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Errata

Title & Document Type:

Manual Part Number:

Revision Date:

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

www.tm.agilent.com

Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

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HP 3852A/3853A Data Acquisition and Control Unit

HP 3852A/3853A
Assembly Level Service Manual

This manual applies to HP 3852A's with a serial number prefix of:

2525A and Above

This manual applies to HP 3853A's with a serial number prefix of:

2526A

WARNING

The information in this manual is to be used by qualified service-trained personnel only. To avoid personal injury, do not perform any procedure explained in this manual, or perform any servicing of the HP 3852A or HP 3853A unless you are qualified to do so.

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Herstellerbescheinigung

Hiermit wird bescheinigt, daß das Gerät/System HP 3852A
in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/Systems angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Zusatzinformation fur Meß- und Testgeräte

Werden Meß- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Meßaufbauten verwendet, so ist vom Betreiber sicherzustellen, daß die Funk-Entstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

Manufacturer's declaration

This is to certify that the equipment HP 3852A
is in accordance with the Radio Interference Requirements of Directive FTZ 1046/84. The German Bundespost was notified that this equipment was put into circulation, the right to check the series for compliance with the requirements was granted.

Additional Information for Test- and Measurement Equipment

If Test- and Measurement Equipment is operated with unscreened cables and/or used for measurements on open set-ups, the user has to assure that under operating conditions the Radio Interference Limits are still met at the border of his premises.

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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 National Institute of Standards and Technologies, to the extent allowed by the the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

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This Hewlett-Packard instrument product is warranted against defects in materials and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

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Hewlett-Packard warrants that its software and firmware designated by -hp- for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

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SAFETY SUMMARY

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 elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements. This is a Safety Class 1 instrument.

GROUND THE INSTRUMENT

To minimize shock hazard, 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 either 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 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 gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite 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 install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DO NOT OPERATE A DAMAGED INSTRUMENT

Whenever it is possible that the safety protection features built into this instrument have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the instrument until safe operation can be verified by service-trained personnel. If necessary, return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

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Operating and Safety Symbols

Symbols Used On Products And In Manuals

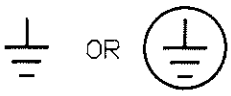
~ LINE — AC line voltage input receptacle.



Instruction manual symbol affixed to product. Warns and cautions the user to refer to respective instruction manual procedures to avoid personal injury or possible damage to the product.



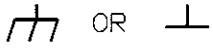
Indicates dangerous voltage – terminals connected to interior voltage exceeding 1000 volts.



Protective conductor terminal. Indicates the field wiring terminal that must be connected to earth ground before operating equipment – protects against electrical shock in case of fault.



Clean ground (low-noise). Indicates terminal that must be connected to earth ground before operating equipment – for single common connections and protection against electrical shock in case of fault.



Frame or chassis ground. Indicates equipment chassis ground terminal – normally connects to equipment frame and all metal parts.



Affixed to product containing static sensitive devices – use anti-static handling procedures to prevent electrostatic discharge damage to components.

NOTE

NOTE

Calls attention to a procedure, practice, or condition that requires special attention by the reader.

CAUTION

CAUTION

Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

WARNING

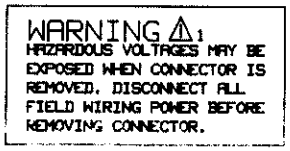
WARNING

Calls attention to a procedure, practice, or condition that could possibly cause bodily injury or death.

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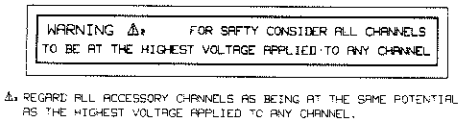
HP 3852A Caution and Warning Labels



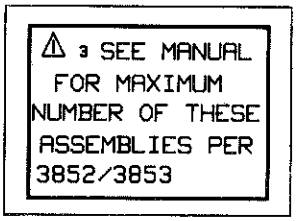
This symbol and warning statement is found beside the Analog Extender port on the HP 3852A and HP 3853A. The analog extender port enables the HP 3852A backplane analog bus to be expanded to an extender. The analog bus routes signals from channels on multiplexer accessories to the voltmeter accessories. Depending on the multiplexer combinations installed and the application wired to the accessories, up to 350V peak (equivalent to 250V AC rms or 250V DC) can be present on the bus and, therefore, on the terminals of the port.



The symbol and these statements are found below the locking ring on the terminal module and on the metal cover fastened to the component module of the plug-in accessories. Since all field wiring and most of the configuration involves the terminal module, the warnings serve as a reminder that even when the terminal module is separated from the component module, hazardous voltages can still be present on the terminal module due to the field wiring connected.



The symbol and these statements are found inside the terminal module and on the metal cover fastened to the component module of the plug-in accessories. The statements serve as a reminder to be careful when wiring in close proximity to other channels in which field wiring is already connected. Recall that hazardous voltages can still be present on the wiring terminals even though the accessory has been removed from the instrument. Note that all field wiring and configuration should be performed with the accessory removed from the instrument and with the terminal module separated from the component module.



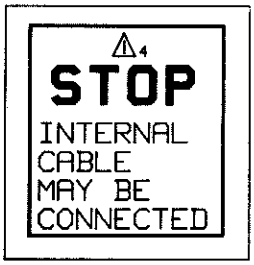
This symbol and statement is found above the locking ring on the terminal module of the HP 44727A, HP 44727B, and HP 44727C DAC (Digital-to-Analog Converter) accessories and on the side of the HP 44701A and HP 44702A/B voltmeter accessories. The symbol and statement refer to the fact that when a specific number of these accessories are installed in the same instrument, they place an excessive drain on the HP 3852A and HP 3853A power supply which in turn, causes degraded and often unpredictable system performance.



This symbol and statement is found on the name plate of the HP 44702A/B 13 bit High Speed Voltmeter accessory. The statement serves as a reminder that before removing the accessory, check to see that an HP 44711A, HP 44712A, or HP44713A High Speed FET multiplexer accessory is not connected to the voltmeter by the ribbon cable.

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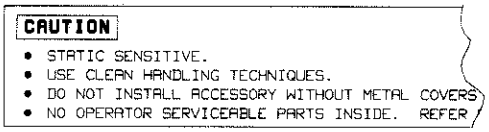
This symbol and statement is found on the bottom "rail" of the HP 44711A, HP 44712A, and HP 44713A High Speed FET multiplexer accessories and is exposed when the accessory's terminal module is removed. The "internal cable" is the ribbon cable that connects the FET multiplexer to the HP 44702A 13 bit High Speed Voltmeter accessory.



This statement appears at the bottom of the HP 3852A and HP 3853A power modules and under the CAUTION label on the metal cover of an accessory's component module. All equipment configuration and repair should be performed by service-trained personnel only.



This statement appears by the fuse socket on the HP 3852A and HP 3853A power modules. The HP 3852A and HP 3853A are shipped without the fuse installed. A 1.5 AT and 750 mAT fuse and a fuse cap are packaged together in a small static shielding bag which accompanies the instruments. A service-trained individual should install the correct fuse and set the LINE SELECTOR switches to the proper position before power is applied to the instrument.



These statements are found under the CAUTION label on the metal cover of an accessory's component module. The statements serve as a reminder to avoid touching the connector contacts and to use care when handling the accessory. Note that the protective cover should be attached following any necessary configuration in order to prevent damage to the components resulting from static discharge or when other accessories are installed.

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GENERAL INFORMATION

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CHAPTER 1
GENERAL INFORMATION

1-1 INTRODUCTION

This manual contains information required to test and support the Hewlett-Packard Model 3852A Data Acquisition and Control Unit, the HP Model 3853A Extender, and any plug-in accessories that may be installed. This manual is intended for use only by service trained personnel. Operating and programming personnel should refer to the HP 3852A Mainframe Configuration and Programming Manual.

Installation instructions, power requirements, or detailed operating and programming information are excluded from this manual. For this information, refer to the HP 3852A Mainframe Configuration and Programming Manual.

WARNING

The information in this manual is for the use of Service Trained Personnel only. To avoid electrical shock, do not perform any procedures in this manual or do any servicing to the HP 3852A/3853A and plug-in accessories, unless you are qualified to do so.

1-2 HOW TO USE THIS MANUAL

This manual is divided into 17 chapters. Each chapter is tabbed for quick reference. Chapter 1 gives general information about the HP 3852A/3853A and plug-in accessories. Chapters 2 through 5 deal with the HP 3852A Mainframe and the HP 3853A Extender. The remaining chapters deal with the plug-in accessories. In some cases, similar accessories are grouped in a single tabbed chapter.

Each accessory chapter (Chapters 6 through 17) contains a technical description of the accessory, specifications, performance tests, assembly level replaceable parts lists, and where applicable, backdating information. This organization was chosen so that all information about a particular plug-in accessory is located in one part of the manual.

The manual is separated as follows:

Chapter 1 -- General Information
Chapter 2 -- Operating Information
Chapter 3 -- HP 3852A/3853A Performance Tests
Chapter 4 -- HP 3852A/3853A Module and Front Panel Removal/Installation Procedures and Mechanical Replaceable Parts
Chapter 5 -- Problem Isolation
Chapter 6 -- HP 44701A Integrating Voltmeter
Chapter 7 -- HP 44702A/B High Speed Voltmeter
Chapter 8 -- HP 44705A/44705H/44706A/44708A/44708H Relay Multiplexers, HP 44717A/44718A Strain Gages
Chapter 9 -- HP 44709A/44710A FET Multiplexers, HP 44719A/44720A Strain Gages
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Chapter 11 -- HP 44715A 5 Channel Counter/Totalizer
Chapter 12 -- HP 44721A/44722A Digital Inputs
Chapter 13 -- HP 44724A Digital Output
Chapter 14 -- HP 44725A General Purpose Switch
Chapter 15 -- HP 44727A/B/C 4 Channel Voltage/Current DACs
Chapter 16 -- HP 44728A 8 Channel Relay Actuator
Chapter 17 -- HP 44729A 8 Channel Power controller

1-3 SERVICE KIT FOR HP 3852A SYSTEM

The operational verification and performance test procedures in this manual are extensive and time consuming. The HP 44743F Service Kit was therefore developed to perform operational verification tests on the HP 3852A and plug-in accessories. The kit also calibrates the accessories, where applicable. No service kit is available for the performance test procedures.

We highly recommend the use of the service kit if you have time contraints on testing and calibration of your HP 3852A system. Although the service kit does not perform any extensive performance tests, in most applications, the service kit will be more than adequate.

Included in the HP 44743F Service Kit are all the necessary test and calibration software. The software is menu driven for ease of use. An HP 9000 Series 200/300 computer is required to run the tests. The service kit uses various test fixtures to test the different plug-in accessories. The test fixtures provide proper connections to a digital voltmeter (like the HP 44701A) to make the necessary measurements.

The HP 44743F Service Kit can be purchased as a complete assembly or as separate components. However, if only the mainframe and/or one or two accessories are to be tested, purchase of the complete may be unnecessary. It is more economical to purchase the software and only the test fixtures for the accessories to be tested, instead of the complete kit. Table 1-1 gives the title, HP part numbers, and description of the software and test fixtures in the complete kit. Use this information to purchase the individual components of the kit.

1-4 GENERAL SYSTEM DESCRIPTION

The HP 3852A Data Acquisition and Control System is designed to allow rapid and easy configurations. At the heart of every system is the HP 3852A Data Acquisition and Control Unit. This mainframe has a full keyboard, two liquid crystal displays, a power supply, and a controller. The HP 3852A provides eight plug-in slots for accessories.

If more than eight plug-in accessories are required, the HP 3853A Extender is needed. A system may have up to seven such extenders. Each HP 3853A Extender provides 10 additional plug-in accessory slots. The HP 3853A contains a power supply and logic used to communicate with the mainframe.

System software is provided under accessory numbers 44456A and 44456B. This software runs on Hewlett-Packard Series 200 and 300 computers. The software provides the capabilities to configure the system, store data collected in the system, acquire high speed data, analyze data, present the data in a display, control a process, schedule a task, and distribute data.

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Table 1-1 HP 44743A Service Kit Description

Multiplexer Test Fixture (Open/Close)		
Part Number	Accessory Number	Description
44743-66205	44705A/H 44706A 44708A 44709A 44710A 44717A 44718A 44719A 44720A	This fixture is used to functionally verify the operation of the Relay and FET Multiplexers. A resistor is connected to one side of each channel and to a common node. An ohmmeter is then used to measure the resistor value when the channels are closed one at a time. This determines if the channel did close or open when commanded to do so.
Multiplexer Test Fixture (Resistance)		
Part Number	Accessory Number	Description
44743-66206	44705A/H 44706A 44708A 44709A 44710A 44717A 44718A 44719A 44720A	The channel path resistance of the Relay and FET Multiplexers is determined using this test fixture. All channels are tied together to form a common node on the test fixture. An ohmmeter is connected across the multiplexer's common node and the test fixture's common node. The ohmmeter is then used to measure the channel path resistance of each channel when closed. Note: Functional testing using the 44743-66205 test fixture should be performed before doing this test.
High Speed FET Multiplexer Test Fixture		
Part Number	Accessory Number	Description
44743-66211	44711A 44712A 44713A	This fixture is used to both functionally verify the operation and determine the channel path resistance of the High Speed FET Multiplexers. All channels are tied together to form a common node on the test fixture. An ohmmeter is connected across the multiplexer's common node and the test fixture's common node. The ohmmeter is then used to measure the channel path resistance of each channel when closed. The ohmmeter reading determines the channel path resistance and functionality of the multiplexer. The test fixture is also used to test ribbon cable operation.
Counter Test Fixture		
Part Number	Accessory Number	Description
44743-66215	44715A	Operational verification of the Counter is performed using this test fixture. The PACER output from the HP 3852A mainframe is used to trigger a dual one-shot on the test fixture. The one-shot output is processed to provide low level AC signals along with TTL compatible signals. The counter's Period, Totalize, Frequency, and Interrupt functions are all tested.

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Table 1-1 HP 44743A Service Kit Description (Cont.)

Digital Input Test Fixture		
Part Number	Accessory Number	Description
44743-66221	44721A 44722A	The Digital Input accessories are operationally verified using this test fixture. Pattern testing of the digital inputs are done by switching a "0101...1010..." pattern to the channel inputs. The counter function and interrupt operation are also tested using a 500 Hz TTL compatible signal. The signal is generated by a one-shot on the test fixture and the PACER output of the HP 3852A.
Digital Output and Form C Test Fixture (Open/Close)		
Part Number	Accessory Number	Description
44743-66224	44724A 44725A 44728A	This fixture is used to functionally verify the operation of the Digital Output, General Purpose Switch, and Relay Actuator accessories. A resistor is connected to one side of each channel and to a common node on the test fixture. The common of each channel is also tied together on the test fixture. An ohmmeter is then used to measure the resistor value when the channels are closed one at a time. This determines if the channel did close or open when commanded to do so.
Digital Output and Form C Test Fixture (Resistance)		
Part Number	Accessory Number	Description
44743-66225	44724A 44725A 44728A	The resistance of each channel of the Digital Output accessories are tested with this fixture. All channels are tied together to form a common node on the test fixture. One side of an ohmmeter is connected to this common node. The other side is switched to a common node of the NO contacts, NC contacts, or drain connections. The ohmmeter is then used to measure the resistance of each channel. Note: Functional testing using the 44743-66224 test fixture should be performed before doing this test.
DAC Test and Calibration Fixture		
Part Number	Accessory Number	Description
44743-66227	44727A	This test fixture is used to perform both output testing and calibration of the DAC accessories. A digital voltmeter with the test fixture is use to test and calibrate both the voltage and current outputs. A 250 Ω resistor is used as a shunt for current testing and calibration.

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Table 1-1 HP 44743A Service Kit Description (Cont.)

Power Controller Test Fixture		
Part Number	Accessory Number	Description
44743-66229	44729A	This fixture is used to functionally verify the operation of the Power Controller. An AC voltmeter and a 12 V, 60 Hz AC signal source are required for the tests. Each Power Controller channel is connected to a resistive voltage divider on the test fixture. When a channel is closed, the AC voltmeter measures the voltage on a node of the divider. This determines if the channel did close or open when commanded to do so.
Test and Calibration Software (5.25 inch flexible disc)		
Part Number	Accessory Number	Description
44743-10205	All	This menu driven software is available on a 5.25 inch flexible disc. It is written for the HP Series 200/300 computer. The software provides semi-automated testing and calibration (where required) of the HP 3852A and plug-in accessories. The above listed test fixtures are required to run the tests. Instructions are given to the user for external connections, hookups, fixture switch settings, etc. The test data is displayed and optionally printed as a permanent test record.
Test and Calibration Software (3.5 inch flexible disc)		
Part Number	Accessory Number	Description
44743-10203	All	This menu driven software is available on a 3.5 inch flexible disc. It is written for the HP Series 200/300 computer. The software provides semi-automated testing and calibration (where required) of the HP 3852A and plug-in accessories. The above listed test fixtures are required to run the tests. Instructions are given to the user for external connections, hookups, fixture switch settings, etc. The test data is displayed and optionally printed as a permanent test record.
User Manual		
Part Number	Accessory Number	Description
44743-90001	All	This manual is provided in each Service Kit and explains the different test fixtures, software, and tests. Each test is explained such that the user has a good understanding of how the tests are performed. Schematics of the test fixtures are also included to show all connections made during testing.

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1-5 PLUG-IN ACCESSORIES DESCRIPTION

The plug-in accessories for the HP 3852A/3853A can be separated into analog and digital inputs, counters, analog and digital outputs, switching, and breadboard. The following paragraphs describe the accessories.

1-6 Analog Input Accessories

The analog input accessories consist of the following:

HP 44701A Integrating Voltmeter
HP 44702A/B High Speed Voltmeter
HP 44705A/44705H/44706A/44708A/44708H Relay Multiplexers
HP 44709A/44710A/44711A/44712A/44713A FET Multiplexers
HP 44717A/44718A/44719A/44720A Strain Gages

The analog input accessories provide dc voltage, ac voltage, ohms measurement capability, and also provides the input measurement paths.

1-7 HP 44701A Integrating Voltmeter

The HP 44701A Integrating Voltmeter performs very accurate DC voltage, AC voltage, four-wire ohms, and offset compensated ohms measurements. The voltmeter uses an integrating technique for the analog to digital conversion.

The voltmeter's dc volt ranges are 30 mV, 300 mV, 3 V, 30 V, and 300 V. The ac volts ranges are 200 mV, 2 V, 20 V, and 200 V. The ohms ranges are 30 Ω, 300 Ω, 3 kΩ, 30 kΩ, 300 kΩ, and 30 MΩ. The ranges can be selected automatically or manually. The voltmeter resolution is selectable by choosing the integration time in Number of Power Line Cycles (NPLC). The corresponding integration time for 6 1/2, 5 1/2, 4 1/2, and 3 1/2 digit resolution is 1, 0.1, 0.005, and 0.0005 NPLC, respectively.

The voltmeter uses a current source for ohms measurements. The current source is part of the voltmeter circuitry but has to be externally connected (using a 4-wire ohms configuration) to the voltmeter's volts input terminals for ohms measurements. The current source ranges are 1 mA, 100 µA, 10 µA, and 1 µA. The appropriate current source range is automatically selected when the desired ohms range is selected.

1-8 HP 44702A/B High Speed Voltmeter

The HP 44702A/B High Speed Voltmeter performs DC voltage and ohms measurements at a 100,000 readings/second rate. The voltmeter uses an successive approximation technique for the analog to digital conversion.

The voltmeter has an on-board buffer to store readings. The readings can be transferred to the HP 3852A's internal memory or to a hard disk via GPIO and a DMA controller while making measurements. The HP 44702A can store over 8,000 readings and the HP 44702B can store over 64,000 readings. An extended memory card is available for the HP 44702A (not the HP 44702B) to extend its reading storage capability to 64,000.

The voltmeter resolution is 12 bits plus a sign bit. The voltmeter's dc volt ranges are 40 mV, 320 mV, 2.58 V, and 10.24 V. The ohms ranges depend on the ohms function (i.e., current source range) selected (see next paragraph for the ranges). The ranges can be selected automatically or manually.

The voltmeter uses a current source for ohms measurements. The current source is part of the voltmeter circuitry but needs to be externally connected (using a 4-wire ohms configuration) to the voltmeter's volts input terminals for ohms measurements. The current source ranges are 1 mA, 100 µA, and 10 µA and are

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selected by the 10 kΩ, 100 kΩ, and 1 MΩ ohms functions, respectively. The ranges for the 10 kΩ function are 40 Ω, 320 Ω, 2.56 kΩ, and 10.24 kΩ. The ranges for the 100 kΩ function are 400 Ω, 3.2 kΩ, 25.6 kΩ, and 102.4 kΩ. The ranges for the 1 MΩ function are 4 kΩ, 32 kΩ, 256 kΩ, and 1.024 MΩ.

1-9 HP 44705A/44705H/44706A/44708A/44708H Relay Multiplexers

These relay multiplexers provide the analog measurement paths to either the HP 3852A backplane and/or to a common point on the multiplexer's terminal module. All have High, Low, and Guard inputs for good common mode rejection.

The HP 44705A/H and HP 44708A/H can each multiplex 20 channels. Both are used for voltage, and 2-wire and 4-wire ohms measurements. The HP 44708A/H also has thermocouple compensation for temperature measurements using thermocouples. Individual relays are used to switch the High, Low, and Guard inputs of each channel. The only difference between the HP 44705A/44708A and 44705H/44708H is that the 44705H/44708H can operate at higher voltages.

The HP 44706A can multiplex 60 channels and can only be used for single ended measurements. The multiplexer is used for voltage and 2-wire (not 4-wire) ohms measurements. Individual relays are used to switch only the High input of each channel. The Low and Guard inputs of all channels are connected to a common point with no switching performed by any relays.

1-10 HP 44709A/44710A/44711A/44712A/44713A FET Multiplexers

These FET multiplexers provide the analog measurement paths to either the HP 3852A backplane and/or to a common point on the multiplexer's terminal module. The HP 44709A and HP 44710A have High, Low, and Guard inputs for good common mode rejection. The HP 44711A, HP 44712A, and HP 44713A only have High and Low inputs.

The HP 44709A and HP 44710A can each multiplex 20 channels. The HP 44709A is used for voltage, and 2-wire and 4-wire ohms measurements. The HP 44710A is used for voltage and 2-wire (not 4-wire) ohms measurements. The HP 44710A also has thermocouple compensation for temperature measurements using thermocouples. Individual FET switches are used to switch the High, Low, and Guard inputs of each channel.

The HP 44711A, HP 44712A, and HP 44713A are all High Speed FET Multiplexers. They are specifically designed to operate with the HP 44702A/B High Speed Voltmeter. The HP 44702A/B can directly control these multiplexers and take measurement via an externally connected ribbon cable. With ribbon cable control, the FETs can switch at a reading rate of up to 100,000 readings/second. If the ribbon cable is not used, they operate at the same speed as the HP 44709A and HP 44710A FET Multiplexers.

The HP 44711A and HP 44713A can each multiplex 24 channels. The HP 44712A can multiplex 48 channels and can only be used for single ended measurements. All are used for voltage measurement. The HP 44711A is also used for 4-wire (not 2-wire) ohms measurements. The HP 44711A and HP 44713A use individual FET switches to switch the High and Low inputs of each channel. The HP 44712A can only switch the High input of each channel. On the HP 44712A, all Low inputs are connected to a common point with no switching performed by any FET switches.

1-11 HP 44717A/44718A/44719A/44720A Strain Gages

The HP 44717A and HP 44718A are terminal modules that work in conjunction with the HP 44705A Relay Multiplexer component module. These can only be used for strain gage measurements. The HP 44717A is used for 120 Ω measurements and the HP 44718A is used for 350 Ω measurements.

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The HP 44717A and HP 44718A are terminal modules that work in conjunction with the HP 44709A FET Multiplexer component module. These can only be used for strain gage measurements. The HP 44719A is used for 120 Ω measurements and the HP 44720A is used for 350 Ω measurements.

1-12 HP 44721A/44722A Digital Input Accessories

The HP 44721A has 16 channels and can detect the presence of DC voltage inputs. The HP 44722A has 8 channels and can detect the presence of both DC voltage inputs, and AC voltage inputs at sine wave frequencies between 47 Hz and 470 Hz. The input detection of both accessories are based on nominal voltages selected by movable jumpers. For the HP 44721A, the nominal voltages are 5, 12, 24, and 48 volts DC. For the HP 44722A, the nominal voltages are 24, 210, and 240 volts DC. All channels are isolated from chassis ground using opto-isolators.

Each channel of the accessories also has the ability to independently totalize both positive and negative logic transitions, whichever one is selected. The maximum on/off frequency for the HP 44721A is 500 cycles/second and for the HP 44722A is 10 cycles/second. Any channel can also be programmed to set an interrupt for an edge occurrence (positive or negative) or a counter rollover to zero.

The accessories have a common debounce circuitry for all channels to prevent erroneous readings. The debounce time is user selectable by changing the the debounce oscillator frequency (for the HP 44721A only). The frequencies are 10 Hz, 100 Hz, and 1 kHz. The oscillator frequency for the HP 44722A is not selectable and is set to 10 Hz.

The HP 44721A also has a non isolated low current 5 V DC supply with 9.4 kΩ pull-up resistors on each channel input. The supply can be used to detect contact closures.

1-13 HP 44715A 5 Channel Counter Accessory

The HP 44715A 5 Channel Counter/Totalizer is used to count transitions, and make period and frequency measurements. It can accurately measure logic or RMS AC inputs with frequencies up to 200 kHz. The counter has 5 isolated and 5 non-isolated channels.

Isolated channels independently count on either positive or negative transitions. Nominal DC voltages are selectable by movable jumpers. The voltages are 5, 12, and 24 volts DC. Non-isolated channels have either TTL or low level RMS voltage inputs available. The TTL level is 5 V and the low level RMS sensitivity is 50 mV from DC to 10 kHz and 25 mV from 10 kHz to 200 kHz. The TTL and RMS inputs are also selectable by movable jumpers. Non-isolated channels set for low level RMS inputs use a zero crossing technique for measurements. Any channel that is totalizing can also be programmed to set an interrupt for a counter rollover to zero.

The debounce time of the accessories is user selectable for all channels to prevent erroneous readings.

The HP 44715A also has a non isolated low current 5 V DC supply with pull-up resistors. The supply can be used to detect contact closures.

1-14 HP 44727A/B/C 4 Channel Voltage/Current DACs Accessories

The HP 44727A/B/C accessories are Digital to Analog Converters that output either voltage or current. Each accessory has 4 channels of output available. The channels configured for voltage also have remote sensing capabilities. The channels are isolated and can be connected in series for voltage and parallel for current.

The accessories have two voltage ranges and two current ranges. The voltage ranges are 0 to +10.235 V and -10.235 V to +10.235 V with 2.5 mV resolution (12 bits plus a sign bit). The current ranges are 0 to +20.16 mA and +4 mA to +20.16 mA with 2.5 µA resolution (13 bits).

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Three configurations of the accessory are available. The HP 44727A accessory outputs voltage on 4 channels. The HP 44727B accessory outputs current on 4 channels. The HP 44727C accessory outputs voltage on 2 channels and current on the other 2 channels. However, each channel on the accessories can be reconfigured for voltage or current with movable jumpers on the accessories.

1-15 HP 44724A Digital Output Accessory

The HP 44724A accessory uses open drain digital outputs to control DC devices (up to 55 V) or to drive TTL logic levels. In either mode, an external power supply and pull-up resistors are needed. The accessory has 16 channels of output available.

1-16 Switching Accessories

There are three accessories for switching; HP 44725A 16 Channel general Purpose Switch, HP 44728A 8 Channel Relay Actuator, and HP 44729A 8 Channel Power Controller.

The HP 44725A and HP 44728A both use single pole double throw (SPDT) For C relays that return to the normally closed position at power down. The HP 44725A is used for low level power or moderate voltage and current switching. The HP 44728A is used for higher level power, and larger voltages and currents.

The HP 44729A is used to distribute AC line power. It switches on at the zero voltage crossing point and switches off at the zero current crossing point of the AC voltage. This method is used to prolong switch life and low channel path resistance.

1-17 HP 44736A Breadboard Accessory

The HP 44736A Breadboard is used to add specialized circuitry by the user. The breadboard consist of a printed circuit board (with no components installed), shield, and terminal module with 35 screw terminals. With the breadboard, the user has access to the HP 3852A/3853A backplane signals. Included are the control lines from the mainframe controller and power supplies.

1-18 INSTRUMENT IDENTIFICATION

Hewlett-Packard instruments are identified by a two part, ten digit serial number. This number is in the form 0000A00000. The first four digits, called the serial number prefix, is the same for all identical instruments, it changes only when a change is made to the instrument. The letter indicates the country of origin, A indicates the instrument was built in the United States of America. The last five digits, called the serial number suffix, are unique for each instrument.

Be sure to include the entire serial number, both prefix and suffix, in any correspondence about your instrument.

The serial number for the HP 3852A and HP 3853A is located on a label below the right side of the front panel. Each plug-in accessory also has a serial number. The accessory serial number is on a label affixed to the side frame of each accessory component module. The terminal modules are not serialized.

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Table 1-2 Assemblies/Module Exchange Part Numbers

Accessory Number	Ref Desig	HP Part Number	Description
3852X	3852X	03852-69203	Controller Module without A24 Extended Memory
44703A	A24	09826-69524	Printed Circuit Assembly with 256 k bytes extended memory
44703B	A24	98257-69524	Printed Circuit Assembly with 1 M bytes extended memory
3852PS	3852PS	06852-69202	Mainframe Power Supply Module
3853PS	3852PS	03853-69202	Extender Power Supply and Logic Module
44701A	44701A	44701-69201	5 1/2 Digit Integrating Voltmeter
44702A	44702A	44702-69201	13-Bit High Speed Voltmeter with 8 k reading storage
44702B	44702B	44702-69203	13-Bit High Speed Vottmeter with 64 k reading storage
44709A	44709A	44709-69201	20 Channel FET Multiplexer Component Module
44710A	44710A	44709-69201	20 Channel FET Multiplexer Component Module
44719A	44719A	44709-69201	20 Channel FET Multiplexer Component Module
44720A	44720A	44709-69201	20 Channel FET Multiplexer Component Module
44711A	44711A	44711-69201	24/48 Channel High Speed FET Multiplexer Component Module
44712A	44712A	44711-69201	24/48 Channel High Speed FET Multiplexer Component Module
44713A	44713A	44711-69201	24/48 Channel High Speed FET Multiplexer Component Module
44715A	44715A	44715-69201	5 Channel Counter/Totalizer Component Module
44721A	44721A	44721-69201	16 Channel DC/8 Channel AC Digital Input Component Module
44722A	44722A	44721-69201	16 Channel DC/8 Channel AC Digital Input Component Module
44724A	44724A	44724-69201	16 Channel Digital Output Component Module
44727A	44727A	44727-69201	4 Channel Voltage/Current DAC Component Module
44727B	44727B	44727-69201	(use reconfigured & recalibrated 44727A)
44727C	44727C	44727-69201	(use reconfigured & recalibrated 44727A)
44729A	44729A	44729-69201	8 Channel Power Controller Component Module

1-19 HP 3852A SYSTEM ASSEMBLIES/MODULE EXCHANGE

Some of the replaceable assemblies and modules for the HP 3852A/3853A and plug-in accessories are available as restored products through the Hewlett-Packard Exchange Program. These products are sold at a discount and require the return for credit of your defective assembly. Table 1-2 lists the assemblies/modules that my be exchanged. Included in the table are reference designators, HP part numbers, and description.

When an exchange assembly or module is ordered, Hewlett-Packard will ship a restored assembly with instructions for returning your defective assembly. Upon receipt of your defective assembly, Hewlett-Packard then credits your bill (give you a discount) and invoice you accordingly. You are allowed

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a specific time period to return your defective assembly after receiving the replacement assembly from HP. If the defective assembly is not received within this period the discount will not be given.

For more information on this program contact your nearest Hewlett-Packard Sales Office. Hewlett-Packard Sales Offices are listed in the back of this manual.

1-20 HP 3852A SYSTEM OPTIONS/ACCESSORIES AVAILABLE

The following lists all options and accessories available for the HP 3852A System. It is only intended to show possible configurations. It should not be used as an ordering guide for future accessories and systems. Ordering information can be obtained from your nearest Hewlett-Packard Sales Office. Sales Offices are listed at the back of this manual.

1-21 HP 3852A System Options Available

The following lists the options available for the HP 3852A System.

```
HP 3852A     Data Acquisition and Control Unit
  Opt 907    Front handle kit
  Opt 908    Rack mounting hardware
  Opt 909    Rack mounting hardware and front handle kit
  Opt 910    Extra set of HP 3852A/HP 3853A documentation

HP 3853A     Extender
  Opt 001    4 meter digital cable (replaces standard 1 meter cable)
  Opt 907    Front handle kit
  Opt 908    Rack mounting hardware
  Opt 909    Rack mounting hardware and front handle kit
  Opt C01    Add specified length of analog cable
  Opt C02    Add specified length of digital cable
  Opt K01    Specified length of analog cable (field kit) (100 meters max)
  Opt K02    Specified length of digital cable (field kit) (25 meters max)
```

1-22 HP 3852A System Accessories Available

Table 1-3 lists all accessories available for the HP 3852A System. Included are all plug-in modules, HP-IB cables, and system software.

1-23 HP 3852A Service Accessories and Support Courses Available

Table 1-4 lists all service accessories and support courses available for the HP 3852A System.

1-24 HP 3852A SYSTEM REQUIRED TEST EQUIPMENT

The required test equipment for the HP 3852A and plug-in accessories are listed in Table 1-5. This equipment is necessary to perform the Operational Verification Test, Performance Test, and Calibration procedures. The equipment is also listed in each applicable chapter.

1-25 HP 3852A/3853A SPECIFICATIONS

The HP 3852A/3583A specifications are listed in Table 1-6.

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Table 1-3 HP 3852A System Accessories

Accessory Number	Title
44458A	System Software for Series 200/300 Computer on 3.5 inch Flexible Discs (BASIC 4.0)
44458B	System Software for Series 200 Computer on on 5.25 inch Flexible Discs (BASIC 4.0)
44458R	License to produce HP 44458A or 44458B; includes one set of Software Manuals
44701A	5 1/2 Digit Integrating Voltmeter
44702A	13 Bit High Speed Voltmeter - 100 kHz (with 8 k reading memory)
44702B	13 Bit High Speed Voltmeter - 100 kHz (with 64 k reading memory)
44703A	Mainframe 256 k byte Memory expansion (field installed)
44703B	Mainframe 1 M byte memory expansion (field installed)
44703C	Reading memory expansion to 64 k for HP 44702A (field installed)
44705A	20 Channel Relay Multiplexer
44705H	20 Channel High Voltage Relay Multiplexer
44706A	60 Channel Single Ended Relay Multiplexer
44708A	20 Channel Relay Multiplexer with Thermocouple Compensation
44717A	10 Bridge 120 Ohm Static Strain Gage Relay Multiplexer
44708H	20 Channel High Voltage Relay Multiplexer with Thermocouple Compensation
44718A	10 Bridge 350 Ohm Static Strain Gage Relay Multiplexer
44709A	20 Channel FET Multiplexer
44710A	20 Channel FET Multiplexer with Thermocouple Compensation
44719A	10 Bridge 120 Ohm Static Strain Gage FET Multiplexer
44720A	10 Bridge 350 Ohm Static Strain Gage FET Multiplexer
44711A	24 Channel High Speed FET Multiplexer
44712A	48 Channel Single Ended High Speed FET Multiplexer
44713A	24 Channel High Speed FET Multiplexer with Thermocouple Compensation
44715A	5 Channel Counter/Totalizer (200 kHz)
44721A	16 Channel Digital Input
44722A	8 Channel AC Digital Input
44724A	16 Channel Digital Output (open drain)
44725A	16 Channel General Purpose Switch
44727A	4 Channel Voltage DAC
44727B	4 Channel Current DAC
44727C	2 Channel Voltage and 2 Channel Current DAC
44728A	8 Channel Relay Actuator
44729A	8 Channel Power Controller
44736A	Breadboard
44705AT	Extra terminal module for HP 44705A 20 Channel Relay Multiplexer
44705HT	Extra terminal module for HP 44705H 20 Channel High Voltage Relay Multiplexer
44706AT	Extra Terminal Module for HP 44706A 60 Channel Single Ended Relay Multiplexer
44708AT	Extra Terminal Module for HP 44708A 20 Channel Relay Multiplexer with TC
44708HT	Extra Terminal Module for HP 44708H 20 Channel High Voltage Relay Mux with TC

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Table 1-3 HP 3852A System Accessories (Cont.)

Accessory Number	Title
44709AT	Extra Terminal Module for 20 Channel FET Multiplexer
44710AT	Extra Terminal Module for 20 Channel FET Multiplexer with Thermocouple Compensation
44711AT	Extra Terminal Module for 24 Channel High Speed FET Multiplexer
44712AT	Extra Terminal Module for 48 Channel Single Ended High Speed FET Multiplexer
44713AT	Extra Terminal Module for 24 Channel High Speed FET Multiplexer with TC
44715AT	Extra Terminal Module for 5 Channel Counter/Totalizer (200 kHz)
44717AT	Extra Terminal Module for 10 Bridge 120 Ohm Static Strain Gage Relay Multiplexer
44718AT	Extra Terminal Module for 10 Bridge 350 Ohm Static Strain Gage Relay Multiplexer
44719AT	Extra Terminal Module for 10 Bridge 120 Ohm Static Strain Gage FET Multiplexer
44720AT	Extra Terminal Module for 10 Bridge 350 Ohm Static Strain Gage FET Multiplexer
44721AT	Extra Terminal Module for 16 Channel Digital Input
44722AT	Extra Terminal Module for 8 Channel AC Digital Input
44724AT	Extra Terminal Module for 16 Channel Digital Output (open drain)
44725AT	Extra Terminal Module for 16 Channel General Purpose Switch
44727AT	Extra Terminal Module for 4 Channel Voltage DAC
44727BT	Extra Terminal Module for 4 Channel Current DAC
44727CT	Extra Terminal Module for 2 Channel Voltage and 2 Channel Current DAC
44728AT	Extra Terminal Module for 8 Channel Relay Actuator
44729AT	Extra Terminal Module for 8 Channel Power Controller
44736AT	Extra Terminal Module for Breadboard
44740A	76.2 cm Rack with 110 V Power Panel and Instrument Installed
44740B	76.2 cm Rack with 220 V Power Panel and Instrument Installed
44741A	142.24 cm Rack with 110 V Power Panel and Instrument Installed
44741B	142.24 cm Rack with 220 V Power Panel and Instrument Installed
44495A	Field Wiring Terminal Panel (not rack installed)
98620B	2 Channel DMA Controller for HP Series 200/300 Computers
98622A	GPIO Interface for HP Series 200/300 Computers
98625A	High Speed HP-IB Disc Interface for HP Series 200/300 Computers
44744A	2 Meter GPIO Cable with Mating for HP 44702A/B and HP 98622A
44744B	4 Meter GPIO Cable with Mating for HP 44702A/B and HP 98622A
44745A	4 Meter GPIO Cable with Mating for HP 44702A/B and HP 12006A (GPIO for HP 1000)
10833A	1 Meter HP-IB Cable
10833B	2 Meter HP-IB Cable
10833C	4 Meter HP-IB Cable
10833D	0.5 Meter HP-IB Cable
8120-3448	6 Meter HP-IB Cable
8120-3449	8 Meter HP-IB Cable

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Table 1-4 Service Accessories and Support Courses

Accessory Number	Title
44743A	Service Module for Plug-in Accessories (backplane extender)
44743B	Service Module for Power Supply (backplane extender)
44743F	Service Kit; includes software and test fixures for mainframe and plug-in accessories operational verification tests and calibration
50011B	HP-IB Course for HP Series 200/300 Computers
50015A	Data Acquisition and Control Fundamentals Course
50016E	HP-IB Course for HP 1000 Computers
500600B	Instrument Application Services (consulting)

Table 1-5 Equipment Required for HP 3852A System

Accessory or Model Number	Use*	Instrument	Recommended Model
3852A	O	System Controller	HP 9000 Series 200/300, Basic 3.0 or 4.0
3853A		HP-IB Cable	HP Number 10833A
		Printer	HP Model 9876A
		Pulse/Function Generator	HP Model 8116A
		BNC to BNC Cable	HP Number 10503A
44701A	OPC	DC Voltage Standard	Datron Model 4000 or 4000A
		Resistance Standard	Datron Model 4000 or 4000A
		AC Voltage Standard	Datron Model 4200
44702A/B	OPC	Test Cables (2 each)	HP Number 03498-61602
		DC Voltage Standard	Datron Model 4000 or 4000A
		Resistance Standard	Datron Model 4000 or 4000A
		Computer	HP 9000 Series 200/300, Basic 4.0
		High Speed FET Multiplexer	HP 44711A, 44712A, or 44713A with 44711AT Terminal Module
44705A	OP	Digital Multimeter	HP 3456A
44705H		Oscilloscope	HP 1740A
44708A		Test Fixure	Made from HP 44705AT Terminal Module
44708H		Service Module	HP 44743A
		+20 V Power Supply	HP 6212A
		1 kΩ Resistor	Any 1 kΩ Resistor ±5% or Better
		10 MΩ Resistor	Any 10 MΩ Resistor ±5% or Better
44706A	OP	Digital Multimeter	HP 3456A
		Oscilloscope	HP 1740A
		Test Fixure	Made from HP 44706AT Terminal Module
		Service Module	HP 44743A
		+20 V Power Supply	HP 6212A
		1 kΩ Resistor	Any 1 kΩ Resistor ±5% or Better
		10 MΩ Resistor	Any 10 MΩ Resistor ±5% or Better

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Table 1-5 Equipment Required for HP 3852A System (Cont.)

Accessory or Model Number	Use*	Instrument	Recommended Model
44709A	OP	Digital Multimeter	HP 3456A
44710A		Oscilloscope	HP 1740A
		Test Fixure	Made from HP 44709AT Terminal Module
		Service Module	HP 44743A
		+20 V Power Supply	HP 6212A
		1 kΩ Resistor	Any 1 kΩ Resistor ±5% or Better
		10 MΩ Resistor	Any 10 MΩ Resistor ±5% or Better
		+10 V Power Supply	HP 6234A
		-10 V Power Supply	HP 6234A
44711A	OP	Digital Multimeter	HP 3456A
44713A		Oscilloscope	HP 1740A
		Test Fixture	Made from HP 44711AT Terminal Module
		Service Module	HP 44743A
		High Speed Voltmeter	HP 44702A/B
		1 kΩ Resistor	Any 1 kΩ Resistor ±5% or Better
		10 MΩ Resistor	Any 10 MΩ Resistor ±5% or Better
		+10 V Power Supply	HP 6234A
		-10 V Power Supply	HP 6234A
44712A	OP	Digital Multimeter	HP 3456A
		Oscilloscope	HP 1740A
		Test Fixture	Made from HP 44712AT Terminal Module
		Service Module	HP 44743A
		High Speed Voltmeter	HP 44702A/B
		1 kΩ Resistor	Any 1 kΩ Resistor ±5% or Better
		10 MΩ Resistor	Any 10 MΩ Resistor ±5% or Better
		+10 V Power Supply	HP 6234A
		-10 V Power Supply	HP 6234A
44715A	OP	Function Generator	HP Model 3325A
		Test Fixture	Made from HP 44715AT Terminal Module
44721A	OP	DC Voltmeter	Any DC Voltmeter able to read +5 V, ±10%
44722A		Function Generator	HP 8116A
		Test Fixture	Made from HP 44721AT Terminal Module
44724A	OP	Digital Multimeter	HP 3456A
		Test Fixture	Made from HP 44724AT Terminal Module
		+5 V Power Supply	HP 6214A
		10 Ω Resistor	Any 10 Ω 5 W Resistor 10% or Better
44725A	OP	Digital Multimeter	HP 3456A
		Test Fixture	Made from HP 44725AT Terminal Module
		Service Module	HP 44743A
		10 MΩ Resistor	Any 10 MΩ Resistor ±5% or Better
		+20 V Power Supply	HP 6212A

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Table 1-5 Equipment Required for HP 3852A System (Cont.)

Accessory or Model Number	Use*	Instrument	Recommended Model
44727A/B/C	OPC	Digital Multimeter	HP 3456A
		Test Fixture	Made from HP 44727AT Terminal Module
		Service Module	HP 44743A
		500 Ω Resistor	Any 500 Ω .25 W Resistor ±5% or Better
		125 Ω Resistor	Any 125 Ω 5 W Low TC Resistor ±5% or Better
		600 Ω to 630 Ω Resistor	Any 600 Ω to 630 Ω .5 W Low TC Resistor ±5% or Better
44728A	OP	Digital Multimeter	HP 3456A
		Test Fixture	Made from HP 44728AT Terminal Module
		Service Module	HP 44743A
44729A	OP	Digital Multimeter	HP 3456A
		Function Generator	HP 8116A
		Test Fixture	Made from HP 44729AT Terminal Module
		Service Module	HP 44743A

*O=Operational Verification, P=Performance, and C=Calibration

Table 1-6 HP 3852A/3853A Specifications

HP 3852A Mainframe

Real Time Clock:

Accuracy: ±0.004% of elapsed time since setting ±2 msec at temperature of setting.

Temperature Coefficient:

Add as an additional accuracy error, where Tdif is the absolute difference between the operating temperature and the temperature when the time was set.

$\pm((4.5*10^{-6})\%$ of elapsed time since setting$)*Tdif^2$

Resolution: 1 msec

Nonvolatile Lifetime: 4 years

Pacer:

Programmable Intervals: 1 µsec to 4.19 sec with 0.25 µsec resolution.

Accurcacy (First Pulse after Trigger):

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Table 1-6 HP 3852A/3853A Specifications (Cont.)

Programmed Delay ±0.005% of delay + (0 to 1 µsec)

Accuracy (Additional Pulses):

Programmed pules interval ±0.005% of pulse interval ±50 nsec

Number of Pulses: 1 to 65,535 or continuous.

Pulse Widths: 0.5 µsec nominally (low true)

Backplane Trigger Delay: Maximum delay between System Trigger In and actual trigger on the backplane,

200 nsec

Physical Characteristics:

Size: 22.225 cm (8 3/4 in) H (with feet removed) X 42.55 cm (16 3/4 in) W X 50.8 cm (20 in) D. Add 1.27 cm (0.5 in) for feet.

Weight: 16.8 kg (37 lbs)without function modules; 31.8 kg (70 lbs) loaded.

HP 3853A Extender

Backplane Trigger Delay: Maximum delay between HP 3852A backplane trigger and the actual trigger on the HP 3853A Extender backplane,

75 nsec + 5 nsec per meter of extender control cable (between mainframe and extender)

Physical Characteristics:

Size: 22.225 cm (8 3/4 in) H (with feet removed) X 42.55 cm (16 3/4 in) W X 50.8 cm (20 in) D. Add 1.27 cm (0.5 in) for feet.

Weight: 15.0 kg (33 lbs) without function modules; 32.7 kg (72 lbs) loaded.

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CHAPTER 2
OPERATING INFORMATION

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CHAPTER 2
OPERATING INFORMATION

2-1 INTRODUCTION

This chapter summarizes HP 3852A operation. Complete operating information is in the HP 3852A Mainframe Configuration and Programming Manual. Operating information about plug-in accessories are in the HP 3852A Plug-In Accessory Configuration and Programming Manuals.

The information in this chapter is about entering commands. Also included are the addressing conventions used in this and other manuals, the syntax rules for the commands, subroutines, and service related commands. A command reference that lists all commands in alphabetical order is in Table 2-2. Detailed information is given about the service related commands.

2-2 ENTERING COMMANDS

Most of the commands in the procedures and examples in this manual may be entered from the front panel. These commands may also be sent over the HP-IB. Some commands may only be sent over the HP-IB. These commands typically involve a symbol or parameter that cannot be entered from the front panel. For example, the FOR...NEXT construct cannot be entered from the front panel due to the lack of an "=" key.

Commands can be entered from the front panel in two ways. By pressing the key with the function name desired, if a key for that function is available, or by pressing the blue shift key and then entering the command name desired. After the blue shift key is pressed, the keyboard is a full alpha keyboard, laid out in a typewriter "QWERTY" fashion.

2-3 ADDRESSING CONVENTIONS

In this and other manuals about the HP 3852A, commands that contain parameters for a slot, channel, or channel list use the **ESCC** convention. In this convention:

E = Extender number
In the HP 3852A, E = 0
In the HP 3853A, E = 1 to 7

S = Slot number in extender **E**
In the HP 3852A, S = 0 to 7
In the HP 3853A, S = 0 to 9

CC = Channel number in slot **S**
If only a slot is specified, channel number is 00.

For example, the following command string (using the ID? command) asks the identity of the accessory installed in slot 5 of extender 3.

Select from front panel by executing:

```
ID? 3500
```


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Select from a Basic language Computer by executing:

```
OUTPUT 709;"ID? 3500"
```

In the command string, leading zeros are not required, trailing zeros are required.

2-4 The USE Command

The accessory slot or channel specified by a **USE** command is the selected slot or channel for all following commands not specifying a different channel or slot. After power-on or reset, the default USE channel is the lowest slot number and channel number with an accessory installed.

2-5 SYNTAX RULES

These rules describe the format and programming conventions associated with the HP 3852A command set shown in Table 2-1.

1. Commands generally consist of a header and one or more parameters. Headers can be entered in either upper or lower case. However, in the command reference table they are shown in upper case and in bold print (e.g., **ADDR?**).

2. Parameters can be entered in either upper or lower case. However, in the command reference table they are shown in lower case italics (e.g., *mode*).

3. Parameters shown in the command reference table not enclosed in **[ ]** (brackets) are required parameters. They must be specified each time the command is used. Parameters enclosed in **[ ]** (brackets) are optional parameters and can be omitted when executing the command. If the optional parameter is not specified, a default parameter is assigned.

4. Numeric parameters can be either integer, floating point, or exponential format. Numbers in floating point format are rounded to the nearest integer if the command requires an integer.

5. Command headers and parameters must be separated by either a space or a comma. Multiple spaces and/or commas are also accepted.

6. Command delimiters are the **;** (semicolon), **<LF>** (line feed) or **EOI** (HP-IB). When entered from the front panel, the ENT (enter) key signals the end of command.

7. Over the HP-IB, multiple commands can be sent as a single string by separating the commands with a semicolon.

2-6 SUBROUTINES

The HP 3852A allows subroutines to be entered and executed in mainframe memory. Subroutines may be entered from either the HP-IB or the front panel. The following guidelines apply when using subroutines.

1. The subroutine name may be any combination of alpha and numeric characters, up to eight characters. The first character of a subroutine name must be an alpha character. Special characters are not allowed in subroutine names.

2. Subroutines are erased from memory when the RESET or SCRATCH command is executed or at power-down.

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Table 2-1 Format Specifiers

fmt	Definition	Restrictions
IASC	Short Integer number (+12345)	Output buffer & display format. Not a mainframe storage format.
LASC	Long Integer number (+1234567890)	Output buffer & display format. Not a mainframe storage format.
RASC	Real number (+1.234567E-12)	Output buffer & display format. Not a mainframe storage format.
DASC	Double Real number (+1.234567890123456E-123)	Output buffer & display format. Not a mainframe storage format.
PACK	Packed as received from the accessory	Output buffer & mainframe storage format. Not a display format.
RL64	64-bit REAL number	Output buffer & mainframe storage format. Not a display format.
IN16	16-bit INTEGER number	Output buffer & mainframe storage format. Not a display format.

3. The execution of a subroutine can be viewed by sending the **FASTDISP OFF** command prior to the subroutine call. The **STEP** command can also be used to control subroutine execution speed.

4. Variables and arrays are global. They can be declared and dimensioned inside or outside a subroutine and then used inside or outside a subroutine.

5. Math functions, trigonometric operations, and binary functions can be used in subroutines.

6. The following commands can only be used inside subroutines:

FOR ... NEXT
IF ... END IF
WHILE ... END WHILE

7. The following commands cannot be used inside subroutines:

DELSUB
SCRATCH
STEP
CONT
SUB ... SUBEND

8. A subroutine can be aborted by sending the HP-IB Device Clear command or pressing the front panel CLEAR button.

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2-7 SERVICE COMMANDS

2-8 CAL Command

The **CAL** command is used to set the gain and offset of either the HP 44701A Integrating Voltmeter or the HP 44702A/B High Speed Voltmeter. The command syntax is shown in Figure 2-1. Complete calibration procedures are given in the appropriate chapter of this manual.

CAL, *number* **[,USE** *ch***]**

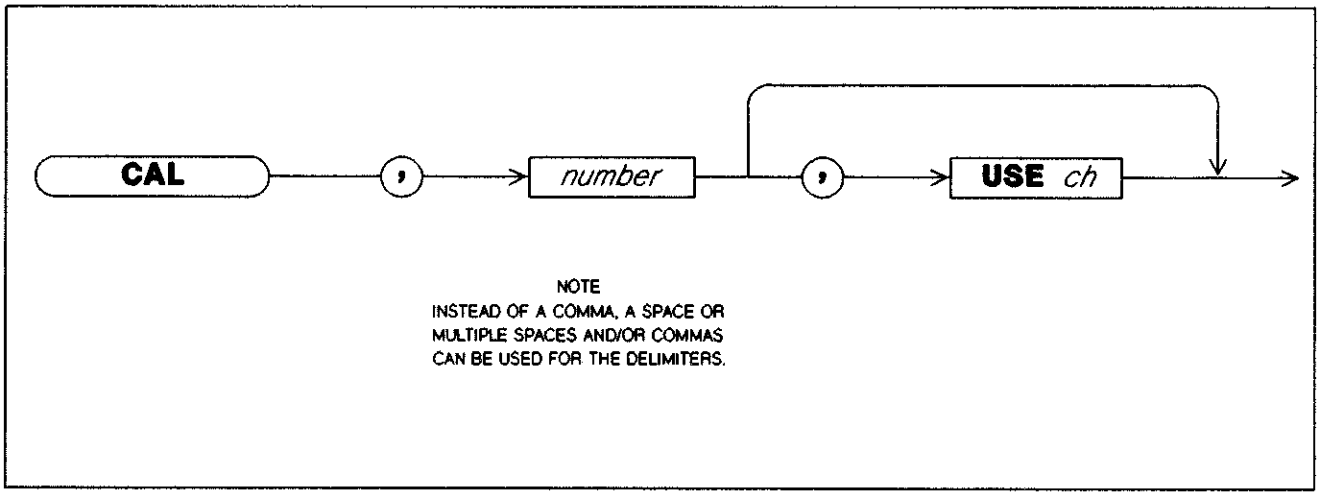


Figure 2-1 CAL Syntax

The *number* parameter represents what the reading should be in the range and function selected. To set the offset the *number* parameter is set to 0. To set the gain, the *number* parameter is set to the actual measurement value.

The optional **USE** *ch* parameter is the slot destination for the command. The **USE** *ch* parameter has the form **ESCC**, where **E** = the extender number, **S** = the slot number, and **CC** = 00 for the CAL command. The default for the **USE** *ch* parameter is the last slot assigned in a **USE** command or, if no **USE** command has been sent, the power-on **USE** *ch* value.

2-9 SREAD Command

This command interrogates registers on the accessory modules in the HP 3852A. The syntax for the command is shown in Figure 2-2.

SREAD, *slot, register_number* **[,INTO** *name***]** or **[,***fmt***]**

NOTE

The accessory must not be busy when attempting to read a register.

The *slot* parameter has the form ES00, where E = extender number (HP 3852A = 0, HP 3853A = 1 to 7) and S = slot number (HP 3852A = 0 to 7, HP 3853A = 0 to 9). The *register_number* is specific to the accessory being interrogated. Refer to the specific accessory chapter for register numbers and their uses.

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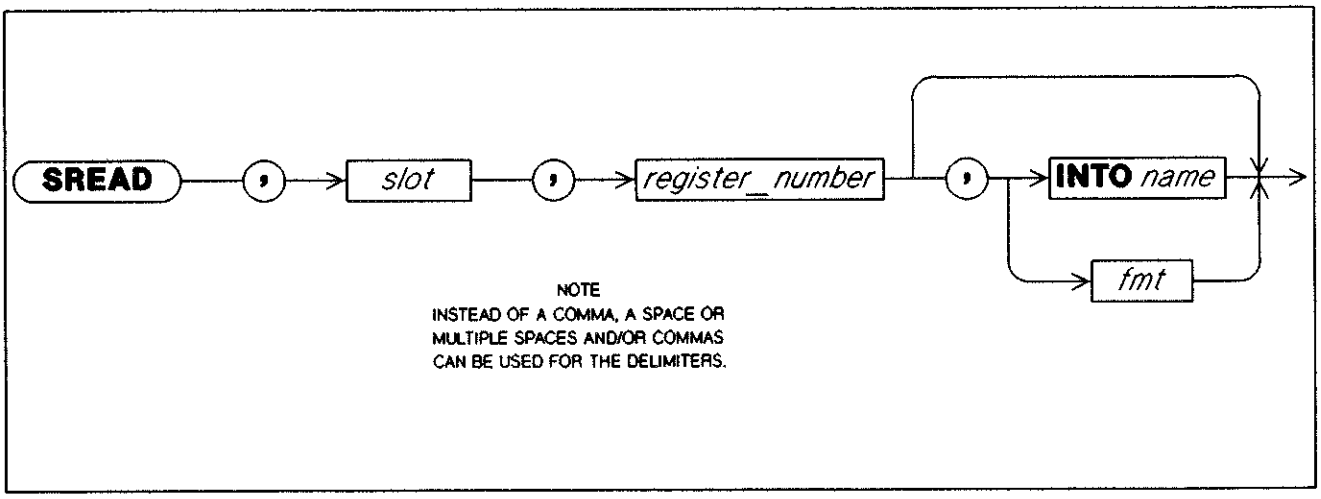


Figure 2-2 SREAD Syntax

The **INTO** *name* is an optional parameter for transferring the register reading into a variable or array. If **INTO** *name* is not used the reading will go to the output buffer and/or display. If **SREAD** was initiated from the front panel, the data is routed to the display. If **SREAD** was initiated from the HP-IB, the data is sent to the HP-IB output buffer and to the display.

The optional *fmt* parameter is the output buffer/display format specifier. Table 2-1 lists format specifiers. If the *fmt* parameter is not specified, the default format for SREAD is IASC.

NOTE

The read and write registers of an accessory are binary registers. The SREAD and SWRITE commands use a decimal representation of this two's compliment binary number. If using an HP Series 200 or 300 computer the IVAL$ and IVAL commands can be used to convert decimal to binary or binary to decimal. In the HP 85A/B the DTB$ and BTD commands can be used to perform these functions.

2-10 SWRITE Command

This command writes a specified value to a register on the accessory modules in the HP 3852A. The syntax for the SWRITE command is shown in Figure 2-3.

SWRITE, *slot, register_number, register_value*

NOTE

The accessory must not be busy when sending the SWRITE command.

The *slot* parameter has the form ES00, where E = extender number (HP 3852A = 0, HP 3853A = 1 to 7) and S = slot number (HP 3852A = 0 to 7, HP 3853A = 0 to 9). The *register_number* is specific to the accessory being addressed. Refer to the specific accessory chapter for register numbers and their uses.

The *register_value* is the decimal value you are sending to the register.

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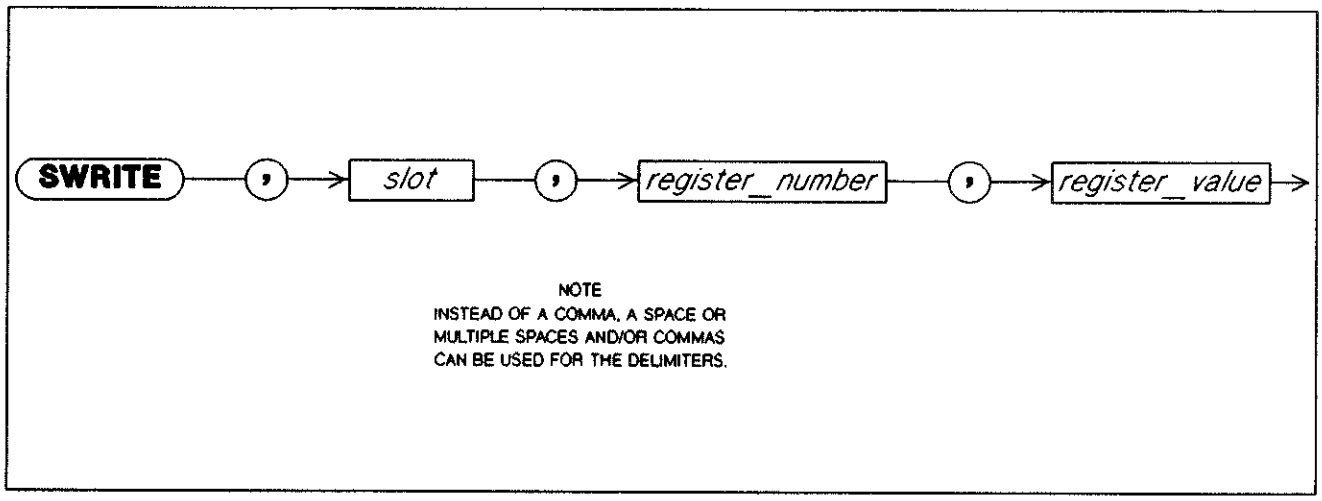


Figure 2-3 SWRITE Syntax

NOTE

The read and write registers of an accessory are binary registers. The SREAD and SWRITE commands use a decimal representation of this two's compliment binary number. If using an HP Series 200 or 300 computer the IVAL$ and IVAL commands can be used to convert decimal to binary or binary to decimal. In the HP 85A/B the DTB$ and BTD commands can be used to perform these functions.

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Table 2-2 Command Reference

ADDR *number*
Set the HP-IB address
number = 0 to 30

ADDRESS - See ADDR

ADDR? [INTO *name***] or [***fmt***]**
Read the HP-IB address

ALRM [INTO *name***] or [***fmt***]**
Read current alarm setting

exp **AND** *exp* ********
Logical AND function
exp = variable or number

APPLY DCI *ch, number*
Set output current level on DAC
ch = HP 44727B/C channel
number = 0 to .0201675

APPLY DCV *ch, number*
Set output voltage level on DAC
ch = HP 44727A/C channel
number = -10.235 to 10.235

APPLY PERC *ch, number*
Set percentage of full scale output on DAC
ch = HP 44727A/B/C channel
number = -102.35 to 102.35

ARANGE [*mode***] [USE** *ch***]**
Set voltmeter autorange mode
mode = OFF or ON
USE *ch* = HP 44701A slot

ARMODE [*mode***] [USE** *ch***]**
Set voltmeter autorange mode, BEFORE or AFTER measure trigger
mode = BEFORE or AFTER
USE *ch* = HP 44702A/B slot

ASCAN [*mode***] [USE** *ch***]**
Set autoscan function
mode = ON or OFF
USE *ch* = HP 44702A/B slot

ATN (*number***) *****
Return arctangent in radians
number = number in controller range

AZERO [*mode***] [USE** *ch***]**
Autozero the voltmeter
mode = OFF, ON, ONCE
USE *ch* = HP 44701A/02A/B slot

BEEP [*mode***]**
Enables or disables the mainframe beeper
mode = ON, OFF, ONCE

BINAND (*number, number***) ****
Bit-level binary AND function
number = -32768 through 32767

BINCMP (*number***) ****
Binary complement
number = -32768 through 32767

BINEOR (*number, number***) ****
Bit-level exclusive-OR function
number = -32768 through 32767

BINIOR (*number, number***) ****
Bit-level inclusive-OR function
number = -32768 through 32767

BIT (*number, bit_position***) ****
Bit test
number = -32768 through 32767
bit_position = 0 through 15

BLOCKOUT [*mode***]**
Set the Block Output mode
mode = OFF or ON

CAL *number* **[USE** *ch***]**
Calibrates the voltmeters
number = desired calibration value
USE *ch* = HP 44701A/02A/B slot

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Table 2-2 Command Reference (Cont.)

CALL *name* [*number*]
Call a subroutine
name = subroutine name
number = 1 to 2147483647

CAT
Return list of variables, arrays, and subroutines

CHREAD *ch* [**INTO** *name*] **or** [*fmt*]
Transfer a single reading
ch = HP 44715A/21A/22A channel or HP 44701A/02A/02B slot

CHREADZ *ch* [**INTO** *name*] **or** [*fmt*]
Read and zero channel count
ch = HP 44715A/21A/22A channel

CHWRITE *ch, number*
Write a number to a channel
ch = HP 44724A/25A/28A/29A channel
number = -32768 to 32767

CLOSE *ch_list*
Close a channel
ch_list = HP 44705A/06A/08A/09A/ 10A/11A/12A/13A or HP 44724A/25A/28A/29A channels

CLOSE? *ch_list* [**INTO** *name*] **or** [*fmt*]
Return the state of specified channel
ch_list = HP 44705A/06A/08A/09A/ 10A/11A/12A/13A or HP 44724A/25A/28A/29A channels list

CLR
Mainframe CLEAR.

CLROUT
Clear the HP-IB output buffer

CLWRITE [*ribbon_bus*] *ch_list* [**RANGE** *range_list*] [**USE** *ch*]
Set channel list and ranges to be scanned
ribbon_bus = SENSE, COM or SEP
ch_list = HP 44702A/B channel list
RANGE *range_list* = HP 44702A/B range or AUTO
USE *ch* = HP 44702A/B slot

CNTSET [*number*] [**USE** *ch*]
Preset the counter channel
number = -2147483648 to 2147483647
USE *ch* = HP 44715A/21A/22A channel

CONF *function* [**USE** *ch*]
Configure the voltmeter
function = ACV, DCV, OHM, TEMPtype, REFT, THMtype, OHMF, THMFtype, RTDtype, RTDFtype (HP 44701A); = DCV, OHM, OHM10K, OHM100K, OHM1M, OHMF, OHMF10K, OHM100K, OHMF1M, TEMPtype, REFT, THMtype, THMFtype, RTDtype, RTDFtype (HP 44702A/B); = TOTAL, TOTALM, UDC, UDCM, CD, CDM, RAT, PER, PERD (HP 44715A); = LVL (HP 44721A/22A)
USE *ch* = HP 44715A/21A/22A channel or HP 44701A/02A/B slot

CONFMEAS *function, ch_list* [**USE** *ch*][**INTO** *name*] **or** [*fmt*]
Configure the voltmeter and initiate a measurement
function = ACV, DCV, OHM, OHMF, TEMPtype, REFT, THMtype, THMFtype, RTDtype, RTDFtype (HP 44701A); = DCV, OHM, OHM10K, OHM100K, OHM1M, OHMF, OHMF10K, OHM100K, OHMF1M, TEMPtype, REFT, THMtype, THMFtype, RTDtype, RTDFtype HP 44702A/B
ch_list = HP 44705A/06A/08A/ 09A/10A/11A/12A/13A channels
USE *ch* = HP 44701A/02A/B slot

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Table 2-2 Command Reference (Cont.)

CONT
Continue a paused or stepped subroutine

CONV *domain, range, var* **[INTO** *name***] or [**fmt**]**
Convert data from pre-defined look-up table
domain = x-coordinates array
range = y-coordinates array
var = array to be converted

COS (*number***) *****
Return the cosine of the number
number = number in radians

DELAY *trig_delay* **[USE** *ch***]**
Set delay between trigger and measurement
trig_delay = 0 to 4294.967295 sec
USE *ch* = HP 44701A slot

DELAY *trig_delay* **[***sample_period***] [USE** *ch***]**
Set delay between triger and measurement
trig_delay = 0 to 16.38375msec
sample_period = 0 to 1073.741823 sec
USE *ch* = HP 44702A/B slot

DELSUB *name*
Deletes subroutine contents
name = delete code for subname

DELVAR *name*
Deletes variable memory space
name = delete space for array name

DIM *name (max_index)* **[***name* (max_index) **...]**
Defines a REAL array
name (max_index) = REAL array name and max index

DISABLE *event*
Disables an event
event = ALRM, INTR SYS, INTR [USE ch], LMT, LOGCHAN

DISABLE INTR [USE *ch***]**
Disable the voltmeter interrupt
USE *ch* = HP 44715A/21A/22A channel or HP 44701A/02A/B slot

DISP *mode* **or [***message***]**
Set the display mode or display a message
mode = ON, OFF, or MSG
[message]
message = string or numbers

EDGE *trans* **[***trans***] [USE** *ch***]**
Set the transition for counting or interrupt
trans = HL, LH, HI, LO
USE *ch* = HP 44715A/21A/22A channel

ELSE - See **IF**

ENABLE *event*
Enables an event to be recognized and serviced
event = ALRM, INTR SYS, INTR [USE ch], LMT, LOGCHAN

ENABLE INTR [USE *ch***]**
Enables voltmeter interrupt
USE *ch* = HP 44715A/21A/22A channel or HP 44701A/02A/B slot

END IF - See **IF...END IF**

END WHILE - See **WHILE..END WHILE**

ERR? [INTO *name***] or [***fmt***]**
Read mainframe error code

ERROR? - See **ERR?**

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Table 2-2 Command Reference (Cont.)

ERRSTR?
Read the mainframe error message and error code

EXP (*number*) *
Raises base e to the number specified
number = -708.396418532264 through 709.7828933838

EXTEND? [INTO *name*] **or** [*fmt*]
Identifies the HP 3853A Extender Units connected to the mainframe

FASTDISP [*mode*]
Set the fast display mode
mode = OFF or ON

FASTOUT [*mode*]
Set the fast output mode
mode = OFF or ON

FOR *counter = init_value* **TO** *final_value* [**STEP** *step_size*]
program segment
NEXT *counter*
Defines a subroutine loop
counter = counter var. name
init_value = counter beginning value
final_value = counter ending value
step_size = up/down amount

FUNC *function* [*range*] [**USE** *ch*]
Set the voltmeter function
function = DCV, ACV, OHMF (HP 44701A); = DCV, OHMF10K, OHMF100K, OHMF1M (HP 44702A/B)
range = HP 44701A/02A/B range or AUTO
USE *ch* = HP 44701A/02A/B slot

FUNC *function* [*tbase*] [**USE** *ch*]
Set the counter function
function = TOTAL, TOTALM, UDC, UDCM, CD, CDM, RAT, PER, PERD
tbase = .000001 to .01 sec
USE *ch* = HP 44715A channel

GET
Mainframe Group Execute Trigger

ID? [*slot*]
Read the accessory identity
slot = slot addressed

IDN?
Read system identification

IF *expression* **THEN**
program segment
[**ELSE**]
[program segment]
END IF
Set a conditional subroutine branch
expression = TRUE if <>0; FALSE if 0

INBUF [*mode*]
Set the state of the command input buffer
mode = OFF or ON

INDEX *name, number*
Set array index pointer for next data element
name = name of array
number = next element to store data

INDEX? *name* [**INTO** *name*] **or** [*fmt*]
Read the index pointer
name = array name

INTEGER *name* [*(max_index)*] [*name* [*(max_index)*]...]
Define an INTEGER variable or array
name (max_index) = INTEGER variable or array name and max index

INTR? [INTO *name*] **or** [*fmt*]
Return the address of last channel interrupt serviced

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Table 2-2 Command Reference (Cont.)

[LET] *variable = number*
Assign a value to a variable or array
variable = variable or array element
number = numeric expression

LGT (*number*) *
Return the logarithm of the number
number = number >= 0

LMT *min, max, index_stor, var*
Post-processing limit testing
min = name that stores lower limits
max = name that stores upper limits
index_stor = name for index numbers
var = name that stores reading

LMT *min, max, index_stor*
Real time limit testing
min = name that stores lower limits
max = name that stores upper limits
index_stor = name for index numbers

LOCAL
Restores front panel control

LOCK [*mode*]
Enables or disables the front panel
mode = OFF or ON

LOG (*number*) *
Return the natural logarithm of the number
number = number >0

LOGCHAN *var*
Designates array to receive channel numbers
var = name holding channel numbers

MEAS *function, ch_list* **[USE** *ch*]
[INTO *name*] **or** [*fmt*]
Set the voltmeter measurement function
function = ACV, DCV, OHM, OHMF, TEMPtype, REFT, THMtype, THMFtype, RTDtype, RTDFtype (HP 44701A); = DCV, OHM, OHM10K, OHM100K, OHM1M, OHMF, OHMF10K, OHMF100K, OHMF1M, TEMPtype, REFT, THMtype, THMFtype, RTDtype, RTDFtype (HP 44702A/B)
ch_list HP 44705A/06A/08A/09A/10A/11A/12A/13A channels
USE *ch* = HP 44701A/02A/B slot

MON [*ch*] **or** [*mode*]
Enables or disables the monitor mode
ch = address of channel monitored
mode = OFF, ON, or ALL

MONITOR - See **MON**

MONMEAS *function, ch_list*
[USE *ch*]
Set the voltmeter function and initiate the measurement
function = ACV, DCV, OHM, OHMF, REFT, THMtype, THMFtype, RTDtype, RTDFtype (HP 44701A); = DCV, OHM, OHM10K, OHM100K, OHM1M, OHMF, OHMF10K, OHMF100K, OHMF1M, REFT, THMtype, THMFtype, RTDtype, RTDtype (HP 44702A/B)
ch_list = HP 44705A/06A/08A/09A/10A/11A/12A/13A channel list
USE *ch* = HP 44701A/02A/B slot

NEXT - See **FOR ...NEXT**

NPER *number* **[USE** *ch*]
Set the number of periods the counter will measure over
number = 1 to 65535
USE *ch* = HP 44715A channel

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Table 2-2 Command Reference (Cont.)

NPLC *number* **[USE** *ch***]**
Set the integration time of the voltmeter
number = 0 to 16
USE *ch* = HP 44701A slot

NRDGS *number* **[USE** *ch***]**
Set the number of readings per trigger
number = 1 to 65535
USE *ch* = HP 44701A/02A/B slot

OCOMP [*mode***] [USE** *ch***]**
Enables or disables offset compensation
mode = OFF or ON
USE *ch* = HP 44701A slot

OFF *event*
Disables interrupts
event = ALRM, INTR [USE ch], LMT

ON *event* **CALL** *name*
Enables interrupts
event = ALRM, INTR [USE ch], LMT
name = name of subroutine called

OPEN *ch_list*
Opens the specified channel
ch_list = HP 44705A/06A/08A/09A/10A/11A/13A/ or HP 44724A/25A/28A/29A channel list

exp **OR** *exp* ********
Logical inclusive-or function
exp = variable or number

OUTBUF [*mode***]**
Enables or disables the HP-IB output buffer
mode = OFF or ON

PACER *period* **[***count***]**
Set pacer repetition period and number of pulses
period = .000001 to 4.19430375 sec
count = 0 to 65535

PACKED *name (max_index)* **[***name* (max_index)**...]**
Defines a PACKED array
name (max_index) = name/max index (bytes) of PACKED array

PAUSE
Pauses subroutine execution

PDELAY *trigger_delay*
Set delay between pacer trigger and first pulse
trigger_delay = 500 nsec to 4.19430375 sec

PERC *threshold* **[USE** *ch***]**
Set voltmeter trigger threshold
threshold = number between -128% to 127% of HP 44702A/B full scale value
USE *ch* = HP 44702A/B slot

POSTSCAN *number* **[USE** *ch***]**
Set number of scans for voltmeter after stop trigger
number = 0 to 65535
USE *ch* = HP 44702A/B slot

POWEROFF [INTO *name***] or [***fmt***]**
Julian date and time of last power down

PRESCAN *number* **[USE** *ch***]**
Set number of voltmeter scans before stop trigger
number = 0 to 65535
USE *ch* = HP 44702A/B slot

PTRIG [*source***]**
Set pacer trigger source
source = EXT, SGL, or HOLD

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Table 2-2 Command Reference (Cont.)

RANGE [*range*] [**USE** *ch*]
Set voltmeter range
range = HP 44701A/02A/B range or AUTO
USE *ch* = HP 44701A/02A/B slot

RDGS *dest* [**USE** *ch*]
Specify destination of measurement data
dest = SYS or GPIO
USE *ch* = HP 44702A/B slot

RDGSMODE *mode* [**USE** *ch*]
Set voltmeter storage mode and interrupt condition
mode = BURST, DAV, END, or COMPLETE
USE *ch* = HP 44702A/B slot

READ *slot* [**INTO** *name*] **or** [*fmt*]
Read the state of a channel
slot = HP 44721A/22A/24A/25A/28A/29A slot

REAL *name* [*(max_index)*] [*name* [*(max_index)*]...]
Defines a REAL variable or array
name (max_index) = REAL variable or array name and max index

RQS *mode* or *unmask*
Enables the mainframe SRQ
mode = OFF or ON
unmask = number (0-3711) or mnemonic (ALRM, LMT, INTR, ERR, RDY, LCL, FPS, PWR, DAV)

RQS? [**INTO** *name*] **or** [*fmt*]
Return decimal sum of status register bits

RESET - See **RST**

RST [*slot*]
Resets to power-on state
slot = slot addressed

SADV *source*
Set channel scan advance source
source = SCAN, CHADV, KEY, or PACER

SCALE *offset, scale, readings* [**INTO** *name*] **or** [*fmt*]
Post-processing scaling function
offset = name that stores offsets
scale = name that stores scale factors
readings = name that stores readings

SCAN [*backplane_bus*] *ch_list*
Establishes a scan list
backplane_bus = SENSE, COM, or SEP
ch_list = HP 44705A/06A/08A/09A/10A/11A/12A/13A channel list

SCANMODE *mode* [**USE** *ch*]
Set voltmeter operating mode
mode = OFF or ON
USE *ch* = HP 44702A/B slot

SCDELAY *trig_delay* [*scan_pace*] [**USE** *ch*]
Set delay betwen scan trigger and start of scan
trig_delay = 0 to 16.38375 ms
scan_pace = 0 to 1073.741823 sec
USE *ch* = HP 44702A/B slot

SCRATCH
Deletes subroutines, arrays, and variables

SCSLOPE *mode* [**USE** *ch*]
Specify scan trigger edge
mode = LH or HL
USE *ch* = HP 44702A/B slot

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Table 2-2 Command Reference (Cont.)

SCTRIG [*source*] [**USE** *ch*]
Specify scan trgger source
source = SCAN, SGL, HOLD, EXT0 EXT1, SYS, INT, MEAS, or GPIO
USE *ch* = HP 44702A/B slot

SET ALRM *seconds*
Set the alarm
seconds = 0 to 86399.999

SET TIME *seconds*
Set the real-time clock
seconds = 0 to 86399.999

SET TIMEDATE *seconds*
Set Julian time and date in real-time clock
seconds = 2.08662912E+11 through 4.768629999E+11

SIN (*number*) ***
Return sine of number in radians
number = abs value <2.98156826E+8 radians

SIZE? *name* [**INTO** *name*] **or** [*fmt*]
Return the maximum size of specified array
name = array name

SLOPE *mode* [**USE** *ch*]
Specify voltmeter trigger edge
mode = LH or HL
USE *ch* = HP 44702A/B slot

SPER *sample_period* [**USE** *ch*]
Set sample period of voltmeter
sample_period = 0 to 1073.741823 sec
USE *ch* = HP 44702A/B slot

SPER *number* [**USE** *ch*]
Set the sample period of accessory channels
number = 0.000001 to 0.16 seconds
USE *ch* = HP 44715A channel

SQR (*number*) *
Return square root of number
number = number >= 0

SREAD *slot, register_number* [**INTO** *name*] **or** [*fmt*]
Read specified accessory register
slot = slot number
register_number = register address

SRQ
Programmed HP-IB service request

STAT *min, max, mean, std, var*
Perform statistical analysis of data
min = name to store lowest value
max = name to store highest value
mean = name storing mean value
std = name storing std dev
var = name that stores values

STA? [**INTO** *name*] **or** [*fmt*]
Read system status register

STATE? [**INTO** *name*] **or** [*fmt*]
Return present configuration of HP 3852A

STB? [**INTO** *name*] **or** [*fmt*]
Read system status byte

STEP [*name*]
Steps through a subroutine
name = subroutine name

STRIG *source*
Set scan trigger source
source = SCAN, CHADV, KEY, or PACER

STSLOPE *mode* [**USE** *ch*]
Set the stop trigger edge
mode = LH or HL
USE *ch* = HP 44702A/B slot

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Table 2-2 Command Reference (Cont.)

STTRIG [*source*] **[USE** *ch*]
  Specify stop trigger source
  source = SCAN, SGL, HOLD, EXT0 EXT1, SYS, INT, MEAS, or GPIO
  USE *ch* = HP 44702A/B slot

SUB *name*
commands
SUBEND
  Subroutine construction
  name = subroutine name

SUBEND - See **SUB**

SWRITE *slot, register_number,* register_value
  Write a value to a specified accessory register
  slot = slot number
  register_number = register address
  register_value = desired value of register

SYSOUT *mode*
  Set system output mode
  mode = OFF or ON

TBASE [*tbase*] **[USE** *ch*]
  Set the counter time base
  tbase = .000001 to 1 sec
  USE *ch* = HP 44715A channel

TERM *terminal* **[USE** *ch*]
  Select the voltmeter input terminals
  terminal = BOTH, INT, ZERO, RIBBON
  USE *ch* = HP 44701A/02A/B slot

TERM *terminal* [*terminal*] **[USE** *ch*]
  Set the input terminals for the counter
  terminal = ISO or NON
  USE *ch* = HP 44715A channel

TEST [*slot*]
  Perform a self-test
  slot = mainframe or extender slot

TIME [INTO *name*] **or** [*fmt*]
  Return current real-time clock reading in seconds

TIMEDATE [INTO *name*] **or** [*fmt*]
  Return Julian date and time

TRG [*source*]
  Set system trigger source and mode
  source = EXT, GET, HOLD, SGL

TRIG [*source*] **[USE** *ch*]
  Set voltmeter trigger source or mode
  source = AUTO, EXT0, EXT1, GPIO, HOLD, MEAS, SCAN, SGL, SYS
  USE *ch* = HP 44701A/02A/B slot

TRIG *source* **[USE** *ch*]
  Set the counter trigger source and mode
  source = SGL, AUTO, HOLD, SYS
  USE *ch* = HP 44715A channel

TRIGOUT [*mode*] **[USE** *ch*]
  Set voltmeter EXT0 as trigger source
  mode = OFF or ON
  USE *ch* = voltmeter slot

USE *ch*
  Specify accesory to receive subsequent commands
  ch = HP 44715A/21A/22A channel or HP 44701A/02A/B slot

USE? [INTO *name*] **or** [*fmt*]
  Return current use channel

VREAD *array* [*(indes)*] **or** *variable* **[INTO** *name*] **or** [*fmt*]
  Read contents of array or variable
  array [*(index)*] = array name or name and index to an element
  variable = variable name

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Table 2-2 Command Reference (Cont.)

VWRITE *array, item_list or array (element), number or variable,* number
  Write data to array or variable
  array, item_list = write item list to array (<=10 items)
  array (element), number = write number to array element
  variable, number = write number to variable

WAIT [*number*]
  Wait specified amout of time
  number = 0 to 86400 seconds

WAIT FOR - See **WAITFOR**

WAITFOR *condition*
  Wait for specified condition
  condition = ALRM, EVENT, INTR, PACER

WHILE *expression*
program segment
END WHILE
  Defines a subroutine loop
  expression = TRUE if <>0; FALSE if 0

WRITE *slot, number*
  Write a number to specified slot
  slot = HP 44724A/25A/28A/29A slot
  number = -32768 to 32767

XRDGS *ch* [*count*] [**INTO** *name*] **or** [*fmt*]
  Transfer specified number of readings from voltmeter
  ch = HP 44715A/21A/22A channel or HP 44701A/02A/02B slot
  count = 1 to 2147483647

* = Math Function
** = Binary Function
*** = Trigonometric Operation
**** = Logical Operators
(only used within **IF...END IF** and **WHILE...END WHILE**)

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CHAPTER 3
HP 3852A/3853A
PERFORMANCE TESTS

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CHAPTER 3
HP 3852A/3853A
PERFORMANCE TESTS

3-1 INTRODUCTION

This chapter contains a series of tests designed to give a high confidence level that the HP 3852A and HP 3853A are operating within published specifications.

These tests can be used as a first step in system troubleshooting, as an "incoming inspection" procedure, or to verify that a repair was actually accomplished.

All tests given in this chapter can be performed from a system controller connected through HP-IB to the HP 3852A. Some of the tests can be performed from the front panel of the HP 3852A if desired. The tests that require a system controller and that cannot be performed from the front panel are the following:

HP-IB Test -- Section 3-7
Keyboard Test -- Section 3-8
Pacer Test -- Section 3-12
HP 3853A Test Procedures -- Section 3-15

3-2 HP 3852A PERFORMANCE TEST

3-3 Equipment Required

The following test equipment is required to run the performance tests:

1. System Controller -- HP 9000 Series 200/300 or equivalent
2. HP-IB Cable -- HP 10833A or equivalent
3. Printer -- HP 9876A or equivalent
4. Pulse/Function Generator -- HP 8116A or equivalent
5. BNC to BNC cable -- HP 10503A or equivalent

NOTE

The test programs listed in this Chapter require the I/O and HP-IB options for BASIC 3.0 and 4.0 on HP 9000 Series 200 and 300 computers.

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3-4 3852A Test Procedures

WARNING

Even with power removed from the HP 3852A, high voltages, generated in other parts of the system, may be present at the terminal module of each accessory. Service personnel should ensure that all external power is removed from the system before installing, removing, testing or repairing any plug-in accessory.

3-5 Power-Up Self-Test

This test performs two internal self-test routines and, if passed, provides a high confidence level that the HP 3852A local controller is operational. The two routines are referred to as the fatal and non-fatal error test routines. A third routine can also be accessed from the front panel and is described in Section 3-6. Do the following:

1. Remove power from the HP 3852A.

2. Remove the digital extender cable from the connector on the rear panel of the power supply (not all applications use the digital extender cable). Remove all plug-in accessories from the mainframe. The accessory component module must be removed as well as the terminal module.

3. Apply power to the HP 3852A and observe the displays. As the HP 3852A cycles through the self-test routine the displays will indicate the area under test and provide other system information.

4. The self-test is sucessful if the word READY appears in the left display and the MON and PWR ON annunciators are on in the right display. No other messages should be in the displays and no other annunciators should be on (in particular, the ERR annunciator should not be on).

5. If a display other than READY is obtained, or if additional annunciators are on, a self-test error is indicated. Chapter 5 provides an in-depth explanation of the self-test routines and the possible errors that may be encountered.

NOTE

A successful self-test does not, by itself, ensure proper instrument operation. A self-test failure, however, does indicate an instrument malfunction.

3-6 Display Test and Self-Test

This test performs the front panel accessed self-test routine. This routine checks 60% of the HP 3852A local controller and includes a display test. It is important that the power-up self-test in Section 3-5 has been sucessfully performed before initiating this test. Do the following:

1. Initiate the self-test routine by executing:

```
TEST
```


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2. Observe the HP 3852A displays. The beeper should sound and all display segments in both displays will be turned on (except the top dot of the colon). After the display test the message "SELF TEST OK" should be present in the right display. The MON and PWR ON annunciators in the right display should be on. No other messages should be in the displays and no other annunciators should be on.

The test can be repeated, if necessary, to allow enough time to check all display segments.

If a message other than "SELF TEST OK" is in the displays or if the ERR annunciator in the left display is on, a self-test error is indicated. Chapter 5 provides an in-depth explanation of the self-test and the errors that may be encountered. If all the display segments are not on during the self-test, a display failure is indicated. Chapter 5 provides a procedure to isolate the displays from the drive logic.

3-7 HP-IB Test

This test checks the ability of the HP 3852A to communicate with a system controller through the HP-IB connection. The test sets and checks the SRQ mask and performs a remote self-test. Do the following:

1. Ensure the system controller is connected to the HP 3852A with the HP-IB cable.

2. Verify that the HP 3852A HP-IB address is set to 9 by executing from the front panel:

    ADDR?

3. The right display should show the number 9. If the number 9 is obtained, proceed to Step 4. If a number other than 9 is obtained, record the number for later reference and change the HP-IB address by executing from the front panel:

    ADDR 9

4. Load Test Program 3-1 into the system controller. The program is located at the end of this chapter. Test Program 3-1 was written in BASIC on an HP 9000 System 200 computer. Other computers may differ slightly in syntax.

5. Run the program and observe the system controller print out. The system printer will indicate a sucessful test with the message HP 3852A PASSED HP-IB TEST. Any other message indicates a failure of the test. In some cases, an error message will be printed on the system printer. If the test fails, additional problem isolation tests can be found in Chapter 5.

If the Keyboard Test in Section 3-8 or Pacer Test in Section 3-12 is not to be performed, reset the HP-IB address to the value recorded in Step 3 (if the HP-IB address was 9, it is not necessary to reset the address). To reset the address, execute from the front panel:

    ADDR X (where X = address recorded in Step 3)

3-8 Keyboard Test

This test checks for correct response from the keyboard. The keyboard is electrically arranged into a 6 by 8 matrix. This test checks each column and row of the matrix by pressing six keys.

1. Verify the system controller is connected to the HP 3852A with the HP-IB cable.

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2. Verify that the HP 3852A HP-IB address is set to 09 by executing from the front panel:

ADDR?

3. The right display should show the number 9. If the number 9 is obtained, proceed to Step 4. If a number other than 9 is obtained, record the number for later reference and change the HP-IB address by executing from the front panel:

ADDR 9

4. Load Test Program 3-2 into the system controller. The program is located at the end of this chapter. Test Program 3-2 was written in BASIC on an HP 9000 System 200 computer. Other computers may differ slightly in syntax.

5. Run the program. Press the following keys on the HP 3852A front panel in the order given:

DISPLAY

TEST

SRQ

TRIG

TOTAL

CONF

5

3

6. The program will stay in a loop until all six required keys are pressed. A sucessful test is indicated by the message, HP 3852A PASSED KEYBOARD TEST, on the system printer. If the program will not terminate the loop (pressing additional keys will not affect the outcome of the test), a failure of the keyboard or drive logic is indicated. Should a failure be encountered, it will be necessary to reset the system controller and cycle power on the HP 3852A to exit the test loop. Chapter 5 contains additional problem isolation information.

If the Pacer Test in Section 3-12 is not to be performed, reset the HP-IB address to the value recorded in Step 3 (if the HP-IB address was 9, it is not necessary to reset the address). To reset the address, execute from the front panel:

ADDR X (where X = address recorded in Step 3)

3-9 Clock and Non-Volatile Memory Test

This test checks the operation of the system clock and verifies that the non-volatile memory is functional. Do the following:

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NOTE

This test requires that the system clock be set to a known value. The clock must be reset to the correct time following this test. A procedure to set the correct time and date is given in Section 3-18. Because of the Julian format of the clock, setting the date is a tedious process. The currently set date can be retrieved by executing the TIMEDATE command and recording the number returned. If this number is then reprogrammed into the system clock, only the current time will need to be reset.

1. Set the timedate to September 10, 1985 by executing:

   SET TIMEDATE 2.113619616E+011

2. Verify that the new timedate is held in the memory by executing

   TIMEDATE

3. The value displayed in the right display should be close to the value entered in Step 2 (the display will have to be scrolled to see the entire number). The difference between the two numbers represents the amount of seconds that have elapsed since the original value was entered. In general, the nine most significant digits should not change (i.e., they should be 2.11361961)

4. Cycle power to the HP 3852A. Wait for the HP 3852A to complete its wake-up sequence and the left display to show the message: READY. Obtain a display indicating the time that the power was removed by executing:

   POWEROFF

5. The value displayed in the right display should be close to the value entered in Step 2 (the display will have to be scrolled to see the entire number). The difference between the numbers represents the seconds that elapsed between the time Step 2 was executed and the time that power was removed from the HP 3852A. In general, the eight most significant digits should not change (i.e., they should be 2.1136196). This test is a check of the non-volatile memory operation. If the number returned is very different from the number entered in Step 2, the non-volatile memory may be failing.

If the Alarm Test in Section 3-10 is not to be performed, reset the system clock and date as described in Section 3-18.

3-10 Alarm Test

This test checks the operation of the system alarm and subsequently checks that the HP 3852A local controller can enter and execute a subroutine.

NOTE

This test requires that the system clock be set to a known value. The clock must be reset to the correct time following this test. A procedure to set the correct time and date is given in Section 3-18. Because of the Julian format of the clock, setting the date is a tedious process. The currently set date can be retrieved by executing the TIMEDATE command and recording the number returned. If this number is then reprogrammed into the system clock, only the current time will need to be reset.

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1. Enter the alarm subroutine into memory by executing:

```
SUB ATST
WAITFOR ALRM
BEEP
SUBEND
```

NOTE

Steps 2, 3, 4, and 5 must be executed within 1.5 minutes. The test sets the time and then enables an alarm to occur within two minutes. If Steps 2, 3, 4, and 5 are not executed in less than two minutes the test will fail.

2. Set the time to 4:00 PM by executing:

```
SET TIME 58600
```

3. Set the system alarm to 4:03 PM by executing:

```
SET ALRM 58780
```

4. Enable the alarm by executing:

```
ENABLE ALRM
```

5. Initiate the system alarm test by executing:

```
CALL ATST
```

6. After executing the above command, the left display should show the message WAITFOR and the WAITING annunciator should be on. This condition will remain until the alarm occurs.

7. The HP 3852A alarm should beep once within 1 or 2 minutes, the message SUBEND should appear in the left display, and the ALRM annunciator should be on. If the alarm does not occur within the time frame expected, press the CLEAR key on the front panel (DO NOT press the RST key) and repeat the test starting at Step 3. (If the RST key has been pressed or if power has been cycled to the HP 3852A, the subroutine in Step 2 will have to be re-entered.) If the test does not pass a second time, a failure with the HP 3852A local controller is indicated.

8. Reset the system time and timedate as described in Section 3-18.

3-11 Event In BNC Test

This test checks for proper operation of the event in BNC circuitry and that the HP 3852A can respond to an external event. Do the following:

1. Connect the output of the pulse/function generator (HP 8116A) to the HP 3852A EVENT IN connector with a BNC to BNC cable. The EVENT IN connector is the top connector on the rear panel of the HP 3852A controller module.

2. Set the pulse/function generator to output a 5 volt square wave at a 2 Hz rate.

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3. Enter the test subroutine by executing the following statements:

```
SUB EITST
WHILE 1
WAITFOR EVENT
BEEP
END WHILE
SUBEND
```

4. Initiate the test by executing:

```
CALL EITST
```

5. The HP 3852A should beep approximately two times per second continuously. If the HP 3852A is unable to respond, the HP 3852A local controller will be stuck in the subroutine. This indicates a failure of the HP 3852A local controller. If a failure is encountered, it will be necessary to cycle power on the HP3852A to exit the subroutine.

6. To exit from the test, press the front panel CLEAR key.

3-12 Pacer Test

This test checks that the internal pacer in the HP 3852A can initiate some event and that the pacer can be triggered externally. Do the following:

1. Verify the system controller is connected to the HP 3852A with the HP-IB cable.

2. Verify that the HP 3852A HP-IB address is set to 09 by executing from the front panel:

```
ADDR?
```

3. The right display should show the number 9. If the number 9 is obtained, proceed to Step 4. If a number other than 9 is obtained, record the number for later reference and change the HP-IB address by executing from the front panel:

```
ADDR 9
```

4. Connect the pulse/function generator (HP 8116A) output to the PACER TRIGGER IN connector. The PACER TRIGGER IN connector is the bottom BNC connector on the HP 3852A rear panel.

5. Set the pulse/function generator to output a 5 V square wave at a 2 Hz rate.

6. Load Test Program 3-3 into the system controller. The program is located at the end of this chapter. Test Program 3-3 was written in BASIC on an HP 9000 System 200 computer. Other computers may differ slightly in syntax.

7. Run the program. A sucessful test will be indicated when the HP 3852A beeper beeps four times and the system printer has the message, HP 3852A PASSED PACER TEST. If the test is not sucessful, the beeper will not be heard and the system printer may print an error message. Additional problem isolation tests can be found in Chapter 5. Reset the HP-IB address to the value recorded in Step 3 (if the HP-IB address was 9, it is not necessary to reset the address). To reset the address, execute from the front panel:

```
ADDR X   (where X = address recorded in Step 3)
```


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3-13 HP 3853A PERFORMANCE TEST

3-14 Equipment Required

The following test equipment is required to run the performance test:

1. Mainframe -- HP 3852A

2. System Controller -- HP 9000 Series 200/300 or equivalent

3. HP-IB Cable -- HP 10833A or equivalent

4. Printer -- HP 9876A or equivalent

3-15 HP 3853A Test Procedures

These procedures test the ability of the HP 3853A Extender Unit to communicate with the HP 3852A over the digital bus. Because all system Extender Units are in parallel on this bus, only a single Extender Unit at a time should be connnected for these tests.

3-16 Power-On Test

This test checks that the HP 3853A will power-up and is not holding an illegal state on the digital bus. Do the following:

1. Remove power from the HP 3852A and HP 3853A. Connect the HP 3852A to the HP 3853A with the digital extender cable.

2. Apply power to the HP 3852A. The HP 3852A displays will remain blank indicating that the HP 3852A is not performing its wake-up sequence. After a brief period, the HP 3852A should beep and display:

ERROR 38: CHECK POWER

3. Cycle power to the HP 3852A and apply power to the HP 3853A. observe the HP 3852A. The HP 3852A should perform its wake-up sequence and end with the display:

READY

4. If the HP 3852A will not complete its wake-up sequence or appears to be lost, a failure of the HP 3853A or digital bus is indicated. To assure that the HP 3853A is at fault, remove any accessories from the HP 3853A (remove both the terminal module and the component module) and perform the test again. A second failure indicates a failure of the HP 3853A.

3-17 Extender Response Test

This test ensures that the HP 3853A can correctly identify itself to the HP 3852A. Do the following:

1. Load Test Program 3-4 into the system controller. The program is located at the end of this chapter. Test Program 3-4 was written in BASIC on an HP 9000 Series 200. Other computers may differ in syntax.

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2. Run the test progam.

3. A sucessful test is indicated on the system printer by the message: HP 3852A PASSED EXTENDER TEST, followed by a list of the addresses of any installed Extender Units.

3-18 SETTING THE SYSTEM CLOCK

The system clock will have to be reset to the correct time and date after performance of the Clock and Non-Volatile Memory Test in Section 3-9 or the Alarm Test in Section 3-10.

Internally, the system clock maintains the year, month, day, hour, minute, and second as a single real number. This number is scaled to an arbitrary "dawn of time" thus allowing it to also represent the Julian date. In this system, the number 2.08662912E+011 represents midnight March 1, 1900.

Since a single number is used to represent the year, month, day, hour, minute, and second, it is necessary to set the TIMEDATE first (thus setting the system time to midnight of the year, month, and day desired) and then set the TIME (adding the time of the current day to the TIMEDATE number).

3-19 Setting the TIMEDATE

The following program example will convert the current date into the TIMEDATE format. The example was written in BASIC for an HP 9000 Series 200. On other computers the exact syntax may vary.

```
10     !CONVERT DAY, MONTH, AND YEAR TO TIMEDATE
20     PRINT "ENTER THE DESIRED DATE AS A SINGLE"
30     PRINT "NUMBER IN THE FORM   DDMMYY"
40     INPUT String$
50     Day = VAL (String$[1,2])
60     Month = VAL (String$[3,4])
70     Year = VAL (String$[5,6])
80     DIM X(1:12)
90     DATA 306,337,0,31,61,92,122,153,184,214,245,275
100    READ X(*)
110    Time_date = X(Month) + Day - 1
120    IF Month < 3 THEN Year = Year - 1
130    Time_date = Time_date + Year * 365 + Year DIV 4
140    Time_date = Time_date + Year DIV 100 + (Year + 300) DIV 400
150    Time_date = Time_date * 86400 + 2.08662912E+11
160    DISP "THE TIMEDATE IS:",Time_date
170    END
```

Once the TIMEDATE value has been obtained, it can be entered into the HP 3852A memory be executing:

SET TIMEDATE <*value*>

3-20 Setting the TIME

After the TIMEDATE value has been entered, set the TIME value. The following program can be used to compute the current value of the time in seconds since midnight. The example was written in BASIC on an HP 9000 Series 200. On other computers, the exact syntax may vary.

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```
10     !SECONDS SINCE MIDNIGHT
20     PRINT "PLEASE ENTER THE DESIRED TIME AS A SINGLE"
30     PRINT "NUMBER IN THE FORM  HHMMSS"
40     INPUT String$
50     Hours = VAL (String$[1,2])
60     Mins = VAL (String$[3,4])
70     Secs = VAL (String$[5,6])
80     Total = Hours * 3600
90     Total = Total + Mins * 60
100    Total = Total + Secs
110    DISP "THE TIME, IN SECONDS, IS:",Total
120    END
```

Once the current time in seconds has been obtained, it can be entered in the HP 3852A memory by executing:

SET TIME <*value*>

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TEST PROGRAM 3-1

```
10    !HP-IB TEST
20    !
30    DIM E$[80]
40    A=709
50    RESET 7
60    ON TIMEOUT 7,10 GOTO 840
70    !    EXECUTE MAINFRAME SELF TEST FROM HP-IB
80    OUTPUT A;"RST"
90    OUTPUT A;"INBUF OFF"
100   OUTPUT A;"RQS 32"
110   OUTPUT A;"RQS ON"
120   OUTPUT A;"TEST"       !SELF TEST FAILURE WILL
130   OUTPUT A;"STB?"       !BE REPORTED IN STATUS
140   ENTER A;B             !BITS 5 AND 6.
150   IF BIT(B,6) THEN
160      PRINT "HP 3852A FAILED SELF TEST OVER HP-IB"
170      IF BIT(B,5) THEN
180         PRINT "  THIS ERROR HAS OCCURRED:"
190         OUTPUT A;"ERRSTR?"
200         ENTER A;E$
210         PRINT "    ";E$
220      END IF
230   ELSE
240      PRINT "HP 3852A PASSED SELF TEST OVER HP-IB"
250   END IF
260   !    CLEAR SERVICE REQUEST MASK AND READ
270   OUTPUT A;"RQS OFF"
280   OUTPUT A;"RQS 0"
290   OUTPUT A;"RQS?"
300   ENTER A;B
310   IF B<>0 THEN
320      PRINT "HP 3852A FAILED SERVICE REQUEST MASK TEST FOR 0"
330      PRINT "  EXPECTED 0, READ";B
340   ELSE
350      PRINT "HP 3852A PASSED SERVICE REQUEST MASK TEST FOR 0"
360   END IF
370   !    SET ERROR BIT IN REQUEST MASK (ON SETS SRQ) AND READ
380   OUTPUT A;"RQS 32"
390   OUTPUT A;"RQS ON"
400   OUTPUT A;"RQS?"
410   ENTER A;B
420   IF B<>96 THEN
430      PRINT "HP 3852A FAILED SERVICE REQUEST MASK FOR 96"
440      PRINT "  EXPECTED 96, READ";B
450   ELSE
460      PRINT "HP 3852A PASSED SERVICE REQUEST MASK TEST FOR 96"
```


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TEST PROGRAM 3-1 (Cont.)

