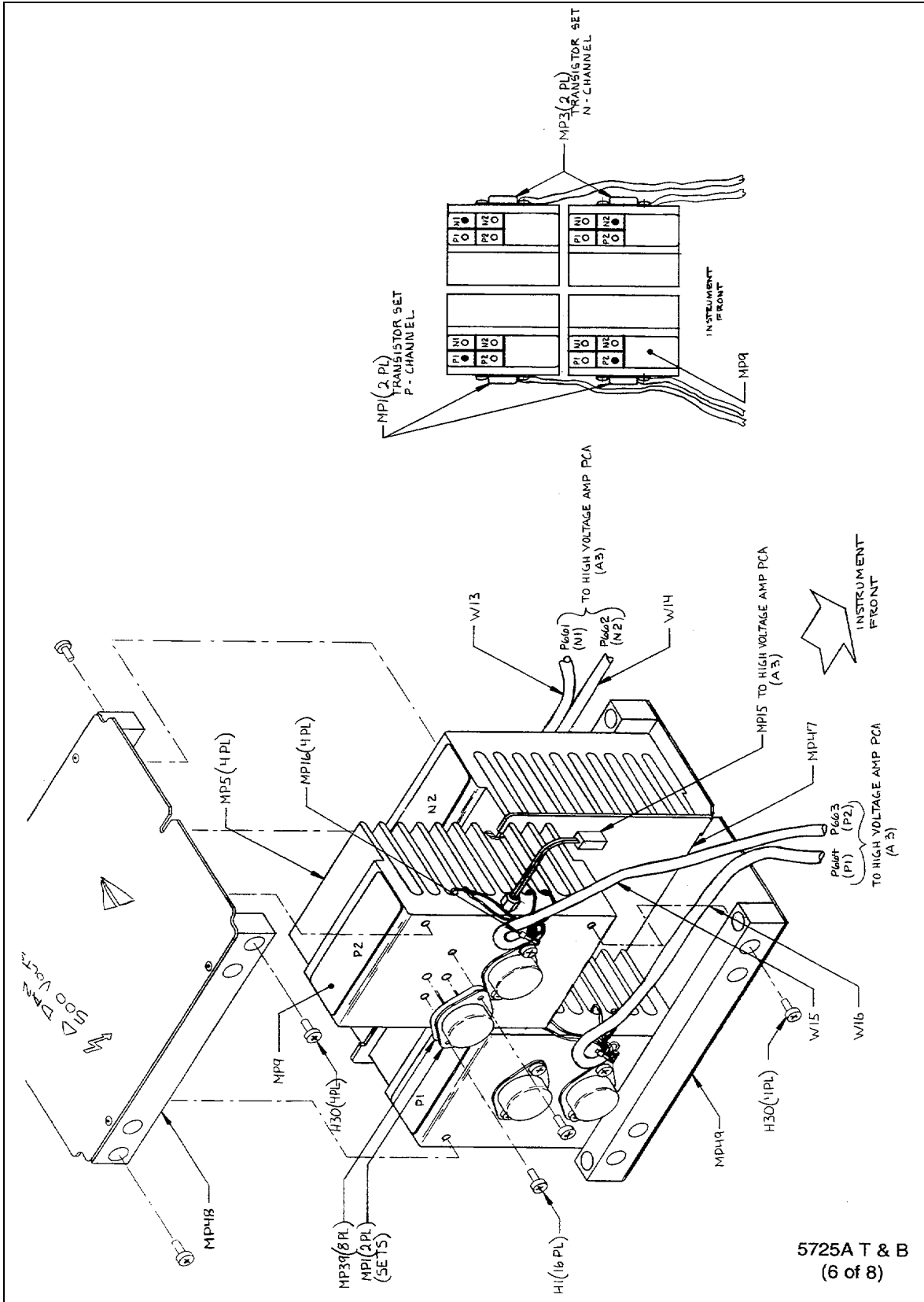


Figure 8-1. Final Assembly (cont)



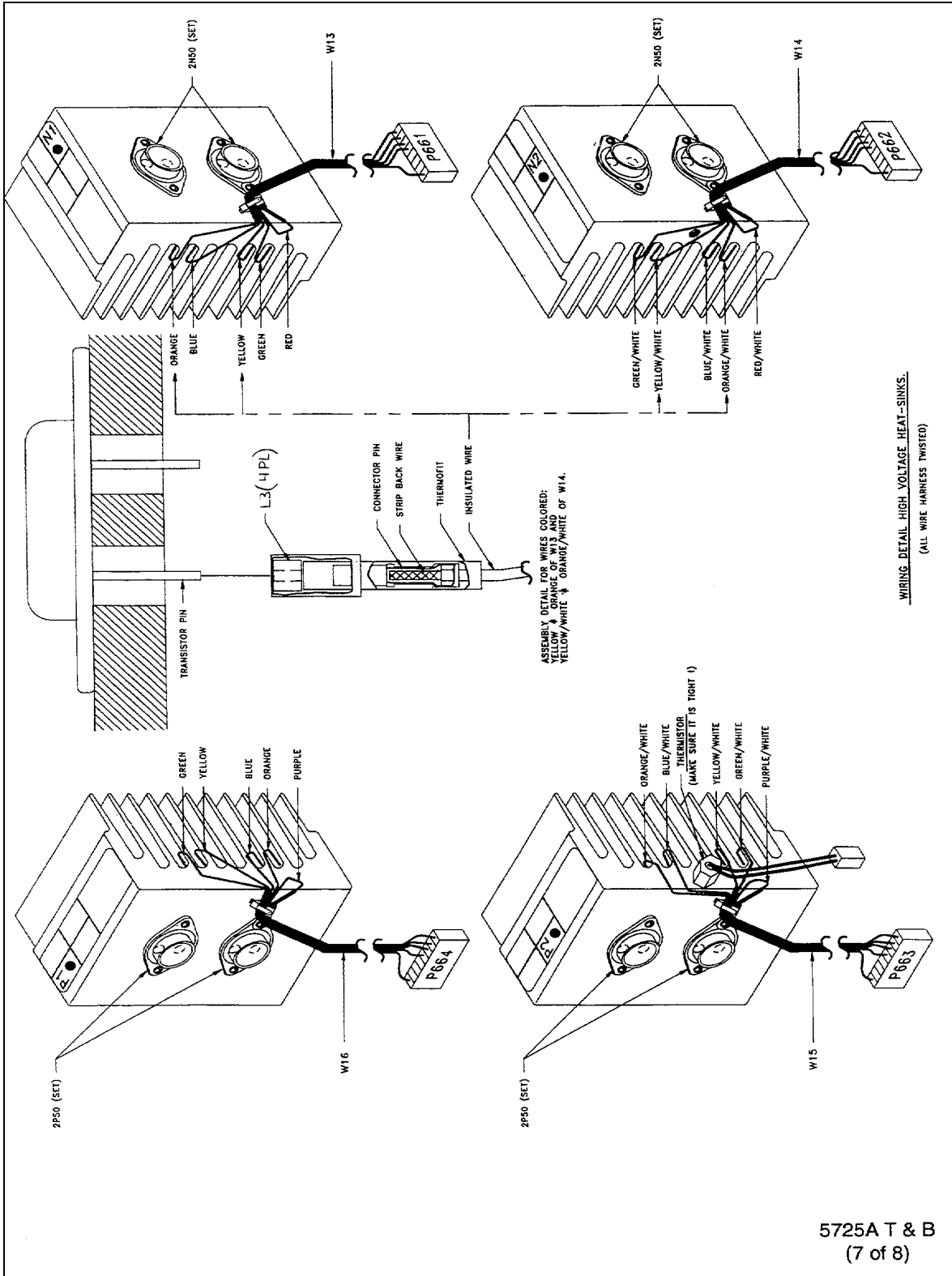


Figure 8-1. Final Assembly (cont)

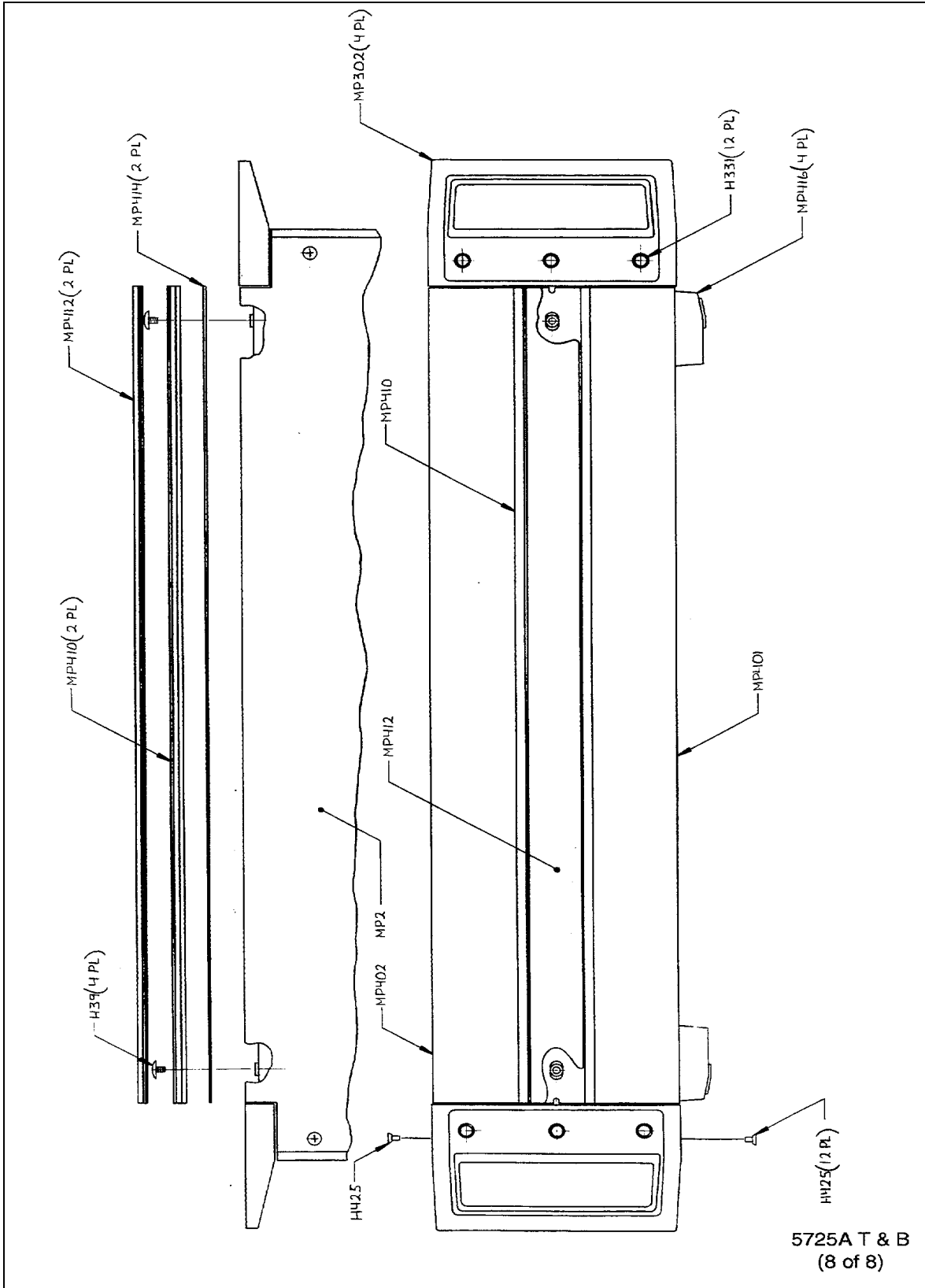
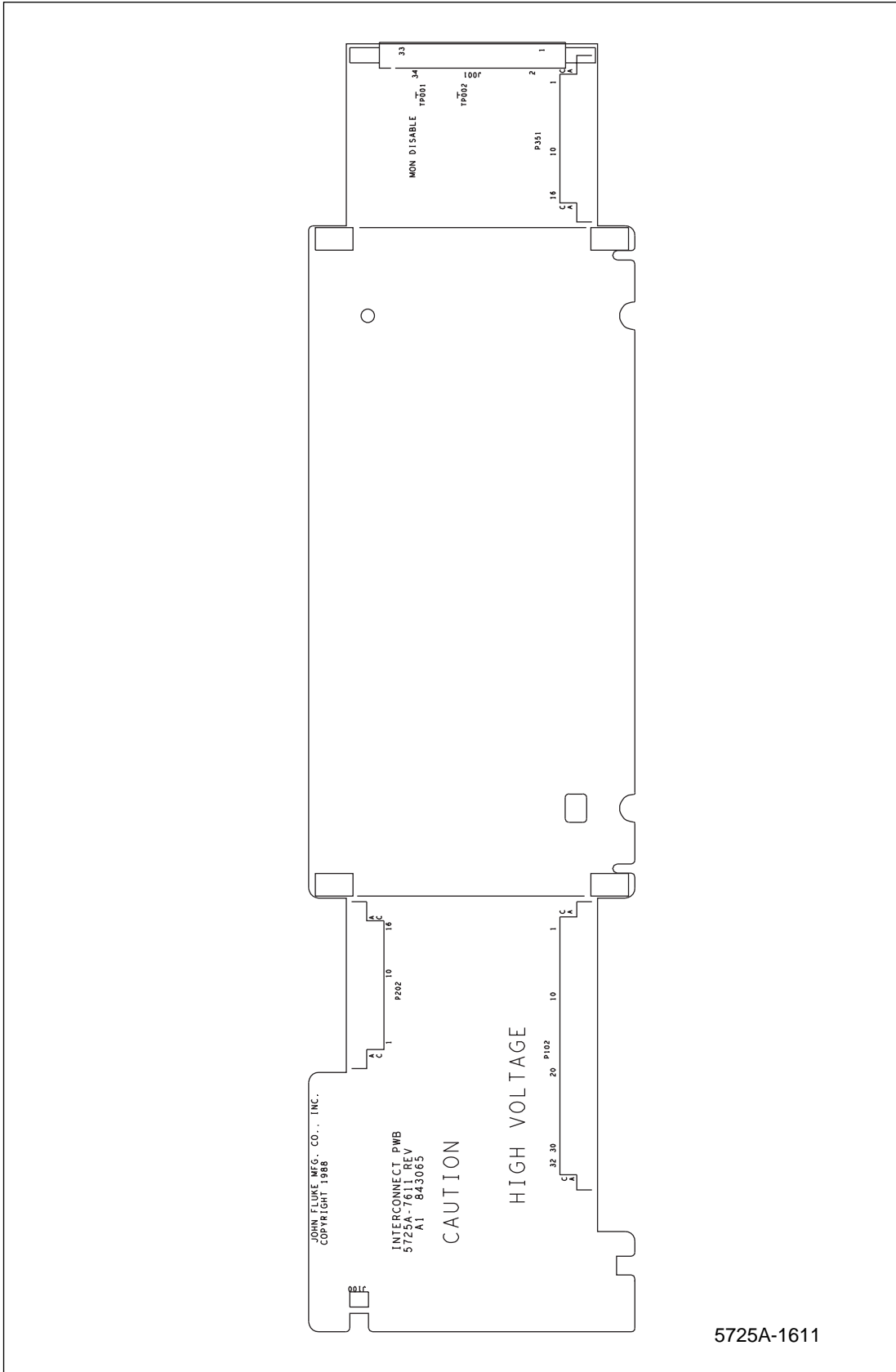


Figure 8-1. Final Assembly (cont)

**Table 8-3. A1 Interconnect PCA**

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
CR1,CR13-15	* DIODE,SI,BV=75V,IO=150MA,500MW	203323	4	
H13	RIVET,S-TUB,OVAL,AL,.087,.343	838458	8	
H22	RIVET,S-TUB,OVAL,STL,.118,.218	103606	4	
J1	HEADER,2 ROW,.100CTR,34 PIN	836577	1	
J2	HEADER,1 ROW,.156CTR,10 PIN	446724	1	
J100,J103	HEADER,1 ROW,.100CTR,RT ANG,2	851667	2	
K1	RELAY,ARMATURE,2 FORM C,5VDC	810911	1	
K13-15	RELAY,REED,1 FORM A,5VDC	806950	3	
MP1	BRACKET,RIGHT ANGLE,TAPPED,BRA	404525	4	
MP5	GUIDE, HEATSINK	860205	2	
P102	CONN,DIN41612,TYPE R,RT ANG,64	782102	1	
P202,P351,P653	CONN,DIN41612,TYPE 1/2R,RT ANG	836882	3	
TP1,TP2	JUMPER,WIRE,NONINSUL,0.200CTR	816090	2	



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Figure 8-2. A1 Interconnect PCA

Table 8-4. A2 Current Amplifier PCA

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
C201,C202,C207, C208,C211,C212, C226,C227,C236	CAP,AL,22UF,+20%,35V	817056 817056 817056	9	
C203,C204,C216, C217,C238-240	CAP,POLYES,0.1UF,+10%,50V	649913 649913	7	
C205,C206	CAP,POLYES,0.001UF,+10%,50V	720938	2	
C210,C214,C215, C234	CAP,POLYES,0.47UF,+10%,50V	697409 697409	4	
C213	CAP,CER,22PF,+2%,50V,C0G	714832	1	
C218-221	CAP,AL,50000UF,+100-10%,20V,LO	830539	4	
C222,C223	CAP,AL,470UF,+20%,35V,SOLV PR	756700	2	
C224,C225	CAP,AL,10UF,+20%,63V,SOLV PRO	816843	2	
C228	CAP,CER,100PF,+5%,50V,C0G	831495	1	
C230	CAP,CER,47PF,+2%,100V,C0G	832295	1	
C233	CAP,TA,2.2UF,+20%,16V	706804	1	
C235	CAP,POLYES,1UF,+10%,100V	447847	1	
C237	CAP,CER,39PF,+2%,50V,C0G	714840	1	
CR201-204, CR207,CR220, CR221	* DIODE,SI,BV=75V,IO=150MA,500MW * *	203323 203323 203323	7	
CR205	* DIODE,SI,N-JFET,CURRENT REG,IF	334839	1	
CR206	DIODE,SI,RECT,BRIDGE,BV=50V,IO	886945	1	
CR208-219, CR222	DIODE,SI,400 PIV,1 AMP	831586 831586	13	
E255	TERM,FASTON,TAB,.110,SOLDER	512889	1	
F201,F202	FUSE,.25X1.25,20A,32V,FAST	518860	2	
H16	WASHER,FLAT,STL,.170,.375,.031	110288	1	
H25	RIVET,POP,DOME,AL,.125,.316	807347	4	
H201	LABEL,C-MOS INSTRUCTION	464016	1	
H207	RIVET,S-TUB,OVAL,AL,.087,.250	838482	2	
H209	SCREW,PH,P,LOCK,STL,8-32,.625	114983	1	
H210	SCREW,PH,P,SEMS,STL,6-32,.375	177022	6	
H216	SCREW,PH,P,LOCK,MAG SS,6-32,.2	772236	8	
H230	NUT,BROACH,STL,6-32	393785	2	
H232	SCREW,PH,P,SS,10-32,.250	855184	8	
J201	CONN,MATE-N-LOK,HEADER,8 PIN	570515	1	
J202	CONN,DIN41612,TYPE 1/2R,32 PIN	836874	1	
J204	HEADER,1 ROW,.100CTR,2 PIN	643916	1	
J205	HEADER,1 ROW,.100CTR,2 PIN	602698	1	
J222	CONN,MATE-N-LOK,HEADER,4 PIN	512269	1	
J252	CONN,COAX,SMB(M),PWB	352450	1	
K201,K205-209	RELAY,ARMATURE,2 FORM C,5V	733063	6	
K202-204	RELAY,ARMATURE,2 FORM A,5VDC	830547	3	
L201	CHOKE, 3 TURN	452888	1	

