Keysight 85060C Electronic Calibration Control Unit

Notice: Hewlett-Packard's former Test and Measurement business became part of Agilent Technologies in 1999, and then Keysight Technologies in August 2014. This document is provided as a courtesy but is no longer kept current and thus will contain historical references to Agilent, HP or Hewlett-Packard. For more information, go to www.keysight.com.

KEYSIGHT TECHNOLOGIES

Operating, Programming and Service Manual

Notices

© Keysight Technologies, 1997 - 2014

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Agilent Technologies, Inc. as governed by United States and international copyright laws.

Manual Part Number

85060-90002

Edition

October 2014

Published by:

Keysight Technologies, Inc.
1400 Fountaingrove Pkwy.
Santa Rosa, CA 95403 USA

Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED "AS IS," AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED, WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR OF ANY INFORMATION CONTAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT WILL CONTROL.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Restricted Rights Legend

U.S. Government Restricted Rights. Software and technical data rights granted to the federal government include only those rights customarily provided to end user customers. Keysight provides this customary commercial license in Software and technical data pursuant to FAR 12.211 (Technical Data) and 12.212 (Computer Software) and, for the Department of Defense, DFARS 252.227-7015 (Technical Data - Commercial Items) and DFARS 227.7202-3 (Rights in Commercial Computer Software or Computer Software Documentation).

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

HP 85060C
Electronic Calibration Control Unit

Operating, Programming and Service Manual

HP part number: 85060-90002
Printed in USA
November 1997
Revision 2.0

Notice

The information contained in this document is subject to change without notice.

Hewlett-Packard makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Hewlett-Packard shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Hewlett-Packard assumes no responsibility for the use or reliability of its software on equipment that is not furnished by Hewlett-Packard.

This document contains proprietary information which is protected by copyright. All rights are reserved. No part of this document may be photocopied, reproduced, or translated to another language without prior written consent of Hewlett-Packard Company.

Restricted Rights Legend

Use, duplication, or disclosure by the U.S. Government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.227-7013 for DOD agencies, and subparagraphs (c)(1) and (c)(2) of the Commercial Computer Software Restricted Rights clause at FAR 52.227-19 for other agencies.

Hewlett-Packard Company
Santa Rosa Systems Division
1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799, U.S.A.

© Copyright Hewlett-Packard Company 1996, 1997

What You'll Find in This Manual…

HP 85060C Electronic Calibration Control Unit

Chapter 1
- General Information

Chapter 2

Chapter 3
- Operation

Chapter 4
- Command Reference

Chapter 5
- Troubleshooting

Chapter 6
- Replacement Procedures

Chapter 7
- Replaceable Parts

Warranty

Certification

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

Warranty

This Hewlett-Packard system product is warranted against defects in materials and workmanship for a period corresponding to the individual warranty periods of its component products. Instruments are warranted for a period of one year. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products that prove to be defective.

Warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within HP service travel areas. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses. In all other areas, products must be returned to a service facility designated by HP.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

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

LIMITATION OF WARRANTY. The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES. THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR

CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Assistance

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

For assistance, call your local Hewlett-Packard Sales and Service Office (refer to “Support and Service”).

Support and Service

Any adjustment, maintenance, or repair of this product must be performed by qualified personnel. Contact your local HP sales and service office.

US Field Operation Headquarters

Hewlett-Packard Company
19320 Pruneridge Avenue
Cupertino, CA 95014
USA
(800) 752-0900

Southern California

Hewlett-Packard Company
1421 South Manhattan Avenue
Fullerton, CA 92631
(714) 999-6700

Northern California

Hewlett-Packard Company
301 E. Evelyn
Mountain View, CA 94041
(415) 694-2000

Colorado

Hewlett-Packard Company
24 Inverness Place, East
Englewood, CO 80112
(303) 649-5000

Georgia

Hewlett-Packard Company
2000 South Park Place
Atlanta, GA 30339
(404) 9554-1500

Illinois

Hewlett-Packard Company
5201 Tollview Drive
Rolling Meadows, IL 60008
(708) 342-2000

New Jersey

Hewlett-Packard Company
West 120 Century Road
Paramus, NJ 07653
(201) 599-5000

Texas

Hewlett-Packard Company
930 E. Campbell Road
Richardson, TX 75081
(214) 231-6101

European Operations Headquarters

Hewlett-Packard S.A
150, route du Nant-d'Avril
1217 Meyrin 2/Geneva
Switzerland
(41 22) 780.8111

France

Hewlett-Packard France
1 avenue du Canada
Zone d'Activite de Courtaboeuf
F-91947 Les Ulis Cedex
France
(33 1) 69 82 60 60

Germany

Hewlett-Packard GmbH
Hewlett-Packard-Strasse
61352 Bad Homburg
Germany
(+49 6172) 16-0

Great Britain

Hewlett-Packard Ltd.
Eskdale Road
Winnersh Triangle
Wokingham, Berkshire RG11 5DZ
England
(44 734) 696622

Intercon Operations Headquarters

Hewlett-Packard Company
3495 Deer Creek Road
Palo Alto, CA 94304-1316
USA
(415) 857-5027

Australia

Hewlett-Packard Australia, Ltd.
31-41 Joseph Street
Post Office Box 221
Blackburn, Victoria 3130
Australia
(61 3) 895-2895

Canada

Hewlett-Packard (Canada), Ltd.
17500 South Service Road
Trans-Canada Highway
Kirkland, Quebec H9J 2X8
Canada
(514) 697-4232

China

China Hewlett-Packard Co., Ltd.
38 Bei San Huan Road
Shuang Yu Shu
Hai Dian District, Beijing
China
(86 1) 256-6888

Japan

Yokogawa-Hewlett-Packard, Ltd.
1-27-15 Yabe
Sagamihara
Kanagawa 229
Japan
(81 427) 59-1311

Singapore

Hewlett-Packard Singapore (Pte.), Ltd.
Alexandra Post Office Box 87
Singapore 9115
(65) 271-9444

Taiwan

Hewlett-Packard Company
8th Floor
337 Fu Hsing North Road
Taipei
Taiwan
(866 2) 712-0404

Safety and Regulatory Information

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument This product has been designed and tested in accordance with international standards.

WARNING

The WARNING notice denotes a hazard. It calls attention to a procedure, practice, or the like, that, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

CAUTION

The **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

Instrument Markings

	When you see this symbol on your instrument, you should refer to the instrument's instruction manual for important information.
	This symbol indicates hazardous voltages.
	The laser radiation symbol is marked onproducts that have a laser output.
	This symbol indicates that the instrument requires alternating current (ac) input.
	The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.
	The CSA mark is a registered trademark of the Canadian Standards Association.
1SM1-A	This text indicates that the instrumentis an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).
	This symbol indicates that the power line switch is ON.
	This symbol indicates that the power line switch is OFF or in STANDBY position.

Safety Earth Ground

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

Before Applying Power

Verify that the product is configured to match the available main power source as described in the input power configuration instructions in this manual. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.

Declaration of Conformity

Typeface Conventions

Italics

- Used to emphasize important information:
  Use this software *only* with the HP xxxxxX system.
- Used for the title of a publication:
  Refer to the *HP xxxxxX System-Level User's Guide*.
- Used to indicate a variable:
  Type `LOAD BIN` *filename.*

`Instrument Display`

- Used to show on-screen prompts and messages that you will see on the display of an instrument:
  The HP xxxxxX will display the message **`CAL1 SAVED`**.

[Keycap]

- Used for labeled keys on the front panel of an instrument or on a computer keyboard:
  Press **[Return]**.

{Softkey}

- Used for simulated keys that appear on an instrument display:
  Press ***{Prior Menu}***.

`User Entry`

- Used to indicate text that you will enter using the computer keyboard; text shown in this typeface must be typed *exactly* as printed:
  Type `LOAD PARMFILE`
- Used for examples of programming code:

```
#endif // ifndef NO_CLASS
```

`Path Name`

- Used for a subdirectory name or file path:
  Edit the file *`usr/local/bin/sample.txt`*

Computer Display

- Used to show messages, prompts, and window labels that appear on a computer monitor:
  The **Edit Parameters** window will appear on the screen.
- Used for menus, lists, dialog boxes, and button boxes on a computer monitor from which you make selections using the mouse or keyboard:
  Double-click **EXIT** to quit the program.

Contents

Notice iv
What You'll Find in This Manual. v
Warranty vi
Certification vi
Warranty vi
Assistance vii
Support and Service viii
Safety and Regulatory Information ix
Safety Earth Ground x
Before Applying Power x
Declaration of Conformity xi
Typeface Conventions xii

1. General Information

Description 1-1
Documentation 1-1
Specifications 1-1
Safety Considerations 1-2
Instruments Covered by this Manual 1-2
Options 1-2
Accessories Supplied 1-2
Accessories Available 1-2
Table 1-1. Electrical and Mechanical Characteristics 1-3
Table 1-2. Environmental Specifications 1-3

2. Installation

Introduction 2-1
Initial Inspection 2-1
Preparation for Use 2-2
Installation Checklist 2-2
Power Requirements 2-2
Line Voltage and Fuse Selection 2-2
Table 2-1. Fuse Ratings 2-2
Power Cables 2-3
Figure 2-1. Power Cable and Line (Main) Plug Part Numbers 2-4
HP-IB Address Selection for the Control Unit 2-5
HP-IB Address Selection for the Network Analyzer 2-5
Additional Switch Settings 2-5
Figure 2-2. Rear Panel HP-IB Address Selection DIP Switches 2-5
Interconnections 2-5
Operating Environment 2-6
Bench Operation 2-6

Figure 2-3. HP 85060C ECal System Bench Set-up Example 2-6
Rack Mounting 2-6
Storage and Shipment 2-7
Environment 2-7
Packaging 2-7

3. Operation

Introduction 3-1
ESD Cautions 3-1
Theory of Operation 3-1
Figure 3-1. HP 85060C ECal System Conceptual Block Diagram . . 3-2
Figure 3-2. Typical Operating Sequence 3-3
Operating Characteristics 3-4
Table 3-1. Operating Characteristics 3-4
Turn-on Information 3-5
Connecting and Disconnecting Modules 3-6
Figure 3-3. Front and Rear Panel Features 3-7
Panel Features 3-8
Front Panel and Rear Panel Features for the Standard and Optional Configurations 3-8
Table 3-2. Panel Feature Descriptions 3-8
Figure 3-4. Sample Network Analyzer ECal Menus 3-10
Stand-alone (Manual) Operation 3-11
System Configuration for Stand-alone Operation 3-11
Accessing Menus 3-11
Types of Analyzers 3-11
Setting Calibration Parameters 3-11
Table 3-3. Calibration Parameters 3-12
Selecting Modules 3-12
Performing Calibrations 3-13
Calibration Procedures 3-16
To Perform an S11 1-PORT Calibration 3-16
To Perform an S22 1-PORT Calibration 3-17
To Perform a FULL 2-PORT Calibration 3-18
To Perform an OMIT ISOL 2-PORT Calibration 3-19
To Perform an ADAPTER 2-PORT Calibration 3-20
Figure 3-5. Adapter Calibration Connection Diagram 3-21
To Perform an OMIT ISOL ADP 2-PORT Calibration 3-22
Performing the Confidence Check 3-23
To Perform a Confidence Check 3-24
Remote Operation 3-25
System Configuration for Remote Operation 3-25
Communicating with Host Computers 3-25
Sending Commands Which Require Pass Control 3-26
Sending Commands Which Do Not Require Pass Control 3-27
Setting Calibration Parameters for Remote Operation 3-27
Selecting Modules for Remote Operation 3-27

Performing Calibrations by Remote Operation 3-28
Host Initiated Manual Calibration 3-28
Host Directed Full Calibration 3-29
Host Directed Adapter Calibration 3-29
Responding to the ECal "RUN" Key 3-30

4. Command Reference

Command Types 4-1
SCPI Command Format 4-1
Common Command Format 4-1
SCPI Command Reference 4-2
DISPlay:MENU 4-2
ECALibration 4-4
SENSe: CORRection: COLLect 4-5
SYST em 4-9
Common Command Reference 4-10
Table 4-1. ECal Event Status Register 4-10
Table 4-2. ECal Status Byte Register 4-13
Quick Reference for SCPI and IEEE-488 Commands 4-15
Table 4-3. SCPI Commands - Quick Reference 4-15
Table 4-4. Common Commands - Quick Reference 4-17

5. Troubleshooting

Introduction 5-1
Operator Errors 5-1
Recommended Test Equipment 5-1
Diagnostic Software 5-1
Troubleshooting Sequence 5-1
Figure 5-1. Front Panel LED Status Conditions 5-2
Table 5-1. Front Panel LED Status Conditions 5-3
Troubleshooting Procedures 5-5
For a No DC Power Condition 5-5
If the Control Unit Does Not Recognize the Module 5-5
If The Calibration Results Are Unsatisfactory 5-5

6. Replacement Procedures

Introduction 6-1
Equipment Needed (but not supplied) 6-2
Table 6-1. Equipment Needed to Replace ECal Control Unit Major Assemblies 6-2
Figure 6-1. Assembly Locations 6-3
Assembly Replacement Procedures 6-4
Preliminary Precautions 6-4
. 6-4
To Remove The Cover 6-4
To Remove the Fan Assembly (FAN1) 6-5
To Remove the IEEE 488 Adapter Board Assembly (A1) 6-5
To Remove the Microprocessor Board Assembly (A2) 6-5

To Remove the Control Logic Board Assembly (A3) 6-6
To Remove the 24V Power Supply Assembly (A4) 6-6
To Remove the 5V Power Supply Assembly (A5) 6-6
To Remove the Display Board (A6) 6-7
To Remove the HP-IB Switch Board (A7) 6-7
To Remove the 3.5 Inch Floppy Drive Assembly (D1) 6-7

7. Replaceable Parts

Introduction 7-1
Replaceable Parts List 7-1
Ordering Information 7-1
To Order Parts...Fast 7-1
Table 7-1. Replaceable Parts List 7-2

1 General Information

Description

The HP 85060C Electronic Calibration (ECal) Control Unit is the controller for electronic calibration of vector network analyzers. It performs one-port or full two-port calibrations using the HP 8506x series of two-port electronic calibration modules.

Using a single-connection to a variable impedance, solid-state calibration standard (the calibration module) the HP 85060C can create either a 12-Term, two-port error model, or a 3-Term, one-port error model. The single connection setup can be applied to connector configurations including insertable and non-insertable. The HP 85060C is designed for use with the following network analyzer systems::

- HP 8510B
- HP 8510C
- HP 8719C
- HP 8720C
- HP 8722C
- HP 8753C
- HP 8753D

It houses a central processing unit with built-in firmware and controls the entire calibration process from either the front panel of the network analyzer or through an external system controller.

Documentation

This manual contains the information required to install, operate, program, and service the HP 85060C Electronic Calibration Control Unit.

This manual is divided into seven major chapters:

- CHAPTER 1 - GENERAL INFORMATION
- CHAPTER 2 - INSTALLATION
- CHAPTER 3 - OPERATION
- CHAPTER 4 - COMMAND REFERENCE
- CHAPTER 5 - TROUBLESHOOTING
- CHAPTER 6 - REPLACEMENT PROCEDURES
- CHAPTER 7 - REPLACEABLE PARTS

Additional copies of this manual can be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the inside of the title page of this manual.

Specifications

Electrical and mechanical characteristics are listed in Table 1-1. These characteristics are the standards or limits against which the instrument may be tested.

Environmental specifications are listed in Table 1-2.

Safety Considerations

This product is a Safety Class I instrument, that is, one provided with a protective earth terminal. The ECal Control Unit and all documentation should be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information for installation, operation, and performance testing is found in appropriate places throughout this manual.

Instruments Covered by this Manual

Attached to the rear panel of this instrument is a serial number plate which shows the instrument's model and serial numbers. The serial number is in the form; 0000000000. The first six digits form the serial number prefix (the first two digits are a country code, the next four are a year/week designation). The last four digits form the suffix (a simple counting sequence). The contents of this manual apply directly to instruments having the serial numbers prefix(es) listed under SERIAL NUMBERS on the title page.

