HP 4062C/PC Semiconductor Parametric Test System
HP 4062UX Semiconductor Process Control System

Service Manual

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Product Warranty

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The Hewlett-Packard products may contain remanufactured parts equivalent to new in performance or may have been subject to incidental use.

The warranty period begins on the date of delivery or on the date of installation if installed by Hewlett-Packard. If customer schedules or delays Hewlett-Packard installation more than 30 days after delivery, warranty begins on the 31st day from delivery.

Warranty does not apply to defects resulting from (a) improper or inadequate maintenance or calibration, (b) software, interfacing, parts or supplies not supplied by Hewlett-Packard, (c) unauthorized modification or misuse, (d) operation outside of the published environmental specifications for the product, or (e) improper site preparation or maintenance.

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Hewlett-Packard will be liable for damage to tangible property per incident up to the greater of $300,000 or the actual amount paid for the product that is the subject of the claim, and for damages for bodily injury or death, to the extent that all such damages are determined by a court of competent jurisdiction to have been directly caused by a defective Hewlett-Packard product.

To the extent allowed by local law, the remedies in this warranty statement are customer's sole and exclusive remedies. Except as indicated above, in no event will Hewlett-Packard or its suppliers be liable for loss of data or for direct, special, incidental, consequential (including lost profit or data), or other damage, whether based in contract, tort, or otherwise.

For consumer transactions in Australia and New Zealand: the warranty terms contained in this statement, except to the extent lawfully permitted, do not exclude, restrict or modify and are in addition to the mandatory statutory rights applicable to the sale of this product to you.

Assistance

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales Office.

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 Technology** (NIST), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Printing History

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional and replacement pages to be merged into the manual by the customer. The dates on the title page change only when a new edition is published. No information is incorporated into a reprinting unless it appears as a prior update; the edition does not change when an update is incorporated.

The software revision code printed before the date indicates the version level of the software product at the time the manual or update was issued. Many product updates and fixes do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one to one correspondence between product updates and manual updates.

Edition 1	for system software revision 5.6, July 1990
Update 1	for system software revision 5.7, October 1990
Update 2	for system software revision 6.0, August 1991
Update 3	for system software revision 6.2, March 1992
Update 4	for an emergency off unit, August 1992
Edition 2	for system software revision 7.0 or earlier, January 1995

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 may impair the protections provided by the equipment. In addition, it violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for customer's failure to comply with these requirements.

Note

HP 4062C/UX/PC complies with INSTALLATION CATEGORY II and POLLUTION DEGREE 2 defined in IEC 1010-1.
HP 4062C/UX/PC is INDOOR USE product.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The power terminal and the power cable must 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

Operation 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 services and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS

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

Warning

Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

Safety Symbols

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

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

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

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

OR

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

Alternating current.

Direct current.

ON (Supply).

OFF (Supply).

STANDBY (Supply).

Warning

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

Caution

The caution sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

Note

The note sign denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.

Preface

This manual contains the service information for *HP 4062C/UX/PC* systems. When you calibrate or repair a HP 4062C/UX/PC system, you can use this manual. For information about the installation of a HP 4062C/UX/PC system, refer to the *Installation Manual*

Note

HP 4062PC is an HP 4062C system that works with HP BASIC/DOS, which runs on an MS-DOS personal computer (PC) and an HP 82324 High-Performance Measurement Coprocessor. The HP 4062PC system software can be ordered by specifying HP 4062C Option PC5 or PC7.

Audience

This manual is intended for the HP Customer Engineers or service personnel who perform service on the HP 4062C/UX/PC system.

Contents

Chapter 1, "General Information," covers performance evaluation strategy, options, accessories, and specifications of the HP 4062C/UX/PC system.

Chapter 2, "Performance Verification," covers the performance verification using PV4062 program included in the HP 4062C/UX/PC system software.

Chapter 3, "Troubleshooting," provides information on troubleshooting the HP 4062C/UX/PC system.

Chapter 4, "Replaceable Parts," provides information of the replaceable parts for HP 4085B and HP 4089A/B Switching Matrix, HP 4084B Switching Matrix Controller, and so on.

Appendix A, "System Cabinet Information," covers specifications, operations, and replaceable parts on the system cabinet and its accessories.

Appendix B, "SWC and SWM Operating Theory," provides operating theory of the switching matrix (SWM) and switching matrix controller (SWC).

Appendix C, "Port Expander Information," covers specification, performance verification, troubleshooting, and replaceable parts information on the port expander that can be installed on the HP 4089B 96-pin SWM.

Appendix D, "Check Sheet for Input Relay and Port Expander Relay Troubleshooting," provides useful check sheet when you troubleshoot the input relays and port expander relays in the SWM.

Appendix E, "Configuring the System Printer," covers how to configure the system printer used in the performance verification (PV) software.

Appendix F, "Instrument Compatibility," provides information on the HP 4062 series: system history, instrument information in the system, and so on.

Other Manuals

You can refer to the following manuals when you service the HP 4062C/UX/PC system:

HP 4062C/UX System Information (HP part number 04062-90311)

HP 4062C/UX System Operation (HP part number 04062-90321)

HP 4062C/UX Programming Reference (HP part number 04062-90331)

HP 4062C/UX Quick Reference (HP part number 04062-90341)

HP 4062UX/F Installation Manual (HP part number 04062-90240), revision 7.0 or later

HP 4062C/UX Installation Manual (HP part number 04062-90211), revision 6.3 or earlier (including HP 4062PC installation information)

HP 4062B/C/UX Quick Maintenance Guide (HP part number 04062-90120)

For servicing the HP 4062F system, you need the following manuals:

Manual Supplement for Service: HP 4062F (HP part number 04062-90530)

Manual Supplement for System Operation: HP 4062F (HP part number 04062-90380)

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General Information

This manual provides the instructions, procedures, and information required to verify and repair the HP 4062C/PC Semiconductor Parametric Test System or the HP 4062UX Semiconductor Process Control System hardware.

This chapter covers performance evaluation and repair strategies, and system specifications. Chapter 2 explains how to test and verify your HP 4062C/UX/PC using the performance verification software. Chapter 3 provides troubleshooting information. Chapter 4 covers system parts information.

Note

HP 4062PC is an HP 4062C system that works with HP BASIC/DOS, which runs on an MS-DOS® personal computer (PC) and an HP 82324 High-Performance Measurement Coprocessor. The HP 4062PC system software can be ordered by specifying HP 4062C Option PC5 or PC7.

System Configuration

The HP 4062C/UX is designed for use with an HP 9000 Series 300 or 700 computer and an automatic wafer prober. The HP 4062PC is designed for use with an HP 82324 measurement coprocessor installed in an IBM PC-AT compatible personal computer. System configurations differ depending on which switching matrix (SWM, 48- or 96-pins) your HP 4062C/UX is equipped with. Figure 1-1 and Table 1-1 shows a typical HP 4062C/UX system configuration.

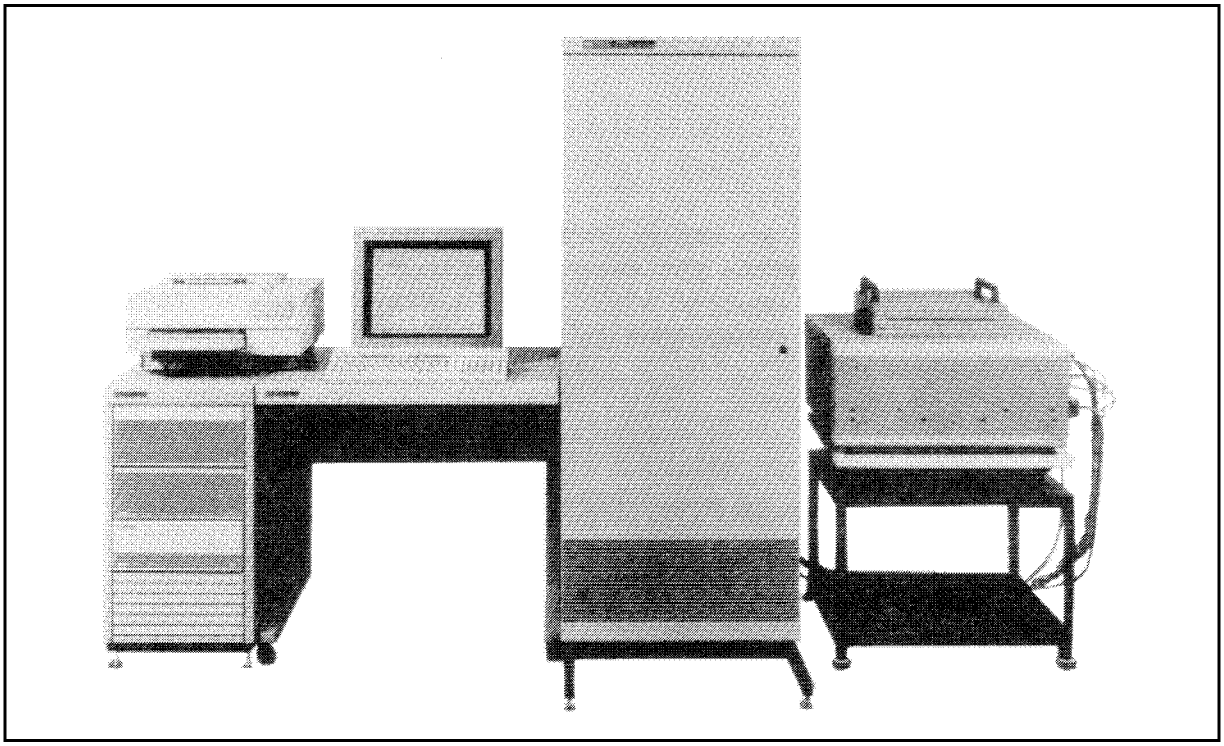


Figure 1-1. A Typical HP 4062C/UX/PC System

Table 1-1. A Typical HP 4062C/UX/PC System

Description	48-pin SWM	96-pin SWM
HP 4084B Switching Matrix Controller (SWC)	1 ea.	2 ea.
HP 4085B (48-pin) Switching Matrix (SWM)	1 ea.	—
HP 4089A/B (96-pin) Switching Matrix (SWM)	—	1 ea.
HP 4142B Modular DC Source/Monitor (DCS)	1 ea.	1 ea.
HP 41420A Source/Monitor Unit (SMU 200 V/1 A)	1 ea.	1 ea.
HP 41421B Source/Monitor Unit (SMU 100 V/100 mA)	3 ea.	3 ea.
HP 41424A V Source/V Monitor Unit (VS/VMU)	1 ea.	1 ea.
HP 41425A Analog Feedback Unit (AFU)	1 ea.	1 ea.
HP 4284A 20 Hz–1 MHz Precision LCR Meter (CMU84)	1 ea.	1 ea.
System Cabinet	1 ea.	1 ea.
HP 16321A VFP Timer Board (HP 4062C only)	1 ea.	1 ea.
System Software Test Instruction Set (TIS), Virtual Front Panel (VFP), Probing Pattern Generator (PPG), System Diagnostics (DIAG), and Performance Verification (PV4062) (Rev. 5.5 or later)	1 ea.	1 ea.
System Controller for HP 4062C: HP 9000 Series 300 Model 310, 320, 330, 332, 350, 360, 362, 370, 375, 380, or 382 System Controller for HP 4062UX: HP 9000 Series 300 Model 320, 330, 350, 360, 362, 370, 375, 380, or 382 HP 9000 Series 300 Model 318M, 319C+, 340, or 345 for diskless cluster configurations HP 9000 Series 700 Model 725, 745i, or 747i System Controller for HP 4062PC: HP 82324 High-Performance Measurement Coprocessor and an IBM PC/AT compatible personal computer Disk Drive Printer		
Automatic Wafer Prober		

Figure 1-2 shows an HP 4085B 48-pin Switching Matrix (SWM) system configuration. The HP 4142B provides the DC Measurement Subsystem (DCS), and the HP 4280A CMU or HP 4284A CMU84 provides the Capacitance Measurement Subsystem (CMS).

System measurements are made at the pins of the SWM, and SWM connections are controlled by the HP 4084B Switching Matrix Controller (SWC). System instruments, except for the SWM, are controlled by an HP 9000 Series 300 or 700 computer (system controller) via HP-IB.

If your system includes a wafer prober, the system controller also controls the wafer prober, thereby letting you make wafer measurements automatically.

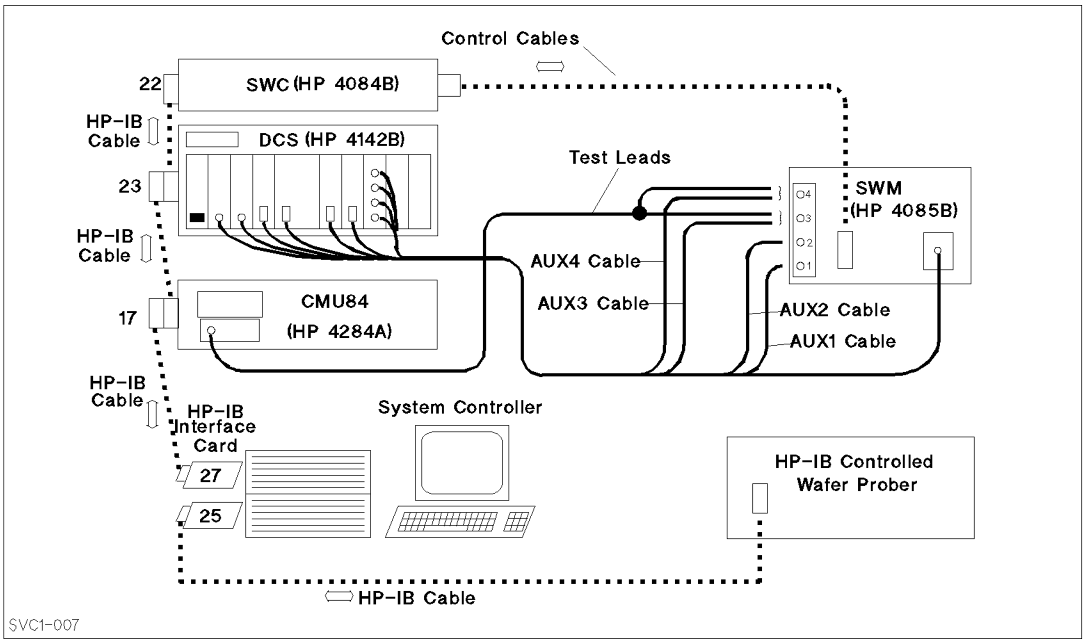


Figure 1-2. System Configuration: 48-pin SWM System

Figure 1-3 shows an HP 4089A/B 96-pin SWM system configuration. SWM connections for 96-pin SWM systems are controlled by two SWCs (SWC 1 and 2).

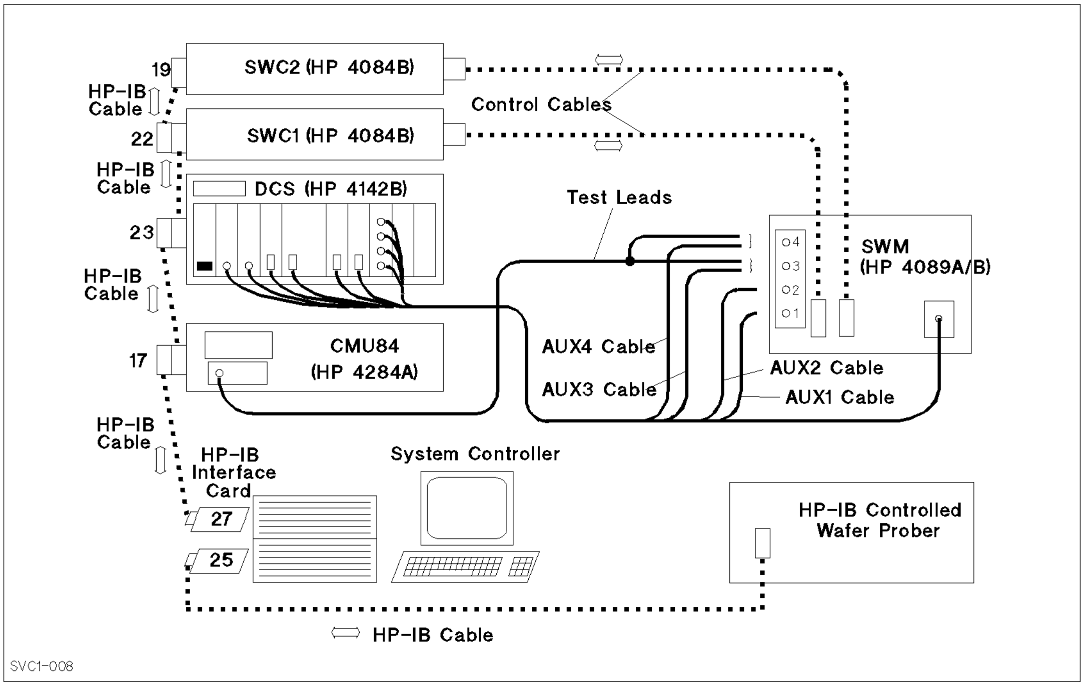


Figure 1-3. System Configuration: 96-pin SWM System

Abbreviations

This paragraph provides the abbreviations for HP 4062C/UX/PC system used through this manual as shown in the following lists. For more information on the abbreviations, see the *System Information* manual.

Abbreviation	Term
PCS	Process Control System
DCS	DC Measurement Subsystem: HP 4142B Modular DC Source/Monitor
CMS	Capacitance Measurement Subsystem
CMU	Capacitance Measurement Unit: HP 4280A 1 MHz C Meter/C-V Plotter
CMU84	Capacitance Measurement Unit: HP 4284A 20 Hz–1 MHz Precision LCR Meter
LCR	Capacitance Measurement Unit: HP 4274A Multi-Frequency LCR Meter
SMS	Switching Matrix Subsystem
SWM	Switching Matrix: HP 4085B 48-pin SWM or HP 4089A/B 96-pin SWM
SWC	Switching Matrix Controller: HP 4084B Switching Matrix Controller
SMU	Source Monitor Unit: HP 41420A 200 V/1 A SMU or HP 41421B 100 V/100 mA SMU
VS	Voltage Source
VM	Voltage Monitor
VS/VMU	Voltage Source/Voltage Monitor Unit: HP 41424A VS/VMU
AFU	Analog Feedback Unit: HP 41425A AFU
TIS	Test Instruction Set
VFP	Virtual Front Panel
PPG	Probing Pattern Generator
DIAG	Diagnostics for HP 4062C/UX/PC System
PV4062	Performance Verification for HP 4062C/UX/PC system
DVM	Digital Voltmeter
DMM	Digital Multimeter (including DVM)
HP IMA	HP Interactive Measurement and Analysis (IMA)

Performance Evaluation Strategy

Diagnostics

Your HP 4062C/UX/PC provides the following four levels of diagnostics:

START:

The START program runs the self-test of each subsystem and confirms the presence and operational status of each subsystem. START executes automatically when you load and run the system software or the Diagnostics (DIAG) program. You can also execute START from the main menu of the performance verification (PV4062) program.

DIAG and DIAG4274:

The DIAG program checks the basic measurement capabilities of each HP 4062C/UX/PC subsystem, and requires the furnished system test module.

If your HP 4062 system is equipped with an HP 4274A Multi-Frequency LCR Meter, the DIAG4274 program checks the basic performance of the HP 4274A as a system instrument. DIAG4274 also requires the furnished system test module.

DIAG, and DIAG4274 if applicable, should be run as part of your daily start-up routine for your system to ensure the reliability of subsequent measurements.

For more information about DIAG, refer to "Diagnostics" of the *HP 4062C/UX System Information*.

PV4062 and PV4274:

The PV4062 program checks system performance. PV4062 is similar to DIAG, but provides stricter test limits. PV4062 should be performed to verify system performance, and after system calibration or troubleshooting. PV4062 consists of two tests, as follows:

PV4062 without (W/O) DVM:

This test does not require a digital voltmeter (DVM) or digital multimeter (DMM), and is performed after installation, regular maintenance, and repairs.

PV4062 with (W/) DVM:

This test requires a DVM or DMM, and is performed when accurate data is required for troubleshooting purposes.

If your HP 4062C/UX/PC is equipped with an HP 4274A Multi-Frequency LCR Meter, the PV4274 program checks the performance of the HP 4274A as a system instrument.

PV4142 and HP 4280A or HP 4284A Performance Verifications:

The PV4142 program checks the performance of the HP 4142B as a standalone instrument, and is also used for isolating problems. You can also run PV4142 from PV4062. Refer to "4142B Test" in Chapter 2 for details.

The HP 4280A or HP 4284A performance verification checks the performance of each instrument after repairs, and is also used for isolating troubles.

Table 1-2 lists the differences between the DIAG and the PV4062 programs. Table 1-3 lists each test and gives the levels that the specifications are checked for in each test.

Table 1-2. Differences between DIAG and PV4062

	DIAG	PV4062
When to use	Daily—@ system start-up	Verification, Calibration, and Troubleshooting
How to obtain	Furnished with system	Furnished with system[1]
Program location for HP 4062C	`/PCS/DIAG` directory or SYSTEM SOFTWARE disk (5)	`/PCS/DIAG` directory or PERFORMANCE VERIFICATION disks
Program location for HP 4062UX	`/usr/pcs/diag` directory	`/usr/pcs/diag` directory
Program location for HP 4062PC	`\PCS\DIAG` directory or SYSTEM SOFTWARE disk (1)	`/PCS/DIAG` directory or PERFORMANCE VERIFICATION disks
Test limits	General	Specific

1 For HP 4062C Rev. 5.6 or earlier, PV disk set is included in the Product Support Package. The PV disk set can also be ordered separately.

Table 1-3. DIAG and PV4062 Tests and Level of Testing

Test Name	DIAG	PV4062				
		W/O DVM	W/ DVM	4142B	TIMER	4274A
Relay Test	A	A				
SMU Test	C	B	A			
VS Test	C	B	A			
VM Test	C	B	A			
CMS C-G Test	C	A				
CMS Bias Test	C	A				
CMU84 C-G Test	C	A				
CMU84 Bias Test	C	A				
Leakage Test	C	A				
GNDU Test	*	*	A			
Kelvin Test	*	*	A			
HP 4142B Test	*	*		A		
Timer Test[1]					A	
LCR C-G Test[2]						A
LCR Bias Test[2]						A

1 For HP 4062C only.

2 For HP 4062C and HP 4062UX only.

A: Checks specifications completely.
B: Checks general specifications.
C: Verifies proper system operation.
*: Checked during other tests.

Calibration

The recommended system calibration cycle is once a year. The estimated mean time for calibration is one hour. To perform the calibration, execute 4062 W/O and W/ DVM Test of the PV4062, which is performance verification software for HP 4062C/UX/PC. See Chapter 2 about the PV4062.

The PV4062 meets or exceeds MIL-STD 45622 specifications. When you perform calibration for the MIL-STD, execute the 4062 W/O and W/ DVM Test of the PV4062 storing the calibration results in a file, and display or print the test results using the VIEW RESULTS function of the PV4062. Note that the PV4274 does not meet the MIL-STD 45622 specifications.

Note Use calibration modules that are calibrated at least once a year when performing the calibration.

Adjustments

The DCS and CMU or CMU84 are the only HP 4062C/UX/PC subsystems that require adjustments; and the DCS requires adjustment only if it fails PV4142. Refer to the HP 4142B *Service Manual*, HP 4280A *Operation and Service Manual*, and HP 4284A *Service Manual* for the adjustment procedures.

Preventive Maintenance

Preventive maintenance (PM) consists of performance verification and normal PM routines. No special preventive maintenance is required. Recommended PM cycle is once a year.

To maintain the system's low current measurement capability, the pin boards, measurement pins, test fixtures, and exposed signal lines must be kept extremely clean. If the system is operating in a room where air purity is high and where personnel take the necessary precautions against contamination, only periodic cleaning is required. In any other environment, however, cleaning must be done as often as possible. The procedure for cleaning is given in Chapter 3 of the *HP 4062C/UX System Information* manual.

If the system cabinet has an emergency off unit, you must check its functions at least once a year. Therefore, perform this check when performance verification of the HP 4062C/UX/PC is executed. The procedure for checking an emergency off unit is given in Appendix A.

Product Support Package (PSP)

Hewlett-Packard provides the HP 16290A Product Support Package (PSP), which is designed to help facilitate on-site isolation and repair of HP 4062 system failures except the system controller and peripherals. This package includes the HP 16346B System Calibration Module and Performance Verification Disk for diagnosis of the system problems. The package also includes tools to help troubleshoot and repair the system instruments: HP 4085B 48-pin Switching Matrix and HP 4141B DC Source/Monitor. Table 1-4 lists the contents of the HP 16290A PSP.

Table 1-4. Contents of HP 16290A PSP

Item	Description
HP 16346B System Calibration Module	A calibrated system module for performance verification. This is designed for an HP 4085B 48-pin SWM.
Performance Verification Disk	A disk set that includes the performance verification software for an HP 4062C system.
Solder	Special solder used to repair circuit boards and other assemblies.
Pin Board Extender	Used to extend pin boards to access pin board relays.
Pin Board Extension Cable	
Pin Board Extractor	Required to extract pin boards from the SWM when component level access is necessary.
Extender Board (large)	Used to extend boards A2 through A8 and A13 through A16 of the HP 4141B when board level access is necessary.
Extender Board (small)	
Sample Devices	Depletion type p-channel J-FETs to help facilitate verification of HP 4062C/UX/PC performance after repair.
Gloves	Used to keep assemblies, boards, and relays free of hand oils, grease, and other contaminants during the replacement of an assembly, board, or component.

Options

Table 1-5 and Table 1-6 lists the options available for the HP 4062C and the HP 4062UX, respectively.

Table 1-5. HP 4062C Options

Option	Description
001	12-pin Configuration of HP 4085B 48-pin SWM
002	24-pin Configuration of HP 4085B 48-pin SWM
003	36-pin Configuration of HP 4085B 48-pin SWM
004	Add Spare Pin Board for HP 4085B 48-pin SWM
012	24-pin Configuration of HP 4089A/B 96-pin SWM
013	36-pin Configuration of HP 4089A/B 96-pin SWM
014	48-pin Configuration of HP 4089A/B 96-pin SWM
015	64-pin Configuration of HP 4089A/B 96-pin SWM
016	72-pin Configuration of HP 4089A/B 96-pin SWM
017	84-pin Configuration of HP 4089A/B 96-pin SWM
018	96-pin Configuration of HP 4089A/B 96-pin SWM
019	Add Spare Pin Board for HP 4089A/B 96-pin SWM
020	Replace an HP 41420A SMU with an HP 41421B SMU
021	Add Spare HP 41421B SMU
022	Add Spare HP 41420A SMU
023	Add Spare HP 41424A VS/VMU
024	Delete one HP 41421B SMU
025	Delete one HP 41420A SMU
026	Delete one HP 41424A VS/VMU
027	Delete one HP 41425A
050	50 Hz Line Frequency
060	60 Hz Line Frequency
100	100 Vac Line Voltage
102	Delete HP 4280A 1 MHz C Meter/C–V Plotter
110	Delete Package Device Test Fixtures for HP 4085B 48-pin SWM
115	Delete Package Device Test Fixtures for HP 4089A/B 96-pin SWM
120	120 Vac Line Voltage
130	Delete System Cabinet
1BE	Replace System Cabinet with a Small Cabinet (1 m height)
220	220 Vac Line Voltage
240	240 Vac Line Voltage
310[1]	Add HP 4274A Multi-Frequency LCR Meter
311[1]	Add ±35 V dc Bias for HP 4274A
312[1]	Add ±100 V dc Bias for HP 4274A

1 Options 310, 311, and 312 were discontinued at October 1993.

Table 1-5. HP 4062C Options (continued)

Option	Description
320	Add HP 4284A 20 Hz–1 MHz Precision LCR Meter (including HP 4284A options 001 and 006)
340	Add a Port Expander for HP 4089B 96-pin SWM
341	Add an SMU Cable (4 m, Triaxial)
405	System Software Right-to-Copy
450[1]	Add HP 16276B Interactive Measurement and Analysis (IMA) Software License-to-use, Media, and Manuals
451[1]	Add HP 16276B IMA Software License-to-use
503	Replace the furnished personality board of 48-pin SWM for Electroglas wafer probers
540	Delete HP 16071A Universal Fixture for 48-pin SWM
541	Delete HP 16072A Personality Board for 48-pin SWM
550	Delete HP 16376A Universal Fixture for 96-pin SWM
552	Delete HP 16377A Personality Board for 96-pin SWM
570	Add HP 16071A Universal Fixture for 48-pin SWM
571	Add HP 16072A Option 001[2] Personality Board for 48-pin SWM
572	Add HP 16072B Personality Board for 48-pin SWM
573	Add HP 16072B Option 001[2] Personality Board for 48-pin SWM
580	Add HP 16376B Universal Fixture for 96-pin SWM
582	Add HP 16377B Personality Board for 96-pin SWM
701	HP 9000 Series 300 System Processing Unit (SPU) Rack Mount Kit
702	HP 9000 Series 300 SPU and Backplane Expander Rack Mount Kit
703	SPU Rack Mount Kit for HP 9000 Series 300 model 362 and 382
704	SPU & Backplane Expander Rack Mount Kit for Series 300 model 362 and 382
710[3]	Hard Disk Rack Mount Kit (for HP 9153A/B, or HP 9154A/B)
720	Hard Disk Rack Mount Kit (for HP 9133H, 7957A/B, 7958A/B, 7959B, HP 7962B, or HP 7963B)
730[3]	Hard Disk Rack Mount Kit (for HP 7946A)
740	Cartridge Tape Drive Rack Mount Kit (for HP 9144A or HP 9145A)
910	Extra System Documentation Set
P53[1]	Add HP IMA/PC Software License-to-use
P55[1]	Add HP 16278B IMA/PC Software License-to-use, Media (5.25 inch), and Manuals
P57[1]	Add HP 16278B IMA/PC Software License-to-use, Media (3.5 inch), and Manuals
PC5	HP 4062PC Software License-to-use, Media (5.25 inch), and Manuals
PC7	HP 4062PC Software License-to-use, Media (3.5 inch), and Manuals
PCL	HP 4062PC Software License-to-use

1 Options 450, 451, P53, P55, and P57 were discontinued October 1994.

2 For Electroglas 1034X/2001X Wafer Probers.

3 Options 710 and 730 were discontinued at October 1994.

Table 1-6. HP 4062UX Options

Option	Description
022	HP 4062UX software (1/4 inch tape media), and HP-UX and HP BASIC/UX software (1/4 inch tape media) and manuals (s300)
023	HP 4062UX software (DDS[1] formatted DAT[2]), HP-UX software (DDS formatted DAT) and manuals, and HP BASIC/UX software (DDS formatted DAT) and manuals (s300)
024	HP 4062UX software (DDS formatted DAT) (s300)
026	HP 4062UX software (DDS formatted DAT), HP-UX software (DDS formatted DAT) and manuals, and HP BASIC/UX software (DDS formatted DAT) and manuals (s700)
027	HP 4062UX software (DDS formatted DAT) (s700)
032	Software (1/4 inch tape media) and manuals for system software used with C Language, and C/ANSI C Developer's Bundle (s300)
033	Software (DDS formatted DAT) and manuals for system software used with C Language, and C/ANSI C Developer's Bundle (s300)
034	Software (1/4 inch tape media) and manuals for system software used with C Language, and C/ANSI C Developer's Bundle (s700)
035	Software (DDS formatted DAT) and manuals for system software used with C Language (s700)
050	50 Hz Line Frequency
060	60 Hz Line Frequency
100	100 Vac Line Voltage
120	120 Vac Line Voltage
1BE	Replace System Cabinet with a Small Cabinet (1 m height)
220	220 Vac Line Voltage
240	240 Vac Line Voltage
310	12-pin Configuration of HP 4085B 48-pin SWM
311	Add one HP 16320B Pin Board for HP 4085B 48-pin SWM
312	Add Packaged Device Test Fixtures for HP 4085B 48-pin SWM
313	Add HP 16077A Extension Cable Fixture for HP 4085B 48-pin SWM
314	Add HP 16071A Universal Fixture for HP 4085B 48-pin SWM
315	Add HP 16071B Universal Fixture for HP 4085B 48-pin SWM
316	Add HP 16072A Personality Board for HP 4085B 48-pin SWM
317	Add HP 16072A Option 001[3] Personality Board for HP 4085B 48-pin SWM
318	Add HP 16072B Personality Board for HP 4085B 48-pin SWM
319	Add HP 16072B Option 001[3] Personality Board for HP 4085B 48-pin SWM
330	24-pin Configuration of HP 4089A/B 96-pin SWM
331	Add One HP 16320C Pin Board for HP 4089A/B 96-pin SWM
332	Add Packaged Device Fixtures for HP 4089A/B 96-pin SWM
333	Add HP 16378B Extension Cable Fixture for HP 4089A/B 96-pin SWM

1 DDS stands for Digital Data Storage.

2 DAT stands for Digital Audio Tape.

3 For Electroglas 1034X/2001X Wafer Probers.

Table 1-6. HP 4062UX Options (continued)

Option	Description
334	Add HP 16376A Universal Fixture for HP 4089A/B 96-pin SWM
335	Add HP 16376B Universal Fixture for HP 4089A/B 96-pin SWM
336	Add HP 16377A Personality Board for HP 4089A/B 96-pin SWM
337	Add HP 16377B Personality Board for HP 4089A/B 96-pin SWM
340	Add a Port Expander for HP 4089B 96-pin SWM
341	Add an SMU Cable (4 m, Triaxial)
400	Add HP 4142B Modular DC Source/Monitor (DCS)
405	Field Installation Kit for HP 4142B
410	Add HP 41420A SMU (200 V/1 A)
411	Add HP 41421B SMU (100 V/100 mA)
414	Add HP 41424A VS/VMU
415	Add HP 41425A AFU
450[1]	Add HP 16277B Interactive Measurement and Analysis (IMA) Software License-to-use, Media, and Manuals
451[1]	Add HP 16277B IMA Software License-to-use
452[1]	Add HP 16277B IMA Software License-to-use, Media (DDS formatted DAT), and Manuals
510	Add HP 4280A 1 MHz C Meter/C-V Plotter (CMU)
515	Field Installation Kit for HP 4280A
520[2]	Add HP 4274A Multi-Frequency LCR Meter (LCR)
521[2]	Add ±35 V dc Bias for HP 4274A
522[2]	Add ±100 V dc Bias for HP 4274A
525[2]	Field Installation Kit for HP 4274A
530	Add HP 4284A 20 Hz–1 MHz Precision LCR Meter (CMU84) (including HP 4284A options 001 and 006)
535	Field Installation Kit for HP 4284A
701	HP 9000 Series 300 System Processing Unit (SPU) Rack Mount Kit
702	HP 9000 Series 300 SPU and Backplane Expander Rack Mount Kit
703	SPU Rack Mount Kit for HP 9000 Series 300 model 362 and 382
704	SPU & Backplane Expander Rack Mount Kit for Series 300 model 362 and 382
705	SPU Rack Mount Kit for HP 9000 Series 700 model 745i
706	SPU Rack Mount Kit for HP 9000 Series 700 model 747i
710[3]	Hard Disk Rack Mount Kit (for HP 9153A/B or HP 9154A/B)
720	Hard Disk Rack Mount Kit (for HP 9133H, 7957A/B, 7958A/B, 7959B, HP 7962B, or HP 7963B)
730[3]	Hard Disk Rack Mount Kit (for HP 7946A)
740	Cartridge Tape Drive Rack Mount Kit (for HP 9144A or HP 9145A)
910	Extra System Documentation Set

1 Options 450 and 451 were discontinue at October 1994.

2 Options 520, 521, 522, and 525 were discontinued at October 1993.

3 Options 710 and 730 were discontinued at October 1994.

Furnished Accessories

Table 1-7 and Table 1-8 list the accessories furnished with the standard HP 4062C/UX/PC.

Table 1-7. HP 4062C/PC Furnished Accessories

For HP 4085B 48-pin SWM	For HP 4089A/B 96-pin SWM
HP 16066A Test Fixture Adapter	HP 16321A VFP Timer Board
HP 16067A Low Leakage Fixture (24-pin DIP)	HP 16355A Relay Test Adapter
HP 16068A Low Leakage Fixture (48-pin DIP)	HP 16356A System Test Module
HP 16069A Universal Low Leakage Fixture	HP 16370A Test Fixture Adapter
HP 16070A General Purpose DIP Fixture	HP 16371A Low Leakage Fixture (24-pin DIP)
HP 16071A/B Universal Fixture	HP 16372A Low Leakage Fixture (48-pin DIP)
HP 16072A/B Personality Board	HP 16373A Low Leakage Fixture (64-pin DIP)
HP 16075A Relay Test Adapter	HP 16374A Universal Low Leakage Fixture
HP 16076A System Test Module	HP 16375A General Purpose DIP Fixture
HP 16077A Extension Cable Fixture	HP 16376A/B Universal Fixture
HP 16321A VFP Timer Board	HP 16377A/B Personality Board
Screwdriver (HP part number 8710-0900)	HP 16378B Extension Cable Fixture
Pin Board Extractor (HP part number 04085-69001)	Hexhead Wrench 5 mm (HP part number 8710-1838)
	Hexhead Wrench 6 mm (HP part number 8710-1839)
	Pin Board Extractor (HP part number 04085-69001)

Table 1-8. HP 4062UX Furnished Accessories

For HP 4085B 48-pin SWM	For HP 4089A/B 96-pin SWM
HP 16066A Test Fixture Adapter	HP 16355A Relay Test Adapter
HP 16075A Relay Test Adapter	HP 16356A System Test Module
HP 16076A System Test Module	HP 16370A Test Fixture Adapter
Screwdriver (HP part number 8710-0900)	Hexhead Wrench 5 mm (HP part number 8710-1838)
Pin Board Extractor (HP part number 04085-69001)	Hexhead Wrench 6 mm (HP part number 8710-1839)
	Pin Board Extractor (HP part number 04085-69001)

In addition to the furnished accessories listed in Table 1-7 and Table 1-8, the HP 4062C/UX/PC also includes HP 4280A or HP 4284A accessories and your system manuals.

Available Accessories

Additional HP 16320B Pin Boards (for HP 4085B 48-pin SWMs) and HP 16320D Pin Boards (for HP 4089A/B 96-pin SWMs) can be purchased as replacements or for configuration changes.

Table 1-9. HP 4062C/UX/PC Available Accessories

For HP 4085B 48-pin SWM	For HP 4089A/B 96-pin SWM
HP 16066A Test Fixture Adapter	HP 16320D Pin Board
HP 16067A Low Leakage Fixture (24-pin DIP)	HP 16321A VFP Timer Board[1]
HP 16068A Low Leakage Fixture (48-pin DIP)	HP 16355A Relay Test Adapter
HP 16069A Universal Low Leakage Fixture	HP 16356A System Test Module
HP 16070A General Purpose DIP Fixture	HP 16370A Test Fixture Adapter
HP 16071A/B Universal Fixture	HP 16371A Low Leakage Fixture (24-pin DIP)
HP 16072A/B Personality Board	HP 16372A Low Leakage Fixture (48-pin DIP)
HP 16075A Relay Test Adapter	HP 16373A Low Leakage Fixture (64-pin DIP)
HP 16076A System Test Module	HP 16374A Universal Low Leakage Fixture
HP 16077A Extension Cable Fixture	HP 16375A General Purpose DIP Fixture
HP 16320B Pin Board	HP 16376A/B Universal Fixture
HP 16321A VFP Timer Board[1]	HP 16377A/B Personality Board
	HP 16378B Extension Cable Fixture

1 HP 4062C only.

Specifications

This paragraph contains HP 4062C/UX/PC specifications. These specifications are the performance standards or limits against which HP 4062C/UX/PCs are tested. When shipped from the factory, each system meets or exceeds the specifications listed in this paragraph.

For complete DCS specifications, refer to the HP 4142B *Operation Manual*; for complete CMU specifications, refer to the HP 4280A *Operation and Service Manual*; for complete CMU84 specifications, refer to the HP 4284A *Operation Manual*.

General Description

The HP 4062C/UX/PC measures the dc current, dc voltage, and capacitance of test samples which have up to 96 pins.

- Measurement Functions:

  DC Current, DC Voltage, and Capacitance

  - DC Measurement Mode

    Spot Measurement, Sweep Measurement, Pulse Measurement, Pulse Sweep Measurement, and Analog Search

- Measurement Pins:

  96 (Maximum)

- SWM Instrument Ports: 9 (optionally 17)
  - High Resolution SMU: 1 port

    Current Measurement Range: ±20 fA to ±1 A

    Voltage Measurement Range: ±40 μV to ±200 V
  - High Current SMU, Kelvin: 1 port

    Current Measurement Range: ±2 pA to ±1 A

    Voltage Measurement Range: ±40 μV to ±200 V
  - SMUs, Kelvin: 2 ports

    Current Measurement Range: ±2 pA to ±1 A

    Voltage Measurement Range: ±40 μV to ±200 V
  - SMUs, Non-Kelvin: 2 ports (optional)

    Current Measurement Range: ±2 pA to ±1 A

    Voltage Measurement Range: ±40 μV to ±100 V
  - GNDU, Kelvin: 1 port

    Voltage Output Range: 0 V
  - VS/VMU: 4 ports (optionally 10)

    Voltage Output Range: ±1 mV to ±40 V

Voltage Measurement Range: ±40 μV to ±40 V (4 μV resolution with differential V measurements)

- Capacitance Measurements:
  - CMU

    Test Frequency: 1 MHz

    Capacitance Measurement Range: 0.001 pF to 1.2 nF

    Conductance Measurement Range: 0.01 μS to 12.00 mS

    DC Bias Voltage: ±100 V
  - CMU84

    Test Frequency: 1 k, 10 k, 100 k, and 1 MHz

    Capacitance Measurement Range: 1 fF to 100 nF

    Conductance Measurement Range: 0.1 nS to 7.5 mS

    DC Bias Voltage: ±40 V
  - LCR

    Test Frequency: 100, 120, 200, 400, 1 k, 2 k, 4 k, 10 k, 20 k, 40 k, 100 kHz

    Capacitance Measurement Range: 0.001 pF to 1.9 nF

Switching Matrix Subsystem (SMS)

The SMS of the HP 4062C/UX/PC consists of one of the following configurations:

One HP 4085B 48-pin SWM and one HP 4084B SWC

or

One HP 4089A/B 96-pin SWM and two HP 4084B SWCs.

- HP 4085B SWM Measurement Pins:

  The HP 4085B SWM can be equipped with 12 to 48 measurement pins.

- HP 4089A/B SWM Measurement Pins:

  The HP 4089A/B SWM can be equipped with 24 to 96 measurement pins.

- SWM Instrument Ports:

  The SWM provides 9 instrument ports:

  High Resolution SMU: 1 port

  High Current SMU: 1 port

  Standard SMUs: 2 ports

  GNDU: 1 port

  Auxiliary (AUX): 4 ports (optionally 12 ports)

  Auxiliary ports (AUX1–4) can be used with the VSs and VMs of the DCS (up to 4 ports); and the CMS (up to 2 ports—AUX3 and 4) for C, C-V, and C-t measurements.

  If the SWM is equipped with a port expander, up to 12 ports can be used. AUX11–13, AUX21–23, AUX31–32, and AUX41–42 can be used with the DCS's VSs and VMs (up to 10 ports), AUX31 and AUX41 can be used with the CMS for C, C-V, and C-t measurements, and AUX33 and AUX43 can be used with the SMU for general dc measurements.

- Maximum Voltage at each Port:

  ±200 V: SMU ports

  ±100 V: AUX ports

- Maximum Current through Ports to Pins:

  ±1.6 A: GNDU port

  ±1.0 A: SMU ports

  ±500 mA: AUX1–2 or AUX11–13 and AUX21–23 ports

  ±1.0 A: AUX3–4 or AUX31–33 and AUX41–43 ports

- Maximum Stray Capacitance: ≤6 pF (between C measurement ports)

DC Measurement Subsystem (DCS)

The HP 4062C/UX/PC's DCS consists of the HP 4142B Modular DC Source/Monitor and your combination of the following plug-in modules:

HP 41421B 100 V/100 mA SMU, 1 slot

HP 41420A 200 V/1 A SMU, 2 slots

HP 41424A VS/VMU, 1 slot

HP 41425A AFU, 1 slot

The DCS provides 8 plug-in module slots.

High Resolution SMU: 1 port

This port is for low current measurement.

HP 41420A or HP 41421B SMU is used.

Voltage Source/Monitor Range, Resolution, and Accuracy (@ 48-pin SWM pins)

V Range Full Scale	Resolution Force/Measure	Accuracy (Io = Output I) ±(% of reading + % of range + V)
±2 V	100 μV/40 μV	±(0.05%+0.05%+0.5 Ω×Io+100 μV)
±20 V	1 mV/400 μV	±(0.05%+0.05%+0.5 Ω×Io)
±40 V	2 mV/800 μV	
±100 V	5 mV/2 mV	
±200 V[1]	10 mV/4 mV	

1 HP 41420A SMU only.

Voltage Source/Monitor Range, Resolution, and Accuracy (@ 96-pin SWM pins)

V Range Full Scale	Resolution Force/Measure	Accuracy (Io = Output I) ±(% of reading + % of range + V)
±2 V	100 μV/40 μV	±(0.05%+0.05%+0.6 Ω×Io+100 μV)
±20 V	1 mV/400 μV	±(0.05%+0.05%+0.6 Ω×Io)
±40 V	2 mV/800 μV	
±100 V	5 mV/2 mV	
±200 V[1]	10 mV/4 mV	

1 HP 41420A SMU only.

Current Source/Monitor Range, Resolution, and Accuracy

I Range Full Scale	Resolution Force/Measure	Accuracy (Vo = Output V) ±(% of reading + of range +A)
1 A[1]	50 μA/20 μA	±[0.5%+(0.1+0.002×Vo)%]
±100 mA ±10 mA ±1 mA ±100 μA ±10 μA	5 μA/2 μA 500 nA/200 nA 50 nA/20 nA 5 nA/2 nA 500 pA/200 pA	±[0.2%+(0.1+0.002×Vo)%]
±1 μA ±100 nA	50 pA/20 pA 5 pA/2 pA	±[0.5%+(0.1+0.002×Vo)%]
±10 nA	500 fA/200 fA[2]	±[1%+(0.002×Vo)%+15 pA]
±1 nA	50 fA/20 fA[2]	±[1%+(0.002×Vo)%+8 pA]

1 HP 41420A SMU only.

2 I monitor resolution of 200 fA/20 fA @ 10 nA/1 nA ranges are obtained when the DCS's integration time is set to LONG.

Residual Resistance: ≤0.5 Ω (48-pin SWM); ≤0.6 Ω (96-pin SWM)

Input Resistance: ≥10^{12} Ω (in I source mode)

Output Terminals: Force and Guard

High Current SMU: 1 port

This port is for low voltage measurement with high current output.

HP 41420A or HP 41421B SMU is used.

Voltage Source/Monitor Range, Resolution, and Accuracy

V Range Full Scale	Resolution Force/Measure	Accuracy (Io = Output I) ±(% of reading + % of range + V)
±2 V	100 μV/40 μV	±(0.05%+0.05%+2.5 mΩ×Io+100 μV)
±20 V	1 mV/400 μV	±(0.05%+0.05%+2.5 mΩ×Io)
±40 V ±100 V ±200 V[1]	2 mV/800 μV 5 mV/2 mV 10 mV/4 mV	±(0.05%+0.05%)

1 HP 41420A SMU only.

Current Source/Monitor Range, Resolution, and Accuracy

I Range Full Scale	Resolution Force/Measure	Accuracy (Vo = Output V) ±(% of reading + % of range)
±1 A[1]	50 μA/20 μA	±[0.5%+(0.1+0.002×Vo)%]
±100 mA	5 μA/2 μA	±[0.2%+(0.1+0.002×Vo)%]
±10 mA	500 nA/200 nA	
±1 mA	50 nA/20 nA	
±100 μA	5 nA/2 nA	
±10 μA	500 pA/200 pA	±[0.2%+(0.1+0.003×Vo)%]
±1 μA	50 pA/20 pA	±[0.5%+(0.01×Vo)%+2 nA]
±100 nA	5 pA/2 pA	±[0.5%+(0.1×Vo)%+1 nA]

1 HP 41420A SMU only.

Note: 10 nA and 1 nA ranges are not specified.

Input Resistance: $\geq 10^{10}$ Ω (in I source mode)

Output Terminals: Force, Sense, and Guard

SMUs: 2 ports

HP 41420A or HP 41421B SMU is used.

Voltage Source/Monitor Range, Resolution, and Accuracy (@ 48-pin SWM pins)

V Range Full Scale	Resolution Force/Measure	Accuracy (Io = Output I) ±(% of reading + % of range + V)
±2 V	100 μV/40 μV	±(0.05%+0.05%+100 μV)(0 A≤Io≤0.1 A) Add 40 mΩ×Io[1] (0.1 A<Io≤0.5 A) Add 200 mΩ×Io[1] (0.5 A<Io≤1 A)
±20 V	1 mV/400 μV	±(0.05%+0.05%) (0 A≤Io≤0.1 A) Add 40 mΩ×Io[1] (0.1 A<Io≤0.5 A) Add 200 mΩ×Io[1] (0.5 A<Io≤1 A)
±40 V	2 mV/800 μV	±(0.05%+0.05%)
±100 V	5 mV/2 mV	
±200 V[2]	10 mV/4 mV	

1 Reference data only.

2 HP 41420A SMU only.

Voltage Source/Monitor Range, Resolution, and Accuracy (@ 96-pin SWM pins)

V Range Full Scale	Resolution Force/Measure	Accuracy (Io = Output I) ±(% of reading + % of range + V)
±2 V	100 μV/40 μV	±(0.05%+0.05%+2.5 mΩ×Io+100 μV)
±20 V	1 mV/400 μV	±(0.05%+0.05%+2.5 mΩ×Io)
±40 V	2 mV/800 μV	±(0.05%+0.05%)
±100 V	5 mV/2 mV	
±200 V[1]	10 mV/4 mV	

1 HP 41420A SMU only.

Current Source/Monitor Range, Resolution, and Accuracy

I Range Full Scale	Resolution Force/Measure	Accuracy (Vo = Output V) ±(% of reading + % of range)
±1 A[1]	50 μA/20 μA	±[0.5%+(0.1+0.002×Vo)%]
±100 mA	5 μA/2 μA	±[0.2%+(0.1+0.002×Vo)%]
±10 mA	500 nA/200 nA	
±1 mA	50 nA/20 nA	
±100 μA	5 nA/2 nA	
±10 μA	500 pA/200 pA	±[0.2%+(0.1+0.003×Vo)%]
±1 μA	50 pA/20 pA	±[0.5%+(0.01×Vo)%+2 nA]
±100 nA	5 pA/2 pA	±[0.5%+(0.1×Vo)%+1 nA]

1 HP 41420A SMU only.

Note: 10 nA and 1 nA ranges are not specified.

Input Resistance: $\geq 10^{10}$ Ω (I source mode)

Output Terminal: Force, Sense, and Guard

SMUs on Port Expander: 2 ports

HP 41420A or HP 41421B SMU is used.

Voltage Source/Monitor Range, Resolution, and Accuracy (@ 96-pin SWM pins)

V Range Full Scale	Resolution Force/Measure	Accuracy (Io = Output I) ±(% of reading + % of range + V)
±2 V	100 μV/40 μV	±(0.05%+0.05%+1.3 Ω×Io+180 μV)
±20 V	1 mV/400 μV	±(0.05%+0.05%+1.3 Ω×Io)
±40 V	2 mV/800 μV	
±100 V	5 mV/2 mV	
±200 V[1]	10 mV/4 mV	

1 HP 41420A SMU only. Note that the maximum voltage is 100 V.

Current Source/Monitor Range, Resolution, and Accuracy

I Range Full Scale	Resolution Force/Measure	Accuracy (Vo = Output V) ±(% of reading + % of range + A)
±1 A[1]	50 μA/20 μA	±[0.5%+(0.1+0.002×Vo)%]
±100 mA	5 μA/2 μA	±[0.2%+(0.1+0.002×Vo)%]
±10 mA	500 nA/200 nA	
±1 mA	50 nA/20 nA	
±100 μA	5 nA/2 nA	
±10 μA	500 pA/200 pA	±[0.2%+(0.1+0.003×Vo)%]
±1 μA	50 pA/20 pA	±[0.5%+(0.01×Vo)%+2 nA]
±100 nA	5 pA/2 pA	±[0.5%+(0.1×Vo)%+1 nA]

1 HP 41420A SMU only.

Note: 10 nA and 1 nA ranges are not specified.

Input Resistance: $\geq 10^{10}\ \Omega$ (I source mode)

Output Terminal: Force and Guard

SMU Common Specifications

Voltage Source/Monitor Ranges and Maximum Currents

V Range Full Scale	Maximum Current	
	HP 41420A	HP 41421B
±2 V	1.0 A	100 mA
±20 V	1.0 A (≤14 V) 0.7 A (≤20 V)	100 mA
±40 V	350 mA	50 mA
±100 V	125 mA	20 mA
±200 V	50 mA	—

Current Source/Monitor Range and Max. Voltage

I Range Full Scale	Maximum Voltage	
	HP 41420A	**HP 41421B**
±1 A	14 V (≤1 A) 20 V (≤0.7 A) 40 V (≤350 mA) 100 V (≤125 mA) 200 V (≤50 mA)	—
±100 mA	100 V (≤100 mA) 200 V (≤50 mA)	20 V (≤100 mA) 40 V (≤50 mA) 100 V (≤20 mA)
±10 mA ±1 mA ±100 nA ±10 nA ±1 nA	200 V	100 V

- Maximum Output Power: 14 W (HP 41420A SMU); 2 W (HP 41421B SMU)
- Current Over-range: 15% of range, 0% of maximum range
- Current/Voltage Compliance:
  - Setting Range:

    1 pA ≤ I Compliance ≤ Maximum I

    V Compliance ≤ Maximum V
  - Setting Accuracy:

    Same as accuracy indicated previously for all SMUs.
  - Opposite Polarity Setting Accuracy:

    +2%: 100 nA to 1 A ranges

    +10%: 1 nA and 10 nA ranges

Note

Accuracies are specified at 23° C ±5° C after a minimum 40 minute warm-up period, with less than 3° C temperature change after calibration. Accuracies apply at all measurement pins. Errors double at 5° C–18° C and 28° C–40° C.

SMU Reference Data

Maximum Capacitance Load: 1000 pF

Maximum Allowable Guard Capacitance: 100 pF

Maximum Slew Rate: 0.2 V/μs

Note Reference data are *not* guaranteed specifications, but are provided as additional operator information.

Auxiliary (AUX): 4 ports (optionally 10 ports)

HP 41424A VS/VMU is used.

The VS/VMU provides two V source channels, VS1 and VS2, that can also monitor current; and two V monitor channels, VM1 and VM2, that can also function as a differential voltmeters.

- VS1 and VS2:

VS Voltage Output Range, Resolution, and Accuracy

V Range Full Scale	Resolution	Accuracy	Max. I
±20 V	1 mV	±(0.1% of setting + 10 mV)	100 mA
±40 V	2 mV	±(0.1% of setting + 20 mV)	20 mA

VS Current Measurement Range, Resolution, and Accuracy

I Range Full Scale	Resolution	Accuracy	V Range
±20 mA	20 μA	±(3% of reading + 200 μA)	40 V
±100 mA	100 μA	±(3% of reading + 1 mA)	20 V

Output Terminal: Force and Guard

Note Accuracies are specified at 23° C ±5° C after a minimum 40 minute warm-up period, with less than 3° C temperature change after calibration. Accuracies apply at all measurement pins. Errors double at 5° C–18° C and 28° C–40° C.

- VS Reference Data:

  Output Resistance: ≤2.0 Ω (Typically 1.0 Ω)

  Maximum Capacitance Load: 10 μF

  Maximum Slew Rate: 0.2 V/μs

  Current Limit Accuracy: −0%, +20%

Note Reference data are *not* guaranteed specifications, but are provided as additional operator information.

- VM1 and VM2

VM Input Range, Resolution, and Accuracy (Grounded Measurements)

V Range Full Scale	Resolution	Accuracy	AUX Port Number
±2 V	40 μV	±(0.05% of reading + 1.1 mV)	1–4, 11–13, 21–23
		±(0.05% of reading + 1.2 mV)	31, 32, 41, 42
±20 V	400 μV	±(0.05% of reading + 10 mV)	1–4, 11–13, 21–23, 31, 32, 41, 42
±40 V	800 μV	±(0.05% of reading + 20 mV)	1–4, 11–13, 21–23, 31, 32, 41, 42

VM Input Range, Resolution, and Accuracy (Differential Measurements)

V Range Full Scale	Resolution	Max. Common Voltage	Accuracy (Vi = VM2 Input V) ±(% of reading + V + common mode error)	AUX Port Number
±0.2 V	4 μV	40 V	±(0.2% + 0.5 mV + 2.5 μV×Vi)	1–4
			±(0.2% + 0.62 mV + 2.5 μV×Vi)	11–13, 21–23
			±(0.2% + 0.76 mV + 2.5 μV×Vi)	31, 32, 41, 42
±2 V	40 μV	40 V	±(0.1% + 2.1 mV + 25 μV×Vi)	1–4, 11–13, 21–23, 31, 32, 41, 42

Note

Accuracies are specified at 23° C ±5° C after a minimum 40 minute warm-up period, with less than 3° C temperature change after calibration. Accuracies apply at all measurement pins. Errors double at 5° C–18° C and 28° C–40° C.

- VM Reference Data:

  Input Resistance: ≥50 MΩ

Note

Reference data are *not* guaranteed specifications, but are provided as additional operator information.

Pulsed Measurements

Pulsed bias and pulsed sweep measurements can be performed using SMUs and VSs.

Measurement Modes:

Pulsed spot, Pulsed linear sweep, and linear sweep with pulsed bias

Pulse Width Setting Range: 1 ms to 50 ms, 0.1 ms resolution

Pulse Period Setting Range: 10 ms to 500 ms, 0.1 ms resolution

Hold Time setting Range: 0 ms to 655.35 s, 0.01 s resolution

Pulsed V Force Range: 2 V to 200 V

Pulsed I Force Range: 10 nA to 1 A

Ground Unit (GNDU)

The GNDU can be used as measurement ground.

Output V: 0 V

I Range: ±1.6 A

Offset V: ±1 mV

Maximum Capacitance Load: 10 μF (reference data only)

Analog Feedback Unit (AFU)

HP 41425A AFU.

By using an analog feedback method, the AFU performs high speed measurements by controlling the output voltage of one SMU (Search SMU) while another SMU (Sense SMU) monitors I or V until a specified target value is reached.

Search SMU Specifications:

- Search V Range: 2 V, 20 V, 40 V, 100 V, or 200 V (HP 41420A)
- Search V Slew Rate Range: 0.5 mV/ms–100 V/ms
- Search Start V Accuracy: 0.5% of setting + 0.5% of V range
- Search Stop V Accuracy: 3% of V range
- Search V Slew Rate Resolution: 1/100 of slew rate range
- Feedback Integration Time Range: 2.5 μs–500 ms

Sense SMU Specifications:

- Setting Range and Resolution: Same as SMU used
- Setting Accuracy: SMU's accuracy + 0.1% of setting value + 0.1% of SMU's range
- Maximum I Setting Value: 900 mA (HP 41420A); 90 mA (HP 41421B)
- Maximum V Setting Value: 180 V (HP 41420A); 90 V (HP 41421B)

AFU Reference Data

Sense SMU Specifications:

- Search V Slew Rate Accuracy: 30% + 10% of slew rate range
- Ramp Voltage Stop Delay Time: 5 μs
- Feedback Integration Time accuracy: 30% of Setting

Note

Reference data are *not* guaranteed specifications, but are provided as additional operator information.

Capacitance Measurement Subsystem (CMS)

The HP 4062C/UX's CMS consists of the HP 4280A 1MHz C Meter/C-V Plotter, the HP 4284A Precision LCR Meter, or the HP 4274A Multi-Frequency LCR Meter.

CMU (HP 4280A 1 MHz C Meter/C-V Plotter)

Capacitance Measurement Range:	1 fF to 1.2 nF
Conductance Measurement Range:	0.01 μS to 12 mS
C-t Measurements:	Measurement Time Interval: 60 ms to 32 s
	Pulse Width Setting Range: 10 ms to 32 s
Test Frequency:	1 MHz $\pm$0.01%
Test Signal Level:	30 mVrms $\pm$10% and 10 mVrms $\pm$10% for AUX3 and AUX4 ports 30 mVrms $\pm$20% and 10 mVrms $\pm$20% for AUX31 and AUX41 ports
Display Resolution:	4-1/2 digits max.

C & G Measurement Ranges and Accuracies

C & G Range Full Scale	Accuracy[1] $\pm$[% of reading + (% of range)]
C:10 pF[2]	$\pm$[0.8%+(0.7+1.5$\times G_m$/100 μS)]
G:100 μS[2]	$\pm$[1.5%+(0.7+0.2$\times C_m$/10 pF)]
C:100 pF	$\pm$[0.5%+(0.1+1.5$\times G_m$/1000 μS)]
G:1000 μS	$\pm$[1.5%+(0.2+0.2$\times C_m$/100 pF)]
C:1000 pF	$\pm$[1.5%+(0.2+3.5$\times G_m$/10 mS)][3]
G:10 mS	$\pm$[3.5%+(0.4+0.5$\times C_m$/1000 pF)]

1 G_m: conductance measurement value
C_m: capacitance measurement value

2 Reference data only—not a guaranteed specification.

3 $\pm$[1.7%+(0.2+3.5$\times G_m$/10 mS)] for AUX31 and AUX41

Note

After the minimum 40 minute warm-up period, accuracy is specified (1) at 23° C $\pm$ 5° C with the test signal level set to 30 mV and MEAS SPEED set to MEDIUM; (2) between any two measurement pins, and (3) with dissipation D < 1. The stray capacitance between two measurement pins is measured first. Then the stray capacitance value is subtracted from the measured data when a DUT is measured.

When using the 10 mV test signal level, add (0.1% + 0.1%) to the C or G error. If the stray capacitance to the guard exceeds 5 pF, add 0.8% of the reading to C or G errors for each 100 pF increment of stray capacitance to the guard. Errors double at 5° C–18° C and 28° C–40° C.

CMU84 (HP 4284A Precision LCR Meter)

Measurement Range:	1 fF – 1.2 nF and 10 nS – 7.5 mS (1 MHz) 1 fF – 10 nF and 1 nS – 6.3 mS (100 kHz) 1 fF – 100 nF and 0.1 nS – 6.3 mS (10 kHz) 10 fF – 100 nF and 0.1 nS – 0.63 mS (1 kHz)
Measurement Frequency:	1 k, 10 k, 100 k, and 1 MHz
Frequency Accuracy:	±0.01 %
Test Signal Level:	30 mVrms

Capacitance Measurement Frequencies, Ranges, and Accuracies

Frequency (Hz)	C (F)	Accuracy[1] ±[% of reading + (% of range)]
1 M	10 p[2]	±[0.8%+(1.0+0.6×Gm;/63 μS)]
	100 p	±[0.8%+(0.3+0.6×Gm/630 μS)]
	1 n[3]	±[1.9%+(0.2+1.7×Gm/6.3 mS)]
100 k	10 p[2]	±[0.4%+(1.0+0.3×Gm/6.3 μS)]
	100 p	±[0.3%+(0.3+0.3×Gm/63 μS)]
	1 n	±[0.3%+(0.2+0.4×Gm/630 μS)]
	10 n	±[0.5%+(0.2+1.0×Gm/6.3 mS)]
10 k	100 p	±[0.3%+(0.2+0.3×Gm/6.3 μS)]
	1 n	±[0.3%+(0.1+0.3×Gm/63 μS)]
	10 n	±[0.3%+(0.1+0.3×Gm/630 μS)]
	100 n	±[0.3%+(0.1+1.0×Gm/6.3 mS)]
1 k	100 p[2]	±[0.4%+(0.5+0.4×Gm/0.63 μS)]
	1 n	±[0.3%+(0.1+0.3×Gm/6.3 μS)]
	10 n	±[0.3%+(0.1+0.3×Gm/63 μS)]
	100 n	±[0.3%+(0.1+0.3×Gm/630 μS)]

1 Gm = conductance measurement value

2 Reference data only—not a guaranteed specification.

3 Maximum count is 12000 (120% full scale).

Conductance Measurement Frequencies, Ranges, and Accuracies

Frequency (Hz)	G (S)	Accuracy[1] ±[% of reading + (% of range)]
1 M	63 μ[2]	±[0.8%+(1.0+0.6×Cμ/10 pF)]
	630 μ	±[0.8%+(0.3+0.6×Cμ/100 pF)]
	6.3 m[3]	±[1.3%+(0.2+2.2×Cμ/1.0 nF)]
100 k	6.3 μ[2]	±[0.4%+(1.0+0.4×Cμ/10 pF)]
	63 μ	±[0.3%+(0.3+0.3×Cμ/100 pF)]
	630 μ	±[0.3%+(0.2+0.4×Cμ/1 nF)]
	6.3 m	±[0.7%+(0.2+0.8×Cμ/10 nF)]
10 k	6.3 μ	±[0.3%+(0.2+0.3×Cμ/100 pF)]
	63 μ	±[0.3%+(0.1+0.3×Cμ/1 nF)]
	630 μ	±[0.3%+(0.1+0.3×Cμ/10 nF)]
	6.3 m	±[0.7%+(0.1+0.7×Cμ/100 nF)]
1 k	0.63 μ[2]	±[0.4%+(0.5+0.4×Cμ/100 pF)]
	6.3 μ	±[0.3%+(0.1+0.3×Cμ/1 nF)]
	63 μ	±[0.3%+(0.1+0.3×Cμ/10 nF)]
	630 μ	±[0.3%+(0.1+0.3×Cμ/100 nF)]

1 Cm = capacitance measurement value

2 Reference data only—not a guaranteed specification.

3 Maximum count is 12000 (120% full scale)

Note

After the minimum 45 minute warm-up period, accuracy is specified at 23° C ± 5° C with MEAS SPEED set to MEDIUM and with a 30 mVrms test signal level. The stray capacitance between two measurement pins is measured first. Then the stray capacitance value is subtracted from the measured data when a DUT is measured.

LCR (HP 4274A Multi-Frequency LCR Meter)

- Measurement Function: Capacitance
- Measurement Frequencies:

  100, 120, 200, 400, 1 k, 2 k, 4 k, 10 k, 20 k, 40 k, 100 kHz ±0.01%
- Measurement Range: 0.001 pF to 1.9 nF
- Accuracy: 1% of the measurement range as an additional error to the HP 4274A's accuracy. This additional error is specified under the following conditions:
  - If capacitance zero offset adjustment is performed.
  - If measurement range is the 100 pF or 1000 pF range.
  - If the dissipation factor of the test device does not exceed 0.1.
  - If the LCR's OSC Level vernier is set to its maximum level on the ×5 and ×1 ranges.

Internal dc bias options for HP 4274A are not specified for system use.

System Controller

- Supported Computers:
  - For HP 4062C:

    HP 9836A/C (Series 200 Model 236A/C), HP 9000 Series 300 Model 310, 320, 330, 332, 340, 345, 350, 360, 362, R/362, 370, 375, 380, 382, or R/382
  - For HP 4062UX:

    HP 9000 Series 300 Model 330, 332, 350, 360, 370, 375, 380, 382, or R/382

    or

    HP 9000 Series 300 Model 318, 319, 340, 345 for diskless cluster configurations.

    or

    HP 9000 Series 700 Model 725, 745i, or 747i
  - For HP 4062PC:

    HP 82324A High-Performance Measurement Coprocessor and a Vectra PC (IBM PC-AT, IBM PS-2 Model 30/286, or supported AT-compatible computer can be used.). Note that the Vectra PC must be equipped with a VGA display adapter and monitor.
- Operating System:

HP 4062C	HP BASIC/WS
Rev 5.0	5.0, 5.1, or 5.13
Rev 5.6	5.0, 5.1, or 5.13
Rev 5.7	6.0
Rev 6.0	6.0
Rev 6.2	6.2
Rev 6.3	6.2, 6.21, or 6.3

HP 4062UX (s300)	HP BASIC/UX (s300)	HP-UX (s300)
Rev 5.5	5.5	6.2
Rev 5.51	5.51	6.5
Rev 5.61	5.52	7.0 or 7.05
Rev 6.0	5.52	7.0 or 7.05
Rev 6.2	6.2	8.0
Rev 6.3	6.3	9.0
Rev 7.0	6.3	9.0 or 9.03

HP 4062UX (s700)	HP BASIC/UX (s700)	HP-UX (s700)
Rev 7.0	7.0	9.03

HP 4062PC	HP BASIC/DOS	MS-DOS
Rev 6.2	6.2	3.1 or later
Rev 6.3	6.2	3.1 or later

HP BASIC Plus can be used with any HP BASIC system.

- Required Memory:
  - For HP 4062C:

    Greater than 2 MB; greater than 4 MB when using the HP IMA software (add 1 MB when using BASIC Plus)
  - For HP 4062UX (s300):

    Greater than 8 MB (recommended: greater than 16 MB); greater than 8 MB when using the HP IMA software (add 1 MB when using BASIC Plus)
  - For HP 4062UX (s700):

    Greater than 32 MB (recommended: greater than 64 MB); greater than 64 MB when using the HP IMA software
  - For HP 4062PC:

    Vectra PC requires greater than 640 KB for MS-DOS.

    Measurement coprocessor requires greater than 2 MB; greater than 4 MB when using the HP IMA software (add 1 MB when using BASIC Plus)
- Required Interface/Module:
  - For HP 4062C/UX (s300)
    - HP 98624A HP-IB Interface Card (2 ea.)

      For the HP 4062C/UX's hardware
      For the wafer prober
      (Built-in HP-IB is for tape drives, printers, and plotters.)

      If your HP 4062UX is configured in a diskless cluster, an HP-IB interface card is not required because the computer's built-in HP-IB can be used for the HP 4062UX and wafer prober.
    - Disk Interface Card (1 each)
    - Required HP-HIL device: One HP 46084A ID Module.
  - For HP 4062UX (s700)
    - HP E2071B EISA HP-IB Interface Card (2 ea.)

      For the HP 4062UX hardware
      For the wafer prober

      You can use built-in HP-IB of model 745i or 747i for the HP 4062UX hardware or wafer prober.
    - Required HP-HIL device: One HP 46084A ID Module.
  - For HP 4062PC

- HP 82335A/82990A HP-IB Interface Card for the wafer prober

  (Built-in HP-IB of the measurement coprocessor is used for the system instruments.)

- Parallel or serial interface card for MS-DOS (if need)
- Required peripheral devices for your Vectra PC

- Peripherals
  - □ Printer

    PPG, MAP, DIAG, PV4062, and BSDM support printers. The following conditions are required for the printers:

    - HP-IB interface printer

      Response to serial polls
      More than 79 characters per line
      More than 24 lines per page
      Sufficient resolution of the printer for graphics dump (if need)

    - RS-232C serial interface printer

      More than 79 characters per line
      More than 24 lines per page
      Sufficient resolution of the printer for graphics dump (if need)

    - Centronics interface printer

      More than 79 characters per line
      More than 24 lines per page
      Sufficient resolution of the printer for graphics dump (if need)

  - □ Plotter

    BSDM supports plotters. The following conditions are required for the plotters:

    - HP-IB interface plotter

      Response to serial polls

System Software

Standard HP 4062C/UX/PC software provides the following capabilities.

- System Initialization
- Control of system subsystems
- Monitor of system subsystems and measurement data
- Parameter measurement utility
- Offline debugging (HP 4062UX only)
- Probing pattern generation and wafer maps display
- BSDM data format generation library
- Wafer prober control utility subprograms include:
  - □ Electroglas Model 1034X/2001X/2010A/3001X
  - □ Tokyo Seimitsu Model AP-M-3000A/6000A/7000A
- Operational Verification Diagnostics

General Information

- Operating Temperature Range:

  5°C to 40°C, 5% to 70% RH. Permissible temperature change is less than 3°C after calibration.

- Storage temperature Range:

  −20°C to 60°C; 15% to 90% RH @65°C

- Air Cleanliness: Better than class 100,000
- Power Requirements: 100 Vac (90 – 110 Vac); 120 Vac (108 – 132 Vac); 220 Vac (198 – 242 Vac); 240 Vac (216 – 252 Vac); 48 – 66 Hz, 1150 VA max.
- Dimensions:

  System Cabinet (standard) = 600 mm (W) by 1600 mm (H) by 800 mm (D).

  System Cabinet (small) = 600 mm (W) by 1000 mm (H) by 800 mm (D).

  HP 4085B 48-pin SWM = 470 mm (W) by 230 mm (H) by 440 mm (D).

  HP 4089A/B 96-pin SWM = 620 mm (W) by 250 mm (H) by 600 mm (D).

  Port Expander = 227 mm (W) by 180 mm (H) by 57 mm (D).

- Weight:

  System Cabinet (standard) = about 230 kg

  System Cabinet (small) = about 210 kg

  HP 4085B 48-pin SWM = about 22 kg

  HP 4089A/B 96-pin SWM = about 55 kg

  Port Expander = about 1.1 kg

- DCS (HP 4142B) Power Limitation: 32 W

Typical Performance

- Command Execution Time: (Single user, single task mode for HP 4062UX)
  - Switching Matrix

    Connect: 4.5 ms

  - DC Source/Monitor[1]

    Force (I or V): 3.9 ms

    Measure (I or V): 6 ms

    Analog Search: 25 ms (does not include the switching time; for MOSFET Vth measurement (Id=1 μA))

    [1] Integration time set to SHORT; not applicable on 1 nA and 10 nA ranges.

- Typical SWM Performance (at 23 °C, 50% RH)

Typical SWM Performance (at 23 °C, 50%RH)

Parameter	SMU1	SMU2–4	AUX1–4	AUX1x & AUX2x	AUX31, 32 & AUX41, 42	AUX33 & AUX43
Offset Voltage/Pin	50 μV	50 μV	50 μV	50 μV	80 μV	80 μV
Offset Current/Pin	1 pA	40 pA	1 nA	1 nA	1 nA	40 pA
Isolation Resistance	8×10^{13} Ω	5×10^{11} Ω	4×10^{8} Ω	4×10^{8} Ω	4×10^{8} Ω	5×10^{11} Ω
Path to Ground Capacitance	30 pF[1]	60 pF	—	—	—	60 pF
Stray C between CMS ports	—	—	4 pF[2]	—	4 pF[3]	—

1 15 pF for HP 4089A/B SWM.

2 Between AUX3 and AUX4.

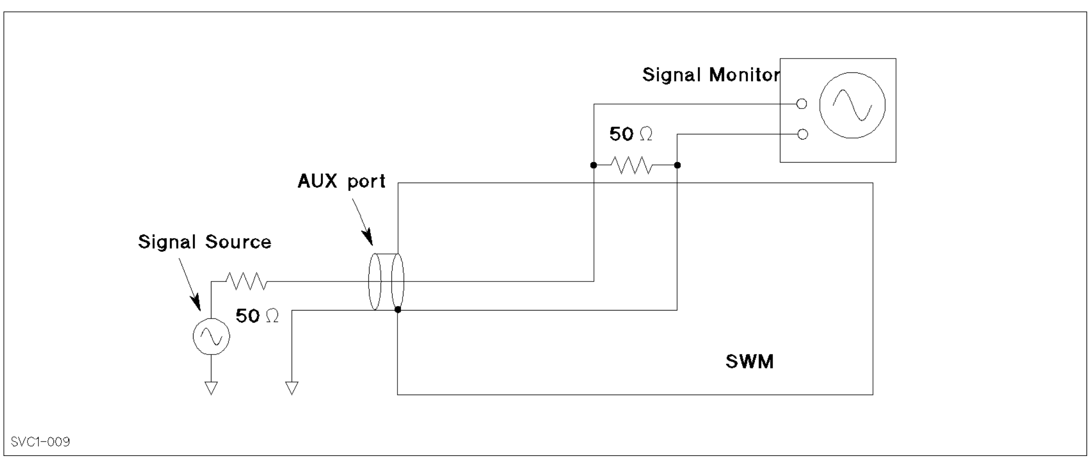
3 Between AUX31 and AUX41.

- Insertion Loss of the AUX Ports

Insertion Loss of the AUX Ports (dB)

SWM and Ports		Frequency ≤100 kHz	Frequency ≤1 MHz	Frequency ≤10 MHz	−3 dB Frequency
HP 4085B	AUX1, AUX2	< 0.5	< 0.6	< 5.0	7.5 MHz
	AUX3, AUX4	< 0.5	< 0.6	< 2.5	13.0 MHz
HP 4089B	AUX1, AUX2	< 0.2	< 0.5	< 5.5	5.5 MHz
	AUX3, AUX4	< 0.3	< 0.4	< 2.3	11.5 MHz

The measurement circuit is shown as follows:

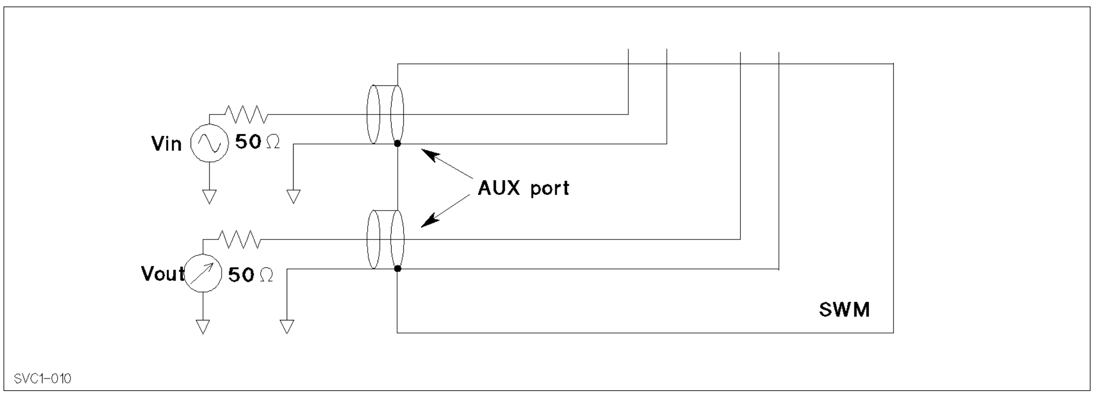


■ Crosstalk of the AUX Ports

Crosstalk of the AUX Ports (dB)

SWM and Ports		Frequency <10 kHz	Frequency <100 kHz	Frequency <1 MHz
HP 4085B	AUX1 to AUX2	<−90	<−70	<−50
	AUX3 to AUX4			
HP 4089B	AUX1 to AUX2	<−90	<−70	<−50
	AUX3 to AUX4	<−95	<−80	<−60

The measurement circuit is shown as follows:

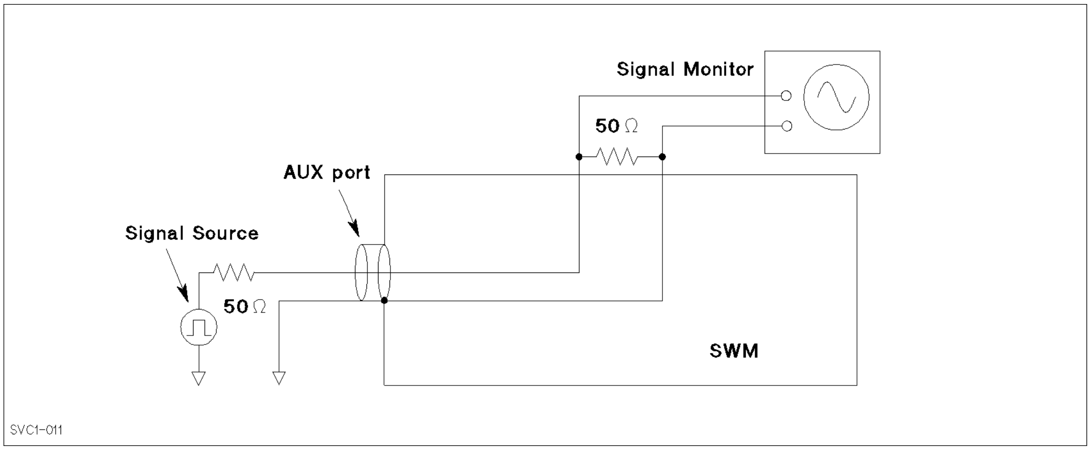


■ Pulse Rising Time and Delay Time

Pulse Rising Time and Delay Time of the AUX Ports

SWM and Ports		Rising Time	Delay Time
HP 4085B	AUX1, AUX2	40 ns	—
	AUX3, AUX4	30 ns	
HP 4089B	AUX1, AUX2	60 ns	25 ns
	AUX3, AUX4	35 ns	

The measurement circuit is shown as follows:


Signal Monitor
50 Ω
AUX port
Signal Source
50 Ω
SWM
SVC1-011

2

Performance Verification

This chapter provides HP 4062C/UX/PC Performance Verification (PV) software information. Included are discussions on software coverage, the test procedures for each test, and how to interpret test results.

Description

The PV software consists of a file called PV4062 for verifying system performance. If your system is equipped with the HP 4274A Multi-Frequency LCR Meter (option 310 for HP 4062C; option 520 for HP 4062UX), the PV software to verify the HP 4274A is also included in the system software for the HP 4274A.

- For the HP 4062C

  The PV software has been included in the system software since revision C.05.70. For system software revision C.05.70 or later, use the PV software furnished with the system software. For a previous revision, use the PV software furnished with the HP 16290A Product Support Package (PSP) or supplied on the PV disk set. See "Performance Verification Software" in Appendix D for PV software compatibility. The PV disk set consists of the following disks:

  - For revision C.05.05, C.05.10, C.05.70, and C.06.00 (3.5 inch single-sided flexible disks):

    PV4062 #1, PV4062 #2, PV4142 #1, PV4142 #2, and VIEW disks. (Note: VIEW disk is not supplied with system revision C.05.70 or later. Use SYSTEM SOFTWARE (5) disk instead.)
  - For revision C.06.20 and C.06.30 (3.5 inch double-sided flexible disks):

    PV4062 #1, PV4062 #2, PV4062 #3, and PV4142 disks.

  Note that the PV software is installed in your hard disk or SRM system for revision C.06.00 or later.

- For HP 4062UX

  The PV software is included in your system software, which is located in the `/usr/pcs/diag` directory.

- For the HP 4062PC

  The PV software is included in the following disks:

  - PV4062 #1, PV4062 #2, and PV4142 disks.

PV4062

The PV software can be started by running PV4062 program. PV4062 consists of the following tests:

- 4062 Without Digital Voltmeter (W/O DVM) Test
- 4062 With Digital Voltmeter (W/ DVM) Test
- 4142B Test
- Timer Test (for HP 4062C only)
- START
- View Result
- 4274A Test

These tests are independent: Any test can be run by selecting the corresponding softkey when you execute PV4062.

4062 W/O DVM Test — Checks the output and measurement capabilities of the system at the measurement pins. For normal servicing (installation, periodic calibration, troubleshooting, and performance testing after repairs), perform only the 4062 W/O DVM Test.

4062 W/ DVM Test — Checks the dc output and measurement capabilities of the HP 4142B DCS at the measurement pins in the SWM using a DVM or DMM.

Note

The 4062 W/ and W/O DVM Tests do *not* check additional SMUs that are not connected to SWM ports or AUX33, 43 ports on the port expander: that is, if your DCS is equipped with extra SMUs or VS/VMUs not connected at test execution time. To check these units, connect them using an interconnection cable, run START, and perform the required test again.

4142B Test — Checks dc output and measurement capabilities at the front panel of the HP 4142B DCS. Perform this test if the DCS fails the 4062 W/O DVM Test.

VFP Timer Test — Checks the operation of the HP 16321A VFP Timer Board installed in the system controller. This test is for the HP 4062C only.

START — Performs the following functions:

- Verifies the system configuration.
- Initializes the individual system instruments.
- Checks the measurement cable connections.
- Measures the residual impedances of the system measurement cabling and stores the measured values for error compensation purposes.
- Declares the COM blocks accessed by various other system software program files.

For more information about the START program, see the *HP 4062C/UX System Operation* manual.

Note

START executes automatically when you run the 4062 W/ or W/O DVM Test, if the COM blocks declared in the START program are broken.

View Result

Displays test results on the CRT or prints test results on a printer. The 4062 W/ and W/O DVM Tests and the 4142B Test can keep the test results in a file, and the contents can be printed with this function.

PV4274

Tests the HP 4274A Multi-Frequency LCR Meter (option 310 for HP 4062C; option 520 for HP 4062UX). PV4274 also includes tests for ±35 V or ±100 V internal dc bias (option 311/312 for HP 4062C; option 521/522 for HP 4062UX). PV4274 consists of the following tests:

- LCR Capacitance-Conductance Accuracy (LCR C-G) Test
- LCR DC Bias (LCR Bias) Test

The LCR C-G Test performs the self-test of the HP 4274A, measures stray capacitance in the SWM, and checks the accuracy of capacitance measurements.

The LCR Bias Test checks the accuracy of the internal dc bias output voltage of the HP 4274A. This test is performed only if the HP 4062C/UX is equipped with ±35 V or ±100 V internal dc bias option.

Note that the PV4274 has no function to save the test results to a file.

Note

The PV4274 program, which is linked and run by the PV4062 program, is supplied only when your system is equipped with an HP 4274A. For the HP 4062C, the PV4274 program is stored in the SYSTEM SOFTWARE FOR HP 4274A disk; for HP 4062UX, the PV4274 program is located in the `/usr/pcs/diag` directory.

Required Test Equipment

Table 2-1 lists the required PV4062 test equipment and identifies the equipment required for each test. For example, to perform the 4062UX W/O DVM Test, you need the relay test adapter, test fixture adapter, HP 4062UX Product Support Package, and system calibration module.

Table 2-1. Required PV4062 Test Equipment

Item	For 48-pin Systems	For 96-pin Systems	W/O DVM	W/ DVM	4142B	START	4274A
Relay Test Adapter[1]	HP 16075A	HP 16355A	√				
Test Fixture Adapter[1,2]	HP 16066A	HP 16370A	√			√	√
Product Support Package (PSP) for HP 4062C/UX/PC	HP 16290A		√	√	√		
PV4062 Software Disk Set (for HP 4062C only)	04062-65431		√	√	√	√	√
System Calibration Module[3]	HP 16346B/C	HP 16366A/B	√	√			√
Digital Multimeter (DMM)	HP 3456A or HP 3458A			√	√		
BNC-to-Dual Banana Plug Cable[4]	11001-60001			√			
BNC-BNC Cable (Maximum 3m)	HP 10503A or 8120-1840 (2 each)			√			
Mini Pin Plug-to-Banana Plug Cable	04155-61648			√			
Banana-to-Banana Cable[5]	HP 34118A			√			
BNC-to-Single Banana Jack[5]	1250-1263 (2 each)			√			
HP-IB Cable	HP 10833B/C			√	√		
BNC-T Adapter	1250-0781 (2 each)				√		√
Alligator Clips-to-Dual Banana Plug Cable	HP 11002A				√		
Product Support Package (PSP) for HP 4142B	04142-65801				√		
Calibration Adapter	HP 16330A				√		
RC Box	HP 16340A				√		

1 Furnished system accessory.

2 If the test fixture adapter is not available, the HP 16077A or HP 16378B Extension Cable Fixture—with nothing connected to it—can be used. If neither of these fixtures are available, the system calibration module can be used.

3 See "System Calibration Module" for details.

4 Required for revision 6.0 or earlier.

5 Required for revision 6.2 or later.

System Calibration Module

Hewlett-Packard provides five kinds of system calibration modules for the HP 4062 system: the HP 16346A/B/C and the HP 16366A/B. The HP 16346A/B/C is designed for an HP 4085A/B 48-pin SWM and the HP 16366A/B is for an HP 4089A/B 96-pin SWM. Table 2-2 shows the required system calibration module for your system.

Table 2-2. Required System Calibration Module

Subsystem		For 48-pin SWM System	For 96-pin SWM System
HP 4142B DCS	HP 41420A 200 V/1 A SMU	HP 16346B	HP 16366A or B
	HP 41421B 100 V/100 mA SMU	HP 16346A or B	HP 16366A or B
HP 4280A CMU		HP 16346A or B	HP 16366A or B
HP 4274A LCR		HP 16346A or B	HP 16366A or B
HP 4284A CMU84		HP 16346C	HP 16366B

The HP 16346A and B are for verifying the performance of HP 4142B DCS, HP 4280A CMU, and HP 4274A LCR. The HP 16346B is especially required for the 1 A range current accuracy test of the HP 4142B DCS, if the DCS is equipped with an HP 41420A 200 V/1 A SMU. The remaining tests can be performed using either the HP 16346A or B.

The HP 16346C System Calibration Module is required for testing the HP 4284A CMU84 performance if the system is equipped with an HP 4284A (option 320 for HP 4062C/PC; option 530 for HP 4062UX).

The HP 16366A and B are for verifying the performance of HP 4142B DCS, HP 4280A CMU, and HP 4274A LCR. The HP 16366B is also required for the HP 4284A CMU84 performance test if the system is equipped with an HP 4284A (option 320 for HP 4062C/PC; option 530 for HP 4062UX). Otherwise, either the HP 16366A or B can be used for PV4062.

Mounting Test Equipment

The procedure for mounting test equipment differs depending on which SWM the HP 4062C/UX/PC is equipped with.

Caution

Do not touch the measurement pins of the SWM or the contact pads of the test equipment with bare hands. Oil, perspiration, and dirt prevent good contact and may cause the system to fail the tests.

Mounting Test Equipment on the HP 4085B 48-pin SWM

The procedure for mounting the HP 16066A Test Fixture Adapter, HP 16075A Relay Test Adapter, and HP 16346A/B/C System Calibration Module onto the HP 4085B 48-pin SWM is as follows:

1. Position the required test equipment on the SWM.
2. Tighten the four thumb screws, two at a time, diagonally. For example, tighten the upper right and lower left thumb screws at the same time, then tighten the remaining pair.

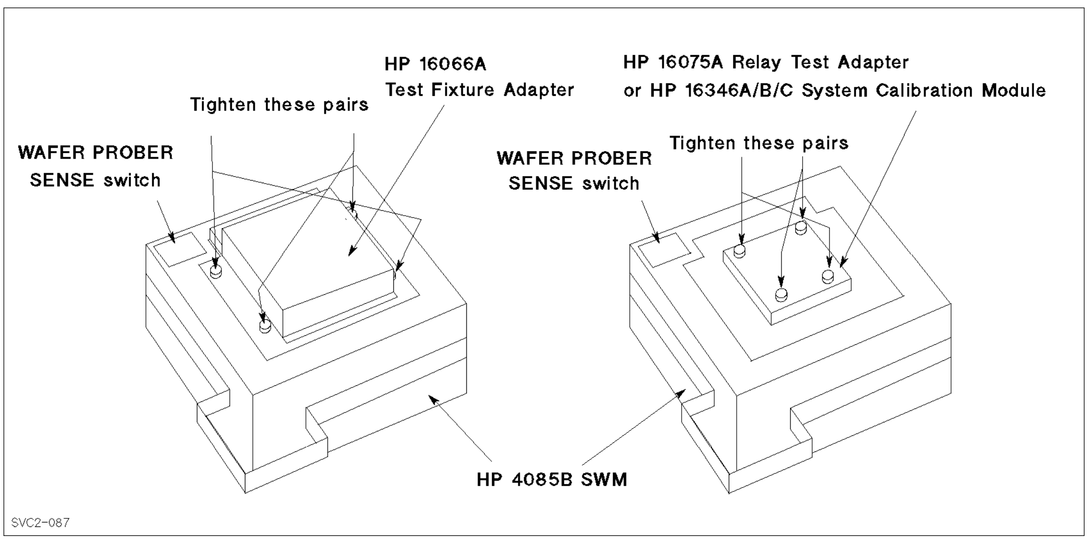


Figure 2-1. Mounting Test Equipment on the HP 4085B 48-pin SWM

Mounting Test Equipment on the HP 4089A/B 96-pin SWM

The procedure for mounting the HP 16370A Test Fixture Adapter, the HP 16355A Relay Test Adapter, and the HP 16366A/B System Calibration Module onto the HP 4089A/B 96-pin SWM is as follows (to mount the test fixture adapter only, start from step 4):

1. Turn the required test equipment and the test fixture adapter upside down.
2. Position the test equipment in the test fixture adapter and push the black push-to-lock fasteners of the test equipment to lock the test equipment into the test fixture adapter.
3. Turn the test fixture adapter over again (topside up).
4. Position the test fixture adapter on the SWM.
5. Push the right and left levers of the test fixture adapter down to secure the test fixture adapter on the SWM.

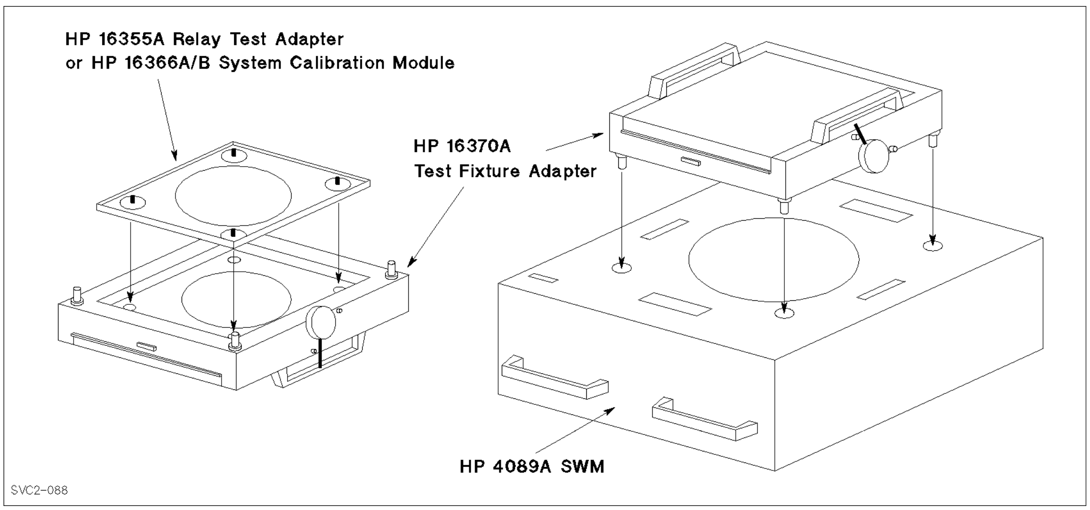


Figure 2-2. Mounting Test Equipment on the HP 4089A/B 96-pin SWM

Running the PV4062

Use the following procedure to start the PV4062. If an error message is displayed during PV4062 execution, proceed to the troubleshooting tree in chapter 3.

- For an HP 4062C/PC:
  1. Turn the system controller on and boot the HP BASIC/WS or HP BASIC/DOS system.
  2. Change the current directory to the `/PCS/DIAG` directory as follows:

     `MSI "/PCS/DIAG"` (Return) *for HP 4062C/PC*
     `MSI "\PCS\DIAG"` (Return) *for HP 4062PC*

  3. Load and run the PV4062 program as follows:

     `LOAD "PV4062"` (Return)
     `RUN` (Return) *or select the* `RUN` *softkey*

  If the PV software is not stored in the `/PCS/DIAG` directory, load and run the PV software from the PV software disks. To execute the PV4062 program, insert the PV4062 #1 disk into the flexible disk drive, set MASS STORAGE IS (MSI) to the PV4062 #1 disk, and load and run the PV4062 program.

- For an HP 4062UX:
  1. Turn the system controller on and boot the HP-UX system.
  2. Log in as a superuser.
  3. Change the current directory to the `/usr/pcs/diag` directory as follows:

     `$ cd /usr/pcs/diag`

  4. Enter the HP BASIC/UX environment as follows:

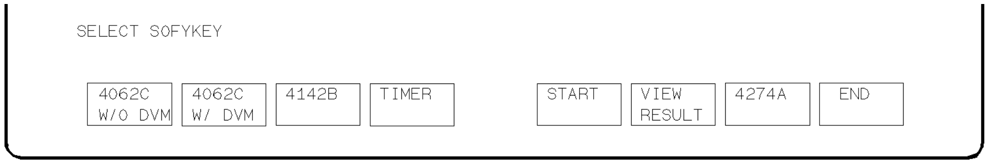
     `$ rmb`

  5. Load and run the PV4062 program as follows:

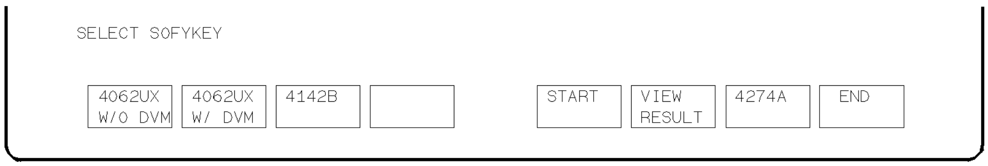
     `LOAD "PV4062"` (Return)
     `RUN` (Return) *or select the* `RUN` *softkey*

Note The START program must be in the current MASS STORAGE when the PV4062 program is executed.

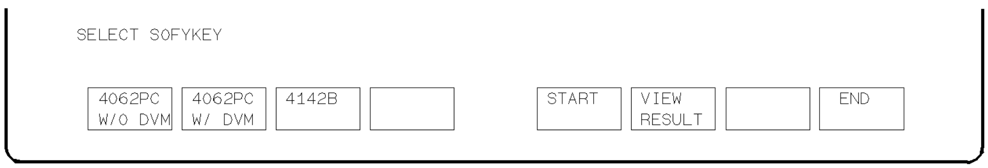
PV4062 main menu page is displayed as shown in Figure 2-3.



(a) Main Menu Softkeys for HP 4062C



(b) Main Menu Softkeys for HP 4062UX



(c) Main Menu Softkeys for HP 4062PC

Figure 2-3. PV4062 Menu Page

The 4062 W/O DVM Test

The 4062 W/O DVM Test checks the measurement accuracy of the HP 4142B DCS and CMS (HP 4280A CMU or HP 4284A CMU84) at the measurement pins of the SWM. Program structure and operating procedures are nearly identical to those of the DIAG program of the system software. DIAG, however, provides an overall system performance check, while the 4062 W/O DVM Test provides a check of the system specifications.

This test should be used for normal servicing: installation, periodic calibration, troubleshooting, and performance testing after repairs.

The 4062 W/O DVM Test consists of the following eight subtests (listed in the recommended execution order).

1. Relay Test
2. SMU Test
3. Voltage Source (VS) Test
4. Voltage Monitor (VM) Test
5. Analog Feedback Unit (AFU) Test
6. CMS Capacitance-Conductance (C-G) Test or CMU84 C-G Test
7. CMS BIAS Test or CMU84 BIAS Test
8. DC LEAK Test

You can perform each test individually and in any order. To ensure accurate test results, however, tests should be performed in the sequence listed here. To do so, select the SEQ softkey (press Shift - Menu if the SEQ softkey is not displayed). The SEQ test can keep test results in a file, which can be printed using the View Result function of the PV4062.

When the 4062 W/O DVM Test is performed, the START program is automatically executed first. However, the execution of the START program is skipped if the START program has been executed and the COM blocks are not broken.

The 4062 W/O DVM Test measures the capacitance offset data during the initialization procedure for the CMS C-G Test.

See Table 2-3 for the pin boards that must be installed in the slots of the SWMs for each test. More pin boards may be installed, but the list includes the minimum pin boards required for the test. Note that the Relay Test and DC Leak Test check the pin boards found by the START program.

Table 2-3. Required Pin Boards for Each Test

Test Name	Slot Number for 48-pin SWM	Slot Number for 96-pin SWM
SMU Test	4, 8, 12, 16, 20, 24, 28, and 32	12, 16, 20, 24, 28, 32, 76, 80, 84, and 88
VS Test	4 and 8	84 and 88
VM Test	4 and 8	84 and 88
AFU Test	12 and 16	20 and 24
CMS C-G Test	36, 40, 44, and 48	4, 36, 40, 68, 72, and 96
CMS Bias Test	4 and 8	84 and 88
CMU84 C-G Test	4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, and 48	20, 24, 36, 40, 48, 52, 56, 60, 64, 68, and 72
CMU84 Bias Test	20 and 24	84 and 88
SEQ Test	4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, and 48	4, 12, 16, 20, 24, 28, 32, 36, 40, 68, 72, 76, 80, 84, 88, and 96 for HP 4280A CMU. 4, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68, 72, 76, 80, 84, 88, and 96 for HP 4284A CMU84.

⚠ WAFER PROBER SENSE Switch

Warning **If either the FIXTURE CLOSED DETECT switch or WAFER PROBER SENSE switch is closed, dangerous dc voltage exceeding ±42 V may be present at the measurement pins. Severe electric shock will result if the measurement pins are touched.**

- Required Equipment:

  Test fixture adapter

  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

Note The test fixture adapter, with no test fixture installed, is used to hold the WAFER PROBER SENSE switch closed during this test (to enable SWM output). If the test fixture adapter is not available, press and hold the SENSE switch during this test (see Figure 2-1 or Figure 2-2 for the location of the SENSE switch).

- Test Procedure:

1. Mount the test fixture adapter *only* on the SWM (see "Mounting Test Equipment").
2. Select the `4062C W/O DVM`, `4062UX W/O DVM`, or `4062PC W/O DVM` softkey from the PV4062 main menu.
3. The START program runs automatically. Refer to "The START Program" for more information on the START program.

4. When START is finished, the program displays the start-up menu page as shown in Figure 2-4. For the HP 4062C, "HP 4062C" is displayed instead of "HP 4062UX", and for the HP 4062PC, "HP 4062PC" is displayed instead of "HP 4062UX". This rule applies to the following pages.

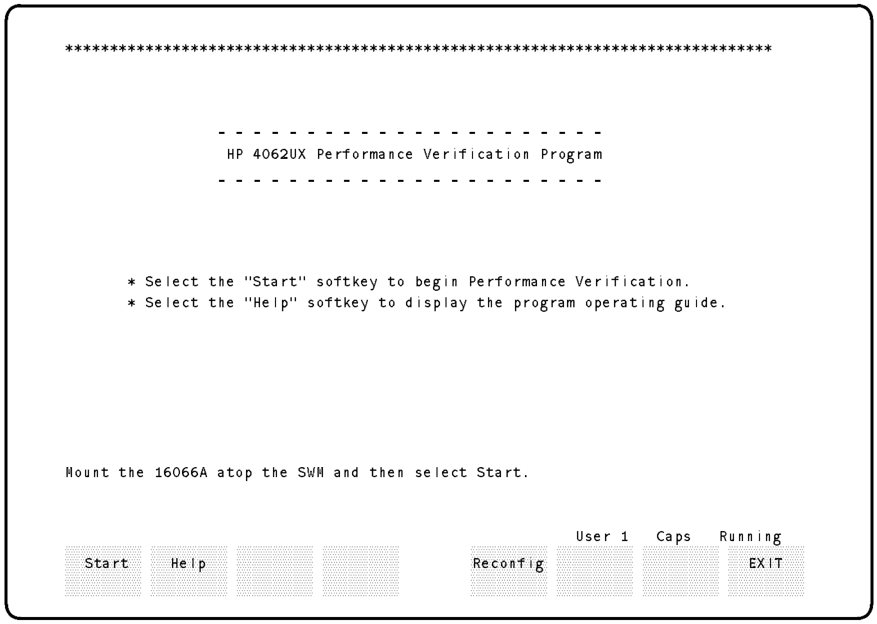


Figure 2-4. 4062 W/O DVM Test Start-up Menu Page

- □ To display a brief operating guide, select the `Help` softkey.
- □ To verify or change the calibrated values of the system calibration module, select the `Reconfig` softkey and proceed to the next step.

If your HP 4062C/UX/PC system is equipped with an HP 4284A CMU84, the `HP4284A Corr.` softkey is also displayed. When you select this softkey, the CMU84 performs the OPEN and SHORT correction. Go to step 9. For more information about the OPEN and SHORT correction, refer to the HP 4284A *Operation Manual*.

If you don't need to change the calibrated value of the calibration module or execute the OPEN and SHORT correction of the CMU84, go to step 10.

