HP 4142B Modular DC Source/Monitor

Service Manual

SERIAL NUMBERS

This manual applies to instruments with serial numbers 2716J-, 2839J-, 2946J-, and 3121J-.

HP Part No. 04142-90210
Printed in Japan February 1992

Edition 3
E0292

IN THIS MANUAL

This manual contains information relating to the performance verification, adjustment, and repair of the HP 4142B. The manual consists of the following chapters and appendixes:

Chapter 1 Service Introduction

Contains the information needed before the HP 4142B performance verifications, adjustments, and repairs.

Chapter 2 Performance Verification

Contains the HP 4142B performance verification test procedures using the HP 4142B Performance Verification Software.

Chapter 3 Adjustments

Contains the HP 4142B adjustment procedures using the HP 4142B Performance Verification Software.

Chapter 4 Replaceable Parts

Contains the HP 4142B replaceable parts information.

Chapter 5 Disassembly Procedures

Contains the HP 4142B modules, covers, and assemblies removal procedures; and module installation procedures.

Chapter 6 Troubleshooting

Contains information and instructions for troubleshooting and repairing the HP 4142B.

Chapter 7 Theory of Operation

Contains the theory of operation to aid in troubleshooting the HP 4142B.

Appendix A Error Messages

Contains error meanings of the ERROR/FAILURE display and error codes.

This manual does not contain the HP 4142B specification, options, accessories, and customer installation procedures. Refer to the *Operation Manual* for more detailed information on these topics.

WARNING

THE INFORMATION IN THIS MANUAL IS PROVIDED FOR USE BY SERVICE TRAINED PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY PROCEDURES IN THIS MANUAL, UNLESS YOU ARE QUALIFIED TO DO SO.

SAFETY PRECAUTIONS FOR THE HP 4142B

WARNING

HIGH VOLTAGES SHOCK HAZARD (MAX. 1000 V dc)

The HP 41423A HVU (±1000 V), HP 41420A SMU (±200 V), and HP 41421B SMU (±100 V) force dangerous voltages on the FORCE, GUARD, and SENSE terminals. To prevent an electrical shock, the following safety precautions must be observed.

- **Ground the HP 4142B using a three-conductor ac power cable.**
- **Connect the Interlock (INTLK) terminal to a switch that turns off when the shielding box access door is opened.**
- **For HVU, connect the OUTPUT ON/OFF STATUS terminal to a warning indicator.**
- **For HVU, perform the operation tests of the INTLK and OUTPUT ON/OFF STATUS circuits at least once a day, before using the HP 4142B.**
- **Before touching the connections of the FORCE, GUARD, and SENSE terminals, turn the HP 4142B off, and discharge any capacitors (if connected).**

  If you do not turn the HP 4142B off, perform the following four steps:
  1) **Set the HVU and SMU output switches to off.**
  2) **For HVU, confirm that the warning indicator is not lit.**
  3) **Open the shielding box access door (open the INTLK terminal).**
  4) **Discharge any capacitors, if connected.**

- **Warn workers around the HP 4142B about dangerous conditions.**

SAFETY SUMMARY

General Safety Precautions

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific **WARNINGS** given elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. **The Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.**

GROUND THE INSTRUMENT
To minimize shock hazards, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor AC power cable. The power cable must be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (**green**) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and the mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE
Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a safety hazard.

KEEP AWAY FROM LIVE CIRCUITS
Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE
Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT
Because of the danger of introducing additional hazards, do not substitute parts or perform unauthorized modifications to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

DANGEROUS PROCEDURE WARNINGS
WARNINGs, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

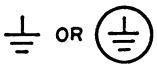
DANGEROUS VOLTAGES, CAPABLE OF CAUSING DEATH, ARE PRESENT IN THIS INSTRUMENT. USE EXTREME CAUTION WHEN HANDLING, TESTING, AND ADJUSTING THIS INSTRUMENT.

Safety Symbols

The general definitions of safety symbols used on equipment or in manuals are listed below.

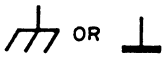
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (Operating) manual, and before operating the equipment.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

WARNING

A **WARNING** denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

CAUTION

A **CAUTION** sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result damage to or destruction of part or all of the product.

NOTE

A **NOTE** denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.

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Hewlett-Packard Company
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Palo Alto, CA 94304 U.S.A.

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (formerly National Bureau of Standards), to the extent allowed by that organization's calibration facility, or to the calibration facilities of other International Standards Organization members.

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This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.
For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.
HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instruction when property installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

Limitation of Warranty

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Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.
For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Address are provided at the back of this manual.

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CHAPTER 1, SERVICE INTRODUCTION

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CHAPTER 1
SERVICE INTRODUCTION

CONTENTS

INTRODUCTION

This chapter provides preliminary information for the HP 4142B performance verifications, adjustments, and repairs, including summaries, calibration cycles, required equipment, available service kits, and upgrades.

PERFORMANCE VERIFICATION TESTS

Performance Verification Tests are used to verify the HP 4142B specifications. All tests can be easily performed by using the HP 4142B Performance Verification (P.V.) software (not furnished, 5.25-inch mini flexible disks: part number 04142-65114, 3.5-inch micro flexible disks: part number 04142-65214) and the digital voltmeter (HP 3456A or HP 3458A), with no need to access the interior of the HP 4142B. The software operates under HP BASIC 3.0 or later.

The performance verification tests consist of the following main tests:

- HP 4142B Mainframe Test (takes about 2 minutes)
- HP 41420A or HP 41421B SMU Test (takes about 5 minutes per module)
- HP 41422A HCU Test (takes about 5 minutes per module)
- HP 41423A HVU Test (takes about 4 minutes per module)
- HP 41424A VS/VMU Test (takes about 4 minutes per module)
- HP 41425A AFU Test (takes about 3 minutes per module)

Perform the tests for periodic verification of performance, for incoming inspection, and for inspection after troubleshooting or adjustments.
If the tests indicate that the HP 4142B is operating outside the specified limits, then proceed to adjustments or troubleshooting.

Test Record

The HP 4142B P.V. software can print out the test results as a Test Record after the test is completed. The Test Record lists all test specifications and acceptable limits; and its format is compatible with the Mil-std 45662A.

The results you record at incoming inspection can be used for comparison after periodic maintenance, troubleshooting, repairs, or adjustments.

Calibration Cycle

The HP 4142B requires periodic verification of performance. Depending on the conditions under which the instrument is used (for example, environmental conditions or frequency of use), you should check the HP 4142B at least once a year using the performance tests described here.

To keep the downtime to a minimum and to insure optimum operation, preventive maintenance using the performance verification tests should be performed on the HP 4142B at least twice a year.

ADJUSTMENTS

Adjustments are performed to maintain the HP 4142B optimum operating performance. All adjustments can be easily performed by using the HP 4142B P.V. software and digital voltmeter (HP 3456A or HP 3458A), and by following the displayed instructions of the software.

The adjustable modules in the HP 4142B are:

- GNDU/ADC module, which is the third slot from the left and has the **GNDU** terminal.
- HP 41420A/HP 41421B SMU
- HP 41422A HCU
- HP 41423A HVU

Perform these adjustment procedures if your HP 4142B fails the performance test. If you cannot achieve proper performance after adjustments, proceed with troubleshooting. If the HP 41424A VS/VMU or HP 41425A AFU fails the performance test, proceed directly to troubleshooting.

REPAIR POLICY

Most HP 4142B repairs are handled on an assembly-level (module) replacement basis. HP 41420A, HP 41421B, HP 41422A, HP 41423A, HP 41424A, HP 41425A, CPU, GNDU/ADC, and Power Supply modules are set up as Exchange Assemblies as described in chapter 4. Mechanical parts, LEDs, and fuses are handled on a parts-level replacement basis.

REQUIRED EQUIPMENT

The following tables list the equipment required for performance tests, adjustments, and troubleshooting; and the equipment required for each performance test, respectively.

NOTE

Equipment should be calibrated by an instrument traceable to the National Institute of Standards and Technology (NIST) or an equivalent standard; or calibrated directly by an authorized calibration organization such as NIST. The calibration cycle should be in accordance with the stability specifications of each component.

Required Equipment

Equipment	Procedure [1]		
	P	A	T
Computer / HPBASIC 3.0 or later / Disk Drive	Yes	Yes	Yes
HP-IB cables, 3 ea.	Yes	Yes	Yes
Printer and its HP-IB or RS-232C cable [2]	Yes		
HP 3456A or HP 3458A Digital Voltmeter [3]	Yes	Yes	Yes
DC 24V±10% Source (Current > 120 mA)			Yes
Product Support Package (04142-65801):			
HP 4142B Performance Verification Software Rev. 6.05 disks (04142-65114 or 04142-65214)	Yes	Yes	Yes
Resistor 1kΩ (04142-61041)	Yes		Yes
Quadraxial cable (1 m) (04142-61642)	Yes		Yes
Triaxial cable (1 m) (04142-61641)	Yes		Yes
Miniature pin plug lead (115 mm) (16058-61601)	Yes	Yes	Yes
Triaxial connector (1250-1848), 3 ea.	Yes	Yes	Yes
BNC connector (1250-1798)	Yes		Yes
Extender Module (04142-61100)		Yes	Yes
Module Extractor (04142-24099)		Yes	Yes
HP 16330A Calibration Adapter	Yes		Yes
HP 16331A HCU Calibrator (0.1Ω)	Yes		Yes
HP 16340A RC Box and furnished accessories:			
HP 16340A RC Box	Yes		Yes
Triaxial cable (1 m) (16053-61002)	Yes		Yes
BNC cable (1 m) (16053-61003)	Yes		Yes
Power Supply Monitor Port Unit (09480-65002)			Yes
Test lead for PSMPU (09480-61200)			Yes
HCU Calibration Adapter Cable	Yes		Yes
HVU I Calibration Adapter (41423-60011)	Yes		Yes
HVU V Calibration Adapter (41423-60012)	Yes		Yes
HVU cable (1.5 m) (HP 16493F Opt. 001 or 41423-60002)	Yes		Yes
Test Lead Kit (HP 34118A)	Yes		Yes
Alligator clips-to-dual banana plug cable (HP 11002A or equivalent)	Yes	Yes	Yes
BNC-to-dual banana plug cable (11001-60001 or equivalent)	Yes		Yes
BNC cable (maximum 3 m), 2 ea.	Yes		Yes
Shorting cap (1250-0929 or equivalent)	Yes	Yes	Yes
BNC-T adapter (1250-0781 or equivalent), 2 ea.	Yes		Yes
Resistor 10 kΩ			Yes

[1] P = Performance Verification, A = Adjustment, T = Troubleshooting

[2] Required only if you want to print the performance verification results.

[3] Must have been calibrated within the last year (within the last 90 days is recommended). To be based on the Mil-std 45662A, use the HP 3458A.

Required Equipment for each Performance Test

Equipment	Test Unit					
	Main-frame	SMU	HCU	HVU	VS/ VMU	AFU
Computer / HP BASIC 3.0 or later / Disk Drive	Yes	Yes	Yes	Yes	Yes	Yes
HP-IB cables, 3 ea.	Yes	Yes	Yes	Yes	Yes	Yes
Printer and its HP-IB or RS-232C cable [1]	Yes	Yes	Yes	Yes	Yes	Yes
HP 3456A or HP 3458A Digital Voltmeter [2]	Yes	Yes	Yes	Yes	Yes	Yes
Product Support Package (04142-65801):						
HP 4142B Performance Verification Software Rev. 6.05 disks (04142-65114 or 04142-65214)	Yes	Yes	Yes	Yes	Yes	Yes
Resistor 1 kΩ (04142-61041)						Yes
Quadraxial cable (1 m) (04142-61642)		Yes				
Triaxial cable (1 m) (04142-61641)		Yes	Yes	Yes	Yes	Yes
Miniature pin plug lead(115mm)(16058-61601)	Yes	Yes			Yes	
Triaxial connector (1250-1848), 2 ea.		Yes				Yes
Triaxial connector (1250-1848), 1 ea.	Yes			Yes		Yes
BNC connector (1250-1798), 2 ea.					Yes	
HP 16330A Calibration Adapter		Yes	Yes	Yes	Yes	
HP 16331A HCU Calibrator (0.1Ω)		Yes				
HP 16340A RC Box and furnished accessories:						
HP 16340A RC Box		Yes	Yes	Yes		
Triaxial cable (1 m) (16053-61002)		Yes	Yes	Yes		
BNC cable (1 m) (16053-61003)		Yes	Yes	Yes		
HCU Calibration Adapter Cable (04142-61610)			Yes			
HVU I Calibration Adapter (41423-60011)				Yes		
HVU V Calibration Adapter (41423-60012)				Yes		
HVU cable (1.5 m) (HP 16493F Opt. 001 or 41423-60002)				Yes		
Test Lead Kit (HP 34118A)				Yes		
Alligator clips-to-dual banana plug cable (HP 11002A or equivalent)	Yes	Yes			Yes	Yes
BNC-to-dual banana plug cable (11001-60001 or equivalent)		Yes	Yes	Yes	Yes	
BNC cable (maximum 3 m), 2 ea.					Yes	
Shorting cap (1250-0929 or equivalent)	Yes	Yes		Yes		
BNC-T adapter (1250-0781 or equivalent), 2 ea.					Yes	

[1] Required only if you want to print the performance verification results.

[2] Must have been calibrated within the last year (within the last 90 days is recommended). To be based on the Mil-std 45662A, use the HP 3458A.

SERVICE KITS

Product Support Package

The Product Support Package for the HP 4142B (part number 04142-65801) contains items required for performance testing, adjusting, and troubleshooting the HP 4142B. The contents are shown below.

Content of Product Support Package

Part Number	Qty.	Description
04142-65114	1	HP 4142B Performance Verification Software disks (5.25-inch)
04142-65214	1	HP 4142B Performance Verification Software disks (3.5-inch)
04142-61041	1	Resistor 1 kΩ
04142-61642	1	Quadraxial cable (1 m)
04142-61641	1	Triaxial cable (1 m)
16058-61601	1	Miniature pin plug lead (115 mm)
1250-1848	3	Triaxial connector
1250-1798	2	BNC connector
04142-61100	1	Extender Module
04142-24099	1	Module Extractor
1540-0863	1	Plastic Case
16296-60101	1	Carrying Case

Field Service Inventory

Stocking spare parts enhance a quick return to service in the event of a malfunction. Field Service Inventory 1 (part number 04142-65901) and Field Service Inventory 2 (part number 04142-65902) for the HP 4142B are available for this purpose.

Each Field Service Inventory consists of selected replaceable assemblies and components, and each is provided with a carrying case. The following two tables list the contents of each Field Service Inventory.

Contents of Field Service Inventory 1

Reference No.	Part Number	Qty.	Description
1	04142-61620	1	Power ON/OFF Switch Assembly
2	04142-66526	1	A6 Interface Connector Board Assembly
3	04142-66534	1	A4 Display Board Assembly
4	04142-69042	1	Restored CPU Module
5	04142-69023	1	Restored GNDU/ADC Module
6	1250-0083	1	BNC Connector
7	1250-1906	2	Triaxial Connector (W WSHR/NUT)
8	1510-0130	1	Binding Post SGL (For GNDU/ADC)
9	1990-0487	1	LED - Yellow (For A4 Bd)
10	1990-0517	1	LED - Red (For A4 Bd)
11	1990-0730	1	LED - 7 Segment (For A4 Bd)
12	2110-0055	2	Fuse 4 A 250 V
13	2110-0342	2	Fuse 8 A 250 V
14	3101-0402	1	Line ON/OFF Switch
15	41420-69001	1	Restored HP 41420A SMU
16	41421-69001	2	Restored HP 41421B SMU
17	41424-69001	1	Restored HP 41424A VS/VMU
18	41425-69001	1	Restored HP 41425A AFU
19	5060-9436	1	Pushbutton Switch (For A4 Bd)
20	16297-60101	1	Carrying Case
21	1540-0863	1	Parts Case

Contents of Field Service Inventory 2

Reference No.	Part Number	Qty.	Description
1	04142-69015	1	Restored Power Supply Module
2	16297-60102	1	Carrying Case

UPGRADES

The previous versions of the HP 4142B do not operate several functions of the current version. The previous versions can be upgraded to the current version at an HP service center (with charges).

The previous versions of the HP 4142B have some of the following modules:

- CPU module with part number 04142-61012 or 04142-69012 (For this CPU module, the ROM version is 2.21, 2.40, 2.50, 2.51, or 2.52.)

  The HP 4142B with this module does not operate the following functions. These HP 4142Bs were shipped before December 1989.

  - HP 41422A HCU
  - 40 V, 100 V, and 200 V range of the Search SMU in the Analog feedback measurements
  - HP 41423A HVU
  - CONTROL connector
  - Quasi-pulsed spot measurement
  - 20 kbyte program memory

- GNDU/ADC module with part number 04142-61013 or 04142-69013

  The HP 4142B with this module does not operate the following function. These HP 4142Bs were shipped before December 1989.

  - HP 41422A HCU (The HCU does not meet output/measurement accuracy specifications.)

- CPU module with part number 04142-61032 or 04142-69032 (For this CPU module, the ROM version is 3.0 or 3.1.)

  The HP 4142B with this module does not operate the following functions. These HP 4142Bs were shipped before June 1991.

  - HP 41423A HVU
  - CONTROL connector
  - Quasi-pulsed spot measurement
  - 20 kbyte program memory

In the above, the CPU module is the module that is installed in the second slot from the left and that has the **INTLK** terminal. The GNDU/ADC module is the module that is installed in the third slot from the left and has the **GNDU** terminal. Part numbers of these modules are stamped on the lower part of the module front panel, which are visible if you remove the front panel of the HP 4142B mainframe.

The contents of the upgrade kit include several parts for the GNDU/ADC module, firmware (ROMs) for the CPU module, manuals, and Control Software.

NOTE

The HP 4142B option 300 Control Unit (CONTROL connector) can be retrofitted at an HP service center.

CHAPTER 2
PERFORMANCE VERIFICATION

CONTENTS

INTRODUCTION

This chapter provides the HP 4142B performance verification test procedures using the HP 4142B Performance Verification Software.

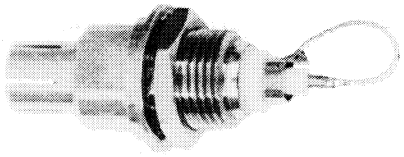
PREPARATION

Before the tests, perform the following steps:

1. Prepare the required equipment shown in chapter 1.
2. Prepare the connectors as follows:

   - GNDU output terminal connector

     Solder a wire to short the center conductor and the inner shield of a triaxial connector (part number 1250-1848) as shown in the following figure. Solder the wire so that the loop is large enough so that an alligator clip can be easily connected to the loop. This connector will be connected to the GNDU output terminal.



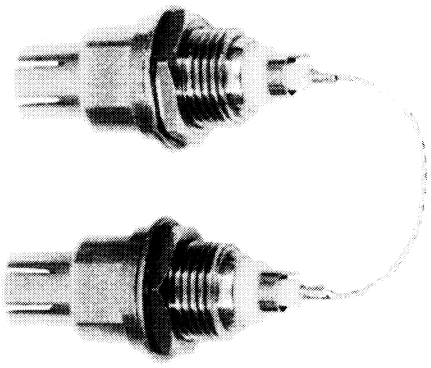
Connector for the GNDU Output Terminal

   - SMU output terminal connectors

     Solder a wire to connect the center conductor of one triaxial connector (part number 1250-1848) to the center conductor of another triaxial connector (part number 1250-1848) as shown in the following figure. The wire must be long enough so that the connectors can be connected to the **FORCE** and **SENSE** terminals of an SMU. These connectors will be connected to the **FORCE** and the **SENSE** terminals of the SMU.

WARNING

SHORTING THE INTLK TERMINAL ENABLES SMU/HVU OUTPUT TO EXCEED ±42V. DANGEROUS VOLTAGES MAY BE PRESENT AT SMU/HVU FORCE, SENSE, AND GUARD TERMINALS WHEN THE INTLK TERMINAL IS SHORTED.



Connectors for the SMU Output Terminals

3. Warm up your HP 4142B and digital voltmeter.

   Allow the HP 4142B to warm up and stabilize for at least 40 minutes to ensure proper instrument performance. Also, allow the digital voltmeter to warm up and stabilize for at least 60 minutes.

   To perform the performance verification of the HP 41425A AFU, install two SMUs (HP 41420A or HP 41421B) because the AFU test uses two SMUs.

4. Connect the HP-IB cables.

   Interconnect the controller, HP 4142B, digital voltmeter, disk drive, and printer with interface cables. A printer is required only if you want to print the Test Record after the test is complete.

5. Perform the following steps:

   a. Short the **CIRCUIT COMMON** (⏚) and the **CHASSIS GROUND** (⊥) terminals of the HP 4142B with the shorting bar.

   b. Set the **FILTER** switch on the rear panel of the HP 4142B to the correct frequency for the ac power source.

   c. Set **GUARD** switch of the digital voltmeter to **TO LO**.

6. Remove the front panel.

   To gain access to the **ZERO CHECK** terminal, remove the front panel as follows:

   a. Turn the HP 4142B off.

   b. With a slotted screwdriver, loosen the two screws located in the lower left and right corners of the front panel. Swing the front panel slightly upward, then down, until it comes loose. Disconnect the flat cable of the front panel from the mainframe connector.

STARTING THE P.V. SOFTWARE

The following procedure explains how to start the HP 4142B P.V. software when using an ITF keyboard (HP 46020 or HP 46021). This software can be executed in a similar manner on the HP 98203A, B, or C keyboards. However, the labels for the keys and softkeys have the following differences:

ITF Keyboards	HP 98203A, B, or C Keyboards
Return key	**ENTER** key
f1 to **f8** keys	**k0** to **k3** and **k5** to **k8** keys
'RUN' softkey	**RUN** key

1. Load BASIC

   Insert the BASIC 3.0 (or later) disk into the disk drive and turn your computer on. The language system loads automatically and "BASIC Ready" is displayed when BASIC is loaded. Remove the disk.

2. Load BASIC BIN files

   Load the following binary (BIN) files from the BASIC Drivers Disk and the BASIC Language Extensions Disk:

Drivers BIN files:	HPIB
Language Extension BIN files:	CLOCK, ERR, IO, MAT

   If you are using an external disk drive or other storage medium, you also need to load other BIN files (for example CS80 and DISC). Remove the disk.

3. Load "PV4142"

Insert the PV4142#1 disk into the disk drive and type the following:

LOAD "PV4142" **[Return]**

NOTE

The HP 4142B P.V. software consists of three disks (PV4142#1 disk, PV4142#2 disk, and VIEW disk), and contains the following program and data files:

PV4142#1 disk:

- PV4142: Main Program file for performance verification and adjustment.

PV4142#2 disk:

- PV4142_SUB: Subprogram file for the PV4142 program.
- ACC_4142: Data file for the performance test limits.
- R_DATA: Data file for the standard resistor values.
- ADDR_DATA: Data file for the HP-IB addresses, type of digital voltmeter, and printer control settings.

VIEW disk:

- VIEW: Program file for printing the Test Record of the performance verification. This program can also be a subprogram of the PV4142 program.
- VIEW_DATA: Data file for printer control settings.
- UNC_4142 Data file for measurement uncertainty values.

4. Run "PV4142"

   a. Select the **'RUN'** softkey to start the program. The following message is displayed:

      Insert 'PV4142_SUB' into the current mass storage device. Then press Continue.

   b. Insert the PV4142#2 disk into the disk drive and select the **'Continue'** softkey. After the copyright message is displayed, the START UP MENU is displayed as shown in the following figure.

      After selecting the **'Continue'** softkey, the PV4142 links the subprogram PV4142_SUB and reads three data files (ACC_4142, R_DATA, and ADDR_DATA) from this disk.

      If you restart the P.V. software after you stop it, insert the PV4142#2 disk into the disk drive and select the **'RUN'** softkey.

START UP MENU SOFTKEYS:

START (f1)	RECONFIG (f5)

Softkey descriptions:

'START': Displays the MAIN MENU. Select this softkey to skip the RECONFIG MENU and proceed to performance verification or adjustment.

'RECONFIG': Displays the RECONFIG (Reconfiguration) MENU.

START UP MENU SOFTKEYS

NOTE

If either of the following error messages is displayed, make sure that the PV4142#2 disk is inserted and that the HP-IB connection and address setting of your mass storage device is correct, then run the program again.

"Error [*BASIC error code*] ([*BASIC error message*]) occurred in writing R_DATA (ACC_4142 or ADDR_DATA)"

"Error [*BASIC error code*] ([*BASIC error message*]) occurred in reading R_DATA (ACC_4142 or ADDR_DATA)"

5. Change the HP-IB addresses, standard resistor values, digital voltmeter, or printer type (if necessary).

   a. To display the RECONFIG MENU, do the following step:

      Select the **'RECONFIG'** softkey. The RECONFIG MENU is displayed as shown in the following figure.

RECONFIG MENU SOFTKEYS:

4142B ADDR	DVM	PRINTER ADDR [1]	PRINTER TYPE	CAL DATA	START UP MENU
(f1)	(f2)	(f3)	(f4)	(f5)	(f8)

[1] Or **SPOOL DIR.**.

Softkey descriptions:

'4142B ADDR': For changing the HP 4142B HP-IB address.

'DVM': For changing the digital voltmeter (HP 3456A or HP 3458A) and its HP-IB address. If you select this softkey, the following are displayed:

3456A	3458A
(f1)	(f2)

'PRINTER ADDR': For changing the printer control settings. If the PRINTER TYPE is set to LOCAL, this softkey is displayed.

'SPOOL DIR.': For changing the spool directory of the SRM system. If the PRINTER TYPE is set to FILE SPOOL, this softkey is displayed.

'PRINTER TYPE': For changing the printer type. If you select this softkey, the following are displayed:

LOCAL	FILE SPOOL(f2)
(f1)	

'CAL DATA': For changing the standard resistor values. If you select this softkey, the CALIBRATION DATA ENTRY MENU is displayed as follows:

CALIBRATION DATA ENTRY MENU SOFTKEYS:

16330A	16340A	16331A	RECONFIG MENU (f8)
(f1)	(f2)	(f3)	

Softkey descriptions:

'16330A', '16340A', '16331A': For changing the HP 16330A/ HP 16340A/ HP 16331A standard resistor values.

'RECONFIG MENU': Displays the RECONFIG MENU.

'START UP MENU': Displays the START UP MENU.

RECONFIG MENU SOFTKEYS

b. To change the HP-IB address of the HP 4142B, use the following step:

Select the **'4142B ADDR'** softkey and type the new HP-IB address for the HP 4142B. Press [**Return**]. The range allowed is between 700 to 3130. The lower two digits must be 30 or less.
The new HP-IB address is displayed.

NOTE

If you press **[Return]** without entering numeric data, such as the address and resistor values, the present value is retained.

c. To change the digital voltmeter or its HP-IB address, use the following steps:

Select the **'DVM'** softkey, then select the digital voltmeter with the **'3456A'** or **'3458A'** softkey. Enter the new HP-IB address for the digital voltmeter using the same procedure as in step b.

d. To change the printer control settings, use the following steps (omit this step if you do not print the test results):

Select the **'PRINTER TYPE'** softkey, then select the **'LOCAL'** softkey. If you use the SRM, select the **'FILE SPOOL'** softkey instead of **'LOCAL'**.

- If you select the **'LOCAL'** softkey:
  Select the **'PRINTER ADDR'** softkey. The message "Type new address." is displayed.

  If you use the HP-IB interface printer, enter the new printer address between 700 and 3130. The lower two digits must be 30 or less. Then select the **'HP-IB'** softkey.

  If you use the RS-232C interface printer, enter the new printer address between 8 and 31, then select the **'RS-232C'** softkey, then enter the baud rate of the RS-232C interface. The following values are allowed:

  50, 75, 110, 134, 150, 200, 300, 600, 1800, 2400, 3200, 4800, 9600, 19200

- If you select **'FILE SPOOL'** softkey:

  Select the **'SPOOL DIR.'** softkey, then enter the new spooling directory. For example, type: "/spool:REMOTE" **[Return]**
  If you do not enter a volume specifier, the volume specifier of the current mass storage unit is used.

e. To change the standard resistor values of the HP 16330A, use the following steps (omit this step if you do not perform the SMU, HCU, HVU, or VS/VMU test):

Select the **'CAL DATA'** softkey, the **'16330A'** softkey, and the **'YES'** softkey in that order. (If you select the **'NO'** softkey instead of **'YES'**, the CALIBRATION DATA ENTRY MENU is displayed again.) Type in the new calibration data value for the 1Ω resistor and press [**Return**]. Similarly, type in the new 10 and 100Ω resistor values. Allowable resistor values are within ±1% of the nominal value.

When all data are entered, the message "Are you sure?" is displayed. If you entered all the values correctly, then select the **'YES'** softkey. To retain the old data, select the **'NO'** softkey.

f. To change the standard resistor values of the HP 16340A, use the following steps (omit this step if you do not perform the SMU, HCU, or HVU test):

Select the **'16340A'** softkey. Enter the 1k, 10k, 100k, 1M, 10M, 100M, and 1GΩ resistor calibration data in the same way as in step e.

Do not enter the k, M, or G suffixes because these are automatically supplied by the software. For example, if you want to enter 10.1kΩ for the 10kΩ resistor value, enter only 10.100, then press [**Return**]

g. To change the standard resistor values for the HP 16331A, use the following step (omit this step if you do not perform the HCU test):

Select the **'16331A'** softkey. Enter the 0.1Ω resistor calibration data in the same way as in step e.

h. To return to the START UP MENU, use the following steps:

If you removed the PV4142#2 disk from the disk drive, insert the disk. Select the **'RECONFIG MENU'** softkey, then the **'START UP MENU'** softkey. The START UP MENU is displayed.

When you select the **'RECONFIG MENU'** softkey, the standard resistor values are resaved to the PV4142#2 disk (File name: R_DATA). When you select the **'START UP MENU'** softkey, the HP-IB addresses, type of the digital voltmeter, and printer control settings are resaved to the disk (File name: ADDR_DATA).

The P.V. software reads the saved data when you run the PV4142 program. Therefore, if you perform step 5 once, you can omit step 5 and remove the PV4142#2 disk after the START UP MENU is displayed.

6. Display the MAIN MENU.

   Select the **'START'** softkey in the START UP MENU. The MAIN MENU is displayed as shown in the following figure.

MAIN MENU MENU SOFTKEYS:

P.V. (f1)	**ADJUST** (f2)	**VIEW RESULT**(f5)	**QUIT** (f8)

Softkey descriptions:

'P.V.': Displays the P.V. MENU.

'ADJUST': Displays the ADJUST MENU. Refer to chapter 3 for details.

'VIEW RESULT': Displays the VIEW RESULT MENU. Refer to paragraph "Viewing Test Results" for details.

'QUIT': Terminates the P.V. software.

MAIN MENU SOFTKEYS

EXECUTING PERFORMANCE VERIFICATION

To execute the performance verification tests, perform the following steps:

1. Display the P.V. MENU.

   To display the P.V. MENU shown in the following figure, select the **'P.V.'** softkey in the MAIN MENU.

NOTE

Selecting the **'P.V.'** softkey initializes the HP 4142B and the digital voltmeter. If the HP-IB addresses are not set correctly, one of the following messages is displayed and the "PV4142" program terminates.

"DVM is not connected or bad address is specified."
"HP 4142B is not connected or bad address is specified."

If another device is connected to the same address as one of these devices, the error may not be detected and the P.V. software may hang up. In this case, stop the P.V. software by pressing [**Break**], and check the device addresses. Then run the "PV4142" program again.

P.V. MENU SOFTKEYS:

ALL (f1)	MAINFRM (f2)	SMU (f3)	HCU (f4)	HVU (f5)	VS/VMU (f6)	AFU (f7)	MAIN MENU(f8)

Softkey descriptions:

'ALL': Performs tests on the mainframe and all installed plug-in modules. The table on the next page shows all test items and the execution order of each test item. If there is no corresponding module, that test is automatically skipped.

'MAINFRM', 'SMU', 'HCU', 'HVU', 'VS/VMU', 'AFU':
Use these softkeys to selectively test the mainframe or the corresponding module of the HP 4142B.
If the corresponding module is not installed in your HP 4142B, the associated softkey is not displayed.

'MAIN MENU': Displays the MAIN MENU.

NOTE

You can save the test results to a disk and print out the test results as the Test Record ONLY when you select the **'ALL'** softkey.

P.V. MENU SOFTKEYS (1 of 2)

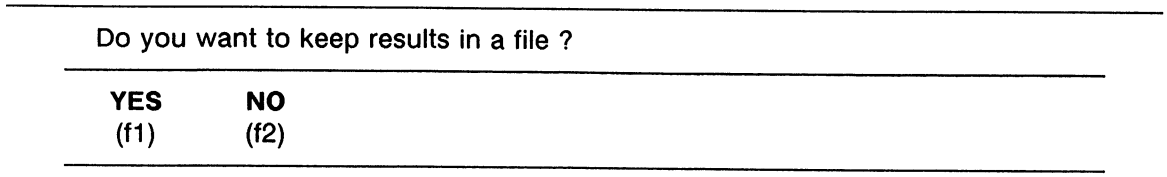
Test Unit	Test Item	All Tests Execution Order	Execution Time	These Tests Must Pass First
Mainframe	Self-Test	1	30 s	---
	GNDU Test	2	30 s	Self-Test
SMU	Guard Potential Offset Test	3	35 s	Mainframe Test
	Voltage Accuracy Test	4	40 s	
	Current Accuracy Test	5	150 s	
	CMR Accuracy Test	6	15 s	
HCU	Voltage Accuracy Test	7	60 s	
	Current Accuracy Test for 1 mA and 10 mA ranges	8	90 s	
	Current Accuracy Test for 100 mA to 1 A ranges	9	70 s	
	CMR Accuracy Test	10	20 s	
HVU	Guard Potential Offset Test	11	15 s	
	Voltage Accuracy Test	12	40 s	
	Current Accuracy Test	13	60 s	
	Leakage Current Test	14	20 s	
VS/VMU	Voltage Accuracy Test	15	60 s	
	Differential Voltage Accuracy Test [1]	16	45 s	
	Current Accuracy Test [2]	17	70 s	
AFU	Convergence Accuracy Test	18	70 s	Mainframe Test and SMU Test
	Setting Accuracy Test	19	80 s	

[1] Includes CMR Accuracy Test.
[2] Includes Current Limit Accuracy Test.

2. Execute the tests.

   To perform all tests sequentially, use the following steps:

   a. Select the **'ALL'** softkey. The message and softkeys shown in the following figure are displayed:



Softkey Descriptions:

'YES': Test results are saved in a file.

'NO': Test results are not saved in a file.

NOTE

To be able to print out the test results as the Test Record, you must save the test results in a file (select the **'YES'** softkey).

Test Results Handling Selection

   b. Select the desired softkey (**'YES'** or **'NO'**). If you select the **'NO'** softkey, go to step g.

   c. Insert a disk for saving the test results. Do not remove the disk until the P.V. MENU is displayed again after all tests are complete, because "PV4142" creates temporary files on the disk during the tests and merges them into one file after all tests are complete.

NOTE

You can execute any BASIC statement directly whenever P.V. software is waiting for softkey input. For example, you can execute the **CAT** statement to display the catalog, or you can execute the **PURGE** statement to purge a file.

d. Type the name of the file in which you want to save the test results, then press [**Return**]. If you press [**Return**] without typing a filename, the P.V. software returns you to step b again.

NOTE

Do not use "TEMP001" through "TEMP999" as your test results filename because the P.V. software creates temporary files with these names during the tests. After the tests are complete, these files are automatically purged.

If you specify a file that has already been used to save the test results of a previous HP 4142B performance test, you can selectively resave the results of desired test items. In this case, go to step g since you cannot change the contents of step e. You can perform the desired test items by using the **'CONTINUE'** softkey and the **'SKIP'** softkey to skip over undesired test items.

After step d, the P.V. software checks whether the disk has more than 320 records (81.92 KB) of available space to avoid overflow during the test. If the disk does not have enough space available, the following message is displayed:

"Not enough space on the medium. Do you wish to continue ?"

Select the **'NO'** softkey to return to step b, then insert a disk that has enough available space. If you select the **'YES'** softkey for the above message, the message "Are you sure ? Data may be lost." is displayed. Select the **'NO'** softkey to return to step b. If you select the **'YES'** softkey instead, the program goes to step e. However, the test data file is not created if an overflow occurs during the test.

e. Type the operator's name and press [**Return**]. Then enter the Serial Number, Date, Temperature, and Humidity of the HP 4142B mainframe, and the Serial Number of each module as prompted. Press [**Return**] after each entry.

f. Once you select the **'YES'** softkey, you can never change the data entered in step e.

If you correctly entered all the data in step e, select the **'YES'** softkey. If you select the **'NO'** softkey, the P.V. software returns you to step e again.

g. Perform test items in accordance with the messages that are displayed during test execution. Refer to "Connections for Each Test Item" for details about cable connections for each test item.

WARNING

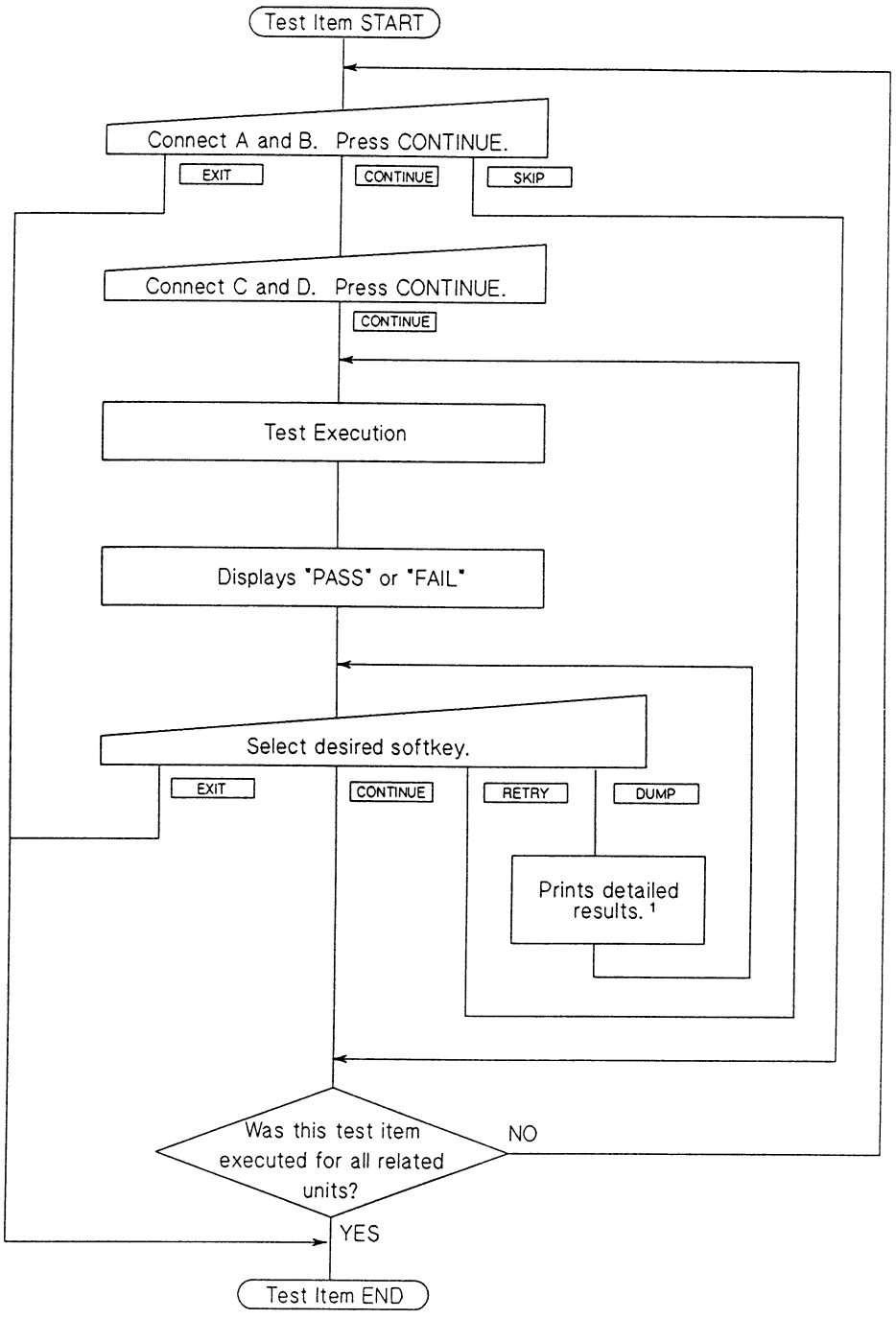
SHORTING THE INTLK TERMINAL ENABLES SMU/HVU OUTPUT TO EXCEED ±42V. DANGEROUS VOLTAGES MAY BE PRESENT AT SMU/HVU FORCE, SENSE, AND GUARD TERMINALS WHEN THE INTLK TERMINAL IS SHORTED.

The following figure shows the general flow chart for test items. First, connect the cables in accordance with the displayed messages, then select the **'CONTINUE'** softkey to execute the test item. After the test result ("PASS" or "FAIL") is displayed, select the **'CONTINUE'** softkey to perform the next test item. Basically, you can perform all test items by changing the cable connections, then selecting the **'CONTINUE'** softkey. After all tests are complete, the P.V. MENU is displayed. The figure also shows the softkeys that are displayed during test item execution.

During a test, "SMU1", "SMU2", "HCU1", "HVU2", "VS3/VM3", etc. is displayed to distinguish between plug-in modules. The first SMU from the left is SMU1, the second is SMU2, etc. The program does not distinguish between HP 41420As and HP 41421Bs. Each VS/VMU module has two VSs and two VMs. The first VS/VMU from the left is VS1/VS2 and VM1/VM2, the second is VS3/VS4 and VM3/VM4, etc. An empty slot does not affect the numbering. The AFU does not have a number. An example is shown below:

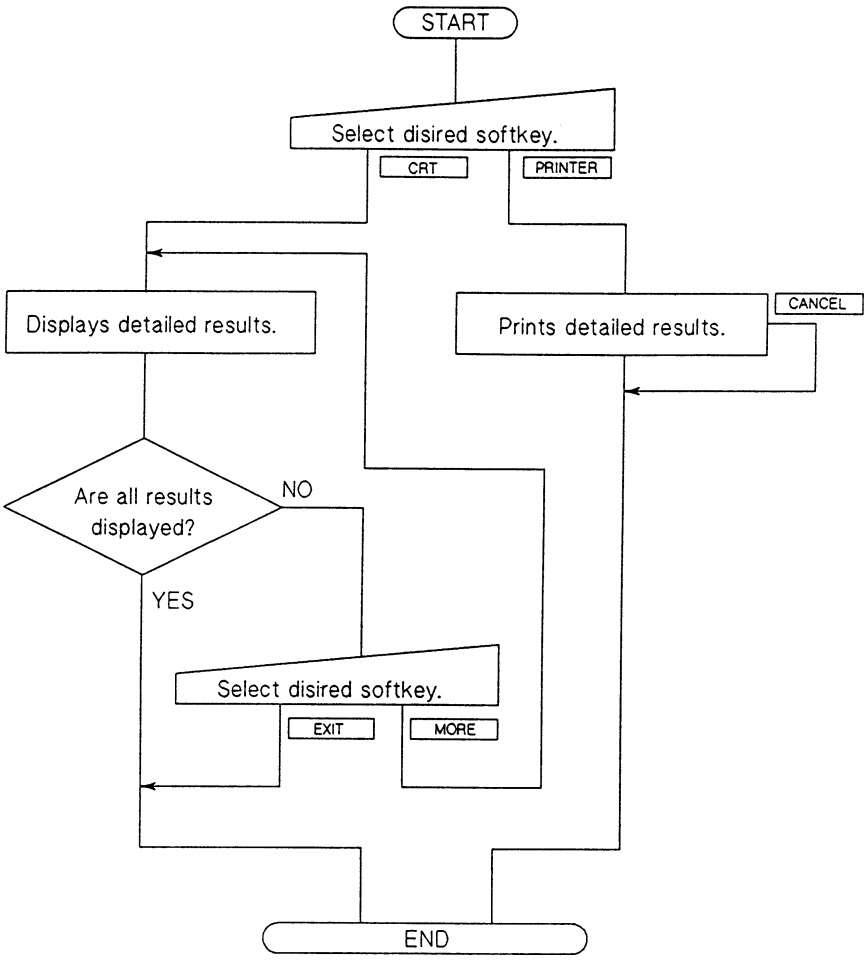
SLOT#1:	HP 41421B SMU	SMU1
SLOT#2:	empty	
SLOT#3:	HP 41420A SMU	SMU2
SLOT#4:	HP 41420A SMU	
SLOT#5:	empty	
SLOT#6:	HP 41424A VS/VMU	VS1/VS2 and VM1/VM2
SLOT#7:	HP 41424A VS/VMU	VS3/VS4 and VM3/VM4
SLOT#8:	HP 41425A AFU	AFU

To obtain a correct GNDU test, the Self-Test must pass first. Similarly, to obtain correct SMU, HCU, HVU, or VS/VMU tests, the Self-Test and the GNDU test must pass first. To obtain a correct AFU test, the Self-Test, the GNDU test, and the SMU test for SMU1 and SMU2 must pass first.



General Test Item Flow Chart (1 of 3)

[1] Prints detailed results:



General Test Item Flow Chart (2 of 3)

Softkey Descriptions

'CONTINUE': Goes to the next procedure in the test item.

'SKIP': Goes to the next unit.

'EXIT': Goes to the next test item. Or if this softkey is selected after selecting the **'CRT'** softkey, exits from displaying the detailed test results.

'RETRY': Performs the test item again. If the test fails, make sure the cable connections are correct, then select this softkey if you want to perform the test item again. If the test results are being saved to a disk, the new test results overwrite the old test results.

'DUMP': Displays or prints the detailed test results.

If the PRINTER TYPE is set to FILE SPOOL, the created filename is PV4142_D*n* (*n* is incremented from 1 to 99 repeatedly, such as 1, 2, ..., 99, 1) and the file type is ASCII (LIF ASCII).

'CRT': Displays the detailed test results.

'PRINTER': Prints the detailed test results.

'MORE': Displays one more screen of the detailed test results.

'CANCEL': Cancels printing.

General Test Item Flow Chart (3 of 3)

NOTE

- If the following type of error message occurs while recording the test results, check the following: the mass storage device is specified correctly, the disk is inserted, the disk is not write protected, the disk was not changed during the test, the disk has enough available space. Then select the **'RUN'** softkey to run the test again.

  "Error [*BASIC error code*] ([*BASIC error message*]) occurred. [*P.V. software error message*]."

  The *P.V. software error messages* are as follows:

  - "Can't create *specified filename*."
  - "Can't output data to TEMP*xxx*."
  - "Can't copy TEMP*xxx* to *specified filename*."
  - "Can't purge TEMP*xxx*"
  - "Can't assign *specified filename*."
  - "Can't assign TEMP*xxx*."
  - "Can't read/write *specified filename*/TEMP*xxx*."

- When printing or displaying the detailed test results (**'CRT'** or **'PRINTER'** softkey is selected), the following may occur:

  - In the Self-Test results, a "?" occurs if more than 4 errors occur during Self-Test. The HP 4142B error register can store only 4 error codes in the error register.

  - In the V/I accuracy tests, if the measurement data overflows so the gain error and offset error cannot be calculated, the displayed gain error is set to "-100%" and the displayed offset error is set to "+9.999E+9". In this case, check the cable connection to the digital voltmeter. If the measured gain error exceeds ±1000%, the displayed error (gain error) is set to "+999.9%" or "-999.9%", depending on the sign.

- The AFU convergence accuracy test and setting accuracy test require two SMUs. If fewer than two SMUs are installed in your HP 4142B for these tests, one of the following messages is displayed:

  - "This test requires two verified SMUs. SMU1 performance verified only."
  - "SMU performance not verified. Press CONTINUE and test SMUs"

  In this case, select the **'CONTINUE'** softkey to complete the test and display the P.V. MENU. Select the **'MAIN MENU'** softkey to display the MAIN MENU, turn the HP 4142B off, install two SMUs, perform the SMU test, then perform the AFU test.

NOTE

- The file size of the test data when saving the test results to a disk can be calculated by using the following equation. However, the available space on the disk is required more than double the file size because the P.V. software creates temporary files. Before the test starts, the P.V. software confirms that the disk has at least 81.92KB (320 records) of available space.

  file size (bytes) = (Definition: 8KB) +
  (Mainframe Tests: 0.2KB) +
  (SMU Tests: 3.6KB) (Number of SMUs) +
  (HCU Tests: 4KB) (Number of HCUs) +
  (HVU Tests: 4.7KB) (Number of HVUs) +
  (VS/VMU Tests: 2.2KB) (Number of VS/VMUs) +
  (AFU Tests: 1KB) (Number of AFUs)

  The P.V. software saves all executed test results in the file until all tests are complete, and then combines the latest test results to be displayed as the Test Record. Therefore, for the following two cases, the file size is larger than the value calculated by the above equation:

  - The **'RETRY'** softkey is selected.
  - New test results were saved for a test that already had test results saved.

  If the available space is used up before the tests are complete, the specified file cannot be created. Or if you selectively perform some tests again and the file overflows, the file will be lost. If there is not enough space to selectively retry the tests, you should use another disk that has enough space.

- To perform tests selectively, do the following:

  1. Select the desired softkey from the P.V. MENU: **'MAINFRM'**, **'SMU'**, **'HCU'**, **'HVU'**, **'VS/VMU'**, or **'AFU'**.

  2. Select the softkey of the desired test item. If you select the SMU test, HCU test, HVU test, or the VS/VMU test and more than one SMU, HCU, HVU, or VS/VMU is installed in your HP 4142B, then select the softkey of the desired module.

  3. Perform the test in accordance with the messages that are displayed during test execution. See step g in the all tests description.

  4. After the test is completed, select the **'EXIT'** softkey to return to the P.V. MENU.

NOTE

- If an HP 4142B error occurs, the P.V. software displays one of the following messages, and terminates.

  - "4142B SHUT DOWN !!"
    This error occurs when the HP 4142B automatically turns off to prevent damage, or when a momentary power loss occurs.

  - "4142B NOT INTERLOCKED !!"
    This error occurs when the INTLK terminal is opened during the measurement.

  - "4142B ERROR *4142B_error_code* In *PV4142_subprogram_name*"
    This error occurs when the error of the displayed error code occurs.

- If the unit that fails in Self-Test/Self-Calibration is installed in the HP 4142B, the P.V. software does not perform the performance verification except Self-Test. Under these conditions, the P.V. software displays the following message, and terminates.

  "4142B ERROR *4142B_error_code* In Cal_hp4142"

- If the HVU fails the Self-Test, the P.V. software automatically terminates for safety after displaying the test result and the following message.

  "4142B ERROR In Mainframe_cpu"

CONNECTIONS FOR EACH TEST ITEM

The test cable connections for each test item are as follows.

Mainframe Self-Test

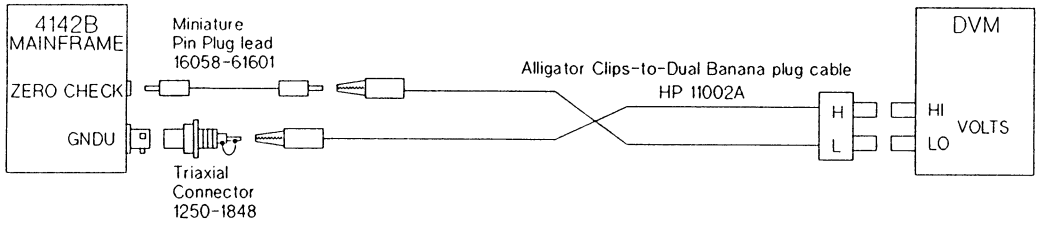
This test is executed by the HP 4142B, independently of the input and output connections.

If the HVU is installed in the HP 4142B, short the INTLK terminal with a BNC shorting cap.

WARNING

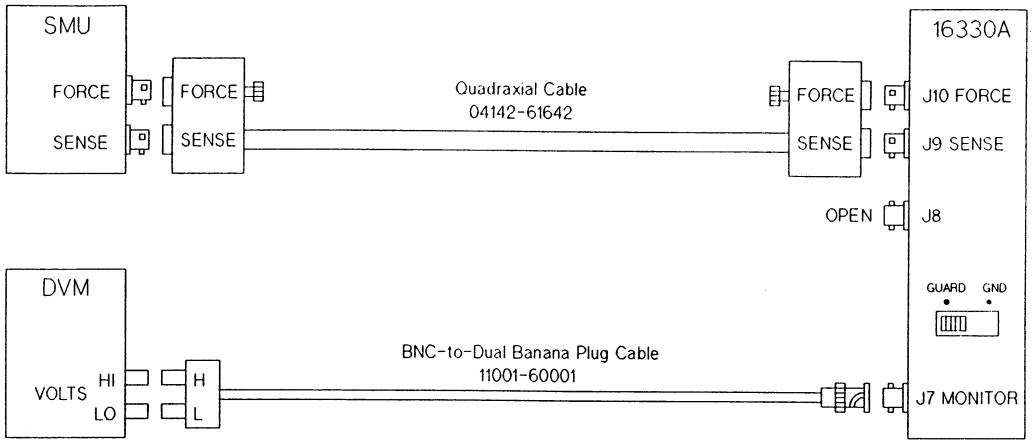
SHORTING THE INTLK TERMINAL ENABLES SMU/HVU OUTPUT TO EXCEED ±42V. DANGEROUS VOLTAGES MAY BE PRESENT AT SMU/HVU FORCE, SENSE, AND GUARD TERMINALS WHEN THE INTLK TERMINAL IS SHORTED.