Options

- Option 001 provides front panel ECal module interconnections.
- Option 908 provides a rack mount kit which does not retain the Control Unit front handles.
- Option 910 provides an additional Operating, Programming, and Service Manual.
- Option 913 provides a rack mount kit which retains the Control Unit front handles.

Accessories Supplied

The accessories supplied with the ECal Control Unit are listed on the packing slip. The line power cable is supplied in one of several configurations, depending on the destination of the original shipment. Refer to Power Cables in Chapter 2 of this manual.

Accessories Available

Rack Mounting Kit

Two rack mount kits are available as options (see Options above). Both rack mounting kits contain all of the necessary hardware to allow the ECal Control Unit to be solidly mounted into an equipment rack.

Cables

The ECal Control Unit-to-ECal Module tuner control cable is a DB-25 style, 25 pin, male-to-male, D connector. The HP part number for this and other parts is listed in Chapter 7.

Table 1-1 Electrical and Mechanical Characteristics

Characteristics	Performance Limits
Power Requirements:	
Line Voltage	90 to 250 Vac.
Line Frequency	47 to 63 Hz
Power Dissipation:	200 VA Maximum
Safety:	Meets requirements of IEC 348 and CETM 755
Weights:	
Net Weight	40 kg (18 lbs)
Shipping Weight	50 kg (22.5 lbs)
Dimensions:	
Height	100 mm (3.875 in.)
Width	458 mm (18 in.)
Length	569 mm (22.375 in.)

Table 1-2 Environmental Specifications

Specification	Limits
Operating Temperature[a]	0 to 55 °C (+68 to +79° F).
Error-Corrected Temperature Range[b]	±1 °C of measurement calibration temperature.
Storage Temperature	−40 to 75 °C (-40 to + 167 °F).
Barometric Pressure Altitude:	
Operation	<4,5000 meters (15,000 feet).
Storage	<15,000 meters (50,000 feet).
Relative Humidity	Non-condensing at all times.
Operation	0 to 80% (26 °C maximum dry bulb).
Storage	0 to 95%
EMI	
Conducted susceptibility	CETM 765
Radiated Susceptibility	EN 50082-1 / IEC 801-3
Radiated Emissions	CISPR11
Magnetic Emissions	CETM 765

a. The temperature at which the calibration standards maintain performance to their specifications.

b. The allowable network analyzer ambient temperature drift during measurement calibration and during measurements when the network analyzer correction is turned on. Also, the range over which the

2 Installation

Introduction

This chapter provides the information to install the HP 85060C Electronic Calibration (ECal) Control Unit. Included is information pertinent to initial inspection, power requirements, line voltage and fuse selection, power cables, interconnection, mating connectors, operating environment, bench operations, rack mounting, and storage and shipment. In addition, this chapter contains the procedures for HP-IB address selection.

Initial Inspection

WARNING

To avoid hazardous electrical shock, do not turn on the instrument when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, display).

If the shipping container or cushioning material is damaged, keep it until the contents of the shipment are checked for completeness, and the instrument is checked both mechanically and electrically.

Procedures for checking electrical performance are given in Chapter 3. If the ECal Control Unit does not pass the electrical performance tests, refer to the troubleshooting paragraphs located in Chapter 5.

Notify Hewlett-Packard if any of the following conditions exist:

- The instrument does not pass the performance tests and, using the troubleshooting procedures in Chapter 5, you cannot correct the problem.
- The instrument does not pass the performance tests and you do not wish to troubleshoot the instrument yourself.
- The shipping contents are incomplete.
- There is mechanical damage or defect.

Preparation for Use

Installation Checklist

Before plugging the Control Unit into the line (Main) voltage, ensure that the following steps are taken:

- Check the line (Main) voltage to ensure compatibility with Control Unit requirements (see the section on “Power Requirements”).
- Ensure that the fuse rating is appropriate for the line voltage used. Fuse ratings are listed in Table 2-1 on page 2-2.
- Ensure that the power cable to be used is the required type (See the section on “Power Cables”.
- Plug in the power cable.

CAUTION

*Before plugging this instrumen*t into the line (Main) voltage, ensure that the correct voltage and fuse have been selected.

Power Requirements

The Control Unit requires a power source of 90 to 250 Vac, 47 to 63 Hz single phase. Power consumption is 200 VA maximum.

Line Voltage and Fuse Selection

CAUTION

*Before plugging this instrumen*t into the line (Main) voltage, ensure that the correct voltage and fuse have been selected.

Verify that the fuse is matched to the power source. See Table 2-1 for fuse ratings. Part numbers for these and other parts are listed in Chapter 7.

Table 2-1 Fuse Ratings

LIne Voltage	Fuse Rating
115/120 VAC	4 Amperes
230/240 VAC	2 Amperes

Power Cables

WARNING

Before connecting this instrument, the protective earth terminals of this instrument must be connected to the protective conductor of the line (Main) power cable. The line plug shall only be inserted into a socket provided with a protective earth circuit. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two conductor outlet is not sufficient protection.

This instrument is equipped with a three wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument chassis. The type of power cable plug shipped with each instrument depends on the country of destination. Figure 2-1 on page 2-4 Power Cable and Line (Main) Plug Part Numbers, for the part numbers of these power cables. Cables are available in different lengths and some with right angle plugs to the instrument. Check with your nearest HP service center for descriptions and part numbers for these cables.

THIS PAGE IN FOR THE POWER CABLE AND LINE PLUG PART NUMBERS

FULL PAGE FIGURE 2-1

Figure 2-1 Power Cable and Line (Main) Plug Part Numbers

HP-IB Address Selection for the Control Unit

The HP-IB address for the ECal control unit is selectable from the rear panel using the DIP switch shown in Figure 2-2. When shipped from the factory the address of the HP 85060C is 18. HP-IB addresses from 0 to 30 can be used.

HP-IB Address Selection for the Network Analyzer

The HP-IB address for the network analyzer is selectable from the rear panel using the DIP switches shown in Figure 2-2. When shipped from the factory, the address of the network analyzer is typically 16. Refer to your network analyzer for the actual address. HP-IB addresses from 0 to 30 can be used.

Additional Switch Settings

Both DIP switches contain additional switches labeled "A", "B", and 'T' or "S". Switches "A" and "B" are for future options and should be left in the "0" position. 'T' is a factory test switch and should be left in the "0" position. "S" is used to specify the system controller mode; in the "1" position, the ECal Control Unit functions as the system controller, in the "0" position, it does not.

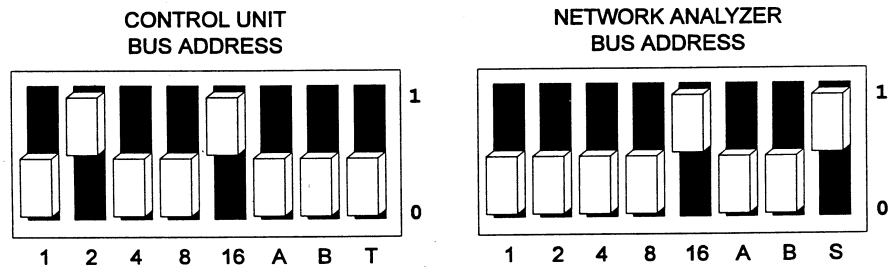

Figure 2-2 Rear Panel HP-IB Address Selection DIP Switches

Interconnections

The connection from the ECal Control Unit to the ECal Module is made through Tuner Control cables. These cables are specifically designed for this application, including EMI considerations, and are the only cables which should be used.

HP-IB Interface Connector. The HP-IB mating connector is standard IEEE-488. Note that the two securing screws are metric.

Operating Environment

The operating environment for the ECal Control Unit is specified in Table 1-2 on page 1-4 in the “Environmental Specification” section. The operating environment for the ECal Modules is specified in the applicable Operating and Service manual(s).

Bench Operation

The instrument has plastic feet and fold away tilt stands for convenience in bench operation. The plastic feet are designed to ensure self aligning of instruments when stacked. The tilt stands raise the front of the instrument for easier viewing of the front panel.

A stacked bench setup diagram is provided as an example in Figure 2-3 on page 2-6.

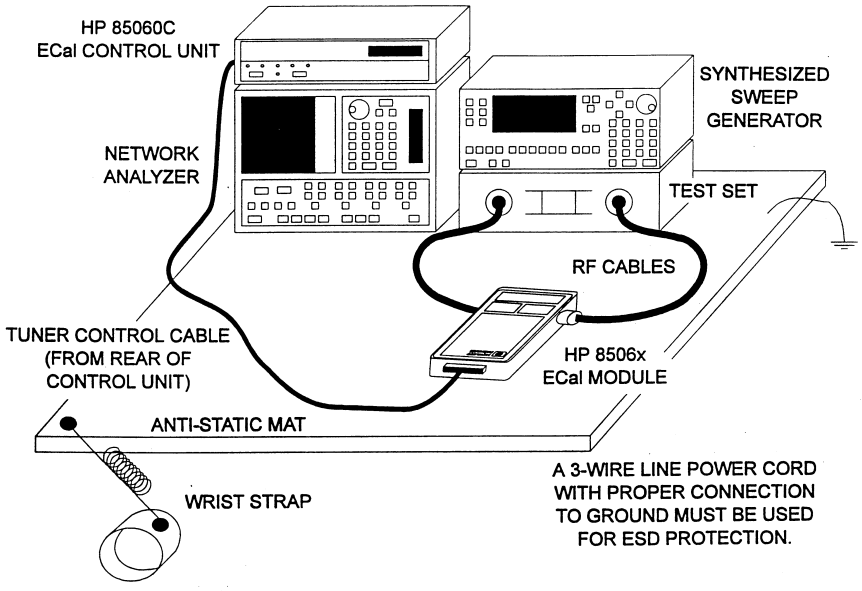

Figure 2-3 HP 85060C ECal System Bench Set-up Example

Rack Mounting

The Control Unit may be rack mounted using Hewlett-Packard sub-module cabinets. Rack mounting information is provided with the rack mounting kits. If the kits were not ordered with the instrument as options, they may be ordered through the nearest Hewlett-Packard office. Refer to Options in Chapter 1 for information regarding rack mounting kits.

Storage and Shipment

Environment

The storage and shipment environment for the ECal Control Unit is specified in Table 1-2 on page 1-4**,** *Environmental Specifications*. The storage and shipment environment for the ECal Modules is specified in the applicable Operating and Service manual(s).

Packaging

Tagging for Service.

If the instrument is being returned to Hewlett-Packard for service, please provide the following information (attach to the instrument if possible):

- COMPANY NAME
- COMPANY ADDRESS
- TECHNICAL CONTACT PERSON
- TELEPHONE NUMBER and EXTENSION
- MODEL NUMBER
- SERIAL NUMBER
- P.O. NUMBER
- DATE
- ACCESSORIES RETURNED WITH INSTRUMENT
- TYPE OF SERVICE NEEDED (REPAIR, CALIBRATION, etc...)
- FAILURE DESCRIPTION

To minimize repair time, be as specific as possible when describing the failure. Keep the following two items in mind when describing the failure:

1. Describe what makes you think the instrument is failing. An example might be "The network analyzer menus do not appear when I push the RUN button on the Control Unit".
2. If the failure occurs only under certain conditions, explain how to duplicate the failure. An example might be "The Control Unit will not calibrate the network analyzer in the 45 MHz to 1.5 GHz range."

Original Packaging

Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. Mark the container "FRAGILE" to encourage careful handling. In any correspondence, refer to the instrument by model number and full serial number.

Other Packaging

The following general instructions should be used for repackaging with commercially available materials.

1. Wrap the instrument in heavy paper or ESD protective packaging. If shipping to a Hewlett-Packard office or repair center, supply the information mentioned above (in Tagging For Service) and attach it to the instrument.
2. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.
3. Use enough shock-absorbing material (75 to 100 mm layer; 3 to 4 inches) around all sides of the instrument to provide a firm cushion and prevent movement in the container. Protect the front panel with an appropriate type of cushioning material to prevent damage during shipment.
4. Seal the shipping container securely.
5. Mark the shipping container "FRAGILE" to encourage careful handling.

3 Operation

Introduction

This chapter describes the operation and characteristics of the ECal system, illustrates the features and functions of the standard and optional front and rear panels of the ECal control unit and explains the setup and use of the control unit in a system.

ESD Cautions

Always use an antistatic wrist strap when calibrating or verifying the test set or when using the test set to measure devices. Never touch test port or ECal module center conductors or the exposed pins of the tuner control cable.

Theory of Operation

The ECal (Electronic Calibration) system determines the systematic errors of a vector network analyzer through a one-time connection of the ECal module to the network analyzer port(s). The random error of connector non-repeatability is reduced substantially through the one-time connection when compared to the frequent connects and disconnects of the conventional method (open / short / load).

The ECal Module is a solid state, microwave, two-port device which is capable of establishing a plurality of reflection coefficients at each of its ports, a low-loss transmission coefficient between its ports, and also high isolation between its ports. This allows the module to simulate a wide variety of conventional calibration standards. These coefficients are characterized (pre-calibrated) for each module at the factory, and the characterization is stored within each module. The characterization is traceable to the National Institute of Standards and Technology (NIST).

Since the response of the ECal module is known to a high degree of accuracy the ECal system can present one or more of these modules, use the results of these uncorrected measurements to produce error coefficients, and provide these error coefficients for use by the accuracy enhancement algorithms of the network analyzer. The network analyzer can then use this data in a model of the measurement system, measure a device, and utilize vector mathematics to compute actual device response by removing error contributions.

Figure 3-1 on page 3-2 shows a typical ECal system conceptual diagram. Figure 3-2 on page 3-3 shows a typical operating sequence.

NOTE This drawing is not to scale.