5. The calibration module menu page shown in Figure 2-5 shows the product number of the calibration modules. For a 48-pin SWM, "16346A," "16346B," and "16346C" are shown, and for a 96-pin SWM, "16366A" and "16366B" are shown. Hewlett-Packard recommends using the HP 16346B for performance verification of the HP 4085B 48-pin SWM.

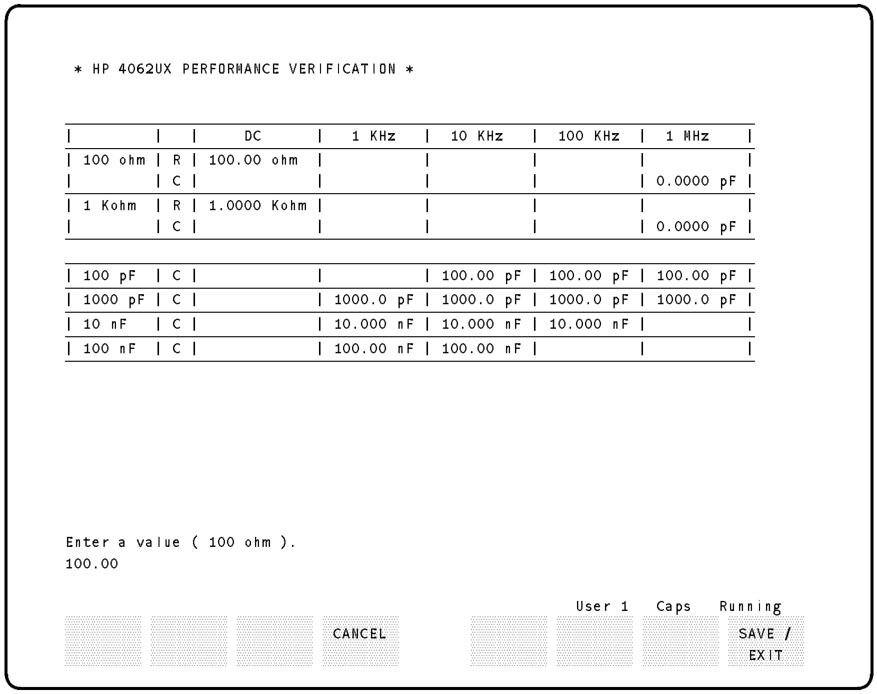
   Select the desired softkey of the product number according to your system instrument. For example, if your system is equipped with an HP 4284A CMU84 and a 48-pin SWM, select the `16346B` and `16346C` softkeys and modify the calibration module data of both.

```
------------------------------------
 HP 4062UX PERFORMANCE VERIFICATION
------------------------------------


 Calibration Modules:

   16346A :  SMU TEST,  VS TEST,  VM TEST,  AFU TEST,
             CMS C-G TEST,  CMS BIAS TEST

   16346B :  SMU TEST,  VS TEST,  VM TEST,  AFU TEST,
             CMS C-G TEST,  CMS BIAS TEST

   16346C :  CMU84 C-G TEST,  CMU84 BIAS TEST




Select a System Calibration Module for the calibration data entry.

                                                User 1   Caps   Running
 16346A   16346B   16346C                                       Start-up
                                                                  Menu
```

Figure 2-5. Calibration Module Menu Page for 48-pin SWM System

6. Figure 2-6 shows an example of an HP 16346C calibration data entry page. The field pointer shows the entry of data and, if it is re-entered, the current data is displayed in the display area. If you want to change the current data, move the field pointer using the arrow keys or the (Tab) key and type in the new data and (Return). After entering the calibration data, select the SAVE/EXIT softkey to return to the calibration module menu page.

   Use the same method to enter calibration data for other calibration modules.



* HP 4062UX PERFORMANCE VERIFICATION *

		DC	1 KHz	10 KHz	100 KHz	1 MHz
100 ohm	R	100.00 ohm				
	C					0.0000 pF
1 Kohm	R	1.0000 Kohm				
	C					0.0000 pF
100 pF	C			100.00 pF	100.00 pF	100.00 pF
1000 pF	C		1000.0 pF	1000.0 pF	1000.0 pF	1000.0 pF
10 nF	C		10.000 nF	10.000 nF	10.000 nF	
100 nF	C		100.00 nF	100.00 nF		

Enter a value (100 ohm).
100.00

User 1 Caps Running

CANCEL SAVE / EXIT

Figure 2-6. An Example of the Calibration Data Entry Page: HP 16346C

7. After entering the necessary calibration data, select the `Start-up Menu` softkey on the calibration module menu page to return to the start-up page.
8. Before returning to the 4062 W/O DVM Test start-up menu page, select the softkey that indicates the system calibration module type that you use for the PV.
9. If your HP 4062C/UX/PC system is equipped with an HP 4284A CMU84, perform the OPEN and SHORT corrections of the CMU84. To do so, select the `HP4284A Corr.` softkey and follow the displayed prompts. It takes about three minutes for the corrections.

   For an OPEN correction, disconnect the BNC-BNC cables from the SWM, and remove the BNC-BNC cables and BNC f-to-f adapters as shown in Figure 2-7.

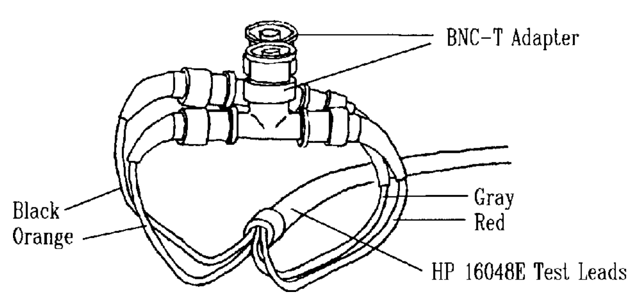


Figure 2-7. Test Lead Connections for an OPEN Correction

For a SHORT correction, interconnect the BNC-T adapters with a BNC f-to-f adapter as shown Figure 2-8.

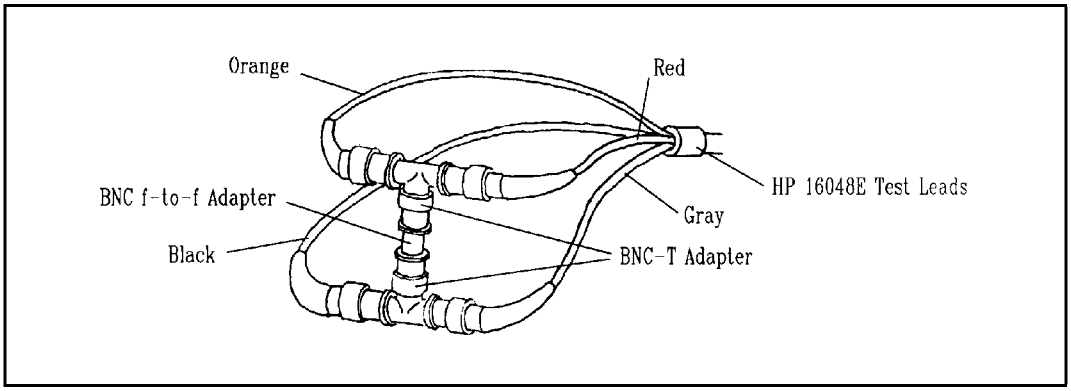


Figure 2-8. Test Lead Connections for a SHORT Correction

After the OPEN and SHORT corrections, connect the test leads to the SWM using the BNC-BNC cables and the BNC f-to-f adapters.

10. Select the `Start` softkey after only the test fixture is mounted on the SWM. The START measures the stray capacitance for the CMS C-G Test or CMU84 C-G Test. Then the 4062 W/O DVM test menu page similar to Figure 2-9 is displayed. Select the desired subtest by selecting the corresponding softkey, and follow the displayed instructions.

    See the following paragraphs for the procedures for each subtest.

```
    M E N U
                            * * * * * * * * * * * * * * * * * * * * * * * *
    Relay Test              *                 NOTES:                       *
    SMU   Test              *   Tests can be  executed  individually by    *
    VS    Test              *   selecting  the  corresponding  softkey.    *
    VM    Test              *   The Relay Test should be executed first.   *
    AFU   Test              *   All tests can be  executed  sequentially   *
    CMU84 C-G Test          *   by selecting the "SEQ" softkey.            *
    CMU84 Bias Test         *                                              *
    DC Leakage Test         * * * * * * * * * * * * * * * * * * * * * * * *

Before executing the desired test, attach the proper adapter to the SWM.

      Relay Test ................................  16075A
      SMU, VS, VM, AFU, CMS C-G, CMS BIAS Tests ...  16346B
      CMU84 C-G, CMU84 BIAS Tests ................  16346C
      DC LEAK Test ..............................  16066A

Select the desired softkey -------- Press [SHIFT] [MENU] for more keys.

                                                      User 1   Caps   Running
 RELAY    SMU     VS      VM          AFU      CMU84    CMU84   DC LEAK
                                               C-G      BIAS
```

Figure 2-9. 4062 W/O DVM Test Menu Page

SEQ Test

The SEQ Test performs the following eight subtests in the order listed. The SEQ Test can keep the test results in a file, and test results can be printed using the View Result function (see "View Result").

1. Relay Test
2. SMU Test
3. VS Test
4. VM Test
5. AFU Test
6. CMS C-G Test or CMU84 C-G Test
7. CMS Bias Test or CMU84 Bias Test
8. DC Leak Test

Note

If the system is not equipped with a VS/VMU, an AFU , a CMU or CMU84, the corresponding tests (VS, VM, AFU, CMS C-G and CMS Bias, CMU84 C-G and CMU84 Bias) are skipped automatically. If this is the case and you are performing tests separately, select the `SKIP` softkey to skip tests that are not required.

To store the test results file for the HP 4062C/PC, use an exclusive flexible disk or an exclusive directory. If you use HP BASIC on an HFS formatted hard disk or on an SRM system, /PCS/DIAG/DATA directory is recommended to store the test result file. If you use HP BASIC on an LIF formatted hard disk or from the BASIC system disks (flexible disks), prepare an exclusive flexible disk for storing the test result file, which is formatted as an LIF disk.

To store the test results file for the HP 4062UX, use the exclusive directory or /usr/pcs/diag/data directory.

- Required Equipment:

  Relay test adapter
  Test fixture adapter
  System calibration module
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

  1. Access the second set of softkeys by pressing (Shift)-(Menu), and select the `SEQ` softkey. The following message is displayed:

     `Do you want to keep result in a file ? (Type CAT to get file catalog)`

     To keep test results in a file, select the `Yes` softkey and proceed to the next step. If a test result file is not required, select the `No` softkey and proceed to the Relay Test.

  2. Specify the test result file name. For example:

     - For an HP 4062C/PC, type as follows:

       `DATA/PVW00190` (Return) *for HFS hard disk or SRM system of HP 4062C*
       `DATA\PVW00190` (Return) *for MS-DOS hard disk of HP 4062PC*
       `PVW00190:,700,1` (Return) *for flexible disk*

- ☐ For an HP 4062UX, type as follows:

  `data/PVW00190` (Return)

(PVW00190: Performance Verification W/O DVM, January(1) 1990)

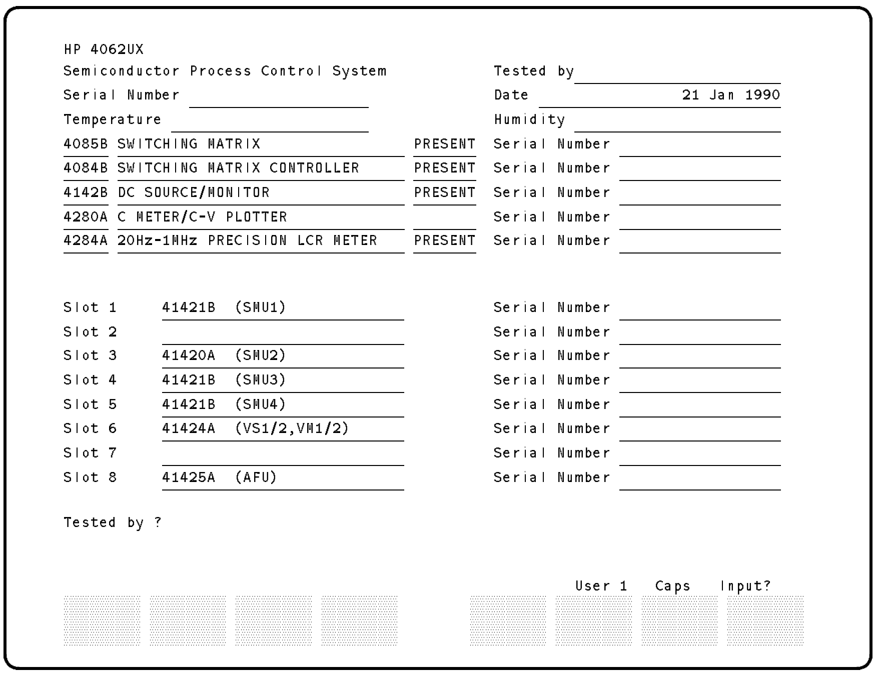
Note

A typical test result file size is about 200 records (51 kilobytes—if you don't retry the tests).

You can specify an existing file name, in which case data is appended to the end of the existing file. When printing test result files of this type, only the most recently entered data is printed.

3. If you specified an existing file name in the previous step, proceed to the Relay Test.

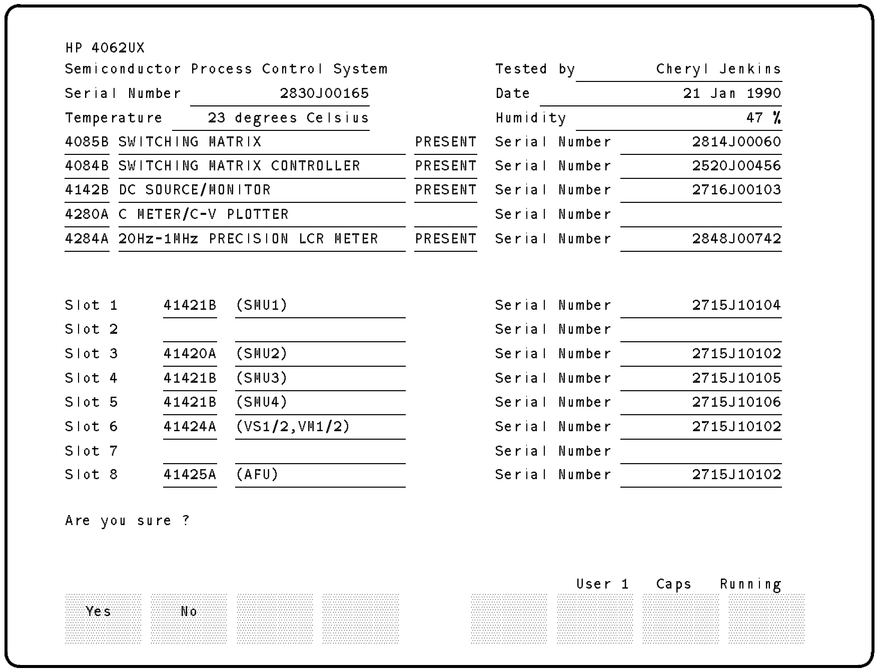
   If you specified a new file name in the previous step, a test result file data entry page similar to Figure 2-10 is displayed to let you enter information relevant to the file. Follow the displayed instructions.



```
HP 4062UX
Semiconductor Process Control System             Tested by
Serial Number                                    Date                21 Jan 1990
Temperature                                      Humidity
4085B SWITCHING MATRIX                   PRESENT Serial Number
4084B SWITCHING MATRIX CONTROLLER        PRESENT Serial Number
4142B DC SOURCE/MONITOR                  PRESENT Serial Number
4280A C METER/C-V PLOTTER                        Serial Number
4284A 20Hz-1MHz PRECISION LCR METER      PRESENT Serial Number

Slot 1     41421B  (SMU1)                        Serial Number
Slot 2                                           Serial Number
Slot 3     41420A  (SMU2)                        Serial Number
Slot 4     41421B  (SMU3)                        Serial Number
Slot 5     41421B  (SMU4)                        Serial Number
Slot 6     41424A  (VS1/2,VM1/2)                 Serial Number
Slot 7                                           Serial Number
Slot 8     41425A  (AFU)                         Serial Number

Tested by ?

                                                 User 1   Caps   Input?
```

Figure 2-10. PV Test Results Header Entry Page

Figure 2-11 shows an example header entry page with test result data. After you enter the header data, select one of the displayed prompts: the `Yes` softkey if all information is correct, or the `No` softkey to correct erroneous information.



HP 4062UX

Semiconductor Process Control System			Tested by	Cheryl Jenkins
Serial Number	2830J00165		Date	21 Jan 1990
Temperature	23 degrees Celsius		Humidity	47 %
4085B	SWITCHING MATRIX	PRESENT	Serial Number	2814J00060
4084B	SWITCHING MATRIX CONTROLLER	PRESENT	Serial Number	2520J00456
4142B	DC SOURCE/MONITOR	PRESENT	Serial Number	2716J00103
4280A	C METER/C-V PLOTTER		Serial Number	
4284A	20Hz-1MHz PRECISION LCR METER	PRESENT	Serial Number	2848J00742

Slot 1	41421B	(SMU1)	Serial Number	2715J10104
Slot 2			Serial Number	
Slot 3	41420A	(SMU2)	Serial Number	2715J10102
Slot 4	41421B	(SMU3)	Serial Number	2715J10105
Slot 5	41421B	(SMU4)	Serial Number	2715J10106
Slot 6	41424A	(VS1/2,VM1/2)	Serial Number	2715J10102
Slot 7			Serial Number	
Slot 8	41425A	(AFU)	Serial Number	2715J10102

Are you sure ?

User 1 Caps Running

Yes No

Figure 2-11. Example PV Test Result Header Entry Page

Note

If an error occurs when recording the test results header, the program aborts and cannot be continued. Possible errors and their probable causes are listed below, where *xxxxx* is the file name (specified in step 2) and *yyyyy* is the temporary file name.

If an error occurs (program aborts), catalog the files on the data disk and delete temporary files (`TEMP001`, `TEMP002`, and so on).

- `Can't create` *xxxxx*`.`

  An incorrect mass storage or a write protected device is specified. Or this error may occur when reading a previously recorded file, or if mass storage is full.

- `Can't output data to` *yyyyy*`.`

  Error when writing data to a temporary file. Disk rejected.

- `Can't copy` *yyyyy* `to` *xxxxx*`.`

  Error when copying a temporary file to a user specified file.

- `Can't purge` *yyyyy*`.`

  Error when purging temporary files.

- `Can't assign` *xxxxx* `(`*yyyyy*`).`

  The ASSIGN statement failed.

- `Error in copying data from` *yyyyy* `to` *xxxxx*`.`

  Error when reading or writing a file.

Relay Test

The Relay Test checks all relays on the pin boards installed in the SWM for correct on/off (make/break) operation. For 96-pin SWM systems, the Relay Test checks the pin board relays by dividing the SWM into two sets of pins: pins 1–48 (Block 1) and pins 49–96 (Block 2). Also, for 96-pin SWM systems, the Relay Test checks the input relays on the SMU and AUX port boards.

The total time required to complete the Relay Test depends on the number of pin boards installed in the SWM. For a fully configured 48-pin SWM, the Relay Test takes about 60 seconds; for a fully configured 96-pin SWM, the Relay Test takes about 150 seconds.

Note

The Relay Test must be executed before the SMU Test because the SMU Test requires correct relay operation.

To perform the Relay Test, at least five pin boards, arranged in any configuration, must be installed in the SWM.

- Required Equipment:

  Relay test adapter
  Test fixture adapter (for 96-pin SWM systems)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Install the relay test adapter on the SWM (see “Mounting Test Equipment”).

Note

Be sure that the relay test adapter is mounted securely and that its contacts are clean. Poor contact with the measurement pins of the SWM may cause the system to fail the Relay Test.

2. Select the `Relay` softkey. If performing the SEQ Test, select the `NEXT` softkey. (To skip this test, select the `SKIP` softkey.) The Relay Test starts immediately.

3. If a faulty relay is detected, the Relay Test stops and an error message like the one below is displayed:

```
PV. ERROR !!  A relay is open (contacts will not MAKE).
    Relay#K21 on pin board#26.
    Normally open contacts of a SENSE TRANSFER relay not functioning
    properly.
```

   Note the displayed error message and the number of the faulty relay, and proceed to the troubleshooting tree in Chapter 3.

   If a faulty relay is detected, the Relay Test stops and cannot be continued. Therefore, additional faulty relays may exist. After repairing the indicated faulty relay, be sure to run the Relay Test again (select the `RETRY` softkey) to check for additional faulty relays.

   While testing the HP 4085B 48-pin SWM, the Relay Test performs a Pin Board Test, which checks all relays on the pin boards on/off (make/break) operation. When the

Relay Test finishes without errors, the test results are displayed as shown in Figure 2-12.

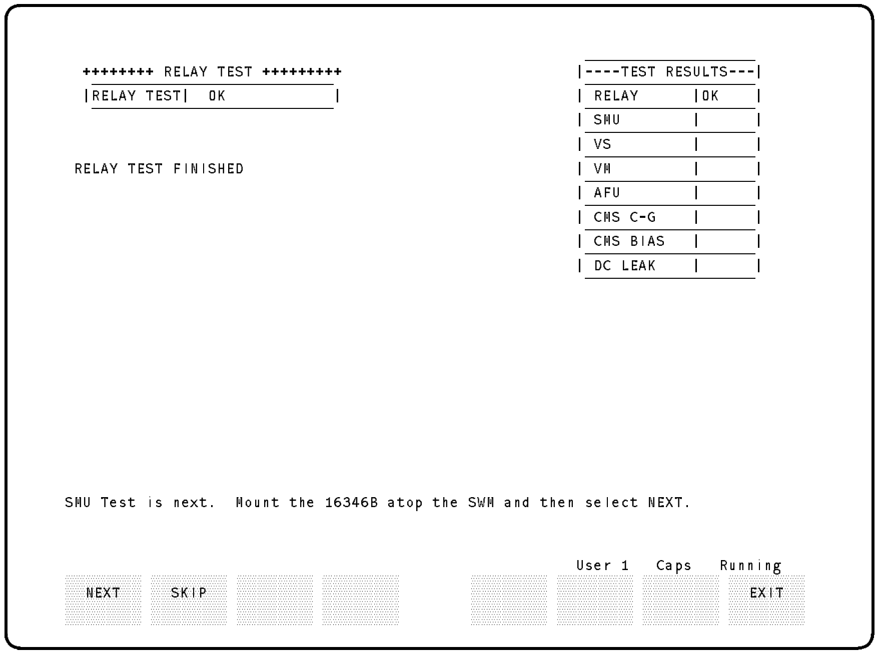


Figure 2-12. Relay Test Results Page for 48-pin SWM

When testing the HP 4089A/B 96-pin SWM, the Relay Test performs not only a Pin Board Test but an Input Relay Test, which checks all input relays on the port boards on/off (make/break) operation. The following message is displayed:

`INPUT RELAY TEST is next. Mount 16370A atop the SWM, then select NEXT.`

4. If the system has a 48-pin SWM, select the `NEXT` softkey (exits the Relay test) and go to the SMU Test.

   If the system has a 96-pin SWM, go to the next step.

5. Remove the test fixture adapter from the SWM and remove the relay test adapter from the test fixture adapter, and reinstall the (empty) test fixture adapter on the SWM.

6. Select the `NEXT` softkey to start the input relay test.

Note

Only input relays connected to a port are tested. If an input relay is not connected to a port, the corresponding row of that port is left blank on the RELAY TEST display page; and `OK(*)` is displayed in the RELAY row of the TEST RESULTS display page if all pin board relays are operating correctly (see Figure 2-13).

Note

For revision 5.6 only

If your system has a 96-pin SWM and is equipped with an HP 4284A CMU84, the Input Relay Test cannot check the input relay operation for port 8 and 9, which are CMH and CML ports respectively.

To check the input relay operation for port 8 and 9, use the following procedure:

1. After completing the 4062 W/O DVM Test, return to the PV4062 menu page.
2. Disconnect the test leads from the SWM, and connect the VM1 and VM2 of the VS/VMU to the AUX3 (CMH) and AUX4 (CML) ports using the interconnection cables.
3. Perform the START program by selecting the `START` softkey.
4. After completing the START program, select the `4062 W/O DVM` softkey.
5. Select the `Start` softkey on the 4062 W/O DVM Test start-up menu page.
6. Select the `RELAY` softkey on the 4062 W/O DVM Test menu page to perform the Relay Test independently. After the pin board relay test, all the input relays connected to the SMUs, VSs, and VMs are checked.
7. After completing the Relay Test, return to the PV4062 menu page.

If an error is detected when the input relay is checked, troubleshoot the input relay. See "Troubleshooting Pin Boards and Interface Boards" in Chapter 3 in chapter 3.

If the SWM is equipped with a port expander, the Port Expander Relay Test is performed. Go to the next step. Otherwise, go to the SMU Test.

7. Disconnect all unsupported instruments, and place BNC shorting caps on the connectors in place of the unsupported instruments and also on unused coaxial connectors.
8. Select the `NEXT` softkey to start the Port Expander Relay Test.

   When the Relay Test finishes without errors, test results are displayed as shown in Figure 2-13.

   Proceed to the SMU Test.

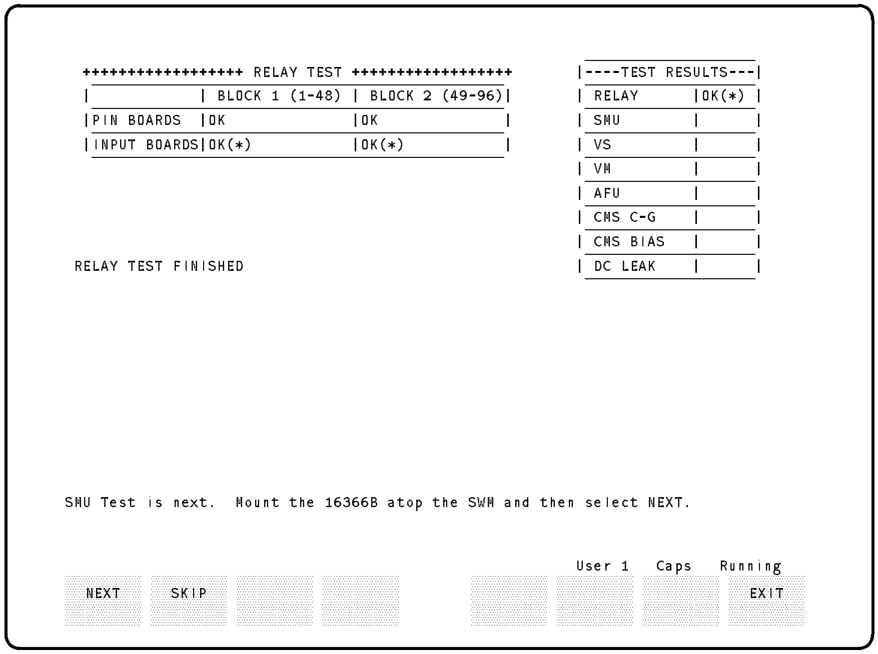


Figure 2-13. Relay Test Results Page for 96-pin SWM

When an error occurs during the Input Relay Test, the measurement value is displayed with the test limits on the screen similar to Figure 2-14.

For the input relay K11 force/guard side test and input relay K10 guard side test, a warning message similar to the following may be displayed when the measurement impedance is between 235 Ω and 500 Ω:

```
PV ERROR 18 (WARNING) Block 1 Input Relay K11 force side test failed.
Also CHECK FOLLOWING: Connection; Pin b'd 1; I-relay K10,K20,K21; SMU 1,2;
```

Poor contact between the mount of the J1 connector and the ground pattern on the SMU port board (see Figure 3-17) can cause the warning message. Check the contact between the J1 connector and the SMU port board.

```
++++++++++++++++++ RELAY TEST ++++++++++++++++++      |----TEST RESULTS---|
|             | BLOCK 1 (1-48)  | BLOCK 2 (49-96)|      | RELAY     |OK(*)  |
|PIN BOARDS   |OK              |OK              |      | SMU       |       |
|INPUT BOARDS|OK(*)           |ERROR           |      | VS        |       |
                                                      | VM        |       |
|INPUT RELAY  | BLOCK 2 K10 FORCE                   |  | AFU       |       |
|             | Low Limit   |Measure Value| High Limit |  | CMS C-G   |       |
| MAKE  [ohm]| 170.        | 2.44567E+00 | 500.( 235.)|  | CMS BIAS  |       |
| BREAK [ohm]| 1.000E+06   | 2.99988E+09 | 9.990E+99  |  | DC LEAK   |       |

RELAY TEST FINISHED




SMU Test is next.  Mount the 16366B atop the SWM and then select NEXT.

                                              User 1   Caps   Running
  NEXT     SKIP                                                   EXIT
```

Figure 2-14. Relay Test Results Page for 96-pin SWM

Note

The Relay Test is also performed in the following cases:

1. The Diagnostics (DIAG) program is run.
2. The LOCAL/SELF TEST key on the SWC is pressed.
3. The `TS` program code is sent to the SWC.

Relay Test results obtained by pressing the LOCAL/SELF TEST key of the SWC and when the `TR` program code is sent to the SWC can be read only under remote program control via HP-IB. Note that the relay test adapter must be installed on the SWM, when the Relay Test is performed. See "Troubleshooting with the Relay Test" in Chapter 3 for details.

SMU Test

The SMU Test checks each of the SMUs of the HP 4142B DCS for correct source and measurement operation. The SMU Test consists of the following tests:

- Self-Test of the DCS
- Repeat Test of the SMU
- Spot Test of the SMU

SMU Test execution time depends on the module configuration of the HP 4142B DCS. For a standard DCS configuration, which contains one HP 41420A 200 V/1 A SMU and three HP 41421B 100 V/100 mA SMUs, the SMU Test takes about 80 seconds.

Note

The Relay Test must be executed before the SMU Test because the SMU Test requires correct relay operation.

To perform the SMU Test, at least eight pin boards must be installed in the SWM at pin board locations 4, 8, 12, 16, 20, 24, 28, and 32 for 48-pin SWM systems; or pin board locations 12, 16, 20, 24, 28, 32, 76, 80, 84, and 88 for 96-pin SWM systems.

- Required Equipment:

  System calibration module
  Test fixture adapter (for 96-pin SWM systems)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Install the system calibration module on the SWM (see "Mounting Test Equipment").
2. Select the `SMU TEST` softkey. If performing the SEQ Test, select the `NEXT` softkey. (To skip this test, select the `SKIP` softkey.) The SMU Test starts immediately.
3. If the test detects an SMU failure, the test stops and an error code is displayed.

   When the SMU Test is finished, the test results are displayed, as shown in Figure 2-15.

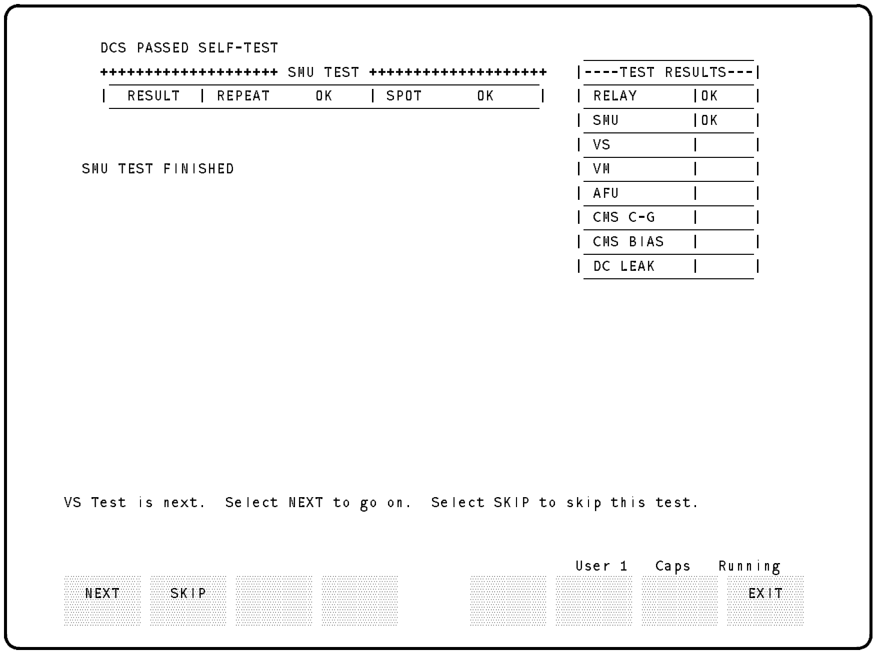


Figure 2-15. SMU Test Results

VS Test

The VS Test checks voltage sources VS1 and VS2 of the DCS VS/VMU for correct dc output. The VS Test takes about 10 seconds.

Note

To perform the VS Test, at least two pin boards must be installed in the SWM at pin board locations 4 and 8 for 48-pin SWM systems; or pin board locations 84 and 88 for 96-pin SWM systems.

- Required Equipment:

  System calibration module
  Test fixture adapter (for 96-pin SWM systems)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Install the system calibration module on the SWM (see "Mounting Test Equipment").
2. Connect the AUX1 and AUX2 cables to the VS1 and VS2 connectors, respectively.
3. Select the `VS Test` softkey. If performing the SEQ Test, select the `NEXT` softkey. (To skip this test, select the `SKIP` softkey.) After a brief connection check is made, the VS Test starts.

   After the VS Test is finished, a brief reconnection check is made and the test results are displayed as shown in Figure 2-16.

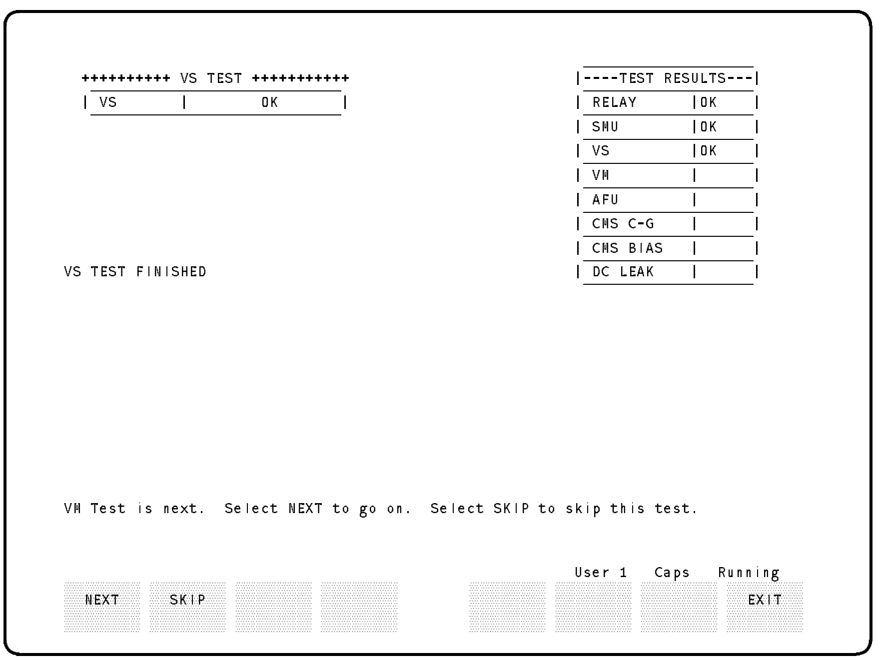


Figure 2-16. VS Test Results

VM Test

The VM Test checks voltage monitors VM1 and VM2 of the DCS VS/VMU for correct dc measurement operation. The VM Test takes about 10 seconds.

Note To perform the VM Test, at least two pin boards must be installed in the SWM at pin board locations 4 and 8 for 48-pin SWM systems; or pin board locations 84 and 88 for 96-pin SWM systems.

- Required Equipment:

  System calibration module
  Test fixture adapter (for 96-pin SWM systems)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Install the system calibration module on the SWM (see "Mounting Test Equipment").
2. Connect the AUX1 and AUX2 cables to the VM1 and VM2 connectors, respectively.
3. Select the `VM Test` softkey. If performing the SEQ Test, select the `NEXT` softkey. (To skip this test, select the `SKIP` softkey.) After a brief connection check is made, the VM Test starts.

   After the VM Test is finished, a brief reconnection check is made and the test results are displayed as shown in Figure 2-17.

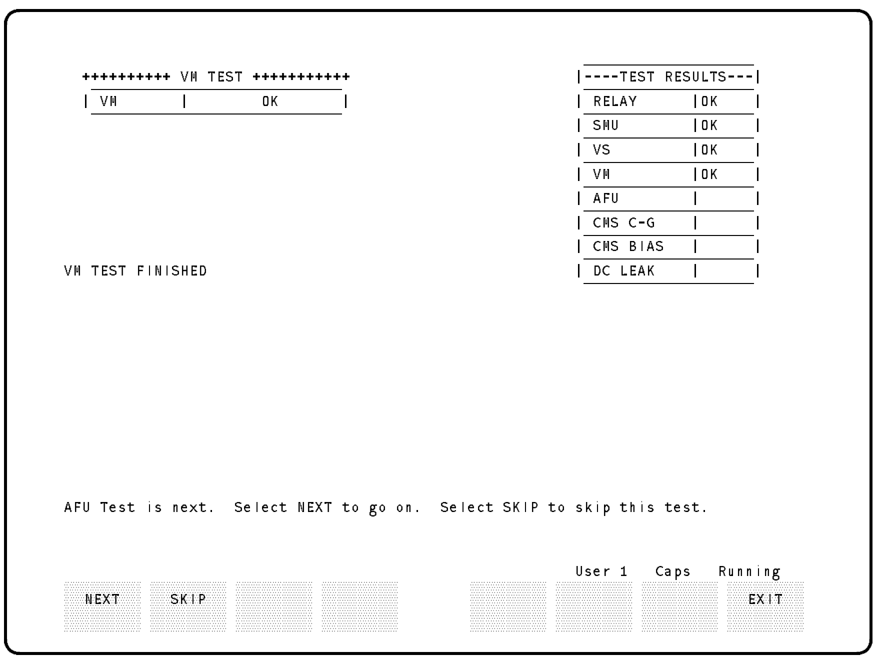


Figure 2-17. VM Test Results

AFU Test

The AFU Test checks the AFU of the HP 4142B DCS for correct operation. The AFU Test takes about 10 seconds.

Note To perform the AFU Test, at least two pin boards must be installed in the SWM at pin board locations 12 and 16 for 48-pin SWM systems; or pin board locations 20 and 24 for 96-pin SWM systems.

- Required Equipment:

  System calibration module
  Test fixture adapter (for 96-pin SWM systems)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Install the system calibration module on the SWM (see "Mounting Test Equipment").
2. Select the `AFU Test` softkey. If performing the SEQ Test, select the `NEXT` softkey. (To skip this test, select the `SKIP` softkey.) The AFU Test starts immediately.

   After the AFU Test is finished, test results are displayed as shown in Figure 2-18.

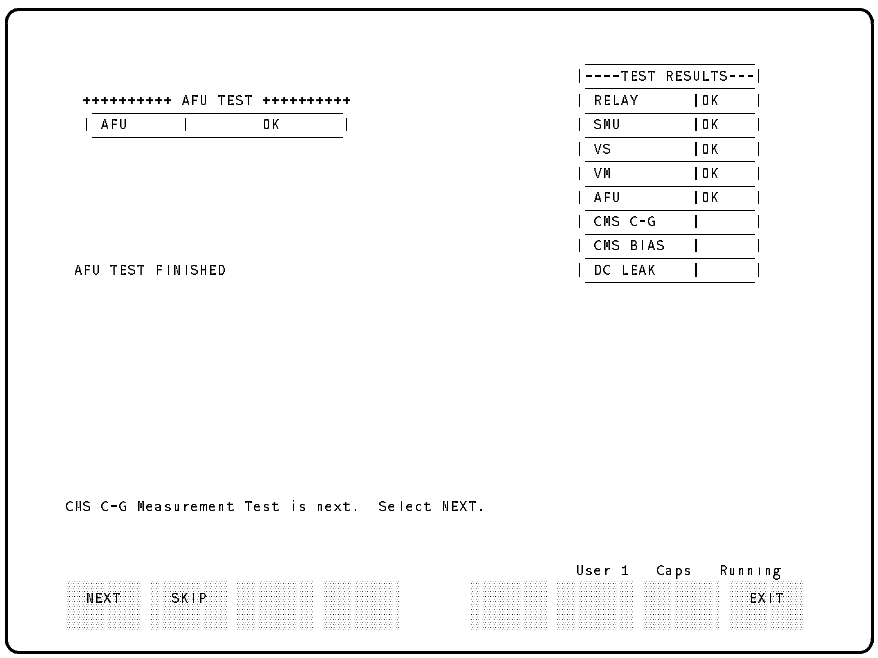


Figure 2-18. AFU Test Results

CMS C-G Test

The CMS C-G Test checks the capacitance C and conductance G measurement accuracy of the HP 4280A CMU. The test consists of the following tests:

- Self-Test of the CMU
- C Measurement Test
- G Measurement Test
- Stray Capacitance Test.

For 96-pin SWM systems, this test also includes a C and G Measurement Test between blocks 1 (pins 1 to 48) and 2 (pins 49 to 96).

The CMS C-G Test takes about 20 seconds for 48-pin SWM systems, and about 30 seconds for 96-pin SWM systems.

Note

To perform the CMS C-G Test for 48-pin SWM systems, at least four pin boards must be installed in the SWM at pin board locations 36, 40, 44, and 48; for 96-pin SWM systems, at least six pin boards must be installed in the SWM at pin board locations 4, 36, 40, 68, 72 and 96.

Before executing the CMS C-G Test, make sure the CMH and CML cables are properly connected.

- Required Equipment:

  System calibration module
  Test fixture adapter (for 96-pin SWM systems)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

  1. Install the system calibration module on the SWM (see "Mounting Test Equipment").
  2. Select the `CMS C-G` softkey. If performing the SEQ Test, select the `NEXT` softkey. (To skip this test, select the `SKIP` softkey.) The CMS C-G Test starts immediately.

     After the CMS C-G Test is finished, test results are displayed as shown in Figure 2-19.

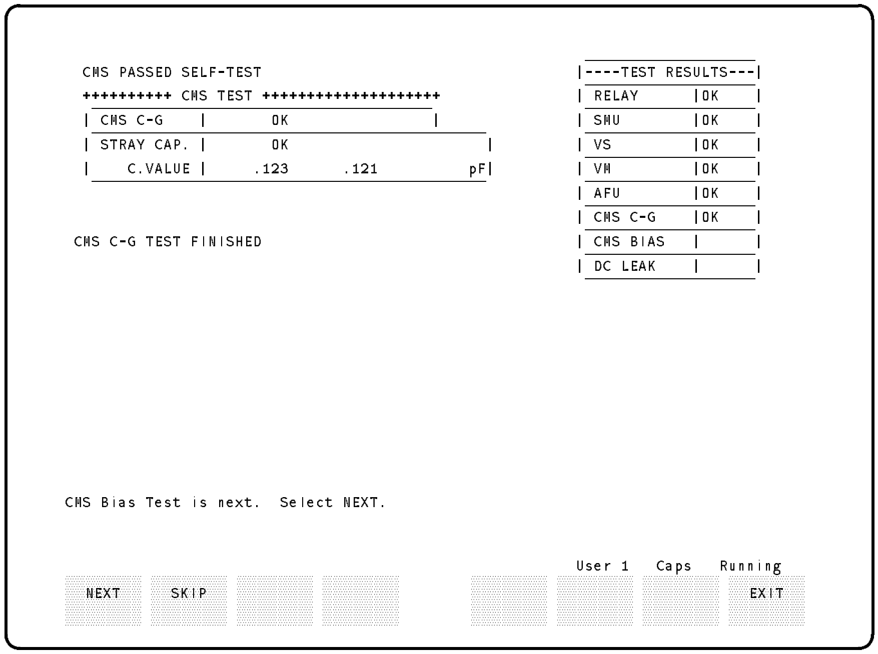


Figure 2-19. CMS C-G Test Result Page for an HP 4280A

CMS Bias Test

The CMS Bias Test checks the accuracy of the internal dc bias source of the HP 4280A CMU. The CMS Bias Test takes about 20 seconds.

Note To perform the CMS Bias Test, at least two pin boards must be installed in the SWM at pin board locations 4 and 8 for 48-pin SWM systems; or pin board locations 84 and 88 for 96-pin SWM systems.

- Required Equipment:

  System calibration module
  Test fixture adapter (for 96-pin SWM systems)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Install the system calibration module on the SWM (see "Mounting Test Equipment").
2. Select the `CMS BIAS` softkey. If performing the SEQ Test, select the `NEXT` softkey. (To skip this test, select the `SKIP` softkey.) The CMS Bias Test starts immediately.

   After the CMS Bias Test is finished, test results are displayed as shown in Figure 2-20.

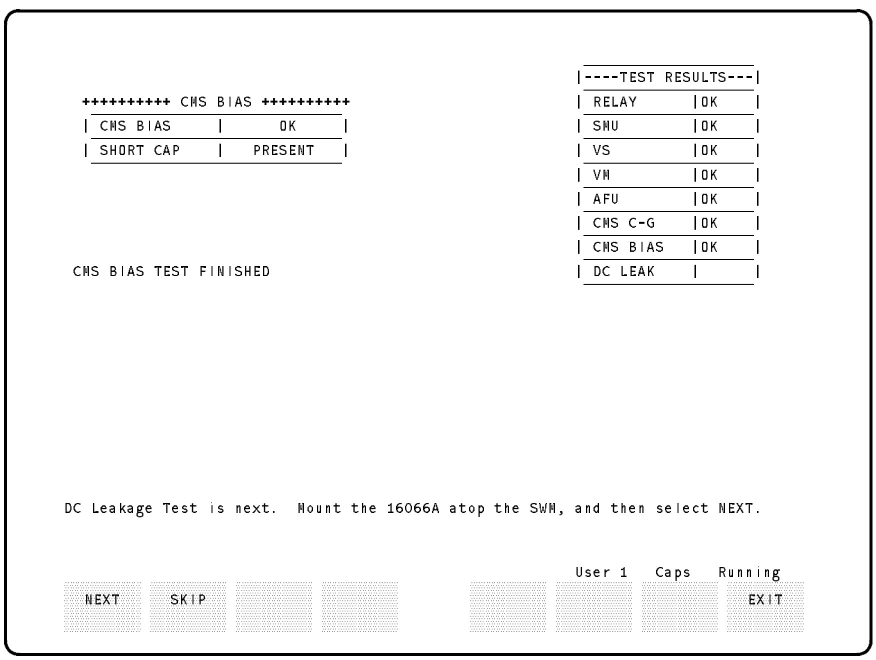


Figure 2-20. CMS Bias Test Results for an HP 4280A

CMU84 C-G Test

The CMU84 C-G Test checks the capacitance C and conductance G measurement accuracy of the HP 4284A CMU84. The test consists of the following tests:

- C Measurement Test
- G Measurement Test
- Stray Capacitance Test

For 96-pin SWM systems, this test also includes a C and G Measurement Test between blocks 1 (pins 1 to 48) and 2 (pins 49 to 96).

The CMU84 C-G Test takes about 10 seconds.

Note

To perform the CMU84 C-G Test for 48-pin SWM systems, at least twelve pin boards must be installed in the SWM at pin board locations 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, and 48; for 96-pin SWM systems, at least twelve pin boards must be installed in the SWM at pin board locations 20, 24, 36, 40, 44, 48, 52, 56, 60, 64, 68, and 72.

Before executing the CMU84 C-G Test, make sure the HP 16048E Test Leads are properly connected.

- Required Equipment:

  System calibration module
  Test fixture adapter (for 96-pin SWM systems)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Install the system calibration module on the SWM (see "Mounting Test Equipment").
2. Select the `CMU84 C-G` softkey. If performing the SEQ Test, select the `NEXT` softkey. (To skip this test, select the `SKIP` softkey.) The CMU84 C-G Test starts immediately.

   After the CMU84 C-G Test is finished, test results are displayed as shown in Figure 2-21.

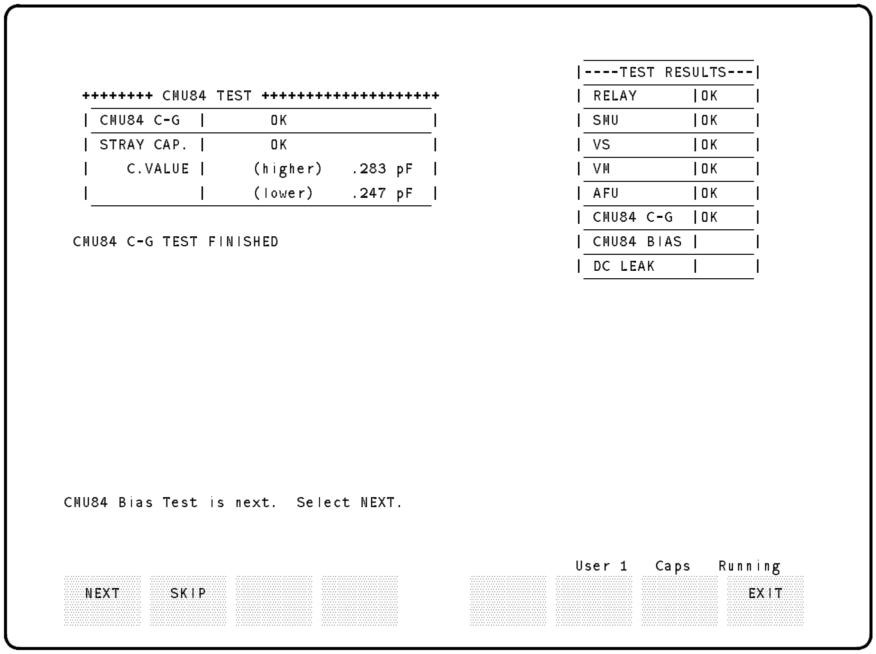


Figure 2-21. CMU84 C-G Test Result Page for an HP 4284A

CMU84 Bias Test

The CMU84 Bias Test checks the accuracy of the internal dc bias source of the HP 4284A CMU84. The CMU84 Bias Test takes about 20 seconds.

Note To perform the CMU84 Bias Test, at least two pin boards must be installed in the SWM at pin board locations 20 and 24 for 48-pin SWM systems; or pin board locations 84 and 88 for 96-pin SWM systems.

- Required Equipment:

  System calibration module
  Test fixture adapter (for 96-pin SWM systems)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Install the system calibration module on the SWM (see “Mounting Test Equipment”).
2. Select the `CMU84 BIAS` softkey. If performing the SEQ Test, select the `NEXT` softkey. (To skip this test, select the `SKIP` softkey.) The CMU84 Bias Test starts immediately.

   After the CMU84 Bias Test is finished, test results are displayed as shown in Figure 2-22.

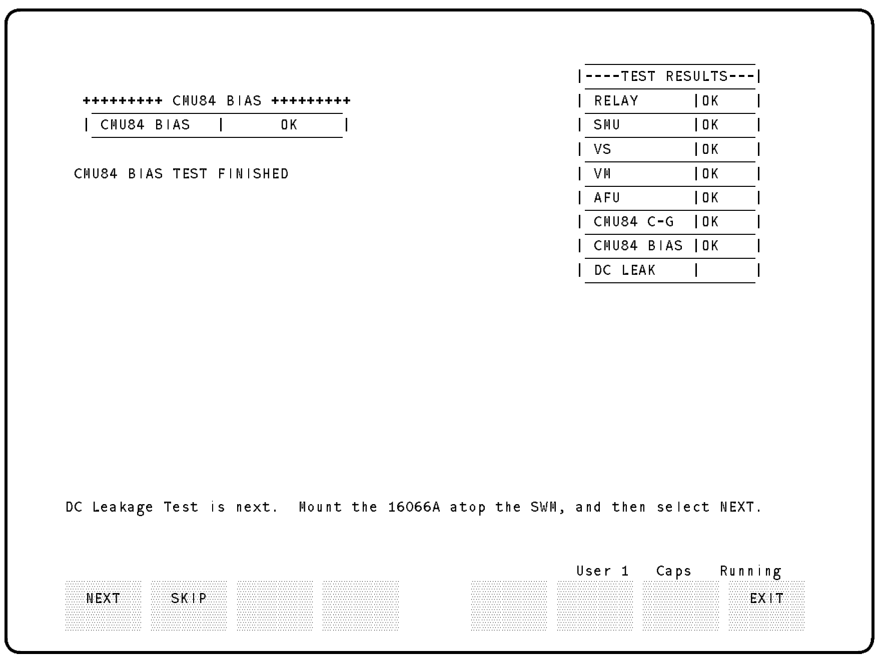


Figure 2-22. CMU84 Bias Test Results for an HP 4284A

DC Leak Test

The DC Leak Test checks all pin boards and all SMU ports for excessive leakage current to ground. The test consists of the following tests:

- Open test
- Short test

The DC Leak Test takes about 30 seconds. If the system fails the Short Test, however, test time may exceed 5 minutes.

- Required Equipment:

  Test fixture adapter
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Install the (empty) test fixture adapter on the SWM (see "Mounting Test Equipment").

Note Make sure to install *only* the test fixture adapter on the SWM, and that nothing is connected to the measurement pins of the SWM. If the test fixture adapter is not available, the extension cable fixture—with nothing connected to it—can be used.

2. Select the `DC LEAK` softkey. If performing the SEQ Test, select the `NEXT` softkey. (To skip this test, select the `SKIP` softkey.) The DC Leak Test starts immediately.

   After the DC Leak Test is finished, test results are displayed as shown in Figure 2-23.

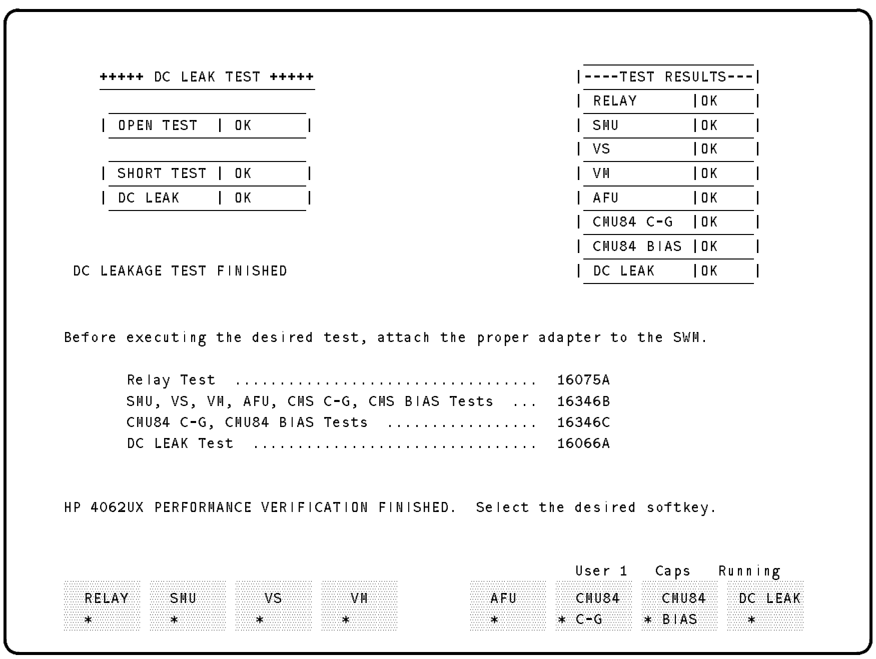


Figure 2-23. DC Leak Test Results

The 4062 W/ DVM Test

The 4062 W/ DVM Test uses a DVM to check the dc output and the measurement capabilities of the DCS at the measurement pins of the SWM, and consists of the following six subtests:

1. Ground Unit (GNDU) Test
2. Kelvin Connection Test
3. Voltage Source/Monitor Accuracy Test
4. Current Source/Monitor Accuracy Test
5. Voltage Source (VS) Accuracy Test
6. Voltage Monitor (VM) Accuracy Test

Note

To perform the 4062 W/ DVM Test for 48-pin SWM systems, at least eight pin boards must be installed in the SWM at pin board locations 4, 8, 12, 16, 20, 24, 28, and 32; for 96-pin SWM systems, at least ten pin boards must be installed in the SWM at pin board locations 12, 16, 20, 24, 28, 32, 76, 80, 84, and 88.

WAFER PROBER SENSE Switch

Warning

If either the FIXTURE CLOSED DETECT switch or WAFER PROBER SENSE switch is closed, dangerous dc voltage exceeding ±42 V may be present at the measurement pins. Severe electric shock will result if the measurement pins are touched.

Required Equipment

System calibration module (see "System Calibration Module")
Test fixture adapter
Digital multimeter (DMM)
HP-IB cable
BNC-to-dual banana plug cable (for revision 6.2 or earlier)
Mini pin plug-to-banana plug cable
Two banana-to-banana cables (for revision 6.2 or later)
Two BNC-to-Single banana jacks (for revision 6.2 or later)
PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

Note

The test fixture adapter, with no test fixture installed, is used to hold the WAFER PROBER SENSE switch closed during this test (to enable the SWM). If the test fixture adapter is not available, press and hold the SENSE switch during this test (see Figure 2-1 or Figure 2-2 for the location of the SENSE switch).

Note

For revision 6.2 or earlier

To make an accurate zero reference of the DMM for the test, use the following procedure:

1. When you perform the MIL standard calibration or when you need more accurate data for troubleshooting, use the ZERO CHECK terminal on the front of the GNDU module. Note that you must remove the HP 4142B front panel without disconnecting the signal cable (flat cable) to connect the DMM LO terminal to the HP 4142B ZERO CHECK terminal.
2. Otherwise use the outer conductor of the BNC connector on the system calibration module as a zero reference point.

Preparation

1. Connect an HP-IB cable to the HP-IB connector on the rear panel of the DMM.
2. Connect the other end of the HP-IB cable to the built-in HP-IB connector or the HP-IB card of the system controller. Here, you must remember the select code number of HP-IB interface where you connect the HP-IB cable.
3. Make sure TERMINALS push-switch on the DMM front panel is at the out position. This allows you to use the front panel input terminals.
4. Check the HP-IB address setting of DMM as follows, and remember it:
   - For HP 3458A:

     Press blue [ ] and [Local] (Address). The address appears on the front panel.
   - For HP 3456A:

     Check the DIP switch setting labeled ADDRESS on the rear panel. This DIP switch has 7 switches. The setting is the 5 rightmost switches. The TALK ONLY switch must always be 0.
5. Remember the device selector of the DMM used in the HP BASIC. For example, "2710" is the DMM of HP-IB address 10 connected to the select code 27 of HP-IB interface.

Note

The DMM must be warmed up: at least four hours for HP 3458A; one hour for HP 3456A.

Test Procedure

1. Install the test fixture adapter only on the SWM (see "Mounting Test Equipment").
2. Select the `4062C W/ DVM`, `4062UX W/ DVM`, or `4062PC W/ DVM` softkey from the PV4062 main menu.

   If COM blocks need to be redeclared, the START program runs automatically to redeclare them. If so, the configuration page is displayed temporarily, then the following startup menu page is displayed.

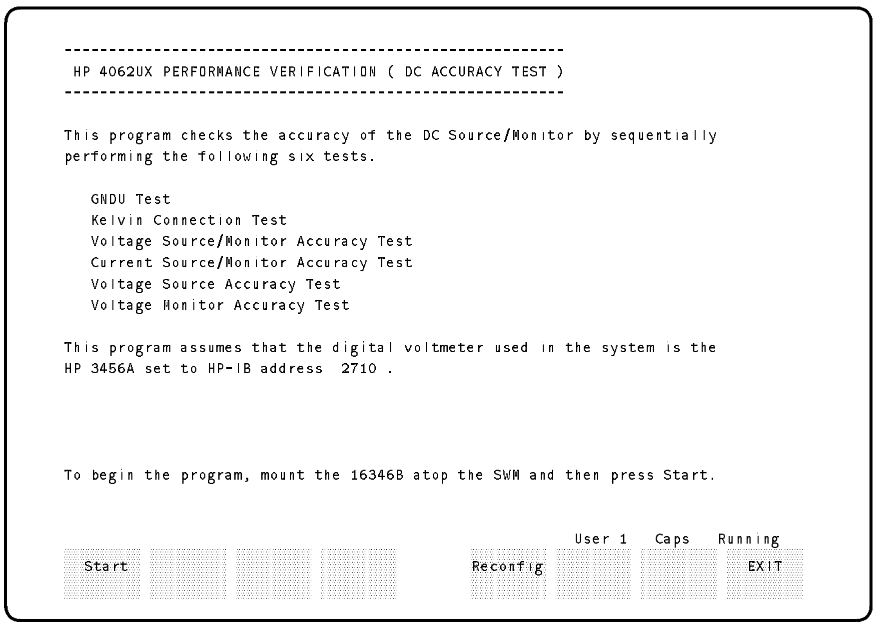


Figure 2-24. The 4062 W/ DVM Test Startup Menu Page

3. To verify or change the digital multimeter (DMM—HP 3456A or HP 3458A), the HP-IB address of DMM, or the calibration values of the system calibration module, select the `Reconfig` softkey, then do the following. Otherwise, go to step 4.

   The menu page shown in Figure 2-25 appears, which shows the selectable system calibration modules, the presently set DMM, and the HP-IB address of the DMM.

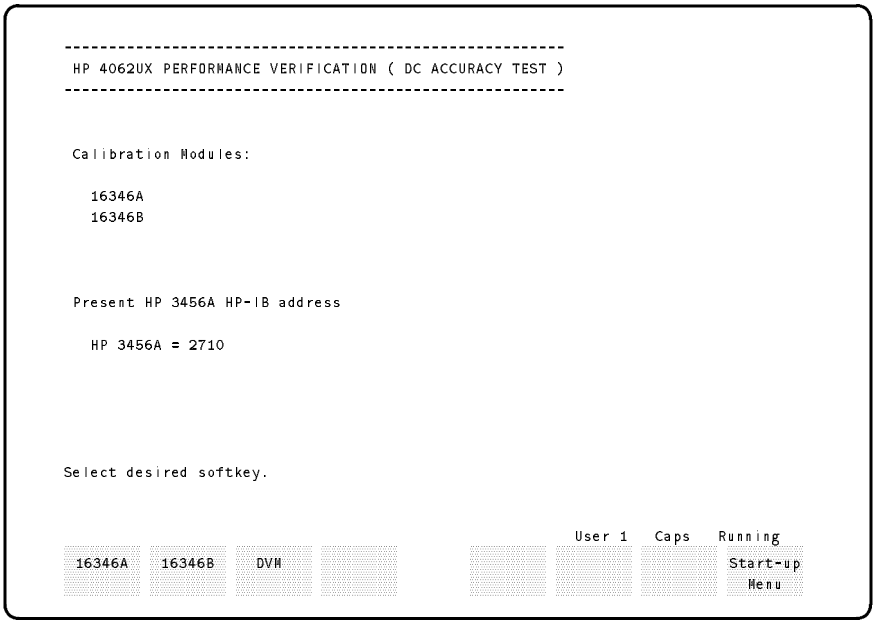


Figure 2-25. The 4062 W/ DVM Test Reconfiguration Menu Page

a. If you want to change the DMM or its HP-IB address setting (device selector), select the `DVM` softkey. Then, select the softkey of your DMM, and type in the device selector (for example, type: `710` (Return)).

b. If you want to check the calibration data, select the softkey of your system calibration module. The calibration data is displayed. Make sure this data matches data on the *CALIBRATION REPORT* sheet that is furnished with the module. If not, enter the correct data. To move the field pointer, use the (Tab) key or arrow keys. After completing the calibration data update, select the `SAVE/EXIT` softkey to store the data.

Note

Calibration data is stored in the /usr/pcs/diag/CAL_PV file and is used each time the PV software is run. For the revision 5.7 or earlier, CAL_DATA file is used instead of CAL_PV file.

c. Select the `Start-up Menu` softkey.

d. Select softkey of your system calibration module.

4. Remove the test fixture adapter, then install the system calibration module on the SWM as follows (see "Mounting Test Equipment"):

   For 48-pin SWMs, HP 16346A or B.
   For 96-pin SWMs, HP 16366A or B.

5. Select the `Start` softkey. The HP 4142B calibration executes, then the following message is displayed:

```
Do you want to keep result in a file ? (Type CAT to get file catalog)
```

- To not save results to a file, select `No` softkey. Then, go to step 6.

- To list existing file names, type: `CAT` (Return).
- To save results to a file, select the **Yes** softkey. The following message is displayed:

  `Type filename.  Clear line and press RETURN to cancel.`

  Default file name is displayed: `/usr/pcs/diag/data/PVW`*MonthYear* (revision 6.2 or later).

  a. Edit filename using arrow keys if desired.
     Do not use the same file name as for 4062 W/O DVM test. Also, do not save to present directory (/PCS/DIAG or /usr/pcs/diag directory). Hewlett-Packard recommends to save PV and DIAG results in /PCS/DIAG/DATA or /usr/pcs/diag/data directory. For example, enter as follows:

     `data/PVW0294` (Return)

     (`PVW0294`: Performance Verification W/ DVM, February (02) 1994.)

  b. If you entered an existing file name, go to step 6.
     If you entered a new file name, a page is displayed (similar to that shown in Figure 2-26) for entering test information. Follow the displayed instructions.

```
HP 4062UX
Semiconductor Process Control System          Tested by ____________
Serial Number ____________                    Date ________ 21 Jan 1990
Temperature ____________                      Humidity ____________
SWM  4085B SWITCHING MATRIX            PRESENT Serial Number ________
SWC  4084B SWITCHING MATRIX CONTROLLER PRESENT Serial Number ________
DCS  4142B DC SOURCE/MONITOR           PRESENT Serial Number ________
CMS  4280A C METER/C-V PLOTTER         _______ Serial Number ________

Slot 1                                        Serial Number ________
Slot 2      41420A  (SMU1)                    Serial Number ________
Slot 3      41421B  (SMU2)                    Serial Number ________
Slot 4      41421B  (SMU3)                    Serial Number ________
Slot 5                                        Serial Number ________
Slot 6      41420A  (SMU4)                    Serial Number ________
Slot 7      41424A  (VS1/2,VM1/2)             Serial Number ________
Slot 8      41425A  (AFU)                     Serial Number ________


Tested by ?

                                          User 1   Caps   Running
```

Figure 2-26. The PV Test Results Header Entry Page

After you enter the test information, reply to displayed prompt "`Are you sure?`": select **Yes** softkey if all information is correct, or **No** softkey if you need to re-enter information.

Note

Typical test result file size is about 200 records (51 kilobytes—if you don't retry the tests).

You can specify an existing file name, in which case data is appended to the end of the existing file. When printing test result files of this type, only the most recently entered data is printed.

Note

If an error occurs when recording test results, the program aborts and cannot be continued. Possible errors and their probable causes are listed as follows: where *xxxxx* is the file name (specified in step 10) and *yyyyy* is the temporary file name.

If an error occurs (program aborts), catalog the files on the data disk and delete temporary files (`TEMP001`, `TEMP002`, and so on).

- `Can't create` *xxxxx*`.`

  An incorrect mass storage, or a write protected device is specified. Or this error may occur when reading a previously recorded file, or if mass storage is full.
- `Can't output data to` *yyyyy*`.`

  Error when writing data to a temporary file. Disk rejected.
- `Can't copy` *yyyyy* `to` *xxxxx*`.`

  Error when copying a temporary file to a user specified file.
- `Can't purge` *yyyyy*`.`

  Error when purging temporary files.
- `Can't assign` *xxxxx* `(`*yyyyy*`).`

  The ASSIGN statement failed.
- `Error in copying data from` *yyyyy* `to` *xxxxx*`.`

  Error when reading from or writing to a file.

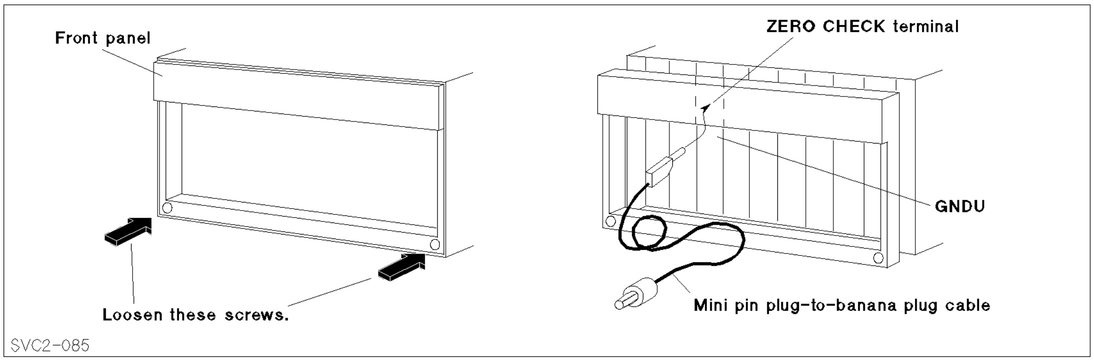
6. The following screen is displayed to describe the zero ground reference point of the HP 4062 system (revision 6.3 or later).

```
-----------------------------------------------------------------
                              NOTES
-----------------------------------------------------------------

In the tests follow, you must connect the DMV HIGH and LO terminals
to the correct positions according to the system messages.

In the system messages, pin number of the system calibration
module and ZERO CHECK terminal are used.  The ZERO CHECK terminal
is the zero reference point of HP 4142B.  To access the ZERO CHECK
terminal, you must remove the front panel of the HP 4142B, but do
not disconnect the signal cable (flat cable).







Press NEXT.

                                                User 1         Running
  NEXT
```

Figure 2-27.
Ground-level Reference Point of HP 4062 (Rev. 6.3 or later)

Perform the following procedure to remove the front panel of HP 4142B, so that you can access the zero reference point:

a. Loosen two screws on the front panel of the HP 4142B.
b. Remove the front panel from the HP 4142B. But *do not* disconnect the flat cable from the front panel.
c. Insert the pin plug of the mini pin plug-to-banana plug cable into the ZERO CHECK terminal on the GNDU module of the HP 4142B. Make sure the banana plug of the of the cable is not touching any other parts during testing.



Select the NEXT softkey.

7. **GNDU Test:**

- For revision 6.3 or later:

  Connect DMM HI to the system calibration module as follows:
  (Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
  Then select the NEXT softkey.

  For 48-pin SWMs, to either one of the pin 4 connectors.
  For 96-pin SWMs, to the pin 84 connector.

  Connect DMM LO to HP 4142B ZERO CHECK.
  (Use mini pin plug-to-banana plug cable).
  Then select the NEXT softkey.

- For revision 6.2 or earlier:

  Connect the DMM to the system calibration module as follows:
  (Use BNC-to-dual banana plug cable.)

  For 48-pin SWMs, to either one of the pin 4 connectors.
  For 96-pin SWMs, to the pin 84 connector.

  Then, select the NEXT softkey.

The GNDU Test starts. Figure 2-28 shows the GNDU Test display page.

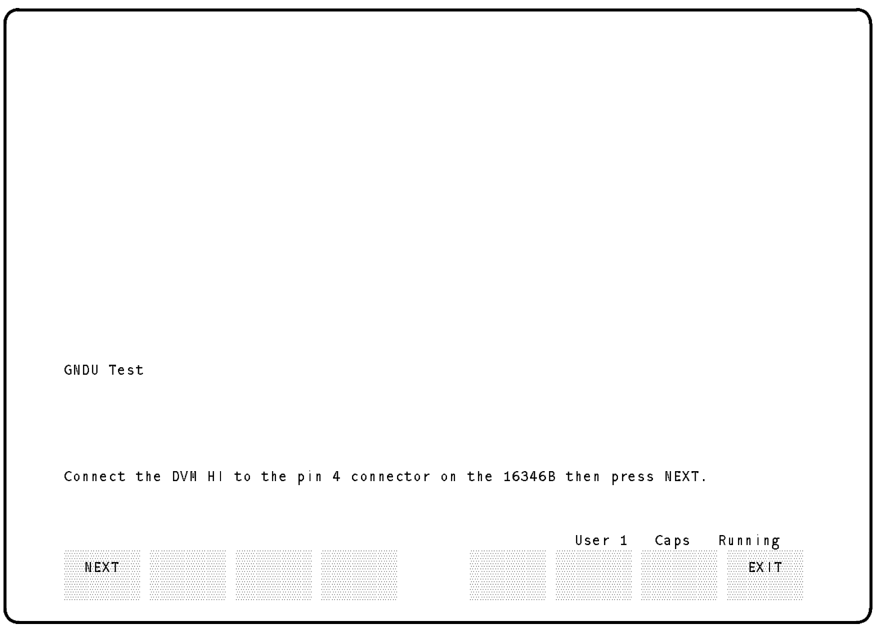


Figure 2-28. GNDU Test Page

8. **Kelvin Connection Test**:

- For revision 6.3 or later:

  With the same DMM to system calibration module connections as for the GNDU Test (previous test), select the NEXT softkey to run the Kelvin Connection Test.

- For revision 6.2 or earlier:

  Keep same connections as for the GNDU Test (previous test).
  Select the NEXT softkey *twice*.

The Kelvin Connection Test starts. Figure 2-29 shows the Kelvin Connection Test display page.

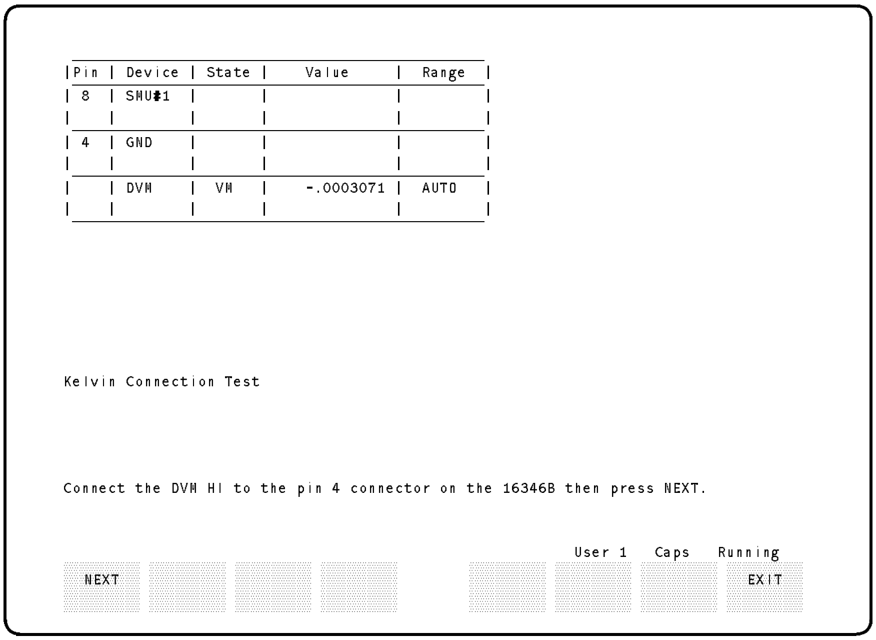


Figure 2-29. Kelvin Connection Test Page

9. **Voltage Source/Monitor Accuracy Test**:

- For revision 6.3 or later:

  Connect DMM HI to the system calibration module as follows:
  (Use banana plug-to-banana plug cable with the BNC-to-single banana jack.)
  Then select the NEXT softkey.

  For 48-pin SWMs, to the pin 20 connector.
  For 96-pin SWMs, to the pin 76 connector.

  Connect DMM LO to HP 4142B ZERO CHECK.
  (Use the mini pin plug-to-banana plug cable.)
  Then select the NEXT softkey.

- For revision 6.2 or earlier:

  Connect the DMM to the system calibration module as follows:
  (Use BNC-to-dual banana plug cable.)
  For 48-pin SWMs, to the pin 20 connector.
  For 96-pin SWMs, to the pin 76 connector.

  Select the NEXT softkey.

The Voltage Accuracy Test starts. Figure 2-30 shows the Voltage Accuracy Test display page.

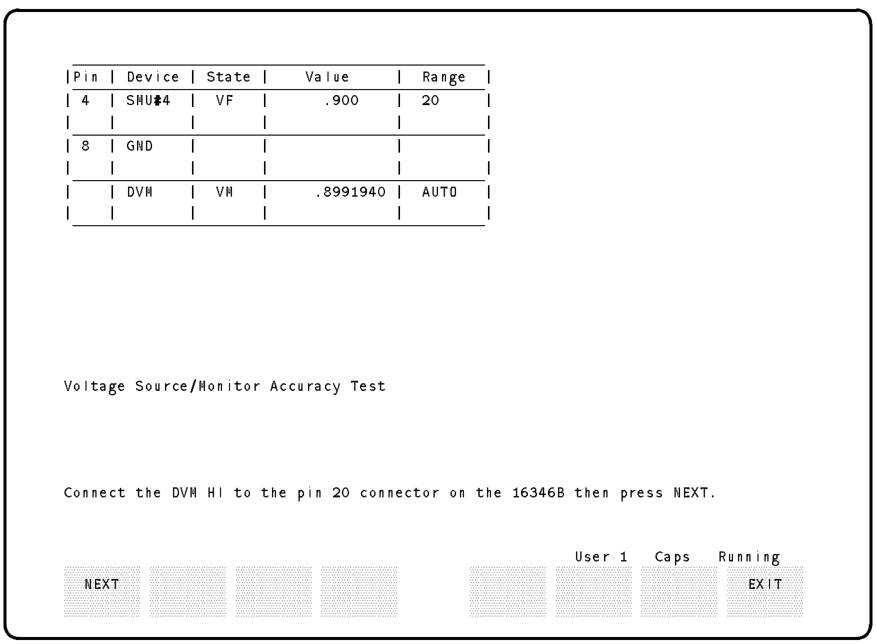


Figure 2-30. Voltage Accuracy Test Page

10. **Current Source/Monitor Accuracy Test**:

Note To check the accuracy of the 1 A range (HP 41420A SMU installed in the DCS), the HP 16346B System Calibration Module is required (other tests can be performed using the HP 16346A or B).

- For revision 6.3 or later:
  a. Connect DMM HI to the system calibration module as follows:
  (Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
  Then select the NEXT softkey.
  For 48-pin SWMs, to either one of the pin 4 connectors.
  For 96-pin SWMs, to the pin 84 connector.

Note If an HP 41420A SMU is connected to the SMU2 port, connect DVM HI to pin 8 of HP 16346B or to pin 12 of HP 16366, instead of pin 4 or 84, respectively. Either pin 8 or 12 connector is OK.

Connect DMM LO to the system calibration module as follows:
(Use the banana plug-to-banana plug cable with BNC-to-single banana jack.)
Then select the NEXT softkey.
For 48-pin SWMs, to the pin 12 connector.
For 96-pin SWMs, to the pin 16 connector.

The first part of the Current Accuracy Test starts.

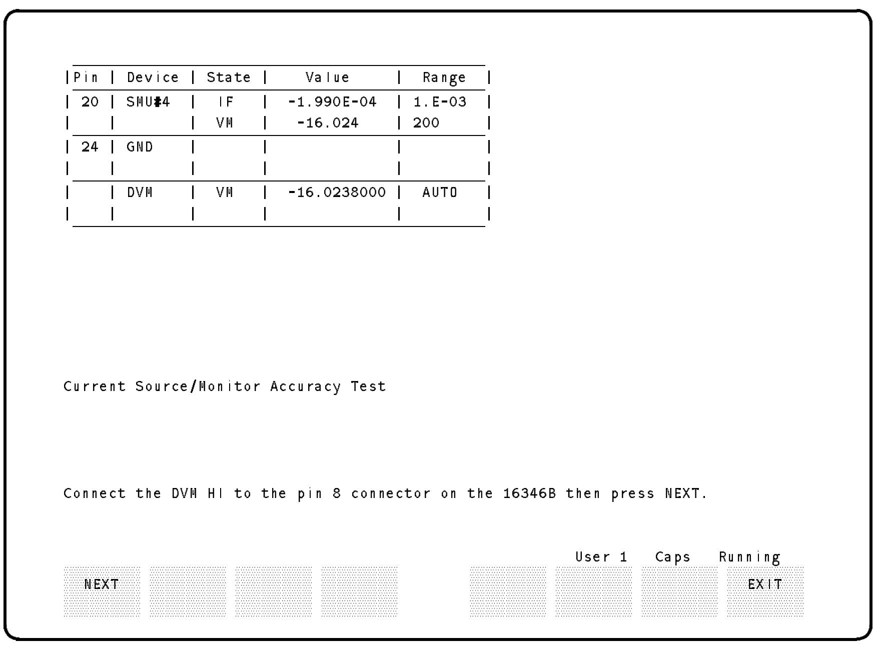


Figure 2-31. Current Accuracy Test Page

b. Connect DMM HI to the system calibration module as follows:
(Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
Then select the NEXT softkey.

For 48-pin SWMs, to either one of the pin 4 connectors.
For 96-pin SWMs, to the pin 84 connector.

Connect DMM LO to the system calibration module as follows:
(Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
Then select the NEXT softkey.

For 48-pin SWMs, to the pin 8 connector.
For 96-pin SWMs, to the pin 88 connector.

The second part of the Current Accuracy Test starts.

c. Connect DMM HI to the system calibration module as follows:
(Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
Then select the NEXT softkey.

For 48-pin SWMs, to the pin 12 connector.
For 96-pin SWMs, to the pin 20 connector.

Connect DMM LO to the system calibration module as follows:
(Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
Then select the NEXT softkey.

For 48-pin SWMs, to the pin 16 connector.
For 96-pin SWMs, to the pin 24 connector.

The third part of the Current Accuracy Test starts.

d. Connect DMM HI to the system calibration module as follows:
(Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
Then select the NEXT softkey.

For 48-pin SWMs, to the pin 20 connector.
For 96-pin SWMs, to the pin 76 connector.

Connect DMM LO to the system calibration module as follows:
(Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
Then select the NEXT softkey.

For 48-pin SWMs, to the pin 24 connector.
For 96-pin SWMs, to the pin 80 connector.

The fourth part of the Current Accuracy Test starts.

e. Connect DMM HI to the system calibration module as follows:
(Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
Then select the NEXT softkey.

For 48-pin SWMs, to the pin 32 connector.
For 96-pin SWMs, to the pin 32 connector.

Connect DMM LO to HP 4142B ZERO CHECK.
(Use mini pin plug-to-banana plug cable).
Then select the NEXT softkey.

The last part of the Current Accuracy Test starts.

- For revision 6.2 or earlier:
  a. Connect the DMM to the system calibration module as follows:
     (Use BNC-to-dual banana plug cable.)
     For 48-pin SWMs, to the pin 4 connector, or the pin 8 connector if an HP 41420A SMU is connected to the SMU2 port of the SWM.
     For 96-pin SWMs, to the pin 84 connector, or the pin 12 connector if an HP 41420A SMU is connected to the SMU2 port of the SWM.

     Then, select the `NEXT` softkey.
  b. Connect the DMM to the system calibration module as follows:
     (Use BNC-to-dual banana plug cable.)
     For 48-pin SWMs, to the pin 12 connector.
     For 96-pin SWMs, to the pin 20 connector.

     Then, select the `NEXT` softkey.
  c. Connect the DMM to the system calibration module as follows:
     (Use BNC-to-dual banana plug cable.)
     For 48-pin SWMs, to the pin 20 connector.
     For 96-pin SWMs, to the pin 76 connector.

     Then, select the `NEXT` softkey.

11. **VS Accuracy Test**:

- For revision 6.3 or later:

  This test checks the voltage output accuracy and current measurement accuracy of the VS. First, the voltage output accuracy test is executed, then the current measurement accuracy test is executed.

  a. Connect DMM HI to the system calibration module as follows:
     (Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
     Then select the `NEXT` softkey.

     For 48-pin SWMs, to the pin 32 connector.
     For 96-pin SWMs, to the pin 32 connector.

  b. Connect DMM LO to HP 4142B ZERO CHECK.
     (Use mini pin plug-to-banana plug cable).
     Then, select `NEXT` softkey.

  c. Connect VS1 output terminal to AUX1 port.
     Connect VS2 output terminal to AUX2 port.
     Then, select `NEXT` softkey.

  The voltage output accuracy test starts.

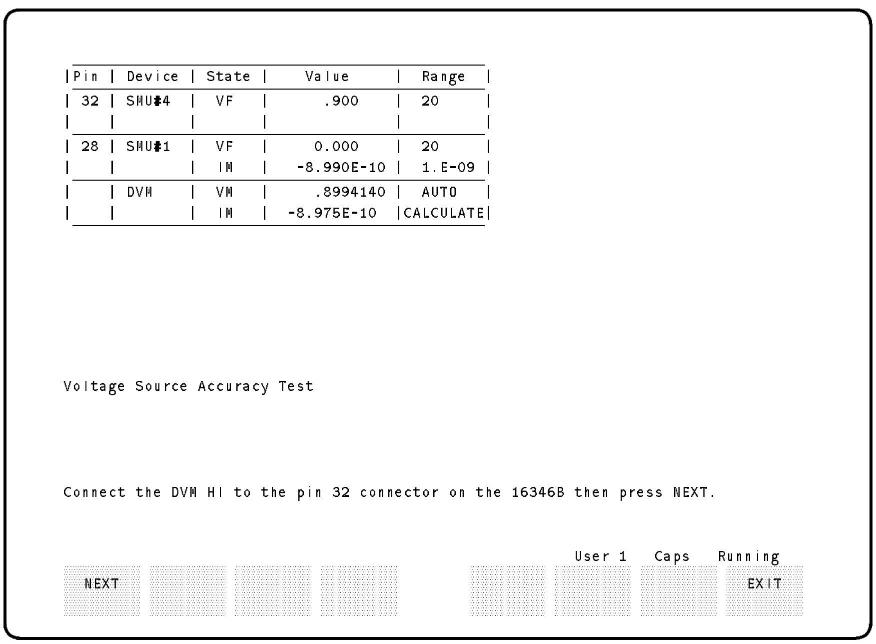


Figure 2-32. VS Test Page

  Then, some instructions appear depending on the configuration.

  a. Connect DMM HI to the system calibration module as follows:
     (Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
     Then select the `NEXT` softkey.

     For 48-pin SWMs, to either one of the pin 4 connectors.
     For 96-pin SWMs, to the pin 84 connector.

b. Connect DMM LO to the system calibration module as follows:
   (Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
   Then select the NEXT softkey.
   - For 48-pin SWMs, to either one of the pin 8 connectors.
   - For 96-pin SWMs, to the pin 88 connector.

c. Connect VS1 output terminal to AUX1 port.
   Connect VS2 output terminal to AUX2 port. Then, select NEXT softkey.

The current measurement accuracy test starts.
Then, some instructions appear depending on the configuration.

- For revision 6.2 or earlier:

  This test checks the voltage output accuracy and current measurement accuracy of the VS. First, the voltage output accuracy test is executed, and then the current measurement accuracy test is executed. For revision 6.0 or earlier, only the voltage output accuracy test is performed.

  - Voltage output accuracy test:

    Connect the DMM to the system calibration module as follows:
    (Use BNC-to-dual banana plug cable.)
    For 48-pin SWMs, to the pin 32 connector.
    For 96-pin SWMs, to the pin 32 connector.

    Then, select the NEXT softkey to run the VS Test.

  - Current measurement accuracy test:

    Connect the DMM to the system calibration module as follows:
    (Use BNC-to-dual banana plug cable.)
    For 48-pin SWMs, to either one of the pin 4 connectors.
    For 96-pin SWMs, to the pin 84 connector.

    Then, select the NEXT softkey to run the current measurement accuracy test.

12. **VM Accuracy Test**:

- For revision 6.3 or later:

  This test checks the voltage measurement accuracy for both grounded and differential measurement modes. First, the voltage measurement accuracy test for grounded mode is executed, then the voltage measurement accuracy test for differential mode is executed.

  a. Connect DMM HI to the system calibration module as follows:
  (Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
  Then select the NEXT softkey.

  For 48-pin SWMs, to either one of the pin 4 connectors.
  For 96-pin SWMs, to the pin 84 connector.

  b. Connect DMM LO to HP 4142B ZERO CHECK.
  (Use mini pin plug-to-banana plug cable).
  Then select the NEXT softkey.

  c. Connect VM1 output terminal to AUX1 port.
  Connect VM2 output terminal to AUX2 port.
  Then, select the NEXT softkey.

  The voltage measurement accuracy test for grounded measurement mode starts.

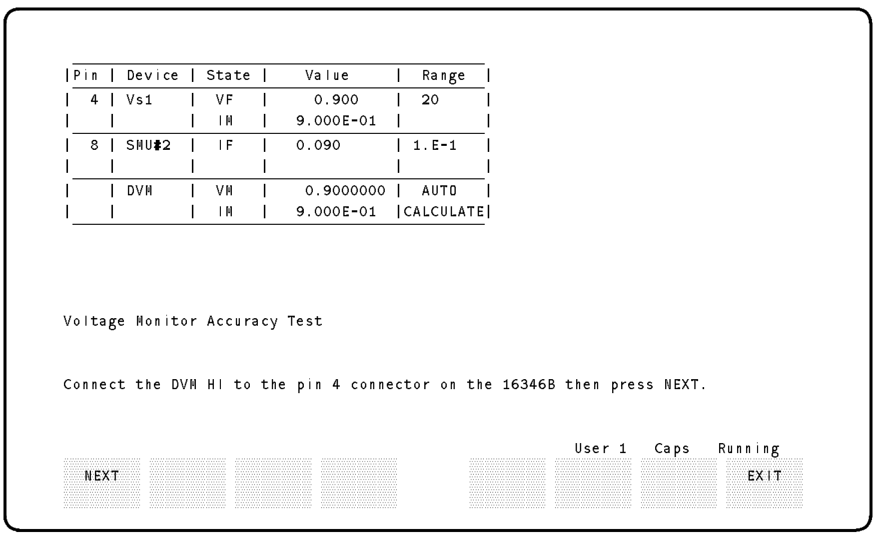


Figure 2-33. VM Test Page

  Then, some instructions appear depending on the configuration.

  a. Connect DMM HI to the system calibration module as follows:
  (Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
  Then select the NEXT softkey.

  For 48-pin SWMs, to either one of the pin 4 connectors.
  For 96-pin SWMs, to either one of the pin 4 connectors.

b. Connect DMM LO to the system calibration module as follows:
(Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
Then select the NEXT softkey.
   For 48-pin SWMs, to the pin 24 connector.
   For 96-pin SWMs, to the pin 24 connector.
c. Connect VM1 output terminal to AUX1 port.
Connect VM2 output terminal to AUX2 port.
Then, select the NEXT softkey.

The voltage measurement accuracy test for differential measurement mode starts. Then, some instructions appear depending on the configuration.

- For revision 6.2 or earlier:

This test checks the voltage measurement accuracy for both grounded and differential measurement modes. First, the voltage measurement accuracy test for grounded measurement mode is executed, and then the voltage measurement accuracy test for differential measurement mode is executed. For revision 6.0 or earlier, only the test for grounded measurement mode is executed.

- For grounded measurement mode:

  Connect the DMM to the system calibration module as follows:
  (Use BNC-to-dual banana plug cable.)
     For 48-pin SWMs, to either one of the pin 4 connectors.
     For 96-pin SWMs, to the pin 84 connector.

  Then, select the NEXT softkey to run the VM Test.

- For differential measurement mode:

  Connect DMM HI to the system calibration module as follows:
  (Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
     For 48-pin SWMs, to either one of the pin 4 connectors.
     For 96-pin SWMs, to the pin 84 connector.

  Connect DMM LO to the system calibration module as follows:
  (Use banana plug-to-banana plug cable with BNC-to-single banana jack.)
     For 48-pin SWMs, to the pin 48 connector.
     For 96-pin SWMs, to the pin 80 connector.

  Then, select the NEXT softkey.

13. **Test Results of 4062 W/ DVM Test**:

When all 4062 W/ DVM tests are finished, SMU and VS/VM (if the system is equipped with a VS/VMU) test results are displayed as shown in Figure 2-34 and Figure 2-35.

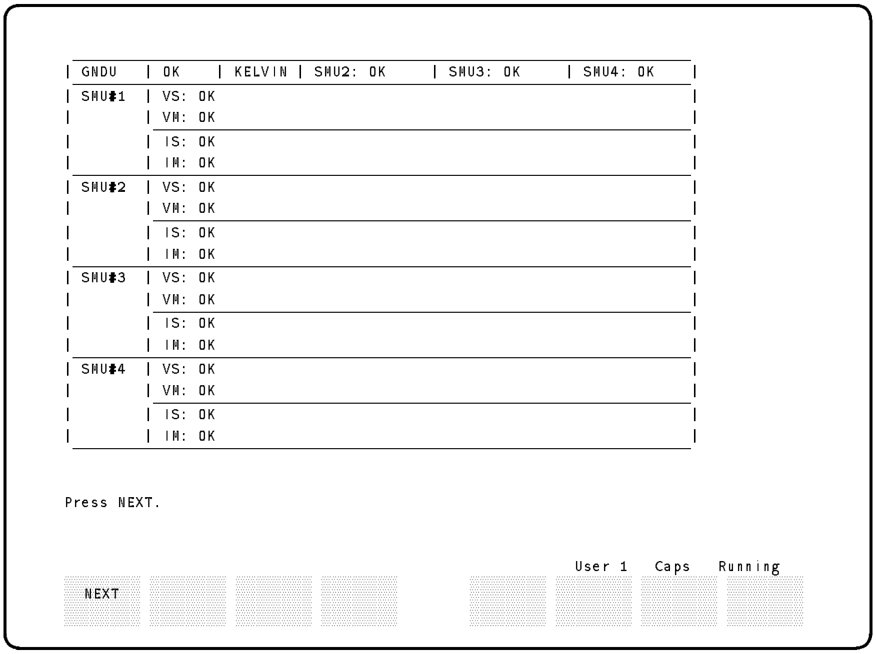


Figure 2-34. The 4062 W/ DVM SMU Test Results Page

The top display line of the Test Results page shows the GNDU and Kelvin Test results, and succeeding lines show the SMU Test results. The number displayed next to each SMU corresponds to the number of the SMU, not the SMU port number.

If an error was detected during the SMU Test, the range at which the error occurred is displayed next to the SMU's VS, VM, IS, or IM test where the error occurred.

If the VS/VM Tests were performed, select the NEXT softkey to display the VS/VM Test Results page as shown in Figure 2-35.

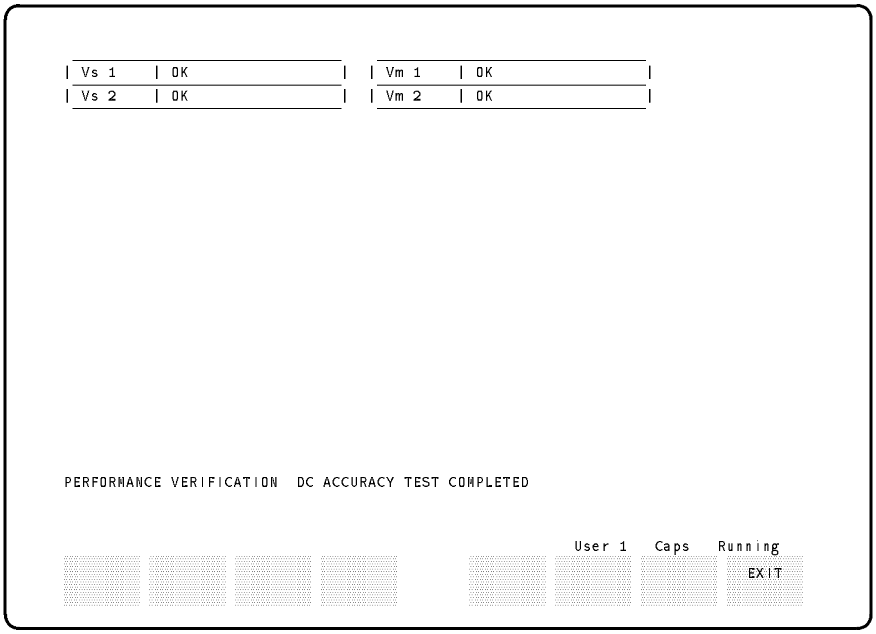


Figure 2-35. The 4062 W/ DVM VS/VM Test Results Page

4142B Test

The 4142B Test checks the dc output and measurement capabilities of the HP 4142B DCS at the front panel of the HP 4142B. This test should be performed, if the DCS fails the 4062 W/O DVM Test.

Because this test is identical to the test performed by the Performance Verification software for the HP 4142B, refer to the HP 4142B *Service Manual* for the test procedure.

- Required Equipment:

  Product Support Package for HP 4142B
  Calibration adapter
  Digital multimeter (DMM)
  RC box
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Setting up for the 4142B Test:

1. Select the 4142B softkey from the PV4062 main menu. The 4142B Test start-up menu page is displayed as shown in Figure 2-36.

```
******** HP 4142B TEST ********

** START UP MENU **

 Required test equipments are listed below.

   HP 4142B Modular DC Source/Monitor (HP-IB ADDRESS = 717)
   HP 3456A Digital Voltmeter         (HP-IB ADDRESS = 710)
   Printer Type                       (HP-UX SPOOL)
   Spooling command  (| lp)
   Product Support Package for HP 4142B (HP 16296A or 04142-65801)
   HP 16330A Calibration Adapter  ;  HP 16331A HCU Calibrator (0.1 ohm)
   HP 16340A RC Box and furnished accessories
   41422-61610 HCU Calibration Adapter Cable
   Dual Banana-to-BNC Cable (P/N 11001-60001)  ;  BNC Cables (max 3m), 2 ea
   Dual Banana-to-Alligator Clip (HP 11002A)   ;  BNC Shorting Cap
   BNC T-Adapters: Dual-Female-to-Male (P/N 1250-0781)
   Triaxial Male connectors (P/N 1250-1848), 3 ea


Press START to begin.

                                                User 1   Caps   Running
START                                 RECONFIG
```

Figure 2-36. The 4142B Test Start-up Menu Page

2. See "Performance Verification" in the HP 4142B *Service Manual* for procedures.

Timer Test (for HP 4062C only)

The Timer Test checks the HP 16321A VFP Timer Board for its switch settings and interrupt capability. This test is for the HP 4062C only.

- Required Equipment:

  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Select the TIMER softkey from the PV4062 main menu. The Timer Test display page is displayed as shown in Figure 2-37.

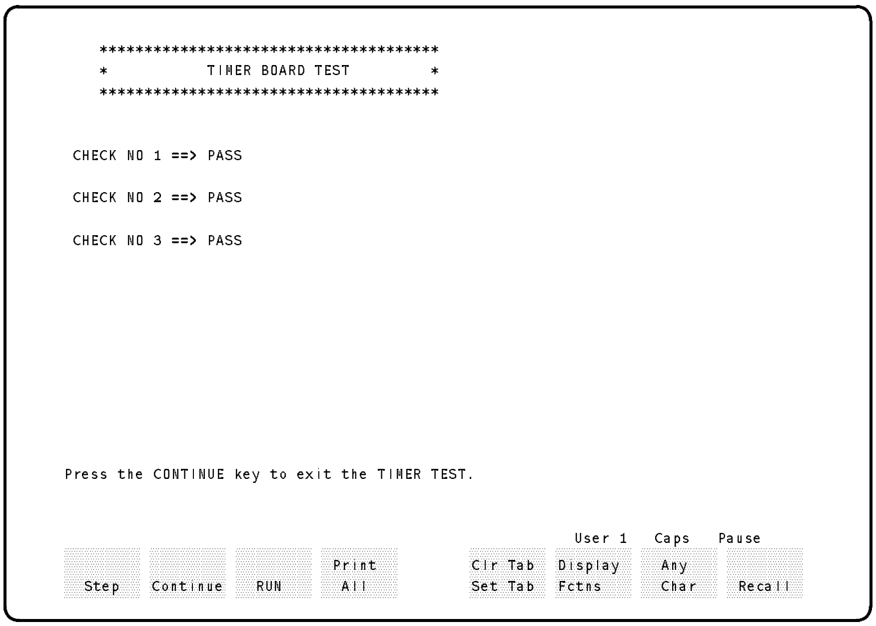


Figure 2-37. Timer Test Page

2. If an error occurs, check the switch settings (select code and interrupt level) of the VFP timer board. Figure 2-38 shows the correct settings.

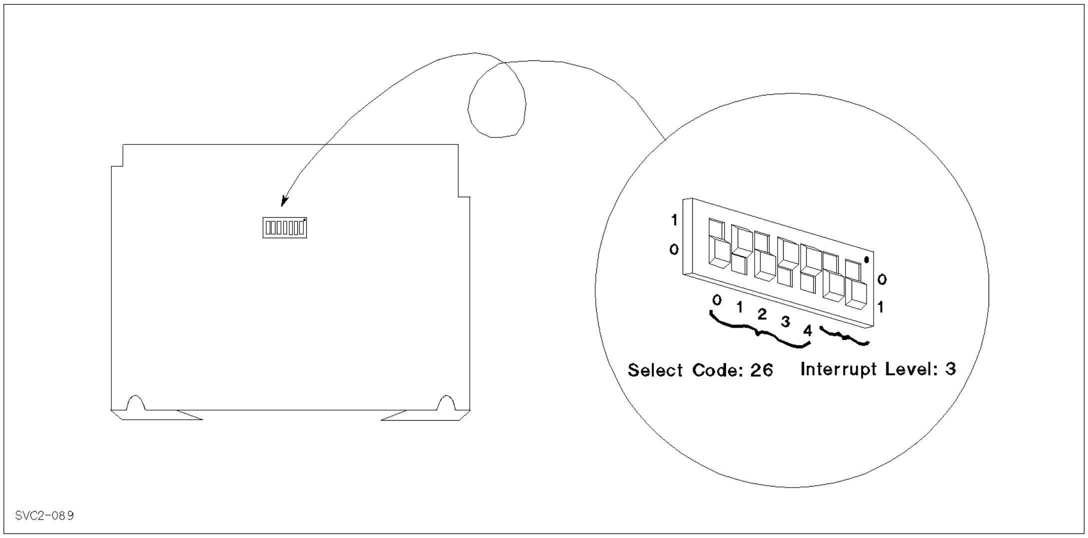


Figure 2-38. VFP Timer Board Settings

The START Program

The START program verifies the system configuration, initializes the individual system components, checks the measurement cable connections, measures the residual impedances of the measurement cabling and stores these measurement values for error compensation purposes, and declares the COM blocks accessed by various other system software program files.

Note

If the COM blocks declared during START are lost, the following error may occur:

```
ERROR 145 IN 10 May not build COM at this time
```

If this error occurs, run START before proceeding. For more information on COM blocks, refer to the *BASIC Programming Techniques* Manual.

Pre-START Conditions

Before START can be run, the following conditions must be satisfied. Note that most, or all, of these conditions were established at system installation and should not have been changed.

- The HP-IB interface card for the system instruments must be set as follows:

Table 2-4. HP-IB Interface Card Setting

	HP 4062C	HP 4062UX (s300)	HP 4062UX (s700)	HP 4062PC
Controller	HP 9000 s300	HP 9000 s300[1]	HP 9000 s700	HP 82324A with PC
HP-IB Interface	HP 98624A	HP 98624A	HP E2071B or Built-in HP-IB	Built-in HP-IB
Select Code	27	27	27[2]	7[3]
HP-IB Address	21	21	21[2]	21[4]
System Controller	ON	ON	ON[2]	ON[4]
Interrupt Level	3	3	3[2]	3[3]

1 If the system controller is an HP 9000 Series 300 Model 318M, 319C+, 340, or 345 computer, ignore this condition.

2 These settings are defined in /usr/pil/etc/hwconfig.cf file.

3 These settings cannot be changed for the built-in HP-IB of HP 82324A.

4 Hardware configuration switch (SW1) on the HP 82324A board defines whether or not the board is system controller or non-system controller. When the board is system controller, the HP-IB address of built-in HP-IB is 21.

- The HP-IB addresses of the system instruments must be set as follows:

SWC (HP 4084B Switching Matrix Controller):	22
DCS (HP 4142B Module DC Source/Monitor):	23
CMU (HP 4280A 1MHz C Meter/C-V Plotter):	24
CMU84 (HP 4284A 20 Hz–1 MHz Precision LCR Meter):	17

If the system is equipped with the HP 4089A/B (96-pin) SWM, be sure the HP-IB address of the second HP 4084B SWC is set to 19.