Mainframe GNDU Test



Mainframe GNDU Test Cable Connections

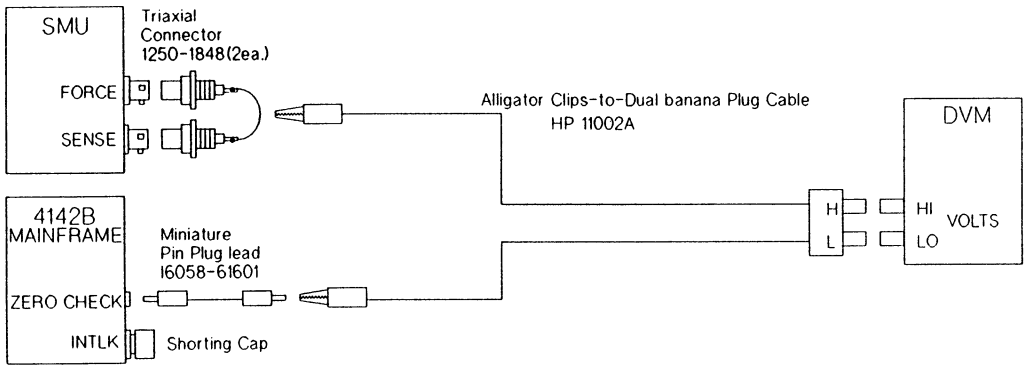
SMU Guard Potential Offset Test



SMU Guard Potential Offset Test Cable Connections

WARNING

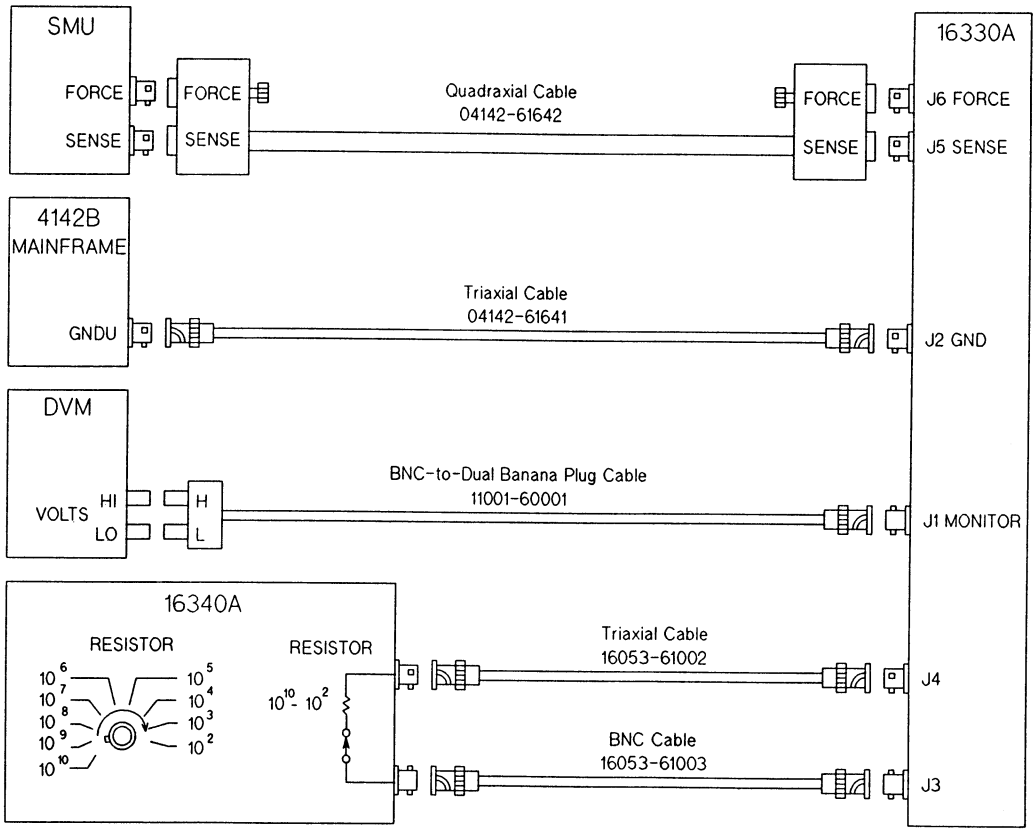
SMU MAXIMUM VOLTAGE (200 V OR 100 V) IS FORCED IN THIS TEST.



SMU Voltage Accuracy Test Cable Connections

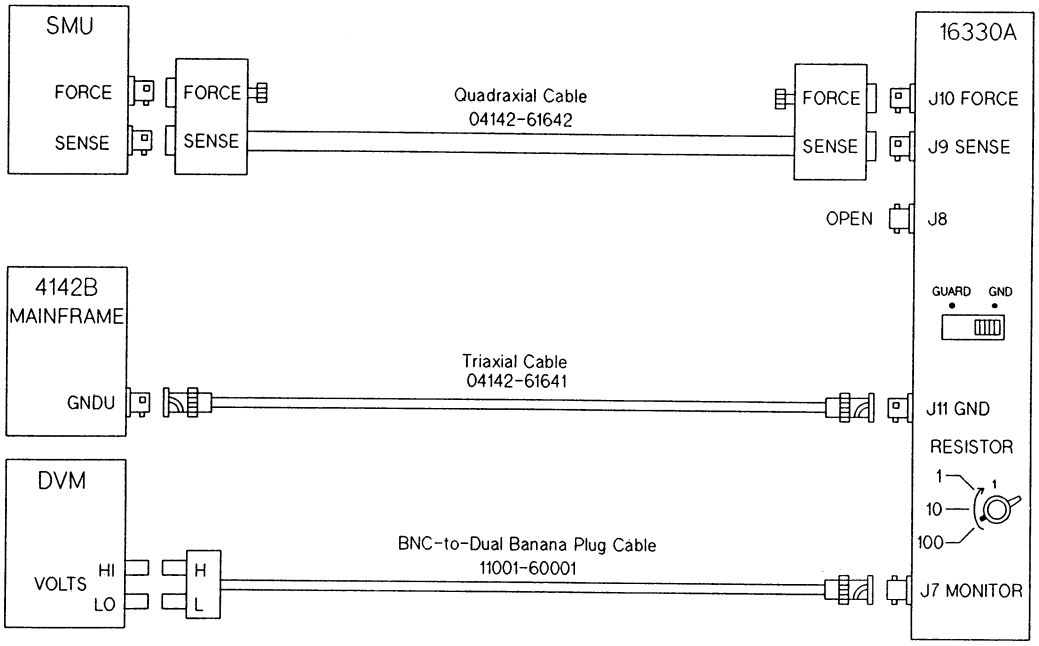
SMU Current Accuracy Test

a. 1 nA to 1 mA Range



SMU Current Accuracy Test (1 nA to 1 mA Range) Cable Connections

b. 10 mA to 1 A Range



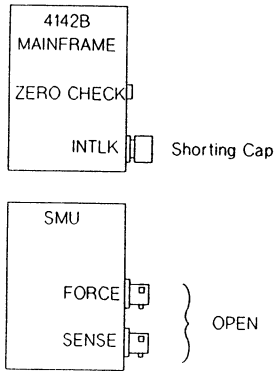
[1] For 41420A SMU, set to 100, 10 or 1 ohm. For 41421B SMU, set to 100 or 10 ohm.

SMU Current Accuracy Test (10 mA to 1 A Range) Cable Connections

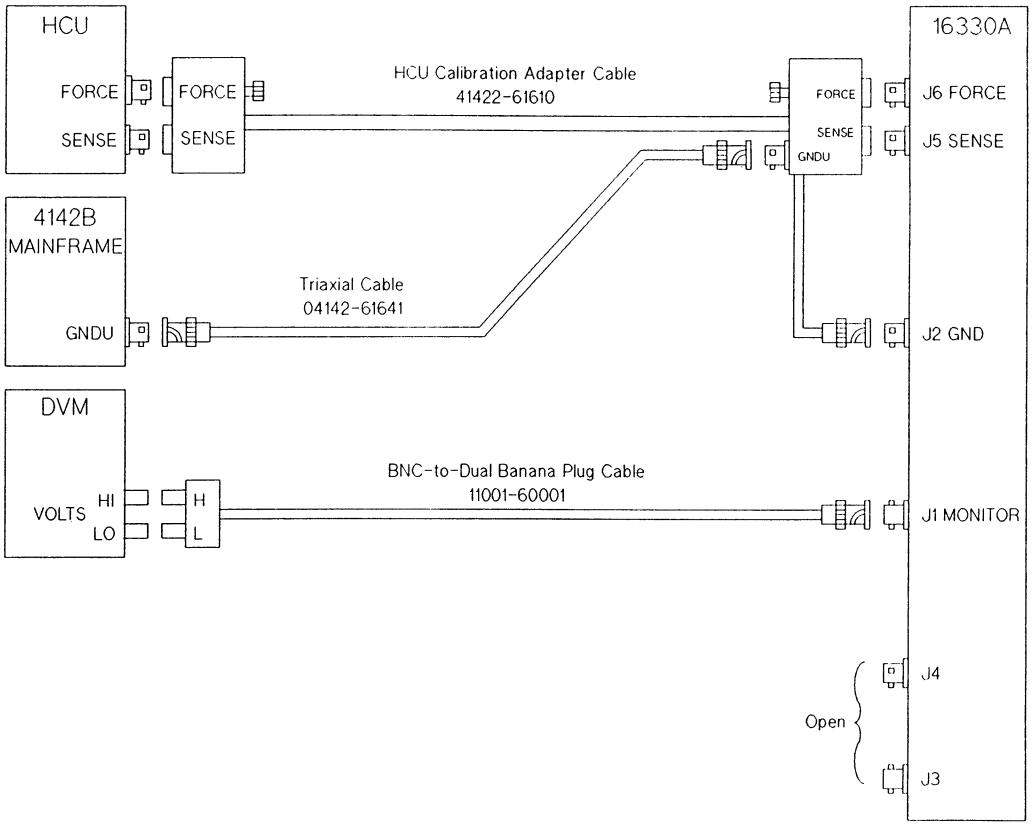
SMU CMR Accuracy Test

WARNING

100 V IS FORCED IN THIS TEST.



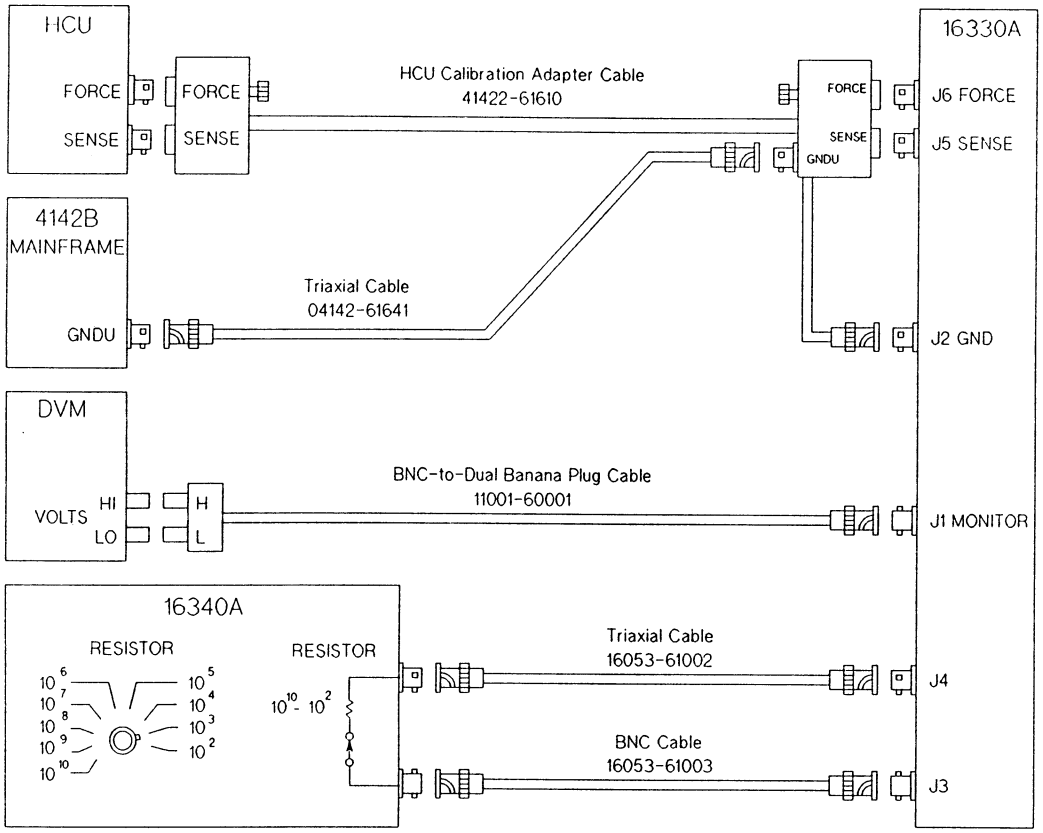
SMU CMR Accuracy Test Cable Connections



HCU Voltage Accuracy Test Cable Connections

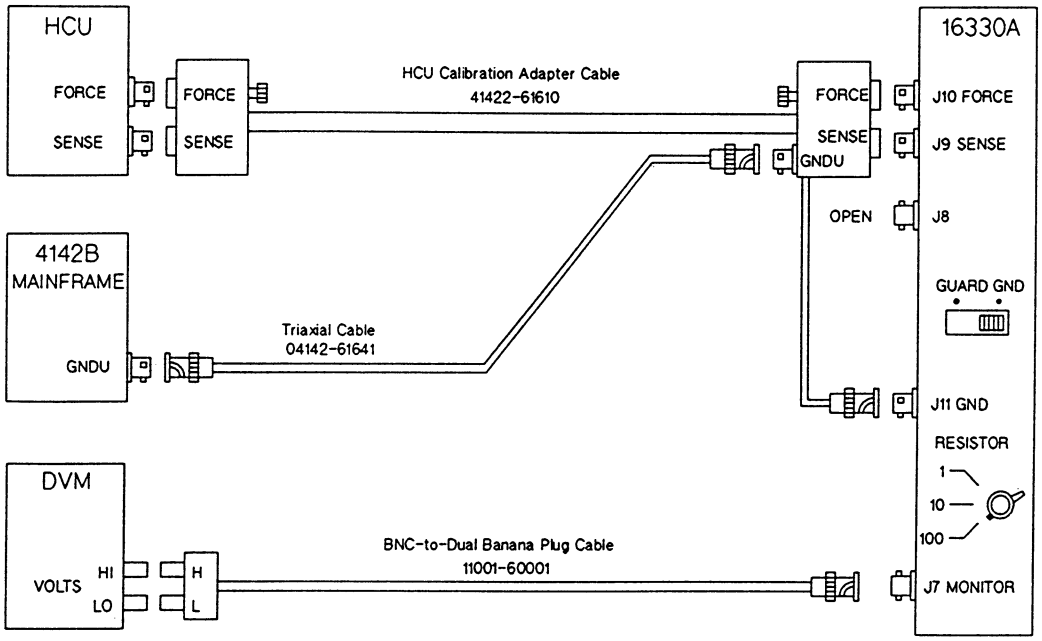
HCU Current Accuracy Test

a. 1 mA Range (I ACC. LOW)



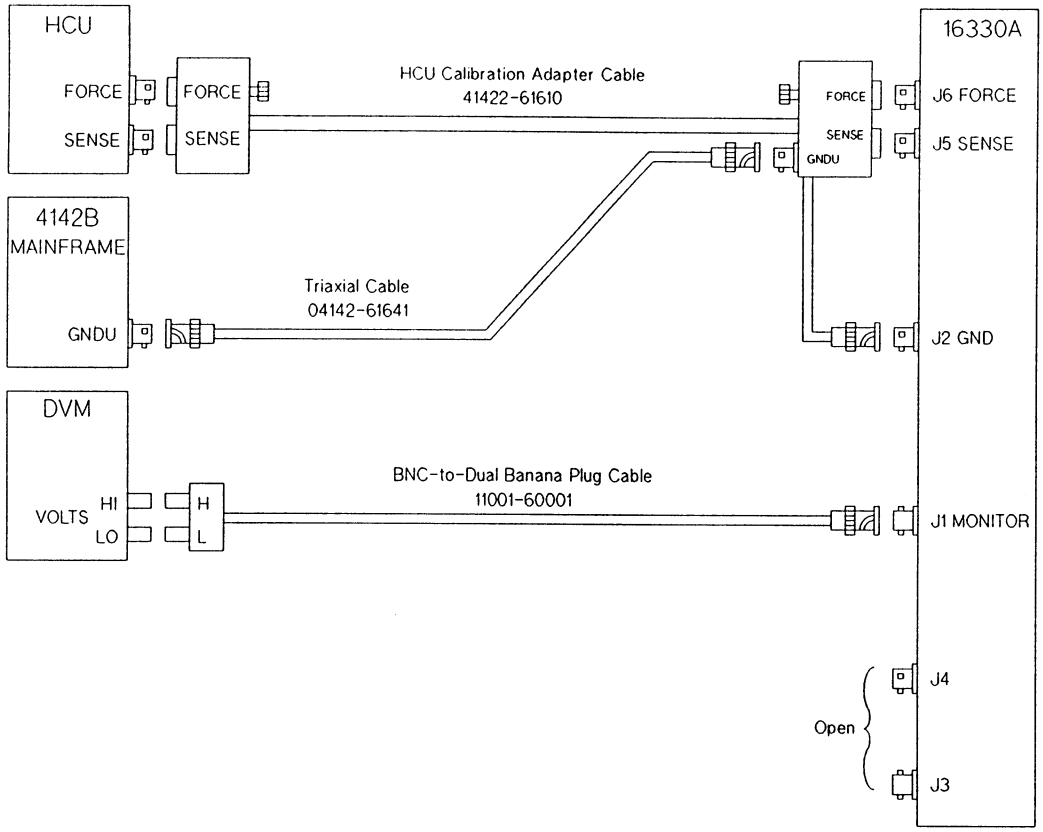
HCU Current Accuracy Test (1 mA Range) Cable Connections

b. 10 mA Range (I ACC. LOW)



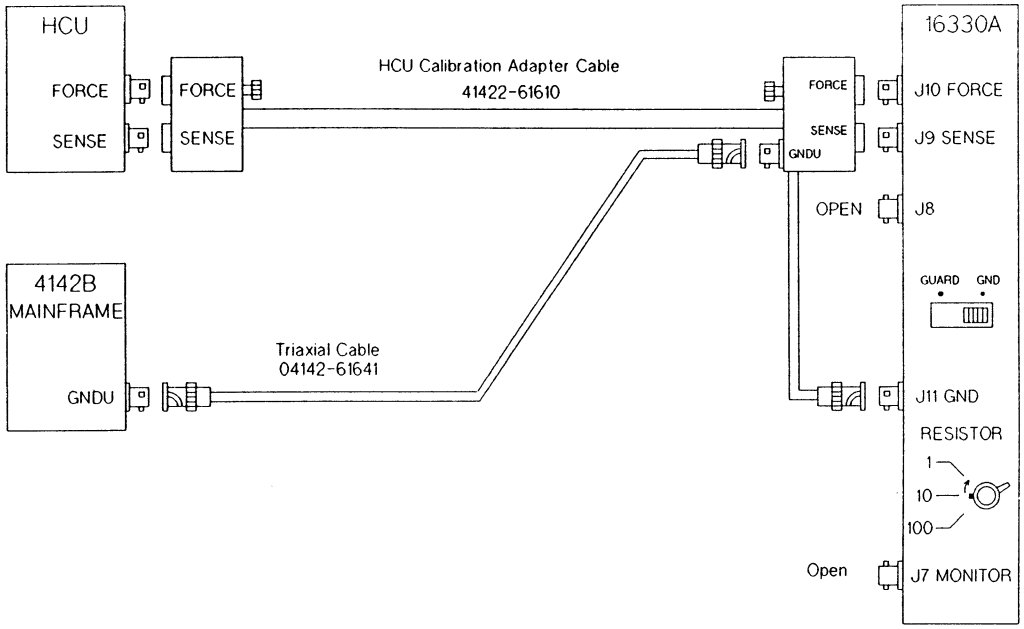
HCU Current Accuracy Test (10 mA Range) Cable Connections

c. Pre-measurement for 100mA/1A/10A Range Test (I ACC. HIGH)



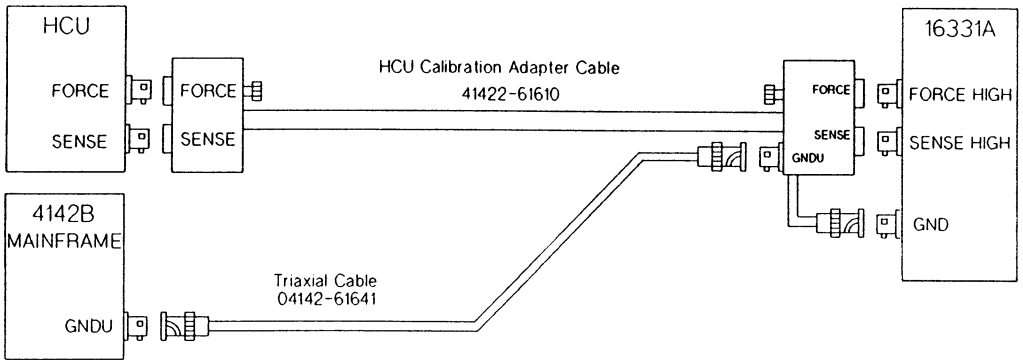
HCU Current Accuracy Test (Pre-measurement for 100 mA to 10 A range Test) Cable Connections

d. 100mA/1A Range (I ACC. HIGH)

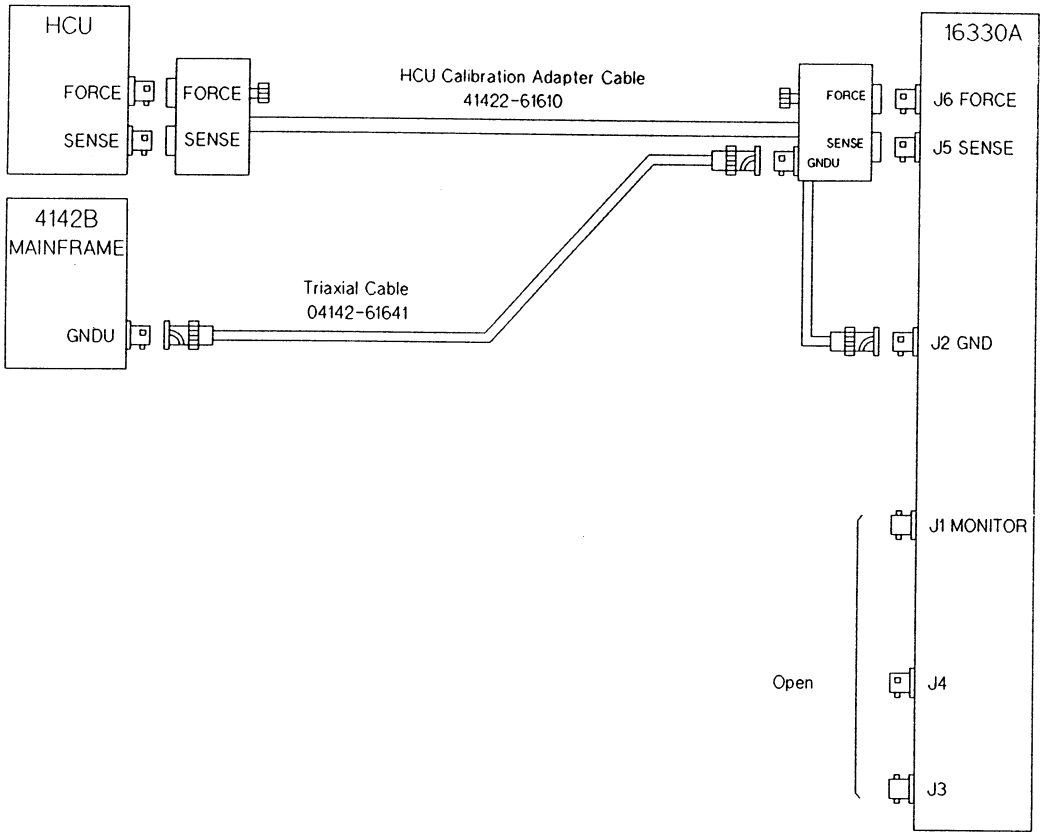


HCU Current Accuracy Test (100mA/1A Range) Cable Connections

e. 10 A Range (I ACC. HIGH)



HCU Current Accuracy Test (10 A Range) Cable Connections

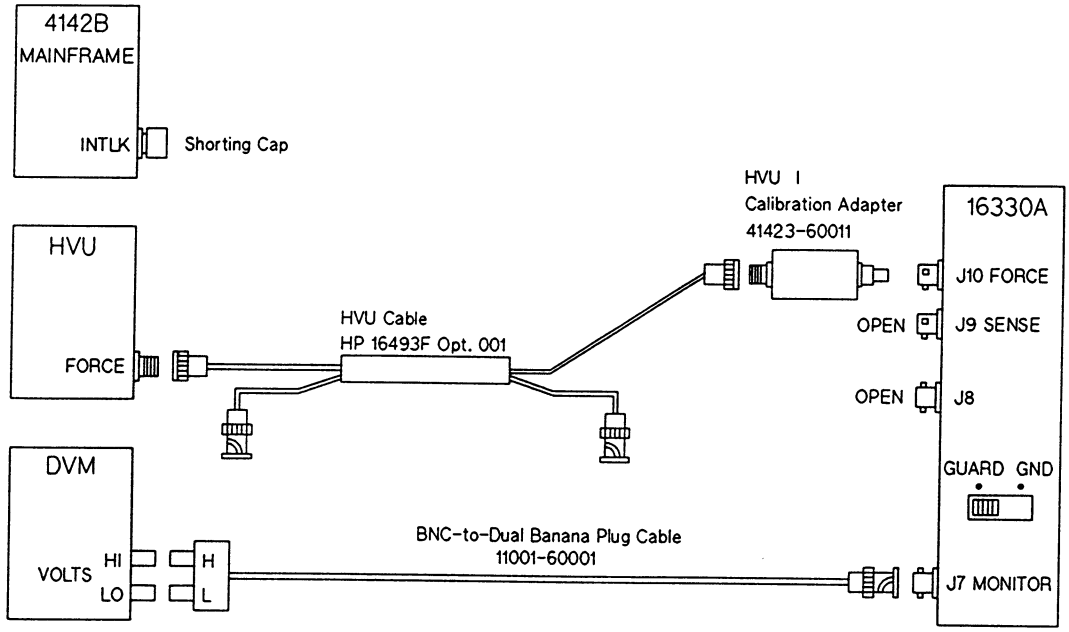


HCU CMR Accuracy Test Cable Connections

HVU Guard Potential Offset Test

WARNING

HVU OUTPUT SWITCH IS SET TO ON IN THIS TEST.

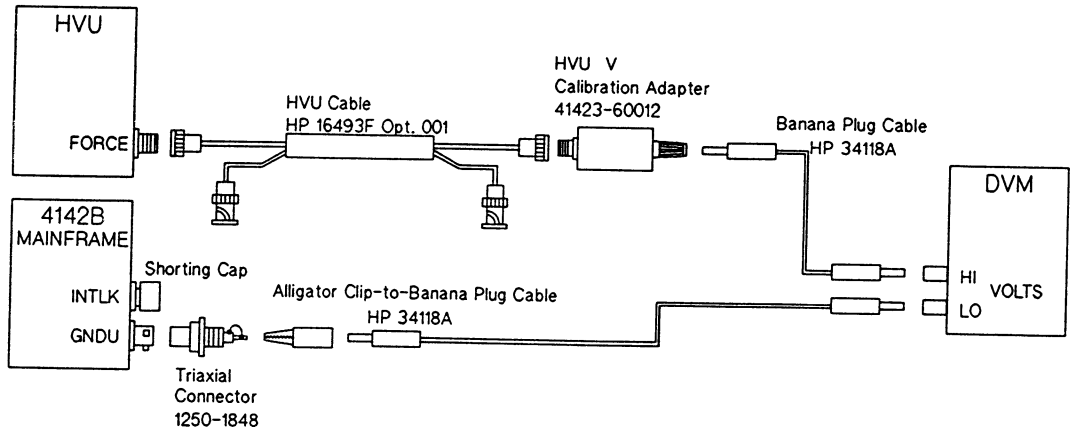


HVU Guard Potential Offset Test Cable Connections

HVU Voltage Accuracy Test

WARNING

900 V IS FORCED IN THIS TEST.



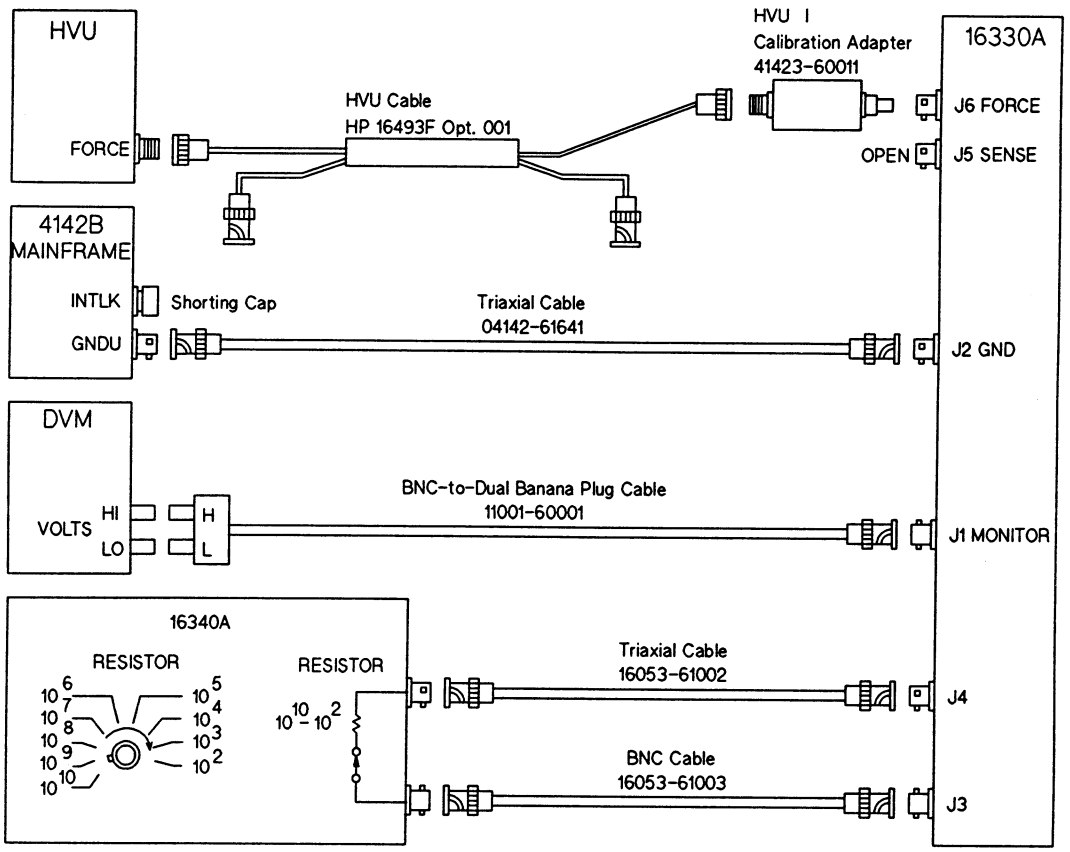
HVU Voltage Accuracy Test Cable Connections

HVU Current Accuracy Test

a. 100 nA to 1 mA Range

WARNING

HVU OUTPUT SWITCH IS SET TO ON IN THIS TEST.

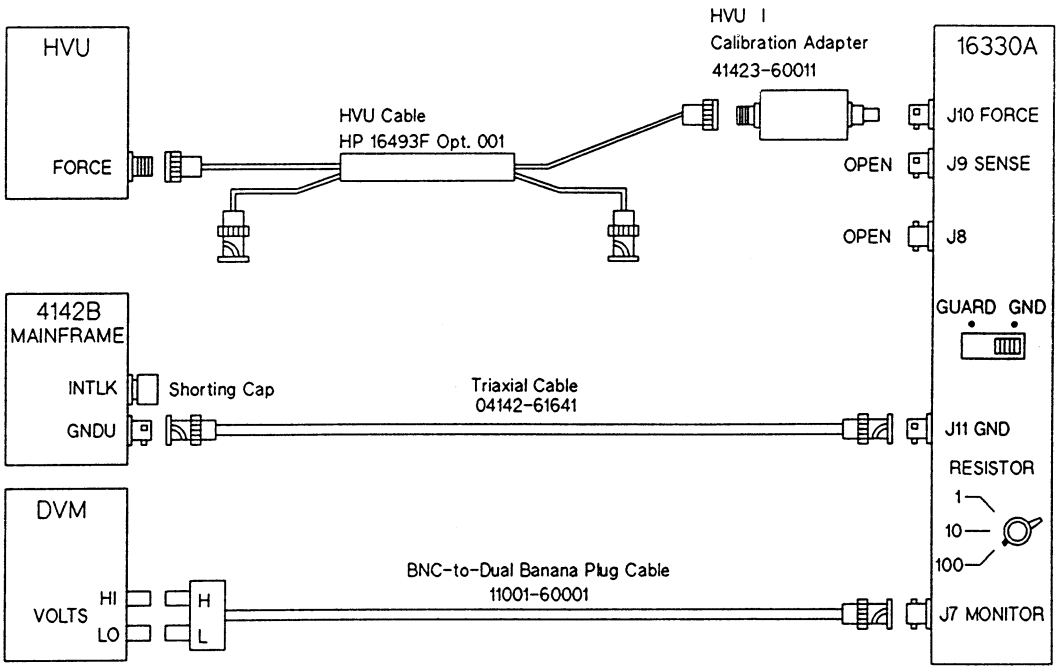


HVU Current Accuracy Test (100 nA to 1 mA Range) Cable Connections

b. 10 mA Range

WARNING

HVU OUTPUT SWITCH IS SET TO ON IN THIS TEST.

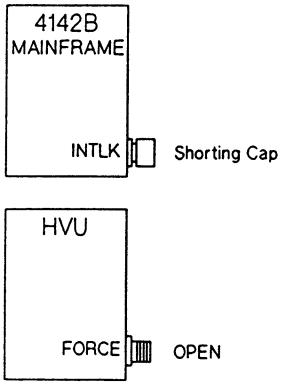


HVU Current Accuracy Test (10 mA Range) Cable Connections

HVU Leakage Current Test (Current Offset Error under High Voltage)

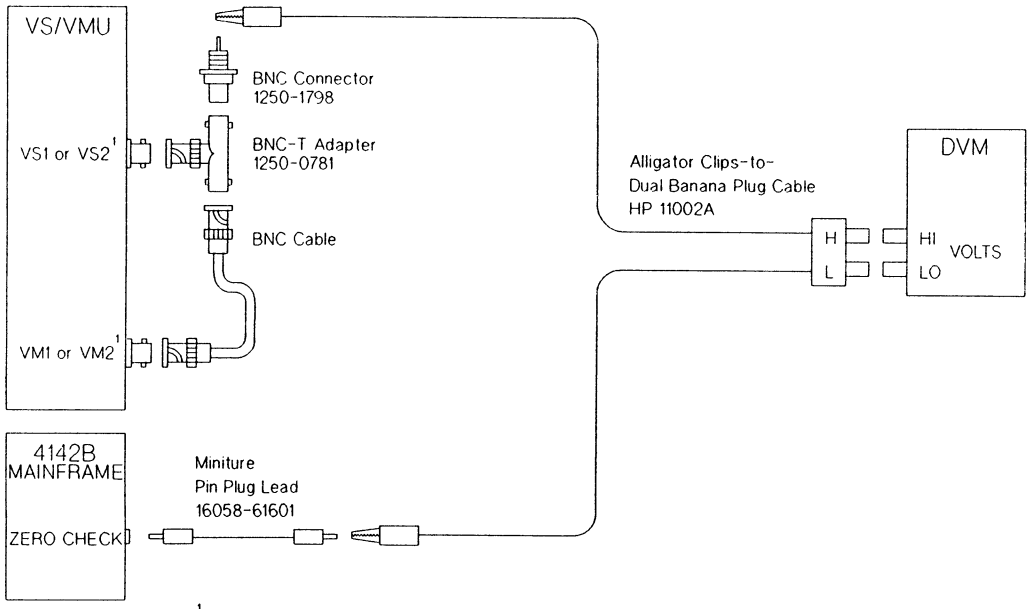
WARNING

1000 V IS FORCED IN THIS TEST.



HVU Leakage Current Test Cable Connections

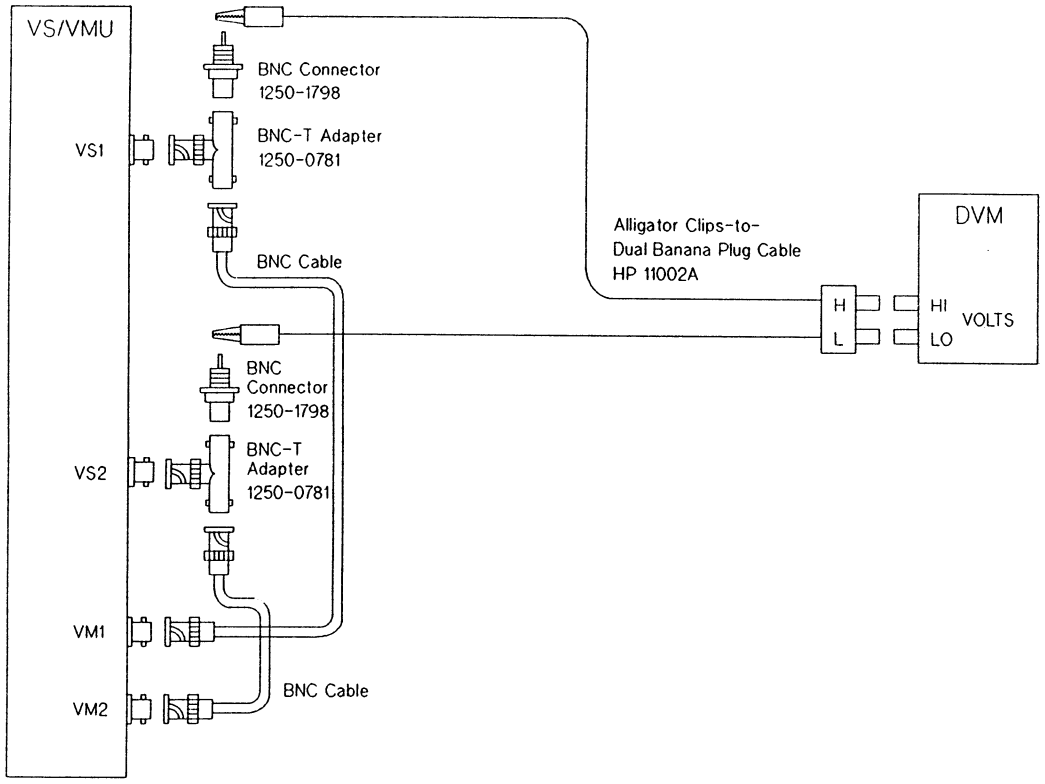
VS/VMU Voltage Accuracy Test



[1] The connection of VS and VM is either VS1 and VM1 or VS2 and VM2.

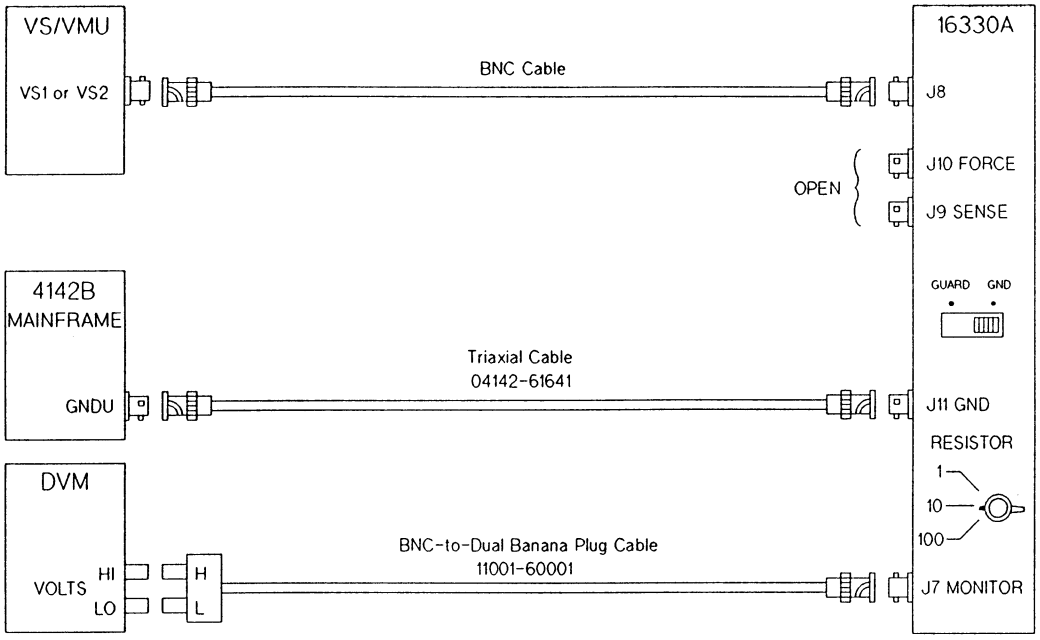
VS/VMU Voltage Accuracy Test Cable Connections

VM Differential Voltage Accuracy Test



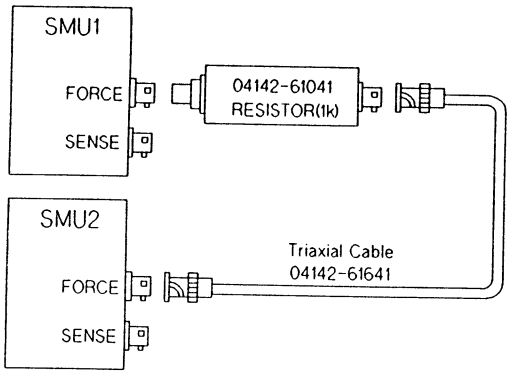
VM Differential Voltage Accuracy Test Cable Connections

VS Current Accuracy Test

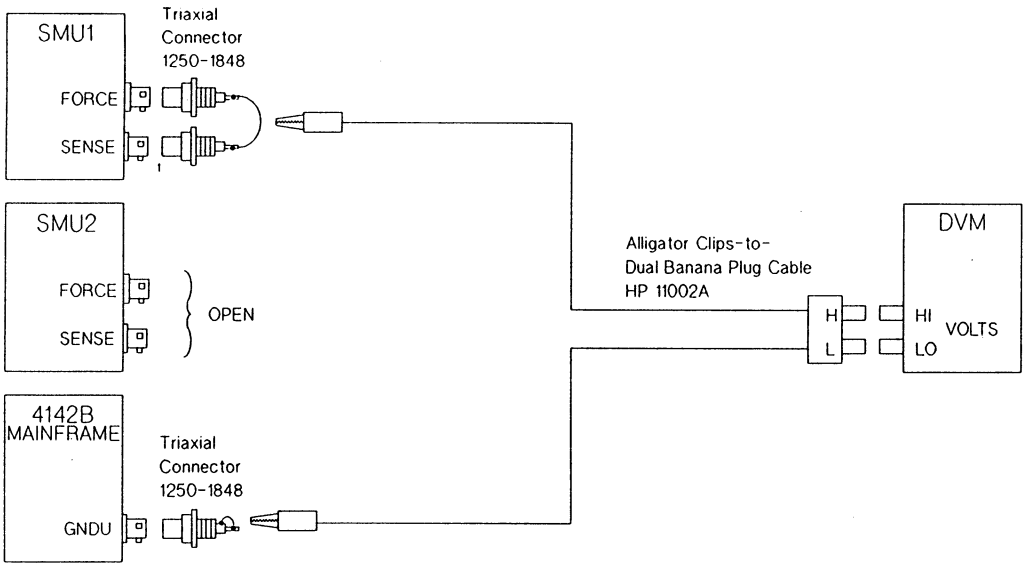


VS Current Accuracy Test Cable Connections

AFU Convergence Accuracy Test



AFU Convergence Accuracy Test Cable Connections



1 This test can be also performed by connecting only FORCE terminal without connecting SENSE terminal.

AFU Setting Accuracy Test Cable Connections

VIEWING TEST RESULTS

The HP 4142B and digital voltmeter are not required to view the test results (Test Record). The test results (Test Record) can be printed by the printer or displayed on the CRT. To view the test results, perform the following steps:

1. Display the MAIN MENU.

2. Select the **'VIEW RESULT'** softkey. The following message is displayed:

   "Insert 'VIEW' into the current mass storage device. Then press Continue."

3. Insert the VIEW disk. Then select the **'CONTINUE'** softkey. The VIEW RESULT MENU shown in the following figure is displayed:

VIEW RESULT MENU SOFTKEYS:

READ FILE(f1)	**MAIN MENU**(f8)

Softkey descriptions:

'READ FILE': Enables test results to be viewed.

'MAIN MENU': Displays the MAIN MENU.

VIEW RESULT MENU SOFTKEYS

NOTE

The VIEW program can be executed independent of the PV4142 program. Instead of steps 1 to 3 above, perform the following:

1. Insert the VIEW disk.
2. LOAD "VIEW"
3. RUN

4. Remove the VIEW disk, then insert the disk that contains the test results. Execute the **CAT** statement to see the catalog of the disk so that you can confirm the filename of test result data.

5. If the disk does not contain the file "UNC_4142", copy the UNC_4142 file from the VIEW disk to the disk. For example, send the following command:

   COPY "UNC_4142:, 700, 1" TO "UNC_4142:,700,0"

   If the UNC_4142 file does not exist on the current mass storage unit when you press the **'CRT'** or **'PRINTER'** softkey later, the measurement uncertainty values are not displayed or printed on the Test Record.

6. Select the **'READ FILE'** softkey. The following message is displayed:

   "Type file name. Press RETURN to cancel."

7. Type the name of the file that you want to view. Then press [**Return**]. The softkeys shown in the following figure are displayed. If you press [**Return**] without typing the file name, the VIEW RESULT MENU is displayed again.

   If you want to view the file from the mass storage unit that is not specified as the current mass storage unit, type the mass storage unit specifier after the file name; such as, RESULTS1:, 700, 1.

Softkeys:

CRT	PRINTER
(f1)	(f2)

Softkey descriptions:

'CRT': Displays the test results on the CRT.
If you select this softkey, the following is displayed:

MORE	EXIT
(f5)	(f8)

'MORE': Displays the next screen of test results on the CRT. If this softkey is selected after all the test results have been displayed, the VIEW RESULT MENU is displayed again.

'EXIT': Displays the VIEW RESULT MENU.

'PRINTER': Enables the test results to be printed to the printer. If you select this softkey, the following is displayed after typing the test record report number:

PRINT	RECONFIG	EXIT
(f1)	(f4)	(f8)

'PRINT': Prints the test results to the printer.

If the PRINTER TYPE is set to FILE SPOOL, the created filename is the same as the test result file you entered, and the file type is ASCII (LIF ASCII).

If you set the printer address to 1 and set the printer I/F to OTHER, this key does not print, but instead displays the test result. Use this setting to confirm the printing format.

'RECONFIG': Enables the printer control settings to be changed.

'EXIT': Displays the VIEW RESULT MENU.

Output Device Selection

NOTE

When you perform step 8, the P.V. software executes the following BASIC statement to use memory volume ":MEMORY,0,15". If you already use that memory volume, move your data to another memory volume or it will be lost when you perform step 8.

INITIALIZE ":MEMORY,0,15"

8. Select the desired softkey (**'CRT'** or **'PRINTER'**).

   - **'CRT'** softkey is selected
     The first screen of test results is displayed on the CRT. Select the **'MORE'** softkey to view the next screen. If all the test results have been displayed, the VIEW RESULT MENU is displayed again.

   - **'PRINTER'** softkey is selected
     a. "Type report number." is displayed. If you want to print the report number on the test record, type the report number within 14 characters, then press [**Return**]. If not, press [**Return**] without typing the report number.

     b. Select **'RECONFIG'** softkey. The VIEW RESULT RECONGIG MENU shown in the following figure is displayed. Change the printer control settings to your desired settings. After you finish changing the settings, select the **'RETURN'** softkey.

     c. Select the **'PRINT'** softkey. The test results are printed as the Test Record. During printing, the **'CANCEL'** softkey is displayed. If you select this key, printing is canceled. When printing is complete, the VIEW RESULT MENU is displayed again.
     A Test Record example is shown in the following second figure.

NOTE

- If a test fails, the following characters are printed or displayed on the "Fail" column of the test record.

  - If the test result is over the maximum value: >>>
  - If the test result is under the minimum value: <<<
  - If the Self-Test fails: ***

- The following tests have no uncertainty data because the measurements of the tests are performed by the HP 4142B itself. These tests are for troubleshooting.

  Self-test, SMU/HCU/VM CMR accuracy test, HVU guard potential offset test, HVU leakage current test, and VS current limit accuracy test.

VIEW RESULT RECONFIG MENU SOFTKEYS:

PRINTER ADDR [1]	PAGE LENGTH	MARGIN	PAGE NUMBER	PRINTER TYPE	SAVE DATA	RETURN
(f1)	(f2)	(f3)	(f4)	(f5)	(f7)	(f8)

[1] Or **SPOOL DIR.**.

Softkey descriptions:

'PRINTER ADDR', 'SPOOL DIR.', 'PRINTER TYPE':
These softkeys are the same as the softkeys in the RECONFIG MENU, which is directly under the START UP MENU.

'PAGE LENGTH': For changing the page length (lines/page) of the printer. The allowable range is 17 for disabled the PAGE NUMBER (19 for enabled the PAGE NUMBER) through 32767.

'MARGIN': For changing the top, bottom, and left margins.

After selecting this softkey, the message "Type new margin (top,bottom,left)." is displayed. Enter the three values, separated by commas. For example, enter: 4,4,2

The top margin, bottom margin, and page length settings must satisfy the following conditions:

top margin $\geq$ 0, bottom margin $\geq$ 0
if page numbering on, then:
top margin + bottom margin < page length - 6
if page numbering off, then:
top margin + bottom margin < page length - 8

'PAGE NUMBER': For enabling and disabling page number and test result file name to be printed on the bottom of each page.

VIEW RESULT RECONFIG MENU SOFTKEYS (1 of 2)

'SAVE DATA': For saving or resaving the setting data of VIEW RESULT RECONFIG MENU into the file VIEW_DATA.

When you select the **'VIEW RESULT'** softkey in the MAIN MENU, if the disk that the VIEW_DATA file is stored (for example: VIEW disk) exists in the current mass storage unit, all settings of VIEW RESULT RECONFIG MENU are read from this file. If the VIEW_DATA file does not exist, the settings are as follows:

PAGE LENGTH: 66 lines/page
MARGIN: Top: 2 line, Bottom: 2 line, Left: 0 space
PAGE NUMBERING: ON
Other settings: the settings of RECONFIG MENU directly under the START UP MENU.

If you use the VIEW_DATA file that is stored on a disk that is not the VIEW disk, go to the MAIN MENU, insert the disk, then select the **'VIEW RESULT'** softkey again.

'RETURN': For returning to the previous menu.