```
470   END IF
480   !    REQUEST THE SYSTEM ID
490   OUTPUT A;"ID?"
500   ENTER A;E$
510   IF E$<>"HP3852A" THEN
520      PRINT "HP 3852A FAILED ID PART OF HP-IB TEST"
530      PRINT "EXPECTED HP3852A, READ   ";E$
540   ELSE
550      PRINT "HP 3852A PASSED ID PART OF HP-IB TEST"
560   END IF
570   !    CREATE AN ERROR WHICH SHOULD ASSERT SRQ
580   ENABLE INTR 7;2
590   ON INTR 7 GOTO 630
600   OUTPUT A;"SRT"
610   WAIT 1
620   Nosrq=1
630   IF Nosrq THEN
640      PRINT "HP 3852A FAILED SRQ ASSERTION TEST"
650   ELSE
660      PRINT "HP 3852A PASSED SRQ ASSERTION TEST"
670   END IF
680   OFF INTR 7
690   !   READ STATUS REGISTER, SHOULD REPORT ERR AND SRQ
700   OUTPUT A;"STB?;"
710   ENTER A;B
720   IF B<>96 THEN
730      PRINT "HP 3852A FAILED STATUS BYTE REPORT"
740      PRINT "  EXPECTED 96, READ";B
750   ELSE
760      PRINT "HP 3852A PASSED STATUS BYTE REPORT"
770      OUTPUT A;"ERRSTR?;"
780      ENTER A;E$
790      PRINT "  THIS ERROR WAS CAUSED ON PURPOSE AS PART OF TEST:"
800      PRINT E$
810   END IF
820   STOP
830   !  STOP IF I/O TIMEOUT OCCURS
840   PRINT "HP 3852A DID NOT RESPOND:"
850   PRINT "  HP-IB I/O TIMEOUT ERROR OCCURRED"
860   END
```


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TEST PROGRAM 3-2

```
10    !KEYBOARD TEST
20    OPTION BASE 1
30    INTEGER I,J,K
40    DATA 2078,0078,43FA,001C,22A8,0002,43FA,0008,2149,0002
50    DATA 4E75,0839,0003,00E4,0001,6606,4EF9,0001,0000,2F09,43FA
60    DATA 000D,12B9,0081,0001,225F,4E73,0000!68000 CODE
70    DATA 247,228,227,246,232,245,181,179!KEYSTROKES
80    PRINT "PRESS THE FOLLOWING HP 3852A KEYS IN ORDER:"
90    PRINT "  DISPLAY->  TEST  SRQ  TRIG  TOTAL  CONF  5 3"
100   A=709
110   OUTPUT A;"RST;INTEGER A(27)"
120   FOR I=0 TO 27
130     READ J$
140     OUTPUT A;"VWRITE A";DVAL(J$,16)
150   NEXT I
160   OUTPUT A;"JSR A(0)"
170   FOR I=1 TO 8
180     READ K
190     REPEAT
200       OUTPUT A;"VREAD A(27)"
210       ENTER A;J
220     UNTIL J=K
230   NEXT I
240   PRINT "HP 3852A PASSED KEYBOARD TEST"
250   END
```


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TEST PROGRAM 3-3

```
10    !PACER TEST
20    DIM E$[80]
30    A=709
40    RESET 7
50    ON TIMEOUT 7,5 GOTO 260
60    ENABLE INTR 7;2           !ENABLE HP-IB INTERRUPT ON SRQ
70    ON INTR 7 GOTO 290
80    OUTPUT A;"RST"
90    OUTPUT A;"INBUF OFF"
100   OUTPUT A;"RQS ON"         !ENABLE SERVICE REQUEST MASK
110   OUTPUT A;"RQS 32"         !ENABLE SERVICE MASK ERROR BIT
120   OUTPUT A;"INTEGER I"
130   OUTPUT A;"SUB PTST"
140   OUTPUT A;"PTRIG EXT"
150   OUTPUT A;"FOR I=1 TO 4"
160   OUTPUT A;"WAITFOR PACER"
170   OUTPUT A;"BEEP"
180   OUTPUT A;"NEXT I"
190   OUTPUT A;"SUBEND"
200   OUTPUT A;"PDELAY 1"
210   OUTPUT A;"PACER 1,4"      !COUNT FOUR PULSES ONE SECOND APART
220   OUTPUT A;"CALL PTST;"     !INITIATE THE TEST
230   PRINT "HP 3852A PASSED PACER TEST"
240   LOCAL A
250   STOP
260   PRINT "HP 3852A DID NOT RESPOND.  HP-IB TEST ERROR OCCURRED."
270   LOCAL A
280   STOP
290   OFF INTR 7
300   OUTPUT A;"STB?"
310   ENTER A;B
320   IF BIT(B,5) THEN
330     PRINT "AN ERROR HAS OCCURRED:"
340     OUTPUT A;"ERRSTR?"
350     ENTER A;E$
360     PRINT "  ";E$
370   END IF
380   LOCAL A
390   END
```


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TEST PROGRAM 3-4

```
10    !EXTENDER TEST
20    DIM E$[80]
30    A=709
40    RESET 7
50    ON TIMEOUT 7,5 GOTO 240
60    ENABLE INTR 7;2              !ENABLE HP-IB INTERRUPT ON SRQ
70    ON INTR 7 GOTO 270
80    OUTPUT A;"RST"
90    OUTPUT A;"INBUF OFF"
100   OUTPUT A;"RQS ON"            !ENABLE SERVICE REQUEST MASK
110   OUTPUT A;"RQS 32"            !ENABLE SERVICE MASK ERROR BIT
120   OUTPUT A;"INTEGER I"
130   OUTPUT A;"EXTEND?;"          !DETERMINE NUMBER OF EXTENDERS
140   PRINT "HP 3852A PASSED EXTENDER TEST"
150   Tally=0
160   FOR I=1 TO 7
170     ENTER A;E$
180     IF VAL(E$)>0 THEN PRINT "  Extender";E$;" is connected"
190     Tally=Tally+VAL(E$)
200   NEXT I
210   IF Tally=0 then PRINT " No extender are connected"
220   LOCAL A
230   STOP
240   PRINT "HP 3852A did not respond. HP-IB timeout error occurred"
250   LOCAL A
260   STOP
270   OFF INTR 7
280   OUTPUT A;"STB?"
290   ENTER A;B
300   IF BIT(B,5) THEN
310     PRINT "An error has occurred:"
320     OUTPUT A;"ERRSTR?"
330     ENTER A;E$
340     PRINT "  ";E$
350   END IF
360   LOCAL A
370   END
```


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CHAPTER 4
HP 3852A/3853A
MODULE AND FRONT PANEL REMOVAL/INSTALLATION PROCEDURES
AND MECHANICAL REPLACEABLE PARTS

4-1 INTRODUCTION
4-2 REMOVAL/INSTALLATION PROCEDURES
4-3 Controller Module Removal/Installation Procedures
4-4 Controller Module Removal Procedure
4-5 Controller Module Installation Procedure
4-6 Power Supply Module Removal/Installation Procedures
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CHAPTER 4
HP 3852A/3853A
MODULE AND FRONT PANEL REMOVAL/INSTALLATION PROCEDURES AND MECHANICAL REPLACEABLE PARTS

4-1 INTRODUCTION

This chapter contains removal and installation procedures for the HP 3852A Controller Module and Front Panel, and for both HP 3852A and HP 3853A Power Supply Modules. Mechanical replaceable parts are also listed in this chapter. Electrical assemblies are listed as replacement assemblies only. Electrical assembly components (e.g., resistors, capacitors, and ICs) are not documented in this manual. This chapter also covers new replacement part ordering information and the HP Exchange Program for restored assemblies and modules.

Replaceable mechanical parts for the plug-in assemblies are given in the appropriate chapter of this manual (see Chapter 1 for a listing of the chapters).

4-2 REMOVAL/INSTALLATION PROCEDURES

WARNING

To prevent personal injury, the ac line power cable and all other connections must be removed from the HP 3852A and/or HP 3853A before performing any disassembly or assembly procedures.

CAUTION

To prevent static discharge damage, observe static handling procedures during disassembly and assembly (see Chapter 5).

4-3 Controller Module Removal/Installation Procedures

The controller module is located at the left side of HP 3852A mainframe with the rear of the instrument facing forward. This module is the one with the HP-IB and extender connectors. The module plugs directly into the mainframe backplane via a 74 pin lead-edge connector.

4-4 Controller Module Removal Procedure

To remove the controller module, do the following:

1. Remove ac power from the HP 3852A.

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2. Make sure the rear of the instrument is facing forward. Locate the controller module.

3. On the controller module, loosen the captive screw located at the bottom and center of the module. Turn the screw only two to three turns to the left.

4. Carefully pull the module straight out. Use the right edge of the module's rear panel as a hold. DO NOT hold or pull the module by the BNC, HP-IB, or digital extender connectors or damage to the connectors can result.

NOTE

Do not touch the controller module's printed circuit assemblies and edge connector after removal, or contamination to the assemblies/connector may result.

4-5 Controller Module Installation Procedure

1. Make sure the rear of the instrument is facing forward.

2. Locate the extreme left slot in the HP 3852A mainframe chassis. This slot is left of slot "0".

3. Carefully slide the module into the chassis. Make sure that both the top and bottom of the module lines up with the respective slots.

4. Make sure the module is firmly seated into the chassis. This is necessary for the module's edge connector to make good connections with the mother board connector.

5. Turn the captive screw located at the bottom and center of the module to the left until snug (about two to three turns). DO NOT over tighten the screw.

4-6 Power Supply Module Removal/Installation Procedures

The power supply module is located at the right side of HP 3852A/3853A with the rear of the instrument facing forward. This module is the one with the power connector at the rear and the main power line switch at the front of the module.

Attached to the power line switch is a long push-rod to which is attached a key cap that protrudes through the front panel. Keep the push-rod and switch in mind when removing/installing the power supply module since these can very easily be broken.

4-7 Power Supply Module Removal Procedure

To remove the power supply module, do the following:

1. Remove ac power from the HP 3852A.

2. Remove any plug-in accessories in slots 4, 5, 6, and 7. This is necessary to remove the power supply module.

3. Turn the instrument until its right side (i.e., side with the power supply module) is facing forward.

4. Remove the side handle strap from the instrument by removing a screw and handle retainer at each end of the strap.

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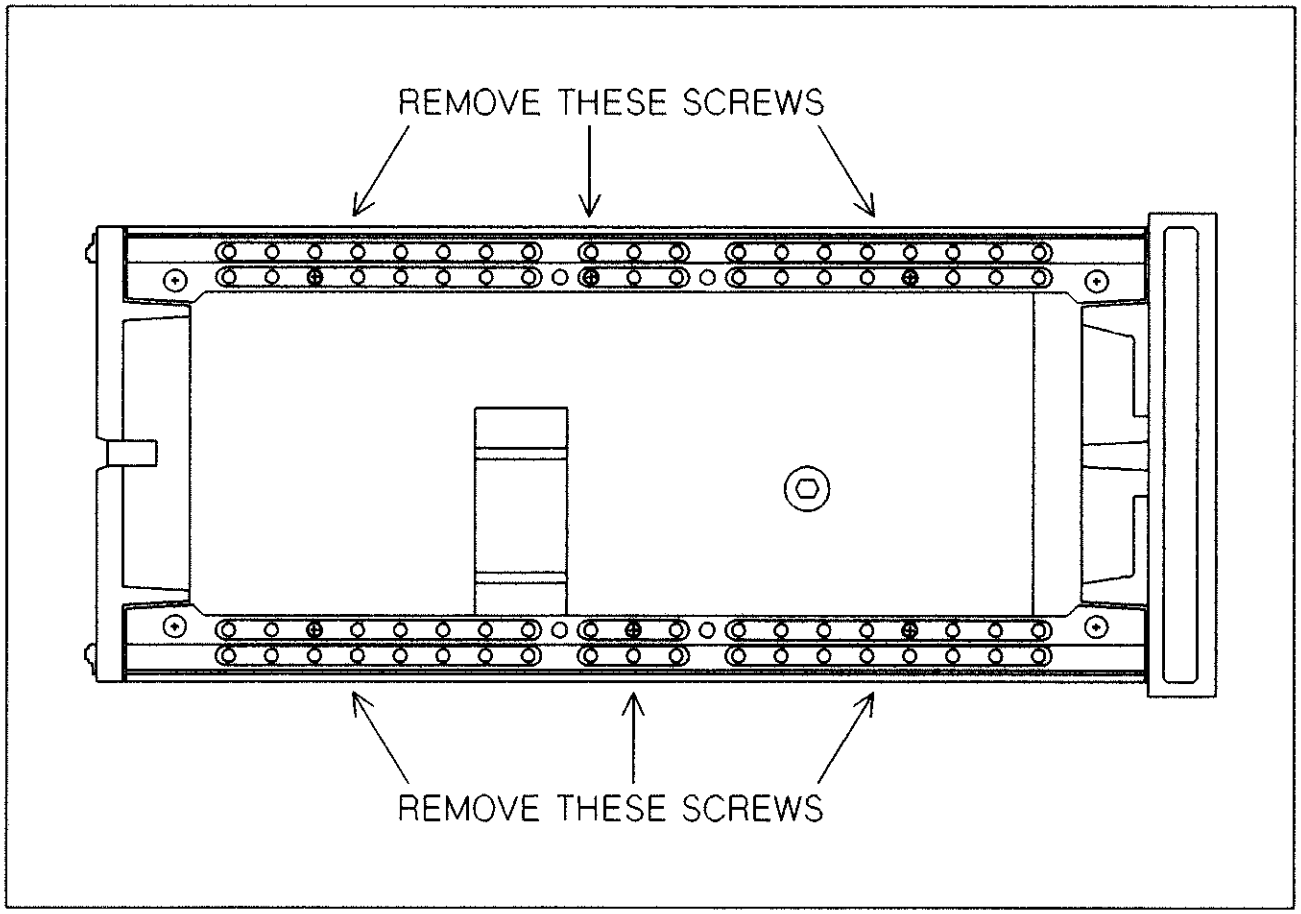


Figure 4-1 Power Supply Mounting Screws Locations

5. Remove the right side panel by pulling and sliding the panel towards the rear of the instrument.

6. Refer to Figure 4-1 and remove only the six power supply module retaining screws. DO NOT remove any other screws.

7. Turn the instrument until its right and rear sides are facing forward.

8. Refer to Figure 4-2 to determine how the power supply module is to be removed. The figure shows the path of the power supply module's front cover screw located at the bottom of the module. Carefully study the path before removing the module.

9. Refer to Figure 4-3-A (Figure A in Figure 4-3). Note that the figure shows the present location of the power supply module. The dashes lines in the figure represents the module.

NOTE

All figures in Figure 4-3 show a partial inside right view (with rear of instrument facing forward) of the chassis, as viewed from the top. The dashed lines in all figures represents the power supply module.

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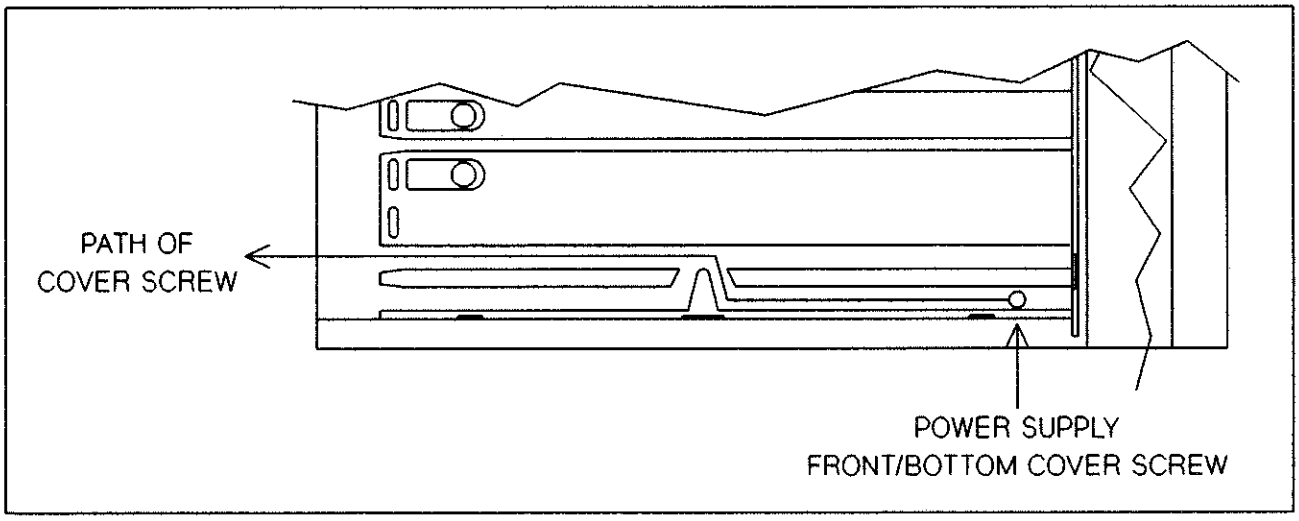


Figure 4-2 Power Supply Removal Path

10. Figure 4-3-A shows the direction at which the power supply module is to be pulled out first. Hold the power supply module by the rear panel. Carefully pull it straight out toward the rear of the instrument until it stops. The module should now be partially pulled out of the chassis as shown in Figure 4-3-B.

11. Figure 4-3-B shows the direction at which the module is to be pulled out next. However, before pulling on the module, locate the slot 7 grounding spring under the top part of the chassis. Depress the spring and then pull the power supply module to the left until it stops. Make sure the spring is depressed before moving the power supply module or damage to the spring can result. The module should now be in the position shown in Figure 4-3-C.

12. Figure 4-3-C shows the direction at which the module is to be pulled out last. Pull the power supply module completely out of the chassis until the power switch push-rod clears the chassis. Make sure that the module is pulled straight out and completely out to prevent the power switch push-rod from breaking. Place the module gently on a flat surface.

13. If the module is to be returned to the factory for repair, always return the module WITH the rear panel analog extender block and WITHOUT the power switch push-rod and key cap. The push-rod is removed by pulling it straight off the power line switch. Be careful not to exert lateral forces on the push-rod to prevent breakage of the switch.

4-8 Power Supply Module Installation Procedure

To install the power supply module, do the following:

1. Remove ac power from the HP 3852A.

2. Make sure the power switch push-rod and key cap assembly is attached to the power supply module's power switch. Be sure that the word "LINE" is correctly oriented on the key cap.

3. Remove any plug-in accessories in slots 4, 5, 6, and 7. This is necessary to install the power supply module.

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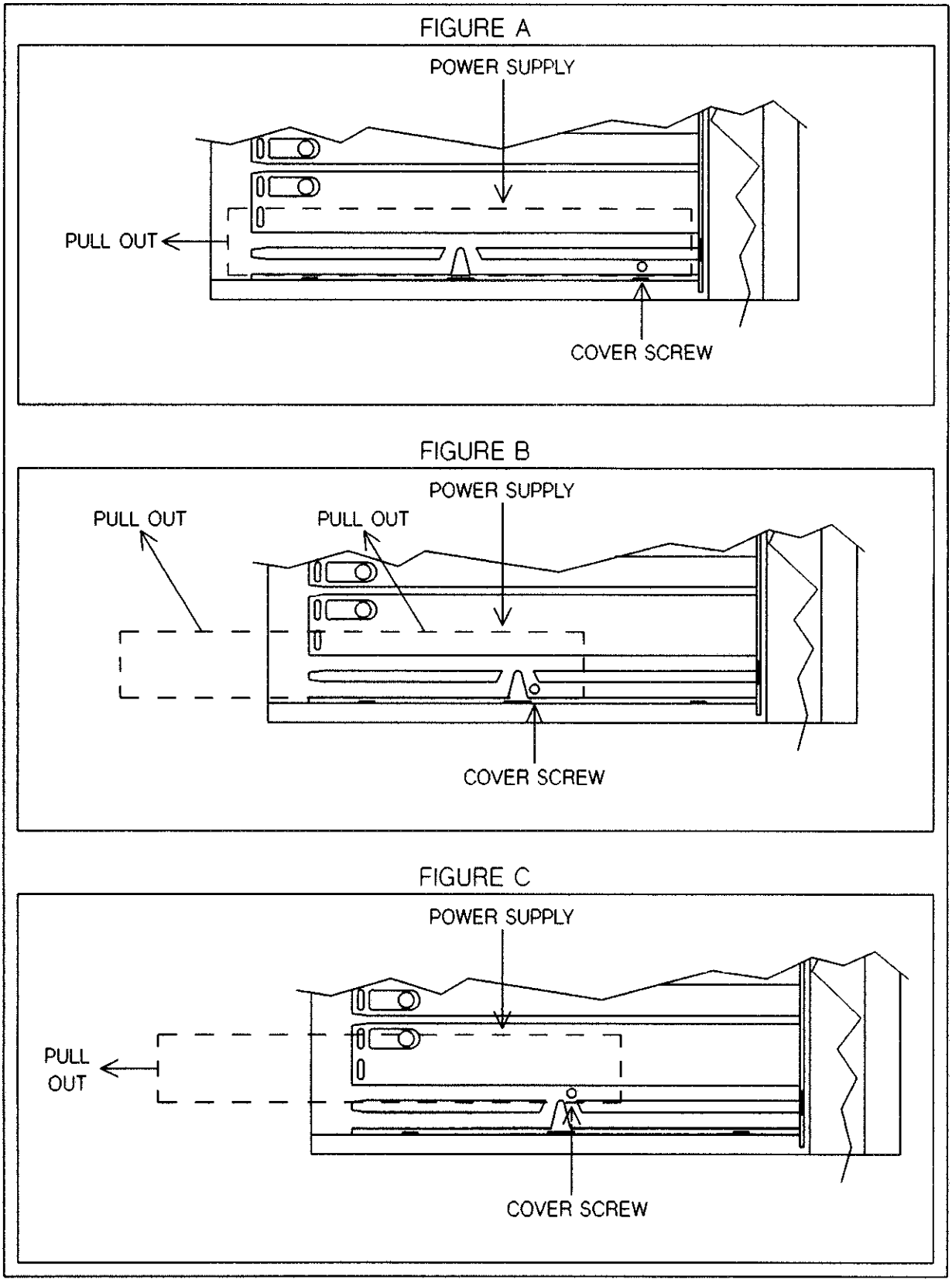


Figure 4-3 Power Supply Removal

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4. Make sure the side handle strap and right side panel is removed from the instrument (see steps 4 and 5 in Section 4-7).

5. Turn the instrument until its right and rear sides are facing forward.

6. Refer to Figure 4-4-A (Figure A in Figure 4-4) to determine how the power supply module is to be installed. The figure shows the path of the power supply module's front cover screw located at the bottom of the module. Carefully study the path before installing the module. The dashes lines in the figure represents the module.

NOTE

All figures in Figure 4-4 show a partial inside right view (with rear of instrument facing forward) of the chassis. The dashed lines in all figures represents the power supply module.

7. Figure 4-4-A shows the direction at which the power supply module is to be pushed in first. Align the power supply module's cover screw with the slot next to slot 7, as shown in Figure 4-4-A. Carefully push the module into the chassis until the key cap on the power switch push-rod barely touches the mother board. The module should now be in the position shown in Figure 4-4-B.

CAUTION

Make sure that the power supply module is pushed in gently and no further than shown in Figure 4-4-B. This prevents the push-rod and/or power switch from breaking.

8. Figure 4-4-B shows the direction at which the module is to be pushed in next. However, before pushing on the module, locate the power supply grounding spring under the top part of the chassis. Depress the spring and then push the power supply module to the right until it stops. Make sure the spring is depressed before moving the power supply module or damage to the spring can result. The module should now be in the position shown in Figure 4-4-C.

9. Figure 4-4-C shows the direction at which the module is to be pushed in last. However, before pushing on the module, align the power switch push-rod with the center part of the opening on the mother board, as shown in Figure 4-4-C. Then push the power supply module completely into the chassis until its connector is firmly seated in the mother board connector.

10. Turn the instrument until its right side is facing forward.

11. Secure the power supply module with six mounting screws. Refer to Figure 4-1 for the location of the screws.

12. Install the instrument's right side cover. Slide the cover from the rear of the instrument over the rear frame and side frames.

13. Install and secure the handle strap using the handle strap retainers and retainer screws. Make sure the correct retainer is used at the ends of the strap. The right retainer slips under the front frame of the instrument and the left retainer slips over the rear frame.

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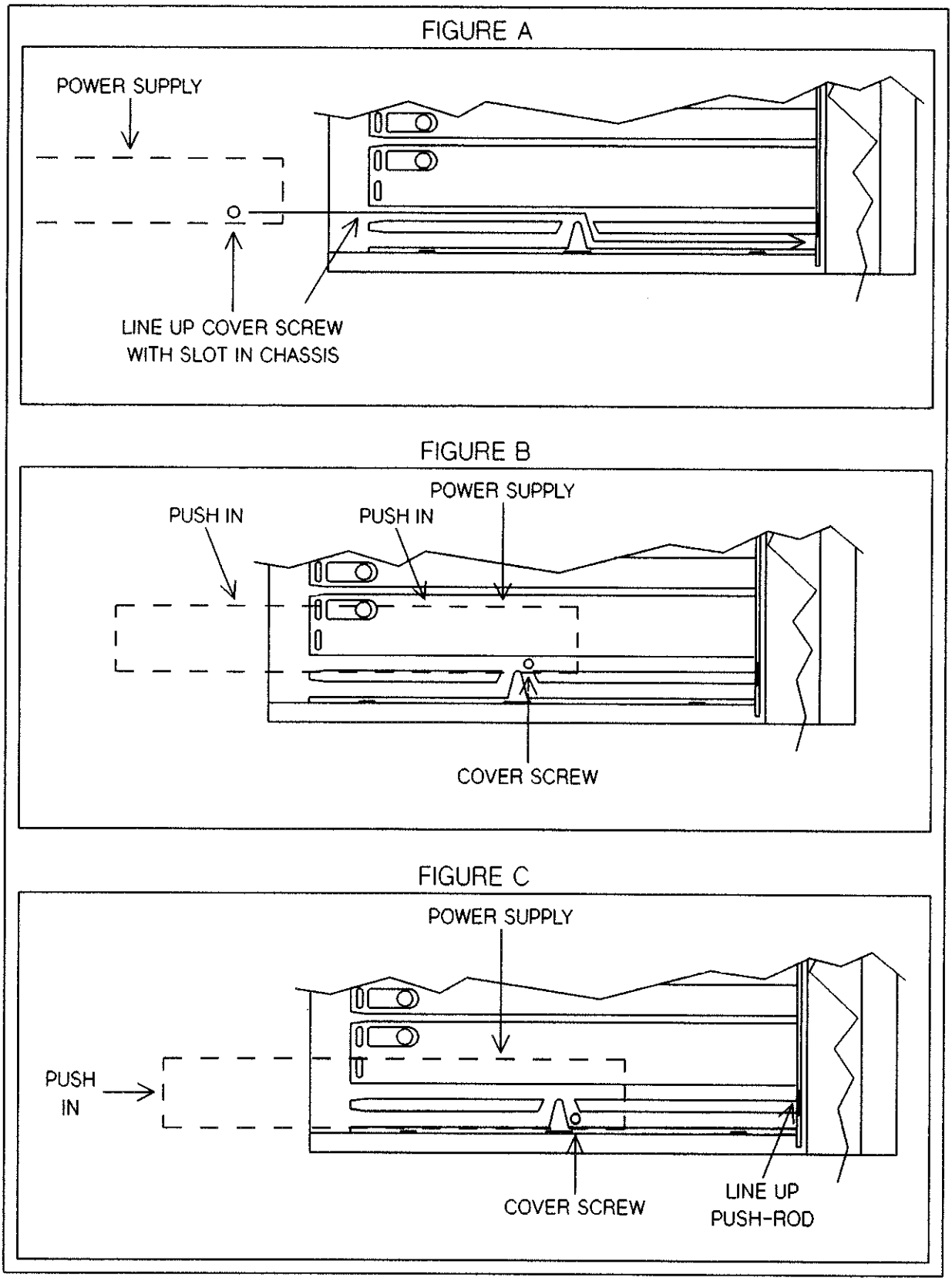


Figure 4-4 Power Supply Installation

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4-9 Front Panel Removal/Installation Proceduress

The following procedure shows how to remove the front panel for both the HP 3852A Mainframe and HP 3853A Extender. Except for disconnecting a ribbon cable for the HP 3852A front panel, the procedures for both are the same.

4-10 Front Panel Removal Procedure

To remove the front panel assembly, do the following:

1. Remove ac power from the HP 3852A.

2. Locate the four front panel mounting screws. They are located at the front and bottom of the panel under the protrusion.

3. Lift the lower part of the panel out and up until the power switch key cap is completely out of the front panel assembly. Then lower the panel out of the front frame. If the front panel is from an HP 3852A Mainframe, disconnect the ribbon cable from the front panel printed circuit board.

4-11 Front Panel Installation Procedure

To install the front panel assembly, do the following:

1. Remove ac power from the HP 3852A.

2. If the front panel is to be installed into an HP 3853A Extender, continue with step 3. If the front panel is for an HP 3852A Mainframe, connect the ribbon cable into the front panel printed circuit board. Make sure the red band on the ribbon cable or the arrow on the ribbon cable connector is aligned with pin 1 on the front panel printed circuit board connector.

3. Place the top part of the front panel assembly under the top part of the instrument's front frame.

4. Carefully lower the bottom part of the front panel into the front frame.

5. Secure the panel with the four mounting screws located at the front and bottom of the panel under the protrusion.

4-12 THE HEWLETT-PACKARD EXCHANGE PROGRAM

Some of the replaceable assemblies and modules are available as restored products through the Hewlett-Packard Exchange Program. These products are sold at a discount and require the return for credit of your defective assembly.

When an exchange assembly or module is ordered, Hewlett-Packard will ship a restored assembly with instructions for returning your defective assembly. Upon receipt of your defective assembly, Hewlett-Packard then credits your bill (gives you a discount) and invoices you accordingly. You are allowed a specific time period to return your defective assembly after receiving the replacement assembly from HP. If the defective assembly is not received within this period the discount will not be given.

For more information on this program contact your nearest Hewlett-Packard Sales Office. Hewlett-Packard Sales Offices are listed in the back of this manual.

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4-13 MECHANICAL REPLACEABLE PARTS

4-14 Part Ordering Information

To order a part in the replaceable parts lists, quote the Hewlett-Packard part number, the check digit (abbreviated CD), and the quantity desired. Address the order to the nearest Hewlett-Packard Sales Office. Hewlett-Packard Sales Offices are listed at the back of this manual.

4-15 Direct Mail Ordering

Within the U.S.A. only, Hewlett-Packard can supply parts to your location through a direct mail order system. Mail order forms and specific ordering information are available through you local Hewlett-Packard Sales Office.

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Table 4-1 HP 3852X Controller Module

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
3852X	Module; controller (without A24)	1	03852-66203	5	MOD-CONTROLLER
A3	PCA; controller	1	03852-66503	8	PCA-CONTROLLER
A4	PCA; HP-IB & extender communication	1	03852-66504	9	PCA-HPIB/EXT COM
A21	PCA; mainframe memory interface	1	44703-66501	2	PCA-MF MEM INTFC
A24	PCA; 256 kB extnd mem; 44703A	1	09826-66524	3	256K MEMORY BD
	PCA; 1 MB extend mem; 44703B	1	98257-66524	1	1 MB MEMORY CARD
MP1	Screw; rear panel and A3 PCA	8	0515-0886	3	SCR-PH M3.0X6 LK
MP2	Hex standoff; extender connector	2	0380-1810	8	STDF-HX M/F M3TH
MP3	Lock washer; extender connector	2	2190-0913	9	WSHR-LK HLCL
MP4	Hex standoff; HP-IB connector	2	0380-1332	9	STDF-HEX .18-IN
MP5	Lock washer; HP-IB connector	2	2190-0577	1	WSHR-LK SCR-10
MP6	(NOT USED)				
MP7	(NOT USED)				
MP8	Panel; rear with screw latch	1	03852-00202	6	0601 PNL-CONT RR
MP9	Screw; cover	6	0515-0890	9	SCR-FH M3.0X6 LK
MP10	Shell; U shaped (aluminum)	1	03852-00101	4	0601 CVR-P/S LGE
MP11	Cover; (aluminum)	1	03852-00103	6	0601 CVR-CONTR
MP12	(NOT USED)				
MP13	Screw; A4 PCA	4	0515-1323	5	SCR-PH M3.0X30LK
MP14	Screw; A24 PCA	2	0515-0403	0	SCR-PH M2.5X8 LK
MP15	(NOT USED)				

Restored Assemblies/Modules

The following restored assemblies/modules are available through the HP Exchange Program. For details see Section 1-19.

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
3852X	Module; controller (without A24)		03852-69203	1	RBLT-03852-66203
A24	PCA; 256 kB extnd mem; 44703A		09826-69524	9	RBLT-09826-66524
	PCA; 1 MB extend mem; 44703B		98257-69524	7	RBLT-98257-66524

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Table 4-2a HP 3852PS Mainframe Power Supply Module (older version)

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
3852PS	Module; mainframe power supply	1	03852-66202	4	MOD-MF PWR SPPLY
A2	PCA; power supply	1	03852-66502	7	PCA-POWER SUPPLY
F101	Fuse; 1.5A slow blow (100/120V line)	1	2110-0304	4	FUSE,1.5A 250VTD
	Fuse; .75A slow blow (220/240V line)	1	2110-0360	2	FU-.75A 250V TD
FC101	Fuse cap	1	2110-0565	9	FUHLR CAP 12A
MP16	Screw; rear panel, A2 PCA & cover	14	0515-0886	3	SCR-PH M3.0X6 LK
MP17	(NOT USED)			8	
MP18	Terminal; ground	1	1510-0038	8	BDG-POST SINGLE
MP19	Lock washer; ground terminal	1	2190-0060	7	WSHR-LK INTL T
MP20	Nut; ground terminal	1	2950-0006	3	NUT-HEX-DBL CHAM
MP21	Terminal block; analog ext. w/screws	1	03852-82101	6	CONN-6P F,VM I N
MP22	Screw; line receptacle	2	0515-0925	1	SCR-M3.0X10 SS
MP23	Lock washer; line receptacle	2	2190-0003	8	WSHR-LK HLCL
MP24	Panel; rear	1	03852-00201	5	0601 PNL-P/S RR
MP25	Screw; cover	2	0515-0890	9	SCR-FH M3.0X6 LK
MP26	Bolt; line transformer	1	0515-0759	9	SCR-CAP M6.0X20
MP27	Lock washer; line transformer	1	2190-0032	3	WSHR-LK HLCL
MP28	Flat washer; line transformer	1	3050-0190	9	WSHR-FLT .25X.87
MP29	Shell; U shaped (aluminum)	1	03852-00101	4	0601 CVR-MOD LGE
MP30	Cover; (aluminum)	1	03852-00102	5	0601 CVR P/S, MF
MP31	Screw; cover to heat sink	2	0515-0885	2	SCR-PH M4.0X8 LK
MP32	(NOT USED)				
MP33	(NOT USED)				
MP34	(NOT USED)				
MP35	(NOT USED)				
SW101	Switch; line power (on A2 PCA)	1	3101-2252	7	SW-PB-DPDT
T101	Transformer; line power (torroid)	1	9100-4467	4	XFMR-PWR, TOROID

Restored Assemblies/Modules

The following restored assemblies/modules are available through the HP Exchange Program. For details see Section 1-19.

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
3852PS	Module; mainframe power supply		03852-69202	0	RBLT-03852-66202

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Table 4-2b HP 3852PS Mainframe Power Supply Module (newer version)

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
3852PS	Module; mainframe power supply	1	03852-66212	6	MOD-MF PWR SPPLY
A2	PCA; power supply	1	03852-66512	9	PCA-POWER SUPPLY
F101*	Fuse; 3.0A slow blow (120V line)	1	2110-0003	0	FUSE,3.0A 250NTD
	Fuse; 1.5A slow blow (240V line)	1	2110-0043	8	FUSE,1.5A 250NTD
FC101	Fuse cap	1	2110-0565	9	FUHLR CAP 12A
MP16	Screw; rear panel, A2 PCA & cover	5	0515-0886	3	SCR-PH M3.0X6 LK
MP17	(NOT USED)			8	
MP18	Terminal; ground	1	1510-0038	8	BDG-POST SINGLE
MP19	Lock washer; ground terminal	1	2190-0060	7	WSHR-LK INTL T
MP20	Nut; ground terminal	1	2950-0006	3	NUT-HEX-DBL CHAM
MP21	Terminal Block; analog ext. w/screws	1	03852-82101	6	CONN-6P F, VM IN
MP22	(NOT USED)				
MP23	(NOT USED)				
MP24	Panel; rear	1	03852-00203	7	0601 PNL-P/S RR
MP25	(NOT USED)				
MP26	(NOT USED)				
MP27	(NOT USED)				
MP28	(NOT USED)				
MP29	Shell; U shaped (aluminum)	1	03852-00105	8	0601 CVR-MOD LGE
MP30	(NOT USED)				
MP31	(NOT USED)				
MP32	(NOT USED)				
MP33	(NOT USED)				
MP34	(NOT USED)				
MP35	(NOT USED)				
MP36	Screw;	4	0515-0408	5	SCR-PH M3.0X12 LK
PWR1**	AC-DC Switching Power Supply	1	0950-1889	0	70 W AC-DC SW
SW101	Switch; line power (on A2 PCA)	1	3101-2252	7	SW-PB-DPDT

*CAUTION: Do not replace the fuse if blown; a blown fuse indicates a defective power supply that needs to be repaired.

**Please return any defective power modules to Hewlett-Packard for evaluation.

Restored Assemblies/Modules

The following restored assemblies/modules are available through the HP Exchange Program. For details see Section 1-19.

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
3852PS	Module; mainframe power supply		03852-69212	2	RBLT-03852-66212

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Table 4-3 Mainframe Front Panel

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
A7	PCA; front panel logic	1	03852-66507	2	PCA-FRNT PNL LOG
MP36	Screw; front panel	4	0515-0897	6	SCR-PH M3.0X8 LK
MP37	Screw; display and A7 PCA	7	0624-0333	6	SCR-PH 4-20X.25
MP38	(NOT USED)				
MP39	Assembly; LCD display and driver	2	5061-1190	6	LCD & DRVR ASSY
MP40	Assembly; front panel with keyboard	1	03852-60201	1	ASSY-FRNT PNL&KB
MP41	Leaf spring; front panel grounding	1	1460-1452	5	STPG--SPR LEAF
MP42	Screw; leaf spring	1	0515-0866	9	SCR-PH M3.0X8 CW
MP43	Screw; fan	2	0515-0885	2	SCR-PH M4.0X8 LK
MP44	Fan retainer; with foam	2	03852-61201	3	RETAINER-FAN
MP45	Fan boot; rubber	1	3160-0400	7	BOOT-FAN 80MM SQ
MP46	Fan; with wire and 1/2 connector	1	3160-0482	5	FAN-12V W/CONN
MP47	(NOT USED)				
MP48	Push rod; power switch	1	5041-3153	3	PUSH ROD
MP49	Key cap; power switch	1	5041-1682	9	KEY CAP-LINE
MP50	Clip; fan cable tie back w/adhesive	1	1400-0877	0	CLP-CBL .375-WD
W1	Cable; display, long with ends	1	03852-61602	8	CBL-16P DSPL,LG
W2	Cable; display, short with ends	1	03852-61603	9	CBL-16P DSPL,SHT
W3	Cable; keyboard with ends	1	03852-61604	0	CBL-16P KYBD

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Table 4-4 Mainframe Chassis

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
A1	PCA; mainframe backplane	1	03852-66501	6	PCA MF BACKPLANE
MP51	Screw; backplane shield	4	0515-0886	3	SCR-PH M3.0X6 LK
MP52	Screw; A1 PCA	7	0515-0866	9	SCR-PH M3.0X8 CW
MP53	Screw; top and bottom subpanel	8	0515-0885	2	SCR-PH M4.0X8 LK
MP54	Screw; corner strut	16	0515-1331	5	SCR-MTRC SPCLY
MP55	Screw; power supply module securing	6	0515-1106	2	SCR-PH M4.0X16LK
MP56	Screw; slot ID label	8	0515-1232	5	SCR-PH M3.5X8LK
MP57	Subpanel; front (molded)	1	03852-40202	0	PNL-MLD,SUBPNL
MP58	Support; center (aluminum)	1	03852-04701	8	0601 SPRT-CD CAG
MP59	Label; mainframe slot ID w/adhesive	2	03852-84321	6	LBL-SLOT/ID,MF
MP60	Leaf spring strip; slot grounding	1	03852-89101	0	SPR-GROUNDING
MP61	(NOT USED)				
MP62	(NOT USED)				
MP63	Screw; front subpanel	4	0515-0896	5	SCR-FL M4.0X10LK
MP64	Shield; backplane (aluminum w/foam)	1	03852-00603	1	0601 SHLD-MTHR B
MP65	Subpanel; top (molded)	1	03852-66601	7	ASSY-CRD CAGE TP
MP66	Subpanel; bottom w/buttons (molded)	1	03852-66602	8	ASSY-CRD CAGE BT
MP67	Trim strip; front top	1	5040-7202	9	TRIM TOP
MP68	Trim strip; side	2	5001-0441	2	TRIM SIDE 8.75"
MP69	Frame; front	1	5021-5807	6	FRAME, FM, FRONT
MP70	Foot	4	5040-7201	8	FOOT
MP71	Tilt stand	2	1460-1345	5	TILT-STAND SST
MP72	Cover; top with screw	1	5061-9435	8	CVR, FM, TOP
MP73	Strut; corner	4	5021-5837	2	STRUT, CORNER
MP74	Frame; rear	1	5021-5808	7	FRAME, FM, REAR
MP75	Handle; metal strap and cover	2	5060-9804	3	STRAP HDL 181N
MP76	Cap; rear of handle	2	5041-6820	7	CAP-STRP HDL RR
MP77	Screw; handle	4	0515-1132	4	SCR-MACH M5X0.8
MP78	Cover; side with handle slot	2	5060-9888	3	CVR-SIDE W/HDL
MP79	Cover; bottom with screw	1	5061-9447	2	CVR, FM, BTM
MP80	Cap; front of handle	2	5041-6819	4	CAP-STRP HDL FRT

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Table 4-5a HP 3853PS Extender Power Supply Module (older version)

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
3853PS	Module; extender pwr supply & logic	1	03853-66202	5	MOD-EXT PS/LOGIC
A2	PCA; power supply	1	03852-66502	7	PCA-POWER SUPPLY
A3	PCA; extender logic	1	03853-66503	9	PCA-EXTNDR LOGIC
F101	Fuse; 1.5A slow blow (100/120V line)	1	2110-0304	4	FUSE,1.5A 250VTD
	Fuse; .75A slow blow (220/240V line)	1	2110-0360	2	FU-.75A 250V TD
FC101	Fuse cap	1	2110-0565	9	FUHLR CAP 12A
MP1-15	(NOT USED)				
MP16	Screw; rear panel, A2/A3 PCA & cover	21	0515-0886	3	SCR-PH M3.0X6 LK
MP17	(NOT USED)				
MP18	Terminal; ground	1	1510-0038	8	BDG-POST SINGLE
MP19	Lock washer; ground terminal	1	2190-0060	7	WSHR-LK INTL T
MP20	Nut; ground terminal	1	2950-0006	3	NUT-HEX-DBL CHAM
MP21	Terminal block; analog ext. w/screws	1	03852-82101	6	CONN-6P F,VM IN
MP22	Screw; line receptacle	2	0515-0925	1	SCR-M3.0X10 SS
MP23	Lock washer; line receptacle	2	2190-0003	8	WSHR-LK HLCL
MP24	Panel; rear	1	03853-00201	6	0601 PNL-P/S RR
MP25	Screw; cover	2	0515-0890	9	SCR-FH M3.0X6 LK
MP26	Bolt; line transformer	1	0515-0759	9	SCR-CAP M6.0X20
MP27	Lock washer; line transformer	1	2190-0032	3	WSHR-LK HLCL
MP28	Flat washer; line transformer	1	3050-0190	9	WSHR-FLT .25X.87
MP29	Shell; U shaped (aluminum)	1	03852-00101	4	0601 CVR-MOD LGE
MP30	Cover; (aluminum)	1	03853-00102	6	0601 CVR-PWRSPLY
MP31	Screw; cover to heat sink	2	0515-0885	2	SCR-PH M4.0X8 LK
MP32	Hex standoff; extender connector	4	0380-1810	8	STDF-HX M/F M3TH
MP33	Lock washer; extender connector	4	2190-0913	9	WSHR-LK HLCL
MP34	Cable; analog extender (1m, 3 cond.)	2	03498-61602	8	CBL-EXT H-L-G
MP35	Cable; digital extender (1 meter)	1	03853-61601	1	CBL-DIGITAL 1M
	Cable; digital extender (4 meter)	1	03853-61602	2	CBL-DIGITAL 4M
SW101	Switch; line power (on A2 PCA)	1	3101-2252	7	SW-PB-DPDT
T101	Transformer; line power (torroid)	1	9100-4467	4	XFMR-PWR,TOROID

Restored Assemblies/Modules

The following restored assemblies/modules are available through the HP Exchange Program. For details see Section 1-19.

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
3853PS	Module; extender pwr supply & logic		03853-69202	1	RBLT-03853-66202

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Table 4-5b HP 3853PS Extender Power Supply Module (newer version)

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
3853PS	Module; extender pwr supply & logic	1	03853-66212	7	MOD-EXT PS/LOGIC
A2	PCA; power supply	1	03852-66512	9	PCA-POWER SUPPLY
A3	PCA; extender logic	1	03853-66503	9	PCA-EXTNDR LOGIC
F101*	Fuse; 3.0A slow blow (120V line)	1	2110-0004	0	FUSE,3.0A 250VNTD
	Fuse; 1.5A slow blow (240V line)	1	2110-0304	8	FUSE,1.5A 250VNTD
FC101	Fuse cap	1	2110-0565	9	FUHLR CAP 12A
MP16	Screw; rear panel	5	0515-0886	3	SCR-PH M3.0X6 LK
MP17	(NOT USED)			8	
MP18	Terminal; ground	1	1510-0038	8	BDG-POST SINGLE
MP19	Lock washer; ground terminal	1	2190-0060	7	WSHR-LK INTL T
MP20	Nut; ground terminal	1	2950-0006	3	NUT-HEX-DBL CHAM
MP21	Terminal block; analog ext. w/screws	1	03852-82101	6	CONN-6P F,VM IN
MP22	(NOT USED)				
MP23	(NOT USED)				
MP24	Panel; rear	1	03853-00203	8	0601 PNL-P/S RR
MP25	(NOT USED)				
MP26	(NOT USED)				
MP27	(NOT USED)				
MP28	(NOT USED)				
MP29	Shell; U shaped (aluminum)	1	03852-00105	8	0601 CVR-MOD LGE
MP30	(NOT USED)				
MP31	(NOT USED)				
MP32	Hex standoff; extender connector	4	0380-1810	8	STDF-HX M/F M3TH
MP33	Lock washer; extender connector	4	2190-0913	9	WSHR-LK HLCL
MP34	Cable; analog extender (1m, 3 cond.)	2	03498-61602	8	CBL-EXT H-L-G
MP35	Cable; digital extender (1 meter)	1	03853-61601	1	CBL-DIGITAL 1M
	Cable; digital extender (4 meter)	1	03853-61602	2	CBL-DIGITAL 4M
MP36	Screw;	4	0515-0408	5	SCR-PH M3.0X12 LK
PWR1**	AC-DC Switching Power Supply	1	0950-1889	0	70 W AC-DC SW
SW101	Switch; line power (on A2 PCA)	1	3101-2252	7	SW-PB-DPDT

*CAUTION: Do not replace the fuse if blown; a blown fuse indicates a defective power supply that needs to be repaired.

**Please return any defective power modules to Hewlett-Packard for evaluation.

Restored Assemblies/Modules

The following restored assemblies/modules are available through the HP Exchange Program. For details see Section 1-19.

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
3853PS	Module; extender pwr supply & logic		03853-69212	3	RBLT-03853-66212

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Table 4-6 Extender Front Panel

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
MP36	Screw; front panel	4	0515-0897	6	SCR-PH M3.0X8 LK
MP37	(NOT USED)				
MP38	(NOT USED)				
MP39	(NOT USED)				
MP40	Assembly; front panel w/label	1	03853-40203	2	PNL ASSY W/LBL
MP41	(NOT USED)				
MP42	(NOT USED)				
MP43	Screw; fan	2	0515-0885	2	SCR-PH M4.0X8 LK
MP44	Fan retainer; with foam	2	03852-61201	3	RETAINER-FAN
MP45	Fan boot; rubber	1	3160-0400	7	BOOT-FAN 80MM SQ
MP46	Fan; with wire and 1/2 connector	1	3160-0482	5	FAN-12V W/CONN
MP47	(NOT USED)				
MP48	Push rod; power switch	1	5041-3153	3	PUSH ROD
MP49	Key cap; power switch	1	5041-1682	9	KEY CAP-LINE
MP50	Clip; fan cable tie back w/adhesive	1	1400-0877	0	CLP-CBL .375-WD

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Table 4-7 Extender Chassis

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
A1	PCA; extender backplane	1	03853-66501	7	PCA-EXTENDR BKPL
MP51	Screw; backplane shield	4	0515-0886	3	SCR-PH M3.0X6 LK
MP52	Screw; A1 PCA	6	0515-0866	9	SCR-PH M3.0X8 CW
MP53	Screw; top and bottom subpanel	8	0515-0885	2	SCR-PH M4.0X8 LK
MP54	Screw; corner strut	16	0515-1331	5	SCR-MTRC SPCLY
MP55	Screw; power supply module securing	6	0515-1106	2	SCR-PH M4.0X16LK
MP56	Screw; slot ID label	8	0515-1232	5	SCR-PH M3.5X8LK
MP57	Subpanel; front (molded)	1	03852-40202	0	PNL-MLD,SUBPNL
MP58	Support; center (aluminum)	1	03852-04701	8	0601 SPRT-CD CAG
MP59	Label; extender slot ID label	2	03853-84321	7	LBL-SLOT/ID,EXT
MP60	Leaf spring strip; slot grounding	1	03852-89101	0	SPR-GROUNDING
MP61	(NOT USED)				
MP62	(NOT USED)				
MP63	Screw; front subpanel	4	0515-0896	5	SCR-FL M4.0X10LK
MP64	Shield; backplane (aluminum w/foam)	1	03852-00603	1	0601 SHLD-MTHR B
MP65	Subpanel; top (molded)	1	03852-66601	7	ASSY-CRD CAGE TP
MP66	Subpanel; bottom w/buttons (molded)	1	03852-66602	8	ASSY-CRD CAGE BT
MP67	Trim strip; front top	1	5040-7202	9	TRIM TOP
MP68	Trim strip; side	2	5001-0441	2	TRIM SIDE 8.75"
MP69	Frame; front	1	5021-5807	6	FRAME, FM, FRONT
MP70	Foot	4	5040-7201	8	FOOT
MP71	Tilt stand	2	1460-1345	5	TILT-STAND SST
MP72	Cover; top with screw	1	5061-9435	8	CVR, FM, TOP
MP73	Strut; corner	4	5021-5837	2	STRUT, CORNER
MP74	Frame; rear	1	5021-5808	7	FRAME, FM, REAR
MP75	Handle; metal strap and cover	2	5060-9804	3	STRAP HDL 18IN
MP76	Cap; rear of handle	2	5041-6820	7	CAP-STRP HDL RR
MP77	Screw; handle	4	0515-1132	4	SCR-MACH M5X0.8
MP78	Cover; side with handle slot	2	5060-9888	3	CVR-SIDE W/HDL
MP79	Cover; bottom with screw	1	5061-9447	2	CVR, FM, BTM
MP80	Cap; front of handle	2	5041-6819	4	CAP-STRP HDL FRT

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Table 4-8 HP 44743A Plug-In Accessory Service Module (backplane extender)

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44743A	Module; plug-in accessory service	1	44743A	8	MOD-ACCESRY SRVC
A1	PCAs; backplane & extended	1	44743-66501	0	PCA-ACCESRY SRVC
MP1	Screw; cover	4	0515-0160	6	SCR-PH M3.0X25
MP2	Guide rail; top (molded)	1	44743-21201	3	MLD-RAIL,TOP
MP3	Guide rail; bottom (molded)	1	44743-21202	4	MLD-RAIL,BOTTOM
MP4	Cover; right (aluminum)	1	03852-04102	3	0601 CVR-ACC Rt
MP5	(NOT USED)				
MP6	Label; 44743A service module	1	44743-84321	0	LBL-SVC MOD "A"
MP7	Edge protector; 0.5 feet	6	0400-0163	6	GROMMET-CONT
W1-2	Cable; 1.3m ribbon (included w/PCAs)	2	03852-61607	3	CBL-RBN,40P 1.3M

Table 4-9 HP 44743B Power Supply Service Module (backplane extender)

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44743B	Module; power supply service	1	44743B	0	MOD-PWRSPLY SRVC
A2	PCAs; pwr supply, backpln & extended	1	44743-66502	1	PCA-PWRSPLY EXTN
A3	PCAs; extender logic, bckpln & extnd	1	44743-66503	2	PCA-EXTLOGC EXTN
MP1	Screw; A2/A3 PCAs & cover (ends)	16	0515-0886	3	SCR-PH M3.0X6 LK
MP2	Screw; cover (center)	2	0515-0890	9	SCR-FH M3.0X6 LK
MP3	Shell; U shaped (aluminum)	1	03852-00101	4	0601 CVR-MOD LGE
MP4	Cover; (aluminum)	1	03853-00102	6	0601 CVR-PWRSPLY
MP5	Label; 44743B service module	1	44743-84322	1	LBL-SVC MOD "B"
MP6	Edge protector; 0.5 feet	6	0400-0163	6	GROMMET-CONT
W1-4	Cable; 1.3m ribbon (included w/PCAs)	4	03852-61607	3	CBL-RBN,40P 1.3M

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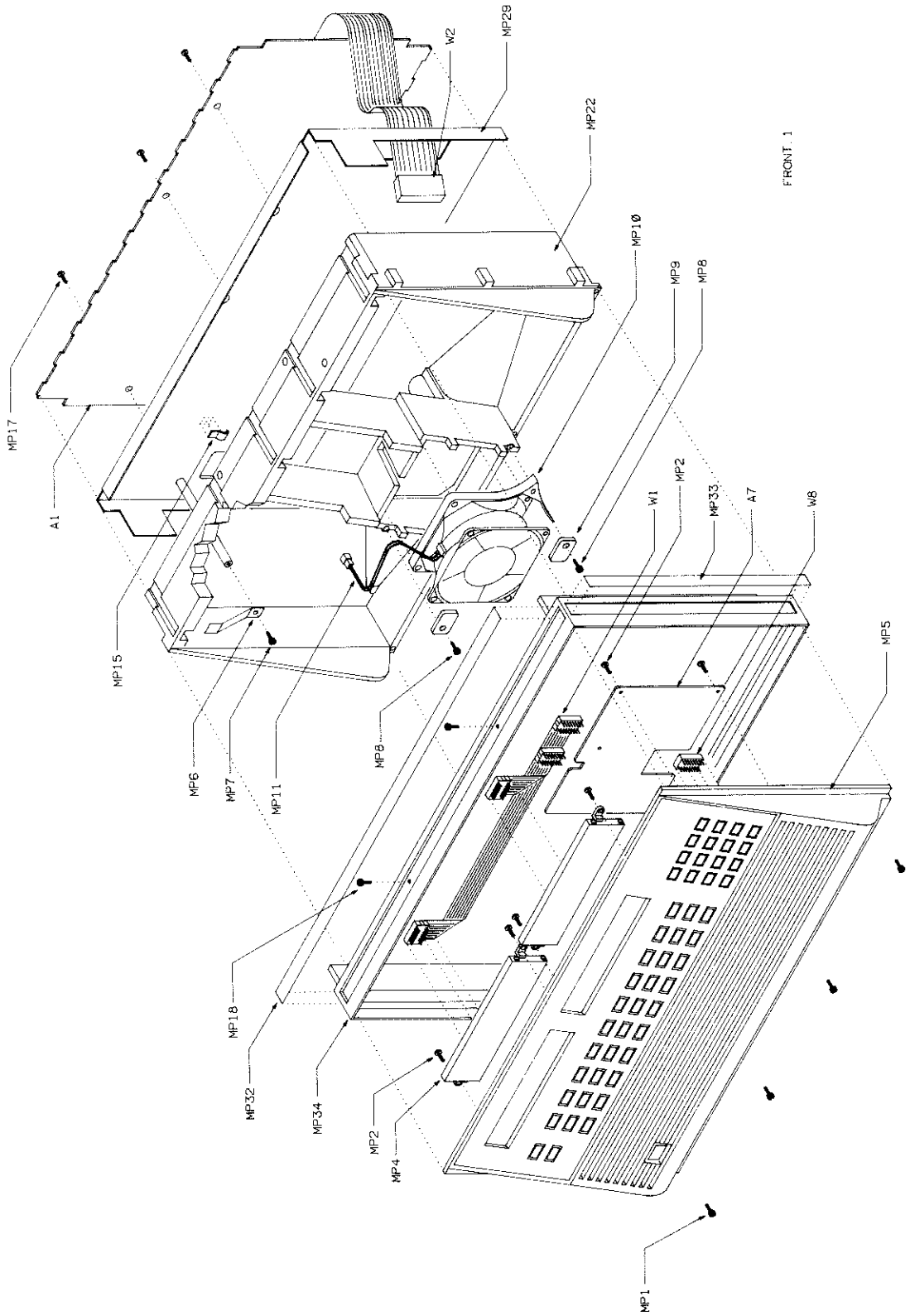


Figure 4-5 Mainframe/Extender Front Panel Exploded View

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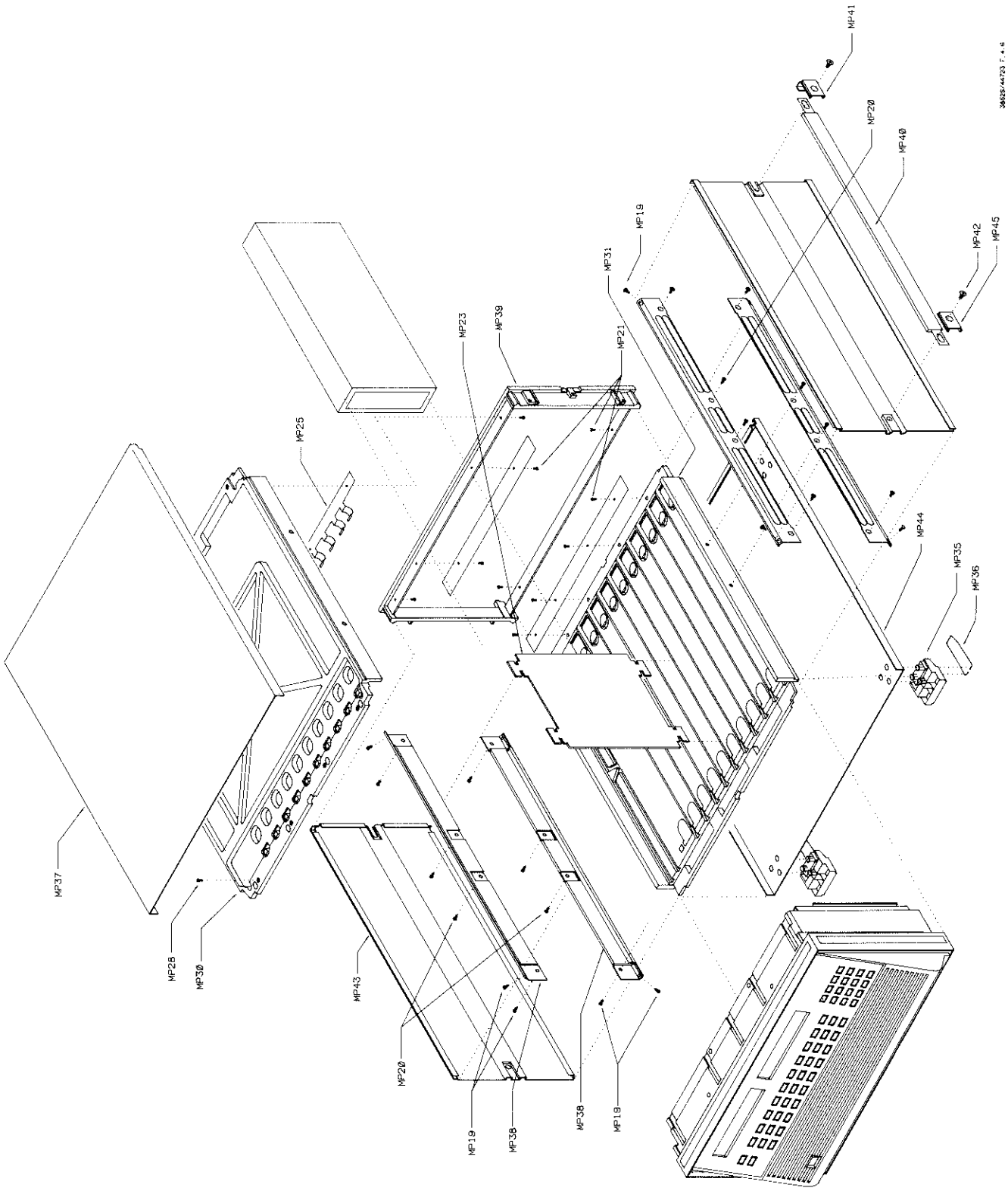


Figure 4-6 Mainframe/Extender Chassis Exploded View

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CHAPTER 5
PROBLEM ISOLATION

5-1 INTRODUCTION
5-2 SAFETY CONSIDERATIONS
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CHAPTER 5
PROBLEM ISOLATION

5-1 INTRODUCTION

This chapter contains information and procedures to aid in problem isolation. A block level technical description of the HP 3852A and HP 3853A is given to provide an understanding of the system functions and operation. This chapter also contains a description of the self-test and error codes. Finally, the chapter provides a series of troubleshooting hints to aid in problem isolation.

5-2 SAFETY CONSIDERATIONS

Only service trained personnel should attempt to repair the HP 3852A or HP 3853A. There are two places within the instrument where dangerous voltages may exist: the power supply module and analog backplane bus.

The ac line voltage present in the power supply module can only be contacted if the module's shields are removed. The line power switch is contained within the power supply module, so line power is not routed to the front panel.

The other potentially lethal voltage, and one that can be contacted by service personnel, is the analog backplane bus in the instrument. A voltage on this bus originates externally to the instrument. The power to external wiring and connections must be removed prior to servicing. Such external wiring is connected to the terminal modules. Depending upon the current configuration of the plug-in accessories, a voltage on the terminal modules may be present on the backplane analog bus. Once on the analog bus, this voltage will be present at each plug-in slot in the instrument. It will also be present at the analog extender connector on the rear of the power supply, and, if an analog extender cable is installed, on the analog bus of all installed extenders. It should be noted that if an analog extender cable is installed, voltages present on a plug-in at an extender (HP 3853A) can also be present on the HP 3852A analog bus.

WARNING

Only personnel with a knowledge of electronic circuitry and an awareness of the hazards involved should install, re-configure, or make any repairs to this instrument or assembly.

CAUTION

To prevent equipment circuit damage, always set the line power switch to off before removing or replacing any assembly. To prevent static zap of IC's, always observe anti-static techniques when assemblies are handled or serviced.

5-3 Static Handling

Static electricity is a familiar phenomenon which, except for an occasional shock, doesn't seem very serious. However, it has been proven that in the electronics industry electrostatic discharge (ESD) is a major cause of component failure. In many cases, the component damaged may not immediately fail, causing low

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instrument reliability and future repairs. ESD damage can occur at static levels below human perception. It has also been shown that ESD can affect both passive and active devices.

The following guidelines are the minimum requirements for a static safe service environment.

- The workbench should be equipped with a conductive table mat. The mat should be grounded to earth ground through a 1 M ohm resistor. The mat should be equipped with at least one swivel connector for connecting wrist straps.

- All service and handling personnel should wear a conductive wrist strap in contact with bare skin. This strap should be connected to the swivel connector on the conductive table mat through a 1 M ohm resistor.

- All metal equipment at a work station must be grounded. This includes soldering irons, solder removers, shelving, and equipment stands.

- Only one common ground should be provided at the workstation.

- The workstation should be kept free of nonconductors. No common plastics, polybags, cardboard, cigarette or candy wrappers should be allowed. There should not be rugs or carpet on the floor, shelving, or bench top.

- Only proper containers should be used for shipping, storing or transporting assemblies. This is *required* on any module or assembly shipped to Hewlett-Packard for repair or replacement.

Static precautions apply to all parts of the HP 3852A system, with the exception of the terminal modules. Any module or assembly removed from the instrument MUST be handled in accordance with anti-static procedures.

5-4 PRINTED CIRCUIT ASSEMBLY IDENTIFICATION

The printed circuit assemblies within the HP 3852A system are identified by the HP part number of the printed circuit board and the engineering revision code (ERC). These two sequences of numbers are used to exactly identify the electrical characteristics of the printed circuit board. In any correspondence concerning a particular printed circuit board, it is important to accurately identify the board configuration. This is done by using the board part number, followed by the engineering revision code (ERC) on the board. For example:

03852-66503-2528

would identify a particular printed circuit board in the HP 3852A. The board part number is 03852-66503 and the ERC is 2528.

5-5 Board Part Number

The Hewlett-Packard part number of a printed circuit board is etched on the board. This is a ten digit number, separated by a hyphen into two groups of five digits. The first five digits identify the model number or accessory number of which the printed circuit board is a part. The last five digits are a unique part number identifying the printed circuit board.

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5-6 Engineering Revision Code

Figure 5-1 shows a typical Engineering Revision Code (ERC) label. This four digit code is in the form of YYWW, where YY represents the last two digits of the year minus 60 and WW is the week code. For example, an Engineering Revision Code of 2528 would identify a change made in the 28th week of 1985.

The ERC number is updated whenever a change is made to the assembly. This change may be a printed circuit board revision, a component change, or a revised test and assembly procedure. The ERC should be checked against schematics, component locator diagrams, and parts lists to ensure compatibility. ERC's with values lower than those noted on the schematics, component locator diagrams, and parts lists are described in a backdating section. ERC's with a value higher that those noted will be covered by manual change sheets or manual revisions.

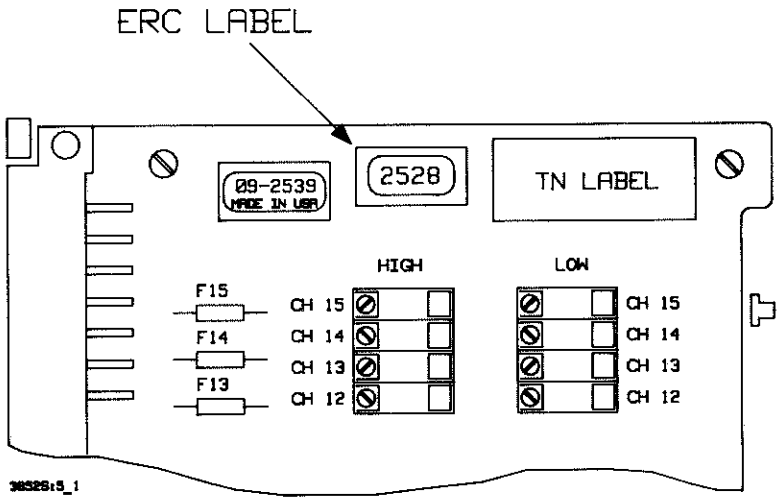


Figure 5-1 Typical ERC Label

5-7 HP 3852A TECHNICAL DESCRIPTION

The major assemblies of the HP 3852A are shown in Figure 5-2. The following discussion describes each of the major assemblies.

5-8 Local Controller

The microprocessor is the heart of the local controller. The microprocessor used is a Motorola MC68000. The MC68000 utilizes a 23 bit address bus and a 16 bit data bus. The microprocessor is clocked at a 4 MHz rate. The local controller uses a memory mapped system. In a memory mapped system, all peripherals to the microprocessor are treated as memory locations.

The firmware for the operation of the microprocessor is located in ROMs. The ROMs also contains special service routines. The standard HP 3852A contains 128 K words of ROM space, of which 5 K words are used for overhead.

The microprocessor uses 16 K word of addressable RAM. The RAM is used to store subprograms, variables, measurement results, scan lists, the HP-IB address, and the instrument serial number. A portion of the RAM is provided with a battery back-up circuit to prevent loss of data during power-down periods.

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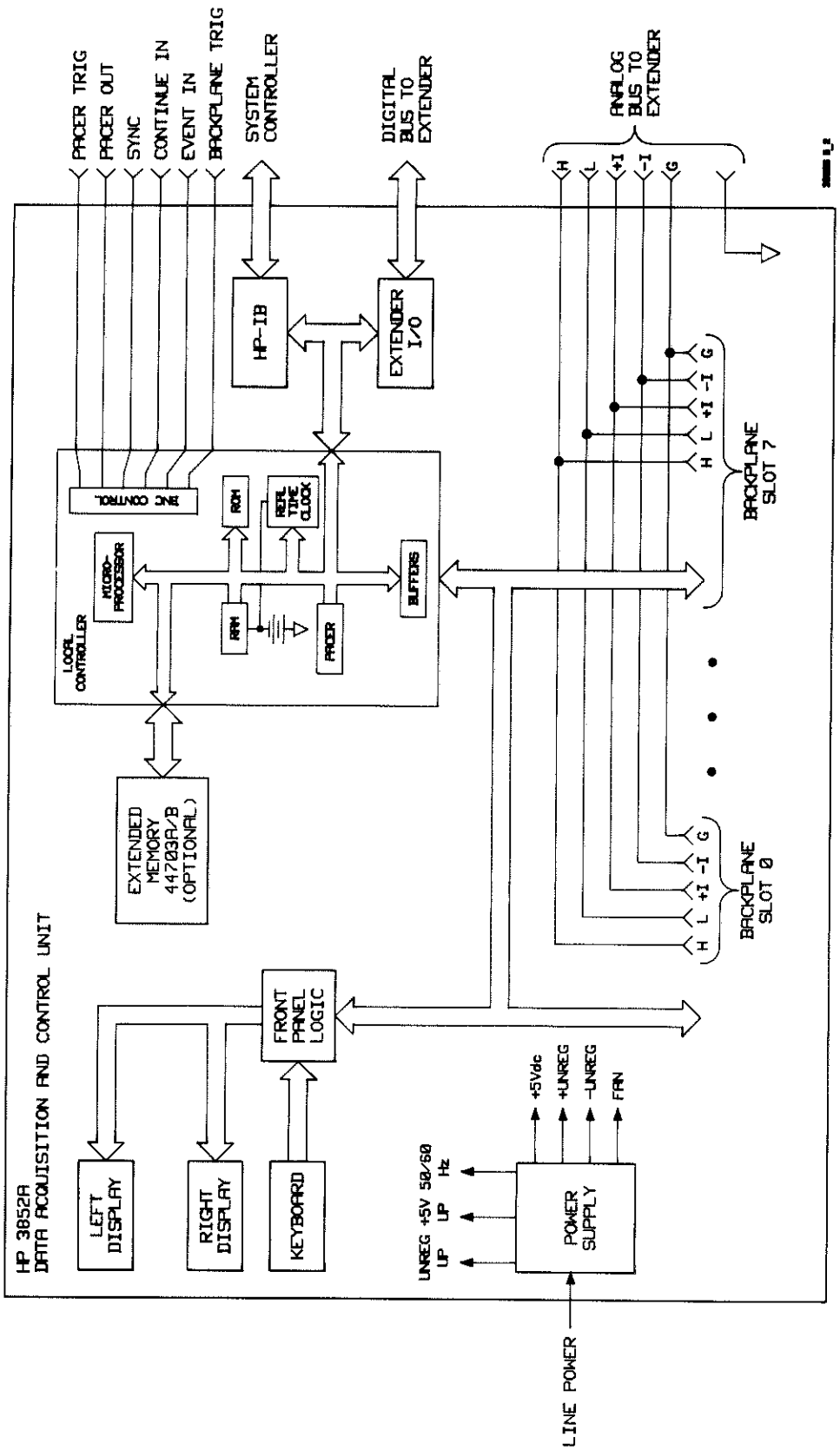


Figure 5-2. HP 3852A Block Diagram

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The real time clock is also a part of the local controller. This clock contains the time, date, and alarm settings. The real time clock is provided with a battery back-up circuit to ensure that the time, data, and alarm settings are not lost during power-down periods. The real time clock is clocked by a 32 MHz crystal oscillator.

The local controller contains a pacer. This programmable pacer can be used to initiate scans, events, or measurements. The pacer can be programmed to output from one to 65,535 pulses or output continuously. The output pulse interval is programmable from 1 microsecond to 4.19 seconds in 0.25 microsecond steps. The width of the output pulse is not programmable, it is fixed at 0.5 microsecond. The pacer output is available at a BNC on the rear panel of the controller module. At the BNC, the pacer output is a negative pulse.

On the rear panel of the controller module are six BNC connectors. Four of the BNC's are inputs and two are outputs. The BNC's are physically attached to the controller printed circuit board. They are not directly attached to the rear panel sheet metal. Electrically, the BNC case is connected to earth ground. The six connectors and their functions are described in Table 5-1. Figure 5-3 shows a typical BNC input and BNC output circuit.

Table 5-1 BNC Input and BNC Output Description

Name	Description
EVENT IN	used with the "wait for event" command to initiate an action
CHANNEL ADVANCE	advances a scan to the next channel in the scan list
CHANNEL CLOSED	used to indicate that a channel is closed, may be used to trigger an external voltmeter
SYSTEM TRIGGER IN	allows an input to trigger all plug-in accessories
PACER OUT	output from the programmable system pacer
PACER TRIGGER IN	triggers the system pacer (when in the external trigger mode)

5-9 Extended Memory

The HP 3852A can support additional memory of 256 K bytes, 1 M bytes, 2 M bytes, and 4 M bytes. The 256 K bytes and 1 M bytes memory cards are available from Hewlett-Packard as Options 001 and 002, respectively. The optional memory cards can also be ordered as field installable kits under accessory numbers 44703A (256 K bytes) and 44703B (1 M byte). The 2 M bytes and 4 M bytes memory cards are available from Infotek Systems, 1400 N Baxter Street, Anaheim, California 92806-1201 as AM220B and AM244B, respectively. Unlike the 256 K bytes and 1 M byte cards, the 2 M byte and 4 M byte cards have been *functionally tested, but are not warranted or supported by HP.*

The optional memory cards are directly connected to the controller data and address buses. Memory allocation is dynamic and, to the local controller, the memory is an extension of RAM. The additional memory is used to store readings and sub-programs.

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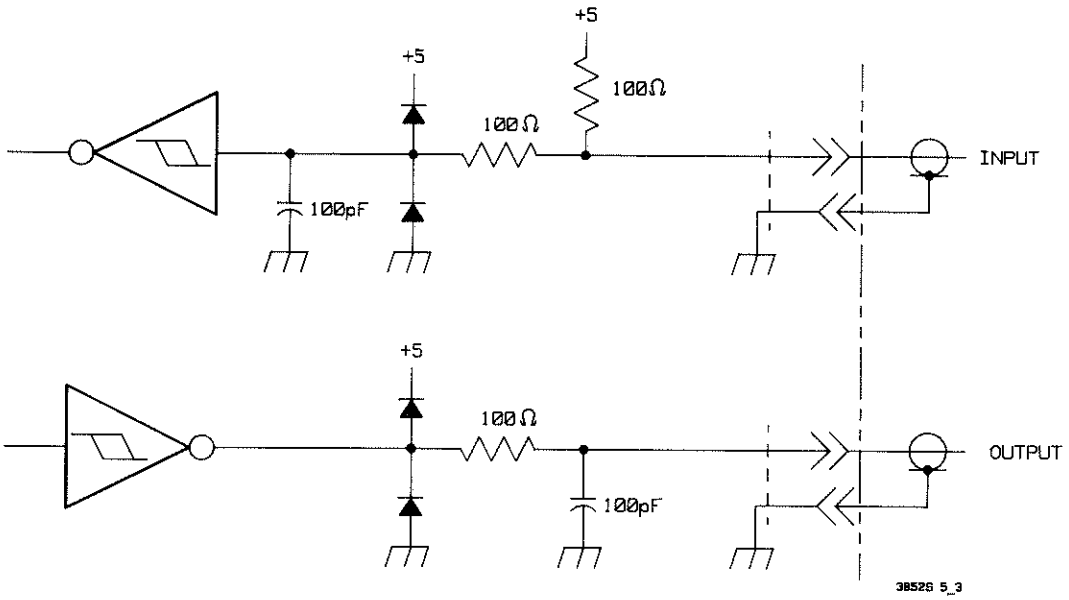


Figure 5-3 Typical BNC Input and BNC output Circuit

The HP memory cards used are the same as the optional memory cards for the HP 9000 Series 200 and 300 computers. The required address switch settings on the memory boards are shown in Figure 5-4.

5-10 HP-IB

The HP-IB section allows the HP 3852A to interface with the external system controller. HP-IB is a carefully defined parallel interface and is Hewlett-Packard's implementation of IEEE 488-1978. The HP-IB connector is located on the rear panel of the controller module.

HP-IB capabilities supported by the HP 3852A are: SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, and C0. A complete explanation of these codes can be found in the IEEE 488-1978 standard. The HP-IB section is clocked at a 4 MHz rate. The maximum data transfer rate over the bus to an ideal listener is 140 K bytes/second.

Physically, the HP-IB section shares a part of the HP-IB/Extender Logic printed circuit board. This circuit board is mounted as a "piggy-back" board on the controller board, inside the controller module.

5-11 Extender I/O

The Extender I/O interfaces the HP 3852A with the HP 3853A Extender. This digital interface is accessed through a 37 pin connector located on the rear panel of the controller module. This digital interface allows up to seven HP 3853A Extenders to be connected in a daisy chain fashion to the HP 3852A. Electrically, all extenders are in parallel. The maximum interface cable length between units is 4 meters (a 1 meter cable is standard) and the entire system can have no more than 25 meters of digital extender cable.

The Extender I/O circuitry is located inside the controller module, on a "piggy-back" printed circuit board. This printed circuit board also contains the HP-IB circuitry.

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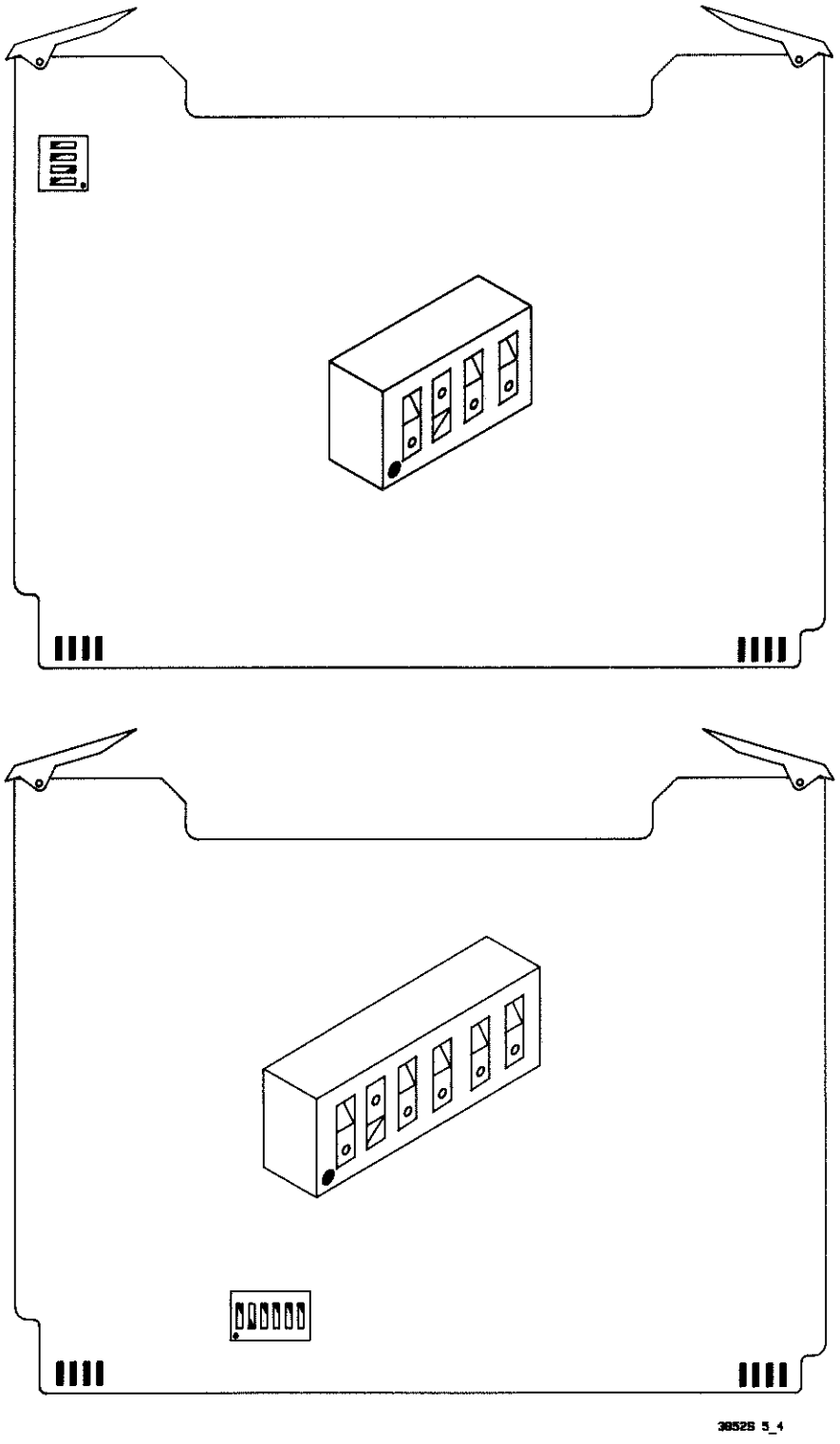


Figure 5-4 Extended Memory Address Settings

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5-12 Front Panel Logic

The front panel logic functions as a bidirectional buffer between the keyboard, display, and the local controller. The front panel logic accepts data and commands from either the keyboard or the local controller. It also controls the two displays. Keyboard scanning is controlled by the front panel logic.

The front panel logic communicates with the local controller over the eight least significant backplane data lines (BD0 through BD7). Since the front panel communicates over the backplane data bus and control lines, a failure in the front panel may appear like a slot failure.

The front panel logic is contained on a printed circuit board mounted to the front panel. A ribbon cable to the backplane provides the necessary control and data lines. The beeper is mounted to the front panel logic circuit board.

5-13 Keyboard

The keyboard has 48 keys. The keys are electrically arranged into a 6 by 8 matrix that is scanned by the front panel logic. When a key is pressed, the front panel logic sends a byte corresponding to the key code to the local controller. On the keyboard, 30 of the keys have a shifted function. These keys are controlled by the blue SHIFT key. No byte is sent to the local controller when the SHIFT key is pressed. The shifted keys are arranged in a standard QWERTY keyboard arrangement.

The keyboard is heat staked to the front panel. The rubber keys, the contacts and the printed circuit board are not individually replaceable. Repair of the keyboard is accomplished by replacing the molded plastic panel and keyboard as an assembly.

5-14 Displays

There are two display assemblies on the front panel, referred to as the left and right display as seen looking at the front panel. Each Liquid Crystal Display has 12 starburst characters and 12 annunciators. During self test or when initiated by a service test jumper all segments of the display are turned on. Missing segments or annunciators indicate a failing display.

The display assemblies are connected to the front panel logic by ribbon cables. Repair of a failing display assembly is done by replacing the assembly. Chapter 4 of this manual gives replacement part numbers.

5-15 Backplane

The HP 3852A provides eight slots for plug-in accessories. Each accessory electrically connects to the backplane through a 74 pin connector. This connector contains all the digital and analog lines. The backplane provides a five line analog bus to each plug-in accessory. This bus may or may not be used, depending upon the plug-in accessories installed and the application.

If an HP 3853A Extender is connected, the digital bus is extended through the HP-IB/Extender logic. The analog bus is directly extended with a dedicated cable between the units. Not all systems require the analog bus of the HP 3853A. If a plug-in voltmeter accessory is used to measure a voltage through a multiplexer plug-in accessory that is not installed in the same unit, then the analog extension is needed. No analog extension is needed for a voltmeter to measure a voltage through a multiplexer accessory in the same unit.

A plug-in accessory backplane connector is shown in Figure 5-5. This 74 pin connector contains all the power supplies, grounds, analog bus lines and logic bus lines. Each of the lines is described in Table 5-2. The plug-in accessory backplane connector is the same in the HP 3852A and the HP 3853A.

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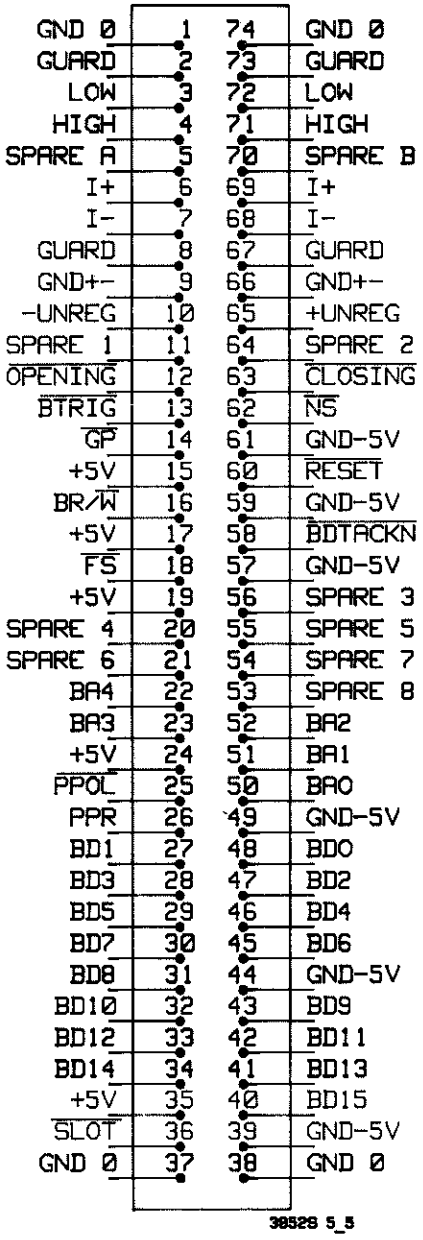


Figure 5-5 Backplane Connector

5-16 Power Supply

The power supply provides power for all the circuitry in the HP 3852A and all plug-in accessories installed. The power supply outputs four supplies and three control lines. The supplies output are: +5 VDC, +UNREG (+21 VDC unregulated), -UNREG (-24 VDC unregulated), and fan power (derived from the +UNREG supply). The power supply specifications are listed in Table 5-2.

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Table 5-2 Plug-In Accessory Backplane Lines

Line Type	Line Name	Line Description
LOGIC BUS	RESET	Backplane reset input to plug-in accessories. Pulled low to reset.
	BR/W	Read/write direction control input to plug-in accessories. High = read, Low = write.
	SLOT	Slot select line input to plug-in accessories. Selects slot when low.
	BDTACKN	Data Acknowledged. Bus handshake line output from plug-in accessory. Pulsed low to handshake.
	BA0-BA4	Register address lines input to plug-in accessories. High = 1.
	BD0-BD15	Backplane data bus. These are bidirectional lines.
	PPOL	Parallel poll line input to plug-in accessories that have the capability of interrupting the local controller. Line is pulled low to poll.
	PPR	Parallel poll response line output from the plug-in accessories in response to a parallel poll. The plug-in pulls this line low to indicate an affirmative response. On the backplane, each PPR line is tied to the data line (BD) corresponding to the slot number.
	BTRIG	Backplane trigger input to plug-in accessories. A low initiates the trigger. Not all plug-in accessories can respond to this trigger.
	GP	General purpose interrupt output from plug-in accessory. Set low to interrupt.
	NS	Normal scan interrupt output from an HP 44701A. Set low to interrupt.
	FS	Fast scan interrupt output from an HP 44702A/B. Set low to interrupt.
	OPENING	Opening signal line used by the multiplexer plug-in accessories to synchronize the "break-before-make" channel openings. Each multiplexer inputs and outputs this line. Line is set low to indicate that a channel is in the process of opening.
	CLOSING	Closing signal line output from the multiplexer plug-in accessories to one of the voltmeter accessories. Line is pulled low to indicate a channel is in the process of closing.
	SPARE	All lines labeled SPARE are not connected.

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Table 5-2 Plug-In Accessory Backplane Lines (Cont)

Line Type	Line Name	Line Description
GROUNDS	GND 0	ESD discharge path and safety ground. This ground is tied to all sheet metal on the plug-in accessories.
	GND-5	The reference for the +5 VDC power supply. This ground is the logic reference ground.
	GND+-	The reference for the -UNREG and +UNREG supplies.
POWER SUPPLIES	+5V	The 5 VDC supply. May range from +4.8 Vdc to +5.25 VDC Ripple and noise on this supply < 100 mV peak-to-peak.
	+UNREG	The positive unregulated supply. Voltage may range from +17.4 Vdc to +22.0 Vdc. Ripple and noise; <0.5 V peak-to-peak.
	-UNREG	The negative unregulated supply. Voltage may range from -17.4 Vdc to -31.0 Vdc. Ripple and noise are not specified.
ANALOG BUS	HIGH,LOW	The HP 44701A and HP 44702A/B can make measurements from these lines.
	GUARD	Used to guard measurements made by the HP 44701A. If an HP 44702A/B is installed, GUARD is tied to chassis ground (GND 0).
	I+,I-	Used to provide current source for ohms measurements. Both the HP 44701 and HP 44702 can source current on these lines.

The three control lines are output to the local controller. These three control lines are: UNREG UP (indicating that the unregulated supplies are operating), +5 UP (indicating that the + 5 VDC supply is operating), and 50/60 Hz (used by the local controller to set voltmeter integration times).

The local controller monitors the UNREG UP and +5 UP lines to determine if a power failure is occurring. The power supply outputs have enough filtering to allow the local controller to initiate a shut-down sequence if either of these control lines indicates an imminent failure.

5-17 HP 3853A TECHNICAL DESCRIPTION

The major assemblies of the HP 3853A Extender are shown in Figure 5-6. The HP 3853A provides an additional ten plug-in accessory slots. Up to seven HP 3853As may be installed in a single system.

5-18 Extender I/O

The Extender I/O interfaces the HP 3853A with the HP 3852A. This digital interface is accessed through a 37 pin connector located on the rear panel of the HP 3853A. There are two connectors on the rear panel of the HP 3853A. The two connectors are wired in parallel to allow several (up to seven) HP 3853As to be connected in a daisy chain fashion. Electrically, all extenders are in parallel.

The Extender I/O circuitry is located on a printed circuit board mounted inside the power supply module.

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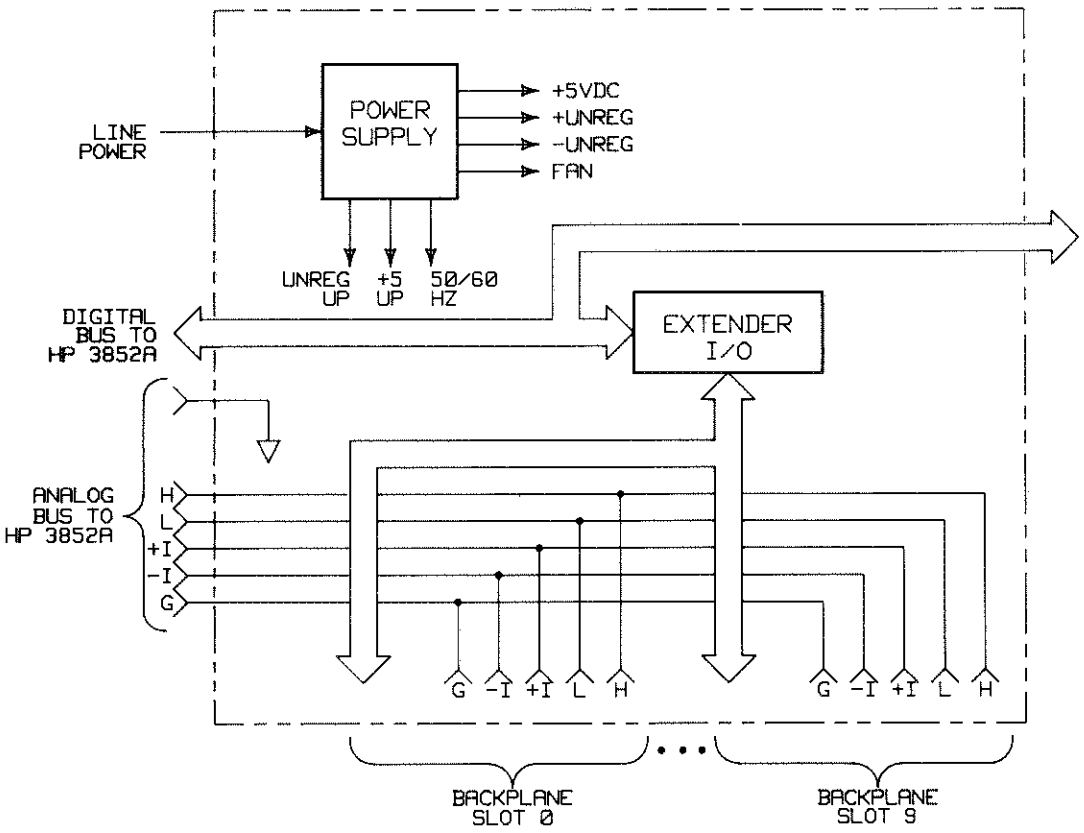


Figure 5-6 HP 3853A Block Diagram

5-19 Power Supply

The power supply in the HP 3853A is the same supply as that used in the HP 3852A. It provides power for the Extender I/O circuitry and all plug-in accessories installed. The power supply provides +UNREG, -UNREG, +5 VDC, and fan power. The +5 UP and UNREG UP control lines are combined into a single control line on the Extender I/O circuit board and placed on a dedicated line in the digital interface. This line is monitored by the HP 3852A local controller and, if the state of the line indicates an imminent power failure, initiates the power down sequence of the local controller.

Because the digital interface is shared by all the HP 3853A Extenders installed in the system, any one extender with a failing power supply will initiate the power down sequence (or prevent a proper wake up sequence) in the HP 3852A.

5-20 PROBLEM ISOLATION

The following procedures assume that reasonable steps have been taken to isolate the problem to the HP 3852A system. Such steps may include testing of the system controller, HP-IB, and system inputs.

Within the HP 3852A are five major electronic assemblies. These assemblies are: 1) the keyboard, 2) the displays, 3) front panel logic, 4) the power supply, and 5) the local controller. Because of the interaction of some of these assemblies problem isolation is limited to replacement of the suspected assembly. The following paragraphs detail problem isolation to each of the assemblies.

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Within the HP 3853A Extender is only one electronic assembly. This assembly contains both the power supply and the Extender I/O logic. The HP 3853A power supply is tested in the same manner as the HP 3852A power supply. Section 5-34, System Troubleshooting Hints, contains information to isolate a problem to the HP 3853A Extender.

5-21 Keyboard

The keyboard printed circuit board is heat staked to the front panel. It is replaced as an assembly. Electrically, the keys are arranged into a 6 by 8 matrix that is scanned by the front panel logic. There are no active components on the keyboard printed circuit board.

Symptoms of a failing keyboard include: A single key failure or a set of keys failing (a bad row or column in the matrix). Multiple key closures, no response to any key, or an incorrect response to keys are indicative of failures in the front panel logic or the local controller; not necessarily the keyboard assembly.

5-22 Displays

The two displays are identical and interchangeable. Failing displays are evidenced by missing segments or fading characters. A display may also be completely dead. If both displays exhibit a failure, the front panel logic or local controller should be suspected. If one or the other display exhibits a failure, the display cables to the front panel logic board can be swapped to isolate the problem to the display or front panel logic.

CAUTION

The connectors used on the display cable are delicate connectors. Use care when removing or installing the cables to prevent damage to the connector.

Two ways are provided to test the displays. A test of the displays occurs following the execution of the TEST command. This self-test turns on all segments in both displays for a short time. There is also a test point on the front panel logic board that forces the front panel logic into a self-test routine and turn on all segments of both displays. The use of this test point is described in Section 5-23.

5-23 Front Panel Logic

The front panel logic scans the keyboard and controls both displays. The beeper is also located on the front panel logic. The front panel logic is tested in the self-test routines (see Sections 5-30, 5-31 and 5-32). An additional test can be initiated by use of a test point on the circuit board. Figure 5-7 shows the location of the test point and a ground test point. To use the test point:

1. Remove ac power from the HP 3852A.

2. Remove the front panel. A procedure to remove the front panel is in Chapter 4 of this manual.

2. Connect the TEST pin (TP202) to the ground pin (TP201). The test points are shown in Figure 5-7.

3. Apply ac power to the instrument and turn it on. The beeper should sound and all segments of the display should be on. The display segments will be on until the jumper is removed. Pressing the CLEAR key re-initiates the test.

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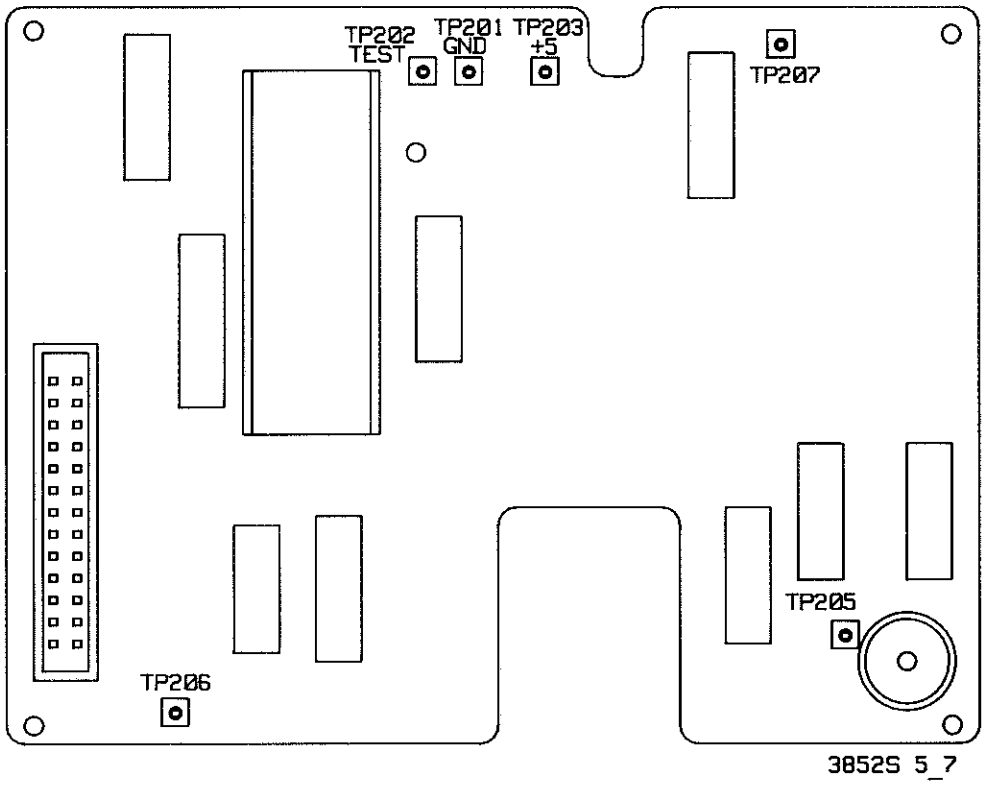


Figure 5-7 Front Panel Logic Circuit Board

The HP 3852A is able to operate with the front panel removed. If the front panel is suspected of a problem that inhibits the proper wake-up and self-test sequence of the HP 3852A, the cable can be removed from J201 on the front panel logic (this removes the front panel logic from the internal logic bus). After cycling power to the unit, it should respond normally to commands over the HP-IB. This test can be used to isolate a faulty front panel.

5-24 Power Supply

There are four outputs from the power supply assembly: +UNREG, -UNREG, +5 Vdc, and fan power. Fan power is derived from the +UNREG supply.

Testing the power supply for correct operation requires a voltmeter and an HP 44743A service module. A recommended voltmeter is the HP 3456A. The service module provides a means to extend the plug-in accessory backplane connector and includes marked test jumpers for all the backplane lines. Additionally, ripple and noise on the supplies can be checked with an oscilloscope. A recommended oscilloscope is the HP 1740A.

To test the power supply:

1. Remove ac power from the HP 3852A.

2. Install the service module in any available plug-in accessory slot.

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3. Apply power to the instrument and turn it on.

4. Connect the negative lead of the voltmeter to the GND+- jumper on the service module.

4. Connect the positive lead of the voltmeter to the +UNREG jumper on the service module. The voltage should read between +17.4 Vdc and +22.0 Vdc. Ripple and noise on this supply should be less than 0.5 V peak-to-peak as measured on an oscilloscope.

5. Connect the positive lead of the voltmeter to the -UNREG jumper on the service module. The voltage should be between -17.4 Vdc and -31.0 Vdc.

6. Connect the negative lead of the voltmeter to the GND-5 jumper on the service module. Connect the positive lead of the voltmeter to the +5 jumper on the service module. The voltage should be between +4.8 Vdc and +5.25 Vdc. Ripple and noise on this supply should be less than 100 mV peak-to-peak as measured on an oscilloscope.

There are two control lines from the power supply that may cause problems with the local controller. These lines are the +5-UP and UNREG-UP lines. These lines are high in normal operation. The state of these lines can be checked at the test jumpers on the service module when it is installed in the controller slot in the backplane. If the UNREG-UP line does not go high after power is applied, both displays will be blank. If the +5-UP line does not go high after power is applied, the displays will contain random characters and the beeper will sound continuously. It is important to check the power supply outputs for correct voltages before checking these two control lines.

Another control line from the power supply is the 50/60 HZ line. This line allows the local controller to determine the line input frequency. The line provides a 5 volt square wave for a short time after power is applied to the unit. The 50/60 HZ line is available on the service module when it is installed in the local controller connector. A failing 50/60 HZ line will also be trapped by the power-on self-test and generate Error 26. Section 5-31 gives more information about the specific error code relating to the 50/60 HZ line.

5-25 Local Controller

Local controller failures should be trapped by the power-on self-test. There are three self-test routines run by the local controller. These routines are described in Section 5-30.

5-26 Error Codes

Table 5-3 lists all error codes that may be encountered when operating the HP 3852S system. Most of these error codes apply to programming, configuration or execution errors. The meaning of these codes is described in more detail in Appendix B of the HP 3852A Mainframe Configuration and Programming Manual. This section only describes the error codes that indicate an equipment failure or that may be useful for problem isolation.

Three error codes that are important for troubleshooting are: Error 80, Error 26, and Error 27. These codes will be returned following an unsuccessful internal self-test. Error 80 is described in more detail in section 5-30. Error 26 is described in section 5-31, and error 27 is described in section 5-32.

Other error codes that have significance to system troubleshooting are: Error 25 and Error 18. Error 25 is described in Section 5-27 and Error 18 is described in Section 5-28.

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Table 5-3 HP 3852A Error Codes

Error Codes	Error Message	Error Codes	Error Message
ERROR 00:	NO ERROR	ERROR 43:	END OF ARRAY REACHED
ERROR 01:	OUT OF MEMORY	ERROR 44:	NOT ENOUGH VARIABLE SPACE
ERROR 02:	SYMBOL TOO LONG	ERROR 45:	ARRAY NOT REAL
ERROR 03:	BAD NUMBER FORMAT	ERROR 46:	VARIABLE NOT DEFINED
ERROR 04:	SYNTAX	ERROR 47:	PACKED NOT ALLOWED
ERROR 05:	SUBEND WITHOUT SUB	ERROR 48:	ARRAY SIZES DIFFER
ERROR 06:	MISSING FOR	ERROR 49:	DATA OUT OF BOUNDS
ERROR 07:	NOT ALLOWED IN SUB	ERROR 50:	EMPTY ARRAY
ERROR 08:	ALLOWED ONLY IN SUB	ERROR 51:	SYMBOL TABLE FULL
ERROR 09:	SUB CODE TOO LONG	ERROR 52:	SCAN IN PROGRESS
ERROR 10:	SUB WAS DELETED	ERROR 53:	NO SCAN LIST
ERROR 11:	NO ACTIVE SUB	ERROR 54:	NO VALID CHAN IN LIST
ERROR 12:	CANNOT RE-TYPE A VARIABLE	ERROR 55:	STRUCTURED COMMANDS NESTED TOO DEEP
ERROR 13:	MISSING IF	ERROR 56:	SUBEND IN STRUCTURED COMMAND
ERROR 14:	MISSING WHILE	ERROR 57:	LIST TOO LONG
ERROR 15:	IMPROPER FOR/NEXT MATCHING	ERROR 58:	SUBS NESTED TOO DEEP
ERROR 16:	SUBSCRIPT OUT OF BOUNDS	ERROR 59:	SUB ALREADY EXISTS
ERROR 17:	END OF COMMAND INSIDE STRING	ERROR 60:	ACCESSORY INTERFACE ERROR
ERROR 18:	SYSTEM ERROR	ERROR 61:	CALIBRATION RAM ERROR
ERROR 19:	INVALID CHAR RECEIVED	ERROR 62:	CALIBRATION FAILURE
ERROR 20:	COMMAND BUFFER OVERFLOW	ERROR 63:	SCAN LIST TOO BIG
ERROR 21:	TOO MANY ARGUMENTS	ERROR 64:	MUST_USE DIFFERENT VARIABLE
ERROR 22:	CANNOT EXECUTE	ERROR 65:	NO RESPONSE - ACCESSORY REMOVED
ERROR 23:	SETTINGS CONFLICT	ERROR 66:	INVALID CHANNEL FOR COMMAND
ERROR 24:	ARGUMENT OUT OF RANGE	ERROR 67:	OVERVOLTAGE ON BACKPLANE
ERROR 25:	DEVICE FAILURE	ERROR 68:	SUB NAME NOT EXPECTED
ERROR 26:	POWER ON TEST FAILED	ERROR 69:	SCALAR NAME NOT EXPECTED
ERROR 27:	INVALID SLOT	ERROR 70:	ARRAY NAME NOT EXPECTED
ERROR 29:	SPURIOUS FAST SCAN INTERRUPT	ERROR 71:	UNDEFINED WORD
ERROR 30:	SPURIOUS NORMAL SCAN INTERRUPT	ERROR 72:	THIS KEYWORD NOT EXPECTED
ERROR 31:	INVALID COMMAND FOR ACCESSORY	ERROR 73:	NO READINGS TO TRANSFER
ERROR 32:	NO ACCESSORY PRESENT	ERROR 74:	COMMAND END NOT EXPECTED
ERROR 33:	INVALID CHANNEL	ERROR 75:	INSIDE SUB CALLED MORE THAN ONCE
ERROR 34:	INVALID REGISTER	ERROR 76:	INSIDE NESTED SUB
ERROR 35:	DIFFERENT PACKED TYPES	ERROR 77:	NOT ALLOWED WHILE STORING SUB
ERROR 36:	DATA LOST DUE TO FORMAT	ERROR 78:	NOT ALLOWED DURING HP-IB COMMAND
ERROR 37:	TRIGGER TOO FAST	ERROR 79:	STANDARD DEVIATION NOT DEFINED
ERROR 38:	CHECK POWER	ERROR 80:	No message - power-on test failed,
ERROR 39:	MEMORY LOST		instrument locks up.
ERROR 40:	CANNOT EXECUTE IN REMOTE	ERROR 81:	TOO MANY READINGS REQUESTED
ERROR 41:	EXECUTE FROM FP ONLY	ERROR 82:	SYMBOL ALREADY EXISTS
ERROR 42:	MATH ERROR		

5-27 Error 25

Error 25, "DEVICE FAILURE", indicates that one of the plug-in accessories is incorrectly interrupting or is holding some illegal state on the backplane bus. Typically, this error is encountered immediately following a command. The failing plug-in module is most likely located at the address used in the last command executed.

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5-28 Error 18

Error 18, "SYSTEM ERROR", occurs when either firmware or hardware has placed the internal processor in an illegal state. In some cases, an expanded error message will be shown in the display. When this error is received, the instrument locks up. The only active key on the front panel will be the CLEAR key. Pressing the CLEAR key returns control of the unit. The ERRSTR? command can be used to retrieve the error message in the display, and the display scrolled to the left to reveal the entire error message.

Do the following if Error 18 is encountered:

1. Note the action that caused the failure. If possible, determine the command sequence that was sent.

2. Press the CLEAR key to return control of the unit.

3. Execute the ERRSTR? command to show the error message in the display. Scroll the message to the left and note the entire error message.

4. Retrieve all stored data or subroutines from the HP 3852A memory. The next step cycles power and destroys any information stored.

5. Cycle power on the front panel. Observe any error messages or codes generated by the internal wake-up self-test. (The power-on self-test gives a more extensive test than the internal TEST command.) Sections 5-30 and 5-31 describe the internal self-tests and the error codes that may be obtained in each.

5-29 Internal Self-Test

The HP 3852A has three internal test routines. Two of the routines are automatically accessed when power is applied to the unit. These tests are referred to as the fatal error test and non-fatal error test routines. The third routine is accessed by use of the TEST command.

These tests only check the internal controller, HP-IB interface, and front panel. They do not check plug-in accessories or HP 3853A Extenders.

5-30 Fatal Error Test (Error 80)

When power is applied the HP 3852A begins the first of two internal self-tests. The first test routine is the fatal error routine. If a failure is detected in this routine, the unit will beep, display the error, and lock-up. A failure in this routine indicates that the system cannot function with any degree of confidence. When a fatal error is encountered the display indicates "ERROR 80:" followed by the error code. The error code will be four digits. The error code is in hexadecimal notation (Section 5-33 contains a description of hexadecimal notation). Each bit of the error code has an individual meaning. Table 5-4 lists the meaning of each bit. Bit 0 is the least significant bit of the least significant digit (the rightmost bit/digit). The errors are additive in the code.

This test routine also sends a reduced error code to the HP-IB section, allowing the fatal errors to be read over the bus (assuming that the HP-IB is functional). This reduced error code is given in Table 5-5.

The fatal error test routine checks the following functional areas:

ROM
RAM
DTACK
HP-IB

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Table 5-4 Fatal Error Test Codes (Error 80)

Data Bit	Meaning	Data Bit	Meaning
0	Bad ROM check sum (U57)	8	Bad RAM read/write check sum (U92)
1	Bad ROM check sum (U58)	9	Bad RAM read/write check sum (U93)
2	Bad ROM check sum (U59)	10	General purpose DTACK error
3	Bad ROM check sum (U60)	11	HP-IB DTACK error
4	Bad ROM check sum (U61)	12	Bad data from HP-IB
5	Bad ROM check sum (U62)	13	Status error from HP-IB
6	Bad RAM check sum (U63 or U90)	14	Bad U90 (firmware Rev 3.5 or above)
7	Bad RAM check sum (U64 or U91)	15	Bad U91 (firmware Rev 3.5 or above)

Table 5-5 HP-IB Fatal Error Codes

Data Bit	Meaning
0	Check sum error in ROM
1	Check sum error in RAM
2	DTACK error
3	Not significant
4	HP-IB error
5	HP-IB status error
6	Always 0
7	Not significant

5-31 Non-Fatal Error Test (Error 26)

If the fatal error routine passes, the local controller begins the non-fatal error test routine. This routine tests 90% of the local controller. Failures detected during the routine do not stop the test. A failure of this routine is indicated by the message "ERROR 26:" in the left display and the words "POWER ON TEST FAILED" in the right display. Since these tests are not considered fatal, the unit will continue the wake-up sequence until the message "READY" is obtained in the left display. The error annunciator will be on in the left display. The error message and the error code can be retrieved by executing the ERRSTR? command. It will be necessary to scroll the display to the left to see the error code. The error code is a six digit code in hexadecimal notation (Section 5-33 describes hexadecimal notation). Each bit of the code has an individual meaning. Table 5-6 lists the bits and their meaning. Bit 0 is the least significant bit of the least significant digit. The errors are additive in the code.

The non-fatal test routine checks the following functional areas:

CHANNEL ADVANCE
EVENT IN
REAL TIME CLOCK
RAM RESET
PACER
LOCAL CONTROLLER CLOCKS
PARALLEL POLL/DTACK
BACKPLANE DATA LINES
50/60 Hz
OPTIONAL MEMORY
OPENING or CLOSING LINES
FRONT PANEL

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Table 5-6 Non-Fatal Error Codes (Error 26)

Data Bit	Meaning
0	Channel advance latch is stuck
1	Event in latch is stuck
2	Real time clock not running
3	RAM has been reset
4	No DTACK from real time clock
5	Pacer running without start command
6	Pacer will not start upon command
7	Pacer will not stop at end of count
8	Crystal frequency incorrect (one of 2 crystals)
9	Parallel poll strobe or backplane DTACK failure
10	Backplane data line stuck (failed plug-in module)
11	50/60 Hz line failure
12	Optional memory failure (or wrong address)
13	Optional memory failure of read/write
14	Optional ROM failure
15	Optional ROM failure
16	Opening or Closing line stuck low
17	Front panel timeout (BUSY)
18	Front panel timeout (DATA_READY after reset)
19	Front panel timeout (self-test ON command)
20	Front panel self-test complete without ON echo
21	Front panel timeout (self-test OFF command)
22	Front panel self-test complete without OFF echo
23	Not used

5-32 Test (Error 27)

The TEST command can be executed at any time to provide a confidence check of the local controller operation. The TEST routine checks 60% of the local controller. It does this without changing any of the current data in memory, the pacer functions, or the rear panel BNC inputs and outputs.

As a part of the TEST routine, all the segments of both LCD displays are turned on. The beeper will provide a continuous tone while the displays are on. If no errors are encountered during the routine the message "SELF TEST OK" will be shown in the right display. Some annunciators may be on.

If the TEST routine detects a failure, the failure is indicated by a beep and the words "ERROR 27:" in the left display, and "SELF TEST FAILED" in the right display. Scrolling the display will show the failure error code. This is an eight digit code in hexadecimal notation. Each bit of the code has an individual meaning. Table 5-7 lists the bits and their meaning. Bit 0 is the least significant bit of the least significant digit. The errors are additive in the code.

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Table 5-7 TEST Command Error Codes (Error 27)

Data Bit	Meaning
0	Bad ROM check sum (U57)
1	Bad ROM check sum (U58)
2	Bad ROM check sum (U59)
3	Bad ROM check sum (U60)
4	Bad ROM check sum (U90)
5	Bad ROM check sum (U91)
6	Bad RAM check sum
7	General purpose DTACK error
8	HP-IB DTACK error
9	Real time clock not running
10	Not used
11	Real time clock DTACK error
12	Parallel poll/backplane DTACK error
13	Backplane data line bad (dead plug-in module)
14	50/60 Hz line failure
15	Optional memory failure (or wrong address)
16	Optional memory read/write failure
17	Optional ROM check sum error
18	Optional ROM check sum error
19	Front panel timeout (BUSY)
20	Front panel timeout (DATA_READY after reset)
21	Front panel timeout (self-test ON command)
22	Front panel self-test complete without ON echo
23	Front panel timeout (self-test OFF command)
24	Front panel self-test complete without OFF echo
25	Not used
26	Not used
27	Not used
28	Not used
29	Not used
30	Not used
31	Not used

The TEST command tests the following functional areas:

ROM
RAM
DTACK
REAL TIME CLOCK
PARALLEL POLL
BACKPLANE DATA LINES
50/60 Hz
OPTIONAL MEMORY
FRONT PANEL

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5-33 Decoding Hexadecimal Notation

Hexadecimal is a numbering system with a base of 16. The error codes used by the HP 3852A are in hexadecimal notation. In this notation, each digit of the error code represents four bits of information. The entire error code is thus divided into four bit groups, each group represented by a digit. For convenience, the error code tables presented in this chapter provide the bit codes in groups of four. To determine the meaning of an error code, each non-zero digit is analyzed as an individual group of bits. The least significant bits (data bits 0, 1, 2 and 3) are represented by the least significant digit (the rightmost digit). Table 5-8 decodes the four digit groups into the equivalent hexadecimal notation.

Table 5-8 Hexadecimal Codes

Hexadecimal Code	Bit Pattern	Hexadecimal Code	Bit Pattern
0	0000	8	1000
1	0001	9	1001
2	0010	A	1010
3	0011	B	1011
4	0100	C	1100
5	0101	D	1101
6	0110	E	1110
7	0111	F	1111

5-34 System Troubleshooting Hints

The following points should be kept in mind when troubleshooting a HP 3852S system:

- The HP 3852A self-test is an internal self-test. It does not check any plug-in accessories or extenders units. Descriptions of the three self-test routines begin in Section 5-29. Plug-in accessories that support an internal self-test can be tested using the TEST <slot> command.

- Any HP 3853A Extenders connected to the HP 3852A must have power applied and be correctly functioning for the system to operate. Failing extenders can be isolated by removing the digital extender cable from the HP 3852A and checking for correct operation. It may be necessary to cycle power on the HP 3852A after removing the cable. Analog extender cables, if installed, need not be removed for this test.

- Line power status is indicated in the HP 3852A right display by an annunciator. Line power status is not indicated on the extenders (HP 3853A). Line power indication can be obtained by listening to or testing for fan operation. The fan is strong enough to pull a piece of paper to the front panel. Since the fan receives its operating voltage from the power supply, fan operation is an indication of power supply operation. It is not, however, conclusive proof of correct power supply operation.

- The HP 3852A supports a DISP command that allows the display to be turned off. Even if the DISP OFF command has been sent, some display annunciators will still function. No display and no annunciators indicates a failure.

- Each of the plug-in modules share a common command line called DTACK (data acknowledged). The local controller in the HP 3852A must receive confirmation of bus activities through this line. If any plug-in module is holding the DTACK line in an incorrect state (low), the local controller will lock-up. This is true whether the plug-in module is located in the HP 3852A or in an HP 3853A Extender. If the DTACK line is stuck when power is first applied to the HP 3852A, there will be no

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display (including annunciators). If DTACK is stuck after the HP 3852A has completed its wake-up sequence, the displays will appear to be normal but the unit will not respond to key closures or HP-IB commands.

- The local controller compiles a reference table of all plug-in accessories installed in the system. It does this at power-on or after a system reset. For this reason, the local controller will not recognize any plug-in accessories installed after the power is applied (it is not recommended to install or remove plug-in accessories with the power applied). To make the reference table the local controller polls each slot in the system. One of three responses can be generated from each slot: 1) no response -- indicating no card is present, 2) a partial response -- indicating that the accessory module is installed without a terminal module, and 3) a full response -- indicating the model of the accessory installed at that slot.

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CHAPTER 6
HP 44701A INTEGRATING VOLTMETER

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CHAPTER 6
HP 44701A
INTEGRATING VOLTMETER

6-1 INTRODUCTION

This chapter provides a technical description, performance test procedures, calibration procedures, and replaceable parts lists for the HP 44701A Integrating Voltmeter.

6-2 Technical Description

The HP 44701A Integrating Voltmeter is a complete four function analog to digital converter. The functions available are DC volts, AC volts, four-wire ohms, and offset compensated ohms.

The voltmeter has an auto-range function that can select the appropriate range for the measurement in progress. This function can be disabled and a fixed range programmed. The ranges available in each function are listed in Table 6-2 (HP 44701A Specifications).

The HP 44701A's integration time can be programmed. It is specified as a number of power line cycles. Integration times from 0.0005 to 16 power line cycles are available. The choice of integration times produces measurement resolutions from 3 1/2 to 6 1/2 digits.

Calibration of the voltmeter is accomplished programatically. There are no mechanical adjustments in the voltmeter. Calibration constants for gain and offset are contained in non-volatile memory within the HP 44701A.

The HP 44701A can be divided into two main parts: the control logic and the analog to digital converter. The control logic is also referred to as the outguard section and the analog to digital converter as the inguard section.

A basic block diagram of the HP 44701A is shown in Figure 6-1. The control logic section interfaces the voltmeter with the HP 3852A. The control logic provides isolation between the HP 3852A mainframe and the analog to digital converter. The HP 3852A communicates with the HP 44701A through the use of read and write registers. These registers are located within the control logic section.

All circuitry needed to perform a full precision measurement and convert the measured value into digital representation is contained in the analog to digital converter. The functions and conversions are performed under microprocessor control. This processor is located in the analog to digital converter. Additionally, calibration constants are stored in the analog to digital converter in an EEPROM.

The control logic and the analog to digital converter are isolated by the crossguard data link. This link transmits data in a serial fashion. The data, clock, and reset information, having been converted to a serial format by the control logic, is optically transmitted to the analog to digital converter. The analog to digital converter returns an optically isolated latch pulse to the control logic to control the receipt of data. The analog to digital converter also transmits both the data and the clock information through a single transformer link to the control logic.

The HP 44701A takes its measurements from either the rear panel terminals or the HP 3852A backplane analog bus. These two sources of measurements are in parallel. The isolation relays provide a means to separate the voltmeter from the backplane analog bus.

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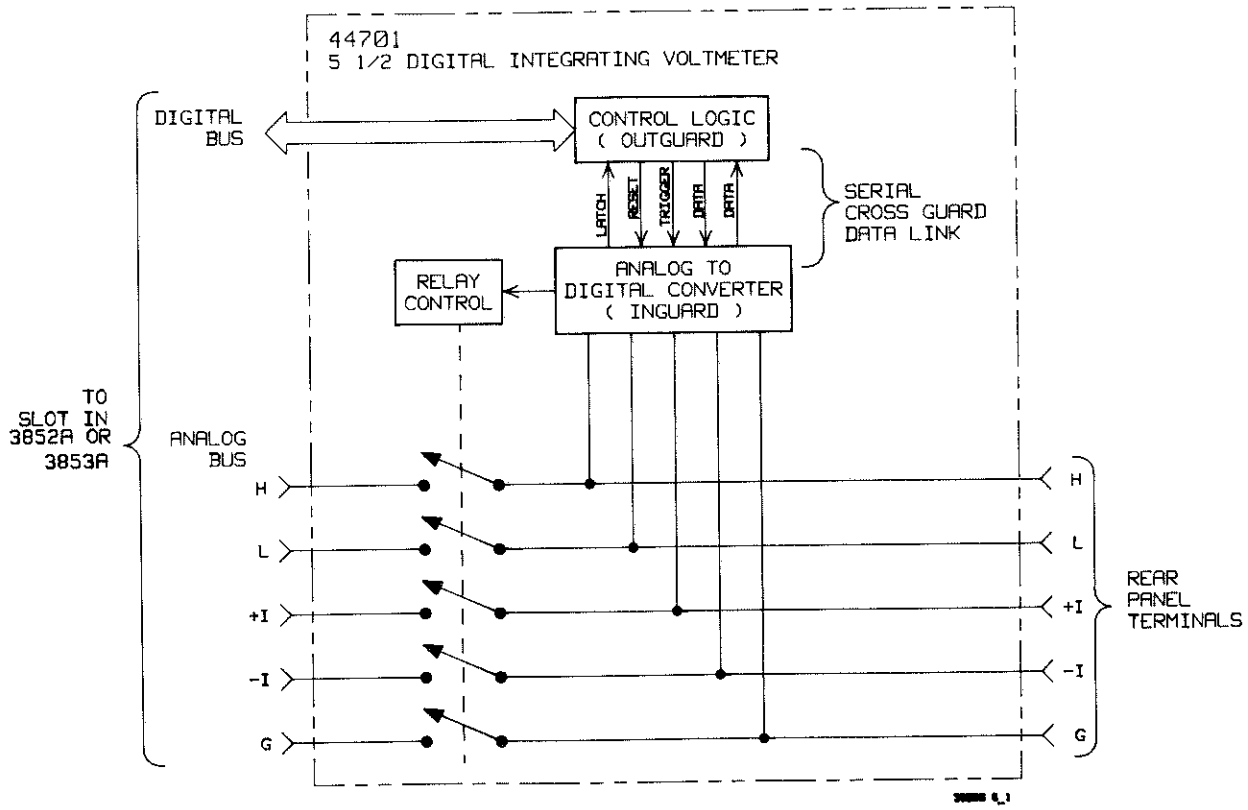


Figure 6-1 HP 44701A Basic Block Diagram

The measurement bus also provides a current path for resistance measurements. The analog to digital converter has a current source for this purpose. All resistance measurements made by the HP 44701A are four-wire ohms measurements. In some cases, the current source and measurement paths are combined on an accessory to allow a two-wire ohms measurement at a particular set of terminals.

6-3 Read And Write Registers

The HP 3852A mainframe communicates with the HP 44701A through the use of read and write registers. High level commands are translated into appropriate register commands. The SREAD and SWRITE commands can be used to directly control each register.

SREAD and SWRITE are described in Chapter 3 of this manual. Table 6-1 shows the read and write registers used by the HP 44701A.

CAUTION

Using the low level commands (SREAD and SWRITE) may cause unexpected and undesirable effects on the plug-in accessories. It is possible to program some plug-in accessories into unknown or unpredictable states with these commands. The commands are documented here for service purposes only.

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Table 6-1 Integrating Voltmeter Read and Write Registers

Register #	READ Registers	WRITE Registers
0	Accessory Identification	Accessory Control
1	Accessory Status	Trigger Control
2	Data (most significant word)	Command Register
3	Data (least significant word)	Data Ready Acknowledge
4	Not Used	Not Used
5	Not Used	Not Used
6	Not Used	Parameter Register
7	Not Used	VM Complete Acknowledge

6-4 Read Registers

6-5 Register 0. Read Register 0 is the accessory identification register. This register uses eight bits. The eight bits are output to the HP 3852A local controller on the eight least significant backplane data lines (BD0 through BD7). The results returned from an SREAD of register 0 will be a two's compliment decimal number and for the HP 44701A should be -200.

6-6 Register 1. Read Register 1 is the accessory status register. This is an eight bit register output to the HP 3852A mainframe on the eight least significant backplane data lines (BD0 through BD7). Read Register 1 is read to obtain the current status of the voltmeter before a new command is sent. The meaning of each bit in the status word is defined in the following paragraphs. Note that an SREAD of the register returns a decimal value equivalent to the two's compliment of the register value.

The least significant bit, Bit 0, is the data ready bit. This bit is set by the HP 44701A to indicate that data is ready in one or both of the data registers. The bit is cleared by the HP 3852A local controller when the data is removed from the register. Having bit 0 set does not prevent the HP 44701A from placing new data in the registers.

Bit 1 is the command register status bit, or busy bit. This bit is set when the HP 3852A local controller writes to either the command or parameter register. The bit is cleared by the HP 44701A when the last command has been completely executed. This bit should be checked to prevent sending a new command before the last command has been executed.

Bit 2 indicates voltmeter complete. This bit is set by the HP 44701A when integrator run-up is complete. The bit is cleared when the HP 3852A local controller acknowledges the end of run-up.

Bit 3 is the error status bit. If bit 3 is set an error occurred. When the bit is set the data registers will contain a code indicating the error type.

Bit 4 is the done bit. This bit is cleared when the HP 3852A local controller writes to either the command or parameter registers. The HP 44701A will set bit 4 when the last command received has been completed. Bit 4 is used together with bit 1 to control the communication process between the HP 44701A and the HP 3852A local controller.

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Bit 6 is a timing bit. It indicates the status of the sample rate of the measurements. Because the HP 3852A local controller can request N readings per trigger the sample rate of the measurements can become aperiodic. When this error occurs, bit 6 is set. If the voltmeter is operating in the autorange mode and N readings per trigger is requested, bit 6 is always set.

Bit 7 is not used.

6-7 Registers 2 and 3. Read Registers 2 and 3 are the data registers. Register 2 contains the most significant data word (bits 16 through 31). Register 3 contains the least significant data word (bits 0 through 15).

6-8 Write Registers

6-9 Register 0. Write register 0 is the control register. This eight bit register sets the reset and interrupt capability for the HP 44701A. Only the four least significant bits are used. Bits 4 through 7 are ignored.

Bit 0 is the master interrupt enable bit. When this bit is set the interrupts are enabled. Clearing this bit prevents any backplane interrupts.

Setting bit 1 true resets the HP 44701A. The HP 44701A requires a time of at least 500 μsec after bit 1 is cleared to perform the reset. Bit 1 in read register 1 can be used to determine when the HP 44701A has completed the reset.

Bit 2 is used to determine the type of interrupt that the HP 44701A will generate. When the bit is cleared the HP 44701A will interrupt on the HP 3852A general purpose interrupt line (GP). When bit 2 is set, the HP 44701A will interrupt on the HP 3852A normal scan interrupt line (NS).

Bit 3 sets the interrupt source. When bit 3 is cleared the HP 44701A will interrupt only when bit 0 in read register 1 is set (data is ready). When bit 3 is set the HP 44701A will interrupt either when bit 0 in read register 1 is set (data ready) or when bit 2 in read register 1 is set (voltmeter complete).

6-10 Register 1. Write register 1 is the trigger control register. The two least significant bits are used to control the trigger capability. When bit 0 is set the HP 44701A will allow triggers, when cleared the HP 44701A will ignore triggers. Bit 1 sets the type of trigger that will be allowed when bit 0 is set. Setting bit 1 sets the HP 44701A to trigger on the falling edge of the backplane trigger line. Clearing bit 1 sets the HP 44701A to trigger on the rising edge of the backplane CLOSING line.

6-11 Register 2. Write register 2 is the command register. The HP 3852A local controller uses this register to set the mode and function of the HP 44701A.

6-12 Register 3. Write register 3 controls the "data ready" interrupt. Any data written to this register will clear the "data ready" interrupt.

6-13 Register 6. Write register 6 is the parameter register. The HP 3852A local controller uses this register to send parameters in combination with the command register.

6-14 Register 7. Write register 7 controls the "voltmeter complete" interrupt. Any data written to this register will clear the "voltmeter complete" interrupt.

6-15 SPECIFICATIONS

Specifications for the HP 44701A are given in Table 6-2. Specifications are the performance standards or limits against which the integrating voltmeter may be tested.

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Table 6-2 HP 44701A Specifications

DC VOLTAGE

Accuracy: ±(% of reading + volts) rear terminal, one hour warmup, specified over time since last calibration, and operating temperature.

90 Days, 18°C to 28°C, Autozero On

Range	Integration Time in Number of Power Line Cycles (NPLC)			
	1	0.1	0.005	0.0005
30 mV	0.02%+6µV	0.02%+8µV	0.02%+20µV	0.02%+60µV
300 mV	0.008%+6µV	0.008%+10µV	0.008%+40µV	0.008%+400µV
3 V	0.008%+8µV	0.008%+40µV	0.008%+400µV	0.008%+4mV
30 V	0.008%+300µV	0.008%+700µV	0.008%+4mV	0.008%+40mV
300 V	0.008%+700µV	0.008%+4mV	0.008%+40mV	0.008%+400mV

1 Year: Add 0.01% of reading to the 90 Days Specifications

Temperature Coefficient:

Add as an additional accuracy error using ±(% of reading + volts) per °C change outside 18° to 28°C, as long as the operating temperature is maintained between 0 to 18° or 28° to 55°C.

For 30 mV Range add 0.001% + 30 nV
For 300 mV and 3 V Ranges add 0.0006% + 300 nV
For 30 V and 300 V Ranges add 0.0006% + 30 µV

Auto-zero Off:

Add as an additional accuracy error if autozero is turned off. Assumes stable environment, ±1°C, for 24 hours.

For 30 mV, 300 mV, and 3 V Ranges add 10 µV
For 30 V Range add 100 µV
For 300 V Range add 1 mV

Resolution:

Range	Integration Time in Number of Power Line Cycles (NPLC)			
	1	0.1	0.005	0.0005
30 mV	10nV	100nV	1µV	10µV
300 mV	100nV	1µV	10µV	100µV
3 V	1µV	10µV	100µV	1mV
30 V	10µV	100µV	1mV	10mV
300 V	100µV	1mV	10mV	100mV

Over-ranging: 1% of full scale

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Table 6-2 HP 44701A Specifications (Cont.)

Reading Rate/Noise Rejection:

	Integration Time in Number of Power Line Cycles (NPLC)			
	1	0.1	0.005	0.0005
Integration Time: 60 Hz 50 Hz	16.7mS 20.0mS	1.67mS 2.0mS	100MS 100MS	10MS 10MS
Number of Converted Digits	6 1/2	5 1/2	4 1/2	3 1/2
Reading Rate (reading/sec) with autozero and auto-range off: 60 Hz 50 Hz	57 48	415 360	1350 1350	1600 1600
Min. Noise Rejection (dB) Normal Mode Rejection at 50 or 60 Hz ±0.09%	60	0	0	0
DC Commom Mode Rejection with 1 kΩ in low lead	120	120	120	120
Effective Common Mode Rejection, DC to 60 Hz with 1 kΩ in low lead	150	90	90	90

RESISTANCE

Accuracy: ±(% of reading + ohms), 4-wire or 2-wire ohms, offset compensation on or off, rear terminal inputs, one hour warmup, specifeid over time since last calibration, and operating temperature. (Current source compliance voltage is at least 6 V).

90 Days, 18°C to 28°C, Autozero On

Range	Integration Time in Number of Power Line Cycles (NPLC)			
	1	0.1	0.005	0.0005
30 Ω	0.02%+6mΩ	0.02%+20mΩ	0.02%+40mΩ	0.02%+75mΩ
300 Ω	0.015%+6mΩ	0.015%+20mΩ	0.015%+60mΩ	0.015%+400mΩ
3 kΩ	0.015%+60mΩ	0.015%+200mΩ	0.015%+650mΩ	0.015%+4Ω
30 kΩ	0.015%+80mΩ	0.015%+400mΩ	0.015%+5Ω	0.015%+80Ω
300 kΩ	0.015%+1Ω	0.015%+4Ω	0.015%+50Ω	0.015%+800Ω
3 MΩ	0.1%+17Ω	0.1%+70Ω	0.1%+500Ω	0.1%+6kΩ

1 Year: Add 0.01% of reading to the 90 Days Specifications

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Table 6-2 HP 44701A Specifications (Cont.)

Ohms Current Source Output:

30 Ω and 300 Ω Ranges: 1 mA
3 kΩ and 30 kΩ Ranges: 100 µA
300 kΩ Range: 10 µA
3 MΩ Range: 1 µA

Temperature Coefficient:

Add as an additional accuracy error using ±(% of reading + ohms) per °C change outside 18° to 28°C, as long as the operating temperature is maintained between 0 to 18°C or 28° to 55°C.

For 30 Ω, 300 Ω, and 3 kΩ Ranges add 0.0006% + 500 µΩ
For 30 kΩ Range add 0.0006% + 5 mΩ
For 300 kΩ Range add 0.001% + 50 mΩ
For 3 MΩ Range add 0.001% + 500 mΩ

Reading Rate:

	Integration Time in Number of Power Line Cycles (NPLC)			
	1	0.1	0.005	0.0005
Reading Rate (reading/sec) with autozero and auto-range off: 60 Hz	25	100	155	160
50 Hz	20	95	155	160

AC VOLTAGE

Accuracy: ±(% of reading + volts), 1 NPLC integration time, one hour warmup, specified over time since last calibration, and operating temperature. AC measurements are made with an average detector calibrated in RMS, and are intended to measure sine waves between 45 Hz to 500 Hz (AC coupled). The voltmeter accuracy is **specified only when the input voltage is greater than 10% of full scale.**

Range	90 Days, 18°C to 28°C	1 Year, 18°C to 28°C
200 mV	0.5% + 600 µV	0.75% + 900 µV
2 V	0.5% + 6 mV	0.75% + 9 mV
20 V	0.5% + 60 mV	0.75% + 90 mV
200 V	0.5% + 600 mV	0.75% + 900 mV

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Table 6-2 HP 44701A Specifications (Cont.)

Temperature Coefficient:

Add as an additional accuracy error using ±(% of reading + volts per °C change outside 18° to 28°C, as long as the operating temperature is maintained between 0 to 18°C or 28° to 55°C.

For 200 mV Range add 0.01% + 7 µV
For 2 V Range add 0.01% + 70 µV
For 20 V Range add 0.01% + 700 µV
For 200 V Range add 0.01% + 7 mV

Reading Rate: 1.5 seconds/reading; changing to the AC Volts function requires approximately 4 seconds.

INPUT CHARACTERISTICS

Maximum Input Voltage: 350 V peak or 250 V DC between any two points (terminals or chassis).
Warning: This voltage is higher than the ratings for multiplexers or high-speed voltmeters that can share the analog backplane.

Input Impedance:

Ranges	Terminals		
	High to Low	Low to Guard	Guard to Chassis
Resistance (Ω):			
30 mV to 3 V Ranges	$>10^9$	$>10^8$	$>10^8$
30 V, 300 V Ranges	10^7 ±5%	$>10^8$	$>10^8$
Max. Capacitance (pF) at 1 MHz, all Ranges	120	2700	2500

Maximum Bias Current: Current sourced by high to low into rear input terminals or backplane.
±1 nA DC

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6-16 HP 44701A PERFORMANCE TESTS

6-17 Introduction

The following Performance Tests check the operation of the HP 44702A Integrating Voltmeter. Successful completion of all Performance Tests in this chapter provides a high confidence level that the voltmeter is meeting its listed specifications.

The Performance Tests should be performed in the order they are presented. The completion of each test increases the confidence level of the Integrating Voltmeter operation. A minimum set of tests is given as Operational Verification Tests. These tests are described in Section 6-22.

The Performance Test procedures described in this chapter are involved and time consuming. Since the Operational Verification Tests yield a 90% confidence that the Integrating Voltmeter is operating normally, it is not recommended that the Performance Tests be performed unless one of the tested specifications is in question. However, if a complete Performance Test is required, do not perform the Operational Verification Test but go to Section 6-34 for the Performance Tests.

6-18 Equipment Required

The following test equipment is required to run the Performance/Operational Verification Tests.

1. Low Thermal Short -- Use a solid copper wire

2. Test Leads

3. DC Voltage Standard -- Datron Model 4000/4000A

If the recommended DC Voltage Standard is not available, use one that is capable of outputting the following voltages at the specified limits. The listed specifications are at least four times better than the specifications of the HP 44701A Integrating Voltmeter.

*30 mV (±0.01%)
300 mV (±0.0025%)
3 V (±0.002%)
*2 V (±0.002%)
*1 V (±0.002%)
30 V (±0.002%)
*300 V (±0.002%)

*For Performance Test only

4. Resistance Standard -- Datron Model 4000/4000A

The Datron Model 4000/4000A normally have resistance values of 1 Ω though 1 MΩ. However, a special version is available with resistance values of 3 Ω through 3 MΩ. Either version will work for the HP 44701A Ohms Performance/Operational Verification Tests. Both the full scale test limits, using 3 Ω through 3 MΩ resistors, and the 1/3 scale test limits, using 1 Ω through 10 MΩ resistors, are given. You must use the appropriate test limits when performing the ohms tests.

If the recommended Resistance Standard is not available, use one that is capable of outputting the following resistance values at the specified limits. The listed specifications are at least four times better than the specifications of the HP 44701A Integrating Voltmeter.

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Instead of using a resistance standard (like the Datron 4000/4000A), you can use standard resistors. Likewise with the resistance standard, you can also use either 30Ω through 30 MΩ resistors (full scale inputs) or 10 Ω through 10 MΩ resistors (1/3 scale inputs).

*30 Ω or 10 Ω (±0.01%)
*300 Ω or 100 Ω (±.004%)
3 kΩ or 1 kΩ (±0.004%)
30 kΩ or 10 kΩ (±0.0038%)
300 kΩ or 100 kΩ (±0.0038%)
*3 MΩ or 1 MΩ (±0.025%)

*For Performance Test only

5. AC Voltage Standard -- Datron Model 4200

If the recommended AC Voltage Standard is not available, use one that is capable of outputting the following voltages at the specified frequencies and limits. The listed specifications are at least four times better than the specifications of the HP 44701A Integrating Voltmeter.

20 mV (±0.1%) at 45 Hz, 150 Hz, and 500 Hz
200 mV (±0.1%) at 45 Hz, 150 Hz, and 500 Hz
2 V (±0.1%) at 45 Hz, 150 Hz, and 500 Hz
20 V (±0.1%) at 45 Hz, 150 Hz, and 500 Hz
*200 V (±0.1%) at 45 Hz, 150 Hz, and 500 Hz

*For Performance Test only

6-19 Test Considerations

Because the HP 44701A Integrating Voltmeter is capable of making very accurate measurements, use standards that are at least four times more accurate than the accessory. However, keep in mind that these standards may introduce potential uncertainties. To keep the uncertainties at a minimum, have these standards certified by the National Bureau of Standards (NBS) before using them. Ideally, standards that are ten times more accurate should be used.

6-20 Test Records

The results of the operational verification tests and performance tests may be recorded on Test Cards at the end of the respective procedures. The test cards include setup data and test limits of all operational verification and performance tests in this chapter.

6-21 Test Cycle

The HP 44701A Integrating Voltmeter requires periodic verification that it is meeting its specifications. The frequency at which the accessory may be tested depends on its usage and environmental operating conditions. To maintain the 90 day specifications, check the accessory at 90 day intervals. To maintain the 1 year specifications, check the accessory at 1 year intervals. For normal operation, check at the 90 day intervals.

6-22 Operational Verification Tests

Perform the Operational Verification Tests only if you do not plan to do the Performance Tests. If you plan to do the Performance Tests, do not perform the following tests but go to Section 6-28 instead.

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The following tests are the minimum set of tests recommended for the Integrating Voltmeter. Successful completion of these tests provides a 90% confidence level that the voltmeter is operating normally and is within specification.

The Operational Verification Tests consist of the following:

Section 6-24 - Set-Up Procedure
Section 6-25 - DC Voltage Operational Verification Test
Section 6-26 - Ohms Operational Verification Test
Section 6-27 - AC Voltage Operational Verification Test

6-23 Operational Verification Test Procedures

WARNING

Even with power removed from the HP 3852A, high voltages, generated in other parts of the system, may be present at the terminal module of each accessory. Service personnel should ensure that all external power is removed from the system before installing, removing, testing or repairing any plug-in accessory.

NOTE

The temperature of the environment where the following tests are to be performed must be within ±5° C of the temperature of the environment where the instrument was last calibrated. The HP 44701A Integrating Voltmeter was calibrated at the factory at an environment temperature of 20° C.

6-24 Set-Up Procedure

1. Apply power to the HP 3852A and allow the HP 44701A Integrating Voltmeter a one hour warm-up period inside the mainframe. This is necessary to stabilize the voltmeter before performing any tests. Most DC, AC, and Ohms Standards also need a one hour warm-up period.

2. Press the RESET button on the HP 3852A front panel. Perform the HP 44701A Integrating Voltmeter self-test by executing:

TEST ES00 (where E = extender number, S = slot number)

3. The HP 3852A right display should show:

SELF TEST OK

If the display shows a different message, or if the ERR annunciator is on, the HP 44701A Integrating Voltmeter may be failing its self test. Test the voltmeter again by executing the command in step 2. If the voltmeter still fails, repair of the unit may be necessary.

4. Designate the HP 44701A to be tested by executing:

USE ES00 (where E = extender number, S = slot number)

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This command establishes the extender/slot number used in all Performance/Operational Verification Tests for command destination. If the HP 3852A is reset or power is removed, it is necessary to perform step 4 again to re-establish the extender/slot number.

6-25 DC Voltage Operational Verification Test

This test determines if the dc offset and full scale accuracy of the HP 44701A Integrating Voltmeter are within the specified limits. The following procedure sets the HP 44701A to certain dc voltage ranges and then transfers the resultant readings to the mainframe.

1. DC VOLTAGE OFFSET TEST. The following test determines if the dc voltage offset readings of the HP 44701A are within the specified limits.

2. Perform the Set-Up Procedure in Section 6-21, if not previously performed.

3. Connect a low thermal short across the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory.

4. Set the HP 44701A to measure dc volts (at the rear terminals), to internal trigger, and to update the display every second by executing the following commands:

```
FUNC DCV
NPLC 16
TERM EXT
TRIG AUTO
DELAY 1
```

5. The 30 V Range is tested first to allow any thermal voltages that may affect the readings on other ranges to dissipate. Set the HP 44701A to the 30 V Range by executing:

```
RANGE 30
```

6. Transfer the HP 44701A readings to the HP 3852A right display by executing:

```
XRDGS ES00,100   (where E = extender number, S = slot number)
```

This causes the display to update continuously for 100 readings.

7. Note the readings on the HP 3852A display. If any offset reading is out of the limits specified in Table 6-3, perform the DC Volts Calibration procedure in Section 6-34.

8. The measurements can be stopped any time by pressing the HP 3852A front panel CLEAR button.

9. Repeat steps 6, 7, 8, and 9 for the 3 V and 300 mV Ranges. Set the range in step 5 by executing RANGE 3 for the 3 V Range and RANGE .3 for the 300 mV Range.

10. When all ranges are tested, stop the measurement by pressing the HP 3852A front panel CLEAR button. Leave the setup in step 4 for the next test. Remove the low thermal short from the HI and LO Input Terminals.

11. DC VOLTAGE GAIN TEST. The following test determines if the dc voltage full scale readings of the HP 44701A are within the specified limits.

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12. Set the DC Voltage Standard output to +300 mV. Then connect the DC Voltage Standard to the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory. The connections are shown in Figure 6-2.

13. Test the 300 mV Range by executing:

```
RANGE .3
```

14. Transfer the HP 44701A reading to the HP 3852A right display by executing:

```
XRDGS ES00,1   (where E = extender number, S = slot number)
```

15. Note the reading on the HP 3852A display. If the full scale reading is out of the limits specified in Table 6-3, perform the DC Volts Calibration procedure in Section 6-34.

16. Repeat steps 13, 14, and 15 for the 3 V and 30 V Ranges. Set the range in step 13 by executing RANGE 3 for the 3 V Range and RANGE 30 for the 30 V Range. Also set the DC Standard output accordingly as listed in Table 6-3.

17. When all ranges are tested, reduce the DC Voltage Standard output to 0 V. Then remove the DC Voltage Standard from the HI and LO Input Terminals.

6-26 Ohms Operational Verification Test

This test determines if the ohms offset and full scale accuracy of the HP 44701A Integrating Voltmeter are within the specified limits. The following procedure sets the HP 44701A to certain ohms ranges and then transfer the resultant readings to the mainframe.

1. OHMS OFFSET TEST. The following test determines if the ohms offset readings of the HP 44701A are within the specified limits.

2. Perform the Set-Up Procedure in Section 6-21, if not previously performed.

3. Connect the HP 44701A rear panel Current Source HI Output Terminal to the rear panel HI Input Terminal. Connect the rear panel Current Source LO Output Terminal to the rear panel LO Input Terminal. Connect a low thermal short across the rear panel HI and LO Input Terminals. The connections are shown in Figure 6-3.

4. Set the HP 44701A to measure ohms (at the rear terminals), to internal trigger, and to update the display every second by executing:

```
FUNC OHMF
NPLC 16
TERM EXT
TRIG AUTO
DELAY 1
```

5. Set the HP 44701A to the 3 Kohm Range by executing:

```
RANGE 3E3
```

6. Transfer the HP 44701A readings to the HP 3852A right display by executing:

```
XRDGS ES00,100   (where E = extender number, S = slot number)
```


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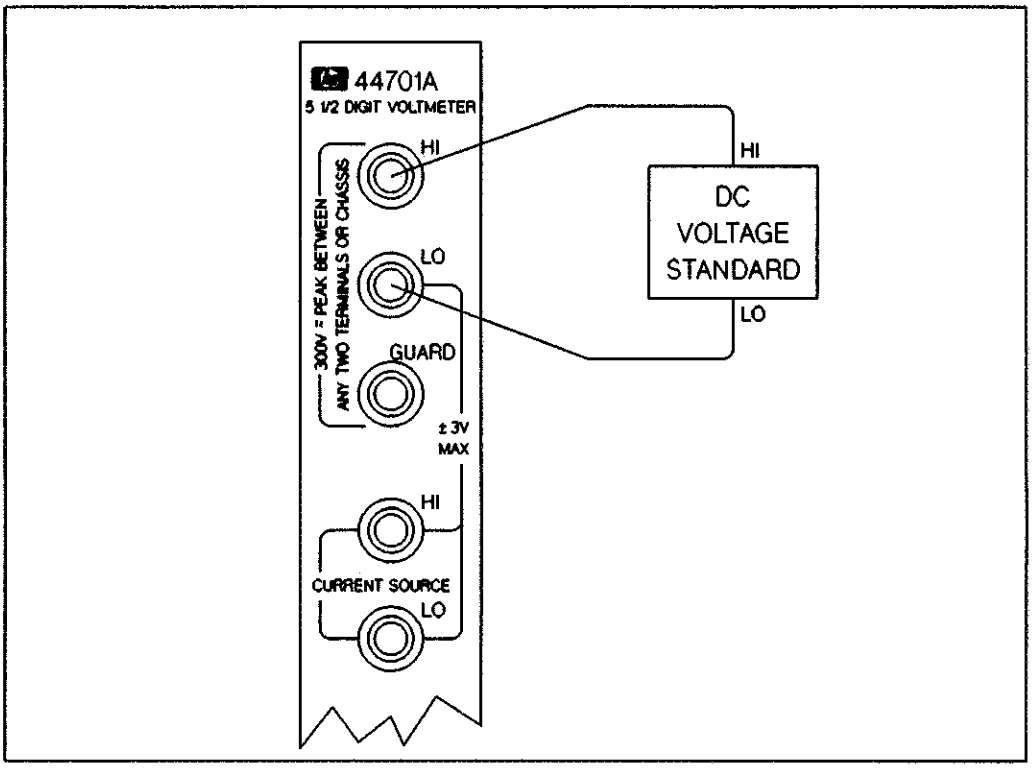


Figure 6-2 DC Voltage Test Connections

Table 6-3 DC Voltage Operational Verification Test Limits

DC Voltage Offset Test Limits						
44701A Input	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
Short	30 V	FUNC DCV	+3.000000E-04	-3.000000E-04	+3.000000E-04	-3.000000E-04
Short	3 V	FUNC DCV	+8.000000E-06	-8.000000E-06	+8.000000E-06	-8.000000E-06
Short	300 mV	FUNC DCV	+6.000000E-06	-6.000000E-06	+6.000000E-06	-6.000000E-06
DC Voltage Gain Test Limits						
44701A Input	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
+300 mV	300 mV	FUNC DCV	+3.000300E-01	+2.999700E-01	+3.000600E-01	+2.999400E-01
+3 V	3 V	FUNC DCV	+3.000248E+00	+2.999752E+00	+3.000548E+00	+2.999452E+00
+30 V	30 V	FUNC DCV	+3.000270E+01	+2.999730E+01	+3.000570E+01	+2.999430E+01

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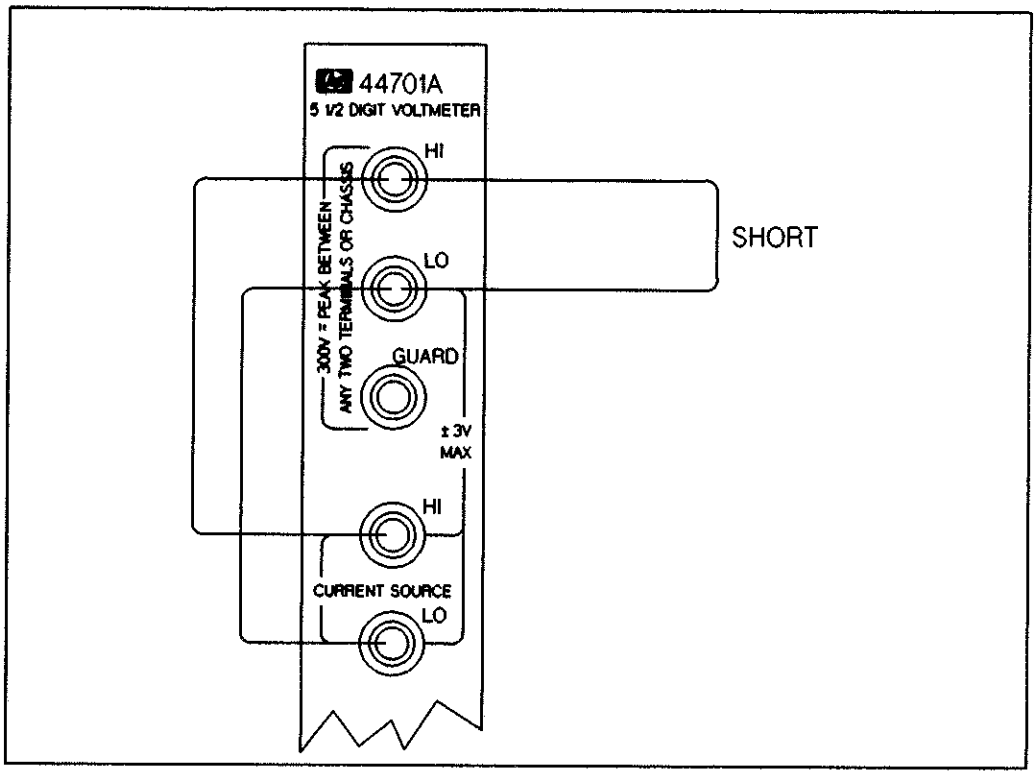


Figure 6-3 Ohms Offset Test Connections

Table 6-4 Ohms Operational Verification Test Limits

Ohms Offset Test Limits						
44701A Input	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
Short	3 Kohm	FUNC OHMF	6.000000E-02	0.000000E+00	6.000000E-02	0.000000E+00
Short	30 Kohm	FUNC OHMF	8.000000E-02	0.000000E+00	8.000000E-02	0.000000E+00
Short	300 Kohm	FUNC OHMF	1.000000E+00	0.000000E+00	1.000000E+00	0.000000E+00
Ohms Gain Test Limits						
44701A Input	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
3 Kohm	3 Kohm	FUNC OHMF	3.000510E+03	2.999490E+03	3.000810E+03	2.999190E+03
1 Kohm*	3 Kohm	FUNC OHMF	1.000210E+03	9.997900E+02	1.000310E+03	9.996900E+02
30 Kohm	30 Kohm	FUNC OHMF	3.000458E+04	2.999542E+04	3.000758E+04	2.999242E+04
10 Kohm*	30 Kohm	FUNC OHMF	1.000158E+04	9.998420E+03	1.000258E+04	9.997420E+03
300 Kohm	300 Kohm	FUNC OHMF	3.000460E+05	2.999540E+05	3.000760E+05	2.999240E+05
100 Kohm*	300 Kohm	FUNC OHMF	1.000160E+05	9.998400E+04	1.000260E+05	9.997400E+04
*For 1/3 scale inputs only						

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This causes the display to update continuously for 100 readings.

7. Note the readings on the HP 3852A display. If any offset reading (i.e., with HP 44701A input shorted) is out of the limits specified in Table 6-4, perform the Ohms Calibration procedure in Section 6-34.

8. The measurements can be stopped any time by pressing the HP 3852A front panel CLEAR button.

9. Repeat steps 5, 6, 7, and 8 for the 30 Kohm and 300 Kohm Ranges. Set the range in step 3 by executing RANGE 30E3 for the 30 Kohm Range and RANGE 300E3 for the 300 Kohm Range.

10. Stop the measurement by pressing the HP 3852A front panel CLEAR button. Leave the setup in step 5 for the next test. Remove the low thermal short from the HI and LO Input Terminals, but do not remove the other connections.

11. OHMS GAIN TEST. The following test determines if the ohms full scale readings of the HP 44701A are within the specified limits. Either 3, 30, and 300 Kohm resistors (full scale inputs) or 1, 10, and 100 Kohm resistors (1/3 scale inputs) can be used for the test.

12. If using the Resistance Standard, set its output to either 3 Kohm or 1 Kohm. If using a Standard Resistor, select either a 3 Kohm or 1 Kohm value. Connect the Resistance Standard/Standard Resistor to the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory. The connections are shown in Figures 6-4a and 6-4b.

13. Test the 3 Kohm Range by executing:

```
RANGE 3E3
```

14. Transfer the HP 44701A reading to the HP 3852A right display by executing:

```
XRDGS ES00,1    (where E = extender number, S = slot number)
```

15. Note the reading on the HP 3852A display. If the full scale reading is out of the limits specified in Table 6-4 (use either the 3 Kohm or 1 Kohm limits), perform the Ohms Calibration procedure in Section 6-34.

16. Repeat steps 13, 14, and 15 for the 30 Kohm and 300 Kohm Ranges. Set the range in step 13 by executing RANGE 30E3 for the 30 Kohm Range and RANGE 300E3 for the 300 Kohm Range. Also set the Resistance Standard output or select a standard resistor accordingly as listed in Table 6-4.

17. When all ranges are tested, remove the Resistance Standard/Standard Resistor from the HI and LO Input Terminals. Remove the other terminal connections from the HP 44701A rear panel.

6-27 AC Voltage Operational Verification Test

This test determines if the ac offset voltage and the full scale accuracy of the HP 44701A Integrating Voltmeter are within the specified limits. Since the specified ac accuracy is for inputs greater than 10% of full scale, the offset is tested with a 10% of full scale input. The following procedure sets the HP 44701A to certain ac volts ranges and then transfers the resultant readings to the mainframe.

The following tests also checks the frequency response of the HP 44701A accessory.

1. AC VOLTAGE OFFSET/GAIN TEST. The following tests check if the ac offset and ac full scale readings of the HP 44701A Integrating Voltmeter are within the specified limits.

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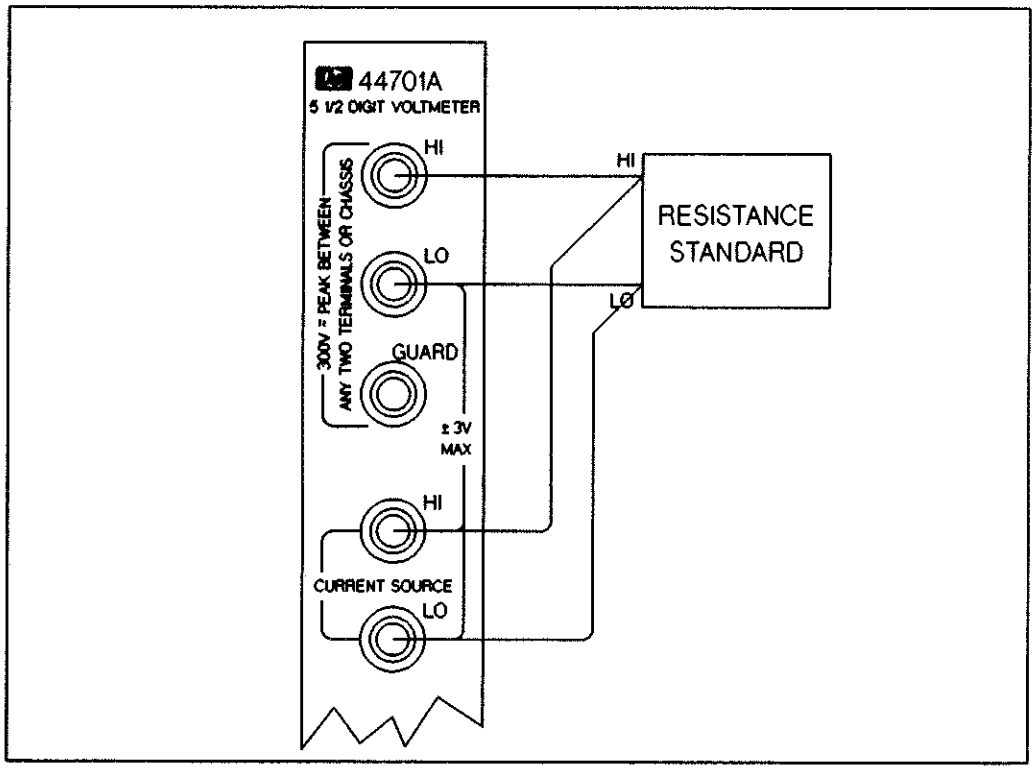


Figure 6-4a Ohms Gain Test Connections Using a Resistance Standard

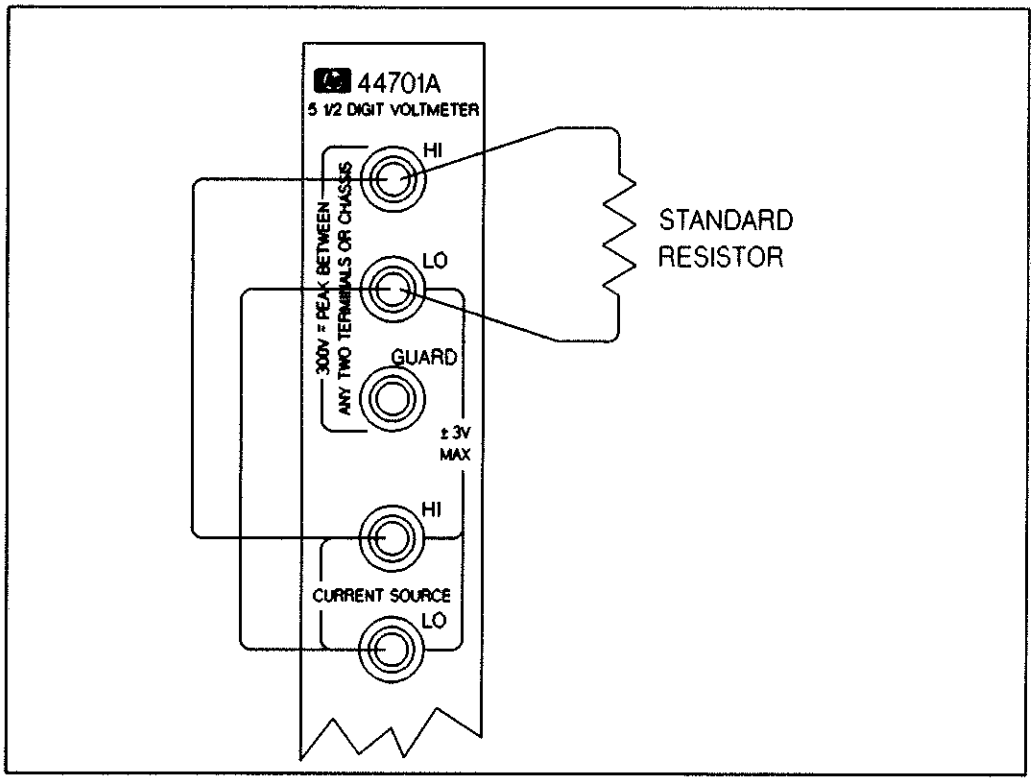


Figure 6-4b Ohms Gain Test Connections Using Standard Resistors

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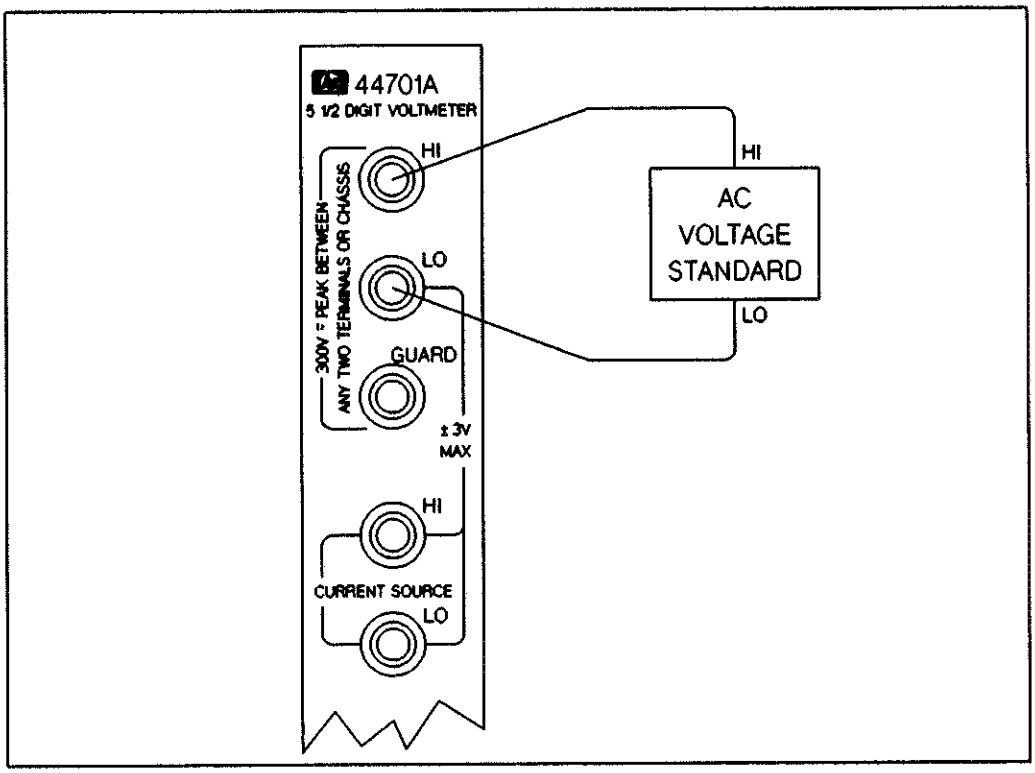


Figure 6-5 AC Voltage Test Connections

2. Perform the Set-Up Procedure in Section 6-21, if not previously performed.

3. Set the AC Voltage Standard output to 20 mV at 150 Hz. Then connect the AC Voltage Standard to the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory. The connections are shown in Figure 6-5.

4. Set the HP 44701A to measure ac volts (at the rear terminals), and to internal trigger by executing the following commands:

```
FUNC ACV
NPLC 16
TERM EXT
TRIG AUTO
```

5. Set the HP 44701A to the 200 mV Range by executing:

```
RANGE .2
```

6. Transfer the HP 44701A reading to the HP 3852A right display by executing:

```
XRDGS ES00,1   (where E = extender number, S = slot number)
```

7. Note the reading on the HP 3852A display. If the offset reading is out of the limits specified in Table 6-5, perform the AC Volts Calibration procedure in Section 6-34.

8. Check the HP 44701A 200 mV Range full scale accuracy by setting the AC Voltage Standard output to 200 mV at 150 Hz.

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Table 6-5 AC Voltage Operational Verification Test Limits

AC Voltage Offset and Gain Test Limits							
44701A Input	Input Freq.	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Limits High	1 Year Limits Low
20 mV	150 Hz	200 mV	FUNC ACV	2.070000E-02	1.930000E-02	2.105000E-02	1.895000E-02
200 mV	150 Hz	200 mV	FUNC ACV	2.016000E-01	1.984000E-01	2.024000E-01	1.976000E-01
200 mV	150 Hz	2 V	FUNC ACV	2.070000E-01	1.930000E-01	2.105000E-01	1.895000E-01
2 V	150 Hz	2 V	FUNC ACV	2.016000E+00	1.984000E+00	2.024000E+00	1.976000E+00
2 V	150 Hz	20 V	FUNC ACV	2.070000E+00	1.930000E+00	2.105000E+01	1.895000E+01
20 V	150 Hz	200 V	FUNC ACV	2.070000E+01	1.930000E+01	2.105000E+01	1.895000E+01
AC Voltage Frequency Response Test Limits							
44701A Input	Input Freq.	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Limits High	1 Year Limits Low
200 mV	45 Hz	200 mV	FUNC ACV	2.016000E-01	1.984000E-01	2.024000E-01	1.976000E-01
200 mV	500 Hz	200 mV	FUNC ACV	2.016000E-01	1.984000E-01	2.024000E-01	1.976000E-01
2 V	45 Hz	2 V	FUNC ACV	2.016000E+00	1.984000E+00	2.024000E+00	1.976000E+00
2 V	500 Hz	2 V	FUNC ACV	2.016000E+00	1.984000E+00	2.024000E+00	1.976000E+00

9. Transfer the HP 44701A reading to the HP 3852A right display by executing:

   XRDGS ES00,1 (where E = extender number, S = slot number)

10. Note the reading on the HP 3852A display. If the full scale reading is out of the limits specified in Table 6-5, perform the AC Volts Calibration procedure in Section 6-34.

11. Set the HP 44701A to the 2 V Range by executing:

   RANGE 2

12. Transfer the HP 44701A reading to the HP 3852A right display by executing:

   XRDGS ES00,1 (where E = extender number, S = slot number)

13. Note the reading on the HP 3852A display. If the offset reading is out of the limits specified in Table 6-5, perform the AC Volts Calibration procedure in Section 6-34.

14. Check the HP 44701A 2 V Range full scale accuracy by setting the AC Voltage Standard output to 2 V at 150 Hz.

15. Transfer the HP 44701A reading to the HP 3852A right display by executing:

   XRDGS ES00,1 (where E = extender number, S = slot number)

16. Note the reading on the HP 3852A display. If the full scale reading is out of the limits specified in Table 6-5, perform the AC Volts Calibration procedure in Section 6-34.

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17. Set the HP 44701A to the 20 V Range by executing:

RANGE 20

18. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

19. Note the reading on the HP 3852A display. If the offset reading is out of the limits specified in Table 6-5, perform the AC Volts Calibration procedure in Section 6-34.

20. Check the HP 44701A 200 V Range offset by setting the AC Voltage Standard output to 20 V at 150 Hz.

21. Set the HP 44701A to the 200 V Range by executing:

RANGE 200

22. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

23. Note the reading on the HP 3852A display. If the offset reading is out of the limits specified in Table 6-5, perform the AC Volts Calibration procedure in Section 6-34.

24. Reduce the AC Voltage Standard output to 0 V. Leave the setup in step 4 for the next test. Also leave the AC Voltage Standard connected to the HI and LO Input Terminals.

25. AC VOLTAGE FREQUENCY RESPONSE TEST. The following test checks the frequency response of the HP 44701A Integrating Voltmeter.

26. With the test setup shown in Figure 6-5, set the AC Voltage Standard to output 200 mV at 45 Hz.

27. Set the HP 44701A to the 200 mV Range by executing:

RANGE .2

28. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

29. Note the reading on the HP 3852A display. If the full scale reading at 45 Hz is out of the limits specified in Table 6-5, perform the AC Volts Calibration procedure in Section 6-34.

30. Change the AC Voltage Standard frequency to 500 Hz.

31. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

32. Note the reading on the HP 3852A display. If the full scale reading at 500 Hz is out of the limits specified in Table 6-5, perform the AC Volts Calibration procedure in Section 6-34.

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33. Set the HP 44701A to the 2 V Range by executing:

RANGE 2

34. Set the AC Voltage Standard to output 2 V at 45 Hz.

35. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

36. Note the reading on the HP 3852A display. If the full scale reading at 45 Hz is out of the limits specified in Table 6-5, perform the AC Volts Calibration procedure in Section 6-34.

37. Change the AC Voltage Standard frequency to 500 Hz.

38. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

39. Note the reading on the HP 3852A display. If the full scale reading at 500 Hz is out of the limits specified in Table 6-5, perform the AC Volts Calibration procedure in Section 6-34.

40. Remove the AC Voltage Standard from the HP 44701A HI and LOW Input Terminals.

THIS CONCLUDES THE OPERATIONAL VERIFICATION PORTION OF THE HP 44701A PERFORMANCE TESTS.

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DC VOLTAGE OPERATIONAL VERIFICATION TEST CARD

90 DAY TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
DC VOLTAGE OFFSET TEST							
Short	30 V	FUNC DCV	+3.000000E-04	_____	-3.000000E-04	____	____
Short	3 V	FUNC DCV	+8.000000E-06	_____	-8.000000E-06	____	____
Short	300 mV	FUNC DCV	+6.000000E-06	_____	-6.000000E-06	____	____
DC VOLTAGE GAIN TEST							
+300 mV	300 mV	FUNC DCV	+3.000300E-01	_____	+2.999700E-01	____	____
+3 V	3 V	FUNC DCV	+3.000248E+00	_____	+2.999752E+00	____	____
+30 V	30 V	FUNC DCV	+3.000270E+01	_____	+2.999730E+01	____	____

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DC VOLTAGE OPERATIONAL VERIFICATION TEST CARD

1 YEAR TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
DC VOLTAGE OFFSET TEST							
Short	30 V	FUNC DCV	+3.000000E-04	_____	-3.000000E-04	____	____
Short	3 V	FUNC DCV	+8.000000E-06	_____	-8.000000E-06	____	____
Short	300 mV	FUNC DCV	+6.000000E-06	_____	-6.000000E-06	____	____
DC VOLTAGE GAIN TEST							
+300 mV	300 mV	FUNC DCV	+3.000600E-01	_____	+2.999400E-01	____	____
+3 V	3 V	FUNC DCV	+3.000548E+00	_____	+2.999452E+00	____	____
+30 V	30 V	FUNC DCV	+3.000570E+01	_____	+2.999430E+01	____	____

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OHMS OPERATIONAL VERIFICATION TEST CARD

90 DAY TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
OHMS OFFSET TEST							
Short	3 Kohm	FUNC OHMF	6.000000E-02	_____	0.000000E+00	____	____
Short	30 Kohm	FUNC OHMF	8.000000E-02	_____	0.000000E+00	____	____
Short	300 Kohm	FUNC OHMF	1.000000E+00	_____	0.000000E+00	____	____
OHMS GAIN TEST							
3 Kohm	3 Kohm	FUNC OHMF	3.000510E+03	_____	2.999490E+03	____	____
1 Kohm*	3 Kohm	FUNC OHMF	1.000210E+02	_____	9.997900E+02	____	____
30 Kohm	30 Kohm	FUNC OHMF	3.000458E+04	_____	2.999542E+04	____	____
10 Kohm*	30 Kohm	FUNC OHMF	1.000158E+04	_____	9.998420E+03	____	____
300 Kohm	300 Kohm	FUNC OHMF	3.000460E+05	_____	2.999540E+05	____	____
100 Kohm*	300 Kohm	FUNC OHMF	1.000160E+05	_____	9.998400E+04	____	____

*For 1/3 scale inputs only

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OHMS OPERATIONAL VERIFICATION TEST CARD

1 YEAR TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
OHMS OFFSET TEST							
Short	3 Kohm	FUNC OHMF	6.000000E-02	_____	0.000000E+00	____	____
Short	30 Kohm	FUNC OHMF	8.000000E-02	_____	0.000000E+00	____	____
Short	300 Kohm	FUNC OHMF	1.000000E+00	_____	0.000000E+00	____	____
OHMS GAIN TEST							
3 Kohm	3 Kohm	FUNC OHMF	3.000810E+03	_____	2.999190E+03	____	____
1 Kohm*	3 Kohm	FUNC OHMF	1.000310E+02	_____	9.996900E+02	____	____
30 Kohm	30 Kohm	FUNC OHMF	3.000758E+04	_____	2.999242E+04	____	____
10 Kohm*	30 Kohm	FUNC OHMF	1.000258E+04	_____	9.997420E+03	____	____
300 Kohm	300 Kohm	FUNC OHMF	3.000760E+05	_____	2.999240E+05	____	____
100 Kohm*	300 Kohm	FUNC OHMF	1.000260E+05	_____	9.997400E+04	____	____

*For 1/3 scale inputs only

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AC VOLTAGE OPERATIONAL VERIFICATION TEST CARD

90 DAY TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
AC VOLTAGE OFFSET AND GAIN TESTS							
20 mV, 150 Hz	200 mV	FUNC ACV	2.070000E-02	_____	1.930000E-02	____	____
200 mV, 150 Hz	200 mV	FUNC ACV	2.016000E-01	_____	1.984000E-01	____	____
200 mV, 150 Hz	2 V	FUNC ACV	2.070000E-01	_____	1.930000E-01	____	____
2 V, 150 Hz	2 V	FUNC ACV	2.016000E+00	_____	1.984000E+00	____	____
2 V, 150 Hz	20 V	FUNC ACV	2.070000E+00	_____	1.930000E+00	____	____
20 V, 150 Hz	200 V	FUNC ACV	2.070000E+01	_____	1.930000E+01	____	____
AC VOLTAGE FREQUENCY RESPONSE TEST							
200 mV, 45 Hz	200 mV	FUNC ACV	2.016000E-01	_____	1.984000E-01	____	____
200 mV, 500 Hz	200 mV	FUNC ACV	2.016000E-01	_____	1.984000E-01	____	____
2 V, 45 Hz	2 V	FUNC ACV	2.016000E+00	_____	1.984000E+00	____	____
2 V, 500 Hz	2 V	FUNC ACV	2.016000E+00	_____	1.984000E+00	____	____

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AC VOLTAGE OPERATIONAL VERIFICATION TEST CARD

1 YEAR TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
AC VOLTAGE OFFSET AND GAIN TESTS							
20 mV, 150 Hz	200 mV	FUNC ACV	2.105000E-02	_____	1.895000E-02	____	____
200 mV, 150 Hz	200 mV	FUNC ACV	2.024000E-01	_____	1.976000E-01	____	____
200 mV, 150 Hz	2 V	FUNC ACV	2.105000E-01	_____	1.895000E-01	____	____
2 V, 150 Hz	2 V	FUNC ACV	2.024000E+00	_____	1.976000E+00	____	____
2 V, 150 Hz	20 V	FUNC ACV	2.105000E+00	_____	1.895000E+00	____	____
20 V, 150 Hz	200 V	FUNC ACV	2.105000E+01	_____	1.895000E+01	____	____
AC VOLTAGE FREQUENCY RESPONSE TEST							
200 mV, 45 Hz	200 mV	FUNC ACV	2.024000E-01	_____	1.976000E-01	____	____
200 mV, 500 Hz	200 mV	FUNC ACV	2.024000E-01	_____	1.976000E-01	____	____
2 V, 45 Hz	2 V	FUNC ACV	2.024000E+00	_____	1.976000E+00	____	____
2 V, 500 Hz	2 V	FUNC ACV	2.024000E+00	_____	1.976000E+00	____	____

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6-28 Performance Tests

Perform the Performance Tests only if you do not plan to do the Operational Verification Tests. If you plan to do the Operational Verification Tests, do not perform the following tests but go to Section 6-22 instead.

Do the following tests if you desire a high confidence level that the voltmeter is operating normally and is within specifications.

The Performance Tests consist of the following:

Section 6-30 - Set-Up Procedure
Section 6-31 - DC Voltage Performance Test
Section 6-32 - Ohms Performance Test
Section 6-33 - AC Voltage Performance Test

6-29 Performance Test Procedures

WARNING

Even with power removed from the HP 3852A, high voltages, generated in other parts of the system, may be present at the terminal module of each accessory. Service personnel should ensure that all external power is removed from the system before installing, removing, testing or repairing any plug-in accessory.

WARNING

The following procedures are intended for Service Trained Personnel who understand electronic circuitry and are aware of the hazards involved. Do not attempt to perform any of the procedures unless you are qualified to do so.

NOTE

The temperature of the environment where the following tests are to be performed must be within ±5° C of the temperature of the environment where the instrument was last calibrated. The HP 44701A Integrating Voltmeter was calibrated at the factory at an environment temperature of 20° C.

6-30 Set-Up Procedure

1. Apply power to the HP 3852A and allow the HP 44701A Integrating Voltmeter a one hour warm-up period inside the mainframe. This is necessary to stabilize the voltmeter before performing any tests.

2. Press the RESET button on the HP 3852A front panel. Perform the HP 44701A Integrating Voltmeter self-test by executing:

TEST ES00 (where E = extender number, S = slot number)

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3. The HP 3852A right display should show:

SELF TEST OK

If the display shows a different message, or if the ERR annunciator is on, the HP 44701A Integrating Voltmeter may be failing its self test. Test the voltmeter again by executing the command in step 2. If the voltmeter still fails, repair of the unit may be necessary.

4. Designate the HP 44701A to be tested by executing:

USE ES00 (where E = extender number, S = slot number)

This command establishes the extender/slot number used in all Performance/Operational Verification Tests for command destination. If the HP 3852A is reset or power is removed, it is necessary to perform step 4 again to re-establish the extender/slot number.

6-31 DC Voltage Performance Test

This test determines if the dc offset voltage and the full scale accuracy of the HP 44701A Integrating Voltmeter are within the specified limits. The following procedure sets the HP 44701A to certain dc voltage ranges and then transfers the resultant readings to the mainframe.

1. DC VOLTAGE OFFSET TEST. The following test determines if the dc voltage offset readings of the HP 44701A are within the specified limits.

2. Perform the Set-Up Procedure in Section 6-30, if not previously performed.

3. Connect a low thermal short across the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory.

4. Set the HP 44701A to measure dc volts (at the rear terminals), to internal trigger, and to update the display every second by executing the following commands:

```
FUNC DCV
NPLC 16
TERM EXT
TRIG AUTO
DELAY 1
```

5. The 30 V Range is tested first to allow any thermal voltages that may affect the readings on other ranges to dissipate. Set the HP 44701A to the 30 V Range by executing:

RANGE 30

6. Transfer the HP 44701A readings to the HP 3852A right display by executing:

XRDGS ES00,100 (where E = extender number, S = slot number)

This causes the display to update continuously for 100 readings.

7. Note the readings on the HP 3852A display. If any offset reading is out of the limits specified in Table 6-6, perform the DC Volts Calibration procedure in Section 6-34.

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Table 6-6 DC Voltage Performance Test Limits

DC Voltage Offset Test Limits						
44701A Input	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
Short	30 V	FUNC DCV	+3.000000E-04	-3.000000E-04	+3.000000E-04	-3.000000E-04
Short	300 V	FUNC DCV	+7.000000E-04	-7.000000E-04	+7.000000E-04	-7.000000E-04
Short	3 V	FUNC DCV	+8.000000E-06	-8.000000E-06	+8.000000E-06	-3.000000E-06
Short	300 mV	FUNC DCV	+6.000000E-06	-6.000000E-06	+6.000000E-06	-6.000000E-06
Short	30 mV	FUNC DCV	+6.000000E-06	-6.000000E-06	+6.000000E-06	-6.000000E-06
DC Voltage Gain Test Limits						
44701A Input	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
+30 mV	30 mV	FUNC DCV	+3.001200E-02	+2.998800E-02	+3.001500E-02	+2.998500E-02
+300 mV	300 mV	FUNC DCV	+3.000300E-01	+2.999700E-01	+3.000600E-01	+2.999400E-01
+3 V	3 V	FUNC DCV	+3.000248E+00	+2.999752E+00	+3.000548E+00	+2.999452E+00
+30 V	30 V	FUNC DCV	+3.000270E+01	+2.999730E+01	+3.000570E+01	+2.999430E+01
+300 V	300 V	FUNC DCV	+3.000247E+02	+2.999753E+02	+3.000547E+02	+2.999453E+02
DC Voltage Linearity Test Limits						
44701A Input	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
+2 V	3 V	FUNC DCV	+2.000168E+00	+1.999832E+00	+2.000368E+00	+1.999632E+00
+1 V	3 V	FUNC DCV	+1.000088E+00	+9.999120E-01	+1.000188E+00	+9.998120E-01
-1 V	3 V	FUNC DCV	-1.000088E+00	-9.999120E-01	-1.000188E+00	-9.998120E-01
-2 V	3 V	FUNC DCV	-2.000168E+00	-1.999832E+00	-2.000368E+00	-1.999632E+00
-3 V	3 V	FUNC DCV	-3.000248E+00	-2.999752E+00	-3.000548E+00	-2.999452E+00

8. The measurements can be stopped any time by pressing the HP 3852A front panel CLEAR button.

9. Repeat steps 6, 7, 8, and 9 for the 300 V, 3 V, 300 mV, and 30 mV Ranges. To set the different ranges in step 5, execute the following:

300 V Range - RANGE 300
3 V Range - RANGE 3
300 mV Range - RANGE .3
30 mV Range - RANGE .03

10. When all ranges are tested, stop the measurement by pressing the HP 3852A front panel CLEAR button. Leave the setup in step 4 for the next test and leave the HP 44701A in the 30 mV Range. Remove the low thermal short from the HI and LO Input Terminals.

11. DC VOLTAGE GAIN TEST. The following test determines if the dc voltage full scale readings of the HP 44701A are within the specified limits.

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NOTE

Always uprange the HP 44701A Integrating Voltmeter before upranging the DC Voltage Standard and always downrange the DC Voltage Standard before downranging the HP 44701A.

12. Set the DC Voltage Standard output to +30 mV. Then connect the DC Voltage Standard to the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory. The connections are shown in Figure 6-2.

13. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

14. Note the reading on the HP 3852A display. If the full scale reading is out of the limits specified in Table 6-6, perform the DC Volts Calibration procedure in Section 6-34.

15. Repeat steps 12, 13, and 14 for the 300 mV, 3 V, 30 V and 300 V Ranges. To set the different ranges (see step 5), execute the following commands. Also set the DC Standard output accordingly as listed in Table 6-6.

300 mV Range - RANGE .3
3 V Range - RANGE 3
30 V Range - RANGE 30
300 V Ranges - RANGE 300

16. When all ranges are tested, reduce the DC Voltage Standard output to +2 V. Leave the DC Voltage Standard connected to the HI and LO Input Terminals.

17. DC VOLTAGE LINEARITY TEST. The following test determines if the dc voltage linearity of the HP 44701A is within the specified limits.

18. Set the HP 44701A to the 3 V Range by executing:

RANGE 3

19. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

20. Note the reading on the HP 3852A display. If the +2 V reading is out of the limits specified in Table 6-6, perform the DC Volts Calibration procedure in Section 6-34.

21. Set the DC Voltage Standard output to +1 V and repeat steps 19 and 20.

22. Set the DC Voltage Standard output to -1 V and repeat steps 19 and 20. (If the DC Voltage Standard is unable to output -1 V, reverse the connections to the HP 44701A rear terminals.)

23. Set the DC Voltage Standard output to -2 V and repeat steps 19 and 20.

24. Set the DC Voltage Standard output to -3 V and repeat steps 19 and 20.

25. Reduce the DC Voltage Standard output to 0 V. Then remove the DC Standard from the HI and LO Input Terminals.

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6-32 Ohms Performance Test

This test determines if the ohms offset and full scale accuracy of the HP 44701A Integrating Voltmeter are within the specified limits. The following procedure sets the HP 44701A to certain ohms ranges and then transfers the resultant readings to the mainframe.

1. OHMS OFFSET TEST. The following test determines if the ohms offset readings of the HP 44701A are within the specified limits.

2. Perform the Set-Up Procedure in Section 6-30, if not previously performed.

3. Connect the HP 44701A rear panel Current Source HI Output Terminal to the rear panel HI Input Terminal. Connect the rear panel Current Source LO Output Terminal to the rear panel LO Input Terminal. Connect a low thermal short across the rear panel HI and LO Input Terminals. The connections are shown in Figure 6-3.

4. Set the HP 44701A to measure ohms (at the rear terminals), to internal trigger, and to update the display every second by executing:

```
FUNC OHMF
NPLC 16
TERM EXT
TRIG AUTO
DELAY 1
```

5. Set the HP 44701A to the 30 ohm Range by executing:

```
RANGE 30
```

6. Transfer the HP 44701A readings to the HP 3852A right display by executing:

```
XRDGS ES00,100   (where E = extender number, S = slot number)
```

This causes the display to update continuously for 100 readings.

7. Note the readings on the HP 3852A display. If any offset reading (i.e., with HP 44701A input shorted) is out of the limits specified in Table 6-7, perform the Ohms Calibration procedure in Section 6-34.

8. The measurements can be stopped any time by pressing the HP 3852A front panel CLEAR button.

9. Repeat steps 6, 7, 8, and 9 for the 300 ohm through 3 Mohm Ranges. To set the different ranges in step 5, execute the following:

```
300 Ω Range - RANGE 300
3 KΩ Range - RANGE 3E3
30 KΩ Range - RANGE 30E3
300 KΩ Range - RANGE 300E3
3 MΩ Range - RANGE 3E6
```

10. Stop the measurement by pressing the HP 3852A front panel CLEAR button. Leave the setup in step 5 for the next test. Remove the low thermal short from the HI and LO Input Terminals, but do not remove the other connections.

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Table 6-7 Ohms Performance Test Limits

Ohms Offset Test Limits						
44701A Input	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
30 ohm	30 ohm	FUNC OHMF	6.000000E-03	0.000000E+00	6.000000E-03	0.000000E+00
300 ohm	300 ohm	FUNC OHMF	6.000000E-03	0.000000E+00	6.000000E-03	0.000000E+00
3 Kohm	3 Kohm	FUNC OHMF	6.000000E-02	0.000000E+00	6.000000E-02	0.000000E+00
30 Kohm	30 Kohm	FUNC OHMF	8.000000E-02	0.000000E+00	8.000000E-02	0.000000E+00
300 Kohm	300 Kohm	FUNC OHMF	1.000000E+00	0.000000E+00	1.000000E+00	0.000000E+00
3 Mohm	3 Mohm	FUNC OHMF	1.700000E+01	0.000000E+00	1.700000E+01	0.000000E+00
Ohms Gain Test Limits						
44701A Input	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
30 ohm	30 ohm	FUNC OHMF	3.001200E+01	2.998800E+01	3.001500E+01	2.998500E+01
10 ohm*	30 ohm	FUNC OHMF	1.000800E+01	9.992000E+00	1.000900E+01	9.991000E+00
300 ohm	300 ohm	FUNC OHMF	3.000510E+02	2.999490E+02	3.000810E+02	2.999190E+02
100 ohm*	300 ohm	FUNC OHMF	1.000210E+02	9.997900E+01	1.000310E+02	9.996900E+01
3 Kohm	3 Kohm	FUNC OHMF	3.000510E+03	2.999490E+03	3.000810E+03	2.999190E+03
1 Kohm*	3 Kohm	FUNC OHMF	1.000210E+03	9.997900E+02	1.000310E+03	9.996900E+02
30 Kohm	30 Kohm	FUNC OHMF	3.000458E+04	2.999542E+04	3.000758E+04	2.999242E+04
10 Kohm*	30 Kohm	FUNC OHMF	1.000158E+04	9.998420E+03	1.000258E+04	9.997420E+03
300 Kohm	300 Kohm	FUNC OHMF	3.000460E+05	2.999540E+05	3.000760E+05	2.999240E+05
100 Kohm*	300 Kohm	FUNC OHMF	1.000160E+05	9.998400E+04	1.000260E+05	9.997400E+04
3 Mohm	3 Mohm	FUNC OHMF	3.003017E+06	2.996983E+06	3.003317E+06	2.996683E+06
1 Mohm*	3 Mohm	FUNC OHMF	1.001017E+06	9.989830E+05	1.001117E+06	9.988830E+05
*For 1/3 scale inputs only						

11. OHMS GAIN TEST. The following test determines if the ohms full scale readings of the HP 44701A are within the specified limits. Either 30 ohm through 3 Mohm or 10 ohm through 1 Mohm resistors can be used for the test.

12. If using the Resistance Standard, set its output to either 30 ohm or 10 ohm. If using a Standard Resistor, select either a 30 ohm or 10 ohm value. Connect the Resistance Standard/Standard Resistor to the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory. The connections are shown in Figures 6-4a and 6-4b.

13. Test the 30 ohm Range by executing:

```
RANGE 30
```

14. Transfer the HP 44701A reading to the HP 3852A right display by executing:

```
XRDGS ES00,1    (where E = extender number, S = slot number)
```


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15. Note the reading on the HP 3852A display. If the full scale reading is out of the limits specified in Table 6-7 (use either the 3 Kohm or 1 Kohm limits), perform the Ohms Calibration procedure in Section 6-34.

16. Repeat steps 13, 14, and 15 for the 300 ohm through 3 Mohm Ranges. To set the different ranges in step 13, execute the following commands. Also set the Resistance Standard output or select a standard resistor accordingly as listed in Table 6-7.

300Ω Range - RANGE 300
3 KΩ Range - RANGE 3E3
30 KΩ Range - RANGE 30E3
300 KΩ Range - RANGE 300E3
3 MΩ Range - RANGE 3E6

17. When all ranges are tested, remove the Resistance Standard/Standard Resistor from the HI and LO Input Terminals. Remove the other terminal connections from the HP 44701A rear panel.

6-33 AC Voltage Performance Test

This test determines if the ac offset voltage and the full scale accuracy of the HP 44701A Integrating Voltmeter are within the specified limits. Since the specified ac accuracy is for inputs greater than 10% of full scale, the offset is tested with a 10% of full scale input. The following procedure sets the HP 44701A to certain ac volts ranges and then transfers the resultant readings to the mainframe.

The following tests also checks the frequency response of the HP 44701A accessory.

1. AC VOLTAGE OFFSET/GAIN TEST. The following tests check if the ac offset and ac full scale readings of the HP 44701A Integrating Voltmeter are within the specified limits.

NOTE

Always uprange the HP 44701A Integrating Voltmeter before upranging the AC Voltage Standard and always downrange the AC Voltage Standard before downranging the HP 44701A.

2. Perform the Set-Up Procedure in Section 6-30, if not previously performed.

3. Set the AC Voltage Standard output to 20 mV at 150 Hz. Then connect the AC Voltage Standard to the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory. The connections are shown in Figure 6-5.

4. Set the HP 44701A to measure ac volts (at the rear terminals) and to internal trigger by executing the following commands:

FUNC ACV
NPLC 16
TERM EXT
TRIG AUTO

5. Set the HP 44701A to the 200 mV Range by executing:

RANGE .2

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6. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

7. Note the reading on the HP 3852A display. If the offset reading is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

Table 6-8 AC Voltage Performance Test Limits

AC Voltage Offset and Gain Test Limits							
44701A Input	Input Freq.	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Limits High	1 Year Limits Low
20 mV	150 Hz	200 mV	FUNC ACV	2.070000E-02	1.930000E-02	2.105000E-02	1.895000E-02
200 mV	150 Hz	200 mV	FUNC ACV	2.016000E-01	1.984000E-01	2.024000E-01	1.976000E-01
200 mV	150 Hz	2 V	FUNC ACV	2.070000E-01	1.930000E-01	2.105000E-01	1.895000E-01
1 V	150 Hz	2 V	FUNC ACV	1.011000E+00	9.890000E-01	1.016500E+00	9.835000E-01
2 V	150 Hz	2 V	FUNC ACV	2.016000E+00	1.984000E+00	2.024000E+00	1.976000E+00
2 V	150 Hz	20 V	FUNC ACV	2.070000E+00	1.930000E+00	2.105000E+01	1.895000E+01
20 V	150 Hz	20 V	FUNC ACV	2.016000E+01	1.984000E+01	2.024000E+01	1.976000E+01
20 V	150 Hz	200 V	FUNC ACV	2.070000E+01	1.930000E+01	2.105000E+01	1.895000E+01
200 V	150 Hz	200 V	FUNC ACV	2.160000E+02	1.984000E+02	2.024000E+02	1.976000E+02
AC Voltage Frequency Response Test Limits							
44701A Input	Input Freq.	44701A Range	44701A Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Limits High	1 Year Limits Low
200 mV	45 Hz	200 mV	FUNC ACV	2.016000E-01	1.984000E-01	2.024000E-01	1.976000E-01
200 mV	500 Hz	200 mV	FUNC ACV	2.016000E-01	1.984000E-01	2.024000E-01	1.976000E-01
2 V	45 Hz	2 V	FUNC ACV	2.016000E+00	1.984000E+00	2.024000E+00	1.976000E+00
2 V	500 Hz	2 V	FUNC ACV	2.016000E+00	1.984000E+00	2.024000E+00	1.976000E+00
20 V	45 Hz	20 V	FUNC ACV	2.016000E+01	1.984000E+01	2.024000E+01	1.976000E+01
20 V	500 Hz	20 V	FUNC ACV	2.016000E+01	1.984000E+01	2.024000E+01	1.976000E+01
200 V	45 Hz	200 V	FUNC ACV	2.016000E+02	1.984000E+02	2.024000E+02	1.976000E+02
200 V	500 Hz	200 V	FUNC ACV	2.016000E+02	1.984000E+02	2.024000E+02	1.976000E+02

8. Check the HP 44701A 200 mV Range full scale accuracy by setting the AC Voltage Standard output to 200 mV at 150 Hz.

9. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

10. Note the reading on the HP 3852A display. If the full scale reading is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

11. Set the HP 44701A to the 2 V Range by executing:

RANGE 2

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12. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

13. Note the reading on the HP 3852A display. If the offset reading is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

14. Check the HP 44701A 2 V Range 1/2 scale accuracy by setting the AC Voltage Standard output to 1 V at 150 Hz.

15. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

16. Note the reading on the HP 3852A display. If the 1/2 scale reading is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

17. Check the HP 44701A 2 V Range full scale accuracy by setting the AC Voltage Standard output to 2 V at 150 Hz.

18. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

19. Note the reading on the HP 3852A display. If the full scale reading is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

20. Set the HP 44701A to the 20 V Range by executing:

RANGE 20

21. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

22. Note the reading on the HP 3852A display. If the offset reading is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

23. Check the HP 44701A 20 V Range full scale accuracy by setting the AC Voltage Standard output to 20 V at 150 Hz.

24. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

25. Note the reading on the HP 3852A display. If the full scale reading is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

26. Set the HP 44701A to the 200 V Range by executing:

RANGE 200

27. Transfer the HP 44701A reading to the HP 3852A right display by executing:

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XRDGS ES00,1 (where E = extender number, S = slot number)

28. Note the reading on the HP 3852A display. If the offset reading is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

29. Check the HP 44701A 200 V Range full scale accuracy by setting the AC Voltage Standard output to 200 V at 150 Hz.

30. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

31. Note the reading on the HP 3852A display. If the full scale reading is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

32. Reduce the AC Voltage Standard output to 0 V. Leave the setup in step 4 for the next test and leave the AC Voltage Standard connected to the HI and LO Input Terminals.

33. AC VOLTAGE FREQUENCY RESPONSE TEST. The following test checks the frequency response of the HP 44701A Integrating Voltmeter.

34. With the test setup shown in Figure 6-5, set the AC Voltage Standard to output 200 mV at 45 Hz.

35. Set the HP 44701A to the 200 mV Range by executing:

RANGE .2

36. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

37. Note the reading on the HP 3852A display. If the full scale reading at 45 Hz is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

38. Change the AC Voltage Standard frequency to 500 Hz.

39. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

40. Note the reading on the HP 3852A display. If the full scale reading at 500 Hz is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

41. Set the HP 44701A to the 2 V Range by executing:

RANGE 2

42. Set the AC Voltage Standard to output 2 V at 45 Hz.

43. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

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44. Note the reading on the HP 3852A display. If the full scale reading at 45 Hz is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

45. Change the AC Voltage Standard frequency to 500 Hz.

46. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

47. Note the reading on the HP 3852A display. If the full scale reading at 500 Hz is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

48. Set the HP 44701A to the 20 V Range by executing:

RANGE 20

49. Set the AC Voltage Standard to output 20 V at 45 Hz.

50. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

51. Note the reading on the HP 3852A display. If the full scale reading at 45 Hz is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

52. Change the AC Voltage Standard frequency to 500 Hz.

53. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

54. Note the reading on the HP 3852A display. If the full scale reading at 500 Hz is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

55. Set the HP 44701A to the 200 V Range by executing:

RANGE 200

56. Set the AC Voltage Standard to output 200 V at 45 Hz.

57. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

58. Note the reading on the HP 3852A display. If the full scale reading at 45 Hz is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

59. Change the AC Voltage Standard frequency to 500 Hz.

60. Transfer the HP 44701A reading to the HP 3852A right display by executing:

XRDGS ES00,1 (where E = extender number, S = slot number)

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61. Note the reading on the HP 3852A display. If the full scale reading at 500 Hz is out of the limits specified in Table 6-8, perform the AC Volts Calibration procedure in Section 6-34.

62. Set the AC Voltage Standard to its lowest voltage range. Then remove the AC Voltage Standard from the HP 44701A HI and LOW Input Terminals.

THIS CONCLUDES THE HP 44701A PERFORMANCE TESTS.

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DC VOLTAGE PERFORMANCE TEST CARD

90 DAY TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
DC VOLTAGE OFFSET TEST							
Short	30 V	FUNC DCV	+3.000000E-04	_____	-3.000000E-04	____	____
Short	300 V	FUNC DCV	+7.000000E-04	_____	-7.000000E-04	____	____
Short	3 V	FUNC DCV	+8.000000E-06	_____	-8.000000E-06	____	____
Short	300 mV	FUNC DCV	+6.000000E-06	_____	-6.000000E-06	____	____
Short	30 mV	FUNC DCV	+6.000000E-06	_____	-6.000000E-06	____	____
DC VOLTAGE GAIN TEST							
+30 mV	30 mV	FUNC DCV	+3.001200E-02	_____	+2.998800E-02	____	____
+300 mV	300 mV	FUNC DCV	+3.000300E-01	_____	+2.999700E-01	____	____
+3 V	3 V	FUNC DCV	+3.000248E+00	_____	+2.999752E+00	____	____
+30 V	30 V	FUNC DCV	+3.000270E+01	_____	+2.999730E+01	____	____
+300 V	300 V	FUNC DCV	+3.000247E+02	_____	+2.999753E+02	____	____
DC VOLTAGE LINEARITY TEST							
+2 V	3 V	FUNC DCV	+2.000168E+00	_____	+1.999832E+00	____	____
+1 V	3 V	FUNC DCV	+1.000088E+00	_____	+9.999120E-01	____	____
-1 V	3 V	FUNC DCV	-1.000088E+00	_____	-9.999120E-01	____	____
-2 V	3 V	FUNC DCV	-2.000168E+00	_____	+1.999832E+00	____	____
-3 V	3 V	FUNC DCV	-3.000248E+00	_____	-2.999752E+00	____	____

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DC VOLTAGE PERFORMANCE TEST CARD

1 YEAR TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
DC VOLTAGE OFFSET TEST							
Short	30 V	FUNC DCV	+3.000000E-04	_____	-3.000000E-04	____	____
Short	300 V	FUNC DCV	+7.000000E-04	_____	-7.000000E-04	____	____
Short	3 V	FUNC DCV	+8.000000E-06	_____	-8.000000E-06	____	____
Short	300 mV	FUNC DCV	+6.000000E-06	_____	-6.000000E-06	____	____
Short	30 mV	FUNC DCV	+6.000000E-06	_____	-6.000000E-06	____	____
DC VOLTAGE GAIN TEST							
+30 mV	30 mV	FUNC DCV	+3.001500E-02	_____	+2.998500E-02	____	____
+300 mV	300 mV	FUNC DCV	+3.000600E-01	_____	+2.999400E-01	____	____
+3 V	3 V	FUNC DCV	+3.000548E+00	_____	+2.999452E+00	____	____
+30 V	30 V	FUNC DCV	+3.000570E+01	_____	+2.999430E+01	____	____
+300 V	300 V	FUNC DCV	+3.000547E+02	_____	+2.999453E+02	____	____
DC VOLTAGE LINEARITY TEST							
+2 V	3 V	FUNC DCV	+2.000368E+00	_____	+1.999632E+00	____	____
+1 V	3 V	FUNC DCV	+1.000188E+00	_____	+9.998120E-01	____	____
-1 V	3 V	FUNC DCV	-1.000188E+00	_____	-9.998120E-01	____	____
-2 V	3 V	FUNC DCV	-2.000188E+00	_____	+1.999632E+00	____	____
-3 V	3 V	FUNC DCV	-3.000548E+00	_____	-2.999452E+00	____	____

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OHMS PERFORMANCE TEST CARD

90 DAY TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
OHMS OFFSET TEST							
Short	30 ohm	FUNC OHMF	6.000000E-03	_____	0.000000E+00	____	____
Short	300 ohm	FUNC OHMF	6.000000E-03	_____	0.000000E+00	____	____
Short	3 Kohm	FUNC OHMF	6.000000E-02	_____	0.000000E+00	____	____
Short	30 Kohm	FUNC OHMF	8.000000E-02	_____	0.000000E+00	____	____
Short	300 Kohm	FUNC OHMF	1.000000E+00	_____	0.000000E+00	____	____
Short	3 Mohm	FUNC OHMF	1.700000E+01	_____	0.000000E+00	____	____
OHMS GAIN TEST							
30 ohm	30 ohm	FUNC OHMF	3.001200E+01	_____	2.998800E+01	____	____
10 ohm*	30 ohm	FUNC OHMF	1.000800E+01	_____	9.992000E+01	____	____
300 ohm	300 ohm	FUNC OHMF	3.000510E+02	_____	2.999490E+02	____	____
100 ohm*	300 ohm	FUNC OHMF	1.000210E+02	_____	9.997900E+01	____	____
3 Kohm	3 Kohm	FUNC OHMF	3.000510E+03	_____	2.999490E+03	____	____
1 Kohm*	3 Kohm	FUNC OHMF	1.000210E+02	_____	9.997900E+02	____	____
30 Kohm	30 Kohm	FUNC OHMF	3.000458E+04	_____	2.999542E+04	____	____
10 Kohm*	30 Kohm	FUNC OHMF	1.000158E+04	_____	9.998420E+03	____	____
300 Kohm	300 Kohm	FUNC OHMF	3.000460E+05	_____	2.999540E+05	____	____
100 Kohm*	300 Kohm	FUNC OHMF	1.000160E+05	_____	9.998400E+04	____	____
3 Mohm	3 Mohm	FUNC OHMF	3.003017E+06	_____	2.996983E+06	____	____
1 Mohm*	3 Mohm	FUNC OHMF	1.001017E+06	_____	9.989830E+05	____	____

*For 1/3 scale inputs only

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OHMS PERFORMANCE TEST CARD

1 YEAR TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
OHMS OFFSET TEST							
Short	30 ohm	FUNC OHMF	6.000000E-03	_____	0.000000E+00	____	____
Short	300 ohm	FUNC OHMF	6.000000E-03	_____	0.000000E+00	____	____
Short	3 Kohm	FUNC OHMF	6.000000E-02	_____	0.000000E+00	____	____
Short	30 Kohm	FUNC OHMF	8.000000E-02	_____	0.000000E+00	____	____
Short	300 Kohm	FUNC OHMF	1.000000E+00	_____	0.000000E+00	____	____
OHMS GAIN TEST							
30 ohm	30 ohm	FUNC OHMF	3.001500E+01	_____	2.998500E+01	____	____
10 ohm*	30 ohm	FUNC OHMF	1.000900E+01	_____	9.991000E+00	____	____
300 ohm	300 ohm	FUNC OHMF	3.000810E+02	_____	2.999190E+02	____	____
100 ohm*	300 ohm	FUNC OHMF	1.000310E+02	_____	9.996900E+01	____	____
3 Kohm	3 Kohm	FUNC OHMF	3.000810E+03	_____	2.999190E+03	____	____
1 Kohm*	3 Kohm	FUNC OHMF	1.000310E+02	_____	9.996900E+02	____	____
30 Kohm	30 Kohm	FUNC OHMF	3.000758E+04	_____	2.999242E+04	____	____
10 Kohm*	30 Kohm	FUNC OHMF	1.000258E+04	_____	9.997420E+03	____	____
300 Kohm	300 Kohm	FUNC OHMF	3.000760E+05	_____	2.999240E+05	____	____
100 Kohm*	300 Kohm	FUNC OHMF	1.000260E+05	_____	9.997400E+04	____	____
3 Mohm	3 Mohm	FUNC OHMF	3.003317E+06	_____	2.996683E+06	____	____
1 Mohm*	3 Mohm	FUNC OHMF	1.001117E+06	_____	9.988830E+05	____	____

*For 1/3 scale inputs only

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AC VOLTAGE PERFORMANCE TEST CARD

90 DAY TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
AC VOLTAGE OFFSET AND GAIN TESTS							
20 mV, 150 Hz	200 mV	FUNC ACV	2.070000E-02	_____	1.930000E-02	____	____
200 mV, 150 Hz	200 mV	FUNC ACV	2.016000E-01	_____	1.984000E-01	____	____
200 mV, 150 Hz	2 V	FUNC ACV	2.070000E-01	_____	1.930000E-01	____	____
1 V, 150 Hz	2 V	FUNC ACV	1.011000E+00	_____	9.890000E-01	____	____
2 V, 150 Hz	2 V	FUNC ACV	2.016000E+00	_____	1.984000E+00	____	____
2 V, 150 Hz	20 V	FUNC ACV	2.070000E+00	_____	1.930000E+00	____	____
20 V, 150 Hz	20 V	FUNC ACV	2.016000E+01	_____	1.984000E+01	____	____
20 V, 150 Hz	200 V	FUNC ACV	2.070000E+01	_____	1.930000E+01	____	____
200 V, 150 Hz	200 V	FUNC ACV	2.016000E+02	_____	1.984000E+02	____	____
AC VOLTAGE FREQUENCY RESPONSE TEST							
200 mV, 45 Hz	200 mV	FUNC ACV	2.016000E-01	_____	1.984000E-01	____	____
200 mV, 500 Hz	200 mV	FUNC ACV	2.016000E-01	_____	1.984000E-01	____	____
2 V, 45 Hz	2 V	FUNC ACV	2.016000E+00	_____	1.984000E+00	____	____
2 V, 500 Hz	2 V	FUNC ACV	2.016000E+00	_____	1.984000E+00	____	____
20 V, 45 Hz	20 V	FUNC ACV	2.016000E+01	_____	1.984000E+01	____	____
20 V, 500 Hz	20 V	FUNC ACV	2.016000E+01	_____	1.984000E+01	____	____
200 V, 45 Hz	200 V	FUNC ACV	2.016000E+02	_____	1.984000E+02	____	____
200 V, 500 Hz	200 V	FUNC ACV	2.016000E+02	_____	1.984000E+02	____	____

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AC VOLTAGE PERFORMANCE TEST CARD

1 YEAR TEST LIMITS

Hewlett-Packard Model 44701A

Integrating Voltmeter

Test Performed By_____

Date_____ Reference Temperature_____

44701A Input	44701A Range	44701A Set-Up	High Limit	Reading	Low Limit	Test Pass	Test Fail
AC VOLTAGE OFFSET AND GAIN TESTS							
20 mV, 150 Hz	200 mV	FUNC ACV	2.105000E-02	_____	1.895000E-02	____	____
200 mV, 150 Hz	200 mV	FUNC ACV	2.024000E-01	_____	1.976000E-01	____	____
200 mV, 150 Hz	2 V	FUNC ACV	2.105000E-01	_____	1.895000E-01	____	____
1 V, 150 Hz	2 V	FUNC ACV	1.016500E+00	_____	9.835000E-01	____	____
2 V, 150 Hz	2 V	FUNC ACV	2.024000E+00	_____	1.976000E+00	____	____
2 V, 150 Hz	20 V	FUNC ACV	2.105000E+00	_____	1.895000E+00	____	____
20 V, 150 Hz	20 V	FUNC ACV	2.024000E+01	_____	1.976000E+01	____	____
20 V, 150 Hz	200 V	FUNC ACV	2.105000E+01	_____	1.895000E+01	____	____
200 V, 150 Hz	200 V	FUNC ACV	2.024000E+02	_____	1.976000E+02	____	____
AC VOLTAGE FREQUENCY RESPONSE TEST							
200 mV, 45 Hz	200 mV	FUNC ACV	2.024000E-01	_____	1.976000E-01	____	____
200 mV, 500 Hz	200 mV	FUNC ACV	2.024000E-01	_____	1.976000E-01	____	____
2 V, 45 Hz	2 V	FUNC ACV	2.024000E+00	_____	1.976000E+00	____	____
2 V, 500 Hz	2 V	FUNC ACV	2.024000E+00	_____	1.976000E+00	____	____
20 V, 45 Hz	20 V	FUNC ACV	2.024000E+01	_____	1.976000E+01	____	____
20 V, 500 Hz	20 V	FUNC ACV	2.024000E+01	_____	1.976000E+01	____	____
200 V, 45 Hz	200 V	FUNC ACV	2.024000E+02	_____	1.976000E+02	____	____
200 V, 500 Hz	200 V	FUNC ACV	2.024000E+02	_____	1.976000E+02	____	____

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6-34 CALIBRATION

6-35 Introduction

The calibration procedures in this section are used to calibrate the HP 44701A Integrating Voltmeter in all functions (DCV, ACV, and Ohms).

The HP 44701A Integrating Voltmeter is calibrated programatically; no internal adjustments are performed. All calibration is done from the front panel (or by computer control). Calibration is performed by applying a known calibration signal to the voltmeter input terminals. This signal is measured by the voltmeter from which calibration constants are calculated. These constants are then stored in an EEPROM and are used to correctly calculate the measurements normally made by the voltmeter.

WARNING

The following procedures are intended for Service Trained Personnel who understand electronic circuitry and are aware of the hazards involved. Do not attempt to perform any of the procedures unless you are qualified to do so.

6-36 Equipment Required

The following test equipment is required to calibrate the voltmeter accessory.

1. Low Thermal Short -- Use a solid copper wire

2. Test Leads

3. DC Voltage Standard -- Datron Model 4000/4000A

If the recommended DC Voltage Standard is not available, use one that is capable of outputting the following voltages at the specified limits. The listed specifications are at least eight times better than the specifications of the HP 44701A Integrating Voltmeter.

30 mV (±0.005%)
300 mV (±0.0012%)
3 V (±0.001%)
30 V (±0.0011%)
300 V (±0.001%)

4. Resistance Standard -- Datron Model 4000/4000A

The Datron Model 4000/4000A normally have resistance ranges of 1 Ω though 1 MΩ. However, a special version is available with resistance ranges of 3 Ω through 3 MΩ. Either version will work to calibrate the HP 44701A Ohms function.

If the recommended Resistance Standard is not available, use one that is capable of outputting the following resistance values at the specified limits. The listed specifications are at least eight times better than the specifications of the HP 44701A Integrating Voltmeter.

Instead of using a resistance standard (like the Datron 4000/4000A), you can use standard resistors. Likewise with the resistance standard, you can also use either 30 Ω through 30 MΩ resistors (full scale inputs) or 10 Ω through 10 MΩ resistors (1/3 scale inputs).

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30 Ω or 10 Ω (±0.005%)
300 Ω or 100 Ω (±.0021%)
3 kΩ or 1 kΩ (±0.0021%)
30 kΩ or 10 kΩ (±0.0019%)
300 kΩ or 100 kΩ (±0.0018%)
3 MΩ or 1 MΩ (±0.012%)

5. AC Voltage Standard -- Datron Model 4200

If the recommended AC Voltage Standard is not available, use one that is capable of outputting the following voltages at the specified frequencies and limits. The listed specifications are at least eight times better than the specifications of the HP 44701A Integrating Voltmeter.

20 mV (±0.066%) at 45 Hz, 150 Hz, and 500 Hz
200 mV (±0.066%) at 45 Hz, 150 Hz, and 500 Hz
2 V (±0.066%) at 45 Hz, 150 Hz, and 500 Hz
20 V (±0.066%) at 45 Hz, 150 Hz, and 500 Hz
200 V (±0.066%) at 45 Hz, 150 Hz, and 500 Hz

6-37 Calibration Cycle

Periodic calibration should be performed to ensure that the voltmeter is meeting its accuracy specifications. All functions should be calibrated every 90 days or 1 year, dependent on accuracy requirements. Calibration should also be performed if it is determined by the Performance/Operational Verification Test procedures that it is needed.

6-38 Calibration Environment

The HP 44701A Integrating Voltmeter may be calibrated in a "bench" environment or system cabinet. For best accuracy, the temperature of the calibration environment should be within ±5° C of the actual operating environment. The HP 44701A was calibrated at the factory at an environment temperature of 20° C.

6-39 Calibration Procedures

The calibration procedures should be performed in the order they are given. It is especially important to perform the DC Volts Calibration Procedure before performing the Ohms Calibration Procedure. This is necessary because the ohms calibration constants depend on the dc volts calibration constants. The calibration procedures consist of the following:

Section 6-40 - Set-Up Procedure
Section 6-41 - DC Volts Calibration Procedure
Section 6-42 - Ohms Calibration Procedure
Section 6-43 - AC Volts Calibration Procedure

WARNING

Even with power removed from the HP 3852A, high voltages, generated in other parts of the system, may be present at the terminal module of each accessory. Service personnel should ensure that all external power is removed from the system before installing, removing, testing or repairing any plug-in accessory.

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6-40 Set-Up Procedure

1. Apply power to the HP 3852A and allow the HP 44701A Integrating Voltmeter a one hour warm-up period inside the mainframe. This is necessary to stabilize the voltmeter before calibration.

2. Press the RESET button on the HP 3852A front panel. Perform the HP 44701A Integrating Voltmeter self-test by executing:

```
TEST ES00   (where E = extender number, S = slot number)
```

3. The HP 3852A right display should show:

```
SELF TEST OK
```

If the display shows a different message, or if the ERR annunciator is on, the HP 44701A Integrating Voltmeter may be failing its self test. Test the voltmeter again by executing the command in step 2. If the voltmeter still fails, repair of the unit may be necessary.

4. Designate the HP 44701A to be calibrated by executing:

```
USE ES00   (where E = extender number, S = slot number)
```

This command establishes the extender/slot number used in all calibration procedures for command destination. If the HP 3852A is reset or power is removed, it is necessary to perform step 4 again to re-establish the extender/slot number.

6-41 DC Voltage Calibration

Calibration of the dc volts function consists of calibrating both the function's offset and gain on all ranges. Offset calibration is performed by applying 0 V. Gain calibration is performed by applying full scale voltages (i.e., 300 V, 30 V, 3 V, 300 mV, and 30 mV).

1. DC VOLTAGE OFFSET CALIBRATION. The following calibrates the dc volts function's offset on all ranges.

2. Perform the Set-Up Procedure in Section 6-40, if not previously performed.

3. Connect a low thermal short across the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory.

4. Set the HP 44701A to calibrate dc volts by executing:

```
FUNC DCV
NPLC 16
TERM EXT
TRIG HOLD
```

5. The 300 V Range is calibrated first. Set the HP 44701A to the 300 V Range by executing:

```
RANGE 300
```

6. The value of the calibration signal is now entered in order for the voltmeter to calculate the offset calibration constant. Since a short is applied to the Input Terminals, the calibration signal value is 0. This

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value is entered using the CAL *num* command (where *num* is the value of the calibration signal). Execute the following:

```
CAL 0
```

7. The BUSY annunciator in the HP 3852A display will be on while calibration is taking place. When the annunciator turns off, calibration is completed.

8. Repeat steps 5, 6, and 7 for the 30 V, 3 V, 300 mV, and 30 mV Ranges. To set the different ranges, use the following commands:

```
30 V Range - RANGE 30
3 V Range - RANGE 3
300 mV Range - RANGE .3
30 mV Range - RANGE .03
```

9. When all ranges are calibrated, leave the setup in step 4 for the next calibration procedure. Remove the low thermal short from the HI and LO Input Terminals.

10. DC VOLTAGE GAIN CALIBRATION. The following calibrates the dc volts function's gain on all ranges.

NOTE

Always uprange the HP 44701A Integrating Voltmeter before upranging the DC Voltage Standard and always downrange the DC Voltage Standard before downranging the HP 44701A.

WARNING

Since lethal voltages are used to calibrate the dc volts function, use extreme caution when performing the calibration procedure.

11. Make sure the DC Voltage Standard output is turned off or set the output to 0 volts. Then connect the DC Voltage Standard to the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory. The connections are shown in Figure 6-6.

12. Set the HP 44701A to the 300 V Range by executing:

```
RANGE 300
```

13. Set the DC Voltage Standard to output 300 Vdc.

14. The value of the calibration signal is now entered in order for the voltmeter to calculate the gain calibration constant. The value is entered using the CAL *num* command (where *num* is the value of the calibration signal). Execute the following:

```
CAL 300
```

15. The BUSY annunciator in the HP 3852A display will be on while calibration is taking place. When the annunciator turns off, calibration is completed.

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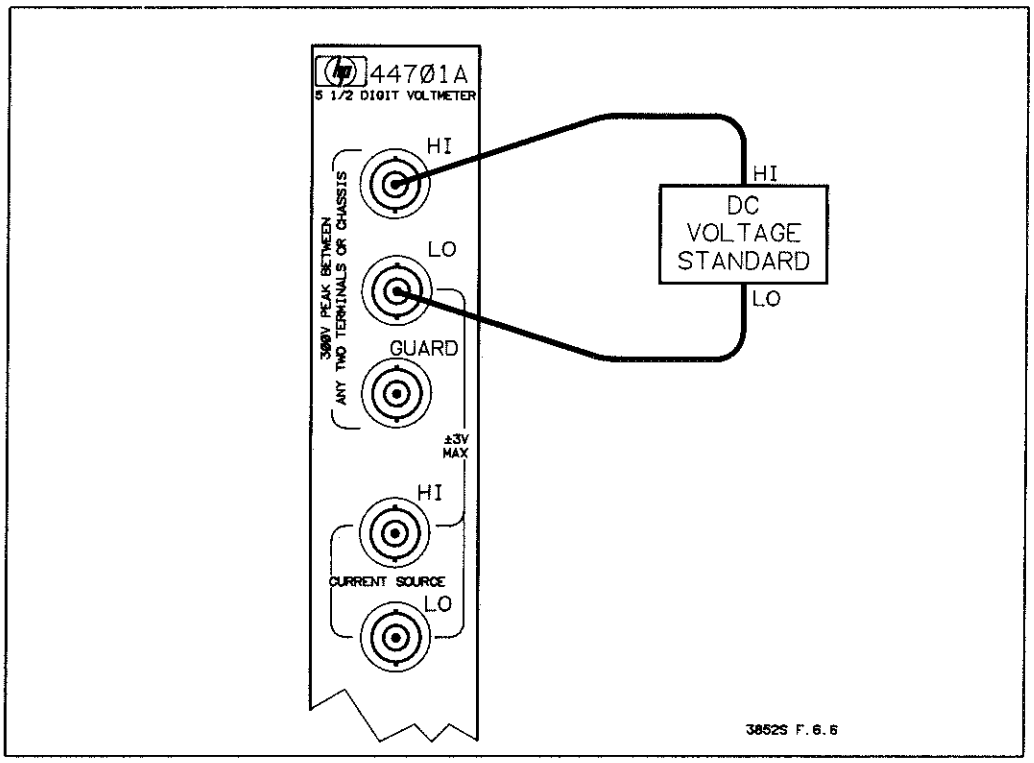


Figure 6-6 DC Voltage Gain Calibration

Table 6-9 DC Voltage Gain Calibration Configurations

44701A Range	Cal Signal	Range Select	Cal Select
300 V	+300 V	RANGE 300	CAL 300
30 V	+30 V	RANGE 30	CAL 30
3 V	+3 V	RANGE 3	CAL 3
300 mV	+0.3 V	RANGE .3	CAL .3
30 mV	+0.03 V	RANGE .03	CAL .03

16. Repeat steps 12, 13, 14, and 15 for the 30 V, 3 V, 300 mV, and 30 mV Ranges. To calibrate the next lower range, **first reduce the DC Voltage Standard to the appropriate calibration voltage. Then set the HP 44701A to the next lower range.** Table 6-9 lists the different dc volts ranges, the appropriate RANGE command to select the ranges, and the appropriate CAL command to calibrate the different ranges.

17. When all ranges are calibrated, turn the DC Voltage Standard output off or set the output to 0 volts. Then remove the DC Voltage Standard from the HI and LO Input Terminals.

6-42 Ohms Calibration

Make sure DC Volts Calibration in Section 6-41 has been performed before doing Ohms Calibration.

Calibration of the ohms function consists of calibrating both the function's offset and gain on all ranges. Offset calibration is performed by applying 0 Ω. Gain calibration is performed by applying full scale resistance values (i.e., 3 Mohm through 30 ohm) or 1/3 scale resistance values (i.e., 1 Mohm through 10 ohm).

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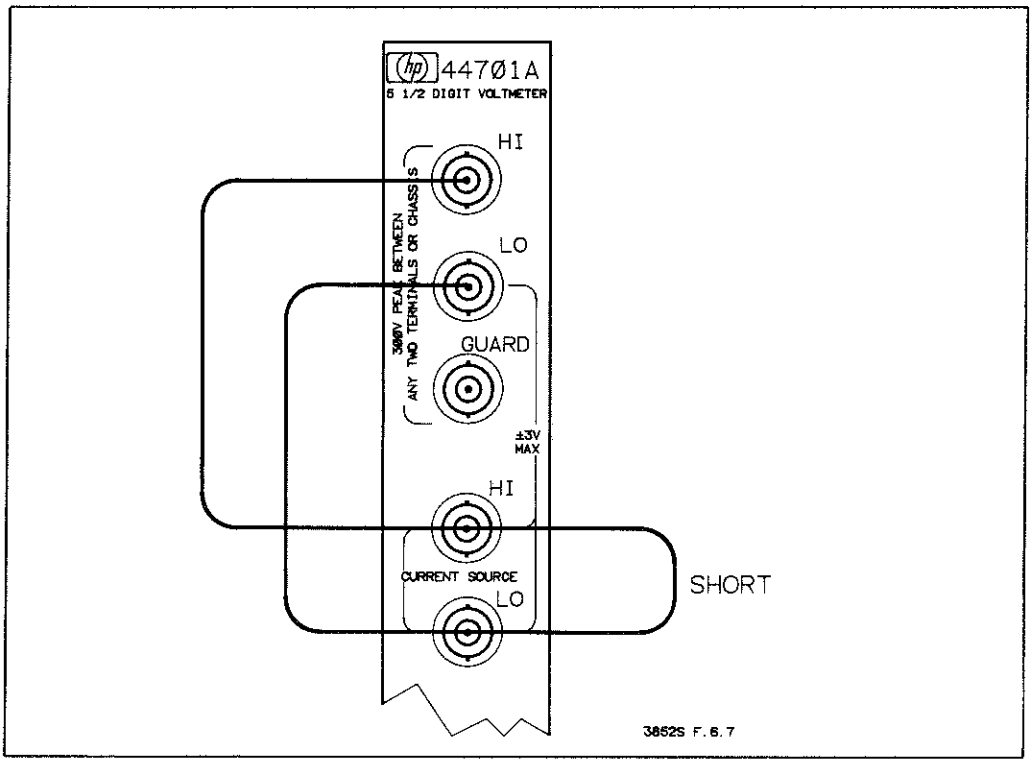


Figure 6-7 Ohms Offset Calibration

1. OHMS OFFSET CALIBRATION. The following calibrates the ohms function's offset on all ranges.

2. Perform the Set-Up Procedure in Section 6-40, if not previously performed.

3. Connect the HP 44701A rear panel Current Source HI Output Terminal to the rear panel HI Input Terminal. Connect the rear panel Current Source LO Output Terminal to the rear panel LO Input Terminal. Connect a low thermal short across the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory. The connections are shown in Figure 6-7.

4. Set the HP 44701A to calibrate ohms by executing:

```
FUNC OHMF
NPLC 16
TERM EXT
TRIG HOLD
```

5. The 3 Mohm Range is calibrated first. Set the HP 44701A to the 3 Mohm Range by executing:

```
RANGE 3E6
```

6. The value of the calibration signal is now entered in order for the voltmeter to calculate the offset calibration constant. Since a short is applied to the Input Terminals, the calibration signal value is 0. This value is entered using the CAL *num* command (where *num* is the value of the calibration signal). Execute the following:

```
CAL 0
```


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7. The BUSY annunciator in the HP 3852A display will be on while calibration is taking place. When the annunciator turns off, calibration is completed.

8. Repeat steps 5, 6, and 7 for the 300 Kohm, 30 Kohm, 3 Kohm, 300 ohm, and 30 ohm Ranges. To set the different ranges, use the following commands:

300 Kohm Range - RANGE 3E5
30 Kohm Ranges - RANGE 3E4
3 Kohm Range - RANGE 3E3
300 ohm Range - RANGE 300
30 ohm Range - RANGE 30

9. When all ranges are calibrated, leave the setup in step 4 for the next calibration procedure. Remove the low thermal short from the HI and LO Input Terminals, but do not remove the other connections.

10. OHMS GAIN CALIBRATION. The following calibrates the ohms function's gain on all ranges. Either 3 Mohm through 30 ohm ohm resistors or 1 Mohm through 10 ohm resistors can be used to calibrate the ohms function.

11. If using the Resistance Standard, set its output to 3 Mohm or 1 Mohm. If using a Standard Resistor, select either a 3 Mohm or 1 Mohm resistor. Connect the Resistance Standard/Standard Resistor to the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter. The connections are shown in Figure 6-8.

12. Set the HP 44701A to the 3 Mohm Range by executing:

RANGE 3E6

13. The value of the calibration signal is now entered in order for the voltmeter to calculate the gain calibration constant. The value is entered using the CAL *num* command (where *num* is the value of the calibration signal). Execute the following:

CAL 3E6

14. The BUSY annunciator in the HP 3852A display will be on while calibration is taking place. When the annunciator turns off, calibration is completed.

15. Repeat steps 11, 12, 13, and 14 for the 300 Kohm through 30 ohm Ranges. Table 6-10 lists the different ohms ranges, the appropriate RANGE command to select the ranges, and the appropriate CAL command to calibrate the different ranges.

16. When all ranges are calibrated, remove the Resistance Standard/Standard Resistor from the HI and LO Input Terminals.

6-43 AC Voltage Calibration

Calibration of the ac volts function consists of calibrating both the function's offset and gain on all ranges. Offset calibration is performed by applying 0 V. Gain calibration is performed by applying full scale voltages (i.e., 200 V, 20 V, 2 V, and 200 mV).

1. AC VOLTAGE OFFSET CALIBRATION. The following calibrates the ac volts function's offset on all ranges.

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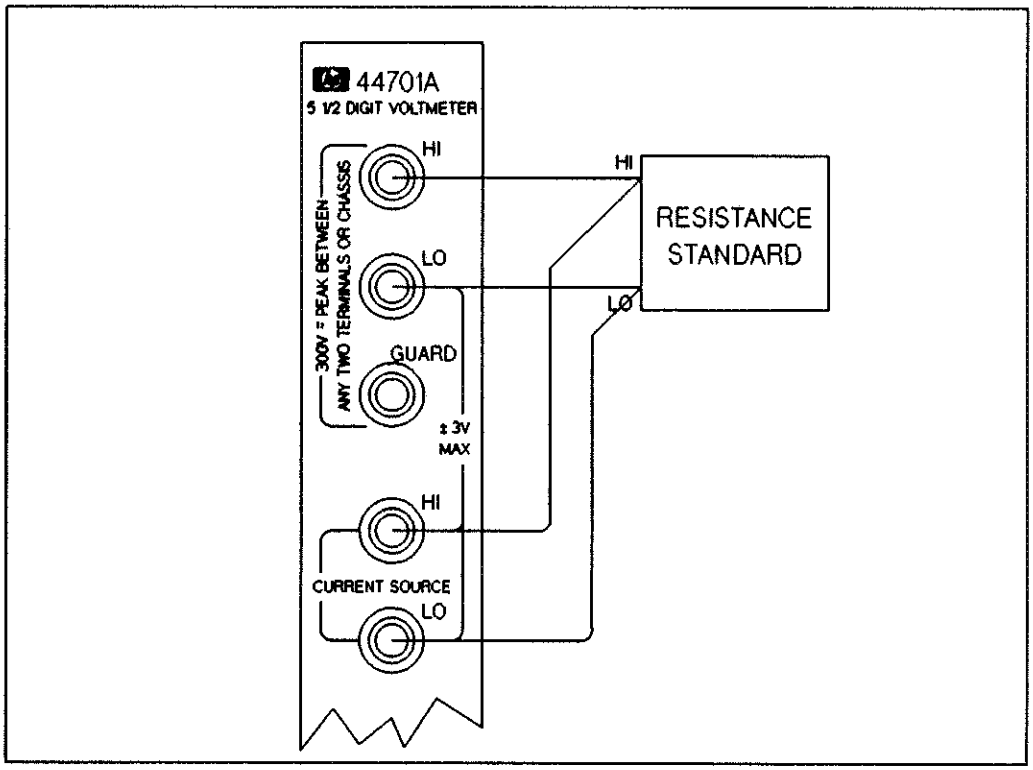


Figure 6-8a Ohms Gain Calibration Using a Resistance Standard

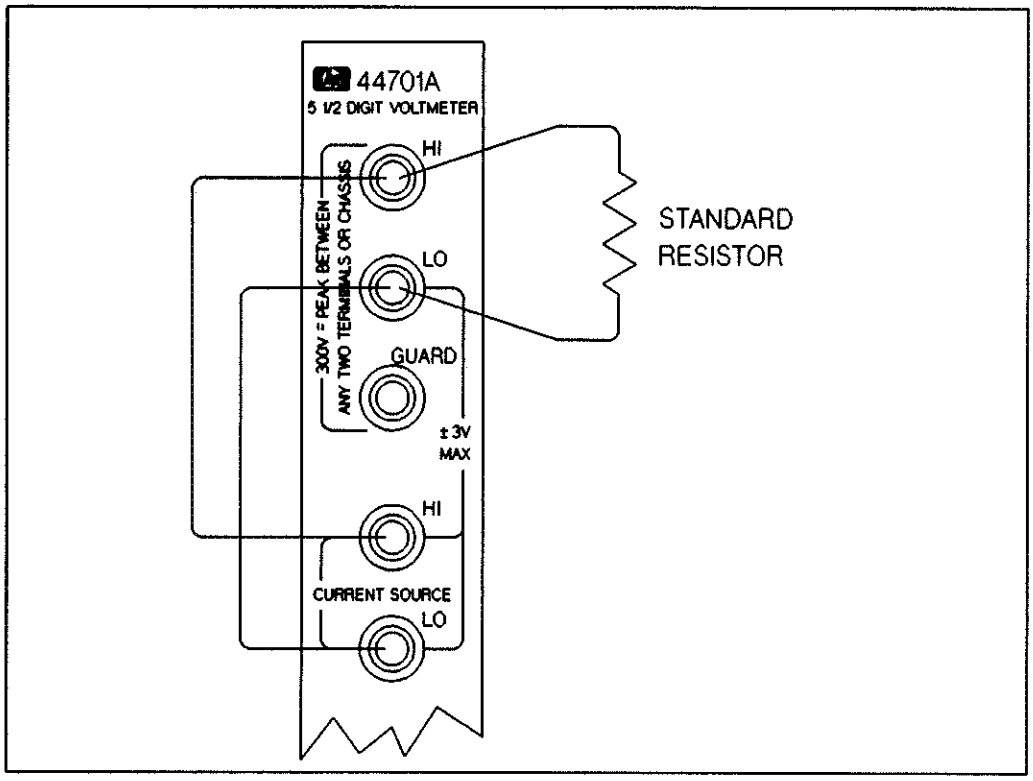


Figure 6-8b Ohms Gain Calibration Using Standard Resistors

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Table 6-10 Ohms Gain Calibration Configurations

44701A Range	Cal Signal	Range Select	Cal Select
3 Mohm	3 Mohm	RANGE 3E6	CAL 3E6
3 Mohm*	1 Mohm	RANGE 3E6	CAL 1E6
300 Kohm	300 Kohm	RANGE 3E5	CAL 300E3
300 Kohm*	100 Kohm	RANGE 3E5	CAL 100E3
30 Kohm	30 Kohm	RANGE 3E4	CAL 30E3
30 Kohm*	10 Kohm	RANGE 3E4	CAL 10E3
3 Kohm	3 Kohm	RANGE 3E3	CAL 3E3
3 Kohm*	1 Kohm	RANGE 3E3	CAL 1E3
300 ohm	300 ohm	RANGE 300	CAL 300
300 ohm*	100 ohm	RANGE 300	CAL 100
30 ohm	30 ohm	RANGE 30	CAL 30
30 ohm*	10 ohm	RANGE 30	CAL 10
*For 1/3 scale inputs only			

2. Perform the Set-Up Procedure in Section 6-40, if not previously performed.

3. Connect a low thermal short across the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory.

4. Set the HP 44701A to calibrate ac volts by executing:

```
FUNC ACV
NPLC 16
TERM EXT
TRIG HOLD
```

5. The 200 V Range is calibrated first. Set the HP 44701A to the 200 V Range by executing:

```
RANGE 200
```

6. The value of the calibration signal is now entered in order for the voltmeter to calculate the offset calibration constant. Since a short is applied to the Input Terminals, the calibration signal value is 0. This value is entered using the CAL *num* command (where *num* is the value of the calibration signal). Execute the following:

```
CAL 0
```

7. The BUSY annunciator in the HP 3852A display will be on while calibration is taking place. When the annunciator turns off, calibration is completed.

8. Repeat steps 5, 6, and 7 for the 20 V, 2 V, and 200 mV Ranges. To set the different ranges, use the following commands:

```
20 V Range - RANGE 20
2 V Range - RANGE 2
200 mV Range - RANGE .2
```


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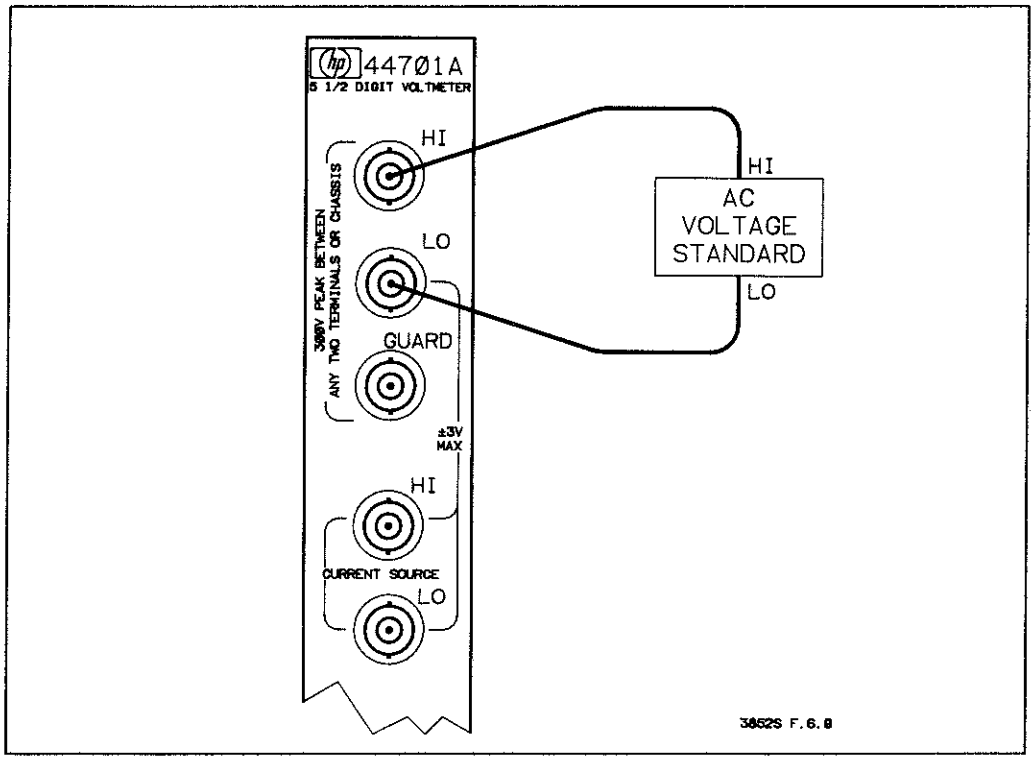


Figure 6-9 AC Voltage Gain Calibration

9. When all ranges are calibrated, leave the setup in step 4 for the next calibration procedure. Remove the low thermal short from the HI and LO Input Terminals.

10. AC VOLTAGE GAIN CALIBRATION. The following calibrates the ac volts function's gain on all ranges.

NOTE

Always uprange the HP 44701A Integrating Voltmeter before upranging the AC Voltage Standard and always downrange the AC Voltage Standard before downranging the HP 44701A.

WARNING

Since lethal voltages are used to calibrate the ac volts function, use extreme caution when performing the calibration procedure.

11. Make sure the AC Voltage Standard output is turned off or set the output to 0 volts. Then connect the AC Voltage Standard to the rear HI and LO Input Terminals of the HP 44701A Integrating Voltmeter accessory. The connections are shown in Figure 6-9.

12. Set the HP 44701A to the 200 V Range by executing:

RANGE 200

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13. Set the AC Voltage Standard to output 200 VRMS at 50 Hz.

14. The value of the calibration signal is now entered in order for the voltmeter to calculate the gain calibration constant. The value is entered using the CAL *num* command (where *num* is the value of the calibration signal). Execute the following:

CAL 200

15. The BUSY annunciator in the HP 3852A display will be on while calibration is taking place. When the annunciator turns off, calibration is completed.

16. Repeat steps 12, 13, 14, and 15 for the 20 V, 2 V, and 200 mV Ranges. To calibrate the next lower range, first reduce the AC Voltage Standard to the appropriate calibration voltage. Then set the HP 44701A to the next lower range. Table 6-11 lists the different ac volts ranges, the appropriate RANGE command to select the ranges, and the appropriate CAL command to calibrate the different ranges.

Table 6-11 AC Voltage Gain Calibration Configurations

44701A Range	Cal Signal	Range Select	Cal Select
200 V	200 V, 50 Hz	RANGE 200	CAL 200
20 V	20 V, 50 Hz	RANGE 20	CAL 20
2 V	2 V, 50 Hz	RANGE 2	CAL 2
200 mV	0.2 V, 50 Hz	RANGE .2	CAL .2

17. When all ranges are calibrated, turn the AC Voltage Standard output off or set the output to 0 volts. Then remove the AC Voltage Standard from the HI and LO Input Terminals.

THIS CONCLUDES THE HP 44701A CALIBRATION PROCEDURES.

6-44 REPLACEABLE PARTS

Figure 6-10 shows the mechanical breakdown of the HP 44701A. This figure also provides assembly and disassembly information. The parts in Figure 6-10 are keyed to the parts list in Table 6-12.

To order a part listed in Table 6-12, quote the Hewlett-Packard part number, the check digit (abbreviated CD in Table 6-12), the HP factory reference, and the quantity desired. Address the order to the nearest Hewlett-Packard Sales Office. Hewlett-Packard Sales Offices are listed at the back of this manual.

CAUTION

The printed circuit boards in the HP 44701A are static sensitive devices. Refer to Chapter 5 for additional information about handling static sensitive devices.

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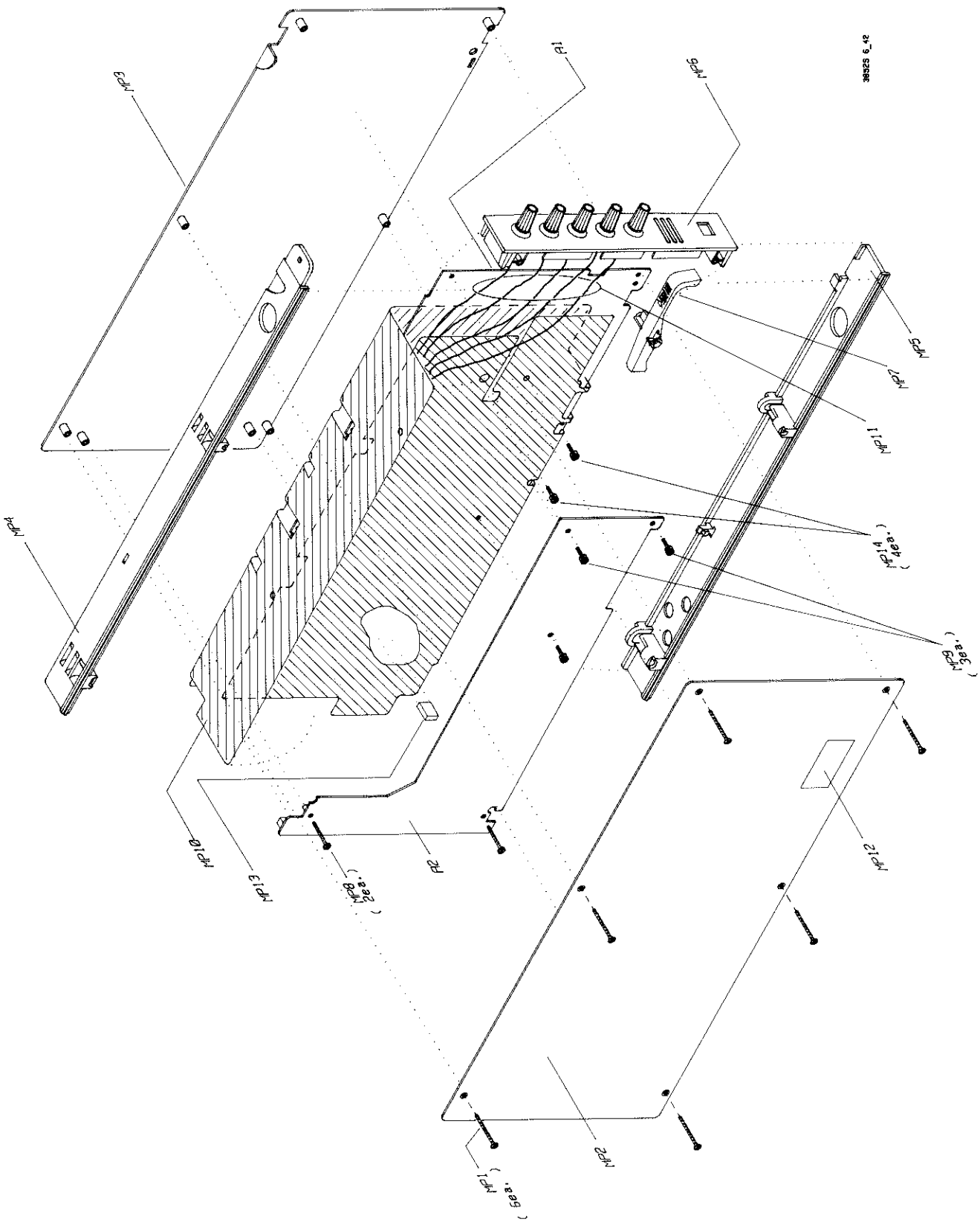


Figure 6-10 Integrating Voltmeter Exploded View

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Table 6-12 HP 44701A 5-1/2 Digit Integrating Voltmeter

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44701A	5-1/2 digit integrating voltmeter	1	44701A	8	INTEGRATING VM
A1	PCA; integrating voltmeter analog	1	44701-66501	0	PCA-INT VM ANALG
A2	PCA; integrating voltmeter digital	1	44701-66502	1	PCA-INT VM DIGTL
MP1	Screw; cover	6	0515-1322	4	SCR-FH M3.0X30LK
MP2	Cover; left (aluminum)	1	44701-04101	6	0601 CVR-A/D LT
MP3	Cover; right (aluminum)	1	44701-04102	7	0601 CVR-A/D RT
MP4	Guide rail; top (molded)	1	03852-41201	1	MLD-RAIL,TOP
MP5	Guide rail; bottom (molded)	1	03852-41202	2	MLD-RAIL,BOTTOM
MP6	Panel; rear (molded) with terminals	1	44701-60201	5	PNL-RR,PREC A/D
MP7	Pull lever; (molded)	1	03852-45002	8	MLD-PULL LEVER
MP8	Screw; A2 PCA (connector end of PCA)	2	0515-0845	4	SCR-PH M3.0X18LK
MP9	Screw; A2 PCA (with captive washer)	3	0515-0866	9	SCR-PH M3.0X8 CW
MP10	Shield; flexible poly covered foil	1	44701-60601	9	SHLD-FLM,POLY AL
MP11	Cable; voltmeter input (5 conductor)	1	44701-61602	2	CBL-VM INPUT
MP12	Label; "maximum number assemblies.."	1	03852-84326	1	LBL-CAUTION,PWR
MP13	Jumper; A1 PCA jumper J200	1	1258-0141	8	JMPR-REM .025P
MP14	Screw; flexible shield	4	0515-0886	3	SCR-PH M3.0X6LK

Restored Assemblies/Modules

The following restored assemblies/modules are available through the HP Exchange Program at a discount. For details see Section 1-19.

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44701A	5-1/2 digit integrating voltmeter		44701-69201	3	RBLT-44701A

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CHAPTER 7
HP 44702A/B 13-BIT HIGH SPEED VOLTMETER

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CHAPTER 7
HP 44702A/B
13-BIT HIGH SPEED VOLTMETER

7-1 INTRODUCTION

This chapter provides a technical description, performance test procedures, calibration procedures and replaceable parts lists for the HP 44702A and HP 44702B 13-Bit High Speed Voltmeter.

7-2 HP 44702A and HP 44702B Differences

The HP 44702A allows up to 8 K readings to be stored in on board memory in the voltmeter. The HP 44702B increases this readings storage capacity to 64 K. The increase in the capacity is accomplished by the addition of an extended memory printed circuit board. With the exception of this extended memory the HP 44702A and HP 44702B are identical.

7-3 Technical Description

The HP 44702A/B is a two function voltmeter. The functions directly supported by the voltmeter are DC volts and four wire ohms measurements. The voltmeter is capable of measuring current when supplied with an external shunt.

The HP 44702A/B makes measurements from any of three input sources: the HP 3852A backplane analog bus, the rear panel terminals, or the ribbon cable analog bus.

The voltmeter measurement resolution is 12 bits plus a sign bit. The voltmeter is capable of auto-ranging and auto-zeroing the input. The maximum reading rate of 100.000 readings per second can only be achieved when the HP 44702A/B is used with a high-speed FET multiplexer accessory and the measurements are transferred over the ribbon cable analog bus.

The voltmeter may be controlled through the HP 3852A backplane digital bus or through a GPIO port. The GPIO port is located on the rear panel of the HP 44702A/B. The use of the GPIO port allows measurements to be transferred directly to computer memory.

Calibration of the HP 44702A/B is accomplished programatically. There are no mechanical adjustments in the voltmeter. Calibration constants for gain and offset are retained in non-volatile memory within the HP 44702A/B.

A block diagram of the HP 44702A/B is shown in Figure 7-1. As described in Section 7-2, the addition of the HP 44703C extended memory changes the HP 44702A into an HP 44702B.

The HP44702A/B has two internal address and data busses. The 16-bit Bus is used for data (reading) transfer from the analog-to-digital (A/D) converter to the Data Buffer/Memory. It is also used to transfer data from the Data Buffer/Memory to either the Backplane or GPIO Interface.

Commands from the mainframe via the backplane or commands from the GPIO Interface are also transferred by the 16-bit Bus to the Control/Data Registers. All external communications to and from the Local Controller go through these registers.

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The HP 44702A/B local controller contains the voltmeter microprocessor. The local controller sets up the requested measurements, performs the voltmeter data conversions, and controls the high-speed ribbon cable bus. The calibration constants for the voltmeter are stored in the local controller in an EEPROM.

The Bus Controller controls the 16-bit Bus using a direct memory access technique (DMA).

The On-Board Input Multiplexer is a FET multiplexer which connects any one of three external analog busses to the A/D converter. These include the backplane input (through the isolation relays), rear panel input terminals on the voltmeter module, and High-Speed Ribbon Cable.

The High-Speed Ribbon Cable is designed to connect the HP 44702A/B to the high-speed FET multiplexers. There are three FET multiplexers available: the HP 44711A 24 Channel High-Speed FET Multiplexer, the HP 44712A 48 Channel Single Ended High-Speed FET Multiplexer, and the HP 44713A 24 Channel High-Speed FET Multiplexer with Thermocouple Compensation. These multiplexers can all be controlled through the ribbon cable digital bus. The ribbon cable bus can be connected in a daisy-chain fashion so that the HP 44702A/B can control several multiplexers at once. The connection of the ribbon cable forms a separate and independent sub-system within the HP 3852A system.

The controlling of the high-speed FET multiplexers is done by passing coded channel list information to the multiplexers over the ribbon cable. This is used to close the proper channel before a measurement is made. The coded channel list information is stored in the Scan RAM. The Scan Control circuitry consists of counters that are used to sequence (address) the Scan RAM causing its data to be sent to the Ribbon Cable Interface. The Ribbon Cable Interface sends this data over the ribbon cable to the high-speed FET multiplexer to close the appropriate channel. Both the Scan RAM and Scan Control circuitry are setup by the Local Controller prior to initiating a scan sequence.

The Scan and Meas Trigger/Pacer block contains the trigger selection circuitry and the trigger pacers. The trigger pacers are only used if selected as the trigger source.

The analog to digital converter performs the actual measurements. The measurements are input to the analog to digital converter from the input multiplexer. The local controller communicates with the analog to digital converter through the Control/Data Registers.

The Current Source contains the source and selection circuitry for the 1 mA, 100 µA, and 10 µA sources. These are used to make four-wire ohms measurements.

The ID, Status, Control, and Trigger Registers are used to allow the external mainframe or GPIO controller to directly control the voltmeter and transfer readings from the voltmeter.

The Data Buffer/Memory is used to store readings taken by the A/D converter. It can only be read through the GPIO and backplane by an external controller.

The Backplane interface and GPIO interface perform the necessary bus control functions such as handshaking and interrupting. The interfaces communicate with the HP 44702A/B through the Control/Data Registers.

The analog bus can be isolated from the HP 3852A backplane by isolation relays. These relays can be opened to reduce the backplane loading effect of the voltmeter.

7-4 SPECIFICATIONS

Specifications for the HP 44702A/B are given in Table 7-1. Specifications are the performance standards or limits against which the HIgh Speed Voltmeter may be tested.

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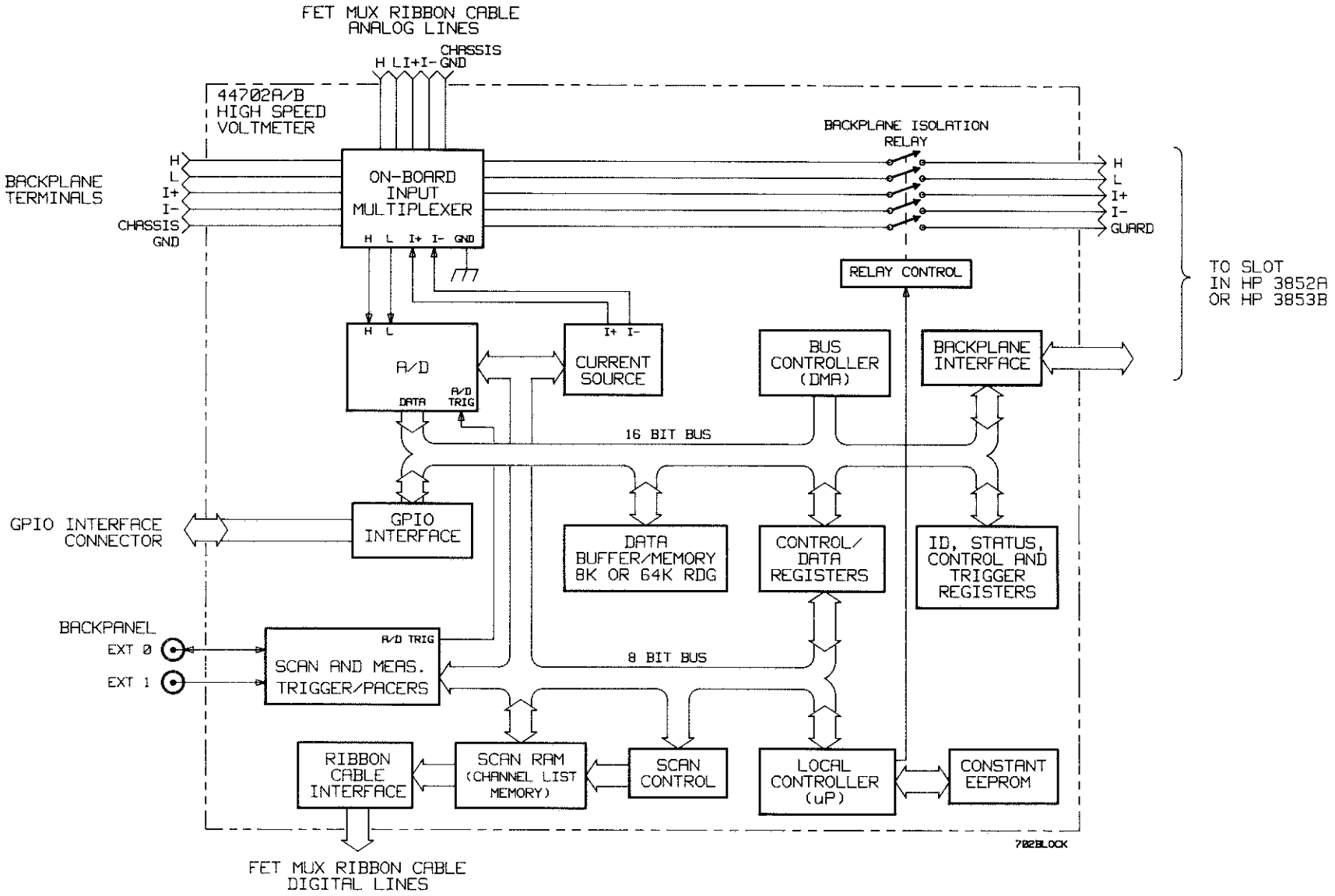


Figure 7-1 HP 44702A/B Block Diagram

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Table 7-1 HP 44702A/B Specifications

DC VOLTAGE

Accuracy: ±(% of reading + volts) rear terminal, one hour warmup, specified over time since last calibration, and operating temperature, with auto-zeroing performed within one minute of measurement.

90 Days, 18°C to 28°C

40 mV Range:	0.05% + 68 µV
320 mV Range:	0.05% + 234 µV
2.56 V Range:	0.05% + 1.88 mV
10.24 V Range:	0.05% + 7.5 mV

Average Readings, 90 Days 18° to 28°C

Accuracy if 100 readings are averaged:

For 40 mV Range: 0.05% + 39 µV

Accuracy if 10 readings are averaged (little advantage to averaging more readings):

For 320 mV Range: 0.05% + 156 µV
For 2.56 V Range: 0.05% + 1.25 mV
For 10.24 V Range: 0.05% + 5 mV

1 Year: Add 0.05% of reading to the 90 Days Specifications

Temperature Coefficient:

Add as an additional accuracy error using ±(% of reading + volts) per °C change outside 18° to 28°C, as long as the operating temperature is maintained between 0 to 18° or 28° to 55°C.

For 40 mV Range add 0.004% + 0.488 µV
For 320 mV Range add 0.002% + 3.91 µV
For 2.56 V Range add 0.002% + 31.3 µV
For 10.24 V Range add 0.002% + 125 µV

Resolution: 12 bits plus a sign bit

Range	Resolution
40 mV	9.77 µV
320 mV	78.1 µV
2.56 V	625 µV
10.24 V	2.5 mV

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Table 7-1 HP 44702A/B Specifications (Cont.)

Over-ranging: None; maximum signal (high to low) + common mode voltage (low to chassis) to prevent out-of-range indication is ±10.24 V.

Reading Rate: 100,000 readings/second with auto-ranging. Proper auto-ranging is ensured as long as a single-channel signal changes no more than 600 volts/second during auto-ranging.

RESISTANCE

Accuracy: ±(% of reading + ohms), 4-wire or 2-wire ohms, maximum expected (resistance function) determines the current source used, rear terminal inputs, one-hour warmup, specified over time since last calibration, and operating temperature, with auto-zeroing performed within one minute of measurement. (Current source compliance voltage is at least 17 V. Only the HP 44711A FET multiplexer is recommended for measuring resistance properly.

90 Days, 18°C to 28°C

Function	Range	Accuracy
10 KΩ (1 mA current source)	40 Ω 320 Ω 2.56 KΩ 10.24 KΩ	0.07% + 107 mΩ 0.07% + 234 mΩ 0.07% + 1.875 Ω 0.07% + 7.5 Ω
100 KΩ (100 µA current source)	400 Ω 3.2 KΩ 25.6 KΩ 102.4 KΩ	0.07% + 1.07 Ω 0.07% + 2.34 Ω 0.07% + 18.75 Ω 0.07% + 75 Ω
1 MΩ (10 µA current source)	4 KΩ 32 KΩ 256 KΩ 10.24 MΩ	0.07% + 12.7 Ω 0.07% + 39.1 Ω 0.07% + 312.5 Ω 0.07% + 1.25 KΩ

Average Readings, 90 Days 18° to 28°C

Accuracy if 100 readings are averaged:

For 40 Ω Range: 0.07% + 78.1 mΩ
For 400 Ω Range: 0.07% + 781 mΩ
For 4 KΩ Range: 0.07% + 9.77 Ω

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Table 7-1 HP 44702A/B Specifications (Cont.)

Accuracy if 10 readings are averaged (little advantage to averaging more readings):

For 320 Ω Range: 0.07% + 156 mΩ
For 3.2 KΩ Range: 0.07% + 1.56 Ω
For 32 KΩ Range: 0.07% + 31.25 Ω
For 2.56 KΩ Range: 0.07% + 1.25 Ω
For 25.6 KΩ Range: 0.07% + 12.5 Ω
For 256 KΩ Range: 0.07% + 250 Ω
For 10.24 KΩ Range: 0.07% + 5 Ω
For 102.4 KΩ Range: 0.07% + 50 Ω
For 1.024 MΩ Range: 0.07% + 1 KΩ

1 Year: Add 0.03% of reading to the 90 Days Specifications

Temperature Coefficient:

Add as an additional accuracy error using ±(% of reading + ohms) per °C change outside 18° to 28°C, as long as the operating temperature is maintained between 0 to 18° or 28° to 55°C.

For 40 Ω Range add 0.005% + 0.488 mΩ
For 400 Ω Range add 0.005% + 4.88 mΩ
For 4 KΩ Range add 0.005% + 48.8 mΩ
For 320 Ω Range add 0.003% + 3.91 mΩ
For 3.2 KΩ Range add 0.003% + 39.1 mΩ
For 32 KΩ Range add 0.003% + 391 mΩ
For 2.56 KΩ Range add 0.003% + 31.3 m Ω
For 25.6 KΩ Range add 0.003% + 313 mΩ
For 256 KΩ Range add 0.003% + 3.13 Ω
For 10.24 KΩ Range add 0.7% + 5 Ω
For 102.4 KΩ Range add 0.07% + 50 Ω
For 1.024 MΩ Range add 0.07% + 1 KΩ

Reading Rate: 100,000 readings/second with auto-ranging. Proper auto-ranging is ensured as long as a single-channel signal changes no more than 600 volts/second during auto-ranging.

PACER

Programmable Intervals: 10 µsec to 17 minutes with .25 µsec resolution.

Accuracy: Programmed pulse interval ±0.01% of pulse interval

Pulse Widths: 0.5 µsec nominally (low true)

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Table 7-1 HP 44702A/B Specifications (Cont.)

INPUT CHRACTERISTICS

Noise Rejection: Min effective common mode rejection specified in dB for DC to 60 Hz with 1 KΩ in low lead; maximum signal (high to low) + coomon mode voltage (low to chassis) for proper operation is ±10.24 volts.

Range	ECMR
40 mV	90
320 mV	80
2.56 V	70
10.24 V	70

Maximum Input Voltage: All inputs (ribbon, rear, and back-plane) are protected to 16 V peak. Input impedance, however, decreases abpve 12 V due to internal protection circuitry. The analog back-plane can be disconnected from the high-speed voltmeter, allowing the maximum back-plane voltage to be 42 V peak.

Bandwidth: 50 Ω source, 1 MΩ termination

Range	0.1% Flatness	1.0% Flatness	-3 dB Bandwidth
40 mV	10 kHz	45 kHz	250 kHz
320 mV to 10.24 V	15 kHz	55 kHz	400 kHz

Input Impedance: All Ranges.

Impedance	Terminals	
	High to Low	High or Low to Chassis
Power On Resistance (Ω)	$>10^8$	$>10^8$
Power Off Resistance (Ω) Vin 10 V	>1000	>1000
Power Off Resistance (Ω) Vin >10 V	>470	>470
Max. Capacitance (pf) at 1MHz	100	200

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Table 7-1 HP 44702A/B Specifications (Cont.)

Maximum Bias Current: Currents sourced by high or low into rear terminals, ribbon cable, or back-plane. These currents may affect accuracy for source impedances >1 KΩ.

±1.4 nA DC (0 to 28°C)
±18 nA DC (28° to 55°C)

Settling Time: To within 0.1% of step change.

Fixed Rate: Any full scale step change (worst case) <10 µsec

Range Changes from Lower to Higher Range: <10 µsec

Rnage Changes from Higher to Lower Range (resulting in a step voltage change at the inputs):

2.56 V Destination Range: <30 µsec (10.24 v step change)
320 mV Destination Range: <20 µsec (2.56 V step change)
<100 µsec (10.24 V step change)
40 mV Destination Range: <20 µsec (320 mV step change)
<120 µsec (2.56 V step change)
<1 msec (10.24 V step change

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7-5 HP 44702A/B PERFORMANCE TESTS

7-6 Introduction

The following Performance Tests check the operation of the HP 44702A High Speed Voltmeter. Successful completion of all Performance Tests in this chapter provides a high confidence level that the voltmeter is meeting its listed specifications.

The Performance Tests should be performed in the order they are presented. The completion of each test increases the confidence level in the High Speed Voltmeter operation. A minimum set of tests is given as Operational Verification Tests. These tests are described in Section 7-10.

The Performance Test procedures described in this chapter are involved and time consuming. Since the Operational Verification Tests yield a 90% confidence that the High Speed Voltmeter is operating normally, it is not recommended that the Performance Tests be performed unless one of the tested specifications is in question. However, if complete Performance Tests are required, do not perform the Operational Verification Tests but go to Section 7-16 for the Performance Tests.

7-7 Equipment Required

The following test equipment is required to run the Performance/Operational Verification Tests.

1. 2 Low Thermal Shorts -- Use solid copper wires

2. 2 Test Cables -- HP Part Number 03498-61602

To assure accurate readings when testing the HP 44702A/B, shielded twisted pair cables MUST be used for all input connections. Coaxial cables are NOT recommended for use. The shielded twisted pair cables are necessary for the HP 44702A/B to reject noise picked up by the input cables. The cables and cable connections are illustrated in the figures showing the different test setups. You can use the figures to to manufacture your own cables, but keep the length of the unshielded wires of the cables to a minimum.

3. DC Voltage Standard -- Datron Model 4000/4000A

If the recommended DC Voltage Standard is not available, use one that is capable of outputting the following voltages at the specified limits. The listed specifications are at least four times better than the specifications of the HP 447021A/B High Speed Voltmeter.

*36 mV (±0.056%)
300 mV (±0.031%)
*1.25 V (±0.15%)
2.5 V (±0.031%)
*5 V (±0.05%)
*10 V (±0.031%)

*For Performance Test only

4. Resistance Standard -- Datron Model 4000/4000A

The Datron Model 4000/4000A normally have resistance values of 1 Ω though 1 MΩ. However, a special version is available with resistance values of 3 Ω through 3 MΩ. Either version will work for the HP 44702A/B Ohms Performance/Operational Verification Tests.

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If the recommended Resistance Standard is not available, use one that is capable of outputting the following resistance values at the specified limits. The listed specifications are at least four times better than the specifications of the HP 44702A/B High Speed Voltmeter.

Instead of using a resistance standard (like the Datron 4000/4000A), you can use standard resistors. Likewise with the resistance standard, you can also use either 10 kΩ, 100 kΩ, and 1 MΩ resistor values or 3 kΩ, 30 kΩ, and 300 kΩ resistor values.

10 kΩ or 3 kΩ (±0.036%)
*100 kΩ or 30 kΩ (±0.036%)
*1 MΩ or 300 kΩ (±0.036%)

*For Performance Test only

5. Computer with HP-IB Interface -- HP Series 200/300 with BASIC 4.0

The recommended computer is used to run various test programs that are part of the Performance/Operational Tests. The computer may also be used to execute the various setup commands, instead of executing them from the front panel.

If the recommended computer is not available, use one that is capable of executing the test program at the end of this chapter. Modification of the program may be necessary if a different computer is used.

6. High Speed FET Multiplexer with Test Fixure -- HP 44711A, HP 44712A, or HP 44713A with an HP 44711AT Terminal Module

The High Speed FET Multiplexer accessory and test fixure are NOT required if only the Operational Verification Tests are to be performed. The accessory and fixure are ONLY needed for the Ribbon Cable Test portion of the Performance Tests. The Ribbon Cable Test is ONLY required if you plan to use the HP 44702A/B to control and read an HP 44711A, 44712A, or 44713A High Speed FET Multiplexer accessory in your application.

In addition to the High Speed FET Multiplexer accessory, a test fixure is also needed. This is the same fixure used to test the High Speed FET Multiplexer accessories as described in Chapter 10. A schematic of the test fixure is shown in Figure 7-2a. The fixure can be manufactured using an HP 44711AT terminal module (see Figure 7-2b). Because wiring the test fixure will make the terminal module unusable in an application, an additional terminal module should be ordered for service purposes.

If the test fixure is to be fabricated from other than an HP 44711AT terminal module, it is important that the terminal ID lines, shown in Figure 7-2a, be correctly wired. The HP 3852A local controller will not allow the execution of some commands with an incorrect ID.

The test fixure consists of a short circuit between all channel HIGH lines and a short circuit between all channel LOW lines. The use of the test fixure minimizes the number of test connections required for the Ribbon Cable Test.

7. DMA Controller, GPIO Interface, and GPIO Cable -- HP 96620B 2 Channel DMA Controller, HP 98622A GPIO Interface, and HP 44744A/44B/45A GPIO Cable

The DMA Controller, GPIO Interface, and GPIO Cable are NOT required if only the Operational Verification Tests are to be performed. The GPIO accessories are ONLY needed for the GPIO Test portion of the Performance Tests. The GPIO Test is ONLY required if you plan to use the HP 44702A/B to transfer readings over the GPIO.

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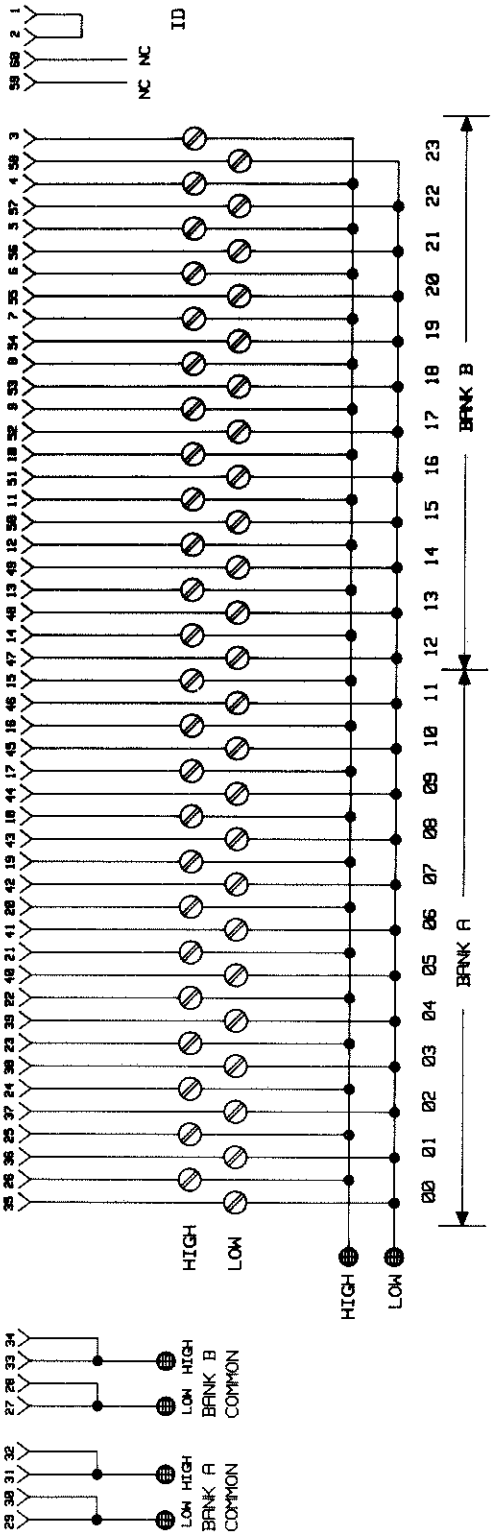


Figure 7-2a HP 44711A Test Fixure Schematic

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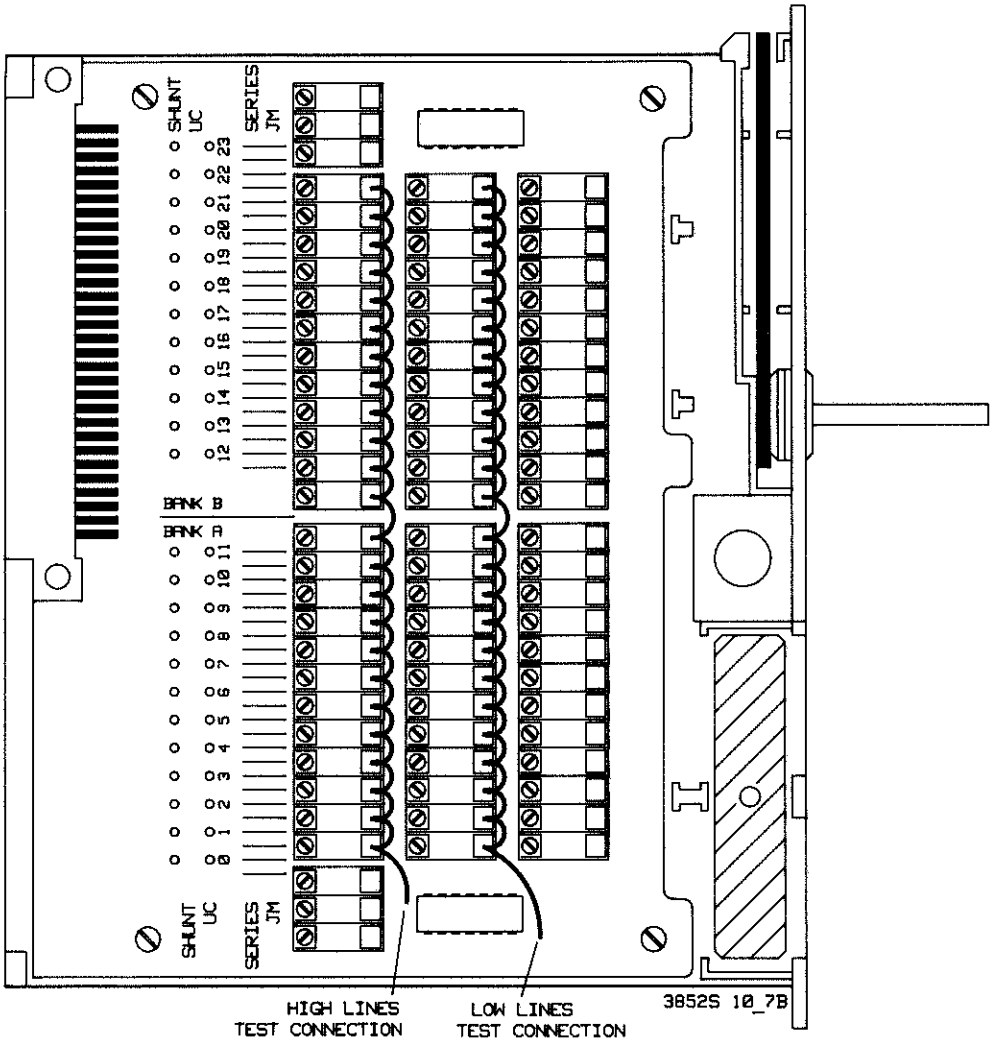


Figure 7-2b HP 44711A Test Fixure

To run the GPIO Test, the HP 98622A GPIO Interface card may need to be re-configured. The correct configuration is shown in Figure 7-3.

7-8 Test Considerations

Because the HP 44702A/B High Speed Voltmeter is capable of making accurate measurements, use standards that are at least four times more accurate than the accessory. However, keep in mind that these standards may introduce potential uncertainties. To keep the uncertainties at a minimum, have these standards certified by the National Bureau of Standards (NBS) before using them. Ideally, standards that are ten times more accurate should be used.

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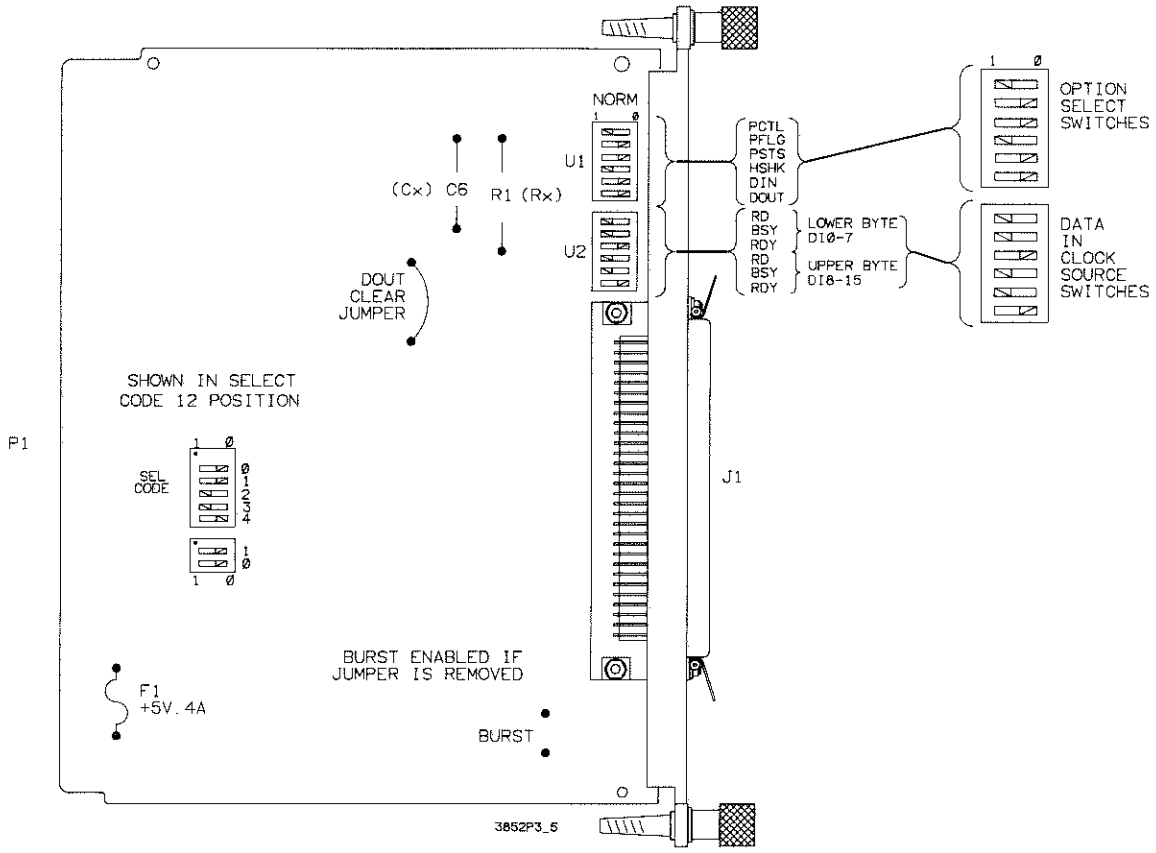


Figure 7-3 HP 98622A Configuration for GPIO Test

7-9 Test Cycle

The HP 44702A/B High Speed Voltmeter requires periodic verification that it is meeting its specifications. The frequency at which the accessory may be tested depends on its usage and environmental operating conditions. To maintain the 90 day specifications, check the accessory at 90 day intervals. To maintain the 1 year specifications, check the accessory at 1 year intervals. For normal operation, check at the 90 day intervals.

7-10 Operational Verification Tests

Perform the Operational Verification Tests only if you do not plan to do the Performance Tests. If you plan to do the Performance Tests, do not perform the following tests but go to Section 7-16 instead.

The following tests are the minimum set of tests recommended for the High Speed Voltmeter. Successful completion of these tests provides a 90% confidence level that the voltmeter is operating normally and is within specification.

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The Operational Verification Tests consist of the following:

Section 7-12 - Set-Up Procedure
Section 7-13 - DC Voltage Operational Verification Test
Section 7-14 - Ohms Operational Verification Test
Section 7-14 - Autorange Test

7-11 Operational Verification Test Procedures

WARNING

Even with power removed from the HP 3852A, high voltages, generated in other parts of the system, may be present at the terminal module of each accessory. Service personnel should ensure that all external power is removed from the system before installing, removing, testing or repairing any plug-in accessory.

NOTE

The temperature of the environment where the following tests are to be performed must be within ±5° C of the temperature of the environment where the instrument was last calibrated. The HP 44702A/B High Speed Voltmeter was calibrated at the factory at an environment temperature of 20° C.

7-12 Set-Up Procedure

1. Apply power to the HP 3852A and allow the HP 44702A/B High Speed Voltmeter a one hour warm-up period inside the mainframe. This is necessary to stabilize the voltmeter before performing any tests.

2. Press the RESET button on the HP 3852A front panel. Perform the HP 44702A/B High Speed Voltmeter self-test by executing:

TEST ES00 (where E = extender number, S = slot number)

3. The HP 3852A right display should show:

SELF TEST OK

If the display shows a different message, or if the ERR annunciator is on, the HP 44702A/B High Speed Voltmeter may be failing its self test. Test the voltmeter again by executing the command in step 2. If the voltmeter still fails, repair of the unit may be necessary.

4. Designate the HP 44702A/B to be tested by executing:

USE ES00 (where E = extender number, S = slot number)

The command establishes the extender/slot number used in all Performance/Operational Verification Tests for command destination. If the HP 3852A is reset or power is removed, it is necessary to perform step 4 again to re-establish the setup parameters.

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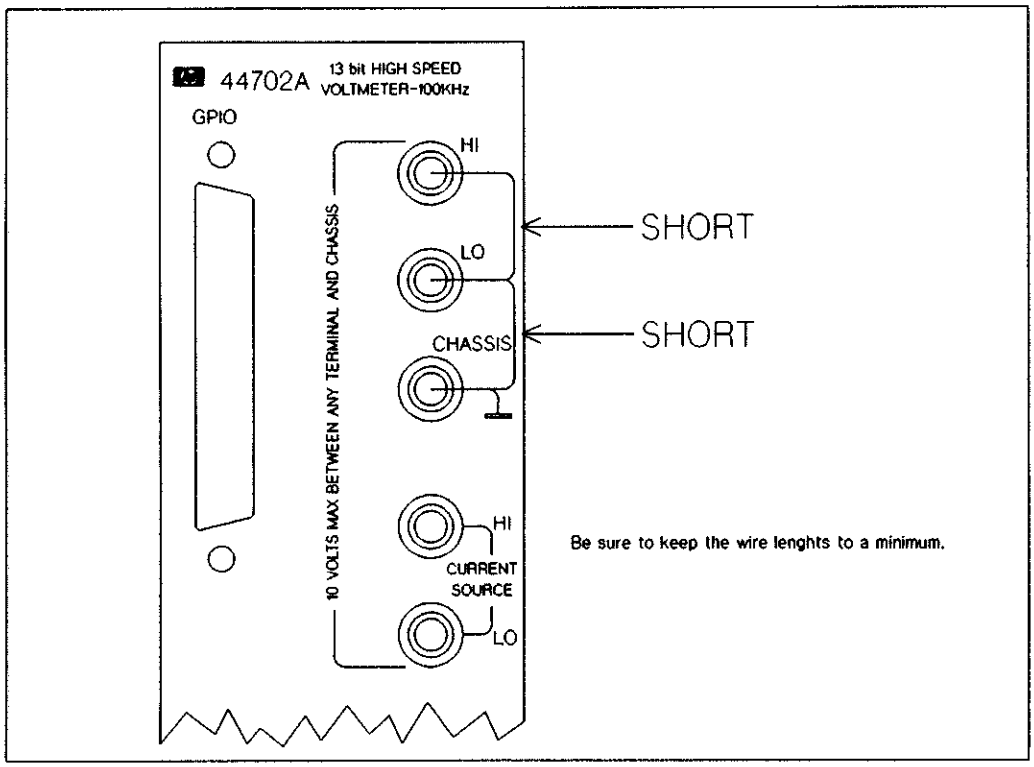


Figure 7-4 DC Voltage Offset Test Connections

7-13 DC Voltage Operational Verification Test

This test determines if the dc offset voltage and the full scale accuracy of the HP 44702A/B High Speed Voltmeter are within the specified limits. The following procedure sets the HP 44702A/B to certain dc volts ranges and take 1000 readings on each range. The minimum and maximum values of the readings are then compared with the limits shown in Table 7-2.

1. DC VOLTAGE OFFSET TEST. The following test determines if the dc voltage offset readings of the HP 44702A/B are within the specified limits.

2. Perform the Set-Up Procedure in Section 7-12, if not previously performed.

3. Connect a low thermal short across the rear HI and LO Input Terminals of the HP 44702A/B High Speed Voltmeter accessory. Then connect another low thermal short across the rear LO and CHASSIS Terminals. The connections are shown in Figure 7-4.

4. Set the HP 44702A/B to measure dc volts and take 1000 readings by executing:

```
REAL MIN,MAX,MEAN,STDD
DIM A(999)
TERM EXT
NRDGS 1000
FUNC DCV
```

If the HP 3852A is reset or power is removed, it is necessary to perform step 4 and step 4 in Section 7-12 again to re-establish the setup parameters.

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Table 7-2 DC Voltage Operational Verification Test Limits

DC Voltage Offset Test Limits						
44702A/B Input	44702A/B Range	44702A/B Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
Short	40 mV	FUNC DCV	+6.800000E-05	-6.800000E-05	+6.800000E-05	+6.800000E-05
Short	10.24 V	FUNC DCV	+7.500000E-02	-7.500000E-02	+7.500000E-02	+7.500000E-02
DC Voltage Gain Test Limits						
44702A/B Input	44702A/B Range	44702A/B Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
+300 mV	320 mV	FUNC DCV	+3.003840E-01	+2.996160E-01	+3.005340E-01	+2.994660E-01
+2.5 V	2.56 V	FUNC DCV	+2.503130E+00	+2.496870E+00	+2.504380E+00	+2.495620E+00

5. Set the HP 44702A/B to the 40 mV Range by executing:

```
RANGE .04
```

6. Trigger the HP 44702A/B and transfer the resulting readings to the HP 3852A by executing:

```
TRIG SGL
XRDGS ES00,1000 INTO A   (where E = extender number, S = slot number)
```

7. Determine the minimum and maximum values of the readings by executing the following commands. The minimum value of all 1000 readings is first shown on the HP 3852A's right display followed by the maximum value. Note both values.

```
STAT MIN,MAX,MEAN,STDD,A
VREAD MIN   (note the minimum reading)
VREAD MAX   (note the maximum reading)
```

8. If any of the maximum and minimum offset readings are out of the limits specified in Table 7-2, perform the DC Volts Calibration procedure in Section 7-32.

9. Repeat steps 5, 6, 7, and 8 for the 10.24 V Range. Set the range in step 5 by executing RANGE 10.24.

10. When both ranges are tested, leave the setup in step 4 for the next test. Remove the low thermal short from the HI and LO, and LO and CHASSIS Input Terminals.

11. DC VOLTAGE GAIN TEST. The following test determines if the dc voltage full scale readings of the HP 44702A/B are within the specified limits. Since the HP 44702A/B High Speed Voltmeter cannot measure inputs at full scale, the DC Voltage Gain Test is performed at <99.6% of full scale.

12. Set the DC Voltage Standard output to +300 mV. Then connect the DC Voltage Standard to the rear HI and LO Input Terminals of the HP 44702A/B High Speed Voltmeter accessory. The connections are shown in Figure 7-5. Make sure shielded twisted pair cables are used for the connections as shown in the figure.

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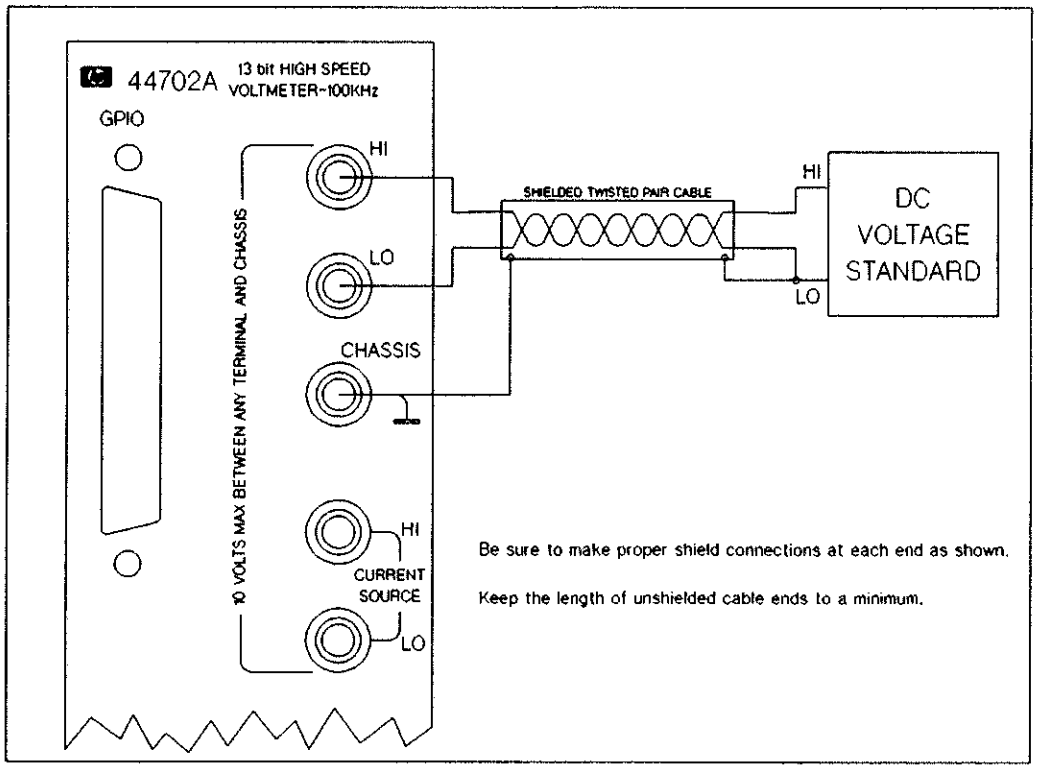


Figure 7-5 DC Voltage Gain Test Connections

13. Test the 320 mV Range by executing the following command. The voltmeter automatically selects the 320 mV Range, even though a value of .3 is used for the range instead of .32.

```
RANGE .3
```

14. Trigger the HP 44702A/B and transfer the resulting readings to the HP 3852A by executing:

```
TRIG SGL
XRDGS ES00,1000 INTO A   (where E = extender number, S = slot number)
```

15. Determine the minimum and maximum values of the readings by executing the following. The minimum value of all 1000 readings is first shown on the HP 3852A's right display followed by the maximum value. Note both values.

```
STAT MIN,MAX,MEAN,STDD,A
VREAD MIN   (note the minimum reading)
VREAD MAX   (note the maximum reading)
```

16. If any of the maximum and minimum gain readings are out of the limits specified in Table 7-2, perform the DC Volts Calibration procedure in Section 7-32.

17. Repeat steps 13, 14, 15 and 16 for 2.56 V Range. Set the range in step 13 by executing RANGE 2.5 for the 2.56 V Range. Make sure the DC Voltage Standard output is set to +2.5 V as shown in Table 7-2.

18. Remove the DC Voltage Standard from the HI and LO Input Terminals.

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Table 7-3 Ohms Operational Verification Gain Test Limits

44702A/B Input	44702A/B Range	44702A/B Set-Up	90 Day Test Limits		1 Year Test Limits	
			High	Low	High	Low
10 Kohm*	10.24 Kohm	OHMF10K	1.001450E+04	9.985500E+03	1.001750E+04	9.982500E+03
3 Kohm	10.24 Kohm	OHMF10K	3.009600E+03	2.990400E+03	3.010500E+03	2.989500E+03
*Preferred Resistance Value						

7-14 Ohms Operational Verification Test

This test determines if the ohms full scale accuracy of the HP 44702A/B High Speed Voltmeter is within the specified limits. The following procedure checks the accuracy of the 1 mA current source only (10 Kohm Function) but includes an operational check of the 10 µA (100 Kohm Function) and 100 µA (1 Mohm Function) current sources.

The recommended Resistance Standard or a Standard Resistor can be used to test the ohms function. In either case, use either a 10 Kohm resistance value (recommended value) or a 3 Kohm resistance value (optional value).

1. Perform the Set-Up Procedure in Section 7-12, if not previously performed.

2. If using the Resistance Standard, set its output to either 10 Kohm or 3 Kohm. If using a Standard Resistor, select either a 10 Kohm or 3 Kohm value. Connect the Resistance Standard or Standard Resistor to the rear HI and LO Input Terminals of the HP 44702A/B High Speed Voltmeter. The connections are shown in Figure 7-6a and 7-6b.

3. Set the HP 44702A/B to measure ohms using the 1 mA current source and take a single reading by executing:

```
RESET ES00   (where E = extender number, S = slot number)
TERM EXT
FUNC OHMF10K
NRDGS 1
```

4. Set the HP 44702A/B to the 10.24 Kohm Range by executing:

```
RANGE 10E3
```

5. Trigger the HP 44702A/B and transfer the resulting reading to the HP 3852A by executing:

```
TRIG SGL
XRDGS ES00,1   (where E = extender number, S = slot number)
```

6. Note the gain reading on the HP 3852A right display. If the reading is out of the limits specified in Table 7-3, perform the Ohms Calibration procedure in Section 7-33. In the table, both the 90 Day and 1 Year test limits are listed for both 10 Kohm and 3 Kohm inputs.

7. Repeat steps 3 and 5 for the 100 µA and 10 µA current sources. Set the current source in step 3 by executing FUNC OHMF100K for the 100 µA current source and FUNC OHMF1M for the 10 µA current source. Make sure both current sources are operational.

8. Remove the Resistance Standard or Standard Resistor from the HP 44702A/B rear panel.

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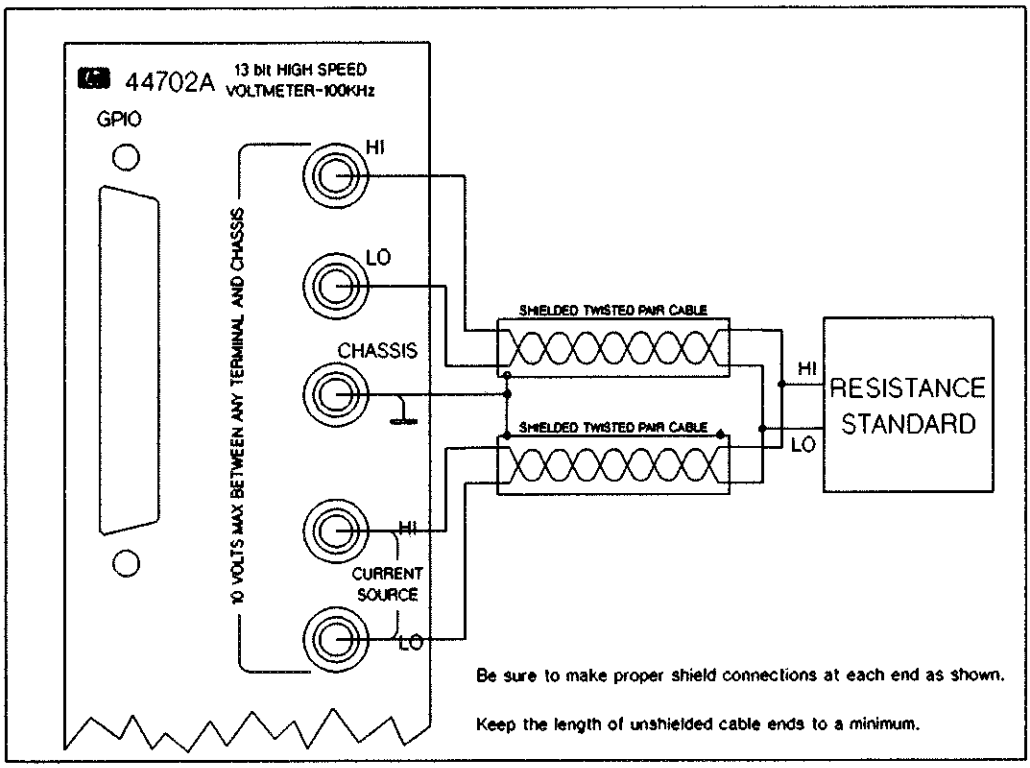


Figure 7-6a Ohms Gain Test Connections Using a Resistance Standard

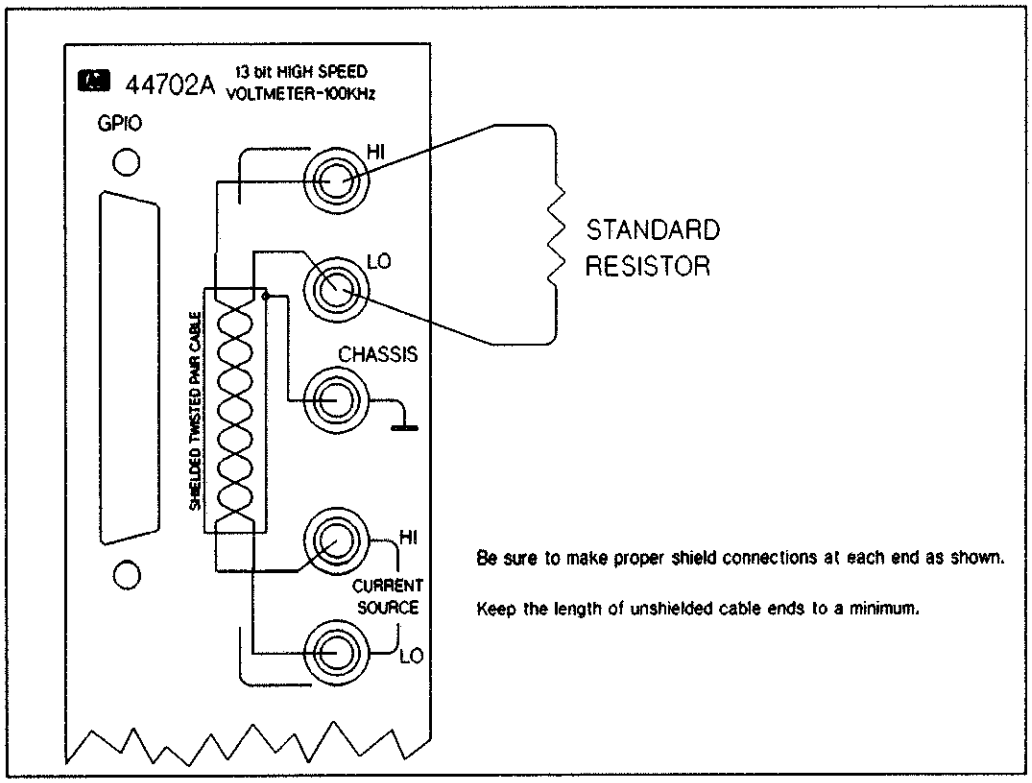


Figure 7-6b Ohms Gain Test Connections Using a Standard Resistor

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Table 7-4 HP 44702A/B Autorange Test

44702A/B Range	44702A/B Initial Input Voltage	Input Voltage Incremented by	Maximum Voltage for Upranging	Range after Upranging
40 mV	+28 mV	+2 mV	+36 mV	320 mV
320 mV	+224 mV	+20 mV	+304 mV	2.56 V
2.56 V	+1.8 V	+200 mV	+2.4 V	10.24 V

7-15 Autorange Test

This test uses Test Program 7-1 to check the autorange capability of the HP 44702A/B High Speed Voltmeter. The program is located at the end of this chapter. The program continually displays the present voltmeter range on the computer. From the displayed range and the HP 44702A/B input voltage level, the voltmeter's uprange and downrange points are determined.

NOTE

Test Program 7-1 was created for the HP Series 200/300 Computer with Basic 4.0. However, the program is sufficiently simple that it may be translated into other languages and computers.

A dc voltage source is required to run the test. The voltage source must be capable of outputting a dc voltage ranging from +28 mV to +2.4 V dc. Some way of determining its output voltage level (i.e., the HP 44702A/B input voltage) is also necessary. A good choice is the recommended DC Voltage Standard, since it is used in other procedures. If using a different voltage source, like a power supply, a dc voltmeter may be necessary to determine the power supply's output voltage.

1. Enter Test Program 7-1 into the computer.

Two modifications to the test program may be necessary. These are the mainframe address in line 30 and the voltmeter slot location number in line 40. If needed, change line 30 to reflect the mainframe address. Likewise, change line 40 to reflect the slot location of the voltmeter. For example, if your voltmeter is in slot 5 of extender 1, line 40 should look like this:

```
40    Slot=1500
```

2. Set the dc voltage source output to +28 mV. Then connect it to the HP 44702A/B HI and LO Input Terminals. The connections are shown in Figure 7-5.

3. Execute RUN on the computer.

4. Use Table 7-4 to determine the uprange and downrange points of the HP 44702A/B. This is done by using the table in conjunction with the range displayed on the computer and the HP 44702A/B input voltage level. The following procedure shows how this is done.

   a. With the HP 44702A/B input at +28 mV, the 40 mV Range should be displayed on the computer.

   b. While observing the range on the computer, increment the dc voltage source output in approximately +2 mV steps until upranging occurs (i.e., range goes to 320 mV). Note the HP 44702A/B input voltage level where upranging occurred. If using the recommended DC Voltage Standard, the HP 44702A/B input level can easily be determined by noting the output voltage setting of the

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standard. Make sure this voltage is at or below the specified limit listed under "Maximum Voltage for Upranging" in Table 7-4.

c. Decrement the dc voltage source output by +2 mV. The HP 44702A/B should downrange back to the 40 mV Range.

d. Repeat steps a, b, and c for the 320 mV and 2.56 V Ranges. Use the appropriate data in Table 7-4 for these ranges.

THIS CONCLUDES THE OPERATIONAL VERIFICATION PORTION OF THE HP 44702A/B PERFORMANCE TESTS.

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7-16 Performance Tests

Perform the Performance Tests only if you do not plan to do the Operational Verifications Tests. If you plan to do the Operational Verification Tests, do not perform the following tests but go to Section 7-10 instead.

Do the following tests if you desire a high confidence level that the voltmeter is operating normally and is within specifications.

The Performance Tests consist of the following:

Section 7-18 - Set-Up Procedure
Section 7-19 - DC Voltage Performance Test
Section 7-20 - Ohms Performance Test
Section 7-21 - Autorange Test
Section 7-22 - Ribbon Cable Test
Section 7-23 - GPIO Test

7-17 Performance Test Procedures

WARNING

Even with power removed from the HP 3852A, high voltages, generated in other parts of the system, may be present at the terminal module of each accessory. Service personnel should ensure that all external power is removed from the system before installing, removing, testing or repairing any plug-in accessory.

NOTE

The temperature of the environment where the following tests are to be performed must be within ±5° C of the temperature of the environment where the instrument was last calibrated. The HP 44702A/B High Speed Voltmeter was calibrated at the factory at an environment temperature of 20° C.

7-18 Set-Up Procedure

1. Apply power to the HP 3852A and allow the HP 44702A/B High Speed Voltmeter a one hour warm-up period inside the mainframe. This is necessary to stabilize the voltmeter before performing any tests.

2. Press the RESET button on the HP 3852A front panel. Perform the HP 44702A/B High Speed Voltmeter self-test by executing:

TEST ES00 (where E = extender number, S = slot number)

3. The HP 3852A right display should show:

SELF TEST OK

If the display shows a different message, or if the ERR annunciator is on, the HP 44702A/B High Speed Voltmeter may be failing its self test. Test the voltmeter again by executing the command in step 2. If the voltmeter still fails, repair of the unit may be necessary.

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4. Designate the HP 44702A/B to be tested by executing:

```
USE ES00   (where E = extender number, S = slot number)
```

The command establishes the extender/slot number used in all Performance/Operational Verification Tests for command destination. If the HP 3852A is reset or power is removed, it is necessary to perform step 4 again to re-establish the setup parameters.

7-19 DC Voltage Performance Test

This test determines if the dc offset voltage and the full scale accuracy of the HP 44702A/B High Speed Voltmeter are within the specified limits. The following procedure sets the HP 44702A/B to certain dc volts ranges and take 1000 readings on each range. The minimum and maximum values of the readings are then compared with the limits shown in Table 7-5.

1. DC VOLTAGE OFFSET TEST. The following test determines if the dc voltage offset readings of the HP 44702A/B are within the specified limits.

2. Perform the Set-Up Procedure in Section 7-18, if not previously performed.

3. Connect a low thermal short across the rear HI and LO Input Terminals of the HP 44702A/B High Speed Voltmeter accessory. Then connect another low thermal short across the rear LO and CHASSIS Terminals. The connections are shown in Figure 7-4.

4. Set the HP 44702A/B to measure dc volts and take 1000 readings by executing:

```
REAL MIN,MAX,MEAN,STDD
DIM A(999)
TERM EXT
NRDGS 1000
FUNC DCV
```

If the HP 3852A is reset or power is removed, it is necessary to perform step 4 and step 4 in Section 7-18 again to re-establish the setup parameters.

5. Set the HP 44702A/B to the 40 mV Range by executing:

```
RANGE .04
```

6. Trigger the HP 44702A/B and transfer the resulting readings to the HP 3852A by executing:

```
TRIG SGL
XRDGS ES00,1000 INTO A   (where E = extender number, S = slot number)
```

7. Determine the minimum and maximum values of the readings by executing the following commands. The minimum value of all 1000 readings is first shown on the HP 3852A's right display followed by the maximum value. Note both values.

```
STAT MIN,MAX,MEAN,STDD,A
VREAD MIN   (note the minimum reading)
VREAD MAX   (note the maximum reading)
```

8. If any of the maximum and minimum offset readings are out of the limits specified in Table 7-5, perform the DC Volts Calibration procedure in Section 7-32.

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Table 7-5 DC Voltage Performance Test Limits

DC Voltage Offset Test Limits						
44702A/B Input	44702A/B Range	44702A/B Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
Short	40 mV	FUNC DCV	+6.800000E-05	-6.800000E-05	+6.800000E-05	-6.800000E-05
Short	320 mV	FUNC DCV	+2.340000E-04	-2.340000E-04	+2.340000E-04	-2.340000E-04
Short	2.56 V	FUNC DCV	+1.880000E-03	-1.880000E-03	+1.880000E-03	-1.880000E-03
Short	10.24 V	FUNC DCV	+7.500000E-02	-7.500000E-02	+7.500000E-02	-7.500000E-02
DC Voltage Gain Test Limits						
44702A/B Input	44702A/B Range	44702A/B Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
+36 mV	40 mV	FUNC DCV	+3.608600E-02	+3.591400E-02	+3.610400E-02	+3.589600E-02
-36 mV	40 mV	FUNC DCV	-3.608600E-02	-3.591400E-02	-3.610400E-02	-3.589600E-02
+300 mV	320 mV	FUNC DCV	+3.003840E-01	+2.996160E-01	+3.005340E-01	+2.994660E-01
-300 mV	320 mV	FUNC DCV	-3.003840E-01	-2.996160E-01	-3.005340E-01	-2.994660E-01
+2.5 V	2.56 V	FUNC DCV	+2.503130E+00	+2.496870E+00	+2.504380E+00	+2.495620E+00
-2.5 V	2.56 V	FUNC DCV	-2.503130E+00	-2.496870E+00	-2.504380E+00	-2.495620E+00
+10 V	10.24 V	FUNC DCV	+1.001250E+01	+9.987500E+00	+1.001750E+01	+9.982500E+00
-10 V	10.24 V	FUNC DCV	-1.001250E+01	-9.987500E+00	-1.001750E+01	-9.982500E+00
DC Voltage Linearity Test Limits						
44702A/B Input	44702A/B Range	44702A/B Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
+5 V	10.24 V	FUNC DCV	+5.010000E+00	+4.990000E+00	+5.012500E+00	+4.987500E+00
+2.5 V	10.24 V	FUNC DCV	+2.508750E+00	+2.491250E+00	+2.51000 E+00	+2.490000E+00
+1.25 V	10.24 V	FUNC DCV	+1.258125E+00	+1.241875E+00	+1.258750E+00	+1.241250E+00

9. Repeat steps 5, 6, 7, and 8 for the 320 mV, 2.56 V, and 10.24 V Ranges. To set the different ranges in step 5, execute the following:

320 mV Range - RANGE .32
2.56 V Range - RANGE 2.56
10.24 V Range - RANGE 10.24

10. When all ranges are tested, leave the setup in step 4 for the next test. Remove the low thermal short from the HI and LO, and LO and CHASSIS Input Terminals.

11. DC VOLTAGE GAIN TEST. The following test determines if the dc voltage full scale readings of the HP 44702A/B are within the specified limits. Since the HP 44702A/B High Speed Voltmeter cannot measure inputs at full scale, the DC Voltage Gain Test is performed at <99.6% of full scale.

12. Set the DC Voltage Standard output to +36 mV. Then connect the DC Voltage Standard to the rear HI and LO Input Terminals of the HP 44702A/B High Speed Voltmeter accessory. The connections are shown in Figure 7-5. Make sure shielded twisted pair cables are used for the connections as shown in the figure.

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13. Test the 40 mV Range by executing the following command. The voltmeter automatically selects the 40 mV Range, even though a value of .036 is used for the range instead of .04.

```
RANGE .036
```

14. Trigger the HP 44702A/B and transfer the resulting readings to the HP 3852A by executing:

```
TRIG SGL
XRDGS ES00,1000 INTO A   (where E = extender number, S = slot number)
```

15. Determine the minimum and maximum values of the readings by executing the following. The minimum value of all 1000 readings is first shown on the HP 3852A's right display followed by the maximum value. Note both values.

```
STAT MIN,MAX,MEAN,STDD,A
VREAD MIN   (note the minimum reading)
VREAD MAX   (note the maximum reading)
```

16. If any of the maximum and minimum gain readings are out of the limits specified in Table 7-5, perform the DC Volts Calibration procedure in Section 7-32.

17. Set the DC Voltage Standard output to -36 mV.

18. Trigger the HP 44702A/B and transfer the resulting readings to the HP 3852A by executing:

```
TRIG SGL
XRDGS ES00,1000 INTO A   (where E = extender number, S = slot number)
```

19. Determine the minimum and maximum values of the readings by executing the following. The minimum value of all 1000 readings is first shown on the HP 3852A's right display followed by the maximum value. Note both values.

```
STAT MIN,MAX,MEAN,STDD,A
VREAD MIN   (note the minimum reading)
VREAD MAX   (note the maximum reading)
```

20. If any of the maximum and minimum gain readings are out of the limits specified in Table 7-5, perform the DC Volts Calibration procedure in Section 7-32.

21. Repeat steps 13 through 20 for the 320 mV, 2.56 V, and 10.24 V Ranges. To set the different ranges in step 13, execute the following. Also set the DC Standard output accordingly as listed in Table 7-5.

