

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

Service Manual



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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
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Safety Summary

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

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

Warning



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

Safety Symbols

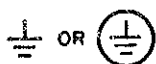
The general definitions of safety symbols used on equipment or in manuals are listed below.



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.



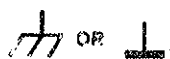
Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



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.



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



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



Alternating current (power line).



Direct current (power line).



Alternating or direct current (power line).

Warning



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

Purpose

This manual contains the service information for both the HP 4062C and the HP 4062UX systems. Refer to the *Installation Manual* for information about the installation of the HP 4062C/UX system.

Audience

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

Contents

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

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

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

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

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Manual Update

Note: This update is applicable for HP 4062C Revision 5.7 (C.05.70) only.

Identification

Manual Identification	Update Identification
<i>Service Manual</i> HP Part Number: 04062-90511 Manufacturing Number 04062-90512 Edition 1: July 1990	Update Number: 1 Manufacturing Number: 04062-90513 Update Date: October 1990 Previous Updates included: None

How to Use This Update

The purpose of this manual update is to accumulate all of the changes applicable to this edition of the manual. This update package consists of two parts. The current update follows this cover sheet. All unincorporated earlier updates to this edition have been consolidated and placed behind the current update. A blank yellow sheet separates the two parts if they are both present. Duplicate and superseded pages have been removed from the earlier updates.

Changed pages have the update number at the bottom of the page. Changes are marked with a vertical in the margin. A change bar opposite a blank line indicates deleted text. A page with an update number but no change bars has text that has moved without being changed.

To update your manual, determine if the earlier updates (if present) at the back of this package have been incorporated into your manual. If not, insert the earlier update by replacing existing pages with the corresponding pages from the update. Also insert new pages from the update. After the earlier updates have been incorporated (if necessary), follow the same procedure to incorporate the current update. Destroy all replaced pages.

New or Replacement Pages

Title Page
Printing History Page
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2-37 and 2-38
2-21 through 2-24
2-67 through 2-70t
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3-23 through 3-24
Appendix E

General Information

Introduction

This manual provides the instructions, procedures, and information required to verify and repair the HP 4062C 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 using the performance verification software. Chapter 3 provides troubleshooting information. Chapter 4 covers system parts information.

System Configuration

The HP 4062C/UX is designed for use with an HP 9000 Series 300 computer and an automatic wafer prober. 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.

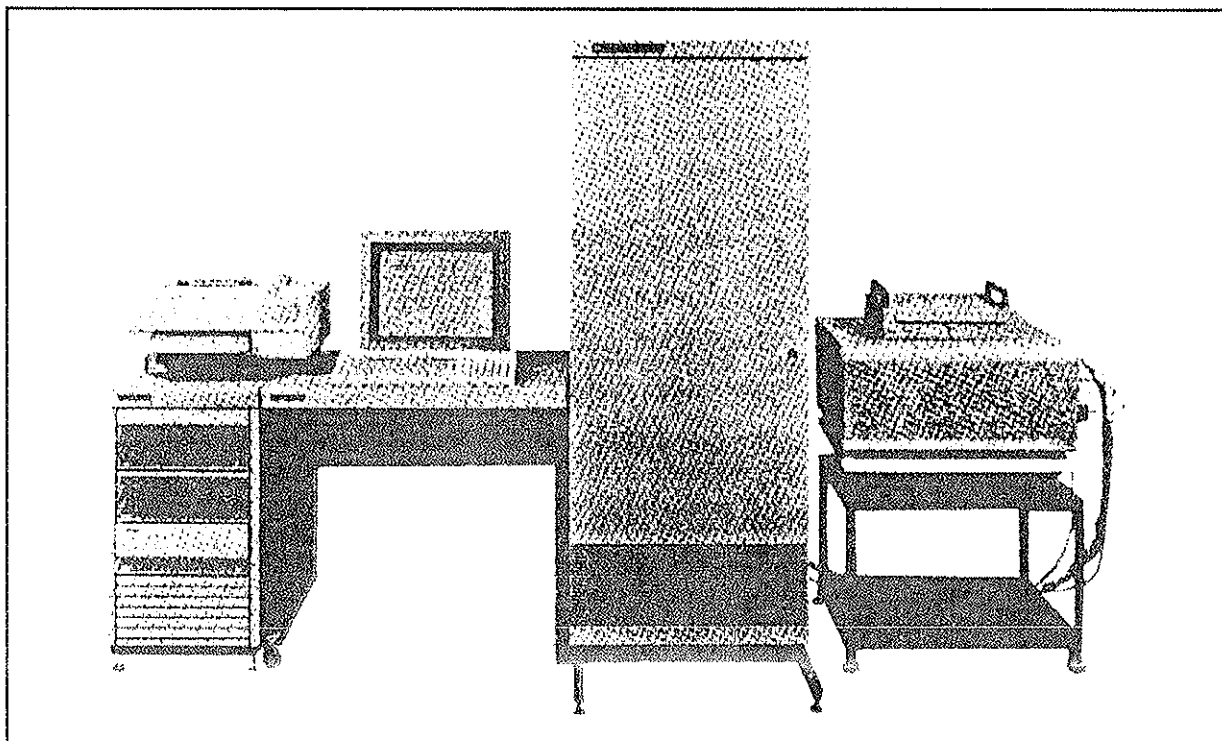


Figure 1-1. A Typical HP 4062C/UX System

Table 1-1. A Typical HP 4062C/UX 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 (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 4280A 1 MHz C Meter/C-V Plotter (CMU)	1 ea.	1 ea.
System Cabinet	1 ea.	1 ea.
HP 16321A VFP Timer Board (HP 4062C only)	1 ea.	1 ea.
System Software	1 ea.	1 ea.
Test Instruction Set (TIS)		
Virtual Front Panel (VFP)		
Probing Pattern Generator (PPG)		
System Diagnostics (DIAG)		
Performance Verification (PV4062) (HP 4062UX only)		
System Controller for HP 4062C: HP 9000 Series 300 Model 310, 320, 330, 332, 350, 360, or 370		
System Controller for HP 4062UX: HP 9000 Series 300 Model 320, 330, 350, 360, 370, or 375		
HP 9000 Series 300 Model 318M, 319C+, 340, or 345 for diskless cluster configurations		
Disk Drive		
Printer		
Automatic Wafer Prober		

Figure 1-2 shows an IIP 4085B 48-pin Switching Matrix (SWM) system configuration. The IIP 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 IIP 4084B Switching Matrix Controller (SWC). System instruments, except for the SWM, are controlled by an HP 9000 Series 300 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.

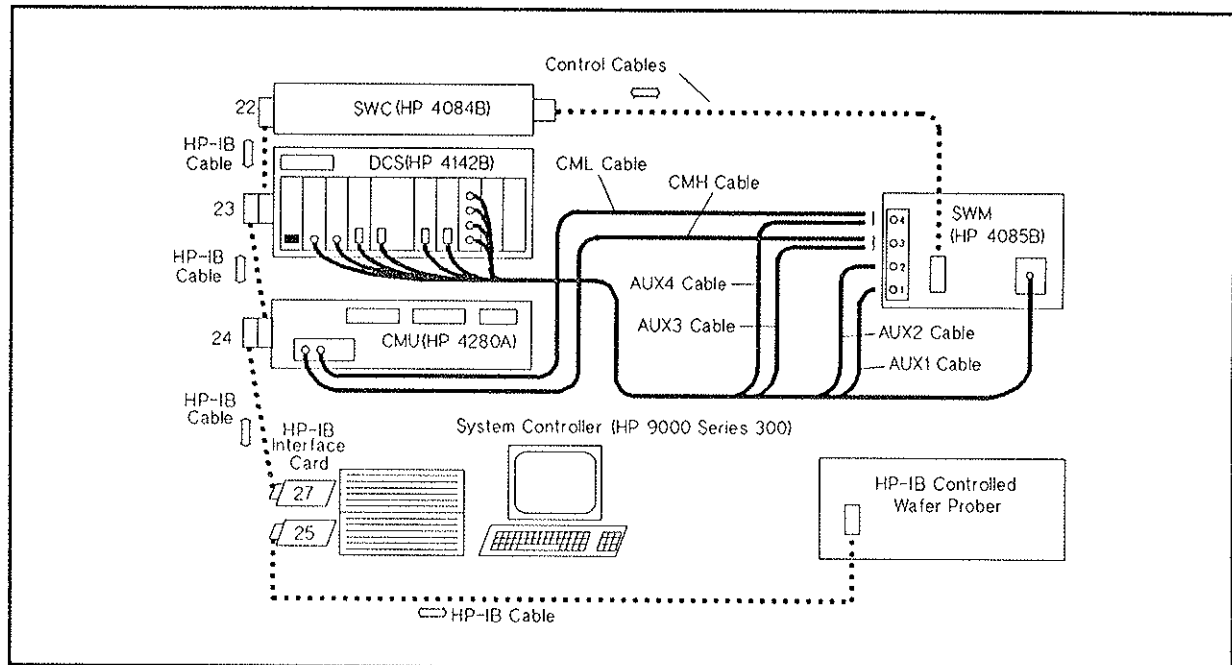


Figure 1-2. System Configuration: 48-pin SWM System

Figure 1-3 shows an HP 4089A 96-pin SWM system configuration.

SWM connections for 96-pin SWM systems are controlled by two SWCs (SWC 1 and 2).

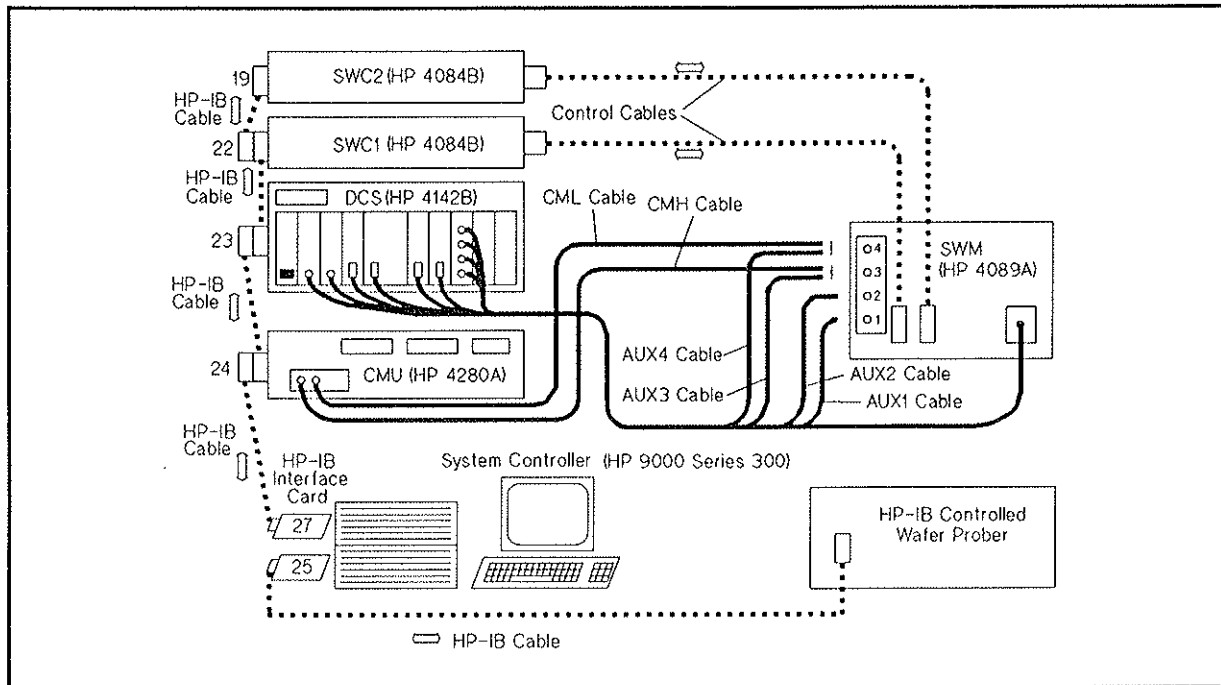


Figure 1-3. System Configuration: 96-pin SWM System

Abbreviations

This paragraph provides the abbreviations for HP 4062C/UX 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 Modula DC Source/Monitor
CMS	Capacitance Measurement Subsystem
CMU	Capacitance Measurement Unit: IIP 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
SWS	Switching Matrix Subsystem
SWM	Switching Matrix: HP 4085B 48-pin SWM or HP 4089A 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 System
PV4062	Performance Verification for HP 4062C/UX System
DVM	Digital Voltmeter
DMM	Digital Multimeter (including DVM)

Performance Evaluation Strategy

Diagnostics

Your HP 4062C/UX 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 subsystem, and requires the furnished system test module.

Uses:

HP 16075A Relay Adaptor
HP 16076A System Test Module

If your HP 4062 system is equipped with an HP 4274A Multi-Frequency LCR Meter (option 310 for HP 4062C; option 520 for HP 4062UX), 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:

HP 16346B For 41420A Smu

HP 16346A/B For 41421B Smu

PV4062 without (W/O) DVM:

HP 16346C For Cmu84 Capacitance meter

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 is equipped with an HP 4274A Multi-Frequency LCR Meter (option 310 for HP 4062C; option 520 for HP 4062UX), 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	Included in the Product Support Package. Can also be ordered separately for HP 4062C. For HP 4062UX, furnished with system.
Program location for HP 4062C	SYSTEM SOFTWARE disk (5)	PERFORMANCE VERIFICATION disks
Program location for HP 4062UX	/usr/pcs/diag directory	/usr/pcs/diag directory
Test limits	General	Specific

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						A
LCR Bias Test						A

¹ For HP 4062C 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. 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



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 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.

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 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 48-pin SWM
002	24-pin Configuration of 48-pin SWM
003	36-pin Configuration of 48-pin SWM
004	Add Spare Pin Board for 48-pin SWM
012	24-pin Configuration of 96-pin SWM
013	36-pin Configuration of 96-pin SWM
014	48-pin Configuration of 96-pin SWM
015	64-pin Configuration of 96-pin SWM
016	72-pin Configuration of 96-pin SWM
017	84-pin Configuration of 96-pin SWM
018	96-pin Configuration of 96-pin SWM
019	Add Spare Pin Board for 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
102	Delete HP 4280A 1 MHz C Meter/C-V Plotter
110	Delete Package Device Test Fixtures for 48-pin SWM
115	Delete Package Device Test Fixtures for 96-pin SWM
130	Delete System Cabinet
310	Add HP 4274A Multi-Frequency LCR Meter
311	Add ± 35 V dc Bias for HP 4274A
312	Add ± 100 V dc Bias for HP 4274A
320	Add HP 4284A 20 Hz–1 MHz Precision LCR Meter (including HP 4284A option 006)
321	Add ± 40 V Internal dc Bias for HP 4284A
405	System Software Right-to-Copy
450	Add Interactive Measurement and Analysis (IMA) Software License-to-use, Media, and Manuals
451	Add IMA Software License-to-use

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

Option	Description
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 ¹ Personality Board for 48-pin SWM
572	Add HP 16072B Personality Board for 48-pin SWM
573	Add HP 16072B Option 001 ¹ 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
710	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	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 For Electroglas 1034X/2001X Wafer Probers.

Table 1-6. HP 4062UX Options

Option	Description
050	50 Hz Line Frequency
060	60 Hz Line Frequency
022	1/4 inch tape media for HP 4062UX software and media/manual for HP-UX and HP BASIC/UX
310	12-pin Configuration of HP 4085B (48-pin) SWM
311	Add one HP 16320B Pin Board for HP 4085B SWM
312	Add Packaged Device Test Fixtures for HP 4085B SWM
313	Add HP 16077A Cable Extension Fixture for HP 4085B SWM
314	Add HP 16071A Universal Fixture for HP 4085B SWM
315	Add HP 16071B Universal Fixture for HP 4085B SWM
316	Add HP 16072A Personality Board for HP 4085B SWM
317	Add HP 16072A Option 001 ¹ Personality Board for HP 4085B SWM
318	Add HP 16072B Personality Board for HP 4085B SWM
319	Add HP 16072B Option 001 ¹ Personality Board for HP 4085B SWM
330	24-pin Configuration of HP 4089A SWM
331	Add One HP 16320C Pin Board for HP 4089A SWM
332	Add Packaged Device Fixtures for HP 4089A SWM
333	Add HP 16378B Cable Extension Fixture for HP 4089A SWM
334	Add HP 16376A Universal Fixture for HP 4089A SWM
335	Add HP 16376B Universal Fixture for HP 4089A SWM
336	Add HP 16377A Personality Board for HP 4089A SWM
337	Add HP 16377B Personality Board for HP 4089A SWM
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	Add Interactive Measurement and Analysis (IMA) Software License-to-use, Media, and Manuals
451	Add IMA Software License-to-use
510	Add HP 4280A 1 MHz C Meter/C-V Plotter (CMU)
515	Field Installation Kit for HP 4280A

¹ For Electroglas 1034X/2001X Wafer Probers.

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

Option	Description
520	Add HP 4274A Multi-Frequency LCR Meter (LCR)
521	Add ± 35 V dc Bias for HP 4274A
522	Add ± 100 V dc Bias for HP 4274A
525	Field Installation Kit for HP 4274A
530	Add HP 4284A 20 Hz–1 MHz Precision LCR Meter (CMU84) (including HP 4284A option 006)
531	Add 40 V Internal dc Bias for HP 4284A
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
710	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	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

Furnished Accessories

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

Table 1-7. HP 4062C Furnished Accessories

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

Table 1-8. HP 4062UX Furnished Accessories

For HP 4085B 48-pin SWM	For HP 4089A 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 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 16320C Pin Boards (for HP 4089A 96-pin SWMs) can be purchased as replacements or for configuration changes.

Specifications

This paragraph contains HP 4062C/UX specifications. These specifications are the performance standards or limits against which HP 4062C/UXs 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 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

□ High Resolution SMU: 1 port

Current Measurement Range: ± 20 fA to ± 1 A

Voltage Measurement Range: ± 40 μ V to ± 200 V

□ High Current SMU, Kelvin: 1 port

Current Measurement Range: ± 2 pA to ± 1 A

Voltage Measurement Range: ± 40 μ V to ± 200 V

□ SMUs, Kelvin: 2 ports

Current Measurement Range: ± 2 pA to ± 1 A

Voltage Measurement Range: ± 40 μ V to ± 200 V

□ GNDU, Kelvin: 1 port

Voltage Output Range: 0 V

□ VS/VMU: 4 ports

Voltage Output Range: ± 1 mV to ± 40 V

Voltage Measurement Range: ± 40 μ V to ± 40 V (4 μ V 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 μ S 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

Switching Matrix Subsystem (SMS)

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

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

or

One HP 4089A 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 SWM Measurement Pins:

The HP 4089A 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

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.

■ 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: AUX ports

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

DC Measurement Subsystem (DCS)

The DCS of the HP 4062C/UX 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 Analog Feedback Unit (AFU), 1 slot

The DCS provides 8 plug-in module slots.

High Resolution SMU: 1 port

This port is for low current measurement.

An IIP 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 ($I_o = \text{Output } I$) $\pm(\% \text{ of reading} + \% \text{ of range} + V)$
$\pm 2 \text{ V}$	$100 \mu\text{V}/40 \mu\text{V}$	$\pm(0.05\%+0.05\%+0.5 \Omega \times I_o+100 \mu\text{V})$
$\pm 20 \text{ V}$	$1 \text{ mV}/400 \mu\text{V}$	$\pm(0.05\%+0.05\%+0.5 \Omega \times I_o)$
$\pm 40 \text{ V}$	$2 \text{ mV}/800 \mu\text{V}$	
$\pm 100 \text{ V}$	$5 \text{ mV}/2 \text{ mV}$	
$\pm 200 \text{ V}^1$	$10 \text{ mV}/4 \text{ mV}$	

¹ HP 41420A SMU only.

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

V Range Full Scale	Resolution Force/Measure	Accuracy ($I_o = \text{Output } I$) $\pm(\% \text{ of reading} + \% \text{ of range} + V)$
$\pm 2 \text{ V}$	$100 \mu\text{V}/40 \mu\text{V}$	$\pm(0.05\%+0.05\%+0.6 \Omega \times I_o+100 \mu\text{V})$
$\pm 20 \text{ V}$	$1 \text{ mV}/400 \mu\text{V}$	$\pm(0.05\%+0.05\%+0.6 \Omega \times I_o)$
$\pm 40 \text{ V}$	$2 \text{ mV}/800 \mu\text{V}$	
$\pm 100 \text{ V}$	$5 \text{ mV}/2 \text{ mV}$	
$\pm 200 \text{ V}^1$	$10 \text{ mV}/4 \text{ mV}$	

¹ HP 41420A SMU only.

Current Source/Monitor Range, Resolution, and Accuracy

I Range Full Scale	Resolution Force/Measure	Accuracy ($V_o = \text{Output } V$) $\pm(\% \text{ of reading} + \% \text{ of range} + A)$
1 A^1	$50 \mu\text{A}/20 \mu\text{A}$	$\pm[0.5\%+(0.1+0.002 \times V_o)\%]$
$\pm 100 \text{ mA}$	$5 \mu\text{A}/2 \mu\text{A}$	$\pm[0.2\%+(0.1+0.002 \times V_o)\%]$
$\pm 10 \text{ mA}$	$500 \text{ nA}/200 \text{ nA}$	
$\pm 1 \text{ mA}$	$50 \text{ nA}/20 \text{ nA}$	
$\pm 100 \mu\text{A}$	$5 \text{ nA}/2 \text{ nA}$	
$\pm 10 \mu\text{A}$	$500 \text{ pA}/200 \text{ pA}$	
$\pm 1 \mu\text{A}$	$50 \text{ pA}/20 \text{ pA}$	$\pm[0.5\%+(0.1+0.002 \times V_o)\%]$
$\pm 100 \text{ nA}$	$5 \text{ pA}/2 \text{ pA}$	
$\pm 10 \text{ nA}$	$500 \text{ fA}/200 \text{ fA}^2$	$\pm[1\%+(0.002 \times V_o)\%+15 \text{ pA}]$
$\pm 1 \text{ nA}$	$50 \text{ fA}/20 \text{ fA}^2$	$\pm[1\%+(0.002 \times V_o)\%+8 \text{ pA}]$

¹ HP 41420A SMU only.

² I monitor resolution of $200 \text{ fA}/20 \text{ fA}$ @ $10 \text{ nA}/1 \text{ nA}$ ranges are obtained when the integration time of the DCS is set to LONG.

Residual Resistance: $\leq 0.5 \Omega$ (48-pin SWM)
 $\leq 0.6 \Omega$ (96-pin SWM)
Input Resistance: $\geq 10^{12} \Omega$ (in I source mode)
Output Terminals: Force and Guard

High Current SMU: 1 port

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

An HP 41420A or HP 41421B SMU is used. Note that 10 nA and 1 nA ranges are not specified.

Voltage Source/Monitor Range, Resolution, and Accuracy

V Range Full Scale	Resolution Force/Measure	Accuracy ($I_o = \text{Output I}$) $\pm(\% \text{ of reading} + \% \text{ of range} + V)$
$\pm 2 \text{ V}$	$100 \mu\text{V}/40 \mu\text{V}$	$\pm(0.05\%+0.05\%+2.5 \text{ m}\Omega \times I_o+100 \mu\text{V})^1$
$\pm 20 \text{ V}$	$1 \text{ mV}/400 \mu\text{V}$	$\pm(0.05\%+0.05\%+2.5 \text{ m}\Omega \times I_o)^1$
$\pm 40 \text{ V}$	$2 \text{ mV}/800 \mu\text{V}$	$\pm(0.05\%+0.05\%)$
$\pm 100 \text{ V}$	$5 \text{ mV}/2 \text{ mV}$	
$\pm 200 \text{ V}^2$	$10 \text{ mV}/4 \text{ mV}$	

1 You can ignore the term $2.5 \text{ m}\Omega \times I_o$ when the $|I_o|$ is less than or equal to 100 mA.

2 HP 41420A SMU only.

Current Source/Monitor Range, Resolution, and Accuracy

I Range Full Scale	Resolution Force/Measure	Accuracy ($V_o = \text{Output V}$) $\pm(\% \text{ of reading} + \% \text{ of range} + A)$
$\pm 1 \text{ A}^1$	$50 \mu\text{A}/20 \mu\text{A}$	$\pm[0.5\%+(0.1+0.002 \times V_o)\%]$
$\pm 100 \text{ mA}$	$5 \mu\text{A}/2 \mu\text{A}$	$\pm[0.2\%+(0.1+0.002 \times V_o)\%]$
$\pm 10 \text{ mA}$	$500 \text{ nA}/200 \text{ nA}$	
$\pm 1 \text{ mA}$	$50 \text{ nA}/20 \text{ nA}$	
$\pm 100 \mu\text{A}$	$5 \text{ nA}/2 \text{ nA}$	
$\pm 10 \mu\text{A}$	$500 \text{ pA}/200 \text{ pA}$	$\pm[0.2\%+(0.1+0.003 \times V_o)\%]$
$\pm 1 \mu\text{A}$	$50 \text{ pA}/20 \text{ pA}$	$\pm[0.5\%+(0.01 \times V_o)\%+2 \text{ nA}]$
$\pm 100 \text{ nA}$	$5 \text{ pA}/2 \text{ pA}$	$\pm[0.5\%+(0.1 \times V_o)\%+1 \text{ nA}]$

1 HP 41420A SMU only.

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

Output Terminals: Force, Sense, and Guard

SMUs: 2 ports

HP 41420A or HP 41421B SMU is used. Note that 10 nA and 1 nA ranges are not specified.

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

V Range Full Scale	Resolution Force/Measure	Accuracy ($I_o = \text{Output I}$) $\pm(\% \text{ of reading} + \% \text{ of range} + V)$
$\pm 2 \text{ V}$	$100 \mu\text{V}/40 \mu\text{V}$	$\pm(0.05\%+0.05\%+100 \mu\text{V})(0 \text{ A} \leq I_o \leq 0.1 \text{ A})$
		Add $40 \text{ m}\Omega \times I_o^1$ ($0.1 \text{ A} < I_o \leq 0.5 \text{ A}$)
		Add $200 \text{ m}\Omega \times I_o^1$ ($0.5 \text{ A} < I_o \leq 1 \text{ A}$)
$\pm 20 \text{ V}$	$1 \text{ mV}/400 \mu\text{V}$	$\pm(0.05\%+0.05\%)$ ($0 \text{ A} \leq I_o \leq 0.1 \text{ A}$)
		Add $40 \text{ m}\Omega \times I_o^1$ ($0.1 \text{ A} < I_o \leq 0.5 \text{ A}$)
		Add $200 \text{ m}\Omega \times I_o^1$ ($0.5 \text{ A} < I_o \leq 1 \text{ A}$)
$\pm 40 \text{ V}$	$2 \text{ mV}/800 \mu\text{V}$	$\pm(0.05\%+0.05\%)$
$\pm 100 \text{ V}$	$5 \text{ mV}/2 \text{ mV}$	
$\pm 200 \text{ V}^2$	$10 \text{ mV}/4 \text{ mV}$	

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 ($I_o = \text{Output I}$) $\pm(\% \text{ of reading} + \% \text{ of range} + V)$
$\pm 2 \text{ V}$	$100 \mu\text{V}/40 \mu\text{V}$	$\pm(0.05\%+0.05\%+2.5 \text{ m}\Omega \times I_o+100 \mu\text{V})$
$\pm 20 \text{ V}$	$1 \text{ mV}/400 \mu\text{V}$	$\pm(0.05\%+0.05\%+2.5 \text{ m}\Omega \times I_o)$
$\pm 40 \text{ V}$	$2 \text{ mV}/800 \mu\text{V}$	$\pm(0.05\%+0.05\%)$
$\pm 100 \text{ V}$	$5 \text{ mV}/2 \text{ mV}$	
$\pm 200 \text{ V}^1$	$10 \text{ mV}/4 \text{ mV}$	

1 HP 41420A SMU only.

Current Source/Monitor Range, Resolution, and Accuracy

I Range Full Scale	Resolution Force/Measure	Accuracy ($V_o = \text{Output V}$) $\pm(\% \text{ of reading} + \% \text{ of range} + A)$
$\pm 1 \text{ A}^1$	$50 \mu\text{A}/20 \mu\text{A}$	$\pm[0.5\%+(0.1+0.002 \times V_o)\%]$
$\pm 100 \text{ mA}$	$5 \mu\text{A}/2 \mu\text{A}$	$\pm[0.2\%+(0.1+0.002 \times V_o)\%]$
$\pm 10 \text{ mA}$	$500 \text{ nA}/200 \text{ nA}$	
$\pm 1 \text{ mA}$	$50 \text{ nA}/20 \text{ nA}$	
$\pm 100 \mu\text{A}$	$5 \text{ nA}/2 \text{ nA}$	
$\pm 10 \mu\text{A}$	$500 \text{ pA}/200 \text{ pA}$	$\pm[0.2\%+(0.1+0.003 \times V_o)\%]$
$\pm 1 \mu\text{A}$	$50 \text{ pA}/20 \text{ pA}$	$\pm[0.5\%+(0.01 \times V_o)\%+2 \text{ nA}]$
$\pm 100 \text{ nA}$	$5 \text{ pA}/2 \text{ pA}$	$\pm[0.5\%+(0.1 \times V_o)\%+1 \text{ nA}]$

1 HP 41420A SMU only.

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

Output Terminal: Force, Sense, and Guard

1-20 General Information

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)	100 mA
	0.7 A (≤ 20 V)	
±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	—	20 V (≤ 100 mA)
	100 V (≤ 100 mA)	40 V (≤ 50 mA)
	200 V (≤ 50 mA)	100 V (≤ 20 mA)
±10 mA	200 V	100 V
±1 mA		
±100 nA		
±10 nA		
±1 nA		

- 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:
 - $1 \text{ pA} \leq I \text{ Compliance} \leq \text{Maximum } I$
 - $V \text{ Compliance} \leq \text{Maximum } V$
 - 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 $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ($73^{\circ}\text{F} \pm 9^{\circ}\text{F}$) after a minimum 40 minute warm-up period, with less than a 3°C (6°F) temperature change after calibration. Accuracies apply to all measurement pins. Errors double at 5°C -18°C and 28°C – 40°C (41°F – 64°F and 82°F – 104°F).

SMU Reference Data:

Maximum Capacitance Load: 1000 pF

Maximum Allowable Guard Capacitance: 100 pF

Maximum Slew Rate: $0.2\text{ V}/\mu\text{s}$

Note

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

Auxiliary (AUX): 4 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
$\pm 20\text{ V}$	1 mV	$\pm(0.1\% \text{ of setting} + 10\text{ mV})$	100 mA
$\pm 40\text{ V}$	2 mV	$\pm(0.1\% \text{ of setting} + 20\text{ mV})$	20 mA

VS Current Measurement Range, Resolution, and Accuracy

I Range Full Scale	Resolution	Accuracy	V Range
$\pm 20\text{ mA}$	$20\text{ }\mu\text{A}$	$\pm(3\% \text{ of reading} + 200\text{ }\mu\text{A})$	40 V
$\pm 100\text{ mA}$	$100\text{ }\mu\text{A}$	$\pm(3\% \text{ of reading} + 1\text{ mA})$	20 V

Output Terminal: Force and Guard

Note

Accuracies are specified at $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ($73^{\circ}\text{F} \pm 9^{\circ}\text{F}$) after a minimum 40 minute warm-up period, with less than 3°C (6°F) temperature change after calibration. Accuracies apply at all measurement pins. Errors double at 5°C -18°C and 28°C – 40°C (41°F – 64°F and 82°F – 104°F).

■ VS Reference Data:

Output Resistance: $\leq 2.0\text{ }\Omega$ (Typically $1.0\text{ }\Omega$)

Maximum Capacitance Load: $10\text{ }\mu\text{F}$

Maximum Slew Rate: 0.2 V/ μ s
 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
± 2 V	40 μ V	$\pm(0.05\%$ of reading + 1.1 mV)
± 20 V	400 μ V	$\pm(0.05\%$ of reading + 10 mV)
± 40 V	800 μ V	$\pm(0.05\%$ of reading + 20 mV)

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

V Range Full Scale	Resolution	Accuracy (V_i = VM2 Input V)	Maximum Common Voltage
± 0.2 V	4 μ V	$\pm(0.2\%$ of reading + 0.5 mV + $2.5 \times 10^{-6} \times V_i$)	40 V
± 2 V	40 μ V	$\pm(0.1\%$ of reading + 2.1 mV + $2.5 \times 10^{-5} \times V_i$)	40 V

Input Terminal: Sense and Guard

Note  Accuracies are specified at 23° C $\pm 5^\circ$ C (73° F $\pm 9^\circ$ F) after a minimum 40 minute warm-up period, with less than 3° C (6° F) temperature change after calibration. Accuracies apply at all measurement pins. Errors double at 5° C--18° C and 28° C--40° C (41° F--64° F and 82° F--104° F).

■ VM Reference Data:

Input Resistance: ≥ 50 M Ω

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 μ F (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 (HP 41421B) or 200 V (HP 41420A)
 Search V Slew Rate Range: 0.5 mV/ms–100 V/ms
 Search V Slew Rate Resolution: 1/100 of slew rate range
 Feedback Integration Time Range: 2.5 μ s–500 ms
 Feedback Integration Time Resolution: 1/10 of range

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 μ s
 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 CMS of the HP 4062C/UX consists of the HP 4280A 1 MHz 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 μ S 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%
Display Resolution: 4-1/2 digits max.

C & G Measurement Ranges, Resolutions, and Accuracies

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

¹ G μ = conductance measurement value.

G_r = conductance range value.

C μ = capacitance measurement value.

C_r = capacitance range value.

² Reference data only—not a guaranteed specification.

Note



Accuracy is specified with the following three conditions:

- At 23° C $\pm$ 5° C (73° F $\pm$ 9° F) after a minimum 40 minute warm-up period.
- Test signal level set to 30 mVrms.
- MEAS SPEED set to MEDIUM.
- Between any two measurement pins.
- Dissipation D < 1.

When using the 10 mVrms 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 (41° F–64° F and 82° C–104° F).

CMU84 (HP 4284A Precision LCR Meter)

Capacitance Measurement Frequencies, Ranges, and Accuracies

Frequency	Capacitance	Accuracy ¹ : $\pm(\% \text{ of reading} + \text{of range})$
1 MHz	10 pF ²	$\pm[0.8\% + (1.0 + 0.6 \times G\mu / 63 \mu)\%]$
	100 pF	$\pm[0.8\% + (0.3 + 0.6 \times G\mu / 630 \mu)\%]$
	1 nF ³	$\pm[1.9\% + (0.2 + 1.7 \times G\mu / 6.3 \text{ m})\%]$
100 kHz	10 pF ²	$\pm[0.4\% + (1.0 + 0.4 \times G\mu / 6.3 \mu)\%]$
	100 pF	$\pm[0.3\% + (0.3 + 0.3 \times G\mu / 63 \mu)\%]$
	1 nF	$\pm[0.3\% + (0.2 + 0.4 \times G\mu / 630 \mu)\%]$
	10 nF	$\pm[0.5\% + (0.2 + 1.0 \times G\mu / 6.3 \text{ m})\%]$
10 kHz	100 pF	$\pm[0.3\% + (0.2 + 0.3 \times G\mu / 6.3 \mu)\%]$
	1 nF	$\pm[0.3\% + (0.1 + 0.3 \times G\mu / 63 \mu)\%]$
	10 nF	$\pm[0.3\% + (0.1 + 0.3 \times G\mu / 630 \mu)\%]$
	100 nF	$\pm[0.3\% + (0.1 + 1.0 \times G\mu / 6.3 \text{ m})\%]$
1 kHz	100 pF ²	$\pm[0.4\% + (0.5 + 0.4 \times G\mu / 0.63 \mu)\%]$
	1 nF	$\pm[0.3\% + (0.1 + 0.3 \times G\mu / 6.3 \mu)\%]$
	10 nF	$\pm[0.3\% + (0.1 + 0.3 \times G\mu / 63 \mu)\%]$
	100 nF	$\pm[0.3\% + (0.1 + 0.3 \times G\mu / 630 \mu)\%]$

1 $G\mu$ = conductance measurement value.

$C\mu$ = capacitance 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	Conductance	Accuracy ¹ : $\pm$ (% of reading + of range)
1 MHz	63 μS^2	$\pm[0.8\%+(1.0+0.6\times C\mu/10 \text{ p})\%]$
	630 μS	$\pm[0.8\%+(0.3+0.6\times C\mu/100 \text{ p})\%]$
	6.3 mS ³	$\pm[1.3\%+(0.2+2.2\times C\mu/1.0 \text{ n})\%]$
100 kHz	6.3 μS^2	$\pm[0.4\%+(1.0+0.4\times C\mu/10 \text{ p})\%]$
	63 μS	$\pm[0.3\%+(0.3+0.3\times C\mu/100 \text{ p})\%]$
	630 μS	$\pm[0.3\%+(0.2+0.4\times C\mu/1 \text{ n})\%]$
	6.3 mS	$\pm[0.7\%+(0.2+0.8\times C\mu/10 \text{ n})\%]$
10 kHz	6.3 μS	$\pm[0.3\%+(0.2+0.3\times C\mu/100 \text{ p})\%]$
	63 μS	$\pm[0.3\%+(0.1+0.3\times C\mu/1 \text{ n})\%]$
	630 μS	$\pm[0.3\%+(0.1+0.3\times C\mu/10 \text{ n})\%]$
	6.3 mS	$\pm[0.7\%+(0.1+0.7\times C\mu/100 \text{ n})\%]$
1 kHz	0.63 μS^2	$\pm[0.4\%+(0.5+0.4\times C\mu/100 \text{ p})\%]$
	6.3 μS	$\pm[0.3\%+(0.1+0.3\times C\mu/1 \text{ n})\%]$
	63 μS	$\pm[0.3\%+(0.1+0.3\times C\mu/10 \text{ n})\%]$
	630 μS	$\pm[0.3\%+(0.1+0.3\times C\mu/100 \text{ n})\%]$

1 $G\mu$ = conductance measurement value.

$C\mu$ = capacitance measurement value.

2 Reference data only—not a guaranteed specification.

3 Maximum counts are 12000 (120% full scale).

Note



Accuracy is specified at the following conditions:

- 23° C $\pm$ 5° C (73° F $\pm$ 9° F).
- Test signal level is set to 30 mVrms.
- MEAS SPEED set to MEDIUM or LONG.
- After a minimum 15 minute warm-up period.
- After OPEN and SHORT corrections are performed.

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 $\pm 0.01\%$

Measurement Range: 0.001 pF to 1.9 nF

Accuracy: 1% of the measurement range as an additional error to the accuracy of the HP 4274A.

This additional error is specified under the following conditions:

- If a capacitance zero offset adjustment is performed.
- If the 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 OSC Level vernier of the LCR is set to its maximum level on the $\times 5$ and $\times 1$ ranges.

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

System Controller

■ Supported Computers:

□ For HP 4062C

HP 9000 Series 300 Model 310, 320, 330, 332, 340, 350, 360, or 370

□ For HP 4062UX

HP 9000 Model 320, 330, 332, 350, 360, 370, or 375

or

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

■ Operating System:

□ For HP 4062C

BASIC 5.13

□ For HP 4062UX

HP-UX 7.0

BASIC/UX 5.52

■ Required Memory:

□ For HP 4062C

Greater than 2 MB

Greater than 4 MB when using the HP IMA software

□ For HP 4062UX

Greater than 4 MB (Recommended: greater than 8 MB)

Greater than 8 MB when using the HP IMA software

■ Required Interface/Module:

□ HP 98624A HP-IB Interface Card (2 ea.)

For the HP 4062C/UX hardware

For the wafer prober

(Internal 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 internal HP-IB of the computer can be used for the HP 4062UX and wafer prober.

□ Disk Interface Card (1 each)

□ Required HP-III device: One HP 46084A ID Module.

System Software

Standard HP 4062C/UX software provides the following capabilities:

■ System Initialization

■ Subsystem control

- Subsystems and measurement data monitor
- Parameter measurement utility
- Offline debugging (HP 4062UX only)
- Probing pattern generation and wafer maps display
- Basic Statistics & Data Manipulation (BSDM) data format generation library
- Wafer prober control utility subprograms include Electroglas Model 1034X/2001X and AP-M-3000A/6000A/7000A prober control commands.
- Operational Verification Diagnostics

General Information

- Operating Temperature Range:
5° C–40° C (41° F–104° F), 5%–70% RH. Permissible temperature change is less than 3° C (6° F) after calibration.
- Air Cleanliness: Better than Class 100,000
- Power Requirements: 100 V (90–110 V); 120 V (108–127 V); 220 V (198–242 V); 240 V (216–252 V); 48–66 Hz, 1150 VA max.
- Dimensions:

System Cabinet:	600 mm (W) × 1600 mm (H) × 800 mm (D) 23.6 in. (W) × 63 in. (H) × 31.5 in. (D)
HP 4085B 48-pin SWM:	409 mm (W) × 210 mm (H) × 380 mm (D) 16.1 in. (W) × 8.3 in. (H) × 15 in. (D)
HP 4089A 96-pin SWM:	620 mm (W) × 250 mm (H) × 600 mm (D) 24.4 in. (W) × 9.8 in. (H) × 23.6 in. (D)
- Weight:

System Cabinet:	approximately 230 kg (507 lbs) (with instruments installed)
HP 4085B 48-pin SWM:	approximately 22 kg (48.5 lbs)
HP 4089A 96-pin SWM:	approximately 55 kg (121.3 lbs)
- 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 (Integration time set to SHORT; not applicable on 1 nA and 10 nA ranges)
 - Force (I or V): 3.9 ms
 - Measure (I or V): 6 ms

Analog Search: 25 ms (For example, a MOSFET V_{th} measurement is 25 ms under the following conditions: $I_d=1\ \mu A$; this time does not include the switching time.)

■ Typical SWM Performance (at 23 °C or 73 °F, 50% RH)

- Offset V per pin: 50 μV (for all the ports)
- Offset I per pin: 1 pA (for the High Resolution SMU port); 40 pA (for the other SMU ports)
- Isolation between ports:
 - 8 $\times 10^{13}\ \Omega$ (between the High Resolution SMU port and the other port)
 - 5 $\times 10^{11}\ \Omega$ (between the other SMU port and the other port)
- Path to Ground Capacitance: 30 pF (for the High Resolution SMU port); 60 pF (for the other ports)

Performance Verification

Introduction

This chapter provides HP 4062C/UX 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 (HP part number 04062-65431). The PV disk set consists of the following five disks:

- PV4062 #1
- PV4062 #2
- PV4142 #1
- PV4142 #2
- VIEW (This disk is not supplied with system revision C.05.70 or later. Use SYSTEM SOFTWARE (5) disk instead.)

For the HP 4062UX, the PV software is included in your system software, which is located in the `/usr/pcs/diag` directory.

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 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 an SWM port: 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 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 <i>System Operation</i> 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



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.

Figure 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	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	11001-60001			✓			
BNC-BNC Cable (Maximum 3m)	HP 10503A or 8120-1840 (2 each)			✓			
HP-IB Cable	HP 10833A/B/C/D			✓	✓		
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.

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 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
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
CMU		HP 16346A or B	HP 16366A or B
LCR		HP 16346A or B	HP 16366A or B
CMU84		HP 16346C	HP 16366B

The HP 16346A and B is for verifying the performance of DCS, CMU, and LCR. The HP 16346B is especially required for the 1 A range current accuracy test of the 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 CMU84 performance if the system is equipped with an HP 4284A 20 Hz–1 MHz Precision LCR Meter (option 320 for HP 4062C; option 530 for HP 4062UX).

The HP 16366A and B are for verifying the performance of DCS, CMU, and LCR. The HP 16366B is also required for the CMU84 performance test if the system is equipped with an HP 4284A 20 Hz–1 MHz Precision LCR Meter (option 320 for HP 4062C; 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 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.

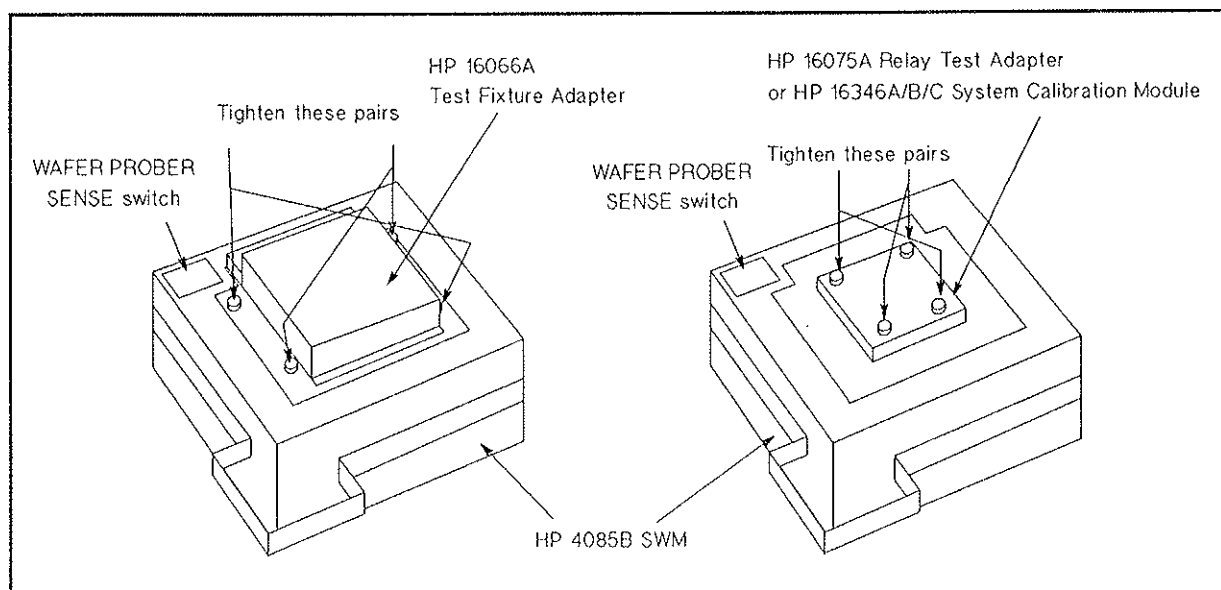


Figure 2-1. Mounting Test Equipment on the HP 4085B 48-pin SWM

Mounting Test Equipment on the HP 4089A 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 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.

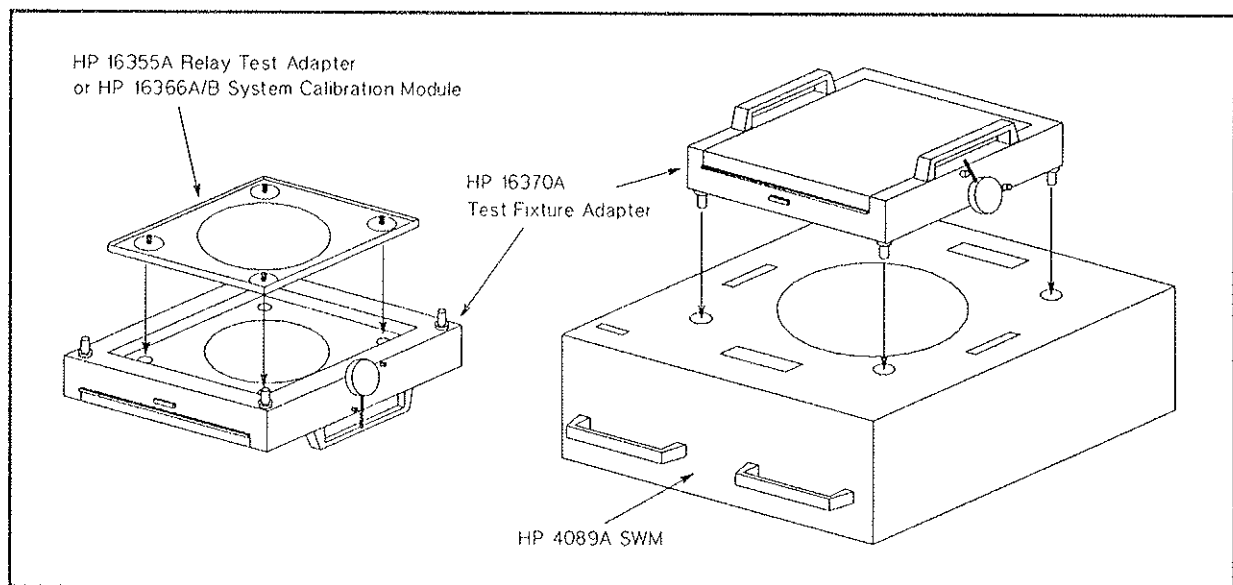


Figure 2-2. Mounting Test Equipment on the HP 4089A 96-pin SWM

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:

1. Turn the system controller on and boot the HP BASIC system.
2. Insert the PERFORMANCE VERIFICATION (PV4062 #1) disk into the flexible disk drive and set MASS STORAGE IS to PERFORMANCE VERIFICATION (PV4062 #1) disk. For example, type as follows:

```
MSI ":,700,1"
```

3. Load the PV4062 program. For example, type as follows:

```
LOAD "PV4062: ,700,1"
```

4. Run the PV4062 by selecting the **RUN** softkey or type: RUN **Return**.

■ For an HP 4062UX:

1. Turn the system controller on and boot the HP-UX system.
2. Log in as an "hpce" user. If an "hpce" user does not exist, create a user named "hpce."
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"
```

```
RUN                      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.

SELECT SOFYKEY

4062C W/O DVM	4062C W/ DVM	4142B	TIMER	START	VIEW RESULT	4274A	END
------------------	-----------------	-------	-------	-------	----------------	-------	-----

(a) Main Menu Softkeys for HP 4062C

SELECT SOFYKEY

4062UX W/O DVM	4062UX W/ DVM	4142B		START	VIEW RESULT	4274A	END
-------------------	------------------	-------	--	-------	----------------	-------	-----

(b) Main Menu Softkeys for HP 4062UX

Figure 2-3. PV4062 Menu Page

The 4062 W/O DVM Test

system specs → The 4062 W/O DVM Test checks the measurement accuracy of the DCS and CMS (CMU or 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
- PTSD only* →

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 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 CMU84.

■ Required Equipment:

Test fixture adapter

PV4062 software disk set (for HP 4062C only)

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: *4062 w/o DVM*

1. Mount the test fixture adapter *only* on the SWM (see "Mounting Test Equipment").
2. Select the *4062C W/O DVM* or *4062UX 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." This rule applies to the following pages.

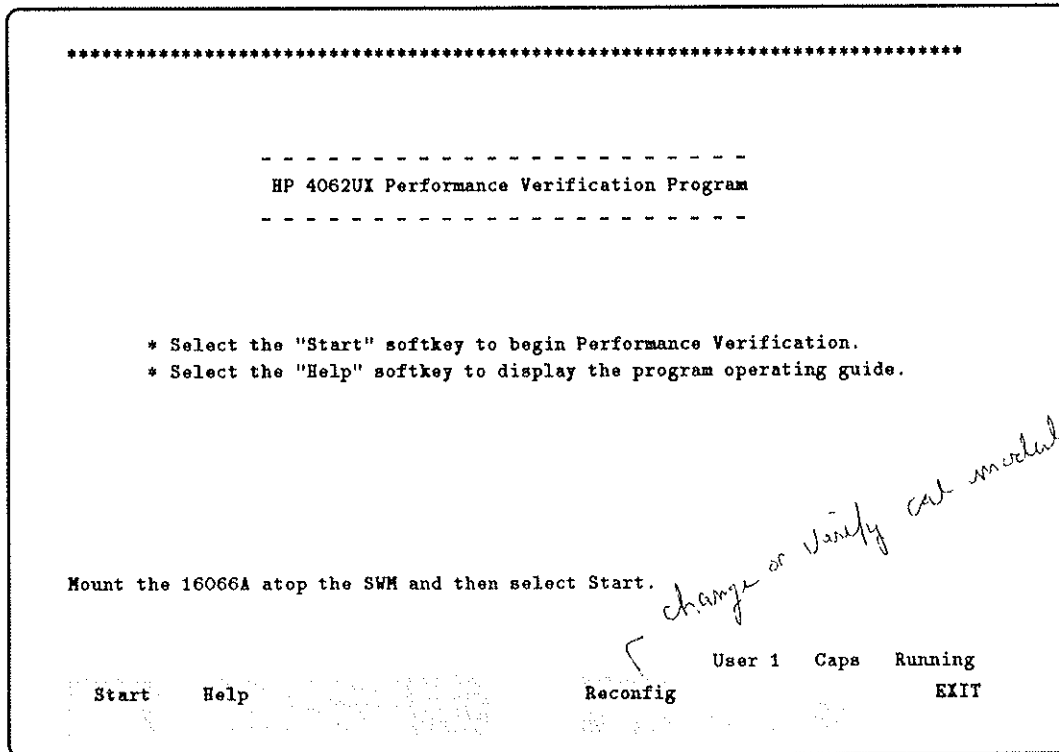


Figure 2-4. 4062 W/O DVM Test Start-up Menu Page

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 system is equipped with a 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.