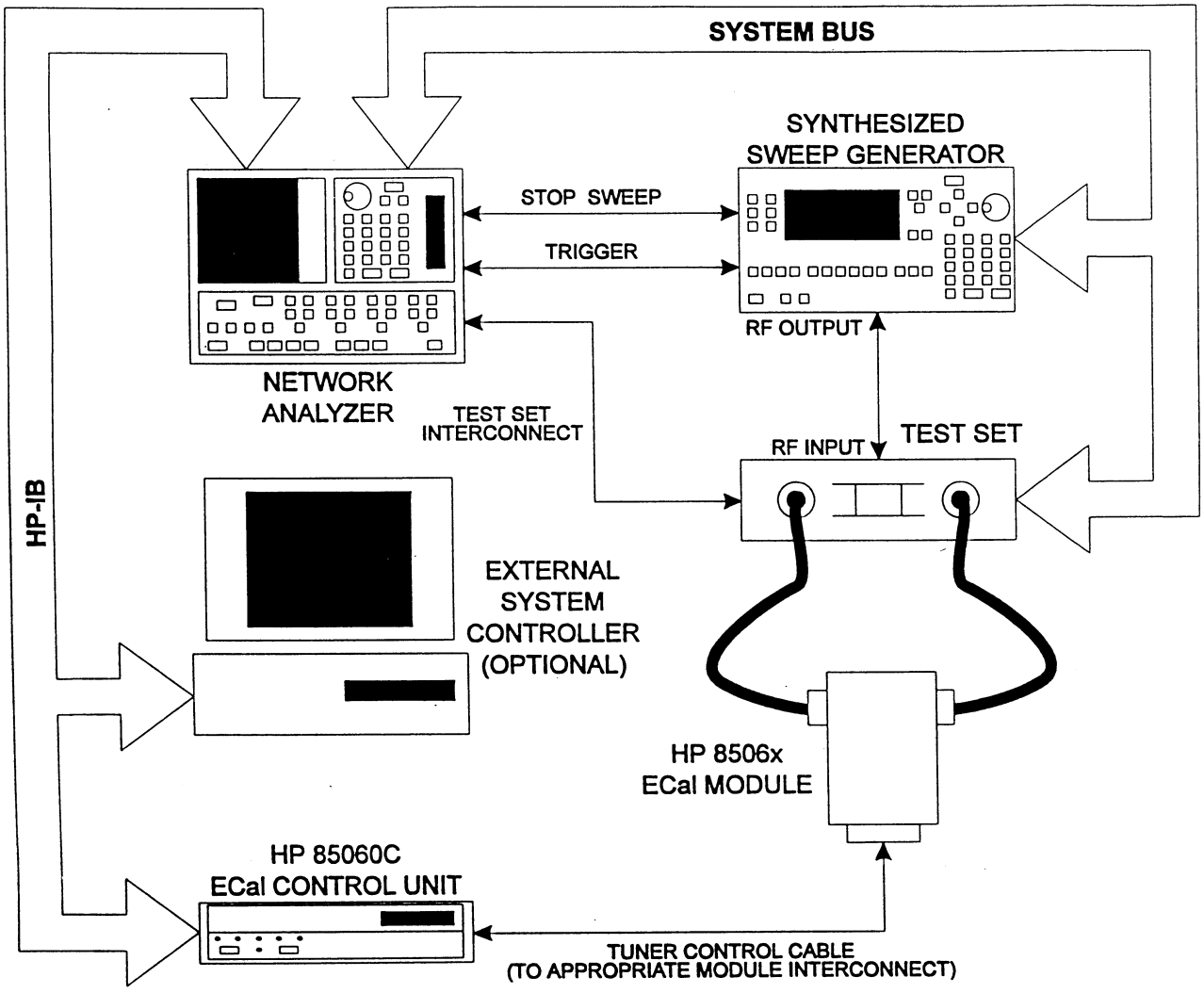

Figure 3-1 HP 85060C ECal System Conceptual Block Diagram

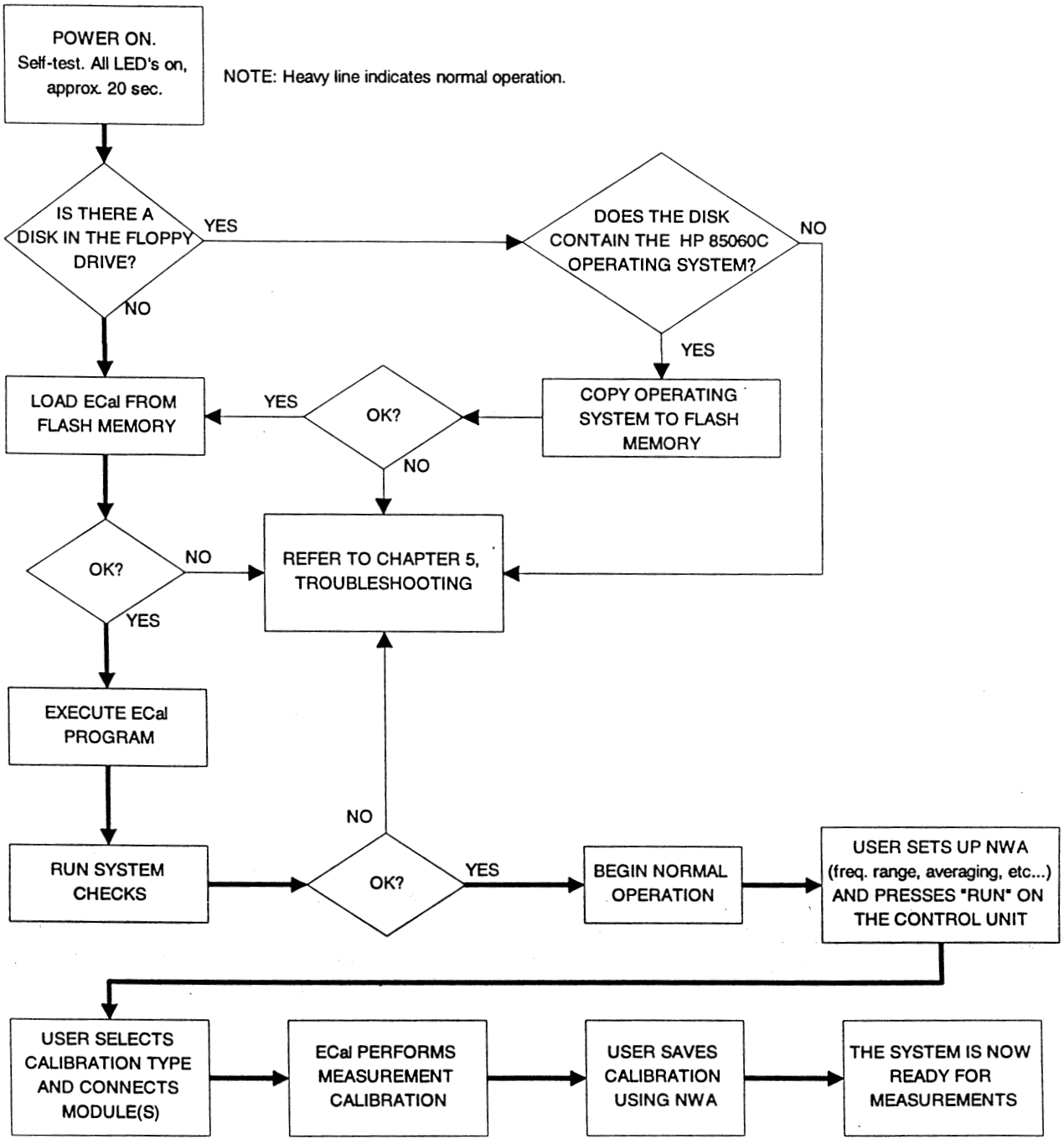

Figure 3-2 Typical Operating Sequence

Operating Characteristics

The operating characteristics of the ECal control unit are largely module dependent. Table 3-1 briefly summarizes the major operating characteristics of the ECal System, i.e.; the control unit with module(s). This table is not intended to be an in-depth listing of all operations and ranges but gives an idea of the instruments capabilities.

RF Input Power is +20 dBm maximum, any module, any condition.

Table 3-1 Operating Characteristics

Module Part Number	Connector Type	Frequency Range
85060-60001	7 millimeter	45 MHz to 2 GHz
85060-60002	7 millimeter	1 to 18 GHz
85062-60001	3.5 millimeter, insertable	45 MHz to 2 GHz
85062-60002	3.5 millimeter, insertable	1 to 26.5 GHz
85062-60003	3.5 millimeter, insertable male	45 MHz to 2 GHz
85062-60004	3.5 millimeter, insertable male	1 to 26.5 GHz
85062-60005	3.5 millimeter, insertable female	45 MHz to 2 GHz
85062-60006	3.5 millimeter, insertable female	1 to 26.5 GHz
85064-60001	Type N, insertable	45 MHz to 2 GHz
85064-60002	Type N, insertable	1 to 18 GHz
85064-60003	Type N, insertable male	45 MHz to 2 GHz
85064-60004	Type N, insertable male	1 to 18 GHz
85064-60005	Type N, insertable female	45 MHz to 2 GHz
85064-60006	Type N, insertable female	1 to 18 GHz

Turn-on Information

WARNING

Before the instrument is switched on, all protective earth terminals, extension cords, autotransformers, and devices connected to it should be connected to protective earth grounded socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury. Only fuses listed in Table 2-1 should be used. Do not use repaired fuses or short circuited fuse holders. To do so could cause a shock or fire hazard.

Turn-on Procedure

If the control unit is already plugged in, press the line switch to ON. If the power cable is not plugged in follow these instructions:

1. Check that the fuse rating is appropriate for the line voltage used (see Table 2-1 on page 2-2).
2. Plug in the power cable.
3. Insure that there is no diskette in the floppy drive unless an ECal System firmware upgrade is to performed.
4. On the front panel, press the LINE switch to ON.

When the control unit is turned on, all of the front panel LED's will come on until the power up is complete. When power up is complete all of the LED's, except the Line Power LED, will turn off.

If any of the LED's fail to come on, the Line Power LED fails to remain on, or the other LED's remain on after power up, refer to the “Troubleshooting” chapter in this manual.

Connecting and Disconnecting Modules

WARNING

DO NOT connect or disconnect calibration modules while loading system software using the floppy drive. Doing so may cause internal damage to the control unit.

At other times, modules may be connected or disconnected during control unit operation, although sufficient module warm-up time must be allowed before initiation of the calibration process (see note below).

Ensure that only HP 85060X ECal Modules are connected to the ECal control unit module interface, and that only Tuner Control Cables provided with the ECal Control Unit are used.

NOTE

Valid calibration can not be guaranteed without proper warm-up. Refer to the appropriate calibration kit Operating and Service Manual.

The control unit automatically recognizes ECal modules as they are connected. Any of the four module interconnections may be used for any ECal module. The ECal system will recognize a module as Module A, B, C, or D based on the module interconnection used.

Unused modules, or modules that have completed the calibration process, may be left connected and, therefore, warmed up and ready for use. Insure that proper care is taken with ECal modules at all times, refer to the appropriate calibration kit Operating and Service Manual for more information.

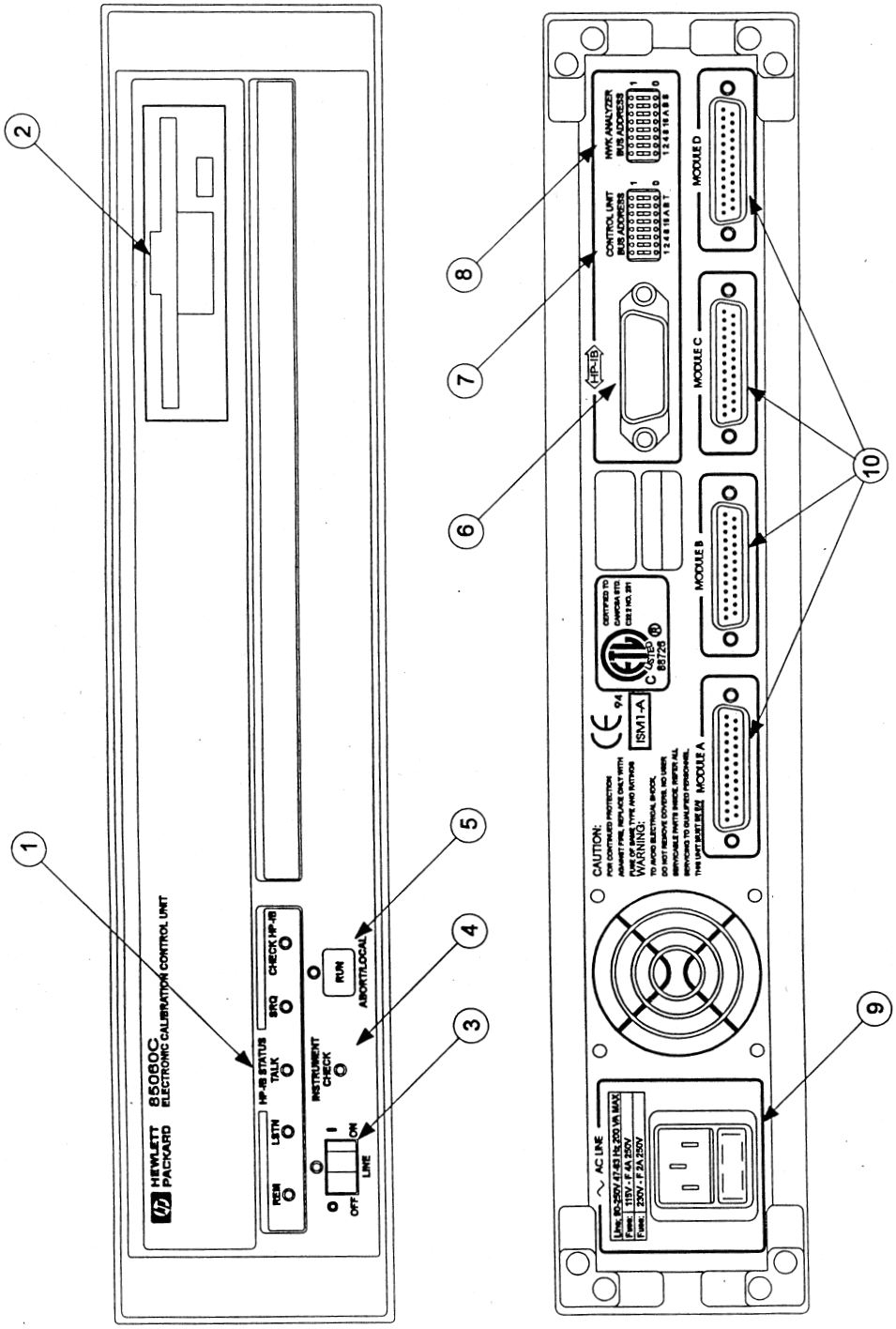

Figure 3-3 Front and Rear Panel Features

Panel Features

Front Panel and Rear Panel Features for the Standard and Optional Configurations

Figure 3-3 on page 3-7 shows the ECal control unit front and rear panel features for the standard configuration (rear panel ECal module interconnections).

In the optional configuration (front panel ECal module connections) the functionality of all of the features remain the same as in the standard configuration. Only the location of the module interconnections is changed.

Refer to Figure 3-3 on page 3-7 for the following panel feature descriptions.

Table 3-2 Panel Feature Descriptions

Panel Feature	Descriptions
HP-IB Status LED's	These LED's show the HP-IB interface status as follows:
REM:	When illuminated this LED indicates the interface is in the REMOTE mode.
LSTN:	When illuminated this LED indicates the ECal control unit is addressed as LISTENER.
TALK:	When illuminated this LED indicates the ECal control unit is addressed as TALKER.
SRQ:	When illuminated this LED indicates the ECal control unit is asserting a SERVICE REQUEST.
Check HP-IB:	When illuminated this LED indicates an HP-IB (IEEE488) fault.
3.5 inch Floppy Disk Drive	Used for ECal firmware upgrades. Floppy drive usage is not required for operation.
Line Switch and Line LED	The line switch turns the ECal control unit on and off. When the side of the switch labeled 0 is depressed, the control unit is off; 1 is on. The line LED goes on and off with the control unit line switch.
Instrument Check LED	Continued illumination of this LED after turn-on indicates a that the built-in diagnostic routine has detected some problem. Refer to Chapter 5, Troubleshooting.
Run Switch	The RUN switch controls test set calibration from the front panel of the control unit. Depressing this switch begins the calibration process. This switch also functions as an ABORT to stop the calibration process.
System Bus Connector	This connector is used for HP-IB communications with the network analyzer.

Table 3-2 Panel Feature Descriptions (Continued)

Panel Feature	Descriptions
Control Unit Bus Address Switch	This eight-pole weighted switch sets the system bus address of the control unit. The binary weight of each pole is indicated on the rear panel, as are the on and off positions. Decimal 18 is the default setting.
Network Analyzer Bus Address Switch	This eight-pole weighted switch sets the system bus address of the network analyzer. The binary weight of each pole is indicated on the rear panel, as are the on and off positions. Decimal 16 is the default setting.
Line Module	This assembly houses the line cord connector and line fuse. Pull out the bottom of the line module cover to replace or change the fuse. Recommended fuse values are printed on the rear panel.
ECal Module Interconnects	These connectors transmit the control information to the appropriate calibration module. The connections for the individual modules are printed on the rear panel (Module A,B,C,or D).