VIEW RESULT RECONFIG MENU SOFTKEYS (2 of 2)

Test Facility:

Hewlett-Packard

Report No. 4142B-8711-101

Date 25 Nov 1987

Customer

Tested by Masayuki NOTO

HP 4142B:

Serial No. 2716J00102

Firmware Revision

Temperature 23 C C

Humidity 45 %R.H.%

Line Frequency Hz(nominal)

Configuration

Slot 1	41421B	(SMU1)	Serial No. 2715J10103
Slot 2			Serial No.
Slot 3	41420A	(SMU2)	Serial No. 2715J10101
Slot 4			Serial No.
Slot 5			Serial No.
Slot 6	41424A	(VS1/2,VM1/2)	Serial No. 2715J10101
Slot 7			Serial No.
Slot 8	41425A	(AFU)	Serial No. 2715J10101

Special Notes:

PV_DATA1 --- 1/ ---

Test Record Example (1 of 17)

Model: HP 4142B Report No.: 4142B-8711-101 Date: 25 Nov 1987

Test Equipment Used:

	Description	Model No.	Trace No.	Cal Due Date
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				

Test Record Example (2 of 17)

Model: HP 4142B Report No.: 4142B-8711-101 Date: 25 Nov 1987

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
Mainframe Test						
Self-Test						
GNDU Accuracy Test		-500.0000uV	-1.3000uV	+500.0000uV	1.0000uV	
SMU Accuracy Test						
Guard Potential Offset Test						
SMU 1		-1.0000mV	+11.5000uV	+1.0000mV	1.0000uV	
SMU 2		-1.0000mV	-26.9000uV	+1.0000mV	1.0000uV	
Voltage Control Accuracy Test						
SMU 1						
2 V	Error	-.05%	+.0090%	+.05%	.000900%	
	Offset	-1.0000mV	+210.0000uV	+1.0000mV	1.0000uV	
20 V	Error	-.05%	+.0045%	+.05%	.001150%	
	Offset	-10.0000mV	+900.0000uV	+10.0000mV	1.0000uV	
40 V	Error	-.05%	+.0055%	+.05%	.001070%	
	Offset	-20.0000mV	+3.6000mV	+20.0000mV	1.0000uV	
100 V	Error	-.05%	+.0021%	+.05%	.001030%	
	Offset	-50.0000mV	+4.0000mV	+50.0000mV	1.0000uV	
SMU 2						
2 V	Error	-.05%	+.0050%	+.05%	.000900%	
	Offset	-1.0000mV	-10.0000uV	+1.0000mV	1.0000uV	
20 V	Error	-.05%	+.0110%	+.05%	.001150%	
	Offset	-10.0000mV	+400.0000uV	+10.0000mV	1.0000uV	
40 V	Error	-.05%	+.0033%	+.05%	.001070%	
	Offset	-20.0000mV	+2.7000mV	+20.0000mV	1.0000uV	
100 V	Error	-.05%	-.0110%	+.05%	.001030%	
	Offset	-50.0000mV	+2.6000mV	+50.0000mV	1.0000uV	
200 V	Error	-.05%	-.0090%	+.05%	.001050%	
	Offset	-100.0000mV	+6.0000mV	+100.0000mV	1.0000uV	
Voltage Measurement Accuracy Test						

PV_DATA1 --- 3/ ---

Test Record Example (3 of 17)

Model: HP 4142B Report No.: 4142B-8711-101 Date: 25 Nov 1987

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
SMU 1						
2 V	Error	-.05%	-.0110%	+.05%	.000900%	
	Offset	-1.0000mV	-50.0000uV	+1.0000mV	1.0000uV	
20 V	Error	-.05%	-.0020%	+.05%	.001150%	
	Offset	-10.0000mV	-100.0000uV	+10.0000mV	1.0000uV	
40 V	Error	-.05%	-.0042%	+.05%	.001070%	
	Offset	-20.0000mV	+400.0000uV	+20.0000mV	1.0000uV	
100 V	Error	-.05%	-.0022%	+.05%	.001030%	
	Offset	-50.0000mV	+0.0000 V	+50.0000mV	1.0000uV	
SMU 2						
2 V	Error	-.05%	-.0050%	+.05%	.000900%	
	Offset	-1.0000mV	+10.0000uV	+1.0000mV	1.0000uV	
20 V	Error	-.05%	-.0050%	+.05%	.001150%	
	Offset	-10.0000mV	+0.0000 V	+10.0000mV	1.0000uV	
40 V	Error	-.05%	-.0052%	+.05%	.001070%	
	Offset	-20.0000mV	+500.0000uV	+20.0000mV	1.0000uV	
100 V	Error	-.05%	-.0030%	+.05%	.001030%	
	Offset	-50.0000mV	-2.6000mV	+50.0000mV	1.0000uV	
200 V	Error	-.05%	-.0040%	+.05%	.001050%	
	Offset	-100.0000mV	-2.0000mV	+100.0000mV	1.0000uV	
Current Control Accuracy Test						
SMU 1						
1E-1 A	Error	-.2%	-.042%	+.2%	.050000%	
	Offset	-100.0000uA	+10.9773uA	+100.0000uA	200.0000nA	
1E-2 A	Error	-.2%	-.003%	+.2%	.050000%	
	Offset	-10.0000uA	-1.0801uA	+10.0000uA	20.0000nA	
1E-3 A	Error	-.2%	-.002%	+.2%	.050000%	
	Offset	-1.0000uA	-139.2360nA	+1.0000uA	2.0000nA	
1E-4 A	Error	-.2%	+.019%	+.2%	.050000%	
	Offset	-100.0000nA	-13.8166nA	+100.0000nA	200.0000pA	
1E-5 A	Error	-.2%	-.009%	+.2%	.050000%	
	Offset	-10.0000nA	-1.3301nA	+10.0000nA	20.0000pA	
1E-6 A	Error	-.5%	-.012%	+.5%	.100000%	
	Offset	-1.0000nA	-115.7010pA	+1.0000nA	2.0000pA	

PV_DATA1 --- 4/ ---

Test Record Example (4 of 17)

Model: HP 4142B Report No.: 4142B-8711-101 Date: 25 Nov 1987

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
1E-7 A	Error	-.5%	-.001%	+.5%	.100000%	
	Offset	-100.0000pA	-11.8433pA	+100.0000pA	200.0000fA	
1E-8 A	Error	-1.0%	+.063%	+1.0%	.100000%	
	Offset	-15.0000pA	-1.2658pA	+15.0000pA	20.0000fA	
1E-9 A	Error	-1.0%	+.217%	+1.0%	.150000%	
	Offset	-6.0000pA	+156.4130fA	+6.0000pA	2.0000fA	
SMU 2						
1E+0 A	Error	-.5%	+.021%	+.5%	.050000%	
	Offset	-1.0000mA	+18.7746uA	+1.0000mA	2.0000uA	
1E-1 A	Error	-.2%	-.040%	+.2%	.050000%	
	Offset	-100.0000uA	-5.0775uA	+100.0000uA	200.0000nA	
1E-2 A	Error	-.2%	-.009%	+.2%	.050000%	
	Offset	-10.0000uA	-512.2680nA	+10.0000uA	20.0000nA	
1E-3 A	Error	-.2%	-.015%	+.2%	.050000%	
	Offset	-1.0000uA	-84.1633nA	+1.0000uA	2.0000nA	
1E-4 A	Error	-.2%	+.020%	+.2%	.050000%	
	Offset	-100.0000nA	-7.4585nA	+100.0000nA	200.0000pA	
1E-5 A	Error	-.2%	-.018%	+.2%	.050000%	
	Offset	-10.0000nA	-802.9450pA	+10.0000nA	20.0000pA	
1E-6 A	Error	-.5%	-.018%	+.5%	.100000%	
	Offset	-1.0000nA	-74.2445pA	+1.0000nA	2.0000pA	
1E-7 A	Error	-.5%	-.025%	+.5%	.100000%	
	Offset	-100.0000pA	-7.3104pA	+100.0000pA	200.0000fA	
1E-8 A	Error	-1.0%	-.214%	+1.0%	.100000%	
	Offset	-15.0000pA	-985.9760fA	+15.0000pA	20.0000fA	
1E-9 A	Error	-1.0%	+.253%	+1.0%	.150000%	
	Offset	-6.0000pA	-64.7803fA	+6.0000pA	2.0000fA	
Current Measurement Accuracy Test						
SMU 1						
1E-1 A	Error	-.2%	+.054%	+.2%	.050000%	
	Offset	-100.0000uA	-2.0940uA	+100.0000uA	200.0000nA	
1E-2 A	Error	-.2%	+.016%	+.2%	.050000%	
	Offset	-10.0000uA	+288.6290nA	+10.0000uA	20.0000nA	

PV_DATA1 --- 5/ ---

Test Record Example (5 of 17)

Model: HP 4142B Report No.: 4142B-8711-101 Date: 25 Nov 1987

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
1E-3 A	Error	-.2%	+.019%	+.2%	.050000%	
	Offset	-1.0000uA	+52.5808nA	+1.0000uA	2.0000nA	
1E-4 A	Error	-.2%	-.013%	+.2%	.050000%	
	Offset	-100.0000nA	+2.4825nA	+100.0000nA	200.0000pA	
1E-5 A	Error	-.2%	+.020%	+.2%	.050000%	
	Offset	-10.0000nA	+685.8220pA	+10.0000nA	20.0000pA	
1E-6 A	Error	-.5%	+.023%	+.5%	.100000%	
	Offset	-1.0000nA	+69.0567pA	+1.0000nA	2.0000pA	
1E-7 A	Error	-.5%	+.013%	+.5%	.100000%	
	Offset	-100.0000pA	+2.9555pA	+100.0000pA	200.0000fA	
1E-8 A	Error	-1.0%	-.054%	+1.0%	.100000%	
	Offset	-15.0000pA	+176.2120fA	+15.0000pA	20.0000fA	
1E-9 A	Error	-1.0%	-.204%	+1.0%	.150000%	
	Offset	-6.0000pA	-116.0590fA	+6.0000pA	2.0000fA	
SMU 2						
1E+0 A	Error	-.5%	-.014%	+.5%	.050000%	
	Offset	-1.0000mA	-56.6700uA	+1.0000mA	2.0000uA	
1E-1 A	Error	-.2%	+.052%	+.2%	.050000%	
	Offset	-100.0000uA	+8.1913uA	+100.0000uA	200.0000nA	
1E-2 A	Error	-.2%	+.018%	+.2%	.050000%	
	Offset	-10.0000uA	-937.6720nA	+10.0000uA	20.0000nA	
1E-3 A	Error	-.2%	+.025%	+.2%	.050000%	
	Offset	-1.0000uA	+41.9651nA	+1.0000uA	2.0000nA	
1E-4 A	Error	-.2%	-.020%	+.2%	.050000%	
	Offset	-100.0000nA	+1.4571nA	+100.0000nA	200.0000pA	
1E-5 A	Error	-.2%	+.022%	+.2%	.050000%	
	Offset	-10.0000nA	+614.8610pA	+10.0000nA	20.0000pA	
1E-6 A	Error	-.5%	+.025%	+.5%	.100000%	
	Offset	-1.0000nA	+40.9296pA	+1.0000nA	2.0000pA	
1E-7 A	Error	-.5%	+.023%	+.5%	.100000%	
	Offset	-100.0000pA	+6.5449pA	+100.0000pA	200.0000fA	
1E-8 A	Error	-1.0%	+.214%	+1.0%	.100000%	
	Offset	-15.0000pA	+640.1550fA	+15.0000pA	20.0000fA	
1E-9 A	Error	-1.0%	-.257%	+1.0%	.150000%	
	Offset	-6.0000pA	+49.0584fA	+6.0000pA	2.0000fA	

PV_DATA1 --- 6/ ---

Test Record Example (6 of 17)

Model: HP 4142B Report No.: 4142B-8711-101 Date: 25 Nov 1987

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
CMR Accuracy Test						
SMU 1		-400.0000nA	+82.0000nA	+400.0000nA		
SMU 2		-400.0000nA	+128.0000nA	+400.0000nA		
VS/VMU Accuracy Test						
Voltage Control Accuracy Test						
VS 1						
20 V	Error	-.1%	+.004%	+.1%	.001500%	
	Offset	-10.0000mV	+900.0000uV	+10.0000mV	1.0000uV	
40 V	Error	-.1%	-.007%	+.1%	.001075%	
	Offset	-20.0000mV	-1.6000mV	+20.0000mV	1.0000uV	
VS 2						
20 V	Error	-.1%	+.008%	+.1%	.001500%	
	Offset	-10.0000mV	+1.9000mV	+10.0000mV	1.0000uV	
40 V	Error	-.1%	+.011%	+.1%	.001075%	
	Offset	-20.0000mV	-1.3000mV	+20.0000mV	1.0000uV	
Voltage Measurement Accuracy Test						
VM 1						
2 V	Error	-.05%	+.0050%	+.05%	.000900%	
	Offset	-1.0000mV	-120.0000uV	+1.0000mV	1.0000uV	
20 V	Error	-.05%	-.0045%	+.05%	.001500%	
	Offset	-10.0000mV	-100.0000uV	+10.0000mV	1.0000uV	
40 V	Error	-.05%	-.0040%	+.05%	.001075%	
	Offset	-20.0000mV	+800.0000uV	+20.0000mV	1.0000uV	
VM 2						
2 V	Error	-.05%	+.0180%	+.05%	.000900%	
	Offset	-1.0000mV	-300.0000uV	+1.0000mV	1.0000uV	
20 V	Error	-.05%	-.0080%	+.05%	.001500%	
	Offset	-10.0000mV	-700.0000uV	+10.0000mV	1.0000uV	
40 V	Error	-.05%	-.0047%	+.05%	.001075%	
	Offset	-20.0000mV	+500.0000uV	+20.0000mV	1.0000uV	

PV_DATA1 --- 7/ ---

Test Record Example (7 of 17)

Model: HP 4142B Report No.: 4142B-8711-101 Date: 25 Nov 1987

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
Differential Voltage Measurement Accuracy Test						
VM 1 /VM 2						
.2 V	Error	-.2%	-.139%	+.2%	.001300%	
	Offset	-400.0000uV	+113.0000uV	+400.0000uV	1.0000uV	
2.0 V	Error	-.1%	-.014%	+.1%	.000900%	
	Offset	-2.0000mV	+20.0000uV	+2.0000mV	1.0000uV	
CMR Accuracy Test						
VM 1 /VM 2						
.2 V		-200.0000uV	-101.8000uV	+200.0000uV		
Current Measurement Accuracy Test						
VS 1						
2E-2 A	Error	-3.0%	-.189%	+3.0%	.050000%	
	Offset	-200.0000uA	-11.9077uA	+200.0000uA	100.0000nA	
1E-1 A	Error	-3.0%	-.024%	+3.0%	.050000%	
	Offset	-1.0000mA	-88.8959uA	+1.0000mA	100.0000nA	
VS 2						
2E-2 A	Error	-3.0%	-.035%	+3.0%	.050000%	
	Offset	-200.0000uA	-3.8053uA	+200.0000uA	100.0000nA	
1E-1 A	Error	-3.0%	-.278%	+3.0%	.050000%	
	Offset	-1.0000mA	-5.0952uA	+1.0000mA	100.0000nA	
Current Limit Accuracy Test						
VS 1						
2E-2 A	-2E-02 A	-24.0000mA	-22.0086mA	-20.0000mA		
	+2E-02 A	+20.0000mA	+22.1615mA	+24.0000mA		
VS 2						
2E-2 A	-2E-02 A	-24.0000mA	-21.8372mA	-20.0000mA		
	+2E-02 A	+20.0000mA	+21.6920mA	+24.0000mA		
AFU Accuracy Test						
Convergence Accuracy Test						

PV_DATA1 --- 8/ ---

Test Record Example (8 of 17)

Model: HP 4142B Report No.: 4142B-8711-101 Date: 25 Nov 1987

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
Start V Stop V	+0 V +20 V	-5.0150mA	-5.0012mA	-4.9850mA	1.0000uA	
Start V Stop V	-10 V +10 V	-10.0000uA	+200.0000nA	+10.0000uA	1.0000uA	
Start V Stop V	+0 V -20 V	+4.9850mA	+5.0004mA	+5.0150mA	1.0000uA	
Setting Accuracy Test						
Start V Stop V Delay Hold	+20 V +0 V 0 5	+19.8000 V	+19.9908 V	+20.2000 V	230.0000uV	
Start V Stop V Delay Hold	+0 V +20 V 0 5	-100.0000mV	-7.9000mV	+100.0000mV	1.0000uV	
Start V Stop V Delay Hold	-20 V +0 V 0 5	-20.2000 V	-20.0216 V	-19.8000 V	230.0000uV	
Start V Stop V Delay Hold	+0 V +20 V 5 0	+19.4000 V	+19.9423 V	+20.6000 V	230.0000uV	
Start V Stop V Delay Hold	-20 V +0 V 5 0	-600.0000mV	-71.9000mV	+600.0000mV	1.0000uV	
Start V Stop V Delay Hold	+0 V -20 V 5 0	-20.6000 V	-19.9224 V	-19.4000 V	230.0000uV	

[END OF REPORT]

Test Facility:

Hewlett-Packard

Report No. 4142B-9111-101

Date 19 Nov 1991

Customer

Tested by Masayuki Noto

HP 4142B:

Serial No. 2839J00652

Temperature 23 C

Firmware Revision

Humidity 45%

Line Frequency Hz(nominal)

Configuration

Slot 1			Serial No.
Slot 2			Serial No.
Slot 3			Serial No.
Slot 4	41422A	(HCU1)	Serial No. 2944J10125
Slot 5			Serial No.
Slot 6			Serial No.
Slot 7			Serial No.
Slot 8	41423A	(HVU1)	Serial No. 3122J00102

Special Notes:

PV_DATA2 --- 1/ ---

Test Record Example (10 of 17)

Model: HP 4142B Report No.: 4142B-9111-101 Date: 19 Nov 1991

Test Equipment Used:

	Description	Model No.	Trace No.	Cal Due Date
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				

PV_DATA2 --- 2/ ---

Test Record Example (11 of 17)

Model: HP 4142B Report No.: 4142B-9111-101 Date: 19 Nov 1991

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
Mainframe Test						
Self-Test						
GNDU Accuracy Test		-500.0000uV	-1.3583uV	+500.0000uV	1.0000uV	
HCU Accuracy Test						
Voltage Control Accuracy Test						
HCU 1						
+2 V	Error	-.50%	-.0182%	+.50%	.000900%	
	Offset	-10.0000mV	-200.7680uV	+10.0000mV	1.0000uV	
-2 V	Error	-.50%	-.0160%	+.50%	.000900%	
	Offset	-10.0000mV	+201.8970uV	+10.0000mV	1.0000uV	
+20 V	Error	-.50%	-.0171%	+.50%	.001150%	
	Offset	-100.0000mV	+960.1610uV	+100.0000mV	1.0000uV	
-20 V	Error	-.50%	-.0134%	+.50%	.001150%	
	Offset	-100.0000mV	+667.3400uV	+100.0000mV	1.0000uV	
Voltage Measurement Accuracy Test						
HCU 1						
+2 V	Error	-.50%	+.0142%	+.50%	.000900%	
	Offset	-10.0000mV	+796.5390nV	+10.0000mV	1.0000uV	
-2 V	Error	-.50%	+.0100%	+.50%	.000900%	
	Offset	-10.0000mV	-41.9176uV	+10.0000mV	1.0000uV	
+20 V	Error	-.50%	+.0171%	+.50%	.001150%	
	Offset	-100.0000mV	-160.3250uV	+100.0000mV	1.0000uV	
-20 V	Error	-.50%	+.0094%	+.50%	.001150%	
	Offset	-100.0000mV	-267.4030uV	+100.0000mV	1.0000uV	
Current Control Accuracy Test (1mA, 10mA ranges)						
HCU 1						
+1E-3 A	Error	-.5%	+.008%	+.5%	.050000%	
	Offset	-2.0000uA	-82.3988nA	+2.0000uA	2.0000nA	
-1E-3 A	Error	-.5%	+.011%	+.5%	.050000%	
	Offset	-2.0000uA	-1.1502nA	+2.0000uA	2.0000nA	

PV_DATA2 --- 3/ ---

Test Record Example (12 of 17)

Model: HP 4142B Report No.: 4142B-9111-101 Date: 19 Nov 1991

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
+1E-2 A	Error	-.5%	-.009%	+.5%	.050000%	
	Offset	-20.0000uA	-770.3630nA	+20.0000uA	20.0000nA	
-1E-2 A	Error	-.5%	-.006%	+.5%	.050000%	
	Offset	-20.0000uA	+80.1063nA	+20.0000uA	20.0000nA	
Current Measurement Accuracy Test (1mA, 10mA ranges)						
HCU 1						
+1E-3 A	Error	-.5%	-.010%	+.5%	.050000%	
	Offset	-2.0000uA	+4.6129nA	+2.0000uA	2.0000nA	
-1E-3 A	Error	-.5%	-.007%	+.5%	.050000%	
	Offset	-2.0000uA	+25.5946nA	+2.0000uA	2.0000nA	
+1E-2 A	Error	-.5%	+.005%	+.5%	.050000%	
	Offset	-20.0000uA	+14.8450nA	+20.0000uA	20.0000nA	
-1E-2 A	Error	-.5%	+.008%	+.5%	.050000%	
	Offset	-20.0000uA	+142.1090nA	+20.0000uA	20.0000nA	
Current Control Accuracy Test (100mA, 1A, 10A ranges)						
HCU 1						
+1E-1 A	Error	-.5%	+.033%	+.5%	.050000%	
	Offset	-200.0000uA	-4.8949uA	+200.0000uA	200.0000nA	
-1E-1 A	Error	-.5%	+.035%	+.5%	.050000%	
	Offset	-200.0000uA	+1.4576uA	+200.0000uA	200.0000nA	
+1E+0 A	Error	-1.0%	-.176%	+1.0%	.050000%	
	Offset	-2.0000mA	-107.7700uA	+2.0000mA	2.0000uA	
-1E+0 A	Error	-1.0%	-.176%	+1.0%	.050000%	
	Offset	-2.0000mA	-31.7060uA	+2.0000mA	2.0000uA	
+1E+1 A	Error	-2.0%	+.004%	+2.0%	.200000%	
	Offset	-20.0000mA	-610.0480uA	+20.0000mA	20.0000uA	
-1E+1 A	Error	-2.0%	-.002%	+2.0%	.200000%	
	Offset	-20.0000mA	-262.9490uA	+20.0000mA	20.0000uA	
Current Measurement Accuracy Test (100mA, 1A, 10A ranges)						
HCU 1						
+1E-1 A	Error	-.5%	-.023%	+.5%	.050000%	
	Offset	-200.0000uA	-3.1328uA	+200.0000uA	200.0000nA	

PV_DATA2 --- 4/ ---

Test Record Example (13 of 17)

Model: HP 4142B Report No.: 4142B-9111-101 Date: 19 Nov 1991

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
-1E-1 A	Error	-.5%	-.029%	+.5%	.050000%	
	Offset	-200.0000uA	+1.2021uA	+200.0000uA	200.0000nA	
+1E+0 A	Error	-1.0%	+.175%	+1.0%	.050000%	
	Offset	-2.0000mA	-98.7455uA	+2.0000mA	2.0000uA	
-1E+0 A	Error	-1.0%	+.169%	+1.0%	.050000%	
	Offset	-2.0000mA	+2.6589uA	+2.0000mA	2.0000uA	
+1E+1 A	Error	-2.0%	+.008%	+2.0%	.200000%	
	Offset	-20.0000mA	-135.7310uA	+20.0000mA	20.0000uA	
-1E+1 A	Error	-2.0%	+.004%	+2.0%	.200000%	
	Offset	-20.0000mA	-142.9890uA	+20.0000mA	20.0000uA	
CMR Accuracy Test						
HCU 1						
+1E-3 A		-.20000%	+.00320%	+.20000%		
-1E-3 A		-.20000%	-.00444%	+.20000%		
+1E-2 A		-.20000%	-.00160%	+.20000%		
-1E-2 A		-.20000%	-.00213%	+.20000%		
+1E-1 A		-.20000%	+.00213%	+.20000%		
-1E-1 A		-.20000%	+.00071%	+.20000%		
+1E+0 A		-.20000%	+.00089%	+.20000%		
-1E+0 A		-.20000%	+.00089%	+.20000%		
+1E+1 A		-.20000%	-.00089%	+.20000%		
-1E+1 A		-.20000%	+.00053%	+.20000%		
HVU Accuracy Test						
Guard Potential Offset Test						
HVU 1		-1.0000mV	-284.3320uV	+1.0000mV		
Voltage Control Accuracy Test						
HVU 1						
+100 V	Error	-.50%	-.0196%	+.50%	.003200%	
	Offset	-500.0000mV	-3.6692mV	+500.0000mV	300.0000uV	

PV_DATA2 --- 5/ ---

Test Record Example (14 of 17)

Model: HP 4142B Report No.: 4142B-9111-101 Date: 19 Nov 1991

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
-100 V	Error	-.50%	-.0227%	+.50%	.003200%	
	Offset	-500.0000mV	+2.6236mV	+500.0000mV	300.0000uV	
+200 V	Error	-.50%	+.0040%	+.50%	.005200%	
	Offset	-1.0000 V	-1.6685mV	+1.0000 V	2.0000mV	
-200 V	Error	-.50%	+.0004%	+.50%	.005200%	
	Offset	-1.0000 V	+4.1177mV	+1.0000 V	2.0000mV	
+500 V	Error	-.50%	-.0017%	+.50%	.008200%	
	Offset	-2.5000 V	-31.2834mV	+2.5000 V	2.0000mV	
-500 V	Error	-.50%	-.0043%	+.50%	.008200%	
	Offset	-2.5000 V	+12.0009mV	+2.5000 V	2.0000mV	
+1000 V	Error	-.50%	+.0164%	+.50%	.019000%	
	Offset	-5.0000 V	-59.9679mV	+5.0000 V	2.0000mV	
-1000 V	Error	-.50%	+.0049%	+.50%	.019000%	
	Offset	-5.0000 V	+22.1675mV	+5.0000 V	2.0000mV	
Voltage Measurement Accuracy Test						
HVU 1						
+100 V	Error	-.50%	+.0076%	+.50%	.003200%	
	Offset	-500.0000mV	+1.6692mV	+500.0000mV	300.0000uV	
-100 V	Error	-.50%	+.0147%	+.50%	.003200%	
	Offset	-500.0000mV	-623.5860uV	+500.0000mV	300.0000uV	
+200 V	Error	-.50%	-.0020%	+.50%	.005200%	
	Offset	-1.0000 V	+1.6685mV	+1.0000 V	2.0000mV	
-200 V	Error	-.50%	+.0056%	+.50%	.005200%	
	Offset	-1.0000 V	-117.7000uV	+1.0000 V	2.0000mV	
+500 V	Error	-.50%	-.0023%	+.50%	.008200%	
	Offset	-2.5000 V	+1.2834mV	+2.5000 V	2.0000mV	
-500 V	Error	-.50%	+.0063%	+.50%	.008200%	
	Offset	-2.5000 V	-2.0009mV	+2.5000 V	2.0000mV	
+1000 V	Error	-.50%	-.0208%	+.50%	.019000%	
	Offset	-5.0000 V	-32.1386uV	+5.0000 V	2.0000mV	
-1000 V	Error	-.50%	-.0071%	+.50%	.019000%	
	Offset	-5.0000 V	-2.1675mV	+5.0000 V	2.0000mV	
Current Control Accuracy Test						
HVU 1						

PV_DATA2 --- 6/ ---

Test Record Example (15 of 17)

Model: HP 4142B Report No.: 4142B-9111-101 Date: 19 Nov 1991

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
+1E-7 A	Error	-1.0%	+.163%	+1.0%	.123800%	
	Offset	-1.0000nA	+35.5521pA	+1.0000nA	101.0000pA	
-1E-7 A	Error	-1.0%	+.162%	+1.0%	.123800%	
	Offset	-1.0000nA	+42.3463pA	+1.0000nA	101.0000pA	
+1E-6 A	Error	-1.0%	+.145%	+1.0%	.063800%	
	Offset	-10.0000nA	+357.7120pA	+10.0000nA	1.0100nA	
-1E-6 A	Error	-1.0%	+.144%	+1.0%	.063800%	
	Offset	-10.0000nA	+501.8170pA	+10.0000nA	1.0100nA	
+1E-5 A	Error	-1.0%	-.040%	+1.0%	.064400%	
	Offset	-100.0000nA	-818.8940pA	+100.0000nA	10.1000nA	
-1E-5 A	Error	-1.0%	-.040%	+1.0%	.064400%	
	Offset	-100.0000nA	+8.0498nA	+100.0000nA	10.1000nA	
+1E-4 A	Error	-1.0%	-.012%	+1.0%	.069800%	
	Offset	-1.0000uA	+33.2720nA	+1.0000uA	101.0000nA	
-1E-4 A	Error	-1.0%	-.012%	+1.0%	.069800%	
	Offset	-1.0000uA	+72.7377nA	+1.0000uA	101.0000nA	
+1E-3 A	Error	-1.0%	+.156%	+1.0%	.125800%	
	Offset	-10.0000uA	+302.2410nA	+10.0000uA	1.0100uA	
-1E-3 A	Error	-1.0%	+.153%	+1.0%	.125800%	
	Offset	-10.0000uA	+400.2700nA	+10.0000uA	1.0100uA	
+1E-2 A	Error	-1.0%	+.001%	+1.0%	.055800%	
	Offset	-100.0000uA	-3.0309uA	+100.0000uA	100.0000nA	
-1E-2 A	Error	-1.0%	-0.000%	+1.0%	.055800%	
	Offset	-100.0000uA	+4.1196uA	+100.0000uA	100.0000nA	
Current Measurement Accuracy Test						
HVU 1						
+1E-7 A	Error	-1.0%	-.154%	+1.0%	.123800%	
	Offset	-1.0000nA	-45.8159pA	+1.0000nA	101.0000pA	
-1E-7 A	Error	-1.0%	-.142%	+1.0%	.123800%	
	Offset	-1.0000nA	-48.5533pA	+1.0000nA	101.0000pA	
+1E-6 A	Error	-1.0%	-.134%	+1.0%	.063800%	
	Offset	-10.0000nA	-598.6170pA	+10.0000nA	1.0100nA	
-1E-6 A	Error	-1.0%	-.122%	+1.0%	.063800%	
	Offset	-10.0000nA	-446.5020pA	+10.0000nA	1.0100nA	

PV_DATA2 --- 7/ ---

Test Record Example (16 of 17)

Model: HP 4142B Report No.: 4142B-9111-101 Date: 19 Nov 1991

TEST DESCRIPTION		Minimum	Results	Maximum	Uncertainty	Fail
+1E-5 A	Error	-1.0%	+.051%	+1.0%	.064400%	
	Offset	-100.0000nA	-4.2985nA	+100.0000nA	10.1000nA	
-1E-5 A	Error	-1.0%	+.054%	+1.0%	.064400%	
	Offset	-100.0000nA	-4.7179nA	+100.0000nA	10.1000nA	
+1E-4 A	Error	-1.0%	+.030%	+1.0%	.069800%	
	Offset	-1.0000uA	-43.5039nA	+1.0000uA	101.0000nA	
-1E-4 A	Error	-1.0%	+.030%	+1.0%	.069800%	
	Offset	-1.0000uA	-30.5744nA	+1.0000uA	101.0000nA	
+1E-3 A	Error	-1.0%	-.151%	+1.0%	.125800%	
	Offset	-10.0000uA	-495.3950nA	+10.0000uA	1.0100uA	
-1E-3 A	Error	-1.0%	-.113%	+1.0%	.125800%	
	Offset	-10.0000uA	-305.5820nA	+10.0000uA	1.0100uA	
+1E-2 A	Error	-1.0%	+.004%	+1.0%	.055800%	
	Offset	-100.0000uA	-595.7870nA	+100.0000uA	100.0000nA	
-1E-2 A	Error	-1.0%	+.025%	+1.0%	.055800%	
	Offset	-100.0000uA	-672.2720nA	+100.0000uA	100.0000nA	
Leakage Current Test						
HVU 1						
+1000 V		-1.0000nA	-12.0000pA	+1.0000nA		
-1000 V		-1.0000nA	-28.0000pA	+1.0000nA		

[END OF REPORT]

PV_DATA2 --- 8/ ---

Test Record Example (17 of 17)

FACTORY SETTINGS OF THE P.V. SOFTWARE

The following lists the factory settings of the HP 4142B performance verification software.

- HP 4142B HP-IB Address : 723
- Digital Voltmeter HP-IB Address : 710
- Printer Type : LOCAL
- Printer Interface : HP-IB
- Printer Address : 701
- Spool Directory : /spool:REMOTE
- Baud Rate of RS-232C I/F : 9600 baud
- Page Length : 66 lines/page
- Margin : Top: 2 line, Bottom: 2 line, Left: 0 space
- Page Numbering : ON
- Standard Resistor values : Nominal values

PERFORMING SAFETY TESTS FOR THE HVU

If the HP 41423A HVU is installed in the HP 4142B, perform the following circuit operation tests of **INTLK** terminal and **OUTPUT ON/OFF STATUS** terminals for safety.

Required Equipment

- BNC shorting cap or HP 16088B Test Fixture
- Warning indicator (part Number 16087-60013/-60014/-60015), HP 16088B Test Fixture, or Computer and Voltmeter

Procedure

WARNING

SHORTING THE INTLK TERMINAL ENABLES SMU/HVU OUTPUT TO EXCEED ±42V. DANGEROUS VOLTAGES MAY BE PRESENT AT SMU/HVU FORCE, SENSE, AND GUARD TERMINALS WHEN THE INTLK TERMINAL IS SHORTED.

IF BOTH OR EITHER OF THE TESTS DO NOT PASS, DO NOT USE THE HVU. REMOVE THE HVU FROM YOUR HP 4142B.

PERFORM THE INTLK CIRCUIT AND THE OUTPUT ON/OFF STATUS CIRCUIT TESTS AT LEAST ONCE A DAY BEFORE USING THE HP 4142B.

- INTLK Circuit Test:

1. Open the shielding box access door (open the **INTLK** terminal).
2. Press the **LOCAL/SELF TEST** key to perform the Self-Test.
3. Confirm that **U** is displayed in the **ERROR/FAILURE** display after the Self-Test finishes.
4. Close the shielding box access door (short the **INTLK** terminal).
5. Press the **LOCAL/SELF TEST** key to perform the Self-Test.
6. Confirm that **0** is displayed in the **ERROR/FAILURE** display after the Self-Test finishes.

If step 3 or step 6 does not pass, something is wrong with the HP 4142B.

- OUTPUT ON/OFF STATUS Circuit Test:

If you have the warning indicator:

1. Connect the warning indicator to the HVU **OUTPUT ON/OFF STATUS** terminal.
2. Press the **LOCAL/SELF TEST** key to perform the Self-Test.
3. During Self-Test, confirm that the warning indicator connected to the **OUTPUT ON/OFF STATUS** terminal is lit for about 5 seconds for each HVU installed.
4. Confirm that the warning indicator is not lit after the Self-Test finishes.

If step 3 or step 4 does not pass, something is wrong with the HP 4142B.

If you do not have the warning indicator:

1. Using the HP-IB cable, connect the computer and the HP 4142B. Connect the voltmeter to the HVU **OUTPUT ON/OFF STATUS** Terminal.
2. Send the following command to set the HVU output switch to on.
   OUTPUT 717;"CN";*hvu_slot#*
   The *hvu_slot#* is *8*, if the HVU is installed in slot#7 and slot#8.
3. Measure the voltage of the HVU **OUTPUT ON/OFF STATUS** terminal. Confirm that the voltage is within from 4.5 V to 5.25 V. If not, something is wrong with the HP 4142B.
4. Send the following command to reset the HP 4142B.
   CLEAR 717

CHAPTER 3
ADJUSTMENTS

CONTENTS

INTRODUCTION

This chapter provides the HP 4142B adjustment procedures using the HP 4142B Performance Verification Software.
For the required equipment, refer to chapter 1.

Safety Considerations

The HP 4142B complies with international safety standards. The information in this section, including all warnings, cautions, and notes, must be observed to ensure the safety of service personnel and to prevent damage to the instrument. Only qualified service personnel should perform the adjustments described in this chapter.

WARNING

ADJUSTMENTS DESCRIBED IN THIS CHAPTER ARE PERFORMED WITH POWER APPLIED TO THE INSTRUMENT AND WITH PROTECTIVE COVERS REMOVED. DANGEROUS VOLTAGES UP TO ±1000 V MAY BE PRESENT ON THE BOARDS. DO NOT TOUCH THE BOARDS: CONTACT WITH HIGH VOLTAGE CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

PREPARATION

Before adjusting a module, perform the following steps:

1. Turn the HP 4142B off, and remove the modules that will not be adjusted (for example VS/VMUs and AFU) for ease of removing and installing modules and the Extender Module.

2. Perform steps 1 to 6 in the paragraph "Preparation," chapter 2. Note the following:

   - The SMU output terminal connectors and printer are not used for adjustments.
   - Only for the HVU, you can perform the adjustment without warm-up.

ADJUSTING

To execute the adjustment, perform the following steps:

1. Perform step 1 to 6 in paragraph "Starting the P.V. Software", chapter 2. Note that the printer and standard resistors are not used for adjustments.

2. Select the **'ADJUST'** softkey. The following ADJUSTMENT MENU is displayed:

NOTE

Selecting the **'ADJUST'** softkey initializes the HP 4142B and the digital voltmeter. If the HP-IB addresses are not set correctly, one of the following messages is displayed and the "PV4142" program terminates.

"DVM is not connected or bad address is specified."

"HP 4142B is not connected or bad address is specified."

If another device is connected to the same address as one of these devices, the error may not be detected and the P.V. software may hang up. In this case, stop the P.V. software by pressing [**Break**], and check the device addresses. Then run the "PV4142" program again.

ADJUSTMENT MENU SOFTKEYS:

ADJUST ALL	ADJUST ADC	ADJUST GNDU	ADJUST SMUs	ADJUST HCUs	ADJUST HVUs	MAIN MENU
(f1)	(f2)	(f3)	(f4)	(f5)	(f6)	(f8)

Softkey descriptions:

ADJUST ALL Starts sequential adjustments of ADC, GNDU, and the installed plug-in modules. All adjustments are performed in the following order:

1. ADC Adjustment
   a. ADC 10 V Reference Adjustment
   b. ADC CAL Bus Gain Adjustment
2. GNDU Adjustment
   a. GNDU Voltage Buffer Idle Current Adjustment
   b. GNDU Output Voltage Adjustment
3. SMU Adjustment
   a. SMU Power Amp Bias Current Adjustment
   b. SMU CMR Adjustment
4. HCU Adjustment
   a. HCU Idle Current Adjustment
5. HVU Adjustment
   a. HVU Bias Current Adjustment

ADJUST ADC, ADJUST GNDU, ADJUST SMUs, ADJUST HCUs, ADJUST HVUs
Use these softkeys to selectively adjust the conrresponding unit. If the corresponding module is not installed in your HP 4142B, the associated softkeys is not displayed.

MAIN MENU Displays the **MAIN MENU**.

ADJUSTMENT MENU SOFTKEYS

3. Select the desired softkey, then select the **'START'** softkey.

4. If you select **'ADJUST SMUs'**, **'ADJUST HCUs'**, or **'ADJUST HVUs'**, select softkey that designates the unit that you need to adjust.

5. Perform the following:

   a. Turn the HP 4142B off.

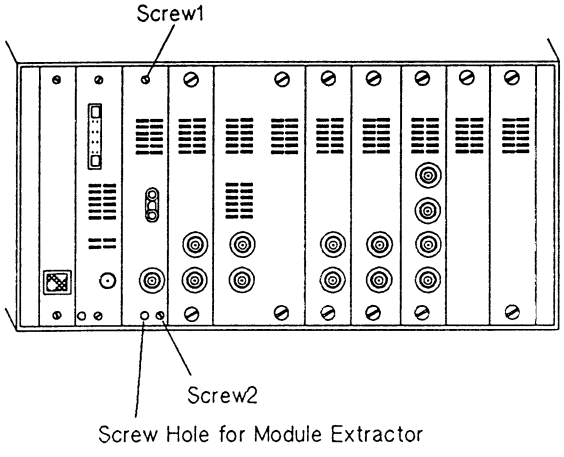
   b. Remove the specified unit from the HP 4142B.

CAUTION

To prevent damage to modules, be sure to turn your HP 4142B off and wait for at least 10 seconds before you install or remove modules.

To extract the GNDU/ADC module, use the Module Extractor and perform as follows:

1. Remove screws 1 and 2 from the GNDU/ADC module. Refer to the following figure.
2. Screw the Module Extractor into the screw hole for the Module Extractor.
3. Holding the Module Extractor, gently pull the GNDU/ADC module free from its mainframe connector, and remove the module.



How To Extract the GNDU/ADC Module

c. Remove its shield cover.

For the HP 41420A SMU, HP 41422A HCU, and HP 41423A HVU, remove the following side shield covers:

HP 41420A: To the right side of the front panel
HP 41422A: To the left side of the front panel
HP 41423A: To the left side of the front panel

WARNING

HAZARDOUS VOLTAGES ARE EXPOSED WHEN THE SHIELD COVER IS REMOVED. VOLTAGES UP TO ±1000 V MAY BE PRESENT ON THE BOARD AND ARE CAPABLE OF CAUSING SERIOUS INJURY OR DEATH. TO GUARD AGAINST ELECTRICAL SHOCK, USE INSULATED TOOLS FOR ALL ADJUSTMENTS.

DO NOT TOUCH THE BOARD UNTIL THE HP 4142B HAS BEEN TURNED OFF FOR AT LEAST 10 SECONDS.

d. If the adjusted module is the HVU, connect jumper W202 on the board to the lower two pins on J202. For location of the jumper W202, refer to paragraph "Setup for Each Adjustment."

CAUTION

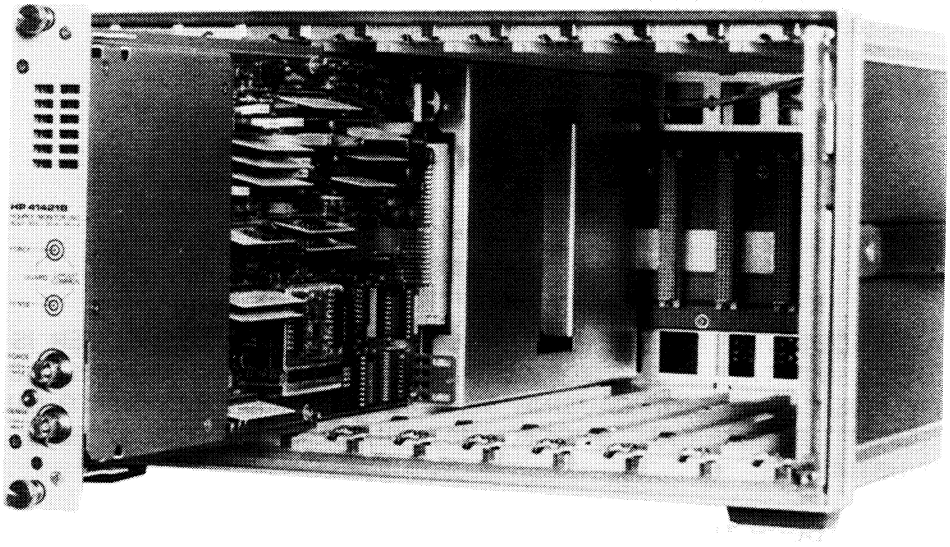
If you remove the HVU shield cover and turn the HP 4142B on to perform the adjustment, turn the HP 4142B off within 10 minutes and keep the HP 4142B off for 5 minutes to prevent damage to the HVU.

e. Install the Extender Module in the slot of the specified unit, and install the specified unit on the Extender Module as shown in the following figure.

NOTE

After you select the **'ADJUST'** softkey on the **MAIN MENU**, the software checks the number and type of installed module.
Therefore, when you remove and reinstall SMUs, HCUs, or HVUs after you select the **'ADJUST'** softkey, make sure you do *not* change SMU, HCU, or HVU order. You can reinstall SMUs, HCUs, or HVUs in any slot as long as you do not change their order.

To make it easier to remove/install/adjust units, try to arrange the units so the slot to the right of the each unit is empty.



Module Installed on the Extender Module

f. Turn the HP 4142B on.

g. Press **'CONTINUE'** softkey.

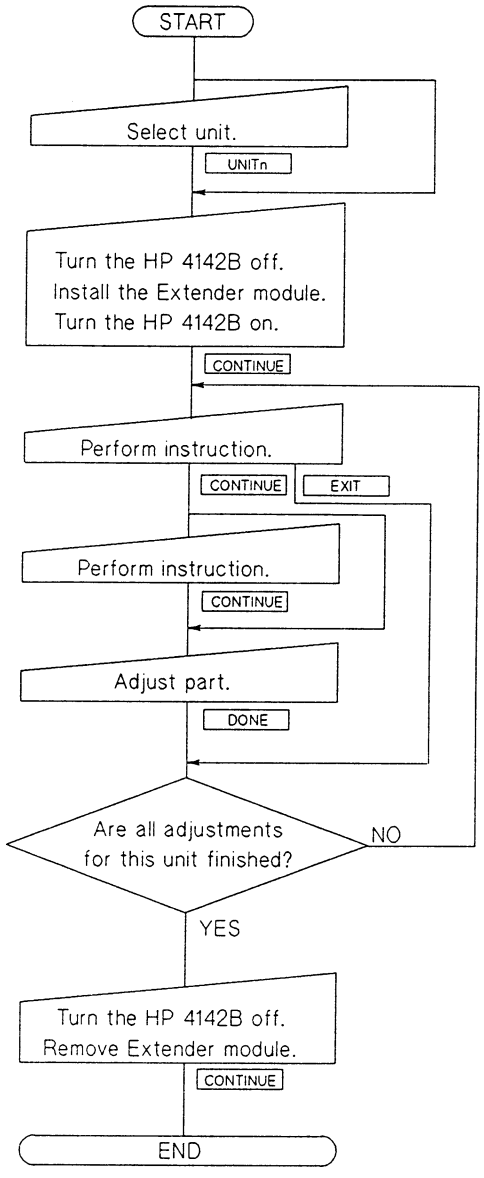
6. Perform adjustments in accordance with the displayed messages. Refer to paragraph "Setup for Each Adjustment" for details about cable connections and adjustment points.

   The following figure shows the general flow for each adjustment.

NOTE

While adjusting a part, the measurement is performed continuously and the result is displayed as TEST RESULTS. The calculated result is not displayed immediately because of the time required for the measurements to be made. The measurement stops when you select the **'DONE'** softkey.

If "--------V" or "--------A" is displayed as TEST RESULTS, check the test cable connections and the settings (**GUARD** and **TERMINALS** switches) of the digital voltmeter. If the connections or switch settings are incorrect, stop the adjustment and make corrections, then start again from the first step of the adjustment program.



General Adjustment Flow Chart

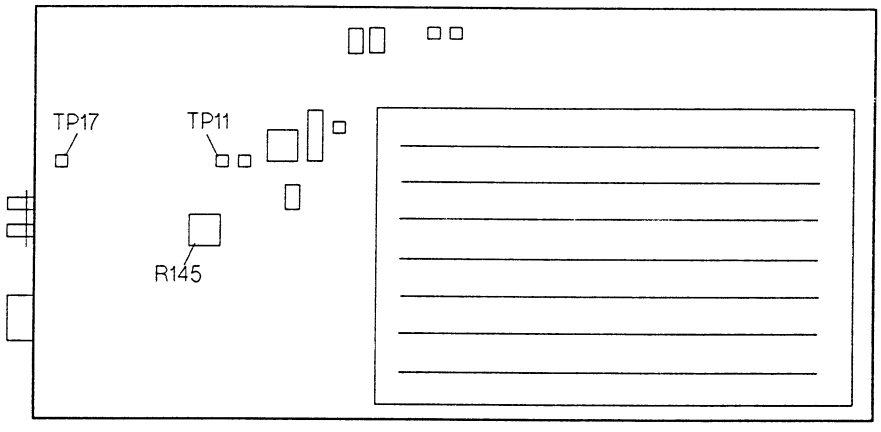
SETUP FOR EACH ADJUSTMENT

The cable connections and adjustment point for each adjustment are as follows.

ADC 10 V Reference Adjustment

WARNING

250 V IS PRESENT ON THIS BOARD.



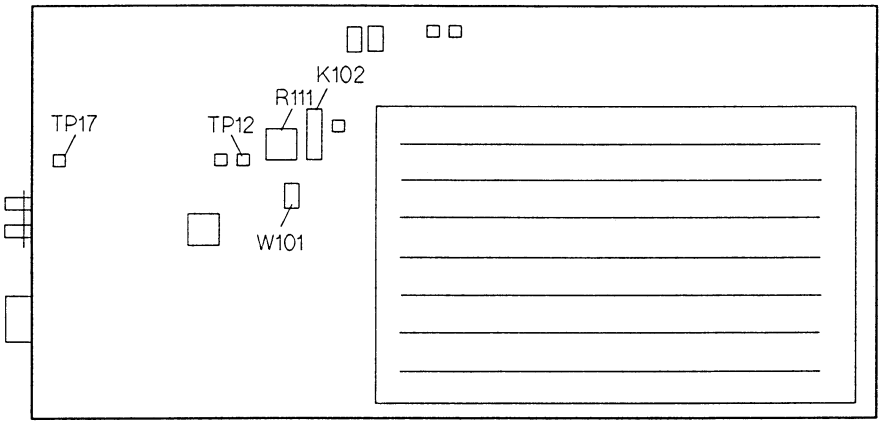
Procedure:

1. Connect DVM HI to TP11, and connect DVM LO to TP17 using the alligator clips-to-dual banana plug cable.
2. Adjust R145 until TEST RESULTS is within TEST LIMITS (10.0000 ± 0.0001 V).

ADC 10 V Reference Adjustment

WARNING

250 V IS PRESENT ON THIS BOARD.



Procedure:

1. Connect DVM HI to TP12, and connect DVM LO to TP17 using the alligator clips-to-dual banana plug cable.
   (After this, the DVM measures the voltage Va, which is the voltage when W101 is set to pins 1 and 2, and the internal relay K102 is OFF.)

2. Change jumper W101 to pins 2 and 3 (Test State).
   (After this, the DVM measures the voltage Vb, which is the voltage when W101 is set to pins 2 and 3, and K102 is OFF.)

3. Adjust R111 until TEST RESULTS is within the following TEST LIMITS:

   TEST LIMITS = Vc ± 0.00008 V, Vc = Vm1 + 0.2(Vb - Va)

   (TEST RESULTS is the voltage when W101 is set to pins 2 and 3, and K102 is ON.)

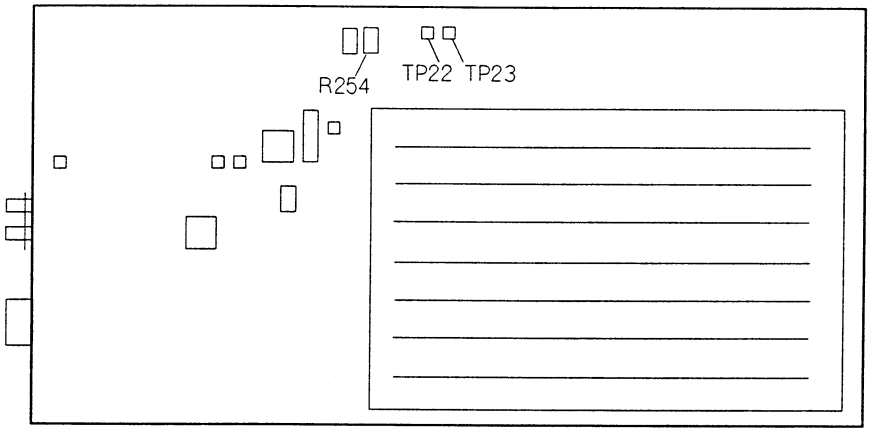
4. Set jumper W101 to pins 1 and 2 (Normal State), or the HP 4142B will not work properly.

NOTE

Do *not* abort the adjustment program while the "**Adjust R111 until DVM readout is within limits. Press DONE**" instruction is displayed. If you do, the internal relay (K102) will not be set correctly. For normal operation, the relay (K102) is set to OFF. The relay is set to ON while this instruction is displayed and set to OFF after you select **'DONE'**.

WARNING

250 V IS PRESENT ON THIS BOARD.



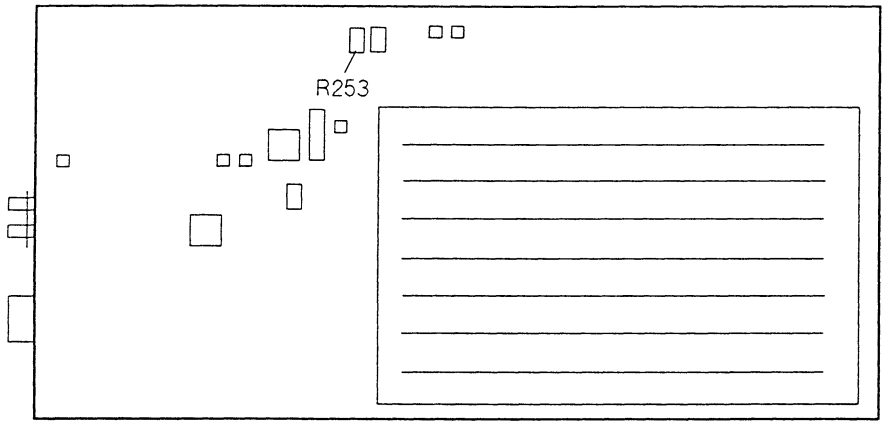
Procedure:

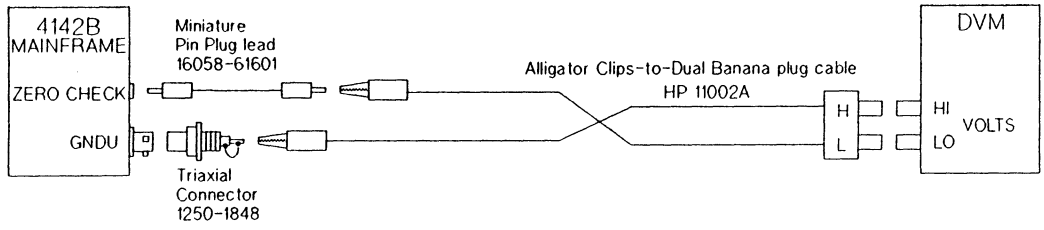
1. Rotate R254 clockwise, two or three times.
2. Connect DVM HI to TP22, and connect DVM LO to TP23 using the alligator clips-to-dual banana plug cable.
3. Adjust R254 until TEST RESULTS is within TEST LIMITS (16.000E-3 ± 1.500E-3 V).

