MODEL
360B
VECTOR NETWORK ANALYZER

OPERATION MANUAL

Software Version: 4.05

IMPORTANT NOTICE AFFECTING OPERATION

When using a 3612A, 3613A, 3622A, 3623A, or 3631A Test Set and a 68XXXB Source in the SS mode, the 360B will fail to lock above 60 GHz. The output frequency of the 68XXB Source must be used at 20 GHz or below, or the 68XXB can be used in the Tracking mode at any frequency.

Version 4.04 Basic Measurement Software removes the restriction from changing source power above 40 GHz. While this allows increased measurement flexibility, Lock Failure 301DE may occur when the source power is set to less than +5 dBm and the stop frequency is greater than 40 GHz. If Error 301DE occurs under this condition, increase the source power until phase lock is re-acquired.

Anritsu

490 JARVIS DRIVE ● MORGAN HILL, CA 95037-2809

P/N: 10410-00110
REVISION: F
PRINTED: OCTOBER 1997

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The ANRITSU product(s) listed on the title page is (are) warranted against defects in materials and workmanship for one year from the date of shipment.

ANRITSU's obligation covers repairing or replacing products which prove to be defective during the warranty period. Buyers shall prepay transportation charges for equipment returned to ANRITSU for warranty repairs. Obligation is limited to the original purchaser. ANRITSU is not liable for consequential damages.

LIMITATION OF WARRANTY

The foregoing warranty does not apply to ANRITSU connectors that have failed due to normal wear. Also, the warranty does not apply to defects resulting from improper or inadequate maintenance by the Buyer, unauthorized modification or misuse, or operation outside of the environmental specifications of the product. No other warranty is expressed or implied, and the remedies provided herein are the Buyer's sole and exclusive remedies.

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GPC-7 is a registered trademark of Amphenol Corporation.
ANACAT is a registered trademark of EEsof, Inc.
Ink Jet and Think Jet are registered trademarks of Hewlett-Packard Co.
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Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, ANRITSU Company uses the following symbols to indicate safety-related information. For your own safety, please read the information carefully BEFORE operating the equipment.

Symbols used in manuals

DANGER — This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.

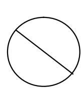
WARNING — This indicates a hazardous procedure that could result in serious injury or death if not performed properly.

CAUTION — This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

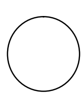
Safety Symbols Used on Equipment and in Manuals

(Some or all of the following five symbols may or may not be used on all ANRITSU equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.)

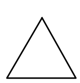
The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE operating the equipment.



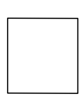
This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.



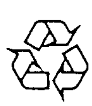
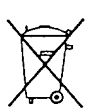
This indicates a compulsory safety precaution. The required operation is indicated symbolically in or near the circle.



This indicates warning or caution. The contents are indicated symbolically in or near the triangle.

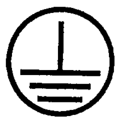


This indicates a note. The contents are described in the box.

These indicate that the marked part should be recycled.

For Safety



or

WARNING

When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Repair

WARNING ⚠

WARNING

This equipment can not be repaired by the operator. DO NOT attempt to remove the equipment covers or to disassemble internal components. Only qualified service technicians with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.

Changing Fuse

CAUTION ⚠

WARNING

Before changing the fuse, ALWAYS remove the power cord from the power outlet. There is the risk of receiving a fatal electric shock if the fuse is replaced with the power cord connected.

Always use a new fuse of the type and rating specified by the fuse markings on the rear panel of the instrument.

For Safety

WARNING

Use two or more people to lift and move this equipment, or use an equipment cart. There is a risk of back injury, if this equipment is lifted by one person.

DECLARATION OF CONFORMITY

Manufacturer's Name: ANRITSU COMPANY

Manufacturer's Address: Microwave Measurements Division
490 Jarvis Drive
Morgan Hill, CA 95037-2809
USA

declares that the product specified below:

Product Name: Microwave Vector Network Analyzers

Model Number: 360B, 360ACM, 36xxA, 3635B, 3640B, 3641B

conforms to the requirement of:

EMC Directive 89/336/EEC as amended by Council Directive 92/31/EEC & 93/68/EEC
Low Voltage Directive 73/23/EEC as amended by Council directive 93/68/EEC

Electromagnetic Interference:

Emissions: CISPR 11:1990/EN55011:1991 Group 1 Class A

Immunity: IEC 1000-4-2:1995/prEN50082-1:1995 - 4kV CD, 8kV AD
IEC 1000-4-3:1993/ENV50140:1994 - 3V/m
IEC 1000-4-4:1995/prEN50082-1:1995 - 0.5kV SL, 1kV PL

Electrical Safety Requirement:

Product Safety:

360B, 360ACM	IEC 1010-1:1990 + A1/EN61010-1:1993
36xxA, 3635B, 3640B, 3641B	Complies when used with 360B or 360ACM

Jim Blasi
Manager of Corporate Quality

Morgan Hill, CA

9-SEPT-97
Date

European Contact: For Anritsu product EMC & LVD information, contact Anritsu LTD, Rutherford Close, Stevenage Herts, SG1 2EF UK, (FAX 44-1438-740202)

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Tab / Section Title

VI Error And Status Messages
This section describes the type of error messages you may encounter during operation and provides a tabular listing. This listing describes and defines the error types.

VII Data Displays
This section provides a detailed description of the various data displays. It describes the graph types, frequency markers, measurement limit lines, status displays, and data display controls.

VIII Measurement Calibration
This section provides a discussion and tutorial on measurement calibration. It contains step-by-step calibration procedures for the Standard (OSL), Offset-Short, and LRL/LRM methods. It also has a procedure for calibrating using a sliding termination.

IX Measurements
This section discusses measurements with the 360B VNA. It contains subsections that provide a detailed descriptions for the following measurement types.

- Transmission and Reflection
- Low Level and Gain
- Group Delay
- Active Device
- Dual Source Control

X Options
This section describes the major measurement options. It contains subsections that provide discussion and description for the following measurement options.

- Option 2A, Time Domain
- Option 5, Receiver Mode

A1 Appendix 1 — Front Panel Menus, Alphabetical Listing
This appendix shows all of the menus that are called up using the front panel controls. It provides a replica of the menu and descriptive text for all of the various menu choices. The listing is alphabetical by the menu call letters mentioned and/or illustrated in Section V.

A2 Appendix 2 — Model 360 System Rear Panel Connectors
This appendix describes the rear panel connectors for system instruments. It provides illustrations for the network analyzer, frequency source, and test set rear panels. It also provides pinout listings for the illustrated connectors.

A3 Appendix 3 — Performance Specifications
This appendix provides system performance specifications.

Supplements
This tab provides a repository for data sheets and other material used to supplement manual sections.

Index

Repair

WARNING ⚠

WARNING

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Chapter 1
General Information

Table of Contents

Figure 1-1. *Model 360B Vector Network Analyzer System (Shown installed in Model 360C1 System Console*

Chapter 1
General Information

1-1 SCOPE OF MANUAL

This manual provides general information, installation, and operating information for the Model 360B Vector Network Analyzer (VNA) system. (Throughout this manual, the terms *360B VNA* and *360B* will be used interchangeable to refer to the system.) Manual organization is shown in the table of contents.

1-2 INTRODUCTION

This section provides general information about the 360B VNA system, which consists of the network analyzer, a test set, a signal (frequency) source, and one or more precision-component calibration or performance verification kits. The section also provides system specifications and a listing of recommended test equipment.

1-3 IDENTIFICATION NUMBER

All ANRITSU instruments are assigned a unique six-digit ID number, such as “701001.” This number is affixed to a decal on the rear panel of each unit. In any correspondence with ANRITSU Customer Service, please use this number.

NOTE

The system operating software is keyed to the analyzer identification number. For systems having the time-domain option installed, the operating-system will only load on the serial-numbered 360B one for which the software is identified.

1-4 RELATED MANUALS

Manuals related to the operation and maintenance of the 360B VNA system are listed in Table 1-1. This table also lists the 360B VNA optional equipment manuals.

Table 1-1. List of Related Manuals (Continued)

Title	Description	Part Number
Model 360B Vector Network Analyzer GPIB Programming Manual	This manual provides programming information for the 360B GPIB interface.	10410-00113
360B GPIB Quick Reference Guide	Alphabetically list and briefly describes all 360B GPIB commands. Provides references to fuller command descriptions located in 360B GPIB PM. Manual is bound with the 360B GPIB PM, but can be ordered separately.	10410-00114
Model 360B Vector Network Analyzer Maintenance Manual	Provides service information for the 360B VNA.	10410-00116
Model 36XX Calibration and Verification Kit Manuals	Provides operating instructions and maintenance information for the Models 3650, 3651, 3652, and 3653 Calibration Kits and the Models 3666, 3667, and 3668 Verification Kits.	10100-00024
3680 Series Universal Test Fixture Operation and Maintenance Manual	Provides general information, operating instructions, calibration procedures, and maintenance information for the 3680 Series Universal Test Fixture and optional accessories.	10410-00064
Model 2300-11 Materials Measurement Software User's Guide	Provides operating information for the Model 360 VNA Materials Measurement Software, ANRITSU part numbers 2300-11A.	10410-00066

1-5 SYSTEM DESCRIPTION

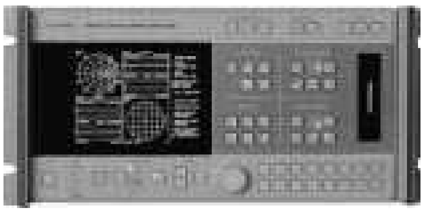


Figure 1-2. *Network Analyzer*

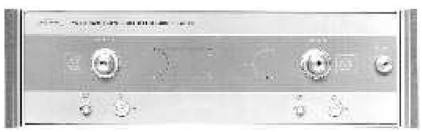


Figure 1-3. *Reversing Test Set*

Figure 1-4. *Signal Source*

Network Analyzer

The 360B Network Analyzer (Figure 1-2) is the control and display unit for all versions of the system. Its front panel controls provide menu selections for test functions, test parameters, measurement enhancements, and frequencies. Frequency information is sent to the signal (frequency) source over a dedicated system GPIB. Test parameters, system status, and measurement data are displayed on the large color screen and can be hard copied on a printer or plotter.

Test Set

Test Sets (Figure 1-3) are available that allow microwave vector measurements—including S-Parameter measurements of both active and passive devices—frequency conversion measurements, antenna measurements, and receiver measurements. The frequency range for coaxial test sets is 40 MHz to 65 GHz. (Test Set Option 6 provides operation to 67 GHz with test set models 3613A or 3623A.) The range for frequency converter test sets is 10 MHz to 60 GHz. The model 3535B millimeter-wave test set provides coverage from 33 to 110 GHz.

Signal Source

Two dedicated signal sources (Figure 1-4) are available—10 MHz to 20 GHz and 10 MHz to 40 GHz. Coverage to 60 or 65 GHz is provided by using a model 360SS69 Signal Source with the appropriate 361XA/362XA coaxial test set models. (Test set models 3612/22A and 3613A/23A include a frequency tripler for operation to 65 GHz.) The signal source is controlled by the network analyzer through a dedicated IEEE-488 bus. It provides clean, phase-locked test signals for precise test data. Frequency resolution is 100 kHz.

ANRITSU 6600B Sweep Generator models are also compatible and can be used in place of the 360SS47 and 360SS69 sources.

ANRITSU 67XXB Swept Frequency Synthesizer or 681XXA Synthesized Sweep Generator models are also compatible and offer 1 kHz frequency resolution.

1-6 PRECISION COMPONENT KITS

Two types of precision-component kits are available: calibration and verification. Calibration kits contain components used to identify and separate error sources inherent in microwave test setups. Verification kits consist of components with characteristics traceable to the National Institute of Standards and Technology (NIST). This type of kit is usually kept in the metrology laboratory where it provides the most dependable means of checking system accuracy. Each of these kits contains a microfloppy disk providing coefficient or measurement data for each component. Details of these kits are described in the following paragraphs.

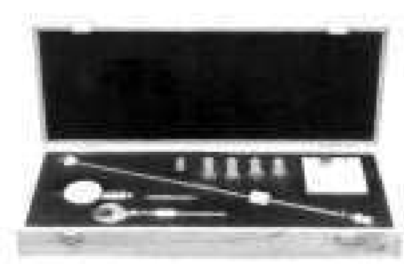


Figure 1-5. *Typical Model 365X Calibration Kit*

Model 3650 SMA/3.5 mm Calibration Kit

The 3650 Calibration Kit (Figure 1-5) contains all the precision components and tools required to calibrate the 360B VNA for 12-term error-corrected measurements of test devices with SMA or 3.5 mm connectors. Components are included for calibrating both male and female test ports. The kit supports calibration with broadband loads. Option 1 adds sliding loads. Kit consists of the following components:

- ☐ 23S50 Short, SMA/3.5 mm Male
- ☐ 23SF50 Short, SMA/3.5 mm Female
- ☐ 24S50 Open, SMA/3.5 mm Male
- ☐ 24SF50 Open, SMA/3.5 mm Female
- ☐ 28S50–2 Termination, SMA/3.5 mm Male, 2 ea. (dc–26.5 GHz)
- ☐ 28SF50–2 Termination, SMA/3.5 mm Female, 2 ea. (dc–26.5 GHz)
- ☐ 33SFSF50 Insertable, SMA/3.5 mm Female/Female, 2 ea.
- ☐ 33SS50 Insertable, SMA/3.5 mm Male/Male
- ☐ 33SSF50 Insertable, SMA/3.5 mm Male/Female, 2 ea.
- ☐ 34AS50–2 Adapter, GPC–7 to SMA/3.5 mm Male, 2 ea.
- ☐ 34ASF50-2 Adapter, GPC–7 to SMA/3.5 mm Female, 2 ea.
- ☐ 01–201 Torque Wrench
- ☐ 01–210 Reference Flat
- ☐ 01–222 Connector Gauge
- ☐ 01–223 Gauge Kit Adapter
- ☐ Data Disk

Option 1: Adds 17S50 Sliding Load, SMA/3.5 mm Male; 17SF50 Sliding Load, SMA/3.5 mm Female; 01–211 Female Flush Short; and 01–212 Male Flush Short.

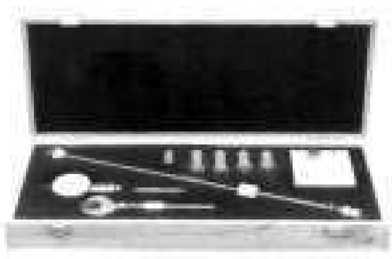


Figure 1-5. Typical Model 365X Calibration Kit (Repeated)

Model 3651 GPC–7 Calibration Kit

The 3651 Calibration Kit (Figure 1-5) contains all the precision components and tools required to calibrate the 360B for 12-term error-corrected measurements of test devices with GPC–7 connectors. The kit supports calibration with broadband loads. Option 1 adds a sliding load and a pin depth gauge. Kit consists of the following components:

- ☐ 23A50 Short, GPC–7
- ☐ 24A50 Open, GPC–7
- ☐ 28A50–2 Termination, GPC–7, 2 ea. (dc–18 GHz)
- ☐ 01–200 Torque Wrench
- ☐ 01–221 Collet Extractor Tool and Vial of 4 Collets
- ☐ Data Disk

Option 1: Adds 17A50 Sliding Load, GPC–7; and 01–220 GPCP–7 Connector Gauge; and 01–210 Reference Flat.

Model 3652 K Connector ® Calibration Kit

The 3652 Calibration Kit (Figure 1-5) contains all the precision components and tools required to calibrate the 360B for 12-term error-corrected measurements of test devices with K Connectors. Components are included for calibrating both male and female test ports. The kit supports calibration with broadband loads. Option 1 adds sliding loads. Kit consists of the following components:

- ☐ 23K50 Short, K Male
- ☐ 23KF50 Short, K Female
- ☐ 24K50 Open, K Male
- ☐ 24KF50 Open, K Female
- ☐ 28K50 Termination, K Male, 2 ea. (dc–40 GHz)
- ☐ 28KF50 Termination, K Female, 2 ea. (dc–40 GHz)
- ☐ 33KK50 Insertable, K Male/Male
- ☐ 33KFKF50 Insertable K Female/Female, 2 ea.
- ☐ 33KKF50 Insertable, K Male/Female, 2 ea.
- ☐ 34AK50 Adapter, GPC–7/K Male, 2 ea.
- ☐ 34AKF50 Adapter, GPC–7/K Female, 2 ea.
- ☐ 01–201 Torque Wrench
- ☐ 01–210 Reference Flat
- ☐ 01–222 Connector Gauge
- ☐ 01–223 Gauge Kit Adapter
- ☐ Data Disk

Option 1: Adds 17K50 Sliding Load, K Male; 17KF50 Sliding Load, K Female; 01–211 Female Flush Short; and 01–212 Male Flush Short.

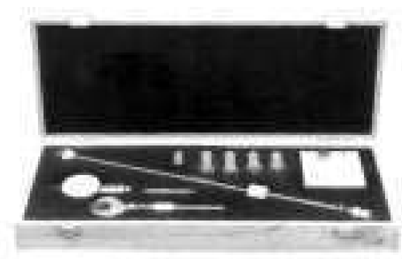


Figure 1-5. Typical Model 365X Calibration Kit (Repeated)

Model 3653 Type N Calibration Kit

The 3653 Calibration Kit (Figure 1-5) contains all the precision components and tools required to calibrate the 360B for 12-term error-corrected measurements of test devices with Type N connectors. Components are included for calibrating both male and female test ports. The kit supports calibration with broadband loads. Option 1 for sliding loads is not available in this calibration kit. Kit consists of the following components:

- ☐ 23N50 Short, N Male
- ☐ 23NF50 Short, N Female
- ☐ 24N50 Open, N Male
- ☐ 24NF50 Open, N Female
- ☐ 28N50–2 Termination, N Male, 2 ea. (dc–18 GHz)
- ☐ 28NF50–2 Termination, N Female, 2 ea. (dc–18 GHz)
- ☐ 34AN50–2 Adapter, GPC–7/N Male, 2 ea.
- ☐ 34ANF50–2 Adapter, GPC–7/N Female, 2 ea.
- ☐ 01–213 Type N Reference Gauge
- ☐ 01–224 Type N Connector Gauge
- ☐ Data Disk

Model 3654B V Connector® Calibration Kit

The model 3654B Calibration Kits (Figure 1-5) contain all the precision components and tools required to calibrate the 360B for 12-term error-corrected measurements of test devices with V Connectors. This kit supports system calibration to 65 GHz. Components are included for calibrating both male and female test ports. The kit supports calibration with broadband loads. Kit consists of the following:

- ☐ 23V50B-5.1 Short, V Male
- ☐ 23VF50B-5.1 Short, V Female
- ☐ 24V50B Open, V Male
- ☐ 24VF50B Open, V Female
- ☐ 28V50B Termination, V Male, 2 ea. (dc–65 GHz)
- ☐ 28VF50B Termination, V Female, 2 ea. (dc–65 GHz)
- ☐ 33VV50B Insertable, V Male/Male
- ☐ 33VFVF50B Insertable V Female/Female, 2 ea.
- ☐ 33VVF50B Insertable, V Male/Female, 2 ea.
- ☐ 01–201 Torque Wrench
- ☐ 01–210 Reference Flat
- ☐ 01–322 Connector Gauge
- ☐ 01–323 Gauge Kit Adapter
- ☐ 17V50B Sliding Load, V Male
- ☐ 17VF50B Sliding Load, V Female
- ☐ 01-311 Female Flush Short
- ☐ 01-312 Male Flush Short

Figure 1-6. *Model 3666 Verification Kit*

- ☐ Data Disk

Model 3666 3.5 mm Verification Kit

The 3666 Verification Kit (Figure 1-6) contains precision 3.5 mm components with characteristics that are traceable to the NIST. Used primarily by the metrology laboratory, these components provide the most dependable means of determining system accuracy. A disk containing factory-measured test data for all components is supplied for comparison with customer-measured data.

The 3666 consists of the following components:

- ☐ 19S50–7 7.5 cm Air Line
- ☐ 19S50–7B 7.5 cm Stepped Impedance Air Line (Beatty Standard)
- ☐ 42S–20 20 dB Attenuator
- ☐ 42S–50 50 dB Attenuator

Figure 1-7. *Model 3667 Verification Kit*

Model 3667 GPC–7 Verification Kit

The 3667 Verification Kit (Figure 1-7) contains precision GPC–7 components with characteristics that are traceable to the NIST. Used primarily by the metrology laboratory, these components provide the most dependable means of determining system accuracy. A disk containing factory-measured test data for each component is supplied for comparison with customer-measured data. Kit consists of the following components:

- ☐ 18A50–10B 10 cm Stepped Impedance Air Line (Beatty Standard)
- ☐ 18A50–10 10 cm Air Line
- ☐ 42A–20 20 dB Attenuator
- ☐ 42A–50 50 dB Attenuator

Figure 1-8. *Model 3668 Verification Kit*

Model 3668 K Connector® Verification Kit

The 3668 Verification Kit (Figure 1-8) contains precision K Connector components with characteristics that are traceable to the NIST. Used primarily by the metrology laboratory, these components provide the most dependable means of determining system accuracy. A disk containing factory-measured test data for each component is supplied for comparison with customer-measured data. Kit consists of the following components:

- ☐ 19K50–7 7.5 cm Air Line
- ☐ 19K50–7B 7.5 cm Stepped Impedance Air Line (Beatty Standard)
- ☐ 42K–20 20 dB Attenuator
- ☐ 42K–50 50 dB Attenuator

Figure 1-9. Model 3669 Verification Kit

Model 3669B V Connector® Verification Kit

The 3669B Verification Kits (Figure 1-9) contain precision V Connector components with characteristics that are traceable to the NIST. Model 3669B supports verification to 65 GHz .Used primarily by the metrology laboratory, these components provide the most dependable means of determining system accuracy. A disk containing factory-measured test data for each component is supplied for comparison with customer-measured data. Kit consists of the following components:

- ☐ 19V50–5 5 cm Air Line
- ☐ 19V50–5B 5 cm Stepped Impedance Air Line (Beatty Standard)
- ☐ 42V–20 20 dB Attenuator
- ☐ 42V–40 40 dB Attenuator

1-7 OPTIONS

The following options are available.

Network Analyzer

- ☐ Option 1: Rack Mount Slides and Ears.
- ☐ Option 2A: High Speed Time (Distance) Domain Measurement Capability.
- ☐ Option 5: Receiver Mode Capability
- ☐ Option 102A: Field upgrade of Option 2A.

Test Set

- ☐ Option 1: Rack Mount Slides and Ears.
- ☐ Option 3: Assymetrical configuration, optimizes dynamic range and performance for the forward parameters. (Not available for 3630A and 3631A Test Sets)
- ☐ Option 4: 10 MHz Frequency Coverage (Available only for 3630A and 3631A Test Sets)
- ☐ Option 5: 62.5 GHz Frequency Coverage (Available only for 3612A and 3622A Test Sets)
- ☐ Option 6: 67 GHz Frequency Coverage (Available only for 3613A and 3623A Test Sets)

Signal Source

- ☐ Option 1: Rack Mount Slides and Ears.

Cabinets

- ☐ 360C1 System Console, including a work shelf, support rails, component storage drawer, and power distribution.
- ☐ 360C2 System Cabinet, including support rails, component storage drawer and power distribution.
- ☐ 360C3 Millimeter-Wave System Console.

1-8 FEATURES AND MISCELLANEOUS

Test Port Cables

- ☐ 3670A50–1 Test Port Cable, dc to 18 GHz, GPC–7 connectors, 1 foot long, 2 each required.
- ☐ 3670A50–2 Test Port Cable, dc to 18 GHz, GPC–7 connectors, 2 feet long.
- ☐ 3670K50–1 Test Port Cable, dc to 40 GHz, K Connectors, 1 foot long, male/female, 2 each required.
- ☐ 3670K50–2 Test Port Cable, dc to 40 GHz, K Connectors, 2 feet long, male/female.
- ☐ 3670V50–1 Test Port Cable, dc to 60 GHz, V Connectors, 1 foot long, male/female, 2 each required.
- ☐ 3670V50–2 Test Port Cable, dc to 60 GHz, V Connectors, 2 feet long, male/female.

Test Port Converters

Test port converters are available for use with the 3610A, 3611A, 3620A, and 3621A Test Sets.

- ☐ 34UA50 Test Port Adapter, Universal/GPC–7
- ☐ 34UK50 Test Port Adapter, Universal/K Connector, male.
- ☐ 34UN50 Test Port Adapter, Universal/N male.
- ☐ 34UNF50 Test Port Adapter, Universal/N female.
- ☐ 34UQ50 Test Port Adapter, Universal/2.4mm male.
- ☐ 34US50 Test Port Adapter, Universal/APC-3.5

Test port converters for 3612A and 3622A Test Set

- ☐ 34YA50 Test Port Adapter, Universal/ GPC–7
- ☐ 34YK50 Test Port Adapter, Universal/ K Connector, male.
- ☐ 34YQ50 Test Port Adapter, Universal/2.4mm male.
- ☐ 34YSS50 Test Port Adapter, Universal/SSMA male.
- ☐ 34YV50 Test Port Adapter, Universal/V male.

Other

- ☐ 01-202 Wrench, for changing test set Test Port Converters.
- ☐ 2300-10 ANACAT Software.
- ☐ 2300-11A Material Measurement Software
- ☐ 2300-13 Lab Windows® Software
- ☐ 2300-14 360/360B Instrument Driver for Lab Windows®

Replacement GPIB Cables

- ☐ 2100-1 GPIB Cable, 1m (3.3 ft.)
- ☐ 2100-2 GPIB Cable, 2m (6.6 ft.)
- ☐ 2100-4 GPIB Cable, 4m (13.2 ft.)
- ☐ 2100-5 GPIB Cable, 0.5m (1.65 ft.)

Accessories

- ☐ 2225C Ink Jet Dot-Matrix Printer.
- ☐ 2225-1 Spare Printer Interface Cable.
- ☐ 2225-2 Replacement Ink Jet Cartridges.
- ☐ 2225-3 Fan-Fold Ink Jet Printer Paper (500 sheets).
- ☐ 2000-209 3.5-inch Blank Diskettes (Box of 10)..

On-Site Support

- ☐ 360MS Option 11: On-Site Verification.
- ☐ 360MS Option 12: On-Site Service.

Extended Service Options

Additional, one year and two year “return to WILTRON” service is available. Prices and details are available from your ANRITSU Sales Representative or by contacting the factory.

1-9 PERFORMANCE SPECIFICATIONS

System performance specifications are provided in Appendix 3.

1-10 RECOMMENDED TEST EQUIPMENT

Table 1-2 lists the recommended test equipment for maintaining and servicing the 360B VNA system.

Instrument	Critical Specification	Recommended Manufacturer/Model
Spectrum Analyzer, with Diplexer and External Mixers	*Frequency:* 0.01 to 60 GHz *Resolution:* 10 Hz	Tektronix, Inc. Model 494P,with External Mixers: WM 490K (18 to 26.5 GHz) WM 490A (26.5 to 40 GHz) WM 490U (40 to 60 GHz) WM 490V (50 to 75 GHz) Diplexer PN: 015-0385-00
Power Meter, with Power Sensors	*Range:* –30 to +20 dBm (1µW to 100 mW) *Other:* GPIB-controllable	Hewlett-Packard Model 437B, with Option 22 (GPIB), and Power Sensors: HP 8485A (0.05 to 26.5 GHz) HP 8487A (0.05 to 50 GHz)
Digital Multimeter	*Resolution:* 4-1/2 digits *DC Accuracy:* 0.002% +2 counts *DC Input Z:* 10 MΩ *AC Accuracy:* 0.07% +100 counts (to 20 kHz) *AC Input Z:* 1 MΩ	John Fluke, Inc. Model 8840A, with Option 8840A-09 (True RMS AC)
Frequency Counter, with External Mixers	*Range:* 0.01 to 60 GHz *Input Z: 50Ω* *Resolution:* 1 Hz *Other:* External Time Base Input	EIP Microwave, Inc. Model 578A, with External Mixers: Option 91 (26.5 to 40 GHz) Option 92 (40 to 60 GHz) Option 93 (60 to 90 GHz)
Oscilloscope	*Bandwidth:* DC to 150 MHz *Vertical Sensitivity:* 2 mV/ division *Horiz Sensitivity:* 50 ns/ division	Tektronix, Inc. Model 2445
Function Generator	*Output Voltage Range:* 300 mV to 10V *Functions:* 200 Hz Sine Wave 100 Hz Square Wave	Hewlett-Packard Model 3325A

1-11 PREVENTIVE MAINTENANCE

Cleaning of the rear panel fan filters is the only preventive maintenance that is required on the 360B VNA System (Analyzer, Test Set, Signal Source). These filters should be inspected montly and cleaned when necessary. To clean:

Step 1. Turn power off on the 360B, using the POWER key.

Step 2. Remove the four thumbscrews securing the fan guard and remove the fan filter.

Step 3. Clean the filter using warm water and a mild detergent.

Step 4. Reinstall the filter and fan guard.

Step 5. Restore the power and verify that the fan is operational.

Chapter 2
Installation

Table of Contents

WARNING

Use two or more people to lift and move this equipment, or use an equipment cart. There is a risk of back injury, if this equipment is lifted by one person.

Chapter 2
Installation

2-1 INTRODUCTION

This chapter provides information on initial inspection, preparation for use, and Calibration KitsGeneral Purpose Interface Bus (GPIB) interconnections. It also includes reshipment and storage information.

2-2 CONFIGURATIONS

The 360B system has three possible console configurations (C1, C2, C3), and multiple Test Set and Source configurations. The 360C1, for example, provides space for the VNA unit, one Test Set unit, two Source units, and either an Auxiliary Control Module or a 360TSM Multiplexer. In this chapter, we will describe the assembly of each of console type and provide cabling information for the basic configurations.

2-3 INITIAL INSPECTION

Inspect the shipping container for damage. If the container or cushioning material is damaged, retain until the contents of the shipment have been checked against the packing list and the instrument has been checked for mechanical and electrical operation.

If any network analyzer instruments or components are damaged mechanically, notify your local sales representative or ANRITSU Customer Service. If either the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as ANRITSU. Keep the shipping materials for the carrier's inspection.

2-4 PREPARATION FOR USE, 360C1 CONSOLE

The 360B system comes packaged in six boxes. Preparation for use consists of the following:

- ☐ Inventorying the shipment, including the attaching-parts kit contained in Box 5.
- ☐ Unpacking the equipment
- ☐ Assembling the console.
- ☐ Installing the system instruments.
- ☐ Installing the shelf.
- ☐ Cabling the instruments.
- ☐ Checking the line voltage setting; resetting for the line-voltage value in your area, if appropriate.

Table 2-1 shows the attaching-parts kit. Use this information to ensure that all of the required parts are available before beginning the assembly of the console. The steps required to assembly the console are given on the following pages.

Attaching Parts for Assembling 360C1 Console

Table 2-1. 360C1 Console Parts

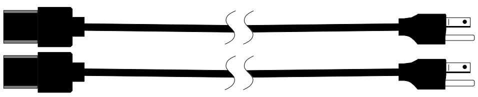
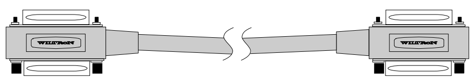
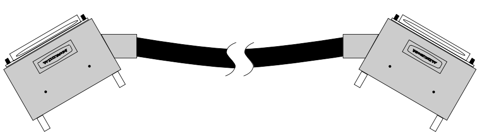
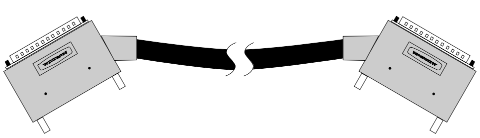
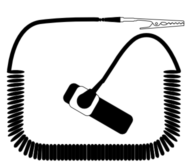
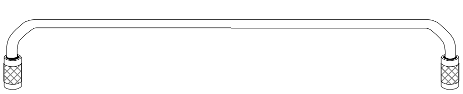
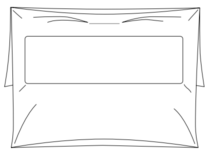
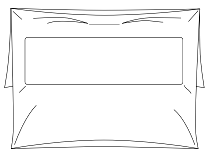
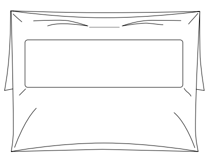
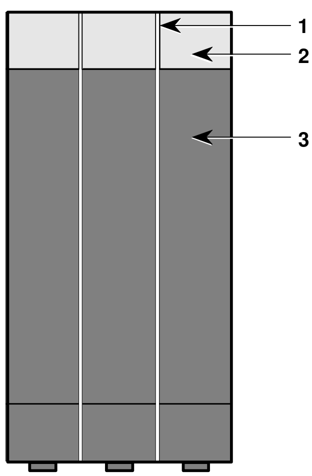
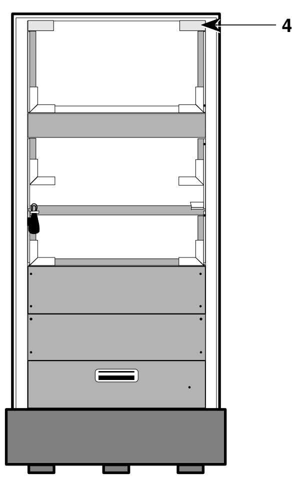
	Description	ANRITSU Part No.	Qty
	Cords for connecting analyzer and signal source to ac bus.	800-279 (110V) 806-9 (220V)	2
	Interconnect cable having GPIB connectors on each end, 1 m long. Used to connect analyzer to source.	2100-1	1
	Signal cable having BNC female connectors on each end, 3 ft long. Used to connect between FM ØLOCK ports of signal source and analyzer.	800-124	1
	Mat for dissipating static electricity.	2000-204	1
	Interface cable used to connect between CONTROL ports on analyzer and test set.	C35811-5	1
	Interface cable used to connect between SIGNAL ports on analyzer and test set.	C35812-5	1
	Strap and cord for connecting between operator's wrist and static dissipative mat.	783-163	1
	RF cable between test set and signal source. Ruggedized cable has male ANRITSU K Connectors on each end.	C34429-1	1

Table 2-1. 360C1 Console Parts (Continued)

	Description	ANRITSU Part No.	Qty
	Packet containing grey, decorative screws used to secure the analyzer, test set, and source to the front panel of the console.	900-609	12
	Packet containing the below listed parts. Parts are used to assemble the writing shelf. Washer, #10, Split Lk Screw, Pan Hd, 10-32x0.5 inch, Phillips. Used to mount the rails to the writing surface and the console rail guides. Washer, #10, Flat, 0.375 inch	900-396 900-223 900-352	8 8 2
	Packet containing the below listed parts. Parts are used to assemble the bracket-clip. Bracket-clip used to retain analyzer, test set, and source to the rear of their individual support brackets. Nut, Kep, 8-32 x 0.343 inch Washer, #8, Flat, 0.375 inch	A32339 900-336 900-351	6 12 12
	Wrench	01-202	1

Preparing the 360C1 Console





Unpack and setup the 360C1 console as described below.

Step 1. Remove the console from its shipping container, as follows:

a. Cut the bands (1).

b. Lift off the top (2).

c. Remove the cardboard sleeve (3) by pulling straight up and away.

d. Remove the packing materials.

e. Remove the writing surface from atop the console and set it aside. You will be directed to complete its assembly in a later step.

Step 2. Remove the console from the shipping pallet, as follows:

a. Insert two 4-to-6 foot lengths of 2x4-inch lumber through the top opening in the console (4).

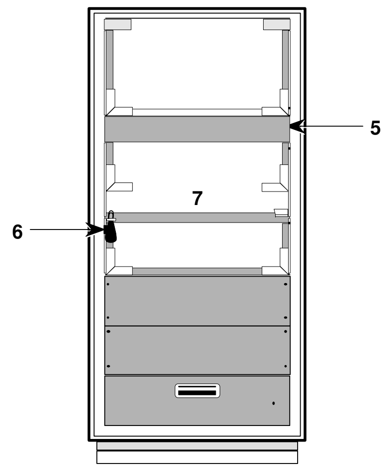
b. With a person stationed on the front side and another on the back side, use the 2x4's to lift the console off and away from the pallet.

<u>*Alternate Procedure*</u>

c. Tilt the console on its back, being careful not to scratch the paint.

d. Remove the pallet.

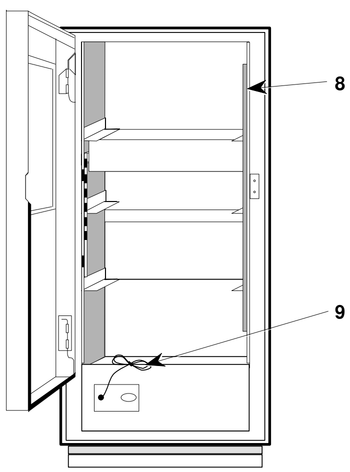
NOTE
The empty console weights 65.9 kg (145 lb). We recommend employing two or more people to lift it off of the shipping pallet.



Step 3. Prepare the front of the console for installation of the equipment, as follows:

a. Remove the drawer retaining bracket (5).

b. Cut the tie wrap from the Wrist Strap/Table Mat. Ground Port (6), bring it out through the opening above the small panel (7), and let it hang free and out of the way.



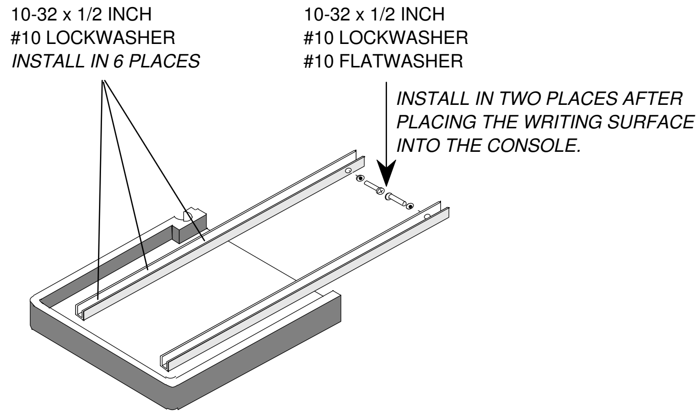
Step 4. Prepare the rear of the console for installation of the equipment, as follows:

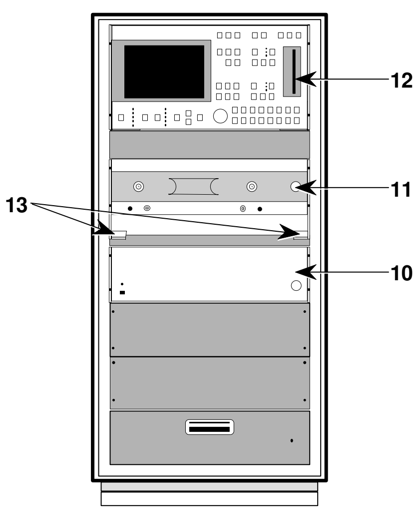
a. Open the rear door, cut the tie wraps from the writing-surface rails (8), and remove the rails from the console.

b. Cut the tie wrap from the Line Cord (9), and uncoil the cord.

Step 5. Prepare the Writing Surface, as follows:

a. Attach the two rails as shown below, using the 10-32 x 1-inch screws and #10 split-lockwashers supplied in the attaching-parts kit.





Step 6. Install the instruments as follows:

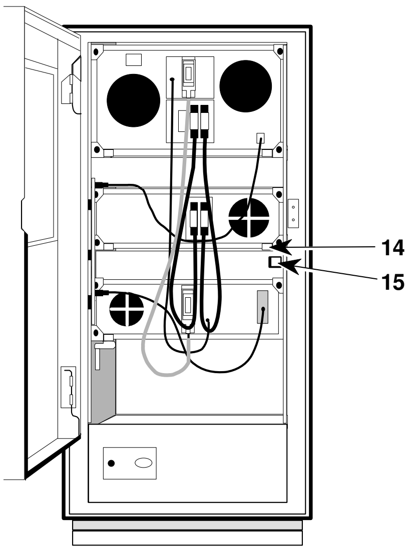
a. Unpack the Frequency Source, and install it in the lower opening (10) of the console.

b. Push the Source into the console until it is flush with the front of the opening.

c. Secure the Source using four of the panel screws supplied in the attaching-parts kit.

d. In a like manner, install the Test Set (11) and Analyzer (12).

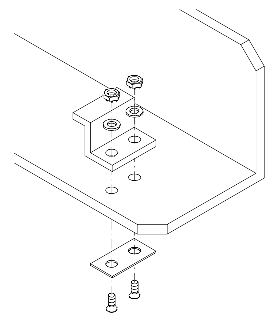
e. Install the Writing Surface by inserting its rails into the rail guides (13) and pushing in until its rear is flush with the front of the console.



Step 7. Secure the instruments and install the interconnecting cables, as follows:

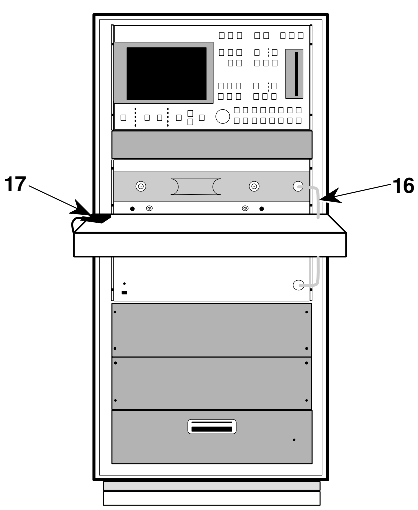
a. Install the Retainer Clips (14) on the rear of the Support Brackets (Detail A). Secure the three instruments. Use 8-32 Kep nuts and #8 flatwashers.

DETAIL A



b. Install the interconnect cables as shown at left and in Figures 2-1 through 2-5. For test set models 3613A and 36123A, connect the 40-5x Auxiliary Power Supply* to the rear panel AUXILIARY POWER INPUT connector.

c. Secure the Writing Surface rails to the tapped hole in each rail guides (15). Use two 10-32 x 1/2-inch screws, two #10 split-lockwashers, and two #10 flatwashers from the attaching-parts kit.



Step 8. Complete the assembly, as follows:

a. Install the semirigid RF output cable (16) between the Source and the Test Set. Some movement to align may be necessary.

b. Lay the Static Mat onto the Writing Surface.

c. Snap the Wrist Strap/Ground Port (17) to the Static Mat.

d. Plug the end of the Wrist Strap into the Wrist Strap/Ground Port.

e. Check the line voltage setting on the rear of the Analyzer and Source. If either differs from the voltage present in your area, refer to paragraph 2-8 for instructions.

∗ Refer to Table 1-2 of 360B VNA Maintenance Manual.

2-5 EQUIPMENT INTERCONNECTIONS

Illustrations of the equipment rear panels are given in Figures 2-1 through 2-6.

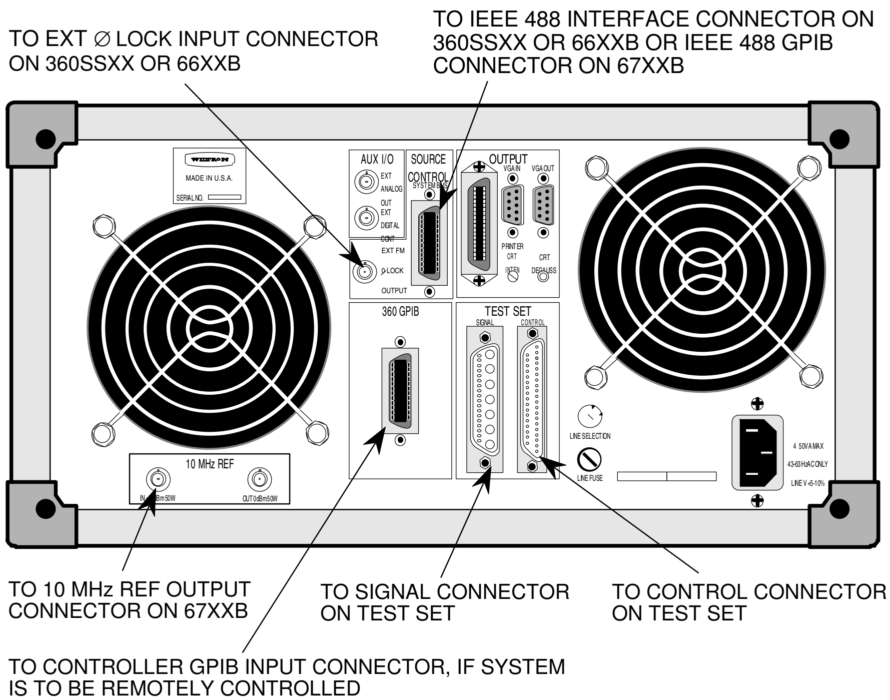


Figure 2-1. 360B Vector Network Analyzer Rear Panel

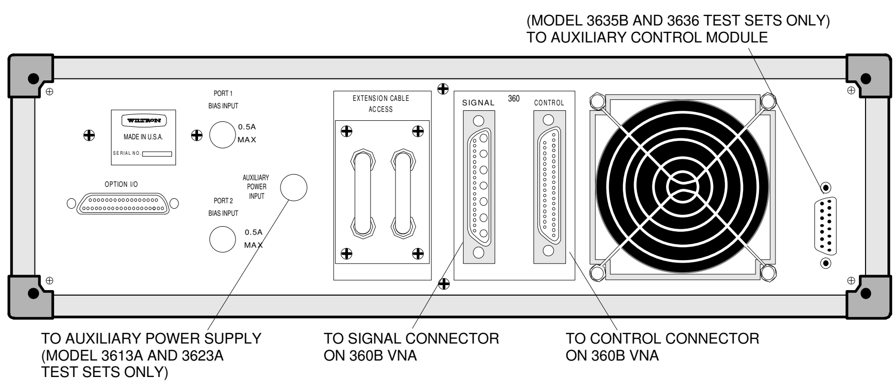


Figure 2-2. Test Set Rear Panel

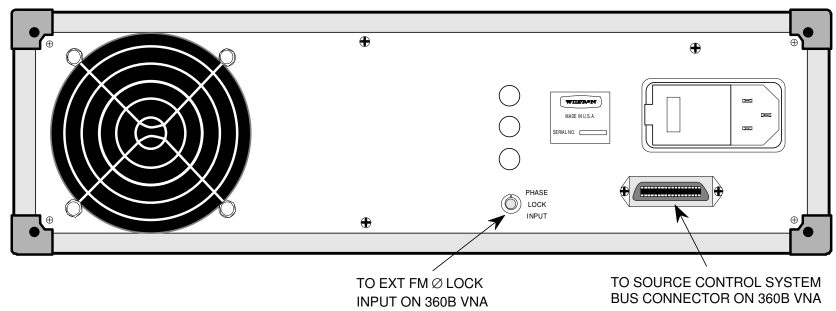


Figure 2-3. *Model 36SSXX Signal Source Rear Panel*

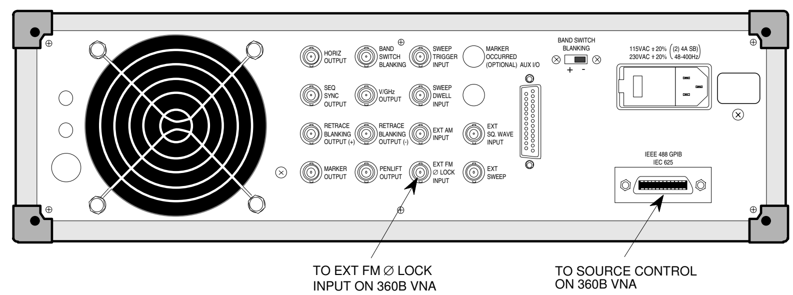


Figure 2-4. *Model 66XXB Sweep Generator Rear Panel*

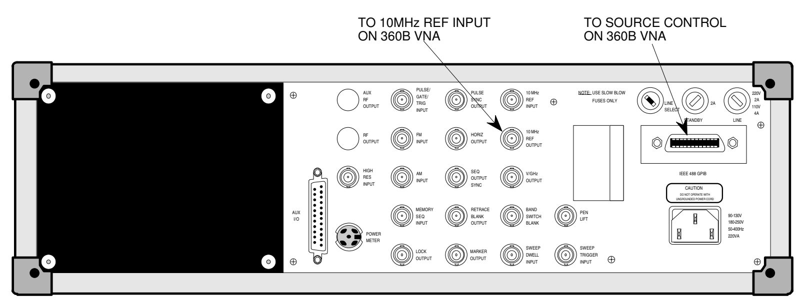


Figure 2-5. *Model 67XXB Frequency Synthesizer Rear Panel*

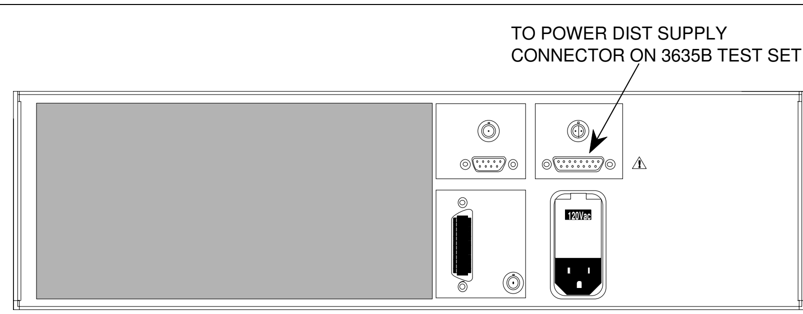


Figure 2-6. *Auxilliary Control Module Rear Panel*

2-6 PREPARATION FOR USE, 360C2 CABINET

The 360B system comes packaged in six boxes. Preparation for use consists of the following:

- ☐ Inventorying the shipment, including the attaching-parts kit contained in Box 5.
- ☐ Unpacking the equipment
- ☐ Assembling the cabinet.
- ☐ Installing the system instruments.
- ☐ Cabling the instruments.
- ☐ Checking the line voltage setting; resetting for the line-voltage value in your area, if appropriate.

Table 2-2 provides a listing of the hardware. You can use this illustration to ensure that all of the required parts are available before beginning the assembly of the cabinet. The steps required to assemble the cabinet are given on the following pages.

WARNING

Changing Fuse

Before changing the fuse, ALWAYS remove the power cord from the power outlet. There is the risk of receiving a fatal electric shock if the fuse is replaced with the power cord connected.

CAUTION ⚠

Always use a new fuse of the type and rating specified by the fuse markings on the rear panel of the instrument.

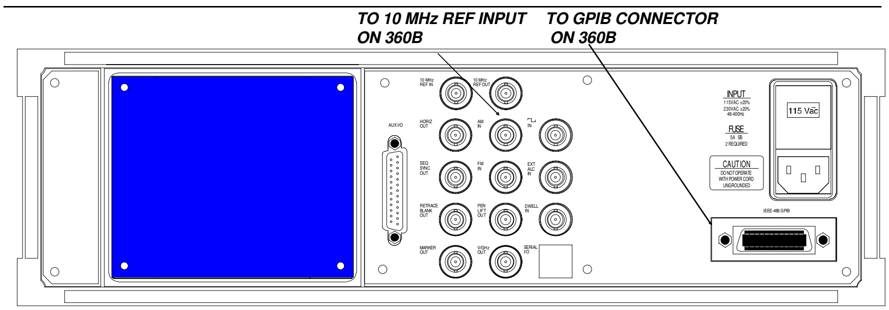


Figure 2-6A. *Model 681XXA Synthesized Sweep Generator Rear Panel*

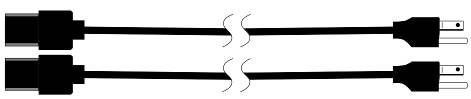
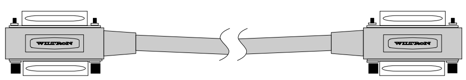
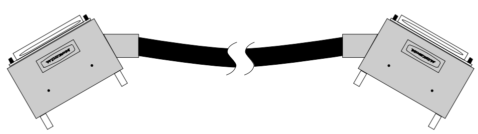
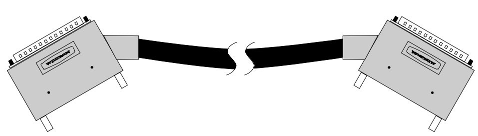
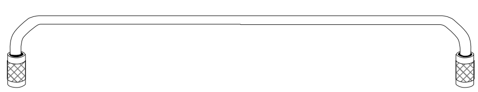
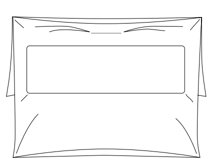
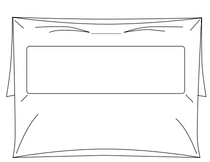
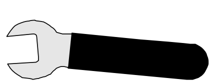
WARNING

or

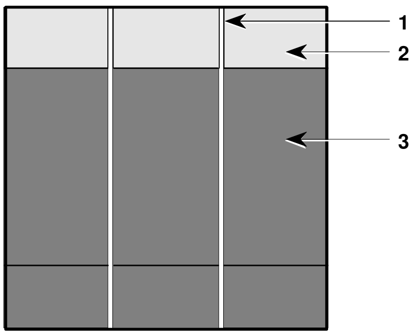
When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Attaching Parts for Assembling 360C2 Cabinet

Table 2-2. 360C2 Cabinet Parts

	Description	ANRITSU Part No.	Qty
	Cords for connecting analyzer and signal source to ac bus.	800-279 (110V) 806-9 (220V)	2
	Interconnect cable having GPIB connectors on each end, 0.5 m long. Used to connect analyzer to source.	2100-5	1
	Signal cable having BNC female connectors on each end, 18 in. long. Used to connect between FM ØLOCK ports of signal source and analyzer.	800-118	1
	Interface cable used to connect between CONTROL ports on analyzer and test set.	800-300	1
	Interface cable used to connect between SIGNAL ports on analyzer and test set.	800-303	1
	RF cable between test set and signal source. Ruggedized cable has male ANRITSU K Connectors on each end.	C34429-2	1
	Packet continain grey, decorative screws used to secure the analyzer, test set, and source to the front panel of the console.	900-609	12
	Packet containing the below listed parts. Parts are used to assemble the bracket-clip. Bracket-clip used to retain analyzer, test set, and source to the rear of their individual support brackets. Nut, Kep, 8-32 x 0.343 inch Washer, #8, Flat, 0.375 inch	 A32339 900-336 900-351	 6 12 12
	Wrench	01-202	1

Preparing the 360C2 Cabinet



Unpack and setup the 360C1 console as described below.

Step 1. Remove the cabinet from its shipping container, as follows:

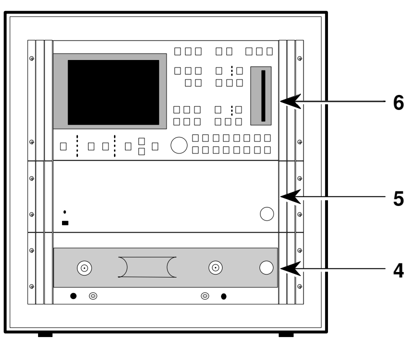
a. Cut the bands (1).

b. Lift off the top (2).

c. Remove the cardboard sleeve (3) by pulling straight up and away.

d. Remove the packing materials.

Step 2. Install the instruments as follows:

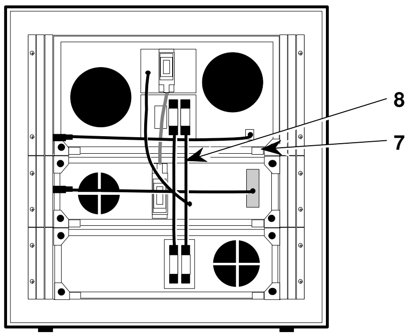


a. Unpack the Test Set, and install it in the lower opening (4) of the cabinet.

b. Push the Test Set into the cabinet until it is flush with the front of the opening.

c. Secure the Test Set using four of the panel screws supplied in the attaching-parts kit.

d. In a like manner, install the Source (5) and Analyzer (6).

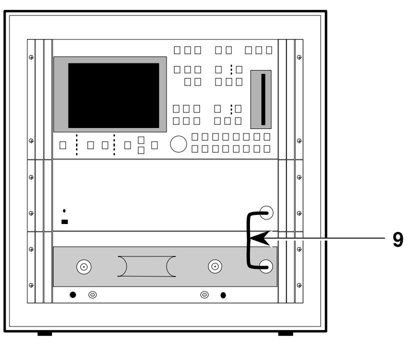


Step 3. Secure the instruments and install the interconnecting cables, as follows:

a. Install the Retainer Clips (7) n the rear of the Support Brackets and secure the three instruments. Use 8-32 Kep nuts and #8 flatwashers.

b. Install the interconnect cables as shown at left and in Figures 2-1 through 2-5. For test set models 3613A and 36123A, connect the 40-5x Auxiliary Power Supply* to the rear panel AUXILIARY POWER INPUT connector.

c. Connect the Line Cords on the Analyzer and Source (8) to the ac receptacle.



Step 4. Complete the assembly, as follows:

a. Install the semirigid RF output cable (9) between the Source and the Test Set.

b. Check the line voltage setting on the rear of the Analyzer and Source. If either differs from the voltage present in your area, refer to paragraph 2-8 for instructions.

* Refer to Table 1-2 of 360B VNA Maintenance Manual.

2-7 PREPARATION FOR USE, 360C3 CONSOLE

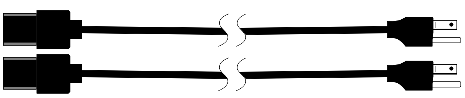
The 360B system comes packaged in six boxes. Preparation for use consists of the following:

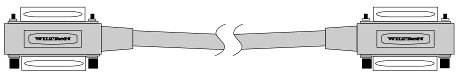
- ☐ Inventorying the shipment, including the attaching-parts kit contained in Box 5.
- ☐ Unpacking the equipment
- ☐ Assembling the cabinet.
- ☐ Installing the system instruments.
- ☐ Cabling the instruments.
- ☐ Checking the line voltage setting; resetting for the line-voltage value in your area, if appropriate.

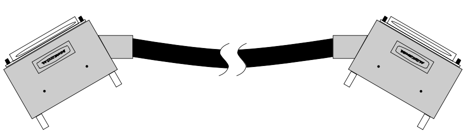
Table 2-3 provides a listing of the hardware. Using this illustration to ensure that all of the required parts are available before beginning the assembly of the console. The steps required to assemble the console are given on the following pages.

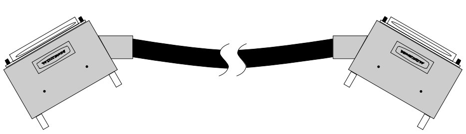
Attaching Parts for Assembling 360C3 Console

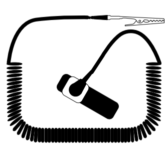
Table 2-3. 360C3 Console Parts

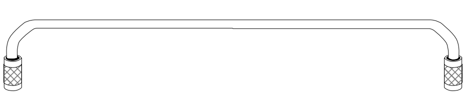






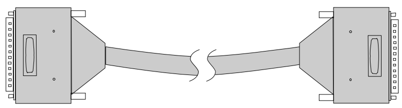
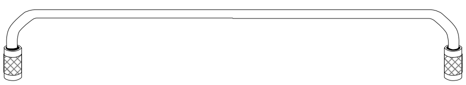
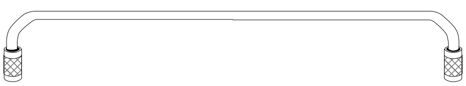
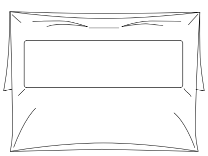
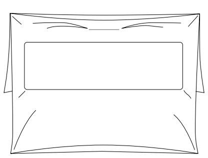
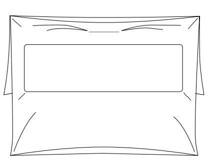
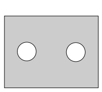
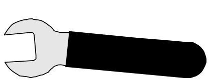






Description	ANRITSU Part No.	Qty
Cords for connecting analyzer and signal source to ac bus.	800-279 (110V) 806-9 (220V)	3
Interconnect cable having GPIB connectors on each end, 1 m long. Used to connect analyzer to source.	2100-1	2
Signal cable having BNC female connectors on each end, 3 ft long. Used to connect between FM ØLOCK ports of signal source and analyzer.	800-124	1
Mat for dissipating static electricity.	2000-292	1
Interface cable used to connect between CONTROL ports on analyzer and test set.	C35811-5	1
Interface cable used to connect between SIGNAL ports on analyzer and test set.	C35812-5	1
Strap and cord for connecting between operator's wrist and static dissipative mat.	783-163	1
RF cable between test set (all but 3636A/B) and signal source. Ruggedized cable has male ANRITSU K Connectors® on each end.	C35639	1

Table 2-3. *360C3 Console Parts (Continued)*

	Description	ANRITSU Part No.	Qty
	External Power cable between Auxiliary Control Module and Test Set	803-49	1
	RF cable between test set (all but 3635B) and signal source. Ruggedized cable has male ANRITSU K Connectors on each end.	C35640	1
	RF cable between 3635A/B and signal source. Ruggedized cable has male ANRITSU K Connectors on each end.	C35714	1
	RF cable between 3635B and signal source. Ruggedized cable has male ANRITSU K Connectors on each end.	C35715	1
	Grey, decorative screws used to secure the analyzer, test set, and source to the front panel of the console.	900-609	20
	Packet containing the below listed parts. Parts are used to assemble the writing shelf. Washer, #10, Split Lk Screw, Pan Hd, 10-32x0.5 inch, Phillips. Used to mount the rails to the writing surface and the console rail guides. Washer, #10, Flat, 0.375 inch	 900-396 900-223 900-352	 8 8 2
	Packet containing the below listed parts. Parts are used to assemble the bracket-clip. Bracket-clip used to retain analyzer, test set, and source to the rear of their individual support brackets. Nut, Kep, 8-32 x 0.343 inch Washer, #8, Flat, 0.375 inch	 A32339 900-336 900-351	 6 20 20
	Shim, spacer, used between console shelf and 67XXB	A34974	2
	Wrench	01-202	1

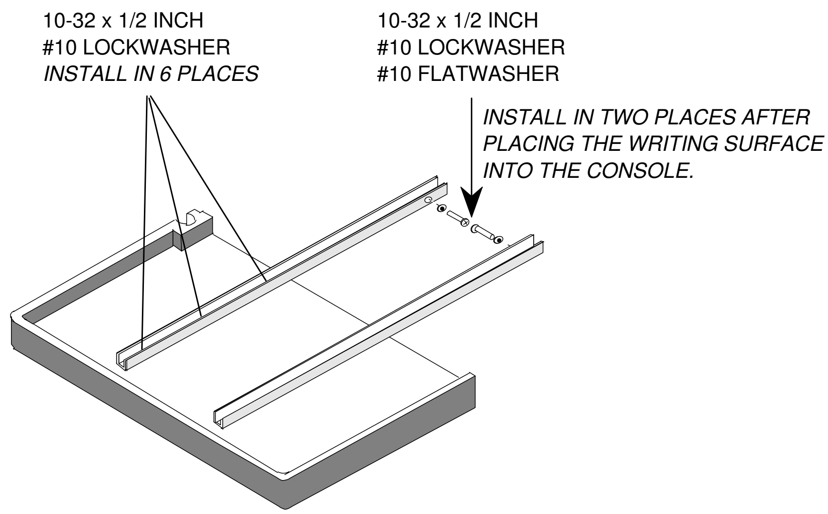
Preparing the 360C3 Console

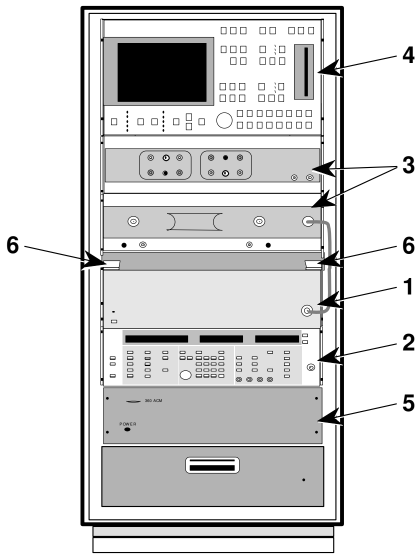
Unpack and setup the 360C3 console as described below.

Step 1. Perform steps 1 through 4 of the 360C1 Console procedure, pages 2-6 and 2-7.

Step 2. Prepare the Writing Surface, as follows:

a. Attach the two rails as shown below, using the 10-32 x 1-inch screws and #10 split-lockwashers supplied in the attaching-parts kit.





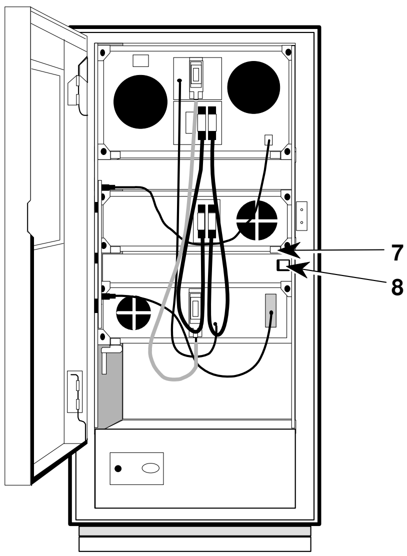
Step 3. Install the instruments as follows:

a. Unpack the Frequency Sources, and install one in opening (1) and the other in opening (2) of the console.

b. Push the Sources into the console until they are flush with the front of the opening, and secure using the panel screws supplied in the attaching-parts kit.

c. In a like manner, install the Test Sets (3). Analyzer (4), and Auxiliary Control Module (5).

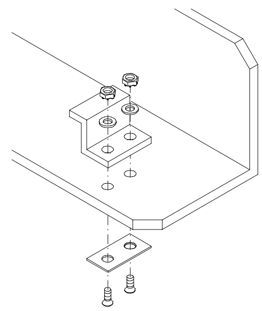
d. Install the Writing Surface by inserting its rails into the rail guides (6) and pushing in until its rear is flush with the front of the console.



Step 4. Secure the instruments and install the interconnecting cables, as follows:

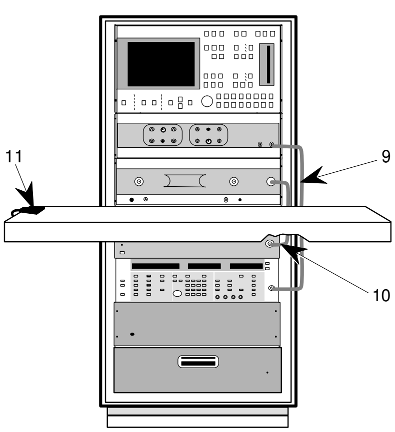
a. Install the Retainer Clips (7) on the rear of the Support Brackets (Detail A). Secure the three instruments. Use 8-32 Kep nuts and #8 flatwashers.

DETAIL A



b. Install the interconnect cables as shown at left and in Figures 2-1 through 2-6, depending upon the type of Source and Test Set units you have. For test set models 3613A and 36123A, connect the 40-5x Auxiliary Power Supply* to the rear panel AUXILIARY POWER INPUT connector.

c. Secure the Writing Surface rails to the tapped hole in each rail guides (8). Use two 10-32 x 1/2-inch screws, two #10 split-lockwashers, and two #10 flatwashers from the attaching-parts kit.



Step 5. Complete the assembly, as follows:

a. Install the semirigid RF cables (9) and (10 between the Test Set, Source 1, and Source 2. Some movement to align may be necessary.

b. Lay the Static Mat onto the Writing Surface.

c. Snap the Wrist Strap/Ground Port (11) to the Static Mat.

d. Plug the end of the Wrist Strap into the Wrist Strap/Ground Port.

e. Check the line voltage setting on the rear of the Analyzer and Source. If either differs from the voltage present in your area, refer to paragraph 2-8 for instructions.

* Refer to Table 1-2 of 360B VNA Maintenance Manual.

2-8 CHANGING THE LINE VOLTAGE

The Network Analyzer unit and Frequency Source(s) contain a module that permits the instrument to operate on line voltages of either 110 or 220 Vac. Prior to leaving the factory, the instruments are set to the proper line voltage. The 360B is intended for Installation Category (Overvoltage Category) II operation.

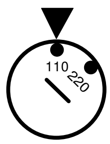


Figure 2-7. *LINE SELECTION Setting (Network Analyzer)*

Network Analyzer To determine if your network analyzer is correctly set for line voltage, check LINE SELECTION setting (Figure 2-7) on rear panel .

Frequency Source To determine if your source is correctly set, check the LINE SELECTOR setting on its rear panel (Figure 2-8). If the setting is incorrect, use the below procedure to change it.

NOTE
Refer to Figure 2-9 for steps 1, 2, and 4, below.

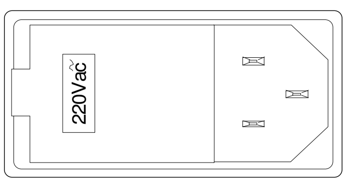


Figure 2-8. *LINE SELECTOR Setting (Source)*

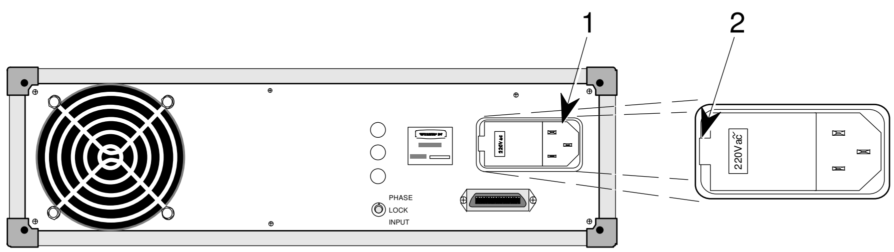


Figure 2-9. *Line Voltage Module*

Step 1. Disconnect the power cord from the voltage selector module (1) and open the cover (2) to gain access to the selector drum (Figure 2-10).

Step 2. Using the example for 220 Vac (Figure 2-9) as a guide, remove and reinstall the drum so that the correct voltage value is visible in the slot when the cover is closed.

Step 3. After changing the drum, check that the fuse is correct for the line voltage. Fuse values are indicated on the instrument.

Step 4. Close cover on voltage selector module.

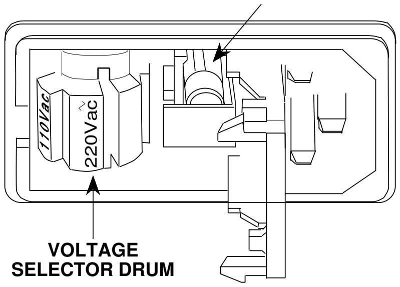


Figure 2-10. *Line Voltage PC Board*

2-9 GPIB SETUP AND INTERCONNECTION

The network analyzer system provides automated microwave measurements via the GPIB. The following paragraphs provide information about interface connections, cable requirements, and the addressing of the network analyzer.

Interface Connector Interface between the network analyzer and other devices on the GPIB is via a 24-wire interface cable. This cable uses connector shells having two connector faces. These double-faced connectors allow for the parallel connection of two or more cables to a single device.

Cable Length Restrictions The GPIB system can accommodate up to 15 instruments at any one time. To achieve design performance on the bus, proper timing and voltage level relationships must be maintained. If either the cable length between separate instruments or the accumulated cable length between all instruments is too long, the data and control lines cannot be driven properly and the system may fail to perform. Cable length restrictions are as follows:

No more than 15 instruments may be installed on the bus.

Total accumulative cable length in meters may not exceed two times the number of bus instruments or 20 meters—whichever is less.

NOTE

For low EMI applications, the GPIB cable should be a fully shielded type, with well-grounded metal-shell connectors

GPIB Interconnection The only interconnection required for GPIB operation is between the network analyzer and the external computer/controller. This interconnection is via a standard GPIB cable. The ANRITSU Part number for such a cable is 2000-1, -2, or -4 (1, 2, or 4 meters in length).

CAUTION

Do not mate an external GPIB cable with the system bus. A connector marked “360 GPIB” is provided on the 360B for this use with an external computer/controller.

GPIB Address

The network analyzer leaves the factory preset to address 6. If a different address is desired, it can be set from menu GP7 (Appendix 1).

Data Delimiting (CR-CR/LF Switch)

Data is delimited on the GPIB by either the carriage return (CR) ASCII character or both the carriage return and line feed (CR/LF) ASCII characters. Which character is used depends upon the requirements of the system controller. Most modern controllers can use either CR or CR/LF, while many older controllers require one or the other. Consult the controller's manual for its particular requirements.

As with the address, you can select which delimiting character to use from Menu GP7.

2-10 PRINTER SETUP AND INTERCONNECTION

The 360 VNA is equipped with a Centronics interface for parallel printer support (Appendix 2, Figure A2-2). The 360 software supports the following printers:

- ANRITSU 2225C Inkjet
- HP QuietJet or ThinkJet
- HP DeskJet, DeskJet Plus, or LaserJet II
- Epson EX, FX, LX, or Epson compatible

If the ANRITSU 2225 Ink Jet Dot-Matrix printer— which is available as an accessory—is used, all rear panel MODE SELECT switches are set to the "0" position (down).

2-11 PREPARATION FOR STORAGE/SHIPMENT

The following paragraphs give instructions for preparing the network analyzer for storage or shipment.

Preparation for Storage

Preparing the network analyzer for storage consists of cleaning the units, packing the inside with moisture-absorbing desiccant crystals, and storing the them in a temperature environment that is maintained between –40 and +70 degrees centigrade (–40 to +158 degrees Farenheit).

Preparation for Shipment

To provide maximum protection against damage in transit, the network analyzer instruments should be repackaged in their original shipping containers. If these containers are no longer available and the instruments are being returned to ANRITSU for repair, advise ANRITSU Customer Service; they will send new shipping containers free of charge. In the event neither of these two options is possible, instructions for packaging and shipment are given below.

Use a Suitable Container.
Obtain a corrugated cardboard carton with a 275-pound test strength. This carton should have inside dimensions of no less than six inches larger than the instrument dimensions to allow for cushioning.

Protect the Instrument.
Surround the instrument with polyethylene sheeting to protect the finish.

Cushion the Instrument.
Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument. Provide at least three inches of dunnage on all sides.

Seal the Container.
Seal the carton by using either shipping tape or an industrial stapler.

Address the Container.
If the instrument is being returned to ANRITSU for service, mark the ANRITSU address (Table 2-4) and your return address on the carton in one or more prominent locations.

2-12 RACK MOUNT INSTALLATION (OPTION 1)

The Option 1 Rack Mount side rails are mounted on replacement side panels for each of the 360B VNA instruments (Analyzer, Test Set, and Signal Source). The install this kit,

- ☐ Remove the four feet from the rear panel.
- ☐ Remove the side panels.
- ☐ Install the Option 1 side panels.
- ☐ Replace the four feet.

Table 2-4. ANRITSU Service Centers

UNITED STATES
ANRITSU COMPANY
685 Jarvis Drive
Morgan Hill, CA 95037-2809
Telephone: (408) 776-8300
FAX: 408-776-1744

ANRITSU COMPANY
10 Kingsbridge Road
Fairfield, NJ 07004
Telephone: (201) 227-8999
FAX: 201-575-0092

AUSTRALIA
ANRITSU PTY. LTD.
Unit 3, 170 Foster Road
Mt Waverley, VIC 3149
Australia
Telephone: 03-9558-8177
Fax: 03-9558-8255

BRAZIL
ANRITSU ELECTRONICA LTDA.
Praia de Botafogo, 440, Sala 2401
CEP22250-040, Rio de Janeiro, RJ, Brasil
Telephone: 021-28-69-141
Fax: 021-53-71-456

CANADA
ANRITSU INSTRUMENTS LTD.
215 Stafford Road, Unit 102
Nepean, Ontario K2H 9C1
Telephone: (613) 828-4090
FAX: (613) 828-5400

CHINA
ANRITSU BEIJING SERVICE CENTER
Beijing Fortune Building
416W, 5 Dong San Huan Bei Lu
Chaoyang qu
Beijing 100004, China
Telephone: 010-501-7559
FAX: 010-501-7558

FRANCE
ANRITSU S.A
9 Avenue du Quebec
Zone de Courtaboeuf
91951 Les Ulis Cedex
Telephone: 016-44-66-546
FAX: 016-44-61-065

GERMANY
ANRITSU GmbH
Grafenberger Allee 54-56
D-40237 Dusseldorf
Germany
Telephone: 0211-67 97 60
FAX: 0211-68 33 53

INDIA
MEERA AGENCIES (P) LTD.
A-23 Hauz Khas
New Delhi 110 016
Telephone: 011-685-3959
FAX: 011-686-6720

ISRAEL
TECH-CENT, LTD
Haarad St. No. 7, Ramat Haahayal
Tel-Aviv 69701
Telephone: (03) 64-78-563
FAX: (03) 64-78-334

ITALY
ANRITSU Sp.A
Roma Office
Via E. Vittorini, 129
00144 Roma EUR
Telephone: (06) 50-22-666
FAX: (06) 50-22-4252

JAPAN
ANRITSU CORPORATION
1800 Onna Atsugi-shi
Kanagawa-Prf. 243 Japan
Telephone: 0462-23-1111
FAX: 0462-25-8379

KOREA
ANRITSU KOREA (AWK)
#901 Daeo Bldg. 26-5
Yeoido Dong, Youngdeungpo
Seoul Korea 150 010
Telephone: 02-782-7156
FAX: 02-782-4590

SINGAPORE
ANRITSU (SINGAPORE) PTE LTD
3 Shenton Way #24-03
Shenton House
Singapore 0106
Telephone: 2265206
FAX: 2265207

SOUTH AFRICA
ETESCSA
1st Floor Montrose Place
Waterfall Park
Becker Road
MIDRAND
SOUTH AFRICA
Telephone: 011-315-1366
Fax: 011-315-2175

SWEDEN
ANRITSU AB
Box 247
S-127 25 Skarholmen
Telephone: (08) 74-05-840
FAX: (08) 71-09-960

TAIWAN
ANRITSU CO., LTD.
8F, No. 96, Section 3
Chien Kuo N. Road
Taipei, Taiwan, R.O.C.
Telephone: (02) 515-6050
FAX: (02) 509-5519

UNITED KINGDOM
ANRITSU LTD.
200 Capability Green
Luton, Bedfordshire
LU1 3LU, England
Telephone: 015-82-41-88-53
FAX: 015-82-31-303

Chapter 3
Network Analyzers, A Primer

Table of Contents

Chapter 3
Network Analyzers, A Primer

3-1 INTRODUCTION

This section provides front (control) panel operating and measurement application information and data. It includes discussions on the following topics:

- ☐ System description
- ☐ General discussion about network analyzers
- ☐ Basic measurements and how to make them
- ☐ Error correction
- ☐ General discussion on test sets

3-2 GENERAL DESCRIPTION

The Model 360B Vector Network Analyzer System measures the magnitude and phase characteristics of networks: amplifiers, attenuators, and antennas. It compares the incident signal that leaves the analyzer with either the signal that is transmitted through the test device or the signal that is reflected from its input. Figures 3-1 and 3-2 illustrate the types of measurements that the 360B can make.

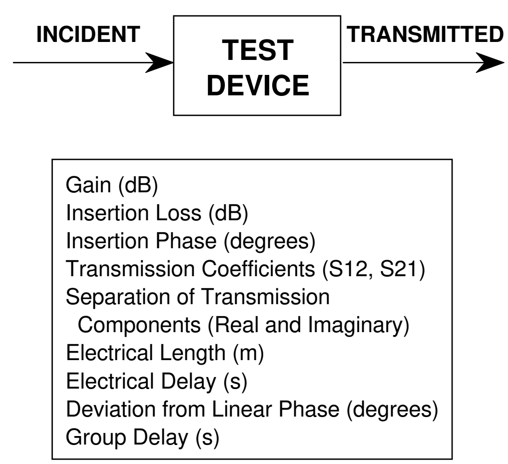


Figure 3-1. *Transmission Measurements*

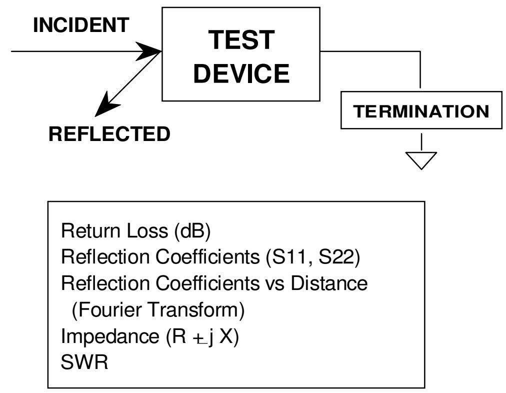


Figure 3-2. *Reflection Measurements*

The 360B is a self-contained, fully integrated measurement system that includes an optional time domain capability. The system hardware consists of the following:

- Analyzer
- Test set (auto reversing, active device, or millimeter wave)
- Signal source
- Precision components required for calibration and performance verification.

The 360B system instruments perform the following functions:

Signal Source This instrument provides the stimulus to the device under test (DUT). The frequency range of the source and test set establish the frequency range of the system. The signal source normally provides two frequency ranges: 10 MHz to 20 GHz and 10 MHz to 40 GHz. The frequency stability of the source is an important factor in the accuracy (especially phase accuracy) of the network analyzer. Hence, the 360B always phase locks the source to an internal 10 MHz crystal reference.

Test Set The test set routes the stimulus signal to the DUT and samples the incident, reflected, and transmitted signals. The type of test port connector used is important, as is the “Auto Reversing” feature. Auto Reversing means that it applies the measurement signal in both the forward and reverse direction. The direction is reversed automatically. This saves you from having to reverse the test device physically to measure all four scattering parameters (S-parameters). Frequency conversion (1st, 2nd, and 3rd IFs) occurs in the test set.