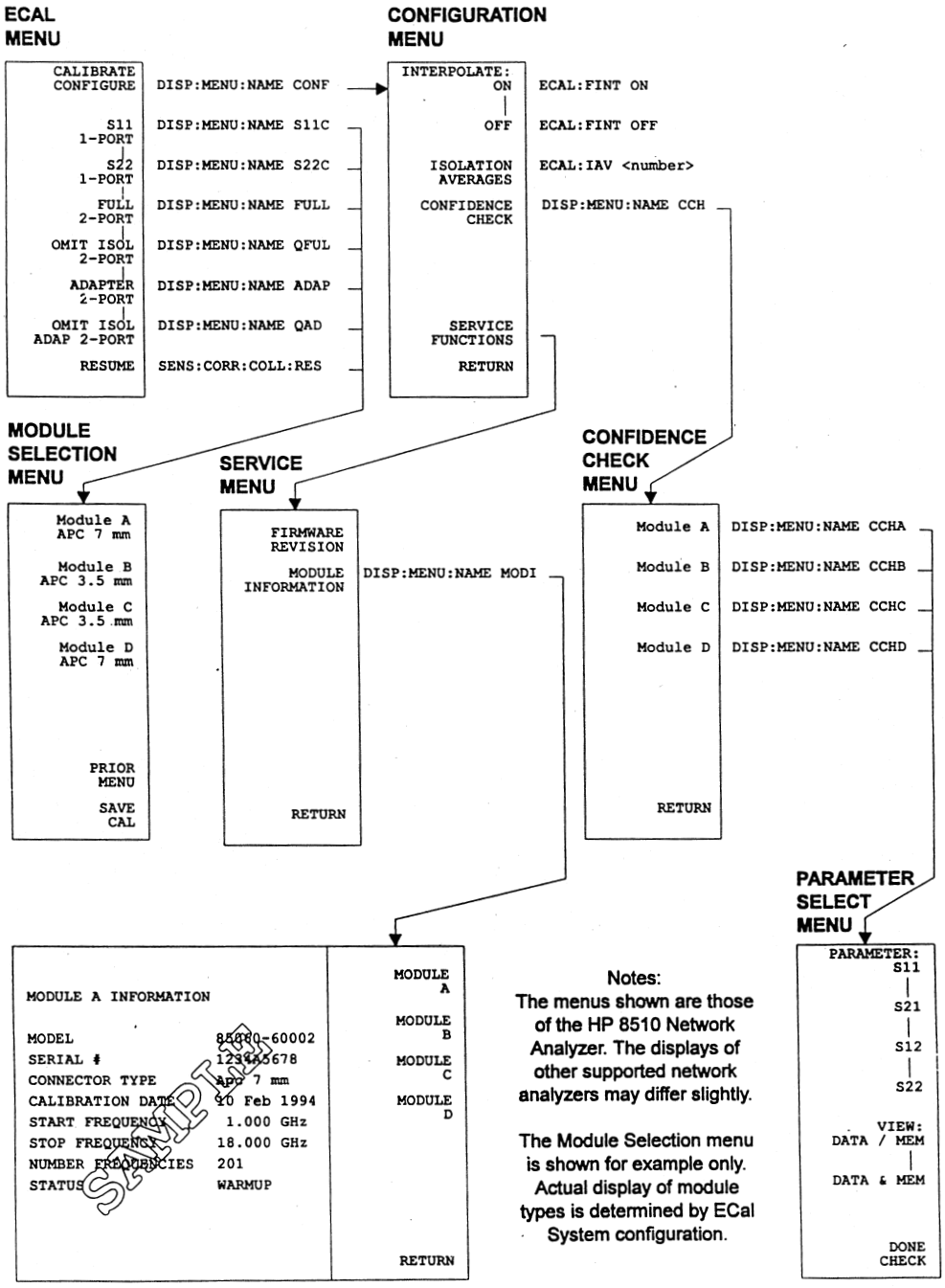

Figure 3-4 Sample Network Analyzer ECal Menus

Stand-alone (Manual) Operation

System Configuration for Stand-alone Operation

- Connect the network analyzer to the ECal control unit via HP-IB cable (when using the HP 8510, use the HP-IB connector as opposed to the 8510 Interconnect).
- Insure ECal is set as the system controller, refer to the "Additional Switch Settings" section in the "Installation" chapter for DIP switch settings. Other instruments may be on the bus, but ECal must be the only controller.
- The ECal control unit and the network analyzer each must have unique HP-IB addresses as defined on the ECal rear panel. Defaults are 18 for the ECal control unit, 16 for the network analyzer.
- DIP switch settings are only read during the boot cycle. After changing settings, remember to cycle power to use the new settings.

Accessing Menus

All calibration menus and prompts required in the ECal process will be displayed on the network analyzer.

- Pressing "RUN,' on the ECal control unit initiates the calibration process as follows:
  - Illuminates the ECal control unit "RUN" LED.
  - Accesses the ECal top level menu on the network analyzer display using commands appropriate to the module type(s). Pressing one of the softkeys will then access ECal sub-menus, shown in Figure 3-4 on page 3-11 The ECal menus will remain on the display until a network analyzer action accesses a non-ECal menu, or the ECal front panel "RUN" button is pressed.

If the ECal menus do not appear, note the condition of the ECal front panel LED's and refer to the "Troubleshooting" chapter in this manual.

Types of Analyzers

The ECal System is designed to work with a variety of network analyzers. Supported models are listed in the "General Information" chapter of this manual.

Setting Calibration Parameters

Calibration parameters define specific calibration settings or provide the user with information on the ECal setup. Select "CALIBRATION CONFIGURE" in the top level ECal menu to access the configuration menu (Figure 3-4 on page 3-11.

The function of each calibration parameter is as follows:

Table 3-3 Calibration Parameters

Calibration Parameter	Function
Interpolate <ON I OFF>	The Interpolate <ON I OFF> function is used to enable or disable the frequency interpolation capability of the ECal system. With interpolation ON (enabled), any frequencies within the span of the characterized modules may be measured. With interpolation OFF (disabled), only frequencies which correspond to characterization frequencies of the modules will be allowed.
Isolation Averages	For all calibration measurements other than Isolation, calibration measurements will be performed with the averaging value specified in the network analyzer setup. Typically, the user will increase the number of averages significantly if Isolation measurements are to be performed. The Isolation Averages function is used to set the number of averages to a user specified value (1-4096 for the HP 8510, 1-999 for the HP 87xx series).
Confidence Check	This function provides a comparison of the current ECal module measurements vs. the factory characterization measurements. Results are displayed using the network analyzer.
Service Functions: Firmware Revision	This function will display the ECal system firmware revision on the network analyzer display.
Service Functions: Module Information	This function will display the following module information on the network analyzer display; Model Number, Serial Number, Connector Type, Calibration Date, Start Frequency, Stop Frequency, Number of Frequencies, and Current Module Status.
Return	This function will return the user to the top level menu.

Selecting Modules

ECal module selection is performed by the user and should be based on connector type and frequency range of the device-under-test. Available modules are listed by part number and description in Table 3-1.

Performing Calibrations

The calibration type and procedure to be used depends on the type and accuracy of measurement required for the device-under-test. The following paragraphs provide information regarding the six available calibration types, including the best application for each type and a brief description. For more detailed information, refer to the appropriate network analyzer user's manual or Hewlett-Packard application notes.

Calibrations are performed using the network analyzer configuration settings (number of averages, etc...) with the exception of isolation calibrations which are performed using the number of averages set in the ECal configuration menu.

When using HP 8510 series network analyzers, calibrations cannot be performed in the ramp sweep mode. If ramp sweep is required during measurement of the device-under-test, calibrate in step mode and perform measurements in ramp mode. When switching from step to ramp mode, the message CAUTION: CORRECI ION MAY BE INVALID will be displayed. It is the users responsibility to determine whether the change invalidates the calibration. This can be accomplished by comparing the DUT response in step vs. ramp mode. In general, ramp sweep is recommended only for tuning purposes; for accurate device measurements, use step sweep.

Likewise, for HP 8720 series network analyzers, "swept" mode calibrations are not allowed. Calibrations should be performed using sweep type "STEPPED ON". If swept measurements are required, calibrate in step mode (STEPPED ON) and perform measurements in swept mode (STEPPED OITF). The network analyzer will display the message "C?" to indicate that the sweep type was changed.

The “Performing Calibrations” section in this chapter describes the calibration procedures in detail.

NOTE

Insertable devices are those in which the mating connectors are of the same type, opposite gender. For example; a device where the input connector is male, and the output connector is female. Non-lnsertable devices are those in which the mating connectors are of the same type, and same gender. For example; a device where both input and output connectors are female.

For adapter calibrations using multiple (more than one) calibration modules, all modules must be measured before adapters are measured.

S11-PORT

The Sll 1-PORT calibration is best applied to high accuracy reflection measurements of one-port devices using Port 1 of the test set.

This calibration determines the directivity, source match, and reflection tracking error terms. These terms are then loaded into the network analyzer to be used in vector error correction for reflection measurements.

S221-PORT

The S22 1-PORT is essentially the same calibration as the S 11 1 -PORT, but uses Port 2 of the test set.

FULL 2-PORT

The FULL 2-PORT calibration is best applied to high accuracy magnitude and phase measurements (including isolation) of insertable two-port devices.

This 12-term calibration provides full directivity, isolation, source match, load match, and frequency response vector error correction for transmission and reflection measurements. It requires measurement of all four S-parameters and is therefore more time consuming.

OMIT ISOL 2-PORT

The OMIT ISOL 2-PORT calibration is best applied to high accuracy magnitude and phase measurements (excluding isolation) of insertable two-port devices.

This calibration provides all of the functionality of the FULL 2-PORT calibration with the exception of isolation measurements, and is therefore quicker.

ADAPTER 2-PORT

The ADAPTER 2-PORT calibration is best applied to high accuracy magnitude and phase measurements (including isolation) of non-insertable two-port devices. This is essentially the same calibration as the FULL 2-PORT with the exception that metrology grade adapters are used.

This 12-term calibration provides full directivity, isolation, source match, load match, and frequency response vector error correction for transmission and reflection measurements. It requires measurement of all four S-parameters and is therefore more time consuming.

OMIT ISOL ADP 2-PORT

The OMIT ISOL ADP 2-PORT calibration is best applied to high accuracy magnitude and phase measurements (excluding isolation) of non-insertable two-port devices. This is essentially the same calibration as the OMIT ISOL 2-PORT with the exception that metrology grade adapters are used.

This calibration provides all of the functionality of the ADAPIER 2-PORT calibration with the exception of isolation measurements, and is therefore quicker.

Optimizing Performance in the Overlapping Frequency Range

The HP 85060 series calibration kits may contain two modules, lowband and highband, which overlap in frequency coverage. For example; the HP 85060A with Option 001 contains a lowband (0.045-2 GHz) module and a high band (1-18 GHz) module. In the overlapping frequency range, the module specifications may vary.

When performing measurements in the overlapping frequency range, use the module with the best specifications over the overlapping frequency range. Consult the *HP 85060 Family Electronic Calibration System Product Overview* or the network analyzer verification software for specifications.

When performing broadband calibrations that span the overlapping frequency range, e.g. 0.045-18 GHz, the HP 85060C control unit uses the data from the module which was connected *last* during the calibration sequence. For best performance, connect the highest performance module last during the calibration sequence.

Calibration Procedures

To Perform an S11 1-PORT Calibration

1. Set up the network analyzer as required (see the appropriate network analyzer user's manual for more information).
2. Select the appropriate ECal module(s) for frequency range and connector type (see Table 3-1 on page 3-4 for a listing).
3. Connect ECal module to the control unit to begin the warm-up. Refer to the appropriate calibration kit Operating and Service Manual.
4. Press "RUN" on the control unit.
5. Select "S 11 1-PORT" from the top level menu of the network analyzer (see Figure 3-4 on page 3-11).This will access the measurement menus.
6. Connect the module to Port 1 of the network analyzer (although module Port A or B may be used interchangeably for single port measurements, module Port A is preferred).
7. Press the appropriate measurement key for the module type connected. The ECal system will now begin the calibration process, progress is indicated on the network analyzer display. Upon calibration completion, the module designation (Module A, B, etc...) will be underlined on the network analyzer menu.
8. Repeat as necessary using all modules required to cover the desired frequency band.
9. Press "SAVE CAL" on the measurement menu.
10. . Select a storage register from the network analyzer save register menu.The HP 8510B/C will request the user to select a calset register, this is optional on the HP 87xx series network analyzers. The ECal control unit floppy drive can not be used for this purpose.
11. Calibration is now complete. The network analyzer display returns to the top level menu.

To Perform an S22 1-PORT Calibration

1. Set up the network analyzer as required (see the appropriate network analyzer user's manual for more information).
2. Select the appropriate ECal module(s) for frequency range and connector type (see Table 3-1 on page 3-4 for a listing).
3. Connect ECal module to the control unit to begin the warm-up. Refer to the appropriate calibration kit Operating and Service Manual.
4. Press "RUN" on the control unit.
5. Select "S22 1-PORT" from the top level menu of the network analyzer (see Figure 3-4 on page 3-11**.** This will access the measurement menus.
6. Connect the module to Port 2 of the network analyzer (although module Port A or B may be used interchangeably for single port measurements, module Port A is preferred).
7. Press the appropriate measurement key for the module type connected. The ECal system will now begin the calibration process, progress is indicated on the network analyzer display. Upon calibration completion, the module designation (Module A, B, etc...) will be underlined on the network analyzer menu.
8. Repeat as necessary using all modules required to cover the desired frequency band.
9. Press "SAVE CAL" on the measurement menu.
10. Select a storage register from the network analyzer save register menu.The HP 8510B/C will request the user to select a calset register, this is optional on the HP 87xx series network analyzers. The ECal control unit floppy drive can not be used for this purpose.
11. Calibration is now complete. The network analyzer display returns to the top level menu.

To Perform a FULL 2-PORT Calibration

1. Set up the network analyzer as required (see the appropriate network analyzer user's manual for more information).
2. Select the appropriate ECal module(s) for frequency range and connector type Figure 3-1 on page 3-4 for a listing).
3. Connect ECal module to the control unit to begin the warm-up. Refer to the appropriate calibration kit Operating and Service Manual.
4. Press "RUN" on the control unit.
5. Select "FULL 2-PORT" from the top level menu of the network analyzer (see Figure 3-4 on page 3-11). This will access the measurement menus.
6. Connect the module to the network analyzer.
7. Press the appropriate measurement key for the module type connected. The ECal system will now begin the calibration process, progress is indicated on the network analyzer display. Upon calibration completion, the module designation (Module A, B, etc...) will be underlined on the network analyzer menu.
8. Repeat as necessary using all modules required to cover the desired frequency band.
9. Press "SAVE CAL" on the measurement menu.
10. Select a storage register from the network analyzer save register menu.The HP 8510B/C will request the user to select a calset register, this is optional on the HP 87xx series network analyzers. The ECal control unit floppy drive can not be used for this purpose.
11. Calibration is now complete. The network analyzer display returns to the top level menu.

To Perform an OMIT ISOL 2-PORT Calibration

1. Set up the network analyzer as required (see the appropriate network analyzer user's manual for more information).
2. Select the appropriate ECal module(s) for frequency range and connector type (Table 3-1 on page 3-4 a listing).
3. Connect ECal module to the control unit to begin the warm-up. Refer to the appropriate calibration kit Operating and Service Manual.
4. Press "RUN" on the control unit.
5. Select "OMIT ISOL 2-PORT" from the top level menu of the network analyzer (Figure 3-4 on page 3-11). This will access the measurement menus.
6. Connect the module to the network analyzer.
7. Press the appropriate measurement key for the module type connected. The ECal system will now begin the calibration process, progress is indicated on the network analyzer display. Upon calibration completion, the module designation (Module A, B, etc...) will be underlined on the network analyzer menu.
8. Repeat as necessary using all modules required to cover the desired frequency band.
9. Press "SAVE CAL" on the measurement menu.
10. Select a storage register from the network analyzer save register menu.The HP 8510B/C will request the user to select a calset register, this is optional on the HP 87xx series network analyzers. The ECal control unit floppy drive can not be used for this purpose.
11. Calibration is now complete. The network analyzer display returns to the top level menu.

To Perform an ADAPTER 2-PORT Calibration

1. Set up the network analyzer as required (see the appropriate network analyzer user's manual for more information).
2. Select the appropriate ECal module(s) for frequency range and connector type Table 3-1 on page 3-4 a listing). Also, select the appropriate adapter(s).
3. Connect ECal module to the control unit to begin the warm-up. Refer to the appropriate calibration kit Operating and Service Manual.
4. Press "RUN" on the control unit.
5. Select "ADAPTER 2-PORT" from the top level menu of the network analyzer (see Figure 3-4 on page 3-11. This will access the measurement menus.
6. Connect the module(s) to Port 2 of the network analyzer as shown in Figure 3-5 on page 3-22 Press the appropriate measurement key for the module type connected. The ECal system will now begin the calibration process, progress is indicated on the network analyzer display. Upon calibration completion, the module designation (Module A, B, etc...) will be underlined on the network analyzer menu.
7. Repeat as necessary using all modules required to cover the desired frequency band.
8. Press "NEXT MENU" to continue.
9. Connect the adapter to Port 2 of the network analyzer as shown in Figure 3-5 on page 3-22 For adapter calibrations using multiple (more than one) calibration modules, all modules must be measured before adapters are measured. For best accuracy, once connected to Port 2 the adapter should remain connected until calibration is complete.
10. Connect the module between Port 1 of the network analyzer and the adapter as shown in Figure 3-5 on page 3-22 Repeat step 7.
11. Repeat as necessary using all modules required to cover the desired frequency band.
12. Press "SAVE CAL" on the measurement menu.