GNDU Voltage Buffer Idle Current Adjustment

WARNING

250 V IS PRESENT ON THIS BOARD.





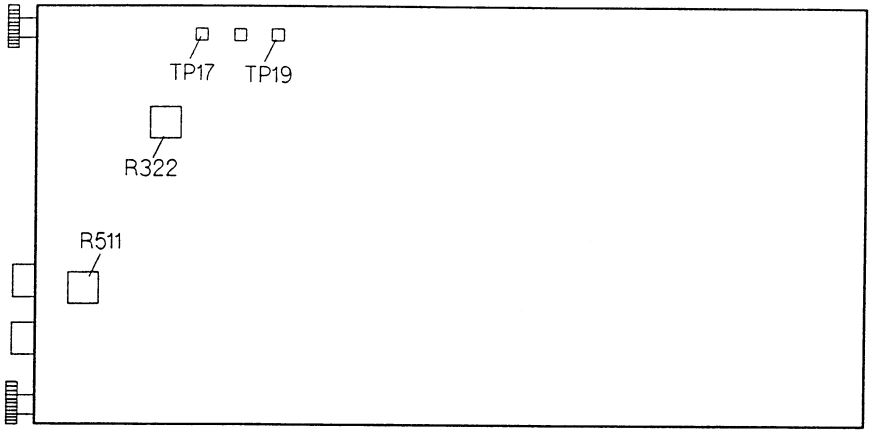
Procedure:

1. Connect DVM LO to **ZERO CHECK** terminal using the alligator clips-to-dual banana plug cable and the miniature pin plug lead.
2. Connect DVM HI to the short-circuited triaxial connector that is connected to GNDU.
3. Adjust R253 until TEST RESULTS is within TEST LIMITS (0.000E-3 ± 0.010E-3 V).

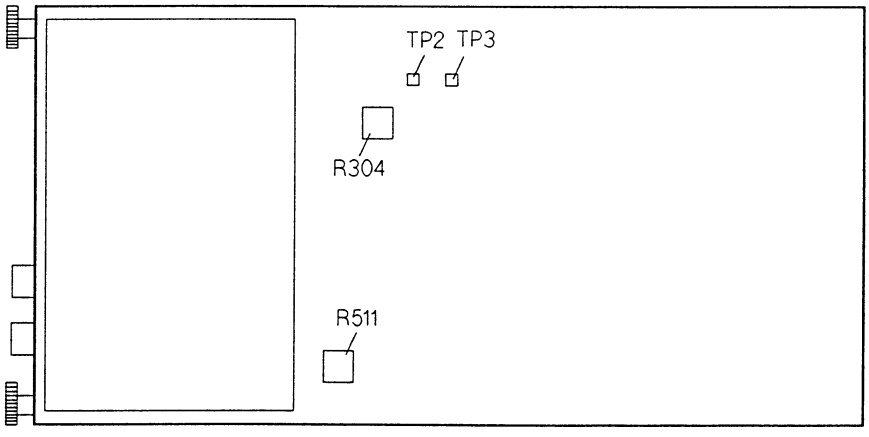
WARNING

250 V IS PRESENT ON THIS BOARD.

HP 41420A



HP 41421B



Procedure:

1. Rotate R322 (for HP 41420A) or R304 (for HP 41421B) clockwise, two or three times.

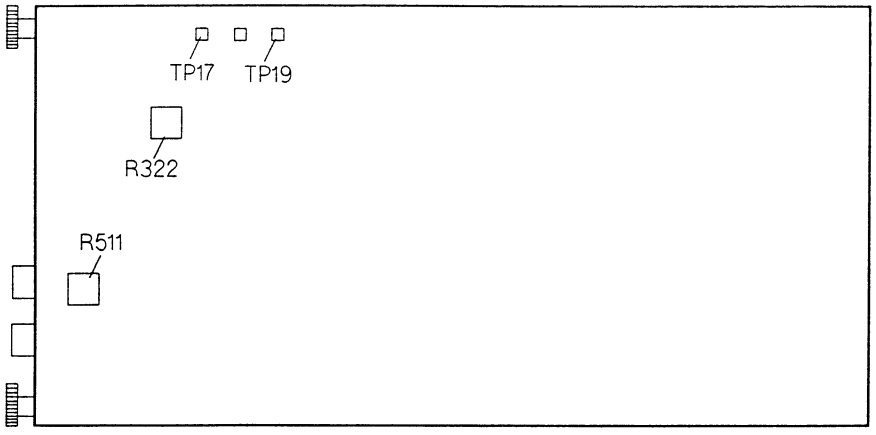
2. Connect DVM LO to TP17 (for HP 41420A) or TP3 (for HP 41421B).
   Connect DVM HI to TP19 (for HP 41420A) or TP2 (for HP 41421B) using the alligator clips-to-dual banana plug cable.

3. Adjust R322 (for HP 41420A) or R304 (for HP 41421B) until TEST RESULTS is within TEST LIMITS (0.33000 ± 0.03000 V).

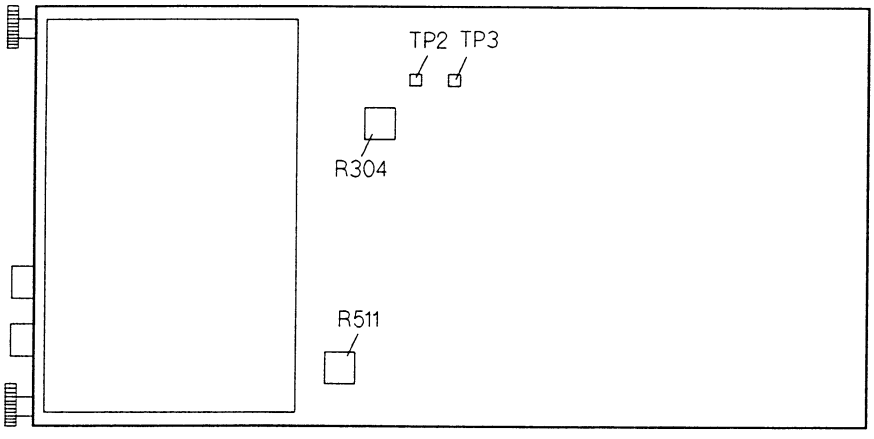
WARNING

250 V IS PRESENT ON THIS BOARD.

HP 41420A

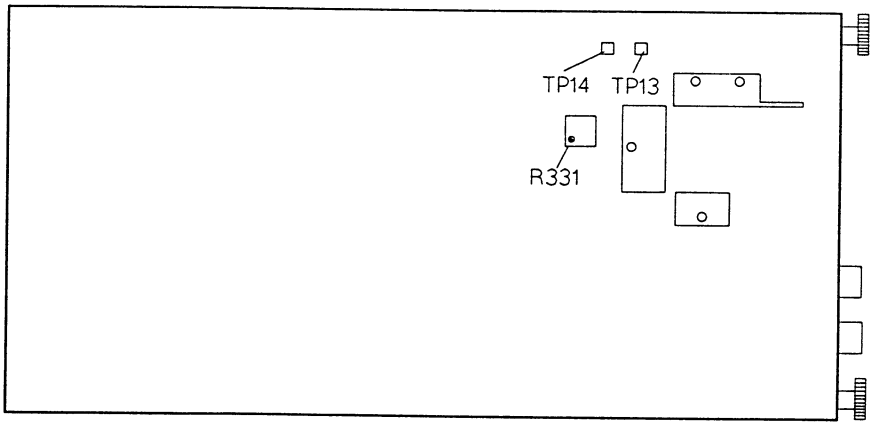


HP 41421B



Procedure:

1. Disconnect all cables from SMU.
2. Connect BNC shorting cap to CPU module INTLK connector.
3. Adjust R511 until TEST RESULTS is within TEST LIMITS (0.000E-6 ± 1.000E-6 A).



Procedure:

1. Rotate R331 clockwise, two or three times.

2. Connect DVM LO to TP13, and connect DVM HI to TP14 using the alligator clips-to-dual plug cable.

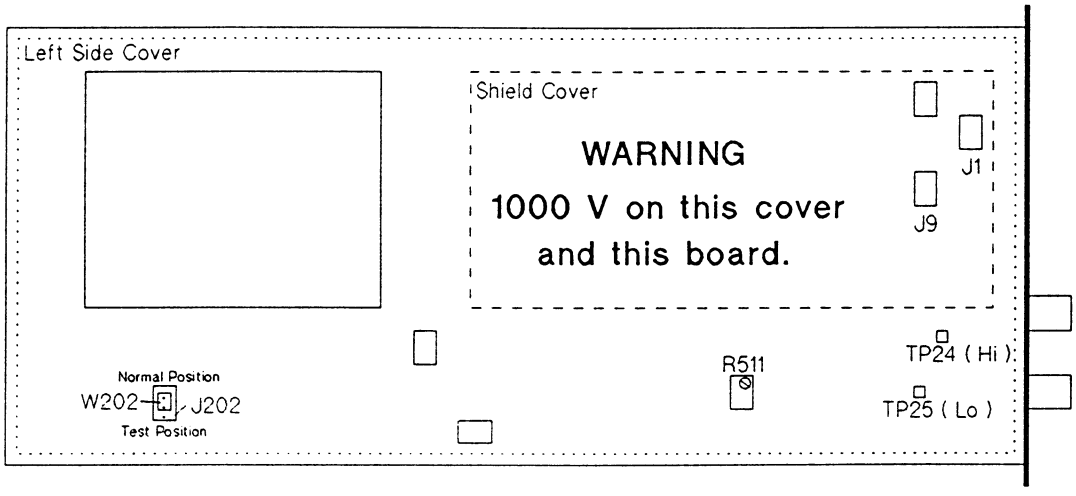
3. Adjust R331 until TEST RESULTS is within TEST LIMITS (0.6600 ± 0.0200 V). Wait 10 minutes for the HCU idle current to stabilize and re-adjust R331. Select the **DONE** softkey.

WARNING

150 V IS PRESENT ON THIS BOARD IF JUMPER W202 CONNECTS THE LOWER TWO PINS ON J202 (TEST POSITION). IF JUMPER W202 IS NOT IN THIS POSITION OR IF THE HVU IS DAMAGED, 1000 V MAY BE PRESENT ON THIS BOARD.

CAUTION

If you remove the HVU shield cover and turn the HP 4142B on to perform the adjustment, turn the HP 4142B off within 10 minutes and keep the HP 4142B off for 5 minutes to prevent damage to the HVU.



Procedure:

1. Turn the HP 4142B off, and connect jumper W202 to the lower two pins on J202 (Test Position).
2. Connect the BNC shorting cap to the INTLK terminal.
3. Connect DVM LO to TP25, and connect DVM HI to TP24 using the alligator clips-to-dual plug cable, and turn the HP 4142B on.
4. Rotate R511 clockwise, two or three times.
5. Wait 120 seconds for the HVU bias current to stabilize.
6. Adjust R511 until TEST RESULTS is within TEST LIMITS (0.2600 ± 0.0200 V). Select the **DONE** softkey.
7. Turn the HP 4142B off, and return jumper W202 to the upper two pins on J202. (Normal Position).

NOTE

- You can perform the HVU adjustment without warming up the HP 4142B.
- If 8 minutes pass after waiting 120 seconds, a beep tone sounds until the **DONE** key is pressed. In this case, immediately press the **DONE** key and turn the HP 4142B off.
- Connecting jumper W202 to the test position puts the HVU into power save mode. This is for safety.
- The P.V. software performs the Self-Test after you connect jumper W202 to the lower two pins on J202 (Test Position). The P.V. software handles this result as follows:

  Error 549 or 551: The software starts the adjustment. If you connect jumper W202 to the lower two pins on J202, an HVU that is correctly operating causes this error.

  No error: The software displays: "Self-Test failed. Perform the above procedures again. Press CONTINUE."

  Other errors: The software stops for safety.

- The P.V. software performs the Self-Test after you return jumper W202 to the upper two pins on J202 (Normal Position). The P.V. software handles this result as follows:

  No error: The software goes to the next step.

  Error 549 or 551: The software displays: "Self-Test failed. Perform the above procedures again. Press CONTINUE."

  Other errors: The software stops for safety.

- Do not attach any heat-sink to the HVU board because you cannot adjust the HVU correctly.

HVU Bias Current Adjustment (2 of 2)

CHAPTER 4
REPLACEABLE PARTS

CONTENTS

INTRODUCTION

This chapter contains HP 4142B replaceable parts information.

ABBREVIATIONS

The following table lists letter designations and abbreviations used in the parts lists and schematics.

Letter Designations and Abbreviations

LETTER DESIGNATIONS

A	= assembly
B	= motor
BT	= battery
C	= capacitor
CP	= coupler
CR	= diode
DL	= delay line
DS	= device signaling (lamp)
E	= misc electronic part
F	= fuse
FL	= filter
J	= jack
K	= relay
L	= inductor
M	= meter
MP	= mechanical part
P	= plug
Q	= transistor
R	= resistor
RT	= thermistor
S	= switch
T	= transformer
TB	= terminal board
TP	= test point
U	= integrated circuit
V	= vacuum, tube, neon bulb, photocell, etc.
VR	= voltage regulator
W	= cable
X	= socket
Y	= crystal

ABBREVIATIONS

A	= amperes
A.F.C.	= automatic frequency control
AMPL	= amplifier
B.F.O.	= beat frequency oscillator
BE CU	= beryllium copper
BH	= binder head
BP	= bandpass
BRS	= brass
BWO	= backward wave oscillator
CCW	= counter-clockwise
CER	= ceramic
CMO	= cabinet mount only
COEF	= coefficient
COM	= common
COMP	= composition
COMPL	= complete
CONN	= connector
CP	= cadmium plate
CRT	= cathode-ray tube
CW	= clockwise
DEPC	= deposited carbon
DR	= drive
ELECT	= electrolytic
ENCAP	= encapsulated
EXT	= external
F	= farads
f	= femto = 10^{-15}
FH	= flat head
FIL H	= fillister head
FXD	= fixed
G	= giga = 10^{9}
GE	= germanium
GL	= glass
GRD	= ground(ed)
H	= henries
HEX	= hexagonal
HG	= mercury
HR	= hour(s)
Hz	= hertz
IF	= intermediate freq.
IMPG	= impregnated
INCD	= incandescent
INCL	= include(s)
INS	= insulation(ed)
INT	= internal
k	= kilo = 1000
LH	= left hand
LIN	= linear taper
LK WASH	= lock washer
LOG	= logarithmic taper
LPF	= low pass filter
m	= milli = 10^{-3}
M	= meg = 10^{6}
MET FLM	= metal film
MET OX	= metallic oxide
MFR	= manufacturer
MINAT	= miniature
MOM	= momentary
MTG	= mounting
MY	= "mylar"
n	= nano = 10^{-9}
N/C	= normally closed
NE	= neon
NI PL	= nickel plate
N/O	= normally open
NPO	= negative positive zero (zero temperature coefficient)
NPN	= negative-positive-negative
NRFR	= not recommended for field replacement
NSR	= not separately replaceable
OBD	= order by description
OH	= oval head
OX	= oxide
P	= peak
PC	= printed circuit
p	= pico = 10^{-12}
PH BRZ	= phosphor bronze
PHL	= Phillips
PIV	= peak inverse voltage
PNP	= positive-negative-positive
P/O	= part of
POLY	= polystyrene
PORC	= porcelain
POS	= position(s)
POT	= potentiometer
PP	= peak-to-peak
PT	= point
PWV	= peak working voltage
RECT	= rectifier
RF	= radio frequency
RH	= round head or right hand
RMO	= rack mount only
RMS	= root-mean square
RWV	= reverse working voltage
S-B	= slow-blow
SCR	= screw
SE	= selenium
SECT	= section(s)
SEMICON	= semiconductor
SI	= silicon
SIL	= silver
SL	= slide
SPG	= spring
SPL	= special
SST	= stainless steel
SR	= split ring
STL	= steel
TA	= tantalum
TD	= time delay
TGL	= toggle
THD	= thread
TI	= titanium
TOL	= tolerance
TRIM	= trimmer
TWT	= traveling wave tube
μ	= micro = 10^{-6}
VAR	= variable
VDCW	= dc working volts
W/	= with
W	= watts
WIV	= working inverse voltage
WW	= wirewound
W/O	= without

0001-9700

REPLACEABLE PARTS LIST ORGANIZATION

Replaceable parts lists (shown later) are organized as follows:

1. Electrical assemblies and components in alphanumeric order by reference designation.
2. Chassis-mounted parts in alphanumeric order by reference designation.
3. Miscellaneous parts.
4. Illustrated parts breakdown, if appropriate.

The information for each part includes the following:

1. The Hewlett-Packard part number.
2. The total quantity (Qty.) used in the assembly.
3. A description of the part.

ORDERING INFORMATION

To order a part listed in the replaceable parts lists, specify the HP part number and quantity required, and send the order to the nearest Hewlett-Packard office.

To order a part not listed in the replaceable parts lists, specify the full instrument model and serial number, describe the form and function of the part, and specify the quantity required. Send your order to the nearest Hewlett-Packard office.

DIRECT MAIL ORDER SYSTEM

Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are as follows:

- Direct ordering and shipment from the HP Parts Center in Mountain View, California.
- No maximum or minimum order amount (there is a minimum order amount for parts ordered through local HP Offices when the orders require billing and invoicing).
- Prepaid transportation (there is a small handling charge for each order).
- No invoices - to provide these advantages, a check or money order must accompany each order.

Mail order forms and specific ordering information are available through your local HP Office. Addresses and phone numbers are located at the back of this manual.

EXCHANGE PROGRAM

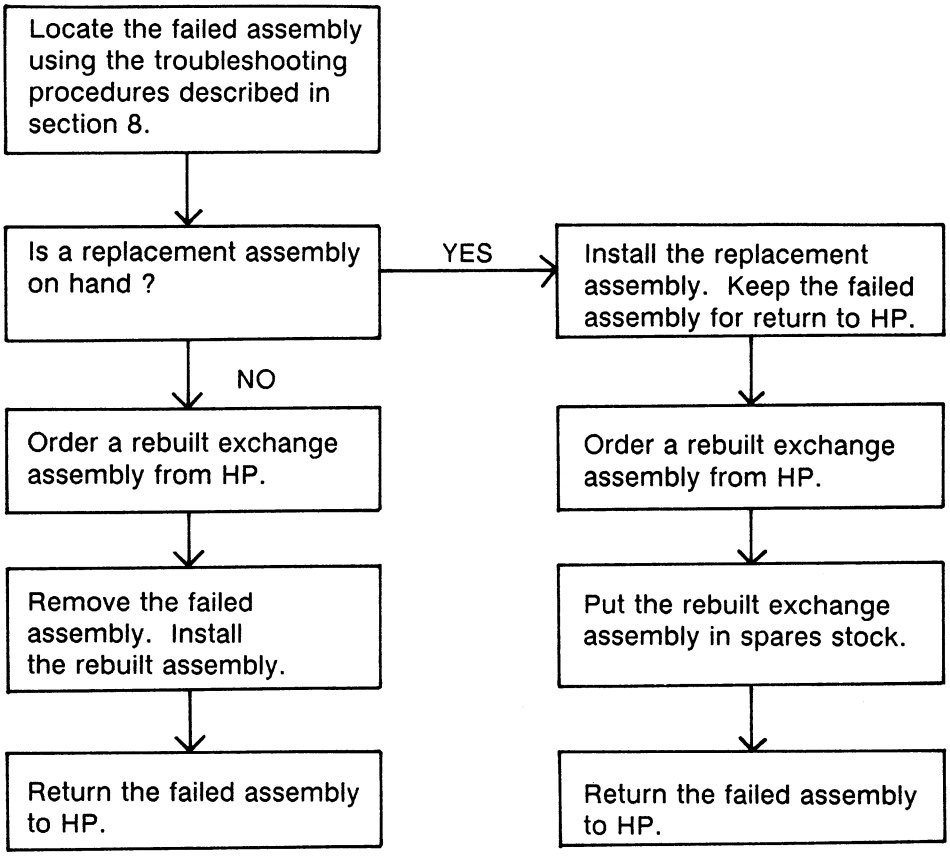
The following table lists the assemblies covered by the HP 4142B Exchange Program. This exchange-for-credit program allows customers who return their failed assembly to HP to purchase rebuilt assemblies at a much lower price than for a new assembly. When ordering an exchange assembly, be sure to use the exchange program part numbers listed.

Refer to the following figure for a description of the exchange program.

Exchange Program Assemblies

Assembly Name	New Assembly Part Number	Exchange Program Part Number
CPU Module	04142-61042	04142-69042
GNDU/ADC Module	04142-61023	04142-69023
Power Supply Module	04142-61015	04142-69015
Power Supply Module A0 PS Primary B'd	04142-65530	04142-69530
HP 41420A SMU	HP 41420A	41420-69001
HP 41420A SMU A1 SMU Main B'd	41420-65501	41420-69501
HP 41421B SMU	HP 41421B	41421-69001
HP 41422A HCU	HP 41422A	41422-69001
HP 41423A HVU A1 Floating SMU B'd	41423-65501	41423-69501
HP 41424A VS/VMU	HP 41424A	41424-69001
HP 41425A AFU	HP 41425A	41425-69001

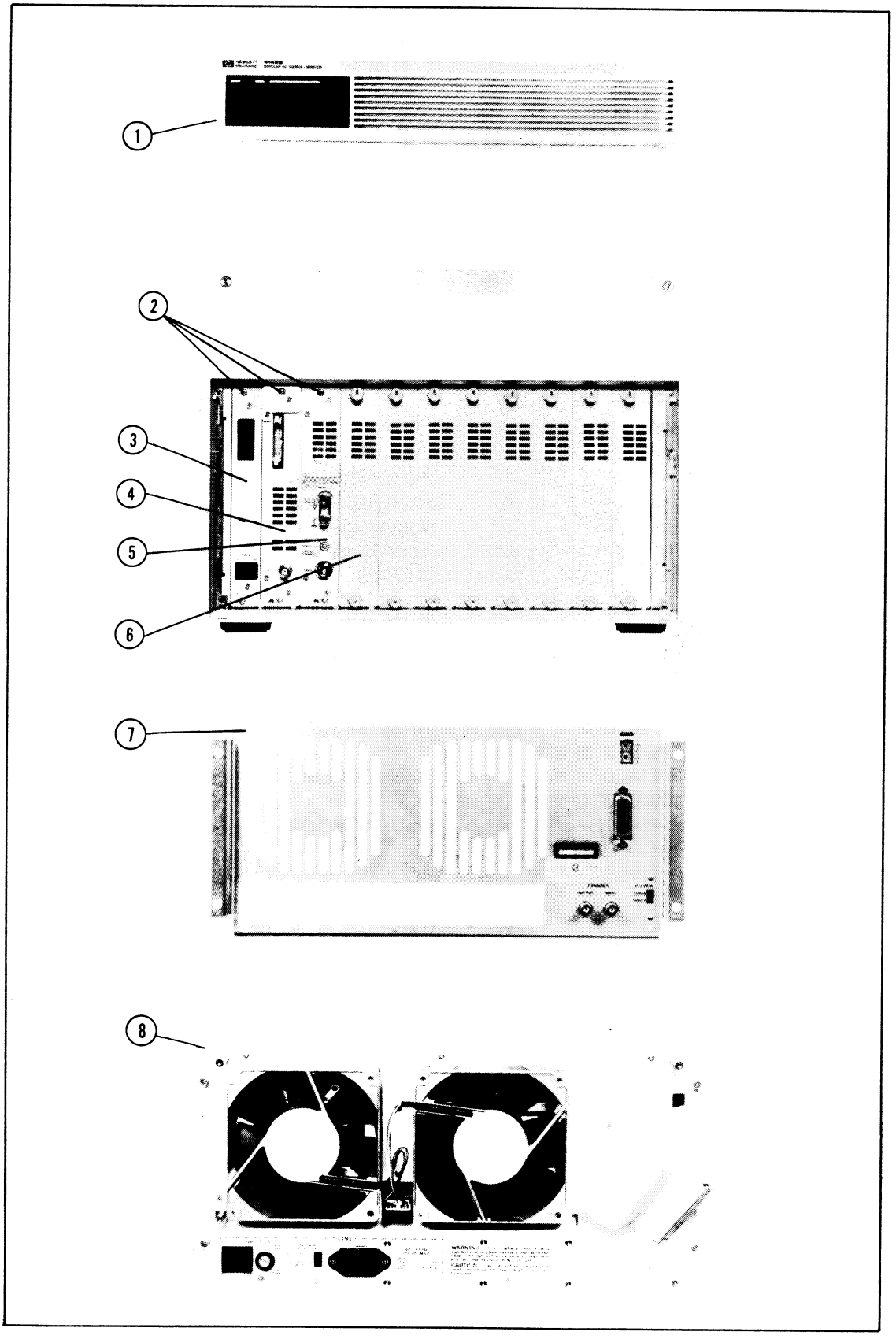
The assembly exchange program is a cost-effective method for keeping your Hewlett-Packard instrument in service without repairing the instrument to the component level. When an assembly covered by the exchange program fails, do the following:



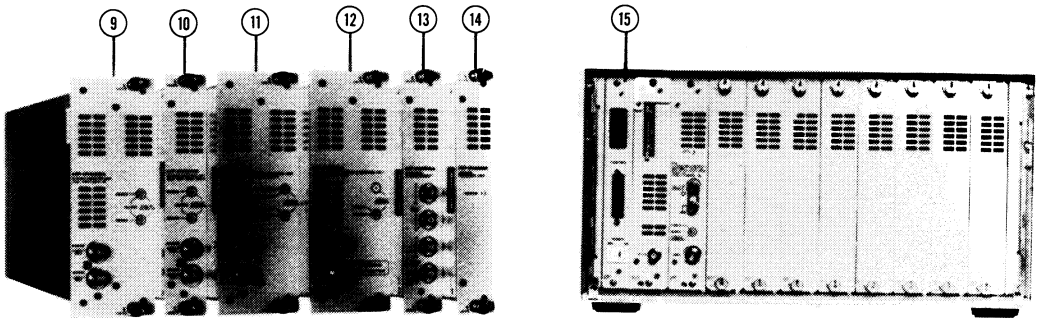
1. Rebuilt exchange assemblies are shipped individually, and the shipping box contains the following:
   - Rebuilt exchange assembly
   - Assembly repair report
   - Return address label
   - Tape for resealing box
2. Open the box carefully because you will use it to return the failed assembly to HP. Complete the repair report. Place the repair report and failed assembly in the box. Be sure to take the enclosed return address label out of the box.
3. Seal the box with the provided tape. Inside the USA[1], affix the preprinted return address label over the label already on the box, and return the box to HP. Outside the U.S.A., do not use the address label. Instead, address the box to the nearest HP office.

[1] HP pays postage on boxes mailed in the USA.

Exchange Program



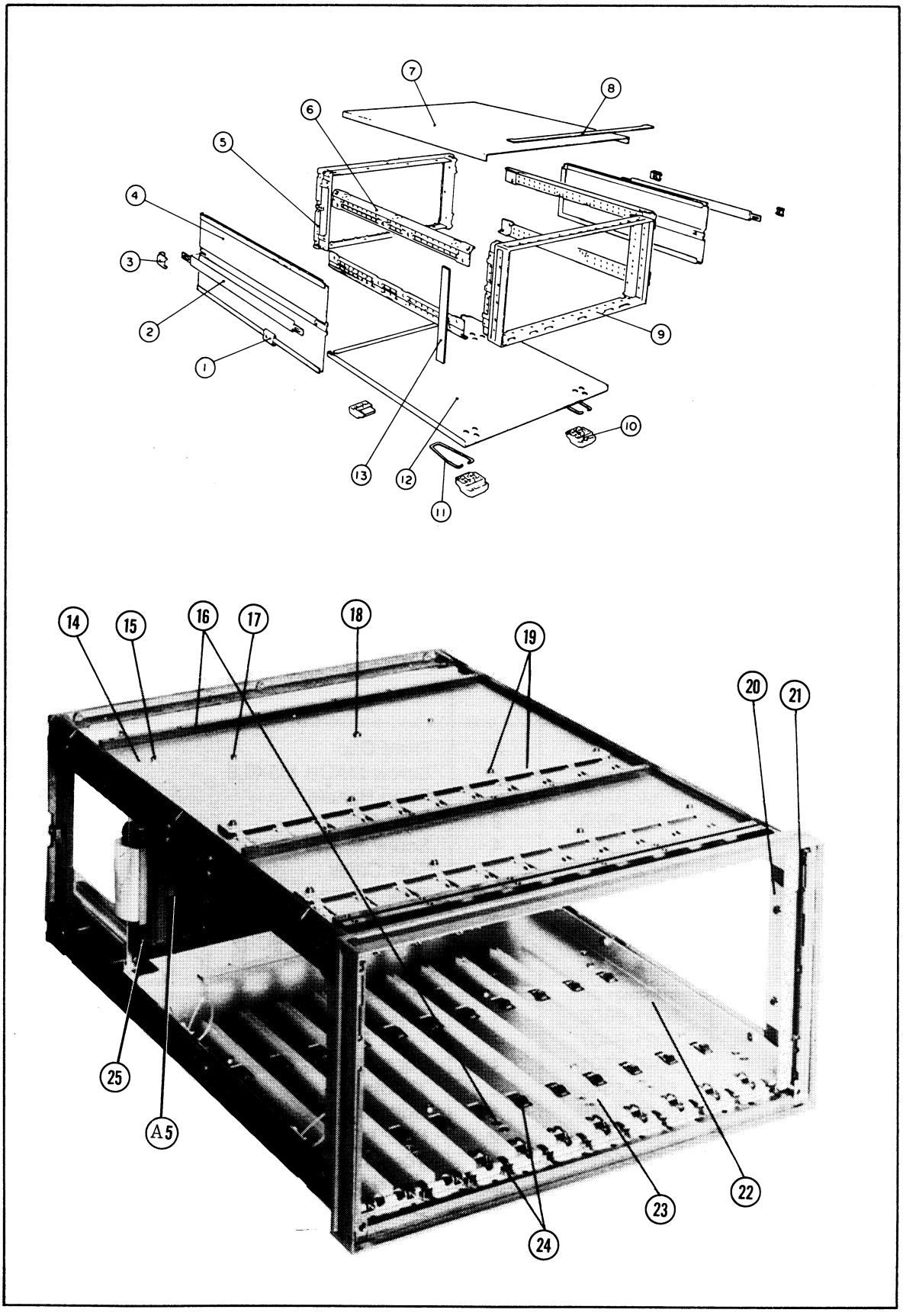
Module-Level Replaceable Parts (1 of 2)



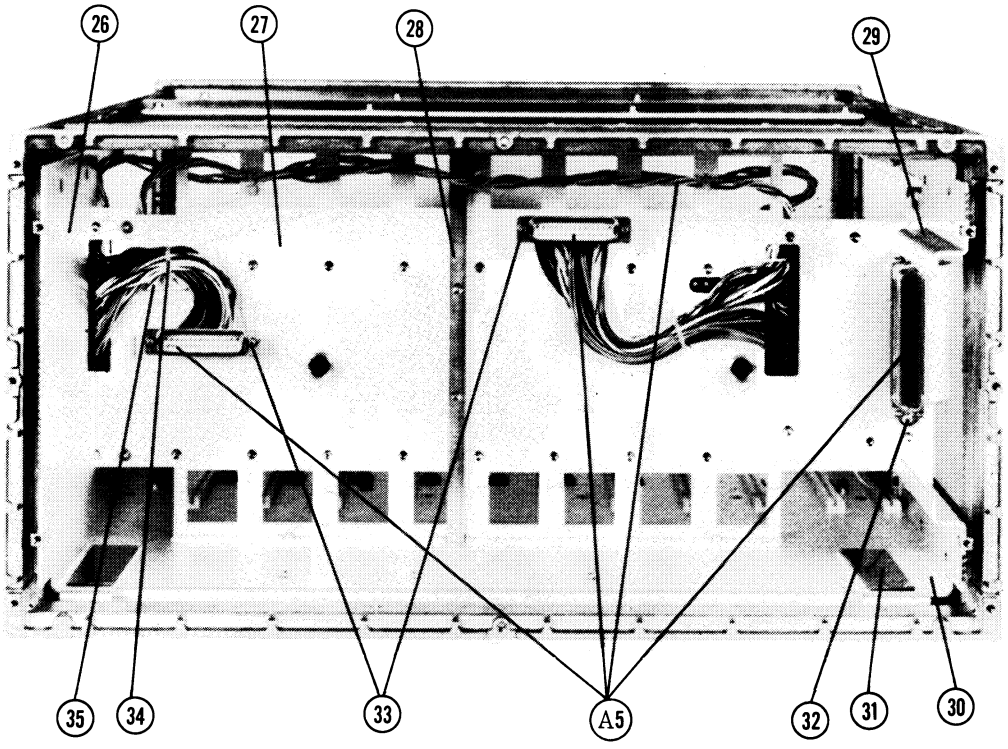
Reference Designation	Part Number [1]	Qty.	Description
1	04142-61014	1	Front Panel Assembly
2	0515-1550	6	Screw M3-L8 P-H
	3050-0891	6	Washer M3
3	04142-60011	1	Front Switch Panel Assembly
4	04142-61042	1	CPU Module
	(04142-69042)		
5	04142-61023	1	GNDU/ADC Module
	(04142-69023)		
6	04142-60012	8	Blank Panel
7	0515-1550	4	Screw M3-L8 P-H
8	04142-61015	1	Power Supply Module
	(04142-69015)		
9	HP 41420A	-	SMU 200V/1A
	(41420-69001)		
10	HP 41421B	-	SMU 100V/100mA
	(41421-69001)		
11	HP 41422A	-	HCU
	(41422-69001)		
12	HP 41423A	-	HVU
13	HP 41424A	-	VS/VMU
	(41424-69001)		
14	HP 41425A	-	AFU
	(41425-69001)		
15	04142-61011	-	Control Unit

[1] Part numbers in parentheses "( )" are Exchange Program part numbers.

Module-Level Replaceable Parts (2 of 2)



Chassis Replaceable Parts (1 of 3)

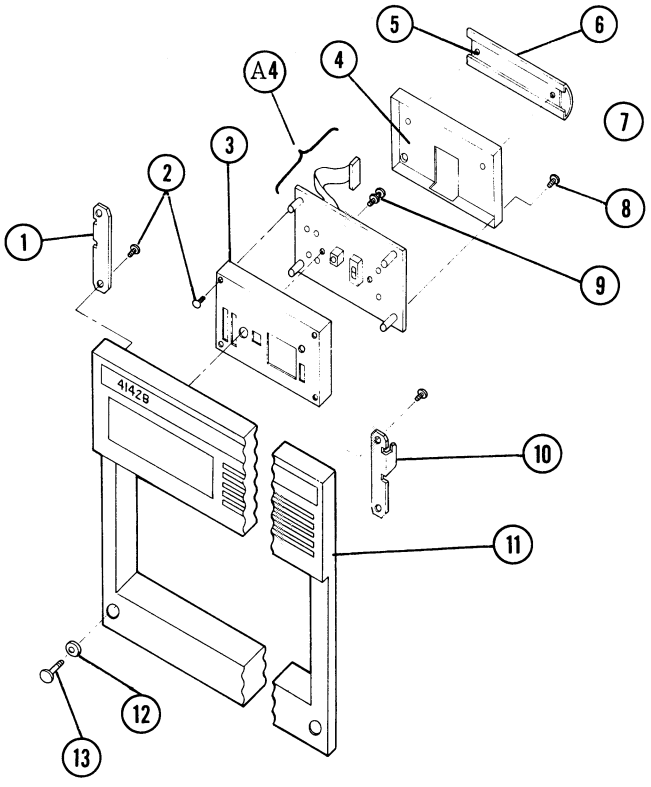


Reference Designation	Part Number	Qty.	Description
1	5041-8819	2	Front Cap
	0515-1132	2	Screw MACH M5X0.8
2	5062-3705	2	Strap Handle
3	5041-8820	2	Rear Cap
	0515-1132	4	Screw MACH M5X0.8
4	5062-3789	2	Side Cover
5	5021-5808	1	Rear Frame
6	5021-5838	4	Corner Strut
	0515-1668	16	Screw MTRC SPCLY
	0515-0885	17	Screw Metric
7	5062-3736	1	Top Cover
8	5041-8802	1	Top Trim
9	5021-8407	1	Front Frame
10	5040-8801	4	Foot
11	1460-1345	2	Tilt Stand
12	5062-3748	1	Bottom Cover
13	5001-0541	2	Side Trim
14	04142-00111	1	Top Chassis
15	0535-0031	6	Nut Hex W/Locker
16	94802-29003	9	Beam
	0515-1012	54	Screw FL M4L8
17	0515-1550	4	Screw M3-L8 P-H
18	0515-0885	2	Screw Metric

Chassis Replaceable Parts (2 of 3)

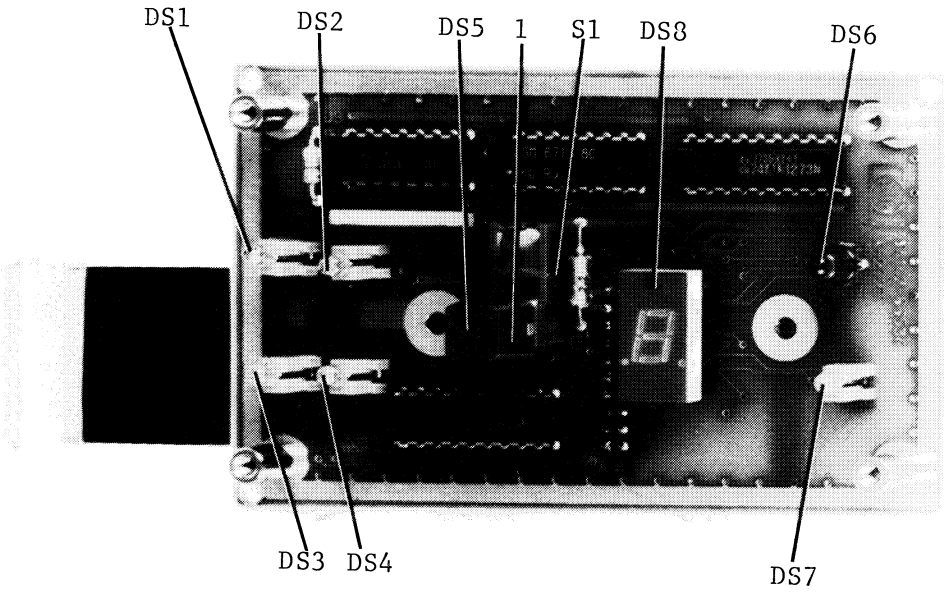
Reference Designation	Part Number	Qty.	Description
19	94801-01241	4	Angle
	94802-00636	4	Plate
	0515-1551	16	Screw M3-L10 P-H
	3050-0891	16	Washer M3
	3050-0647	16	Washer SHLDR
20	94801-00244	1	Panel Angle (Slot#8 side)
	04142-00205	1	Panel Angle (Slot#1 side)
	0515-0885	4	Screw Metric
21	04142-01214	1	Angle (Slot#8 side)
	04142-01213	1	Angle (Slot#1 side)
	0515-0889	4	Screw MACH M3.5X.6
22	04142-00112	1	Bottom Chassis
23	0403-0540	22	Module Guide
24	94802-08001	57	Gasket
25	0515-1550	14	Screw M3-L8 P-H
26	04142-01201	1	Angle
	6960-0016	2	Plug - Hole
27	04142-00101	1	Mother Chassis
	0515-0914	4	Screw MACH M3X0.5
28	94802-23041	1	Shaft
	0515-1012	2	Screw FL M4L8
29	04142-01203	1	Angle
	6960-0016	2	Plug - Hole
30	04142-01202	1	Angle
31	94802-25043	2	Plate Insulator
32	0515-1550	2	Screw M3-L8 P-H
33	0515-0976	4	Screw M2L6
	2190-0654	4	Washer SP M2
	3050-1066	4	Washer
34	1400-0249	7	Cable Tie
35	1400-0584	4	Mount - Cable Tie
A5	04142-66525	1	Mother Board Assembly

Chassis Replaceable Parts (3 of 3)



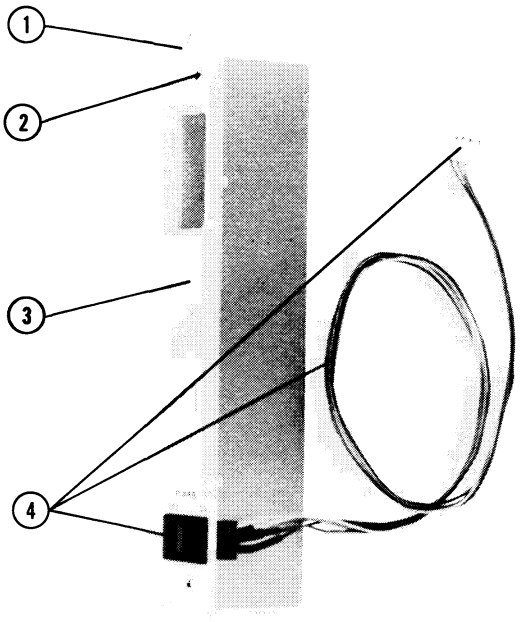
Reference Designation	Part Number	Qty.	Description
1	04142-01211	1	Angle
2	0515-0914	8	Screw MACH M3X0.5
3	04142-00631	1	Shielding
4	04142-00632	1	Shielding
5	8160-0592	1	Shield Finger
6	0361-1260	2	Nylon Rivet
7	8160-0593	1	Bar
8	0515-1006	4	Screw MACH M3X0.5
9	0515-1550	2	Screw M3-L8 P-H
10	04142-01212	1	Angle
11	04142-60024	1	Front Panel
12	3050-0891	2	Washer M3
13	04142-24031	2	Screw
A4	04142-66534	1	Display Board Assembly

Front Panel (04142-61014) Replaceable Parts



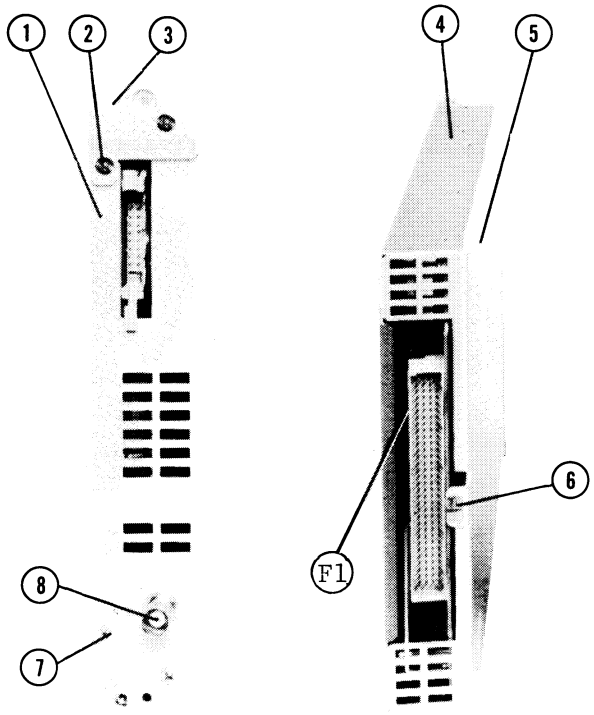
Reference Designation	Part Number	Qty.	Description
1	5041-0384	1	Key - GRAY
A4DS1	1990-0487	1	LED - Yellow
A4DS2	1990-0487	1	LED - Yellow
A4DS3	1990-0487	1	LED - Yellow
A4DS4	1990-0487	1	LED - Yellow
A4DS5	1990-0670	1	LED - Yellow
A4DS6	1990-0517	1	LED - Red
A4DS7	1990-0487	1	LED - Yellow
A4DS8	1990-0730	1	LED - 7 Segment
A4S1	5060-9436	1	Pushbutton Switch

A4 Display Board Assembly Replaceable Parts



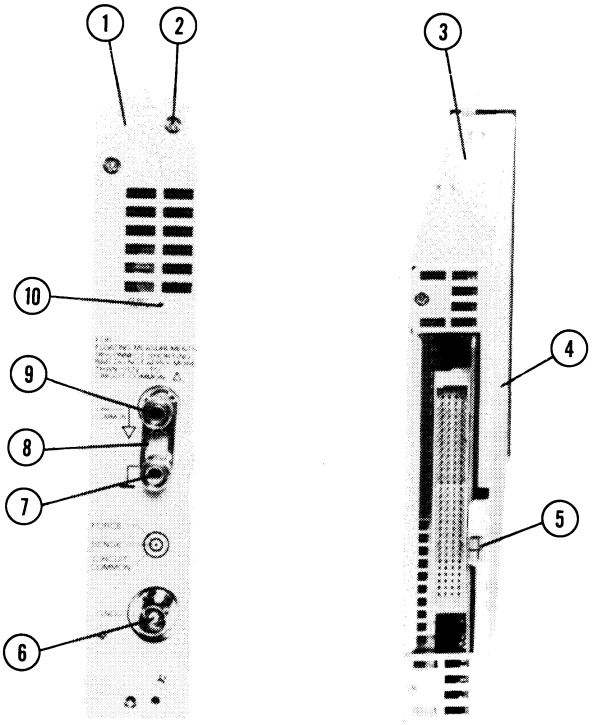
Reference Designation	Part Number	Qty.	Description
1	04142-00221	1	Panel
2	0515-0914	2	Screw MACH M3X0.5
3	04142-01205	1	Angle
4	04142-61620	1	Power ON/OFF Switch Assembly

Front Switch Panel (04142-60011) Replaceable Parts



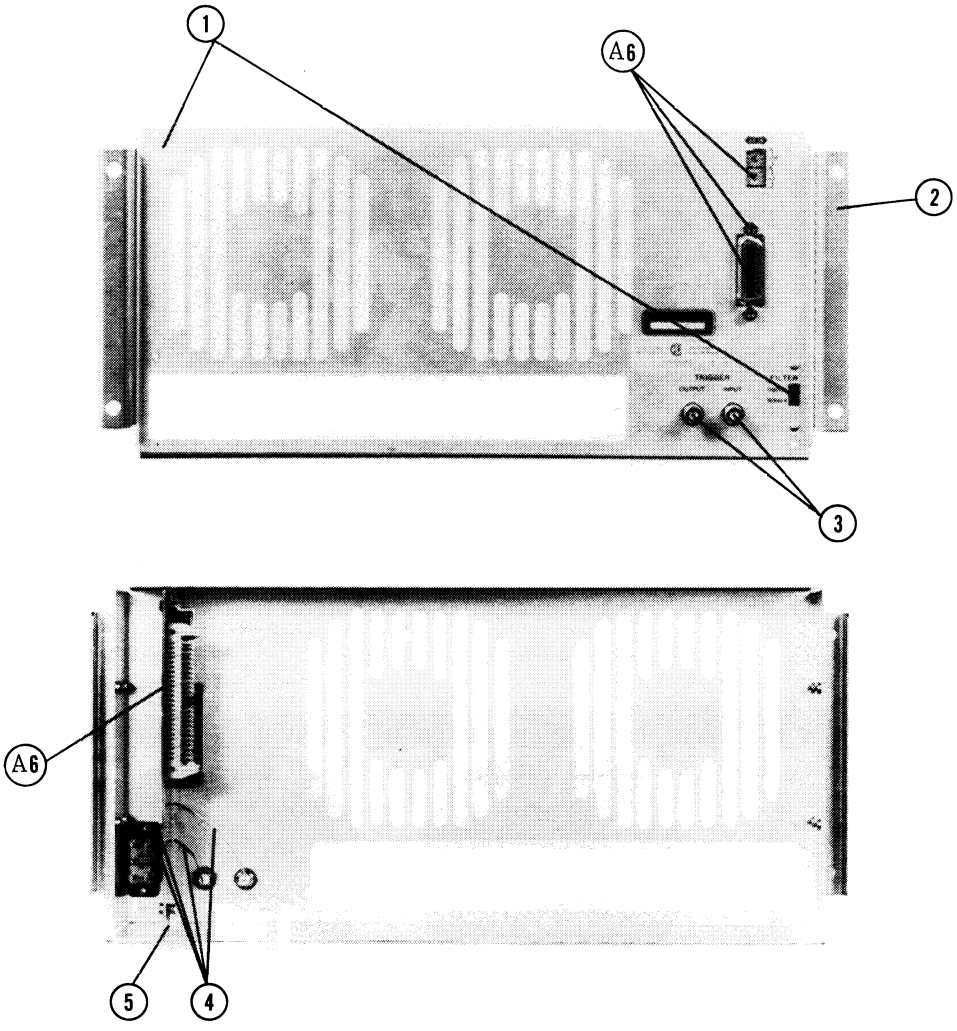
Reference Designation	Part Number	Qty.	Description
1	04142-00226	1	Panel
2	0515-0907	2	Screw MACH M3X0.5
3	04142-00612	1	Plate
4	04142-04014	1	Top Cover
	0515-0914	8	Screw MACH M3X0.5
5	04142-04013	1	Bottom Cover
6	8160-0552	0.03	RFI Gasket
7	0515-0914	2	Screw MACH M3X0.5
8	1250-0083	1	BNC Connector
	2190-0016	2	Washer LK INTL T
	0360-1190	1	Terminal - Solder Lug
	2950-0001	1	Nut HEX-DBL-CHAM
	0160-4808	1	CAP 470PF 5%
F1	2110-0749	1	Fuse 7A

CPU Module (04142-61042) Replaceable Parts



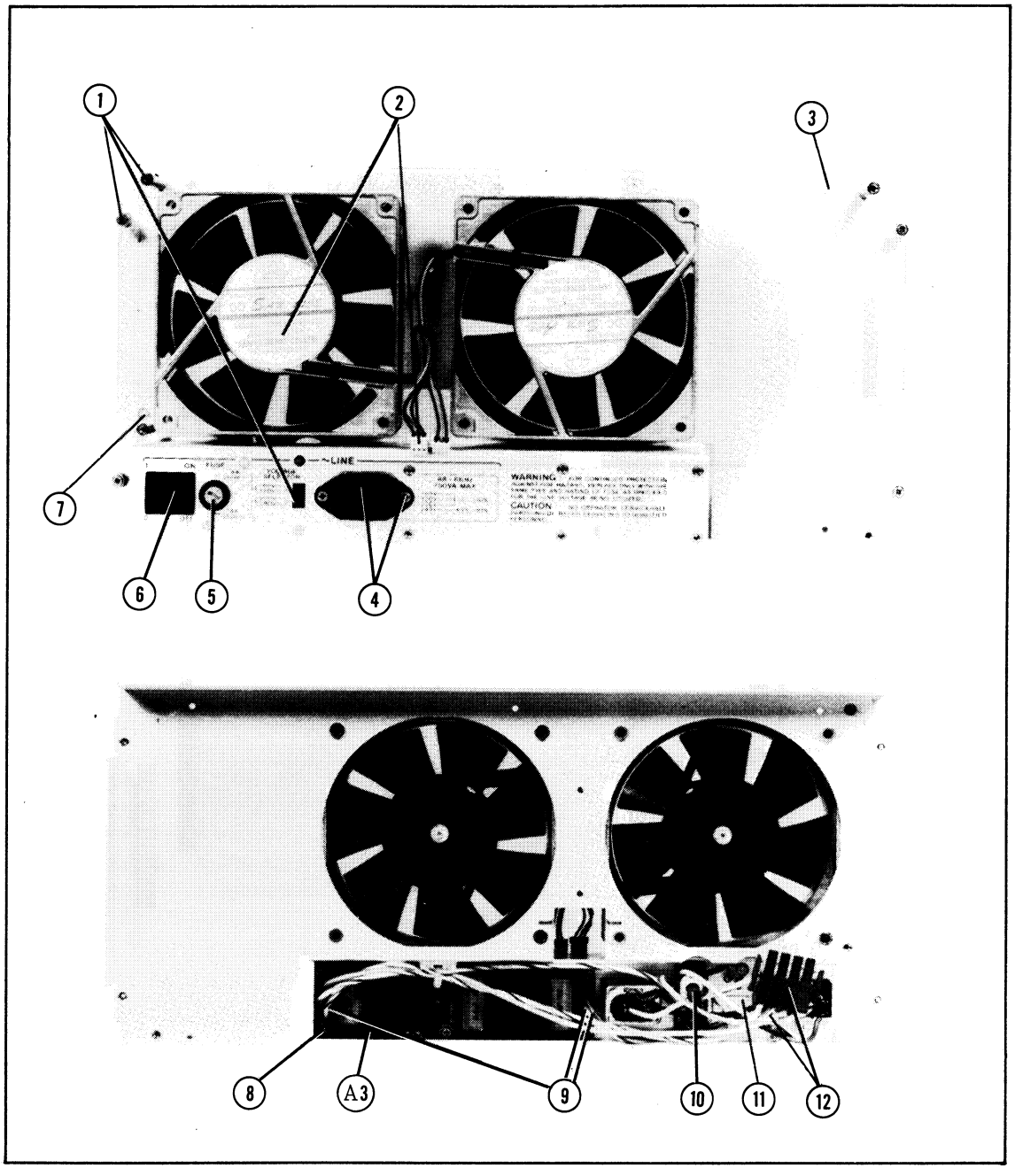
Reference Designation	Part Number	Qty.	Description
1	04142-00223	1	Panel
	04142-00621	1	Plate
2	0515-0907	4	Screw MACH M3X0.5
3	04142-04023	1	Top Cover
	0515-0914	6	Screw MACH M3X0.5
4	04142-04024	1	Bottom Cover
5	8160-0552	0.03	RFI Gasket
6	1250-1906	1	Triaxial Connector (W WSHR/NUT)
	04142-61619	1	Cable Assembly
	04142-01221	1	Angle
7	1510-0130	1	Binding Post SGL
	2190-0084	2	Washer LK INTL T
	0360-1155	1	Terminal - Solder Lug
	2950-0006	1	Nut HEX-DBL-CHAM
8	5000-4206	1	Shorting Link
9	1510-0130	1	Binding Post SGL
	04142-24022	1	Spacer
	0360-1155	1	Terminal - Solder Lug
	2190-0084	1	Washer LK INTL T
	2950-0006	1	Nut HEX-DBL-CHAM
	1901-1219	1	Varister
10	1251-2151	1	Connector SGL CONT
	04142-61617	1	Cable Assembly