16346A  16346B  16346C

User 1  Caps  Running
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
SAVE /
EXIT

CANCEL

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

- 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.
- 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.
- If your HP 4062C/UX system is equipped with a 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.

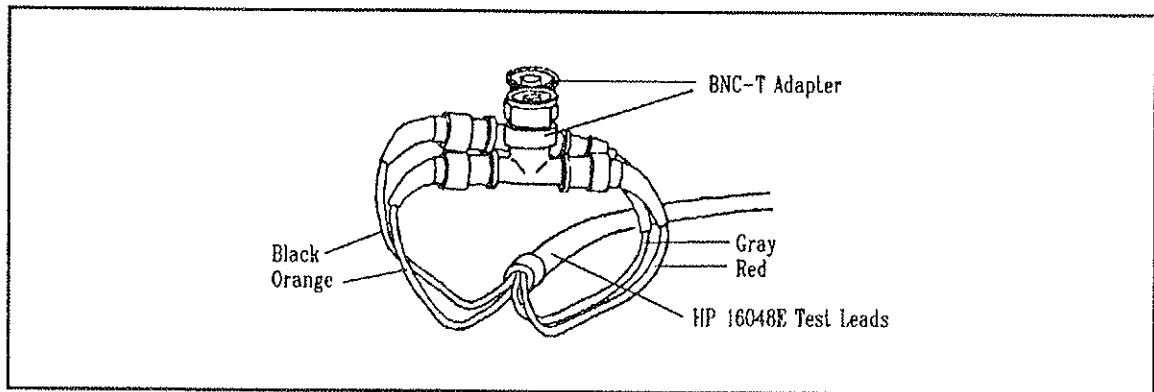


Figure 2-7. Test Lead Connections for an OPEN Correction

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

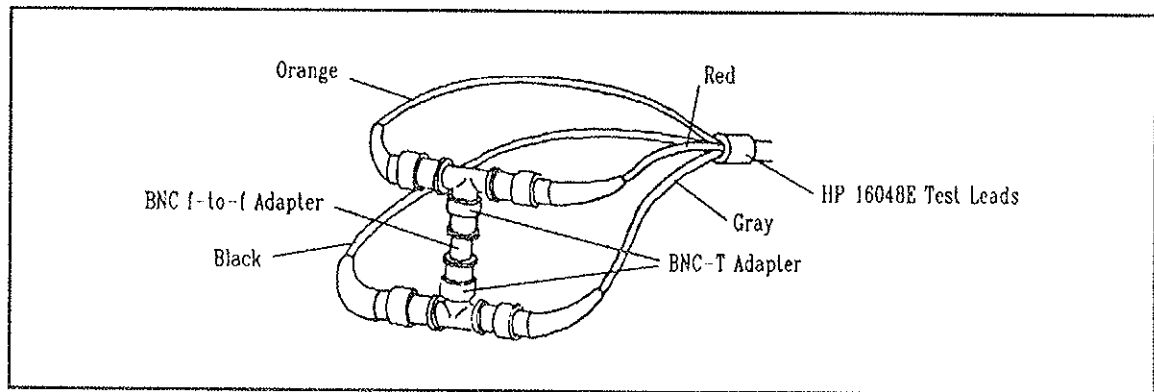


Figure 2-8. Test Lead Connections for a SHORT Correction

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
 SMU Test
 VS Test
 VM Test
 AFU Test
 CMU84 C-G Test
 CMU84 Bias Test
 DC Leakage Test

```

*****
*                                     *
*          NOTES:                    *
*   Tests can be executed individually by *
*   selecting the corresponding softkey. *
*   The Relay Test should be executed first. *
*   All tests can be executed sequentially *
*   by selecting the "SEQ" softkey.      *
*                                     *
*****
  
```

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.

RELAY	SMU	VS	VM	AFU	User 1	Caps	Running
					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, 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, make a new directory named "HPCE" and store the test result file in it. 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 named "/users/hpce" that is created for the HP CE.

■ Required Equipment:

- Relay test adapter
- Test fixture adapter
- System calibration module
- PV4062 software disk set (for HP 4062C only)

■ 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, type as follows:

/HPCE/PVW00190 for HFS hard disk or SRM system
PVW00190: ,700,1 for flexible disk

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

/users/hpce/PVW00190

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

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

Are you sure ?

Yes No

User 1 Caps Running

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 *yyyyyy* is the temporary file name.

If an error occurs (program aborts), catalog the files on the data disk and delete temporary files (TEMPO01, TEMPO02, 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 *yyyyyy*.

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

☐ Can't copy *yyyyyy* to *xxxxx*.

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

☐ Can't purge *yyyyyy*.

Error when purging temporary files.

☐ Can't assign *xxxxx* (*yyyyyy*).

The ASSIGN statement failed.

☐ Error in copying data from *yyyyyy* 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 (for HP 4062C only)

■ 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.

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

Proceed to the SMU Test.

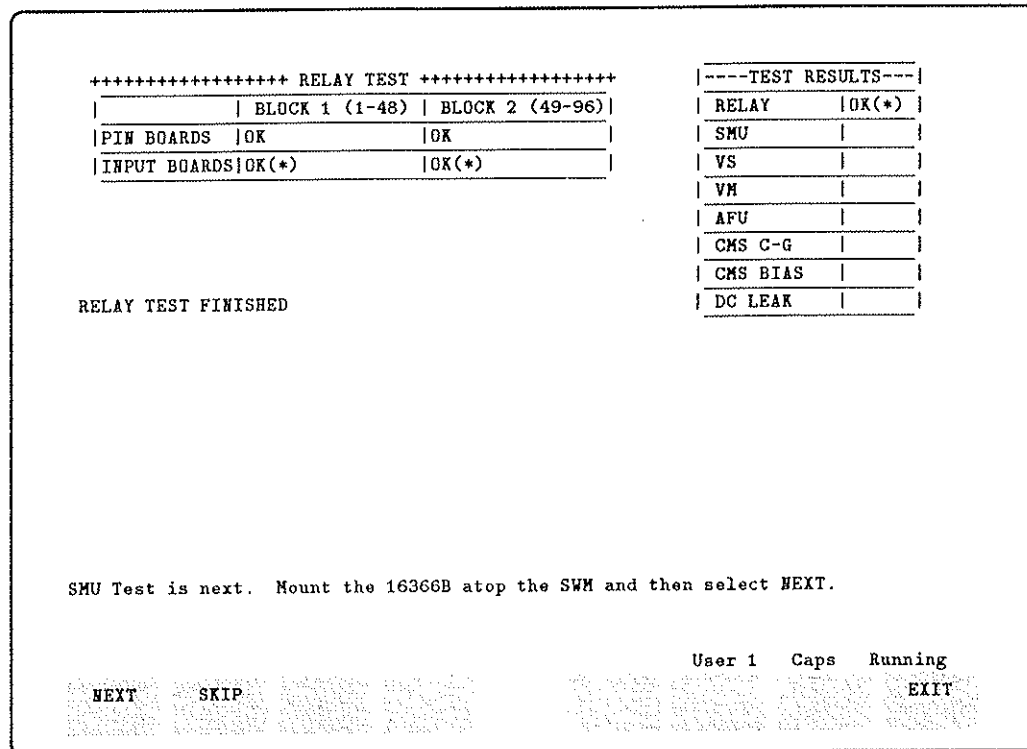


Figure 2-13. Relay Test Results Page for 96-pin SWM

When an error occurs during the Input Relay Test, the measurement value is displayed with the test limits on the screen similar to Figure 2-13a.

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 3-12c) 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	
INPUT RELAY		BLOCK 2 K10 FORCE		VM	
	Low Limit	Measure Value	High Limit	AFU	
MAKE [ohm]	170.	2.44567E+00	500.(235.)	CMS C-G	
BREAK [ohm]	1.000E+06	2.99988E+09	9.990E+99	CMS BIAS	
				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 2-13a. Relay Test Results Page for 96-pin SWM

Note



The Relay Test is also performed in the following cases:

- The Diagnostics (DIAG) program is run.
- The LOCAL/SELF TEST key on the SWC is pressed.
- 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. See "Troubleshooting with the Relay Test" in Chapter 3 for details.

SMU Test

The SMU Test checks each of the SMUs of the 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 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 (for HP 4062C only)

■ 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 2-14.

DCS PASSED SELF-TEST					-----TEST RESULTS-----	
+++++ SMU TEST +++++					RELAY	OK
RESULT	REPEAT	OK	SPOT	OK	SMU	OK
					VS	
SMU TEST FINISHED					VH	
					AFU	
					CMS C-G	
					CMS BIAS	
					DC LEAK	
VS Test is next. Select NEXT to go on. Select SKIP to skip this test.						
NEXT		SKIP		User 1 Caps Running		
				EXIT		

Figure 2-14. SMU Test Results

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.

■ **Required Equipment:**

PV4062 software disk set (for HP 4062C only)

(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 2-15.

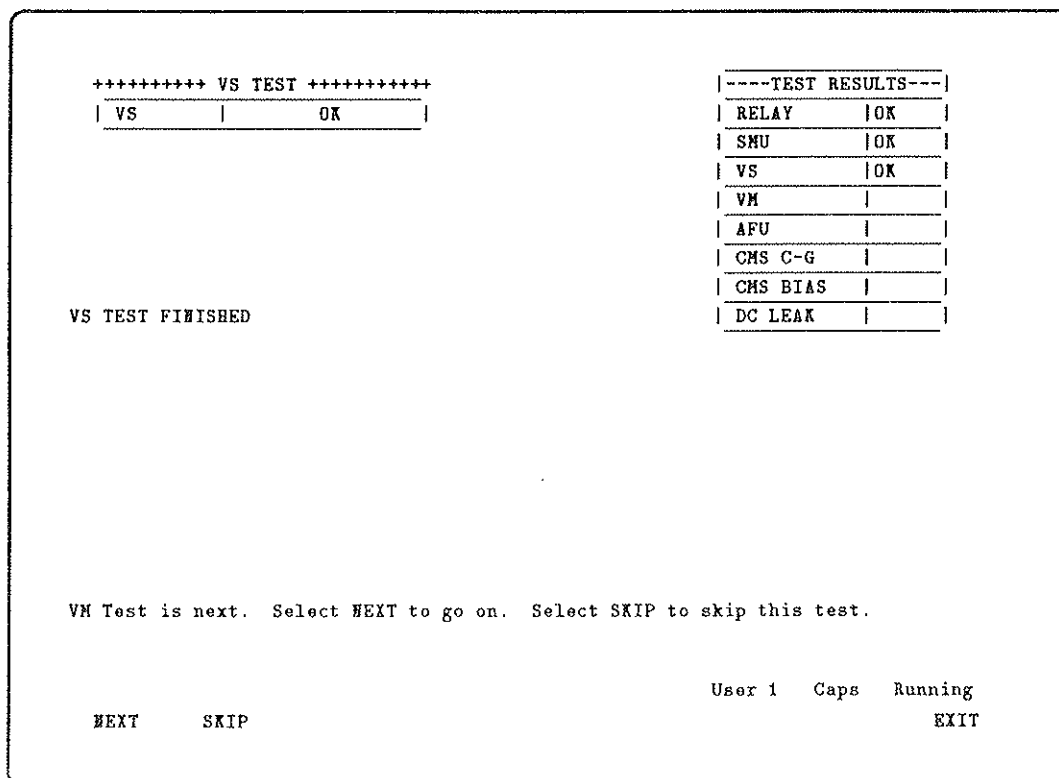


Figure 2-15. VS Test Results

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 (for HP 4062C only)

■ 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 2-16.

+++++ VM TEST +++++		----TEST RESULTS----	
VM	OK	RELAY	OK
		SHU	OK
		VS	OK
		VM	OK
		AFU	
		CMS C-G	
		CMS BIAS	
		DC LEAK	

VM TEST FINISHED

AFU Test is next. Select NEXT to go on. Select SKIP to skip this test.

USER 1 Caps Running
EXIT

Figure 2-16. VM Test Results

AFU Test

The AFU Test checks the AFU of the 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 (for HP 4062C only)

■ 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 2-17.

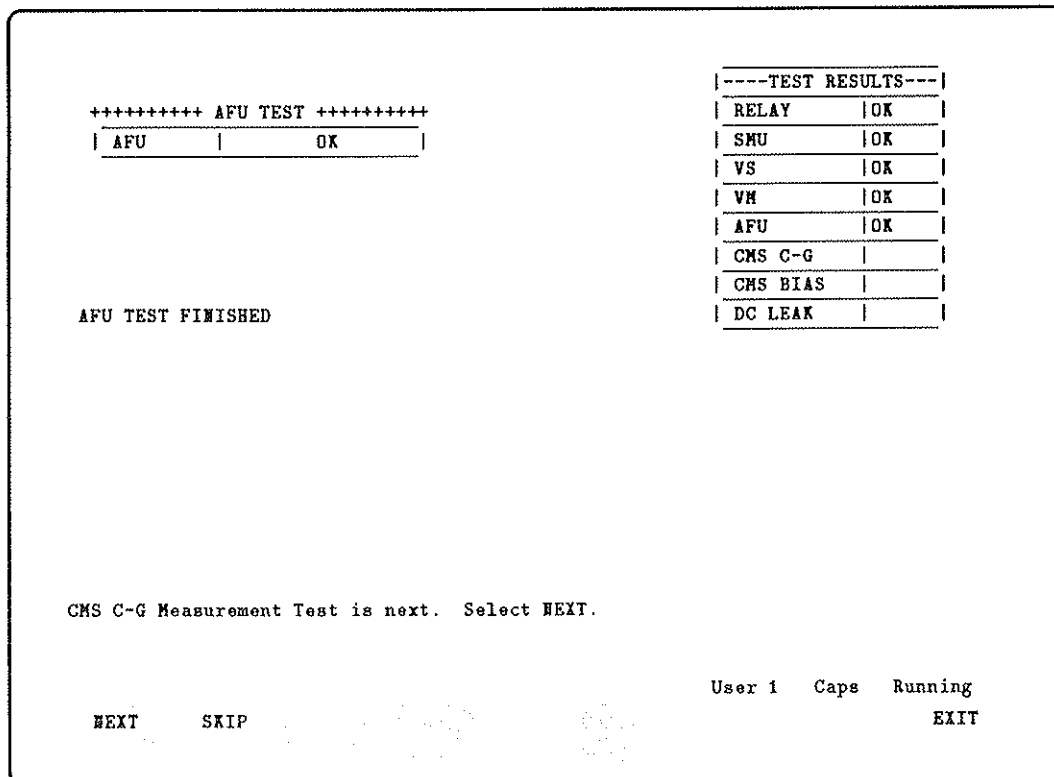


Figure 2-17. AFU Test Results

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 (for HP 4062C only)

■ 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 2-18.

CMS PASSED SELF-TEST

+++++ CMS TEST +++++

CMS C-G	OK
STRAY CAP.	OK
C.VALUE	.123 .121 pF

CMS C-G TEST FINISHED

----TEST RESULTS----	
RELAY	OK
SMU	OK
VS	OK
VM	OK
AFU	OK
CMS C-G	OK
CMS BIAS	
DC LEAK	

CMS Bias Test is next. Select NEXT.

NEXT

SKIP

User 1 Caps Running

EXIT

Figure 2-18. 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 (for HP 4062C only)

■ 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 2-19.

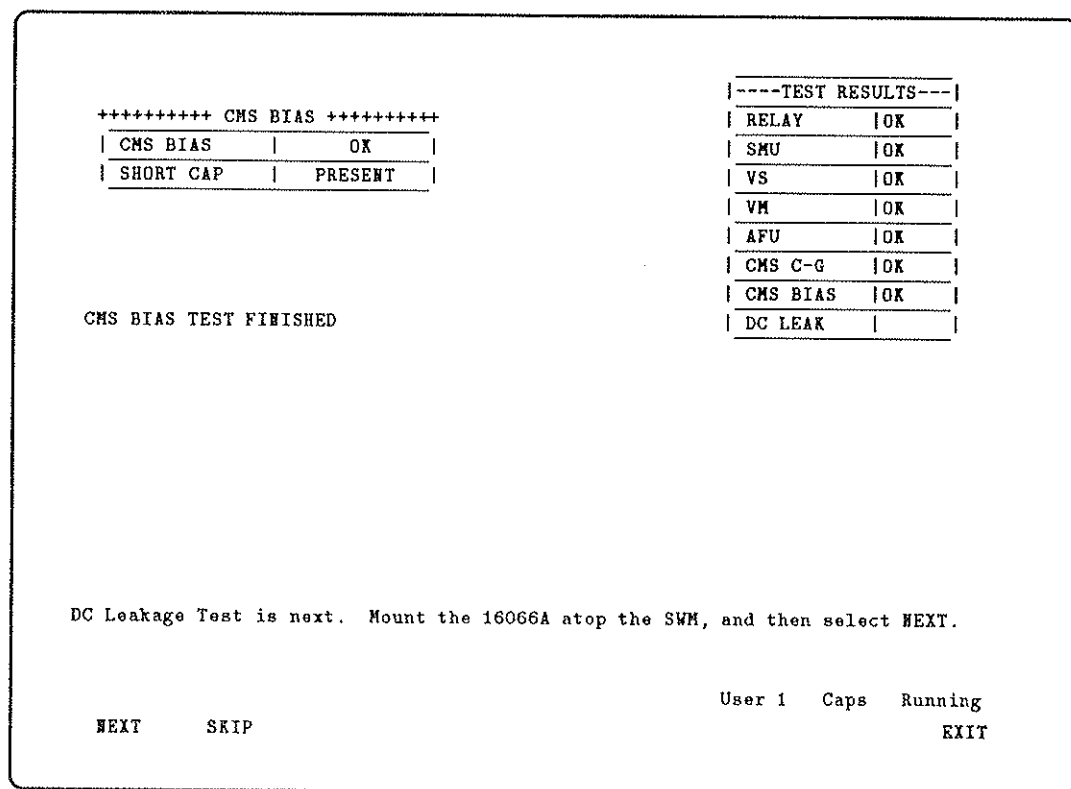


Figure 2-19. CMS Bias Test Results for an HP 4280A

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 HP 16396C
Test fixture adapter (for 96-pin SWM systems)
PV4062 software disk set (for HP 4062C only)

■ 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 2-20.

+++++ CMU84 TEST +++++			
CMU84 C-G	OK		
STRAY CAP.	OK		
C.VALUE	(higher)	.283 pF	
	(lower)	.247 pF	

CMU84 C-G TEST FINISHED

----TEST RESULTS----	
RELAY	OK
SMU	OK
VS	OK
VM	OK
AFU	OK
CMU84 C-G	OK
CMU84 BIAS	
DC LEAK	

CMU84 Bias Test is next. Select NEXT.

NEXT SKIP

User 1 Caps Running
EXIT

Figure 2-20. 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 (for HP 4062C only)

■ 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 2-21.

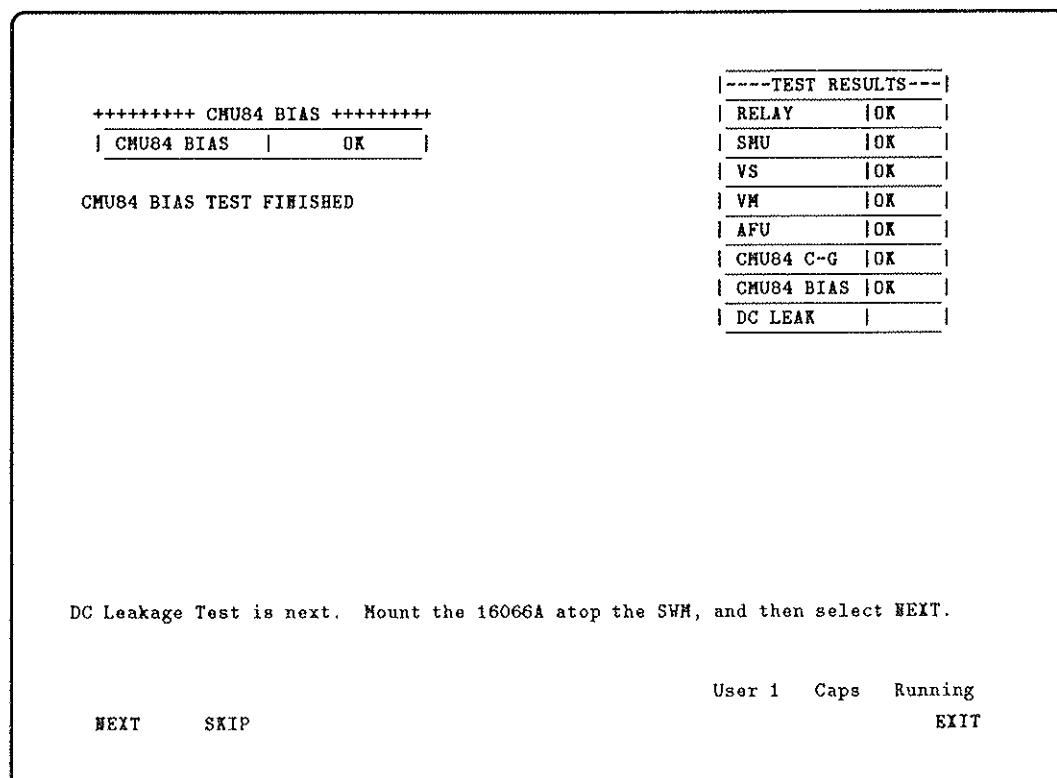


Figure 2-21. CMU84 Bias Test Results for an HP 4284A

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 (for HP 4062C only)

■ 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 2-22.

+++++ DC LEAK TEST +++++

OPEN TEST	OK
-----------	----

SHORT TEST	OK
------------	----

DC LEAK	OK
---------	----

DC LEAKAGE TEST FINISHED

-----TEST RESULTS-----

RELAY	OK
-------	----

SMU	OK
-----	----

VS	OK
----	----

VM	OK
----	----

AFU	OK
-----	----

CMU84 C-G	OK
-----------	----

CMU84 BIAS	OK
------------	----

DC LEAK	OK
---------	----

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

HP 4062UX PERFORMANCE VERIFICATION FINISHED. Select the desired softkey.

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

Figure 2-22. DC Leak Test Results

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 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.

■ Required Equipment:

System calibration module
Test fixture adapter
Digital multimeter (DMM)
HP-IB cable
BNC – dual banana cable
PV4062 software disk set (for HP 4062C only)

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



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.
-

■ Test Procedure:

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

3. If the COM blocks declared in the START program are broken, the START program runs automatically. Refer to "The START Program" for more information on the START program. When START is finished, the program displays the start-up menu page as shown in Figure 2-23.

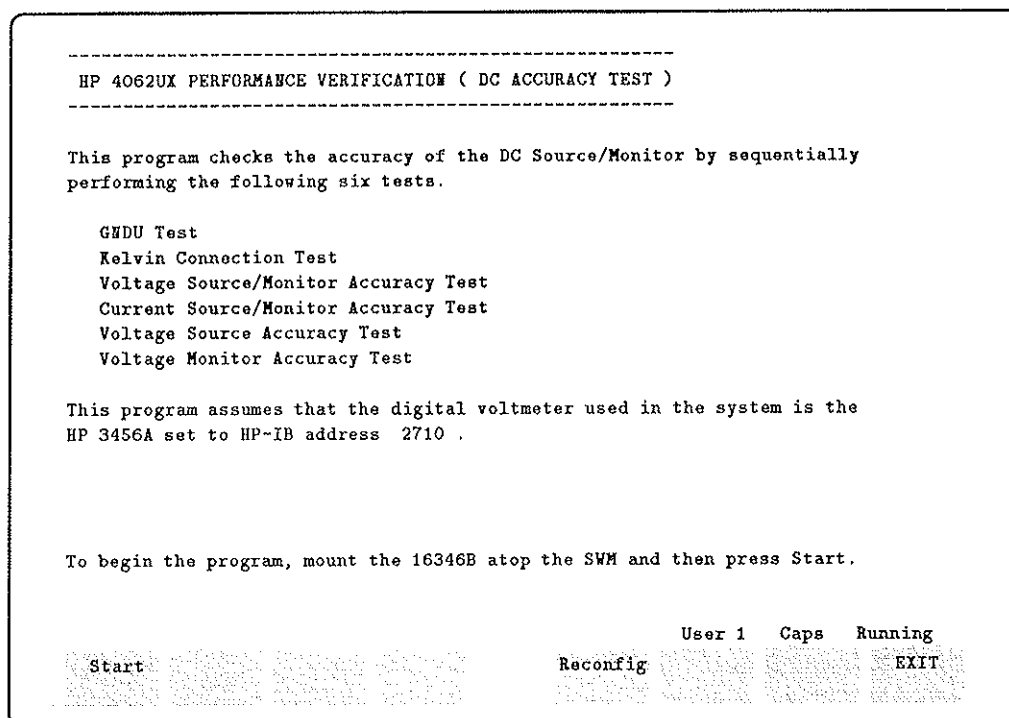


Figure 2-23. The 4062 W/ DVM Test Startup Menu Page

To display a brief operating guide, select the **Help** softkey.

To verify or change the calibrated values of the system calibration module, the digital multimeter (DMM—HP 3456A Digital Multimeter or HP 3458A Digital Multimeter), or the HP-IB address of DMM, select the **Reconfig** softkey and proceed to the next step. Otherwise, proceed to step 7.

4. The menu page shown in Figure 2-24 shows the available system calibration modules, the DMM presently set, and the HP-IB address of the DMM.

■ Test Procedure:

1. aho

Caution



This page is need to print this UPDATE because the number of the *list element* is start at 4 in the next page. Never add or delete the item of the list element.

2. aho

3. aho

Caution



This page is need to print this UPDATE because the number of the *list element* is start at 4 in the next page. Never add or delete the item of the list element.

```

-----
HP 4062UX PERFORMANCE VERIFICATION ( DC ACCURACY TEST )
-----

Calibration Modules:

16346A
16346B

Present HP 3456A HP-IB address

HP 3456A = 2710

Select desired softkey.

16346A 16346B DVM User 1 Caps Running
                                     Start-up
                                     Menu

```

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

If you want to change the DMM or its HP-IB address setting, select the **DVM** softkey. Then select the desired softkey that shows your DMM, and type in the device selector; for example, type: 710 **Return**.

To check the calibration data against the data on the *calibration data sheet* furnished with the system calibration module, select the desired softkey that shows your system calibration module. To update calibrated values, type in the new calibrated data when the field pointer is in place. 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.

5. To return to the start-up menu page, select the **Start-up Menu** softkey.
6. Before the HP 4062C/UX returns to the start-up menu page, you must select your system calibration module from softkeys that appear at the bottom of the menu.

Note



Calibration data is stored in the CAL_DATA file and is used each time the PV software is run.

7. Connect the DMM to the system controller using an HP-IB cable. For information on how to use the DMM, refer to the *Operation Manual* of the DMM.
8. Install the system calibration module on the SWM (see "Mounting Test Equipment").
9. Select the **Start** softkey. The following message is displayed:

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

To keep the 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 step 12.

10. Type the desired file name **Return**. See the following examples:

- ☐ For an HP 4062C:

/HPCE/PVW0190 *for HFS hard disk or SRM system*
PVW0190:,700,1 *for flexible disk*

- ☐ For an HP 4062UX:

/users/hpce/PVW0189

(PVW0490: Performance Verification W/ DVM, January (1) 1990)

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.

11. If you specified an existing file name in the previous step, proceed to step 12.

If you specified a new file name in the previous step, a test result file data entry page similar to that shown in Figure 2-25 is displayed to let you enter information relevant to the file. Follow the displayed instructions.

When you finish entering the data, the following message is displayed:

Are you sure ?

If the data is correct, select the **Yes** softkey and proceed to the next step. If you need to make further changes to the data, select the **No** softkey and re-enter data as required.

HP 4062UX		Tested by _____	
Semiconductor Process Control System		Date	21 Jan 1990
Serial Number _____		Humidity _____	
Temperature _____			
SWH	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 2-25. The PV Test Results Header Entry Page

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 (TEMPO01, TEMPO02, 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.

12. GNDU Test:

Using a BNC-to-dual banana plug cable, connect the DMM to the system calibration module as follows:

For 48-pin SWMs: To either one of the pin 4 connectors.

For 96-pin SWMs: To the pin 84 connector.

Select the **NEXT** softkey to run the GNDU Test, which takes about 10 seconds.

Figure 2-26 shows the GNDU Test display page.

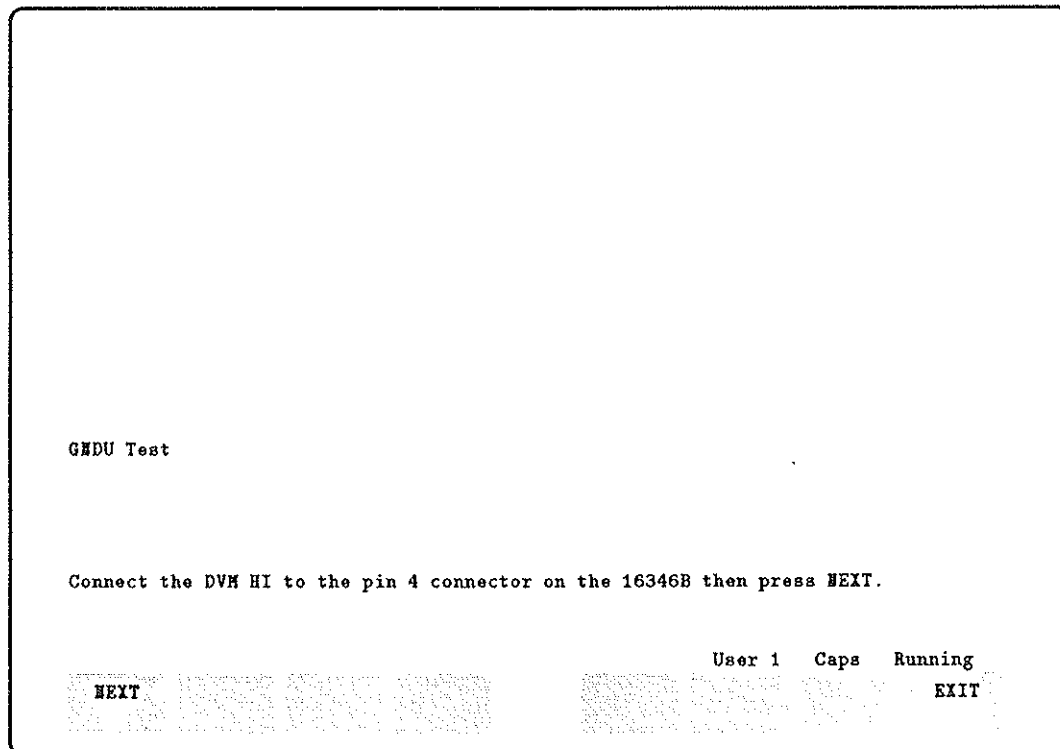


Figure 2-26. GNDU Test Page

13. Kelvin Connection Test:

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, which takes about 10 seconds. Figure 2-27 shows the Kelvin Connection Test display page.

Pin	Device	State	Value	Range
8	SMU#1			
4	GND			
	DVM	VM	-.0003071	AUTO

Kelvin Connection Test

Connect the DVM HI to the pin 4 connector on the 16346B then press **NEXT**.

NEXT **EXIT**

User 1 Caps Running

Figure 2-27. Kelvin Connection Test Page

14. Voltage Source/Monitor Accuracy Test:

Connect the DMM to the system calibration module as follows:

For 48-pin SWMs: To the pin 20 connector.

For 96-pin SWMs: To the pin 76 connector.

Select the **NEXT** softkey to run the Voltage Accuracy Test, which takes about 2.5 minutes. Figure 2-28 shows the Voltage Accuracy Test display page.

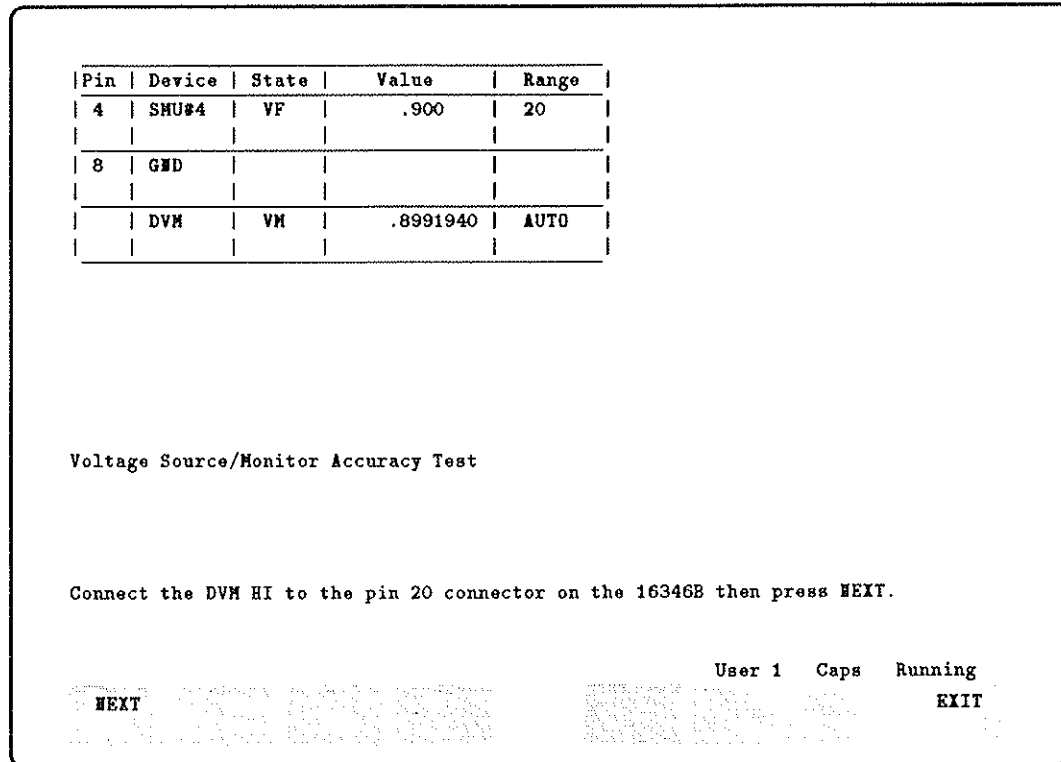


Figure 2-28. Voltage Accuracy Test Page

15. Current Source/Monitor Accuracy Test:

Connect the DMM to the system calibration module as follows:

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.

Select the **NEXT** softkey. When this portion of the Current Accuracy Test completes, connect the DMM as follows:

For 48-pin SWMs: To the pin 12 connector.

For 96-pin SWMs: To the pin 20 connector.

Select the **NEXT** softkey. When this portion of the Current Accuracy Test completes, connect the DMM as follows:

For 48-pin SWMs: To the pin 20 connector.

For 96-pin SWMs: To the pin 76 connector.

Select the **NEXT** softkey. The Current Accuracy Test takes about 2 minutes (total). Figure 2-29 shows the Current Accuracy Test display page.

Note



The 100 nA through 1 nA ranges test requires at least two SMUs.

To check the accuracy of the 1 A range for 48-pin SWM systems (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).

Pin	Device	State	Value	Range
20	SMU#4	IF	-1.990E-04	1.E-03
		VM	-16.024	200
24	GND			
	DVM	VM	-16.0238000	AUTO

Current Source/Monitor Accuracy Test

Connect the DVM HI to the pin 8 connector on the 16346B then press NEXT.

NEXT

User 1 Caps Running
EXIT

Figure 2-29. Current Accuracy Test Page

16. VS Accuracy Test:

Connect the DMM to the pin 32 connector system calibration module (for both 48- and 96-pin SWMs).

Select the **NEXT** softkey to run the VS Test, which takes about 30 seconds.

Figure 2-30 shows the VS Test display page.

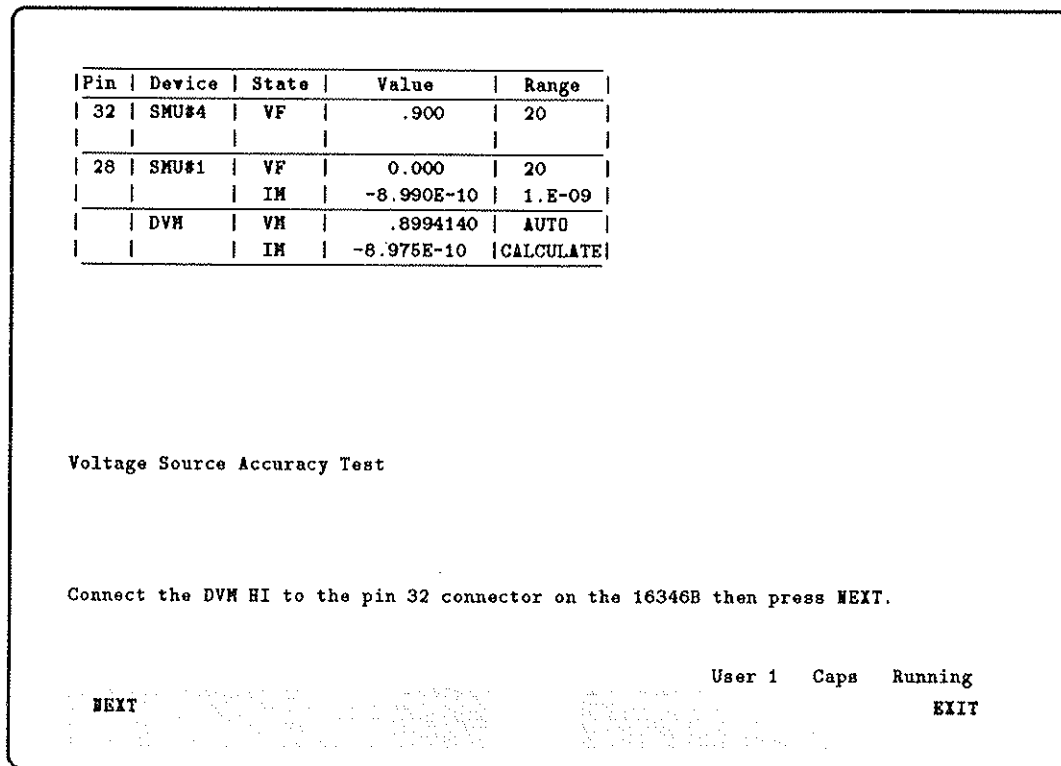


Figure 2-30. VS Test Page

17. VM Accuracy Test:

Connect the DMM to the system calibration module as follows:

For 48-pin SWMs: To either one of the pin 4 connector.

For 96-pin SWMs: To the pin 84 connector.

Select the **NEXT** softkey to run the VM Test, which takes about 30 seconds.

Figure 2-31 shows the VM Test display page.

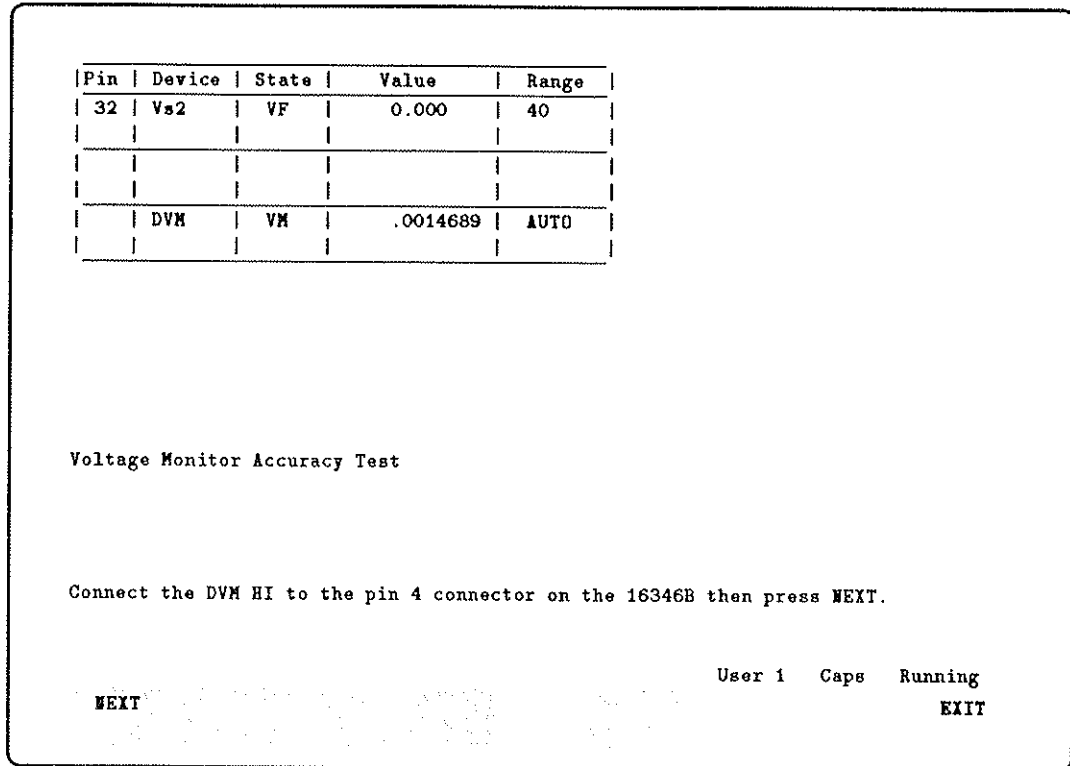


Figure 2-31. VM Test Page

18. 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 2-32 and Figure 2-33.

GNDU	OK	KELVIN	SMU2: OK	SMU3: OK	SMU4: OK
SMU#1	VS: OK				
	VM: OK				
	IS: OK				
	IM: OK				
SMU#2	VS: OK				
	VM: OK				
	IS: OK				
	IM: OK				
SMU#3	VS: OK				
	VM: OK				
	IS: OK				
	IM: OK				
SMU#4	VS: OK				
	VM: OK				
	IS: OK				
	IM: OK				

Press NEXT.

User 1 Caps Running

NEXT

Figure 2-32. 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 2-33.

Vs 1	OK	Vm 1	OK
Vs 2	OK	Vm 2	OK

PERFORMANCE VERIFICATION DC ACCURACY TEST COMPLETED

User 1 Caps Running
EXIT

Figure 2-33. The 4062 W/ DVM VS/VM Test Results Page

4142B Test

The 4142B Test checks the dc output and measurement capabilities of the DCS at the front panel of the DCS. 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 (for HP 4062C only)

■ 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 2-34.

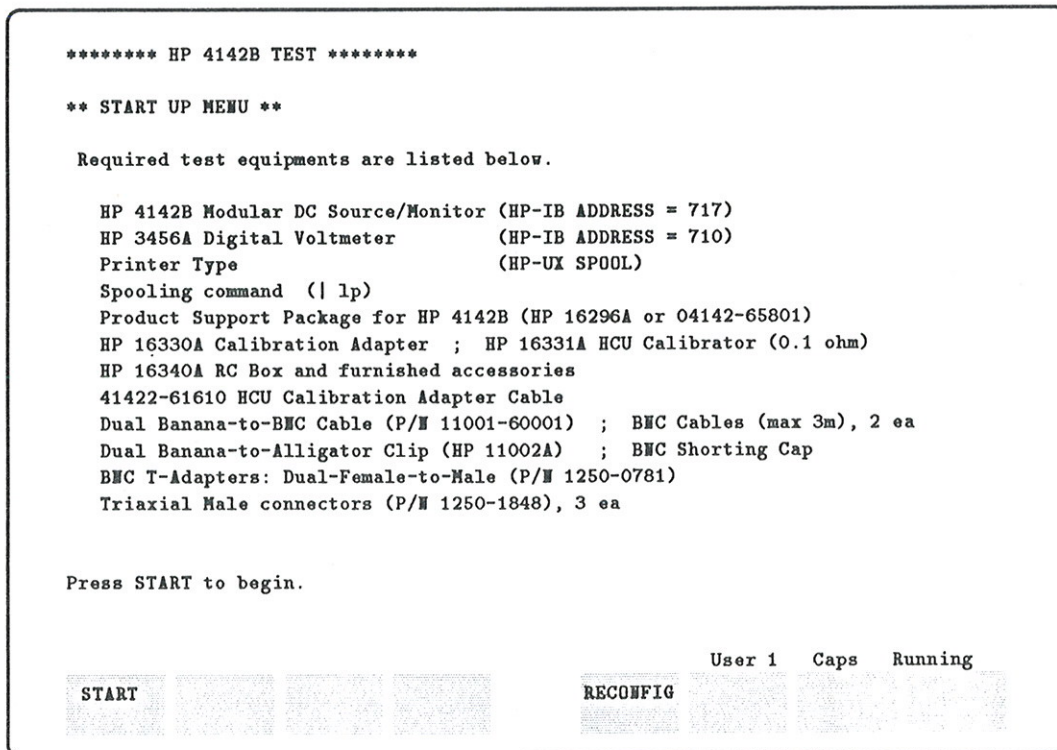


Figure 2-34. The 4142B Test Start-up Menu Page

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

■ Test Procedure:

1. Select the **TIMER** softkey from the PV4062 main menu. The Timer Test display page is displayed as shown in Figure 2-35.

```
*****
*          TIMER BOARD TEST          *
*****

CHECK NO 1 ==> PASS

CHECK NO 2 ==> PASS

CHECK NO 3 ==> PASS


Press the CONTINUE key to exit the TIMER TEST.


User 1  Caps  Pause
Step  Continue  RUN  Print  Clr Tab  Display  Any
Set Tab  Fctns  Char  Recall
```

Figure 2-35. Timer Test Page

2. If an error occurs, check the switch settings (select code and interrupt level) of the VFP timer board. Figure 2-36 shows the correct settings.

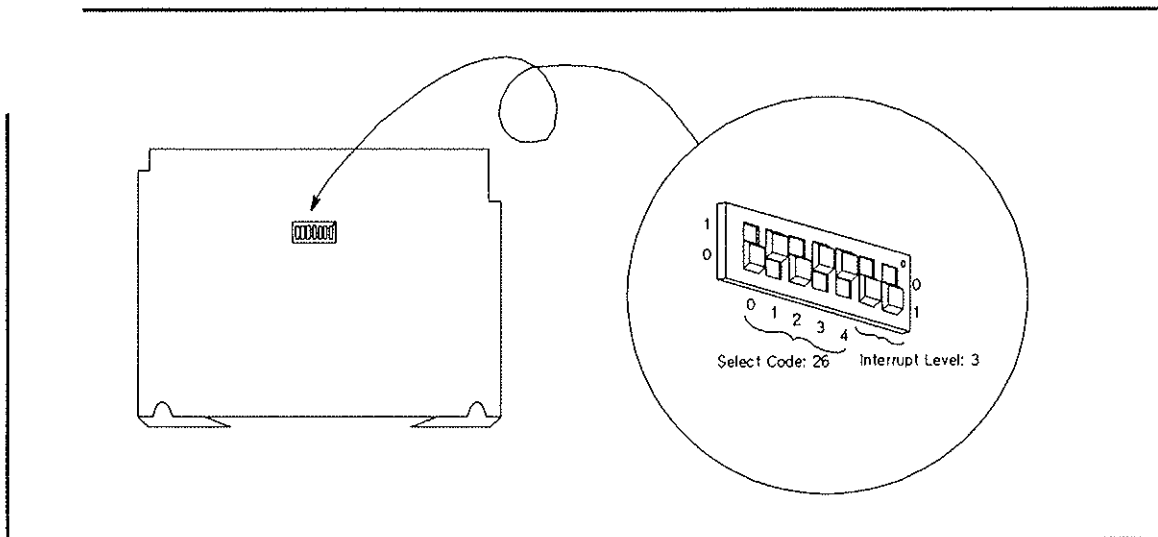


Figure 2-36. VFP Timer Board Settings

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 of the system controller must be set as follows:

Select Code:	27
HP-IB Address:	21
System Controller:	ON
Interrupt Level:	3

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

- The HP-IB addresses of the rack-mounted system components 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 (96-pin) SWM, be sure the HP-IB address of the second SWC is set to 19.

- If the system controller is an HP 9000 Series 300 Model 318M, 319C+, or 340 computer, the SWC, DCS, and CMS (CMU or CMU84) must be connected to the internal 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 CMU front panel.
- The INT BIAS limit switch on the CMU front panel must be set to ± 100 V.
- A BNC shorting cap must be connected to the EXT BIAS-SLOW connector on the 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+, or 340 computer, you can connect automatic wafer probers to the internal 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 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 a CMU is used, the CMU and SWM must be interconnected using the test lead assembly, the CMH cable, and the CML cable.

If a 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 (for HP 4062C only)

■ 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 2-37 and Figure 2-38. 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 2-37. 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)             SLOTS: 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             |
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 2-38. System START Page (for HP 4062UX)

SYSTEM CONFIGURATION

Shows which system components are correctly set (**Present**) for system operation. If an instrument is displayed as **Not present**, make sure the instrument is turned on, check the HP-IB address setting and HP-IB cable connections of the instrument, and execute the START program again. The system controller conducts a serial poll of the individual system components on the HP-IB during START.

DCS CONFIGURATION

Shows each 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 DCS slots and the START program *sees* only the higher of the 2 slots where the SMU is installed (in this example, slot 3). Vacant slots are left blank (slot 7). If you reconfigure any DCS plug-in modules after you've executed START, you must execute START again.

AUXILIARY PORT CONFIGURATION

Shows the configuration of the AUX ports of the SWM. If the AUX ports are connected incorrectly, **Nothing Connected** is displayed. If you reconfigure any AUX port cables after you've executed START, you must execute START again.

AVAILABLE PINS

Lists the available measurement pins (pin boards) installed in the SWM. Pin boards not present at system START are not listed (won't be 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.

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
4. Select the **CRT** softkey to display the test results. A View Result Display page similar to Figure 2-39 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 2-39. 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:
/users/hpce/PVW00190
4. Select the **PRINTER** softkey. The printer configuration page is similar to Figure 2-40 is displayed.

```
***** CONFIGURATION *****  
  
PRINTER TYPE   = LOCAL  
PRINTER ADDR   = 701  
PRINTER I/F    = HP-IB  
PAGE LENGTH    = 66  
MARGIN        : TOP = 2   BOTTOM = 2   LEFT = 0  
PAGE NUMBERING = ON  
  
Select desired softkey.  
  
User 1   Caps   Running  
PRINT    RECONFIG    EXIT
```

Figure 2-40. An Example of the Printer Configuration Page

5. To change the printer configuration, select the **RECONFIG** softkey. Refer to Appendix C 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 2-41 is printed.

```

=====
PERFORMANCE TEST RECORD
=====

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 _____2246J10104
4284A 20Hz-1MHz PRECISION LCR METER PRESENT Serial Number _____2848J00742

Slot 2  41421B (SMU1)           Serial Number _____2715J10104
Slot 3                                     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

=====
TEST                               Results
=====
| Minimum | Actual | Maximum | P/F
=====
Relay Test                          | Pass
=====
SMU Accuracy Test
Self-test                          | Pass
=====
Repeat Test
=====
| SMU 1 |
=====
| Vf/Im | -92.0 V | -.669 % | -.037 % | +.669 % | Pass
| If/Vm | -9.2E-5 A | -.669 % | -.026 % | +.669 % | Pass
=====

```

Figure 2-41. 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 (for HP 4062C only)

■ 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 2-42.

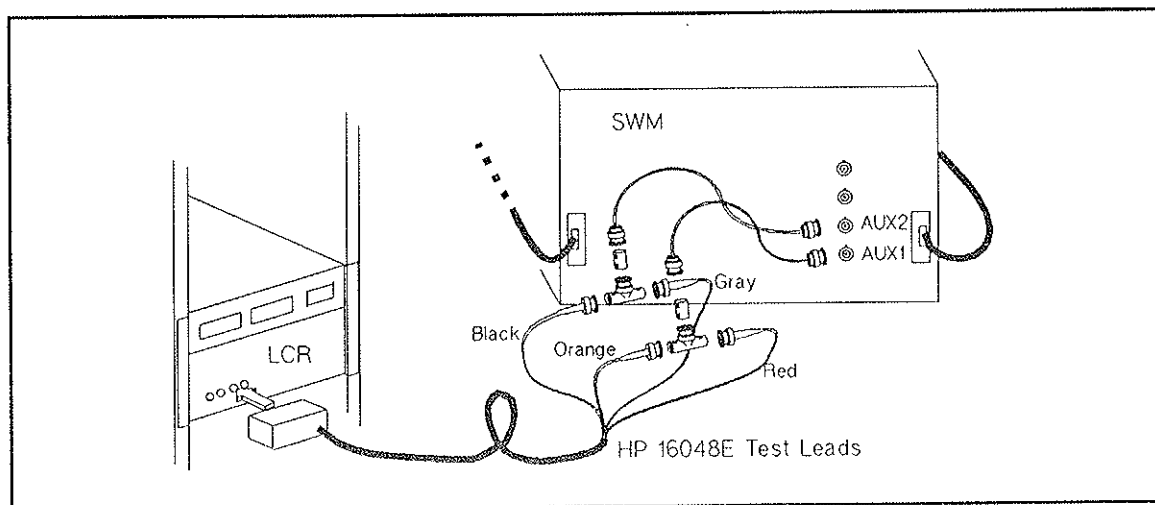


Figure 2-42. Cable Connections for the HP 4274A LCR

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

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

The **Instruction** softkey displays a brief operating guide.