- If the system controller is an HP 9000 Series 300 Model 318M, 319C+, 340, or 345 computer, the SWC, DCS, and CMS (CMU or CMU84) must be connected to the built-in HP-IB interface (select code 7). Otherwise, the SWC, DCS, and CMS must be connected to the HP-IB interface card (select code 27). Connect *no* other instruments to this interface.
- The SWC and SWM must be interconnected with the control cable(s).
- A BNC shorting cap must be connected to the INT BIAS-REMOTE ON/OFF connector on the HP 4280A CMU front panel.
- The INT BIAS limit switch on the HP 4280A CMU front panel must be set to ±100 V.
- A BNC shorting cap must be connected to the EXT BIAS-SLOW connector on the HP 4280A CMU rear panel.
- Automatic wafer probers should be connected to the HP-IB interface card (select code 25).

  If the system controller is an HP 9000 Series 300 Model 318M, 319C+, 340, or 345 computer, you can connect automatic wafer probers to the built-in HP-IB interface (select code 7). In this case, the SYSCONFIG file must be modified.

  For complete details on wafer prober use, refer to Chapter 5 of the *HP 4062C/UX System Operation*.
- The HP 4142B DCS and SWM must be interconnected using the interconnection cable assembly. The SMU2 port cable should be connected to an HP 41420A SMU of the DCS. VSs and VMs of the DCS can be connected to any of the AUX ports of the SWM using the AUX cables.

  If an HP 4280A CMU is used, the CMU and SWM must be interconnected using the test lead assembly, the CMH cable, and the CML cable.

  If an HP 4284A CMU84 is used, the CMU84 and SWM must be interconnected using the HP 16048E Test Leads, two BNC T-adapters, two BNC f-to-f adapters, and two BNC-BNC cables.

Running the START Program

- Required Equipment:

  Test fixture adapter
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)
- Test Procedure:
  1. Install the (empty) test fixture adapter on the SWM or press and hold the WAFER PROBER SENSE switch of the SWM while START runs. Do *not* use the relay test adapter for START.
  2. Select the `START` softkey from PV4062 main menu.
  3. If your system is an HP 4062C, the START program prompts you to correct the date and time. If no change is needed, press the (Return) key.

After system initialization, the START program displays the system configuration page, similar to that shown in Figure 2-39 and Figure 2-40. Explanations for each area of this display page follow the figure.

```
*************** SYSTEM CONFIGURATION ******************|**** AVAILABLE PINS *****
16321A VFP TIMER BOARD:                    Present     |         02    04
4084B/4085B SWITCHING MATRIX:              Present     |         06    08
4142B DC SOURCE/MONITOR (Rev. 3.00):       Present     |         10    12
4280A 1 MHz C METER/C-V PLOTTER:           Not present |         14    16
4284A 20MHz-1MHz LCR METER (Opt. 001/006): Present     |         18    20
ELECTROGLAS 2001X WAFER PROBER:            Present     |         22    24
***************** DCS CONFIGURATION *******************|         26    28
SLOT1: 41421B (SMU1)       SLOT5: 41421B (SMU4)        |         30    32
SLOT2:                     SLOT6: 41424A (AUX1/2)      |         34    36
SLOT3: 41420A (SMU2)       SLOT7:                      |         38    40
SLOT4: 41421B (SMU3)       SLOT8: 41425A               |         42    44
************ AUXILIARY PORT CONFIGURATION *************|         46    48
AUX1: VS1                  AUX3: CMH84                 |
AUX2: VS2                  AUX4: CML84                 |


System date & time:  21 Jan 1990  12:34:56


"START" end.     ---------- Press [SHIFT] [MENU] for more keys.


                                                          User 1   Caps   Idle
EDIT     Continue   RUN    SCRATCH         LOAD ""  RE-STORE  Delete    Link
                                                       ""       TIS      TIS
```

Figure 2-39. System START Page (for HP 4062C)

```
*************** SYSTEM CONFIGURATION ******************|**** AVAILABLE PINS *****
4084B/4085B SWITCHING MATRIX:              Present     |         02    04
4142B DC SOURCE/MONITOR (Rev. 3.00):       Present     |         06    08
4280A 1 MHz C METER/C-V PLOTTER:           Not present |         10    12
4284A 20MHz-1MHz LCR METER (Opt. 001/006): Present     |         14    16
ELECTROGLAS 2001X WAFER PROBER:            Present     |         18    20
***************** DCS CONFIGURATION *******************|         22    24
SLOT1: 41421B (SMU1)       SLOT5: 41421B (SMU4)        |         26    28
SLOT2:                     SLOT6: 41424A (AUX1/2)      |         30    32
SLOT3: 41420A (SMU2)       SLOT7:                      |         34    36
SLOT4: 41421B (SMU3)       SLOT8: 41425A               |         38    40
************ AUXILIARY PORT CONFIGURATION *************|         42    44
AUX1: VS1                  AUX3: CMH84                 |         46    48
AUX2: VS2                  AUX4: CML84                 |

        Session ID:  pcs_2193
    Execution mode:  ON LINE

System date & time:  21 Jan 1990  12:34:56

"START" end.     ---------- Press [SHIFT] [MENU] for more keys.


                                                          User 1   Caps   Idle
EDIT     Continue   RUN    SCRATCH         LOAD ""  RE-STORE  Delete    Link
                                                       ""       TIS      TIS
```

Figure 2-40. System START Page (for HP 4062UX)

- SYSTEM CONFIGURATION

  This area lists which system instruments are correctly set ("`Present`") for system operation. If an instrument is displayed as "`Not Present`", make sure the instrument is turned on, check the instrument's HP-IB address setting and HP-IB cable connections, and execute the START program again. The system controller conducts a serial poll of the individual system instruments on the HP-IB during START.

  "`4142B DC SOURCE MONITOR`" description shows the firmware ROM revision number. If the number is under 3.00, you can force only up to 20 V to search port when you perform analog search measurements.

  "`4284A 20Hz-1MHz LCR METER`" description shows if option 001 Power Amplifier/DC bias and option 006 2 m/4 m Cable Length Operation exist. If option 001 does not exist, you cannot perform C-V measurement. If option 006 does not exist, the measurement accuracy is not guaranteed.

- DCS CONFIGURATION

  This area lists each HP 4142B DCS slot number, the model number of the plug-in module installed in each slot, and the SWM port (in parentheses) to which each module is connected. If an SWM port is not displayed, that module is not connected to the SWM (in this example, slot 8). Note that the HP 41420A SMU occupies 2 slots, and START program lists only higher of the 2 slots where the SMU is installed (in this example, slot 3). Vacant slots are left blank (in this example, slot 7). If you reconfigure any DCS plug-in modules after you have executed START, you *must* execute START again.

- AUXILIARY PORT CONFIGURATION

  This area lists the configuration of the SWM's AUX ports. If the AUX ports are connected incorrectly, "`Nothing Connected`" is displayed. If you reconfigure any AUX port cables after you have executed START, you *must* execute START again.

- AVAILABLE PINS

  This area lists the available measurement pins (pin boards) installed in the SWM. Pin boards not present at system START are not listed (are not displayed).

After the START program is over, the PV4062 main menu is displayed.

View Result

The View Result function of PV4062 is for printing 4062 W/O DVM and W/ DVM test results on the display of the system controller or a system printer.

Note

For revision 6.0 or later, the test results also include "Uncertainty" to meet with the MIL-STD 45662A specifications.

Displaying PV test results

1. From the PV4062 main menu page (Figure 2-3), select the `VIEW RESULT` softkey to display the View Result Start page. For the HP 4062C, follow the displayed instructions.
2. Select the `READ FILE` softkey to obtain PV test results.
3. Enter the name of the file that contains the PV test results. For example, enter:

   `PVW00190:,700,1` (Return)
4. Select the `CRT` softkey to display the test results. A View Result Display page similar to Figure 2-41 is displayed. Select the `MORE` softkey to display the next page of test results.

```
==================================================================================
                  P E R F O R M A N C E   T E S T   R E C O R D
==================================================================================

Hewlett-Packard

HP 4062UX
 Semiconductor Process Control System          Tested by _______Cheryl Jenkins

 Serial Number __________2830J00165            Date _______________21 Jan 1990

 Temperature ____23 degrees Celsius            Humidity ___________________47 %

4085B SWITCHING MATRIX                 PRESENT Serial Number  _______2814J00060
4084B SWITCHING MATRIX CONTROLLER      PRESENT Serial Number _______2520J00456
4142B DC SOURCE/MONITOR                PRESENT Serial Number _______2716J00103
4280A C METER/C-V PLOTTER                      Serial Number __________________
4284A 20MHz-1MHz PRECISION LCR METER   PRESENT Serial Number _______2848J00742



                                                          User 1   Caps   Running
                                        MORE                              EXIT
```

Figure 2-41. An Example Page of View Result (CRT)

Printing PV test results:

1. From the PV4062 main menu page (Figure 2-3), select the VIEW RESULT softkey to display the View Result Start page. For the HP 4062C, follow the displayed instructions.
2. Select the READ FILE softkey to obtain PV test results.
3. Enter the name of the file that contains the PV test results. For example, enter:

   `data/PVW00190` (Return)

4. Select the PRINTER softkey. The printer configuration page is similar to Figure 2-42 is displayed.

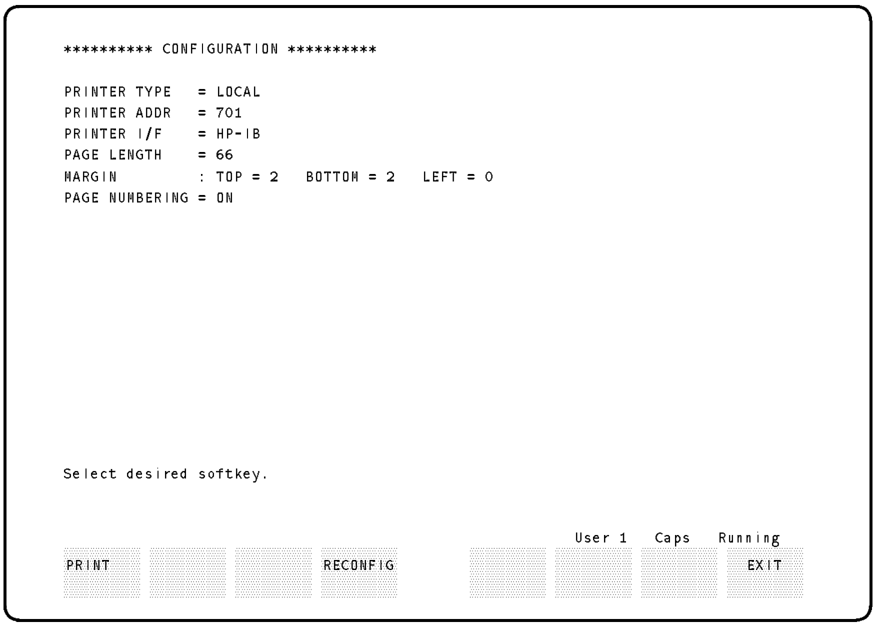


Figure 2-42. An Example of the Printer Configuration Page

5. To change the printer configuration, select the RECONFIG softkey. Refer to Appendix E for information to configure the system printer.

   If the printer configuration is correct and if the printer is ready, select the PRINT softkey. A print out similar to Figure 2-43 is printed.

6. Enter the report number. You can enter strings as well as numbers. Then a print out similar to Figure 2-43 is printed.

```
Test Facility

 Hewlett-Packard                              Report No. ______________________

 _________________________________            Date ________________30 May 1991

 _________________________________            Customer ________________________

 _________________________________            Tested by _________Cheryl Jenkins

HP 4062UX:

 Serial No. ____________2814J00060            Temperature ___23 degrees Celsius

 Firmware Revision _______________            Humidity ____________________47 %

                                              Line Frequency _______Hz(nominal)

Configuration

 4085B SWITCHING MATRIX                   PRESENT Serial No. ________2814J00060
 4084B SWITCHING MATRIX CONTROLLER        PRESENT Serial No. ________2520J00456
```

```
Model: HP4062UX          Report No.: 101                Date: 30 May 1991

================================================================================
                          |           |            |            |           |
TEST DESCRIPTION          |  Minimum  |  Results   |  Maximum   |Uncertainty|Fail
                          |           |            |            |           |
================================================================================
 SMU Accuracy Test
--------------------------------------------------------------------------------
Self-test                 |                                                 |
--------------------------------------------------------------------------------
 Repeat Test
--------------------------------------------------------------------------------
 | SMU1                   |
 |-------------------------------------------------------------------------------
 | Vf/Im    |     -52.0 V |    -.740% |     -.019% |    +.740% |           |
 | If/Vm    |   -5.2E-5 a |    -.740% |     -.027% |    +.740% |           |
 |-------------------------------------------------------------------------------
 | vF/iM    |     -47.0 v |    -.772% |     -.030% |    +.772% |           |
```

SVC2-090

Figure 2-43. An Example Page of View Result (Printer)

The PV4274 Test

If the HP 4062C is equipped with an HP 4274A Multi-Frequency LCR Meter (option 310), or if the HP 4062UX is equipped with an HP 4274A (option 520), PV4274 verifies the performance of the HP 4274A (LCR). If the LCR is equipped with an internal dc bias source (±35 V or ±100 V), PV4274 also verifies the output accuracy of the bias source.

Before you run PV4274, run the Relay and SMU Tests, which are included in the 4062 W/O DVM Test of the PV4062. If, for any reason, the COM blocks established by START were destroyed after PV4062 was performed, run the START program by selecting `START` softkey of the PV4062 menu page.

- Required Equipment:

  Test fixture adapter
  System calibration module
  Option 310 software disk (for HP 4062C only)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Select the `4274A` softkey from PV4062 main menu.

   The following message is displayed:

   `Are you sure to continue ?`

   To return to the PV4062 main menu, select the `EXIT` softkey. To perform PV4274, select the `CONTINUE` softkey, and the PV4274 start-up page is displayed.

2. Be sure the test leads are connected to the AUX1 and AUX2 terminals of the SWM as shown in Figure 2-44.

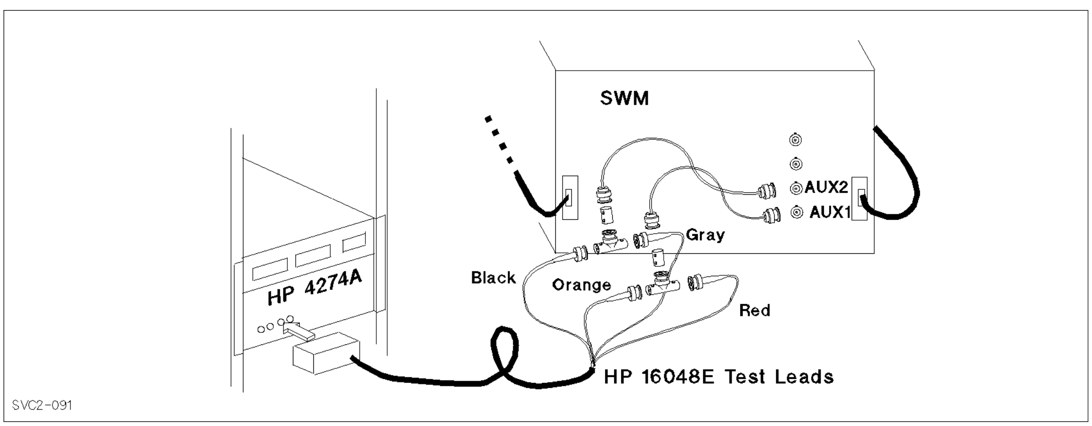


Figure 2-44. Cable Connections for the HP 4274A LCR

3. Select the `Start` softkey. The PV4274 menu page is displayed.

   Select desired subtest by selecting corresponding softkey. Follow displayed instructions.

   The `Instruction` softkey displays a brief operating guide.

LCR C-G Test

The LCR C-G Test checks the capacitance measurement accuracy of the HP 4274A LCR.

- Required Equipment:

  Test fixture adapter
  System calibration module
  Option 310 software disk (for HP 4062C only)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Install the test fixture adapter on the SWM. Select the `LCR C-G` softkey to start the test.
2. Turn the OSC LEVEL (V) knob fully clockwise on the LCR front panel.
3. Disconnect the BNC-T adapters from the BNC f-to-f adapters that connected to the AUX1 and AUX2 terminals of the SWM (leave the test leads connected to the BNC-T adapters).
4. Select the `Continue` softkey to start the Open Self-Test and Zero Open Offset Adjustment of the LCR. Be sure the outer conductors of the BNC-T adapters are shorted to each other.

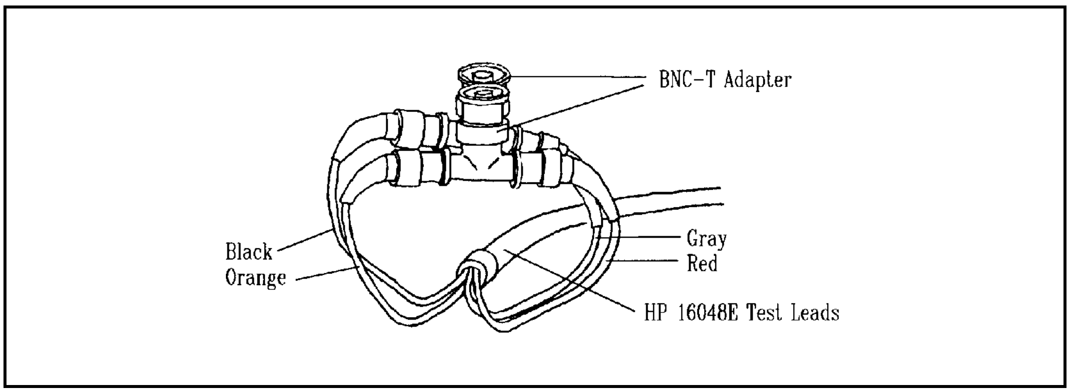


Figure 2-45. Test Lead Connections for OPEN Correction

5. When the Open Self-Test and Zero Open Offset Adjustment completes, connect the BNC-T adapters together with a BNC f-to-f adapter.
6. Select the `Continue` softkey to start the Short Self-Test and Zero Short Offset Adjustment.

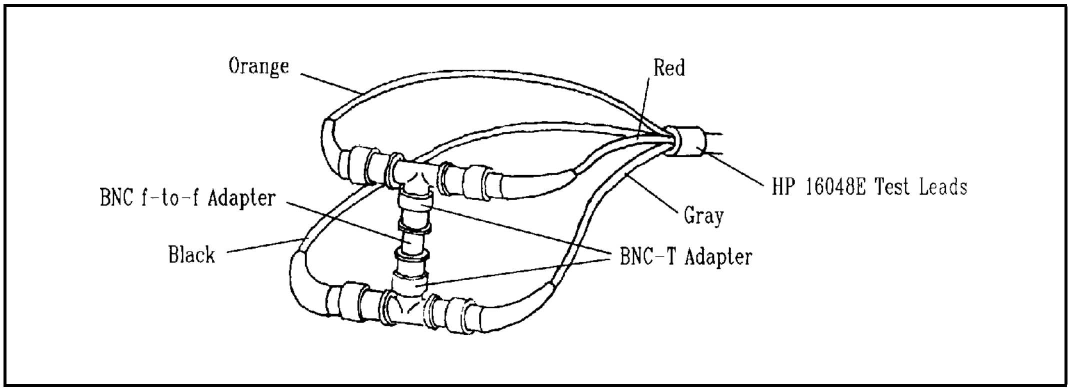


Figure 2-46. Test Lead Connections for SHORT Correction

7. When the Short Self-Test and Zero Short Offset Adjustment completes, the capacitance calibration data of the system calibration module is displayed (see Figure 2-47).

   To revise calibration data, select the `Yes` softkey and go to "Revising Calibration Data".

   If it is not necessary to revise calibration data, select the `No` softkey and proceed to the next step.

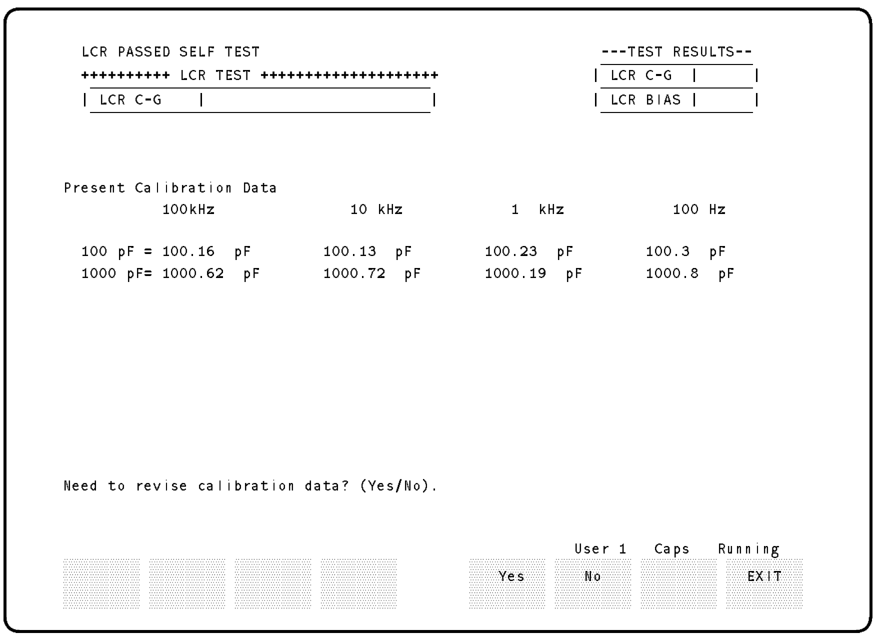


Figure 2-47. LCR C-G Test Page

8. Remove the BNC f-to-f adapter and reconnect the BNC-T adapters (with the test leads) to the AUX1 and AUX2 terminals of the SWM as shown in Figure 2-44.
9. Select the `Continue` softkey to measure the offset capacitance of the SWM and the test fixture adapter.
10. Remove the test fixture adapter from the SWM and install the system calibration module.

11. Select the `Continue` softkey to measure the 100 pF and 1000 pF capacitors of the system calibration module, which checks the capacitance measurement accuracy of the LCR.

    If the capacitance measurement values are not within limits, the measurement results and the test limits are displayed.

    If the capacitance measurement values are within limits, a display similar to Figure 2-48 is displayed.

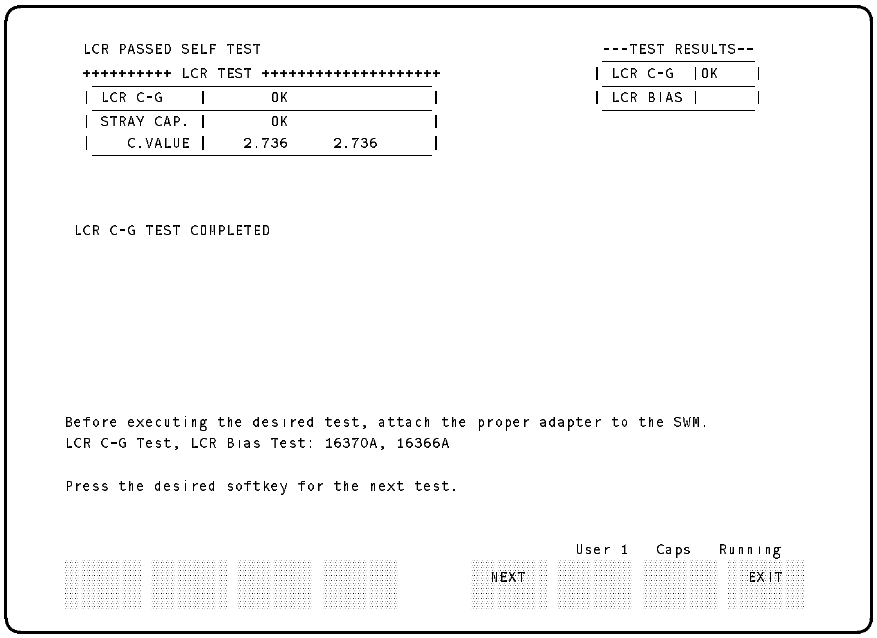


Figure 2-48. The LCR C-G Test Result Page

LCR Bias Test

If the HP 4274A LCR is equipped with an internal dc bias source (±35 V or ±100 V), this test checks the output accuracy of the bias source.

- Required Equipment:

  System calibration module
  Test fixture adapter
  Option 310 software disk (for HP 4062C only)
  PV4062 software disk set (only for HP 4062C revision 5.7 or earlier)

- Test Procedure:

1. Install the system calibration module on the SWM. Select the `LCR BIAS` softkey to start the test.
2. Set the DC BIAS switch on the rear panel of the LCR to the INT 35V/100V ($\leq$ .1 μF) position. Select the `Continue` softkey.

   The dc bias source outputs a voltage, which is monitored by an SMU.

   If the output voltage accuracy of the bias source is not within test limits, the output measurement value and the test limits are displayed.

Revising Calibration Data

PV4274 provides two methods to measure the 100pF and 1000pF capacitor system calibration module at 100 kHz, 10 kHz, 1 kHz, and 100 Hz and stores these measurement results as revised calibration data.

The first method automatically measures the capacitors at each frequency and stores the measurement results as revised calibration data. The second method requires that you manually measure capacitors at each frequency, then enter (from the keyboard) the measurement results as revised calibration data.

Revised calibration data is stored in the `CAL_DAT74` file, which is in the SYSTEM SOFTWARE FOR HP 4274A (Option 310) disk for the HP 4062C. The file is located in the `/usr/pcs/diag` directory for HP 4062UX.

These procedures are performed as follows:

- Automatically obtain and store revised calibration data

  1. From the step 7 display page of the LCR C-G Test, select the `Measure` softkey.
  2. Connect the HP 16048E Test Leads and BNC-T adapters to the (standalone) 100 pF capacitor connectors of the system calibration module. Select the `Continue` softkey.
  3. When the 100 pF capacitor measurement completes, calibration data is stored automatically. Select the `Measure` softkey again.
  4. Connect the test leads and BNC-T adapters to the 1000 pF capacitor connectors of the system calibration module. Select the `Continue` softkey.
  5. When the 1000 pF capacitor measurement completes, calibration data is stored automatically, and the program returns to step 8 of the LCR C-G Test (see "LCR C-G Test").

- Manually obtain and store revised calibration data

  1. Using the LCR, measure the (standalone) 100 pF and 1000 pF capacitors of the system calibration module at 100 kHz, 10 kHz, 1 kHz, and 100 Hz. Note these measurement results as revised calibration data.
  2. From the step 7 display page of the LCR C-G Test, select the `Key in` softkey.
  3. Enter the revised calibration data, obtained in step 1, for the 100 pF capacitor at each frequency.
  4. When you finish with step 3, select the `Key in` softkey again.
  5. Enter the revised calibration data, obtained in step 1, for the 1000 pF capacitor at each frequency.
  6. When you finish entering data, the program returns to step 8 of the LCR C-G Test (see "LCR C-G Test").

Performance Verification Operating Theory

This section provides the operating theory of the PV program and test limits.

W/O DVM Test Operating Theory

Relay Test Operation

Figure 2-49 shows a simplified Pin Board Relay Test circuit. See Appendix B for an exploded view of the Pin Board and a parts list.

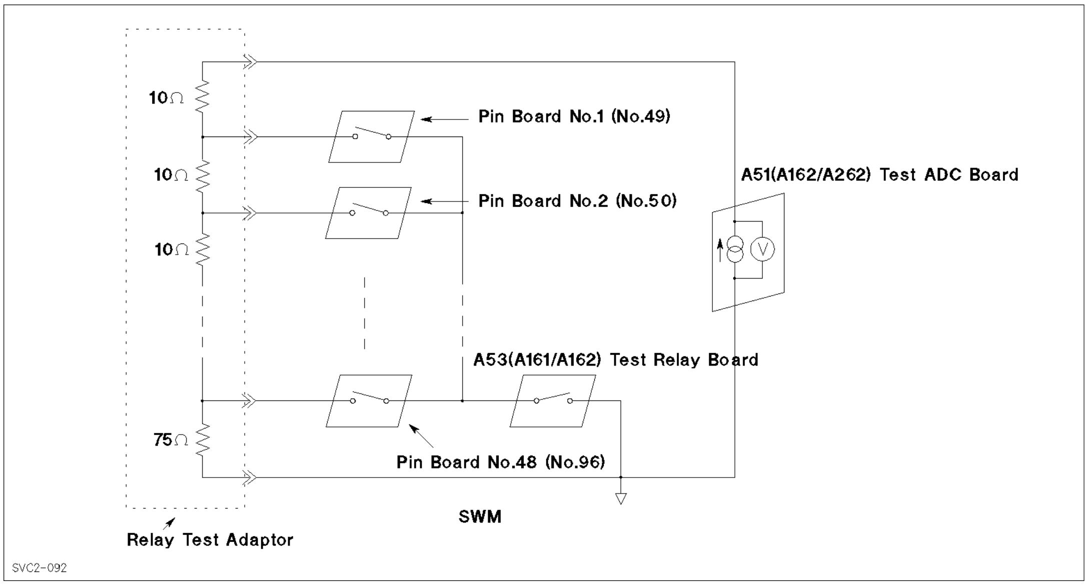


Figure 2-49. Pin Board Relay Test Circuit

As the Relay Test begins, the test ADC board in the SWM outputs a constant current to the relay test adapter. The voltage drop across the relay test adapter is then measured by the voltage monitor function of the test ADC board, thus providing a check of the relay test adapter.

Next, the first relay to be tested—for example, the sense relay on pin board 1—and the appropriate relays on the test relay board of the SWM are set to make (on), and the voltage across the first resistor is measured (see Figure 2-49). If this voltage is correct, the specified relay on pin board 2 is set to make, the relay on pin board 1 is set to break (off), and the voltage across the first two resistors is measured.

This sequence continues until the sense, force, and guard relays on all pin boards are tested.

If a relay is not functioning properly, the measured voltage is incorrect, the Relay Test stops, and an error message is displayed. Also, when a pin board is tested, an LED on the pin board lights. If a faulty relay is detected, the Relay Test stops and the LED on the faulty pin board blinks.

The Relay Test is controlled by the firmware of the SWC.

For 96-pin (HP 4089A/B) SWM systems, the Relay Test also tests the input relays on the input relay boards, which consist of the SMU and AUX port boards, for block 1 and 2

SWM ports. See Figure B-10 and Figure B-11 for the circuit diagram. Figure 2-50 shows a simplified Input Relay Test circuit. To check the break/make operation of the input relay on the guard path of SMUn, the force path of another SMUm is connected to the guard path of SMUn using a pin board.

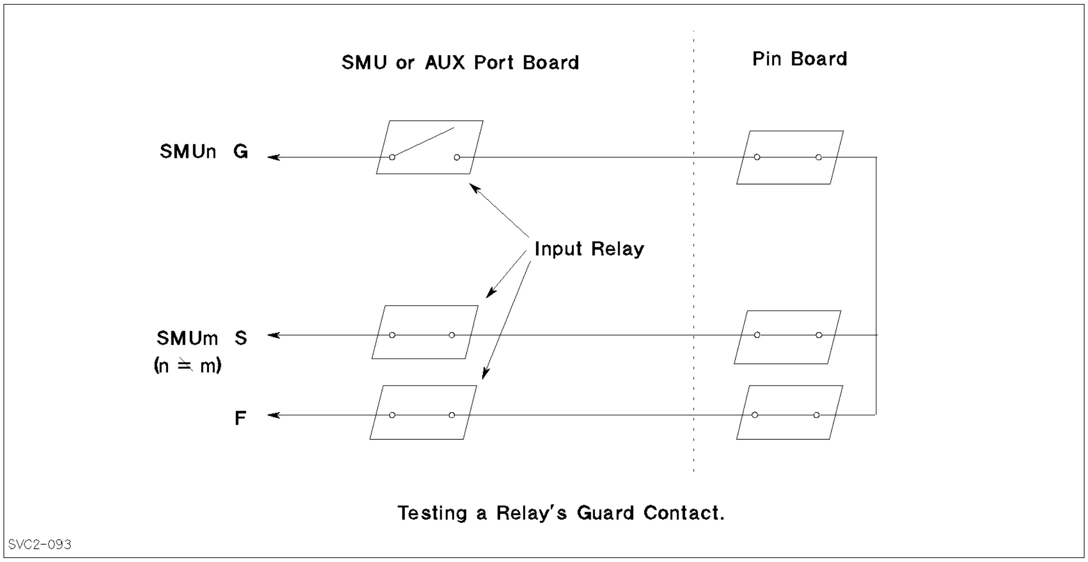


Figure 2-50. Input Relay Test Circuit

The following input relays are tested for the SWM port listed. SWM ports are tested in ascending order (port 1 through port 9).

Port 1 (SMU1) Test:	K10 guard contact K10 force contact K11 force contact K11 guard contact
Port 2 (SMU2) Test:	K21 K20 force contact K20 sense contact
Port 3 (SMU3) Test:	K30 force contact K30 sense contact
Port 4 (SMU4) test:	K41 K40 force contact K40 sense contact
Port 5 (AUX1) test:	K50 guard contact K50 force contact
Port 6 (AUX2) test:	K60 guard contact K60 force contact
Port 7 (GNDU) test:	K70 force and sense contacts
Port 8 (AUX3) test:	K81 force contact K81 guard contact

	K80 guard contact K80 force contact
Port 9 (AUX4) test:	K91 force contact K91 guard contact K90 guard contact K90 force contact

Note

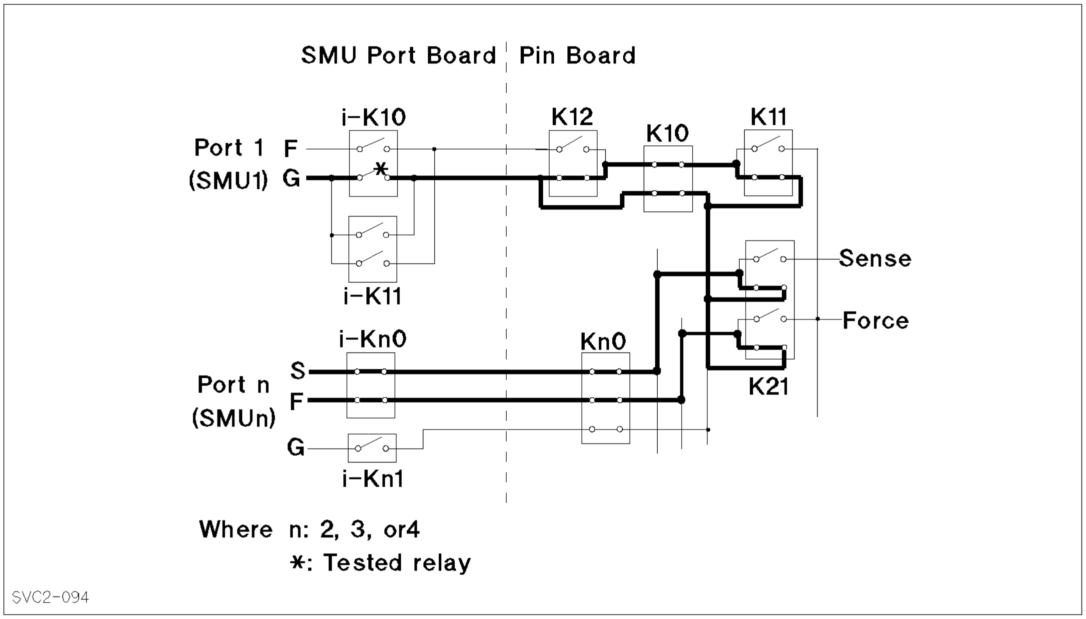
The Input Relay Test uses other system equipment; SMUs, interconnection cables, pin boards, and so on. If the Input Relay Test detects a faulty relay, the indicated relay may not actually be the problem and other equipment may have some problems.

Input relays are tested using an SMU connected to the tested port via the pin boards. If a pin board is used for the Input Relay Test, the pin board at the slot farthest from the SMU port board (that is, the lowest numbered pin board in block 1 and the highest numbered pin board in block 2) is used. If two pin boards are used, the first pin board is selected as above, and the next farthest pin board is used as the second pin board. For the K20, K30, K40 sense side test, three pin boards are used; see the "i-K20, i-K30, and i-K40 Sense Side Test."

The following pages briefly show the test operation for the input relays:

- i-K10 Guard Side Test

  The test path for the i-K10 guard side test is shown as follows:



The guard side path of port 1 (SMU1) is connected to the guard terminal of an SMU. The guard of the SMU has an impedance of about 200 Ω.

□ Make test of i-K10 guard side contact

1. Make i-K10 input relay.
2. Force 0.1 V from SMUn (2 V range, 100 mA compliance).
3. Force 0 V from SMU1 (2 V range, 100 mA compliance).
4. Measure current value of SMUn (auto range).
5. Calculate impedance and compare with test limits (Table 2-5).

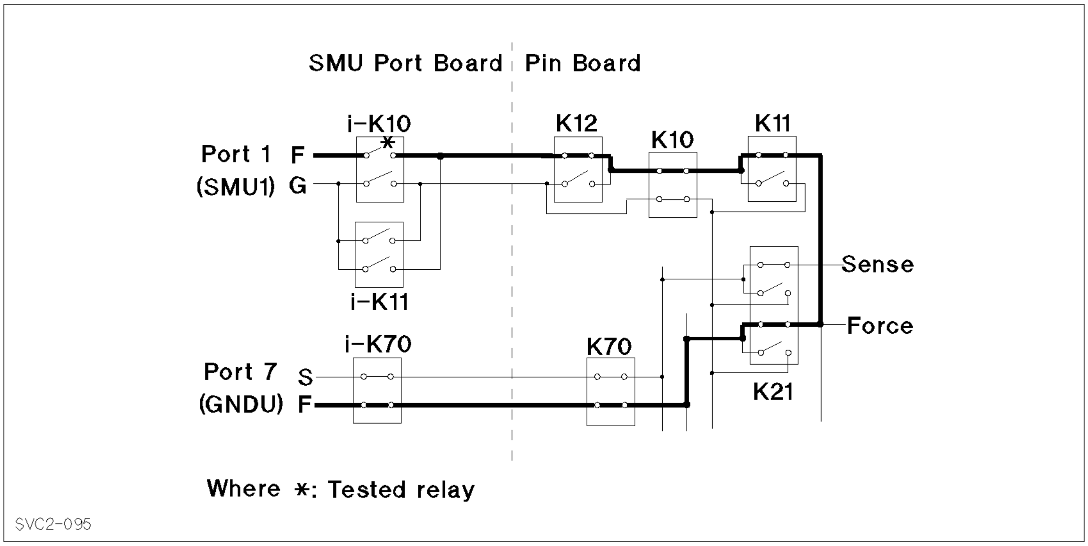
□ Break test of i-K10 guard side contact

1. Break i-K10 input relay.
2. Force 10 V from SMUn (20 V range, 100 μA compliance).
3. Force 0 V from SMU1 (2 V range, 100 mA compliance).
4. Measure current value of the SMUn (100 μA range).
5. Calculate impedance and compare with test limits (Table 2-5).

where SMUn is SMU2, SMU3, or SMU4; SMUn is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU found is used.

■ i-K10 Force Side Test

The test path for the i-K10 force side test is shown as follows:



□ Make test of i-K10 force side contact

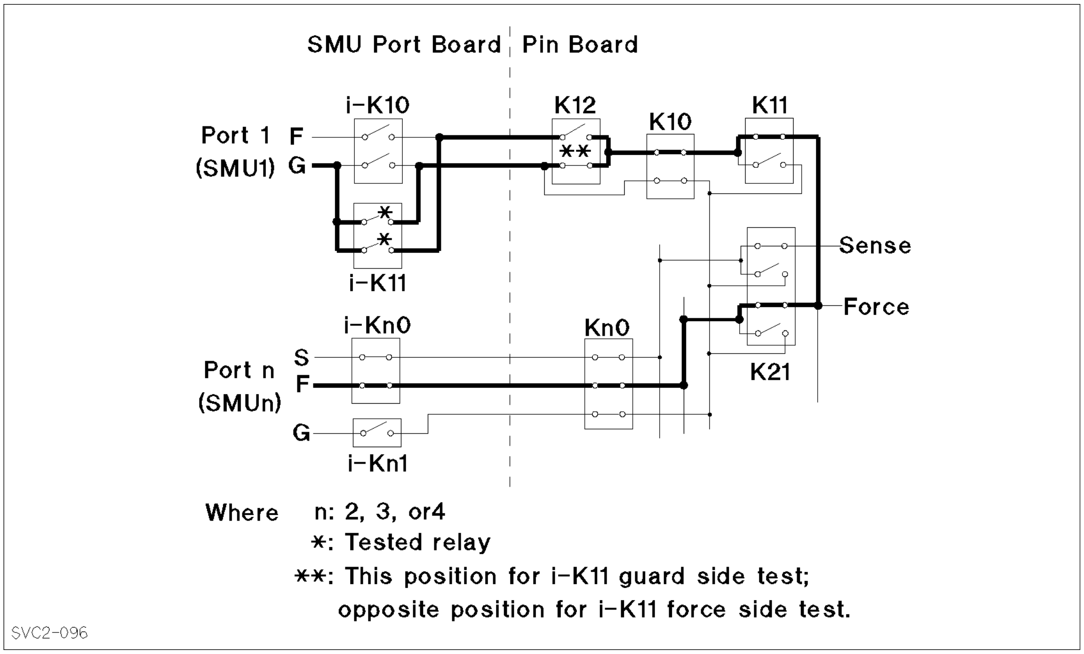
1. Make i-K10 input relay.
2. Force 90 mA from SMU1 (100 mA range, 1.9 V compliance).
3. Measure voltage of SMU1.
4. Calculate impedance and compare with test limits (Table 2-5).

□ Break test of i-K10 force side contact

1. Break i-K10 input relay.
2. Force 10 V from SMU1 (20 V range, 100 μA compliance).
3. Measure current value of SMU1 (100 μA range).
4. Calculate impedance and compare with test limits (Table 2-5).

- i-K11 Guard and Force Side Test

The test path for the i-K11 guard or force side test is shown as follows:



The guard side path of port 1 (SMU1) is connected to the guard terminal of an SMU. The guard of the SMU has an impedance of about 200 Ω.

- Make test of i-K11 guard or force side contact

1. Make i-K11 input relay.
2. Make K12 relay of pin board for force side test;
   break K12 relay of pin board for guard side test.
3. Force 0.1 V from SMUn (2 V range, 100 mA compliance).
4. Force 0 V from SMU1 (2 V range, 100 mA compliance).
5. Measure voltage of SMUn (auto range).
6. Calculate impedance and compare with test limits (Table 2-5).

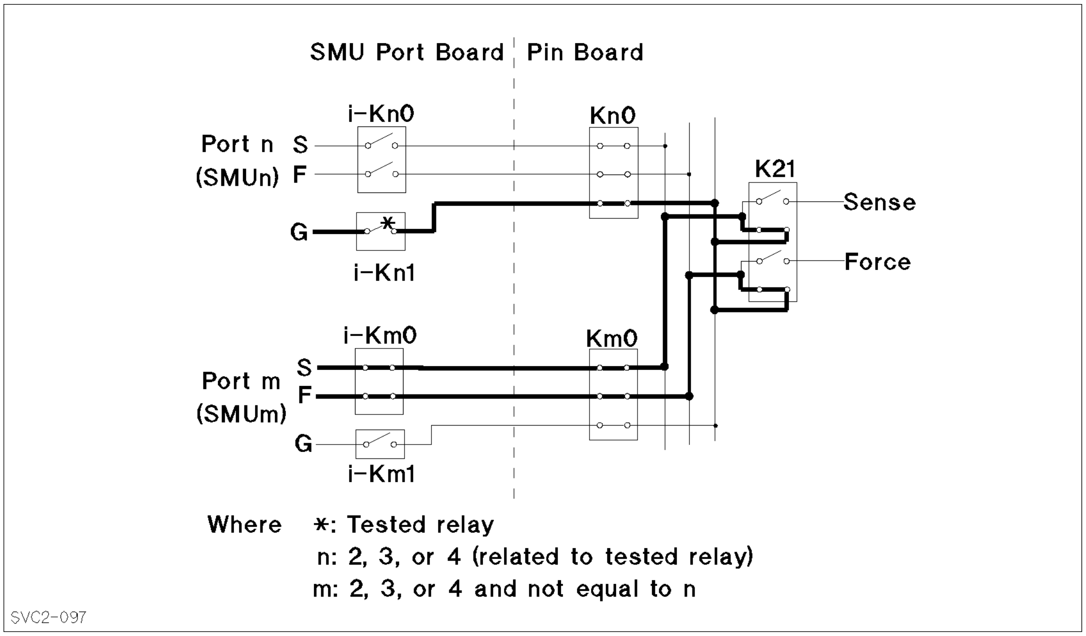
- Break test of i-K11 guard or force side contact

1. Break i-K11 input relay.
2. Make K12 relay of pin board for force side test;
   break K12 relay of pin board for guard side test.
3. Force 10 V from SMUn (20 V range, 100 μA compliance).
4. Force 0 V from SMU1 (2 V range, 100 mA compliance).
5. Measure current value of SMUn (100 μA range).
6. Calculate impedance and compare with test limits (Table 2-5).

where SMUn is SMU2, SMU3, or SMU4; SMUn is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU found is used.

■ i-K21, i-K31, and i-K41 Test

The test path for the i-K21, i-K31, and i-K41 tests is shown as follows. The i-K21, i-K31, and i-K41 input relays are on guard paths for SMU2, SMU3, and SMU4, respectively. The i-K31 shares a relay box with the i-K21, which includes two relay devices and is labeled "K21."



The guard side path of port 2, 3, or 4 (SMU2, SMU3, or SMU4) is connected to the guard terminal of an SMU. The guard of the SMU has an impedance of about 200 Ω.

□ Make test of i-K21, i-K31, and i-K41 guard contact

1. Make i-K21 (i-K31) or i-K41 input relay.
2. Force 0.1 V from SMU*m* (2 V range, 100 mA compliance). *m* is 2, 3, or 4 and not equal to *n*.
3. Force 0 V from SMU*n* (2 V range, 100 mA compliance). SMU*n* corresponds to the guard path of the objective input relay.
4. Measure current value of SMU*m* (auto range).
5. Calculate impedance and compare with test limits (Table 2-5).

□ Break test of i-K21, i-K31, and i-K41 guard contact

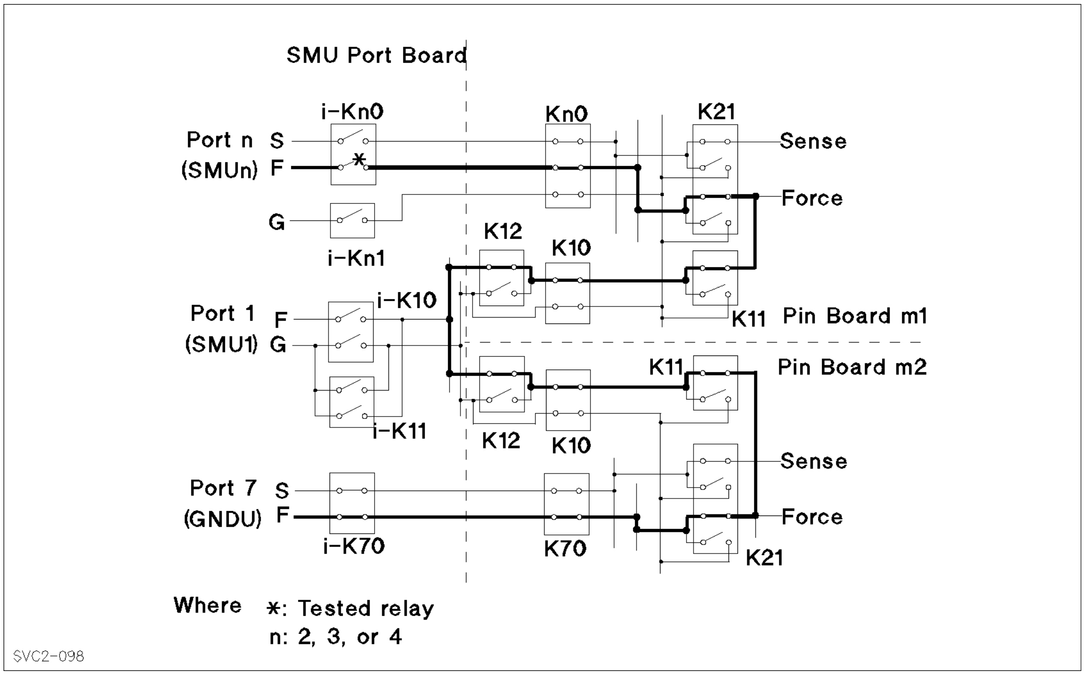
1. Break i-K21 (i-K31) or i-K41 input relay.
2. Force 10 V from SMU*m* (20 V range, 100 μA compliance). SMU*m* does not correspond to the guard path of the objective input relay.
3. Force 0 V from SMU*n* (2 V range, 100 mA compliance). SMU*n* corresponds to the guard path of the objective input relay.
4. Measure current value of the SMU*m* (100 μA range).
5. Calculate impedance and compare with test limits (Table 2-5).

where SMU*n* is an SMU connected to the objective input relay. SMU*m* is defined in the following way:

Test Port	SMUm is defined as:
Port 2 (SMU2)	Ports 4 and 3 are searched, in this order, and the first SMU found is used.
Port 3 (SMU3)	Ports 4 and 2 are searched, in this order, and the first SMU found is used.
Port 4 (SMU4)	Ports 2 and 3 are searched, in this order, and the first SMU found is used.

- i-K20, i-K30, and i-K40 Force Side Test

The test path for the i-K20, i-K30, and i-K40 force side test is shown as follows. The i-K20, i-K30, and i-K40 input relays are on force and sense paths for SMU2, SMU3, and SMU4, respectively.



This test uses two pin boards, which are installed in the slots farthest from the SMU port board; pin board *m1* is installed in the farthest slot of the SWM from the SMU port board and pin board *m2* is in the second farthest slot.

□ Make test of i-K20, i-K30, and i-K40 force side contact

1. Make i-K20, i-K30, or i-K40 input relay.
2. Force 90 mA from SMUn (100 mA range, 1.9 V compliance).
3. Measure voltage of SMUn (auto range).
4. Calculate impedance and compare with test limits (Table 2-5).

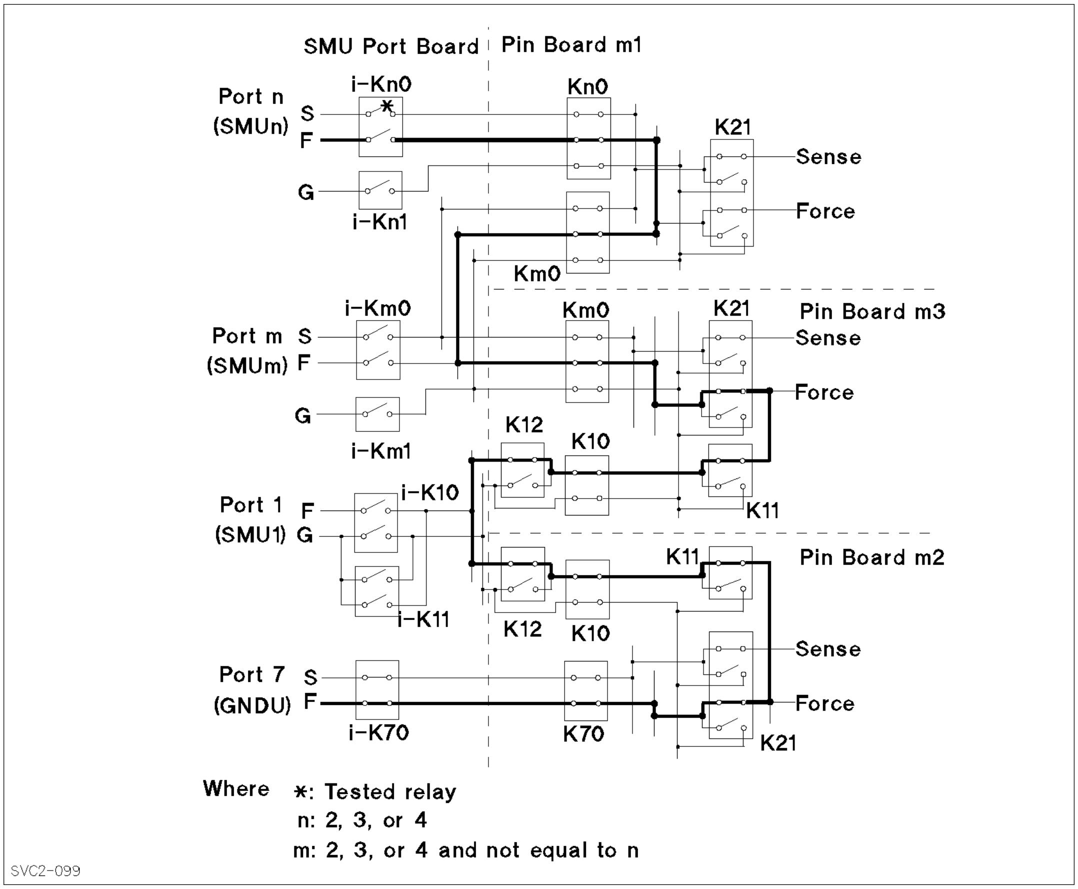
□ Break test of i-K20, i-K30, and i-K40 force side contact

1. Break i-K20, i-K30, or i-K40 input relay.
2. Force 10 V from SMUn (20 V range, 100 μA compliance).
3. Measure current value of SMUn (100 μA range).
4. Calculate impedance and compare with test limits (Table 2-5).

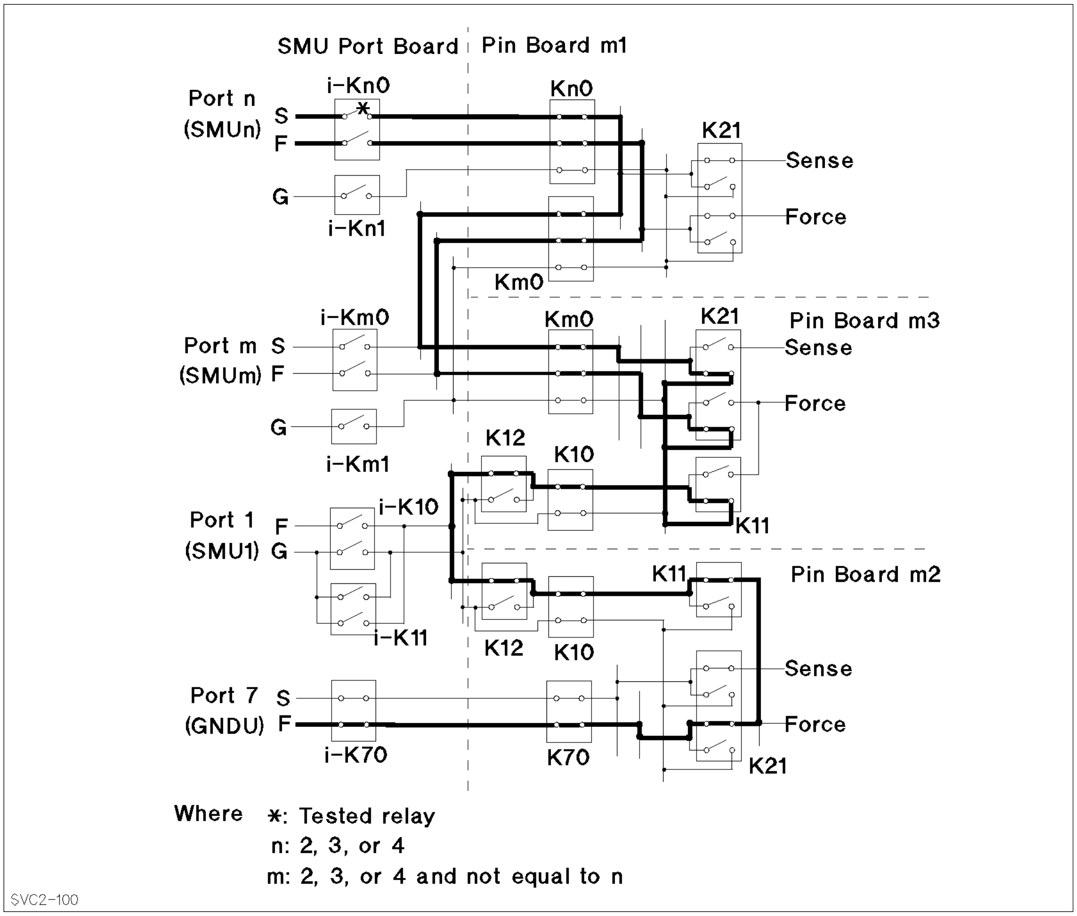
where SMUn corresponds to the objective input relay.

- i-K20, i-K30, and i-K40 Sense Side Test

The test path for the i-K20, i-K30, and i-K40 sense side test is shown as follows. The i-K20, i-K30, and i-K40 input relays are on force and sense paths for SMU2, SMU3, and SMU4, respectively.



Test Path (a)



Test Path (b)

Because the residual resistance on the test path is low, a longer test path is needed to increase the residual resistance. Three pin boards are needed to perform this test for higher resistance (more than about 0.4 Ω) between the SMU*n* and the contact point of the sense and force paths. Pin board *m1* is the farthest pin board from the SMU port board, pin board *m2* is the second farthest pin board from the SMU port board, and pin board *m3* is the nearest pin board to the SMU port board.

□ Make test of i-K20, i-K30, and i-K40 sense side contact

1. Set the test path as shown in the previous figure (a).
2. Make i-K20, i-K30, or i-K40 input relay.
3. Force 90 mA from SMU*n* (100 mA range, 1.9 V compliance).
4. Measure voltage of SMU*n*.
5. Calculate impedance and keep the value in memory.
6. Change the test path as shown in the previous figure (b).
7. Make i-K20, i-K30, or i-K40 input relay.
8. Force 90 mA from SMU*n* (100 mA range, 1.9 V compliance).
9. Measure voltage of SMU*n*.
10. Calculate impedance, subtract the latter from the former, and compare with test limits (Table 2-5).

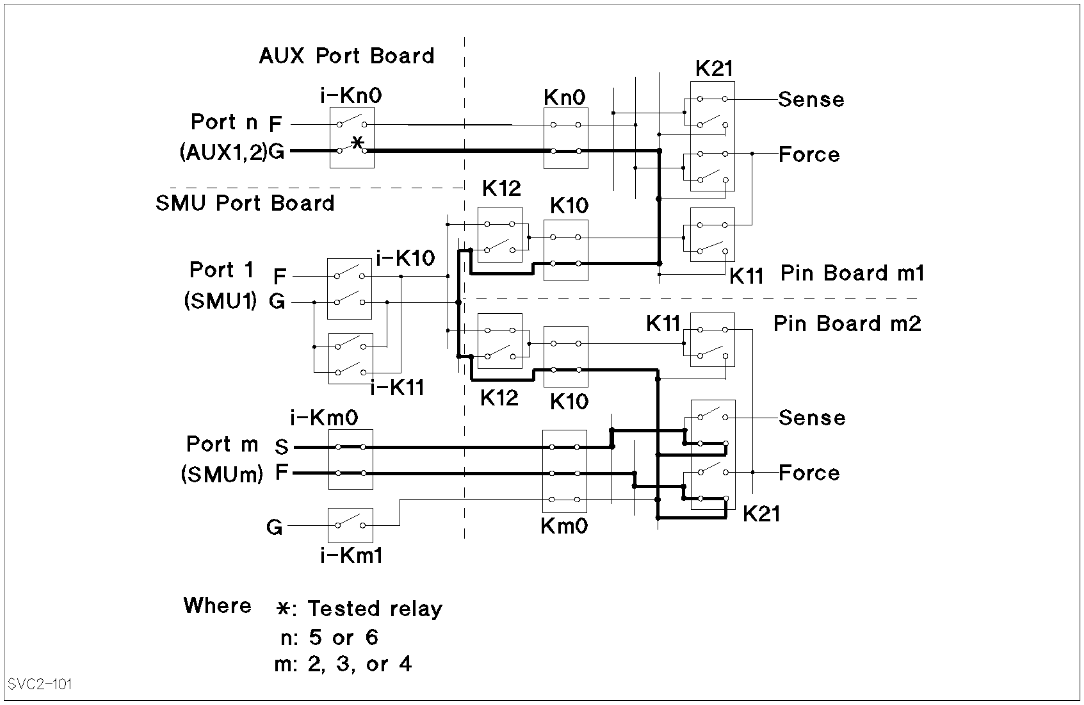
□ Break test of i-K20, i-K30, and i-K40 sense side contact

1. Set the test path as shown in the previous figure (b).
2. Break i-K20, i-K30, or i-K40 input relay.
3. Force 10 V from SMUn (20 V range, 100 μA compliance).
4. Measure current value of SMUn (100 μA range).
5. Calculate impedance and compare with test limits (Table 2-5).

where SMUn corresponds to the objective input relay.

■ i-K50 and i-K60 Guard Side Test

The test path for the i-K50 or i-K60 guard side test is shown as follows:



The guard side path of ports 5 and 6 (AUX1 and AUX2) are connected to the circuit common terminal of an VS or VM.

□ Make test of i-K50 and i-K60 guard side contact

1. Make i-K50 or i-K60 input relay.
2. Force 90 mA from SMU*m* (100 mA range, 1.9 V compliance).
3. Measure voltage value of SMU*m*.
4. Calculate impedance and compare with test limits (Table 2-5).

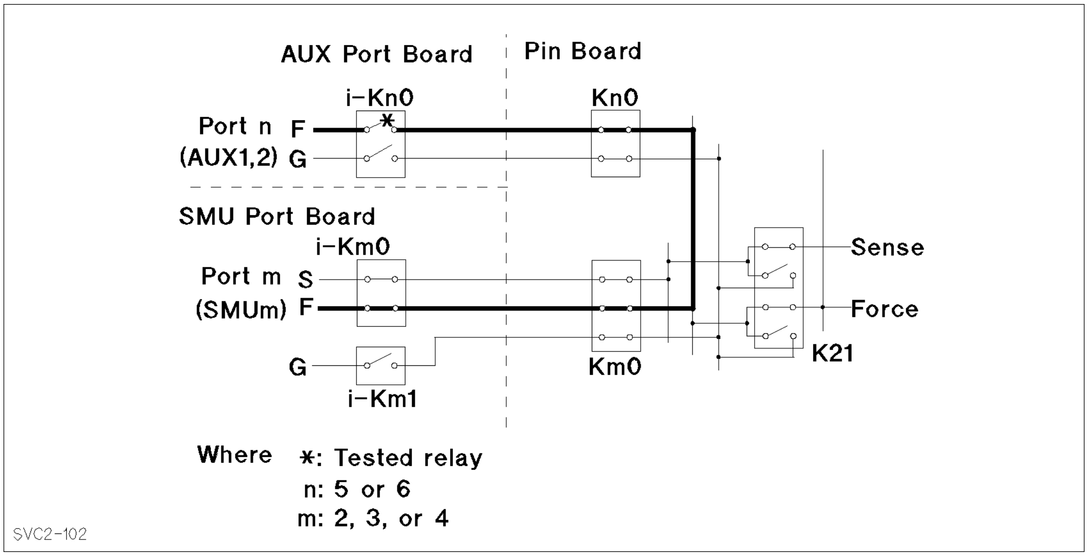
□ Break test of i-K50 and i-K60 guard side contact

1. Break i-K10 input relay.
2. Force 10 V from SMU*m* (20 V range, 100 μA compliance).
3. Measure current value of SMU*m* (100 μA range).
4. Calculate impedance and compare with test limits (Table 2-5).

where SMU*m* is SMU2, SMU3, or SMU4; SMU*m* is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU found is used.

- i-K50 and i-K60 Force Side Test

  The test path for the i-K50 or i-K60 force side test is shown as follows:



□ If VS is connected to test port:

- Make test of i-K50 and i-K60 force side contact

  1. Make i-K50 or i-K60 input relay.
  2. Force 10 μA from SMUm (1 mA range, 0 V compliance).
  3. Force 0.5 V from VS (2 V range, 10 mA limiter).
  4. Measure voltage value of SMUm.
  5. Compare with test limits (Table 2-5).

- Break test of i-K50 and i-K60 force side contact

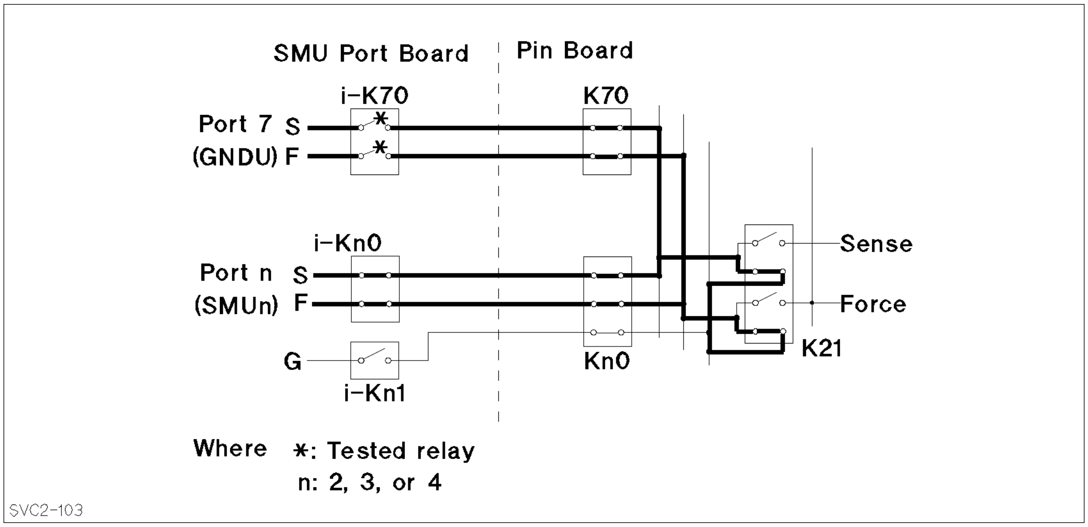
  1. Break i-K50 or i-K60 input relay.
  2. Force 10 μA from SMUm (1 mA range, 0 V compliance).
  3. Force 0.5 V from VS (2 V range, 10 mA limiter).
  4. Measure voltage value of SMUm.
  5. Compare with test limits (Table 2-5).

- ☐ If VM is connected to a test port:
  - ■ Make test of i-K50 and i-K60 force side contact
    1. Make i-K50 or i-K60 input relay.
    2. Force −0.5 V from SMUm (2 V range, 10 mA compliance).
    3. Measure voltage using VM and compare with test limits (Table 2-5).
    4. If passed, force 0.5 V from SMUm (2 V range, 10 mA compliance).
    5. Measure voltage using VM and compare with test limits (Table 2-5).
  - ■ Break test of i-K50 and i-K60 force side contact
    1. Break i-K50 or i-K60 input relay.
    2. Force −0.5 V from SMUm (2 V range, 10 mA compliance).
    3. Measure voltage using VM and compare with test limits (Table 2-5).
    4. If failed, force 0.5 V from SMUm (2 V range, 10 mA compliance).
    5. Measure voltage using VM and compare with test limits (Table 2-5).

where SMUm is SMU2, SMU3, or SMU4; SMUm is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU found is used.

■ i-K70 Force and Sense Side Test

The test path for the i-K70 force and sense side test is shown as follows:



□ Make test of i-K70 force and sense side contact

1. Make i-K70 input relay.
2. Force 90 mA from SMUn (100 mA range, 1.9 V compliance).
3. Measure voltage value of SMUn.
4. Compare with test limits (Table 2-5).

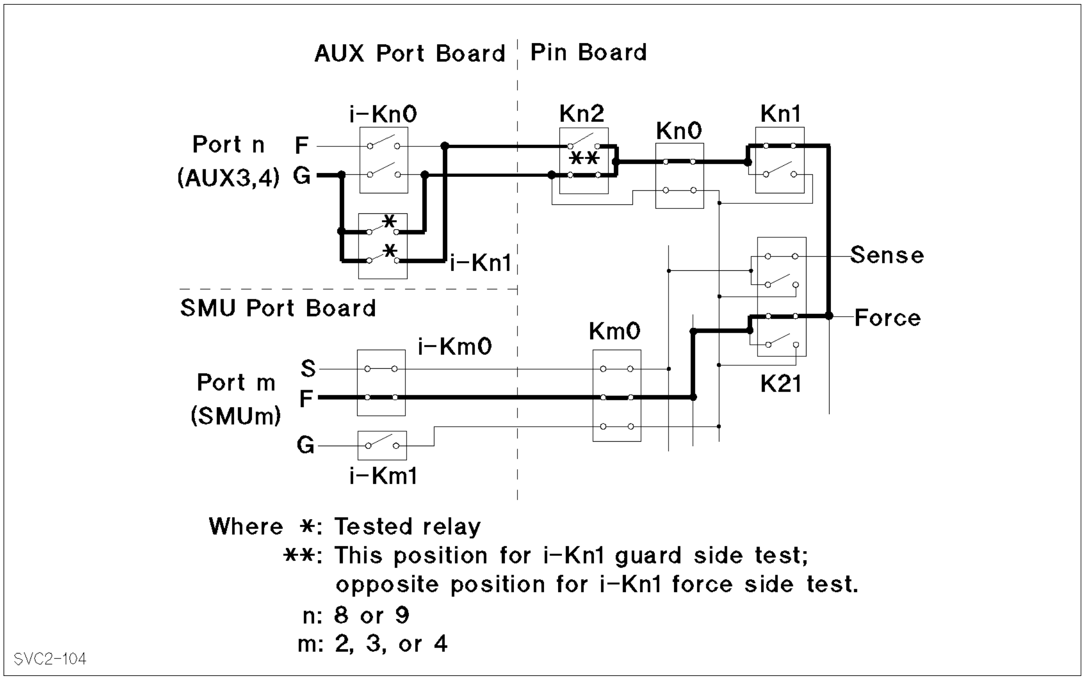
□ Break test of i-K70 force and sense side contact

1. Break i-K70 input relay.
2. Force 10 V from SMUn (20 V range, 100 μA compliance).
3. Measure current value of SMUn (100 μA range).
4. Compare with test limits (Table 2-5).

where SMUn is SMU2, SMU3, or SMU4; SMUn is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU is used.

■ i-K81 and i-K91 Guard and Force Side Test

The test path for the i-K81 or i-K91 guard and force side test is shown as follows:



If VS or VM is connected to port 8 or 9, the guard side path of ports 8 and 9 (AUX3 and AUX4) are connected to circuit common of the HP 4142B DCS.

If CMH and CML terminals of the HP 4280A CMU are connected to ports 8 and 9, the guard side path of ports 8 and 9 are led to circuit common of the CMU. Circuit common of the CMU is connected to circuit common of the DCS through the chassis.

If the H_P-H_C and L_P-L_C terminals of the HP 4284A CMU84 are connected to ports 8 and 9, the guard side path of ports 8 and 9 are led to chassis ground of the CMU84. Chassis ground of the CMU84 is connected to circuit common of the DCS through the chassis of the DCS.

□ Make test of i-K81 and i-K91 guard and force side contact

1. Make i-K81 or i-K91 input relay.
2. Make K82 or K92 relay of pin board for force side test;
   break K82 or K92 relay of pin board for guard side test.
3. Force 90 mA from SMU*m* (100 mA range, 1.9 V compliance).
4. Measure voltage value of SMU*m*.
5. Calculate the impedance and compare with test limits (Table 2-5).

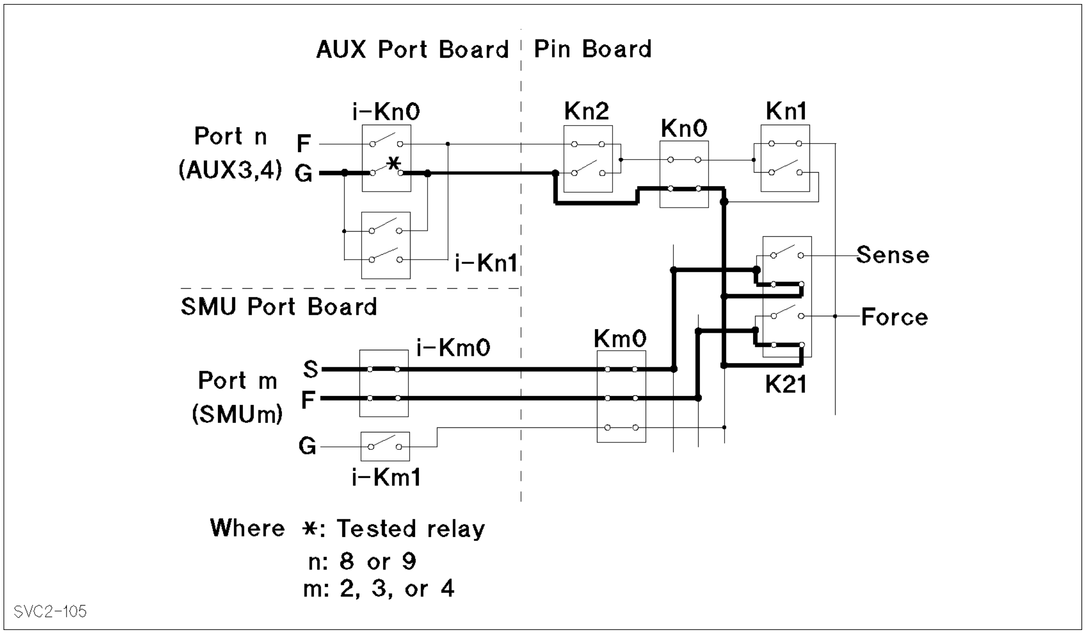
- ☐ Break test of i-K81 or i-K91 guard and force

1. Break i-K81 or i-K91 input relay.
2. Make K82 or K92 relay of pin board for force test;
   break K82 or K92 relay of pin board for guard test.
3. Force 10 V from SMUm (20 V range, 100 μA compliance).
4. Measure current value of SMUm (100 μA range).
5. Compare with test limits (Table 2-5).

where SMUm is SMU2, SMU3, or SMU4; SMUm is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU found is used.

■ i-K80 and i-K90 Guard Side Test

The test path for the i-K80 or i-K90 guard side test is shown as follows:



If VS or VM is connected to port 8 or 9, the guard side paths of ports 8 and 9 (AUX3 and AUX4) are connected to circuit common of the HP 4142B DCS.

If the CMH and CML terminals of the HP 4280A CMU are connected to ports 8 and 9, the guard side paths of ports 8 and 9 are led to circuit common of the CMU. Circuit common of the CMU is connected to circuit common of the DCS through the chassis.

If the H_C-H_P and L_P-L_C terminals of the HP 4284A CMU84 are connected to ports 8 and 9, the guard side paths of ports 8 and 9 are led to chassis ground of the CMU84. Chassis ground of the CMU84 is connected to the circuit common of the DCS through the chassis of the DCS.

□ Make test of i-K80 and i-K90 guard side contact

1. Make i-K80 or i-K90 input relay.
2. Force 90 mA from SMU*m* (100 mA range, 1.9 V compliance).
3. Measure voltage value of SMU*m*.
4. Calculate the impedance and compare with test limits (Table 2-5).

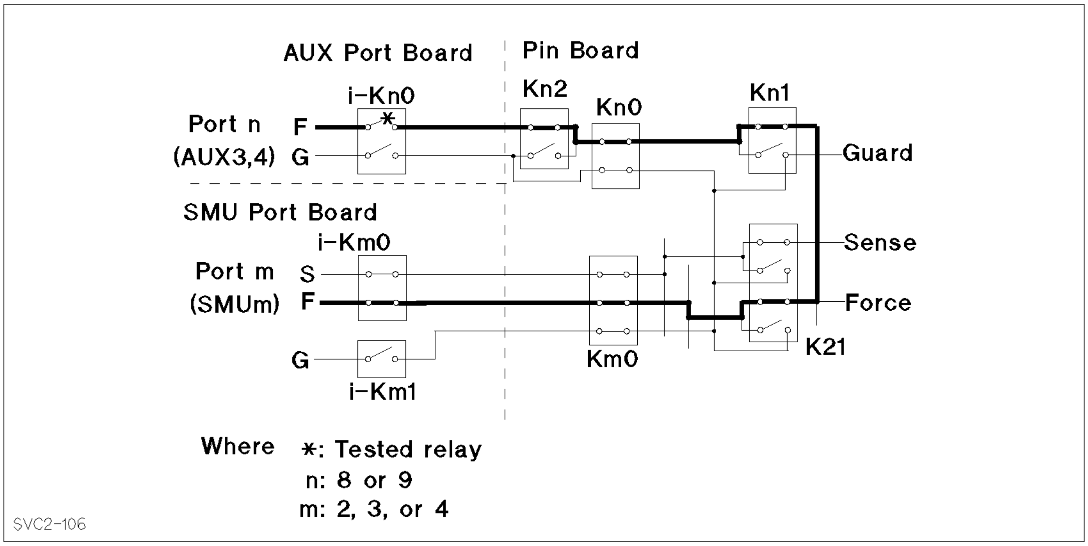
□ Break test of i-K80 or i-K90 guard side contact

1. Break i-K80 or i-K90 input relay.
2. Force 10 V from SMU*m* (20 V range, 100 μA compliance).
3. Measure current value of SMU*m* (100 μA range).
4. Compare with test limits (Table 2-5).

where SMU*m* is SMU2, SMU3, or SMU4; SMU*m* is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU found is used.

- i-K80 and i-K90 Force Side Test

  When the VS or VM is connected to the test path, the test path is shown as follows:



If VS or VM is connected to port 8 or 9, the guard side paths of ports 8 and 9 (AUX3 and AUX4) are connected to the circuit common of the HP 4142B DCS.

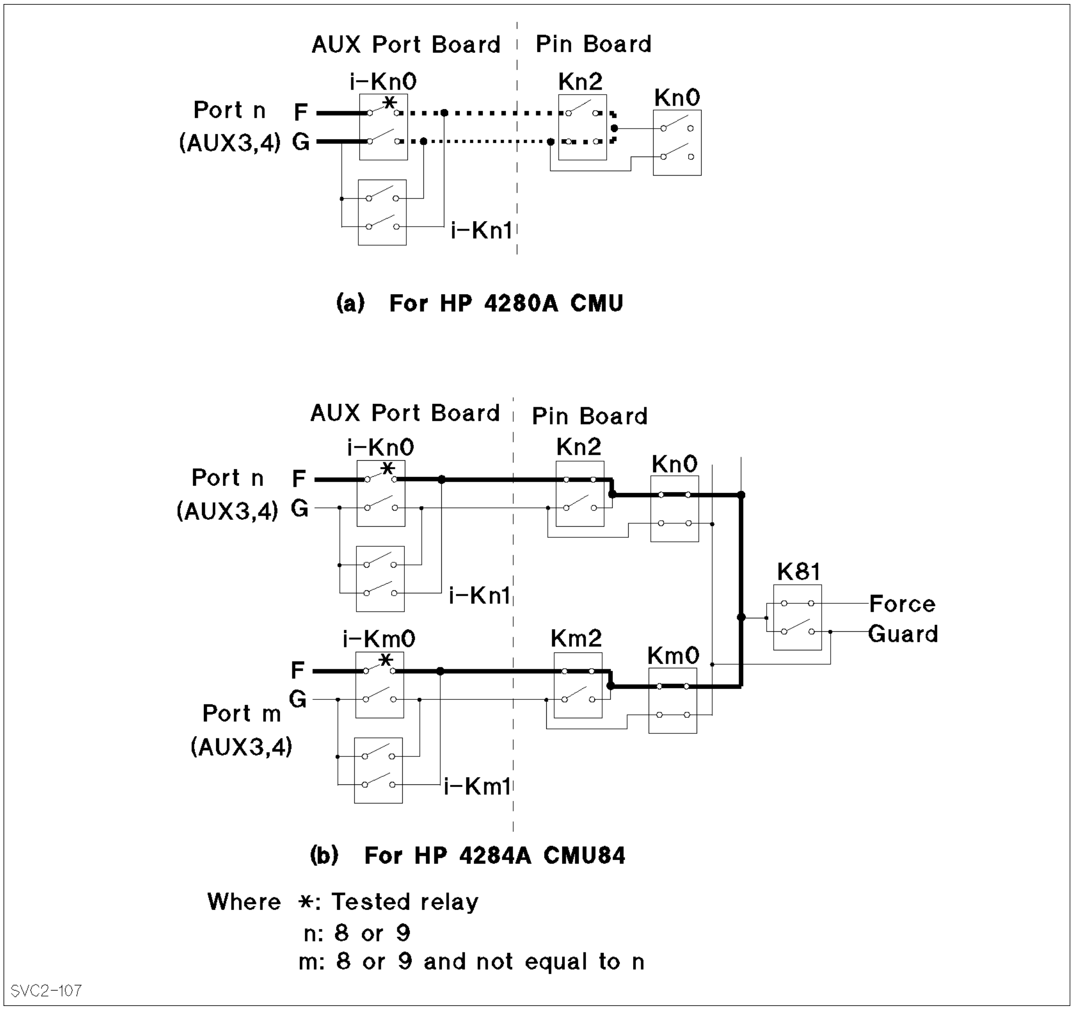
□ If VS is connected to the test port:

- Make test of i-K80 and i-K90 force side contact
  1. Make i-K80 or i-K90 input relay.
  2. Force 10 μA from SMUm (1 mA range, 0 V compliance).
  3. Force 0.5 V from VS (2 V range, 10 mA limiter).
  4. Measure voltage value of SMUm.
  5. Compare with test limits (Table 2-5).
- Break test of i-K80 and i-K90 force side contact
  1. Break i-K80 or i-K90 input relay.
  2. Force 10 μA from SMUm (1 mA range, 0 V compliance).
  3. Force 0.5 V from VS (2 V range, 10 mA limiter).
  4. Measure current value of SMUm.
  5. Compare with test limits (Table 2-5).

- ☐ If VM is connected to the test port:
  - ■ Make test of i-K80 and i-K90 force
    1. Make i-K80 or i-K90 input relay.
    2. Force −0.5 V from SMU*m* (2 V range, 100 mA compliance).
    3. Measure voltage using VM and compare with test limits (Table 2-5).
    4. If passes, force 0.5 V from SMU*m* (2 V range, 100 mA compliance).
    5. Measure voltage using VM and compare with test limits (Table 2-5).
  - ■ Break test of i-K80 and i-K90 force
    1. Break i-K80 or i-K90 input relay.
    2. Force −0.5 V from SMU*m* (2 V range, 100 mA compliance).
    3. Measure voltage using VM and compare with test limits (Table 2-5).
    4. If fails, force 0.5 V from SMU*m* (2 V range, 100 mA compliance).
    5. Measure voltage using VM and compare with test limits (Table 2-5).

where SMU*m* is SMU2, SMU3, or SMU4; SMU*m* is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU found is used.

When the HP 4280A CMU or HP 4284A CMU84 is connected to the test path, the test path is shown as follows:



If the CMH and CML terminals of the HP 4280A CMU are connected to ports 8 and 9, the guard side paths of ports 8 and 9 are led to circuit common of the CMU. Circuit common of the CMU is connected to circuit common of the HP 4142B DCS through the chassis.

If the H_C-H_P and L_P-L_C terminals of the HP 4284A CMU84 are connected to ports 8 and 9, the guard side paths of ports 8 and 9 are led to chassis ground of the CMU84. Chassis ground of the CMU84 is connected to circuit common of the DCS through the chassis of the DCS.

- If HP 4280A CMU is connected to the test port:
  - Make and break test of i-K80 force side contact
    1. Set the connection mode of the CMU to CN19 (grounded measurement mode).
    2. Make i-K80 input relay.
    3. Measure capacitance between force and guard paths and keep the value in memory.
    4. Break i-K80 input relay.
    5. Measure capacitance between force and guard paths.
    6. Calculate the difference between the two capacitances and compare with the test limits (Table 2-5).
  - Make and break test of i-K90 force side contact
    1. Set the connection mode of the CMU to CN16 (grounded measurement mode).
    2. Make i-K90 input relay.
    3. Measure capacitance between force and guard paths and keep the value in memory.
    4. Break i-K90 input relay.
    5. Measure capacitance between force and guard paths.
    6. Calculate the difference between the two capacitances and compare with the test limits (Table 2-5).
- If HP 4284A CMU84 is connected to the test port:
  - Make test of i-K80 and i-K90 force side contact
    1. Make i-K80 or i-K90 input relay.
    2. Set the CMU84 to Z-θ measurement mode, 30 mVrms measurement signal level, and 1 KHz measurement frequency.
    3. Measure impedance and compare with the test limits (Table 2-5).
  - Break test of i-K80 and i-K90 force side contact
    1. Break i-K80 or i-K90 input relay.
    2. Set the CMU84 to Z-θ measurement mode, 30 mVrms measurement signal level, and 1 KHz measurement frequency.
    3. Measure impedance and compare with the test limits (Table 2-5).

Relay Test Limits

Table 2-5. The Input Relay Test Limits

Port	Relay	Make	Break
1	K10 guard	170 Ω to 500 Ω[1]	≥1 MΩ
	K10 force	0 Ω to 10 Ω	≥1 MΩ
	K11 guard and force	170 Ω to 500 Ω[1]	≥1 MΩ
2, 3, 4	K21, K31, K41	170 Ω to 235 Ω	≥1 MΩ
	K20, K30, K40 force	0 Ω to 10 Ω	≥1 MΩ
	K20, K30, K40 sense	0.4 Ω to 10 Ω	≥1 MΩ
5, 6	K50, K60 guard	0 Ω to 10 Ω	≥1 MΩ
	K50, K60 force (VS)	0.487 V to 0.513 V	−3 mV to +3 mV
	K50, K60 force (VM)	(forced voltage) ±3 mV	[2]
7	K70	0 Ω to 10 Ω	≥1 MΩ
8, 9	K81, K91	0 Ω to 10 Ω	≥1 MΩ
	K80, K90 guard	0 Ω to 10 Ω	≥1 MΩ
	K80, K90 force (VS)	0.487 V to 0.513 V	−3 mV to +3 mV
	K80, K90 force (VM)	(forced voltage) ±3 mV	[2]
	K80, K90 force (CMU)	C (make) − C (break) ≥ 100 pF	
	K80, K90 force (CMU84)	0 Ω to 10 Ω	≥1 MΩ

1 If the measured value is between 235 Ω and 500 Ω, a warning message is displayed.

2 If the measured voltage of the VM does not correspond to the output voltage (−5 V or +5 V) of the SMU, the break test of the input relay is recognized to be passed.

SMU Test Operation

Figure 2-51 shows a simplified SMU Test circuit.

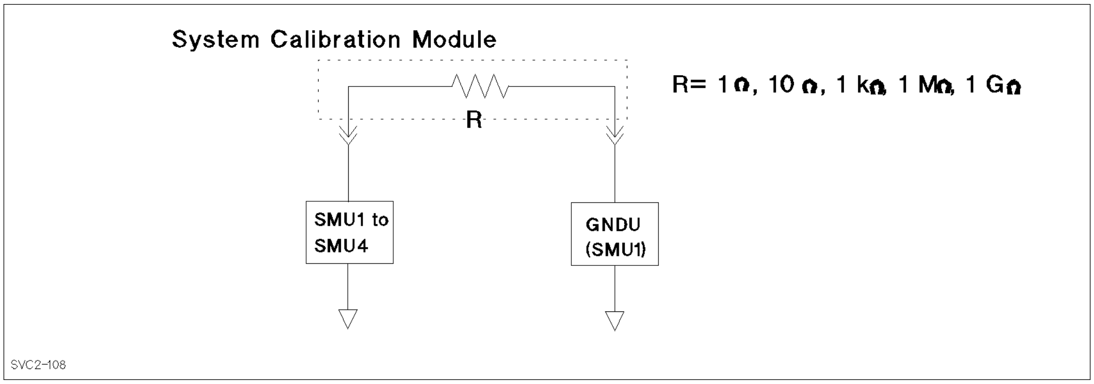


Figure 2-51. SMU Test Circuit

During the SMU Test, each SMU is tested at each voltage and current range in both the V and I source modes by performing V and I measurements of the known resistances of the system calibration module.

SMU Test Limits

Table 2-6. SMU Repeat Test Limits

Nominal Resistance	Voltage/Current Range	Value		Tolerance(%)	
		Voltage	Current	SMU1	SMU2,3,4
1 MΩ	200 V/100 μA[1]	±92 V	±92 μA	±0.669	±0.669
		±72 V	±72 μA	±0.729	±0.729
	100 V/100 μA	±52 V	±52 μA	±0.740	±0.740
		±47 V	±47 μA	±0.772	±0.772
		±42 V	±42 μA	±0.809	±0.809
	40 V/100 μA	±37 V	±37 μA	±0.777	±0.777
		±32 V	±32 μA	±0.829	±0.829
		±27 V	±27 μA	±0.898	±0.898
		±22 V	±22 μA	±1.000	±1.000
	20 V/100 μA	±17 V	±17 μA	±1.103	±1.103
		±12 V	±12 μA	±1.375	±1.375
	20 V/10 μA	±7 V	±7 μA	±0.570	±0.580
		±2 V	±2 μA	±1.320	±1.330
		±1.2 V	±1.2 μA	±1.275	±1.288
	20 V/1 μA	±0.4 V	±0.4 μA	±1.325	±1.585

1 This range is tested only when the DCS is equipped with HP 41420A 200 V/1 A SMUs.

Table 2-7. SMU Spot Test Limits

Nominal Resistance	Voltage/Current Range	Value		Tolerance(%)		
		Voltage	Current	SMU1	SMU2[1]	SMU3&4
1 GΩ	100 V/100 nA	±50 V	±50 nA	±1.370	±3.170	±3.170
	20 V/10 nA	±5 V	±5 nA	±2.250	—	—
	20 V/1 nA	±0.5 V	±0.5 nA	±7.150	—	—
1 kΩ	20 V/10 mA	±5 V	±5 mA	±0.740[2]	±0.690	±0.690
	20 V/1 mA	±0.5 V	±0.5 mA	±2.702	±2.652	±2.652
10 Ω	2 V/1 A[3]	±1 V	±100 mA	±6.780[4]	±1.780	±1.780
	20 V/100 mA	±0.5 V	±50 mA	±7.652[5]	±2.652	±2.652
1 Ω	2 V/1 A[3]	±1 V	±1 A	±50.862[6]	±1.112	±20.862[7]

1 If an HP 41420A SMU is used. If SMU2 is an HP 41421B SMU, these test limits are the same as for SMU3 and SMU4.

2 ±0.750 for HP 4089A/B 96-pin SWM system.

3 This range is tested only when the DCS is equipped with HP 41420A 200 V/1 A SMUs.

4 ±7.780 for HP 4089A/B 96-pin SWM system.

5 ±8.652 for HP 4089A/B 96-pin SWM system.

6 ±60.862 for HP 4089A/B 96-pin SWM system.

7 ±1.112 for HP 4089A/B 96-pin SWM system.

VS Test Operation

The VS Test checks the voltage sources VS1 and VS2 of the HP 4142B DCS for correct dc output and measurement. The VS Test performs two tests: voltage output accuracy test and current measurement accuracy test. For revision 6.0 or earlier, only the voltage output accuracy test is performed. Figure 2-52 shows a simplified VS Test circuit.

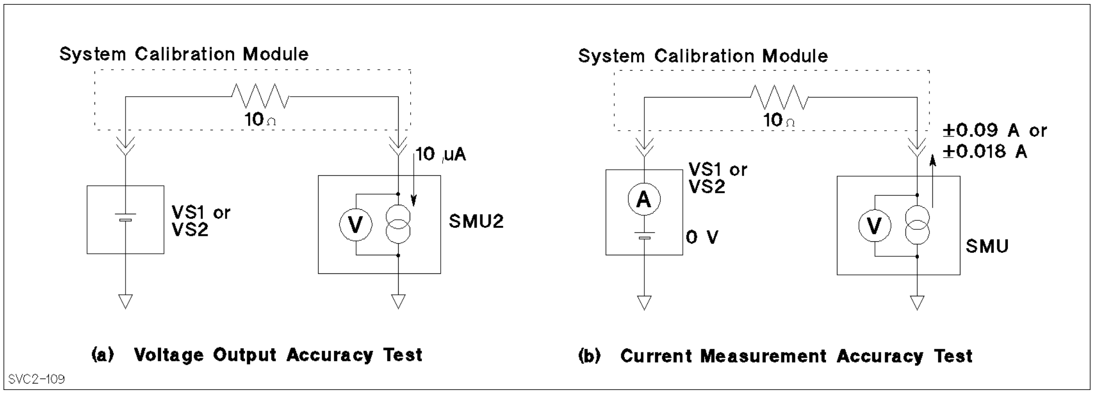


Figure 2-52. VS Test Circuit

The VS Test performs the voltage output accuracy test and current measurement accuracy test as follows:

- Voltage output accuracy test:

  During the voltage output accuracy test, VS1 and VS2 force the specified voltages. The SMU is set to a 10 μA current sink, which can be ignored because the voltage drop of the 10 Ω resistor is low compared to the output voltage of the VS1 or VS2. VS1 and VS2 force -15 V, 1 V, and 10 V for the 20 V range and 35 V for the 40 V range. Then the SMU measures the voltage and it is compared against the test limit.

- Current measurement accuracy test:

  During the current measurement accuracy test, VS1 and VS2 force 0 V, and the SMU forces $\pm$0.09 A and $\pm$0.018 A of current. VS1 and VS2 measure the current value and it is compared against the test limit.

VS Test Limits

Table 2-7. VS Test Limits

	Range	Nominal value	Error
Voltage Output Accuracy Test	20 V	−15 V	±52.5 mV
		1 V	±31.5 mV
		10 V	±45.0 mV
	40 V	35 V	±92.5 mV
Current Measurement Accuracy Test	0.1 A	±0.09 A	±4.5 mA
		±0.018 A	±0.74 mA

VM Test Operation

The VM Test checks the voltage monitors VM1 and VM2 of the HP 4142B DCS for correct dc measurement operation. The VM Test verifies the voltage measurement operation in both grounded measurement mode and differential measurement mode. For revision 6.0 or earlier, only the test for grounded measurement mode is performed. Figure 2-53 shows a simplified VM Test circuit.

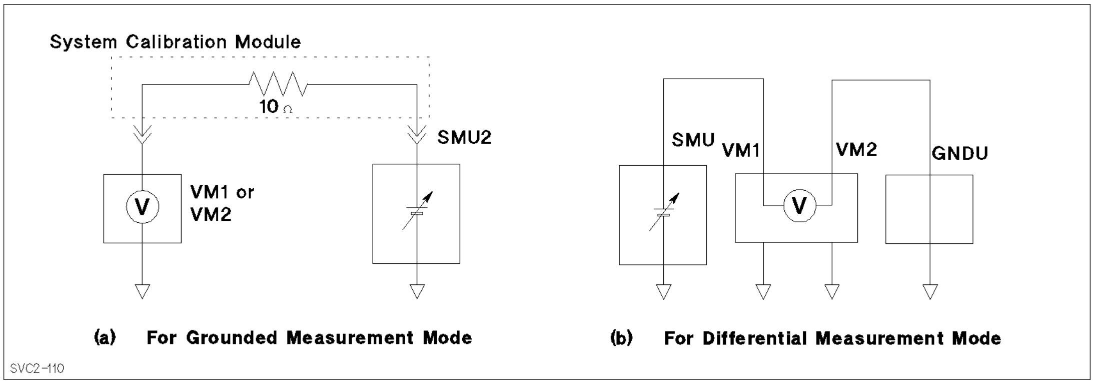


Figure 2-53. VM Test Circuit

The VM Test performs the voltage measurement test as follows:

- For grounded measurement mode:

  An SMU forces voltages of −15 V, 1 V, 10 V, and 35 V. VM1 and VM2 are then checked by measuring these voltages. The 10 Ω resistor in the system calibration module has no effect on the voltages measured by each VM because of the high input resistance of the VMs.

- For differential measurement mode:

  VM1 is shorted to an SMU through the pin board. VM2 is shorted to the GNDU through the pin board. VM1 is set to the differential measurement mode. The SMU forces −1.9 V and +1.9 V at the 2 V range, voltage is measured at both the SMU and VM1, and the measured value at VM1 is compared with the measured value at the SMU against the test limit.

VM Test Limits

Table 2-8. VM Test Limits

Measurement mode	Range	Nominal value	Error
Grounded meas.	20 V	−15 V	±35.0 mV
	2 V	1 V	±3.2 mV
	20 V	10 V	±30.0 mV
	40 V	35 V	±75.0 mV
Differential meas.	2 V	±1.9 V	±4.025 mV

AFU Test Operation

The AFU Test checks the AFU of the HP 4142B DCS for correct measurement operation. The AFU Test performs a feedback measurement and checks whether the measurement (target) value is within test limits. Figure 2-54 shows a simplified AFU Test circuit.

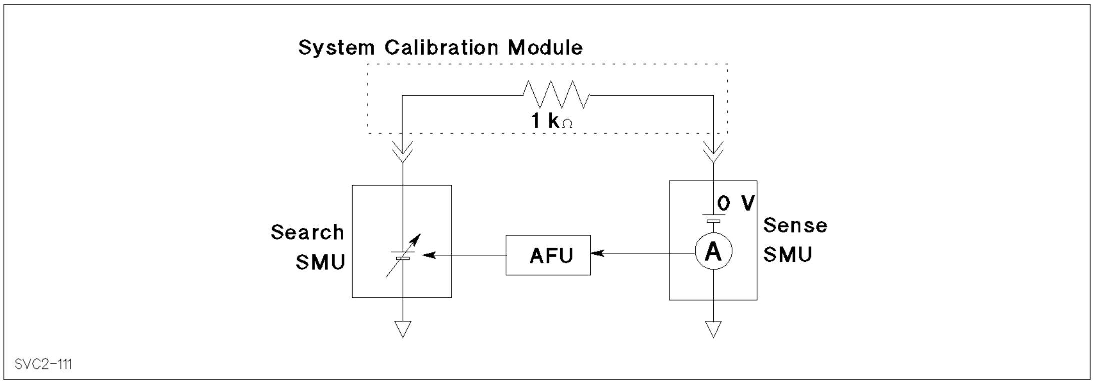


Figure 2-54. AFU Test Circuit

The known resistance of the system calibration module is connected between the search and sense SMUs. The sense SMU sets to the I measure (V force) mode with 0 V bias voltage. As the AFU starts its feedback measurement, the search SMU sweeps voltage within a certain range, and the sense SMU measures the current until the current reaches the target value. Then the measured value is compared to the target value.

AFU Test Limits

Table 2-9. AFU Test Limits

Sense SMU Range	Target Value	Error
10 mA	−5 mA	±15 μA
	0 A	±10 μA
	5 mA	±15 μA

CMS C-G Test Operation

The CMS C-G Test checks the C-G measurement accuracy of the HP 4280A CMU, and consists of the following subtests performed in the order listed.

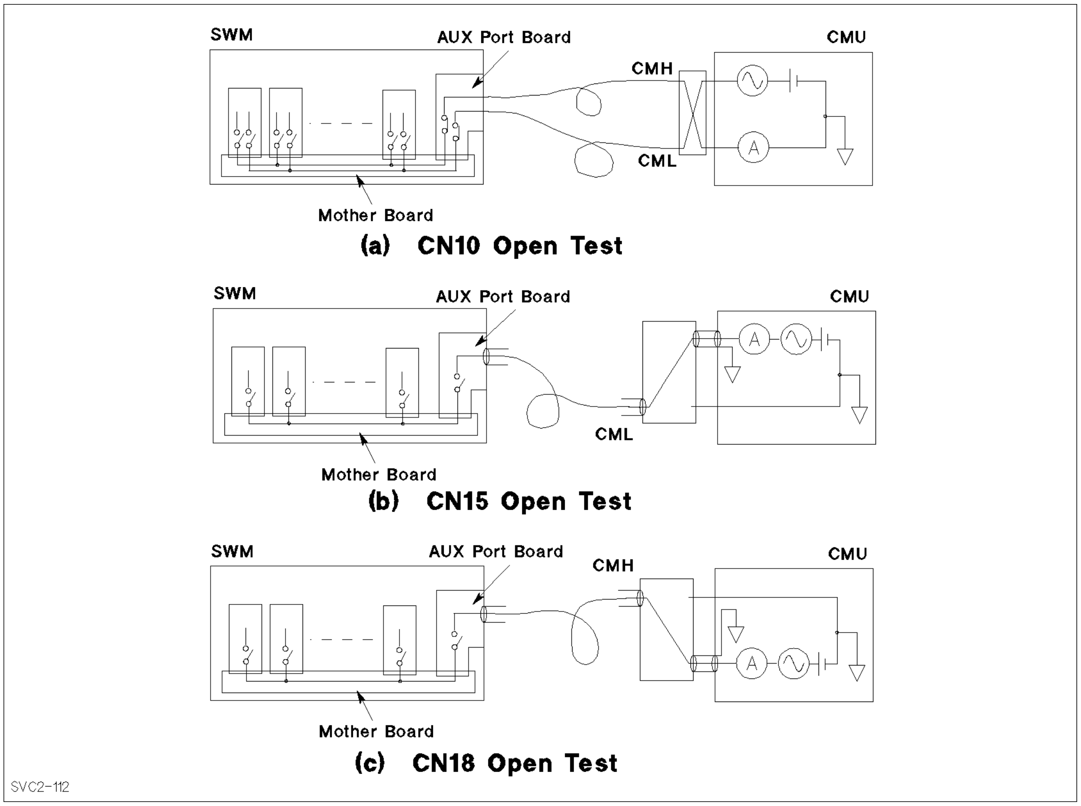
1. CMU Self-Test

   Performs a shorter version of the standalone self-test of the CMU. Contents and test limits for this shorter CMU self-test differ from the standalone self-test of the CMU because this version requires that the CMH and CML cables be connected, while the standalone self-test of the CMU is performed with nothing connected.

   The CMU Self-Test executes the following tests:

VRD Zero Test	Verifies correct zero scale output from the vector ratio detector (VRD). This test is one of the built-in self-tests of the CMU. Test limits are 0.0 ±6.0 fF for capacitance and 0.0 ±60 nS for conductance.
Full Scale Test	Verifies correct full scale output from the vector ratio detector (VRD). This test is one of the built-in self-tests of the CMU. Test limits are 0.0 ±2.3 pF for capacitance and 0.0 ±23 mS for conductance.
CN10 Open Test	Verifies stray capacitance and conductance for connection mode 10. This test is one of the built-in self-tests of the CMU. Test limits are 5.0 ±5.0 pF for capacitance and 1.0 ±2.0 μS for conductance.
CN15 Open Test	Verifies stray capacitance and conductance for connection mode 15. This test is equivalent to built-in selt-test No. 5. Test limits are 550 ±100 pF for capacitance and 15 ±25 μS for conductance.
CN18 Open Test	Verifies stray capacitance and conductance for connection mode 18. This test is equivalent to built-in selt-test No. 6. Test limits are 550 ±100 pF for capacitance and 15 ±25 μS for conductance.

   For more details on these tests, see the HP 4280A *Troubleshooting Guide*.



CN10, CN15, and CN18 Open Test

2. C-G Measurement Test
   a. Measures the capacitance of the 100 pF and 1000 pF capacitors in the system calibration module, and compares measurement results with the calibrated values of the system calibration module.
   b. Measures the conductance of the 100 pF and 1000 pF capacitors and 1 kΩ resistor in the system calibration module, and checks measurement results against the test limits.
3. Stray Capacitance Test

   Measures the stray capacitance 36–40 and 44–48 pins for HP 4085B 48-pin SWM; 36–40, 68–72, and 4–96 pins for HP 4089A/B 96-pin SWM. Then, checks measurement results against the test limits.

CMS C-G Test Limits

Table 2-10. CMS C-G Test Limits

Nominal Value	Range	Test Signal Level	Error
1 mS (1 kΩ)	1 mS	30 mVrms	±50 μS
100 pF/0.0 S	100 pF/1 mS	10 mVrms	±0.8 pF/±5 μS
100 pF/0.0 S	100 pF/1 mS	30 mVrms	±0.6 pF/±4 μS
1000 pF/0.0 S	1000 pF/10 mS	10 mVrms	±19 pF/±100 μS
1000 pF/0.0 S	1000 pF/10 mS	30 mVrms	±17 pF/±90 μS

Table 2-11. Stray Capacitance Test Limit

Range	Test Signal	Error
Auto	30 mVrms	±6 pF

CMS Bias Test Operation

The CMS Bias Test checks the accuracy of the internal dc bias source of the HP 4280A CMU. Figure 2-55 shows a simplified CMS Bias Test circuit.