GNDU/ADC Module (04142-61023) Replaceable Parts

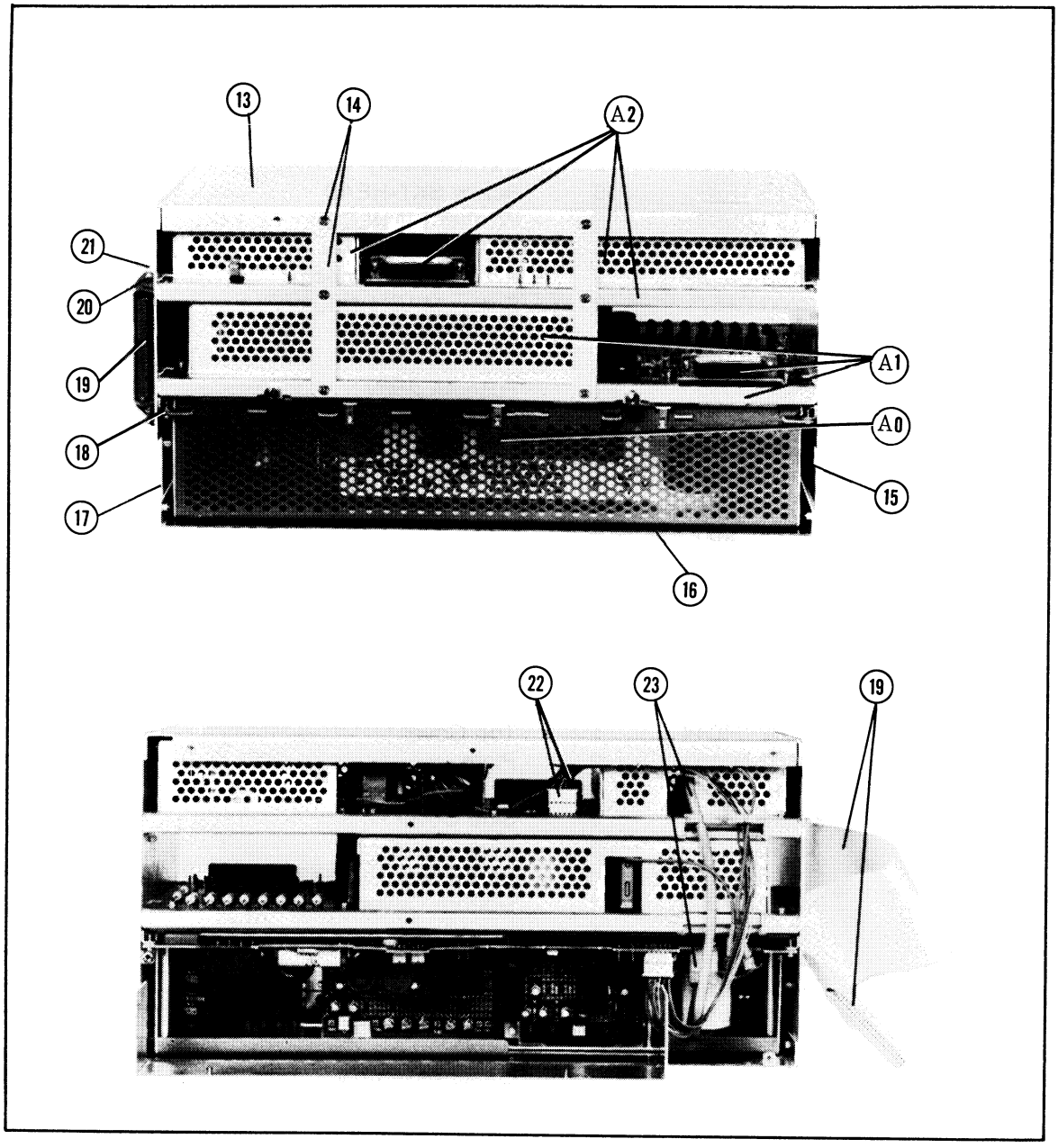


Reference Designation	Part Number	Qty.	Description
1	04142-04003	1	Fan Cover
2	04142-01253	2	Angle
	0515-0907	8	Screw MACH M3X0.5
3	1250-0083	2	BNC Connector
	2190-0016	2	Washer LK INTL T
	2950-0001	2	Nut HEX-DBL-CHAM
4	04142-68006	1	Jumper Wire Set (4ea.)
5	0515-0914	2	Screw MACH M3X0.5
A6	04142-66526	1	Interface Connector Board Assembly

Rear Panel Replaceable Parts



Power Supply Module (04142-61015) Replaceable Parts (1 of 3)

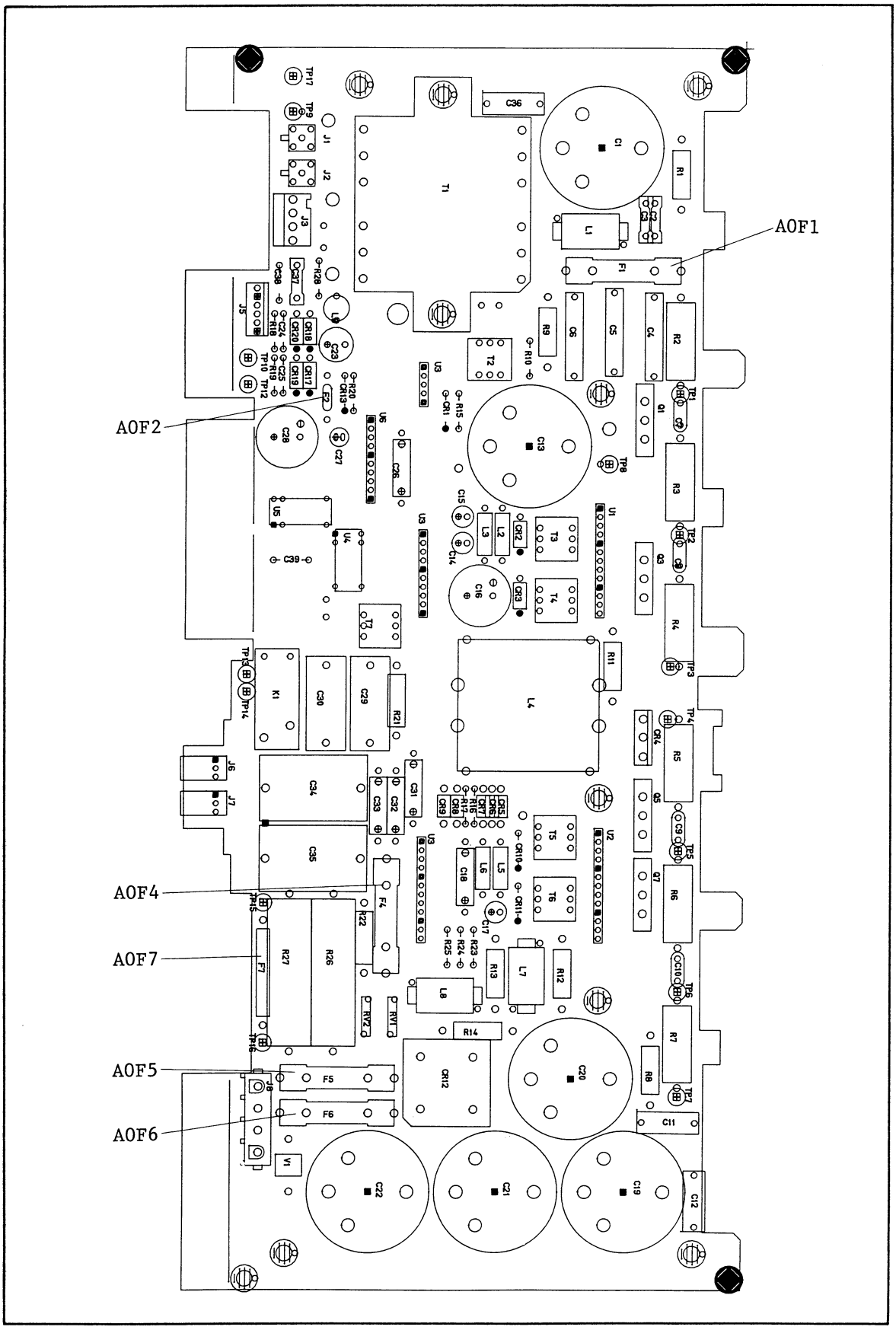


Power Supply Module (04142-61015) Replaceable Parts (2 of 3)

Reference Designation	Part Number [1]	Qty.	Description
1	94802-00401	1	Rear Panel
2	04142-61787	2	Fan Assembly
	0515-1598	8	Screw SKT-HEAD
	2190-0586	8	Washer LK HLCL
3	0515-1550	6	Screw M3-L8 P-H
4	9135-0293	1	AC Power Connector
	2200-0167	2	Screw MACH 4-40
5	2110-0565	1	Fuseholder Cap
	2110-0342	1	Fuse 8A 250V
	2110-0055	1	Fuse 4A 250V
	2110-0566	1	Fuse Holder
	2110-0569	1	Nut - Fuse Holder
6	3101-0402	1	Line ON/OFF Switch
7	0515-0914	3	Screw MACH M3X0.5
8	0515-1550	6	Screw M3-L8 P-H
9	04142-68002	1	Jumper Wire Set (3ea.)
10	9170-0956	2	Core Toroid
	94802-68003	1	Jumper Wire Set (4ea.)
11	1400-0584	2	Mount - Cable Tie
	1400-0249	2	Cable Tie
12	04142-61786	1	Cable Assembly
13	94802-04044	1	Top Cover
14	94802-00151	2	Plate
	0515-0914	6	Screw MACH M3X0.5
15	94802-04041	1	Side Cover
	6960-0016	2	Plug - Hole
	0515-0914	10	Screw MACH M3X0.5
16	94802-04043	1	Bottom Cover
	94802-25041	1	Insulator
17	04142-04051	1	Side Cover
	6960-0016	2	Plug - Hole
	0515-0914	10	Screw MACH M3X0.5
18	94802-09044	2	Angle
19	04142-61618	1	Cable Assembly
20	0515-0976	2	Screw M2L6
	2190-0654	2	Washer SP M2
	3050-1066	2	Washer
21	04142-01251	1	Angle
	0515-0914	2	Screw MACH M3X0.5
22	04142-61661	1	Wire Assembly (6 pin)
23	04142-61662	1	Cable Assembly (4 pin)
A0	04142-65530	1	PS Primary Board Assembly
	(04142-69530)		
A1	04142-65531	1	PS Secondary#1 Board Assembly
A2	04142-65532	1	PS Secondary#2 Board Assembly
A3	04142-66592	1	PS Line Filter Board Assembly

[1] Part numbers in parentheses "( )" are Exchange Program part numbers.

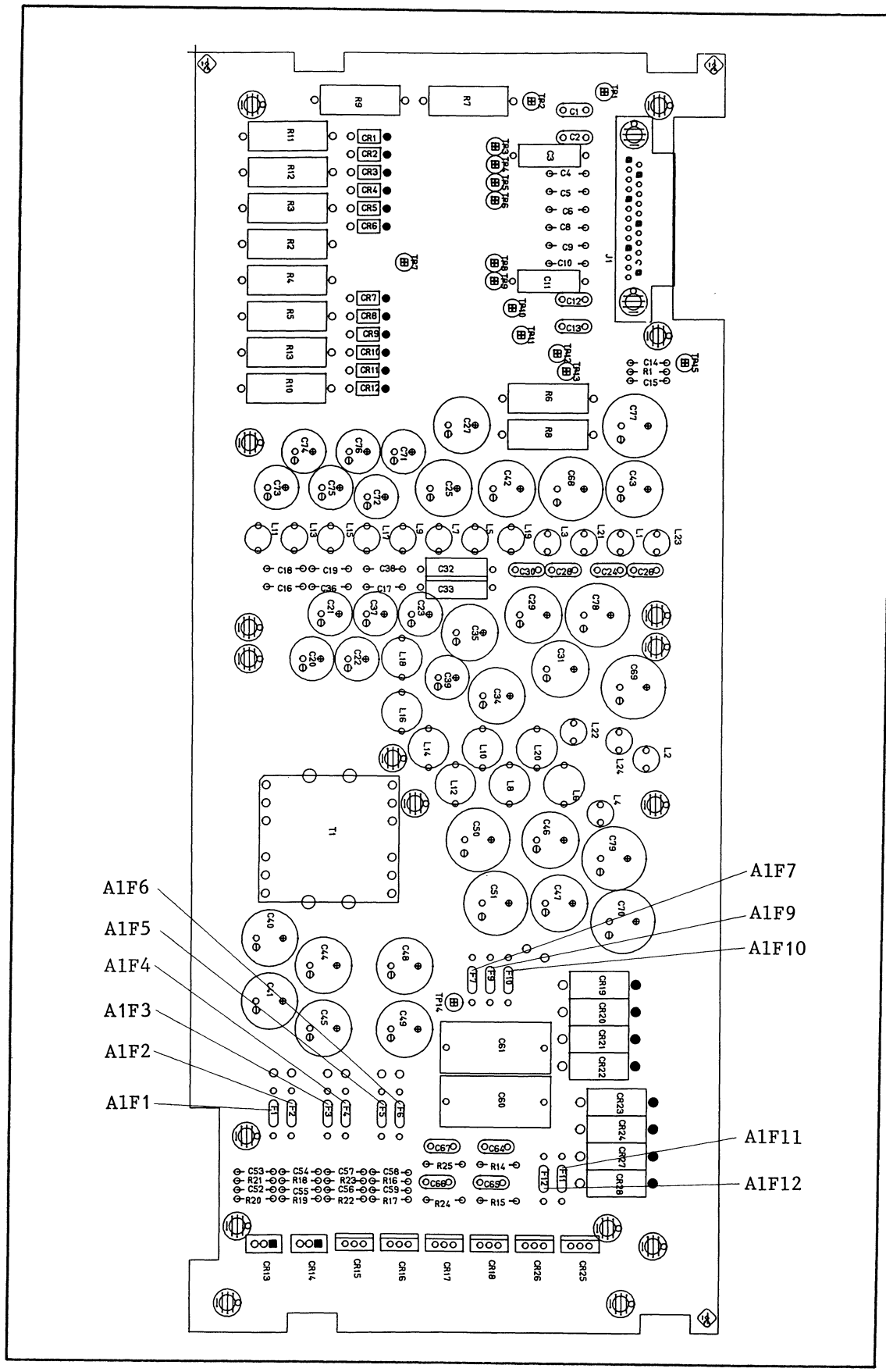
Power Supply Module (04142-61015) Replaceable Parts (3 of 3)



A0 PS Primary Board Assembly Replaceable Parts (1 of 2)

Reference Designation	Part Number	Qty.	Description
A0F1	2110-0083	1	Fuse 2.5A 250V
A0F2	2110-0745	1	Fuse 3A 125V
A0F4	2110-0002	1	Fuse 2A 250V
A0F5	2110-0365	1	Fuse 4A SB
A0F6	2110-0383	1	Fuse 8A 250V
A0F7	2110-0663	1	Fuse TEMP 96deg.

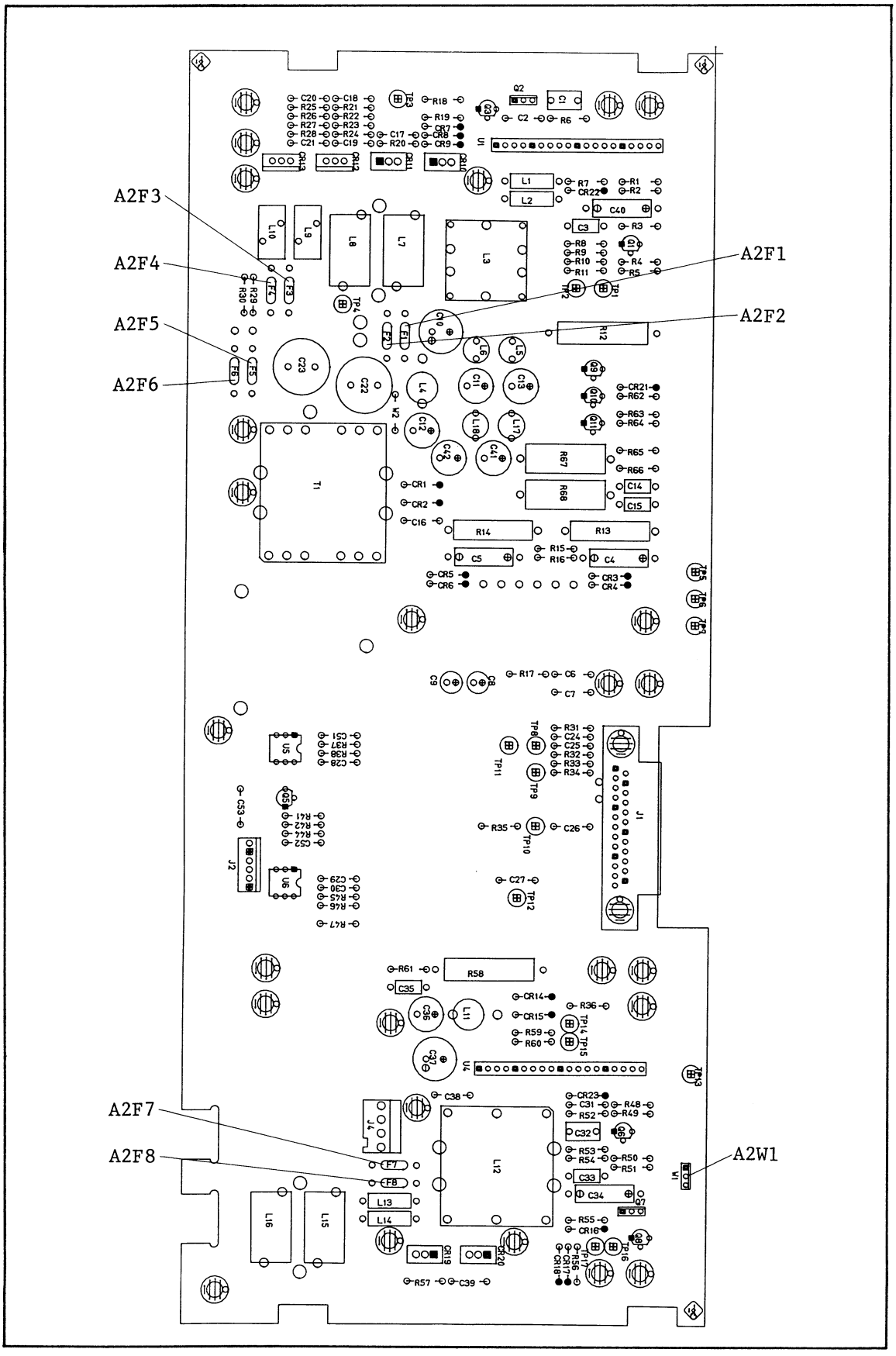
A0 PS Primary Board Assembly Replaceable Parts (2 of 2)



A1 PS Secondary#1 Board Assembly Replaceable Parts (1 of 2)

Reference Designation	Part Number	Qty.	Description
A1F1	2110-0745	1	Fuse 3A 125V
A1F2	2110-0745	1	Fuse 3A 125V
A1F3	2110-0743	1	Fuse 2A
A1F4	2110-0743	1	Fuse 2A
A1F5	2110-0698	1	Fuse SUBMIN 2.5A
A1F6	2110-0698	1	Fuse SUBMIN 2.5A
A1F7	2110-0741	1	Fuse 1A 125V
A1F9	2110-0739	1	Fuse SUBMIN 0.5A
A1F10	2110-0739	1	Fuse SUBMIN 0.5A
A1F11	2110-0741	1	Fuse 1A 125V
A1F12	2110-0741	1	Fuse 1A 125V

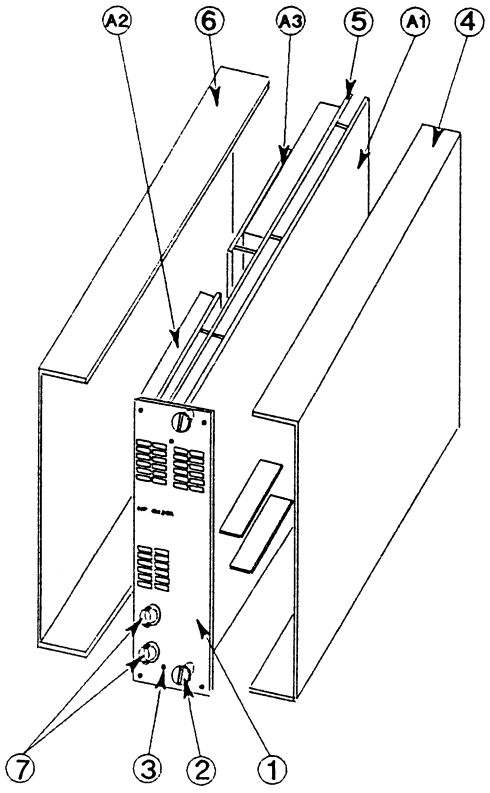
A1 PS Secondary#1 Board Assembly Replaceable Parts (2 of 2)



A2 PS Secondary#2 Board Assembly Replaceable Parts (1 of 2)

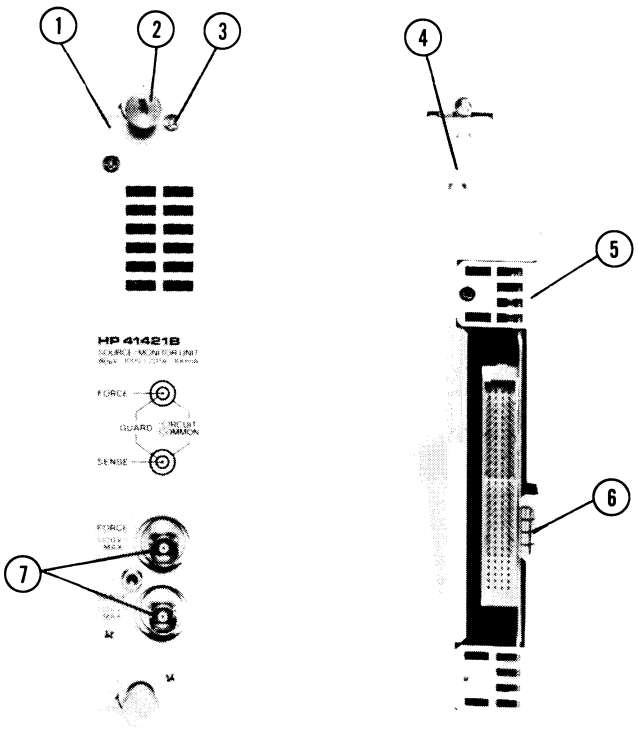
Reference Designation	Part Number	Qty.	Description
A2F1	2110-0745	1	Fuse 3A 125V
A2F2	2110-0745	1	Fuse 3A 125V
A2F3	2110-0746	1	Fuse 4A
A2F4	2110-0746	1	Fuse 4A
A2F5	2110-0746	1	Fuse 4A
A2F6	2110-0746	1	Fuse 4A
A2F7	2110-0749	1	Fuse 7A
A2F8	2110-0749	1	Fuse 7A
A2W1	1258-0141	1	Wire - Removable Jumper
	1251-4822	1	Connector 3-Pin Male

A2 PS Secondary#2 Board Assembly Replaceable Parts (2 of 2)



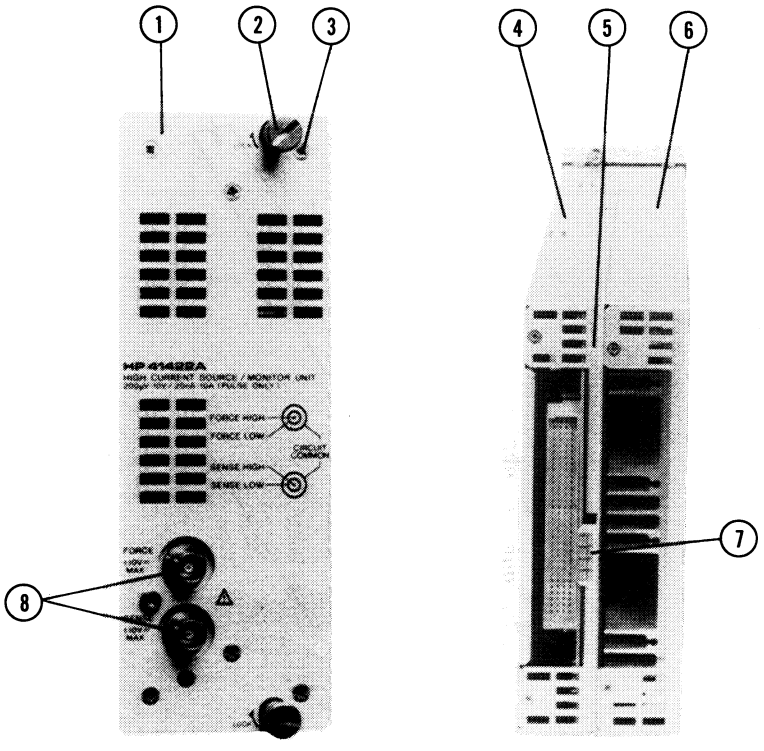
Reference Designation	Part Number [1]	Qty.	Description
1	41420-00201	1	Panel
	41420-00603	1	Plate
	0160-4808	1	CAP 470pF 5%
2	94802-29001	2	Fastener
	94802-40003	2	Insulator (Front)
	94802-40004	2	Insulator (Back)
	0510-0045	2	Retainer - Ring
3	0515-0907	6	Screw MACH M3X0.5
4	41420-04002	1	Side Cover
	0515-0914	8	Screw MACH M3X0.5
5	41420-04001	1	Center Cover
	8160-0552	0.06	RFI Gasket
6	41420-04003	1	Side Cover
	0515-0914	4	Screw
7	1250-1906	2	Triaxial Connector (W WSHR/NUT)
	2190-0104	1	Washer LK INTL T
	5000-4218	1	Terminal (Lug)
	41420-01201	1	Angle
A1	41420-65501	1	SMU Main Board Assembly
	(41420-69501)		
A2	41420-65502	1	Output Floating Board Assembly
A3	41420-65503	1	+/-4V Floating Board Assembly

[1] Part numbers in parentheses "( )" are Exchange Program part numbers.



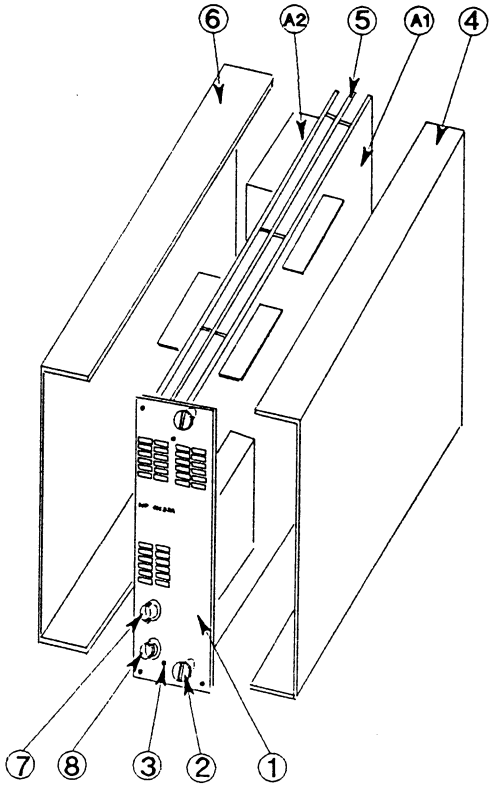
Reference Designation	Part Number	Qty.	Description
1	41421-00201	1	Panel
	41421-00605	1	Plate
	0160-4808	1	CAP 470pF 5%
	0360-0042	1	Terminal - Solder Lug
2	94802-29001	2	Fastener
	94802-40003	2	Insulator (Front)
	94802-40004	2	Insulator (Back)
	0510-0045	2	Retainer - Ring
3	0515-0907	4	Screw MACH M3X0.5
4	41421-04012	1	Top Cover
	0515-0914	8	Screw MACH M3X0.5
5	41421-04001	1	Bottom Cover
6	8160-0552	0.06	RFI Gasket
7	1250-1906	2	Triaxial Connector (W WSHR/NUT)
	41421-01201	1	Angle

HP 41421B SMU Replaceable Parts



Reference Designation	Part Number	Qty.	Description
1	41422-00201	1	Panel
	41422-00601	1	Plate
	0160-4808	1	CAP 470pF 5%
2	94802-29001	2	Fastener
	94802-40003	2	Insulator (Front)
	94802-40004	2	Insulator (Back)
	0510-0045	2	Retainer - Ring
3	0515-0907	6	Screw MACH M3X0.5
4	41422-04002	1	Side Cover
	0515-0914	8	Screw MACH M3X0.5
5	41422-04001	1	Center Cover
6	41422-04003	1	Side Cover
	0515-0914	8	Screw
7	8160-0552	0.06	RFI Gasket
8	1250-1906	2	Triaxial Connector (W WSHR/NUT)
	2190-0104	1	Washer LK INTL T
	5000-4218	1	Terminal (Lug)
	41422-01201	1	Angle

HP 41422A HCU Replaceable Parts

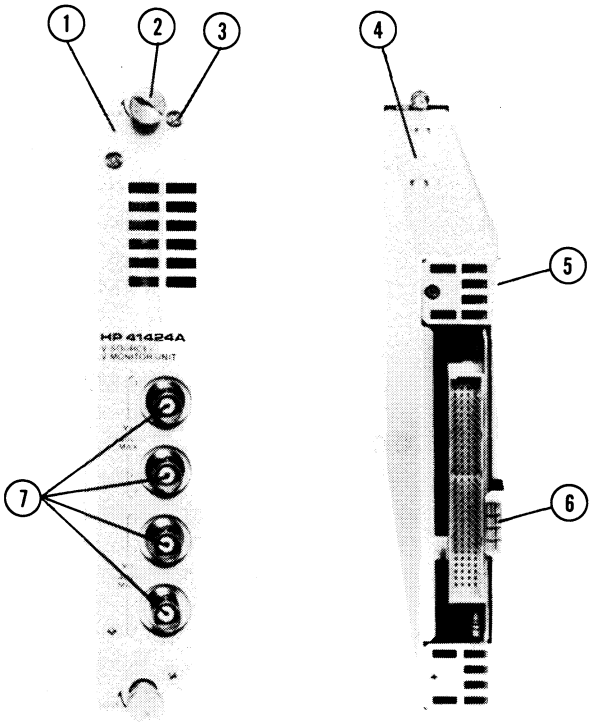


HP 41423A HVU Replaceable Parts (1 of 2)

Reference Designation	Part Number [1]	Qty.	Description
1	41423-00201	1	Panel
	41420-00603	1	Plate
	0160-4808	1	CAP 470pF 5%
2	94802-29001	2	Fastener
	94802-40003	2	Insulator (Front)
	94802-40004	2	Insulator (Back)
	0510-0045	2	Retainer - Ring
3	0515-0907	6	Screw MACH M3X0.5
4	41423-04002	1	Side Cover
	41423-00632	1	Plate - Insulator
	0515-0914	6	Screw MACH M3X0.5
5	41423-04001	1	Center Cover
	8160-0552	0.06	RFI Gasket
	41423-00633	1	Plate - Insulator (left side)
	41423-00631	1	Plate - Insulator (right side)
6	41423-04003	1	Side Cover
	41423-00634	1	Plate - Insulator
	0515-0914	6	Screw
7	1250-0083	1	BNC Connector
	2190-0016	2	Washer LK INTL T
	0360-1190	1	Terminal - Solder Lug
	2950-0001	1	Nut
	41423-61653	1	Cable Assembly
8	1250-2228	1	Triaxial Connector (W WSHR/NUT)
	2190-0104	1	Washer LK INTL T
	5000-4218	1	Terminal (Lug)
	41423-61654	1	Cable Assembly
	41423-01201	1	Angle
A1	41423-65501	1	Floating SMU Board Assembly
	(41423-69501)		
A2	41423-65502	1	Power Amplifier Board Assembly
A1F1	2110-0679	1	Fuse-subminiature 1.5A 125V
A1F201	2110-0683	1	Fuse-subminiature .75A 125V

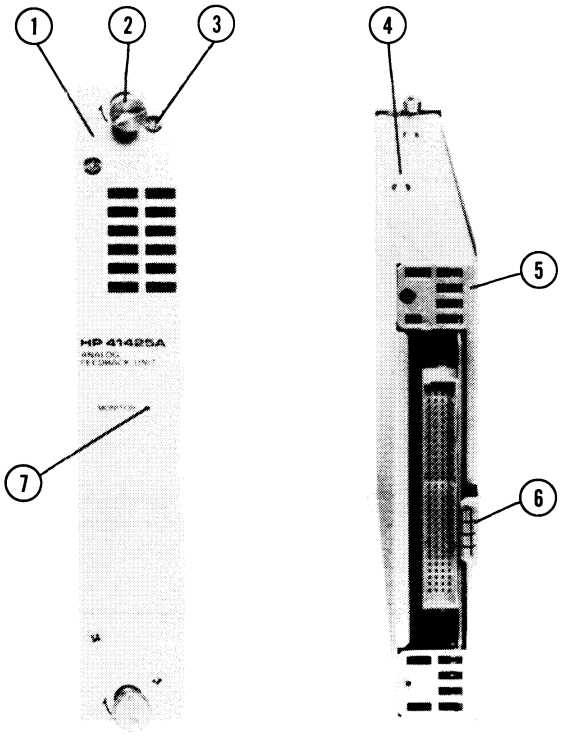
[1] Part numbers in parentheses "( )" are Exchange Program part numbers.

HP 41423A HVU Replaceable Parts (2 of 2)



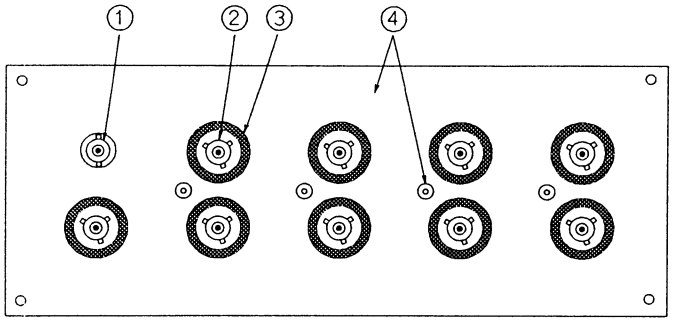
Reference Designation	Part Number	Qty.	Description
1	41424-00201	1	Panel
	41424-00601	1	Plate
	0160-4808	1	CAP 470pF 5%
	0360-0042	1	Terminal - Solder Lug
2	94802-29001	2	Fastener
	94802-40003	2	Insulator (Front)
	94802-40004	2	Insulator (Back)
	0510-0045	2	Retainer - Ring
3	0515-0907	4	Screw MACH M3X0.5
4	41424-04002	1	Top Cover
	0515-0914	10	Screw MACH M3X0.5
5	41424-04001	1	Bottom Cover
6	8160-0552	0.06	RFI Gasket
7	1250-0083	4	BNC Connector
	2190-0016	4	Washer
	2950-0001	4	Nut
	41424-01201	1	Angle

HP 41424A VS/VMU Replaceable Parts



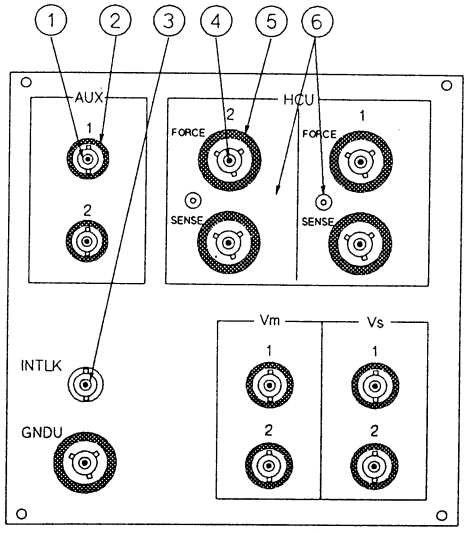
Reference Designation	Part Number	Qty.	Description
1	41425-00201	1	Panel
	41425-00601	1	Plate
2	94802-29001	2	Fastener
	94802-40003	2	Insulator (Front)
	94802-40004	2	Insulator (Back)
	0510-0045	2	Retainer - Ring
3	0515-0907	4	Screw MACH M3X0.5
4	09480-04041	1	Top Cover
	0515-0914	6	Screw MACH M3X0.5
5	41424-04001	1	Bottom Cover
6	8160-0552	0.06	RFI Gasket
7	1251-2151	1	Connector - SGL CONT
	41425-61601	1	Wire Assembly

HP 41425A AFU Replaceable Parts



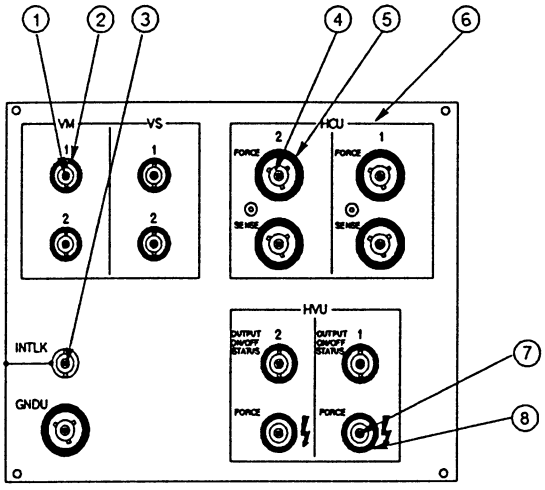
Reference Designation	Part Number	Qty.	Description
1	1250-0083	1	BNC Connector
	2190-0016	1	Washer LK INTL T
	2950-0001	1	Nut HEX-DBL-CHAM
2	1250-1906	9	Triaxial Connector (W WSHR/NUT)
	5000-4218	9	Terminal
	2190-0104	9	Washer LK INTL T
3	16146-40002	9	Insulator (Connector Side)
	16146-40001	9	Insulator (Terminal Side)
4	04142-00643	1	Plate

Connector Plate (04142-60021) Replaceable Parts



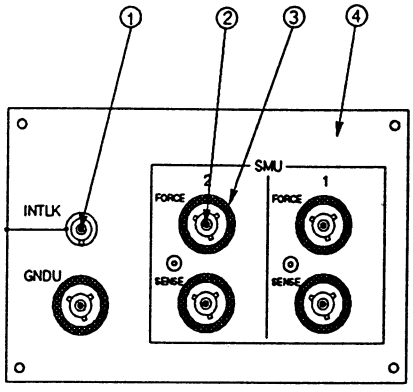
Reference Designation	Part Number	Qty.	Description
1	1250-0118	6	BNC Connector
	0360-1190	6	Terminal
	2190-0016	6	Washer LK INTL T
	2950-0001	6	Nut HEX-DBL-CHAM
2	5040-0345	12	Insulator
3	1250-0118	1	BNC Connector
	2190-0016	1	Washer LK INTL T
	2950-0001	1	Nut HEX-DBL-CHAM
4	1250-1906	5	Triaxial Connector (W WSHR/NUT)
	5000-4218	5	Terminal
	2190-0104	5	Washer LK INTL T
5	16146-40002	5	Insulator (Connector Side)
	16146-40001	5	Insulator (Terminal Side)
6	04142-00671	1	Plate

Connector Plate (04142-60031) Replaceable Parts



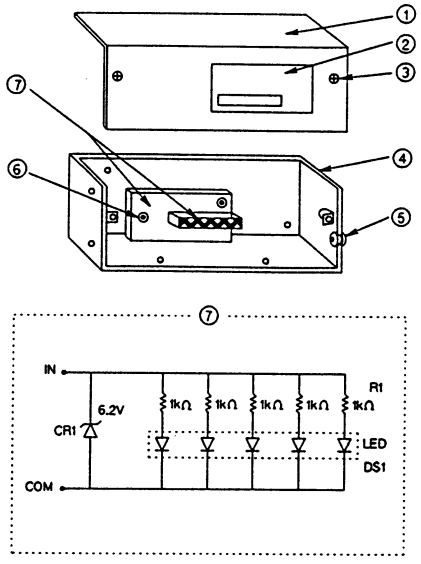
Reference Designation	Part Number	Qty.	Description
1	1250-0118	6	BNC Connector
	0360-1190	6	Terminal
	2190-0016	6	Washer LK INTL T
	2950-0001	6	Nut HEX-DBL-CHAM
2	5040-0345	12	Insulator
3	1250-0118	1	BNC Connector
	2190-0016	1	Washer LK INTL T
	2950-0001	1	Nut HEX-DBL-CHAM
4	1250-1906	5	Triaxial Connector (W WSHR/NUT)
	5000-4218	5	Terminal
	2190-0104	5	Washer LK INTL T
5	16146-40002	5	Insulator (Connector Side)
	16146-40001	5	Insulator (Terminal Side)
6	04142-00672	1	Plate
	04142-04072	1	Angle for Connectors
	04142-04071	1	Cover
	0515-1550	2	Screw M3-L 8 P-H
	0535-0031	2	Nut - Hex W/Locker
	0400-0306	2	Grommet
7	1250-2228	2	Triaxial Connector (W WSHR/NUT)
	5000-4218	2	Terminal
	2190-0104	2	Washer LK INTL T
8	16146-40002	2	Insulator (Connector Side)
	16146-40001	2	Insulator (Terminal Side)

Connector Plate (04142-60032) Replaceable Parts



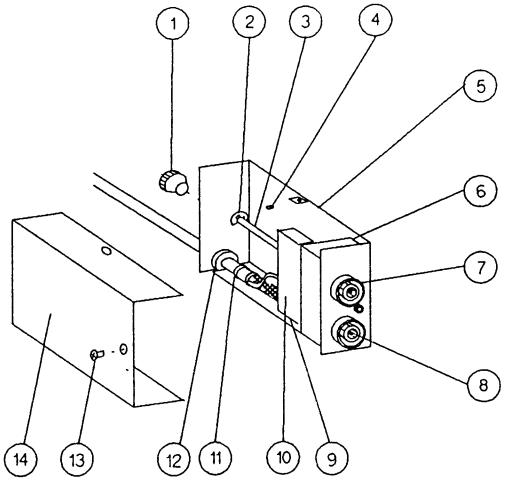
Reference Designation	Part Number	Qty.	Description
1	1250-0083	1	BNC Connector
	0360-1190	1	Terminal - Solder Lug
	2190-0016	1	Washer LK INTL T
	2950-0001	1	Nut HEX-DBL-CHAM
2	1250-1906	5	Triaxial Connector (W WSHR/NUT)
	5000-4218	5	Terminal
	2190-0104	5	Washer LK INTL T
3	16146-40002	5	Insulator (Connector Side)
	16146-40001	5	Insulator (Terminal Side)
4	16087-00201	1	Plate

Connector Plate (16087-60002) Replaceable Parts



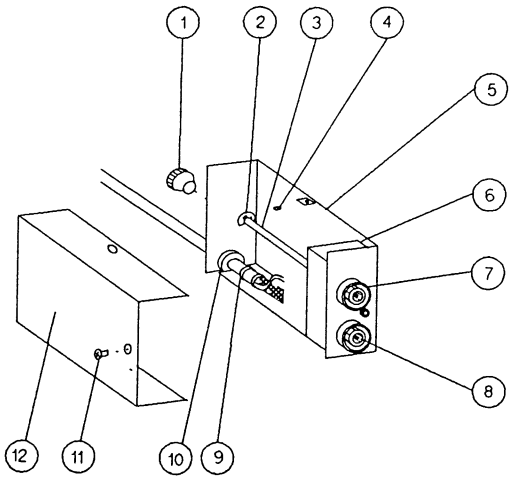
Reference Designation	Part Number	Qty.	Description
1	16087-04005	1	Top Cover
2	16088-87102	(1)	Label English (for 16087-60013)
	16088-87103	(1)	Lable Japanese (for 16087-60014)
	16088-87141	(1)	Lable German (for 16087-60015)
3	0515-0914	2	Screw
4	16087-04006	1	Bottom Cover
5	0400-0002	1	Grommet
6	0515-1550	2	Screw
7	16088-66502	1	LED Board Assembly
R1	0757-0280	5	RES 1k 1% .125W
DS1	1990-1219	1	LED-LT-BAR
CR1	1902-0551	1	DIO-ZNR 6.19V 5%

Warning Indicator (16087-60013/-60014/-60015) Replaceable Parts



Reference Designation	Part Number	Qty.	Description
1	0370-2446	2	Knob CONC 1/2
2	0510-0305	2	E Ring
3	04142-24041	2	Screw (Shaft)
4	6960-0016	4	Plug - Hole
5	04142-04041	2	Bottom Cover
6	04142-00141	2	Angle
7	5040-3342	4	Stud
8	16146-40002	4	Insulator
	5000-4218	4	Terminal
	1250-1848	4	Triaxial Connector (W WSHR/NUT)
9	04142-00642	2	Shielding
10	04142-00641	2	Shielding
11	1400-0493	4	Cable Tie
12	0400-0306	2	Grommet
13	0515-0914	10	Screw MACH M3X0.5
14	41420-04041	2	Top Cover for 41420-61601
	41420-04043	2	Top Cover for 41420-61603

Quadraxial Cable (41420-61601 and 41420-61003) Replaceable Parts



Reference Designation	Part Number	Qty.	Description
1	0370-2446	2	Knob CONC 1/2
2	0510-0305	2	E Ring
3	04142-24041	2	Screw (Shaft)
4	6960-0016	4	Plug - Hole
5	41422-04041	2	Bottom Cover
6	41422-00141	2	Angle
7	5040-3342	4	Stud
8	16146-40002	4	Insulator
	5000-4218	4	Terminal
	1250-1848	4	Triaxial Connector (W WSHR/NUT)
	41422-24099	2	Sleeve for contact
9	1400-0493	4	Cable Tie
10	0400-0306	2	Grommet
11	0515-0914	10	Screw MACH M3X0.5
12	41422-04042	2	Top Cover for 41422-61601
	41422-04043	2	Top Cover for 41422-61602

Dual Coaxial Cable (41422-61601 and 41422-61002) Replaceable Parts

CHAPTER 5
DISASSEMBLY PROCEDURES

CONTENTS

INTRODUCTION

This chapter contains the HP 4142B modules, covers, and assemblies removal procedures; and module installation procedures.

WARNING

POTENTIAL SHOCK HAZARD. DANGEROUS VOLTAGES MAY BE PRESENT ON THE FOLLOWING BOARD ASSEMBLY (INCLUDES SHIELD COVER) FOR UP TO 10 SECONDS AFTER YOU SET THE LINE ON/OFF SWITCH TO OFF.

HVU MODULE: MAX. ±1000 V
POWER SUPPLY MODULE: MAX. ±340 V
OTHER MODULES AND A5 MOTHER BOARD: MAX. ±250 V

DANGEROUS VOLTAGES (MAX. ±340V) MAY BE PRESENT ON THE A0 PS PRIMARY BOARD ASSEMBLY (INCLUDES SHIELD COVER) AND A3 PS LINE FILTER BOARD ASSEMBLY WHEN THE LINE ON/OFF SWITCH IS ON, EVEN IF THE POWER ON/OFF SWITCH IS OFF.

CAUTION

To prevent damage to HP 4142B modules, be sure to turn your HP 4142B OFF and wait for at least 10 seconds before you install modules.

To prevent thermal damage to HP 4142B modules, be sure that Blank Panels (part number 04142-60012) are installed in all unused slots, except when removal is required for service.

FRONT PANEL REMOVAL

To remove the Front Panel (Front Panel Assembly), perform as follows:

1. Set the **LINE ON/OFF** or **POWER ON/OFF** switch to OFF.
2. With a slotted screwdriver, loosen the two screws located in the lower left and right corners of the front panel. Swing the front panel slightly upward, then down, until it comes loose. Disconnect the flat cable from the front panel of the mainframe connector.

PLUG-IN MODULE REMOVAL

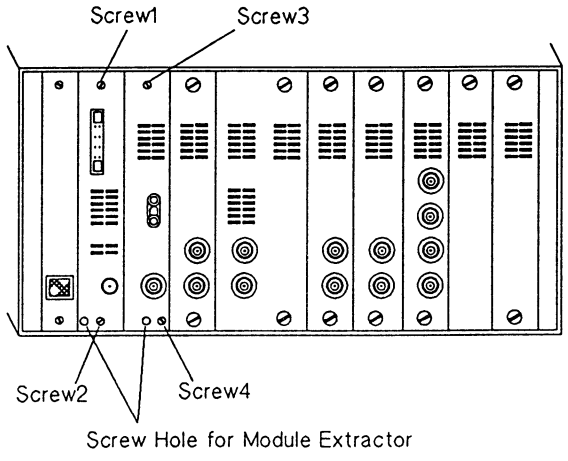
To remove plug-in modules, perform as follows:

1. Set the **LINE ON/OFF** or **POWER ON/OFF** switch to OFF.
2. Turn the upper and lower module quick-disconnect screws 90° counterclockwise to unlock the module. Gently pull the module free from its mainframe connector and remove the module.

CPU MODULE AND GNDU/ADC MODULE REMOVAL

To remove the CPU module or GNDU/ADC module, perform as follows:

1. Set the **LINE ON/OFF** or **POWER ON/OFF** switch to OFF.
2. Refer to the following figure to remove screws 1 and 2 from the CPU module. Or remove screws 3 and 4 from the GNDU/ADC module.
3. Refer to the following figure to screw the Module Extractor (part number 04142-24099) into the screw hole for the Module Extractor on the module.
4. Holding the Module Extractor, gently pull the module free from its mainframe connector, and remove the module.

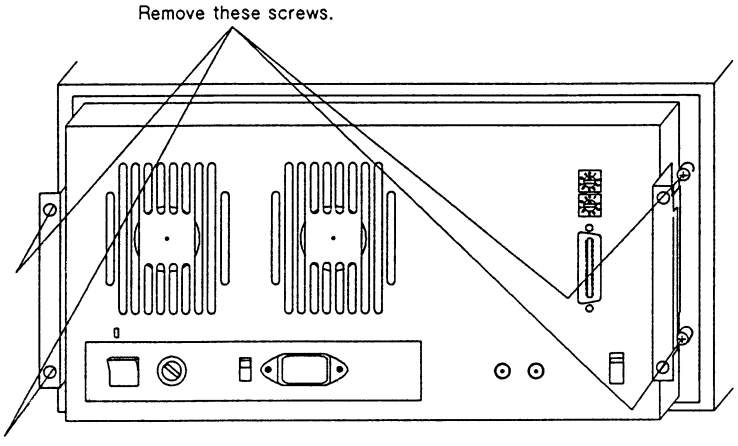


CPU and GNDU/ADC Module Removal

PS MODULE REMOVAL

To remove the PS module, perform as follows:

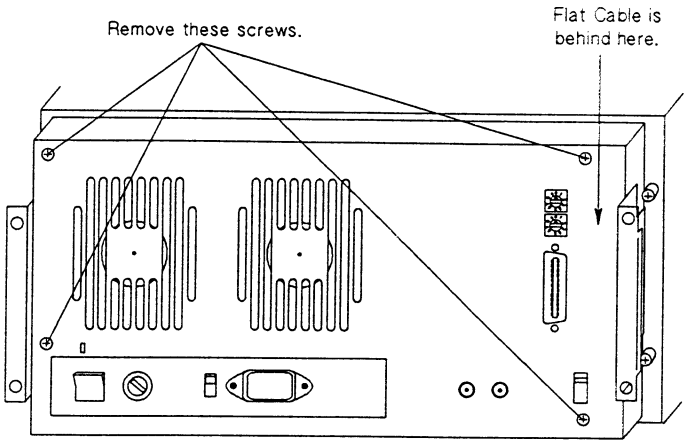
1. Set the **LINE ON/OFF** switch to OFF.
2. Remove the power cord. Wait 10 seconds.
3. Refer to the following figure and, with a slotted screwdriver, loosen four screws on the PS module.
4. Gently pull the PS module free from its mainframe connector, and remove the module.



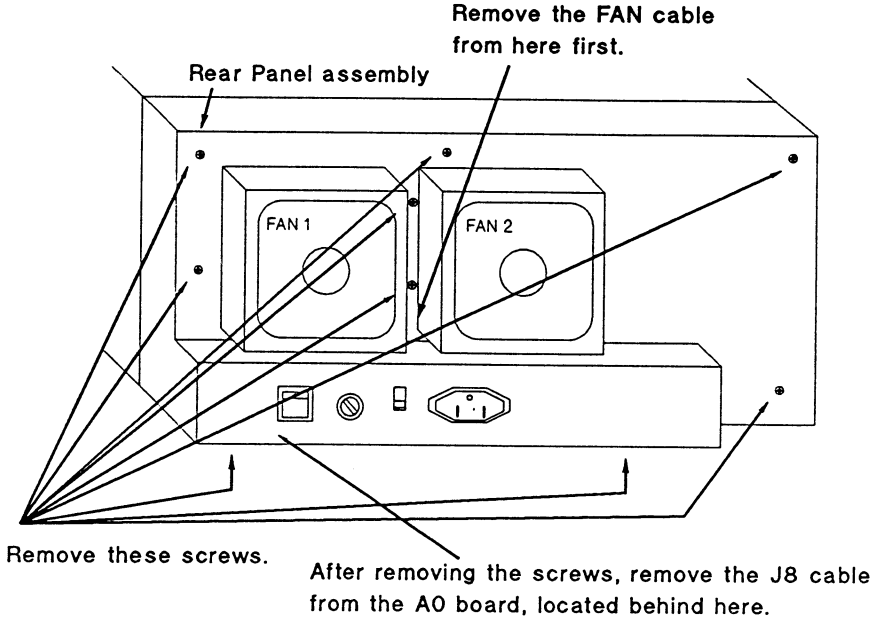
PS Module Removal

Removal of PS Module Assemblies

The following two figures show the removal of the PS module fan cover and rear panel assembly, respectively.