LCR C-G Test

For HP 4274A LCR

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 (for HP 4062C only)

■ 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.

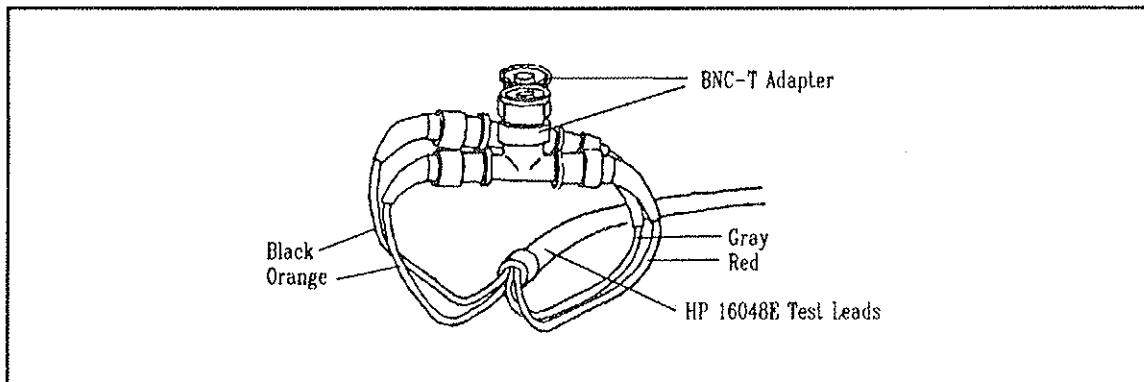


Figure 2-43. Test Lead Connections for OPEN Correction

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.

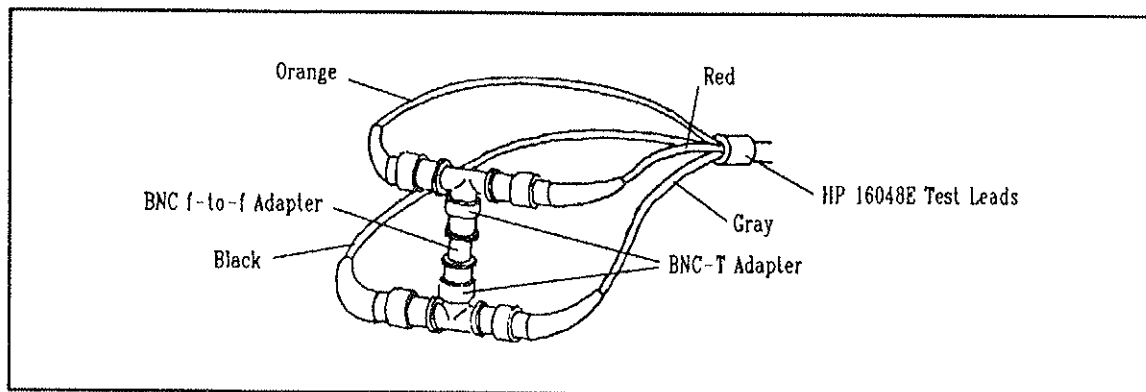


Figure 2-44. Test Lead Connections for SHORT Correction

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 2-45).

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.

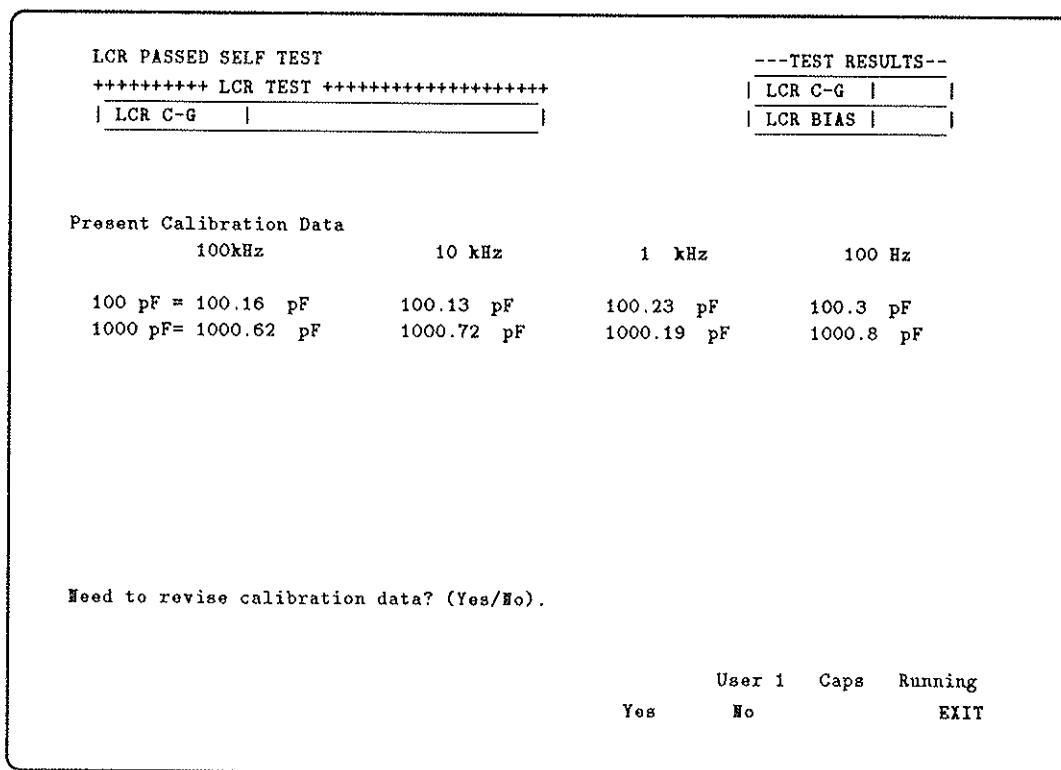


Figure 2-45. LCR C-G Test Page

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 2-42.

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 2-46 is displayed.

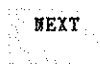
LCR PASSED SELF TEST				---TEST RESULTS---	
+++++ LCR TEST +++++					
LCR C-G	OK				
STRAY CAP.	OK				
C.VALUE	2.736	2.736			
LCR C-G TEST COMPLETED					
Before executing the desired test, attach the proper adapter to the SWM. LCR C-G Test, LCR Bias Test: 16370A, 16366A Press the desired softkey for the next test.					
				User 1 Caps Running EXIT	

Figure 2-46. 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 (for HP 4062C only)

■ 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 ($\leq .1 \mu\text{F}$) 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 the test limits.

W/O DVM Test Operating Theory

Relay Test Operation

Figure 2-47 shows a simplified Pin Board Relay Test circuit. See Appendix B for an exploded view of the Pin Board and a parts list.

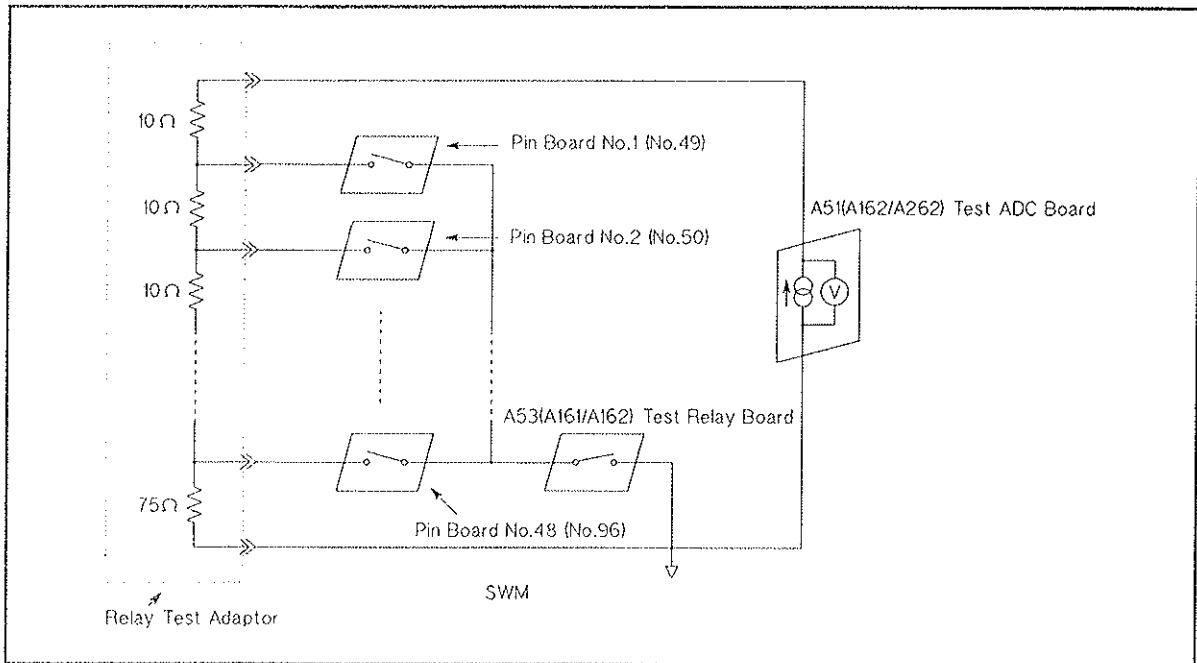


Figure 2-47. Pin Board Relay Test Circuit

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

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 2-47). 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) 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 2-48 shows a simplified example of the Input Relay Test circuit. To check the break/make operation of the input relay on the guard path of SMU_n, the force path of another SMU_m is connected to the guard path of SMU_n using a pin board.

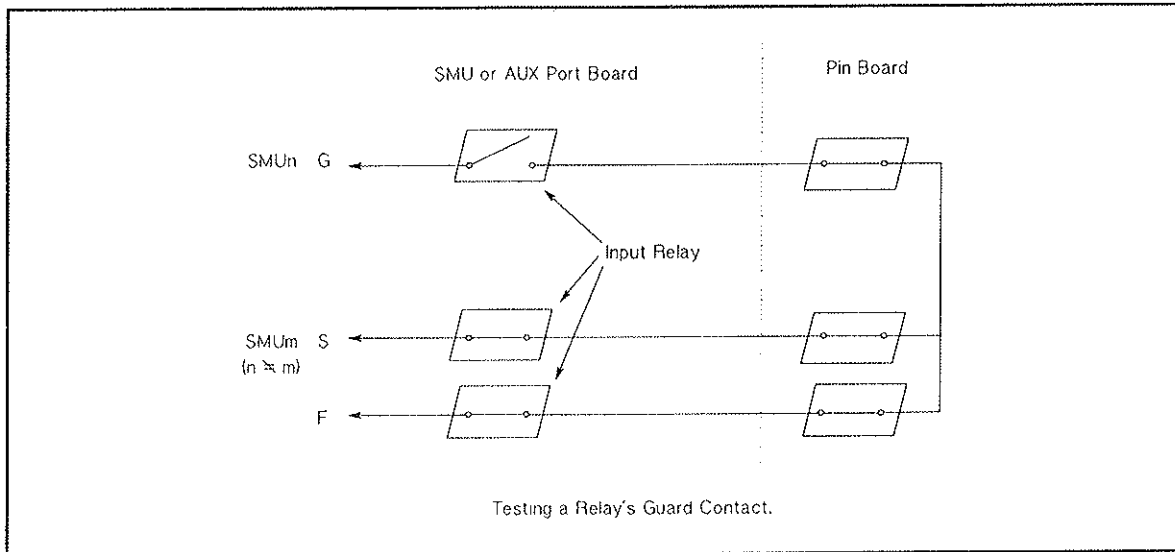


Figure 2-48. Input Relay Test Circuit

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: | K11 guard side contact
K11 force side contact
K10 guard side contact
K10 force side contact |
| Port 2 (SMU2) Test: | K21
K20 force side contact
K20 sense side contact |
| Port 3 (SMU3) Test: | K31
K30 force side contact
K30 sense side contact |
| Port 4 (SMU4) test: | K41
K40 force side contact
K40 sense side contact |

Port 5 (AUX1) test:	K50 guard side contact K50 force side contact
Port 6 (AUX2) test:	K60 guard side contact K60 force side contact
Port 7 (GNDU) test:	K70 force and sense side contacts
Port 8 (AUX3) test:	K81 guard side contact K81 force side contact K80 guard side contact K80 force side contact
Port 9 (AUX4) test:	K91 guard side contact K91 force side contact K90 guard side contact K90 force side contact

Note



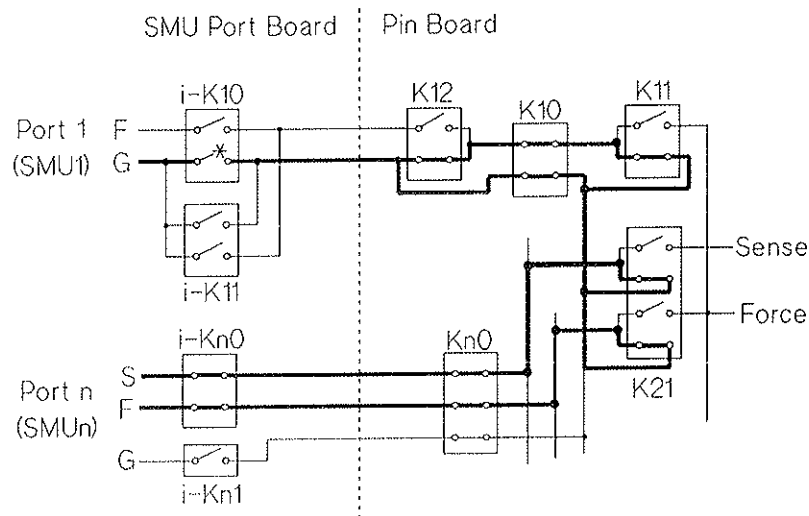
The Input Relay Test uses other system equipment; SMUs, interconnection cables, pin boards, and so on. If the Input Relay Test detects a faulty relay, the indicated relay may not actually be the problem and other equipment may have some problems.

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:



Where n : 2, 3, or 4
 *: Tested relay

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 2-4).

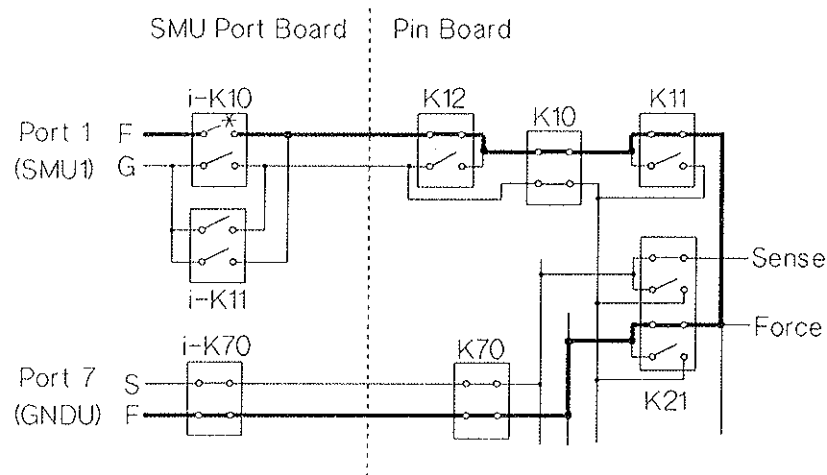
□ Break test of i-K10 guard side contact

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

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:



Where *: Tested relay

□ Make test of i-K10 force side contact

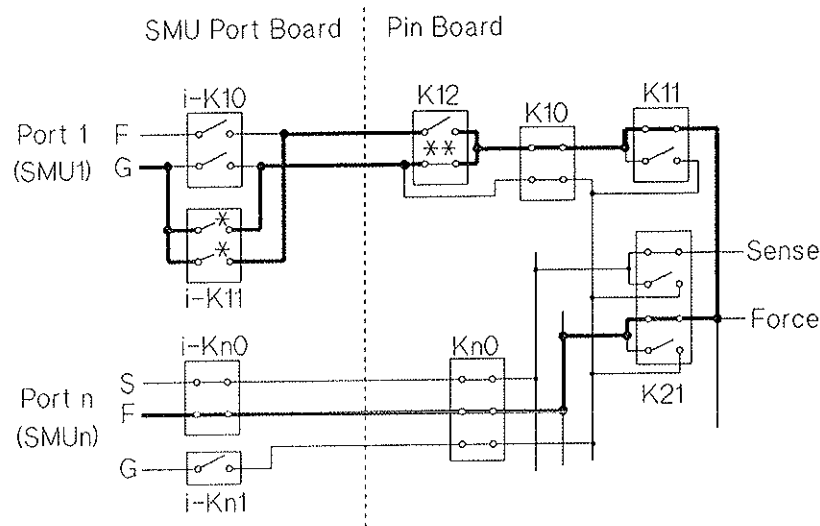
1. Make i-K10 input relay.
2. Force 90 mA from SMU1 (100 mA range, 1.9 V compliance).
3. Measure voltage of SMU1.
4. Calculate impedance and compare with test limits (Table 2-4).

□ Break test of i-K10 force side contact

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

■ i-K11 Guard and Force Side Test

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



Where n: 2, 3, or 4

*: Tested relay

** : This position for i-K11 guard side test;
opposite position for i-K11 force side test.

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 2-4).

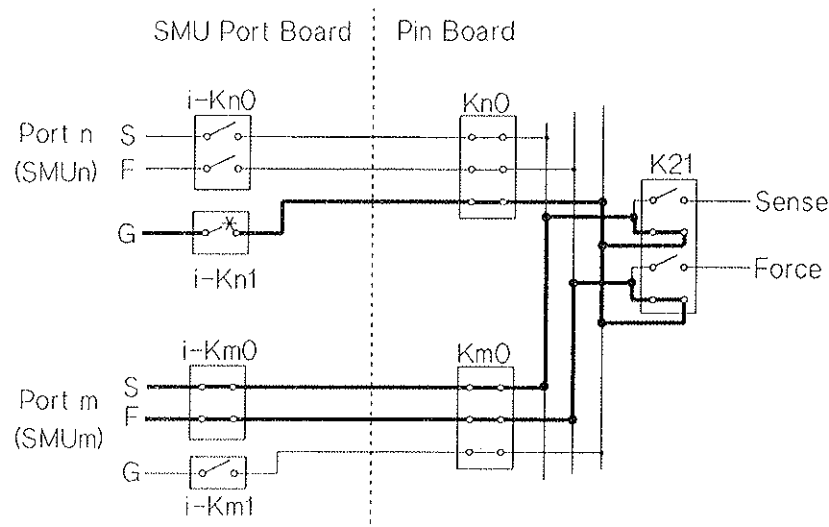
□ Break test of i-K11 guard or force side contact

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 μ A compliance).
4. Force 0 V from SMU1 (2 V range, 100 mA compliance).
5. Measure current value of SMUn (100 μ A range).
6. Calculate impedance and compare with test limits (Table 2-4).

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."



Where *: Tested relay
 n: 2, 3, or 4 (related to tested relay)
 m: 2, 3, or 4 and not equal to n

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

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

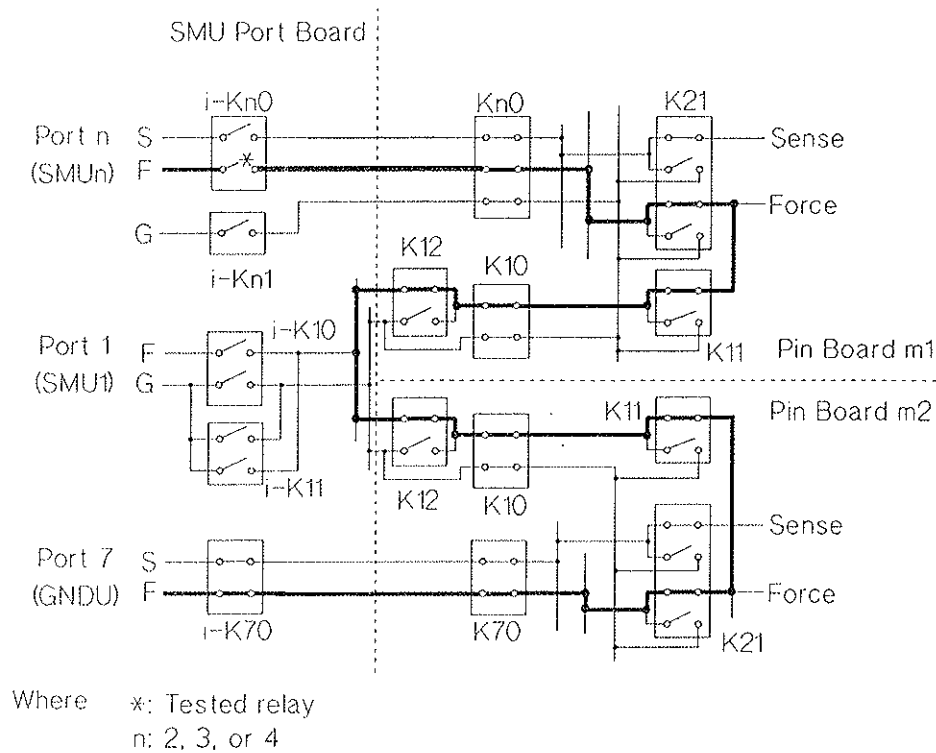
1. Break i-K21 (i-K31) or i-K41 input relay.
2. Force 10 V from SMUm (20 V range, 100 μ A compliance). SMUm does not correspond to the guard path of the objective input relay.
3. Force 0 V from SMUn (2 V range, 100 mA compliance). SMUn corresponds to the guard path of the objective input relay.
4. Measure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

where SMU_n is an SMU connected to the objective input relay. SMU_m is defined in the following way:

Test Port	SMU_m 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 SMU*n* (100 mA range, 1.9 V compliance).
3. Measure voltage of SMU*n* (auto range).
4. Calculate impedance and compare with test limits (Table 2-4).

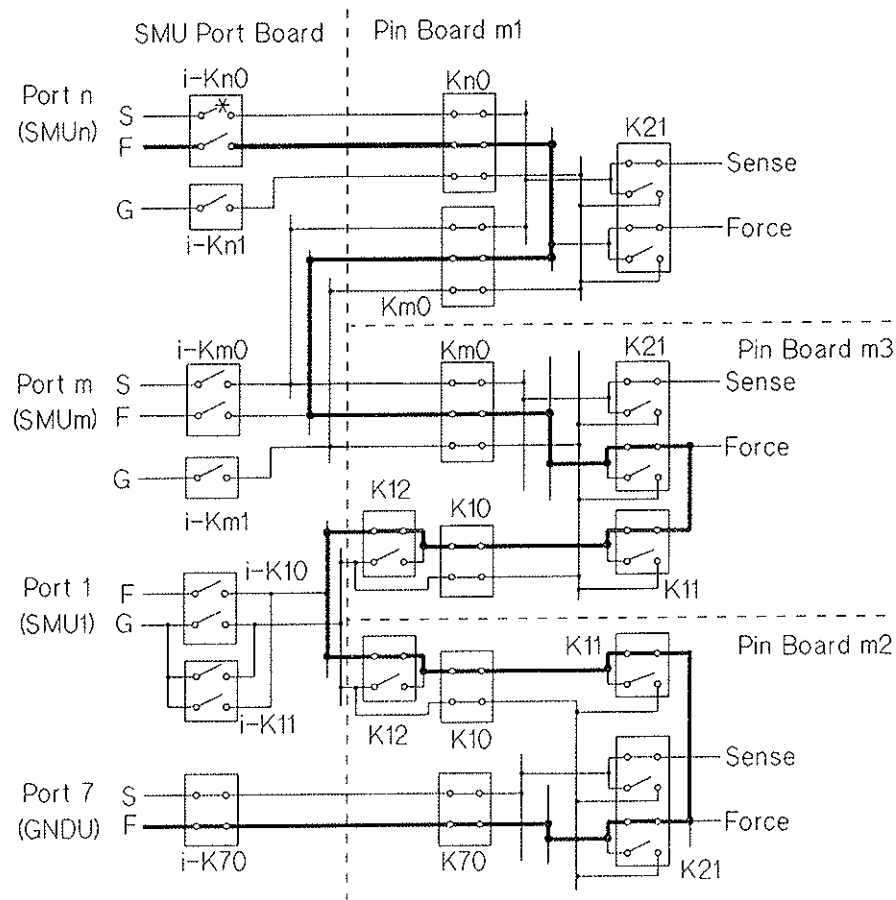
□ Break test of i-K20, i-K30, and i-K40 force side contact

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

where SMU*n* corresponds to the objective input relay.

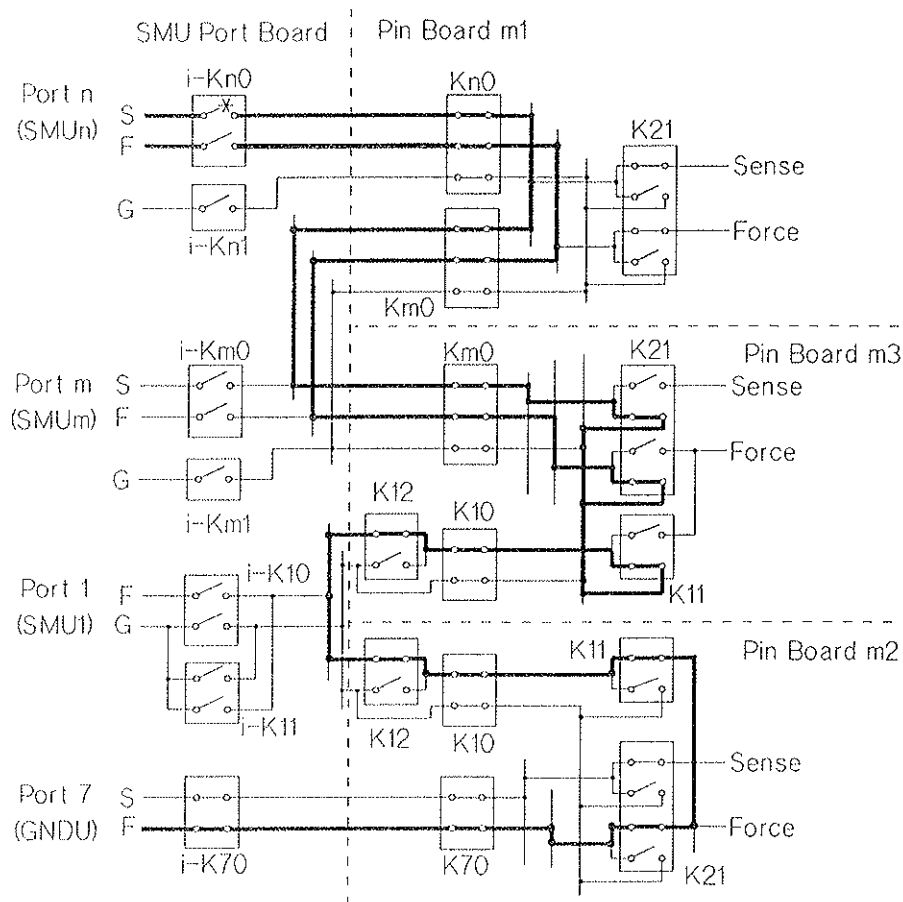
■ i-K20, i-K30, and i-K40 Sense Side Test

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.



Where *: Tested relay
n: 2, 3, or 4
m: 2, 3, or 4 and not equal to n

Test Path (a)



Where *: Tested relay
 n: 2, 3, or 4
 m: 2, 3, or 4 and not equal to n

Test Path (b)

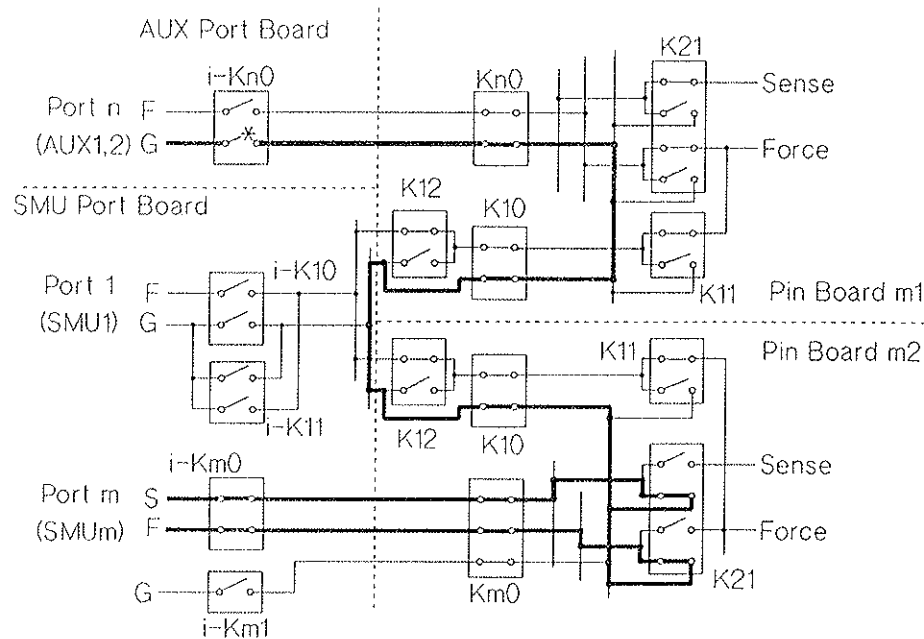
Because the residual resistance on the test path is low, a longer test path is needed to increase the residual resistance. Three pin boards are needed to perform this test for higher resistance (more than about 0.4Ω) between the SMU_n and the contact point of the sense and force paths. Pin board *m1* 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 2-4).
- 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 SMU n (20 V range, 100 μ A compliance).
 4. Measure current value of SMU n (100 μ A range).
 5. Calculate impedance and compare with test limits (Table 2-4).

where SMU n 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:



Where *: Tested relay
 n: 5 or 6
 m: 2, 3, or 4

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 2-4).

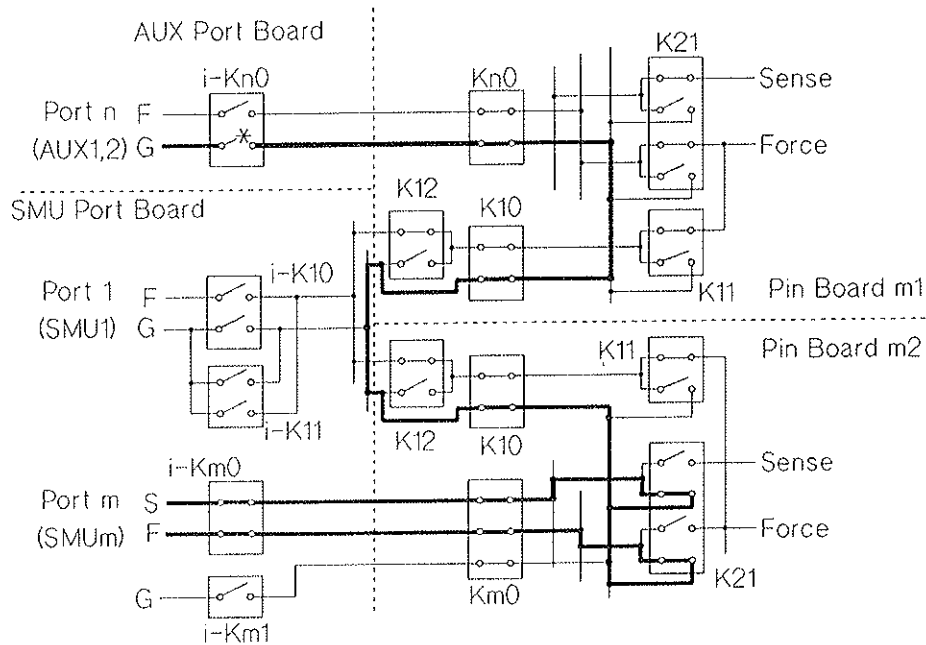
□ Break test of i-K50 and i-K60 guard side contact

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

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:



Where *: Tested relay
 n: 5 or 6
 m: 2, 3, or 4

□ 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 $10\ \mu\text{A}$ from SMU_m (1 mA range, 0 V compliance).
3. Force 0.5 V from VS (2 V range, 10 mA limiter).
4. Measure voltage value of SMU_m .
5. Compare with test limits (Table 2-4).

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

1. Break i-K50 or i-K60 input relay.
2. Force $10\ \mu\text{A}$ from SMU_m (1 mA range, 0 V compliance).
3. Force 0.5 V from VS (2 V range, 10 mA limiter).
4. Measure voltage value of SMU_m .
5. Compare with test limits (Table 2-4).

■ 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 SMU_m (2 V range, 10 mA compliance).
3. Measure voltage using VM and compare with test limits (Table 2-4).
4. If passed, force 0.5 V from SMU_m (2 V range, 10 mA compliance).
5. Measure voltage using VM and compare with test limits (Table 2-4).

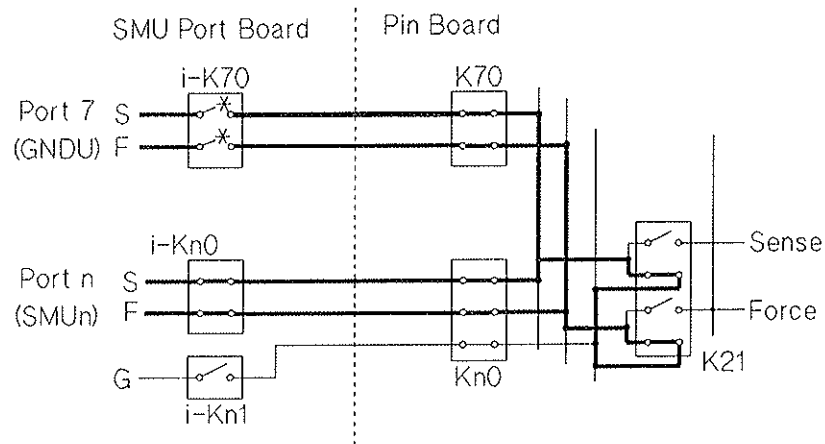
□ Break test of i-K50 and i-K60 force side contact

1. Break i-K50 or i-K60 input relay.
2. Force -0.5 V from SMU_m (2 V range, 10 mA compliance).
3. Measure voltage using VM and compare with test limits (Table 2-4).
4. If failed, force 0.5 V from SMU_m (2 V range, 10 mA compliance).
5. Measure voltage using VM and compare with test limits (Table 2-4).

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-K70 Force and Sense Side Test

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



Where * : Tested relay
n: 2, 3, or 4

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

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

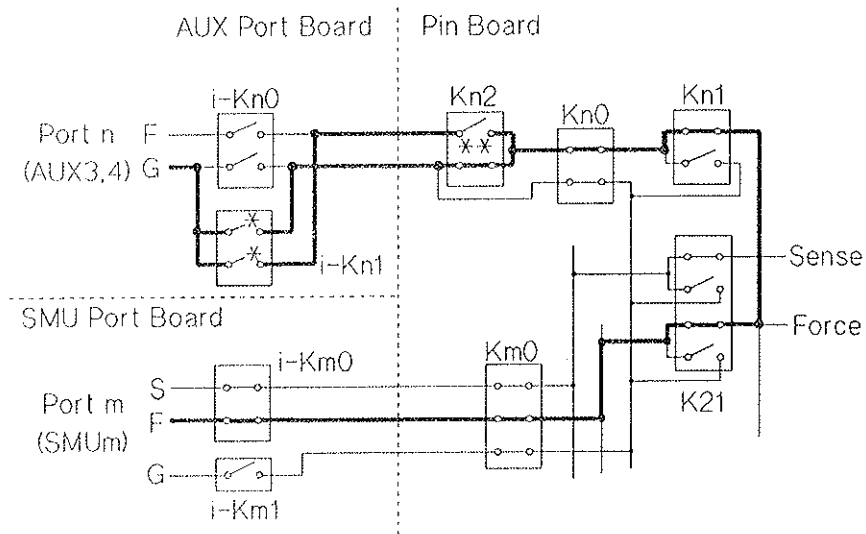
□ Break test of i-K70 force and sense side contact

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

where SMU_n is SMU2, SMU3, or SMU4; SMU_n 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:



Where * : Tested relay
 **: This position for i-Kn1 guard side test;
 opposite position for i-Kn1 force side test.
 n: 8 or 9
 m: 2, 3, or 4

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 DCS.

If CMH and CML terminals of the 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.

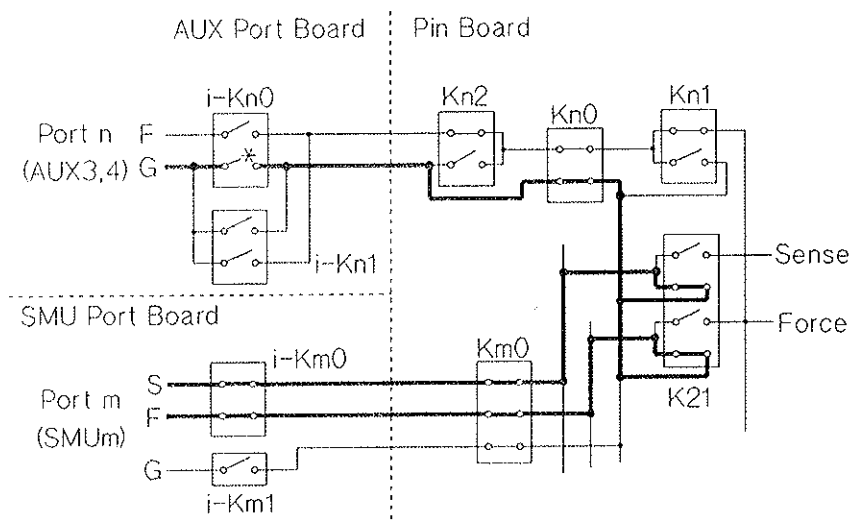
If the II_P - II_C and L_P - L_C terminals of the CMU84 are connected to ports 8 and 9, the guard side path of ports 8 and 9 are led to chassis ground of the CMU84. Chassis ground of the CMU84 is connected to circuit common of the DCS through the chassis of the DCS.

- 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 2-4).
- 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 SMU m (20 V range, 100 μ A compliance).
 4. Measure current value of SMU m (100 μ A range).
 5. Compare with test limits (Table 2-4).

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 Guard Side Test

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



Where *: Tested relay

n: 8 or 9

m: 2, 3, or 4

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 DCS.

If the CMH and CML terminals of the 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 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 SMUm (100 mA range, 1.9 V compliance).
3. Measure voltage value of SMUm.
4. Calculate the impedance and compare with test limits (Table 2-4).

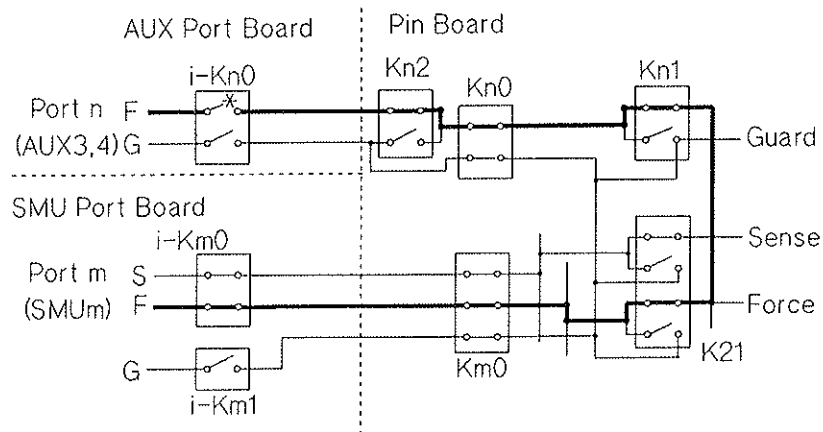
□ Break test of i-K80 or i-K90 guard side contact

1. Break i-K80 or i-K90 input relay.
2. Force 10 V from SMUm (20 V range, 100 μ A compliance).
3. Measure current value of SMUm (100 μ A range).
4. Compare with test limits (Table 2-4).

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 Force Side Test

When the VS or VM is connected to the test path, the test path is shown as follows:



Where *: Tested relay
 n: 8 or 9
 m: 2, 3, or 4

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 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 $10\ \mu\text{A}$ from SMU_m (1 mA range, 0 V compliance).
3. Force 0.5 V from VS (2 V range, 10 mA limiter).
4. Measure voltage value of SMU_m .
5. Compare with test limits (Table 2-4).

■ Break test of i-K80 and i-K90 force side contact

1. Break i-K80 or i-K90 input relay.
2. Force $10\ \mu\text{A}$ from SMU_m (1 mA range, 0 V compliance).
3. Force 0.5 V from VS (2 V range, 10 mA limiter).
4. Measure current value of SMU_m .
5. Compare with test limits (Table 2-4).

■ If VM is connected to the test port:

□ Make test of i-K80 and i-K90 force

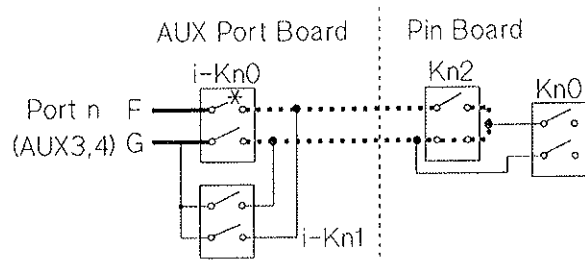
1. Make i-K80 or i-K90 input relay.
2. Force -0.5 V from SMU m (2 V range, 100 mA compliance).
3. Measure voltage using VM and compare with test limits (Table 2-4).
4. If passes, force 0.5 V from SMU m (2 V range, 100 mA compliance).
5. Measure voltage using VM and compare with test limits (Table 2-4).

□ Break test of i-K80 and i-K90 force

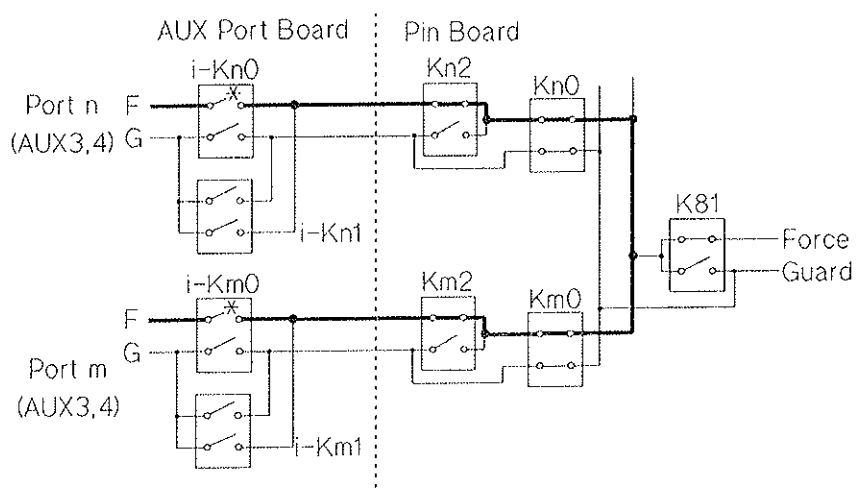
1. Break i-K80 or i-K90 input relay.
2. Force -0.5 V from SMU m (2 V range, 100 mA compliance).
3. Measure voltage using VM and compare with test limits (Table 2-4).
4. If fails, force 0.5 V from SMU m (2 V range, 100 mA compliance).
5. Measure voltage using VM and compare with test limits (Table 2-4).

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 CMU or CMU84 is connected to the test path, the test path is shown as follows:



For CMU



For CMU84

Where *: Tested relay
 n: 8 or 9
 m: 8 or 9 and not equal to n

If the CMH and CML terminals of the 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 HC-IIp and LP-LC terminals of the 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 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 2-4).
 - 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 2-4).
- If 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 2-4).
 - 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 2-4).

Relay Test Limits. Table 2-1 lists the test limits of the Input Relay Test.

Table 2-1. The Input Relay Test Limits

Port	Relay	Make	Break
1	K10 guard	170 Ω to 500 Ω ¹	≥ 1 M Ω
	K10 force	0 Ω to 10 Ω	≥ 1 M Ω
	K11 guard and force	170 Ω to 500 Ω ¹	≥ 1 M Ω
2, 3, 4	K21, K31, K41	170 Ω to 235 Ω	≥ 1 M Ω
	K20, K30, K40 force	0 Ω to 10 Ω	≥ 1 M Ω
	K20, K30, K40 sense	0.4 Ω to 10 Ω	≥ 1 M Ω
5, 6	K50, K60 guard	0 Ω to 10 Ω	≥ 1 M Ω
	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 M Ω
8, 9	K81, K91	0 Ω to 10 Ω	≥ 1 M Ω
	K80, K90 guard	0 Ω to 10 Ω	≥ 1 M Ω
	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 M Ω

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 2-49 shows a simplified SMU Test circuit.

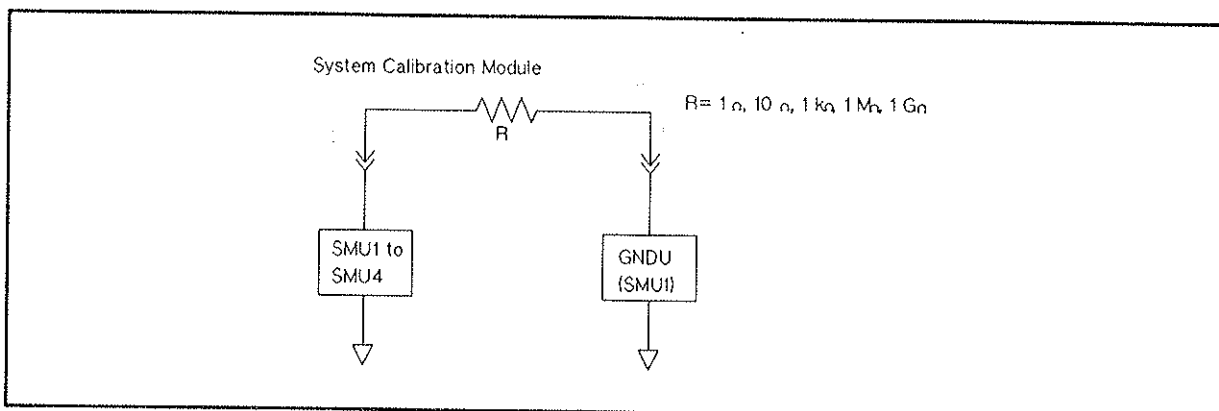


Figure 2-49. SMU Test Circuit

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 2-5 and Table 2-6 list the Repeat and Spot Test limits of the SMU Test, respectively.

Table 2-5. SMU Repeat Test Limits

Nominal Resistance	Voltage/Current Range	Value		Tolerance(%)	
		Voltage	Current	SMU1	SMU2,3,4
1 M Ω	200 V/100 μ A ¹	± 92 V	± 92 μ A	± 0.669	± 0.669
		± 72 V	± 72 μ A	± 0.729	± 0.729
	100 V/100 μ A	± 52 V	± 52 μ A	± 0.740	± 0.740
		± 47 V	± 47 μ A	± 0.772	± 0.772
		± 42 V	± 42 μ A	± 0.809	± 0.809
	40 V/100 μ A	± 37 V	± 37 μ A	± 0.777	± 0.777
		± 32 V	± 32 μ A	± 0.829	± 0.829
		± 27 V	± 27 μ A	± 0.898	± 0.898
		± 22 V	± 22 μ A	± 1.000	± 1.000
	20 V/100 μ A	± 17 V	± 17 μ A	± 1.103	± 1.103
		± 12 V	± 12 μ A	± 1.375	± 1.375
	20 V/10 μ A	± 7 V	± 7 μ A	± 0.570	± 0.580
		± 2 V	± 2 μ A	± 1.320	± 1.330
		± 1.2 V	± 1.2 μ A	± 1.275	± 1.288
	20 V/1 μ A	± 0.4 V	± 0.4 μ A	± 1.325	± 1.585

¹ This range is tested only when the DCS is equipped with HP 41420A 200 V/1 A SMUs.

Table 2-6. SMU Spot Test Limits

Nominal Resistance	Voltage/Current Range	Value		Tolerance(%)		
		Voltage	Current	SMU1	SMU2 ¹	SMU3&4
1 G Ω	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 k Ω	20 V/10 mA	± 5 V	± 5 mA	$\pm 0.740^2$	± 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	$\pm 6.780^4$	± 1.780	± 1.780
	20 V/100 mA	± 0.5 V	± 50 mA	$\pm 7.652^5$	± 2.652	± 2.652
1 Ω	2 V/1 A ³	± 1 V	± 1 A	$\pm 50.862^6$	± 1.112	$\pm 20.862^7$

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 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 96-pin SWM system.

⁵ ± 8.652 for HP 4089A 96-pin SWM system.

⁶ ± 60.862 for HP 4089A 96-pin SWM system.

⁷ ± 1.112 for HP 4089A 96-pin SWM system.

VS Test Operation

The VS Test checks the voltage sources VS1 and VS2 of the DCS for correct dc output. Figure 2-50 shows a simplified VS Test circuit.

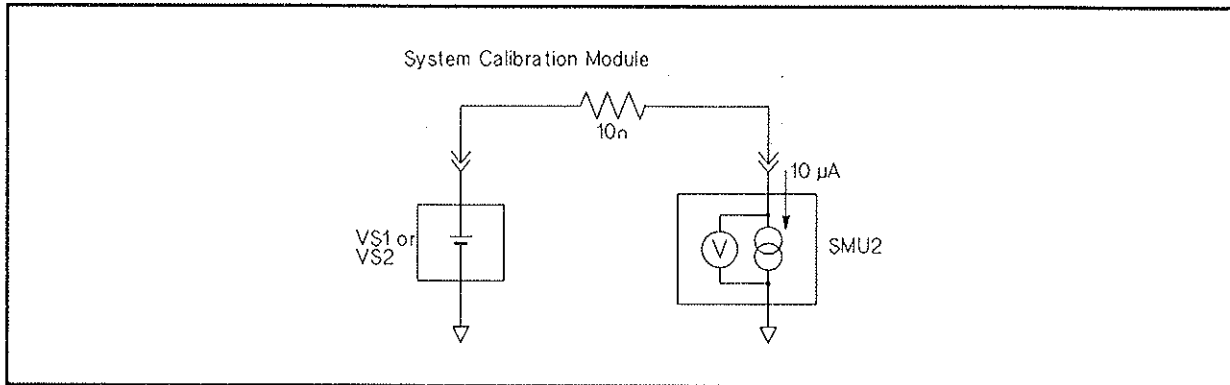


Figure 2-50. VS Test Circuit

During the VS Test, VS1 and VS2 output specified voltages, that are measured by an SMU. The SMU is set to a current source that sinks 10 μ A current, which can be ignored because the voltage drop of the 10 Ω resistor is low against 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.

VS Test Limits. Table 2-7 lists the VS Test limits.

Table 2-7. VS Test Limits

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 Operation

The VM Test checks the voltage monitors VM1 and VM2 of the DCS for correct dc measurement operation. Figure 2-51 shows a simplified VM Test circuit.

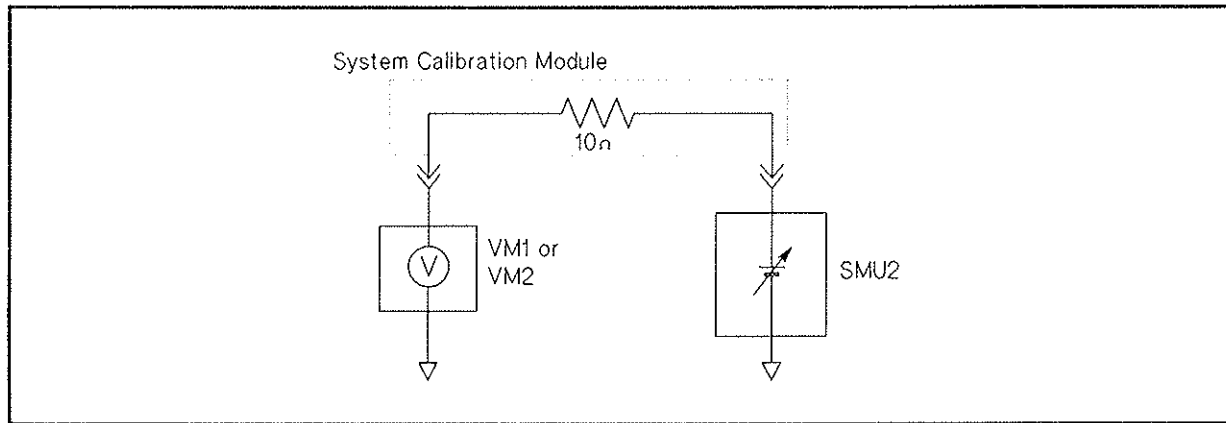


Figure 2-51. VM Test Circuit

During the VM Test, an SMU outputs voltages of -15 V , 1 V , 10 V , and 35 V . VM1 and VM2 are then checked by measuring these voltages. The 10Ω 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.