13. Select a storage register from the network analyzer save register menu.The HP 8510B/C will request the user to select a calset register, this is optional on the HP 87xx series network analyzers. The ECal control unit floppy drive can not be used for this purpose.
14. Calibration is now complete. The network analyzer display returns to the top level menu.

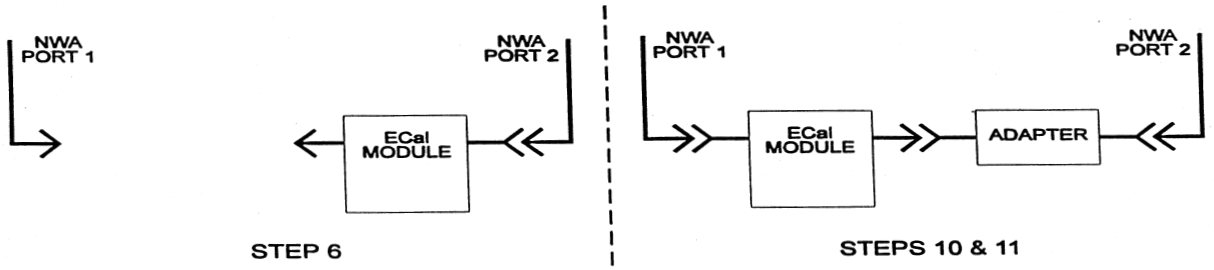

Figure 3-5 Adapter Calibration Connection Diagram

To Perform an OMIT ISOL ADP 2-PORT Calibration

1. Set up the network analyzer as required (see the appropriate network analyzer user's manual for more information).
2. Select the appropriate ECal module(s) for frequency range and connector type (refer to Table 3-1 on page 3-4 for a listing). Also, select the appropriate adapter(s).
3. Connect ECal module to the control unit to begin the wann-up. Refer to the appropriate calibration kit Operating and Service Manual.
4. Press "RUN" on the control unit.
5. Select "OMIT ISOL ADP 2-PORT" from the top level menu of the network analyzer (see Figure 3-4 on page 3-11). This will access the measurement menus.
6. Connect the module(s) to Port 2 of the network analyzer as shown in Figure 3-5 on page 3-22.
7. Press the appropriate measurement key for the module type connected. The ECal system will now begin the calibration process, progress is indicated on the network analyzer display. Upon calibration completion, the module designation (Module A, B, etc...) will be underlined on the network analyzer menu.
8. Repeat as necessary using all modules required to cover the desired frequency band.
9. Press "NEXT MENU" to continue.
10. Connect the adapter to Port 2 of the network analyzer as shown in Figure 3-5 on page 3-22**.**

NOTE

For adapter calibrations using multiple (more than one) calibration modules, all modules must be measured before adapters are measured. For best accuracy, once connected to Port~2 the adapter should remain connected until calibration is complete.

11. Connect the module between Port 1 of the network analyzer and the adapter as shown in Figure 3-5 on page 3-22 Repeat step 7.
12. Repeat as necessary using all modules required to cover the desired frequency band.
13. Press "SAVE CAL" on the measurement menu.
14. Select a storage register from the network analyzer save register menu.The HP 8510B/C will request the user to select a calset register, this is optional on HP 87xx series network analyzers. The ECal control unit floppy drive can not be used for this purpose.

15. Calibration is now complete. The network analyzer display returns to the top level menu.

Performing the Confidence Check

The CONFIDENCE CHECK function is provided as a means of checking the accuracy of a stored (saved) calibration. Each ECal module has a special state, the confidence state, which has been pre-measured. The pre-measured corrected data has been stored in nonvolatile, or permanent, module memory.

The confidence check has been designed for use after a two-port calibration. It can, however, be used after a one-port calibration provided the unused module port is terminated with a 50 ohm load with a minimum of 30 dB of return loss.

When the confidence check is selected, the ECal control unit will read the pre-measured corrected data, store it into network analyzer memory, and then use the calibration stored in the network analyzer to make a corrected measurement of the confidence state. These measurements are then presented in a graphical way.

The graphical options available depend on the type of calibration being checked. If the confidence check is used for a two-port calibration, all four S-parameters are available. For a one-port calibration, the reflection option S 11 or S22 will be available, depending on the calibration type.

In any case, the data may be displayed in one of two ways:

- With the "BOTH" option, the pre-measured data and the current data are displayed, and a visual comparison of these measurements may be made.
- With the "DIV" option, only a ratio of the pre-measured data to the current data is displayed.

The confidence check will change many network analyzer parameters for data presentation. Choosing "DONE CHECK" will complete the confidence check and restore the network analyzer conditions—with the exception of data in memory that were in effect before the confidence check was invoked.

To Perform a Confidence Check

1. Set up the network analyzer as required (see the appropriate network analyzer user's manual for more information).
2. Select the appropriate ECal module(s) for frequency range and connector type (see Table 3-1 on page 3-4 for a listing). Also, select the appropriate adapter(s).
3. Connect ECal module to the control unit to begin the warm-up. Refer to the appropriate calibration kit Operating and Service Manual.
4. Press "RUN" on the control unit.
5. Select "CALIBRATE CONFIGURE" from the top level menu of the network analyzer (see Figure 3-4 on page 3-11). This will access the configuration menu.
6. Select "CONFIDENCE CHECK" from the configuration menu. This will access the confidence check module selection menu.
7. Connect the module(s) to the network analyzer as appropriate.
8. Select a module from the module selection menu. This will access the parameter selection menu.
9. Select a parameter and / or a display option from the parameter selection menu. This will cause a series of events which include downloading the corrected pre-measured parameter data and measurement of the confidence state. The data will be presented in the manner selected.
10. If another parameter or display option is desired, repeat step 9.
11. When finished, select "DONE CHECK". This will reset the network analyzer to the conditions that were in e*ect when the confidence check was invoked. If this is not done, noncritical scales, parameters, and display options may be left in place.
12. Confidence check is now complete. The network analyzer display returns to the top level menu.

Remote Operation

The ECal system is capable of remote operation via the Hewlett-Packard Interface Bus (HP-IB) and is compliant with EKE 488.2-1987, IEEE Standard Codes, Formats, Protocols, and Common Commands for use with ANSI/IEEE Standard 488.2-1987.

Instructions pertinent to HP-IB operation cover considerations and instructions specific to remote operation including capabilities, addressing, input and output formats, the status byte, and service requests.

System Configuration for Remote Operation

- Connect the host computer and network analyzer to the ECal control unit via HP-IB cable (when using the HP 8510, use the HP-IB connector as opposed to the 8510 Interconnect).
- Insure ECal is not set as the system controller, see paragraph 2-3.7 for DIP switch settings. Other instruments may be on the bus, but ECal must be the only controller. The host computer, the ECal control unit, and the network analyzer each must have unique HP-IB addresses as defined on the ECal rear panel. Defaults are 18 for the ECal control unit, 16 for the network analyzer. Refer to the “Additional Switch Settings” section in the “Installation” chapter of this manual for DIP switch settings.

NOTE

DIP switch settings are only read during the boot cycle. After changing settings, remember to cycle power to use the new settings.

Communicating with Host Computers

ECal functions can be grouped into two categories, those which require active control (specifically, ECal commands which talk to the network analyzer) and those which do not. The following seven commands require active control:

- **`DISP:MENU:NAME`**
- **`SENS:CORR:COLL:ACQ`**
- **`SENS:CORR:COLL: SAVE`**
- **`SENS:CORR:COLL:RESU`**
- **`SENS:CORR:COLL: DONE`**
- **`SENS:CORR:COLL: NEXT`**
- **`SENS:CORR:COLL:PRI`**

All other commands are handled solely by the ECal control unit, and therefore do not require active control.

Sending Commands Which Require Pass Control

Commands listed in the “Sending Commands Which Do Not Require Pass Control” section in this chapter require access to the network analyzer, and therefore require that the host pass control to the ECal control unit.

The following example sends the DISP:MENU:NAME ECAL command which tells the control unit to display the top level ECal system menu.

```
10   OUTPUT 718;.DISP:MENU:NAME ECAL
20   CALL Pass_control
30   END
40   SUB Pass_control
50   OUTPUT 718;”*ESR?”       ! Read the Event Status Register
60   ENTER 718;Esr
70   IF NOT BIT (Esr,1) THEN  ! Ensure that ECal wants control
80     PRINT “ECal does not want control”
90   ELSE
100    REMOTE 7
110    PASS CONTROL 718       ! Pass control to ECal
120    PRINT “CONTROL PASSED TO ECAL
130    LOOP
140      STATUS 7,3;Stat      ! Monitor Interface Status
150      EXIT IF BIT (Stat,6)! Finish when Control is returned
160  END LOOP
170  PRINT “CONTROL RETURNED FROM ECAL”
180   END IF
190   SUBEND
```

When this example is run, the DISP:MENU:NAME command is sent in line 10. You should then see the "CONTROL PASSED TO ECAL” message on the host, and the top level ECal menu on the network analyzer display. You may move through the ECal menus as desired. When finished, exit the ECal menus (press the ECal "RUN" key or select a network analyzer menu). The message "CONTROL RETURNED FROM ECAL~ will be displayed on the host.

NOTE

The ECal system will pass control back to the host when it is finished with the network. It expects to find the host at address 21 unless that address has been changed with the *PCB command. If your host is not at address 21, you should include an OUTPUT statement with the * PCB command before line 10 in this example.

Sending Commands Which Do Not Require Pass Control

Most ECal commands are sent and received very simply as shown in the following example:

```
10          DIM Iden$[80]
20          OUTPUT 718; " * IDN?"
30          ENTER 718; Iden$
40          END
```

Line 10 sends a command to the ECal control unit requesting it's identity (identification query). Line 20 reads the string back from the ECal control unit.

Setting Calibration Parameters for Remote Operation

The majority of the parameters used for calibration are configured by setting the network analyzer as desired before initiating the calibration, but, as in the manual measurement mode, there are several parameters which are specific to ECal and may need to be set. They are:

- **`EC AL:FINT`** Frequency Interpolation
- **`EC AL: IAV`** Isolation Averages (see "Setting Calibration Parameters") for details.

Selecting Modules for Remote Operation

ECal module selection is performed by the user and should be based on connector type and frequency range of the device-under-test. Available modules are listed by part number and description in Table 3-1 on page 3-4**.**

Performing Calibrations by Remote Operation

The calibration type and procedure to be used depends on the type and accuracy of measurement required for the device-under-test. See the "Performing Calibrations" section of this chapter it provides information regarding the six available calibration types, the best application for each type, and a brief description. For more detailed information, refer to the appropriate network analyzer user's manual or Hewlett-Packard application notes. In all cases, performing calibrations by Remote Operation is very similar to performing calibrations by Stand-alone Operation.

A host application may direct a calibration in one of two fashions as follows:

1. Initiate the calibration remotely and then allow the user to use ECal menus to measure each module.
2. The application may control each step of the calibration, prompting the user to connect specific modules.

Host Initiated Manual Calibration

If an application requires a calibration, but the parameters (module, frequency range, connector type) vary from day to day, it may be appropriate for the application to initiate a calibration, and then allow the user perform the calibration. An example of this is as follows:

```
10 OUTPUT 716;"PRES"               ! Commands to set up MWA
20 OUTPUT 716;"STAR 2 GHZ;STOP 18 GHZ
30 OUTPUT 718;"DISP:MENU:NAME FULL" ! Goto FULL 1-PORT Menu
40 CALL Pass_control
50                      ! The application continues here
60 END
```

See the "Sending Commands Which Require Pass Control" section for the listing of the Pass_control subprogram.

This example will set up the network analyzer as required for the measurement, and then command the ECal control unit to begin a FULL 2-PORT calibration. The Module Selection menu will be displayed on the network analyzer, and the user will be able to select and calibrate using appropriate modules. When the calibration is completed, control will be returned to the host application.

Host Directed Full Calibration

For many production applications, the same exact calibration procedures will be used day in and day out. For these, it is appropriate to have the application prompt the user with the specific steps to follow. This sample executes a FULL 2-PORT calibration remotely.

```
10  OUTPUT 716;"PRES"!Commands to set up the network analyzer
20   OUTPUT 716;"STAR 2 GHZ;STOP 18 GHZ"
30  OUTPUT 718;"SENS:CORR:COLL:METH FULL" ! Start Cal
40  INPUT "Connect Module A to NWA, then Press ENTER",Dum$
50  OUTPUT 718;"SENS:CORR:COLL:ACQ A" ! Cal with Module A
60  CALL Pass_control
70  INPUT "Connect Module B to NWA, then Press ENTER",Dum$
80  OUTPUT 718;"SENS:CORR:COLL:ACQ B"! Cal with Module B
90  CALL Pass_control
100 OUTPUT 718;"SENS:CORR:COLL:SAVE 5" ! Save in calset 5
110 CALL Pass_control
120  ! The application continues here
130 END
```

See paragraph 3-8.2.1 for the listing of the Pass_control subprogram.

Host Directed Adapter Calibration

The adapter calibration can be controlled remotely as shown in the following example:

```
10 OUTPUT 716;"PRES"                          ! Set up NWA
20 OUTPUT 716;"STAR 2 GHZ;STOP 18 GHZ"
30 OUTPUT 718;"SENS:CORR:COLL:METH FULL" ! Start Cal
40 INPUT "Connect Module A to NWA Port 2, then Press ENTER",Dum$
50 OUTPUT 718;"SENS:CORR:COLL:ACQ A" ! Cal with Module A
60 CALL Pass_control
70 INPUT "Connect Module B to NWA Port 2, then Press ENTER",Dum$
80 OUTPUT 718;"SENS:CORR:COLL:ACQ B"! Cal with Module
90 CALL Pass_control
100 OUTPUT 718;"SENS:CORR:COLL:NEXT" ! Go to 2nd phase
110 CALL Pass_control
120 PRINT "Connect Adapter to NWA Port 2"
130 INPUT "Connect Module A between Port 1 and Adapter, then Press
ENTER",Dum$
140 OUTPUT 718;"SENS:CORR:COLL:ACQ A" ! Cal with Module A
150 CALL Pass_control
160 NPUT "Connect Module A between Port 1 and Adapter, then Press
ENTER",Dum$
170 OUTPUT 718;"SENS:CORR:COLL:ACQ B" ! Cal with Module B
180 CALL Pass_control
190 OUTPUT 718;"SENS:CORR:COLL: SAVE 5"!Save in Calset 5
200 CALL Pass_control
210                                           ! The application continues here
```

```
220 END
```

See the “Sending Commands Which Require Pass control” section for the listing of the Pass_control subprogram.

Responding to the ECal "RUN" Key

For a particular application, it might be desirable to have the user calibrate the analyzer manually. The sample in paragraph ***3-8.5.1 is one*** possible means of this. This example shows another method, where the user will press the ECal control unit "RUN" button when they wish to perform a calibration. The control unit will then interrupt the application program to get control and allow the user to perform the calibration.

```
10                                      !  Set up ECal masks, and interrupt handlers
20   OUTPUT 718; "*SRE  32"             !  Enable Interrupt on Event Status Bit
30   OUTPUT 718; "*ESE  2"              !  Enable Interrupt on Request Control
40   ON INTR 7,2 CALL Srq_handler
50   LOOP                               !  The application continues here?
60              PRINT "Count is ";I     !  Dummy application
70        I=I+1
80   END LOOP
90   END
100  SUB Srq_handler
110  IF NOT BIT(SPOLL(718),5) THEN
120       PRINT "ECal is not causing Interrupt"
130  ELSE
140  OUTPUT 718;"*ESR?"                 !  Read the Event Status Register
150  ENTER 718;Esr
160  IF NOT BIT (Esr,1) THEN            !  Ensure that the ECal wants Control
170       PRINT "ECal does not want control"
180     ELSE
190       PASS CONTROL 718             !  Pass control to ECal
200       PRINT "CONTROL PASSED TO ECAL"
210       LOOP
220            STATUS 7,3;Stat         !  Monitor Interface Status
230            EXIT IF BIT (Stat,6)    !  Finish when Control is returned
240       END LOOP
250       PRINT "CONTROL RETURNED FROM ECAL"
260     END IF
270  END IF
280  SUBEND
```

4 Command Reference

Command Types

HP-IB (Hewlett-Packard Interface Bus) commands are separated into two types: SCPI (Standard Commands for Programmable Instruments) commands and IEEE 488.2 Common Commands.