```
320 mV Range - RANGE .3
2.56 V Range - RANGE 2.5
10.24 V Range - RANGE 10
```

22. When all ranges are tested, set the DC Standard output to 2.5 mV. Leave the DC Voltage Standard connected to the HP 44702A/B for the next test.

23. DC VOLTAGE LINEARITY TEST. The following test determines if the dc voltage linearity of the HP 44702A/B is within the specified limits.

24. Set the HP 44702A/B to the 10.24 V Range by executing:

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RANGE 10

25. Set the DC Voltage Standard output to +5 V.

26. Trigger the HP 44702A/B and transfer the resulting reading to the HP 3852A by executing:

```
TRIG SGL
XRGDS ES00,1   (where E = extender number, S = slot number)
```

27. Note the reading on the HP 3852A display. If the +5 V reading is out of the limits specified in Table 7-5, perform the DC Volts Calibration procedure in Section 7-32.

28. Set the DC Voltage Standard output to +2.5 V.

29. Trigger the HP 44702A/B and transfer the resulting reading to the HP 3852A by executing:

```
TRIG SGL
XRGDS ES00   (where E = extender number, S = slot number)
```

30. Note the reading on the HP 3852A display. If the +2.5 V reading is out of the limits specified in Table 7-5, perform the DC Volts Calibration procedure in Section 7-32.

31. Set the DC Voltage Standard output to +1.25 V.

32. Trigger the HP 44702A/B and transfer the resulting reading to the HP 3852A by executing:

```
TRIG SGL
XRGDS ES00   (where E = extender number, S = slot number)
```

33. Note the reading on the HP 3852A display. If the +1.25 V reading is out of the limits specified in Table 7-5, perform the DC Volts Calibration procedure in Section 7-32.

34. Remove the DC Voltage Standard from the HI and LO Input Terminals.

7-20 Ohms Performance Test

This test determines if the ohms full scale accuracy of the HP 44702A/B High Speed Voltmeter is within the specified limits. The following procedure checks the accuracy of the 1 mA (10 Kohm Function), 10 µA (100 Kohm Function), and 100 µA (1 Mohm Function) current sources.

The recommended Resistance Standard or Standard Resistors can be used to test the ohms function. In either case, use either 10 Kohm, 100 Kohm, and 1 Mohm resistance values (recommended values) or 3 Kohm, 30 Kohm, and 300 Kohm resistance values (optional values).

1. Perform the Set-Up Procedure in Section 7-18, if not previously performed.

2. If using the Resistance Standard, set its output to either 10 Kohm or 3 Kohm. If using a Standard Resistor, use either a 10 Kohm or 3 Kohm value. Connect the Resistance Standard/Standard Resistor to the rear HI and LO Input Terminals of the HP 44702A/B High Speed Voltmeter. The connections are shown in Figure 7-6a and 7-6b.

3. Set the HP 44702A/B to measure ohms using the 1 mA current source and take a single reading by executing:

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Table 7-6 Ohms Performance Test Limits

44702A/B Input	44702A/B Range	44702A/B Set-Up	90 Day Test Limits High	90 Day Test Limits Low	1 Year Test Limits High	1 Year Test Limits Low
10 Kohm*	10.24 Kohm	OHMF10K	1.001450E+04	9.985500E+03	1.001750E+04	9.982500E+03
3 Kohm	10.24 Kohm	OHMF10K	3.009600E+03	2.990400E+03	3.010500E+03	2.989500E+03
100 Kohm*	102.4 Kohm	OHMF100K	1.001450E+05	9.985500E+04	1.001750E+05	9.982500E+04
30 Kohm	102.4 Kohm	OHMF100K	3.009600E+04	2.990400E+04	3.010500E+04	2.989500E+04
1 Mohm*	1.024 Mohm	OHMF1M	1.001950E+06	9.980500E+05	1.002250E+06	9.977500E+05
300 Kohm	1.024 Mohm	OHMF1M	3.014600E+05	2.985400E+05	3.015500E+05	2.984500E+05
*Preferred Resistance Values						

RESET ES00 (where E = extender number, S = slot number)
TERM EXT
FUNC OHMF10K
NRDGS 1

4. Set the HP 44702A/B to the 10.24 Kohm Range by executing:

RANGE 10E3

5. Trigger the HP 44702A/B and transfer the resulting reading to the HP 3852A by executing:

TRIG SGL
XRDGS ES00,1 (where E = extender number, S = slot number)

6. Note the gain reading on the HP 3852A right display. If the reading is out of the limits specified in Table 7-6, perform the Ohms Calibration procedure in Section 7-33. In the table, both the 90 Day and 1 Year test limits are listed for both 10 Kohm and 3 Kohm inputs.

7. If using the Resistance Standard, set its output to either 100 Kohm or 30 Kohm. If using a Standard Resistor, remove the 10 Kohm or 3 Kohm resistor from the HP 44702A/B and connect either a 100 Kohm or 30 Kohm resistor.

8. Set the HP 44702A/B to measure ohms using the 100 µA current source by executing:

FUNC OHMF100K

9. Set the HP 44702A/B to the 102.4 Kohm Range by executing:

RANGE 100E3

10. Trigger the HP 44702A/B and transfer the resulting reading to the HP 3852A by executing:

TRIG SGL
XRDGS ES00,1 (where E = extender number, S = slot number)

11. Note the gain reading on the HP 3852A right display. If the reading is out of the limits specified in Table 7-6, perform the Ohms Calibration procedure in Section 7-33.

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12. If using the Resistance Standard, set its output to either 1 Mohm or 300 Kohm. If using a Standard Resistor, remove the 100 Kohm or 30 Kohm resistor from the HP 44702A/B and connect either a 1 Mohm or 300 Kohm resistor.

13. Set the HP 44702A/B to measure ohms using the 10 μA current source by executing:

```
FUNC OHMF1M
```

14. Set the HP 44702A/B to the 1.024 Mohm Range by executing:

```
RANGE 1E6
```

15. Trigger the HP 44702A/B and transfer the resulting reading to the HP 3852A by executing:

```
TRIG SGL
XRDGS ES00,1   (where E = extender number, S = slot number)
```

16. Note the gain reading on the HP 3852A right display. If the reading is out of the limits specified in Table 7-6, perform the Ohms Calibration procedure in Section 7-33.

17. Remove the Resistance Standard or Standard Resistor from the HP 44702A/B rear panel.

7-21 Autorange Test

This test uses Test Program 7-1 to check the autorange capability of the HP 44702A/B High Speed Voltmeter. The program is located at the end of this chapter. The program continually displays the present voltmeter range on the computer. From the displayed range and the HP 44702A/B input voltage level, the voltmeter's uprange and downrange points are determined.

NOTE

Test Program 7-1 was created for the HP Series 200/300 Computer with Basic 4.0. However, the program is sufficiently simple that it may be translated into other languages and computers.

A dc voltage source is required to run the test. The voltage source must be capable of outputting a dc voltage ranging from +28 mV to +2.4 V dc. Some way of determining its output voltage level (i.e., the HP 44702A/B input voltage) is also necessary. A good choice is the recommended DC Voltage Standard, since it is used in other procedures. If using a different voltage source, like a power supply, a dc voltmeter may be necessary to determine the power supply's output voltage.

1. Enter Test Program 7-1 into the computer.

Two modifications to the test program may be necessary. These are the mainframe address in line 30 and the voltmeter slot location number in line 40. If needed, change line 30 to reflect the mainframe address. Likewise, change line 40 to reflect the slot location of the voltmeter. For example, if your voltmeter is in slot 5 of extender 1, line 40 should look like this:

```
40    Slot=1500
```

2. Set the dc voltage source output to +28 mV. Then connect it to the HP 44702A/B HI and LO Input Terminals. The connections are shown in Figure 7-5.

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3. Execute RUN on the computer.

4. Use Table 7-4 to determine the uprange and downrange points of the HP 44702A/B. This is done by using the table in conjunction with the range displayed on the computer and the HP 44702A/B input voltage level. The following procedure shows how this is done.

a. With the HP 44702A/B input at +28 mV, the 40 mV Range should be displayed on the computer.

b. While observing the range on the computer, increment the dc voltage source output in approximately +2 mV steps until upranging occurs (i.e., range goes to 320 mV). Note the HP 44702A/B input voltage level where upranging occurred. If using the recommended DC Voltage Standard, the HP 44702A/B input level can easily be determined by noting the output voltage setting of the standard. Make sure this voltage is at or below the specified limit listed under "Maximum Voltage for Upranging" in Table 7-4.

c. Decrement the dc voltage source output by +2 mV. The HP 44702A/B should downrange back to the 40 mV Range.

d. Repeat steps a, b, and c for the 320 mV and 2.56 V Ranges. Use the appropriate data in Table 7-4 for these ranges.

7-22 Ribbon Cable Test

This test verifies that the HP 44702A/B High-Speed Voltmeter can control the HP 44711A, 44712A, or 44713A High Speed FET Multiplexer accessories. It also verifies that measurement results can be transferred to the voltmeter over the ribbon cable. The ribbon cable is used by the voltmeter to communicate with and control the multiplexer.

NOTE

Due to extra test equipment required to perform the Ribbon Cable Test, perform the test only if the HP 44702A/B High Speed Voltmeter is to be used with an HP 44711A, 44712A, or 44713A/B High Speed FET Multiplexer accessory.

1. Remove power from the HP 3852A.

2. Install the HP 44711A component module in the mainframe next to an HP 44702A/B. Connect the ribbon cable between the FET multiplexer and the HP 44702A/B. Note the slot number where the FET under test is installed and the slot number where the HP 44702A/B is installed.

3. Install the test fixture on the High Speed FET Multiplexer.

4. Apply power to the HP 3852A.

5. Set up the tests by executing the following commands:

```
USE ES00  (where E = extender number, S = slot number for High Speed Voltmeter)
FASTDISP OFF
SCANMODE ON
TERM RIBBON
```

6. On the test fixture, connect a jumper between the shorted HIGH lines and the shorted LOW lines.

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7. Enter, but do not execute, the following command:

CONFMEAS OHM ES00-ES23 (where E = extender number, S = FET mux. slot number)

8. When the command entered in step 7 is executed, the HP 44702A/B will perform a resistance measurement on all channels on the HP 44711A. With the FASTDISP OFF, each measurement will appear in the HP 3852A right display. The HP 3852A left display will indicate each channel as it is scanned. Observe the HP 3852A displays and press execute. The resistance indicated in the right display, for all channels, should be less than 6.2 kohms (the number in the display will be in exponential format). The resistance indicated includes the on-resistance of the channel FET switch, the on-resistance of the tree FET switch, and the resistance of the series protection resistors. The scan list can be repeated, if desired, by pressing the RECALL ENTRY key and then the ENTER key.

9. If any reading is incorrect, the voltmeter, ribbon cable, and/or multiplexer accessory may be defective. Go to Chapter 10 of this manual to test the multiplexer accessory before suspecting the voltmeter.

10. Disconnect and remove the High Speed FET Multiplexer accessory from the HP 44702A/B.

7-23 GPIO Test

This test verifies that the HP 44702A/B High-Speed Voltmeter can transfer readings over the GPIO to a hard disc using a DMA controller (i.e., Series 200/300 computer with DMA controller).

This test uses Test Program 7-2 to check the GPIO capability of the HP 44702A/B High Speed Voltmeter. The program is located at the end of this chapter. Make sure the HP 98622A GPIO Interface card for the Series 200/300 Computer is configured as shown in Figure 7-3 (see Section 7-7).

NOTE

Due to extra test equipment required to perform the GPIO Test, perform the test only if the HP 44702A/B High Speed Voltmeter is to be used to transfer readings over the GPIO.

Test Program 7-2 was created for the HP Series 200/300 Computer with Basic 4.0.

1. Remove power from the HP 3852A.

2. Connect the GPIO cable between the HP 44702A/B and computer.

3. Apply power to the HP 3852A.

4. Enter Test Program 7-2 into the computer. The program is written for select code 12 on the HP 98622A GPIO Interface card, as shown in Figure 7-3. If the select code is different, change the select code in line 150 of Test Program 7-2 accordingly. For example, for a select code of 20, change line 150 to the following.

```
150    Gpio=20
```

5. Execute RUN on the computer.

THIS CONCLUDES THE HP 44702A/B PERFORMANCE TESTS.

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7-24 CALIBRATION

7-25 Introduction

The calibration procedures in this section are used to calibrate the HP 44702A/B High Speed Voltmeter in all functions (DCV and Ohms).

The HP 44702A/B High Speed Voltmeter is calibrated programatically; no internal adjustments are performed. Calibration is done from the front panel (or by computer control) by applying a known calibration signal to the voltmeter input terminals. This signal is measured by the voltmeter from which calibration constants are calculated.

WARNING

The following procedures are intended for Service Trained Personnel who understand electronic circuitry and are aware of the hazards involved. Do not attempt to perform any of the procedures unless you are qualified to do so.

7-26 Equipment Required

The following test equipment is required calibrate the voltmeter accessory.

1. 2 Test Cables -- HP Part Number 03498-61602

To assure accurate calibration of the HP 44702A/B, shielded twisted pair cables MUST be used for all input connections. Coaxial cables are NOT recommended for use. The shielded twisted pair cables are necessary for the HP 44702A/B to reject noise picked up by the input cables. The cables and cable connections are illustrated in the figures showing the different test setups. If you wish to manufacture your own cables, keep the length of the unshielded wires of the cables to a minimum.

2. DC Voltage Standard -- Datron Model 4000/4000A

If the recommended DC Voltage Standard is not available, use one that is capable of outputting the preferred voltage values at the specified limits, as listed in Table 7-7. However, Although it is other values may be used. Those are also listed in Table 7-7.

Table 7-7 DC Voltage Calibration Requirements

44702A/B Range	Preferred Cal Values	Permissable Cal Values	Required Accuracy
40 mV	36 mV	30 mV to 39 mV	+-0.022%
320 mV	300 mV	240 mV to 318 mV	+-0.012%
2.56 V	2.5 V	1.92 V to 2.5 V	+-0.012%
10.24 V	10 V	7.68 V to 10.1 V	+-0.012%

3. Resistance Standard -- Datron Model 4000/4000A

The Datron Model 4000/4000A normally have resistance values of 1 Ω though 1 MΩ. However, a special version is available with resistance values of 3 Ω through 3 MΩ. Either version will work to calibrate the HP 44702A/B Ohms function.

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All the HP 44702A/B ohms ranges can be calibrated using a single resistance value. The preferred value is 10 Kohm with a required accuracy of ±.014%. However, other values may be used. These values are listed as follows:

240 Ω through 318 Ω (±0.014%)
1.92 kΩ through 3.18 k Ω (±0.014%)
7.68 kΩ through 10.1 kΩ (±0.014%)
19.2 kΩ through 31.8 kΩ (±0.014%)
76.8 kΩ through 101 kΩ (±0.014%)
192 kΩ through 250 kΩ (±0.014%)
768 kΩ through 1.01 MΩ (±0.014%)

Instead of using a resistance standard (like the Datron 4000/4000A), you can use a standard resistor with any of the resistance values listed above.

7-27 Calibration Cycle

Periodic calibration should be performed to ensure that the voltmeter is meeting its accuracy specifications. The voltmeter should be calibrated every 90 days or 1 year, dependent on accuracy requirements. Calibration should also be performed if determined by the Performance/Operational Verification Test procedures that calibration is needed.

7-28 Calibration Environment

The HP 44702A/B High Speed Voltmeter may be calibrated in a "bench" environment or system cabinet. For best accuracy, the temperature of the calibration environment should be within ±5° C of the actual operating environment. The HP 44702A/B was calibrated at the factory at an environment temperature of 20° C.

7-29 Calibration Error Codes

In the calibration procedures, the HP 3852A may beep after executing the CAL command. When this happens, look for an error message on the HP 3852A display. The error message most likely indicates some sort of calibration error code and description. These are described as follows:

ERROR 3: BAD NUMBER FORMAT - CAL XXXX (where XXXX is number entered)

This message shows that a letter or other than a number was included in the number executed with the CAL command. For example, typing "O" instead of "0" after another digit within the number causes this error message.

ERROR 71: UNDEFINED WORD - XXXX (where XXXX is number entered)

This shows that the command typed in was invalid. For example, the syntax of the command may be incorrect or an "O" instead of "0" was typed in as the first digit of the number in the CAL command.

ERROR 24: ARGUMENT OUT OF RANGE

This message shows that the number value entered with the CAL command was neither zero nor within the 75% to 99.6% of full scale for the range selected.

ERROR 62: CALIBRATION FAILURE

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This shows that the voltmeter is unable to compensate for the difference between the voltage/resistance measured and the value entered with the CAL command. Use another voltmeter/ohmmeter to determine if the calibration voltage/resistance value applied Input Terminals to the HP 44702A/B is correct. If correct, reset the HP 44702A/B and repeat the calibration procedure. If the error returns, repair of the HP 44702A/B may be necessary.

For any other errors, refer to Appendix B of the HP 3852A Mainframe Configuration and Programming Manual.

7-30 Calibration Procedures

The calibration procedures should be performed in the order they are given. It is especially important to perform the DC Volts Calibration Procedure before performing the Ohms Calibration Procedure. This is necessary because the ohms calibration constants depend on the dc volts calibration constants. The calibration procedures consist of the following:

Section 7-31 - Set-Up Procedure
Section 7-32 - DC Volts Calibration Procedure
Section 7-33 - Ohms Calibration Procedure

WARNING

Even with power removed from the HP 3852A, high voltages, generated in other parts of the system, may be present at the terminal module of each accessory. Service personnel should ensure that all external power is removed from the system before installing, removing, testing or repairing any plug-in accessory.

7-31 Set-Up Procedure

1. Apply power to the HP 3852A and allow the HP 44702A/B High Speed Voltmeter a one hour warm-up period inside the mainframe. This is necessary to stabilize the voltmeter before calibration.

2. Press the RESET button on the HP 3852A front panel. Perform the HP 44702A/B Integrating Voltmeter self-test by executing:

TEST ES00 (where E = extender number, S = slot number)

3. The HP 3852A right display should show:

SELF TEST OK

If the display shows a different message, or if the ERR annunciator is on, the HP 44702A/B High Speed Voltmeter may be failing its self test. Test the voltmeter again by executing the command in step 2. If the voltmeter still fails, repair of the unit may be necessary.

4. Designate the HP 44702A/B to be calibrated by executing:

USE ES00 (where E = extender number, S = slot number)

This command establishes the extender/slot number used in all calibration procedures for command destination. If the HP 3852A is reset or power is removed, it is necessary to perform step 4 again to re-establish the extender/slot number.

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7-32 DC Voltage Calibration

Calibration of the dc volts function consist of calibrating both the function's offset and gain on all ranges.

Offset calibration is performed by applying 0 V using the accessory's Internal Offset Switch. This switch is enabled by executing the CAL 0 command. The switch then disconnects the external connections from the voltmeter input and places a short across the input.

Gain calibration is performed by applying +36 mV, +300 mV, +2.5 V, and +10 V for the 40 mV, 320 mV, 2.56 V, and 10.24 V Ranges, respectively. Although these values are chosen for calibration, other values may be used. Any value that is between 75% and 99.6% of full scale can be used as listed in Table 7-7.

1. DC VOLTAGE OFFSET CALIBRATION. The following calibrates the dc volts function's offset on all ranges.

2. Perform the Set-Up Procedure in Section 7-31, if not previously performed.

3. Set the HP 44702A/B to calibrate dc volts by executing:

```
TERM EXT
FUNC DCV
TRIG SGL
```

If the HP 3852A is reset or power is removed, it is necessary to perform step 3 again to re-establish the setup parameters.

4. Calibrate the offset on all ranges by executing:

```
CAL 0
```

5. DC VOLTAGE GAIN CALIBRATION. The following calibrates the dc volts function's gain on all ranges.

6. Set the DC Voltage Standard output to +36 mV. Then connect the DC Voltage Standard to the rear HI and LO Input Terminals of the HP 44702A/B High Speed Voltmeter accessory. The connections are shown in Figure 7-7. Make sure shielded twisted pair cables are used for the connections as shown in the figure.

7. Calibrate the 40 mV Range by executing the following commands.

```
RANGE .036
CAL .036
```

8. Set the DC Voltage Standard output to +300 mV.

9. Calibrate the 320 mV Range by executing the following commands.

```
RANGE .3
CAL .3
```

10. Set the DC Voltage Standard output to +2.5 V.

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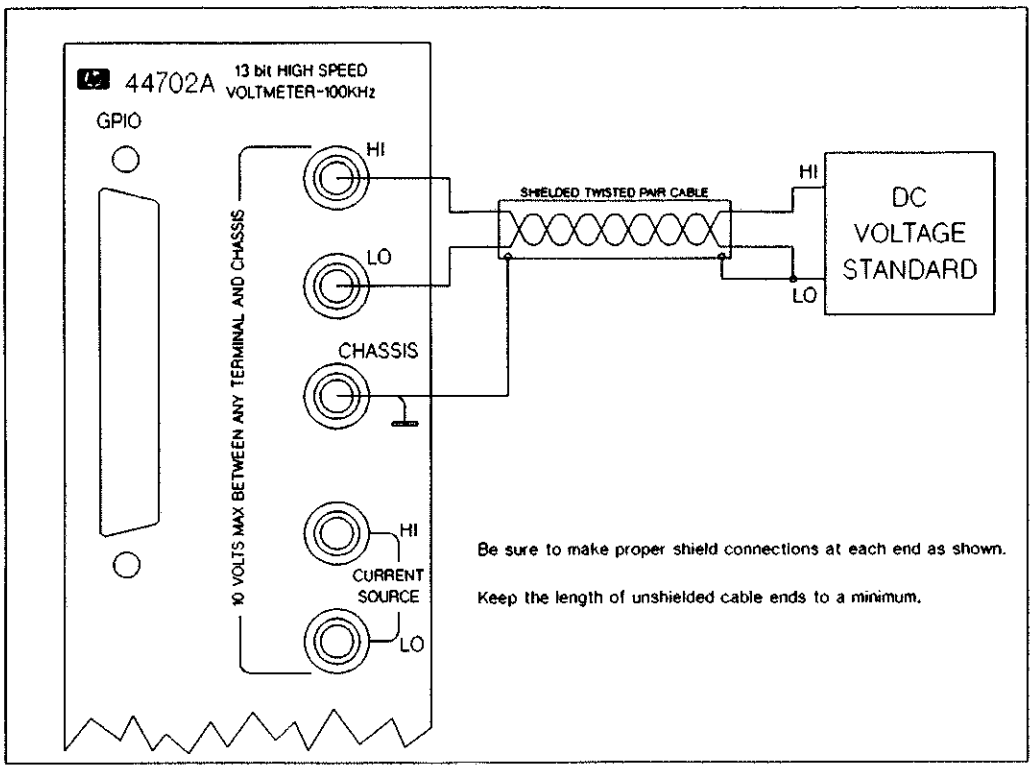


Figure 7-7 DC Voltage Gain Calibration Connections

11. Calibrate the 2.56 V Range by executing the following commands.

```
RANGE 2.5
CAL 2.5
```

12. Set the DC Voltage Standard output to +10 V.

13. Calibrate the 10.24 V Range by executing the following commands.

```
RANGE 10
CAL 10
```

14. Remove the DC Voltage Standard from the HI and LO Input Terminals.

7-33 Ohms Calibration

Make sure DC Volts Calibration in Section 7-32 has been performed before doing Ohms Calibration.

The current sources used for ohms measurements are precision matched and rely on a single gain constant. Therefore, only a single current source needs calibration using a single 10 Kohm resistance value. Although a 10 Kohm value is chosen, any value listed in Section 7-26 step 3 can be used.

Use the following priorities to select the resistance value other than the recommended value.

a. Use a value that calibrates the largest current source/lowest resistance function (i.e., 1 mA/10 Kohm function).

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b. A value that is nearest to 99.6% of full scale of a range.

c. Use the highest range within a function.

1. OHMS GAIN CALIBRATION. The following calibrates the ohms function's gain on all ranges.

2. Perform the Set-Up Procedure in Section 7-31, if not previously performed.

3. Set the HP 44702A/B to calibrate ohms by executing:

```
FUNC OHMF10K
```

The command FUNC OHMF10K selects the 1 mA current source/10 Kohm function. This current source is selected when using a 10 Kohm resistance value for calibration. If a different resistance value is used, select the appropriate current source using the priorities previously listed. For example, select the 100 µA current source by executing FUNC OHMF100K if a 3 Kohm value is used.

11. If using the Resistance Standard, set its output to 10 Kohm (or 3 Kohm). If using a Standard Resistor, select any value listed in Section 7-26 step 3.

12. Connect the Resistance Standard/Standard Resistor to the rear HI and LO Input Terminals of the HP 447021A/B High Speed Voltmeter. The connections are shown in Figure 7-8. If using the Resistance Standard, the cable shields must be connected at the HP 44702A/B chassis and must be disconnected at the Resistance Standard

13. Calibrate ohms by executing:

```
RANGE 10E3
CAL 10E3
```

The commands RANGE 10E3 and CAL 10E3 are used only if a 10 Kohm resistance value is used for calibration. If a different resistance value is used, change the commands to reflect that value. For example, use RANGE 3E3 and CAL 3E3 if a 3 Kohm resistance value is used.

14. When calibration is completed, remove the Resistance Standard/Standard Resistor from the HI and LO Input Terminals.

THIS CONCLUDES THE HP 44702A/B CALIBRATION PROCEDURES.

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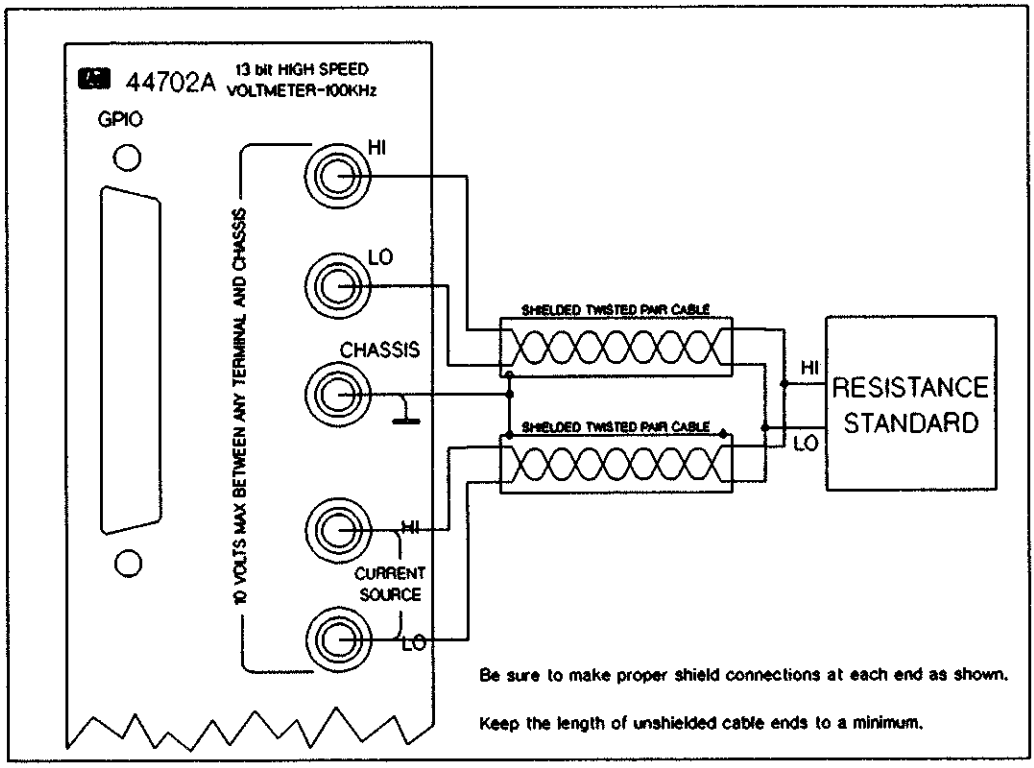


Figure 7-8a Ohms Gain Calibration Connections Using a Resistance Standard

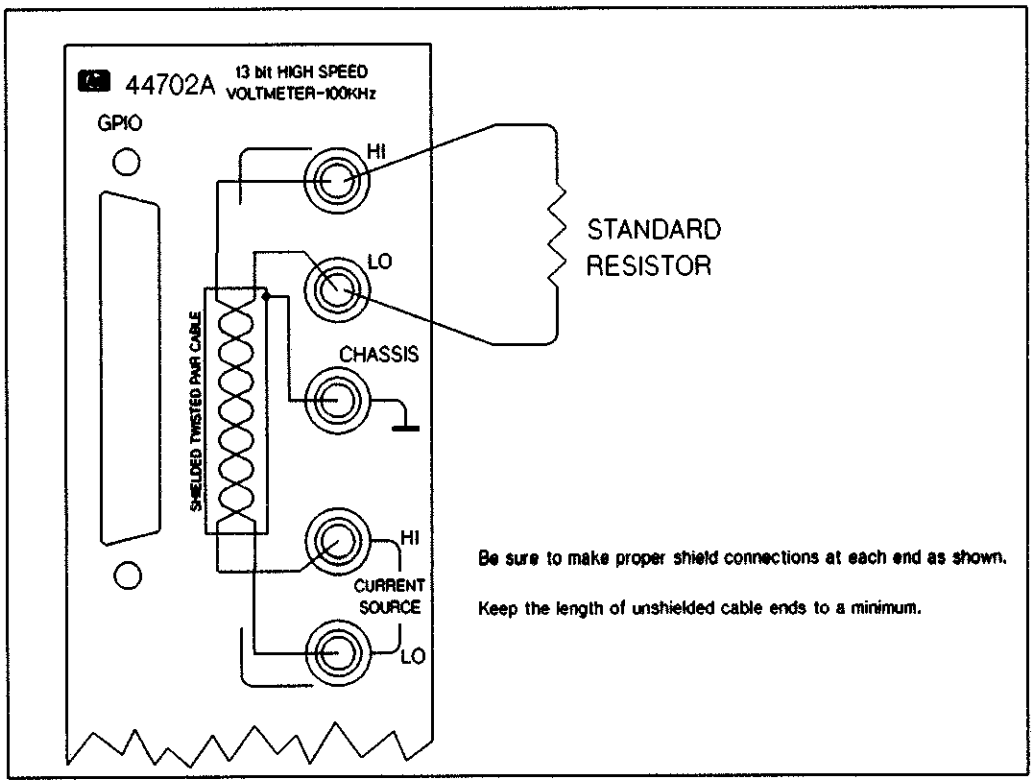


Figure 7-8b Ohms Gain Calibration Connections Using a Standard Resistor

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7-34 REPLACEABLE PARTS

To order a part listed in Table 7-8, quote the Hewlett-Packard part number, the check digit (abbreviated CD in Table 7-8), the HP factory reference, and the quantity desired. Address the order to the nearest Hewlett-Packard Sales Office. Hewlett-Packard Sales Offices are listed at the back of this manual.

CAUTION

The printed circuit boards in the HP 44702A/B are static sensitive devices. Refer to Chapter 5 for additional information about handling static sensitive devices.

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Table 7-8 HP 44702A/B 13-bit High Speed Voltmeter

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44702A	13-bit high speed voltmeter (8kRdg)	1	44702A	9	HI-SPD VM/8KRDG
44702B	13-bit high speed voltmeter (64kRdg)	1	44702B	1	HI-SPD VM/64KRDG
A1	PCA; high speed voltmeter digital	1	44702-66501	1	PCA-HS VM,DIGITL
A2	PCA; high speed voltmeter analog	1	44702-66502	2	PCA-HS VM ANALOG
A3	PCA; high speed voltmeter 56kRdg mem	1	44702-66503	3	PCA-VM MEM 56KRD
MP1	Screw; rear panel and A1/A2 PCAs	8	0515-0886	3	SCR-PH M3.0X6 LK
MP2	Hex standoff; GPIO connector	2	0380-1332	9	STDF-HEX .18-IN
MP3	Lock washer; GPIO connector	2	2190-0577	1	WSHR-LK SCR-10
MP4	Terminal; rear panel input	5	1510-0091	3	BDG POST ASSYRED
MP5	Spring washer; rear panel input term	5	3050-0593	6	WSHR-SPR-CRVD
MP6	Nut; rear panel input terminal	5	2950-0001	8	NUT-HEX-DBL CHAM
MP7	Pull lever; (molded)	1	03852-45002	8	MLD-PULL LEVER
MP8	Panel; rear 44702A/B (no 44702B lbl)	1	44702-00201	0	0601 PNL-RR,A/D
MP9	Label; rear panel 44702B (only)	1	44702-84334	6	LBL-PNL,44702B
MP10	Screw; A3 PCA	2	0515-1060	7	SCR PH M3.0X25
MP11	Cable; rear panel input, with socket	1	44702-61602	3	CBL-6P VM IN
MP12	Label; "maximum number assemblies.."	1	03852-84326	1	LBL-CAUTION,PWR
MP13	Cover; left (aluminum)	1	44702-04101	7	0601 COVER,LEFT
MP14	Cover; right (aluminum)	1	44702-04102	8	0601 COVER-RIGHT
MP15	Shield; between A1 and A2 (aluminum)	1	44702-00601	4	0601 SHIELD-CNTR
MP16	Screw; right and left covers	4	0515-1322	4	SCR-FH M3.0X30LK
MP17	Cable; analog A1 to A2, with sockets	1	44702-61601	2	CBL-11P F/F KEYD
MP18	Label; "STOP" internal cable warning	1	44711-84321	2	LBL-CAUTION-STOP

Restored Assemblies/Modules

The following restored assemblies/modules are available through the HP Exchange Program at a discount. For details see Section 1-19.

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44702A	13-bit high speed voltmeter (8kRdg)		44702-69201	4	RBLT-44702A
44702B	13-bit high speed voltmeter (64kRdg)		44702-69203	6	RBLT-44702B

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TEST PROGRAM 7-1

```
10    ! Autorange test program for the HP 44702A/B
20    !
30    Addr=709                                  ! HP 3852A HP-IB Address.
40    Slot=100                                  ! HP 44702A/B slot.
50    OUTPUT Addr;"RST"                         ! Resets HP 3852A.
60    DISP "RESETTING THE HP 3852A, PLEASE WAIT."
70    WAIT 2
80    DISP "Press STOP or PAUSE to stop program execution."
90    OUTPUT Addr;"USE "&VAL$(Slot)&";TERM EXT;FUNC DCV;TRIG INT"
100   OUTPUT Addr;"XRDGS "&VAL$(Slot)&",1,PACK"
110   ENTER Addr USING "%,W";Packed       ! Enter into packed.
120   Good_flag=BINAND(Packed,-32768)     ! Check bit 15.
130   IF NOT (BIT(Good_flag,15)) THEN
140     PRINT "Input amp saturation detected by HP 44702A/B."
150     PRINT "Program aborted."
160     STOP
170   ELSE
180     Range=SHIFT(BINAND(Packed,24576),13) ! Check bits 14 and 13.
190   END IF
200   Sign=1
210   IF BIT(Packed,12) THEN Sign=-1
220   Raw_mag=BINAND(Packed,4095)             ! Strips the 4 msb's.
230   IF Range=0 THEN Volts=Raw_mag*.04/4096*Sign
240   IF Range=1 THEN Volts=Raw_mag*.32/4096*Sign
250   IF Range=2 THEN Volts=Raw_mag*2.56/4096*Sign
260   IF Range=3 THEN Volts=Raw_mag*10.24/4096*Sign
270   PRINT "VOLTAGE = ",Volts
280   IF Range=0 THEN PRINT "RANGE = 40 mV"
290   IF Range=1 THEN PRINT "RANGE = 320 mV"
300   IF Range=2 THEN PRINT "RANGE = 2.56 V"
310   IF Range=3 THEN PRINT "RANGE = 10.24 V"
320   PRINT
330   WAIT 1
340   GOTO 100
350   END
```


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TEST PROGRAM 7-2

```
10     ! Test Program to check the GPIO interface on the HP 44702A/B
20     ! High Speed Voltmeter.
30     !
40     ! Make sure the GPIO Interface Card is configured correctly.
50     !
60     ! Make sure the variable 'Gpio' matches the address selection
70     | switch on the GPIO Interface Card.
80     !=============================================================
90 Main_program:    !
100    !=============================================================
110    !
120    REAL Test_word,Not_test_word,Inverted,Non_inverted
130    INTEGER Gpio,Failed
140    !
150    Gpio=12                                  ! GPIO Address
160    Failed=0                                 ! Failure flag initialized
170    Test_word=21846                          | Pattern of 010101...
180    Not_test_word=-24846                     ! Pattern of 101010...
190    !
200    CONTROL Gpio,2;5                         ! Sends Echo command to
210    OUTPUT Gpio USING "#,W";3                ! the HP 44702A/B
220    CONTROL Gpio,2;4
230    OUTPUT Gpio USING "#,W";193
240    WAIT .1
250    !
260    CONTROL Gpio,2;5                         ! Sends data to be echo'd
270    OUTPUT Gpio USING "#,W";2                ! by the HP 44702A/B
280    CONTROL Gpio,2;4
290    OUTPUT Gpio USING "#,W";Test_word
300    WAIT .1
310    !
320    CONTROL Gpio,2;5                         ! Reads first echo'd data
330    OUTPUT Gpio USING "#,W";2                ! from the HP 44702A/B
340    CONTROL Gpio,2;4
350    ENTER Gpio USING "#,W";Inverted
360    WAIT .1
370    !
380    CONTROL Gpio,2;5                         ! Reads second echo'd data
390    OUTPUT Gpio USING "#,W";2                ! from the HP 44702A/B
400    CONTROL Gpio,2;4
410    ENTER Gpio USING "#,W";Non_inverted
420    !
430    IF Non_inverted<>Test_word THEN Failed=1
440    IF Inverted<>Not_test_word THEN Failed=1
450    !
```


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TEST PROGRAM 7-2 (Cont.)

```
460   IF FAILED THEN
470      PRINT "HP 44702A/B's GPIO failed to echo data properly."
480      PRINT "Inverted = ",Inverted
490      PRINT "Non-inverted = ",Non_inverted
500      PRINT "This test is complete."
510   ELSE
520      PRINT "HP 44702A/B passed the GPIO Test."
530      PRINT "This test is complete."
540   END IF
550   !
560   END
```


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CHAPTER 8
HP 44705A/44705H/44706A/44708A/44708H RELAY MULTIPLEXERS
HP 44717A/44718A STRAIN GAGES

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CHAPTER 8
HP 44705A/44705H/44706A/44708A/44708H RELAY MULTIPLEXERS
HP 44717A/44718A STRAIN GAGES

8-1 INTRODUCTION

This chapter provides a technical description, performance test procedures, relay troubleshooting procedures, and replaceable parts lists for the HP 44705A/H 20 Channel Relay Multiplexer, the HP 44706A 60 Channel Single Ended Relay Multiplexer, and the HP 44708A/H 20 Channel Relay Multiplexer with Thermocouple Compensation. This chapter also has a technical description and replaceable parts list for the HP 44717A 10 Bridge 120Ω Static Strain Gage Relay Multiplexer and the HP 44718A 10 Bridge 350Ω Static Strain Relay Multiplexer Accessories.

NOTE

The Strain Gage accessories can only be used with instruments having a firmware revision of 2.0 or above. Determine the firmware revision by sending the "IDN?" *command.*

8-2 HP 44705A Technical Description

The HP 44705A/H 20 Channel Relay Multiplexer has two main assemblies: the component module and the terminal module. The component module contains the backplane interface electronics, the relay control logic, and the relays. The terminal module contains terminal strips for connecting external wiring and provides mounting holes for user installed components such as: one pole low pass filters, voltage dividers, current shunt resistors (to allow current measurements), surge current limit resistors or fuses.

Figure 8-1 shows a simplified schematic of the HP 44705A/H. In the component module, the relays are electrically arranged into channel relays and tree relays. The channel relays are further arranged into two banks of 10. These banks are referred to as Bank A and Bank B. Each bank has its own set of common terminals and can be controlled independently of the other bank. In normal operation, only one channel in each bank may be closed at a time. The relays used are triple-pole single-throw relays (TPST). This allows HIGH, LOW, and GUARD to be switched, in unison, for all channels.

The tree switch relays are controlled independently from the channel relays. There are four tree relays: two connected to the backplane analog source bus and two connected to the backplane analog sense bus. These relays allow channel connections to the backplane bus. The backplane analog bus can be used for measurements by either of the plug-in accessory voltmeters (HP 44701A or HP 44702A/B). The sense bus is used for voltage measurements. The source bus provides a current source (generated by either the HP 44701A or HP 44702A/B) for resistance measurements. The tree relays are controlled by giving them channel numbers. The relays have channel numbers 91, 92, 93, and 94. Channels 91 and 92 are the sense bus tree relays, channels 93 and 94 are the source bus tree relays.

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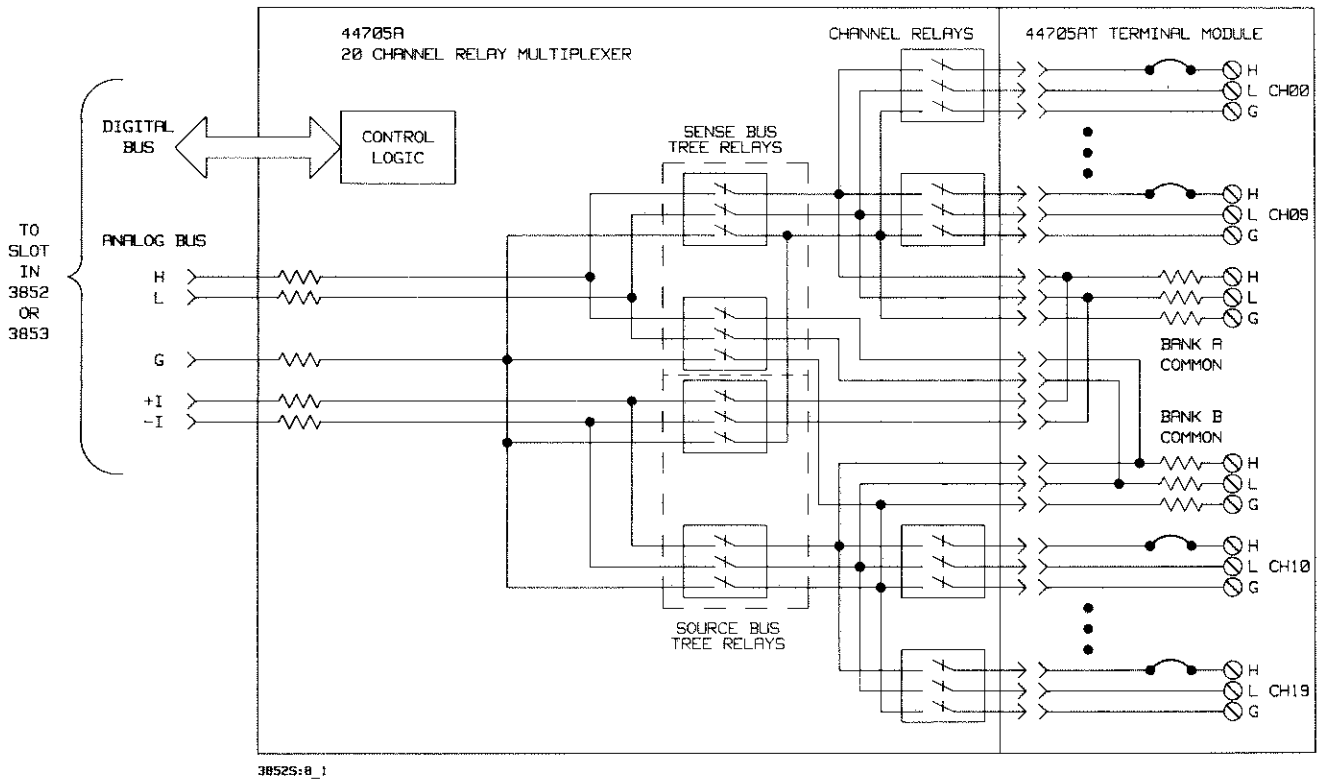


Figure 8-1 HP 44705A/H Simplified Schematic

Four-wire ohms measurements can be made by pairing a channel in Bank A with a channel in Bank B. One of the paired channels provides the current source from the backplane analog source bus and the other channel provides a voltage measurement path through the backplane analog sense bus. Two wire ohms measurements are possible at each channel by combining the backplane source bus and sense bus at the channel relay.

An isolation jumper is provided in the component module of the HP 44705A that enables or disables the tree relay drive lines. This jumper provides a positive means to isolate the backplane analog bus from the signals present on the channel inputs. The tree relay drive lines are isolated when the jumper is set to the disable position.

8-3 HP 44706A Technical Description

The HP 44706A 60 Channel Single Ended Relay Multiplexer has two main assemblies: the component module and the terminal module. The component module contains the backplane interface electronics, the relay control logic and the relays. The terminal module contains the terminal strips for connection to external wiring.

Figure 8-2 shows a simplified schematic of the HP 44706A. In the component module, the relays are arranged into channel relays and tree relays. For the HP 44706A, the backplane analog bus is the common connection of the multiplexer channels. On the terminal module, LOW and GUARD are common for all channels.

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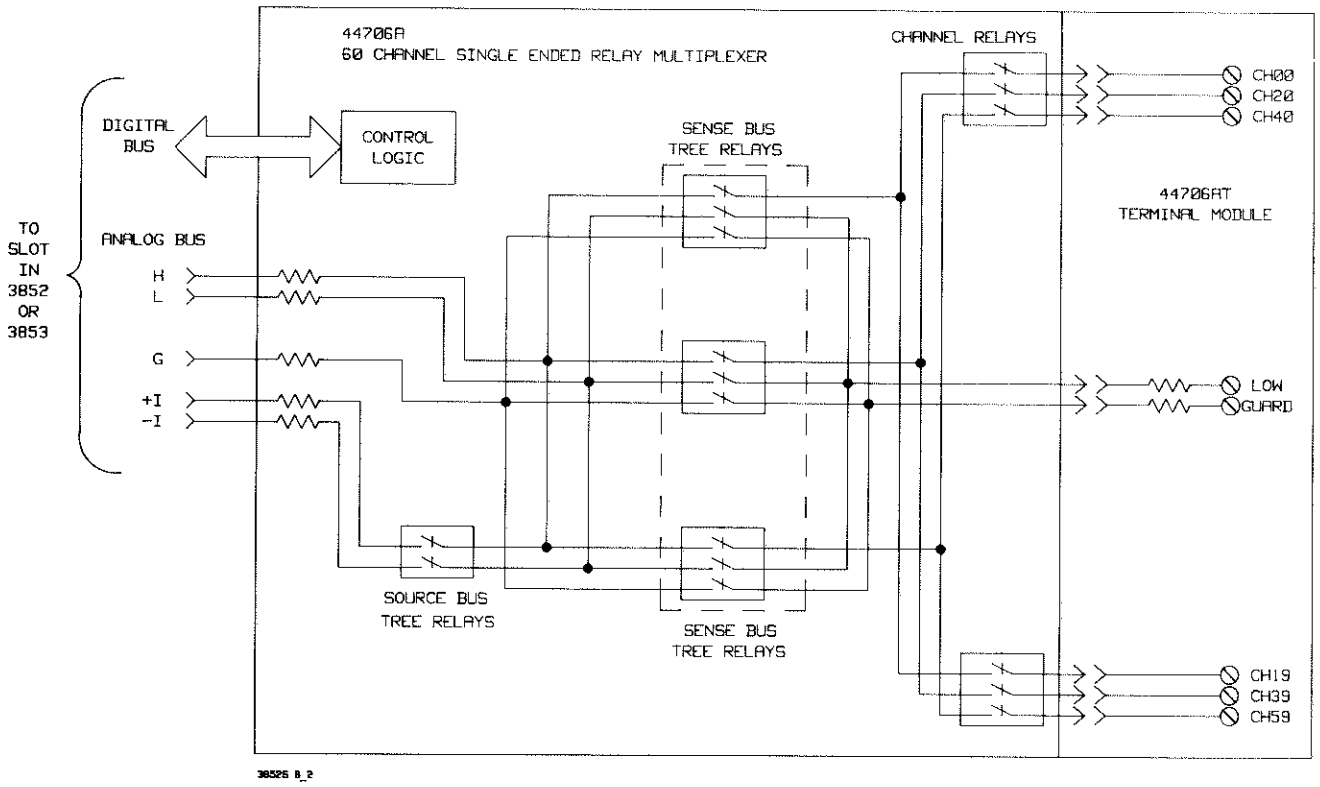


Figure 8-2 HP 44706A Simplified Schematic

The channel relays are triple-pole, single throw relays. Each channel relay switches three channels. Selection of the desired channel is accomplished by closing one of three sense bus tree relays. Thus, closing a specified channel closes the appropriate channel relay and one of the three sense bus tree relays. In normal operation, only one channel may be closed at a time.

The backplane analog source bus tree relay is used when the HP 44706A is programmed for resistance measurements and allows the current source bus to be connected to the desired channel. The current source is provided by one of the two plug-in voltmeter accessories (HP 44701A or HP 44702A/B). The source bus tree relay has a channel number of 91. The HP 44706A only supports two-wire ohms measurements at each channel.

8-4 HP 44708A/H Technical Description

The HP 44708A/H 20 Channel Relay Multiplexer with Thermocouple Compensation has two main assemblies: the component module and the terminal module. The component module contains the backplane interface electronics, the relay control logic, and the relays. The terminal module contains terminal strips for connecting external wiring, a thermocouple mounted in a thermal block, and provides mounting holes for user installed components such as: one pole low pass filters, voltage dividers, current shunt resistors (to allow current measurements), surge current limit resistors or fuses.

The HP 44708A/H component module is the same module used in the HP 44705A/H. The HP 44708A/H is made unique by the addition of the terminal module. A simplified schematic of the HP 44708A/H is given in Figure 8-3. Section 8-2 provides a technical description of the HP 44705A/H which also applies to the HP 44708A/H component module. Because the HP 44708A/H terminal module uses two of the tree switches to measure the thermocouple, ohms measurements at each channel are limited to two-wire ohms.

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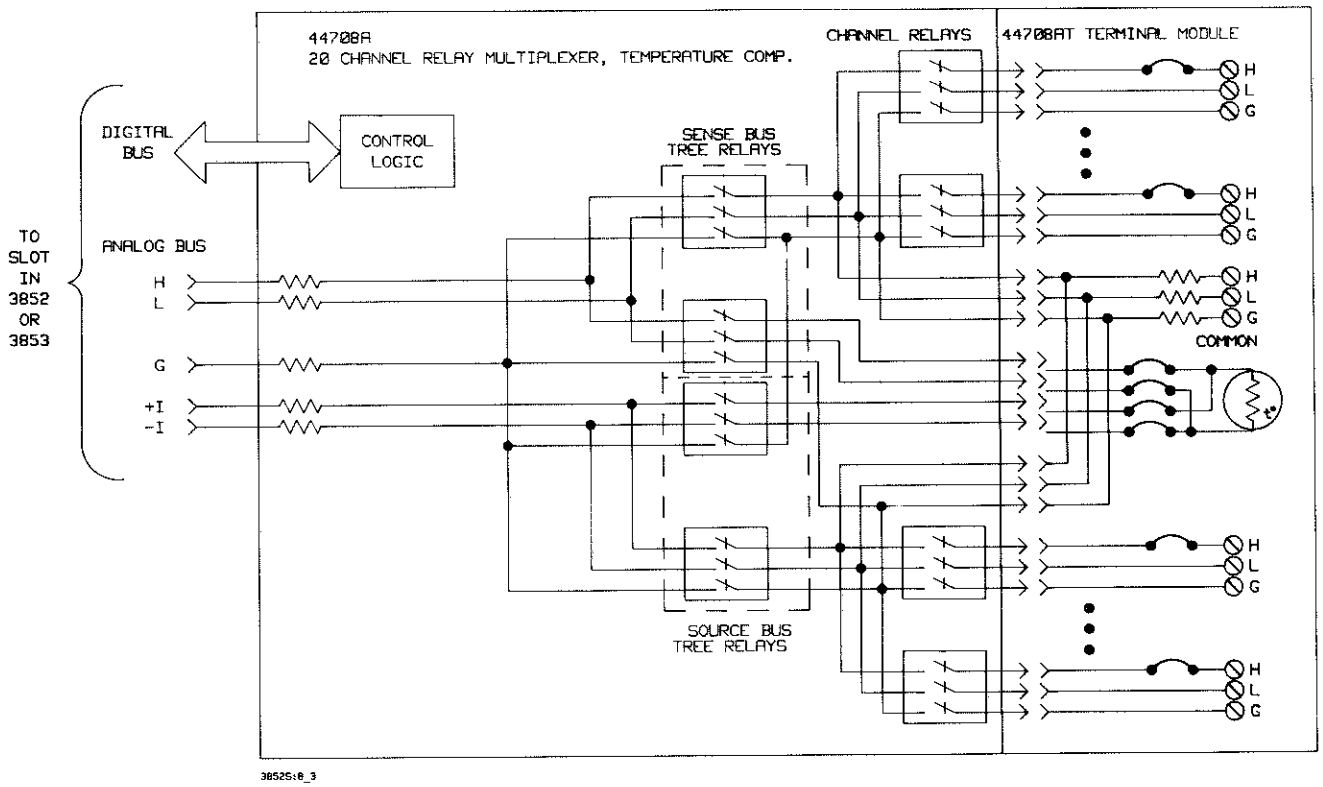


Figure 8-3 HP 44708A/H Simplified Schematic

On the terminal module, only one common connection is provided for all 20 channels. The addition of the thermistor in the thermal block on the terminal module provides for temperature compensation measurements. The thermistor is read as a four wire ohms measurement by closing a sense bus and a source bus tree relay.

8-5 HP 44717A and HP 44718A Technical Description

The HP 44717A and HP 44718A Strain Gages modules work in conjunction with HP 44705A 20 Channel Multiplexer Relay Assemblies to make strain gage measurements. (see Section 8-2 for a description of the multiplexer assembly) The HP 44717A is used for 120Ω strain gage measurements and the HP 44718A is used for 350Ω measurements. The modules contain terminal strips for making external connections for quarter, half, and/or full bridge configurations.

Figure 8-4 shows a simplified schematic of the HP 44717A and 44718A strain gage modules and also shows the different strain gage configurations. The actual strain gage measurements are made through the 20 Channel Relay Multiplexer using either the HP 44701A 5 1/2 Digit Integrating Voltmeter, the HP 44702A/B 13 Bit High Speed Voltmeter, or an external voltmeter. Only 10 channels of the multiplexer are used for strain gage measurements. The other 10 channels are used to measure the external bridge exitation voltage, shunt verification, gage isolation, internal half bridge voltage, guard voltage, and leadwire resistance. These channels only check the external connections to the strain gage module, and not the operation of the strain gage module itself.

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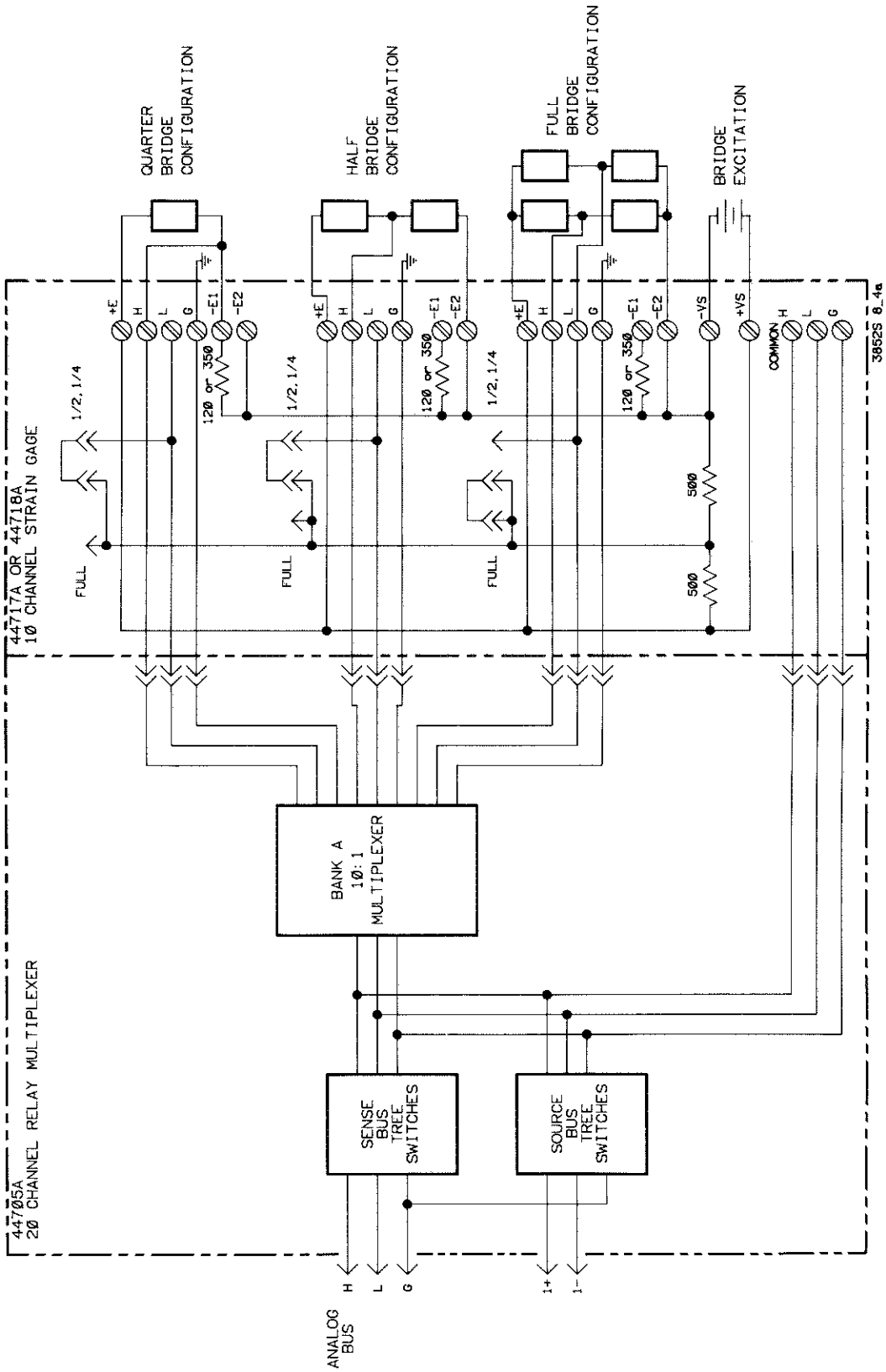


Figure 8-4 HP 44717A/44718A Simplified Schematic

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8-6 Read And Write Registers

The HP 3852A local controller communicates with each plug-in accessory by using read and write registers. All accessory commands are translated into appropriate register commands by the HP 3852A local controller. The SREAD and SWRITE commands are used to directly control each accessory register.

SREAD and SWRITE are described in detail in Chapter 2 of this manual. Table 8-1 shows the registers implemented on the HP 44705A/H, HP 44706A, and HP 44708A/H.

CAUTION

Using the primitive commands (SREAD and SWRITE) may cause unexpected and undesirable effects on the plug-in accessories. It is possible to program some plug-in accessories into illegal and potentially damaging states with these commands. The commands are documented here for service purposes only.

Table 8-1 Relay Multiplexer Read and Write Registers

Register #	READ Registers	WRITE Registers
0	Accessory Identification	Accessory Reset
1	Accessory Status	Not Used
2	Relay Status	Not Used
3	Not Used	Relay Opening
4	Not Used	Not Used
5	Not Used	Not Used
6	Not Used	Relay Closing

8-7 Read Registers

8-8 Register 0. Read Register 0 contains the accessory identification. Eight bits are used for the identification. The eight bits are output from the register on the lower eight backplane data bits (BD0-BD7). The upper eight backplane data bits (BD8-BD15) are pulled high when the register is read.

The eight bit identification is a two part identification. The most significant five bits identify the component module, the least significant three bits identify the terminal module. If a terminal module is not present, the lower three bits are pulled high on the component module. The HP 3852A local controller can thus identify the type of plug-in accessory installed and determine if a terminal module is installed. If a terminal module is installed, the type of terminal is also identified.

At power-on or after a reset, the HP 3852A local controller reads the Accessory Identification register and determines the type of accessory installed. The local controller will then not allow incorrect accessory commands to be sent to that slot. If the local controller determines that a terminal module is not installed, the local controller will not allow any commands (except SREAD and SWRITE) to be sent to the slot.

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Table 8-2 lists the two's compliment decimal equivalent codes returned in response to an SREAD of Register 0 for all combinations of the modules.

Table 8-2 HP 44705A, HP 44706A, and HP 44708A Identification Codes

Module Combinations	Codes
HP 44705A Component Module (no terminal module installed)	3847
HP 44705A Component Module, HP 44705AT Terminal Module installed	3840
HP 44705A Component Module, HP 44708AT Terminal Module installed	3842
HP 44705A Component Module, HP 44717AT Terminal Module installed	3844
HP 44705A Component Module, HP 44718AT Terminal Module installed	3845
HP 44706A Component Module, (no terminal module installed)	4087
HP 44706A Component Module, HP 44706AT Terminal Module installed	4080

8-9 Register 1. Read Register 1 contains the accessory status word. This status word is used by the local controller to control data and commands sent to the multiplexer. Bit 1 in this register is the BUSY bit, used to indicate to the local controller that the relay multiplexer is executing a previous command and is not ready to receive a new command.

8-10 Register 2. Read Register 2 is the relay status register. This register uses backplane data bits 0 through 11 to indicate the current status of each relay on the multiplexer. Figure 8-5 shows the relay status word.

```
Bits:      15  14  13  12 | 11  10  9   8 | 7  6  5  4 | 3  2  1  0
Meaning:   0   0   0   0  |  Tree Relays  |  Bank B    |   Bank A
                           94  93  92  91  (K10 - K19)    (K0 - K9)
```

Figure 8-5 Relay Multiplexer Read Register 2 Status Word

In the status word four bits (8 through 11) are used to indicate the the status of the tree relays (tree relays are referred to as channels 91 through 94. Four bits (4 through 7) represent the status of the relays in Bank B and four bits (0 through 3) represent the status of relays in Bank A. With no relays closed, the two most significant Bank A and Bank B status bits are set. When a channel is closed, the decimal equivalent of the four-bit binary code represents the channel number.

For example, reading Register 2 following a reset (no relays closed) will return a decimal value of 204 (binary 0000000011001100). Closing channel 00 would result in a register value of 192 (binary 0000000011000000). Note that the Bank B bits are not reset (since channel 00 is in Bank A). Closing channel 01 gives a register value of 193 (binary 0000000011000001).

The result of an opening or closing command is not placed in the register until the action has occurred. A delay of at least 1.1 milliseconds must be used between sending a relay close or open command and reading Register 2 to ensure that the register contains the new status.

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8-11 Write Registers

8-12 Register 0. Write Register 0 is the accessory reset register. Any data written to this register will cause a reset of all relays and stop opening and closing coordination. A write to Register 0 produces the same result on the accessory as a system reset (backplane reset) or slot reset.

8-13 Register 3. Write Register 3 is the opening register. Writing a command word to register 4 will cause the OPENING pulse to be asserted on the backplane and will execute the relay opening indicated in the command word. The command word is described in Section 8-15.

8-14 Register 6. Write Register 6 is the closing register. Writing a command word to register 6 will cause the CLOSING pulse to be asserted on the backplane and will execute the relay closures indicated in the command word. However, the relay will only close after the opening pulse on the backplane is completed, if present. The command word is described in Section 8-15.

8-15 Command Word

The command word uses 15 bits. The bits are arranged into mask bits, tree relay bits, Bank A relay bits and Bank B relay bits. Figure 8-6 represents the command word. The command word is used for both opening and closing the relays. The opening or closing function is determined by the register number receiving the command word (Register 4 for opening, Register 6 for closing).

```
Bits:      15 14 13 12 | 11 10  9  8 | 7 6 5 4 | 3 2 1 0
Meaning:   X  T  B  A  | Tree Relays | Bank B  | Bank A
             (mask)
```

Figure 8-6 Relay Command Word

The mask bits in the command word determine which set of relays will be operated upon. Bit 14 sets the tree relay mask, bit 13 the Bank B relay mask, and bit 12 the Bank A relay mask. When the mask bit is set, the corresponding four bits of the command word are used to control the relays. More than one mask bit can be set at a time.

The correspondence of the Tree Relay bits are in Table 8-3.

Table 8-3 Relay Correspondence

Bit	HP 44705A/44708A HP 44705H/44708H	HP 44706A	Relay
11	Ch 94	Ch 40-59	K20
10	Ch 93	Ch 20-39	K21
9	Ch 92	Ch 00-19	K22
8	Ch 91	Ch 91	K23

The Bank A and Bank B bits can be decoded as a decimal number corresponding to the channel number. Each set of four bits (0 through 3 or 4 through 7) is individually decoded (depending upon the mask bits set). Bank B bits are also decimally decoded into channel numbers but are a decade ahead of the Bank A channel numbers (Bank A channel 00 corresponds to Bank B channel 10).

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8-16 SPECIFICATIONS

Specifications for the HP 44705A/H, HP 44706A, and HP 44708A/H are given in Table 8-4. Specifications are the performance standards or limits against which the relay multiplexers may be tested.

NOTE

The installation of the HP 44705A/H or HP 44708A/H reduces the maximum allowable analog backplane voltages to ±170 V peak between any two points in the circuit or between the circuit and chassis.

The installation of the HP 44706A reduces the maximum allowable analog backplane voltages to ±42 V peak between any two points in the circuit or between the circuit and chassis.

Table 8-4 HP 44705A/05H/06A/08A/08H/17A/18A Specifications

HP 44705A 20 Channel Relay Multiplexer

Maximum Switch Rate: 450 channels/second

Maximum Input Voltage: 170 V peak or 120 V DC between any two points (Terminal or Chassis)

Maximum Input Current: 50 mA non-inductive per channel

Maximum Input Power: 1 VA RMS per channel

Characteristic Relay Lifetime:

Voltage*	Number of on/off Cycles
10 V peak or 7 V DC	10^8
40 V peak or 30 V DC	$1.5*10^7$
100 V peak or 70 V DC	10^7

Input Impedance: >10^9 Ω High to Low, Low to Guard, and Guard to Chassis Terminals

Bandwidth: 1.0% flatness at 1 MHz, -3 dB Bandwidth at 10 MHz (50 Ω source, 1 MΩ termination)

Crosstalk: -70 dB at 100 kHz (channel-to-channel, 50 Ω source, 1 MΩ termination)

Maximum Offset Voltage: 2 µV (between High and Low)

Maximum Bias Current: ±1 nA DC (Current sourced by High, Low, or Guard to Chassis into Input Terminals or back plane)

Maximum Wire Size: 16 AWG

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Table 8-4 HP 44705A/05H/06A/08A/08H/17A/18A Specifications (Cont.)

HP 44705H 20 Channel High Voltage Relay Multiplexer

Maximum Switch Rate: 250 channels/second

Maximum Input Voltage: 354 V peak or 250 V DC between any two points (Terminal or Chassis)

Maximum Input Current: 50 mA non-inductive per channel (15 mA in Guard Terminal)

Maximum Input Power: 1 VA RMS per channel

Characteristic Relay Lifetime:

Voltage*	Number of on/off Cycles
10 V peak or 7 V DC	10^8
40 V peak or 30 V DC	$1.5*10^7$
100 V peak or 70 V DC	10^7
354 V peak (250 V RMS Sine)	10^6
200 V DC	$5*10^5$

Input Impedance: >10^9 Ω High to Low, Low to Guard, and Guard to Chassis Terminals

Bandwidth: 1.0% flatness at 1 MHz, -3 dB Bandwidth at 5 MHz (50 Ω source, 1 MΩ termination)

Crosstalk: -35 dB at 100 kHz (channel-to-channel, 50 Ω source, 1 MΩ termination)

Maximum Offset Voltage: 10 µV (between High and Low)

Maximum Bias Current: ±1 nA DC (Current sourced by High, Low, or Guard to Chassis into Input Terminals or back plane)

Maximum Wire Size: 16 AWG

HP 44706A 60 Channel Single Ended Relay Multiplexer

Maximum Switch Rate: 450 channels/second

Maximum Input Voltage: 42 V peak or 30 V DC between any two points (Terminal or Chassis)

Maximum Input Current: 50 mA non-inductive per channel

Maximum Input Power: 1 VA RMS per channel

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Table 8-4 HP 44705A/05H/06A/08A/08H/17A/18A Specifications (Cont.)

Characteristic Relay Lifetime:

Voltage*	Number of on/off Cycles
10 V peak or 7 V DC	10^8
40 V peak or 30 V DC	$1.5*10^7$
100 V peak or 70 V DC	10^7

Input Impedance: >10^9 Ω High to Low, Low to Guard, and Guard to Chassis Terminals

Bandwidth: 1.0% flatness at 1 MHz, -3 dB Bandwidth at 10 MHz (50 Ω source, 1 MΩ termination)

Crosstalk: -70 dB at 100 kHz (channel-to-channel, 50 Ω source, 1 MΩ termination)

Maximum Offset Voltage: 200 µV (between High and Low)

Maximum Bias Current: ±1 nA DC (Current sourced by High, Low, or Guard to Chassis into Input Terminals or back plane)

Maximum Wire Size: 16 AWG

HP 44708A 20 Channel Relay Multiplexer With Thermocouple Compensation

Maximum Switch Rate: 450 channels/second

Maximum Input Voltage: 170 V peak or 120 V DC between any two points (Terminal or Chassis)

Maximum Input Current: 50 mA non-inductive per channel

Maximum Input Power: 1 VA RMS per channel

Characteristic Relay Lifetime:

Voltage*	Number of on/off Cycles
10 V peak or 7 V DC	10^8
40 V peak or 30 V DC	$1.5*10^7$
100 V peak or 70 V DC	10^7

Input Impedance: >10^9 Ω High to Low, Low to Guard, and Guard to Chassis Terminals

Bandwidth: 1.0% flatness at 1 MHz, -3 dB Bandwidth at 10 MHz (50 Ω source, 1 MΩ termination)

Crosstalk: -70 dB at 100 kHz (channel-to-channel, 50 Ω source, 1 MΩ termination)

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Table 8-4 HP 44705A/05H/06A/08A/08H/17A/18A Specifications (Cont.)

Maximum Offset Voltage: 2 µV (between High and Low)

Maximum Bias Current: ±1 nA DC (Current sourced by High, Low, or Guard to Chassis into Input Terminals or back plane)

Maximum Wire Size: 16 AWG

Ref. Junction Compensation Accuracy: 0.1 °C (over 18 to 28 °C operating temperature)

Max Temperature Difference Across Isothermal Module: 0.2 °C

HP 44708H 20 Channel High Voltage Relay Multiplexer with Thermocouple Compensation

Maximum Switch Rate: 250 channels/second

Maximum Input Voltage: 354 V peak or 250 V DC between any two points (Terminal or Chassis)

Maximum Input Current: 50 mA non-inductive per channel (15 mA in Guard Terminal)

Maximum Input Power: 1 VA RMS per channel

Characteristic Relay Lifetime:

Voltage*	Number of on/off Cycles
10 V peak or 7 V DC	10^8
40 V peak or 30 V DC	$1.5*10^7$
100 V peak or 70 V DC	10^7
354 V peak 250 V RMS (sine)	10^6
200 V DC	$5*10^5$

Input Impedance: >10^9 Ω High to Low, Low to Guard, and Guard to Chassis Terminals

Bandwidth: 1.0% flatness at 1 MHz, -3 dB Bandwidth at 5 MHz (50 Ω source, 1 MΩ termination)

Crosstalk: -35 dB at 100 kHz (channel-to-channel, 50 Ω source, 1 MΩ termination)

Maximum Offset Voltage: 10 µV (between High and Low)

Maximum Bias Current: ±1 nA DC (Current sourced by High, Low, or Guard to Chassis into Input Terminals or back plane)

Maximum Wire Size: 16 AWG

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Table 8-4 HP 44705A/05H/06A/08A/08H/17A/18A Specifications (Cont.)

Ref. Junction Compensation Accuracy: 0.1 °C (over 18 to 28 °C operating temperature)

Max Temperature Difference Across Isothermal Module: 0.2 °C

HP 44717A/44718A 10 Bridge Static Strain Gage Multiplexer**
(Use HP 44705A Specifications with these changes/additions)

Maximum Input Voltage: 42 V peak or 30 V DC between High and Low
170 V peak or 120 V DC between any other two points (Terminal or Chassis)

Strain Gage Resolution:

Bridge Configuration	Bridge Exitation Voltage 5 V	1 V	0.1 V
Full	0.01 με	0.05 με	0.5 με
1/2	0.02 με	0.1 με	1 με
1/4	0.04 με	0.2 με	2 με

Bridge Exitation Requirements: An inexpensive power supply, such as an HP 6214B can be used for the following requirements

Current Requirements for Exitation Voltage (5.4 V maximum for specified accuracy):

Bridge Type	Bridge Configuration	Current per Channel
120 Ω	Full	50 mA
120 Ω	1/2	25 mA
120 Ω	1/4	25 mA
350 Ω	Full	17 mA
350 Ω	1/2	8.5 mA
350 Ω	1/4	8.5 mA

Ripple and Noise Requirements for Exitation Voltage:

1 mV peak-to-peak (20 Hz to 20 MHz)

Max Self-Heating Offset Due to Change in number of Gages on One Assembly: 2 με per Gage for 120 Ω, 1/4 Bridge Configuration, and 5 V Exitation Voltage (worst-case)

Max Self-Heating Offset Due to a 0.1 V Change in Exitation Voltage: 0.38 με

*The voltage in the table is the total peak voltage between one scanned channel contact and the next, or from a scanned channel contact to 0 volts (i.e., chassis).
**Applies to HP 3852As with firmware revision 2.0 or above.

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8-17 HP 44705A/H AND 44708A/H PERFORMANCE TESTS

8-18 Introduction

The following Performance Tests check the operation of the HP 44705A/H and HP 44708A/H component module. Performance Tests are not given for the terminal modules. Successful completion of all tests in this section provides a high confidence level that the relay multiplexer is meeting its listed specifications.

The Performance Tests should be performed in the order they are presented. The completion of each test increases the confidence level in the relay multiplexer operation. A minimum set of tests is given as the Operational Verification Tests. These tests are described in Section 8-19.

The Performance Test procedures in this chapter are involved and time consuming. Since the most likely parameter to change with time is the contact resistance of a relay, and since the contact resistance is checked as a part of the Operational Verification Tests, it is not recommended that all Performance Tests be performed unless one of the tested specifications is in question.

8-19 Operational Verification

The first tests given in this section are a minimal set of tests recommended for the relay multiplexer. These tests are designed to test the functionality and contact resistance of the relay multiplexer. Successful completion of the Operational Verification Tests provides a 90% confidence level that the relay multiplexer is operating normally and is within specification.

The Operational Verification Tests consist of the following:

Section 8-23 - Set-Up Procedure
Section 8-24 - Channel Relays Test
Section 8-25 - Tree Relays Test
Section 8-26 - Backplane Analog Bus Test

8-20 Equipment Required

The following list of equipment is required for the Performance Tests. Only the first three items in the list are required for the Operational Verification Tests.

1. Digital Multimeter -- HP 3456A or equivalent

2. Test Fixture -- as described in Section 8-21

3. Test Leads and Jumpers

4. Resistor -- 10 Mohm, ±5% or Better

4. Resistor -- 1 kohm, ±5% or Better

5. Oscilloscope -- HP 1740A or equivalent (dual trace with delayed sweep)

7. Service Module -- HP 44743A

8. +20 V Power Supply -- HP 6212 or equivalent

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NOTE

Either of the accessory plug-in voltmeters (HP 44701A or HP 44702A/B) may be used for these tests. The tests do not describe the specific steps required to use the plug-in voltmeters. A description of the plug-in voltmeters can be found in the Plug-In Accessories Configuration and Programming Manual (HP part number 03852-90002).

8-21 Test Fixture

A test fixture is required to run the Performance Tests. A schematic of the required test fixture is shown in Figure 8-7a. A test fixture can be made using the HP 44705AT terminal module for the HP 44705A or the HP 44705HT terminal module for the HP 44705H (see Figure 8-7b). Because wiring the test fixture will make the terminal module unusable in an application, an additional terminal module should be ordered for service purposes.

NOTE

Make sure to use only the HP 44705AT terminal module for the HP 44705A/08A accessories and the HP 44705HT terminal module for the HP 44705H/08H accessories. This is necessary due to connector differences.

If the test fixture is to be fabricated from other than a HP 44705AT/HT terminal module, it is important that the terminal ID lines, shown in Figure 8-7a be correctly wired. The HP 3852A local controller will not allow the execution of some commands with an incorrect terminal ID.

The fixture consists of: a short circuit between all channel HIGH lines, a short circuit between all channel LOW lines, and a short circuit between all channel GUARD lines. The use of the fixture minimizes the number of test lead connections required for the tests.

8-22 Test Procedures

WARNING

Even with power removed from the HP 3852A, high voltages, generated in other parts of the system, may be present at the terminal module of each accessory. Service personnel should ensure that all external power is removed from the system before installing, removing, testing or repairing any plug-in accessory.

8-23 Set-Up Procedure

1. Remove power from the HP 3852A.

NOTE

The complete Performance Test procedure requires that the isolation jumper (J1) on the HP 44705A/H be set to the enabled (EN) position (refer to Figure 8-51). Only the Channel Relays Test can be performed with the jumper in the disabled position.

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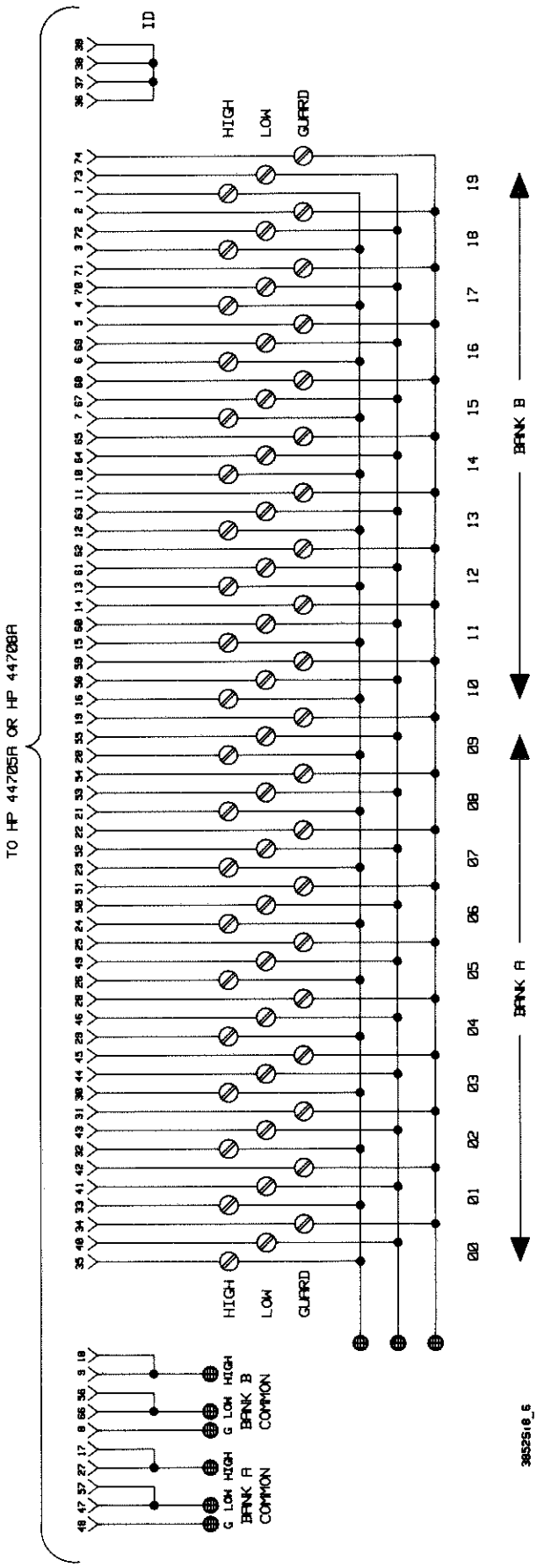


Figure 8-7a HP 44705A/H Test Fixure Schematic

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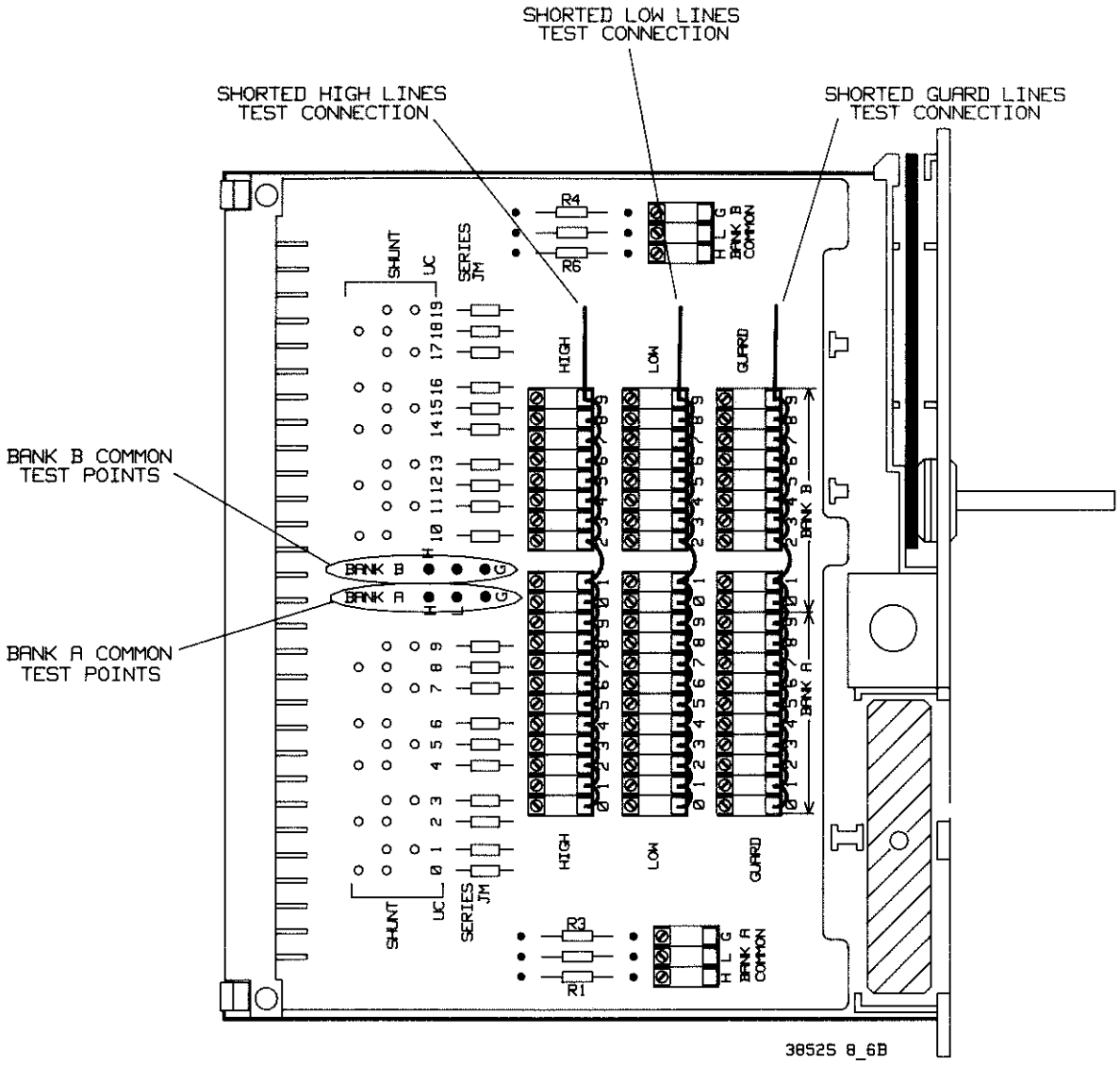


Figure 8-7b HP 44705A/H Test Fixure

2. Remove the terminal module from the rear of the HP 44705A/H component module and install the test fixture. Note the slot number where the HP 44705A/H under test is installed.

3. Verify the correct connections and slot numbers:

   a. Apply power to the HP 3852A. Wait for the HP 3852A to complete its wake-up sequence.

   b. Execute:

      ID? ES00 (where E = extender number, S = slot number)

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c. Verify that the HP 3852A right display shows:

44705A or 44705H

NOTE

If the HP 3852A right display shows a different accessory number, the slot number used may not be correct. If the HP 3852A display shows 447XXX, the test fixture is either not installed or the ID lines on the fixture are incorrectly wired.

4. Set the multimeter to measure two-wire ohms.

8-24 Channel Relays Test

1. BANK A CHANNEL RELAYS TEST: This test checks the contact resistance of the HIGH, LOW and GUARD contacts for all Bank A channel relays.

2. Set the HP 44705A/H to a known state by executing:

RESET ES00 (where E = extender number, S = slot number)

3. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank A HIGH common test point on the test fixture. Connect the multimeter COM lead to the shorted HIGH connections of the channels.

4. Close channel 00 by executing:

CLOSE ES00 (where E = extender number, S = slot number)

5. Observe the reading on the multimeter. The multimeter should indicate less than 2 ohms resistance. If the reading is greater than 2 ohms, channel 00 relay may be faulty.

6. Open channel 00 by executing:

OPEN ES00 (where E = extender number, S = slot number)

7. Observe the reading on the multimeter. The multimeter should indicate an open circuit (>1 GΩ). It is important to perform this step to ensure that none of the relays are stuck closed. If the multimeter does not indicate an open, it will be necessary to troubleshoot to locate the stuck relay. Section 8-49 describes locating a stuck relay.

8. Repeat steps 4, 5, 6, and 7 for channels 01 through 09. In the CLOSE and OPEN commands the last two digits indicate the channel number. For example, CLOSE ES01 would close channel 01.

9. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank A LOW common test point on the test fixture. Connect the multimeter COM lead to the shorted LOW connections of the channels.

10. Repeat steps 4, 5, 6, 7, and 8. This checks the LOW contacts of the channel relays.

11. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank A GUARD common test point on the test fixture. Connect the multimeter COM lead to the shorted GUARD connections of the channels.

12. Repeat steps 4, 5, 6, 7, and 8. This checks the GUARD contacts of the channel relays.

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13. BANK B CHANNEL RELAYS TEST: This test checks the contact resistance of the HIGH, LOW and GUARD contacts for all Bank B channel relays.

14. Set the HP 44705A/H to a known state by executing:

RESET ES00 (where E = extender number, S = slot number)

15. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank B HIGH common test point on the test fixture. Connect the multimeter COM lead to the shorted HIGH connections of the channels.

16. Close channel 10 by executing:

CLOSE ES10 (where E = extender number, S = slot number)

17. Observe the reading on the multimeter. The multimeter should indicate less than 2 ohms resistance. If the reading is greater than 2 ohms, channel 10 relay may be faulty.

18. Open channel 10 by executing:

OPEN ES10 (where E = extender number, S = slot number)

19. Observe the reading on the multimeter. The multimeter should indicate an open circuit (>1 GΩ). It is important to perform this step to ensure that none of the relays are stuck closed. If the multimeter does not indicate an open, it will be necessary to troubleshoot to locate the stuck relay. Section 8-49 describes locating a stuck relay.

20. Repeat steps 16, 17, 18, and 19 for channels 11 through 19. In the CLOSE and OPEN commands the last two digits indicate the channel number. For example, CLOSE ES11 would close channel 11.

21. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank B LOW common test point on the test fixture. Connect the multimeter COM lead to the shorted LOW connections of the channels.

22. Repeat steps 16, 17, 18, 19, and 20. This checks the LOW contacts of the channel relays.

23. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank B GUARD test point on the test fixture. Connect the multimeter COM lead to the shorted GUARD connections of the channels.

24. Repeat steps 16, 17, 18, 19, and 20. This checks the GUARD contacts of the channel relays.

8-25 Tree Relays Test

1. SENSE BUS TREE RELAY TEST: This test checks the contact resistance on the HIGH, LOW and GUARD contacts of the sense bus tree relays (channels 91 and 92).

2. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank B HIGH common test point on the test fixture. Connect the multimeter COM lead to Bank A HIGH common test point on the test fixture.

3. Close the sense bus tree relays by executing:

SWRITE ES00, 6, 17152 (where E = extender number, S = slot number)

4. Observe the multimeter reading. The HIGH contact resistance, as indicated on the multimeter, should be less than 2 ohms. If the reading is greater than 2 ohms, one of the two sense bus relays is failing.

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5. Open the sense bus tree relays by executing:

SWRITE ES00, 4, 17152 (where E = extender number, S = slot number)

6. Observe the multimeter reading. The multimeter should indicate an open circuit (>1 GΩ). If the multimeter does not indicate an open circuit, the tree relays are stuck closed. If the multimeter does not indicate an open, it will be necessary to troubleshoot. Since both tree relays would have to be stuck for this condition to occur, the control logic is probably at fault. Section 8-48 gives a procedure for testing the control logic.

7. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank B LOW common test point on the test fixture. Connect the multimeter COM lead to the Bank A LOW common test point on the test fixture.

8. Close the sense bus tree relays by executing:

SWRITE ES00, 6, 17152 (where E = extender number, S = slot number)

9. Observe the multimeter reading. The LOW contact resistance, as indicated on the multimeter, should be less than 2 ohms. If the reading is greater than 2 ohms, one of the two sense bus relays is failing.

10. Open the sense bus tree relays by executing:

SWRITE ES00, 4, 17152 (where E = extender number, S = slot number)

11. Observe the multimeter reading. The multimeter should indicate an open circuit (>1 GΩ). If the multimeter does not indicate an open circuit, the sense bus tree relays are stuck closed. If the multimeter does not indicate an open, it will be necessary to troubleshoot. Since both tree relays would have to be stuck for this condition to occur, the control logic is probably at fault. Section 8-48 gives a procedure to test the control logic.

12. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank B GUARD common test point on the test fixture. Connect the multimeter COM lead to the Bank A GUARD common test point on the test fixture.

13. Close the sense bus tree relays by executing:

SWRITE ES00, 6, 17152 (where E = extender number, S = slot number)

14. Observe the multimeter reading. The GUARD contact resistance, as indicated on the multimeter, should be less than 2 ohms. If the reading is greater than 2 ohms, on of the two sense bus relays is failing.

15. Open the sense bus tree relays by executing:

SWRITE ES00, 4, 17152 (where E = extender number, S = slot number)

16. Observe the multimeter reading. The multimeter should indicate an open circuit (>1 GΩ). If the multimeter does not indicate an open circuit, the sense bus tree relays are stuck closed. If the multimeter does not indicate an open, it will be necessary to troubleshoot. Since both tree relays would have to be stuck for this condition to occur, the control logic is probably at fault. Section 8-48 gives a test procedure for the control logic.

17. SOURCE BUS TREE RELAY TEST: This test checks the contact resistance on the HIGH, LOW and GUARD contacts of the source bus tree relays (channels 93 and 94).

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18. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank B HIGH common test point on the test fixture. Connect the multimeter COM lead to Bank A HIGH common test point on the test fixture.

19. Close the source bus tree relays by executing:

SWRITE ES00, 6, 19456 (where E = extender number, S = slot number)

20. Observe the multimeter reading. The HIGH contact resistance, as indicated on the multimeter, should be less than 2 ohms. If the reading is greater than 2 ohms, one of the two sense bus relays is failing.

21. Open the source bus tree relays by executing:

SWRITE ES00, 4, 19456 (where E = extender number, S = slot number)

22. Observe the multimeter reading. The multimeter should indicate an open circuit. If the multimeter does not indicate an open circuit, the source bus tree relays are stuck closed. If the multimeter does not indicate an open, it will be necessary to troubleshoot. Since both tree relays would have to be stuck for this condition to occur, the control logic is probably at fault. Section 8-48 gives a control logic test procedure.

23. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank B LOW common test point on the test fixture. Connect the multimeter COM lead to the Bank A LOW common test point on the test fixture.

24. Close the source bus tree relays by executing:

SWRITE ES00, 6, 19456 (where E = extender number, S = slot number)

25. Observe the multimeter reading. The LOW contact resistance, as indicated on the multimeter, should be less than 2 ohms. If the reading is greater than 2 ohms, one of the two source bus relays is failing.

26. Open the source bus tree relays by executing:

SWRITE ES00, 4, 19456 (where E = extender number, S = slot number)

27. Observe the multimeter reading. The multimeter should indicate an open circuit (>1 GΩ). If the multimeter does not indicate an open circuit, the source bus tree relays are stuck closed. If the multimeter does not indicate an open, it will be necessary to troubleshoot. Since both tree relays would have to be stuck for this condition to occur, the control logic is probably at fault. Section 8-48 gives a control logic test procedure.

28. Refer to Figure 8-7. Connect the multimeter DCV lead to the Bank B GUARD common test point on the test fixture. Connect the multimeter COM lead to the Bank A GUARD common test point on the test fixture.

29. Close the source bus tree relays by executing:

SWRITE ES00, 6, 19456 (where E = extender number, S = slot number)

30. Observe the multimeter reading. The GUARD contact resistance, as indicated on the multimeter, should be less than 2 ohms. If the reading is greater than 2 ohms, one of the two source bus relays is failing.

31. Open the source bus tree relays by executing:

SWRITE ES00, 4, 19456 (where E = extender number, S = slot number)

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32. Observe the multimeter reading. The multimeter should indicate an open circuit (>1 GΩ). If the multimeter does not indicate an open circuit, the source bus tree relays are stuck closed. If the multimeter does not indicate an open, it will be necessary to troubleshoot. Since both tree relays would have to be stuck for this condition to occur, the control logic is probably at fault. Section 8-48 gives a control logic test procedure.

8-26 Backplane Analog Bus Test

1. ANALOG BUS HIGH AND LOW TEST: This test checks the backplane analog bus connections through the relay multiplexer.

2. Connect a jumper between the shorted HIGH connections to the shorted LOW connections on the test fixture.

3. Set the multimeter to measure four-wire ohms. Connect the multimeter ohms SENSE leads to the backplane analog bus sense HIGH and LOW lines. Connect the multimeter ohms SOURCE leads to the backplane analog bus current source HIGH and LOW lines.

NOTE

The backplane analog bus can be tested in one of three ways: 1) By connecting an external multimeter to the analog bus connector on the rear panel of the power supply module as shown in Figure 8-8, 2) By connecting an external multimeter to the backplane analog bus line jumpers provided on the 44743A service module as shown in Figure 8-9, or 3) By using a plug-in voltmeter (HP 44701A or HP 44702A/B) programmed to measure four-wire ohms from the backplane.

4. Close a channel relay and the tree relays on the HP 44705A/H by executing:

CLOSE ES00,ES91,ES93 (where E = extender number, S = slot number)

5. Observe the reading on the multimeter. The multimeter should indicate less than 2 ohms. The resistance indicated includes the resistance of the channel relay contacts and the resistance of the test jumpers.

If the resistance measured is not steady, indicating that a four-wire ohms connection is not being made, troubleshoot the connections to the analog bus (the relay contacts on the HP 44705A/H should have been checked in the operational verification tests in Sections 8-24 and 8-25). Note that the HP 44705A/H component module has a 100 ohm resistor in each HIGH and LOW line to the backplane. Note also that the HP 44705A coponent module has a 100 ohm resistor and the HP 44705H has a 1000 ohm resistor in each GUARD line to the backplane. When troubleshooting the connections using two-wire ohms measurements these resistors will be included in the circuit. Figure 8-52 provides a relay schematic.

6. ANALOG BUS GUARD CONNECTION TEST: This test checks the connection of the GUARD connection to the backplane analog bus.

7. Refer to Figure 8-7. Connect a jumper between the shorted HIGH lines and the shorted GUARD lines of the test fixture.

8. Set the multimeter to measure two-wire ohms. Connect the multimeter DCV lead to the backplane analog bus sense HI connection. Connect the multimeter COM lead to the backplane analog bus GUARD connection.

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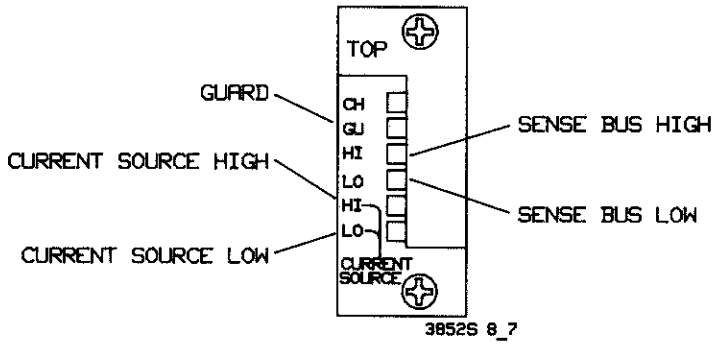


Figure 8-8 Analog Bus Connector

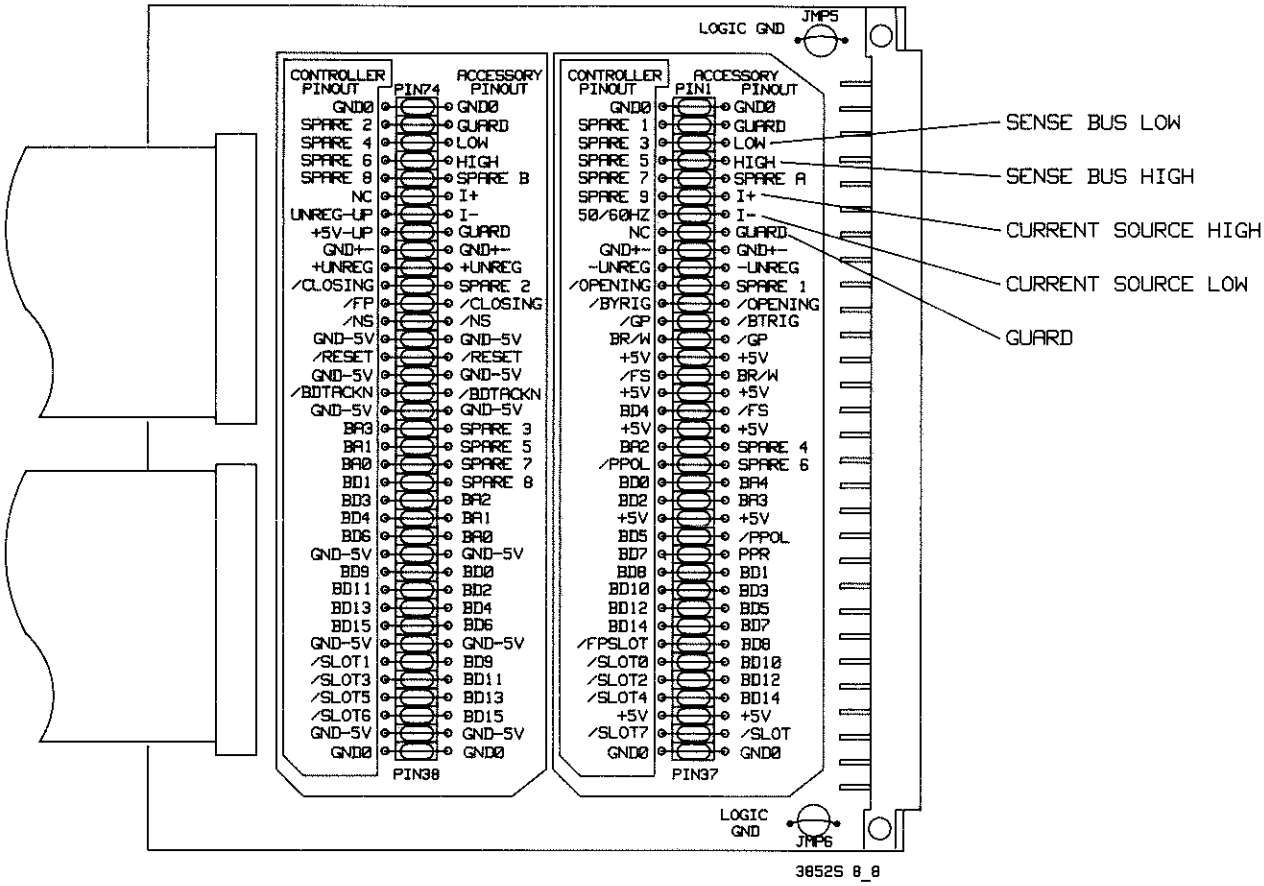


Figure 8-9 HP 44743A Service Module

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9. Observe the reading on the multimeter. The multimeter should indicate approximately 200 ohms for the HP 44705H and 1100 ohms for the HP 44705H The resistance indicated includes the resistance of the channel and tree relay contacts, the resistance of all connections, and the resistance of the series protection resistors in the analog bus lines.

THIS CONCLUDES THE OPERATIONAL VERIFICATION PORTION OF THE HP 44705A/H AND 44708A/H PERFORMANCE TESTS.

8-27 Opening and Closing Time Set-Up Procedure

The Opening and Closng Time test verifies that the channel relays will maintain break-before-make operation and that the multiplexer can scan the channels at the specified speed.

1. Remove power from the HP 3852A and unplug the relay multiplexer to be tested. Install the Service Module in a convenient slot in the HP 3852A. Note the slot number where the Service Module is installed. Install the relay multiplexer on the service module. Install the test fixture on the relay multiplexer. The Set-Up Procedure is shown in Figure 8-10.

2. On an oscilloscope, connect probes to the Channel A INPUT, Channel B INPUT, and EXT TRIGGER input. Set up the oscilloscope to the following:

Dual Trace
Channel A -- DC, 0.5 Volts/Div (if using 10:1 probes)
Channel B -- DC, 0.5 Volts/Div (if using 10:1 probes)
Trigger -- External
Vertical Display -- Chopped
Time -- 5 mses/Div (HP 44705A) or 10 msec/Div (HP 44705H)
Delayed Sweep -- 0.1 msec/Div (HP 44705A) or 0.2 msec/Div (HP 44705H)
Delayed Sweep Dial -- Minimum

3. Connect a jumper from the +5V test connection on the service module to the shorted HIGH connections on the test fixture.

4. Connect a jumper between the Bank A HIGH common test point and the Bank B HIGH common test point.

5. Connect the 1 kohm resistor between the HIGH common test points on the test fixture and the logic ground test connection on the service module.

6. Connect the Channel A oscilloscope probe to the HIGH common test points on the test fixture.

7. Connect the Channel B oscilloscope probe to the OPENING test connection on the service module.

8. Connect the EXT TRIGGER oscilloscope probe to the BTRIG test connection on the service module.

9. Apply power to the HP 3852A. Wait for the wake-up sequence to complete.

10. Set up the following subroutine in HP 3852A memory. When the first statement is entered the SUB ENTRY annunciator should be on in the left display. This annunciator should remain on until the SUBEND statement is entered.