Fan Cover Removal of PS Module



Rear Panel Assembly Removal of PS Module

MODULE INSTALLATION

To install the Front Panel or modules except the PS module, perform as follows:

1. Set the **LINE ON/OFF** or **POWER ON/OFF** switch to OFF.
2. To prevent damage to the equipment, wait at least ten seconds.
3. Install the Front Panel or module by reversing the removal procedures.

To install the PS module, perform as follows:

1. Remove the power cord.
2. Install the PS module by reversing the removal procedure.

CHAPTER 6
TROUBLESHOOTING

CONTENTS

INTRODUCTION

This chapter contains information and instructions for troubleshooting and repairing the HP 4142B.
For the required equipment, refer to chapter 1.

Safety Considerations

The HP 4142B complies with international safety standards. The information in this section, including all warnings, cautions, and notes, must be observed to ensure the safety of service personnel and to prevent damage to the instrument. Only qualified service personnel should perform the troubleshooting described in this section.

Be aware that it is possible for capacitors to remain charged after you turn the HP 4142B off or unplug it from the power source.

WARNING

SOME PROCEDURES DESCRIBED IN THIS CHAPTER ARE PERFORMED WITH POWER APPLIED AND PROTECTIVE COVERS REMOVED. DANGEROUS VOLTAGES UP TO ±1000 V MAY BE PRESENT ON THE BOARDS. DO NOT TOUCH THE BOARDS: CONTACT WITH HIGH VOLTAGE CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

FOR PROCEDURES THAT DO NOT REQUIRE POWER, PERFORM THE PROCEDURE WITHOUT POWER APPLIED. AFTER COMPLETING PROCEDURES, BE SURE THAT ALL SAFELY FEATURES ARE INTACT AND FUNCTIONING PROPERLY AND THAT ALL PROTECTIVE GROUNDING IS INTACT.

TROUBLESHOOTING

Troubleshooting Flow Diagram

The following figure contains a flow diagram to guide you through the troubleshooting process. Turn the HP 4142B off and follow the instructions given in the flow diagram. In this flow diagram, note the following:

- Refer to chapter 4 for the locations of the assemblies and parts specified in the flow diagram.
- If the instruction is "Refer to next paragraph.", refer to the next paragraph in "Power Supply Module Output Voltage Test."
- If you find that the HP 41420A SMU or HP 41423A HVU fails in the flow diagram, perform the board-level troubleshooting described later in this chapter.
- To test the Control Unit, perform the test described later in this chapter.

WARNING

POTENTIAL SHOCK HAZARD. DANGEROUS VOLTAGES MAY BE PRESENT ON THE FOLLOWING BOARD ASSEMBLY (INCLUDES SHIELD COVER) FOR UP TO 10 SECONDS AFTER YOU SET THE LINE ON/OFF SWITCH TO OFF.

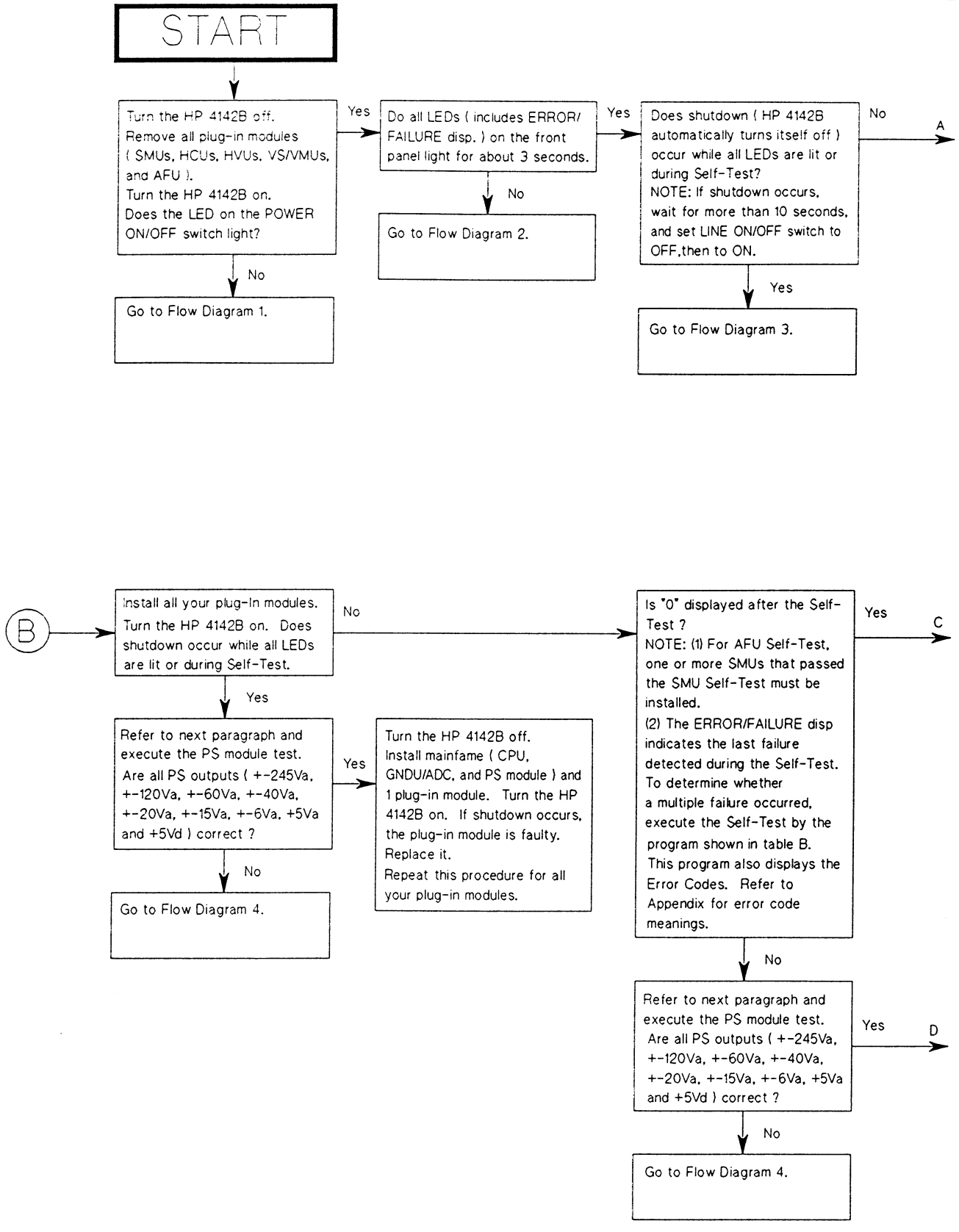
HVU MODULE: MAX. ±1000 V
POWER SUPPLY MODULE: MAX. ±340 V
OTHER MODULES AND A5 MOTHER BOARD: MAX. ±250 V

DANGEROUS VOLTAGES (MAX. ±340V) MAY BE PRESENT ON THE A0 PS PRIMARY BOARD ASSEMBLY (INCLUDES SHIELD COVER) AND A3 PS LINE FILTER BOARD ASSEMBLY WHEN THE LINE ON/OFF SWITCH IS ON, EVEN IF THE POWER ON/OFF SWITCH IS OFF.

CAUTION

To prevent damage to HP 4142B modules, be sure to turn your HP 4142B OFF and wait for at least 10 seconds before you install modules.

NOTES



Troubleshooting Flow Diagram (1a of 4)

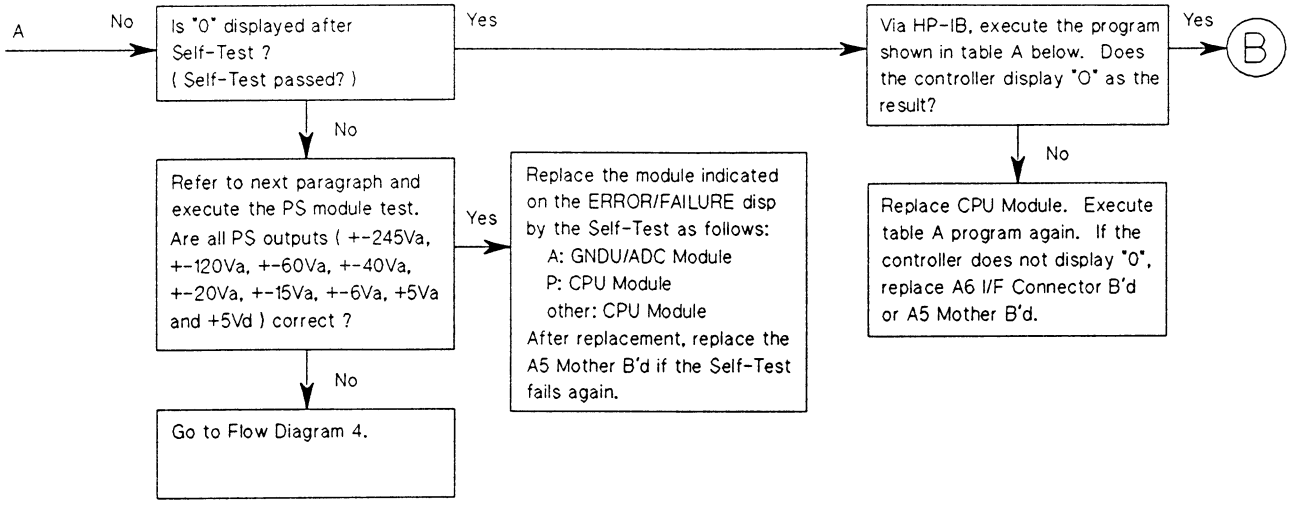


Table A.

```
10 Hp4142=717
20 OUTPUT Hp4142;"*TST?"
30 ENTER Hp4142;A$
40 PRINT "Result: ";A$
50 END
```

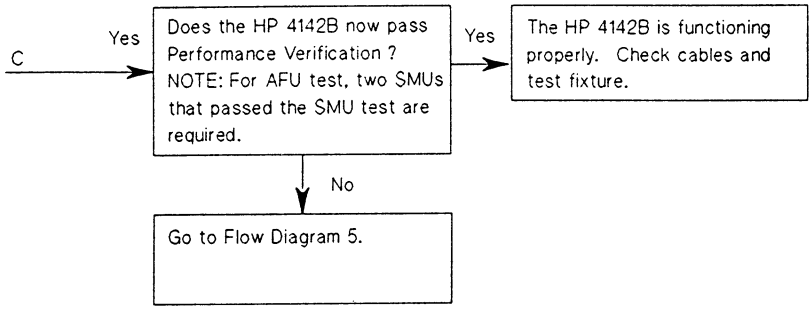
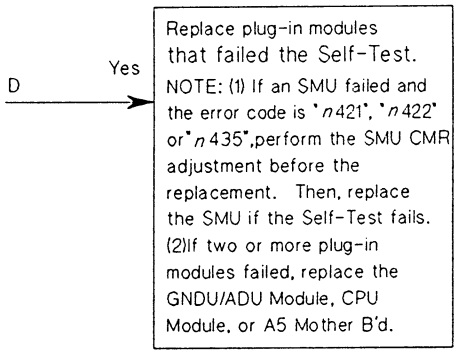
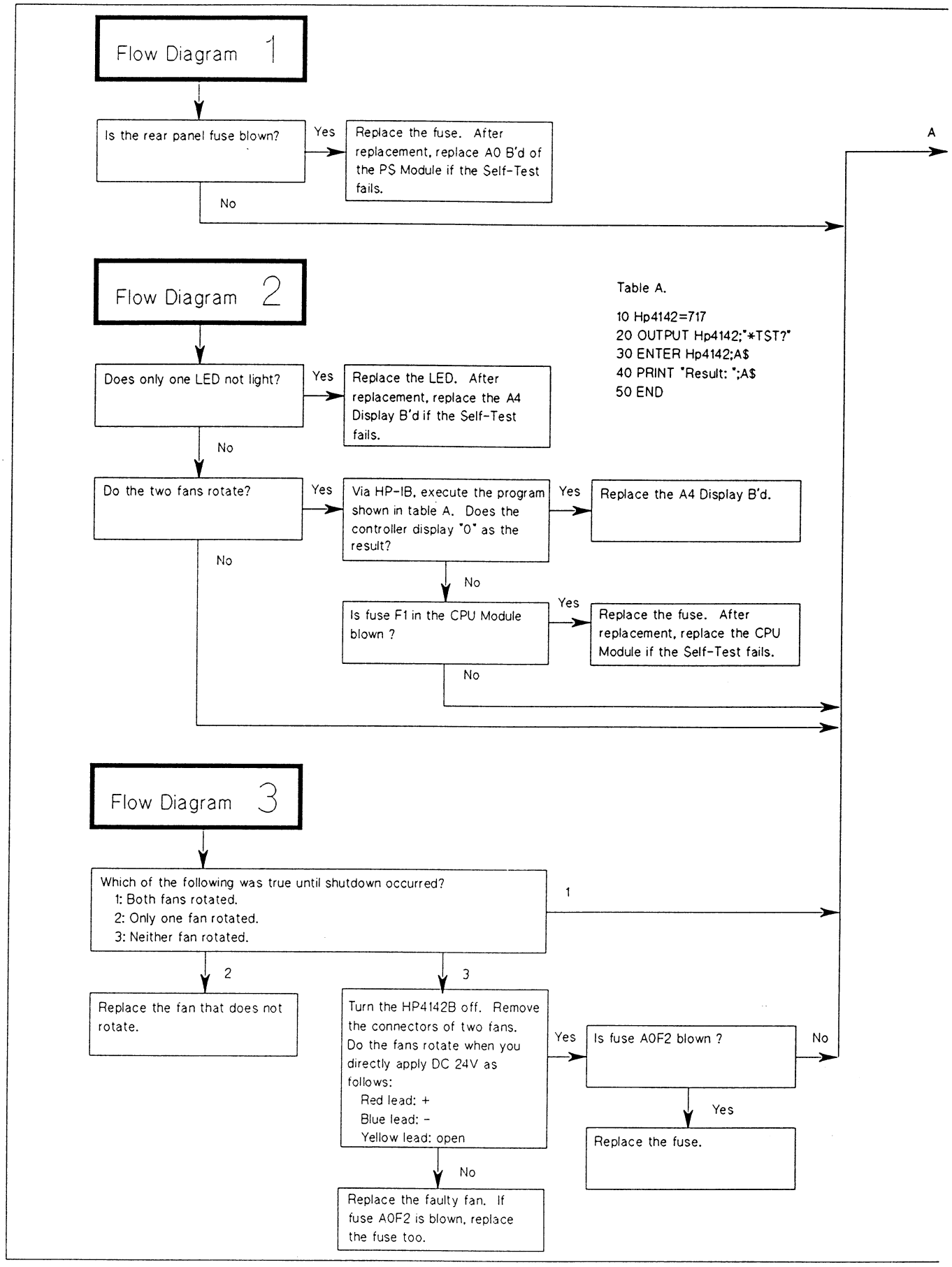


Table B.

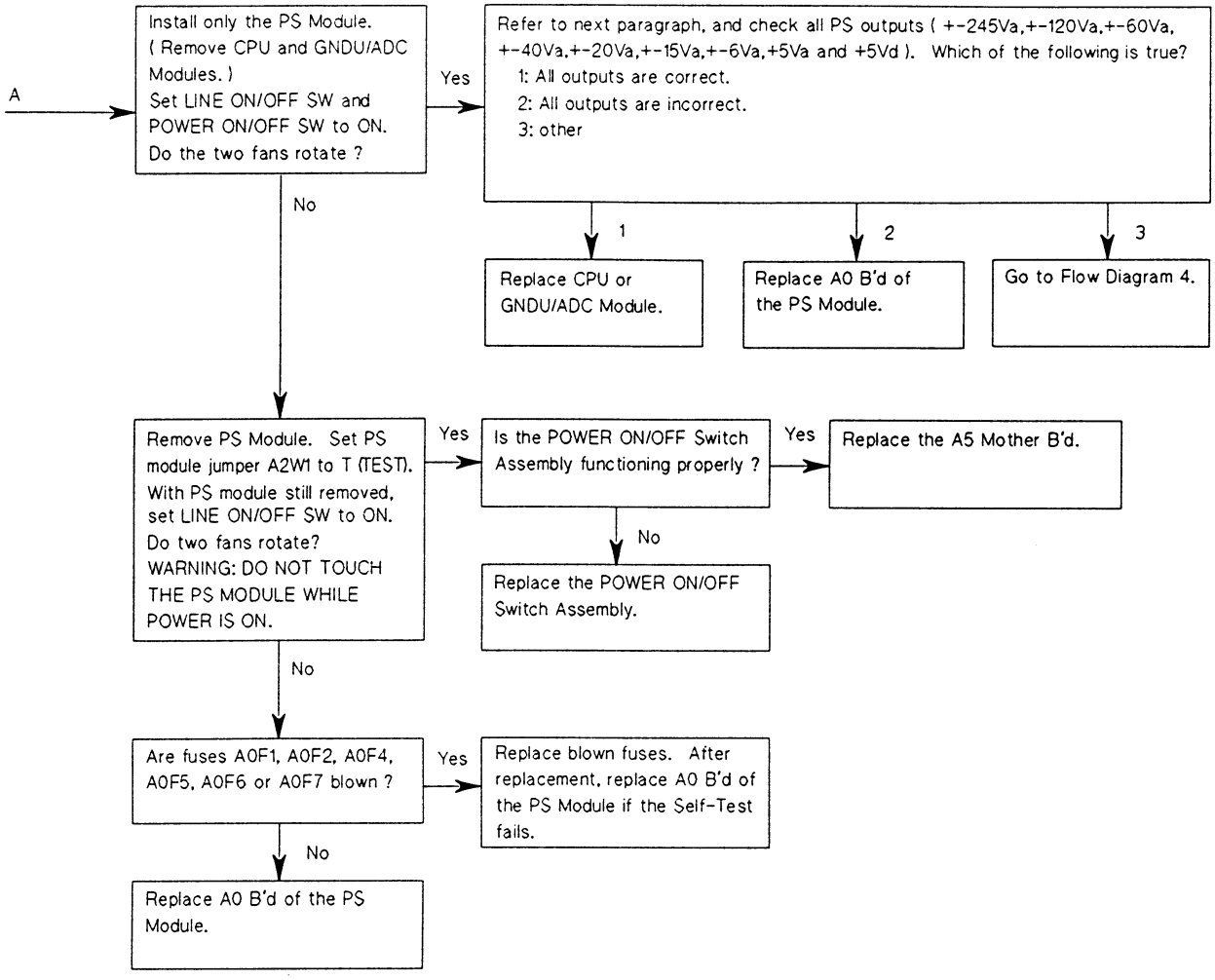
```
10 DIM A$[3], Result$[16], Error$[23]
20 Hp4142=717
30 OUTPUT Hp4142;"*TST?"
40 ENTER Hp4142;A$
50 Result$=IVAL$(VAL(A$),2)
60 Result$=Result$[8,16]
70 ! Result$=xxxxxxxxx   x=0:pass,   x=1:fail
80 !            ||          |
90 ! Mainframe Slot#8 #1
100 OUTPUT Hp4142;"ERR?"
110 ENTER Hp4142;Error$
120 Print"Mainframe87654321"
130 PRINT "Result: ";Result$
140 PRINT "Error Codes: ";Error$
150 END
```



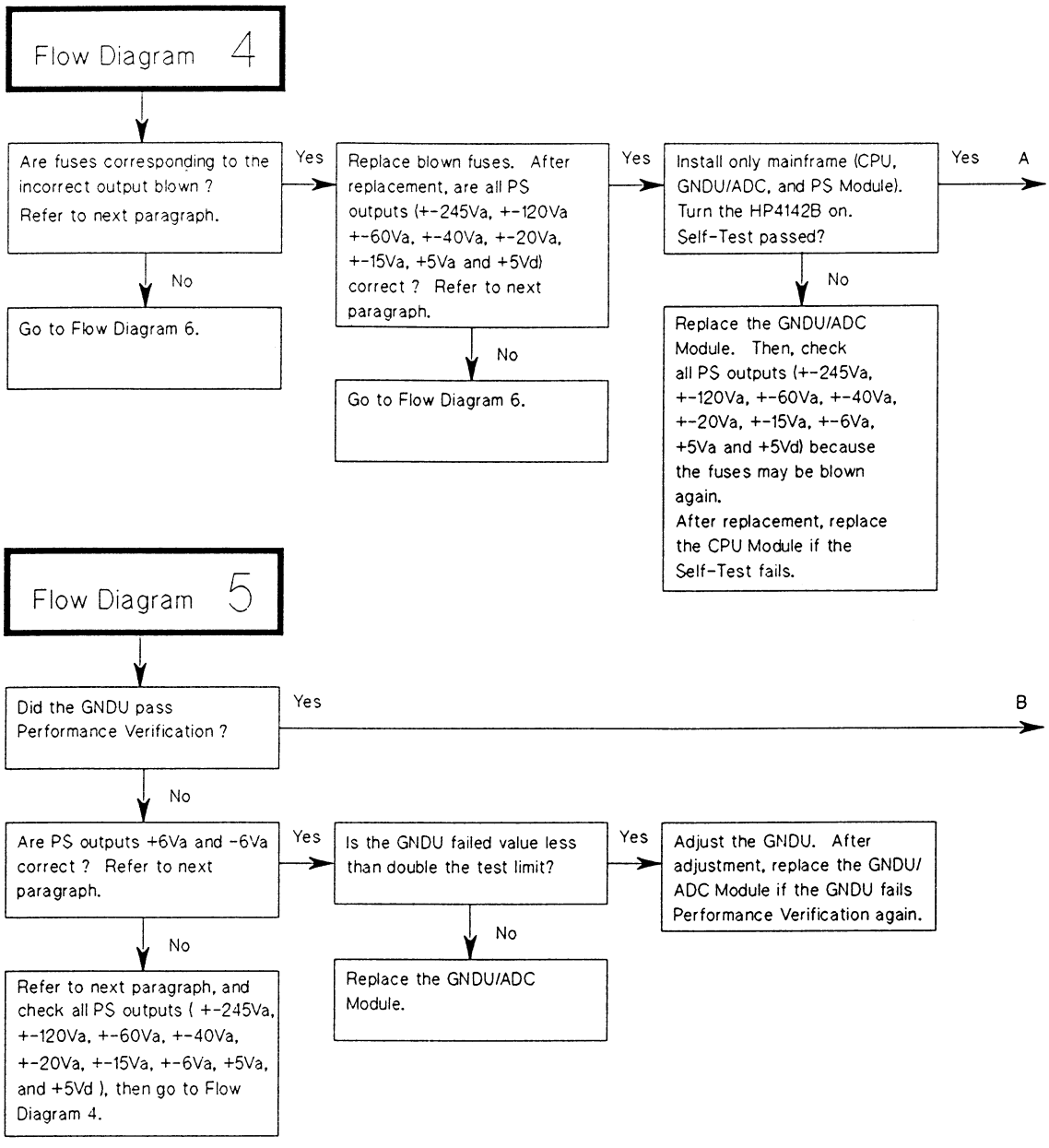
Troubleshooting Flow Diagram (1b of 4)



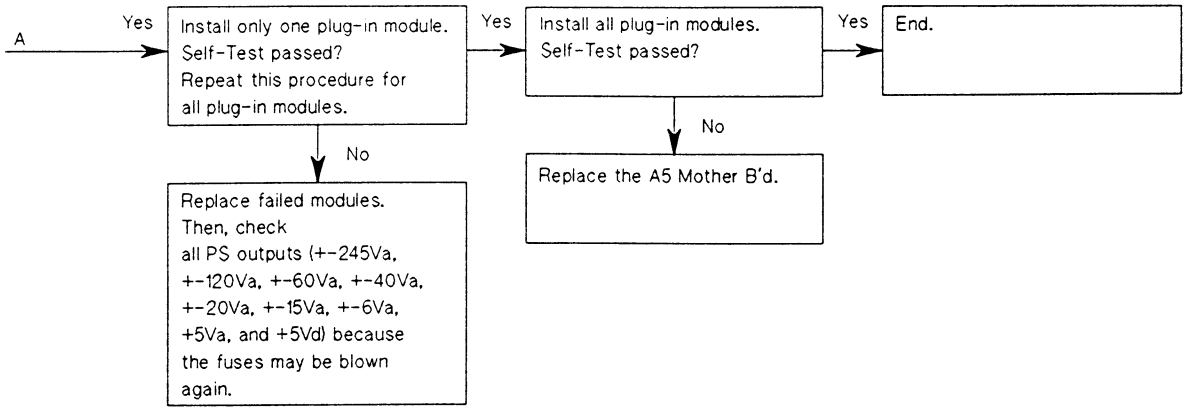
Troubleshooting Flow Diagram (2a of 4)

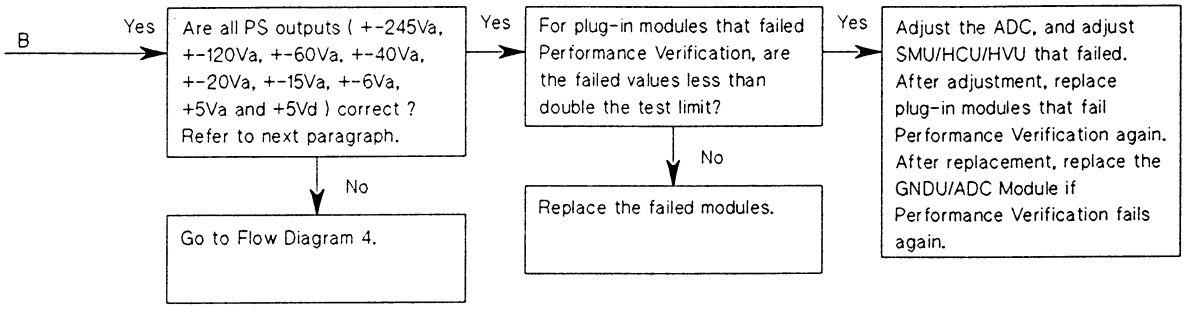


Troubleshooting Flow Diagram (2b of 4)

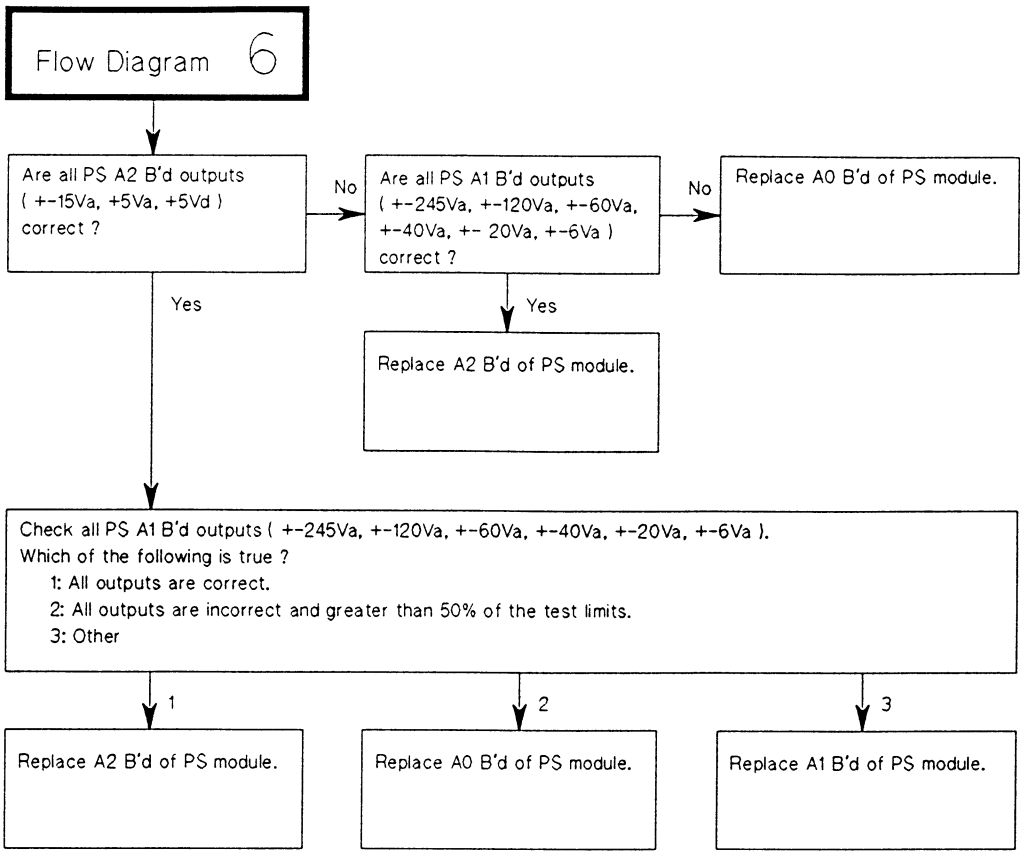


Troubleshooting Flow Diagram (3a of 4)





Troubleshooting Flow Diagram (3b of 4)



Troubleshooting Flow Diagram (4 of 4)

Power Supply Module Output Voltage Test

As a safety feature, the Power Supply Module (PS Module) dc output voltage test is performed via the Power Supply Monitor Port Unit (PSMPU).

The PSMPU attenuates the PS Module output voltages (max. about ±250V) on the A5 Mother Board to less than 42V. The attenuation factor is x0.1 when the nominal output voltage is greater than 42V, or x1 when the nominal output voltage is less than or equal to 42V. The test procedure is as follows:

Required Equipment

- Power Supply Monitor Port Unit (part number 09480-65002)
- Digital Volt Meter (Accuracy ≤ 0.1%, Input Impedance ≥ 10MΩ, for example HP 3456A and HP 3458A)
- Test Lead for PSMPU (part number 09480-61200)

Power Supply Module Tested Signal Names

+245Va, -245Va, +120Va, -120Va, +60Va, -60Va, +40Va, -40Va, +20Va, -20Va, +15Va, -15Va, +6Va, -6Va, +5Va, and +5Vd.

Procedure

1. Set the **Power ON/OFF** switch to OFF.
2. Remove the CPU module, the GNDU/ADC module, and all plug-in modules. Install the PSMPU in the GNDU/ADC slot.
3. Set the **LINE ON/OFF** and **POWER ON/OFF** switches to ON.
4. Use the test lead to connect J1-1 (TP and REF) of the PSMPU to DVM HI and LO as shown in the following figure. This is the +245Va signal. Measure the dc voltage and compare it to the corresponding Test Limits (dc) listed in the following table.
5. Perform procedure 4 for the following pins:

   J1-2 (-245Va), J1-3 (+120Va), J1-4 (-120Va), J1-5 (+60Va), J1-6 (-60Va), J1-7 (+6Va), J1-8 (-6Va), J1-9 (+40Va), J1-10 (-40Va), J1-11 (+20Va), J1-12 (-20Va), J1-13 (+15Va), J1-14 (-15Va) and J1-15 (+5Va).
6. Set the **POWER ON/OFF** switch to OFF.
7. Remove the PSMPU from the GNDU/ADC slot, and install it in the CPU slot.
8. Perform procedure 4 for J3-1 (+5Vd).

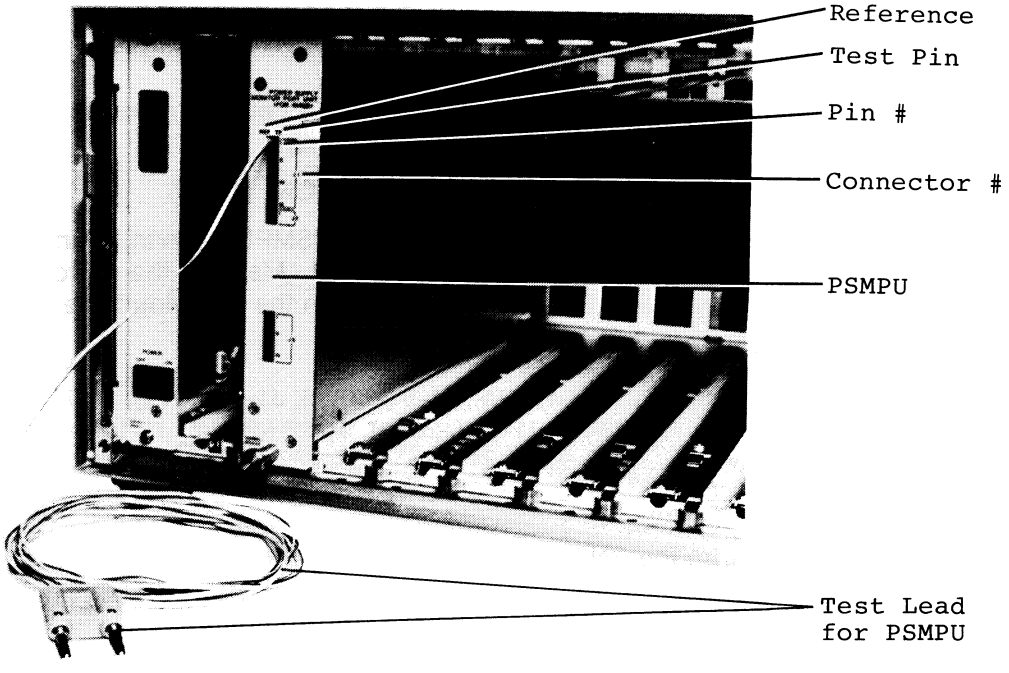
NOTE

- Do not connect unspecified PSMPU pins.
- When connecting the DVM test leads to TP and REF, be sure to use the REF that corresponds to the TP, not the REF of another TP.
- Remove the CPU, GNDU/ADC, and all plug-in modules before performing this test. This is a no-load test of the Power Supply Module.
- The following signals can be tested with the PSMPU installed in any slot number from 1 to 8:

  +245Va, -245Va, +120Va, -120Va, +60Va, -60Va, +40Va, -40Va, +20Va, -20Va, +15Va, -15Va, and +5Va
- If the DVM connected to the PSMPU has an input impedance of 10MΩ, the PSMPU accuracy is ±0.8% (for x1) or ±1.1% (for x0.1).

Fuses Corresponding to each PS Module Output

The following second table lists the fuses that correspond to each PS Module signal. If a signal output is not within limits, check the corresponding fuse.



Power Supply Monitor Port Unit

Power Supply Module Output Voltage Test Limits

Signal Name	Slot for PSMPU	PSMPU Pin#	PSMPU Att.	Test Limits (dc)
+245Va (+232+35-22V)	GNDU/ADC slot	J1-1	x0.1	21.0 to 26.7V
-245Va (-232-35+22V)		J1-2	x0.1	-21.0 to -26.7V
+120Va (+125+19-12V)		J1-3	x0.1	11.3 to 14.4V
-120Va (-125-19+12V)		J1-4	x0.1	-11.3 to -14.4V
+60Va (+61.5+9.9-6.5V)		J1-5	x0.1	5.50 to 7.14V
-60Va (-61.5V-9.9+6.5V)		J1-6	x0.1	-5.50 to -7.14V
+6Va (+6+1.35-1V)		J1-7	x1	5.00 to 7.35V
-6Va (-6-1.35+1V)		J1-8	x1	-5.00 to -7.35V
+40Va (+35+5.7-3.8V)		J1-9	x1	31.2 to 40.7V
-40Va (-35-5.7+3.8V)		J1-10	x1	-31.2 to -40.7V
+20Va (+15+2.9-2V)		J1-11	x1	13.0 to 17.9V
-20Va (-15-2.9+2V)		J1-12	x1	-13.0 to -17.9V
+15Va (+15V±5%)		J1-13	x1	14.25 to 15.75V
-15Va (-15V±5%)		J1-14	x1	-14.25 to -15.75V
+5Va (+5.1V±3%)		J1-15	x1	4.947 to 5.253V
+5Vd (+5.1±3%)	CPU slot	J3-1	x1	-4.947 to -5.253V

Fuses Corresponding to each PS Module Output Voltage

Signal Name	Fuse	Fuse Rating
+245Va	A1F7	1A
-245Va	A1F7	1A
+120Va	A1F10	0.5A
-120Va	A1F9	0.5A
+60Va	A1F12	1A
-60Va	A1F11	1A
+40Va	A1F6	2A
-40Va	A1F5	2A
+20Va	A1F4	2A
-20Va	A1F3	2A
+15Va	A2F3	4A
-15Va	A2F4	4A
+6Va	A1F2	3A
-6Va	A1F1	3A
+5Va	A2F1, A2F2	3A
+5Vd	A2F7, A2F8	7A

Board-level Troubleshooting for HP 41420A SMU

This paragraph describes the board-level replacement troubleshooting basis for the HP 41420A SMU. You can perform this troubleshooting if the HP 41420A SMU fails the Self-Test.

The HP 41420A SMU consists of three PC boards; A1 SMU Main board, A2 Output Floating board, and A3 4V Floating board. One or more of these boards may replace in this troubleshooting.

Required Equipment

- Computer
- Screwdriver

Procedure

WARNING

DANGEROUS VOLTAGES (MAX. 250 Vdc) ARE PRESENT ON THE HP 41420A PC BOARDS AND THE SHIELD COVERS ON THE PC BOARDS, FOR UP TO 10 SECONDS AFTER YOU SET THE LINE ON/OFF SWITCH TO OFF.

1. If the Self-Test does not pass on the HP 41420A SMU and on the HP 4142B mainframe (CPU, Power suppply, and GNDU/ADC modules), troubleshoot the mainframe at first.

2. Press the SELF-TEST key to perform the Self-Test.

3. Excecute the following program to display the HP 4142B error codes that occurred by the Self-Test failure.

```
10 DIM Error$[23]
20 Hp4142=717
30 OUTPUT Hp4142;"ERR?"
40 ENTER Hp4142;Error$
50 PRINT "Error Codes: ";Error$
60 END
```

4. Set the HP 4142B LINE ON/OFF switch to off, and wait ten seconds.

5. According to the first error code of four error codes, replace the following board of the HP 41420A SMU.

Error Code	Replaced Board [1]
420	A1
421	A1
422	A2
423	A2
424	A1
425	A1
426	A1
427	A2
428	A1
429	A1
433	A1
434	A1
435	A2
436	A3
437	A1

[1] A1: SMU Main Board, A2: Output Floating Board, A3: 4V Floating Board

6. After the replacement, confirm that the Self-Test passes. If the Self-Test still fails, replace a different board.

Board-Level Troubleshooting for HP 41423A HVU

This paragraph describes the board-level replacement basis troubleshooting for the HP 41423A HVU. You can perform this troubleshooting if the HP 41423A HVU fails the Self-Test.

The HP 41423A HVU consists of two PC boards; A1 Floating SMU board and A2 Power Amplifier board. One or both of these boards may replace in this troubleshooting.

Required Equipment

- Computer
- Screwdriver

Procedure

WARNING

DANGEROUS VOLTAGES (MAX. 1000 Vdc) ARE PRESENT ON THE HP 41423A PC BOARDS AND THE SHIELD COVERS ON THE PC BOARDS, FOR UP TO 10 SECONDS AFTER YOU SET THE LINE ON/OFF SWITCH TO OFF.

1. If the Self-Test does not pass on the HP 41423A HVU and on the HP 4142B mainframe (CPU, Power suppply, and GNDU/ADC modules), troubleshoot the mainframe at first.

2. Press the SELF-TEST key to perform the Self-Test.

3. Excecute the following program to display the HP 4142B error codes that occurred by the Self-Test failure.

```
10 DIM Error$[23]
20 Hp4142=717
30 OUTPUT Hp4142;"ERR?"
40 ENTER Hp4142;Error$
50 PRINT "Error Codes: ";Error$
60 END
```

4. Set the HP 4142B LINE ON/OFF switch to off, and wait ten seconds.

5. If the first error code of four error codes is 549, 551, or 555, go to step 6. If not, according to the first error code, replace the following board of the HP 41423A HVU.

Error Code	Replaced Board [1]
540	A1
541	A1
542	A1
543	A1
544	A1
545	A1
546	A1
547	A1
548	A1
549	Go to next step
550	A1
551	Go to next step
552	A1
553	A1
554	A1
555	Go to next step
556	A1
557	A1
558	A1
559	A1
560	A1
561	A1
562	A1
563	A1
564	A1

[1] A1: Floating SMU Board, A2: Power Amplifier Board

6. If the first error code is 549, 551, or 555, perform this step. If not, go to step 7.

   6.1. If the first error code is 549 and second error code is 556, replace A2 board. Then, go to step 7. You can omit the following steps in step 6.

   6.2. Perform the following. (The following sets the HP 41423A HVU to test mode.)

      a. Set the LINE ON/OFF switch to OFF, and wait ten seconds.

      b. Remove the HVU module from the HP 4142B.

      c. Remove the cover on the left side of the front panel.

      d. Remove the shield cover of the front panel side from the board.

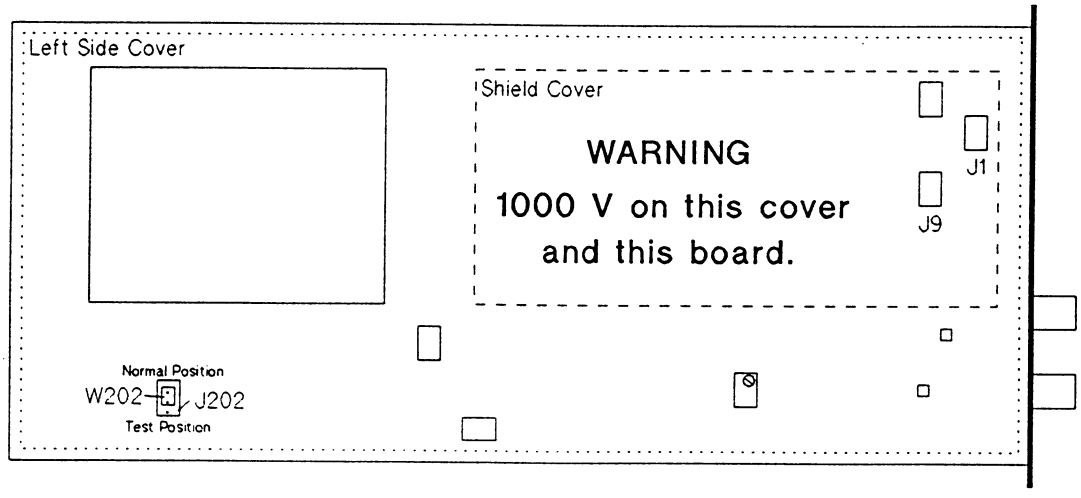
      e. Change the wire from J1 to J9. (Wire: floating SMU common, J1: power amplifier output, J9: circuit common)

      f. Set jumper W202 to the lower two pins on J202 (Test Position). (This sets the HVU to power save mode.)

      g. Install the left side cover to prevent the thermal damage of the HVU and electrical shock during power-on. (You may not install the shield cover of front panel side on the board in this test.)

      h. Install the HVU into the HP 4142B.

      i. Turn the HP 4142B on.



HVU Test Mode Setup

   6.3. Perform the Self-Test, and read the error codes, then turn the HP 4142B off.

6.4. According to the four error codes, replace the following board of the HP 41423A HVU.

Error Code in step 5	Four Error Codes in step 6	Replaced Board
549	Include 549 or 550.	A1
	Do not include 549 and 550.	A2
551	Include 549 or 550.	A1
	Do not include 549 and 550.	A2
555	Include 555.	A1
	Do not include 555.	A2

6.4. Return the wire and jumper, and install the shield cover and left side cover.

7. After the replacement, confirm that the Self-Test passes. If the Self-Test still fails, replace the other board.

Control Unit (Option 300) Test

To test the Control Unit (HP 4142B Option 300), perform the two tests; module selector control pins test, and external relay control pins (16-bit TTL digital output pins) test.

Required Equipment

- Computer
- 10 kΩ resistor
- Voltmeter
- Miniature pin plug lead (115 mm, for accessing the pin of the control unit.)

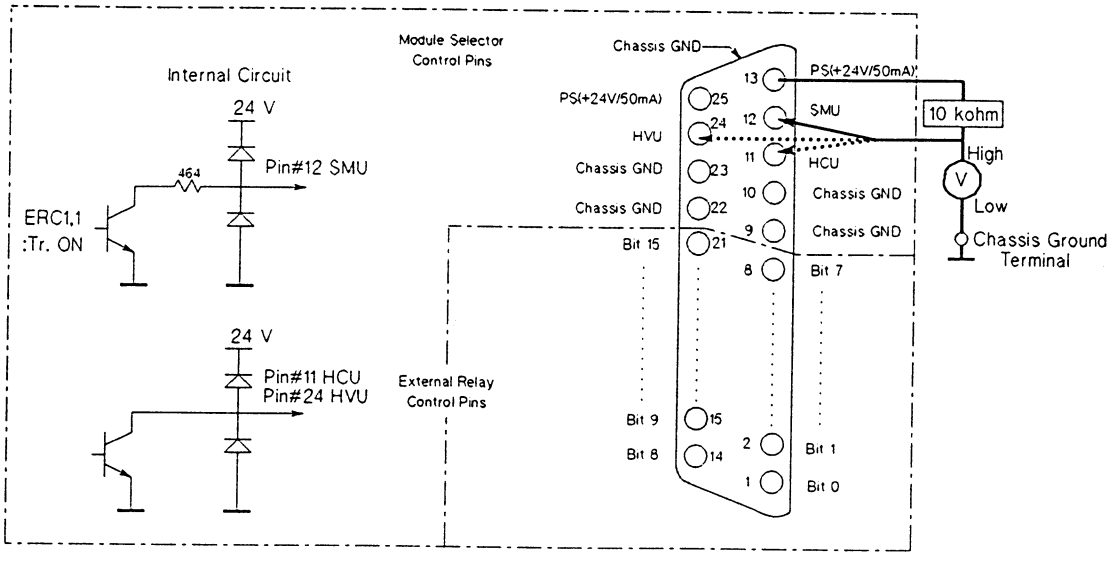
Procedure

- Module Selector Control Pins Test

1. Measure the voltage between pin#13 and the chassis ground terminal, and between pin#25 and the chassis ground terminal. Confirm that the voltage is within the test limit: 24 V ±1.2 V.

2. As shown in the following figure, connect the 10 kΩ resistor, execute the ERC command, and measure the voltage between chassis ground and pin#12 (SMU), between chassis ground and pin#11 (HCU), and between chassis ground and pin#24 (HVU). Confirm that the voltages are within the following test limits.

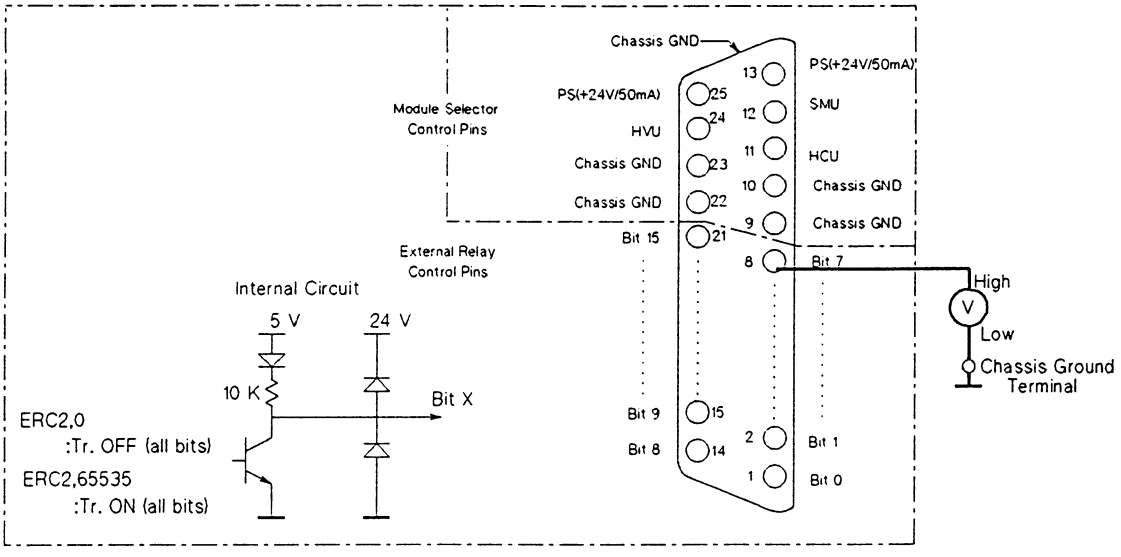
10 kΩ Location	Command	Meas. Pin#	Test Limit
Between pin#13 & #12	OUTPUT 717;"ERC1,0"	pin#12 (SMU)	> 22 V
Between pin#13 & #11	OUTPUT 717;"ERC1,0"	pin#11 (HCU)	> 22 V
Between pin#13 & #24	OUTPUT 717;"ERC1,0"	pin#24 (HVU)	> 22 V
Between pin#13 & #12	OUTPUT 717;"ERC1,1"	pin#12 (SMU)	< 1.5 V
Between pin#13 & #11	OUTPUT 717;"ERC1,3"	pin#11 (HCU)	< 1.5 V
Between pin#13 & #24	OUTPUT 717;"ERC1,2"	pin#24 (HVU)	< 1.5 V



- External Relay Control Pins Test

1. Connect the Low terminal of the voltmeter to the chassis ground.
2. Execute the command: OUTPUT 717;"ERC2,0"
3. Measure the voltage of each pin: pin#1 through pin#8, and pin#14 through pin#21. Confirm that each voltage is within the test limit as shown in the following figure.
4. Execute the command: OUTPUT 717;"ERC2,65535"
5. Perform the step 3.

Command	Meas. Pin#s	Test Limit
OUTPUT 717;"ERC2,0"	1 to 8, 14 to 21	> 4.0 V
OUTPUT 717;"ERC2,65535"	1 to 8, 14 to 21	< 0.3 V



NOTE

The Self-Test does not test the control unit. Therefore, even if the control unit fails, the HP 4142B may indicate no error in the Self-Test.

CHAPTER 7
THEORY OF OPERATION

CONTENTS

INTRODUCTION

This chapter provides a simplified explanation of HP 4142B circuit operation to aid in troubleshooting the HP 4142B. Included are the following sections:

- HP 4142B GENERAL OVERVIEW
- HP 4142B POWER SUPPLY SECTION
- GNDU/ADC
- SMU
- HCU
- HVU
- VS/VMU
- AFU

HP 4142B GENERAL OVERVIEW

The following figure shows the overall HP 4142B block diagram.

Output Flow

1. The CPU module (CPU) receives an output setting command via the HP-IB bus.
2. The CPU interprets the command. If the INTLK terminal is open and the specified voltage value or voltage compliance is greater than ±42V, the CPU asserts an error and stops operation (the following steps are not performed).
3. The CPU calculates the DAC setting value of the specified source unit--using the calibration data of the specified source unit--and the output range. The calibration data is obtained during Self-Calibration. Each source unit has a DAC.
4. The CPU sets the DAC and the output range.
5. The source unit outputs the specified voltage or current.

Measurement Flow

1. The CPU receives a trigger command for measurement via the HP-IB bus.
2. The CPU interprets the command.
3. The CPU sets the measurement range of the specified measurement unit.
4. The CPU connects the measurement bus to the specified measurement unit by closing the appropriate connection switch in the measurement unit. The measurement bus transmits the voltage or current monitor signal from the measurement unit to the ADC.
5. As instructed by the CPU, the ADC converts the voltage or current monitor signal (analog signal) into a digital signal.
6. The CPU receives the digital signal from the ADC, and calculates the measurement value using the measurement range and the calibration data of the measurement unit and the ADC.
7. The CPU stores the measurement data in the output data buffer. The computer that controls the HP 4142B can now read the measurement data from the output data buffer.

There is only one ADC, and it is located in the GNDU/ADC module. Multi-channel measurements are possible when a source unit is set to spot or staircase sweep output. For multi-channel measurements, steps 3 to 7 are repeated for each measurement channel, so the timing for each channel is slightly different.

Analog Search Measurement Flow

Analog search measurements are performed by using the AFU and two SMUs. The AFU controls the output of one SMU (search SMU) to the DUT until the DUT output voltage or current monitored by the other SMU (sense SMU) is equal to the specified target value, then the HP 4142B measures the voltage or current of the search SMU and the sense SMU (if specified). The following describes the analog search measurement flow:

1. The CPU connects the AFU to the search SMU via the search bus, and to the sense SMU via the sense bus, by closing the appropriate switch in each SMU.
2. The AFU outputs the reference ramp voltage to the search SMU.
3. The search SMU amplifies the reference ramp voltage according to the specified voltage output range, and outputs the ramp voltage to the DUT.
4. The sense SMU monitors the DUT output voltage or current. The sense SMU is set to I source mode for monitoring voltage, or set to V source mode for monitoring current.
5. The AFU receives the monitored signal (analog signal) via the sense bus, and compares the monitored signal to the target value until the monitored signal exceeds the target value. For ramp searches, the HP 4142B now measures the voltage or current of the search SMU and the sense SMU (if specified), then disconnects the search and sense bus. For ramp searches, this is the last step.
6. For feedback searches, feedback now starts. The AFU detects the difference between the monitored signal and the target value, and outputs a reference control voltage, in proportion to the difference value, to the search SMU.
7. The search SMU amplifies the reference control voltage, and outputs it to the DUT.
8. This feedback process continues until the monitored value equals the target value, then the HP 4142B measures the voltage or current of the search SMU and the sense SMU (if specified).
9. The CPU disconnects the search bus and sense bus.