VM Test Limits. Table 2-8 lists the VM Test limits.

Table 2-8. VM Test Limits

Range	Nominal value	Error
20 V	-15 V	$\pm 35.0\text{ mV}$
2 V	1 V	$\pm 3.2\text{ mV}$
20 V	10 V	$\pm 30.0\text{ mV}$
40 V	35 V	$\pm 75.0\text{ mV}$

AFU Test Operation

The AFU Test checks the AFU of the DCS for correct measurement operation. The AFU Test performs a feedback measurement and checks whether the measurement (target) value is within test limits. Figure 2-52 shows a simplified AFU Test circuit.

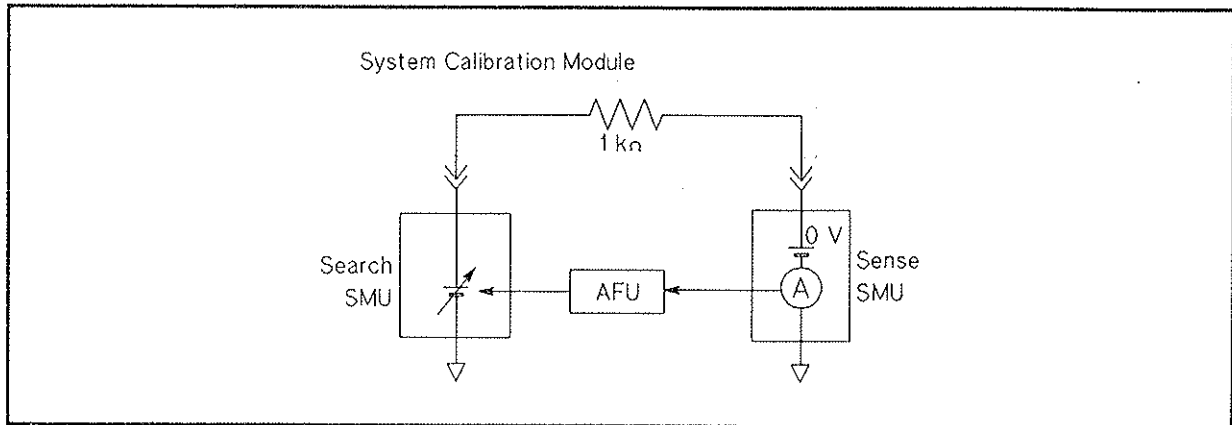


Figure 2-52. AFU Test Circuit

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 lists AFU Test limits.

Table 2-9. AFU Test Limits

Sense SMU Range	Target Value	Error
10 mA	-5 mA	$\pm 15\ \mu\text{A}$
	0 A	$\pm 10\ \mu\text{A}$
	5 mA	$\pm 15\ \mu\text{A}$

CMS C-G Test Operation

The CMS C-G Test checks the C-G measurement accuracy of the 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.

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 k Ω 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 96-pin SWM. Then, checks measurement results against the test limits.

CMS C-G Test Limits. Table 2-10 and Table 2-11 list the CMS C-G Test limits.

Table 2-10. CMS C-G Test Limits

Nominal Value	Range	Test Signal Level	Error
1 mS (1 k Ω)	1 mS	30 mVrms	$\pm 50 \mu\text{S}$
100 pF/0.0 S	100 pF/1 mS	10 mVrms	$\pm 0.8 \text{ pF}/\pm 5 \mu\text{S}$
100 pF/0.0 S	100 pF/1 mS	30 mVrms	$\pm 0.6 \text{ pF}/\pm 4 \mu\text{S}$
1000 pF/0.0 S	1000 pF/10 mS	10 mVrms	$\pm 19 \text{ pF}/\pm 100 \mu\text{S}$
1000 pF/0.0 S	1000 pF/10 mS	30 mVrms	$\pm 17 \text{ pF}/\pm 90 \mu\text{S}$

Table 2-11. Stray Capacitance Test Limit

Range	Test Signal	Error
Auto	30 mVrms	$\pm 6 \text{ pF}$

CMS Bias Test Operation

The CMS Bias Test checks the accuracy of the internal dc bias source of the CMU. Figure 2-53 shows a simplified CMS Bias Test circuit.

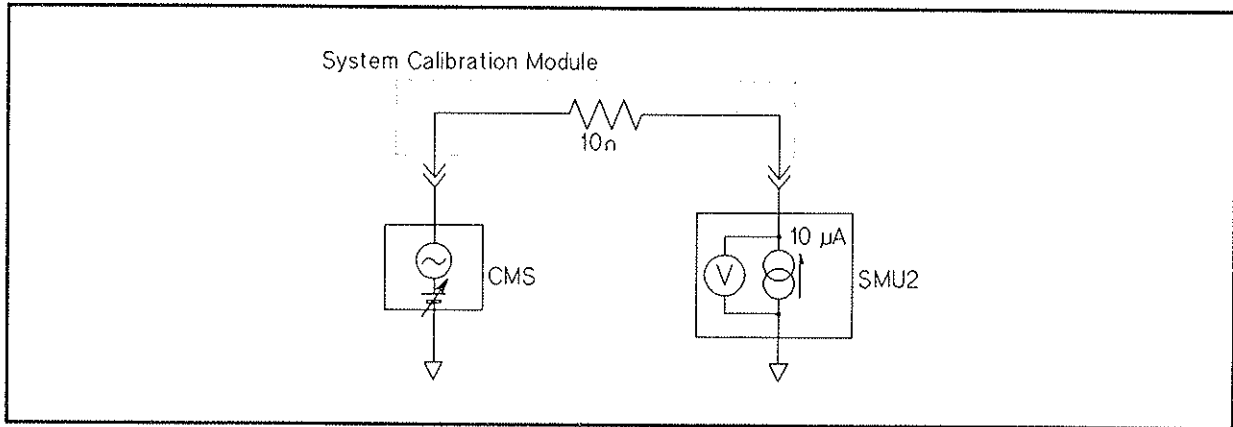


Figure 2-53. CMS Bias Test Circuit

During the CMS Bias Test, the 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 $10\text{ }\mu\text{A}$, and measurement results are compared to the test limits. The voltage drop of the $10\text{ }\Omega$ resistor is low enough not to affect on the voltage measurement value.

Test Limits. Table 2-12 lists CMS Bias Test limits.

Table 2-12. CMS Bias Test Limits

Range	Nominal Value	SMU Measurement Range	Error
1 V	1 V	2 V	$\pm 14.1\text{ mV}$
10 V	-10 V	20 V	$\pm 45\text{ mV}$
100 V	80 V	100 V	$\pm 270\text{ mA}$

CMU84 C-G Test Operation

The CMU84 C-G Test checks the C-G measurement accuracy of the CMU84, and consists of the following subtests performed in the order listed.

1. C-G Measurement Test

- The CMU84 measures the capacitance of the 100 pF, 1000 pF, 10 nF, and 100 nF capacitors and the 100 Ω and 1 k Ω resistors in the system calibration module. The measurement is performed at the frequency of 1 kHz, 10 kHz, 100 kHz, and 1 MHz. Measurement results are compared with the calibrated values of the system calibration module.
- The CMU84 measures the conductance of the 100 pF, 1000 pF, 10 nF, and 100 nF capacitors and the 100 Ω and 1 k Ω resistors in the system calibration module. The measurement is performed at frequencies of 1 kHz, 10 kHz, 100 kHz, 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 and Table 2-14 list 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 μ S	10 kHz	± 0.5 pF/ ± 31.5 nS
	100 pF/63 μ S	100 kHz	± 0.6 pF/ ± 378 nS
	100 pF/630 μ S	1 MHz	± 1.1 pF/ ± 5.67 μ S
1000 pF/0.0 S	1000 pF/6.3 μ S	1 kHz	± 4.0 pF/ ± 25.2 nS
	1000 pF/63 μ S	10 kHz	± 4.0 pF/ ± 252 nS
	1000 pF/630 μ S	100 kHz	± 5.0 pF/3.78 μ S
	1000 pF/6.3 mS	1 MHz	± 21.0 pF/ ± 151 μ S
10 nF/0.0 S	10 nF/63 μ S	1 kHz	± 40.0 pF/ ± 252 nS
	10 nF/630 μ S	10 kHz	± 40.0 pF/ ± 2.52 μ S
	10 nF/6.3 mS	100 kHz	± 70.0 pF/ ± 63 μ S
100 nF/0.0 S	100 nF/630 μ S	1 kHz	± 400 pF/ ± 2.52 μ S
	100 nF/6.3 mS	10 kHz	± 400 pF/ ± 50.4 μ S
100 Ω	6.3 mS/100 nF	10 kHz	± 1.69 nF/ ± 76.3 μ S
	6.3 mS/10 nF	100 kHz	± 179 pF/ ± 82.6 μ S
	6.3 mS/1000 pF	1 MHz	± 29.0 pF/ ± 143 μ S
1 k Ω	630 μ S/100 nF	1 kHz	± 576 pF/ ± 3.63 μ S
	630 μ S/10 nF	10 kHz	± 57.6 pF/ ± 3.63 μ S
	630 μ S/1000 pF	100 kHz	± 8.35 pF/ ± 4.26 μ S
	630 μ S/100 pF	1 MHz	± 1.25 pF/ ± 9.89 μ S

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 2-54 shows a simplified CMU84 Bias Test circuit.

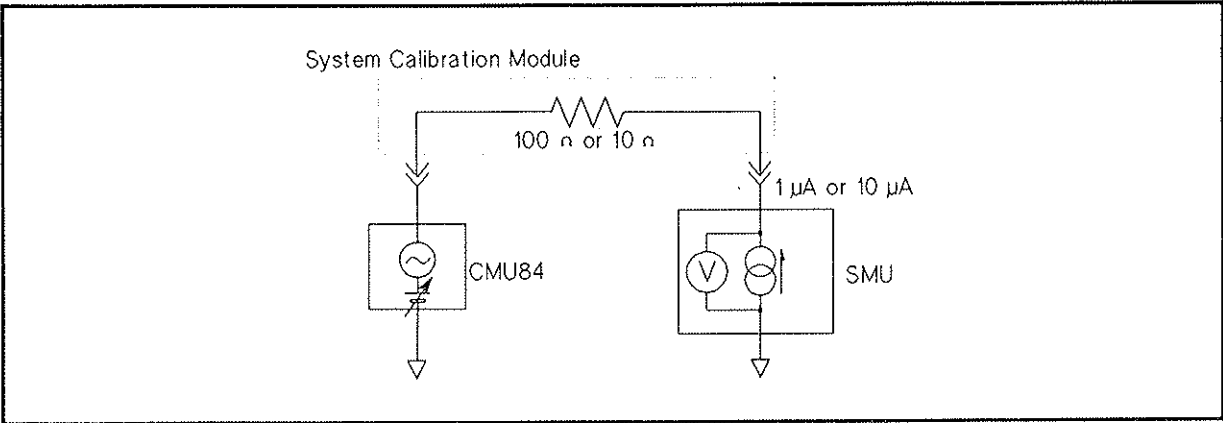


Figure 2-54. CMU84 Bias Test Circuit

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 and Table 2-16 list LCR Bias Test limits.

Table 2-15. CMU84 Bias Test Limits (Without $\pm 40\text{ V}$ dc Bias Source)

Nominal Value	SMU Range	Error
1.5 V	2 V	$\pm 75\text{ mV}$
2.0 V	2 V	$\pm 100\text{ mV}$

Table 2-16. CMU84 Bias Test Limits (With $\pm 40\text{ V}$ dc Bias Source)

Nominal Value	CMU84 Range	SMU Range	Error
0.0 V	4 V	2 V	$\pm 2.1\text{ mV}$
0.1 V	4 V	2 V	$\pm 2.2\text{ mV}$
2.0 V	4 V	2 V	$\pm 5.1\text{ mV}$
6.0 V	8 V	20 V	$\pm 21.0\text{ mV}$
14.0 V	20 V	20 V	$\pm 36.0\text{ mV}$
30.0 V	40 V	40 V	$\pm 75.0\text{ mV}$
40.0 V	40 V	40 V	$\pm 90.0\text{ mV}$
-0.1 V	4 V	2 V	$\pm 2.2\text{ mV}$
-2.0 V	4 V	2 V	$\pm 5.1\text{ mV}$
-6.0 V	8 V	20 V	$\pm 21.0\text{ mV}$
-14.0 V	20 V	20 V	$\pm 36.0\text{ mV}$
-30.0 V	40 V	40 V	$\pm 75.0\text{ mV}$
-40.0 V	40 V	40 V	$\pm 90.0\text{ mV}$

DC Leak Test Operation

The DC Leak Test checks all pin boards and SMU ports for excessive leakage current to ground. Figure 2-55 shows a simplified DC Leak Test circuit.

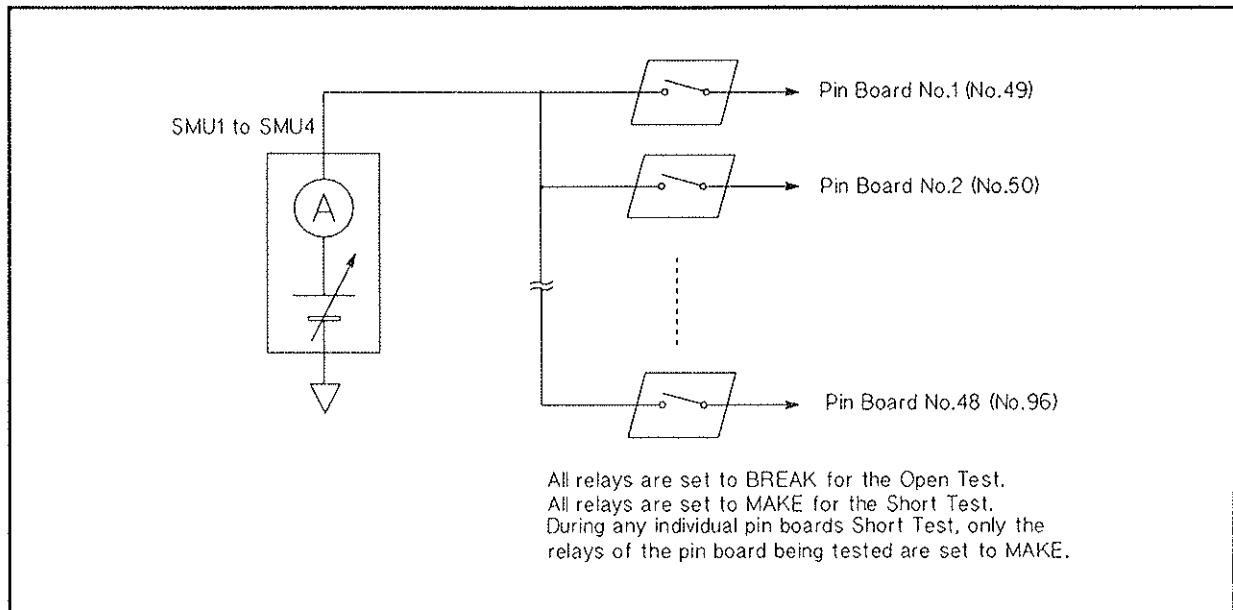


Figure 2-55. DC Leak Test Circuit

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.

Test Limits. Table 2-17 and Table 2-18 list 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 2-56 shows a simplified GNDU Test circuit.

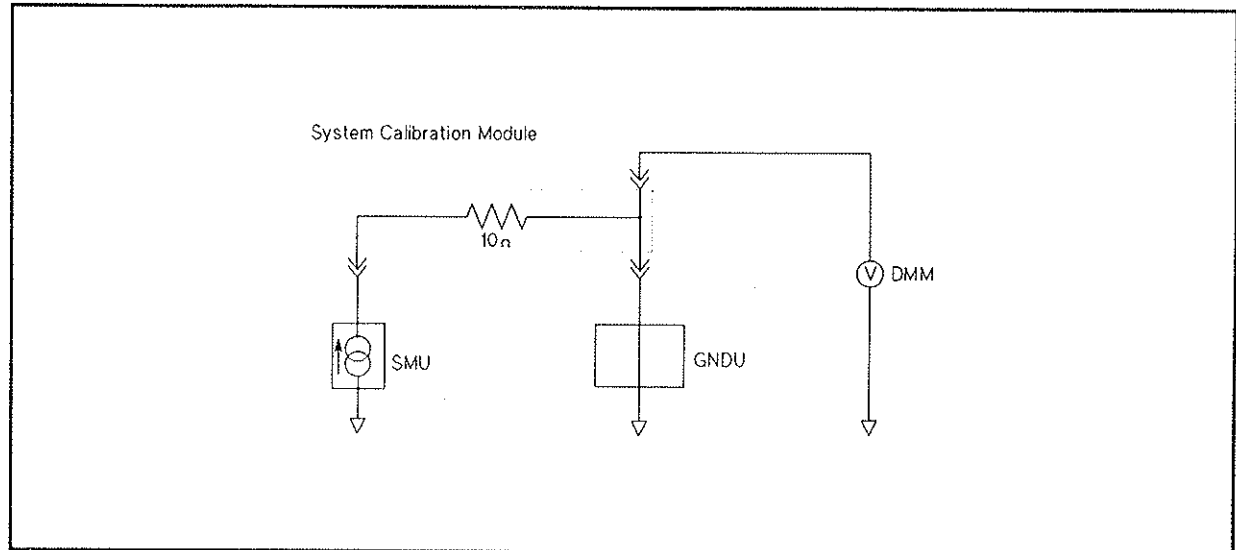


Figure 2-56. GNDU Test Circuit

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 V_g is used in the Current Accuracy Test.

GNDU Test Limits. Table 2-19 lists GNDU Test limits.

Table 2-19. GNDU Test Limits

Nominal Value	Tolerance
0 V	± 1 mV

Kelvin Connection Test Operation

Figure 2-57 shows a simplified Kelvin Connection Test circuit.

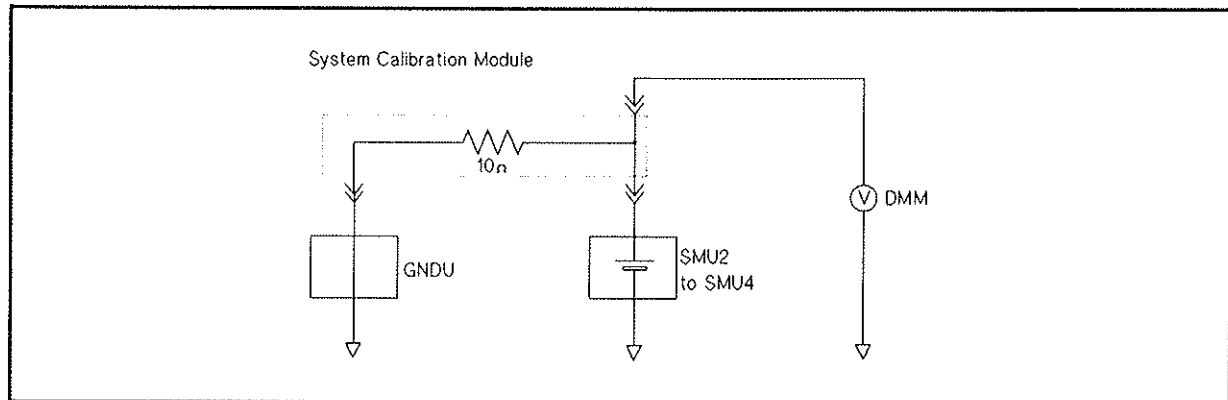


Figure 2-57. Kelvin Connection Test Circuit

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.

Kelvin Connection Test Limits. Table 2-20 lists the 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 2-58 shows a simplified Voltage Accuracy Test circuit.

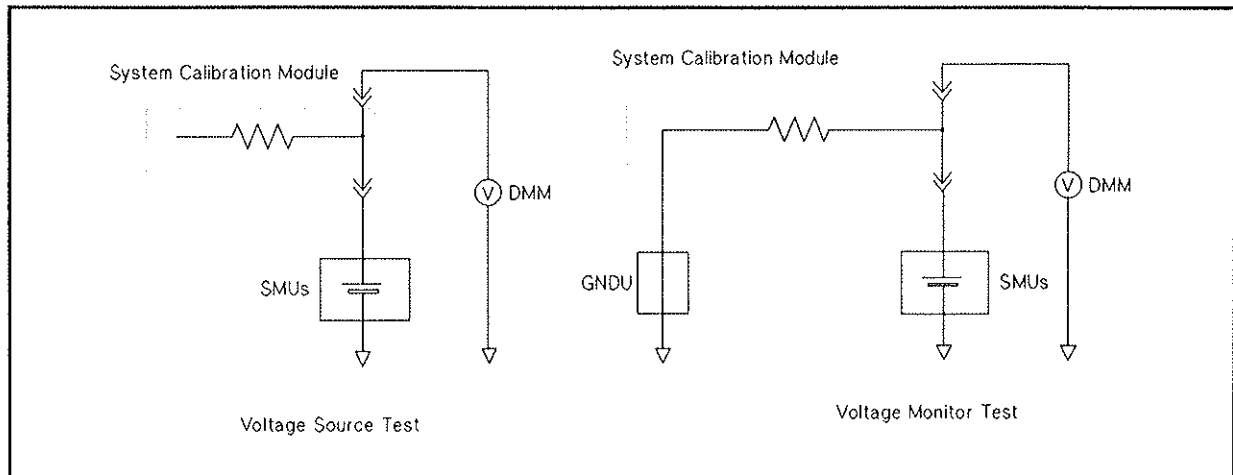


Figure 2-58. Voltage Accuracy Test Circuit

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 lists Voltage Accuracy Test limits.

Table 2-21. Voltage Accuracy Test Limits

Source Mode	Range	Value	Tolerance	
			SMU1	SMU2,3,4
Voltage Source	2 V	± 2 V	± 2.1 mV	± 2.1 mV
		0 V	± 1.1 mV	± 1.1 mV
	20 V	± 20 V	± 20 mV	± 20 mV
		0 V	± 10 mV	± 10 mV
	40 V	± 40	± 40 mV	± 40 mV
		0 V	± 20 mV	± 20 mV
	100 V	± 100 V	± 100 mV	± 100 mV
		0 V	± 50 mV	± 50 mV
	200V ¹	± 200 V	± 200 mV	± 200 mV
		0 V	± 100 mV	± 100 mV
Current Source	2 V	± 1.9 μ A	± 2.05 mV	± 2.05 mV
		0 μ A	± 1.1 mV	± 1.1 mV
	20 V	± 19 μ A	± 19.5 mV	± 19.5 mV
		0 A	± 10 mV	± 10 mV
	40 V	± 39 μ A	± 39.5 mV	± 39.5 mV
		0 μ A	± 20 mV	± 20 mV
	100 V	± 99 μ A	± 99.5 mV	± 99.5 mV
		0 μ A	± 50 mV	± 50 mV
	200 V ¹	± 199 μ A	± 199.6 mV	± 199.5 mV
		0 μ A	± 100 mV	± 100 mV

¹ This range is tested only when the DCS is equipped with HP 41420A 200 V/1 A SMUs.

Current Accuracy Test Operation

Figure 2-59 shows a simplified Current Accuracy Test circuit.

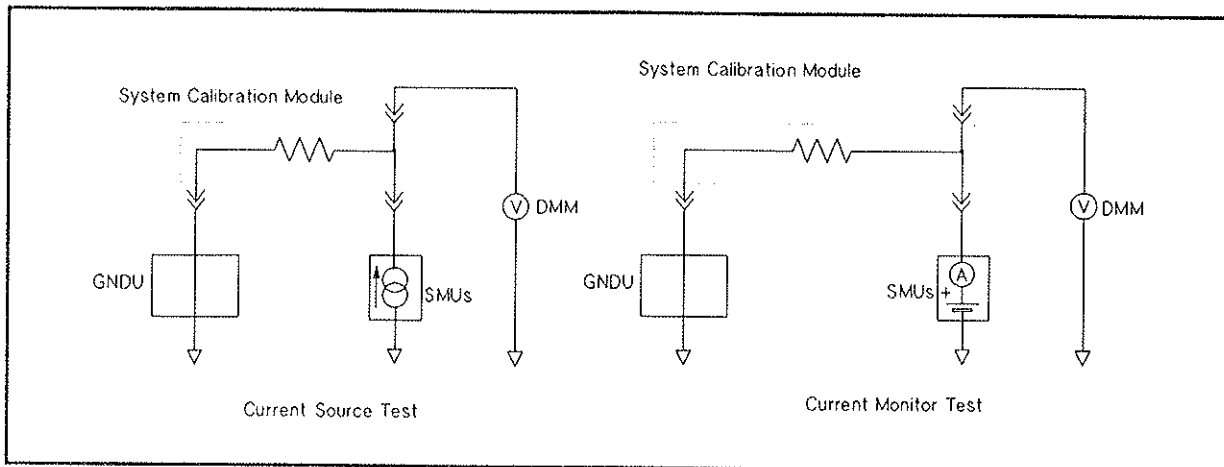


Figure 2-59. Current Accuracy Test Circuit

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 lists Current Accuracy Test limits.

Table 2-22. Current Accuracy Test Limits

Source Mode	Resistance	Range	Force Value	Tolerance	
				SMU1	SMU2,3,4
Current Source Voltage Monitor	1 Ω ¹	1 A	1 A	± 6.02 mA	± 6.02 mA
	10 Ω	100 mA	100 mA	± 302 μ A	± 302 μ A
	1 k Ω	10 mA	10 mA	± 30.2 μ A	± 30.2 μ A
	1 k Ω	1 mA	1 mA	± 3.02 μ A	± 3.02 μ A
	1 M Ω	100 μ A	90 μ A	± 2.45 μ A	± 2.45 μ A
	1 M Ω	10 μ A	10 μ A	± 32 nA	± 32 nA
	1 M Ω	1 μ A	1 μ A	± 7 nA	± 8 nA
Voltage Source Current Monitor	1 Ω ¹	1 A	0.9 V	± 5.518 mA	± 5.518 mA
	10 Ω	100 mA	0.9 V	± 281.8 μ A	± 281.8 μ A
	1 k Ω	10 mA	9 V	± 28.18 μ A	± 28.18 μ A
	1 k Ω	1 mA	0.9 V	± 2.818 μ A	± 2.818 μ A
	1 M Ω	100 μ A	90 V	± 2.45 μ A	± 2.45 μ A
	1 M Ω	10 μ A	9 V	± 29.8 nA	± 29.8 nA
	1 M Ω	1 μ A	0.9 V	± 6.5 nA	± 7.5 nA
	1 G Ω	100 nA	90 V	± 550 pA	± 1.45 nA
	1 G Ω	10 nA	9 V	± 105 pA	—
	1 G Ω	1 nA	0.9 V	± 17 pA	—

¹ This range is tested only when the DCS is equipped with HP 41420A 200 V/1 A SMUs.

VS Test Operation

Figure 2-60 shows a simplified VS Test circuit.

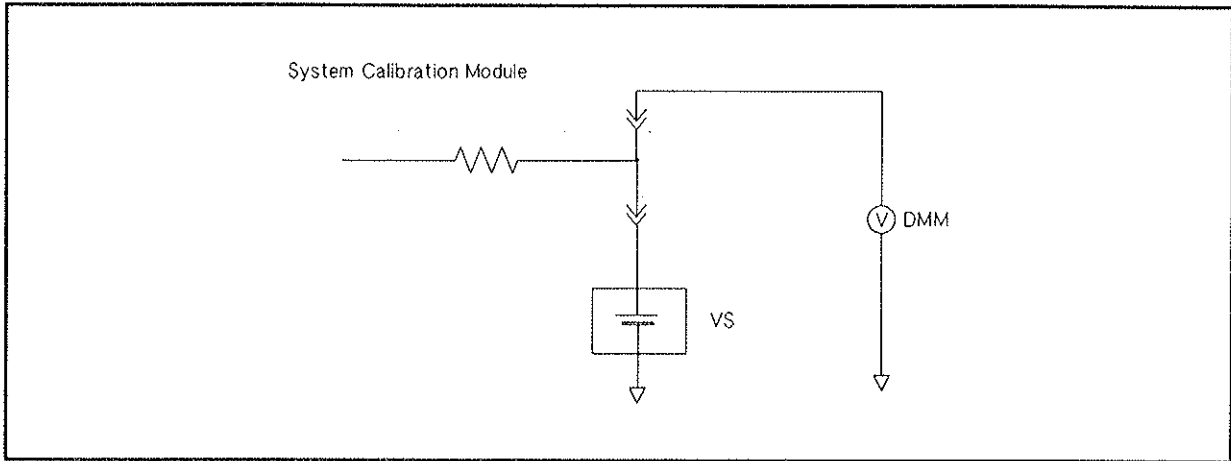


Figure 2-60. VS Test Circuit

During the VS Test, the voltage at the VS1 and VS2 ports are measured with the voltage measurement function of the DMM, and compared with the forced voltage.

VS Test Limits. Table 2-23 lists VS Test limits.

Table 2-23. VS Test Limits

Range	Nominal Value	Tolerance
20 V	± 20 V	± 30 mV
	0 V	± 10 mV
40 V	± 40 V	± 60 mV
	0 V	± 20 mV

VM Test Operation

Figure 2-61 shows a simplified VM Test circuit.

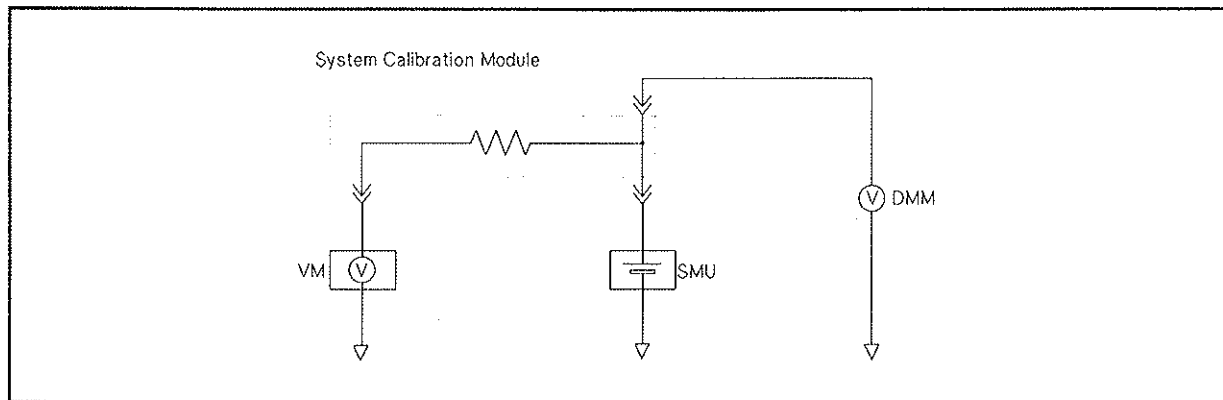


Figure 2-61. VM Test Circuit

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.

VM Test Limits. Table 2-24 lists VM Test limits.

Table 2-24. VM Test Limits

Range	Nominal Value	Tolerance
2 V	± 1.9 V	± 2.05 mV
	0 V	± 1.1 mV
20 V	± 19 V	± 19.5 mV
	0 V	± 10 mV
40 V	± 39 V	± 39.5 mV
	0 V	± 20 mA

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 and Table 2-26 list 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 2-62 shows a simplified LCR Bias Test circuit.

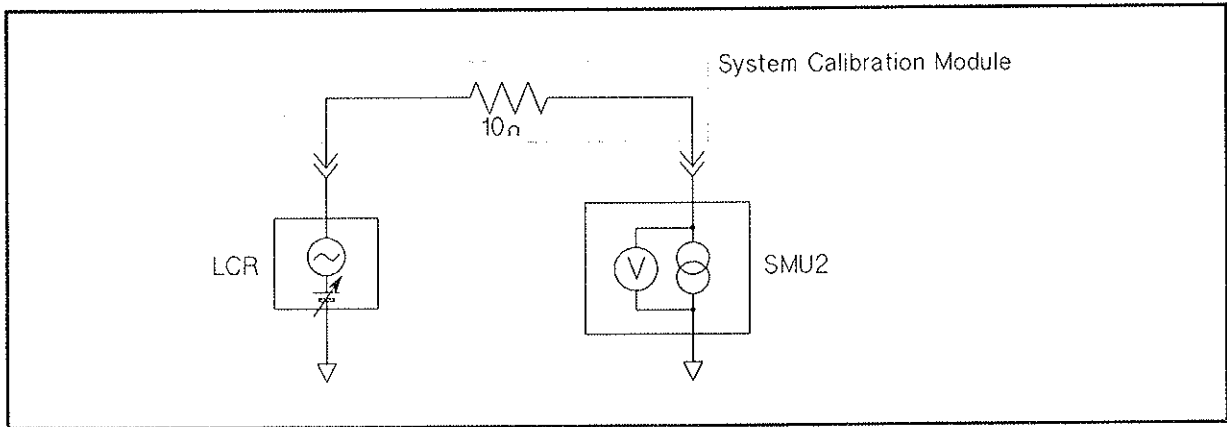


Figure 2-62. LCR Bias Test Circuit

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 and Table 2-28 list the 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

Troubleshooting

Introduction

This chapter contains HP 4062C/UX 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

Table 3-1 lists the test equipment required for troubleshooting. This test equipment is the same as that required for system performance verification.

Table 3-1. Required Test Equipment

Item	48-pin Systems	96-pin Systems
Relay Test Adapter ¹	HP 16075A	HP 16355A
Test Fixture Adapter ^{1,2}	HP 16066A	HP 16370A
Product Support Package (PSP)	HP 16290A	
PV4062 Software Disk Set ³ (for HP 4062C only)	04062-65431	
System Calibration Module	HP 16346A/B/C ⁴	HP 16366A/B ⁵
Digital Multimeter (DMM)	HP 3456A or HP 3458A	
BNC Dual-Banana	11001-60001	
BNC-BNC Cable (Maximum 3m)	HP 10503A or 8120-1840 (2 each)	
HP-IB Cable	HP 10833A/B/C/D	
BNC-T Adapter	1250-0781 (2 each)	
Alligator Clips-to-Dual Banana Plug Cable	HP 11002A	
HP 4142B PSP	04142-65801	
Calibration Adapter	HP 16330A	
RC Box	HP 16340A	

1 Furnished system accessory.

2 If the test fixture adapter is not available (48-pin systems), the HP 16077A 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 Included in the HP 16290A PSP.

4 The HP 16346B System Calibration Module (included in the HP 16290A PSP) is required for the DCS 1A range current accuracy test of the PV4062 W/O or W/ DVM Test if the DCS is equipped with an HP 41420A SMU. The remaining tests can be performed using either the HP 16346A or B.

HP 16346C System Calibration Module is required for testing the CMU84 performance if the system is equipped with an HP 4284A 20 Hz–1 MHz Precision LCR Meter (option 320 for HP 4062C; option 530 for HP 4062UX).

5 HP 16366B System Calibration Module is required for testing the CMU84 performance if the system is equipped with an HP 4284A 20 Hz–1 MHz Precision LCR Meter (option 320 for HP 4062C; option 530 for HP 4062UX). Otherwise, either the HP 16366A or B can be used for PV4062.

Troubleshooting Flow Diagrams

Figure 3-1 through Figure 3-11 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 DCS”.