Table 8-4. A2 Current Amplifier PCA (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
MP2	INSULATOR, CURRENT	850151	1	
MP28	INSULATOR, CURRENT	850156	1	
MP38	BUMPER, HI-TEMP, SILICONE	16018701	1	
MP81	CLAMP,PWB MOUNTING	823039	1	
MP82	CLAMP,PWB MOUNTING	842948	1	
MP203	HEAT DIS,PRESS ON,TO-5	418384	2	
MP205	HEAT DIS,VERT,.83,.50,.395,TO-	800144	1	
MP206	HEAT DIS,ACC,AL FOIL,TO-3	838169	2	
MP211	FUSE CLIP PCB	756460	4	
MP215	SOCKET,SINGLE,PWB,FOR .042-.04	544056	4	
MP225	AIDE,PCB PULL	541730	2	
MP256	INSUL PT,TRANSISTOR MOUNT,DAP,	152207	2	
MP812	HEATSINK, CURRENT	843110	1	
MP816	HEATSINK, RECTIFIER	850169	1	
Q201	* TRANSISTOR,SI,PNP,40V,0.35W,TO	698233	1	
Q202	* TRANSISTOR,SI,NPN,SMALL SIGNAL	698225	1	
Q203	* TRANSISTOR,SI,PNP,SMALL SIGNAL	402586	1	
Q204	* TRANSISTOR,SI,NPN,SMALL SIGNAL	346916	1	
Q205	* TRANSISTOR,SI,BV=100V,50W,TO-2	454041	1	
Q206	* TRANSISTOR,SI,BV=100V,40W,TO-2	454033	1	
Q207	* TRANSISTOR,SI,BV=60V,200W,TO-3	483222	1	
Q208	* TRANSISTOR,SI,BV=60V,200W,TO-3	483230	1	
Q211	* TRANSISTOR,SI,N-JFET,TO-92	832154	1	
Q212,Q213	* TRANSISTOR,SI,N-JFET,REMOTE CU	697987	2	
Q214,Q215	* TRANSISTOR,SI,PNP,80V,0.625W,T	816272	2	
Q216	* TRANSISTOR,SI,N-MOS,350MW,TO-9	783449	1	
R201,R202	RESISTOR .086 OHM 1% 4 TERM 10	490771	2	
R203,R204	RES,MF,43.2,+/-1%,0.5W,100PPM	601823	2	
R205	RES,MF,1K,+/-1%,0.125W,100PPM	168229	1	
R206,R234,R274, R275	RES,MF,31.6K,+/-1%,0.125W,100PP	261610	4	
R207,R222,R232, R235,R239-241	RES,MF,39.2K,+/-0.1%,0.125W,25P	344507	7	
R209	RES,MF,90.9,+/-0.1%,0.5W,25PPM	423947	1	
R211,R251,R252	RES,MF,3.92K,+/-0.1%,.125W,25PP	844662	3	
R212	RES,MF,2K,+/-0.1%,0.125W,25PPM	340174	1	
R213,R214,R217, R218,R231,R271	RES,CF,330,+/-5%,0.25W	368720	6	
R215,R216,R249, R250	RES,MF,3.48K,+/-1%,0.125W,100PP	260687	4	
R219,R220	RES,CC,5.1,+/-5%,1W	219071	2	
R221,R225,R226	RES,CC,51,+/-5%,0.5W	687829	3	
R223,R224,R227, R228	RES,CF,1,+/-5%,0.25W	357665	4	

Table 8-4. A2 Current Amplifier PCA (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
R233,R237,R238, R273	RES,MF,2K,+1%,0.125W,100PPM	235226 235226	4	
R243,R244	RES,CF,100K,+5%,0.25W	348920	2	
R247,R248	RES,MF,232,+1%,0.125W,100PPM	289975	2	
R253,R277,R282, R283,R285,R286	RES,MF,10K,+1%,0.125W,100PPM	168260 168260	6	
R255,R267,R268	RES,CF,470K,+5%,0.25W	342634	3	
R256-259	RES,MF,1M,+1%,0.125W,100PPM	268797	4	
R260	RES,LF,5.1,+5%,0.5W	687779	1	
R261,R263, R290- 295	RES,CF,4.7K,+5%,0.25W	348821 348821	8	
R262	RES,CF,150,+5%,0.25W	343442	1	
R264	RES,CF,1K,+5%,0.25W	343426	1	
R272	SHUNT ASSY	842877	1	
R276	RES,MF,9.09K,+1%,0.125W,100PP	221663	1	
R281	RES,MF,24.9K,+1%,0.125W,100PP	291369	1	
R284	RES,MF,44.2K,+1%,0.125W,25PPM	706317	1	
RT201,RT202	THERMISTOR,DISC,4.85,25C	838102	2	
TP201- 205,TP207-215	JUMPER,WIRE,NONINSUL,0.200CTR	816090 816090	17	
U201	* IC,OP AMP,PRECISION,LOW NOISE	866637	1	
U202	* IC,OP AMP,PRECISION,LOW NOISE	816744	1	
U203	* IC,OP AMP,CURRENT AMP,TO-99 CA	260422	1	
U204	* IC,OP AMP,DUAL,PRECISION MATCH	782375	1	
U205	* IC,VOLT REG,ADJ,1.2 TO 37 V,1.	460410	1	
U206	* IC,VOLT REG,ADJ,NEG,-1.2VTO-37v, 1.5A	772996	1	
U207	* IC,COMPARATOR,DUAL,LO-PWR,8 PI	478354	1	
U208	* IC,OP AMP,PRECISION,LOW NOISE	782920	1	
U209	* IC,BIMOS,8 CHNL HI-VOLT DRVR W	782912	1	
U210	* IC,COMPARATOR,QUAD,14 PIN DIP	387233	1	
U211	* IC,OP AMP,QUAD,JFET INPUT,14 P	483438	1	
VR201,VR202	* ZENER,UNCOMP,6.8V,5%,20.0MA,0.	260695	2	
W6	HARNESS, MFC CURRENT	843008	1	
w206	ASSY, THERMISTOR	843032	1	
Z201,Z203	* RNET,MF,HERM,SIP,5700 LO V INS	809418	2	

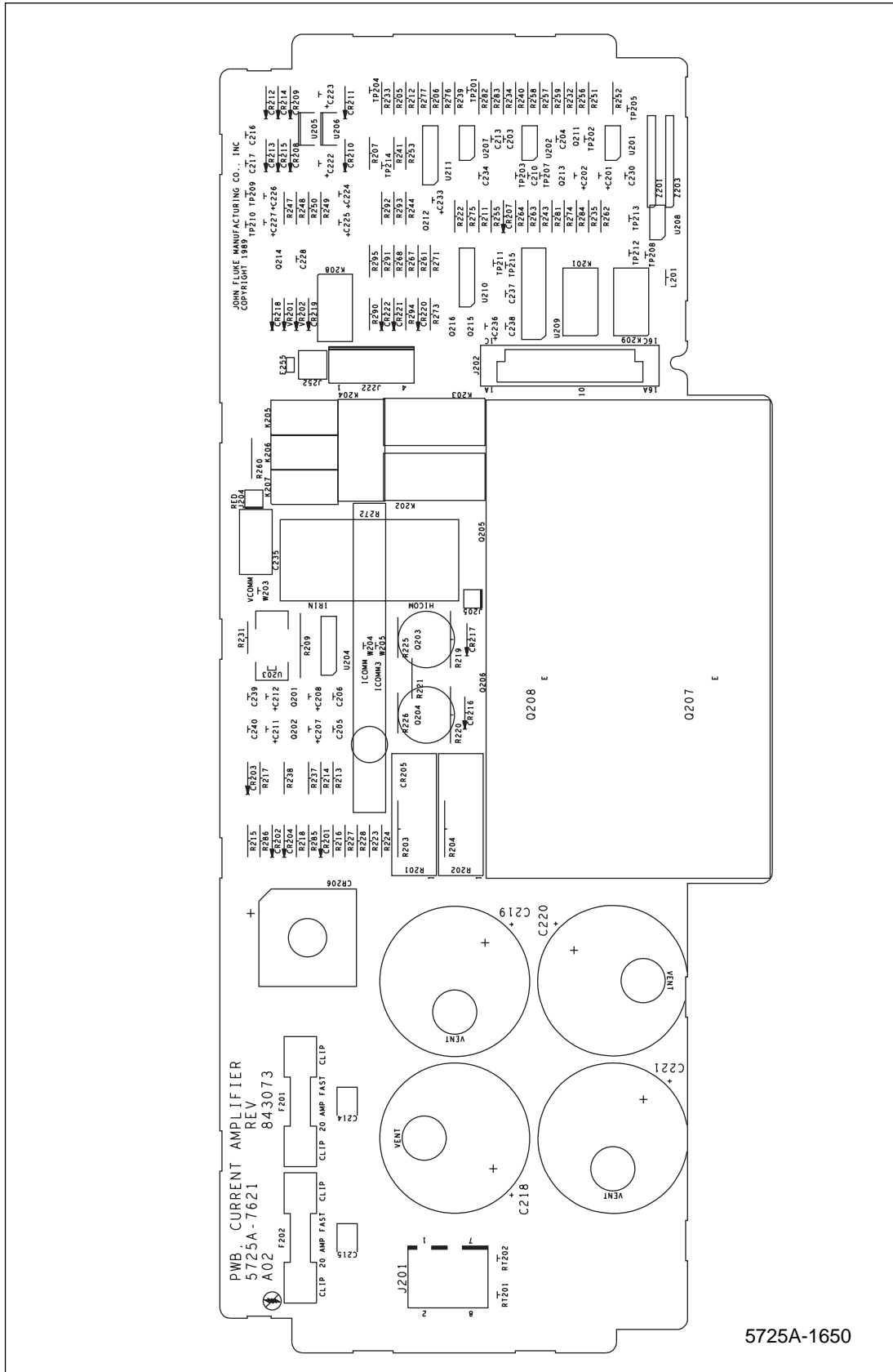


Figure 8-3. A2 Current Amplifier PCA



Table 8-5. A3 High Voltage Amplifier PCA

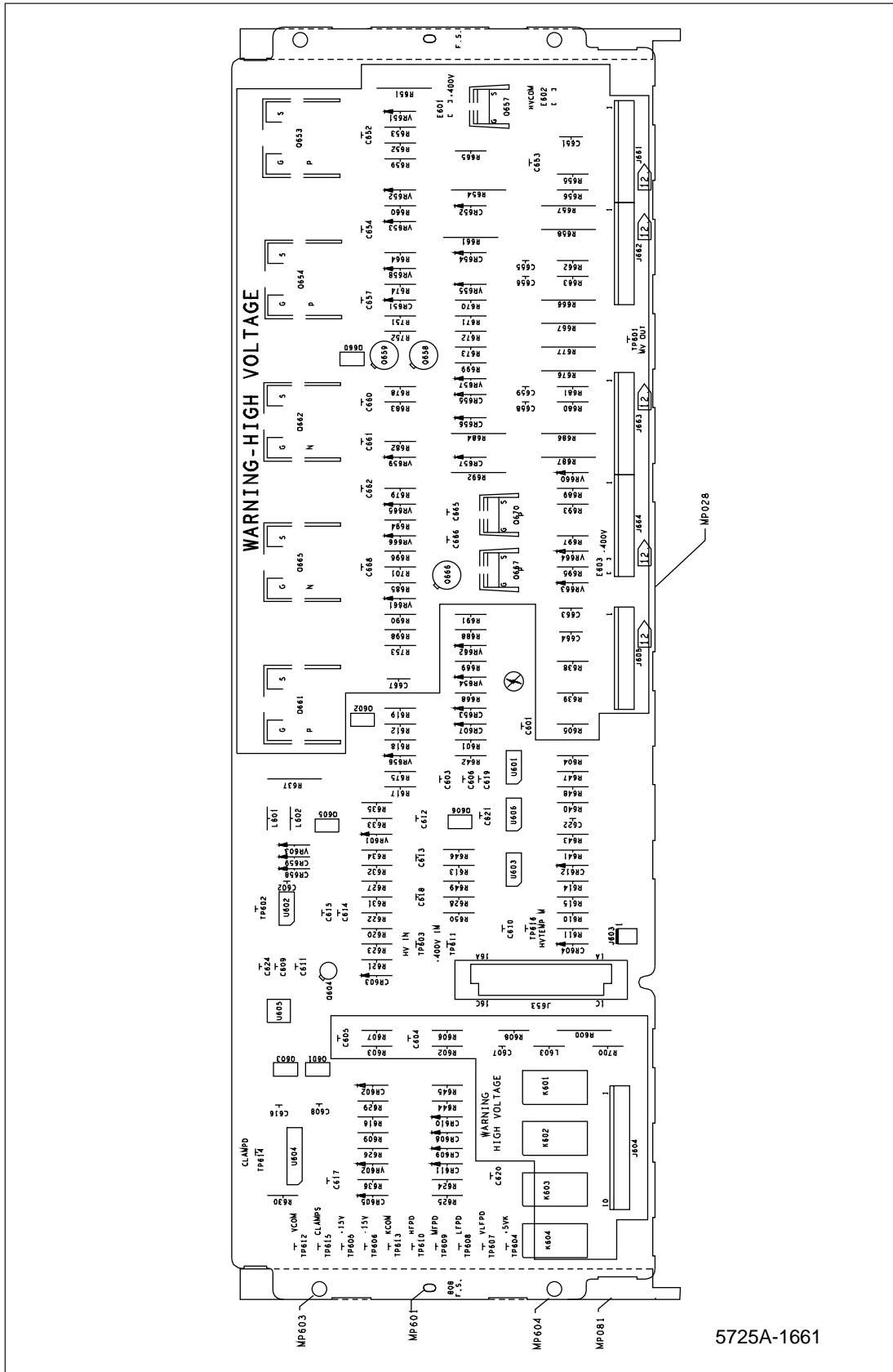
Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
C601	CAP,POLYES,1UF,+/-10%,50V	733089	1	
C602	CAP,CER,100PF,+/-5%,50V,C0G	831495	1	
C603,C606,C609-611,C620	CAP,AL,10UF,+/-20%,63V,SOLV PRO	816843 816843	6	
C604,C605	CAP,CER,1.5PF,+/-0.25PF,1000V,C	836346	2	
C607,C614,C654,C662	CAP,CER,22PF,+/-10%,1000V,C0G	817023 817023	4	
C608,C612,C619,C655,C656,C658,C659,C665,C666,C668	CAP,POLYES,0.1UF,+/-10%,50V	649913 649913 649913 649913	10	
C613	CAP,CER,3.3PF,+0.25PF,100V,C0J	816678	1	
C615,C621,C622,C652,C657	CAP,POLYES,0.01UF,+/-10%,50V	715037 715037	5	
C616	CAP,POLYES,0.001UF,+/-10%,50V	720938	1	
C617	CAP,AL,1UF,+/-20%,50V	782805	1	
C618	CAP,AL,2.2UF,+/-20%,50V	769687	1	
C651,C664,C667	CAP,CER,0.005UF,+/-20%,3000V,Z5	188003	3	
C653	CAP,CER,10PF,+/-10%,3000V,C0G	817049	1	
C660,C661	CAP,CER,39PF,+/-5%,1000V,C0G	817031	2	
C663	CAP,CER,0.01UF,+100-0%,1600V,Z	106930	1	
CR602-605, CR607-612, CR651,CR653, CR655, CR658, CR659	* DIODE,SI,BV=75V,IO=150MA,500MW * * *	203323 203323 203323 203323	15	
CR652,CR654, CR656,CR657	DIODE,SI,1K PIV,1.0 AMP	707075 707075	4	
H601	RIVET,S-TUB,OVAL,AL,.087,.250	838482	2	
H603	RIVET,POP,DOME,AL,.125,.316	807347	4	
H626	LABEL,C-MOS INSTRUCTION	464016	1	
J603	HEADER,1 ROW,.100CTR,2 PIN	602698	1	
J604	HEADER,1 ROW,.156CTR,10 PIN	446724	1	
J605,J661-664	HEADER,1 ROW,.156CTR,8 PIN	385435	5	
J653	CONN,DIN41612,TYPE 1/2R,32 PIN	836874	1	
K601-604	RELAY,ARMATURE,2 FORM C,5V	733063	4	
L601,L602	CHOKE, 3 TURN	452888	2	
L603	INDUCTOR,2.2UH,+/-5%,108MHZ,SHL	806547	1	
MP28	* INSULATOR,PWR SUPPY HIGH VOLT	843102	1	
MP81	CLAMP,PWB MOUNTING	823039	1	
MP82	CLAMP,PWB MOUNTING	842948	1	
MP601	AIDE,PCB PULL	541730	2	
MP658	INSUL PT,TRANSISTOR MOUNT,DAP,	152207	3	

Table 8-5. A3 High Voltage Amplifier PCA (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
Q601	* TRANSISTOR,SI,N-JFET,TO-92	816314	1	
Q602,Q603,Q606	* TRANSISTOR,SI,PNP,40V,0.35W,TO	698233	3	
Q604	* TRANSISTOR,SI,N-DMOS FET,TO-72	394122	1	
Q605,Q660	* TRANSISTOR,SI,NPN,SMALL SIGNAL	698225	2	
Q653, Q654, Q661	HEAT SINK ASSY	665521	2	
Q667, Q670	HEAT SINK ASSY	665536	2	
Q657	HEAT SINK ASSY	665554	1	
Q662, Q665	HEAT SINK ASSY	665528	2	
Q658,Q666	* TRANSISTOR,SI,NPN,SMALL SIGNAL	346916	2	
Q659	* TRANSISTOR,SI,PNP,SMALL SIGNAL	402586	1	
R600	RES,WW,1.2,+5%,2W	248658	1	
R601,R609,R612, R617,R620,R649, R650,R659,R674, R694,R698,R753	RES,CF,1K,+5%,0.25W	343426	12	
R602,R603,R664, R683,R688	RES,CF,4.7K,+5%,0.25W	343426	5	
R604,R605	RES,CF,680K,+5%,0.25W	348821	2	
R606,R607	RES,MF,100K,+1%,0.125W,100PPM	442517	2	
R608	RES,MF,44.2K,+1%,0.125W,25PPM	248807	1	
R610	RES,MF,649,+1%,0.125W,100PPM	706317	1	
R611,R614	RES,MF,2K,+0.1%,0.125W,25PPM	309955	2	
R613	RES,MF,39.2K,+0.1%,0.125W,25P	340174	1	
R615	RES,MF,3.92K,+0.1%,.125W,25PP	344507	1	
R616	RES,CF,6.8K,+5%,0.25W	844662	1	
R618,R665,R675, R690,R691,R697, R699-701,R751, R752	RES,CF,51,+5%,0.25W	368761	11	
R619,R653,R655, R656,R662,R663, R679-681,R685, R689,R693,R696	RES,CF,100,+5%,0.25W	414540	13	
R621,R623,R626	RES,MF,5.49K,+1%,0.125W,100PP	414540	3	
R622	RES,MF,60.4K,+1%,0.125W,100PP	414540	1	
R624,R625 R627- 630,R632-635, R644-646,R652	RES,CF,10K,+5%,0.25W	414540	14	
R631,R660,R678, R682	RES,CF,330,+5%,0.25W	348839	4	
R636	RES,MF,2K,+1%,0.125W,100PPM	368720	1	
R637	RES,CC,1.2K,+5%,1W	235226	1	
R638,R639	RES,CF,1.5M,+5%,0.25W	109892	2	

Table 8-5. A3 High Voltage Amplifier PCA (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
R640,R642	RES,CF,100K,+5%,0.25W	348920	2	
R641,R648	RES,MF,10K,+1%,0.125W,100PPM	168260	2	
R643	RES,CF,4.7M,+5%,0.25W	543355	1	
R647	RES,MF,20K,+1%,0.125W,100PPM	291872	1	
R651	RES,CC,220,+10%,1W	109462	1	
R654,R661,R684, R692	RES,LERM,100K,+5%,3W	820811 820811	4	
R657,R658,R666, R667,R676,R677, R686,R687	RES,MDX,3.9,+1%,1W,200PPM	687852 687852 687852	8	
R668,R669	RES,CF,20K,+5%,0.25W	441477	2	
R670-673	RES,CF,0.51,+5%,0.25W	381954	4	
R695	RES,CF,10M,+5%,.25W	875257	1	
RT663	ASSY, THERMISTOR	843032	1	
TP601-616	JUMPER,WIRE,NONINSUL,0.200CTR	816090	16	
U601,U603	* IC,OP AMP,DUAL,LO OFFST,VOLT,L	685164	2	
U602	* IC,OP AMP,HIGH SPEED,200V/US,3	845466	1	
U604	* IC,COMPARATOR,QUAD,14 PIN DIP	387233	1	
U605	* ISOLATOR,OPTO,LED TO PHOTO-RES	887062	1	
U606	* IC,COMPARATOR,DUAL,LO-PWR,8 PI	478354	1	
VR601	* ZENER,UNCOMP,24.0V,5%,5.2MA,0.	267807	1	
VR602,VR658	* ZENER,UNCOMP,6.8V,5%,20.0MA,0.	260695	2	
VR603,VR666	* ZENER,UNCOMP,5.1V,5%,20.0MA,0.	159798	2	
VR651,VR665	* ZENER,UNCOMP,15.0V,5%,8.5MA,0.	266601	2	
VR652- 657,VR659-662	* ZENER,UNCOMP,10.0V,5%,12.5MA,0	246611 246611	10	
VR663,VR664	* ZENER,UNCOMP,20.0V,5%,12.5MA,1	291575	2	