Analyzer The analyzer receives and interprets the 3rd IF signal for phase and magnitude data. It then displays the results of this analysis on a large, 190 mm (7-1/2 inch) diagonal color display. This display can show all four S-parameters simultaneously. In addition to the installed display, you can also view the measurement results on an external color monitor.

3-3 NETWORK ANALYZERS

We will begin this discussion with a subject familiar to most ANRITSU customers: scalar network analysis. After showing comparisons, we will proceed to the fundamentals of network analyzer terminology and techniques. This discussion serves as an introduction to topics presented in greater detail later in this section. This discussion will touch on new concepts that include the following:

- Reference Delay
- S-Parameters: what they are and how they are displayed
- Complex Impedance and Smith Charts

Scalar Analyzer Comparison Network Analyzers do everything that scalar analyzers do except display absolute power. In addition, they add the ability to measure the phase characteristics of microwave devices and allow greater dynamic range.

If all a Network Analyzer added was the capability for measuring phase characteristics, its usefulness would be limited. While phase measurements are important in themselves, it is the availability of this phase information that unlocks many new features for complex measurements. These features include Smith Charts, Time Domain, and Group Delay. Phase information also allows greater accuracy through *vector error correction* of the measured signal.

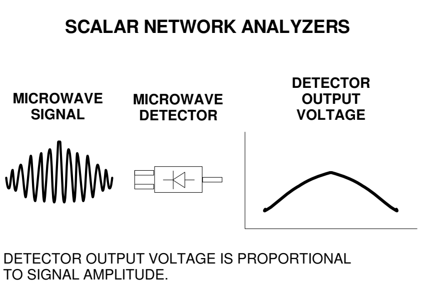


Figure 3-3. *Scalar analyzer detection*

First, let us look at scalar network analyzers (SNAs). SNAs measure microwave signals by converting them to a DC voltage using a diode detector (Figure 3-3). This DC voltage is proportional to the magnitude of the incoming signal. The detection process, however, ignores any information regarding the phase of the microwave signal.

In a network analyzer access is needed to both the magnitude and phase of a microwave signal. There are several different ways to perform the measurement. The method ANRITSU employs (called Harmonic Sampling or Harmonic Mixing) is to down-convert the signal to a lower intermediate frequency (IF). This signal can then be measured directly by a tuned receiver. The tuned receiver approach gives the system greater dynamic range. The system is also much less sensitive to interfering signals, including harmonics.

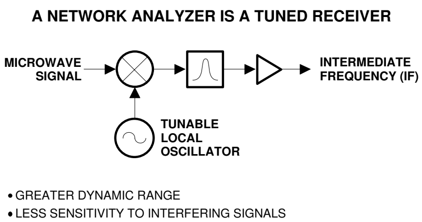


Figure 3-5. *Network analyzer is a tuned receiver*

Vector Network Analyzer Basics

The network analyzer is a tuned receiver (Figure 3-5). The microwave signal is down converted into the passband of the IF. To measure the phase of this signal, we must have a reference to compare it with. If the phase of a signal is 90 degrees, it is 90 degrees different from the reference signal (Figure 3-6). The network analyzer would read this as –90 degrees , since the test signal is delayed by 90 degrees with respect to the reference signal.

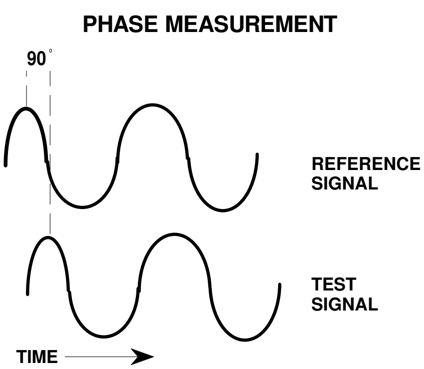


Figure 3-6. *Signals with a 90 degrees phase difference*

This phase reference can be obtained by splitting off some of the microwave signal before the measurement (Figure 3-4).

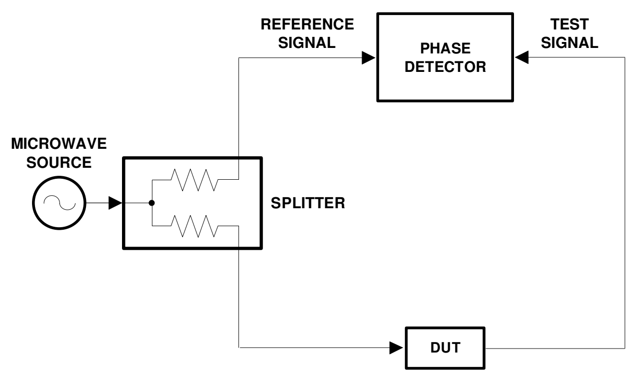


Figure 3-4. *Splitting the microwave signal*

The phase of the microwave signal after it has passed through the device under test (DUT) is then compared with the reference signal. A network analyzer test set automatically samples the reference signal, so no external hardware is needed.

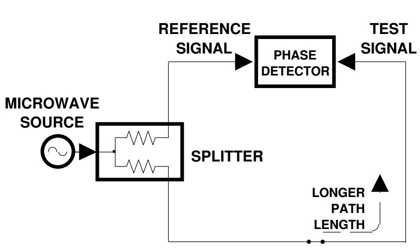


Figure 3-7. *Split signal where a length of line replaces the DUT*

Let us consider for a moment that you remove the DUT and substitute a length of transmission line (Figure 3-7). Note that the path length of the test signal is longer than that of the reference signal. Now let us see how this affects our measurement.

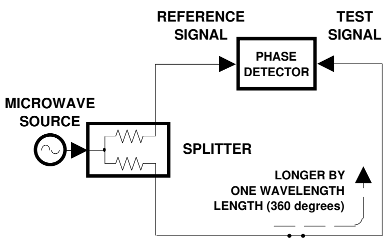


Figure 3-8. *Split signal where path length differs by exactly one wavelength*

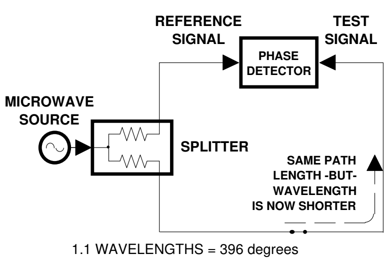


Figure 3-9. *Split signal where path length is longer than one wavelength*

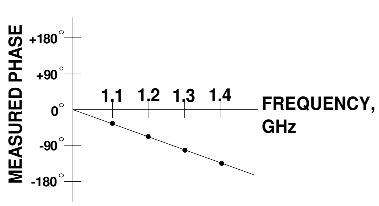


Figure 3-10. *Electrical Delay*

Assume that we are making a measurement at 1 GHz and that the difference in path-length between the two signals is exactly 1 wavelength. This means that test signal is lagging the reference signal by 360 degrees (Figure 3-8). We cannot really tell the difference between one sine wave maxima and the next (they are all identical), so the network analyzer would measure a phase difference of 0 degrees.

Now consider that we make this same measurement at 1.1 GHz. The frequency is higher by 10 percent so therefore the wavelength is shorter by 10 percent. The test signal path length is now 0.1 wavelength longer than that of the reference signal (Figure 3-9). This test signal is:

$$1.1 \times 360 = 396 \text{ degrees.}$$

This is 36 degrees different from the phase measurement at 1 GHz. The network analyzer will display this phase difference as –36 degrees.

The test signal at 1.1 GHz is delayed by 36 degrees more than the test signal at 1 GHz.

You can see that if the measurement frequency is 1.2 GHz, we will get a reading of –72 degrees, –108 degrees for 1.3 GHz, etc (Figure 3-10). There is an electrical delay between the reference and test signals. For this delay we will use the common industry term of reference delay. You also may hear it called phase delay. In older network analyzers you had to equalize the length of the reference arm with that of the test arm to make an appropriate measurement of phase vs frequency.

To measure phase on a DUT, we want to remove this phase-change-vs-frequency-due-to changes in the electrical length. This will allow us to view the actual phase characteristics. These characteristics may be much smaller than the phase-change-due-to-electrical-length difference.

There are two ways of accomplishing this. The most obvious way is to insert a length of line into the reference signal path to make both paths of equal length (Figure 3-11). With perfect transmission lines and a perfect splitter, we would then measure a constant phase as we change the frequency. The problem using this approach is that we must change the line length with each measurement setup.

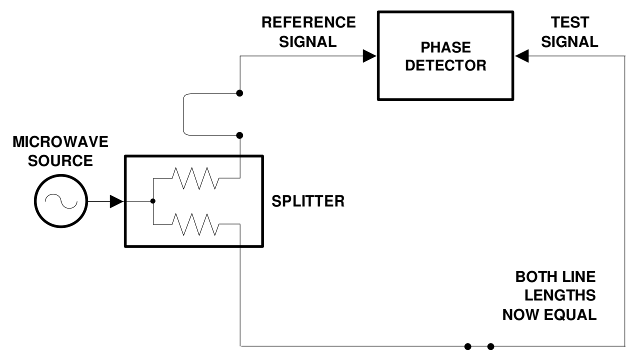


Figure 3-11. *Split signal where paths are of equal length*

Another approach is to handle the path length difference in software. Figure 3-12 displays the phase-vs-frequency of a device. This device has different effects on the output phase at different frequencies. Because of these differences, we do not have a perfectly linear phase response. We can easily detect this phase deviation by compensating for the linear phase. The size of the phase difference increases linearly with frequency so we can modify the phase display to eliminate this delay.

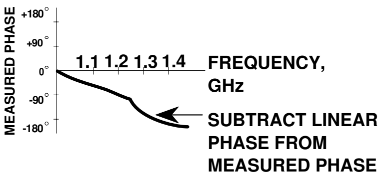


Figure 3-12. *Phase difference increases linearly with frequency*

The 360B offers automatic reference delay compensation with the push of a button. Figure 3-13 shows the resultant measurement when we compensate path length. In a system application you can usually correct for length differences; however, the residual phase characteristics are critical.

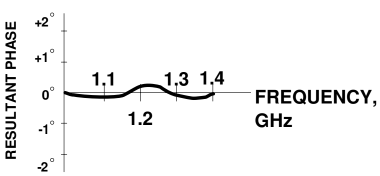


Figure 3-13. *Resultant phase with path length compensation in place*

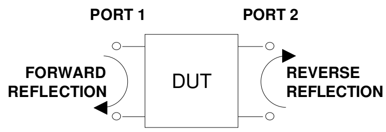


Figure 3-14. *Forward and reverse measurements*

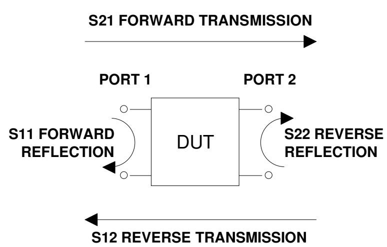


Figure 3-15. *S-Parameters*

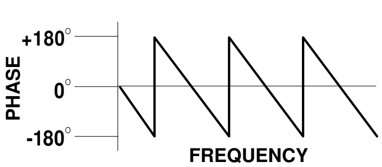


Figure 3-16. *Linear phase-with-frequency waveform*

Network Analyzer Measurements

Now let us consider measuring the DUT. Consider a two port device; that is, a device with a connector on each end. What measurements would be of interest?

First, we could measure the reflection characteristics at either end with the other end terminated into 50 ohms. If we designate one end as the normal place for the input that gives a reference. We can then define the reflection characteristics from the reference end as forward reflection, and those from the other end as reverse reflection (Figure 3-14).

Second, we can measure the forward and reverse transmission characteristics. However, instead of saying "forward," "reverse," "reflection," and "transmission" all the time, we use a shorthand. That is all that S-Parameters are, a shorthand! The "S" stands for scattering. The first number is the port that the signal is leaving, while the second is the port that the signal is being injected into. S_{11}, therefore, is the signal leaving port 1 relative to the signal being injected into port 1. The four scattering parameters (Figure 3-15):

- ☐ S_{11} Forward Reflection
- ☐ S_{21} Forward Transmission
- ☐ S_{22} Reverse Reflection
- ☐ S_{12} Reverse Transmission

S-Parameters can be displayed in many ways. A S-parameter consists of a magnitude and a phase. We can display the magnitude in dB, just like a scalar network analyzer. We often call this term *log magnitude*.

We can display phase as "linear phase" (Figure 3-16). As discussed earlier, we can't tell the difference between one cycle and the next. Therefore, after going through 360 degrees we are back to where we began. We can display the measurement from –180 to +180 degrees. The –180 to +180 approach is more common. It keeps the display discontinuity removed from the important 0 degree area used as the phase reference.

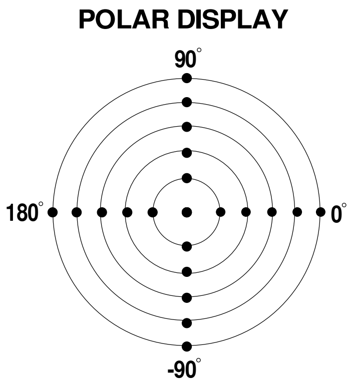


Figure 3-17. *Polar display*

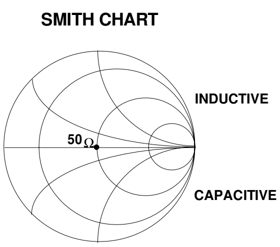


Figure 3-18. *Smith chart*

There are several ways in which all the information can be displayed on one trace. One method is a polar display (Figure 3-17). The radial parameter (distance from the center) is magnitude. The rotation around the circle is phase. We sometimes use polar displays to view transmission measurements, especially on cascaded devices (devices in series). The transmission result is the addition of the phase and log magnitude (dB) information of each device's polar display.

As we have discussed, the signal reflected from a DUT has both magnitude and phase. This is because the impedance of the device has both a resistive and a reactive term of the form $r+jx$. We refer to the r as the real or resistive term, while we call x the imaginary or reactive term. The j, which we sometimes denote as i, is an imaginary number. It is the square root of –1. If x is positive, the impedance is inductive, if x is negative the impedance is capacitive.

The size and polarity of the reactive component x is important in impedance matching. The best match to a complex impedance is the complex conjugate. This complex-sounding term simply means an impedance with the same value of r and x, but with x of opposite polarity. This term is best analyzed using a Smith Chart (Figure 3-18), which is a plot of r and x.

To display all the information on a single S-Parameter requires one or two traces, depending upon format we want. A very common requirement is to view forward reflection on a Smith Chart (one trace) while observing forward transmission in Log Magnitude and Phase (two traces). Let us see how to accomplish this on the 360B.

The 360B has four channels. Each channel can display a complete S-Parameter in any format on either one or two traces. All four S-Parameters can be seen simultaneously in any desired format. A total of eight traces can be viewed at the same time. While this is a lot of information to digest, the 360B's large color display makes recognizing and analyzing the data surprisingly easy.

Another important parameter we can measure when phase information is available is group delay. In linear devices, the phase change through the DUT is linear-with-frequency. Thus, doubling the frequency also double the phase change. An important measurement, especially for communications system users, is the rate of change-of-phase-vs-frequency (group delay). If the rate of phase-change-vs-frequency is not constant, the DUT is nonlinear. This nonlinearity can create distortion in communications systems.

Measurement Error Correction

Since we can measure microwave signals in both magnitude and phase, it is possible to correct for six major error terms:

- ☐ Source Test Port Match
- ☐ Load Test Port Match
- ☐ Directivity
- ☐ Isolation
- ☐ Transmission Frequency Response
- ☐ Reflection Frequency Response

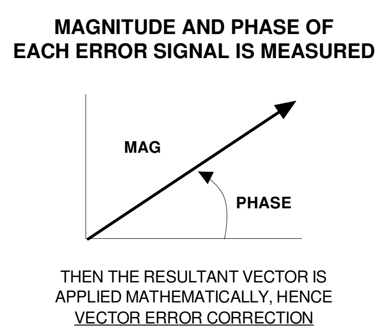


Figure 3-19. *Magnitude and phase measurements*

We can correct for each of these six error terms in both the forward and reverse directions, hence the name 12-term error correction. Since 12-term error correction requires both forward and reverse measurement information, the test set must be *reversing*. “Reversing” means that it must be able to apply the measurement signal in either the forward or reverse direction.

To accomplish this error correction, we measure the magnitude and phase of each error signal (Figure 3-19). Magnitude and phase information appear as a vector that is mathematically applied to the measurement signal. This process is termed *vector error correction*.

3-4 TEST SETS

We have now learned about reference delay. We have discussed S-parameters. We know what they are, how to measure them, and how to display them. We have also learned a little about vector error correction. Let us now turn to the 360B VNA Test Sets. We will see how well they meet our measurement needs. The test sets contain the measurement components for the 360B VNA system. The test sets perform:

- Stimulus signal routing from the signal source to the DUT through one of the test ports (Port 1 or Port 2)
- Signal separation and frequency down conversion of the incident, reflected, and transmitted signals at Ports 1 and 2 into four IF signals (Test A, Reference A, Test B, and Reference B)
- Amplification of the IF signals.

The test sets also provide automatic signal reversing. Any S-parameter can be measured and 12-term error correction can be applied automatically. In fact, we can measure all four S-parameters and apply a 12-term error correction to each.

There are five types of test sets available:

- Reversing
- Active Device
- Frequency Converter
- Millimeter Wave
- Pulse/CW

Reversing Test Set

This is the basic ANRITSU Test Set (Figure 3-20). There are three models of this test set (361XA) providing frequency coverage from 40 MHz to 60 GHz. The test set contains an internal switch to select the direction of the source RF signal. Each port has a directional device. Any S-parameter can be measured and 12-term error correction can be applied automatically. In fact, we can measure all four S-parameters simultaneously and apply a 12-term error correction to each. Also, with the dedicated synthesized RF source, we update the display rapidly enough to allow real-time tuning of the DUT.

The two reference delay lines (one for each port) are external connections. Since the 360B VNA system always uses a synthesized RF signal, we can accurately compensate reference delay in software. While the capability for changing the actual line length is still present, most people will rarely need to use it.

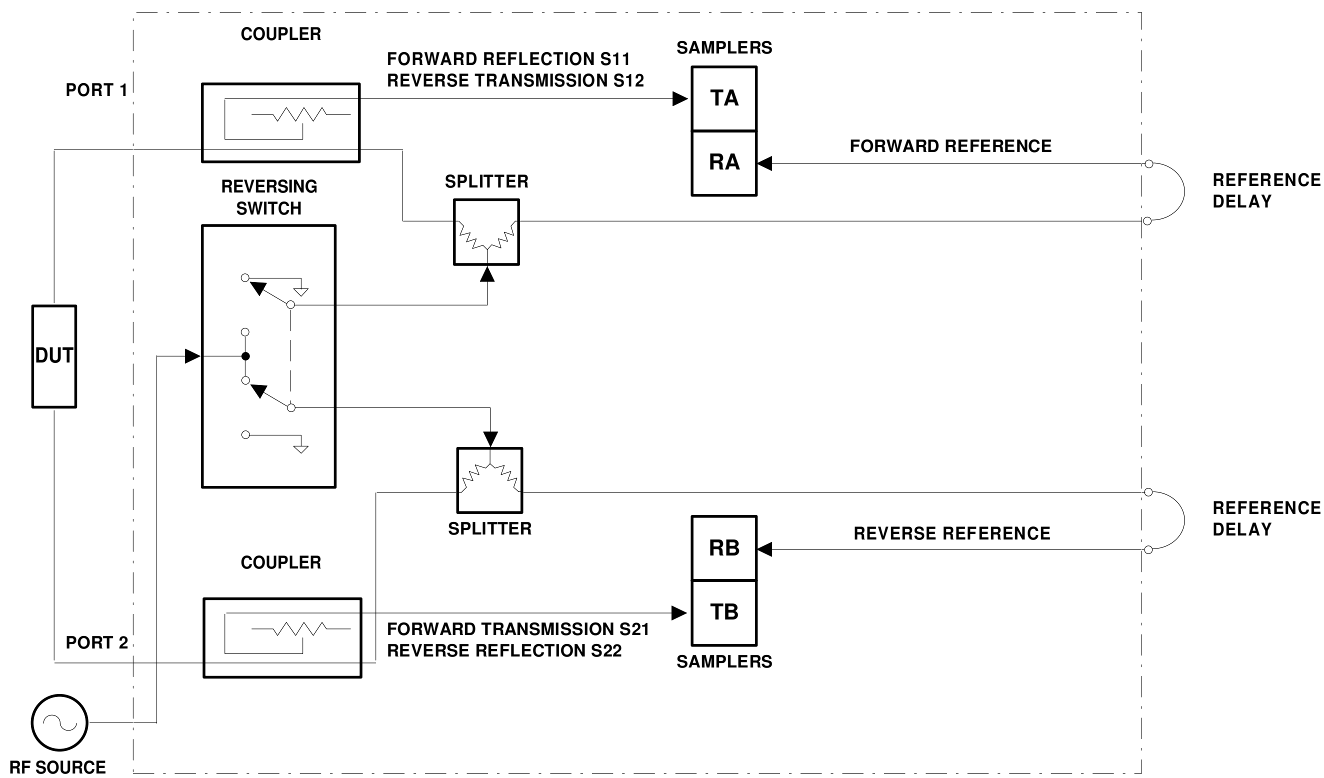


Figure 3-20. Reversing test set

Active Device Test Set

This test set (Figure 3-21) is similar to the reversing test set except that it has been modified to test active devices. There are also three models of this test (362XA) set providing frequency coverage from 40 MHz to 60 GHz. The test set contains a step attenuator in the signal line for each port to adjust the stimulus signal to the DUT. In addition, a third step attenuator is provided in the forward transmission line just ahead of the sampler. This additional step attenuator is used to control the DUT output power to the forward transmission measurement sampler. Reverse transmission and output match measurements are unaffected by the step attenuator. The input match and attenuation of the step attenuator is measured and stored with the calibration data during the calibration process. This test set also contains bias tees for each port to allow biasing of those active DUTs that require it.

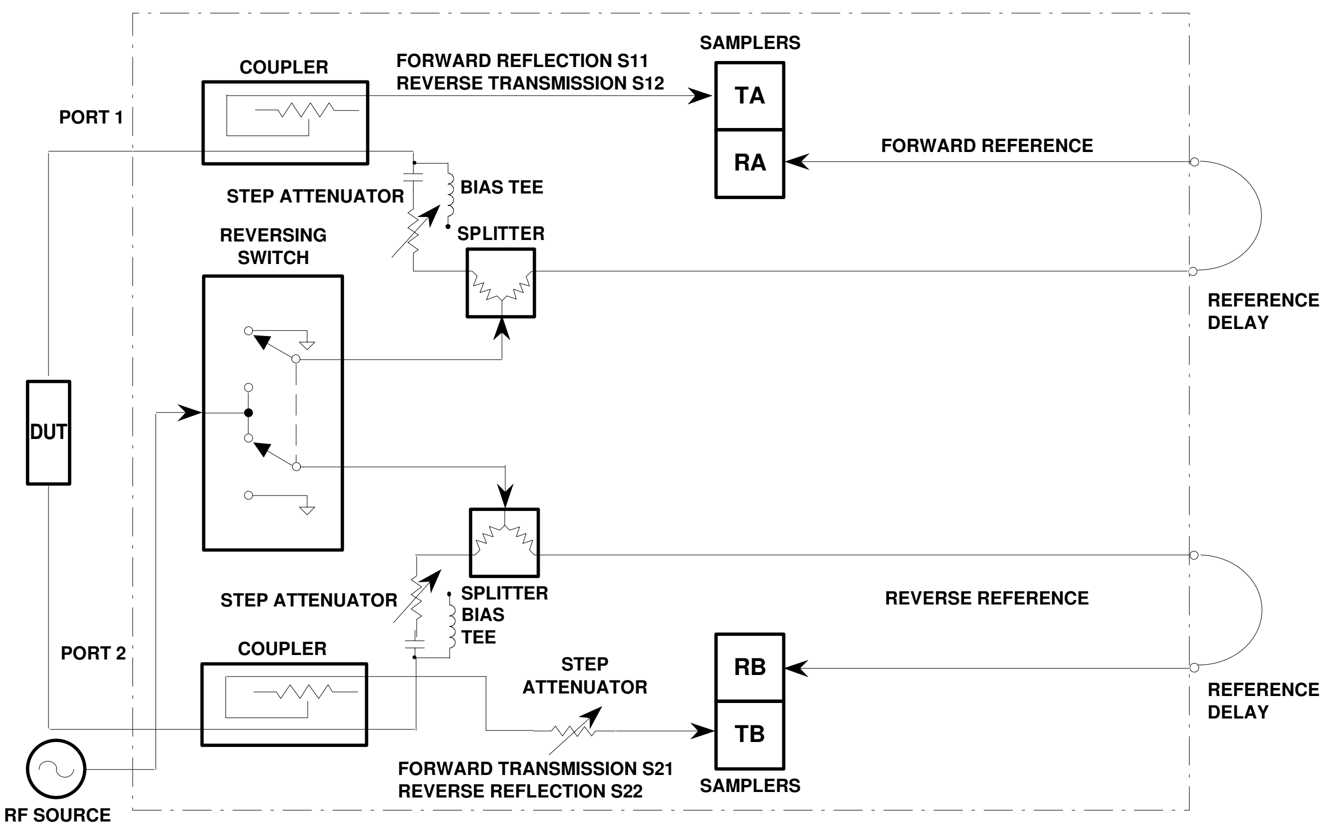


Figure 3-21. *Active device test set*

Frequency Converter Test Set- This test set (Figure 3-22) is a four-channel receiver that measures magnitude and phase of frequency conversion devices. There are two models of the test set (3630A and 3631A) providing frequency coverage from 10 MHz to 60 GHz. The test set can operate with two source signals and the receiver signal, all at different frequencies and controlled from the network analyzer's front panel. A 70 dB step attenuator provides attenuation of the stimulus signal.

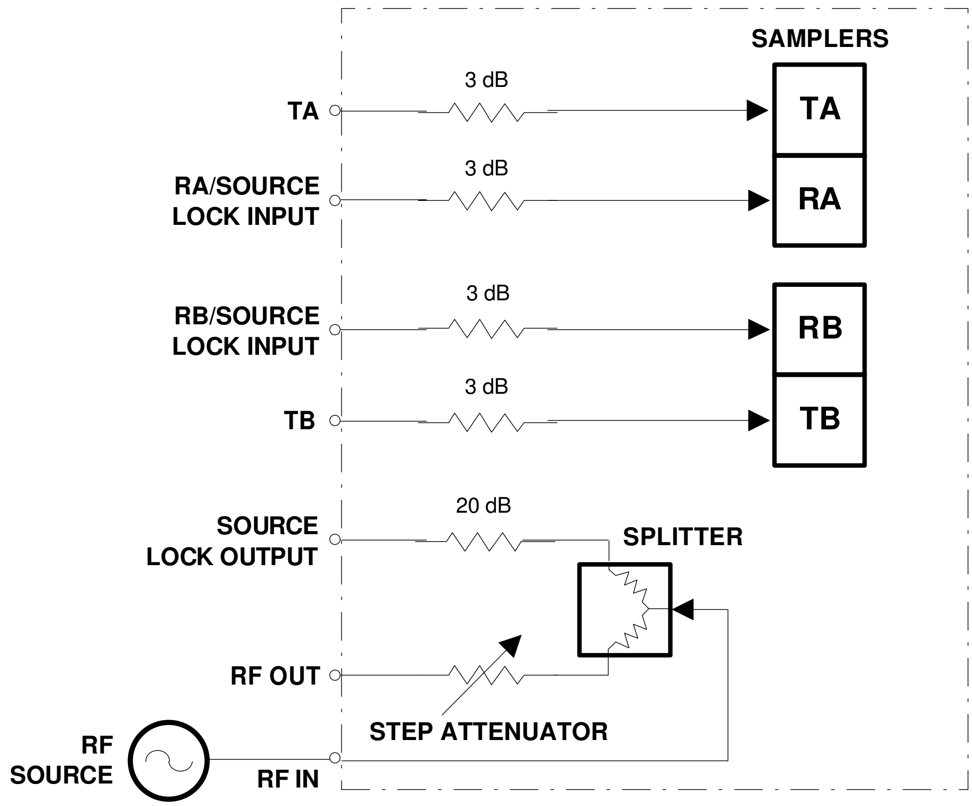


Figure 3-22. Frequency converter test set

Millimeter Wave Test Set

This test set (Figure 3-23) and the companion 3640B/3641B series modules provide measurement capability to 110 GHz in four waveguide bands (Q, U, V, and W). The test set (3635B) interfaces with the network analyzer and provides the necessary dc voltages and RF and LO signals for the 3640B/3641B series modules. 3640B series transmission/reflection modules provide RF stimulus to the DUT and measure relative forward and reflected power. A pair of 3640B modules allow measurement of all four S-Parameters on a two-port device without reversal of the DUT. The 3641B Series modules are transmission only units. A 3640B series module combined with a 3641B series module allows measurement of S_{11} (forward reflection) and S_{21} (forward transmission) characteristics of a DUT. A single 3640B series module allows measurememnt of S_{11} (forward reflection only).

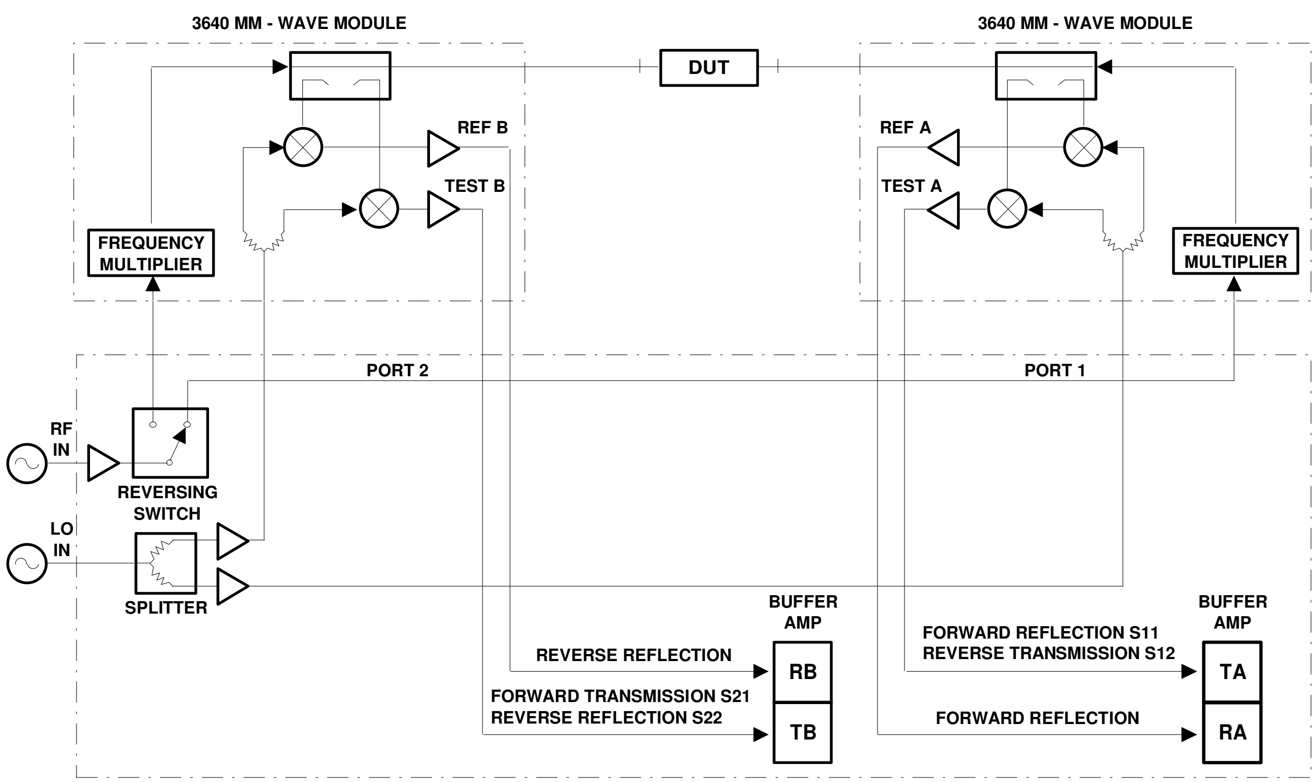


Figure 3-23. Millimeter wave test set

Chapter 4
Instrument Operation

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Chapter 4
Instrument Operation

4-1 INTRODUCTION

This chapter provides an overview of the basic operation of the Model 360B Vector Network Analyzer.

4-2 POWER-UP CHARACTERISTICS

When initially turned on (powered up), the 360B comes on line with the factory-selected default settings. On subsequent power-ups, it returns to the exact status and display that it was in effect when powered down last. Calibration error terms and normalizations are stored in volitile RAM. These are lost when power is turned off.

After coming on line, the 360B executes a self test. It then attempts to load its operating software from the installed disk. If unable to do so, it displays the message: “DISK NOT READY - PRESS ENTER TO TRY AGAIN.” It then waits for you to take the appropriate action.

During the self test, if the program detects a 360B or test set fault, it displays an appropriate error message. Once the self test has finished and the program has loaded, the 360B is ready to operate.

During normal operation, if the program detects a fault in a peripheral device (such as the printer, test set or source), it displays an error message.

4-3 MEASUREMENT CONTROL

Measurement control is provided through selections of start, stop, and marker frequencies, as follows:

Start and Stop Frequencies

Start and stop frequencies must meet the following criteria:

- ☐ Be within the range of the frequency source and test set.
- ☐ Have a span that provides 100 kHz resolution for 360SSXX or 66XXB source. Resolution is 1 kHz if a 67XXB Swept Frequency Synthesizer is used.
- ☐ Have a start frequency lower than the stop frequency.

NOTE

You may change the start and stop frequencies after calibration. However, your new frequencies must fall within the calibrated range when the calibration is applied.

Marker Frequencies

If there are markers at frequencies other than the equally spaced set of calibration frequencies, they will be readjusted to a calibration frequency.

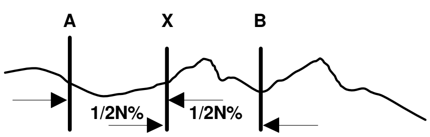
4-4 DATA ENHANCEMENT

Vector Error Correction

The 360B provides software correction for inherent systemic error terms. You can select one of four correction methods: Frequency Response, Reflection Only, One Path-Two Port, or Full 12-Term.

Data Averaging

You can average measurements over time for a more accurate readout of noisy, rapidly changing amplitude data. When using averaging, you select the number of points for which you wish averaging calculated. The sweep repeats to take that number of readings at each frequency point. The program then averages the amplitude and phase readings at that frequency point and writes the average value on the displayed graph-type.



Smoothing

You can smooth measurement variations (amplitude only) over a frequency span of from 0 to 20 percent of the sweep. The smoothing process uses a raised Hamming window to average the data from a span of frequencies. For example, in the figure at left if the program averages all data points from A to B to give point X, then the average of all points from A+1 to B+1 is X+1.

Normalization (Trace Memory)

Normalization means taking data from a standard component (filter or attenuator, for example), then later comparing it with another like item. To normalize data means to divide it by standard data taken earlier and stored in memory.

If **VIEW TRACE ÷ MEMORY** (Menu NO1) has been selected, the following occurs: When the measured data taken from the two components are the same, the 360B displays a straight line. If they differ, however, it displays the degree of departure of the new data from the stored data.

IF Bandwidth Selection

Front-panel switch selects three levels of video IF bandwidth. The NORMAL, REDUCED, and MIN key selections correspond to approximately 10 kHz, 1 kHz, and 100 Hz.

4-5 HUMAN INTERFACE

The 360B interfaces with the user through a system of informative menus coordinated with control panel keys. You are always prompted by the menus to complete an action by pressing one or more keys. If the key is one of the menu-allowed choices, then the 360B responds in one of the following ways:

- It displays a different menu.
- It enters a numeric value.
- It allows a choice in the current menu.

If the key pressed is not a valid choice, the 360B beeps.

Channel Concept

The 360B has four measurement channels that you can display simultaneously, individually, or in pairs. You can display a different S-Parameter on each channel. Or, you can display the same S-Parameter on one or more channels. You can control the four channels separately for some functions and parameters, while others must be the same for all channels. The parameters that can be different for the different channels are as follows:

- Graph-Type (Rectilinear, Polar, or Smith Chart)
- Amplitude Scales
- Reference Plane Setting
- Normalization Memory
- S-Parameters

The parameters that must be the same for all four channels are as follows:

- Start and Stop Frequencies
- Error Correction Type
- Calibration Type and Range
- Averaging
- IF Bandwidth
- Smoothing
- Marker Frequencies, Times, Distances

Display of Messages

The 360B displays on-screen text giving error and other messages. This text concisely states the condition causing the message, specifies an action needed, or both.

Active Parameter

The active parameter is defined as the parameter presently open for change. It is the only one that you can change using the Data Entry keys or knob. We define a parameter as a frequency, time, degree, distance, or other numeric value that you can enter. (You enter a parameter using the keypad or knob; if keypad was used, you must follow entry by pressing one of the Terminator keys [Figure 5-1, Index 13]). You open such a parameter for modification by pointing at it with the menu cursor. That makes it active. You close a parameter by moving the cursor away from it. Or, alternatively, you erase or replace the menu.

Audible Feedback

Audible beeps alert the user that the 360B has configured itself for operation. Configuration is to current hardware requirements or to factory-selected default values. The number of beep (described below) indicates the type of configuration that has occured.

- *One Beep.* Resets front panel states (internal memory location 0) and recalls recognized hardware configuration. Occurs on power-up or after pressing DEFAULT PROGRAM key twice.

- *Two Beeps.* Resets internal memory locations 0 thru 4. Occurs (1) after pressing the DEFAULT PROGRAM key, the 1 key, then the DEFAULT PROGRAM key again or (2) if a different hardware configuration is detected.

- *Three Beeps.* Resets internal memory location 0 thru 4 and reconfigures hardware to settings shown in Table 4-1. Occurs after pressing the DEFAULT PROGRAM key, the 0 key, then the DEFAULT PROGRAM key again*. Also occurs if a different version of Operating System software is loaded or a malfunction occurs in battery-backed RAM.

* Memory (non-volatile RAM) is reset according to DOD 5220.22-M, pages 209-10. This feature provides a manual-secure function for resetting all non-volatile RAM accessible to the user.

Table 4-1. Hardware Default Settings

Item	Default Value
mmWave	
Band	WR-10
Port 1 head	Type A (3640B)
Port 2 head	Type B (3641B)
Receiver	
Type	STANDARD
Mode	SET ON, with user-selected receiver type
Source	
GPIB Control	On, with user-selected source type
360TSM Switches	A
Non-Selected Test Set Power	ON
Printer Type	Thinkjet
GPIB	
Terminators	CR-LF
GPIB Address	6
Instrument Address (System Bus)	0
Source 1 Address	5
Source 2 Address	4
Plotter Address	7
Power Meter	13
Connectors and Waveguide Calibration Kits	Default Values

4-6 DATA STORAGE

The 360B can store control panel setups along with normalization, measurement, and calibration data to either disk or internal memory locations. The following is a list of the items saved. (The 360B saves these parameters for all active channels.)

Display Parameters

- Offset
- Resolution
- Reference Line
- Limits (Enabled, On/ Off/ Values, Miscellaneous)
- Minimum and Maximum Values
- Selected S-Parameter
- Display Type
- Active Channel
- Display Mode
- S-Parameter for Each Channel
- Blank Frequency Display Active, Color Plane
- Reference Plane
- Dielectric Used
- Dielectric Constant
- Normalize Mode

Measurement Parameters

- Start of Sweep
- End of Sweep
- Source Power and Attenuator Settings
- Frequency Resolution
- Device-Under-Test ID
- Domain

Enhancement

- Smoothing Enabled
- Averaging Enabled
- Smoothing % of Sweep
- Number of Points Averaged
- IF Bandwidth

Output

- Type of Output
- Options Enabled (Model, Device ID, Date, Operator
- Resolution

Calibration

- Number of Data Points
- Frequencies
- Port Connector Types
- Calibration Type
- Correction Type
- Load Type
- Capacitance Coefficient for Connector
- Connector Offset Length for Each Port
- Reference Impedance
- Reflection Pairing
- Flat Test Port Correction

Miscellaneous

- Markers (Enabled, On/ Off, Values)
- Delta Reference Mode
- Marker Frequencies, Times, Distances
- GPIB Addresses and Termination Unit

Disk Identification

- Calibration File Name

Control Panel Setups

You can store the instrument state (measurement parameters and operating modes) in internal non-volatile memory or on the installed disk. You select the storage media using the SAVE/RECALL MENU key and its related menus. You can save up to four control panel setups in internal memory and more on the disk. Additionally, the 360B saves certain parameters each time you turn it off. It automatically saves (1) the current control panel setup, (2) all measurement, display, and other parameters and functions. It does not, however, store calibration data. This allows it to return to its exact same state when powered up next.

Calibration Data

The 12-term error correction coefficients for each data point covered by the calibration being saved are stored as 12 single precision (32-bit real, 32-bit imaginary) complex numbers. This results in 96 bytes per point, or 96 KBytes for a 501 point calibration.

Trace Memory

The 360B can store up to four channels of trace data (S-Parameter measurements) in volatile RAM. To prevent the loss of this data when you turn the system off, you may also save it to the disk.

Measured Data

You can also save measured data on the disk. The 360B stores it as ASCII-encoded text. The format is the same as that used for the tabular printout. This feature lets you make a computer analysis of the measured data, provided your computer has a compatible disk drive.

4-7 INTERFACES

Microfloppy Disks

The 360B employs an integrally mounted disk drive for 1.44 MByte (or 720 KByte) 3.5 inch microfloppy diskettes.

GPIB Interface

The 360B has two GPIB interfaces: *System Source Control* (Master) and *360 GPIB* (Slave). You can program each of these interfaces for address, delimiting character, etc. using a menu. The 360B provides GPIB status in a menu.

GPIB specifications are as follows:

- *Interface:* IEEE-488 standard GPIB.
- *System Interface:* IEEE-488 port used exclusively by the 360B to control and extract information from a frequency source and to control a GPIB plotter and/or power meter.
- *Addressing:* Default controller address = 0, source 1 address = 5, source 2 address = 4, plotter address = 7, power meter address = 13. Addresses are settable by menu.
- *Speed*: 200 µs/bus/ cycle (device dependent).

360B GPIB (System Control or Slave) specifications are as follows::

- *Interface:* IEEE-488 standard GPIB.
- *System Interface:* IEEE-488 port by which an external controller may take control of the 360B. The controller can perform all control panel operations.
- *Addressing:* Defaults to address 6, settable by menu control.

Parallel Printer Port

The printer port is compatible with a standard "Centronics" interface. The 360B has the capability for an exact pixel-by-pixel dump of the CRT screen, when used with the following printers:

- ANRITSU 2225C Inkjet
- HP QuietJet
- HP ThinkJet
- HP DeskJet
- HP LaserJet
- Epson FX, LX, EX and compatibles

The output can be any of the following.

- A full-screen dump.
- A data-display dump that does not reproduce the menu.
- A tabulated listing of the data.

Test Set Control Interface

The Control (Power and Data) interfaces use 37-pin "D" subminiature connectors. The Signal (Signal and RF) interfaces use 17-pin, 7 coaxial "D" subminiature connectors.

Video Interface

The 360B provides two video outputs, as follows:

- VGA IN. Allows the input of a standard 640 x 480 pixel VGA display from an external display driver (i.e. external controller)
- VGA OUT. The 360B display data can be displayed on an external VGA monitor connected to this output.

Chapter 5
Front Panel Operation

Table of Contents

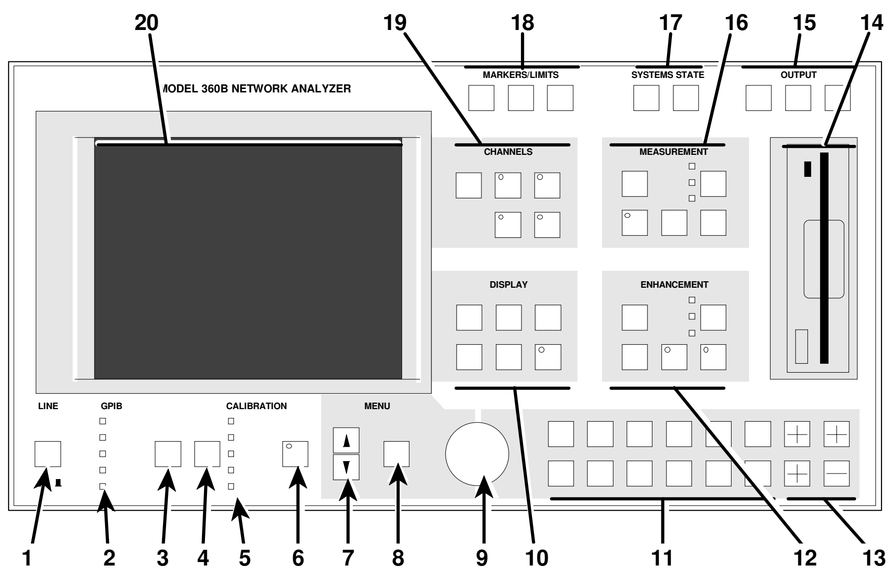
Chapter 5
Front Panel Operation

5-1 INTRODUCTION

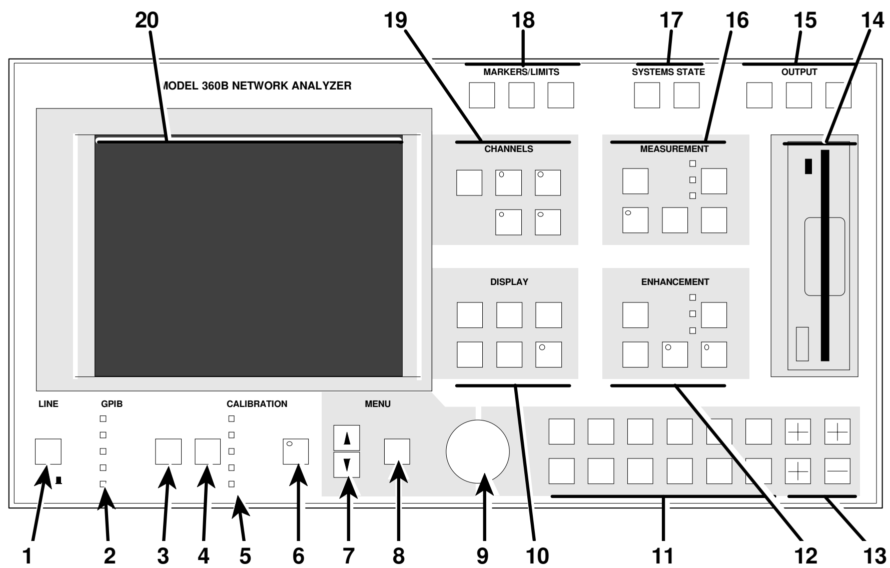
This chapter describes the front panel keys, controls, and menus. The chapter is organized into an overall description of the front panel key-groups and detailed descriptions of individual keys within the key-groups.

5-2 FRONT PANEL KEY-GROUP DESCRIPTIONS

The following pages provide descriptions of the front panel key-groups.



Index 1. **LINE ON/OFF:** Turns the 360B on and off. When pressed to ON, the operating program runs a self test then recalls the parameters and functions in effect when powered down last.



Index 2. **GPIB Indicators**

REMOTE: Lights when the 360B switches to remote (GPIB) control. It remains lit until the unit returns to local control.

TALK: Lights when you address the 360B to talk and remains lit until unaddressed.

LISTEN: Lights when you address the 360B to listen and remains lit until unaddressed.

SRQ: Lights when the 360B sends a Service Requests (SRQ) to the external controller. The LED remains lit until the 360B receives a serial poll or until the controller resets the SRQ function.

LOCAL LOCKOUT: Lights when a local lockout message is received. The LED remains lit until the message is rescinded. When lit, you cannot return the 360B to local control via the front panel.

Index 3. **SAVE/RECALL MENU:** Displays the first of three menus that let you save the current calibration or front panel setup or recall a previously saved calibration or setup.

Index 4. **BEGIN CAL:** Calls up the first in a sequence of menus that guide you through a measurement calibration. Refer to paragraph 5-3 for a detailed discussion of the calibration keys, indicators, and menus.

Index 5. **CALIBRATION Indicators:** Shows the calibration state of the 360B. (FULL 12-TERM; 1 PATH, 2 PORT; FREQUENCY RESPONSE; REFLECTION ONLY; or NONE.)

Index 6. **APPLY CAL:** Turns on and off the applied error correction displayed by the calibration indicators.

Index 7. **MENU:** The arrow keys move the menu cursor up and down to select items appearing in the menu area of the CRT.

Index 8. **ENTER:** Implements the menu selection chosen using the MENU arrow keys.

Index 9. **ROTARY KNOB:** Used to alter measurement values for the *active parameter* (Start Frequency, Stop Frequency, Offset, etc.).

Index 10. **DISPLAY Keys**

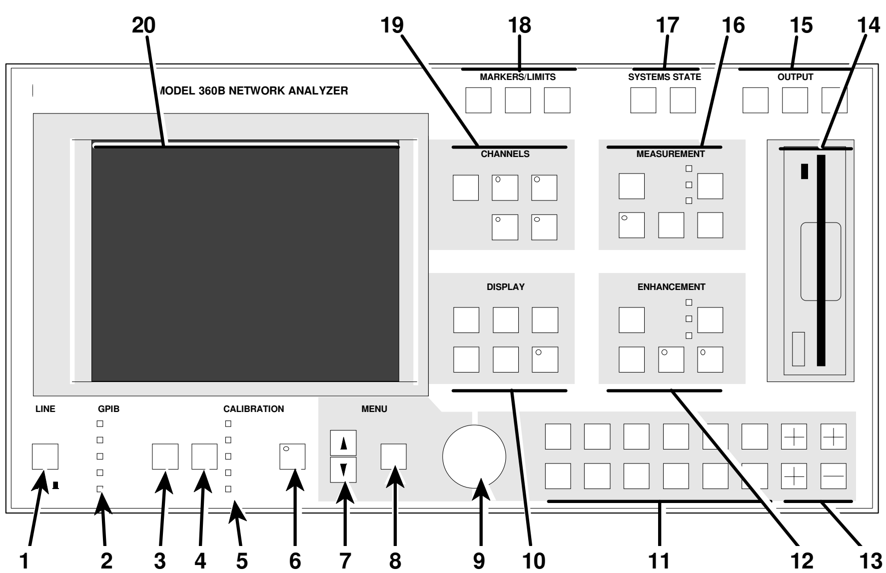
GRAPH TYPE: Displays either of two menus that let you choose the graph type for the active channel.

SET SCALE: Displays the appropriate scaling menu, based on the graph type for the active channel.

AUTO SCALE: Automatically scales the active channel for optimum viewing.

S PARAMS: Displays Menu SP (Appendix 1), which lets you choose between S_{11}, S_{12}, S_{21}, S_{22}, or nine user-defined parameters. You may display the same parameter on two or more channels.

REF POS: Displays the first of two menus that let you enter set the reference plane for the active channel in time or distance. For a correct distance readout, you must set the dielectric constant to the correct value. Refer to the discussion in menu RD2 (Appendix 1).



TRACE MEMORY: Displays either of two menus that let you do any of the following. (1) Store the measured data in memory. (2) View the stored data. (3) Add, subtract, multiply, or divide the measured data from the stored data (normalize to the stored memory). (4) View both the measured and the stored data simultaneously on the active channel. Four memories exist–one for each channel. This lets you normalize the data in each channel independently. The LED on this button lights only when the active channel is displaying measurement data normalized to memory.

Index 11. **KEYPAD:** Provides for entering values for the active parameter. The active parameter is the one to which the menu cursor is pointing.

Index 12. **ENHANCEMENT Keys and LED**

OPTION MENU: Displays a menu showing the choice of options installed.

VIDEO IF BW: Cycles between NORMAL, REDUCED, and MINIMUM intermediate frequency (IF) bandwidths. The appropriate indicator lights to display the selected value.

AVG/SMOOTH MENU: Displays a menu that lets you enter values for AVERAGING and SMOOTHING.

TRACE SMOOTH: Turns the trace smoothing function on and off.

AVERAGE: Turns the average function on and off.

Index 13. **Terminator Keys**

GHz/10^3/µs/m: Terminates a value entered on the keypad in the units shown —that is; gigahertz for frequency, 1X10^3 power for dimensionless or angle entries, microseconds for time, or meters for length.

MHz/X1/ns/cm: Terminates a value entered on the keypad in the units shown—that is; megahertz for frequency, unity for dimensionless or angle entries, nanoseconds for time, or centimeters for length.

kHz/10^{-3}/ps/mm: Terminates a value entered on the keypad in the units shown—that is; kilohertz for frequency, 1X10^{-3} 'for dimensionless or angle entries, picoseconds for time, or millimeters for length.

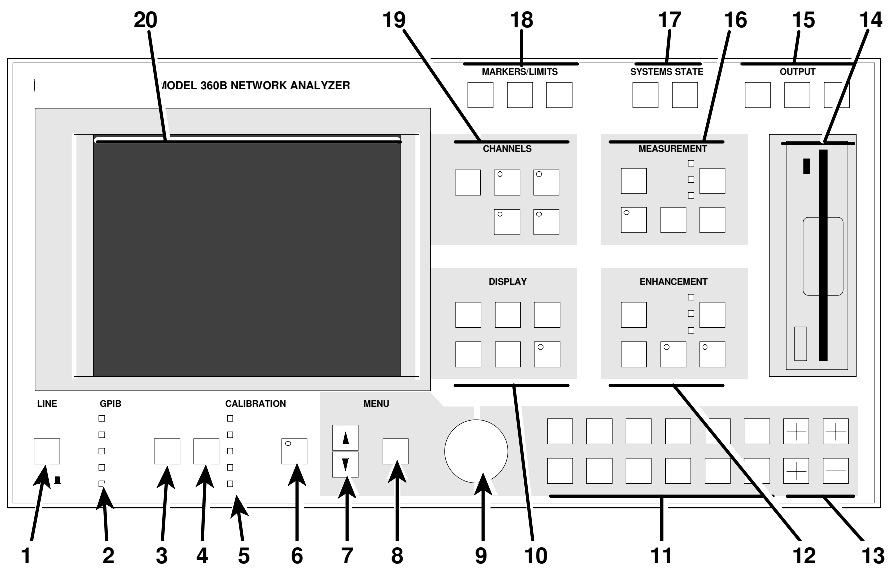
CLEAR/RET LOC:

a. *Local (Non-GPIB) Mode:* (1) The key clears entries not yet terminated by one of the terminator keys above, which allows the previously displayed values to redisplay. Or (2) the key turns off the displayed menu, if you have not made any keypad entries needing termination.

b. *GBIB Mode:* The key returns the instrument to local (front panel) control, unless the controller has sent a local lockout message (LLO) over the bus.

c. *Connect Internal Screen to VGA:* If selected, pressing the CLEAR key returns to 360B video signal.

Index 14. **DISKETTE DRIVE:** Provides a drive for the 3.5-inch floppy diskette used to store both the operating system and the selected front panel setups and calibrations.



Index 15. **OUTPUT Keys**

MENU: Displays option menus that let you define what will happen each time you press the START PRINT key. The displayed menu also selects disk I/O operations.

START PRINT: Tells the printer or plotter to start output based on the current selections or plotting.

STOP PRINT: Immediately stops printing the data, clears the print buffer, and sends a form-feed command to the printer. However, if the printer is not printing data, the key only sends a form-feed command.

Index 16. **MEASUREMENT Keys and LED**

SETUP MENU: Displays the first of several menus that let you select functions affecting measurements.

DATA POINTS: Cycles between maximum, normal, and minimum resolution values. The appropriate MAXIMUM, NORMAL, or MINIMUM switch indicator lights to display the selected value.

HOLD: Toggles the instrument in and out of the hold mode; or it triggers a sweep, depending on the function selected in menu SU4 (Appendix 1).

DOMAIN: Displays the first in a series of menus that let you set the Time Domain display parameters. (This key is only active if your 360B is equipped with the Time Domain option.)

a. If already in the DOMAIN menus, pressing this key will return to the first menu in the sequence.

b. If in the DOMAIN menus and another (non-time domain) menu is displayed by pushing a menu key, the last displayed domain menu redisplays when the DOMAIN key is next pressed.

DEVICE ID: Displays a menu asking you to identify your test device.

Index 17. **SYSTEM STATE Keys**

DEFAULT PROGRAM: Resets the front panel to the factory-preset state and displays Menu SU1, SU2, or SU3, after pressing the key again. Pressing this key in conjunction with the “0” or “1” key resets certain internal memories and front panel key states (refer to paragraphs 4-5 and 5-10).

CAUTION

Use of this key will destroy front panel and calibration setup data, unless they have been saved to disk.

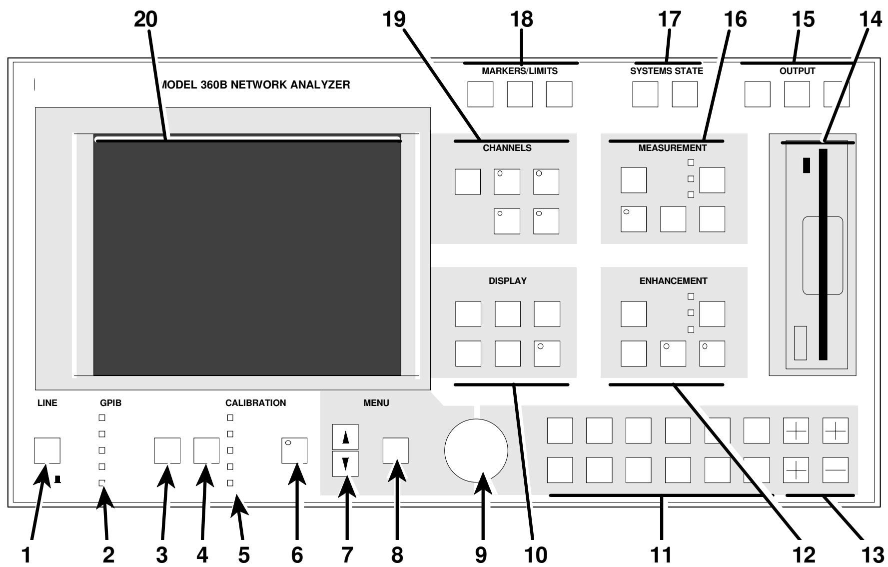
UTILITY MENU: Displays the first in a series of menus that let you perform diskette and other utility-type functions and operations.

Index 18. **MARKERS/LIMIT Keys**

MARKER MENU: Displays the first in a series of menus that let you set and manipulate marker frequencies, times, and distances.

READOUT MARKER: Displays a menu that lists all of the active markers. If no markers are active, the message “NO ACTIVE MARKERS” displays for four seconds in the menu area of the screen.

LIMITS: Displays one of the menus that let you manipulate the Limit 1 and Limit 2 lines displayed on the CRT.



Index 19. **CHANNELS Keys**

CHANNEL MENU: Displays a menu that lets you select the number of channels displayed format.

CH 1: Makes Channel 1 the active channel. The active channel is the one acted on by the keys in the DISPLAY section. Only one channel can be active at any one time.

CH 2: Makes Channel 2 the active channel.

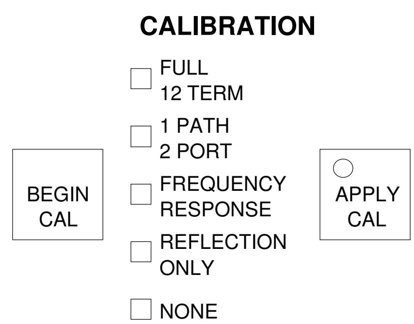
CH 3: Makes Channel 3 the active channel.

CH 4: Makes Channel 4 the active channel.

Index 20. **CRT Display:** Displays any or all of the four measurement channels, plus menus.

5-3 CALIBRATION KEY-GROUP, DESCRIPTIONS AND MENU FLOW

The CALIBRATION keys and indicators are described below. The calibration menus are diagrammed according to the method of calibration performed: Standard OSL, Offset-Short, or LRL/LRM. The menu sequencing is complex and looping and can be said to have two parts: setup and calibration. The setup sequencing for the three calibration methods is diagrammed on pages 5-13 through 5-27. Each of these setup sequencies lead to the main calibration sequence, which is diagramed on page 5-28. A full description of each menu is provided in Appendix 1, where the menus are arranged in alphabetical order by call letter (C1, C2, C3, etc).



BEGIN CAL Key: This key displays a menu that lets you initiate the calibration sequence. That is, to begin a sequence of steps that corrects for errors inherent in a measurement setup.

APPLY CAL Key: This key turns on and off the error correction that you may apply to the displayed channel(s) using the currently valid error-correction indicator.

CALIBRATION Indicators: These indicators show the type of calibration to be applied to the measurement (below). The calibration types are discussed in depth in Chapter 8, "Measurement Calibration."

FULL 12 TERM: You have corrected for all twelve error terms associated with a two-port measurement.

1 PATH, 2 PORT: You have corrected for the five forward-direction error terms (EDF, ESF, ERF, ETF, and EXF). This is a subset of the 12-term calibration.

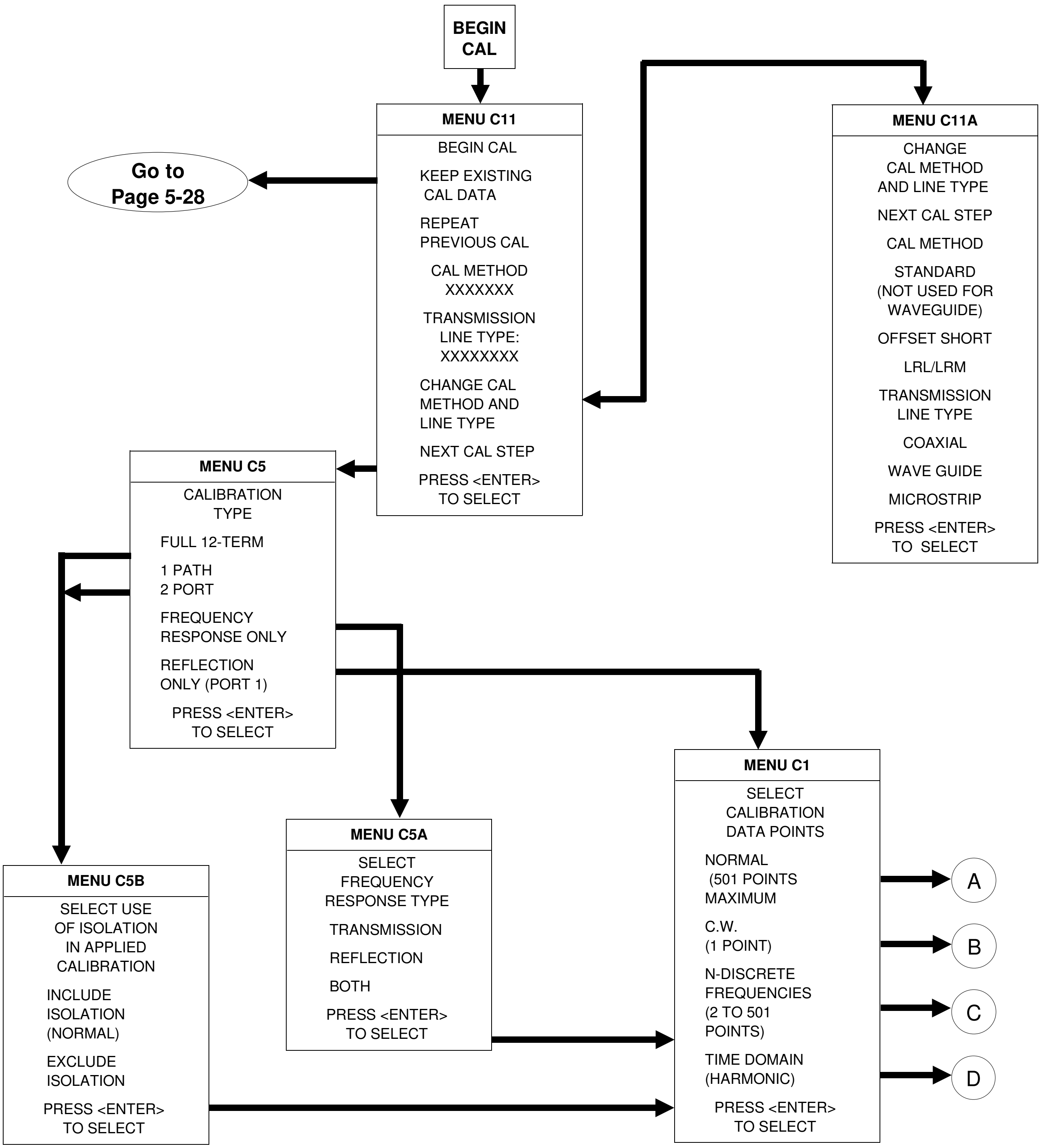
FREQ RESPONSE: You have corrected for one or both of the forward-direction error terms associated with a measurement of S_{11} and S_{21}. This is a subset of the 12-term calibration.

REFLECTION ONLY: You have corrected for the three error terms associated with an S_{11} measurement (EDF, ESF, and ERF). This is a subset of the 12-term calibration.

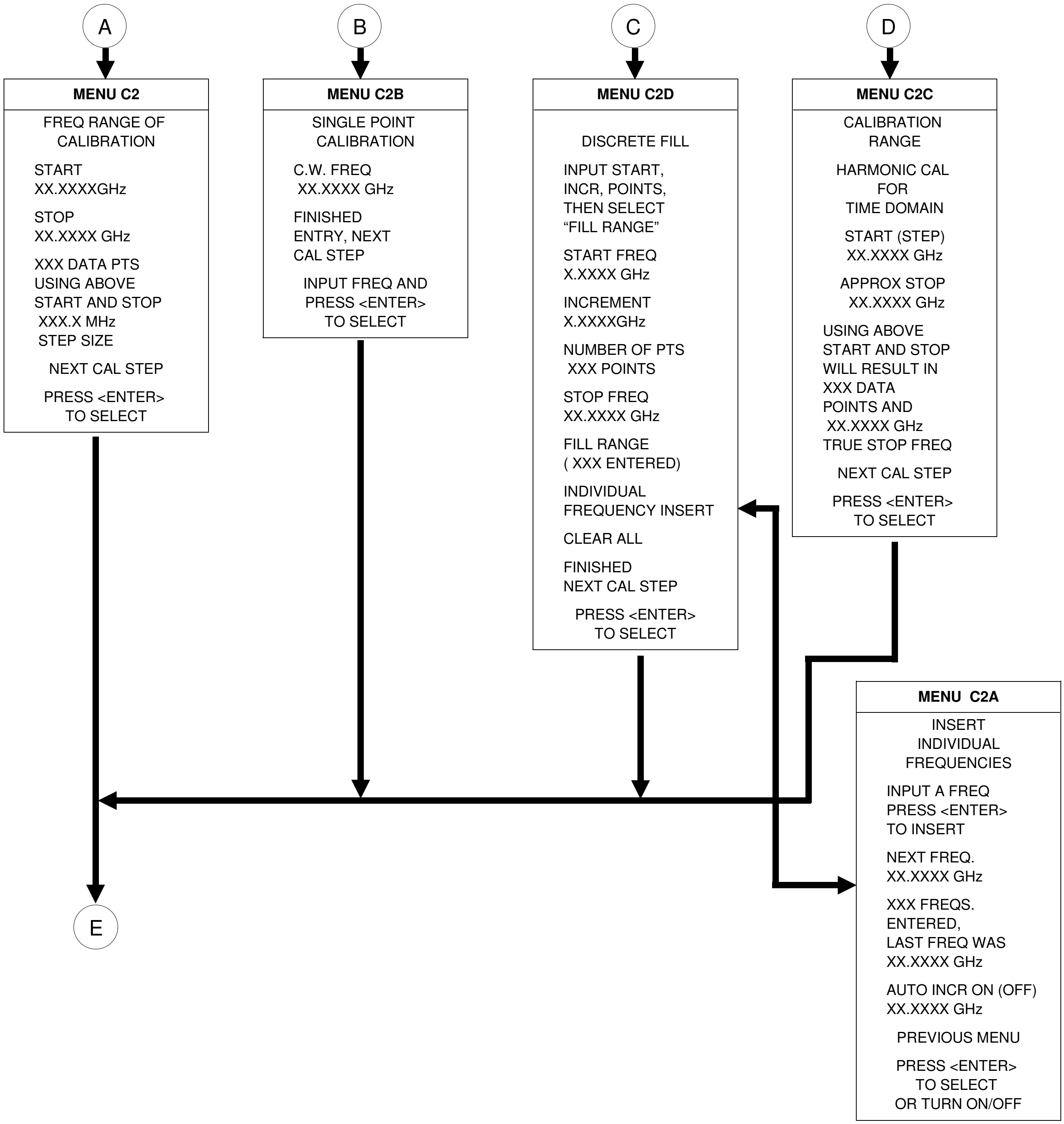
NONE: No calibration data is currently applied.

Menu Flow, Standard OSL Calibration Setup

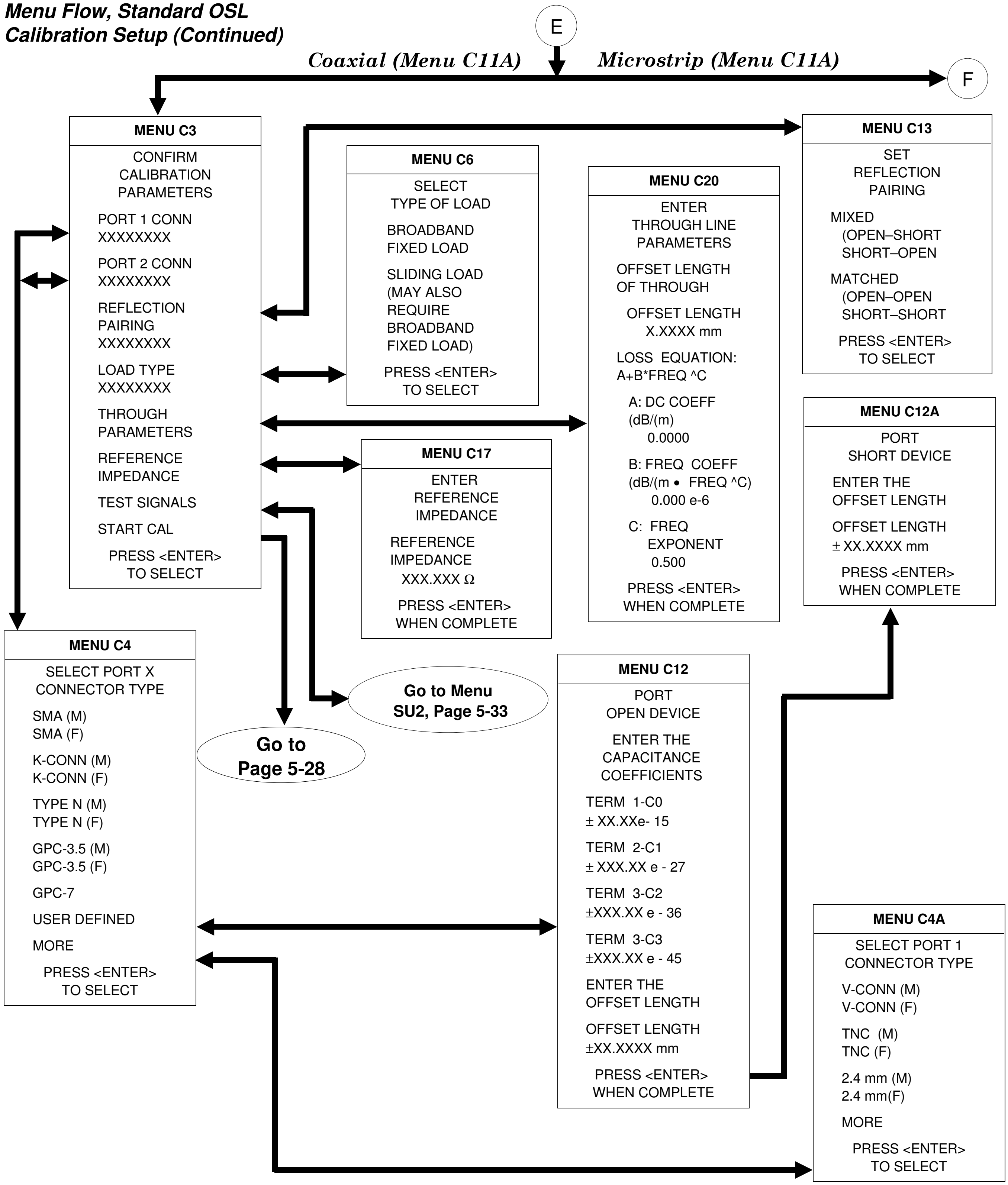
The flow diagram on pages 5-13 through 5-16 show menu flow for a standard OSL (open-short-load) calibration.



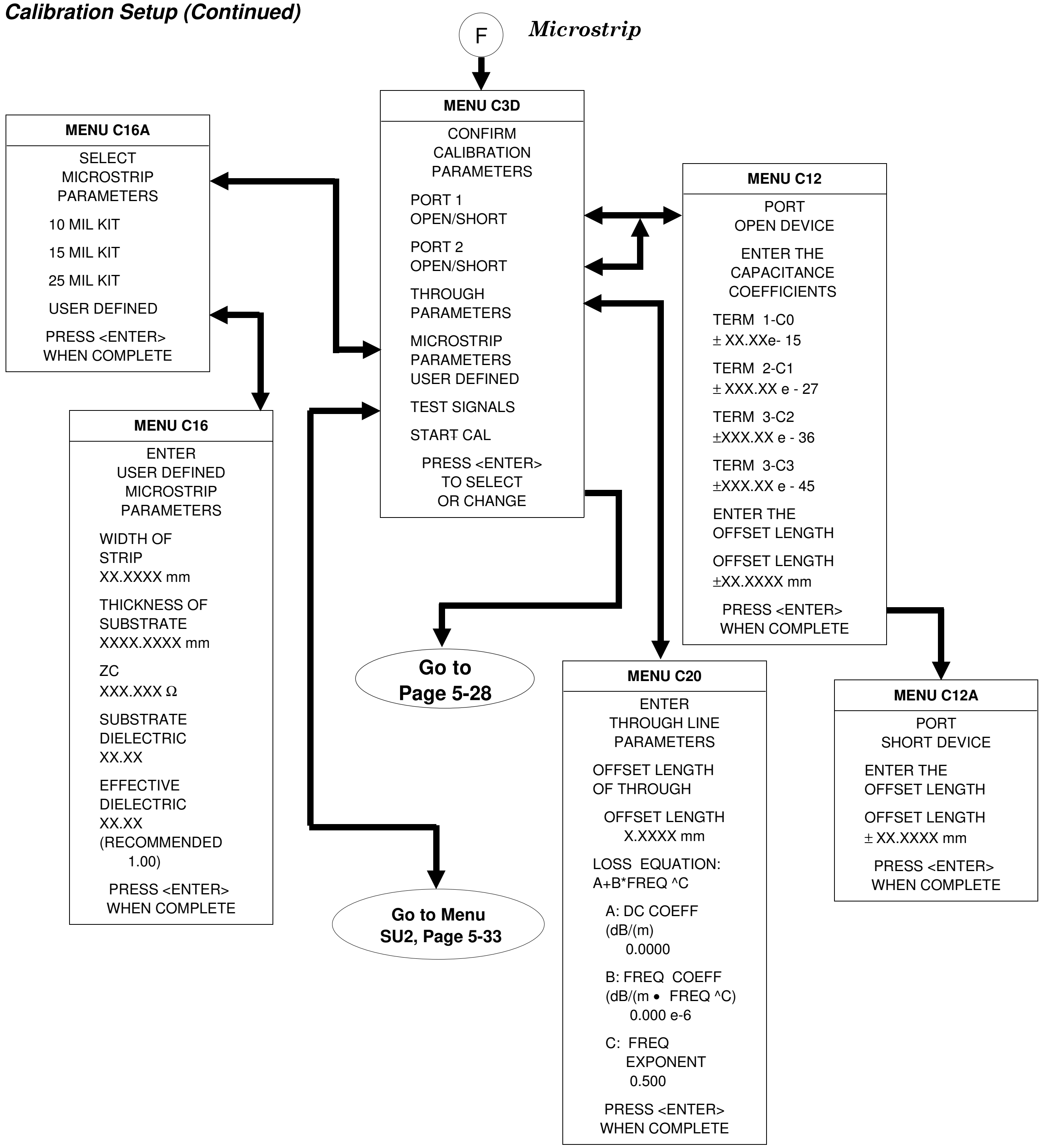
Menu Flow, Standard OSL Calibration Setup (Continued)



Menu Flow, Standard OSL Calibration Setup (Continued)

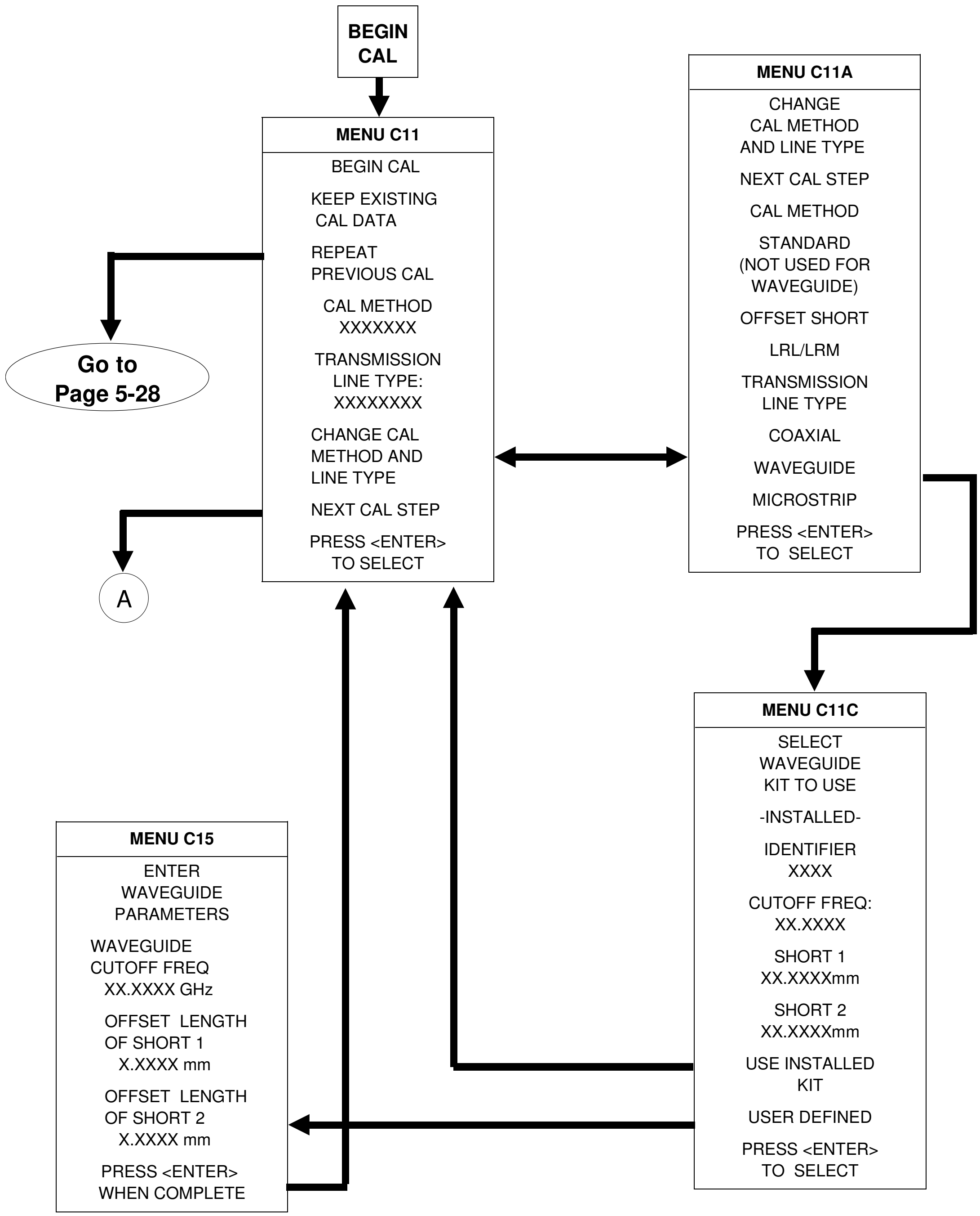


Menu Flow, Standard OSL Calibration Setup (Continued)

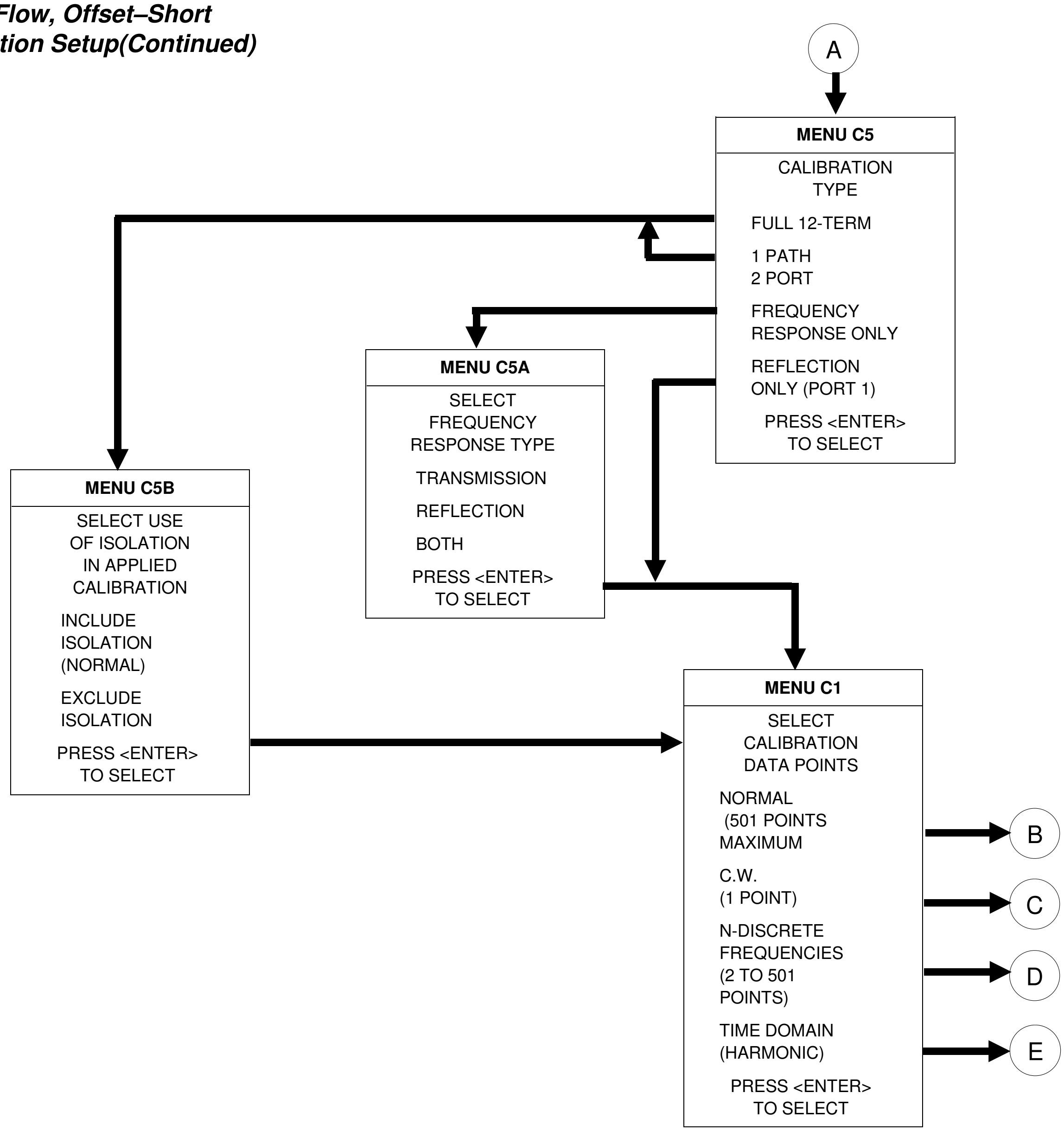


Menu Flow, Offset–Short Calibration Setup

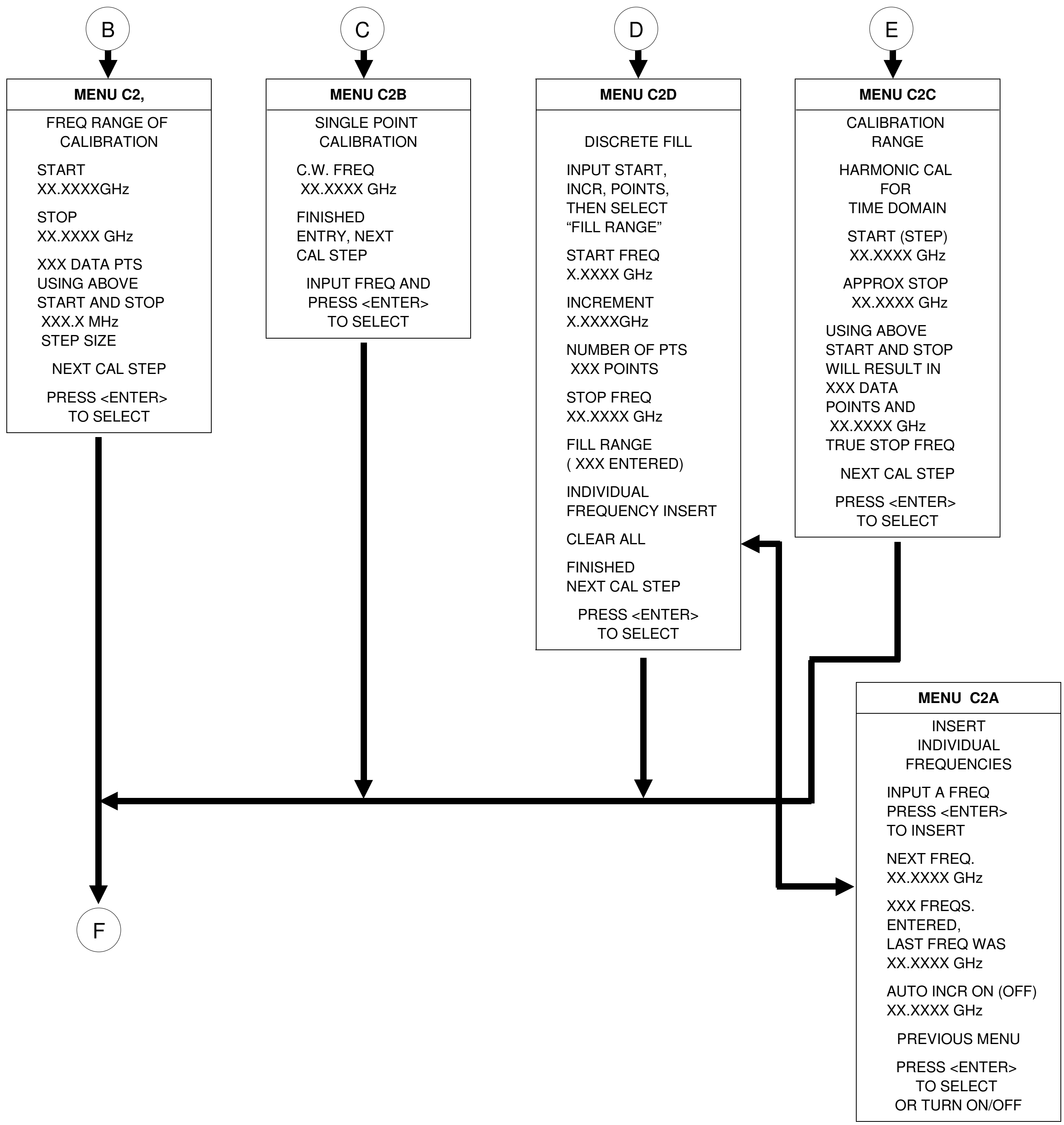
The flow diagram on pages 5-17 through 5-22 show menu flow for an Offset-Short calibration.