HP-IB and Trigger Transmission Path

HP-IB signals are transmitted to the CPU via the following path: rear panel HP-IB connector, A6 Interface Connector Board Assembly, PS module cable assembly, and A5 Mother Board Assembly. The CPU interprets HP-IB signals, and controls the SMUs, HCUs, VS/VMUs, AFU, ADC, and front panel LEDs accordingly.

Triggers are output to the **TRIGGER OUTPUT** terminal and input from the **TRIGGER INPUT** terminal via the same path as HP-IB signals.

Chassis Common Circuitry and Floating Common Circuitry

HP 4142B circuitry can be divided into chassis common circuitry (CHASSIS GROUND) and floating common circuitry (CIRCUIT COMMON). Chassis common circuitry provides the following:

- HP 4142B control
- Communication with other instruments via HP-IB, trigger input, trigger output, INTLK input, and CONTROL output.
- Communication with the user via the display and the **LOCAL/SELF TEST** key

Floating common circuitry is responsible for analog-to-digital and digital-to-analog conversions. To ensure proper common isolation between the two sections, the two sections communicate with each other through an optoisolator in the CPU.

When the shorting bar on the GNDU/ADC front panel is connected, the floating common circuitry (enclosed in dashed lines in the following figure) is tied directly to CHASSIS GROUND. When the shorting bar is disconnected, the floating common circuitry is completely isolated from the chassis common circuitry. Regardless of whether the shorting bar is connected or not, outputs and measurements are always referenced to CIRCUIT COMMON.

Power Supply (PS) Module

The PS module supplies power to the CPU, GNDU/ADC, and plug-in modules. There are 18 PS outputs. Seventeen of the outputs (5V to 250V) are referenced to CIRCUIT COMMON. One output (5V) is referenced to CHASSIS GROUND.

The **LINE ON/OFF** switch connects or disconnects the AC line. The **POWER ON/OFF** switch turns on or off the power supply secondary circuit.

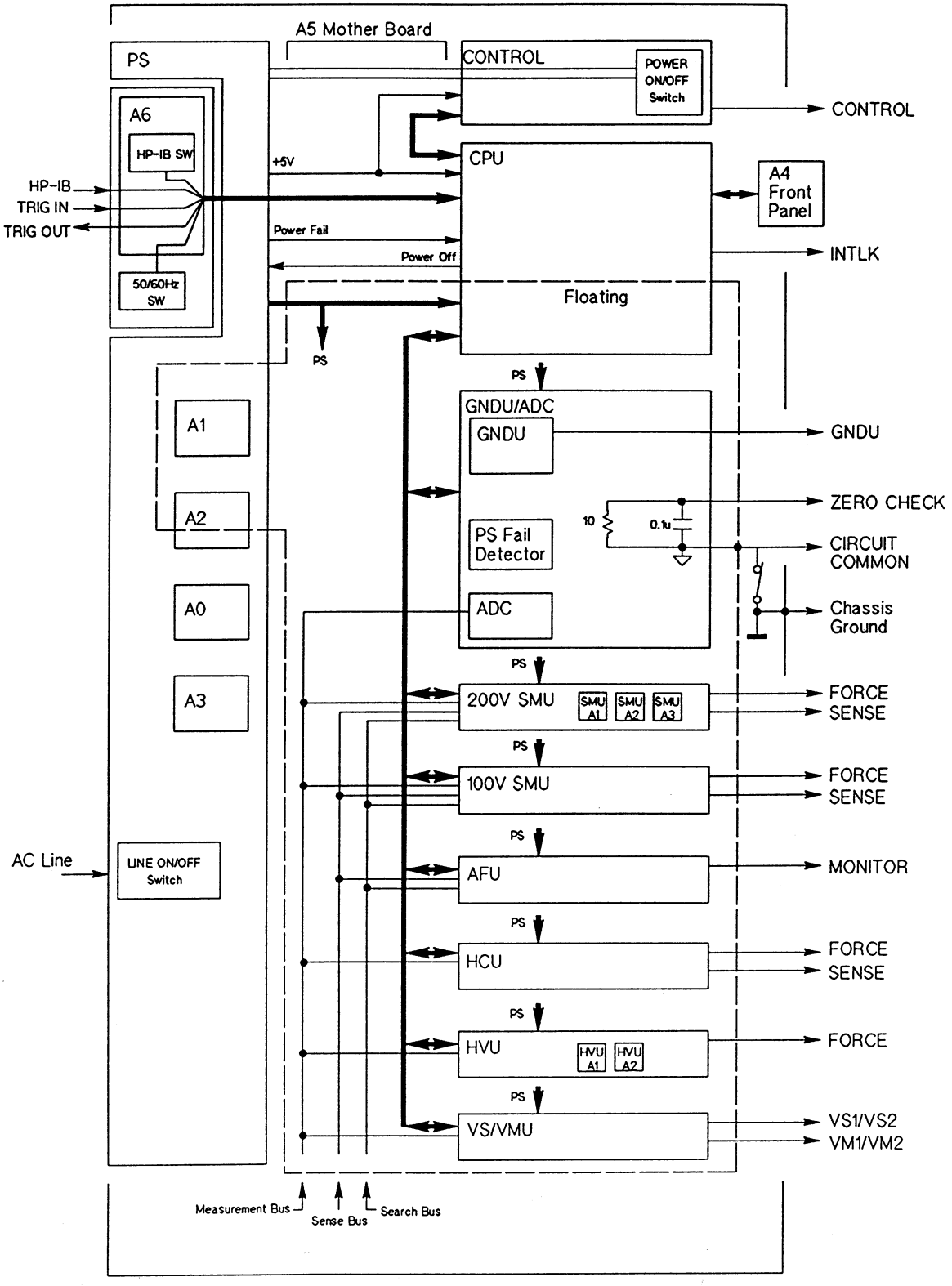
Shutdown Flow

If an abnormal voltage or current occurs in the PS, GNDU, SMUs, HCUs, HVUs, VSs, or VMs, the HP 4142B automatically shuts down to prevent damage. Abnormal voltage or current can be caused by improper connection of the HP 4142B to the DUT, overvoltage or overcurrent input, HP 4142B defects, and so on. Shutdown occurs as follows:

1. If the PS, GNDU, SMUs, HCUs, HVUs, VSs, or VMs detects an abnormal voltage, the CPU is notified. Abnormal PS voltage is also detected by the PS Fail Detector in the GNDU/ADC module.
2. The CPU sets all source unit outputs to 0V, and all source unit output switches to OFF.
3. If the abnormal voltage or current is corrected, "**H**" is displayed on the **ERROR/FAILURE** display. If not, the CPU turns the power supply OFF. The condition is equivalent to the **POWER ON/OFF** switch being set to OFF while the **LINE ON/OFF** switch remains ON.

NOTES

HP 4142B Modular DC Source / Monitor



HP 4142B Overall Block Diagram

HP 4142B POWER SUPPLY SECTION

The following figure shows the block diagram of the HP 4142B power supply section. When the **LINE ON/OFF** switch is set to ON, and the **POWER ON/OFF** switch is set to OFF, AC line voltage is applied to the AC-DC (280V) converter via line filter #1, line filter #2, and the varistor. The AC-DC (280V) converter outputs 280V (for 100Vac), 310V (for 220Vac), or 340V (for 120Vac or 240Vac).

The varistor turns on if more than 150V is applied when the **LINE VOLTAGE SELECTOR** switch is set to 100V or 120V, or if more than 300V is applied when it is set to 220V or 240V. If the varistor turns on, the fuse will blow, thus protecting the circuit.

When the **LINE ON/OFF** switch is set to ON, AC line voltage is also applied to the AC-DC (15V) converter. Power is supplied to the power on/off detector and power on/off logic via the AC-DC (15V) converter.

Next, when the POWER ON/OFF switch is set to ON, the PS operates as follows:

1. The power on/off detector detects that the POWER ON/OFF switch was set to ON.
2. The power on/off logic enables the switching regulator and the DC-AC (155Vp-p) converter.
3. The switching regulator converts the AC-DC (280V) converter output to 155Vdc.
4. The DC-AC (155Vp-p) converter converts the 155Vdc output to 155Vp-p at 50kHz.
5. The transformers transmit this output to the secondary power supply (A1 and A2).
6. The secondary power supply performs the AC-DC conversion.
7. The secondary power supply outputs the voltages listed in the following table to the destinations listed in the following second table.

PS Module Output Voltages

Assembly	Signal	DC/AC	Output Voltage	Common
A1	+6Va	DC	+6(+1.35-1)V	CIRCUIT
A1	-6Va	DC	-6(-1.35+1)V	CIRCUIT
A1	+20Va	DC	+15(+2.9-2)V	CIRCUIT
A1	-20Va	DC	-15(-2.9+2)V	CIRCUIT
A1	+40Va	DC	+35(+5.7-3.8)V	CIRCUIT
A1	-40Va	DC	-35(-5.7+3.8)V	CIRCUIT
A1	+60Va	DC	+61.5(+9.9-6.5)V	CIRCUIT
A1	-60Va	DC	-61.5(-9.9+6.5)V	CIRCUIT
A1	+120Va	DC	+125(+19-12)V	CIRCUIT
A1	-120Va	DC	-125(-19+12)V	CIRCUIT
A1	+245Va	DC	+232(+35-22)V	CIRCUIT
A1	-245Va	DC	-232(-35+22)V	CIRCUIT
A2	+5Vd	DC	+5.1V±3%	Chassis
A2	+5Va	DC	+5.1V±3%	CIRCUIT
A2	+15Va	DC	+15V±3%	CIRCUIT
A2	-15Va	DC	-15V±3%	CIRCUIT
A2	AC1	AC	11Vp	CIRCUIT
A2	AC2	AC	11Vp	CIRCUIT

PS Module Output Destinations

Assembly	Signal	Output Destination								
		CPU	GNDU /ADC	SMU 200V	SMU 100V	HCU	HVU	VS/ VMU	AFU	CTLU
A1	+6Va		YES							
A1	-6Va		YES							
A1	+20Va		YES	YES		YES	YES	YES		
A1	-20Va		YES	YES						
A1	+40Va		YES	YES	YES	YES	YES	YES		
A1	-40Va		YES	YES	YES	YES	YES	YES		
A1	+60Va		YES	YES	YES		YES	YES		
A1	-60Va		YES	YES	YES		YES	YES		
A1	+120Va		YES	YES	YES					
A1	-120Va		YES	YES	YES					
A1	+245Va		YES	YES						
A1	-245Va		YES	YES						
A2	+5Vd	YES								YES
A2	+5Va	YES	YES	YES	YES	YES	YES	YES	YES	
A2	+15Va		YES	YES	YES	YES	YES	YES	YES	
A2	-15Va		YES	YES	YES	YES	YES	YES	YES	
A2	AC1			YES	YES	YES	YES			
A2	AC2			YES	YES	YES	YES			

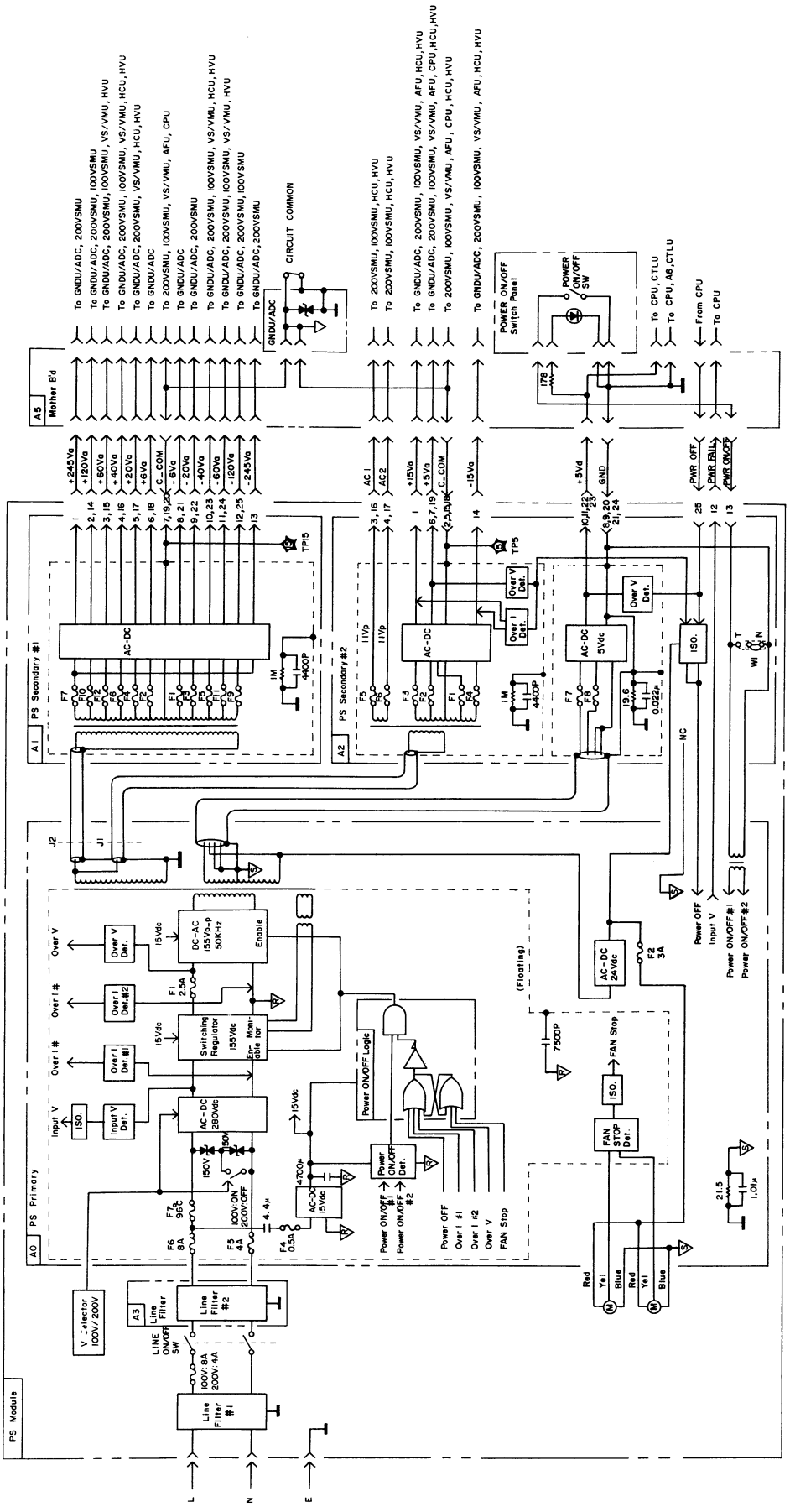
If the over V detector on A0 or A1, or the over I detectors on A0 or A1 detect an abnormal voltage or current, or if the fan stop detector detects that either or both of the fans have stopped, the power on/off logic disables the switching regulator and the DC-AC (155Vp-p) converter. Therefore, the HP 4142B shuts down. This condition is equivalent to the **POWER ON/OFF** switch being set to OFF.

If the input voltage detector detects an abnormal voltage, the HP 4142B performs the following:

1. The PS notifies the CPU via the PWR FAIL (power fail) line.
2. The CPU sets all source unit outputs to 0V, and all source unit output switches to OFF.
3. When the abnormal voltage is corrected, "**H**" is displayed on the **ERROR/FAILURE** display. If not, the CPU shuts down the PS (HP 4142B) via the PWR OFF (power off) line.

The HP 4142B also performs similarly if the over V or over I detector in the GNDU, SMUs, HCUs, HVUs, VSs, or VMs detect overvoltage or overcurrent, or if the PS fail detector in the GNDU/ADC module detects that PS output is abnormal.

NOTES



HP 4142B Power Supply Section Block Diagram

GNDU/ADC MODULE

The following figure shows the block diagram of the GNDU/ADC module. The GNDU/ADC module consists of four sections: GNDU, ADC, PS fail detector, and voltage reference. The following describes each section:

GNDU

The GNDU section consists of the error amplifier, buffer amplifier, and over V/I detector. The error amplifier controls the FORCE voltage so that the SENSE point voltage becomes 0V. When the SENSE conductor on the **GNDU** terminal is open, the sense point is the intersection of the FORCE line and the 38.3kΩ resister. The buffer amplifier supplies the GNDU output current. The over V/I detector is for detecting overvoltage and overcurrent on the FORCE line. If overvoltage or overcurrent is detected, the HP 4142B performs the following.

1. The GNDU notifies the CPU about the overvoltage or overcurrent.
2. The CPU sets all source unit outputs to 0V, and all source unit output switches to OFF.
3. If the abnormal voltage is corrected, "**H**" is displayed on the **ERROR/FAILURE** display. If not, the CPU shuts down the PS (HP 4142B).

The output relay closes when the **LINE ON/OFF** and **POWER ON/OFF** switches are both set to ON, and opens when either the **LINE ON/OFF** or **POWER ON/OFF** switch is set to OFF.

ADC

The ADC section consists of the multiplexer, sample and hold circuit, and ADC. The multiplexer selects one of the following five signals.

- Meas_bus (Measurement bus)
  This bus transmits the voltage or current monitor signal of the SMU , HCU, HVU, or VS/VMU. During AFU Self-Calibration, this bus transmits the AFU internal circuit signal. The signal present on this bus is determined by the switches on each module.
- Cal_bus (Calibration bus)
  This bus transmits the SMU, HVU, or VS/VMU internal circuit signal during SMU, HVU, or VS/VMU Self-Calibration.
- 10Vref (10V reference)
  10V reference voltage for ADC Self-Calibration.
- P_COM (potential common)
  0V reference voltage for ADC Self-Calibration.
- Ramp voltage
  Ramp voltage for ADC Self-Calibration.

The signal selected by the multiplexer is sent to the sample and hold circuit. The sample and hold circuit keeps the signal constant until the ADC completes the A to D conversion. The ADC is a 17-bit successive-approximation A/D converter. The CPU reads the completed A to D conversion value from the successive approximation register (SAR) via the GNDU/ADC logic circuit.

PS Fail Detector

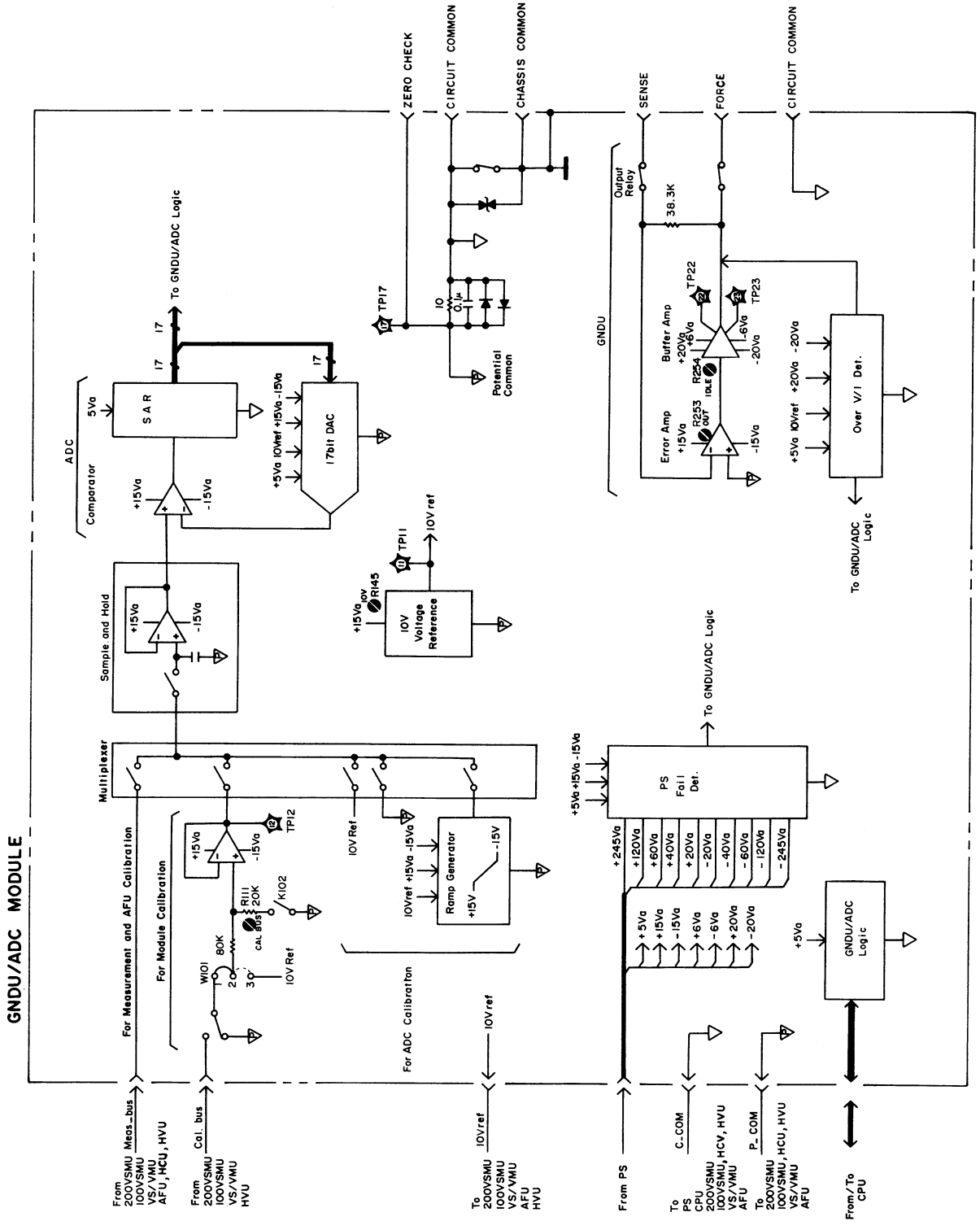
This detector detects if any of the following PS outputs are abnormal: ±20Va, ±40Va, ±60Va, ±120Va or ±245Va. If an abnormal voltage is detected, the HP 4142B performs the procedure described on the previous page for the GNDU over V/I detector.

Voltage Reference

The potential common is used as the HP 4142B (GNDU, SMU, HCU, HVU, VS/VMU, and AFU) output/measurement reference, and can be monitored at the **ZERO CHECK** terminal. The potential common is approximately equal to the CIRCUIT COMMON.

The 10V reference is used as the reference voltage for the GNDU over V/I detector, and for the DACs in the SMUs, HVUs, VSs, and AFU. The 10V reference is also used for the ADC Self-Calibration.

NOTES



GNDU/ADC Module Block Diagram

SMU MODULE

The following second figure shows the block diagram of the HP 41420A SMU. The HP 41421B SMU is exactly the same as the HP 41420A except where marked by footnotes.

Output

- Voltage Output
  The VDAC outputs a voltage that has been normalized to the 0V to ±8V range. The V error amplifier and power amplifier amplify the VDAC output with the gain determined by the V output range resistor. The amplified voltage appears at the sense point on the FORCE line. When the SENSE terminal is open, the sense point is the intersection of the FORCE line and the 10kΩ resistor. The sense point voltage is fed back to the V error amplifier via the buffer amplifier.

- Positive Current Output
  The IDAC outputs a voltage that has been normalized to the 0V to +8V range. The +I error amplifier and power amplifier amplify the inverted IDAC output with a gain of 1/8. The amplified voltage appears across the I range resistor, and this voltage and the I range resistor value determine the positive current output. The voltage across the I range resistor is also amplified with a gain of 8, and fed back to the +I error amplifier.

- Negative Current Output
  The IDAC outputs a voltage that has been normalized to the 0V to +8V range. The -I error amplifier and power amplifier amplify the IDAC output with a gain of 1/8. The amplified voltage appears across the I range resistor, and this voltage and the I range resistor value determine the negative current output. The voltage across the I range resistor is also amplified with a gain of 8, and fed back to the -I error amplifier.

Thus, voltage is controlled by the V error amplifier, positive current is controlled by the +I error amplifier, and negative current is controlled by the -I error amplifier. While one of the amplifiers is controlling the SMU, the other two are completely out of the control loop and do not affect operation. The controlling amplifier is selected by the SMU and DUT characteristics as described later.

Compliance

- I Compliance during Voltage Output:
  During voltage output, IDAC is set to the I compliance value. While the V error amplifier controls the SMU during voltage output, the +I and -I error amplifiers do not affect operation. However, the +I and -I error amplifiers constantly monitor the output current. If the output current is about to exceed I compliance, SMU control is immediately taken over by either the +I or -I error amplifier, and the output current is limited to the I compliance value. In other words, the SMU outputs constant current equal to I compliance.

- V Compliance during Positive Current Output:
  During positive current output, VDAC is set to the V compliance value. While the +I error amplifier controls the SMU during positive current output, the V and -I error amplifiers do not affect operation. However, the V error amplifier constantly monitors the output voltage. If the output voltage is about to exceed V compliance, SMU control is immediately taken over by the V error amplifier, and the output voltage is limited to V compliance. In other words, the SMU outputs constant voltage equal to V compliance.

- V Compliance during Negative Current Output:
  During negative current output, VDAC is set to the V compliance value. While the -I error amplifier controls the SMU during negative current output, the V and +I error amplifiers do not affect operation. However, the V error amplifier constantly monitors the output voltage. If the output voltage is about to exceed V compliance, SMU control is immediately taken over by the V error amplifier, and the output voltage is limited to V compliance. In other words, the SMU outputs constant voltage equal to V compliance.

Output and Compliance

The SMU does not distinguish between V output settings (V source mode) and V compliance settings (I source mode) because V output and V compliance are set by the same circuit. This is also true for I output (I source mode) and I compliance (V source mode). The SMU is controlled by one of the error amplifiers depending on the circuit characteristics, and output depends on the controlling error amplifier as follows:

- V error amplifier
  The V error amplifier controls the SMU to output the voltage $Vset$.

- +I error amplifier
  The +I error amplifier controls the SMU to output one of the following positive current values:

  If $Iset \geq 0$, then the SMU outputs $Iset$.
  If $Iset < 0$, then the SMU outputs $-(Iset + \Delta I)$.

- -I error amplifier
  The -I error amplifier controls the SMU to output one of the following negative current values:

  If $Iset < 0$, then the SMU outputs $Iset$.
  If $Iset \geq 0$, then the SMU outputs $-(Iset + \Delta I)$.

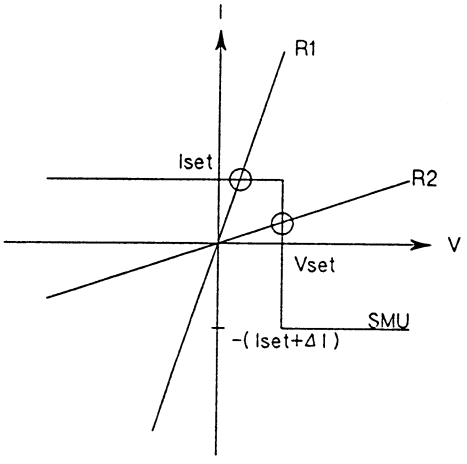
Definitions:

$Vset$: For V source mode, $Vset$ = specified V output value.
For I source mode, $Vset$ = specified V compliance value.

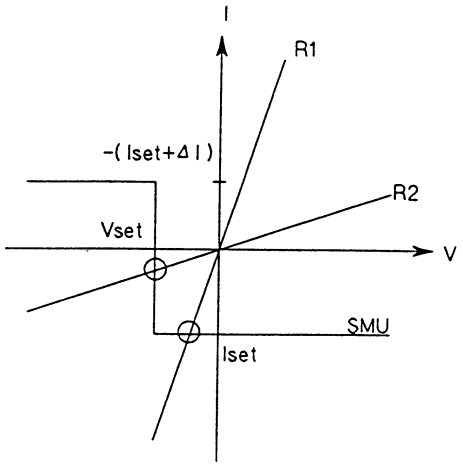
$Iset$: For I source mode, $Iset$ = specified I output value.
For V source mode, $Iset$ = specified I compliance value.

ΔI: For 1nA and 10nA ranges, ΔI = 10% of the I range value.
For 100nA to 1A ranges, ΔI = 2% of the I range value.
For V source mode, I range is the lowest range that includes I compliance.
ΔI is set by the +I bias or -I bias circuit.

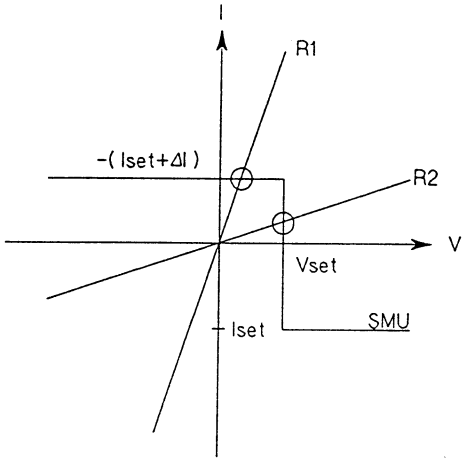
The intersection of the SMU and DUT I-V characteristics curves determine which error amplifier controls the SMU. The SMU I-V characteristics curve consists of three lines: $Vset$, positive current $Iset$ or $-(Iset + \Delta I)$, and negative current $Iset$ or $-(Iset + \Delta I)$. The following figure shows how changing $Vset$ and $Iset$ affects the SMU output for two DUTs (resistor R1 and R2) with different characteristics.



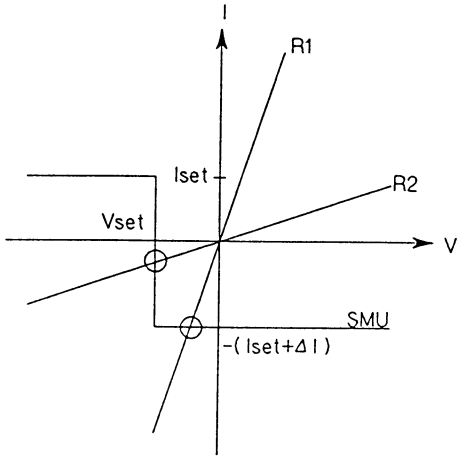
(a) Vset ≥ 0 and Iset ≥ 0



(c) Vset < 0 and Iset < 0



(c) Vset ≥ 0 and Iset < 0



(d) Vset < 0 and Iset ≥ 0

SMU Operation

a. If $Vset \geq 0$ and $Iset \geq 0$ as shown in figure (a), R1 intersects the $Iset$ line and R2 intersects the $Vset$ line. Thus for R1, the SMU outputs $Iset$, and for R2, the SMU outputs $Vset$.

b. If $Vset < 0$ and $Iset < 0$ as shown in figure (b), R1 intersects the $Iset$ line, and R2 intersects the $Vset$ line. Thus for R1, the SMU outputs $Iset$, and for R2, the SMU outputs $Vset$.

c. If $Vset \geq 0$ and $Iset < 0$ as shown in figure (c), R1 intersects the $-(Iset + \Delta I)$ line, R2 intersects the $Vset$ line. Thus for R1, the SMU outputs $-(Iset + \Delta I)$, and for R2, the SMU outputs $Vset$.

d. If $Vset < 0$ and $Iset \geq 0$ as shown in figure (d), R1 intersects the $-(Iset + \Delta I)$ line, and R2 intersects the $Vset$ line. Thus for R1, the SMU outputs $-(Iset + \Delta I)$, and for R2, the SMU outputs $Vset$.

The settings shown in figure (c) and (d) are only possible when you use the **DV** or **DI** command to set the SMU as a constant current source. For other source modes, the source value and the compliance value are automatically set to the same polarity, even if you specify otherwise.

Measurement

- Voltage Measurement
  The buffer amplifier is a high input impedance unity gain amplifier that monitors the voltage of the sense point on the FORCE line. The V monitor amplifier normalizes the output of the buffer amplifier to the 0 to ±8V range. The V monitor amplifier output is transmitted to the ADC via the measurement bus.

- Current Measurement
  The output current is measured by monitoring the voltage across the I range resistor. The I monitor amplifier amplifies this voltage with a gain of 8. The I monitor amplifier output is transmitted to the ADC via the measurement bus.

Other Main Components

- SMU Filter
  Each SMU has a low pass filter (LPF) at the DAC output. When DAC output changes, spikes and overshoot occur. DAC output changes when the output value, compliance value, or output range changes. If the SMU filter is ON, the spike is reduced to 1/30 of its unfiltered value. Output overshoot becomes 0.03% (typically) of the range value.

  If measurement speed is more important than accuracy, the SMU filter should be set to OFF. When the SMU filter is OFF, the DAC output settling time is 1/40 of the filter ON value. However, the actual output terminal settling time is limited by the slew rate, so the output terminal settling time becomes greater than the DAC output settling time as the voltage difference becomes large.

  The slew rate mainly depends on the DUT and the current range. The slew rate is slower for lower current ranges. For current ranges less than 100µA, the settling time at the output terminal when the filter is OFF is about equal to the filter ON value.

- **FORCE** and **SENSE** terminals with GUARD conductor
  SMUs have separate **FORCE** and **SENSE** terminals, thus allowing Force and Sense lines to be extended separately (Kelvin connections) up to the DUT. This cancels the residual resistance of test leads and cables. Each **FORCE** and **SENSE** terminal has a GUARD conductor that is at the same potential as the output, thus eliminating leakage current and reducing the effects of noise to ensure accurate low current measurements.

- Over V Detector and Over I Detector
  The over V detector and the over I detector are for detecting overvoltage and overcurrent on the FORCE line. The HP 41420A does not have an over V detector. If overvoltage or overcurrent is detected, the HP 4142B performs the following:

  1. The SMU notifies the CPU.
  2. The CPU sets all source unit outputs to 0V, and all source unit output switches to OFF.
  3. When the abnormal voltage is corrected, "**H**" is displayed on the **ERROR/FAILURE** display. If not, the CPU shuts down the PS (HP 4142B).

- Oscillation Detector
  The dc characterization of semiconductors is sometimes affected by oscillation. There are two types of oscillation: one caused by the SMU, and the other caused by the DUT and the connection leads. The oscillation detector detects oscillation caused by the SMU. If oscillation is detected, the status part of the measurement data will be set accordingly.

  Oscillation caused by an SMU occurs when an inductive load is connected to the SMU output. The oscillation frequency is low, less than 300kHz. Having an inductive load connected to an SMU is a common situation because SMU output impedance is inductive during V source mode operation, and SMUs are often connected to each other through the DUT. This type of oscillation is detected by the oscillation detector. To prevent oscillation, insert a capacitor between the oscillating SMU and CIRCUIT COMMON.

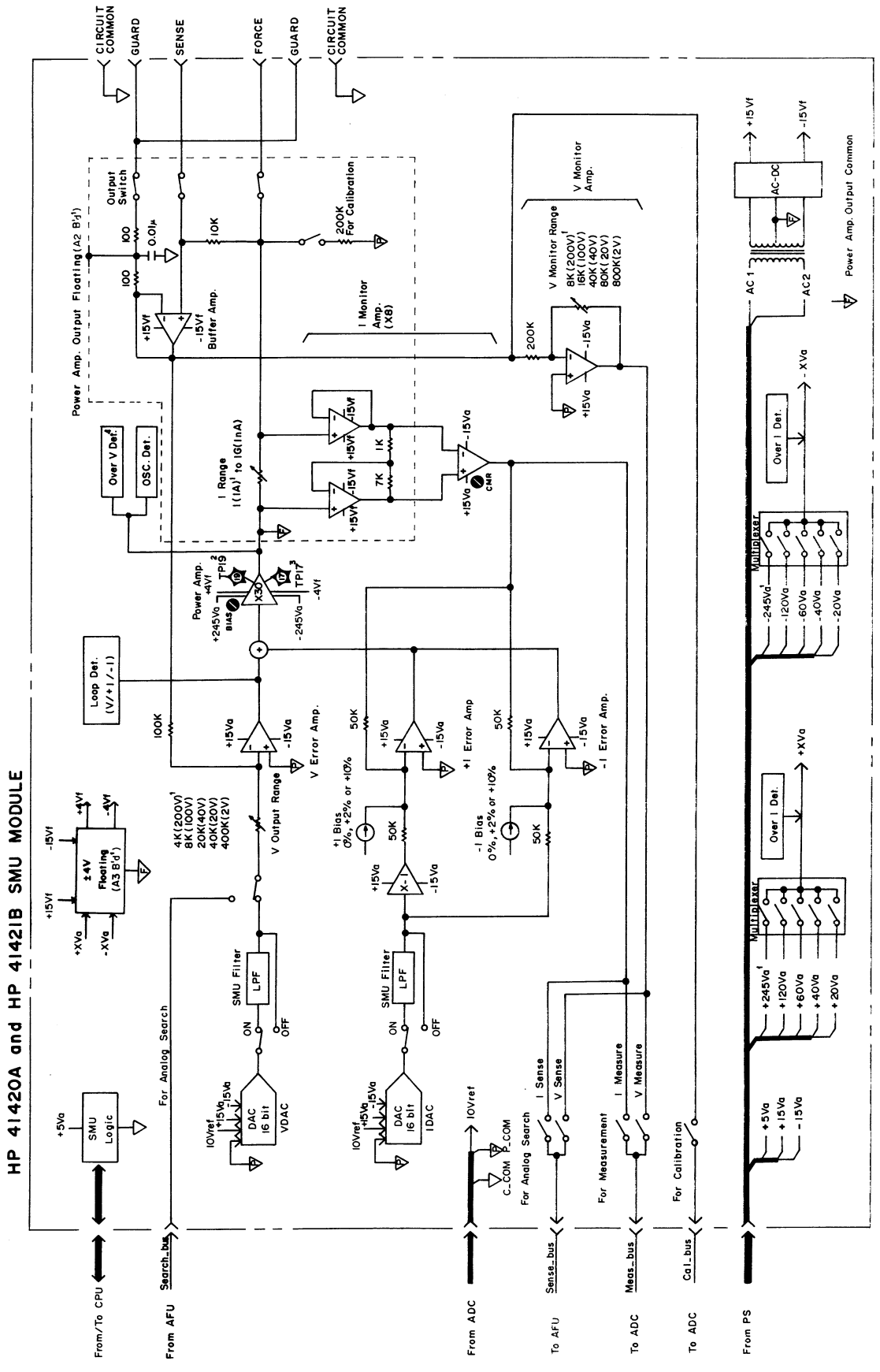
  Oscillation caused by the DUT does not depend on the SMU, but on the combination of the DUT and stray parameters around the DUT, such as load inductance and parasitic capacitance. The frequency of this type of oscillation is high, from 3 to 30MHz. This type of oscillation usually cannot be detected by the oscillation detector: for oscillation detection, monitor the DUT terminal with an oscilloscope. To prevent this type of oscillation, use ferrite beads on the test leads near the DUT.

- Loop Detector
  The loop detector detects whether output reaches compliance during measurement or for the **LOP?** query command, by detecting which error amplifier controls the SMU. For example, if you specify positive current output, the +I error amplifier normally controls the SMU. However, if the loop detector detects that the V error amplifier is controlling the SMU, this means that V compliance was reached. If the output reaches compliance during measurement, the status part of the measurement data will be set accordingly.

- Calibration Bus
  This bus transmits an SMU internal circuit signal (buffer amplifier output) that is used during SMU Self-Calibration.

- Search Bus and Sense Bus
  The search bus transmits the AFU reference ramp voltage or reference control voltage to the search SMU. The search SMU amplifies the reference voltage according to the specified voltage range, and outputs it to the DUT.

  The sense bus transmits the sense SMU voltage or current monitor signal to the AFU.



[1] Only for HP 41420A.
[2] For HP 41421B, this test point number is TP2.
[3] For HP 41421B, this test point number is TP3.
[4] Only for HP 41421B.

SMU Module Block Diagram

HCU MODULE

The following figure shows the block diagram of the HP 41422A HCU. The diagram is basically same as the SMU. Refer to the SMU module block diagram discussion. The following paragraphs discuss the differences between the HCU and SMU.

- The HCU can force a pulse output only, and cannot force a dc current. The HCU is a unipolar source, that is, voltage and current outputs are limited to the same polarity.

- **Voltage and Current Output:** The Pulse VDAC sources a voltage that has been normalized to the 0 V to -8 V range. The voltage output polarity changes by using or not using the inverter amplifier. The HCU forces a pulse voltage by switching the Pulse VDAC and HCU circuit common (HP_COM).

  The Pulse IDAC sources a voltage that has been normalized to the 0 V to +8 V range. The current output polarity changes by using or not using the inverter amplifier. The HCU forces a pulse current by switching the Pulse IDAC and Base IDAC (+Base IDAC for positive or -Base IDAC for negative). The ideal output of each Base IDAC is 8 mV (0.1% of 8 V). However, the actual DAC output values are compensated by the self-calibration.

  The power of the power amplifier is supplied by the capacitance that is charged by a current source. Therefore, the HCU cannot force a dc current of more than 10 mA.

- **Output and Compliance:** If $Iset < 0$, the +I error amplifier causes the HCU to output -(0.1% of the I output range value) instead of the $-(Iset + \Delta I)$ of the SMU. If $Iset \geq 0$, the -I error amplifier causes the HCU to output -(0.1% of I output range value) instead of the $-(Iset + \Delta I)$ of the SMU. The +I bias and -I bias circuit of the HCU are for self-calibration only.
  The HCU voltage and current output are limited to the same polarity.

- **Over V Detector:** The HCU has three over voltage detectors that perform the following functions:
  - Detects that the voltage between the HCU circuit common (HC_COM) and the HP 4142B circuit common (C_COM) exceeds +10 V or -10 V.
  - Detects that the voltage between FORCE LOW and SENSE LOW exceeds +6 V or -6 V.
  - Detects that the voltage of the charger circuit exceeds +35 V or -35 V.

- **Power Supply:** The HCU is isolated from the HP 4142B circuit common (C_COM) by transformers for the analog circuit and opto-isolator for the logic circuit. The purpose is to return the HCU output current (maximum 10 A) to the HCU itself.

  To save the HCU power consumption when the HCU output switch is disconnected, the DC-AC converter is disabled. In this case, the power supply changes from +40VHC/-40VHC to +18VHC/-18VHC and the HCU circuit lies in the idle state.

- FORCE and SENSE terminals: For using the SENSE terminal, the HCU maximum voltage between FORCE HIGH and FORCE LOW at the front panel is 13 V (however, the maximum setting voltage is 10 V). If the total voltage drop of the FORCE HIGH and FORCE LOW connection cables (Vcable) exceeds 3 V (for example, 10[A]*0.3[Ω]), the maximum setting of the voltage is limited to (13 - Vcable) V.

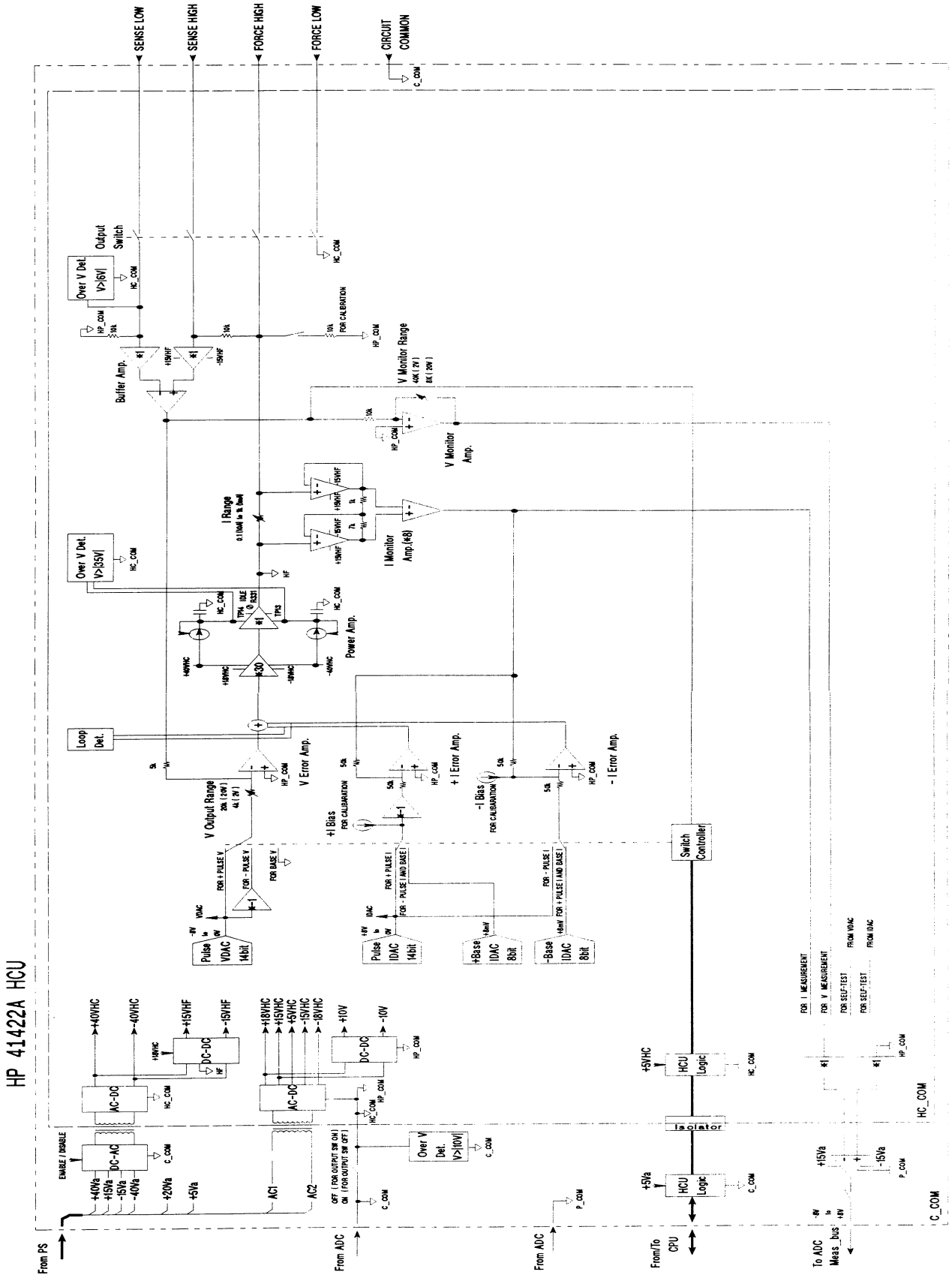
  The allowable voltage drop by a cable between the front panel FORCE HIGH terminal and the test device is within 4 V. The allowable voltage drop between the front panel FORCE LOW terminal and test device is also within 4 V. If the voltage drop exceeds the value, the protection circuit turns on, and voltage/current output and measurement includes a large error.

  The error of output and measurement voltage by FORCE line cable resistance (Rforce) and SENSE line cable resistance (Rsense) is I*Rforce(Rsense/5000), where the I is output current. For example, 10[A]*0.15[Ω](0.5[Ω]/5000) = 150[μV]. However this is when the FORCE HIGH and FORCE LOW line cable resistances are the same Rforce value, and when the SENSE HIGH and SENSE LOW line cable resistances are same Rsense value.

  The FORCE HIGH and LOW terminals, and SENSE HIGH and LOW terminals can be connected by a concentric (triaxial) cable, respectively. This is to minimize cable inductance, which can cause the pulse to become slower.

- The HCU does not have a filter, over current detector, oscillation detector, guard, cal_bus, and search_bus.

NOTES



HCU Module Block Diagram

HVU MODULE

The following figure shows the block diagram of the HP 41423A HVU. The diagram is basically the same as the SMU. Refer to the SMU module block diagram discussion. The following paragraphs discuss the differences between the HVU and SMU.

Output

The HVU circuits roughly consist of the 1 kV power amplifier and floating SMU. The floating SMU operates on the output of the 1 kV amplifier, and forces ±6 V. The HVU voltage output is the sum of the 1 kV power amplifier output and the floating SMU output.

The output response of the ±6 V floating SMU is faster than that of the 1 kV power amplifier. The maximum slew rate for the floating SMU is 300 V/ms. That for the 1 kV power amplifier is 12 V/ms.

In output steady state, the floating SMU forces 4 V on the 1 kV power amplifier except for the case of pulse base output. Assume that the setting voltage is 100 V, the floating SMU forces 4 V and the 1 kV power amplifier forces 96 V. Therefore, the ±6 V floating SMU has the capability to drop 10 V and rise 2 V.
To immediately drop 10 V, the output of the floating SMU is designed to 4 V. When the test device is a semiconductor, this can immediately lower the current, and can minimize any thermal stress to the test device.

Only for pulse base output (in output steady state), the floating SMU forces lower voltage to the power amplifier output by 4 V. Assume that the pulse base voltage is 100 V, the floating SMU forces -4 V and the 1 kV power amplifier forces 104 V. In this case, the floating SMU has the capability to drop 2V and rise 10 V.
To immediately rise 10 V and set to the specified pulse peak value, the output of the floating SMU is set to less than the 1 kV power amplifier output by 4 V.

1 kV Power Amplifier

The 1 kV power amplifier is a unipolar source. Therefore, the voltage and current outputs of the HVU are limited to the same polarity. The 1 kV power amplifier can forces from -8 V to 1060 V.

The 1 kV power amplifier uses a digital transmission, which gives the low power consumption, small parts space, and fast response. The operation sequence is as follows: The window comparator compares the HVU output (buffer amplifier output) and 1 kV power amplifier output (H_COM). Until the voltage difference becomes within 4 V ± 0.9 V (that is, until the floating SMU forces 4 V ± 09 V), the comparator counts down or up the input data of the 1 kV power amplifier DAC 1 count by 1 count. The 1 count changes the 1 kV power amplifier output by 0.83 V. When the voltage difference is within from 3.1 V to 4.9 V, the output of the 1 kV power amplifier does not change, and is a constant. The comparator output signal on the floating common (H_COM) is sent to the up/down counter of the DAC on the circuit common (C_COM) by using the photo coupler.

While the HP 4142B A/D converter performs the measurement, the input data of the 1 kV power amplifier DAC is fixed to stabilize the output.

Floating SMU

The specified voltage and current values are set to the VDAC and IDAC on the floating SMU common. If the difference of the new setting voltage and the present voltage is from -10 V to +2 V (from -2 V to +10 V for pulse base output), the V, +I, or -I error amplifier controls the floating SMU, and the floating SMU immediately forces the specified voltage or current. Then, while the floating SMU is keeping the new setting voltage constant, the 1 kV power amplifier changes its voltage so that the floating SMU can force 4 V on the power amplifier output. For this operation, the maximum slew rate of the HVU output is 300 V/ms.

If the difference exceeds the above area:

1. The V, +I, or -I error amplifier makes the floating SMU output up or down.
2. When the floating SMU output reaches +6 V or -6 V, the +V or -V limit error amplifier controls the floating SMU, and keep the floating SMU output at +6 or -6 V.
3. The power amplifier changes its voltage.
4. When the 1 kV power amplifier output becomes within 6 V from the new setting voltage, the control of the floating SMU moves from +V/-V limit error amplifier to V/+I/-I error amplifier, and the HVU forces the specified voltage or current the same as described above.

For this operation, the HVU maximum slew rate is 12 V/ms.
The floating SMU output is always controlled by the one of the five error amplifiers: V, +I, -I, +V limit, or -V limit.

For voltage output of the HVU, the V error amplifier amplifies the VDAC output according to the following two feedbacks.

- Feedback from the buffer amplifier. This feedbacks the floating SMU output.
- Feedback from the floating voltage feedback amplifier. This feedbacks the floating common voltage, that is, the 1 kV power amplifier output voltage.

The HVU output (Vhvu) is determined by the V output range (Range) and the VDAC output from the floating common (Vdac) as follows:

$$Vhvu = - (500\ k / Range) * Vdac$$

This relationship is obtained by solving the following equations:

$$Idac + Ihvu + Ipower = 0$$
$$Idac = Vdac / Range$$
$$Ihvu = (Vhvu - Vpower) / 500\ k$$
$$Ipower = [Vfeed - Vpower) / 5\ k$$
$$Vfeed = (- Vpower / -100) + Vpower$$

where,

Idac: current from VDAC to V error amplifier.
Ihvu: current from buffer amplifier to V error amplifier.
Ipower: current from floating V feedback amplifier to V error amplifier.
Vpower: voltage between the 1 kV power amplifier output (H_COM) and circuit common.
Vfeed: voltage between the floating V feedback amplifier output and circuit common.

Other Operations

- VDAC
  The VDAC sources a voltage that has been normalized to the 0 V to -8 V range. The voltage output polarity changes by using or not using the inverter amplifier.

- I Monitor Amplifier
  The gain of the I monitor amplifier is two.

- Voltage Sense Point
  The voltage sense point is the intersection of the FORCE line and the 1 kΩ resistor.

- Output and Compliance
  The current compliance of the opposite polarity has the offset: 2% of I range. The maximum of the opposite polarity current compliance is limited to 1 mA, which is set by the 1 mA Limiter at the input of the I error amplifier.

  The specified output and the specified compliance are always limited to the same polarity.