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Figure 8-4. A3 High Voltage Amplifier PCA

Table 8-6. A4 Power Supply PCA

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
C301,C302,C321,C322	CAP,AL,220UF,+20%,350V	854075 854075	4	
C303,C304,C308,C317-319,C352,C355,C358,C360,C362	CAP,POLYES,0.1UF,+10%,50V	649913 649913 649913 649913	11	
C305,C306	CAP,AL,0.47UF,+20%,50V	769695	2	
C307	CAP,POLYES,0.047UF,+10%,50V	820548	1	
C309	CAP,CER,82PF,+2%,50V,C0G	714857	1	
C310,C311,C313,C320	CAP,CER,0.04UF,+20%,3000V,Y5V	851725 851725	4	
C312,C363	CAP,CER,33PF,+5%,50V,C0G	714543	2	
C314	CAP,POLYES,0.47UF,+10%,50V	697409	1	
C315,C316	CAP,POLYES,0.01UF,+10%,50V	715037	2	
C350	CAP,AL,10000UF,+20%,25V	816819	1	
C351,C354,C357,C359,C361	CAP,AL,10UF,+20%,63V,SOLV PRO	816843 816843	5	
C353,C356,C369	CAP,AL,3300UF,+20%,50V	782458	3	
C364-368	CAP,POLYES,0.33UF,+10%,50V	715284	5	
CR301-304,CR310-313	* DIODE,SI,1K PIV,1.0 AMP *	707075 707075	8	
CR305-309,CR316,CR321	DIODE,SI,BV=75V,IO=150MA,500MW	203323 203323	7	
CR314,CR315,CR319,CR320,CR322-325,CR350,CR352-354,CR356-363	DIODE,SI,400 PIV,1 AMP	831586 831586 831586 831586 831586	20	
CR317,CR318	LED,RED,T1,40 MCD	845412	2	
CR351,CR355	DIODE,SI,RECT,BRIDGE,BV=50V,IO	586115	2	
E301	HEADER,1 ROW,.100CTR,4 PIN	417329	1	
E302	SURGE PROTECTOR,630V,+15%	853767	1	
F301,F302	FUSE,.406X1.375,2A,600V,FAST	747600	2	
H301	RIVET,S-TUB,OVAL,AL,.087,.250	838482	1	
H302	RIVET,S-TUB,OVAL,AL,.087,.250	838482	1	
H303-	RIVET,POP,DOME,AL,.125,.316	807347	4	
H307	RIVET,S-TUB,OVAL,STL,.118,.156	103424	4	
J301,J303	CONN,MATE-N-LOK,HEADER,8 PIN	570515	2	
J302,J350	HEADER,1 ROW,.156CTR,8 PIN	385435	2	
J351	CONN,DIN41612,TYPE 1/2R,32 PIN	836874	1	
MP28	* INSULATOR,PWR SUPPY HIGH VOLT	843102	1	
MP81	CLAMP,PWB MOUNTING	823039	1	
MP82	CLAMP,PWB MOUNTING	842948	1	
MP301	HLDR,FUSE,13/32,PWB MT	516880	4	

Table 8-6. A4 Power Supply PCA (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
MP310	AIDE,PCB PULL	541730	2	
MP350	HEAT DIS,VERT,1.13X1.90X0.95,T	830844	3	
MP398	PAD, ADHESIVE	735365	2	
P301	JUMPER,REC,2 POS, .100CTR, .025	530253	1	
Q301,Q302,Q317, Q318	* HEAT SINK ASSY	665536	4	
Q303-305,Q315, Q321,Q322	* TRANSISTOR,SI,NPN,HI-VOLTAGE,T	722934	6	
Q306,Q307,Q311, Q316,Q323,Q324	* TRANSISTOR,SI,PNP,SM SIG,SELEC	602961	6	
Q308	* TRANSISTOR,SI,PNP,40V,0.35W,TO	602961	1	
Q309	* TRANS,SI,N-JFET,REMOTE CUTOFF,	698233	1	
Q310,Q314	* TRANSISTOR,SI,NPN,SMALL SIGNAL	707968	2	
Q312,Q313,Q319, Q320	* HEAT SINK ASSY	698225	4	
Q350,Q351	* TRANSISTOR,SI,BV= 40V, 40W,TO-	66554	2	
R301,R302,R342, R343	RES,CF,470K,+5%,0.25W	418459	4	
R303,R308,R335, R339	RES,MOX,33K,+5%,1W	342634	4	
R304,R305,R340, R341	RES,CF,33K,+5%,0.25W	342634	4	
R306,R332,R349	RES,MF,10K,+1%,0.125W,100PPM	644952	3	
R307,R309,R356	RES,CF,6.8K,+5%,0.25W	644952	3	
R310,R311,R346, R347	RES,CF,1.5M,+5%,0.25W	348888	4	
R312,R317,R330, R331,R353 R357- 360	RES,CF,100,+5%,0.25W	348888	9	
R313,R329	RES,MF,0.39,+5%,2W	348771	2	
R314,R315,R336, R337	RES,CF,15K,+5%,0.5W	219386	4	
R316,R324,R338	RES,CF,100K,+5%,0.25W	687795	3	
R318	RES,MF,86.6K,+1%,0.125W,25PPM	687795	1	
R319	RES,MF,28.7K,+1%,0.125W,100PP	348920	1	
R320,R325,R328, R348,R354	RES,CF,10K,+5%,0.25W	257402	5	
R321	RES,MF,40.2K,+1%,0.125W,100PP	235176	1	
R322,R333	RES,MF,499,+1%,.0.125W,100PM	348839	2	
R323	RES,MF,6.19K,+1%,0.125W,100PP	235333	1	
R326	RES,MF,604,+1%,0.125W,100PPM	168211	1	
R327	RES,MF,60.4K,+1%,0.125W,100PP	283911	1	
R334	RES,CF,2K,+5%,0.25W	320309	1	
R344,R345	RES,CF,240K,+5%,0.25W	291419	2	
R350,R352	RES,MF,20K,+1%,0.125W,100PPM	441469	2	

Table 8-6. A4 Power Supply PCA (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
R351	RES,CF,1K,+5%,0.25W	343426	1	
R355	RES,CF,4.7K,+5%,0.25W	348821	1	
R361,R362	RES,CF,4.7,+5%,0.25W	441584	2	
RT350	THERMISTOR,DISC,O.12,25C	838144	1	
RT351-354	THERMISTOR,DISC,0.81,25C	838136	4	
SW301,SW302	SWITCH,PUSHBUTTON,SPST,MOMENTA	782656	2	
TP301-307,TP350-355,TP357-360	JUMPER,WIRE,NONINSUL,0.200CTR	816090	17	
U301	IC,COMPARATOR,DUAL,LO-PWR,8 PI	478354	1	
U302	IC,CMOS,DUAL D F/F,+EDG TRG W/	536433	1	
U350,U353	IC,VOLT REG,FIXED,+5 VOLTS,1.5	647073	2	
U351	IC,VOLT REG,FIXED 15VOLTS,1.5A	772830	1	
U352	IC,VOLT REG,FIXED,-15 VOLTS,1.	413179	1	
U354	IC,OP AMP,GENERAL PURPOSE,8 PI	478107	1	
VR301,VR302,VR304,VR305	ZENER,UNCOMP,15.0V,5%,8.5MA,0.	266601	4	
VR303	ZENER,UNCOMP,16.0V,5%,7.8MA,0.	325837	1	
VR306,VR307	ZENER,UNCOMP,3.9V,10%,20.0MA,0	113316	2	
VR351	ZENER,UNCOMP,3.9V,5%,320.0MA,5	386995	1	
VR352	ZENER,UNCOMP,24.0V,5%,5.2MA,0.	267807	1	
W8	HARNESS, HIGH VOLTAGE SUPPLY	843016	1	

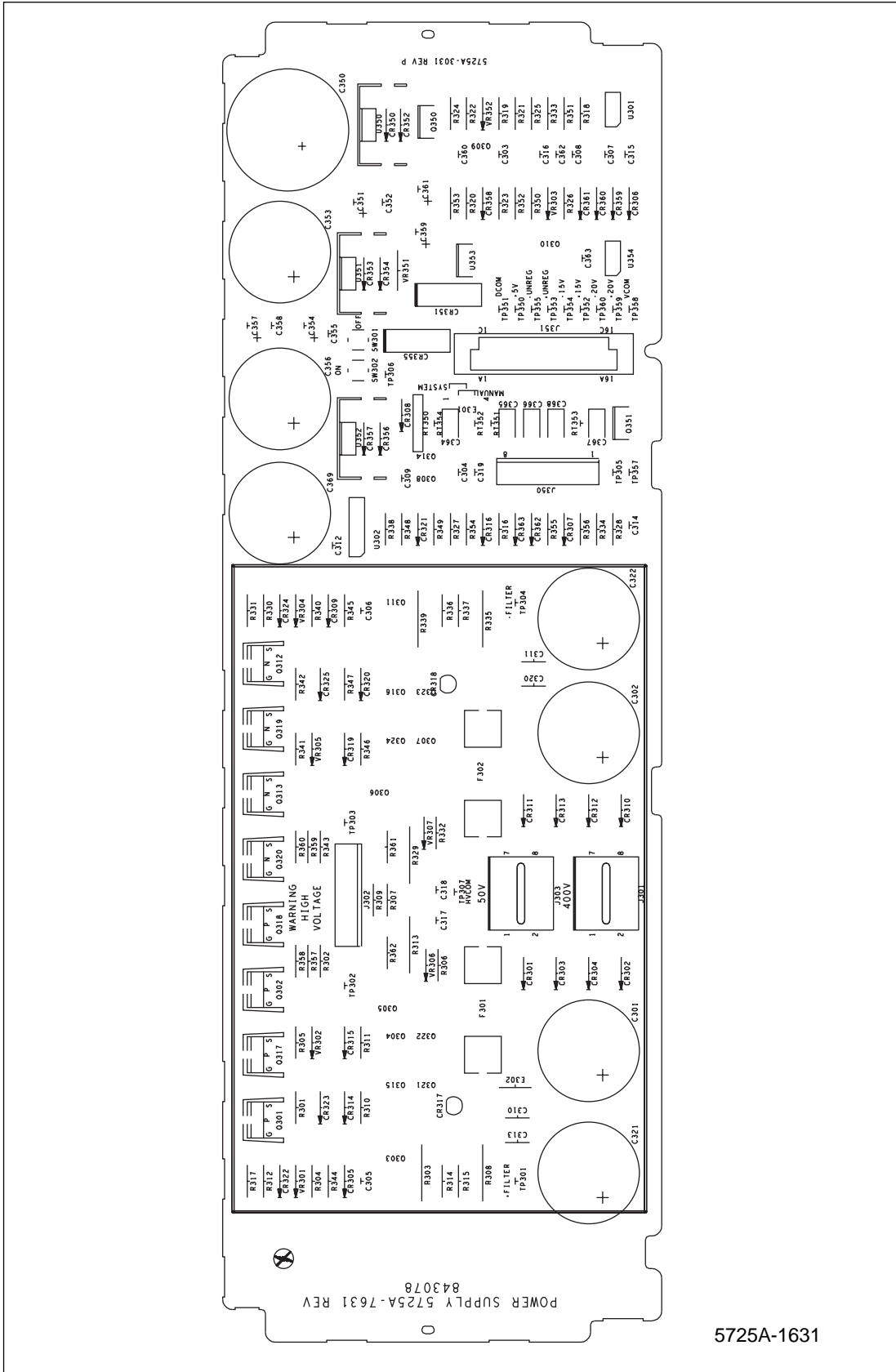


Figure 8-5. A4 Power Supply PCA



Table 8-7. A5 Digital PCA

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
C501,C503-511, C516,C518,C519, C521	CAP,POLYES,0.1UF,+/-10%,50V	649913 649913 649913	14	
C502,C520	CAP,AL,22UF,+/-20%,35V	817056	2	
C512,C513	CAP,CER,15PF,+/-20%,50V,C0G	697524	2	
C514,C517	CAP,POLYES,0.33UF,+/-10%,50V	715284	2	
C515	CAP,TA,10UF,+/-20%,35V	816512	1	
C522-530	CAP,CER,470PF,+/-5%,50V,C0G	830430	9	
C531	CAP,CER,100PF,+/-5%,50V,C0G	831495	1	
CR501,CR504, CR505	LED,GREEN,LIGHT BAR,5.0 MCD	845136 845136	3	
CR502,CR506, CR507	LED,RED,LIGHT BAR,6.0 MCD	534834 534834	3	
CR508,CR509	* DIODE,SI,SCHOTTKY,40V,DO-34	313247	2	
E501	HEADER,1 ROW,.100CTR,4 PIN	417329	1	
J501	SOCKET,IC,0.070 CTR,64 PIN	783688	1	
J502	HEADER,2 ROW,.100CTR,RT ANG,34	836551	1	
J504	SOCKET,IC,28 PIN	448217	1	
J506-509	SOCKET,IC,8 PIN	478016	4	
J512,J515	SOCKET,IC,24 PIN	376236	2	
L501	CHOKE, 3 TURN	452888	1	
MP501	PAD, ADHESIVE	735365	1	
MP502	SLEEVING	142554	1	
MP815	CABLE, INTERCONNECT - FRONT PA	843123	1	
R501	RES,MF,1M,+/-1%,0.125W,100PPM	268797	1	
R502,R509	RES,CF,1K,+/-5%,0.25W	343426	2	
R503-507	RES,CF,47K,+/-5%,0.25W	348896	5	
R508	RES,MF,11.5,+/-1%,0.125W,100PPM	339796	1	
R510	RES,CF,10K,+/-5%,0.25W	348839	1	
SW502	SWITCH,PUSHBUTTON,SPST,MOMENTA	782656	1	
TP501-510	JUMPER,WIRE,NONINSUL,0.200CTR	816090	10	
U501,U510	* IC,CMOS,OCTAL D TRANSPARENT LA	743294	2	
U502	* IC,CMOS,HEX INVERTERS	799924	1	
U503	* IC,CMOS,OCTL LINE DRVR W/3-ST	741892	1	
U504	* IC, 2K X 8 STAT RAM	647222	1	
U505	* IC,CMOS,QUAD INPUT NOR GATE	811158	1	
U506	* IC,CMOS,14 STAGE BINARY COUNT	807701	1	
U507	* IC,CMOS,8-BIT MPU,2.0 MHZ,256	876326	1	
U508	* IC,VOLT SUPERVISOR,4.55V SENSE	780577	1	
U509	* IC,CMOS,DUAL MONOSTABLE MULTIB	454017	1	
U511,U514	* IC,CMOS,QUAD 2 INPUT NAND GATE	707323	2	
U512	IC, NMOS, 2K X 8 EEPROM, 350 N	811075	1	
U513	* IL,CMOS,QUAD 2 INPUT AND GATE	741801	1	
U515	* EPROM,PROGRAMED 27128A-150 U51	860148	1	
Y501	CRYSTAL,4.9152 MHZ,+/- 0.005%,	800367	1	
Z501	RES,CERM,DIP,16 PIN,15 RES,10K	355305	1	
Z502	RES,CERM,DIP,16 PIN,8 RES,24,+	806406	1	



Table 8-8. A6 High Voltage Sense PCA

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
C98,C99	CAP,CER,470PF,+10%,50V,C0G	733071	2	
C100,C121	CAP,POLYCA,1UF,+10%,50V	271619	2	
C101,C103,C106, C107,C109,C111, C114,C115 C117- 119,C124,C125, C150-152,C154, C157,C163,C166, C167,C169-176, C181-183	CAP,POLYES,0.1UF,+10%,50V	649913 649913 649913 649913 649913 649913 649913 649913	32	
C102	CAP,POLYCA,0.15UF,+5%,50V	343616	1	
C104,C127	CAP,CER,680PF,+5%,50V,C0G	743351	2	
C105	CAP,PORC,1.0PF,+0.25PF,1000V	603571	1	
C108	CAP,CER,10PF,+2%,50V,C0G	713875	1	
C110,C112,C122, C123,C177	CAP,TA,10UF,+20%,35V	816512 816512	5	
C113,C128	CAP,CER,100PF,+5%,50V,C0G	831495	2	
C120	CAP,POLYES,0.1UF,+10%,50V	649913	1	
C153	CAP,CER,3300PF,+5%,50V,C0G	830612	1	
C155	CAP,POLYES,0.01UF,+10%,50V	715037	1	
C156,C158-161	CAP,AL,22UF,+20%,35V	817056	5	
C162,C164,C165, C168	CAP,CER,39PF,+2%,50V,C0G	714840 714840	4	
C180	CAP,POLYES,0.47UF,+10%,50V	697409	1	
C401	CAP,AL,600UF,+75-10%,15V,SOLV	557660	1	
C402	CAP,AL,47UF,+20%,50V,SOLV PRO	822403	1	
C403	CAP,CER,0.22UF,+80-20%,50V,Z5U	649939	1	
CR100,CR103, CR104,CR150-153	* DIODE,SI,BV=75V,IO=150MA,500MW	659516 659516	7	
CR101,CR102	* DIODE,SI,BV=20V,IO=50MA,250MW	836288	2	
CR105-108	* DIODE,SI,BV=35V, LOW LEAKAGE	723817	4	
CR401-404	DIODE,SI,400 PIV, 1 AMP	831586	4	
CR405	* DIODE,SI,BV=75V,IO=150MA,500MW	203323	1	
E105	SOCKET,SINGLE,SOLDER,FOR .064	851287	1	
E155	TERM,FASTON,TAB,.110,SOLDER	512889	1	
H27	GROUND STRIP,BECU,SPRING FINGE	370619	1	
H108	RIVET,S-TUB,OVAL,AL,.087,.250	838482	2	
H110	RIVET,S-TUB,OVAL,STL,.118,.281	650283	2	
H121	RIVET,POP,DOME,AL,.125,.316	807347	4	
H126	LABEL,C-MOS INSTRUCTION	464016	1	
J102	CONN,DIN41612,TYPE R,64 PIN	782094	1	
J118-124	SOCKET,SINGLE,SOLDER,FOR .021	851290	7	
J152	CONN,COAX,SMB(M),PWB	352450	1	
J401	CONN,MATE-N-LOK,HEADER,4 PIN	512269	1	
J402	HEADER,1 ROW,.156CTR,12 PIN	831354	1	

Table 8-8. A6 High Voltage Sense PCA (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
J403	HEADER,1 ROW,,156CTR,RT ANG,5	844717	1	
K101,K106-108, K111,K151-153	RELAY,ARMATURE,2 FORM C,5V	733063 733063	8	
K102-105,K109	RELAY,REED,1 FORM A,5VDC	806950	5	
K401	RELAY,ARMATURE,2 FORM A,5VDC	830547	1	
L100-105	CHOKE, 3 TURN	452888	6	
MP1	CABLE ACCESS,TIE,4.00L,,10W,,7	172080	2	
MP25	SHIELD, DIGITAL	842930	1	
MP26	SHIELD, SENSOR	842935	1	
MP27	INSULATOR, SENSE	843099	1	
MP36	SUPPORT,ATTENUATOR	823195	2	
MP038	BUMPER, HI-TEMP	1601870	1	
MP81	CLAMP,PWB MOUNTING	823039	1	
MP82	CLAMP,PWB MOUNTIN	842948	1	
MP101	AIDE,PCB PULL	541730	2	
MP813	WIRE, ATTENUATOR	843094	1	
Q100,Q102	* TRANSISTOR,SI,PNP,80V,0.625W,T	816272	2	
Q101,Q103	* TRANSISTOR,SI,NPN,SMALL SIGNAL	816298	2	
Q104,Q107,Q401	* TRANSISTOR,SI,N-MOS,350MW,TO-9	783449	3	
Q105	* TRANSISTOR,SI,PNP,40V,0.35W,TO	698233	1	
Q106,Q150	* TRANSISTOR,SI,NPN,SMALL SIGNAL	698225	2	
R100,R123,R124, R157,R159-161, R163-167,R177	RES,CF,1.5K,+5%,0.25W	810432 810432 810432	13	
R101,R102	RES,MF,86.6K,+1%,0.125W,100PP	772046	2	
R103	RES,MF,40.2K,+1%,2W,10PPM	811042	1	
R104,R108,R116	RES,CF,330,+5%,0.25W	830596	3	
R105,R114	RES,MF,2K,+1%,0.125W,100PPM	816629	2	
R106	RES,MF,402K,+0.1%,0.125W,100P	714329	1	
R107,R117	RES,CF,240,+5%,0.25W	830588	2	
R110,R113,R115, R119,R121,R122, R128,R129,R150	RES,CF,47,+5%,0.25W	822189 822189 822189	9	
R112	RES,MF,1.21K,+1%,0.125W,100PP	810507	1	
R118	RES,CF,4.7,+5%,0.25W	816637	1	
R120,R170	RES,MF,619,+0.1%,0.125W,100PP	810515	2	
R125,R174,R179	RES,CF,100K,+5%,0.25W	658963	3	
R126	RES,CF,3.9,+5%,0.25W	810473	1	
R127	RES,CF,20K,+5%,0.25W	697110	1	
R130	RES,CF,100,+5%,0.25W	810465	1	
R131,R132	RES,MF,2.67K,+1%,0.125W,100PP	820290	2	
R133,R134	RES,MF,1K,+1%,0.125W,100PPM	816595	2	
R151,R169	RES,MF,18.2K,+1%,0.125W,100PP	756429	2	
R153	RES,MF,80.27K,+0.1%,0.125W,25	851337	1	