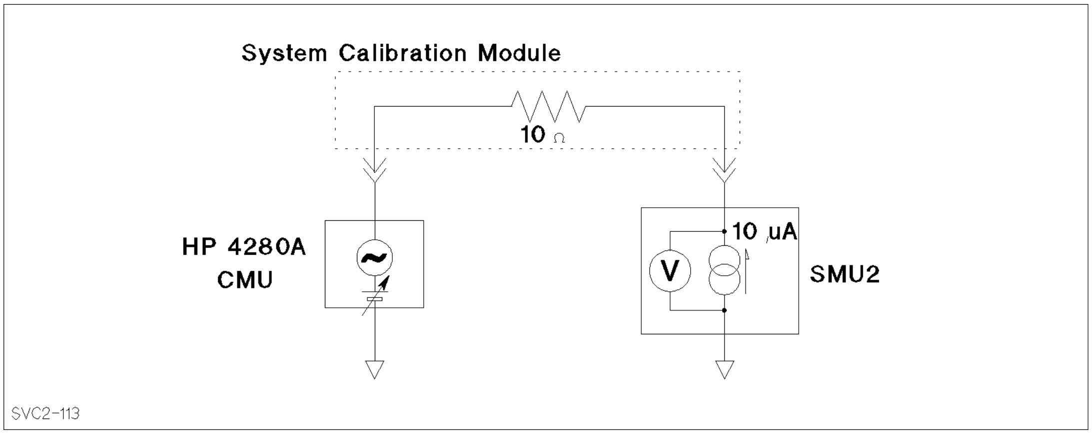


Figure 2-55. CMS Bias Test Circuit

During the CMS Bias Test, the HP 4280A CMU outputs voltages of −10 V, 1 V, and 80 V on the 10 V, 1 V, and 100 V ranges, respectively. These voltages are then measured by an SMU, which is set to current source and forces 10 μA, and measurement results are compared to the test limits. The voltage drop of the 10 Ω resistor is low enough not to affect on the voltage measurement value.

CMS Bias Test Limits

Table 2-12. CMS Bias Test Limits

Range	Nominal Value	SMU Measurement Range	Error
1 V	1 V	2 V	±14.1 mV
10 V	−10 V	20 V	±45 mV
100 V	80 V	100 V	±270 mA

CMU84 C-G Test Operation

The CMU84 C-G Test checks the C-G measurement accuracy of the HP 4284A CMU84, and consists of the following subtests performed in the order listed.

1. C-G Measurement Test
   a. The CMU84 measures the capacitance of the 100 pF, 1000 pF, 10 nF, and 100 nF capacitors and the 100 Ω and 1 kΩ resistors in the system calibration module. The measurement is performed at the frequency of 1 kHz, 10 kHz, 100 k Hz, and 1 MHz. Measurement results are compared with the calibrated values of the system calibration module.
   b. The CMU84 measures the conductance of the 100 pF, 1000 pF, 10 nF, and 100 nF capacitors and the 100 Ω and 1 kΩ resistors in the system calibration module. The measurement is performed at frequencies of 1 kHz, 10 kHz, 100 k Hz, and 1 MHz. Measurement results are checked against the test limits.
2. Stray Capacitance Test

   The CMU84 measures the stray capacitance between 4–8, 12–16, 20–24, 28–32, 36–40, and 44–48 for 48-pin SWM; between 20–24, 36–40, 44–48, 52–56, 60–64, and 68–72 for 96-pin SWM. The measurement values are compared with the calibrated values against the test limits.

CMU84 C-G Test Limits

Table 2-13. CMU84 C-G Test limits

Nominal Value	CMU84 Range	Frequency	Tolerance (Capacitance/Conductance)
100 pF/0.0 S	100 pF/6.3 μS	10 kHz	±0.5 pF/±31.5 nS
	100 pF/63 μS	100 kHz	±0.6 pF/±378 nS
	100 pF/630 μS	1 MHz	±1.1 pF/±5.67 μS
1000 pF/0.0 S	1000 pF/6.3 μS	1 kHz	±4.0 pF/±25.2 nS
	1000 pF/63 μS	10 kHz	±4.0 pF/±252 nS
	1000 pF/630 μS	100 kHz	±5.0 pF/3.78 μS
	1000 pF/6.3 mS	1 MHz	±21.0 pF/±151 μS
10 nF/0.0 S	10 nF/63 μS	1 kHz	±40.0 pF/±252 nS
	10 nF/630 μS	10 kHz	±40.0 pF/±2.52 μS
	10 nF/6.3 mS	100 kHz	±70.0 pF/±63 μS
100 nF/0.0 S	100 nF/630 μS	1 kHz	±400 pF/±2.52 μS
	100 nF/6.3 mS	10 kHz	±400 pF/±50.4 μS
100 Ω	6.3 mS/100 nF	10 kHz	±1.69 nF/±76.3 μS
	6.3 mS/10 nF	100 kHz	±179 pF/±82.6 μS
	6.3 mS/1000 pF	1 MHz	±29.0 pF/±143 μS
1 kΩ	630 μS/100 nF	1 kHz	±576 pF/±3.63 μS
	630 μS/10 nF	10 kHz	±57.6 pF/±3.63 μS
	630 μS/1000 pF	100 kHz	±8.35 pF/±4.26 μS
	630 μS/100 pF	1 MHz	±1.25 pF/±9.89 μS

Table 2-14. Stray Capacitance Test Limits

Range	Frequency	Error
Auto	1 MHz	6 pF
	100 kHz	
	10 kHz	
	1 kHz	

CMU84 Bias Test Operation

Figure 2-56 shows a simplified CMU84 Bias Test circuit.

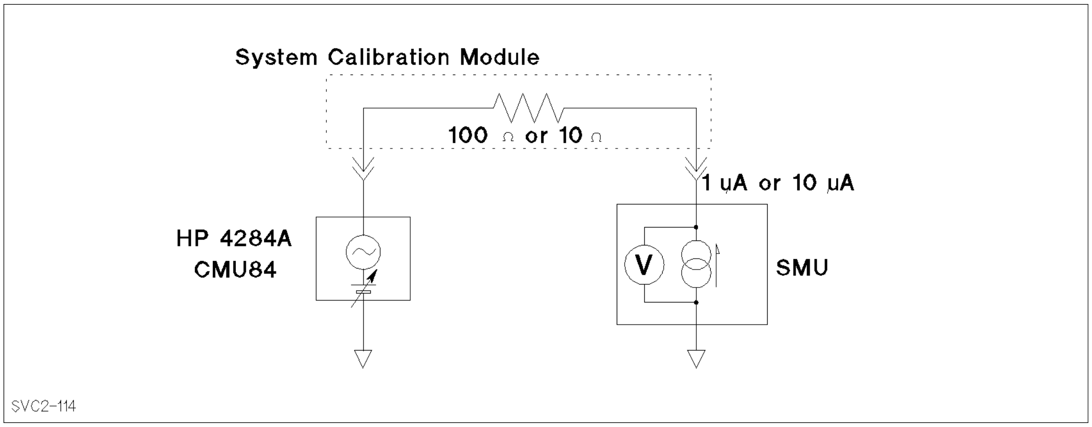


Figure 2-56. CMU84 Bias Test Circuit

The SMU is set to current source (voltage monitor) mode and forces 1 μA for the 48-pin SWM; 10 μA for the 96-pin SWM, which is low enough to have no affect on the voltage measurement. The CMU84 is set to the 0 mVrms signal level and outputs voltages measured by the SMU. The measurement results are checked against the test limits.

CMU84 Bias Test Limits

Table 2-15. CMU84 Bias Test Limits (Without ±40 V dc Bias Source)

Nominal Value	SMU Range	Error
1.5 V	2 V	±75 mV
2.0 V	2 V	±100 mV

Table 2-16. CMU84 Bias Test Limits (With ±40 V dc Bias Source)

Nominal Value	CMU84 Range	SMU Range	Error
0.0 V	4 V	2 V	±2.3 mV
±0.1 V	4 V	2 V	±2.4 mV
±2.0 V	4 V	2 V	±5.3 mV
±6.0 V	8 V	20 V	±21.2 mV
±14.0 V	20 V	20 V	±36.0 mV
±30.0 V	40 V	40 V	±75.0 mV
±40.0 V	40 V	40 V	±90.0 mV

DC Leak Test Operation

The DC Leak Test checks all pin boards and SMU ports for excessive leakage current to ground. Figure 2-57 shows a simplified DC Leak Test circuit.

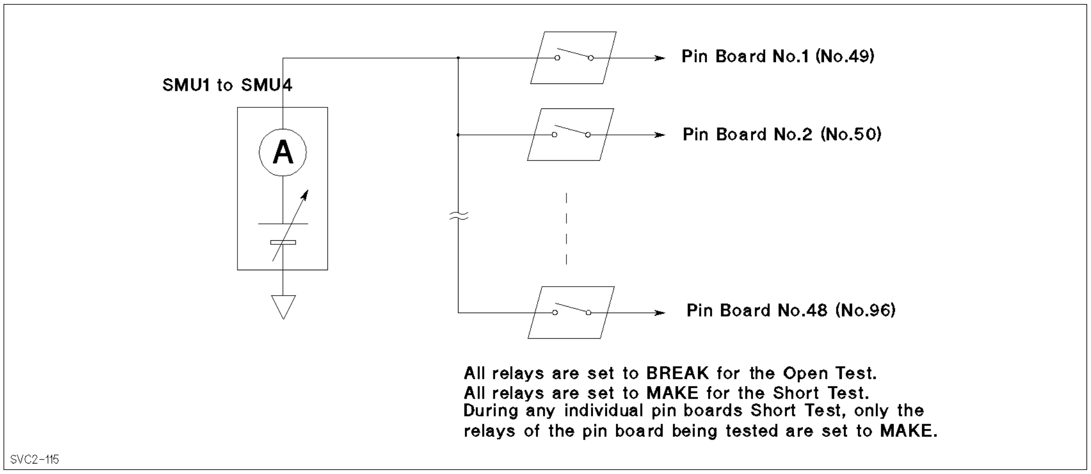


Figure 2-57. DC Leak Test Circuit

The DC Leak Test consists of the following subtests performed in the order listed:

1. Open Test

   All relays on all pin boards are set to break (off), and all SMUs are set to the voltage source (current monitor) mode. SMU1 (if the SMU1 is installed) outputs 20 V, and leakage current is measured. If the leakage current does not exceed the test limits, SMU2 (if the SMU2 is installed) is then tested in the same manner. This test sequence repeats until all four SMUs have been tested.

2. Short Test

   All relays on all pin boards are set to make (on), all measurement pins are connected to the SMU being tested, and all SMUs are set to the voltage source (current monitor) mode. SMU1 (if the SMU1 is installed) outputs 100 V, and leakage current is measured. If the leakage current does not exceed the test limits, SMU2 (if the SMU1 is installed) is then tested. This test sequence repeats until all four SMUs have been tested.

   If the leakage current exceeds the test limits, however, the Short Test is repeated for each pin board installed in the SWM.

DC Leak Test Limits

Table 2-17. DC Leak Open Test Limits

Voltage	Tolerance	
	SMU1	SMU2–4
20 V	±8.4 pA	±3 nA

Table 2-18. DC Leak Short Test Limits

Voltage	Tolerance	
	SMU1	SMU2–4
100 V	±10 pA	±11 nA

4062 W/ DVM Test Operating Theory

GNDU Test Operation

Figure 2-58 shows a simplified GNDU Test circuit.

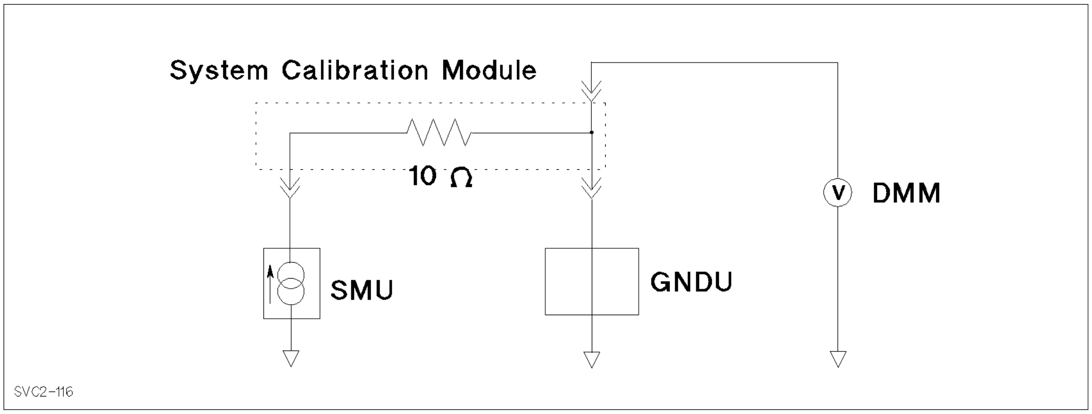


Figure 2-58. GNDU Test Circuit

During the GNDU Test, an SMU forces 100 mA current and the voltage of the GNDU port is measured using the voltage measurement function of the DMM. This voltage measurement value Vg is used in the Current Accuracy Test.

GNDU Test Limits

Table 2-19. GNDU Test Limits

Nominal Value	Tolerance	Uncertainty[1]
0 V	±1 mV	±2.4 μV

1 DVM error.

Kelvin Connection Test Operation

Figure 2-59 shows a simplified Kelvin Connection Test circuit.

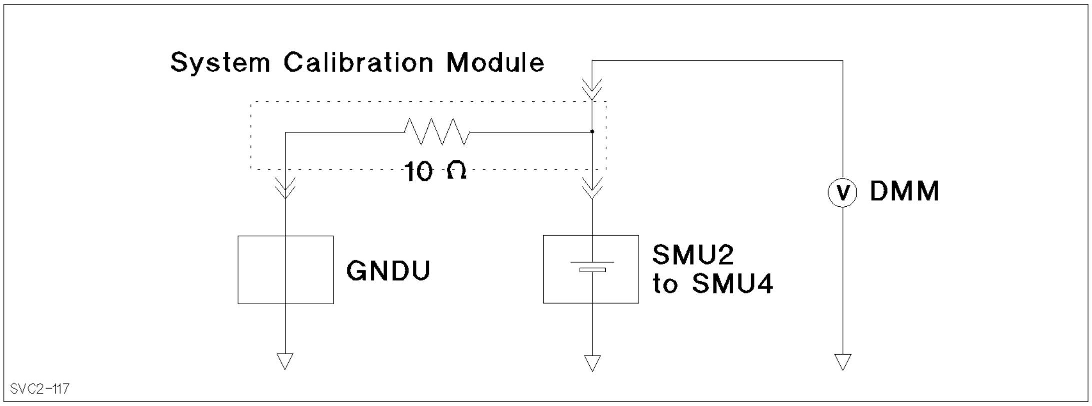


Figure 2-59. Kelvin Connection Test Circuit

During the Kelvin Connection Test, the SMU2, SMU3, and SMU4 force 0.9 V voltage, which is measured using the voltage measurement function of the DMM. The measured voltage is compared with the forced voltage.

Note that this test only checks the connections of force and sense of an SMU.

Kelvin Connection Test Limits

Table 2-20. Kelvin Connection Test Limits

Range	Nominal Value	Tolerance (SMU2–4)
20 V	0.9 V	±50 mV

Voltage Accuracy Test Operation

Figure 2-60 shows a simplified Voltage Accuracy Test circuit.

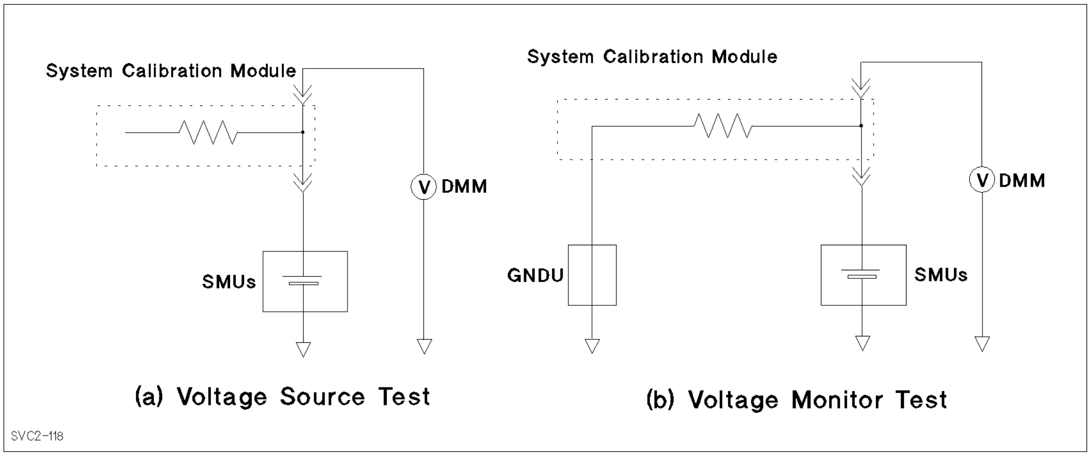


Figure 2-60. Voltage Accuracy Test Circuit

The Voltage Accuracy Test consists of the following subtests, performed in the order listed:

1. Voltage Source Test

   The voltage of each SMU is measured by the voltage measurement function of the DMM.

2. Voltage Monitor Test

   The known resistances of the system calibration module are measured by each SMU set to the I source (V monitor) mode, and measurement results are monitored using the voltage measurement function of the DMM.

Voltage Accuracy Test Limits

Table 2-21. Voltage Accuracy Test Limits

Source Mode	Range	Force Value	Tolerance		Uncertainty[1]
			SMU1	SMU2,3,4	
Voltage Source	2 V	±2 V	±2.1 mV	±2.1 mV	±66 μV
		0 V	±1.1 mV	±1.1 mV	±2.4 μV
	20 V	±20 V	±20 mV	±20 mV	±820 μV
		0 V	±10 mV	±10 mV	±2.4 μV
	40 V	±40	±40 mV	±40 mV	±1.34 mV
		0 V	±20 mV	±20 mV	±2.4 μV
	100 V	±100 V	±100 mV	±100 mV	±2.9 mV
		0 V	±50 mV	±50 mV	±2.4 μV
	200V[2]	±200 V	±200 mV	±200 mV	±6.8 mV
		0 V	±100 mV	±100 mV	±2.4 μV
Current Source	2 V	±1.9 μA	±2.13 mV	±2.13 mV	±63.7 μV
		0 μA	±1.1 mV	±1.1 mV	±2.4 μV
	20 V	±19 μA	±19.5 mV	±19.5 mV	±794 μV
		0 A	±10 mV	±10 mV	±2.4 μV
	40 V	±39 μA	±39.5 mV	±39.5 mV	±1.314 mV
		0 μA	±20 mV	±20 mV	±2.4 μV
	100 V	±99 μA	±99.6 mV	±99.6 mV	±2.874 mV
		0 μA	±50 mV	±50 mV	±2.4 μV
	200 V[2]	±199 μA	±199.6 mV	±199.5 mV	±6.776 mV
		0 μA	±100 mV	±100 mV	±2.4 μV

1 Including DVM error.

2 This range is tested only when the DCS is equipped with HP 41420A 200 V/1 A SMUs.

Current Accuracy Test Operation

Figure 2-61 shows a simplified Current Accuracy Test circuit.

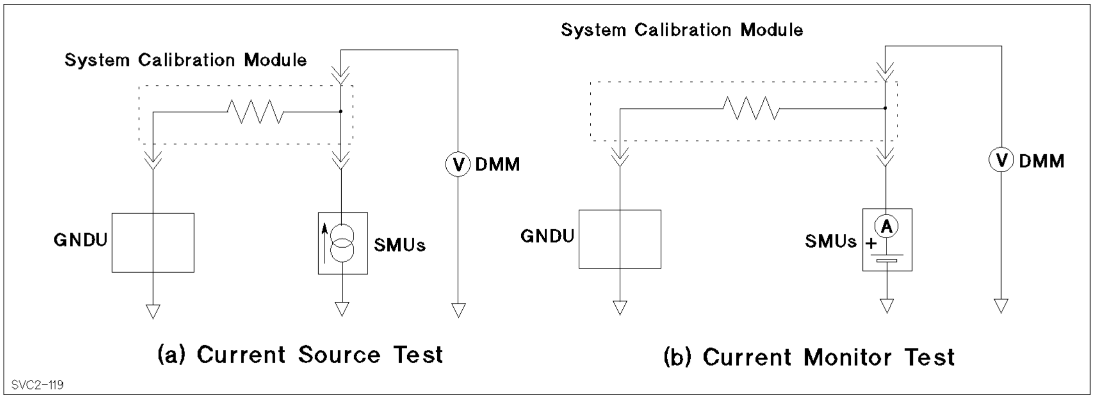


Figure 2-61. Current Accuracy Test Circuit

The Current Accuracy Test consists of the following subtests, performed in the order listed:

1. Current Source Test

   All SMUs are set to the current source (voltage monitor) mode and force a certain current. The voltage drop of the known resistances of the system calibration module is measured with the voltage measurement function of the DMM. The forced current is compared with the current calculated from the measured voltage and the known resistance.

2. Current Monitor Test

   The SMUs are set to the voltage source (current monitor) mode and force a certain voltage. The voltage drop of the known resistances of the system calibration module is measured with the voltage measurement function of the DMM, and the current passing through the resistance is calculated from the measured voltage and the known resistance. The current forced by the SMU is compared with the calculated current.

Current Accuracy Test Limits

Table 2-22. Current Accuracy Test Limits

Source Mode	Resistance	Range	Force Value	Tolerance SMU1	Tolerance SMU2,3,4	Uncertainty[1]
Current Source Voltage Monitor	1 Ω[2]	1 A	1 A	±6.02 mA	±6.02 mA	±1.028 mA
	10 Ω	100 mA	100 mA	±302 μA	±302 μA	±72.8 μA
	1 kΩ	10 mA	10 mA	±32 μA	±32 μA	±7.25 μA
	1 kΩ	1 mA	1 mA	±3.02 μA	±3.02 μA	±728 nA
	1 kΩ	100 μA	90 μA	±280.18 nA	±280.18 nA	±68.46 nA
	1 MΩ	10 μA	10 μA	±32 nA	±33 nA	±7.75 nA
	1 MΩ	1 μA	1 μA	±6.02 nA	±7.1 nA	±778 pA
Voltage Source Current Monitor	1 Ω[2]	1 A	0.9 V	±5.518 mA	±5.518 mA	±925.6 μA
	10 Ω	100 mA	0.9 V	±281.8 μA	±281.8 μA	±65.56 μA
	1 kΩ	10 mA	9 V	±29.8 μA	±29.8 μA	±6.527 μA
	1 kΩ	1 mA	0.9 V	±2.818 μA	±2.818 μA	±655.6 nA
	1 kΩ	100 μA	0.09 V	±280.18 nA	±280.18 nA	±68.46 nA
	1 MΩ	10 μA	9 V	±29.8 nA	±30.7 nA	±6.977 nA
	1 MΩ	1 μA	0.9 V	±5.518 nA	±6.59 nA	±700.6 pA
	1 GΩ	100 nA	90 V	±550 pA	±1.45 nA	±137.64 pA
	1 GΩ	10 nA	9 V	±105 pA	—	±13.73 pA
	1 GΩ	1 nA	0.9 V	±17 pA	—	±1.376 pA

1 Including DVM error and resistance error in the system calibration module.

2 This range is tested only when the DCS is equipped with HP 41420A 200 V/1 A SMUs.

VS Test Operation

The VS Test verifies the voltage output accuracy and the current measurement accuracy using the DMM. For revision 6.0 or earlier, only the voltage output accuracy is verified. Figure 2-62 shows a simplified VS Test circuit.

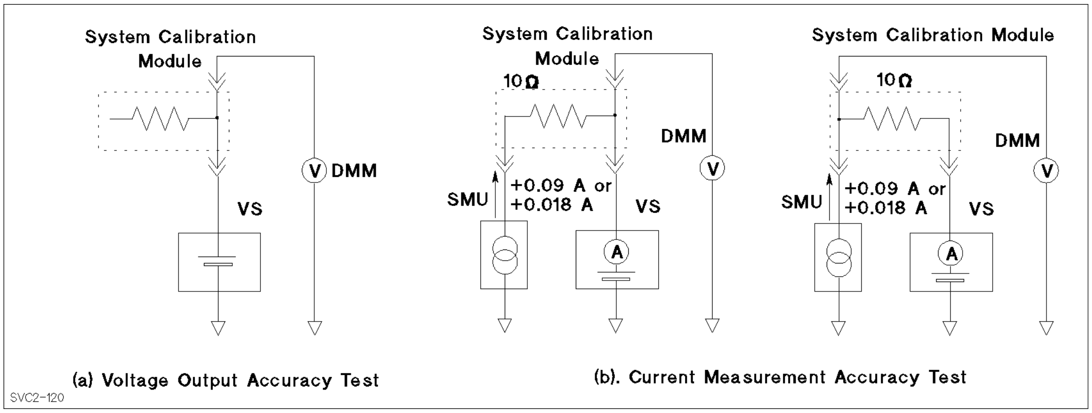


Figure 2-62. VS Test Circuit

The VS Test performs two tests as follow:

- Voltage output accuracy test:

  VS1 and VS2 force specified voltages and the DMM measures the voltage values. The measured values are compared with the output value against the test limits.

- Current measurement accuracy test:

  VS1 or VS2 forces 0 V and the SMU forces the specified current (±90 mA and ±18 mA). The DMM measures the voltage value (V_1) and VS1 or VS2 measures the current value (I_1). Then the connections to the 10 Ω resistor are exchanged and VS1 or VS2 forces 0 V and the SMU forces the specified current (±90 mA and ±18 mA). The DMM measures the voltage value (V_2) and VS1 or VS2 measures the current value (I_2). The current through the 10 Ω resistor is calculated and compared with the average of I_1 and I_2 against the test limits.

VS Test Limits

Table 2-23. VS Test Limits

	Range	Nominal Value	Tolerance	Uncertainty[1]
Voltage output accuracy test	20 V	±20 V	±30 mV	±820 μV
		0 V	±10 mV	±2.4 μV
	40 V	±40 V	±60 mV	±1.34 mV
		0 V	±20 mV	±2.4 μV
Current measurement accuracy test	0.1 A	±0.018 A	±0.74 mA	±13.112 μA
		±0.09 A	±3.7 mA	±65.56 μA

1 Including DVM error.

VM Test Operation

The VM Test verifies the voltage measurement accuracy in both grounded measurement mode and differential measurement mode. This test uses the DMM. For revision 6.0 or earlier, this test verifies accuracy in grounded measurement mode only. Figure 2-63 shows a simplified VM Test circuit.

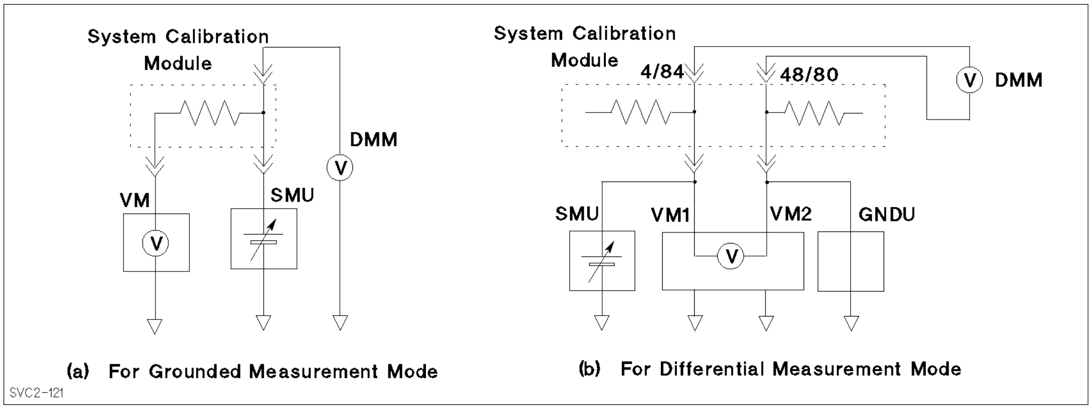


Figure 2-63. VM Test Circuit

The VM Test performs the voltage measurement test as follows:

- For grounded measurement mode:

  An SMU is set to the voltage source (current monitor) mode, and forces a certain voltage during the VM Test. The voltage forced by the SMU is measured with the voltage measurement function of the DMM, and is also monitored by the VM. The measured voltage is compared with the monitored voltage.

- For differential measurement mode:

  VM1 is shorted to an SMU through the pin board, VM2 is shorted to the GNDU through the pin board, and VM1 is set to the differential measurement mode. The SMU forces ± 0.19 V, ± 1.9 V, and 0 V. Then the DMM and VM1 measure the voltage and their measured values are compared against the test limits.

VM Test Limits

Table 2-24. VM Test Limits

Mode	Range	Nominal Value	Tolerance	Uncertainty[1]
Grounded measurement	2 V	±1.9 V	±2.05 mV	±63.7 μV
		0 V	±1.1 mV	±2.4 μV
	20 V	±19 V	±19.5 mV	±794 μV
		0 V	±10 mV	±2.4 μV
	40 V	±39 V	±39.5 mV	±1.314 mV
		0 V	±20 mA	±2.4 μV
Differential measurement	0.2 V	±0.19 V	±0.8804 mV	±8.56 μV
		0 V	±0.5 mV	±2.4 μV
	2 V	±1.9 V	±4.025 mV	±63.7 μV
		0 V	±2.1 mV	±2.4 μV

1 Including DVM error.

PV4274 Operating Theory

LCR C-G Test Operation

The LCR C-G Test checks the C-G measurement accuracy of the HP 4274A LCR. This test consists of the following subtests performed in the order listed:

1. LCR Open Self-Test
2. LCR Short Self-Test
3. C-G Measurement Test

   The LCR measures the 100 pF and 1000 pF capacitors in the system calibration module at 100 Hz, 1 kHz, 10 kHz, and 100 kHz. It compares the measurement results with the calibrated capacitance values of the system calibration module.

4. Stray Capacitance Test

   The LCR measures the stray capacitance between SWM pins 36 and 40, and pins 44 and 48. It compares the measurement results with the test limits.

LCR C-G Test Limits

Table 2-25. LCR C-G Test Limits

Nominal Value	Range	Frequency	Tolerance
100 pF	100 pF	100 kHz	±1 pF
		10 kHz	±1 pF
		1 kHz	±1 pF
		100 Hz	±1 pF
1000 pF	1000 pF	100 kHz	±10 pF
		10 kHz	±10 pF
		1 kHz	±10 pF
		100 Hz	±10 pF

Table 2-26. Stray Capacitance Test Limit

Range	Error
Auto	±10 pF

LCR Bias Test Operation

Figure 2-64 shows a simplified LCR Bias Test circuit.

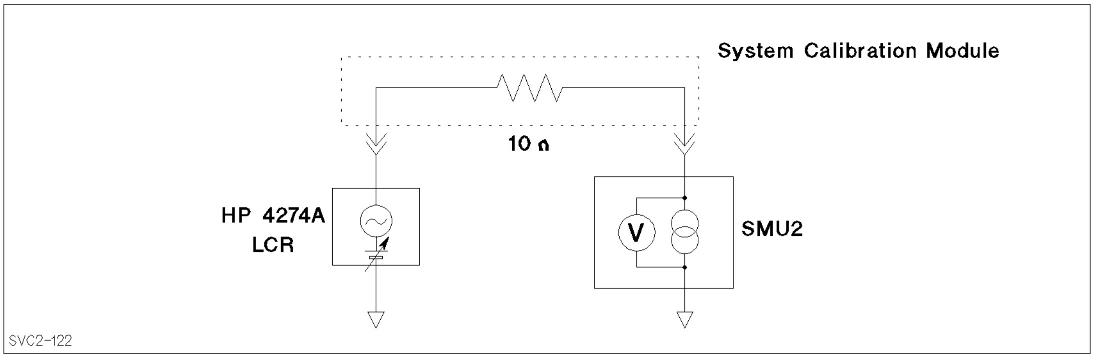


Figure 2-64. LCR Bias Test Circuit

For ±35 V internal dc bias source, the LCR outputs −9.99 V, 0.999 V, and 35 V on the 10 V, 1 V, and 35 V ranges, respectively. For ±100 V internal dc bias source, the LCR outputs 80 V on the 100 V range. Output voltage is then measured by an SMU, and measurement results are compared with the test limits.

LCR Bias Test Limits

Table 2-27. LCR Bias Test Limits (±35 V Internal dc Bias Source)

Range	Nominal Value	SMU Measurement Range	Error
10 V	−9.99 V	100 V	±74 mV
1 V	0.999 V		±18 mV
35 V	35 V		±280 mV

Table 2-28. LCR Bias Test Limits (±100 V Internal dc Bias Source)

Range	Nominal Value	SMU Measurement Range	Error
100 V	80 V	100 V	±1.77 V

3

Troubleshooting

This chapter contains HP 4062C/UX/PC troubleshooting and repair information, and includes step-by-step procedures in flow-diagram format to help you quickly isolate system failures. Also included are system failure and error codes, and messages to facilitate troubleshooting, as well as information on removing system instruments, removing instrument assemblies, and assembly locations.

Note

If the system is installed in a clean room, take special precautions to preserve the air purity in the clean room if it becomes necessary to repair the system. Give a thorough air bath to tools, test equipment, field service inventories, and so on, when you take these items into the clean room.

Safety Considerations

Be sure to observe all notes, cautions, and warnings given throughout this manual to ensure the safety of service personnel and to prevent damage to the system and any system components.

Warning

Several procedures described in this chapter are performed with power applied and protective covers removed. Only trained service personnel aware of the hazards involved should perform such procedures. Where troubleshooting can be performed without power applied, turn the power off. After repairs are completed, make sure all safety features are intact and are functioning properly, and that all necessary parts are connected to their protective grounds.

Required Test Equipment

Test equipment required for troubleshooting is the same as that required for system performance verification. See “Required Test Equipment” in Chapter 2 for details.

Troubleshooting Flow Diagrams

Figure 3-1 through Figure 3-13 provide flow diagrams to guide you through the troubleshooting process. Start with the “Turning the System Instruments On” in Figure 3-1 and follow the instructions given in the diagram.

These troubleshooting flow diagrams make extensive use of the hardware- and software-based troubleshooting aids—START and PV4062 programs, self-tests, and so on—all of which are described in “Troubleshooting Using START” through “Troubleshooting the HP 4142B DCS”.

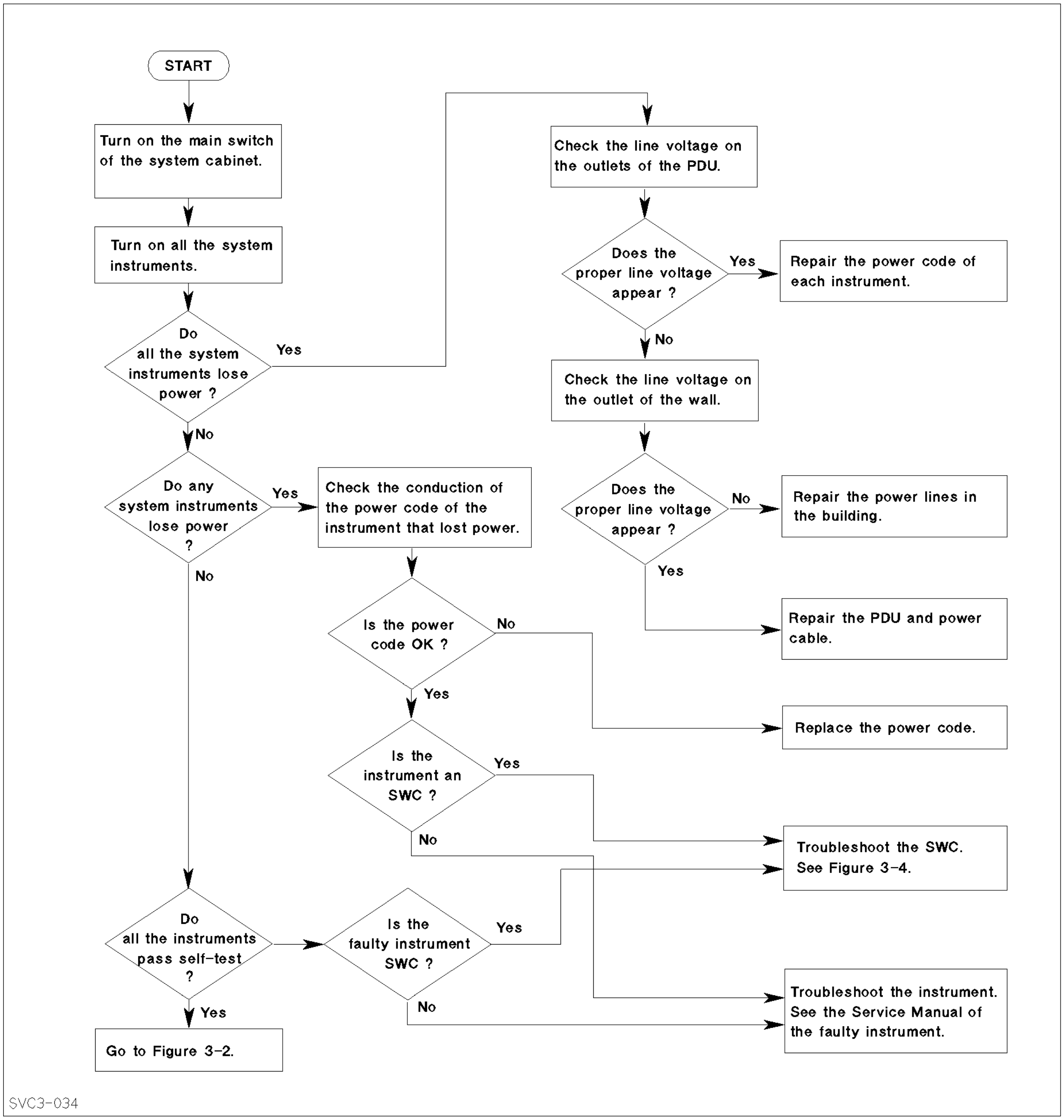


Figure 3-1. Turning the System Instruments On

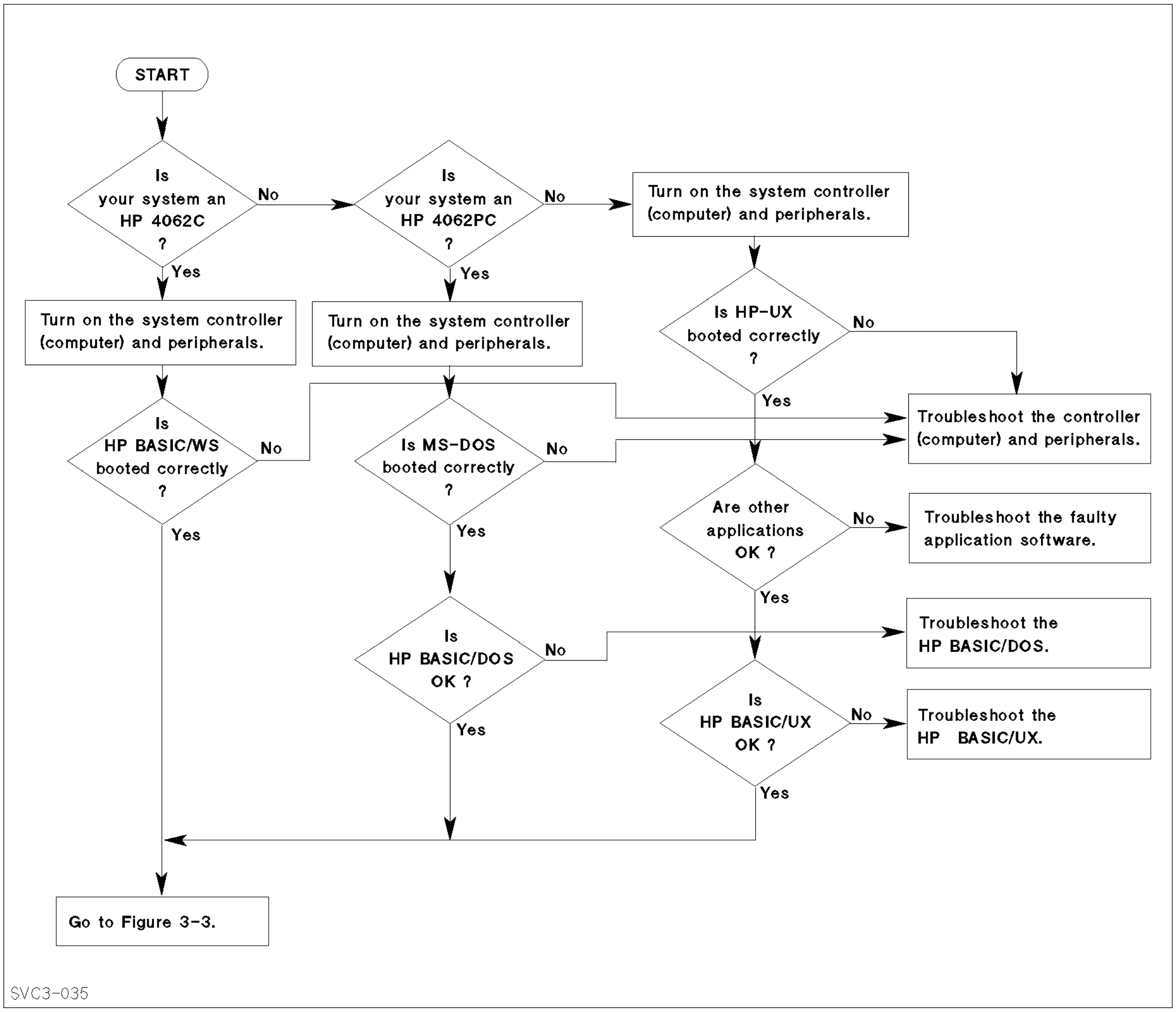


Figure 3-2. Turning the System Controller On

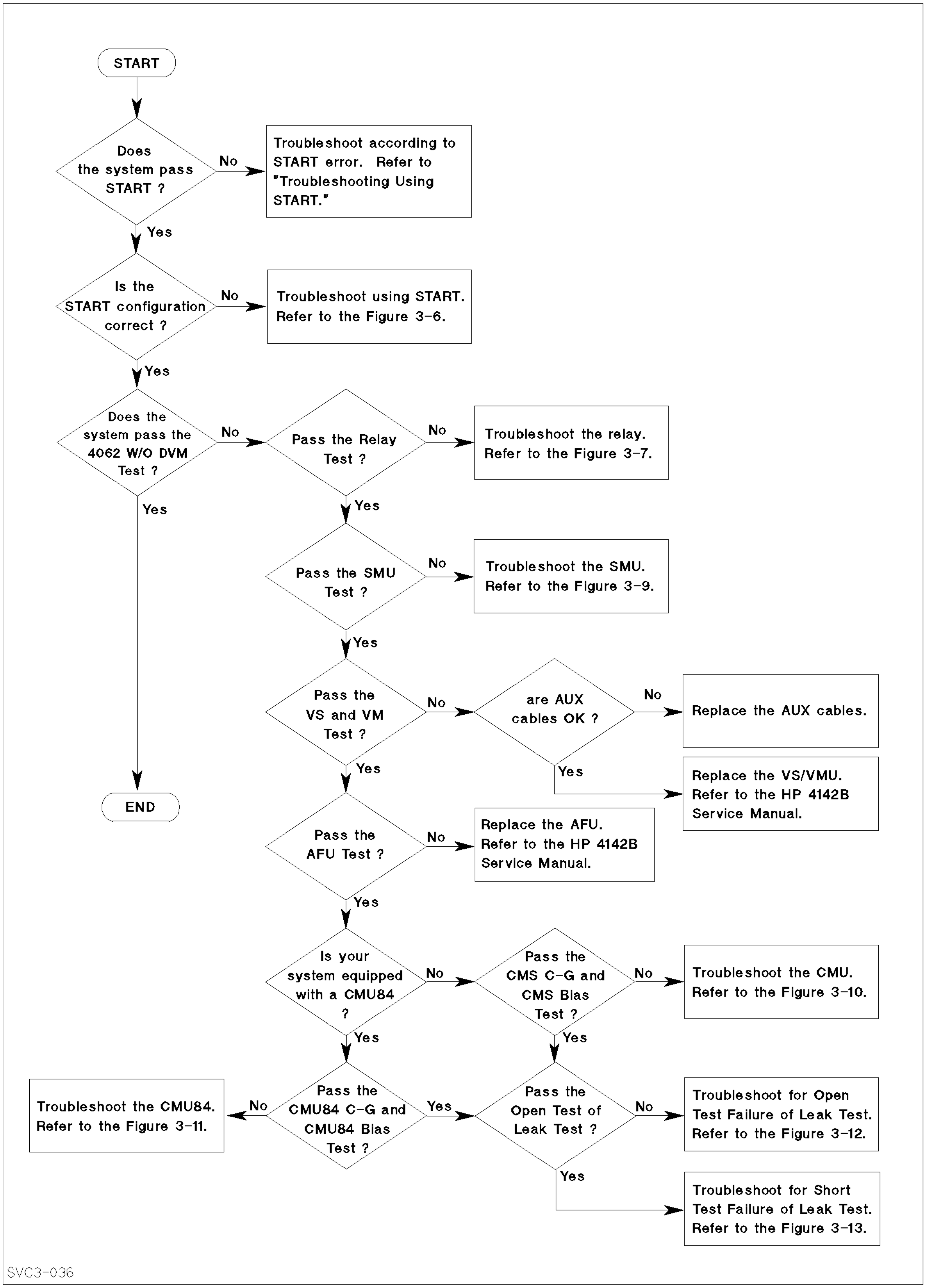


Figure 3-3. Failure Isolation Using PV4062

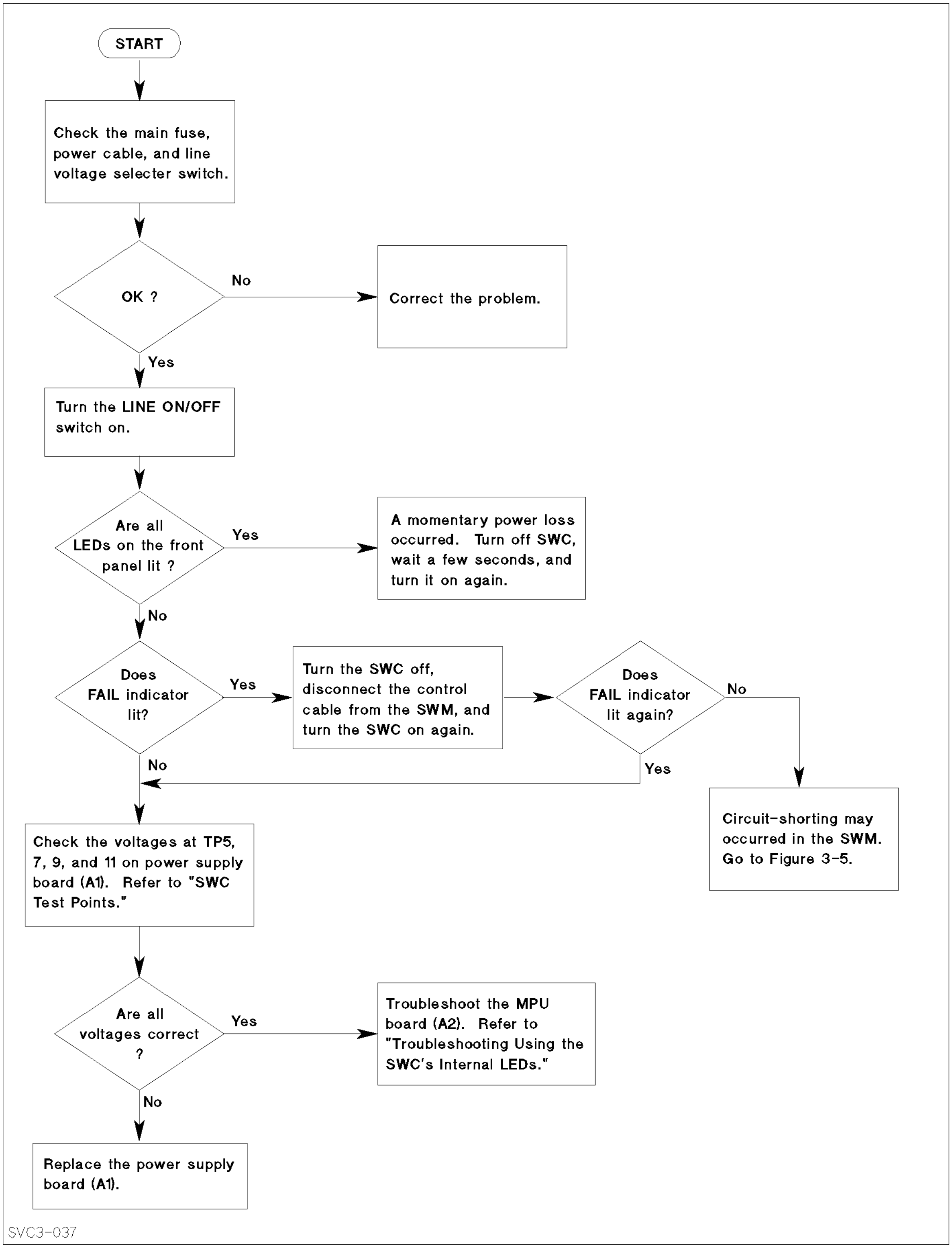


Figure 3-4. HP 4084B SWC Troubleshooting

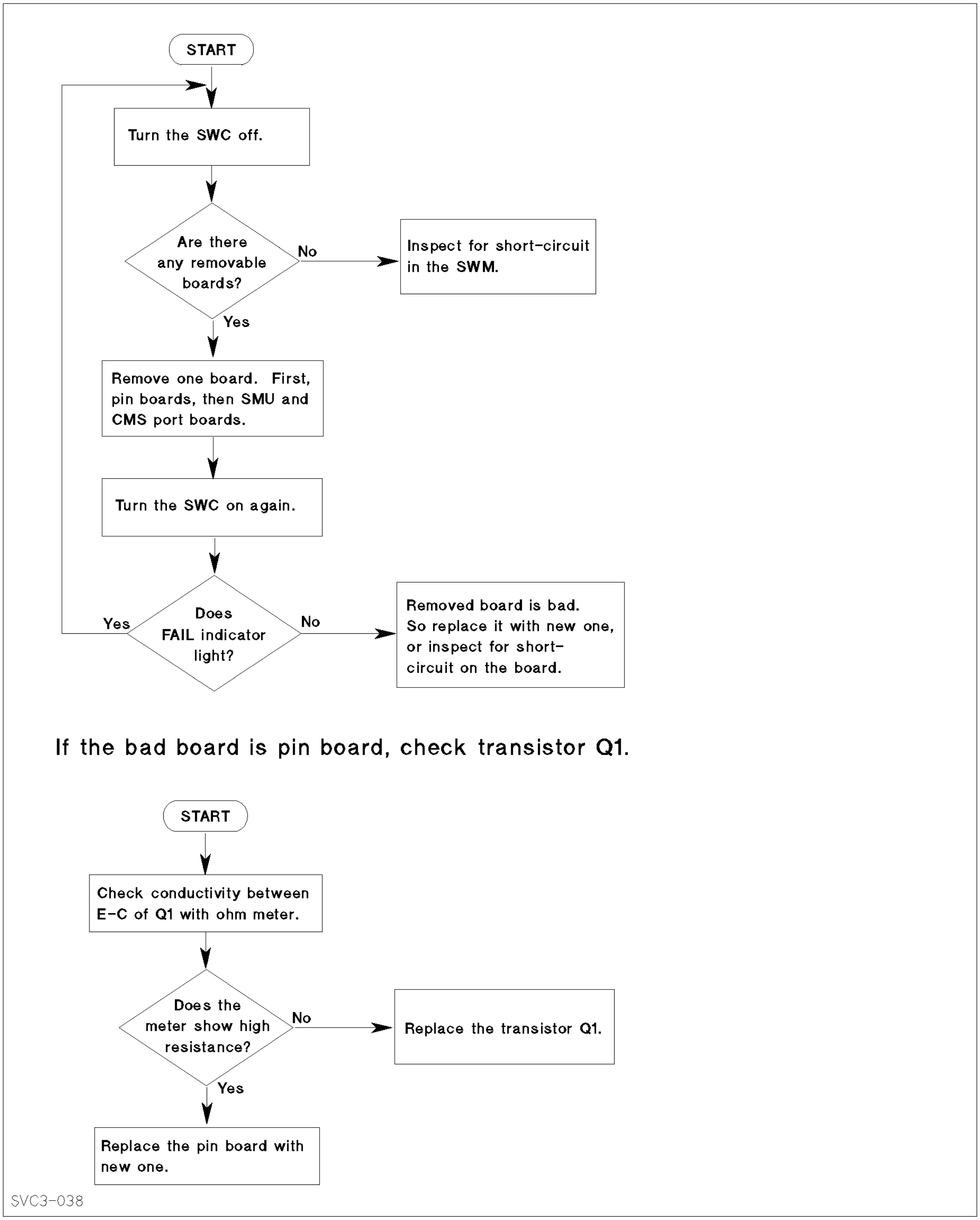


Figure 3-5. SWM Troubleshooting—Short Circuit

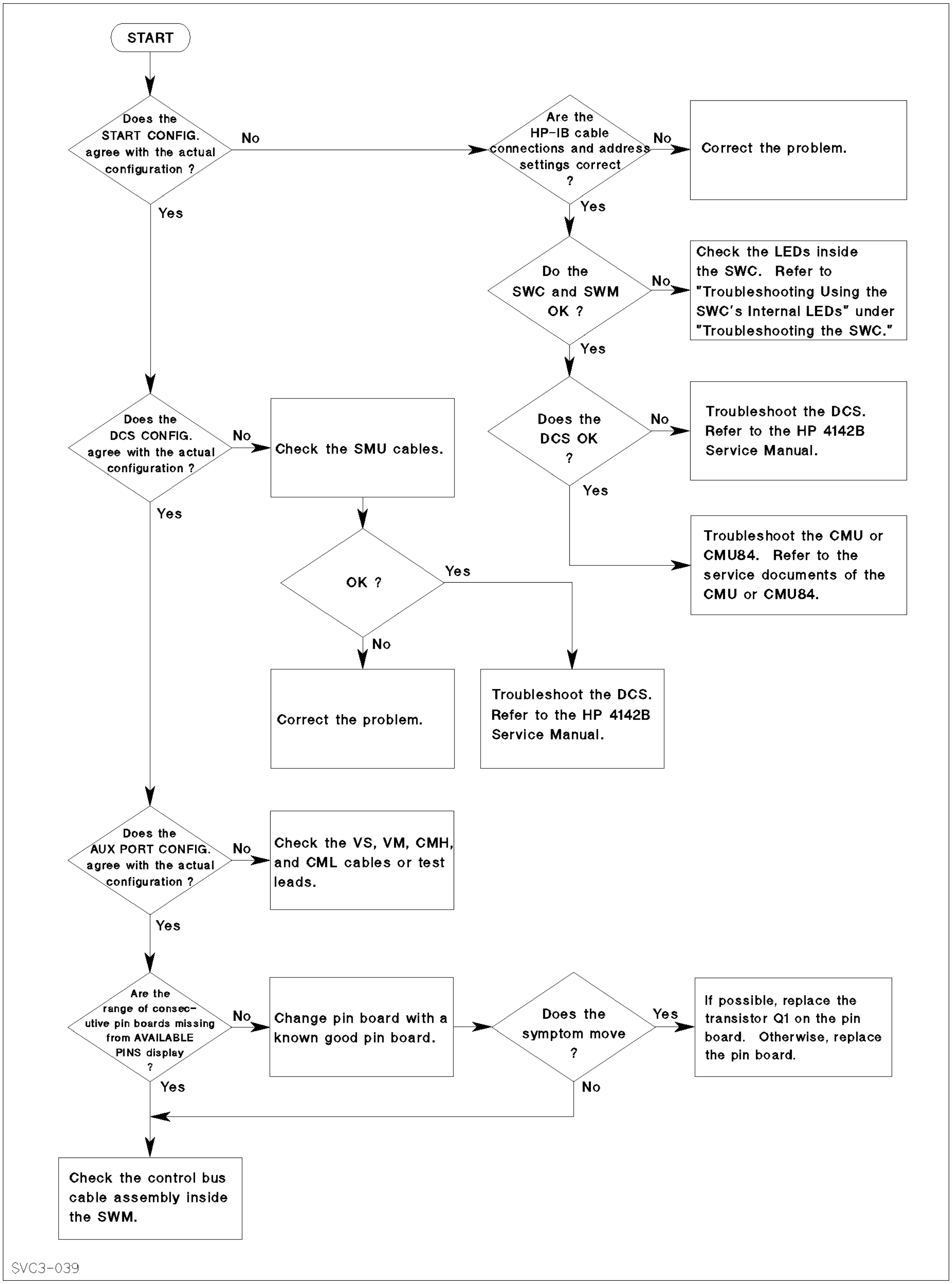


Figure 3-6. START Configuration Troubleshooting

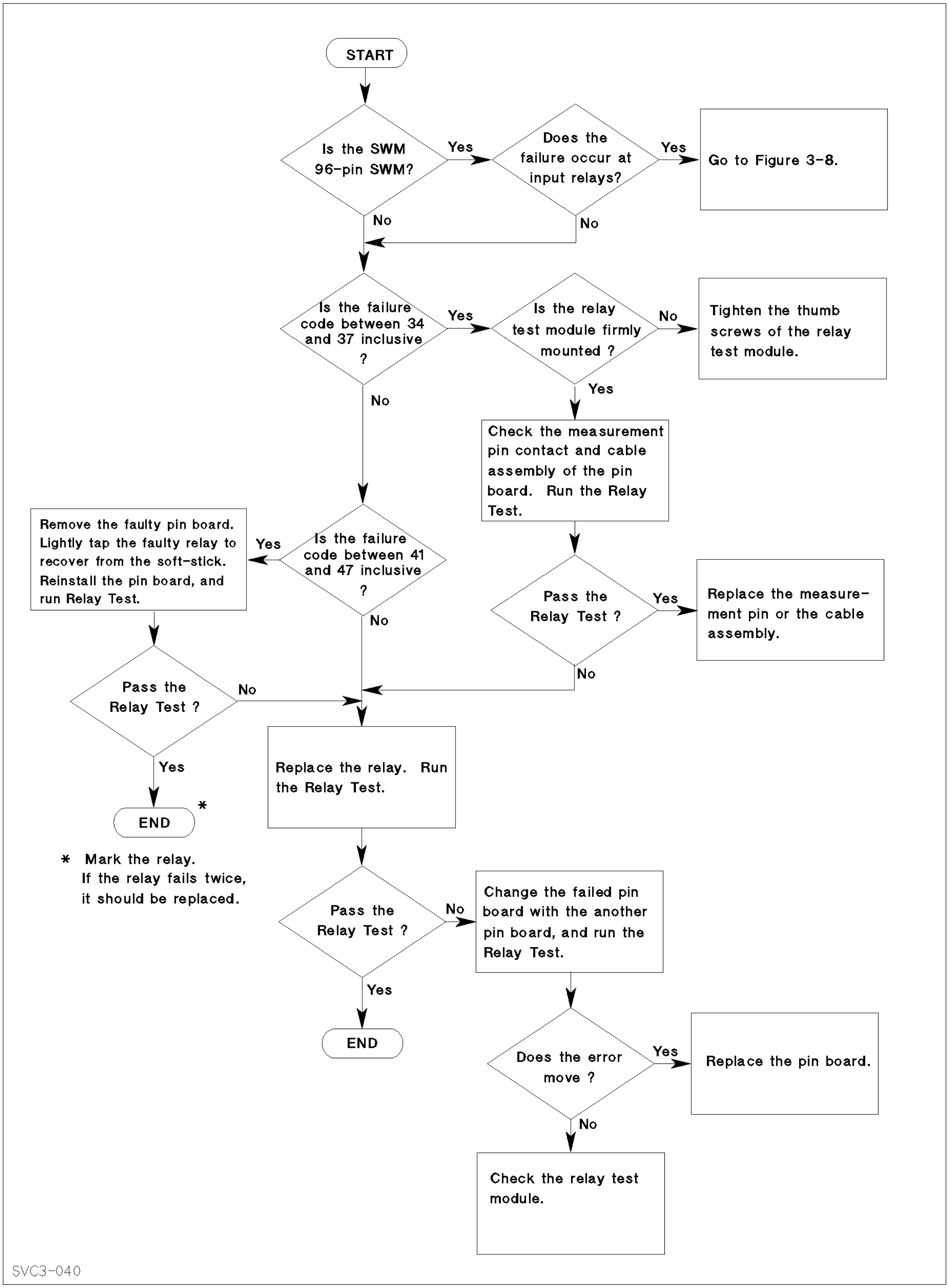


Figure 3-7. Relay Troubleshooting

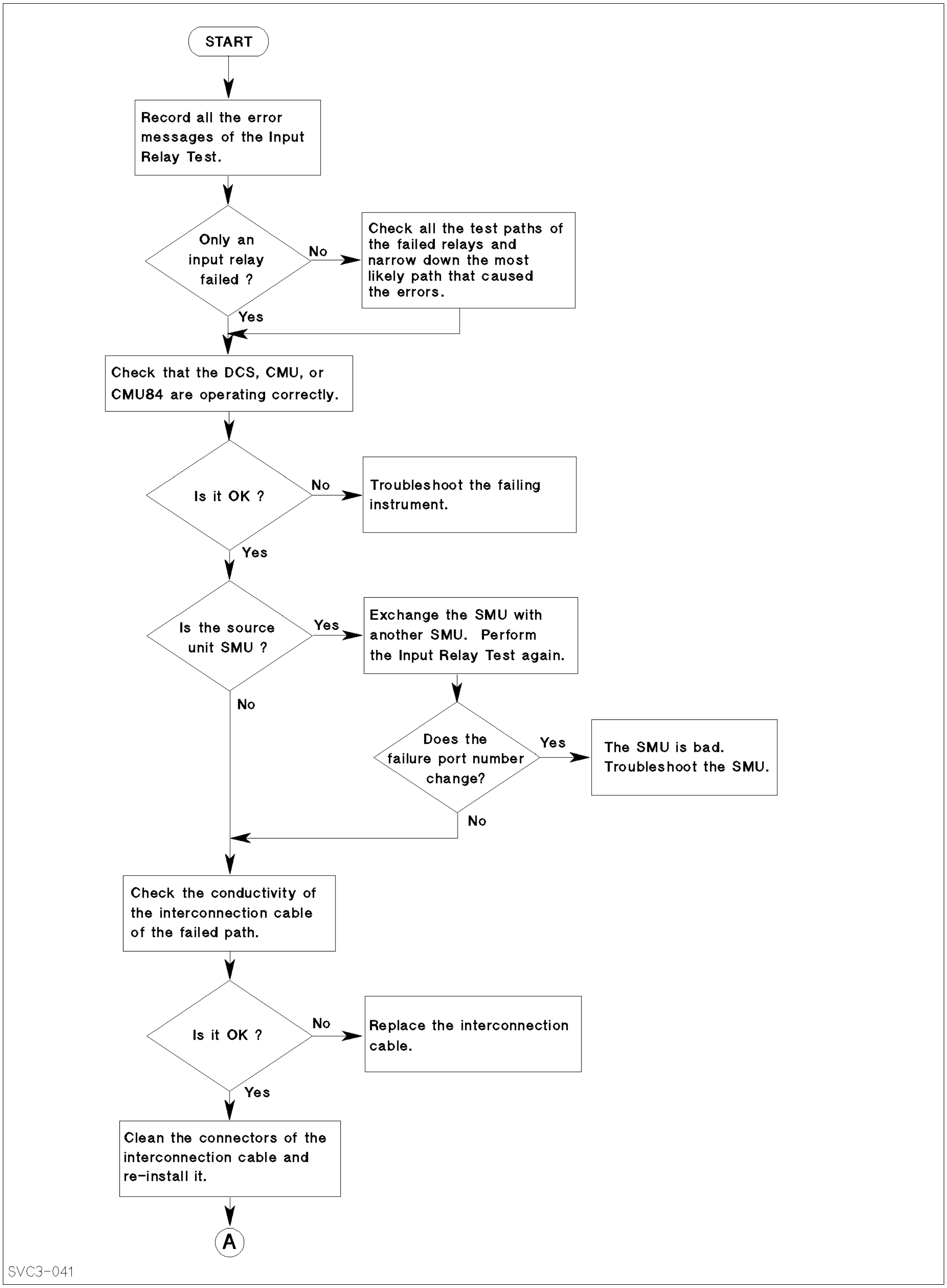
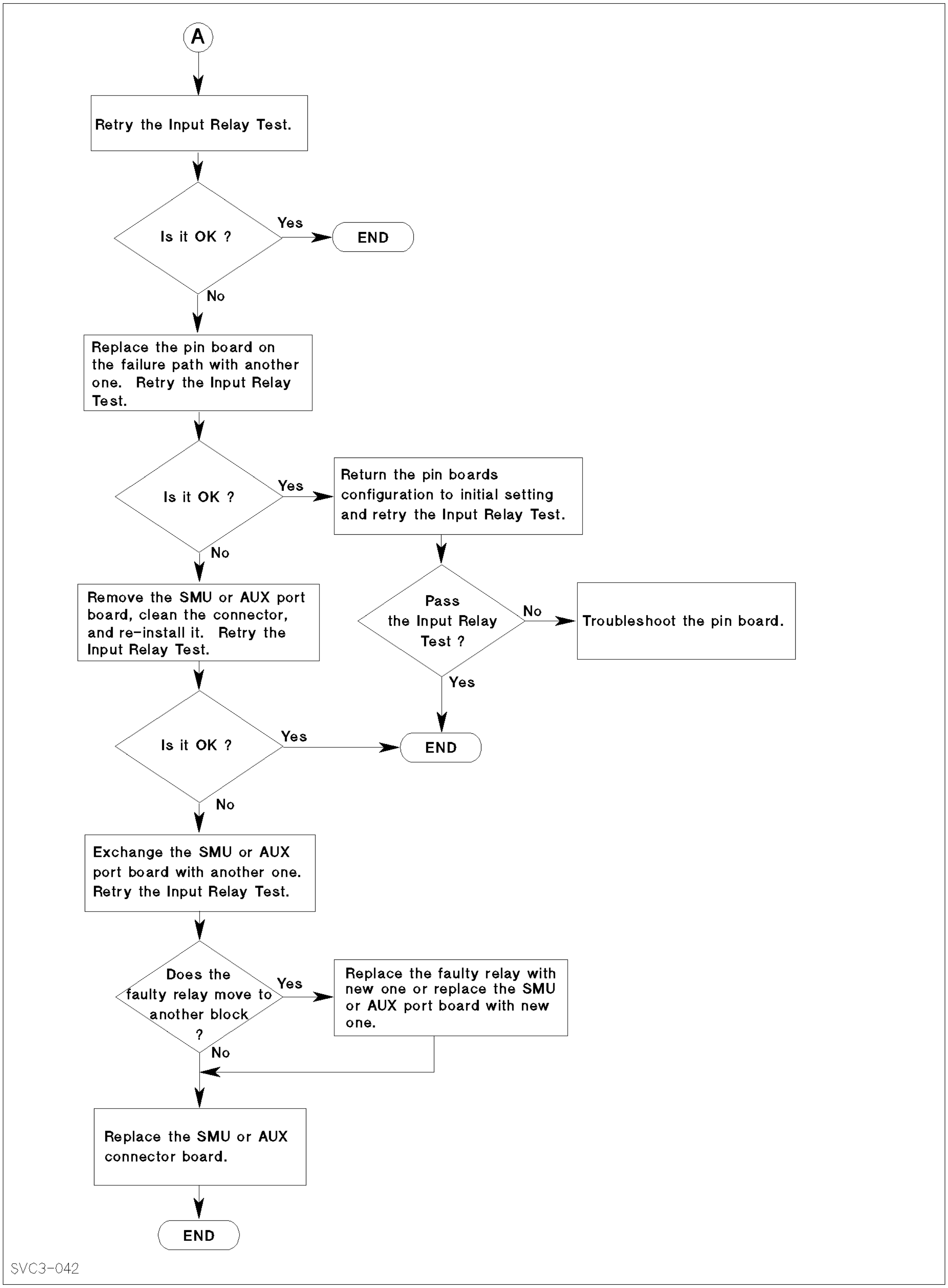


Figure 3-8. Relay Troubleshooting — Input Relay (1 of 2)



Relay Troubleshooting — Input Relay (2 of 2)

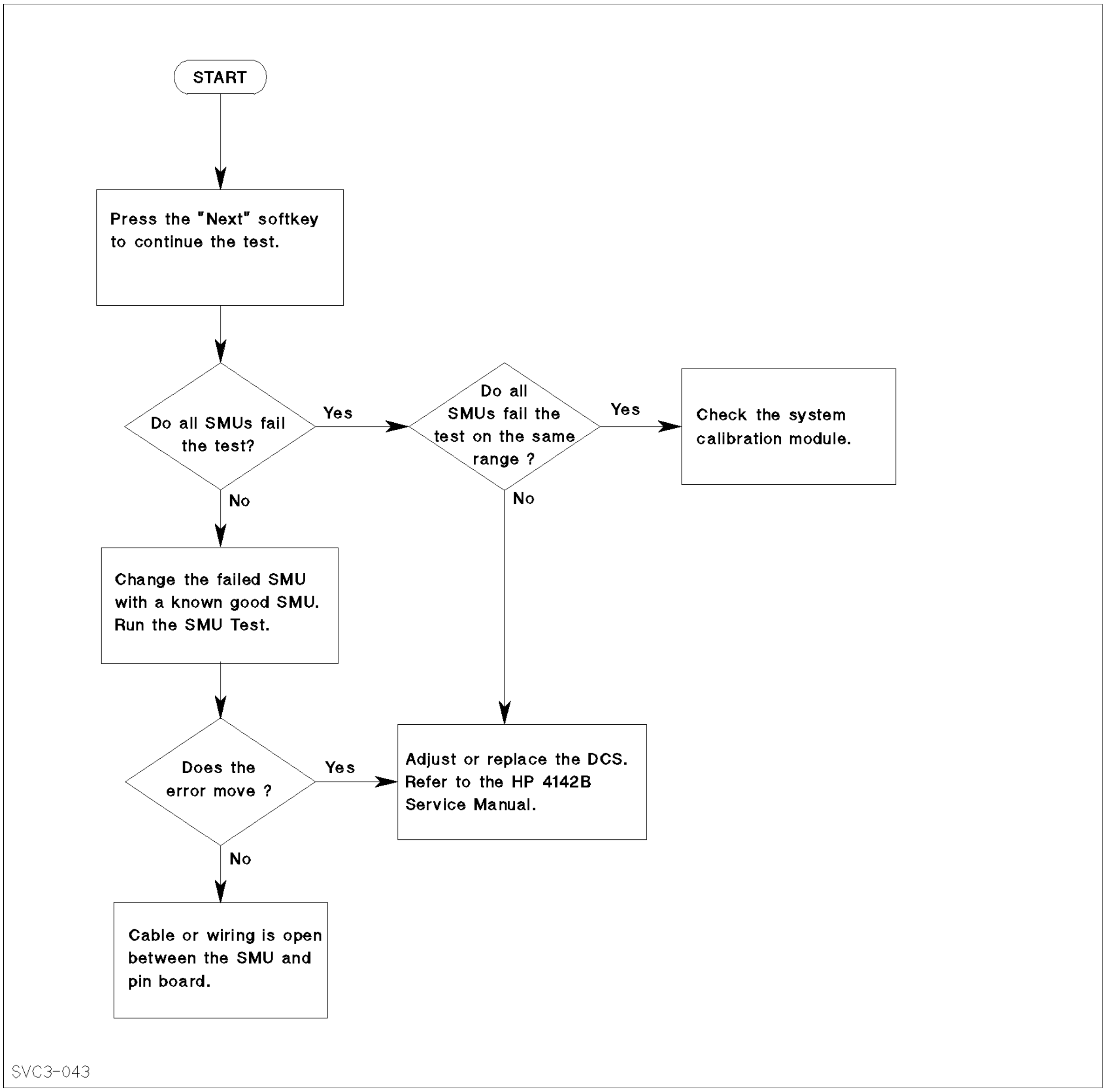


Figure 3-9. SMU Test Troubleshooting

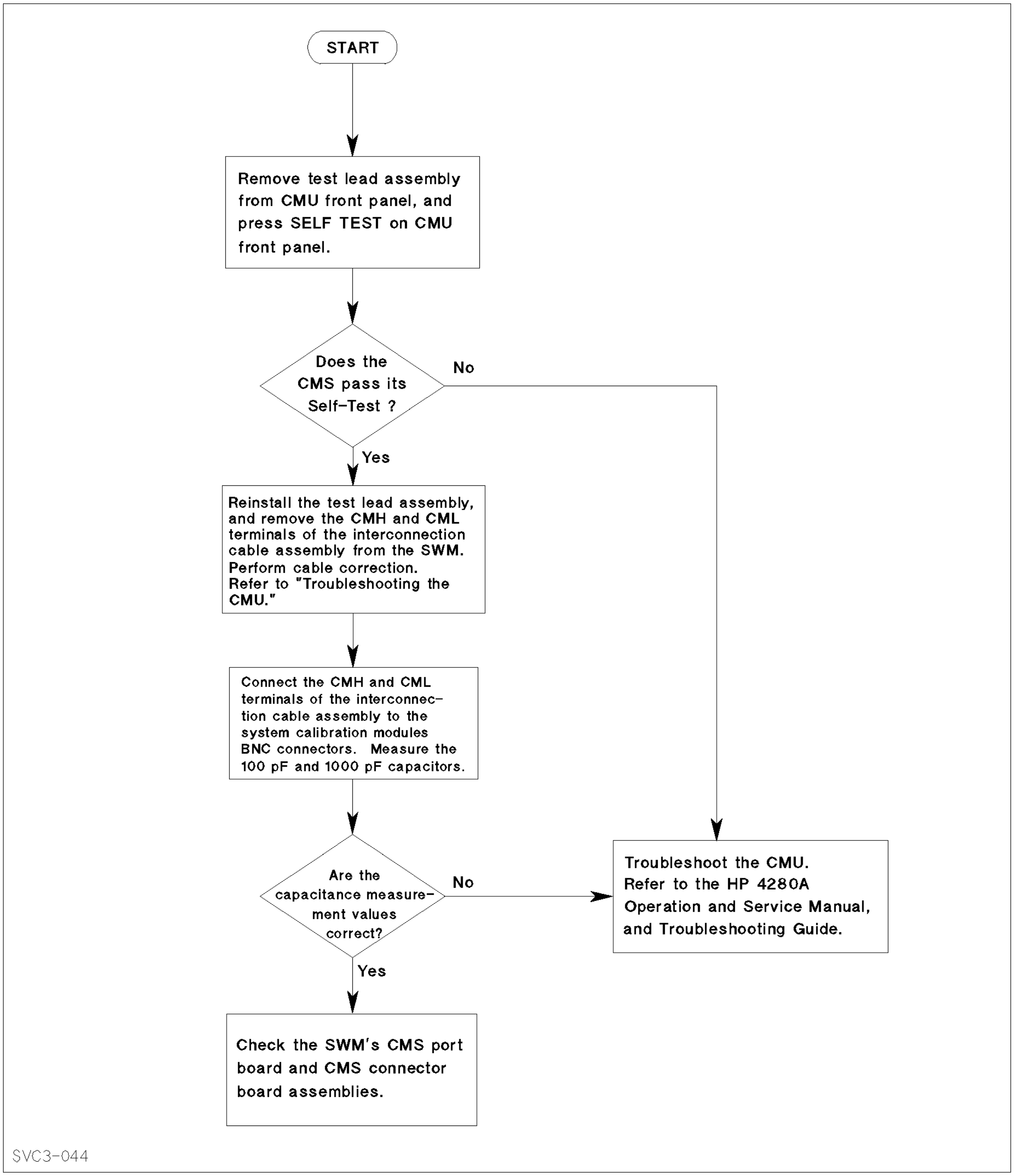


Figure 3-10. HP 4280A CMU Troubleshooting

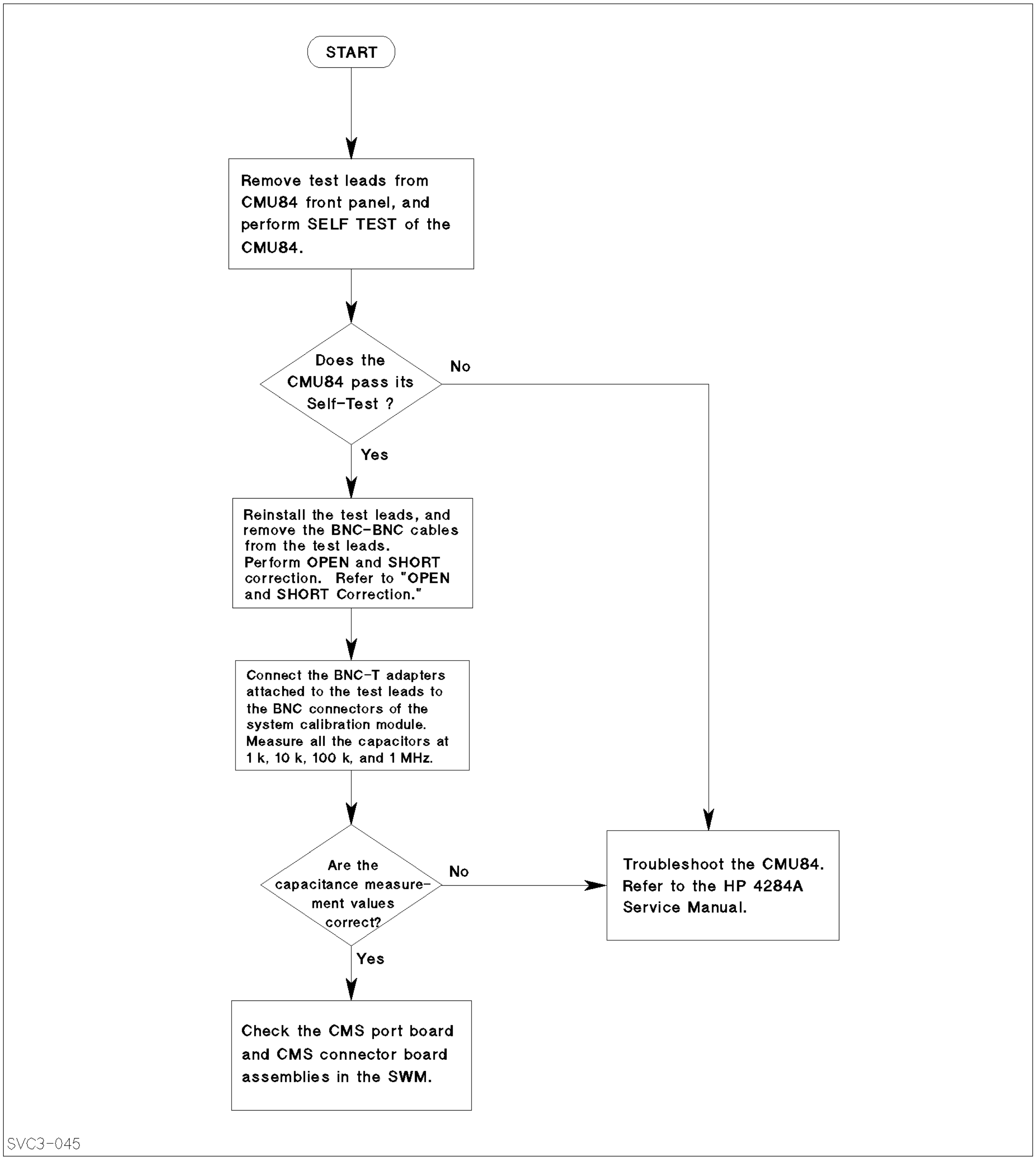


Figure 3-11. HP 4284A CMU84 Troubleshooting

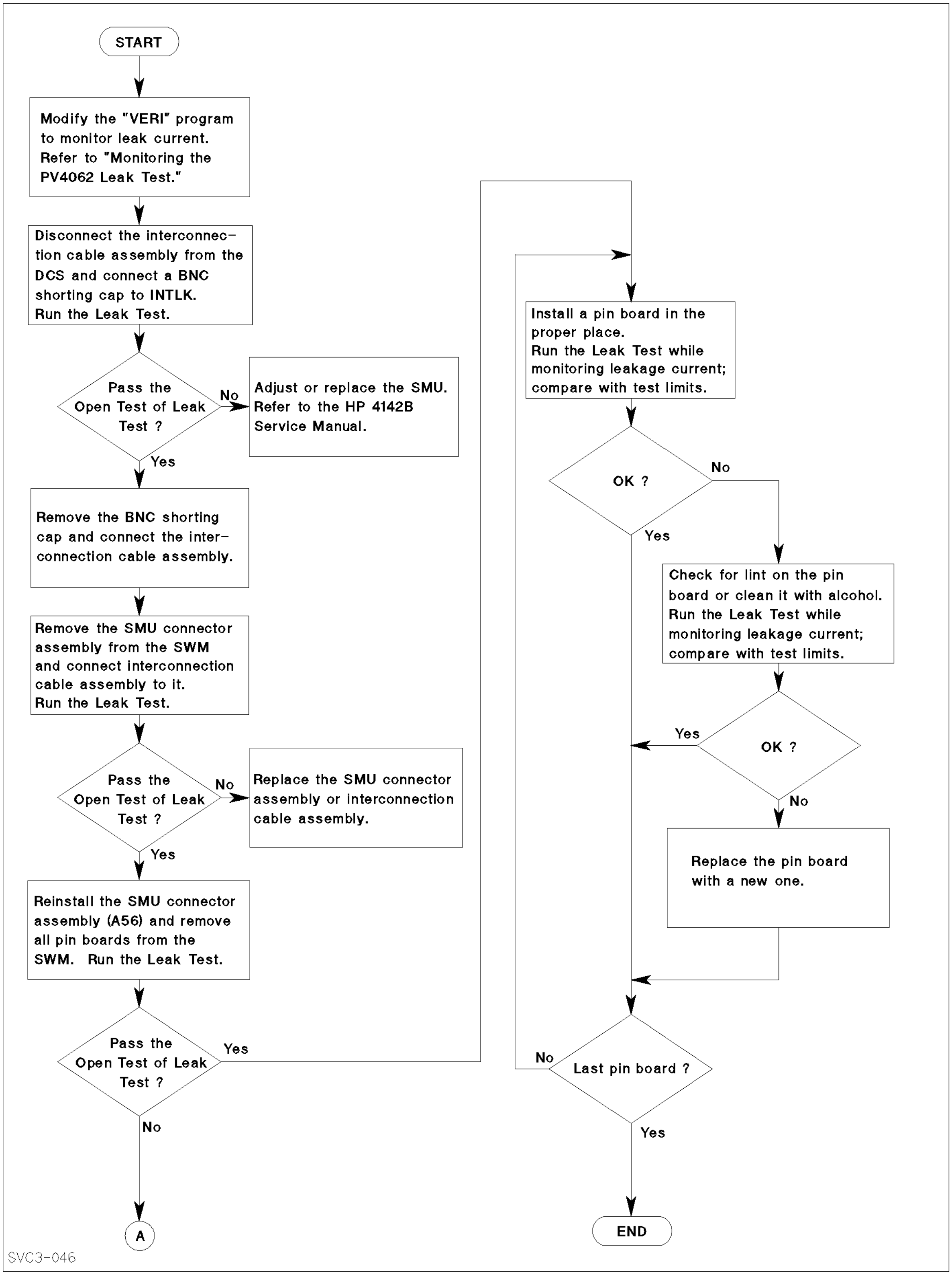
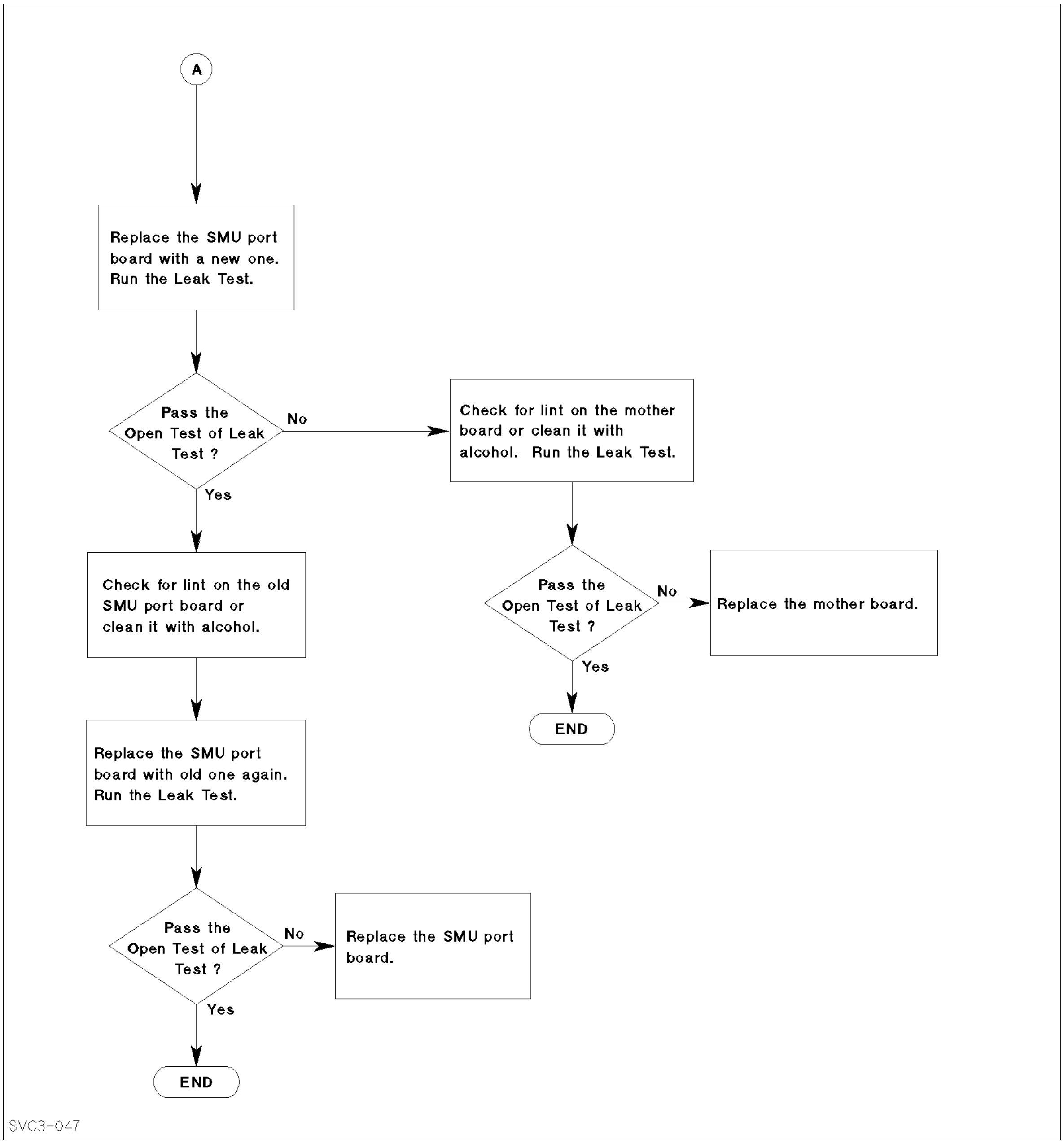


Figure 3-12. DC Leak Test—Open Test Troubleshooting (1 of 2)



DC Leak Test—Open Test Troubleshooting (2 of 2)

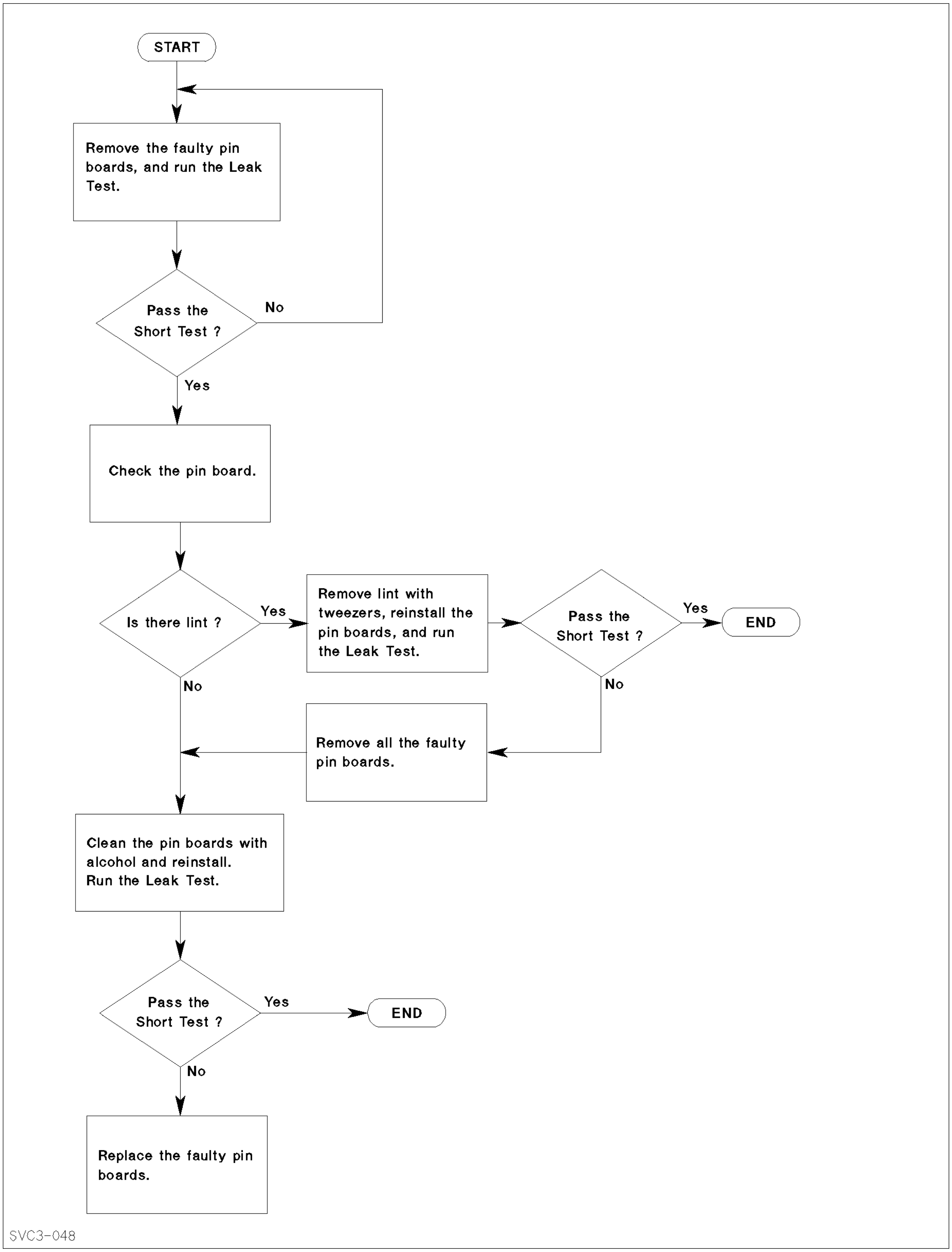


Figure 3-13. DC Leak Test—Short Test Troubleshooting

Removing Rack Mounted Instruments

To remove the HP 4084B SWC, HP 4142B DCS, or HP 4280A CMU/HP 4284A CMU84 from the system cabinet, use the following procedure:

Caution If you remove a board from an instrument, be sure to maintain the board in a clean, static-free environment.

1. Remove the four screws that secure the instrument to the system cabinet.
2. Disconnect all cables connected to the instrument.
3. From the rear of the cabinet, gently push the instrument until it protrudes several inches from the front of the cabinet.
4. Pull the instrument half forward in its support rails by grasping the side belts of the instrument.
5. Lift and pull the instrument from the front of the cabinet.
6. Lay the instrument down on an even bench.

If the HP 4084B SWC is installed in the system cabinet with the slide rail, use the following procedure:

1. Remove the four screws that secure the instrument to the system cabinet.
2. Disconnect all cables connected to the instrument.
3. From the rear of the cabinet, gently push the instrument until it protrudes several inches from the front of the cabinet.
4. Pull the instrument forward on its slide rails from the front of the cabinet.
5. The instrument can now be removed by pressing the release buttons located on both slide rails, then by lifting the instrument free of the cabinet.

Caution Before you remove a board from an HP 4084B SWC, be sure to turn the instrument off. To perform any system operations when you turn an instrument on after you have turned it off, you must run the START program first.

Troubleshooting Using START

A number of system failures can be detected by error messages and the system configuration display page when the START program is performed.

For error messages, refer to "START Errors" in "Messages."

Troubleshooting Using the START Display

If the displayed system configuration in the START program does not agree with the actual system configuration, check the system as listed in Table 3-1.

Table 3-1. Troubleshooting Using the START Display

Incorrect START Display Section	Corrective Action
`SYSTEM CONFIGURATION`	Check the following: ■ HP-IB cable connections, interface select code, and address settings. ■ If the HP 4142B DCS, HP 4280A CMU, or HP 4284A CMU84 is listed as `Not Present`, troubleshoot the instrument. Refer to the *Service Manual* of that instrument for details. ■ If the HP 4084B SWC is listed as `Not Present`, check the LEDs inside the SWC. Refer to "Troubleshooting the SWC."
`DCS CONFIGURATION`	Check the suspect plug-in module and CPU module. Refer to the HP 4142B DCS *Service Manual*.
`AUXILIARY PORT CONFIGURATION`	Check the AUX cables and their connections.
`AVAILABLE PINS`	Check the following: ■ The control bus cables (flat cables) inside the SWM. ■ If an installed pin board does not register on the START display, change the location of the pin board, then run START again. Then if the same thing occurs at the new location of the pin board, transistor Q1 on the faulty pin board may be bad. See "Checking Transistor Q1" to troubleshoot and to repair pin board.

Troubleshooting with the Relay Test

The Relay Test is a valuable aid for troubleshooting the SWC, SWM, and pin boards. Initiate the Relay Test as follows:

- By running the DIAG program.
- By running the 4062 W/O DVM Test of the PV4062.
- By pressing the LOCAL/TEST key on the HP 4084B SWC front panel.
- By sending the `TS` remote program code to the HP 4084B SWC.

To perform the Relay Test, the relay test adapter must be mounted on the SWM.

If the Relay Test is initiated from the DIAG program or 4062 W/O DVM Test of the PV4062, test results are displayed on the CRT of the system controller.

If the Relay Test is initiated manually by pressing the LOCAL/TEST key on the HP 4084B SWC front panel, or remotely from the system controller using the `TS` program code, test results can be obtained by sending the `TR` remote program code to the SWC.

Figure 3-14 provides an example of how to remotely initiate the Relay Test through program control.

The program to remotely initiate the Relay Test requires the following:

System Controller: HP 9000 Series 300 or 700; HP BASIC Language Coprocessor
Language: HP BASIC/WS, HP BASIC/UX, or HP BASIC/DOS
Interface Select Code: 27 or 7
SWC Address: 22 or 19
Program:

- If select code is 27:

```
10   OUTPUT 2722;"TS"
20   OUTPUT 2722;"TR"
30   ENTER 2722;A$
40   PRINT A$
50   END
```

- If select code is 7:

```
10   OUTPUT 722;"TS"
20   OUTPUT 722;"TR"
30   ENTER 722;A$
40   PRINT A$
50   END
```

Description:
Line 10: Initiates the Relay Test by sending the `TS` remote code. This is equivalent to pressing the LOCAL/TEST key on the HP 4084B SWC front panel.
Line 20: Instructs the SWC to output the test results by sending the `TR` remote code.
Line 30: Enters test results into the string variable `A$`.
Line 40: Prints the string variable `A$`.

Figure 3-14. Sample Program to Remotely Initiate the Relay Test (1 of 2)

Print Out: `FL`*xx*`PC`*yy*`K`*zz*

Where *xx* is Failure Code; *yy* is Pin Board Address[1, 2]; *zz* is Relay Number.

[1] If a failure is not related to a pin board error, 00 is displayed.

[2] For 48-pin SWMs:
- 01 through 48 indicates a pin board.
- 61 indicates the Test Relay Board.
- 62 indicates the Test ADC Board.

For 96-pin SWMs:
- 01 through 96 indicates a pin board.
- 161 indicates the block 1 Test Relay Board.
- 162 indicates the block 1 Test ADC Board.
- 261 indicates the block 2 Test Relay Board.
- 262 indicates the block 2 Test ADC Board.

Sample Program to Remotely Initiate the Relay Test (2 of 2)

Table 3-2 lists Relay Test-related Performance Verification (PV) and Diagnostics program (DIAG) failure codes, the corresponding error message of each code, a brief explanation for each error message, and the suggested corrective action.

Note

When the following messages are displayed, check the following item before checking the displayed failure code:

FL33PC*xx*K20	The poor contact between contact pad and contact pin of the guard of the number *xx* may cause this error. Check the corresponding contact.
FL34PC*xx*K21	The poor contact between contact pad and contact pin of the sense of the number *xx* may cause this error. Check the corresponding contact.
FL36PC*xx*K21	The poor contact between contact pad and contact pin of the force of the number *xx* may cause this error. Check the corresponding contact.
FL23PC62K63 FL23PC*x*62K63	The poor contact between contact pad and contact pin of the guard of Test ADC Board may cause this error. Check the corresponding contact.
FL21PC62K63 FL21PC*x*62K63	The poor contact between contact pad and contact pin of the sense of Test ADC Board may cause this error. Check the corresponding contact.
FL22PC62K63 FL22PC*x*62K63	The poor contact between contact pad and contact pin of the force of Test ADC Board may cause this error. Check the corresponding contact.
FL*xx*PC61K*xx* FL*xx*PC*x*61K*xx*	Stuck relay on the SMU or AUX port board may cause this error. Check the relays on the SMU or AUX port board.

Table 3-2. Relay Test Failure Codes

Failure Code (FL)	Error Message and Corrective Action
00	No error.
06	**PV(DIAG) ERROR 11 SWITCHING MATRIX CONTROLLER not functioning properly.** A momentary power loss occurred. Turn off the HP 4084B SWC, wait about 5 seconds, then turn the SWC on again.
07	**PV(DIAG) ERROR 11 SWITCHING MATRIX CONTROLLER not functioning properly.** SEND parity generator faulty. Replace the MPU board of the HP 4084B SWC.
08	**PV(DIAG) ERROR 11 SWITCHING MATRIX CONTROLLER not functioning properly.** SEND/RECEIVE timing circuit faulty. Replace the MPU board of the HP 4084B SWC.
09	**PV(DIAG) ERROR 11 SWITCHING MATRIX CONTROLLER not functioning properly.** MPU data error.
11	**PV(DIAG) ERROR 11 SWITCHING MATRIX not functioning properly.** SWM not connected. Check the cable interconnecting the SWC and SWM.
12	**PV(DIAG) ERROR 11 SWITCHING MATRIX not functioning properly.** SWM open interrupt circuit not functioning properly. Check the cables and the control logic board.
13	**PV(DIAG) ERROR 11 SWITCHING MATRIX not functioning properly.** No pin boards, test relay board, or test ADC board installed in the SWM. Check the control bus cables.
14	**PV(DIAG) ERROR 11 SWITCHING MATRIX not functioning properly.** SEND error. Replace the control logic board.
15	**PV(DIAG) ERROR 11 SWITCHING MATRIX not functioning properly.** RECEIVE parity error. Replace the control logic board.
16	**PV(DIAG) ERROR 11 SWITCHING MATRIX not functioning properly.** REPLY line stuck. Check the control bus cables for proper connection to the pin boards. Also, check transistor Q1 on each pin board.
17	**PV(DIAG) ERROR 11 SWITCHING MATRIX not functioning properly.** Relay power supply overload, possibly caused by a short on one (or more) pin board(s). Remove one pin board and run the Relay Test again. Repeat this process until you find the board that is causing the overload.
18	**PV(DIAG) ERROR 11 SWITCHING MATRIX not functioning properly.** RECEIVE parity circuit not functioning properly. Replace the control logic board.

Table 3-2. Relay Test Failure Codes (continued)

Failure Code (FL)	Error Message and Corrective Action
19	**PV(DIAG) ERROR 11 SWITCHING MATRIX not functioning properly.** Indicated pin board removed since START was last run. Run START again.
20	**PV(DIAG) ERROR 11 Relay test circuit not functioning properly.** Relay test adapter not installed on the SWM. If the relay test adapter is installed, check the control bus cable assemblies for an open.
21	**PV(DIAG) ERROR 11 Relay test circuit not functioning properly.** Current source for sense line on test ADC board not functioning properly. Replace the test ADC board.
22	**PV(DIAG) ERROR 11 Relay test circuit not functioning properly.** Current source for force line on test ADC board not functioning properly. Replace the test ADC board.
23	**PV(DIAG) ERROR 11 Relay test circuit not functioning properly.** Current source for guard line on test ADC board not functioning properly. Replace the test ADC board.
24	**PV(DIAG) ERROR 11 Relay test circuit not functioning properly.** Test relay board not installed.
25	**PV(DIAG) ERROR 11 Relay test circuit not functioning properly.** Test ADC board not installed.
26	**PV(DIAG) ERROR 11 Relay test circuit not functioning properly.** Less than 5 pin boards installed. The Relay Test requires at least 5 pin boards. Install additional pin boards.
31	**PV(DIAG) ERROR 11 A relay is open (contacts will not MAKE).** Sense contact of a relay set to make on the indicated pin board will not close. Replace the relay.
32	**PV(DIAG) ERROR 11 A relay is open (contacts will not MAKE).** Force contact of a relay set to make on the indicated pin board will not close. Replace the relay.
33	**PV(DIAG) ERROR 11 A relay is open (contacts will not MAKE).** Guard contact of a relay set to make on the indicated pin board will not close. Replace the relay.

Table 3-2. Relay Test Failure Codes (continued)

Failure Code (FL)	Error Message and Corrective Action
34	**PV(DIAG) ERROR 11 A relay is open (contacts will not MAKE).** Normally open contacts of a sense relay will not close. Check the sense measurement pin and contacts first. If no problems are found, replace the relay.
35	**PV(DIAG) ERROR 11 A relay is open (contacts will not MAKE).** Normally closed contacts of a sense relay will not close. Check the guard measurement pin and contacts first. If no problems are found, replace the relay.
36	**PV(DIAG) ERROR 11 A relay is open (contacts will not MAKE).** Normally open contacts of a force relay will not close. Check the force measurement pin and contacts first. If no problems are found, replace the relay.
37	**PV(DIAG) ERROR 11 A relay is open (contacts will not MAKE).** Normally closed contacts of a force relay will not close. Replace the relay.
41 – 47	**PV(DIAG) ERROR 11 A relay is stuck (contacts will not BREAK).** Indicated relay is stuck. Lightly tap the relay.
56	**PV(DIAG) ERROR 11 A relay has a tri-point short.** A relay has a tri-point short, but the system cannot determine which pin board the relay is on. Remove one pin board and run the Relay Test again. Repeat this process until you find the board causing the failure.
61 – 63	**PV(DIAG) ERROR 11 A relay may be stuck.** Indicated pin board has a faulty relay, but the system cannot determine which relay is faulty. Lightly tap all relays on the pin board.

Troubleshooting with the Input Relay Test (96-pin SWM Only)

When the Input Relay Test fails, the input relays may not always be the source of the problem. Other problems, such as contact resistance and snapping on the test path, often cause an Input Relay Test failure. For this reason, it can be difficult to troubleshoot the input relays.

This section provides some helpful information on troubleshooting the input relays. Possible points on the Input Relay Test path where the problem may lie are shown below. To help troubleshoot the input relay, a check sheet is provided in Appendix D. To measure the resistance between two points, the pin assignments of the SMU link board are shown.

Possible Causes of Input Relay Failures

Figure 3-15 shows a simplified test circuit of the Input Relay Test.