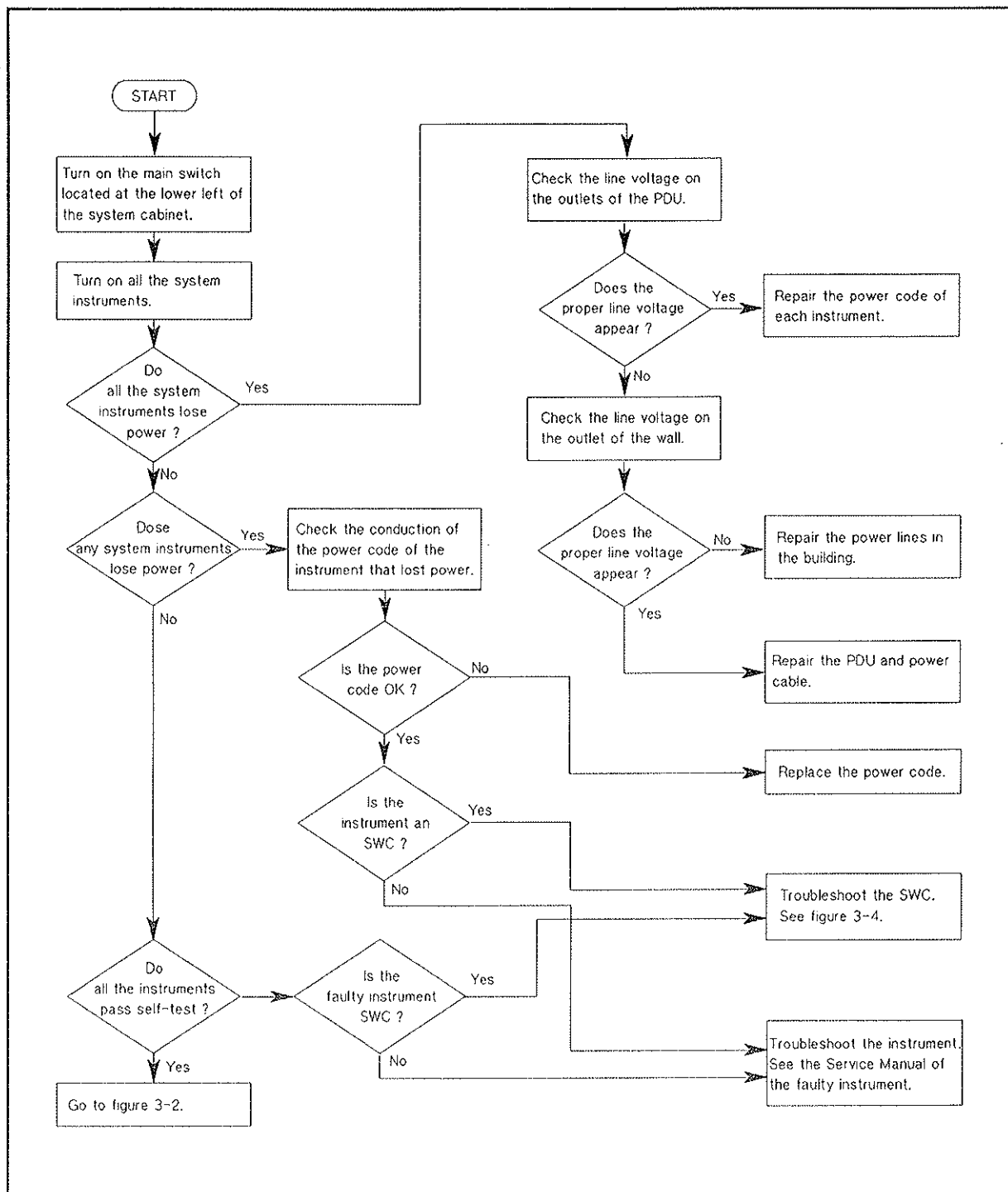


Figure 3-1. Turning the System Instruments On

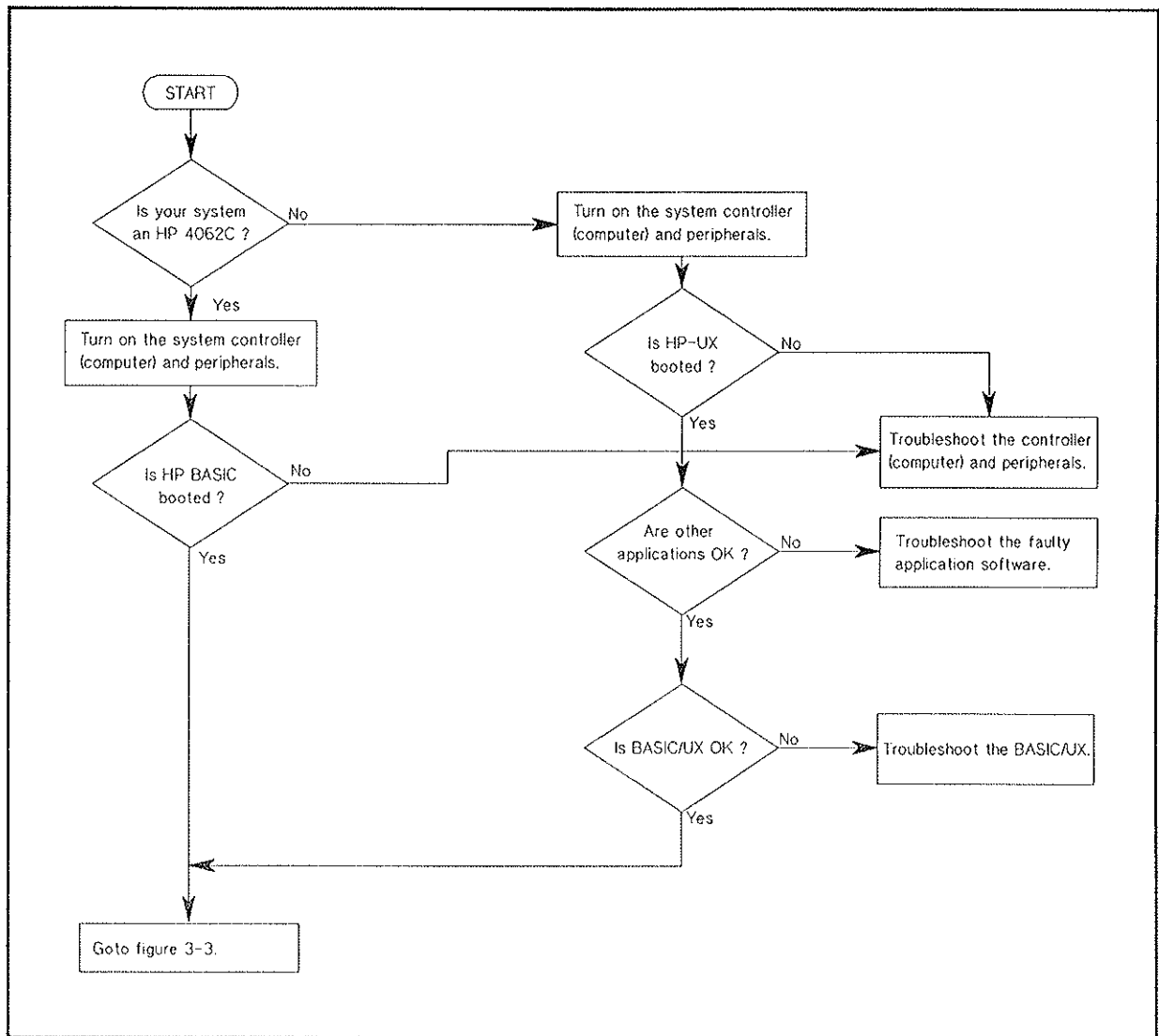


Figure 3-2. Turning the System Controller On

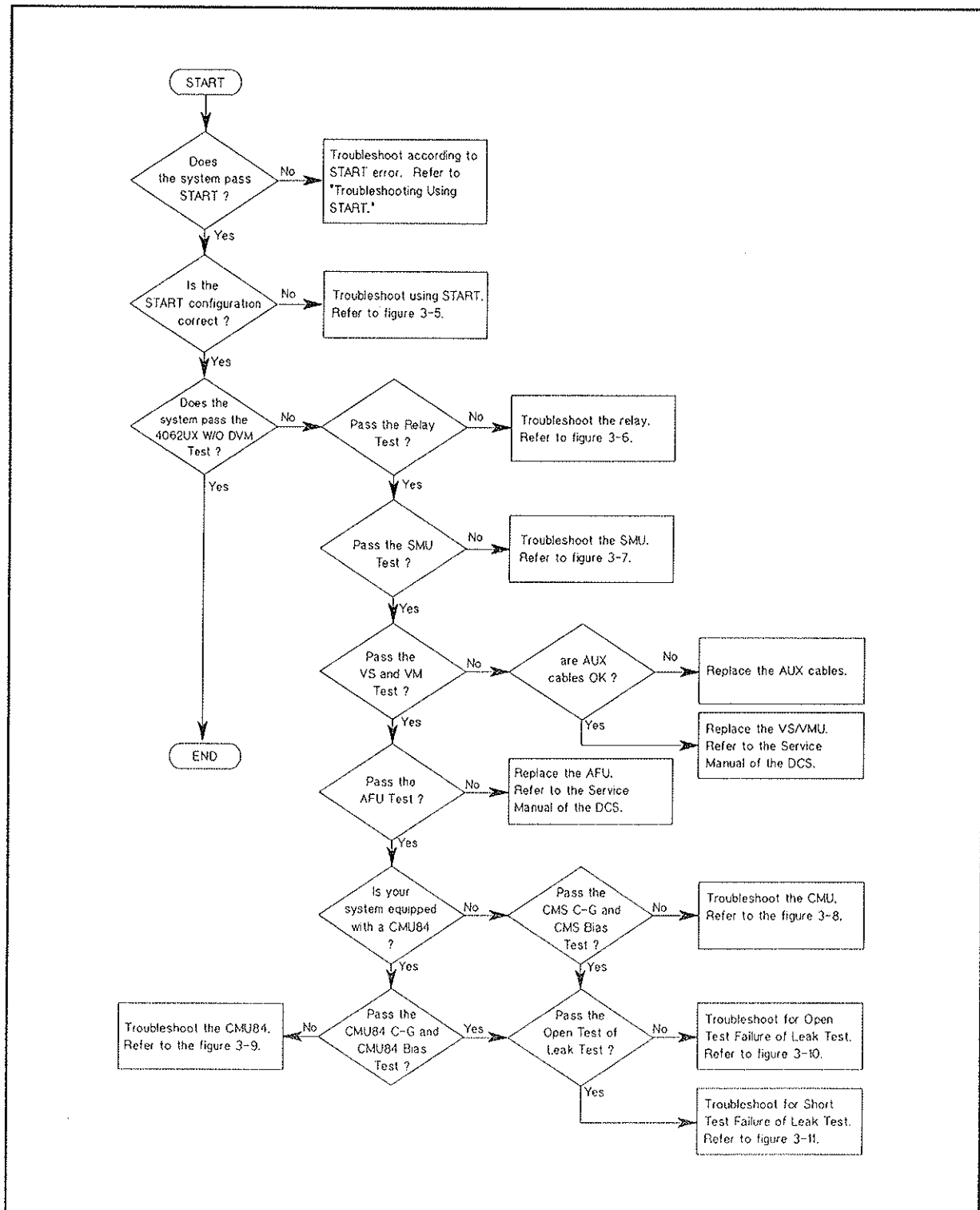


Figure 3-3. Failure Isolation Using PV4062

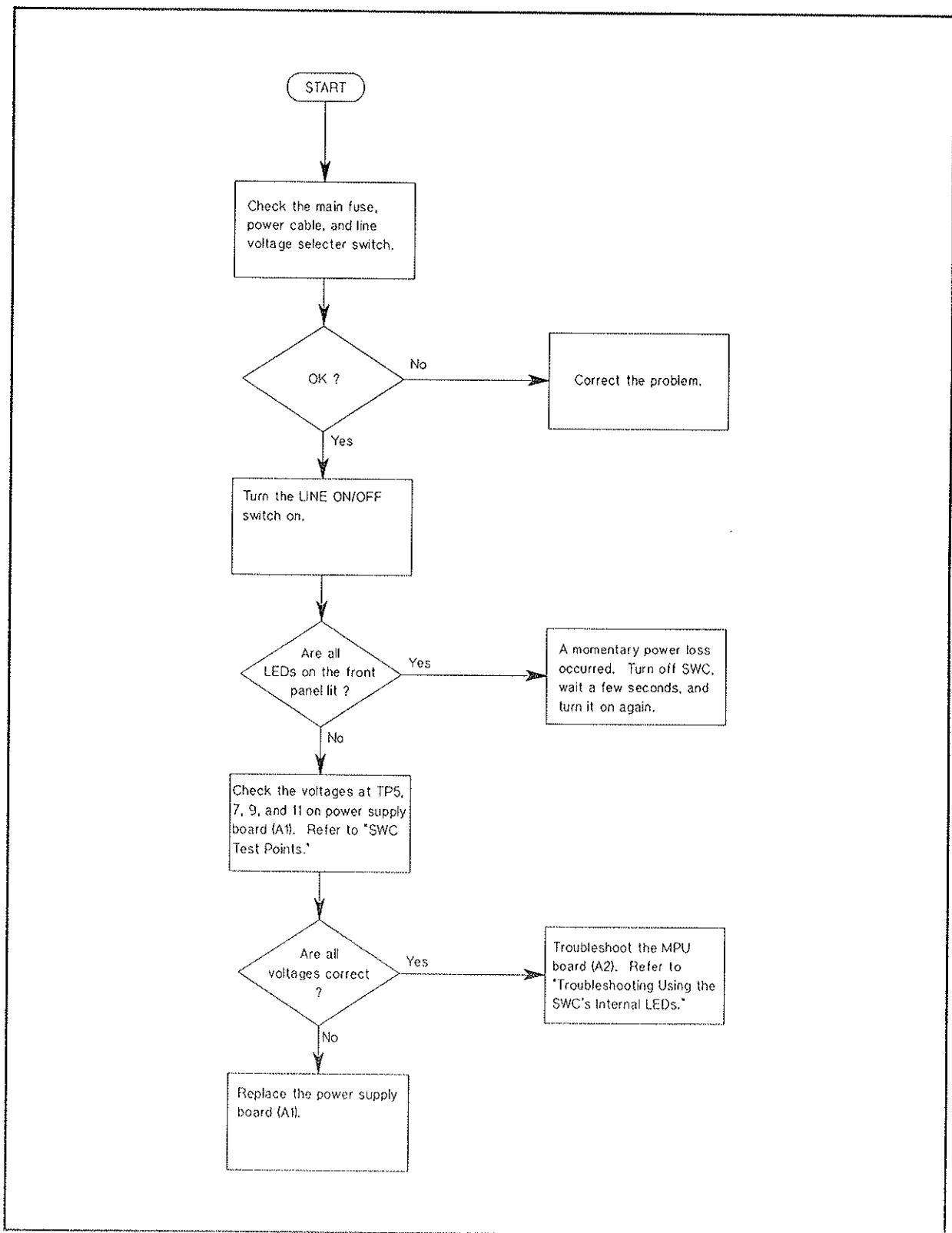


Figure 3-4. SWC Troubleshooting

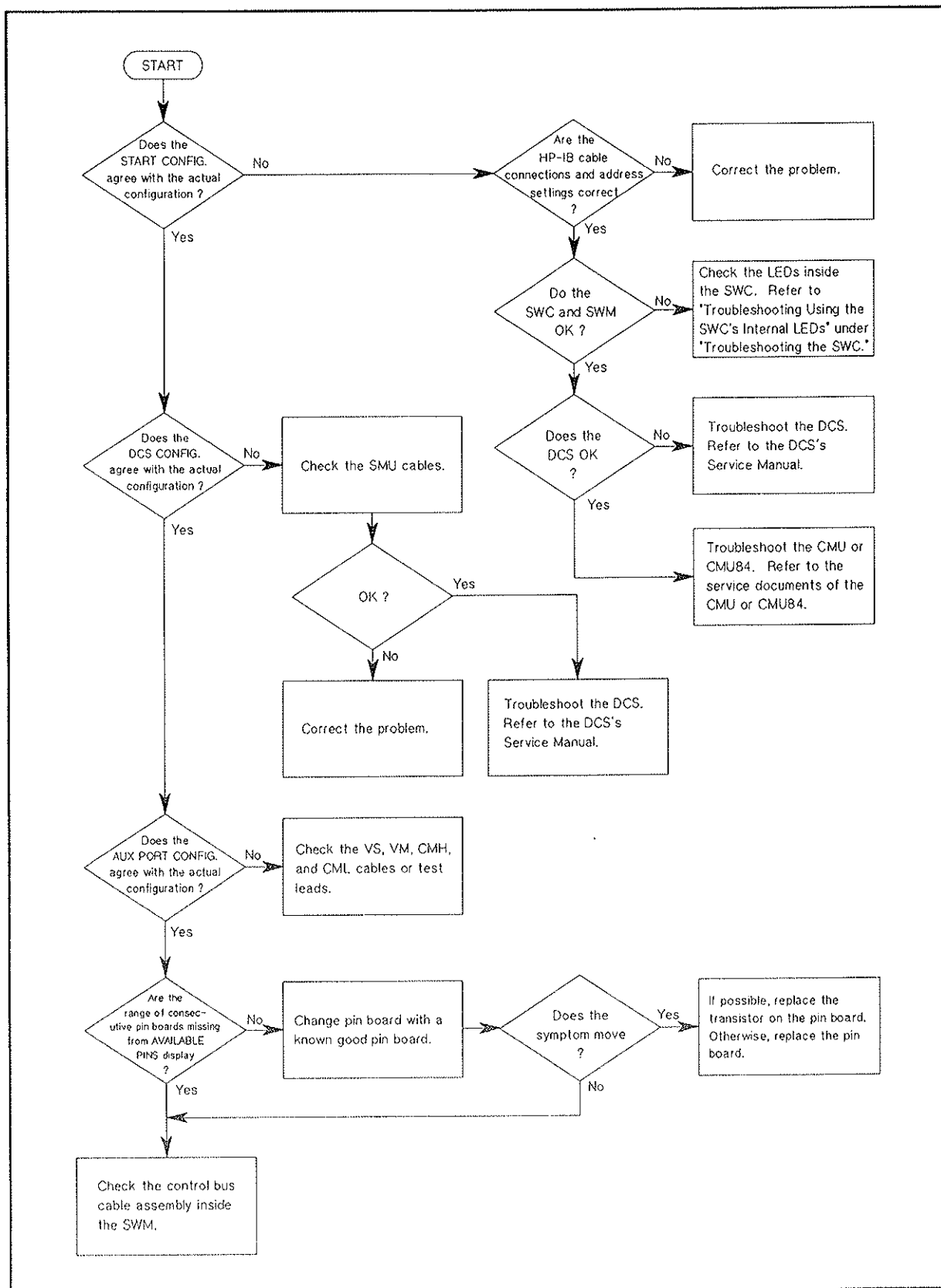


Figure 3-5. START Configuration Troubleshooting

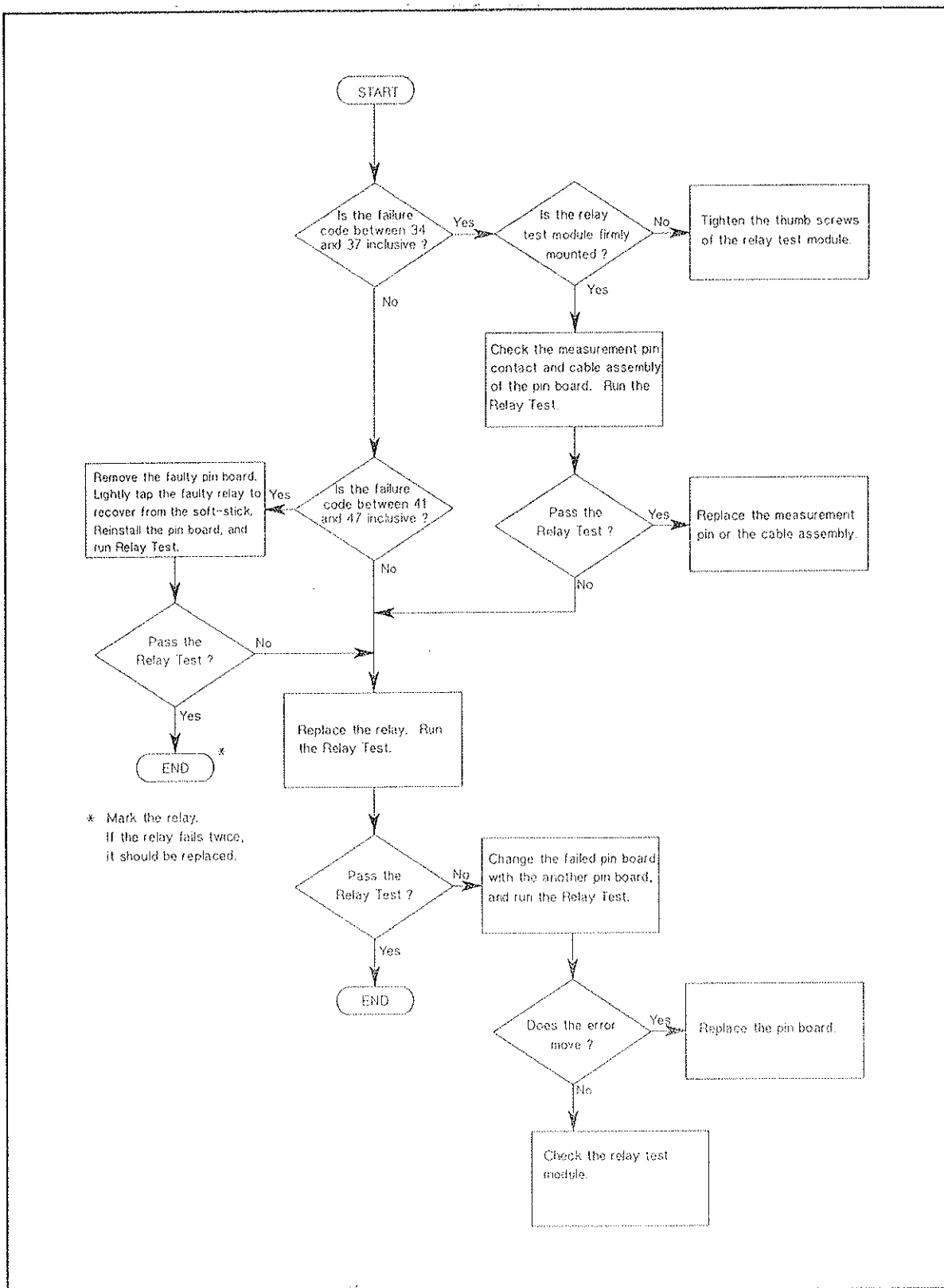


Figure 3-6. Relay Troubleshooting

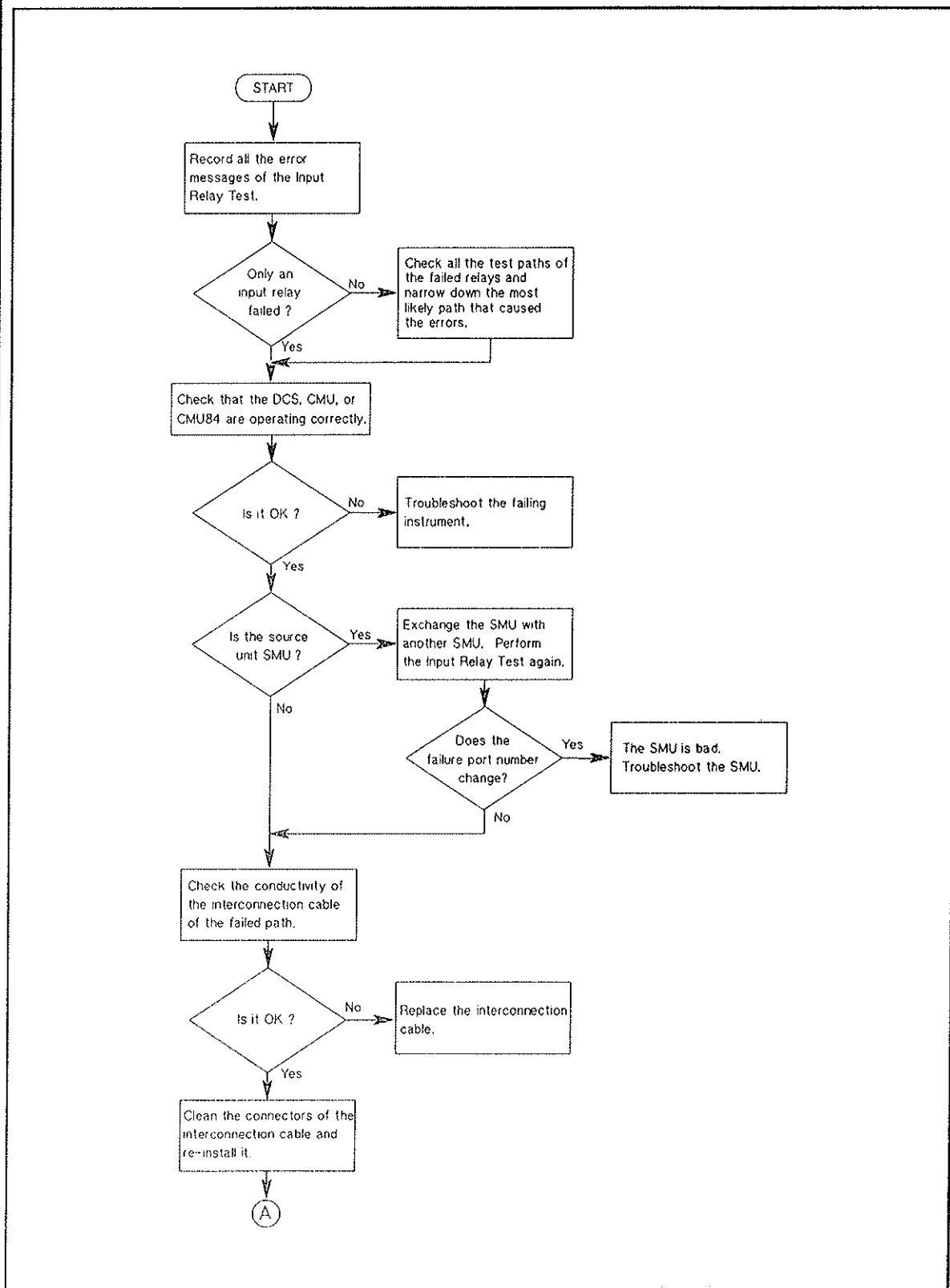


Figure 3-6a. Relay Troubleshooting -- Input Relay (1 of 2)

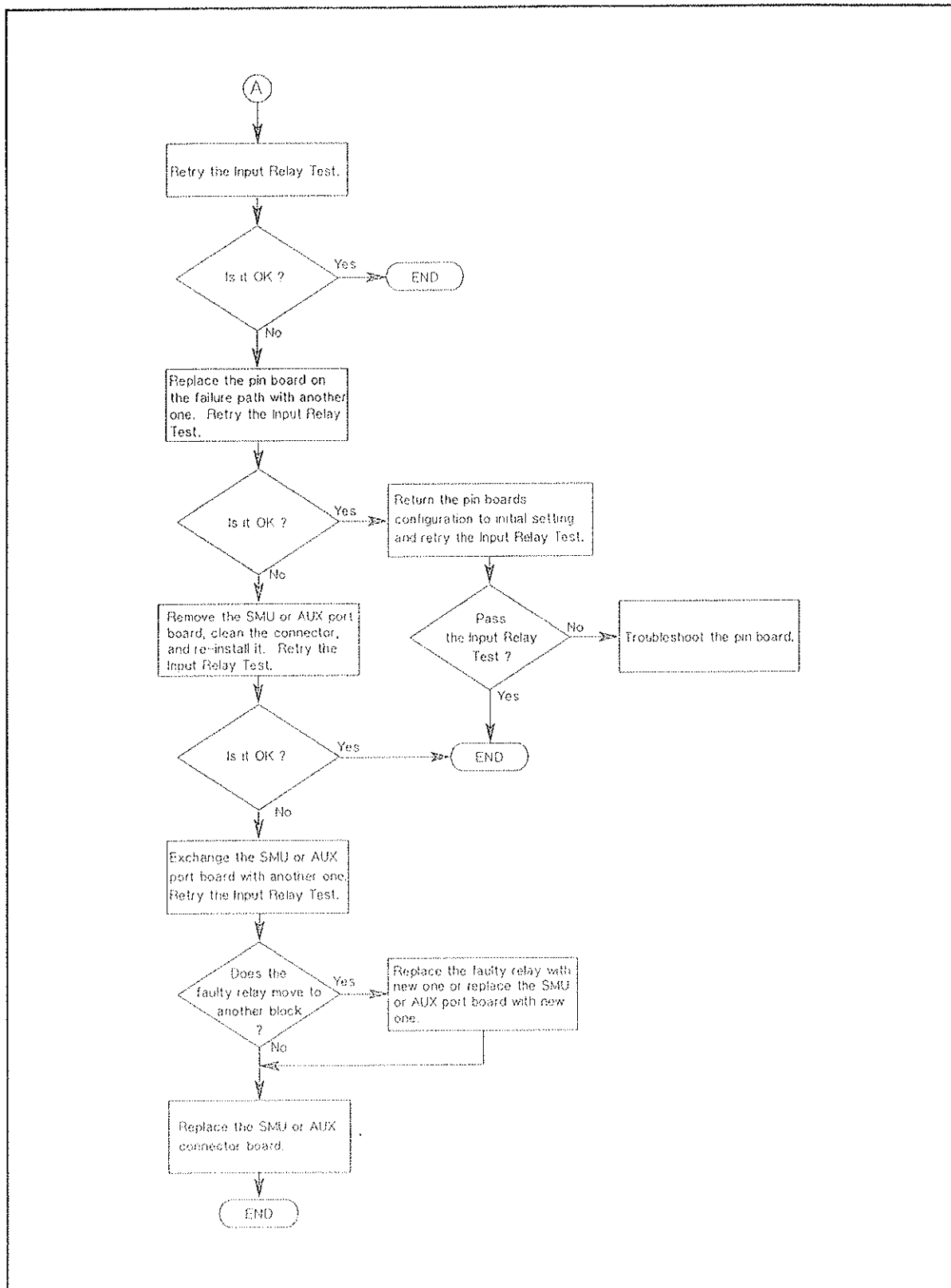


Figure 3-6b. Relay Troubleshooting --- Input Relay (2 of 2)

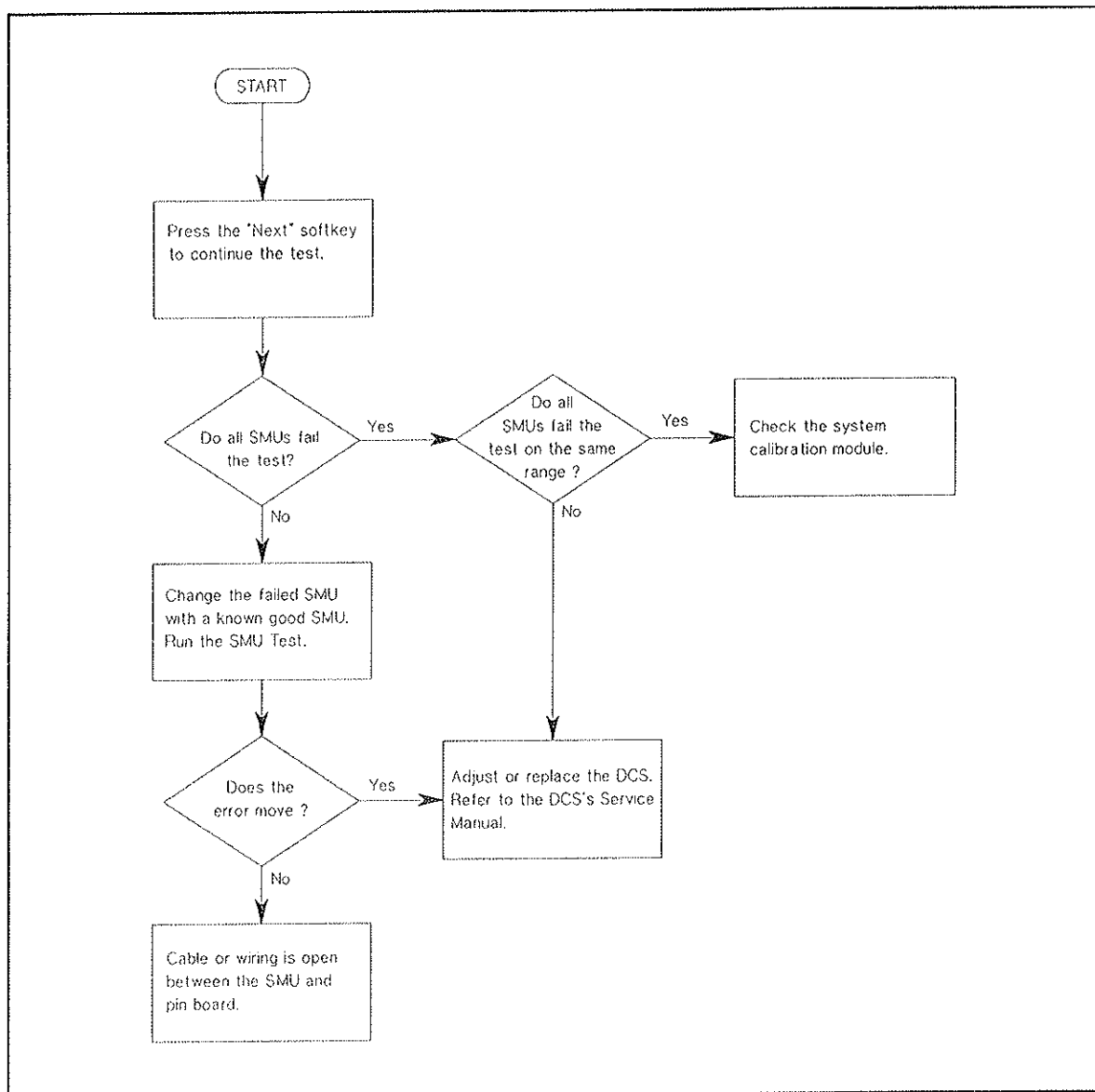


Figure 3-7. SMU Test Troubleshooting

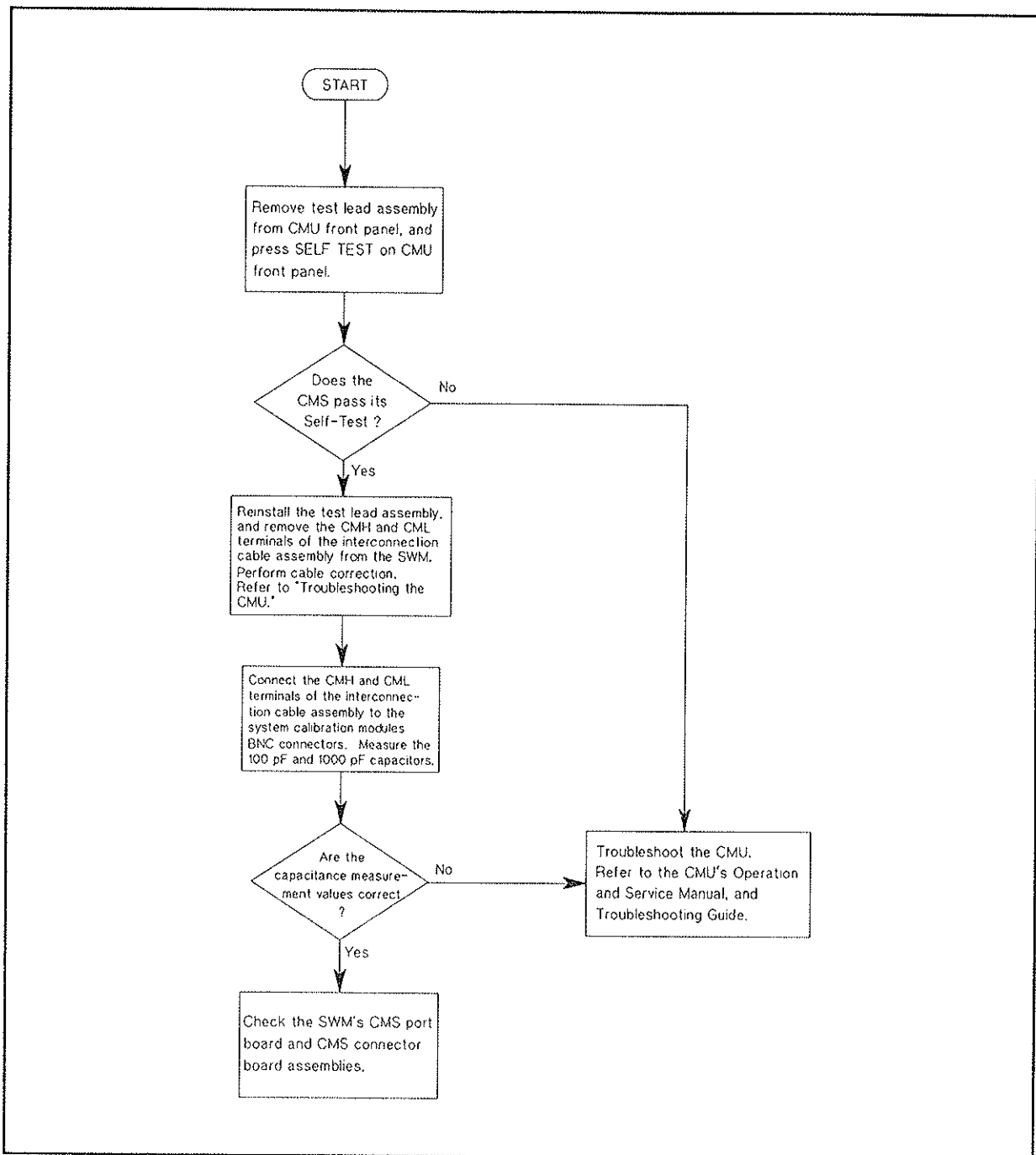


Figure 3-8. CMU Troubleshooting

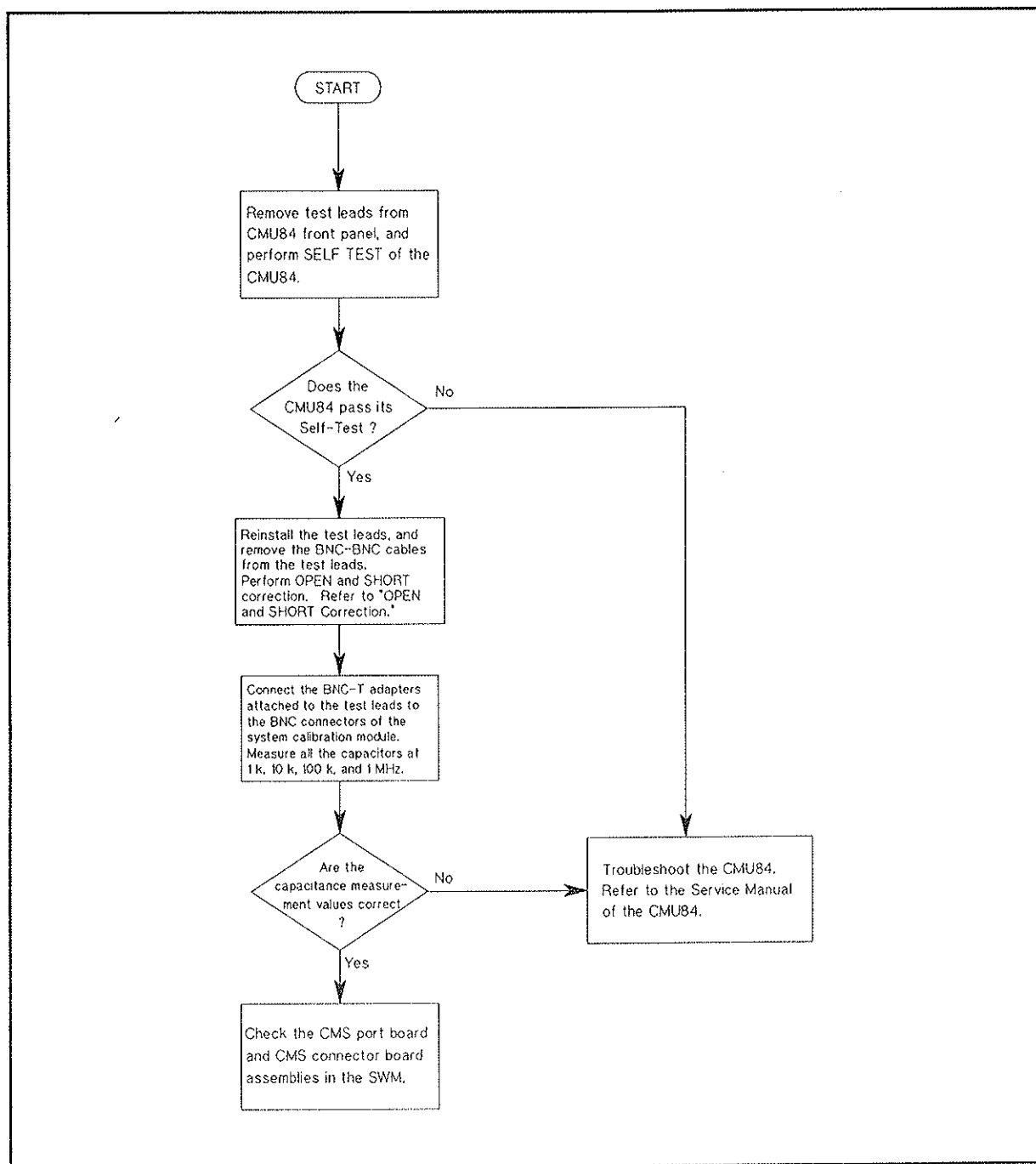


Figure 3-9. CMU84 Troubleshooting

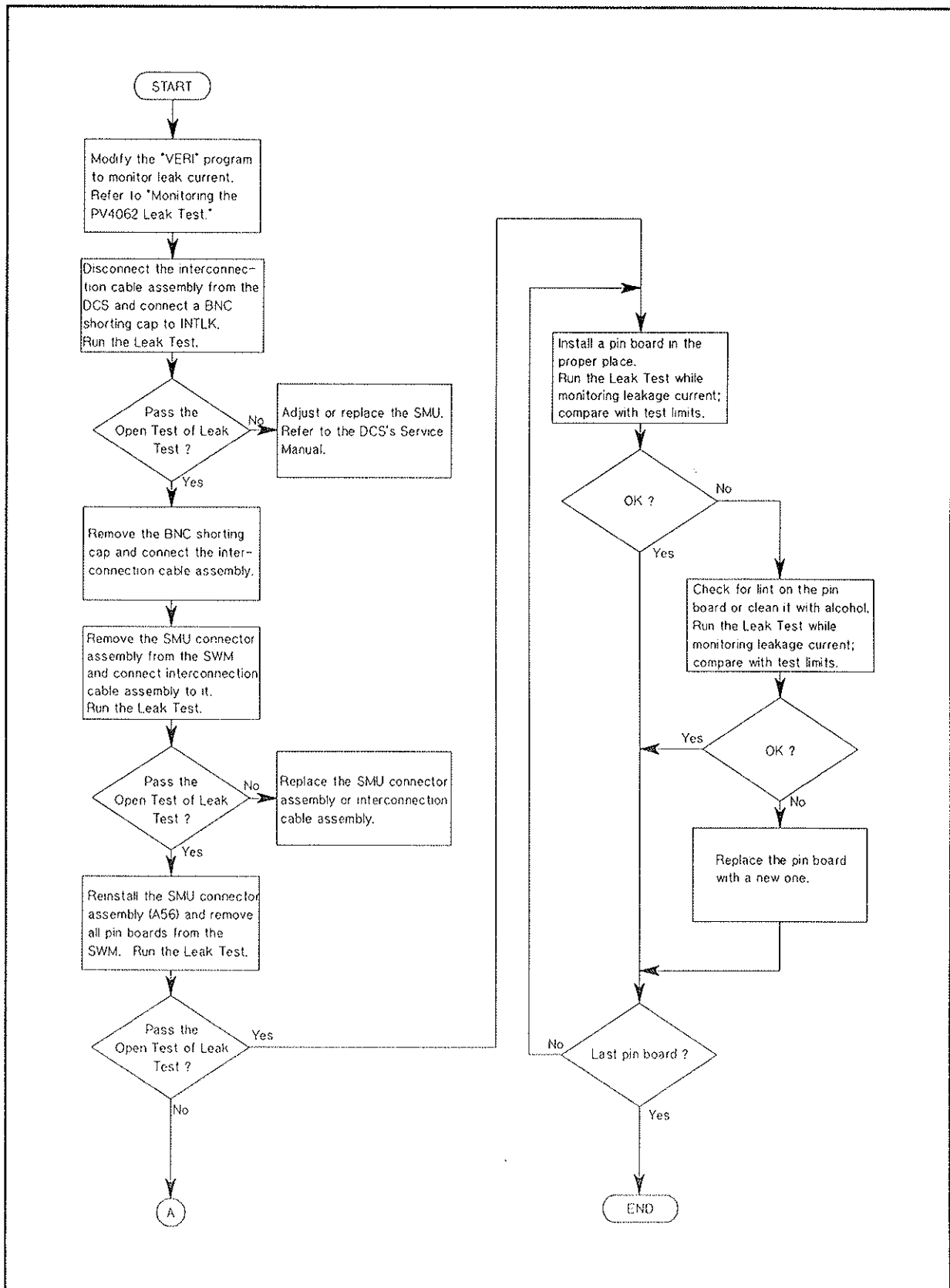
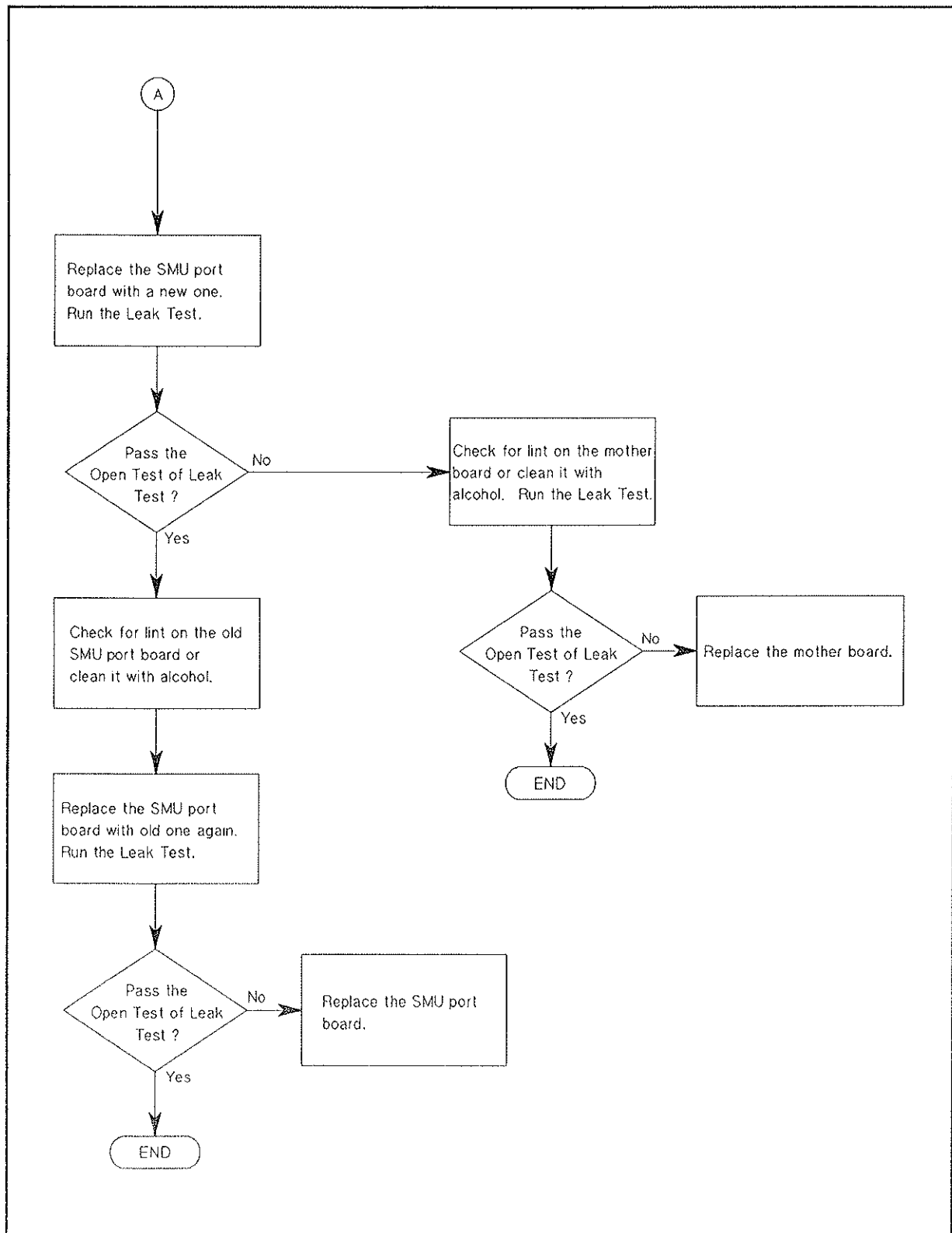


Figure 3-10. DC Leak Test—Open Test Troubleshooting (1 of 2)



DC Leak Test—Open Test Troubleshooting (2 of 2)

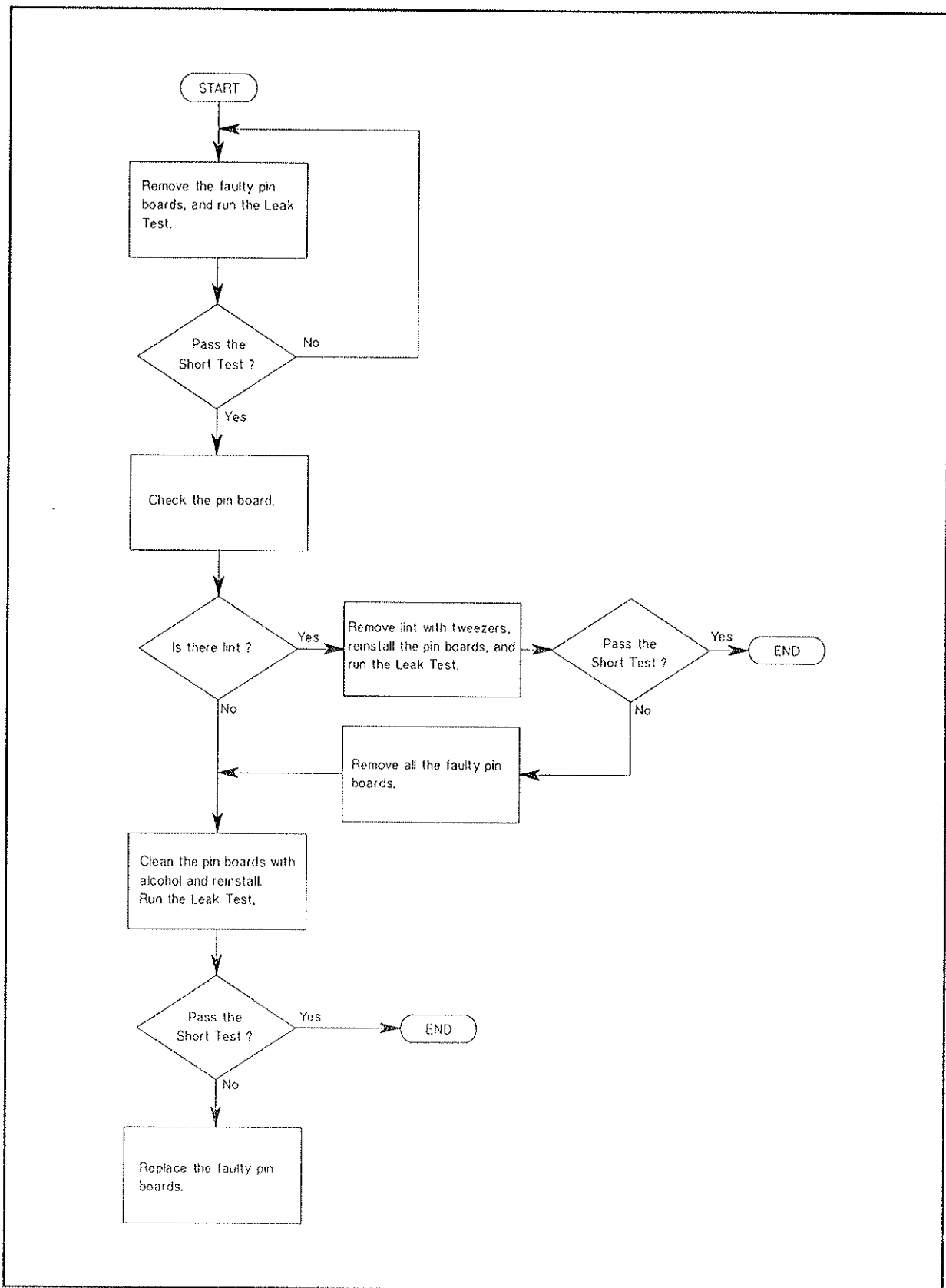


Figure 3-11. DC Leak Test—Short Test Troubleshooting

Removing Rack Mounted Instruments

To remove the SWC, DCS, or CMU/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.

■ For SWC:

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 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.

■ For DCS, CMU, and CMU84:

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.

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 3-2.

Table 3-2. 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 DCS, CMU, or CMU84 is listed as Not Present, troubleshoot the instrument. Refer to the <i>Service Manual</i> of that instrument for details. ■ If the 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 DCS <i>Service Manual</i> .
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 and run START again. If the same thing occurs at the new location of the pin board, replace and troubleshoot the faulty 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 SWC front panel.
- By sending the TS remote program code to the 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 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 3-12 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 Model 310, 318M, 319C+, 320, 330, 332, 340, 345, 350, 360, 370, or 375

Language: HP BASIC or BASIC/UX

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
```

Figure 3-12. Sample Program to Remotely Initiate the Relay Test (1 of 2)

Description:

Line 10 initiates the Relay Test by sending the TS remote code. This is equivalent to pressing the LOCAL/TEST key on the 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\$.

Print Out:

FLxxPCyyKzz

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 3-3 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:

FL33PCxxK20	The poor contact between contact pad and contact pin of the guard of the number xx may cause this error. Check the corresponding contact.
FL34PCxxK21	The poor contact between contact pad and contact pin of the sense of the number xx may cause this error. Check the corresponding contact.
FL36PCxxK21	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	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

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

The poor contact between contact pad and contact pin of the force of Test ADC Board may cause this error. Check the corresponding contact.

Table 3-3. 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 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 SWC.
08	PV(DIAG) ERROR 11 SWITCHING MATRIX CONTROLLER not functioning properly. SEND/RECEIVE timing circuit faulty. Replace the MPU board of the 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 3-3. 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 3-3. 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

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 E. To measure the resistance between two points, the pin assignments of the SMU link board are shown.

Possible Causes of Input Relay Failures

Figure 3-12a shows a simplified test circuit of the Input Relay Test.

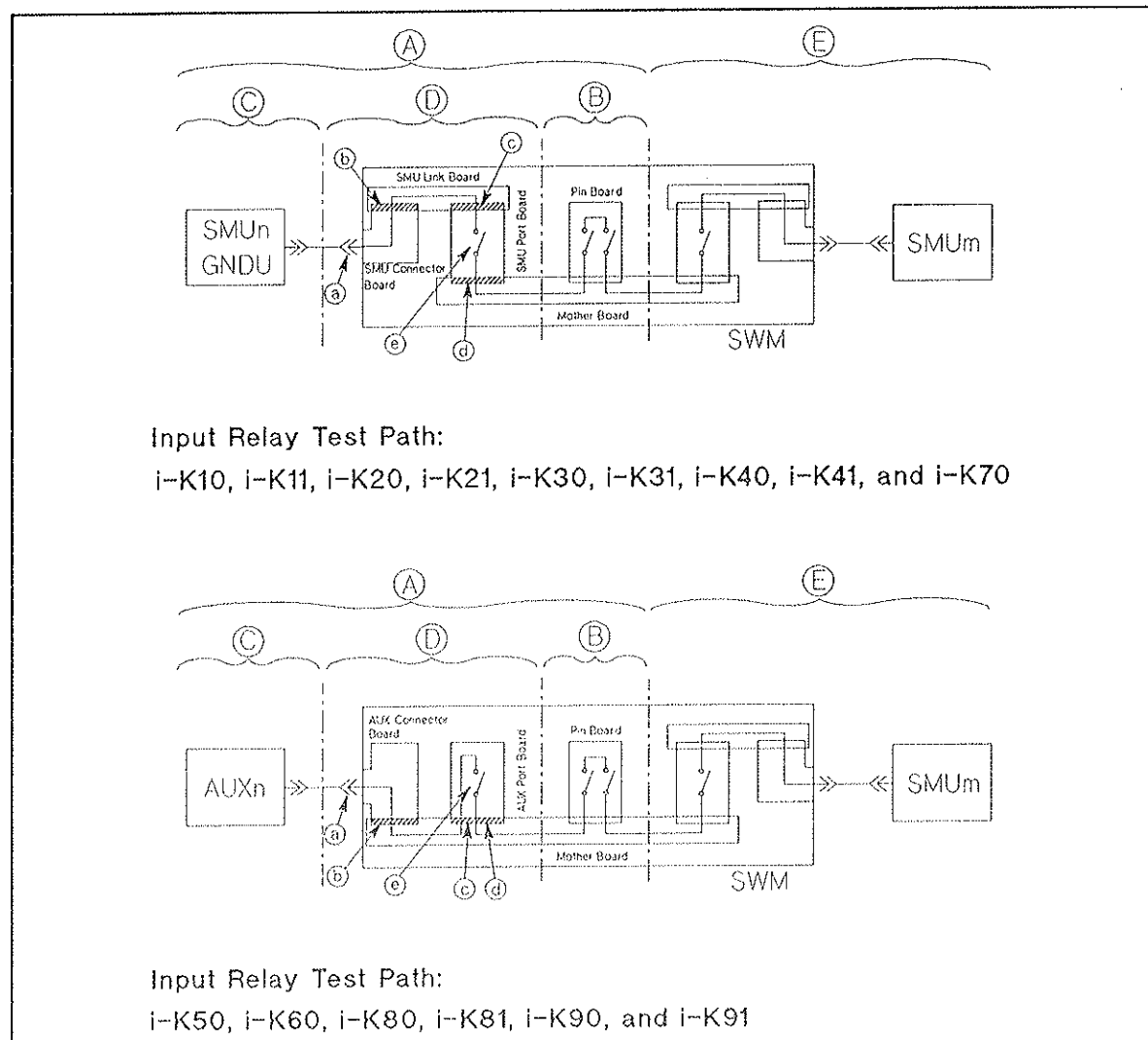


Figure 3-12a. Simplified Test Circuit of Input Relay Test

When a problem lies somewhere on the test path, the Input Relay Test results may show a failed input relay ⑥. 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, ④ or ⑤, 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 ④, ⑤, or ⑥.

2. Does the problem exist in area ④?

To check whether or not the problem exists in area ④, 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 ⑤?

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 connector. The interconnection cable may be snapping. Check the conductor of the interconnection cable.

4. Does the problem exist in area ⑥?

- a. Check the connection or contact resistance at point ③.
- b. Check the contact ③ between the SMU link board and the SMU port board.
- c. Check the contact ⑥ between the SMU link board and the SMU connector board.
- d. Check the contact ④ between the SMU port board and the mother board.
- e. Check the contact ③ between the AUX port board and the mother board.
- f. Check the contact ⑥ 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 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 E, can help you find the cause of the problem on the test path. See Appendix E on how to fill in the check sheet.

For example, Figure 3-12b 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 Troubleshooting: BLOCK ____

Failed Relay and Side	i-K <u>21</u>	i-K <u>31</u> <i>force</i>	i-K ____	i-K ____	i-K ____	i-K ____
Pin Board <u>4</u>	✓	✓				
Pin Board <u>8</u>		✓				
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 3-12b. 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 3-12c shows how to access the SMU link board and Table 3-3a lists the pin assignment of the SMU link board.

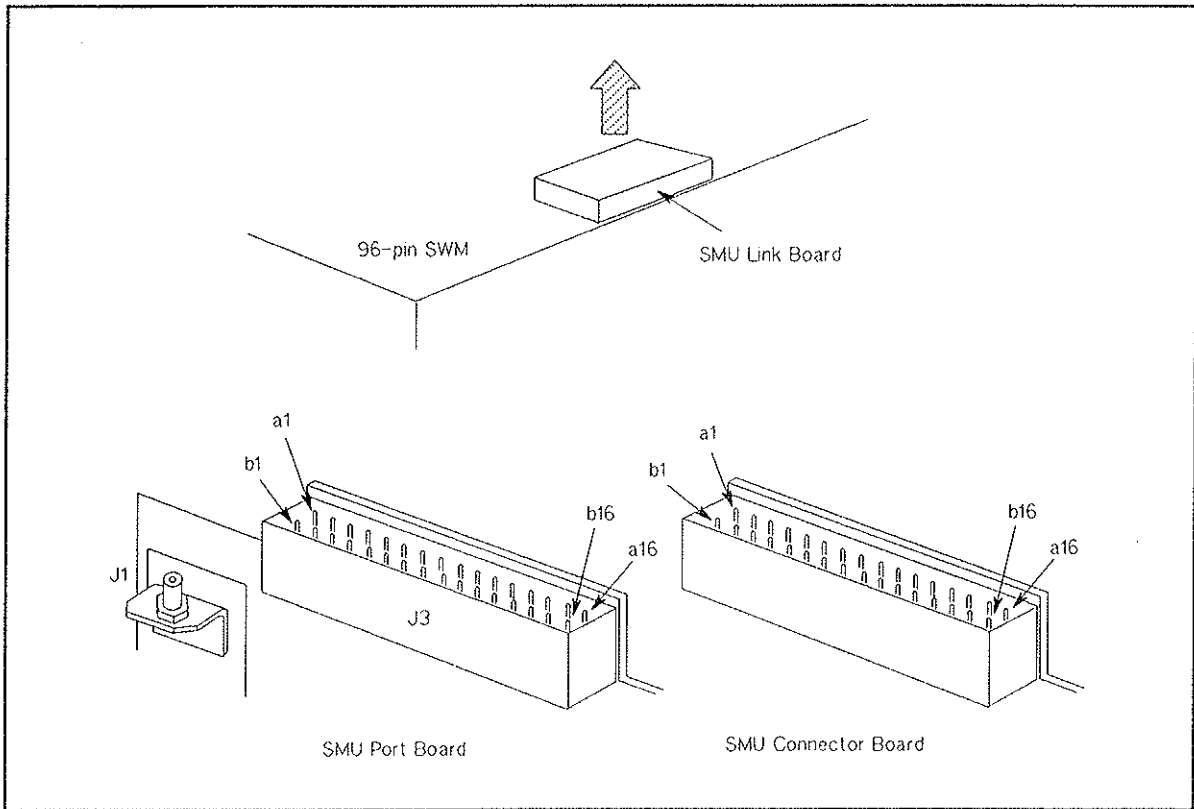


Figure 3-12c. Accessing the SMU Link Board

Table 3-3a. 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 3-13 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:

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" 
```

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" 
```

6. Start the BASIC editor for searching Veri_matrix as follows:

```
EDIT Veri_matrix 
```

Modify the VERI program as shown in Figure 3-13.

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 4062UX system:

1. After logging in and starting BASIC/UX, change the current directory as follows:

```
MASS STORAGE IS "/usr/pcs/diag" 
```

2. Load the VERI program as follows:

```
LOAD "VERI" 
```

3. Store the VERI program as follows:

```
STORE "VERI_ORG" 
```

4. Start the BASIC editor for searching Veri_matrix as follows:

```
EDIT Veri_matrix 
```

Modify the VERI program as shown in Figure 3-13.

5. After modifying, store and backup the modified VERI program as follows:


```
RE-STORE "VERI"   
STORE "VERI_MDF" 
```

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"   
COPY "VERI_ORG" TO "VERI" 
```

```

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."
PAUSE
LOADSUB ALL FROM "VFP"

LOADSUB ALL FROM  "/usr/pcs/bin/VFP"

:
:
:
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
  !
  :
  :
  :
  :
  :
  :

```

For HP 4062C

For HP 4062UX

Figure 3-13. PV4062 Modifications to Allow Leak Test Monitoring (1 of 2)

```

:
:
:
IF First_pin THEN
  FOR Portno=1 TO 4
    IF FWPot(Pot(Portno))>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 FWinlogging THEN
        Trrlog_rem("VERI-SWH-SHORTLEAK2")
        IF Portno=1 THEN
          :
          :
          :
        END IF
      END IF
    END FOR
  END IF
END IF

```

PV4062 Modifications to Allow Leak Test Monitoring (2 of 2)

Troubleshooting the SWC

Accessing 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 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 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 3-14 shows the locations of the SWC assemblies.

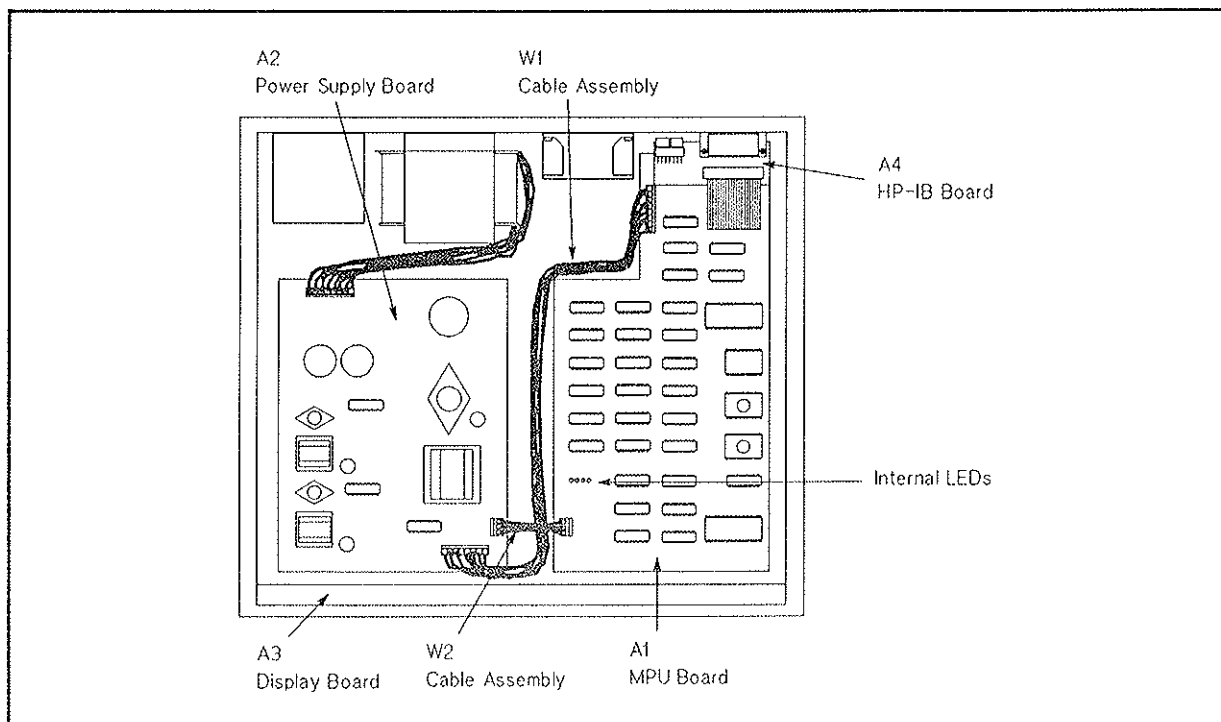


Figure 3-14. SWC Assembly Locations

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 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	IIP-IB control chip error or illegal IIP-IB address setting.
6	off	on	on	off	Momentary power loss occurred. SWC is normal.
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.

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 3-15 shows the locations of the assemblies in the HP 4085B 48-pin SWM. See Chapter 4 for the HP part numbers of each assembly.

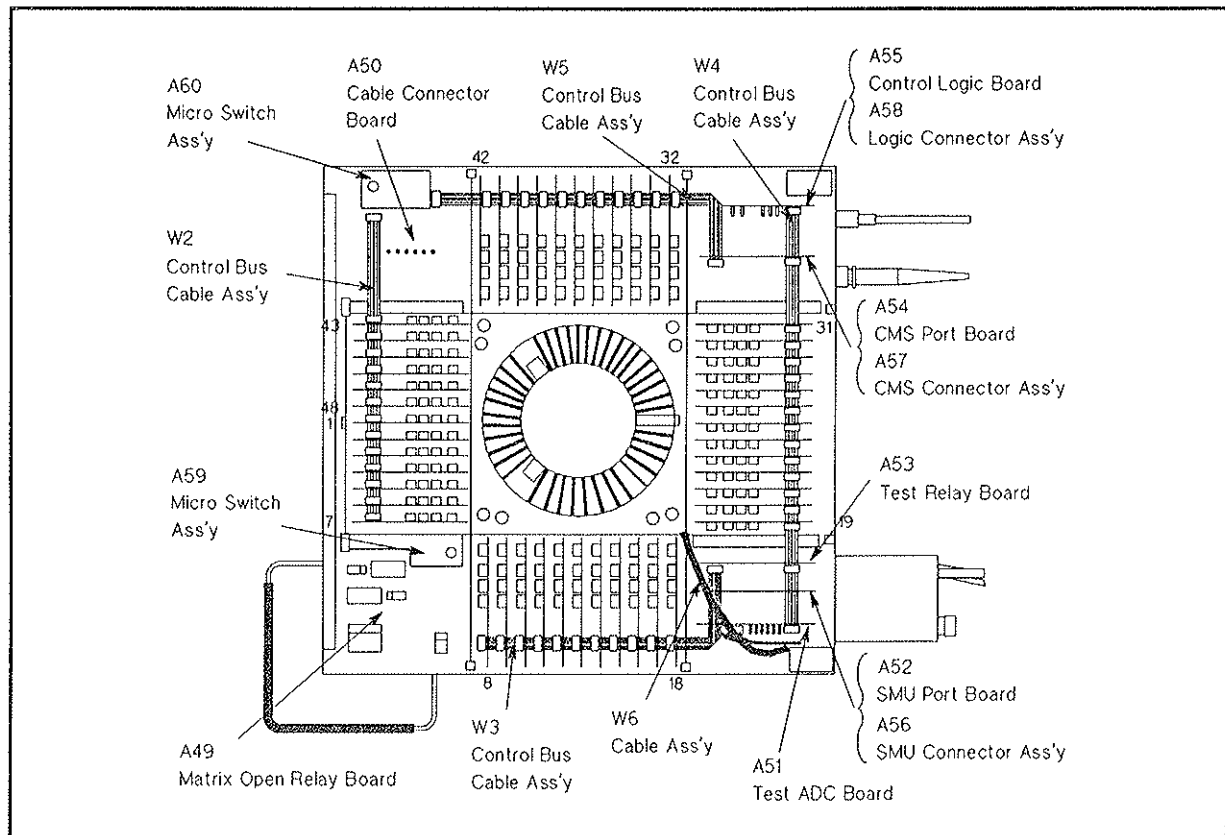


Figure 3-15. Assembly Locations in the HP 4085B 48-pin SWM

Figure 3-16 shows the locations of the assemblies in the HP 4089A 96-pin SWM. See Chapter 4 for the HP part numbers of each assembly.