Table 8-8. A6 High Voltage Sense PCA (cont)

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
R154	RES,MF,20K,+0.1%,0.25W,25PPM	810564	1	
R155	RES,MF,13.7K,+0.1%,0.125W,25P	851340	1	
R156,R158,R168, R173	RES,CF,3.9K,+5%,0.25W	810416	4	
R162	RES,CF,10K,+5%,0.25W	697102	1	
R171	RES,CF,3M,+5%,0.25W	746172	1	
R172,R175	RES,CF,4.7K,+5%,0.25W	721571	2	
R178	RES,CF,2K,+5%,0.25W	810457	1	
R401	RES,MF,6.19K,+1%,0.125W,100PP	283911	1	
R402	RES,CF,20K,+5%,0.25W	441477	1	
R403	RES,CC,56,+10%,0.5W	642907	1	
R404	RES,CF,47K,+5%,0.25W	348896	1	
RT401,RT402	THERMISTOR,DISC,NEG.,10,+15%,	500371	2	
RT403	THERMISTOR,DISC,4.85,25C	838102	1	
RV101,RV155	VARISTOR,33V,+10%,1.0MA	816421	2	
RV151-154	VARISTOR,8.2V,+35%,1.0MA	715052	4	
RV401	VARISTOR,430V,+10%,1.0MA	519355	1	
SW150	SWITCH,SLIDE,DPDT	697466	1	
SW402-404	SWITCH,SLIDE,DPDT,LINE SELECT,	817353	3	
TP100,TP101	JUMPER,WIRE,NONINSUL,0.200CTR	816090	20	
TP103-107,TP151- 154 TP156,TP157, TP159-161,		816090		
		816090		
		816090		
U100	* IC,OP AMP,VLOW IB,LOW VOS,8 PI	875760	1	
U101	RMS CONVERTER TESTED 400 OHM-A	842591	1	
U102	* IC,OP AMP,LOW BIAS,HIGH BANDWI	854133	1	
U103	* IC,OP AMP,LO-OFFSET VOLTAGE,LO	605980	1	
U105	* IC,OP AMP,PRECISION,LOW NOISE	782920	1	
U150	* IC,COMPARATOR,DUAL,LO-PWR,8 PI	478354	1	
U151	* IC,CMOS, 16 CHANNEL ANALOG MUX	723684	1	
U152,U155	* IC,CMOS,OCTAL D TRANSPARENT LA	743294	2	
U153,U154	* IC,OP AMP,DUAL,LO OFFST,VOLT,L	685164	2	
U156	* IC,CMOS,10BIT DAC,8BIT ACCUR,C	524868	1	
U157,U158	* IC,BIMOS,8 CHNL HI-VOLT DRVR W	782912	2	
U159,U161	* ISOLATOR,OPTO,LED TO DARLINGTO	640664	2	
U160	* IC,CMOS,DUAL RS-232 TRANS/RECE	799445	1	
VR100-103,VR105	* ZENER,UNCOMP,3.3V,5%,20.0MA,0.	820423	5	
VR151	* ZENER,UNCOMP,5.1V,5%,20.0MA,0.	853700	1	
W002	CABLE,HIGH VOLTAGE OUTPUT	842950	1	
W006	HARNESS,MFC CURRENT	843008	1	
W009	HARNESS, SUB D	843024	1	
Z100	* RNET,MF,HERM,SIP,5700 HI V AMP	803536	1	
Z150	RES,CERM,DIP,16 PIN,8 RES,1M,+	461731	1	

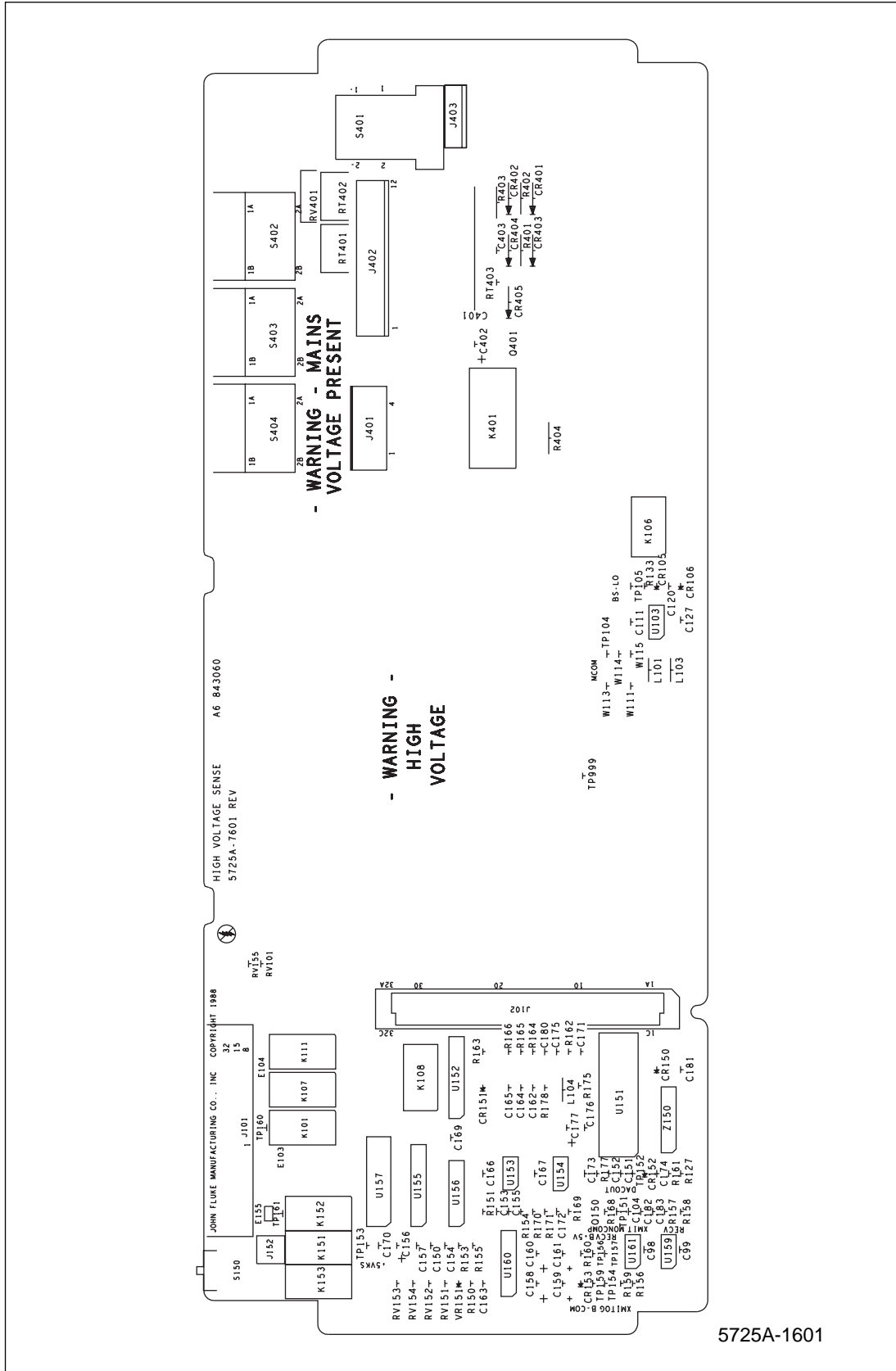


Figure 8-7. A6 High Voltage Sense PCA

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**Table 8-9. A12 Transformer Enclosure Assembly**

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
H1	SCREW,FHU,P,LOCK,SS,6-32,.250	320093	4	
H5	SCREW,PH,P,LOCK,MAG SS,6-32,.2	772236	20	
H39	SCREW,PH,P,LOCK,STL,6-32,.625	152181	2	
H41	SCREW,PH,P,LOCK,SS,4-40,.187	149567	2	
H43	SCREW,PH,P,LOCK,SS,6-32,.500	320051	1	
H44	SCREW,PH,P,LOCK,STL,6-32,.750	114223	5	
H49	WASHER,FLAT,STL,.149,.375,.031	110270	2	
H51	SCREW,HH,H,LOCK,STL,10-32,.375	854794	2	
H53	SCREW,PH,P,LOCK,STL,6-32,.187	381087	4	
H61	SCREW,HH,H,STL,1/4-20,4.00	845078	4	
H65	WASHER,LOCK,SPLIT,STL,.255,.49	111518	4	
H69	WASHER,FLAT,STL,.260,.375,.032	312538	4	
H73	SCREW,PH,P,LOCK,STL,6-32,.375	152165	2	
H75	SCREW,PH,P,LOCK,STL,10-32,.625	114066	2	
MP1	BUSHING,SNAP-IN,NYL,.500 ID	102780	3	
MP4	CABLE ACC,CLAMP,.687 DIA,SCREW	853775	2	
MP12	MACHINED SHEET METAL XFORMER A	860143	1	
MP13	SHEET METAL XFORMER ASSY	850300	1	
MP18	SUPPORT,TRANSFORMER MTG	842919	2	
MP403	CABLE, POWER SWITCH	881847	1	
MP802	SHIELD, TRANSFORMER, BASE	842898	1	
MP803	SHIELD,PWR,TRANSFORMER,COVER	850185	1	
MP804	CUSHION,TRANSFORMER MTG.	842914	2	
P2,P604	HOUSING,1 ROW,0.156 CTR,LOCK,1	446716	2	
P403	HOUSING,1 ROW,0.156 CTR,LOCK,5	831164	1	
T1	LOW FREQ	823336	1	
T2	XFORMER MED FREQUENCY	823344	1	
T3	HIGH FREQ	823351	1	
T101	POWER TRANSFORMER	823369	1	
TB001	TERM STRIP,BULKHEAD,.375CTR,2	276519	1	
W4	HARNESS, CURRENT, FRONT	842997	1	
W5	HARNESS,CURRENT,REAR	843003	1	
W17	CABLE, TRANSFORMER BLACK	850222	1	
W18	CABLE, TRANSFORMER WHITE	850227	1	

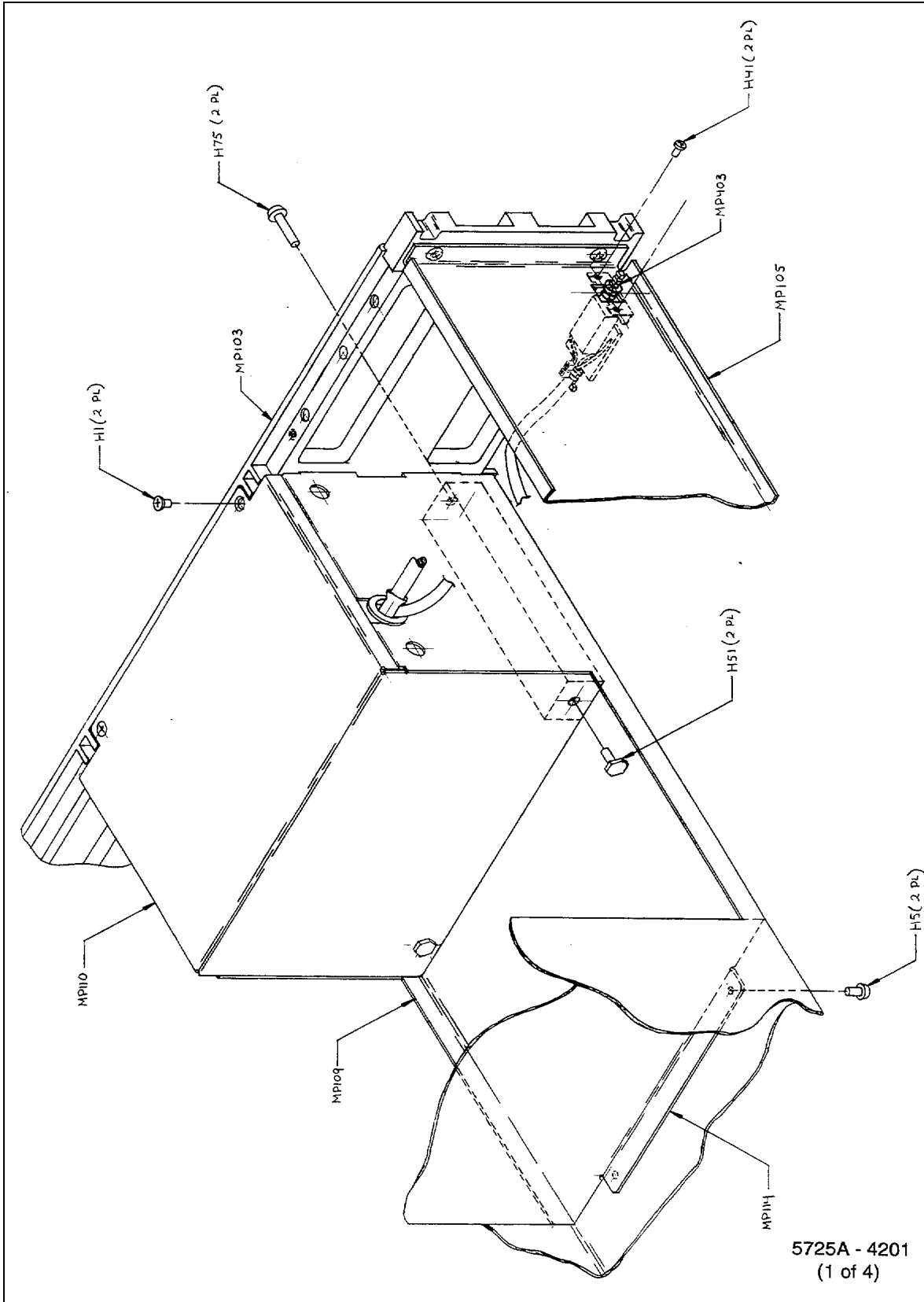


Figure 8-8. A12 Transformer Enclosure Assembly



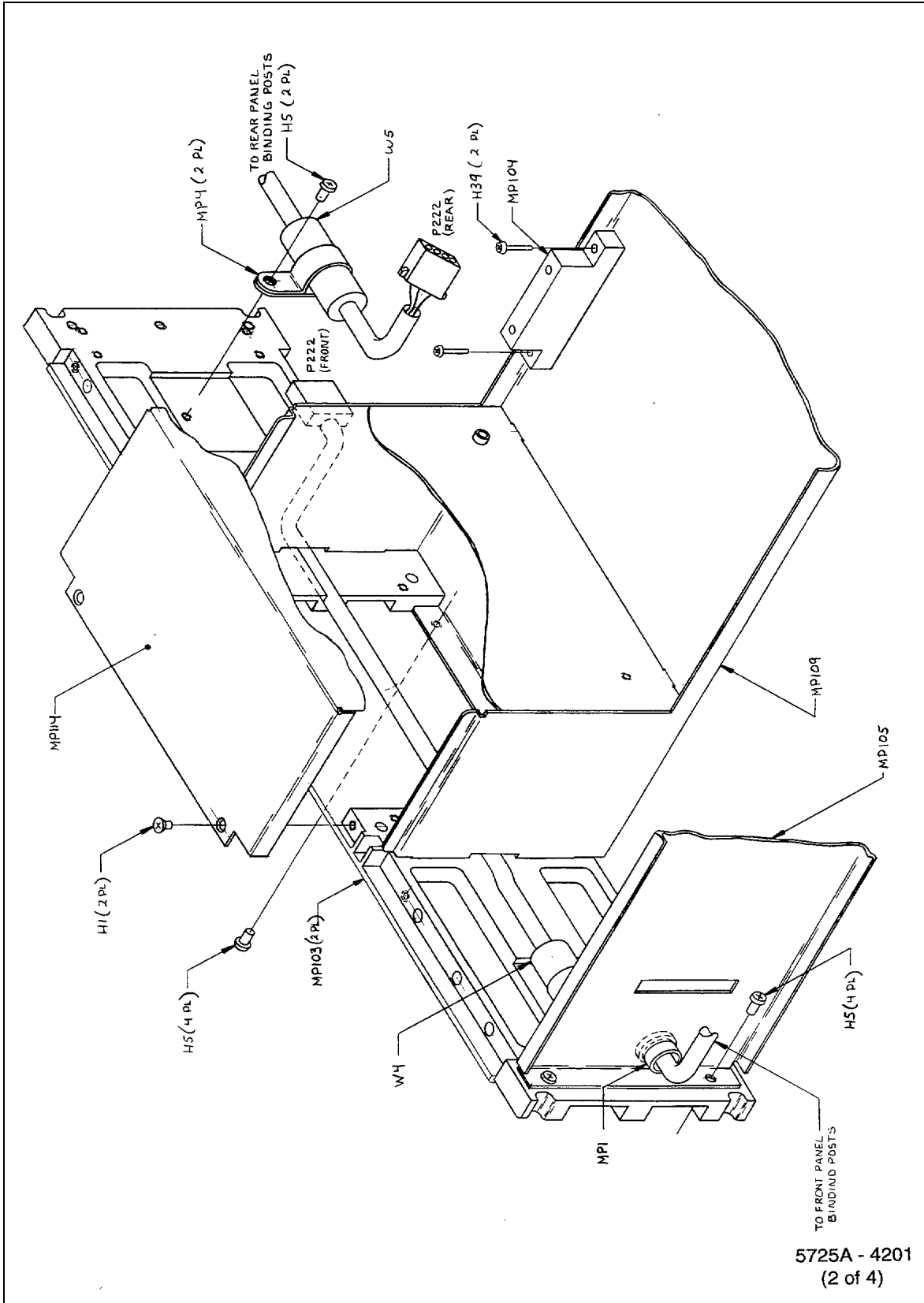
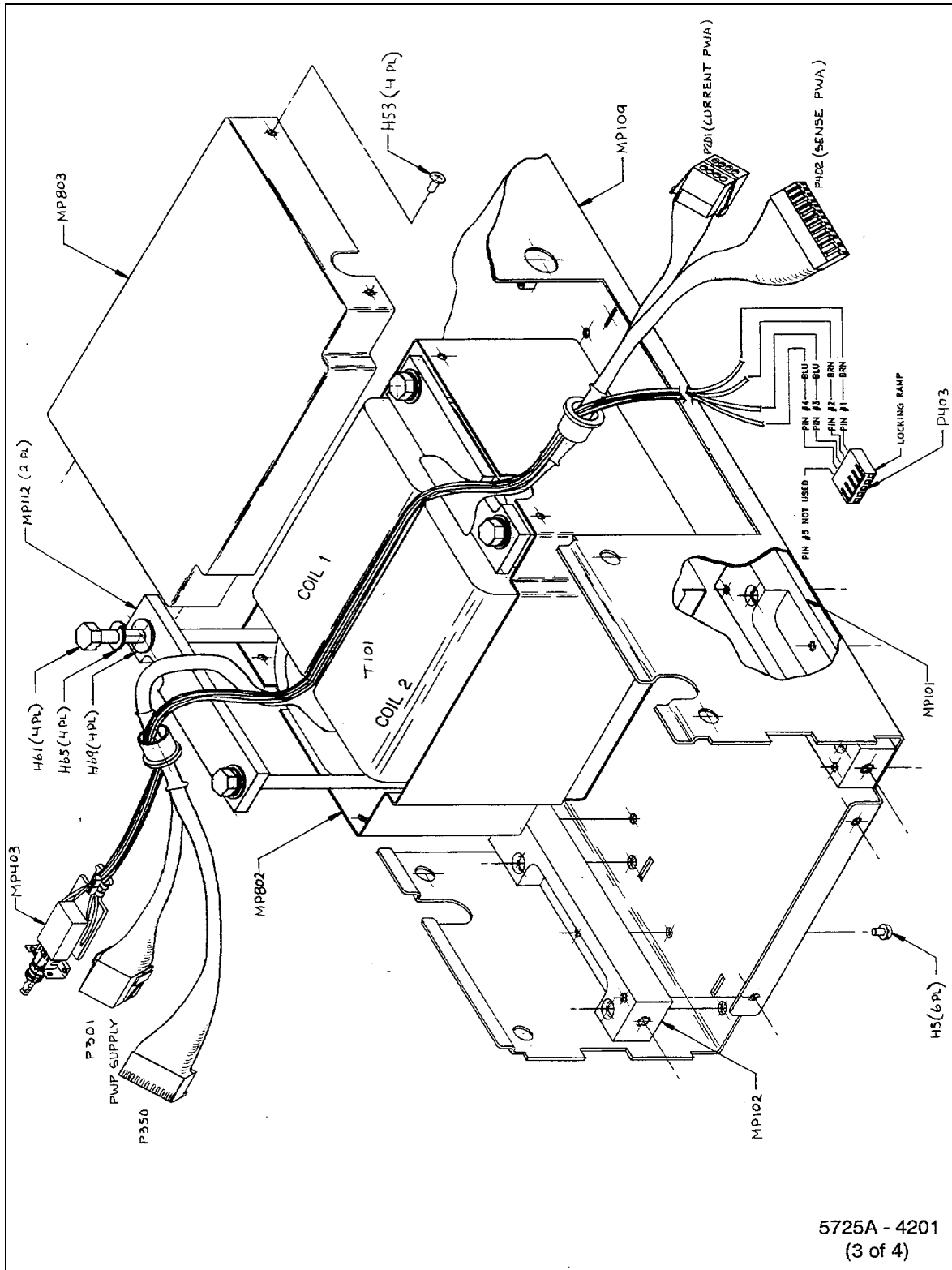