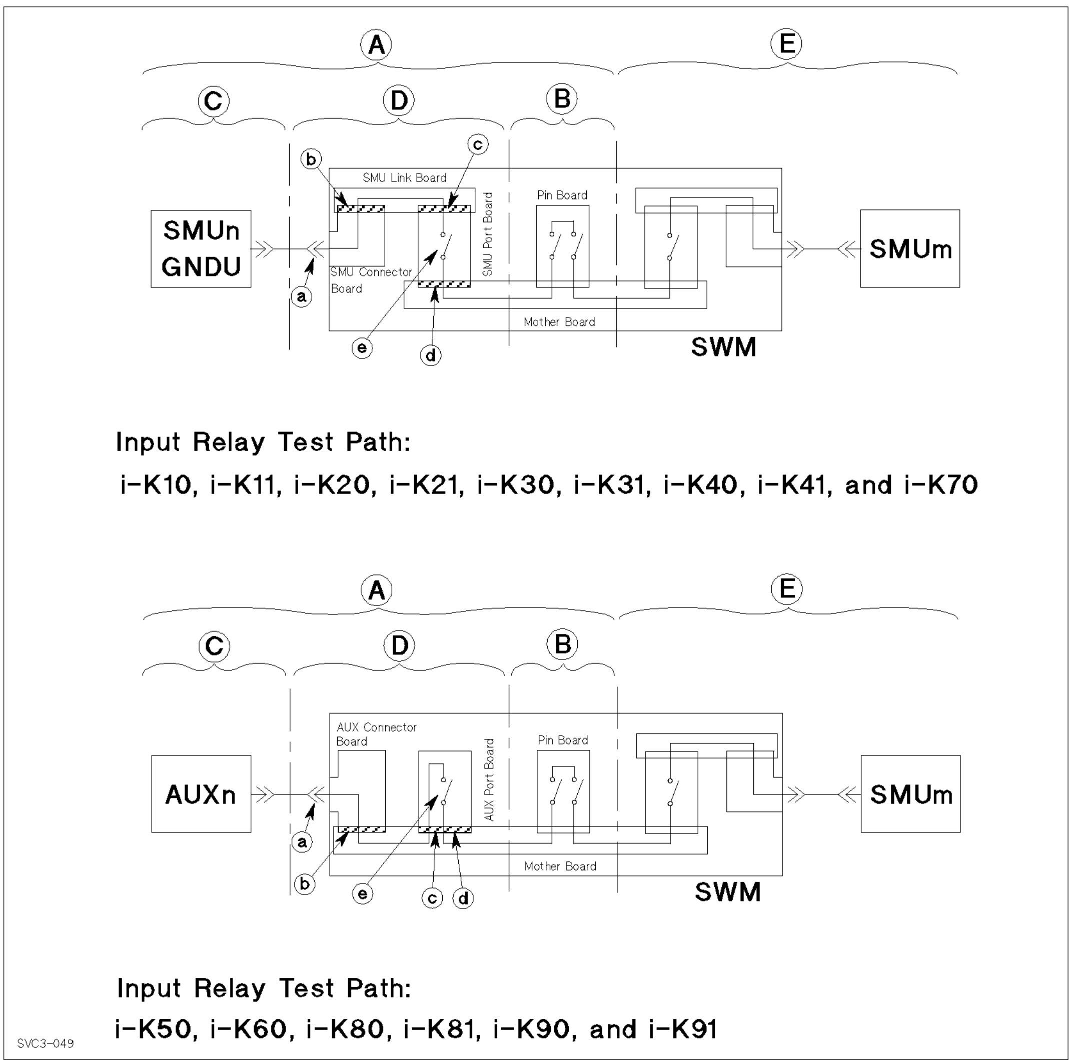


Figure 3-15. Simplified Test Circuit of Input Relay Test

When a problem lies somewhere on the test path, the Input Relay Test results may show a failed input relay ⓔ. Because of this, when a failure of the Input Relay Test occurs, you must troubleshoot the test path as well as the failed input relay.

The following procedures briefly explain how to troubleshoot and how to narrow down possible causes of the input relay failure:

1. In which area, Ⓐ or Ⓔ, does the problem exist?

   The check sheet is useful to answer this question. Write down all the error messages on the check sheet. The most probable cause of the problem can be found by checking all the error messages. You can also narrow the problem area down to Ⓑ, Ⓒ, or Ⓓ.

2. Does the problem exist in area Ⓑ?

   To check whether or not the problem exists in area Ⓑ, change the pin board used for the Input Relay Test with a known good one. You can find which pin board is used for the test from the check sheet.

3. Does the problem exist in area Ⓒ?

   The SMU on the test path may have failed. To check this situation, change the SMU with a known good one, and retry the Input Relay Test.

   The connection between the SMU and the interconnection cable may be poor. Clean the connecter. The interconnection cable may be snapping. Check the conductor of the interconnection cable.

4. Does the problem exist in area Ⓓ?

   a. Check the connection or contact resistance at point ⓐ.
   b. Check the contact ⓒ between the SMU link board and the SMU port board.
   c. Check the contact ⓑ between the SMU link board and the SMU connector board.
   d. Check the contact ⓓ between the SMU port board and the mother board.
   e. Check the contact ⓒ between the AUX port board and the mother board.
   f. Check the contact ⓑ between the AUX connector board and the mother board.

5. Is the failed input relay bad?

   To check the operation of the failed input relay, use the DMM and measure the resistance at the contact point of the input relay. To do so, use the following procedure:

   a. Turn on the computer and system instruments. If your system is an HP 4062UX, start the HP BASIC/UX environment.
   b. Load and run the "`START`" program.
   c. Load and run the "`VFP`" program.
   d. Move into the relay assignment pages.
   e. Probe the two points on the test path that the input relay is between.
   f. Control the make/break operation of the input relay and estimate the measured resistance.

Using Check Sheet for Troubleshooting

When the Input Relay Test reports more than two errors, a problem on the test paths is causing the errors. The check sheet for input relay troubleshooting, which is provided in Appendix D, can help you find the cause of the problem on the test path. See Appendix D on how to fill in the check sheet.

For example, Figure 3-16 shows the problem may hide in either pin board 4, the SMU3, the input relay i-K30, or the input relay i-K70.

Check Sheet for Input Relay Troublshooting: BLOCK ___

Failed Relay and Side	i-K21	i-K31 force	i-K___	i-K___	i-K___	i-K___
Pin Board 4	✓	✓				
Pin Board 8		✓				
Pin Board ___						
SMU1						
SMU2						
SMU3	✓	✓				
SMU4						
VS1						
VS2						
VM1						
VM2						
CMS						
CMU84						
GNDU		✓				
i-K10						
i-K11						
i-K21	✓					
i-K20						
i-K31						
i-K30	✓	✓				
i-K41						
i-K40						
i-K50						
i-K60						
i-K70	✓	✓				
i-K80						
i-K81						
i-K90						
i-K91						

Figure 3-16. Example: Check Sheet for Troubleshooting

Accessing the SMU Link Board

The SMU link board is used to connect the signal lines between the SMU port board and SMU connector board. Figure 3-17 shows how to access the SMU link board and Table 3-3 lists the pin assignment of the SMU link board.

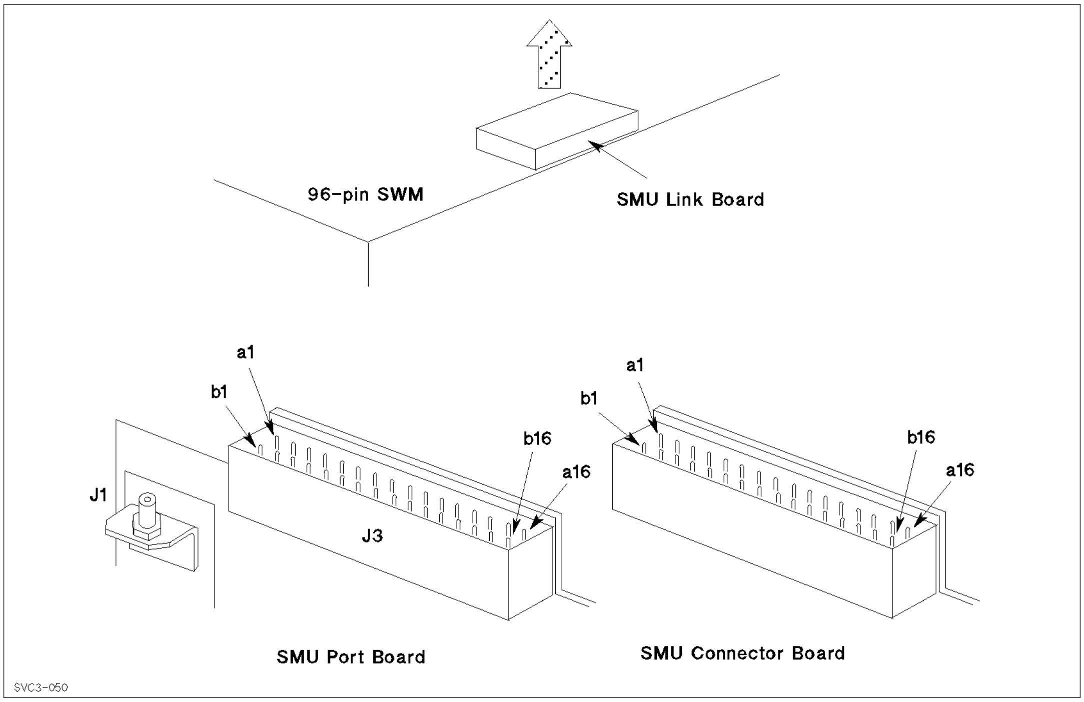


Figure 3-17. Accessing the SMU Link Board

Table 3-3. Pin Assignment of SMU Link Board

Pin No.	Description	Pin No.	Description
a1, b1	Port 7 (GNDU) force	a9, b9	Port 3 (SMU3) sense
a2, b2		a10, b10	Port 3 (SMU3) force
a3, b3	Port 7 (GNDU) sense	a11, b11	Port 3 (SMU3) guard
a4, b4	Port 4 (SMU4) guard	a12, b12	Port 2 (SMU3) guard
a5, b5	Port 4 (SMU4) sense	a13, b13	Port 2 (SMU3) sense
a6, b6	Port 4 (SMU4) force	a14, b14	Port 2 (SMU3) force
a7, b7	Port 4 (SMU4) guard	a15, b15	Port 2 (SMU3) guard
a8, b8	Port 3 (SMU3) guard	a16, b16	Chassis ground

Monitoring the PV4062 Leak Test

To monitor the DC Leak Test of the PV4062 using the VFP monitor function, modify the DC Leak Test program shown in Figure 3-18 by including the indicated statements. This real-time monitoring method makes it possible to step through the test sequence.

The following procedure tells how to modify the DC Leak Test program in the VERI file.

- For HP 4062C system based on the flexible disks:

1. Boot up the HP BASIC system.
2. Prepare a blank flexible disk and format it using the INITIALIZE statement.
3. Copy the Performance Verification Disk 2 to the blank flexible disk. For example, type as follows:

   `COPY ":,702" TO ":,702,1"` (Return)

Note Modify the VERI program on the disk copy. Do not modify the VERI program in the master PERFORMANCE disk.

4. Insert the copied disk into the flexible disk drive and set the MASS STORAGE to flexible disk drive.
5. Load the VERI program as follows:

   `LOAD "VERI"` (Return)

6. Start the BASIC editor for searching `Veri_matrix` as follows:

   `EDIT Veri_matrix` (Return)

   Modify the VERI program as shown in Figure 3-18.

7. After modifying, store the modified VERI program using `RE-STORE` statement.
8. Remove the copied PV Disk 2 and insert PV Disk 1.
9. Load and run the PV4062 program. Refer to chapter 2 for details.

- For HP 4062C/UX/PC system based on the hard disk:

1. After booting up the HP BASIC/WS or HP BASIC/DOS system, or after logging in and starting HP BASIC/UX, change the current directory as follows:

   `MSI "/PCS/DIAG"` (Return) *For HP 4062C/PC*
   `MSI "\PCS\DIAG"` (Return) *For HP 4062PC*
   `MSI "/usr/pcs/diag"` (Return) *For HP 4062UX*

2. Load the VERI program as follows:

   `LOAD "VERI"` (Return)

3. Store the VERI program as follows:

   `STORE "VERI_ORG"` (Return)

4. Start the BASIC editor for searching `Veri_matrix` as follows:

```
EDIT Veri_matrix  Return
```

Modify the VERI program as shown in Figure 3-18.

5. After modifying, store and backup the modified VERI program as follows:

```
RE-STORE "VERI"  Return
STORE "VERI_MDF"  Return
```

6. Load and run the PV4062 program. Refer to chapter 2 for details.

Note

After performing the DC Leak Test while monitoring leakage current, replace the modified VERI program with the original VERI program as follows:

```
PURGE "VERI"  Return
COPY "VERI_ORG" TO "VERI"  Return
```

```
             SUB Veri_matrix
Veri_matrix: !*****************************************
             !*
             !*    D C   L E A K A G E   T E S T
             !*
             !*****************************************
             DISP "Insert the SYSTEM SOFTWARE Disk 4."     For HP 4062C with flexible disk
             PAUSE
             LOADSUB ALL FROM "VFP"

             LOADSUB ALL FROM  "/PCS/BIN/VFP"              For HP 4062C/PC with hard disk
             LOADSUB ALL FROM  "\PCS\BIN\VFP"              For HP 4062PC
             LOADSUB ALL FROM  "/usr/pcs/bin/VFP"          For HP 4062UX
                 :
Matrix1: OUTPUT KBD;CHR$(255);"K";
         CALL Veri_results
         GOSUB Disp_init
         DISP "DC LEAKAGE TEST in progress."
       !
         Sw_matrix$="OK"
         Init_system
         Set_smu(3)
         Column=0
         CALL Vfp_frame
         FOR Portno=1  TO 4
           IF FNPort(Port(Portno))>0 THEN
             Force_v(Port(Portno),20,20,5.E-2,1)
             WAIT (Portno=1)*3+3
             Measure_i(Port(Portno),Imeas,0)
             CALL Vfp_monitor
             Disable_port(Port(Portno))
             IF Portno=1 THEN
               Accy=Mat_acc(1)
             ELSE
               Accy=Mat_acc(2)
             END IF
         !
                 :
```

Figure 3-18. PV4062 Modifications to Allow Leak Test Monitoring (1 of 2)

```
             .
             .
             .
    IF First_pin THEN
      FOR Portno=1 TO 4
        IF FNPort(Port(Potno))>0 THEN
          FOR Pin=First_pin TO End_pin
            Connect(Port(Portno),Pin_board(Pin))
          NEXT Pin
          Force_v(Port(Portno),100,100,1.E-6)
          WAIT (Portno=1)*3+3
          Measure_i(Port(Portno),Imeas,0)
          CALL Vfp_monitor
          Disable_port(Port(Portno))
          IF Portno=1 THEN
            Accy=Mat_acc(3)
          ELSE
            Accy=Mat_acc(4)
          END IF
        !
             .
             .
             .
    IF First_pin THEN
      FOR Pin=First_pin TO End_pin
        DISP "Searching for faulty pins."; TAB(61); "TESTING PIN# ["; Pin_board (Pin); "]"
        Imeas=0
        Ileak(1)=0
        Ileak(2)=0
        FOR Portno=1 TO 4
          IF BIT(Err_port(Block_no),Portno) THEN
        Connect(Port(Portno),Pin_board(Pin))
        Force_v(Port(Portno),100,100,1.E-7)
        WAIT (Portno=1)*3+3
        Measure_i(Port(Portno),Imeas,0)
        CALL Vfp_monitor
        Disable_port(Port(Portno))
!
        IF FNInlogging THEN
          Trrlog_rem("VERI-SWM-SHORTLEAK2")
          IF Portno=1 THEN
             .
             .
             .
```

PV4062 Modifications to Allow Leak Test Monitoring (2 of 2)

Troubleshooting the HP 4084B SWC

Accessing HP 4084B SWC Assemblies

To access the assemblies of the SWC for service or repair, use the following procedure:

1. Disconnect all cables and the power cord from the HP 4084B SWC.
2. Remove the four screws that secure the SWC to the system cabinet.
3. From the rear of the system cabinet, gently push the HP 4084B SWC forward until it protrudes several inches from the front of the cabinet. Then, from the front of the cabinet, pull the SWC forward on its slide rails and lift the SWC free from the cabinet.
4. Remove the top cover of the SWC by fully loosening the top cover screws, then slide the top cover off.

Figure 3-19 shows the locations of the SWC assemblies.

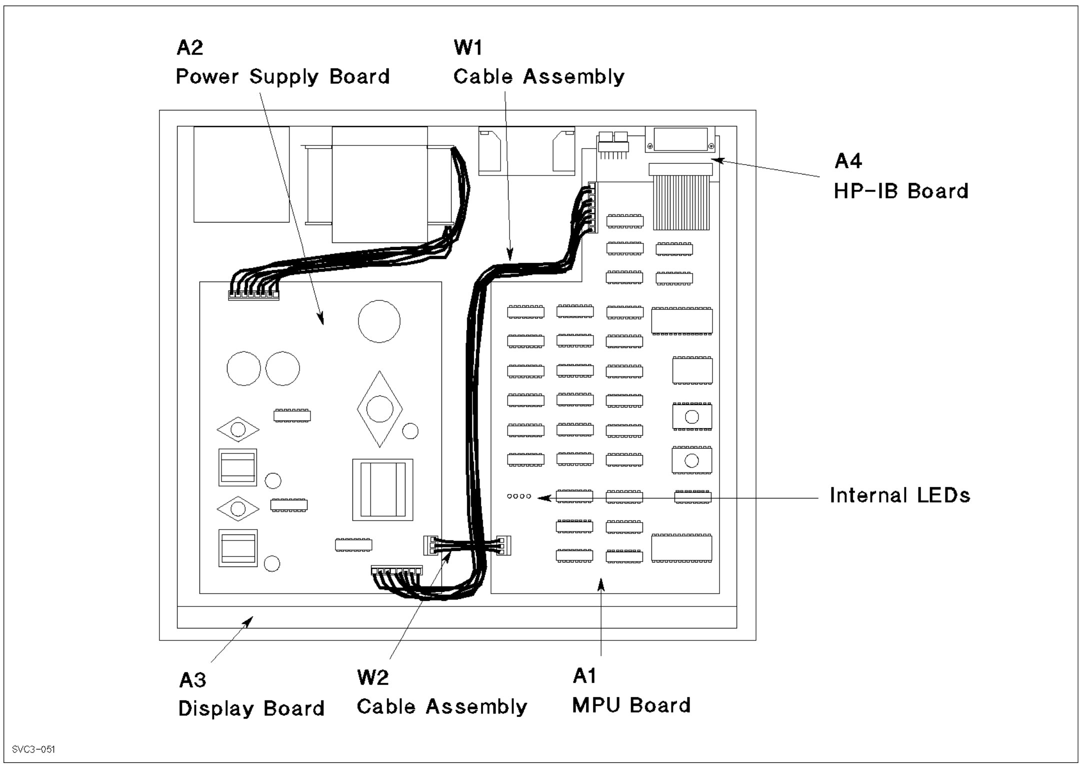


Figure 3-19. HP 4084B SWC Assembly Locations

Troubleshooting Using the Internal LEDs in the SWC

Located on the MPU board are four LEDs that help isolate the cause of certain SWC failures. Table 3-4 lists the possible display patterns of the LEDs, and briefly explains the meaning of each pattern.

Note

These LEDs indicate possible SWC failures only if the SWITCHING MATRIX CONTROLLER FAIL lamp on the HP 4084B SWC front panel is lit. To obtain the failure code for an SWM failure if the SWITCHING MATRIX FAIL lamp is lit, run the START program.

Table 3-4. SWC Internal LED Display Patterns

Fail Number	LED Pattern				Description
	8	4	2	1	
0	off	off	off	off	No error.
1	off	off	off	on	ROM (U38) error. Replace the MPU board.
2	off	off	on	off	ROM (U38) error. Replace the MPU board.
3	off	off	on	on	ROM (U38) error. Replace the MPU board.
4	off	on	off	off	RAM (U39) error.
5	off	on	off	on	HP-IB control chip error or illegal HP-IB address setting.
6	off	on	on	off	Momentary power loss occurred. SWC is normal.[1]
7	off	on	on	on	Replace the MPU board.
8	on	off	off	off	Replace the MPU board.
9	on	off	off	on	Replace the MPU board.

1 Short circuit in the SWM may cause this failure. Check the cable connections such as control bus cable in the SWM.

Checking Voltages on the SWC Boards

Table 3-5 lists the voltages present at the test points on the A1 MPU board and A2 power supply board of the SWC. Test points are small pins identified by their test point numbers. Because a floating power supply is used, proper grounding (voltage reference) is necessary. For example, to measure the voltage at test point (TP) 9 (+12 VF) on the A2 power supply board, use TP 8 (FGND) as a ground reference.

Table 3-5. Voltage Test Points in SWC

Test Point (TP)	A1 MPU Board	A2 Power Supply Board	Test Point (TP)	A1 MPU Board	A2 Power Supply Board
1	GND	—	9	—	+12 VF
4	—	GND	10	—	GND
5	—	+5.2 V	11	—	+5 V
7	—	+12 VF	24	GND	—
8	—	FGND	29	+5 V	—

Troubleshooting the SWM

SWM Assembly Locations

Figure 3-20 shows the locations of the assemblies in the HP 4085B 48-pin SWM. See Chapter 4 for the HP part numbers of each assembly.

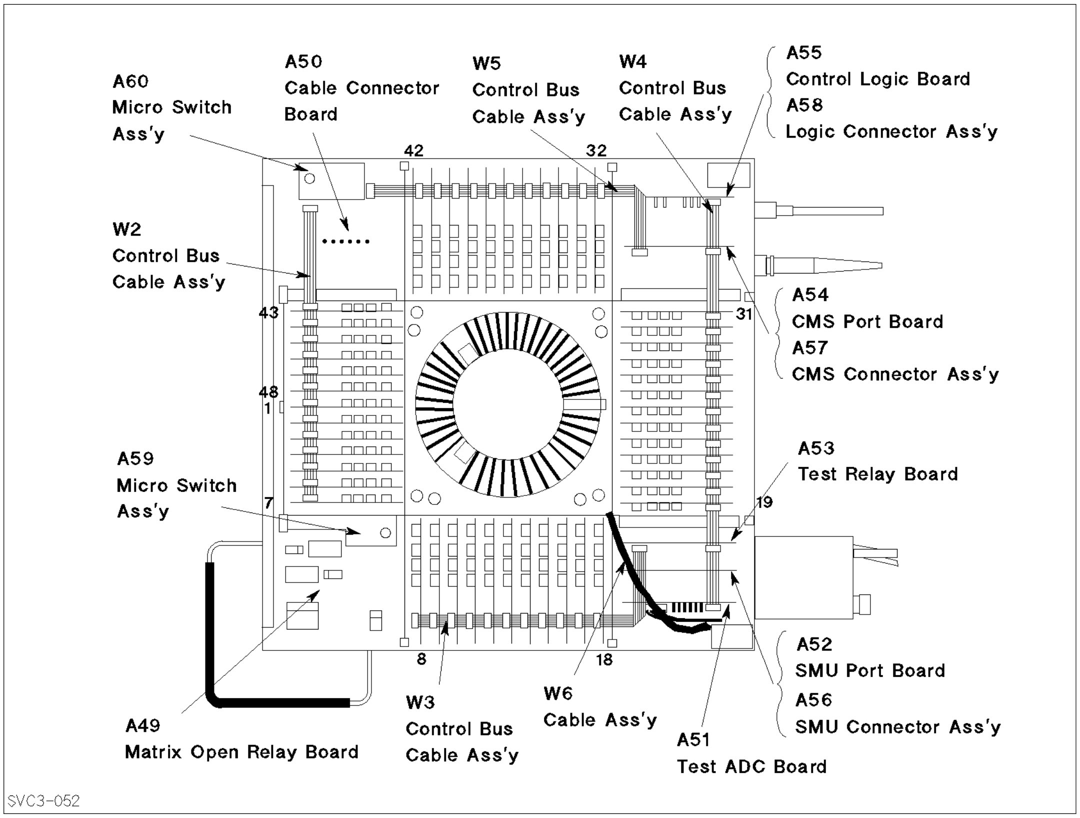


Figure 3-20. Assembly Locations in the HP 4085B 48-pin SWM

Figure 3-21 shows the locations of the assemblies in the HP 4089A/B 96-pin SWM. See Chapter 4 for the HP part numbers of each assembly.

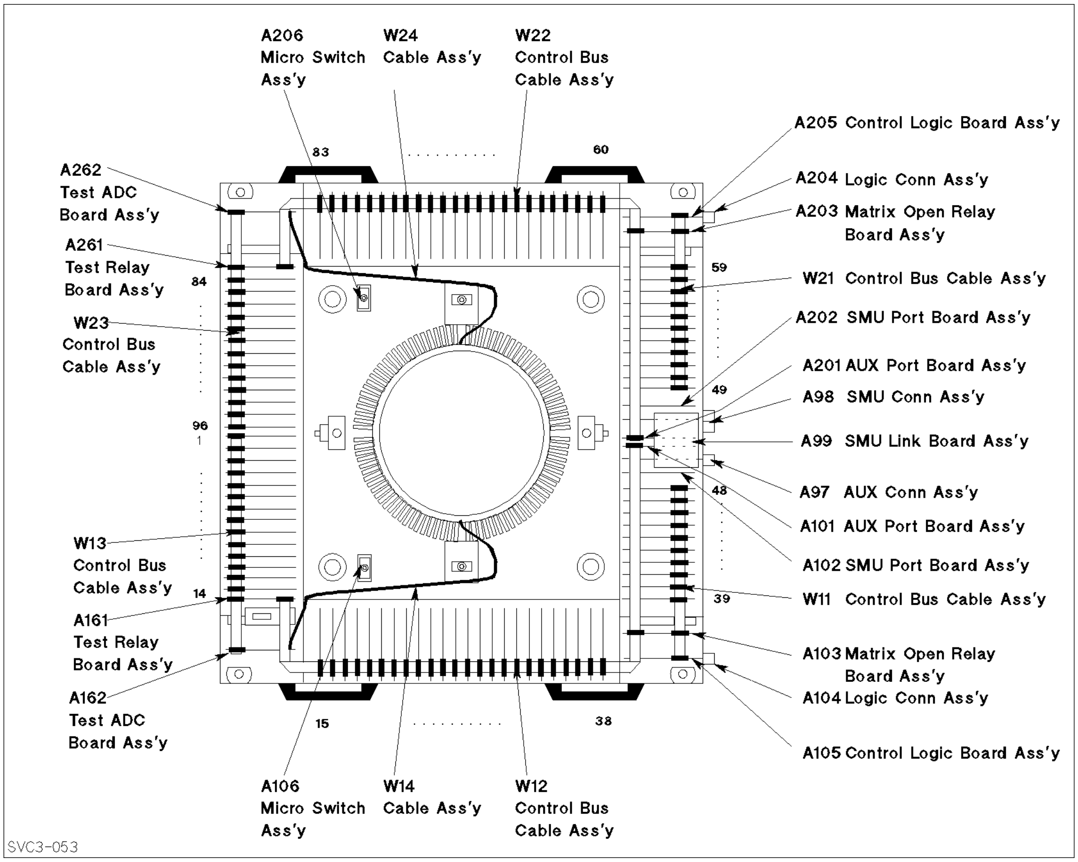


Figure 3-21. Assembly Locations in the HP 4089A/B 96-pin SWM

Removing Pin Boards

To remove pin boards from the SWM, use the following procedure:

1. Remove the bottom panel of the SWM (see Figure 3-22).

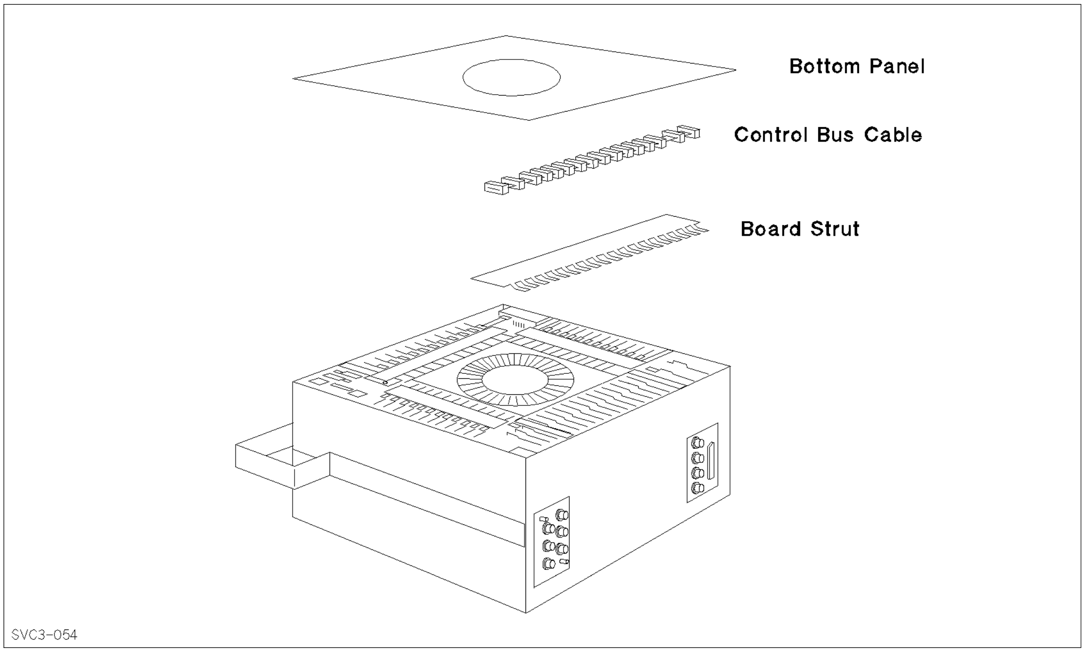


Figure 3-22. Removing the Bottom Panel of the SWM

2. For 48-pin SWM, remove the board strut(s) as required. For 96-pin SWM, remove the pin board cover(s) as required.
3. Disconnect the control bus cable(s) (flat cables) as required.

Caution Never disconnect a control bus cable while power is supplied to the SWM. If you do, the transistor Q1 on the pin board may break.

To check if transistor Q1 is bad, see "Checking Transistor Q1".

Caution When disconnecting a control bus cable, disconnect the cable from each pin board connector separately. Do *not* disconnect a cable by disconnecting one end, then *peeling off* the cable all at once.

4. Remove measurement pin assemblies from the measurement pin mounting ring.
5. Carefully remove pin boards by pulling them out with the pin board extractor as shown in Figure 3-23. Be careful not to let the removed measurement pin assemblies touch any other contact pins.

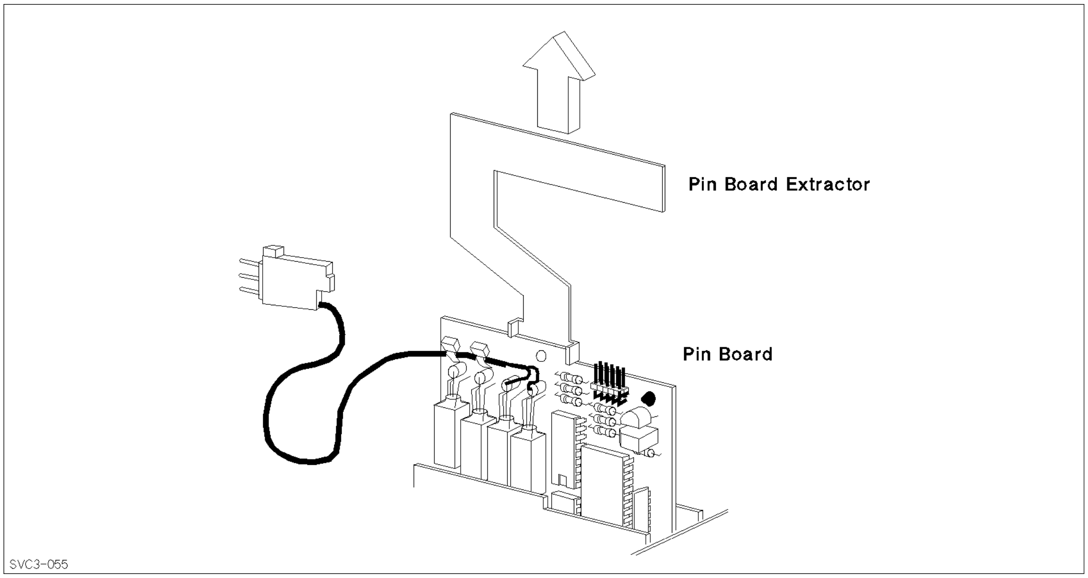


Figure 3-23. Removing Pin Boards

Caution

Wear lint-free gloves when handling pin boards. Lint-free gloves are included in HP 16290A PSP for HP 4062C/UX. If lint-free gloves are not available, hold the board by its edges as shown in Figure 3-24.

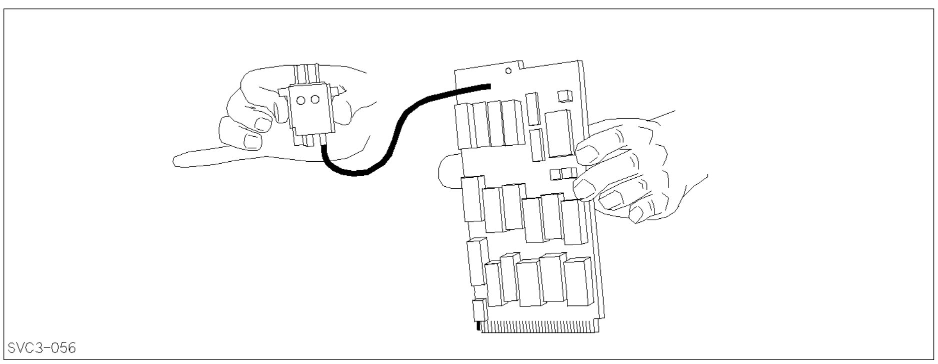


Figure 3-24. Handling Pin Boards

Removing Interface Boards

Removing Interface Boards from HP 4085B 48-pin SWM

To remove the SMU port board, SMU connector, CMS port board, CMS connector, control logic board, or logic connector assemblies, use the following procedure and refer to Figure 3-25:

1. Remove the bottom panel of the 48-pin SWM (see Figure 3-22).
2. Remove the board strut that covers the interface boards.
3. Disconnect the control bus cables from the boards. Depending on the board you wish to remove, disconnect the corresponding external cable from the SWM.
4. Remove the screws 1 that secure the connector assembly to the SWM, and remove the connector assembly.

Note

Before removing the SMU connector assembly, disconnect the SMU cable connected to the SMU port board.

5. Carefully remove the required interface board(s) by pulling them out with the pin board extractor.

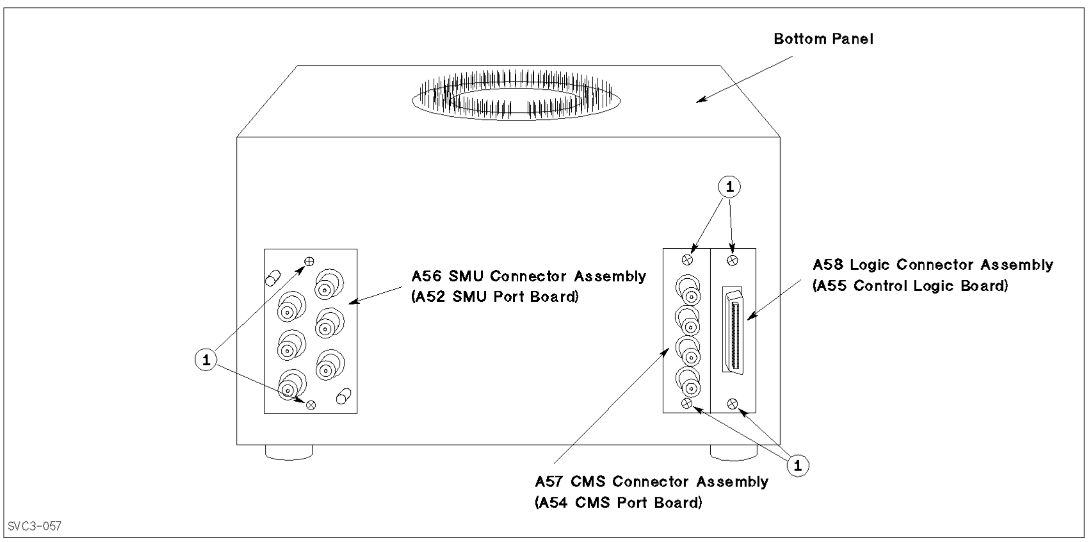


Figure 3-25. Removing Interface Boards of the HP 4085B 48-pin SWM

Removing Interface Boards from HP 4089A/B 96-pin SWM

To remove the SMU link board, SMU port board, SMU connector, AUX port board, AUX connector, control logic board, or logic connector assemblies, use the following procedure and refer to Figure 3-26:

Assembly	Procedure
SMU Link Board SMU Port Board AUX Port Board	1. Remove the bottom panel of the 96-pin SWM. 2. Remove the SMU link board assembly. 3. Disconnect the control bus cables from the boards. Depending on which board you wish to remove, disconnect the corresponding external cable from the SWM. 4. Carefully remove the required interface board(s). For the AUX port board assemblies, use the pin board extractor.
SMU Connector AUX Connector Control Logic Board Logic Connector	1. Remove the bottom panel of the 96-pin SWM. 2. Remove the screws ① that secure the side panel to the SWM, and remove the side panel. 3. Remove the screws ② that secure the required connector assembly to the SWM, and remove the connector assembly. 4. To remove the control logic board assembly, disconnect the control bus cables from the board, and remove the control logic board assembly using the pin board extractor. Note that you must remove the logic connector assembly first when removing the control logic board assembly.

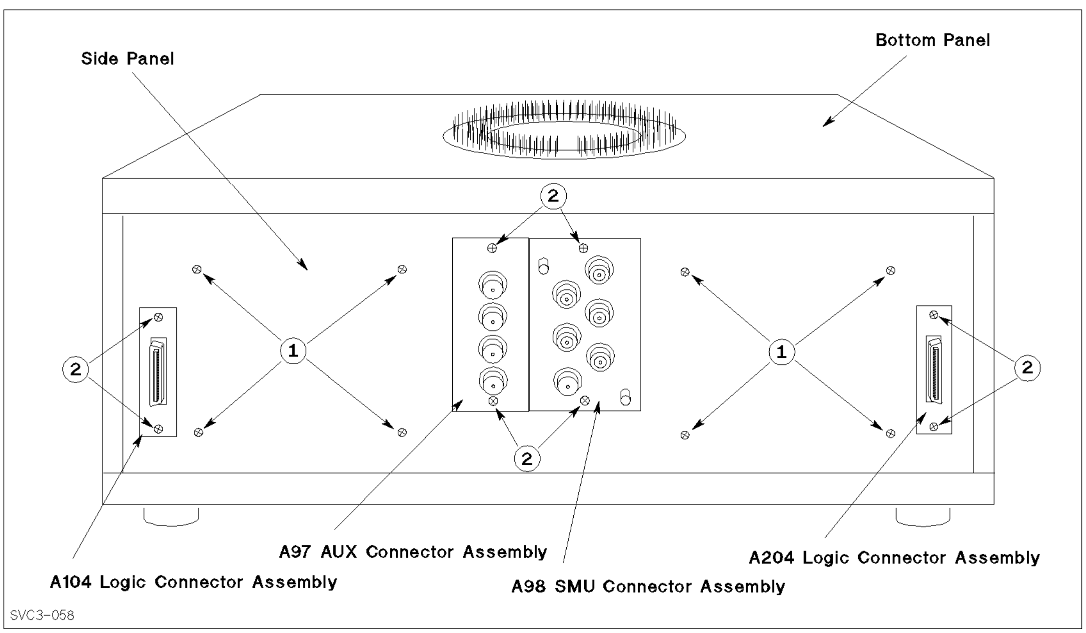


Figure 3-26. Removing Interface Boards of HP 4089A/B 96-pin SWM

Troubleshooting Pin Boards and Interface Boards

Part Locations of Pin Board and Interface Boards

Pin Board

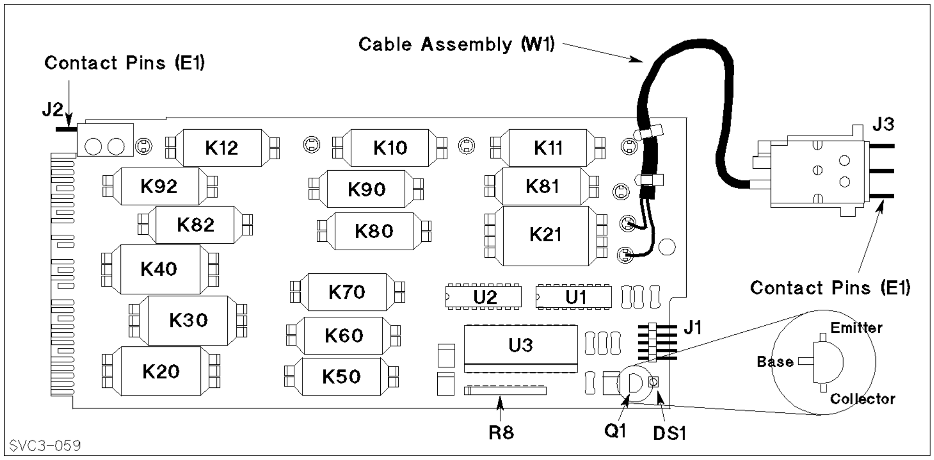


Figure 3-27. Part Locations of Pin Board

SMU Port Board

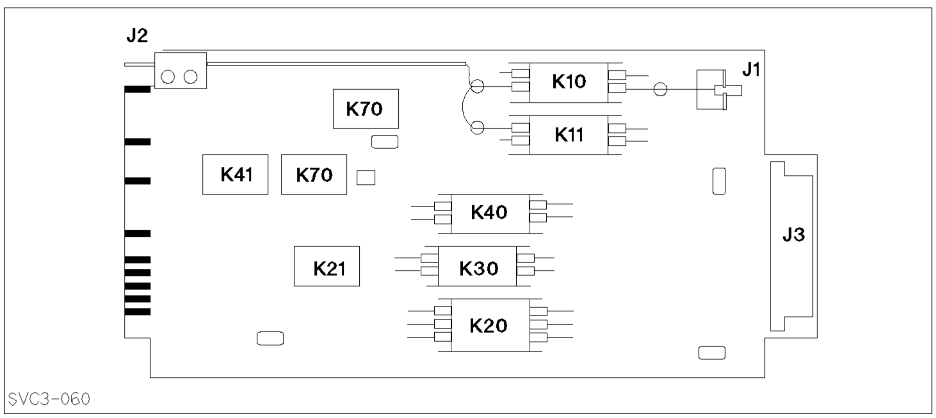


Figure 3-28. Part Locations of SMU Port Board—96-pin SWM

AUX Port Board

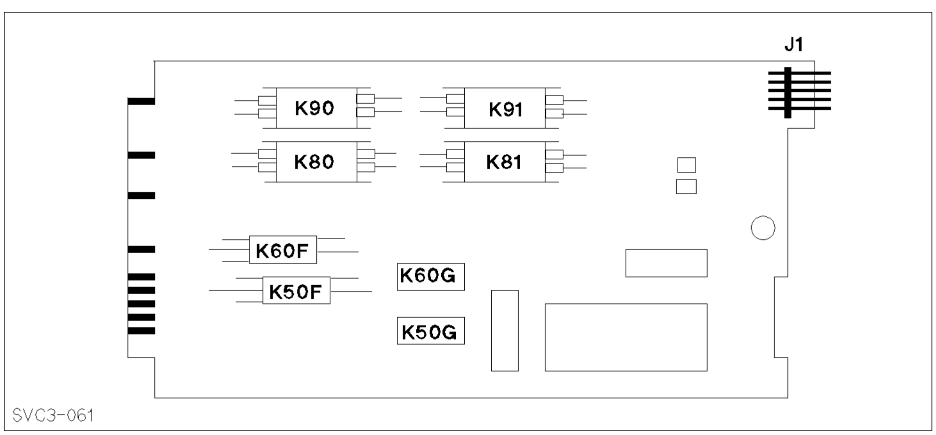


Figure 3-29. Part Locations of AUX Port Board—96-pin SWM

Troubleshooting Pin Boards Using VFP

The third display page of the Virtual Front Panel (VFP) is to check pin board relays. For the 96-pin SWM system, the fourth page of the VFP is also used for checking input relays. Any relay can be set to make or break by positioning the cursor at the desired pin board number—relay number cross point, and selecting the MAKE or BREAK softkey.

To run VFP for troubleshooting pin board and input relays, perform the following procedure:

1. Remove the bottom panel of the SWM, disconnect the required control bus cable(s), and remove the necessary board strut(s).

Caution When disconnecting a control bus cable, disconnect the cable from each pin board connector separately. Do *not* disconnect a cable by disconnecting one end and then *peeling off* the cable all at once.

---

2. Using the pin board extractor, remove the required pin board(s), and extend the pin board as shown in Figure 3-30. The pin board extender and extension cable are included in the HP 4062 Product Support Package.

Caution Do not touch the edge connector, soldered surfaces, or pins of a pin board with bare hands. When handling a pin board, hold it by its edges. If any part of the board becomes contaminated, clean it thoroughly with alcohol.

For troubleshooting the input relays, skip this step because the SMU and AUX port boards cannot be extended using the pin board extender.

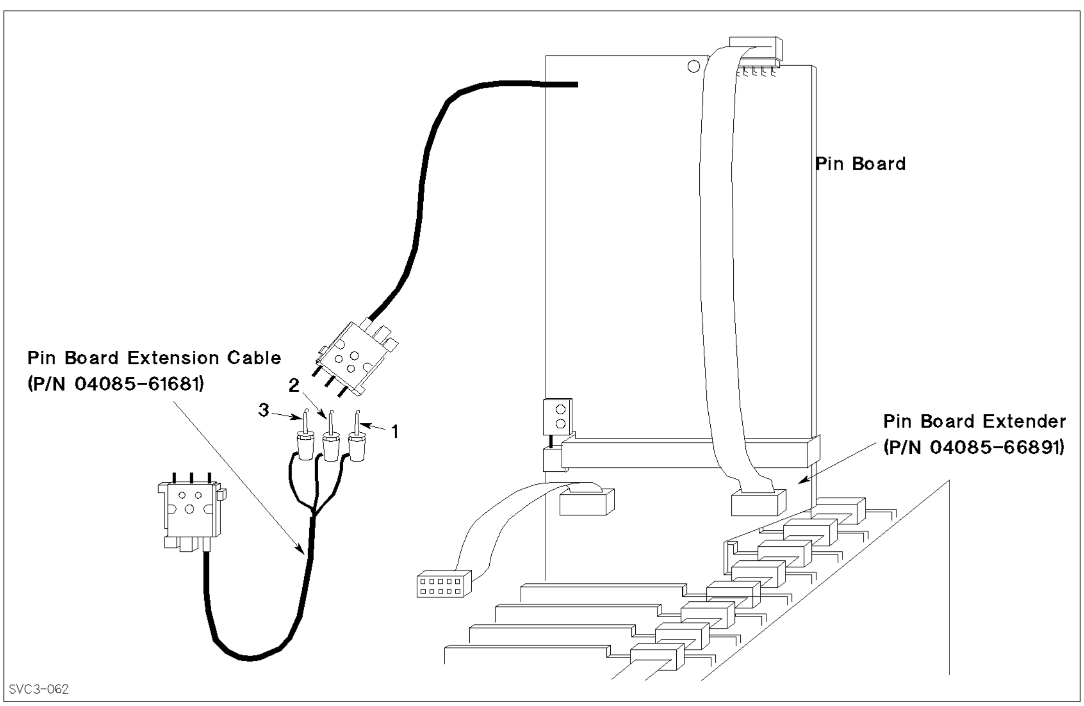


Figure 3-30. Extending Pin Boards

3. Load and run the VFP program. To do so, use the following procedure:

- For HP 4062C and HP BASIC/WS based on flexible disks:

  a. Turn your system instruments on.

  b. Turn the system controller on and boot the HP BASIC/WS system from system disk.

  c. Insert the SYSTEM SOFTWARE disk (1) into the flexible disk drive. Load and run the START program. For example, type as follows:

     `MSI ":,702"` (Return)
     `LOAD "START"` (Return)
     `RUN` (Return) *or select* `RUN` *softkey.*

  d. Insert SYSTEM SOFTWARE disk (4) into the flexible disk drive. Load and run the VFP program. For example, type as follows:

     `MSI ":,702"` (Return)
     `LOAD "VFP"` (Return)
     `RUN` (Return) *or select* `RUN` *softkey.*

- For HP 4062C and HP BASIC/WS based on LIF formatted hard disk:

  a. Turn your system instruments on.

  b. Turn the system controller on and boot the HP BASIC/WS system from the hard disk.

  c. Use `MSI` statement to change to the mass storage device in which the `START` program is located.

  d. Load and run the `START` program as follows:

     `LOAD "START"` (Return)
     `RUN` (Return)

  e. If needed, use the `MSI` statement to change to the mass storage device in which the `VFP`program is located.

  f. Load and run the `VFP` program as follows:

     `LOAD "VFP"` (Return)
     `RUN` (Return)

- For an HP 4062C and HP BASIC/WS based on HFS formatted hard disk or for HP 4062PC and HP BASIC/DOS:

  a. Turn your system instruments on.

  b. Turn the system controller on and boot the HP BASIC/WS or HP BASIC/DOS system from the hard disk.

  c. Use the `MSI` statement to change to the directory in which the `START` program is located. For example, type as follows:

     `MSI "/PCS/BIN"` (Return) *for HP 4062C/PC*
     `MSI "\PCS\BIN"` (Return) *for HP 4062PC*

  d. Load and run the `START` program as follows:

     `LOAD "START"` (Return)

RUN (Return)

e. If needed, use the `MSI` statement to change to the directory in which the `VFP`program is located.

f. Load and run the `VFP` program as follows:

```
LOAD "VFP" (Return)
RUN (Return)
```

- For HP 4062UX and HP BASIC/UX:

a. Turn your system instruments on.

b. Turn the system controller on and boot the HP-UX system.

c. Start the HP BASIC/UX environment as follows:

```
$ rmb
```

d. Load and run the `START` program as follows:

```
LOAD "/usr/pcs/bin/START" (Return)
RUN (Return)
```

e. After the execution mode selection page is displayed, set the Execution mode to ON_LINE using the `NEXT CHOICE` or `PREVIOUS CHOICE` softkey, then select the `Continue` softkey.

f. Load and run the `VFP` program as follows:

```
LOAD "/usr/pcs/bin/VFP" (Return)
RUN (Return)
```

4. If your system is an HP 4062UX, the standalone monitor page is displayed. Select `Lock & Control` softkey.

5. VFP control page 1—for DCS and CMU Measurements, and Pin-port Connections—is displayed. Press the (Next) or (Prev) key a few times until VFP control page 3—for relay assignments—is displayed (see Figure 3-31).

6. Position the cursor at the desired pin board number—relay number cross point, and select the `MAKE` or `BREAK` softkey as desired.

```
RELAY ASSIGNMENT                    PIN NUMBER
      |00000 00001 11111 11112 22222 22223 33333 33334 44444 444|
       12345 67890 12345 67890 12345 67890 12345 67890 12345 678
| K 10 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 20 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++   @ = MAKE
| K 30 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 40 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 50 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 60 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 70 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 80 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 90 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 11 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 21 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 81 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 12 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
| K 82 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++
|_K 92 +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++++ +++

                                                    User 1  Caps  Command
 MAKE     BREAK    CLEAR
                    ALL
```

Figure 3-31. VFP Control Page 3—Relay Assignments

7. For troubleshooting input relays, press the (Next) or (Prev) key a few times until VFP control page 4—for input relay assignments—is displayed (see Figure 3-32). Position the cursor at the desired position, and select the MAKE or BREAK softkey, as needed.

```
                 INPUT  RELAY  CONTROL  PAGE
 _____________________________________________________________________
|                                                                     |
|                          R E L A Y   N U M B E R                    |
|            K10 K20 K30 K40 K50 K60 K70 K80 K90 K11 K21 K41 K81 K91  |
|                                                    (K31)            |
| BLOCK 1     +   +   +   +   +   +   +   +   +   @   @   @   @   @   |
|                                                                     |
| BLOCK 2     +   +   +   +   +   +   +   +   +   @   @   @   @   @   |
|                                                                     |
|           @ : MAKE     + : BREAK      - : SWC NOT PRESENT            |
 ---------------------------------------------------------------------
CAUTION ! This page is for service personnel only.
          If incorrect input relay conditions are set on this page, incorrect
          measurement execution will result.

                                                    User 1  Caps  Command
 MAKE     BREAK    CLEAR
                    ALL
```

Figure 3-32. VFP Control Page 4—Input Relay Assignments

Checking Transistor Q1

You can check whether transistor Q1 on the pin board is good or bad. To do so, you use a handheld multimeter that has diode test function.

The following describes how to check transistor Q1:

1. Turn off the HP 4084B SWC connected to the SWM.
2. Open the bottom panel and remove the pin board from the SWM.
3. Set your multimeter to diode test function.
4. Measure forward and reverse voltages between the base and collector terminals of Q1. "Forward" means that the current goes from the base to collector.
5. Measure forward and reverse voltages between the base and emitter terminals of Q1. "Forward" means that the current goes from the base to emitter.

The following table shows expected forward and reverse voltages:

	Forward voltage	**Reverse Voltage**
Base→Collector	0.6 V to 0.7 V	Overflow
Base→Emitter	0.6 V to 0.7 V	Overflow

Inspecting Pin Boards Visually

If the system fails the DC Leak Test and the cause is isolated to the SWM, perform a visual inspection of the pin boards for a possible *lint bridge*, which can cause excessive leakage current. Figure 3-33 shows an example of a lint bridge.

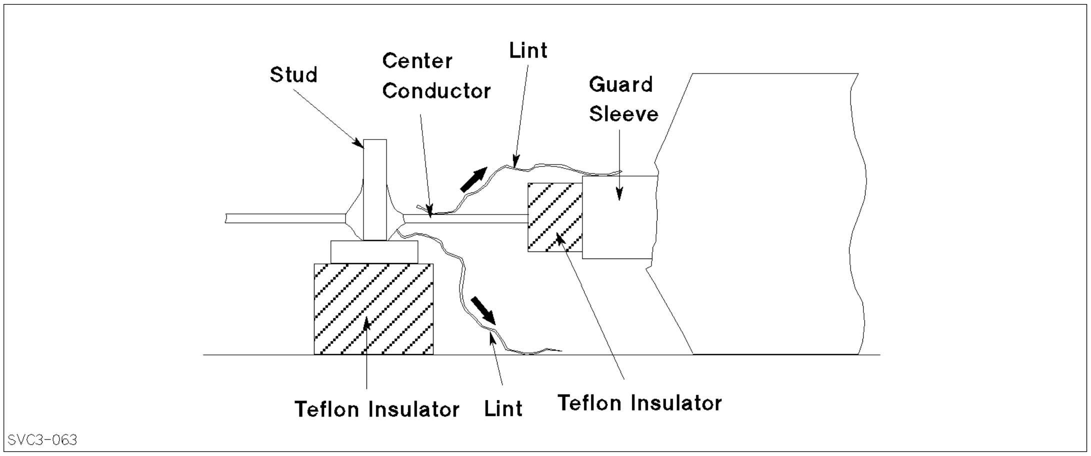


Figure 3-33. Example Pin Board "Lint Bridge"

If the system fails the Open Test (DC Leak subtest), refer to Figure 3-34 and check area A of all pin boards.

If the system failed the Short Test, check area B of the faulty pin board. SMU1 is more likely to fail the Short Test than the other SMUs because it is designed to handle lower currents and its test limits are stricter than those of the other SMUs.

If the pin board fails when SMU1 is connected (you can confirm this using Vfp_monitor—see "Monitoring the PV4062 Leak Test"), check area C.

Use tweezers to remove any lint.

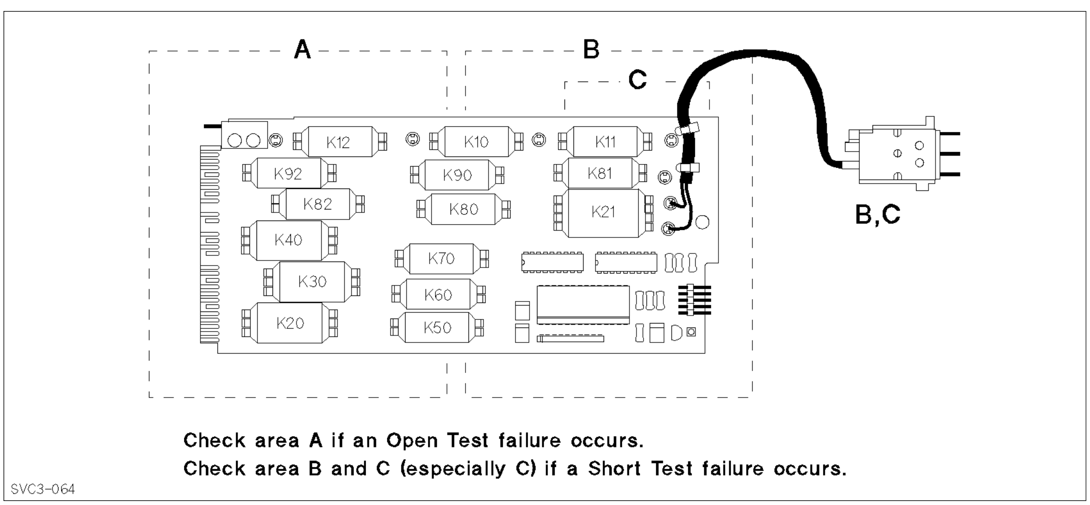


Figure 3-34. Pin Board Areas to Check for "Lint Bridges"

Replacing Pin Board Relays

Before replacing faulty relays on a pin board, prepare the following tools:

- Solder iron
- Solder (HP part number 8090-0433)
- Lint-free gloves (HP part number 9300-0148)
- Tweezers
- Clippers
- Desoldering braid (HP part number 8690-0319)

Use the following procedure to replace faulty pin board relays:

1. Place the pin board on a clean bench.
2. Cut all the leads of the faulty relay.
3. Remove the remaining leads from the board with a soldering iron.
4. Remove any excess solder from the board.
5. Resolder the new relay into place.

Cleaning Pin Boards

To maintain the low current measurement capabilities, pin boards, measurement pins, test fixtures, and exposed signal lines must be kept extremely clean. After repairing pin boards, you must clean the pin boards. The procedure for cleaning pin boards is as follows:

1. Turn the system off.
2. Using the furnished screwdriver, remove the bottom panel of the SWM. Then remove the necessary board struts and control bus cable. Refer to Figure 3-22.

Caution When disconnecting a control bus cable, disconnect the cable from each pin board connector separately. Do *not* disconnect a cable by disconnecting one end and then *peeling off* the cable all at once.

3. Using the pin board extractor, remove the pin boards for cleaning. Refer to Figure 3-23.

Caution Do not touch the edge connector, soldered surfaces, or pins of a pin board with bare hands. When handling a pin board, hold it by its edges as shown in Figure 3-24.

4. Blow pure air on the pin board and remove dust using an air gun or air shower.
5. To clean measurement pins and edge connector, dip lint-free paper into alcohol and wipe them gently.

Caution Do not allow alcohol to splash into the SWM.

6. Insert pin boards into their slots and connect each cable assembly to its corresponding position on the measurement pin mounting ring.
7. Reinstall the board struts, reconnect the control bus cables, and reinstall the bottom panel of the SWM.

Installing Pin Boards

To install the pin boards into the SWM after repairing, use the following procedure. It is assumed that the bottom panel of the SWM is removed and that you can access the pin boards.

1. Hold the measurement pin assembly of the pin board in one hand, and hold the board by its edges in the other hand (see Figure 3-24).
2. Insert the board into the desired slot and press the board down.
3. Mount the measurement pin assembly on the mounting ring of the SWM. Be careful that the slot number of the inserted pin board is the same number as the destination on the mounting ring.
4. Bend the cables of the measurement pin assembly in the direction shown in Figure 3-35.

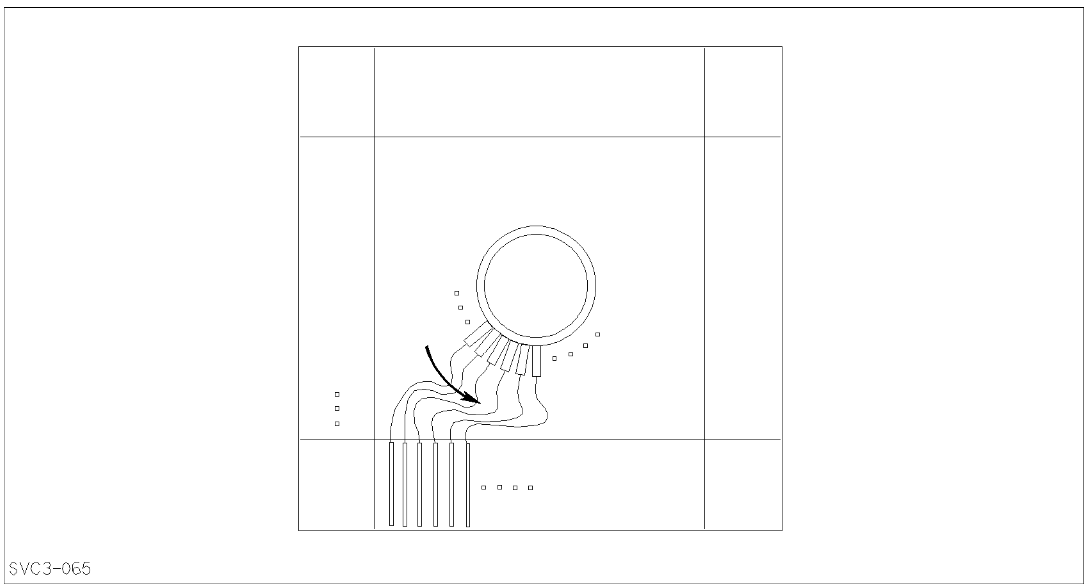


Figure 3-35. Positioning the Cables in the SWM

Troubleshooting the HP 4280A CMU

Required HP 4280A CMU Documents

To troubleshoot the CMU, refer to the HP 4280A *Operation and Service Manual*, and Troubleshooting Guide.

CMU Cable Correction

Cable correction is necessary when making capacitance measurements with the CMU using the CMH and CML cables. To perform CMU cable correction, use the following procedure:

1. Disconnect the CMH and CML cables from the SWM.
2. Press the LOCAL key on the front panel of the CMU.
3. Press the TRIGGER INT key.
4. Press the CABLE LENGTH key to select 0-5(m).
5. Press the CAL key.
6. Press the START key.
7. Connect the outer conductors of the CMH and CML cables to each other, and press the ZERO OPEN key.
8. Press the CORRECT ENABLE key. The open capacitance between the CMH and CML cables is measured and measurement results are displayed on the C display.

Troubleshooting the HP 4284A CMU84

To troubleshoot the HP 4284A CMU84, refer to the HP 4284A *Service Manual*.

After completing service, perform the OPEN and SHORT correction.

OPEN and SHORT Correction of CMU84

Prepare the following items for OPEN and SHORT correction:

- HP 16048E Test Leads
- BNC-T Adapter; 2 each
- BNC f-to-f Adapter; 1 each

Use the following procedure to perform the OPEN and SHORT correction for CMU84 standalone:

1. Connect the test leads to the UNKNOWN terminals on the front panel of the CMU84.
2. Insert the banana terminal of the test leads into the ground terminal (⊥) left side of the UNKNOWN terminals.
3. Connect the red and orange leads from the test leads using a BNC-T adapter.
4. Connect the black and gray leads from the test leads using a BNC-T adapter.
5. Turn the CMU84 on.
6. Press [MEAS SETUP] key.
7. Select CORRECTION softkey.
8. Move the field pointer to the OPEN: by pressing the [⇓] key.
9. Keep the BNC-T connecters open as shown in Figure 3-36, and select MEAS OPEN softkey. The OPEN correction starts immediately.

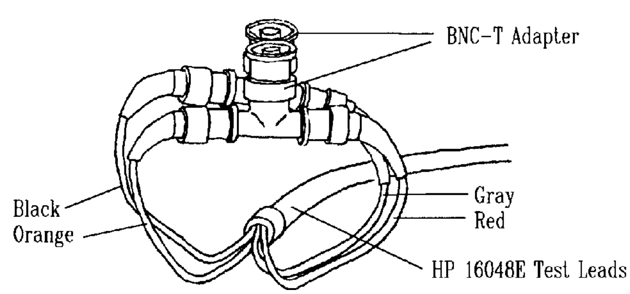


Figure 3-36. Test Leads Connections for OPEN Correction

10. After completing the OPEN correction, move the field pointer to the SHORT: by pressing the [⇓] key.
11. Connect the BNC female adapters connected to the test leads using a BNC f-to-f adapter as shown in Figure 3-37, and select MEAS SHORT softkey. The SHORT correction starts immediately.

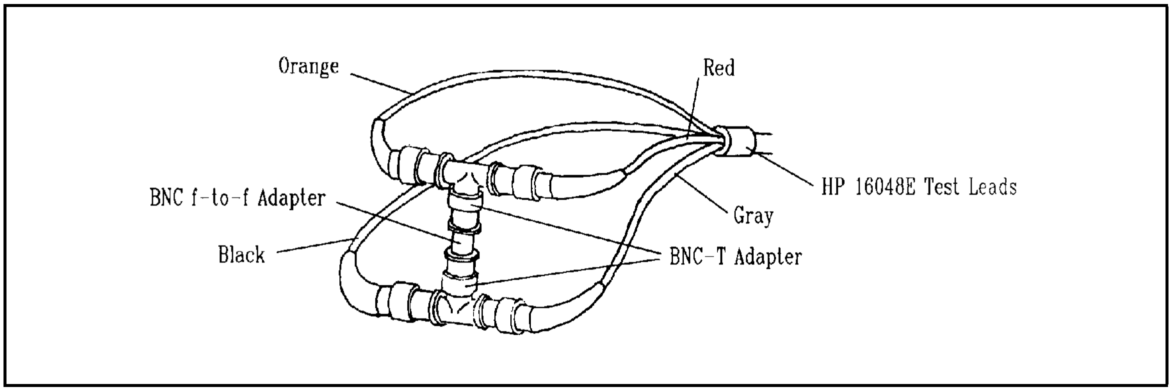


Figure 3-37. Test Leads Connections for SHORT Correction

Troubleshooting the HP 4142B DCS

To troubleshoot the HP 4142B DCS, refer to the HP 4142B *Service Manual*.

Warning

When removing the power supply unit from the HP 4142B DCS, perform the following procedure:

1. **Turn off the power to the HP 4142B DCS.**
2. **Loosen the four screws ① from the flanges that secure the power supply unit to the DCS as shown in Figure 3-38.**
3. **Pull the power supply unit out by grasping the lower part ② of the flanges.**

To avoid injury, do not pull the power supply unit out by grasping the center of the flanges.

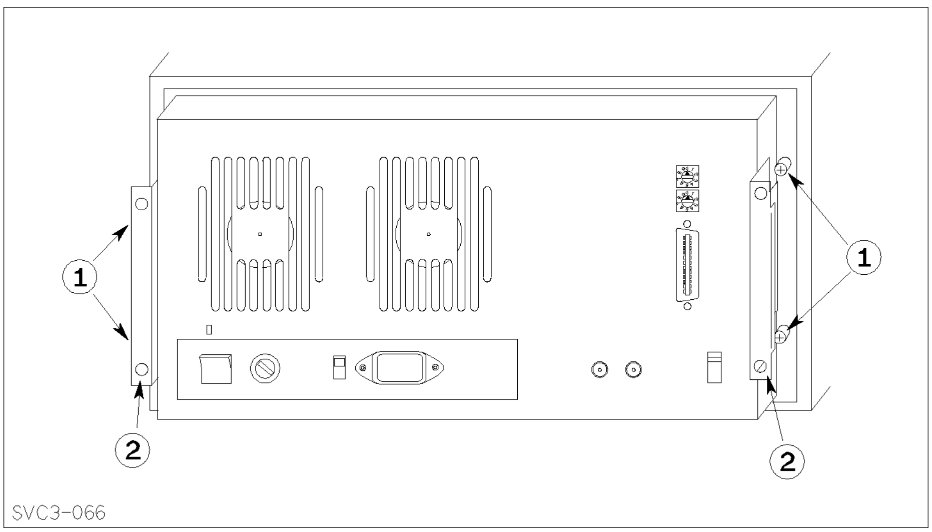


Figure 3-38. Removing the Power Supply Unit form the DCS

4

Replaceable Parts

This chapter contains information for ordering parts. Table 4-3 through Table 4-14 list the replaceable parts in reference designator order for each system instrument.

Stocking spare parts for the system is recommended for a quick return to service in the event of a malfunction. Field Service Inventory (FSI) (HP part number 04085-65902) is available for this purpose. The FSI consists of selected replaceable assemblies and components for SWC, SWM and pin boards, and is provided with a carrying case.

Ordering Information

To order a part listed in the replaceable parts table, give the HP part number, indicate the quantity required, and address the order to the nearest HP office.

To order a part that is not listed in the replaceable parts table, state the full instrument model and serial number, the description and function of the part, and the number of parts required. Address your order to the nearest HP office.

Within the U.S.A., HP can supply parts through a direct mail order system. Advantages of using the system are:

- Direct ordering and shipment from the HP Parts Center in Mountain View, California.
- No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through a local HP office when the orders require billing and invoicing).
- Prepaid transportation (there is a small handling charge for each order).
- No invoice—however, a check or money order must accompany each order for this benefit.

Mail order forms and specific ordering information are available through your local HP office.

Abbreviations

Table 4-1 lists reference designators used in the parts lists schematics.

Table 4-1. Reference Designation

Designation	Description
A	Assembly
E	Misc. Electronic Part
K	Relay
Q	Transistor
W	Cable

Table 4-2 lists the abbreviations used in the part lists and schematics.

Table 4-2. Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
ASSY	Assembly
CONN	Connector
CMS	Capacitance Measurement Subsystem
CPU	Central Processor Unit
DPDT	Double-Pole Double-Throw
F	Female
HEX	Hexagonal
LK	Lock
M	Male
MACH	Machine
MPU	Microprocessor Unit
NPN	Negative-Positive-Negative
PB	Push button
QTY	Quantity
RF	Radio Frequency
SCR	Screw
Si	Silicon
SMU	Source/Monitor Unit
SPDT	Single-Pole Double-Throw
SW	Switch
STD	Standard
W/	With
WASH	Washer
W/O	Without

Replaceable Parts Lists

The replaceable parts lists are organized as follows:

- Illustrated Assembly Locations
- Electrical assemblies and components in alphanumeric order by reference designation.
- Miscellaneous parts.
- Illustrated parts breakdown.

The information for each part includes:

- The HP Part number.
- The total quantity in the instrument.
- A description of the part.

The total quantity for each part is given only once—at the first appearance of the HP part number in the list.

HP 4084B SWC Replaceable Parts

Table 4-3 and Table 4-4 list the replaceable parts of the HP 4084B SWC. Table 4-3 shows the assembly locations of the SWC. Figure 4-1 shows the front panel replaceable parts of the SWC. Figure 4-3 shows the major mechanical parts of the SWC, which are listed in Table 4-5.

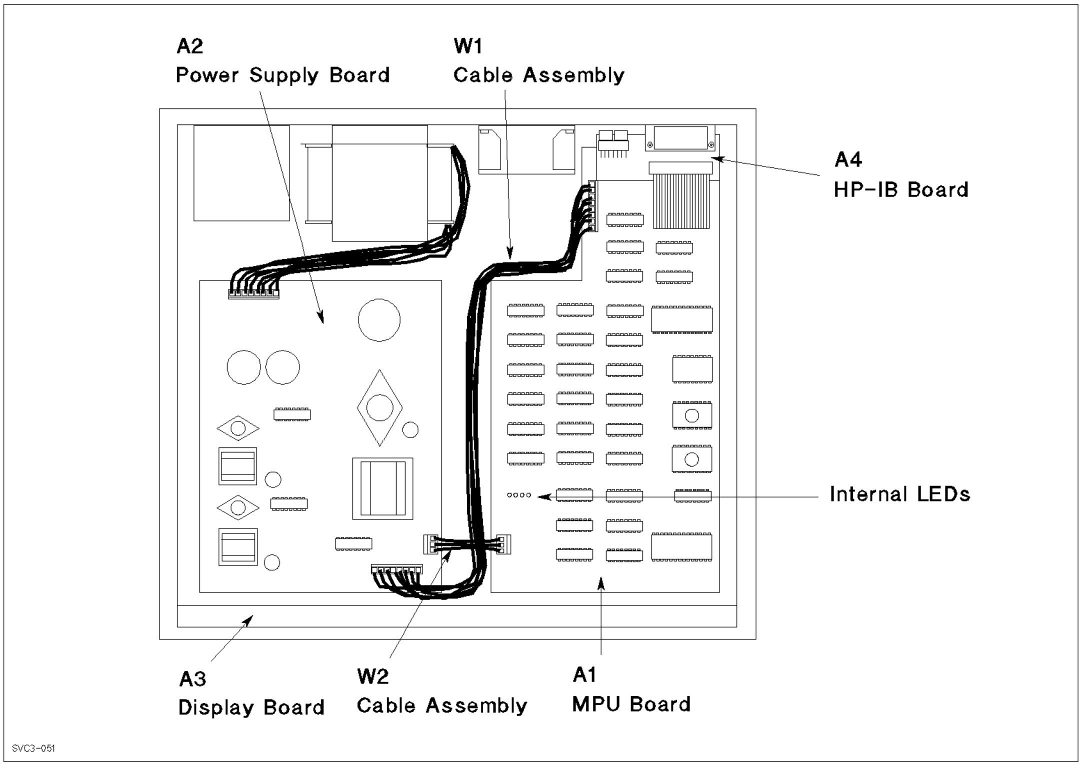


Figure 4-1. SWC Assembly Locations

Table 4-3. SWC Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
A1	04084-66531	1	MPU BOARD ASSY
A2	04084-66502	1	POWER SUPPLY BOARD ASSY
A3	04084-66503	1	DISPLAY BOARD ASSY
A4	04084-66504	1	HP-IB BOARD ASSY
W1	04084-61601	1	CABLE ASSY (Long)
W2	04084-61602	1	CABLE ASSY (Short)

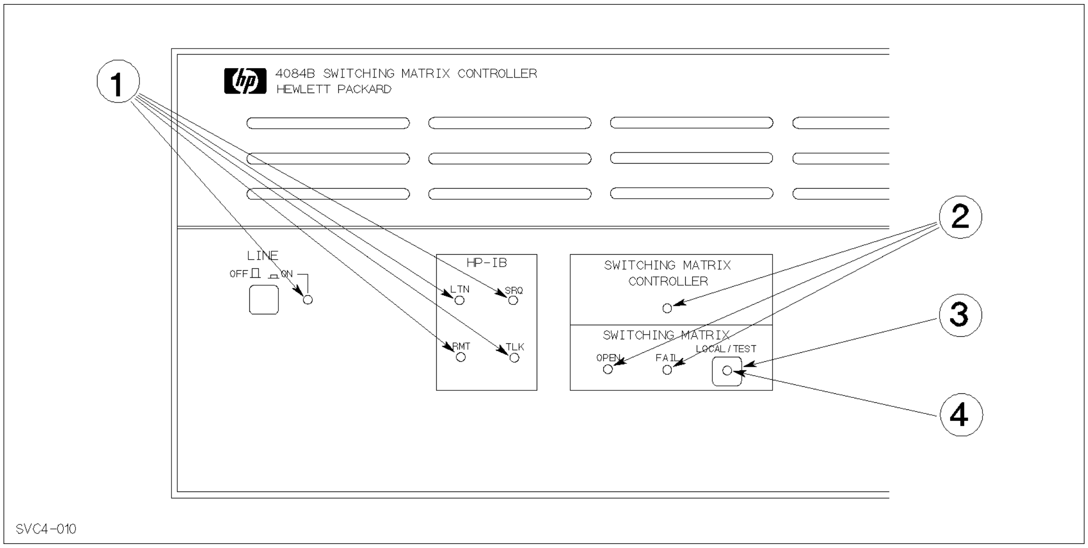


Figure 4-2. SWC Front Panel Part Locations

Table 4-4. SWC Front Panel Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
1	1990-0487	5	LED—YELLOW
2	1990-0486	3	LED—RED
3	5060-9436	1	SW—PB
	5041-0285	1	CAP—KEY
4	1990-0665	1	LED—RED

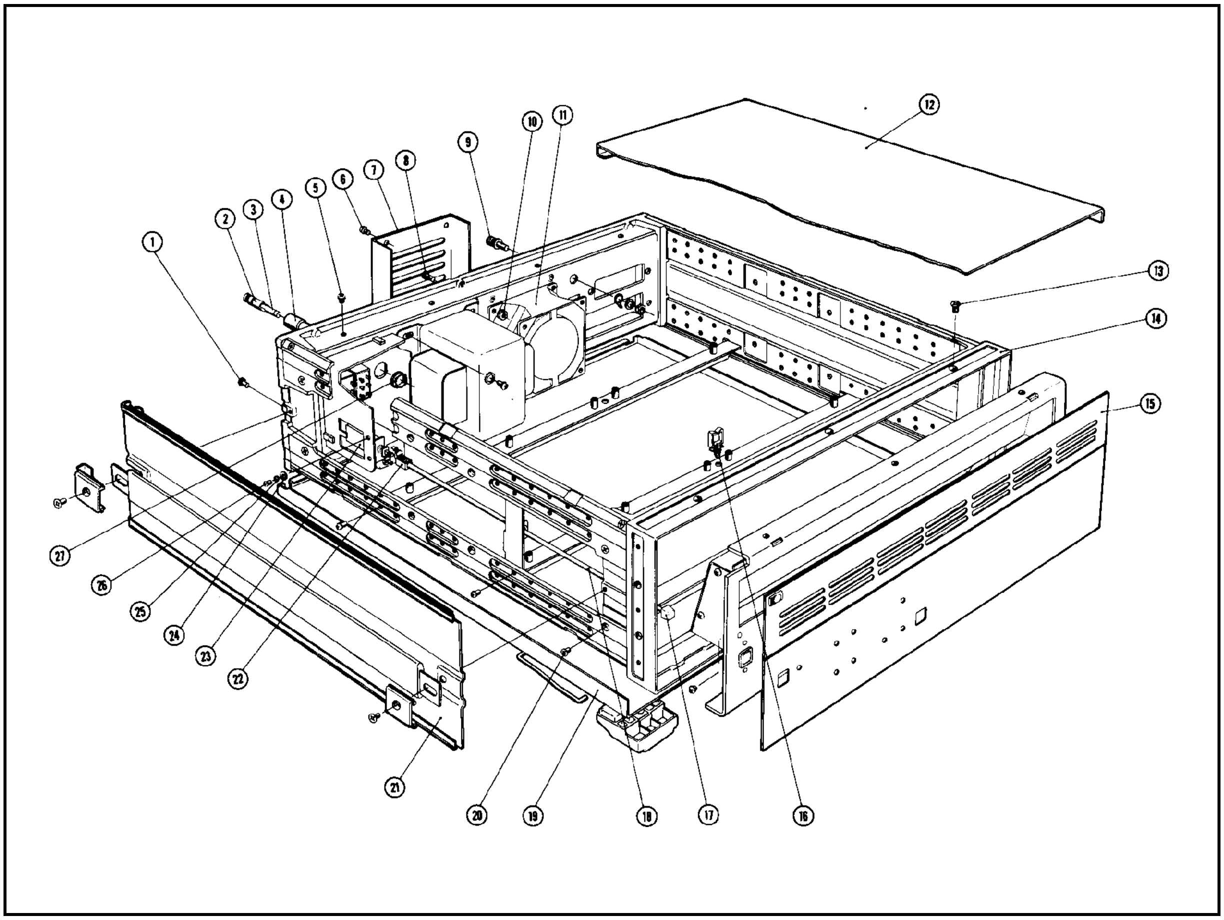


Figure 4-3. SWC Major Mechanical Parts

Table 4-5. SWC Replaceable Mechanical Parts

Reference Designation	HP Part Number	Quantity	Description
1	2360-0113	2	SCR—MACH 6-32
2	2110-0565	1	FUSE HOLDER CAP
3	2110-0304	1	FUSE 1.5 A 250 V for 100 V/120 V LINE
	2110-0360	1	FUSE 0.75 A 250 V for 220 V/240 V LINE
4	2110-0564	1	FUSE HOLDER BODY
5	2360-0113	8	SCR—MACH 6-32
6	2360-0113	4	SCR—MACH 6-32
7	04084-04001	1	FAN COVER
8	0515-1509	4	SCR SOCKET HEAD CAP
9	1510-0130	1	BINDING POST
10	2190-0577	4	LOCK WASH HELICAL
11	3160-0273	1	FAN—TUBE AXIAL
12	5062-3734	1	TOP COVER
13	0515-0889	6	SCR—MACH 6-32
14	5021-8403	1	FRONT FRAME
15	04084-00211	1	FRONT PANEL
16	1400-1051	2	SADDLE—WIRE
17	5041-0564	1	KEY-Q-CORP: WHITE
18	04084-25001	1	ROD
19	5062-3746	1	BOTTOM COVER
20	0515-1668	16	SCR—MTRC SPCLY
21	5062-3779	2	SIDE COVER
22	04192-40002	1	COUPLER
23	3101-2216	1	SW—PB DPDT
24	3050-0235	2	WASH—FLAT METALLIC
25	2190-0225	2	LOCK WASH HELICAL METALLIC
26	0515-0150	2	SCR—MACH
27	2110-0569	1	FUSE HOLDER NUT
28	1494-0076	1	SLIDE KIT (Not shown) for System Cabinet
	1494-0059	1	SLIDE KIT (Not shown) for HP 29402C Cabinet

HP 4085B 48-pin SWM Replaceable Parts

Table 4-6 and Table 4-7 list the replaceable parts for the HP 4085B 48-pin SWM. Figure 4-4 shows the assembly locations of the 48-pin SWM. Figure 4-5 shows the major mechanical parts of the 48-pin SWM.

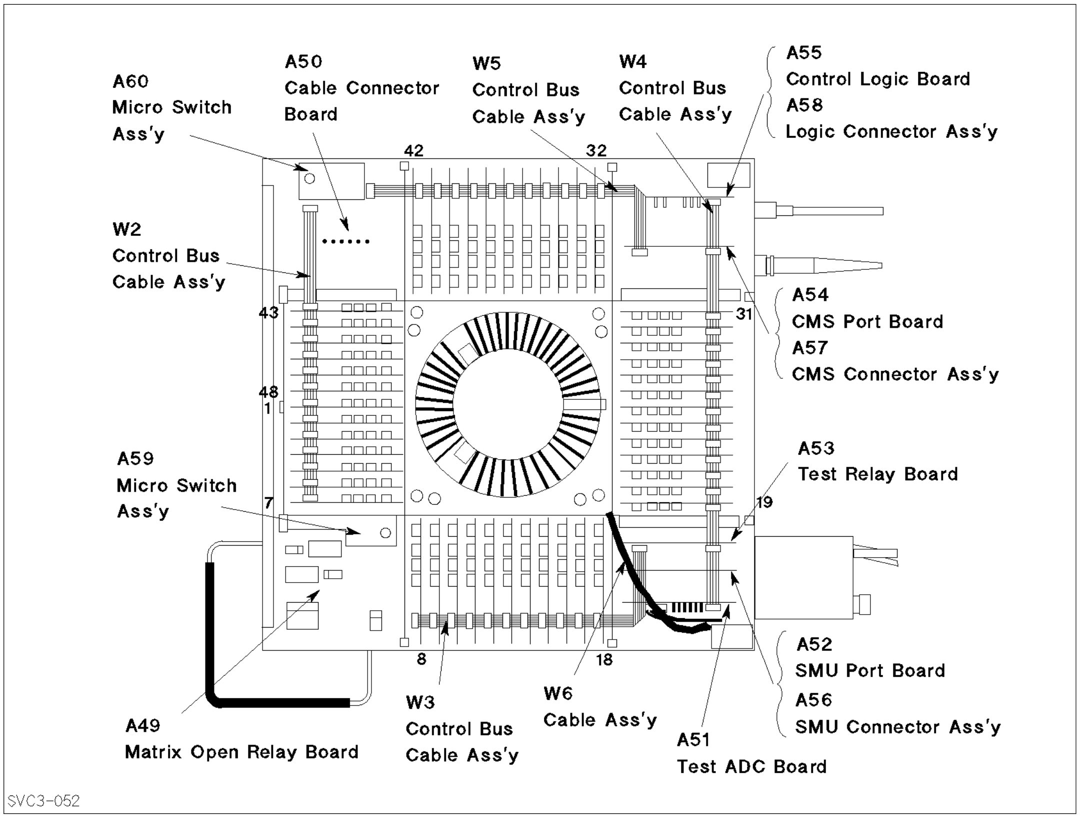


Figure 4-4. Assembly Locations in the HP 4085B 48-pin SWM

Table 4-6. HP 4085B 48-pin SWM Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
A1 – A48	16320-66551	48	PIN BOARD
A49	04085-66549	1	MATRIX OPEN RELAY BOARD ASSY
A50	04085-66550	1	CABLE CONN BOARD ASSY
A51	04085-66561	1	TEST ADC BOARD ASSY
A52	04085-66562	1	SMU PORT BOARD ASSY
A53	04085-66563[1]	1	TEST RELAY BOARD ASSY
A54	04085-66564	1	CMS PORT BOARD ASSY
A55	04085-66555	1	CONTROL LOGIC BOARD ASSY
A56	04085-61021	1	SMU CONN ASSY
A57	04085-61022	1	CMS CONN ASSY
A58	04085-61003	1	LOGIC CONN ASSY
A59	04085-61004	1	MICRO SW ASSY
A60	04085-61005	1	MICRO SW ASSY
—	04085-66569	1	MOTHER BOARD (Not shown)
W2	04085-61602	1	CONTROL BUS CABLE ASSY
W3	04085-61603	1	CONTROL BUS CABLE ASSY
W4	04085-61604	1	CONTROL BUS CABLE ASSY
W5	04085-61605	1	CONTROL BUS CABLE ASSY
W6	04085-61606	1	CABLE ASSY

1 04085-66570 can be used instead of 04085-66563.

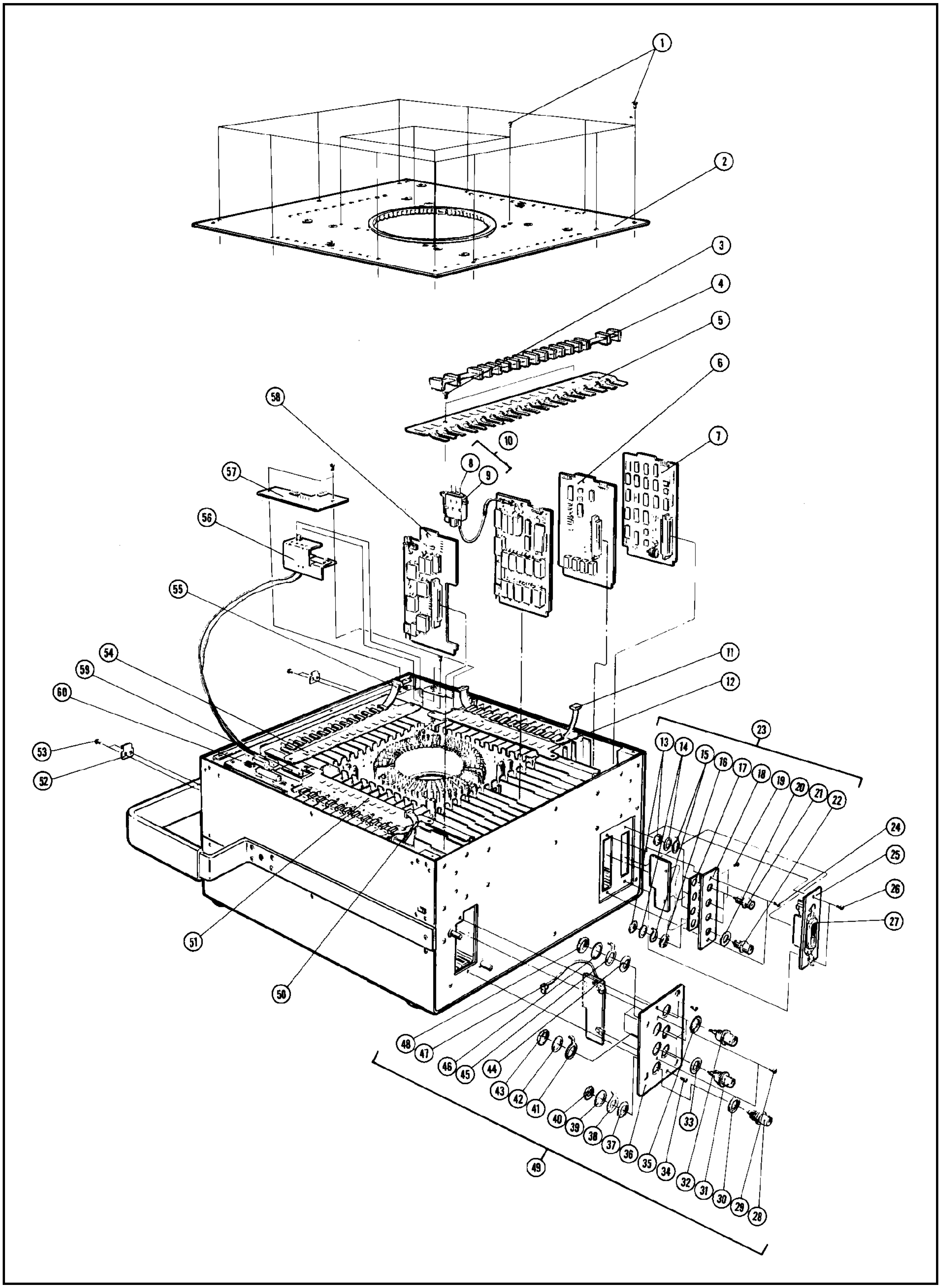


Figure 4-5. HP 4085B 48-pin SWM Major Mechanical Parts

Table 4-7. 48-pin SWM Replaceable Mechanical Parts

Reference Designation	HP Part Number	Quantity	Description
1	2360-0115	15	SCR—MACH 6-32
2	04085-00221	1	BOTTOM PANEL (English)
	04085-00222	1	BOTTOM PANEL (Japanese)
3	2360-0194	8	SCR—MACH 6-32
4	04085-61604	1	CONTROL BUS CABLE ASSY
5	04085-01210	1	GUIDE PLATE
6	04085-66564	1	CMS PORT BOARD
7	04085-66563[1]	1	TEST RELAY BOARD
8	0360-2066	3	CONTACT
9	16320-61601	1	CABLE ASSY (Including CONTACTS)
10	16320-66551	Up to 48	PIN BOARD ASSY
11	04085-61605	1	CONTROL BUS CABLE ASSY
12	04085-01208	1	GUIDE PLATE
13	2950-0001	4	NUT—HEX-DOUBLE CHAMFER
14	2190-0016	4	LOCK WASH INTERNAL TOOTH
15	0360-1190	2	TERMINAL—SOLDER LUG
16	5040-0345	2	INSULATOR CONN
17	04085-01223	1	ANGLE
18	04085-00202	1	PANEL
19	2200-0140	2	SCR—MACH 4-40
20	5040-0345	2	INSULATOR CONN
21	1250-0118	2	CONN—RF BNC
22	1250-0118	2	CONN—RF BNC
23	04085-61022	1	CMS CONN ASSY
24	2360-0115	2	SCR—MACH 6-32
25	04085-61003	1	LOGIC CONN ASSY
26	2360-0115	2	SCR—MACH 6-32
27	1251-0085	1	CONN 36-PIN F
28	1250-0118	1	CONN—RF BNC
29	2360-0194	2	SCR—MACH 6-32
30	5040-0345	1	INSULATOR CONN
31	1250-1906	1	CONN—RF TRIAXIAL
32	1250-1906	4	CONN—RF TRIAXIAL
33	16057-40001	1	INSULATOR

1 04085-66570 can be used instead of 04085-66563.

Table 4-7. 48-pin SWM Replaceable Mechanical Parts (continued)

Reference Designation	HP Part Number	Quantity	Description
34	2360-0115	1	SCR—MACH 6-32
35	16057-40001	4	INSULATOR
36	04085-00201	1	PANEL
37	5040-0345	1	INSULATOR CONN
38	0360-1190	1	TERMINAL—SOLDER LUG
39	2190-0016	1	LOCK WASH INTERNAL TOOTH
40	2950-0001	1	NUT—HEX-DOUBLE CHAMFER
41	0360-1190	1	TERMINAL—SOLDER LUG
42	2190-0102	1	LOCK WASH INTERNAL TOOTH
43	Included in 31	—	—
44	16057-40001	4	INSULATOR
45	5000-4218	4	TERMINAL
46	2190-0102	4	LOCK WASH INTERNAL TOOTH
47	04085-61607	1	CABLE ASSY
48	Included in 32	—	—
49	04085-61021	1	SMU CONN ASSY
50	04085-61603	1	CONTROL BUS CABLE ASSY
51	04085-01208	1	GUIDE PLATE
52	1390-0666	2	FASTENER
53	2360-0115	4	SCR—MACH 6-32
54	04085-01209	1	GUIDE PLATE
55	04085-61603	1	CONTROL BUS CABLE ASSY
56	04085-61005	1	MICRO SW ASSY (with long cable)
57	04085-66550	1	CABLE CONN BOARD
58	04085-66562	1	SMU PORT BOARD
59	04085-61004	1	MICRO SW ASSY (with short cable)
60	04085-66549	1	MATRIX OPEN RELAY BOARD
61	04085-66569	1	MOTHER BOARD (Not shown)

HP 4089A/B 96-pin SWM Replaceable Parts

Table 4-8 and Table 4-9 list the replaceable parts for the HP 4089A/B 96-pin SWM. Figure 4-6 shows the assembly locations of the 96-pin SWM. Figure 4-7 shows the major mechanical parts of the 96-pin SWM.

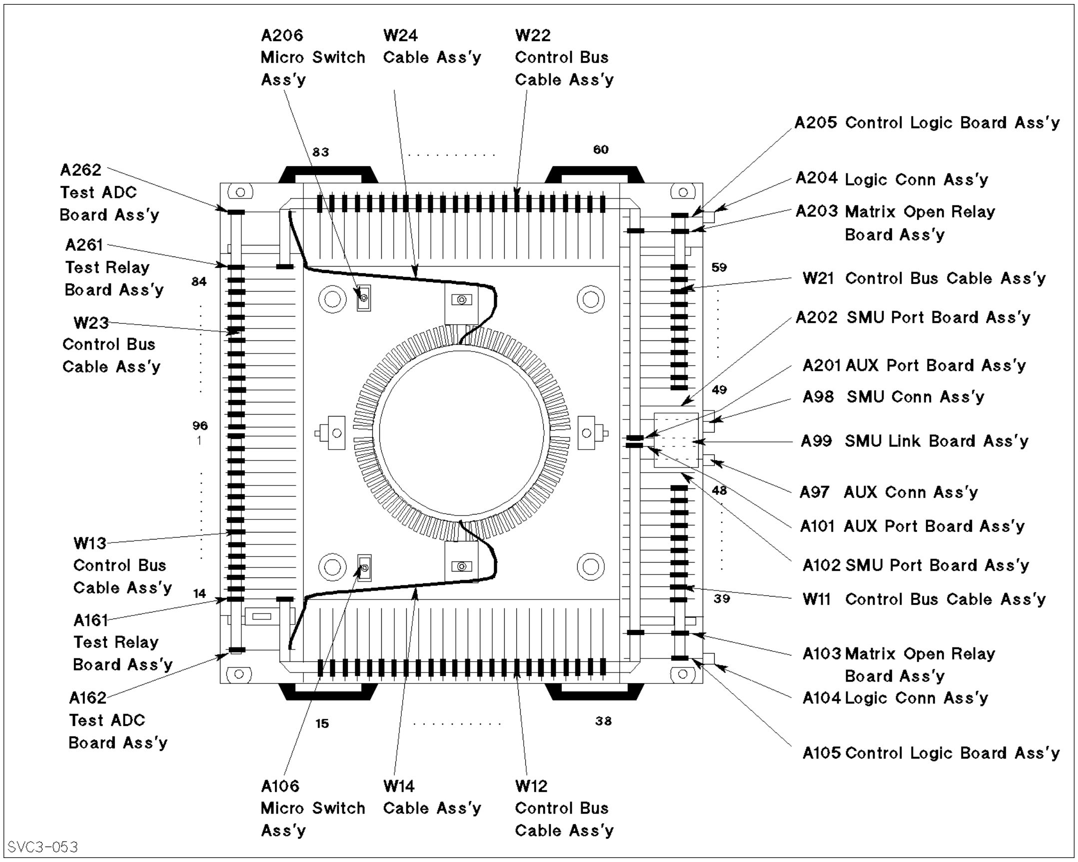


Figure 4-6. Assembly Locations in the HP 4089A/B 96-pin SWM

Table 4-8. HP 4089A/B 96-pin SWM Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
A1 – A96	16320-66552	Up to 96	PIN BOARD (For HP 4089A/B)
A97	04089-66513	1	AUX CONN ASSY (For HP 4089A)
	04089-66533	1	AUX CONN ASSY (For HP 4089B)
A98	04089-66510	1	SMU CONN ASSY
A99	04089-66503	1	LINK BOARD ASSY
A101, A201	04089-66531	2	AUX PORT BOARD ASSY (For HP 4089A/B)
A102, A202	04089-66528	2	SMU PORT BOARD ASSY (For HP 4089A/B)
A103, A203	04089-66504	2	MATRIX OPEN RELAY BOARD ASSY
A104, A204	04089-66506	2	LOGIC CONN ASSY
A105, A205	04085-66555	2	CONTROL LOGIC BOARD ASSY
A106, A206	04089-61901	2	MICRO SW ASSY
A161, A261	04085-66570	2	TEST RELAY BOARD ASSY (For HP 4089A/B)
A162, A262	04085-66561	2	TEST ADC BOARD ASSY
—	04089-66501	1	MOTHER BOARD: BLOCK 1 (Not shown)
—	04089-66502	1	MOTHER BOARD: BLOCK 2 (Not shown)
W11	04089-61621	1	CONTROL BUS CABLE ASSY
W12	04089-61622	1	CONTROL BUS CABLE ASSY (For HP 4089A)
	04089-61648	1	CONTROL BUS CABLE ASSY (For HP 4089B)
W13	04089-61623	1	CONTROL BUS CABLE ASSY
W14	04085-61606	1	CABLE ASSY
W21	04089-61624	1	CONTROL BUS CABLE ASSY
W22	04089-61622	1	CONTROL BUS CABLE ASSY
W23	04089-61626	1	CONTROL BUS CABLE ASSY
W24	04085-61606	1	CABLE ASSY

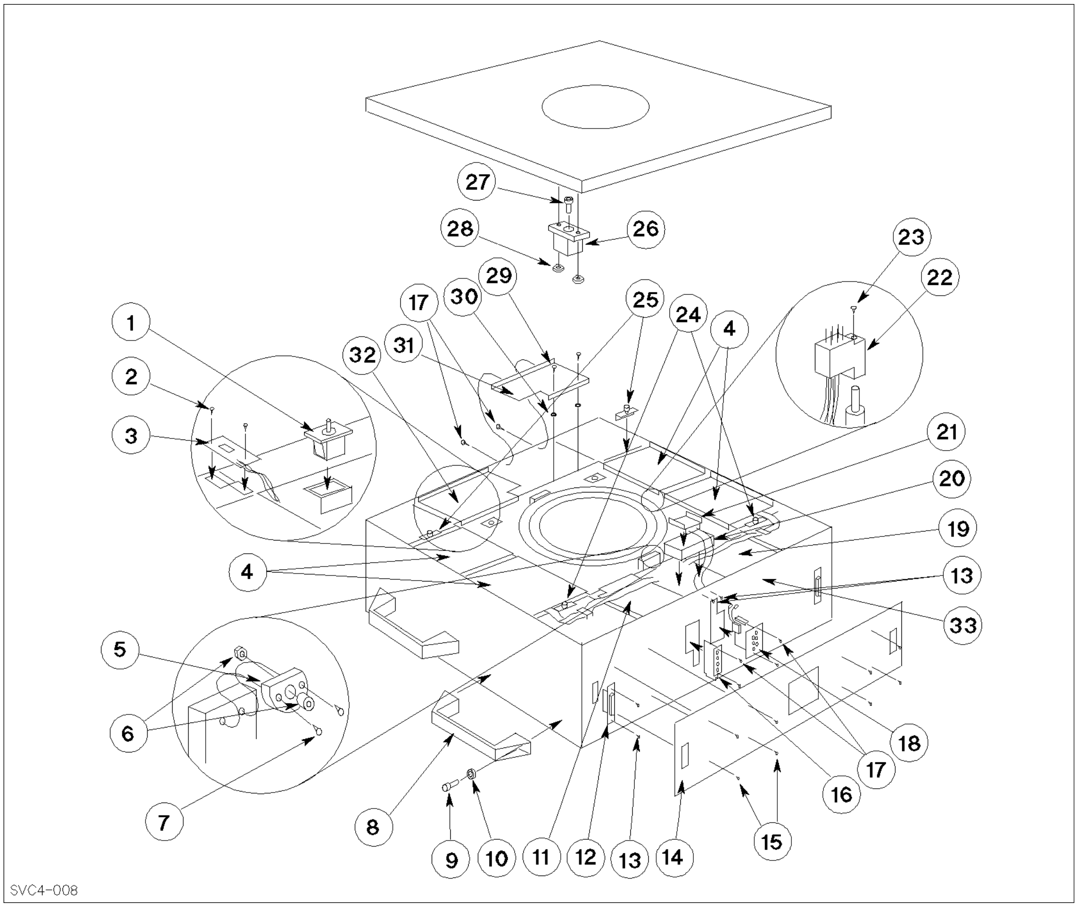


Figure 4-7. HP 4089A/B 96-pin SWM Major Mechanical Parts

Table 4-9. HP 4089A/B 96-pin SWM Replaceable Mechanical Parts

Reference Designation	HP Part Number	Quantity	Description
1	04089-61901	2	MICRO SW ASSY
2	0515-1550	2	SCR M3L8
3	04089-66515	1	DISPLAY BOARD 2
4	04089-01214	4	ANGLE
5	04089-20003	2	HOLDER
6	1410-1264	2	COM FOLLOWER
7	0515-1014	4	SCR FL M4L16
8	1440-0171	4	HANDLE
9	94815-24007	8	SPACER
10	0515-1972	8	BOLT M8
11	04089-01217	1	ANGLE
12	04089-66506	2	CONTROL CONN BOARD
13	0515-0914	6	SCR FL M3L6
14	04089-00201	1	PANEL (For HP 4089A)
	04089-00220	1	PANEL (For HP 4089B)
15	0515-1012	8	SCR FL M4L8
16	04089-66513	1	AUX CONN ASSY
17	0515-0907	20	SCR FL M3L8
18	04089-66510	1	SMU CONN ASSY
19	04089-01218	1	ANGLE
20	04089-66503	1	LINK BOARD
21	04089-01213	1	ANGLE
22	04085-61601	2	WIRE ASSY
23	0520-0173	2	SCR—MACH 2-56
24	04089-01219	2	ANGLE
25	04089-01220	2	ANGLE
26	04089-24012	4	GUIDE
27	0515-0195	4	BOLT M6
28	0535-0043	8	NUT M4
29	0515-1550	16	SCR M3L8
30	3050-1284	16	CAPTIVE WASHER
31	04089-01215	1	ANGLE
32	04089-01216	1	ANGLE
33	04089-00110	1	INSIDE PANEL (For HP 4089A)
	04089-00120	1	INSIDE PANEL (For HP 4089B)

Pin Board Replaceable Parts

Figure 4-8 shows the assembly locations of pin boards. Table 4-10 lists the replaceable parts for pin boards.