```
SUB A
TRG
SCAN ES00-ES19   (where E = extender number, S = slot number)
SUBEND
```


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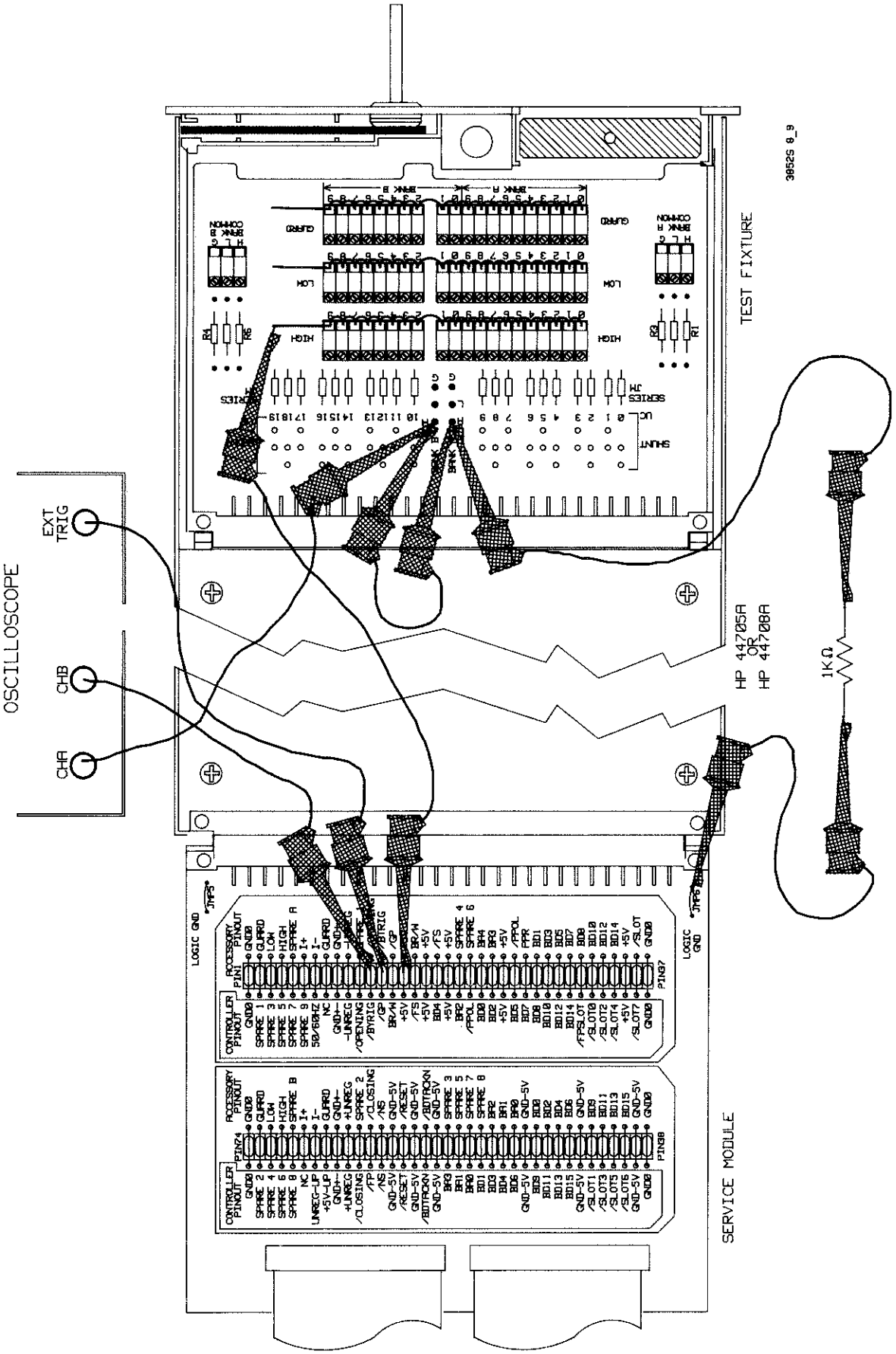


Figure 8-10 HP 44705A/H Opening Time Set-Up

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The subroutine will scan all channels on the relay multiplexer in a break-before-make fashion. The scan will be preceded by a backplane trigger pulse (used to trigger the oscilloscope). Do not reset or cycle power to the HP 3852A or the subroutine will be erased from memory. The front panel CLEAR key may be used without disturbing the subroutine.

8-28 Opening Time Test

1. OPENING PULSE WIDTH TEST. This test checks the pulse width of the OPENING pulse output from the relay multiplexer.

2. Repetitively call the entered subroutine 1000 times by executing:

```
CALL A,1000
```

This statement will call the subroutine 1000 times.

3. Observe the waveform displayed on the Channel B trace and make sure all 20 channels are present. It may also be necessary to adjust the TRIGGER LEVEL and TRIGGER HOLD controls on the scope to synchronize the signal on the scope.

4. The OPENING pulse is a negative pulse. The width of the negative portion of the pulse must be between 0.77 and 0.94 milliseconds for the HP 44705A or between 1.54 and 1.88 milliseconds for the HP 44705H. If the pulse width is not within these limits, the relay multiplexer is failing. The OPENING pulse is shown in Figure 8-11. The waveform exhibits a small amount of jitter caused by the operating system.

NOTE

If necessary, repeat step 2 to allow more time to view the waveform. The 1000 repetitions of the subroutine take approximately 45 seconds to complete. The time may be extended by increasing the number of repetitions specified in step 2.

5. RELAY OPENING TIME TEST. This test checks the ability of each channel relay to open within the time specified.

6. Repetitively call the entered subroutine 10000 times by executing:

```
CALL A,10000
```

7. Rotate the DELAY SWEEP dial to the minimum position. Select the DELAYED sweep mode on the scope. Slowly rotate the DELAY SWEEP dial clockwise while observing the displayed waveforms. The Channel B waveform is the OPENING pulse. The Channel A waveform is the +5V supply as switched by the relays. As the DELAY SWEEP dial is rotated, one relay closure and the associated OPENING pulse will come in to view at a time. The relay opening time is the time between the falling edge of the OPENING pulse (Channel B) and the falling edge of the Channel A waveform. This time must be less than 0.94 milliseconds for the HP 44705A or 1.88 milliseconds for the HP 44705H. This time is illustrated in Figure 8-11.

Continue rotating the DELAY SWEEP dial until all 20 relay channels have been checked. A failing channel indicates a sticking relay contact.

To stop the test at any time press the front panel CLEAR key. The test may be extended by increasing the number of times the subroutine is called, as specified in step 6.

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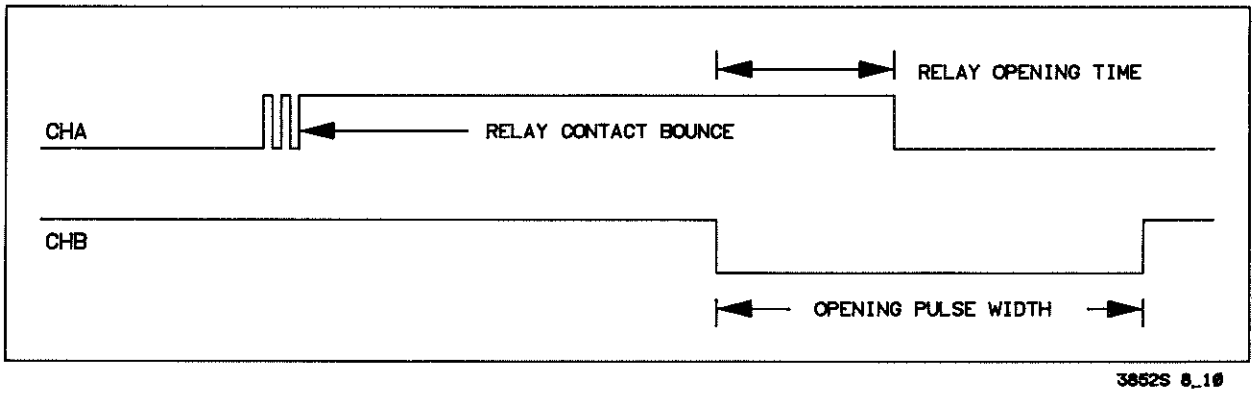


Figure 8-11 HP 44705A/H Opening Time

The waveforms will exhibit a small amount of jitter due to the overhead of the HP 3852A operating system.

8-29 Closing Time Test

1. CLOSING PULSE WIDTH TEST. This test checks the pulse width of the CLOSING pulse output from the relay multiplexer.

2. Move the Channel B oscilloscope probe to the CLOSING connection on the service module (as shown in Figure 8-12).

3. Repetitively call the entered subroutine 1000 times by executing:

CALL A,1000

4. Take the scope out of the DELAYED sweep mode. Observe the waveform displayed on the Channel B trace and make sure all 20 channels are present. It may also be necessary to adjust the TRIGGER LEVEL and TRIGGER HOLD controls on the scope to synchronize the signal on the scope.

5. The CLOSING pulse is a negative pulse. The width of the negative pulse must be between 0.9 and 1.1 milliseconds for the HP 44705A, or 1.8 and 2.2 milliseconds for the HP 44705H. If the pulse is not within these limits, the relay multiplexer is failing. The CLOSING pulse is shown in Figure 8-13. the waveform will exhibit a small amount of jitter caused by the operating system.

NOTE

If necessary, repeat step 2 to allow more time to view the waveform. The 1000 repetitions of the subroutine take approximately 45 seconds to complete. The time may be extended by increasing the number of repetitions specified in step 3.

6. RELAY CLOSING TIME TEST. This test checks the ability of the channel relays to close within the time specified.

7. Repetitively call the entered subroutine 10000 times by executing:

CALL A,10000

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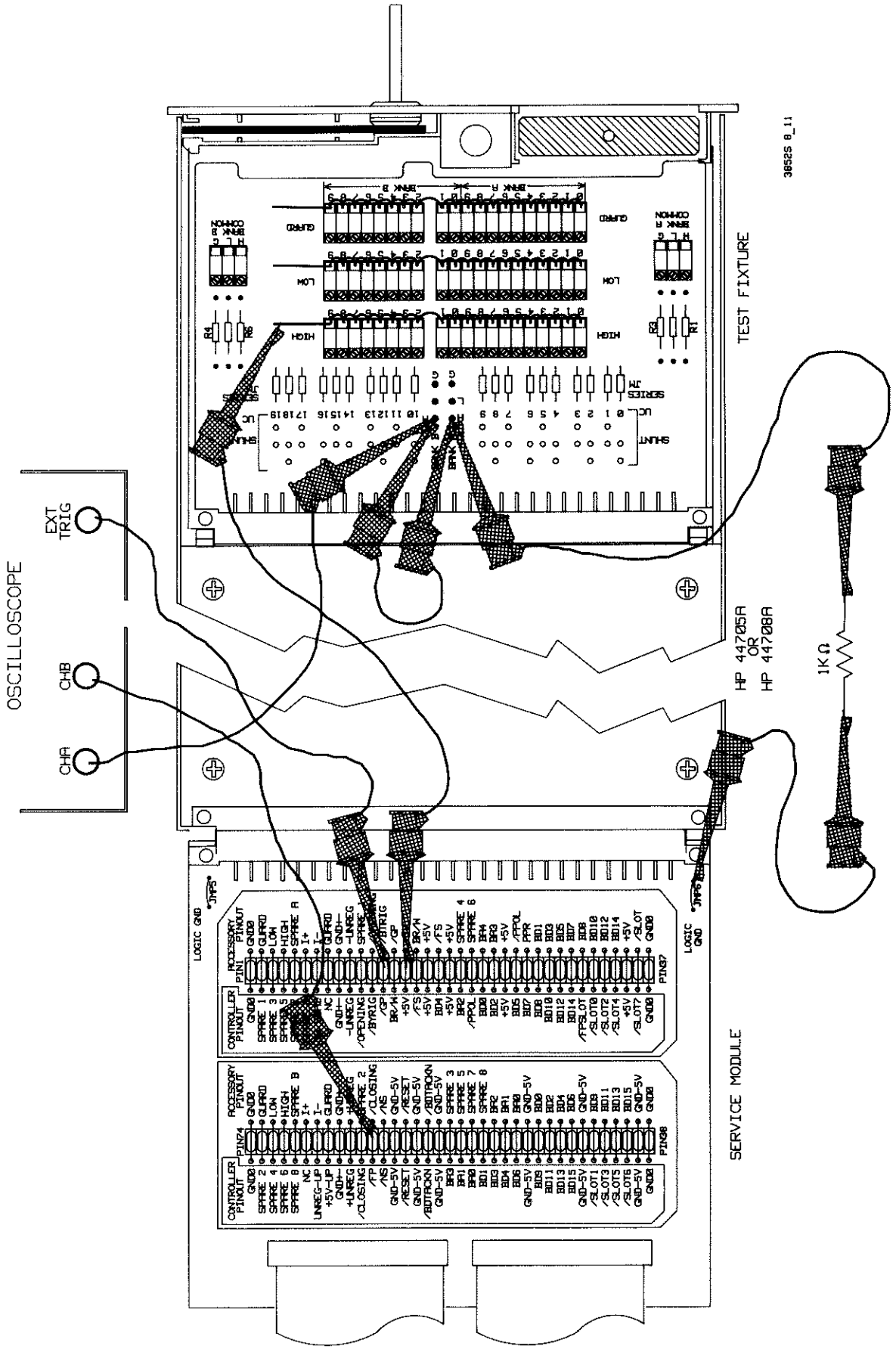


Figure 8-12 HP 44705A/H Closing Time Set-Up

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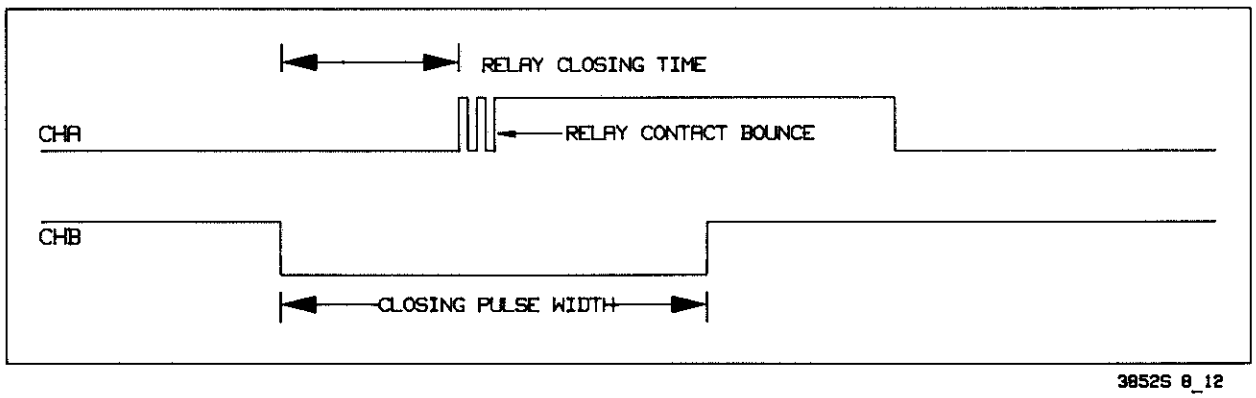


Figure 8-13 HP 44705A/H Closing Time

8. Rotate the DELAY SWEEP dial to the minimum position. Select the DELAYED sweep mode on the scope. Slowly rotate the DELAY SWEEP dial clockwise while observing the displayed waveforms. The Channel B waveform is the CLOSING pulse. The Channel A waveform is the +5V supply as switched by the relays. As the DELAY SWEEP dial is rotated, one relay closure and the associated CLOSING pulse will come in to view at a time. The relay closing time is the time between the falling edge of the CLOSING pulse (Channel B) and the rising edge of the Channel A waveform. This time must be less than 1.1 milliseconds for the HP 44705A or 2.2 milliseconds for the HP 44705H. This time is illustrated in Figure 8-13. Note that there will be some relay bounce indicated on the Channel A waveform.

Continue rotating the DELAY SWEEP dial until all 20 relay channels have been checked. A failing channel indicates a sticking relay contact.

To stop the test at any time press the front panel CLEAR key. The test may be extended by increasing the number of times the subroutine is called, as specified in step 7.

The waveforms will exhibit a small amount of jitter due to the overhead of the HP 3852A operating system.

8-30 DC Isolation Tests

The DC Isolation tests use a power supply, a resistor and the voltmeter to form a voltage divider. The channel being tested is then connected in parallel with this divider and the isolation resistance computed from the measured voltage across the divider.

NOTE

The best test results will be obtained when the resistor value used is the same value as the internal resistance of the voltmeter. The recommended 10 Mohm resistor was selected to match the input impedance of an HP 3456A multimeter set to the 100 Vdc range.

1. SET-UP PROCEDURE. Using the multimeter, measure the exact resistance of the 10 Mohm resistor. This resistance will be referred to as **R1** in the following steps.

2. Set the multimeter to measure DC volts and connect the multimeter to the DC power supply. Adjust the DC power supply output to +20 Vdc ±0.01 Vdc. This voltage will be referred to as **V1** in the following steps.

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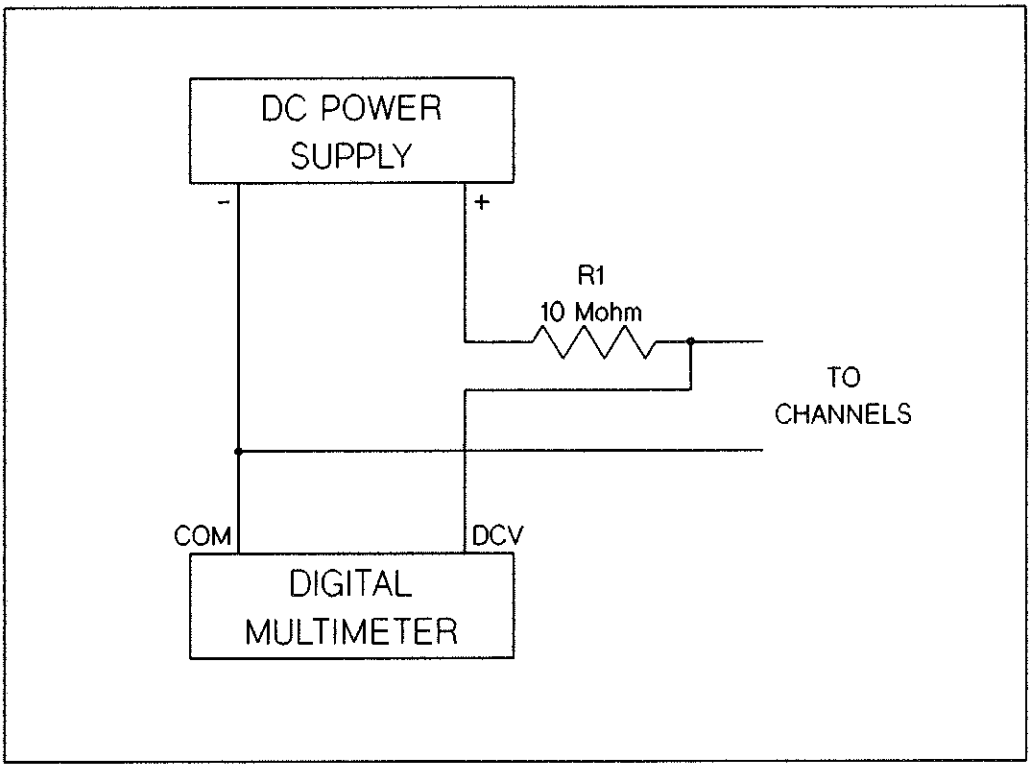


Figure 8-14 HP 44705A/H DC Isolation Set-Up

3. Connect the resistor, power supply and multimeter as shown in Figure 8-14.

4. Set the multimeter to the 100 Vdc range. Measure the exact voltage displayed on the multimeter. This voltage will be referred to as **V2** in the following steps.

5. Calculate the internal resistance of the multimeter (**Rm**) using the following equation:

$$Rm = \frac{R1 \bullet V2}{(V1 - V2)}$$

NOTE

In most cases, the internal resistance of the multimeter is dependent upon the range selected. For this reason, do not change the multimeter range setting in the following procedure.

6. OPEN CHANNEL TO COMMON ISOLATION TEST. This test checks the open channel isolation between the HIGH, LOW and GUARD common connections.

7. Set the multiplexer to a known state by executing:

RESET ES00 (where E = extender number, S = slot number)

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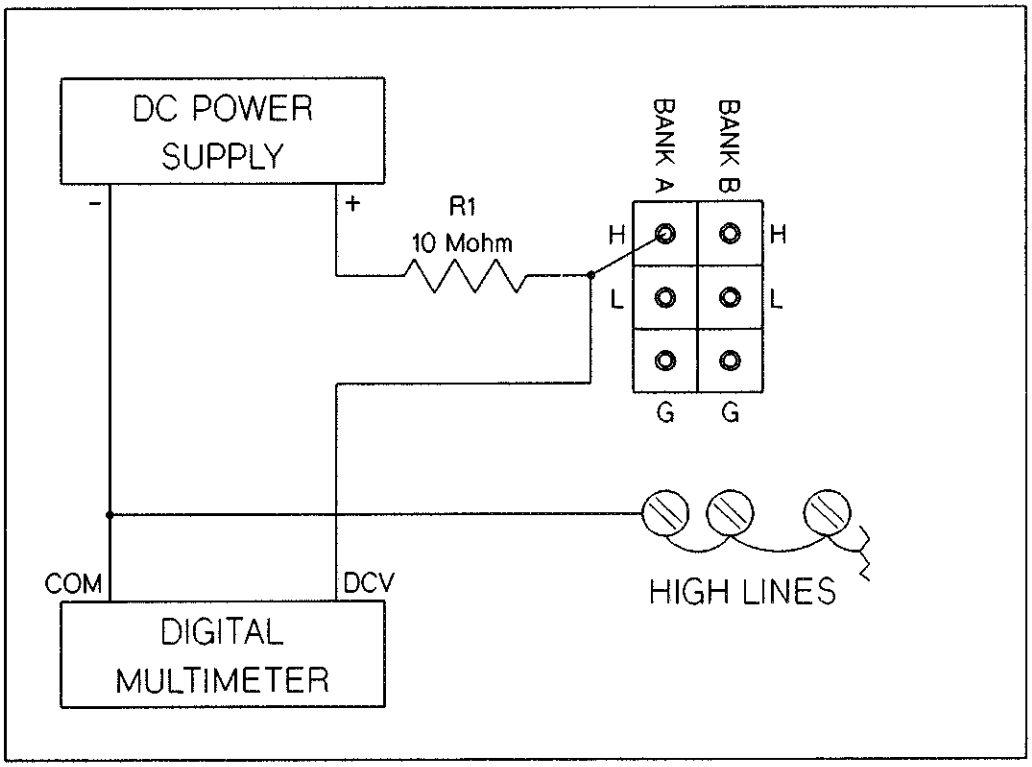


Figure 8-15 HP 44705A/H Bank A HIGH to Common DC Isolation

8. Connect the test circuit between the Bank A HIGH common test point and the shorted HIGH lines of the test fixture as shown in Figure 8-15.

9. Record the multimeter voltage measurement. This reading will be referred to as **V3**.

10. Calculate the DC isolation (**Rc**) using the following equation:

$$Rc = \frac{V3 \bullet R1 \bullet Rm}{Rm \bullet (V1 - V3) - (R1 \bullet V3)}$$

The Open channel DC isolation should be greater than 10^9 ohms.

11. Connect the test circuit between the Bank B HIGH common test point and the shorted HIGH lines of the test fixture as shown in Figure 8-16.

12. Record the multimeter voltage measurement. This reading will be referred to as **V3**.

13. Calculate the DC isolation (**Rc**) using the equation in step 10. The Open channel DC isolation should be greater than 10^9 ohms.

14. Connect the test circuit between the Bank A LOW common test point and the shorted LOW lines of the test fixture as shown in Figure 8-17.

15. Record the multimeter voltage measurement. This reading will be referred to as **V3**.

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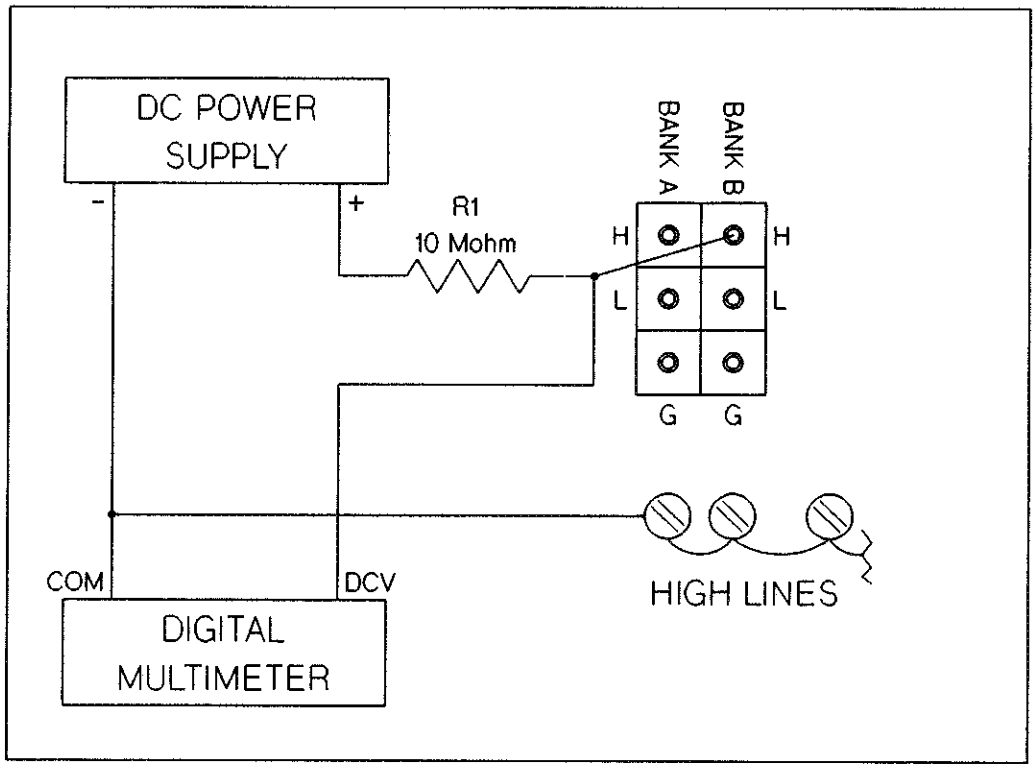


Figure 8-16 HP 44705A/H Bank B HIGH to Common DC Isolation

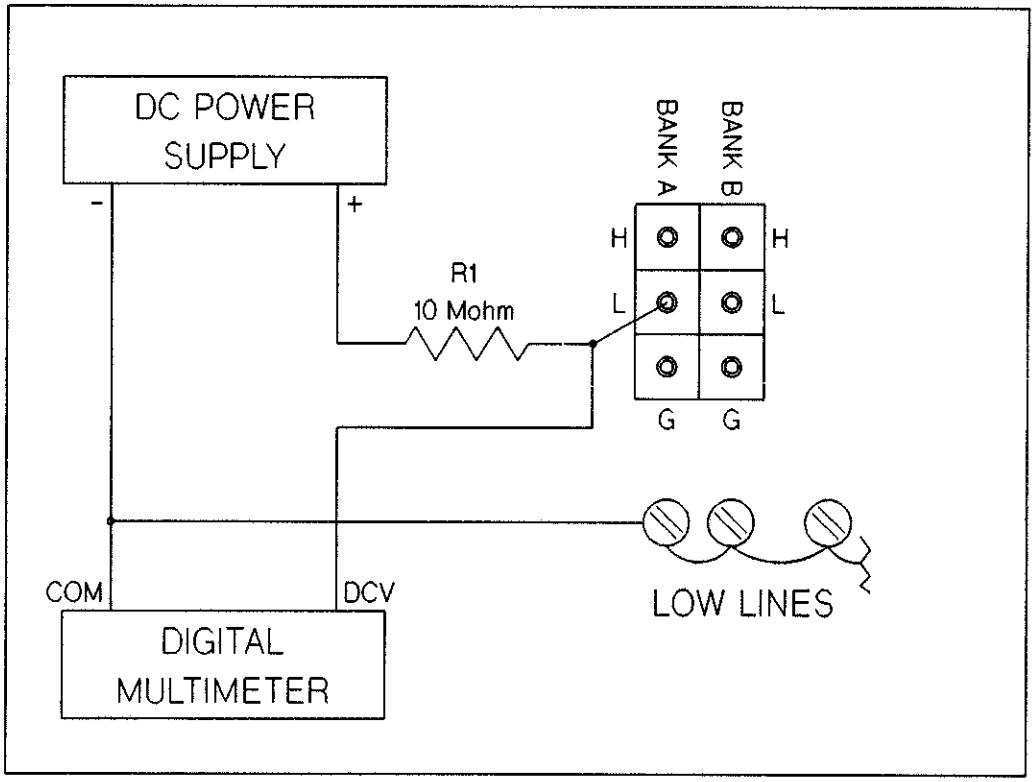


Figure 8-17 HP 44705A/H Bank A LOW to Common DC Isolation

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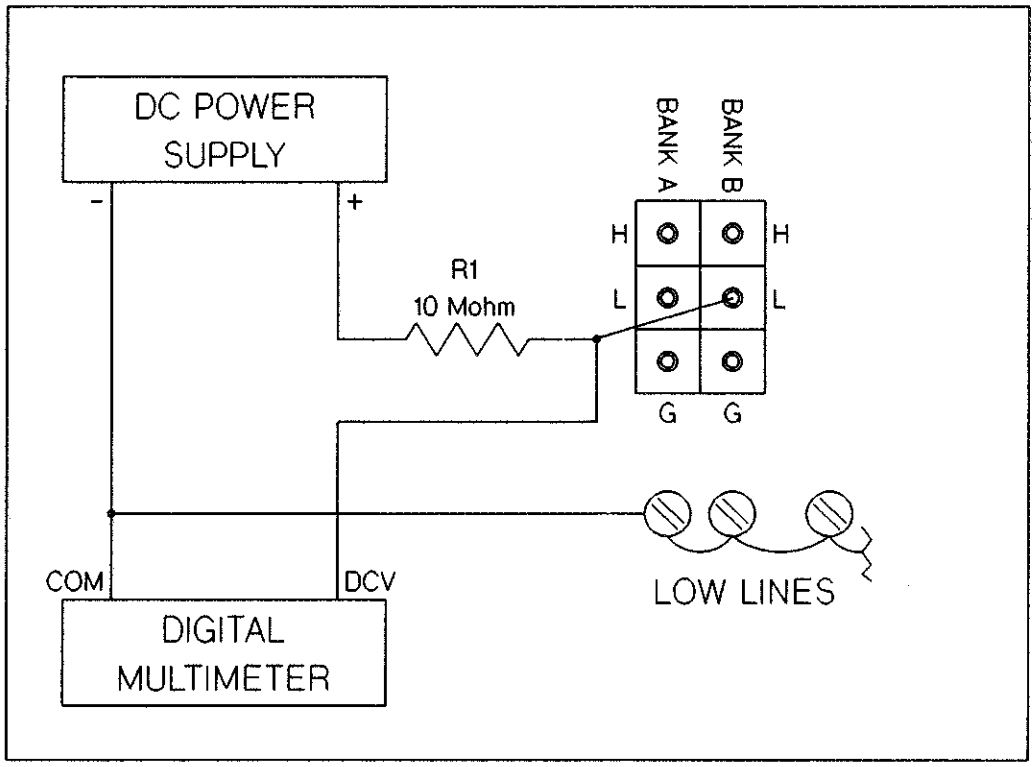


Figure 8-18 HP 44705A/H Bank B LOW to Common DC Isolation

16. Calculate the DC isolation (**Rc**) using the equation in step 10. The Open channel DC isolation should be greater than 10^9 ohms.

17. Connect the test circuit between the Bank B LOW common test point and the shorted LOW lines of the test fixture as shown in Figure 8-18.

18. Record the multimeter voltage measurement. This reading will be referred to as **V3**.

19. Calculate the DC isolation (**Rc**) using the equation in step 10. The Open channel DC isolation should be greater than 10^9 ohms.

20. Connect the test circuit between the Bank A GUARD common test point and the shorted guard lines of the test fixture as shown in Figure 8-19.

21. Record the multimeter voltage measurement. This reading will be referred to as **V3**.

22. Calculate the DC isolation (**Rc**) using the equation in step 10. The Open channel DC isolation should be greater than 10^9 ohms.

23. Connect the test circuit between the Bank B GUARD common test point and the shorted GUARD lines of the test fixture as shown in Figure 8-20.

24. Record the multimeter voltage measurement. This reading will be referred to as **V3**.

25. Calculate the DC isolation (**Rc**) using the equation in step 10. The Open channel DC isolation should be greater than 10^9 ohms.

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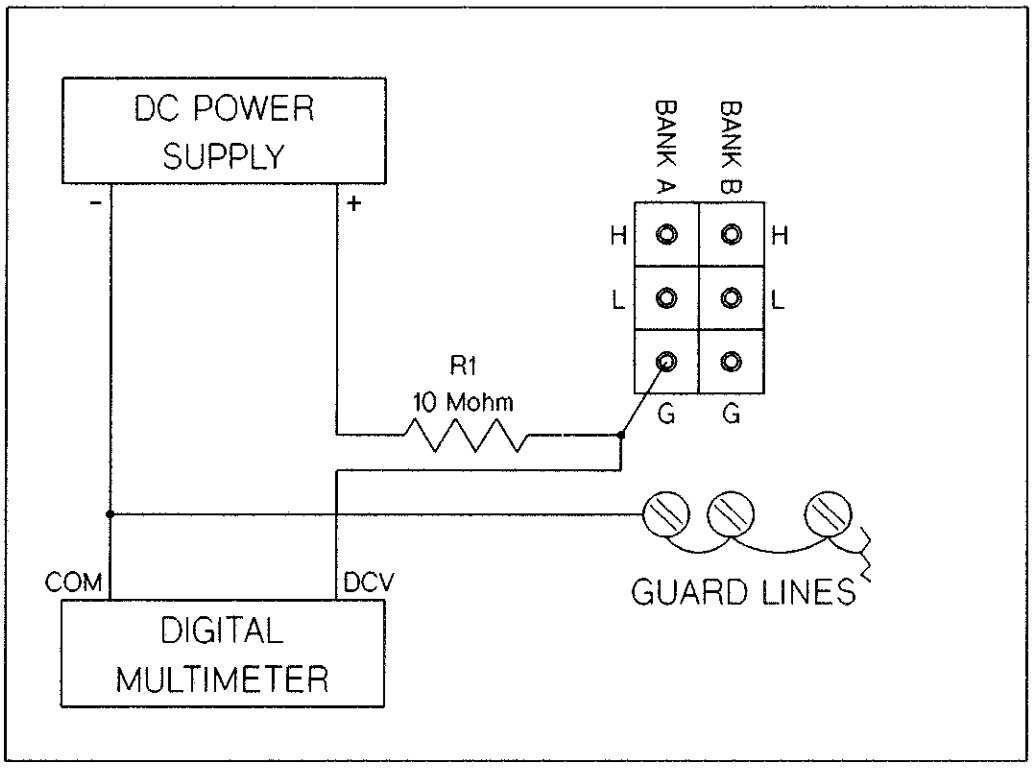


Figure 8-19 HP 44705A/H Bank A GUARD to Common DC Isolation

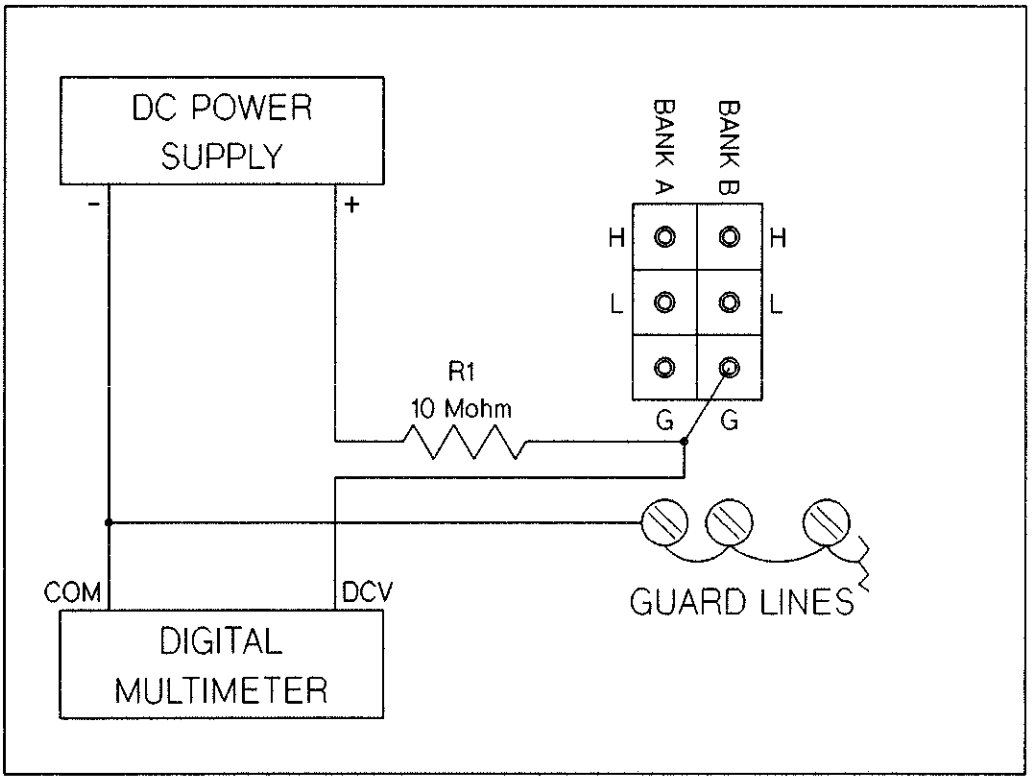


Figure 8-20 HP 44705A/H Bank B GUARD to Common DC Isolation

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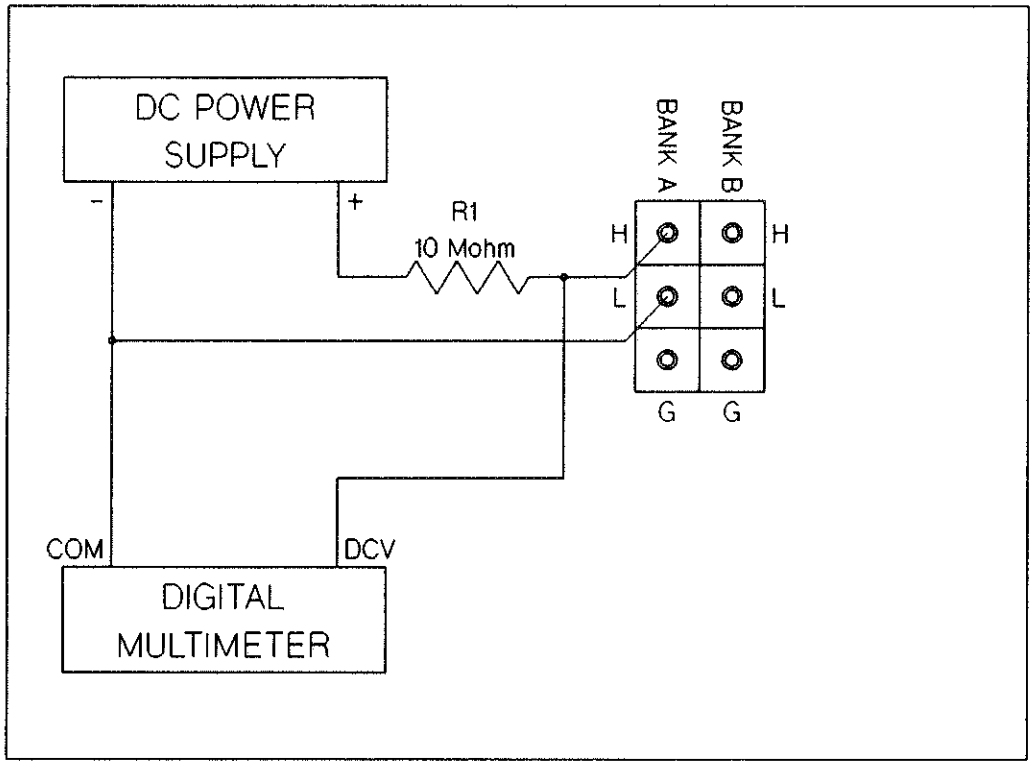


Figure 8-21 HP 44705A/H Bank A HIGH to LOW DC Isolation

26. COMMON HIGH TO LOW TEST. This test checks the DC isolation between the common terminals with a single channel closed.

27. Connect the test circuit between the Bank A HIGH and Bank A LOW common test points on the test fixture as shown in Figure 8-21.

28. Close a channel in Bank A by executing:

CLOSE ES00 (where E = extender number, S = slot number)

29. Record the multimeter voltage measurement. This reading will be referred to as **V4**.

30. Calculate the DC isolation (**Rc**) using the following equation:

$$Rc = \frac{V4 \bullet R1 \bullet Rm}{Rm \bullet (V1 - V4) - (R1 \bullet V4)}$$

The Common HIGH to LOW DC isolation should be greater than 10^9 ohms.

31. Open the channel by executing:

OPEN ES00 (where E = extender number, S = slot number)

32. Repeat steps 28, 29, 30, and 31 for channels 01 through 09. In the CLOSE and OPEN commands the last two digits are the channel number (i.e., CLOSE ES01 for channel 01).

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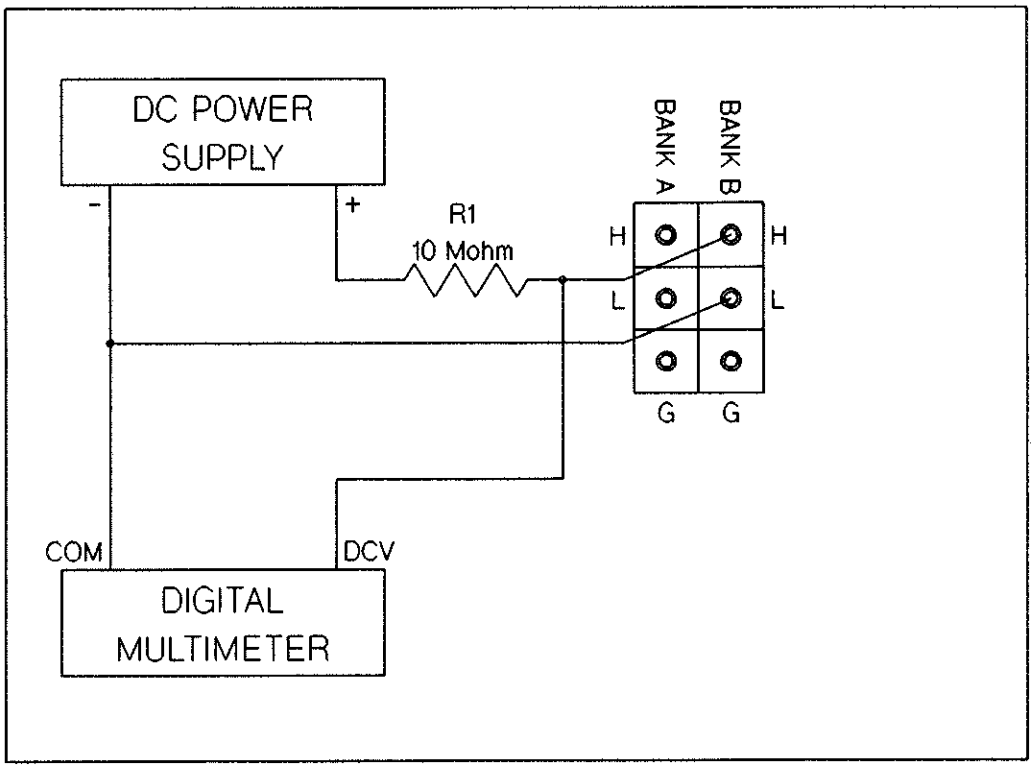


Figure 8-22 HP 44705A/H Bank B HIGH to LOW DC Isolation

33. Connect the test circuit between the Bank B HIGH and LOW common test points on the test fixture as shown in Figure 8-22.

34. Close a channel in Bank B by executing:

CLOSE ES10 (where E = extender number, S = slot number)

35. Record the multimeter voltage measurement. This reading will be referred to as **V4**.

36. Calculate the DC isolation (**Rc**) using the equation given in step 30. The isolation should be greater than 10^9 ohms.

37. Open the channel by executing:

OPEN ES00 (where E = extender number, S = slot number)

38. Repeat steps 34, 35, 36, and 37 for channels 11 through 19. In the CLOSE and OPEN commands the last two digits are the channel number (i.e., CLOSE ES11 for channel 11).

39. HIGH TO GUARD ISOLATION TEST. This test checks the DC isolation from the common HIGH terminal to the common GUARD terminal with a single channel closed.

40. Connect the test circuit between the Bank A common HIGH test point and the Bank A common GUARD test point on the test fixture as shown in Figure 8-23.

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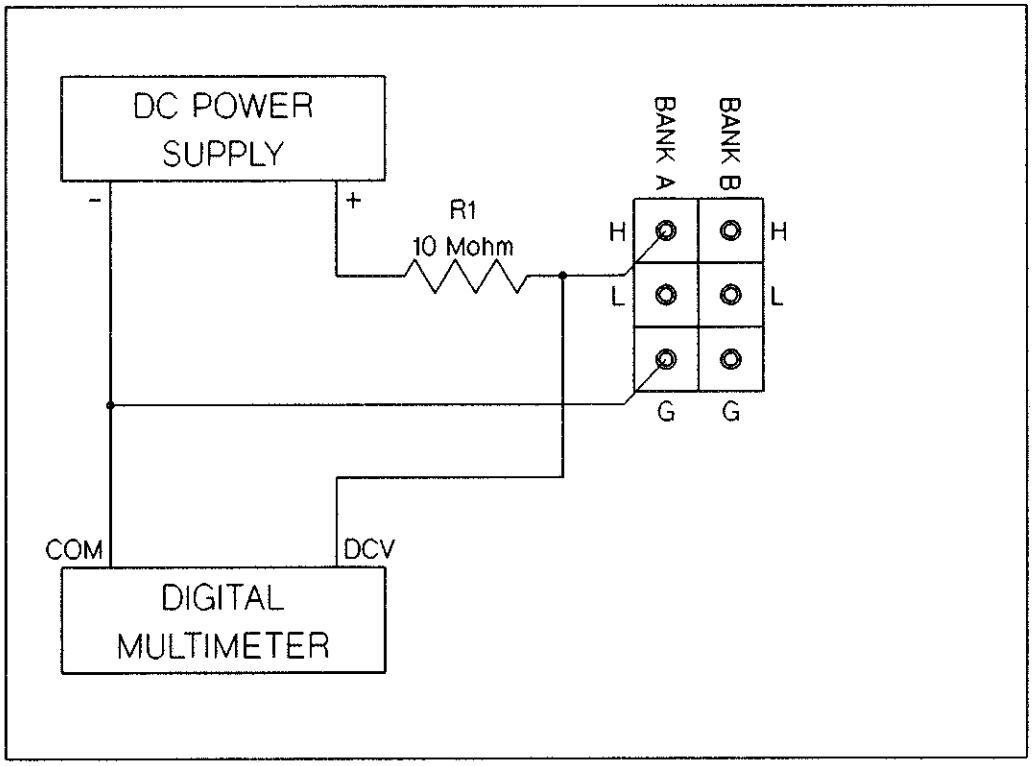


Figure 8-23 HP 44705A/H Bank A HIGH to GUARD DC Isolation

41. Close a channel in Bank A by executing:

    CLOSE ES00 (where E = extender number, S = slot number)

42. Record the the multimeter voltage measurement. This reading will be referred to as **V4**.

43. Calculate the DC isolation by using the equation given in step 30. The isolation should be greater than 10^9 ohms.

44. Open the channel by executing:

    OPEN ES00 (where E = extender number, S = slot number)

45. Repeat steps 41, 42, 43, and 44 for channels 01 through 09. In the CLOSE and OPEN commands the last two digits are the channel number (i.e., CLOSE ES01 for channel 01).

46. Connect the test circuit between the Bank B common HIGH test point and the Bank B common GUARD test point on the test fixture as shown in Figure 8-24.

47. Close a channel in Bank B by executing:

    CLOSE ES10 (where E = extender number, S = slot number)

48. Record the multimeter voltage measurement. This reading will be referred to as **V4**.

49. Calculate the DC isolation by using the equation given in step 30. The isolation should be greater than 10^9 ohms.

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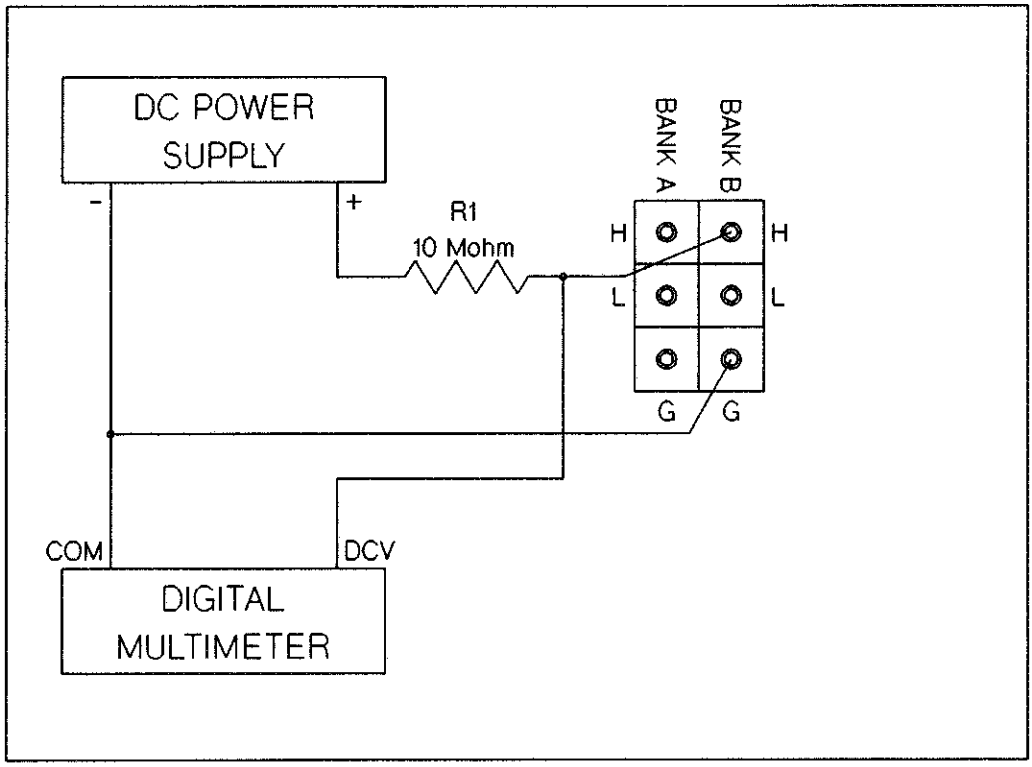


Figure 8-24 HP 44705A/H Bank B HIGH to GUARD DC Isolation

50. Open the channel by executing:

OPEN ES10 (where E = extender number, S = slot number)

51. Repeat steps 47, 48, 49, and 50 for channels 11 through 19. In the CLOSE and OPEN commands the last two digits are the channel number (i.e., CLOSE ES11 for channel 11).

52. LOW TO GUARD ISOLATION TEST. This test checks the DC isolation from the common LOW terminal to the common GUARD terminal with a single channel closed.

53. Connect the test circuit between the Bank A common LOW test point and the Bank A common GUARD test point on the test fixture as shown in Figure 8-25.

54. Close a channel in Bank A by executing:

CLOSE ES00 (where E = extender number, S = slot number)

55. Record the the multimeter voltage measurement. This reading will be referred to as **V4**.

56. Calculate the DC isolation by using the equation given in step 30. The isolation should be greater than 10^9 ohms.

57. Open the channel by executing:

OPEN ES00 (where E = extender number, S = slot number)

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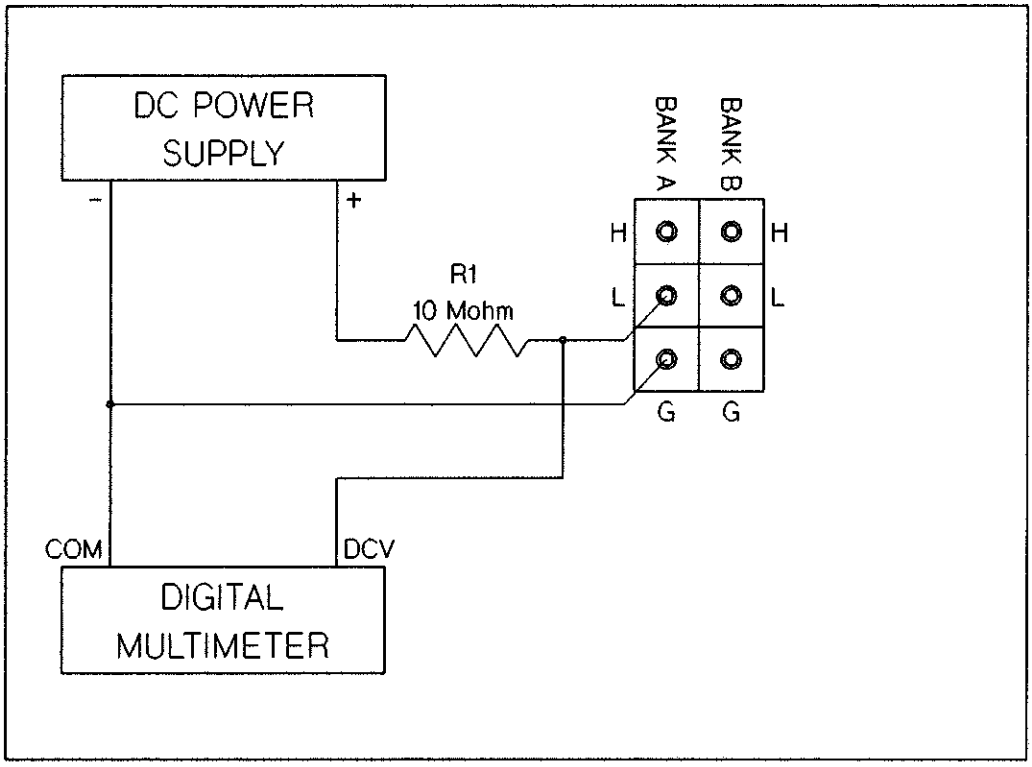


Figure 8-25 HP 44705A/H Bank A LOW to GUARD DC Isolation

58. Repeat steps 54, 55, 56, and 57 for channels 01 through 09. In the CLOSE and OPEN commands the last two digits are the channel number (i.e., CLOSE ES01 for channel 01).

59. Connect the test circuit between the Bank B common LOW test point and the Bank B common GUARD test point on the test fixture as shown in Figure 8-26.

60. Close a channel in Bank B by executing:

CLOSE ES10 (where E = extender number, S = slot number)

61. Record the multimeter voltage measurement. This reading will be referred to as **V4**.

62. Calculate the DC isolation by using the equation given in step 30. The isolation should be greater than 10^9 ohms.

63. Open the channel by executing:

OPEN ES10 (where E = extender number, S = slot number)

64. Repeat steps 60, 61, 62, and 63 for channels 11 through 19. In the CLOSE and OPEN commands the last two digits are the channel number (i.e., CLOSE ES11 for channel 11).

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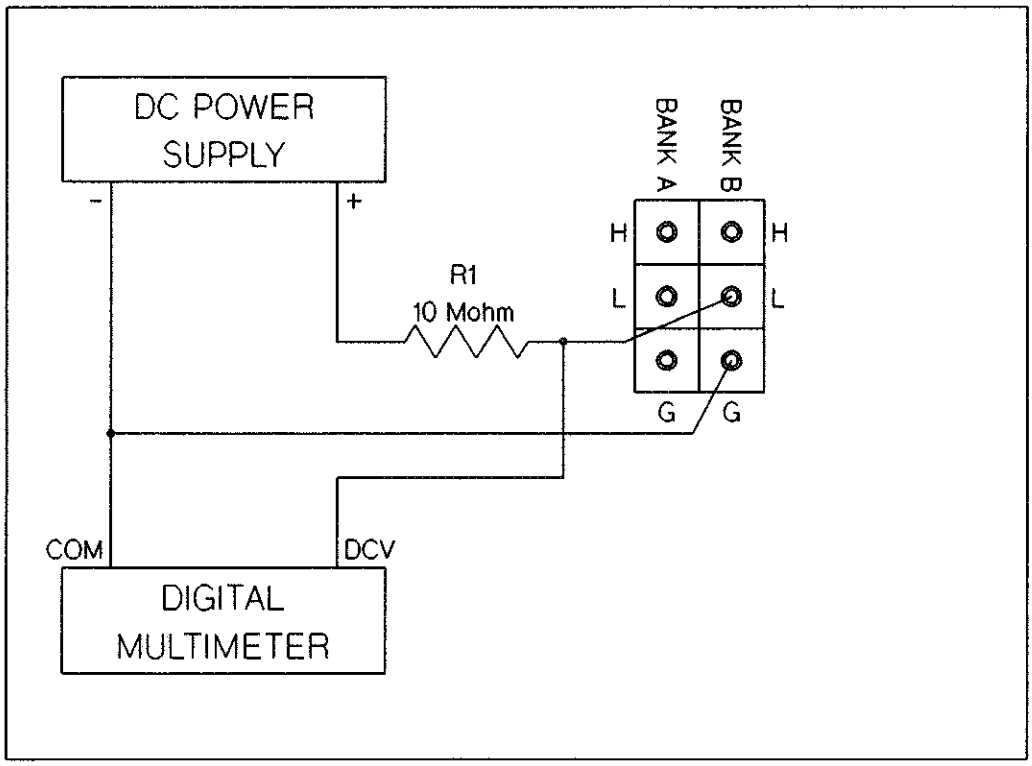


Figure 8-26 HP 44705A/H Bank B LOW to GUARD DC Isolation

8-31 Thermal Offset Test

This test measures the thermally generated voltages on the HP 44705A/H or HP 44708A/H. This test is very sensitive to ambient temperature changes and thermoelectricity generated at the junction of two dissimilar metals. For these reasons, it is important that the test be performed in an environment where the temperature is stable and that the number of test lead connections be kept to a minimum. During the test, care should be taken not to influence the measurements by holding or touching the test leads. The temperature of the leads and connections should be allowed to stabilize for one minute after moving or installing the connections.

1. BANK A CHANNEL-TO-COMMON THERMAL OFFSET TEST. This test checks the thermal offset of the channel relay contacts in Bank A.

2. Set the multimeter to the lowest DC voltage range. The resolution of the multimeter must be at least 0.1 µV. Connect the multimeter test leads together and record the offset voltage indicated on the multimeter. This voltage will be referred to as **V1** in the following steps.

3. Connect the multimeter test leads between the Bank A common HIGH test point and the shorted HIGH connections of the test fixture as shown in Figure 8-27.

4. Close a channel in Bank A by executing:

CLOSE ES00 (where E = extender number, S = slot number)

5. Record the voltage indication on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 1 µV for the HP 44705A or 5 µV for the HP 44705H.

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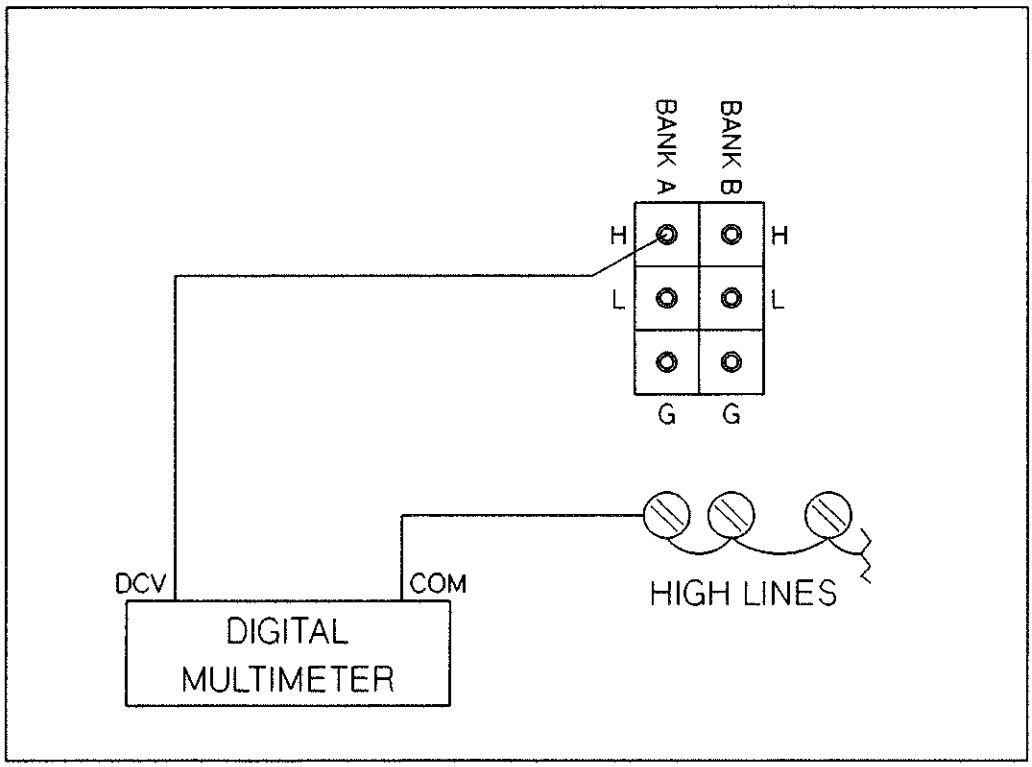


Figure 8-27 HP 44705A/H Bank A HIGH to Common Thermal Offset"

6. Repeat steps 4 and 5 for channels 01 through 09. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES01 for channel 01).

NOTE

If a single channel fails the thermal offset test, the channel relay is probably at fault. If several or all channels fail the test, check the test fixture and test lead connections.

7. Connect the multimeter test leads between the Bank A common LOW test point and the shorted LOW connections of the test fixture as shown in Figure 8-28.

8. Close a channel in Bank A by executing:

CLOSE ES00 (where E = extender number, S = slot number)

9. Record the voltage indication on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 1 µV for the HP 44705A or 5 µV for the HP 44705H.

10. Repeat steps 8 and 9 for channels 01 through 09. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES01 for channel 01).

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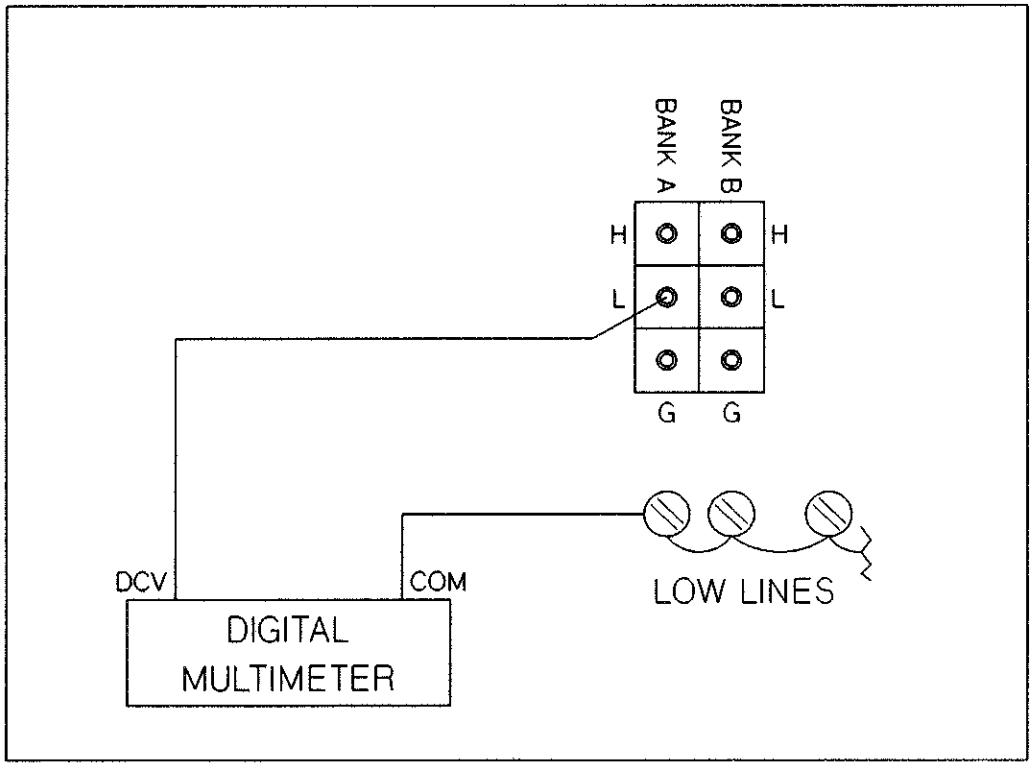


Figure 8-28 HP 44705A/H Bank A LOW to Common Thermal Offset

NOTE

If a single channel fails the thermal offset test, the channel relay is probably at fault. If several or all channels fail the test, check the test fixture and test lead connections.

11. BANK B CHANNEL-TO-COMMON THERMAL OFFSET TEST. This test checks the thermal offset of the channel relay contacts in Bank B.

12. Set the multimeter to the lowest DC voltage range. The resolution of the multimeter must be at least 0.1 µV. Connect the multimeter test leads together and record the offset voltage indicated on the multimeter. This voltage will be referred to as **V1** in the following steps.

13. Connect the multimeter test leads between the Bank B common HIGH test point and the shorted HIGH connections of the test fixture as shown in Figure 8-29.

14. Close a channel in Bank B by executing:

CLOSE ES10 (where E = extender number, S = slot number)

15. Record the voltage indication on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 1 µV for the HP 44705A or 5 µV for the HP 44705H.

16. Repeat steps 14 and 15 for channels 11 through 19. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES11 for channel 11).

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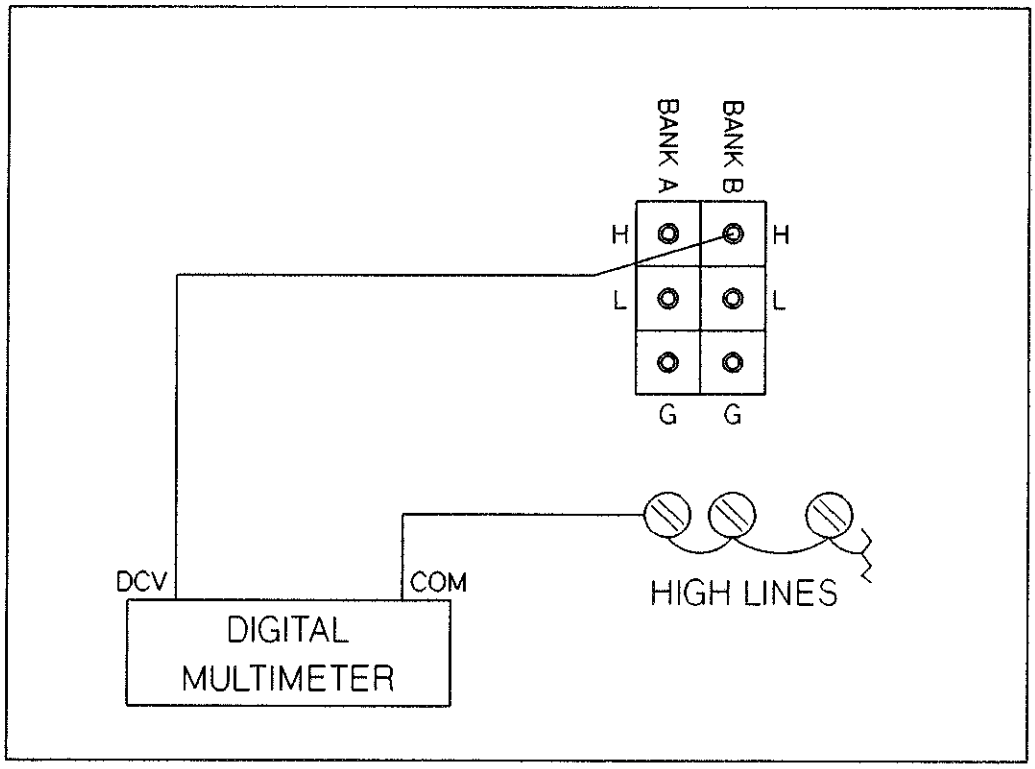


Figure 8-29 HP 44705A/H Bank B HIGH to Common Thermal Offset

NOTE

If a single channel fails the thermal offset test, the channel relay is probably at fault. If several or all channels fail the test, check the test fixture and test lead connections.

17. Connect the multimeter test leads between the Bank B common LOW test point and the shorted LOW connections of the test fixture as shown in Figure 8-30.

18. Close a channel in Bank B by executing:

CLOSE ES10 (where E = extender number, S = slot number)

19. Record the voltage indication on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 1 µV for the HP 44705A or 5 µV for the HP 44705H.

20. Repeat steps 18 and 19 for channels 11 through 19. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES11 for channel 11).

NOTE

If a single channel fails the thermal offset test, the channel relay is probably at fault. If several or all channels fail the test, check the test fixture and test lead connections.

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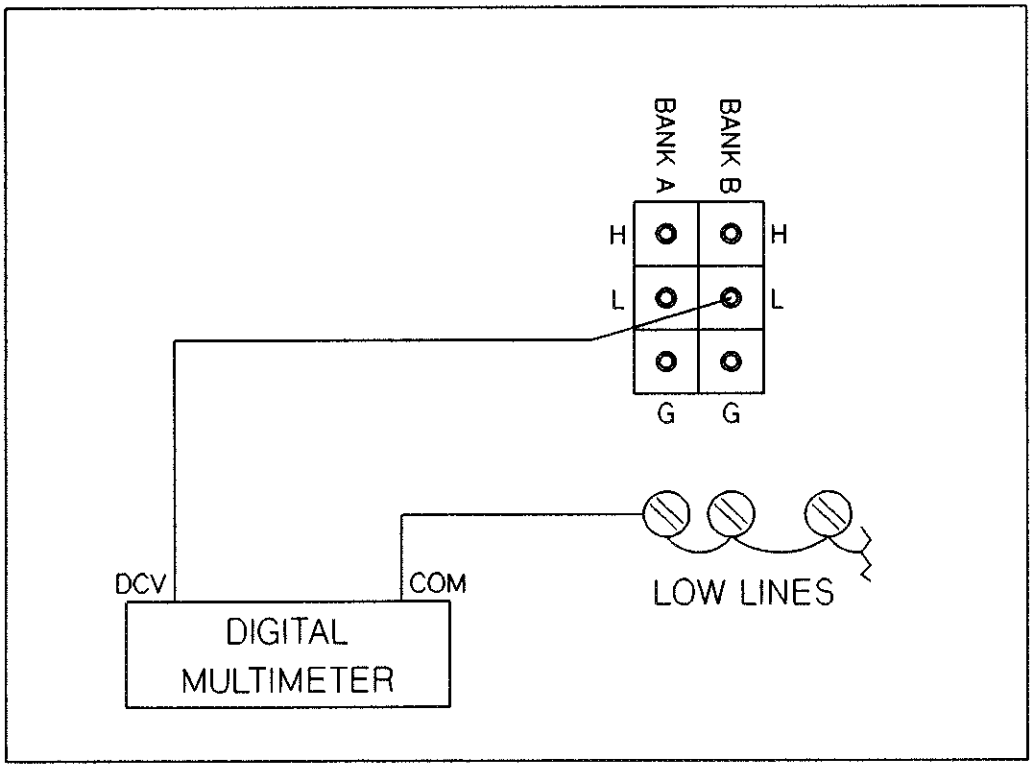


Figure 8-30 HP 44705A/H Bank B LOW to Common Thermal Offset

21. TREE RELAY THERMAL OFFSET TEST. This test checks the thermal offset of the Sense Bus and Source Bus tree relay contacts.

22. Connect the multimeter test leads between the Bank A HIGH common test point and the Bank B HIGH common test point on the test fixture as shown in Figure 8-31.

23. Close the Sense Bus Tree Relays by executing:

SWRITE ES00,6,17152 (where E = extender number, S = slot number)

24. Record the voltage indicated on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 2 µV for the HP 44705A or 10 µV for the HP 44705H.

25. Connect the multimeter test leads between the Bank A LOW common test point and the Bank B LOW common test point on the test fixture as shown in Figure 8-32.

26. Record the voltage indicated on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 2 µV for the HP 44705A or 10 µV for the HP 44705H.

27. Open the Sense Bus Tree Relays by executing:

SWRITE ES00,4,17152 (where E = extender number, S = slot number)

28. Close the Source Bus Tree Relays by executing:

SWRITE ES00,6,19456 (where E = extender number, S = slot number)

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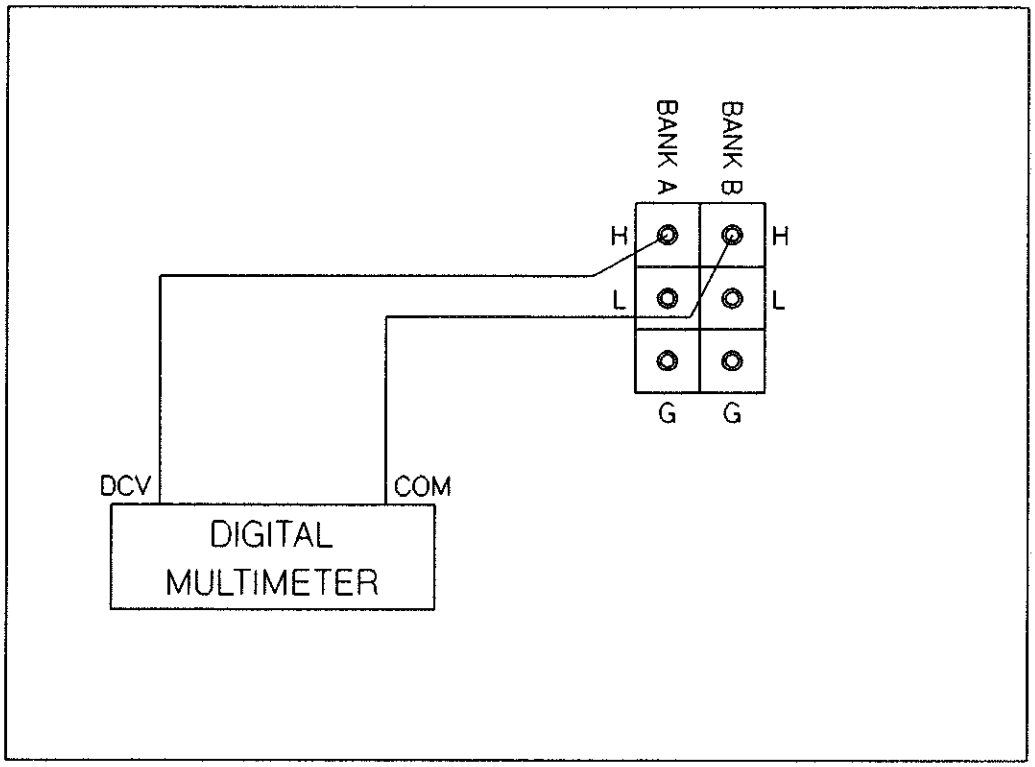


Figure 8-31 HP 44705A/H Sense Tree Thermal Offset

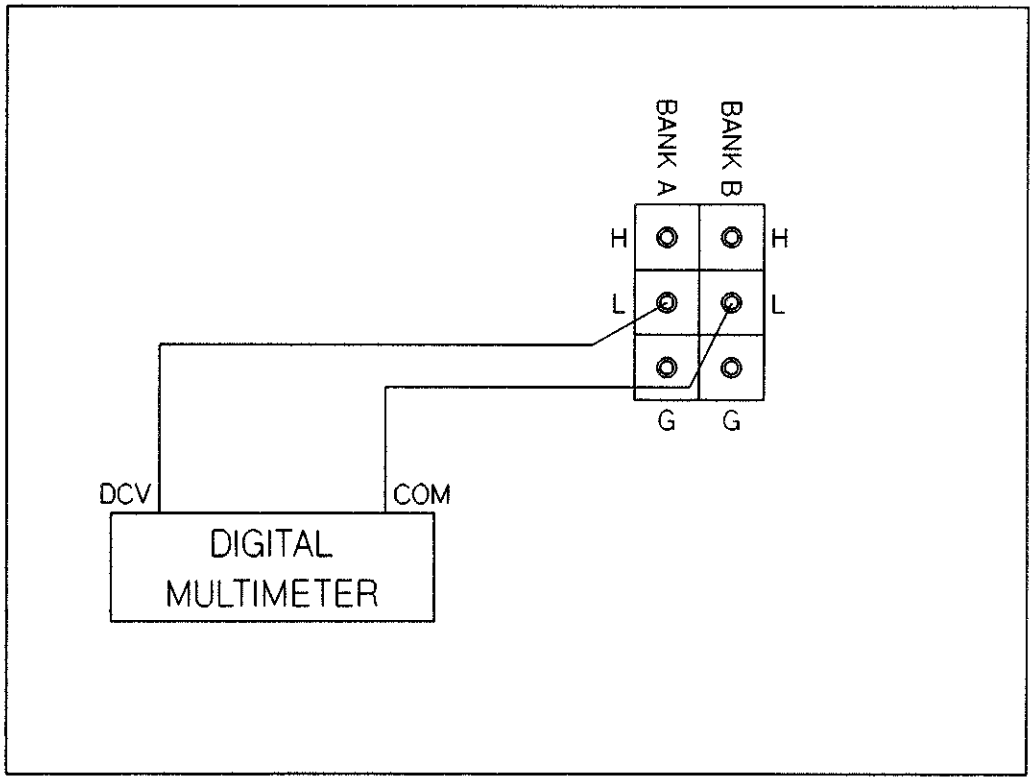


Figure 8-32 HP 44705A/H Source Tree Thermal Offset

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29. Record the voltage indicated on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 2 µV for the HP 44705A or 10 µV for the HP 44705H.

30. Connect the multimeter test leads between the Bank A HIGH common test point and the Bank B HIGH common test point as shown in Figure 8-31.

31. Record the voltage indicated on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 2 µV for the HP 44705A or 10 µV for the HP 44705H.

32. Connect the multimeter test leads between the Bank A LOW common test point and the Bank B LOW common test point on the test fixture as shown in Figure 8-32.

33. Record the voltage indicated on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 2 µV for the HP 44705A or 10 µV for the HP 44705H.

34. Open the Source Bus Tree Relays by executing:

SWRITE ES00,4,19456 (where E = extender number, S = slot number)

8-32 Injected Current Test

This test measures the amount of current injected into the HIGH, LOW, and GUARD contacts of each channel relay. The amount of injected current is deduced by measuring the voltage drop across a known value resistor. A 10 Mohm resistor is recommended.

NOTE

The input resistance of the test digital multimeter could affect the value of R1 in the following tests, if using other than the recommended digital multimeter. The value of R1 should be determined by the 10 Mohm resistor in parallel with the input reistance of the digital multimeter.

1. HIGH LINES INJECTED CURRENT TEST. Set the multimeter to the DC volts function on a range with at least 100 µV of resolution. Install the 10 Mohm resistor across the input terminals of the multimeter. This resistance will be referred to as **R1** in the following steps.

2. Connect the multimeter DCV lead to the shorted HIGH test point of the test fixture. Connect the multimeter COM lead to the LOGIC GND connection on the service module as shown in Figure 8-33.

3. Close the first channel in the multiplexer by executing:

CLOSE ES00 (where E = extender number, S = slot number)

4. Record the voltage indicated on the multimeter. This voltage will be referred to as **V1**.

5. Calculate the injected current (I) from the formula:

$$I = \frac{V1}{R1}$$

The injected current must be less than 1 nA. Once the value of the resistor used is known, the specification can be checked by simply measuring the voltage. For example, using the recommended 10 Mohm resistor, the voltage indicated on the multimeter must be less than 0.01 VDC.

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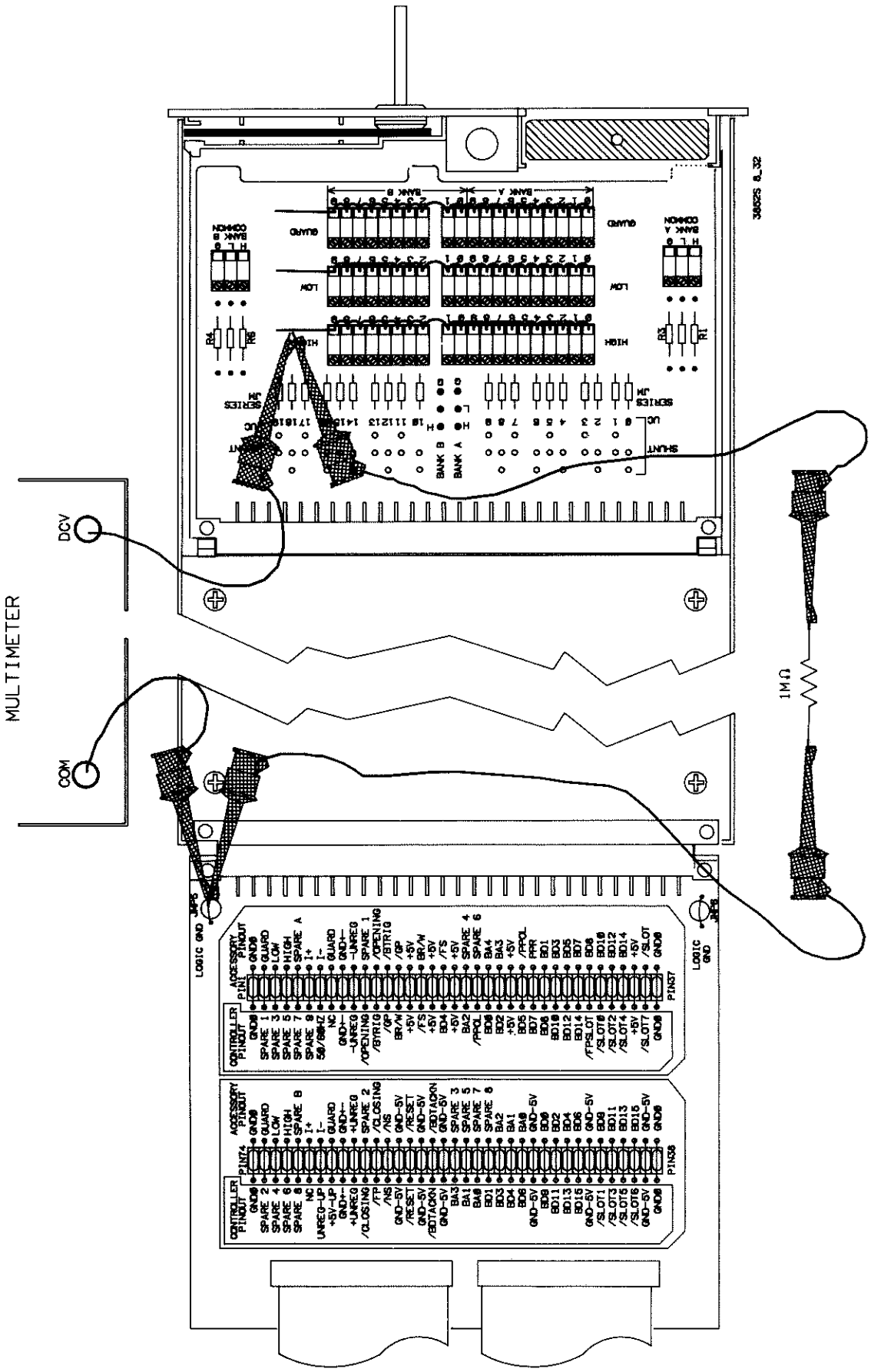


Figure 8-33 HP 44705A/H HIGH Lines Injected Current

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6. Repeat steps 3, 4, and 5 for channels 01 through 19. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES01 for channel 01).

7. LOW LINES INJECTED CURRENT TEST. Move the multimeter DCV lead to the shorted LOW test point on the test fixture as shown in Figure 8-34.

8. Close the first channel in the multiplexer by executing:

CLOSE ES00 (where E = extender number, S = slot number)

9. Record the voltage indicated on the multimeter. This voltage will be referred to as **V1**.

10. Calculate the injected current (I) from the formula:

$$I = \frac{V1}{R1}$$

The injected current must be less than 1 nA.

Once the value of the resistor used is known, the specification can be checked by simply measuring the voltage. For example, using the recommended 10 Mohm resistor, the voltage indicated on the multimeter must be less than 0.01 VDC.

11. Repeat steps 8, 9, and 10 for channels 01 through 19. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES01 for channel 01).

12. GUARD LINES INJECTED CURRENT TEST. Move the multimeter DCV lead to the shorted GUARD test point on the test fixture as shown in Figure 8-35.

13. Close the first channel in the multiplexer by executing:

CLOSE ES00 (where E = extender number, S = slot number)

14. Record the voltage indicated on the multimeter. This voltage will be referred to as **V1**.

15. Calculate the injected current (I) from the formula:

$$I = \frac{V1}{R1}$$

The injected current must be less than 1 nA.

Once the value of the resistor used is known, the specification can be checked by simply measuring the voltage. For example, using the recommended 10 Mohm resistor, the voltage indicated on the multimeter must be less than 0.01 VDC.

16. Repeat steps 8, 9, and 10 for channels 01 through 19. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES01 for channel 01).

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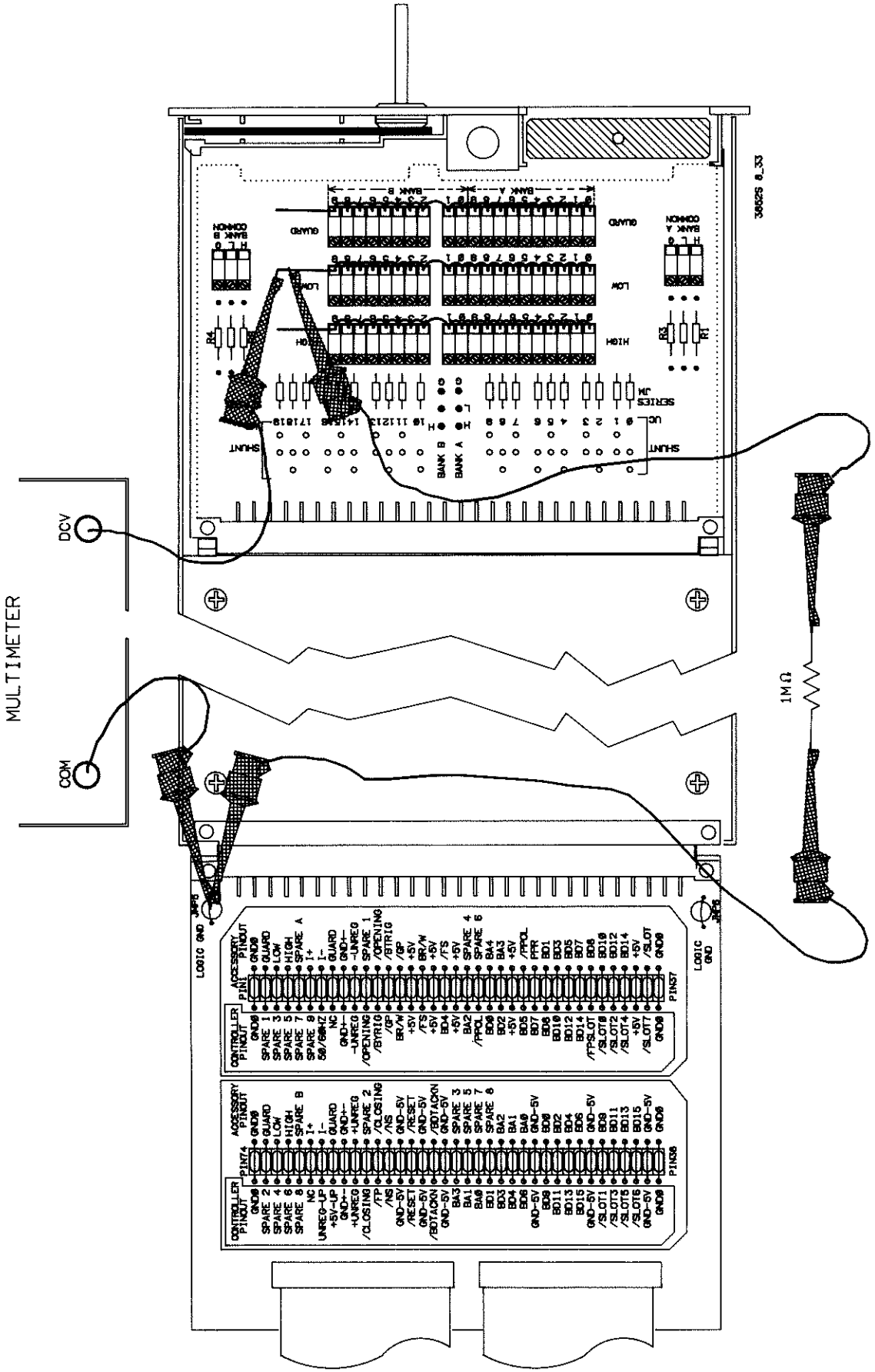


Figure 8-34 HP 44705A/H LOW Lines Injected Current

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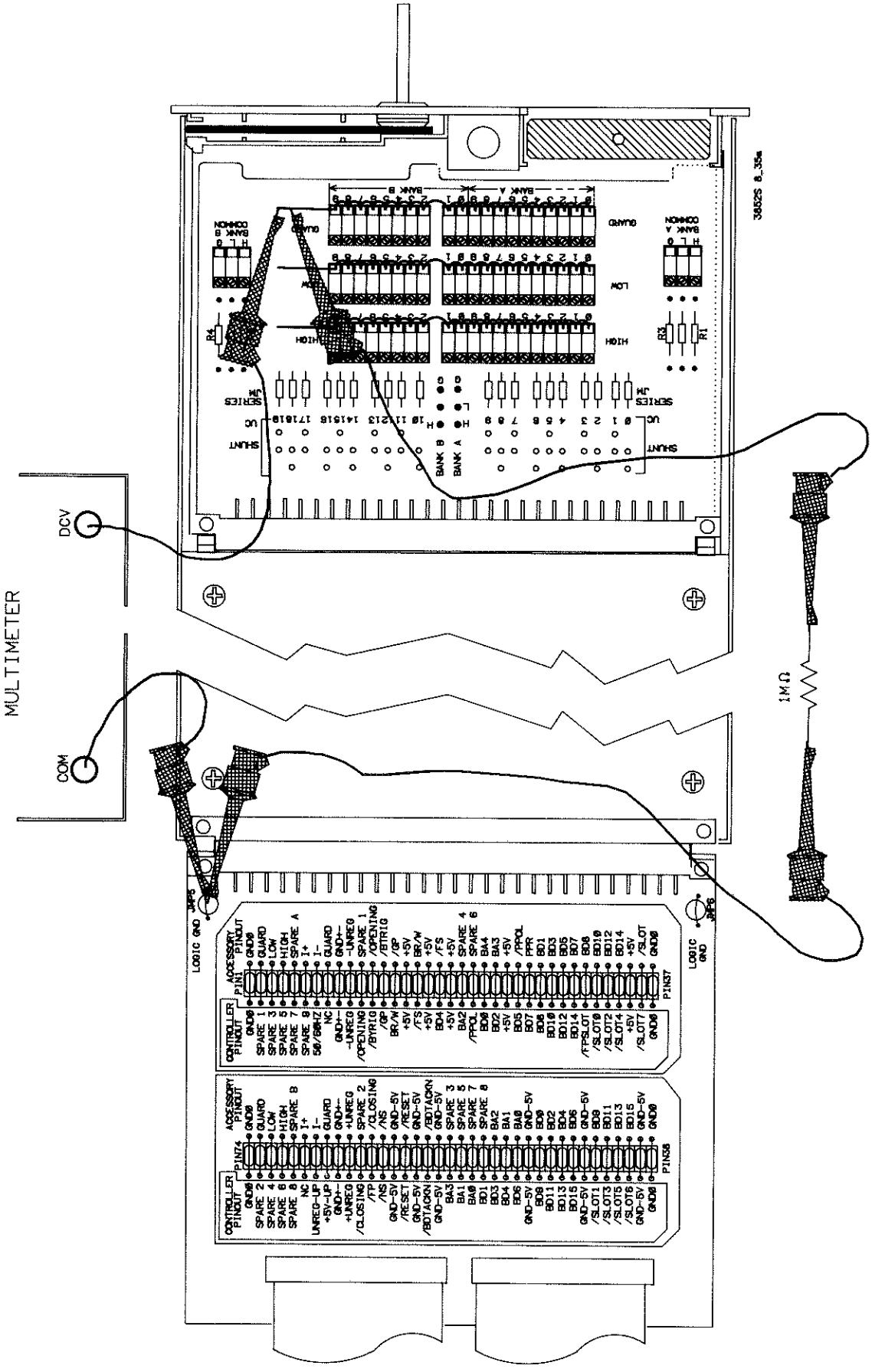


Figure 8-35 HP 44705A/H GUARD Lines Injected Current

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8-33 HP 44706A PERFORMANCE TESTS

8-34 Introduction

The following Performance Tests check the operation of the HP 44706A component module. Performance Tests are not given for the terminal module. Successful completion of all tests in this section provides a high confidence level that the relay multiplexer is meeting its listed specifications.

The Performance Tests should be performed in the order they are presented. The completion of each test increases the confidence level in the relay multiplexer operation. A minimum set of tests is given as the Operational Verification Tests. These tests are described in Section 8-35.

The Performance Test procedures in this chapter are involved and time consuming. Since the most likely parameter to change with time is the contact resistance of a relay, and since the contact resistance is checked as a part of the Operational Verification Tests, it is not recommended that all Performance Tests be performed unless one of the tested specifications is in question.

8-35 Operational Verification

The first tests given in this section are a minimal set of tests recommended for the relay multiplexer. These tests are designed to test the functionality and contact resistance of the relay multiplexer. Successful completion of the Operational Verification Tests provides a 90% confidence level that the relay multiplexer is operating normally and is within specification.

The Operational Verification Tests consist of the following:

Section 8-39 - Set-Up Procedure
Section 8-40 - Relay Contact Resistance Test

8-36 Equipment Required

The following list of equipment is required for the Performance Tests. Only the first three items on the list are required for the Operational Verification Tests.

1. Digital Multimeter -- HP 3456A or equivalent
2. Test Fixture -- as described in Section 8-37
3. Test Leads and Jumpers
4. Resistor -- 10 Mohm
5. Resistor -- 1 kohm
6. Oscilloscope -- HP 1740A or equivalent (dual trace with delayed sweep)
7. Service Module -- HP 44743A
8. +20 V Power Supply -- HP 6212 or equivalent

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NOTE

Either of the accessory plug-in multimeters (HP 44701A or HP 44702A/B) may be used for these tests. The tests do not describe the specific steps required to use the plug-in multimeters. A description of the plug-in multimeters can be found in the Plug-In Accessories Configuration and Programming Manual (HP part number 03852-90002).

8-37 Test Fixture

A test fixture is required to run the Performance Tests. A schematic of the required test fixture is shown in Figure 8-36a. A test fixture can be made using the HP 44706AT terminal module (see Figure 8-36b). Because wiring the test fixture will make the terminal module unusable in an application, an additional terminal module should be ordered for service purposes.

If the test fixture is to be fabricated from other than a HP 44706AT terminal module, it is important that the terminal ID lines, shown in Figure 8-36b be correctly wired. The HP 3852A local controller will not allow the execution of some commands with an incorrect terminal ID.

The fixture consists of: a short circuit between all channel HIGH lines and test connections for the common LOW and GUARD lines. The use of the fixture minimizes the number of test lead connections required for the tests.

8-38 Test Procedures

WARNING

Even with power removed from the HP 3852A, high voltages, generated in other parts of the system, may be present at the terminal module of each accessory. Service personnel should ensure that all external power is removed from the system before installing, removing, testing or repairing any plug-in accessory.

8-39 Set-Up Procedure

1. Remove power from the HP 3852A.

2. Remove the terminal module from the rear of the HP 44706A component module and install the test fixture. Note the slot number where the HP 44706A under test is installed.

3. Verify the correct connections and slot numbers:

   a. Apply power to the HP 3852A. Wait for the HP 3852A to complete its wake-up sequence.

   b. Execute:

      ID? ES00 (where E = extender number, S = slot number)

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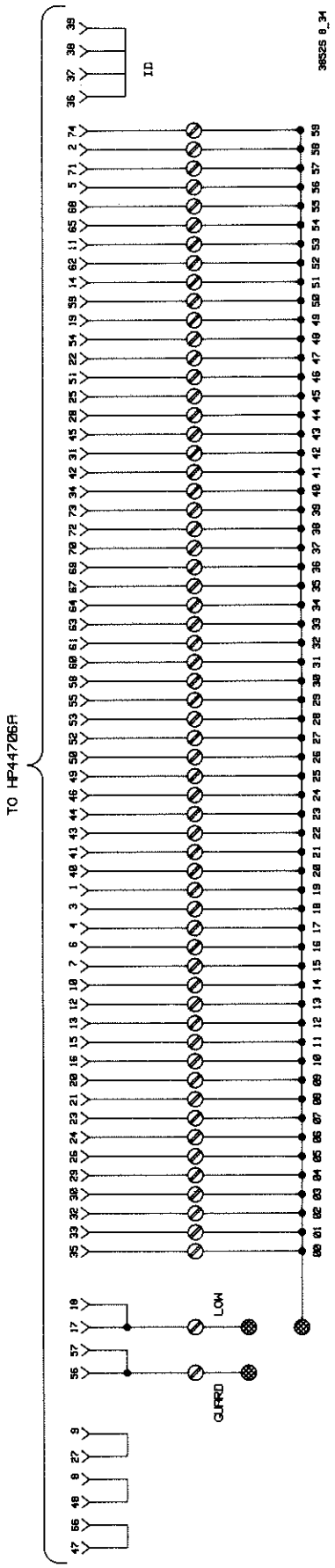


Figure 8-36a HP 44706A Test Fixure Wiring

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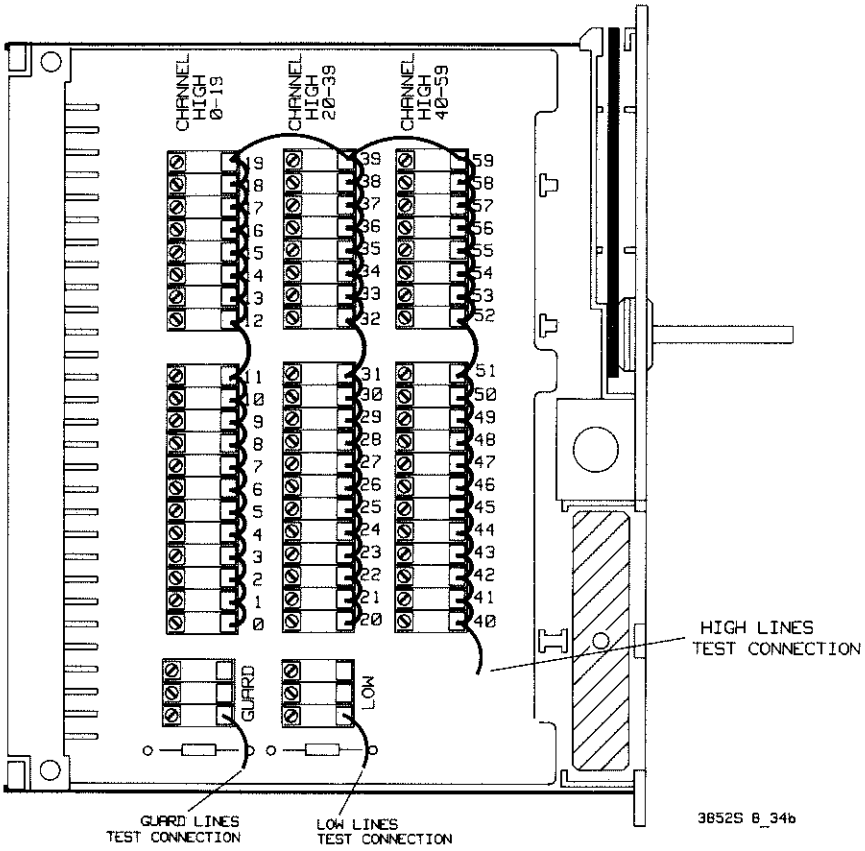


Figure 8-36 HP 44706A Test Fixure

c. Verify that the HP 3852A right display shows:

44706A

NOTE

If the HP 3852A right display shows a different accessory number, the slot number used may not be correct. If the HP 3852A display shows 447XXX, the test fixture is either not installed or the ID lines on the fixture are incorrectly wired.

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4. Set the multimeter to measure ohms.

5. Set the HP 44706A to a known state by executing:

RESET ES00 (where E = extender number, S = slot number)

This opens all relays on the HP 44706A.

6. Short the HIGH lines, LOW line and GUARD lines together on the test fixture with jumpers.

8-40 Relay Contact Resistance Test

1. HIGH AND LOW RELAY TEST: This test checks the relay contact resistance for the channel relays (switching the HIGH line) and the tree relays (switching both the HIGH line and the LOW line).

2. Set the multimeter to measure four-wire ohms. Connect the multimeter ohms SENSE leads to the backplane analog bus sense HIGH and LOW connections. Connect the multimeter ohms SOURCE leads to the backplane analog bus current source HIGH and LOW connections.

NOTE

The backplane analog bus can be tested in one of three ways: 1) By connecting an external multimeter to the analog bus connector on the rear panel of the power supply module as shown in Figure 8-8, 2) By connecting an external multimeter to the backplane analog bus line jumpers provided on the 44743A service module as shown in Figure 8-9, or 3) by using a plug-in multimeter (HP 44701A or HP 44702A/B) programmed to measure four-wire ohms from the backplane.

3. Close channel 00 by executing:

CLOSE ES00,ES91 (where E = extender number, S = slot number)

4. Observe the reading on the multimeter. The multimeter should indicate a resistance of less than 2 ohms.

5. Open the channel by executing:

OPEN ES00 (where E = extender number, S = slot number)

6. Observe the reading on the multimeter. The multimeter should indicate an open circuit (>1 GΩ).

7. Repeat steps 3, 4, 5, and 6 for channels 01 through 59. In the CLOSE and OPEN commands, the last two digits are the channel number. For example, CLOSE ES01 would close channel 01.

8. GUARD RELAY TEST: This test checks the guard connection through the tree relays.

9. Set the multimeter to measure two-wire ohms. Connect the multimeter DCV lead to the backplane analog bus sense LOW connection. Connect the multimeter COM lead to the backplane analog bus GUARD connection.

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10. Close channel 00 by executing:

CLOSE ES00,ES91 (where E = extender number, S = slot number)

11. Observe the reading on the multimeter. The multimeter should indicate approximately 200 ohms. The resistance indicated is the sum of the resistance of the tree relay contacts, the resistance of the connections, and the resistance of the series protection resistors in the analog bus lines (there are 100 ohm resistors on the HP 44706A component module in series with each line to the analog bus).

12. Open the channel by executing:

OPEN ES00 (where E = extender number, S = slot number)

13. Observe the reading on the multimeter. The multimeter should indicate an open circuit (>1 GΩ).

14. Repeat steps 10, 11, 12, and 13 for channel 20 (CLOSE and OPEN ES20).

15. Repeat steps 10, 11, 12, and 13 for channel 40 (CLOSE and OPEN ES40).

THIS CONCLUDES THE OPERATIONAL VERIFICATION PORTION OF THE HP 44706A PERFORMANCE TEST.

8-41 Opening and Closing Time Set-Up Procedure

This test verifies that the channel relays will maintain break-before-make operation and that the multiplexer can scan the channels at the specified speed. Only the first 20 channels, instead of all 60 channels, need testing because each channel relay switches three channel contacts at the same time.

1. Remove power from the HP 3852A and unplug the relay multiplexer to be tested. Install the Service Module in a convenient slot in the HP 3852A. Note the slot number where the Service Module is installed. Install the relay multiplexer on the service module. Install the test fixture on the relay multiplexer. The Set-Up Procedure is depicted in Figure 8-37.

2. On an oscilloscope, connect probes to the Channel A INPUT, Channel B INPUT, and EXT TRIGGER input. Set up the oscilloscope to the following:

Dual Trace
Channel A -- DC, 0.5 Volts/Div (if using 10:1 probes)
Channel B -- DC, 0.5 Volts/Div (if using 10:1 probes)
Trigger -- External
Vertical Display -- Chopped
Time -- 5 mses/Div
Delayed Sweep -- 0.1 msec/Div
Delayed Sweep Dial -- Minimum

3. Connect the 1 kohm resistor between the analog bus HIGH connection and the +5V connection on the service module with jumpers.

4. Connect a jumper between the analog bus LOW test connection and the logic ground test connection on the service module.

5. Connect the Channel A oscilloscope probe to the analog bus HIGH test connection on the service module.

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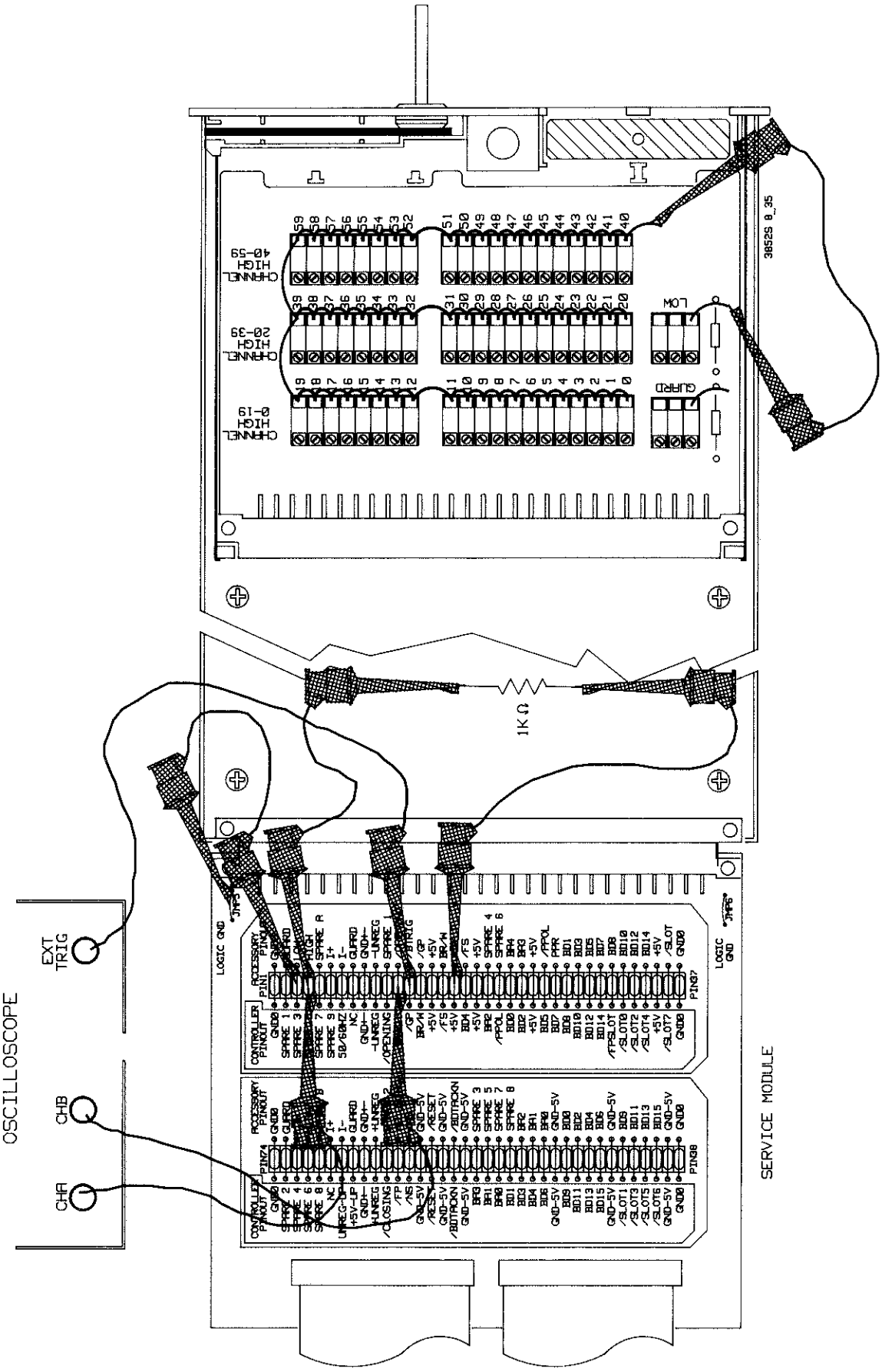


Figure 8-37 HP 44706A Opening Time Set-Up

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6. Connect the Channel B oscilloscope probe to the OPENING test connection on the service module.

7. Connect the EXT TRIGGER oscilloscope probe to the BTRIG test connection on the service module.

8. Short the HIGH lines to the LOW lines on the test fixture with jumpers.

9. Apply power to the HP 3852A.

10. Set up the following subroutine in HP 3852A memory. When the first statement is entered the SUB ENTRY annunciator should be on in the left display. This annunciator should remain on until the SUBEND statement is entered.