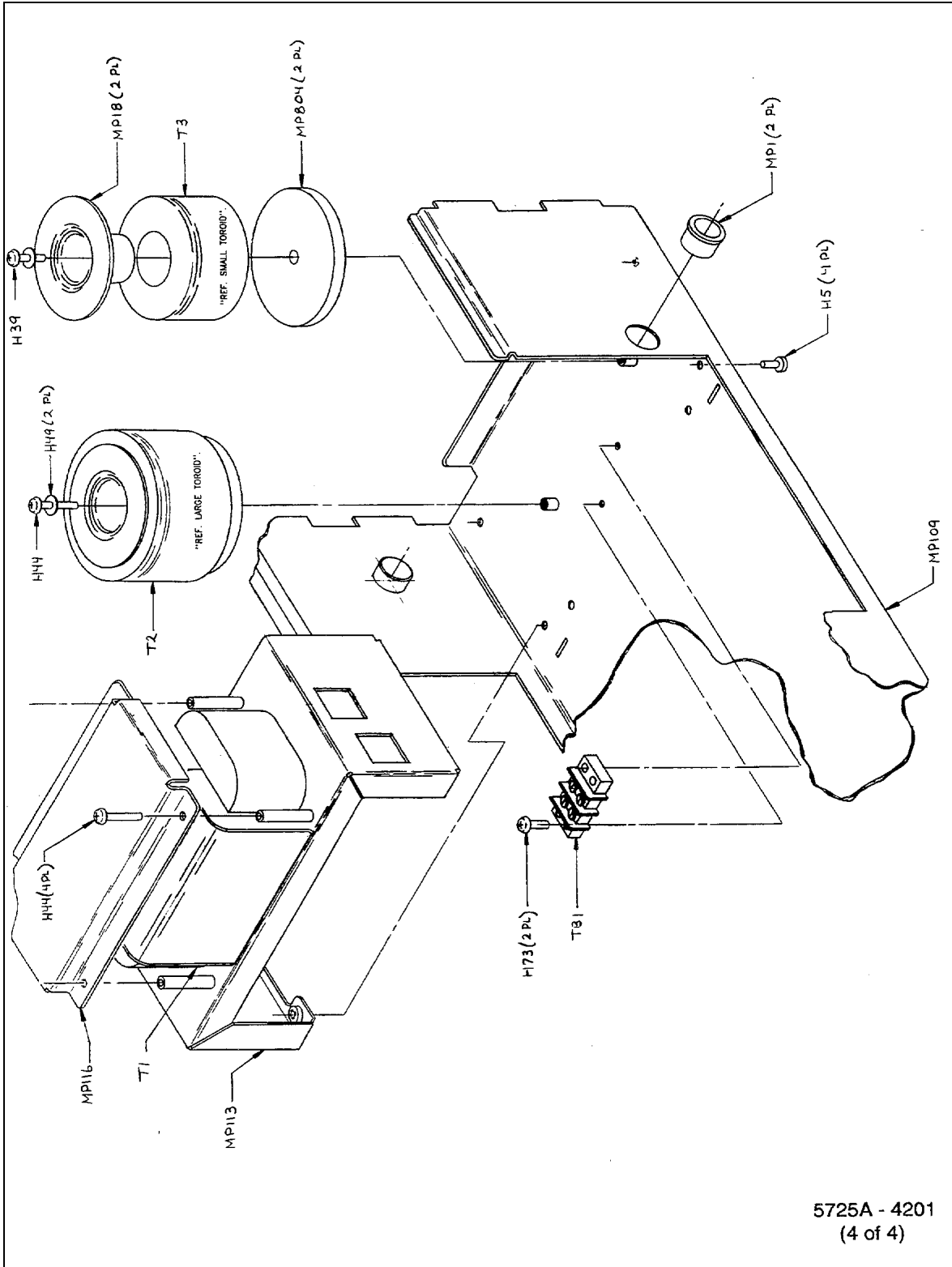
Figure 8-8. A12 Transformer Enclosure Assembly (cont)



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Figure 8-8. A12 Transformer Enclosure Assembly (cont)



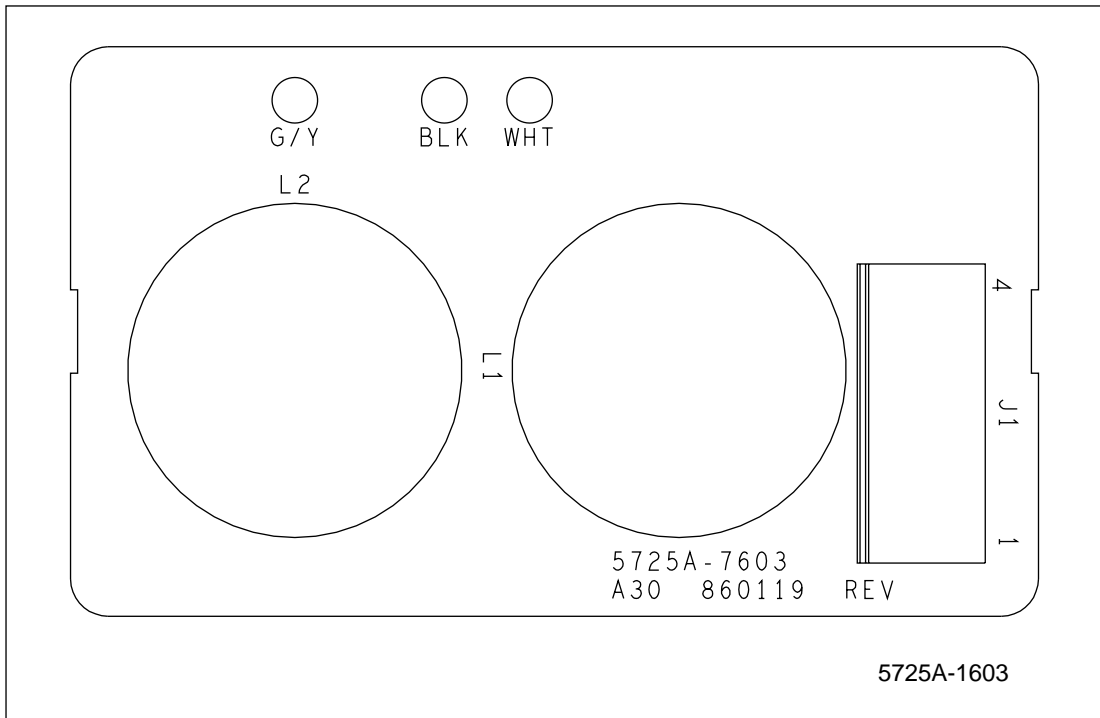
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Figure 8-8. A12 Transformer Enclosure Assembly (cont)

Table 8-10. A30 Inductor PCA

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
J1	CONN,MATE-N-LOK,HEADER,4 PIN	512269	1	
L1,L2	CHOKE	490888	2	
W1	HARNESS, LINE VOLTAGE	843011	1	

1. For schematic, See A6 section 9.



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Figure 8-9. A30 Inductor PCA

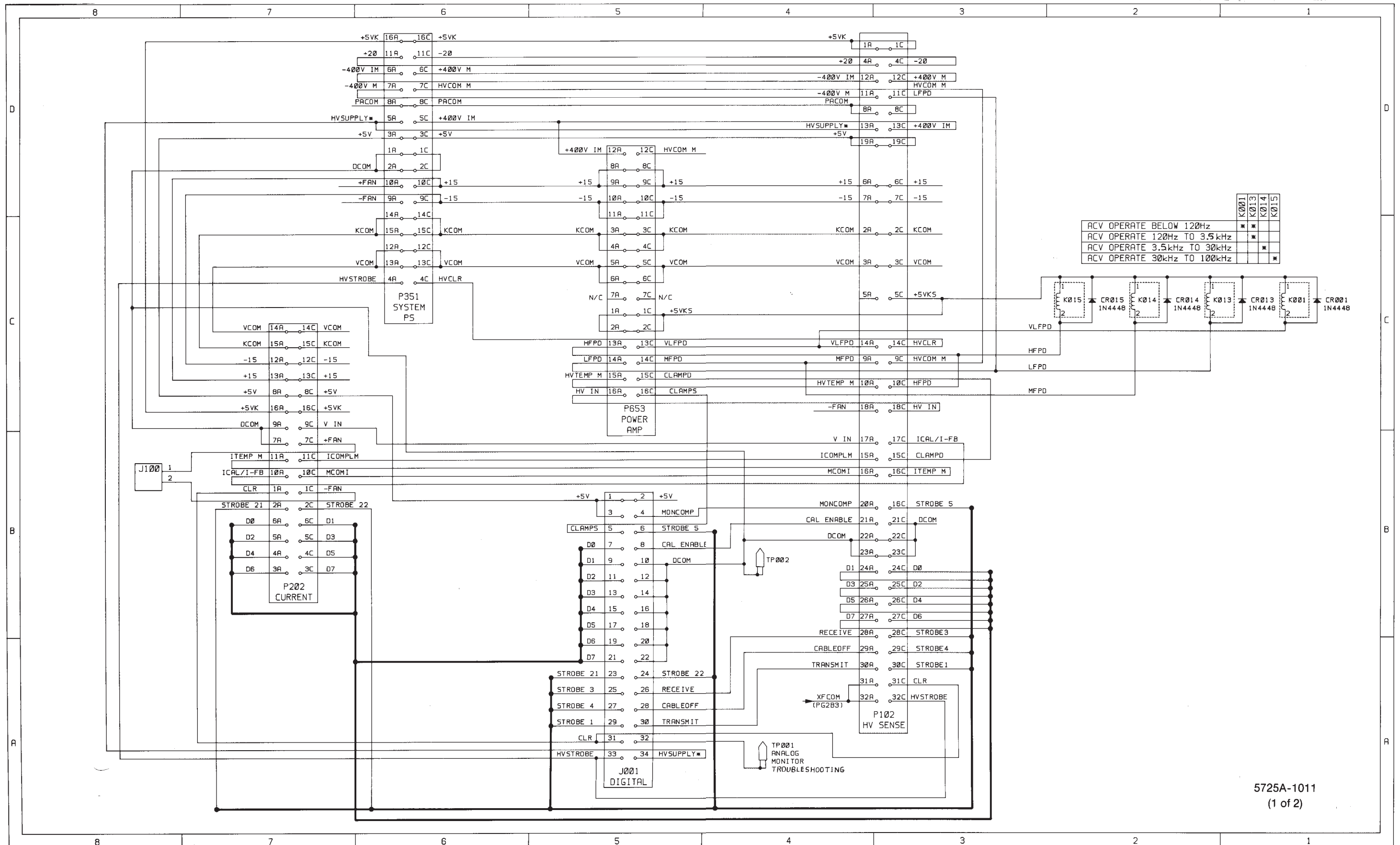
## **Chapter 9**

# **Schematic Diagrams**

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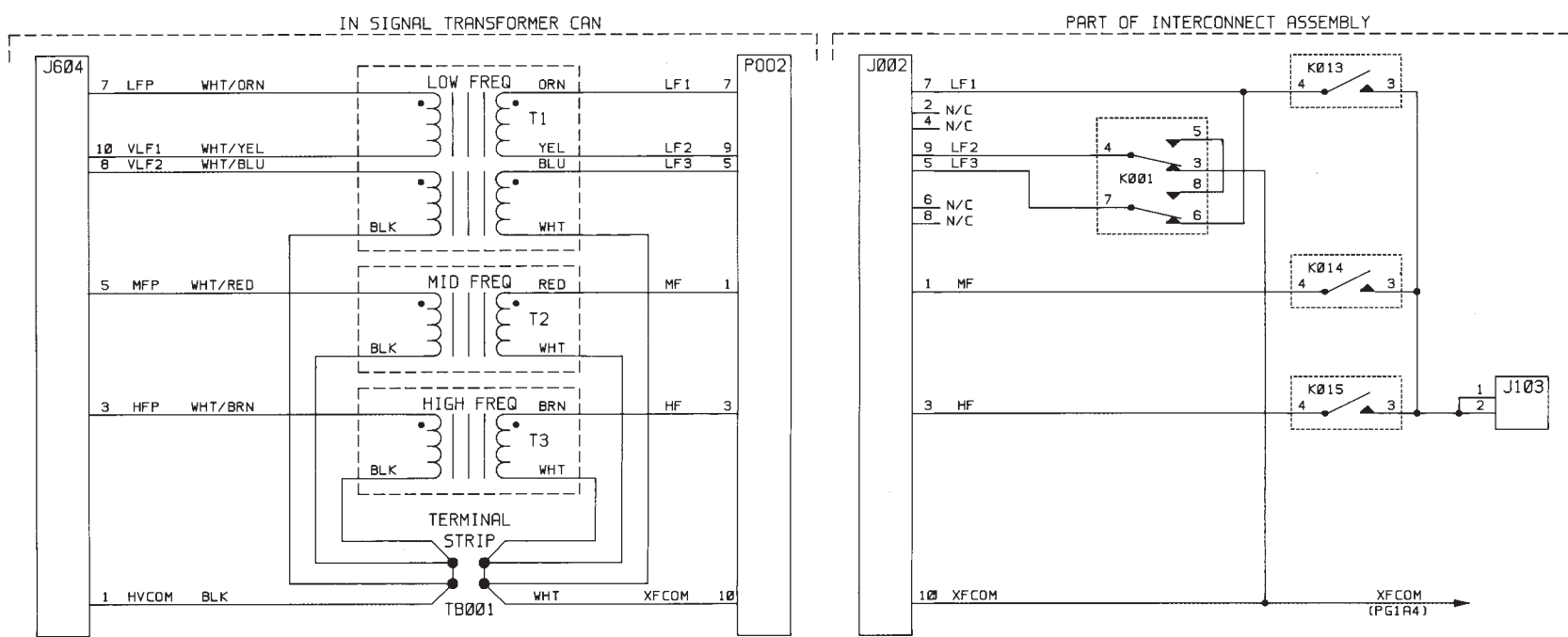


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Figure 9-1. A1 Interconnect PCA (cont)

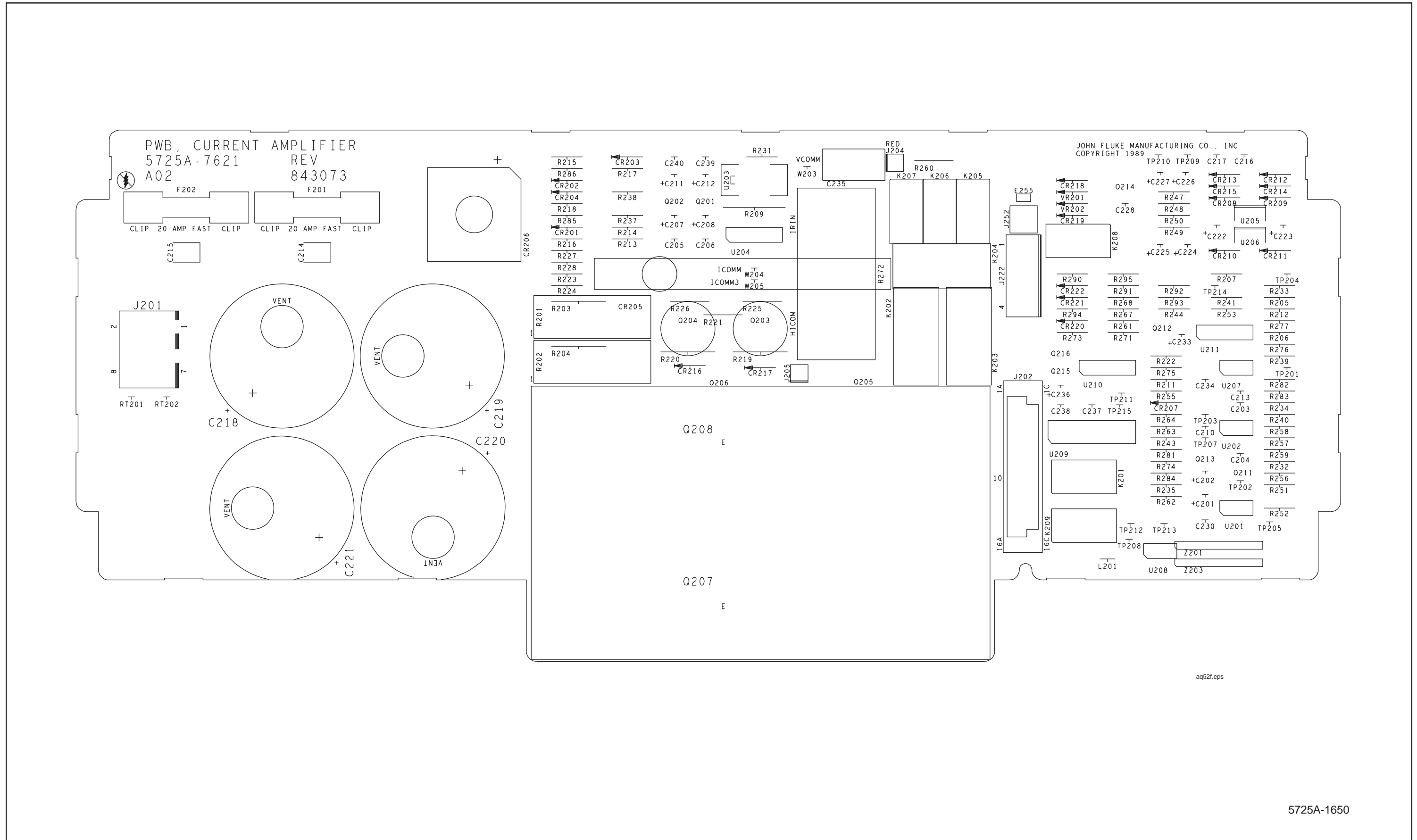


- NOTES:
1. CIRCUIT 4 AREA FILL ELECTRICALLY TIED TO EARTH
  2. CIRCUIT 1 AREA FILL ELECTRICALLY TIED TO VCOM.