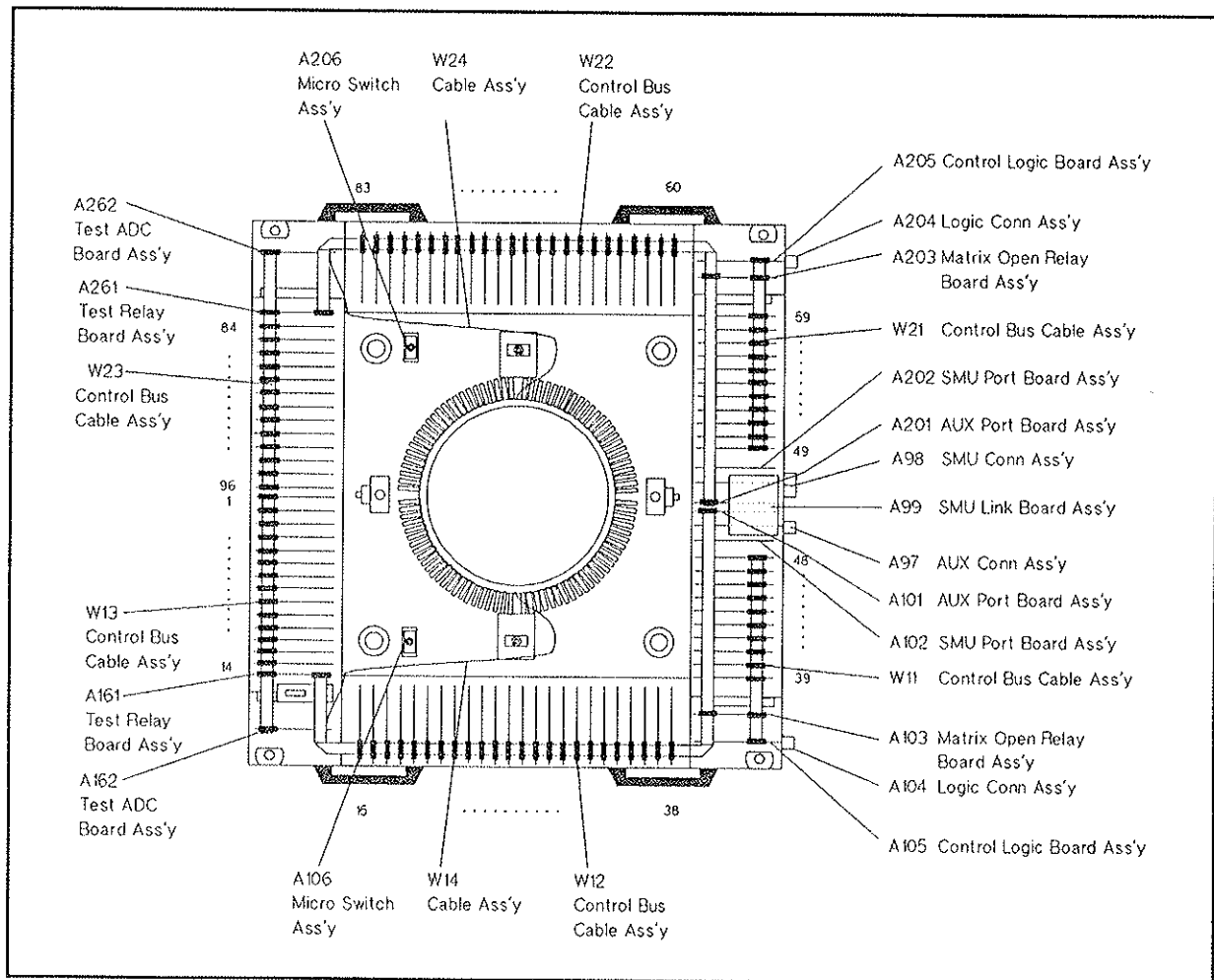


Figure 3-16. Assembly Locations in the HP 4089A 96-pin SWM

Removing Pin Boards

To remove pin boards from the SWM, use the following procedure:

1. Remove the bottom panel of the SWM (see Figure 3-17).

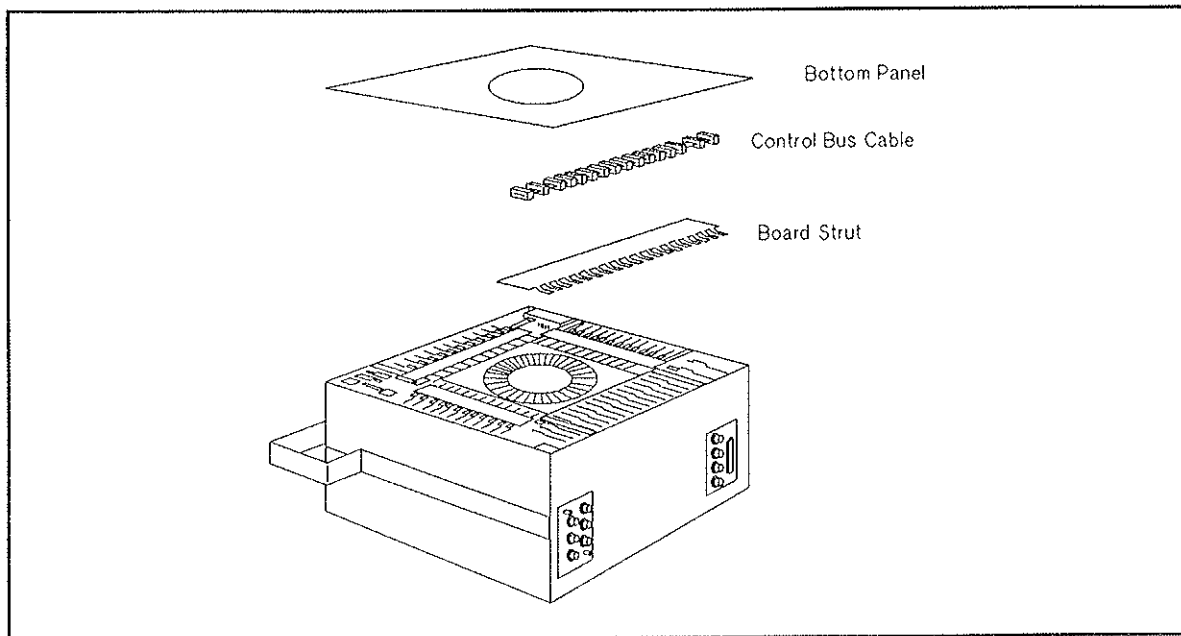


Figure 3-17. Removing the Bottom Panel of the SWM

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



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 3-18. Be careful not to let the removed measurement pin assemblies touch any other contact pins.

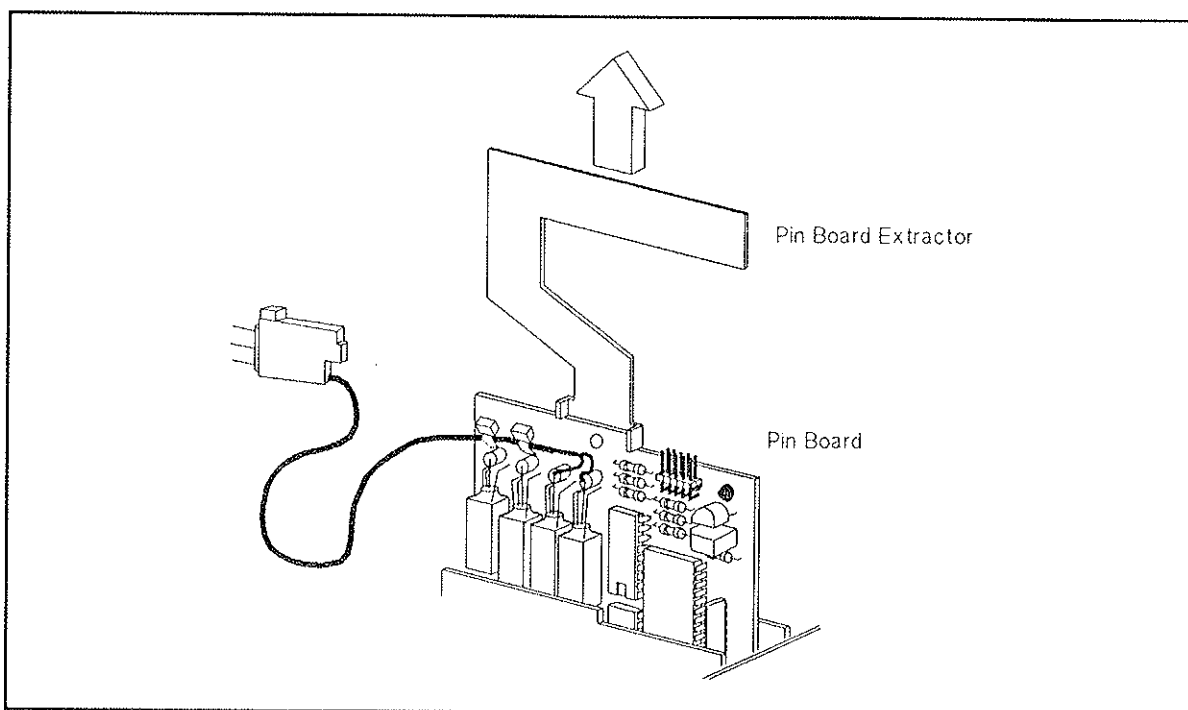


Figure 3-18. Removing Pin Boards

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 3-19.

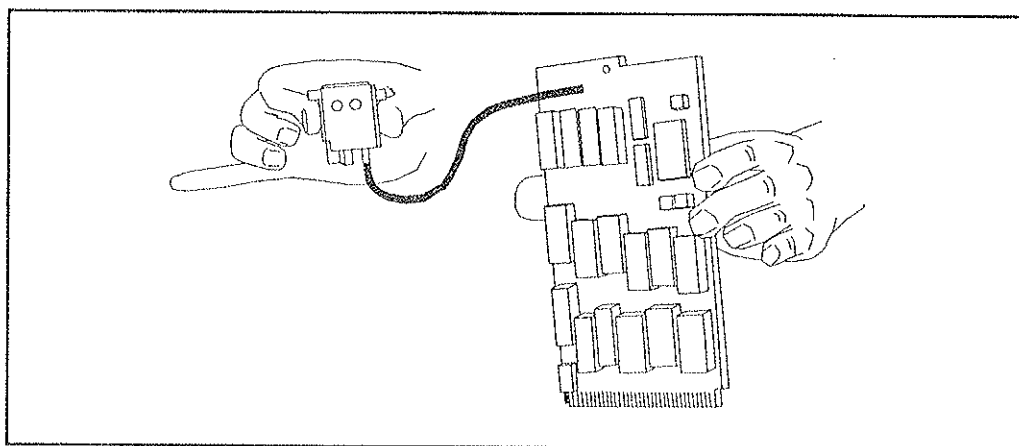


Figure 3-19. Handling Pin Boards

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 3-20:

1. Remove the bottom panel of the 48-pin SWM (see Figure 3-17).
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.

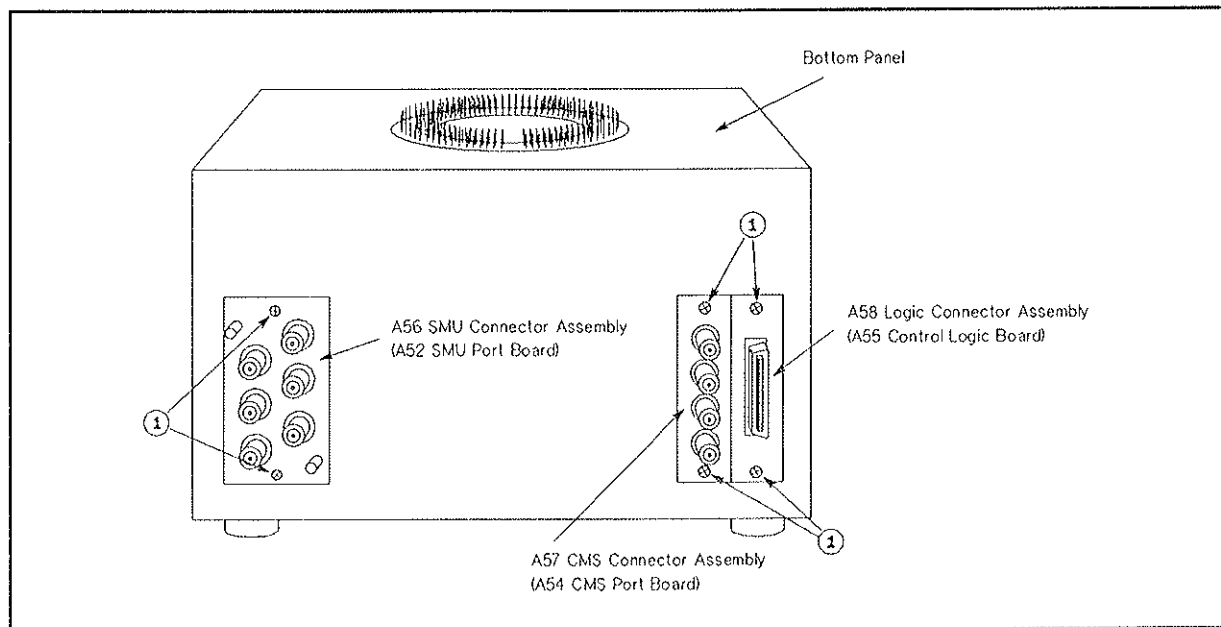


Figure 3-20. Removing Interface Boards of the HP 4085B 48-pin SWM

Removing Interface Boards from HP 4089A 96-pin SWM

To remove the 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 3-21:

Assembly

Link Board
SMU Port Board
AUX Port Board

Procedure

1. Remove the bottom panel of the 96-pin SWM.
2. Remove the 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.

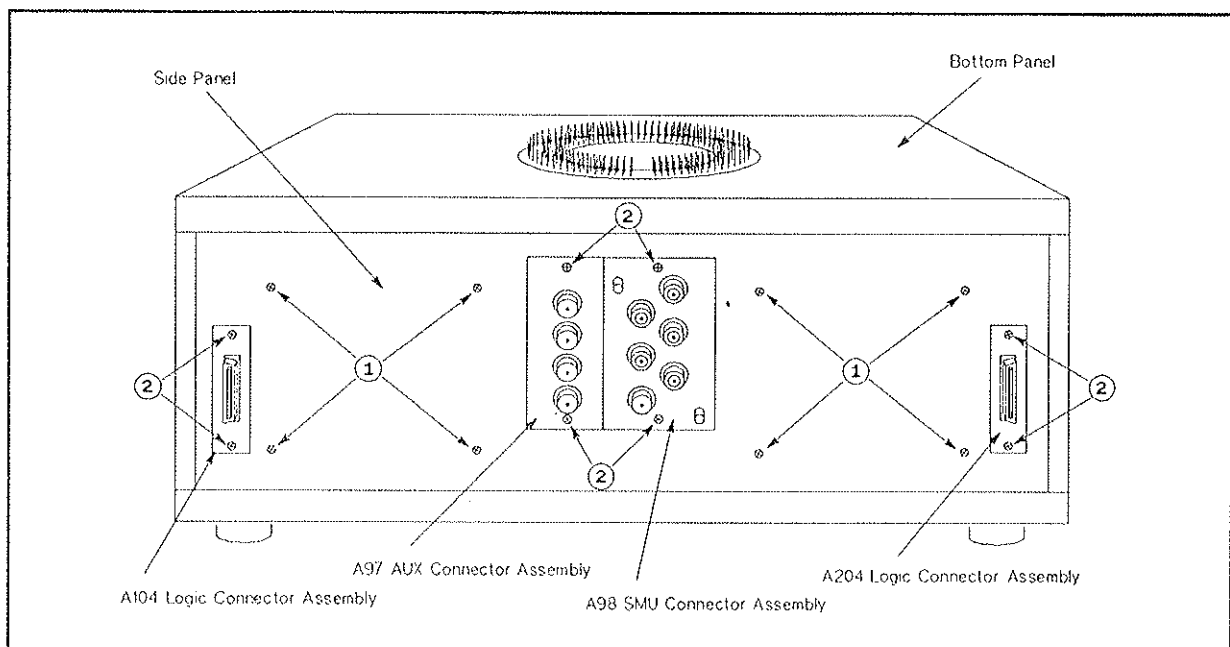


Figure 3-21. Removing Interface Boards of HP 4089A 96-pin SWM

Troubleshooting Pin Boards and Interface Boards

Part Locations of Pin Board and Interface Boards

Pin Board

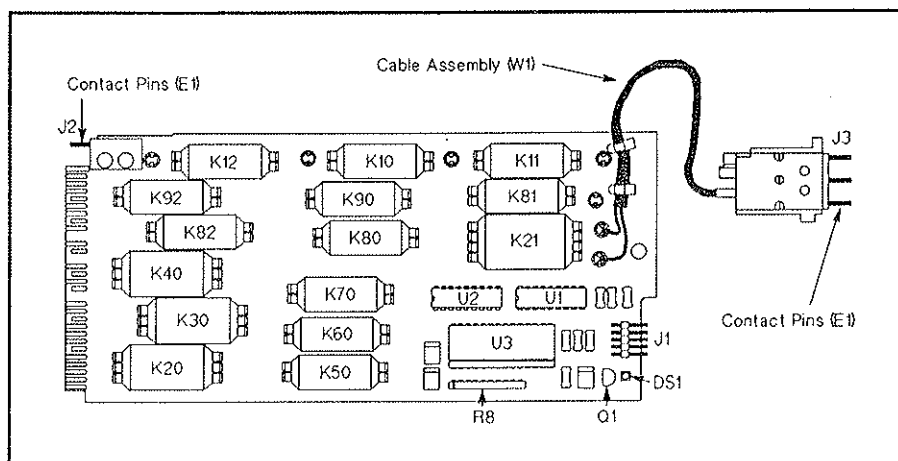


Figure 3-22. Part Locations of Pin Board

SMU Port Board

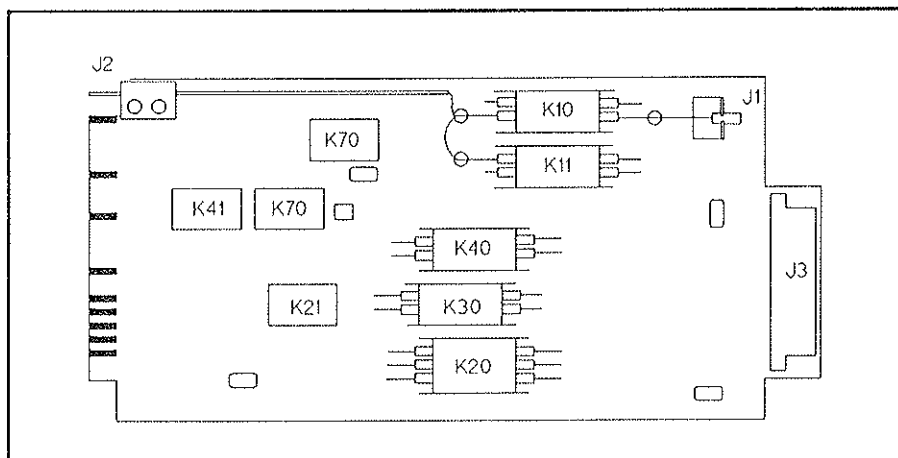


Figure 3-23. Part Locations of SMU Port Board—96-pin SWM

AUX Port Board

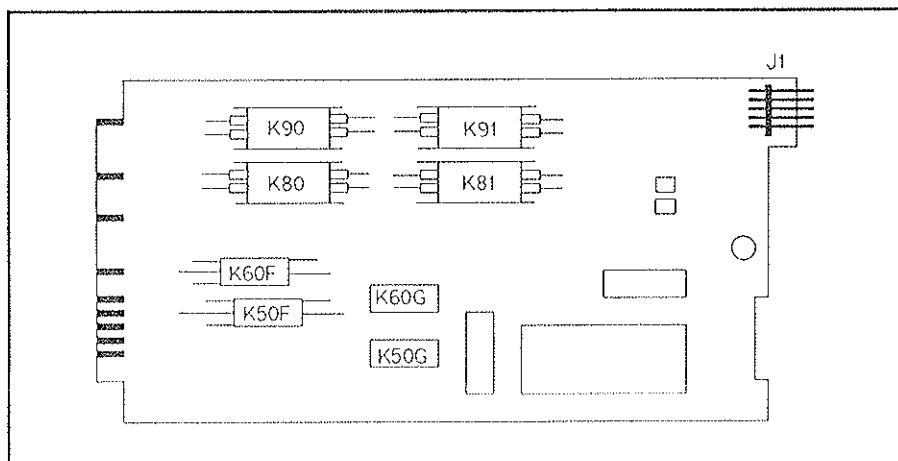


Figure 3-24. Part Locations of AUX Port Board—96-pin SWM

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 3-25. 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.

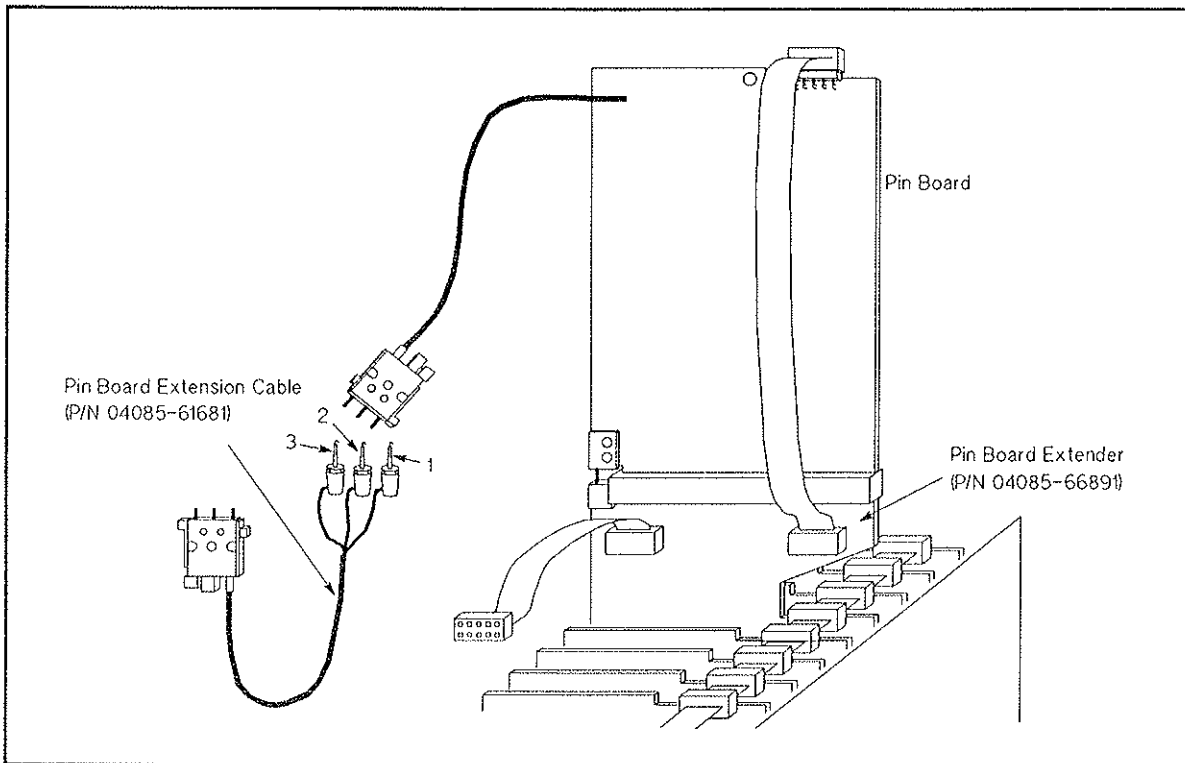


Figure 3-25. Extending Pin Boards

3. Load and run the VFP program. To do so, use the following procedure:

- For IIP 4062C and HP BASIC based on flexible disks:

- a. Turn your system instruments on.
- b. Turn the system controller on and boot the HP BASIC 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 IIP 4062C and HP BASIC based on LIF formatted hard disk:

- a. Turn your system instruments on.
- b. Turn the system controller on and boot the HP BASIC 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"   
RUN 
```

- e. If needed, use the MSI statement to change to the mass storage device in which the VFPprogram is located.

- f. Load and run the VFP program as follows:

```
LOAD "VFP"   
RUN 
```

- For an HP 4062C and HP BASIC based on HFS formatted hard disk:

- Turn your system instruments on.
- Turn the system controller on and boot the HP BASIC system from the hard disk.
- Use the MSI statement to change to the directory in which the START program is located. For example, type as follows:

```
MSI "/PCS/BIN" 
```

- d. Load and run the START program as follows:

```
LOAD "START"   
RUN 
```

- e. If needed, use the MSI statement to change to the directory in which the VFPprogram is located.

- f. Load and run the VFP program as follows:

```
LOAD "VFP"   
RUN 
```

- For HP 4062UX and BASIC/UX:

- Turn your system instruments on.
- Turn the system controller on and boot the HP-UX system.
- Start the BASIC/UX environment as follows:

```
$ rmb 
```

- d. Load and run the START program as follows:

```
LOAD "/usr/pcs/bin/START"   
RUN 
```

- 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"   
RUN 
```

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 3-26).
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	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++
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	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++

@ = MAKE

User 1 Caps Command

MAKE BREAK CLEAR ALL

Figure 3-26. 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 3-27). 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	+	+	+	+	+	+	+	+	+	⓪	⓪	⓪	⓪	⓪
BLOCK 2	+	+	+	+	+	+	+	+	+	⓪	⓪	⓪	⓪	⓪
	⓪ : 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.

MAKE BREAK CLEAR User 1 Caps Command
ALL

Figure 3-27. VFP Control Page 4—Input Relay Assignments

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 3-28 shows an example of a lint bridge.

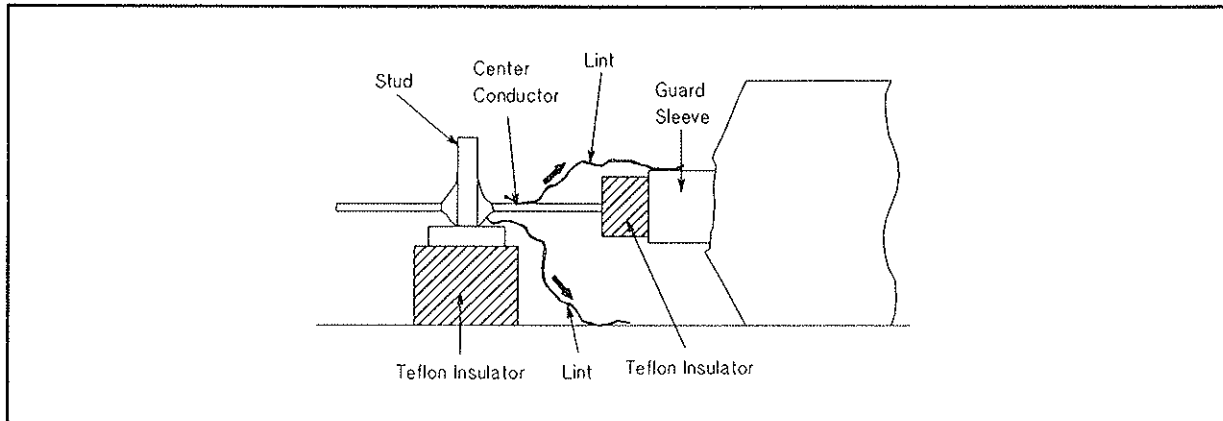


Figure 3-28. Example Pin Board “Lint Bridge”

If the system fails the Open Test (DC Leak subtest), refer to Figure 3-29 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.

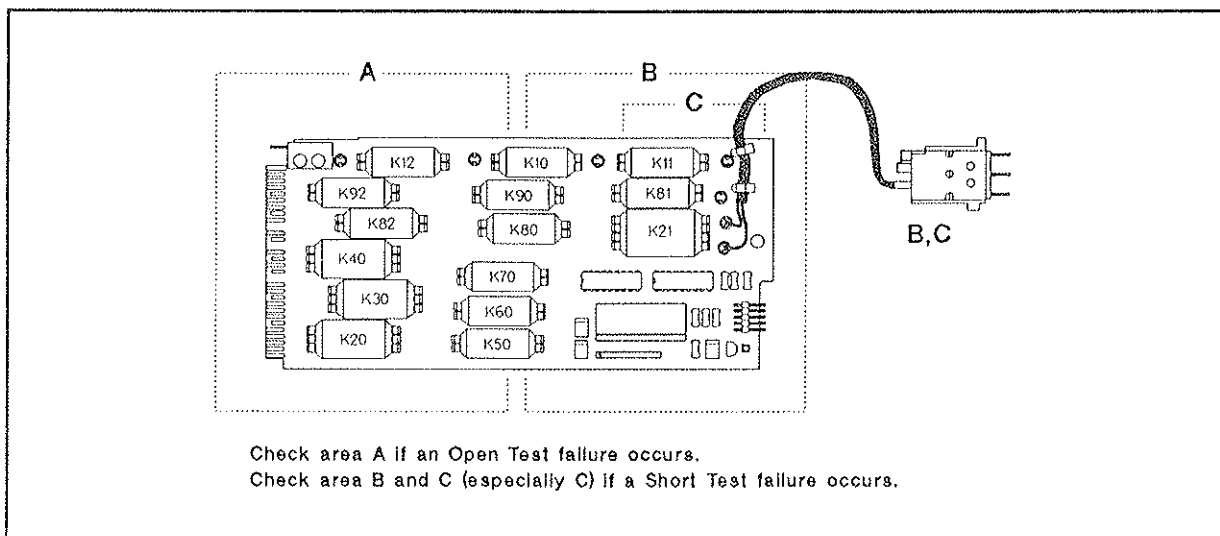


Figure 3-29. Pin Board Areas to Check for “Lint Bridges”

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 3-17.

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 3-18.

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 3-19.

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 3-19).
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 3-30.

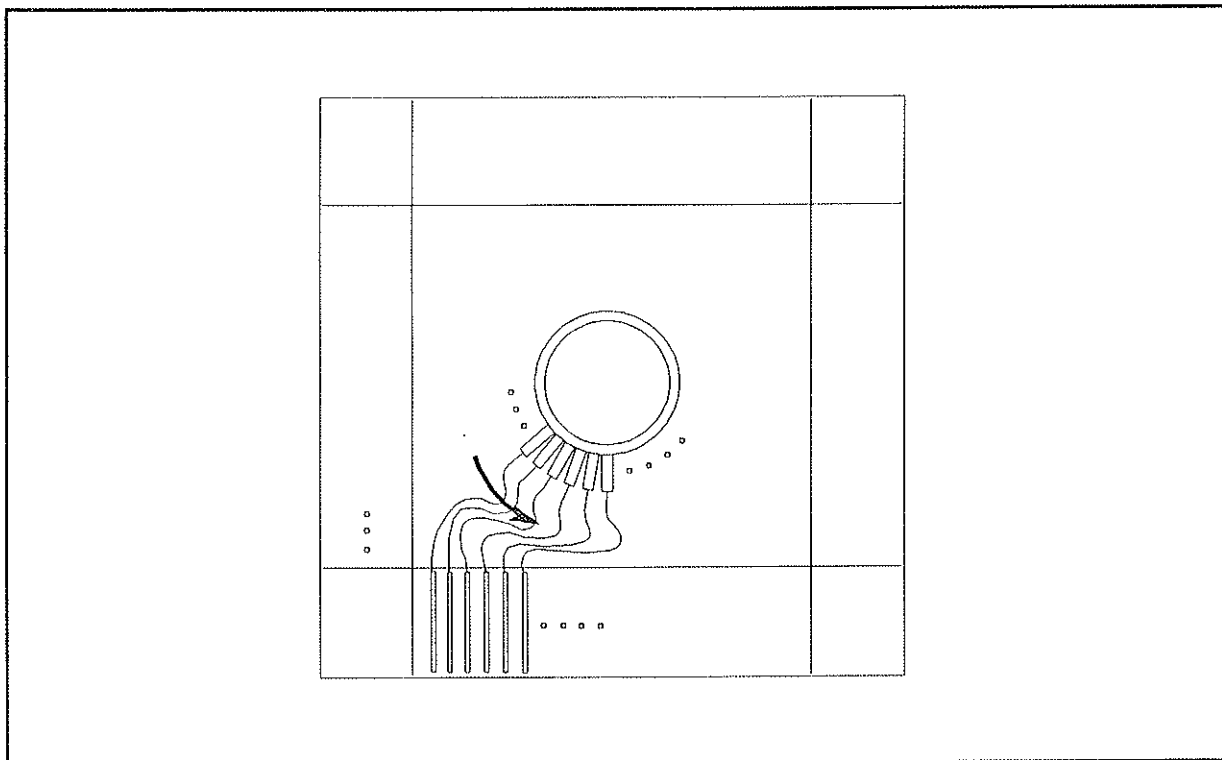


Figure 3-30. Positioning the Cables in the SWM

Troubleshooting the CMU

Required 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 CMU84

To troubleshoot the 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 ($\perp$) 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 connectors open as shown in Figure 3-31, and select **MEAS OPEN** softkey. The OPEN correction starts immediately.

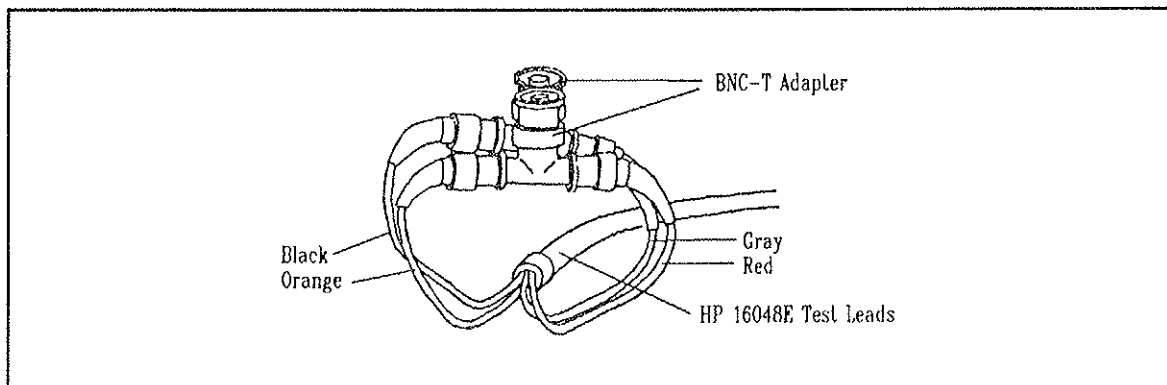


Figure 3-31. Test Leads Connections for OPEN Correction

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 3-32, and select **MEAS SHORT** softkey. The SHORT correction starts immediately.

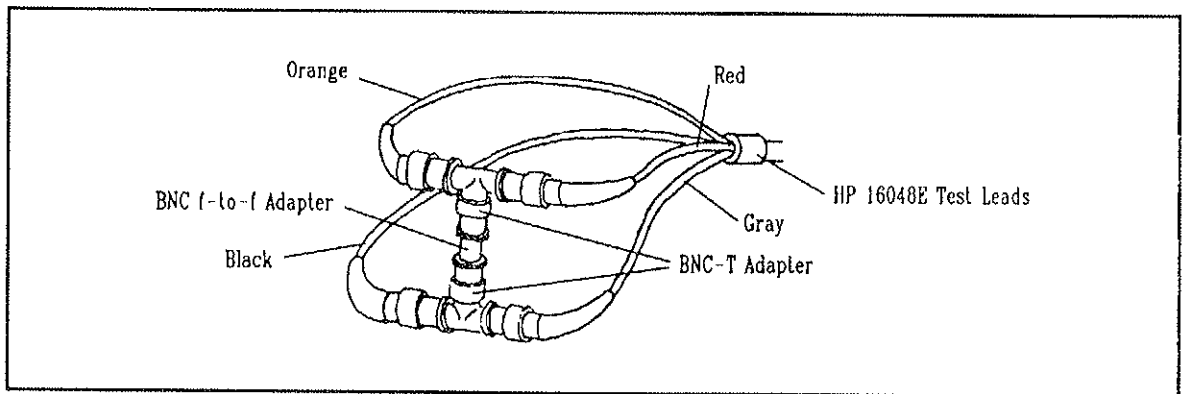


Figure 3-32. Test Leads Connections for SHORT Correction

Troubleshooting the DCS

To troubleshoot the DCS, refer to the HP 4142B *Service Manual*.

Warning



When removing the power supply unit from the DCS, perform the following procedure:

1. Turn off the power to the DCS.
2. Loosen the four screws ① from the flanges that secure the power supply unit to the DCS as shown in Figure 3-33.
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.

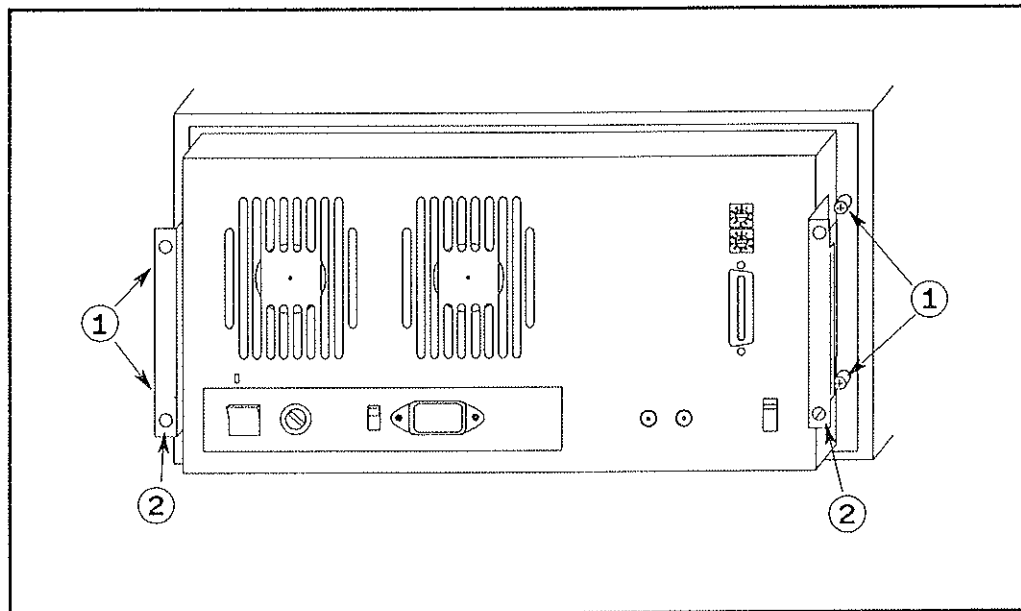


Figure 3-33. Removing the Power Supply Unit from the DCS

Replaceable Parts

Introduction

This chapter contains information for ordering parts. Tables 4-3 through 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. Addresses and phone numbers are located at the back of this manual.

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.

SWC Replaceable Parts

Table 4-3 and Table 4-4 list the replaceable parts of the 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.

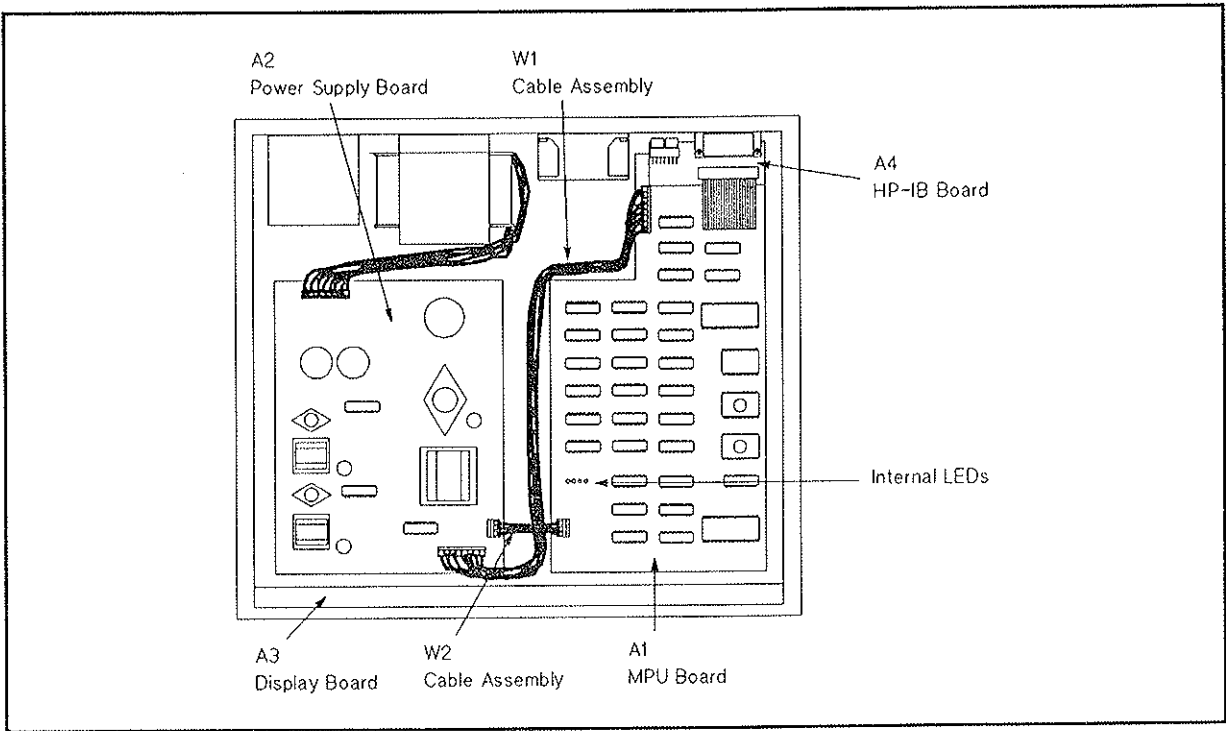


Figure 4-1. SWC Assembly Locations

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)

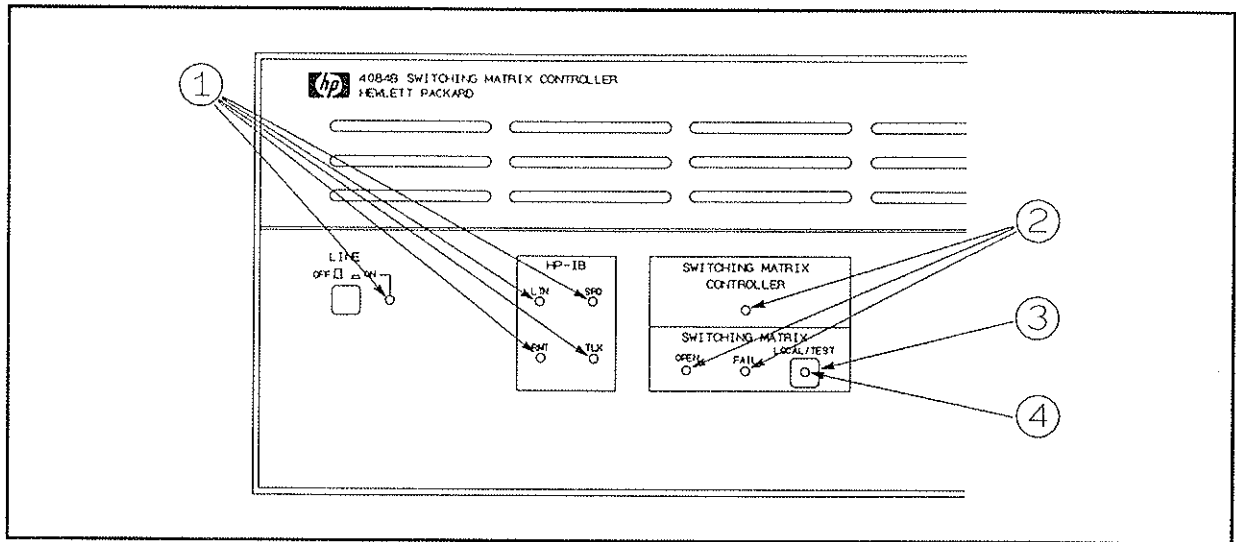


Figure 4-2. SWC Front Panel Part Locations

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

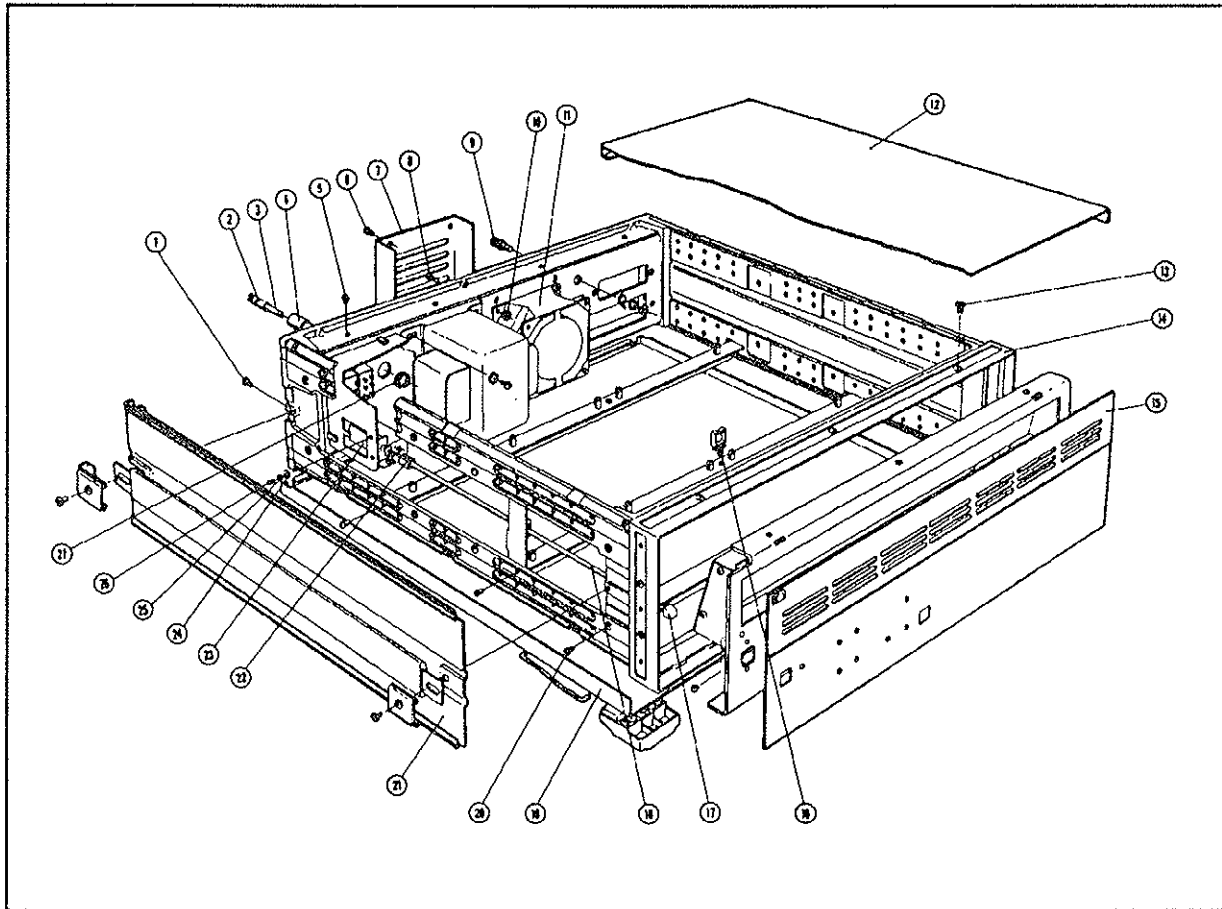


Figure 4-3. SWC Major Mechanical Parts

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

48-pin SWM Replaceable Parts

Table 4-6 and Table 4-7 list the replaceable parts for the 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.