SCPI Command Format

The SCPI commands perform functions like setting parameters, making measurements, and querying instrument states or retrieving data. A subsystem command structure is a hierarchical structure that usually consists of a top level (or root) command, one or more lower level commands, and their parameters. The following example shows part of a typical subsystem:

```
DISP:MENU[:NAME] <ECAL|CONF||SERV|MODI|etc...>
```

DISPis the root command, : MENU is the second level command, and [:NAME] is a third level command with parameters.

In this manual the following conventions are used:

- Bracketed commands, for example [: NAME], indicate defaults, and are therefore optional.
- Commands in angle brackets, <MODI>, are required parameters.
- Commands separated by vertical lines within angle brackets, <SERVIMODI>, indicate available choices.
- Lowercase choices, *n*, indicate that a value must be specified.

Common Command Format

The IEEE 488.2 standard defines the Common Commands that perform functions like reset, self-test, status byte query, etc... Common commands are four or five characters in length, always begin with an asterisk character (*), and may include one or more parameters. The command keyword is separated from the first parameter by a space character. Some examples of common commands are shown below:

***CLS, *IDN?, *SRE**

SCPI Command Reference

This section describes the SCPI commands for the System Instrument. Commands are listed alphabeticallyby subsystem and also within each subsystem. Commands which require pass control in the remote operation mode are identified as such.

DISPlay:MENU

Requires PassControl

DISP:MENU[:NAME]<ECAL|CONF|SERV|MODI|SllC|S22C|FULL|QFUL|ADAP|QAD|CCH|CCHA|CCHB|CCHC|CCHD>

The **DISP:MENU** subsystem commands provide the user with local access to the ECal menu functions via the front panel and CRT of the network analyzer. The available selections follow.

:MENU ADAPter

The module select menu for ADAPTER 2-PORT calibrations.*

:MENU CCH The module select menu for the confidence check

:MENU CCHA The parameter select menu for the Module A confidence check.

:MENU CCHB The parameter select menu for the Module B confidence check.

:MENU CCHC The parameter select menu for the Module C confidence check.

:MENU CCHD The parameter select menu for the Module D confidence check.

:MENU CONFigure

The configuration menu.

* See **SENS:CORR:COLL:METH** for more information.

:MENU ECALibration

The top level ECal menu.

:MENU FULL The module select menu for FULL 2-PORT calibrations.*

:MENU MODInformation

The module information menu.

:MENU SERVice

The service menu.

MENU S11C

The module select menu for **`S11 1-PORT`** calibrations.*

MENU S22C

The module select menu for **`S22 1-PORT`** calibrations.*

MENU QADapter

The module select menu for **`OMIT ISOL ADP 2-PORT`** calibrations.*

MENU QFUL

The module select menu for **`OMIT ISOL 2-PORT`** calibrations.*

ECALibration

ECAL

The ECAL subsystem commands access the functions and variables used to perform the electronic calibration.

ECAL:FINTinterpolate

`ECAL:FINT <ON|OFF|?>`

The **`ECAL:FINT`** subsystem command is used to enable or disable the frequency interpolation capability of the ECal system.

:FINT ON With interpolation enabled (ON), any frequencies within the span of the characterized module may be measured.

:FINT OFF With interpolation disabled (OFF), only those frequencies which correspond to the actual characterization frequencies of the ECal module will be allowed.

:FINT? Returns a 1 if frequency interpolation is enabled, returns a 0 if frequency interpolation is disabled.

ECAL:IAVerages

`ECAL:IAV <numeric_value|?>`

The **`ECAL:IAV`** command allows the ECal system to override, for isolation calibrations, the averaging value specified in the network analyzer setup.

For all other calibrations, measurements are performed using the averaging value specified in the network analyzer setup. However, isolation calibrations typically require significantly increased averaging.

This command will set the averaging value used for isolation measurements to the specified numeric value. If the numeric value is not included, the user will be prompted to enter the desired averaging value using the active entry capability of the network analyzer (softkeys).

:IAV? **`ECAL:IAV?`**

The **`ECAL:IAV?`** command returns the averaging value specified in the network analyzer setup.

SENSe: CORRection: COLLect

SENS:CORR:COLL

The **SENS:CORR:COLL** subsystem commands are used by the host computer to initiate, measure, and bring closure to calibrations.

: ACQuire **SENS:CORR:COLL:ACQ <module_name>**

Requires Pass Control

This command is used to initiate the measurement of a specific ECal module (module A, B, C, or D) after a calibration or confidence check has begun using **SENS:CORR:COLL:METH**.

: DONE **SENS:CORR:COLL: DONE**

Requires Pass Control

This command is used to indicate completion of the confidence check, set the module to its idle state, and restore the network analyzer display,

:METHod **SENS:CORR:COLL:METH <method_name>**

The **SENS:CORR:COLL:METH** subsystem commands initiate a calibration of the specified type. Use this command to initiate a calibration from the host computer only if the host will also be specifying the modules to be measured **(SENS:CORR:COLL:ACQ)**, and executing the save **(SENS:CORR:COLL: SAVE)**.

Use the **DISP:MENU:NAME** command to have the host initiate the calibration. The the user will be prompted to select modules using the active entry capability of the network analyzer (softkeys).

:METH ADAPter

This command is used to initiate the ADAPTER 2-PORT calibration. This is a two-step process for performing non-insertable calibrations using an insertable ECal module with an adapter. The first step uses the ECal module connected directly to Port 2 of the network analyzer to establish the S22 reference plane. The second step of the process uses the ECal module connected to Port 1 of the network analyzer, and an appropriate adapter connected between the ECal module and Port 2 of the network analyzer.

:METH CCH

This command is used to perform a confidence check of the network analyzer calibration.

:METH FULL

This command is used to initiate the FULL 2-PORT calibration of the network analyzer including the isolation terms. After selecting this function, all of the necessary modules must be connected and measured before saving the calibration coefficients to the network analyzer's calibration registers.

:METH QADapter

This command is used to initiate the OMIT ISOL ADP 2PORT calibration of the network analyzer. This calibration is the same as the ADAPTER 2-PORT calibration with the exception that isolation measurements are omitted.

:METH QFUL

This command is used to initiate the OMIT ISOL 2-PORT calibration of the network analyzer. This calibration is the same as the FULL 2-PORT calibration with the exception that isolation measurements are omitted.

:METH S11C

This command is used to initiate the S11 1-PORT calibration using Port 1 of the network analyzer. After selecting this function, all of the necessary modules must be connected and measured before saving the calibration coefficients to the network analyzer's calibration registers.

:METH S22C

This command is used to initiate the S22 1-PORT calibration using Port 2 of the network analyzer. After selecting this function, all of the necessary modules must be connected and measured before saving the calibration coefficients to the network analyzer's calibration registers.

:NEXt `SENS:CORR:COLL:NEX`

Requires Pass Control

This command is used to progress from Phase 1 to Phase 2 of the adapter calibration. All Phase 1 measurements must be completed or errors will be generated.

:PARameter `SENS:CORR:COLL: PAR <Sll|S21|S12|S22>`

This command is used to determine which parameter is displayed when the `SENS:CORR:CORR:ACQ` command is executed.

:PRIor `SENS:CORR:COLL:PRI`

Requires Pass Control

This command is used to return from Phase 2 to Phase 1 of the adapter calibration. Any completed Phase 1 measurements will be lost.

:RESume `SENS:CORR:COLL:RES`

Requires Pass Control

This command is used to resume a calibration already in process.

:SAVE `SENS:CORR:COLL: SAVE [calset number]`

Requires Pass Control

This command is used to end the calibration process after all required modules have been measured, and then load the error coefficients into the network analyzer.

If a calset number is included in the command, the calibration is saved in that register. Otherwise, the user is prompted via the standard network analyzer menus.

:VIEW **SENS:CORR:COLL: VIEW <BOTH|DIV>**

Requires Pass Control

This command is used to set the display mode when the **SENS:CORR:CORR:ACQ** command is executed.

:VIEW BOTH Displays DATA & MEMORY.

:VIEW DIV Displays DATA divided by MEMORY.

SYST em

Subsystem Syntax

SYST

The SYST subsystem commands access certain standard **SCPI** commands not related to instrument performance.

:ERRor? **SYST:ERR?**

Returns the error number and message associated with the latest actions of the ECal system. The errors will be contained in a two element FIFO (First In, First Out) queue. If more than 2 errors occur between readings by the host, the most recent errors will be lost, and the second entry will be replaced with the **QUEUE OVERFLOW** message.

See Table 4-1 for a listing of error messages.

:PRESet **SYST:PRES**

Presets the ECal system to its power-up state. Equivalent to the ***RST** command.

:VERSion?

Returns the SCPI version to which the instrument complies. The returned value is 1994.0.

Common Command Reference

This section describes the EEE-488.2 Common Commands that can be used to program instruments in the mainframe. For additional information on any Common Commands, refer to the IEEE Standard 488.21987.

***CLS** Clear Status. This command clears the status byte register (STB) and the event status register (ESR) for the instrument.

***ESE [n]** Set Event Status Enable Mask. Enables specific bits to be summarized in the ESB bit of the status byte. See ***ESR?** for more details.

***ESE?** Read Event Status Enable Mask. Places the current value of the event status enable register in the output queue.

***ESR?**

Read Event Status Register. Bit numbers, decimal values, and corresponding functions are shown in ***Table 4-1.***

Table 4-1 ECal Event Status Register

BIT #	DECIMAL VALUE	FUNCTION
7	128	Power ON
6	63	User Request (not used)
5	32	Command Error
4	16	Execution Error
3	8	Device Error
2	4	Query Error
1	2	Request Control
0	1	Operation Complete

*** IDN?**

Identification Ouery. Returns a string containing the current revision of the ECal firmware in the following format:

Hewlett Packard, 8 5 0 6 0C, O, xx . YY

The revision varies with the revision of the firmware installed in the system. This is the only indication of which version of firmware is in use. The major number (XX) indicates whether there have been functional changes made in the firmware. The minor number (YY) indicates only that bug fixes and minor changes have been made.

Example: Get the ID fields from the system and print them;

`10 DIM A$ [50]`	Dimension string for ID fields
`20 OUTPUT 718; "*IDN?"`	Sends identification query
`30 ENTER 718;A&`	Places ID fields in string
`40 PRINT A&`	Print ID fields
`50 END`	

***OPC**

Operation Complete. This command prompts ECal to generate the operation complete message in the Event Status Register (ESR) when all pending operations are complete.

***OPC?**

Operation Complete Ouery. Since ECal processes all commands sequentially, this command will always place an ASCII 1 in the ECal output buffer when all pending operations are complete.

***PCB [n]**

Set the Passbook Address. Sets the address of the host computer. In the non-system controller mode, the ECal Control Unit will return active control to the address specified by this command. The default value is 21.

***RST**

Reset Command. Resets an instrument to a known state (the power-on state) as follows:

- Aborts all pending operations.
- Disables the **`*OPC`** and **`*OPC?`** modes.
- Resets the Frequency Interpolation to "ON".
- Resets Isolation Averages to the default values.

*RST (does not effect):

- The state of the HP-IB interface.
- The HP-IB address.
- The output queue.
- The Status Request register.
- Calibration data.

***SRE [n]**

Service Request Enable. When a service request occurs, it sets a corresponding bit in the Status Byte Register. This happens whether or not the event has been enabled (unmasked) by **`*SRE`**. The **`*SRE`** command allows you to identify which of these events will assert an HP-IB service request (SRQ).

When an event is enabled by **`*SRE`** and that event occurs, it sets a bit in the status byte register and issues an SRQ to the computer (sets the HP-IB SRQ line true). You enable an event by specifying its decimal weight for [n]. To enable more than one event, specify the sum of the decimal weights.

Example:

`OUTPUT 718;"*SRE 9"`	Enables bits 0 & 3. Respective weights are 1+8=9

***SRE?**

Status Register Enable Ouery. Returns the weighted sum of all enabled (unmasked) events (those enabled to assert SRQ) in the Status Byte Register.

Example:

```
10 OUTPUT 718;"*SRE?"      Sends Status Register Enable Query
20 ENTER 718; A            Places response in variable
30 PRINT A                 Prints response
40 END
```

***STB?**

Status Byte Enable Query. Returns the current value of the status byte including the master summary bit. The serial poll response is this byte which includes the **RSV** bit.

Reading this byte with **STB?** does not clear the status byte, the master summary bit, or the **RSV** bit. Reading this byte with a serial poll clears only the **RSV** bit.

The status byte can only be cleared by clearing all of the bytes which are summarized within it.

Bit numbers, decimal values, and corresponding functions are shown in ***Table 4-2***.

Table 4-2 ECal Status Byte Register

BIT #	DECIMAL VALUE	FUNCTION
7	128	not used
6	64	RSV bit - Master Summary bit (MSS)
5	32	Event Status Summary (ESB)
4	16	Message Available (MAV)
3	8	not used
2	4	Error Queue
1	2	not used
0	1	not used

***TST?** Self Test. Returns a O indicating that no internal failures have occurred.

***WAI** Wait to Continue. This command prevents the execution of any further commands until pending operations are complete.

Since ECal processes commands sequentially, this command has no effect on ECal operation. It is processed for compliance with EKE - 88.2 standards.

Quick Reference for SCPI and IEEE-488 Commands

The following tables summarize SCPI and IEEE 488.2 Common Commands for the HP 85060C ECal Control Unit.

Table 4-3 SCPI Commands - Quick Reference

Command	Description
DISP:MENU [:NAME]	Display the specified **[NAME]** ECal menu on the network analyzer.
ECAL:IAV <numeric_value|?>	Sets amount or returns value of averages for use in isolation measurements.
ECAL:FINT <ON|OFF|?>	Enable or disable frequency interpolation, or show current frequency interpolation status.
SENS:CORR:COLL:ACQ <A|B|C|D>	Initiate the measurement of a specific ECal module
SENS:CORR:COLL:DONE	Used to indicate confidence check completion, set the module to its idle state, and restore the network analyzer display.
SENS:CORR:COLL:METH <method_name>	Performs the appropriate (specified) calibration.
SENS:CORR:COLL:METH ADAP	Performs an ADAPTER 2-PORT calibration.
SENS:CORR:COLL:METH CCH	Performs a CONfIDENCE CHECK of the NWA calibration.
SENS:CORR:COLL:METH FULL	Performs a FULL 2-PORT calibration including the isolation terms.
SENS:CORR:COLL:METH QAD	Performs an OMIT ISOL ADP 2-PORT calibration

Table 4-3 SCPI Commands - Quick Reference

SENS:CORR:COLL:METH QFUL	Performs an OMIT ISOL 2-PORT calibration.
SENS:CORR:COLL:METH S11C	Performs an S11 1-PORT calibration using NWA Port 1
SENS:CORR:COLL:METH S22C	Performs an S22 1-PORT calibration using NWA Port 2.
SENS:CORR:COLL:MEX	Progress from calibration Phase 1 to Phase 2
SENS:CORR:COLL:PAR	Used to determine which parameter is displayed when the SENS:CORR:COLL:ACQ command is executed.
SENS:CORR:COLL:PRI	Return to calibration Phase I from Phase 2.
SENS:CORR:COLL:RES	Resume a calibration already in process
SENS:CORR:COLL:SAVE [calset number]	End the calibration process, load the error coefficients into the network analyzer.
SENS:CORR:COLL:VIEW <BOTH|DIV>	Used to set the display mode when the SENS:CORR:COLL:ACQ command is executed.
SYST:ERR?	Return the latest error number and message.
SYST:VERS?	Return the ECal firmware revision. Equivalent to the *IDN command.
SYST:PRES	Preset the ECal system to its power-up state. Equivalent to the *RST command.