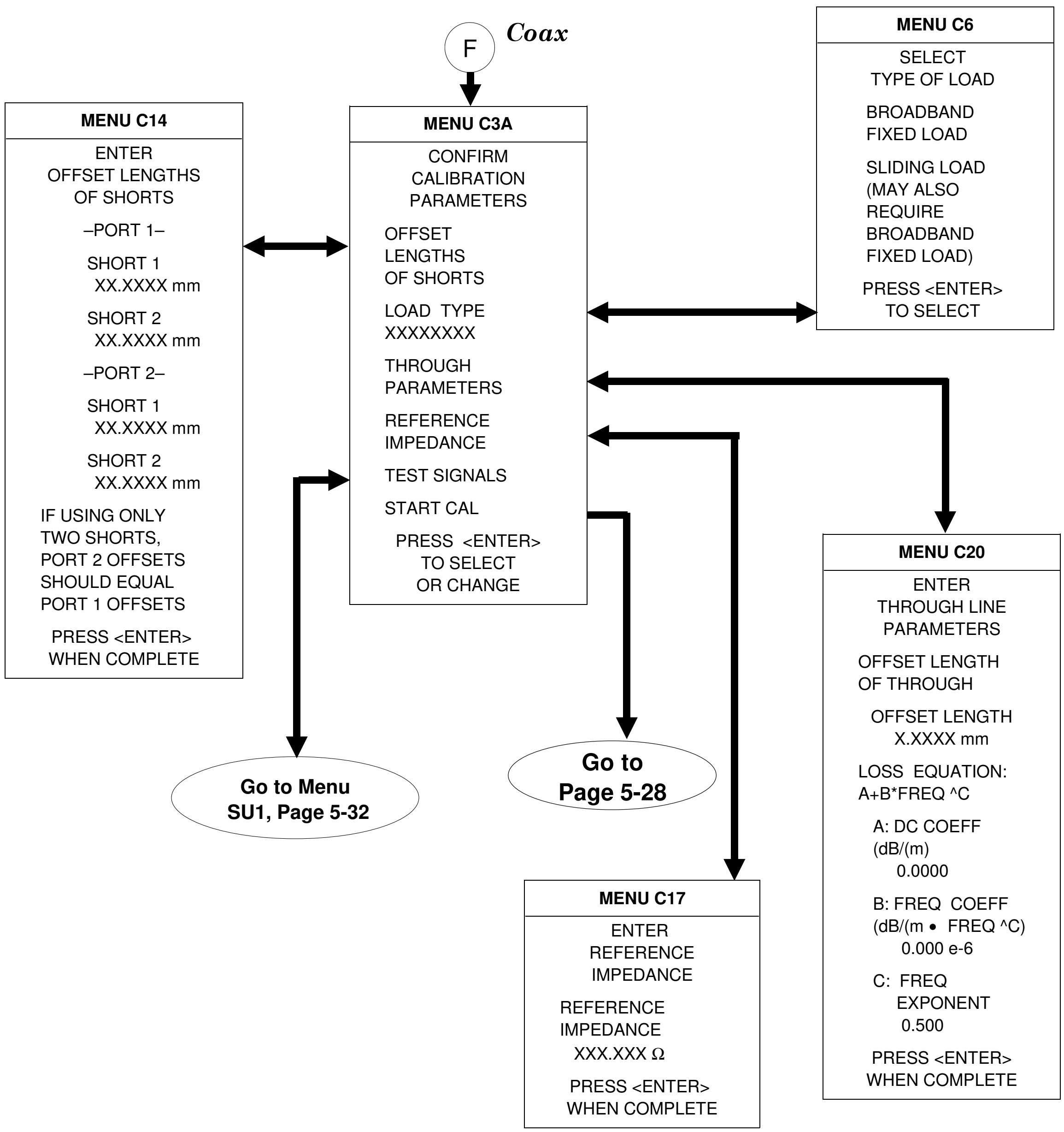
Menu Flow, Offset–Short Calibration Setup(Continued)



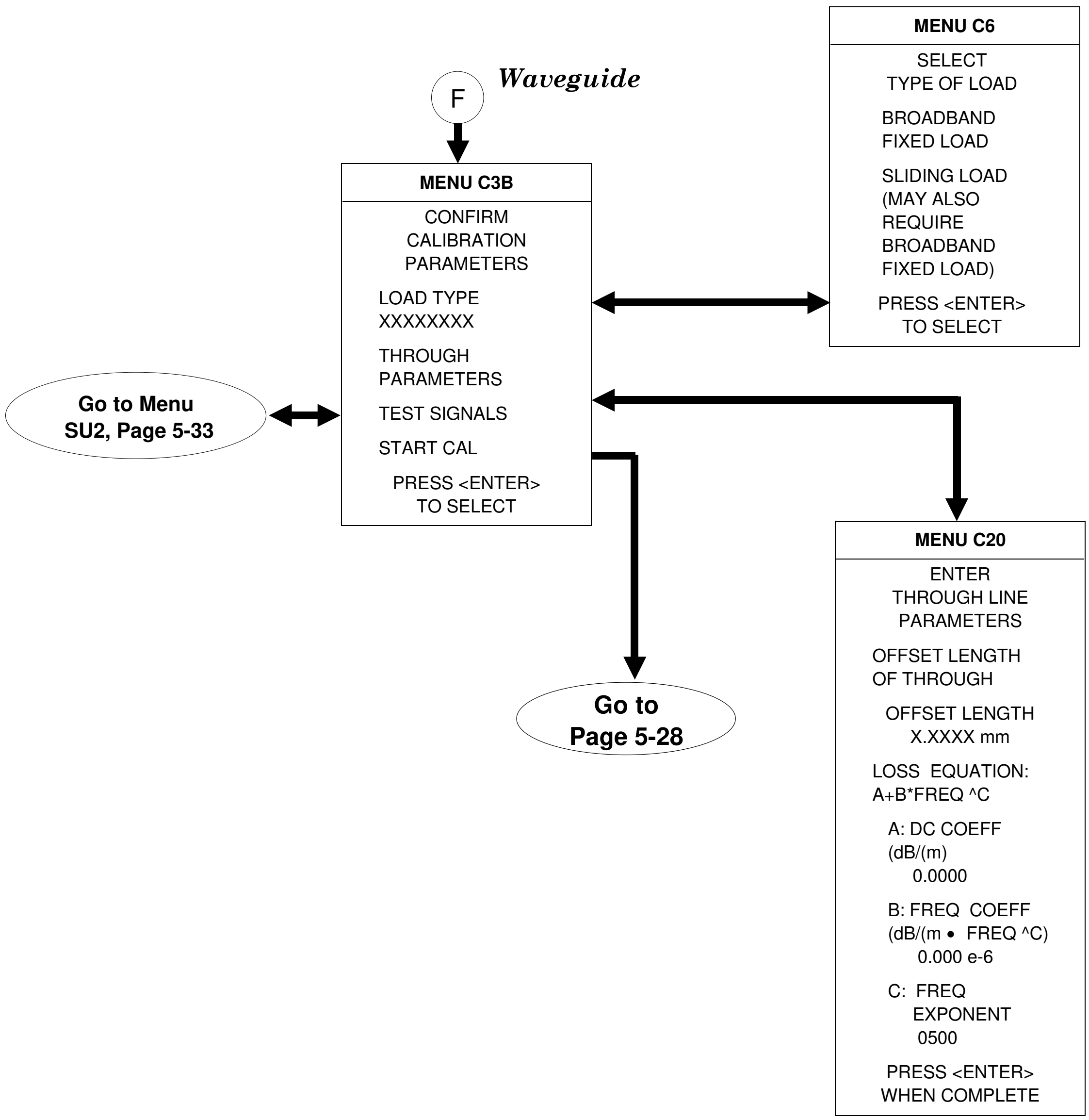
Menu Flow, Offset–Short Calibration Setup (Continued)



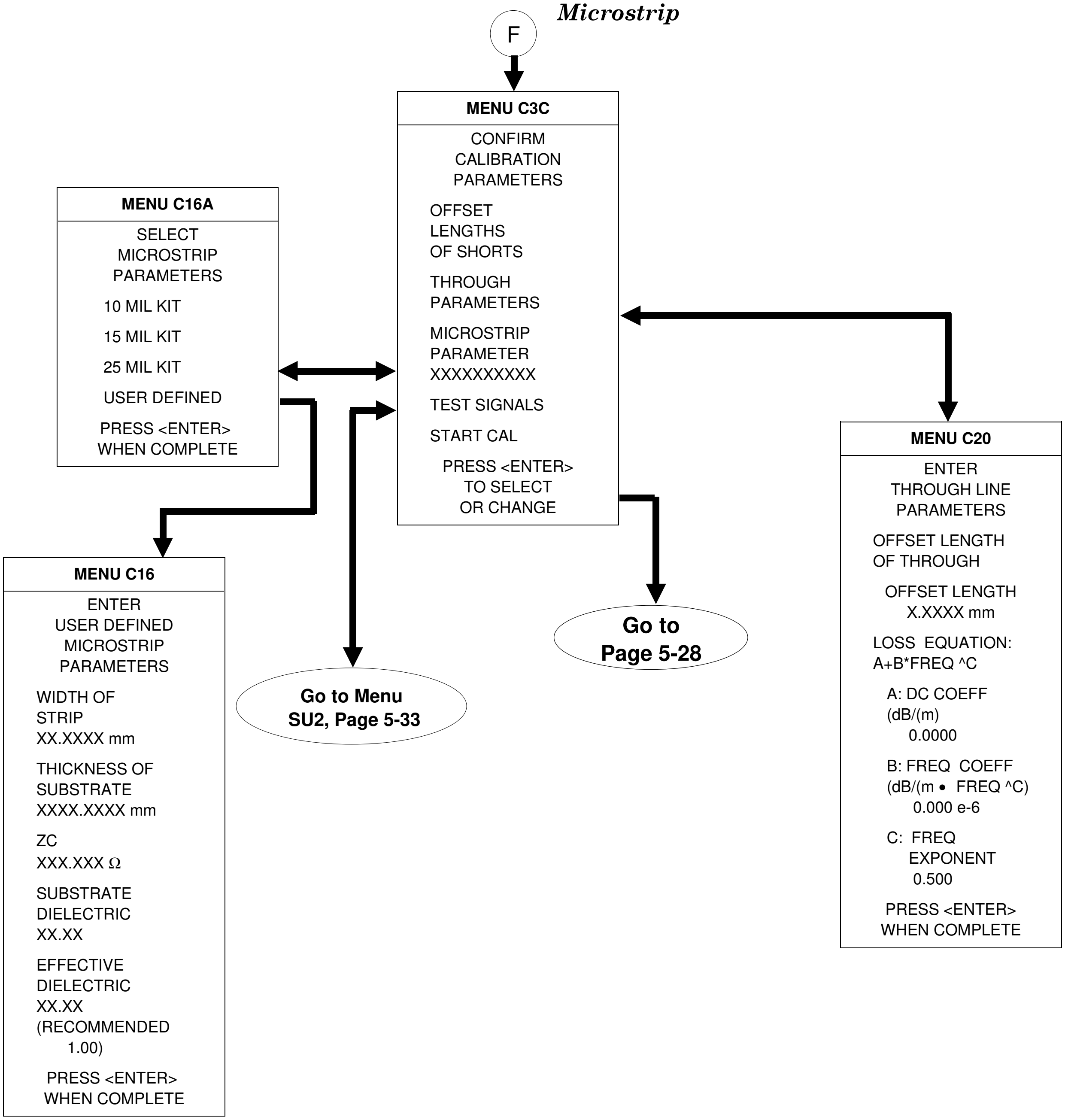
Menu Flow, Offset–Short Calibration Setup (Continued)



Menu Flow, Offset–Short Calibration Setup (Continued)

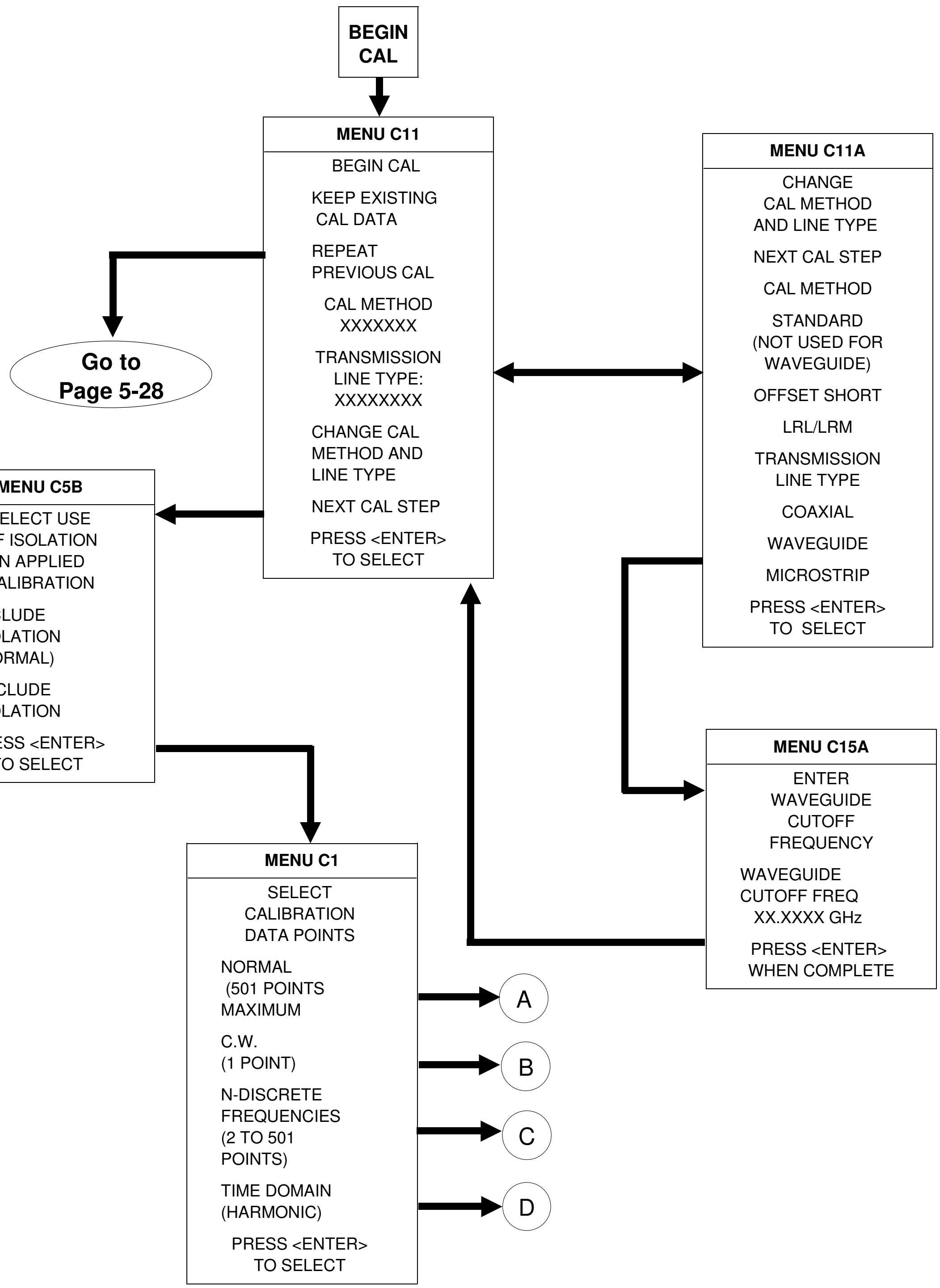


Menu Flow, Offset–Short Calibration Setup (Continued)

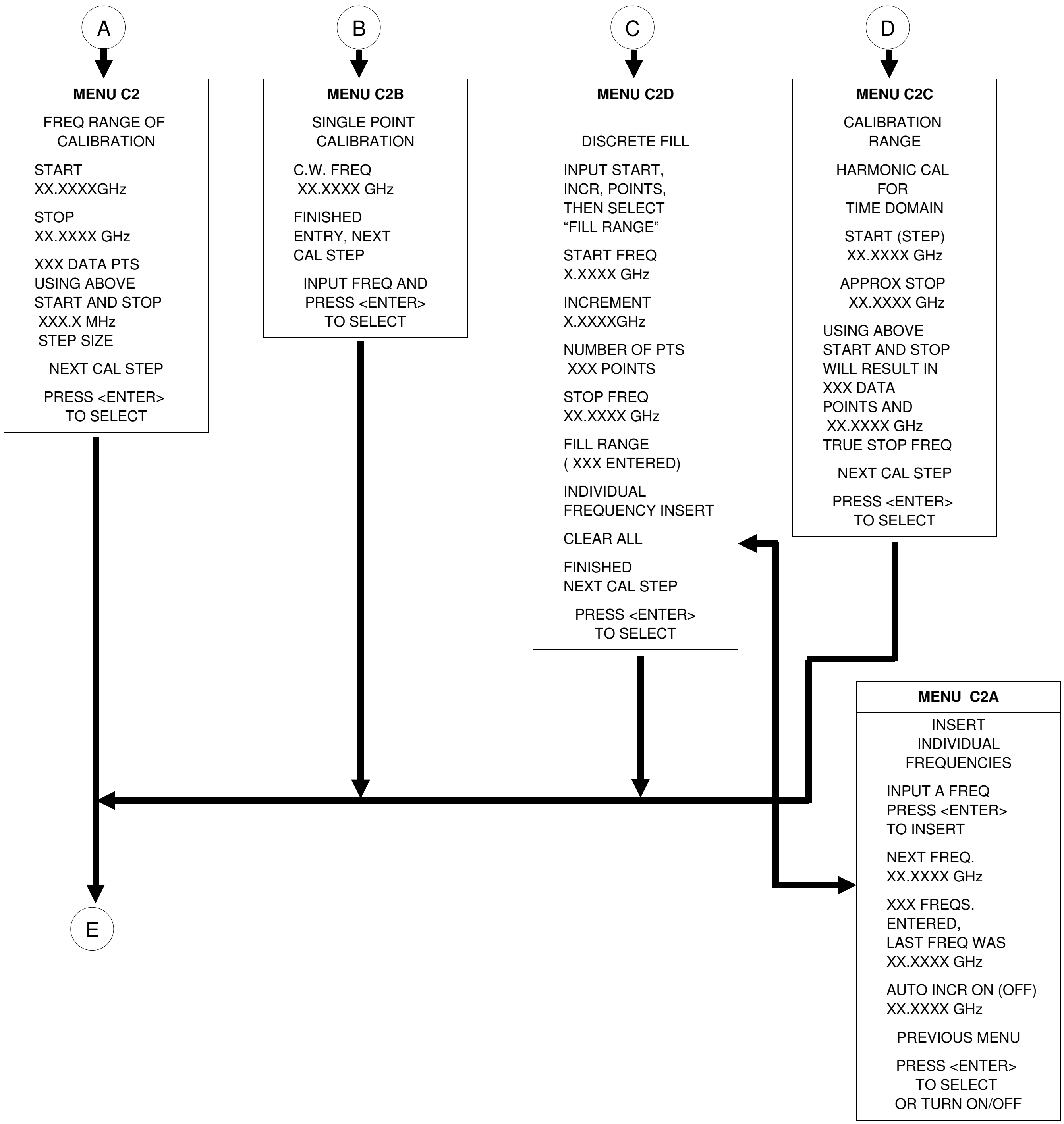


Menu Flow, LRL/LRM Calibration Setup

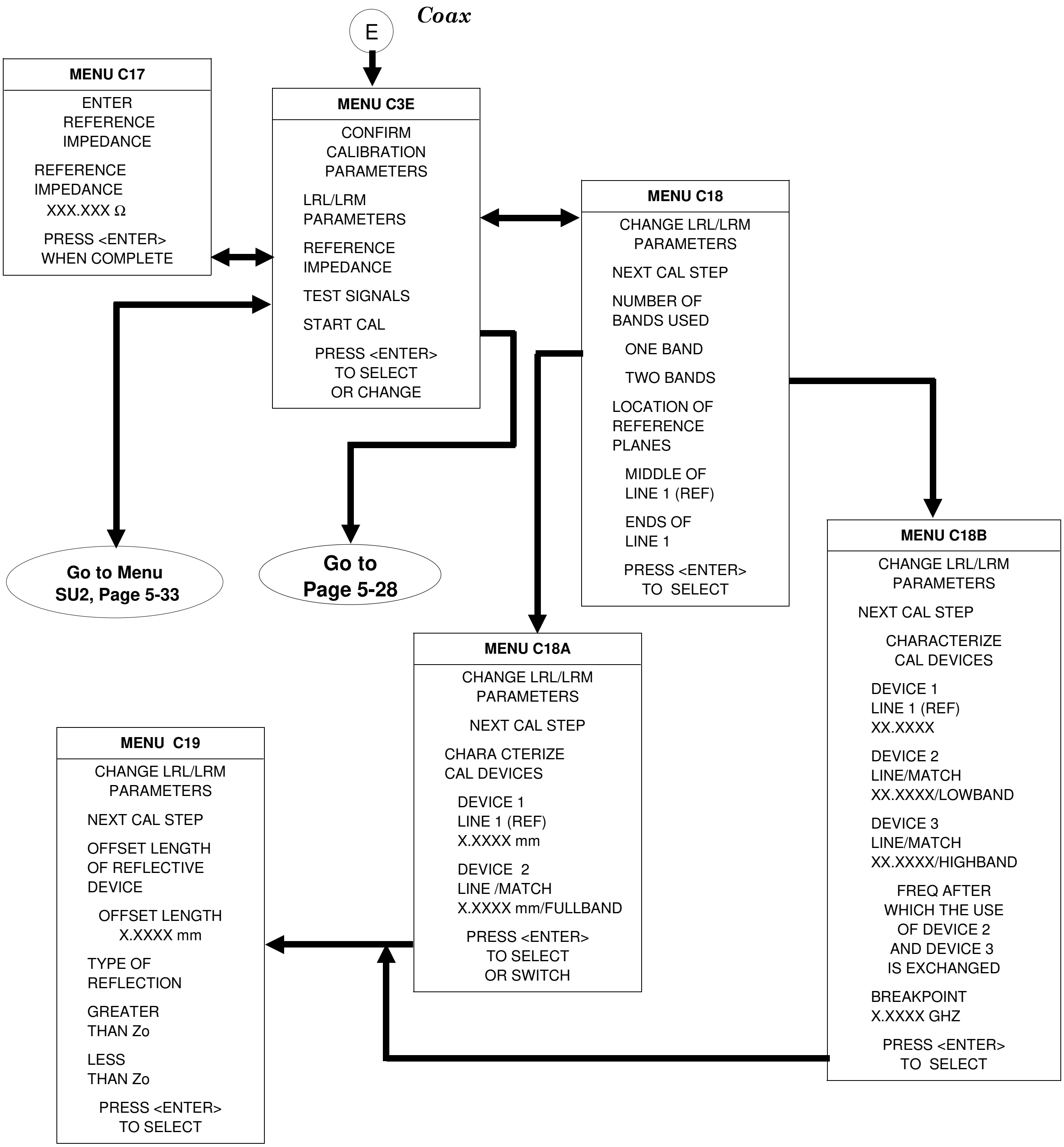
The flow diagram on pages 5-23 through 5-27 show menu flow for an LRL/LRM calibration.



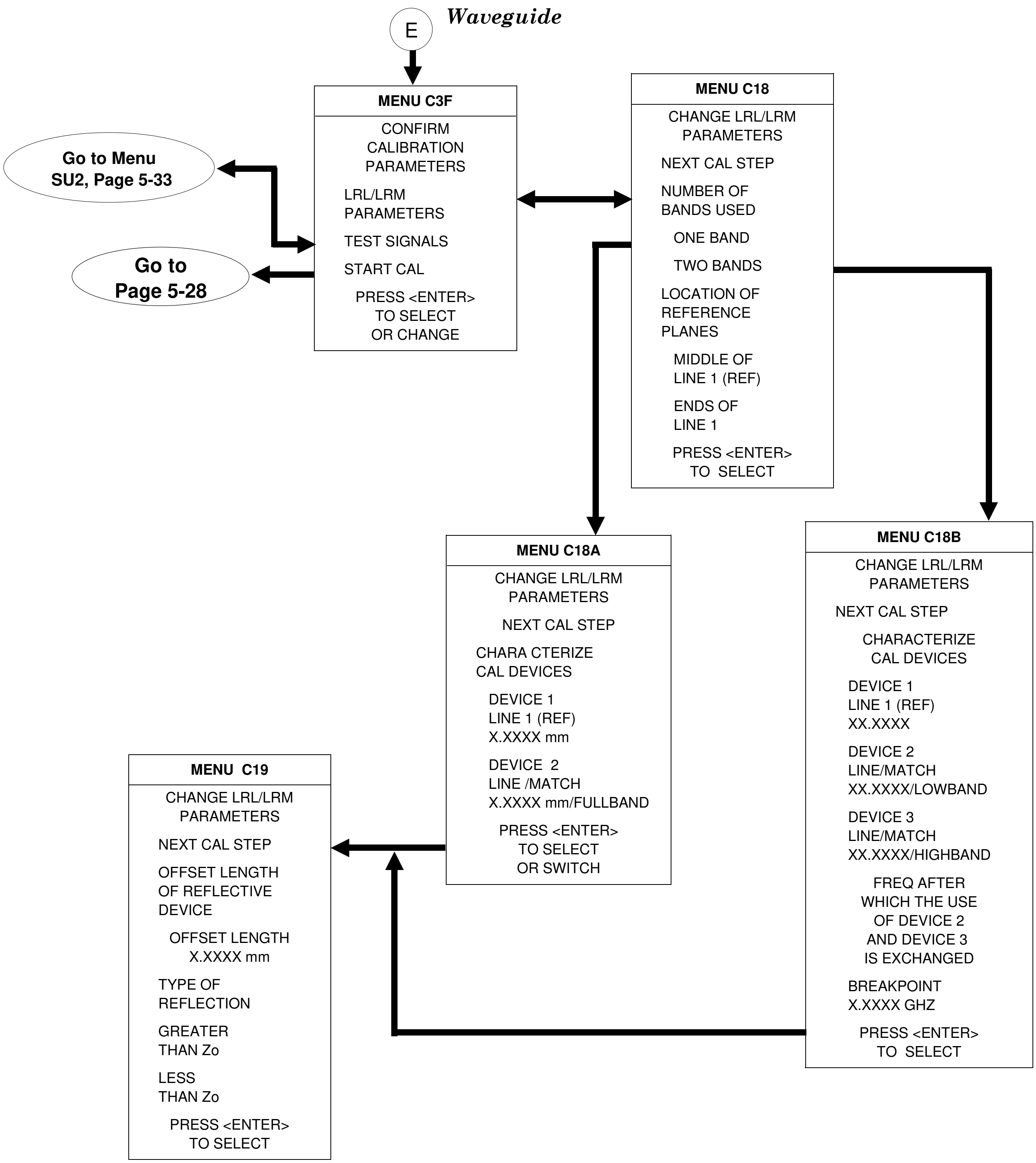
Menu Flow, LRL/LRM Calibration Setup (Continued)



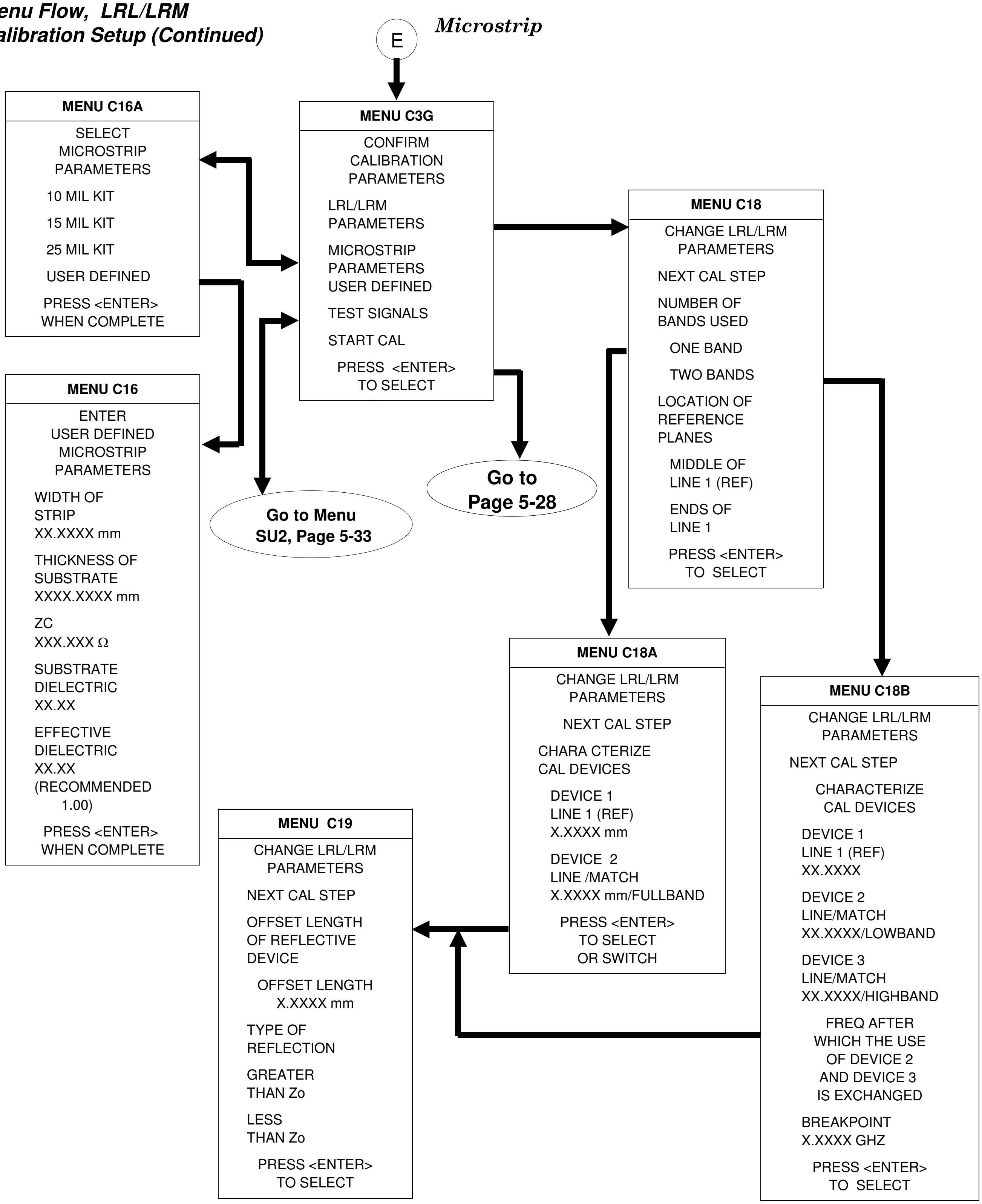
Menu Flow, LRL/LRM Calibration Setup (Continued)



Menu Flow, LRL/LRM Calibration Setup (Continued)

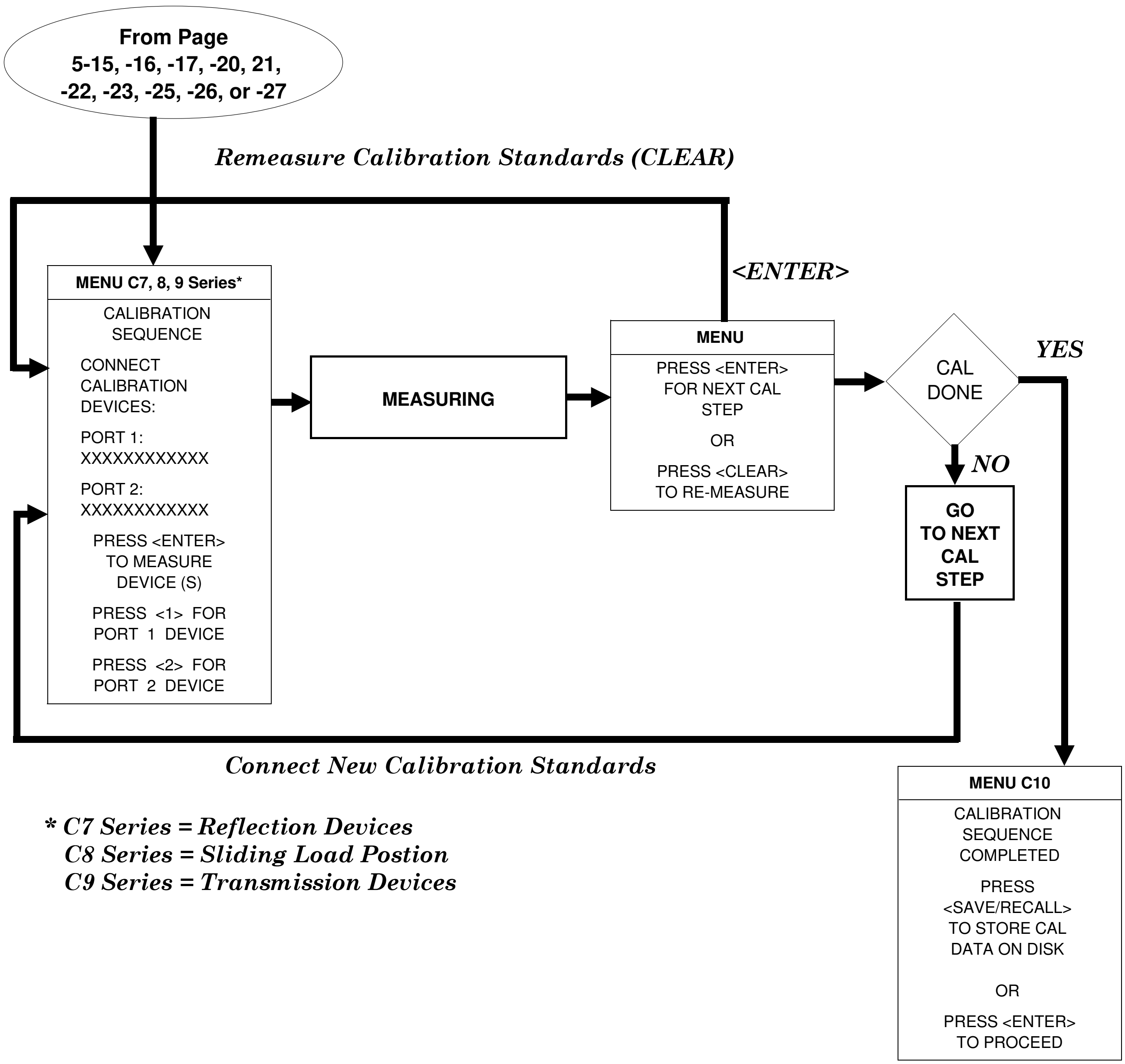


Menu Flow, LRL/LRM Calibration Setup (Continued)



Menu Flow, Main Calibration Measurement Sequence

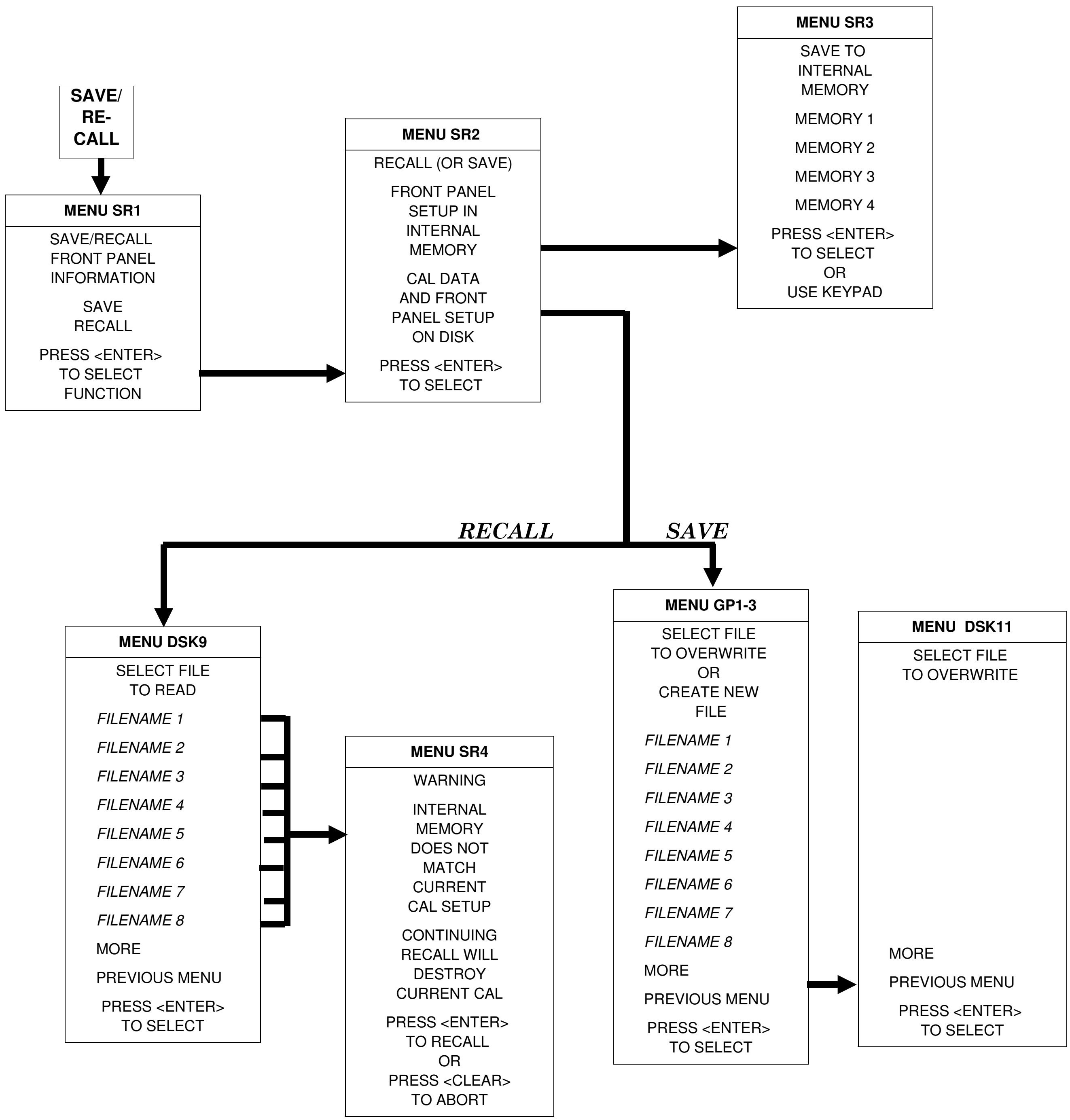
This page provides a menu flow diagram for the main calibation sequence.



** C7 Series = Reflection Devices*
C8 Series = Sliding Load Postion
C9 Series = Transmission Devices

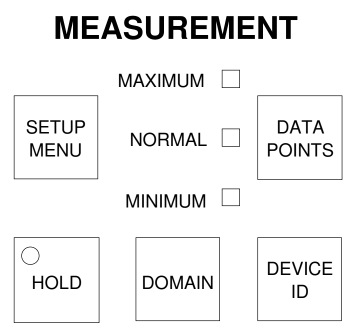
5-4 SAVE/RECALL MENU KEY, DESCRIPTION AND MENU FLOW

Pressing this key displays the first of four menus (below) that allows you to save or recall control panel setups and calibration data. Full menu descriptions can be found in the alphabetical listing under the menu's call letters (SR1, SR2, SR3, etc).



5-5 MEASUREMENT KEY-GROUP , DESCRIPTION AND MENU FLOW

The individual keys within the MEASUREMENT key-group are described below. The menu flow for these key is shown on subsequent pages. Full menu descriptions can be found in the alphabetical listing under the menu's call letters (SU1, SU2, DF, etc).



SETUP MENU Key: Pressing this key calls Sweep Setup Menu SU1 or SU3. Depending upon which menu items you select, additional menus SU2 thru SU6 may also be called.

DATA POINTS Key: Pressing this key toggles between MAXIMUM, NORMAL, and MINIMUM resolution, lighting the appropriate LED. If MAXIMUM resolution is X data points, MINIMUM resolution will be approximately X/6 data points and NORMAL resolution will be approximately X/3 data points. The nominal values are X=501, X/3=167 and X/6=85.

HOLD Key: If the instrument is sweeping, pressing this key results in an immediate halt of the sweep at the current data point. The LED on the button lights, indicating that the Hold Mode is active.

The instrument may be taken out of the hold mode as follows:

- ☐ By using any of the options described in Menu SU4, Select Function for Hold Button.
- ☐ By pressing the Default Program button. This causes the 360B to revert to a predefined state.
- ☐ By pressing the BEGIN CAL key. This causes the 360B to resume sweeping and begin the Calibration Menu sequence.

NOTE

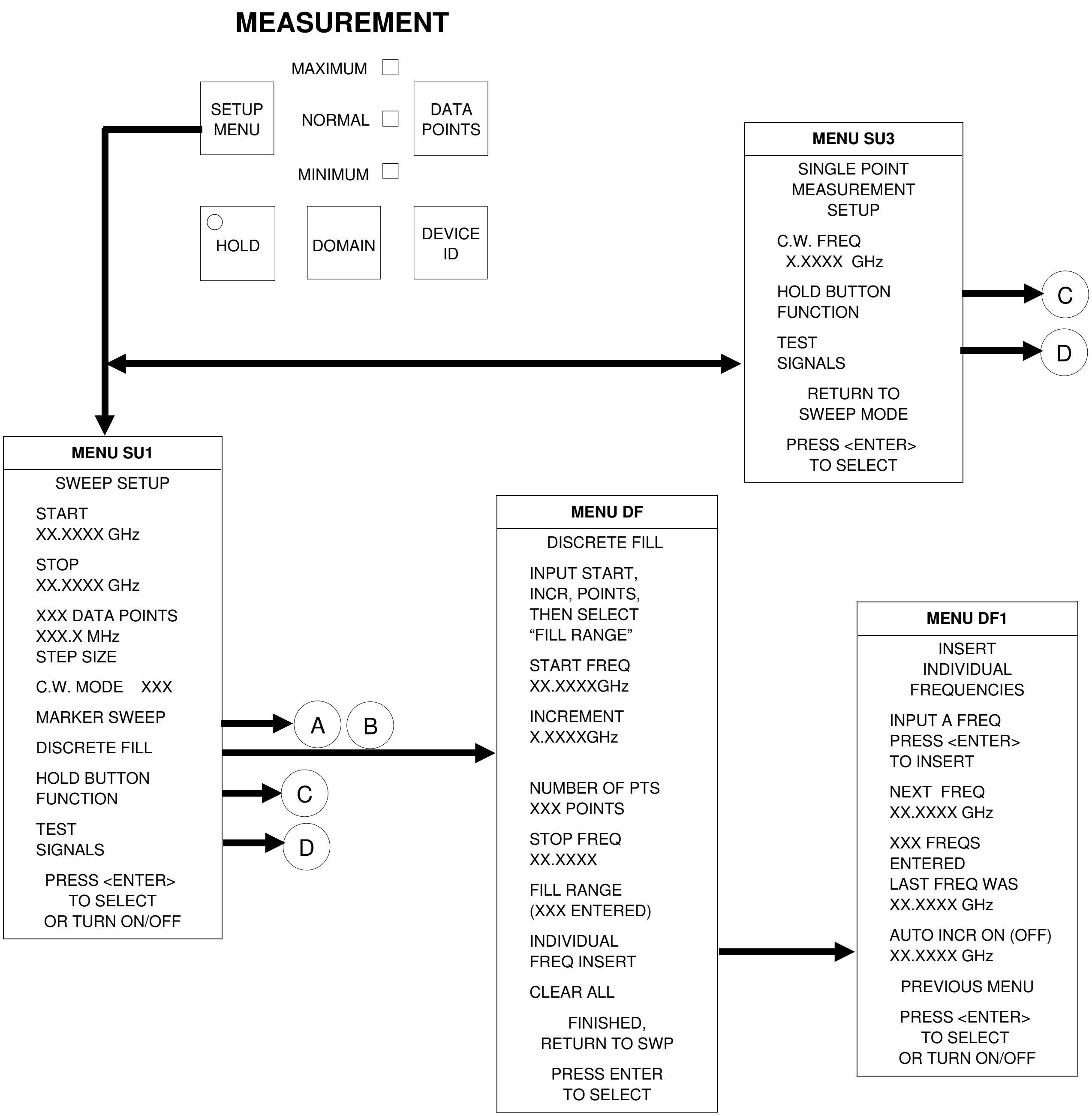
See the description for Menu SU4 for a discussion of the interaction between the Hold Mode and the selection of "Single Sweep" or "Restart Sweep"

If you restart the sweep after performing any disk operations in the Hold Mode (sweep stopped at some data point), the sweep restarts from the beginning.

DOMAIN Key: This key function is fully described in paragraph 5-2 (page 5-9). Additionally, if the Time Domain option is installed, making a selection other than "Frequency Domain" lets you display measured data in the time domain. It also calls a further sequence of Time Domain Menus. Refer to paragraph 10-2 for additional details.

DEVICE ID Key: Pressing this key calls a menu that lets you enter a name for the test device. This key has the same effect as selecting "Device ID" in the PM2 menu.

Menu Flow,* SETUP MENU *Key



Menu Flow,* SETUP MENU *Key (Continued)

A

MENU SU5

FREQUENCY
MARKER SWEEP

START SWEEP
MARKER (n)
XX.XXXX GHz

STOP SWEEP
MARKER (n)
XX.XXXX GHz

USE KEYPAD
TO SELECT
MARKER (1-6)

B

MENU SU6

FREQUENCY
MARKER C.W.

C.W FREQ
MARKER (n)
XX.XXXXXX GHz

USE KEYPAD
TO SELECT
MARKER (1-6)

C

MENU SU4

SELECT
FUNCTION FOR
HOLD BUTTON

HOLD/CONTINUE

HOLD/RESTART

SINGLE SWEEP
AND HOLD

BIAS/RF
HOLD CONDITIONS

BIAS ON
RF ON
DUT/AUT ON

DUT/AUT
PROTECTION
DEFAULT RESET
TURNS ON HOLD
WITH BIAS/RF
TURNED OFF

D

MENU SU2

TEST SIGNALS

SOURCE 1 PWR
XX.X dBm

SOURCE 2 PWR
XX.X dBm

PORT 1 SOURCE
X0 dB (0-70)

PORT 1 TEST
X0 dB (0-00)

PORT 2 SOURCE
X0 dB (0-70)

PORT 2 TEST
X0 dB (0-40)

FLAT TEST
PORT POWER

PREVIOUS MENU

PRESS <ENTER>
TO SELECT

IF FTP CAL DOES EXIST

IF FTP CAL DOES NOT EXIST*

MENU SU8A

CALIBRATE FOR
FLAT TEST PORT POWER

TEST PORT
PORT 1/ PORT 2

NUMBER OF
POWER SWEEPS
X

XX POINTS
MEASURE X PWR
POINT EVERY
X POINTS

START FLAT
CALIBRATION

PREVIOUS MENU

PRESS <ENTER>
TO SELECT
OR SWITCH
OR TURN KNOB TO
CHANGE NUMBER
OF POINTS

MENU SU8

FLAT TEST
PORT POWER

CALIBRATE
FOR FLATNESS

CHARTACTERIZED
FLAT PORT X
AT XX.X dBm
SOURCE X SET
TO X.XX dBm

FLATNESS ON
CORRECTION

TEST PORT PWR
XX.X dBm

PREVIOUS MENU

PRESS <ENTER>
TO SELECT
OR TURN ON/OFF

* FTP = Flat Test Port Power

5-6 CHANNEL KEY-GROUP, DESCRIPTION AND MENU FLOW

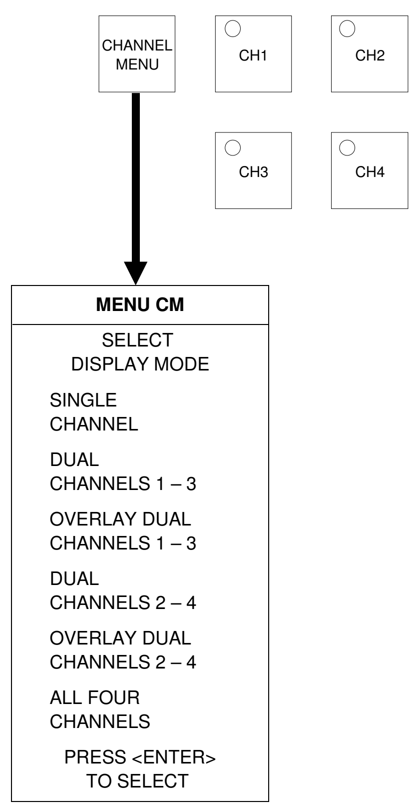
The individual keys within the CHANNEL key-group are described below.

CH 1-4 Keys: These keys (below) define the active channel. One (and only one) must always be active as indicated by the associated LED. Pressing a button makes the indicated channel active. If channel indicated by the key is already active, pressing the key has no effect.

The active channel will be the channel acted upon by the S PARAMS, GRAPH TYPE, REF DELAY, TRACE MEMORY, SET SCALE, AUTO SCALE and DOMAIN keys. When in the single channel display mode, the active channel will be the one displayed.

CHANNEL Menu : Pressing this key calls menu CM (below). Here, you select the number of channels to be displayed. When in the single display mode, only the active channel will be displayed. Full menu description can be found in the alphabetical listing (Appendix 1) under the menu's call letters (CM).

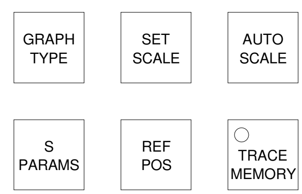
CHANNELS



5-7 DISPLAY KEY-GROUP, DESCRIPTION AND MENU FLOW

The individual keys within the DISPLAY key-group are described below. Menu flow diagrams for the S PARAMS and TRACE MEMORY keys are shown on subsequent pages. Full menu description(s) for menu SP and all others mentioned below can be found in the alphabetical listing (Appendix 1) under the menu's call letters (SP, GT1, RD1, etc).

DISPLAY



GRAPH TYPE Key: Pressing this key calls menu GT1 or GT2. These menus let you select the type of display to appear on the active channel for the selected S-Parameter.

SET SCALE Key: Pressing this key calls the appropriate scaling menu (SS1, SS2, SS3, etc.) depending upon the graph type being displayed on the active channel for the selected S-Parameter.

AUTO SCALE Key: Pressing this key autoscales the trace or traces for the active channel. When in one of the scaling menus, the 360B indicates this is happening by turning the menu entries red for 1 second. The new scaling values are then displayed on the menu and graticule. The resolution will be selected from the normal sequence of values you have available using the knob. When the active channel has a Real and Imaginary type display, the larger of the two signals will be used to autoscale both the real and imaginary graphs. Both graphs will be displayed at the same resolution.

S PARAMS Key: Pressing this key calls menu SP. This menu allows you to select the S-Parameter to be displayed by the active channel for the selected S-Parameter.

REF POS Key: Pressing this key calls menu RD1. This menu lets you input the reference plane in time or distance. You do this by selecting the appropriate menu item. For a correct distance readout, the dielectric constant must be set to the correct value. This is accomplished by selecting **SET DIELECTRIC**, which calls menu RD2.

On menu RD1, selecting **AUTO** and pressing ENTER automatically adjusts the reference delay to unwind the phase. The values for time and distance turn red for one second when you activate **AUTO**.

The 360B unwinds the phase as follows:

- First, it sums the phase increments between each pair of measured data points, then it takes the average “Pdelta” over the entire set of points.
- Next, it corrects the phase data by applying the following formula:

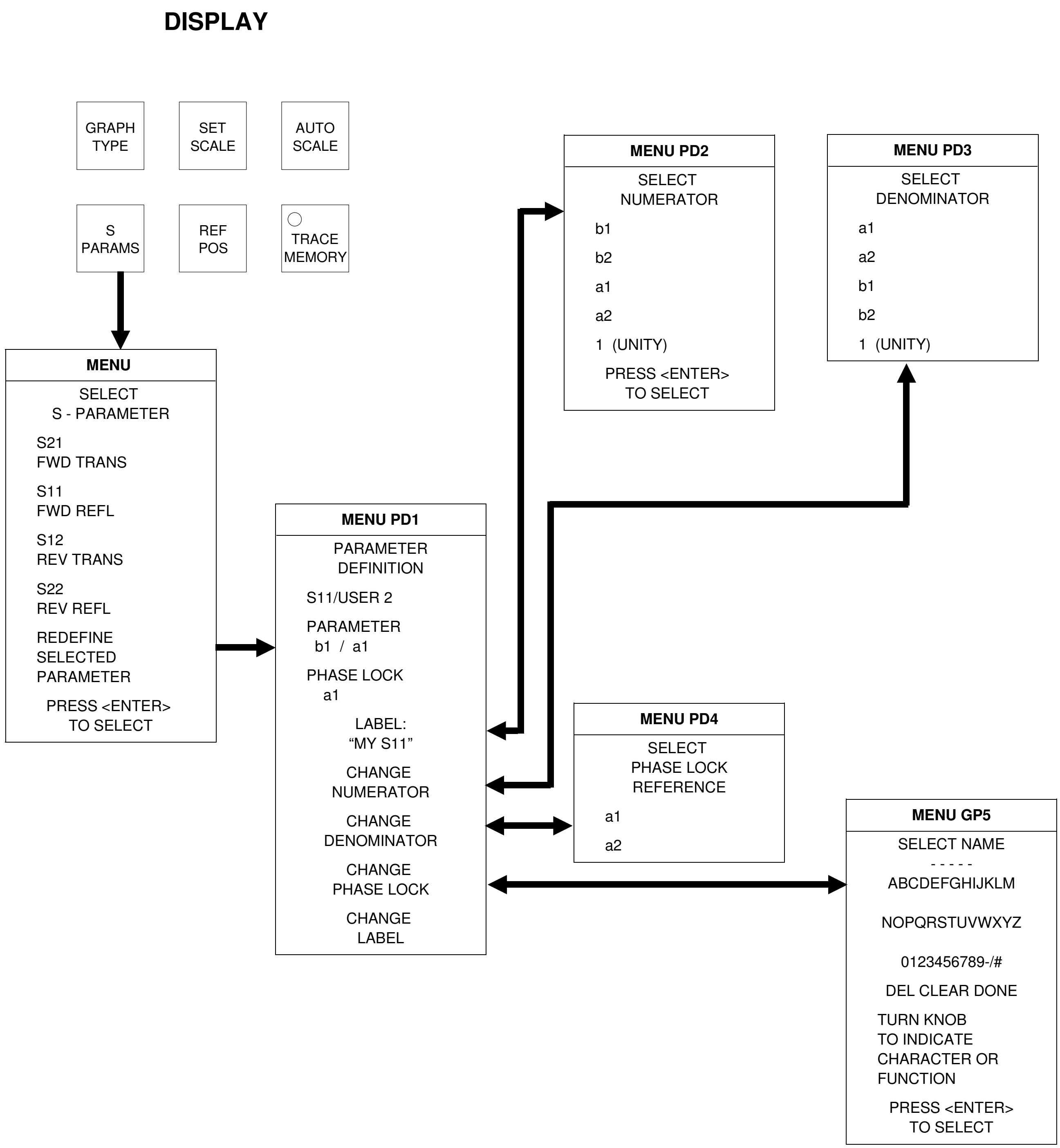
$$P_{correct} = P_{measured} - NxP_{delta}$$

Where P = phase

Assuming there are fewer than 360B degrees of phase rotation between each data point, the operation described above removes any net phase offset. The endpoints of the phase display then fall at the same phase value.

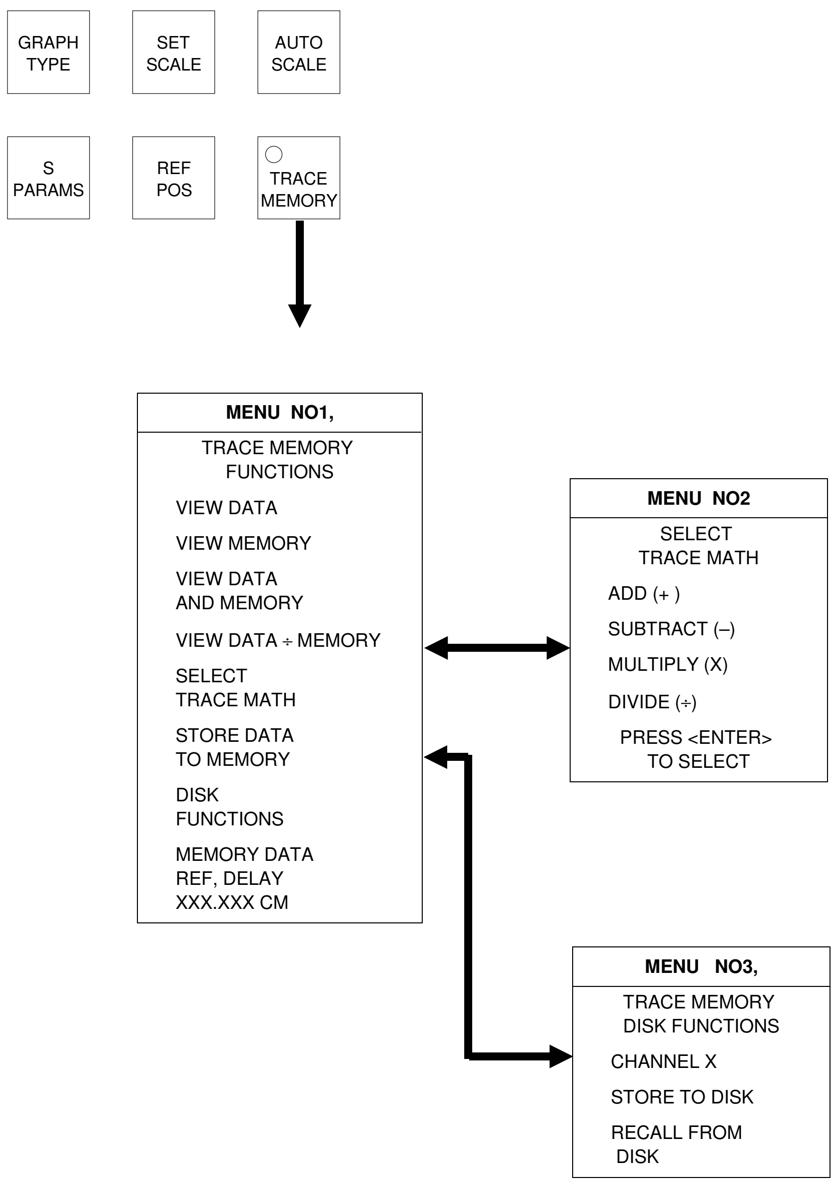
TRACE MEMORY Key: Pressing this key brings up menu NO1. This menu—which relates to the active channel—allows you to store data to memory, view memory, perform operations with the stored memory, and view both data and memory simultaneously. Four memories exist, one for each channel. This allows each channel to be stored and normalized independent of the other channels. Data from the trace memory may be stored on the disk or recalled from it.

Menu Flow,
S PARAMS Key



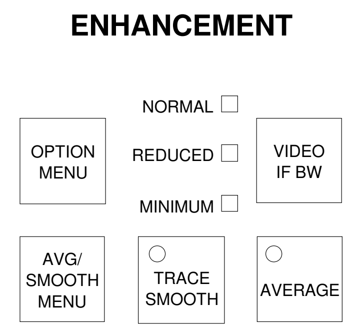
Menu Flow,
TRACE MEMORY *Key*

DISPLAY



5-8 ENHANCEMENT KEY-GROUP, DESCRIPTION AND MENU FLOW

The individual keys within the ENHANCEMENT key-group are described below. Menu flow diagrams for these keys are shown on subsequent pages. Full menu description(s) for menu OPTNS and all others mentioned below can be found in the alphabetical listing (Appendix 1) under the menu's call letters (SP, GT1, RD1, etc).



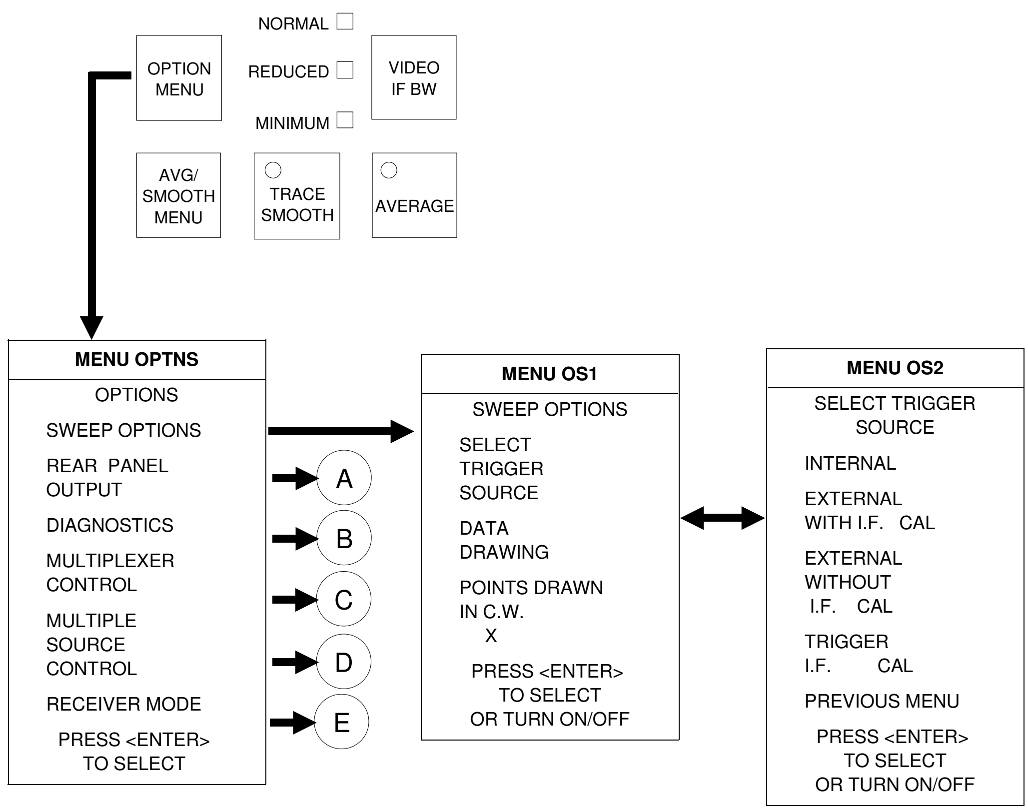
OPTION MENU Key This key brings up the OPTNS menu. Depending on choices selected, this menu causes other menus to appear.

VIDEO IF BW Key Pressing this key cycles between three different IF bandwidths. The applicable NORMAL, REDUCED, or MINIMUM LED lights to indicate selection.

AVG/SMOOTH MENU Key Pressing this key brings up the EM Menu. When pressed during the calibration sequence, it brings up the EM Cal Menu instead.

TRACE SMOOTH and AVERAGE Keys The AVERAGE and TRACE SMOOTH keys select their respective functions on and off with the appropriate LED indicating when the function is selected.

ENHANCEMENT



Menu Flow, OPTION MENU *Key*

A

MENU ORP1

REAR PANEL
OUTPUT CONTROL

OUTPUT OFF

SELECT MODE
HORIZONTAL

SET HORIZONTAL
OR PHASE LOCK
SCALING

START/LOCK a1
X.XXXX V

STOP/LOCK a2
X.XXXX V

VERTICAL
SCALING

X.XX VOLT PER
CHANEL X
GRATICULE LINE

REFERENCE LINE
IS X.XX VOLT

PRESS <ENTER>
TO SELECT
OR TURN ON/OFF

B

MENU DG1

DIAGNOSTICS

TROUBLE
SHOOTING
(ANRITSU
SERVICE
USE ONLY)

TESTS

PRESS <ENTER>
TO SELECT

MENU DG2

TROUBLE
SHOOTING

LINEARITY

LO1 VCO

LO1 DAC

LO2 VCO

LO2 DAC

SOURCE

EXT INPUT

FILTER
RESPONSES

FIRST I.F.
BANDPASS

L0 1 FREQUENCY
X.XXXX GHz

HARMONIC NUM
X

Menu DG2 is intended for use only by ANRITSU Customer Service

MENU DG3

ERROR REPORT

PROM AND
RAM CHECKS

FRONT PANEL
KEYBOARD

CRT

CHECK OPTIONS
INSTALLED

NON-RATIOED
PARAMETERS

PRESS <ENTER>
TO SELECT

MENU ORP2

SELECT MODE
FOR OUTPUT

HORIZONTAL

VERTICAL

SET HORIZONTAL
OR PHASE LOCK
SCALING

PHASE LOCK

PRESS <ENTER>
TO SELECT

Menu Flow, OPTION MENU *Key*

C

MENU MUX1

MULTIPLEXER
CONTROL

RF SWITCH A/B

NON-SELECTED
TEST SET

STANDBY ON
POWER

SYSTEM
HARDWARE
CONFIGURATION

TEST SET A/B

SOURCE A/B

FINISHED
ACCEPT
CONFIGURATION

PRESS <ENTER>
TO SELECT

MENU MUX2

TEST SET A/B
SOURCE A/B

WARNING

CONTINUING
MAY ERASE
CURRENT
SETUP AND
CALIBRATION

YOU MAY CHOOSE
TO ABORT AND
SAVE TO DISK OR
INTERNAL MEMORY
AS A PRECAUTION

PRESS <ENTER>
TO CONTINUE

OR

PRESS <CLEAR>
TO ABORT

D

MENU OM0

MULTIPLE
SOURCE CONTROL

DEFINE BANDS

SELECT
MULTIPLE
SOURCE STATE

OFF

STANDBY

ON

PRESS <ENTER>
TO SELECT
OR SWITCH

MENU OM1

DEFINE BANDS

BAND 1

DISPLAYED
FREQ RANGE

BAND START F
XX.XXXXXX GHz

BAND STOP F
XX.XXXXXX GHz

BAND FUNCTIONS

EDIT SYSTEM
EQUATIONS

STORE BAND 1
BANDS STORED:
(1 2 3 4 5)

CLEAR ALL
DEFINITIONS

SET MULTIPLE
SOURCE STATE

PRESS <ENTER>
TO SELECT

MENU OM2

EDIT SYSTEM
EQUATIONS

SELECT
FUNTION
TO EDIT

SOURCE 1

SOURCE 2

RECEIVER

EQUATION
SUMMARY

C.W. OFF

MULTIPLIER
XX

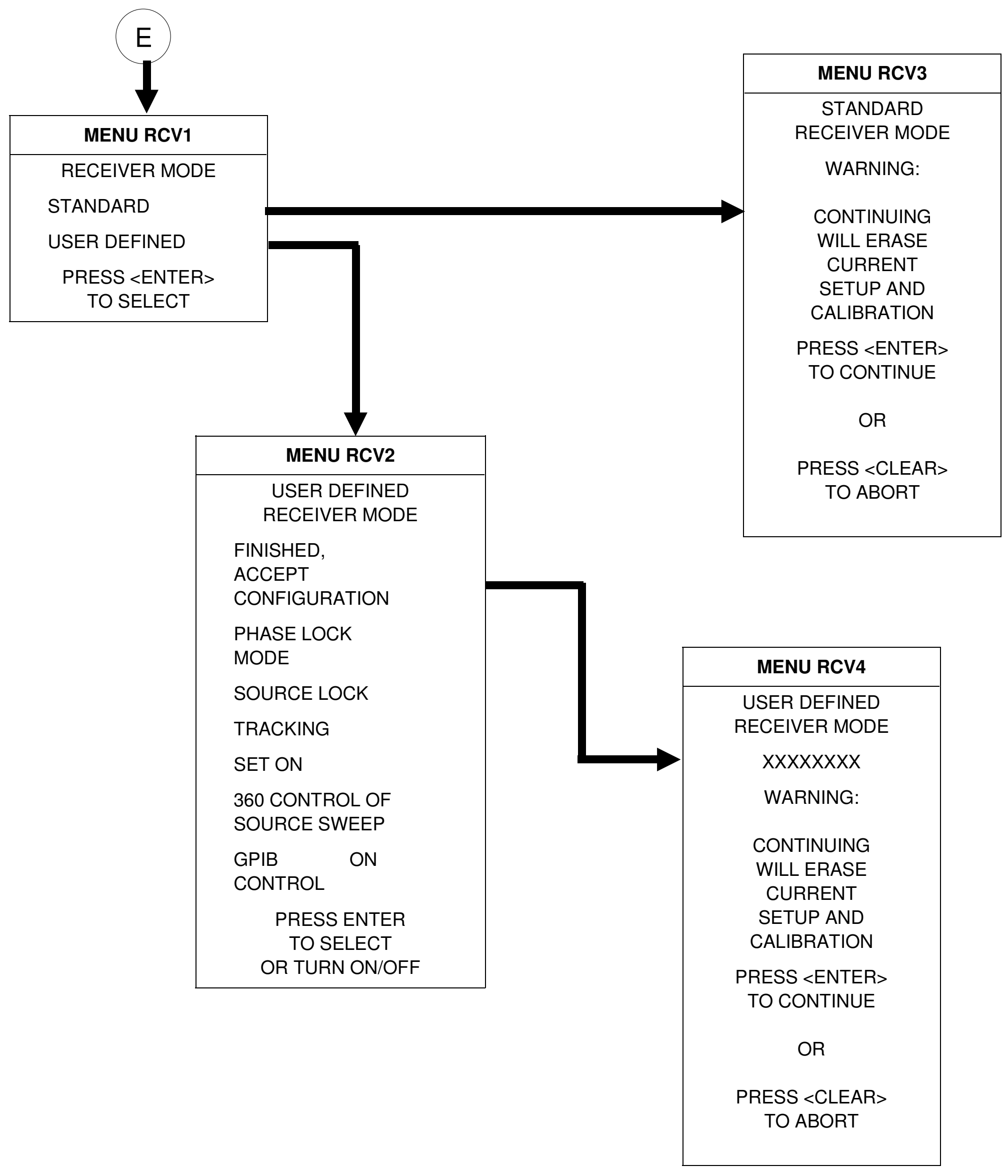
DIVISOR
XX

OFFSET FREQ
X.XXXXXX GHz

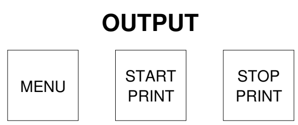
PREVIOUS MENU

PRESS <ENTER>
TO SELECT

Menu Flow,* OPTION MENU *Key



5-9 OUTPUT KEY-GROUP, DESCRIPTION AND MENU FLOW



The individual keys within the OUTPUT key-group are described below. The menu flow for the MENU key is shown on subsequent pages. Full descriptions for menus can be found in the alphabetical listing (Appendix 1) under the menu's call letters (PM1, PM2, PM3, etc.)

MENU Key: Pressing this key brings up menu PM1. This menu allows you to define what will happen every time you press the START PRINT key.

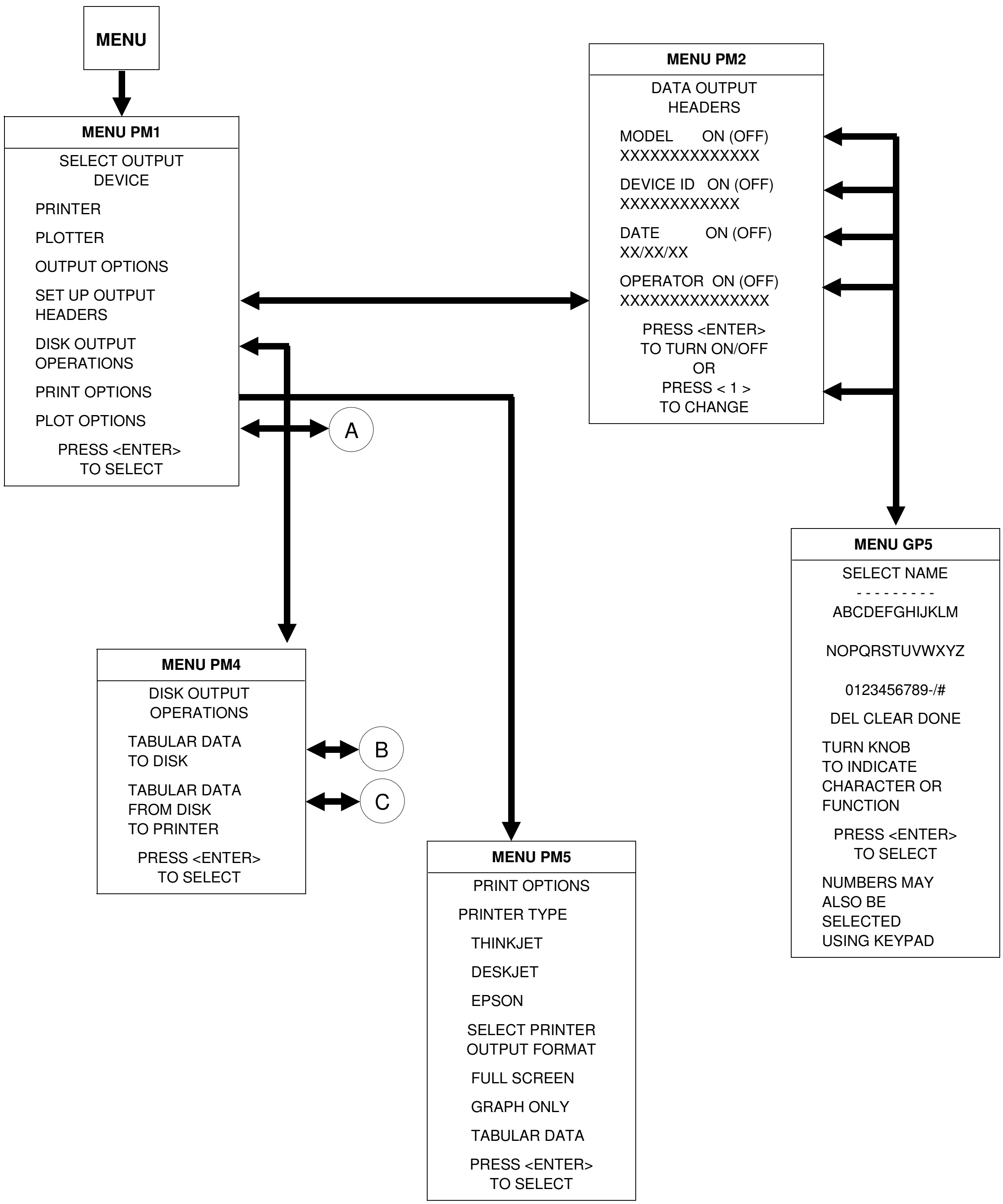
START PRINT Key: Pressing this key starts outputting the measured data as defined by the setup defined by the selected MENU key.