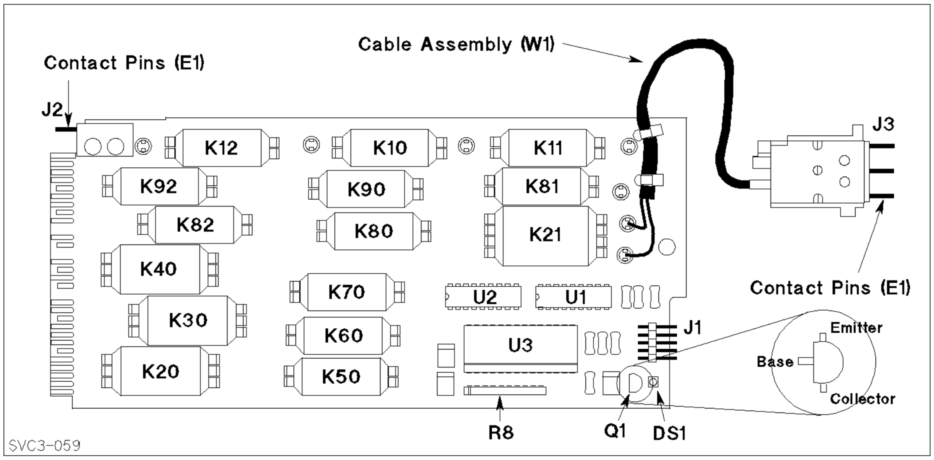


Figure 4-8. Part Locations of Pin Board

Table 4-10. Pin Board Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
E1	0360-2066	3	CONTACT
K10	0490-1629[1], 0490-1793[2]	1	RELAY—REED 2A
K11	0490-1633[1], 0490-1790[2]	1	RELAY—REED 1C
K12	0490-1633[1], 0490-1790[2]	1	RELAY—REED 1C
K20	0490-1630[1], 0490-1791[2]	1	RELAY—REED 3A
K21	0490-1632[1], 0490-1792[2]	1	RELAY—REED 2C
K30	0490-1630[1], 0490-1791[2]	1	RELAY—REED 3A
K40	0490-1630[1], 0490-1791[2]	1	RELAY—REED 3A
K50	0490-1629[1], 0490-1793[2]	1	RELAY—REED 2A
K60	0490-1629[1], 0490-1793[2]	1	RELAY—REED 2A
K70	0490-1629[1], 0490-1793[2]	1	RELAY—REED 2A
K80	0490-1629[1], 0490-1793[2]	1	RELAY—REED 2A
K81	0490-1633[1], 0490-1790[2]	1	RELAY—REED 1C
K82	0490-1633[1], 0490-1790[2]	1	RELAY—REED 1C
K90	0490-1629[1], 0490-1793[2]	1	RELAY—REED 2A
K92	0490-1633[1], 0490-1790[2]	1	RELAY—REED 1C
Q1	1854-0215	1	TRANSISTOR NPN Si
U3	1820-2756	1	GATE ARRAY—Ceramic Package (MB 62115)
	1820-5071	1	GATE ARRAY—Plastic Package (MB 673152)
W1	16320-61601	1	CABLE ASSY (for HP 16320B)
	16320-61602	1	CABLE ASSY (for HP 16320C/D)

1 These parts are used for HP part number 16320-66521, 16320-66531, and 16320-66541.

2 These parts are used for HP part number 16320-66551 and 16320-66552.

SMU and AUX Port Boards Replaceable Parts

Figure 4-9 and Figure 4-10 show the assembly locations of the SMU port board and the AUX port board for the 96-pin SWMs respectively. Table 4-11 and Table 4-12 list the replaceable parts for SMU port board and AUX port board for the 96-pin SWMs, respectively.

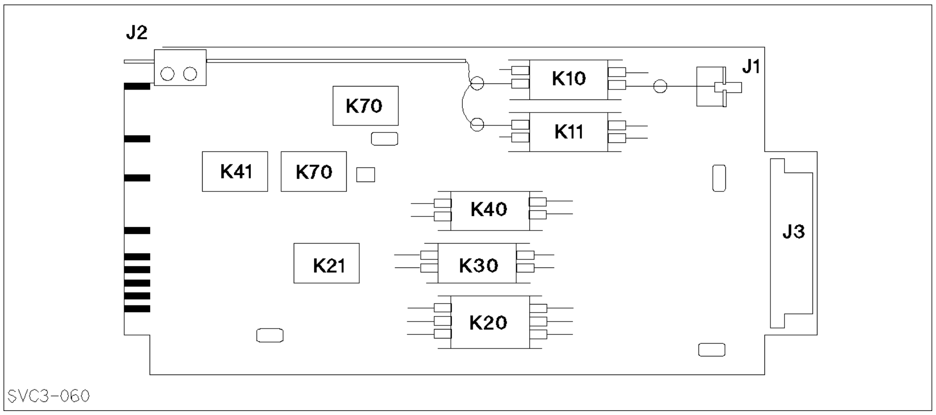


Figure 4-9. Part Locations of SMU Port Board—96-pin SWM

Table 4-11. Replaceable Parts of SMU Port Board—96-pin SWM

Reference Designation	HP Part Number	Quantity	Description
K10	0490-1629	1	RELAY-REED 2A
K11	0490-1631	1	RELAY-REED 2B
K20	0490-1630	1	RELAY-REED 3A
K21	0490-1372	1	RELAY 2C
K30	0490-1629	1	RELAY-REED 2A
K40	0490-1629	1	RELAY-REED 2A
K41	0490-1372	1	RELAY 2C
K70	0490-1372	2	RELAY 2C

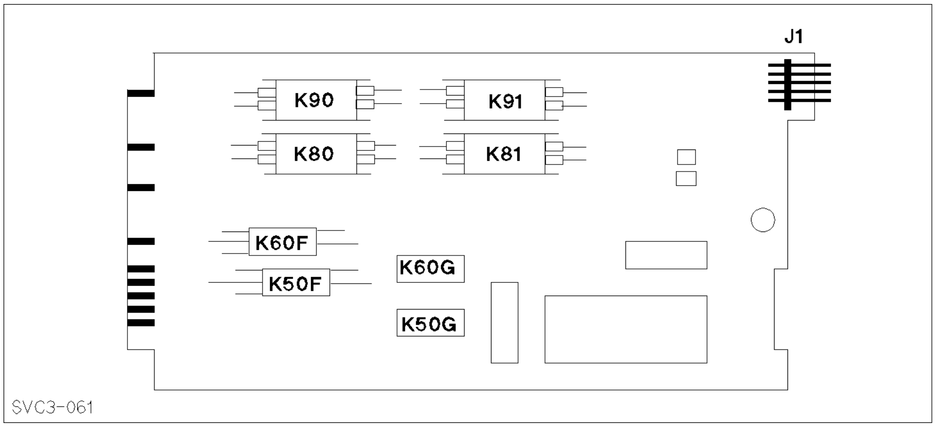


Figure 4-10. Part Locations of AUX Port Board—96-pin SWM

Table 4-12. AUX Port Board Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
K50F	0490-1445	1	RELAY 1M LOW EMF
K50G	0490-0240	1	RELAY—REED 1A
K60F	0490-1445	1	RELAY 1M LOW EMF
K60G	0490-0240	1	RELAY—REED 1A
K80	0490-1629	1	RELAY—REED 2A
K81	0490-1631	1	RELAY—REED 2B
K90	0490-1629	1	RELAY—REED 2A
K91	0490-1631	1	RELAY—REED 2B

Interconnection Cable Assembly Replaceable Parts

Figure 4-11 shows the assembly locations of the interconnection cable assembly. Table 4-13 lists the replaceable parts for the interconnection cable assembly (HP part number 04085-61684).

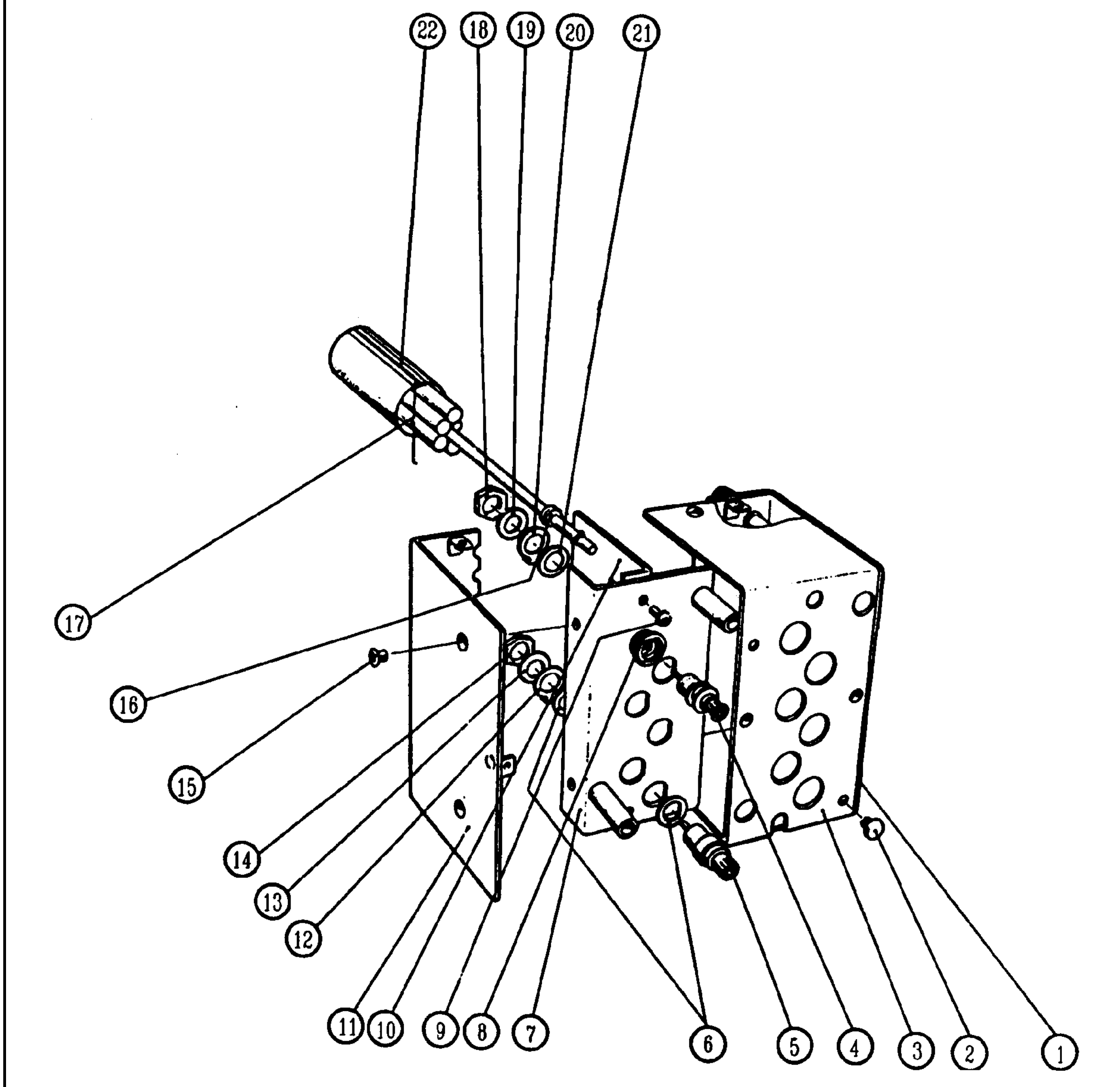
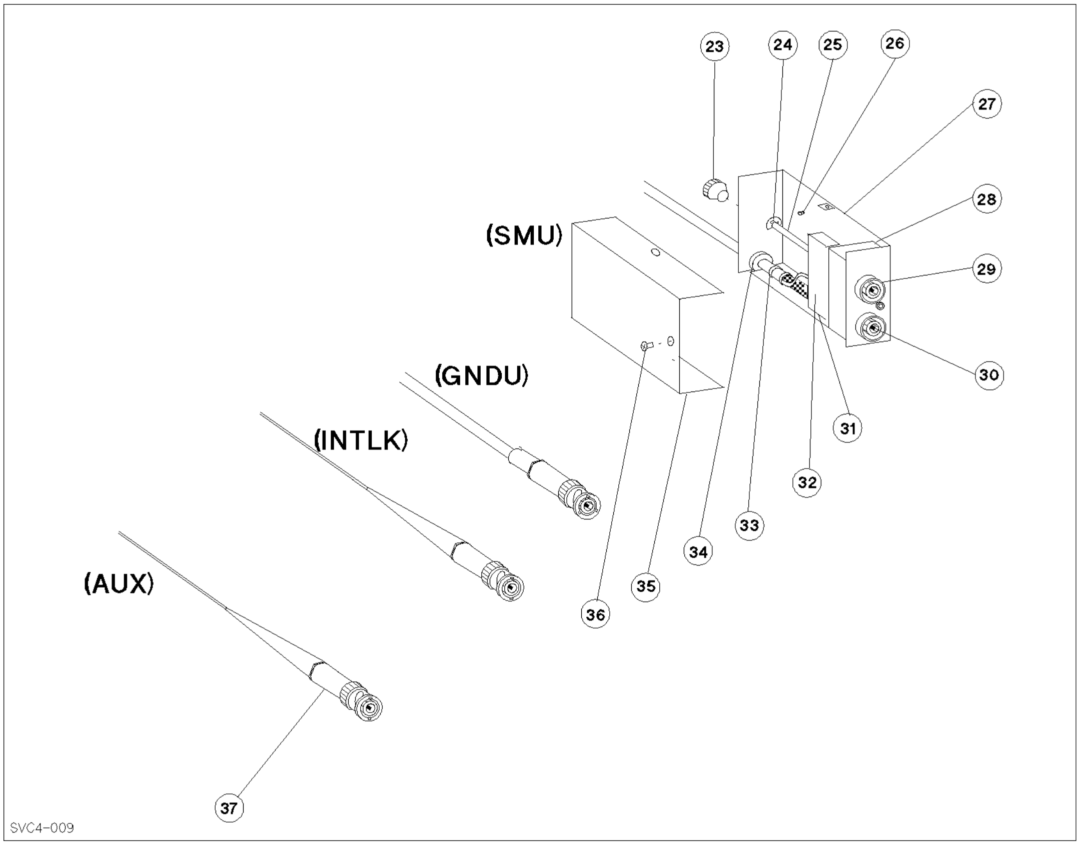


Figure 4-11. Interconnection Cable Assembly Locations (1 of 2)



Interconnection Cable Assembly Locations (2 of 2)

Table 4-13. Interconnection Cable Assembly Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
1	04085-00290	1	COVER
2	0403-0026	2	GLIDE NYLON FITS
3	04085-00250	1	COVER
4	1250-1798	1	CONN—RF BNC
5	1250-1848	4	CONN—RF TRIAXIAL
6	16057-40001	8	INSULATOR
7	04085-00150	1	CHASSIS
8	16047-40002	1	INSULATOR
9	2360-0115	2	SCR—MACH 6-32
10	04085-00253	1	ANGLE

Table 4-13. Interconnection Cable Assembly Replaceable Parts (continued)

Reference Designation	HP Part Number	Quantity	Description
11	04085-00252	1	COVER
12	5000-4218	4	TERMINAL
13	Included in 21	—	—
14	Included in 21	—	—
15	2360-0190	4	SCR—MACH 6-32
16	0400-0002	2	GROMMET—ROUND
17	8120-4939	4	CABLE (400 cm)—TRIAXIAL 105 Ω for SMU1–4
	8120-4938	2	CABLE (400 cm)—TRIAXIAL 105 Ω for GNDU
	8120-0102	1	CABLE (170 in.)—COAXIAL 50 Ω for INTLK
18	2950-0001	1	NUT—HEX-DOUBLE CHAMFER
19	2190-0016	1	LOCK WASH INTERNAL TOOTH
20	0360-1190	1	TERMINAL—SOLDER LUG
21	3050-0789	1	WASH—FLAT NONMETALLIC
22	0890-1475	1	TUBE—ZIPPER (3200 mm)
23	0370-2446	1×4	KNOB—CONCENTRIC
24	0510-0305	1×4	E RING
25	04142-24041	1×4	Screw (Shaft)
26	6960-0016	2×4	Plug-Hole
27	04085-04041	1×4	Bottom Cover
28	04085-00141	1×4	Chassis
29	5040-3342	2×4	Stud
30	16146-40002	2×4	Insulator
	5000-4218	2×4	Terminal
	1250-1848	2×4	Triax Connector
31	04142-00642	1×4	Shielding
32	04142-00641	1×4	Shielding
33	1400-0493	1×4	Cable Tie
34	0400-0306	1×4	Grommet
35	04085-04042	1×4	Top Cover
36	0515-0914	3×4	SCR—MACH 6-32
37	04085-61682	1×4	Cable Assy (AUX)

SWC and SWM Field Service Inventory Contents

Table 4-14 lists the contents of Field Service Inventory (HP part number 04085-65902) for SWC and SWM.

Table 4-14. SWC and SWM Field Service Inventory Contents

No.	HP Part Number	Quantity	Description
1	04084-61601	1	CABLE ASSY (Long)
2	04084-61602	1	CABLE ASSY (Short)
3	04085-61602	1	CONTROL BUS CABLE ASSY
4	04085-61603	1	CONTROL BUS CABLE ASSY
5	04085-61604	1	CONTROL BUS CABLE ASSY
6	04085-61605	1	CONTROL BUS CABLE ASSY
7	04085-61606	1	CABLE ASSY
8	04085-61608	1	WIRE ASSY
9	04085-61609	1	WIRE ASSY
10	04085-61610	1	WIRE ASSY
11	04085-61611	1	WIRE ASSY
12	04085-61682	1	CABLE ASSY (AUX)
13	04085-61661	1	CABLE ASSY
14	04085-61671	1	CABLE ASSY
15	1540-0863	1	PARTS CASE—PLASTIC
16	04084-66502	1	POWER SUPPLY BOARD ASSY
17	04085-61021	1	SMU CONN ASSY
18	04085-61022	1	CMS CONN ASSY
19	04085-61003	1	LOGIC CONN ASSY
20	16321-66511	1	VFP TIMER BOARD ASSY
21	04084-66503	1	DISPLAY BOARD ASSY
22	04084-66504	1	HP-IB BOARD ASSY
23	04085-66549	1	MATRIX OPEN RELAY BOARD ASSY
24	04085-66561	1	TEST ADC BOARD ASSY
25	04085-66562	1	SMU PORT BOARD ASSY
26	04085-66563[1]	1	TEST RELAY BOARD ASSY
27	04085-66564	1	CMS PORT BOARD ASSY
28	04085-66555	1	CONTROL LOGIC BOARD ASSY
29	16320-66551	1	PIN BOARD ASSY
30	04084-66531	1	MPU BOARD ASSY

1 04085-66570 can be used instead of 04085-66563.

Table 4-14. SWC and SWM Field Service Inventory Contents (continued)

No.	HP Part Number	Quantity	Description
31	0490-1629	2	RELAY—REED 2A
32	0490-1630	2	RELAY—REED 3A
33	0490-1632	2	RELAY—REED 2C
34	0490-1633	2	RELAY—REED 1C
35	16320-61601	1	CABLE ASSY (Including CONTACTS)
36	3101-2216	1	SW—PB DPDT
37	0360-2066	10	CONTACT
38	1990-0486	1	LED—RED
39	1990-0487	1	LED—YELLOW
40	1990-0665	1	LED—RED
41	2110-0202	1	FUSE 0.5 A 250 V
42	2110-0304	2	FUSE 1.5 A 250 V
43	2110-0360	1	FUSE 0.75 A 250 V
44	2110-0381	1	FUSE 3 A 250 V
45	3101-0136	1	SW—SENS SPDT
46	5041-0564	1	KEY-Q-CORP: WHITE
47	5060-9436	1	SW—PB
48	04192-40002	1	COUPLER
49	16291-90011	1	OPERATION NOTE
—	16291-60122	1	CARRYING CASE

A

System Cabinet Information

This appendix contains general system cabinet information, including system cabinet description, identification information, and specifications. Figure A-1 shows the system cabinet.

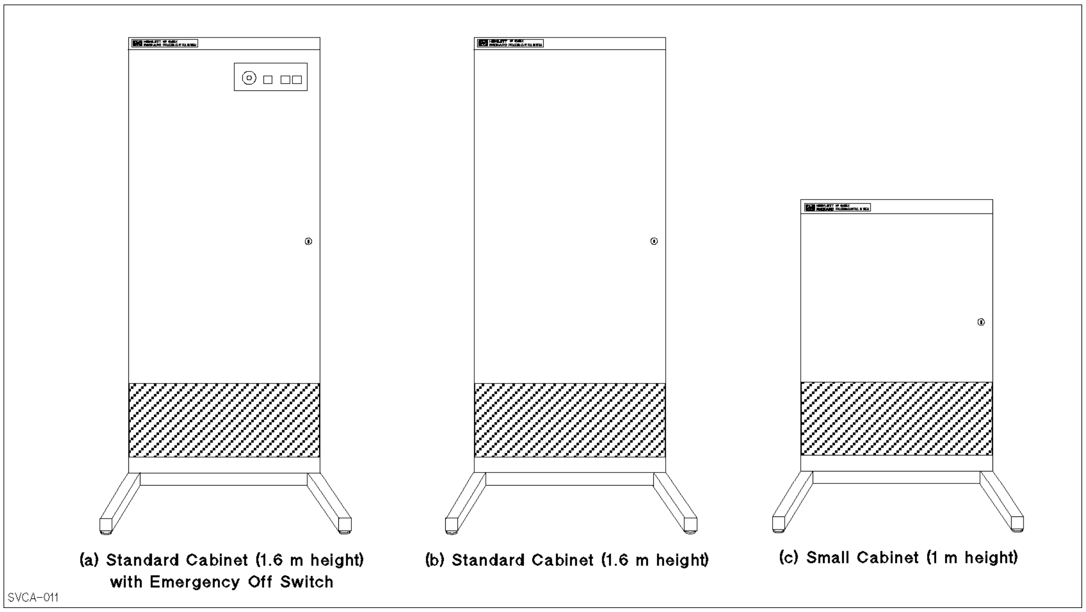


Figure A-1. System Cabinet Overview

The system cabinet is an aluminum and steel sheet metal cabinet, which has a mechanical design based on Electronic Industries Association (EIA) standards. The basic enclosure contains a base, support columns, side panels, a cable entry panel, front and rear extender feet, and front and rear doors. Standard color scheme for the cabinet series is HP dove gray, except for the side panels and rear door, which are HP French gray.

Hewlett-Packard supplies two heights of system cabinet: 1600 mm and 1000 mm. These cabinets have the same width and depth.

The cabinet has usable depth of 742 mm (29 in) and has mounting strips to receive equipment with EIA standard 483 mm (19 in) mounting flanges. The mounting strips run the entire height of the equipment bay in front and rear.

The front and rear doors have locks to prevent access by unauthorized persons. For convenience, one key fits the locks on both cabinet doors.

Support rails are provided for positioning and supporting instruments along the entire depth. The rails come in pairs and are mounted horizontally inside the cabinet on the mounting strips.

Each cabinet is equipped with smooth-rolling heavy-duty casters to facilitate cabinet movement over short distances as required during installation, maintenance, or relocation to another test area.

A Power Distribution Unit (PDU), which is located at the bottom of the system cabinet, is a primary unit for controlling and distributing ac power.

Hewlett-Packard supplies two types of power distribution unit (PDU). One type has a main power switch function, and the other type has a main power switch function plus an emergency off function.

Specifications

System Cabinet

Figure A-2 shows the dimensions of the system cabinet. The weight of the system cabinet with no instruments installed is approximately 100 kg (220 lb) for a standard cabinet (1600 mm height); 80 kg (176 lb) for a small cabinet (1000 mm height).

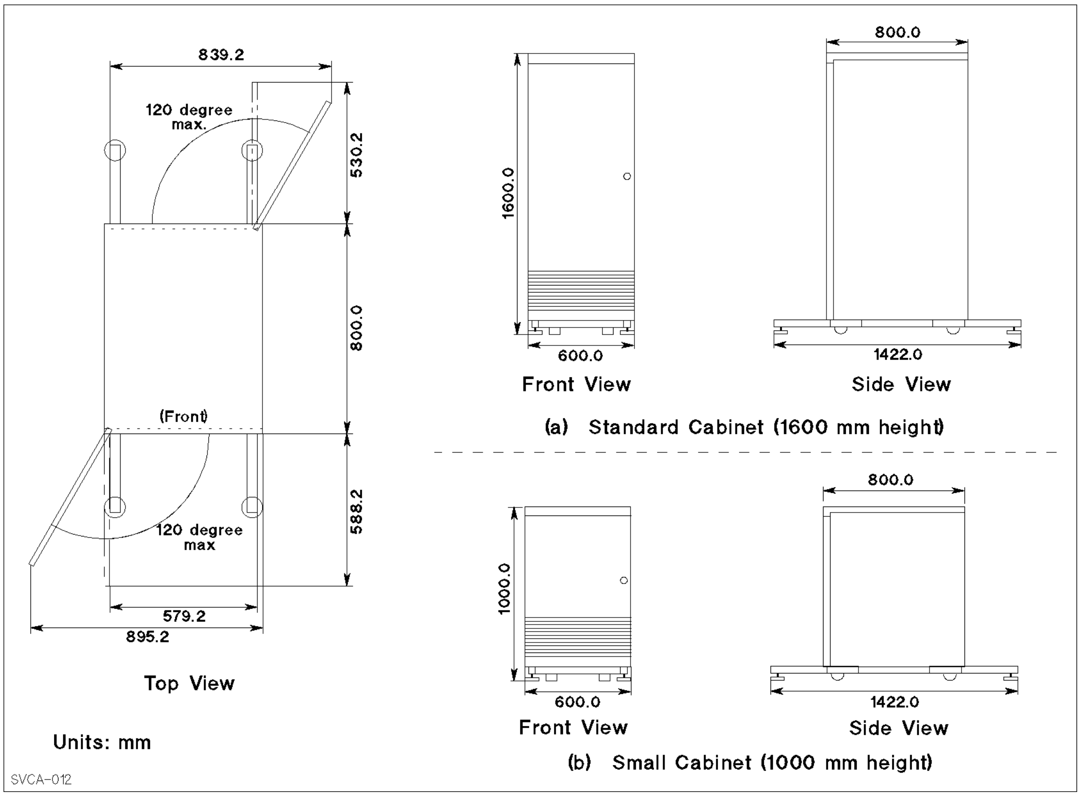


Figure A-2. Dimensions of System Cabinet

Power Distribution Unit (PDU)

The PDU gets ac power from a power switchboard or outlet at your site and distributes ac power to instruments in the system cabinet. The PDU also passes or turns off ac power to the instruments.

Hewlett-Packard provides two types of PDU: one has only the functions above, and the other also has the emergency off function, which must be used with emergency off unit.

PDU without Emergency Off Function

Hewlett-Packard provides two PDUs: HP part number 04062-60201 for 100 or 120 Vac line and HP part number 04062-60202 for 220 or 240 Vac line. The PDU can supply ac power to up to nine instruments. Table A-1 shows the maximum current for each PDU. Figure A-3 shows the circuit diagram of the PDU.

Table A-1. Maximum Current for PDU (Without Emergency Off Unit)

Line Voltage	HP Part Number	Total Maximum Current	Maximum Current of an Outlet
100 V or 120 V	04062-60201	20 A	6 A/each
220 V or 240 V	04062-60202	10 A	6 A/each

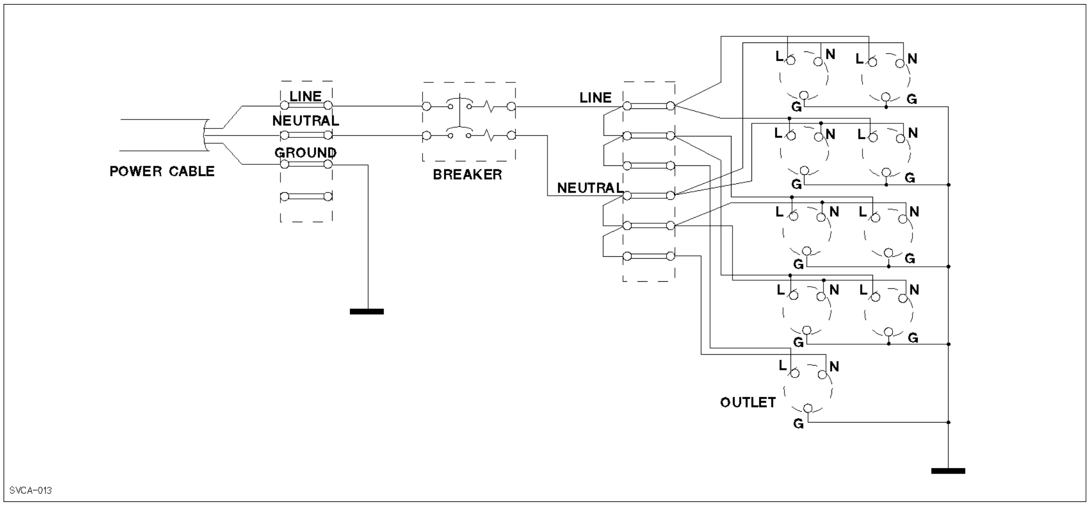


Figure A-3. Circuit Diagram of the PDU

PDU with Emergency Off Function

Hewlett-Packard provides four PDUs: 100, 120, 220, and 240 Vac lines. The PDU can supply ac power to up to twelve instruments. Table A-2 shows maximum current for each PDU. Figure A-4 shows the block diagram of the emergency off unit and PDU.

The main breaker for the 100 Vac line PDU has a ground-fault circuit interrupter (GFCI) function, too. If earth leakage current in the system cabinet exceeds 15 mA, the main breaker turns off.

Table A-2. Maximum Current for PDU with Emergency Off Unit

Line Voltage	HP Part Number	Total Maximum Current	Maximum Current of Each Outlet
100 Vac	04062-60203	30 A	6 A or 10 A[1]
120 Vac	04062-60204	24 A	6 A or 10 A[1]
220 Vac	04062-60205	15 A	6 A
240 Vac	04062-60206	15 A	6 A

1 Actual maximum current is printed on receptacle panel for PDU.

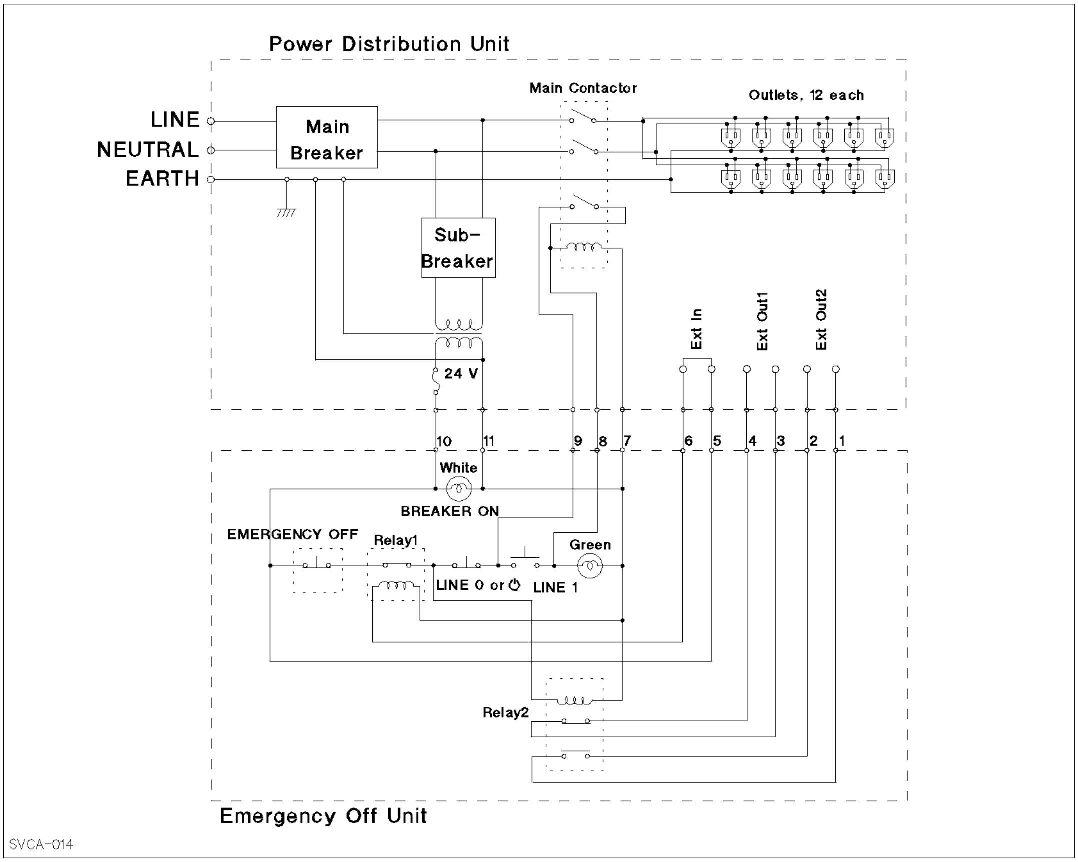


Figure A-4. Block Diagram of Emergency Off Circuit and PDU

Accessories

Several accessories are available that can be installed at a later date.

Anti-tip Leg

Four anti-tip legs stabilize the system cabinet.

Table A-3. Anti-tip Leg

Item	HP Part Number	Quantity
Anti-tip Leg	04062-29001	4

Hour Meter

An hour meter is used to measure the total time that the power is turned on.

Table A-4. Hour Meters and Cables

Line Voltage	HP Part Number of Hour Meter	HP Part Number of Cable[1]
100 V	1010-0070	04062-61602
120 V	1010-0101	
220 V	1010-0102	04063-61601
240 V	1010-0103	

1 This cable is used to connect the hour meter to the outlet on the PDU.

Instrument Support Rails

Support rails are used to mount the HP 4084B SWC, HP 4142B DCS, HP 4280A CMU, or HP 4284A CMU84. The following table lists the required items to mount the instruments.

Table A-5. Support Rails

Item	HP Part Number	Quantity
Support Rail Right	09480-01252	1
Support Rail Left	09480-01253	1
Screw 10-32	2680-0103	4
Flat Washer	3050-0226	4
Lock Washer	2190-0577	4
Nut-Sheetmetal	0590-0804	4

Slide Rails

Slide rails are used to mount the HP 4084B SWC. The following table lists the required items to mount the instrument.

Table A-6. Slide Rails

Item	HP Part Number	Quantity
Slide Rail Kit	1494-0076	1
Screw-Flat M5L16	0515-1021	4
Screw M4L8	0515-0910	8
Screw-Flat 10-32	2680-0119	8
Nut-Sheetmetal	0590-0804	8

Rack Flanges

The rack flanges are used to fasten an instrument to the system cabinet. The following table lists the rack flanges and the screws for each instrument.

Table A-7. Rack Flanges

Instrument	Rack Flanges		Screw[1]	
	HP Part Number	Quantity	HP Part Number	Quantity
HP 4084B SWC	5021-8462	2	0515-1114	6
HP 4142B DCS	04062-01281	2	0515-1013	6
HP 4280A CMU	04062-01283	2	0515-1013	8
HP 4284A CMU84	04062-01283	2	0515-1013	8

1 These screws are used to attach the rack flanges to the instrument.

Blank Panels

The blank panels with standard mounting holes are HP mint gray.

Table A-8. Blank Panels

Product Number	Height	Product Number	Height
HP 12680B	4.5 mm (1.75 in)	HP 12684B	222 mm (8.75 in)
HP 12681B	89 mm (3.5 in)	HP 12685B	267 mm (10.5 in)
HP 12682B	133 mm (5.25 in)	04062-00280	133 mm (5.25 in)[1]
HP 12683B	178 mm (7 in)	04062-00286	60 mm (2.36 in)[1]

1 This panel has two openings for passing through the measurement cables. Grommet (HP part number 0400-0163, units: cm) must be attached to the edge of the openings.

Screws for Mounting Strips

To fasten a rack flange or blank panel to the mounting strips of the system cabinet, use the following screw and washers.

Table A-9. Screws for Mounting Strips

Item	HP Part Number
Flathead Screw	2680-0119
Insert Washer	3050-0248
Cup Washer	3050-0007

Installation

This section contains cabinet installation information.

Moving the System Cabinet

The system cabinet is equipped with casters that let you move the cabinet to the final location. When moving the system cabinet, observe the following precautions:

Warning **When moving the system on its casters, do not allow the casters to become caught on cables or debris, or in cracks in the floor. The cabinet's high center of gravity and the momentum caused by pushing or pulling can cause the system to tip over, resulting in equipment damage and possible serious injury to personnel.**

1. Before moving the system from the receiving area, be sure to verify the route to the final site. Check that there is enough vertical and horizontal clearance through all doors, passageways, and aisles. All floors and elevators must also be capable of supporting the combined weight of the system and personnel.
2. If the system must be lifted off the floor, use a hoist or a similar lifting device that attaches to the lifting fixtures mounted on top of the cabinet (these fixtures are accessible when the cabinet's top cover is removed).

Floor Loading Requirements

If a raised floor has been constructed for the routing of cables beneath the floor surface, it is the customer's responsibility to calculate floor loading. When calculating floor loading, include the weight of cabinet, equipment and cables, interface, and office equipment. Include the weight of the raised floor when calculating primary floor loading.

Since the weight of the equipment in the cabinet is concentrated over the casters, the floor must withstand a concentrated load of 21.09 kilograms per square centimeter (300 pounds per square inch). This requirement is based on calculations for the heaviest equipment cabinet. Note that the anti-tip extender legs are load-bearing only when equipment extends from the cabinet proper.

Installing Anti-tip Legs

Warning **Once the anti-tip legs are installed, they should not be removed unless absolutely necessary. If the anti-tip legs are removed, do not extend any instrument from the cabinet. Failure to observe this warning can result in serious injury to personnel and damage to equipment.**

Caution Fully raise the leveling feet if the cabinet must be moved after the anti-tip legs have been installed.

The extendable anti-tip legs should be installed *before* equipment is installed in the cabinet and *after* the cabinet is located at its permanent site. Install the anti-tip legs as follows:

1. Remove the four anti-tip legs from the cabinet crate.
2. Raise the leveling feet on the anti-tip legs as high as possible.
3. Install two anti-tip legs at the lower front sides of the cabinet.
4. In the same manner, install two anti-tip legs at the lower rear sides of the cabinet.
5. Lower the leveling feet until they are in contact with the floor.

Mounting Strips

Cabinets have mounting strips on each side of the equipment panels, both in front and in the rear. Figure A-5 shows the hole spacing in the mounting strips, and the available equipment space.

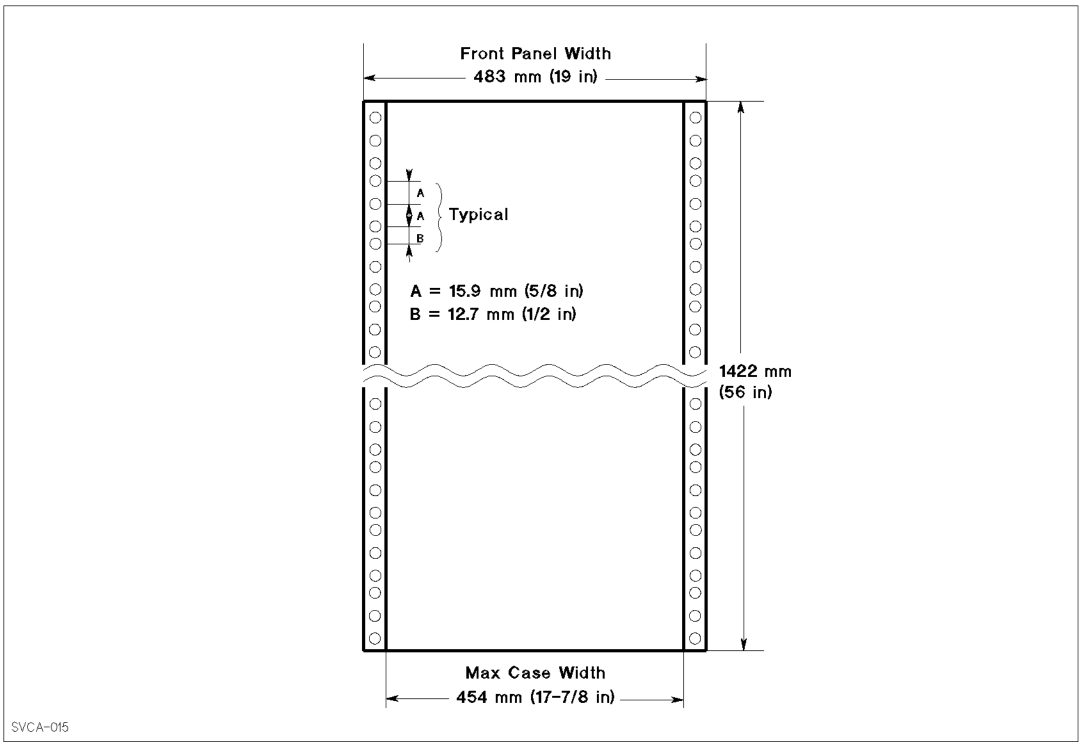


Figure A-5. Mounting Strips

Installing Instruments

To install an instrument in the cabinet, refer to Figure A-6 and proceed as follows:

1. Insert a 10-32 nut-sheetmetal at the side mounting strip holes where the instrument support rails will be positioned.
2. Attach two instrument support rails and secure the rails with 10-32 screws as shown in Figure A-6.
3. Insert a 10-32 nut-sheetmetal at the front mounting strip holes that match the mounting flange holes of the instrument.

4. Secure the mounting flanges of the instrument to the mounting strips with 10-32 screws. Instruments should be installed from top to bottom to facilitate handling.

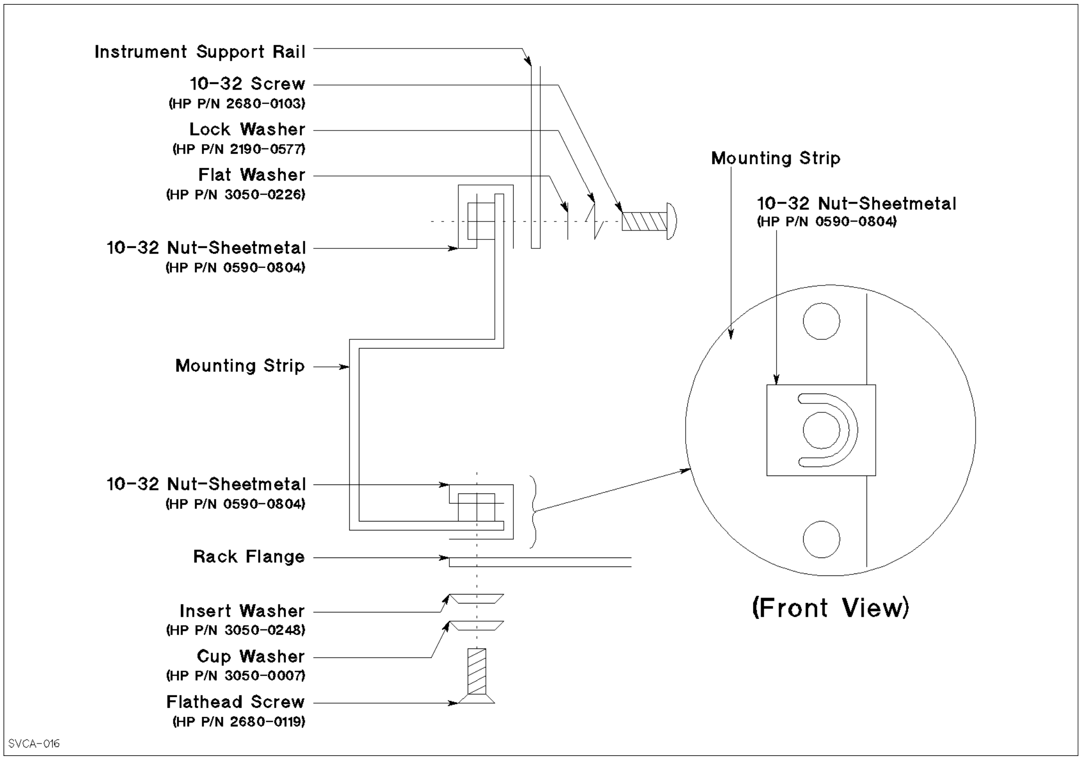


Figure A-6. Section View of Top Left of Cabinet

Cable Access

A cable entry is located on the rear panel.

Hour Meter (Only for Standard Cabinet without Emergency Off Unit)

An hour meter can be installed to the rear panel of the system cabinet. Use the following procedure to install the hour meter:

1. Insert the hour meter into the opening of the rear panel from the outside.
2. Fasten the hour meter using the attachment, washers, and nuts.
3. Connect the power cable (HP part number 04062-61602 for 100 V/120 V, HP part number 04063-61601 for 220 V/240 V) to the hour meter.
4. Solder the ground line (green/yellow wire) of the power cable to the ground terminal on the rear panel.
5. Connect the male plug of the power cable to an outlet on the PDU.

Blank Panels

Blank filler panels are 1.57 mm (0.062 in) thick aluminum formed to the standard 4.7 mm (0.187 in) distance from the panel mounting flange. The panels are supplied with Electronic Industries Association/International Electrotechnical Commission (EIA/IEC) mounting holes and attaching parts.

The mounting parts are:

- Flathead Screw, no.10-32, 0.625 inch (HP Part Number 2680-0106)
- Cup Washer, no.10 (HP Part Number 3050-0007)
- Insert Washer, no.10 (HP Part Number 3050-0248)

Removing Doors

Cabinet doors are equipped with hinge pins for fast removal and replacement. Remove doors as follows:

1. Unlock the door and swing it fully open.
2. Support the weight of the door with one hand, grasp the lower hinge pin with your other hand, and pull the hinge pin out.
3. Support the weight of the door with one hand, grasp the upper hinge pin with your other hand, and pull the hinge pin out.
4. Grasp the door and lift it up until it is free of the cabinet, then pull the door away from the cabinet.

Emergency Off System (Standard Cabinet Only)

The emergency off system can automatically or manually stop the supply of electric power to the system instruments under emergency conditions. For example, if an earthquake occurs and the emergency off switch is pressed, electric power supplied to the system instruments stops and a potential fire caused by an electric short circuit can be prevented.

A variety of emergency off systems can be designed depending on the customer's needs. Hewlett-Packard, however, only provides the function to turn off the system instruments of the HP 4062 system. Customers are responsible for designing the emergency off system including the HP 4062 system according to the customer's needs.

The HP 4062 system with the standard system cabinet (1600 mm height) has an *emergency off unit* at the top of the cabinet as shown in Figure A-7. The emergency off unit has a red, circular push-switch named "EMERGENCY OFF." Pushing the emergency off switch stops the supply of electric power to the system instruments. Once the emergency off switch is pushed, the switch is locked to the pushed condition. To release the locked emergency off switch, you must use a *mechanical key*.

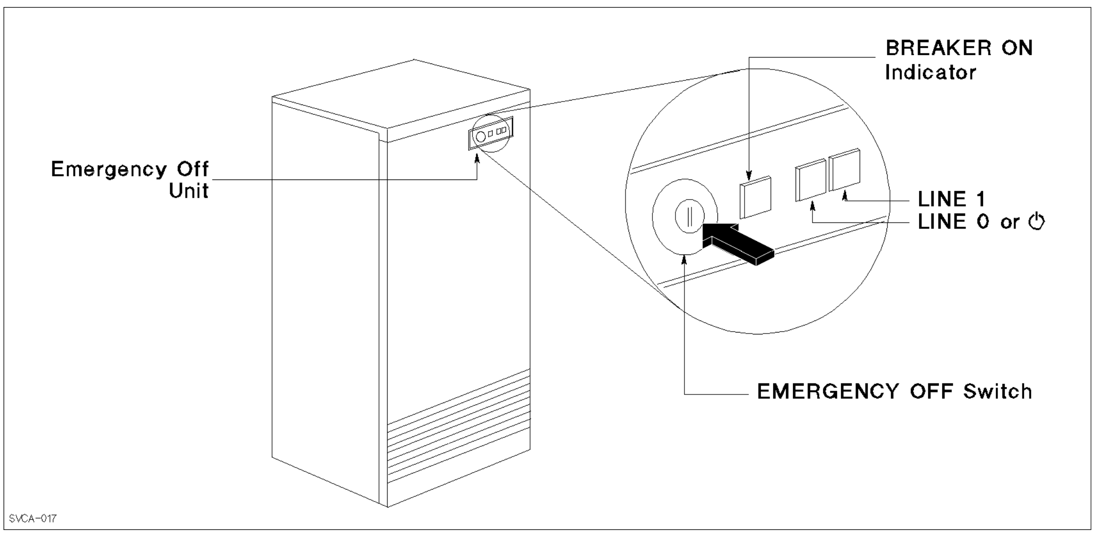


Figure A-7. Emergency Off Unit in Standard System Cabinet

Note that small system cabinet (1000 mm height) has no emergency off unit.

This section provides information on the emergency off unit and power distribution unit for designing the emergency system according to the customer's needs. Included are:

- Circuit diagram and its operation for the emergency off unit and power distribution unit.
- I/O interface (external in/out terminals) specifications of the emergency off unit.
- Example design for an emergency lamp.

Block Diagram and Operation of the Emergency Off Circuit

Figure A-8 shows the block diagram of the emergency off circuit. If your system has the 100 Vac power line option, the main circuit breaker also has a ground-fault circuit interrupter (GFCI) function, which senses the earth leakage current. Note that for the relays in the figure, alternating current as well as direct current switches the contacts in the relay.

The Ext In terminals are shorted using a conductor at the factory.

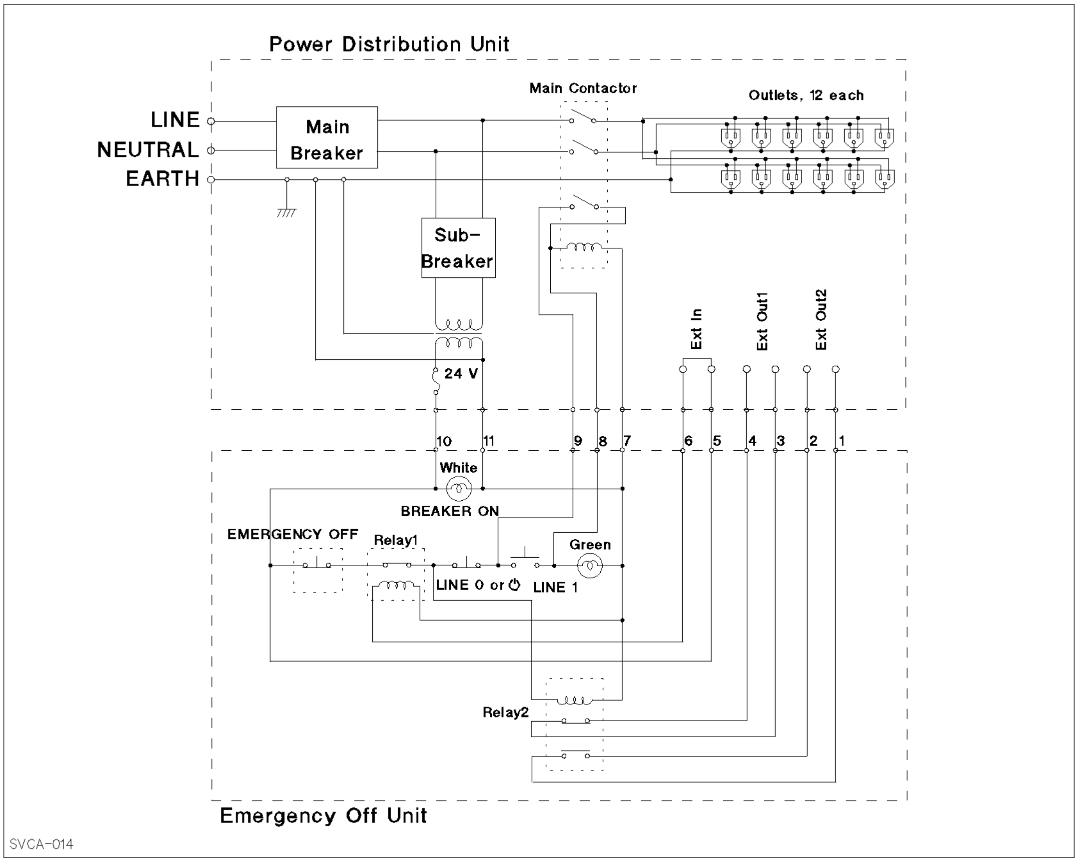


Figure A-8. Block Diagram of Emergency Off Circuit

Switching on the main circuit breaker and sub-circuit breaker turns on the BREAKER ON indicator (white), but the main contactor switch does not close. The figure shows this condition. When the LINE 1 switch closes, the coil of the main contactor is activated and the main contactor switch closes. The LINE 1 indicator (green) also turns on. Under these conditions, the electric power is supplied to the system instruments.

Pressing the LINE 0 or ⏻ switch stops the current through the coil of the main contactor, and the main contactor opens. This stops the electric power to the system instruments.

When the EMERGENCY OFF switch is pressed and its contacts open, the current through the coil of the main contactor stops and the main contactor opens. This stops the electric power to the system instruments.

At the same time, the current through the coil of Relay2 flows and one contact opens and the other closes in Relay2. The Ext Out1, which is normally in the closed state, is opened, and the Ext Out2, which is normally in the open state, is closed.

Opening the Ext In terminals has the same result as pressing the EMERGENCY OFF switch. Opening the Ext In terminals stops the current through the coil of Relay2, and one contact opens and the other closes. Then the current through the coil of the main contactor stops, the main contactor opens, and the electric power to the system instruments stops.

Table A-10 shows the conditions for the normal operation.

Table A-10. Conditions for Normal Operation

Operation	Results		
	Power for System Instruments	**Ext Out 1 (NC[1])**	**Ext Out 2 (NO[2])**
Pressing LINE 1	Supply	Close	Open
Pressing LINE 0	Stop		
Pressing EMERGENCY OFF		Open	Close
Opening External In			

1 NC stands for normally closed.

2 NO stands for normally open.

I/O Specifications

There are four points of I/O interface in the power distribution unit (PDU) that you must note. The following shows the I/O specification:

Outlets for instruments	Maximum current: 6 A or 10 A each (printed on receptacle panel for PDU.)
Ext In	Steady current: 56±11.2 mA (50 Hz); 50±10 mA (60 Hz) at 24 Vac Transient current: 2 – 3 times that of the steady current
Ext Out 1 and Out 2	Maximum current: 3 A at 250 Vac

Example Design for an Emergency Lamp

The following describes a simple example for designing the emergency off system. The operation is as follows:

> After pressing the EMERGENCY OFF switch, the electric power stops being supplied to the system instruments and the emergency lamp turns on.

To accomplish this condition, obtain an emergency lamp that operates on 120 Vac of electric power. The Ext Out 2 terminals (normally open) turn the emergency lamp on or off. The NEUTRAL side of the 120 Vac outlet is connected to a terminal of the emergency lamp, the LINE side of the outlet is connected to one terminal of the Ext Out 2, and the other terminal of the Ext Out 2 is connected to the other terminal of the emergency lamp. Figure A-9 illustrates the connections. Note that the electric power *must not* be supplied from an outlet of the power distribution unit of the system cabinet, because the electric power of the system instruments through the PDU stops after the emergency off system is activated to shut off power.

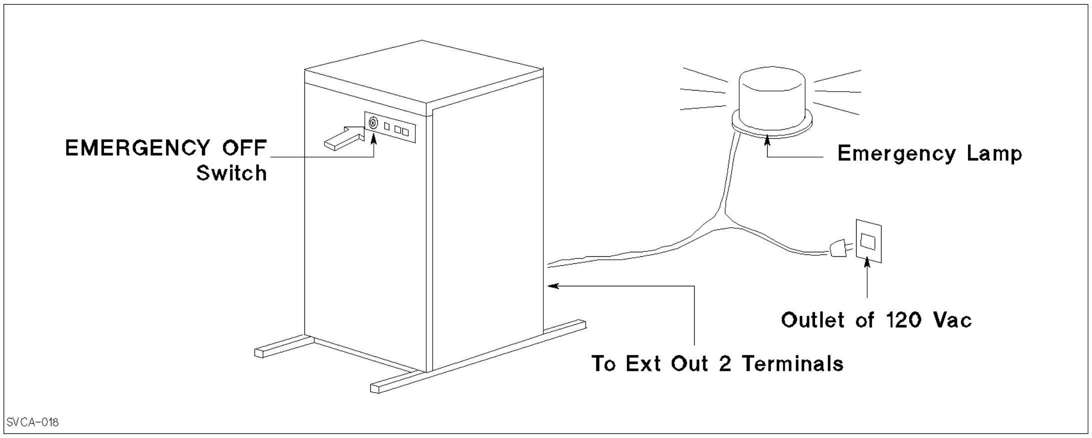


Figure A-9. An Example of Emergency Off System

Testing System Cabinet

This section describes how to perform the system cabinet tests to check the function of emergency off units and power distribution units. You must check functions of the system cabinet as in the following cases:

- After complete system hardware installation
- After repairing Emergency off unit or PDU
- When you execute 4062 system performance verification

Caution

You will turn ON/OFF the power of the HP 4062C/UX system cabinet during this testing. To avoid any computer related trouble, you should shut down a system controller before executing this test if it is connected to the system cabinet outlet.

Testing Emergency Off Unit and Power Distribution Unit (PDU)

If your system is not furnished with an emergency off unit, skip this test.

This test checks the following items:

- □ Operation of the ground-fault circuit interrupter (GFCI)
- □ Operation of BREAKER ON indicator
- □ Operation of LINE switches
- □ Operation of EMERGENCY OFF switch
- □ Operation of Ext In terminals
- □ Operation of Ext Out 1 and 2 terminals

Use the following procedure to check the test items above:

1. Confirm the main circuit breaker or GFCI in the system cabinet and the line switches of all the system instruments are set to OFF. The main circuit breaker or GFCI is located at the bottom of the rear panel.
2. Connect the main power cable to the power source at your site.
3. Turn on the main circuit breaker or GFCI in the system cabinet.
4. If your PDU is furnished with a GFCI, press the red push switch labeled “Breaker Test Switch” to force earth leakage current. The GFCI indicator should extend out to show the earth leakage condition.

   To reset the GFCI indicator, use the following procedure:

   a. Move the switch lever to OFF. The GFCI indicator should retract.

   b. Move the switch lever to ON.
5. Turn on the circuit breaker for the emergency off unit. The “BREAKER ON” indicator (white) should turn on.
6. Turn on and off one of the system instruments. Note that the selected instrument must originally function properly. The instrument should not turn on.

7. Press the LINE 1 switch. The LINE “1” indicator (green) should turn on.
8. Turn on one of the system instruments. Note that the selected instrument must originally function properly. The instrument should turn on.
9. Check conductivity of the Ext Out 1 and 2 terminals by using a resistance meter. The resistance between the Ext Out 1 terminals should be near 0 Ω, and the resistance between the Ext Out 2 terminals should indicate infinity.
10. Press the LINE 0 switch after turning on a system instrument. The instrument should turn off.
11. Press the LINE 1 switch. The instrument should turn on.
12. Press the EMERGENCY OFF switch. The instrument should turn off.
13. Check conductivity of the Ext Out 1 and 2 terminals in the emergency off condition by using a resistance meter. The resistance between the Ext Out 1 terminals should indicate infinity, and the resistance between the Ext Out 2 terminals should be near 0 Ω.
14. Press the LINE 1 switch. Check that the green indicator of the LINE 1 switch does not turn on.
15. Set the LINE switch of the instrument to the OFF condition.
16. Release the lock of the EMERGENCY OFF switch by using the key.
17. Turn on and off one of the system instruments. Note that the selected instrument must originally function properly. The instrument should not turn on.
18. Press the LINE 1 switch and turn on one of the system instruments.
19. Loosen the Ext In terminals and remove the shorting lead connected between the Ext In terminals. The instrument should turn off.
20. Turn off the instrument and the circuit breaker for the emergency off unit.
21. Reinstall the shorting lead to the Ext In terminals.
22. Turn on the circuit breaker for the emergency off unit.
23. Press the LINE 1 switch.

Testing Power Distribution Unit (PDU)

If your system is furnished with an emergency off unit, skip this test.

This test checks the following item:

□ Operation of circuit breaker

Use the following procedure to check the test item above:

1. Confirm the power switch of the system cabinet and the line switches of all the system instruments are set to OFF. The power switch of the system cabinet is located at the right-front of the PDU. See the *Operation Manual* of each instrument for the location of each line switch.
2. Connect the main power cable to the power source at your site.
3. Turn on and off one of the system instruments. Note that the selected instrument must originally function properly. The instrument should not turn on.
4. Set the SYSTEM ON/OFF switch of the system cabinet to ON.
5. Turn on one of the system instruments. Note that the selected instrument must originally function properly. The instrument normally should turn on.

Note

After the inspection, leave the LINE ON/OFF or POWER ON/OFF switch of each instrument to ON to warm up the system instruments.

Troubleshooting Power Distribution Unit (PDU)

This section contains information and instructions for troubleshooting and repairing the Power Distribution Unit (PDU) and emergency off unit in the HP 4062 system cabinet. Use the following procedures when a test of the system cabinet fails.

Warning

Several procedures described in this chapter are performed with power applied and protective covers removed. Only trained service personnel aware of the hazards involved should perform such procedures. Where troubleshooting can be performed without power applied, turn the power off. After repairs are completed, make sure all safety features are intact and are functioning properly, and that all necessary parts are connected to their protective grounds.

1. Check the fuse on PDU rear panel. If the fuse is blown, replace the fuse.
2. Disconnect the cable assembly that connects the PDU to emergency off unit.
3. Check resistance of the disconnected cable assembly. If any cables in the cable assembly are opened, replace the cable assembly.
4. Turn on the main circuit breaker or GFCI, and circuit breaker for the emergency off unit.
5. Check the voltage between pin 10 and 11 on the connector of PDU, which is for connecting to the cable assembly. Refer to the following figure for pin location of the connector. When PDU works correctly, the voltage should be about AC 24V. If not, replace the PDU.
6. Turn off all circuit breakers.
7. Remove the emergency off panel from the system cabinet. Then remove the emergency off board from the emergency off panel. Do not remove connectors.
8. Reconnect the cable assembly between PDU and the emergency off board.
9. Turn on all circuit breakers and LINE 1 switch. Confirm that the "BREAKER ON" indicator turns on. If not, replace the emergency off panel.
10. Check the voltage between pin 7 and 8, and pin 7 and 9 on the connector of the emergency off board (soldering side). When the emergency off board works correctly, the voltage should be about AC 24V at each point. If not, replace the emergency off board.
11. Check the resistance between pin 3 and 4, and pin 5 and 6 on the connector of the emergency off board (soldering side). When the emergency off board works correctly, the resistance should be near 0 Ω for both cases. If not, replace the emergency off board.
12. Press the EMERGENCY OFF switch.
13. Check the resistance between pin 1 and 2, and pin 3 and 4 on the connector of the emergency off board (soldering side). When the emergency off board works correctly, the resistance between pin 1 and 2 should be near 0 Ω and the resistance between pin 3 and 4 should indicate infinity. If not, replace the emergency off board.

Following figure and table show each pin location/assignment of connectors on the PDU and the emergency off board, which are used to connect PDU and emergency off unit to the cable assembly.

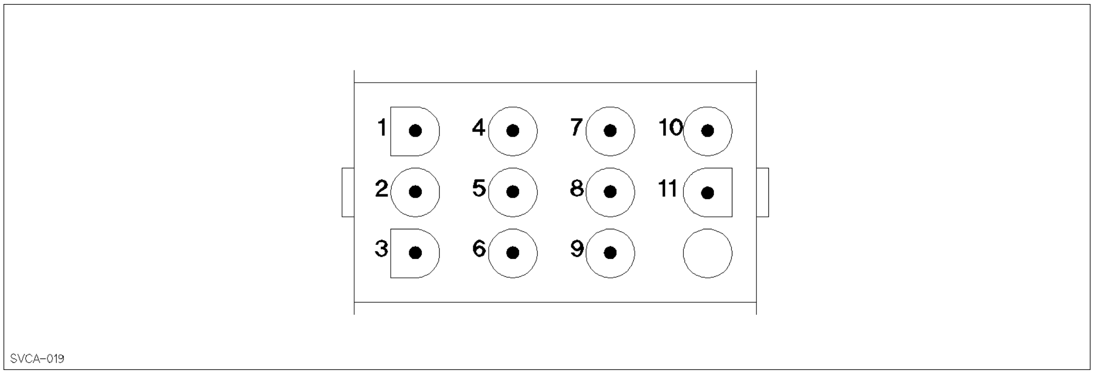


Figure A-10. Connector Pin Location

Table A-11. Connector Pin Assignment

pin No.	function	color of cable
1	to Ext Out 2	brown
2	to Ext Out 2	red
3	to Ext Out 1	orange
4	to Ext Out 1	yellow
5	to Ext In	green
6	to Ext In	blue
7	to main contactor	white/gray/black
8	to main contactor	white/gray/brown
9	to main contactor	white/gray/red
10	AC 24V	black
11	GND	white/gray

Replaceable Parts

This section contains parts information of the system cabinet and PDU.

Replaceable Parts of the Standard System Cabinet (1600 mm height)

Figure A-11 and Table A-12 show and list the field-replaceable parts of the system cabinet.

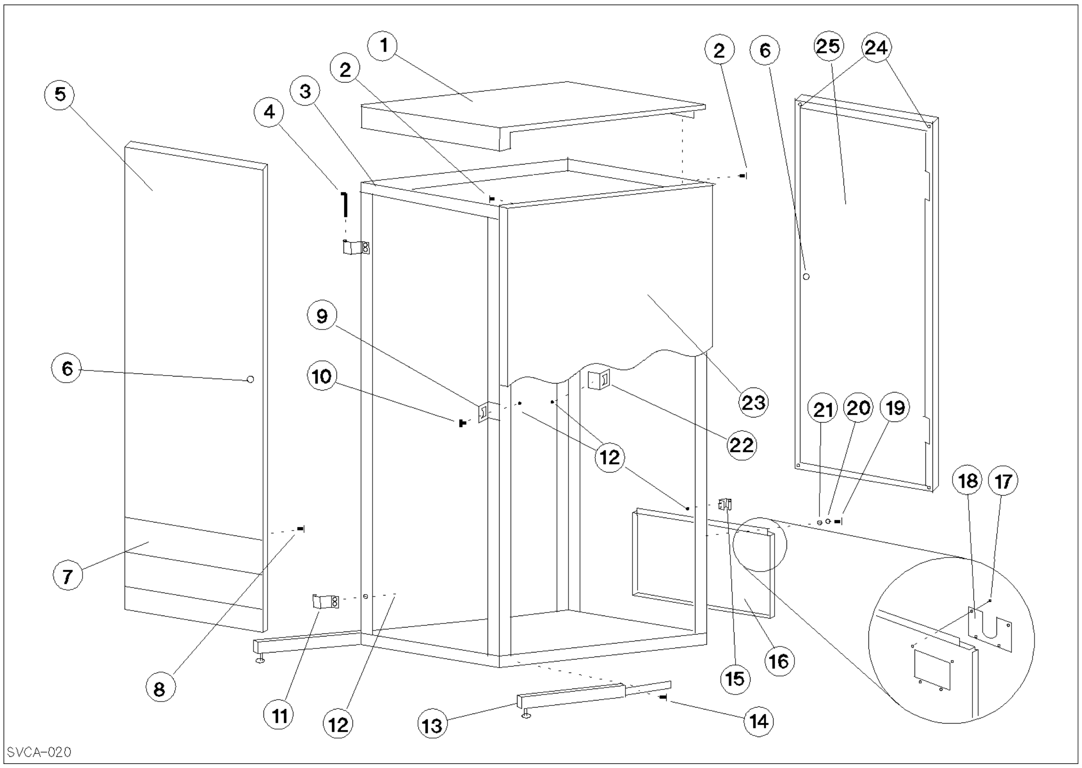


Figure A-11. System Cabinet—Exploded View

Table A-12. Replaceable Parts of the System Cabinet

Reference Designation	HP Part Number	Quantity	Description
1	04062-60104	1	Top Cover
2	0515-0117	6	Screw—M5
3	04062-60105	1	Cabinet Subassembly
4	3110-0166	4	Hinge Pin
5	04062-60401	1	Front Door (for Emergency Off Unit)[1]
	04062-60101	1	Front Door
6	1390-0344	2	Lock Assembly
	04062-00610	2	Plate Sheet
7	04062-40001	2	Grill
8	0515-0914	4	Flathead Screw—M3, L5 (for Emergency Off Unit)
	0515-0907	4	Flathead Screw—M3, L8
9	04062-01291	1	Striker—Front
10	0515-1020	4	Flathead Screw—M5
11	29400-00010	2	Hinge—Front
12	0535-0081	12	Nut—M5
13	04062-29001	4	Anti-tip leg
14	0515-0963	8	Screw—M8
15	29400-00011	2	Hinge—Rear
16	04062-00283	1	Rear Panel
17	0515-0907	4	Flathead Screw—M3, L8
18	04062-00284	1	Plate
19	2680-0119	4	Flathead Screw—10-32
20	3050-0007	4	Cup Washer
21	3050-0248	4	Insert Washer
22	04062-01292	1	Striker—Rear
23	04062-60103	2	Side Panel
24	0403-0692	8	Bumper Foot
25	04062-60102	1	Rear Door

1 There is an opening on the door panel to access the emergency off switch

Replaceable Parts of the Small Cabinet (1000 mm height)

Figure A-12 and Table A-13 show and list the field-replaceable parts of the system cabinet.

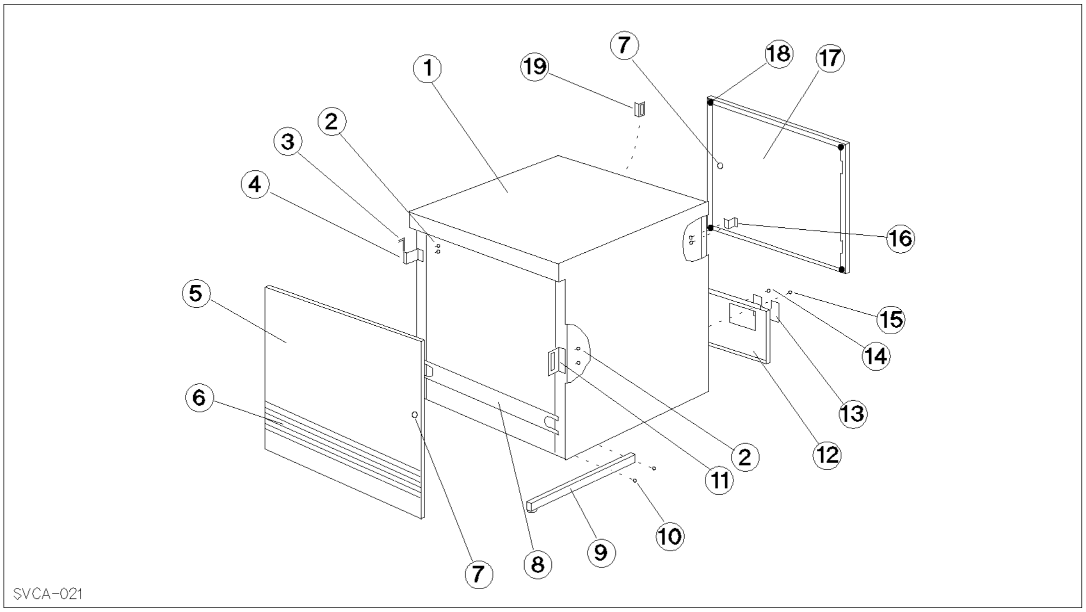


Figure A-12. Small Cabinet (1000 mm height)—Exploded View

Table A-13. Replaceable Parts of the Small Cabinet (1000 mm height)

Reference Designation	HP Part Number	Quantity	Description
1	HP 46298B	1	1000 mm Rack
2	0535-0081	12	Nut—M5
3	3110-0166	4	Hinge Pin
4	29400-00010	2	Hinge—Front
5	04062-60301	1	Front Door
6	04062-40001	1	Grill
7	1390-0344	2	Lock Assembly
	04062-00610	2	Plate Sheet
8	04062-00286	1	Blank Panel
9	04062-29001	4	Anti-tip Leg
10	0515-0963	8	Screw—M8
11	04062-01291	1	Striker—Front
12	04062-00285	1	Rear Panel
13	04062-00284	1	Plate
14	0515-0907	4	Screw—M3, L8
15	2680-0119	4	Flathead Screw—10-32
	3050-0007	4	Cup Washer
	3050-0248	4	Insert Washer
16	29400-00011	2	Hinge—Rear
17	04062-60302	1	Rear Door
18	0403-0629	8	Bumper Foot
19	04062-01292	1	Striker—Rear

Replaceable Parts of the PDU and Emergency Off Unit

Figure A-13 and Table A-14 show and list the field-replaceable parts of the PDU and emergency off unit.

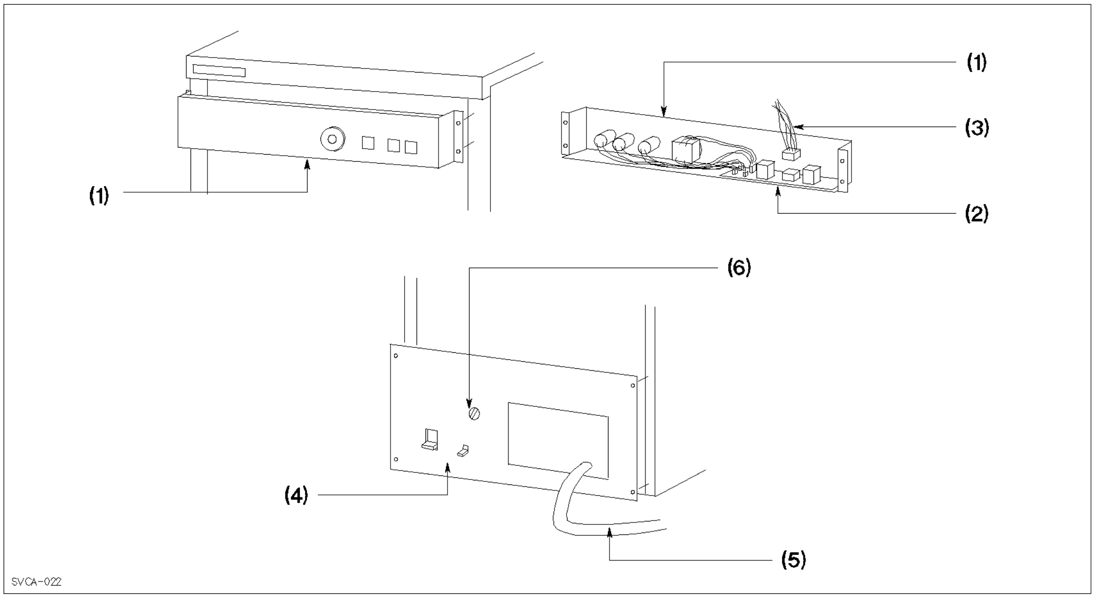


Figure A-13. PDU and Emergency Off Unit

Table A-14. Replaceable Parts of the System Cabinet

Reference Designation	HP Part Number	Quantity	Description
1	04062-61001	1	Emergency Off Unit
2	04062-66501	1	Emergency Off Unit Board
3	04062-61629	1	Cable assembly (connecting between (1) and (4))
4	04062-60203	1	Power Distribution Unit for 100 Vac Line
	04062-60204		Power Distribution Unit for 120 Vac Line
	04062-60205		Power Distribution Unit for 220 Vac Line
	04062-60206		Power Distribution Unit for 240 Vac Line
5	04062-61633	1	Power cable assembly (for 100 and 120 Vac lines)[1]
6	2110-0015	1	Fuse, 2.5A 250V

1 This cable is 3 m length and maximum 30 A current with a NEMA L5-30P plug.

Replaceable Parts of the PDU

Figure A-14 shows the part locations of the PDU. Table A-15 lists the field-replaceable parts of the PDU. Table A-16 also lists the information of the wiring materials in the PDU.

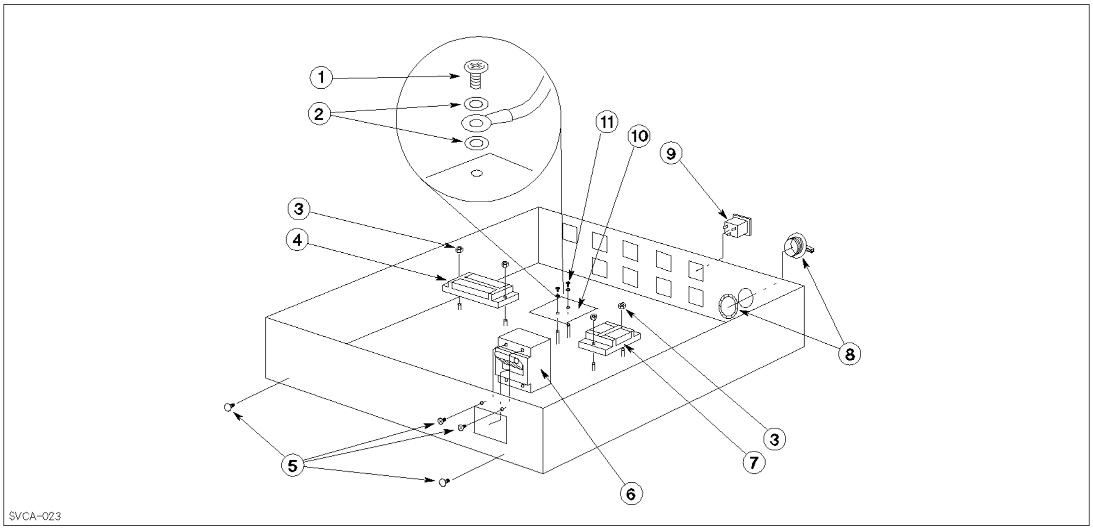


Figure A-14. Part Locations of the PDU

Table A-15. Replaceable Parts of the PDU

Reference Designation	HP Part Number	Quantity	Description
1	0515-0904	4	Screw M5
2	2190-0687	8	Washer M5
3	0535-0043	4	Nut M4
4	0360-2356	1	Barrier Block
5	0515-0907	14	Flatscrew M3
6	3105-0238	1	Circuit Breaker 2 P 30 A 250 Vac
	3105-0237	1	Circuit Breaker 2 P 15 A 250 Vac
7	0360-2357	1	Barrier Block
8	0100-0408	1	CND CONN
9	1252-2571	9	Female Connector - ac power (100 V/120 V)
	1252-2206	9	Female Connector - ac power (220 V/240 V)
10	09480-20003	1	Block Grounding
11	0515-0926	2	Screw M4
	2190-0646	2	Washer

Table A-16. Wiring Material for the PDU

HP Part Number	Unit	Description
8150-2605	inch	Wire 16 Black
8150-2613	inch	Wire 16 White
8150-2629	inch	Wire 16 Green/Yellow
8150-2462	inch	Wire 14 Black
8150-2470	inch	Wire 14 White
8150-2624	inch	Wire 14 Green/Yellow
8150-0567	inch	Wire 10 Green/Yellow
8120-2517	each	Cable Assembly 12 AWG (for 100 V/120 V ac only)[1]

1 This cable is 3 m length and maximum 20 A current with a NEMA 5-20P plug.

B

SWC and SWM Operating Theory

This appendix covers basic HP 4084B SWC and HP 4085B or HP 4089A/B SWM operating theory, and includes block diagrams for each of these system components. For DCS, CMU, and CMU84 operating theory, refer to their service manuals.

System Operation

Figure B-1 shows the basic configuration of a standard HP 4062C/UX system.

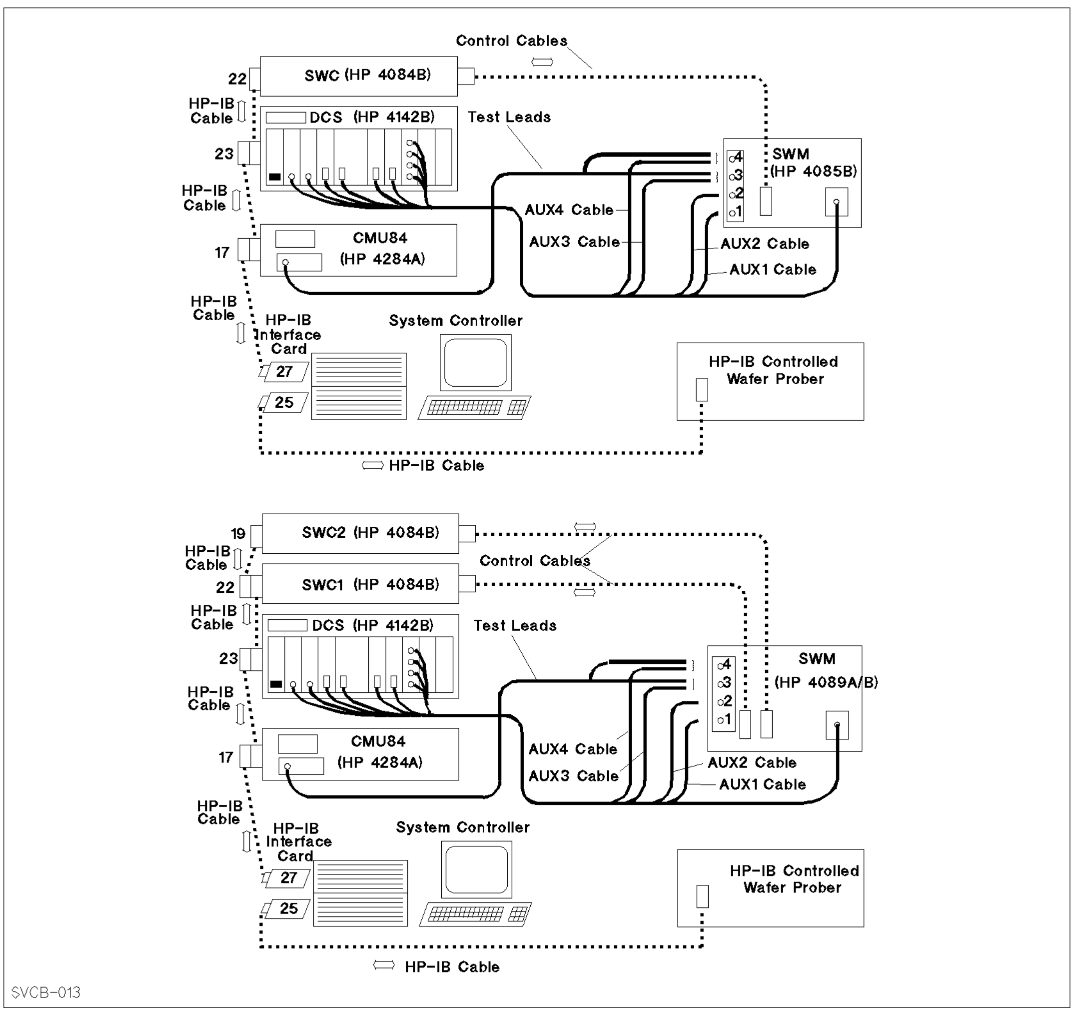


Figure B-1. Standard HP 4062C/UX System Configuration

The main function of the SWM is to interconnect the subsystem components and the measurement pins (contact pins) of the SWM with the measurement ports of the SWM.

Figure B-2 and Figure B-3 shows a simplified SWM pin-port connection diagram with the SWM interconnected with its SWC, DCS, and CMS.

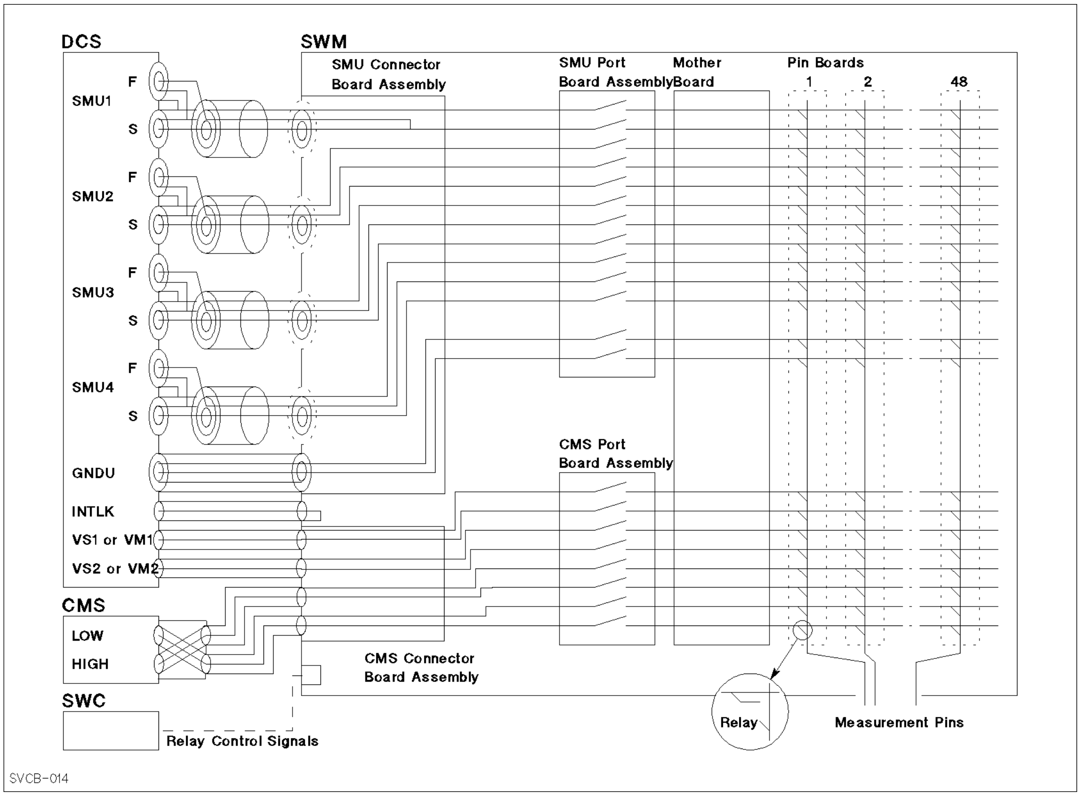


Figure B-2. Simplified SWM Pin-Port Connection Diagram (for 48-pin SWMs)

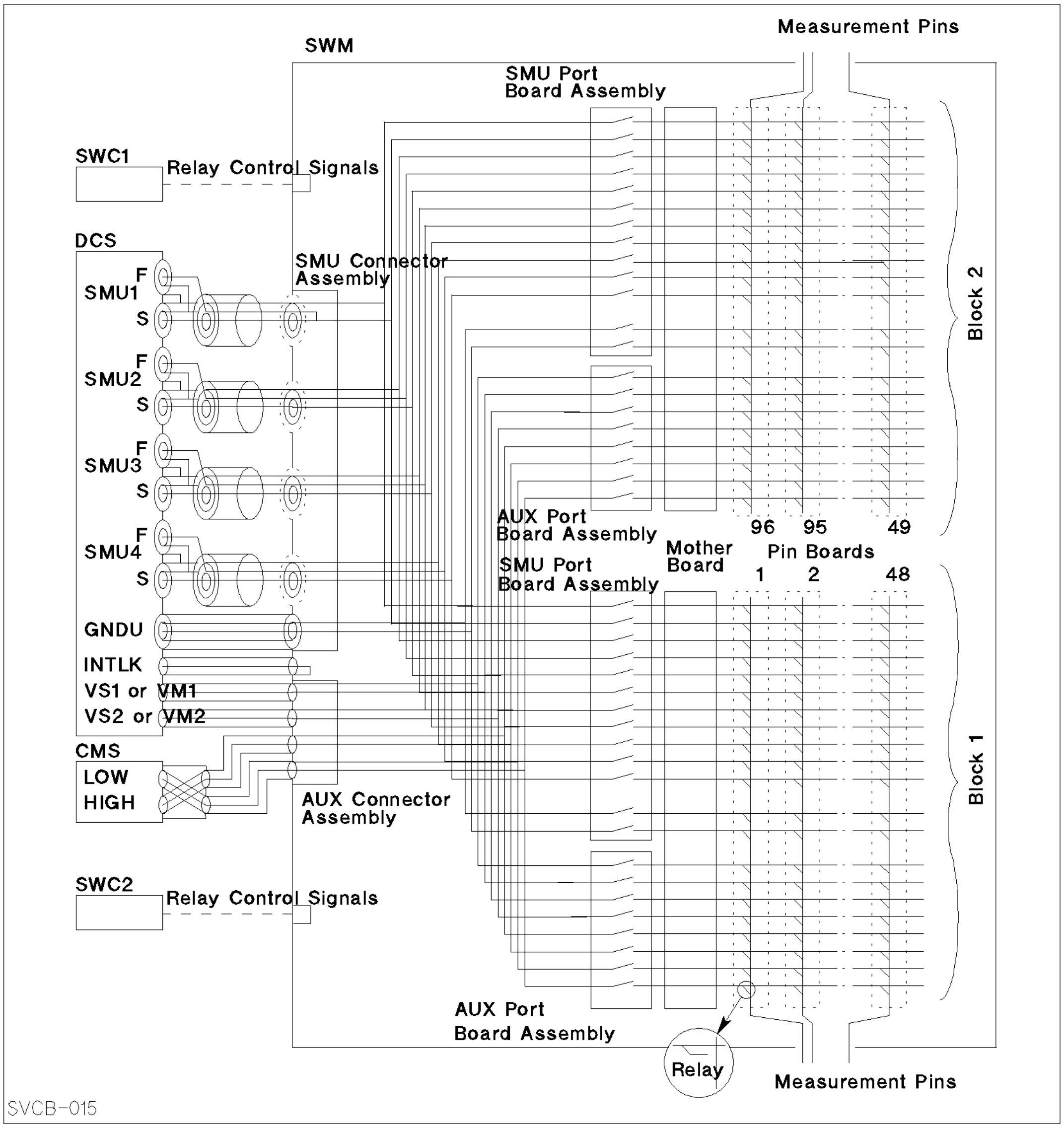


Figure B-3. Simplified SWM Pin-Port Connection Diagram (for 96-pin SWMs)

For HP 4085B 48-pin SWM, the SWM provides 9 measurement ports, 48 measurement pins, thereby constituting a 9 (ports) by 48 (pins) matrix. For HP 4089A/B 96-pin SWM, the SWM provides 9 measurement ports, 96 measurement pins, thereby constituting a 9 (ports) by 96 (pins) matrix. Each measurement pin, under software control, can connect to and disconnect from any port, enabling virtually any pin-port connection combination. This allows control over the subsystem instruments as if they were built into the SWM.

The SWM can connect to a wafer prober (by an HP personality board and the probe card of the prober) or to one of the furnished test fixtures.

Figure B-4 shows simplified circuit diagrams of the source and measurement units of the DCS and CMS.

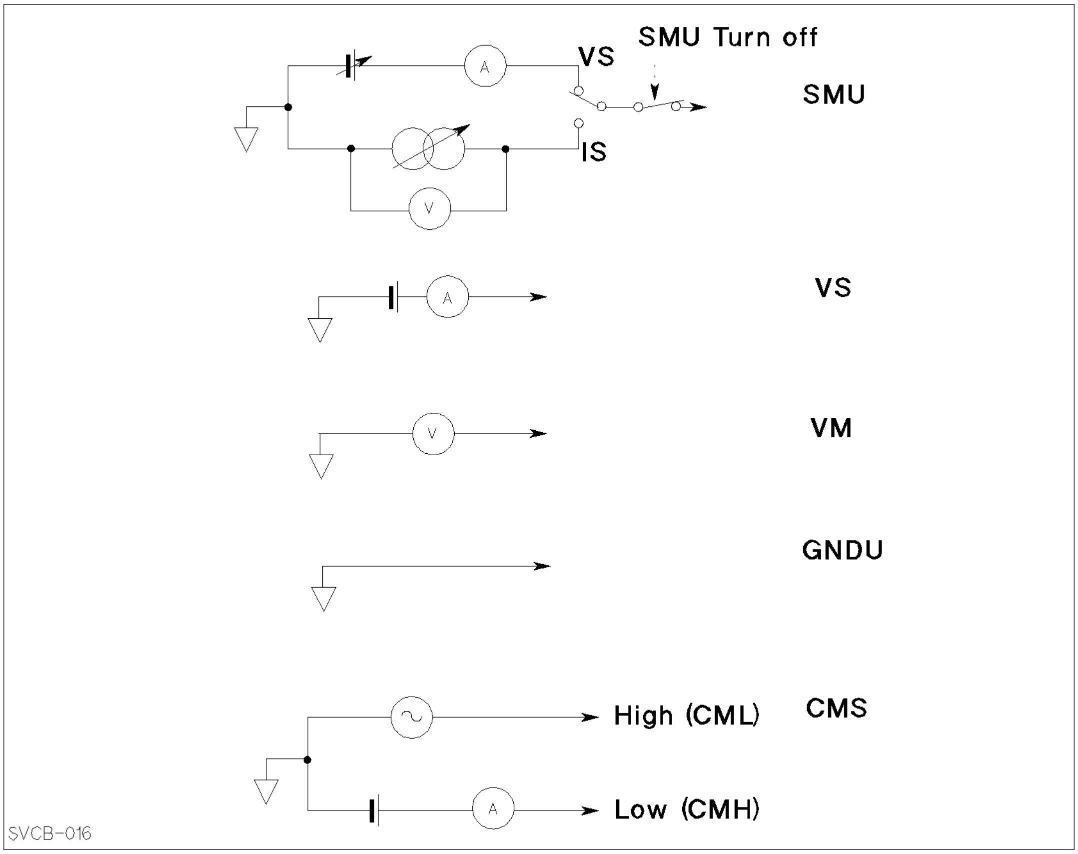


Figure B-4. Simplified Circuit Diagram

SWC and SWM Block Diagram Discussion

Figure B-5 and Figure B-6 show overall block diagrams of the SWC and SWM for 48- and 96-pin SWMs, respectively. These two system components are interconnected by a control cable that includes dc power lines for the SWM, serial data lines, and timing control lines.

Basically, the SWC consists of an MPU board (A1) and a power supply board (A2).

The MPU board contains an 8-bit microprocessor, 16 kilobytes of read-only memory (ROM), 8/2 kilobytes of random-access memory (RAM), the HP-IB interface controller, and the control circuits for the SWM. The main purpose of the MPU Board is to convert parallel control data sent via the HP-IB into serial control data for the SWM.

The power supply board provides rectification, regulation, and filtering for the +5 V and +12 V dc used by the MPU board and the SWM.

The 48-pin SWM can be equipped with up to 48 pin boards, and the 96-pin SWM can be equipped with up to 96 pin boards. Functions of the pin boards are identical, and each has 15 relays. Measurement pin-to-port connections are controlled by the relays on the pin boards. Each pin board location has its own specific address, and all pin boards operate independently.

The control logic board sends address signals and relay control signals to the pin boards by the logic control bus. Measurement signals from the DCS and the CMS are applied to the DCS and CMS (AUX) Port Boards, where they are then distributed through the mother board to the test relay board and the specified pin boards.

The matrix (switching matrix) open relay board detects whether the WAFER PROBER SENSE switch or the FIXTURE CLOSED DETECT switch is open or closed. When either one of these switches is closed, SWM output is enabled.

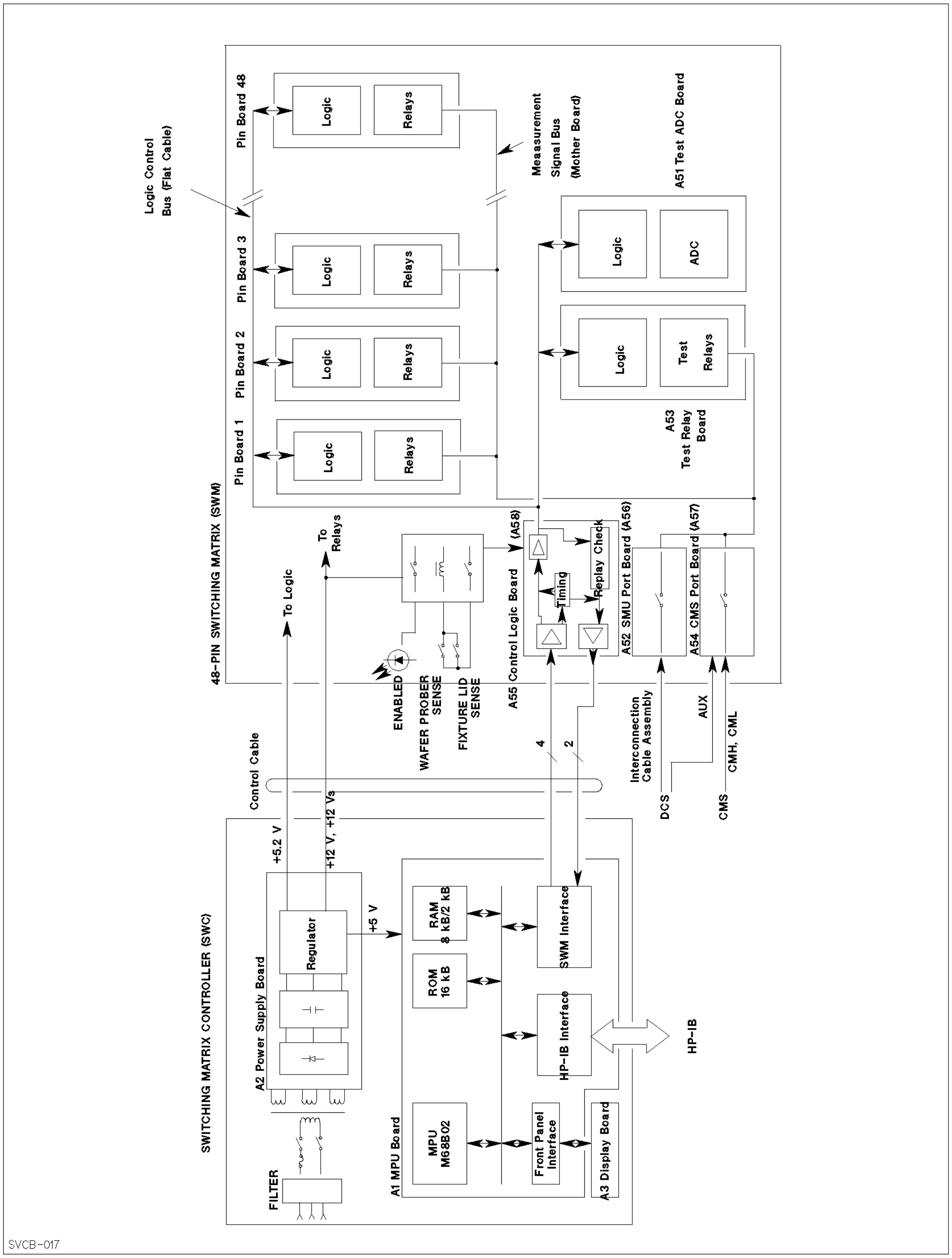


Figure B-5. SWC and SWM Block Diagram (for 48-pin SWM)

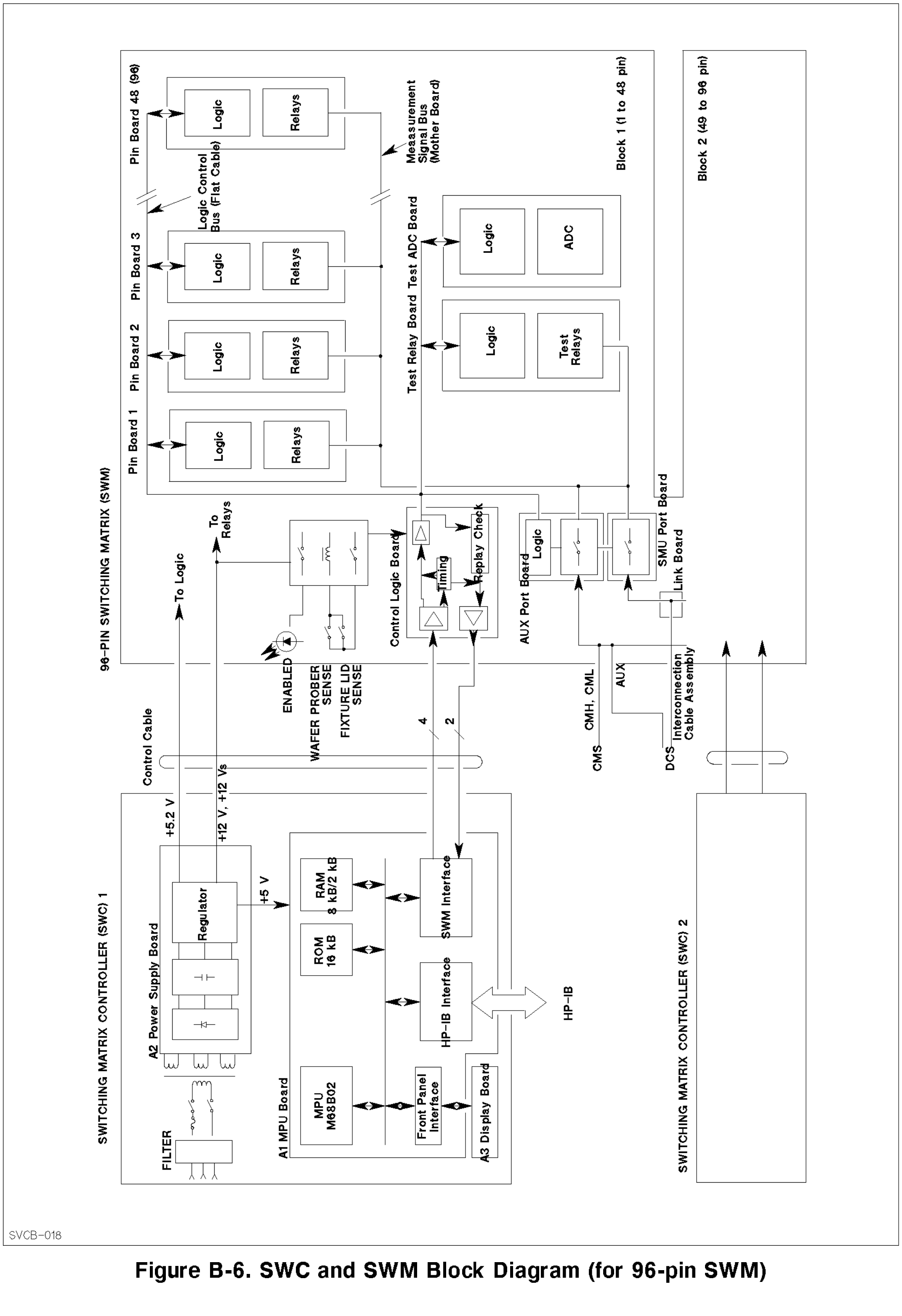


Figure B-6. SWC and SWM Block Diagram (for 96-pin SWM)

Pin Boards

Pin board relays are controlled by serial data sent from the control logic board by the logic control bus. Figure B-7 shows the pin assignments of the J1 (10 pin) connector of each pin board, and provides a brief description of each logic control signal.

Figure B-8 shows a circuit diagram of a pin board. All pin board relays are controlled by the SWC. The control signal from the SWC is received by the interface IC (U3), which drives the pin board relays through the open collector drivers.

The 6-bit address for each pin board location is hard-wired on the edge connectors mounted on the mother board of the SWM. Relay control signals sent to the SWM include pin board address information.

Serial Data Input (SDIN):	For pin board address and relay control data.
Shift Clock (SCLK):	Clock signal for serial data.
Strobe (STB):	Strobe signal that indicates the end of data.
Reply (RPLY):	Reply signal from an addressed pin board. The SWC knows of the availability of the pin if the reply signal is sent back from the addressed pin board.

These signals are all negative logic and are usually held at +5 V.

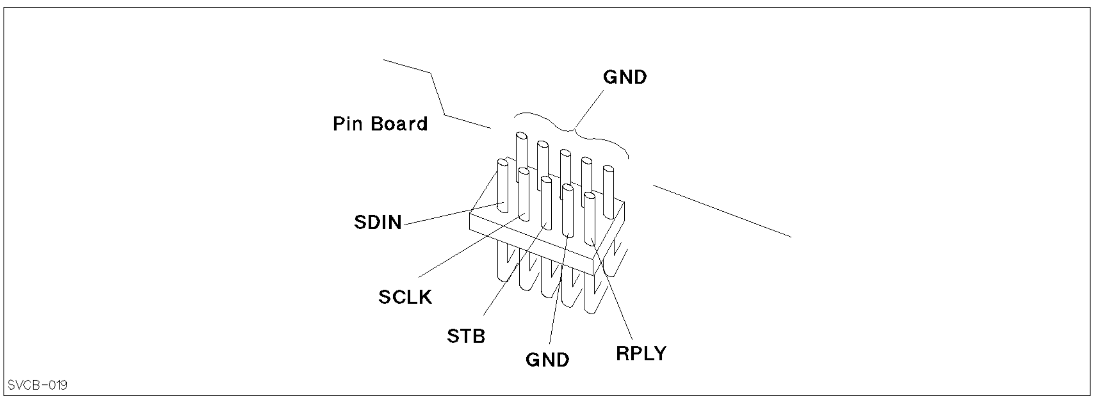


Figure B-7. J1 Pin Assignments for the Pin Board

Integrated circuit U3, which is a gate array, has two types of package: ceramic and plastic. The pin assignment of the ceramic type is different from that of the plastic type. Table B-1 lists the pin assignments of the IC U3.