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Figure 9-1. A1 Interconnect PCA (cont)



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5725A-1650

Figure 9-2. A2 Current Amplifier PCA

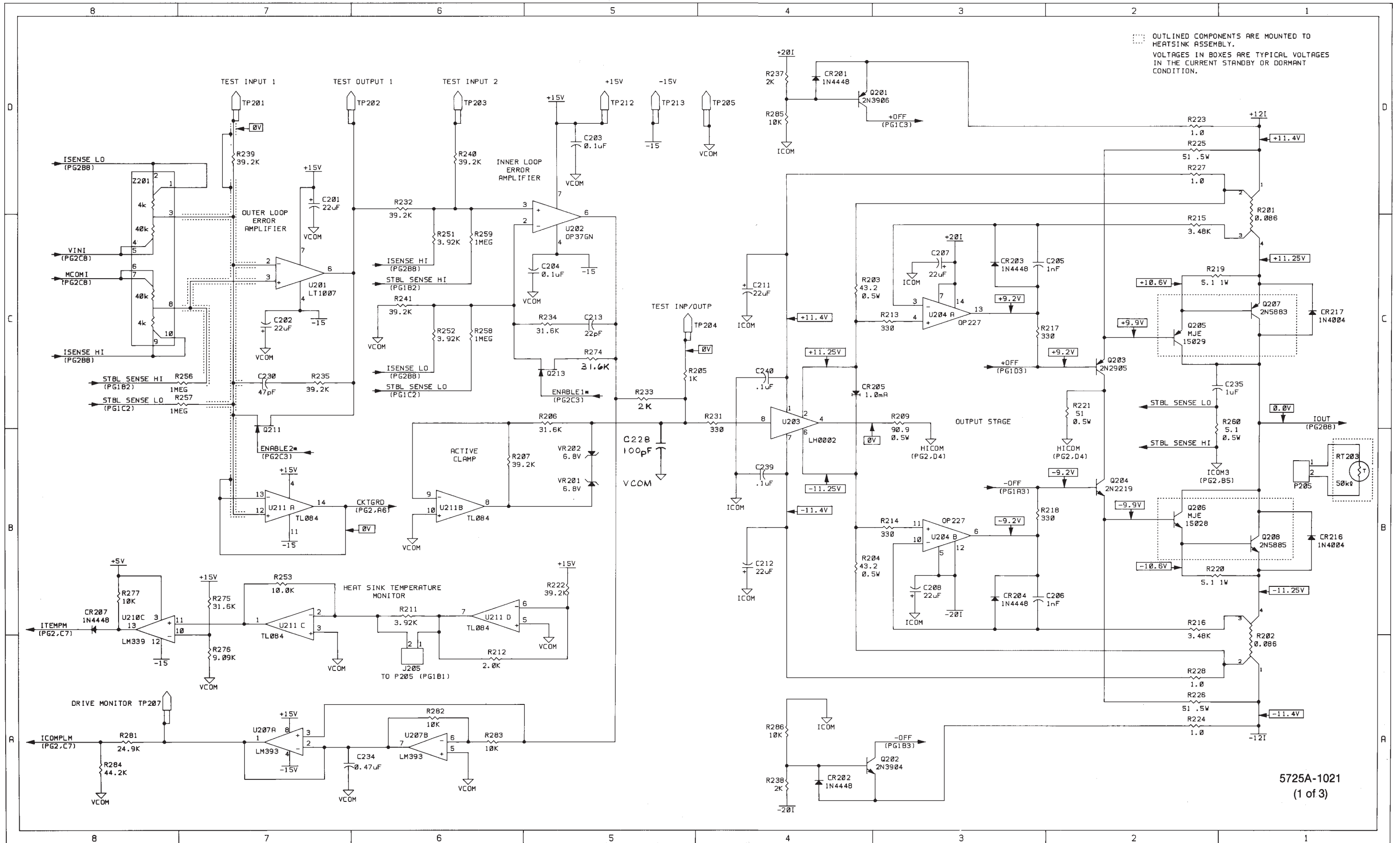
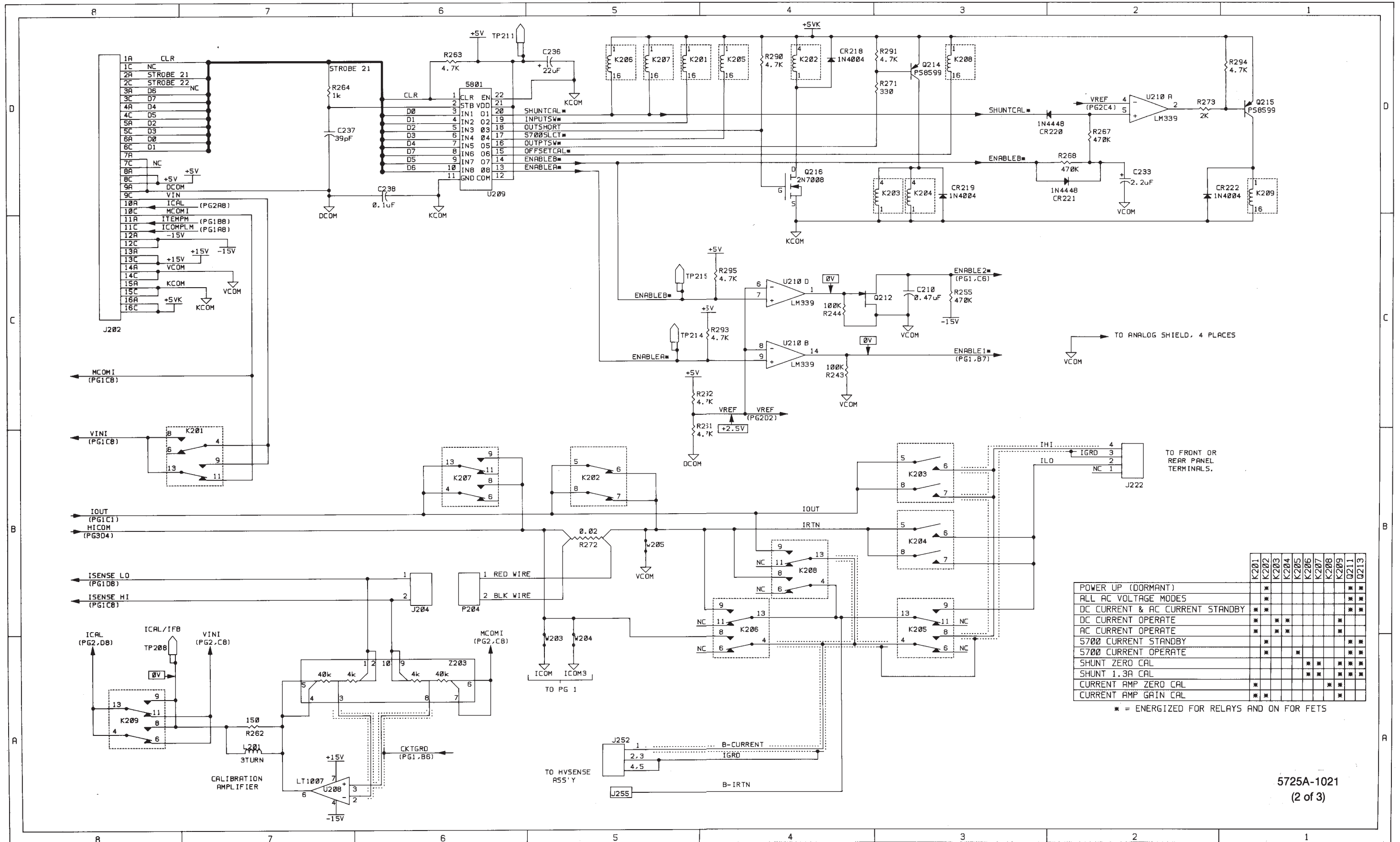


Figure 9-2. A2 Current Amplifier PCA (cont)



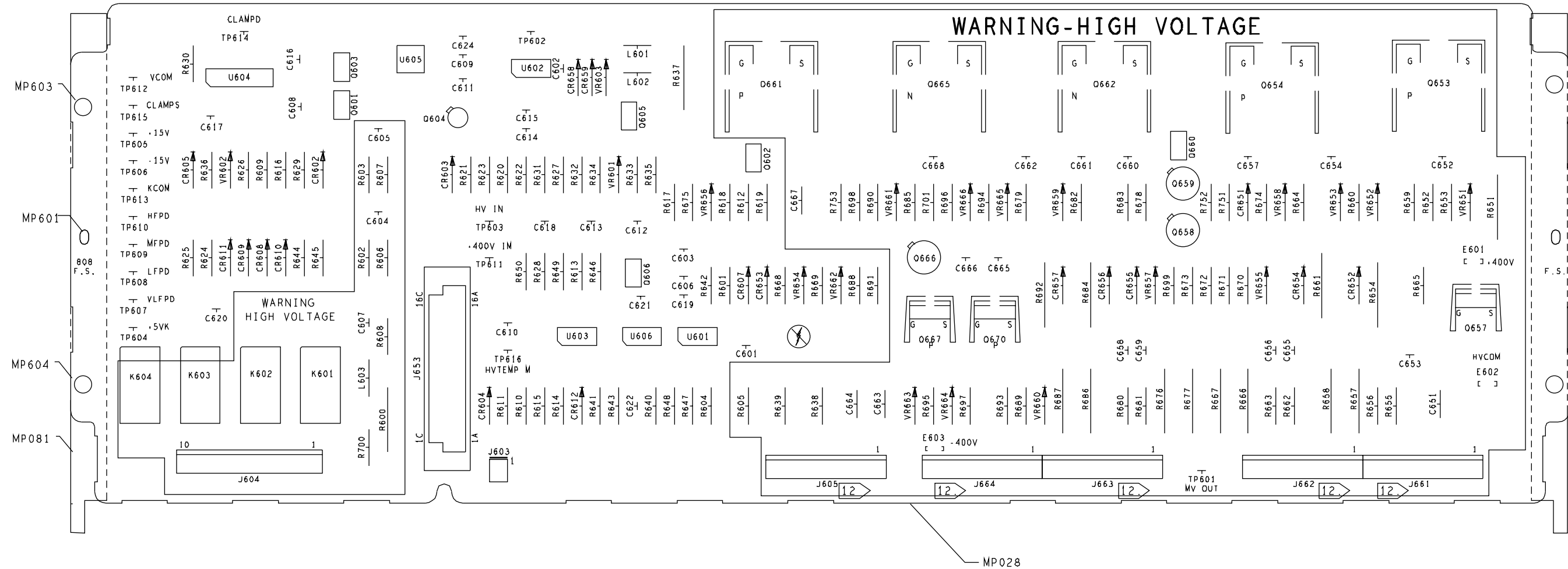
	K201	K202	K203	K204	K205	K206	K207	K208	K209	Q211	Q213
POWER UP (DORMANT)	*	*	*	*	*	*	*	*	*	*	*
ALL AC VOLTAGE MODES	*	*	*	*	*	*	*	*	*	*	*
DC CURRENT & AC CURRENT STANDBY	*	*	*	*	*	*	*	*	*	*	*
DC CURRENT OPERATE	*	*	*	*	*	*	*	*	*	*	*
AC CURRENT OPERATE	*	*	*	*	*	*	*	*	*	*	*
5700 CURRENT STANDBY	*	*	*	*	*	*	*	*	*	*	*
5700 CURRENT OPERATE	*	*	*	*	*	*	*	*	*	*	*
SHUNT ZERO CAL	*	*	*	*	*	*	*	*	*	*	*
SHUNT 1.3A CAL	*	*	*	*	*	*	*	*	*	*	*
CURRENT AMP ZERO CAL	*	*	*	*	*	*	*	*	*	*	*
CURRENT AMP GAIN CAL	*	*	*	*	*	*	*	*	*	*	*

\* = ENERGIZED FOR RELAYS AND ON FOR FETS

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Figure 9-2. A2 Current Amplifier PCA (cont)





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Figure 9-3. A3 High Voltage Amplifier PCA

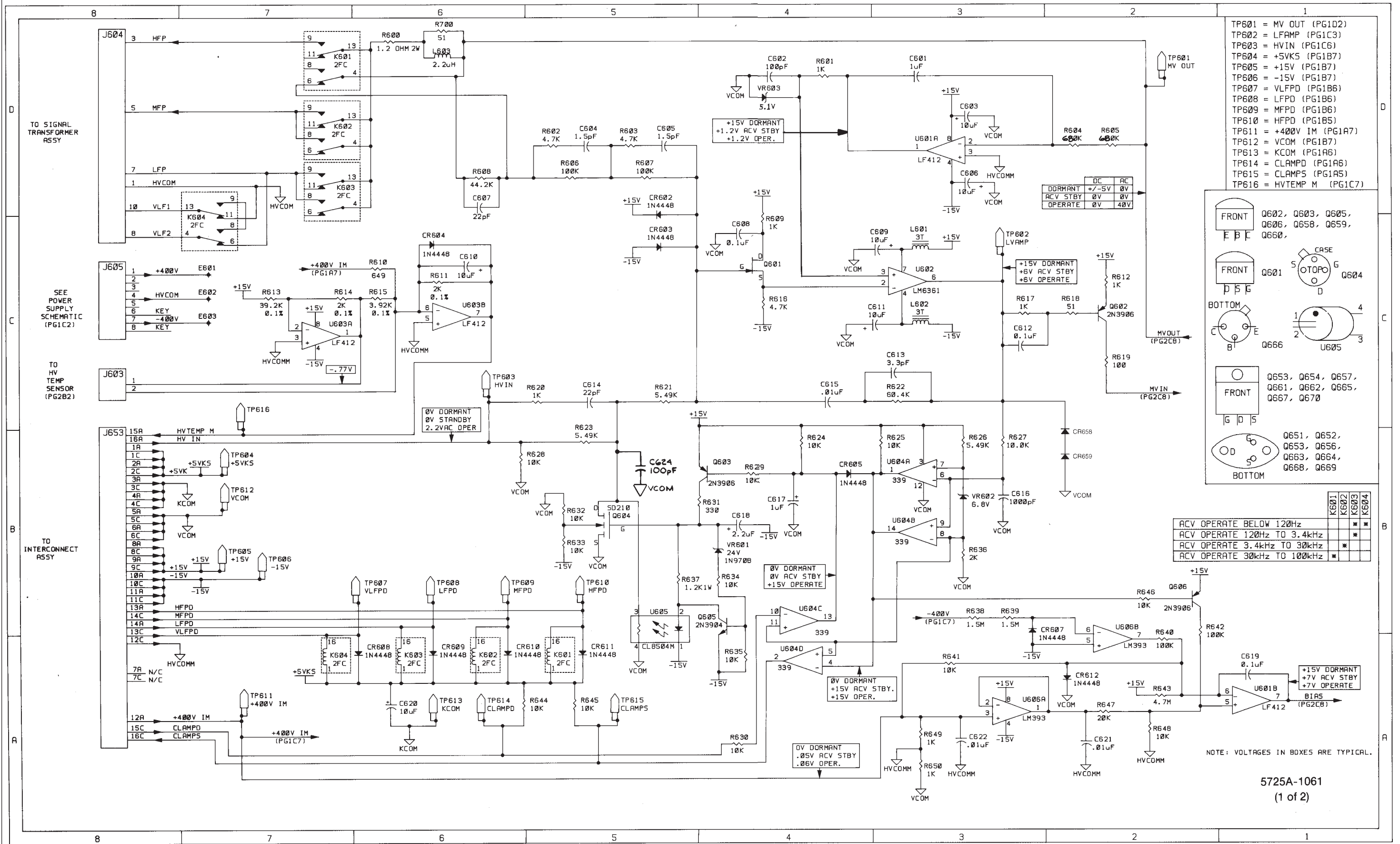
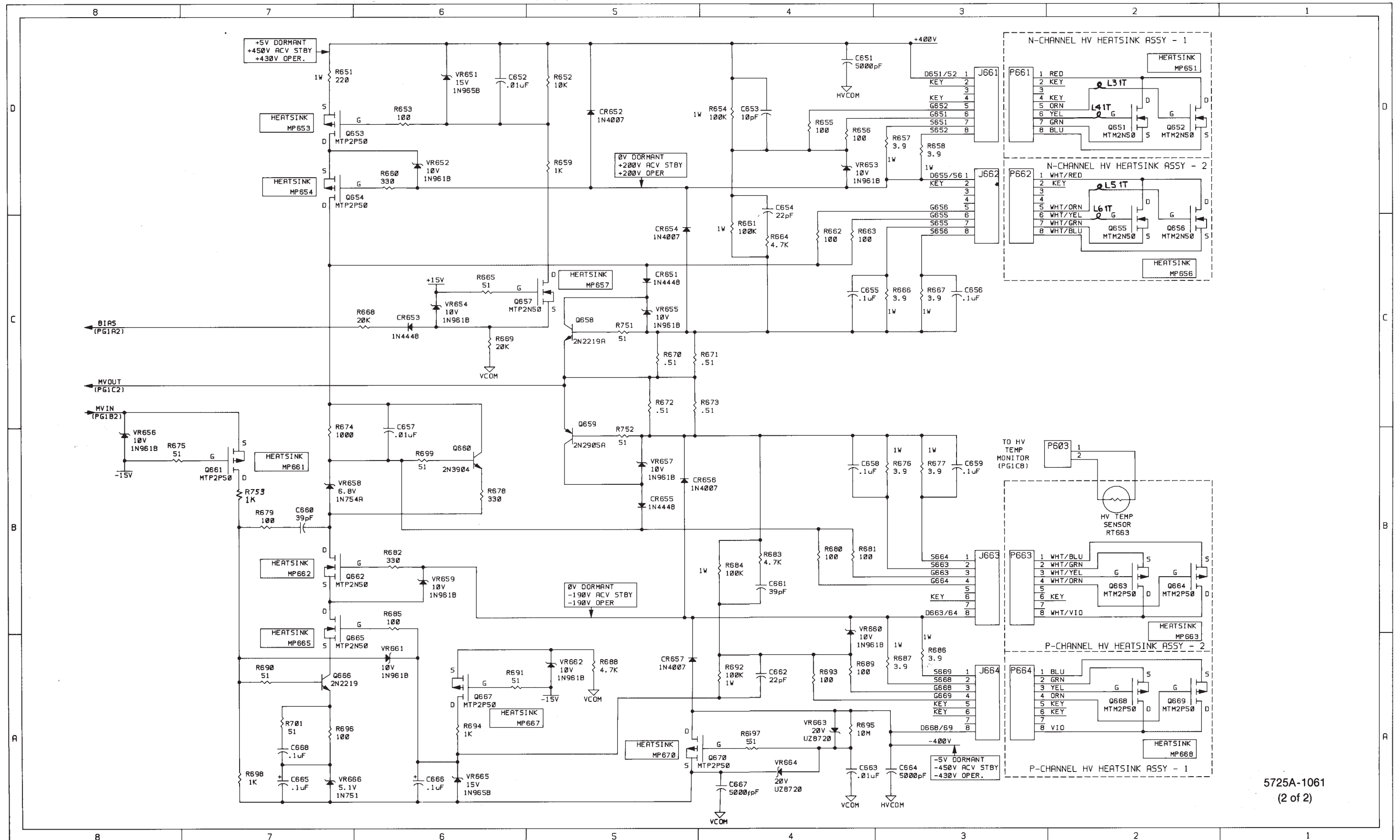