STOP PRINT Key: Pressing this key can result in any of the following actions if the printer is selected

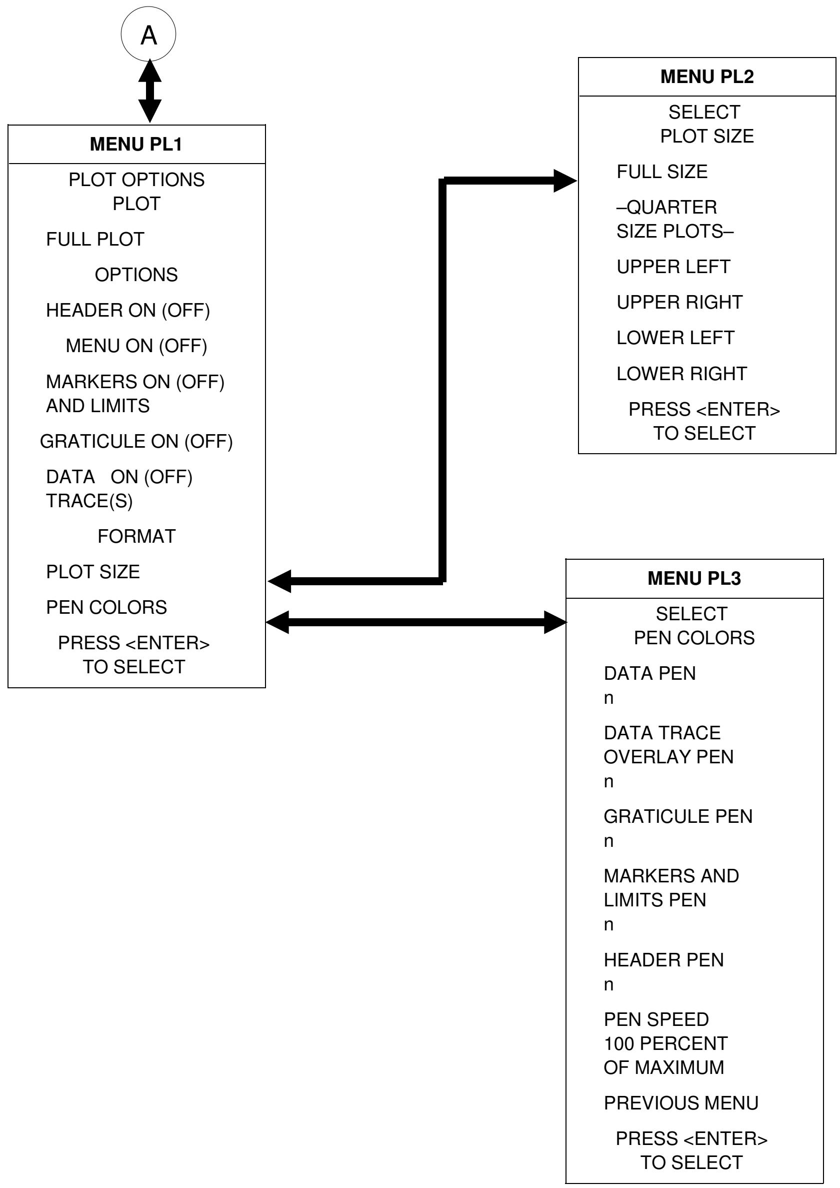
- If the 360B is not outputting data, the key sends a form feed command to the printer.
- If the printer is active, the key aborts the printing and sends a form feed command to the printer. Aborting the printing clears the print buffer.
- If the printer is not selected and another form of output is active, Pressing this key aborts printing but *does not* send a form feed to the printer.

Plotting Functions The 360B can plot an image of either the entire screen or subsets of it. Plots can be either full size or they can be quarter size and located in any of the four quadrants. You can select different pens for plotting different parts of the screen. You cannot, however, plot tabular data.

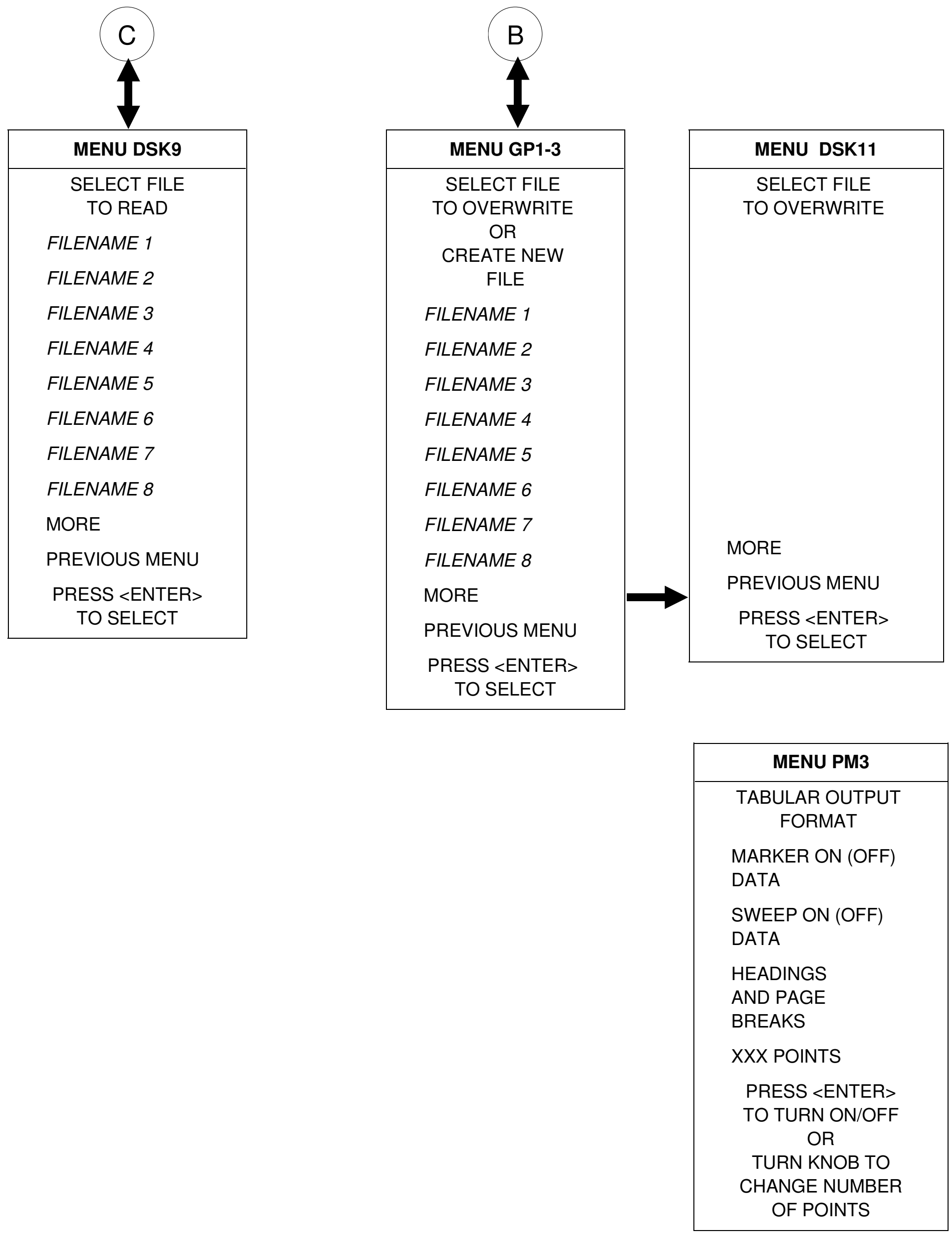
Menu Flow, **MENU** *Key*



Menu Flow,* MENU *Key (Continued)



Menu Flow,* MENU *Key
(Continued)



5-10 SYSTEM STATE KEY-GROUP, DESCRIPTION AND MENU FLOW

SYSTEM STATE

DEFAULT PROGRAM | UTILITY MENU

The individual keys within the SYSTEM STATE key-group are described below. The menu flow for the UTILITY MENU key is shown on subsequent pages. Full descriptions for menus can be found in the alphabetical listing (Appendix 1) under the menu's call letters (U1, U2, U3, etc.)

DEFAULT PROGRAM Key: Pressing this key brings up the default menu. If pressed again, it recalls the factory selected default values for the control panel controls. The values are defined in Table 5-1.

Pressing this key, the 1 key, then this key again resets front panel key states and internal memories 1 thru 4.

Pressing this key, the 0 key, then this key again resets front panel key states, internal memories 1 thru 4, and certain hardware settings. Refer to paragraph 4-5 for additional information on this function.

CAUTION

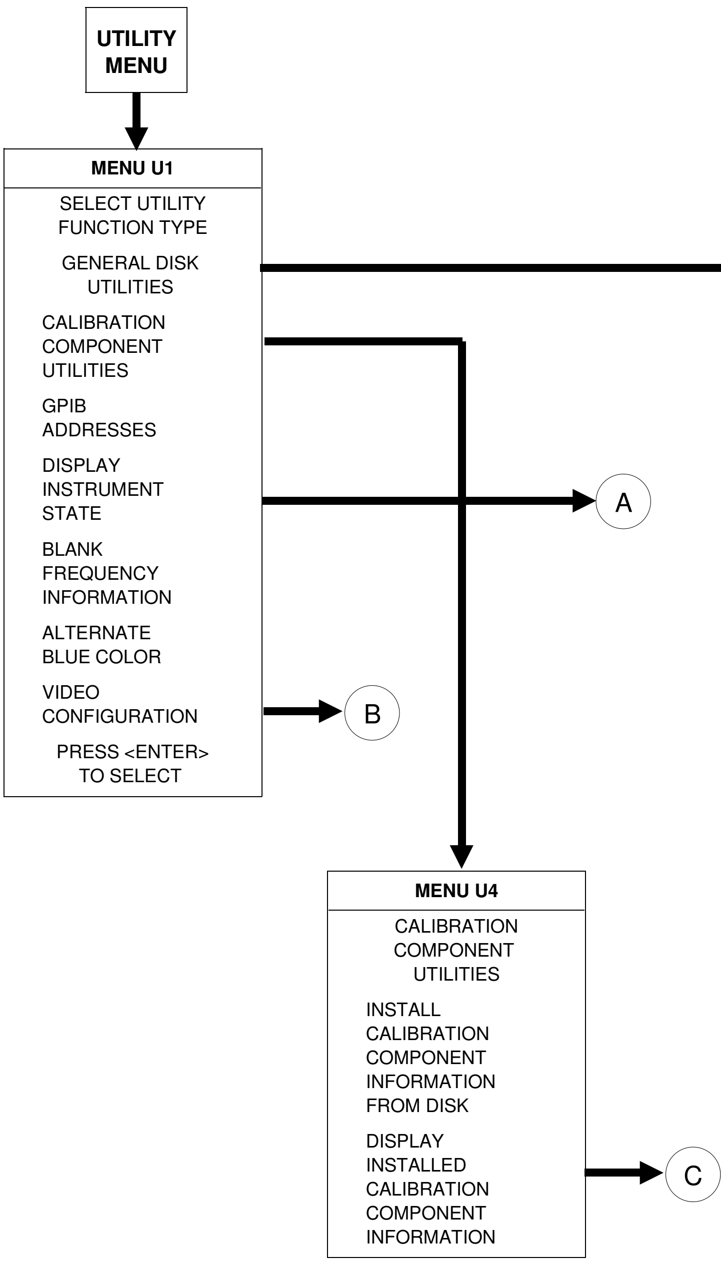
Use of this key will destroy control panel and calibration setup data, unless they have been saved to disk.

UTILITY MENU *Key*: Pressing this key calls menu U1. This menu accesses subordinate menus to perform system, disk, and service utilities. The only functions performed directly from the U1 Menu are "Blank Frequency Information." and "Alternate Blue Color."

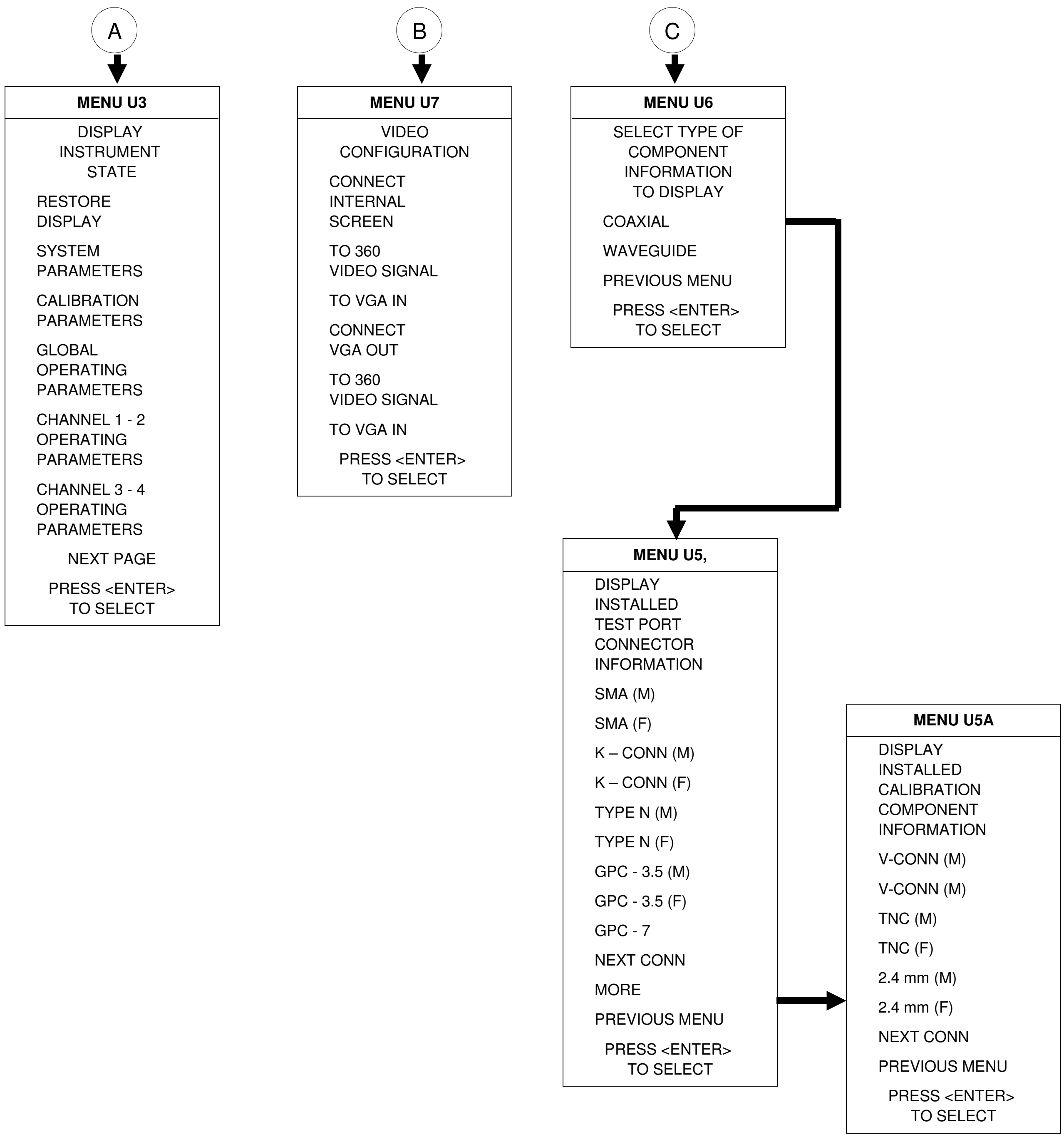
Table 5-1. Default Settings

Function	Default Setting
INSTRUMENT STATE	Measurement Setup Menu Displayed
MEASUREMENT	Maximum sweep range of source and test set *Source Power:* +5.0 dBm *Resolution:* Normal
CHANNEL	Quad (four-channel) display Channel 1 active
DISPLAY	*Channel 1:* S11, 1:1 Smith Chart *Channel 2:* S12, Log Magnitude and Phase *Channel 3:* S21, Log Magnitude and Phase *Channel 4:* S22, 1:1 Smith Chart *Scale:* 10 dB/Division or 90/Division *Offset:* 0.000dB or 0.00 degree *Reference Position:* Midscale *Electrical Delay:* 0.00 seconds *Dielectric:* 1.00 (air) *Normalization:* Off *Normalization Sets:* Unchanged
ENHANCEMENT	*Video IF Bandwidth:* Reduced *Averaging:* Off *Smoothing:* Off
CALIBRATION	*Correction:* Off *Connector:* Test Set dependent *Load:* Broadband
MARKERS/LIMITS	*Markers On/Off:* All off *Markers Enabled/Disabled:* All enabled Marker Frequency: All set to the start-sweep frequency (or start -time distance ∆ *Reference:* Off *Limits:* All set to reference position value (all off all enabled)
SYSTEM STATE	*GPIB Addresses and Terminators:* Unchanged *Frequency Blanking :* Disengaged, *Error(s):* All cleared *Measurement:* Restarted

Menu Flow,* UTILITY *Key



Menu Flow,* UTILITY *Key (Continued



5-11 MARKERS/LIMITS KEY-GROUP, DESCRIPTION AND MENU FLOW

The individual keys within the MARKERS/LIMITS key-group are described below. The menu flow for the MARKER MENU key is shown on the facing page. Full descriptions for these menus can be found in the alphabetical listing (Appendix 1) under the menu's call letters (M1, M2, M3, etc.)

MARKER MENU Key: Pressing the MARKER MENU key calls Menu M1). This menu lets you toggle markers on and off and set marker frequencies, times, or distances.

READOUT MARKER Key: Pressing this key calls different menus, depending upon front panel key selections, as described below.

It calls menu M3 (1) if the Δ Reference mode is off and there is no selected marker, or (2) if the selected marker is not in the sweep range. It also calls menu M3 (1) if the Δ Reference mode is on and the Δ Reference marker is not in the sweep range, or (2) if no Delta ref marker has been selected.

It calls menu M4 if the ΔReference mode is off and the selected marker is in the current sweep range (or time/distance).

It calls menu M5 if the ΔReference mode and marker are both on and and the ΔReference marker is in the selected sweep range (or time/distance).

MENU LFX

READOUT LIMIT FREQUENCIES

–LOG MAG–

LIMIT 1 (REF)
x.xxx dB

LIMIT 2
x.xxx dB

LIMIT Δ(1/2)
x.xxx dB

FREQUENCIES
AT LIMIT 2

2.9843 GHz
5.7210 GHz
7.4412 GHz
9.8764 GHz
10.3901GHz
15.5648 GHz

Limit Frequency Readout Function The 360B has a Limit-Frequency Readout function. This function allows dB values to be read at a specified point (such as the 3 dB point) on the data trace. This function is only available for certain rectilinear graph-types. A typical menu is shown at left.

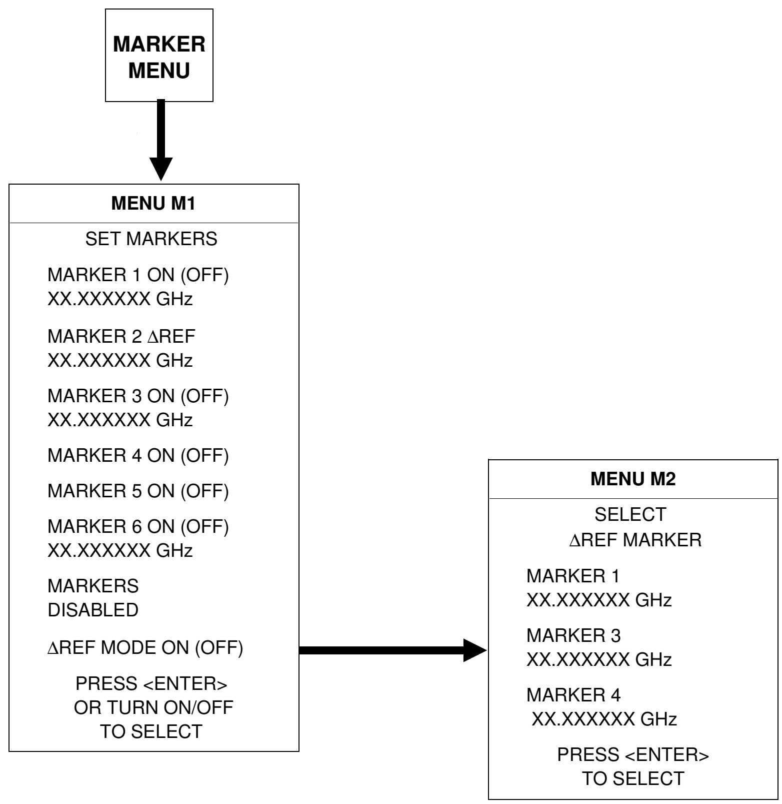
The graph-type and their menu call letters are listed below

- ☐ Log Magnitude, Menu LF1
- ☐ Phase, Menu LF2
- ☐ Group Delay, Menu LF3
- ☐ Linear Magnitude, Menu LF4
- ☐ SWR, Menu LF5

Full menu descriptions can be found in the alphabetical listing (Appendix 1) under the menu call letters (LF1, LF2, LF3, etc.)

LIMITS Key Pressing this key calls the appropriate Limit menu.

MARKER MENU Key Menu Flow



5-12 DISK STORAGE INTERFACE

The 360B has an integrally mounted disk drive of the 3.5 inch removable media type. The format, files, and directory are compatible with PC(MS)-DOS, Version 3.3.

Disk Format Disks are MS-DOS compatible. They may be 720 KByte (recommended) or 1.44 MByte (optional) capacity.

Disk Files You may find any of the following file-types on the 360B disk.

- **Program Files.** These are binary files used to load the operating program. Application-type programs cannot read them.
- **Calibration Data Files:** These are binary files used to store and retrieve calibration and other data. Application-type programs cannot read them. File size depends on calibration type. For example, 61 KBytes for 12 term and 501 points.
- **Tabular Measurement Data Files.** These are ASCII files used to store actual measurement data. They can be read by application-type programs. File size depends on selected options. For example, 25.6 KBytes for 501 points and 1 S-Parameter.
- **Trace Memory Files.** These are data stored in a display, rather than in a floating-point format. Application-type programs cannot read them. You use them to perform trace math operations on data. File size is 4 KBytes.

Disk User Interface A high density disk is capable of holding up to 1.44 Mbytes of data. Using the data size assumptions above, a disk would be capable of holding any of the following:

- 23.6-Plus Calibration and Front Panel Setups
- 360 Sets of Normalization Data
- 56-Plus Sets of Measurement Data

You can also store a downloaded operating program on the disk. However, this reduces the number of the above items that you could store. The disk format imposes a limitation of 112 (720 kByte disk) or 224 (1.44 MByte disk) on the total number of data items. This means the full 360 sets of normalization data could not be stored on the disk.

Backing Up the 360B System Diskette

Although two copies of the 360B system diskette are provided with each system, you may wish to make additional back-up copies. Do this using the "INITIALIZE DISK WITH PROGRAM" selection from the "Disk Utility Functions" menu.

This selection formats a target disk and overwrites any existing information it contains. It then transfers both the operating program and system files needed to make a bootable system disk.

Do not use the "COPY DATA DISK TO DISK" selection to create a system back-up diskette. This selection only copies files from the source to the target diskette. It does not format or transfer operating system files required to have a bootable system disk.

Formatting a Data File Disk

You may format additional diskettes to hold calibration, tabular measurement, and trace-memory data files. Do this using the "INITIALIZE DATA - ONLY DISK" selection on the "Disk Utility Functions" menu. Using this selection will format the target disk and overwrite any existing data it contains. This selection will not copy any data or operating system files; therefore, the resultant diskette will not be a bootable system diskette.

Copying Data Files From Disk to Disk

Use the "COPY DATA DISK TO DISK" selection on the "Disk Utility Functions" menu to copy data files from one diskette to another. This selection copies only data; it does not copy operating system files and will not overwrite existing data on the target diskette.

NOTE

For best disk performance and reliability, the target-data-files diskette should always be formatted in the 360B internal disk drive.

Recovering From Disk Write/Read Errors

If you experience a read or write error during a disk operation, you should:

- ☐ Verify that the diskette has been properly initialized as a system or data disk in the 360B (described above).
- ☐ Verify that the write-protect tab on the disk is not engaged.
- ☐ Retry the disk operation.

Repeated disk errors may indicate a defective diskette and/or initialization. Retry the operation on another diskette (720KB recommended).

Chapter 6
Error and Status Messages

Table of Contents

Chapter 6
Error and Status Messages

6-1 INTRODUCTION

This chapter lists and describes the various error and status messages that you may encounter while operating the network analyzer.

6-2 MESSAGE TYPES

The basic types of messages are categorized by the first digit of their code number, as follows:

009-099		Power Up Self Diagnostic
	000-019	Main Processor #2
	020-039	Main Processor #1
	040-049	I/O Processor
	050-099	Analog Hardware
100-199		System Status
	100-109	Program Load
	110-129	Program Initialization
	130-149	Disk Related
	150-169	Peripheral Related
200-299		Front Panel Operations
300-399		Measurement Related
400-499		GPIB

6-3 FATAL ERRORS

Some errors are "fatal" in that they cause the instrument to terminate operations until you correct the condition causing the error. These errors are listed with an "X" in the column marked "Fatal" in the following tables.

6-4 MESSAGE DEFINITIONS

The following pages provide a listing of error message definitions.

Self Test, Main Microprocessor #2

The following error codes and/or messages report on main microprocessor number 2

Code	Message Text	Fatal	Meaning
000	FIFO RESET FAILURE	X	FIFO failed to reset, PCB A12
002	PROM CHECKSUM FAILURE #2	X	PROM failure, PCB A12
003	BATTERY BACKED RAM FAILURE	X	Non volatile RAM failure, PCB A12
004	EXTENDED MEMORY FAILURE	X	Failure in the extended memory, PCB A12
005	DYNAMIC RAM FAILURE #2	X	Dynamic RAM failure, PCB A12
006	TIMER FAILURE #2	X	Programmable timer failure, PCB A12
007	INTERRUPT CONTROLLER FAILURE #2	X	Interrupt controller failure, PCB A12
008	NUMERIC PROCESSOR FAILURE #2	X	8087 math coprocessor failure, PCB A12
009	FRONT PANEL INTERFACE FAILURE	X	Interface failure, front panel, PCB A12
010	PRINTER INTERFACE FAILURE	X	Printer or interface PCB A12

Self Test, Main Microprocessor #1

The following error codes and/or messages report on main microprocessor number 1

Code	Message Text	Fatal	Meaning
020	FIFO TO #2 FAILED RESET	X	Interface failure with FIFO, PCB A12
022	FIFO TO I/O FAILED RESET	X	Interface failure with FIFO, PCB A13
023	PROM CHECKSUM FAILURE #1	X	Checksum error PROM, PCB A13
024	DYNAMIC RAM FAILURE #1	X	Dynamic RAM failure, PCB A13
025	TIMER FAILURE #1	X	Programmable timer failure, PCB A13
026	INTERRUPT CONTROLLER FAILURE #1	X	Interrupt controller failure, PCB A13
027	DISK DRIVE CONTROLLER FAILURE	X	Disk drive controller failure, PCB A13
028	DISK DRIVE FAILURE	X	Disk drive SEEK failure, PCB A13
029	NUMERIC PROCESSOR FAILURE #1	X	8087 math coprocessor failure, PCB A13
031	DISK DRIVE NOT READY FOR TEST	X	Diskette is not in disk drive

Self Test, I/O Processor and Analog Hardware

The following error codes and/or messages report on the input/output processor and analog hardware errors.

Code	Message Text	Fatal	Meaning
040	PROM CHECKSUM FAILURE I/O	X	PROM failure, PCB A11
041	RAM FAILURE I/O	X	RAM failure, PCB A11
042	TIMER\INTERRUPT LOOPBACK FAILURE	X	Programmable timer failure, PCB A11
043	GPIB INTERFACE FAILURE I/O		GPIB failure PCB A11
044	FIFO FAILURE I/O	X	FIFO failure, PCB A11
050	A1 COMMUNICATIONS FAILURE		LO 1 Phase Lock PCB error
051	A2 COMMUNICATIONS FAILURE		LO 2 Phase Lock PCB failure
052	A3 COMMUNICATIONS FAILURE		Cal/Third Local Oscillator PCB failure
053	A4 COMMUNICATIONS FAILURE		Analog to Digital PCB failure
054	A5 COMMUNICATIONS FAILURE		10 MHz Reference PCB failure
055	A6 COMMUNICATIONS FAILURE		Source lock PCB failure
056	A10 COMMUNICATIONS FAILURE		Power supply/ IF sync PCB
057	8 BIT A/D CONVERTER FAILURE		Failure A/D PCB A4
058	STEERING DAC FAILURE		Failure A/D PCB A4
059	12 BIT A/D OR STEERING DAC FAILURE		Failure A/D PCB A4
060	TEST SET NOT CONNECTED OR NOT WORKING		General failure of test set
061	TEST SET CHAN A CAL PHASING FAILURE		Test set CHAN A failure

Self Test, I/O Processor
(Continued)

Code	Message Text	Meaning
062	TEST SET CHAN A CAL LEVEL FAILURE	Test set Channel A failure
063	TEST SET CHAN A GAIN FAILURE	Test set Channel A failure
064	TEST SET CHAN A PHASE RANGING FAILURE	Test set Channel A failure
065	TEST SET CHAN B CAL PHASING FAILURE	Test set Channel B failure
067	TEST SET CHAN B GAIN FAILURE	Test set Channel B failure
068	TEST SET CHAN B PHASE RANGING FAILURE	Test set Channel B failure
069	TEST SET REF CHAN CAL PHASING FAILURE	Test set Reference Channel failure
070	TEST SET REF CHAN CAL LEVEL FAILURE	Test set Reference Channel failure
071	TEST SET REF CHAN GAIN FAILURE	Test set Reference Channel failure
072	TEST SET REF CHAN PHASE RANGING FAILURE	Test set Reference Channel failure

System Status, Program Load

The following error codes and/or messages report loading the program

Code	Message Text	Fatal	Meaning
100	DISK DRIVE NOT READY	X	Program failed to load from(disk not installed)
102	PROGRAM FILE MISSING		Loader could not find system files
103	DISK ERROR		The 360B is unable to read the disk
104	UNKNOWN DISK ERROR		Loader failed a consistency check
105	PROGRAM DATA ERROR ON #2		Program for processor #2 failed to load

Program Initialization

The following error codes and/or messages report program initialization.

Code	Message Text	Fatal	Meaning
110	SRC ID FAILURE		No sweeper (Source) ID on GPIB; sweeper may not be connected
111	SWPR SELF TEST FAILURE	X	RF source failed power on self test program
112	NO TEST SET	X	Test set not connected. Reconnect and cycle power to clear

Program Initialization, Disk Related

The following error codes and/or messages report on disk related problems that occur during system initialization.

Code	Message Text	Meaning
131	DISK READ ERROR	Hard error reading from disk
132	DISK WRITE ERROR	Hard error writing to disk
133	FILE DELETION ERROR	Write protect tab is in “read only” position
134	DISK NOT READY	Disk is not in unit or not formatted
135	DISK WRITE PROTECTED	Write protect tab is in “read only” position
136	OUT OF DISK SPACE	Disk file space full
137	FILE IS INCOMPATIBLE	File is not a 360 data or program file
138	NO SPACE FOR NEW DATA FILE	Disk file space is full
139	FILE MARKED READ ONLY	Read-only attribute is set on
140	NO FILES REMAIN TO OVERWRITE	All of the files of the type have been deleted
141	NO FILES REMAIN TO DELETE	All of the files of the type have been deleted

Program Initialization, Peripheral

The following error codes and/or messages report on system peripherals.

Code	Message Text	Meaning
170	PRINTER NOT READY	Printer is off line or not connected
171	PLOTTER NOT READY	Plotter is off line or not connected

Control Panel

The following error codes and/or messages report on the control panel.

Code	Message Text	Meaning
200	OUT OF CAL RANGE	Calibration range does not include selected frequency
202	STANDARD CAL NOT VALID FOR WAVEGUIDE	Standard OSL calibration cannot be done with waveguide
203	PORT 2 MODULE INCOMPATIBLE	12-term calibration is not possible with Port 2 Model 364X millimeter head that is not reversing
204	SOURCE 1 INCOMPATIBLE	Source does not support flat port power. Need 360B compatibility
205	WARNING: A21 BOARD FAILURE	Failure detected on A21 DSP PCB (pre 360B). 8087 used instead for time domain
205	WARNING: A13 BOARD DSP FAILURE	Failure detected on A13 PCB DSP-32 chip. 8087 used instead for time domain
206	ONLY ONE VIDEO CONFIG IS ALLOWED	VNA unit does not support switching video signals (that is, non-VGA signals)
208	OUT OF RANGE	Attempted to enter an out of range parameter
209	START GREATER THAN STOP	Attempted to set a start frequency that was greater than the stop frequency
210	OUT OF RANGE, 20 PERCENT MAX	Attempted to enter a smoothing or group delay factor that was greater than 20%
211	USER PARAMETERS NOT ALLOWED WITH CAL APPLIED	User-defined parameters are not allowed with calibration applied. Use S-Parameters or disable correction.
212	TEST SET INCOMPATIBLE	Test Set does not support or allow requested feature (that is, LRL, bias, mm wave, and multiple source control)
213	OUT OF H/W RANGE	Attempted to enter a frequency that is outside of the system hardware design
214	DIFFERENT H/W SETUP. RECALL ABORTED	Source or Test Set is different from the recalled setup
215	TOO CLOSE TO BOUNDARY	Time domain start frequency is too close to stop frequency

Control Panel *(Continued)*

Code	Message Text	Meaning
216	TOO MANY POINTS, 501 MAXIMUM	Attempted to set too many discrete frequency points
217	TOO FEW POINTS, 2 MINIMUM	Attempted to set too few discrete frequency points
218	STEP IS TOO LARGE	Harmonic calibration step size is too large for range of system
219	DISCRETE FREQS LOST	Setup changed in N-discrete frequency mode
220	OUT OF SWEEP RANGE	Input frequency is outside of set frequency range
221	OPTION NOT INSTALLED	Selected option is not installed
222	MEAS DATA NOT AVAILABLE FOR STORAGE	No measured data on channel to be stored
223	NO STORED MEMORY DATA	No data available in memory for channel
224	SYSTEM BUS ADDRESSES MUST BE UNIQUE	Attempted to set GPIB addresses to same value
225	SYSTEM UNCALIBRATED	No calibration exists
226	MEMORY LOCATION CORRUPTED	Saved state data is invalid
227	DIFFERENT S/W VERSION, RECALL ABORTED	Saved state not compatible with hardware or software version
228	WINDOW TOO SMALL	Attempted to set start greater than or equal to stop
229	OUT OF WINDOW RANGE	Attempted to set marker outside start to stop range
230	ATTENUATOR UNAVAILABLE	Selected attenuators not available in test set
231	START MUST BE LESS THAN STOP	Tried to set start frequency equal to or higher than stop frequency in marker sweep
232	ILLEGAL IN C.W. MODE	Attempted to readout limit frequency

Control Panel ***(Continued)***

Code	Message Text	Meaning
233	ILLEGAL IN TIME DOMAIN	Attempted to readout limit frequency
234	BOTH LIMITS MUST BE ON	Attempted to readout limit frequency
235	STOP IS OVER RANGE	Discrete fill parameters cause stop to go over hardware range
236	OUT OF RANGE 10% MINIMUM	Attempted to set pen speed to below 10%
238	UNDEFINED DIVIDE BY ZERO	Denominator cannot be zero in equation.
240	SWEEPER MUST BE SOURCE 1	For multiple source mode, in systems with a 360SSXX or 66XXB, sweep generator must be Source 1. Change addresses.
241	SOURCE 1 DOES NOT EXIST	VNA does not detect presence of Source 1. (1) Turn on VNA. (2) Check address. (3) Press DEFAULT PROGRAM key to identify; ensure that Source 1 is turned on.
242	WARNING: SOURCE 2 DOES NOT EXIST	VNA does not detect presence of Source 2. (1) Turn on VNA. (2) Check address. (3) Press DEFAULT PROGRAM key to identify; ensure that Source 2 is turned on.
243	MULTIPLEXER DOES NOT EXIST	VNA does not detect presence of 360TSM Multiplexer. Press DEFAULT PROGRAM key to identify; ensure that Multiplexer is turned on.
245	NO BANDS ARE STORED	Need to define and store frequency bands to turn on Multiple Source mode
246	FREQUENCIES HAVE REACHED UPPER LIMIT	Frequencies being defined in Multiple Source mode have reached upper limits of Sources and Test Set
247	BANDS MUST SEQUENCE	Frequency bands in Multiple Source mode must sequence in a 1-2-3-4-5 order; no skipping allowed

Control Panel ***(Continued)***

Code	Message Text	Meaning
248	START F FOLLOWS PREVIOUS STOP F	Start frequency of current band immediately follows stop frequency of previous band. Cannot be modified
250	SOURCE 1 OUT OF RANGE BY EQUATION	Equation defined in Multiple Source mode places Source 1 frequency out of range when attempting to store band
251	SOURCE 2 OUT OF RANGE BY EQUATION	Equation defined in Multiple Source mode places Source 2 frequency out of range when attempting to store band
253	RECEIVER OUT OF RANGE BY EQUATION	Equation defined in Multiple Source mode places receiver frequency out of range when attempting to store band
255	WARNING: NO GPIB CONTROL OF SOURCE SWEEP	Neither Source power nor flat-port power can be modified when receiver mode is user-defined with NO Source GPIB control
256	WARNING: SET ON RECEIVER MODE	Phase-lock setting is undefined when VNA in Set-On Receiver mode
271	PRINTER NOT READY	Printer not connected or paper out
272	TOO MUCH PRINT DATA	Print buffer is full. Reduce number of channels or data points.
273	PLOTTER NOT READY	Plotter not connected
274	PARAMETERS INVALID	User-defined parameters cannot turn the correction on
275	CALIBRATION MAY BE INVALID	Calibration applied may be invalid if Source power or flat- power attenuators differ from that used in the calibration
276	FLATNESS CAL MAY BE INVALID	Flat calibration applied may be invalid if Source power attenuators differ from that used in the calibration
277	FREQS DIFFER FROM THOSE USED IN CAL	Frequencies have changed from those used in the flat power calibration; flat power turned off.
280	CAL INVALID	Calibration is incorrect for S-Parameter displayed
281	TIME DOMAIN INVALID	Time domain cannot be used in current setup

Control Panel *(Continued)*

Code	Message Text	Meaning
282	GROUP DELAY INVALID	Group delay cannot be used in current setup
283	GATE MUST BE ON	Attempted to select Frequency With Time Gate off.
284	SMOOTHING INVALID	Attempted to use smoothing while in C.W. mode
285	MEMORY DATA INVALID	Setup has changed since data was stored
286	NEED HARMONIC SWEEP	Time domain channel LP needs harmonic frequencies
287	NON-LOCKED REF N/A	Test Set does not support measuring the non-locked reference for user-defined parameters (no LRL box)
288	PARAMETER INVALID	(Transmission measurement only) Millimeter Wave head (3641) does not lock for channels parameter

Measurement Related

The following error codes or messages report on measurement errors or anomalies.

Code	Message Text	Meaning
300	LOW IF	Insufficient signal level is detected
301	LOCK FAILURE	RF source failed to lock to reference oscillator in 360B Test Set. **NOTE** If flat-port power is being applied, any lock failure may indicate that the source ALC cannot handle the broadband range. Increase the source level or use a narrower frequency range.
302	A/D FAILURE	Analog-to-digital converter not functioning in 360B mainframe
303	RF OVERLOAD	Test signal level is too high; reduce source level or add attenuation
304	TRIGGER MISSED	Trigger not detected for measurement
310	LOW SOURCE POWER	Power level of RF source is set too low: increase the source level
314	DATA DRAWING OFF	Data drawing option is turned off
316	MULT SRC IN STANDBY	Multiple Source mode is in standby while bands are being defined. Complete definitions then turn Multiple Source mode on, or turn Multiple Source mode off

GPIB Related

The following error codes or messages report on GPIB-related errors.

Code	Message Text	Meaning
400	GPIB ERROR	GPIB error on Source Control System bus
401	GPIB INIT FAILURE	GPIB initialization on Source Control System bus

Chapter 7
Data Displays

Table of Contents

Chapter 7
Data Displays

7-1 INTRODUCTION

This chapter provides discussion and examples of the various types of data displays.

7-2 DISPLAY MODES AND TYPES

The 360B displays measurement data using a "Channel Concept". This means that each channel can display both a different S-Parameter and a different graph type for each. As you select each channel the graph type, scaling, reference delay, S-Parameter, etc. associated with that channel appear on the screen. You can display the same S-Parameter on two or more channels.

Several graph-types are possible: polar, rectilinear, or Smith chart. The rectilinear graph-type may be magnitude, phase, magnitude and phase, SWR, group delay, real, imaginary, and real and imaginary. The Smith chart graph-type is specifically designed to plot complex impedances.

Single Channel Display— Ch 1, 2, 3, 4 You select this display type (Figures 7-1 and 7-2) by choosing "Single Display" on Menu CM (Appendix 1). Possible graph types are single, Smith, polar, rectilinear, or dual rectilinear (magnitude and phase).

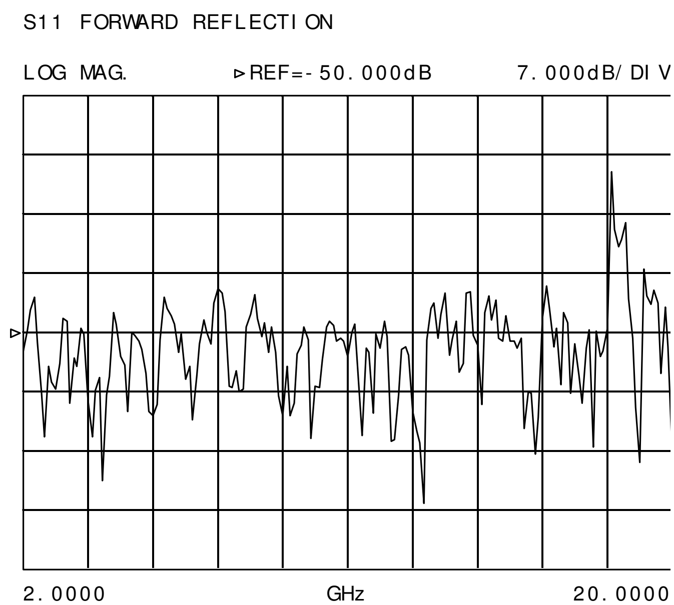


Figure 7-1. *Single Channel Display, Log Magnitude*

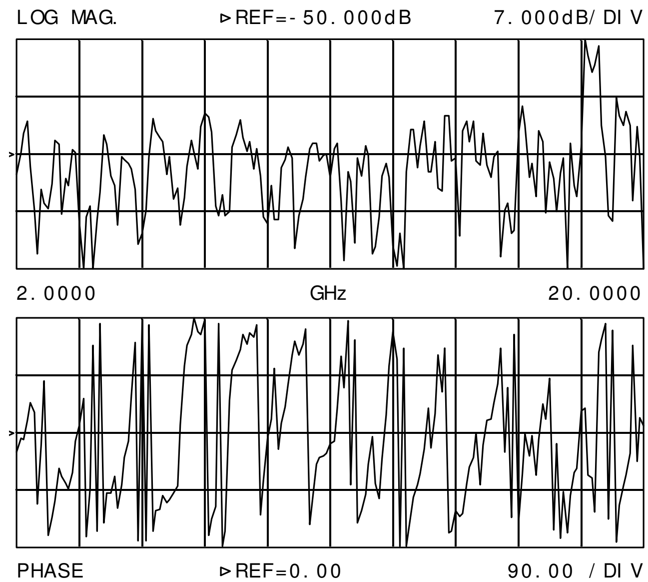


Figure 7-2. *Single Channel Display, Magnitude and Phase*

Dual Channel Display— Ch 1 and 3 or Ch 2 and 4

If you have chosen to display magnitude and phase, the affected area of the CRT screen is subdivided into two smaller portions (Figure 7-3). You select this display type by choosing "Dual Display" in Menu CM (Appendix 1).

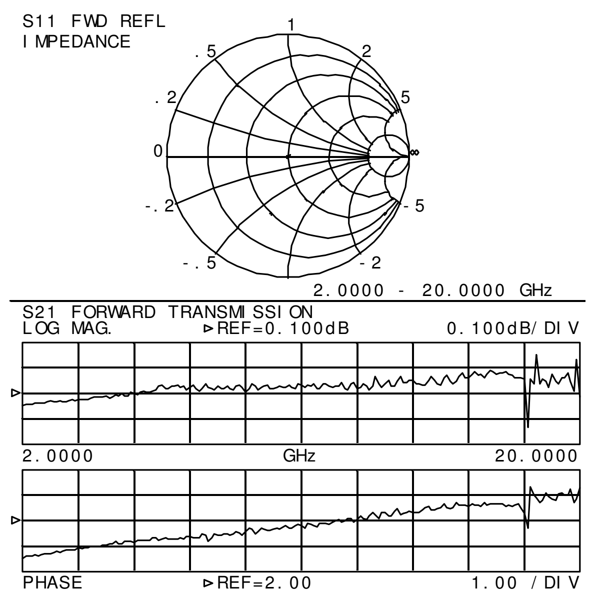


Figure 7-3. *Dual Channel Display*

Four Channel Display— Ch 1, 2, 3, 4

From four-to-eight graph types are displayed. In each quadrant, the graph type can be any of the possible choices listed in the GT menu (Appendix 1). If you have chosen to display magnitude and phase or a channel, the quadrant displaying that channel is further subdivided as described above. You select this display type by choosing “All Four Channels” in Menu CM. An example of a four-channel display appears in Figure 7-4, below.

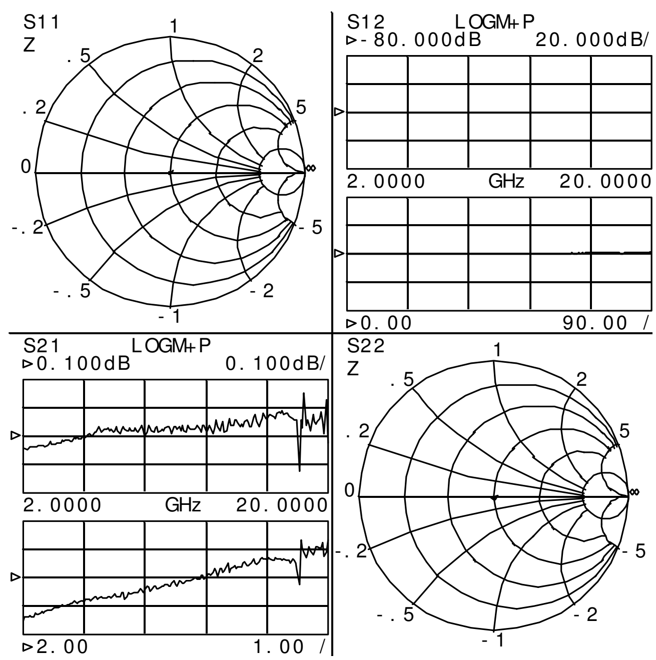


Figure 7-4. *Four Channel Display*

Dual Trace Overlay Two traces are displayed, one overlaid (superimposed) on the other (Figure 7-5). By menu selection, the two traces can be Channels 1 overlaid on Channel 3 or Channel 2 overlaid on Channel 4. Each trace is in a different color. Channels 1 and 2 are displayed in red, while Channels 3 and 4 are displayed in yellow.

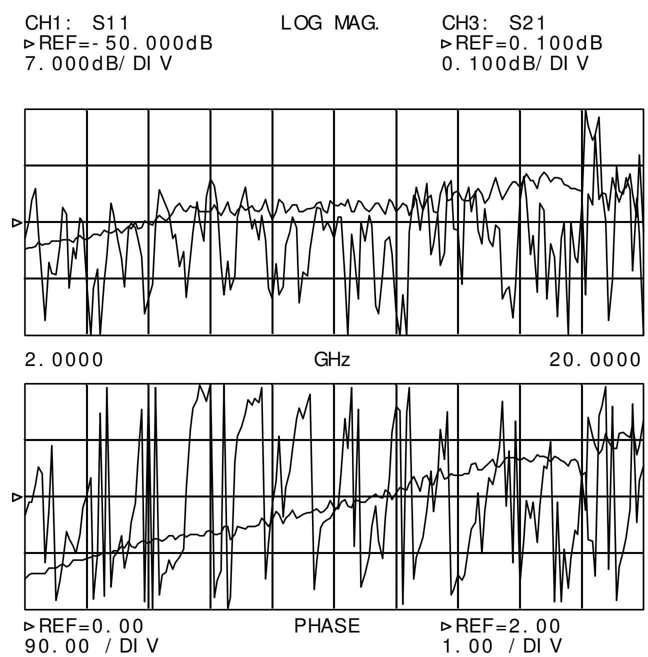


Figure 7-5. *Dual Trace Overlay*

Graph Data Types

The data types (real, imaginary, magnitude, phase) used in the displayed graph-types reflect the possible ways in which S-Parameter data can be represented in polar, Smith, or rectilinear graphs. For example: Complex data—that is, data in which both phase and magnitude are graphed—may be represented and displayed in any of the ways described below:

- Complex Impedance; displayed on a Smith chart graph.
- Real and imaginary; displayed on a real and imaginary graph.
- Phase and magnitude components; displayed on a rectilinear (Cartesian) or polar graph.
- In addition to the above, the 360B can display the data as a group delay plot. In this graph-type, the group-delay measurement units are time. Those of the associated aperture are frequency and SWR.

The quantity group delay is displayed using a modified rectilinear-magnitude format. In this format the vertical scale is in linear units of time (ps-ns-µs). With one exception, the reference value and reference line functions operate the same as they do with a normal magnitude display. The exception is that they appear in units of time instead of magnitude.

Examples of graph-data types are shown in Figure 7-6 through 7-11, on the following pages.

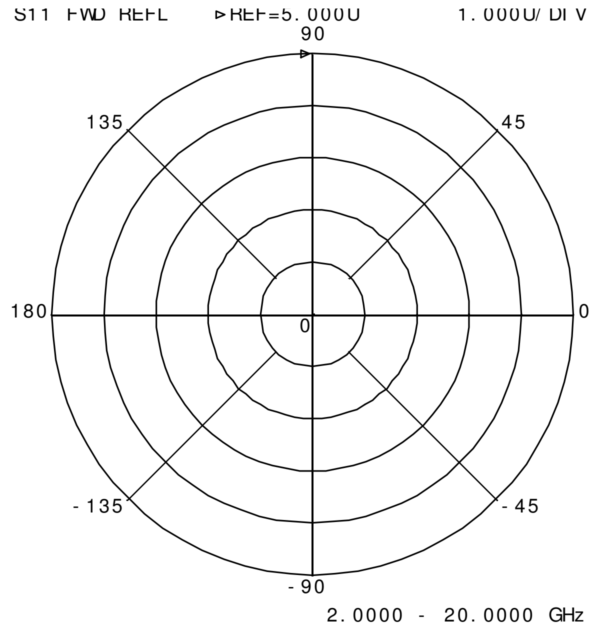


Figure 7-6. *Linear Polar Graticule*

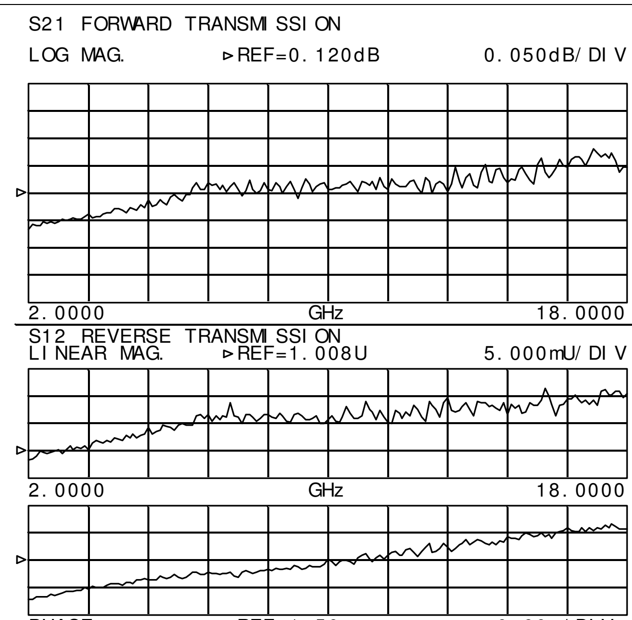


Figure 7-7. *Dual Channel Rectilinear Gratiule*

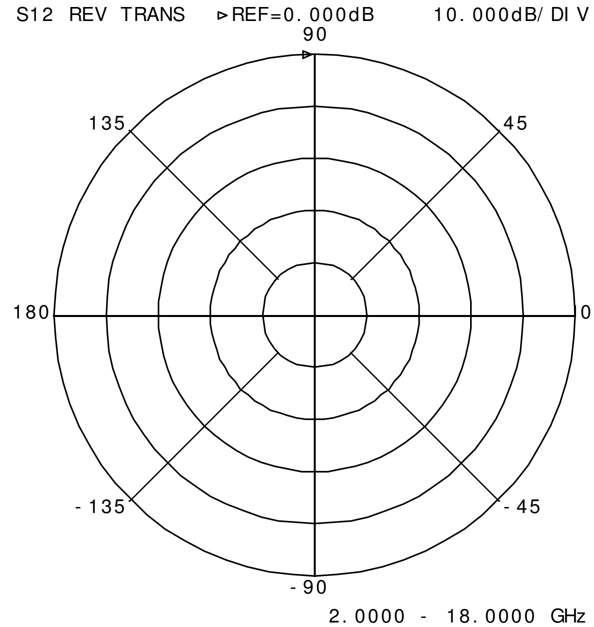


Figure 7-8. *Log Polar Graticule*

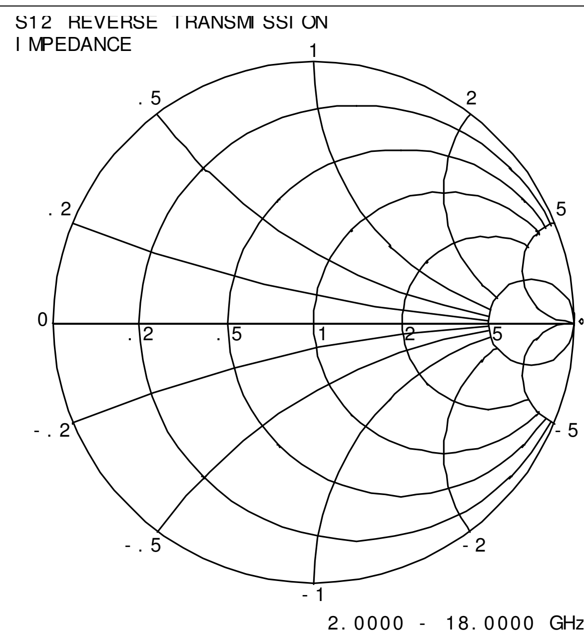


Figure 7-9. *Normal Smith Chart*

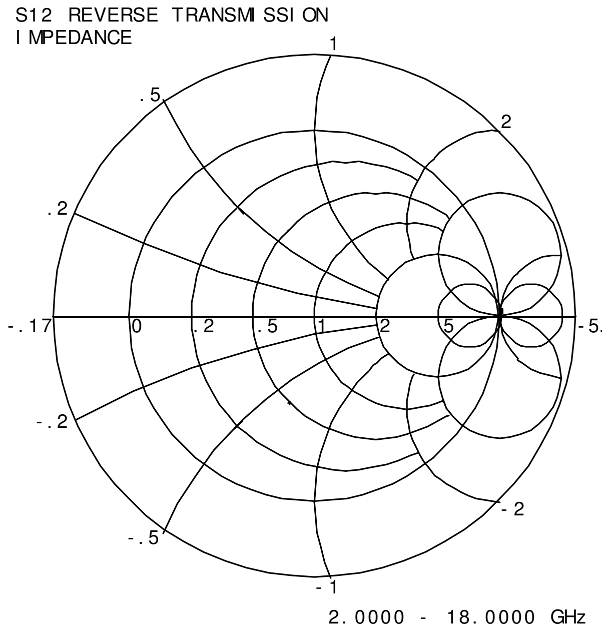


Figure 7-10. 3 dB Compressed Smith Chart

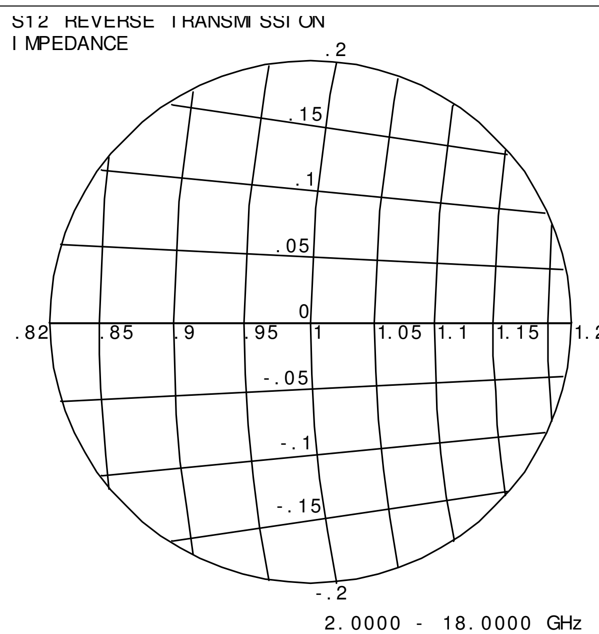
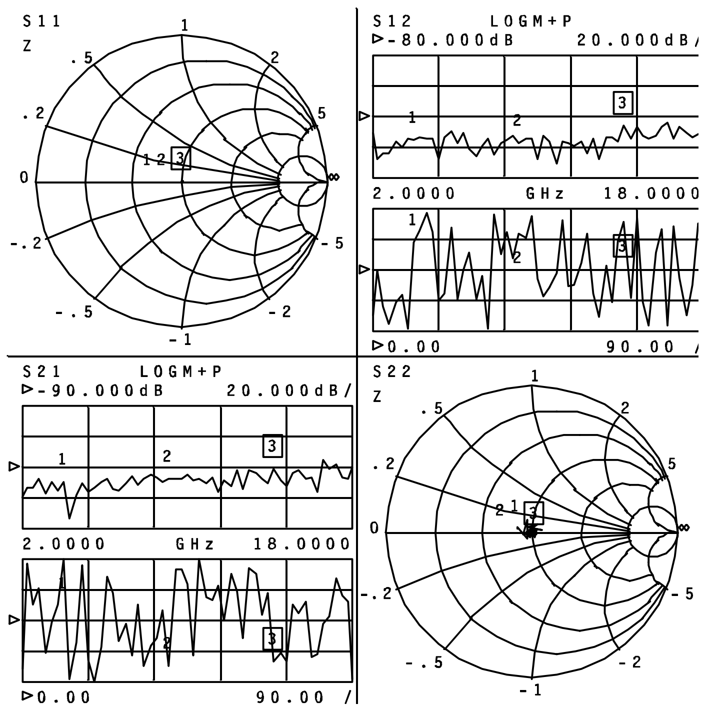


Figure 7-11. 20 dB Expanded Smith Chart

7-3 FREQUENCY MARKERS

Marker Annotation

The example below shows how the 360B annotates markers for the different graph-types. Each marker is identified with its own number. When a marker reaches the top of its graticule, it will flip over and its number will appear below the symbol. When markers approach the same frequency, they will overlap. Their number will appear as close to the marker as possible without overlapping.



Marker Annotation

Marker Designation

Depending on menu selection, you may designate a marker as the "active" or the "delta reference" marker. If you choose a marker to be active—indicated by its number being enclosed in a square box—you may change its frequency or time (distance) with the Data Entry keypad or knob. If you have chosen it to be the delta-reference marker, a delta symbol (Δ) appears on character space above the marker number (or one character space below a "flipped" marker). If the marker is both active and the delta reference marker, the number and the delta symbol appear above (below) the marker. The delta symbol appears above (below) the number.

7-4 LIMITS

Limit lines function as settable maximum and minimum indicators for the value of displayed data. These line are settable in the basic units of the measurement on a channel-by-channel basis. If the display is rescaled the limit line(s) will move automatically and thereby maintain their correct value(s).

Each channel has two limit lines (four for dual displays), each of which may take on any value. Limit lines are either horizontal lines in rectilinear displays or concentric circles around the origin in Smith and polar displays.

7-5 STATUS DISPLAY

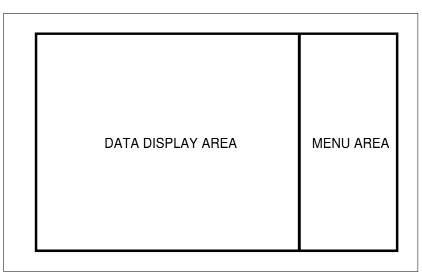
In addition to the graticules, data, markers, and marker annotation, the 360B displays certain instrument status information in the data display area. This information is described below.

Reference Position Marker The Reference Position Marker indicates the location of the reference value. It is displayed at the left edge of each rectilinear graph-type. It consists of a green triangular symbol similar to the cursor displayed in the menu area. You can center this symbol on one of the vertical graticule divisions and move it up or down using the “Reference Position” option. When you do this, the data trace moves accordingly. If you also select the reference value option, the marker will remain stationary and the trace will move with the maximum allowable resolution. When changing from a full-screen display to half- or quarter-screen display, the marker will stay as close to the same position as possible.

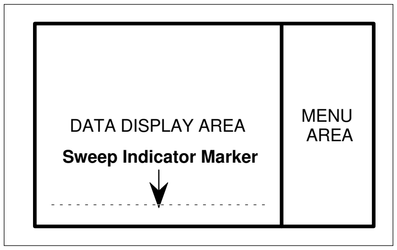
Scale Resolution Each measurement display is annotated with the scale resolution. For log-magnitude displays resolution ranges from 0.001 to 50 dB per division. Linear displays of magnitude range from 0.001 to 50 units per division. Cartesian phase displays can range from 0.01 to 90 degrees per division. The polar display is 45 degrees per display graticule.

Frequency Range Each measurement display is annotated with the frequency range of the measurement.

Analog Instrument Status The 360B displays analog-instrument-status messages (in red when appropriate) in the upper right corner of the data-display area (left). They appear at the same vertical position as line 2 of the menu area. If more than one message appears, they stack up below that line.



Display screen showing the data display and menu areas



Display screen showing the sweep indicator marker

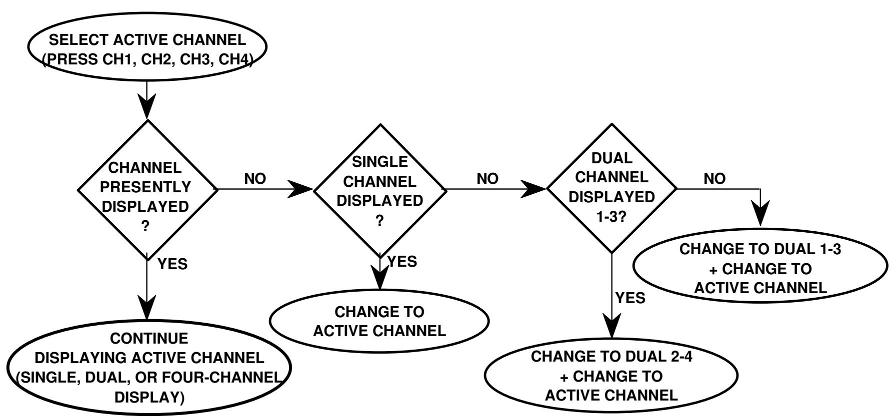
Measurement Status The 360B displays measurement-status messages (in red when appropriate) in the upper-right corner of the graticule (channel) to which they apply.

Sweep Indicator Marker The sweep indicator marker (left) indicates the progress of the current sweep. When measuring quiet data—that is, data having few or no perturbations—this indicator assures that the instrument is indeed sweeping.

The indicator—a blue horizontal line segment 15 pixels long by 1 pixel high—appears along the bottom edge of the data display area. Its position is proportional to the number of data points measured in the current sweep. When this sweep completes, the line segment will have traveled the full width of the data display area. If the sweep should stop for some reason, the position of the indicator will stop changing until the sweep resumes.

7-6 DATA DISPLAY CONTROL

Active Channel Selection The following figure shows the algorithm that the 360B uses to display the active channel.



Active Channel Algorithm

S-Parameter Selection

If you select a new S-Parameter using Menu SP (Appendix 1), it appears on the then-active channel in the same graph-type in which it was last displayed. The following table shows the displayable S-Parameters based on the correction type you have in place. If you attempt to display other S-Parameters, an error message displays. In cases when there is no last-displayed S-Parameter stored, the display will default as shown. If an S-Parameter is selected for which there was no last-displayed graph-type, the display defaults to S_{21}, S_{12} Log Magnitude and Phase and S_{11}, S_{22} Smith.

Correction Type	Displayable S-Parameters	Default Display Position			
		CH1	CH2	CH3	CH4
None	All	S_{11}	S_{12}	S_{21}	S_{22}
Frequency Response					
Transmission	S_{21}	S_{21}	S_{21}	S_{21}	S_{21}
Reflection	S_{11}	S_{11}	S_{11}	S_{11}	S_{11}
Both	S_{11}, S_{21}	S_{11}	S_{11}	S_{21}	S_{21}
Reflection Only	S_{11}	S_{11}	S11	S_{11}	S_{11}
1-Path 2-Port	S_{11}, S_{21}	S_{11}	S_{11}	S_{21}	S_{21}
12-Term	All	S_{11}	S_{12}	S_{21}	S_{22}

Data Display Update

When you change a control panel parameter that affects the appearance of the display, the entire display changes immediately to reflect that change. For example, if you press AUTOSCALE, the entire display rescales immediately. You do not have to wait for the next sweep to see the results of the change. The following parameters are supported for this feature: Reference Delay, Offset, Scaling, Auto Scale, Auto Reference Delay, Trace Math, IF BW, and Smoothing. In the case of Averaging, the sweep restarts.

If the knob is used to vary any of the above parameters, the change occurs as the measurement progresses–that is, the continuing trace will reflect the new setting(s).

When you change a marker frequency or time (distance), the readout parameters will change. This change reflects the changes in measurement data at the marker's new frequency, using data stored from the previous sweep.

Display of Markers Once you have selected a marker to display, it will appear on the screen. It does not matter what resolution you have selected. When you set a marker to another calibrated frequency and then lower the resolution, that frequency and the marker will continue to display. It will display even if its frequency is not consistent with the data points in the lower-resolution sweep.

7-7 HARD COPY AND DISK OUTPUT

In addition to the CRT display, the Model 360B is capable of outputting measured data as a

- Tabular Printout
- Screen-Image Printout
- Pen Plot,
- Disk Image Of The Tabular Data Values

The selection and initiation of this output is controlled by the OUTPUT keys.

Tabular Printout Examples of the printout formats are shown on pages 7-18 and 7-19. These formats are used as follows:

- *Tabular Printout Format:* Used when printing three or four channels.
- *Alternate Data Format:* Used when printing one or two channels.

In tabular printouts, the 360B shifts the data columns to the left when an S-Parameter is omitted. Leading zeroes are always suppressed. The heading (Model, Device I/O, Date, Operator, Page) appears on each page. When using the 360SS sweeper, frequencies are in the format "XX.XXXX". When using the ANRITSU Model 2225C Ink Jet printer, place all of the rear panel MODE SELECT switches in the down (OFF) POSITION.

Screen-Image Printout

In a Screen-Image Printout, the exact data displayed on the screen is dumped to the printer. The dump is in the graphics mode, on a pixel-by-pixel basis. A header (page 7-17) prints before the screen data prints.

Plotter Output

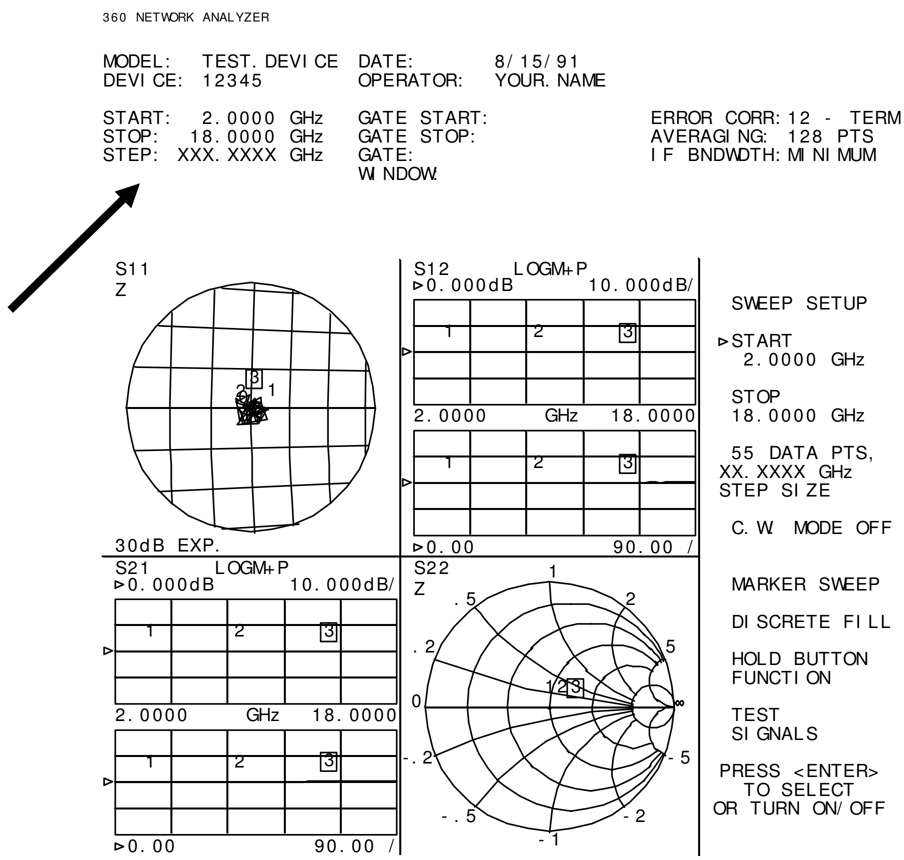
The protocol used to control plotters is “HP-GL (Hewlett-Packard Graphics Language). HP-GL contains a comprehensive set of vector graphics type commands. These commands are explained in the Interfacing and Programming Manual for any current model Hewlett-Packard plotter, such as the 7470A.

When the plotter is selected as the output device, it is capable of drawing the graph shown on the screen or of drawing only the data trace(s), so that multiple traces may be drawn on a single sheet of paper (in different colors, if needed).

Disk Output

The 360B can write-to or read-from the disk all measured data. This data is stored as an ASCII file in the exact same format as that shown for the tabular printout example on page 7-18. If read back from the disk, the data is output to the printer. There, it prints as tabular data.

Screen Dump Header — Example

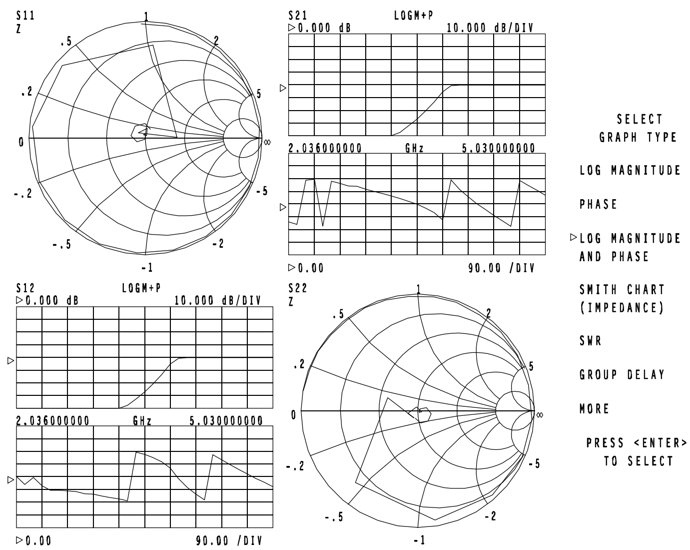


Tabular Printout — Example

```
37247A

MODEL:                        DATE:
DEVICE:                       OPERATOR:                                     I1024

START:   2.036000000          GATE START:          ERROR CORR:MINIMUM
STOP:    5.030000000          GATE STOP:           AVERAGING:     1         PTS
STEP:    0.099800000          GATE:                IF BNDWDTH:MAXIMUM
                              WINDOW:
```



Alternate-Data Tabular Printout — Example

```
37247A

MODEL:                             DATE:                                   Page   1
DEVICE ID:                         OPERATOR:


SWEEP DATA
START:       0.040000000 GHz  GATE START:      -        ERROR CORR:   COR_TWELVE_
STOP:       20.000000000 GHz  GATE STOP:       -        AVERAGING:      1 PTS
STEP:        0.099800000 GHz  GATE:            -        IF BNDWDTH:   MAXIMUM
                              WINDOW:          -
                    ------------CH1-----------
PARAMETER:                           -S11-
NORMALIZATION:                        OFF
REFERENCE PLANE:                 0.0000     mm
SMOOTHING:                       0.0 PERCENT
DELAY APERTURE:                      -

MARKERS:

MKR      FREQ            MAGNITUDE
#        GHz                dB


FREQUENCY POINTS:

PNT      FREQ            MAGNITUDE
#        GHz                dB

1       0.040000000     -54.881
2       0.139800000     -60.875
3       0.239600000     -59.163
4       0.339400000     -55.751
5       0.439200000     -53.856
6       0.539000000     -53.139
7       0.638800000     -51.019
8       0.738600000     -49.457
9       0.838400000     -48.807
10      0.938200000     -48.195

192    19.101800000     -41.057
193    19.201600000     -41.421
194    19.301400000     -42.988
195    19.401200000     -45.713
196    19.501000000     -47.747
197    19.600800000     -48.829
198    19.700600000     -49.502
199    19.800400000     -47.618
200    19.900200000     -46.288
201    20.000000000     -45.085
```

Chapter 8
Measurement Calibration

Table of Contents

Chapter 8
Measurement Calibration

8-1 INTRODUCTION

This section provides discussion and examples for performing a measurement calibration. It also provides a detailed procedure for calibrating with a sliding termination.

8-2 MEASUREMENT CALIBRATION —DISCUSSION

Measurements always include a degree of uncertainty due to imperfections in the measurement system. The measured value is always a combination of the actual value plus the systematic measurement errors. Calibration, as it applies to network analysis, characterizes the systematic measurement errors and subtracts them from the measured value to obtain the actual value.

The calibration process requires that you establish the test ports, perform the calibration, and confirm its quality. Let us examine each of these steps.

Establishing the Test Ports

The simplest approach is to use Port 1 as our test port, which is fine if it is the right connector type. We could also use Port 2 as the second port, unfortunately not many devices-under-test (DUT's) would mate. Therefore, for two port measurements we must have a cable. The end of this cable becomes Port 2 (Figure 8-1).

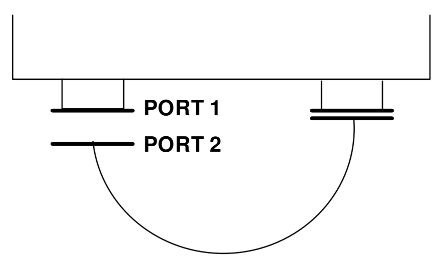


Figure 8-1. *Establishing the Test Port*

In many cases, you may need adapters to change between connector types (N, SMA, GPC-7, etc) or between genders (male [M] or female [F]). You may also need two cables (Figure 8-2).

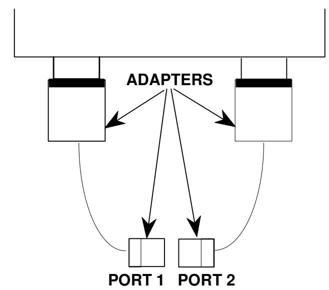


Figure 8-2. Using Adapters on the Test Port

In any case, you should include a phase-equal insertable (PEI) at both test ports. This insertable minimizes the cost of replacing worn or damaged cables and test port connectors. It also allows you to test non-insertable devices, if needed (Figure 8-3).

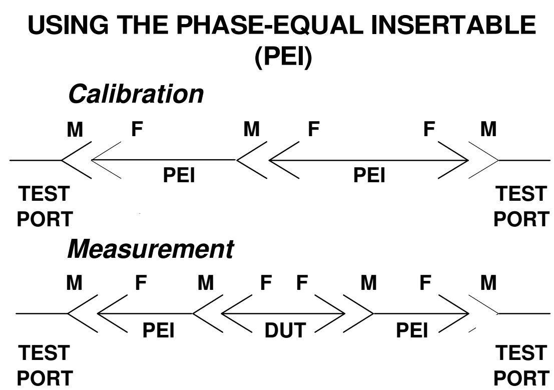


Figure 8-3. Using Phase-Equal Insertables

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In this and other discussions, we will talk about "insertable" and "non-insertable" devices. Insertable devices (insertables) have precisely the same electrical length—that is, they are phase-equal. Insertables are typically used to change a connector's gender. A non-insertable device has the same gender as the device it needs to connect to. Therefore, "non-insertables" cannot be connected directly into the measurement path without an adapter.

Understanding the Calibration System

Measurement errors must be reduced by a process that uses calibration standards. The standards most commonly used are Opens, Shorts, and Z0 (Characteristic Impedance) Loads. In conjunction with a through connection, these standards can correct for the major errors in a microwave test system. These errors are Directivity, Source Match, Load Match, Isolation, and Frequency Tracking (reflection and transmission).

Calibration also corrects for many internal system errors, such as RF leakage, IF leakage, and system component interaction.

Random errors such as noise, temperature, connector repeatability, DUT sensitive leakages, frequency repeatability, and calibration variables are not completely correctable. However, some of them can be minimized by careful control. For instance: temperature effects can be reduced by room temperature control, calibration variables can be reduced through improved technique and training, and frequency errors can be virtually eliminated by source locking.

We know that adapters and cables degrade the basic directivity of the system, but these errors are compensated by vector error correction.

In general, transmission measurement errors are source match, load match, and tracking; while reflection measurement errors are source match, directivity, and tracking.

ERRORS REDUCED BY CALIBRATION

- Directivity
- Source Match
- Load Match
- Frequency Sensitivity (Tracking)
- Internal System Errors

INTERNAL SYSTEM ERRORS

- RF Leakage
- IF Leakage
- System Interaction

RANDOM ERRORS

- Frequency
- Repeatability
- Noise
- Connector Repeatability
- Temperature/Environmental Changes
- Calibration Variables

TRANSMISSION MEASUREMENT ERRORS

- Source Match
- Load Match
- Tracking

REFLECTION MEASUREMENT ERRORS

- Source Match
- Directivity
- Tracking

CALIBRATION TYPES

- Frequency Response
- Reflection Only—1 Port
- 1 Path, 2 Port
- 12 Term—2 Port, Both Directions

Error modeling and flowgraphs are techniques used to analyze the errors in a system. Error models describe the errors, while flowgraphs show how these errors influence the system. Error models (Figure 8-4) can become quite complex. While they provide help for the circuit designer, they are of little importance to the average user.

DIRECTIVITY, SOURCE MATCH, AND TRACKING ERRORS

DISTORTED MEASUREMENT

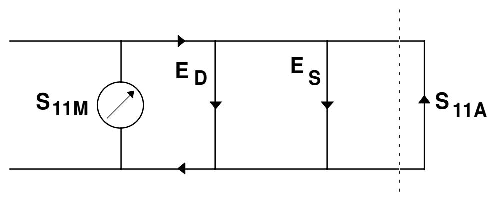


Figure 8-4. *Example of Error Modeling*

The 360B offers a selection of calibration possibilities depending on the user's needs. These possibilities are as follows:

- ☐ Frequency Response
- ☐ Reflection Only—1 Port
- ☐ 1 Path, 2 Port
- ☐ 12 Term—2 Port, Both Directions

These calibration types are described below.

Frequency Response: Corrects for one or both of the forward-direction-error terms associated with a measurement of S_{21} and S_{11}.

Reflection Only: Corrects for the three error terms associated with an S_{11} measurement (EDF, ESF, and ERF).

1 Path, 2 Port: Corrects for the four forward-direction error terms (EDF, ESF, ERF, and ETF).

Full 12 Term: Corrects for all twelve error terms associated with a two-port measurement. A 12-Term error model is shown in Figure 8-5.

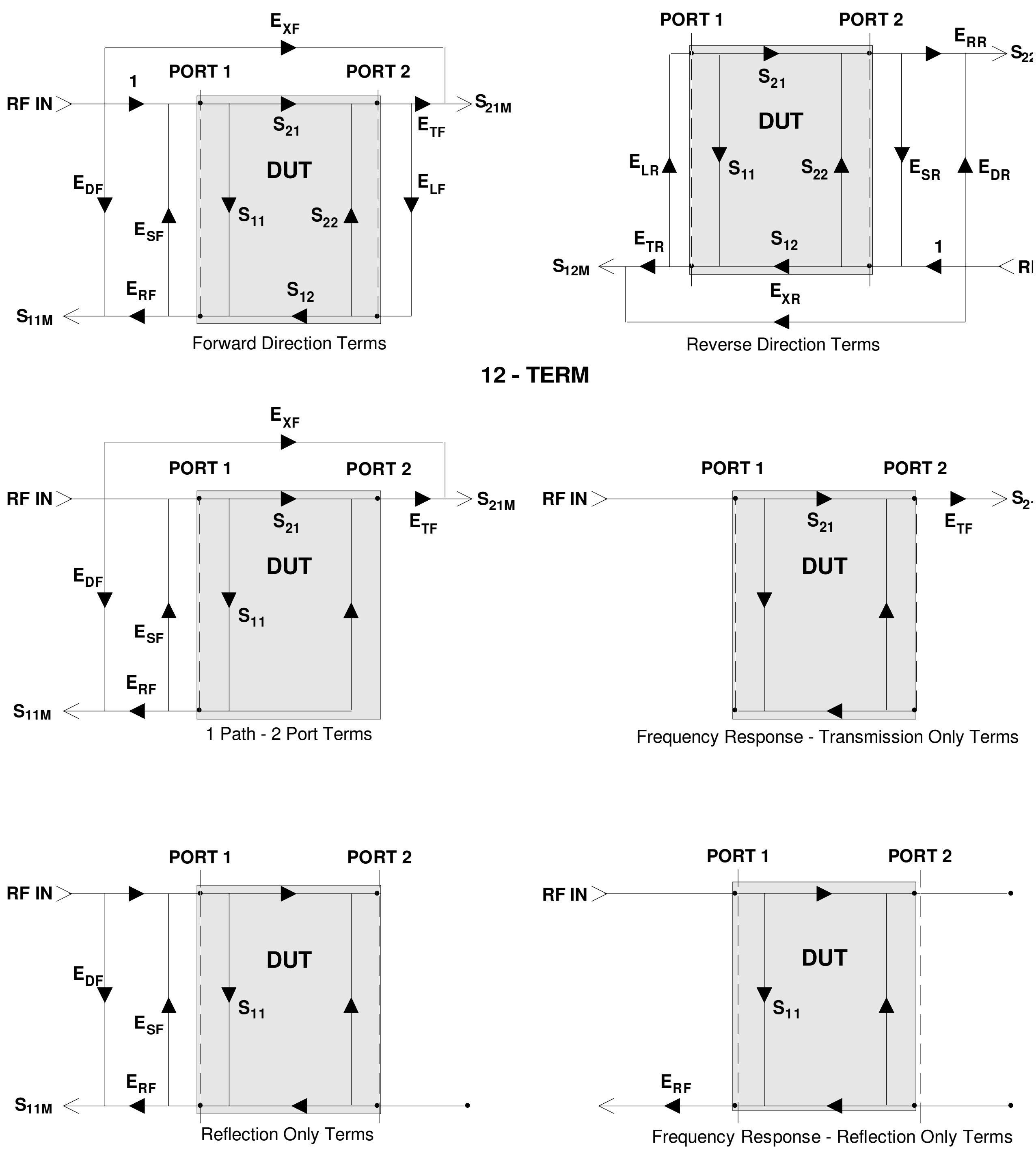


Figure 8-5. Error Models

Measurement calibration using the 360B is straightforward and menu directed. A short time spent in preparation and preplanning will make the process simple and routine. (Example: Adjusting the coaxial cables used in the measurement setup such that insertion of the DUT causes minimal flexing of these cables).