Table 4-4 Common Commands - Quick Reference

Command	Description
***CLS**	Clear Status. Sets the ECal Control Unit status byte to 0.
***ESE**	Set Event Status Enable mask.
***ESE?**	Read Event Status Enable mask.
***IDN?**	Read Event Status Enable register.
***OPC**	Identification Query. Returns the ECal firmware revision. Equivalent to the **SYST:VERS?** command.
***OPC?**	Operation Complete
***PCB [n]**	Operation Complete Query.
***RST**	Presets the ECal system to its power-up state. Equivalent to the **SYST:PRES** command.
***SRE [n]**	Service Request Enable. Masks selected bits of the status byte.
***SRE?**	Status Register Enable Query. Returns the current value of the Serial Poll Mask.
***STB?**	Status Byte Enable Query.
***TST?**	Self Test.
***WAI**	Wait to Continue.

5 Troubleshooting

Introduction

Instrument problems usually fall into three general categories: operator errors, turn-on errors, and run-time errors. The troubleshooting strategy is different for each category.

Operator Errors

Apparent failures often result from operator errors. Refer to Chapter 3, Operation, for proper operation information.

Turn-on Errors and Run-Time Errors:

An error signified by continued illumination of the Instrument Check LED at turn-on or during otherwise normal operation, with or without illumination of other front panel LED's, indicates that the built-in diagnostic routine has detected some problem. Turn the instrument off, then on again. If the error repeats, see the “Troubleshooting Sequence” section in this chapter. information there can be used to isolate a setup error, operator error, or failure of one of the major assemblies in the instrument. Additionally, problems may occur that are not indicated by front panel LED status. See the “Troubleshooting Procedures” section in this chapter.

Recommended Test Equipment

n addition to the equipment listed in Table 6-1 on page 6-2, a voltmeter may be required for troubleshooting.

Diagnostic Software

A factory test diagnostic program is built into firmware. Instructions for use are included where applicable in the troubleshooting procedures below.

Troubleshooting Sequence

Prior to troubleshooting, please insure that normal ECal operation—described in the “Operation” chapter—is fully understood. Figure 3-2 on page 3-3 shows the typical operating sequence and should be particularly helpful in determining whether a failure condition exists.

Troubleshooting should begin with a comparison of the front panel LED status against the conditions shown in Figure 5-1 on page 5-2**.** The descriptions should offer corrective action or lead you to the appropriate troubleshooting procedure(s).

If there is a problem which is not indicated by front panel LED status, see the “Troubleshooting Procedures” section in this chapter**..**

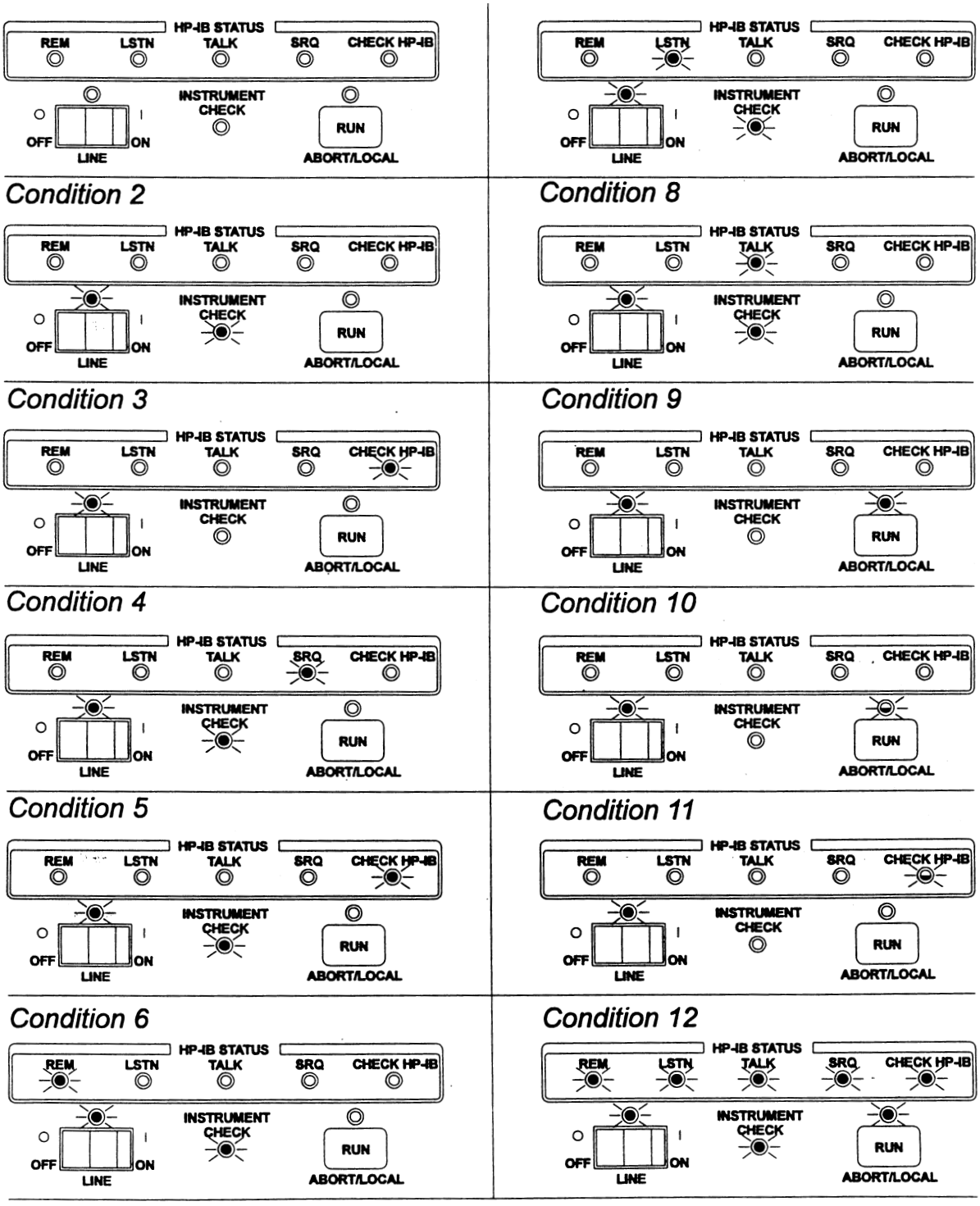

Figure 5-1 Front Panel LED Status Conditions

NOTE Prior to troubleshooting, please insure that normal ECal operation—described in the "Operation" chapter—is fully understood.

Table 5-1 Front Panel LED Status Conditions

Condition #	Indications	
1	All LED's off	Indicates a No DC Power condition. Refer to the "For a No DC Power condition" section.
2	**LINE** and **INSTRUMENT CHECK LED illuminated.**	Indicates that the built-in diagnostic routine has detected some problem. Check connections and restart.
3	**LINE** and **CHECK HP-IB LED illuminated.**	Indicates an HP-IB fault, Check connections and restart. If the problem continues, suspect the HP-IB board.
4	**LINE, INSTRUMENT CHECK,** and **SRQ LED illuminated**	Indicates that the factory test switch is on, and the ECal control unit is not the system controller. This is not an allowable condition for normal use. Check and reset HP-IB address settings (refer to the "Installation" chapter for HP-IB address selection).
5	**LINE, INSTRUMENT CHECK,** and **CHECK HP-IB LED illuminated.**	During the boot sequence (turn-on), this is not an error condition; it indicates that the control unit has passed its self-test and is loading firmware. A continuation of this condition after turn-on indicates that ECal firmware could not initialize the HP-IB hardware. Check connections and restart. If the problem continues, suspect the HP-IB board.
6	**LINE, INSTRUMENT CHECK**, and **REM LED illuminated.**	Indicates that the firmware cannot be loaded from flash memory. Suspect a firmware problem or failed flash memory (microprocessor board). Restart suing the ECal system floppy disk provided with the control unit.

Table 5-1 Front Panel LED Status Conditions

Condition #	Indications	
7	**LINE, INSTRUMENT CHECK**, and **LSTN LED illuminated.**	Indicates that an attempt to execute the program from floppy disk has failed. Suspect an incorrect floppy disk format or a bad floppy disk.
8	**LINE, INSTRUMENT CHECK**, and **TALK LED illuminated.**	Indicates that an attempt to copy the program from floppy disk to flash memory has failed. Suspect an incorrect floppy disk format, a bad floppy disk, or failed flash memory (microprocessor board).
9	**LINE** and **RUN LED illuminated.**	Indicates that ECal is controlling the network analyzer. This is not an error condition.
10	**LINE LED illuminated**, and **RUN LED flashing.**	Indicates that ECal is requesting control from the network analyzer. This is not an error condition. Control must be passed from the host or ECal must be set to function as the non-system controller. Refer to the “Operation” chapter for more information.
11	**LINE LED illuminated,** and **CHECK HP-IB flashing.**	Indicates that the network analyzer is not responding to the control unit. Check HP-IB cables and verify that the control unit and network analyzer address selections are correct. Refer to the “Installation and Operation” chapters for more information.
12	**All LED's remain illuminated.**	Either the CPU has not booted properly, or the control logic printed circuit board cannot control the display printed circuit board.

Troubleshooting Procedures

WARNING

These servicing instructions are for use by qualified personnel only. To avoid arm g electrical shock, do not perform any servicing unless you are qualified to do so.

For a No DC Power Condition

1. Check AC line voltage and the rear panel fuse, and listen for the sound of the rear panel cooling fan.
2. Remove the cover (see the "Assembly Replacement Procedures" section of the "Replacement Procedures" chapter*)* and visually inspect the control unit for obvious damage.
3. Check the power supply fuses. A blown fuse is often indicative of an underlying problem, replacement of the power supply board is recommended.
4. Check the DC Output of each power supply.
5. If there is no DC output, the appropriate power supply should be replaced. If the DC output is correct, suspect either the control logic board or the display board.
6. Substitute the display board with a known good board. If the problem is resolved, replace the display board. If the problem is not resolved, replace the control logic board.

If the Control Unit Does Not Recognize the Module

1. Visually inspect tuner control cable(s), control unit, and module connectors for cleanliness, bent or missing pins, etc...
2. Clean and verify module RF connectors (see appropriate operating and service manual).
3. Retry the calibration using a different ECal module interconnect. Satisfactory performance might indicate a control logic board failure.
4. Retry the calibration using a different tuner control cable or module.

If The Calibration Results Are Unsatisfactory

1. Clean and verify module RF connectors (see appropriate operating and service manual).
2. Retry the calibration using a different ECal module interconnect.
3. Retry the calibration using a different tuner control cable or module.
4. Perform a manual calibration to verify the network analyzer.

6 Replacement Procedures

Introduction

WARNING

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

Procedures are provided for disassembly and reassembly of the following items:

- Cover
- Fan Assembly (reference designator FAN1)
- IEEE 488 Adapter Board Assembly (A1)
- Microprocessor Board Assembly (A2)
- Control Logic Board Assembly (A3)
- 24V Power Supply Assembly (A4)
- 5V Power Supply Assembly (A5)
- Display Board (A6)
- HP-IB Switch Board (A7)
- 3.5 Inch Floppy Drive Assembly (D1)

Figure 6-1 on page 6-3 shows the location of these assemblies within the HP 85060C ECal Control Unit for reference. Part numbers for these and other parts are listed in the "Replaceable Parts" chapter in this manual."

WARNING

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Equipment Needed (but not supplied)

Table 6-1 lists all the equipment required for assembly replacement. Any equipment that satisfies the requirements in the table may be substituted.

Table 6-1 Equipment Needed to Replace ECal Control Unit Major Assemblies

Tool	Used For	HP Part Number
anti-static mat	All Components	9300-0797
wrist strap	All Components	9300-1257
Torx screwdriver (T15)	All Components	8710-1816
Phillips screwdriver (#4 & #6)	All Components	any supplier
Torque screwdriver	All Components	any supplier

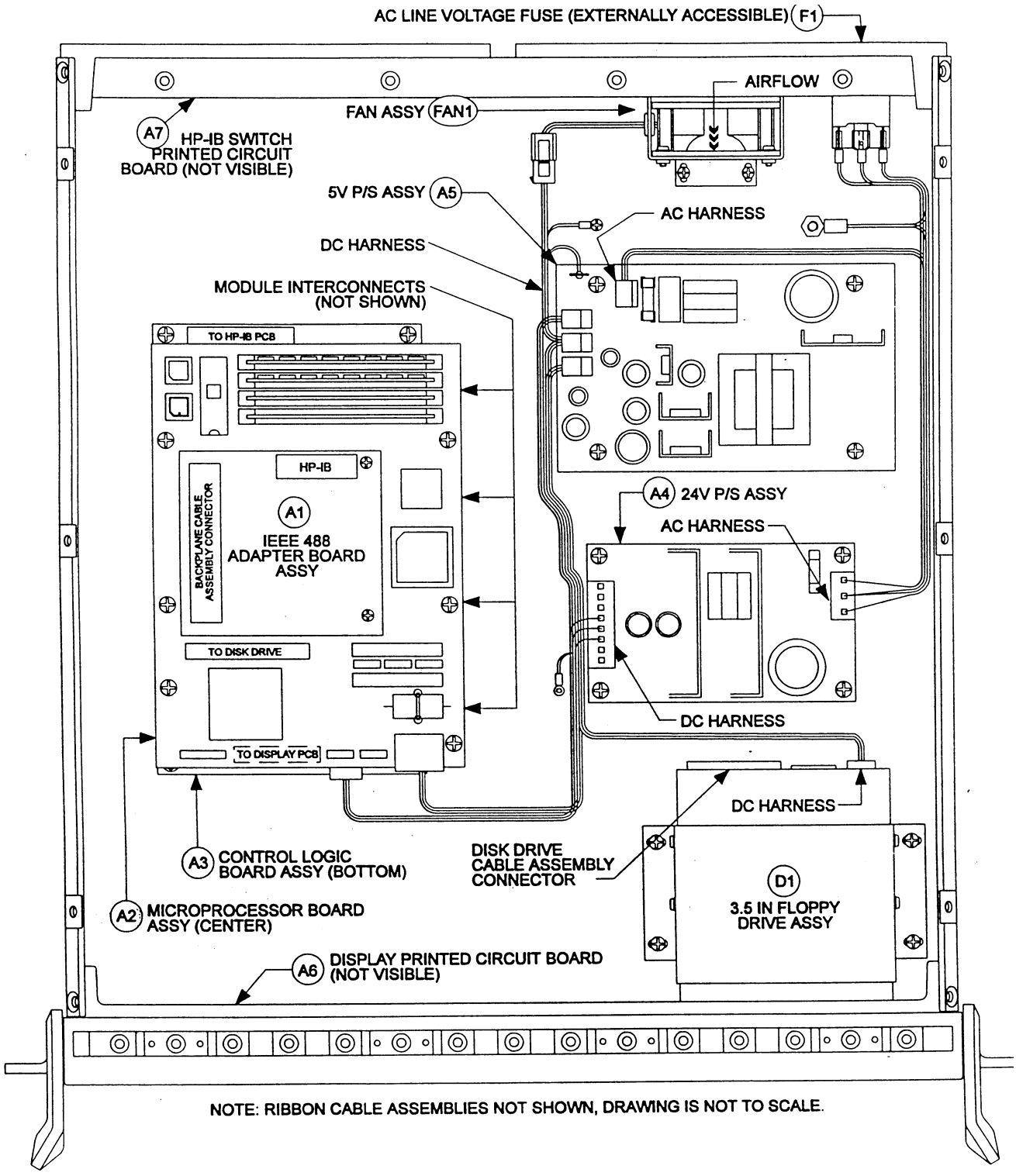

Figure 6-1 Assembly Locations

Assembly Replacement Procedures

Preliminary Precautions

CAUTION

The assemblies handled in these procedures are very sensitive to damage by static electricity. They may or may not continue to function if subjected to an electrostatic discharge. Their reliability will, however, be impaired.