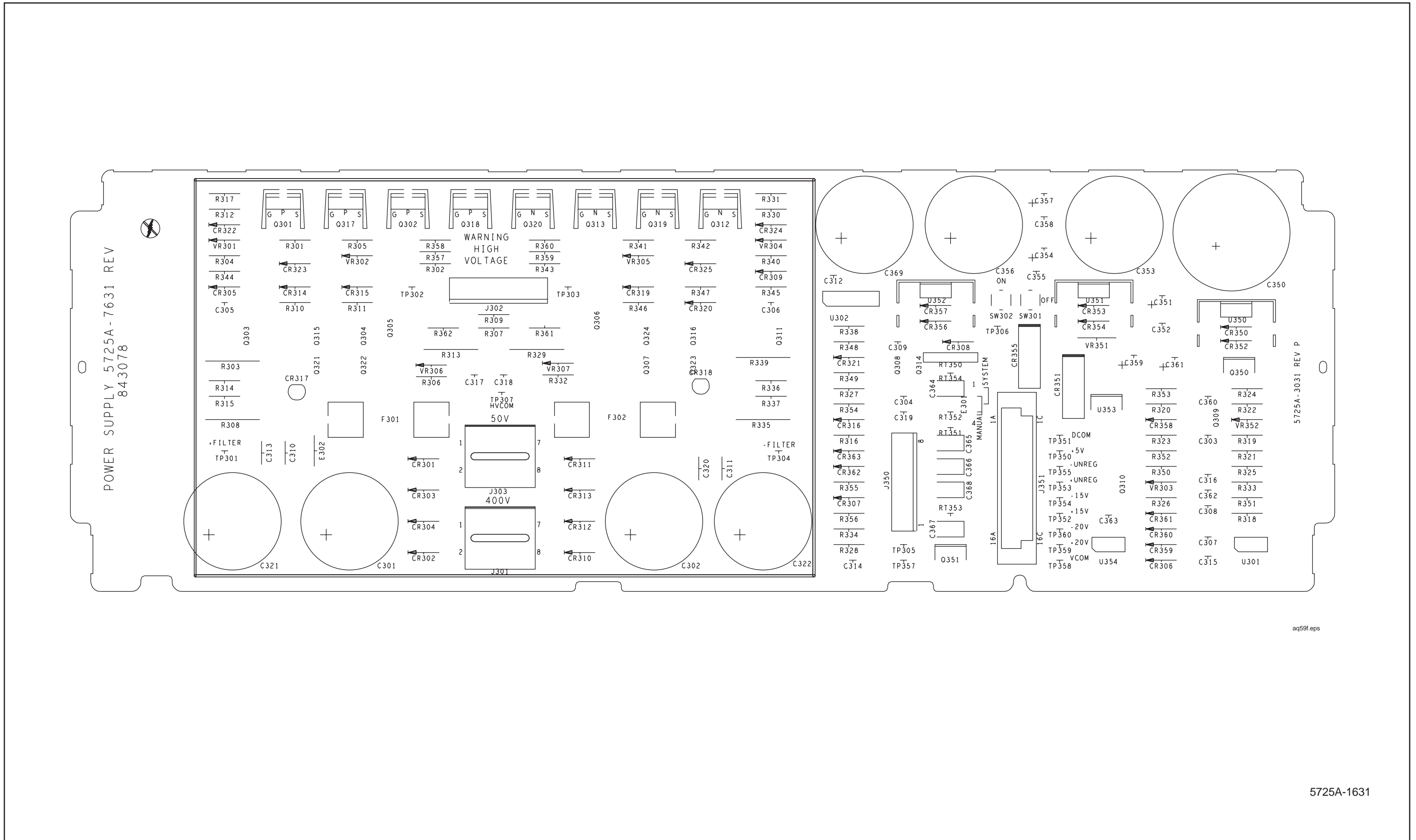
Figure 9-3. A3 High Voltage Amplifier PCA (cont)



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(2 of 2)

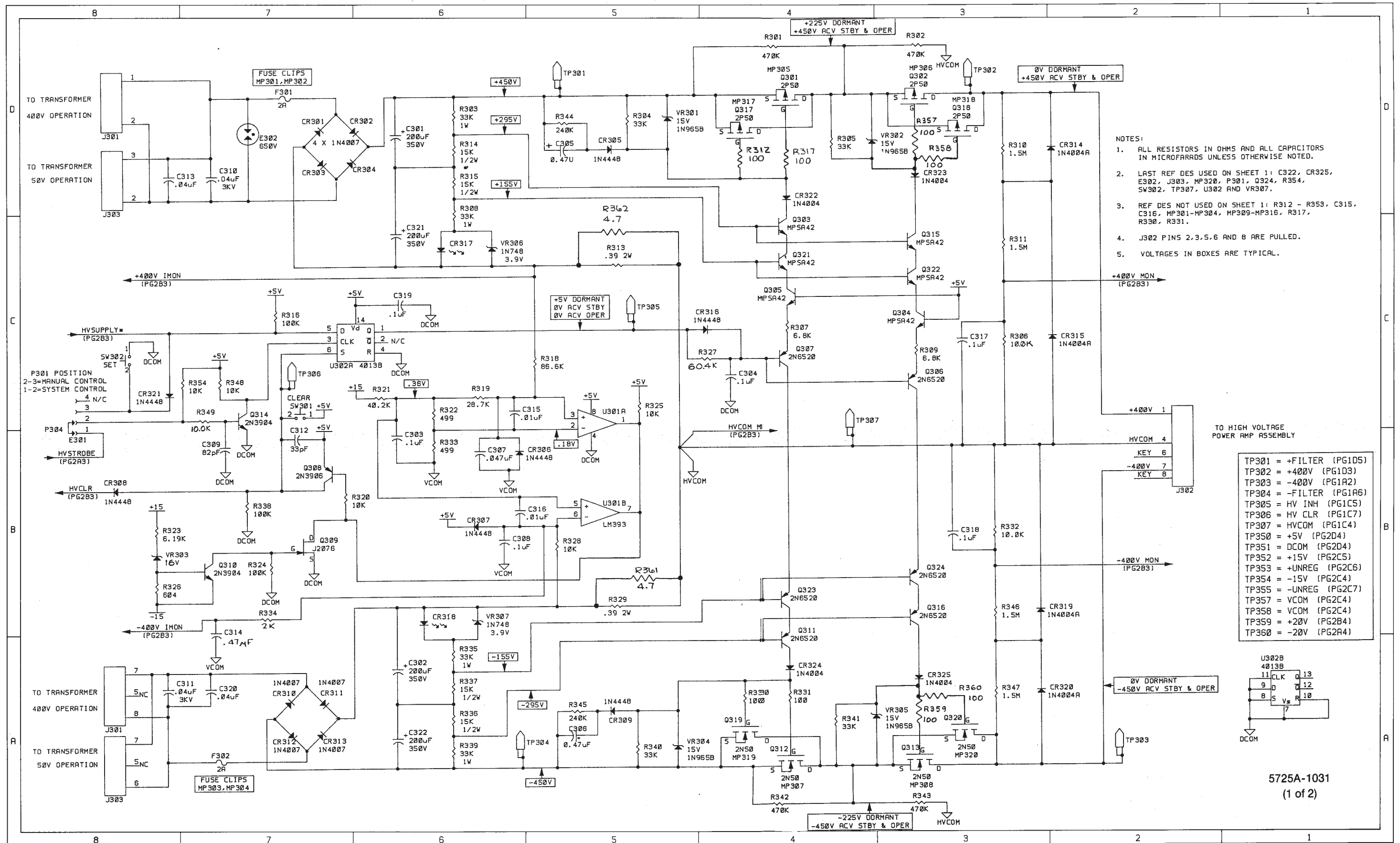
Figure 9-3. A3 High Voltage Amplifier PCA (cont)





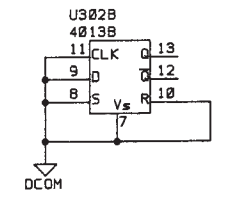
5725A-1631

Figure 9-4. A4 Power Supply PCA



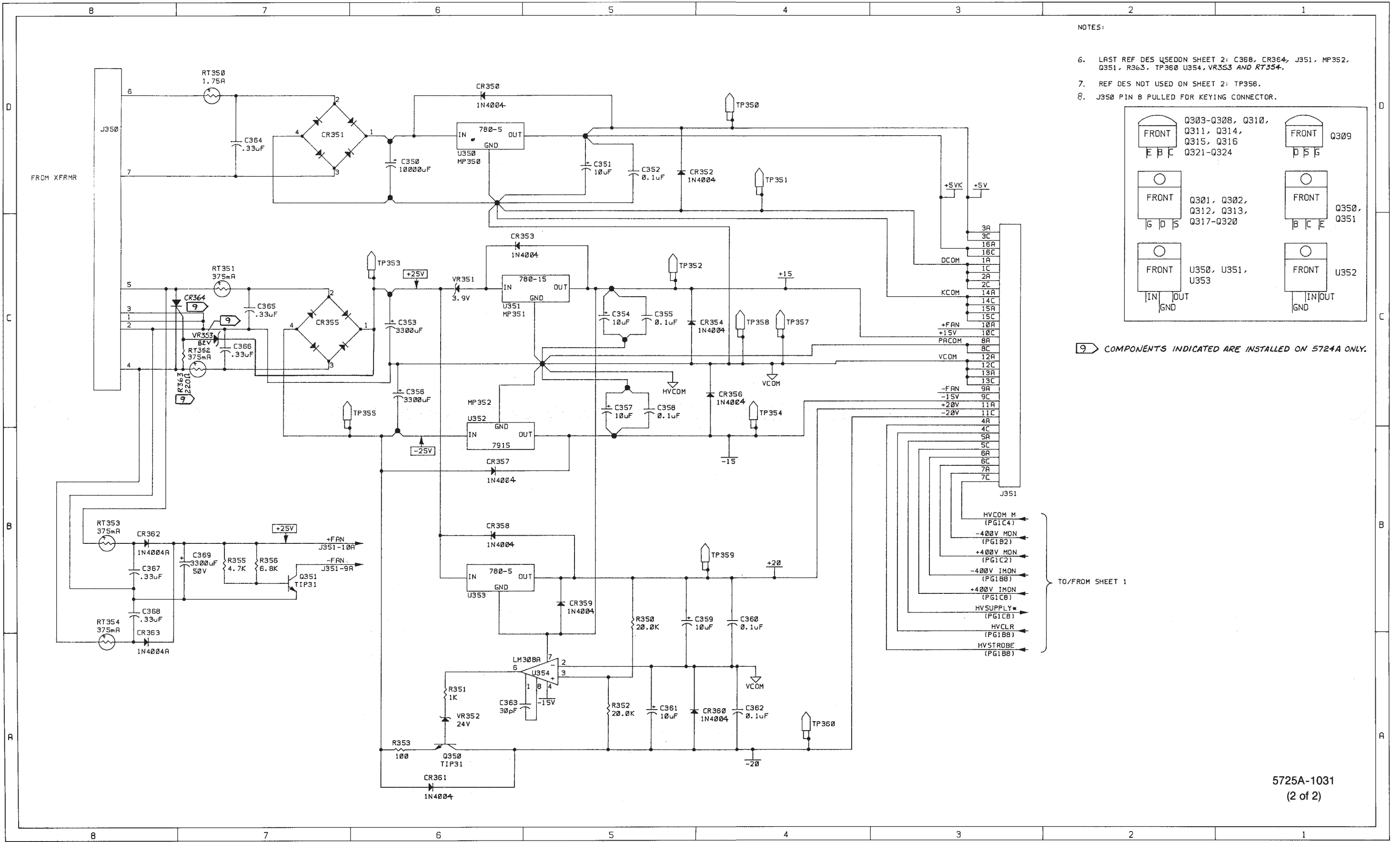
- NOTES:
1. ALL RESISTORS IN OHMS AND ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE NOTED.
  2. LAST REF DES USED ON SHEET 1: C322, CR325, E302, J303, MP320, P301, Q324, R354, SW302, TP307, U302 AND VR307.
  3. REF DES NOT USED ON SHEET 1: R312 - R353, C315, C316, MP301-MP304, MP309-MP316, R317, R330, R331.
  4. J302 PINS 2,3,5,6 AND 8 ARE PULLED.
  5. VOLTAGES IN BOXES ARE TYPICAL.

TP301	= +FILTER (PG105)
TP302	= +400V (PG103)
TP303	= -400V (PG1A2)
TP304	= -FILTER (PG1A6)
TP305	= HV INH (PG1C5)
TP306	= HV CLR (PG1C7)
TP307	= HVCOM (PG1C4)
TP350	= +5V (PG2D4)
TP351	= DCOM (PG2D4)
TP352	= +15V (PG2C5)
TP353	= +UNREG (PG2C6)
TP354	= -15V (PG2C4)
TP355	= -UNREG (PG2C7)
TP357	= VCOM (PG2C4)
TP358	= VCOM (PG2C4)
TP359	= +20V (PG2B4)
TP360	= -20V (PG2A4)

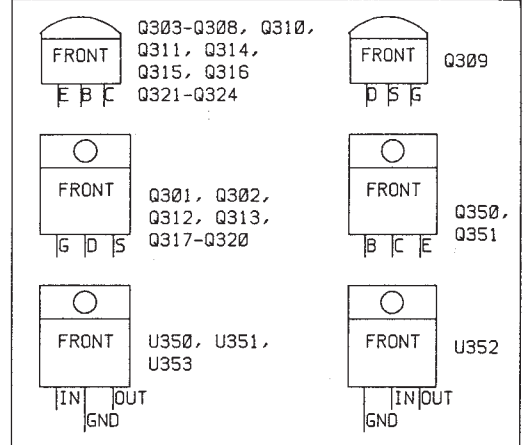


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Figure 9-4. A4 Power Supply PCA (cont)



- NOTES:
6. LAST REF DES USED ON SHEET 2: C368, CR364, J351, MP352, Q351, R363, TP360 U354, VR353 AND RT354.
  7. REF DES NOT USED ON SHEET 2: TP356.
  8. J350 PIN 8 PULLED FOR KEYING CONNECTOR.



9 COMPONENTS INDICATED ARE INSTALLED ON 5724A ONLY.

TO/FROM SHEET 1

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(2 of 2)

Figure 9-4. A4 Power Supply PCA (cont)



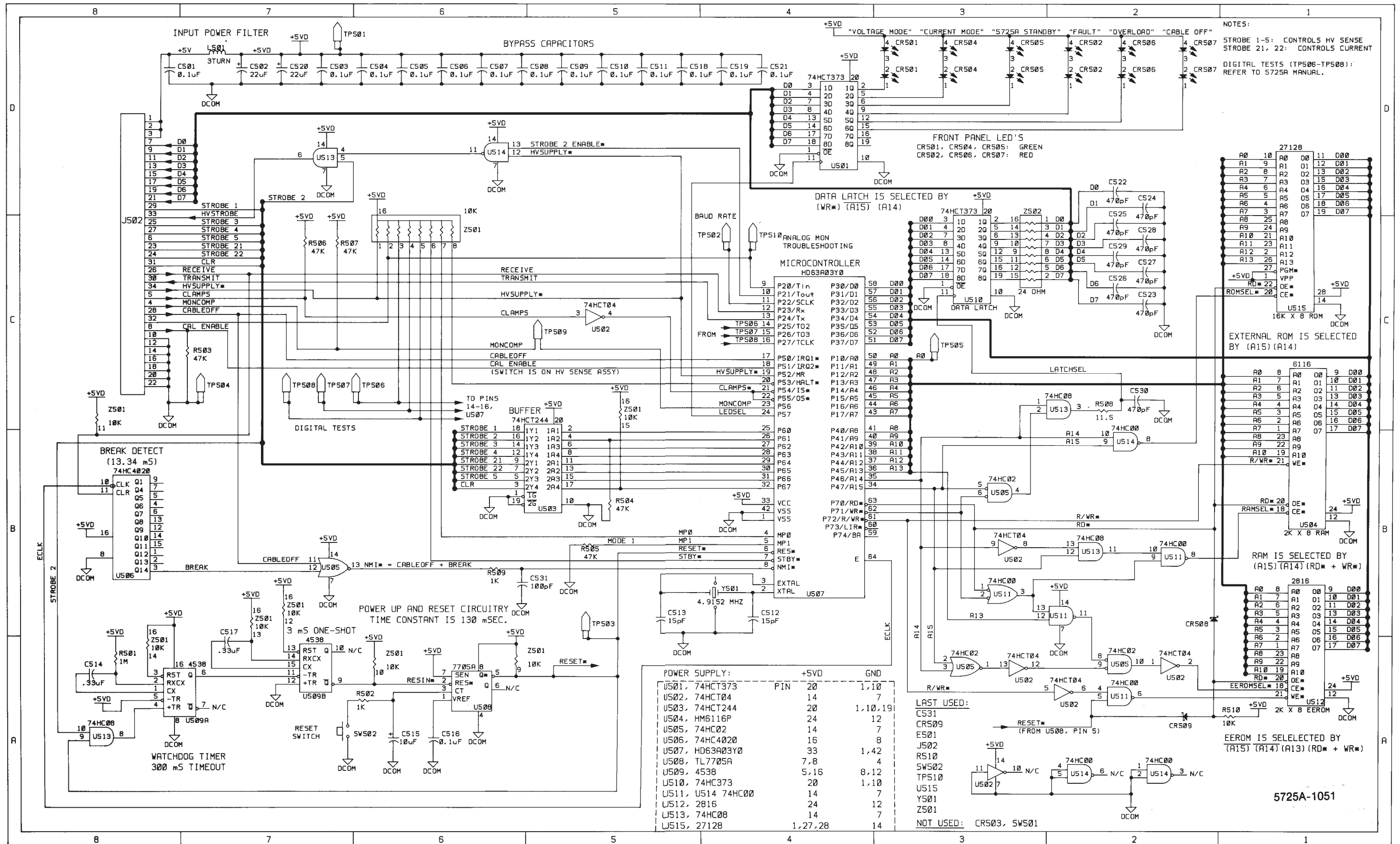
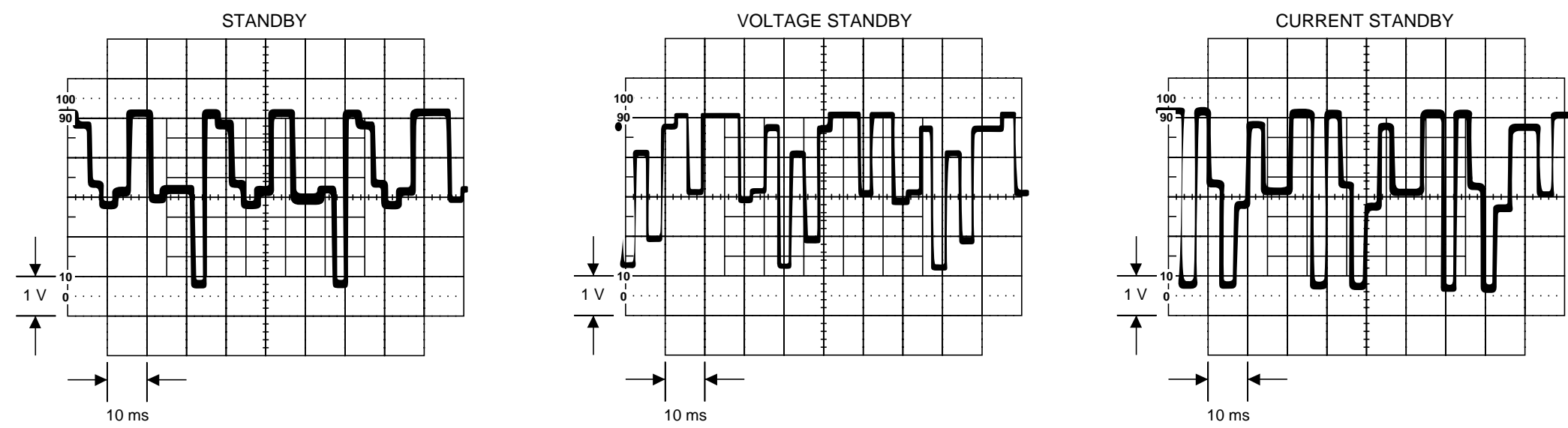
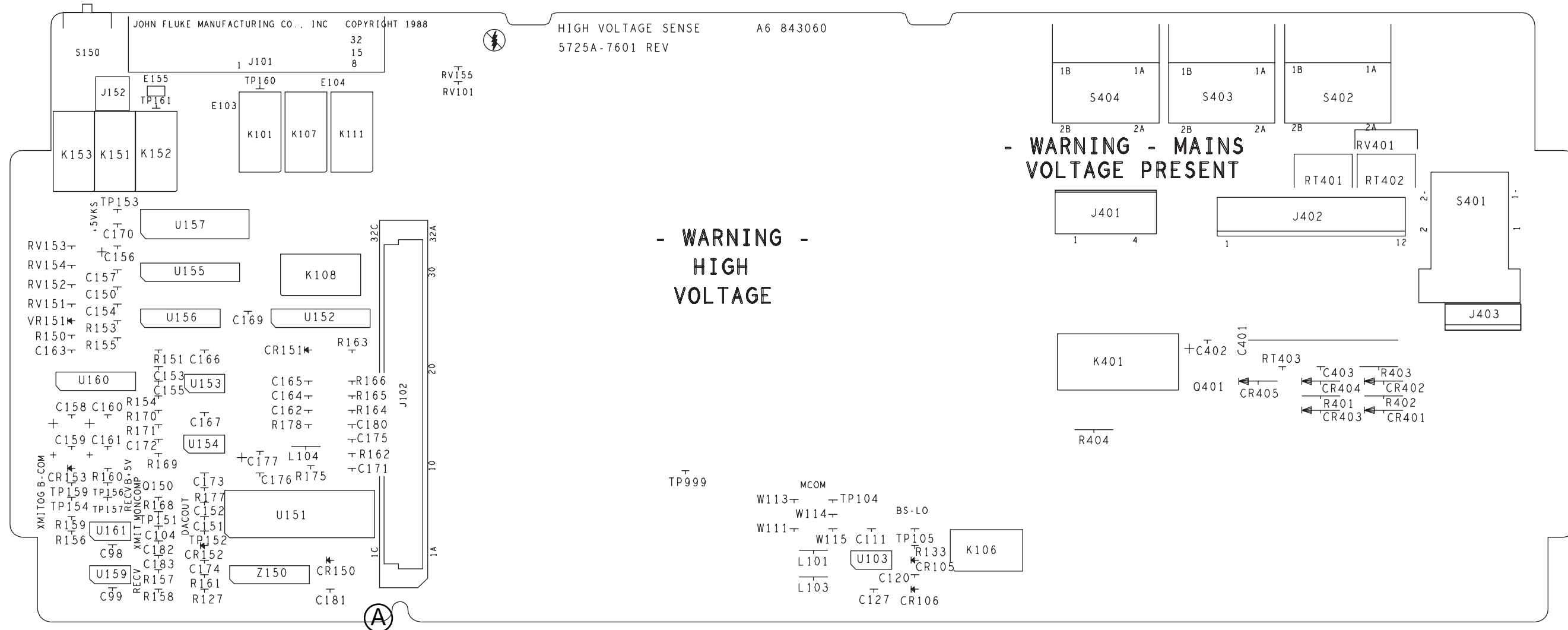