The screen prompts on the 360B guide you through the calibration process—a process that consists of connecting and disconnecting connectors and moving the slide on a sliding load (if one is used).

The most critical part of the calibration process is properly seating and torquing the connectors. Also, you will notice that the calibration takes longer when the ports are terminated with a load. This is intentional. It allows for more averaging during the isolation measurement.

Calibrating for a Measurement

CALIBRATING FOR A REFLECTION MEASUREMENT USES THREE STANDARDS:

- Short
- Open
- Termination

Let us assume that we want to correct for three errors in the reflection measurement: source match, directivity, and tracking. We accomplish this using three standards.

Shorts are the easiest to visualize. They totally reflect all of the incident RF energy output at a precise phase. The terms zero-ohms impedance, voltage null, and 180° phase all define an RF Short.

Opens are similar to Shorts, but their response is more complex. The terms voltage maximum, infinite impedance, and 0° phase all define a perfect Open. A perfect Open, however, is only a concept. In reality Opens always have a small fringing capacitance.

To account for the fact that the Open will not predictably reflect impedance at an exact 0° phase reference, we alter its response using coefficients that accurately characterize the fringing capacitance. The coefficients are different for each coaxial line size, since each size has a different fringing capacitance.

As Opens and Shorts provide two references for a full reflection, Z0 terminations provide a zero-reflection reference.

IDEAL TERMINATIONS

- Reflectionless
- Perfect Connector
- Infinite-Length, Dimensionally Exact, Reflectionless Transmission Line

Ideal Z0 terminations must consist of two parts, a perfect connector and an infinite-length perfect transmission line that absorbs all of the RF energy that enters it (no reflections).

Infinite length transmission lines are unwieldy at best, so you must use less-than-ideal terminations. For calibration purposes there are two common types: broadband loads and sliding terminations.

PRACTICAL Zo TERMINATIONS

- Broadband Load
- Sliding Termination

Broadband loads are widely used. An example is the ANRITSU 28 Series Termination. These terminations are easy to use as calibration tools, and are adequate for most applications.

BROADBAND LOAD

- Easy to Use
- Inexpensive
- Adequate for Most Applications

Sliding Loads are the traditional vector network analyzer Z0 calibration reference. They provide the best performance when the application requires high-precision return loss measurements. Sliding loads consist of a connector, a long section of precision transmission line, and a microwave load that is movable within the transmission line. One thing to remember with sliding loads is that they have a low-frequency limit and must be used with a fixed load below this cutoff frequency for full frequency coverage. ANRITSU sliding loads cut off at 2 GHz. (V-connector sliding loads cut off at 4 GHz).

SLIDING LOAD

- Connector
- Long Transmission Line
- Movable Microwave Load

Pin depth—the relationship between the interface positions of the outer and center conductors—is the most critical parameter under your control in a sliding load. An example of its criticality is that an incorrect pin depth of 0.001 inch can cause a reflection return loss of 44 dB. And, since we are trying to calibrate to accurately measure a 40 dB return loss, correct pin depth makes a *big difference!*

Cables in the measurement system are another cause for concern. The main criteria for a cable are stability and repeatability. ANRITSU offers two types of cables that meet these criteria: semi-rigid and flexible. Our semi-rigid cables provide maximum stability with limited flexibility of movement. Our flexible cables allow more freedom of movement (along with its associated degradation of phase stability).

Evaluating the Calibration

The 360B provides an accurate representation of complex data. However, it can only provide accuracy to the extent of the supplied calibration data. For this reason, it is necessary to periodically verify the calibration data and the 360B system performance.

Calibration verification reveals problems such as a poor contact with one of the calibration components, improper torquing, or a test port out of specification. Problems like these can easily occur during a calibration procedure. Anyone who has experienced one of these problems and stored bad data—after having performed a complete calibration procedure—knows the frustration it can cause. Additionally, it can be very costly to use incorrectly taken measurement data for design or quality assurance purposes.

The best way to confirm a calibration is to measure a precision, known-good device and confirm its specifications.

VERIFICATION KIT

- Used by Calibration and Metrology Labs

Verification Kits

ANRITSU has developed several precision-component kits: for 3.5 mm connectors, for GPC-7 connectors, K Connectors® and V Connectors®. These are, respectively, the Models 3666, 3667, and 3668 and 3669 Verification Kits.

Each of the kits contain 20 dB and 50 dB attenuators, a 10 cm air line beaded at one end, and a 10 cm Beatty Standard. A Beatty Standard is a two-port mismatch similar to a beadless airline. It consists of a center conductor with a discontinuity in the middle providing the mismatch (Figure 8-6).

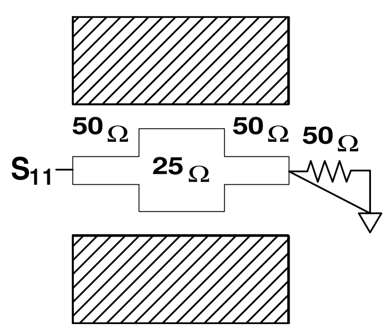


Figure 8-6. *The Beatty Standard*

Typically, these verification kits will be used by calibration or metrology labs. Each of the kits contain several precision components, all of which have been characterized at twenty specified frequencies. The data on these components is stored on a disk provided with the verification kit.

The verification of the kit components is straight forward. The components are first measured with the 360B, then compared with the data recorded on the disk. If the measured data compares favorably with the recorded data (taking tolerances into consideration), then the system is known to be operating properly and providing accurate data.

There is one caution that you need to observe when using Verification Kits. Because the verification components have been characterized, you must handle them carefully so that you do not change their known characteristics. Consequently, you should not have them available for daily use. Rather, you should only use them for the accuracy verification checks taken every 6-to-12 months (or at any other time the system's integrity is in doubt).

This completes the discussion on calibration. Refer to the "Getting Started" pull-out section in the front of the manual for a hands-on tutorial. Refer to paragraph 8-3 for a calibration procedure for calibrating the sliding load.

8-3 MEASUREMENT CALIBRATION —SLIDING TERMINATION

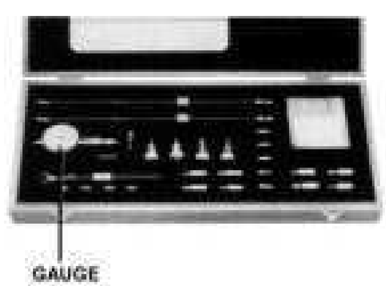
Sliding terminations (loads) are the traditional Z0 calibration-reference devices for vector network analyzer calibration. When correctly used and perfectly aligned, they can be more accurate than precision fixed loads. However, sliding terminations have a 2 GHz (4 GHz for V-Connector sliding loads) low-frequency limit and must be used with a fixed load for full frequency-range coverage.

Sliding terminations consist of a connector, a long section of precision transmission line, and a microwave load that is movable within the transmission line. Pin depth—the relationship between the interface positions of the outer and center conductors—is the most critical parameter that you can control in a sliding termination. An example of its criticality is that an incorrect pin depth of 0.001 inch can cause a reflection return loss of 44 dB. And, since you are usually calibrating to accurately measure a greater than 40 dB return loss, correct pin depth is essential.

Since setting an accurate pin depth is so important, this discussion centers on describing how to set the pin depth for male and female sliding terminations. Calibration with the sliding termination is essentially the same as described below for the broadband load.

The procedure below uses the Model 3652 Calibration Kit and its 17KF50 and 17K50 Sliding Terminations. Calibration is similar for the Model 3650 SMA/3.5mm, Model 3651 GPC-7 and Model 3654 V connector kits. For the 3651, the procedure is simpler: Because the GPC-7 connector is sexless, there is only one sliding termination.

Procedure



Step 1. Remove the Pin Depth Gauge from the kit, place it on the bench top.

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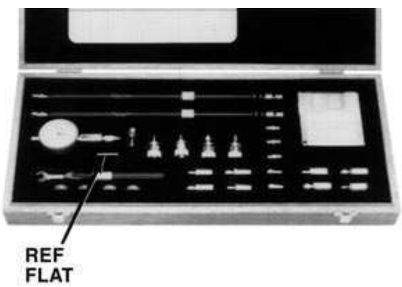
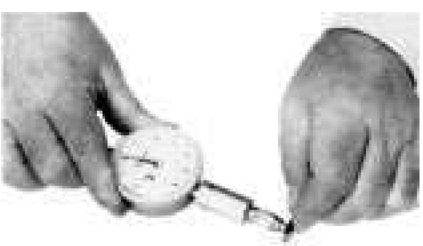
The meter is convertible between male and female. The following procedure describes the zeroing process for the female fitting. The procedure for the male fitting begins with step 16.

Step 2. Push the outer locking ring towards the gauge to expose the center pin.



Step 3. Take the 01-210 Ref Flat from the kit.



Step 4. While holding the gauge as shown, press the Ref Flat firmly against the end of the exposed center pin.

Step 5. While pressing the Ref Flat against the center pin, check that the pointer aligns with the “0” mark. If it does not, loosen the bezel lockscrew and rotate the bezel to align the pointer with the “0” mark. Tighten the bezel lock screw.

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Gently rock the Ref Flat against the center pin to ensure that it is fully depressed and you have accurately set the gauge for zero.

Step 6. Remove the sliding termination with the female-connector (17KF50, for this example) from the kit, and slide the load all the way toward the end closest to the connector.

Step 7. With either hand, pick up the sliding termination near its connector end.

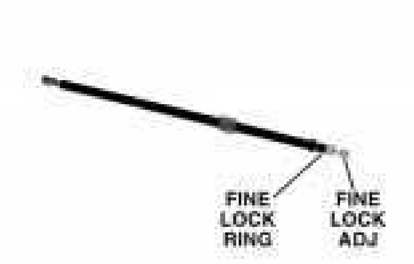
Step 8. Cup the sliding termination in your palm, and support the barrel between your body and crooked elbow.

Step 9. Remove the flush short by holding its body and unscrewing its connector.

Step 10. Install the gauge onto the end of the sliding termination.

Step 11. If the COARSE SET adjustment—which has been set at the factory—has not moved, the inner dial on the gauge will read "0." If it doesn't, perform the Coarse Set Adjustment in step 15.

Step 12. Place the sliding termination, with the gauge attached, on the bench top.



Step 13. Loosen the FINE LOCK ring and turn the FINE ADJ ring to position the gauge pointer 2-3 small divisions on the "–" side of zero.

Step 14. Turn the FINE LOCK ring clockwise to both tighten the adjustment and place the pointer exactly to "0." The Sliding Termination is now ready to use.

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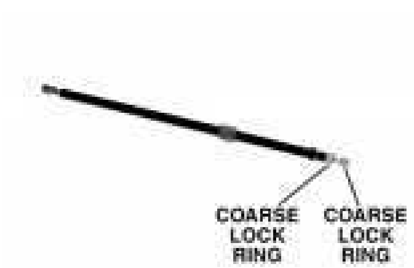
- Ensure that the inner dial read "0."
- The following step is not normally necessary. It needs to be done only if the adjustment has changed since it was set at the factory.



Step 15. With the 01-211 Flush Short installed, loosen the COARSE LOCK and gently push the COARSE SET adjustment rod in as far as it will go. This coarsely sets the center conductor to be flush against the attached short. Return to step 2.

Step 16. The procedure for adjusting the male-connector sliding termination is essentially the same as that described above. The only difference is that you must install the female adapter on the end of the gauge shaft, over the center conductor. To install this adapter, proceed as follows:

- ☐ Zero-set the gauge as described in step 2 above.
- ☐ Push the outer locking ring back toward the gauge and turn it clockwise onto the exposed threads.
- ☐ Loosen the lock ring one turn in a counterclockwise direction.

Step 17. Remove the 01-223 Female Adapter ("F ADAPTER FOR PIN GAUGE") from the kit.

Step 18. Install the female adapter over the center pin and screw it into the locking ring, and tighten the outer ring until it is snug against the housing.

Step 19. Inspect the end of the adapter, you should see no more than two exposed threads. If so, repeat steps 7 thru 10, above.

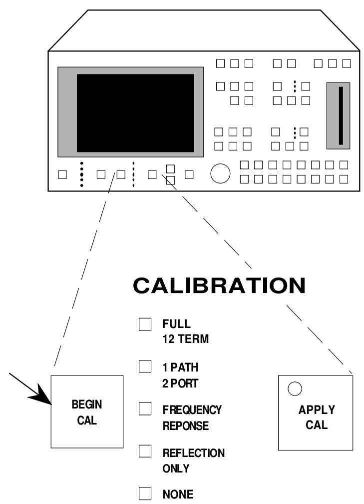
Step 20. Connect the gauge to the sliding termination and zero set the center pin using the FINE ADJ as previously described in step 2 above.

8-4 STANDARD (OSL) CALIBRATION PROCEDURE

The standard calibration for the 360B Vector Network Analyzer system uses an Open, a Short, a Broadband and/or Sliding Load, and a throughline connection to categorize the inherent errors in the measurement system. These errors include those caused by connectors as well as internal system errors such as RF leakage, IF leakage, and component interaction.

Calibration Procedure A detailed, step-by-step procedure for performing a Open-Short-Load calibration is given below.

Step 1. Press the BEGIN CAL key.



MENU C11

BEGIN CAL

KEEP EXISTING CAL DATA

REPEAT PREVIOUS CAL

CAL METHOD XXXXXXX

TRANSMISSION LINE TYPE: XXXXXXXX

CHANGE CAL METHOD AND LINE TYPE

NEXT CAL STEP

PRESS <ENTER> TO SELECT

Step 2. Select **CHANGE CAL METHOD AND LINE TYPE**, in menu C11 (left). (This assumes STANDARD and COAXIAL are not presently shown in blue as being selected.)

MENU C11A

CHANGE
CAL METHOD
AND LINE TYPE

NEXT CAL STEP *c.*

CAL METHOD

STANDARD
(NOT USED FOR
WAVEGUIDE) *a.*

OFFSET SHORT

LRL/LRM

TRANSMISSION
LINE TYPE

COAXIAL *b.*

WAVE GUIDE

MICROSTRIP

PRESS <ENTER>
TO SELECT

Step 3. When menu C11A (left) appears, move cursor to the following:

a. **STANDARD**, then press ENTER key. This selects Standard (OSL) as the calibration method.

b. **COAXIAL,** then press ENTER key. This selects coaxial transmission line media.

c. **NEXT CAL STEP**, then press ENTER key. This causes menu C11 to return to the screen.

Step 4. When menu C11 reappears, move the cursor to **NEXT CAL STEP** and press the ENTER key. This brings up menu C5.

MENU C5

CALIBRATION
TYPE

FULL 12-TERM

1 PATH
2 PORT

FREQUENCY
RESPONSE ONLY

REFLECTION
ONLY (PORT 1)

PRESS <ENTER>
TO SELECT

Step 5. Menu C5 (left) lets you select the type of calibration. For this example, move the cursor to **FULL 12-TERM** and press the ENTER key. This selection calibrates for all twelve error terms.

Step 6. The next menu, C5B, lets you choose whether to include or exclude the error terms associated with leakage between measurement channels. For a normal calibration, you would choose to include these error terms. Therefore, move the cursor to **INCLUDE ISOLATION (NORMAL)** and press the ENTER key.

MENU C5B

SELECT USE
OF ISOLATION
IN APPLIED
CALIBRATION

INCLUDE
ISOLATION
(NORMAL)

EXCLUDE
ISOLATION

PRESS <ENTER>
TO SELECT

MENU C1
SELECT CALIBRATION DATA POINTS
NORMAL (501 POINTS MAXIMUM)
C.W. (1 POINT)
N-DISCRETE FREQUENCIES (2 TO 501 POINTS)
TIME DOMAIN (HARMONIC)
PRESS <ENTER> TO SELECT

Step 7. Next, menu C1 appears. This menu lets you select the number of frequency points at which calibration data is to be taken. The choices are:

a. **NORMAL:** Data is taken at 501 equally spaced frequencies across the calibration frequency range. *Use this selection for this example.*

b. **C.W.:** Data is taken at one point. This choice brings up menu C2B (below) that lets you select the single CW frequency point.

MENU C2B
SINGLE POINT CALIBRATION
C.W. FREQ XX.XXXX GHz
FINISHED ENTRY, NEXT CAL STEP
INPUT FREQ AND PRESS <ENTER> TO SELECT

c. **N-DISCRETE FREQUENCIES:** This selection lets you specify a discrete number of frequency points, from 2 to 501.

d. **TIME DOMAIN:** This selection is the calibration mode for low-pass time-domain processing. It lets you select frequencies at integer (harmonic) multiples of the start frequency.

MENU C2
FREQ RANGE OF CALIBRATION
START 0.0400 GHz
STOP 20.0000 GHz
500 DATA PTS USING ABOVE START AND STOP 40.0 MHz STEP SIZE
NEXT CAL STEP
PRESS <ENTER> TO SELECT

Step 8. The next menu, C2 (left), lets you set your start and stop frequencies. For this example, move cursor to **START,** press 40 on keypad, and hit the MHz terminator key. Perform like operations for the **STOP** choice, except make entry read 20 GHz. After setting the frequencies, select **NEXT CAL STEP** and press the ENTER key.

MENU C3
CONFIRM CALIBRATION PARAMETERS
PORT 1 CONN K CONN (M)
PORT 2 CONN SMA (M)
REFLECTION PAIRING MIXED
LOAD TYPE SLIDING
THROUGH PARAMETERS
REFERENCE IMPEDANCE
TEST SIGNALS
START CAL
PRESS <ENTER> TO SELECT OR CHANGE

Step 9. When menu C3 (left) appears, if you want to change any of the parameters shown in blue letters, place the cursor on that parameter and press the ENTER key. For this example, we will change them all, starting with the top one. Move the cursor to **PORT 1 CONN** and press the ENTER key.

Step 10. In menu C4 (below), which appears next, move the cursor to **K CONN (M)** and then press the ENTER key. This choice presumes that you have a K-Female connector on the device-under-test (DUT). Remember, in this menu you choose the connector type on the test port, or the connector type that *mates* with the DUT connector. When menu C3 returns, observe that **K CONN (M)** is now shown in blue for the **PORT 1 CONN** choice.

MENU C4
SELECT PORT 1 CONNECTOR TYPE
SMA (M)
SMA (F)
K-CONN (M)
K-CONN (F)
TYPE N (M)
TYPE N (F)
GPC-3.5 (M)
GPC-3.5 (F)
GPC-7
USER DEFINED
MORE
PRESS <ENTER> TO SELECT

MENU C3
CONFIRM CALIBRATION PARAMETERS
PORT 1 CONN K CONN (M)
PORT 2 CONN K CONN (M)
REFLECTION PAIRING MIXED
LOAD TYPE SLIDING
THROUGH PARAMETERS
REFERENCE IMPEDANCE
TEST SIGNALS
START CAL
PRESS <ENTER> TO SELECT OR CHANGE

Step 11. With menu C3 (left) displayed, move the cursor to **PORT 2 CONN** and press the ENTER key. Following the procedure in step 10, select **K CONN (M)** for the Port 2 connector.

Step 12. When menu C3 returns:

a. Observe that **PORT 2 CONN** now reflects K CONN (M).

b. Move cursor to **REFLECTION PARING** and press the ENTER key. This brings up menu C13 (below).

SET REFLECTION PAIRING
MIXED (OPEN–SHORT SHORT–OPEN)
MATCHED (OPEN–OPEN SHORT–SHORT)
PRESS <ENTER> TO SELECT

Reflection Pairing lets you mix or match the Open and Short reflection devices in the Calibration Sequence menus. The **MIXED** choice lets you calibrate using first an Open on one port and a Short on the other, then a Short on one port and an Open on the other. Conversely, **MATCHED** lets you calibrate first using an Open on both ports then using a Short on both ports. For this example, choose **MIXED** and press the ENTER key.

MENU C3

CONFIRM
CALIBRATION
PARAMETERS

PORT 1 CONN
TYPE N (M)

PORT 2 CONN
TYPE N (F)

REFLECTION
PARING
MIXED

LOAD TYPE
BROADBAND

THROUGH
PARAMETERS

REFERENCE
IMPEDANCE

TEST SIGNALS

START CAL

PRESS <ENTER>
TO SELECT

Step 13. When menu C3 returns:

a. Observe that **REFLECTION PARING** now reflects MIXED.

b. Move cursor to **LOAD TYPE** and press the ENTER key. This brings up menu C6 (below).

MENU C6

SELECT
TYPE OF LOAD

BROADBAND
FIXED LOAD

SLIDING LOAD
(MAY ALSO
REQUIRE
BROADBAND
FIXED LOAD)

PRESS <ENTER>
TO SELECT

This menu lets you select either of two load types, broadband or sliding. Broadband loads are adequate for all but the most demanding reflection measurements. They are easier to use and less expensive than sliding loads. Refer to the separately bound “Getting Started” guide in the front of this manual for a fuller discussion on these two loads. If you choose a sliding load, refer to paragraph 8-3 for a procedure on setting pin depth.

For this example, select **BROADBAND LOAD** and press the ENTER key.

MENU C20

ENTER THROUGH LINE PARAMETERS

OFFSET LENGTH OF THROUGH

OFFSET LENGTH
0.0000 mm

LOSS EQUATION
A+B*FREQ^c

A: DC COEFF
(dB/m)
0.0000

B: FREQ COEFF
(dB/m*FREQ^c
0.0000 e-6

C: FREQ
EXPONENT
0.500

PRESS <ENTER>
WHEN COMPLETE

Step 14. When menu C3 again returns:

a. Observe that **LOAD TYPE** now shows BROADBAND.

b. Move cursor to **THROUGH PARAMETERS** and press the ENTER key.

Step 15. Menu C20 (left) appears next. It lets you define the characteristics of your non-zero length throughline. The throughline loss equation is defined by a dc coefficient (A), a frequency coefficient (B), and a frequency exponent (C). The equation:

$$Loss\ (dB/m) = A + B \times (Frequency)^C$$

For this example, our throughline will simply be a connection of Port 1 to Port 2, and thus zero-length and lossless. With that being the case, we will leave the offset A, B, and C values in their default (or lossless) state.

Step 16. When menu C3 reappears, move the cursor to **REFERENCE IMPEDANCE** and press the ENTER key. This brings up menu C17 (left).

MENU C17

ENTER REF IMPEDANCE

REFERENCE IMPEDANCE
50.000 Ω

PRESS <ENTER>
WHEN COMPLETE

Step 17. Move cursor to **REFERENCE IMPEDANCE** and use the rotary knob to change the displayed value to 50 Ω. Alternatively, you can key in 50 ohms. That is, press 50 on the keypad and the X1 terminator key. If the value were 1 μΩ, you would key in .001 and press 10^{-3}. Conversely, if the value was 1 MΩ, you would key in 1000 and press the 10^{3} terminator key.

Press the ENTER key when you have completed your value entry.

REDUCED
TEST SIGNALS

SOURCE 1 PWR
XX.X dBm

SOURCE 2
PWR
X.X dBm

PORT 1 SOURCE
X0 dB (0-70)

PORT 1 TEST
X0 dB (0-00)

PORT 2
SOURCE
X0 dB (0-70)

PORT 2 TEST
X0 dB (0-40)

FLAT TEST
PORT POWER

PREVIOUS
MENU

Step 18. When menu C3 returns, select **TEST SIGNALS** to bring up menu SU2 (left).

Step 19. Menu SU2 lets you define the power level of the signals at the two test ports. Power delivered to the DUT by the test set must be such that the measured signals are well above the noise floor but below the 0.1 dB compression level of the Test Set samplers. (Noise floor and maximum signal into Port 2 levels are specified in Appendix 3.)

For active device Test Sets, a third step attenuator in the forward transmission path allows up to 1 Watt of power (30 dBm) before 0.1 dB compression occurs.

Determine the required input power level and the expected output RF power level from the DUT. The RF power supplied at Port 1 and Port 2 of the Test Set is about 10 dB less than the Source power.

For this example, we will say that the Source power is 5 dBm, and the required input power is –15 dBm.

First, move the cursor to **SOURCE 1 PWR** and enter 5 dBm. Knowing that test port power is approximately 10 dB below the Source power level, we should now have –5 dBm at Port 1 and Port 2. We will assume a 2nd Source is not present.

To decrease the input power (Port 1) by an additional 10 dB, move the cursor to **PORT 1 SOURCE** and enter 10 dB (+5 – 10 –10 = –15).

(If you needed to calibrate the test port for power flatness, you would move the cursor to **FLAT TEST PORT POWER** and press the ENTER key. The Flat Test Port Power calibration process will not be described here. Refer to the menu SU8 and SU8A discussions in Appendix 1 and ANRITSU Application Note AN360-14, under the tab labeled "Supplements.")

Finally, move the cursor to **PREVIOUS MENU** and press the ENTER key. This returns you to menu SU1. When you get there, press the ENTER key to return to menu C3.

MENU C3

CONFIRM CALIBRATION PARAMETERS

PORT 1 CONN
TYPE N (M)

PORT 2 CONN
SMA (M)

REFLECTION
PAIRING
MIXED

LOAD TYPE
SLIDING

THROUGH
PARAMETERS

REFERENCE
IMPEDANCE

TEST SIGNALS

START CAL

Step 20. When menu C3 reappears, select **START CAL** and press the ENTER key to begin the calibration procedure.

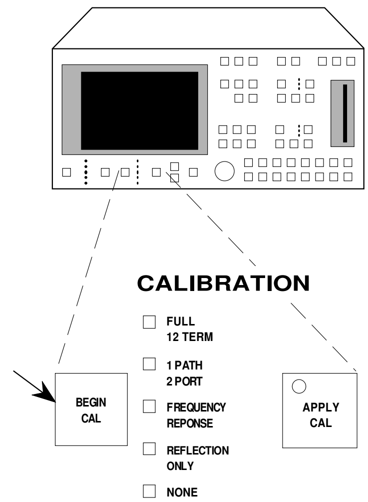
Continue the calibration sequence by following the prompts as they appear. Connect the appropriate Isolation Devices, Broadband Loads, Opens, Shorts, and Throughlines, when requested in the calibration sequence.

8-5 OFFSET-SHORT CALIBRATION PROCEDURE

The Offset-Short calibration is the standard technique for waveguide. It uses an offset Short and a flush Short to categorize the inherent errors in the waveguide measurement system. These errors include those caused by connectors as well as internal system errors such as RF leakage, IF leakage, and component interaction.

Calibration Procedure A detailed, step-by-step procedure for performing a Offset-Short calibration is given below.

Step 1. Press the BEGIN CAL key.



MENU C11

BEGIN CAL

KEEP EXISTING CAL DATA

REPEAT PREVIOUS CAL

CAL METHOD XXXXXXX

TRANSMISSION LINE TYPE: XXXXXXXX

CHANGE CAL METHOD AND LINE TYPE

NEXT CAL STEP

PRESS <ENTER> TO SELECT

Step 2. Select **CHANGE CAL METHOD AND LINE TYPE**, in menu C11 (left). (This assumes OFFSET SHORT and WAVEGUIDE are not presently shown in blue as being selected.)

MENU C11A
CHANGE CAL METHOD AND LINE TYPE
NEXT CAL STEP
CAL METHOD
STANDARD (NOT USED FOR WAVEGUIDE)
OFFSET SHORT
LRL/LRM
TRANSMISSION LINE TYPE
COAXIAL
WAVE GUIDE
MICROSTRIP
PRESS <ENTER> TO SELECT

MENU C11C
SELECT WAVEGUIDE KIT TO USE
–INSTALLED—
IDENTIFIER XXXX
CUTOFF FREQ: XX.XXXX
SHORT 1 XX.XXXX mm
SHORT 2 XX.XXXX mm
USE INSTALLED KIT
USER DEFINED
PRESS <ENTER> TO SELECT

Step 3. When menu C11A (left) appears, move cursor to the following:

a. **OFFSET SHORT**, then press the ENTER key. This selects Offset Short as the calibration method.

b. **WAVEGUIDE,** then press the ENTER key. This brings menu C11C (bottom left) to the screen.

Step 4. When menu C11C appears, move cursor to one of the two available choices and press the ENTER key. These choices are described below. After completing your selection, you are returned to menu C11.

a. **USE INSTALLED KIT:** Selecting this choice uses the values shown in blue for IDENTIFIER, CUTOFF FREQ, SHORT 1, and SHORT 2. (See the separately bound “Getting Started” guide, in the front of this manual, for a discussion on loading the component-coefficient kits files from available diskettes.) *Select this choice, for this example.*

b. **USER DEFINED:** Selecting this choice brings up menu C15 (below), which lets you specify waveguide parameters.

MENU C15
ENTER WAVEGUIDE PARAMETERS
WAVEGUIDE CUTOFF FREQ: XX.XXXX GHz
OFFSET LENGTH OF SHORT 1 XX.XXXX mm
OFFSET LENGTH OF SHORT 2 XX.XXXX mm
PRESS <ENTER> TO SELECT

MENU C5

CALIBRATION TYPE

FULL 12-TERM

1 PATH
2 PORT

FREQUENCY
RESPONSE ONLY

REFLECTION
ONLY (PORT 1)

PRESS <ENTER>
TO SELECT

Step 5. Menu C5 appears next. This menu lets you select the type of calibration. For this example, move the cursor to **FULL 12-TERM** and press the ENTER key. This brings up menu C5B.

Step 6. The next menu, C5B (below), lets you choose whether to include or exclude the error terms associated with leakage between measurement channels. For a normal calibration, you would choose to include these error terms. Therefore, move the cursor to **INCLUDE ISOLATION (NORMAL)** and press the ENTER key.

MENU C5B

SELECT USE
OF ISOLATION
IN APPLIED
CALIBRATION

INCLUDE
ISOLATION
(NORMAL)

EXCLUDE
ISOLATION

PRESS <ENTER>
TO SELECT

Step 7. Menu C1 (left), which appears next, lets you select the number of frequency points at which calibration data is to be taken. Of these choices, which were described in paragraph 8-4, choose **NORMAL (501 POINTS MAXIMUM)** for this example.

MENU C1

SELECT
CALIBRATION
DATA POINTS

NORMAL
(501 POINTS
MAXIMUM)

C.W.
(1 POINT)

N-DISCRETE
FREQUENCIES
(2 TO 501
POINTS)

TIME DOMAIN
(HARMONIC)

PRESS <ENTER>
TO SELECT

MENU C2

FREQ RANGE OF
CALIBRATION

START
0.0400 GHz

STOP
20.0000 GHz

500 DATA PTS
USING ABOVE
START AND STOP
40.0 MHz
STEP SIZE

NEXT CAL STEP

PRESS <ENTER>
TO SELECT

MENU C3B

CONFIRM
CALIBRATION
PARAMETERS

LOAD TYPE
BROADBAND

THROUGH
PARAMETERS

TEST SIGNALS

START CAL

PRESS <ENTER>
TO SELECT
OR CHANGE

Step 8. The next menu, C2 (left), lets you set your start and stop frequencies. For this example, move cursor to **START,** press 40 on keypad, and hit MHz terminator key. Perform like operations for the **STOP** choice, except make entry read 20 GHz. After setting the frequencies, select **NEXT CAL STEP** and press the ENTER key.

Step 9. When menu C3B (bottom left) appears, if you want to change any of the parameters shown in blue letters, place the cursor on that parameter and press the ENTER key. (These choices operate the same as was described for menu C3 in paragraph 8-4.) For this example, we will use the choices shown in blue. Move the cursor to START CAL and press the ENTER key.

Step 10. Continue the calibration sequence by following the prompts as they appear. Connect the appropriate Isolation Devices, Broadband Loads, Shorts, and Throughlines, when requested in the calibration sequence.

8-6 LRL/LRM *CALIBRATION PROCEDURE

The LRL/LRM (line-reflect-line/line-reflect-match) calibration feature provides an enhanced capability for error compensation when making measurements in coaxial, microstrip and waveguide transmission media. Instead of using the standard Open, Short, and Load, the LRL/LRM calibration method uses two lines and a reflection or match. The difference in length between line 1 and line 2 creates the measurements necessary for the error solutions.

Because very high quality air lines are readily available, excellent directivity and source match are possible with this calibration. This calibration is excellent for measurements in transmission media, such as coax or waveguide, in which opens or precision terminations are difficult to realize.

The LRL/LRM calibration technique uses the characteristic impedance of a length of transmission line or a precision match as the calibration standard. A full LRL/LRM calibration consists of two transmission line measurements, a high reflection measurement, and an isolation measurement. Using this technique full 12-term error correction can be performed on the 360B VNA.

Three line LRL/LRM calibration can also be selected. In a two-line LRL measurement, the difference in length between line 1 and line 2 is necessary for calibration but limits the frequency range to a 9:1 span. The use of three lines in the calibration extends the frequency range to an 81:1 span.

Through the use of LRL/LRM calibration and an external computer, in conjunction with ANACAT software, multiple-level de-embedding is possible. This calibration allows you to make semi-conductor chip measurements up to 60 GHz with a single test fixture.

In addition, any non-coaxial transmission media, including mixed media interconnects, can be accommodated. For example, a test device with a waveguide input and a coplanar microstrip output can be measured. Software automatically compensates for the microstrip dispersion.

A detailed procedure for calibrating for a measurement using the LRL/LRM method is provided in the following pages.

* LRM Calibration Method of Rohde $ Schwarz, Germany

LRL/LRM Calibration (Microstrip)

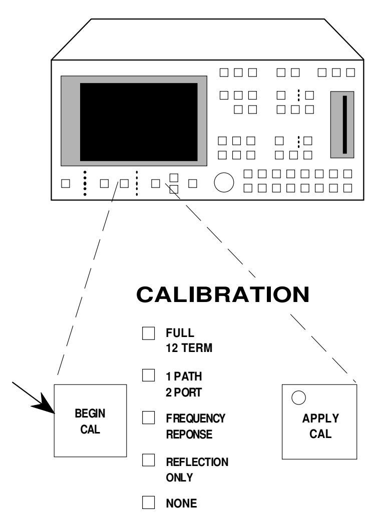
Microstrip is a dispersive media. The VNA applies dispersion compensation during calibration for microstrip measurements. Because the VNA must know the specific microstrip parameters, during the calibration procedure menus are available for entering the

- width of the strip
- thickness of the substrate
- substrate dielectric constant
- effective dielectric constant Zc
- characteristic impedance (reference)

When testing microstrip devices it is necessary to launch from coax to microstrip. In production testing this launching must be temporary, so that the device can easily be installed in and be removed from the fixture. The requirement for launching to 60 GHz is met by the ANRITSU Universal Test Fixture (UTF). The UTF provides accurate, repeatable launch to substrates from 5 to 70 mils thick, and from 0.15 to 2 inches long. Offset connections and right angles can be configured. DC bias probes can be mounted to the UTF to inject bias onto the substrate. UTF calibration/verification kits are available for alumina in 10 mil, 15 mil, and 25 mil microstrip, and for 25 mil coplanar waveguide. Although a UTF is not essential, the following calibration procedures presume its use.

Step 1. Select the desired LRL line substrates from the appropriate microstrip calibration kit. When called for in the calibration sequence, mount the LRL line substrates on the UTF following the procedure given in the 3680 OMM.

Step 2. Press the BEGIN CAL key.



MENU C11
BEGIN CAL
KEEP EXISTING CAL DATA
REPEAT PREVIOUS CAL
CAL METHOD XXXXXXX
TRANSMISSION LINE TYPE: XXXXXXXX
CHANGE CAL METHOD AND LINE TYPE
NEXT CAL STEP
PRESS <ENTER> TO SELECT

Step 3. Select **CHANGE CAL METHOD AND LINE TYPE**, in menu C11 (left). (This assumes LRL and MICROSTRIP are not presently shown in blue as being selected.)

Step 4. When menu C11A (bottom left) appears, highlight the following selections.

a. LRL/LRM and press the ENTER key.

b. MICROSTRIP and press the ENTER key.

c. NEXT CAL STEP and press the ENTER key.

Step 5. When menu C11 reappears, highlight **NEXT CAL STEP** and press ENTER key to proceed with the calibration.

Step 6. Continue through the calibration sequence, and make the following selections from the menus that appear:

INCLUDE ISOLATION (NORMAL) (Menu C5B)
NORMAL (501 POINTS MAXIMUM) (Menu C1)
START (Your start frequency) (Menu C2)
STOP (Your stop frequency) (Menu C2)

MENU C11A	
CHANGE CAL METHOD AND LINE TYPE	
NEXT CAL STEP	*c.*
CAL METHOD	
STANDARD (NOT USED FOR WAVEGUIDE)	
OFFSET SHORT	
LRL/LRM	*a.*
TRANSMISSION LINE TYPE	
COAXIAL	
WAVE GUIDE	
MICROSTRIP	*b.*
PRESS <ENTER> TO SELECT	

MENU C5B
SELECT USE OF ISOLATION IN APPLIED CALIBRATION
INCLUDE ISOLATION (NORMAL)
EXCLUDE ISOLATION
PRESS <ENTER> TO SELECT

MENU C1
SELECT CALIBRATION DATA POINTS
NORMAL (501 POINTS MAXIMUM)
C.W. (1 POINT)
N-DISCRETE FREQUENCIES (2 TO 501 POINTS)
TIME DOMAIN (HARMONIC)
PRESS <ENTER> TO SELECT

MENU C2
FREQ RANGE OF CALIBRATION
START 0.0400 GHz
STOP 20.0000 GHz
500 DATA PTS USING ABOVE START AND STOP 40.0 MHz STEP SIZE
NEXT CAL STEP
PRESS <ENTER> TO SELECT

MENU C3G
CONFIRM CALIBRATION PARAMETERS
LRL/LRM PARAMETERS
MICROSTRIP PARAMETERS USER DEFINED
TEST SIGNALS
START CAL
PRESS <ENTER> TO SELECT OR CHANGE

Step 7. When menu C3G appears, if you want to change microstrip parameters to be different from those shown in blue, place cursor on **CHANGE MICROSTRIP PARAMETERS** and press the ENTER key.

Step 8. When menu C16A appears, move cursor to the ANRITSU 3680 UTF calibration kit you wish to use or to **USER DEFINED**; then press the ENTER key.

The calibration kit selections shown in menu C16A are for the following 3680 Connection Substrate Kits:
10 MIL KIT — 36805-10M
15 MIL KIT — 36805-15M
25 MIL KIT — 36805-25M

If you choose **USER DEFINED**, the next menu that appears (C16), lets you characterize your parameters. Move cursor to each selection, key in a value, then press the ENTER key to return to menu C16A.

MENU C16A
SELECT MICROSTRIP PARAMETERS
10 MIL KIT
15 MIL KIT
25 MIL KIT
USER DEFINED
PRESS <ENTER> WHEN COMPLETE

MENU C16
ENTER USER DEFINED MICROSTRIP PARAMETERS
WIDTH OF STRIP XX.XXXX mm
THICKNESS OF SUBSTRATE XXXX.XXXX mm
ZC XXX.XXX Ω
SUBSTRATE DIELECTRIC XX.XX
EFFECTIVE DIELECTRIC XX.XX (RECOMMENDE D 1.00)
PRESS <ENTER> WHEN COMPLETE

MENU C3G

CONFIRM CALIBRATION PARAMETERS

CHANGE LRL/LRM PARAMETERS

CHANGE MICROSTRIP PARAMETERS XXXXXXXXX

START CAL

PRESS <ENTER> TO SELECT

Step 9. Select **CHANGE LRL/LRM PARAMETERS**, when menu C3G returns.

Step 10. When menu C18 appears, you have two choices to make: whether your calibration is to be two-line or three-line, and where you want to have your reference plane.

a. *Select the reference plane:* Highlight **MIDDLE OF LINE 1 (REF)** or **ENDS OF LINE 1 (REF)** and press the ENTER key.

b. *Select the type of LRL/LRM calibration:* Highlight **ONE BAND,** for a two-line calibration; or **TWO BANDS**, for a three-line calibration.

As mentioned earlier, in a two-line measurement, the difference in length between line 1 and line 2 is necessary for calibration but limits the frequency range to a 9:1 span. By using three lines in the calibration, you extend the frequency range to an 81:1 span.

If you select **TWO BANDS**, skip to Step 12.

MENU C18

CHANGE LRL/LRM PARAMETERS

NEXT CAL STEP

NUMBER OF BANDS USED

ONE BAND

TWO BANDS

EITHER/OR

LOCATION OF REFERENCE PLANES

MIDDLE OF LINE 1 (REF)

ENDS OF LINE 1 (REF)

EITHER/OR

PRESS <ENTER> TO SELECT

MENU C18A	
CHANGE LRL/LRM PARAMETERS	
NEXT CAL STEP	*e.*
CHARA CTERIZE CAL DEVICES	
DEVICE 1 LINE 1 (REF) X.XXXX mm	*a.*
DEVICE 2 LINE /MATCH X.XXXX mm	*b., c., d.*
PRESS <ENTER> TO SELECT OR SWITCH	

Step 11.* *(2-Line Calibration)

When menu C18A (left) appears, make the following selections:

a. Move the cursor to **DEVICE 1 LINE 1 (REF)** and key in the value.

b. Move the cursor to **DEVICE 2 LINE/MATCH.** Here you have another decision to make: whether your calibration is to be LRL or LRM. For this selection, the ENTER key acts as a toggle.

c. If you toggle such that **LINE** turns red, then key in the value for line 2. This value depends on your frequency range.

d. If you toggle **MATCH** red, observe that **FULL-BAND** appears. This indicates that your reflective device covers the full calibration range.

e. When you have made both selections, move the cursor to **NEXT CAL STEP** and press the ENTER key to produce the next menu. Skip to step 13.

MENU C18B	
CHANGE LRL/LRM PARAMETERS	
NEXT CAL STEP	*g.*
CHARACTERIZE CAL DEVICES	
DEVICE 1 LINE 1 (REF) XX.XXXX	*a.*
DEVICE 2 LINE/MATCH XX.XXXX/LOWBAND	*b., c., d.*
DEVICE 3 LINE/MATCH XX.XXXX/HIGHBAND	*e.*
FREQ AFTER WHICH THE USE OF DEVICE 2 AND DEVICE 3 IS EXCHANGED	
BREAKPOINT X.XXXX GHZ	*f.*
PRESS <ENTER> TO SELECT OR SWITCH	

Step 12.

(3-Line Calibration)

When menu C18B (left) appears, make the following selections:

a. Move the cursor to **DEVICE 1 LINE 1 (REF)** and key in the value (typically 1.00 cm). Press the ENTER key to select.

b. Move the cursor to **DEVICE 2 LINE/MATCH.** Both here, and for the next choice, you have another decision to make: whether your calibration is to be LRL or LRM. For this selection, the ENTER key acts as a toggle.

c. If you toggle such that **LINE** turns red, then key in the value for line 2. This value depends on your frequency range.

d. If you toggle **MATCH** red, observe that **LOWBAND** appears. This indicates that your reflection device is a low-band load. This load must have a passband such that it passes all frequencies from the start to the breakpoint (see below).

e. Move the cursor to **DEVICE 3 LINE/MATCH.** If device 3 is a line, key in the value. If it is a match, the term **HIGHBAND** will appear. This indicates that your match is a high-band load. This load must have a passband such that it passes all frequencies from the breakpoint to the stop frequency.

f. Move the cursor to **BREAKPOINT** and enter your breakpoint frequency. For two-line LRL calibrations, select a breakpoint equal to the upper frequency of the low frequency LRL line. For a combined LRL and LRM calibration, select a breakpoint equal to the top frequency of the calibration divided by six; for instance, to cover the frequency range 0.04 to 60 GHz, select 10 GHz as the breakpoint.

g. When you have made all selections, move the cursor to **NEXT CAL STEP** and press ENTER to produce the next menu.

MENU C19	
CHANGE LRL/LRM PARAMETERS	
NEXT CAL STEP	*c.*
OFFSET LENGTH OF REFLECTIVE DEVICE	
OFFSET LENGTH X.XXXX mm	*a.*
TYPE OF REFLECTION	
GREATER THAN Zo	*b. EITHER/OR*
LESS THAN Zo	
PRESS <ENTER> TO SELECT	

Step 13. The next menu, C19, gives you choices for your reflective device.

a. Move the cursor to **OFFSET LENGTH** and key in a value (typically 0.0000 mm).

b. Move the cursor to **GREATER THAN Zo** or **LESS THAN Zo,** depending on whether your reflective device is an Open or a Short. Press the ENTER key to select.

NOTE

Choose **GREATER THAN Zo** for an Open and **LESS THAN Zo** for a Short.

c. When you complete your choices, move the cursor to **NEXT CAL STEP** and press the ENTER key.

Step 14. When menu C3G reappears, move cursor to **START CAL** and press ENTER.

MENU C3G
CONFIRM CALIBRATION PARAMETERS
CHANGE LRL/LRM PARAMETERS
CHANGE MICROSTRIP PARAMETERS XXXXXXXXX
START CAL
PRESS <ENTER> TO SELECT

Step 15. Continue the calibration sequence by following the prompts as they appear. Mount the appropriate LRL line substrates when requested in the calibration sequence.

For the **REFLECTIVE DEVICE** and **BROADBAND LOAD** prompts, remove all substrates from the UTF and allow the lower jaws to short the center conductor. Separate the connector blocks by at least an inch. (The BROADBAND LOAD prompt only appears if you selected to include isolation in menu C5B.)

Step 16. Store the calibration.

LRL/LRM Calibration (Coaxial)

An LRL cal kit is necessary to perform the coaxial calibration. Calibration kits for GPC-7 are available from Maury Microwave and Hewlett Packard.

Two line lengths are used as the impedance standard. The calibration frequency range is limited by the difference in the lengths of the two lines. Their length must be different by approximately 90 degrees at the mid-band frequency. A good calibration can be achieved over the range of 18 degrees to 162 degrees making it possible to calibrate LRL over a 9:1 frequency range.

LRL calibration is very sensitive to uncalibrated source match. If some padding is placed at the test ports, the directivity and source match will be improved. If the goal is high level measurements, then padding should be included. If low level measurements are being performed, then the padding must be left out.

MENU C3E

CONFIRM CALIBRATION PARAMETERS

LRL/LRM PARAMETERS

REFERENCE IMPEDANCE

TEST SIGNALS

START CAL

PRESS <ENTER> TO SELECT

Step 1. Same as Steps 1 through 6 in the Microstrip procedure.

Step 2. When menu C3E (left) appears, if you want to change line impedance, place cursor on **REFERENCE IMPEDANCE** and press the ENTER key.

Step 3. When menu C17 (left) appears, move cursor to **REFERENCE IMPEDANCE,** key in the value, then press the ENTER key.

MENU C17

ENTER REF IMPEDANCE

REFERENCE IMPEDANCE 50.000 Ω

PRESS <ENTER> WHEN COMPLETE

Step 4. Same as Steps 9 through 16 in the microstrip procedure.

In the coaxial, three-line calibration there are factors you need to be aware of. Note that it is the line length *differences* that are important to the LRL calibration, namely (L2–L1) and (L3–L1) where L1 is the length of line 1, L2 is the length of line 2, and L3 is the length of line 3.

Longer length differences are used for longer wavelengths (lower frequencies). For frequencies up to and including the breakpoint frequency, the larger absolute value of the (L2–L1) and (L3–L1) differences is used. At frequencies above the breakpoint, the smaller absolute value of the (L2–L1) and (L3–L1) differences is used.

Consideration must also be given to selecting the breakpoint frequency. Divide the frequency range to satisfy the 9:1 rule for any given pair of lines. The range is thus divided by the frequency breakpoint into the intervals [f1, f2] and [f2, f3]. Based on these intervals, next determine the appropriate length differences; the longer difference is associated with the lower interval [f1, f2]. Note that if the differences are equal to each other, concurrent frequency ranges are implied and only two lines need be used.

Select a line 1 reference (L1) around which to place these two differences. Use any combination of positive or negative differences around line 1. The software selects which interval is associated with either of line 2 or line 3 by comparing the absolute values of the differences with line 1. Data from the two lines, which make up the larger absolute difference, are used for the interval [f1, f2]. Data from the two lines, which make up the smaller absolute difference, are used for the interval [f2, f3].

LRL/LRM Calibration (Waveguide)

The waveguide procedure is very similar to the coaxial and microstrip procedures already described.

Step 1. Same as Steps 1 through 6 in the Microstrip procedure.

The only difference is with menu C11A. For a waveguide calibration, move the cursor to **WAVEGUIDE** and press ENTER. This action calls menu C15A, which lets you enter the waveguide cutoff frequency. After doing, so you are returned to menu C11A.

MENU C11A

CHANGE
CAL METHOD
AND LINE TYPE

NEXT CAL STEP

CAL METHOD

STANDARD
(NOT USED FOR
WAVEGUIDE)

OFFSET SHORT

LRL/LRM

TRANSMISSION
LINE TYPE

COAXIAL

WAVE GUIDE

MICROSTRIP

PRESS <ENTER>
TO SELECT

MENU C15A

ENTER
WAVEGUIDE
CUTOFF
FREQUENCY

WAVEGUIDE
CUTOFF FREQ
XX.XXXX GHz

PRESS <ENTER>
WHEN COMPLETE

Step 2. When menu C3F appears, place cursor on **CHANGE LRL/LRM PARAMETERS** and press the ENTER key.

MENU C3F

CONFIRM
CALIBRATION
PARAMETERS

CHANGE
LRL/LRM
PARAMETERS

START CAL

PRESS <ENTER>
TO SELECT

Step 3. Same as Steps 9 through 12 in the Microstrip procedure.

Chapter 9
Measurements

Table of Contents

Chapter 9 Measurements

9-1 INTRODUCTION

This section discusses four typical measurements that can be made with the Model 360B Vector Network Analyzer.

9-2 TRANSMISSION AND REFLECTION MEASUREMENTS

This discussion provides information on general measurement considerations and transmission and reflection measurements using the 360B.

APPLY POWER TO THE SYSTEM

- First, Turn On the Source
- Then, Turn On the Analyzer

SETUP

- System Should Be Warmed Up for At Least 60 to 90 Minutes

DEFAULT PARAMETERS

- Known-Good Starting Point
- Selected With the DEFAULT PROGRAM Key

SWEEP TEST MENU

- Start and Stop Frequencies
- Source Power Level

NOTE:
The Port 1 power level is about 10 dB less than the source power level.

Setup and Calibration

To get started, apply power to the system. Do this by first turning on the 360B signal source power switch then the analyzer power.

After turning on the power, allow the system to warm up for at least 60 to 90 minutes before operation.

In normal operation, the system comes on line in the state that it was in when last turned off. If you want to return the system to its default state, you can do so by pressing the DEFAULT PROGRAM key twice.

The default parameters provide a known starting point. For example, they reset the start and stop frequencies for maximum sweep width, the source power to +5 dBm, and the display resolution to 501 data points.

The Sweep Setup menu should now appear on the display (it also can be displayed using the SETUP MENU key). If you like, you can select a new start frequency, stop frequency, or source power.

The actual power level at Port 1 is about 10 dB less than the source power level due to internal losses in the test set.

If the 360B system has an Active Device Test Set, you can further reduce the power level at Ports 1 and 2 with the built-in attenuators. Using the Reduced Test Signals option in the Sweep Setup menu, you can change the settings of the Port 1 and 2 source attenuators over a range of from 0 to 70 dB.

SWEEP SETUP MENU

- Use the “Reduced Test Signals” Option to Add Attenuation With the 3620A, 3621A, or 3622A Active Device Test Sets

CALIBRATION

- Select BEGIN CAL Key
- Select Type of Calibration
- Select Frequency Range of Calibration
- Install Calibration Kit Devices As Instructed by the Menu
- Modify the Capacitance Coefficients and the Offset Lengths, If Required
- Store the Calibration Data Internally or to Disk

MEASUREMENT OPTIONS

- Displays
- Markers
- Limits
- Outputs
- Sweeps
- Enhancements

DISPLAYS

- Four Channels
- Each Channel Can Display Up to Two Graph Types
- Calibration Parameters Can Be Selected By Any Channel

The Port 2 test attenuator has a range of from 0 to 40 dB (in 10 dB steps).

Selecting the BEGIN CAL key starts the calibration process. The Calibration menus step you through the calibration process, as follows:

Select the type of calibration desired.

Select the frequency range of calibration. You can choose the normal 501 points, CW (one point), or N-discrete frequencies (from 2 to 501 points), or time domain calibration.

Install the calibration kit devices to the test ports as instructed by the menu. Both the capacitance coefficients for the Open and the offset lengths for the Open and Short can be modified or defined.

When the calibration is completed, you can store the calibration data on a disk. You are now ready to install the test device and proceed with the measurement. At this point you have a number of measurement options to consider such as displays, markers, limits, outputs, sweeps, and enhancements.

You can select any of the available graph types and display them for any calibrated parameter on any of the four channels.

MARKERS

- Selectable User Marker Menu
- 6 Markers Available
- Delta And Max/Min Modes

Up to six markers are available. Using the Marker Menu, you can set the frequency of each one, you can set each one in the delta marker mode, and you can set each marker's level to maximum or minimum.

LIMITS

- Selectable Using LIMITS Key
- Two Limit Lines Available for Each Channel
- Functions With All Graph Types

In some cases—such as in a production environment—limit lines are desireable. Options within the menu called up using the LIMITS key, provide two limit lines for each channel. These limit lines function with all of the graph types, including Smith and admittance. The color of the limit lines (blue) differs from that of the measurement trace. This allows for easy analysis of results.

OUTPUT

- Select START PRINT Key to Output Display
- Use the Output Menu to Choose Output Type and Output Device

The Output Menu (Figure 9-1) gives you a choice between a printer and a colored-pen plotter. It also lets you select menus from which you may chose from a variety of print or plot options.

SELECT OUTPUT DEVICE
PRINTER
PLOTTER
OUTPUT OPTIONS
SETUP OUTPUT HEADERS
DISK OUTPUT OPERATIONS
PRINT OPTIONS
PLOT OPTIONS
PRESS <ENTER> TO SELECT

Figure 9-1. *Output Menu*

OUTPUT HEADERS

- Selected With DEVICE ID Key or From the Output Menu Under the Setup Output Headers Option
- Labels Output With Device/Serial Number, Date, And Operator's Name

To output the display, press the START PRINT key. The default setting provides for a full display printout from the associated printer.

To label the output, select Setup Output Headers in the Output Menu or press the DEVICE ID key.

On the output to the printer, plotter, or disk. a menu then appears that lets you specify the device name/serial number, the date, and the operator's name (Figure 9-2).

```
DATA OUTPUT
HEADERS
MODEL
FILTER
DEVICE ID
870124
DATE
29_JUNE_87
▸ OPERATOR     ON
MIKE
PRESS <ENTER>
TO TURN ON/OFF
```

```
SELECT NAME
FILTER_#2---
ABCDEFGHIJKLM
NOPQRSTUVWXYZ
0123456789_/#
DEL CLEAR DONE

TURN KNOB
TO INDICATE
CHARACTER
OR FUNCTION

PRESS <ENTER>
TO SELECT

NUMBERS MAY
ALSO BE
SELECTED
USING KEYPAD
```

Figure 9-2. *Label Menus*

SWEEPS

- Start/Stop Frequencies Can Be Changed With Calibration Applied
- Marker Sweep Available From the Setup Menu
- Data Points Selectable Using the DATA POINTS Key

Sweep frequencies can be changed with the calibration applied as long as the frequencies are between the calibration start and stop frequencies.

Additionally, a marker sweep can be selected from the Setup Menu. This allows you to sweep between any two active markers as long as the frequency of each falls between the calibrated start and stop frequencies.

Using the DATA POINTS key, you can select the number of data points for optimal resolution-vs-speed.

ENHANCEMENTS

- Intermediate Frequency Bandwidth Changed Using the IFBW Key
- Averaging and Smoothing Values Set Using AVE/SMOOTH MENU Key
- Averaging and Smoothing Turned On or Off Using TRACE SMOOTH and AVERAGE Keys

Finally, you can enhance the measurement data by reducing the IF bandwidth and using averaging and/or smoothing.

- ☐ Change the IF bandwidth by selecting the IF BW key.
- ☐ Set the averaging and smoothing values by selecting the AVG/SMOOTH MENU key.
- ☐ Turn on the averaging and smoothing using the TRACE SMOOTH and AVERAGE keys, which have LED's to let you know that the enhancement is being applied.

Measurement Discussion

Before going any further, let us take a few moments to review some basic principles of network measurements. First, we apply incident energy to the input of a test device. If the device's input impedance differs from the measurement system's impedance, some of that energy is reflected. The remainder is transmitted through the device. We call the ratio of reflected-to-incident energy the reflection coefficient. The ratio of transmitted-to-incident energy we call the transmission coefficient (Figure 9-3).

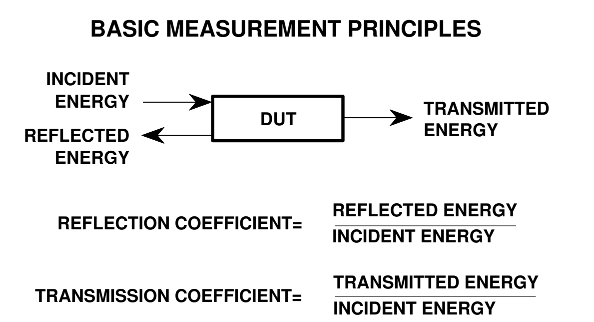


Figure 9-3. Basic Measurement Principles

These ratios are complex quantities that have magnitude and phase components. Using vector representation, the vector magnitude is the ratio of reflected-to-incident magnitude (or transmitted-to-incident magnitude), while the vector phase is the difference in phase between the incident energy and the reflected/transmitted energy (Figure 9-4).

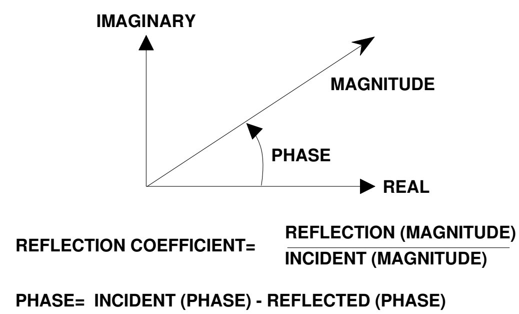


Figure 9-4. *Magnitude/Phase Vector*

REFERENCE PLANE

- Defined At the Test Port Measurement Plane As

  Magnitude = 1
  Phase = 0 Degrees

- Established During Calibration

The measurement reference for the incident energy is the point at which the device connects to the measurement system. We call this point the reference plane. The incident energy at the reference plane is defined as having a magnitude of 1 and a phase of 0 degrees. We establish this during the calibration.

The ratio of reflected and transmitted energy to the incident energy can be represented by a number of different measurements and units, as shown below.

MEASUREMENTS

- Log Magnitude
- Phase
- Smith Chart (Impedance)
- Group Delay (See paragraph 3-13)
- Admittance Smith Chart
- Linear Polar
- Log Polar
- Linear Magnitude
- Real and Imaginary

The default display for reflection measurements is the Smith chart. The default display for transmission measurements is the Log Magnitude and Phase graph.

The Smith chart is a convenient way to display device impedance and is a useful aid for the graphical design and analysis of microwave circuits (Figure 9-5).

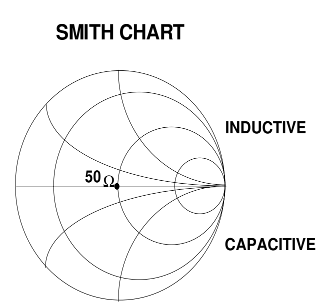


Figure 9-5 *Smith Chart Display 1*

DEFAULT DISPLAYS

Reflection

- Smith Chart

Transmission

- Log Magnitude and Phase Graph

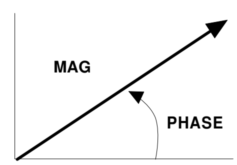
Let us assume both that our system is already calibrated and that we have equalized the system for the test port in use. We would then

1. *Connect the Short*. A Short always appears as a dot at the left-most edge of the Smith chart's horizontal axis.

2. *Connect a Termination*. Now you will see another dot located at the center (1+j0) of the chart (this assumes a 50-ohm load).

3. *Connect the Open*. An Open appears as an arc on the chart's right edge. This is due to the fringing capacitance of the Open standard (Figure 9-6).

MAGNITUDE AND PHASE OF
EACH ERROR SIGNAL IS MEASURED



THEN THE RESULTANT VECTOR IS
APPLIED MATHEMATICALLY, HENCE
VECTOR ERROR CORRECTION

Figure 9-6. *Smith Chart Display 2*

Now let us perform a reflection measurement on a 20 dB attenuator over the 1-to-18 GHz range.

We need to determine the setup, calibration, and measurement requirements.

REFLECTION MEASUREMENT

Example: 20 dB Attenuator

- Setup
- Calibration
- Measurement

SETUP

- Reset With the DEFAULT PARAMETERS Key
- Set the Start Frequency to 1 GHz
- Set the Stop Frequency to 18 GHz

CALIBRATION

- BEGIN CAL Key
- REFLECTION ONLY

MEASUREMENT

- Select Log Magnitude Display
- Install DUT
- Autoscale
- Set Marker 1 to Max, Marker 2 to Min

A known good starting point is to reset with DEFAULT PARAMETERS. Since our measurement lies between 1 and 18 GHz, set the Start and Stop frequencies using the Sweep Setup menu that appears on the display following system reset.

Let us perform a simple calibration, REFLECTION ONLY, which uses an open, a short, and a broadband load. To do this, press the BEGIN CAL key and follow the directions in the menu area.

When you complete the calibration, the “CHANNEL 1 WITH S11” Smith chart appears on the display. Now:

1. Select the Log Magnitude display and install the attenuator.

2. Select AUTOSCALE to optimize the display data.

3. Use Markers 1 and 2 to find the maximum and minimum impedance.

TRANSMISSION MEASUREMENT

Example: 20 dB Attenuator

- Setup
- Calibration
- Measurement

SETUP

- Use Default Parameter Settings

CALIBRATION

- BEGIN CAL Key
- Frequency Response (Transmission Response Only)

Now let us perform a transmission measurement on the same 20 dB attenuator over the same frequency range. We will follow the same steps as before, but this time we will use additional features.

Once again, reset the system using the DEFAULT PARAMETERS key.

In this calibration we will select the N-Discrete Frequencies menu option and step all frequencies in increments of 50 MHz.

When the calibration is complete, Channel 1 will display “S21 FORWARD TRANSMISSION WITH LOG MAGNITUDE AND PHASE.” You can use Markers 1 and 2 to find the maximum and minimum values of the attenuators insertion loss.

9-3 LOW LEVEL AND GAIN MEASUREMENTS

This discussion provides methods and techniques for making gain and low-signal-level measurements. It is divided into 360B system considerations and test device considerations.

360B System Considerations

The 360B system is limited in its ability to test low-signal levels by its dynamic range and low signal-to-noise-power ratio. First we will discuss receiver dynamic range, which is the difference between the maximum and minimum acceptable signal levels (Receiver Dynamic Range = Pmax – Pmin).

DYNAMIC RANGE LIMITS

- High Level Accuracy Limited by the Compression of the Receiver
- Low Level Accuracy Limited by Noise and Leakage SIgnals

Receiver Dynamic Range

The dynamic range of the 360B is limited by the 0.1 dB compression level of the samplers at high signal levels. It is further limited at low signal levels by leakage signals and noise.

Figure 9-7 shows the detected output signal as a function of the power level at the sampler. The 0.1 dB compression level is on the order of –10 dBm. The 360B is designed such that all other conversions compress at a much greater level, which leaves the samplers as the main source of nonlinearity.

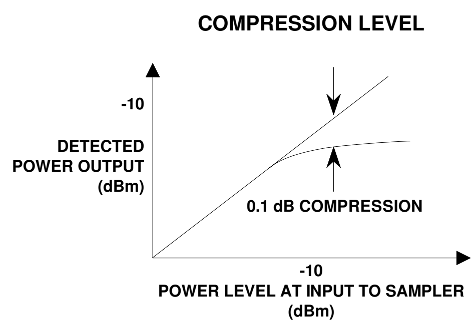


Figure 9-7. *Compression at 0.1 dB*

The small signal response is limited by errors due to noise and leakage signals. The leakage signals are both from within the 360B and at the device-under-test (DUT) connectors.

The detected signal is the vector sum of the desired signals, the noise signals, and the leakage signals. These signals introduce an error or uncertainty (Figure 9-8).

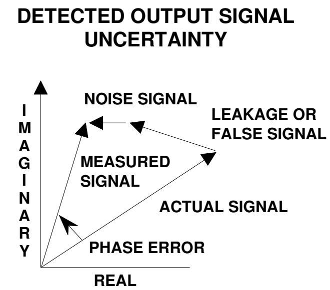


Figure 9-8. *Amplitude and Phase Uncertainty*

LEAKAGE PATHS

- Transfer Switch (120 db)
- Frequency Conversion Module
- DUT Leakage

Some of the possible leakage paths for the 360B are the transfer switch, the frequency conversion module, and leakage from the DUT. The system limits these leakages to greater than 100 dB. The 12-term error correction can reduce this leakage to better than 110 dB at 18 GHz and 90 dB at 40 GHz.

DUT LEAKAGE

- Should Be Greater Than 90 dB to Assure Accurate Measurements

The DUT connectors should have internally captivated center pins. Those connectors which use external pins to captivate the center conductor should have silver loaded epoxy on the pins to reduce radiation to better than 90 dB.

Signal To Noise

S/N Ratio For Test or Reference Channel

$$SN = \frac{SignalPower(dBm)}{NoisePower(dBm)}$$

Signal-to-Noise-Power Ratio

The signal-to-noise-power ratio for each of the test or reference channels is as shown. The “signal power” is the power level of the 83.33 kHz IF signal at the internal synchronous detectors, and the “noise power” is the total power contained within the bandwidth of the bandpass filter at 83.33 kHz.

The uncertainty, or error, in a measurement is a function of the amplitude of leakage signals and of the noise level. The uncertainty in the measurement of magnitude and phase of the s-parameters are calculable and shown below in Figures 9-9 and 9-10.

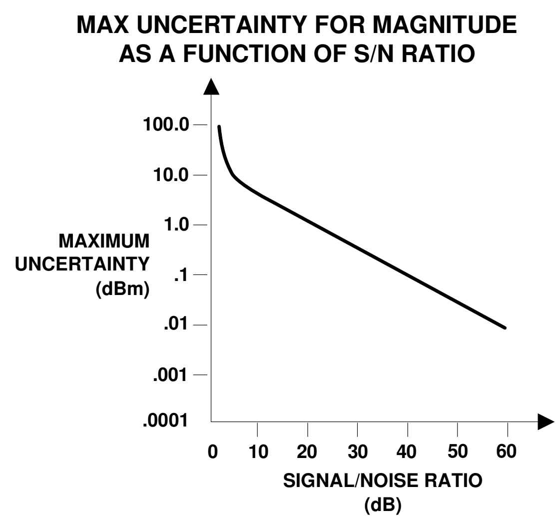


Figure 9-9. *The Effect of S/N Ratio On Magnitude Measurements (Noise Only)*

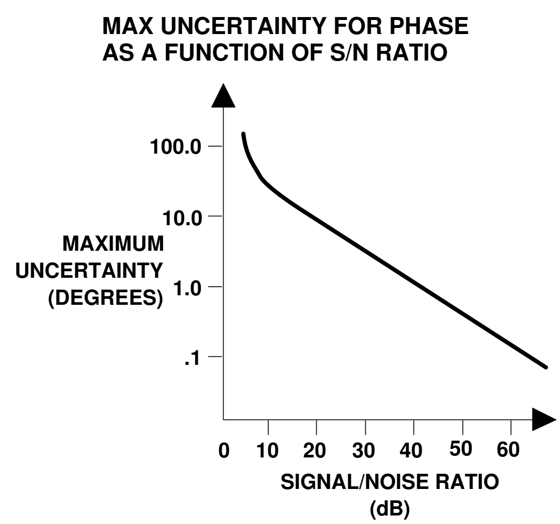


Figure 9-10. *The Effect of S/N Ratio On Phase Measurements (Noise Only)*

The most difficult types of measurements are those that exercise the full dynamic range of the 360B, such as filters (Figure 9-11). Filter measurements are examples of where one must observe both low-insertion loss (in the passband) and high attenuation (in the stop band).

TECHNIQUES TO MAXIMIZE THE S/N RATIO

- Maximize RF Signal Level
- Signal Enhancement

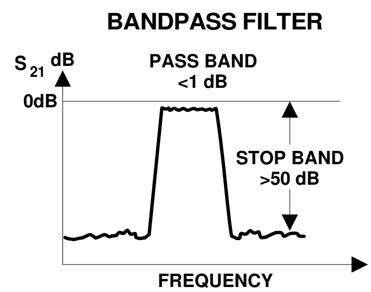


Figure 9-11. Filter Measurements

MAXIMIZE RF SIGNAL LEVEL

- Maximum Dynamic Range
- Optimum Linearity

There are two techniques that you can use to optimize the signal-to-noise ratio. They are (1) maximizing the RF signal level and (2) using signal enhancement.

To maximize the RF signal level, use the default settings of the signal source. The 360SS47 or 69 defaults to +5 dBm—a power level that both maximizes dynamic range and optimizes linearity.

ENHANCEMENTS

- IF Bandwidth Reduction
- Averaging

The 360B provides two enhancements for improving the signal-to-noise ratio: IF bandwidth reduction and averaging.

IF BANDWIDTH REDUCTION

- Three Bandwidths Available
- Noise is Decreased
- Faster Than Averaging

Reducing the IF bandwidth is a primary method for enhancing accuracy. The 360B has a choice of three bandwidths available from the front panel: Normal (10 kHz), Reduced (1 kHz), and Minimum (100 Hz). The noise level should decrease by a factor equal to the square root of the IF bandwidth. Using IF Bandwidth reduction makes for faster measurements than with the use of an equivalent amount of averaging.

AVERAGING

- Up to 4096 Averages
- Reduces Noise
- Increases Sweep Time

Averaging is another way to improve accuracy. The improvement is proportional to the square root of the number of averages. The improvement from averaging, however, comes at the expense of increased sweep time.

Figure 9-12 shows the measured reduction in noise due to bandwidth and averaging.

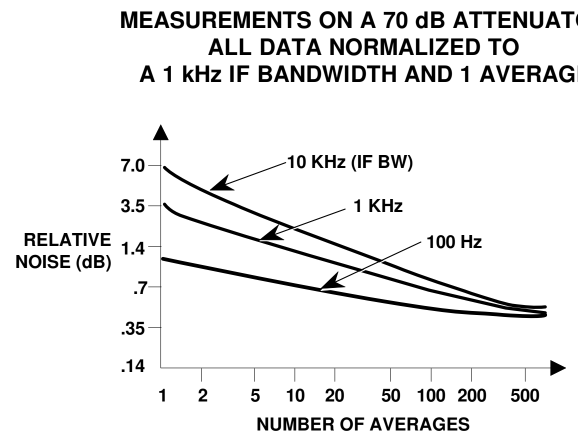


Figure 9-12. *Reduction in Noise Using Averaging*

For a given bandwidth and number of averages, Table 9-1 states the signal-to-noise ratio improvement and relative-time factor required for the measurement. *Example:* Using 1 kHz BW reduction and 10 averages, you would increase the signal-to-noise ratio by 7.6 dB but would lengthen the time required for the measurement by a factor of 4.3. This example assumes a constant signal power.

Table 9-1. *Comparisons of Signal-to-Noise Enhancement Options—1 Channel, 187 Points*

IF BW Reduction	Number of Averages	*S/N Ratio Improvement (dB)	Relative Time Factor
10 kHz	1 10 100 500	0 5.3 9.0 11.0	1 2.8 12.5 59.5
1 kHz	1 10 100 500	2.4 7.6 10.1 11.6	1.6 4.3 12.6 61.0
0.1 kHz	1 10 100 500	7.8 9.4 10.5 11.6	6.2 8.0 13.0 62.2

* Assumes a constant signal power

Test Device (DUT) Considerations

In order to test a device, the required input RF level and the expected device output RF level must be determined.

PORT 1 RF OUTPUT LEVEL

- –10 dBm
- Can Add Up to 70db Attenuation in 10 dB Steps

The RF level at Port 1 must be set for the device input RF power level required. The power level at Port 1 is about 10 dB less than the RF source power level, or about –10 dBm. Attenuation can be added in steps of 10 dB up to 70 dB using the built-in source attenuator in the Models 3620A, 3621A, and 3622A Active Device Test Sets.

PORT 2 RF INPUT LEVEL

- –10 dBm Maximum
- Can Add Up to 40 dB Attenuation in 10 dB Steps

The RF level into Port 2 should be kept to –10 dBm or less to ensure optimum linearity and to protect internal components from damage. The never-to-exceed RF level into either Port 1 or Port 2 is +20 dBm. You can add up to 40 dB of attenuation (in 10 dB steps) into Port 2 using the built-in test attenuator in the active device test sets.

EXTERNAL ATTENUATORS

- Use Only if Internal Attenuator Is Not Available—They Invalidate DUT Match Data

If you are using a test set that does not have built-in attenuators, you should use external attenuators on Port 1 and Port 2 as needed. However, the use of external attenuators invalidates input and output match measurements; whereas, the built-in attenuators are compensated by the calibration and do not affect reflection measurements.

Before calibration, ensure that the test setup is correct by setting the power level and adding attenuation as needed.

CALIBRATION

- Set Desired RF Signal Level
- Include Attenuation As Needed

The 360B uses enhancements in the calibration to ensure a wide dynamic range. It automatically selects the REDUCED IF bandwidth front panel setting and varies the number of averages with the calibration device. Terminations require the most averages.

CALIBRATION

- IF Bandwidth REDUCED Setting
- Number of Averages Varies With Calibration Device Measured

If desired, the IF bandwidth and number of averages can be specified for the calibration measurements. Using 100 averages (AVG = 100) appears to be sufficient for most measurements.

CALIBRATION

- Can Select the Desired IF Bandwidth and Averaging

To obtain the maximum performance from the 360B for measurements of attenuation, you can use the capability of the N discrete frequency calibration to spot check measurements in the frequency band of interest.

TO MEASURE HIGH ATTENUATION

- 10 dBm Source Power
- 100 Averages in Calibration
- 100 Averages in Measurement

The measurement procedure is straight forward, as shown below.

MEASUREMENT PROCEDURE

- Determine DUT I/O RF Levels
- Set Source RF Level
- Set Port 1 Source Attenuator and Port 2 Test Attenuator

EXAMPLE - FILTER

- No Attenuator Needed
- IF Bandwidth "REDUCED" and 100 Averages

EXAMPLE - FET

- Set Port 1 Source Attenuator to 20 dB
- No Port 2 Attenuator Is Needed
- Calibrate
- Use IF Bandwidth and Averaging As Desired

EXAMPLE - AMPLIFIER

- No Port 1 Attenuator
- Port 2 Test Attenuator to 10dB

Wide Dynamic Range Device - Filter
Since you do both low-insertion-loss and high-attenuation measurements simultaneously, use the maximum RF signal level and no attenuation. Selecting the REDUCED IF BW setting and 100 averages will likely suffice for this kind of measurement.

High Gain Device - FET
This device has a typical 15 dB gain and requires an input level of about –30 dBm. Set the Port 1 Source Attenuator to 20 dB. Since the device RF output level is –15 dBm (–30 dBm + 15 dB[gain] = –15 dBm) no attenuation is needed at Port 2.

Medium Power Device - Amplifier
Measure the small signal parameters of a 10 dB gain device that requires an input power level of –10 dBm. Here, Port 1 will have no attenuation. The device RF output level is –10 dBm. This level equals 0 dBm (–10 dBm + 10 dB[gain] = 0 dBm) into Port 2 and will cause compression in the measurement. At least 10 dB of test attenuation will be needed at Port 2, which will reduce the Port 2 RF level to –10 dB.

9-4 GROUP DELAY MEASUREMENTS

Group delay is the measure of transit time through a device at a particular frequency. Ideally, we want to measure a constant—or relatively constant—transit time over frequency. The top waveform shown in Figure 9-13 is measured at one frequency. The bottom waveform is identical to the first, simply delayed in time.

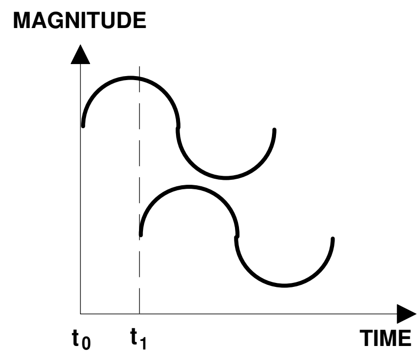


Figure 9-13. *Two Waveforms Delayed in Time*

Referring to Figure 9-14, the first waveform shown is the original waveform. It is made up of many frequency components. After traveling through a device the signal is delayed in time. Some frequencies are delayed more than others and thus our waveform does not have exactly the same shape as before.

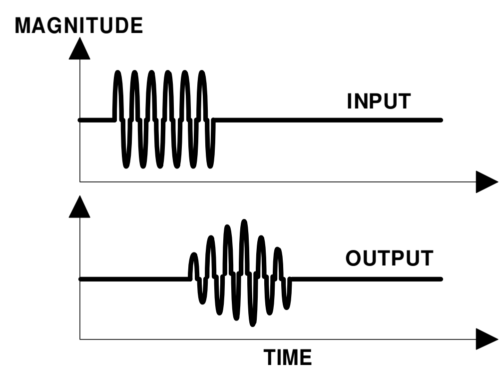


Figure 9-14*. Waveform with Frequency Differences*

NONLINEAR DELAY = DISTORTION

When delay is nonlinear, as shown above, distortion occurs. By measuring group delay with a network analyzer you can characterize the distortion that occurs from a signal traveling through your test device.

GROUP DELAY

- Measure During Design
- Avoid Distortion Later

When designing components it is important to measure group delay so that you can compensate for any distortion caused by the component. You may be able to tune the device so as to optimize the performance of group delay over the frequency range of interest. Outside of the specified frequency range, the group delay may or may not be linear.

GROUP DELAY

- Measure During Test
- Optimize Performance

So how is group delay measured? Signals travel too fast to enable measuring the input and output times of each frequency component. Consequently, we must use mathematical calculations to derive the group delay from the phase slope.

HOW IS GROUP DELAY MEASURED

Mathematical Representation of the Phase Slope

Group delay is mathematically represented by the following equations:

$$\tau = -\frac{d\theta}{d\omega} = \frac{-1}{2\pi}\frac{d\theta}{df} = \frac{-1}{360}\frac{d\theta}{df} = \frac{1}{2\pi}\frac{\Delta\theta}{\Delta f}$$

What this equation shows is that group delay is a measure of the change in phase with relation to the change in frequency.

The change in frequency is referred to as an aperture.

$$\Delta f = Aperture$$

To measure group delay the frequency aperture must be selected. Depending on the size of aperture, different levels of precision can result for the measurement of group delay.

$$Aperture = \frac{Frequency\ Range}{\#\ Of\ Data\ Points}$$

A wide aperture results in a loss of fine-grain variations but gives more sensitivity in the measurement of time delay. A small aperture gives better frequency resolution, but at the cost of lost sensitivity. Thus, for any comparison of group delay data you must know the aperture used to make the measurement (Figure 9-15).

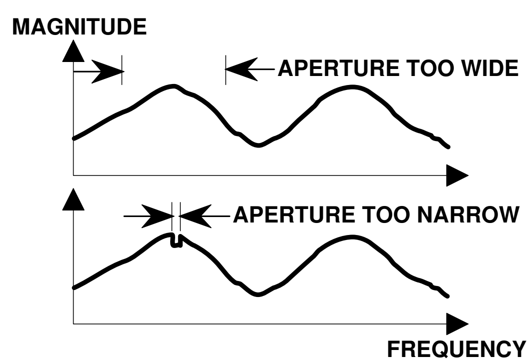


Figure 9-15. *Waveforms With Aperture Differences*

Let us take a look at a group delay measurement made on the ANRITSU 360B Vector Network Analyzer. Group delay, as a measurement option, can be found in the Graph Type menu. After selecting the option, the 360B displays the data in a time-vs-frequency graph, or to be more exact, a group-delay-vs-frequency graph (Figure 9-16).