1. To prevent electrostatic discharge damage, ground the work area and yourself.
2. Turn the control unit off.
3. Disconnect the power cord.
4. Exercise caution when handling ribbon cable connections.
5. To install a part, reverse the appropriate procedure.

To Remove The Cover

WARNING

The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.

1. Set power to OFF, and remove the power cable.
2. Remove the two top rear endcaps from the mainframe (one Torx T-15 screw each).
3. Disengage the cover screw from the top rear center of the mainframe.
4. Slide the cover towards the rear and remove.
5. Reverse order to reinstall the cover.

To Remove the Fan Assembly (FAN1)

1. Remove the cover (see the "To Remove Cover" section in this chapter).
2. Disconnect the DC harness.
3. Remove the two #4 Phillips head screws holding the fan bracket to the mainframe, then the Fan Assembly.
4. Remove the four #4 Phillips head screws holding the fan bracket to the fan.
5. Reverse order to reinstall the Fan Assembly (install so that the air flow is in the direction illustrated). Torque all #4 screws to 7 inch-pounds.

To Remove the IEEE 488 Adapter Board Assembly (A1)

1. Remove the cover (see the "To Remove Cover" section in this chapter).
2. Disconnect the HP-IB cable assembly and the backplane cable assembly.
3. Remove the two #4 Phillips head screws, then lift the Adapter Board Assembly vertically.
4. Reverse order to reinstall the Printed Circuit Assembly. Torque all #4

To Remove the Microprocessor Board Assembly (A2)

1. Remove the cover and the IEEE 488 Adapter Board

1. Remove the cover and the IEEE 488 Adapter Board Assembly (see the "To Remove Cover" and "To Remove the IEEE 488 Adapter Board Assembly (A1)" sections in this chapter).
2. Disconnect the disk drive cable assembly and the DC harness.
3. Remove the six #6 Phillips head screws, then the Microprocessor Board Assembly.
4. Reverse order to reinstall the Microprocessor Board Assembly. Torque all #4 screws to 7 inch-pounds, all #6 screws to 11 inch-pounds.

To Remove the Control Logic Board Assembly (A3)

1. Remove the cover and the IEEE 488 Adapter Board Assembly (see the "To Remove Cover" and "To Remove the IEEE 488 Adapter Board Assembly (A1)" sections in this chapter).
2. On the microprocessor board, remove the disk drive cable assembly and the DC harness. Then remove the three #6 Phillips head screws from the side of the microprocessor board opposite the hinge and swing the microprocessor board up to access the control logic board.
3. On the control logic board, remove the following:
   - Four module cable assemblies.
   - HP-IB switch cable assembly.
   - Display cable assembly.
   - DC harness.
   - Backplane cable assembly.
4. Remove the eight #6 Phillips head screws, then the Microprocessor Board Assembly.
5. Reverse order to reinstall the Microprocessor Board Assembly. Torque all #4 screws to inch-pounds, all #6 screws to 11 inch-pounds.

To Remove the 24V Power Supply Assembly (A4)

1. Remove the cover (see "To Remove the Cover" section in this chapter).

WARNING

(*Whenever you remove the cover*) the AC line voltage is present on this printed circuit assembly. Ensure that the power cable is disconnected for a minimum of one minute before proceeding to allow capacitors to discharge.

2. Disconnect the DC harness and the AC harness.
3. Remove the four #6 Phillips head screws and the 24V Power Supply Assembly.
4. Reverse order to reinstall the 24V Power Supply Assembly. Torque all #6 screws to 11 inch-pounds.

To Remove the 5V Power Supply Assembly (A5)

1. 1. Remove the cover (see “To Remove the Cover” section in this chapter).

Disconnect the DC harness (four connectors) and the AC harness.

Remove the four #6 Phillips head screws and the SV Power Supply Assembly.

Reverse order to reinstall the SV Power Supply Assembly. Torque all #6 screws to 11 inch-pounds.

To Remove the Display Board (A6)

1. Remove the cover “To Remove the Cover” section in this chapter)..
2. Disconnect the ribbon cable assembly.
3. Remove the five #4 Phillips head screws and the Display Board.
4. Reverse order to reinstall the Display Board. Torque all #4 screws to 7 inch-pounds.

To Remove the HP-IB Switch Board (A7)

1. Remove the cover “To Remove the Cover” section in this chapter).
2. Disconnect the ribbon cable assembly.
3. Remove the four #4 Phillips head screws and the HP-IB Switch Board.
4. Reverse order to reinstall the HP-IB Switch Board. Torque all #4 screws to 7 inch-pounds.

To Remove the 3.5 Inch Floppy Drive Assembly (D1)

1. Remove the cover “To Remove the Cover” section in this chapter).
2. Disconnect the DC harness and the disk drive cable assembly from the rear of the floppy drive assembly.
3. Remove the four #4 Phillips head screws holding the floppy drive assembly bracket to the mainframe.
4. Slide the floppy drive assembly towards the rear of the mainframe before lifting out vertically.
5. Remove the six #4 Phillips head screws holding the floppy drive bracket to the floppy drive.
6. Reverse order to reinstall the Floppy Drive Assembly. Follow these steps to insure floppy drive alignment with the mainframe faceplate:
   - Install the bracket loosely to the floppy drive.
   - Slide the assembly into place within the mainframe.
   - Align the front of the floppy drive assembly with the mainframe faceplate. Tighten the four rear #4 Phillips head screws which hold

the floppy drive in the bracket. Torque all #4 screws to 7 inch-pounds.

- Because the two front #4 Phillips head screws which hold the floppy drive in the bracket are inaccessible, remove the assembly again to tighten the two front screws. Again, torque all #4 screws to 7 inch-pounds.
- Continue with the reverse order from above. Torque all #6 screws to 11 inch pounds.

7 Replaceable Parts

Introduction

This section contains information to order replaceable parts for the HP 85060C ECal Control Unit. The replaceable parts include major subassemblies, but not parts of subassemblies.

Replaceable Parts List

Figure 6-1 on page 6-3 should be used to assist in locating and identifying all replaceable parts. Table 7-1, "Replaceable Parts List," on page 7-2 provides the following information:

- Reference Designator (from Table 6-1 on page 6-2*)*.
- Part description.
- Part quantity. There may or may not be more of the same part located elsewhere in the instrument.
- Hewlett-Packard part number.

Ordering Information

To order a part listed in the replaceable parts list, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

To order a part that is not listed in the replaceable parts list, include the instrument model number, complete instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

To Order Parts...Fast

Call (8OO) 227-8164

Monday through Friday, 6 am to 5 pm (Pacific Standard Time)

The parts replacement specialists have direct on-line access to replacement parts inventory corresponding to the replaceable parts listed in this manual. Four day delivery is standard, but one-day delivery is available at extra cost... After hours and holidays, call (415) 968-2347.

This fast service applies to the United States only. Outside the United States, contact your nearest HP office.

Table 7-1 Replaceable Parts List

HP Part Number	Description (Reference Designator	Qty Per Unit
85060-60011	Microprocessor Board Assembly [A2]	1
85060-60012	IEEE488 Adapter Board Assembly [A1]	1
85060-60014	5V Power Supply Assembly [A5]	1
85060-60015	24V Power Supply Assembly [A4]	1
85060-60019	Control Logic Board Assembly [A3]	1
85060-60021	Fuse, AC Line Voltage (4 AMP) [F1]	1
85060-60022	Tuner Control Cable [CABLE1]	4
85060-60023	Base Plate	1
85060-60024	Base Plate Hinge	1
85060-60025	Rear Plate	1
85060-60026	Rear Plate - Option 00	1
85060-60027	AC Receptacle - Filter	1
85060-60028	Bracket - Floppy Drive	1
85060-60029	Bracket - Fan	1
85060-60030	Finger Guard	1
85060-60031	Display Printed Circuit Board [A6]	1
85060-60032	HP-IB Switch Printed Circuit Board [A7]	1
85060-60033	AC Harness	1
85060-60034	DC Harness	1
85060-60035	Module Cable Assembly	4
85060-60036	Module Cable Assembly - Option 001	2
85060-60037	Disk Drive Cable Assembly	1
85060-60038	HP-IB Switch Cable Assembly	1
85060-60039	HP-IB Cable Assembly (Internal)	1
85060-60040	Display Cable Assembly	1
85060-60041	Backplane Cable Assembly	1
85060-60042	Front Panel Lexan	1
85060-60043	Front Panel Lexan - Option 001	1

Table 7-1 Replaceable Parts List (Continued)

HP Part Number	Description (Reference Designator	Qty Per Unit
85060-60044	HP 85060C Operating System Disk	1
85060-60045	EPROM Software	1
85060-60046	Fuse (2 AMP)	2
0950-2075	3.5 Inch Floppy Drive Assembly [D1]	1
3160-0497	Fan Assembly [FAN1]	1
8120-1348	AC Line Cord	1
8120-3445	HP-IB Cable Assembly (External)	1
5062-3735	Cover, Top	1

Index

A

accessing menus, 3-11
accessories
  available, 1-2
    cables, 1-2
    rack mounting kit, 1-2
  supplied, 1-2
additional switch settings, 2-5
assembly replacement
  procedures
    preliminary precautions, 6-4
    removing the 24V power supply, 6-6
    removing the 3.5 inch floppy drive (D1), 6-7
    removing the 488 adapter board, 6-5
    removing the 5V power supply, 6-6
    removing the control logic borad, 6-6
    removing the cover, 6-4
    removing the display board, 6-7
    removing the fam assembly (FAN1), 6-5
    removing the HP-IB switch board, 6-7
    removing the microprocessor board, 6-5

B

bench operation, 2-6

C

calibration
  host directed
    adapter, 3-29
    full, 3-29
  host initiated (manual), 3-28
  procedure
    performing a ADAPTER 2-PORT, 3-14, 3-20
    performing a confidence check, 3-23
    performing a FULL 2-PORT, 3-14, 3-18
    performing a OMIT ISOL 2-PORT, 3-14, 3-19
    performing a OMIT ISOL ADP 2-PORT, 3-14, 3-22
    performing a S11 1-PORT, 3-16
    performing a S22 1-PORT, 3-14, 3-17
  setting parameters, 3-11
  setting parameters for remote operation, 3-27
  Sll 1-PORT, 3-13
command reference, 4-1
command types, 4-1
common command format, 4-1
common command reference, 4-10
common commands, 4-10
  * IDN?, 4-11
  *CLS, 4-10
  *ESE?, 4-10
  *ESR?, 4-10
  *OPC, 4-11
  *OPC?, 4-11
  *RST, 4-12
  *RST (does not effect), 4-12
  *SRE?, 4-13
  *STB?, 4-13
  *TST?, 4-14
  *WAI, 4-14
confidence check
  description, 3-23
  performing, 3-24
control unit does not recognize the module, 5-5
CORR
  COLL, 4-5

E

ECal, 3-9
ECALibration, 4-4
electrical and mechanical characteristics, 1-3
electrical and mechanical characteristics table, 1-3
environmental specifications, 1-3
equipment needed (but not supplied), 6-2
ERR
  PRES, 4-9
errors
  operator, 5-1

F

figures
  adapter calibration connection diagram, 3-21
  assembly locations, 6-3
  ECal system bench set-up example, 2-6
  ECal system conceptual block diagram, 3-2
  front and rear panel features, 3-7
  front panel LED status conditions, 5-2
  power cable and line (main) plug part numbers, 2-4
  rear ranel HP-IB address selection DIP switches, 2-5
  sample network analyzer ECal menus, 3-10
  typical operating sequence, 3-3

G

general information
  description, 1-1

H

host directed
  adapter calibration, 3-29
  full calibration, 3-29
host initiaged manual calibration, 3-28
HP-IB
  addresses
    control unit, 2-5
    network analyzer, 2-5
  mating connectors, 2-5

I

installation, 2-1
  checklist, 2-2
  initial inspection, 2-1
  interconnections, 2-5
  introduction, 2-1
  line voltage and fuse selection, 2-2
  mating connectors, 2-5
  operating environment, 2-6
  power requirements, 2-2
instruments covered by this manual, 1-2
interconnections, 2-5

L

line voltage and fuse selection, 2-2

M

mating connectors, 2-5
modules
  connecting and disconnecting, 3-6

N

common commands
  *ESE, 4-10
  *PCB, 4-11
  *SRE, 4-12
no DC power, 5-5

O

operating environment, 2-6
operation
  characteristics, 3-4
  ESD cautions, 3-1
  introduction, 3-1
  stand-alone
    accessing menus, 3-11
    system configuration, 3-11
  stand-alone (manual), 3-11
operator errors, 5-1
optimizing performance in overlapping frequency range, 3-15
options, 1-2
  descriptions, 1-2
ordering information, 7-1

P

packaging
  original, 2-8
  other, 2-8
  tagging for service, 2-7
panel feature descriptions
  3.5 inch floppy disk drive, 3-8
  control unit bus address switch, 3-9
  HP-IB status LED's, 3-8
  instrument check LED, 3-9
  line module, 3-9
  line switch and line LED, 3-8
  network analyzer bus address switch, 3-9
  system bus connector, 3-9
panel features
  front
    optional, 3-8
    standard, 3-8
  rear
    optional, 3-8
    standard, 3-8
performing calibrations, 3-13
power cables, 2-3
power requirements, 2-2
preparation for use, 2-2
PRES
  VERS, 4-9

Q

quick reference
  commands
    IEEE-488, 4-15
    SCPI, 4-15

R

rack mounging, 2-6
remote operation, 3-25
  communication with host computers, 3-25
  procedure
    performing calibrations, 3-28
  selecting modules, 3-27
  sending commands which do not require pass control, 3-27
  sending commands which require pass control, 3-26
  setting calibration parameters, 3-27
  system configuration, 3-25
  system configureation, 3-25
remote operationl
  sending commands which do not require pass control, 3-27
remote operations

responding to the ECal "RUN" key, 3-30
removing the 24V power supply assembly, 6-6
removing the 24V power supply assembly (A4), 6-6
removing the 3.5 inch floppy drive assembly (D1), 6-7
removing the control logic board (A3), 6-6
removing the cover, 6-4
removing the display board (A6), 6-7
removing the fan assembly (FAN1), 6-5
removing the HP-IB switch board (A7), 6-7
removing the IEEE 488 adapter board assembly (A1), 6-5
removing the microprocessor board assembly (A2), 6-5
replaceable parts, 7-1
introduction, 7-1
list, 7-1
ordering information, 7-1
ordering parts...fast, 7-1
replacement procedures, 6-1
introduction, 6-1
responding to the ECal "RUN" key, 3-30
Run, 3-9
run-time errors, 5-1

S

safety
safety considerations, 1-2
safety considerations, 1-2
SCPI
command
format, 4-1
reference, 4-2
SCPI command format, 4-1
SCPI command reference, 4-2
selecting modules, 3-12
selecting modules for remote operation, 3-27
SENS, 4-5
CORR, 4-5
stand-alone
system configuration, 3-11
stand-alone operation
accessing menus, 3-11
optimizing performance in the overlapping frequency range, 3-15
selecting modules, 3-12
storage and shipment, 2-7
environment, 2-7
packaging, 2-7
original, 2-8
other, 2-8
tagging for service, 2-7
SYST
ERR, 4-9
SYST em, 4-9

T

tables
calibration parameters, 3-12
ECal event status register, 4-10
ECal status byte register, 4-13
environmental specifications, 1-3
equipment needed to replace control unit major assemblies, 6-2
front panel LED status conditions, 5-3
fuse rating, 2-2
operating characteristics, 3-4
panel feature descriptions, 3-8
replaceable parts list, 7-2
SCPI commands -quick reference, 4-15
tagging for service., 2-7
theory of operation, 3-1
troubleshooting, 5-1
diagnostic software, 5-1
procedure
control unit does not recognize the module, 5-5
no DC power condition, 5-5
when calibration results are unsatisfactory, 5-5
recommended test equipment, 5-1
sequence, 5-1
troubleshooting procedures, 5-5
trounleshooting
introduction, 5-1
turn-on
errors, 5-1
information, 3-5
procedure, 3-5
run-time errors, 5-1