```
SUB A
TRG
SCAN ES00-ES19   (where E = extender number, S = slot number)
SUBEND
```

The subroutine will scan all channels on the relay multiplexer in a break-before-make fashion. The scan will be preceded by a backplane trigger pulse (used to trigger the oscilloscope). Do not reset or cycle power to the HP 3852A or the subroutine will be erased from memory. The front panel CLEAR key may be used without disturbing the subroutine.

8-42 Opening Time Test

1. OPENING PULSE WIDTH TEST. This test checks the pulse width of the OPENING pulse output from the relay multiplexer.

2. Repetitively call the entered subroutine by executing:

```
CALL A,1000
```

This statement will call the subroutine 1000 times.

3. Observe the waveform displayed on the Channel B trace and make sure all 20 channels are present. It may also be necessary to adjust the TRIGGER LEVEL and TRIGGER HOLD controls on the scope to synchronize the signal on the scope.

4. The OPENING pulse is a negative pulse. The width of the negative portion of the pulse must be between 0.77 and 0.94 milliseconds. If the pulse width is not within these limits, the relay multiplexer is failing. The OPENING pulse is shown in Figure 8-38. The waveform will exhibit a small amount of jitter caused by the operating system.

NOTE

If necessary, repeat step 2 to allow more time to view the waveform. The 1000 repetitions of the subroutine take approximately 45 seconds to complete. The time may be extended by increasing the number of repetitions specified in step 2.

5. RELAY OPENING TIME TEST. This test checks the ability of each channel relay to open within the time specified.

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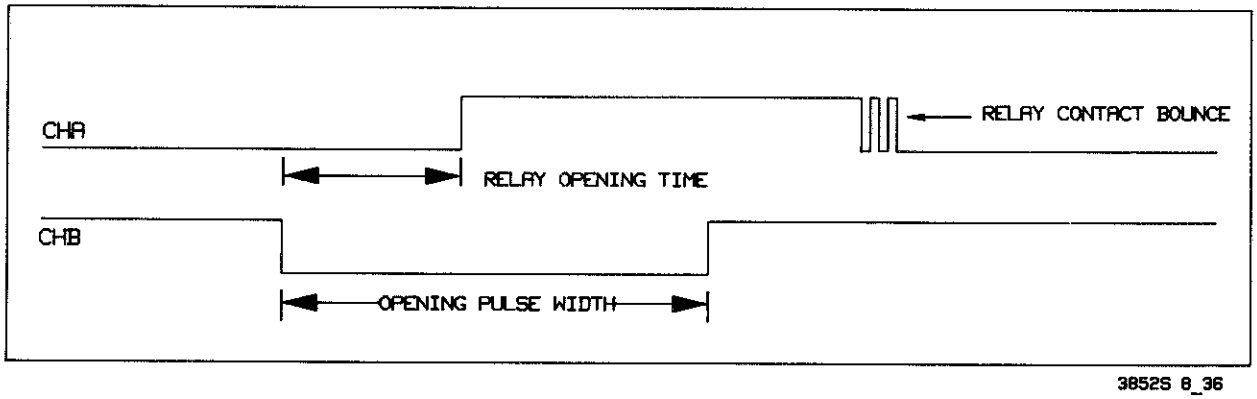


Figure 8-38 HP 44706A Opening Time

6. Repetitively call the entered subroutine by executing:

CALL A,10000

7. Rotate the DELAY SWEEP dial to the minimum position. Select the DELAYED sweep mode on the scope. Slowly rotate the DELAY SWEEP dial clockwise while observing the displayed waveforms. The Channel B waveform is the OPENING pulse. The Channel A waveform is the +5V supply as switched by the relays. As the DELAY SWEEP dial is rotated, one relay closure and the associated OPENING pulse will come in to view at a time. The relay opening time is the time between the falling edge of the OPENING pulse (Channel B) and the falling edge of the Channel A waveform. This time must be less than 0.94 milliseconds. This time is illustrated in Figure 8-38.

Continue rotating the DELAY SWEEP dial until all 20 relay channels have been checked. A failing channel indicates a sticking relay contact. Only the lower 20 channels are checked since channels 21 through 59 utilize different contacts in the same relays.

To stop the test at any time press the front panel CLEAR key. The test may be extended by increasing the number of times the subroutine is called, as specified in step 5.

The waveforms will exhibit a small amount of jitter due to the overhead of the HP 3852A operating system.

8-43 Closing Time Test

1. CLOSING PULSE WIDTH TEST. This test checks the pulse width of the CLOSING pulse output from the relay multiplexer.

2. Move the Channel B oscilloscope probe to the CLOSING connection on the service module. The Set-Up is shown in Figure 8-39.

3. Repetitively call the entered subroutine by executing:

CALL A,1000

4. Take the scope out of the DELAYED sweep mode. Observe the waveform displayed on the Channel B trace and make sure all 20 channels are present. It may also be necessary to adjust the TRIGGER LEVEL and TRIGGER HOLD controls on the scope to synchronize the signal on the scope.

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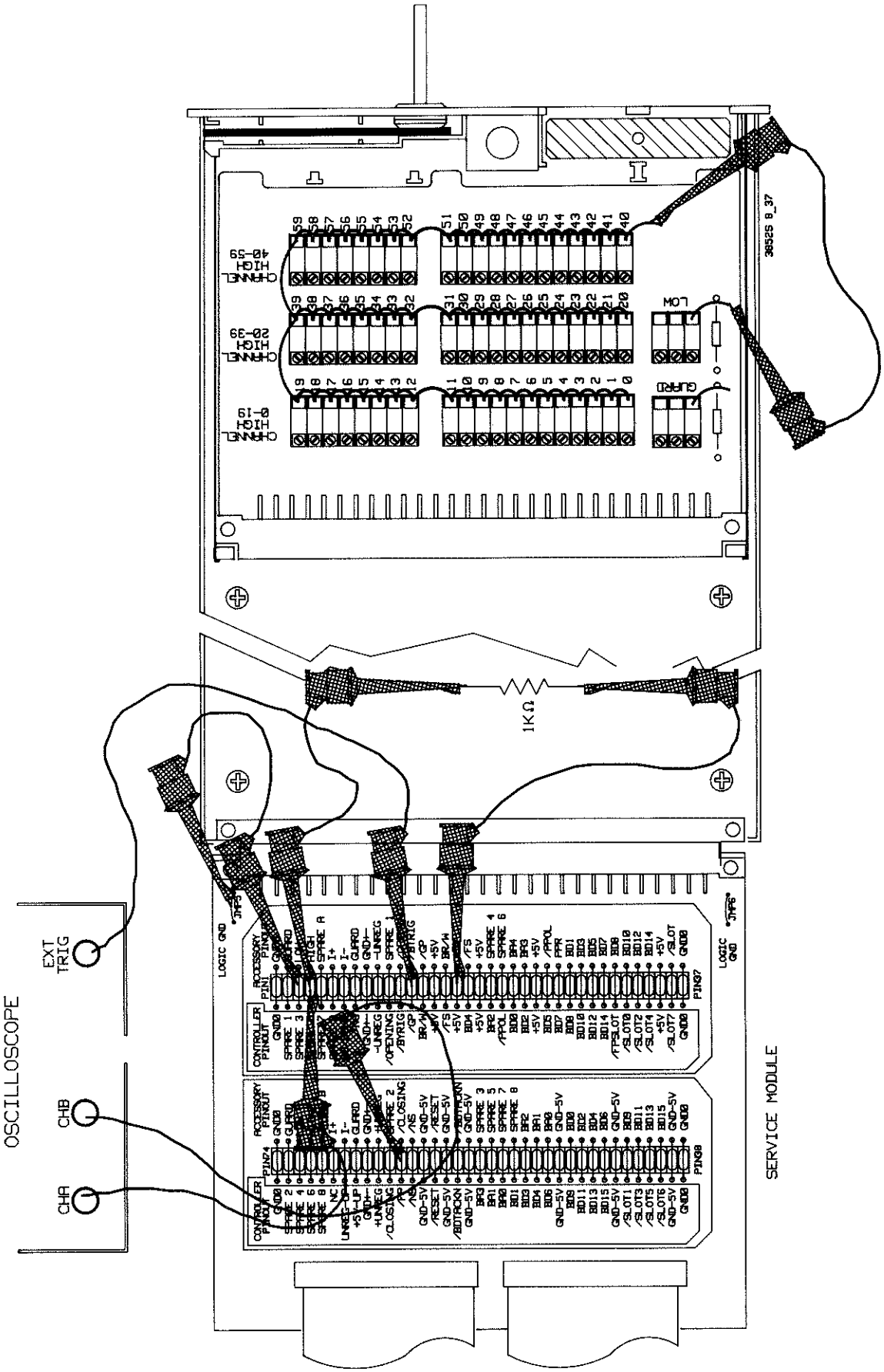


Figure 8-39 HP 44706A Closing Time Set-Up

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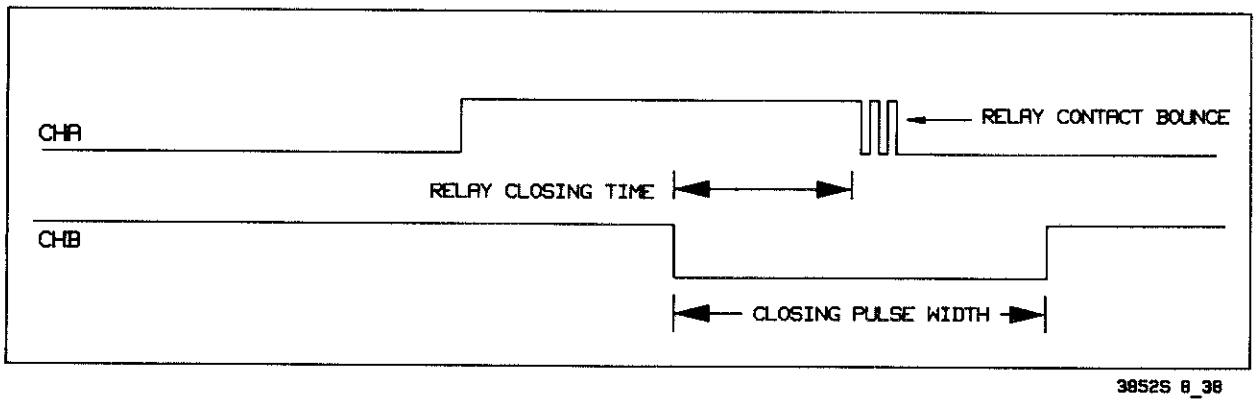


Figure 8-40 HP 44706A Closing Time

5. The CLOSING pulse is a negative pulse. The width of the negative pulse must be between 0.9 msec and 1.1 msec. If the pulse is not within these limits, the relay multiplexer is failing. The CLOSING pulse is shown in Figure 8-40. The waveform will exhibit a small amount of jitter caused by the operating system.

NOTE

If necessary, repeat step 2 to allow more time to view the waveform. The 1000 repetitions of the subroutine take approximately 45 seconds to complete. The time may be extended by increasing the number of repetitions specified in step 3.

6. RELAY CLOSING TIME TEST. This test checks the ability of the channel relays to close within the time specified.

7. Repetitively call the entered subroutine by executing:

CALL A,10000

7. Rotate the DELAY SWEEP dial to the minimum position. Select the DELAYED sweep mode on the scope. Slowly rotate the DELAY SWEEP dial clockwise while observing the displayed waveforms. The Channel B waveform is the CLOSING pulse. The Channel A waveform is the +5V supply as switched by the relays. As the DELAY SWEEP dial is rotated, one relay closure and the associated CLOSING pulse will come in to view at a time. The relay closing time is the time between the falling edge of the CLOSING pulse (Channel B) and the falling edge of the Channel A waveform. This time must be less than 1.1 milliseconds. This time is illustrated in Figure 8-40. Note that there will be some relay bounce indicated on the Channel A waveform.

Continue rotating the DELAY SWEEP dial until all 20 relay channels have been checked. A failing channel indicates a sticking relay contact. Only the lower 20 channels are checked since channels 21 through 59 utilize different contacts in the same relays.

To stop the test at any time press the front panel CLEAR key. The test may be extended by increasing the number of times the subroutine is called, as specified in step 6.

The waveforms will exhibit a small amount of jitter due to the overhead of the HP 3852A operating system.

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8-44 DC Isolation Tests

The DC isolation tests use a power supply, a resistor and the multimeter to form a voltage divider. The channel being tested is then connected in parallel with this divider and the isolation resistance computed from the measured voltage across the divider.

NOTE

The best test results will be obtained when the resistor value used is the same value as the internal resistance of the voltmeter. The recommended 10 Mohm resistor was selected to match the input impedance of an HP 3456A multimeter set to the 100 Vdc range.

1. SET-UP PROCEDURE. Using the multimeter, measure the resistance of the 10 Mohm resistor. This resistance will be referred to as **R1** in the following steps.

2. Set the multimeter to measure DC volts and connect the multimeter to the DC power supply. Adjust the DC power supply output to +20 Vdc ±0.01 Vdc. This voltage will be referred to as **V1** in the following steps.

3. Connect the resistor, power supply and multimeter as shown in Figure 8-41.

4. Set the multimeter to the 100 Vdc range. Measure the exact voltage displayed on the multimeter. This voltage will be referred to as **V2** in the following steps.

5. Calculate the internal resistance of the multimeter (**Rm**) using the following equation:

$$Rm = \frac{R1 \cdot V2}{(V1 - V2)}$$

NOTE

In most cases, the internal resistance of the multimeter is dependent upon the range selected. For this reason, do not change the multimeter range setting in the following procedure.

6. HIGH TO LOW ISOLATION TEST. This test checks the isolation between the HIGH and LOW lines with a single channel closed.

7. Set the multiplexer to a known state by executing:

RESET ES00 (where E = extender number, S = slot number)

8. Connect the test circuit between the shorted HIGH lines and the LOW line on the test fixture as shown in Figure 8-42.

9. Close a channel on the multiplexer by executing:

CLOSE ES00 (where E = extender number, S = slot number)

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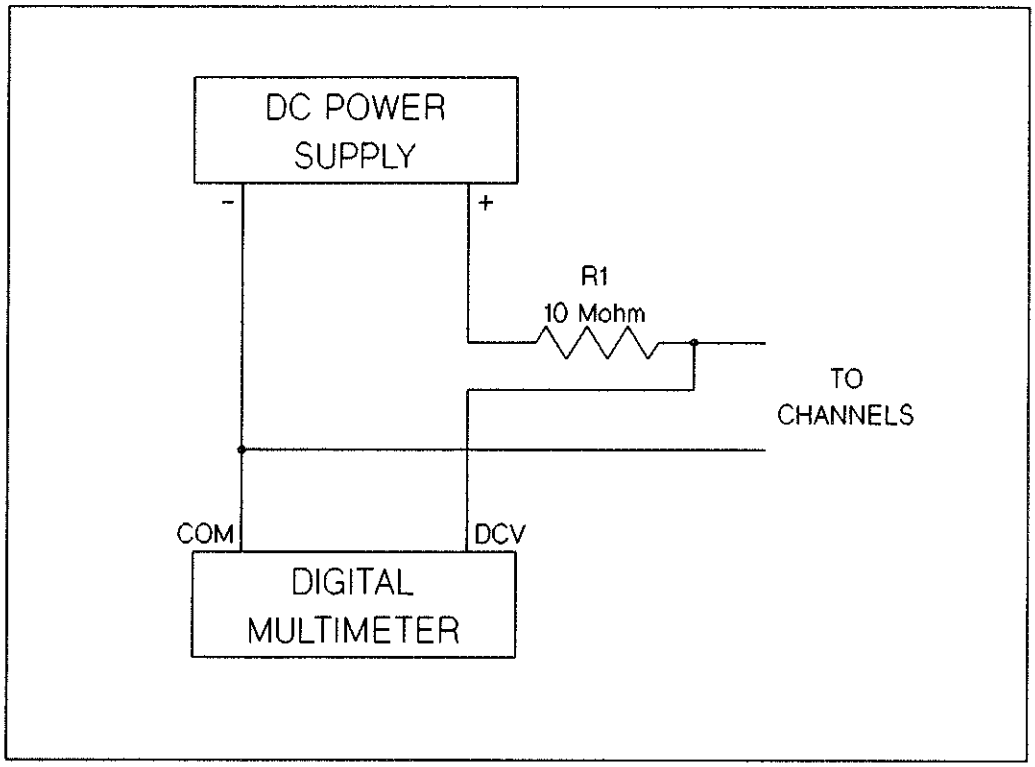


Figure 8-41 HP 44706A DC Isolation Set-Up

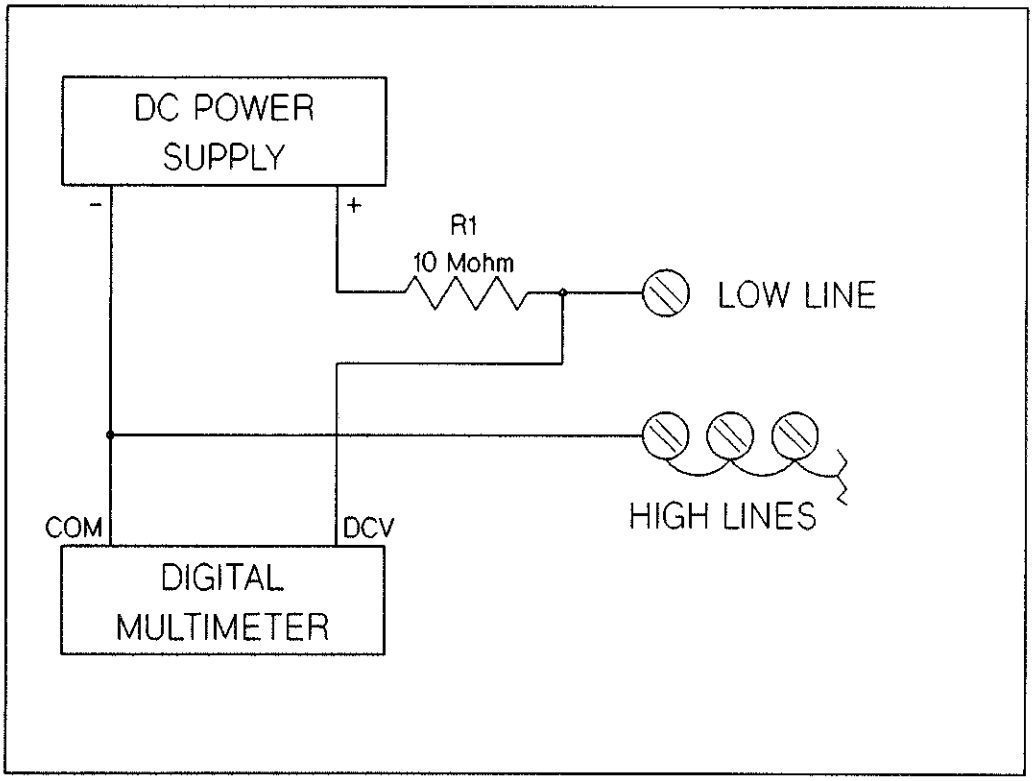


Figure 8-42 HP 44706A HIGH to LOW DC Isolation

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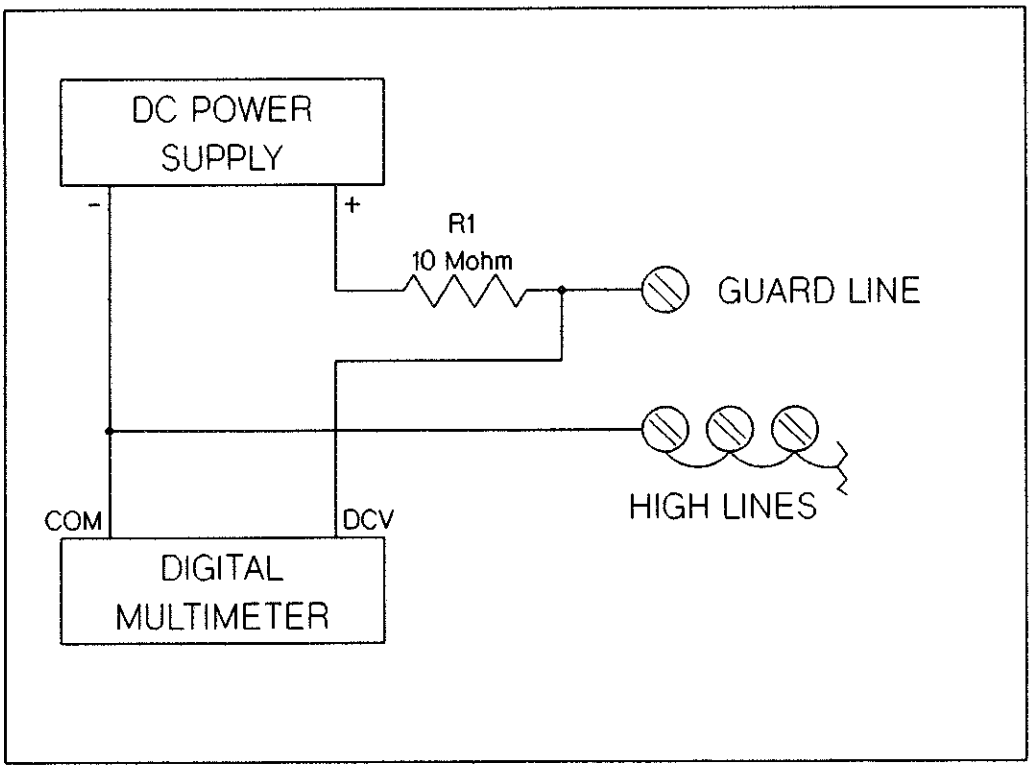


Figure 8-43 HP 44706A HIGH to GUARD DC Isolation

10. Record the multimeter voltage measurement. This reading will be referred to as **V3**.

11. Calculate the DC isolation (**Rc**) using the following equation:

$$Rc = \frac{V3 \bullet R1 \bullet Rm}{Rm \bullet (V1 - V3) - (R1 \bullet V3)}$$

The DC isolation should be greater than 10^9 ohms.

12. Repeat steps 9, 10, and 11 for channels 01 through 59. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES01 for channel 01).

13. HIGH TO GUARD ISOLATION TEST. This test checks the DC Isolation between the HIGH lines and the GUARD lines with a single channel closed.

14. Connect the test circuit between the shorted HIGH lines and the GUARD line of the test fixture as shown in Figure 8-43.

15. Close a channel on the multiplexer by executing:

CLOSE ES00 (where E = extender number, S = slot number)

16. Record the multimeter voltage measurement. This reading will be referred to as **V3**.

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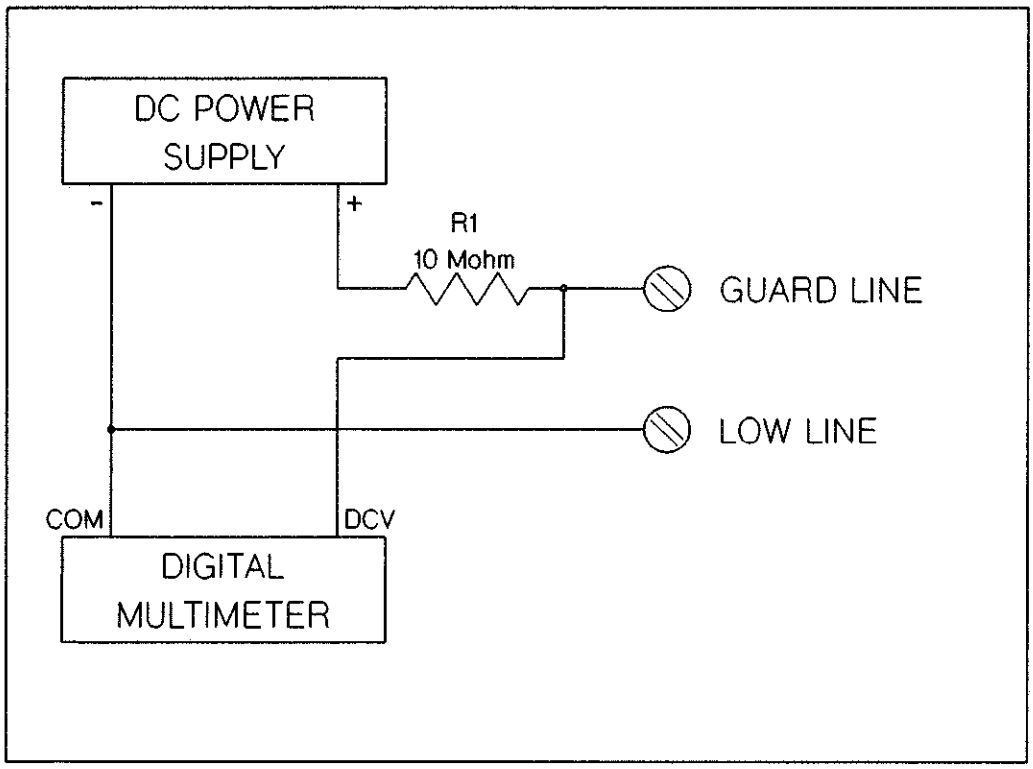


Figure 8-44 HP 44706A LOW to GUARD DC Isolation

17. Calculate the DC isolation (**Rc**) using the equation in step 10. The DC Isolation should be greater than 10^9 ohms.

18. Repeat steps 15, 16, and 17 for channels 01 through 59. In the CLOSE command the last two digits are the channel number. For example, CLOSE ES01 for channel 01.

19. LOW TO GUARD ISOLATION TEST. This test checks the DC Isolation between the LOW and GUARD lines with a single channel closed.

20. Connect the test circuit between the LOW line and the GUARD lines of the test fixture as shown in Figure 8-44.

21. Close a channel on the multiplexer by executing:

CLOSE ES00 (where E = extender number, S = slot number)

22. Record the multimeter voltage measurement. This reading will be referred to as **V3**.

23. Calculate the DC isolation (**Rc**) using the equation in step 10. The DC Isolation should be greater than 10^9 ohms.

24. Repeat steps 21, 22, and 23 for channels 01 through 59. In the CLOSE command the last two digits are the channel number. For example, CLOSE ES01 for channel 01.

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8-45 Thermal Offset Test

This test measures the thermally generated voltages on the HP 44706A. This test is very sensitive to ambient temperature changes and thermoelectricity generated at the junction of two dissimilar metals. For these reasons, it is important that the test be performed in an environment where the temperature is stable and that the number of test lead connections be kept to a minimum. During the test, care should be taken not to influence the measurements by holding or touching the test leads. The temperature of the leads and connections should be allowed to stabilize for at least one minute after moving or installing the connections.

1. HIGH LINES THERMAL OFFSET TEST. This test checks the thermal offset of the channel relay HIGH contacts through the tree switches to the backplane analog bus.

2. Set the multimeter to the lowest DC voltage range. The resolution of the multimeter must be at least 100 µV. Connect the multimeter test leads together and record the offset voltage indicated on the multimeter. This voltage will be referred to as **V1** in the following steps.

3. Refer to Figure 8-45. Connect the multimeter test leads between the shorted HIGH test connections of the test fixture and the backplane analog bus HIGH connection of the service module.

4. Close a channel by executing:

CLOSE ES00 (where E = extender number, S = slot number)

5. Record the voltage indication on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 100 µV.

6. Repeat steps 4 and 5 for channels 01 through 59. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES01 for channel 01).

NOTE

If a single channel fails the thermal offset test, the channel relay is probably at fault. If several or all channels fail the test, check the test fixture and test lead connections. If groups of channels are failing the test, a failure in the tree switches is indicated. Section 8-47 provides additional tests of failing relays.

7. LOW LINES THERMAL OFFSET TEST. This test checks the thermal offset in the LOW lines of the multiplexer. Since the LOW lines are not switched by the channel relays, only the tree relay contacts are tested.

8. Refer to Figure 8-46. Connect the multimeter between the LOW lines test connection on the test fixture and the backplane analog bus LOW connection on the service module.

9. Close the first channel by executing:

CLOSE ES00 (where E = extender number, S = slot number)

10. Record the voltage indication on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 100 µV.

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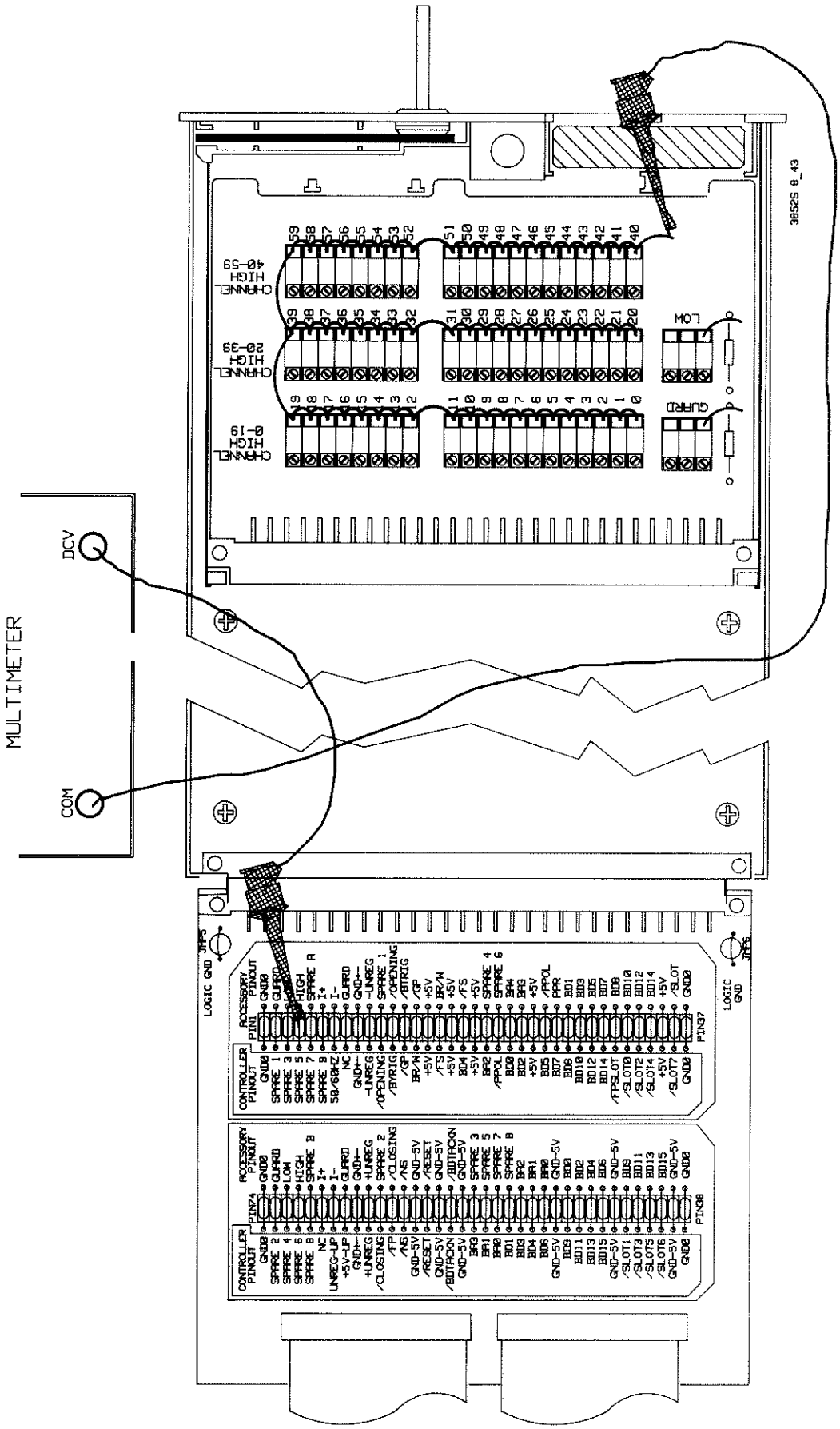


Figure 8-45 HP 44706A HIGH Lines Thermal Offset

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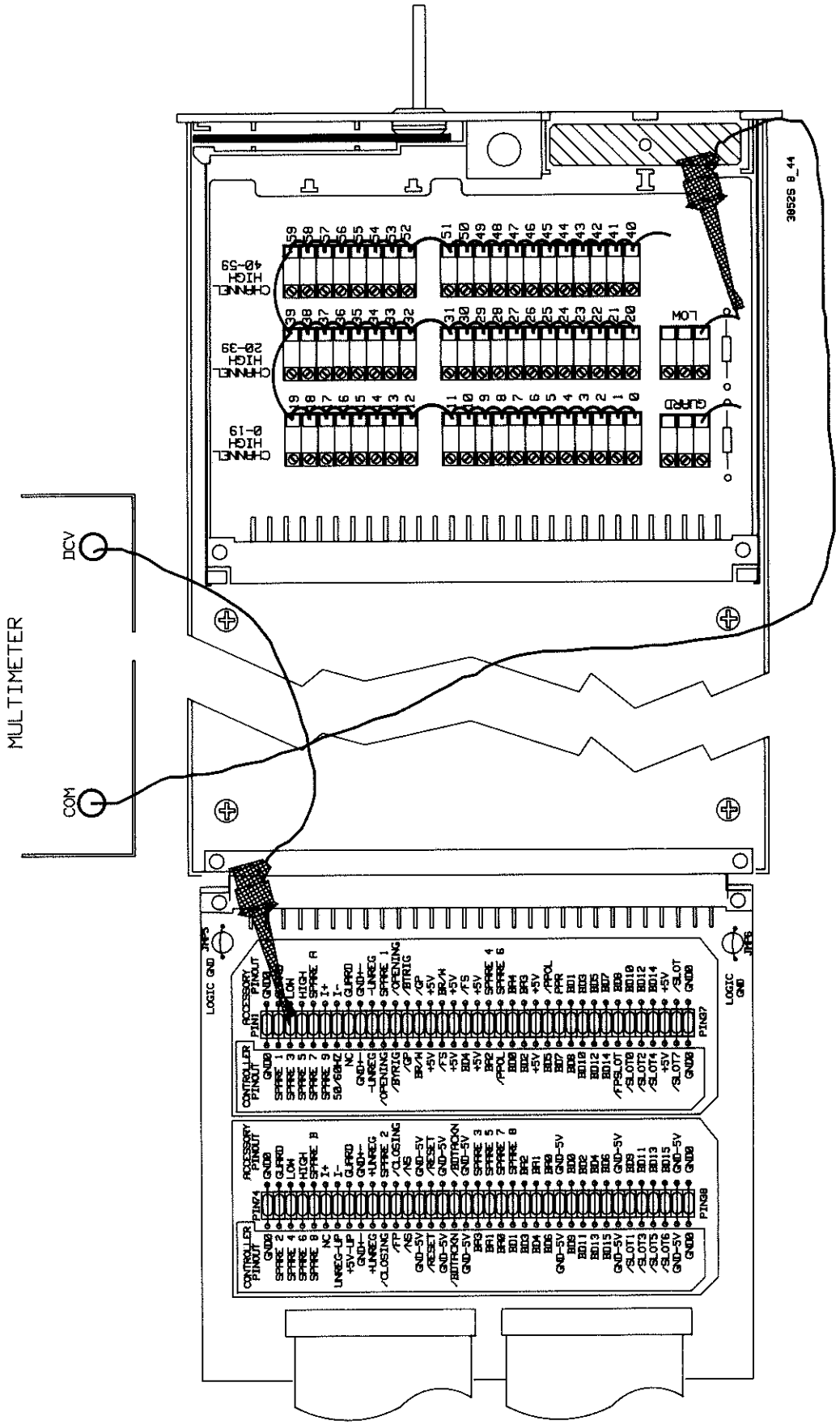


Figure 8-46 HP 44706A LOW Lines Thermal Offset

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11. Repeat steps 8 and 9 for channels 20 and 40. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES20 for channel 20).

12. GUARD LINES THERMAL OFFSET TEST. This test checks the thermal offset of the GUARD lines. Since the GUARD lines are not switched by the channel relays, only the tree switch contacts are tested.

13. Refer to Figure 8-47. Connect the multimeter test leads between the GUARD test connection on the test fixture and the backplane analog bus GUARD line on the service module.

14. Close a channel by executing:

CLOSE ES00 (where E = extender number, S = slot number)

15. Record the voltage indication on the multimeter. This reading will be referred to as **V2**. The difference between **V1** and **V2** must be less than 100 µV.

16. Repeat steps 14 and 15 for channels 20 and 40. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES20 for channel 20).

8-46 Injected Current Test

This test measures the amount of current injected into the HIGH contacts of each channel relay. The LOW and GUARD lines are also tested for injected current by the tree switches. The amount of injected current is deduced by measuring the voltage drop across a known value resistor. A 10 Mohm resistor is recommended.

NOTE

The input resistance of the test digital multimeter could affect the value of R1 in the following tests, if using other than the recommended digital multimeter. The value of R1 should be determined by the 10 Mohm resistor in parallel with the input reistance of the digital multimeter.

1. HIGH LINES INJECTED CURRENT TEST. Set the multimeter to the DC volts function on a range with at least 10 µV of resolution. Install the 10 Mohm resistor across the input terminals of the multimeter. This resistance will be referred to as **R1** in the following steps.

2. Connect the multimeter DCV lead to the shorted HIGH connections of the test fixture. Connect the multimeter COM lead to the LOGIC GND connection on the service module as shown in Figure 8-48.

3. Close the first channel in the multiplexer by executing:

CLOSE ES00 (where E = extender number, S = slot number)

4. Record the voltage indicated on the multimeter. This voltage will be referred to as **V1**.

5. Calculate the injected current (I) using the following formula:

$$I = \frac{V1}{R1}$$

The injected current must be less than 1 nA.

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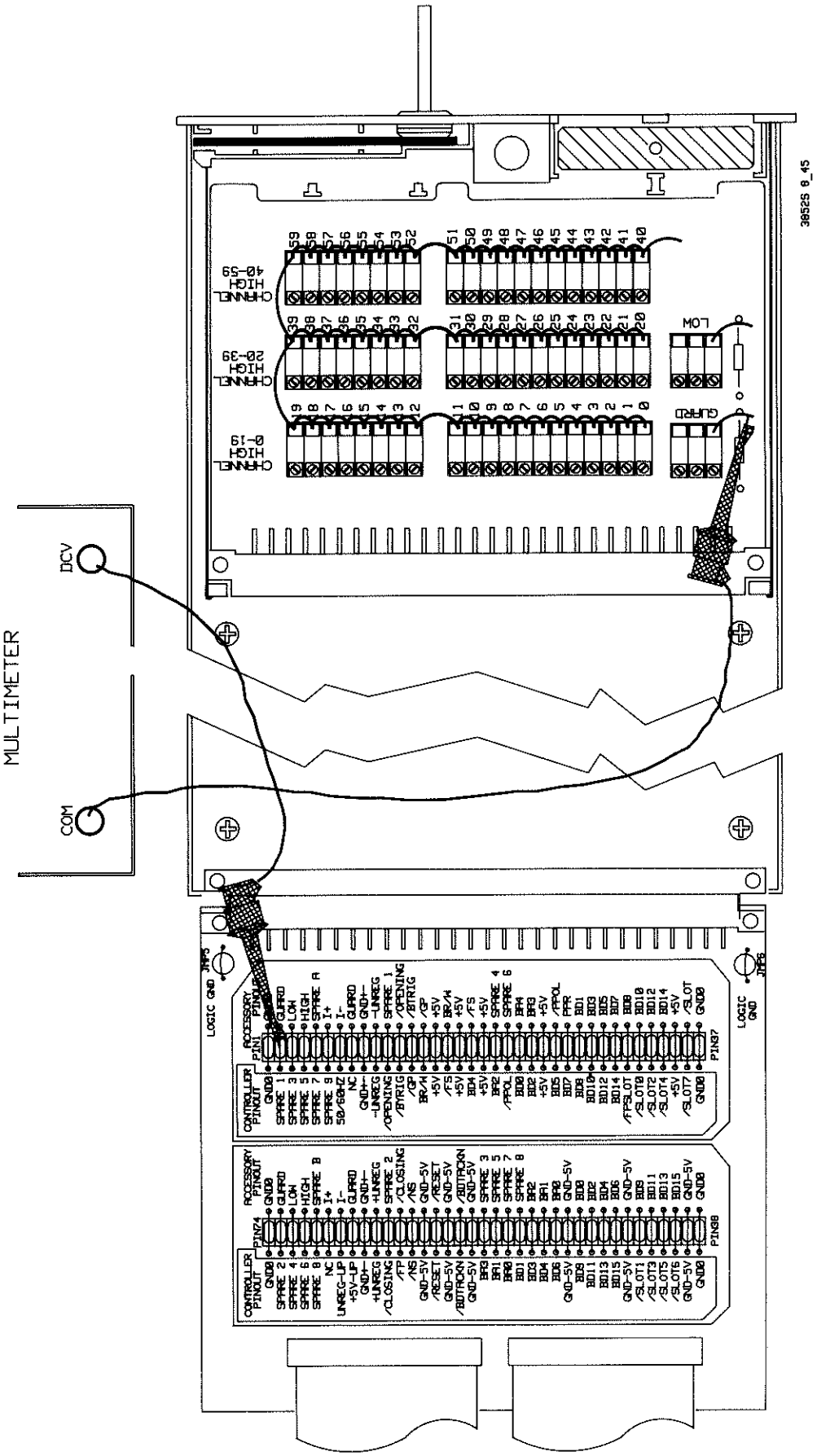


Figure 8-47 HP 44706A GUARD Lines Thermal Offset

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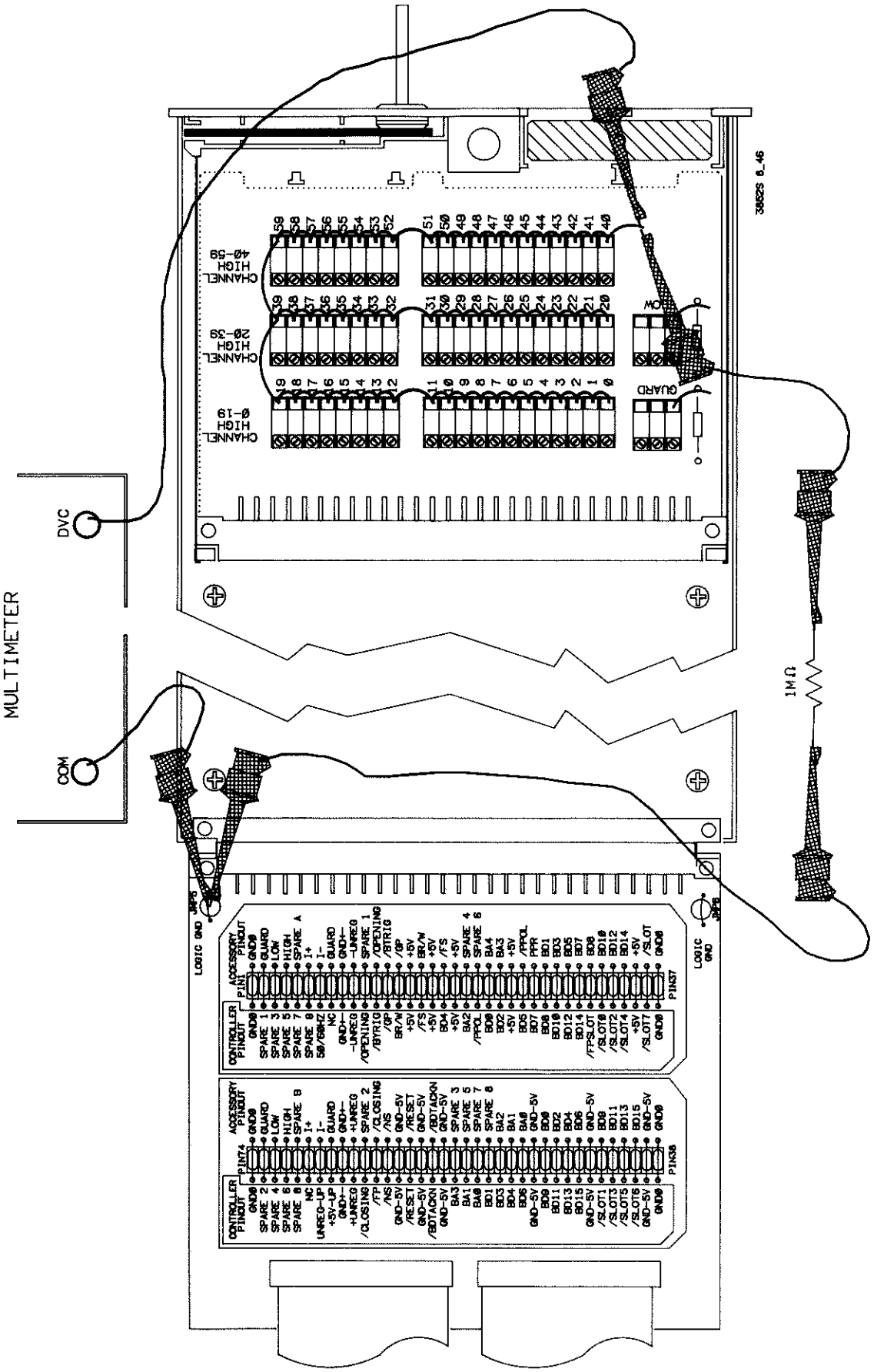


Figure 8-48 HP 44706A HIGH Lines Injected Current

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Once the value of the resistor used is known, the specification can be checked by simply measuring the voltage. For example, using the recommended 10 Mohm resistor, the voltage indicated on the multimeter must be less than 0.01 VDC.

6. Repeat steps 3, 4, and 5 for channels 01 through 59. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES01 for channel 01).

7. LOW LINES INJECTED CURRENT TEST. Move the multimeter DCV lead to the LOW connection test point on the test fixture as shown in Figure 8-49.

8. Close the first channel in the multiplexer by executing:

CLOSE ES00 (where E = extender number, S = slot number)

9. Record the voltage indicated on the multimeter. This voltage will be referred to as **V1**.

10. Calculate the injected current (I) from the following formula:

$$I = \frac{V1}{R1}$$

The injected current must be less than 1 nA.

Once the value of the resistor used is known, the specification can be checked by simply measuring the voltage. For example, using the recommended 10 Mohm resistor, the voltage indicated on the multimeter must be less than 0.01 VDC.

11. Repeat steps 8, 9, and 10 for channels 20 and 40. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES20 for channel 20).

12. GUARD LINES INJECTED CURRENT TEST. Move the multimeter DCV lead to the GUARD connection test point on the test fixture as shown in Figure 8-50.

13. Close the first channel in the multiplexer by executing:

CLOSE ES00 (where E = extender number, S = slot number)

14. Record the voltage indicated on the multimeter. This voltage will be referred to as **V1**.

15. Calculate the injected current (I) from the following formula:

$$I = \frac{V1}{R1}$$

The injected current must be less than 1 nA.

Once the value of the resistor used is known, the specification can be checked by simply measuring the voltage. For example, using the recommended 10 Mohm resistor, the voltage indicated on the multimeter must be less than 0.01 VDC.

16. Repeat steps 8, 9, and 10 for channels 20 and 40. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES20 for channel 20).

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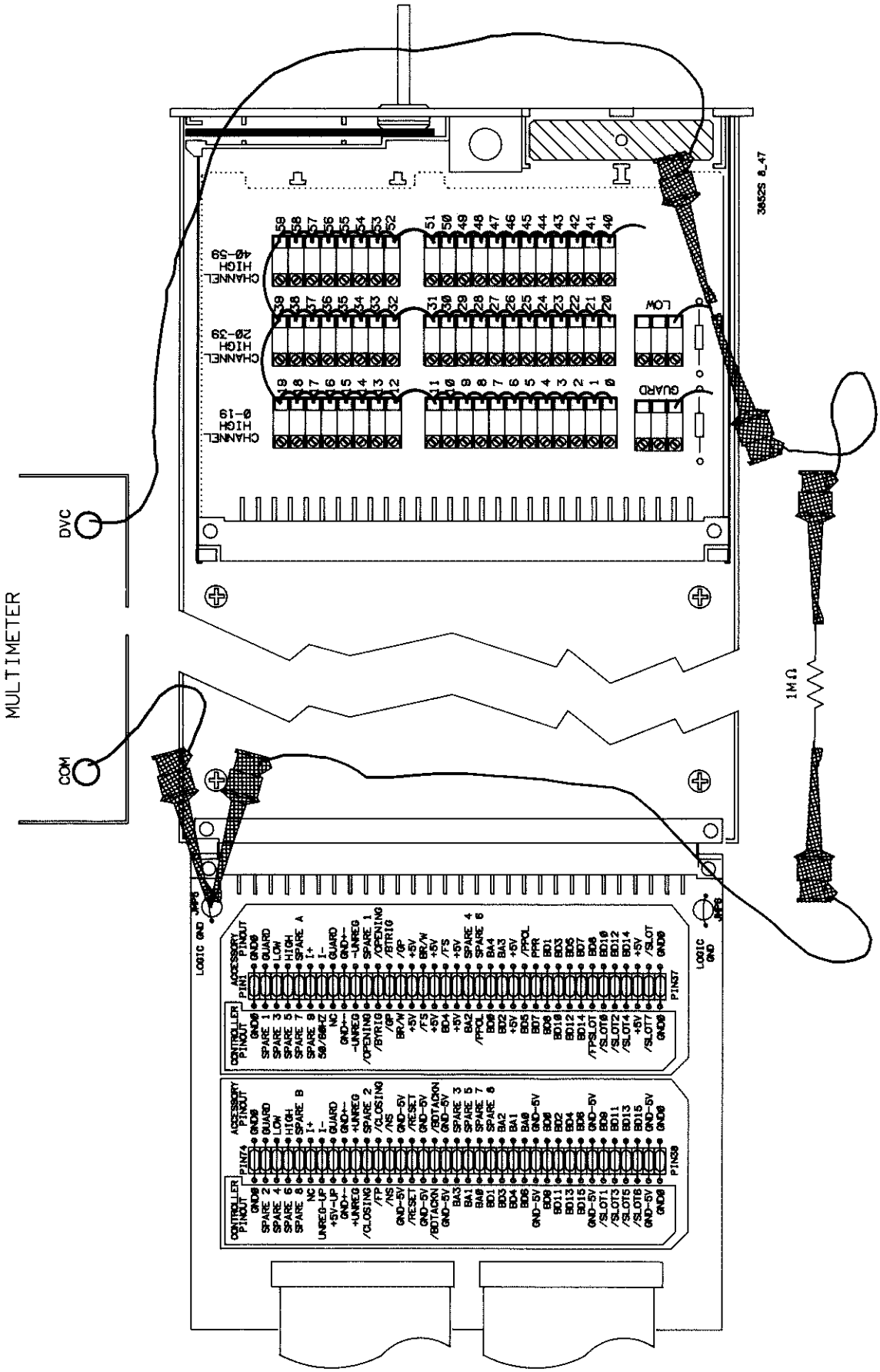


Figure 8-49 HP 44706A LOW Lines Injected Current

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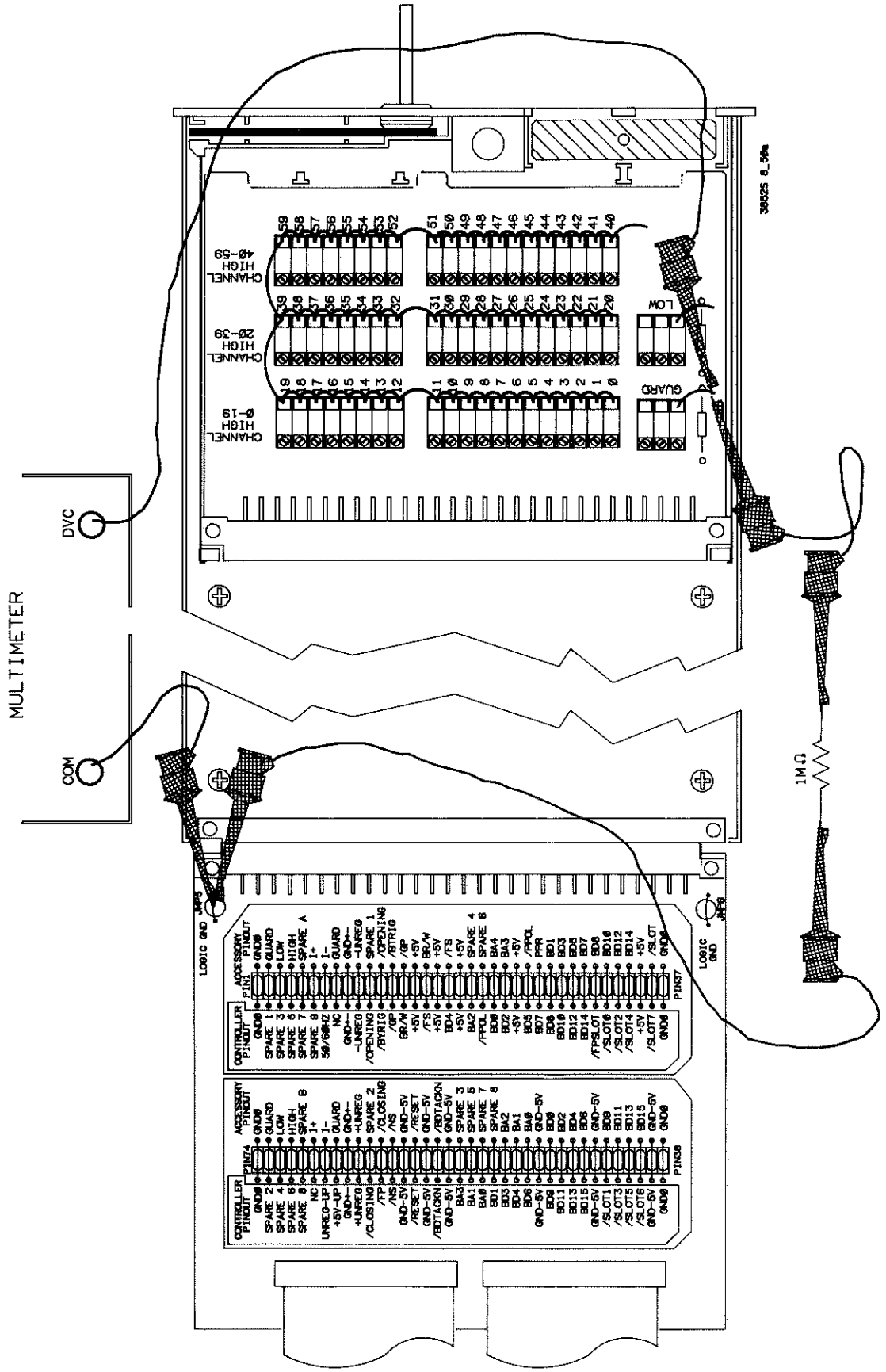


Figure 8-50 HP 44706A GUARD Lines Injected Current

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8-47 RELAY TROUBLESHOOTING

This section describes troubleshooting the relay multiplexers. The troubleshooting procedures described here first determine if the problem is located in the relays or in the control logic. Individual relays may be replaced. If the problem is determined to be in the control logic, complete replacement of the printed circuit board is required.

The Operational Verification tests provide a starting point for problem isolation. Operational Verification tests for the HP 44705A/H and HP 44708A/H are described in Section 8-19. Operational Verification tests for the HP 44706A are described in Section 8-35.

A single failing channel indicates a failing channel relay. The tree switch operational verification tests will isolate a failing relay to within one or two tree relays. Table 8-5a and 8-5b are relay correspondence tables showing the relationship between channel numbers and relay numbers. Figure 8-51 shows the location of the relays on the printed circuit board.

CAUTION

To prevent equipment circuit damage always set the line power switch to off before removing or replacing any assembly. To prevent static zap of ICs always observe anti-static handling techniques when assemblies are handled or stored.

Table 8-5a HP 44705A and HP 44708A Relay Correspondance Table

Bank A		Bank B		Tree Relays	
Ch 00	K0	Ch 10	K10	Ch 91	K20
Ch 01	K1	Ch 11	K11	Ch 92	K21
Ch 02	K2	Ch 12	K12	Ch 93	K22
Ch 03	K3	Ch 13	K13	Ch 94	K23
Ch 04	K4	Ch 14	K14		
Ch 05	K5	Ch 15	K15		
Ch 06	K6	Ch 16	K16		
Ch 07	K7	Ch 17	K17		
Ch 08	K8	Ch 18	K18		
Ch 09	K9	Ch 19	K19		

Table 8-5b HP 44706A Relay Correspondance Table

Bank A		Bank B		Tree Relays	
Ch 00,20,40	K0	Ch 10,30,50	K10	Ch 40...59	K20
Ch 01,21,41	K1	Ch 11,31,51	K11	Ch 20...39	K21
Ch 02,22,42	K2	Ch 12,32,52	K12	Ch 00...19	K22
Ch 03,23,43	K3	Ch 13,33,53	K13	Ch 91	K23
Ch 04,24,44	K4	Ch 14,34,54	K14		
Ch 05,25,45	K5	Ch 15,35,55	K15		
Ch 06,26,46	K6	Ch 16,36,56	K16		
Ch 07,27,47	K7	Ch 17,37,57	K17		
Ch 08,28,48	K8	Ch 18,38,58	K18		
Ch 09,29,49	K9	Ch 19,39,59	K19		

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8-48 Control Logic Problem Isolation

The following control logic test writes relay closing patterns to the relay multiplexer and then checks for an indication of the relay state in the relay status register (Read Register 2). Electrically, this test checks that the correct relay drive lines were enabled. It does not actually check the drive lines. The test does provide an indication that the control logic is performing as required and can communicate with the HP 3852A local controller.

CAUTION

Do not perform any of the following tests and troubleshooting procedures with any external connections made to the terminal module, or damage to the external connections/circuits may result.

NOTE

If using an HP 9000 Series 200 or Series 300 computer to perform this test, it may be necessary to program a delay between the SWRITE and SREAD commands (steps 1, 2, 4, 5, 7 and 8) to allow time for the relay states to be latched into the status register.

1. CONTROL LOGIC TEST: Reset the multiplexer by executing:

   RESET ES00 (E = extender number, S= slot number)

2. Read the relay status register by executing:

   SREAD ES00,2 (where E = extender number, S = slot number)

3. Verify that the 3852A right display shows:

   204

If the display shows 204 (all channels open), the multiplexer has been reset. Proceed to Step 4. If a number other than 204 is displayed, cycle power to the HP 3852A and perform steps 2 and 3 again. If the number is still incorrect, a problem exists with the relay multiplexer control logic or with the HP 3852A. If the HP 3852A seems to operate normally (see Chapter 5 for HP 3852A problem isolation) the problem most likely exists in the relay multiplexer control logic.

4. Send the first pattern to the multiplexer by executing:

   SWRITE ES00,6,31402 (where E = extender number, S = slot number)

5. Read the relay status register by executing:

   SREAD ES00,2 (where E = extender number, S = slot number)

6. Verify that the HP 3852A right display shows:

   2730

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7. Send the second pattern to the multiplexer by executing:

SWRITE ES00,6,30037 (where E = extender number, S = slot number)

8. Read the relay status register by executing:

SREAD ES00,2 (where E = extender number, S = slot number)

9. Verify that the HP 3852A right display shows:

1365

10. Reset the multiplexer by executing:

RESET ES00 (E = extender number, S= slot number)

CAUTION

This procedure sets illegal and potentially damaging states on the relay multiplexer. Be sure to execute the RESET command in Step 10 to clear these states.

If the control logic test passed and a relay is not closing or opening, relay replacement is indicated. Figure 8-51 shows the locations of the relays on the multiplexer printed circuit board. Figures 8-52 and 8-53 are schematics of the relay multiplexers. Also shown in the figures is a package outline and pinout diagram of the type of relay used. Since the control logic test is not able to check the actual relay drive lines, an additional test of the drive can be performed at the relay coil. The relays should have a steady state voltage across the coil of approximately 4.0 Vdc when closed. When open, the coil voltage should be less than 0.2 Vdc.

8-49 Stuck Relay Troubleshooting

When a relay contact is stuck in the closed position it cannot be isolated with the test fixture installed. The test fixture parallels all the relays together. However, the test fixture, or a terminal module, must be installed to allow the HP 3852A to normally communicate with the component module.

There are two ways to isolate the stuck relay. The first, and easiest means is to install a regular terminal module on the failing component module. Each channel of the multiplexer can then be checked with a multimeter by measuring between the channel terminal block and the common terminal block on the terminal module. Once the stuck channel is isolated, Tables 8-5a and 8-5b identifies the stuck relay.

The second means to isolate a stuck relay involves checking for the stuck contacts on the component module connector. This method is not recommended for general use. To use this method, the test fixture or a terminal module must be installed and the HP 3852A power applied. When the wake-up sequence has completed, the test fixture or terminal module is removed. Removing the module after the wake-up sequence will allow commands to be processed since the local controller only queries the slots for accessory identification after power-on or reset. Schematics of the relays and connector are in Figures 8-52 and 8-53.

Stuck tree relays are more difficult to isolate. The Operational Verification tests in this chapter always test at least two of the tree relays at a time. If the tree relay operational verification test indicates stuck tree relays, the control logic is probably at fault (since two relays would have to be stuck at once). The control logic test is given in Section 8-48.

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It is recommended that the entire component module be replaced if the relays are at or near the relay maximum specified life cycle (shown in Table 8-4) and the relays are sticking or the contact resistance is out of specification.

8-50 REPLACEABLE PARTS

Figure 8-54 shows the mechanical breakdown of the HP 44705A/H, HP 44706A, and HP 44708A/H. This figure also provides assembly or disassembly information. The parts shown in Figure 8-54 are keyed to the parts list in Table 8-6.

To order a part listed in Table 8-6, quote the Hewlett-Packard part number, the check digit (abbreviated CD in Table 8-6), and the quantity desired. Address the order to the nearest Hewlett-Packard Sales Office. Hewlett-Packard Sales Offices are listed geographically at the back of this manual.

CAUTION

The component module printed circuit board for the relay multiplexers is a static sensitive device. Refer to Chapter 5 for additional information about handling static sensitive printed circuit boards.

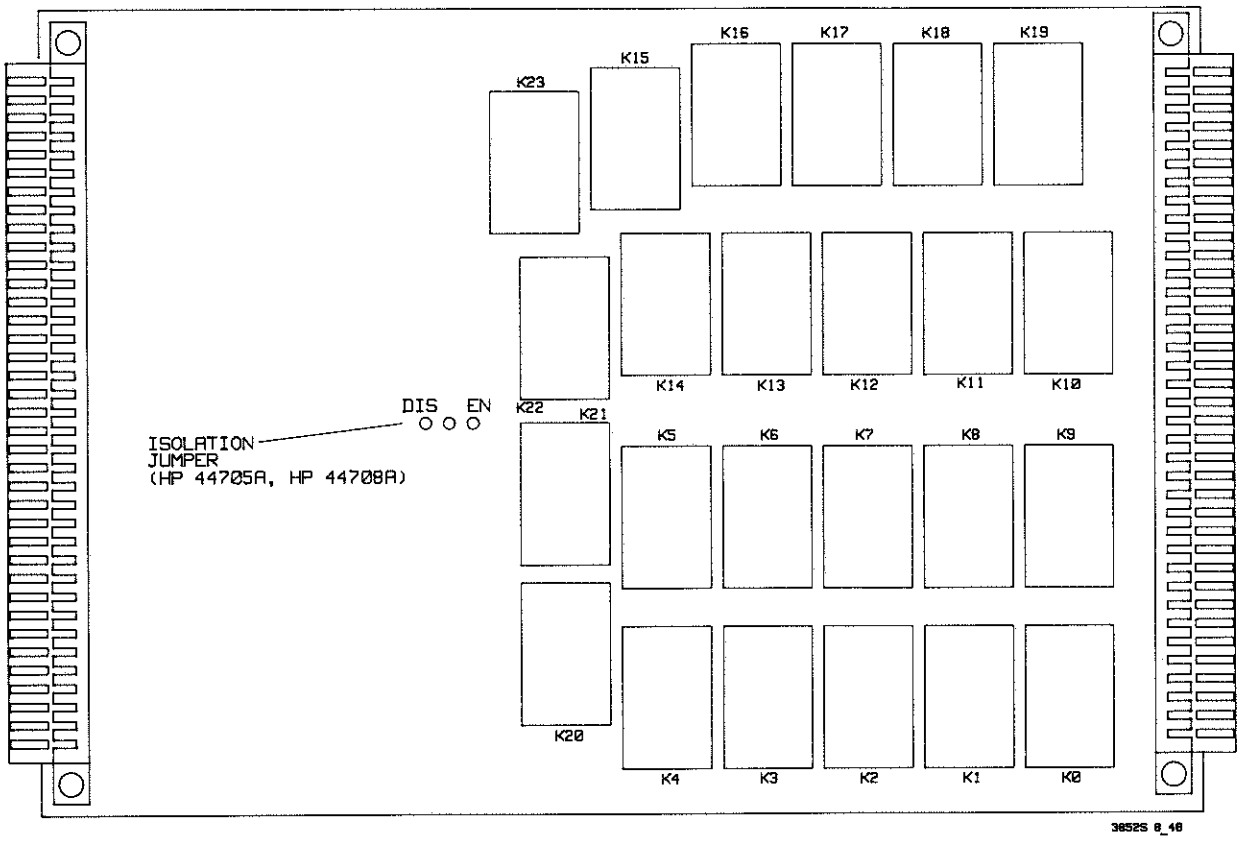


Figure 8-51 Relay Component Locator

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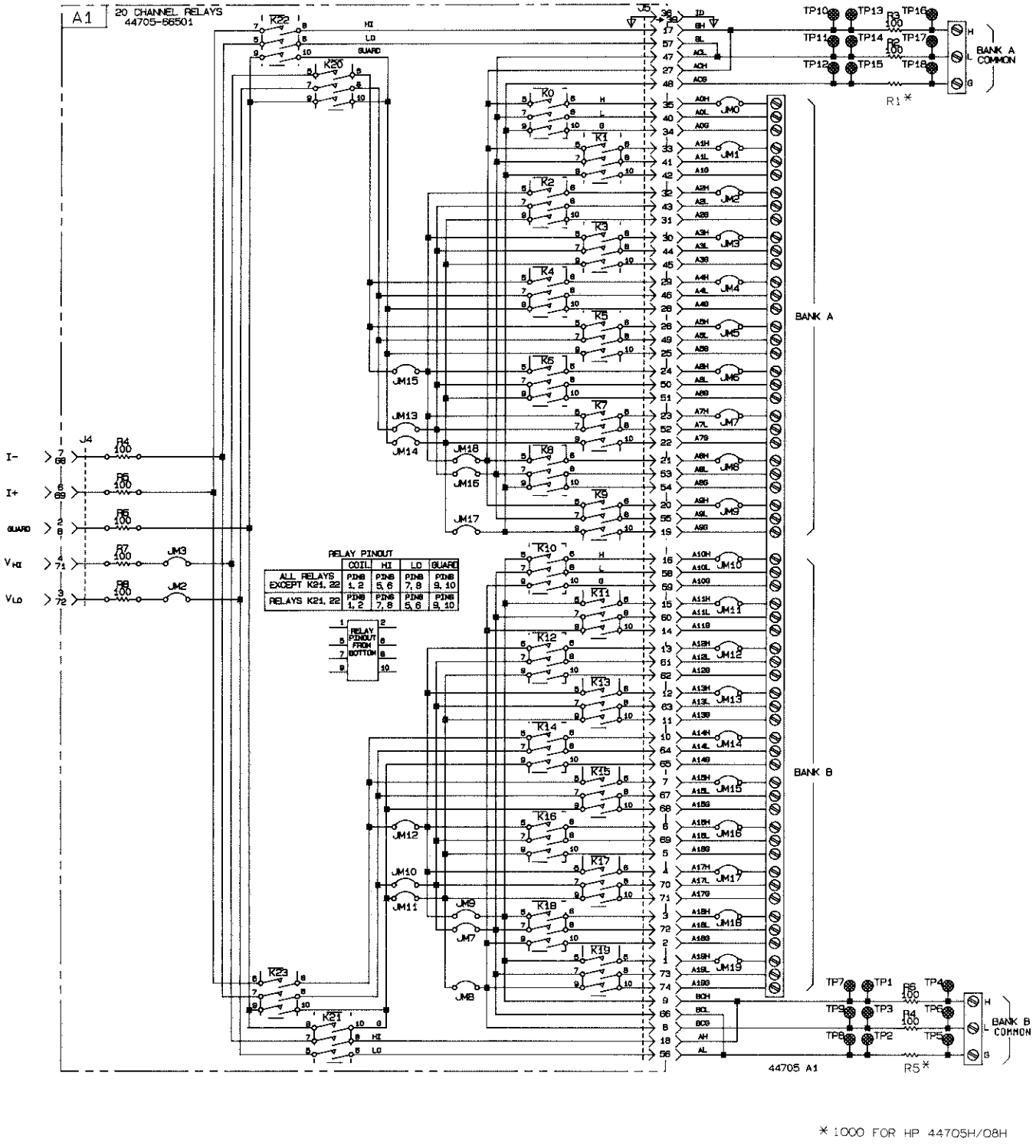


Figure 8-52 20 Channel Mux Schematic

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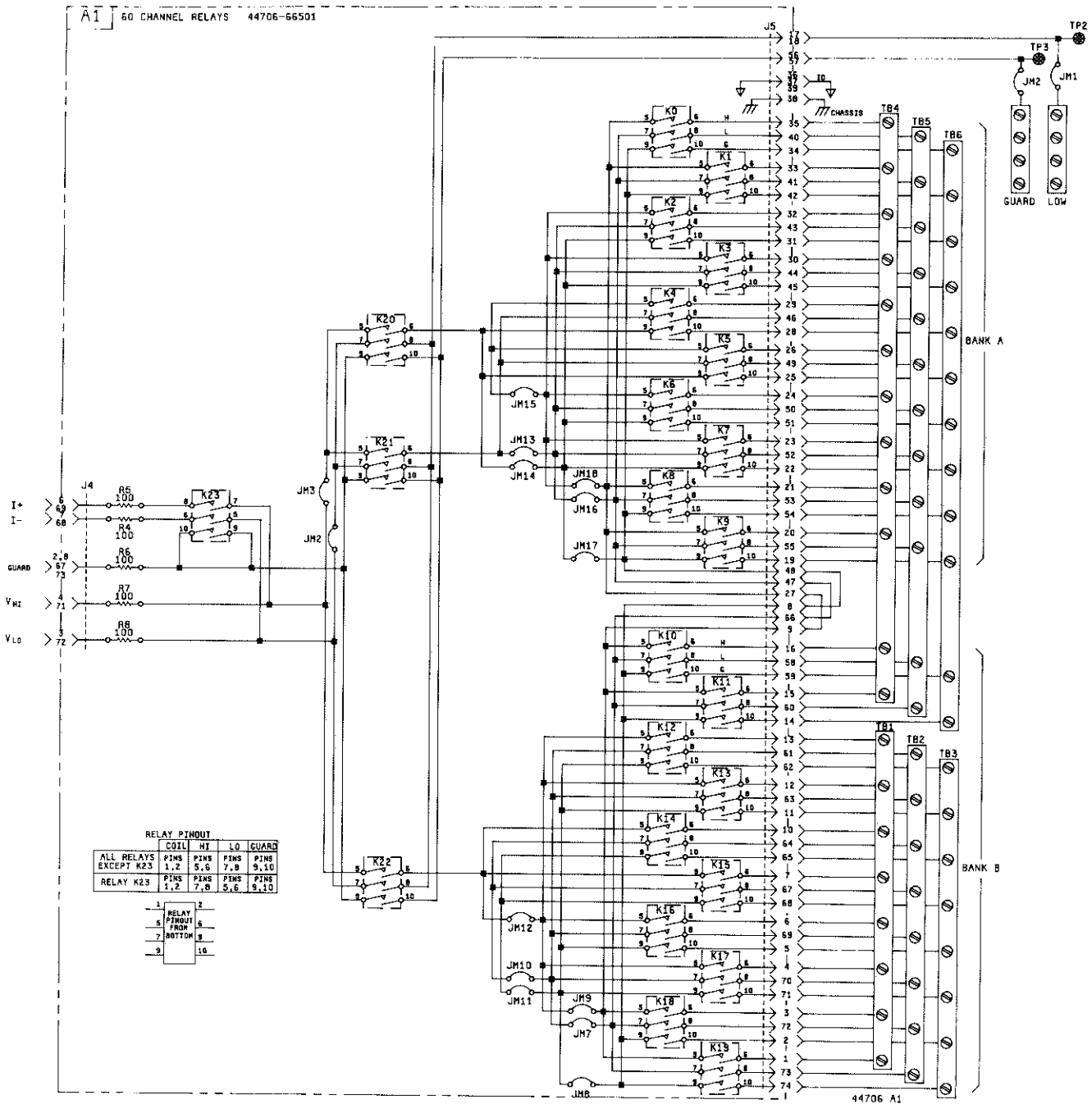


Figure 8-53 60 Channel Mux Schematic

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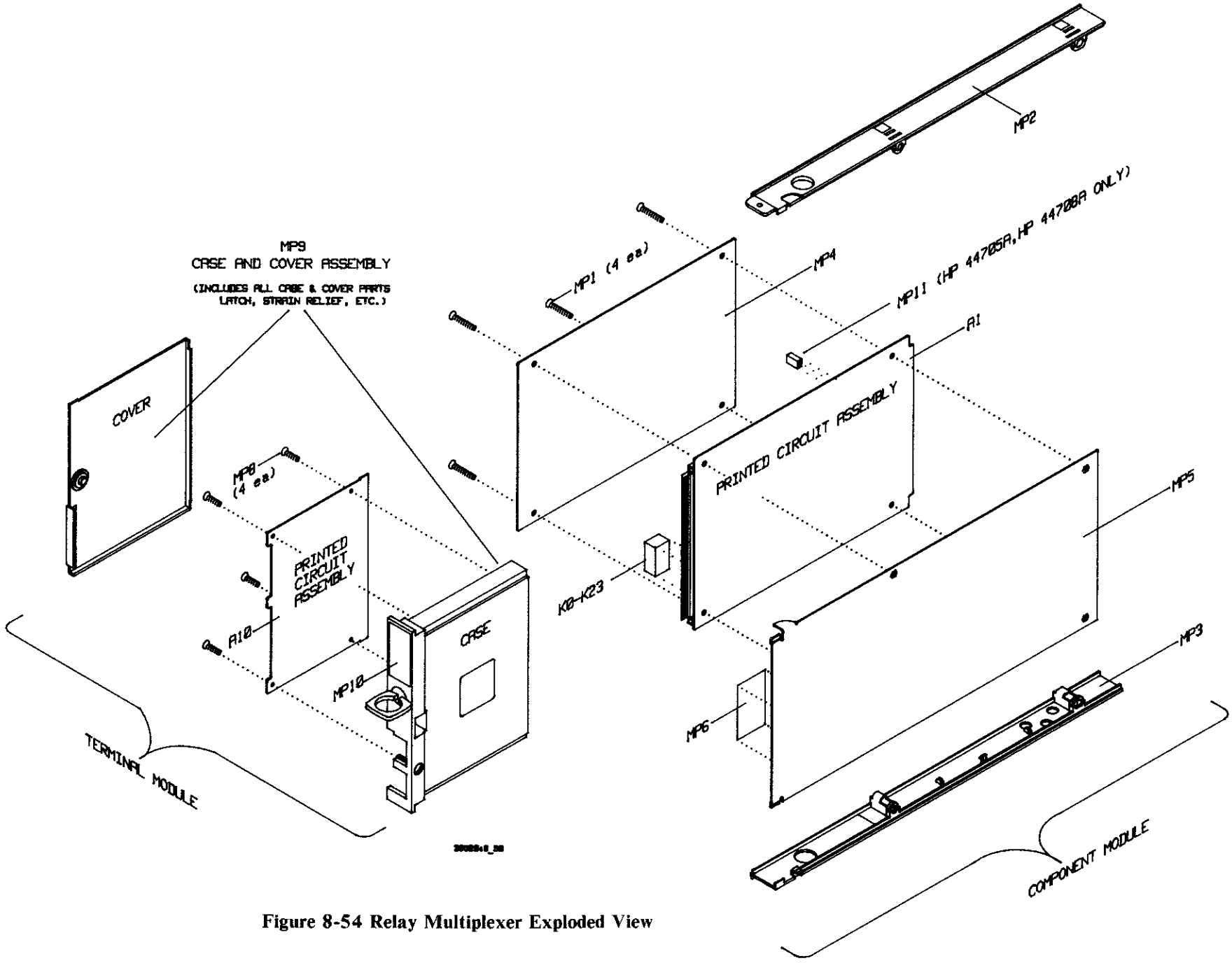


Figure 8-54 Relay Multiplexer Exploded View

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Table 8-6a HP 44705A 20 Channel Relay Multiplexer

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44705A	Module; 20 chan relay mux component	1	44705-66201	1	MOD-20CH RLY MUX
A1	PCA; 20 channel relay mux component	1	44705-66501	4	PCA-20CH RLY MUX
A10	PCA; 20 channel mux terminal	1	44705-66510	5	PCA-20CH MX TERM
K0-K23	Relay; A1 PCA	24	0490-1576	6	RLY-RD FORM 3A
MP1	Screw; cover	4	0515-1322	4	SCR-FH M3.0X30LK
MP2	Guide rail; top (molded)	1	03852-41201	1	MLD-RAIL,TOP
MP3	Guide rail; bottom (molded)	1	03852-41202	2	MLD-RAIL,BOTTOM
MP4	Cover; left (aluminum)	1	03852-04101	2	0601 CVR-ACC LT
MP5	Cover; right (aluminum)	1	03852-04102	3	0601 CVR-ACC RT
MP6	Label; 44705/44708 component module	1	44705-84320	3	LBL-I/O OPTIONS
MP7	(NOT USED)				
MP8	Screw; A10 PCA	4	0515-0886	3	SCR-PH M3.0X6 LK
MP9	Term box; case,cover,latch & str rlf	1	03852-84410	4	ASSY-TERM,LG OPN
MP10	Label; rear panel of term mod 44705A	1	44705-84325	8	LBL-ID,TERM ASSY
MP11	Jumper; removable, A1 PCA	1	1258-0141	8	JMPR-REM .025P

Completely assembled HP 44705A terminal modules can be ordered from your local HP Office by ordering Number 44705AT.

"447xx-662xx" and "447xx-692xx" part numbers are replacement components only and do not include a terminal module.

Table 8-6b HP 44705H 20 Channel High Voltage Relay Multiplexer

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44705H	Module; 20 chan relay HV mux component	1	44705-66202	2	MOD-20CH RLY HV
A4	PCA; 20 channel HV relay mux component	1	44705-66504	0	PCA-20CH RLY HV
A15	PCA; 20 channel HV mux terminal	1	44705-66515	5	PCA-20CH RLY/HV
K0-K23	Relay; A4 PCA	24	0490-1384	4	RLY-HV
MP1	Screw; cover	4	0515-1322	4	SCR-FH M3.0X30LK
MP2	Guide rail; top (molded)	1	03852-41201	1	MLD-RAIL,TOP
MP3	Guide rail; bottom (molded)	1	03852-41202	2	MLD-RAIL,BOTTOM
MP4	Cover; left (aluminum)	1	03852-04101	2	0601 CVR-ACC LT
MP5	Cover; right (aluminum)	1	03852-04102	3	0601 CVR-ACC RT
MP6	Label; 44705/44708 component module	1	44705-84321	4	LBL-I/O OPTS HV
MP7	(NOT USED)				
MP8	Screw; A15 PCA	4	0515-0886	3	SCR-PH M3.0X6 LK
MP9	Term box; case,cover,latch & str rlf	1	03852-84410	4	ASSY-TERM,LG OPN
MP10	Label; rear panel of term mod 44705H	1	44705-84326	9	LBL-ID,TERM HV
MP11	Jumper; removable, A4 PCA	1	1258-0141	8	JMPR-REM .025P

Completely assembled HP 44705H terminal modules can be ordered from your local HP Office by ordering Number 44705HT.

"447xx-662xx" and "447xx-692xx" part numbers are replacement components only and do not include a terminal module.

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Table 8-6c HP 44706A 60 Channel Single Ended Relay Multiplexer

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44706A	Module; 60 ch se relay mux component	1	44706-66201	2	MOD-60CH SE RMUX
A1	PCA; 60 chan se relay mux component	1	44706-66501	5	PCA-60CH SE RMUX
A10	PCA; 60 chan single end mux terminal	1	44706-66510	6	PCA-60CH SE TERM
K0-23	Relay; A1 PCA	24	0490-1576	6	RLY-RD FORM 3A
MP1	Screw; cover	4	0515-1322	4	SCR-FH M3.0X30LK
MP2	Guide rail; top (molded)	1	03852-41201	1	MLD-RAIL,TOP
MP3	Guide rail; bottom (molded)	1	03852-41202	2	MLD-RAIL,BOTTOM
MP4	Cover; left (aluminum)	1	03852-04101	2	0601 CVR-ACC LT
MP5	Cover; right (aluminum)	1	03852-04102	3	0601 CVR-ACC RT
MP6	Label; 44706A component module	1	44706-84320	4	LBL-I/O OPTIONS
MP7	(NOT USED)				
MP8	Screw; A10 PCA	4	0515-0886	3	SCR-PH M3.0X6 LK
MP9	Term box; case,cover,latch & str rlf	1	03852-84410	4	ASSY-TERM,LG OPN
MP10	Label; rear panel term module 44706A	1	44706-84325	9	LBL-ID,TERM ASSY

Completely assembled HP 44706A terminal modules can be ordered from your local HP Office by ordering Number 44706AT.

"447xx-662xx" and "447xx-692xx" part numbers are replacement components only and do not include a terminal module.

Table 5-6d HP 44708A 20 Channel Relay Multiplexer with TC

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44708A	Module; 20 chan relay mux component	1	44705-66201	1	MOD-20CH RLY MUX
A1	PCA; 20 channel relay mux component	1	44705-66501	4	PCA-20CH RLY MUX
A10	PCA; 20 chan mux term w/TC reference	1	44708-66510	8	PCA-20CH TERM/TC
K0-K23	Relay; A1 PCA	24	0490-1576	6	RLY-RD FORM 3A
MP1	Screw; cover	4	0515-1322	4	SCR-FH M3.0X30LK
MP2	Guide rail; top (molded)	1	03852-41201	1	MLD-RAIL,TOP
MP3	Guide rail; bottom (molded)	1	03852-41202	2	MLD-RAIL,BOTTOM
MP4	Cover; left (aluminum)	1	03852-04101	2	0601 CVR-ACC LT
MP5	Cover; right (aluminum)	1	03852-04102	3	0601 CVR-ACC RT
MP6	Label; 44705/44708 component module	1	44705-84320	3	LBL-I/O OPTIONS
MP7	(NOT USED)				
MP8	Screw; A10 PCA	4	0515-0886	3	SCR-PH M3.0X6 LK
MP9	Term box; case,cover,latch & str rlf	1	03852-84410	4	ASSY-TERM,LG OPN
MP10	Label; rear panel of term mod 44708A	1	44708-84325	1	LBL-ID,TERM ASSY
MP11	Jumper; removable, A1 PCA	1	1258-0141	8	JMPR-REM.025P

Completely assembled HP 44708A terminal modules can be ordered from your local HP Office by ordering Number 44708AT.

"447xx-662xx" and "447xx-692xx" part numbers are replacement components only and do not include a terminal module.

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Table 5-6e HP 44708A 20 Channel High Voltage Relay Multiplexer with TC

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44708H	Module; 20 chan HV relay mux component	1	44705-66202	2	MOD-20CH RLY HV
A4	PCA; 20 channel HV relay mux component	1	44705-66504	7	PCA-20CH RLY HV
A15	PCA; 20 chan HV mux term w/TC reference	1	44708-66515	3	PCA-20CH RLY/HV
K0-K23	Relay; A4 PCA	24	0490-1384	4	RLY-RD HV
MP1	Screw; cover	4	0515-1322	4	SCR-FH M3.0X30LK
MP2	Guide rail; top (molded)	1	03852-41201	1	MLD-RAIL,TOP
MP3	Guide rail; bottom (molded)	1	03852-41202	2	MLD-RAIL,BOTTOM
MP4	Cover; left (aluminum)	1	03852-04101	2	0601 CVR-ACC LT
MP5	Cover; right (aluminum)	1	03852-04102	3	0601 CVR-ACC RT
MP6	Label; 44705/44708 component module	1	44705-84321	4	LBL-I/O OPTS HV
MP7	(NOT USED)				
MP8	Screw; A15 PCA	4	0515-0886	3	SCR-PH M3.0X6 LK
MP9	Term box; case,cover,latch & str rlf	1	03852-84410	4	ASSY-TERM,LG OPN
MP10	Label; rear panel of term mod 44708H	1	44708-84326	2	LBL-ID,TERM HV
MP11	Jumper; removable, A4 PCA	1	1258-0141	8	JMPR-REM.025P

Completely assembled HP 44708H terminal modules can be ordered from your local HP Office by ordering Number 44708HT.

"447xx-662xx" and "447xx-692xx" part numbers are replacement components only and do not include a terminal module.

Table 8-6f HP 44717A 10 Bridge 120 ohm Strain Gage Multiplexer

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44717A	Module; 20 chan relay mux component	1	44705-66201	1	MOD-20CH RLY MUX
A1	PCA; 20 channel relay mux component	1	44705-66501	4	PCA-20CH RLY MUX
A10	PCA; 10 chan 120 ohm str. gage term	1	44717-66510	9	PCA-10CH 120 OHM
K0-K23	Relay; A1 PCA	24	0490-1576	6	RLY-RD FORM 3A
MP1	Screw; cover	4	0515-1322	4	SCR-FH M3.0X30LK
MP2	Guide rail; top (molded)	1	03852-41201	1	MLD-RAIL,TOP
MP3	Guide rail; bottom (molded)	1	03852-41202	2	MLD-RAIL,BOTTOM
MP4	Cover; left (aluminum)	1	03852-04101	2	0601 CVR-ACC LT
MP5	Cover; right (aluminum)	1	03852-04102	3	0601 CVR-ACC RT
MP6	Label; 44705/44708/44717/44718 mod	1	44705-84320	3	LBL-I/O OPTIONS
MP7	(NOT USED)				
MP8	Screw; A10 PCA	4	0515-0886	3	SCR-PH M3.0X6 LK
MP9	Term box; case,cover,latch & str rlf	1	03852-84410	4	ASSY-TERM,LG OPN
MP10	Label; rear panel of term mod 44717A	1	44717-84325	2	LBL-ID,TERM ASSY
MP11	Jumper; removable, A1 PCA	1	1258-0141	8	JMPR-REM .025P

Completely assembled HP 44717A terminal modules can be ordered from your local HP Office by ordering Number 44717AT.

"447xx-662xx" and "447xx-692xx" part numbers are replacement components only and do not include a terminal module.

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Table 8-6g HP 44718A 10 Bridge 350 ohm Strain Gage Multiplexer

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44718A	Module; 20 chan relay mux component	1	44705-66201	1	MOD-20CH RLY MUX
A1	PCA; 20 channel relay mux component	1	44705-66501	4	PCA-20CH RLY MUX
A10	PCA; 10 chan 350 ohm str. gage term	1	44718-66510	0	PCA-10CH 350 OHM
K0-K23	Relay; A1 PCA	24	0490-1576	6	RLY-RD FORM 3A
MP1	Screw; cover	4	0515-1322	4	SCR-FH M3.0X30LK
MP2	Guide rail; top (molded)	1	03852-41201	1	MLD-RAIL,TOP
MP3	Guide rail; bottom (molded)	1	03852-41202	2	MLD-RAIL,BOTTOM
MP4	Cover; left (aluminum)	1	03852-04101	2	0601 CVR-ACC LT
MP5	Cover; right (aluminum)	1	03852-04102	3	0601 CVR-ACC RT
MP6	Label; 44705/44708/44717/44718 mod	1	44705-84320	3	LBL-I/O OPTIONS
MP7	(NOT USED)				
MP8	Screw; A10 PCA	4	0515-0886	3	SCR-PH M3.0X6 LK
MP9	Term box; case,cover,latch & str rlf	1	03852-84410	4	ASSY-TERM,LG OPN
MP10	Label; rear panel of term mod 44718A	1	44718-84325	3	LBL-ID,TERM ASSY
MP11	Jumper; removable, A1 PCA	1	1258-0141	8	JMPR-REM .025P

Completely assembled HP 44718A terminal modules can be ordered from your local HP Office by ordering Number 44718AT.

"447xx-662xx" and "447xx-692xx" part numbers are replacement components only and do not include a terminal module.

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CHAPTER 9
HP 44709A/44710A FET MULTIPLEXERS
HP 44719A/44720A STRAIN GAGES

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CHAPTER 9
HP 44709A/44710A
FET MULTIPLEXERS
HP 44719A/44720A
STRAIN GAGES

9-1 INTRODUCTION

This chapter provides a technical description, performance test procedures, and replaceable parts lists for the HP 44709A 20 Channel FET Multiplexer and the HP 44710A 20 Channel FET Multiplexer with Thermocouple Compensation. This chapter also has a technical description and replaceable parts list for the HP 44719A 10 Bridge 120Ω Static Strain Gage FET Multiplexer and the HP 44720A 10 Bridge 350Ω Static Strain FET Multiplexer Accessories.

NOTE

The Strain Gage accessories can only be used with instruments having a firmware revision of 2.0 or above. Determine the firmware revision by sending the "IDN?" *command.*

9-2 HP 44709A and HP 44710A Technical Description

The HP 44709A and HP 44710A have two main assemblies: a component module and a terminal module. The component module contains the backplane interface electronics, FET control logic, an isolation relay, and the FET switches. The same printed circuit board is used in both the HP 44709A and the HP 44710A component modules.

The HP 44709A and the HP 44710A are made unique by the addition of the terminal module. The terminal module for the HP 44709A contains terminal strips for connecting external wiring and provides mounting holes for user installed components such as: one pole low pass filters, voltage dividers, and current shunt resistors. The terminal module for the HP 44710A contains terminal strips for connecting external wiring, a thermocouple mounted in a thermal block, and provides mounting holes for user installed components. The printed circuit board used in the HP 44709AT terminal module is the same as that used in the HP 44705AT terminal module. The printed circuit board used in the HP 44710AT terminal module is the same as that used in the HP 44708AT terminal module.

Figures 9-1 and 9-2 show a simplified schematic for the HP 44709A and the HP 44710A. In the component module the FETs are electrically arranged into channel and tree switches. The channel FETs are further divided into two groups of ten channels. These groups are referred to as Bank A and Bank B. On the HP 44709A terminal module, each bank has its own set of common terminals. The HP 44710A terminal module only provides one set of common terminals for all channels.

Each channel FET switch is in a common package and switches both HIGH and LOW. A separate FET switch package is used for GUARD. HIGH and LOW are connected to the isolation relays through the source and sense bus FET switches. GUARD is routed directly to the isolation relays.

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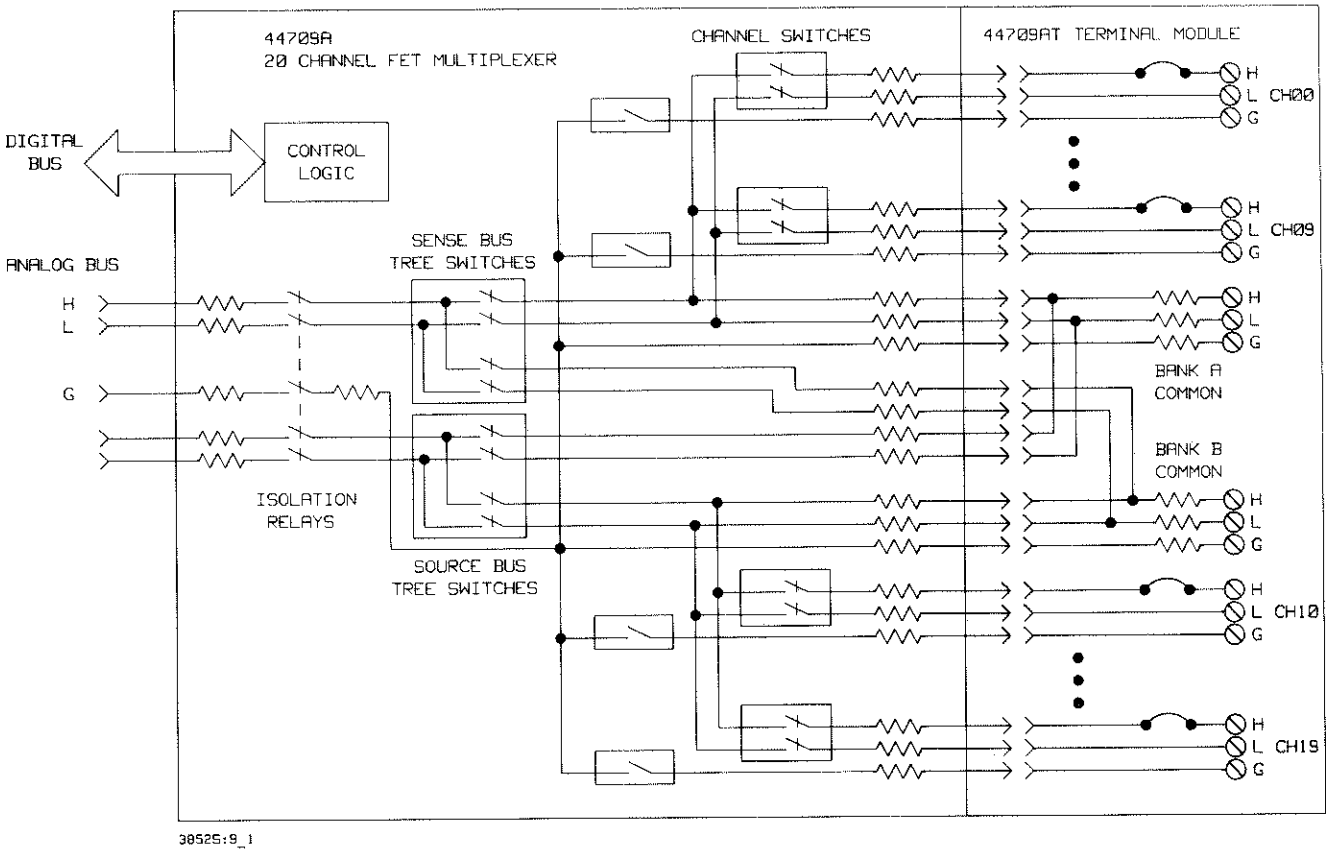


Figure 9-1 HP 44709A Simplified Schematic

The tree FET switches are controlled independently of the channel switches. There are four tree switches: two connected to the backplane analog sense bus and two connected to the backplane analog source bus. The tree switches allow the multiplexer channels to be connected to the backplane analog bus. The backplane analog bus can be used for measurements by either of the accessory plug-in voltmeters (HP 44701A or HP 44702A/B). The sense bus is used for voltage measurements. The source bus provides a current source (generated by either the HP 44701A or HP 44702A/B) for resistance measurements. In the high level commands the tree switches are controlled by giving them channel numbers. The switches have channel numbers 91, 92, 93, and 94. Channels 91 and 92 are the sense bus tree switches and channels 93 and 94 are the source bus tree switches.

On the HP 44709A, four-wire ohms measurements can be made by pairing a channel in Bank A with a channel in Bank B. One of the paired channels provides the current source from the backplane analog source bus and the other channel provides a voltage measurement path through the backplane analog sense bus. Two-wire ohms measurements can also be made by combining the current source bus and the sense bus at the channel switch. The HP 44710A can only support two-wire ohms measurements since two of the tree switches are dedicated to the measurement of the thermistor on the terminal module. In two-wire ohms, the current source bus and the sense bus are combined at the channel FET switch.

Isolation relays are provided on the HP44709A/44710A. These relays allow the FET multiplexer to be completely isolated from the backplane analog bus. The state of these relays are controlled by assigning them channel number 90. Once the isolation relays have been closed, they will remain closed until specifically instructed to open or a reset occurs. The isolation relays can be opened to reduce the leakage current on the backplane analog bus for critical measurements. Also, since the backplane analog sense bus can have up to 42 V peak (with an HP 44709A or HP 44710A installed), the isolation relays provide protection for

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the FET switches. If, for example, an application requires that the backplane analog sense bus voltage is greater than 12 V peak, the isolation relays should be opened to prevent damage to the FET switches. In addition, the FETs are protected from voltages above 15 Vdc by the overvoltage protection circuit on the multiplexer assembly (the input impedance to the FETs, however, decreases above 12 V peak). The overvoltage protection circuit automatically opens the isolation relays, if the backplane analog bus voltage exceeds 15 Vdc.

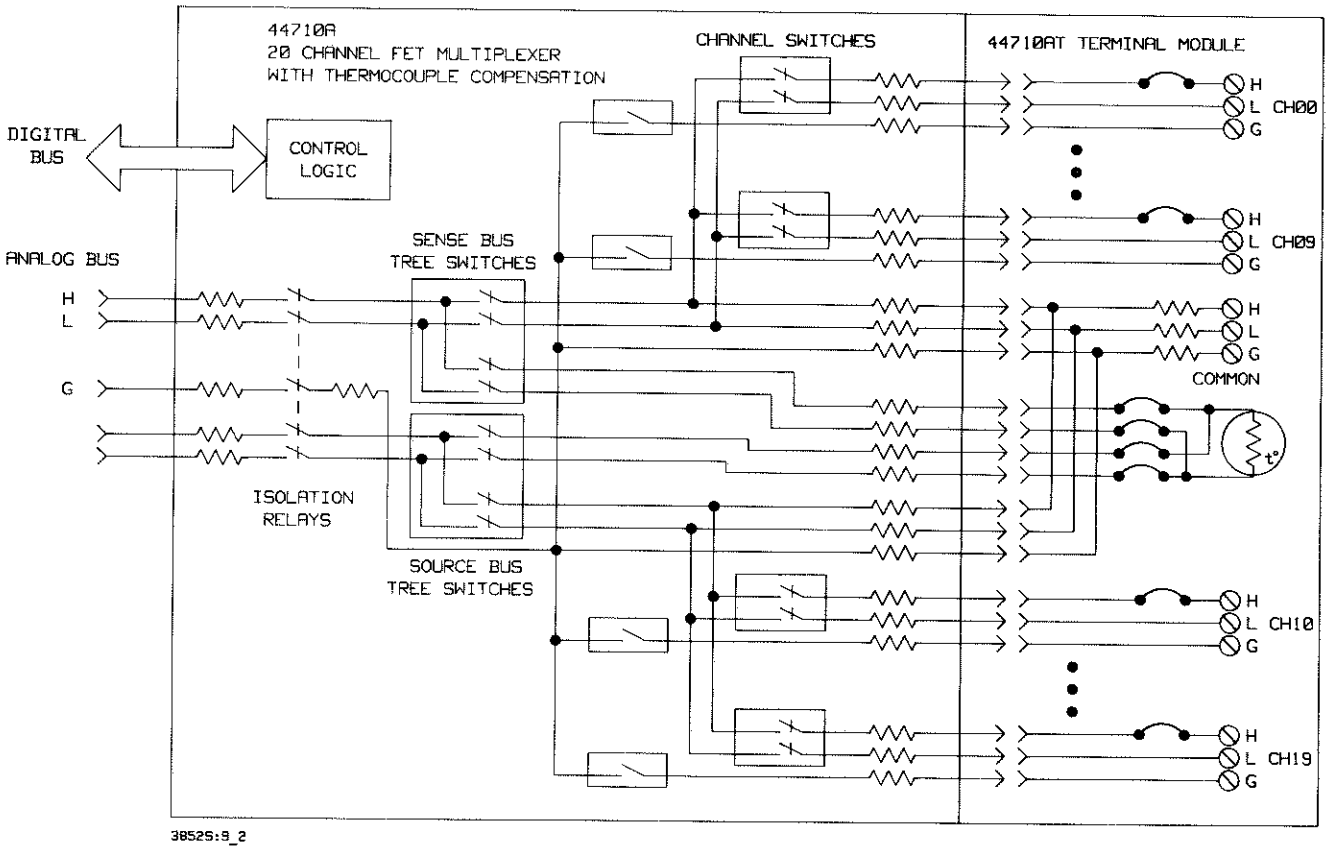


Figure 9-2 HP 44710A Simplified Schematic

9-3 HP 44719A and HP 44720A Technical Description

The HP 44719A and HP 44720A Strain Gages modules work in conjunction with HP 44709A 20 Channel FET Multiplexer Assemblies to make strain gage measurements (see Section 9-2 for a description of the multiplexer assembly). The HP 44719A is used for 120Ω strain gage measurements and the HP 44720A is used for 350Ω measurements. The modules contain terminal strips for making external connections for quarter, half, and/or full bridge configurations.

Figure 9-3 shows a simplified schematic of the HP 44719A and 44720A strain gage modules and also shows the different strain gage configurations. The actual strain gage measurements are made through the 20 Channel FET Multiplexer using either the HP 44701A 5 1/2 Digit Integrating Voltmeter, the HP 44702A/B 13 Bit High Speed Voltmeter, or an external voltmeter. Only 10 channels of the multiplexer are used for strain gage measurements. The other 10 channels are used to measure the external bridge exitation voltage, shunt verification, gage isolation, internal half bridge voltage, guard voltage, and leadwire resistance. These channels only check the external connections to the strain gage module, and not the operation of the strain gage module itself.

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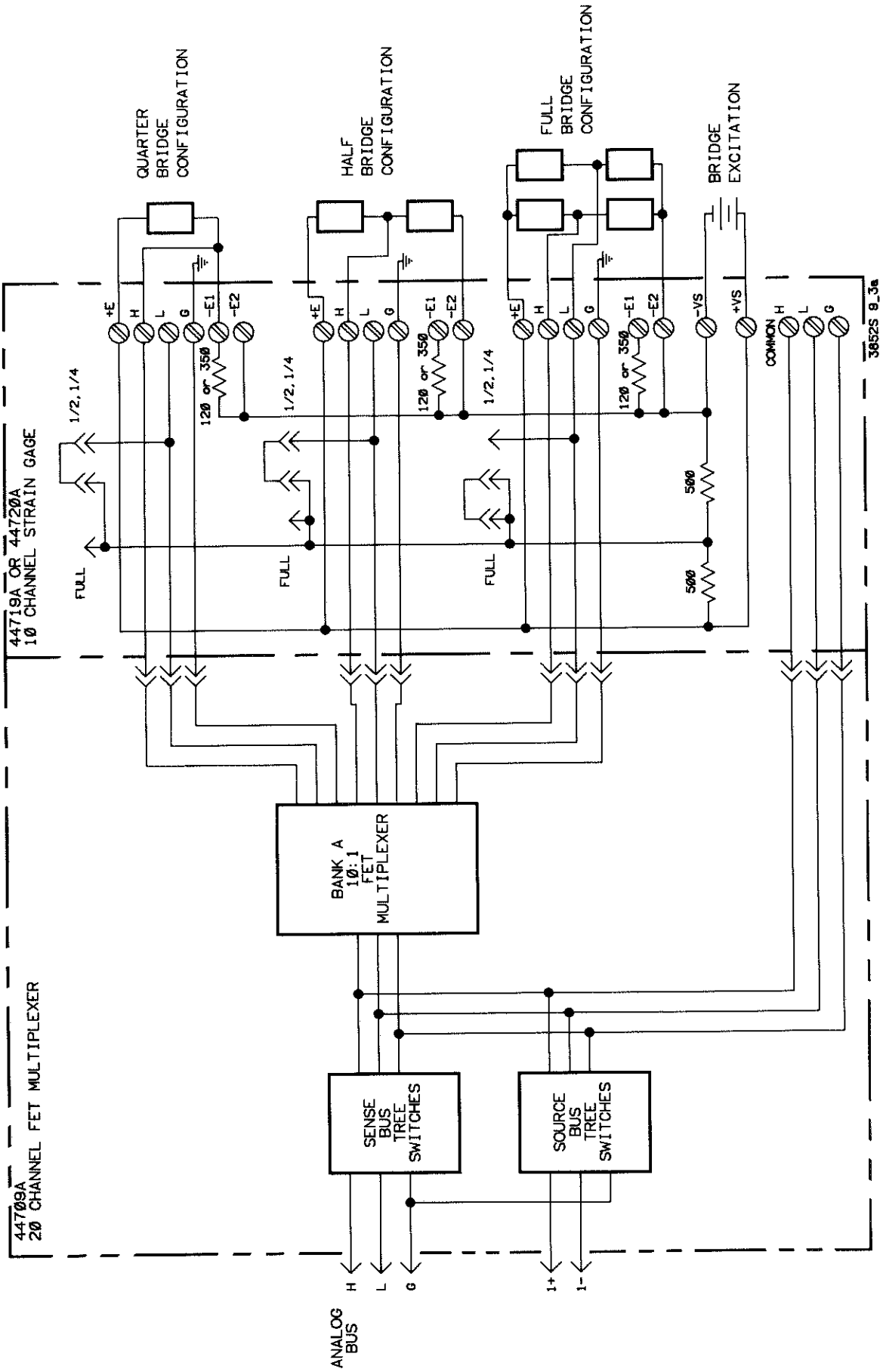


Figure 9-3 HP 44719A/44720A Simplified Schematic

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9-4 Read and Write Registers

The HP 3852A local controller communicates with each plug-in accessory by using read and write registers. High level commands are translated into appropriate register commands. The SREAD and SWRITE commands can be used to directly control each register.

SREAD and SWRITE are described in Chapter 2 of this manual. Table 9-1 shows the registers used by the HP 44709A and HP 44710A.

CAUTION

Using the primitive commands (SREAD and SWRITE) may cause unexpected and undesirable effects on the plug-in accessories. It is possible to program some plug-in accessories into illegal and potentially damaging states with these commands. The commands are documented here for service purposes only.

Table 9-1 FET Multiplexer Read and Write Registers

Register #	READ Registers	WRITE Registers
0	Accessory Identification	Accessory Reset
1	Accessory Status	Not Used
2	FET Switch Status	Not Used
3	Not Used	FET Opening
4	Not Used	Isolation Relay Opening
5	Not Used	Isolation Relay Closing
6	Not Used	FET Closing
7	Not Used	Not Used

9-5 Read Registers

9-6 Read Register 0. Read Register 0 contains the accessory identification. Eight bits are used to uniquely identify the accessory. The eight bits are output on the lower eight bits of the backplane data lines. The upper eight bits of the backplane data bus are passively set true when register 0 is read.

The eight bit identification is in two parts. The five most significant bits identify the component module and the least three significant bits identify the type of terminal module installed. If a terminal module is not present, the lower three bits are set high by the component module. The HP 3852A local controller can thus identify the type of plug-in accessory installed and determine if a terminal module is installed. If a terminal module is installed, the type of terminal module is also identified.

Table 9-2 lists the decimal-equivalent codes returned in response to an SREAD of register 0 for all combinations of the modules. This decimal code is the two's compliment.

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Table 9-2 HP 44709A and HP 44710A Identification Codes

Module Combinations	Codes
HP 44709A Component Module (no terminal module installed)	-201
HP 44709A Component Module, HP 44709AT Terminal Module installed	-208
HP 44709A Component Module, HP 44710AT Terminal Module installed	-206
HP 44709A Component Module, HP 44719AT Terminal Module installed	-204
HP 44709A Component Module, HP 44720AT Terminal Module installed	-203

9-7 Register 1. Read Register 1 is the accessory status register. This register is used by the HP 3852A local controller to coordinate data and commands sent to the FET multiplexer.

9-8 Register 2. Read Register 2 is the FET switch status register. This register uses backplane data bits 0 through 11 to indicate the current status of each FET switch on the multiplexer. Figure 9-4 shows the status word.