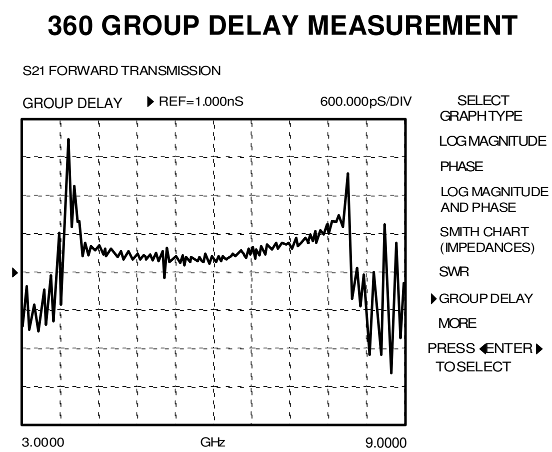


Figure 9-16. *Group Delay-vs-Frequency Graph*

The 360B automatically selects the frequency spacing between data points—that is, the aperture. Notice that this value is displayed on the screen with the measurement (Figure 9-17).

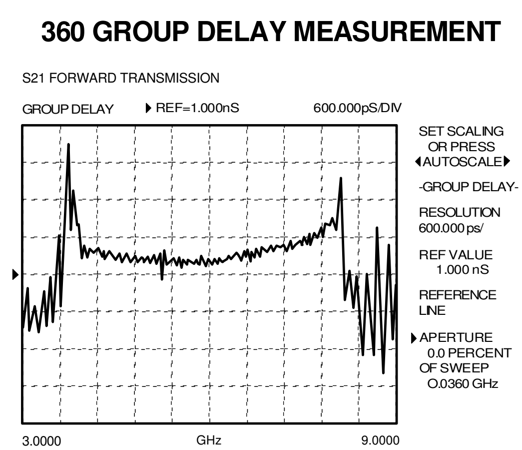


Figure 9-17. *Group Delay Screen Showing Aperture*

The aperture defaults to the smallest setting for the frequency range and number of data points selected. This value is displayed in the SET SCALING menu when measuring group delay (Figure 9-18).

360 APERTURE

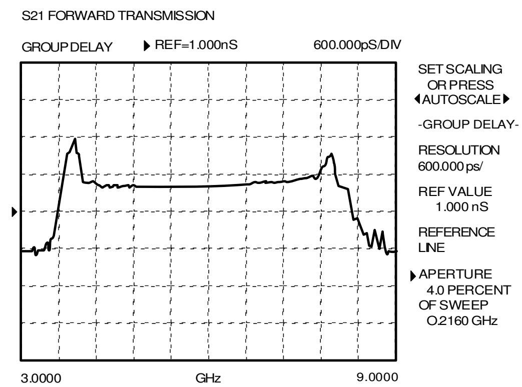


Figure 9-18. *360 Aperture*

GROUP DELAY APPLICATIONS

- Communications

Group delay applications are found throughout the microwave industry, although the majority of such measurements are made in the telecommunications area.

One occurrence of group delay that you may have experienced is with a long-distance telephone call. Occasionally a phone call can be disturbing because of the delay in time from when you speak and when the other person responds. If there is simply a delay, then time delay—or linear group delay—has occurred. But if the voices are also distorted, then non-linear group delay has occurred. It is this distortion that we must avoid. We can avoid linear group delay by measuring group delay both during the design and development stages and during recalibration in the field.

One final group-delay application is found in the development of components. In this application, group delay is measured for the transit time of a signal through the device. When time is of the essence in a fast switching system, as in a modern computer, the travel time through a device is critical.

9-5 ACTIVE DEVICE MEASUREMENTS

Active devices are key components in microwave systems.

The measurements that are made on active devices are similar to those made on passive devices.

ACTIVE DEVICES

- FETs
- Amplifiers
- MMIC's

Active devices come in many shapes and sizes. In most cases we are going to have to develop a fixture in which to mount the device.

Active devices require bias voltages, and in many cases they are easily damaged. High gain amplifiers may saturate with input signals of –50 dBm! With active devices, we have a new set of measurement requirements.

COMMON MEASUREMENTS

- S_{11} Input Match
- S_{21} Gain
- S_{12} Reverse Isolation
- S_{22} Output Match

ANRITSU has developed three models of active device test sets (Models 3620A, 3621A, and 3622A) to help you make these types of measurements. These test sets include two 70 dB step attenuators used to adjust the test port power levels. A third 40 dB step attenuator is also included in the forward transmission path to allow measurement of high gain devices without sacrificing reverse transmission and reflection measurements (S_{12}, S_{22}). Bias tees on each port are used to bias the device via the test port center conductor. This approach to bias is useful for testing transistors; however, MMIC's usually require bias injection at other points (Figure 9-19).

WHAT'S DIFFERENT?

- Connectors
  - There May Not Be Any
  - Instead You Will See: Tabs-Leads-Pads

ACTIVE DEVICE TEST SETS
ATTENUATORS
Bias Tees

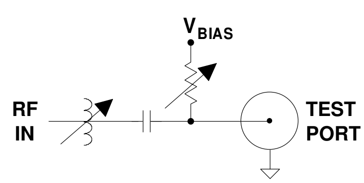


Figure 9-19. *Bias Tee*

WHAT'S DIFFERENT?

- Voltage-Bias Requirements
- Signal Level Performance
  - Power Output
  - Max Input Level
- Non Linear
  - Gain Compression

Test fixtures are necessary for mounting the device so that it can be measured in our coaxial (or waveguide) measuring system (Figure 9-20).

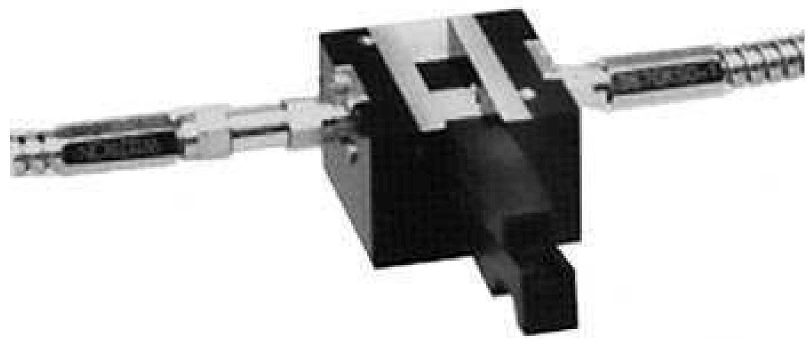


Figure 9-20. Active Device Test Fixture

Now we have an interesting situation. While we can measure the performance at the connector— which is the calibration plane— what we really want to know is how our device performs (Figure 9-21).

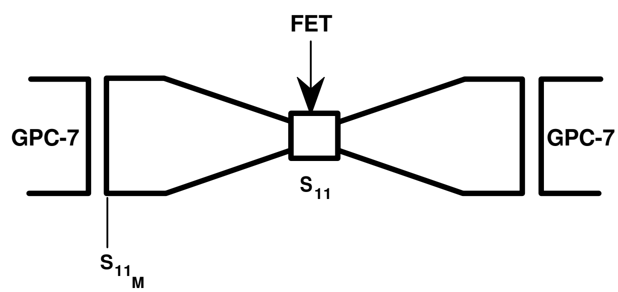


Figure 9-21. Test Device, What It Looks Like

DE-EMBEDDING

Remove or "De-embed" The Effects of the Fixture

You can consider the device embedded in the fixture and can measure the S-Parameters of the fixture with the device installed.

The most elementary situation is a system in which the test fixture is electrically ideal or transparent. In this case the solution is simple— merely move the reference plane out to the device (Figure 9-22).

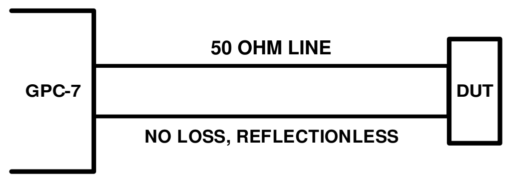


Figure 9-22. Simple Example of De-Embedding

In some cases—depending on the fixture or the device being measured—this is satisfactory. But when it is not, we need to employ other techniques.

One of the reasons that moving the reference plane out to the device does not always work, is that the test fixture includes a transition from coax to a structure such as microstrip, co-planer waveguide, or stripline (Figure 9-23).

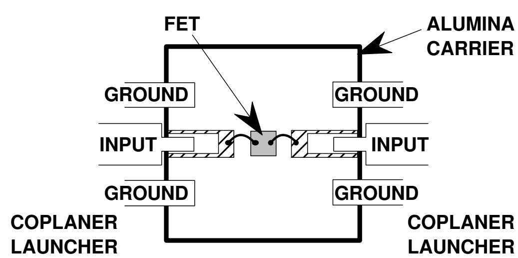


Figure 9-23. Coax-to-Substrate Transition

WHAT DO WE DO?
TWO APPROACHES ARE COMMON

- Calibrate the Fixture As "Part of the Analyzer"
- Characterize the Fixture and Compute the Desired Result

Engineers have come to grips with the general problem. However, there is no established standard approach. Two of the more common approaches are to calibrate the fixture as a part of the analyzer, and to characterize the fixture and compute the desired result.

APPROACH NUMBER 1
CALIBRATE THE FIXTURE

- Special Calibration Devices Required

In the discussion on calibration we saw that the calibration components establish the reference plane and determine the quality of the measurement. If we have a good Open, Short and Z0 load to place at the end of a microstrip line, we can calibrate the system at the point of measurement.

Figure 9-24 shows some of the special test-fixture calibration standards that are available.

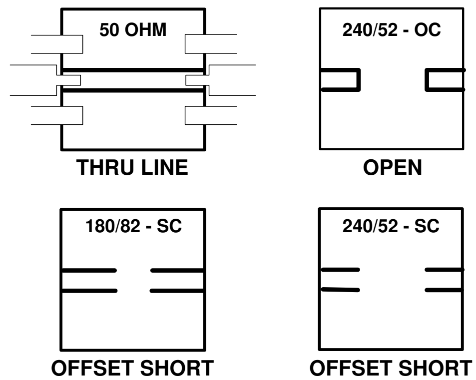


Figure 9-24. Special Test Fixtures

SPECIAL CALIBRATION DEVICES PROBLEMS

- Opens Are Difficult-Radiation Effects
- Good Terminations Are Hard to Find,
  20-30 db Is Often the Best That We Can Do and This Determines the "Effective Directivity"

These special calibration kits are far from perfect, but they are superior to our perfect transmission line assumption.

You may also have heard of the probe stations built to permit on-wafer calibration measurements.

ON-WAFER CALIBRATION

Calibration Standards Are on a Wafer

The Open, Short, termination approach provides three known standards that permit the analyzer to solve for three unknowns (Figure 9-25).

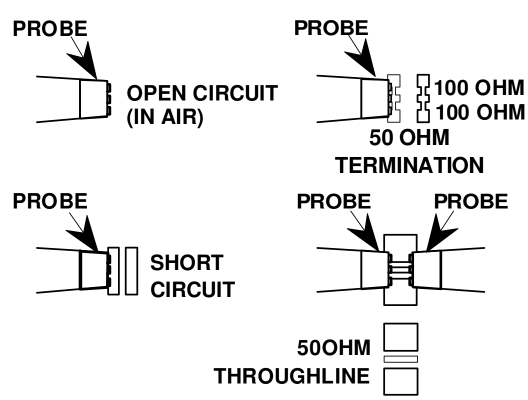


Figure 9-25. *Solving for Unknowns*

CAUTION

You should turn off or disconnect the bias supplies during the calibration, since you are using a Short as the calibration standard.

It is also possible to use three known impedances. For instance, a varactor with three voltages applied (Figure 9-26).

SPECIAL CALIBRATION KITS

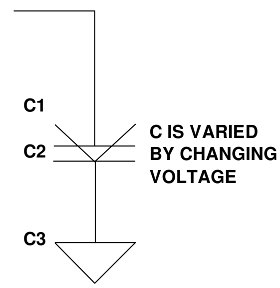


Figure 9-26. Three Known Impedances

**APPROACH NUMBER 2
CHARACTERIZE THE FIXTURE**

- Model
- Measure
- Compute the Desired Result

The second approach is to model the fixture. Modeling is elegant but of limited use due to the non-ideal characteristics of the fixture. Modeling can be accomplished in a CAD system like Touchstone or Compass.

In summary, there are quite a variety of approaches—all with their own characteristic pitfalls. Engineers try to choose the most appropriate technique for their application.

9-6 DUAL SOURCE CONTROL

The Dual Source Control software lets the 360B independently control two sources and a receiver directly, without the need for an external controller. Using this software and a 360B, two ANRITSU compatible sources, and an ANRITSU 36XXA Series Test Set; then mixers, up/down converters, and other devices requiring two-tone stimulus can be tested. Antennas can be tested on a far-field range with one source remote from the 360B.

The frequency ranges and output powers of the two sources can be specified. A frequency sweep can comprise up to five separate bands, each with independent source and receiver settings for convenient testing of frequency translation devices such as mixers. Up to five sub-bands (harmonics) can be tested in one sweep.

Some typical applications of this option are described in the following paragraphs.

Long Distance Antenna Measurements An application of an antenna measurement using dual sources is shown in Figure 9-27. This is an example of the Dual Source Control software controlling two frequency sources and the test set frequency.

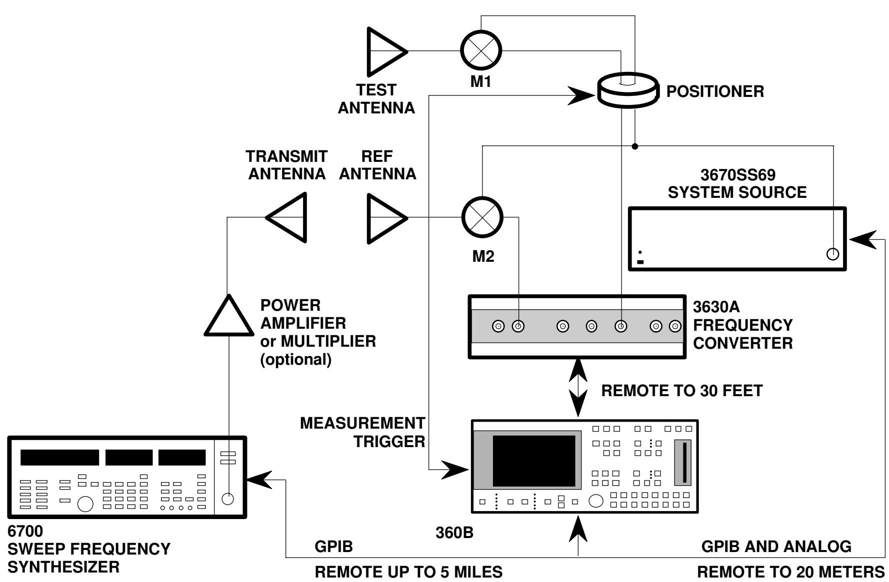


Figure 9-27. *Long Distance Antenna Range with Remote Mixers*

The stimulus for the transmit antenna—which can be up to five miles distant from the 360B—is an ANRITSU 67XX series Sweep Frequency Synthesizer located at the distant transmit antenna. It is remotely controlled by the Dual Source Control software via the GPIB (IEEE-488 interface) bus.

Since the source is far away from the test set, a sample of the source signal cannot be used as the reference. Instead. a fixed antenna located close to the receive antenna is used to supply the reference.

The signal from the test antenna is mixed with the signal from the local oscillator and applied to the 3630A or 3631A Test Set as the test signal. In a second mixer, the signal from the reference antenna is also mixed with the local oscillator and applied to the test set as the reference signal.

The mixers at the antennas convert the reference and test signals to lower frequencies. This arrangement provides the system with a lower overall noise floor than a sampler based test set, providing higher dynamic range.

The 360SS Signal Source, used as the local oscillator for the mixers, is controlled directly by the 360B via the GPIB.

The 3630A or 3631A Test Set enables the user to define the IF frequencies. Harmonic or fundamental mixers can be used, and the test set frequency can be selected for optimum performance.

Selection and placement of the mixers is significant to the performance of the system. Fundamental or harmonic conversion mixers are available. With fundamental mixing, the RF mixes with the fundamental LO to produce the IF. With harmonic mixing, the RF mixes with a harmonic of the LO to produce the IF. Each method has specific advantages and disadvantages that must be considered.

Mixer Testing

Mixer gain/phase matching is easily accomplished by comparing the mixer(s) under test to a reference mixer. With the 3630A or 3631A Frequency Converter Test Set, up to three mixers can be tested on one setup using the four channel display. The ability of the Dual Source Control software to measure up to five bands simultaneously simplifies harmonic mixer testing by displaying as many as five harmonic conversions on one screen. A mixer test setup is shown in Figure 9-28.

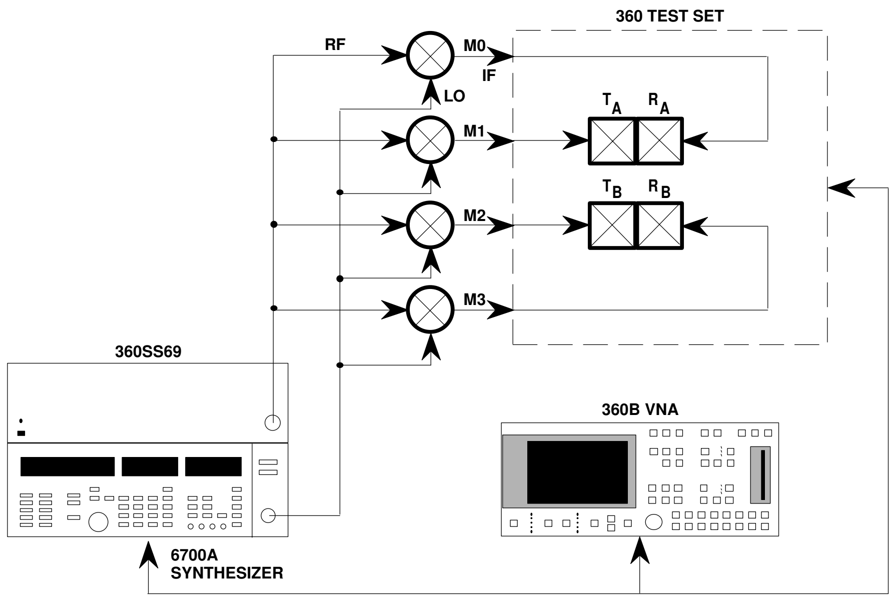


Figure 9-28. *Mixer Testing*

Controllable Sources

The Dual Source Control software can control two sources and a receiver. These can comprise the following:

- **Source #1**: Any one of ANRITSU'S family of 360SS signal sources or any one of ANRITSU'S family of 67XXB synthesizers.
- **Source #2:** Any of ANRITSU'S family of 67XXB synthesizers.
- **Receiver:** Any one of ANRITSU'S family of 36XXA series VNA test sets.

Control Formula

Dual source control is specified as a displayed frequency range partitioned into from one-to-five consecutive bands. For each band Source 1, Source 2, and receiver frequencies may be interdependently specified per the formula:

$$Frequency = \left(\frac{Multiplier}{Divisor}\right) \times \left(\frac{F}{Offset\ Frequency}\right)$$

Where:
- ☐ Multiplier and Divisor are integer constants
- ☐ F is the displayed frequency
- ☐ Offset Frequency is the offset frequency constant

The following rules apply:
- ☐ Multiplier, Divisor and Offset Frequency may be independently specified for each source and receiver.
- ☐ F is global, and is the same value in all formulas.
- ☐ Each source or receiver may, if desired, be set to a CW frequency, removing F from the equation.

NOTE

When a formula results in an unacheivable frequency, such as 1/3 X 1 GHz, the result is rounded to the nearest acheivable frequency, defined by the source frequency resolution. Frequency resolution is 100 kHz for a 360SS and 1 kHz for a 67XXB (2 kHz, 26.5 to 40 GHz). For 40 to 60 GHz, the resolution is 300 kHz for the 360SS and 3 kHz for the 67XXB.

Bands

The displayed frequency range may be divided into up-to five bands. Band 1 must start at the beginning of the frequency range and end at either the user-specified stop frequency or the end of the frequency range. Band 2 must begin at the next point after band 1 ends, and it must end at either the user-specified stop frequency or the end of the frequency range. Band 5 must end at the end of the frequency range. Independent source and receiver control formulas may be specified for each band.

Operation Procedures

Procedures for performing preoperation and operation are given on pages 9-33 thru 9-36.

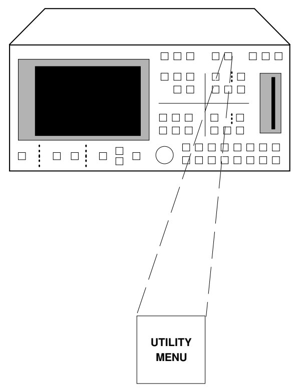
MENU U1
SELECT UTILITY FUNCTION TYPE
GENERAL DISK UTILITIES
CALIBRATION COMPONENT UTILITIES
GPIB ADDRESSES
DISPLAY INSTRUMENT STATE
BLANK FREQUENCY INFORMATION
ALTERNATE BLUE COLOR
VIDEO CONFIGURATION
PRESS <ENTER> TO SELECT

Dual Source Control Preoperational Setup

The two sources receive control information from the 360B VNA over the GPIB (IEEE-488 bus). The GPIB address assigned to a source must be identical to the address contained in the data directed to the source by the 360B VNA. The GPIB address assigned to a source must be the same as the 360B VNA's address for the source. Assure source/VNA address compatibility as follows:

Step 1. Install Sources 1 and 2 on the GPIB (IEEE-488 bus).

Step 2. Press the UTILITY MENU key.



MENU GP7
GPIB SETUP
–360 GPIB–
CR/CR-LF
ADDRESS: 6
–SYSTEM BUS–
CR/CR-LF
INSTR ADDR 0
SOURCE 1 ADDR 5
SOURCE 2 ADDR 4
PLOTTER ADDR 7
POWER METER 3
PRESS <ENTER> TO SELECT

Step 3. Move cursor to **GPIB ADDRESSES** and press ENTER, when menu U1 (left) appears.

Step 4. When menu GP7 (left) appears, observe GPIB address number displayed for **SOURCE 1 ADDR.** Ensure that displayed address is the *same* address programmed into Source 1. (Consult Source 1 operator's manual for procedure to assign address.) If necessary, use keypad to enter Source 1 address on menu.

Observe GPIB address number displayed for **SOURCE 2 ADDR.** In the same manner described above, ensure that it is the *same* address programmed into Source 2.

MENU OPTNS

OPTIONS

SWEEP OPTIONS

REAR PANEL OUTPUT

DIAGNOSTICS

MULTIPLEXER CONTROL

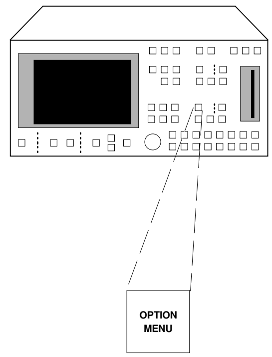
MULTIPLE SOURCE CONTROL

RECEIVER MODE

PRESS <ENTER> TO SELECT

Dual Source Control Operation

Step 5. Press the OPTION MENU key.



Step 6. When menu OPTNS (left) appears, move cursor to **MULTIPLE SOURCE CONTROL** and press ENTER.

Step 7. When menu OM0 (left) appears, move cursor to **DEFINE BANDS** and press ENTER. This brings menu OM 1 to the screen.

MENU OM0

MULTIPLE SOURCE CONTROL

DEFINE BANDS

SELECT MULTIPLE SOURCE STATE

OFF

STANDBY

ON

PRESS <ENTER> TO SELECT OR SWITCH

MENU OM1

DEFINE BANDS

BAND 1

DISPLAYED
FREQ RANGE

BAND START F
XX.XXXXXX GHz

BAND STOP F
XX.XXXXXX GHz

BAND FUNCTIONS

EDIT SYSTEM
EQUATIONS

STORE BAND 1
BANDS STORED:
(1 2 3 4 5)

CLEAR ALL
DEFINITIONS

SET MULTIPLE
SOURCE STATE

PRESS <ENTER>
TO SELECT

MENU OM2

EDIT SYSTEM
EQUATIONS

SELECT
FUNCTION
TO EDIT

SOURCE 1

SOURCE 2

RECEIVER

EQUATION
SUMMARY

C.W. OFF

MULTIPLIER
XX

DIVISOR
XX

OFFSET FREQ
X.XXXXXX GHz

PREVIOUS MENU

PRESS <ENTER>
TO SELECT

Step 8. Coincident with menu OM1, the data display area of the screen presents a chart entitled "RANGES OF BANDS STORED." This chart shows the band start and band stop frequencies that have been stored for each of five bands.

Using menu OM1, the displayed frequency range can be divided into one to five bands.

Band 1 must start at the beginning of the frequency range and end at either the user-specified stop frequency or the end of the frequency range.

Band 2 must begin at the next point after band 1 ends and end at either the user-specified stop frequency or the end of the frequency range.

Step 9. Move cursor to **BAND**; select **BAND 1** by entering "1" using the keypad or rotary knob.

Step 10. Move cursor to **BAND START F**, and use keypad or rotary knob to enter the band 1 start frequency.

Step 11. Move cursor to **BAND STOP F**, and enter the band 1 stop frequency.

Step 12. Move cursor to **EDIT SYSTEM EQUATIONS** and press ENTER.

Step 13. When menu OM2 (left) appears, select **SOURCE 1**.

Step 14. Move cursor to **MULTIPLIER** and use keypad or rotary knob to enter desired multiplier for Source 1. This is the multiplier term in the following equation:

Freq. = (Multiplier/Divisor) X (F + Offset Frequency)

Step 15. Move cursor to **DIVISOR** and use keypad or rotary knob to enter desired **DIVISOR** for source 1. This is the divisor term given in the above equation.

Step 16. Move cursor to either **OFFSET FREQUENCY**, and use keypad or rotary knob to enter desired offset frequency for Source 1; or **C.W. ,** and press ENTER to toggle C.W. to OFF.

The Offset Frequency choice is the offset frequency given in the above equation. The C.W. choice removes F from the equation and places Source 1 in the CW mode.

MENU OM1

DEFINE BANDS

BAND 2

DISPLAYED FREQ RANGE

BAND START F XX.XXXXXX GHz

BAND STOP F XX.XXXXXX GHz

BAND FUNCTIONS

EDIT SYSTEM EQUATIONS

STORE BAND 1
BANDS STORED:
(NONE)

CLEAR ALL DEFINITIONS

SET MULTIPLE SOURCE STATE

PRESS <ENTER> TO SELECT

MENU OM0

MULTIPLE SOURCE CONTROL

DEFINE BANDS

SELECT MULTIPLE SOURCE STATE

OFF

STANDBY

ON

PRESS <ENTER> TO SELECT OR SWITCH

Step 17. Move the cursor to **PREVIOUS MENU** and press ENTER. This returns you to menu OM1 (left).

Step 18. Move cursor to **STORE BAND 1** and press ENTER. This stores the band start frequency, the band stop frequency and the Source 1, Source 2 and Receiver equations.

Step 19. Note that the **BAND** number has incremented to 2.

Step 20. Repeat the above steps to define the start and stop frequencies for bands 2 thru 5. Set up the system equations for each band.

NOTE

Except for band 1, the system software constrains all start frequencies to follow the previous band's stop frequency. However, while frequency bands are being defined or the system equations are being edited, the system is automatically placed in the standby mode. In this mode, frequencies that may be entered are not supervised by the system software; any frequency can be entered and displayed. When the mode is switched to **ON** (in menu OM0, left), the system software restricts the frequencies to band limits. When the mode is switched to **OFF**, the frequencies are restricted to system limits.

Step 21. Define measurement channels and source lock.

Step 22. Calibrate the system.

NOTE

Calibrations are allowed while the multiple source mode is in either the Off or On states. Calibrations are non-transferable between the Off state and the On state. If a calibration has been done with the On state, the user may alter the band definitions. If the calibrated frequency range is not within the stored bands' frequency range a menu warning is displayed when returning the state to On. In addition, if any of the bands' definitions is different from that used in the calibration, a "CAL MAY BE INVALID" warning is displayed in the data area when the correction is applied.

Dual Source Control Operation, Example Using 3630A and 3631A Frequency Converter Test Sets

The 3630A and 3631A Frequency Converters are four-channel receivers that measure magnitude and phase of frequency conversion devices. Two different input frequencies (RF and LO) and the receiver frequency (IF) are controlled from the 360B VNA operating under the Dual Source Control software. Figures 9-27 and 9-28 showed the 3630A/3631A used for antenna measurements and mixer testing.

Figure 9-29 is a block diagram of the 363XA. Compare this to a simplified block diagram of a standard reversing test set such as shown in Figure 9-30. The 363XA Frequency Converter Test Set is not a reversing test set and does not contain front-end signal separation devices.

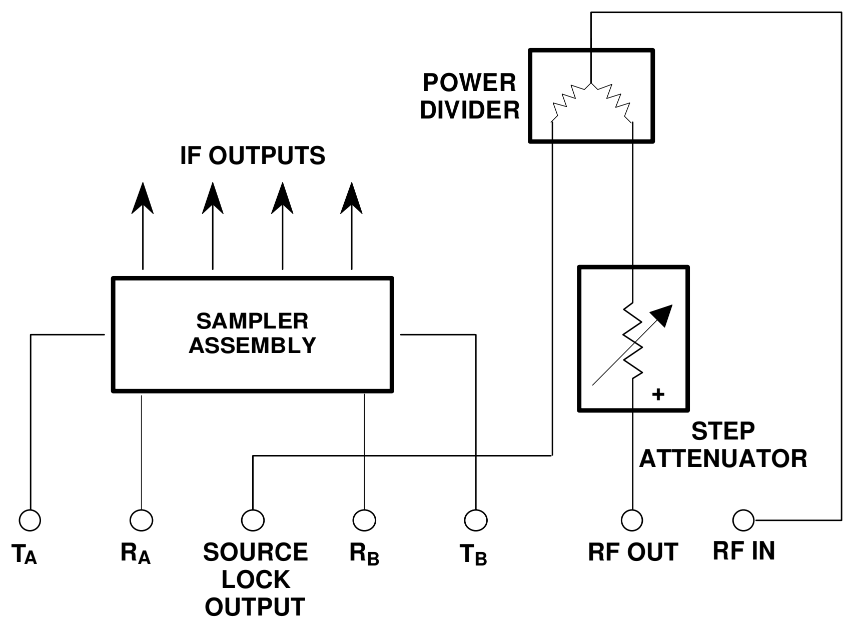


Figure 9-29. *363XA Frequency Converter Test Set Block Diagram*

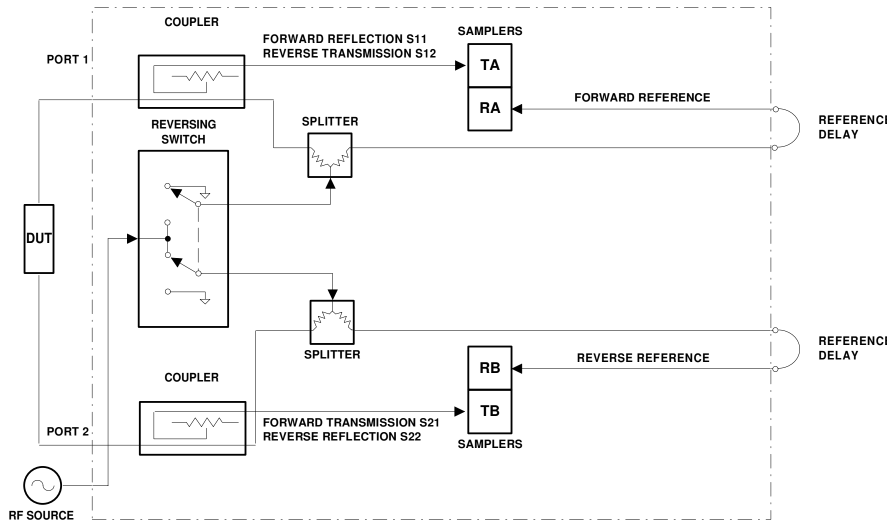


Figure 9-30. *3610 Reversing Test Set Block Diagram*

Preoperational Setup, Discussion

When a fully reversing test set is used with the 360B, the system mathematically compares the relative magnitude and phase changes between the reference and test signals to derive the S-Parameter values for the DUT. These S-Parameters are equivalent to the Multiport Device Definition Ratios as given in Table 9-2.

Table 9-2. *S-Parameter Definitions*

S Parameter	Multiport Device Definition Ratio	360 Measurement Channel Ratio	Measurement Definition
S11	$\frac{b1}{a1}$	$\frac{TA}{RA}$	Forward Reflection
S12	$\frac{b1}{a2}$	$\frac{TA}{RB}$	Reverse Transmission
S21	$\frac{b2}{a1}$	$\frac{TB}{RA}$	Forward Transmission
S22	$\frac{b2}{a2}$	$\frac{TB}{RB}$	Reverse Reflection

Within fully reversing test sets, signal separation and down conversion of the incident, reflected, and transmitted signals at PORTS 1 and 2 result in four IF signals. They are defined as:

R_A (Reference, Channel A) – this signal contains information about the stimulus signal in the forward direction (incident signal) from PORT 1 to the DUT.

T_A (Test, Channel A) – in the forward measurement mode, this signal contains information about the reflected signal from the DUT back to PORT 1. In the reverse measurement mode, this signal contains information about the transmitted signal from the DUT to PORT 1.

R_B (Reference, Channel B) – this signal contains information about the stimulus signal in the reverse direction (incident signal) from PORT 2 to the DUT.

T_B (Test, Channel B) – in the forward measurement mode, this signal contains information about the transmitted signal from the DUT to PORT 2. In the reverse measurement mode, this signal contains information about the reflected signal from the DUT back to PORT 2.

The IF signal ratios that are equivalent to the S-Parameters and Multiport Device Definition Ratios are shown in Table 10-1 in the column headed "360B VNA Measurement Channel Ratio." However, the front-panel nomenclature for the test signals applied to it is consistent with the nomenclature of the IF signal channels of a reversing test set (R_A, T_A, R_B, T_B).

The 360B can measure the ratio of any two of the test signals applied to the 363XA test set. The ratio need not be an S-parameter. Either R_A or R_B can be selected as the reference signal.

Define the ratio you wants to measure by choosing among items presented on a series of menus shown on the 360B display screen. The nomenclature used in these menus is consistent with that of the measurement characteristics of a multi-port device (a_1, a_2, b_1, b_2); it is *not* consistent with front panel nomenclature of the 363XA test set. For purposes of setting-up the 360B VNA for making a measurement using the 363XA test set the following is true:

- ☐ a_1 is comparable to R_A
- ☐ a_2 is comparable to R_B
- ☐ b_1 is comparable to T_A
- ☐ b_2 is comparable to T_B

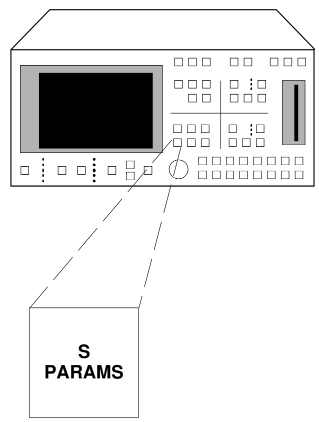
Procedure

A procedure illustrating the pre-operational setup and other operating considerations is provided on the following pages.

Pre-Operation Setup
After the 363XA has been installed in the 360B system and the system is turned on, the 360B will probably display four S-Parameters on the screen. Although this is consistent with a standard reversing test set, the 363XA Frequency Converter Test Set is not usually used in this mode. Therefore, the 360B VNA should be put in the single (or dual) channel mode consistent with the phase lock signal connection (R_A or R_B).

Define the signal configuration using the menus provided on the 360B VNA as follows:

Step 1. Press the front panel S-PARAMS key. This brings the Select S-Parameters menu to the screen (below).



MENU SP

SELECT
S - PARAMETER

S21
FWD TRANS

S11
FWD REFL

S12
REV TRANS

S22
REV REFL

REDEFINE
SELECTED
PARAMETER

PRESS <ENTER>
TO SELECT

Step 2. Select the parameter to be redefined. Move the cursor to that parameter and press ENTER.

Step 3. Select the **REDEFINE SELECTED PAR-AMETER** menu option and press ENTER. This brings the menu PD1 to the screen.

MENU PD1
PARAMETER DEFINITION
S11/USER 2
PARAMETER b1 / a1
PHASE LOCK a1
LABEL: "MY S11"
CHANGE NUMERATOR
CHANGE DENOMINATOR
CHANGE PHASE LOCK
CHANGE LABEL
PRESS <ENTER> TO SELECT OR SWITCH

MENU PD2
SELECT NUMERATOR
b1
b2
a1
a2
1 (UNITY)
PRESS <ENTER> TO SELECT

Step 4. In menu PD1 (left), move the cursor next to the selected parameter (menu top) and press ENTER. This toggles choice to **USER 2**. Note the following:

The definition of the parameter to be measured is shown as a ratio of terms of measurement characteristics of a multiport device (a_1, a_2, b_1, b_2) under **PARAMETER**.

The selected phase lock reference is shown under **PHASE LOCK**.

The name assigned the measurement parameter is shown under **LABEL**.

Each of the above can be changed to suit the conditions of the measurement. The definition can be changed by changing the numerator, the denominator, or both (Steps 5 thru 8)

You can also change the phase-lock parameter or the label (steps **9** and 10).

Step 5. Move the cursor to **PARAMETER** (menu PD1), and press ENTER.

Step 6. Select **CHANGE NUMERATOR** (menu PD1) and press ENTER. This brings menu PD2 (left) to the screen.

Step 7. Choose the numerator of the parameter by selecting **b_1**, b_2, a_1, a_2, or 1 (UNITY) as appropriate for the measurement. Note that the nomenclature a_1, a_2, **b_1**, and **b_2** corresponds to the nomenclature of the signals applied to the 363XA test set in the following way:

b_1 is the signal applied at T_A;

b_2 is the signal applied at T_B;

a_1 is the signal applied at R_A/SOURCE LOCK INPUT;

a_2 is the signal applied at R_B/SOURCE LOCK INPUT.

MENU PD1
PARAMETER DEFINITION
S11/USER 2
PARAMETER b1 / a1
PHASE LOCK a1
LABEL: "MY S11"
CHANGE NUMERATOR
CHANGE DENOMINATOR
CHANGE PHASE LOCK
CHANGE LABEL
PRESS <ENTER> TO SELECT OR SWITCH

Step 8. The denominator of the definition of the measured parameter can be changed also. Select CHANGE DENOMINATOR in menu (PD1). This brings menu PD3 (left) to the screen. As described in step 7, change the denominator.

MENU PD3
SELECT DENOMINATOR
b1
b2
a1
a2
1 (UNITY)
PRESS <ENTER> TO SELECT

MENU PD1
PARAMETER DEFINITION
S11/USER 2
PARAMETER b1 / a1
PHASE LOCK a1
LABEL: "MY S11"
CHANGE NUMERATOR
CHANGE DENOMINATOR
CHANGE PHASE LOCK
CHANGE LABEL
PRESS <ENTER> TO SELECT OR SWITCH

MENU PD4
SELECT PHASE LOCK REFERENCE
a1
a2
PRESS <ENTER> TO SELECT

Step 9. The phase lock reference for a measurement can be selected as a_1 or a_2; these correspond to the R_A/SOURCE LOCK INPUT and the R_B/SOURCE LOCK INPUT respectively. Change the phase lock reference as follows:

With menu PD1 displayed, move the cursor to CHANGE PHASE LOCK then press ENTER. This brings menu PD4 (left) to the screen.

Select a_1 or a_2 as appropriate for the testing requirements.

MENU PD1

PARAMETER
DEFINITION

S11/USER 2

PARAMETER
b1 / a1

PHASE LOCK
a1

LABEL:
“MY S11”

CHANGE
NUMERATOR

CHANGE
DENOMINATOR

CHANGE
PHASE LOCK

CHANGE
LABEL

PRESS <ENTER>
TO SELECT
OR SWITCH

MENU GP5

SELECT NAME
MY S11

ABCDEFGHIJKLM

NOPQRSTUVWXYZ

0123456789-/#

TURN KNOB
TO INDICATE
CHARACTER OR
FUNCTION

PRESS <ENTER>
TO SELECT

NUMBERS MAY
ALSO BE
SELECTED
USING KEYPAD

Step 10. The redefined parameter can be given a suitable name or label. This will appear on the screen naming the measured parameter. Create a label for the redefined parameter as described below.

a. With menu PD1 displayed, move the cursor to CHANGE LABEL then press ENTER. This brings menu GP5 to the screen.

b. Create a name for the measurement parameter by selecting a series of up to five alphanumeric characters from among those provided in menu GP5. Use the control knob to move the cursor to the first alphanumeric to be used in the intended name. Press ENTER to select character and note that it appears in the first blank space below **SELECT NAME** at the top of the menu. (The name “MY S11” is used for this example.)

c. Repeat step 2 and choose up to five characters. If an error is made, select **DEL** to delete character or select **CLEAR** to clear name.

d. When the name is complete, select **DONE**. The name that you have chosen will appear under the LABEL: in menu PD1.

Power Level Considerations

Power level inputs to the 363XA should be less than –10 dBm at all inputs to avoid compression in the output signals. The reference signal selected for phase lock should be between –10 and –25 dBm. A convenient signal for the reference is available at the source lock output connector.

Source power can be controlled from the front panel of the VNA via the Reduced Test Signals menu. Adjust source power as follows:

Press the SETUP MENU key on the 360B VNA. This brings the Sweep Setup menu to the screen.

Select Reduced Test Signals. This brings the Reduced Test Signals menu to the screen.

Adjust source power as required

Menus

The menus associated with Dual Source Control are described in Appendix 1. The menus can be found in the alphabetical listing under their call letters: PD1, PD2, PD3, etc.

Chapter 10
Options

Table of Contents

Chapter 10
Options

10-1 INTRODUCTION

This chapter describes the optional features of Time Domain, Dual Source Control, and Receiver Mode.

10-2 OPTION 2A TIME DOMAIN

TIME DOMAIN
A USEFUL TOOL FOR:

- Identifying and Analyzing Circuit Elements
- Isolating a Desired Response
- Locating Faults
- Making Antenna Measurements

360B TIME DOMAIN MODES

- Lowpass Mode
- Bandpass Mode

LOWPASS MODE

- Either Impulse or Step Response Available
- Displays Impedance Information
- Requires Harmonically Related Frequencies
- Used When Device Has a DC or Low Frequency Path

Time Domain Measurements

The Option 2A, Time Domain feature provides a useful measurement tool for determining the location of impedance discontinuities. Some typical applications are identifying and analyzing circuit elements, isolating and analyzing a desired response, locating faults in cables, and measuring antennas.

The relationship between the frequency-domain response and the time-domain response of a network is described mathematically by the Fourier transform.

The 360B makes measurements in the frequency domain then calculates the inverse Fourier transform to give the time-domain response. The time-domain response is displayed as a function of time (or distance). This computational technique benefits from the wide dynamic range and the error correction of the frequency-domain data.

Let us examine the time-domain capabilities of the Model 360B Vector Network Analyzer. Two measurement modes are available: lowpass and bandpass.

We use the lowpass mode with devices that have a dc or low-frequency response. In the lowpass mode two responses to the device-under-test (DUT) are available: impulse or step response.

The frequencies used for the test must be harmonically related (integer multiples) to the start frequency. The simplest way to calculate this relationship is to divide the highest frequency in the calibration by 500 (the maximum number of points available); this is the start frequency. For example if the highest frequency is 60 GHz, the calculated start frequency is 0.12 GHz (60/500).

LOWPASS IMPULSE RESPONSE

- Location of Discontinuities
- Information on Type of Discontinuities

The lowpass impulse response displays the location of discontinuities as well as information useful in determining the impedance (R, L, or C) of each discontinuity.

The impulse response is a peak that goes positive for $R>Z_0$ and negative for $R<Z_0$. The height of the response is equal to the reflection coefficient

$$\rho = \frac{R - Z_0}{R + Z_0}$$

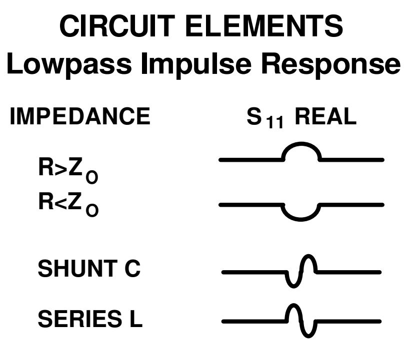


Figure 10-1. Lowpass Impulse Re-

The impulse response for a shunt capacitance is a negative-then-positive peak and for a series inductance is a positive-then-negative peak (Figure 10-1).

An example of using impulse response is circuit impedance analysis. With an impulse response, we can observe the circuit response of a passive device, such as a multielement step attenuator (Figure 10-2), and make final, realtime adjustments during the test.

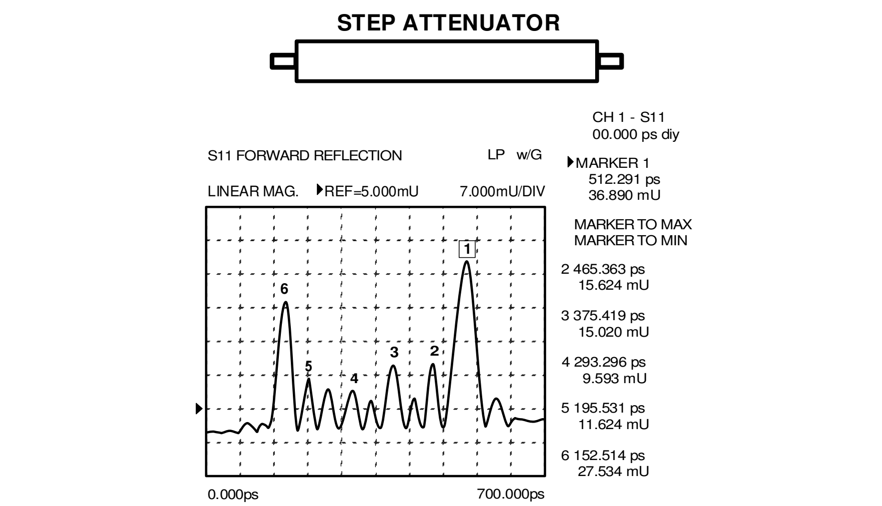


Figure 10-2. *Example of Lowpass Impurse Response*

In the above example, the connectors at each end have been gated out (page 10-12), which lets you better observe the internal circuit response. Each displayed marker has been manually set to the peak of the response at each adjustable circuit element. In this way, the data display lets you make the adjustment in realtime, while the marker menu shows the magnitude of the response at each marker.

The lowpass step response displays the location of discontinuities as well as information useful in determining the impedance (R, L, or C) of each discontinuity. If you are familiar with time-domain reflectometry

LOWPASS STEP RESPONSE

- TDR Measurement
- Location of Discontinuities
- Information on Type of Discontinuities

(TDR) you may feel more comfortable with step response, as the displays are similar.

The lowpass step response for a resistive impedance is a positive level shift for $R>Z_0$ and a negative level shift for $R<Z_0$. The height of the response is equal to the reflection coefficient

$$\rho = \frac{R - Z_0}{R + Z_0}$$

The step response for a shunt capacitance is a negative peak, and for a series inductance it is a positive peak (Figure 10-3).

An example of using the lowpass step response is cable fault location. In the frequency domain a cable with a fault exhibits much worse match than a good cable. Using lowpass step response, both the location of the discontinuity and information about its type are available (Figure 10-4).

CIRCUIT ELEMENTS
Lowpass Step Response

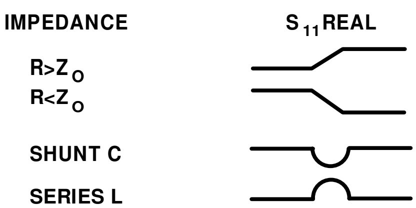


Figure 10-3. Lowpass Step Re-

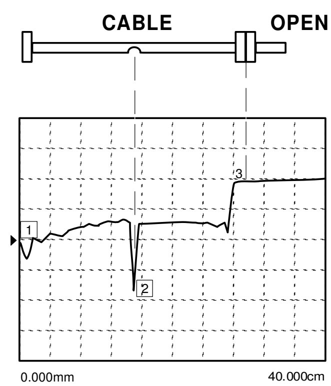


Figure 10-4. Example of Lowpass Step Response

In the above example, the dip in the display shows the shunt-capacitive response caused by a crimp in the cable. The response at the end of the cable shows the step-up that is typical of an open (Figure 10-3).

BANDPASS MODE

- Calculates Impulse or Phasor-Impulse Response
- Uses Any Frequency Range
- Used When Device Does Not Have a DC or Low-Frequency Path

The 360B bandpass mode gives the response of the DUT to an RF-burst stimulus. Two types of response are available: impulse and phasor-impulse. An advantage of the bandpass mode is that any frequency range can be used. Use this mode with devices that do not have a dc or low-frequency path.

BANDPASS IMPULSE RESPONSE

- Magnitude Measurement Only
- Location of Discontinuities
- No Information on Type of Discontinuities

Use the bandpass-impulse response to show the location of a discontinuity in time or distance, as indicated by changes in its magnitude. Unlike the lowpass mode, no information as to the type of the discontinuity is available. A typical use for this mode is to measure devices—such as, filters, waveguide, high-pass networks, bandpass networks—where a low-frequency response is not available.

The bandpass-impulse response for various impedance discontinuities is shown in Figure 10-5. As we can see, no information about the type of discontinuity is available.

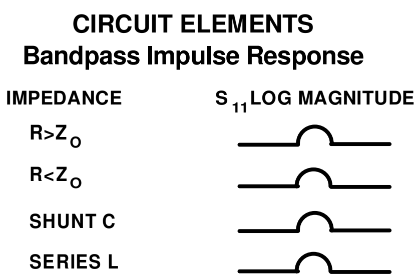


Figure 10-5. Bandpass Impulse Re-

An example of using the bandpass-impulse response, is the pulse height, ringing, and pulse envelope of a bandpass filter (Figure 10-6).Use the phasor-impulse response with bandpass response to determine the type of an isolated impedance discontinuity.

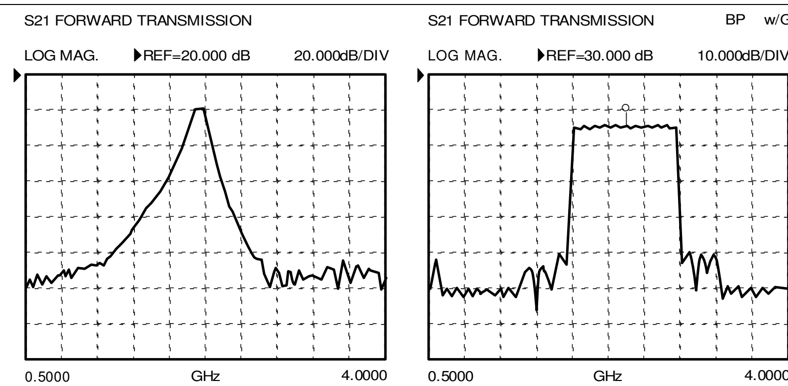


Figure 10-6. *Example of Bandpass-Impulse Response*

PHASOR IMPULSE BANDPASS RESPONSE

- Real and Imaginary Measurement
- Information On Type of Discontinuity

After the bandpass-impulse response has been isolated, the phasor-impulse response for a resistive-impedance-level change is a peak that goes positive ($R>Z_0$) for the real part of S_{11} and negative for $R<Z_0$. The imaginary part remains relatively constant. In each case the peak is proportional to the reflection coefficient. The phasor-impulse response for a shunt capacitance is a negative-going peak in the imaginary part of S_{11}. For a series inductance, it is a positive going peak (Figure 10-7).

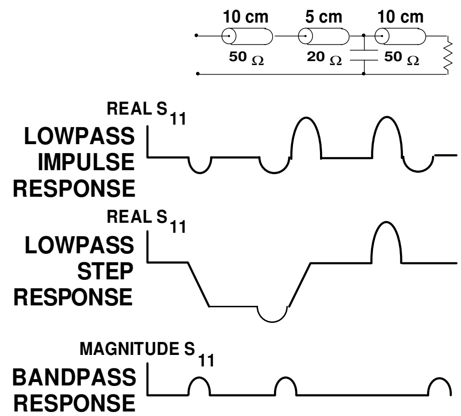


Figure 10-7. *Complex Impedances*

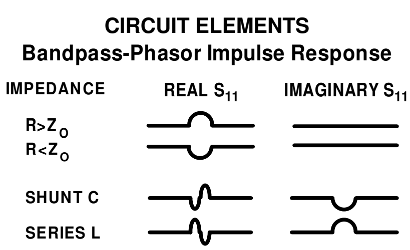


Figure 10-8. *Bandpass Phasor Re-*

Next, let us look at a complex circuit. A resistive impedance change $R<Z_0$ and a shunt capacitance and series inductance. These impedance changes are shown in the time domain for the lowpass-impulse response, lowpass-step response, and bandpass-impulse response (Figure 10-8).

The 360B processes bandpass-impulse-response data to obtain phasor-impulse response. This becomes most advantageous where both a reactive reflection and an impedance change occur at the same location. The real part of the time-domain response shows the location of impedance level changes, while the imaginary part shows the type of reactive discontinuity. Phasor-impulse response displays one discontinuity at a time (Figure 10-9).

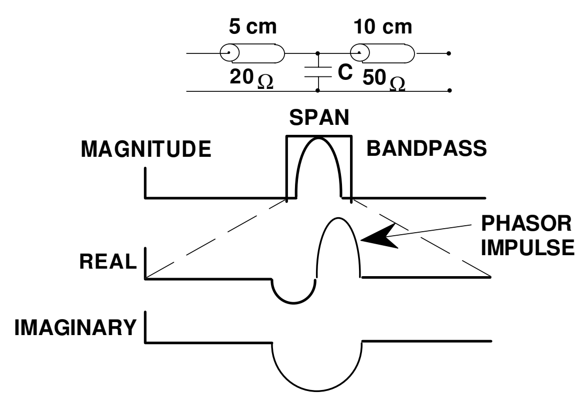
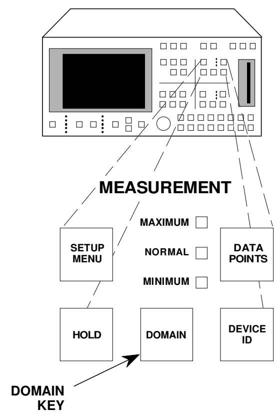


Figure 10-9. *Phasor-Impulse Response Data*

Operating Time Domain

To operate in the time domain mode, press the DOMAIN key (below). A domain menu (Figure 10-10) lets you select the frequency- or time-domain modes by simple cursor selection. The 360B defaults to the frequency domain.

Select time or distance for the horizontal axis. The 360B defaults to time axis.



NOTE

If you select distance, be sure to set the dielectric constant in the Reference Delay menu (Figure 10-11).

SET
DIELECTRIC
CONSTANT
AIR
(1.000649)
POLYETHYLENE
(2.26)
TEFLON
(2.10)
MICROPOROUS
TEFLON
(1.69)
OTHER
XXXX.XX
PRESS <ENTER>
TO SELECT

Figure 10-11. *Reference Delay Menu*

DOMAIN	DOMAIN	DOMAIN
▶ FREQUENCY	FREQUENCY	FREQUENCY
FREQUENCY WITH TIME GATE	FREQUENCY WITH TIME GATE	FREQUENCY WITH TIME GATE
TIME LOWPASS MODE	▶ TIME LOWPASS MODE	TIME LOWPASS MODE
TIME BANDPASS MODE	TIME BANDPASS MODE	▶ TIME BANDPASS MODE
DISPLAY	DISPLAY	DISPLAY
TIME/DISTANCE	TIME/DISTANCE	TIME/DISTANCE
SET RANGE	SET RANGE	SET RANGE
SET GATE	SET GATE	SET GATE
GATE ON/OFF	GATE ON/OFF	GATE ON/OFF
HELP	HELP	HELP
		PRESS <ENTER> TO SELECT OR SWITCH

Figure 10-10. *Domain Menu*

Select SET RANGE and use the START/STOP or GATE/SPAN selections to set the range (Figure 10-12).

DOMAIN FREQUENCY FREQUENCY WITH TIME GATE TIME LOWPASS MODE TIME BANDPASS MODE DISPLAY TIME/DISTANCE SET RANGE SET GATE GATE ON/OFF HELP PRESS <ENTER> TO SELECT OR SWITCH	LOWPASS TIME DOMAIN SETUP START XXX.XXX ps STOP XXX.XXX ps CENTER XXX.XXX ps SPAN XXX.XXX ps MARKER RANGE RESPONSE IMPULSE/STEP MORE PRESS <ENTER> TO SELECT	BANDPASS TIME DOMAIN SETUP START XXX.XXX ps STOP XXX.XXX ps CENTER XXX.XXX ps SPAN XXX.XXX ps MARKER RANGE PHASOR ON/OFF IMPULSE HELP - PHASOR IMPULSE MORE

Figure 10-12. *Set Range Menu*

For the lowpass mode select either IMPULSE or STEP Response and set the DC term. The 360B defaults to the IMPULSE Response and the AUTO EXTRAPOLATE mode for the DC term (Figure 10-13).

NOTE

The bandpass mode displays Bandpass Impulse Response unless we select Phasor Impulse Response.

```
LOWPASS TIME
DOMAIN SETUP
START
  XXX.XXX ps
STOP
  XXX.XXX ps
CENTER
  XXX.XXX ps
SPAN
  XXX.XXX ps
MARKER RANGE

▸ RESPONSE
  IMPULSE/STEP
MORE
PRESS <ENTER>
  TO SELECT
```

```
SET D.C. TERM
FOR LOWPASS
PROCESSING
▸AUTO
 EXTRAPOLATE
LINE
  IMPEDANCE
OPEN
SHORT
OTHER
  –XXX.XXX #
  ABOVE VALUE
  REPRESENTS
  A
  REFLECTION
  COEFF. OF
  XX.XXX mU
PREVIOUS MENU
```

```
BANDPASS TIME
DOMAIN SETUP
START
  XXX.XXX ps
STOP
  XXX.XXX ps
CENTER
  XXX.XXX ps
SPAN
  XXX.XXX ps
MARKER RANGE

▸ PHASOR ON/OFF
  IMPULSE

HELP-PHASOR
IMPULSE
MORE
PRESS <ENTER>
  TO SELECT
```

Figure 10-13. *Response Menus*

The Marker Range menu allows us to zoom in and display the range between two selected markers (Figure 10-14).

```
LOWPASS TIME
DOMAIN SETUP
START
  XXX.XXX ps
STOP
  XXX.XXX ps
CENTER
  XXX.XXX ps
SPAN
  XXX.XXX ps
▸ MARKER RANGE
RESPONSE
  IMPULSE/STEP
MORE
PRESS <ENTER>
  TO SELECT
```

```
TIME
MARKER SWEEP
▸START TIME
  MARKER ( )
  XXX.XXX nS
STOP TIME
  MARKER ( )
  XXX.XXX nS
RESTORE
  ORIGINAL
  RANGE
PREVIOUS MENU
USE KEYPAD
TO CHOOSE
MARKER (1 - 6)
OR
PRESS <ENTER>
TO SELECT
```

Figure 10-14. *Marker Range Menus*

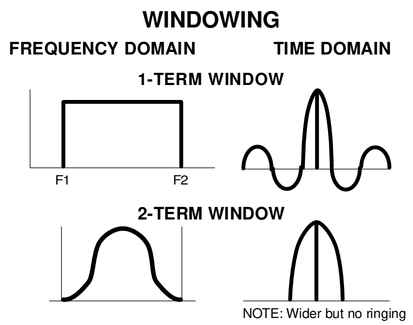


Figure 10-15. *Windowing*

Windowing

Windowing is a frequency filter that we apply to the frequency-domain data when we convert it to time-domain data. This filtering rolls off the abrupt transition at F1 and F2. This effectively produces a time-domain response with lower sidelobes. Windowing allows a limited degree of control over the pulse shape, trading off ringing (sidelobes) for pulse width (Figure 10-15).

We select windowing from the Time Domain Setup menu. Four different windows are available: RECTANGLE, NOMINAL, LOW SIDELOBE, and MINIMUM SIDELOBE. The RECTANGLE option provides the narrowest pulse width, while the MINIMUM SIDELOBE option provides the least ringing (fewest sidelobes). The 360B defaults to the NOMINAL option, which is acceptable for most measurements. Windowing menus are shown in Figure 10-16.

LOWPASS TIME
DOMAIN SETUP
START
XXX.XXX ps
STOP
XXX.XXX ps
CENTER
XXX.XXX ps
SPAN
XXX.XXX ps
MARKER RANGE
RESPONSE
IMPULSE/STEP
➧ MORE
PRESS <ENTER>
TO SELECT

LOWPASS TIME
DOMAIN SETUP
➧ SET WINDOW
NOMINAL
SET GATE
SET D.C. TERM
XXX.XXX
PREVIOUS MENU
PRESS <ENTER>
TO SELECT

SHAPE
➧ RECTANGULAR
NOMINAL
LOW SIDELOBE
MIN SIDELOBE
HELP
PRESS <ENTER>
TO SELECT

Figure 10-16. *Window Shape Menus*

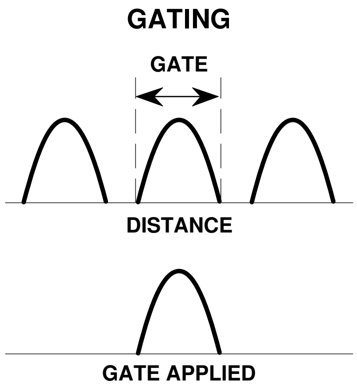


Figure 10-17. *Gating*

Gating

Gating is a time filter that allows for removing unwanted time-domain responses by gating the desired response. We can view the isolated response in both time domain—using the PHASOR IMPULSE RESPONSE option—and in the frequency domain—using the FREQUENCY WITH TIME GATE selection (Figure 10-17).

There are four different gate shapes available: RECTANGLE, NOMINAL, LOW SIDELOBE, and MINIMUM SIDELOBE. The 360B defaults to the NOMINAL gate. To specify a different shape simply enter the Gate menu and select the desired gating shape. The RECTANGLE has the largest ripple, while MINIMUM SIDELOBE has the least (Figure 10-18).

DOMAIN
FREQUENCY
FREQUENCY WITH TIME GATE
TIME LOWPASS MODE
TIME BANDPASS MODE
DISPLAY TIME/DISTANCE
SET RANGE
SET GATE
GATE ON/OFF
HELP
PRESS <ENTER> TO SELECT OR SWITCH

GATE
START XXX.XXX mm
STOP XXX.XXX mm
CENTER XXX.XXX mm
SPAN XXX.XXX mm
SET SHAPE NOMINAL
GATE DISP
PREVIOUS MENU
PRESS <ENTER> TO SELECT

SHAPE
RECTANGULAR
NOMINAL
LOW SIDELOBE
MIN SIDELOBE
HELP
PRESS <ENTER> TO SELECT

Figure 10-18. *Gating Menus*

Gating Example

Let us look at a reflection measurement. A device at the end of a coax cable is measured in the frequency domain. We would like to measure the return loss of this device and characterize its impedance, but to do so we have to eliminate the response of the cable and connectors (Figure 10-19). The steps on the following page describe a method for making this measurement.

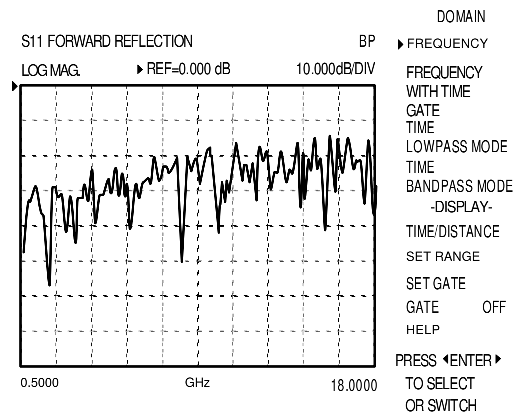


Figure 10-19. *Frequency Gating*

DOMAIN
FREQUENCY
FREQUENCY WITH TIME GATE
TIME LOWPASS MODE
▸ TIME BANDPASS MODE
DISPLAY
SET RANGE
▸ SET GATE
GATE ON/OFF
HELP
PRESS <ENTER> TO SELECT OR SWITCH

Step 1. Convert the frequency domain data into the time domain using TIME BANDPASS MODE (Figure 10-20).

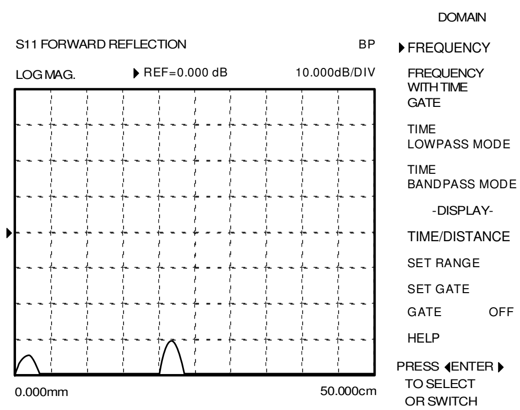


Figure 10-20. *Time Gating*

GATE
START XXX.XXX mm
STOP XXX.XXX mm
CENTER XXX.XXX mm
SPAN XXX.XXX mm
▸ SET SHAPE NOMINAL
GATE DISP
PREVIOUS MENU
PRESS <ENTER> TO SELECT

Step 2. Select SET GATE in the Domain menu (left) then GATE DISP in the Gate menu. This allows us to put the gate around the discontinuity of interest using the START, STOP, CENTER, or SPAN selections (Figure 10-21).

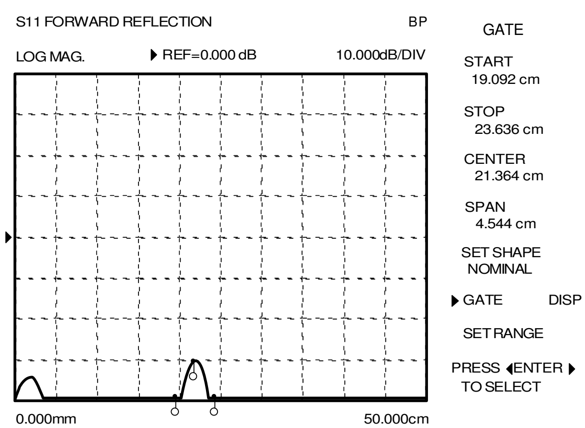


Figure 10-21. *Gate Display*

SHAPE
RECTANGULAR
▸ NOMINAL
LOW SIDELOBE
MIN SIDELOBE
HELP
PRESS <ENTER> TO SELECT

Step 3. Select GATE ON in the Gate menu and the unwanted responses are removed (Figure 10-22).

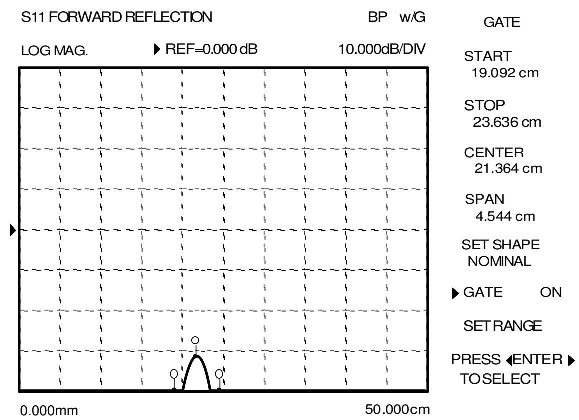


Figure 10-22. *Response with GATE ON Selected*

Step 4. Select PHASOR IMPULSE ON in the Bandpass menu. The real and imaginary responses of the Phasor Impulse Response are displayed. Based on the display, the device has a series inductance as well as resistance >50 ohms (Figure 10-23).

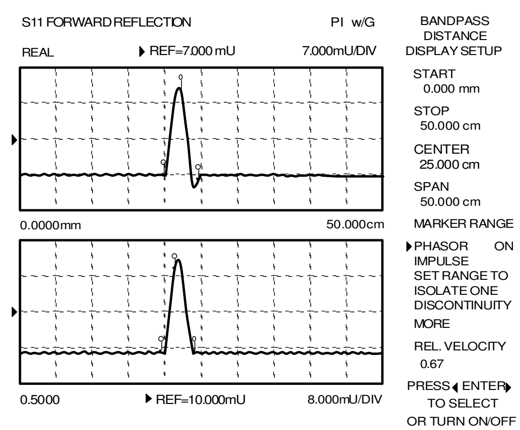


Figure 10-23. *Response with PHASOR IMPULSE ON Selected*

Step 5. Select FREQUENCY WITH TIME GATE in the Domain menu to display the frequency domain S_{11} forward reflection of the gated time domain response (Figure 10-24).

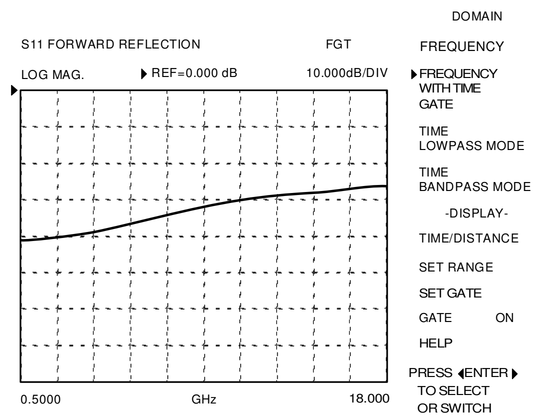


Figure 10-24. *Response FREQUENCY WITH TIME GATE Selected*

An example of gating a transmission measurement is making an antenna measurement. Gating can remove unwanted ground or chamber reflections that interfere with characterizing an antenna's pattern (Figure 10-25).

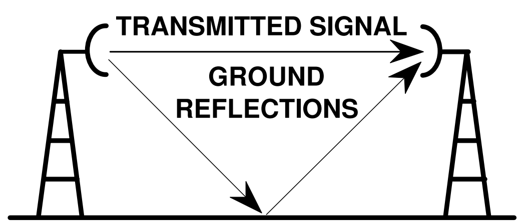


Figure 10-25. *Antenna Measurements*

MEASUREMENT CONSIDERATIONS

- Small Responses
- Close Responses
- Distant Responses

Finally, let's look at some measurement considerations and ways to optimize their time-domain results.

SMALL RESPONSES

- Small Impedance Changes
- Long Lossy Devices
- High Insertion Loss Paths

OPTIMIZE FOR SMALL RESPONSES

- Use Averaging
- Use Reduced IF Bandwidth
- Use Window With Least Ringing

CLOSE RESPONSES

- Physically Close Elements
- Similar Length Transmission Paths

OPTIMIZE FOR CLOSE RESPONSES

- Use Widest Sweep
- Use Window with Narrowest Pulse Shape

DISTANT RESPONSES

- Use 501 Points
- Use Minimum Required Frequency Range

Optimizing Time Domain Results

Small impedance changes cause small responses that can be lost in the noise floor. This is also true of long cable and waveguide runs with high insertion loss.

To optimize for small responses:

- ☐ Use averaging and reduced IF bandwidth to lower the noise floor.
- ☐ Use maximum power to provide maximum dynamic range.
- ☐ Use the window with the lowest sidelobes to reduce ringing.

Elements that are physically close or have similar length transmission paths can have minimal or overlapping time domain responses.

To optimize for close-response measurements and attain the best resolution:

- ☐ Use the widest sweep.
- ☐ Use the window with the narrowest pulse shape.

To maximize the distance measurement capability without causing aliasing (false information), use the minimum-frequency-step size by selecting 501 points and the minimum-required-frequency range.

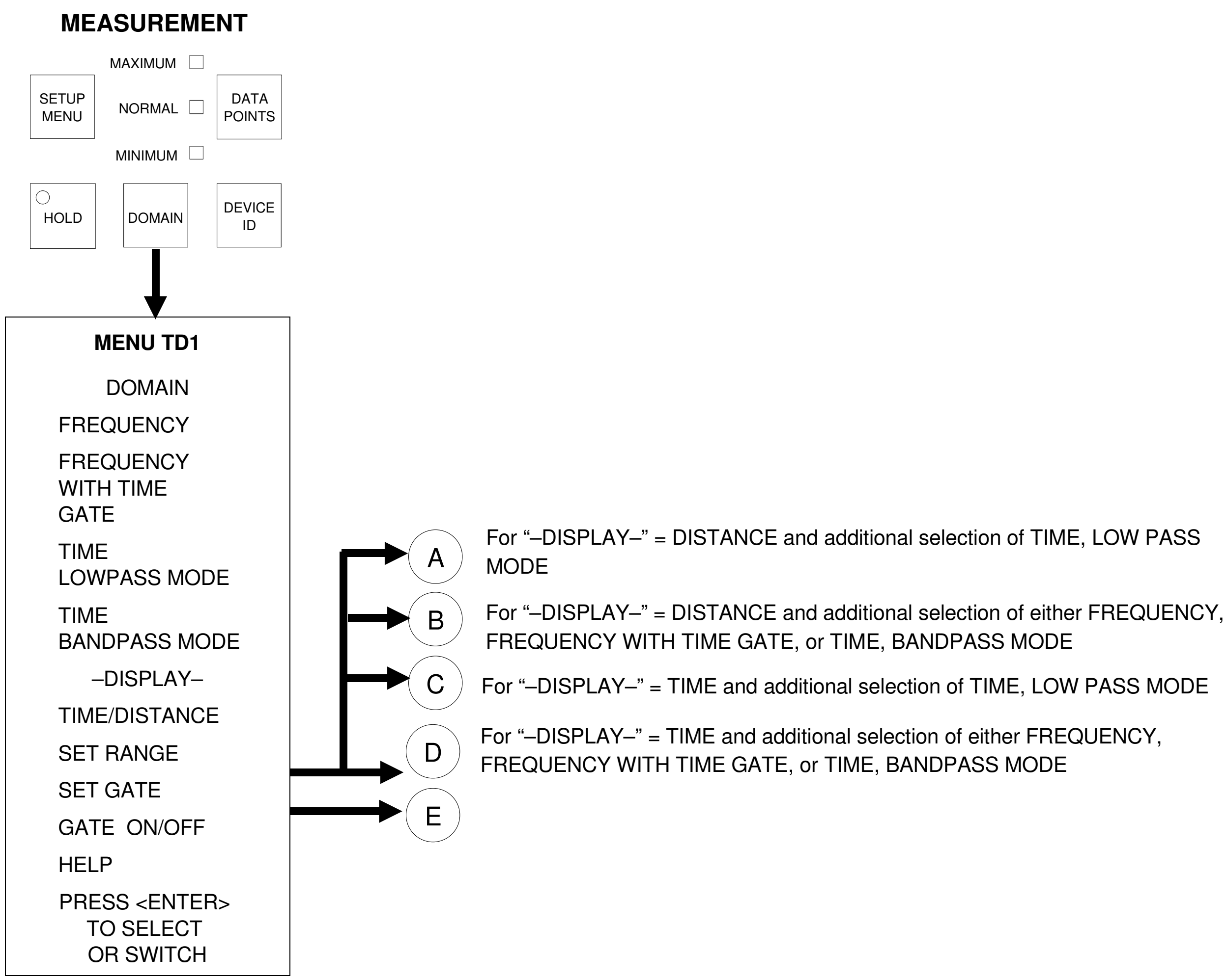
In summary, the 360B Time Domain capability is a powerful and versatile tool in performing network analyzer measurements.

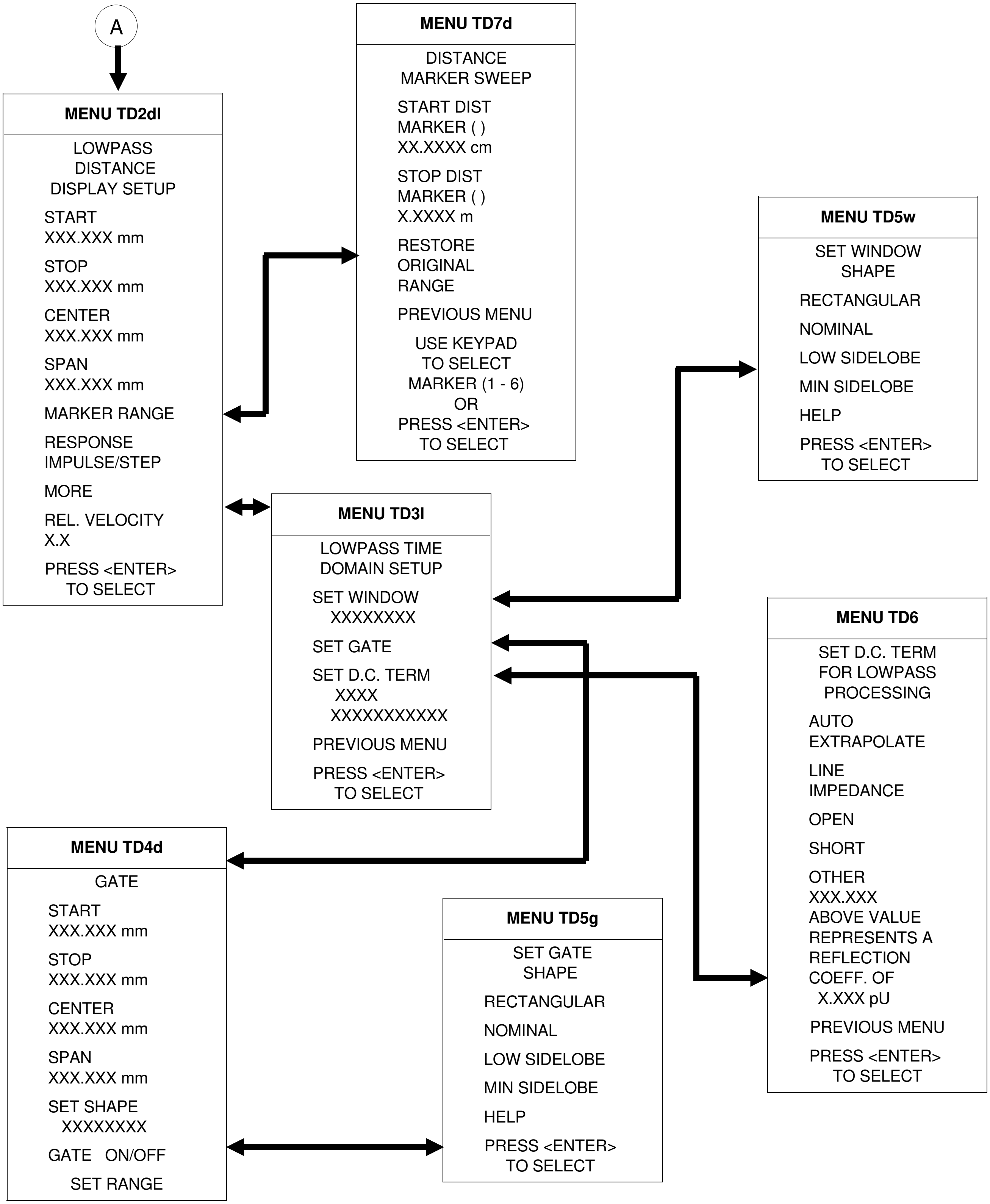
Time Domain Data Sheet

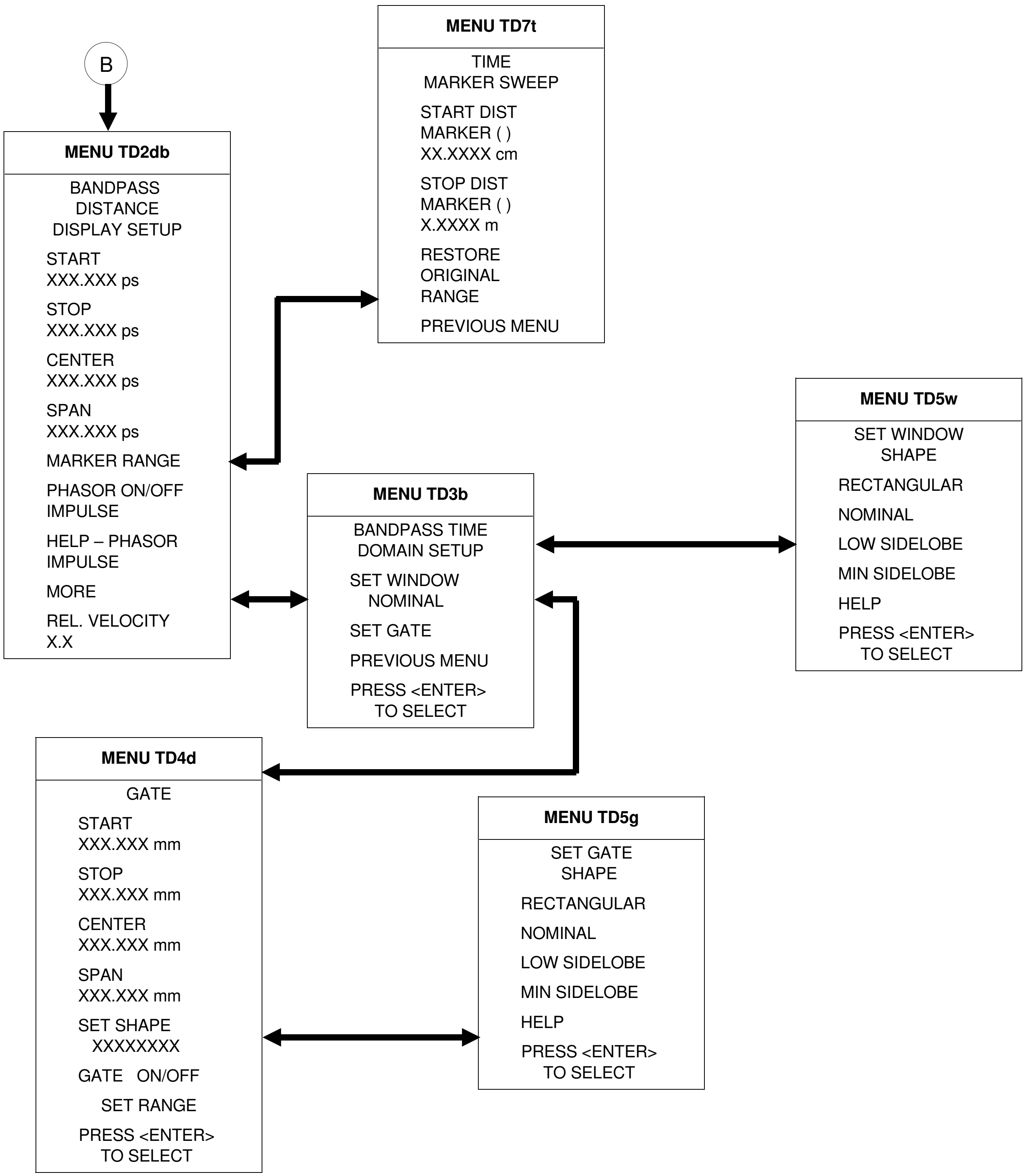
The Option 2A, Time Domain feature is described in depth in the ANRITSU Application Note, AN360-6. For your convenience, a copy of AN360-6 is included at the end of this manual, behind the “Supplements” tab.