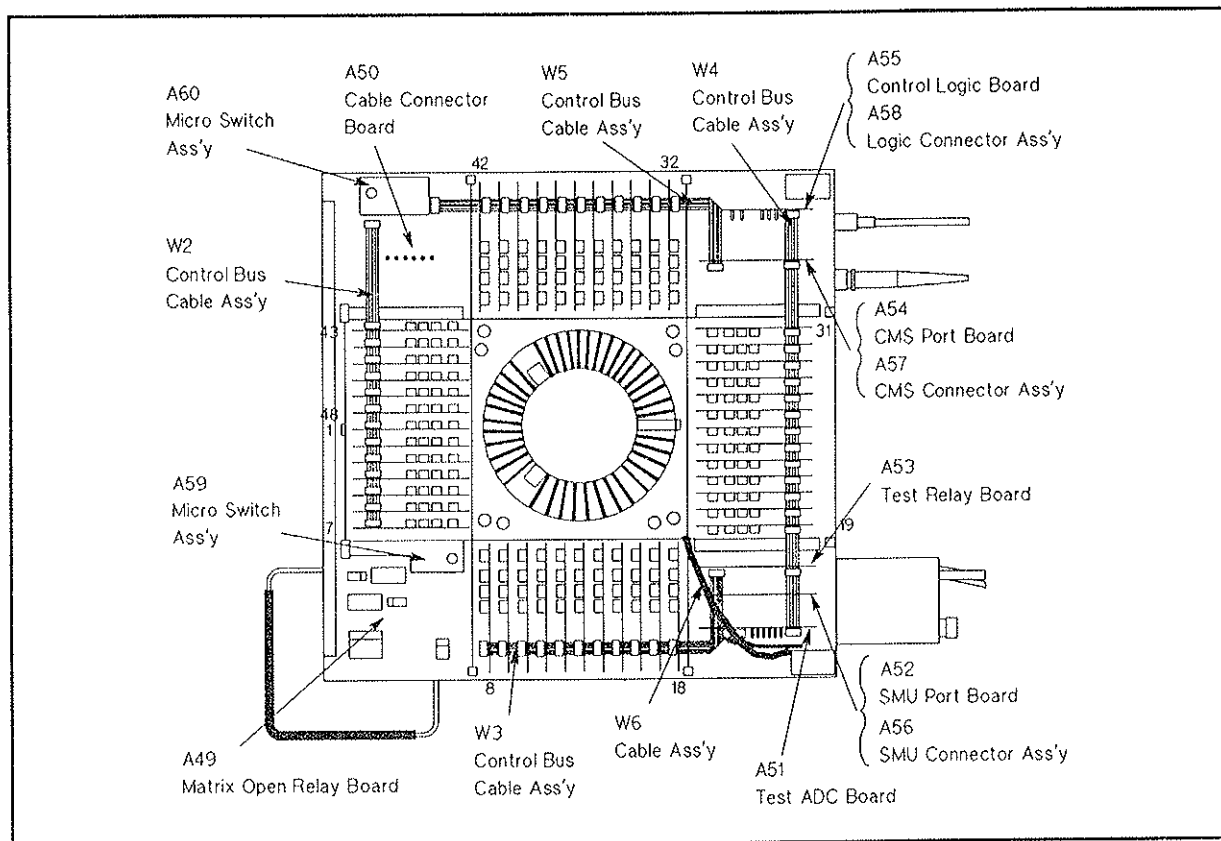


Figure 4-4. Assembly Locations in the HP 4085B 48-pin SWM

Table 4-6. 48-pin SWM Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
A1 – A48	16320-66521	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	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

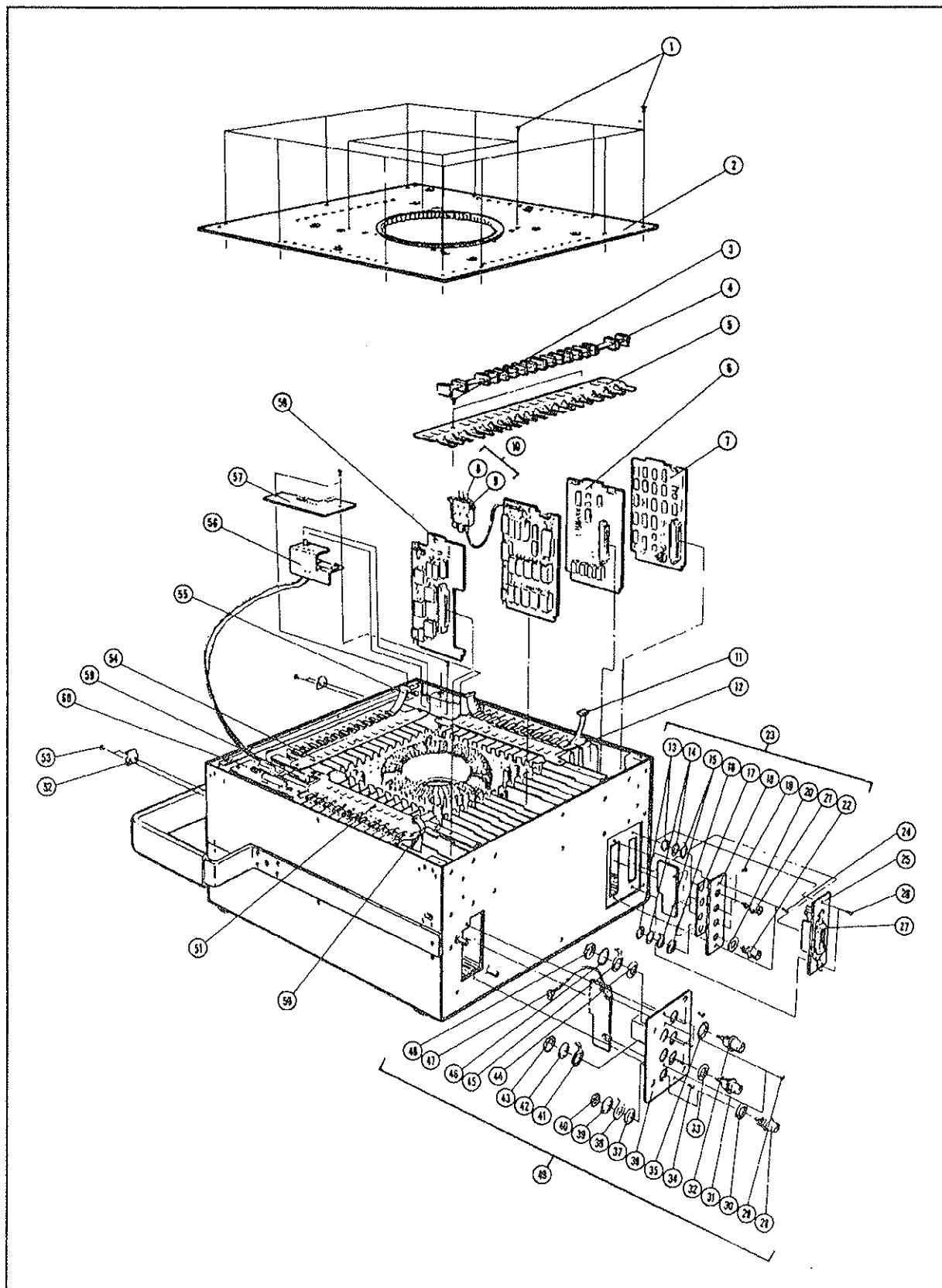


Figure 4-5. 48-pin SWM Major Mechanical Parts

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	TEST RELAY BOARD
8	0360-2066	3	CONTACT
9	16320-61601	1	CABLE ASSY (Including CONTACTS)
10	16320-66521	48(STD)	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

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)

96-pin SWM Replaceable Parts

Table 4-8 and Table 4-9 list the replaceable parts for the 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.

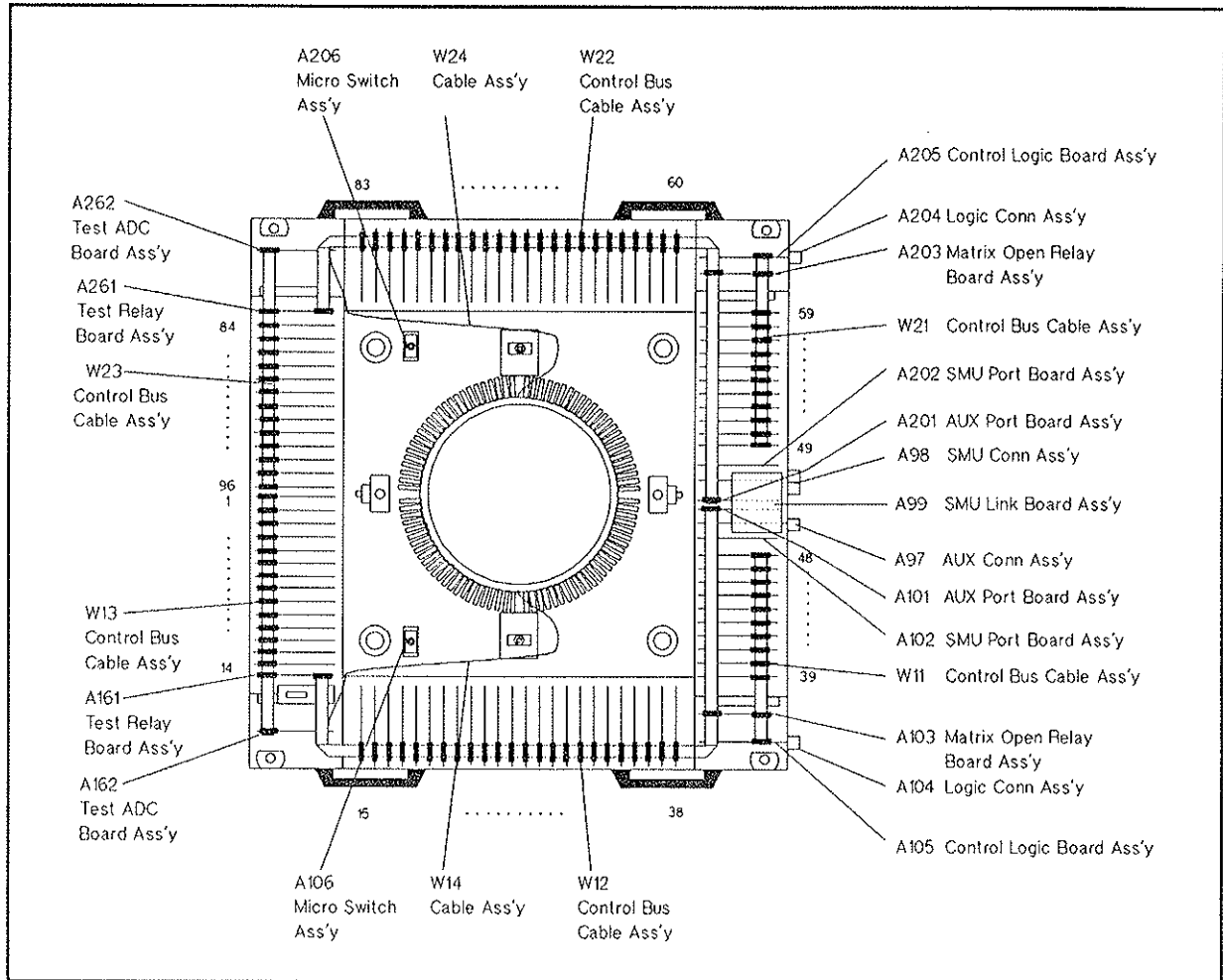


Figure 4-6. Assembly Locations in the HP 4089A 96-pin SWM

Table 4-8. 96-pin SWM Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
A1 – A96	16320-66531	96	PIN BOARD
A97	04089-66513	1	AUX CONN ASSY
A98	04089-66510	1	SMU CONN ASSY
A99	04089-66503	1	LINK BOARD ASSY
A101, A201	04089-66511	2	AUX PORT BOARD ASSY
A102, A202	04089-66508	2	SMU PORT BOARD ASSY
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	04085-66563	2	TEST RELAY BOARD ASSY
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
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

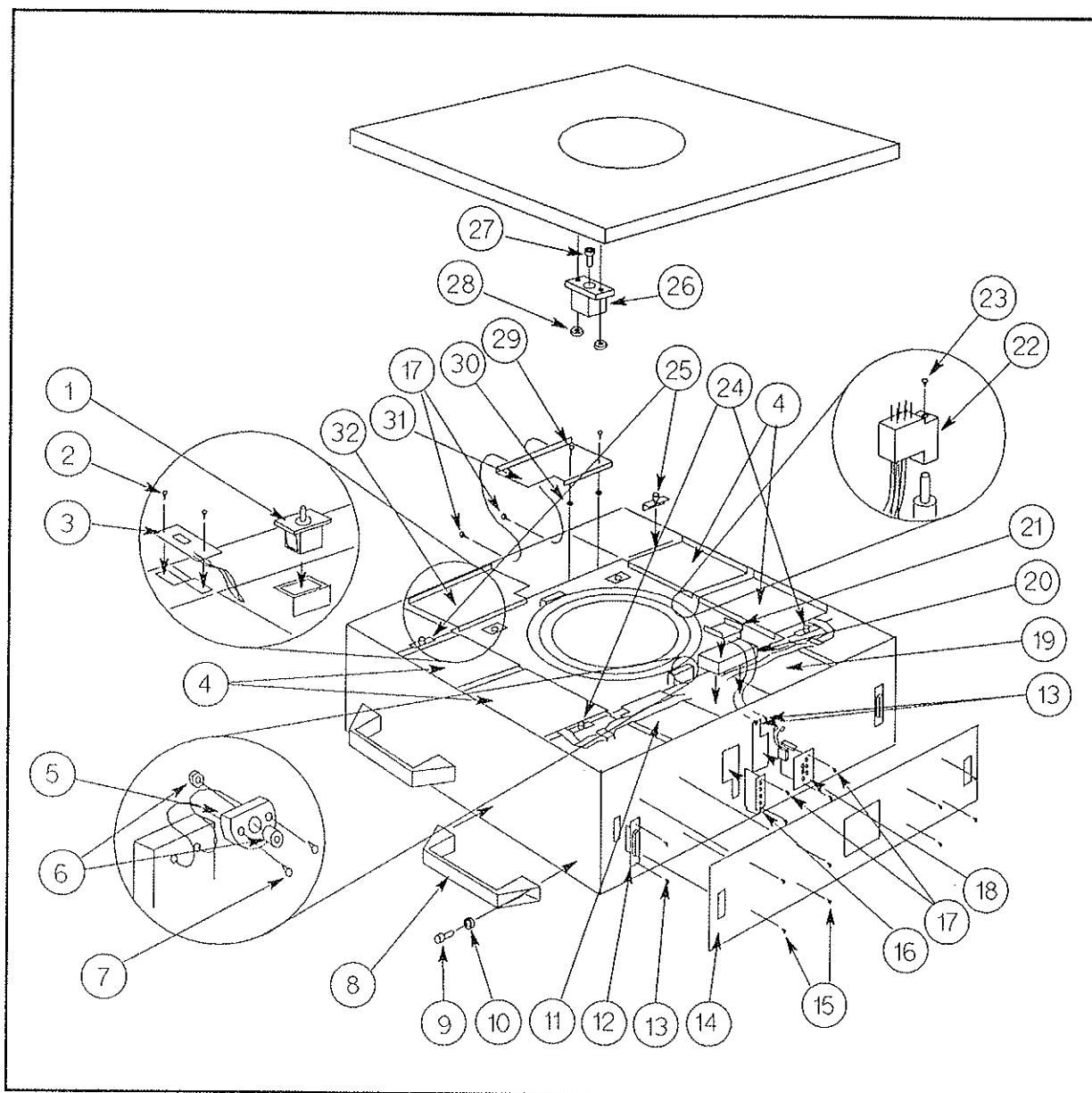


Figure 4-7. 96-pin SWM Major Mechanical Parts

Table 4-9. 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
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

Pin Board Replaceable Parts

Figure 4-8 shows the assembly locations of pin boards. Table 4-10 lists the replaceable parts for pin boards.

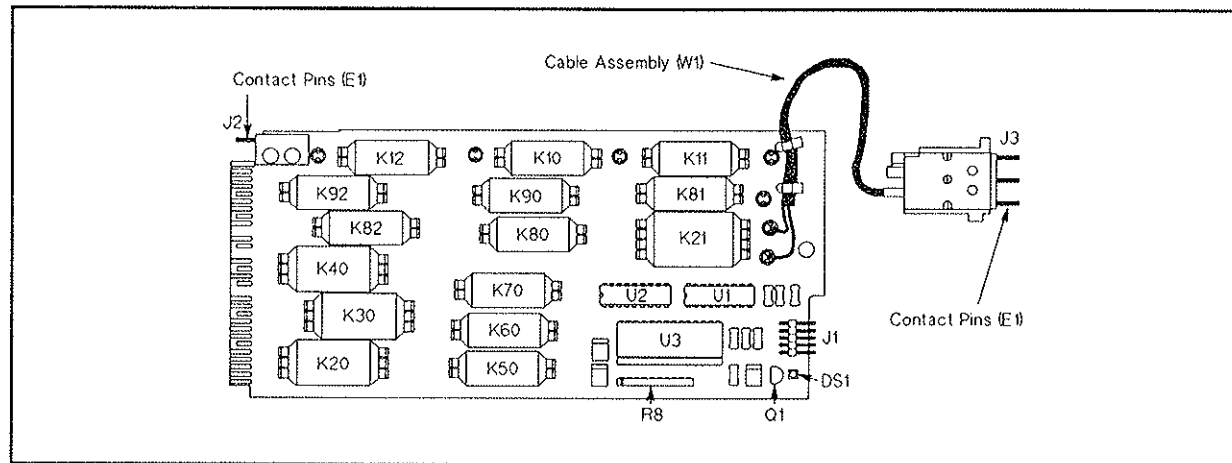


Figure 4-8. Part Locations of Pin Board

Table 4-10. Pin Board Replaceable Parts

Reference Designation	HP Part Number	Quantity	Description
E1	0360-2066	3	CONTACT
K10	0490-1629	1	RELAY—REED 2A
K11	0490-1633	1	RELAY—REED 1C
K12	0490-1633	1	RELAY—REED 1C
K20	0490-1630	1	RELAY—REED 3A
K21	0490-1632	1	RELAY—REED 2C
K30	0490-1630	1	RELAY—REED 3A
K40	0490-1630	1	RELAY—REED 3A
K50	0490-1629	1	RELAY—REED 2A
K60	0490-1629	1	RELAY—REED 2A
K70	0490-1629	1	RELAY—REED 2A
K80	0490-1629	1	RELAY—REED 2A
K81	0490-1633	1	RELAY—REED 1C
K82	0490-1633	1	RELAY—REED 1C
K90	0490-1629	1	RELAY—REED 2A
K92	0490-1633	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)

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.

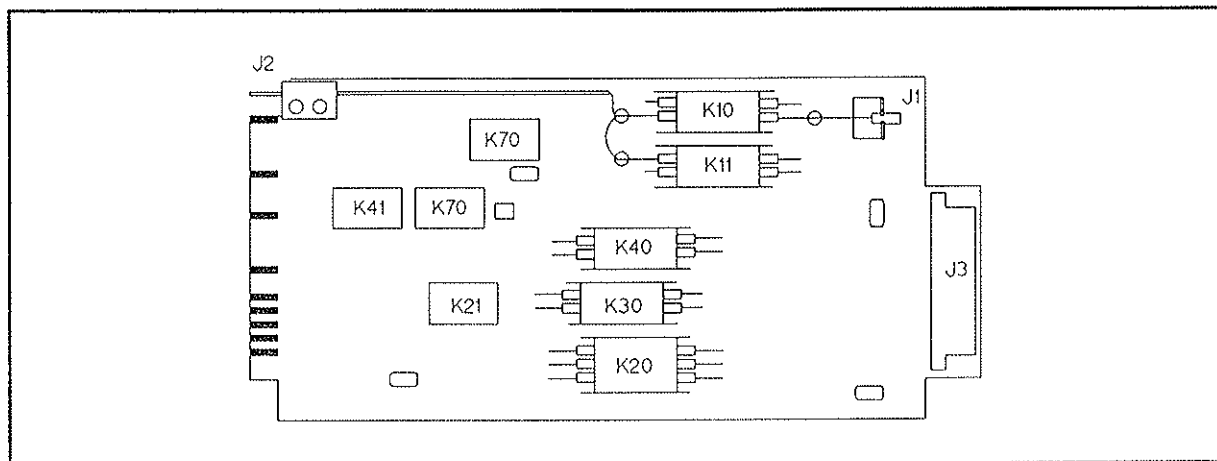


Figure 4-9. Part Locations of SMU Port Board—96-pin SWM

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

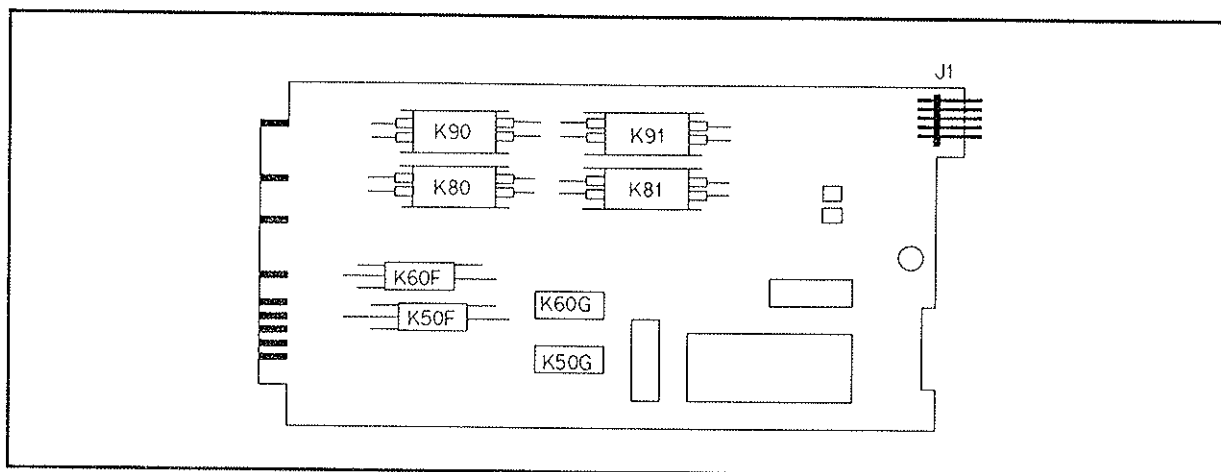


Figure 4-10. Part Locations of AUX Port Board—96-pin SWM

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).

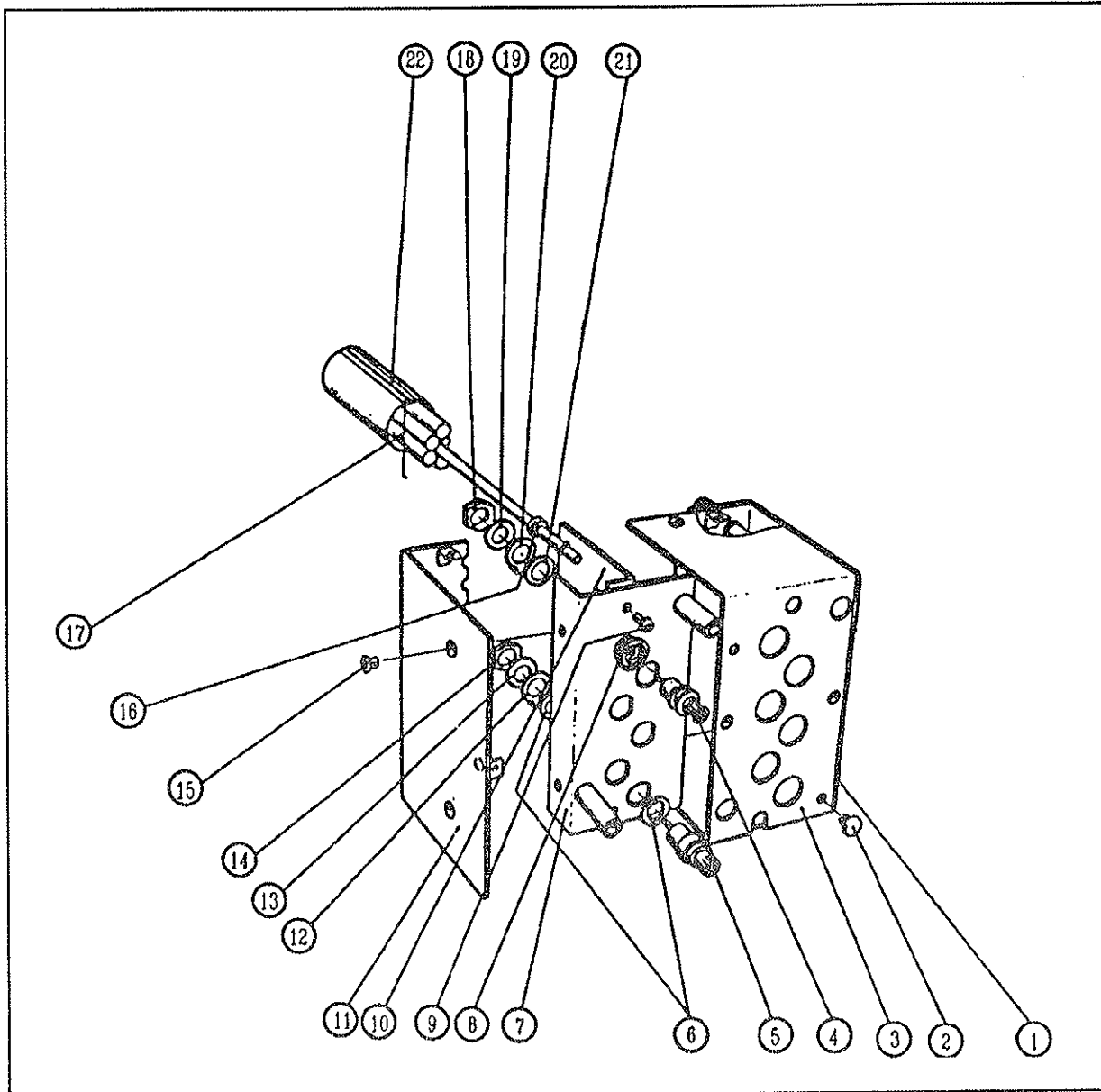
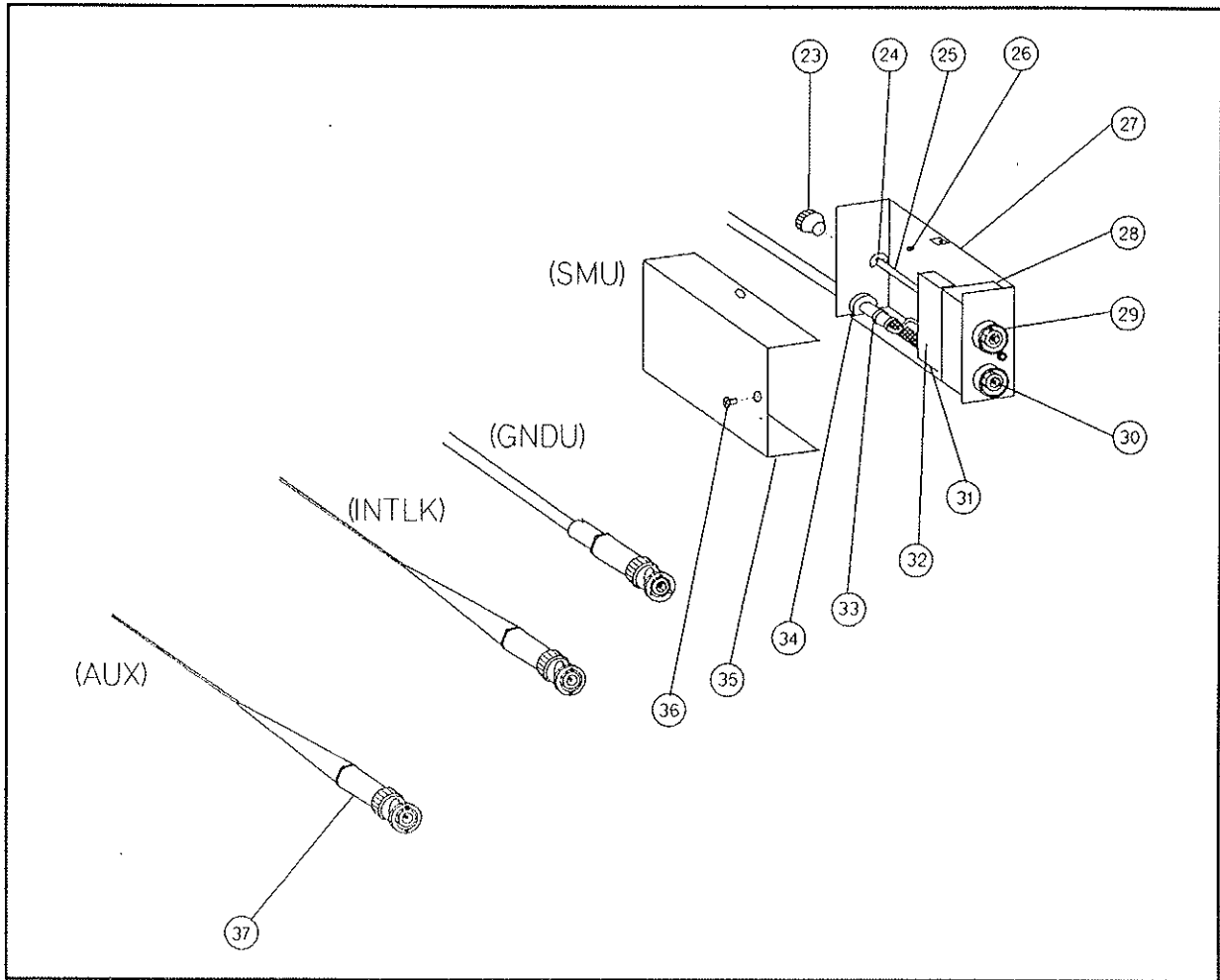


Figure 4-11. Interconnection Cable Assembly Locations (1 of 2)



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	TEST RELAY BOARD ASSY
27	04085-66564	1	CMS PORT BOARD ASSY
28	04085-66555	1	CONTROL LOGIC BOARD ASSY
29	16320-66521	1	PIN BOARD ASSY
30	04084-66531	1	MPU BOARD ASSY

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

System Cabinet Information

Introduction

This appendix contains general system cabinet information, including system cabinet description, identification information, and specifications. Figure A-1 shows the system cabinet.

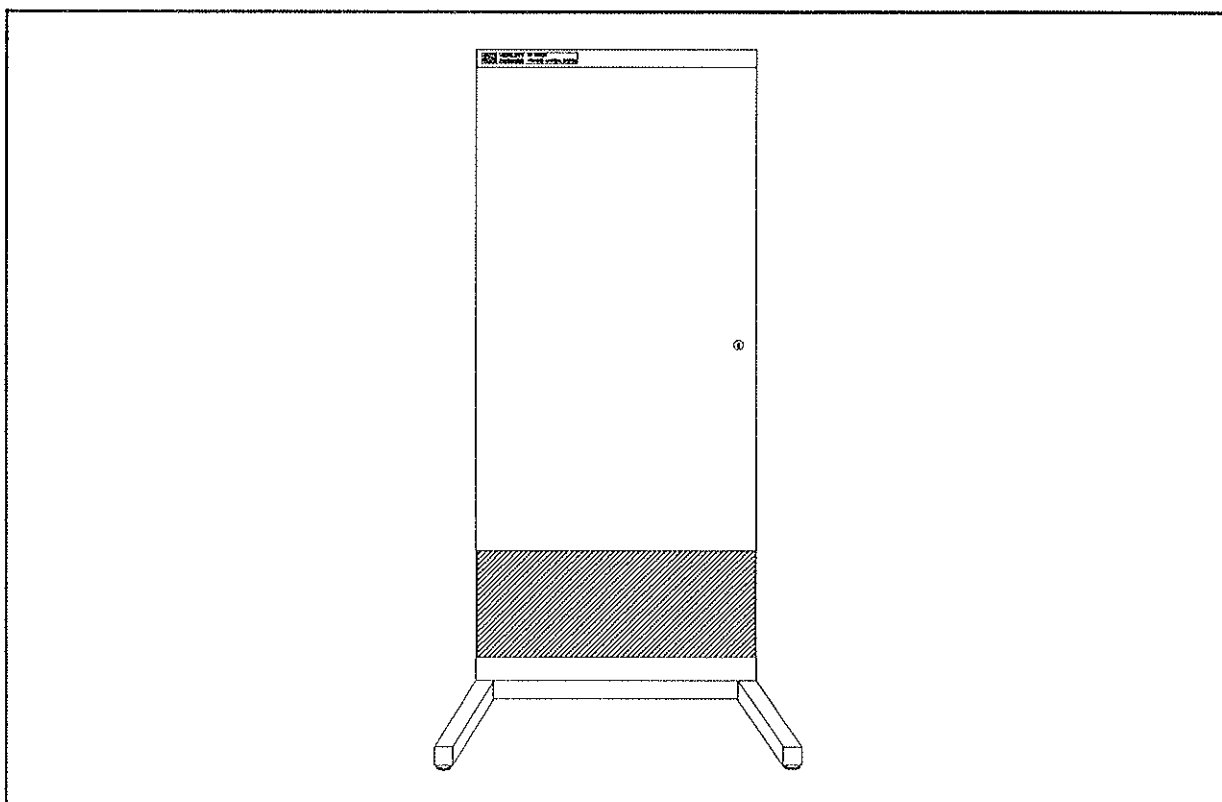


Figure A-1. System Cabinet Overview

Description

The system cabinet is an aluminum and steel sheet metal cabinet in which the mechanical design is 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 with side panels and rear door in HP French gray.

All front and rear doors have locks to prevent access by unauthorized persons. For convenience, one key fits the locks on all cabinet doors.

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.

Support rails are provided for positioning and supporting instruments along the entire depth. The rails come in pairs and are mounted inside the cabinet on channels running vertically from top to bottom.

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.

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.).

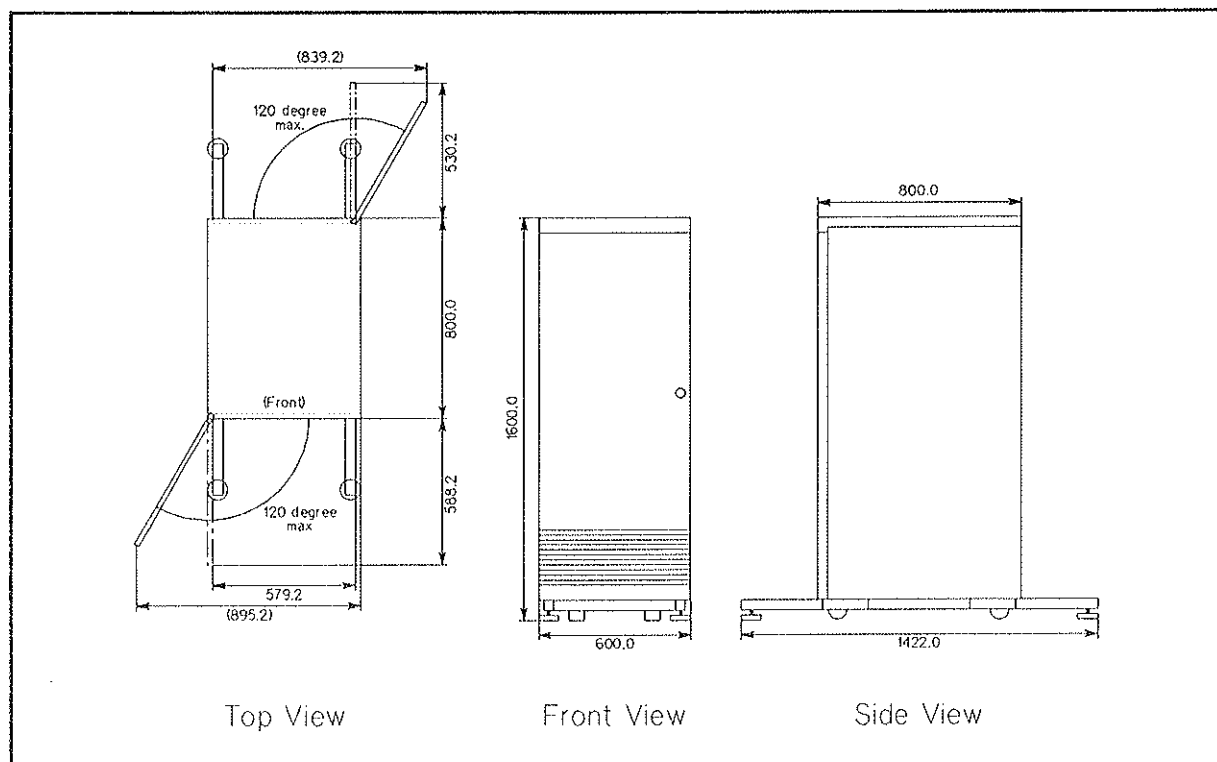


Figure A-2. Dimensions of System Cabinet

Power Distribution Unit (PDU)

The PDU gets ac power from a switchboard or an outlet of the factory 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 PDUs: HP part number 04062-60201 for 100 V or 120 V ac line and HP part number 04062-60202 for 220 V or 240 V ac 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

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

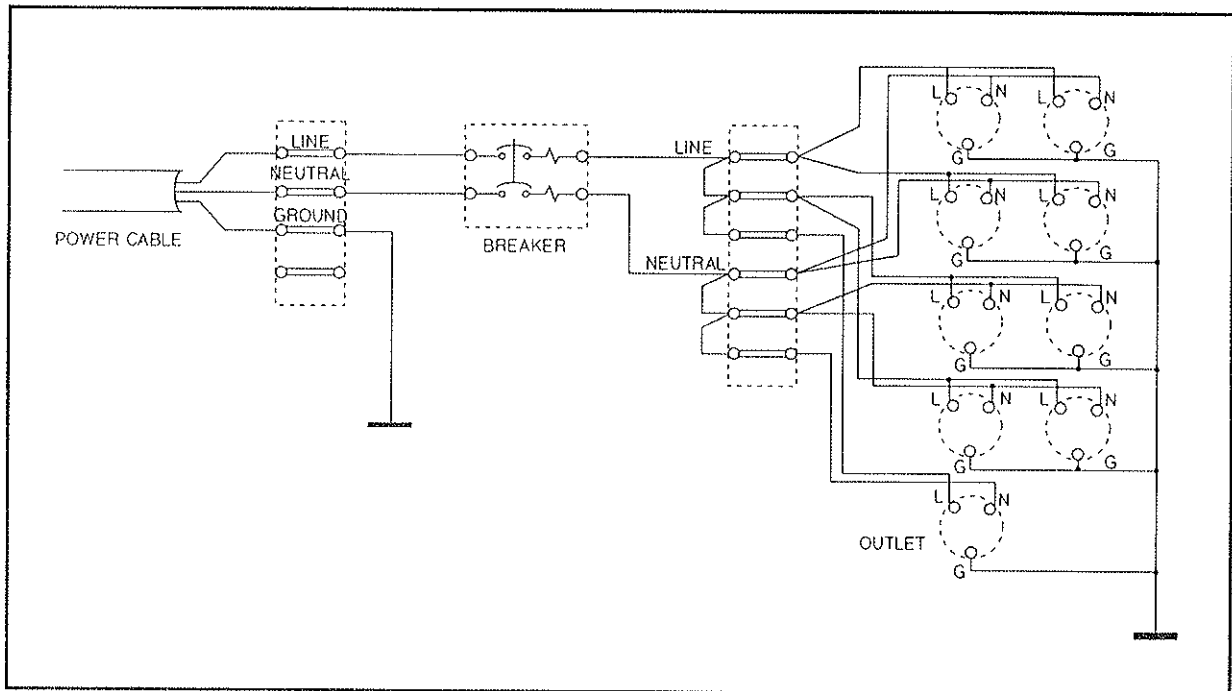


Figure A-3. Circuit Diagram of the PDU

Accessories

Several accessories are available that can be installed at a later date.

Hour Meter

An hour meter is used to measure the total time for turning the power on.

Table A-2. 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 4142B DCS, HP 4280A CMU, or HP 4284A CMU84. The following table lists the required items to mount the instruments.

Table A-3. 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-4. 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 flange and the screws for each instrument.

Table A-5. 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 finished in HP mint gray.

Table A-6. Blank Panels

Product Number	Height	Product Number	Height
HP 12680B	4.5 mm (1.75 in.)	HP 12683B	178 mm (7 in.)
HP 12681B	89 mm (3.5 in.)	HP 12684B	222 mm (8.75 in.)
HP 12682B	133 mm (5.25 in.)	HP 12685B	267 mm (10.5 in.)

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-7. 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 antitip extender legs are load-bearing only when equipment extends from the cabinet proper.

Installing Antitip Legs

Warning



Once the antitip legs are installed, they should not be removed unless absolutely necessary. If the antitip 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 antitip legs have been installed.

The extendable antitip legs should be installed *before* equipment is installed in the cabinet and *after* the cabinet is located at its permanent site. Install the antitip legs as follows:

1. Remove the four antitip legs from the cabinet crate.
2. Raise the leveling feet on the antitip legs as high as possible.
3. Install two antitip legs at the lower front sides of the cabinet.
4. In the same manner, install two antitip 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-4 shows the hole spacing in the mounting strips, and the available equipment space.

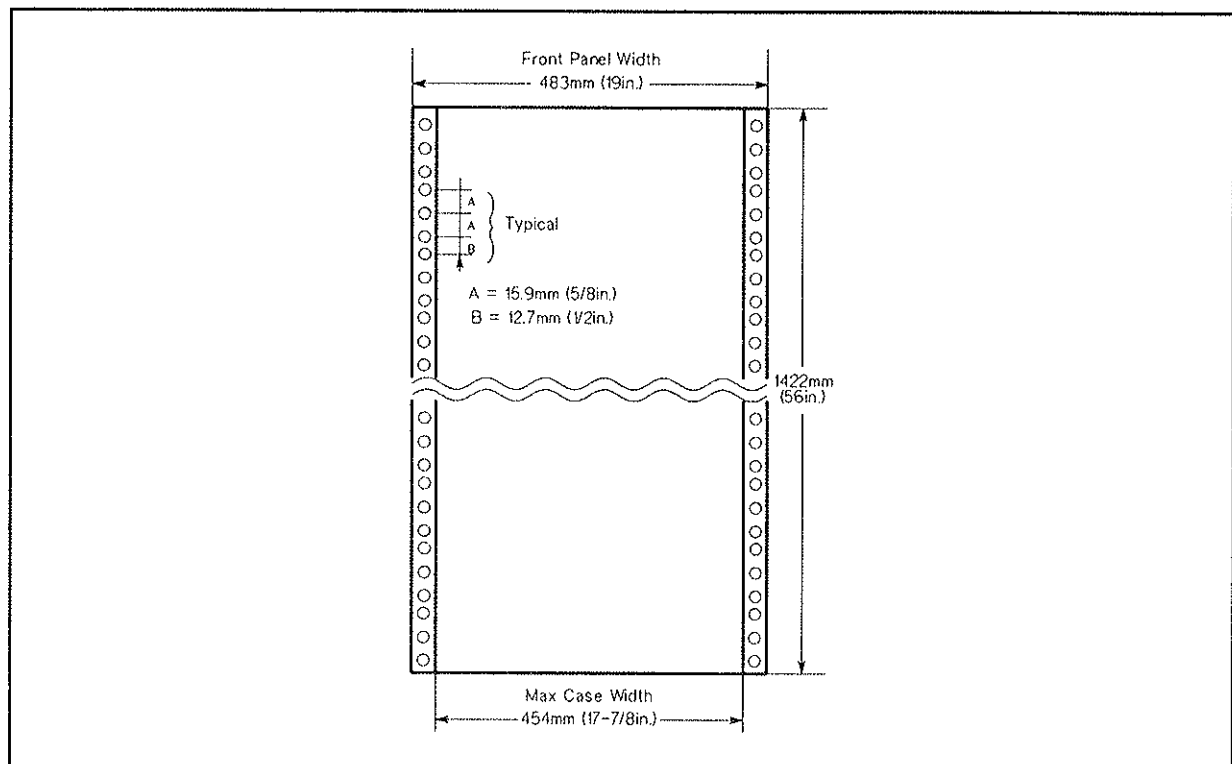


Figure A-4. Mounting Strips

Installing Instruments

To install an instrument in the cabinet, refer to Figure A-5 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-5.
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.

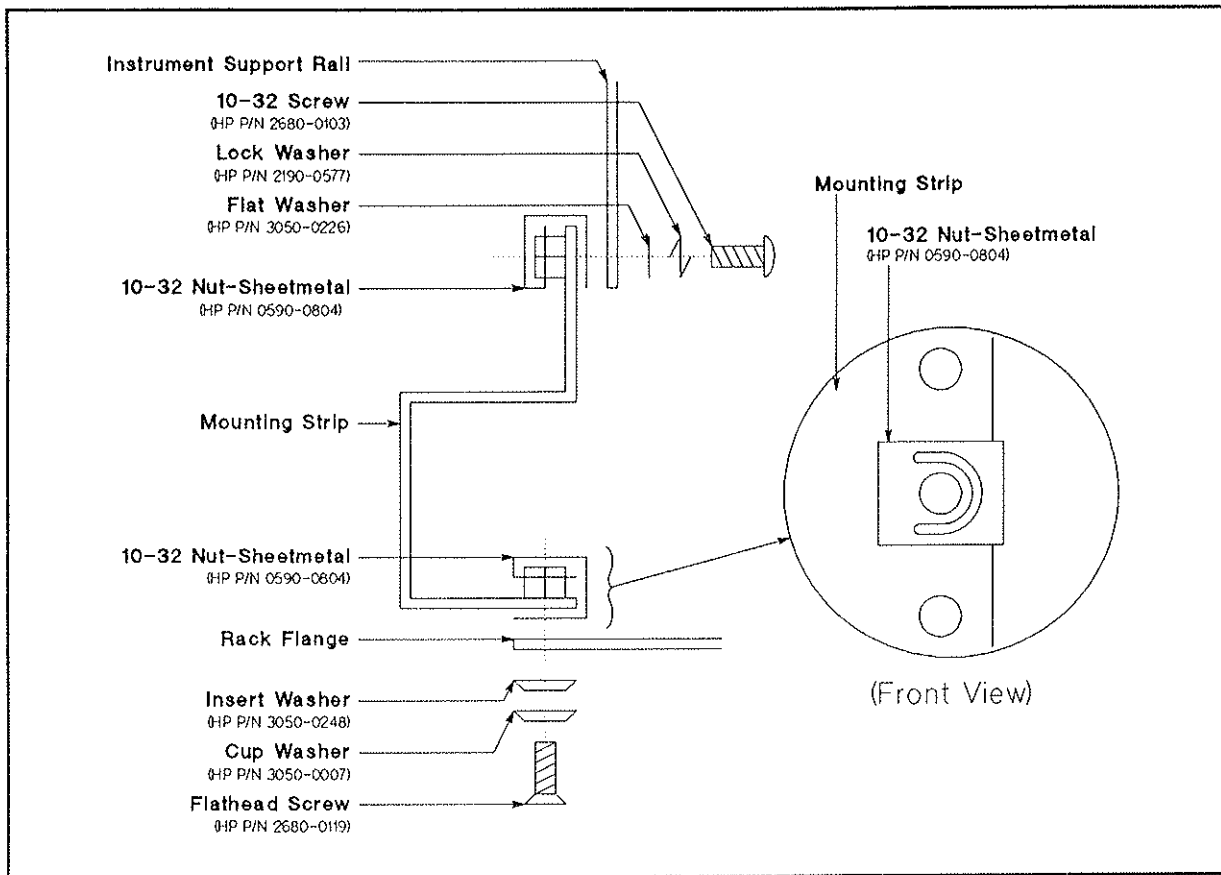


Figure A-5. Section View of Top Left of Cabinet

Cable Access

A cable entry is located on the rear panel.

Hour Meter

An hour meter needs to 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 attaching 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

The following paragraphs provide front and rear door removal information.

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.

Replaceable Parts

This section contains parts information of the system cabinet and PDU.

Replaceable Parts of the System Cabinet

Figure A-6 and Table A-8 show and list the field-replaceable parts of the system cabinet.

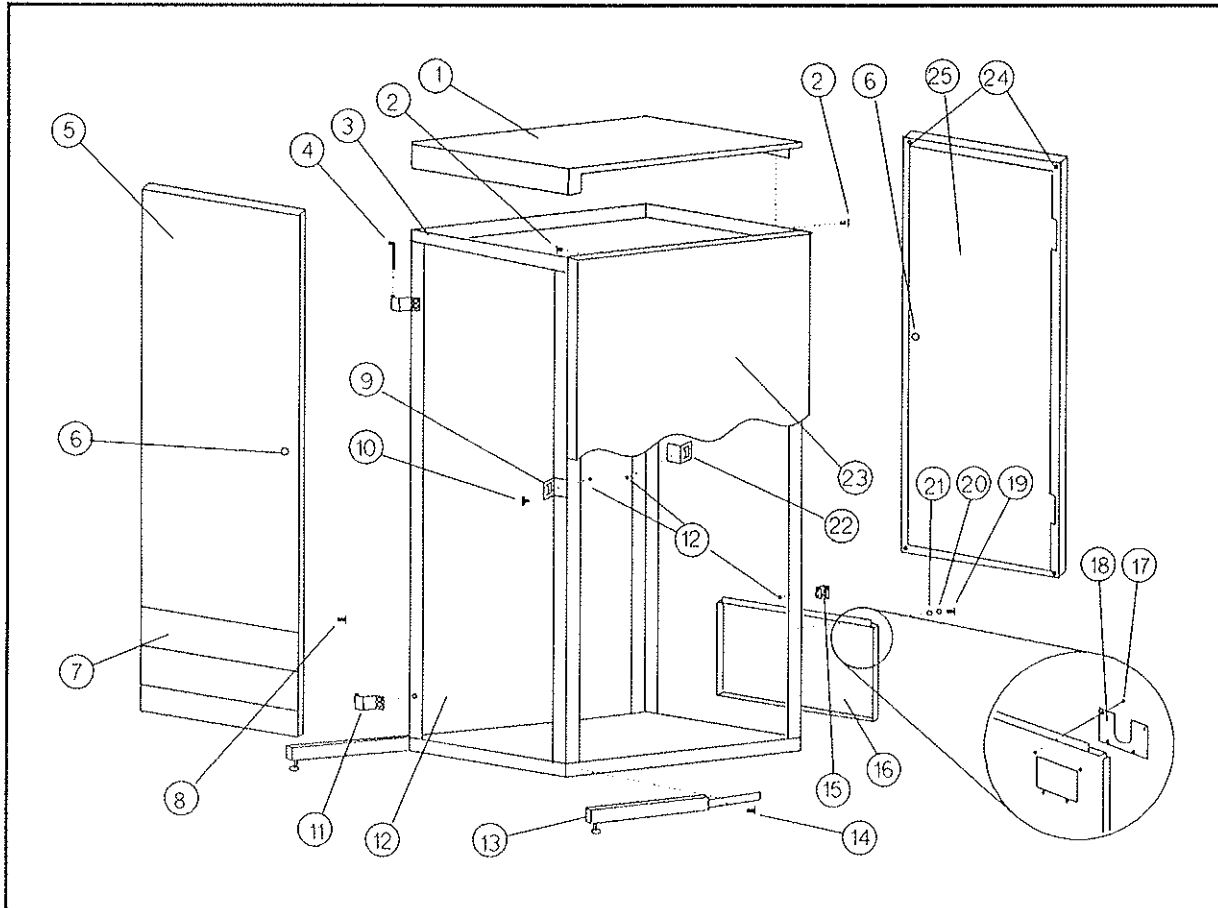


Figure A-6. System Cabinet—Exploded View

Table A-8. 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	04062-60101	1	Front Door
6	1390-0344	2	Lock Assembly
	04062-00610	2	Plate Sheet
7	04062-40001	2	Grill
8	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	Antitip 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

Replaceable Parts of the PDU

Figure A-7 shows the part locations of the PDU. Table A-9 lists the field-replaceable parts of the PDU. Table A-10 also lists the information of the wiring materials in the PDU.

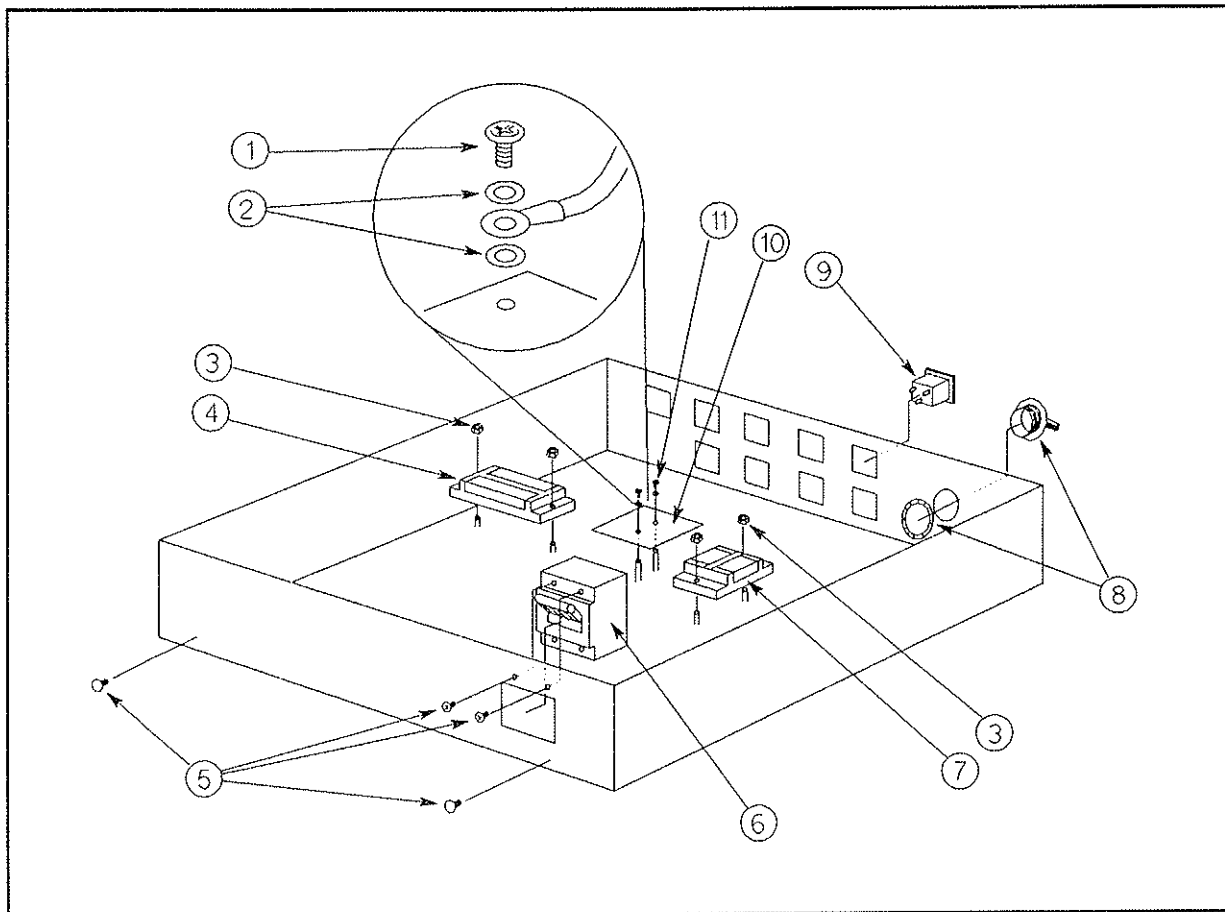


Figure A-7. Part locations of the PDU

Table A-9. Replaceable Parts of the PDU

Reference Designation	HP Part Number	Quantity	Description
1	0515-0904	4	SCR M5
2	2190-0687	8	WASH M5
3	0535-0043	4	NUT M4
4	0360-2356	1	BARRIER BLOCK
5	0515-0907	14	SCR-FL M3
6	3105-0238	1	CIRCUIT BREAKER 2 P 30 A 250 VAC
	3105-0238	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	CONN F - AC POWER (100 V/120 V)
	1252-2206	9	CONN F - AC POWER (220 V/240 V)
10	09480-20003	1	BLOCK GROUNDING
11	0515-0926	2	SCR M4
	2190-0646	2	WASH

Table A-10. 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	CA-ASSY 12 AWG (for 100 V/120 V ac only) ¹

¹ This cable is 3 m length and maximum 20 A current with an NEMA 5-20P plug.