Table B-1. Pin Assignments of Integrated Circuit U3

Pin No.	Symbol		Pin No.	Symbol	
	Ceramics (MB62115)	Plastics (MB673152)		Ceramics (MB62115)	Plastics (MB673152)
1	MPA0	DOL5	15	DOH0	DOH0
2	MPA1	DOL6	16	DOH1	DOH1
3	MPA2	DOL7	17	DOH2	DOH2
4	MPA3	MPA0	18	DOH3	DOH3
5	MPA4	MPA1	19	DOH4	DOH4
6	MPA5	SDIN	20	DOH5	DOH5
7	DOL5	V_{SS} (GND)	21	DOH6	V_{DD} (+5 V)
8	DOL6	SCLK	22	DOH7	DOH6
9	DOL7	STB	23	DOL0	DOH7
10	SDIN	MPA2	24	DOL1	DOL0
11	SCLK	MPA3	25	DOL2	DOL1
12	STB	MPA4	26	DOL3	DOL2
13	RPLY	MPA5	27	DOL4	DOL3
14	V_{SS} (GND)	RPLY	28	V_{DD} (+5 V)	DOL4

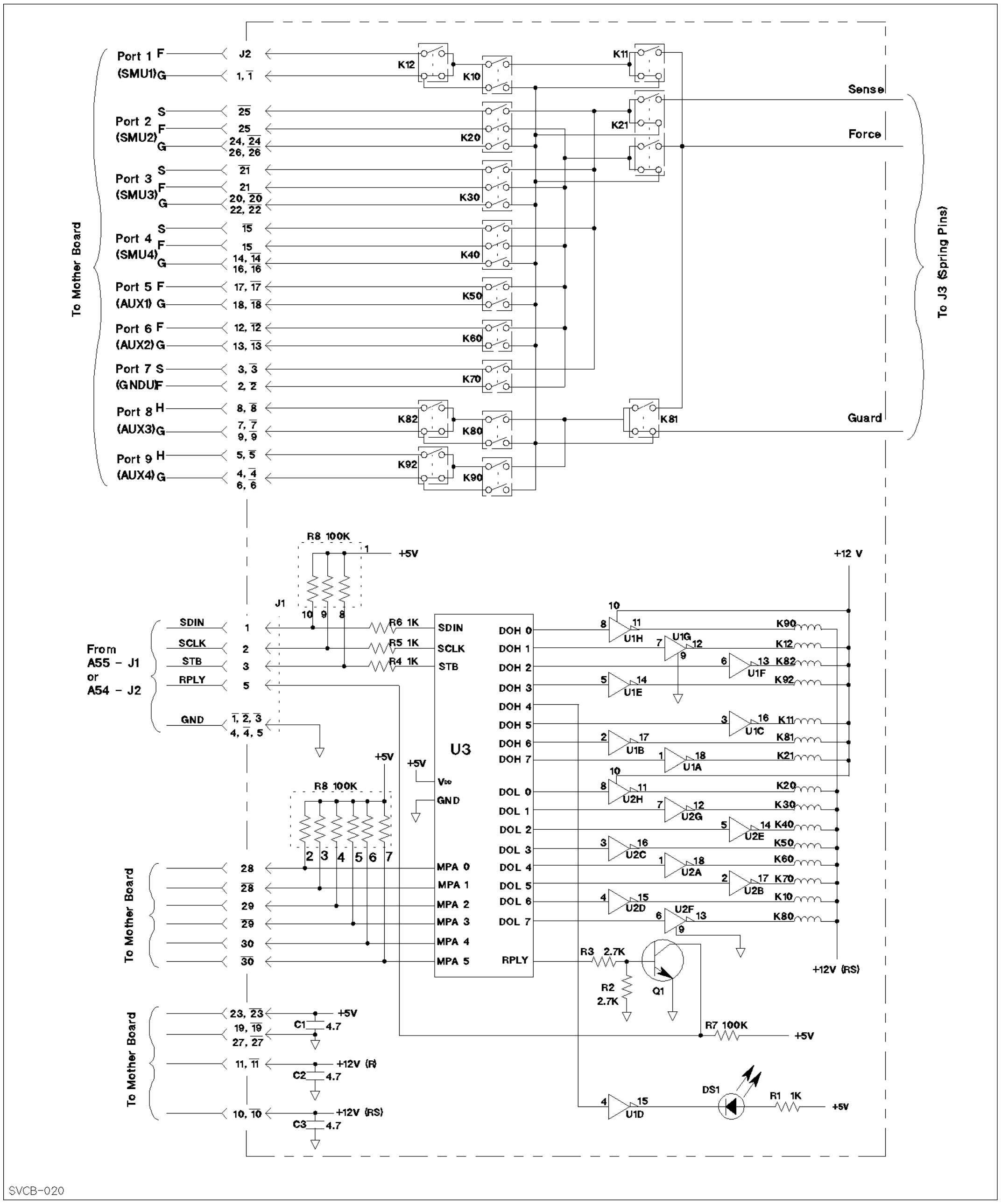


Figure B-8. Circuit Diagram—Pin Board

SMU and AUX Port Boards

For the 96-pin SWM system, input relays on the SMU and AUX port boards are controlled by the SWCs as well as pin boards. The input relays connect or disconnect the SMU and AUX connectors to each port on the each mother board as shown in Figure B-3. The SMU and AUX port boards are also called input relay boards. Figure B-10 and Figure B-11 show the circuit diagrams of the SMU and AUX port boards, respectively.

Serial data sent from the control logic board also controls the input relays by the logic control bus. The serial data is transferred to the control signal for all input relays using integrated circuit U1, which is on the AUX port board. Figure B-9 shows the pin assignments of receptacle J1.

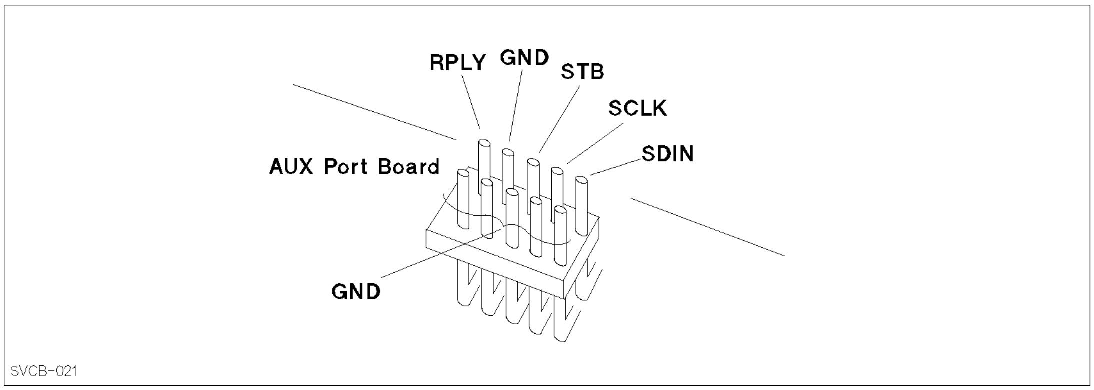


Figure B-9. J1 Pin Assignment for AUX Port Board

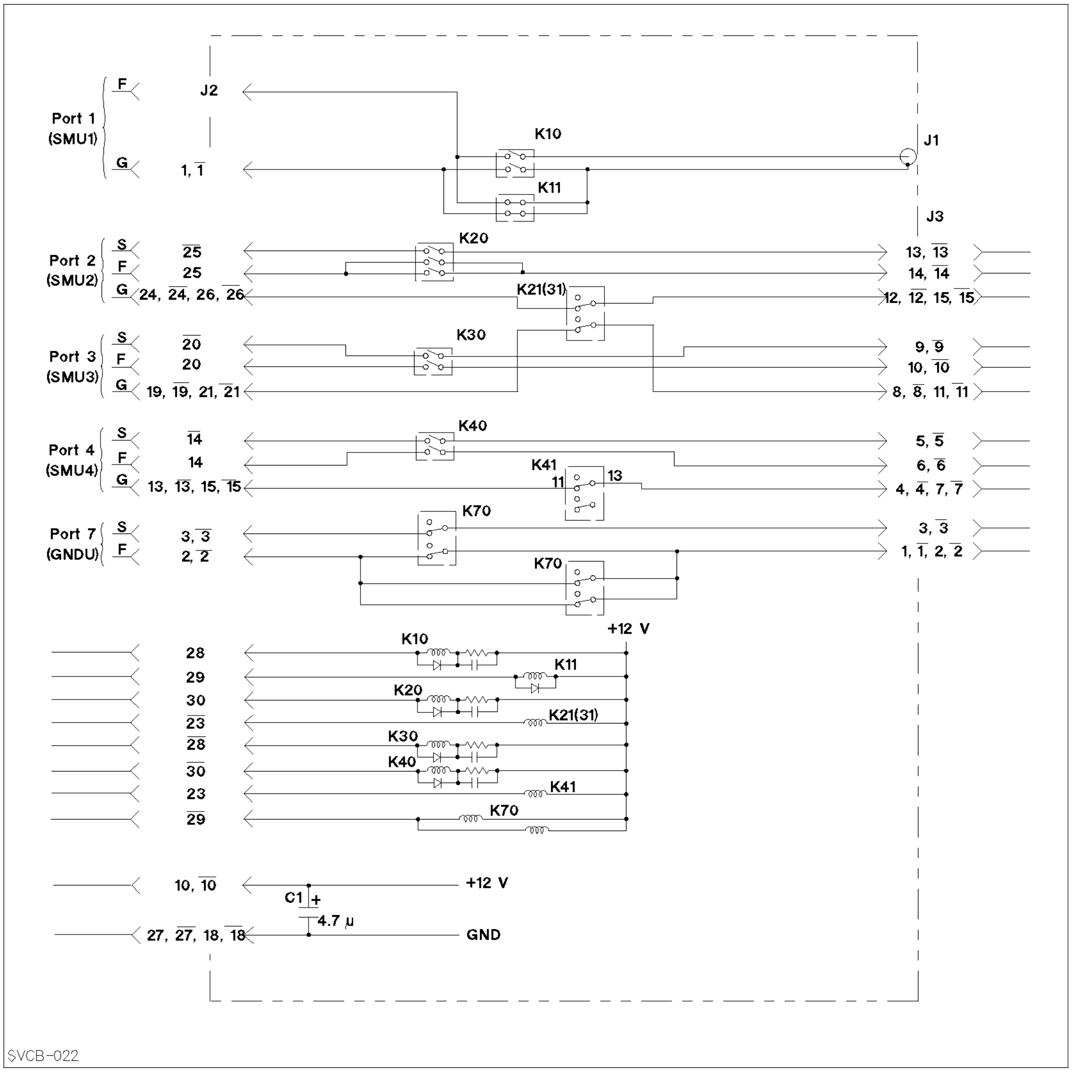


Figure B-10. Circuit Diagram—SMU Port Board

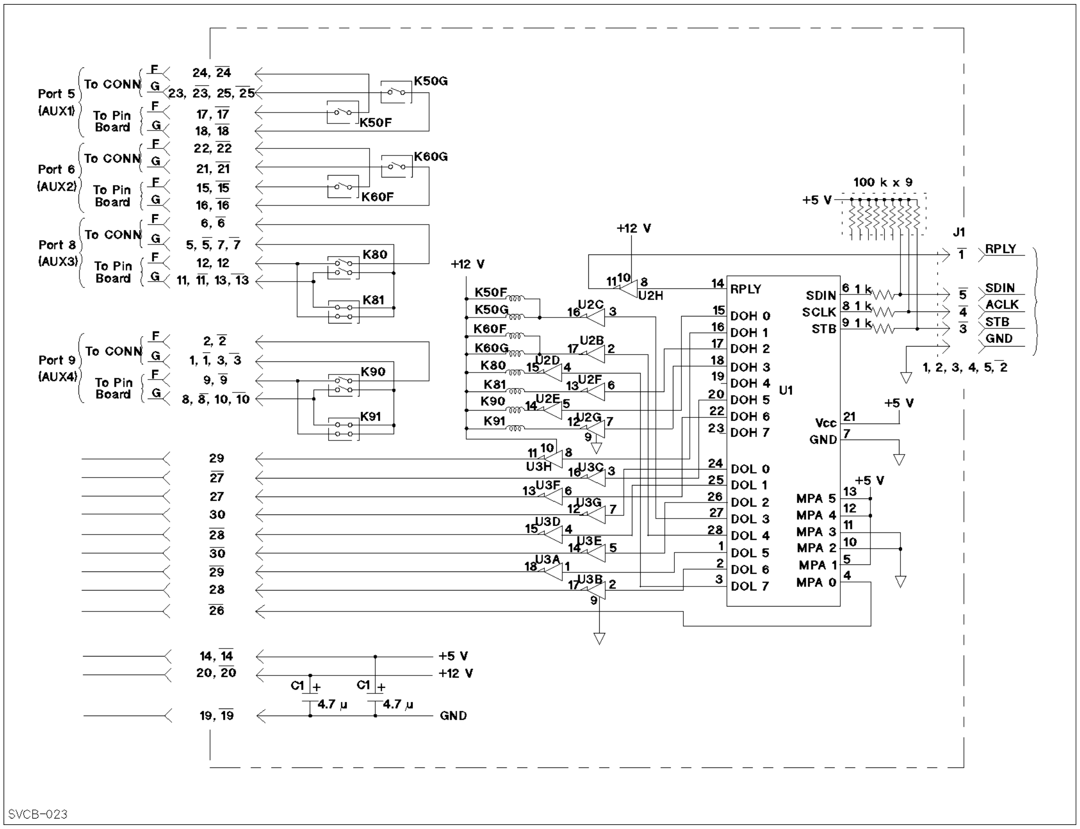


Figure B-11. Circuit Diagram—AUX Port Board

Interlock Function

The input/output terminals of the four SMUs and the GNDU are connected to the SWM through the interconnect cable assembly. Figure B-12 (a) shows the assignment of each interconnect cable assembly connector. Because the outer conductor (guard) of each SMU is at the same potential as the SMU output (driven guard), voltages up to ±200 V may be present at the outer conductors. Refer to Figure B-12 (b).

For operator safety, the outer conductors of the SMUs cannot be touched when the interconnect cable assembly is connected to the DCS and SWM. The INTERLOCK function ensures that the interconnection cable assembly is properly connected. When the INTERLOCK line is LOW (connected to ground), that is, the interconnect cable assembly is properly connected between the DCS and SWM, the DCS can output voltage normally. Refer to Figure B-12 (c). If the INTERLOCK line is HIGH (not grounded), the DCS disables output if the output voltage exceeds ±42 V.

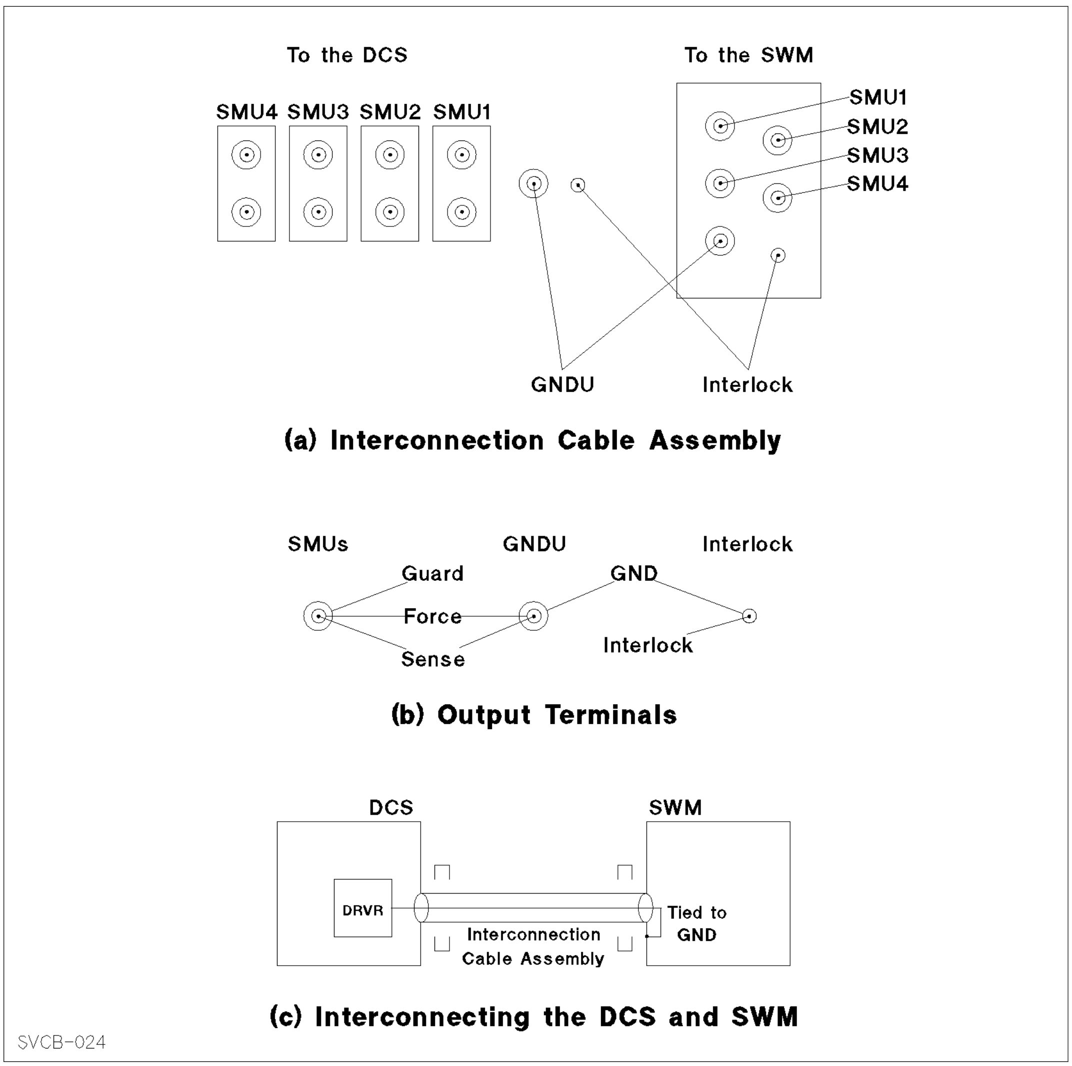


Figure B-12. INTERLOCK function

C

Port Expander Information

This appendix provides the instructions, procedures, and information required to repair the port expander (HP part number 04089-60011) equipped with the HP 4089B Switching Matrix, which is used with the HP 4062C/UX system.

Note that the port expander is supported by the HP 4062C/UX system software revision 6.0 or later.

Specifications

This section provides the specifications of the port expander. For the specifications of a system without a port expander, see "Specifications" in Chapter 1.

What is a Port Expander?

A port expander is used with the HP 4062C/UX system equipped with an HP 4089B 96-pin Switching Matrix (SWM). The port expander is placed between the instruments and the auxiliary (AUX) ports of the SWM, and expands the number of AUX ports from four to twelve. The port expander has four multiplexers (3 to 1), and has ten coaxial connectors and two triaxial connectors. The triaxial connecters can be connected to the SMUs; the coaxial connectors can be connected to the VS, VM, CMU, CMU84, and other unsupported instruments. Note that Hewlett-Packard does not guarantee the system specifications when unsupported instruments are connected to the port expander.

AUX Ports on the Port Expander

The port expander has twelve input ports for the instruments. Table C-1 shows the port name, connector type, and available instrument.

Table C-1. Port specifications of Port Expander

Port Name	Connector Type	Connected to ...
AUX11	coaxial	VS, VM, or unsupported instruments
AUX12		
AUX13		
AUX21	coaxial	VS, VM, or unsupported instruments
AUX22		
AUX23		
AUX31	coaxial	VS, VM, CMU, CMU84[1] or unsupported instruments
AUX32		
AUX33	triaxial	SMU
AUX41	coaxial	VS, VM, CMU, CMU84[1] or unsupported instruments
AUX42		
AUX43	triaxial	SMU

1 If the CMU or CMU84 is connected to the AUX32 or AUX42 port, the CMU or CMU84 specifications are not guaranteed.

Accuracy

The following accuracies are defined at measurement pins of the SWM when the specified units are connected to the specified ports of the port expander.

SMUs on Port Expander: 2 ports

An HP 41420A or HP 41421B SMU is used.

Voltage Source/Monitor Range, Resolution, and Accuracy (@ 96-pin SWM pins)

V Range Full Scale	Resolution Force/Measure	Accuracy (Io = Output I) ±(% of reading + % of range + V)
±2 V	100 μV/40 μV	±(0.05%+0.05%+1.3 Ω×Io+180 μV)
±20 V	1 mV/400 μV	±(0.05%+0.05%+1.3 Ω×Io)
±40 V	2 mV/800 μV	
±100 V	5 mV/2 mV	
±200 V[1]	10 mV/4 mV	

1 HP 41420A SMU only. Note that the maximum voltage is 100 V.

Current Source/Monitor Range, Resolution, and Accuracy

I Range Full Scale	Resolution Force/Measure	Accuracy (Vo = Output V) ±(% of reading + % of range + A)
±1 A[1]	50 μA/20 μA	±[0.5%+(0.1+0.002×Vo)%]
±100 mA	5 μA/2 μA	±[0.2%+(0.1+0.002×Vo)%]
±10 mA	500 nA/200 nA	
±1 mA	50 nA/20 nA	
±100 μA	5 nA/2 nA	
±10 μA	500 pA/200 pA	±[0.2%+(0.1+0.003×Vo)%]
±1 μA	50 pA/20 pA	±[0.5%+(0.01×Vo)%+2 nA]
±100 nA	5 pA/2 pA	±[0.5%+(0.1×Vo)%+1 nA]

1 HP 41420A SMU only.

Note: 10 nA and 1 nA ranges are not specified.

Input Resistance: $\geq 10^{10}$ Ω (I source mode)

Output Terminal: Force and Guard

Note

Accuracies are specified at 23° C ±5° C after a minimum 40 minute warm-up period, with less than 3° C temperature change after calibration. Accuracies apply at all measurement pins. Errors double at 5° C – 18° C and 28° C – 40° C.

Voltage Source (VS) Unit

The following tables specify the accuracy when the VS unit is connected to the AUX11 – 13, AUX21 – 23, AUX31, AUX32, AUX41, or AUX42 port.

VS Voltage Output Range, Resolution, and Accuracy

V Range Full Scale	Resolution	Accuracy	Max. I
±20 V	1 mV	±(0.1% of setting + 10 mV)	100 mA
±40 V	2 mV	±(0.1% of setting + 20 mV)	20 mA

VS Current Measurement Range, Resolution, and Accuracy

I Range Full Scale	Resolution	Accuracy	V Range
±20 mA	20 μA	±(3% of reading + 200 μA)	40 V
±100 mA	100 μA	±(3% of reading + 1 mA)	20 V

Note

Accuracies are specified at 23° C ±5° C after a minimum 40 minute warm-up period, with less than 3° C temperature change after calibration. Accuracies apply at all measurement pins. Errors double at 5° C – 18° C and 28° C – 40° C.

Voltage Monitor (VM) Unit

The following tables specify the accuracy when the VM unit is connected to the AUX11 – 13, AUX21 – 23, AUX31, AUX32, AUX41, or AUX42 port.

VM Input Range, Resolution, and Accuracy (Grounded Measurements)

V Range Full Scale	Resolution	Accuracy	AUX Port Number
±2 V	40 μV	±(0.05% of reading + 1.1 mV)	11–13, 21–23
		±(0.05% of reading + 1.2 mV)	31, 32, 41, 42
±20 V	400 μV	±(0.05% of reading + 10 mV)	11–13, 21–23, 31, 32, 41, 42
±40 V	800 μV	±(0.05% of reading + 20 mV)	11–13, 21–23, 31, 32, 41, 42

VM Input Range, Resolution, and Accuracy (Differential Measurements)

V Range Full Scale	Resolution	Max. Common Voltage	Accuracy (Vi = VM2 Input V) ±(% of reading + V + common mode error)	AUX Port Number
±0.2 V	4 μV	40 V	±(0.2% + 0.62 mV + 2.5 μV×Vi)	11–13, 21–23
			±(0.2% + 0.76 mV + 2.5 μV×Vi)	31, 32, 41, 42
±2 V	40 μV	40 V	±(0.1% + 2.1 mV + 25 μV×Vi)	1–4, 11–13, 21–23, 31, 32, 41, 42

Note

Accuracies are specified at 23° C ±5° C after a minimum 40 minute warm-up period, with less than 3° C temperature change after calibration. Accuracies apply at all measurement pins. Errors double at 5° C – 18° C and 28° C – 40° C.

CMU (HP 4280A)

The following table specifies the accuracy when the CMH and CML terminals of the CMU are connected to the AUX31 and AUX41 ports, respectively.

C & G Measurement Ranges and Accuracies

C & G Range Full Scale	**Accuracy[1] ±[% of reading + (% of range)]**
C:10 pF[2]	±[0.8%+(0.7+1.5×Gm/100 μS)]
G:100 μS[2]	±[1.5%+(0.7+0.2×Cm/10 pF)]
C:100 pF	±[0.5%+(0.1+1.5×Gm/1000 μS)]
G:1000 μS	±[1.5%+(0.2+0.2×Cm/100 pF)]
C:1000 pF	±[1.5%+(0.2+3.5×Gm/10 mS)][3]
G:10 mS	±[3.5%+(0.4+0.5×Cm/1000 pF)]

1 Gm: conductance measurement value
Cm: capacitance measurement value

2 Reference data only—not a guaranteed specification.

3 ±[1.7%+(0.2+3.5×Gm/10 mS)] for AUX31 and AUX41

Note

After the minimum 40 minute warm-up period, accuracy is specified (1) at 23° C ± 5° C with the test signal level set to 30 mV and MEAS SPEED set to MEDIUM; (2) between any two measurement pins, and (3) with dissipation D < 1. The stray capacitance between two measurement pins is measured first. Then the stray capacitance value is subtracted from the measured data when a DUT is measured.

When using the 10 mV test signal level, add (0.1% + 0.1%) to the C or G error. If the stray capacitance to the guard exceeds 5 pF, add 0.8% of the reading to C or G errors for each 100 pF increment of stray capacitance to the guard. Errors double at 5° C – 18° C and 28° C – 40° C.

CMU84 (HP 4284A)

The following tables specify the accuracy when the CMH84 and CML84 terminals of the CMU84 are connected to the AUX31 and AUX41 ports, respectively.

Capacitance Measurement Frequencies, Ranges, and Accuracies

Frequency (Hz)	C (F)	Accuracy[1] ±[% of reading + (% of range)]
1 M	10 p[2]	±[0.8%+(1.0+0.6×Gm/63 μS)]
	100 p	±[0.8%+(0.3+0.6×Gm/630 μS)]
	1 n[3]	±[1.9%+(0.2+1.7×Gm/6.3 mS)]
100 k	10 p[2]	±[0.4%+(1.0+0.4×Gm/6.3 μS)]
	100 p	±[0.3%+(0.3+0.3×Gm/63 μS)]
	1 n	±[0.3%+(0.2+0.4×Gm/630 μS)]
	10 n	±[0.5%+(0.2+1.0×Gm/6.3 mS)]
10 k	100 p	±[0.3%+(0.2+0.3×Gm/6.3 μS)]
	1 n	±[0.3%+(0.1+0.3×Gm/63 μS)]
	10 n	±[0.3%+(0.1+0.3×Gm/630 μS)]
	100 n	±[0.3%+(0.1+1.0×Gm/6.3 mS)]
1 k	100 p[2]	±[0.4%+(0.5+0.4×Gm/0.63 μS)]
	1 n	±[0.3%+(0.1+0.3×Gm/6.3 μS)]
	10 n	±[0.3%+(0.1+0.3×Gm/63 μS)]
	100 n	±[0.3%+(0.1+0.3×Gm/630 μS)]

1 Gm = conductance measurement value

2 Reference data only—not a guaranteed specification.

3 Maximum counts are 12000 (120% full scale).

Conductance Measurement Frequencies, Ranges, and Accuracies

Frequency (Hz)	G (S)	Accuracy[1] ±[% of reading + (% of range)]
1 M	63 μ[2]	±[0.8%+(1.0+0.6×Cm/10 pF)]
	630 μ	±[0.8%+(0.3+0.6×Cm/100 pF)]
	6.3 m	±[1.3%+(0.2+2.2×Cm/1.0 nF)]
100 k	6.3 μ[2]	±[0.4%+(1.0+0.4×Cm/10 pF)]
	63 μ	±[0.3%+(0.3+0.3×Cm/100 pF)]
	630 μ	±[0.3%+(0.2+0.4×Cm/1 nF)]
	6.3 m	±[0.7%+(0.2+0.8×Cm/10 nF)]
10 k	6.3 μ	±[0.3%+(0.2+0.3×Cm/100 pF)]
	63 μ	±[0.3%+(0.1+0.3×Cm/1 nF)]
	630 μ	±[0.3%+(0.1+0.3×Cm/10 nF)]
	6.3 m	±[0.7%+(0.1+0.7×Cm/100 nF)]
1 k	0.63 μ[2]	±[0.4%+(0.5+0.4×Cm/100 pF)]
	6.3 μ	±[0.3%+(0.1+0.3×Cm/1 nF)]
	63 μ	±[0.3%+(0.1+0.3×Cm/10 nF)]
	630 μ	±[0.3%+(0.1+0.3×Cm/100 nF)]

1 Cm = capacitance measurement value

2 Reference data only—not a guaranteed specification.

Note

After the minimum 45 minute warm-up period, accuracy is specified at 23° C ± 5° C with MEAS SPEED set to MEDIUM and with a 30 mVrms test signal level. The stray capacitance between two measurement pins is measured first. Then the stray capacitance value is subtracted from the measured data when a DUT is measured.

Physical Characteristics

Dimensions: 227 mm (W) by 180 mm (H) by 57 mm (D) (see Figure C-1)

Weight: about 1.1 kg

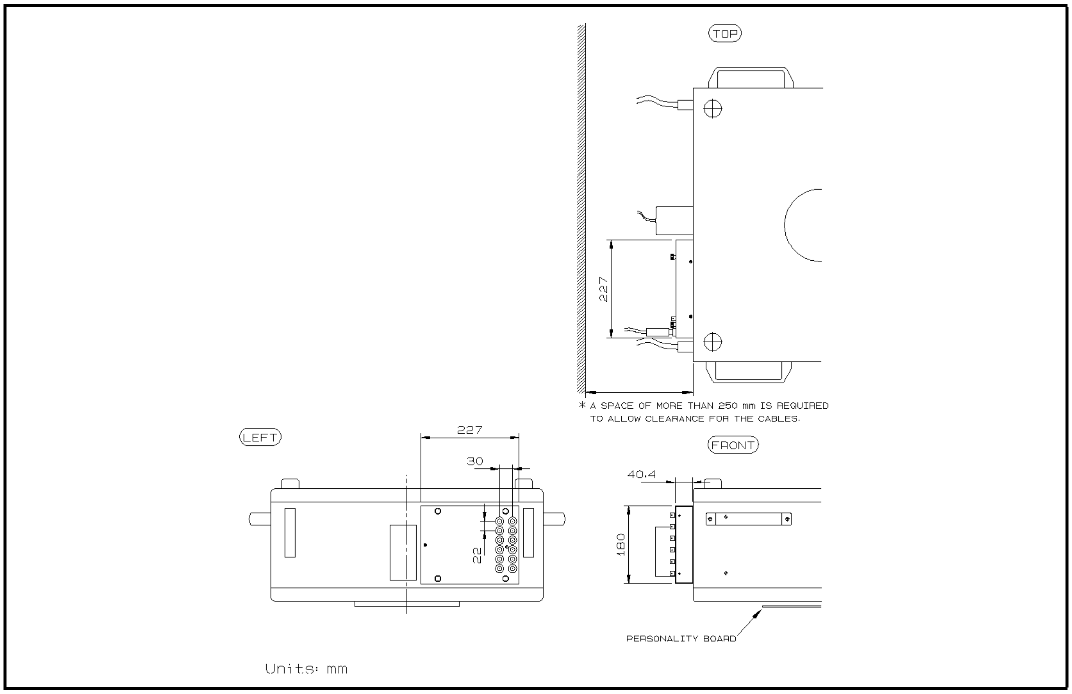


Figure C-1. Port Expander Dimensions

Typical SWM Performance with Port Expander

Typical SWM Performance (at 23 °C, 50%RH)

Parameter	AUX1x & AUX2x	AUX31, 32 & AUX41, 42	AUX33 & AUX43
Offset Voltage/Pin	50 μV	80 μV	80 μV
Offset Current/Pin	1 nA	1 nA	40 pA
Isolation Resistance	$4\times10^8\ \Omega$	$4\times10^8\ \Omega$	$5\times10^{11}\ \Omega$
Path to Ground Capacitance	—	—	60 pF
Stray C between CMS ports	—	4 pF[1]	—

1 Between AUX31 and AUX41.

System Software

The port expander operation is supported by the HP 4062C/UX system software revision 6.0 or later.

Performance Verification for Port Expander

This section covers the performance verification operating theory for the port expander. The PV4062 does not have any subtests to verify performance of the port expander except the Port Expander Relay Test, which is one of the Relay Tests. The SMU Test, VS and VM Test, CMS C-G and Bias Test, and so on, verify the performance of the SWM, port expander, cables, and instruments. For the procedures of the Port Expander Relay Test, see "Relay Test" in Chapter 2.

The Port Expander Relay Test is a part of the Relay Test and is executed after the Input Relay Test, if the SWM is equipped with a port expander. The Port Expander Relay Test checks the relay operations (make and break) of the port expander. If improper relays are detected, this test reports error messages.

If an SMU is connected to the additional SMU port (AUX33 or AUX43), the SMU is used for the Input Relay Test. The test circuit and test operation is described in the following section.

The SMU Test is also executed for the additional SMU port (AUX33 or AUX43) if an additional SMU is connected to the AUX33 or AUX43.

The VS, VM, CMS C-G and Bias, and CMU84 C-G and Bias Tests are also executed for the ports on the port expander.

In W/ DVM Test, Voltage and Current Accuracy Tests and VS and VM Tests are executed for port expander ports.

To perform the Port Expander Relay Test, an SMU is used the same way as with the Input Relay Test. If bad relays are detected, the test circuit path could be the source of the problem and must be checked along with the relays. For example, you may find that poor contact between the AUX port board and mother board is the source of a problem.

The followings explain the test circuit and test operation of the Port Expander Relay Test, and help you troubleshoot the port expander relay errors.

Note that the following abbreviations are used to specify the relays:

K*xx*	Relay on the pin board (pin board relay)
i-K*xx*	Relay on the SMU and AUX port boards (input relay)
e-K*xx*	Relay on the port expander board (port expander relay)

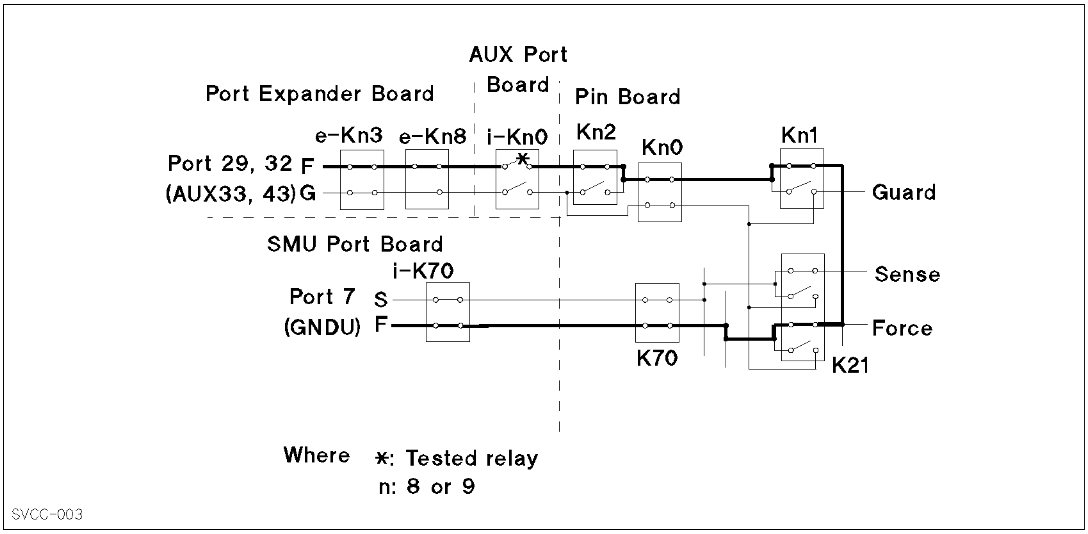
Test Circuit and Test Operation

Input Relay Test

In the following paragraphs, the test circuit and test operation is described when an SMU is connected to the AUX33 or AUX43 port, which is on the port expander.

- i-K80 and i-K90 Force Side Test with SMU

  When the SMU is connected to the AUX33 or AUX43, the test path is as follows:



- Make test of i-K80 and i-K90 force side contact
  1. Make i-K80 or i-K90 input relay.
  2. Force 90 mA from the SMU (100 mA range, 1.9 V compliance).
  3. Measure voltage of the SMU.
  4. Calculate impedance and compare with test limits (Table C-2).
- Break test of i-K80 and i-K90 force side contact
  1. Break i-K80 or i-K90 input relay.
  2. Force 10 V from the SMU (20 V range, 100 μA compliance).
  3. Measure current of the SMU.
  4. Calculate impedance and compare with test limits (Table C-2).

Table C-2. i-K80 and i-K90 Test Limits (with SMU)

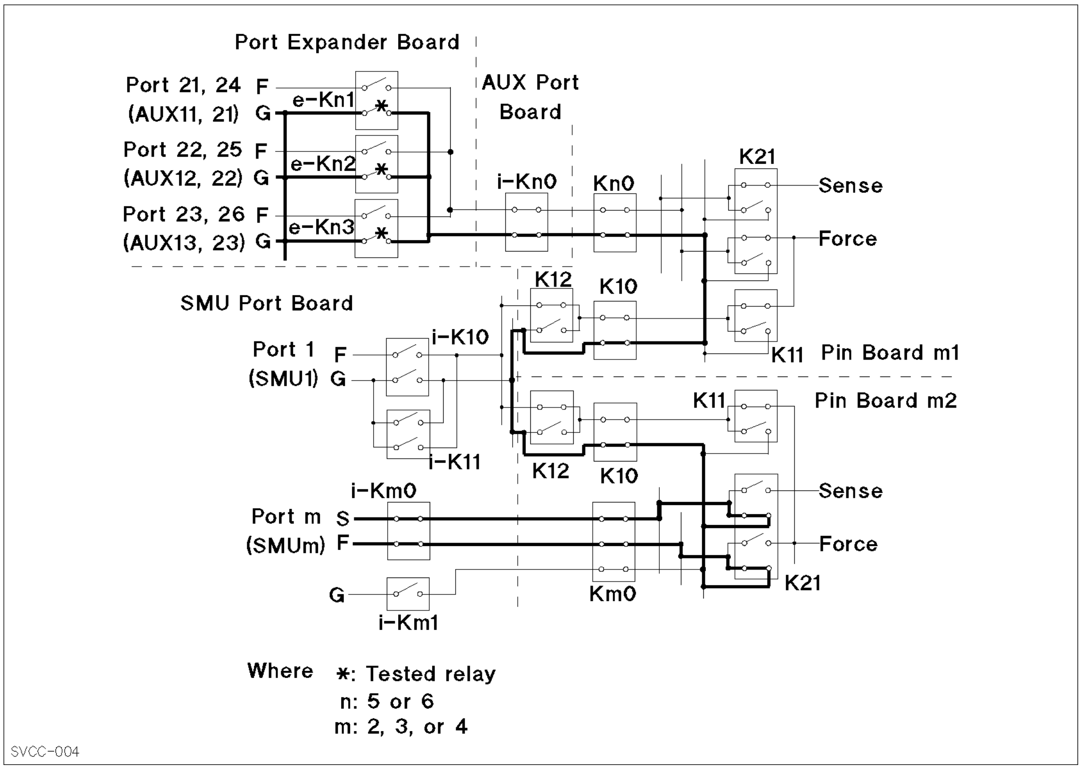
Port	Relay	Make	Break
29, 32	K80, K90 force (SMU)	0 Ω to 10 Ω	≥1 MΩ

Port Expander Relay Test

In this section, the test circuits and test operations of the Port Expander Relay Test are described. The Port Expander Relay Test is executed using the SMU and AUX port boards and pin boards in block 1 of the SWM.

- e-K51, e-K52, e-K53, e-K61, e-K62, e-K63 Guard Side Test

  The test path for the e-K51, e-K52, e-K53, e-K61, e-K62, or e-K63 guard side test is as follows:



□ Make test of e-K51, e-K52, e-K53, e-K61, e-K62, and e-K63 guard side contact

1. Make e-K51, e-K52, e-K53, e-K61, e-K62, or e-K63 relay.
2. Force 90 mA from SMUm (100 mA range, 1.9 V compliance).
3. Measure voltage value of SMUm.
4. Calculate the impedance and compare with test limits (Table C-3).

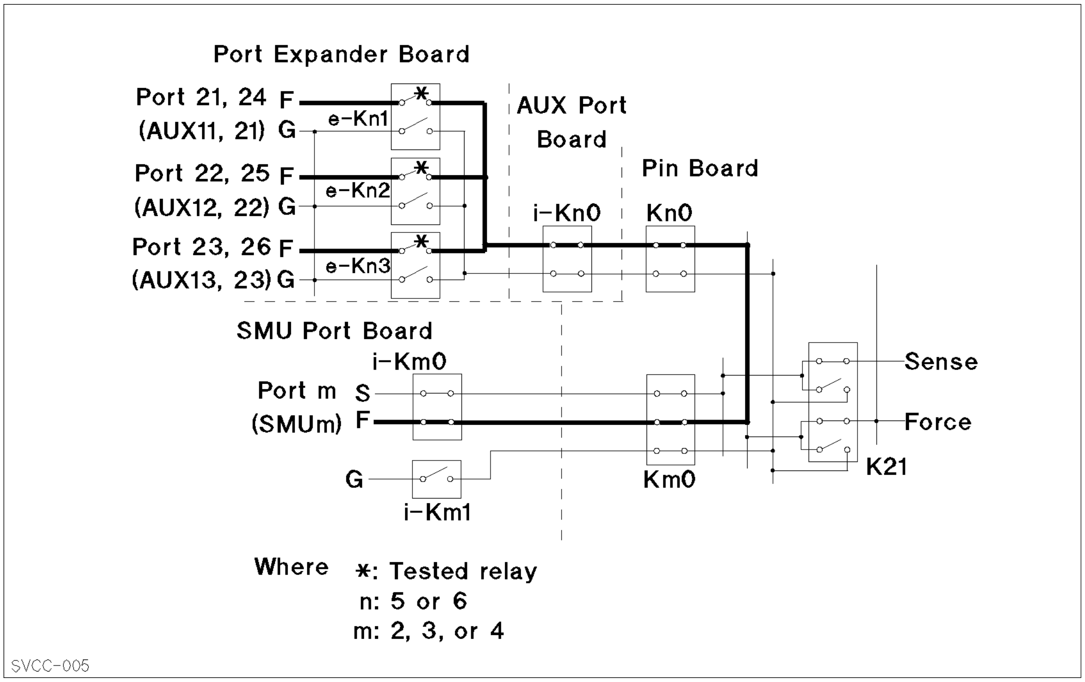
□ Break test of e-K51, e-K52, e-K53, e-K61, e-K62, and e-K63 guard side contact

1. Break e-K51, e-K52, e-K53, e-K61, e-K62, or e-K63 relay.
2. Force 10 V from SMUm (20 V range, 100 μA compliance).
3. Measure current value of SMUm.
4. Calculate the impedance and compare with test limits (Table C-3).

Where SMUm is SMU2, SMU3, or SMU4; SMUm is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU found is used.

- e-K51, e-K52, e-K53, e-K61, e-K62, e-K63 Force Side Test

  The test path for the e-K51, e-K52, e-K53, e-K61, e-K62, or e-K63 force side test is as follows:



- If VS is connected to the test port:
  - Make test of e-K51, e-K52, e-K53, e-K61, e-K62, and e-K63 force side contact
    1. Make e-K51, e-K52, e-K53, e-K61, e-K62, or e-K63 relay.
    2. Force 10 μA from SMUm (1 mA range, 0 V compliance).
    3. Force 0.5 V from VS (20 V range, 100 mA limiter).
    4. Measure voltage value of SMUm.
    5. Compare with test limits (Table C-3).
  - Break test of e-K51, e-K52, e-K53, e-K61, e-K62, and e-K63 force side contact
    1. Break e-K51, e-K52, e-K53, e-K61, e-K62, or e-K63 relay.
    2. Force 10 μA from SMUm (1 mA range, 0 V compliance).
    3. Force 0.5 V from VS (20 V range, 100 mA limiter).
    4. Measure voltage value of SMUm.
    5. Compare with test limits (Table C-3).
- If VM is connected to a test port:
  - Make test of e-K51, e-K52, e-K53, e-K61, e-K62, and e-K63 force side contact
    1. Make e-K51, e-K52, e-K53, e-K61, e-K62, or e-K63 relay.
    2. Force -0.5 V from SMUm (2 V range, 10 mA compliance).
    3. Measure voltage using VM and compare with test limits (Table C-3).
    4. If passed, force 0.5 V from SMUm (2 V range, 10 mA compliance).
    5. Measure voltage using VM and compare with test limits (Table C-3).

- Break test of e-K51, e-K52, e-K53, e-K61, e-K62, and e-K63 force side contact
  1. Break e-K51, e-K52, e-K53, e-K61, e-K62, or e-K63 relay.
  2. Force −0.5 V from SMUm (2 V range, 10 mA compliance).
  3. Measure voltage using VM and compare with test limits (Table C-3).
  4. If failed, force 0.5 V from SMUm (2 V range, 10 mA compliance).
  5. Measure voltage using VM and compare with test limits (Table C-3).

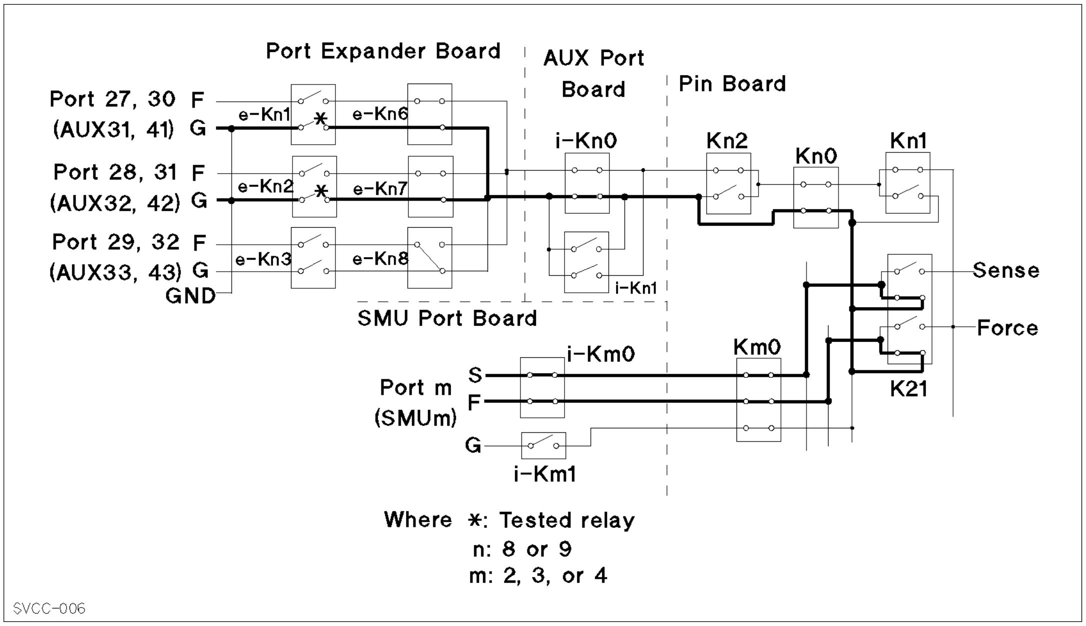
□ If a BNC shorting cap is put on a test port:

- Make test of e-K51, e-K52, e-K53, e-K61, e-K62, and e-K63 force side contact
  1. Make e-K51, e-K52, e-K53, e-K61, e-K62, or e-K63 relay.
  2. Force 90 mA from SMUm (100 mA range, 1.9 V compliance).
  3. Measure voltage value of SMUm.
  4. Calculate the impedance and compare with test limits (Table C-3).
- Break test of e-K51, e-K52, e-K53, e-K61, e-K62, and e-K63 force side contact
  1. Break e-K51, e-K52, e-K53, e-K61, e-K62, or e-K63 relay.
  2. Force 10 V from SMUm (20 V range, 100 μA compliance).
  3. Measure current value of SMUm.
  4. Calculate the impedance and compare with test limits (Table C-3).

Where SMUm is SMU2, SMU3, or SMU4; SMUm is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU found is used.

■ e-K81, e-K82, e-K91, and e-K92 Guard Side Test

The test path for the e-K81, e-K82, e-K91, and e-K92 guard side test is as follows:



□ Make test of e-K81, e-K82, e-K91, and e-K92 guard side contact

1. Make e-K81, e-K82, e-K91, or e-K92 relay.
2. Force 90 mA from SMUm (100 mA range, 1.9 V compliance).
3. Measure voltage value of SMUm.
4. Calculate the impedance and compare with test limits (Table C-3).

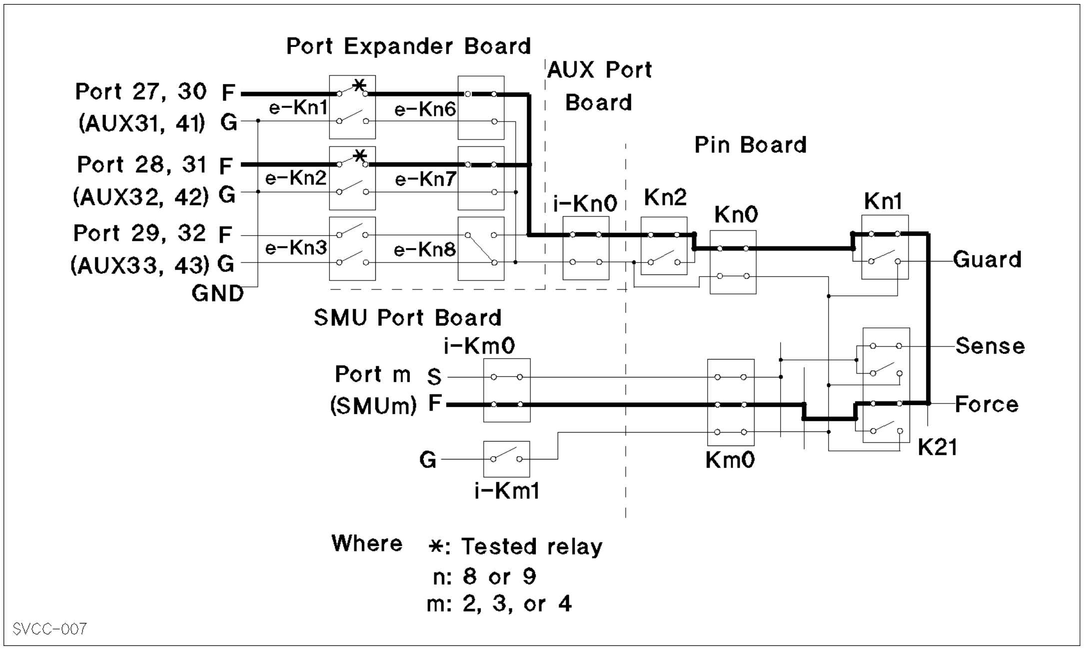
□ Break test of e-K81, e-K82, e-K91, and e-K92 guard side contact

1. Break e-K81, e-K82, e-K91, or e-K92 relay.
2. Force 10 V from SMUm (20 V range, 100 μA compliance).
3. Measure current value of SMUm.
4. Calculate the impedance and compare with test limits (Table C-3).

Where SMUm is SMU2, SMU3, or SMU4; SMUm is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU found is used.

- e-K81, e-K82, e-K91, and e-K92 Force Side Test

When the VS, VM, or BNC shorting cap is connected to the test path, the test path is as follows:



This test is also a make test of the normally open e-Kn6, e-Kn7, and e-Kn8 relays; where n is 8 or 9.

- □ If VS is connected to the test port:
  - Make test of e-K81, e-K82, e-K91, and e-K92 force side contact
    1. Make e-K81, e-K82, e-K91, or e-K92 relay.
    2. Force 10 μA from SMUm (1 mA range, 0 V compliance).
    3. Force 0.5 V from VS (20 V range, 100 mA limiter).
    4. Measure voltage value of SMUm.
    5. Compare with test limits (Table C-3).
  - Break test of e-K81, e-K82, e-K91, and e-K92 force side contact
    1. Break e-K81, e-K82, e-K91, or e-K92 relay.
    2. Force 10 μA from SMUm (1 mA range, 0 V compliance).
    3. Force 0.5 V from VS (20 V range, 100 mA limiter).
    4. Measure current value of SMUm.
    5. Compare with test limits (Table C-3).
- □ If VM is connected to the test port:
  - Make test of e-K81, e-K82, e-K91, and e-K92 force side contact
    1. Make e-K81, e-K82, e-K91, or e-K92 relay.
    2. Force -0.5 V from SMUm (2 V range, 10 mA compliance).
    3. Measure voltage using VM and compare with test limits (Table C-3).
    4. If passes, force 0.5 V from SMUm (2 V range, 10 mA compliance).

5. Measure voltage using VM and compare with test limits (Table C-3).

- Break test of e-K81, e-K82, e-K91, and e-K92 force side contact

1. Break e-K81, e-K82, e-K91, or e-K92 relay.
2. Force −0.5 V from SMUm (2 V range, 10 mA compliance).
3. Measure voltage using VM and compare with test limits (Table C-3).
4. If fails, force 0.5 V from SMUm (2 V range, 10 mA compliance).
5. Measure voltage using VM and compare with test limits (Table C-3).

□ If a BNC shorting cap is put on a test port:

- Make test of e-K81, e-K82, e-K91, and e-K92 force side contact

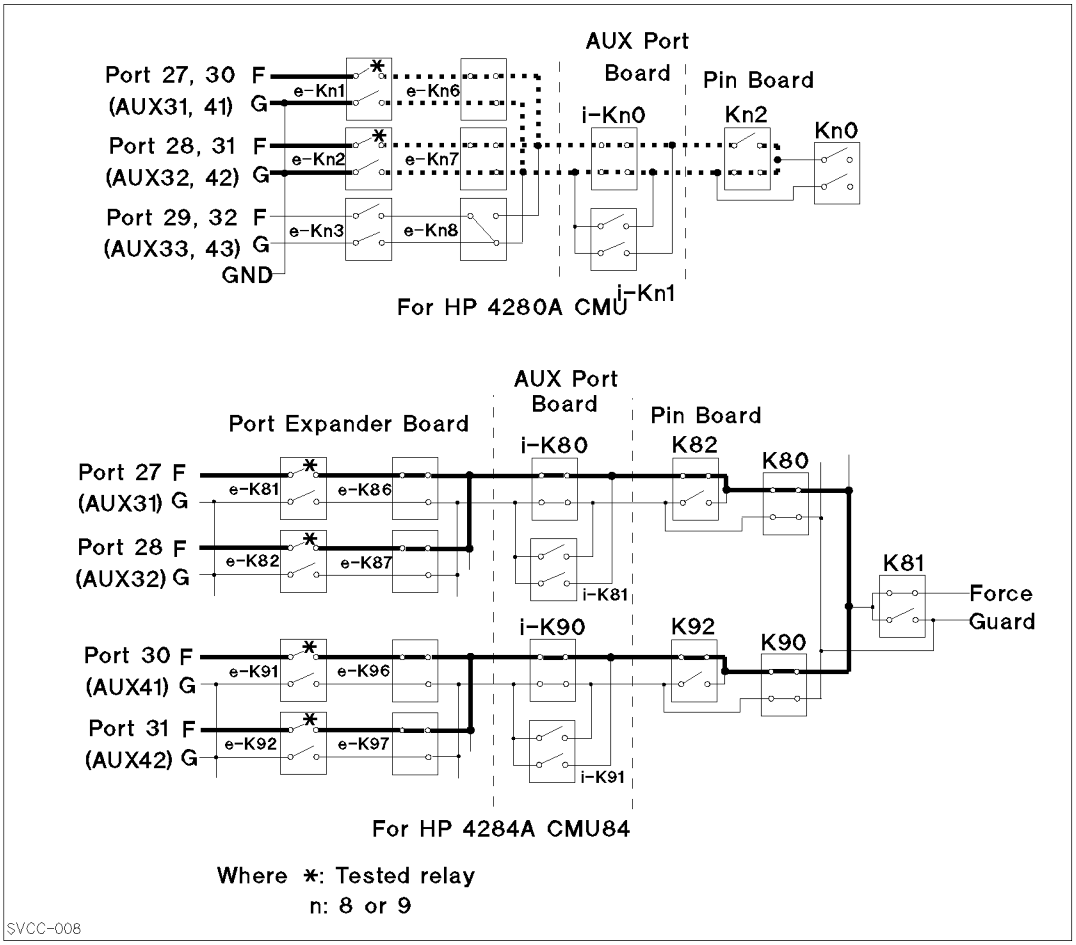
1. Make e-K81, e-K82, e-K91, or e-K92 relay.
2. Force 90 mA from SMUm (100 mA range, 1.9 V compliance).
3. Measure voltage value of SMUm.
4. Calculate the impedance and compare with test limits (Table C-3).

- Break test of e-K81, e-K82, e-K91, and e-K92 force side contact

1. Break e-K81, e-K82, e-K91, or e-K92 relay.
2. Force 10 V from SMUm (20 V range, 100 μA compliance).
3. Measure voltage value of SMUm.
4. Calculate the impedance and compare with test limits (Table C-3).

Where SMUm is SMU2, SMU3, or SMU4; SMUm is defined by searching through SMU2, SMU3, and SMU4, in this order, and the first SMU found is used.

When the CMU or CMU84 is connected to the test path, the test path is as follows:



If the CMH and CML terminals of the CMU are connected to AUX31/32 and AUX41/42 port, the guard side paths of ports 8 and 9 are led to circuit common of the CMU. Circuit common of the CMU is connected to circuit common of the DCS through the chassis.

If the H_C-H_P and L_P-L_C terminals of the CMU84 are connected to AUX31/32 and AUX41/42 port, the guard side paths of ports 8 and 9 are led to chassis ground of the CMU84. Chassis ground of the CMU84 is connected to circuit common of the DCS through the chassis of the DCS.

□ If CMU is connected to the test port:

- Make and break test of e-K81 and e-K82 force side contact

1. Set the connection mode of the CMU to CN19 (grounded measurement mode).
2. Make e-K81 or e-K82 relay.
3. Measure capacitance between force and guard paths and keep the value in memory.
4. Break e-K81 or e-K82 relay.
5. Measure capacitance between force and guard paths.
6. Calculate the difference between the two capacitances and compare with the test limits (Table C-3).

- Make and break test of e-K91 and e-K92 force side contact
  1. Set the connection mode of the CMU to CN16 (grounded measurement mode).
  2. Make e-K91 or e-K92 relay.
  3. Measure capacitance between force and guard paths and keep the value in memory.
  4. Break e-K91 or e-K92 relay.
  5. Measure capacitance between force and guard paths.
  6. Calculate the difference between the two capacitances and compare with the test limits (Table C-3).

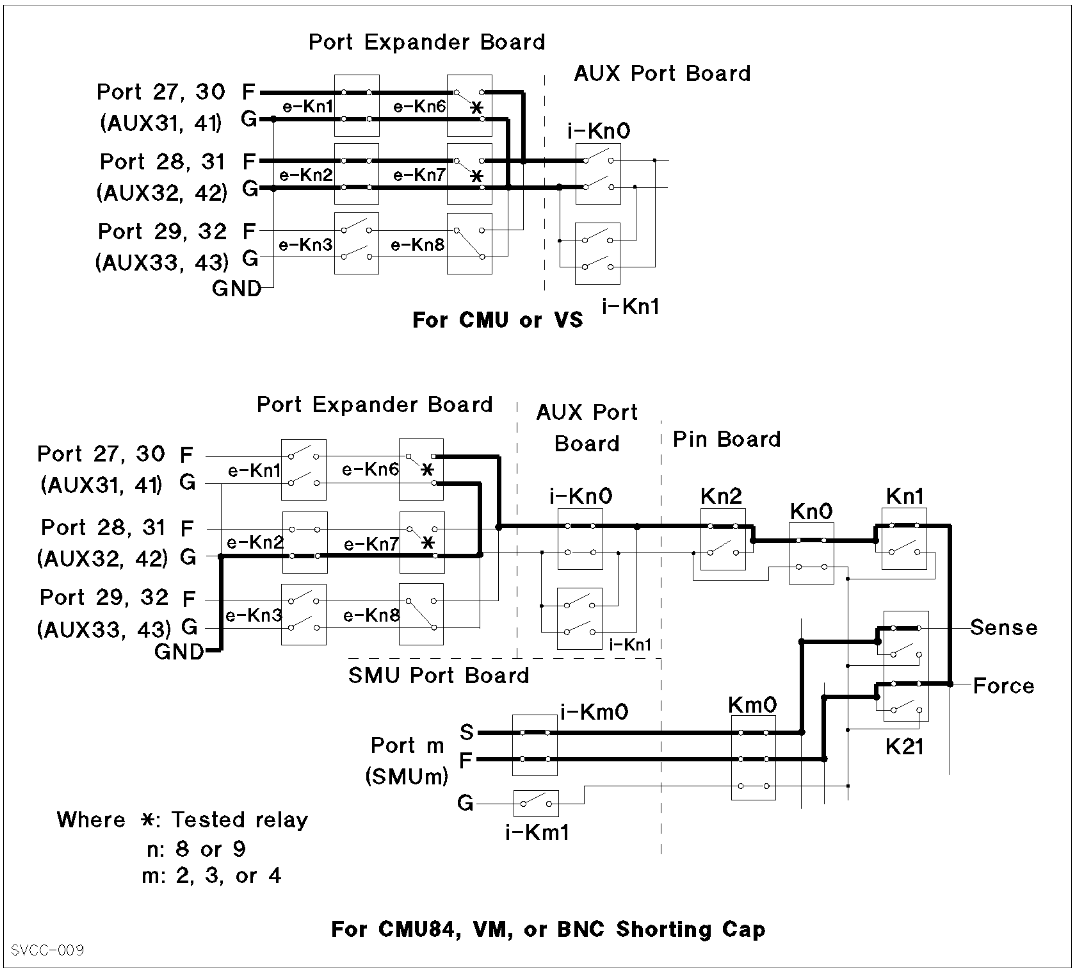
□ If CMU84 is connected to the test port:

- Make test of e-K81, e-K82, e-K91, and e-K92 force side contact
  1. Make e-K81, e-K82, e-K91, or e-K92 relay.
  2. Set the CMU84 to Z-θ measurement mode, 30 mVrms measurement signal level, and 1 KHz measurement frequency.
  3. Measure impedance and compare with the test limits (Table C-3).
- Break test of e-K81, e-K82, e-K91, and e-K92 force side contact
  1. Break e-K81, e-K82, e-K91, or e-K92 relay.
  2. Set the CMU84 to Z-θ measurement mode, 30 mVrms measurement signal level, and 1 KHz measurement frequency.
  3. Measure impedance and compare with the test limits (Table C-3).

■ e-K86, e-K87, e-K96, and e-K97 Transfer Test

If the CMU or VS is connected to a tested port, both the normally closed and the normally open side of the relays are tested. Otherwise, only the normally open side of the relay is tested.

The test paths for the e-K86, e-K87, e-K96, and e-K97 transfer relays are as follows:



□ If VS is connected to AUX31, AUX32, AUX41, or AUX42 port:

- Make test of normally closed contact of e-K86, e-K87, e-K96, and e-K97 relay

  1. Set e-K86, e-K87, e-K96, or e-K97 to normally closed state.
  2. Force 2.0 V from VS (20 V range, 100 mA limiter).
  3. Measure current value at VS.
  4. Calculate impedance and compare with test limits (Table C-4).

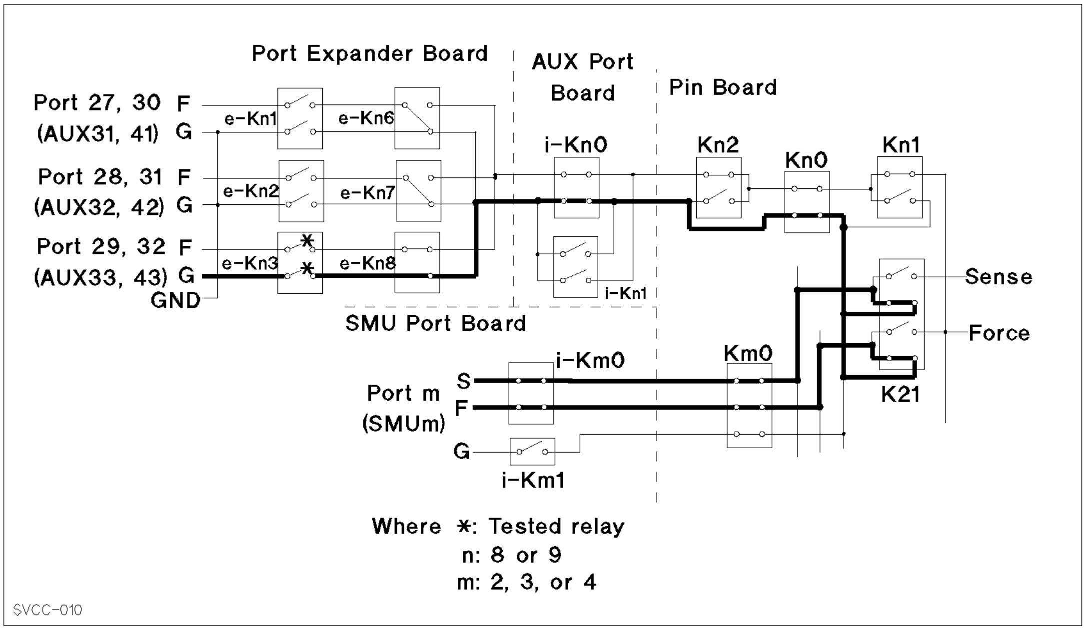
- Break test of normally closed contact of e-K86, e-K87, e-K96, and e-K97 relay

  1. Make contact of normally open side of e-K86, e-K87, e-K96, or e-K97.
  2. Force 10.0 V from VS (20 V range, 100 μA limiter).
  3. Measure current value at VS.
  4. Calculate impedance and compare with test limits (Table C-4).

- If CMU is connected to AUX31/41 or AUX32/42 port:
  - e-K86 and e-K87
    - Make test of normally closed contact of e-K86 and e-K87 relay
      1. Set e-K86 or e-K87 to normally closed state.
      2. Set the connection mode of the CMU to CN23 (L-R measurement mode).
      3. Measure resistance.
      4. Compare with test limits (Table C-4).
    - Break test of normally closed contact of e-K86 and e-K87 relay
      1. Make contact of normally open side of e-K86 or e-K87.
      2. Set the connection mode of the CMU to CN23 (L-R measurement mode).
      3. Measure resistance.
      4. Compare with test limits (Table C-4).
  - e-K96 and e-K97
    - Make test of normally closed contact of e-K96 and e-K97 relay
      1. Set e-K96 or e-K97 to normally closed state.
      2. Set the connection mode of the CMU to CN22 (L-R measurement mode).
      3. Measure resistance.
      4. Compare with test limits (Table C-4).
    - Break test of normally closed contact of e-K96 and e-K97 relay
      1. Make contact of normally open side of e-K96 or e-K97.
      2. Set the connection mode of the CMU to CN22 (L-R measurement mode).
      3. Measure resistance.
      4. Compare with test limits (Table C-4).
- If CMU84, VM, or BNC shorting cap is connected to AUX31/41 or AUX32/42 port, only the break test of normally open side contact is executed:
  1. Set e-K86, e-K87, e-K96, or e-K97 to normally closed state.
  2. Make e-K82, e-K81, e-K92, or e-K91 relay, respectively.
  3. Force 10.0 V from SMUm (20 V range, 100 μA compliance).
  4. Measure current value at SMUm.
  5. Calculate impedance and compare with test limits (Table C-4).

- e-K83 and e-K93 Guard Side Test

The test path for e-K83 and e-K93 guard side is shown as follows:



□ Make test of e-K83 and e-K93 guard side contact

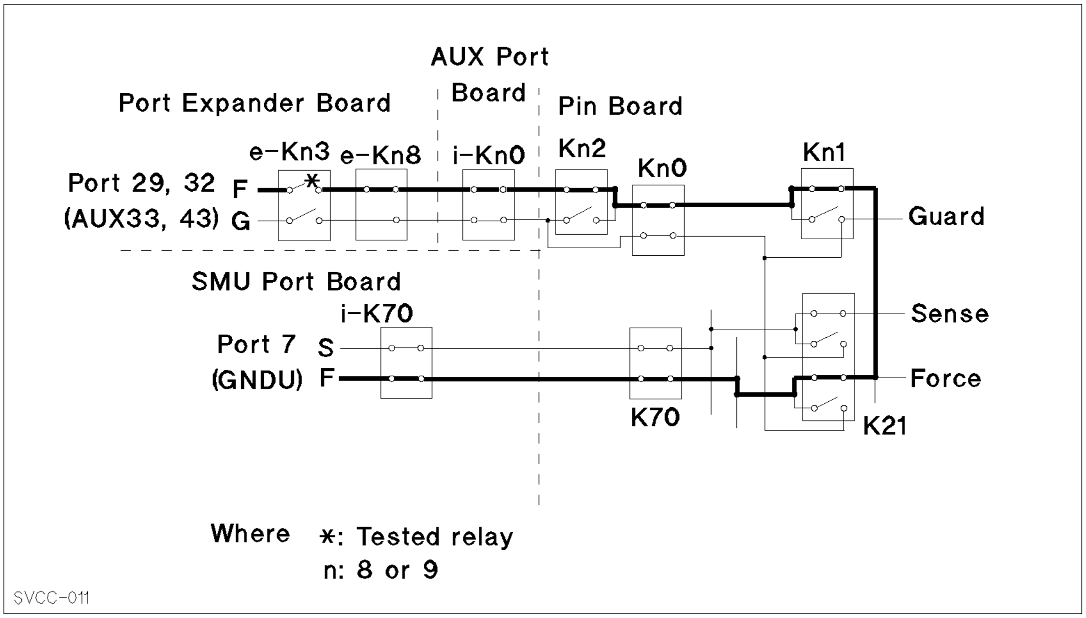
1. Make e-K83 or e-K93 relay.
2. Force 0.1 V from SMUm (2 V range, 100 mA compliance).
3. Force 0.0 V from additional SMU (2 V range, 100 mA compliance).
4. Measure current value at SMUm.
5. Calculate impedance and compare with test limits (Table C-3).

□ Break test of e-K83 and e-K93 guard side contact

1. Break e-K83 or e-K93 relay.
2. Force 10 V from SMUm (20 V range, 100 μA compliance).
3. Force 0.0 V from additional SMU (2 V range, 100 mA compliance).
4. Measure current value at SMUm.
5. Calculate impedance and compare with test limits (Table C-3).

■ e-K83 and e-K93 Force Side Test

The test path for e-K83 and e-K93 force side is shown as follows:



□ Make test of e-K83 and e-K93 force side contact

1. Make e-K83 or e-K93 relay.
2. Force 90 mA from SMUm (100 mA range, 1.9 V compliance).
3. Measure voltage value at SMUm.
4. Calculate impedance and compare with test limits (Table C-3).

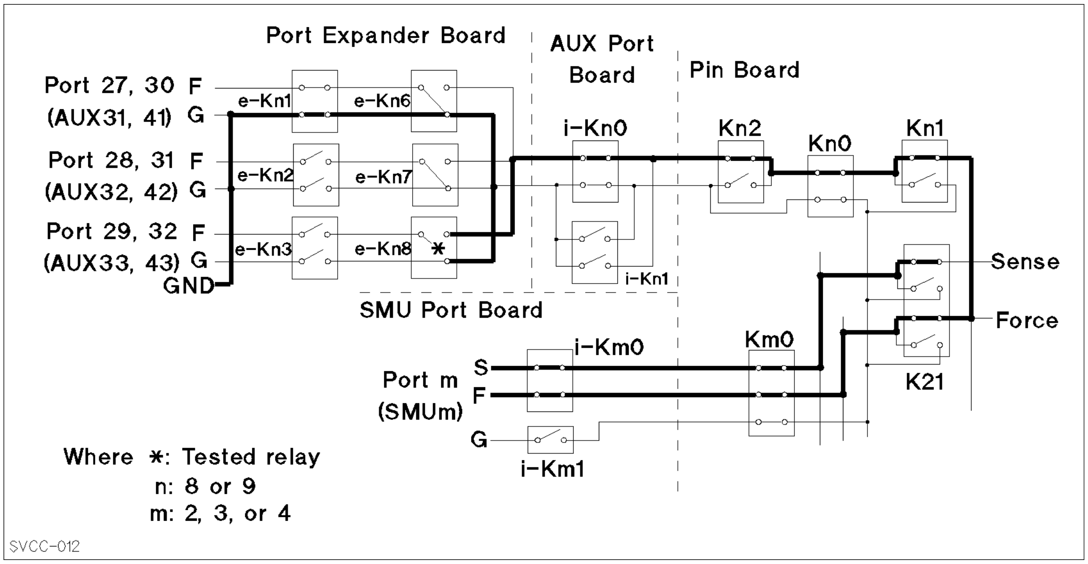
Note that this test includes the make test of the normally open side contact of the e-K88 and e-K98 relays.

□ Break test of e-K83 and e-K93 force side contact

1. Break e-K83 or e-K93 relay.
2. Force 10 V from SMUm (20 V range, 100 μA compliance).
3. Measure current value at SMUm.
4. Calculate impedance and compare with test limits (Table C-3).

■ e-K88 and e-K98 Test

The test path for the e-K88 and e-K98 test is shown as follows:



This test checks the break operation of the normally open side contact.

1. Set e-K88 or e-K98 to normally closed state.
2. Make e-K81 or e-K91.
3. Force 10 V from SMUm (20 V range, 100 μA compliance).
4. Measure current value at SMUm.
5. Calculate impedance and compare with test limits (Table C-4).

Table C-3 and Table C-4 list the test limits of the Port Expander Relay Test.

Table C-3. Port Expander Relay Test Limits

Port	Relay	Test (Connected Unit)	Make	Break
21 (AUX11), 22 (AUX12), 23 (AUX13), 24 (AUX21), 25 (AUX22), 26 (AUX23)	e-K51, e-K52, e-K53, e-K61, e-K62, e-K63	guard (all units)	0 Ω to 10 Ω	≥1 MΩ
		force (VS)	0.487 V to 0.513 V	−3 mV to 3 mV
		force (VM)	(forced voltage) ±3 mV	[1]
		force (BNC shorting cap)	0 Ω to 10 Ω	≥1 MΩ
27 (AUX31), 28 (AUX32), 30 (AUX41), 31 (AUX42)	e-K81, e-K82, e-K91, e-K92	guard (all units)	0 Ω to 10 Ω	≥1 MΩ
		force (VS)	0.487 V to 0.513 V	−3 mV to 3 mV
		force (VM)	(forced voltage) ±3 mV	[1]
		force (BNC shorting cap)	0 Ω to 10 Ω	≥1 MΩ
		force (CMU)	C (make) − C (break) ≥ 100 pF	
		force (CMU84)	0 Ω to 10 Ω	≥1 MΩ
29 (AUX33), 32 (AUX43)	e-K83, e-K93	guard (SMU)	170 Ω to 235 Ω	≥1 MΩ
		force (SMU)[2]	0 Ω to 10 Ω	≥1 MΩ

1 If the measured voltage of the VM does not correspond to the output voltage (−0.5 V to +0.5 V) of the SMU, the break test of the port expander relay is recognized to have passed.

2 This test also checks the make operation of the normally open side of transfer relay e-K88 or e-K98.

Table C-4. Port Expander Relay Test Limits (Transfer Relays)

Port	Relay	Connected Unit	Contact	Make	Break
27 (AUX31), 28 (AUX32), 30 (AUX41), 31 (AUX42)	e-K86, e-K87, e-K96, e-K97	VS	normally closed side	0 Ω to 10 Ω	≥1 MΩ
		CMU	normally closed side	0 Ω to 10 Ω	≥900 Ω
		CMU84, VM, BNC shorting cap	normally open side	—	≥1 MΩ
29 (AUX33), 32 (AUX43)	e-K88, e-K98	SMU	normally open side	—	≥1 MΩ

SMU Test

The SMU Test operation for the AUX33 and SMU43 is the same as that of other SMU ports. The test limits of the SMU Test are as follows:

Table C-5. SMU Repeat Test Limits (AUX33 and AUX43)

Nominal Resistance	Voltage/Current Range	Value		Tolerance(%)
		Voltage	Current	SMU33, 43
1 MΩ	200 V/100 μA[1]	±92 V	±92 μA	±0.669
		±72 V	±72 μA	±0.729
	100 V/100 μA	±52 V	±52 μA	±0.740
		±47 V	±47 μA	±0.772
		±42 V	±42 μA	±0.809
	40 V/100 μA	±37 V	±37 μA	±0.777
		±32 V	±32 μA	±0.829
		±27 V	±27 μA	±0.898
		±22 V	±22 μA	±1.000
	20 V/100 μA	±17 V	±17 μA	±1.103
		±12 V	±12 μA	±1.375
	20 V/10 μA	±7 V	±7 μA	±0.580
		±2 V	±2 μA	±1.330
		±1.2 V	±1.2 μA	±1.288
	20 V/1 μA	±0.4 V	±0.4 μA	±1.585

1 This range is tested only when the DCS is equipped with HP 41420A 200 V/1 A SMUs.

Table C-6. SMU Spot Test Limits (AUX33 and AUX43)

Nominal Resistance	Voltage/Current Range	Value		Tolerance(%)
		Voltage	Current	SMU33, 43
1 kΩ	20 V/10 mA	±5 V	±5 mA	±0.820
	20 V/1 mA	±0.5 V	±0.5 mA	±2.782
10 Ω	2 V/1 A[1]	±1 V	±100 mA	±14.788
	20 V/100 mA	±0.5 V	±50 mA	±15.652
1 Ω	2 V/1 A[1]	±1 V	±1 A	±130.870

1 This range is tested only when the DCS is equipped with HP 41420A 200 V/1 A SMUs.

VS Test

The VS Test operation for the port expander ports is the same as that of AUX ports without a port expander.

The test limits of the VS Test are the same as for the VS Test without a port expander. The test limits are as follows:

Table C-7. VS Test Limits (AUX11–13, 21–23, 31, 32, 41, and 42)

Range	Nominal value	Error
20 V	−15 V	±52.5 mV
	1 V	±31.5 mV
	10 V	±45.0 mV
40 V	35 V	±92.5 mV

VM Test

The VM Test operation for the port expander ports is the same as that of AUX ports without the port expander.

The test limits of the VM Test are the same as for the VM Test without a port expander. The test limits are as follows:

Table C-8. VM Test Limits (AUX11–13, 21–23, 31, 32, 41, and 42)

Range	Nominal value	Error	
		AUX11–13, 21–23	AUX31, 32, 41, 42
20 V	−15 V	±35.0 mV	
2 V	1 V	±3.21 mV	±3.28 mV
20 V	10 V	±30.0 mV	
40 V	35 V	±75.0 mV	

CMS C-G and Bias Test

The CMS C-G and Bias Test operation for the port expander ports is the same as that of AUX ports without a port expander. The CMH and CML terminals must be connected to AUX31 and 41 or AUX32 and 42, respectively.

The test limits of the CMS C-G and Bias Test are the same as for the CMS C-G and Bias Test without a port expander. The test limits are as follows:

Table C-9. CMS C-G Test Limits (AUX 31–41, 32–42)

Nominal Value	Range	Test Signal Level	Error
1 mS (1 kΩ)	1 mS	30 mVrms	$\pm$50 μS
100 pF/0.0 S	100 pF/1 mS	10 mVrms	$\pm$0.8 pF/$\pm$5 μS
100 pF/0.0 S	100 pF/1 mS	30 mVrms	$\pm$0.6 pF/$\pm$4 μS
1000 pF/0.0 S	1000 pF/10 mS	10 mVrms	$\pm$19 pF/$\pm$100 μS
1000 pF/0.0 S	1000 pF/10 mS	30 mVrms	$\pm$17 pF/$\pm$90 μS

Table C-10. Stray Capacitance Test Limit (AUX 31–41, 32–42)

Range	Test Signal	Error
Auto	30 mVrms	$\pm$6 pF

Table C-11. CMS Bias Test Limits (AUX 31–41, 32–42)

Range	Nominal Value	SMU Measurement Range	Error
1 V	1 V	2 V	$\pm$14.1 mV
10 V	$-$10 V	20 V	$\pm$45 mV
100 V	80 V	100 V	$\pm$270 mA

CMU84 C-G and Bias Test

The CMU84 C-G and Bias Test operation for the port expander ports is the same as that of AUX ports without the port expander. The CMH84 and CML84 terminals must be connected to AUX31 and 41 or AUX32 and 42, respectively.

The test limits of the CMU84 C-G Test are the same as for the CMU84 C-G Test without a port expander; however, the test limits of the CMU84 Bias Test have changed, and are as follows:

Table C-12. CMU84 C-G Test limits (AUX31 and 41)

Nominal Value	CMU84 Range	Frequency	Tolerance (Capacitance/Conductance)
100 pF/0.0 S	100 pF/6.3 μS	10 kHz	±0.5 pF/±31.5 nS
	100 pF/63 μS	100 kHz	±0.6 pF/±378 nS
	100 pF/630 μS	1 MHz	±1.1 pF/±5.67 μS
1000 pF/0.0 S	1000 pF/6.3 μS	1 kHz	±4.0 pF/±25.2 nS
	1000 pF/63 μS	10 kHz	±4.0 pF/±252 nS
	1000 pF/630 μS	100 kHz	±5.0 pF/3.78 μS
	1000 pF/6.3 mS	1 MHz	±21.0 pF/±151 μS
10 nF/0.0 S	10 nF/63 μS	1 kHz	±40.0 pF/±252 nS
	10 nF/630 μS	10 kHz	±40.0 pF/±2.52 μS
	10 nF/6.3 mS	100 kHz	±70.0 pF/±63 μS
100 nF/0.0 S	100 nF/630 μS	1 kHz	±400 pF/±2.52 μS
	100 nF/6.3 mS	10 kHz	±400 pF/±50.4 μS
100 Ω	6.3 mS/100 nF	10 kHz	±1.69 nF/±76.3 μS
	6.3 mS/10 nF	100 kHz	±179 pF/±82.6 μS
	6.3 mS/1000 pF	1 MHz	±29.0 pF/±143 μS
1 kΩ	630 μS/100 nF	1 kHz	±576 pF/±3.63 μS
	630 μS/10 nF	10 kHz	±57.6 pF/±3.63 μS
	630 μS/1000 pF	100 kHz	±8.35 pF/±4.26 μS
	630 μS/100 pF	1 MHz	±1.25 pF/±9.89 μS

Table C-13. Stray Capacitance Test Limits (AUX31 and 41)

Range	Frequency	Error
Auto	1 MHz	6 pF
	100 kHz	
	10 kHz	
	1 kHz	

Table C-14.
CMU84 Bias Test Limits: Without ±40 V dc Bias Source (AUX31 and 41)

Nominal Value	SMU Range	Error
1.5 V	2 V	±75 mV
2.0 V	2 V	±100 mV

Table C-15.
CMU84 Bias Test Limits: With ±40 V dc Bias Source (AUX31 and 41)

Nominal Value	CMU84 Range	SMU Range	Error
0.0 V	4 V	2 V	±2.5 mV
±0.1 V	4 V	2 V	±2.6 mV
±2.0 V	4 V	2 V	±5.5 mV
±6.0 V	8 V	20 V	±21.4 mV
±14.0 V	20 V	20 V	±36.0 mV
±30.0 V	40 V	40 V	±75.0 mV
±40.0 V	40 V	40 V	±90.0 mV

DC Leak Test

The DC Leak Test operation for the port expander ports is the same as that of SMU ports without a port expander.

The test limits of the DC Leak Test are the same as for the DC Leak Test without a port expander. The test limits are as follows:

Table C-16. DC Leak Open Test Limits (AUX33 and 43)

Voltage	Tolerance
	SMU33, 43
20 V	±3 nA

Table C-17. DC Leak Short Test Limits (AUX33 and 43)

Voltage	Tolerance
	SMU33,43
100 V	±11 nA

4062 W/ DVM Test

The GNDU Test and Kelvin Connection Test do not use signal paths in the port expander.

Test operation for Voltage Accuracy Test, Current Accuracy Test, VS Test, and VM Test is the same as those without a port expander.

The following tables show the test limits for the Voltage Accuracy Test, Current Accuracy Test, VS Test, and VM Test.

Table C-18. Voltage Accuracy Test Limits (AUX33 and 43)

Source Mode	Range	Value	Tolerance SMU33, 43	Uncertainty[1]
Voltage Source	2 V	±2 V	±2.1 mV	±66 μV
		0 V	±1.1 mV	±2.4 μV
	20 V	±20 V	±20 mV	±820 μV
		0 V	±10 mV	±2.4 μV
	40 V	±40	±40 mV	±1.34 mV
		0 V	±20 mV	±2.4 μV
	100 V	±100 V	±100 mV	±2.9 mV
		0 V	±50 mV	±2.4 μV
	200 V[2]	±100 V	±150 mV	±2.9 mV
		0 V	±100 mV	±2.4 μV
Current Source (R = 1 MΩ)	2 V	±1.9 μA	±2.13 mV	±63.7 μV
		0 μA	±1.1 mV	±2.4 μV
	20 V	±19 μA	±19.5 mV	±794 μV
		0 A	±10 mV	±2.4 μV
	40 V	±39 μA	±39.5 mV	±1.314 mV
		0 μA	±20 mV	±2.4 μV
	100 V	±99 μA	±99.6 mV	±2.874 mV
		0 μA	±50 mV	±2.4 μV
	200 V[2]	±99 μA	±149.6 mV	±2.874 mV
		0 μA	±100 mV	±2.4 μV

1 Including DVM error.

2 This range is tested only when an HP 41420A 200 V/1 A SMU is connected to AUX33 or 43 port.

Table C-19. Current Accuracy Test Limits (AUX33 and 43)

Source Mode	Resistance	Range	Force Value	Tolerance SMU33, 43	Uncertainty[1]
Current Source Voltage Monitor	1 Ω[2]	1 A	1 A	±6.02 mA	±1.028 mA
	10 Ω	100 mA	100 mA	±302 μA	±27.8 μA
	1 kΩ	10 mA	10 mA	±32 μA	±7.25 μA
	1 kΩ	1 mA	1 mA	±3.02 μA	±728 nA
	1 kΩ	100 μA	90 μA	±280.18 nA	±68.46 nA
	1 MΩ	10 μA	10 μA	±33 nA	±7.75 μA
	1 MΩ	1 μA	1 μA	±7.1 nA	±778 pA
Voltage Source Current Monitor	1 Ω[2]	1 A	0.9 V	±5.518 mA	±925.6 μA
	10 Ω	100 mA	0.9 V	±281.8 μA	±65.56 μA
	1 kΩ	10 mA	9 V	±29.8 μA	±6.527 μA
	1 kΩ	1 mA	0.9 V	±2.818 μA	±655.6 nA
	1 kΩ	100 μA	0.09 V	±280.18 nA	±68.46 nA
	1 MΩ	10 μA	9 V	±30.7 nA	±6.977 nA
	1 MΩ	1 μA	0.9 V	±6.59 nA	±700.6 pA
	1 GΩ[3]	100 nA	90 V	±1.45 nA	±137.64 pA

1 Including DVM error and resistance error in system calibration module.

2 This range is tested only when the DCS is equipped with HP 41420A 200 V/1 A SMUs.

3 SMU1 forces specified voltage, an SMU connected to the AUX33 or 43 forces 0 V, and measured current.

Table C-20. VS Test Limits (AUX11–13, 21–23, 31, 32, 41, and 42)

Range	Nominal Value	Tolerance	Uncertainty[1]
20 V	±20 V	±30 mV	±820 μV
	0 V	±10 mV	±2.4 μV
40 V	±40 V	±60 mV	±1.34 mV
	0 V	±20 mV	±2.4 μV

1 Including DMV error.

Table C-21. VM Test Limits (AUX11–13, 21–23, 31, 32, 41, and 42)

Range	Nominal Value	Tolerance		Uncertainty[1]
		AUX11–13, 21–23	AUX31, 32, 41, 42	
2 V	±1.9 V	±2.06 mV	±2.13 mV	±63.7 μV
	0 V	±1.11 mV	±1.18 mV	±2.4 μV
20 V	±19 V	±19.5 mV	±19.5 mV	±794 μV
	0 V	±10 mV	±10 mV	±2.4 μV
40 V	±39 V	±39.5 mV	±39.5 mV	±1.314 mV
	0 V	±20 mA	±20 mA	±2.4 μV

1 Including DVM error.

Troubleshooting

This section covers the SWM troubleshooting and repair information when the SWM has the port expander. For information on troubleshooting other parts, see Chapter 3.

Note

If the system is installed in a clean room, take special precautions to preserve the air purity in the clean room if it becomes necessary to repair the system. Give a thorough air bath to tools, test equipment, field service inventories, and so on, when you take these items into the clean room.

Troubleshooting Flow Diagram

Figure C-2 provides a flow diagram to guide you through the troubleshooting process on the port expander.

This troubleshooting flow diagram makes extensive use of the hardware- and software-based troubleshooting aides—the START and PV4062 programs, and so on.

When errors are detected during the Port Expander Relay Test, record the errors and continue the PV4062 tests. Then follow the flow diagram in Figure C-2.

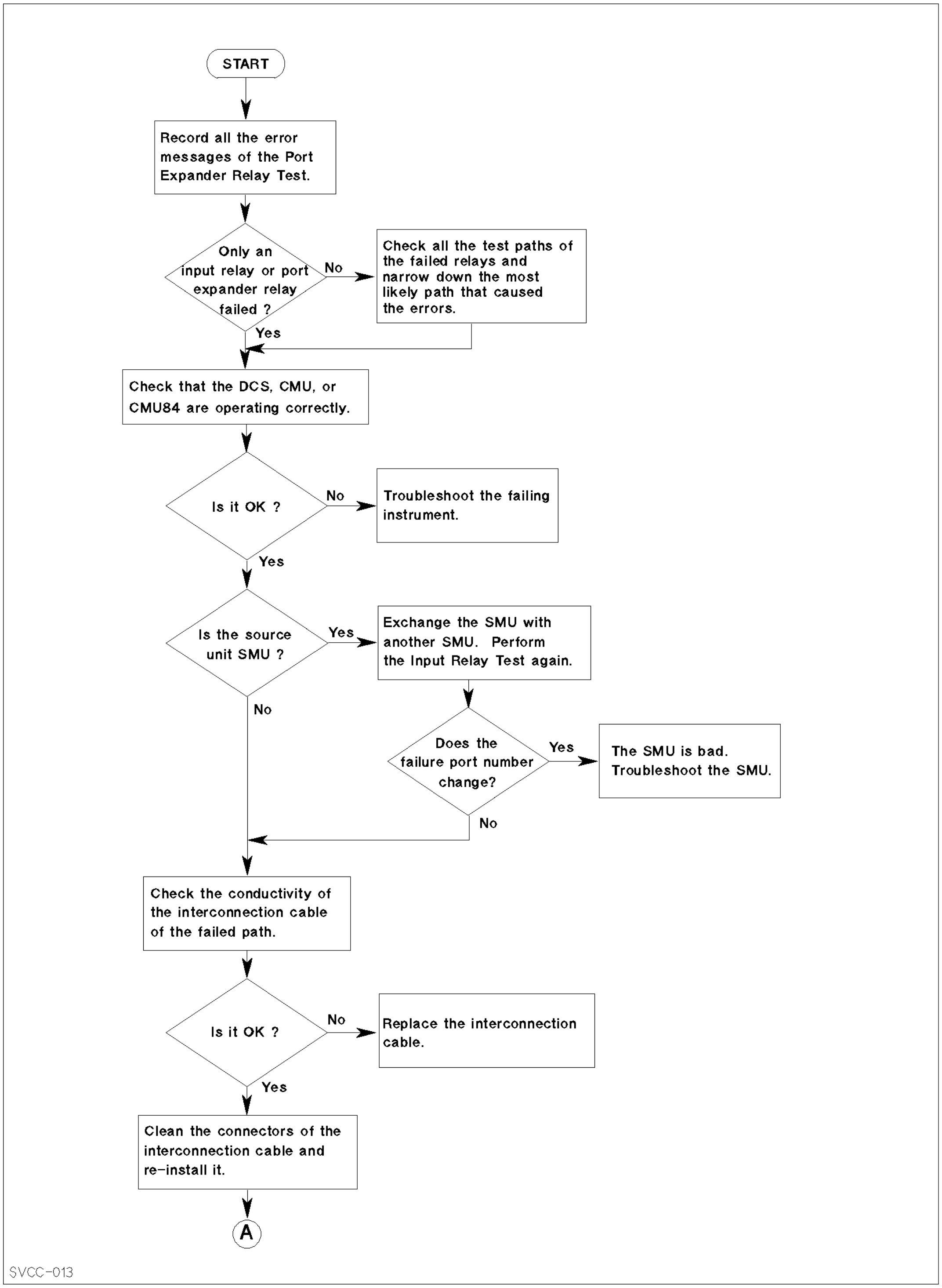
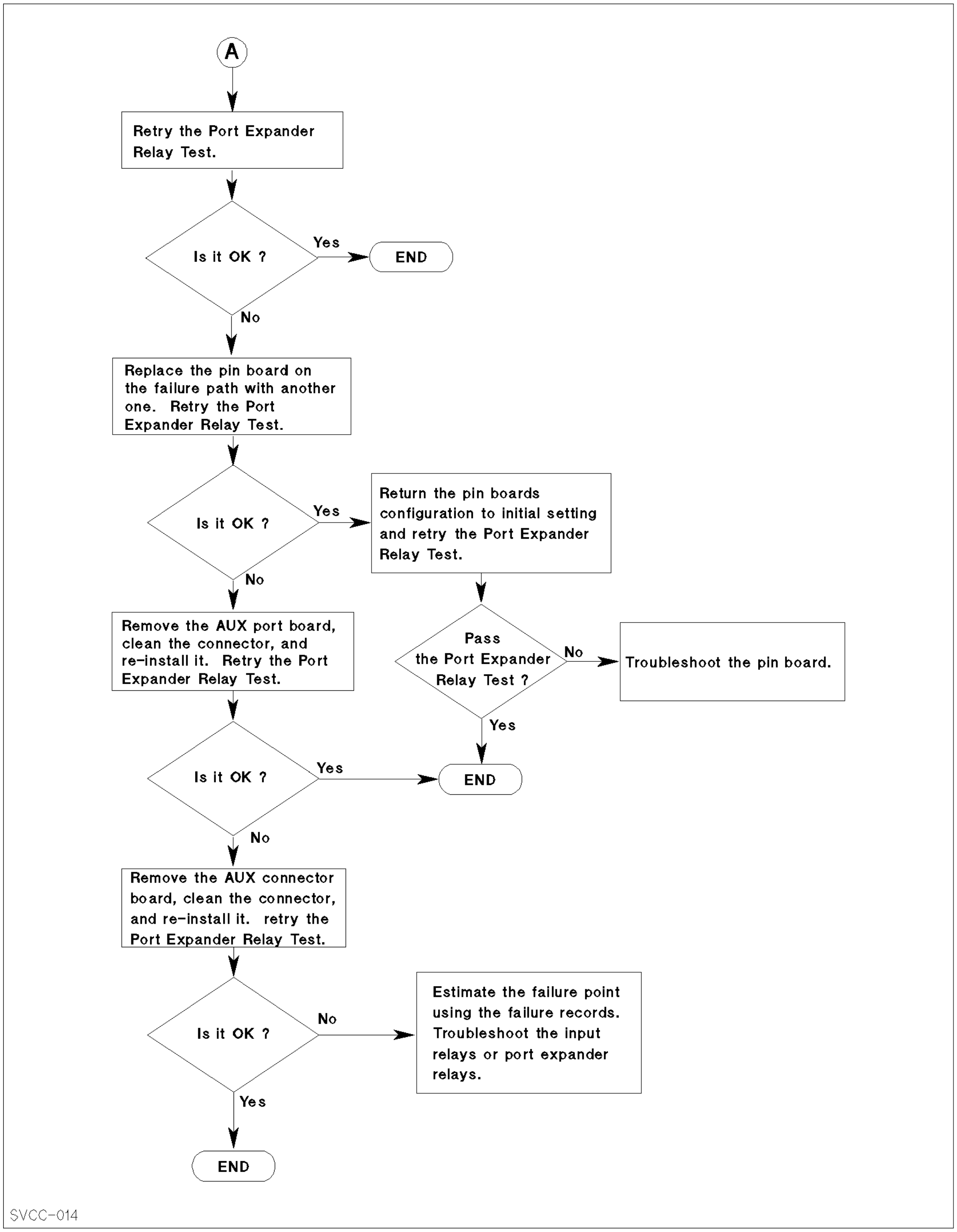


Figure C-2. Relay Troubleshooting—Port Expander Relay (1 of 2)



Relay Troubleshooting—Port Expander Relay (2 of 2)

Troubleshooting with the Port Expander Relay Test

When the Port Expander Relay Test fails, the port expander relays may not always be the source of the problem. Other problems, such as contact resistance and snapping on the test path, often cause Port Expander Relay Test failures. For this reason, it can be difficult to troubleshoot the port expander relays.

This section provides some helpful information on troubleshooting the port expander relays. Possible points in the Port Expander Relay Test path where the problem may lie are shown below. To help troubleshoot the port expander relay, a check sheet is provided in Appendix D.

Possible Causes of Port Expander Relay Failures

Figure C-3 shows a simplified test circuit of the Port Expander Relay Test.

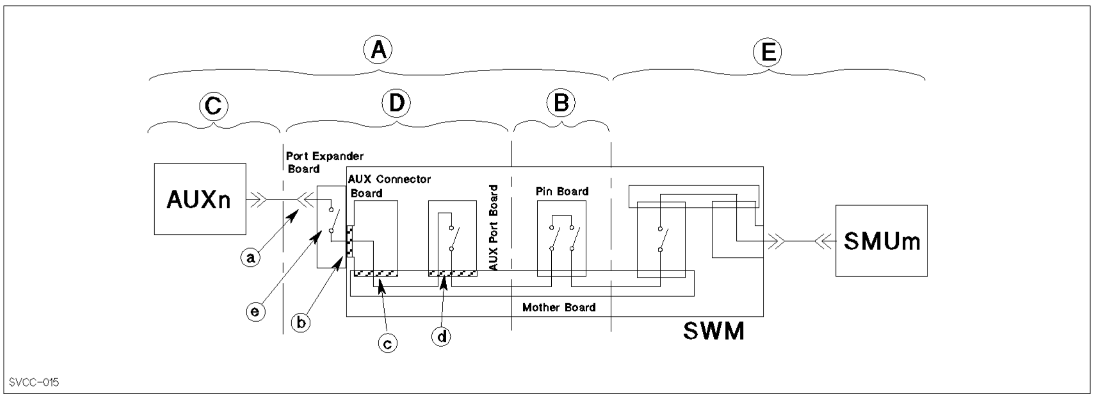


Figure C-3. Simplified Test Circuit of Port Expander Relay Test

When a problem lies somewhere on the test path, the Port Expander Relay Test results may show a failed port expander relay e. Because of this, when a failure of the Port Expander Relay Test occurs, you must troubleshoot the test path as well as the failed port expander relay.

The following procedures briefly explain how to troubleshoot and how to narrow down possible causes of the port expander relay failure:

1. In which area, A or E, does the problem exist?

   The check sheet is useful to answer this question. Write down all the error messages on the check sheet. The most probable cause of the problem can be found by checking all the error messages. You can also narrow the problem area down to B, C, or D.

2. Does the problem exist in area B?

   To check whether or not the problem exists in area B, change the pin board used for the Port Expander Relay Test with a known good one. You can find which pin board is used for the test from the check sheet.

3. Does the problem exist in area C?

   The SMU, VS, VM, or other units on the test path may have failed. To check this situation, change the SMU, VS, VM, or other units with a known good one, and retry the Port Expander Relay Test.

The connection between the unit and the cable may be poor. Clean the connector. The cable may be snapping. Check the conductor of the cable.

4. Does the problem exist in area D?
   a. Check the connection or contact resistance at point a.
   b. Check the contact d between the AUX port board and the mother board.
   c. Check the contact c between the AUX connector board and the mother board.
   d. Check the contact b between the AUX connector board and port expander board.

The Table C-22 shows the failure conditions and possible causes. You can use the Table C-22 after finding the failures in the port expander board.

Note that the VFP program does not have the function to control the port expander relays. To control the port expander relays, you must use Connect statements (see HP 4062C/UX manuals).

Table C-22. Failure Conditions and Possible Causes

Failure Conditions	Possible Causes
If you find a single failed relay,	■ Check the cable in the port expander. ■ Check the failure relay by measuring resistance.
If you find more than one failed relay,	■ Check all the relays by measuring resistance. ■ Check connections between port expander board and AUX connector board. ■ Check the relay driver ICs.

Using Check Sheet for Troubleshooting

When the Port Expander Relay Test reports more than two errors, a problem on the test paths is causing the errors. The check sheet for port expander relay troubleshooting, which is provided in Appendix D, can help you find the cause of the problem on the test path. See Appendix D on how to fill in the check sheet.

For example, the checked items in Figure C-4 show that a problem may exist in either pin board 4, the SMU2, or the i-K50 input relay. It's safe to assume that the failure is around the i-K50 input relay because the e-K6x tests (which use the same pin board and SMU as the e-K5x tests) did not report any failures.

Check Sheet for Port Expander Relay Troubleshooting

Failed Relay and Side	e-K51 force	e-K52 force	e-K53 force	e-K___	e-K___	e-K___
Pin Board 4	✓	✓	✓			
Pin Board ___						
SMU1						
SMU2	✓	✓	✓			
SMU3						
SMU4						
VS1	✓					
VS2						
VM1						
VM2						
CMS						
CMU84						
GNDU						
e-K51	✓					
e-K52		✓				
e-K53			✓			
e-K61						
e-K62						
e-K63						
e-K81						
e-K82						
e-K83						
e-K86						
e-K87						
e-K88						
e-K91						
e-K92						
e-K93						
e-K96						
e-K97						
e-K98						
i-K50	✓	✓	✓			
i-K60						
i-K80						
i-K81						
i-K90						
i-K91						

Figure C-4. Example: Check Sheet for Troubleshooting

Accessing the Port Expander Board

The port expander board is located in the port expander on the SWM side board. To open the port expander cover and to access the port expander board for troubleshooting, use the following procedure:

1. Remove the six screws as shown in (a) of Figure C-5.
2. Remove the port expander cover as shown in (b) of Figure C-5.
3. Troubleshoot the port expander relay failures, for example, by using a digital multimeter as shown in (c) of Figure C-5.