Time Domain Menus

A flow diagram of the menus associated with the Time Domain Option is shown on the following pages. The menu choices are described in Appendix 1. They appear in alphabetical order by their call letters: TD1, TD2, TD2dl, etc.


MEASUREMENT
MAXIMUM
SETUP MENU
NORMAL
DATA POINTS
MINIMUM
HOLD
DOMAIN
DEVICE ID
MENU TD1
DOMAIN
FREQUENCY
FREQUENCY WITH TIME GATE
TIME LOWPASS MODE
TIME BANDPASS MODE
–DISPLAY–
TIME/DISTANCE
SET RANGE
SET GATE
GATE ON/OFF
HELP
PRESS <ENTER> TO SELECT OR SWITCH
A
For “–DISPLAY–” = DISTANCE and additional selection of TIME, LOW PASS MODE
B
For “–DISPLAY–” = DISTANCE and additional selection of either FREQUENCY, FREQUENCY WITH TIME GATE, or TIME, BANDPASS MODE
C
For “–DISPLAY–” = TIME and additional selection of TIME, LOW PASS MODE
D
For “–DISPLAY–” = TIME and additional selection of either FREQUENCY, FREQUENCY WITH TIME GATE, or TIME, BANDPASS MODE
E


A
MENU TD2dl
LOWPASS
DISTANCE
DISPLAY SETUP
START
XXX.XXX mm
STOP
XXX.XXX mm
CENTER
XXX.XXX mm
SPAN
XXX.XXX mm
MARKER RANGE
RESPONSE
IMPULSE/STEP
MORE
REL. VELOCITY
X.X
PRESS <ENTER>
TO SELECT
MENU TD7d
DISTANCE
MARKER SWEEP
START DIST
MARKER ( )
XX.XXXX cm
STOP DIST
MARKER ( )
X.XXXX m
RESTORE
ORIGINAL
RANGE
PREVIOUS MENU
USE KEYPAD
TO SELECT
MARKER (1 - 6)
OR
PRESS <ENTER>
TO SELECT
MENU TD5w
SET WINDOW
SHAPE
RECTANGULAR
NOMINAL
LOW SIDELOBE
MIN SIDELOBE
HELP
PRESS <ENTER>
TO SELECT
MENU TD3l
LOWPASS TIME
DOMAIN SETUP
SET WINDOW
XXXXXXXX
SET GATE
SET D.C. TERM
XXXX
XXXXXXXXXXX
PREVIOUS MENU
PRESS <ENTER>
TO SELECT
MENU TD6
SET D.C. TERM
FOR LOWPASS
PROCESSING
AUTO
EXTRAPOLATE
LINE
IMPEDANCE
OPEN
SHORT
OTHER
XXX.XXX
ABOVE VALUE
REPRESENTS A
REFLECTION
COEFF. OF
X.XXX pU
PREVIOUS MENU
PRESS <ENTER>
TO SELECT
MENU TD4d
GATE
START
XXX.XXX mm
STOP
XXX.XXX mm
CENTER
XXX.XXX mm
SPAN
XXX.XXX mm
SET SHAPE
XXXXXXXX
GATE ON/OFF
SET RANGE
MENU TD5g
SET GATE
SHAPE
RECTANGULAR
NOMINAL
LOW SIDELOBE
MIN SIDELOBE
HELP
PRESS <ENTER>
TO SELECT


B
MENU TD2db
BANDPASS
DISTANCE
DISPLAY SETUP
START
XXX.XXX ps
STOP
XXX.XXX ps
CENTER
XXX.XXX ps
SPAN
XXX.XXX ps
MARKER RANGE
PHASOR ON/OFF
IMPULSE
HELP – PHASOR
IMPULSE
MORE
REL. VELOCITY
X.X
MENU TD7t
TIME
MARKER SWEEP
START DIST
MARKER ( )
XX.XXXX cm
STOP DIST
MARKER ( )
X.XXXX m
RESTORE
ORIGINAL
RANGE
PREVIOUS MENU
MENU TD3b
BANDPASS TIME
DOMAIN SETUP
SET WINDOW
NOMINAL
SET GATE
PREVIOUS MENU
PRESS <ENTER>
TO SELECT
MENU TD5w
SET WINDOW
SHAPE
RECTANGULAR
NOMINAL
LOW SIDELOBE
MIN SIDELOBE
HELP
PRESS <ENTER>
TO SELECT
MENU TD4d
GATE
START
XXX.XXX mm
STOP
XXX.XXX mm
CENTER
XXX.XXX mm
SPAN
XXX.XXX mm
SET SHAPE
XXXXXXXX
GATE ON/OFF
SET RANGE
PRESS <ENTER>
TO SELECT
MENU TD5g
SET GATE
SHAPE
RECTANGULAR
NOMINAL
LOW SIDELOBE
MIN SIDELOBE
HELP
PRESS <ENTER>
TO SELECT

C

MENU TD2tl

LOWPASS TIME DOMAIN SETUP

START
XXX.XXX ps

STOP
XXX.XXX ps

CENTER
XXX.XXX ps

SPAN
XXX.XXX ps

MARKER RANGE

RESPONSE
IMPULSE/STEP

MORE

PRESS <ENTER>
TO SELECT

MENU TD7d

DISTANCE
MARKER SWEEP

START DIST
MARKER ( )
XX.XXXX cm

STOP DIST
MARKER ( )
X.XXXX m

RESTORE
ORIGINAL
RANGE

PREVIOUS MENU

MENU TD5w

SET WINDOW
SHAPE

RECTANGULAR

NOMINAL

LOW SIDELOBE

MIN SIDELOBE

HELP

PRESS <ENTER>
TO SELECT

MENU TD3l

LOWPASS TIME
DOMAIN SETUP

SET WINDOW
XXXXXXXX

SET GATE

SET D.C. TERM
XXXX
XXXXXXXXXXX

PREVIOUS MENU

PRESS <ENTER>
TO SELECT

MENU TD4t

GATE

START
XXX.XXX ns

STOP
XXX.XXX ns

CENTER
XXX.XXX ns

SPAN
XXX.XXX ns

SET SHAPE
XXXXXXXX

GATE ON/OFF

SET RANGE

PRESS <ENTER>
TO SELECT

MENU TD5g

SET GATE
SHAPE

RECTANGULAR

NOMINAL

LOW SIDELOBE

MIN SIDELOBE

HELP

PRESS <ENTER>
TO SELECT

MENU TD6

SET D.C. TERM
FOR LOWPASS
PROCESSING

AUTO
EXTRAPOLATE

LINE
IMPEDANCE

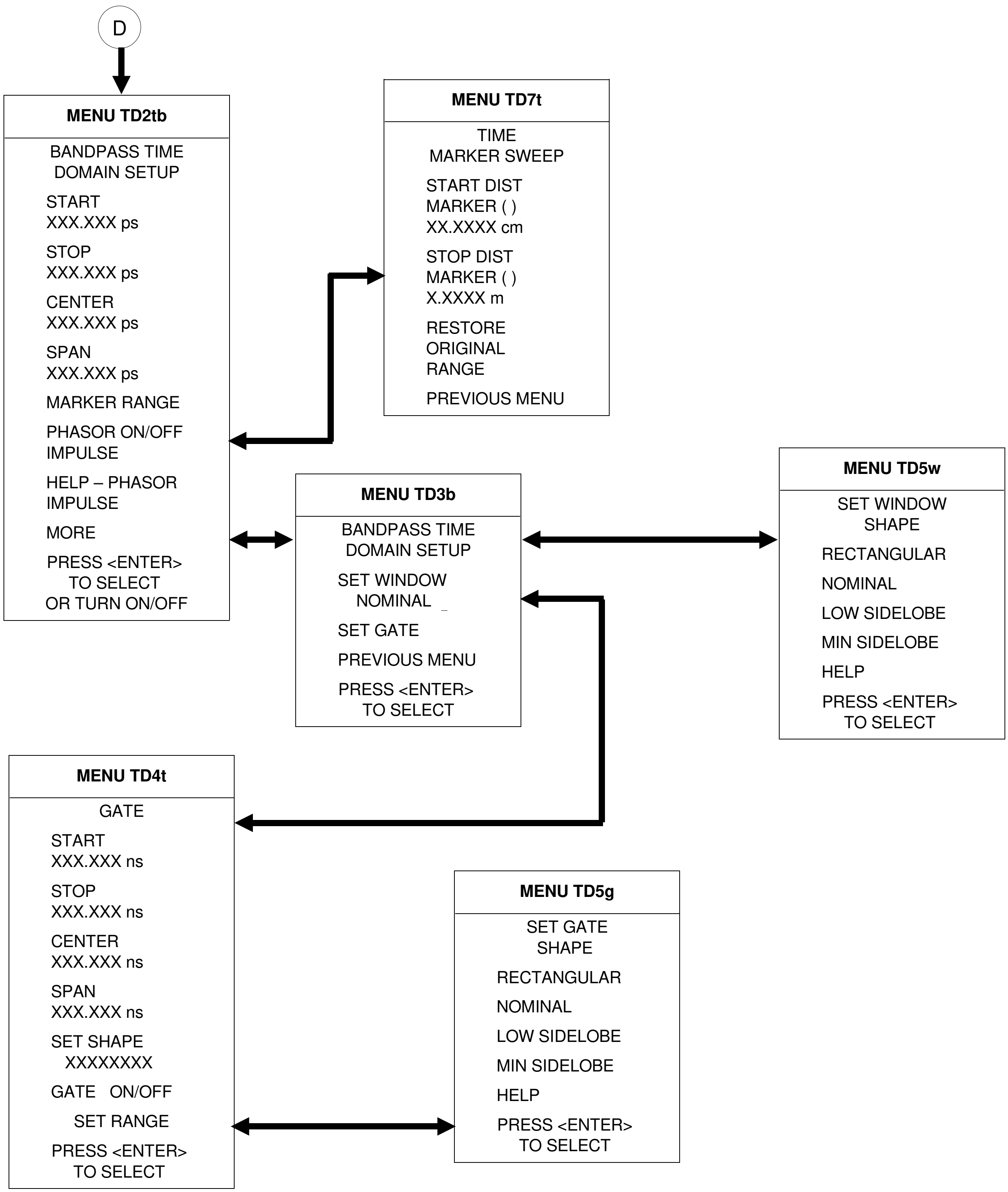
OPEN

SHORT

OTHER
XXX.XXX
ABOVE VALUE
REPRESENTS A
REFLECTION
COEFF. OF
X.XXX pU

PREVIOUS MENU

PRESS <ENTER>
TO SELECT


D
MENU TD2tb
BANDPASS TIME DOMAIN SETUP
START XXX.XXX ps
STOP XXX.XXX ps
CENTER XXX.XXX ps
SPAN XXX.XXX ps
MARKER RANGE
PHASOR ON/OFF IMPULSE
HELP – PHASOR IMPULSE
MORE
PRESS <ENTER> TO SELECT OR TURN ON/OFF
MENU TD7t
TIME MARKER SWEEP
START DIST MARKER ( ) XX.XXXX cm
STOP DIST MARKER ( ) X.XXXX m
RESTORE ORIGINAL RANGE
PREVIOUS MENU
MENU TD3b
BANDPASS TIME DOMAIN SETUP
SET WINDOW NOMINAL
SET GATE
PREVIOUS MENU
PRESS <ENTER> TO SELECT
MENU TD5w
SET WINDOW SHAPE
RECTANGULAR
NOMINAL
LOW SIDELOBE
MIN SIDELOBE
HELP
PRESS <ENTER> TO SELECT
MENU TD4t
GATE
START XXX.XXX ns
STOP XXX.XXX ns
CENTER XXX.XXX ns
SPAN XXX.XXX ns
SET SHAPE XXXXXXXX
GATE ON/OFF
SET RANGE
PRESS <ENTER> TO SELECT
MENU TD5g
SET GATE SHAPE
RECTANGULAR
NOMINAL
LOW SIDELOBE
MIN SIDELOBE
HELP
PRESS <ENTER> TO SELECT

E

MENU TD4d/t

GATE

START
XXX.XXX xx

STOP
XXX.XXX xx

CENTER
XXX.XXX xx

SPAN
XXX.XXX xx

SET SHAPE
XXXXXXXX

GATE ON/OFF

SET RANGE

PRESS <ENTER>
TO SELECT

MENU TD5g

SET GATE
SHAPE

RECTANGULAR

NOMINAL

LOW SIDELOBE

MIN SIDELOBE

HELP

PRESS <ENTER>
TO SELECT

A For "–DISPLAY–" = DISTANCE and additional selection of TIME, LOW PASS MODE in menu TD1

B For "–DISPLAY–" = DISTANCE and additional selection of either FREQUENCY, FREQUENCY WITH TIME GATE, or TIME, BANDPASS MODE in menu TD1

C For "–DISPLAY–" = TIME and additional selection of TIME, LOW PASS MODE in menu TD1

D For "–DISPLAY–" = TIME and additional selection of either FREQUENCY, FREQUENCY WITH TIME GATE, or TIME, BANDPASS MODE in menu TD1

10-3 OPTION 5, RECEIVER MODE

The Option 5, Receiver Mode provides three distinct modes of operation:

- ☐ Sweep/Source Lock mode, used to phase lock a 360SS source
- ☐ Synthesizer/Tracking mode, used to allow the receiver to track a 67XXB synthesizer
- ☐ Set-On mode, allowing the operation of the test set as a tuned receiver

Sweeper/ Source Lock Mode

The Sweeper/Source Lock mode enables the 360B to phase lock frequency sources using the dc control voltage it produces for that purpose (The sources must be capable of being frequency controlled by a dc voltage.) The 360B detects the error in frequency and phase of the source and sends a dc voltage from the EXT FM ∅ LOCK OUTPUT connector on the 360B to the EXT FM ∅ LOCK INPUT connectors on the source. Due to inherent resolution of the 360B's synthesized local oscillators, frequency resolution is limited to 100 kHz intervals. This mode requires that the source be located close to the 360B.

Source lock can be accomplished only if the source frequency is available to one of the reference receive channels. The power level needed at the sampler input is –10 to –30 dBm. All other receive channels will operate over their full dynamic range.

The capabilities required of the RF source are as follows:

- ☐ Greater than 10k ohm input impedance
- ☐ Less than 100 pF input capacitance
- ☐ Greater than 500 kHz 3 dB bandwidth
- ☐ Less than 25 MHz absolute accuracy
- ☐ –6 MHz/V sensitivity

For resolution of less than 100 kHz or receiver frequencies outside the indicated test set range, the use of external mixers and a synthesizer is required. Dual Source Control is required in this case.

Synthesizer/ Tracking Mode

In the Synthesizer/Tracking mode, the 360B steers its second local oscillator frequency and phase signal so as to phase-lock itself to the reference signal. Typically the source is a synthesizer, since it must be accurate to better than ±10 MHz. Due to the inherent resolution of the 360B's frequency readout, frequency resolution is limited to 1 kHz intervals, however the 360B will lock on to any signal within 10 MHz of that setting.

For receive frequencies outside the indicated test set range, the use of external mixers and a synthesizer is required. Dual Source Control is required in this case.

Set-on Mode

In the Set-On mode, the source lock circuitry of the 360B is completely by-passed. Reference signals are no longer necessary for system operation. This allows all of the 360B samplers to operate over their full dynamic range. As a result, the source and the 360B must be locked to the same 10 MHz time base, otherwise coherent detection is not possible. Only synthesized sources may be used in this mode.

Due to the inherent resolution of the 360B's synthesized local oscillators, frequency resolution is limited to 100 kHz intervals over the frequency range of the test set.

To realize resolutions of less than 100 kHz, or for receive frequencies outside the indicated test set range, the use of external mixers and a second synthesizer is required. To assure coherent detection, all time bases must be derived from the same source—either the 360B, one of the synthesizers, or an independent 10 MHz reference. Dual Source Control is required in this case.

The block diagram shown in Figure 10-26 indicates how the system is configured for all of the possible modes of operation. With the switches set as shown, the system operates in the Set-On mode. LO1 and LO2 are pre-set to allow only a prescribed signal to be detected by the synchronous detector. With the switch in SWEEPER position the system is operating in the phase lock mode. With the switch in the SYNTHESIZER position, the system is in the synthesizer tracking mode.

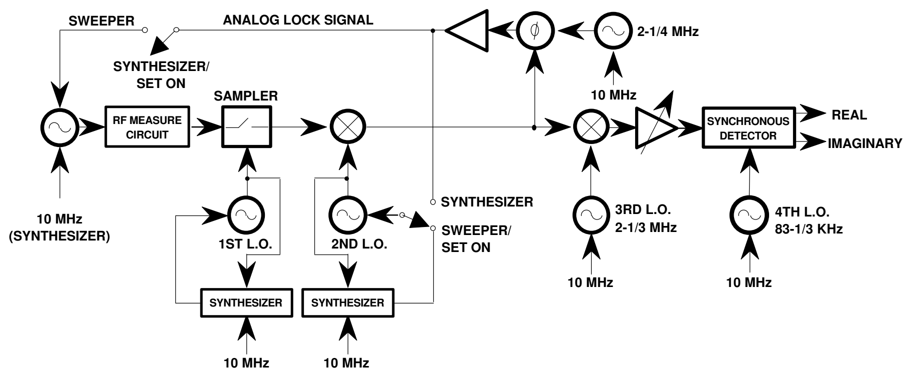


Figure 10-26. 360B Phase Lock Modes

Procedure, Receiver Mode Operation

A detailed procedure for operation using the Receiver Mode option is provided in the following pages.

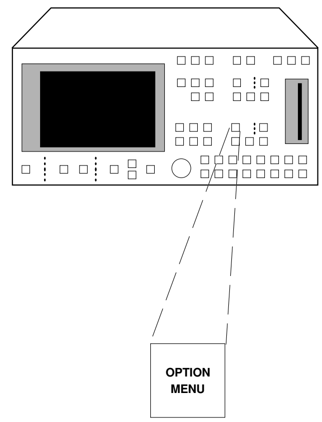
Receiver Mode Menus

The menus associated with the Receiver Mode are described in the alphabetical listing (Appendix 1) under their call sign: RCV1, RCV2, RCV3, etc.

Operating Procedure, Receiver Mode

The three operational modes that comprise the Receiver Mode can be set up as follows:

Step 1. Press the OPTION MENU key (below).



MENU OPTNS

OPTIONS
SWEEP OPTIONS
REAR PANEL OUTPUT
DIAGNOSTICS
MULTIPLEXER CONTROL
MULTIPLE SOURCE CONTROL
RECEIVER MODE
PRESS <ENTER> TO SELECT

Step 2. When menu OPTNS (left) appears, select **RECEIVER MODE**.

MENU RCV1

RECEIVER MODE
STANDARD
USER DEFINED
PRESS <ENTER> TO SELECT

Step 3. When menu RCV1 (left) appears, select either **STANDARD** (step 4) or **USER DEFINED** (step 5). Your selection depends on the application.

Step 4. The Standard mode uses the Synthesizer/Tracking mode for operation with a synthesizer, and the Sweeper/Source Lock mode for operation with a sweeper or 360SS type source. Source control via the GPIB is always in effect. The user has no control over selections within the Standard Mode

Because entering the standard mode erases the current stored calibration data, a warning menu (RCV3) appears when **STANDARD** is selected. Press ENTER to enter into the Standard mode or press CLEAR to abort.

MENU RCV3

STANDARD RECEIVER MODE
WARNING:
CONTINUING WILL ERASE CURRENT SETUP AND CALIBRATION
PRESS <ENTER> TO CONTINUED OR PRESS <CLEAR> TO ABORT

MENU RCV1

RECEIVER MODE
STANDARD
USER DEFINED
PRESS <ENTER>
TO SELECT

MENU RCV2

USER DEFINED
RECEIVER MODE
FINISHED,
ACCEPT
CONFIGURATION
PHASE LOCK
MODE
SOURCE LOCK
TRACKING
SET ON
360 CONTROL OF
SOURCE SWEEP
GPIB ON
CONTROL
PRESS ENTER
TO SELECT
OR TURN ON/OFF

MENU RCV3

STANDARD
RECEIVER MODE
WARNING:
CONTINUING
WILL ERASE
CURRENT
SETUP AND
CALIBRATION
PRESS <ENTER>
TO CONTINUED
OR
PRESS <CLEAR>
TO ABORT

Step 5. Selecting **USER DEFINED RECEIVER MODE** in menu RCV1 brings menu RCV 2 to the screen. When menu RCV 2 appears, the last mode selected is highlighted in red. The default selection is **SOURCE LOCK**.

Source Lock, Tracking or Set-On modes can be selected from this menu. When a mode is selected, information about that mode is displayed on the screen (Figure 10-27, 10-28, or 10-29). This information describes the mode and the capabilities required of the RF source.

Step 6. **GPIB CONTROL** can be toggled **ON** or **OFF** by pressing ENTER.

When **GPIB CONTROL** is set **ON**, the 360B steps the frequency of the source in accordance with the current sweep setup. Use this mode with ANRITSU sources when a normal sweep is desired.

When **GPIB CONTROL** is set **OFF,** the 360B will not change the frequency setting of the source. Use this mode with non-ANRITSU sources, or when GPIB control of the source is not possible or not desired.

Step 7. Move cursor to **FINISHED, ACCEPT CONFIGURATION** and press ENTER. This brings warning menu RCV4 (left) to the screen. The menu indicates which mode has been selected and warns that continuing will erase the current frequencies and calibration setup stored in the 360B. Press ENTER to confirm the selection or press CLEAR to abort.

SOURCE LOCK MODE DESCRIPTION

USED TO PHASE LOCK ANY FREQUENCY SOURCE HAVING AN ANALOG FM INPUT.

SOURCE FREQUENCY MUST BE AVAILABLE TO ONE OF THE REFERENCE RECEIVE CHANNELS. POWER LEVEL NEEDED AT THE SAMPLER INPUT IS -10 TO -30 dBm.

RECEIVER RESOLUTION IS 100 KHz OVER THE FREQUENCY RANGE OF THE TEST SET

RF SOURCE CAPABILITITES REQUIRED

RF SOURCE ANALOG FM INPUT MUST HAVE: > 10K OHM INPUT IMPEDANCE, < 100 pF INPUT CAPACITANCE, > 500 KHz 3 dB BANDWIDTH, -6 MHz/VOLT SENSITIVITY, < 25 MHz ABSOLUTE ACCURACY.

FOR RECEIVE FREQUENCIES OUTSIDE INDICATED TEST SET RANGE, EXTERNAL MIXERS, A SYNTHESIZER AND MULTIPLE SOURCE CONTROL ARE REQUIRED.

360 GPIB CONTROL OF SOUCE SWEEP: ON

USE THIS MODE WITH ANRITSU SOURCES WHEN NORMAL SWEEP IS DESIRED.

Figure 10-27. *Source Lock Mode Information Field*

TRACKING MODE DESCRIPTION

USED TO PHASE LOCK THE 360 RECEIVERS TO A KNOWN FREQUENCY SOURCE, TYPICALLY A SYNTHESIZER.

SOURCE FREQUENCY MUST BE AVAILABLE TO ONE OF THE REFERENCE CHANNELS. POWER LEVEL NEEDED AT THE SAMPLER INPUT IS -10 TO -30 dBm.

RESOLUTION OF 360 DISPLAY READOUT IS 1 KHz, EXCEPT 100 KHz WHEN USING ANRITSU SWEEPER. HOWEVER THE RECEIVER WILL LOCK TO ANY SIGNAL UP TO 10 MHz AWAY FROM THIS FREQUENCY.

RF SOURCE CAPABILITIES REQUIRED

SOURCE MUST BE WITHIN +/- 10 MHz OF THE DESIRED FREQUENCY FOR THE 360 TO LOCK ON.

FOR RECEIVE FREQUENCIES OUTSIDE INDICATED TEST SET RANGE, EXTERNAL MIXERS, A SYNTHESIZER AND MULTIPLE SOURCE CONTROL ARE REQUIRED.

360 GPIB CONTROL OF SOUCE SWEEP: ON

USE THIS MODE WITH ANRITSU SOURCES WHEN NORMAL SWEEP IS DESIRED.

Figure 10-28. *Tracking Mode Information Field*

SET ON MODE DESCRIPTION

DISABLES THE SOURCE LOCK CIRCUITRY. ALL FOUR SAMPLERS OPERATE OVER THEIR FULL DYNAMIC RANGE. REFERENCE SIGNALS ARE NOT NECESSARY.

RECEIVER RESOLUTION IS 100 KHz OVER THE FREQUENCY RANGE OF THE TEST SET.

RF SOURCE CAPABILITIES REQUIRED

ONLY SYNTHESIZED SOURCES MAY BE USED IN THIS MODE. TIME BASE OF RF SOURCE MUST BE COMMON WITH 10 MHz TIME BASE OF 360 FOR SYNCHRONOUS DETECTION TO OCCUR.

FOR RECEIVE FREQUENCIES OURSIDE INDICATED TEST SET RANGE, EXTERNAL MIXERS, A SYNTHESIZER AND MULTIPLE SOURCE CONTROL ARE REQUIRED.

360 GPIB CONTROL OF SOUCE SWEEP: ON

USE THIS MODE WITH ANRITSU SOURCES WHEN NORMAL SWEEP IS DESIRED.

Figure 10-29. *Set On Mode Information Field*

APPENDIX 1
FRONT PANEL MENUS, ALPHABETICAL LISTING

A1-1 INTRODUCTION

This appendix provide description for all menu choices. Menus are arranged in alphabetical order by call sign (C1, SU2, DSK1, etc).

A1-2 MENUS

A listing of all of the menus contained in this appendix is provided in the tabulation below. This listing gives the call sign, name, and page number of the menus.

Menu Call Letter and Name **Page Number**

Table of Contents

MENU	DESCRIPTION
SELECT CALIBRATION DATA POINTS	
NORMAL (501 POINTS MAXIMUM	Selects the standard calibration from a start to a stop frequency that provides for up to 501 equally spaced (except the last) points of data for the defined frequency range.
C.W. (1 POINT)	Selects the single frequency (C.W.) calibration sequence that provides for 1 data point at a selected frequency.
N-DISCRETE FREQUENCIES (2 TO 501 POINTS)	Selects the discrete frequency calibration mode that lets you input a list of 2 to 501 individual data point frequencies.
TIME DOMAIN (HARMONIC)	Selects the calibration mode for low-pass time-domain processing.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your selection.

Menu C1, Select Calibration Data Points

MENU	DESCRIPTION
FREQ RANGE OF CALIBRATION	
START XX.XXXXGHz	Enter the sweep-start frequency for calibration. If you desire, you can change this frequency for your measurement when you reach menu SU1, which follows the final calibration menu. The only restriction is that your start measurement frequency be greater than or equal to your start calibration frequency.
STOP XX.XXXX GHz	Enter the sweep-stop frequency for calibration. Like the start frequency, this too can be changed for your measurement. The stop frequency must be lower than or equal to your stop calibration frequency. In other words, your measurement frequency span must be equal to or smaller than your calibration frequency span.
XXX DATA PTS USING ABOVE START AND STOP XXX.X MHz STEP SIZE	The program automatically sets the step size, based on the selected start and stop frequencies. The step size will be the smallest possible (largest number of points up to a maximum of 501), based on the chosen frequency span.
NEXT CAL STEP	Displays the next menu in the calibration sequence.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C2, Frequency Range of Calibration

MENU	DESCRIPTION
INSERT INDIVIDUAL FREQUENCIES	
INPUT A FREQ PRESS <ENTER> TO INSERT	
NEXT FREQ. XX.XXXX GHz	Move the cursor here and enter the next frequency for which you wish calibration data taken. If the AUTO INCR option is ON, pressing ENTER automatically increments the calibration frequency by the interval in GHz that appears below the option.
XXX FREQS. ENTERED, LAST FREQ WAS XX.XXXX GHz	Shows the number of frequencies that you have entered and reports the value of the last frequency entered.
AUTO INCR ON (OFF) XX.XXXX GHz	Move the cursor here and press ENTER to switch the Auto-Increment mode on or off. If AUTO INCR is on, you may enter the frequency spacing.
PREVIOUS MENU	Calls menu C2D.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing ENTER will cause actions as described above.

Menu C2A, Insert Individual Frequencies

MENU	DESCRIPTION
SINGLE POINT CALIBRATION	
C.W. FREQ XX.XXXX GHz	Move cursor here and enter the frequency for which calibration is to be done.
FINISHED ENTRY, NEXT CAL STEP	Move cursor here and press ENTER when finished.
INPUT FREQ AND PRESS <ENTER> TO SELECT	Input the frequency value and press the ENTER key.

Menu C2B, Single Point Calibration

MENU	DESCRIPTION
CALIBRATION RANGE	
HARMONIC CAL FOR TIME DOMAIN	
START (STEP) XX.XXXX GHz	Move cursor here to enter the desired start frequency. This frequency also will be used as the frequency increment.
APPROX STOP XX.XXXX GHz	Move the cursor here to enter the approximate desired stop frequency. The frequency will be adjusted to the nearest harmonic multiple of the start frequency.
USING ABOVE START AND STOP WILL RESULT IN XXX DATA POINTS AND XX.XXXX GHz TRUE STOP FREQ	The program automatically indicates the number of data points and the true (harmonic) stop frequency.
NEXT CAL STEP	Move the cursor here and press ENTER when finished.
PRESS <ENTER> TO SELECT	

Menu C2C, Calibration Range—Harmonic Cal for Time Domain

MENU	DESCRIPTION
DISCRETE FILL	
INPUT START, INCR, POINTS, THEN SELECT “FILL RANGE”	This menu is used to create one or more ranges of discrete equally spaced frequency points for calibration.
START FREQ X.XXXX GHz	Enter the first frequency of the range.
INCREMENT X.XXXXGHz	Enter the increment (step size) between one frequency and the next.
NUMBER OF PTS XXX POINTS	Enter the number of frequency points in the range.
STOP FREQ XX.XXXX GHz	
FILL RANGE (XXX ENTERED)	Moving the cursor here and pressing ENTER fills the range and shows the number of frequencies selected (in NUM OF PTS above).
INDIVIDUAL FREQUENCY INSERT	Calls menu C2A, which allows you to set the individual frequencies.
CLEAR ALL	Clears all entries displayed above.
FINISHED RETURN TO SWP	Calls menu C3, the next menu in the calibration sequence.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C2D, Fill Frequency Ranges

MENU	DESCRIPTION
CONFIRM CALIBRATION PARAMETERS	
PORT 1 CONN XXXXXXXX	Displays the Port 1 test port connector type to be used during OSL calibration. This should agree with the connector type that both your calibration components and the test device mate with. Move cursor here and press ENTER to display menu used to change connector type.
PORT 2 CONN XXXXXXXX	Displays the Port 2 test port connector type to be used during OSL calibration. This should agree with the connector type that both your calibration components and the test device mate with. Move cursor here and press ENTER to display menu used to change connector type.
REFLECTION PAIRING XXXXXX	Calls menu C13, which lets you select the pairing (mixed or matched) for the types of reflection devices (open/short) that you will use on Ports 1 and 2 for calibration.
LOAD TYPE XXXXXXXX	Displays type of load selected for calibration—broadband fixed or sliding. Move cursor here and press ENTER to display menu used to change load type.
THROUGH PARAMETERS	Move cursor here to display menu used to enter through line parameters—including offset length and loss equation coefficients.
REFERENCE IMPEDANCE	Lets you choose the reference impedance value (1 μΩ to 1 kΩ) for the devices connected to Ports 1 and 2 for calibration. Default value is 50Ω.
TEST SIGNALS	Calls menu SU2, which lets you enter calibrate Flat Test Port Power or change source power(s) and attenuator settings.
START CAL	Starts the standard (OSL) calibration sequence using coaxial standards.
PRESS <ENTER> TO SELECT OR CHANGE	Pressing the ENTER key implements your menu selection.

Menu C3, Confirm Calibration Parameters

MENU	DESCRIPTION
CONFIRM CALIBRATION PARAMETERS	
OFFSET LENGTHS OF SHORTS	Move the cursor to this line and press ENTER to change the offset lengths of the shorts used for coaxial calibration.
LOAD TYPE XXXXXXXX	Displays type of load selected for calibration—broadband fixed or sliding. Move cursor here and press ENTER to display menu used to change load type.
THROUGH PARAMETERS	Move cursor here to display menu used to enter through line parameters—including offset length and loss equation coefficients.
REFERENCE IMPEDANCE	Lets you choose the reference impedance value (1 μΩ to 1 MΩ) for the devices connected to Ports 1 and 2 for calibration. Default value is 50Ω.
TEST SIGNALS	Calls menu SU2, which lets you enter calibrate Flat Test Port Power or change source power(s) and attenuator settings. .
START CAL	Starts the offset-short calibration sequence using coaxial standards.
PRESS <ENTER> TO SELECT OR CHANGE	Pressing the ENTER key implements your menu selection.

Menu C3A, Confirm Calibration Parameters

MENU	DESCRIPTION
CONFIRM CALIBRATION PARAMETERS	
CHANGE LOAD TYPE XXXXXXXX	Displays type of load selected for calibration—broadband fixed or sliding. Move cursor here and press ENTER to display menu used to change load type.
CHANGE THROUGH PARAMETERS	Move cursor here to display menu used to enter through line parameters—including offset length and loss equation coefficients.
TEST SIGNALS	Calls menu SU2, which lets you enter calibrate Flat Test Port Power or change source power(s) and attenuator settings. .
START CAL	Starts the offset-short calibration sequence using waveguide standards.
PRESS <ENTER> TO SELECT OR CHANGE	Pressing the ENTER key implements your menu selection.

Menu C3B, Confirm Calibration Parameters

MENU	DESCRIPTION
CONFIRM CALIBRATION PARAMETERS	
OFFSET LENGTHS OF SHORTS	Change offset lengths of shorts used for microstrip calibration.
THROUGH PARAMETERS	Move cursor here to display menu used to enter through line parameters—including offset length and loss equation coefficients.
MICROSTRIP PARAMETERS XXXXXXXXXXX	Allows you to change microstrip parameters.
TEST SIGNALS	Calls menu SU2, which lets you enter calibrate Flat Test Port Power or change source power(s) and attenuator settings. .
START CAL	Starts the offset-short calibration sequence using microstrip standards.
PRESS <ENTER> TO SELECT OR CHANGE	Pressing the ENTER key implements your menu selection.

Menu C3C, Confirm Calibration Parameters

MENU	DESCRIPTION
CONFIRM CALIBRATION PARAMETERS	
PORT 1 OPEN/SHORT	Move cursor here and press ENTER to display the menu used to define the capacitive coefficients of the Open and offset length of the Short for Port 1.
PORT 2 OPEN/SHORT	Move cursor here and press ENTER to display the menu used to define the capacitive coefficients of the open and offset length of the short for Port 2.
REFLECTION PAIRING XXXXXX	Calls menu C13, which lets you select the pairing (mixed or matched) for the types of reflection devices (open/short) that you will use on Ports 1 and 2 for calibration.
THROUGH PARAMETERS	Move cursor here to display menu used to enter through line parameters—including offset length and loss equation coefficients.
MICROSTRIP PARAMETERS XXXXXXXXXXX	Allows you to change microstrip parameters.
TEST SIGNALS	Calls menu SU2, which lets you enter calibrate Flat Test Port Power or change source power(s) and attenuator settings.
START CAL	Starts the standard (OSL) calibration sequence using microstrip standards.
PRESS <ENTER> TO SELECT OR CHANGE	Pressing the ENTER key implements your menu selection.

Menu C3D, Confirm Calibration Parameters

MENU	DESCRIPTION
CONFIRM CALIBRATION PARAMETERS	
LRL/LRM PARAMETERS	Brings up menu that allows you to change LRL/LRM parameters (Option 3 must be installed).
REFERENCE IMPEDANCE	Allows you to change reference impedance of the coaxial line standard to other than 50 ohms (default).
TEST SIGNALS	Calls menu SU2, which lets you enter calibrate Flat Test Port Power or change source power(s) and attenuator settings.
START CAL	Starts the LRL/LRM calibration sequence using coaxial standards.
PRESS <ENTER> TO SELECT OR CHANGE	Pressing the ENTER key implements your menu selection.

Menu C3E, Confirm Calibration Parameters

MENU	DESCRIPTION
CONFIRM CALIBRATION PARAMETERS	
LRL/LRM PARAMETERS	Brings up menu that allows you to change LRL/LRM parameters. (Option 3 must be installed).
TEST SIGNALS	Calls menu SU2, which lets you enter calibrate Flat Test Port Power or change source power(s) and attenuator settings.
START CAL	Starts the LRL/LRM calibration sequence using waveguide standards.
PRESS <ENTER> TO SELECT OR CHANGE	Pressing the ENTER key implements your menu selection.

Menu C3F, Confirm Calibration Parameters

MENU	DESCRIPTION
CONFIRM CALIBRATION PARAMETERS	
LRL/LRM PARAMETERS	Brings up menu that allows you to change LRL/LRM parameters (Option 3 must be installed).
MICROSTRIP PARAMETERS USER DEFINED	Allows you to change microstrip parameters.
TEST SIGNALS	Calls menu SU2, which lets you enter calibrate Flat Test Port Power or change source power(s) and attenuator settings.
START CAL	Starts the LRL/LRM calibration sequence using microstrip standards.
PRESS <ENTER> TO SELECT OR CHANGE	Pressing the ENTER key implements your menu selection.

Menu C3G, Confirm Calibration Parameters

MENU	DESCRIPTION
SELECT PORT CONNECTOR TYPE	
SMA (M)	Applies the four capacitance-coefficient values to the Open and offset length to the Short. These values are needed to correct for an SMA connector being installed on the test device (male or female).
SMA (F)	
K-CONN (M)	Same as above, except for K **c**onnector.
K-CONN (F)	
TYPE N (M)	Same as above, except for TYPE N connector.
TYPE N (F)	
GPC-3.5 (M)	Same as above, except for GPC-3.5 connector.
GPC-3.5 (F)	
GPC-7	Same as above, except for GPC-7 connector.
USER DEFINED	Calls menu C12, which allows you to specify the connector coefficients.
MORE	Calls additional connector types to screen.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C4, Select Calibration Type

MENU	DESCRIPTION
SELECT PORT 1 CONNECTOR TYPE	
V-CONN (M) V-CONN (F)	Applies the four capacitance-coefficient values to the Open and offset length to the Short. These values are needed to correct for an SMA connector being installed on the test device (male or female).
TNC (M) TNC (F)	Same as above, except for TNC connector.
2.4 mm (M) 2.4 mm(F)	Same as above, except for 2.4 mm connector.
MORE	Calls additional connector types to screen.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C4A, Select Calibration Type

MENU	DESCRIPTION
CALIBRATION TYPE	
FULL 12-TERM	Corrects for error terms ETF, ETR, ERF, ERR, EDF, EDR, EXF, EXR, ESF, ESR, ELF and ELR (Figure 5-6). These are all of the error terms that are associated with a two-port measurement.
1 PATH 2 PORT	Corrects for forward-direction error terms ETF, ERF, EDF and ESF (Forward Isolation (EXF) is an optional fifth error term).
FREQUENCY RESPONSE ONLY	Corrects for forward-transmission (ETF) or forward reflection (ERF), or both, to provide a frequency-response only correction.
REFLECTION ONLY (PORT 1)	Corrects for forward-direction error terms ERF, EDF, and ESF. These provide a reflection-only correction for Port 1.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C5, Select Calibration Type

MENU	DESCRIPTION
SELECT FREQUENCY RESPONSE TYPE	
TRANSMISSION	For the calibration-correction of the transmission frequency-response error term, ETF.
REFLECTION	For the calibration-correction of the reflection-frequency-response error term, ERF.
BOTH	For the calibration-correction of both transmission and reflection frequency-response error terms.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your selection.

Menu C5A, Select Frequency Response Type

MENU	DESCRIPTION
SELECT USE OF ISOLATION IN APPLIED CALIBRATION	
INCLUDE ISOLATION (NORMAL)	Includes isolation term(s).
EXCLUDE ISOLATION	Excludes isolation term(s).
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C5B, Select Use of Isolation

MENU	DESCRIPTION
SELECT TYPE OF LOAD	
BROADBAND FIXED LOAD	Selects calibration based on the broadband load being used.
SLIDING LOAD (MAY ALSO REQUIRE BROADBAND FIXED LOAD)	Selects calibration based on the sliding load being used. If your low-end frequency is below 2 GHz, a fixed broadband load is also required.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C6, Select Load Type

MENU	DESCRIPTION
CALIBRATION SEQUENCE	
CONNECT CALIBRATION DEVICE(S)	
PORT 1: XXXXXXXXXXXX	Connect the required component to Port 1.
PORT 2: XXXXXXXXXXXX	Connect the required component to Port 2.
PRESS <ENTER> TO MEASURE DEVICE(S)	Pressing the ENTER key sequentially measures the devices connected to Ports 1 and 2, beginning with Port 1.
PRESS <1> FOR PORT 1 DEVICE	Pressing the 1 key, on the keypad, measures the device connected to Port 1.
PRESS <2> FOR PORT 2 DEVICE	Pressing the 2 key, on the keypad, measures the device connected to Port 2.

Menu C7-Series, Begin Calibration Sequence

MENU	DESCRIPTION
CALIBRATION SEQUENCE	
SLIDE LOAD TO POSITION X	Slide the load to the next position, then press the ENTER key. Moving the slide to six different positions provides sufficient data for the program to accurately calculate the effective directivity of the system.
PRESS <ENTER> TO MEASURE DEVICE (S)	Pressing the ENTER key begins the measurement.

Menu C8, Slide Load to Position X

MENU	DESCRIPTION
CALIBRATION SEQUENCE	
CONNECT THROUGHLINE XXXXX BETWEEN TEST PORTS	Connect Ports 1 and 2 together using the Throughline standard (zero or non-zero length).
PRESS <ENTER> TO MEASURE DEVICE(S)	Pressing the ENTER key begins the measurement.

Menu C9, Connect Throughline

MENU	DESCRIPTION
CALIBRATION SEQUENCE	
CONNECT DEVICE 1 LINE 1 (REF) XXXXX BETWEEN TEST PORTS	Prompts you to connect reference line 1 between test ports.
PRESS <ENTER> TO MEASURE DEVICE(S)	Pressing the ENTER key begins the measurement.

Menu C9A, Connect Device 1, Line

MENU	DESCRIPTION
CALIBRATION SEQUENCE	
CONNECT DEVICE 2 LINE/ LOWBAND MATCHES BETWEEN TEST PORTS	Connect device 2 between the test ports. This will be a LINE for LRL measurements or LOWBAND MATCHES for LRM measurements.
PRESS <ENTER> TO MEASURE DEVICE(S)	Pressing the ENTER key begins the measurement.

Menu C9B, Connect Device 2, Line/Lowband

MENU	DESCRIPTION
CALIBRATION SEQUENCE	
CONNECT DEVICE 2 LINE XXXXX BETWEEN TEST PORTS	Prompts you to connect the second line standard between the test ports.
PRESS <ENTER> TO MEASURE DEVICE(S)	Pressing the ENTER key begins the measurement.

Menu C9C, Connect Device 2, Line

MENU	DESCRIPTION
CALIBRATION SEQUENCE COMPLETED	
PRESS <SAVE/RECALL> TO STORE CAL DATA ON DISK	Pressing the SAVE/RECALL MENU Key displays menu SR, which lets you save your calibration data onto a disk or recall previously saved calibration data from a disk. While this menu provides a convenient point at which to save the calibration data, it is not the only point allowed. You can use the SAVE/RECALL MENU key at any point in the measurement program.
OR	
PRESS <ENTER> TO PROCEED	Pressing the ENTER key implements your menu selection.

Menu C10, Calibration Sequence Completed

MENU	DESCRIPTION
BEGIN CAL	
KEEP EXISTING CAL DATA	Keep existing calibration data
REPEAT PREVIOUS CAL	Repeats the previous calibration.
CAL METHOD XXXXXXX	Displays the calibration method that you have selected—standard, offset short or LRL/LRM.
TRANSMISSION LINE TYPE: XXXXXXXX	Indicates type of transmission line currently selected, e. g. coaxial, waveguide, microstrip.
CHANGE CAL METHOD AND LINE TYPE	Calls menu C11A, which allows you to change calibration method and transmission line type.
NEXT CAL STEP	Selects the next calibration step.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C11, Begin Calibration

MENU	DESCRIPTION
CHANGE CAL METHOD AND LINE TYPE	
NEXT CAL STEP	Select next calibration step. Must move cursor to here after making below selections. Pressing the ENTER key then moves you to the next step.
CAL METHOD	
STANDARD (NOT USED FOR WAVEGUIDE)	This option and the ones below allow you to select the method (procedure) to be used to calibrate. This method is independent of the calibration type, which may be 12 term, reflection only etc.
OFFSET SHORT	Selects offset-short method.
LRL/LRM	Selects LRL or LRM method
TRANSMISSION LINE TYPE	
COAXIAL	Selects coaxial cable as the transmission line type.
WAVEGUIDE	Selects waveguide as the transmission line type.
MICROSTRIP	Selects microstrip as the transmission line type.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C11A, Select Calibration Method

MENU	DESCRIPTION
SELECT WAVEGUIDE KIT TO USE	
-INSTALLED-	The lines below indicate the characteristics of the installed waveguide calibration kit, if applicable.
IDENTIFIER XXXX	Displays the type of waveguide used.
CUTOFF FREQ: XX.XXXX	Displays the cutoff frequency of the waveguide.
SHORT 1 XX.XXXXmm	Displays the offset length of the first calibration short.
SHORT 2 XX.XXXXmm	Displays the offset length of the second calibration short.
USE INSTALLED KIT	Move the cursor to this line and press ENTER to use the displayed kit.
USER DEFINED	Move the cursor to this line and press ENTER to modify the parameters.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C11C, Select Waveguide Kit to Use

MENU	DESCRIPTION
PORT OPEN DEVICE	Enter the capacitance-coefficient values needed to correct for your Open device. The capacitive phase shift of the Open is characterized by the equation: $C_{Open} = C_O + (C_1 \times f) + (C_2 \times f^2) + (C_3 \times f^3)$
ENTER THE CAPACITANCE COEFFICIENTS	
TERM 1-C0 ± XX.XXe- 15	Enter the term 1 coefficient value (x 10^{-15} F).
TERM 2-C1 ± XXX.XX e - 27	Enter the term 2 coefficient value (x 10^{-27} F/Hz).
TERM 3-C2 ±XXX.XX e - 36	Enter the term 3 coefficient value (x 10^{-36} F/Hz^2).
TERM 4-C3 ±XXX.XX e - 45	Enter the term 4 coefficient value (x 10^{-45} F/Hz^3).
ENTER THE OFFSET LENGTH	
OFFSET LENGTH ±XX.XXXX mm	Select to enter and display offset length of Open.
PRESS <ENTER> WHEN COMPLETE	Pressing the ENTER key implements your menu selection

Menu C12, Enter the Capacitance Coefficients for Open Devices

MENU	DESCRIPTION
PORT SHORT DEVICE	
ENTER THE OFFSET LENGTH	
OFFSET LENGTH ± XX.XXXX mm	Select to enter the length that the Short is offset from the reference plane.
PRESS <ENTER> WHEN COMPLETE	Pressing the ENTER key implements your menu selection.

Menu C12A, Enter the Offset Length

MENU	DESCRIPTION
SET REFLECTION PAIRING	
MIXED (OPEN–SHORT SHORT–OPEN)	Selects different reflection devices (open/short or short/open) to be connected to Ports 1 and 2 for the calibration sequencing.
MATCHED (OPEN–OPEN SHORT–SHORT)	Selects the same type of reflection device (open/open or short/short) to be connected to Ports 1 and 2 for the calibration sequencing.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C13, Set Reflection Pairing Menu

MENU	DESCRIPTION
ENTER OFFSET LENGTHS OF SHORTS	
PORT 1-	
SHORT 1 XX.XXXX mm	Enter the length that Short 1 is offset from the reference plane.
SHORT 2 XX.XXXX mm	Enter the length that Short 2 is offset from the reference plane.
PORT 2	
SHORT 1 XX.XXXX mm	Enter the length that Short 1 is offset from the reference plane.
SHORT 2 XX.XXXX mm	Enter the length that Short 2 is offset from the reference plane.
IF USING ONLY TWO SHORTS, PORT 2 OFFSETS SHOULD EQUAL PORT 1 OFFSETS	
PRESS <ENTER> WHEN COMPLETE	Pressing the ENTER key implements your menu selection.

Menu C14, Enter Offset Lengths (Shorts)

MENU	DESCRIPTION
ENTER WAVEGUIDE PARAMETERS	
WAVEGUIDE CUTOFF FREQ XX.XXXX GHz	Move cursor to this line then press ENTER to bring up menu that allows you to enter waveguide cutoff frequency.
OFFSET LENGTH OF SHORT 1 X.XXXX mm	Move the cursor to this line and enter the offset length of Short 1.
OFFSET LENGTH OF SHORT 2 X.XXXX mm	Move the cursor to this line and enter the offset length of Short 2.
PRESS <ENTER> WHEN COMPLETE	Pressing the ENTER key implements your menu selection.

Menu C15, Enter Waveguide Parameters

MENU	DESCRIPTION
ENTER WAVEGUIDE CUTOFF FREQUENCY	
WAVEGUIDE CUTOFF FREQ XX.XXXX GHz	Enter waveguide cutoff frequency.
PRESS <ENTER> WHEN COMPLETE	Pressing the ENTER key implements your menu selection.

Menu C15A, Enter Waveguide Parameters

MENU	DESCRIPTION
ENTER USER DEFINED MICROSTRIP PARAMETERS	
WIDTH OF STRIP XX.XXXX mm	Move the cursor to this line and enter the width of the microstrip you are using.
THICKNESS OF SUBSTRATE XXXX.XXXX mm	Move the cursor to this line and enter the thickness of the substrate you are using.
ZC XXX.XXX Ω	Move the cursor to this line and enter the characteristic impedance of the microstrip.
SUBSTRATE DIELECTRIC XX.XX	Move the cursor to this line and enter the relative dielectric constant of the substrate you are using.
EFFECTIVE DIELECTRIC XX.XX (RECOMMENDED 1.00)	Move the cursor to this line and enter the effective dielectric constant of the microstrip. A recommended value will also be displayed.
PRESS <ENTER> WHEN COMPLETE	Pressing the ENTER key implements your menu selection.

Menu C16, Enter Microstrip Parameters

MENU	DESCRIPTION
SELECT MICROSTRIP PARAMETERS	
10 MIL KIT	Selects parameters for 10 mil UTF kit.
15 MIL KIT	Selects parameters for 15 mil UTF kit.
25 MIL KIT	Selects parameters for 25 mil UTF kit.
USER DEFINED	Lets user define parameters.
PRESS <ENTER> WHEN COMPLETE	Pressing the ENTER key implements your menu selection.

Menu C16A, Select Microstrip Parameters

MENU	DESCRIPTION
ENTER REF IMPEDANCE	
REFERENCE IMPEDANCE XXX.XXX	Enter the reference impedance (Z_0) of the coaxial reference line standard.
PRESS <ENTER> WHEN COMPLETE	Pressing the ENTER key implements your menu selection.

Menu C17, Enter Line Impedance

MENU	DESCRIPTION
CHANGE LRL/LRM PARAMETERS	
NEXT CAL STEP	Selects next calibration step. Must move cursor to here after making below selections. Pressing the ENTER key then moves you to the next step.
NUMBER OF BANDS USED	
ONE BAND	Selects a one-band LRL or LRM calibration.
TWO BANDS	Selects a two-band LRL or LRM calibration (that is, a three-line LRL or concatenated LRL and LRM calibrations).
LOCATION OF REFERENCE PLANES	
MIDDLE OF LINE 1 (REF)	Select reference planes to be at middle of line 1.
ENDS OF LINE 1 (REF)	Select reference planes to be at end of line 1.

Menu C18, Change LRL/LRM Parameters

MENU	DESCRIPTION
CHANGE LRL/LRM PARAMETERS	
NEXT CAL STEP	Selects next calibration step. Must move cursor to here after making below selections. Pressing the ENTER key then moves you to the next step.
CHARACTERIZE CAL DEVICES	
DEVICE 1 LINE 1 (REF) X.XXXX mm	Enter length of line 1.
DEVICE 2 LINE /MATCH X.XXXX mm	Select device 2—LINE or MATCH; if line is selected, enter length.
PRESS <ENTER> TO SELECT OR SWITCH	Press ENTER to select. If DEVICE 2 is chosen, pressing the ENTER key toggles between LINE and MATCH.

Menu C18A, Change LRL/LRM Parameters

MENU	DESCRIPTION
CHANGE LRL/LRM PARAMETERS	
NEXT CAL STEP	Selects next calibration step. Must move cursor to here after making below selections. Pressing the ENTER key then moves you to the next step.
CHARACTERIZE CAL DEVICES	
DEVICE 1 LINE 1 (REF) XX.XXXX	Enter length of line 1.
DEVICE 2 LINE/MATCH XX.XXXX/LOWBAND	Press ENTER to toggle between LINE and MATCH. If LINE is selected, enter line length. If match is selected, LOWBAND is displayed. This indicates that device 2 is the lowband match.
DEVICE 3 LINE/MATCH XX.XXXX/HIGHBAND	Press ENTER to toggle between LINE and MATCH. If LINE is selected, enter line length. If match is selected, HIGHBAND is displayed. This indicates that device 3 is the high band match.
FREQ AFTER WHICH THE USE OF DEVICE 2 AND DEVICE 3 IS EXCHANGED	
BREAKPOINT X.XXXX GHZ	Enter breakpoint frequency: end of band 1, beginning of band 2.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu C18B, Change LRL/LRM Parameters—Two Band Calibration

MENU	DESCRIPTION
CHANGE LRL/LRM PARAMETERS	
NEXT CAL STEP	Moves to the next calibration step. Must move cursor to here after making below selections. Pressing the ENTER key then moves you to the next step.
OFFSET LENGTH OF REFLECTIVE DEVICE	
OFFSET LENGTH X.XXXX mm	Enter the offset length of the reflective device.
TYPE OF REFLECTION	
GREATER THAN Zo	Specifies the reflection to have an impedance value greater than the reference impedance (Z_0). This is typically an open device.
LESS THAN Zo	Selects the reflection to have an impedance value less than the reference impedance (Z_0). This is typically a short device.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements the selection.

Menu C19, Change LRL/LRM Parameters

MENU	DESCRIPTION
ENTER THROUGH LINE PARAMETERS	
OFFSET LENGTH OF THROUGH	
OFFSET LENGTH X.XXXX mm	Enter offset length of through line.
LOSS EQUATION: A+B*FREQ ^C	
A: DC COEFF (dB/m) 0.0000	Enter DC coefficient A.
B: DC COEFF (dB/(m–FREQ ^C) 0.000 e-6	Enter DC coefficient B.
C: FREQ EXPONENT 0.500	Enter frequency exponent C.
PRESS <ENTER> WHEN COMPLETE	Pressing the ENTER key brings the next calibration menu.

Menu C20, Change Through Parameters

MENU	DESCRIPTION
SELECT DISPLAY MODE	
SINGLE CHANNEL	Selects a single channel for display, which can be log magnitude, phase, log magnitude and phase, or Smith chart. You select the type of display in menu GT.
DUAL CHANNELS 1 – 3	Selects Channels 1 and 3 for display. You select the type of display in menu GT.
OVERLAY DUAL CHANNELS 1 – 3	Lets you simultaneously view the Channel 1 data superimposed over the Channel 3 data on a single display. Channel 1 trace displays in red and Channel 3 in yellow.
DUAL CHANNELS 2 – 4	Selects Channels 2 and 4 for display. You select the type of display in menu GT.
OVERLAY DUAL CHANNELS 2 – 4	Lets you simultaneously view the Channel 2 data superimposed over the Channel 4 data on a single display. Channel 2 trace displays in red and Channel 4 in yellow.
ALL FOUR CHANNELS	Selects all four channels for display. You select the type of display in menu GT.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu CM, Select Display Mode

MENU	DESCRIPTION
PORT 1 MODEL 3640W	Displays the type of test set module that is connected to Port 1.
PORT 2 MODEL 3641W	Displays the type of test set module that is connected to Port 2.
WARNING	
CONTINUING WILL ERASE CURRENT SETUP AND CALIBRATION	
PRESS <ENTER> TO CONTINUE	Pressing the ENTER key implements your menu selection.
OR	
PRESS <CLEAR> TO ABORT	Pressing the CLEAR key aborts your menu selection.

Menu DB1, PORT 1 or PORT 2 Select

MENU	DESCRIPTION
WARNING	
DEFAULT PROGRAM SELECTED	
CONTINUING WILL ERASE CURRENT SETUP AND CALIBRATION	
PRESS <DEFAULT PRGM> TO CONFIRM	Pressing the DEFAULT PROGRAM key a second time resets the 360 VNA to its default settings. Press the DEFAULT PROGRAM key, the “0” key, then the DEFAULT PROGRAM key again clears all internal memories. This keying method can be used to clear memories of data used for classified operations.
OR	
PRESS <CLEAR> TO ABORT	Pressing the CLEAR key implements your menu selection.

Menu DFLT, Default Program Selected

MENU	DESCRIPTION
DIAGNOSTICS	
TROUBLE SHOOTING (ANRITSU SERVICE USE ONLY)	Calls menu DG2, which is used by ANRITSU Customer Service.
TESTS	Call menu DG3, which provides for front panel testing.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

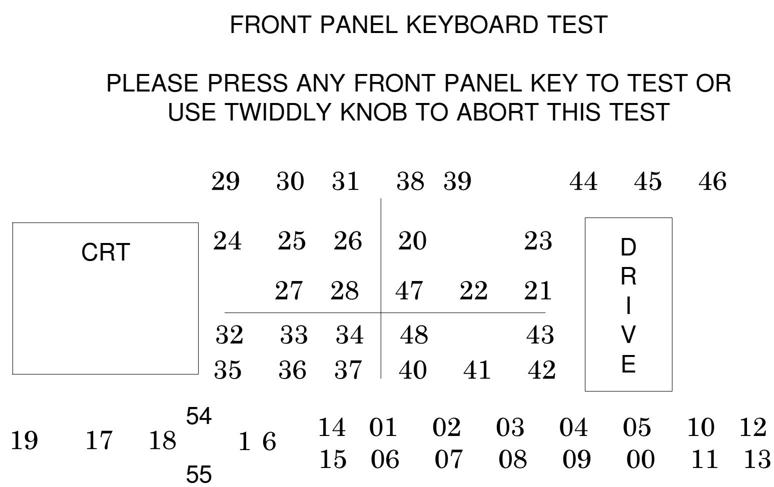
Menu DG1, Diagnostics 1

MENU	DESCRIPTION
TESTS	
ERROR REPORT	Reports on last self-test and current run-time errors.
PROM AND RAM CHECKS	Reports on the status of installed PROM and RAM ICs. Ensuing data screen also shows the version number of the software and the instrument serial number.
FRONT PANEL KEYBOARD	Provides for testing the front panel keyboard, as described on the following page.
CRT	Provides a graphic display that allow you to evaluate screen colors and linearity.
CHECK OPTIONS INSTALLED	Provides a readout screen showing installed options.
NON-RATIOED PARAMETERS	Sets 4-Channel non-ratio Log Mag display (CH1=REF-A, CH3=TST-B, CH2=TST-A, CH4=REF-B).
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu DG3, Diagnostics 3

MENU	DESCRIPTION
NO ROOM FOR NEW DATA FILES	
OVERWRITE EXISTING FILES	Allows you to overwrite an existing file on the current data disk.
DELETE EXISTING FILES	Allows you to delete an existing file on the current data disk.
PRESS <ENTER> TO SELECT	Pressing ENTER implements your menu selection. You will be returned to the previous menu when your selection is made.

Menu DSK3, No Room for New Data Files



NOTES ON TESTING THE FRONT PANEL

The key numbers shown above are arranged to replicate the front panel key layout.

Press the key that corresponds with a number. If the key is good, the number will turn green. If the key contacts do not close, the number will remain red.

Press the key a second time and release it. You should hear a beep. If you don't, the key is stuck closed.

Turning the rotary control aborts the test.

The keyboard tests good if, after pressing all keys and seeing them turn green, the words at the top of the graphic change to

FRONT PANEL KEYBOARD TEST PASSED

MENU	DESCRIPTION
DISK UTILITY FUNCTIONS	
RESTORE DISPLAY	Returns previous menu to screen.
DISPLAY DISK DIRECTORY	Lists files stored on disk.
DELETE FILES FROM DISK	Enables file removal routine.
LOAD PROGRAM FROM DISK TO 360	Reloads system program from program disk.
INITIALIZE DISK WITH PROGRAM	Downloads system program onto disk.
INITIALIZE DATA-ONLY DISK	Initializes disk for use as data storage disk.
COPY DISK TO DISK	Copies all contents of a source disk to a target disk.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu DSK4, Disk Utility Functions

MENU	DESCRIPTION
SELECT CAL & FRONT PANEL SETUP TO DELETE	
FILENAME 2	Selects the file named on this line to be deleted. (The actual name of the file, not “FILENAME 2” will appear.)
FILENAME 3	Same as for Filename 2 above.
FILENAME 4	Same as for Filename 2 above.
FILENAME 5	Same as for Filename 2 above.
FILENAME 6	Same as for Filename 2 above.
FILENAME 7	Same as for Filename 2 above.
FILENAME 8	Same as for Filename 2 above.
FILENAME 9	Same as for Filename 2 above.
MORE	The “More” option only displays if there are more than nine files.
PREVIOUS MENU	Returns to the previous menu in this series.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. You are returned to the previous menu.

Menu DSK5, Select Cal & Front Panel Setup To Delete

MENU	DESCRIPTION
SELECT NORMALIZATION FILE TO DELETE	
FILENAME 1	Selects the file named on this line to be deleted. (The actual name of the file, not “FILENAME 1” will appear.)
FILENAME 2	Same as for Filename 1 above.
FILENAME 3	Same as for Filename 1 above.
FILENAME 4	Same as for Filename 1 above.
FILENAME 5	Same as for Filename 1 above.
FILENAME 6	Same as for Filename 1 above.
FILENAME 7	Same as for Filename 1 above.
FILENAME 8	Same as for Filename 1 above.
MORE	The “More” option only displays if there are more than nine files.
PREVIOUS MENU	Returns to the previous menu in this series.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. You are returned to the previous menu.

Menu DSK6, Select Normalization File To Delete

MENU	DESCRIPTION
SELECT MEASUREMENT FILE TO DELETE	
FILENAME 1	Selects the file named on this line to be deleted. (The actual name of the file, not “FILENAME 1” will appear.)
FILENAME 2	Same as for Filename 1 above.
FILENAME 3	Same as for Filename 1 above.
FILENAME 4	Same as for Filename 1 above.
FILENAME 5	Same as for Filename 1 above.
FILENAME 6	Same as for Filename 1 above.
FILENAME 7	Same as for Filename 1 above.
FILENAME 8	Same as for Filename 1 above.
MORE	The “More” option only displays if there are more than nine files.
PREVIOUS MENU	Returns to the previous menu in this series.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. You are returned to the previous menu

Menu DSK7, Select Measurement File To Delete

MENU	DESCRIPTION
SELECT FILE TO READ	
FILENAME 1	Selects the file named on this line to be read. (The actual name of the file, not “FILENAME 1" will appear.)
FILENAME 2	Same as for Filename 1 above.
FILENAME 3	Same as for Filename 1 above.
FILENAME 4	Same as for Filename 1 above.
FILENAME 5	Same as for Filename 1 above.
FILENAME 6	Same as for Filename 1 above.
FILENAME 7	Same as for Filename 1 above.
FILENAME 8	Same as for Filename 1 above.
MORE	The “More” option only displays if there are more than nine files.
PREVIOUS MENU	Returns to the previous menu in this series
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. You are returned to the previous menu

Menu DSK9, Select File To Read

MENU	DESCRIPTION
SELECT FILE TO OVERWRITE	
MORE	Displays additional menus.
PREVIOUS MENU	Displays the previous menu.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu DSK11, Select File to Overwrite

MENU	DESCRIPTION
DATA ENHANCEMENT	
AVERAGING XXXX MEAS. PER POINT	Averages the measured data over time, as follows: 1. The sweep stops at the first frequency point and takes a number of readings, based on the selected number of points. 2. The program averages the readings and writes the average value for that frequency point in the displayed graph. 3. The sweep then advances to the next sequential frequency point and repeats the process.

Menu EM, Enhancement Menu

MENU	DESCRIPTION
DATA ENHANCEMENT	
AVERAGING XXXX MEAS. PER POINT	Averages the measured data over time, as follows: 1. The sweep stops at the first frequency point and takes a number of readings, based on the selected number of points. 2. The program averages the readings and writes the average value for that frequency point in the displayed graph. 3. The sweep then advances to the next sequential frequency point and repeats the process.

Menu EMCal, Enhancement Menu for Calibration

MENU	DESCRIPTION
SELECT FILE TO OVERWRITE OR CREATE NEW FILE	
FILENAME 1	Selects disk File 1 for storing the calibration data or front (control) panel setup. Name the file using Menu GP5.
FILENAME 2	Selects disk File 2 for storage of data.
FILENAME 3	Selects disk File 3 for storage of data.
FILENAME 4	Selects disk File 4 for storage of data.
FILENAME 5	Selects disk File 5 for storage of data.
FILENAME 6	Selects disk File 6 for storage of data.
FILENAME 7	Selects disk File 7 for storage of data.
FILENAME 8	Selects disk File 8 for storage of data.
MORE	Displays additional menus.
PREVIOUS MENU	Displays the previous menu.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu GP1-3, Select File to Overwrite or Create New File

MENU	DESCRIPTION
SELECT NAME - - - - - - - - - ABCDEFGHIJKLM NOPQRSTUVWXYZ 0123456789-/#	Name your file using the rotary knob to select letters, numbers, or both. A letter or number turns red to indicate that the letter/number has been chosen for selection. Pressing the ENTER key selects the letter or number. the name you spell out displays in the area below “SELECT NAME.” You are allowed up to eight characters for a file name and twelve characters for a label.
DEL CLEAR DONE	Selecting “DEL” deletes the last letter in the name displayed above. Selecting “CLEAR” deletes the entire name. Selecting “DONE” signals that you have finished writing the name.
TURN KNOB TO INDICATE CHARACTER OR FUNCTION	Use the rotary knob to indicate the letter or number you wish to select. You can use the up-arrow and down-arrow keys to move between rows.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.
NUMBERS MAY ALSO BE SELECTED USING KEYPAD	You may also select numbers and decimals using the keypad.

Menu GP5, Select Name

MENU	DESCRIPTION
GPIB SETUP	
–360 GPIB–	
CR/CR-LF	Selects either the CR (carriage return) character or the CR-LF (Carriage Return-Line Feed) characters as the data terminator for GPIB transmissions.
ADDRESS: 6	Selects the GPIB address for the 360 analyzer. The 360 is set to address 6 before leaving the factory.
–SYSTEM BUS–	
CR/CR-LF	Selects either the CR (carriage return) character or the CR-LF (Carriage Return-Line Feed) characters as the data terminator for System Bus transmissions
INSTR ADDR 0	Selects the address for the System Bus controller. This is the address the 360 uses to address the Source. The 360 is set to address 0 before leaving the factory.
SOURCE 1 ADDR 5	Selects the address for Source 1. The Source 1 is set to address 5 before leaving the factory.
SOURCE 2 ADDR 4	Selects the address for Source 2. The Source 2 is set to address 4 before leaving the factory.
PLOTTER ADDR 7	Selects the address for a compatible plotter.
POWER METER 3	Selects the address for an HP4370 Power Meter.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection of CR/CR-LF. Pressing X1 terminator key implements your address selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu GP7, Display GPIB Status

MENU	DESCRIPTION
SELECT GRAPH TYPE	
LOG MAGNITUDE	Selects a log magnitude graph for display on the active channel's selected S-parameter. The active channel is indicated by its key (CH1, CH2, CH3, CH4) being lit.
PHASE	Selects a phase graph for display on the active channel.
LOG MAGNITUDE AND PHASE	Selects log magnitude and phase graphs for display on the active channel.
SMITH CHART (IMPEDANCES)	Selects a Smith chart for display on the active channel.
SWR	Selects an SWR display for the active channel.
GROUP DELAY	Selects a Group Delay display for the active channel.
MORE	Takes you to additional graph type selections on menu GT2.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection and resumes the calibration from where it left off, if in the calibration mode. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu GT1, Select Graph Type

MENU	DESCRIPTION
SELECT GRAPH TYPE	
ADMITTANCE SMITH CHART	Selects an Admittance Smith chart for display on the active channel's S-parameter.
LINEAR POLAR	Selects a Linear Polar graph for display on the active channel's S-parameter.
LOG POLAR	Selects a Log Polar graph for display on the active channel's S-parameter.
LINEAR MAG	Selects a Linear Magnitude graph for display on the active channel's S-parameter.
LINEAR MAG AND PHASE	Selects Linear Magnitude and Phase graphs for display on the active channel's S-parameter.
REAL	Selects Real data for display on the active channel's s-parameter.
IMAGINARY	Selects Imaginary data for display on the active channel's s-parameter.
REAL AND IMAGINARY	Selects both Real and Imaginary data for display on the active channel's S-parameter.
MORE	Takes you to additional graph type selections.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection and resumes the calibration from where it left off, if in the calibration mode. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET key is pressed.
PRESS <ENTER> TO SELECT AND RESUME CALIBRATION	Pressing the ENTER key implements your menu selection and resumes the calibration from where it left off, if in the calibration mode. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu GT2, Select Graph Type

MENU	DESCRIPTION
SET LIMITS	
—LOG MAG—	
LIMIT 1 ON (OFF) XXX.XXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your log-magnitude graph beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX dB	Turns the Limit 2 line on or off for the active channel on the log-magnitude graph.
READOUT LIMIT FREQUENCIES	Displays Menu LF1, which shows all points where the current s-parameter equals the limit values.
–PHASE–	
LIMIT 1 ON (OFF) XXX.XX DEG	Turns the Limit 1 line on or off for the active channel on the phase graph.
LIMIT 2 ON (OFF) XXX.XX DEG	Turns the Limit 2 line on or off for the active channel on the phase graph.
READOUT LIMIT FREQUENCIES	Displays Menu LF1, which shows all points where the current S-parameter equals the limit values.
DISPLAY ON (OFF) LIMITS	Enables both limit lines for the active channel on both the log-magnitude and phase graphs.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L1, Set Limits—Magnitude and Phase

MENU	DESCRIPTION
SET LIMITS	
–LINEAR POLAR–	
LIMIT 1 ON (OFF) XXX.XXX mV	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your polar display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX mV	Turns the Limit 2 line on or off for the active channel on your polar display.
DISPLAY ON (OFF) LIMITS	Enables both previously set limit lines to appear for the active channel on your polar display.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L2, Set Limits—LinearPolar

MENU	DESCRIPTION
SET LIMITS	
–LINEAR POLAR– (–SMITH CHART–)	
LIMIT 1 ON (OFF) XXX.XXX mV	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your Smith chart or polar display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX mV	Turns the Limit 2 line on or off for the active channel on your Smith chart or polar display.
DISPLAY ON (OFF) LIMITS	Enables both previously set limit lines to appear for the active channel on your Smith chart or polar display.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L3, Set Limits—LinearPolar/Smith Chart

MENU	DESCRIPTION
SET LIMITS	
–LOG MAG–	
LIMIT 1ON (OFF) XXX.XXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your Log Mag display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX dB	Turns the Limit 2 line on or off for the active channel on your Log Mag display.
READOUT LIMIT FREQUENCIES	Displays Menu LF1, which shows all points where the current S-parameter equals the limit values
DISPLAY ON (OFF) LIMITS	Enables both previously set limit lines to appear for the active channel on your Log Mag display.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L4, Set Limits—Log Magnitude

MENU	DESCRIPTION
SET LIMITS	
–PHASE–	
LIMIT 1 ON (OFF) XXX.XX DEG	Turns the Limit 1 line on or off for the active channel on the phase graph.
LIMIT 2 ON (OFF) XXX.XX DEG	Turns the Limit 2 line on or off for the active channel on the phase graph.
READOUT LIMIT FREQUENCIES	Displays Menu LF1, which shows all points where the current S-parameter equals the limit values.
DISPLAY ON (OFF) LIMITS	Enables both limit lines for the active channel on a phase graph.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L5, Set Limits—Phase

MENU	DESCRIPTION
SET LIMITS	
–LOG POLAR–	
LIMIT 1 ON (OFF) XXX.XXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your Log Polar display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX dB	Turns the Limit 2 line on or off for the active channel on your Log Polar display.
DISPLAY ON (OFF) LIMITS	Enables both previously set limit lines to appear for the active channel on your Log Polar display.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L6, Set Limits—Log Polar

MENU	DESCRIPTION
SET LIMITS	
–GROUP DELAY–	
LIMIT 1 ON (OFF) XXX.XXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your Group Delay display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX dB	Turns the Limit 2 line on or off for the active channel on your Group Delay display.
READOUT LIMIT FREQUENCIES	Displays Menu LF1, which shows all points where the current S-parameter equals the limit values.
DISPLAY ON (OFF) LIMITS	Enables both previously set limit lines to appear for the active channel on your Group Delay display.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L7, Set Limits—Group Delay

MENU	DESCRIPTION
SET LIMITS	
–LINEAR MAG–	
LIMIT 1 ON (OFF) XXX.XXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your Linear Mag display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX dB	Turns the Limit 2 line on or off for the active channel on your Linear Mag display.
READOUT LIMIT FREQUENCIES	Displays Menu LF1, which shows all points where the current S-parameter equals the limit values.
DISPLAY ON (OFF) LIMITS	Enables both previously set limit lines to appear for the active channel on your Linear Mag display.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L8, Set Limits—Linear Magnitude

MENU	DESCRIPTION
SET LIMITS	
–LINEAR MAG–	
LIMIT 1 ON (OFF) XXX.XXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your Linear Mag display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX dB	Turns the Limit 2 line on or off for the active channel on your Linear Mag display.
READOUT LIMIT FREQUENCY	Displays Menu LF1, which shows all points where the current S-parameter equals the limit values.
-PHASE-	
LIMIT 1 ON (OFF) XXX.XXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your Phase display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX dB	Turns the Limit 2 line on or off for the active channel on your Phase display.
DISPLAY ON (OFF) LIMITS	Enables both previously set limit lines to appear for the active channel on your Phase display.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L9, Set Limits—Linear Magnitude and Phase

MENU	DESCRIPTION
SET LIMITS	
–REAL–	
LIMIT 1 ON (OFF) XXX.XXX mU	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your Real values display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX pU	Turns the Limit 2 line on or off for the active channel on your Real values display.
DISPLAY ON (OFF) LIMITS	Enables both previously set limit lines to appear for the active channel on your Real values display.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L10, Set Limits—Real Values

MENU	DESCRIPTION
SET LIMITS	
–IMAGINARY–	
LIMIT 1 ON (OFF) XXX.XXX mU	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your Real values display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX pU	Turns the Limit 2 line on or off for the active channel on your Imaginary values display.
DISPLAY ON (OFF) LIMITS	Enables both previously set limit lines to appear for the active channel on your Imaginary values display.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L11, Set Limits—Imaginary Values

MENU	DESCRIPTION
SET LIMITS	
–REAL–	
LIMIT 1 ON (OFF) XXX.XXX mU	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your Real values display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX mU	Turns the Limit 2 line on or off for the active channel on your Real values display.
–IMAGINARY–	
LIMIT 1 ON (OFF) XXX.XXX pU	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line on your Imaginary values display beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX pU	Turns the Limit 2 line on or off for the active channel on your Imaginary values display.
DISPLAY ON (OFF) LIMITS	Enables both previously set limit lines to appear for the active channel on your Imaginary values display.
PRESS TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L12, Set Limits—Real and Imaginary Values

MENU	DESCRIPTION
SET LIMITS	
–SWR—	
LIMIT 1 ON (OFF) XXX.XXX mU	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line beyond which the measured values are unacceptable.
LIMIT 2 ON (OFF) XXX.XXX pU	Turns the Limit 2 line on or off for the active channel.
READOUT LIMIT FREQUENCIES	
DISPLAY ON (OFF) LIMITS	Enables both previously set limit lines to appear for the active channel.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu L13, Set Limits—Real Values

MENU	DESCRIPTION
SET LIMIT FREQUENCIES	
–LOG MAG—	
LIMIT 1 ON (REF) X.XXXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line beyond which the measured values are unacceptable.
LIMIT 1 ON (1—2) X.XXXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line beyond which the measured values are unacceptable.
LIMIT Δ ON (1—2) X.XXXX dB	Turns the Limit-delta feature on. This feature displays the difference in value between Limit 1 and Limit 2.
FREQUENCIES AT LIMIT 2	Displays all points where the S-Parameter is equal to Limit 2.
X.XXXX GHz X.XXXX GHz X.XXXX GHz X.XXXX GHz XX.XXX GHz XX.XXX GHz	
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu LF1, Set Limit Frequencies, Log Mag

MENU	DESCRIPTION
SET LIMIT FREQUENCIES	
–GROUP DELAY—	
LIMIT 1 ON (REF) X.XXXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line beyond which the measured values are unacceptable.
LIMIT 1 ON (1—2) X.XXXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line beyond which the measured values are unacceptable.
LIMIT Δ ON (1—2) X.XXXX dB	Turns the Limit-delta feature on. This feature displays the difference in value between Limit 1 and Limit 2.
FREQUENCIES AT LIMIT 2	Displays all points where the S-Parameter is equal to Limit 2.
X.XXXX GHz X.XXXX GHz X.XXXX GHz X.XXXX GHz XX.XXX GHz XX.XXX GHz	
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu LF3, Set Limit Frequencies, Group Delay

MENU	DESCRIPTION
SET LIMIT FREQUENCIES	
–LINEAR MAG—	
LIMIT 1 ON (REF) X.XXXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line beyond which the measured values are unacceptable.
LIMIT 1 ON (1—2) X.XXXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line beyond which the measured values are unacceptable.
LIMIT Δ ON (1—2) X.XXXX dB	Turns the Limit-delta feature on. This feature displays the difference in value between Limit 1 and Limit 2.
FREQUENCIES AT LIMIT 2	Displays all points where the S-Parameter is equal to Limit 2.
X.XXXX GHz X.XXXX GHz X.XXXX GHz X.XXXX GHz XX.XXX GHz XX.XXX GHz	
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu LF4, Set Limit Frequencies, Linear Mag

MENU	DESCRIPTION
SET LIMIT FREQUENCIES	
–SWR—	
LIMIT 1 ON (REF) X.XXXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line beyond which the measured values are unacceptable.
LIMIT 1 ON (1—2) X.XXXX dB	Turns the Limit 1 line on or off for the active channel. For your convenience, the arbitrarily set limit lines allow you to delineate a go/no go line beyond which the measured values are unacceptable.
LIMIT Δ ON (1—2) X.XXXX dB	Turns the Limit-delta feature on. This feature displays the difference in value between Limit 1 and Limit 2.
FREQUENCIES AT LIMIT 2	Displays all points where the S-Parameter is equal to Limit 2.
X.XXXX GHz X.XXXX GHz X.XXXX GHz X.XXXX GHz XX.XXX GHz XX.XXX GHz	
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu LF5, Set Limit Frequencies, SWR

MENU	DESCRIPTION
SET MARKERS	
MARKER 1 ON (OFF) XX.XXXXXX GHz	Turns Marker 1 on or off (activates or deactivates). When on (active), the frequency, time, or distance may be set using the keypad or rotary knob. ***NOTE*** In this text, markers are referred to as being active and as being selected. Any marker that has been turned on and assigned a frequency is considered to be active. The marker to which the cursor presently points is considered to be selected. The selected marker is the only one for which you can change the frequency.
MARKER 2 ΔREF XX.XXXXXX GHz	
MARKER 3 ON (OFF) XX.XXXXXX GHz	Turns Marker 3 on or off (activates or deactivates). When on (active), the frequency, time, or distance may be set using the keypad or rotary knob.
MARKER 4 ON (OFF)	Turns Marker 4 on or off (activates or deactivates). When on (active), the frequency, time, or distance may be set using the keypad or rotary knob.
MARKER 5 ON (OFF)	Turns Marker 5 on or off (activates or deactivates). When on (active), the frequency, time, or distance may be set using the keypad or rotary knob.
MARKER 6 ON (OFF) XX.XXXXXX GHz	Turns Marker 6 on or off (activates or deactivates). When on (active), the frequency, time, or distance may be set using the keypad or rotary knob.
MARKERS DISABLED	Disables all markers.
ΔREF MODE ON (OFF)	Calls Menu M2, which lets you select the ΔREF Marker.
PRESS <ENTER> OR TURN ON/OFF TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu M1, Set Markers

MENU	DESCRIPTION
SELECT ∆REF MARKER	
MARKER 1 XX.XXXXXX GHz	Marker 1 only appears if it has been activated in Menu M1. Placing the cursor on Marker 1 and pressing the ENTER key here selects it as the ∆REF marker. The ∆REF marker is the one from which the other active markers are compared and their difference frequency measured and displayed in Menu M3. The marker frequency may be set using the keypad or rotary knob.
MARKER 3 XX.XXXXXX GHz	Same as above, but for Marker 3
MARKER 4 XX.XXXXXX GHz	Same as above, but for Marker 4
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu M2, Select ∆REF Marker

MENU	DESCRIPTION
SELECT READOUT MARKER	
MARKER 1 XX.XXXXXX GHz	Displays the frequency and S-Parameter value(s) of Marker 1 on all CRT-displayed graphs and Smith Charts. The frequency of Marker 1 also displays here. If Marker 1 was activated in Menu M2 as the REF marker, REF appears as shown for Marker M5 below.
MARKER 2 XX.XXXXXX GHz	Same as above, but for Marker 2
MARKER 5 XX.XXXXXX GHz	Same as above, but for Marker 5
∆REF MODE IS ON	Indicates the status of the ∆REF mode.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu M3, Select Readout Marker

MENU	DESCRIPTION
C H 1 — S 1 1	Selects channel for readout
XX.XXX PS DLY	
MARKER 1 XX.XXXXXX GHz XX.XXX dB XXX.XXX DEG	The selected marker—that is, the one to which the cursor points in Menu M1—and its frequency, time, or distance display here. This could be any one of the six available markers: Marker 1 thru Marker 6.
MARKER TO MAX	Causes the active marker to go to the frequency with the *greatest* S-Parameter value on the active channel.
MARKER TO MIN	Causes the selected marker to go to the frequency with the *smallest* S-Parameter value on the active channel.
2 XX.XXXX GHz XX.XXX dB XXX.XXX DEG	Displays the frequency, magnitude, and phase of the active S-Parameter at marker 2, if the marker is enabled.
3 XX.XXXX GHz XX.XXX dB	Displays the frequency, magnitude, and phase of the active S-Parameter at marker 3, if the marker is enabled.
4 XX.XXXX GHz XX.XXX dB XXX.XXX DEG	Displays the frequency, magnitude, and phase of the active S-Parameter at marker 4, if the marker is enabled.
5 XX.XXXX GHz XX.XXX dB XXX.XXX DEG	Displays the frequency, magnitude, and phase of the active S-Parameter at marker 5, if the marker is enabled.
6 XX.XXXX GHz XX.XXX dB XXX.XXX DEG	Displays the frequency, magnitude, and phase of the active S-Parameter at marker 6, if the marker is enabled.