SWC and SWM Operating Theory

Introduction

This appendix covers basic SWC and 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.

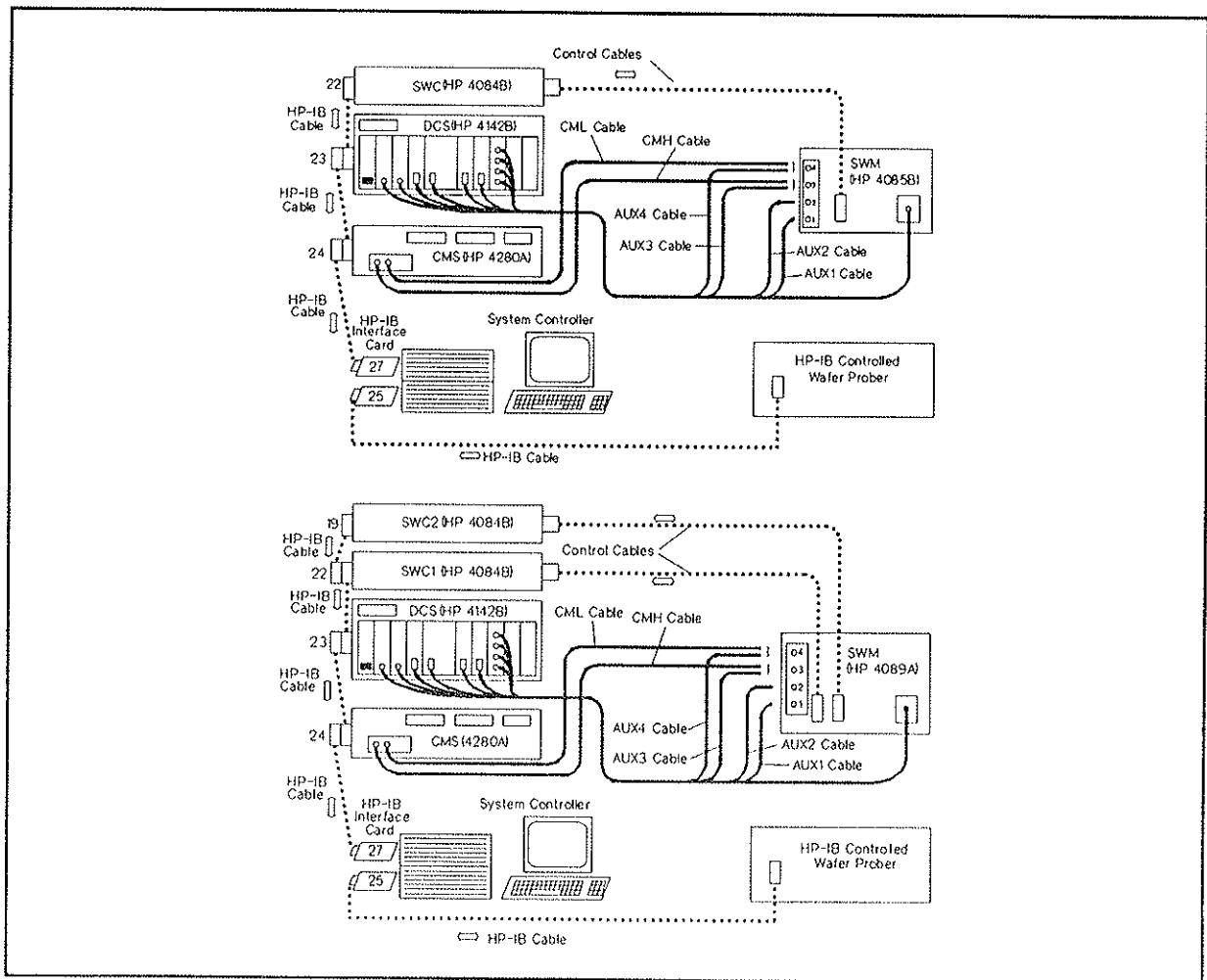


Figure B-1. Standard HP 4062C/UX System Configuration

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.

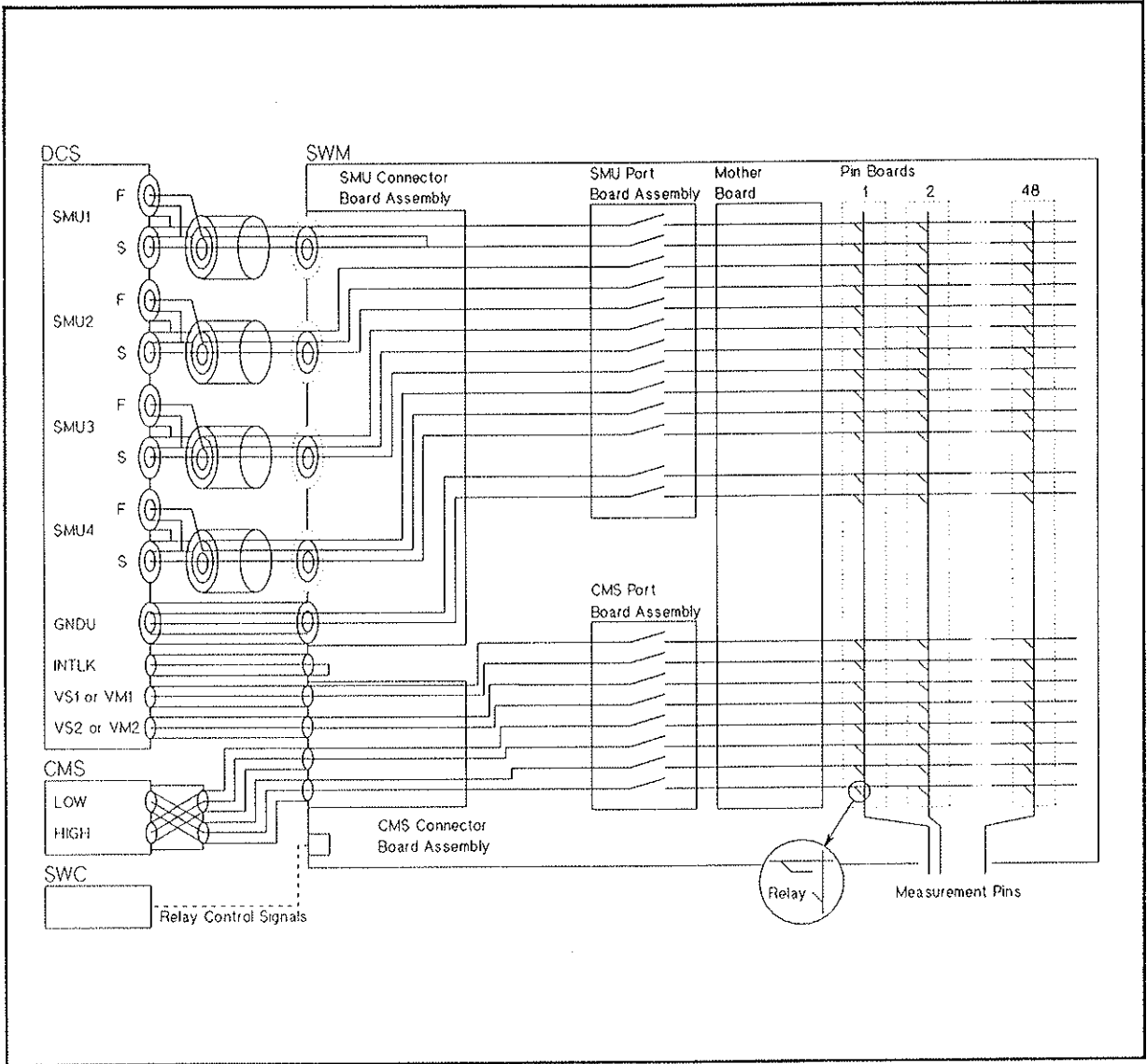


Figure B-2. Simplified SWM Pin-Port Connection Diagram (for 48-pin SWMs)

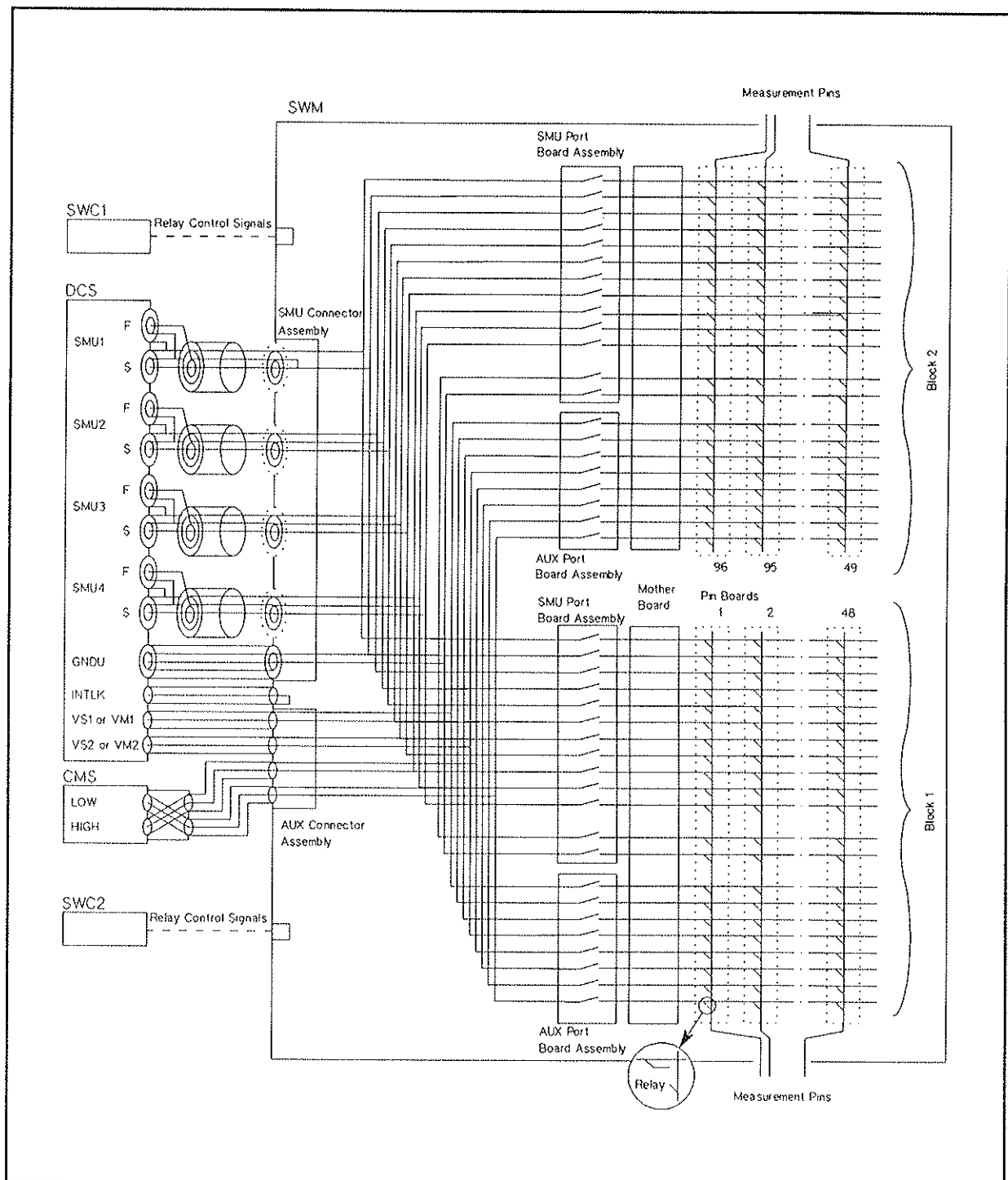


Figure B-3. Simplified SWM Pin-Port Connection Diagram (for 96-pin SWMs)

For IIP 4085B 48-pin SWM, the SWM provides 9 measurement ports, 48 measurement pins, thereby constituting a 9 (ports) by 48 (pins) matrix. For IIP 4089A 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.

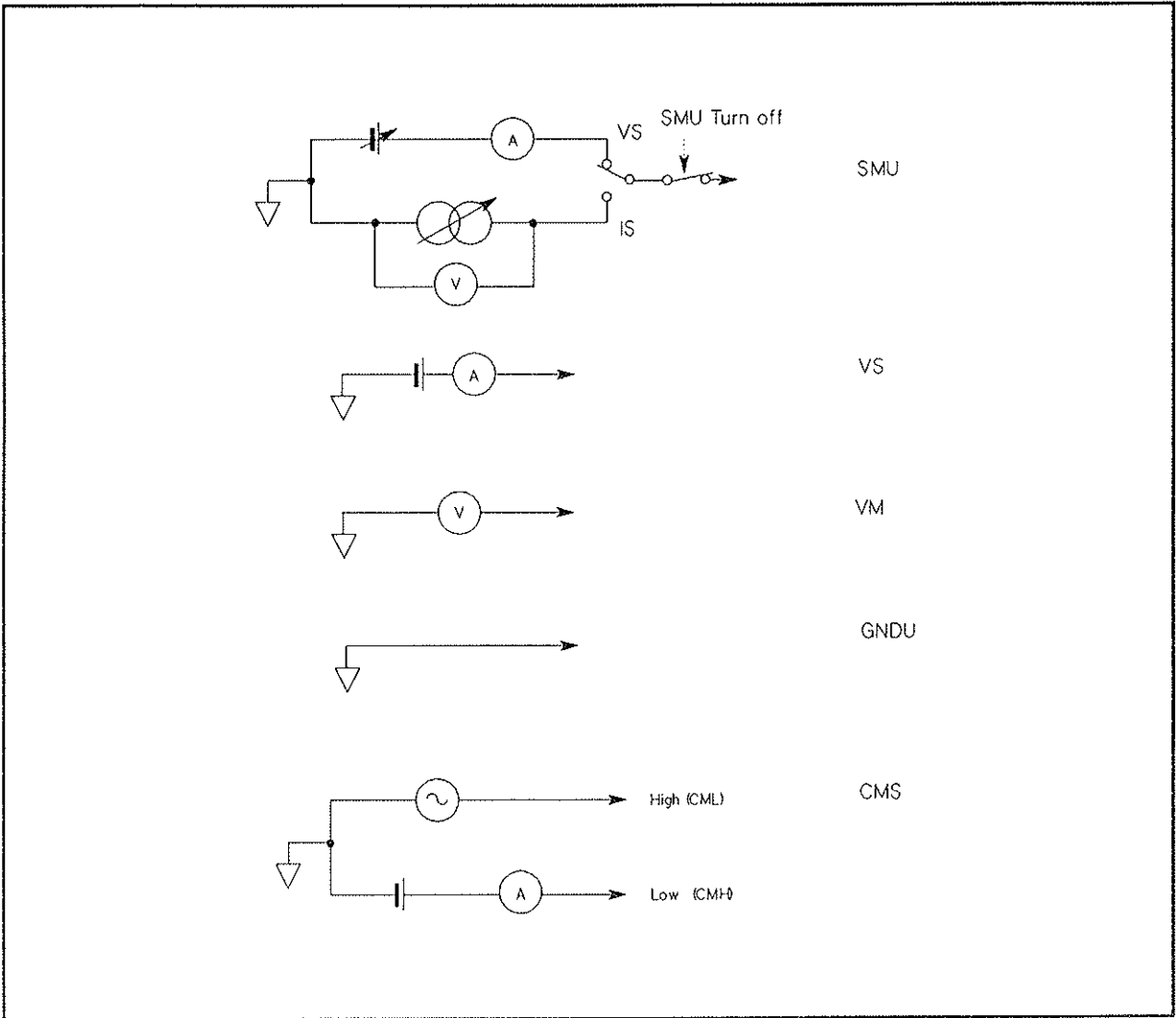


Figure B-4. Simplified Circuit Diagram

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.

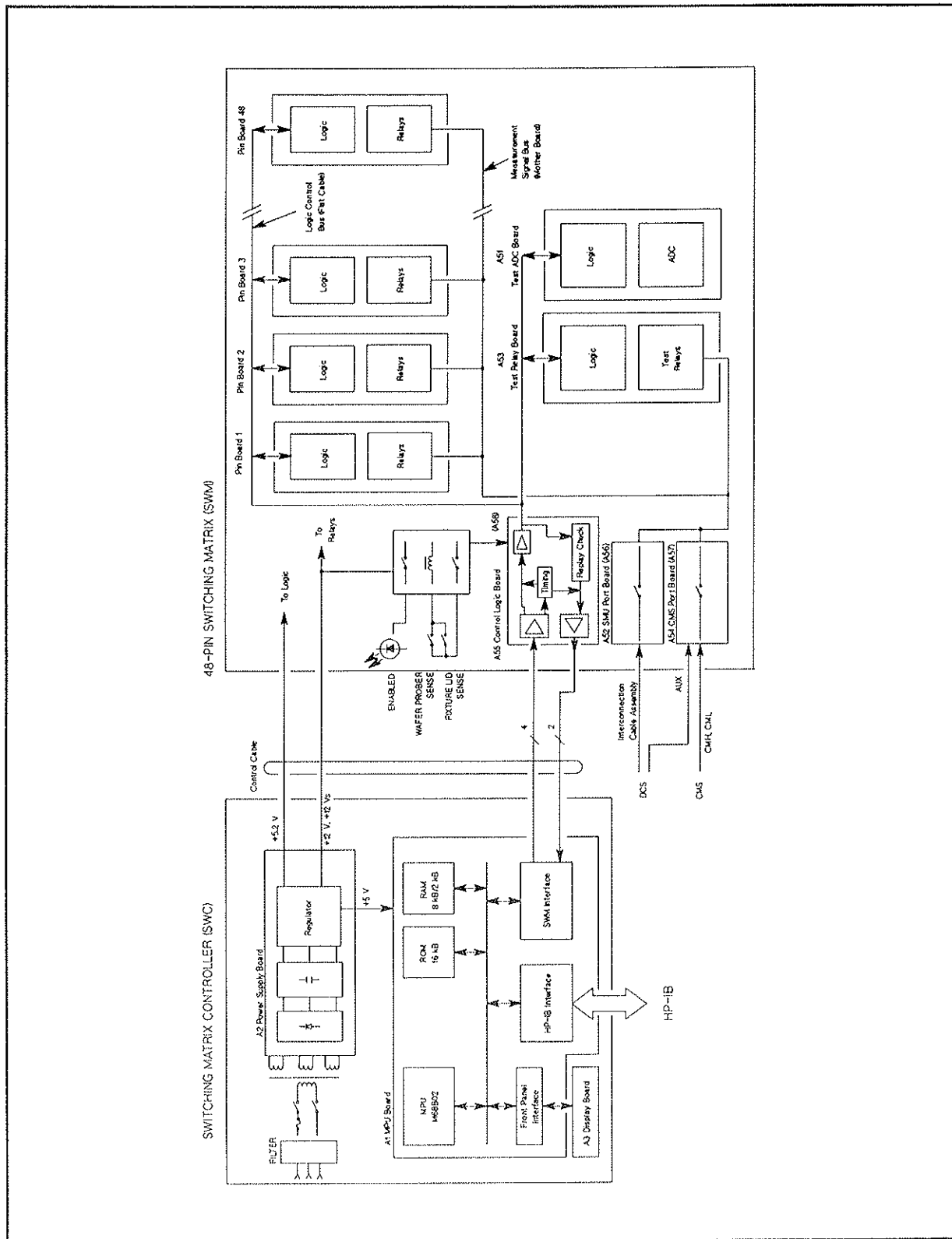


Figure B-5. SWC and SWM Block Diagram (for 48-pin SWM)

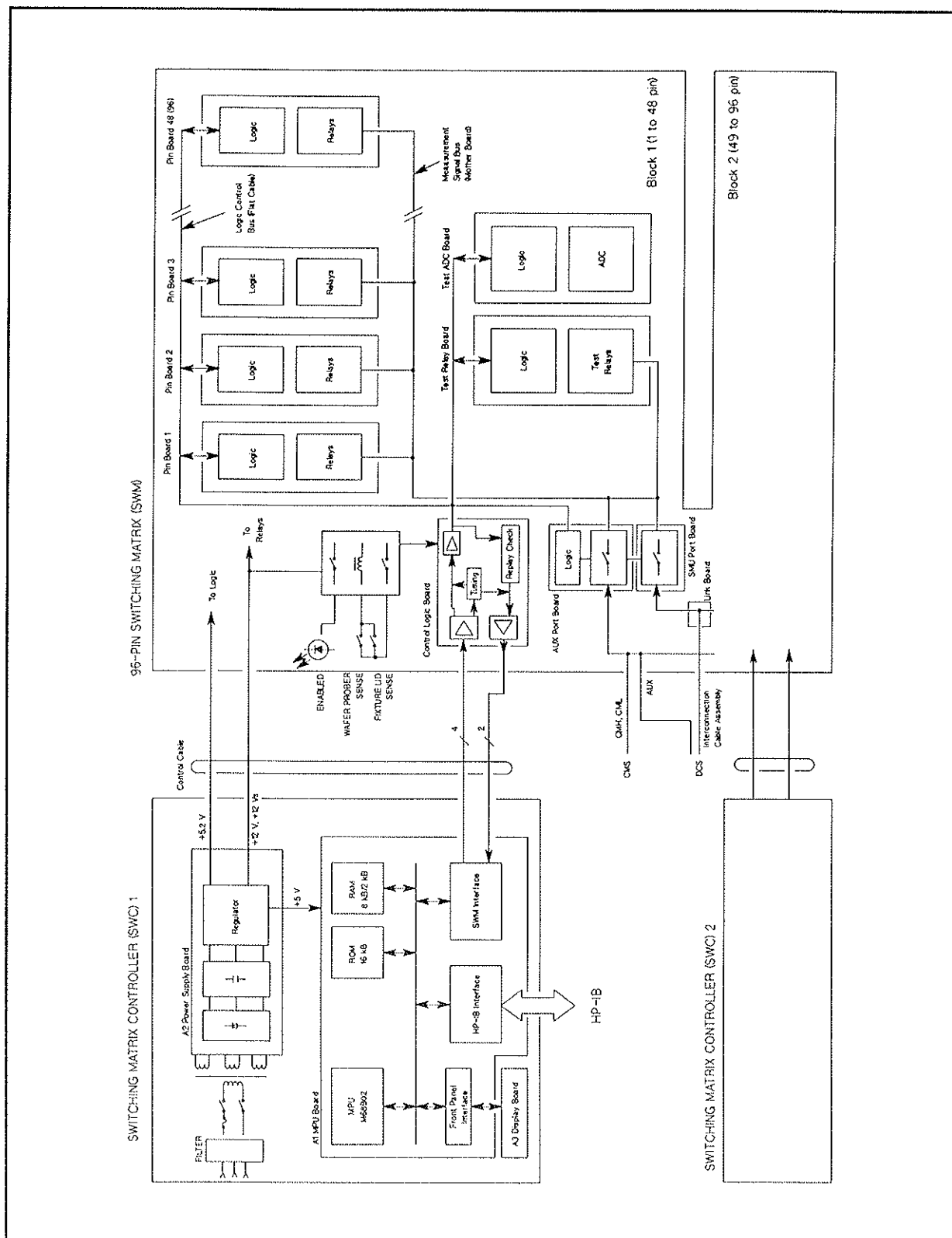


Figure B-6. SWC and SWM Block Diagram (for 96-pin SWM)

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 +5V.

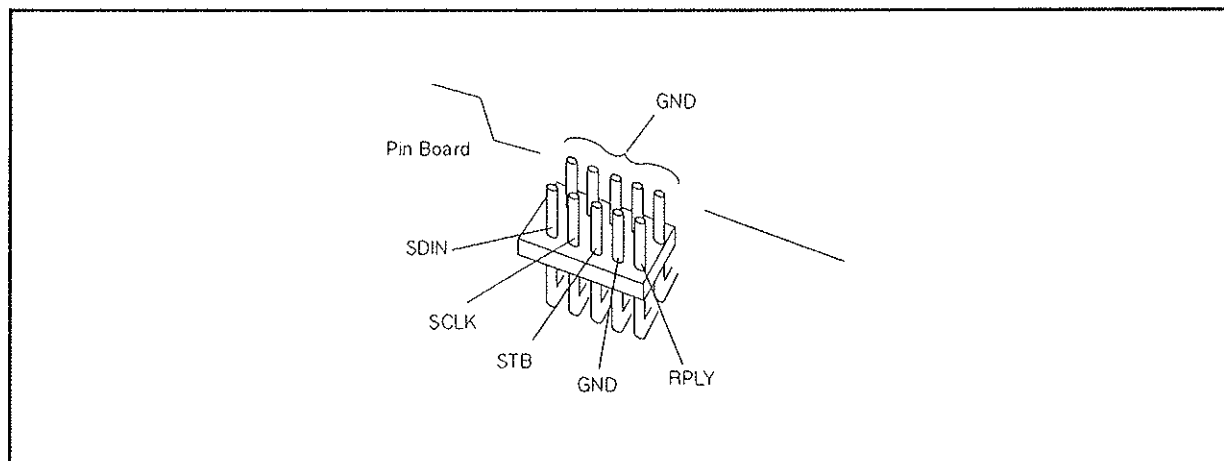


Figure B-7. J1 Pin Assignments for the Pin Board

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

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.

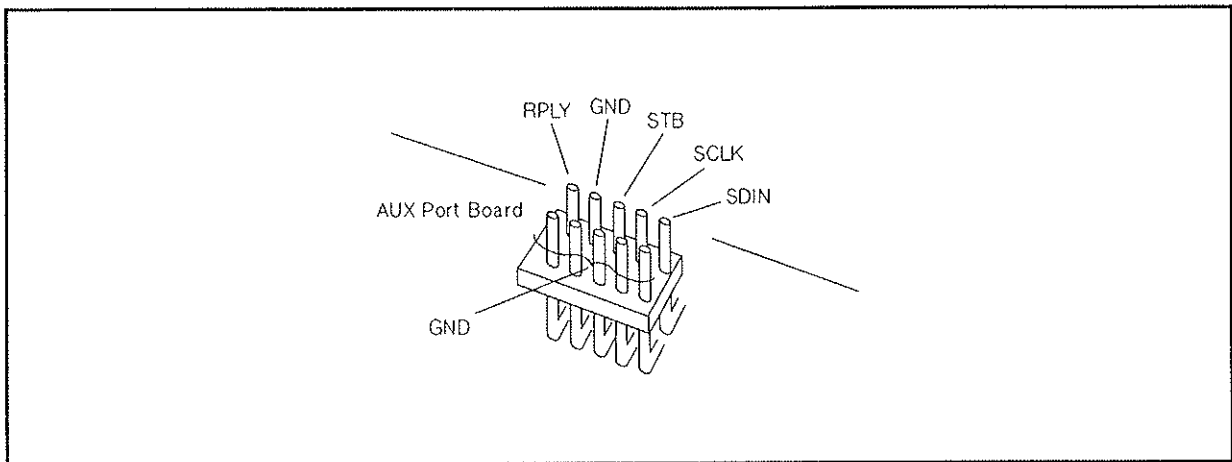


Figure B-9. J1 Pin Assignment for AUX Port Board

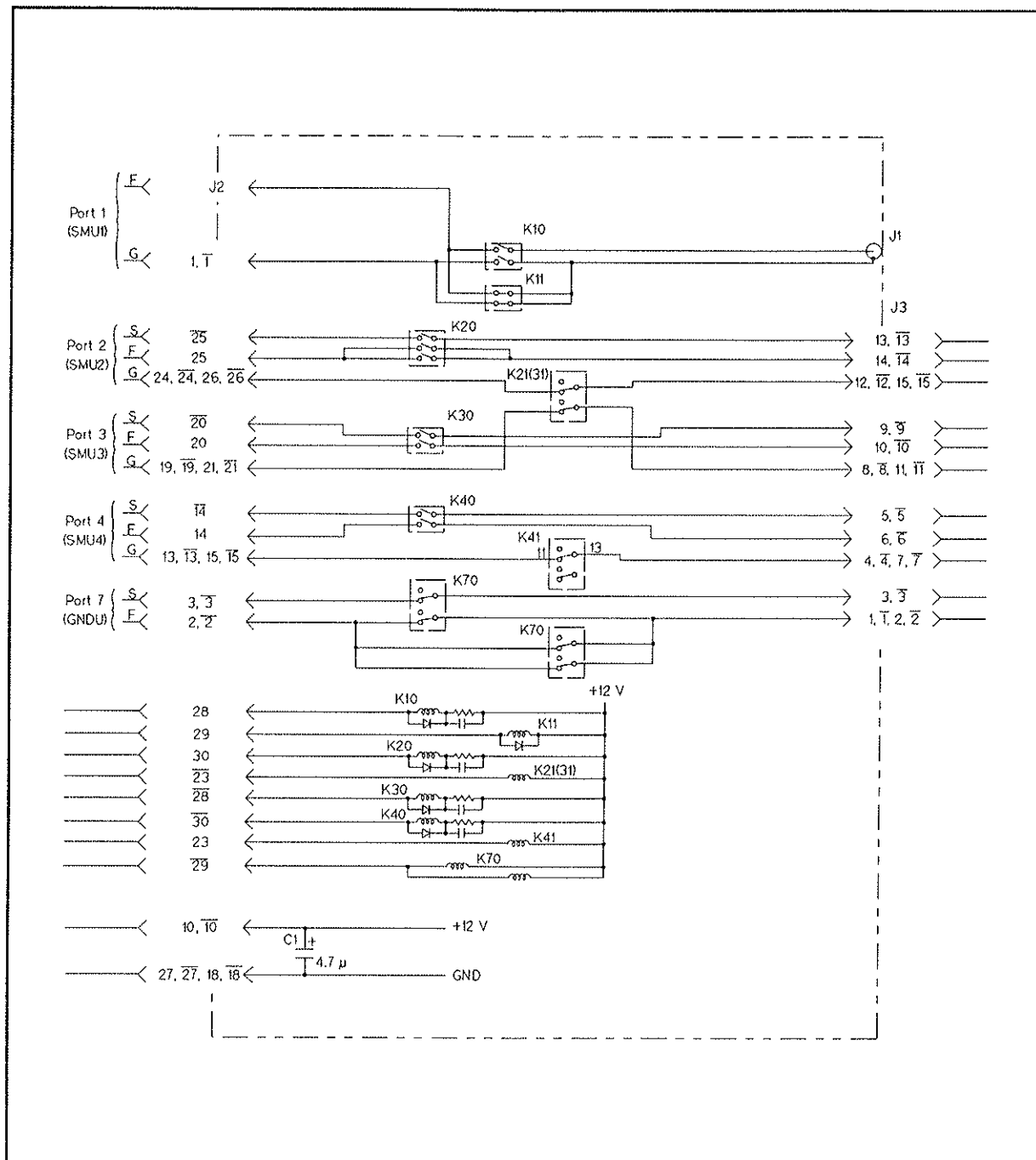


Figure B-10. Circuit Diagram—SMU Port Board

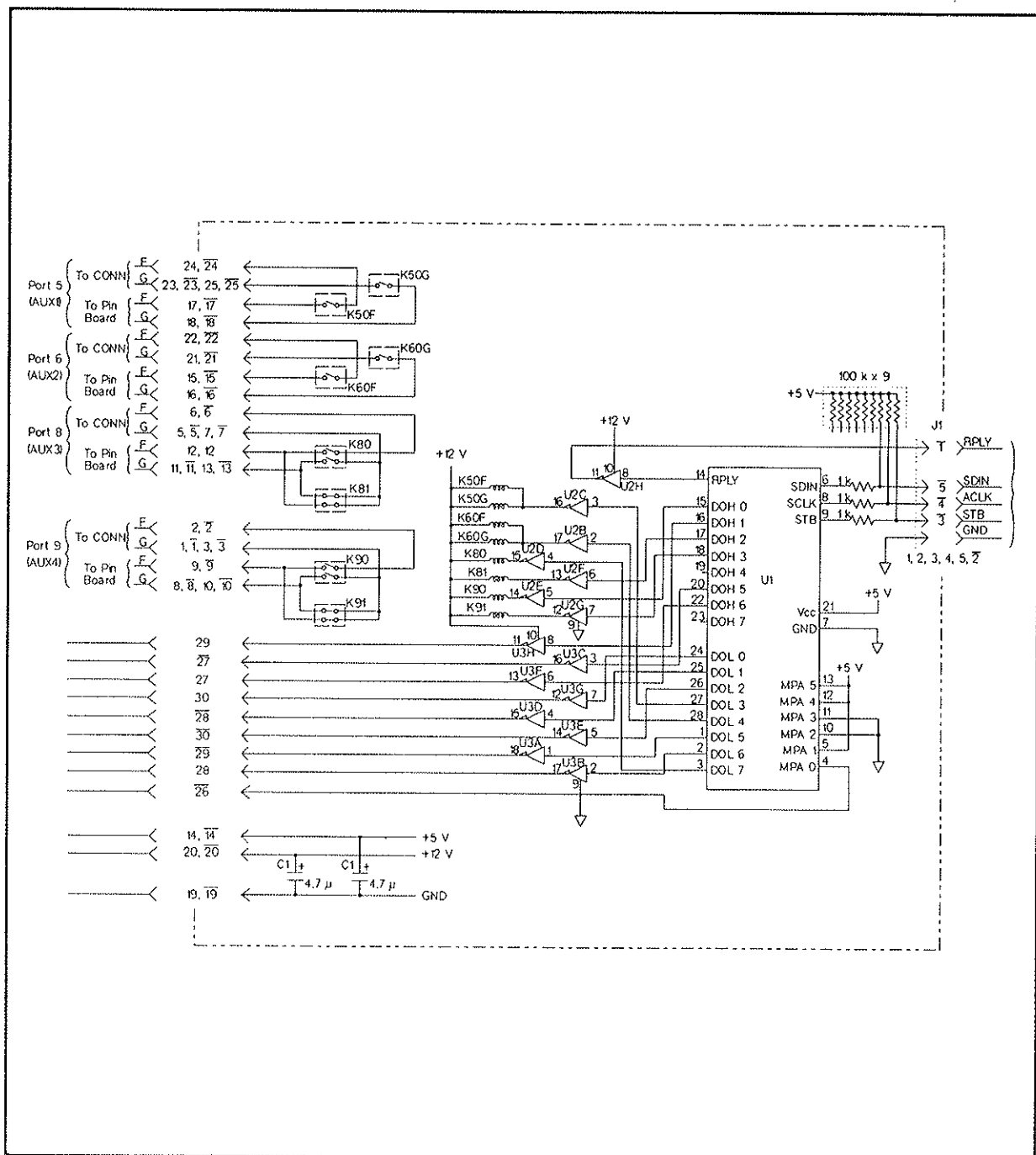


Figure B-11. Circuit Diagram—AUX Port Board

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.

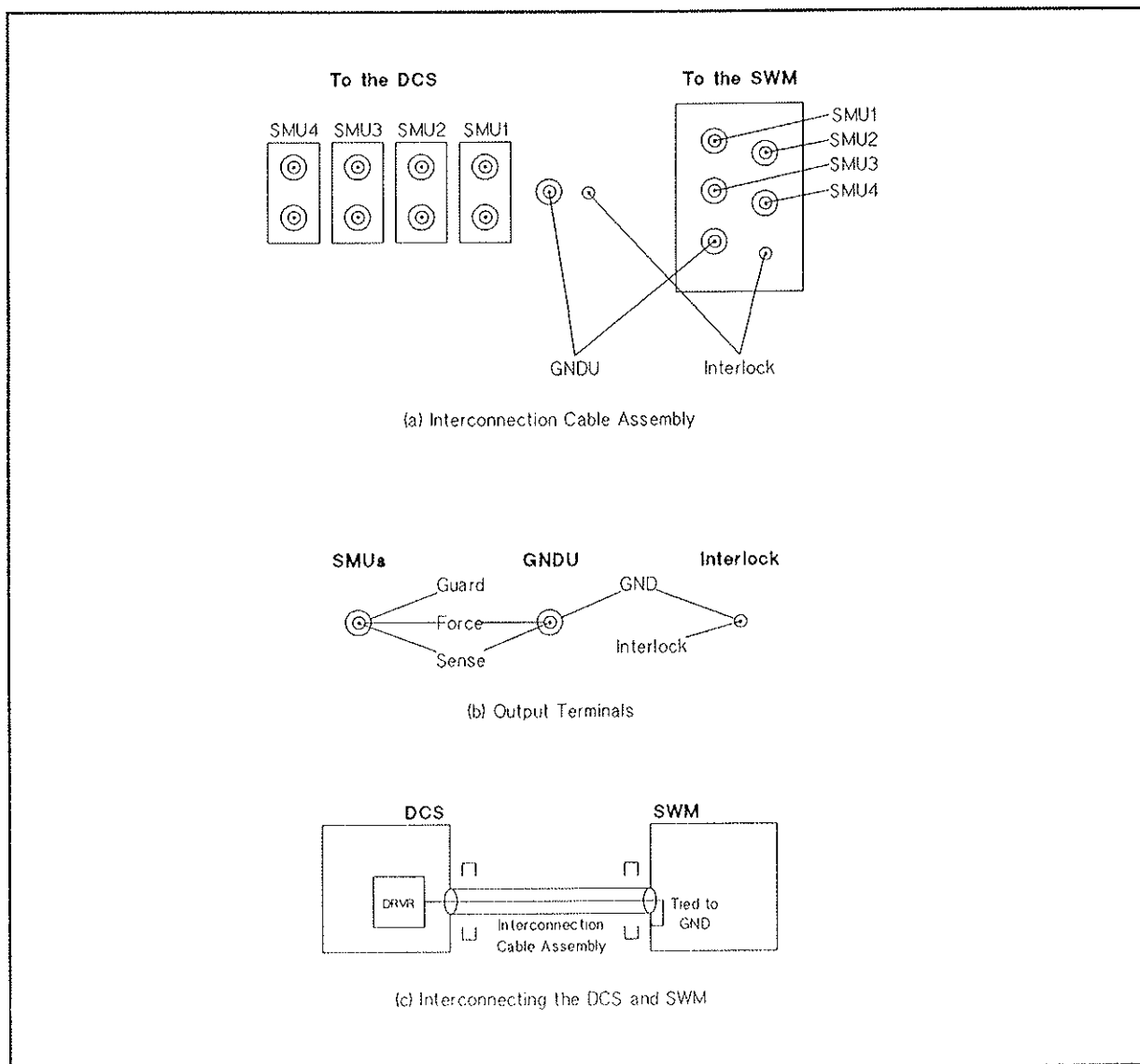


Figure B-12. INTERLOCK function

Configuring the System Printer

Introduction

This appendix explains how to change the configuration of your system printer for printing test results using the VIEW RESULT function (see “View Result” in Chapter 2).

The HP 4062C environment supports two types of printers: local (HP BASIC) and remote (SRM). The HP 4062UX environment supports three types of printers: local (HP BASIC), spooled (HP-UX), and remote (SRM). Before either print environment can be used, though, the desired environment must be modified accordingly. For information on establishing print environments, refer to the *Installing and Maintaining the BASIC 5.0/5.1 System* or the *HP-UX Administrator Manual* and *Installing and Maintaining the BASIC/UX System*.

The HP 4062 system software also provides a facility for modifying specific page formatting items such as page length, margins, and page numbering on or off.

Figure C-1 shows an example for the printer configuration page of the HP 4062UX system. To display this page, use the following procedure:

1. Load and run the PV4062 program.
2. Select the **VIEW RESULT** softkey.
3. Select the **READ FILE** softkey.
4. Enter the name of the file that contains the test results.
5. Select the **PRINTER** softkey.

```

***** CONFIGURATION *****

PRINTER TYPE  = LOCAL
PRINTER ADDR  = 701
PRINTER I/F   = HP-IB
PAGE LENGTH   = 66
MARGIN        : TOP = 2   BOTTOM = 2   LEFT = 0
PAGE NUMBERING = ON

Select desired softkey.

User 1  Caps  Running
PRINT  RECONFIG  EXIT

```

Figure C-1. An Example of Printer Configuration Page—HP 4062UX System

Configuring the System Printer

The default settings of the printer configuration are listed in Table C-1. To change these settings, select the **RECONFIG** softkey from the printer configuration page shown in Figure C-1.

Table C-1. Default Printer Configuration Settings

Item	Default Setting	
	HP 4062C System	HP 4062UX System
PRINTER TYPE	LOCAL	HP-UX SPOOL
PRINTER ADDRESS	701	701
PRINTER I/F	HP-IB	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	

Figure C-2 shows a diagram for configuring printer settings. Change printer settings as required by selecting the desired softkeys and entering the required values and names.

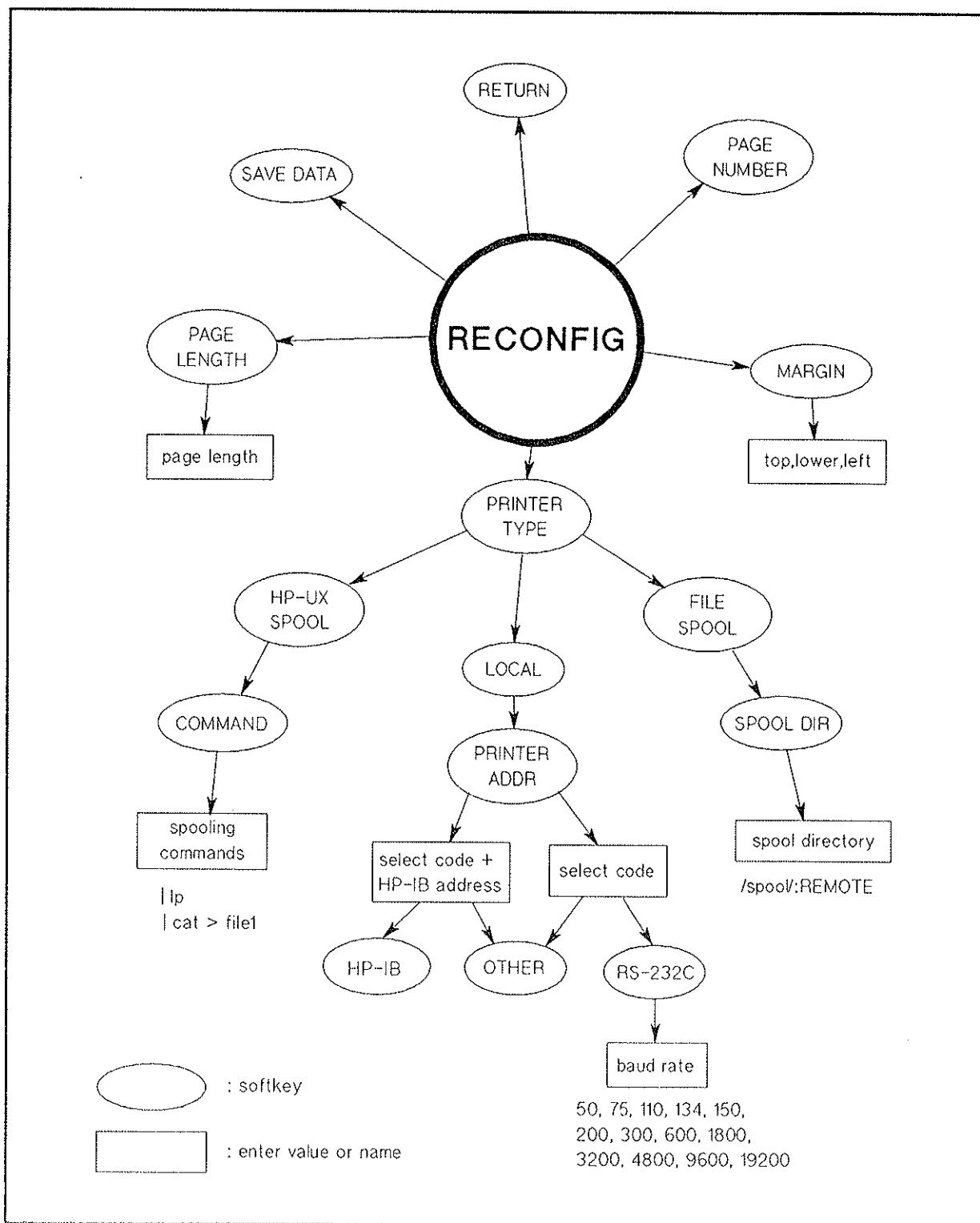


Figure C-2. Printer Configuration Diagram

Each softkey and its function is described as 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 printer's device selector (select code and HP-IB address).

After selecting this softkey, the message "Type new address." is displayed. Enter: device selector of new printer . If you press only, the present device selector of the printer is retained.

If you entered 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 entered 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 allowed:

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

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 following message appears, and the current spooling command is displayed at the keyboard input line.

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 hpuxlp -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. If specifying the directory path, the last slash "/" is required. For example, "/spool:REMOTE."

PAGE LENGTH : For changing the page length (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,
top margin + bottom margin < page length – 6
- if page numbering off,
top margin + bottom margin < page length – 8

PAGE NUMBER : For turning page numbering on and off (toggles between page numbering on/off).

SAVE DATA : For saving configuration data into the file VIEW_DATA.

RETURN : For exiting the printer configuration facility.

Instrument Compatibility

Introduction

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 four products in the HP 4062 Semiconductor Parametric Test System series: HP 4062A, HP 4062B, HP 4062C, and HP 4062UX. Note that the HP 4062UX is named Semiconductor Process Control System, but the function of the HP 4062UX system is the same as other HP 4062 system.

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 D-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 D-1. The table does not include minor changes.

Table D-1. History of HP 4062 Series

	HP 4062A ¹	HP 4062B	HP 4062C			HP 4062UX	
System Software Revision	Rev. 2.x	Rev. 3.x Rev. 4.x	C.05.0x	C.05.1x	C.05.6x	X.05.5x	X.05.6x
48-pin SWM	HP 4085A	HP 4085A	HP 4085B or HP 4085A ²			HP 4085B or HP 4085A ²	
96-pin SWM	—	—	—	HP 4089A		HP 4089A	
SWC	HP 4084A	HP 4084B	HP 4084B	HP 4084B ³		HP 4084B ³	
DCS	HP 4141A	HP 4141B	HP 4142B			HP 4142B	
CMS	HP 4280A	HP 4280A	HP 4280A		HP 4280A or HP 4284A	HP 4280A	HP 4280A or HP 4284A

¹ The HP 4062A was discontinued in February 1985.

² 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.

³ Two HP 4084B SWCs are need for the HP 4089A 96-pin SWM.

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 less than or equal to 100 mA is passed through the SWM.

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 less than or equal to 100 mA is passed through SWM.

SWM Compatibility

The HP 4085B 48-pin SWM and the HP 4089A 96-pin SWM are available for the HP 4062C/UX system.

Table D-2 shows the board compatibility of the SWM.

Table D-2. Boards Compatibility of SWM

Description	Board Designation		HP 4085A	HP 4085B	HP 4089A
	HP 4085A/B	HP 4089A			
Pin Board	A1 – A48	A1 – A96	16320-66511	16320-66521 ¹	16320-66531
Control Logic Board	A55	A105, A205	04085-66555	← ²	← ²
Control Connector Board	A58	A104, A204	04085-61003	← ²	04085-66506
Test ADC Board	A51	A162, A262	04085-66551	04085-66561 ¹	← ²
Test Relay Board	A53	A161, A261	04085-66553	04085-66563	← ²
SMU Port Board	A52	A102, A202	04085-66552	04085-66562 ¹	04089-66508 (2 each)
SMU Connector Board	A56	A98	04085-61001	04085-61021 ¹	04089-66510
SMU Link Board	—	A99	—	—	04089-66503
AUX (CMS) Port Board	A54	A101, A201	04085-66554	04085-66564 ¹	04089-66511 (2 each)
AUX (CMS) Connector Board	A57	A97	04085-61002	04085-61022 ¹	04089-66513
Matrix Open Relay Board	A49	A103, A203	04085-66549	← ²	04089-66504 (2 each)
Display Board 1	—	—	—	—	04089-66514
Display Board 2	—	—	—	—	04089-66515
Mother Board: Block 1	—	—	04085-66559	04085-66569	04089-66501
Mother Board: Block 2	—	—	—	—	04089-66502

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 connector boards (HP part number 04085-66562 and 04085-61021) for the HP 4085B SWM can be used for the HP 4085A SWM. But you must replace both SMU port and connector boards when either needs to be replaced because the SMU port and connector boards are a set. The same rule applies to the AUX (CMS) port and connector boards.

The difference between the pin board for the HP 4085B and for the HP 4089A 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. But pin boards for the HP 4089A cannot be used in the HP 4085B SWM, and pin boards for the HP 4085B cannot be used in the HP 4089A 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 D-3 shows the MPU board and firmware ROM compatibility of the HP 4084A/B SWC.

Table D-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	Used for	
		Matrix	System
04084-66501	04084-86000 ¹	HP 4085A	HP 4062A
04084-66511	04084-85101	HP 4085A	HP 4062B
04084-66511	04084-85111	HP 4085A/B	HP 4062B/C
04084-66521 04084-66531	04084-85121	HP 4085A/B, and HP 4089A	HP 4062B/C/UX

¹ This includes a pair of programmed ROMs, which are 64 kilobit.

Check Sheet for Input Relay Troubleshooting

This appendix provides a check sheet for troubleshooting the Input Relay Test failures.

Fill in the sheet according to the results of the Input Relay Test. The error messages displayed by the Input Relay Test include a row headed by "ALSO CHECK THE FOLLOWING:." Make checks on the sheet according to the test results.

For example, 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;

the sheet is filled in with the following points:

- In "BLOCK ____" of the table title, a "1," which is the block number of the failure, is written.
- In one column of the row "Failed Relay and Side," i-K 11 and force is written.
- In a row called "Pin Board ____," a "4," which is a pin board number, is written down, and a check sign ("√") is made in the cross point between the failed input relay and the pin board used for the test.
- Five check signs ("√") are made in the cross points between the failed input relay and SMU1, SMU2, i-K10, i-K20, or i-K21.

After checking all the errors, the most possible point of the Input Relay Test failure is made more evident and the sheet can help you troubleshoot the input 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						

Error Messages

If your HP 4062C/UX 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, a BASIC or BASIC/UX 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 *BASIC* or *BASIC/UX Language Reference Manual* for details on system errors.

■ HP 4062C/UX Errors

If an HP 4062C/UX 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 error messages and includes a partial listing of system controller error codes. For details on system controller error codes, refer to the *BASIC* or *BASIC/UX 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. 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 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 20 CMH cable connected to CML(AUX4) port on SWM.

START ERROR 21 CML terminal improperly connected.

START ERROR 22 CML cable connected to CMH(AUX3) 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*

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:

The description of DUMCONFIG is not proper. Rerun the START 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/hpibxx* not found.

START ERROR 331 HP-IB interface card not on select code *xxx*.

START ERROR 332 */dev/rmb/hpibxx* is not an HP-IB device file.

START ERROR 333 HP-IB device file */dev/rmb/hpibxx* is not for select code *xx*.

START ERROR 334 */dev/rmb/hpibxx* 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 psclean 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.

Check for one of the following possible causes:

- Contents of the shared memory for HP 4062UX is destroyed.
- The pcsdaemon process is aborted. (for Rev. X.05.50 only)

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 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 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.

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 $\leq 32w$.

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.

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 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 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 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)

TIS ERROR 247 Fatal error (errno = *xxx*)

TIS ERROR 248 Fatal error (errno = *xxx*)

TIS ERROR 249 Fatal error (errno = *xxx*)

TIS ERROR 250 Fatal error (errno = *xxx*)

TIS ERROR 251 Fatal error (errno = *xxx*)

TIS ERROR 252 Fatal error (errno = *xxx*)

TIS ERROR 253 Fatal error (errno = *xxx*)

TIS ERROR 254 Fatal error (errno = *xxx*)

TIS ERROR 255 Fatal error (errno = *xxx*)

TIS ERROR 246 Fatal error (errno = *xxx*)

TIS ERROR 247 Fatal error (errno = *xxx*)

TIS ERROR 248 Fatal error (errno = *xxx*)

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

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.

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 *BASIC* or *BASIC/UX 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 VS_x to the AUX1 port, VS_y to the AUX2 port, and perform the VS Test again. If the second error occurs, connect VS_x 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 VM_x to the AUX1 port, VM_y to the AUX2 port, and perform the VM Test again. If the second error occurs, connect VM_x 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.

BASIC or BASIC/UX Language System Errors

This section lists several of the more common errors related to the BASIC or BASIC/UX language system. For more details, refer to the *BASIC or BASIC/UX 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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