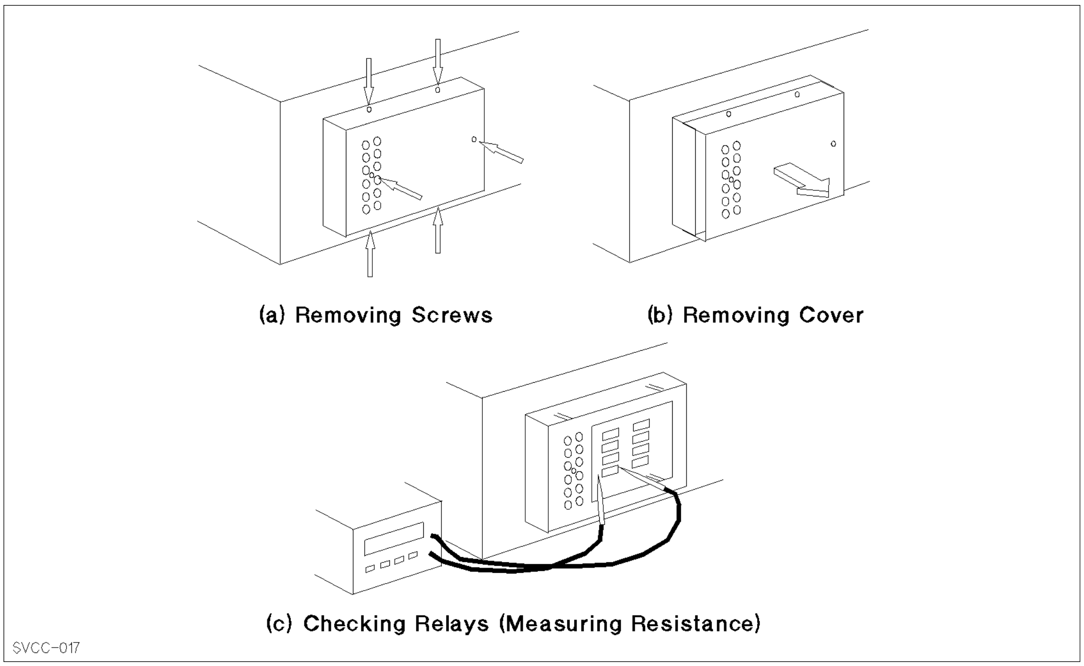


Figure C-5. Accessing the Port Expander Board

Figure C-6 shows the view of the port expander board.

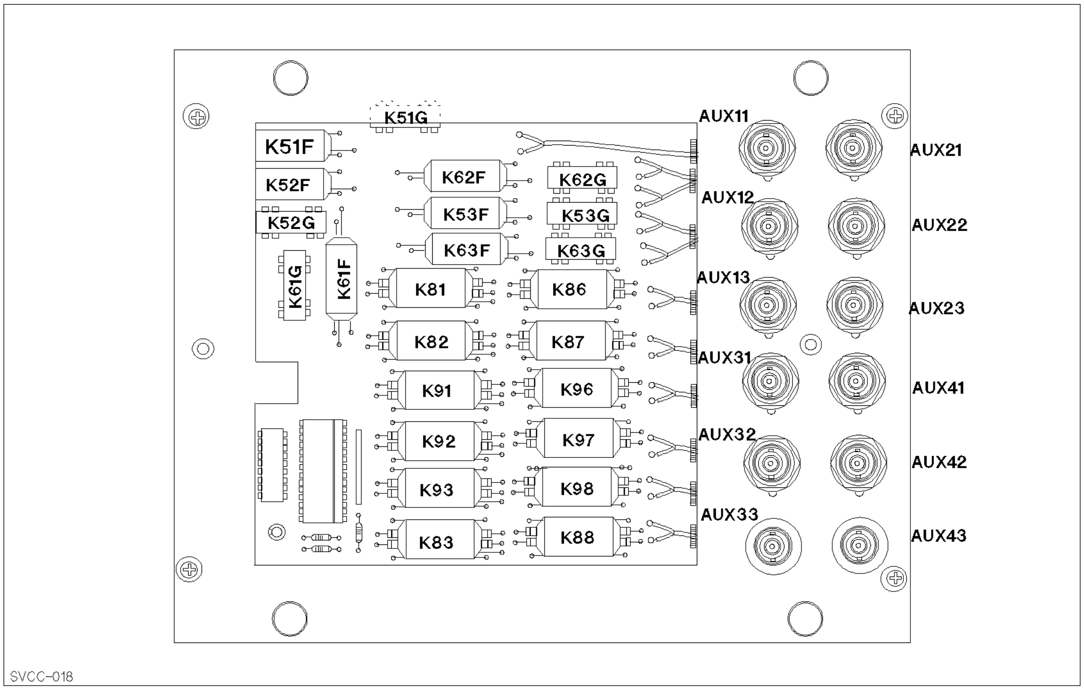


Figure C-6. View of Port Expander Board

Replaceable Parts

The replaceable parts lists are organized as follows:

- Illustrated Assembly Locations
- Electrical assemblies and components in alphanumeric order by reference designation.
- Miscellaneous parts.
- Illustrated parts breakdown.

The information for each part includes:

- The HP Part number.
- The total quantity in the instrument.
- A description of the part.

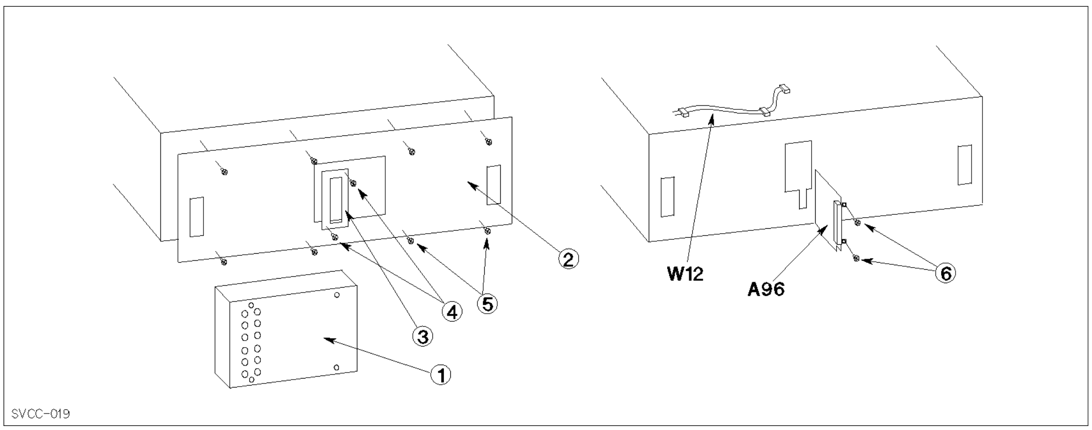


Figure C-7. SWM Assembly Locations for Port Expander

Table C-23. SWM Replaceable Parts for Port Expander

Reference Designation	HP Part Number	Quantity	Description
1	04089-60011	1	Port expander
2	04089-00220	1	Side cover for port expander
3	04089-00210	1	Side panel for port expander
4	0515-0907	2	Flat screw, M3L8
5	0515-1012	8	Flat screw, M4L8
6	0515-0914	2	Flat screw, M3L6
W12	04089-61648	1	Control bus cable assembly
A96	04089-66536	1	AUX connector board (for port expander)

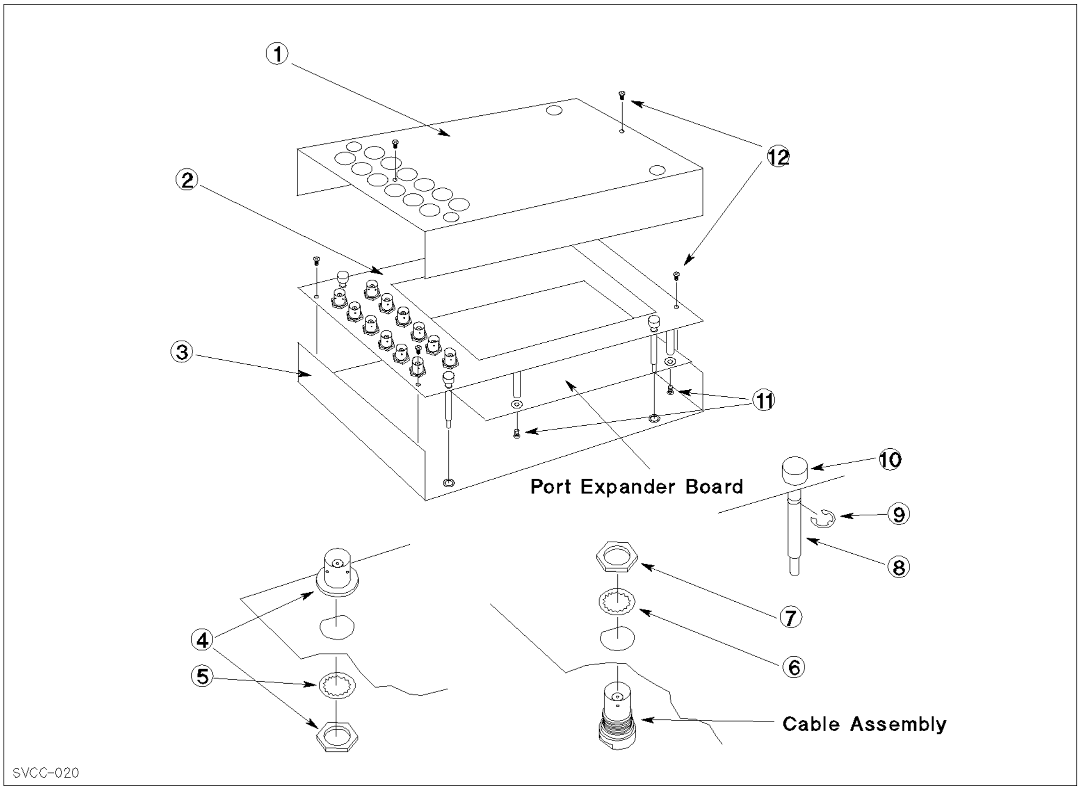


Figure C-8. Port Expander Part Locations

Table C-24. Port Expander Replaceable Parts

Reference Designa-tion	HP Part Number	Quantity	Description
1	04089-00211	1	Top cover
2	04089-00213	1	Inner plate
3	04089-00212	1	Bottom cover
4	1250-1906	2	Triaxial connector
5	2190-0104	2	Lock washer, internal tooth
6	2190-0102	10	Lock washer, internal tooth
7	2950-0035	10	Nut, hex-double chamfer
8	04089-24027	4	Screw
9	0510-0305	4	E-ring
10	0370-2446	4	Knob
11	0515-1550	5	Screw, M3L8 P-H
12	0515-0914	10	Flat screw, M3L6

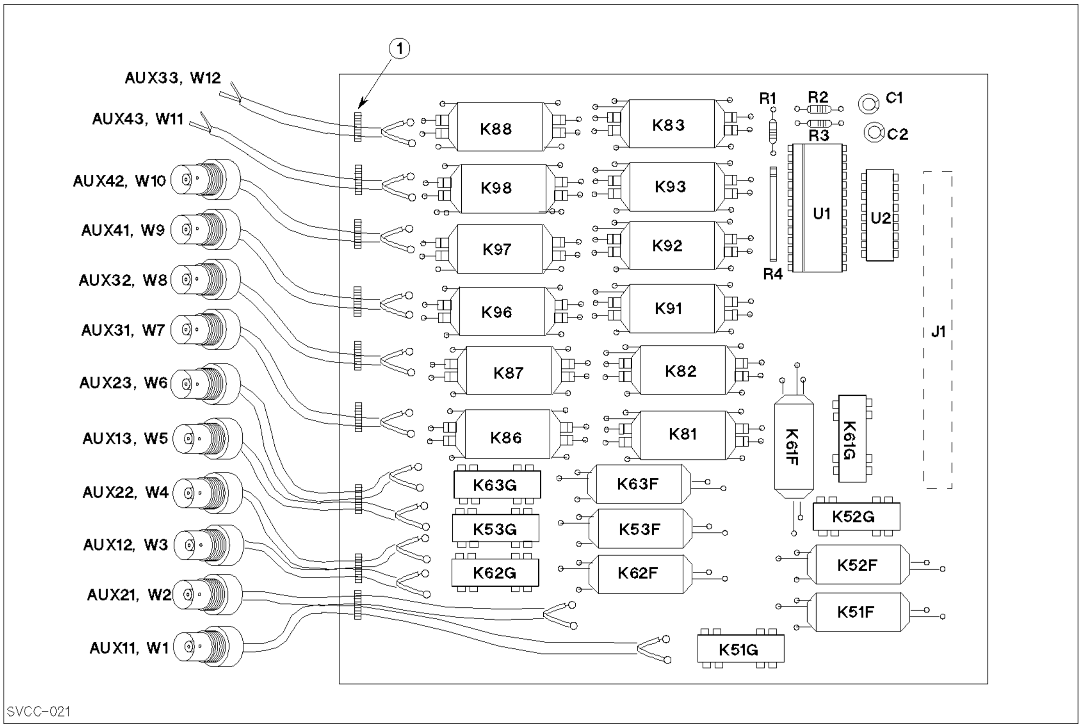


Figure C-9. Port Expander Board Part Locations

Table C-25. Port Expander Board Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
1	1400-0249	10	Cable tie
C1, C2	0180-3583	2	Capacitor, 10 μF 50 V
J1	1252-1990	1	Connector—mail, 3×32
K51F, K52F, K53F, K61F, K62F, K63F	0490-1445	6	Relay—1 M LOW EMF
K51G, K52G, K53G, K61G, K62G, K63G	0490-1620	6	Relay—1 M 1 A 200 V
K81, K82, K83, K91, K92, K93	0490-1633	6	Relay—read 1C
K86, K87, K88, K96, K97, K98	0490-1629	6	Relay—read 2A
R1, R2, R3	0757-0280	3	Resistor—1 KΩ 1% 0.125 W
R4	1810-0281	1	Network resistor
U1	1820-5071	1	Gate array
U2	1858-0084	1	Transistor array
W1, W2	04089-61646	2	Cable assembly
W3, W5, W7, W8	04089-61643	4	Cable assembly
W4, W6, W9, W10	04089-61645	4	Cable assembly
W11	04089-61642	1	Cable assembly
W12	04089-61641	1	Cable assembly

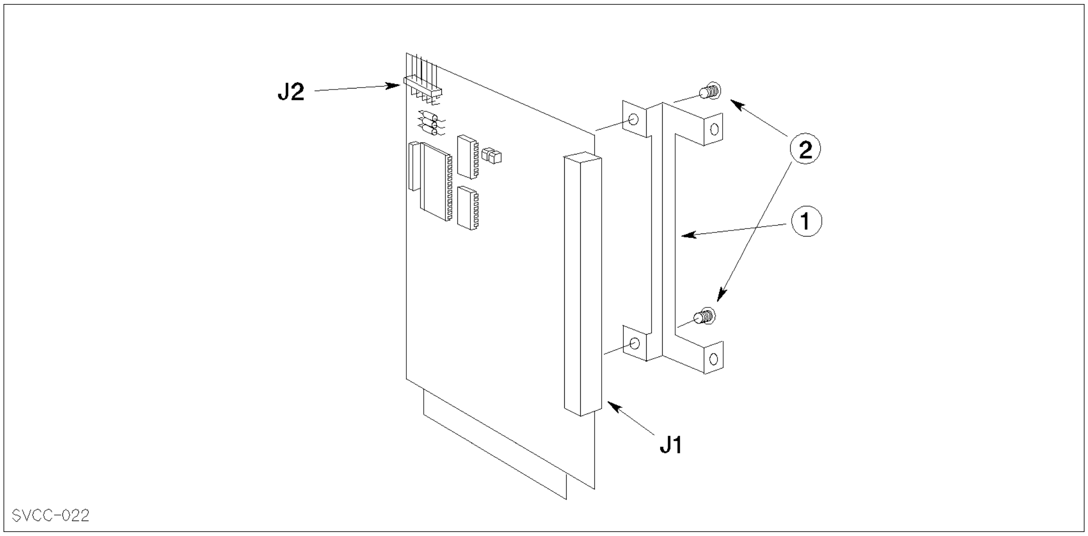


Figure C-10. AUX Connector Board Part Locations (for Port Expander)

Table C-26. Port Expander Board Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
1	04089-00611	1	Angle
2	0515-1550	2	Screw—M3L8, P-H
J1	1252-1127	1	Connector—female, 3×32
J2	1251-4582	1	Connector—male, 10-pin

Port Expander Operating Theory

This section covers basic operating theory of the port expander, and includes circuit diagrams for each board. For SWC and SWM operating theory, see Appendix B.

Port Expander Usage

The port expander is attached to the SWM side instead of AUX ports, as shown in Figure C-11. The port expander has four 3-to-1 multiplexers connected to four AUX ports, and is equipped with ten coaxial (BNC) connectors and two triaxial connectors. The port expander lets you use up to two more SMUs, in additional to the four SMUs, or use up to ten VSs, VMs, CMU/CMU84, or other instruments. Note that up to four ports can be used at a time.

Note

Using instruments that are not supported by Hewlett-Packard does not guarantee system specifications.

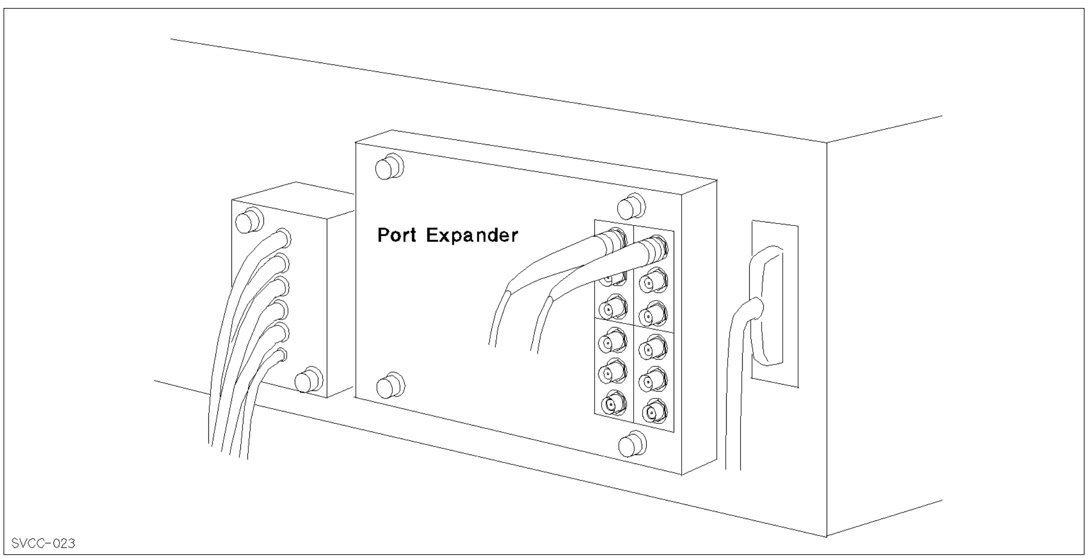


Figure C-11. Port Expander View and Simplified Circuit Scheme

The port expander has twelve ports named AUX11—13, AUX21—23, AUX31—33, and AUX41—43. Table C-27 lists the port name, port number, connector type, and which port is connected.

Table C-27. Port Expander Ports

Port Name	Port Number	Connector Type	Connected to . . .
AUX11	21	coaxial	AUX1
AUX12	22	coaxial	
AUX13	23	coaxial	
AUX21	24	coaxial	AUX2
AUX22	25	coaxial	
AUX23	26	coaxial	
AUX31	27	coaxial	AUX3
AUX32	28	coaxial	
AUX33	29	triaxial	
AUX41	30	coaxial	AUX4
AUX42	31	coaxial	
AUX43	32	triaxial	

To control the multiplexers in the port expander, you can use Connect statements (included in TIS) without considering the multiplexer circuits, such as the AUX1, AUX2, AUX3, or AUX4 port. For example, you can use the following statement to connect the AUX31 port to pin 16:

```
Connect(FNAux(31),16)
```

Port Expander Operation

Figure C-12 shows a simplified circuit diagram of the port expander. A 3-to-1 multiplexer circuit consists of three relays for AUX1*x* and AUX2*x* ports; six relays for AUX3*x* and AUX4*x* ports. The AUX33 and AUX43 connectors are triaxial; the other connectors are coaxial.

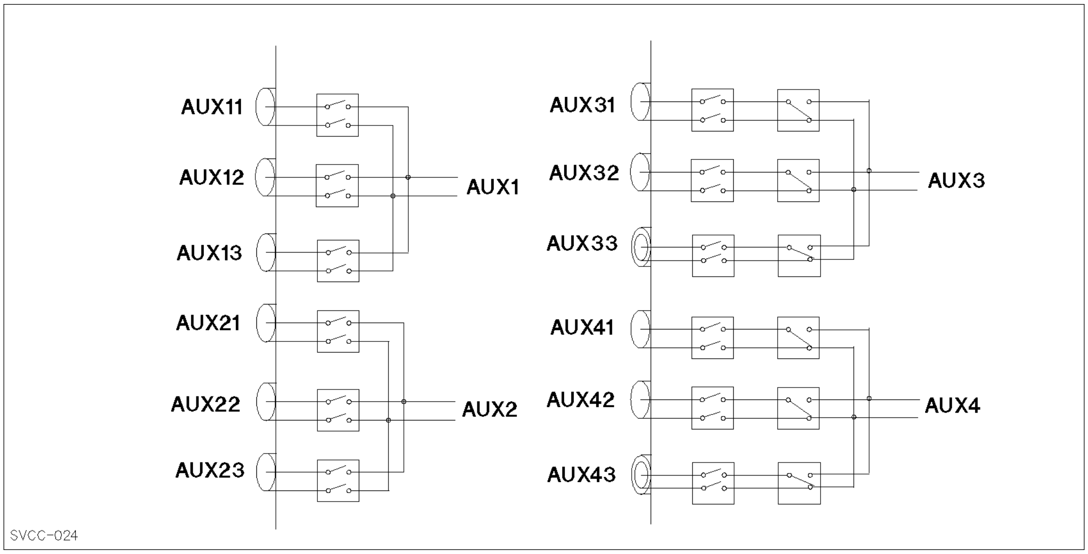


Figure C-12. Simplified Circuit Diagram of the Port Expander

The outer conductor of the coaxial connector is connected to the chassis leading to the circuit common, and the inner conductor is for forced/sensed signals. The outer conductor of the triaxial connector is connected to the chassis leading to the circuit common, the middle conductor is used as SMU guard, and the inner conductor is for the forced signal.

To control the port expander relays, serial data sent from the control logic board is used like pin boards. The converter circuit from the serial data to relay control signal consists of ICs. For details on the serial data and ICs, see Appendix B.

The port expander circuit consists of two boards: port expander board and AUX connector board (for port expander). Later sections describe these circuit boards.

Port Expander Board

The port expander board functions:

- Controlling signal paths for the port expander ports.
- Converting serial data to a relay control signal for the AUX1x and AUX2x ports.

Where the serial data is sent from the SWC and is used to control relays.

Figure C-13 shows the circuit diagram of the port expander board.

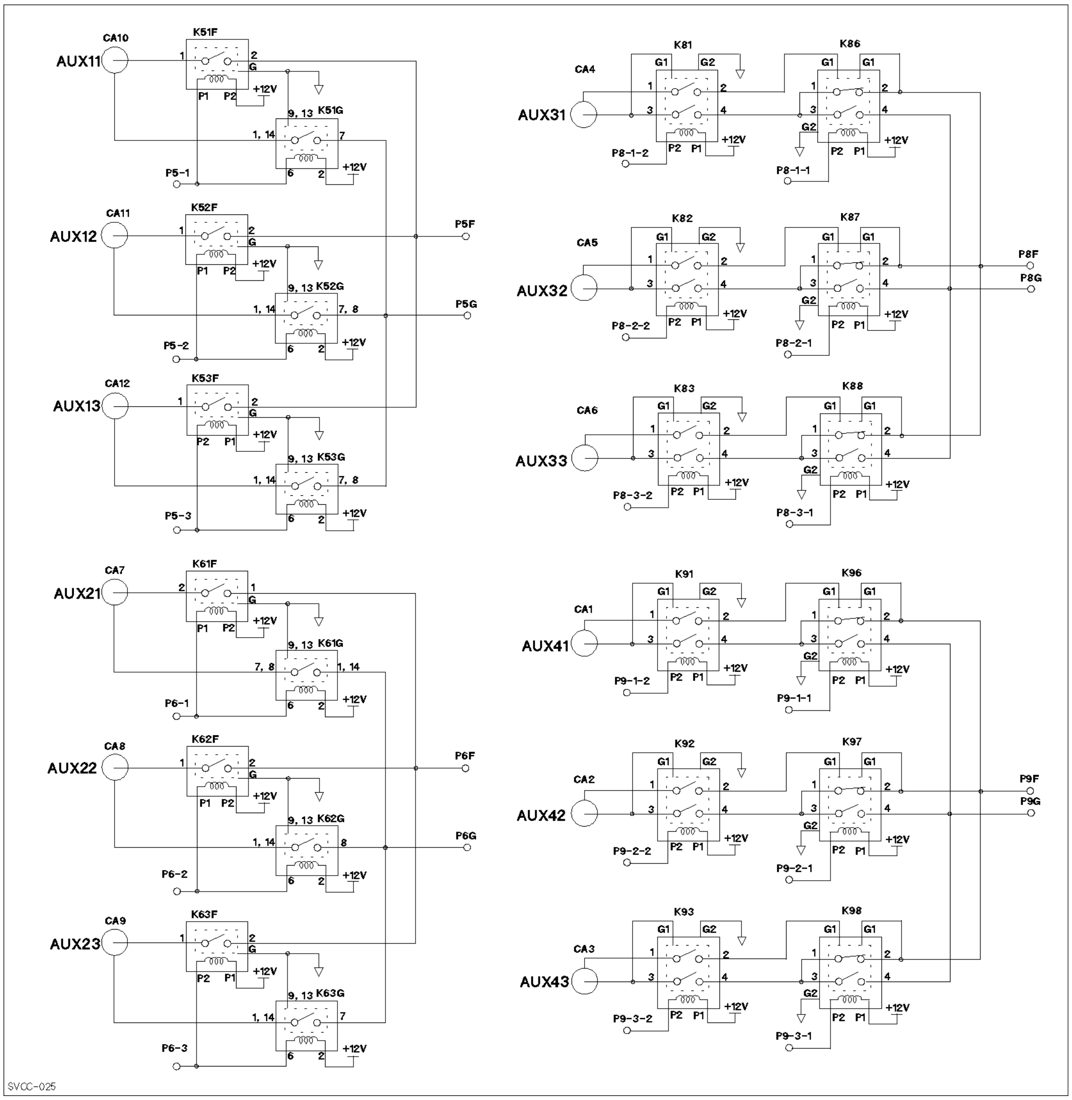
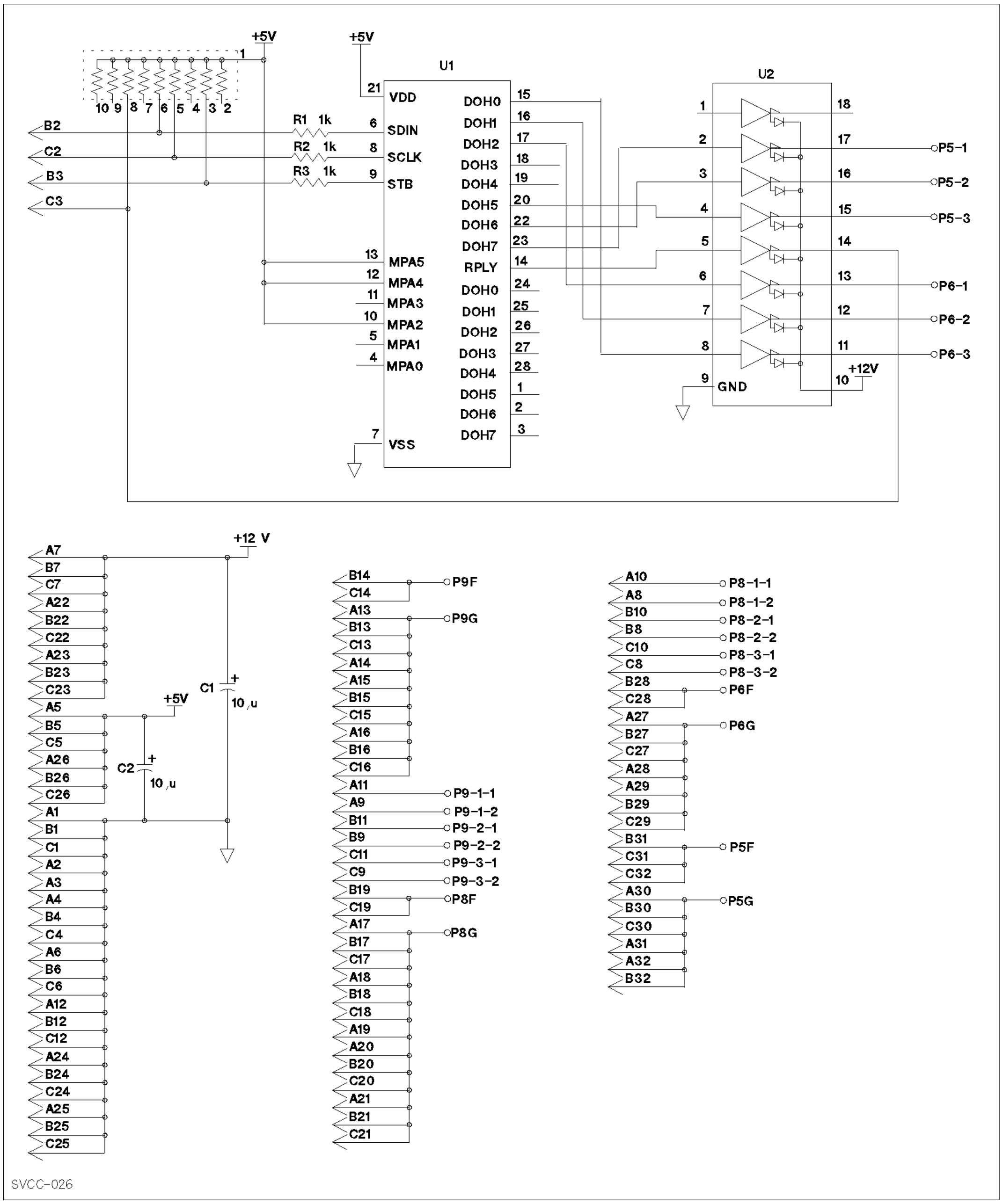


Figure C-13. Circuit Diagram—Port Expander Board (1 of 2)



Circuit Diagram—Port Expander Board (2 of 2)

AUX Connector Board (for Port Expander)

The AUX connector board of port expander functions:

- Transferring the forced/sensed signal and serial data.
- Converting serial data to a relay control signal for AUX3x and AUX4x ports.

Figure C-14 shows the circuit diagram of the AUX connector board.

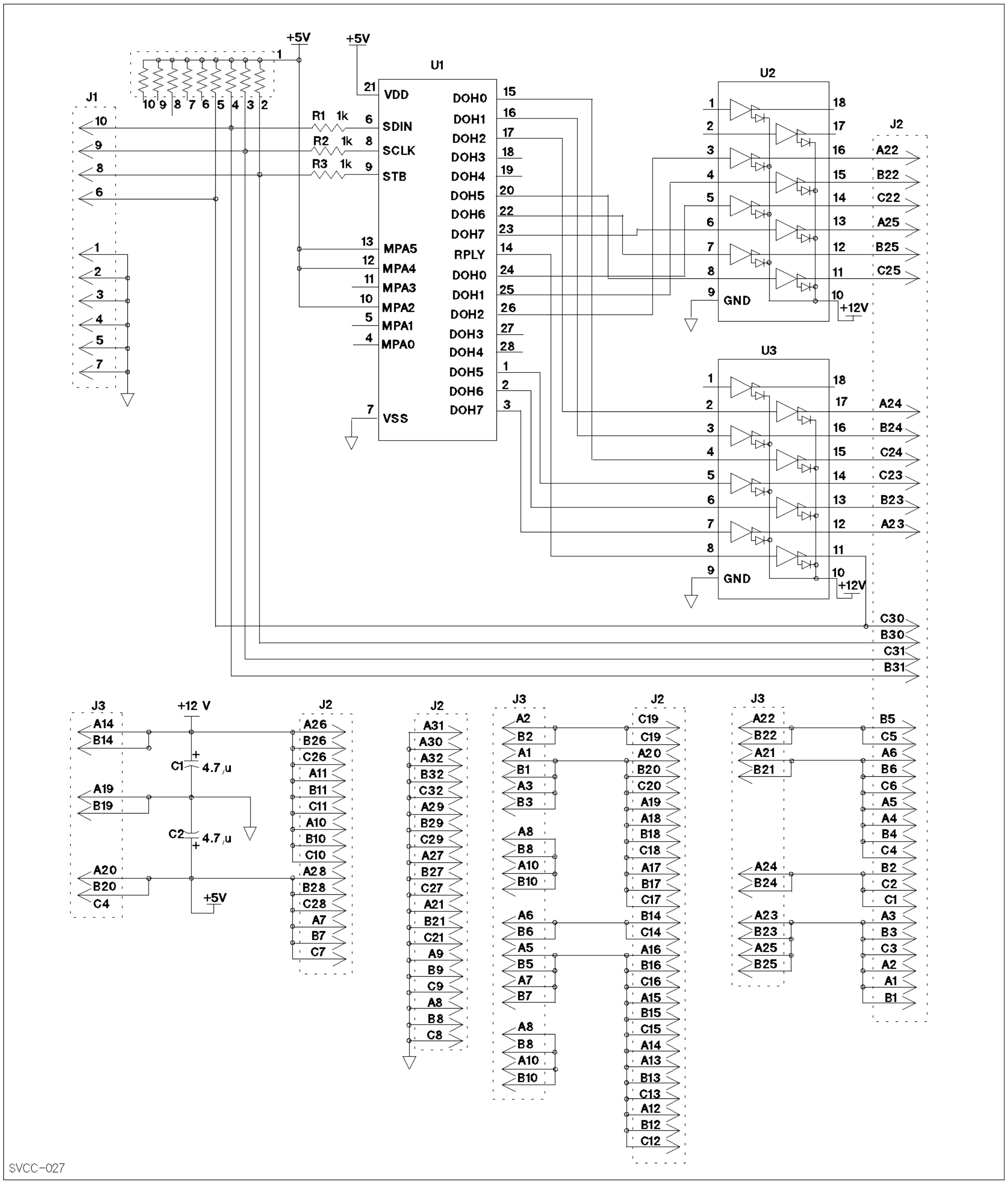


Figure C-14. Circuit Diagram—AUX Connector Board (for Port Expander)

The J4 pin assignments are equal to the J1 pin assignments of the pin board. See "Pin Boards" in Appendix B.

D

Check Sheet for Input Relay and Port Expander Relay Troubleshooting

This appendix provides check sheets for troubleshooting the Input Relay Test failures and Port Expander Relay Test failures.

Fill in the sheet according to the results of the Input Relay Test or Port Expander Relay Test. The error messages displayed by the Input Relay Test or Port Expander Relay Test include a row headed by "`ALSO CHECK THE FOLLOWING:`." Make checks on the sheet according to the test results.

Example 1: Input Relay Failure.
When the error message is as follows:

```
PV ERROR 19 Block 1 Input Relay K11 force side test failed.
ALSO CHECK THE FOLLOWING: Connection; Pin b'd 4; I-relay K10,K20,K21; SMU1,2;
```

Fill in the sheet as follows:

- In "BLOCK___" of the table title, enter a "1," which is the block number of the failure.
- In a "Failed Relay and Side" column header cell, enter i-K 11 and force .
- In "Pin Board ___", enter "4", which is the pin board number, and enter a check sign ("√") in associated cell of failed relay column.
- Enter a check sign ("√") in SMU1, SMU2, i-K10, i-K20, and i-K21 cells of the failed relay column.

After checking all the errors, the most probable point of the Input Relay Test failure is made more evident and the sheet can help you troubleshoot the input relays.

Example 2: Port Expander Relay Failure.
When the error message is as follows:

```
PV. ERROR 45 Port Expander Relay K51 guard side test failed.
ALSO CHECK THE FOLLOW: Connection; Pin b'd 4,8; I-relay K10,K11,K20,K21,K50
                       SMU2
```

Fill in the check sheet as follows:

- In a "Failed Relay and Side" column header cell, enter e-K 51 and guard .
- In "Pin Board ___", enter a "4", which is the pin board number, and enter a check sign ("√") in the associated cell in the failed relay column. In the next row, enter an "8" into "Pin Board ___", and enter a check sign in the associated cell in the failed relay column.
- In "i-K___", enter a "10", which is the input relay number, and enter a check sign ("√") in the associated cell in the failed relay column. Do the same for i-K11, i-K20, and i-K21.
- Enter a check sign ("√") into i-K50 cell of the failed relay column.
- Enter a check sign ("√") into SMU2 cell of the failed relay column.

After checking all the errors, the most probable point of the Port Expander Relay Test failure is made more evident and the sheet can help you troubleshoot the port expander relays.

Note

The sheet attached in this appendix is the original. Make and use copies of the sheet for troubleshooting.

Check Sheet for Input Relay Troubleshooting: BLOCK ___

Failed Relay and Side	i-K___ ______	i-K___ ______	i-K___ ______	i-K___ ______	i-K___ ______	i-K___ ______
Pin Board ___						
Pin Board ___						
Pin Board ___						
SMU1						
SMU2						
SMU3						
SMU4						
VS1						
VS2						
VM1						
VM2						
CMS						
CMU84						
GNDU						
i-K10						
i-K11						
i-K21						
i-K20						
i-K31						
i-K30						
i-K41						
i-K40						
i-K50						
i-K60						
i-K70						
i-K80						
i-K81						
i-K90						
i-K91						

Check Sheet for Port Expander Relay Troubleshooting

Failed Relay and Side	e-K____ ________	e-K____ ________	e-K____ ________	e-K____ ________	e-K____ ________	e-K____ ________
Pin Board ____						
Pin Board ____						
SMU1						
SMU2						
SMU3						
SMU4						
VS1						
VS2						
VM1						
VM2						
CMS						
CMU84						
GNDU						
e-K51						
e-K52						
e-K53						
e-K61						
e-K62						
e-K63						
e-K81						
e-K82						
e-K83						
e-K86						
e-K87						
e-K88						
e-K91						
e-K92						
e-K93						
e-K96						
e-K97						
e-K98						
i-K____						
i-K____						
i-K____						
i-K____						
i-K50						
i-K60						
i-K80						
i-K81						
i-K90						
i-K91						

E

Configuring the System Printer for PV4062

This appendix describes how to change the configuration of the system printer to print test results using the VIEW RESULT function.

The HP 4062C environment allows two types of printers: local (BASIC/WS) and remote (SRM), the HP 4062UX environment allows three types of printers: local (BASIC/UX), spooled (HP-UX), and remote (SRM), and the 4062PC environment allows two types of printers: local (BASIC/DOS) and remote (SRM). The desired environment must be modified before either print environment can be used. To establish print environments, refer to the HP BASIC documentation.

You may also modify specific page formatting items such as page length, margins, and page numbering on or off with the PV4062 program in the HP 4062C/UX/PC system software.

Figure E-1 shows the PV4062 printer configuration page. To display this page, load and run the PV4062 program, select the `VIEW RESULT` softkey, select the `READ FILE` softkey, enter the name of the file that contains the test results, then select the `PRINTER` softkey.

```
********** CONFIGURATION **********

  PRINTER TYPE    = HP-UX SPOOL
  SPOOL COMMAND   = | lp
  PAGE LENGTH     = 66
  MARGIN          : TOP = 2   BOTTOM = 2   LEFT = 0
  PAGE NUMBERING = ON




Select desired softkey


PRINT                  RECONFIG                           EXIT
```

Figure E-1. An Example of the Printer Configuration Page (HP 4062UX)

Configuring the System Printer

The default settings of the printer configuration are listed in Table E-1, Table E-2, and Table E-3. To change these settings, select the RECONFIG softkey from the printer configuration page shown in Figure E-1.

Table E-1. Default Printer Configuration Settings (HP 4062C)

Item	Default
PRINTER TYPE	LOCAL
PRINTER ADDRESS	701
PRINTER I/F	HP-IB
SPOOL DIRECTORY	/spool:REMOTE
SPOOL COMMAND	| lp
BAUD RATE (RS-232C)	9600 baud
PAGE LENGTH	66 line/page
MARGIN	Top: 2 line, Bottom: 2 line, Left: 0 space
PAGE NUMBERING	ON

Table E-2. Default Printer Configuration Settings (HP 4062UX)

Item	Default
PRINTER TYPE	HP-UX SPOOL
PRINTER ADDRESS	701
PRINTER I/F	HP-IB
SPOOL DIRECTORY	/spool:REMOTE
SPOOL COMMAND	| lp
BAUD RATE (RS-232C)	9600 baud
PAGE LENGTH	66 line/page
MARGIN	Top: 2 line, Bottom: 2 line, Left: 0 space
PAGE NUMBERING	ON

Table E-3. Default Printer Configuration Settings (HP 4062PC)

Item	Default
PRINTER TYPE	LOCAL
PRINTER ADDRESS	26
PRINTER I/F	OTHER
SPOOL DIRECTORY	/spool:REMOTE
SPOOL COMMAND	| lp
BAUD RATE (RS-232C)	9600 baud
PAGE LENGTH	66 line/page
MARGIN	Top: 2 line, Bottom: 2 line, Left: 0 space
PAGE NUMBERING	ON

Figure E-2 shows a diagram for configuring printer settings. Note that the HP-UX SPOOL printer can not be used for the HP 4062C system. Select the desired softkeys and enter the required values and names to change printer settings.

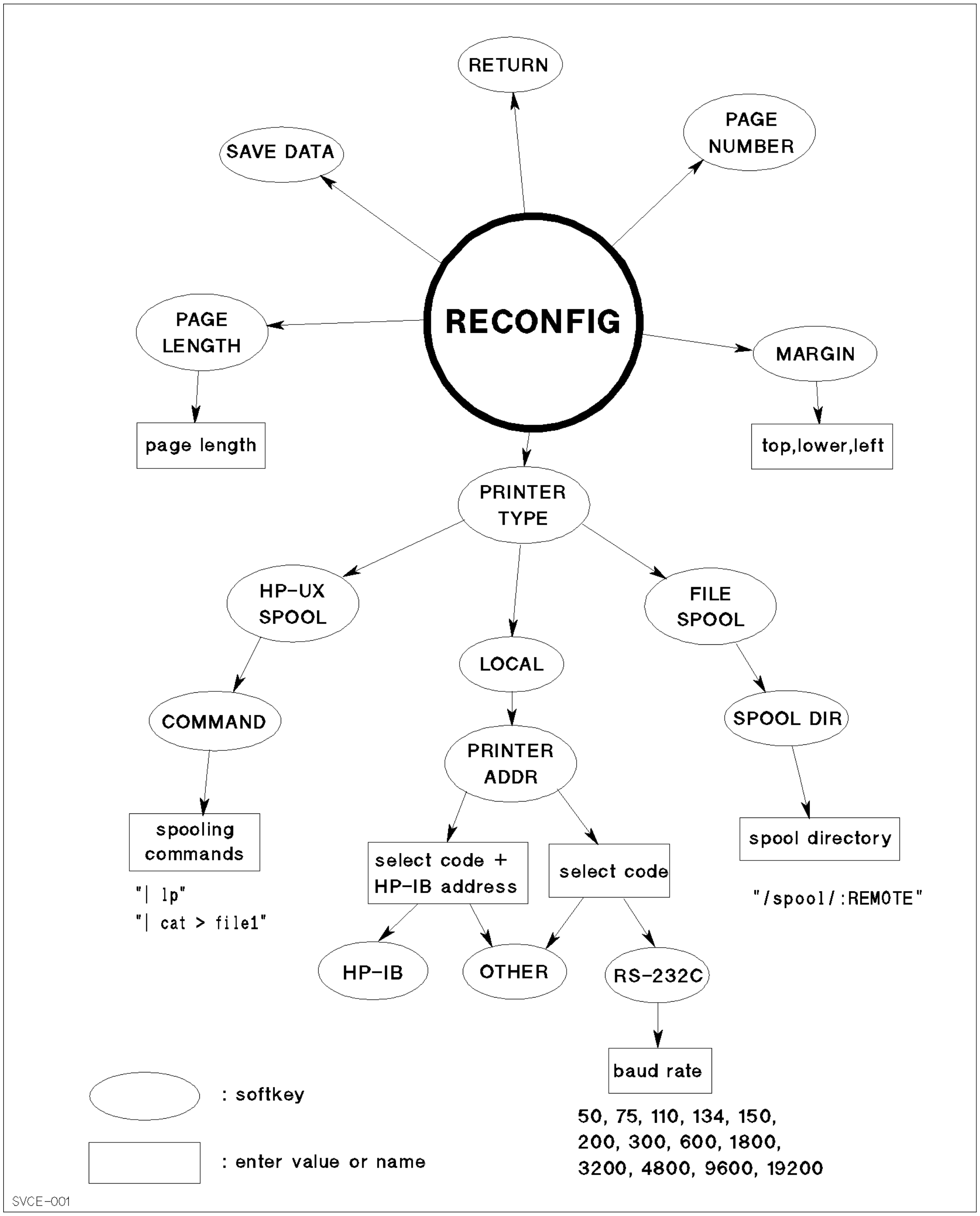


Figure E-2. Printer Configuration Diagram

Each softkey and a description of its function follows:

`PRINTER TYPE` Displays the `LOCAL`, `FILE SPOOL`, and `HP-UX SPOOL` softkeys for selecting or changing the presently set printer.

`PRINTER ADDR` Displayed only when PRINTER TYPE is set to LOCAL. This softkey is for changing the address of the printer (select code and HP-IB address).

After selecting this softkey, the message "Type new address" is displayed. Enter the new printer address and press (Return). If you press (Return) only, the present address of the printer is retained.

If you enter a new select code and HP-IB address, the message "Select printer I/F" is displayed and two softkeys—`HP-IB` and `OTHER`—appear. Select the required softkey.

If you enter a new select code only, the message "Select printer I/F" is displayed and two softkeys—`RS-232C` and `OTHER`—appear. If you select the `RS-232C` softkey, the message "Enter baud rate of RS-232C I/F" is displayed. The following baud rates are available:

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

If you use a parallel printer, select `OTHER` softkey.

`COMMAND` Displayed only when PRINTER TYPE is set to HP-UX SPOOL. This softkey is for changing the HP-UX spooling command.

After selecting this softkey, the current spooling command is displayed at the keyboard input line and the following message appears.

```
Enter new spooling command with leading '|' in double quotations.
```

Enter the new spooling command. Note that the pipe '|' must be specified first. For example, "`| lp`," "`| cat > file1`," or "`| remsh hpux lp -dlaser -oc -od`."

`SPOOL DIR.` Displayed only when PRINTER TYPE is set to FILE SPOOL. This softkey is for changing the spool directory of the SRM system.

After selecting this softkey, the following message appears, and the current spooling command is displayed at the keyboard input line.

```
Enter new spooling directory in double quotations.
```

Enter the new spooling directory. For example, "/spool:REMOTE."

`PAGE LENGTH` For changing the page length of the printer (lines/page). The allowable range is 10 through 32767.

`MARGIN` For changing the top, bottom, and left margins.

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

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

top margin ≥ 0

bottom margin ≥ 0

if page numbering on, then:
top margin + bottom margin < page length − 6

if page numbering off, then:
top margin + bottom margin < page length − 8

`PAGE NUMBER` Turns page numbering on and off (toggles between page numbering on/off).

`SAVE DATA` Saves configuration data into the file VIEW_DATA.

`RETURN` Exits the printer configuration facility.

F

Instrument Compatibility

This appendix covers the history of the HP 4062 series and compatibility information of the instruments used by the HP 4062C/UX system. There are five products in the HP 4062 Semiconductor Parametric Test System series: HP 4062A, HP 4062B, HP 4062C, HP 4062UX, and HP 4062PC. Actually, the HP 4062PC is provided by specifying HP 4062C option PC5, PC7, or PCL. Note that the HP 4062UX is named Semiconductor Process Control System, but the function of the HP 4062UX system is the same as the other HP 4062 systems.

For compatibility information, this appendix covers only the SWC and the SWM. For compatibility information of the other instruments, see the following manuals:

- HP 4062A *Service Manual*
- HP 4062B *Service Manual*
- HP 4142B *Service Manual*
- HP 4280B *Operation and Service Manual*
- HP 4284B *Service Manual*

Note that compatibility information for HP 4141A/B (see Table F-1) is described in the HP 4062A or B *Service Manual*.

History of HP 4062 Series

This paragraph provides a brief history of the HP 4062 series shown in Table F-1. The table does not include minor changes.

Table F-1. History of HP 4062 Series

	System Software Revision	48-pin SWM	96-pin SWM	SWC	DCS	CMS
HP 4062A[1]	Rev. 2.x	HP 4085A	—	HP 4084A	HP 4141A	HP 4280A
HP 4062B[2]	Rev. 3.x Rev. 4.x B.05.0x B.06.0x	HP 4085A	—	HP 4084B	HP 4141B	HP 4280A
HP 4062C	C.05.0x	HP 4085B or HP 4085A[3]	—	HP 4084B	HP 4142B	HP 4280A
	C.05.1x		HP 4089A	HP 4084B[4]		
	C.05.6x C.05.7x					HP 4280A or HP 4284A
	C.06.0x C.06.2x C.06.3x		HP 4089B[5]			
HP 4062UX	X.05.5x	HP 4085B or HP 4085A[3]	HP 4089A	HP 4084B[4]	HP 4142B	HP 4280A
	X.05.6x					HP 4280A or HP 4284A
	X.06.0x X.06.2x X.06.3x X.07.0x		HP 4089B[5]			
HP 4062PC	P.06.2x P.06.3x	HP 4085B	HP 4089B	HP 4084B[4]	HP 4142B	HP 4280A or HP 4284A

1 The HP 4062A was discontinued in February 1985.

2 The HP 4062B was discontinued in November 1991.

3 The HP 4085A SWM can be used for up to 100 V/100 mA measurements in the HP 4062C/UX. The HP 16294B/C Upgrade Kit supports this configuration.

4 Two HP 4084B SWCs are needed for the HP 4089A/B 96-pin SWM.

5 HP 4089B SWM can be equipped with a port expander.

The following upgrade kits for the HP 4062 series are available:

HP 16294B — Upgrades HP 4062B to HP 4062C. You can use the HP 4085A SWM instead of the HP 4085B SWM in the HP 4062C system if current through the SWM is to 100 mA or less.

HP 16294C — Upgrades HP 4062C to HP 4062UX. You can use the HP 4085A SWM instead of the HP 4085B SWM in the HP 4062UX system if current through the SWM is to 100 mA or less.

SWM Compatibility

The HP 4085B 48-pin SWM and the HP 4089A/B 96-pin SWM are available for the HP 4062C/UX system.

Table F-2 shows the board compatibility of the SWM.

Table F-2. Boards Compatibility of SWM

Description	Board Designation		HP 4085A	HP 4085B	HP 4089A	HP 4089B
	HP 4085A/B	HP 4089A/B				
Pin Board	A1 – A48	A1 – A96	16320-66511	16320-66521[1], 16320-66531[1], 16320-66551[1]	16320-66541, 16320-66552	⇐=[2]
Control Logic Board	A55	A105, A205	04085-66555	⇐=[2]	⇐=[2]	⇐=[2]
Control Connector Board	A58	A104, A204	04085-61003	⇐=[2]	04089-66506	⇐=[2]
Test ADC Board	A51	A162, A262	04085-66551	04085-66561[1]	⇐=[2]	⇐=[2]
Test Relay Board	A53	A161, A261	04085-66553	04085-66570	⇐=[2]	⇐=[2]
SMU Port Board	A52	A102, A202	04085-66552	04085-66562[1]	04089-66528 (2 each)	⇐=[2]
SMU Connector Board	A56	A98	04085-61001	04085-61021[1]	04089-66510	⇐=[2]
SMU Link Board	—	A99	—	—	04089-66503	⇐=[2]
AUX (CMS) Port Board	A54	A101, A201	04085-66554	04085-66564[1]	04089-66531 (2 each)	⇐=[2]
AUX (CMS) Connector Board	A57	A97	04085-61002	04085-61022[1]	04089-66513	04089-66533
Matrix Open Relay Board	A49	A103, A203	04085-66549	⇐=[2]	04089-66504 (2 each)	⇐=[2]
Display Board 1	—	—	—	—	04089-66514	⇐=[2]
Display Board 2	—	—	—	—	04089-66515	⇐=[2]
Mother Board: Block 1	—	—	04085-66559	04085-66569	04089-66501	⇐=[2]
Mother Board: Block 2	—	—	—	—	04089-66502	⇐=[2]

1 This board can be used for the HP 4085A SWM because of upward compatibility.

2 The same board as in the left column is used.

SMU port and connecter boards (HP part number 04085-66562 and 04085-61021) for the HP 4085B SWM can be used for the HP 4085A SWM. For example, you can use the SMU port board (HP part number 04085-66562) in the HP 4085A SWM when the SMU port board (HP part number 04085-66552) is damaged.

The difference between the pin board for the HP 4085B and for the HP 4089A/B is only the length of the cable between the printed board and the fixture of contact pins. The same pin board relays are used for both the HP 4085B and the HP 4089A/B. But pin boards for the HP 4089A/B cannot be used in the HP 4085B SWM, and pin boards for the HP 4085B cannot be used in the HP 4089A/B SWM because the stray capacitance between any two pins is not equal.

SWC Compatibility

The HP 4084A or B has been revised a few times; specifically, the MPU board and the firmware ROM has been changed. Table F-3 shows the MPU board and firmware ROM compatibility of the HP 4084A/B SWC.

Table F-3. MPU Board and Firmware ROM Compatibility of the HP 4084A/B SWC

HP Part Number of MPU Board	HP Part Number of Firmware ROM	Firmware Revision	Used for	
			Matrix	System
04084-66501	04084-86000[1]	Rev. 1.0	HP 4085A	HP 4062A
04084-66511[2]	04084-85101	Rev. 2.0	HP 4085A	HP 4062B
04084-66511[2]	04084-85111[2]	Rev. 2.0	HP 4085A/B	HP 4062B/C
04084-66521[2], 04084-66531	04084-85121	Rev. 3.0	HP 4085A/B, and HP 4089A/B	HP 4062B/C/UX/PC

1 This includes a pair of programmed ROMs, which are 64 kilobit.

2 These parts are discontinued.

To show the firmware revision of the SWC, you can use the following HP BASIC program:

```
100  DIM A$[80]
110  OUTPUT 2722;"ID"
120  ENTER A$
130  PRINT A$
140  END
```

For example, you may get the following result:

```
HP 4084B REV. 3.0
```

Performance Verification Software (HP 4062A/B/C Only)

The performance verification (PV) software for HP 4062A/B/C revision 5.7 or later is included on the system software disk set. However, the PV software for revision 5.6 or earlier is supplied separately from the system software.

Table F-4 shows the part number of the PV disk set for the HP 4062 series.

Table F-4. PV Software Compatibility (HP 4062A/B/C Only)

HP BASIC Revision	HP 4062A	HP 4062B	HP 4062C		
	Rev. 2.0	Rev. 3.0/4.0/5.0	Rev. 5.05	Rev. 5.10	Rev 5.60
2.1	04062-65101[1]				
3.0		04062-65201[1]			
4.0		04062-65301[2]			
5.0		04062-65313[3]			
			04062-65411[2] 04062-65412[1]		
5.0/5.1				04062-65421[2] 04062-65422[1]	
					04062-65431[2]

1 Software is supplied on 5.25 inch flexible disks.

2 Software is supplied on 3.5 inch flexible disks.

3 Software is supplied on 5.25 and 3.5 inch flexible disks.

PV software for the HP 4062C/UX software revision 5.05 to 5.7 meets or exceeds MIL-STD 45662 specifications. PV software for revision 6.0 or later meets or exceeds MIL-STD 45662A specifications.

Error Messages

If your HP 4062C/UX/PC detects a hardware failure or an illegal operation, an error message or error code, often both, appears on the display of the system controller. Errors are divided into two basic categories: system controller-related and HP 4062C/UX-related, as explained below:

- System Controller Errors

  If a system controller error occurs, an HP BASIC/WS, HP BASIC/UX, or HP BASIC/DOS language system error code is displayed, as in the following example:

  ```
  Error 7 in 1250  Undefined function or sub
  ```

  If a system controller hardware failure occurs, a SYSTEM ERROR message is displayed. Refer to the HP BASIC *Language Reference Manual* for details on system errors.

- HP 4062C/UX/PC Errors

  If an HP 4062C/UX/PC error occurs, an error message is displayed, as in the following example:

  ```
  TIS ERROR 20 Device not present.
  ERROR 449 IN 10
  ```

  Error message prefixes give the name of the program or subprogram in which the error occurred. In the example above, the error occurred in TIS. In some cases, only an error code is displayed.

The information in this back matter lists all the HP 4062C/UX/PC error messages and includes a partial listing of system controller error codes. For details on system controller error codes, refer to the HP BASIC *Language Reference Manual*.

This back matter lists the following HP 4062C/UX system software file error messages:

START, TIS, DVR4284, VFP, PPG, and DIAG.

Note

If an error occurs when using files other than those listed above, an error code is displayed. If an error occurs when using PARA, however, a TIS error message is displayed.

START Errors

START ERROR 0 Not authorized to use the software.
START ERROR 0 Not authorized to use the software (some HP-HIL devices locked).
START ERROR 0 Not authorized to use the software. No CODEWORD file found.

The ID module is not connected—or not connected properly—to your system controller, the CODEWORD file does not exist, or the codeword in the CODEWORD file is incorrect.

START ERROR 1 SWM/SWC failed power-on test.
START ERROR 2 No pin boards installed in SWM.
START ERROR 3 SWM down. SRQ asserted.

A hardware failure occurred during the SWC/SWM power-on self-test. Check for one of the following possible causes:

- A momentary power loss may have occurred.
- The control cable interconnecting the SWM and SWC is disconnected, making poor contact, or defective.
- The SWM control bus cable is disconnected, making poor contact, or defective.

After checking the above, rerun the START program. If the same error code is displayed, contact your system administrator or nearest HP Service Office.

START ERROR 4 SWM syntax error. SRQ asserted.

The SWC received an illegal program code. Rerun the START program.

START ERROR 5 SWM pin board malfunction. SRQ asserted.

Pin board failure occurred during the SWC/SWM power-on self-test.

START ERROR 6 Switching matrix is open.

Enable the SWM by installing the test fixture adapter on the SWM (closes the FIXTURE CLOSED DETECT switch) or by pressing and holding the WAFER PROBER SENSE switch of the SWM, and rerun the START program.

START ERROR 7 This version of switching matrix controller not supported: HP 4084A REV. *xx.xx*

HP 4062C/UX/PC supports only the HP 4084B (Rev. 2.0 or later) SWC.

START ERROR 10 DCS failed power-on test.

A hardware failure occurred during DCS self-test.

START ERROR 11 DCS syntax error. SRQ asserted. : Error *xxx*

The DCS received an illegal program code. Rerun the START program. The *xxx* above is the error code of the DCS. Refer to the HP 4142B *Operation Manual*, for details on DCS error codes.

START ERROR 12 DCS not interlocked. SRQ asserted.

The interconnection cable assembly is disconnected, making poor contact, or defective. Check these possible causes and rerun the START program.

START ERROR 13 DCS shutdown. SRQ asserted.

DCS output is disabled because of a momentary power loss or because voltage or current in excess of an SMU's maximum current, voltage, or power was applied to an SMU. Rerun the START program.

START ERROR 14 DCS calibration error. SRQ asserted. : Error *xxx* in slot *y*

A hardware failure occurred during DCS calibration. The *xxx* above is the error code of the DCS and *y* is the slot number of the failed module. For example, if the module in slot 1 is not functioning properly, the following error message is displayed:

```
START ERROR 14 DCS calibration error.  SRQ asserted.  : Error 420 in slot 1
```

If this error occurs, contact your system administrator or nearest HP Service Office. For emergency repair, replace or remove the module in the slot indicated and rerun the START program.

START ERROR 15 CMS syntax error. SRQ asserted.
START ERROR 16 CMS illegally programmed. SRQ asserted.
START ERROR 17 CMS triggered too fast. SRQ asserted.

Check your cabling configuration and BNC shorting cap connections, and rerun the START program.

START ERROR 18 CMS sweep/bias error. SRQ asserted.

The BNC shorting cap is not connected to the REMOTE ON/OFF connector on the front panel of the CMU. Connect the BNC shorting cap and rerun the START program.

START ERROR 19 CMH terminal improperly connected.
START ERROR 19 CMH84 terminal improperly connected.
START ERROR 20 CMH terminal connected to CML (AUX*xx*) port on SWM.
START ERROR 20 CMH84 terminal connected to CML (AUX*xx*) port on SWM.
START ERROR 20 CMH terminal connected to AUX*xx* port on SWM.
START ERROR 20 CMH84 terminal connected to AUX*xx* port on SWM.

START ERROR 21 CML terminal improperly connected.
START ERROR 21 CML84 terminal improperly connected.
START ERROR 22 CML terminal connected to CMH (AUX*xx*) port on SWM.
START ERROR 22 CML84 terminal connected to CMH (AUX*xx*) port on SWM.
START ERROR 22 CML terminal connected to AUX*xx* port on SWM.
START ERROR 22 CML84 terminal connected to AUX*xx* port on SWM.

The CML or CMH cable is connected to the wrong terminal. Check for proper connection between the CMU and SWM, and rerun the START program.

START ERROR 23 CMS INT BIAS switch improperly set.

The INT BIAS switch on the CMU front panel is set to the ±42 V MAX position. Set the switch to ±100 V MAX and rerun the START program.

START ERROR 24 CMS cable impedance incorrect.

CMH or CML cable impedance is either too high or too low. Use the cables furnished with the system and rerun the START program.

START ERROR 25 CMU84 caused an SRQ. Error code *xxx*

Check the cabling configuration and rerun the pcsstart program.

START ERROR 26 Relays for AUX*yy* of port expander cannot be controlled.

The Port Expander relays can not be controlled because one of the Port Expander relay control boards is either missing or incorrectly installed. The *yy* above refers to the AUX relays controlled. Check the installation and rerun the START program.

START ERROR 90 SYSCONFIG file not found; online mode is not available.

Since SYSCONFIG does not exist in the `/usr/pcs/etc` directory, you can perform only offline mode operations.

START ERROR 91 The instruments are being used in another session.

Another session already locks the instruments. You can perform only offline mode operations until the session is stopped or changed to offline mode.

START ERROR 92 HP-IB timeout is detected at address *xxx*.

An expected interrupt did not occur within the limits specified in the START program. Check for one of the following possible causes:

- The HP-IB cables interconnecting the system controller and instruments were *not* connected, making poor contact, or defective, when the START program executed.
- Instruments were *not* ON when the START program executed.
- HP-IB Interface was *not* functioning properly.

After checking the above, rerun the START program. If the same error code is displayed, exit from BASIC/UX and HP-UX, then reload HP-UX and BASIC/UX and rerun the START program.

START ERROR 100 DUMCONFIG file (*xxx*) not found.
START ERROR 101 Non ASCII character '*xxx*' in DUMCONFIG file.
START ERROR 102 Error in DUMCONFIG: File incompletely terminated.
START ERROR 110 Error in DUMCONFIG: Invalid pin description:
START ERROR 120 Error in DUMCONFIG: Invalid DCS configuration description:
START ERROR 121 Error in DUMCONFIG: Invalid slot number:
START ERROR 122 Error in DUMCONFIG: HP 41420A can not be installed in DCS slot 1.
START ERROR 123 Error in DUMCONFIG: HP 41420A requires slot X to be empty.
START ERROR 124 Error in DUMCONFIG: Slot X is already occupied by an HP 41420A.
START ERROR 125 Error in DUMCONFIG: Two or more units assigned in slot X.
START ERROR 126 Error in DUMCONFIG: Unrecognized module *xxxx*.
START ERROR 130 Error in DUMCONFIG: Invalid cabling description:
START ERROR 131 Error in DUMCONFIG: Only Cmu(1) is attachable to CMH port:
START ERROR 132 Error in DUMCONFIG: Only Cmu(2) is attachable to CML port.
START ERROR 133 Error in DUMCONFIG: Invalid DCS/CMS unit address:
START ERROR 134 Error in DUMCONFIG: Invalid SWM port address:
START ERROR 135 Error in DUMCONFIG: Corresponding unit not installed:
START ERROR 136 Error in DUMCONFIG: Multiple units are attached to SWM port X.
START ERROR 137 Error in DUMCONFIG: SMU *xxx* has multiple cabling to SWM ports.
START ERROR 138 Error in DUMCONFIG: VS *xxx* has multiple cabling to SWM ports.
START ERROR 139 Error in DUMCONFIG: VM *xxx* has multiple cabling to SWM ports.
START ERROR 140 Error in DUMCONFIG: Invalid CMS port connection:
START ERROR 141 Error in DUMCONFIG: Invalid CMU84 port connection: *xxx*.
START ERROR 142 Error in DUMCONFIG: CMU(*xxx*) has multiple cabling to SWM ports.
START ERROR 143 Error in DUMCONFIG: CMU84(*xxx*) has multiple cabling to SWM ports.

The description of DUMCONFIG is not proper. The *xxx* above refers to the unit number. The X refers to a slot or port number. Rerun the pcsstart program. If the same error code is displayed, contact your system administrator or nearest HP Service Office.

START ERROR 201 Illegal command parameter --- *xxx*.

Rerun the START program. If the same error code is displayed, contact your system administrator or nearest HP Service Office.

START ERROR 202 Session *xxx*: Permission denied.

The session that is specified by environment variable PCS_SESSION_ID does not allow accessing. Rerun the START program. If the same error code is displayed, contact your system administrator or nearest HP Service Office.

START ERROR 203 Session *xxx* busy.

Another process is making measurements using TIS statements or locks the instruments.

START ERROR 300 PCS_SESSION_ID not defined.
START ERROR 301 Session ID *xxxx* too long.
START ERROR 310 Group 'pcs' not registered.
START ERROR 320 Non ASCII character '*xxx*' in SYSCONFIG file.
START ERROR 321 Invalid SYSCONFIG entry.
START ERROR 322 SYSCONFIG file contains no effective description.
START ERROR 323 Error in SYSCONFIG: HP-IB select code must be identical.
START ERROR 324 Error in SYSCONFIG: HP-IB address *xxx* not identical among components.
START ERROR 325 Error in SYSCONFIG: Invalid HP-IB address *xxx*.
START ERROR 326 Error in SYSCONFIG: Invalid select code *xxx*.
START ERROR 327 Error in SYSCONFIG: *xxx* is not supported as SWM.
START ERROR 327 Error in SYSCONFIG: *xxx* is not supported as SWC.
START ERROR 327 Error in SYSCONFIG: *xxx* is not supported as DCS.
START ERROR 327 Error in SYSCONFIG: *xxx* is not supported as CMS.
START ERROR 330 Device file /dev/rmb/hpib*xx* not found.
START ERROR 331 HP-IB interface card not on select code *xxx*.
START ERROR 332 /dev/rmb/hpib*xx* is not an HP-IB device file.
START ERROR 333 HP-IB device file /dev/rmb/hpib*xx* is not for select code *xx*.
START ERROR 334 /dev/rmb/hpib*xx* is not a raw HP-IB device file.
START ERROR 341 Can not create session key file; directory /usr/pcs/sessions not found.
START ERROR 350 Error on pcsstart invocation; *xxx*
START ERROR 350 Failed on ps command invocation (errno = *xxx*)
START ERROR 351 Failed on pcsclean command invocation (errno = *xxx*)

`errno` = *xxx* shows the error code of HP-UX system call. Check for one of the following possible causes:

- The system software is not installed properly.
- System files are destroyed.
- Cluster node is not added properly.

Contact your system administrator or nearest HP Service Office.

START ERROR 400 Test session pcs_*xxx* is in bad state.
START ERROR 401 Test session is in bad state; No shared memory.
START ERROR 402 Test session is in bad state; No semaphore.
START ERROR 404 Invalid shared memory segment.
START ERROR 405 Invalid shared memory segment.
START ERROR 406 Invalid semaphore entity.
START ERROR 407 Semaphore ID mismatched.
START ERROR 408 Session ID inconsistent between key file and shared memory.
START ERROR 410 Pcsstart co-exists; Shared memory found.
START ERROR 411 Pcsstart co-exists; Semaphore found.
START ERROR 412 Semaphore removed.
START ERROR 413 The online_lock file seems to be snatched by other session.
START ERROR 450 Fatal error in pcsstart command.

Quit the BASIC/UX, log out, log in again, and restart the BASIC/UX. Then execute the START program. If the same error is detected, contact your system administrator or nearest HP Service office.

TIS Errors

TIS ERROR 1 Not authorized to use the software.

The ID module is not connected—or not connected properly—to your system controller. Correct the connection and rerun the START program.

TIS ERROR 2 Load and run START program to initialize system.

The COM blocks established by START are lost. Rerun the START program.

TIS ERROR 10 HP-IB time out error.

The HP-IB operation terminated after the HP-IB interface connected to the system instruments did not receive a response within the timeout period, which is set by ON TIMEOUT statement. Note that BASIC cannot detect an HP-IB timeout error that occurs during CSUB execution. For the HP 4062UX, this error also cannot be detected when the system instruments are locked by the Lock_system statement.

TIS ERROR 20 Device not present.

An instrument that was not present during START (displayed as `Not present`) is specified. For HP 4062C, the COM blocks may be lost. Check the connection between the instruments and rerun the START program.

TIS ERROR 21 Invalid port or pin assigned.

A port or pin board is illegally specified. For example, a VS is specified in a Force_i statement; or an illegal pin, such as −5, is specified in a Force_v statement.

TIS ERROR 22 Improper number of pass parameters specified.

In the calling context of the Sweep_miv subprogram, the number of measurement ports in the measurement port list is different than the number of measurement data arrays.

TIS ERROR 23 Improper size of pass parameters specified.

In the calling context of Sweep_iv or Sweep_miv subprogram, the size of the *measurement arrays*, *source array*, *primary array*, or *secondary array* is too large. The size of these arrays must be less than or equal to 2001.

In the calling context of Rsweep_miv subprogram, the size of *measurement arrays*, *status array*, *primary value*, or *secondary value* is less than the number of measurement port specified by the *measurement port array*. The size of these arrays must be more than or equal to the number of the measurement port.

TIS ERROR 24 Improper pass parameters' value specified.

Improper pass parameter value was specified.

TIS ERROR 25 Between PREPARE ... EXECUTE, a port is measure-assigned twice.

One port is assigned to perform two or more functions within one Prepare ... Execute construct. Rewrite the measurement commands and assign only one function to a port within each Prepare ... Execute construct. Initialize your system using the Init_system subprogram.

TIS ERROR 26 Do not execute TIS while using DCS program memory library.

After invoking a DCS program memory segment with the Run_dcs_program function, you called a regular TIS function. Only an Init_system, Long_cal, Short_cal, or Disable_port function is allowed to be executed after the execution of the DCS program memory segment.

TIS ERROR 30 SWM down. SRQ asserted.

The SWC or SWM is not functioning properly. Check your cabling configuration and rerun the START program.

TIS ERROR 31 SWM syntax error. SRQ asserted.

The SWC received an illegal program code. Initialize your system using the Init_system subprogram.

TIS ERROR 32 SWM open. SRQ asserted.

SWM output is disabled. This may occur if you're using a wafer prober and your SWM is not mounted properly on the prober; if the test fixture adapter is mounted on SWM but its cover is not closed; or if there is nothing mounted on the SWM.

TIS ERROR 33 Specified pin board not present. SRQ asserted.

A pin board registered during START (pin number displayed) is specified, but cannot be accessed. Check for proper pin board configuration and installation. If you rearranged pin boards, make sure they are properly installed and that the control bus cable is connected.

TIS ERROR 34 Pin board not present.

A specified pin board is not installed in the SWM. Check for proper pin board configuration and rerun the START program.

TIS ERROR 35 (first pin number) >= (last pin number)

In the calling context of the Connect_th subprogram, the first specified pin number is larger than the last specified pin number.

TIS ERROR 40 DCS reports the error code. Error code is *xxxx*.

The DCS received an illegal program code. Initialize your HP 4062C/UX/PC using the Init_system subprogram. The *xxxx* is the error code of the DCS.

TIS ERROR 41 DCS not interlocked. SRQ asserted.

The interconnection cable assembly is disconnected and an attempt was made to output voltage in excess of ±42 V. Connect the cable assembly.

TIS ERROR 44 VS output voltage incompatible with set voltage range.

Specified output voltage of the VS exceeds the selected voltage range. Decrease the output voltage or increase the voltage range setting.

TIS ERROR 45 SMU compliance incompatible with set source or set range. (for revision 5.7 or eariler)
TIS ERROR 45 Improper SMU current source, range, or compliance specified. (for revision 6.0 or later)

Specified compliance value of the SMU is too large for the selected range or specified output value. Decrease the current compliance or the output value, or increase the voltage range setting.

TIS ERROR 46 Illegal sweep power-compliance specified.

In the calling context of the Set_iv subprogram, the specified power compliance is larger than the maximum output power of the SMU. Decrease the power compliance setting.

TIS ERROR 47 Start and stop value are not same polarity.

In the calling context of the Set_iv subprogram, the start value and stop value for a logarithmic (log) sweep measurement must be the same polarity.

TIS ERROR 49 Illegal SMU measurement function assigned.

During a sweep or pulsed measurement, an SMU is set to the wrong mode for the specified measurement. SMUs must be set to VS mode for current measurements, and IS mode for voltage measurements.

TIS ERROR 50 Target value incompatible with compliance value.

In the calling context of the Set_asearch, Set_bsearch, or Set_lsearch subprograms, the target value is larger than the compliance value of the sense unit.

TIS ERROR 51 This port must be the same V/I mode as the control variable.

In the calling context of the Set_sync subprogram, the output modes (VS or IS) of the search port and synchronous search port must be the same.

TIS ERROR 52 Improper search offset value specified.

Offset value specified in the Set_sync subprogram for the search measurements is out of range.

TIS ERROR 53 Sense port must be different from search port.

In the calling context of the Set_asearch subprogram, the search and sense ports are both specified (illegally) as the same port (unit).

TIS ERROR 54 Target value out of range.

The specified target value exceeds the measurement range of the sense unit.

TIS ERROR 55 Illegal search v_range, time, and speed combination specified.

In the calling context of the Set_asearch subprogram, the start value, stop value, ramp rate, and feedback integration time settings are incompatible.

TIS ERROR 56 SMU output voltage incompatible with set voltage range.

Specified output voltage of the SMU exceeds the selected voltage range. Decrease the output voltage or increase the voltage range setting.

TIS ERROR 57 Analog Feedback Unit (AFU) not present.

The AFU is specified for use in a measurement, but is not registered during START, or the COM blocks are lost. Make sure your AFU is installed in the DCS and rerun the START program.

TIS ERROR 58 Pulse period incompatible with pulse width.

The specified pulse width is greater than 50% of the specified pulse period. Decrease the pulse width or increase the pulse period.

TIS ERROR 59 Improper DCS sweep, search, and pulse settings.

In a sweep, search, or pulsed measurement, the measurement execution subprogram executed before you established the measurement conditions. For example, a Sweep_iv subprogram executed before its corresponding Set_iv subprogram executed.

TIS ERROR 60 Improper search values (start_value and stop_value) specified.

The following conditions cause this error:

The start_value and stop_value is set over the available maximum voltage range.
The difference between the start_value and stop_value is less than the value required for the AFU.

TIS ERROR 61 Base_value and peak_value are not same polarity.

In a pulsed current measurement, the specified pulse base and peak values must be of the same polarity.

TIS ERROR 62 Specified VM is still set to Differential Voltage Measurement mode.

In a pulsed measurement, differential voltage measurement mode of the VM cannot be used.

TIS ERROR 63 Sync range adjustment error.

The range of the synchronous search port must be the same as the range of the primary search port for the synchronous search measurements.

TIS ERROR 64 Cannot specify zero (0) for sweep or bias&sweep.

In a pulsed sweep or sweep with pulsed bias measurement, you cannot set the pulse period to 0.

TIS ERROR 65 Improper pulse measurement pass parameter specified for Set_iv.

In the calling context of the Set_iv subprogram, the specified compliance value is invalid or the logarithmic sweep mode is specified.

TIS ERROR 66 Improper pulse measurement range specified.

In a pulsed current measurement, the specified current range is too low for the voltage range set. If the voltage range is larger than 2 V, the current range must be greater than or equal to 1.E−4 A.

TIS ERROR 67 Total power exceeds the limit. It must be =< 32w.

The total power supplied by the DCS exceeds the maximum rating.

TIS ERROR 68 Set_sync and Set_iv cannot specify the same port.

The Set_sync and Set_iv subprograms cannot specify the same port.

TIS ERROR 69 Set_sync cannot be used with Set_piv or Set_pbias.

The secondary sweep parameter cannot be used with pulsed or pulsed bias sweep measurements.

TIS ERROR 70 Start or Stop value is out of minimum resolution.

Unsuitable start or stop values are set in the Set_iv subprogram, or unsuitable offset or ratio is set in the Set_sync subprogram.

TIS ERROR 71 VS cannot be used if the primary SMU is current source mode.

When using a VS as a secondary sweep source, the VS and SMU must be the same source mode.

TIS ERROR 72 Set_sync cannot use before Set_iv. (for revision 5.7 or eariler)
TIS ERROR 72 Set_sync cannot be used before primary search or sweep setup. (for revision 6.0 or later)

The primary sweep port must be set before the secondary sweep port is set.

TIS ERROR 73 The secondary sweep port is not set.

The secondary sweep arrayor value was specified in spite of setting no synchronous sweep port.

TIS ERROR 74 In high voltage state, output relay can't be disconnected.
TIS ERROR 75 In high voltage state, output relay can't be connected.

DCS cannot disconnect or connect the output relay when the output voltage is more than 42 V.

TIS ERROR 76 Source SMU or VS unit is masked.

The specified module in the DCS is masked by Ch_sw_off statement. Unmask the module by running the START program or executing the Init_system, Long_cal, or Short_cal subprograms.

TIS ERROR 77 TIS cannot be used with this revision.

Quasi-pulsed measurements are available for HP 4142B Rev. 4.0 or later.

TIS ERROR 80 CMS syntax error. SRQ asserted.
TIS ERROR 81 CMS illegally programmed. SRQ asserted.

The CMU received an illegal programming code. Initialize your HP 4062C/UX/PC using the Init_system subprogram.

TIS ERROR 82 CMS triggered too fast. SRQ asserted.

The CMU received a trigger signal while outputting measurement data from the previous measurement. Make sure that nothing is connected to the EXT TRIGGER terminal on the rear panel of the CMU.

TIS ERROR 83 CMS sweep/bias error. SRQ asserted.

The BNC shorting cap was removed from the REMOTE ON/OFF connector on the front panel of the CMU. Connect the BNC shorting cap and initialize your HP 4062C/UX using the Init_system subprogram.

TIS ERROR 84 CMS output voltage incompatible with set voltage range.

Specified output voltage of the CMU exceeds the selected voltage range. Decrease the output voltage or increase the voltage range setting.

TIS ERROR 85 CMU84 reports an SRQ. Error code is *xxxx*.

The CMU84 caused a service request. The *xxxx* is the error code of the CMU84. For the error code, see the *HP 4284A Operation Manual*.

TIS ERROR 86 CMU84 Option 001 is not present.

In order to force arbitrary voltage by the HP 4284A (CMU84), the HP 4284A must be furnished with Option 001.

TIS ERROR 94 Voltage difference between start and stop is less than 10 V.

The conditions for Set_bdv or Set_ileak are not being met.

For the Set_bdv function, the start and stop values must satisfy the following conditions:

- Stop $\geq$ start + 10

For the Set_ileak function, the start and stop values must satisfy the following conditions:

- Start $\leq$ voltage − 10

TIS ERROR 95 Measure_bdv can not be used before Set_bdv.

You called the Measure_bdv function before setting up the measurement conditions with the Set_bdv function.

TIS ERROR 95 Measure_bdv can not be used before Set_bdv.

You called the Measure_bdv function before setting up the measurement conditions with the Set_bdv function.

TIS ERROR 96 Measure_ileak can not be used before Set_ileak.

You called the Measure_ileak function before setting up the measurement conditions with the Set_ileak function.

TIS ERROR 100 This TIS subprogram is not supported by offline mode.

A TIS subprogram that is not supported by offline mode is used.

TIS ERROR 101 Specified file cannot be opened.

The file specified by the Off_line_data subprogram cannot be opened. One of the following may be the cause:

- The file does not exist.
- The directory path name is incorrect.

TIS ERROR 102 Specified file cannot be opened.

The file specified by the Data_creation subprogram cannot be created. One of the following may be the cause:

- A file with the same name already exists and is protected.
- The directory path name is incorrect.

TIS ERROR 103 Invalid file data is found.

While reading the data from the file, invalid data are found. Check for one of the following possible causes:

- TIS subprogram name is not proper: The TIS subprogram that is executed in the program is different from the TIS subprogram that is declared in the file, a name that is not a TIS subprogram is detected, or not allowable characters are used.
- Measurement data are not proper: data that are not number are detected or not allowable separators are used.
- Data that is specified in option parameter does not exist in the file.
- The end of the file is reached after the data has been read.

TIS ERROR 200 No test session; TIS is used before START program.

TIS subprograms are called before the START program is executed.

TIS ERROR 201 Permission denied to access this session.

The session that is specified by environment variable PCS_SESSION_ID does not allow accessing. Rerun the START program. If the same error message is displayed, contact your system administrator or nearest HP Service Office.

TIS ERROR 202 Session locked.

Another process in the same session locks the instruments.

TIS ERROR 203 Test session not ready; TIS in used after START failed.

TIS subprograms are called after the START program failed.

TIS ERROR 204 Number of session processes exceeds the system limit.

More than 11 processes call the TIS subprograms in one session.

TIS ERROR 205 No valid HP-IB address; TIS is used after START failed.

TIS subprograms are called after the START program failed.

TIS ERROR 220 PCS_SESSION_ID not defined.
TIS ERROR 221 Session identifier too long.
TIS ERROR 222 Failed to attach shared memory.

System software is not installed or customized properly. Contact your system administrator or nearest HP Service Office.

TIS ERROR 240 Fatal error (errno = *xxx* **)**
TIS ERROR 241 Fatal error (errno = *xxx* **)**
TIS ERROR 242 Fatal error (errno = *xxx* **)**
TIS ERROR 243 Fatal error (errno = *xxx* **)**
TIS ERROR 244 Fatal error (errno = *xxx* **)**
TIS ERROR 245 Fatal error (errno = *xxx* **)**
TIS ERROR 246 Fatal error (errno = *xxx* **)**
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TIS ERROR 249 Fatal error (errno = *xxx* **)**
TIS ERROR 250 Fatal error (errno = *xxx* **)**
TIS ERROR 251 Fatal error (errno = *xxx* **)**

A fatal system error occurred. The *xxx* above is the error code of the HP-UX system call. Contact your system administrator or nearest HP Service Office.

DVR4284 Errors

This section lists errors related to your system's DVR4284 subprograms. Note that the DVR4284 errors are available for revision 5.6 and 5.7.

DVR4284 ERROR 1 HP 4284A driver is not initialized yet.

The START program has not been run or the COM blocks are lost. Run the START program.

DVR4284 ERROR 2 HP 4284A caused an SRQ. Error code is *zzzzz*.

A hardware failure occurred. The *zzzzz* above is the CMU84's error code. Refer to the HP 4284A *Operation Manual*.

DVR4284 ERROR 3 Improper Switching Matrix Model.

An unexpected error occurred. Contact your system administrator or nearest HP Service Office.

DVR4284 ERROR 4 HP 4284A is not present.

The CMU84 was not present during START (displayed as `Not present`) or the COM blocks are lost. Check the connection between the CMU84 and rerun the START program.

DVR4284 ERROR 5 Improper Switching Matrix connection.

Check your cabling configuration and rerun the START program.

DVR4284 ERROR 6 Option #001 is missing.

Option 001 Power Amplifier/DC Bias is not installed in the CMU84. If this is the case:

You can not use Set_cv84 and Sweep_cv84 subprograms.

The test signal level is limited from 5 mV to 2 V.

The internal dc bias is fixed to 0 V, 1.5 V, or 2 V.

DVR4284 ERROR 7 Improper Integration Time parameter.

In the Set_cmu84, the specified measurement integration time value is invalid.

DVR4284 ERROR 8 Improper Averaging Time parameter.

DVR4284 ERROR 9 Improper Mode parameter.

An unexpected error occurred. Contact your system administrator or nearest HP Service Office.

DVR4284 ERROR 10 Improper Signal Level parameter.

In Set_cmu84, the specified test signal level value is invalid.

DVR4284 ERROR 11 Improper DC Bias parameter.

In Force_v84, the specified internal dc bias source value is invalid.

DVR4284 ERROR 12 Improper Measurement Function parameter.

An unexpected error occurred. Contact your system administrator or nearest HP Service Office.

DVR4284 ERROR 13 Improper Frequency parameter.

In Frequency84, the specified measurement frequency value is invalid.

DVR4284 ERROR 14 Improper Hold/Delay Time parameter.

In Set_cv84, the specified hold time or delay time value for the C·G–V sweep measurements is invalid.

DVR4284 ERROR 15 Improper Sweep Step parameter.

In Set_cv84, the specified number of steps value for the C·G–V sweep measurement is invalid.

DVR4284 ERROR 16 Improper Sweep Bias parameter.

In Set_cv84, the specified start voltage or stop voltage value is invalid.

PGMLIB Errors

This section lists errors related to the DCS Program Memory Library (PGMLIB). You need to use the error handling facilities of the C Library and the HP 4062UX to see the PGMLIB error numbers and messages.

PGMLIB ERROR 1 Pgm_start is not declared.

DCS Program Library functions, such Pgm_force_v, are used before the Pgm_start function.

PGMLIB ERROR 2 Pgm_start is nested.

Pgm_start is called twice before the first Pgm_start is ended by a Pgm_end function.

PGMLIB ERROR 20 Device not present.

The DCS is not on line; that is, it is not recognized by the START program.

PGMLIB ERROR 21 Invalid port assigned.

An invalid port address or a unit address is specified to the function. Note that a SWM pin number is not accepted as the unit specifier for the PGMLIB functions.

PGMLIB ERROR 24 Improper pass parameter specified.

The parameter value passed is incompatible with the corresponding range restrictions.

PGMLIB ERROR 100 Error in Pcs_hpib_open.

PGMLIB ERROR 101 Error in Pcs_hpib_output.

PGMLIB ERROR 102 Error in Pcs_hpib_enter.

PGMLIB ERROR 103 Error in Pcs_hpib_clear.

PGMLIB ERROR 104 Error in Pcs_hpib_spoll.

The PGMLIB functions failed to operate on the HP-IB. Check the connection of the HP-IB.

VFP Errors

WARNING 1 SWM open

SWM output is disabled. This may occur if you are using a wafer prober and your SWM is not mounted properly on the prober; if the test fixture adapter is mounted on SWM but its cover is not closed; or if there is nothing mounted on the SWM.

WARNING 2 DCS shutdown

DCS output is disabled because of a momentary power loss or because voltage or current in excess of maximum current or voltage of an SMU is applied to the SMU. Initialize your HP 4062C/UX using the Init_system subprogram.

WARNING 3 DCS not interlocked

The interconnect cable assembly is disconnected and an attempt was made to output voltage in excess of ±42 V. Connect the cable assembly.

VFP ERROR 1 Improper cursor position

The cursor is not positioned correctly for the parameter being set, or you pressed the wrong key when changing a parameter. This error occurs under the following circumstances:

- If you select the `[ ]` softkey when the cursor is *not* positioned in a `[ ]` field.
- If you press a numeric key or the space bar when the cursor is positioned in a `[ ]` field.
- If you select the `[ ]`, `EXECUTE ON / OFF`, or `MEAS / NOT MEAS` softkey when the cursor is positioned in the PIN CONNECTION area.
- If you rotate the rotary knob on the keyboard when the output is enabled (EXEC mode) and the cursor is *not* positioned in an output value field.

Note that you *cannot* change the cursor position when the EXEC mode is enabled.

VFP ERROR 2 Illegal value

A value exceeding specified limits of a parameter was entered.

VFP ERROR 3 Not allowed while OFF status

While in the EXEC mode, an attempt was made to sweep the output of a source device (an SMU, a VS, or internal dc bias source of the CMU) that was set to `OFF`. Set the source device to `ON` by exiting from the EXEC mode and selecting the `EXECUTE ON / OFF` softkey.

VFP ERROR 4 Not allowed while ON status

An attempt was made to change the voltage range or compliance setting of a source device (an SMU or internal dc bias source of the CMU) that was set to `ON`. Set the source device to `OFF` by selecting the `EXECUTE ON / OFF` softkey before changing parameters.

VFP ERROR 5 Not allowed in EXEC mode

While in the EXEC mode, an attempt was made to change a control setting, or you pressed a key or selected a softkey other than the `EXECUTE ON / OFF` softkey.

VFP ERROR 6 Return (or Enter) key was not pressed

A parameter is set or a control setting is changed, but not entered, because you did not press (Return) or (Enter).

VFP ERROR 7 DCS output voltage incompatible with set voltage range

Specified output voltage of an SMU exceeds the selected voltage range. Decrease the output voltage or increase the voltage range setting.

VFP ERROR 8 SMU voltage compliance incompatible with set current value

The power calculated with the compliance setting and the specified output value of an SMU exceeds the power of the SMU. Decrease either the compliance setting or the specified output value.

VFP ERROR 9 SMU current compliance incompatible with set voltage value

Specified current compliance of an SMU is too high for the selected voltage range. Decrease the current compliance setting or increase the voltage range setting.

VFP ERROR 10 CMS output voltage incompatible with set voltage range

Specified output voltage of the CMU exceeds the selected dc bias range. Decrease the output voltage or increase the voltage range setting.

VFP ERROR 11 Illegal key

A key other than the VFP control keys was pressed.

VFP ERROR 12 DCS not present

The DCS was not registered during START (displayed as `Not present`) and an attempt was made to operate the DCS. Make sure the DCS is turned on and the HP-IB cable is connected. Rerun the START program.

VFP ERROR 13 CMS not present

The CMU was not registered during START (displayed as `Not Present`) and an attempt is made to operate the CMU. Make sure the CMU is turned on and the HP-IB cable is connected. Rerun the START program.

VFP ERROR 14 SWM not present

The SWM was not registered during START (displayed as `Not Present`) and an attempt is made to operate the SWM. Make sure the SWC is turned on and the HP-IB cable is connected. Rerun the START program.

VFP ERROR 15 Pin board not present

A pin board not registered during START (pin number not displayed) is specified. Check for proper pin board configuration and installation. If you rearranged pin boards, make sure they are properly installed and that the control bus cable is connected. Rerun the START program.

VFP ERROR 16 System is already locked, not allowed to enter Control mode.

The `Lock & Control` softkey is selected while another process locks the instruments.

PPG Errors

PPG ERROR 1 Printer timeout.

A printer is not connected, or the HP-IB address of the printer is not set to 1. Make sure a printer is connected and that its HP-IB address is 1.

PPG ERROR 6 File name is not specified.

The file name is not specified when you save the probing pattern data.

PPG ERROR 7 Duplicate file name. Overwrite or Abort ("O", "o": others) ?

The specified file name already exists in the directory when you save the probing pattern data.

PPG ERROR 8 Max. module number is too large.

The maximum module number exceeds the allowable limits because the specified module size is too small. Re-enter the appropriate module size.

PPG ERROR 11 Chip size > Wafer size

The specified chip size is too large for the specified wafer size. Re-enter the appropriate chip size.

PPG ERROR 12 Number of chips is too large (MAX X=255 Y=255)

The calculated number of chips exceeds the allowable limits (max. 255 for the X-coordinate; 255 for the Y-coordinate) because the specified chip size is too small. Re-enter the appropriate chip size.

PPG ERROR 13 Module size * Module number > Chip size

The module size multiplied by the module number exceeds the specified chip size. The specified module size is too large or the chip size is too small. Re-enter the appropriate module or chip size.

PPG ERROR 14 Module size > Chip size

The module size exceeds the specified chip size. The specified module size is too large or the chip size is too small. Re-enter the appropriate module or chip size.

PPG ERROR 15 Probing sequence number must be 1 to 6

The probing sequence number exceeds the allowable limits. The probing sequence number must be 1 through 6. Re-enter the appropriate probing sequence number.

PPG ERROR 16 Wafer size must be 0.1 to 99.99999 inches

The wafer size exceeds the allowable limits. The wafer size must be 0.1 through 99.99999 inches. Re-enter the appropriate wafer size.

PPG ERROR 17 Chip X-Y size must be 1 to 99999 microns.

The X- or Y- chip size exceeds the allowable limits. The X- and Y- chip size must be 1 through 99999 microns. Re-enter the appropriate chip size.

PPG ERROR 18 Module X-Y size must be 1 to 99999 microns.

The X- or Y- module size exceeds the allowable limits. The X- and Y- module size must be 1 to 99999 microns. Re-enter the appropriate module size.

PPG ERROR 19 Number of X-Y modules must be 1 to 6.

The X- or Y- module number exceeds the allowable limits. The X- and Y- module number must be 1 through 6. Re-enter the appropriate module number.

PPG ERROR 21 Illegal input

An attempt was made to enter a value that exceeds the specified limits.

PPG ERROR 22 No modules have been selected

No modules are selected. You must select at least one module. To select modules individually, place the cursor at the desired module and select the `SELECT` softkey. To select all modules, select the `SELECT ALL` softkey.

PPG ERROR 26 Number of selected chips is too large. (MAX 32760)

The calculated number of chips exceeds the allowable limits (max. 32760) because the specified chip size is too small. Re-enter the appropriate chip size.

PPG ERROR 27 No chips have been selected

No chips are selected. You must select at least one chip. To select chips individually, place the cursor at the desired chip and select the `SELECT` softkey. To select all chips, select the `SELECT ALL` softkey.

PPG ERROR 28 X or Y (No. *xxx*) not set. Enter missing value, or delete (no. *xxx*).

The X- or Y- coordinate is not entered. The *xxx* above is the module number. Enter the appropriate coordinate or delete it.

PPG ERROR 31 Wget is not declared

The Wget subprogram is not included in your measurement program, or is placed out of sequence. The Wget subprogram must precede the Wstart_number or Wstart_xy subprogram.

PPG ERROR 32 Improper number of pass parameters specified

Only one coordinate (X- or Y-) is specified in the Wstart_xy subprogram. You must specify both X- and Y-coordinates.

PPG ERROR 33 Wstart_xy or Wstart_number is not declared

The Wstart_number or Wstart_xy subprogram is not included in your measurement program, or does not precede a Wmove_next, Wmove_number, or Wmove_xy subprogram.

PPG ERROR 34 Illegal chip coordinate

The X- and Y-chip coordinates specified in the Wmove_xy subprogram designate a non-existent chip.

PPG ERROR 35 CHIP not registered

A chip not registered during the WAFER configuration stage is specified in a Wmove_number or Wmove_xy subprogram. Execute PPG and register the chip, or delete all references to the chip in your Wmove_number or Wmove_xy subprogram.

PPG ERROR 36 MODULE not registered

A module not registered during the CHIP configuration stage is specified in a Wmove_number or Wmove_xy subprogram. Execute PPG and register the chip, or delete all references to the chip in your Wmove_number or Wmove_xy subprogram.

PPG ERROR 41 Illegal VAR NAME (no VAR NAME in DATA file)

A VAR NAME not listed in the data file is specified.

PPG ERROR 42 Illegal LIMIT value

One or all of the wafer map LIMIT values is specified out of sequence. For example, the uppermost LIMIT value must be greater than or equal to the second LIMIT value; the second LIMIT value must be greater than or equal to the third LIMIT value, and so on.

PPG ERROR 43 Illegal COORDINATE value

The X- or Y-axis of the wafer map is improperly scaled. For example, the X-axis minimum value is greater than the X-axis maximum value.

PPG ERROR 44 Illegal input (MAX COLUMN=*xx* ROW=*yy*)

The value specified for the X- or Y-axis of the wafer map exceeds the allowable limit (max. *xx* for the X- [COLUMN] axis, *yy* for the Y- [ROW] axis).

PPG ERROR 71 Illegal DATA file (MIN Nv=3)

The minimum number of variables (Nv) required for generation of a wafer map is not specified in the data file. At least three (3) variables must be specified (COLUMN, ROW, and measurement data).

PPG ERROR 72 Illegal DATA file (Vn$(1)="COLUMN" Vn$(2)="ROW")

Illegal string variable is specified. VN$(1) must be "COLUMN" and VN$(2) must be "ROW."

PPG ERROR 73 Illegal DATA NAME in SUB Wput_data or SUB Wput_array

Null data (" ") is specified as the string variable (DATA NAME) in a SUB Wput_array or SUB Wput_data subprogram.

PPG ERROR 74 DATA NAME overflow

The number of characters specified in the data file name exceeds the allowable limit (max. 50 characters).

PPG ERROR 75 DATA number overflow

The number of data file variables multiplied by the number of chips exceeds the allowable limit (max. 1500).

Note

HP BASIC Language System errors occurring in PPG are displayed between two graphics arrows, as in the following example:

```
====> ERROR 53 IN 1950 Improper file name <====
```

For details on HP BASIC errors, refer to the HP BASIC *Language Reference Manual*.

Performance Verification (PV) (or DIAG) Errors

PV(DIAG). ERROR 10 Switching Matrix not ready.

The SWC is not turned on, or the HP-IB cable is not connected (SWC displayed as `Not present` during START). Stop the program, check the power and the HP-IB cable, and select the `RUN` softkey.

PV(DIAG). ERROR 11 (Switching Matrix error)

A relay failure is detected in the SWM. The displayed error message indicates the failure location. Make sure the relay test adapter is installed securely on the SWM, and select the `RETRY` softkey.

If the same error occurs at the same location, contact your nearest HP Service Office. If emergency repair is necessary, replace the defective pin board. See the *System Information* manual for details on replacing pin boards.

If a PV(DIAG). ERROR 11 followed by the message `A relay is stuck` ... is displayed, you may be able to repair the relay itself. See the *System Information* manual for details.

Whenever a relay failure occurs, repair or remove the faulty pin board and rerun the relay test to check for additional failures.

PV(DIAG). ERROR 12 Leakage in Switching Matrix.

Excessive leakage current is detected in the SWM, or in the cabling to the SWM. Contact your nearest HP Service Office.

PV(DIAG). ERROR 13 Leakage in Switching Matrix.

Excessive leakage current is detected on a pin board. If a test fixture is mounted in the test fixture adapter, remove the fixture and select the `RETRY` softkey. If the same error occurs, contact your nearest HP Service Office.

PV(DIAG). ERROR 14 Some pin boards are not installed.

Pin boards required for PV(DIAG) program are not installed.

PV(DIAG). ERROR 19 Block *x* Input Relay K*yz* test failed.

An input relay failure is detected in the SWM. The displayed error message indicates the failure location. Make sure the relay test adapter is installed securely on the SWM, and select the `RETRY` softkey. If the same error occurs at the same location, contact your nearest HP Service Office.

PV(DIAG). ERROR 20 DC Source/Monitor not ready.

The DCS is not turned on, its HP-IB cable is not connected (DCS displayed as `Not present` during START), or a plug-in module required for a test execution is not present or is not connected to the SWM. Stop the program, check these items, and select the `RUN` softkey.

PV(DIAG). ERROR 21 DC Source/Monitor failed SELF TEST.

An SMU failure is detected during the self-test of the DCS. Contact your nearest HP Service Office.

PV(DIAG). ERROR 22 I-V measurement test failed.

PV(DIAG). ERROR 23 I-V measurement test failed.

PV(DIAG). ERROR 24 I-V measurement test failed.

PV(DIAG). ERROR 25 I-V measurement test failed.

An SMU failure is detected. If the relay test has not yet been performed, run the relay test, then retry the SMU test. If the same error occurs, contact your nearest HP Service Office. If emergency repair is necessary, replace the defective SMU plug-in module. See the *System Information* for details.

PV(DIAG). ERROR 26 VS*x* and VS*y* are not connected.

PV(DIAG). ERROR 26 VS*x* is not connected.

Where x and y are integers from 1 to 16, and x is a lower integer than y. If the first error occurs, connect VSx to the AUX1 port, VSy to the AUX2 port, and perform the VS Test again. If the second error occurs, connect VSx to the AUX1 port, and perform the VS Test again.

PV(DIAG). ERROR 27 Voltage output test failed.

A VS failure is detected. Contact your nearest HP Service Office.

PV(DIAG). ERROR 28 VM*x* and VM*y* are not connected.

PV(DIAG). ERROR 28 VM*x* is not connected.

Where x and y are integers from 1 to 16, and x is a lower integer than y. If the first error occurs, connect VMx to the AUX1 port, VMy to the AUX2 port, and perform the VM Test again. If the second error occurs, connect VMx to the AUX1 port, and perform the VM Test again.

PV(DIAG). ERROR 29 Voltage measurement test failed.

A VM failure is detected. Contact your nearest HP Service Office.

PV(DIAG). ERROR 30 C Meter/C-V Plotter not ready.

The CMU is not turned on, its HP-IB cable is not connected (CMU displayed as `Not present` during START), or it is not connected to the SWM. Stop the program, check the power of the CMU, HP-IB cable, and SWM interconnection cables, and select the `RUN` softkey.

PV(DIAG). ERROR 31 C Meter/C-V Plotter failed SELF TEST.

The CMU failed its self-test. Contact your nearest HP Service Office.

PV(DIAG). ERROR 32 C-G measurement test failed.

A CMU or CMU84 measurement circuit failure is detected. Contact your nearest HP Service Office.

PV(DIAG). ERROR 33 Stray capacitance too high.

Stray capacitance in the SWM or the CMH or CML cable exceeds 6 pF. Contact your nearest HP Service Office.

PV(DIAG). ERROR 34 Bias output test failed.

A CMU and CMU84 internal dc bias source failure is detected. Contact your nearest HP Service Office.

PV(DIAG). ERROR 35 Rear panel short-cap disconnected.

A BNC shorting cap is not connected to the EXT. BIAS-SLOW connector on the rear panel of the CMU.

PV(DIAG). ERROR 36 Analog Feedback Unit test failed.

A failure is detected in the AFU of the DCS. If this error occurs when all SMUs are functioning normally, contact your nearest HP Service Office.

PV(DIAG). ERROR 40 (CMU84 not ready)

The CMU84 is not turned on, its HP-IB cable is not connected (CMU84 displayed as `Not present` during START), or it is not connected to the SWM. Stop the program, check the power of the CMU84, HP-IB cable, and SWM interconnection cables, and select the `RUN` softkey.

PV(DIAG). ERROR 45 Port Expander Relay K*xx* *yyy* side test failed

DIAG program detected an malfunctioning Port Expander relay K*xx* (where *xx* is one of the relay number). The *yyy* in the above message should be replaced by either `force` or `guard`.

HP BASIC/WS, HP BASIC/UX, or HP BASIC/DOS Language System Errors

This section lists several of the more common errors related to the HP BASIC/WS, HP BASIC/UX, or HP BASIC/DOS language system. For more details, refer to the HP BASIC *Language Reference Manual*.

ERROR 5

Improper context terminator. There is no END statement in the program. Also applies to SUBEND and FNEND.

ERROR 7

Undefined function or subprogram. An attempt was made to call a SUB or user-defined function that is not in memory. Look for program lines that assume an optional CALL.

ERROR 8

Improper parameter matching. A type mismatch between a pass parameter and a formal parameter of a subprogram. See *Programming Reference* for parameter types.

ERROR 9

Improper number of parameters. Passing either too few or too many parameters to a subprogram. Applies only to non-optional parameters. See *Programming Reference* for details on the number of parameters.

ERROR 53

Improper file name. File names are limited to 10 characters. Foreign characters are allowed, but punctuation is not.

ERROR 56

File name is undefined. The specified file name does not exist in the directory. Check the contents of your disk using the CAT command.

ERROR 145

May not build COM at this time. An attempt is made to add or change COM while a program is running. For example, a program does a LOADSUB, and the COM in the new subprogram does not match the existing COM. Rerun the START program.

ERROR 499

This error code is preceded by one of the TIS errors. See TIS Errors.

ERROR 902

Must delete entire context. An attempt is made to delete a SUB or DEF FN statement without deleting its entire context. Easiest way to delete is with DELSUB. :

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