Figure 9-5. A5 Digital PCA (cont)



5725A-1601

Figure 9-6. A6 High Voltage Sense PCA

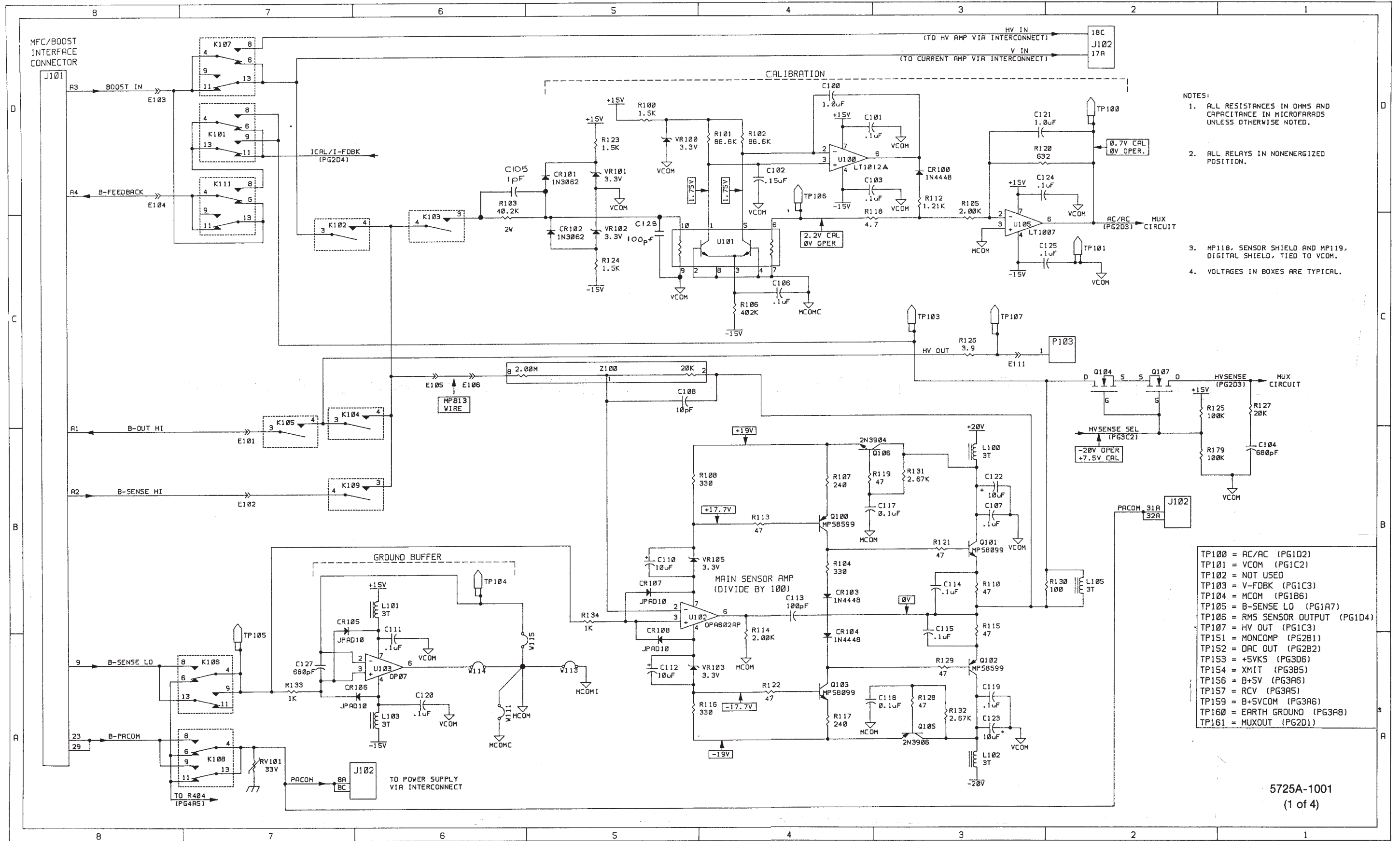
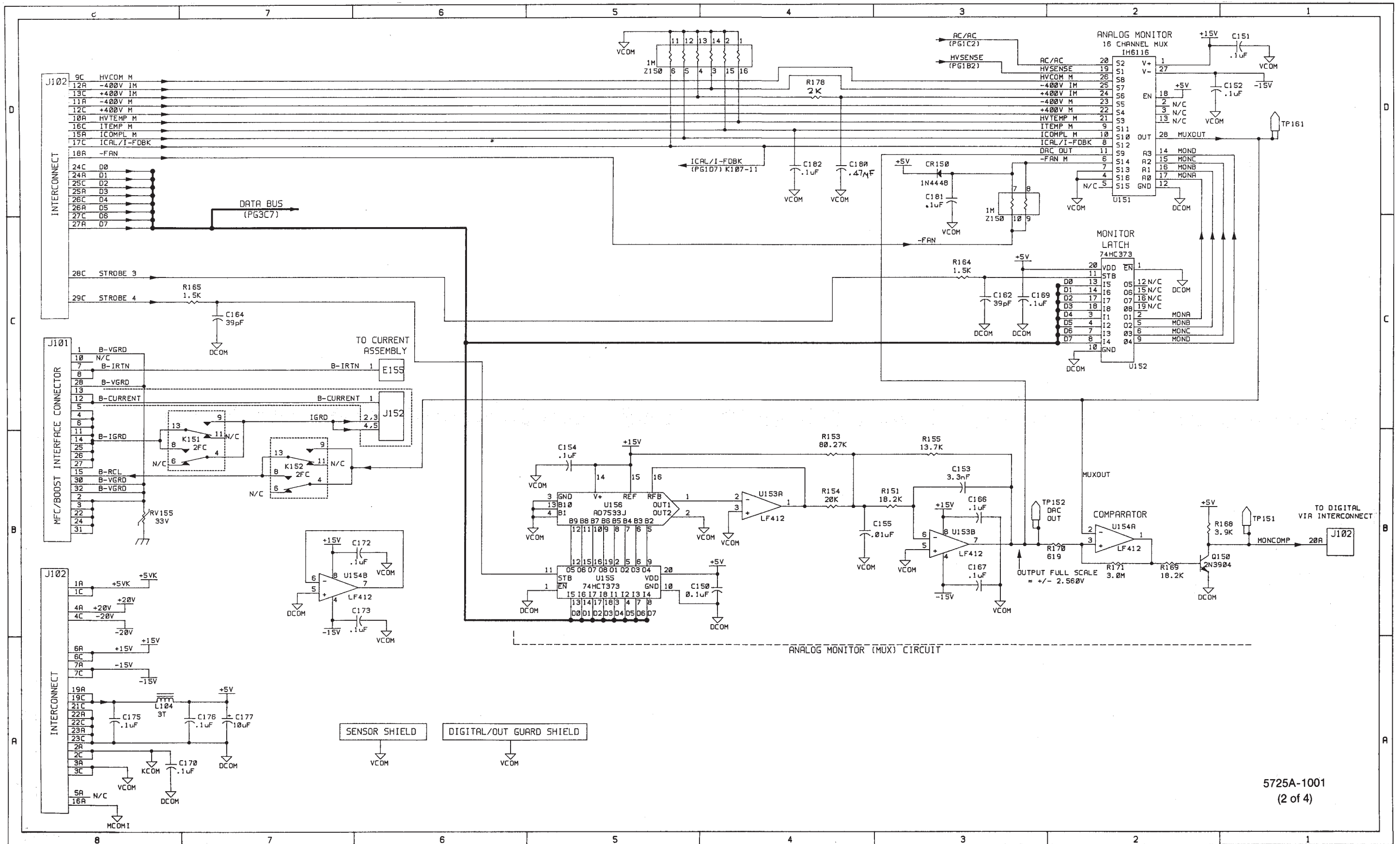


Figure 9-6. A6 High Voltage Sense PCA (cont)



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(2 of 4)

Figure 9-6. A6 High Voltage Sense PCA (cont)



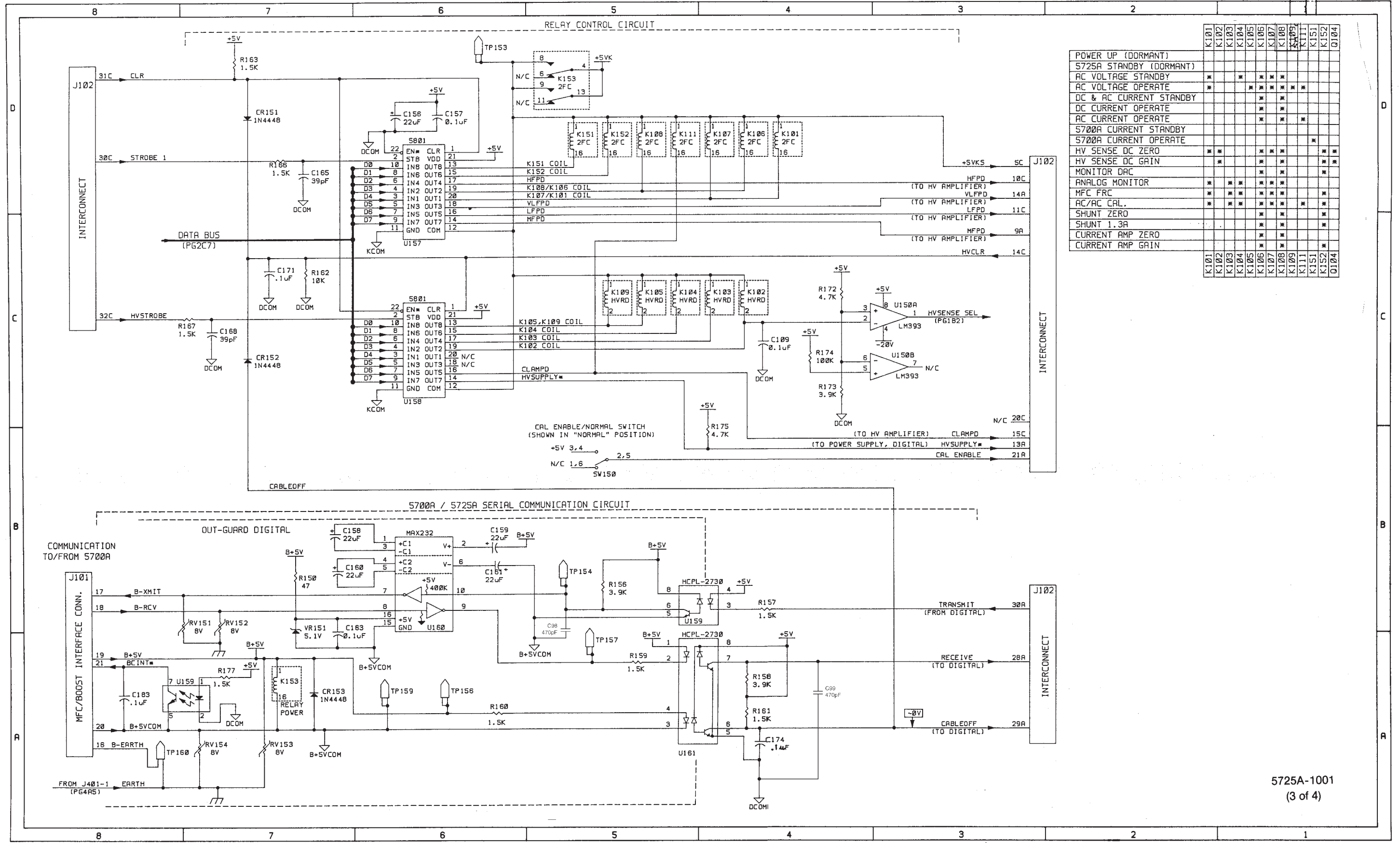
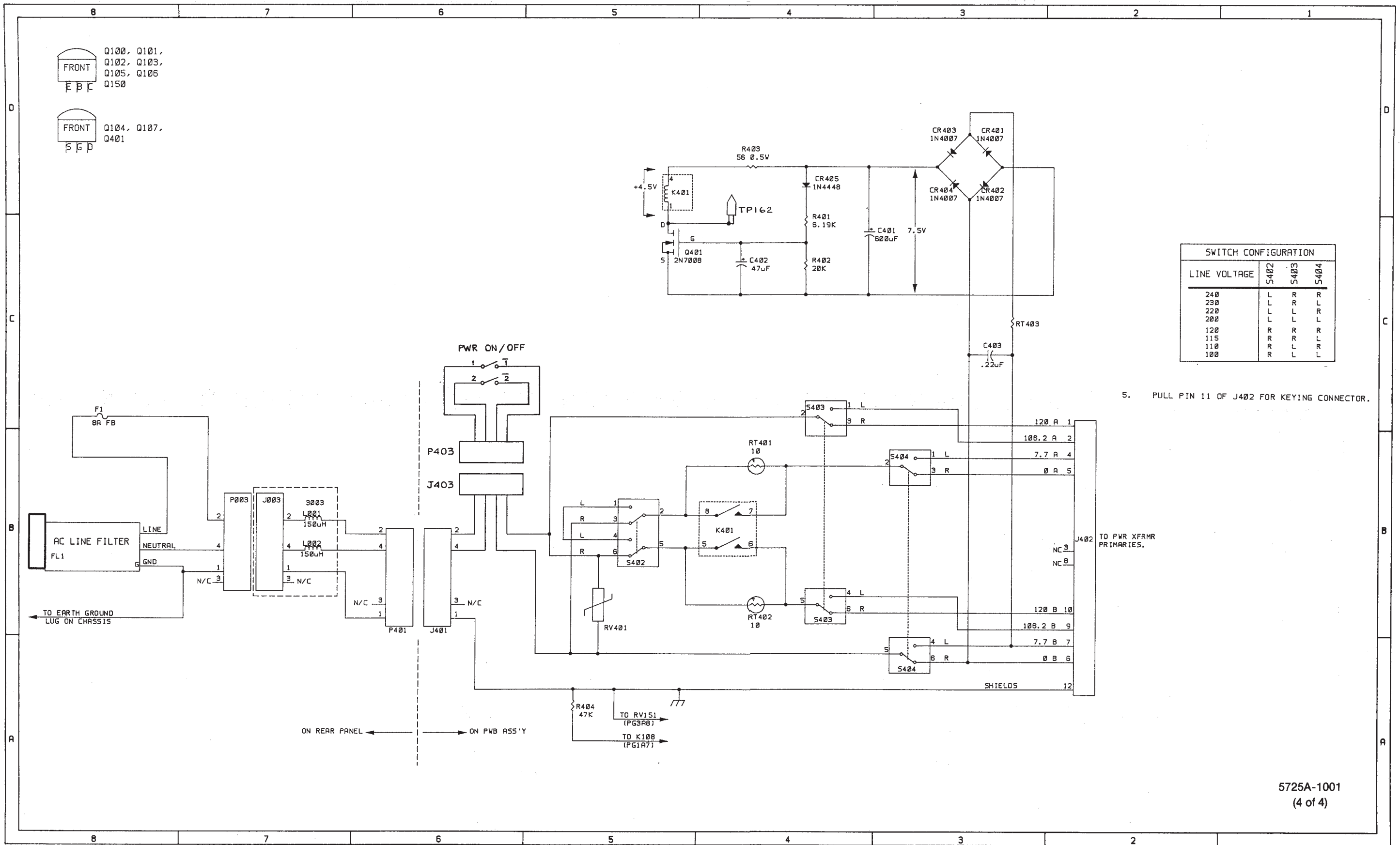
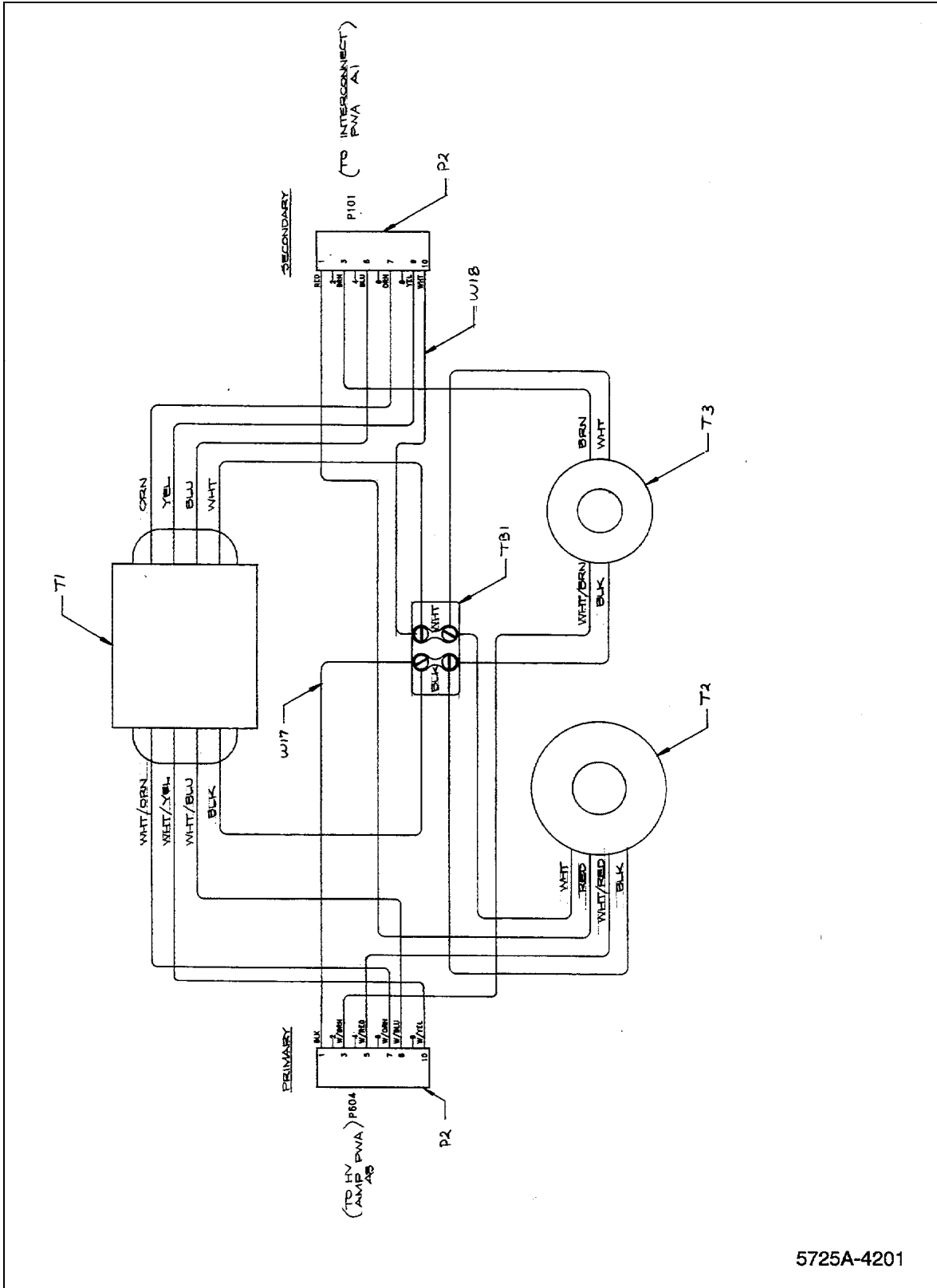


Figure 9-6. A6 High Voltage Sense PCA (cont)



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Figure 9-6. A6 High Voltage Sense PCA (cont)



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Figure 9-7. A12 Transformer Enclosure Assembly



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