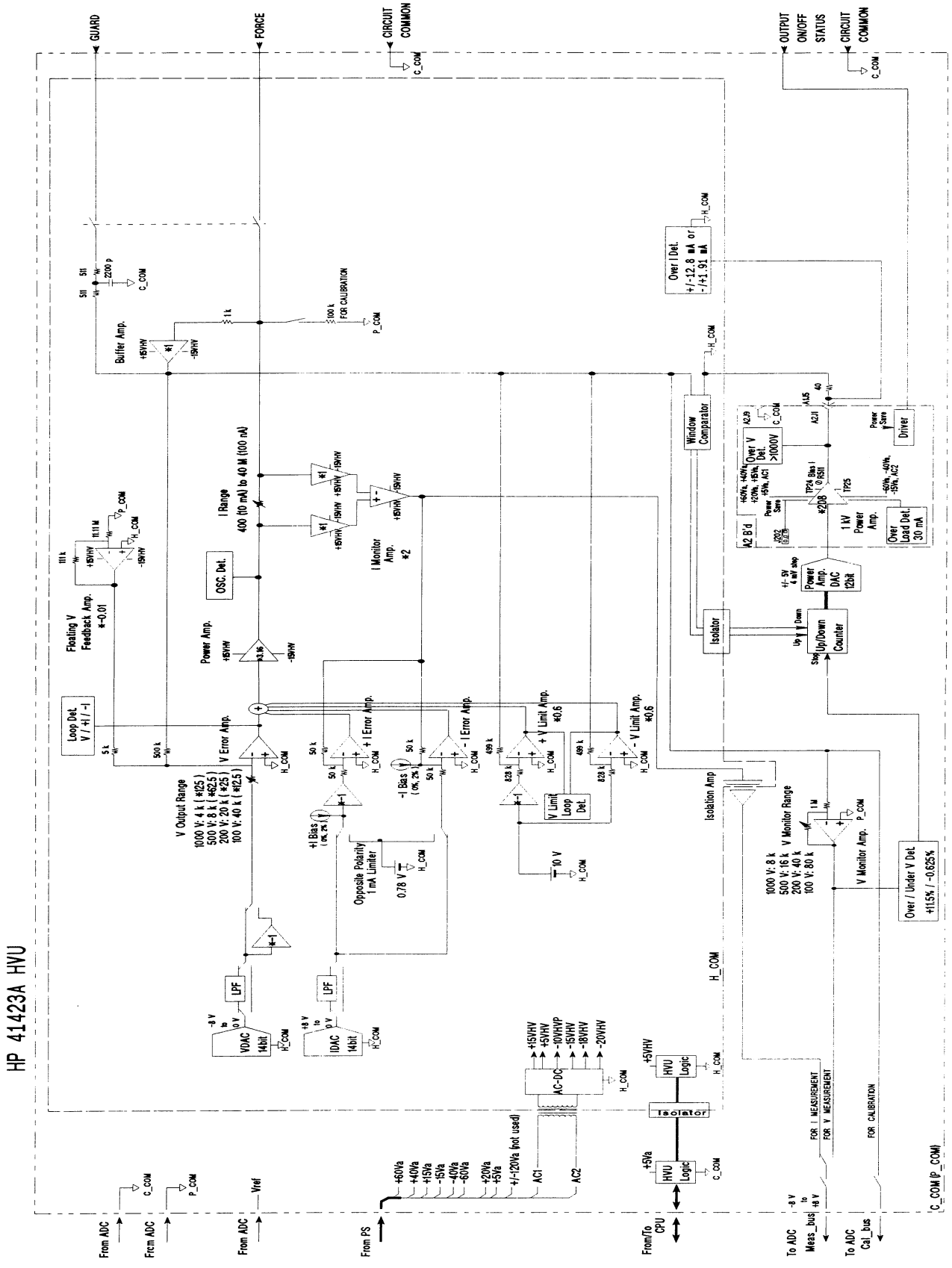
- Over V/I Detector
  The HVU has the following three over voltage and current detectors. If one of these detects abnormal, the HP 4142B mainframe CPU proceeds the same as for the over current detector of the HP 41420A/HP 41421B SMU.
  - The over voltage detector detects when the voltage between the power amplifier output (H_COM) and the HP 4142B circuit common (C_COM) exceeds +1000 V or -1000 V.
  - The over current detector detects when the current of the 1 kV power amplifier output exceeds +/-12.8 mA or -/+1.91 mA.
  - The over load (current) detector detects when the drive current of the 1 kV power amplifier exceeds 30 mA.

- V Limit Loop Detector
  The V limit loop detector detects whether the +V/-V limit error amplifier is controlling the floating SMU output during measurement or for the **LOP?** query command. If the +V/-V limit error amplifier controls the floating SMU output, the floating SMU output reaches +6 V or -6 V. This means that the output of the 1 kV power amplifier has not settled yet.
  If this is detected during measurement, the HP 4142B sets the status part of the measurement data to F.

- Filter
  The filter of the HVU has its effect when the floating SMU changes the output, that is, when the change of the HVU output is within 10 V.

- Power Save State
  To save the HVU power consumption when the HVU output switch is disconnected, the 1 kV power amplifier is disabled. In this case, the 1 kV power amplifier output becomes a high impedance state. Connecting the jumper W202 to the test position also sets the HVU to power save state.

- The HVU does not have a sense_bus and sense terminal.



HVU Module Block Diagram

VS/VMU MODULE

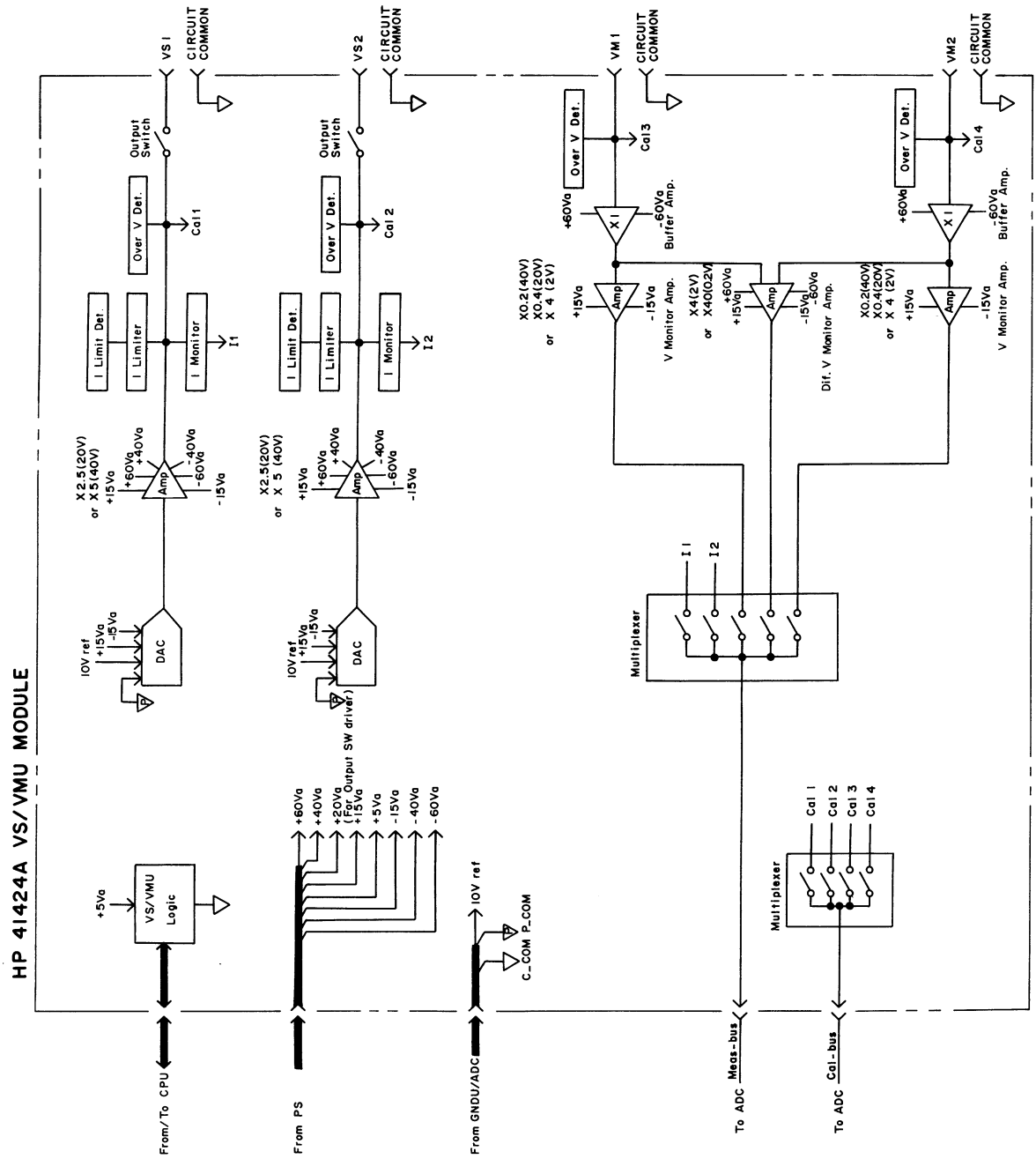
The following figure shows the block diagram of the VS/VMU module. The VS/VMU module contains two VSs and two VMs. The following is a brief description of the main VS/VMU components:

VS

- DAC
  The DAC outputs a voltage that has been normalized to the 0V to ±8V range.
- Amplifier
  The amplifier amplifies the DAC output with the gain determined by the output range: gain = 2.5 for the 20V range and gain = 5 for the 40V range.
- I Limiter and I Limit Detector
  The I limiter limits the output current to 100mA at the 20V range, or to 20mA at the 40V range. The I limit detector detects when the output current is limited, and the data status part of the measurement data is set accordingly.
- I Monitor
  The I monitor monitors the current. The monitor signal is transmitted to the ADC via the measurement bus.
- Over V detector
  The over V detector detects overvoltage. If overvoltage is detected, the HP 4142B performs as follows:
  1. The VS/VMU notifies the CPU.
  2. The CPU sets all source unit outputs to 0V, and all source unit output switches to OFF.
  3. If the abnormal voltage is corrected, "**H**" is displayed on the **ERROR/FAILURE** display. If not, the CPU shuts down the PS (HP 4142B).

VM

- Buffer Amplifier
  The buffer amplifier is a high input impedance unity gain amplifier.
- V Monitor Amplifier
  The V monitor amplifier normalizes the output of the buffer amplifier to the 0V to ±8V range. The amplifier gain is determined by the range: gain = 0.2 for the 40V range, gain = 0.4 for the 20V range, and gain = 4 for the 2V range.
- Differential V Monitor Amplifier
  The differential V monitor amplifier normalizes the differential voltage (VM1 - VM2) to the 0V to ±8V range. The amplifier gain is determined by the range: gain = 4 for the 2V range and gain = 40 for the 0.2 V range.
- Over V Detector
  The over V detector detects overvoltage. If overvoltage is detected, the HP 4142B performs the same procedure as described above for the VS over V detector.
- Input Relay
  The following figure does not show the input relay, but it is located between the VM terminal and the buffer amplifier input. This relay closes when the LINE ON/OFF and the POWER ON/OFF switches are both set to ON, and opens when either the LINE ON/OFF or the POWER ON/OFF switch is set to OFF.



VS/VMU Module Block Diagram

AFU MODULE

The following two figures show the AFU module block diagram, and the block diagram of the analog search measurement circuit, respectively.

The AFU can perform two types of searches: ramp wave searches and feedback searches. Ramp wave searches are for performing high speed search measurements, where measurement speed is more important than accuracy; and feedback searches are for performing highly accurate search measurements, where measurement accuracy is more important than speed. The following describes both types of searches:

Ramp Wave Searches

1. When the CPU receives a trigger, the search SMU outputs 0V.
2. The search SMU is connected to the AFU via the search bus.
3. The sense SMU is connected to the AFU via the sense bus.
4. The sense SMU outputs the specified output voltage or current.
5. The search start voltage setting DAC outputs the search start reference voltage.
6. The V adder amplifier adds the search start reference voltage to the integrator output, and outputs it to the search SMU. The integrator output is 0V at this time.
7. The search SMU amplifies this AFU output voltage (-8V to +8V) according to the search SMU V output range, and outputs the voltage to the DUT. This is the search start voltage.
8. The ramp rate setting DAC outputs a constant voltage to the integrator.
9. The integrator converts this constant voltage to a ramp voltage.
10. The V adder amplifier adds this ramp voltage to the search start reference voltage, and outputs this reference ramp voltage to the search SMU.
11. The search SMU amplifies the reference ramp voltage according to the search SMU V output range, and outputs the ramp voltage to the DUT.
12. When the switch control logic (SW Control Logic) detects that the DUT output voltage or current exceeds the target value, it changes the switch from the "Ramp Search" position to the "Ramp Search Completion" position, thus stopping the voltage applied to the integrator. This detection occurs as follows:

    a. The error amplifier amplifies the difference of the target value setting DAC output and the sense SMU monitor signal (DUT output). When the DUT output is equal to the target value, the error amplifier outputs 0V to the comparator. If the DUT output is greater or less than the target value, the error amplifier outputs a positive or negative voltage.
    b. The comparator output goes to the SW control logic. When the comparator output polarity reverses, the SW control logic detects that DUT output exceeds the target value.

    If the search stop reference voltage is reached before the DUT output exceeds the target value, the AFU output is limited to the search stop reference voltage by the limiter and the search SMU outputs the search stop voltage.
13. After the DUT output exceeds the target value, about 50µs elapses before the switch is set to "Ramp Search Completion". The 0.1µF capacitor now maintains a constant voltage to the V adder amplifier, so search SMU output becomes constant.
14. The HP 4142B waits the specified delay time after the switch is disconnected.
15. The HP 4142B measures the voltage or current of the search SMU.
16. If specified, the HP 4142B measures the voltage or current of the sense SMU.
17. The search SMU outputs the search start voltage.
18. The sense SMU outputs the same value as before the trigger.
19. The search SMU outputs 0V.
20. The search SMU and sense SMU are disconnected from the AFU.

Feedback Searches

1. Same as for steps 1 to 11 of ramp searches.
2. When the switch control logic (SW Control Logic) detects that the DUT output voltage or current exceeds the target value, it changes the switch from the "Ramp Search" position to the "Feedback Search" position, thus disconnecting the ramp rate setting DAC from the integrator and connecting the error amplifier to the integrator. This detection is the same as described for ramp searches in step 12.
3. The error amplifier detects the difference between the DUT output and the target value, and controls the integrator output (the voltage charged on the capacitor) in proportion to the difference value. Accordingly, the AFU (V adder amplifier) outputs a reference control voltage to search SMU. This feedback process continues until the DUT output is converged to the target value.

   The time that it takes for DUT output to be converged to the target value depends on the time constant of the feedback loop (sense SMU - AFU - search SMU - DUT - sense SMU).

   For analog feedback searches, you specify a *feedback integration time*, which is the time constant from sense SMU input to search SMU output. For this loop to be stable, you should specify a *feedback integration time* that satisfies the following:

   feedback integration time >> DUT time constant

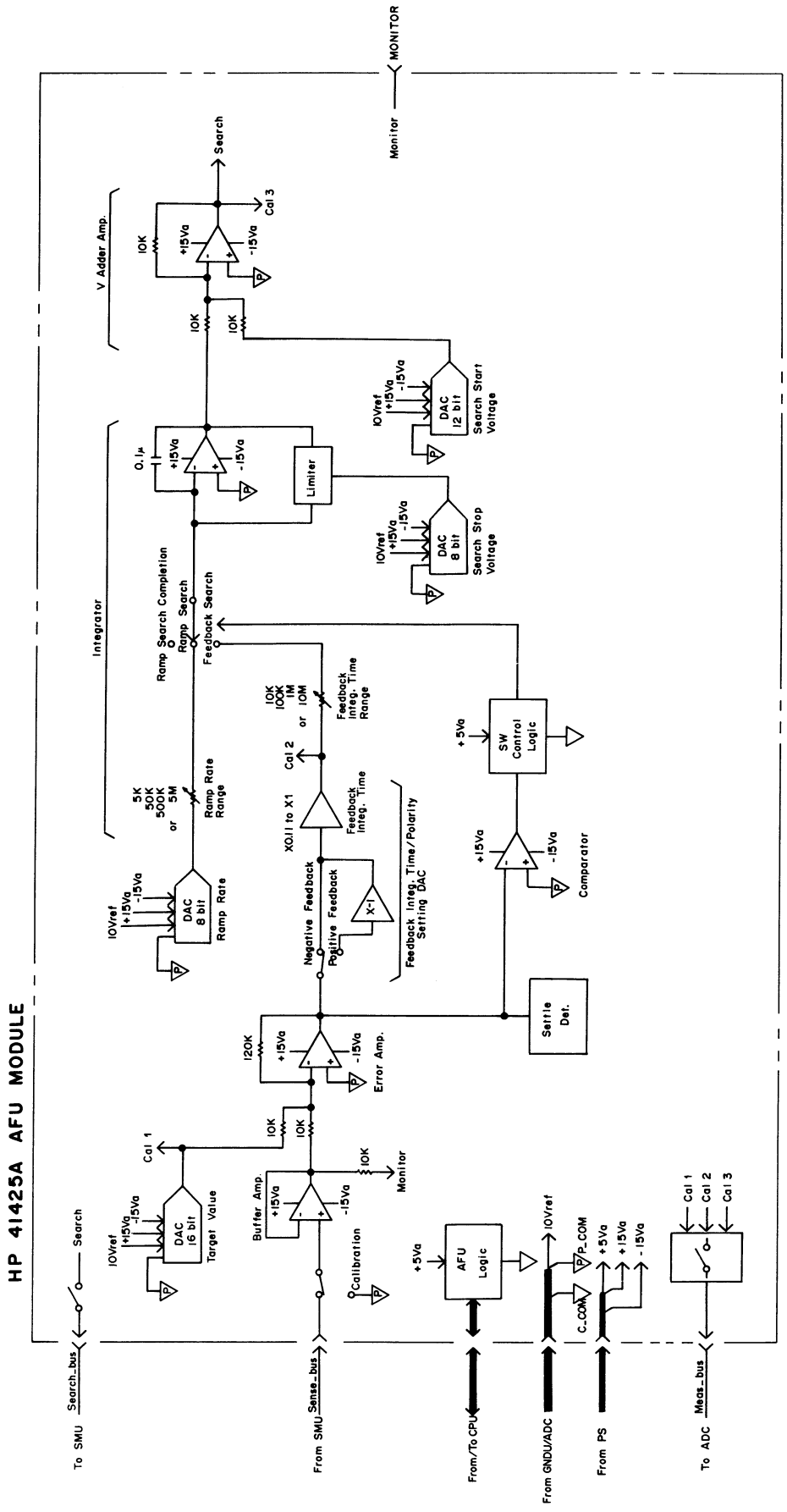
   The time constant from the sense SMU input to the search SMU output is determined by the following:

   - sense SMU monitor circuit gain
   - AFU error amplifier gain
   - AFU integrator gain
   - search SMU output circuit gain

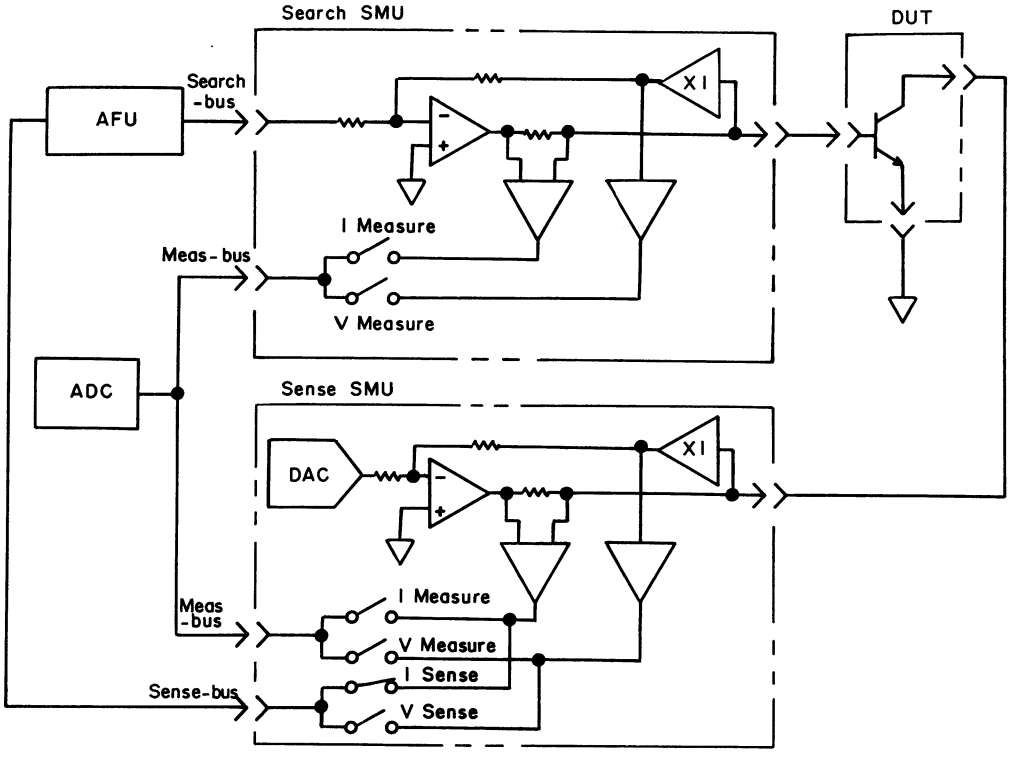
   The specified *feedback integration time* is realized by adjusting the AFU integrator gain. The HP 4142B adjusts the integrator gain by selecting the appropriate feedback integration time range resistor and feedback integration time setting DAC output, which equivalently amplifies the error amplifier output with a gain that is from 1 (for the minimum value of the feedback integration time range) to 0.11 (for the maximum value of the range). Nine different gains are possible within the range.

   You can specify either a negative or positive feedback search. For the positive feedback search, the error amplifier output polarity is reversed by the feedback polarity setting DAC. The feedback integration time setting DAC and feedback polarity setting DAC are actually the same DAC.
4. After the switch changes to the "Feedback Search" position, the HP 4142B waits either the specified feedback integration time or 100µs, whichever is longer, and the specified delay time.
5. Same as steps 15 to 20 for ramp wave searches.
   The feedback search operation in step 3 continues until measurements are performed. The settle detector detects whether the DUT output value is equal to the target value (error amplifier output is 0V). If not, the data status part of the measurement data is set accordingly.

NOTES



AFU Module Block Diagram



Analog Search Measurement Circuit Block Diagram

APPENDIX A
ERROR MESSAGES

CONTENTS

ERROR/FAILURE Display

The front panel **ERROR/FAILURE Display** indicates the status of the HP 4142B by displaying one of the following: **0** to **8**, **A**, **C**, **E**, **F**, **H**, **P**, or **U**. See the descriptions below.

0: Displayed during normal operating conditions: The HP 4142B or specified plug-in unit(s) passed Self-Test or Self-Calibration.

C: The HP 4142B or specified plug-in unit(s) are now performing Self-Test or Self-Calibration.

E: The HP 4142B received an undefined command; all succeeding commands did not execute. Check for correct command syntax and out-of-range parameters.

F: The command or parameter value is not allowed in the present HP 4142B settings. Confirm the command execution condition or parameter value.

If you set the **INTLK** terminal to open while the output switch of an HVU is set to on, and while another HVU is performing Self-Test/Self-Calibration by the **CA** or ***TST?** command with the optional parameter *ch#*, then the HP 4142B stops the Self-Test/Self-Calibration of the unit to set the HVU output switch to off (error codes 565 and 202). In this case, the unit that is stopped from performing Self-Test/Self-Calibration loses the calibration data from Self-Calibration. Be sure to perform Self-Calibration before measurements on the unit that lost the calibration data. If a unit does not have the calibration data, the unit cannot perform outputs and measurements within the accuracy of the specifications. Note that even if the unit loses the calibration data, the unit performs measurements and no errors occur. If the command is the ***TST?**, the HP 4142B does not return the query data.

If a sweep measurement is aborted by the power compliance function or automatic sweep abort function, an **F** is displayed to indicate that the specified function works.

H: Output switches of all measurement units are disconnected to prevent damage to the HP 4142B from overvoltage or overcurrent, or from a momentary power loss. Check the input voltage, input current, cable connections, and ac power. Reconnect the output switches with the **CN** command.

U: The HVU Self-Test or HVU Self-Calibration cannot be performed because the **INTLK** terminal is open.

If the error code is 565 or 567, the HVU lost the calibration data of the Self-Calibration. Be sure to perform the HVU Self-Calibration before measurements. If the HVU loses the calibration data, the HVU cannot perform outputs and measurements within the accuracy of the specifications. Note that even if the HVU loses the calibration data, the HVU still performs measurements and no errors occur.

1 to **8**, **A**, **P**:

The HP 4142B failed. If a plug-in unit failed, **1** to **8** indicates the slot # of the failed unit. **A** indicates a failure in the HP 4142B analog-to-digital conversion (ADC) section; **P** indicates a failure in the HP 4142B central processing unit (CPU). If more than one failure occurs, the **ERROR/FAILURE** display indicates the last failure detected during Self-Test or Self-Calibration. Self-Test and Self-Calibration are performed in the following order.

1) CPU
2) ADC
3) All plug-in units by slot # (ascending), except the AFU.
4) AFU

To determine whether a multiple failure occurred, execute the ***TST?** command. This command performs the Self-Test again and displays test results on the controller.

If a plug-in unit fails, remove the failed unit from slot and use a known good unit to perform your measurement. Contact the nearest Hewlett-Packard Sales and Service office for assistance.

If an **A**, **E**, **F**, **H**, **P**, **U**, or **1** to **8** is displayed, details about errors (error codes) are stored in the error register. Refer to "ERROR CODE" in this Appendix for error code descriptions.

The **ERROR/FAILURE Display** and error register are initialized (set to **0** and "0, 0, 0, 0", respectively) when the ***RST**, **ERR?**, or Device Clear (HPBASIC **CLEAR** statement) is executed. The error register is also initialized when **CA** or ***TST?** command execution begins.

Error Codes

If errors occur, the HP 4142B can store up to 4 error codes in the error register. Execute the **ERR?** command to transfer the error codes from the error register to the output data buffer. You can then use the controller to read the output data buffer (ENTER statement in HP BASIC).

error code, *error code*, *error code*, *error code* CR/LF^EOI

The output of the error codes is in the order that they occurred, and only the first four error codes are sent. If no errors occurred, *0s* are sent. The following are the error codes and their meanings.

Error Code	Meaning
100	Undefined HP-IB command.
102	Improper numeric data syntax.
103	Improper position of terminator (CR/LF) in the HP-IB command.
120	Improper parameter value.
121	Improper *Channel#*. *Channel#* must be 1 to 8, 11 to 18, or 21 to 28.
122	Improper number of channels specified in **MM**, **FL**, **CN**, **CL**, **IN**, **DZ**, or **RZ** command.
123	Improper SMU/HCU/HVU *V* or *I compliance* value.
124	Improper *measurement range* or *output range* value.
125	For analog search measurements, the *target* value must be less than the *compliance* value.
126	When current pulse source is specified by **PI**, **PWI**, or **PDI** command, SMU/HVU *base current* and *pulse current* must be set to the same polarity. If *base current* ≥ 0, then *pulse current* must be ≥ 0; if *base current* ≤ 0, then *pulse current* must be ≤ 0.
127	The difference of *search start voltage* and *search stop voltage* in **ASV** command is out of range.
128	Improper SMU *V* or *I compliance* value in **PV**, **PI**, **PWV**, **PWI**, **PDV**, or **PDI** commands (*V* or *I compliance* value exceeds the limit on pulse output). Or 1 nA range cannot be used. Or AUTO ranging cannot be used when *pulse current* is less than 1.15 nA (in case of *V compliance* ≤ 2V) or less than 11.5 µA (in case of *V compliance* > 2 V).
129	*Pulse width* must be less than (*pulse period* / 2).
130	For a log sweep (in **WV**, **WI**, **WSV**, or **WSI** command), the *start* or *stop* value cannot be 0, and the polarity of the *start* and *stop* values must be the same.
150	Command input buffer is full. Maximum number of characters that can be input at one time is 256 (including terminator).
151	Specified unit cannot execute this HP-IB command.
152	Unit failed Self-Test. Cannot perform setting. If you perform the setting to repair the HP 4142B, send the RCV command.
153	A unit is not installed at specified channel. Or you cannot use the ERC command because the CONTROL unit is not installed.

160	**ST** command cannot be input twice before **END** command.
161	**ST** command must be input before **END** command.
162	A command that cannot be stored in program memory is input between **ST** and **END** commands.
190-199	An error occurred that could not be defined. Correct the error that occurred before this error, then run the program again. If no error occurred before this error, contact the nearest Hewlett-Packard service office because there may be an error in the HP 4142B firmware.
200	This HP-IB command cannot be executed when the output switch of the unit is OFF.
201	Specify the *compliance* when you change the source mode of SMU/HVU. Or HCU *V compliance* cannot be omitted in **PI**, **PWI**, or **PDI** command.
202	When **INTLK** terminal is open, the High voltage state (*Output voltage* or *V compliance* is set to greater than 42 V) and the HVU output switch cannot be set to on. If the **INTLK** terminal is opened while they are set to on, outputs of all units are set to 0 V, and the HVU output switches are set to off.
203	Output switch cannot be set to ON in high voltage state (*Output voltage* or *V compliance* is set to greater than 42 V).
204	Output switch cannot be set to OFF in high voltage state (*Output voltage* or *V compliance* is set to greater than 42 V). However, **CL** command without parameters can set output switches of all units to OFF.
205	**RZ** command cannot be executed before **DZ** command.
206	**RZ** command cannot be executed if one of the specified channels has been used in a previous **RZ** command.
207	Total output of all units exceeds maximum power output of the HP 4142B. This error may also occur when you perform Self-Test or Self-calibration with only one unit specified. In this case, after disconnecting some or all the output switches of the unit to OFF, send the command of the Self-Test or Self-Calibration again. During the Self-Test or Self-Calibration, the HP 4142B consumes the following power. HPSMU: 20 W, MPSMU: 2 W, HCU: 10.02 W, HVU: 11 W, VS: 2.2 W
208	20 V or 40 V range is not available for differential measurement by VM.
209	0.2 V range not available for grounded measurement by VM.
210	EXT trigger measurement cannot be performed when HP 4142B is busy.
211	HP-IB GET command (TRIGGER statement in HPBASIC) is valid only in trigger mode 1.
212	Improper SMU *V* or *I compliance* value in **DV**, **DI**, **PV**, **PI**, **PWV**, **PWI**, **PDV**, **PDI**, **ASV**, **AVI**, or **AIV** command. Do not omit *V* or *I compliance*; specify a proper value.
213	Self-Calibration or Self-Test cannot be performed in high voltage state (*Output voltage* or *V compliance* is set to greater than 42 V).
214	*Measurement mode* must be set by **MM** command before measurement trigger.

215 Change the HVU output polarity to the same polarity in the settings for the **DV**, **DI**, **PV**, **PI**, or **BDV** command by using the **POL** command before the **DV**, **DI**, or measurement trigger. Or, before the **RZ** command, return the HVU output polarity to polarity after the **DZ** command execution.

220 Set sweep channel by **WV** or **WI** command, before staircase sweep (**MM2**) measurement trigger, before staircase sweep with pulsed bias (**MM5**) measurement trigger, or before setting synchronous sweep channel by **WSV** or **WSI** command.

221 Set pulse sweep channel by **PWV** or **PWI** command before pulsed sweep (**MM4**) measurement trigger.

222 Set pulse bias channel by **PV** or **PI** command before staircase sweep with pulsed bias (**MM5**) measurement trigger.

223 Improper SMU *V* or *I compliance* value in **WV**, **WI**, **WSV**, or **WSI** command. Do not omit *V* or *I compliance*; specify a proper value.

224 Main sweep channel (set by **WV** or **WI**) and synchronous sweep channel (set by **WSV** or **WSI**) must be set to different channels and same source mode i.e., both channels are either voltage sources (set by **WV** and **WSV**) or current sources (set by **WI** and **WSI**).

225 Synchronous sweep source data cannot be output because synchronous sweep source channel is not set by the **WSV** or **WSI** command.

226 A log sweep cannot be specified by **PWV**, **PWI** command. Or a log sweep cannot be specified by **WV** or **WI** command during the staircase sweep with pulsed bias measurements (**MM5**).

227 Sweep measurement aborted by automatic sweep abort function or because sweep source output reached *V*, *I*, or *power compliance*.

228 Must specify *pulse period* for pulse sweep (**MM4**), staircase sweep with pulse bias (**MM5**), or pulsed sweep with pulsed bias (**MM8**) measurements.

229 Change the HVU output polarity to the same polarity in the settings for the **WV**, **WI**, **WSV**, **WSI**, **PWV**, or **PWI** command by using the **POL** command before measurement trigger.

230 Pulse source must be set before measurement trigger. **PV** or **PI** command is required for 1ch pulsed spot measurement (**MM3**). **PV** or **PI**, and **PDV** or **PDI** commands are required for 2ch pulsed spot measurements (**MM7**). **PWV** or **PWI**, and **PDV** or **PDI** commands are required for pulsed sweep with pulsed bias measurements (**MM8**).

231	Improper SMU *V* or *I output range* value in **PV**, **PI**, **PWV**, **PWI**, **PDV**, **PDI**, **WV**, or **WI** command (*V* or *I compliance* value exceeds the limit on pulse output). Do not omit *V* or *I compliance*; specify a proper value.
232	Improper SMU voltage or current measurement range for pulse measurement. Specify the higher current measurement range by RI command. Or in current measurement, set *I compliance* of measurement channel to larger. Or in voltage measurement, set *V compliance* of measurement channel to 2 V or less.
233	Set SMU/HVU Filter of pulse source channel to OFF for pulse measurements by **FL** command.
236	Differential measurement by VM cannot be performed for pulse measurements.
237	HCU pulse duty (*pulse width / pulse period*) is too large in **PT** command.
238	HCU *pulse width* is too large in **PT** command. Or, if you use two HCUs in 2ch pulsed spot measurements, you cannot specify *pulse period* to 0.
239	SMU/HVU/VS *pulse width* is smaller than the minimum value 1ms in **PT** command.
240	Set the search SMU by **ASV** command before analog search measurement trigger.
241	Set the sense SMU by **AVI** or **AIV** command before analog search measurement trigger.
242	Analog Feedback Unit is not installed, or Analog Feedback Unit failed Self-Test.
243	Search (set by **ASV**) and sense (set by **AVI** or **AIV**) channel units must be SMUs for analog search measurements.
244	*Target* value cannot exceed *compliance* value.
246	Improper *ramp rate* or *feedback integration time* value for V output range of search SMU.
247	Search SMU and sense SMU must be different channels.
253	Program memory is full.
254	HP-IB GET command (TRIGGER statement in HPBASIC) or EXT trigger input is invalid between **ST** and **END** commands.
255	In program memory, nesting of programs (one program calling another) cannot be greater than 8.
260	Data output buffer for measurement data is full.
280-299	An error occurred that can not be defined. Correct the error that occurred before this error, then run the program again. If no error occurred before this error, contact the nearest Hewlett-Packard service office because there may be an error in the HP 4142B firmware.

301 A momentary power loss occurred. All output switches are set to OFF.

302 Something is wrong with the power supply section of the HP 4142B mainframe or plug-in unit. All output switches are set to OFF. Confirm by Self-Test whether unit works normally.

303 Overvoltage that exceeds maximum voltage at the present current range is sent to the MPSMU. All output switches are set to OFF.

304 Overvoltage or overcurrent is input to GNDU, or Force line of the GNDU is not connected to the DUT. All output switches are set to OFF.

305 Overcurrent that exceeds maximum current at the present voltage range is input to the SMU (HPSMU and MPSMU). All output switches are set to OFF.

306 The executing command is canceled because the data communication between the HP 4142B and the computer via the HP-IB is interrupted by a hardware reset of your computer, or because the HP-IB cable was disconnected, or by some other interruption. Send the command again.

307 This unit is not supported by this ROM version. Until you change the ROM, use the HP 4142B with this unit removed.

308 For the HCU, one of the following errors occurred. All output switches are set to off.

- Overvoltage (more than ±10 V) is input to FORCE LOW of the HCU. Connect FORCE LOW of the HCU to GNDU.
- Overvoltage (more than ±6 V) is input between FORCE LOW and SENSE LOW of the HCU. Connect FORCE LOW and SENSE LOW of the HCU to GNDU correctly, or make the wiring resistance of FORCE LOW lower (recommendation: less than 150 mΩ).
- Overvoltage (more than ±30 V) is input between FORCE HIGH and FORCE LOW of the HCU.

For the HVU, one of the following errors occurred. All output switches are set to off.

- Overvoltage is input.
- Overcurrent is input.
- Opposite polarity voltage or current is input.
- Something is wrong with the HVU power amplifier. Confirm that the unit is functioning properly with Self-Test.

380-399 An error occurred that can not be defined. Correct the error that occurred before this error, then run the program again. If no error occurred before this error, contact the nearest Hewlett-Packard service office because there may be an error in the HP 4142B firmware.

410 CPU module is not functioning properly. CPU module failed ROM Identification Test of Self-Test.

411 CPU module is not functioning properly. CPU module failed ROM Checksum Test of Self-Test.

412 CPU module is not functioning properly. CPU module failed Timer IC Test of Self-Test.

413 CPU module is not functioning properly. CPU module failed Digital-to-Analog Section Bus Isolator Test of Self-Test. Or the PS module +5 V output voltage is not within limits.

415 GNDU/ADC module is not functioning properly. ADC section of GNDU/ADC failed ADC Conversion Function Test of Self-Test.

416 GNDU/ADC module is not functioning properly. ADC section of GNDU/ADC failed ADC Linearity Test of Self-Test.

417 GNDU/ADC module is not functioning properly. ADC section of GNDU/ADC failed ADC Accuracy Test of Self-Test.

420 SMU is not functioning properly. SMU failed V Output/ Measurement Function Test of Self-Test.

421 SMU is not functioning properly. SMU failed I Output/ Measurement Function Test of Self-Test.

422 SMU is not functioning properly. SMU failed Common Mode Rejection Test of Self-Test.

423 SMU is not functioning properly. SMU failed I Monitor Amp. Offset Error Test of Self-Test.

424 SMU is not functioning properly. SMU failed V Monitor Amp. Offset Error Test of Self-Test.

425 SMU is not functioning properly. SMU failed I Output and V Measurement Function Test of Self-Test.

426 SMU is not functioning properly. SMU failed V Monitor Amp. Gain Error Test of Self-Test.

427 SMU is not functioning properly. SMU failed I Monitor Amp. Gain Error Test of Self-Test.

428 SMU is not functioning properly. SMU failed V DAC Test of Self-Test.

429 SMU is not functioning properly. SMU failed I DAC Test of Self-Test.

433 SMU is not functioning properly. SMU failed +I Bias Circuit Test of Self-Test.

434 SMU is not functioning properly. SMU failed -I Bias Circuit Test of Self-Test.

435 SMU is not functioning properly. SMU failed I Range Circuit Test of Self-Test.

436 SMU is not functioning properly. SMU failed Power Amp. Supply Voltage Switching Circuit Test of Self-Test.

437 SMU is not functioning properly. SMU failed Oscillation Detect Circuit Test of Self-Test.

440 VS/VMU is not functioning properly. VS and VM failed V Output/Measurement Function Test of Self-Test.

441 VS/VMU is not functioning properly. VM failed Gain Error Test of Self-Test.

442 VS/VMU is not functioning properly. VM failed Offset Error Test of Self-Test.

443	VS/VMU is not functioning properly. VS failed Lower DAC Test of Self-Test.
444	VS/VMU is not functioning properly. VS failed Upper DAC Test of Self-Test.
445	VS/VMU is not functioning properly. VS failed 40 V Range Gain Error Test
447	VS/VMU is not functioning properly. VM failed Differential Mode Gain Error Test of Self-Test.
448	VS/VMU is not functioning properly. VM failed Differential Mode Offset Error Test of Self-Test.
449	VS/VMU is not functioning properly. VS failed I Limit Detect Circuit Test of Self-Test.
450	VS/VMU is not functioning properly. VS failed I Limit Circuit Test of Self-Test.
451	VS/VMU is not functioning properly. VS failed I Measurement Function Test of Self-Test.
461	AFU is not functioning properly. AFU failed Target Value Setting Lower DAC Test of Self-Test.
462	AFU is not functioning properly. AFU failed Target Value Setting Upper DAC Test of Self-Test.
463	AFU is not functioning properly. AFU failed Search Start Voltage Setting DAC Test of Self-Test.
464	AFU is not functioning properly. AFU failed Error Amp. Offset Voltage Test of Self-Test.
465	AFU is not functioning properly. AFU failed Integrator Offset Current Test of Self-Test.
466	AFU is not functioning properly. AFU failed Search Stop Voltage Accuracy Test of Self-Test.
467	AFU is not functioning properly. AFU failed Ramp Rate Accuracy Test of Self-Test.
468	AFU is not functioning properly. AFU failed Error Amp. Function Test of Self-Test.
469	AFU is not functioning properly. AFU failed Settle Detect Circuit Test of Self-Test.
470	AFU is not functioning properly. AFU failed Target and Sense Value Comparator Test of Self-Test.
471	AFU is not functioning properly. AFU failed Search Stop Voltage Limit Detect Circuit Test of Self-Test.
480-499	An error occurred that can not be defined. Correct the error that occurred before this error, then run the program again. If no error occurred before this error, contact the nearest Hewlett-Packard service office because there may be an error in the HP 4142B firmware.
500	HCU is not functioning properly. HCU failed V DAC Function Test of Self-Test.
501	HCU is not functioning properly. HCU failed I Pulse DAC Function Test of Self-Test.
502	HCU is not functioning properly. HCU failed I Monitor Offset Error Test of Self-Test.
503	HCU is not functioning properly. HCU failed 0 V Output Test of Self-Test.

504	HCU is not functioning properly. HCU failed V Monitor Offset Error Test of Self-Test.
505	HCU is not functioning properly. HCU failed I Monitor Gain Error Test of Self-Test.
506	HCU is not functioning properly. HCU failed -2 V Range V Gain Error Test of Self-Test.
507	HCU is not functioning properly. HCU failed +2 V Range V Gain Error Test of Self-Test.
508	HCU is not functioning properly. HCU failed -20 V Range V Gain Error Test of Self-Test.
509	HCU is not functioning properly. HCU failed +20 V Range V Gain Error Test of Self-Test.
510	HCU is not functioning properly. HCU failed -2 V Range V Offset Error Test of Self-Test.
511	HCU is not functioning properly. HCU failed +2 V Range V Offset Error Test of Self-Test.
512	HCU is not functioning properly. HCU failed -20 V Range V Offset Error Test of Self-Test.
513	HCU is not functioning properly. HCU failed +20 V Range V Offset Error Test of Self-Test
514	HCU is not functioning properly. HCU failed +I Pulse Gain Error Test of Self-Test.
515	HCU is not functioning properly. HCU failed -I Pulse Gain Error Test of Self-Test.
516	HCU is not functioning properly. HCU failed +I Pulse Offset Error Test of Self-Test.
517	HCU is not functioning properly. HCU failed -I Pulse Offset Error Test of Self-Test.
518	HCU is not functioning properly. HCU failed +I Base Gain Error Test of Self-Test.
519	HCU is not functioning properly. HCU failed -I Base Gain Error Test of Self-Test.
520	HCU is not functioning properly. HCU failed +I Base Offset Error Test of Self-Test.
521	HCU is not functioning properly. HCU failed -I Base Offset Error Test of Self-Test.
522	HCU is not functioning properly. HCU failed 1mA Range Output/Measurement Function Test of Self-Test.
523	HCU is not functioning properly. HCU failed 10mA Range Output/Measurement Function Test of Self-Test.
524	HCU is not functioning properly. HCU failed 100mA Range Output/Measurement Function Test of Self-Test.
525	HCU is not functioning properly. HCU failed +I Bias Circuit Off Test of Self-Test.
526	HCU is not functioning properly. HCU failed +I Bias Circuit On Test of Self-Test.
527	HCU is not functioning properly. HCU failed -I Bias Circuit Off Test of Self-Test.
528	HCU is not functioning properly. HCU failed -I Bias Circuit On Test of Self-Test.
529	HCU is not functioning properly. HCU failed I Pulse Output/ Measurement Function Test of Self-Test.
530	HCU is not functioning properly. HCU failed V Pulse Output/ Measurement Function Test of Self-Test.

540	HVU is not functioning properly. HVU failed V Monitor Gain Error Test of Self-Test/Self-Calibration.
541	HVU is not functioning properly. HVU failed V Monitor Offset Error Test of Self-Test/Self-Calibration.
542	HVU is not functioning properly. HVU failed I Monitor Gain Error Test of Self-Test/Self-Calibration.
543	HVU is not functioning properly. HVU failed I Monitor + Polarity Offset Error Test of Self-Test/Self-Calibration.
544	HVU is not functioning properly. HVU failed I Monitor - Polarity Offset Error Test of Self-Test/Self-Calibration.
545	HVU is not functioning properly. HVU failed VDAC + Polarity Test of Self-Test/Self-Calibration.
546	HVU is not functioning properly. HVU failed VDAC - Polarity Test of Self-Test/Self-Calibration.
547	HVU is not functioning properly. HVU failed IDAC + Polarity Test of Self-Test/Self-Calibration.
548	HVU is not functioning properly. HVU failed IDAC - Polarity Test of Self-Test/Self-Calibration.
549	HVU is not functioning properly. HVU failed Power Amp. 0 V Output Test of Self-Test.
550	HVU is not functioning properly. HVU failed V Monitor 0 V Measurement Test of Self-Test.
551	HVU is not functioning properly. HVU failed Power Amp. 100 V Output Test of Self-Test.
552	HVU is not functioning properly. HVU failed V Monitor 100 V Measurement Test of Self-Test.
553	HVU is not functioning properly. HVU failed -V Limit Loop Function Test of Self-Test.
554	HVU is not functioning properly. HVU failed +V Limit Loop Function Test of Self-Test.
555	HVU is not functioning properly. HVU failed Power Amp. O V Output Test or +V/-V Limit Loop Function Test of Self-Test.
556	HVU is not functioning properly. HVU failed Power Amp. Offset Error Test of Self-Test.
557	HVU is not functioning properly. HVU failed +V Limit Loop Operation Accuracy Test of Self-Test.
558	HVU is not functioning properly. HVU failed -V Limit Loop Operation Accuracy Test of Self-Test.
559	HVU is not functioning properly. HVU failed +V/-V Limit Loop Function Test of Self-Test.
560	HVU is not functioning properly. HVU failed Power Amp. Control Circuit Function Test of Self-Test.
561	HVU is not functioning properly. HVU failed Loop Detector Function Test of Self-Test.
562	HVU is not functioning properly. HVU failed Current Range Function Test of Self-Test.
563	HVU is not functioning properly. HVU failed +I Bias Circuit Function Test of Self-Test.
564	HVU is not functioning properly. HVU failed -I Bias Circuit Function Test of Self-Test.

565	If you performed Self-Test or Self-Calibration on all units, the Self-Test/Self-Calibration of the HVU stopped and skipped to the next unit because the **INTLK** is opened. Be sure to perform the HVU Self-Calibration or Self-Test because the HVU lost the calibration data. Or if you performed the Self-Test or Self-Calibration only on one unit while the HVU output switch is set to on, the Self-Test/Self-Calibration stopped because the **INTLK** is open while the HVU output switch is set to on. Be sure to perform the Self-Test or Self-Calibration on the unit that stopped because the unit lost calibration data. Note that if the unit does not have the calibration data, the unit cannot force and measure the output within the accuracy of the specifications.
566	Self-Test or Self-Calibration is not performed on the HVU because the **INTLK** terminal is open.
567	At power-on, Self-Test is not performed on the HVU because the **INTLK** terminal is open. The HVU does not have the calibration data. Be sure to perform the HVU Self-Test. Note that if the unit does not have the calibration data, the unit cannot force and measure the output within the accuracy of the specifications.
600	The unit specified by the **PDM** must be one of the units specified by **PDV/PDI** and **PV/PI** for 2ch pulsed spot measurement (**MM7**), or must be one of the units specified by **PDV/PDI** and **PWV/PWI** for pulsed sweep with pulsed bias measurement (**MM8**).
601	At least one of the units specified by **PDV/PDI** and **PV/PI** must be the HCU for 2ch pulsed spot measurement (**MM7**). Or at least one of the units specified by **PDV/PDI** and **PWV/PWI** must be the HCU for pulsed sweep with pulsed bias measurement (**MM8**).
602	The unit specified by **PV** or **PI** must be the HPSMU, MPSMU, or HCU for 2ch pulsed spot measurement (**MM7**). Or the unit specified by **PWV** or **PWI** must be the HPSMU, MPSMU, or HCU for pulsed sweep with pulsed bias measurement (**MM8**).
603	The units specified by **WV/WI** and **PV/PI** are duplicate for staircase sweep with pulsed bias measurement (**MM5**). Or the units specified by **PDV/PDI** and **PV/PI** are duplicate for 2ch pulsed spot measurement (**MM7**). Or the units specified by **PDV/PDI** and **PWV/PWI** are duplicate for pulsed sweep with pulsed bias measurement (**MM8**).
610	Set the quasi-pulsed source by the **BDV** command before a quasi-pulsed spot measurement trigger.
611	For quasi-pulsed measurement, the monitor unit that is specified by **MM** command must be an HVU, HPSMU, or MPSMU.
1100-8611	For this type of error code (*nxxx*), *n* is the slot# for the plug-in unit and *xxx* is the error code.
11100-28611	For this type of error code (*nnxxx*), *nn* is the *channel*# for the VS/VMU and *xxx* is the error code.

Measurement Data Status

The following shows the measurement data status. The priority of status is:

Priority: F > X > V > C > T > S > G > N

For quasi-pulsed spot measurement:

Priority: S or G > F > X > V > C > T > N

The following numbers in the parentheses denote the measurement data status for Binary format.

N (0): Normal measurement data. For quasi-pulsed spot measurement, normal measurement data when the quasi-pulsed source reaches the *stop voltage*.

G (6): For analog search measurement:
The *target* value is not reached during a search (between *search start voltage* and *search stop voltage*).

For quasi-pulsed spot measurement:
The detection time is over the limit (3 s for Short mode, 12 s for Long mode). Set the *detection interval* to Long. If this status occurs even if the *detection interval* is set to Long, perform the spot measurement by constant source.

Or perform the following to speed up the settling time:
- Make the *I compliance* of the quasi-pulsed source larger.
- Make the *start voltage* larger.

S (7): For analog search measurement:
Measurement is made before the feedback search is complete.

For quasi-pulsed spot measurement:
The settling detection cannot be performed because the output slew rate is too slow. Perform the following:
- Set the *detection interval* to Long to enable the detection for the slow slew rate. If this status occurs even when the *detection interval* is set to Long, perform the spot measurement by constant source or pulsed measurement.
- Make the *I compliance* of the quasi-pulsed source larger to speed up the slew rate.

Or the settling detection cannot be performed because the quasi-pulsed source output voltage when the current reaches the *I compliance* is less than 10 V from the *start voltage*. Perform the pulsed measurement or spot measurement.

T (1): Another channel(s) reach V compliance, I compliance, power compliance, or the current limit of VS. In I compliance, the compliance of the opposite polarity that you specify is also set.

Or another HCU voltage output(s) does not settle before measurement. Perform the following:

- Make the *pulse width* larger to wait for settling time.
- Make the *I compliance* larger to speed up settling time.

C (2): This measurement channel reaches V compliance, I compliance, power compliance, or current limit of VS. In I compliance, the compliance of the opposite polarity that you specify is also set.

Or this HCU voltage output does not settle before measurement. Perform the following:

- Make the *pulse width* larger to wait for the settling time.
- Make the *I compliance* larger to speed up the settling time.

Note that status C occurs even if status C and T occur together.

V (3): This channel output exceeds the measurement range. The measurement value is a dummy value (199.999E+99 for ASCII format). Make the measurement range higher.

Or dummy data (199.999E+99 for ASCII format) is stored because the sweep measurement is automatically aborted by the automatic sweep abort function or power compliance.

X (4): One or more SMU/HVU(s) is oscillating.

Or, one or more SMU/HVU output(s) does not settle before measurement. Perform the following:

- Make the wait time, *delay time*, or *pulse width* larger to wait for the settling time.
- Make the *I compliance* larger to speed up the settling time.
- For pulsed measurement, make the *base* value closer to the *pulse* value to reduce the settling time.
- For current output by the limited auto ranging, make the I output range lower to speed up the settling time.

F (5): One or more HVU output(s) does not settle before the measurement. Perform the following:

- Make the wait time, *delay time*, or *pulse width* larger to wait for the settling time.
- Make the *I compliance* larger to speed up the settling time.
- For pulsed measurement, make the *base* value closer to *pulse* value to reduce the settling time.
- For current output by limited auto ranging, make the I output range lower to speed up the settling time.

For pulsed measurement, if the *pulse width* is set to maximum (50 ms), perform the quasi-pulsed spot measurement or spot measurement by constant source.

W (1): Indicates the sweep source data of the first or intermediate sweep step. For sweep source data, the status is always W or E. If the number of sweep steps is 1, the status is E.

E (2): Indicates the sweep source data of the final sweep step. For sweep source data, the status is always W or E. If the number of sweep steps is 1, the status is E.

The second character of the measurement data for ASCII format indicates the measurement channel number for measurement data, and indicates the sweep source channel number for sweep source data, as follows.

<channel>:			
	A: Ch#1	I: Ch#11	Q: Ch#21
	B: Ch#2	J: Ch#12	R: Ch#22
	C: Ch#3	K: Ch#13	S: Ch#23
	D: Ch#4	L: Ch#14	T: Ch#24
	E: Ch#5	M: Ch#15	U: Ch#25
	F: Ch#6	N: Ch#16	V: Ch#26
	G: Ch#7	O: Ch#17	W: Ch#27
	H: Ch#8	P: Ch#18	X: Ch#28

For differential measurements, the HP 4142B shows the unit specified by the **MM** or **TV** command.

The third character of the measurement data for ASCII format indicates the voltage data or current data as follows.

<V/I>:	
	V: Voltage data
	I: Current data

Reorder No. or
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