```
Bits:     15 14 13 12 | 11 10  9  8 | 7 6 5 4 | 3 2 1 0
Meaning:  X  X  X  X  |Tree Switches| Bank B  | Bank A
                       94 93 92 91
```

Figure 9-4 Read Register 2 FET Switch Status Word

In the status word, bits 12 through 15 are undefined and can return any value.

Bits 8 through 11 define the status of the tree switches (the tree switches are referred to as channels 91 through 94 in the high level commands). A set bit indicates that the switch is closed.

Bits 4 through 7 define the status of the Bank B switches and bits 0 through 3 define the status of the Bank A switches. A set bit indicates a closed switch. Valid codes for the bank switches range from 0000 to 1001. Code 1111 indicates that all switches are open in the bank. The four bits are decimally decoded into the closed channel number. For example, if bits 7, 6, 5, and 4 are 0011 respectively, it would indicate that channel 3 in Bank B is closed (channel 3 in Bank B is referred to as channel 13).

NOTE

The decimal number returned after the execution of an SREAD command represents the two's compliment of the status word.

9-9 Write Registers

9-10 Register 0. Write Register 0 is the accessory reset register. Any data written to this register will cause a reset of all FET switches (set open) and stop opening and closing coordination on the backplane. A write to register 0 produces the same results as a system reset (backplane reset).

9-11 Register 3. Write Register 3 is the opening register. Writing a command word to register 3 will cause the OPENING pulse to be asserted on the backplane and will execute the FET switch openings indicated in the command word. The command word is described in Section 9-15.

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9-12 Register 4. Write Register 4 is the isolation relays opening register. Any data written to this register will cause the isolation relays to open and the OPENING pulse be asserted on the backplane.

9-13 Register 5. Write Register 5 is the isolation relays closing register. Any data written to this register will cause the isolation relays to begin closing. The closing is controlled by the backplane OPENING line so that the break-before-make switching is assured. When the relays are closing the backplane CLOSING line is pulsed to indicate the closure to the HP 3852A local controller.

9-14 Register 6. Write Register 6 is the FET closing register. Writing a command word to register 6 will cause the CLOSING pulse to be asserted on the backplane and will execute the FET switch closures indicated in the command word. The command word is described in Section 9-15.

9-15 Command Word

The command word uses 15 bits. The bits are arranged into mask bits, tree switch bits, Bank A switch bits and Bank B switch bits. Figure 9-5 represents the command word. The command word is used for both opening and closing the switches. The opening or closing function is determined by the register number receiving the command word.

```
Bits:      15 14 13 12 | 11 10  9  8 | 7 6 5 4 | 3 2 1 0
Meaning:   I  T  B  A  | Tree Switch | Bank B  | Bank A
             (mask)
```

Figure 9-5 Command Word

The mask bits in the command word determine which set of switches will be operated upon. Bit 15 controls the channel 90 isolation relays. Setting this bit in the command word will close the isolation relays. Bit 14 sets the tree switch mask, bit 13 the Bank B switch mask, and bit 12 the Bank A switch mask. When the mask bit is set, the corresponding four bits of the command word are used to control the switches. More than one mask bit can be set at a time.

The Tree Switch bits have the following correspondence: Bit 11 sets channel 94 tree switch (source bus), Bit 10 sets channel 93 tree switch (source bus), bit 9 sets channel 92 tree switch (sense bus), and Bit 8 sets channel 91 tree switch (sense bus).

The Bank A and Bank B bits can be decoded as a decimal number corresponding to the channel number. Each set of four bits is individually decoded (depending upon the mask bits set). Bank B bits are decimally decoded into channel numbers but are a decade ahead of the Bank A channel numbers (Bank A channel 00 corresponds to Bank B channel 10).

9-16 SPECIFICATIONS

Specifications for the HP 44709A and HP 44710A are given in Table 9-3. Specifications are the performance standards or limits against which the FET multiplexers may be tested.

NOTE

The installation of an HP 44709A or HP 44710A reduces the maximum backplane voltages to 42 V peak.

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Table 9-3 HP 44709A/44710A/44719A/44720A Specifications

HP 44709A 20 Channel FET Multiplexer

Maximum Switch Rates: 5500 channels/second*

Maximum Input Voltage: Rear and back-plane inputs protected to 16 V peak (input impedance decreases above 12 V due to internal protection circuitry). With analog back-plane disconnected from multiplexer, the back-plane voltage can go up to 42 V peak.

Maximum Input Current: 1 mA non-inductive per channel

Input Impedance:

Impedance	Terminals		
	High to Low	Low to Guard	Guard to Chassis
Power On Resistance (Ω)	$>10^8$	$>10^8$	$>10^8$
Power Off Resistance (Ω) Vin 10 V	>1000	>1000	>1000
Power Off Resistance (Ω) Vin >10 V	>200	>200	>200
Max. Capacitance (pf) at 1MHz	200	200	200

Closed Channel Path Resistance: 3.1 kΩ for either High or Low Inputs considered separately
2.1 kΩ for the Guard Input

Bandwidth: 1.0% flatness at 20 kHz, -3 dB Bandwidth at 200 kHz (50 Ω source, 1 MΩ termination)

Crosstalk: -50 dB at 10 kHz, -35 dB at 100 kHz (channel-to-channel, 50 Ω source, 1 MΩ termination)

Maximum Offset Voltage: 15 µV at 0 to 28 °C
185 µV at 28 to 55 °C
(offset voltage between High and Low)

Maximum Bias Current: ±5 nA DC at 0 to 28 °C
±15 nA DC at 28 to 55 °C
(Current sourced by High or Low to Chassis into Input Terminals or back-plane, with isolation relays closed)

±65 nA DC at 0 to 28 °C
±770 nA DC at 28 to 55 °C
(Current sourced by Guard to Chassis into Input Terminals, with isolation relays closed)

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Table 9-3 HP 44709A/44710A/44719A/44720A Specifications (Cont.)

±1 nA DC at 0 to 55 °C
(Current sourced by High or Low to Chassis into back-plane, with isolation relays open) (Current sourced by Guard to Chassis into back-plane with isolation relays open)

Maximum Wire Size: 16 AWG

HP 44710A 20 Channel FET Multiplexer with Thermocouple Compensation

Maximum Switch Rates: 5500 channels/second*

Maximum Input Voltage: Rear and back-plane inputs protected to 16 V peak (input impedance decreases above 12 V due to internal protection circuitry). With analog back-plane disconnected from multiplexer, the back-plane voltage can go up to 42 V peak.

Maximum Input Current: 1 mA non-inductive per channel

Input Impedance:

Impedance	Terminals		
	High to Low	Low to Guard	Guard to Chassis
Power On Resistance (Ω)	$>10^8$	$>10^8$	$>10^8$
Power Off Resistance (Ω) Vin 10 V	>1000	>1000	>1000
Power Off Resistance (Ω) Vin >10 V	>200	>200	>200
Max. Capacitance (pf) at 1MHz	200	200	200

Closed Channel Path Resistance: 3.1 kΩ for either High or Low Inputs considered separately
2.1 kΩ for the Guard Input

Bandwidth: 1.0% flatness at 20 kHz, -3 dB Bandwidth at 200 kHz (50 Ω source, 1 MΩ termination)

Crosstalk: -50 dB at 10 kHz, -35 dB at 100 kHz (channel-to-channel, 50 Ω source, 1 MΩ termination)

Maximum Offset Voltage: 15 µV at 0 to 28 °C
185 µV at 28 to 55 °C
(offset voltage between High and Low)

Maximum Bias Current: ±5 nA DC at 0 to 28 °C
±15 nA DC at 28 to 55 °C
(Current sourced by High or Low to Chassis into Input Terminals or back-plane, with isolation relays closed)

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Table 9-3 HP 44709A/44710A/44719A/44720A Specifications (Cont.)

±65 nA DC at 0 to 28 °C
±770 nA DC at 28 to 55 °C
(Current sourced by Guard to Chassis into Input Terminals, with isolation relays closed)

±1 nA DC at 0 to 55 °C
(Current sourced by High or Low to Chassis into back-plane, with isolation relays open) (Current sourced by Guard to Chassis into back-plane with isolation relays open)

Maximum Wire Size: 16 AWG

Ref. Junction Compensation Accuracy: 0.1 °C (over 18 to 28 °C operating temperature)

Max Temperature Difference Across Isothermal Module: 0.2 °C

HP 44719A/44720A 10 Bridge Static Strain Gage Multiplexer*
(Use HP 44709A Specifications with these changes/additions)

Strain Gage Resolution:

Bridge Configuration	Bridge Excitation Voltage 5 V	1 V	0.1 V
Full	0.01 με	0.05 με	0.5 με
1/2	0.02 με	0.1 με	1 με
1/4	0.04 με	0.2 με	2 με

Bridge Exitation Requirements: An inexpensive power supply, such as an HP 6214B can be used for the following requirements

Current Requirements for Excitation Voltage (5.4 V maximum for specified accuracy):

Bridge Type	Bridge Configuration	Current per Channel
120 Ω	Full	50 mA
120 Ω	1/2	25 mA
120 Ω	1/4	25 mA
350 Ω	Full	17 mA
350 Ω	1/2	8.5 mA
350 Ω	1/4	8.5 mA

Ripple and Noise Requirements for Excitation Voltage:

1 mV peak-to-peak (20 Hz to 20 MHz)

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Table 9-3 HP 44709A/44710A/44719A/44720A Specifications (Cont.)

Max Self-Heating Offset Due to Change in number of Gages on One Assembly: 2 με per Gage for 120 Ω, 1/4 Bridge Configuration, and 5 V Excitation Voltage (worst-case) **Max Self-Heating Offset Due to a 0.1 V Change in Excitation Voltage:** 0.38 με
*Applies to HP 3852As with firmware revision 2.0 or above.

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9-17 HP 44709A AND HP 44710A PERFORMANCE TESTS

9-18 Introduction

The following Performance Tests check the operation of the HP 44709A and HP 44710A component module. Performance Tests are not given for the terminal modules. Successful completion of all tests in this chapter provides a high confidence level that the FET Multiplexer is meeting its listed specifications.

The Performance Tests should be performed in the order they are presented. The completion of each test increases the confidence level in FET Multiplexer operation. A minimum set of tests is given as Operational Verification Tests. These tests are described in Section 9-19.

The Performance Test procedures described in this chapter are involved and time consuming. Since the Operational Verification Tests yield a 90% confidence that the FET Multiplexer is operating normally, it is not recommended that all the Performance Tests be performed unless one of the tested specifications is in question.

9-19 Operational Verification

The first tests given in this section are the minimum set of tests recommended for the FET Multiplexer. These tests are designed to test the functionality and the on resistance of the FET switches. Successful completion of the Operational Verification Tests provides a 90% confidence level that the FET Multiplexer is operating normally and is within specification.

The Operational Verification Tests consist of the following:

Section 9-23 - Set-Up Procedure
Section 9-24 - Channel Switches Test
Section 9-25 - Tree Switch and Isolation Relay Test

9-20 Equipment Required

The following test equipment is required to run the Performance Tests. Only the first three items in the list are required for the Operational Verification Tests.

1. Test Fixture (as described in Section 9-21)
2. Digital Multimeter -- HP 3456A or equivalent
3. Test Leads and Jumpers
4. Service Module -- HP 44743A
5. Resistor -- 10 Mohm
6. Resistor -- 1 kohm
7. Oscilloscope -- HP 1740A or equivalent (dual trace with delayed sweep)
8. +10 V Power Supply -- HP 6234 or equivalent
9. -10 V Power Supply -- HP 6234 or equivalent

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NOTE

Either of the accessory plug-in voltmeters (HP 44701A or HP 44702A/B) may be used for this test. This test does not describe the specific steps required to use the plug-in voltmeters. A description of the plug-in voltmeters can be found in the Plug-In Accessories Configuration and Programming Manual (HP part number 03852-90002).

9-21 Test Fixture

A test fixture is required to run the Performance Tests. A schematic of the required test fixture is shown in Figure 9-6a. A test fixture can be manufactured using an HP 44705AT terminal module (it is the same as an HP 44709AT terminal module; see Figure 9-6b). Because wiring the test fixture will make the terminal module unusable in an application, an additional terminal module should be ordered for service purposes.

If the test fixture is to be fabricated from other than an HP 44705AT or HP 44709AT terminal module, it is important that the terminal ID lines, shown in Figure 9-6a, be correctly wired. The HP 3852A local controller will not allow the execution of some commands with an incorrect terminal ID.

The test fixture consists of: a short circuit between all channel HIGH lines, a short circuit between all channel LOW lines, and a short circuit between all channel GUARD lines. The use of the test fixture minimizes the number of test lead connections required for the tests.

9-22 Test Procedures

WARNING

Even with power removed from the HP 3852A, high voltages, generated in other parts of the system, may be present at the terminal module of each accessory. Service personnel should ensure that all external power is removed from the system before installing, removing, testing or repairing any plug-in accessory.

9-23 Set-Up Procedure

1. Remove power from the HP 3852A.

2. Remove the terminal module from the rear of the FET Multiplexer component module and install the test fixture. Note the slot number where the FET Multiplexer under test is installed.

3. Verify the correct connections and slot numbers:

   a. Apply power to the HP 3852A. Wait for the HP 3852A to complete its wake-up sequence.

   b. Execute:

      ID? ES00 (where E = extender number, S = slot number)

   c. Verify that the HP 3852A right display shows:

      44709A

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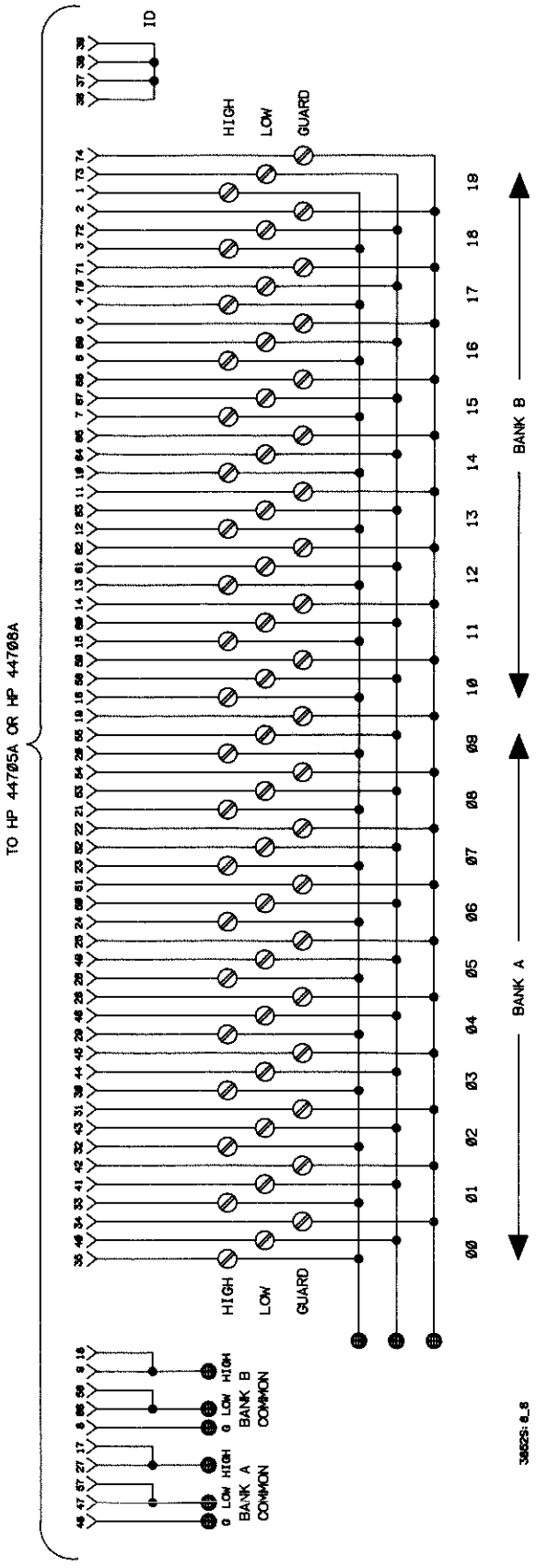


Figure 9-6a HP 44709A and HP 44710A Test Fixure Schematic

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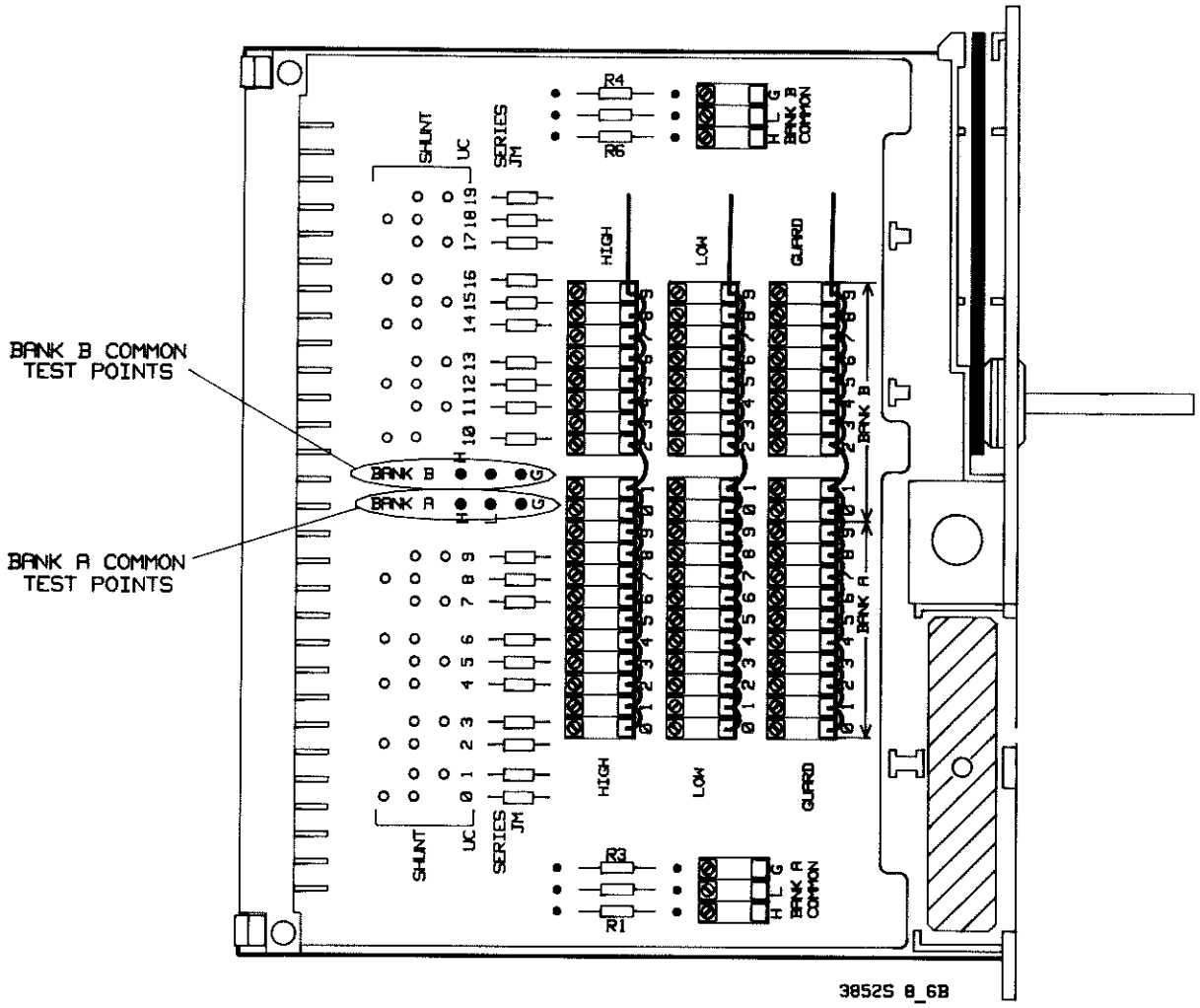


Figure 9-6b HP 44709A and HP 44710A Test Fixure

NOTE

If the HP 3852A right display shows a different accessory number, the slot number used may not be correct. If the HP 3852A display shows 447XXX, the test fixture is either not installed or the ID lines on the fixture are incorrectly wired.

9-24 Channel Switches Test

This test checks the on resistance for the HIGH, LOW, and GUARD FET switches in both Banks A and B.

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1. Set the HP 44709A to a known state by executing:

RESET ES00 (where E = extender number, S = slot number)

This opens all switches on the HP 44709A.

2. Refer to Figure 9-7. On the test fixture, connect the multimeter DCV lead to the Bank A HIGH common test point. Connect the multimeter COM lead to the shorted HIGH connections of the channels. Short the Bank A and Bank B HIGH common test points together. Set the multimeter to measure two-wire ohms.

3. Close the first channel by executing:

CLOSE ES00 (where E = extender number, S = slot number)

4. Observe the reading on the multimeter. The multimeter should indicate a resistance <1.6 kohms. If the reading is greater than 1.6 kohms, the channel FET switch may be faulty.

5. Open the channel by executing:

OPEN ES00 (where E = extender number, S = slot number)

6. Observe the reading on the multimeter. The multimeter should indicate a resistance greater than 100 Mohm. It is important to perform this step to ensure that none of the FET switches are stuck on or leaking.

7. Repeat steps 3, 4, 5, and 6 for channels 01 through 19. In the CLOSE and OPEN commands the last two digits indicate the channel number. For example, CLOSE ES01 closes channel 01 in extender E at slot S.

8. Refer to Figure 9-8. Connect the multimeter DCV lead to the Bank A LOW common test point on the test fixture. Connect the multimeter COM lead to the shorted LOW connections of the channels. Short the Bank A and Bank B LOW common test points together.

9. Repeat steps 3, 4, 5, 6, and 7. This checks the LOW path through the FET switches. Make sure the FET on resistance is <1.6 kohms and its off resistance is >100 Mohms as shown in steps 4 and 6, respectively.

10. Refer to Figure 9-9. Connect the multimeter DCV lead to the Bank A GUARD test point on the test fixture. Connect the multimeter COM lead to the shorted GUARD connections of the channels. Short the Bank A and Bank B GUARD common test points together.

11. Repeat steps 3, 4, 5, 6, and 7. This checks the GUARD contacts of the channel FET switches. The GUARD on resistance, measured in step 5, should be less than 2.1 kohms.

9-25 Tree Switch and Isolation Relay Test

1. SENSE BUS TREE SWITCH AND ISOLATION RELAY TEST: This test checks the measurement path from the backplane analog sense bus through the isolation relay and tree switches.

2. Connect a jumper between the Bank A common HIGH and Bank A common LOW connections on the test fixture.

3. Set the multimeter to measure two-wire ohms. Connect the multimeter test leads to the backplane analog bus sense HIGH and LOW lines.

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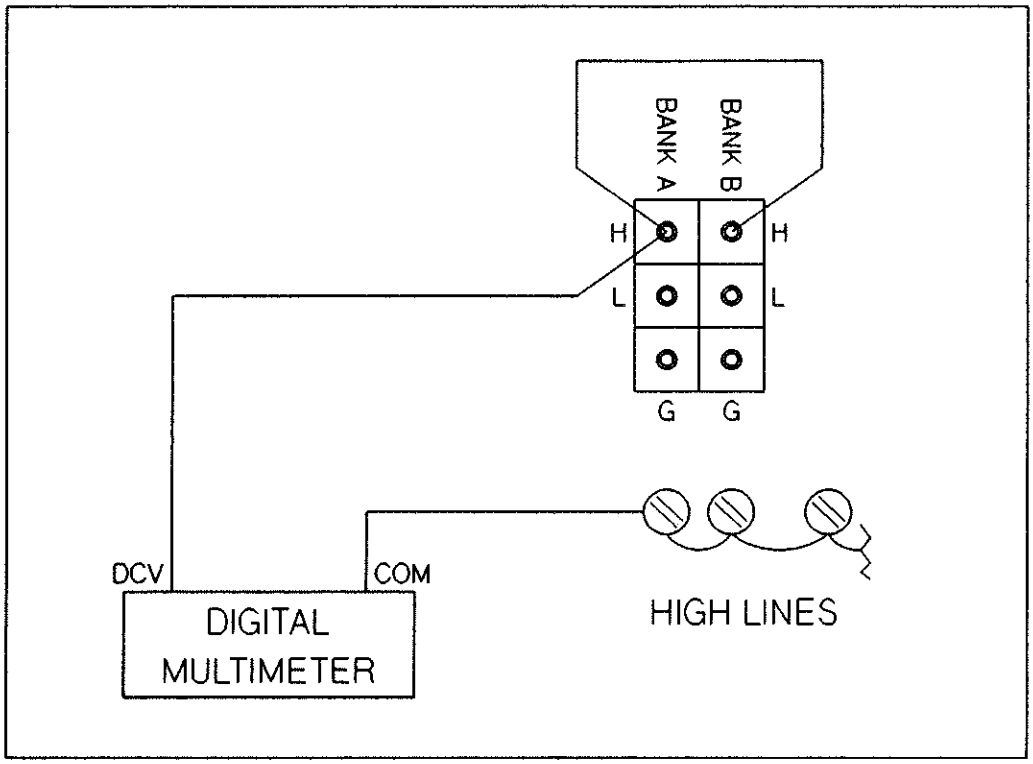


Figure 9-7 HP 44709A/44710A HIGH Channel Test Set-Up

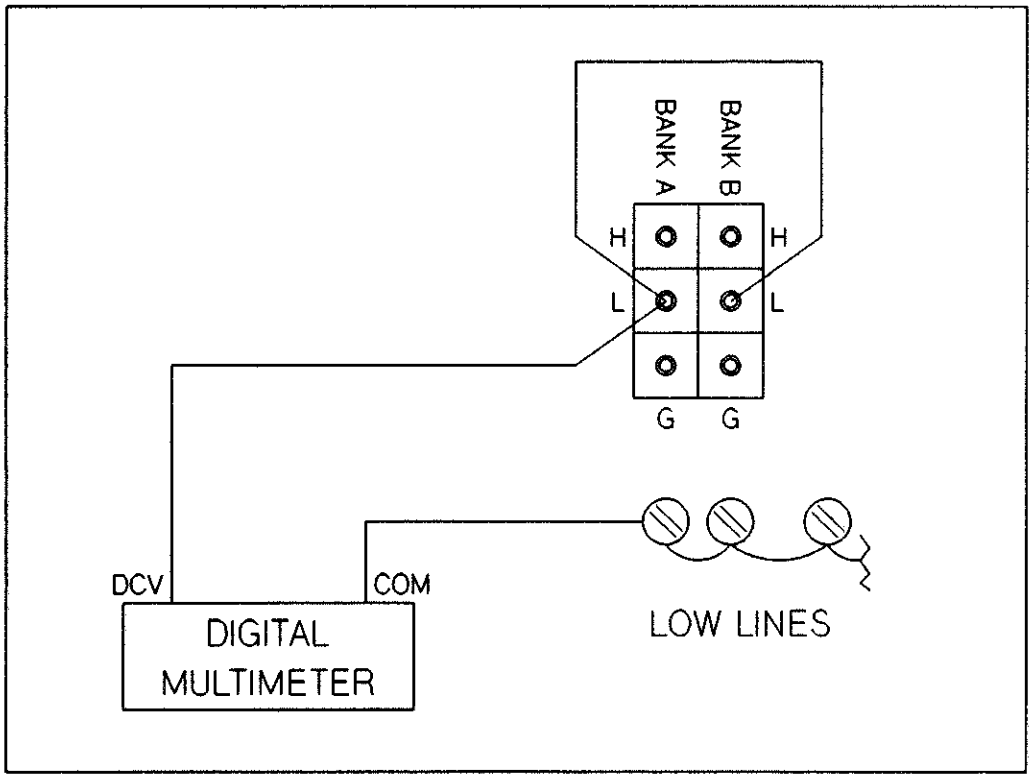


Figure 9-8 HP 44709A/44710A LOW Channel Test Set-Up

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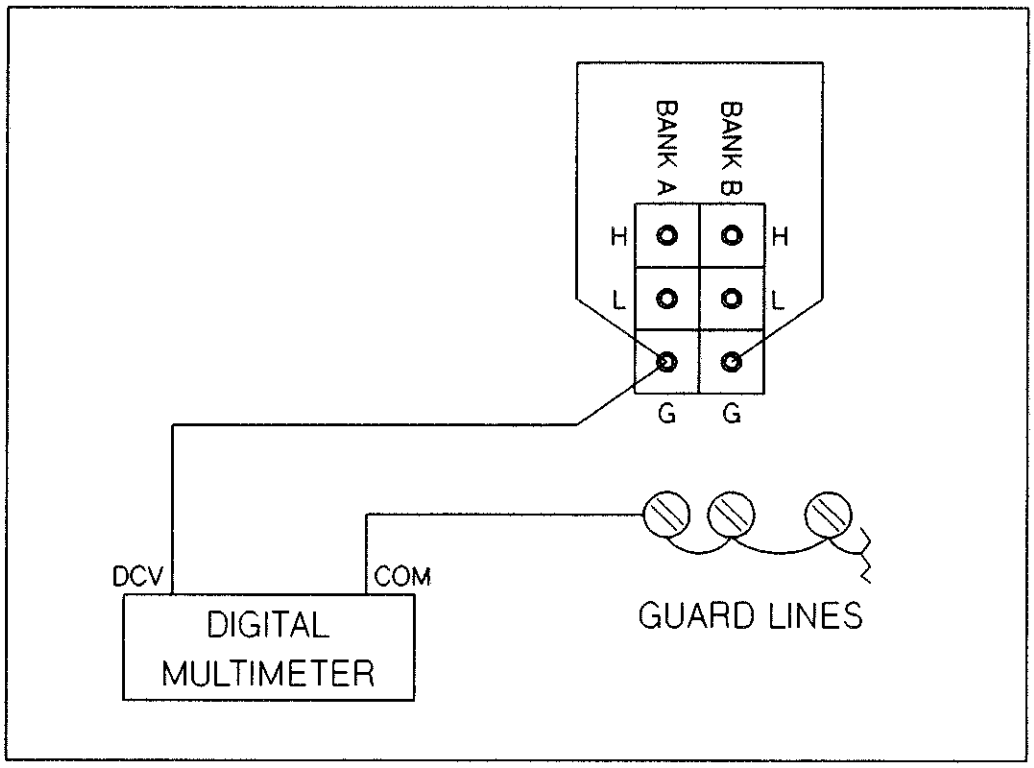


Figure 9-9 HP 44709A/44710A GUARD Channel Test Set-Up

NOTE

The backplane analog bus can be tested in one of two ways: 1) By connecting an external multimeter to the analog bus connector on the rear panel of the power supply module as shown in Figure 9-10, or 2) By connecting an external multimeter to the backplane analog bus line jumpers provided on the 44743A service module as shown in Figure 9-11.

4. Close Bank A sense tree switch and isolation relay by executing:

   CLOSE ES90,ES91 (where E = extender number, S = slot number)

5. Observe the indication on the multimeter. The multimeter should indicate less than 3.2 kohm.

6. Open the tree switch and isolation relay by executing:

   RESET ES00 (where E= extender number, S= slot number)

7. Observe the indication on the multimeter. The multimeter should indicate greater than 100 Mohm.

8. Disconnect the jumper between the Bank A common HIGH and the Bank A common low connection on the test fixure. Connect a jumper between the Bank B common HIGH and the Bank B common LOW connections on the test fixture.

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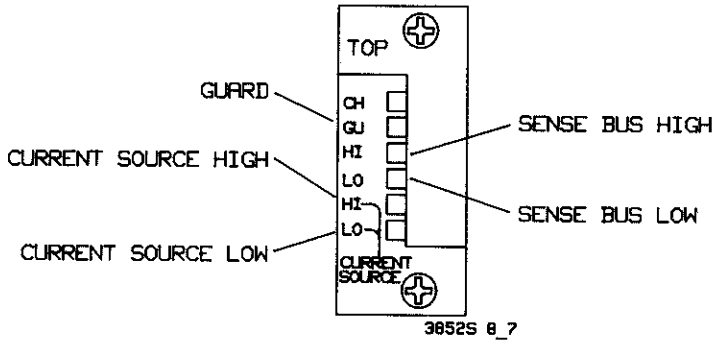


Figure 9-10 Analog Bus Connector

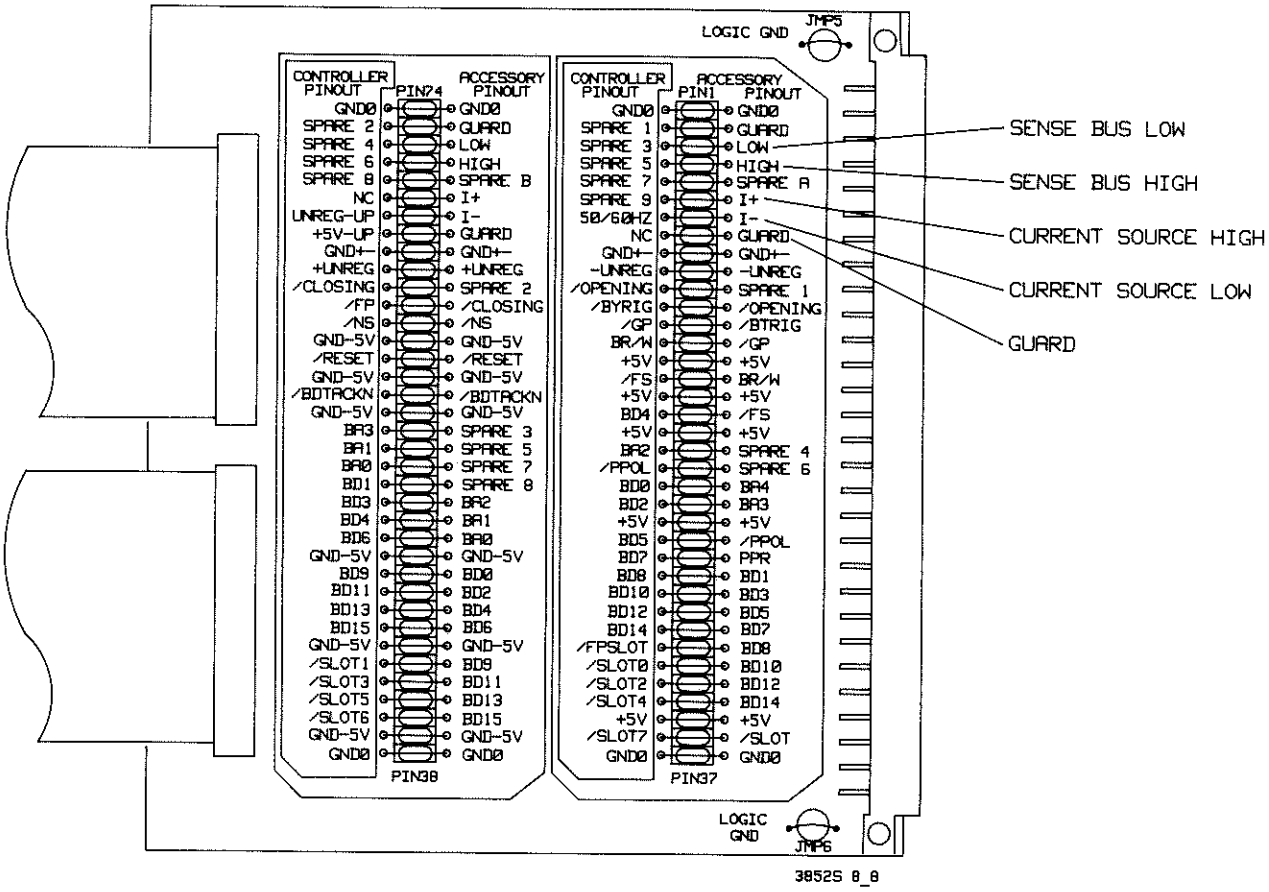


Figure 9-11 HP 44743A Service Module

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9. Close the Bank B sense tree switch and isolation relay by executing:

CLOSE ES90,ES92 (where E = extender number, S = slot number)

10. Observe the indication on the multimeter. The multimeter should indicate less than 3.2 kohm.

11. Open the Bank B sense tree switch and isolation relay by executing:

RESET ES00 (where E= extender number, S= slot number)

12. Observe the indication on the multimeter. The multimeter should indicate greater than 100 Mohm.

13. SOURCE BUS TREE SWITCH AND ISOLATION RELAY TEST: This test checks the measurement path from the backplane analog source bus through the isolation relay and tree switches.

14. Set the multimeter to measure two-wire ohms. Connect the multimeter test leads to the backplane analog source bus HIGH and LOW lines.

15. Disconnect the jumper between the Bank B common HIGH and the Bank B common low connection on the test fixure. Connect a jumper between the Bank A common HIGH and the Bank A common LOW connections on the test fixture.

16. Close Bank A source tree switch and isolation relay by executing:

CLOSE ES90,ES93 (where E = extender number, S = slot number)

17. Observe the indication on the multimeter. The multimeter should indicate less than 3.2 kohm.

18. Open the tree switch and isolation relay by executing:

RESET ES00 (where E = extender number, S = slot number)

19. Observe the indication on the multimeter. The multimeter should indicate greater than 100 Mohm.

20. Disconnect the jumper between the Bank A common HIGH and the Bank A common low connection on the test fixure. Connect a jumper between the Bank B common HIGH and the Bank B common LOW connections on the test fixture.

21. Close the Bank B source tree switch and isolation relay by executing:

CLOSE ES90,ES94 (where E = extender number, S = slot number)

22. Observe the indication on the multimeter. The multimeter should indicate less than 3.0 kohm.

23. Open the Bank B source tree switch and isolation relay by executing:

RESET ES00 (where E = extender number, S = slot number)

24. Observe the indication on the multimeter. The multimeter should indicate greater than 100 Mohm.

25. GUARD ISOLATION RELAY TEST: This test checks the GUARD path through the backplane analog bus and the isolation relay.

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26. Connect a jumper between the Bank A common LOW connection and the Bank A common GUARD connection on the test fixture.

27. Set the multimeter to measure two-wire ohms. Connect the multimeter DCV lead to the backplane analog sense bus LOW connection. Connect the multimeter COM lead to the backplane analog bus GUARD connection.

28. Close the isolation relays and the Bank A sense tree switch by executing:

CLOSE ES90,ES91 (where E = extender number, S = slot number)

29. Observe the reading on the multimeter. The multimeter should indicate <3.0 kohms. This resistance includes the resistance of the backplane bus connections, the Bank A tree switch, the protection resistors in the LOW and GUARD paths, and the isolation relays.

30. Reset the FET multiplexer by executing:

RESET ES00 (where E = extender number, S = slot number)

THIS CONCLUDES THE OPERATIONAL VERIFICATION PORTION OF THE HP 44709A/44710A PERFORMANCE TESTS.

9-26 DC Offset Test

1. Perform the Set-Up Procedure given in Section 9-23. The DC Offset test set-up is shown in Figure 9-12.

2. Set the multimeter to measure DC volts, on a range with at least 10 µV resolution. Connect the multimeter DCV lead to the shorted HIGH lines of the test fixture. Connect the multimeter COM lead to the shorted LOW lines of the test fixture.

3. Connect the 1 kohm resistor across the multimeter input leads.

NOTE

The offset voltage is specified with a resistance of 1 kohm or less. A smaller value resistor may be used for this test.

4. Close the first channel in the multiplexer by executing:

CLOSE ES00 (where E = extender number, S = slot number)

5. Observe the indication on the multimeter. The voltage indicated should be less than 15 µV (0 to 28 °C) or less than 185 µV (28 to 55 °C). A failure of the DC Offset test indicates a failing channel FET switch.

6. Repeat steps 4 and 5 for channels 01 through 19. In the CLOSE command the last two digits are the channel number (i.e., CLOSE ES01 would close channel 01 in extender E at slot S).

9-27 Opening and Closing Time Set-Up Procedure

The Opening and Closing Time test verifies that the channel FETs will switch on and off and that the multiplexer can scan the channels at the specified speed.

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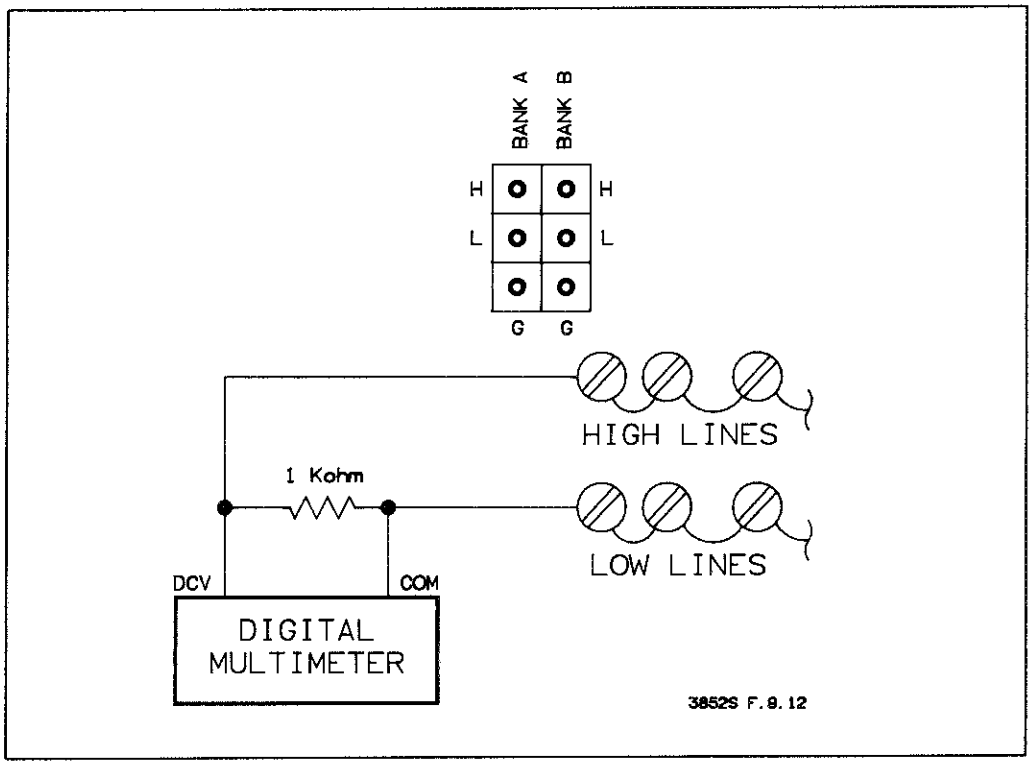


Figure 9-12 HP 44709A/44710A DC Offset Test Set-Up

1. Remove power from the HP 3852A and unplug the multiplexer to be tested. Install the Service Module in a convenient slot in the HP 3852A. Note the slot number where the Service Module is installed. Install the multiplexer on the service module. Install the test fixture on the multiplexer. The Set-Up Procedure is depicted in Figure 9-13.

2. On an oscilloscope, connect probes to the Channel A INPUT and Channel B INPUT. Set up the oscilloscope to the following:

Dual Trace
Channel A -- DC, 0.2 Volts/Div (if using 10:1 probes)
Channel B -- DC, 0.5 Volts/Div (if using 10:1 probes)
Trigger -- Internal, triggered on Channel B
Vertical Display -- Alternate
Time -- 0.2 mses/Div
Delayed Sweep -- 0.1 µsec/Div
Delayed Sweep Dial -- Minimum

3. Connect a jumper from the +5V test connection on the service module to the shorted HIGH connections on the test fixture.

4. Connect a jumper between the Bank A HIGH common test point and the Bank B HIGH common test point on the test fixure.

5. Connect the 1 kohm resistor between the HIGH common test points on the test fixture and the logic ground test connection on the service module.

6. Connect the Channel A oscilloscope probe to the HIGH common test points on the test fixture.

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7. Connect the Channel B oscilloscope probe to the OPENING test connection on the service module.

8. Apply power to the HP 3852A. Wait for the wake-up sequence to complete.

9. Set up the following subroutine in HP 3852A memory. When the first statement is entered the SUB ENTRY annunciator should be on in the left display. This annunciator should remain on until the SUBEND statement is entered.

```
SUB A
TRG
SCAN ES00-ES19   (where E = extender number, S = slot number)
SUBEND
```

The subroutine will scan all channels on the FET multiplexer. Do not reset or cycle power to the HP 3852A or the subroutine will be erased from memory. The front panel CLEAR key may be used without disturbing the subroutine.

9-28 Opening Time Test

This test checks the time it takes for the FET to open after receiving an OPENING pulse from the FET multiplexer.

1. Repetitively call the entered subroutine 10000 times by executing:

```
CALL A,10000
```

This statement will call the subroutine 10000 times.

2. Observe the waveform displayed on the Channel B trace and make sure all 20 channels are present. It may also be necessary to adjust the TRIGGER LEVEL and TRIGGER HOLD controls, and to select the negative trigger pulse position on the scope to synchronize the signal on the scope.

3. Rotate the DELAY SWEEP dial to the minimum position. Select the DELAYED sweep mode on the scope. Slowly rotate the DELAY SWEEP dial clockwise while observing the displayed waveforms. The Channel B waveform is the OPENING pulse. The Channel A waveform is the +5V supply as switched by the relays. As the DELAY SWEEP dial is rotated, each channel switch and the associated OPENING pulse will come into view. The FET opening time is the time from the falling edge of the OPENING pulse to the falling edge of the Channel A waveform. This time must be less than 1.2 µseconds. The opening time is illustrated in Figure 9-14.

NOTE

The +5 V power supply waveform on Channel A will show an amplitude difference between the Bank A and Bank B FET switches. This is due to impedance differences in the Bank A common and Bank B common measurements paths on the multiplexer.

Continue rotating the DELAY Sweep dial until all 20 FET channels have been checked. A failing channel indicates a failing FET switch.

To stop the test at any time, press the front panel CLEAR key. The test time may be extended by by increasing the number of times the subroutine is called, as specified in step 1.

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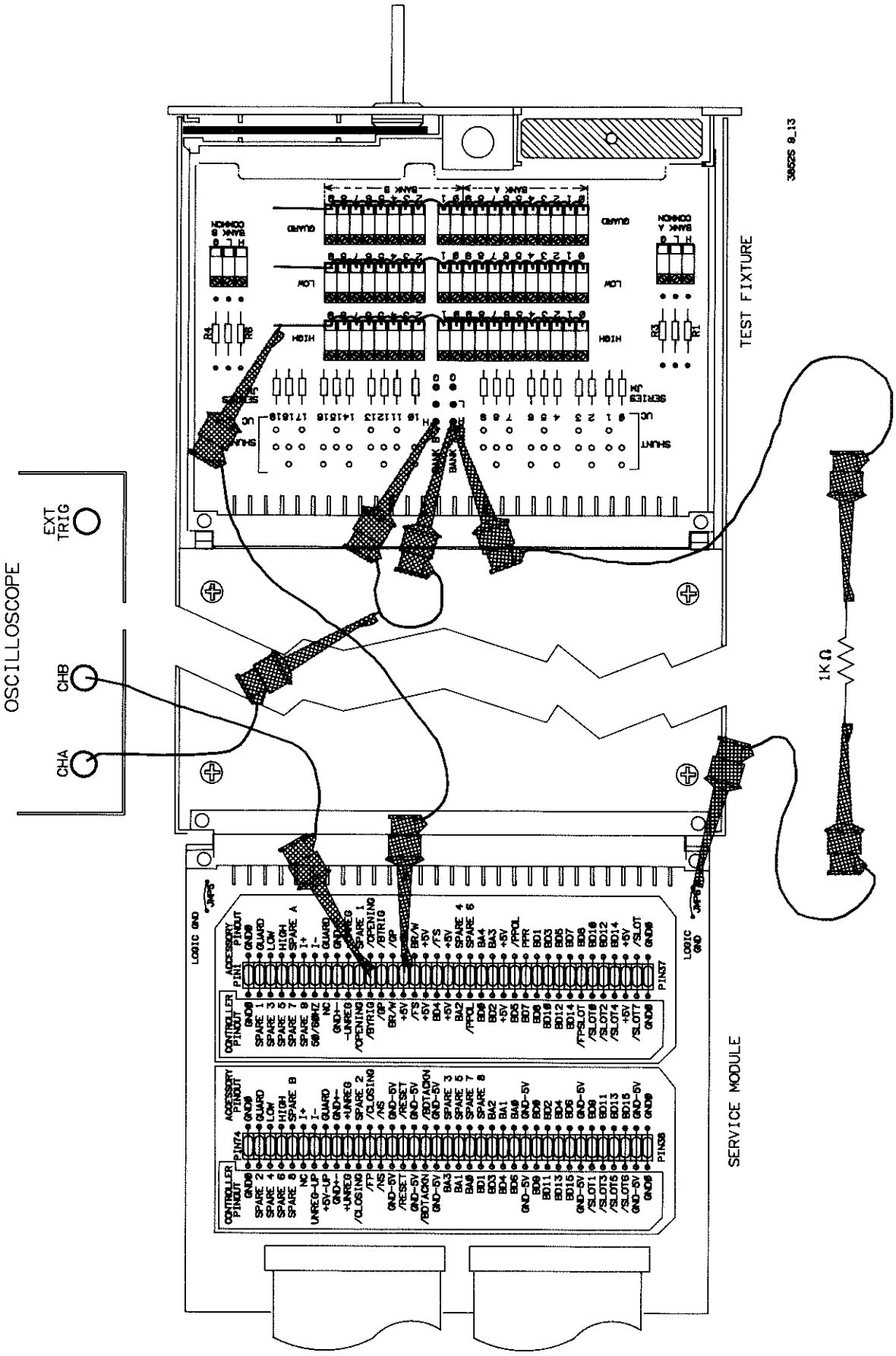


Figure 9-13 HP 44709A/44710A Opening Time Set-Up

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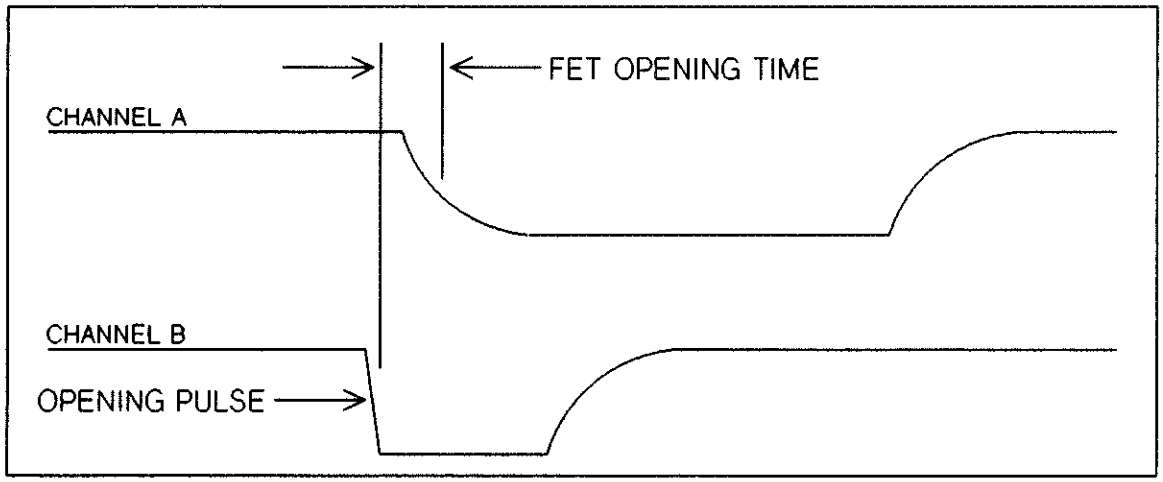


Figure 9-14 HP 44709A/44710A Opening Time

The waveform will exhibit a small amount of jitter due to the overhead requirements of the HP 3852A operating system.

9-29 Closing Time Test

This test checks the time it takes for the FET to close after receiving a CLOSING pulse from the FET multiplexer.

1. Move the channel B oscilloscope probe to the CLOSING connection on the service module. The Closing Time test set-up is shown in Figure 9-15.

2. Repetitively call the entered subroutine by executing:

```
CALL A,10000
```

3. Rotate the DELAY SWEEP dial on the oscilloscope to the minimum position. Slowly rotate the dial clockwise until the first closing is displayed. The Channel B trace is the closing pulse output from the multiplexer. The Channel A waveform is the +5V supply, as switched by the FET channel switches. As the DELAY SWEEP dial is rotated, each channel switch and the associated CLOSING pulse will come into view. The FET closing time is the time from the falling edge of the CLOSING pulse to the rising edge of the Channel A waveform. This time must be less than 2.25 µseconds. The closing time is illustrated in Figure 9-16.

Continue rotating the DELAY Sweep dial until all 20 FET channels have been checked. A failing channel indicates a failing FET switch.

To stop the test at any time, press the front panel CLEAR key. The test time may be extended by by increasing the number of times the subroutine is called, as specified in step 2.

The waveform will exhibit a small amount of jitter due to the overhead requirements of the HP 3852A operating system.

9-30 Leakage/Bias Current Test

The leakage current test checks the FET switches for excessive leakage/bias current. Leakage/bias current is sourced by the multiplexer from HIGH, LOW, or GUARD to chassis ground.

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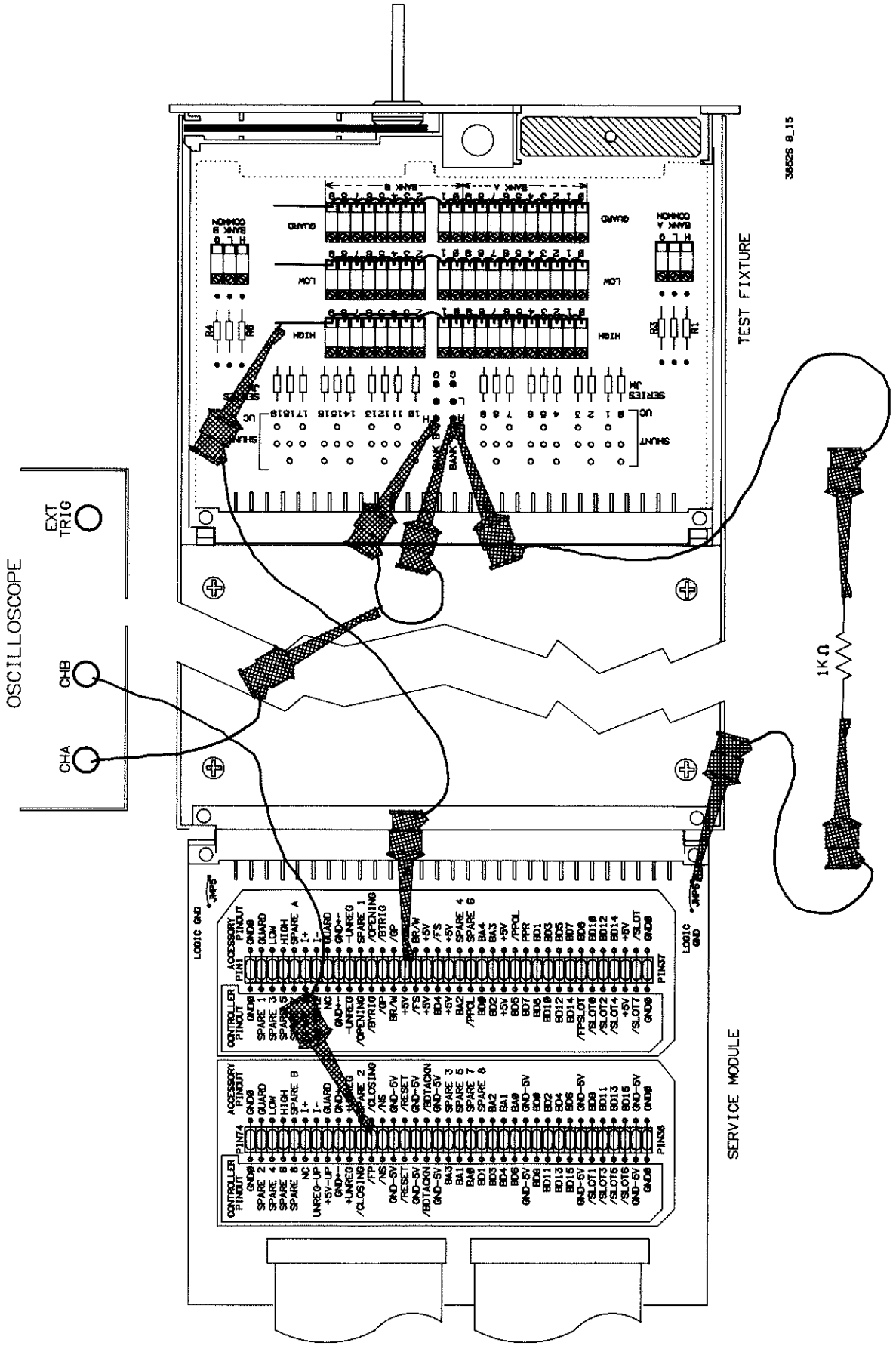


Figure 9-15 HP 44709A/44710A Closing Time Set-Up

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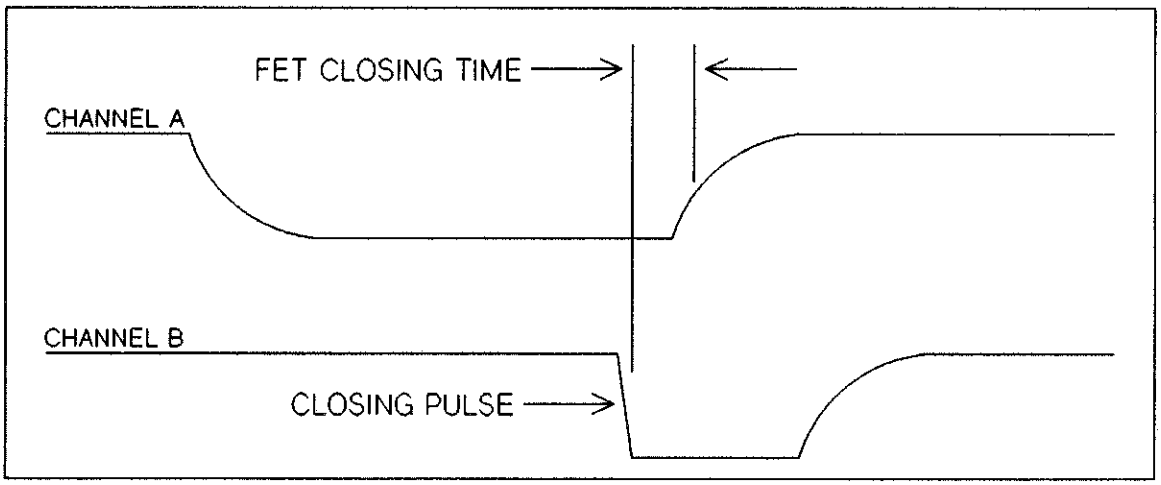


Figure 9-16 HP 44709A/44710A Closing Time

NOTE

The input resistance of the test digital multimeter could affect the value of R1 in the following tests, if using other than the recommended digital multimeter. The value of R1 should be determined by the 10 Mohm resistor in parallel with the input reistance of the digital multimeter.

1. OPEN CHANNELS LEAKAGE/BIAS CURRENT TEST. This test checks the leakage current with all channels open. A simplified schematic of the setup is shown in Figure 9-17 and the test setup for the HIGH lines is shown in Figure 9-18.

2. Perform the Set-Up procedure in Section 9-23.

3. Set the negative power supply to 10 Vdc and connect the negative lead to the shorted HIGH lines on the test fixure. Connect the negative power supply common lead to the chassis.

NOTE

Connections to chassis ground can be accomplished by connecting to any sheet metal part. Chassis ground is also available at a connector on the rear panel of the HP 3852A power supply.

4. Set the positive power supply output to 10 Vdc and connect the positive lead to the multimeter common. Connect the positive power supply common to the chassis.

5. Connect the 10 Mohm resistor (**R1**) across the multimeter input terminals. Connect the multimeter DCV input terminal to the Bank A HIGH common test point. Short the Bank A and Bank B HIGH common test points together.

6. Open all switches on the multiplexer by executing:

RESET ES00 (where E = extender number, S = slot number)

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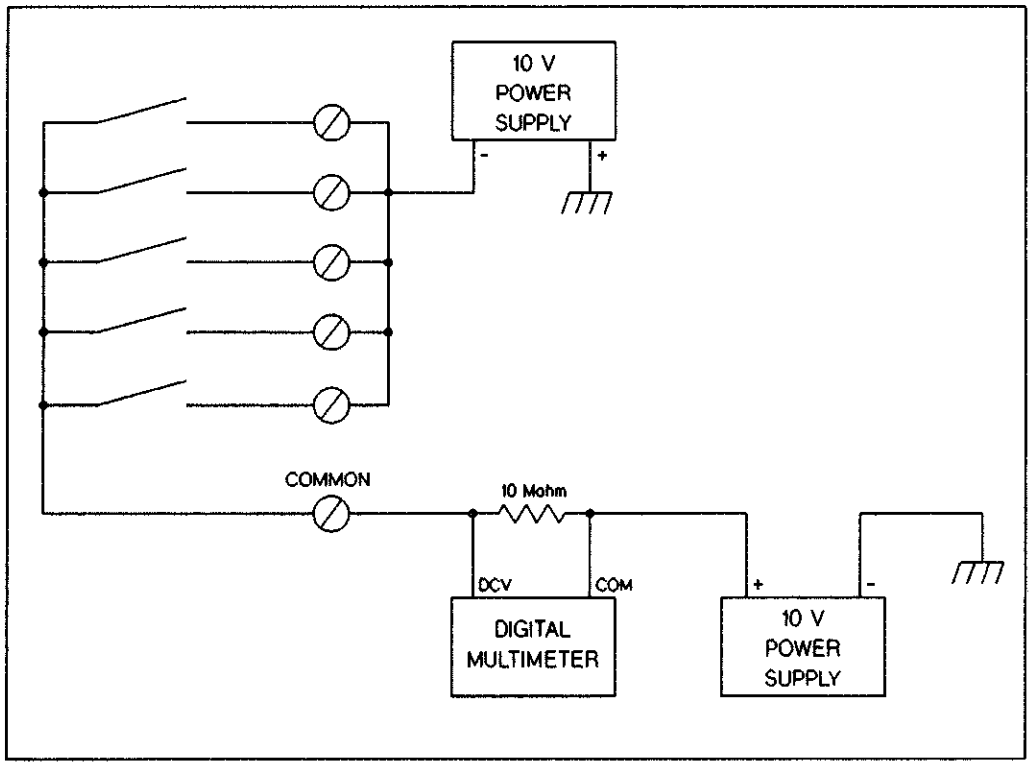


Figure 9-17 Open Channel Leakage Test

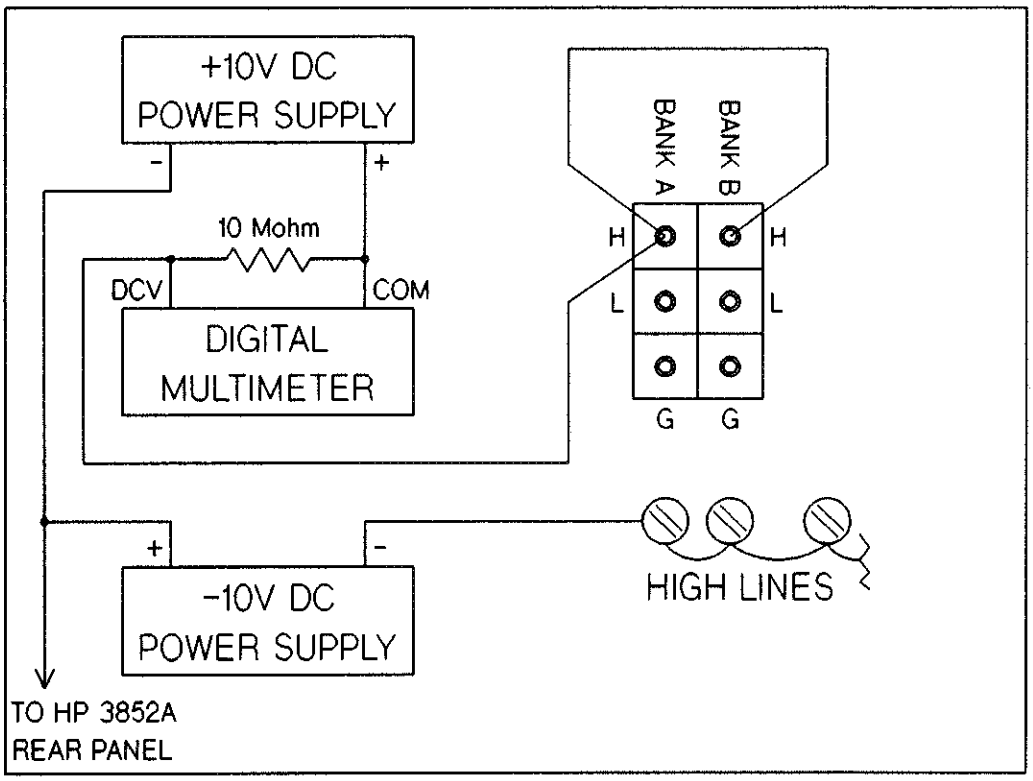


Figure 9-18 HP 44709A/44710A Open HIGH Channel Test Set-Up

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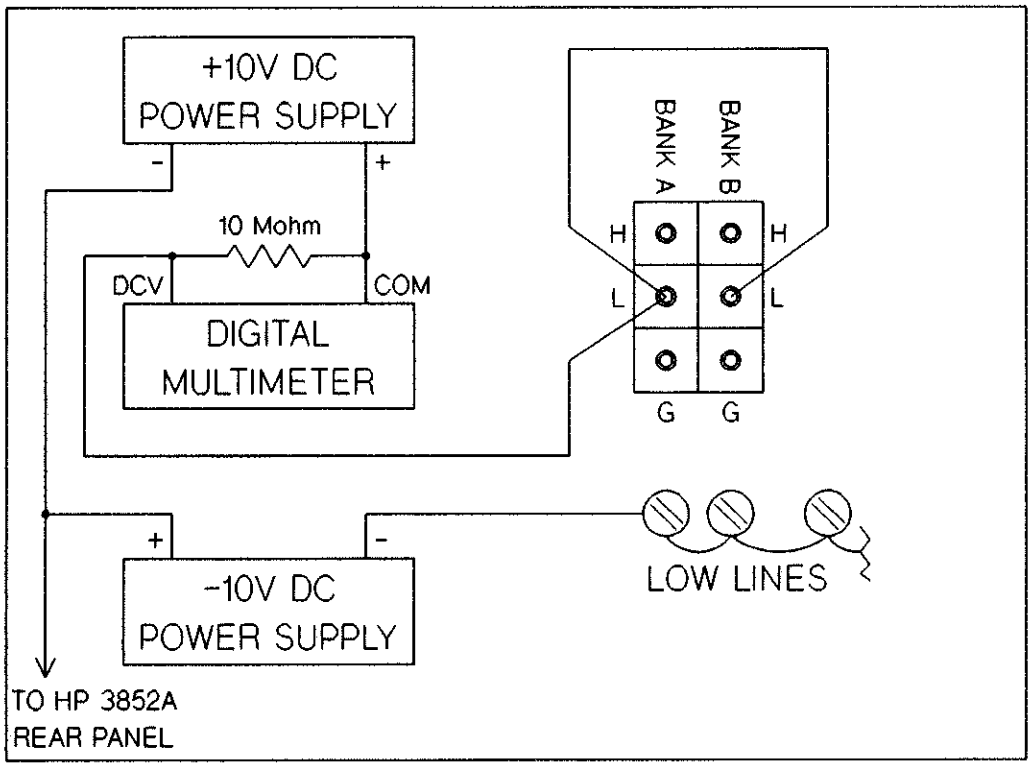


Figure 9-19 HP 44709A/44710A Open LOW Channel Test-Setup

7. Close the isolation relay and a tree switch by executing:

   CLOSE ES90,ES91 (where E = extender number, S = slot number)

8. Observe the reading on the multimeter. This reading is referred to as **V1** in the following steps.

9. Calculate the leakage current (I) from the formula:

$$I = \frac{V1}{R1}$$

The calculated open channel leakage current for the HIGH lines should be less than 2 nA for a room temperature between 0° and 28° C (for temperatures in the range of 0° to 55° C the leakage current should be less than 11 nA).

10. Refer to Figure 9-19. Connect the negative power supply's negative lead to the shorted LOW lines on the test fixure. Connect the negative power supply common lead to the chassis.

11. Connect the multimeter DCV lead to the Bank A common LOW test point. Short the Bank A and Bank B LOW common test points together.

12. Observe the reading on the multimeter. This reading is referred to as **V1** in the following step.

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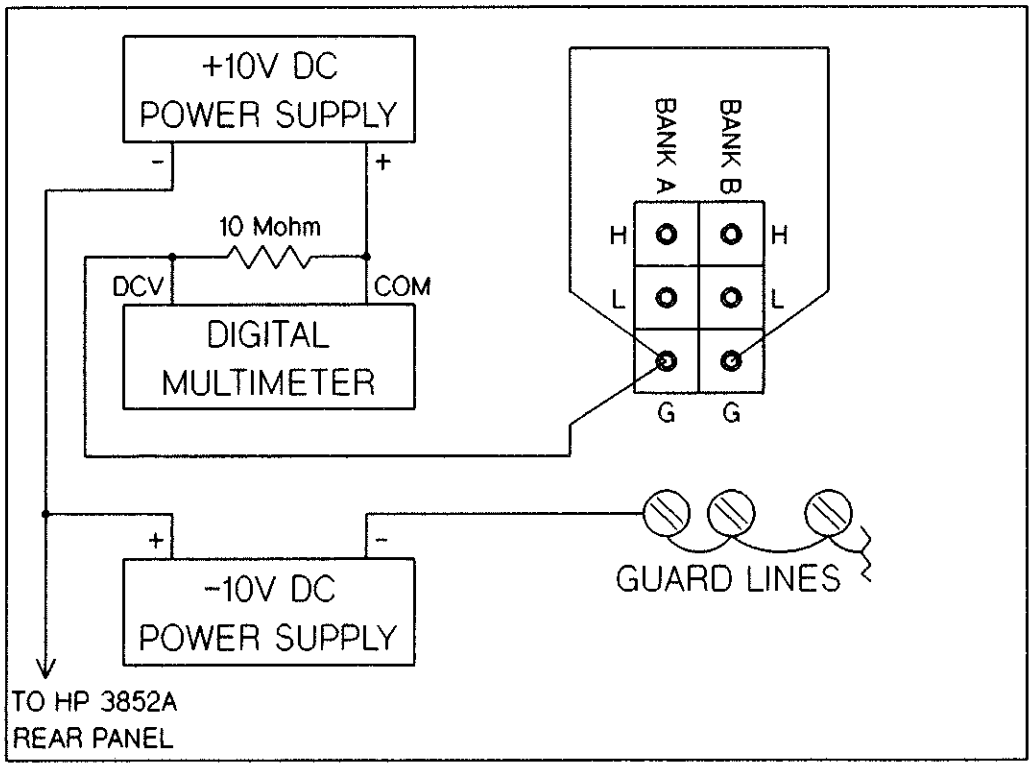


Figure 9-20 HP 44709A/44710A Open GUARD Channel Test-Setup

13. Calculate the leakage current (I) from the formula:

$$I = \frac{V1}{R1}$$

The calculated open channel leakage current for the LOW lines should be less than 2 nA for a room temperature between 0° and 28° C (for temperatures in the range of 0° to 55° C the leakage current should be less than 11 nA).

14. Refer to Figure 9-20. Connect the negative power supply's negative lead to the shorted GUARD lines on the test fixure. Connect the negative power supply common lead to the chassis.

15. Connect the multimeter DCV lead to the Bank A common GUARD test point. Short the Bank A and Bank B GUARD common test points together.

16. Observe the reading on the multimeter. This reading is referred to as **V1** in the following step.

17. Calculate the leakage current (I) from the formula:

$$I = \frac{V1}{R1}$$

The calculated open channel leakage current for the GUARD lines should be less than 6 nA for a room temperature between 0° and 28° C (for temperatures in the range of 0° to 55° C the leakage current should be less than 110 nA).

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18. CLOSED CHANNEL LEAKAGE/BIAS CURRENT TEST. This test checks each channel HIGH, LOW, and GUARD for leakage current when a channel is closed. A simplified schematic of the setup is shown in Figure 9-21 and the test setup for the HIGH lines is shown in Figure 9-22.

19. Remove the negative power supply from the test fixure.

20. On the test fixture, connect the shorted HIGH lines to the Bank A HIGH common test point. Short the Bank A and Bank B common HIGH test points together.

21. Connect the +10 V power supply common to chassis ground. Connect the power supply positive lead to the common input of the multimeter.

22. Connect the 10 Mohm resistor across the multimeter input terminals. Connect the multimeter DCV input terminal to the shorted HIGH lines on the test fixture.

23. Close the isolation relay by executing:

CLOSE ES90 (where E = mainframe number, S = slot number)

24. Close the first channel in Bank A and the associated tree switch by executing:

CLOSE ES91,ES00 (where E = mainframe number, S = slot number)

25. Observe the voltage reading on the multimeter. This voltage is referred to as **V1** in the following step.

26. Calculate the leakage current (I) from the formula:

$$I = \frac{V1}{R1}$$

The leakage current should be less than 5.0 nA for room temperatures in the range of 0° to 28° C (leakage current should be less than 15 nA for a temperature range of 28° to 55° C).

27. Repeat steps 24, 25, and 26 for channels 01 through 09. In step 21, the channel under test is specified in the second term of the CLOSE command (i.e., CLOSE ES91,ES01 for channel 01).

28. Close the first channel in Bank B and the associated tree switch by executing:

CLOSE ES92,ES10 (where E = mainframe number, S = slot number)

29. Observe the voltage reading on the multimeter. This voltage is referred to as **V1** in the following step.

30. Calculate the leakage current (I) from the formula:

$$I = \frac{V1}{R1}$$

The leakage current should be less than 5.0 nA for room temperatures in the range of 0° to 28° C (leakage current should be less than 15 nA for a temperature range of 28° to 55° C).

31. Repeat steps 28, 29, and 30 for channels 11 through 19. In step 28, the channel under test is specified in the second term of the CLOSE command (i.e., CLOSE ES92,ES11 for channel 11).

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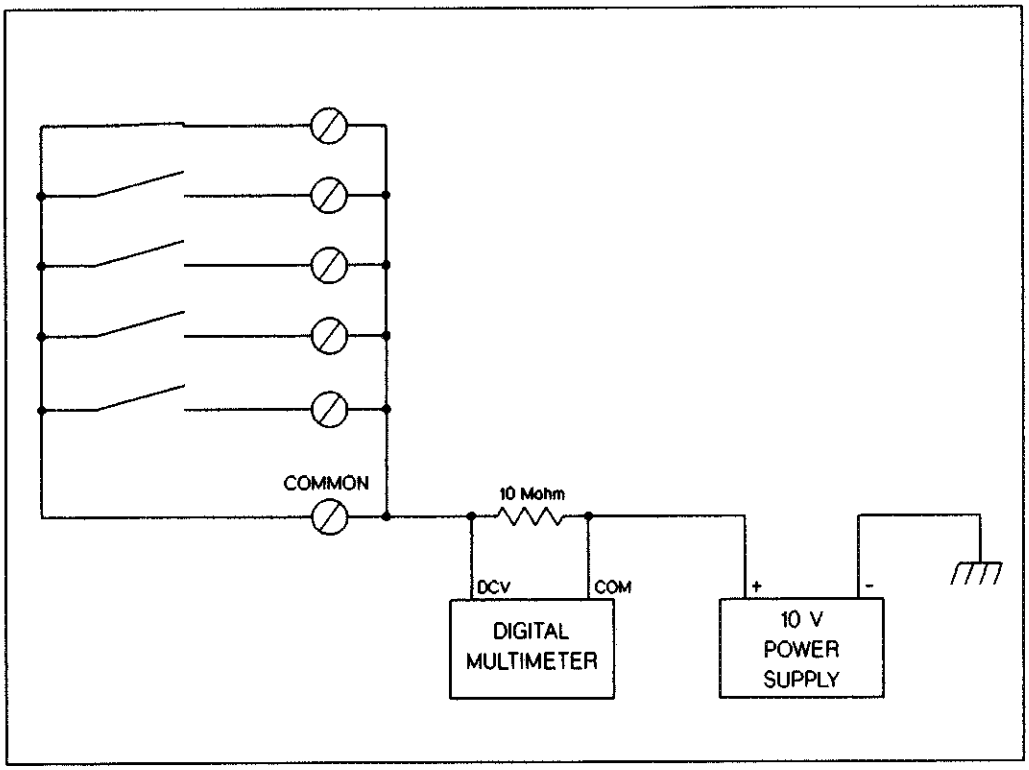


Figure 9-21 Closed Channel Leakage Test

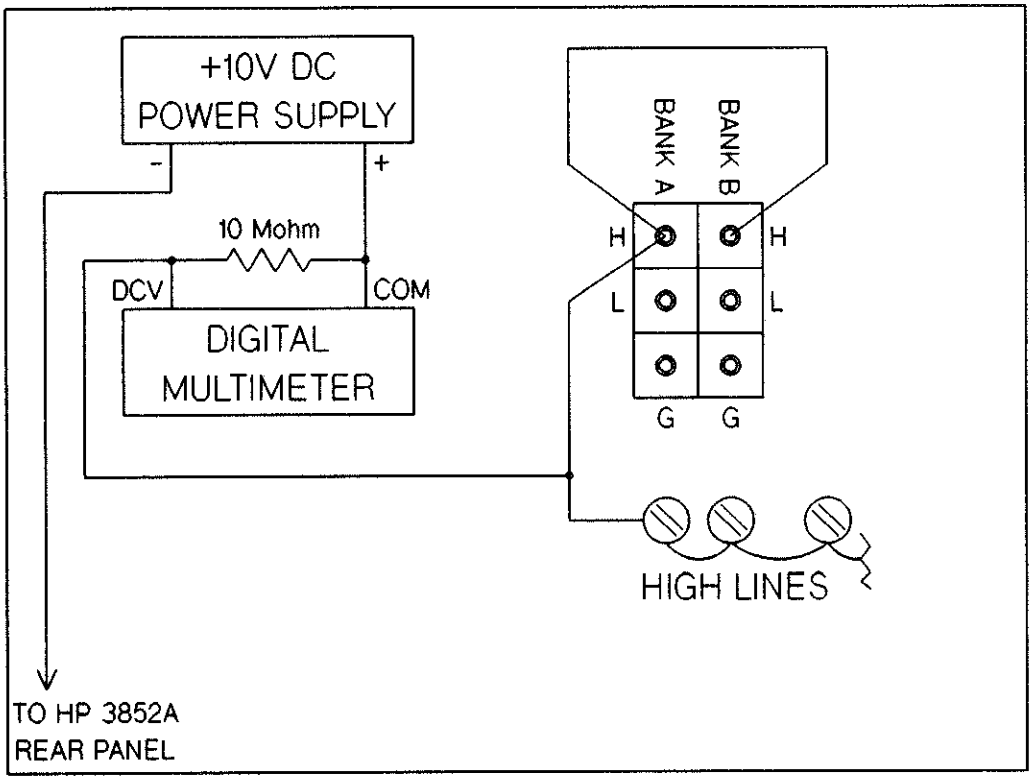


Figure 9-22 HP 44709A/44710A Closed HIGH Channel Test Set-Up

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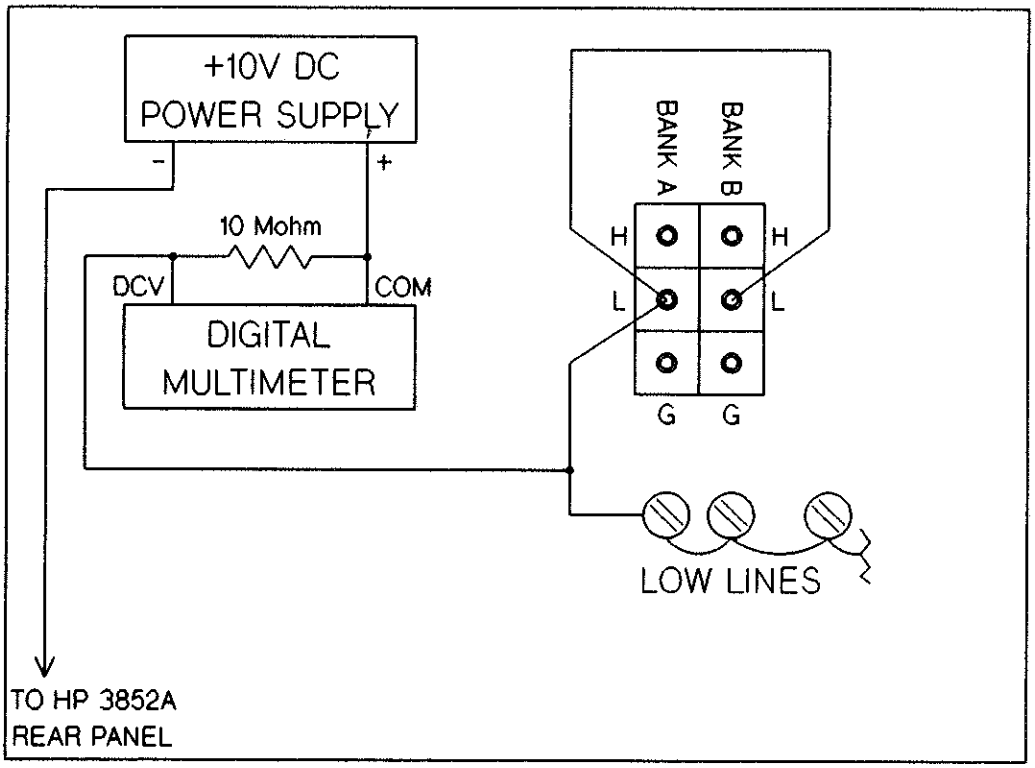


Figure 9-23 HP 44709A/44710A Closed LOW Channel Test Set-Up

32. Refer to Figure 9-23. On the test fixture, connect the shorted LOW lines to the Bank A common LOW test point. Short the Bank A and Bank B LOW common test points together.

33. Connect the multimeter DCV input terminal to the shorted LOW lines on the test fixture.

34. Close the first channel in Bank A and the associated tree switch by executing:

    CLOSE ES91,ES00 (where E = mainframe number, S = slot number)

35. Observe the voltage reading on the multimeter. This voltage is referred to as **V1** in the following step.

36. Calculate the leakage current (I) from the formula:

$$I = \frac{V1}{R1}$$

The leakage current should be less than 5.0 nA for room temperatures in the range of 0° to 28° C (leakage current should be less than 15 nA for a temperature range of 28° to 55° C).

37. Repeat steps 34, 35, and 36 for channels 01 through 09. In step 34, the channel under test is specified in the second term of the CLOSE command (i.e., CLOSE ES91,ES01 for channel 01).

38. Close the first channel in Bank B and the associated tree switch by executing:

    CLOSE ES92,ES10 (where E = mainframe number, S = slot number)

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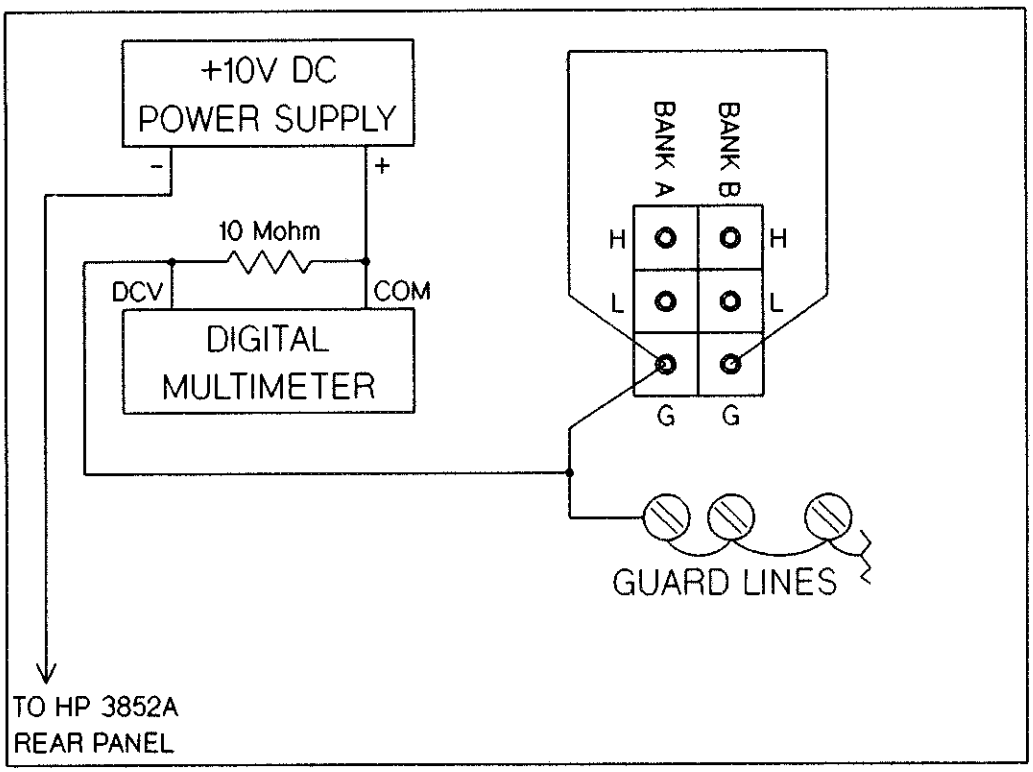


Figure 9-24 HP 44709A/44710A Closed GUARD Channel Test Set-Up

39. Observe the voltage reading on the multimeter. This voltage is referred to as **V1** in the following step.

40. Calculate the leakage current (I) from the formula:

$$I = \frac{V1}{R1}$$

The leakage current should be less than 5.0 nA for room temperatures in the range of 0° to 28° C (leakage current should be less than 15 nA for a temperature range of 28° to 55° C).

41. Repeat steps 38, 39, and 40 for channels 11 through 19. In step 38, the channel under test is specified in the second term of the CLOSE command (i.e., CLOSE ES92,ES11 for channel 11).

42. Refer to Figure 9-24. On the test fixture, connect the shorted GUARD lines to the Bank A common GUARD test point. Short the Bank A and Bank B common GUARD test points together.

43. Connect the multimeter DCV input terminal to the shorted GUARD lines on the test fixture.

44. Close the first channel in Bank A and the associated tree switch by executing:

CLOSE ES91,ES00 (where E = mainframe number, S = slot number)

45. Observe the voltage reading on the multimeter. This voltage is referred to as **V1** in the following step.

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46. Calculate the leakage current (I) from the formula:

$$I = \frac{V1}{R1}$$

The leakage current should be less than 65 nA for room temperatures in the range of 0° to 28° C (leakage current should be less than 770 *n*A for a temperature range of 28° to 55° C).

47. Repeat steps 44, 45, and 46 for channels 01 through 09. In step 44, the channel under test is specified in the second term of the CLOSE command (i.e., CLOSE ES91,ES01 for channel 01).

48. Close the first channel in Bank B and the associated tree switch by executing:

CLOSE ES92,ES10 (where E = mainframe number, S = slot number)

49. Observe the voltage reading on the multimeter. This voltage is referred to as **V1** in the following step.

50. Calculate the leakage current (I) from the formula:

$$I = \frac{V1}{R1}$$

The leakage current should be less than 65 nA for room temperatures in the range of 0° to 28° C (leakage current should be less than 770 nA for a temperature range of 28° to 55° C).

51. Repeat steps 48, 49, and 50 for channels 11 through 19. In step 48, the channel under test is specified in the second term of the CLOSE command (i.e., CLOSE ES92,ES11 for channel 11).

9-31 REPLACEABLE PARTS

Figure 9-25 shows the mechanical breakdown of the HP 44709A and HP 44710A. This figure also provides assembly or disassembly information. The parts shown in Figure 9-25 are keyed to the parts list in Table 9-4.

To order a part listed in Table 9-4, quote the Hewlett-Packard part number, the quantity desired, the HP system description, and the check digit (abbreviated CD in Table 9-4). Address the order to the nearest Hewlett-Packard Sales Office. Hewlett-Packard Sales Offices are listed geographically at the back of this manual.

CAUTION

The component module printed circuit board for the FET multiplexers is a static sensitive device. Refer to Chapter 5 for additional information about handling static sensitive printed circuit boards.

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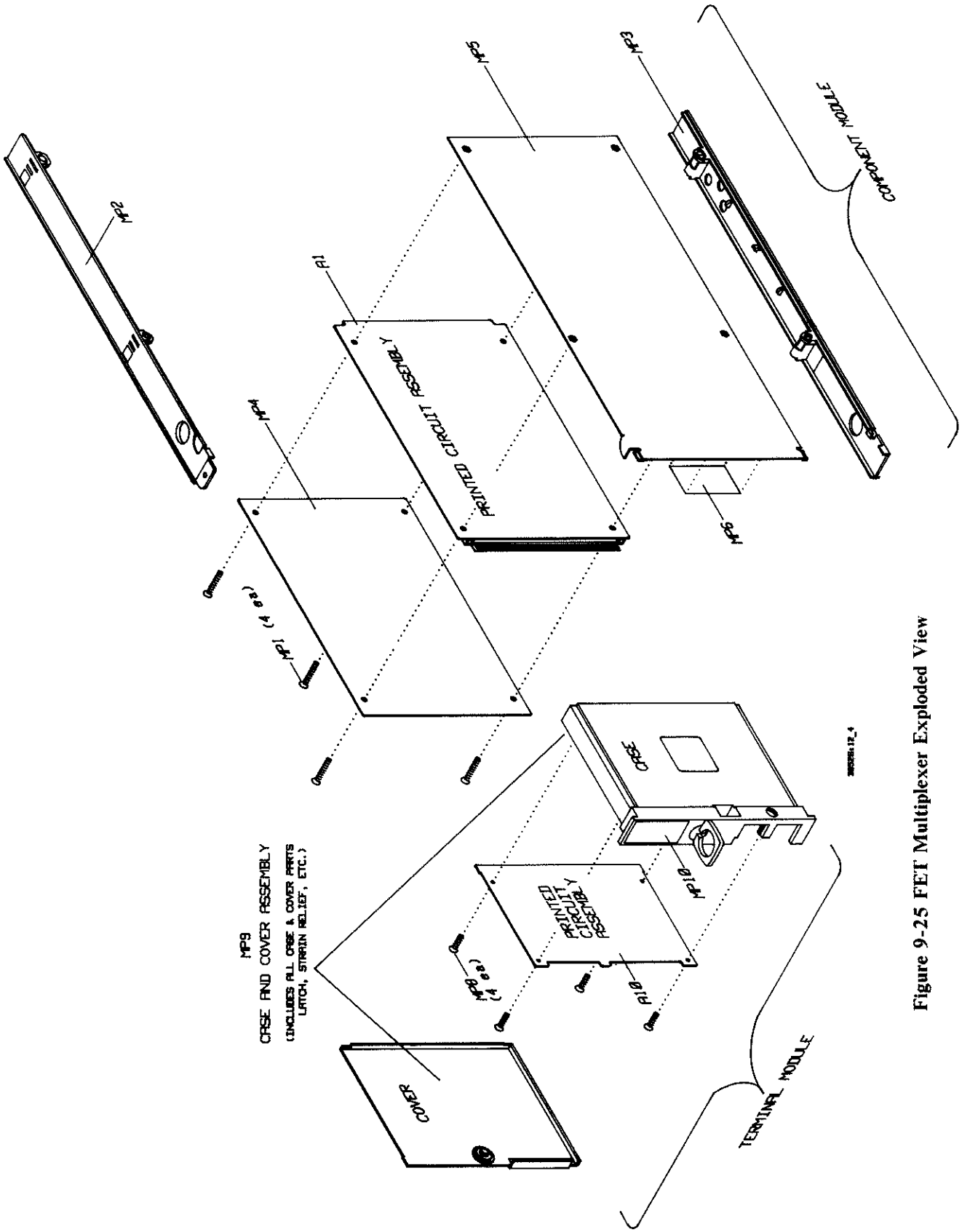


Figure 9-25 FET Multiplexer Exploded View

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Table 9-4a HP 44709A 20 Channel FET Multiplexer

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44709A	Module; 20 channel FET mux component	1	44709-66201	5	MOD-20CH FET MUX
A1	PCA; 20 channel FET mux component	1	44709-66501	8	PCA-20CH GP F/MU
A10	PCA; 20 channel mux terminal	1	44705-66510	5	PCA-20CH MX TERM
MP1	Screw; cover	4	0515-1322	4	SCR-FH M3.0X30LK
MP2	Guide rail; top (molded)	1	03852-41201	1	MLD-RAIL,TOP
MP3	Guide rail; bottom (molded)	1	03852-41202	2	MLD-RAIL,BOTTOM
MP4	Cover; left (aluminum)	1	03852-04101	2	0601 CVR-ACC LT
MP5	Cover; right (aluminum)	1	03852-04102	3	0601 CVR-ACC RT
MP6	Label; 44709/44710 component module	1	44709-84320	7	LBL-I/O OPTIONS
MP7	(NOT USED)				
MP8	Screw; A10 PCA	4	0515-0886	3	SCR-PH M3.0X6 LK
MP9	Term box; case,cover,latch & str rlf	1	03852-84410	4	ASSY-TERM,LG OPN
MP10	Label; rear panel of term mod 44709A	1	44709-84325	2	LBL-ID,TERM ASSY

Completely assembled HP 44709A terminal modules can be ordered from your local HP Office by ordering Number 44709AT.

"447xx-662xx" and "447xx-692xx" part numbers are replacement components only and do not include a terminal module.

Restored Assemblies/Modules

The following restored assemblies/modules are available through the HP Exchange Program at a discount. For details see Section 1-19.

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44709A	Module; 20 channel FET mux component		44709-69201	1	RBLT-44709-66201

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Table 9-4b HP 44710A 20 Channel FET Mux with Thermocouple Compensation

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44710A	Module; 20 channel FET mux component	1	44709-66201	5	MOD-20CH FET MUX
A1	PCA; 20 channel FET mux component	1	44709-66501	8	PCA-20CH GP F/MU
A10	PCA; 20 chan mux term w/TC reference	1	44708-66510	8	PCA-20CH TERM/TC
MP1	Screw; cover	4	0515-1322	4	SCR-FH M3.0X30LK
MP2	Guide rail; top (molded)	1	03852-41201	1	MLD-RAIL,TOP
MP3	Guide rail; bottom (molded)	1	03852-41202	2	MLD-RAIL,BOTTOM
MP4	Cover; left (aluminum)	1	03852-04101	2	0601 CVR-ACC LT
MP5	Cover; right (aluminum)	1	03852-04102	3	0601 CVR-ACC RT
MP6	Label; 44709/44710 component module	1	44709-84320	7	LBL-I/O OPTIONS
MP7	(NOT USED)				
MP8	Screw; A10 PCA	4	0515-0886	3	SCR-PH M3.0X6 LK
MP9	Term box; case,cover,latch & str rlf	1	03852-84410	4	ASSY-TERM,LG OPN
MP10	Label; rear panel of term mod 44710A	1	44710-84325	5	LBL-ID,TERM ASSY

Completely assembled HP 44710A terminal modules can be ordered from your local HP Office by ordering Number 44710AT.

"447xx-662xx" and "447xx-692xx" part numbers are replacement components only and do not include a terminal module.

Restored Assemblies/Modules

The following restored assemblies/modules are available through the HP Exchange Program at a discount. For details see Section 1-19.

REF DESIG	DESCRIPTION	QTY	HP PART NUMBER	C D	HP FACTORY REFERENCE
44710A	Module; 20 channel FET mux component		44709-69201	1	RBLT-44709-66201

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