Menu M4, Readout Marker

MENU	DESCRIPTION
CH 1 – S11	
XXX.XXX ns DLY	
MARKER 1 ΔREF XX.XXXXXX GHz MARKER TO MAX MARKER TO MIN	The REF marker, as activated in Menu M2, its frequency, its reference delay, and the channel on which it appears display here. The REF marker could be any one of the six available markers: M1-M6. The frequency of the REF marker can be changed using the keypad or rotary knob.
Δ(1 - 2) XX.XXXXX GHz XX.XXX dB (XXX.XX DEG)	The marker numbers of the REF marker and the next lowest-numbered active marker appear between the parentheses. This example assumes Marker 1 as the Ref marker and Marker 2 as the next lowest-numbered active marker. The lines below display the difference frequency, (or time/distance) and trace value(s) between these two markers on the active channel.
Δ(1 - 3) XX.XXXXX GHz XX.XXX dB (XXX.XX DEG)	The marker numbers of the REF marker and the next lowest-numbered active marker appear between the parentheses. This example assumes Marker 1 as the Ref marker and Marker 3 as the next lowest-numbered active marker. The lines below display the difference frequency, (or time/distance) and trace value(s) between these two markers on the active channel.
Δ(1 - 4) XX.XXXXX GHz XX.XXX dB (XXX.XX DEG)	The marker numbers of the REF marker and the next lowest-numbered active marker appear between the parentheses. This example assumes Marker 1 as the Ref marker and Marker 4 as the next lowest-numbered active marker. The lines below display the difference frequency, (or time/distance) and trace value(s) between these two markers on the active channel.
Δ(1 - 5) XX.XXXXX GHz XX.XXX dB (XXX.XX DEG)	The marker numbers of the REF marker and the next lowest-numbered active marker appear between the parentheses. This example assumes Marker 1 as the Ref marker and Marker 5 as the next lowest-numbered active marker. The lines below display the difference frequency, (or time/distance) and trace value(s) between these two markers on the active channel.
Δ(1 - 6) XX.XXXXX GHz XX.XXX dB (XXX.XX DEG)	The marker numbers of the REF marker and the next lowest-numbered active marker appear between the parentheses. This example assumes Marker 1 as the Ref marker and Marker 6 as the next lowest-numbered active marker. The lines below display the difference frequency, (or time/distance) and trace value(s) between these two markers on the active channel.

Menu M5, Set ΔREF Marker Readout

MENU	DESCRIPTION
MULTIPLEXER CONTROL	
RF SWITCH A/B	Switches the polarity of the voltage at the RF SWITCH CONTROL port on the 360 TSM so as to switch the user-supplied RF switch between its A and B ports.
NON-SELECTED TEST SET	
STANDBY ON POWER	Selects whether the test set not presently selected is to be powered on (STANDBY) or off.
SYSTEM HARDWARE CONFIGURATION	
TEST SET A/B	Tells the software where the test set is connected—Port A or Port B.
SOURCE A/B	Tells the software where the source is connected—Port A or Port B.
FINISHED ACCEPT CONFIGURATION	Call menu MUX2, which allows you to accept the configuration indicated by the selections in this menu.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu MUX1, Control Test Set/Source Multiplexer 1

MENU	DESCRIPTION
TEST SET A/B	Shows to which port (A or B) the test set is connected.
SOURCE A/B	Shows to which port (A or B) the source is connected.
WARNING	
CONTINUING MAY ERASE CURRENT SETUP AND CALIBRATION	
YOU MAY CHOOSE TO ABORT AND SAVE TO DISK OR INTERNAL MEMORY AS A PRECAUTION	
PRESS <ENTER> TO CONTINUE	Pressing the ENTER key accepts your menu selections.
OR	
PRESS <CLEAR> TO ABORT	Pressing the CLEAR key aborts your menu selections.

Menu MUX2, Control Test Set/Source Multiplexer 2

MENU	DESCRIPTION
TRACE MEMORY FUNCTIONS	
VIEW DATA	Displays measured data; that is, the data presently being taken.
VIEW MEMORY	Displays stored data; that is, data that was previously taken and stored in memory.
VIEW DATA AND MEMORY	Displays measured data superimposed over stored data.
VIEW DATA ÷ MEMORY	Displays measured data divided by stored data.
SELECT TRACE MATH	Takes you to menu NO2 for selection of the type of math operation to be performed.
STORE DATA TO MEMORY	Stores the measured data to internal memory.
DISK FUNCTIONS	Brings up menu NO3, which allows data to be stored to or recalled from the disk.
MEMORY DATA REF, DELAY XXX.XXX CM	Indicates the reference delay applied to the memory data being displayed.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu NO1, Trace Memory Functions

MENU	DESCRIPTION
SELECT TRACE MATH	
ADD (+)	Selects DATA + MEMORY as the math function.
SUBTRACT (–)	Selects DATA – MEMORY as the math function.
MULTIPLY (X)	Selects DATA X MEMORY as the math function.
DIVIDE (÷)	Selects DATA ÷ MEMORY as the math function.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu returns to the NO1 menu.

Menu NO2, Select Trace Math

MENU	DESCRIPTION
TRACE MEMORY DISK FUNCTIONS	
CHANNEL X	Indicates the channel to be used (active channel).
STORE TO DISK	Displays GP1-3 or DSK11 menu to select file to store data from selected channel on disk.
RECALL FROM DISK	Displays DSK9 menu to select file to recall from disk.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu NO3, Trace Memory Disk Functions

MENU	DESCRIPTION
MULTIPLE SOURCE CONTROL	
DEFINE BANDS	Calls menu OM1, which lets you define a frequency band.
SELECT MULTIPLE SOURCE STATE	
OFF	Turns multiple source operating mode off placing 360 VNA in normal operating mode.
STANDBY	Sets multiple source mode to STANDBY. This mode is automatically entered when the operator adjusts the bands and frequency limits of the sources and receiver permitting any frequency ranges to be entered. When mode is set to ON, the frequencies entered are checked against the limitations of the attached sources and receiver.
ON	Sets multiple source mode to ON.
PRESS <ENTER> TO SELECT OR SWITCH	Pressing the ENTER key implements your menu selection.

Menu OM0, Multiple Source Control Menu

MENU	DESCRIPTION
DEFINE BANDS	
BAND 1	Displays the band number being defined.
DISPLAYED FREQ RANGE	
BAND START F XX.XXXXXX GHz	Displays the start frequency for the band.
BAND STOP F XX.XXXXXX GHz	Displays the stop frequency for the band.
BAND FUNCTIONS	
EDIT SYSTEM EQUATIONS	Calls menu OM2, which lets you edit system equations.
STORE BAND 1 BANDS STORED: (1 2 3 4 5)	Indicates the band that will be stored and, within the parenthesis, indicates the bands that have been stored.
CLEAR ALL DEFINITIONS	Clears all the band definitions that may have been previously stored.
SET MULTIPLE SOURCE STATE	Selects Multiple Source Control menu OM0.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu OM1, Define Bands Menu

MENU	DESCRIPTION
EDIT SYSTEM EQUATIONS	
SELECT FUNCTION TO EDIT	
SOURCE 1	Selects source 1 frequency equation for change.
SOURCE 2	Selects source 2 frequency equation for change.
RECEIVER	Selects receiver frequency equation for change.
EQUATION SUMMARY	
C.W. OFF	Toggles frequency term (F) in equation ON or OFF.
MULTIPLIER XX	Enables changing multiplier term of frequency equation via key pad or rotary knob.
DIVISOR XX	Enables changing divisor term frequency equation via key pad or rotary knob.
OFFSET FREQ X.XXXXXX GHz	Enables changing offset frequency term frequency equation via key pad or rotary knob.
PREVIOUS MENU	Recalls menu OM1.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu OM2, Edit System Equations

MENU	DESCRIPTION
OPTIONS	
SWEEP OPTIONS	Calls menu OS1, which lets you define sweep options.
REAR PANEL OUTPUT	Calls menu ORP1, which lets you select an output for the rear panel AUX I/O connector.
DIAGNOSTICS	Calls menu DG1, which lets you implement system diagonistics.
MULTIPLEXER CONTROL	Calls menu MUX1, which lets you control multiplexer operations (if a 360 TSM is installed).
MULTIPLE SOURCE CONTROL	Calls menu OM0, which lets you use and define multiple sources.
RECEIVER MODE	Calls menu RCV1, which lets you enter into the receiver set-on mode, if Option 5 is installed.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu OPTNS, Select Options

MENU	DESCRIPTION
REAR PANEL OUTPUT CONTROL	
OUTPUT ON (OFF)	Turns the rear panel AUX I/O output on or off.
SELECT MODE XXXXXXXXXX	Calls menu ORP2, which lets you select an output mode.
SET HORIZONTAL OR PHASE LOCK SCALING	
START/LOCK a1 X.XXXX V	Lets you enter a voltage for the start/lock frequency. Value will be a frequency start voltage if SELECT MODE choice is HORIZONTAL. It will be a phase-lock voltage if SELECT MODE choice is PHASELOCK.
STOP/LOCK a2 X.XXXX V	Lets you enter a voltage for the start/lock frequency. Value will be a frequency stop voltage if SELECT MODE choice is HORIZONTAL. It will be a phase-lock voltage if SELECT MODE choice is PHASELOCK.
VERTICAL SCALING	
1.00 VOLT PER CHANNEL 1 GRATICULE LINE	Shows fixed value for VERTICAL mode.
REFERENCE LINE IS 0.00 VOLT	Shows fixed value for VERTICAL mode.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection.

Menu ORP1, Rear Panel Output Control

MENU	DESCRIPTION
SELECT MODE FOR OUTPUT	
HORIZONTAL	Pressing ENTER key selects horizontal drive for external chart recorder connected to AUX I/O connector.
VERTICAL	Pressing ENTER key selects vertical drive for external chart recorder connected to AUX I/O connector.
PHASE LOCK	Pressing ENTER key selects phase-lock for external chart recorder connected to AUX I/O connector.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu ORP2, Select Output Mode

MENU	DESCRIPTION
SWEEP OPTIONS	
SELECT TRIGGER SOURCE	Calls menu OS2, which lets you select a triggering source.
DATA ON (OFF) DRAWING	Toggles the data-drawing function on or off.
POINTS DRAWN IN C.W. X	Move the cursor to here and enter the number of points to be drawn in the CW mode.

Menu OS1, Select Sweep Options

MENU	DESCRIPTION
SELECT TRIGGER SOURCE	
INTERNAL	Pressing ENTER key selects trigger source to be internal.
EXTERNAL WITH I.F. CAL	Pressing ENTER key selects trigger source to be external with the IF calibrated.
EXTERNAL WITHOUT I.F. CAL	Pressing ENTER key selects trigger source to be external without the IF being calibrated.
TRIGGER I.F. CAL	Pressing ENTER key triggers an IF calibration.
PREVIOUS MENU	Returns you to menu OS1.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing ENTER key implements your selection.

Menu OS2, Select Trigger Source

MENU	DESCRIPTION
SELECT POLAR CHART MODE	
MAGNITUDE PHASE	Selects Polar Chart Display to show magnitude and phase for the full frequency range—from start frequency to stop frequency.
MAGNITUDE SWP POSITION	Selects Polar Chart Display to show magnitude information only for the phase data that falls between the start and stop angles selected below.
SET SWEEP POSITION BOUNDARIES	Sets the start and stop angles for the data display.
START ANGLE X.XX	
STOP ANGLE X.XX	
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu PC1, Select Polar Chart Mode

MENU	DESCRIPTION
PARAMETER DEFINITION	
S11/USER 2	Lets you choose between displaying a pre-defined S-Parameter or a user-defined parameter.
PARAMETER b1 / a1	Displays the parameters chosen as numerator and denominator.
PHASE LOCK a1	Displays the phase-lock parameter.
LABEL: “MY S11”	Displays the name of the user-defined parameter.
CHANGE NUMERATOR	Calls menu PD2, which lets you change the numerator.
CHANGE DENOMINATOR	Calls menu PD3, which lets you change the denominator.
CHANGE PHASE LOCK	Calls menu PD4, which lets you change the phase-lock parameter.
CHANGE LABEL	Calls menu GP5, which lets you name your newly defined parameter. The label appears at the top of the graph-type display and under the word “LABEL” in the menu.

Menu PD1, Select Parameter Definition

MENU	DESCRIPTION
SELECT NUMERATOR	
b1	Selects b1 as the numerator.
b2	Selects b2 as the numerator.
a1	Selects a1 as the numerator.
a2	Selects a2 as the numerator.
1 (UNITY)	Selects the numerator to be 1 (unity).
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu PD2, Select Numerator

MENU	DESCRIPTION
SELECT DENOMINATOR	
b1	Selects b1 as the denominator.
b2	Selects b2 as the denominator.
a1	Selects a1 as the denominator.
a2	Selects a2 as the denominator.
1 (UNITY)	Selects the denominator to be 1 (unity).
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu PD3, Select Denominator

MENU	DESCRIPTION
SELECT PHASE LOCK REFERENCE	
a1	Selects Port 1 (a1) as the phase-lock reference.
a2	Selects Port 2 (a2) as the phase-lock reference.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu PD4, Select Phase Lock Reference

MENU	DESCRIPTION
PLOT OPTIONS PLOT	
FULL PLOT	The plotter will plot everything displayed on the screen (data traces, graticule, menu text) when START PRINT is pressed.
OPTIONS	
HEADER ON (OFF)	The plot will include an information header if this option is on and START PRINT is pressed.
MENU ON (OFF)	The plot will include the menu text if this option is on and START PRINT is pressed.
MARKERS ON (OFF) AND LIMITS	The plot will include any marker or limit lines if this option is on and START PRINT is pressed.
GRATICULE ON (OFF)	The plot will include the graticule and annotation if this option is on and START PRINT is pressed. The plotter plots the graticule.
DATA ON (OFF) TRACE(S)	The plot will include the data if this option is on and START PRINT is pressed. The plotter plots the graticule.
FORMAT	
PLOT SIZE	Calls menu PL2, which lets you select the size and location of the plot.
PEN COLORS	Calls menu PL3, which lets you select pen colors for the various elements of the plot: graticule, data traces, menu text and header. Also lets you select the relative pen speed.

Menu PL1, Plot Options

MENU	DESCRIPTION
SELECT PLOT SIZE	
FULL SIZE	Selects a full size (page) plot.
–QUARTER SIZE PLOTS–	
UPPER LEFT	Selects a quarter-size plot, upper-left quadrant.
UPPER RIGHT	Selects a quarter-size plot, upper-right quadrant.
LOWER LEFT	Selects a quarter-size plot, lower-left quadrant.
LOWER RIGHT	Selects a quarter-size plot, lower-right quadrant.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu PL2, Select Plot Size

MENU	DESCRIPTION
SELECT PEN COLORS	
DATA PEN n	Selects the color in which the data will be plotted. The number of the pen displays where the “n” is shown.
DATA TRACE OVERLAY PEN n	Selects the color in which the 2nd trace in a dual trace overlay plot will be plotted. The number of the pen displays where the “n” is shown.
GRATICULE PEN n	Selects the color in which the graticule will be plotted. The number of the pen displays where the “n” is shown.
MARKERS AND LIMITS PEN n	Selects the color in which the markers and limits will be plotted. The number of the pen displays where the “n” is shown.
HEADER PEN n	Selects the color in which the header information will be plotted. The number of the pen displays where the “n” is shown.
PEN SPEED 100 PERCENT OF MAXIMUM	Selects the pen’s speed as a percentage of the plotter’s maximum speed. (Used to optimize plots on transparencies or with worn pens.)
PREVIOUS MENU	Recalls menu PL1.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu PL3, Select Pen Colors

MENU	DESCRIPTION
SELECT OUTPUT DEVICE	
PRINTER	Selects the printer as your output device.
PLOTTER	Selects the plotter as your output device.
OUTPUT OPTIONS	
SET UP OUTPUT HEADERS	Calls menu PM2, which lets you define the output header information shown on printer/plotter output.
DISK OUTPUT OPERATIONS	Calls menu PM4, which lets you store/recall tabular data to/from disk.
PRINT OPTIONS	Calls menu PM5.
PLOT OPTIONS	Calls menu PL1.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu PM1, Select Data Output Type

MENU	DESCRIPTION
DATA OUTPUT HEADERS	
MODEL ON (OFF) XXXXXXXXXXXX	Selecting <1>displays menu GP5, which lets you select the letters and/or numbers in your model identifier.
DEVICE ID ON (OFF) XXXXXXXXXXXX	Selecting <1>displays menu GP5, which lets you select the letters and/or numbers in your Device I.D. identifier.
DATE ON (OFF) XXXXXXXXXXXX	Selecting <1>displays menu GP5, which lets you select the letters and/or numbers in the date.
OPERATOR ON (OFF) XXXXXXXXXXXX	Selecting <1> displays menu GP5, which lets you select the letters identifying the operator.
PRESS <ENTER> TO TURN ON/OFF	Pressing the ENTER key selects between menu selections. Pressing the CLEAR/RET LOC key lets you change the between ON and OFF states
OR	
PRESS < 1 > TO CHANGE	Pressing <1> lets you enter the desired label in menu GP5,

Menu PM2, Data Output Headers

MENU	DESCRIPTION
TABULAR OUTPUT FORMAT	
MARKER ON (OFF) DATA	Provides for printing markers data.
SWEEP ON (OFF) DATA	Provides for printing frequency sweep data. If you elect to print the sweep data, you can choose how many frequency points to print out.
HEADINGS AND PAGE BREAKS	Toggles headings and page breaks on or off.
XXX POINTS THIS PRINT MODE OUTPUTS 1 POINT EVERY XX POINTS	Outputs one point every X points. Use rotary knob to select total number of points to output.
PREVIOUS MENU	Returns you to the previous menu.
PRESS <ENTER> TO TURN ON/OFF OR TURN KNOB TO CHANGE NUMBER OF POINTS	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed. Turning the knob on number of points changes the value of X to define the number of points printed.

Menu PM3, Tabular Output Format

MENU	DESCRIPTION
DISK OUTPUT OPERATIONS	
TABULAR DATA TO DISK	Outputs tabular data to the disk and takes you to GP1-3 or DSK 11 for selection of a file name.
TABULAR DATA FROM DISK TO PRINTER	Brings up DSK9 for selection of a measurement data file to be output to the printer.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu PM4, Disk Output Operations

MENU	DESCRIPTION
PRINT OPTIONS	
PRINTER TYPE	
THINKJET	Select when ANRITSU 2225C Inkjet, HP QuietJet, or HP ThinkJet is connected to 360B VNA
DESKJET	Select when HP DeskJet, HP DeskJet Plus, or HP LaserJet II is connected to 360B VNA
EPSON	Select when Epson EX, Epson FX, Epson LX, or Epson compatible is connected to 360B VNA
SELECT PRINTER OUTPUT FORMAT	
FULL SCREEN	Prints full screen data, including the menu.
GRAPH ONLY	Prints only the graph or Smith chart, including any and all data it contains.
TABULAR DATA	Prints a tabulation of the measured data
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu PM5, Printer Type, Options

MENU	DESCRIPTION
RECEIVER MODE	
STANDARD	Selects STANDARD mode (RECEIVER mode is not activated).
USER DEFINED	Selects USER DEFINED mode. Brings the User Defined Receiver Mode menu to the screen.

Menu RCV1, Receiver Mode

MENU	DESCRIPTION
USER DEFINED RECEIVER MODE	
FINISHED, ACCEPT CONFIGURATION	Select to indicate that mode has been chosen.
PHASE LOCK MODE	
SOURCE LOCK	Phase locks sources having phase control reference inputs.
TRACKING	Phase locks 360 receivers to a known frequency source.
SET ON	Disables source lock circuitry, local oscillators are phase locked to the 360 internal crystal reference oscillator.
360 CONTROL OF SOURCE SWEEP	
GPIB ON CONTROL	Turns GPIB control of source on or off.
PRESS ENTER TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection or turns GPIB control on or off.

Menu RCV2, User Defined Receiver Mode Menu

MENU	DESCRIPTION
STANDARD RECEIVER MODE	Indicates that Standard Receiver mode has been selected
WARNING:	Indicates that continuing (by pressing <ENTER>) will erase current setup and calibration stored in 360 VNA.
CONTINUING WILL ERASE CURRENT SETUP AND CALIBRATION	

Menu RCV3, Standard Receiver Mode Warning Menu

MENU	DESCRIPTION
USER DEFINED RECEIVER MODE	
XXXXXXXX	Indicates selected mode
WARNING:	Indicates that continuing (by pressing <ENTER>) will erase current setup and calibration stored in 360 VNA.
CONTINUING WILL ERASE CURRENT SETUP AND CALIBRATION	
PRESS <ENTER> TO CONTINUE	Pressing ENTER key implements selected mode.
OR	
PRESS <CLEAR> TO ABORT	Pressing the CLEAR key aborts the selected mode; current setup and calibration data stored in 360 VNA is preserved.

Menu RCV4, User Defined Receiver Mode Warning Menu

MENU	DESCRIPTION
SET REFERENCE PLANE	
AUTO	Automatically sets the reference delay so that the cumulative phase shift is zero. This selection unwinds the phase in a Smith chart display or reduces the phase revolutions in a rectilinear display to less than one.
DISTANCE XXX.XXX mm	Electrically repositions the measurement reference plane, as displayed on the active channel, by a distance value entered in millimeters. This selection lets you compensate for the phase reversals inherent in a length of transmission line connected between the test set's Port 1 connector and the device-under-test (DUT).
TIME XXX.XXX ms	Electrically repositions the measurement reference plane by a distance value that corresponds to the time in milliseconds.
SET DIELECTRIC	Displays menu RD2, which lets you enter a value for the dielectric constant of your transmission line.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu RD1, Set Reference Delay

MENU	DESCRIPTION
SET DIELECTRIC CONSTANT	
AIR (1.000649)	Calculates reference delay based on dielectric constant of air (1.000649).
POLYETHYLENE (2.26)	Calculates reference delay based on the dielectric constant of polyethylene (2.26).
TEFLON (2.10)	Calculates reference delay based on the dielectric constant of teflon (2.1).
MICROPOROUS TEFLON (1.69)	Calculates reference delay based on the dielectric constant of microporous teflon (1.69).
OTHER XXXX.XX	Calculates reference delay based on the value you enter. Terminate your entry using any terminator and select with the ENTER key.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection and returns you to the RD1 menu.

Menu RD2, Set Dielectric Constant

MENU	DESCRIPTION
SELECT S - PARAMETER	
S21 FWD TRANS	Selects the S_{21} parameter to be displayed on the active channel The parameter can be displayed in any of the available formats.
S11 FWD REFL	Selects the S_{11} parameter to be displayed on the active channel. The parameter can be displayed in any of the available formats.
S12 REV TRANS	Selects the S_{12} parameter to be displayed on the active channel. The parameter can be displayed in any of the available formats.
S22 REV REFL	Selects the S_{22} parameter to be displayed on the active channel. The parameter can be displayed in any of the available formats.
REDEFINE SELECTED PARAMETER	Calls menu PD1, which lets you redefine your measurement parameter from a standard S-Parameter to one of your own choosing.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/LOC key is pressed.

Menu SP, Select S Parameter

MENU	DESCRIPTION
SAVE/RECALL FRONT PANEL INFORMATION	
SAVE RECALL	Displays menu SR2, which asks you to select a storage location—internal memory or disk.
PRESS <ENTER> TO SELECT FUNCTION	Pressing the ENTER key implements your selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu SR1, Save/Recall Front Panel Information

MENU	DESCRIPTION
RECALL (OR SAVE)	
FRONT PANEL SETUP IN INTERNAL MEMORY	Calls menu SR3, which lets you save the control panel setup into or recalls it from internal memory.
CAL DATA AND FRONT PANEL SETUP ON DISK	Saves the calibration data and control panel setup onto the disk or recall them from the disk. This selection displays Menu DSK9(recall) or DSK11, and GP1-3(save) which asks you to select a disk file.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu SR2, Recall or Save

MENU	DESCRIPTION
SAVE TO INTERNAL MEMORY	
MEMORY 1	Causes the current control (front) panel setup to be saved to memory location 1.
MEMORY 2	Same as above, except the setup saves to memory location 2.
MEMORY 3	Same as above, except the setup saves to memory location 3.
MEMORY 4	Same as above, except the setup saves to memory location 4.
PRESS <ENTER> TO SELECT OR USE KEYPAD	You may press the ENTER key or use the keypad to implement your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu SR3, Save to Internal memory

MENU	DESCRIPTION
WARNING	
INTERNAL MEMORY DOES NOT MATCH CURRENT CAL SETUP	Warns that the setup you are attempting to recall is not compatible with the current control panel setup.
CONTINUING RECALL WILL DESTROY CURRENT CAL	Recalling the setup in question will destroy the current calibration data.
PRESS <ENTER> TO RECALL OR PRESS <CLEAR> TO ABORT	Pressing the ENTER key recall the selected setup, while pressing the clear key aborts the selection.

Menu SR4, Warning—Internal Memory Does Not Match Current Cal Setup

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
–LOG MAG–	
RESOLUTION XX.XXX dB/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XXX dB	Sets the value at the reference line for the active channel amplitude measurement on the log-magnitude graph. The value can be set in increments of 0.001 dB using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement on the log-magnitude graph. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.
–PHASE–	
RESOLUTION XX.XX DEG/DIV	Sets the resolution for the vertical axis of the active channel's displayed phase graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XX DEG	Sets the value at the reference line for the active channel amplitude measurement on the phase graph. The value can be set in increments of 0.001 dB using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's phase measurement on the phase graph. This is the line about which the phase expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.
PHASE OFFSET X.XX	Sets the value by which the active channel's phase measurement is offset on the phase graph. The offset can be set in increments of 0.01 degrees using the keypad or rotary knob.

Menu SS1, Set Scaling 1

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
–LINEAR POLAR–	
RESOLUTION XX.XXX U/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob. The center is fixed at 0 units; therefore, changing the resolution also changes the reference value and vice versa
REF VALUE XXX.XXX U	Sets the value at the reference line for the active channel amplitude measurement on the displayed graph. The value can be set in increments of 0.001 U using the keypad or rotary knob.
FIXED REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.
SELECT POLAR CHART MODE MAGNITUDE PHASE	Calls menu PC1, which lets you define the phase angles between which your polar chart will display data.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection and resumes the calibration from where it left off, if in the calibration mode. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu SS2, Set Scaling 2

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
IMPEDANCE SMITH CHART	Scales an Impedance Smith chart for display in the active channel.
NORMAL SMITH (REFL = 1.000 FULL SCALE)	Selects a normal Smith chart for display in the active channel.
EXPAND 10 dB (REFL = 0.316 FULL SCALE)	Selects a 10 dB expansion of the Smith chart being displayed for the active channel.
EXPAND 20 dB (REFL = 0.099 FULL SCALE)	Selects a 20 dB expansion of the Smith chart being displayed for the active channel.
EXPAND 30 dB (REFL = 0.031 FULL SCALE)	Selects a 30 dB expansion of the Smith chart being displayed for the active channel.
COMPRESS 3 dB (REFL =1.413 FULL SCALE)	Selects a 3 dB compression of the Smith chart being displayed for the active channel.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection and resumes the calibration from where it left off, if in the calibration mode.. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu SS3, Set Scaling 3

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
–LOG MAG–	
RESOLUTION XX.XXX dB/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XXX dB	Sets the value at the reference line for the active channel amplitude measurement on the displayed graph. The value can be set in increments of 0.001 dB using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement on the log-magnitude graph. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.

Menu SS4, Set Scaling 4

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
–PHASE–	
RESOLUTION XX.XXX ^{o}/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XXX ^{o}	Sets the value at the reference line for the active channel amplitude measurement on the displayed graph. The value can be set in increments of 0.01 ^{o} using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.
PHASE OFFSET X.XX	Sets the value by which the active channel's phase measurement is offset on the phase graph. The offset can be set in increments of 0.01 degrees using the keypad or rotary knob.

Menu SS5, Set Scaling 5

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
–LOG POLAR–	
RESOLUTION XX.XXX dB/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XXX dB	Sets the value at the reference line for the active channel amplitude measurement on the displayed graph. The value can be set in increments of 0.001 dB using the keypad or rotary knob.
FIXED REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.
SELECT POLAR CHART MODE MAGNITUDE PHASE	Calls menu PC1, which lets you define the phase angles between which your polar chart will display data.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection and resumes the calibration from where it left off, if in the calibration mode. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu SS6, Set Scaling 6

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
–GROUP DELAY–	
RESOLUTION XX.XXX s/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XXX fs	Sets the value at the reference line for the active channel amplitude measurement on the displayed graph. The value can be set in increments of 0.0001 s using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.
APERTURE X.X PERCENT OF SWEEP XX.XX	Sets and displays the frequency span over which group delay is calculated.

Menu SS7 Set Scaling 7

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
–LINEAR MAG–	
RESOLUTION XX.XXX U/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XXX pU	Sets the value at the reference line for the active channel amplitude measurement on the displayed graph. The value can be set in increments of 0.001 U using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.

Menu SS8, Set Scaling 8

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
–LINEAR MAG–	
RESOLUTION XX.XXX U/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XXX pU	Sets the value at the reference line for the active channel amplitude measurement on the displayed graph. The value can be set in increments of 0.001 U using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.
–PHASE–	
RESOLUTION XX.XX DEG/DIV	Sets the resolution for the vertical axis of the active channel's displayed phase graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XX DEG	Sets the value by which the active channel's phase measurement is offset on the phase graph. The offset can be set in increments of 0.01 degrees using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's phase measurement on the phase graph. This is the line about which the phase expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.

Menu SS9, Set Scaling 9

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE> –REAL–	
RESOLUTION XX.XXX U/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XXX pU	Sets the value at the reference line for the active channel amplitude measurement on the displayed graph. The value can be set in increments of 0.001 U using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.

Menu SS10, Set Scaling 10

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
–IMAGINARY–	
RESOLUTION XX.XXX U/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XXX pU	Sets the value at the reference line for the active channel amplitude measurement on the displayed graph. The value can be set in increments of 0.001 U using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.

Menu SS11, Set Scaling 11

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
–REAL–	
RESOLUTION XX.XXX U/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XXX pU	Sets the value at the reference line for the active channel amplitude measurement on the displayed graph. The value can be set in increments of 0.001 U using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.
–IMAGINARY–	
RESOLUTION XX.XX DEG/DIV	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XX DEG	Sets the value by which the active channel's phase measurement is offset on the phase graph. The offset can be set in increments of 0.01 degrees using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's phase measurement on the phase graph. This is the line about which the phase expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.

Menu SS12, Set Scaling 12

MENU	DESCRIPTION
SET SCALING OR PRESS <AUTOSCALE>	
–SWR–	
RESOLUTION XX.XXX U /	Sets the resolution for the vertical axis of the active channel's displayed graph. Resolution can by set incrementally using the keypad or rotary knob.
REF VALUE XXX.XXX U	Sets the value at the reference line for the active channel amplitude measurement on the displayed graph. The value can be set in increments of 0.001 U using the keypad or rotary knob.
REFERENCE LINE	Sets the reference line for the active channel's amplitude measurement. This is the line about which the amplitude expands with different resolution values. The reference line can be set to any vertical division using the rotary knob.

Menu SS13, Set Scaling 13

MENU	DESCRIPTION
SWEEP SETUP	
START XX.XXXXXX GHz	Enter the sweep-start frequency in GHz. The start frequency must be lower than the stop frequency.
STOP XX.XXXXXX GHz	Enter the sweep-stop frequency in GHz. The stop frequency must be higher than the start frequency.
XXX DATA PTS XXX.X MHz STEP SIZE	Displays the number of frequency points and the spacing between points for the start and stop frequencies selected above. The number of points shown provides the finest frequency resolution possible, based on your DATA POINTS key MAXIMUM-NORMAL- MINIMUM selection.
C.W. MODE ON (OFF) XX.XXXXXX GHZ	Move cursor here and press ENTER to enable the CW mode. Enter CW frequency for measurements.
MARKER SWEEP	Move cursor here and press ENTER to set the start and stop frequencies (menu SU5) of the CW frequency (menu SU6) to the values of any marker
DISCRETE FILL	Calls Discrete Fill Menu (menu DF).
HOLD BUTTON FUNCTION	Calls menu SU4, which lets you set the action of the HOLD key.
TEST SIGNALS	Calls menu SU2, which lets you set the source power and the values for the attenuators in the Model 362XA Series Test Set. It also provides entry into the Flat Test Port Power calibration.
WR AND PORT MODEL NUMBERS	This choice appears in place of “TEST SIGNALS,” if you are working in millimeter wave and using the 3635A or 3635B test set. Selecting this choice calls menu SU7, and lets you specify waveguide type and port numbers.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu SU1, Sweep Setup 1

MENU	DESCRIPTION
REDUCED TEST SIGNALS	
SOURCE 1 PWR XX.X dBm	Enter the output-power level for the source 1 sweep generator (frequency source) in dBm.
SOURCE 2 PWR XX.X dBm	Enter the output-power level for the source 2 sweep generator (frequency source) in dBm.
PORT 1 SOURCE X0 dB (0-70)	Attenuates the microwave source power at port 1 from 0 to 70 dB, in 10 dB steps. The power is attenuated before being applied to Port 1 for a forward transmission or reflection test (S_{21} or S_{11}, respectively).
PORT 1 TEST X0 dB (0-00)	Attenuates from 0 to 40 dB (10 dB steps) the microwave power being input to Port 1 from the device-under-test (DUT), for Model 3636A Pulse Test Set.
PORT 2 SOURCE X0 dB (0-70)	Attenuates the microwave source power from 0 to 70 dB, in 10 dB steps. The power is attenuated before being applied to Port 2 for a reverse transmission or reflection test (S_{12} or S_{22}, respectively).
PORT 2 TEST X0 dB (0-40)	Attenuates from 0 to 40 dB (10 dB steps) the microwave power being input to Port 2 from the device-under-test (DUT).
FLAT TEST PORT POWER	Calls menu SU8 or SU8A, , depending on whether valid Flat Test Port Power calibration data exists. Both of these menus provide selection control for the Flat Test Port Power feature.
PREVIOUS MENU	Returns you to the previous menu.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu SU2, Sweep Setup 2

MENU	DESCRIPTION
SINGLE POINT MEASUREMENT SETUP	
C.W. FREQ XX.XXXXXX GHz	Enter the measurement frequency in GHz for continuous wave (CW) operation.
HOLD BUTTON FUNCTION	Calls menu SU4, which lets you set the action of the HOLD key.
TEST SIGNALS	Calls menu SU2, which lets you set values for the source power and attenuators in the Model 362XA Series Test Set. It also provides entry into the Flat Test Port Power calibration.
RETURN TO SWEEP MODE	Move cursor here and press ENTER to return to the F1-F2 sweep mode (Menu SU1).
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu SU3, Single-Point Measurement Setup

MENU	DESCRIPTION
SELECT FUNCTION FOR HOLD BUTTON	
HOLD/CONTINUE	Causes the hold key (button) to stop and start the sweep.
HOLD/RESTART	Causes the hold key to stop and restart the sweep.
SINGLE SWEEP AND HOLD	Causes the hold key to trigger a single sweep and hold when finished. (Two sweeps, one from Port 1 to 2 and another from Port 2 to 1, are accomplished for a 12-Term measurement.)
BIAS/RF HOLD CONDITIONS	
BIAS ON (OFF)	Select bias to be on or off (test sets having bias input only) while system is in hold.
RF ON (OFF)	Selects RF to be on or off while system is in hold.
DUT/AUT ON (OFF)	When turned on, pressing the DEFAULT PROGRAM key places the VNA in the hold mode with RF and BIAS turned off.

Menu SU4, Select Function for Hold Button

MENU	DESCRIPTION
FREQUENCY MARKER SWEEP	
START SWEEP MARKER (n) XX.XXXX GHz	Pressing a number on the keypad causes the associated marker to be the start frequency of the sweep.
STOP SWEEP MARKER (n) XX.XXXX GHz	Pressing a number on the keypad causes the associated marker to be the stop frequency of the sweep.
USE KEYPAD TO SELECT MARKER (1-6)	Use the keypad to select markers 1, 2, 3, 4, 5, or 6.

Menu SU5, Frequency Marker Sweep

MENU	DESCRIPTION
FREQUENCY MARKER C.W.	
C.W FREQ MARKER (n) XX.XXXXXX GHz	Pressing a number on the keypad causes the associated marker to be the C.W. frequency.
USE KEYPAD TO SELECT MARKER (1-6)	Use the keypad to select markers 1, 2, 3, 4, 5, or 6.

Menu SU6, Frequency Marker C.W.

MENU	DESCRIPTION
SELECT WR NUMBER	
WR—22 (33–50 GHz)	Selects WR-22 waveguide designation for measurement use.
WR—19 (40–60 GHz)	Selects WR-19 waveguide designation for measurement use.
WR—15 (50–75 GHz)	Selects WR-15 waveguide designation for measurement use.
WR—12 (60–90 GHz)	Selects WR-12 waveguide designation for measurement use.
WR—10 (75–110 GHz)	Selects WR-10 waveguide designation for measurement use.
PORT 1 MODEL 3640	Displays the selected module for Port 1.
SELECT PORT 2 MODEL NUMBER	
3640	Selects Model 3640 for Port 2.
3641	Selects Model 3641 for Port 2.
LOAD NEW MODULES	Calls menu DB1, which lets you tell the software to which ports your 364X modules are connected.
PREVIOUS MENU	Returns you to previous menu.

Menu SU7, Select WR Number

MENU	DESCRIPTION
FLAT TEST PORT POWER	
CALIBRATE FOR FLATNESS	Calls menu SU8A, which lets you perform a calibration.
CHARACTERIZED FLAT PORT X AT XX.X dBm SOURCE X SET TO XX.X dBm	Displays the port number you have selected for flattened power, the power level at which flatness occurs, and the power output level of the source at the time of calibration. If you later change either the source or attenuation power levels, a message (276: FLAT MAY BE INVALID) appears in red for 2 seconds. (Refer to Application Note, AN360-14 for further information on this feature.)
FLATNESS (ON /OFF) CORRECTION	Turns the flatness correction on and off.
TEST PORT PWR XX.X dBm	Select power at test port.
PREVIOUS MENU	Returns you to previous menu.
PRESS <ENTER> TO SELECT ON TURN ON/OFF	Pressing the ENTER key implements your menu selection or turns the function on/off.

Menu SU8, Correct/Calibrate Flat Test Port Power

MENU	DESCRIPTION
CALIBRATE FOR FLAT PORT POWER	
TEST PORT PORT 1/PORT 2	Select the port for which flatness is to be imposed.
NUMBER OF POWER SWEEPS X	Select the number of times (1 – 5) that the power point for each frequency is to be measured (swept).
XXX POINTS MEASURE 1 PWR POINT EVERY XX POINTS	Displays the number of power points (0 – 50) to be skipped during the power sweep. The points not measured are interpolated to provide a flat sweep.
START FLAT CALIBRATION	Begins the calibration. If calibration is successful, you are returned to menu SU8. If the calibration unsuccessful due to a fatal error (Source or power meter inoperable or not connected), this menus remains displayed. At any time, you can abort the calibration by pressing the DEFAULT PROGRAM or CLEAR/RET LOC keys. All other keys are locked out.
PREVIOUS MENU	Returns you to previous menu.
PRESS <ENTER> TO SELECT OR SWITCH OR TURN KNOB TO CHANGE NUMBER OF POINTS	Pressing the ENTER key implements your menu selection or turns the function on/off.

Menu SU8A, Calibrate For Flat Test Port Power

–FLAT POWER CALIBRATION–

FLAT POWER CALAIBRATION ADJUSTS THE SOURCE OUTPUT POWER AT EACH MEASUREMENT POINT ACROSS A FREQUENCY SPAN TO PROVIDE A CONSTANT POWER LEVEL AT THE SELECTED TEST PORT.

–INSTRUCTIONS–

1. PRESET, ZERO, AND CALIBRATE THE POWER METER.

2. CREATE AND ACTIVATE THE POWER METER'S CAL FACTOR LIST FOR THE POWER SENSOR BEING USED.

3. CONNECT THE POWER METER TO THE SYSTEM BUS AND THE POWER SENSOR TO THE TEST PORT.

4. SELECT START FLAT CALIBRATION.

–FOR BEST RESULTS–

1, SET THE SOURCE 1 POWER TO MAXIMUM POWER.

2. SELECT AT LEAST 2 POWER SWEEP READINGS.

3. MEASURE 1 POWER POINT FOR EVERY DATA POINT.

Text Associated With Flat Power Calibation Menu SU8A

MENU	DESCRIPTION
DOMAIN	
FREQUENCY	Displays the data in normal frequency domain format.
FREQUENCY WITH TIME GATE	Displays the data in the frequency domain after a specific time range has been sampled by the gate function.
TIME LOWPASS MODE	Displays the data in the time (distance) domain, using true lowpass processing. Data must be taken using a harmonic series calibration and sweep in order to use this mode.
TIME BANDPASS MODE	Displays the data in the time (distance) domain using bandpass processing. Any data sweep range using normal calibration can be used.
–DISPLAY–	
TIME/DISTANCE	Switches the mode of display between time and distance. This does not affect the actual displayed data, but only the annotation.
SET RANGE	Call a menu that lets you set range and other display parameters.
SET GATE	Calls a menu that lets you set gate parameters.
GATE ON/OFF	Switches the gate on or off each time ENTER is pressed.
HELP	Displays an informational help menu.
PRESS <ENTER> TO SELECT OR SWITCH	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD1, Domain (Frequency/Display)

MENU	DESCRIPTION
LOWPASS TIME DOMAIN SETUP	
START XXX.XXX ps	Sets the start time of the display.
STOP XXX.XXX ps	Sets the stop time of the display..
CENTER XXX.XXX ps	Sets the center time of the display.
SPAN XXX.XXX ps	Sets the span (Stop - Start) of the display.
MARKER RANGE	Takes you to a menu that lets you set the display to a range determined by two of the markers.
RESPONSE IMPULSE/STEP	Switches between Impulse and Step response each time ENTER is pressed.
MORE	Takes you to a menu that contains additional selections for display setup.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD2tl, Lowpass Time Domain Setup

MENU	DESCRIPTION
LOWPASS DISTANCE DISPLAY SETUP	
START XXX.XXX mm	Sets the start time of the display.
STOP XXX.XXX mm	Sets the stop time of the display.
CENTER XXX.XXX mm	Sets the center time of the display.
SPAN XXX.XXX mm	Sets the span (Stop - Start) of the display.
MARKER RANGE	Takes you to a menu that lets you set the display to a range determined by two of the markers.
RESPONSE IMPULSE/STEP	Switches between Impulse and Step response each time ENTER is pressed.
MORE	Takes you to a menu that contains additional selections for display setup.
REL. VELOCITY X.X	Indicates the relative velocity of light, as set by the dielectric constant in menu RD2.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD2dl, Lowpass Distance Display Setup

MENU	DESCRIPTION
BANDPASS TIME DOMAIN SETUP	
START XXX.XXX ps	Sets the start time of the display.
STOP XXX.XXX ps	Sets the stop time of the display..
CENTER XXX.XXX ps	Sets the center time of the display.
SPAN XXX.XXX ps	Sets the span (Stop - Start) of the display.
MARKER RANGE	Takes you to a menu that lets you set the display to a range determined by two of the markers.
PHASOR ON/OFF IMPULSE	Switches Phasor Impulse processing on or off each time ENTER is pressed.
HELP – PHASOR IMPULSE	Displays an informational help menu.
MORE	Takes you to a menu that contains additional selections for display setup.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD2tb, Bandpass Time Domain Setup

MENU	DESCRIPTION
BANDPASS DISTANCE DISPLAY SETUP	
START XXX.XXX mm	Sets the start time of the display.
STOP XXX.XXX mm	Sets the stop time of the display.
CENTER XXX.XXX mm	Sets the center time of the display.
SPAN XXX.XXX mm	Sets the span (Stop - Start) of the display.
MARKER RANGE	Takes you to a menu that lets you set the display to a range determined by two of the markers.
PHASOR ON/OFF IMPULSE	Switches Phasor Impulse processing on or off each time ENTER is pressed.
HELP – PHASOR IMPULSE	Displays an informational help menu.
MORE	Takes you to a menu that contains additional selections for display setup.
REL. VELOCITY X.X	Indicates the relative velocity of light, as set by the dielectric constant in menu RD2.
PRESS <ENTER> TO SELECT OR TURN ON/OFF	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD2db, Bandpass Distance Display Setup

MENU	DESCRIPTION
BANDPASS TIME DOMAIN SETUP	
SET WINDOW NOMINAL	Takes you to a menu that lets you change the window type.
SET GATE	Takes you to a menu that lets you set the gate parameters.
PREVIOUS MENU	Returns you to the previous menu.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD3b, Bandpass Time Domain Setup

MENU	DESCRIPTION
LOWPASS TIME DOMAIN SETUP	
SET WINDOW NOMINAL	Takes you to a menu that lets you change the window type.
SET GATE	Takes you to a menu that lets you set the gate.
SET D.C. TERM XXXXX XXXXXXXXXX	Takes you to a menu that lets you set the D.C. term for lowpass processing.
PREVIOUS MENU	Returns you to the previous menu.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD3l, Lowpass Time Domain Setup

MENU	DESCRIPTION
GATE	
START XXX.XXX xx	Sets the start time of the gate.
STOP XXX.XXX xx	Sets the stop time of the gate.
CENTER XXX.XXX xx	Sets the center time of the gate.
SPAN XXX.XXX xx	Sets the span (Stop - Start) of the gate.
SET SHAPE XXXXXXXXX	Takes you to a menu that lets you set the shape of the gate.
GATE ON/OFF	Switches the gate on or off each time ENTER is pressed.
SET RANGE	Takes you back to menu TD2dl or TD2db, depending on the type of measurement you selected in menu TD1.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD4d/t, Gate (Distance/Time)

MENU	DESCRIPTION
SET WINDOW SHAPE	
RECTANGULAR	Selects a Rectangular (one-term) shape.
NOMINAL	Selects a two-term Hamming shape.
LOW SIDELOBE	.Selects a three-term Blackman-Harris shape.
MIN SIDELOBE	Selects a four-term Blackman-Harris shape.
HELP	Displays an informational help menu.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD5w, Shape

MENU	DESCRIPTION
SET GATE SHAPE	
RECTANGULAR	Selects a Rectangular (one-term) shape.
NOMINAL	Selects a two-term Hamming shape.
LOW SIDELOBE	Selects a three-term Blackman-Harris shape.
MIN SIDELOBE	Selects a four-term Blackman-Harris shape.
HELP	Displays an informational help menu.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD5g, Shape

MENU	DESCRIPTION
SET D.C. TERM FOR LOWPASS PROCESSING	Since it is impossible to measure the true D.C. term required for lowpass processing, a value must be estimated. This menu allows a choice between five different selections for this value.
AUTO EXTRAPOLATE	Sets the D.C. term to a value determined by extrapolating the data points near the zero frequency.
LINE IMPEDANCE	Sets the D.C. term to the characteristic impedance of the transmission medium (Z_0).
OPEN	Sets the D.C. term to correspond to an open circuit.
SHORT	Sets the D.C. term to correspond to a short circuit.
OTHER XXX.XXX ABOVE VALUE REPRESENTS A REFLECTION COEFF. OF X.XXX pU	Sets the D.C. term to the value entered.
PREVIOUS MENU	Returns you to the previous menu.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD6, Set D.C. Term for Low Pass Processing

MENU	DESCRIPTION
TIME MARKER SWEEP	
START TIME MARKER ( ) XXX.XXX ns	Sets the start time to the value of the selected marker.
STOP TIME MARKER ( ) XXX.XXX ns	Sets the stop time to the value of the selected marker.
RESTORE ORIGINAL RANGE	Returns the display to the original time range that was in effect before the marker range was selected.
PREVIOUS MENU	Returns you to the previous menu.
USE KEYPAD TO CHOOSE MARKER (1 - 6)	Select marker number from keypad.
OR PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD7t, Time Marker Sweep.

MENU	DESCRIPTION
DISTANCE MARKER SWEEP	
START DIST MARKER ( ) XX.XXXX cm	Sets the start time to the value of the selected marker.
STOP DIST MARKER ( ) X.XXXX m	Sets the stop time to the value of the selected marker.
RESTORE ORIGINAL RANGE	Returns the display to the original time range that was in effect before the marker range was selected.
PREVIOUS MENU	Returns you to the previous menu.
USE KEYPAD TO CHOOSE MARKER (1 - 6)	Select marker number from keypad.
OR	
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu TD7d, Distance Marker Range

MENU	DESCRIPTION
SELECT UTILITY FUNCTION TYPE	
GENERAL DISK UTILITIES	Calls menu U2, which lets you select between several disk utilities.
CALIBRATION COMPONENT UTILITIES	Calls menu U4, which lets you select between several calibration-- component utilities.
GPIB ADDRESSES	Displays the current GPIB addresses of the various system instruments.
DISPLAY INSTRUMENT STATE	Calls menu U3, which lets you display the various instrument state parameters.
BLANK FREQUENCY INFORMATION	Blanks all frequency-identifier information from the 360 displays, if such information is presently being displayed.
ALTERNATE BLUE COLOR	Switches between blue and cyan colors
VIDEO CONFIGURATION	Calls menu U7 which lets you adjust video signal routing.
PRESS <ENTER> TO SELECT	Switches between blue and cyan colors. Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu U1, Utility Menu

MENU	DESCRIPTION
DISK UTILITY FUNCTIONS	
RESTORE DISPLAY	
DISPLAY DISK DIRECTORY	Displays disk directory in data area
DELETE FILES FROM DISK	Calls menu DSK2, which lets you delete files from the disk.
LOAD PROGRAM FROM DISK TO 360	Reloads the operating program from the disk. ***CAUTION*** Choosing the above option may destroy all of the data in memory.
INITIALIZE DISK WITH PROGRAM	Prepares (formats or initializes) the disk for use with the 360, including the operating program.
INITIALIZE DATA - ONLY DISK	Prepares the disk for use with the 360 but *does not* copy the operating program to the disk ***CAUTION*** Choosing either of the two options above will destroy all of the data on the disk
COPY DISK TO DISK	Lets you copy one disk to another.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu U2, Disk Utility Functions

MENU	DESCRIPTION
DISPLAY INSTRUMENT STATE	
RESTORE DISPLAY	Restores the normal data display.
SYSTEM PARAMETERS	Displays all of the system parameters (Readout Text U3 a thru e, on the following pages).
CALIBRATION PARAMETERS	Displays the calibration parameters.
GLOBAL OPERATING PARAMETERS	Displays the global operating parameters.
CHANNEL 1 - 2 OPERATING PARAMETERS	Displays the Channel 1-2 operating parameters.
CHANNEL 3 - 4 OPERATING PARAMETERS	Displays the Channel 3-4 operating parameters.
NEXT PAGE	Alternately displays Readout Text U3 a thru e.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu U3, Display Instrument State

Readout Text U3a, Global Operating Parameters

Parameter	Display Format
- Number of Points	
- Source 1 Power	xx.x dBm
- Source 2 Power	xx.x dBm
- Port 1 Source Atten	xxdB
- Port 1 Test Atten	Not Available
- Port 2 Source Atten	xx dB
- Port 2 Test Atten	xx dB
- Z_0	50.000 Ohm
- Averaging	xxMeas/Pts Off/on
- Smoothing	xx.x % SPAN Off/on

Readout Text U3d, System Parameters

Parameter	Display Format
360 GPIB	
- Address	xx
- Terminator	xxxxxxxx
- Primary SRQ Mask	xxxxxxxx
- Secondary SRQ Mask	xxxxxxxx
System Bus	
- Instrument Address	xx
- Source 1 Address	xx
- Source 2 Address	xx
- Plotter Address	
- Terminator	
Test Set (Standard)	
- Model	xxxxx
Receiver Mode (Std.)	
- Mode	xxxxxxxxxxx
- GPIB Control of	
- Source Sweep	xxx
360 TSM	
- Test Set	x
- Source	xxx
- RF Switch	xx
- Power to Unused	
- Test Set	xxx
Software	
- Version	4.0
- Serial Number	xxxxx

Readout Text U3b and U3c, Operating Parameters

Parameter	Display Format	
	Channel 1-3	Channel 2-4
- Parameters	xxx	xxx
- Reference Plane	xxx.xxx mm	xxx.xxx mm
Time Domain Mode	xxxxxxxxxx	xxxxxxxxxx
Start	xxx.xxx ns	xxx.xxx ps
Stop		
Window Type	xxxxxxxxxx	xxxxxxxxxx
Gate Start	xxx.xxx ns	xxx.xxx ns
Gate Stop	xxx.xxx ns	xxx.xxx ns
Gate Shape	xxxxxxxxxx	xxxxxxxxxx

Readout Text U3e, Calibration Parameters

Parameter	Display Format	
Number of Points	xxx	
Source Power	xxx dBm	
Cal Type	xxxx	
Start Frequency	xx.xxx GHz	
Stop Frequency	xx.xxx GHz	
Load Type	xxxxxxxxx	
Connector	–PORT1–	–PORT 2–
	xxxxxxxxx	xxxxxxxxx
Open Device	*NOT INSTALLED	*NOT INSTALLED
C0 (e–15)	–xxx.xxx	–xxx.xxx
C1 (e–27)	–xxx.xxx	–xxx.xxx
C2 (e–36)	–xxx.xxx	–xxx.xxx
C3 (e–45)	–xxx.xxx	–xxx.xxx
Offset Length	–xxx.xxx	–xxx.xxx
Serial Number	xxxxxxxxx	xxxxxxxxx
Short Device	*NOT INSTALLED	*NOT INSTALLED
Offset Length	–xxx.xxx mm	–xxx.xxx mm
Serial Number	xxxxxxxxx	xxxxxxxxx
Atten Settings		
Source	xxdB	xxdB
Test		xxdB

* If not installed, displays “NOT INSTALLED.”

MENU	DESCRIPTION
CALIBRATION COMPONENT UTILITIES	
INSTALL CALIBRATION COMPONENT INFORMATION FROM DISK	Reads into memory the coefficient data from the calibration-components disk supplied with the calibration kits.
DISPLAY INSTALLED CALIBRATION COMPONENT INFORMATION	Calls menu U5, which lets you display the connector information for the various connectors supported.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu U4, Calibration Component Utilities

MENU	DESCRIPTION
DISPLAY INSTALLED TEST PORT CONNECTOR INFORMATION	This menu lets you view coefficient data on components. The data appears in the display area of the screen (See readout text on next page).
SMA (M)	Select to display coefficient data for the SMA male components.
SMA (F)	Select to display coefficient data for the SMA female components.
K – CONN (M)	Select to display coefficient data for the K Connector™ male components.
K – CONN (F)	Select to display coefficient data for the K Connector female male components.
TYPE N (M)	Select to display coefficient data for the Type N male components.
TYPE N (F)	Select to display coefficient data for the Type N female components.
GPC - 3.5 (M)	Select to display coefficient data for the GPC-3.5 male components.
GPC - 3.5 (F)	Select to display coefficient data for the GPC-3.5 female components.
GPC - 7	Select to display coefficient data for the sexless GPC-7 components.
NEXT CONN	Cycles through selections SMA (M) to GPC 7.
MORE	Calls up menu U5A and lets you select more connectors.
PREVIOUS MENU	Displays menu U4.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu U5, Display Installed Calibration Components Information 1

Parameter	Display Format
Connector Type	NOT INSTALLED (If not installed from disk, “NOT INSTALLED” is displayed)
Open Device	–XXX.XXXe–15
C0 (e–15)	–XXX.XXX e–27
C1 (e–27)	–XXX.XXX e–36
C2 (e–36)	–XXX.XXX e–45
C3 (e–45)	–XXX.XXX mm
Offset Length	XXXXXXXXX
Serial Number	*NOT INSTALLED
Short Device	–XXX.XXX mm
Offset Length	XXXXXXXXX
Serial Number	

Readout Text Associated With Menu U5

MENU	DESCRIPTION
DISPLAY INSTALLED CALIBRATION COMPONENT INFORMATION	This menu lets you view coefficient data for connectors. The data appears in the display area of the screen.
V-CONN (M)	Select to display coefficient data for the V male components.
V-CONN (M)	Select to display coefficient data for the V female components.
TNC (M)	Select to display coefficient data for the TNC male components.
TNC (F)	Select to display coefficient data for the TNC female male components.
2.4 mm (M)	Select to display coefficient data for the 2.4 mm male components.
2.4 mm (F)	Select to display coefficient data for the 2.4 mm female components.
NEXT CONN	
PREVIOUS MENU	Returns you to menu U4.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection. The menu remains on the screen until another menu is selected for display or until the CLEAR/RET LOC key is pressed.

Menu U5A, Display Installed Calibration Components Information 2

MENU	DESCRIPTION
SELECT TYPE OF COMPONENT INFORMATION TO DISPLAY	
COAXIAL	Select to display coaxial component data.
WAVEGUIDE	Select to display waveguide component data.
PREVIOUS MENU	Returns you to the previous menu.
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu U6, Select Type Of Component Information To Display

MENU	DESCRIPTION
VIDEO CONFIGURATION	
CONNECT INTERNAL SCREEN	
TO 360 VIDEO SIGNAL	Connects internal screen to 360 video signal.
TO VGA IN	Connects internal screen to video signal on VGA IN connector (rear panel).
CONNECT VGA OUT	
TO 360 VIDEO SIGNAL	Connects 360 video signal to VGA OUT connector (rear panel).
TO VGA IN	Connects signal on VGA IN connector (rear panel) to VGA OUT - connector (rear panel).
PRESS <ENTER> TO SELECT	Pressing the ENTER key implements your menu selection.

Menu U7, VGA Configuration

APPENDIX 2
MODEL 360B SYSTEM
REAR PANEL CONNECTORS

A2-1 INTRODUCTION

This appendix provides descriptions for the rear panel connectors on system instruments.

A2-2 36XXA TEST SET REAR PANEL

Figure A2-1 describe the rear panel connectors on a typical 36XXA test set.

A2-3 360B NETWORK ANALYZER REAR PANEL

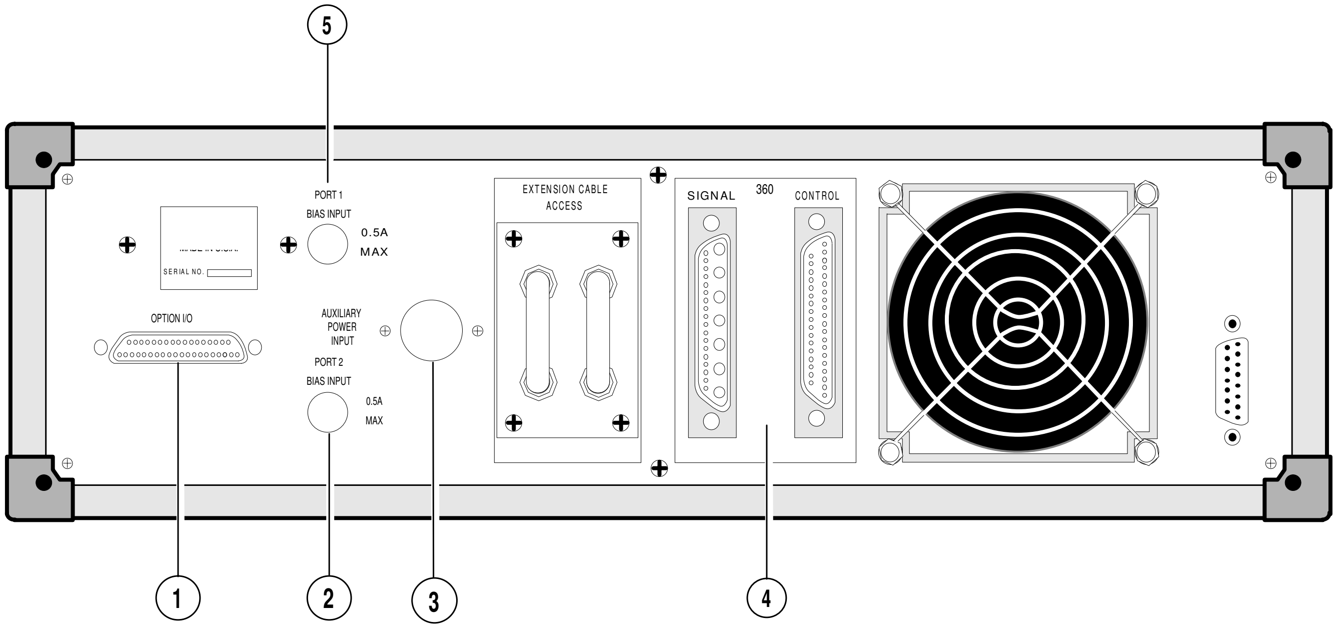
Figure A2-2 describe the rear panel connectors on the 360B analyzer.

A2-4 360SSXX FREQUENCY SOURCE REAR PANEL

Figure A2-3 describe the rear panel connectors on a 360SSXX Frequency Source.

A2-5 CONNECTOR PINOUT DIAGRAMS

Figures A2-4 thru A2-8 provide pinout diagrams for connectors used on system instruments.



① **OPTION I/O:** Provides control and data interface between the network analyzer and a 360B VNA module via the test set. Voltage to power the module is also provided via this connector. Figure A2-9 describes the signal lines and shows the connector pinout.

② **PORT 2 BIAS INPUT:** Provides for applying an external bias to the active device connected to test port 2 without disturbing the accuracy of the 360B measurement. (For 362XA Series, only).

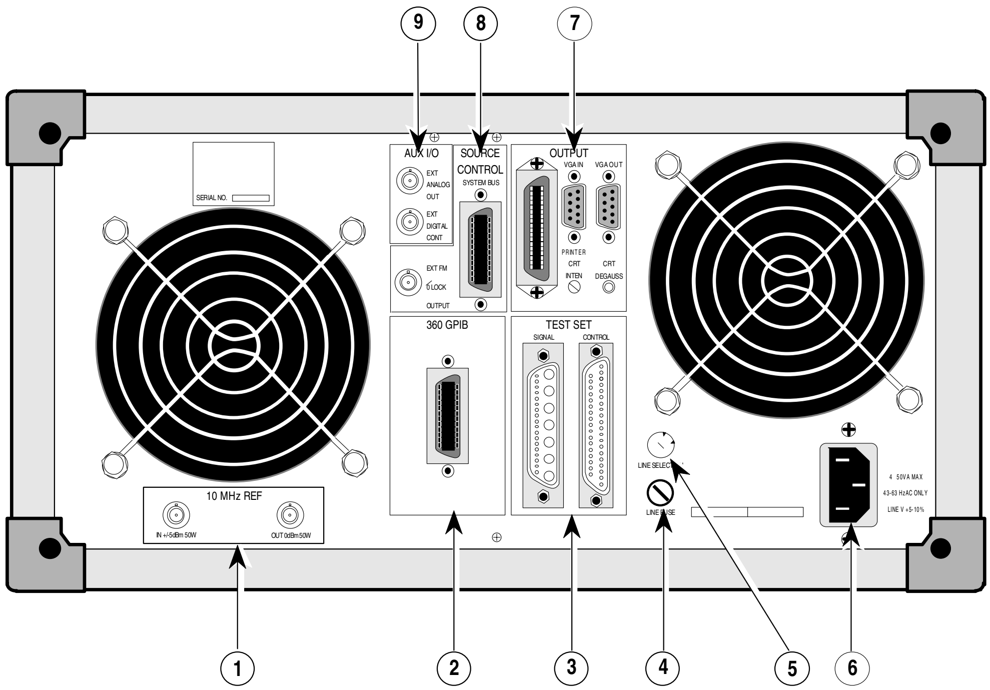
③ **AUXILIARY POWER INPUT:** Connects to 40-5x* Auxiliary Power Supply, which supplies power to internal tripler assemblies (Test Set Models 3613A and 3623A only). The pinout of this 5-pin DIN connector is shown in Figure A2-10

* Refer to Table 1-2 in 360B Vector Network Analyzer System Maintenance Manual.

④ **360 SIGNAL:** 17 pin/7 coaxial connector that provides signal lines to/from the companion network analyzer. Figure A2-5 describes the signal lines and shows the connector pinout.
360 CONTROL: 36-pin connector that provides signal and control lines for the companion network analyzer. Figure A2-7 describes the signal lines and shows the connector pinout.

⑤ **PORT 1 BIAS INPUT:** Provides for applying an external bias to the active device connected to test port 1 without disturbing the accuracy of the 360B measurement. (For 362XA Series, only).

Figure A2-1. *Model 36XXA Test Set Rear Panel Connectors*



1 **10 MHz REF**

IN: BNC connector that allows an external 10 MHz signal (–5 to +5 dBm) to be used as the frequency reference for phase locking the source frequency. 50 Ω impedance.

OUT: BNC connector that allows the internal 10 MHz reference to be used to phase lock an external counter or other measuring instrument. Level is typically 0 dBm into 50 Ω impedance.

2 **360 GPIB:** 24-pin connector that provides for remotely controlling the 360 from an external computer/controller via the IEEE-488 bus (GPIB). Figure A2-4 provides a pinout diagram.

3 **TEST SET**

SIGNAL: 17-pin/7-coaxial connector that provides signal lines for the companion test set. Figure A2-6 describes the signal lines and shows the connector pinout.

CONTROL: 37-pin connector that provides control lines for the companion test set. Figure A2-8 describes the signal lines and shows the connector pinout.

4 **LINE FUSE:** 3 AG fuse cartridge that protects for an input overcurrent condition. The fuse should be 5A for line voltages between 100 and 120 Vac and 2.5A for line voltages between 220 and 240 Vac.

Figure A2-2 *Model 360B Network Analyzer Rear Panel Connectors (1 of 2)*

5 **LINE SELECTION:** Slotted control that switches between 110 and 220 Vac line voltages.

6 **Line Voltage Module:** Three-prong ac plug and module that provides filtering for the 50/60 Hz input-line power. The line voltage must be between +5% and –10% of the nominal, input 100-120 or 220-240 Vac value.

7 **OUTPUT**

PRINTER: 36-pin connector that provides a parallel interface to the companion printer. Figure A2-6 describes the signal lines and shows the connector pinout.

VGA IN: 15-pin connector accepts standard VGA signal input. Figure A2-8 describes the signal lines and shows the connector pinout.

VGA OUT: 15-pin connector provides VGA output of 360B video display. Figure A2-8 describes the signal lines and shows the connector pinout.

CRT INTEN: Control that adjusts the screen intensity of the external monitor.

CRT DEGAUSS: Momentary-on pushbutton that degausses the internal color monitor. It has no effect on a monochrome monitor.

8 **SOURCE CONTROL**

EXT FM ∅LOCK OUTPUT: Provides a –6 MHz/Volt signal to phase lock the sweeper to the internal (crystal) reference for exact frequency control.

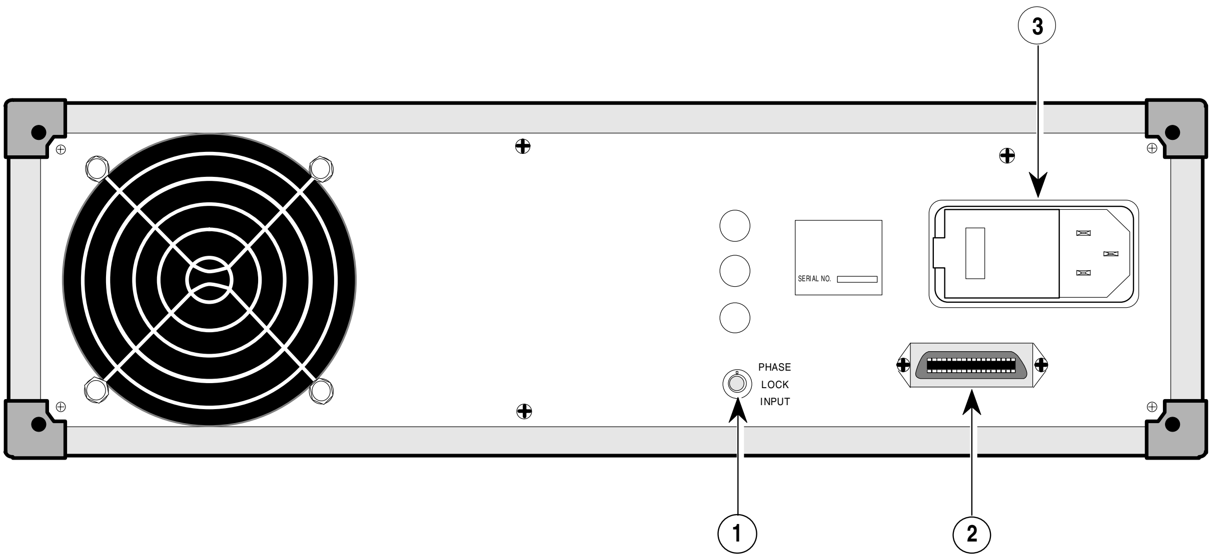
SYSTEM BUS: 24-pin connector that provides for remotely controlling the frequency source and plotter—from the 360B—via the IEEE-488 bus (GPIB). Figure A2-4 provides a pinout diagram.

AUX I/O

9 **EXT ANALOG OUT:** Provides an up-to ±10V signal for use in driving an external plotter or antenna system (CW draw).

EXT DIGITAL CONTROL: Allows a ±1V signal to externally sync the 360B measurements.

Figure A2-2. *Model 360B Network Analyzer Rear Panel Connectors (2 of 2)*

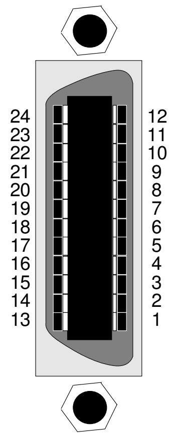


1 **EXT FM ∅LOCK INPUT:** Accepts a –6 MHz/Volt signal to phase lock the sweeper to the internal (crystal) reference for exact frequency control.

2 **GPIB Interface:** 24-pin connector that provides for remotely controlling the frequency source from the IEEE-488 bus (GPIB)—via the 360B system bus. Figure A2-4 provides a pinout diagram.

3 **Line Selector Module:** Provides for selecting between four international line voltages: 100, 110/120, 200, 220/240 Vac. Refer to Section II for instructions on how to change to a different line voltage.

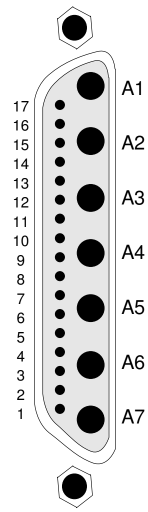
Figure A2-3. *Model 360SSXX Frequency Source Rear Panel Connectors*



Pinout Diagram

PIN	NAME	DESCRIPTION
1-4	DIO 1 thru DIO 4	*Data Input/Output.* Bits are HIGH with the data is logical 0 and LOW when the data is logical 1.
5	EOI	*End Or Identify.* A low-true state indicates that the last byte of a multibyte message has been placed on the line.
6	DAV	*Data Valid.* A low-true state indicates that the talker has (1) sensed that NRFD is LOW, (2) placed a byte of data on the bus, and (3) waited an appropriate length of time for the data to settle.
7	NRFD	*Not Ready For Data.* A high-true state indicates that valid data has not yet been accepted by a listener.
8	NDAC	*Not Data Accepted.* A low-true state indicates that the current data byte has been accepted for internal processing by a listener.
9	IFC	*Interface Clear.* A low-true state places all bus instruments in a known state—such as, unaddressed to talk, unaddressed to listen, and service request idle.
10	SRQ	*Service Request.* A low-true state indicates that a bus instrument needs service from the controller.
11	ATN	*Attention.* A low-true state enables the controller to respond to both it's own listen/talk address and to appropriate interface messages — such as, device clear and serial poll.
12	Shield	Ground Point.
13-16	DIO 5 thru DIO 8	*Data Input/Output.* Bits are high with the data is logical 0 and LOW when the data is logical 1.
17	REN	*Remote Enable.* A low-true state enables bus instruments to be operated remotely, when addressed.
18-24	GND	Logic ground.

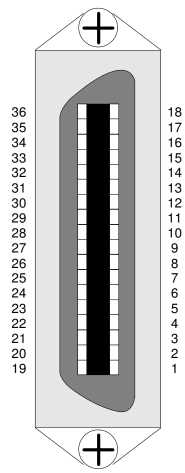
Figure A2-4. *Pinout Diagram, GPIB Connector*



Pinout Diagram

PIN	NAME	DESCRIPTION
1	EXT A/D	External analog-to-digital-converter input.
2	EXT A/D RTN	Return for EXT A/D converter input.
3-8	Spare	
9	LO2 LOCK	2nd local oscillator phase-lock error signal.
10	LO2 LOCK RTN	Return for 2nd LO phase-lock error signal.
11	LO2 DAC	Local oscillator 2 loop gain.
12	LO2 DAC RTN	Return for LO2 DAC loop gain.
13	Spare	
14	LO1 LOCK	1st local oscillator phase-lock error signal.
15	LO1 LOCK RTN	Return for 1st local oscillator phase-lock error signal.
16	LO1 DAC	Local oscillator loop gain.
17	LO1 DAC RTN	Return for LO1 loop gain.
A1	CHN A IF	Channel A 3rd IF.
A2	FIRST LO	First local oscillator reference.
A3	SOURCE LOCK	Source lock IF signal.
A4	3rd LO/CAL	3rd local oscillator/83-1/3 kHz IF cal.
A5	CHN REF	Reference channel, 3rd IF.
A6	SECOND LO	Second local oscillator reference.
A7	CHN B IF	Channel B 3rd IF.

Figure A2-5. *Pinout Diagram, Signal Connector*



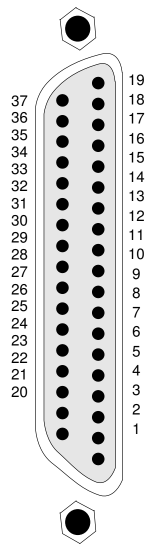
Pinout Diagram

PIN	NAME	DESCRIPTION
1	$\overline{\text{STROBE}}$	*Printer Strobe.* A low-true pulse that tells the printer valid data has been placed on the bus.
2-9	DATA1 thru DATA8	*Data Lines.* Bits are HIGH when the data is logical 1 and LOW when the data is a logical 0.
10	$\overline{\text{ACK NLG}}$	*Printer Acknowledgement.* A low-true, approximately 5 µs, pulse sent back by the printer to acknowledge that the data has been accepted.
11	BUSY	*Printer Busy.* High-true level sent by the printer to indicate that it is not available. This line is HIGH at the following times: (1) During data entry. (2) While printing. (3) When off-line. (4) When a printer-error has been signaled.
12	PE	*Printer Error.* High-true level sent by the printer to indicate that it is out of paper.
13	SLCT	*Select.* A high-true logic level.
14	$\overline{\text{AUTO FEED XT}}$	*Automatic Paper Feed.* A low-true level that tells the printer to feed the paper automatically.
15	NC	No Connection.
16	OV	Logic GND Level.
17	CHASSIS GND	Chassis ground, which is isolated from logic ground.
18	NC	No Connection.
19	$\overline{\text{STROBE}}$ RTN	Return line for $\overline{\text{STROBE}}$ signal.
20-27	DATA RTN	Return lines for DATA1 thru DATA8 lines.

Figure A2-6. *Pinout Diagram, Printer Connector (1 of 2)*

PIN	NAME	DESCRIPTION
28	$\overline{\text{ACKNLG}}$ RTN	Return line for ACKNLG signal.
29	BUSY RTN	Return line for BUSY signal.
30	PE RTN	Return line for PE signal.
31	$\overline{\text{INIT}}$	*Printer Initial State.* A low-true pulse that tells the printer to assume its initial state and clear its print buffer.
32	$\overline{\text{ERROR}}$	*Printer Error.* A low-true signal that indicates the printer is (1) out of paper, (2) off-line, or (3) in an error state.
33	GND	Ground level.
34	NC	No Connection.
35	+5V	+5V dc level.
36	$\overline{\text{SLCT IN}}$	*Printer Select Input.* A low-true level that permits the printer to accept data.

Figure A2-6. *Pinout Diagram, Printer Connector (2 of 2)*



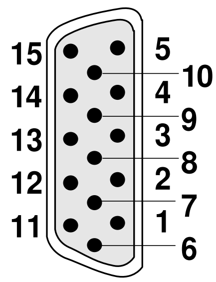
Pinout Diagram

PIN	NAME	DESCRIPTION
1	Chassis ground	
2	+8V RTN	Return for the +8V input.
3	+8V	+8V input.
4	+18V RTN	Return for the +18V input.
5	+18V RTN	Return for the +18V input.
6	+18V	+18V input.
7	-18V	-18V input.
8	+27V RTN	Return for the +27V input.
9	+27V	+27V input.
10	Spare	
11	STATUS	A logic-low-signal level indicates that the status of the test set is not satisfactory for the measurement of data.
12	Spare	
13	L LOAD RTN	Return for the L LOAD signal.
14	TS STROBE RTN	Return for the Test Set STROBE signal.
15	DATA RTN	Return for the D0-D7 data/address lines.

Figure A2-7. *Pinout Diagram, Control Connector (1 of 2)*

PIN	NAME	DESCRIPTION
16	D1	*Data/Address lines.* Bits are HIGH when the data/address signal is a logic-1 and LOW when the data/address signal is a logic-0.
17	D3	Same as above
18	D5	Same as above
19	D7	Same as above
20	Spare	
22	+8V	+8V input.
23	+18V RTN	Return for the +18V input.
24	+18V	+18V input.
25	+18V	+18V input.
26	-18V	-18V input.
27	-27V RTN	Return for the -27V input.
28	-27V	-27V input.
29	STATUS RTN	Return for the STATUS signal input.
30	Spare	
31	Shield	
32	L LOAD IN	A logic-low signal causes all of the required data for the next frequency point to be loaded.
33	TS STROBE	TTL pulse that strobes address information into the test set on the falling edge and data information on the rising edge.
34	D0	Data/Address lines. Bits are HIGH when the data/address signal is a logic-1 and LOW when the data/address signal is a logic-0.
35	D2	Same as above
36	D4	Same as above
37	D6	Same as above

Figure A2-7*. Pinout Diagram, Control Connector (2 of 2)*

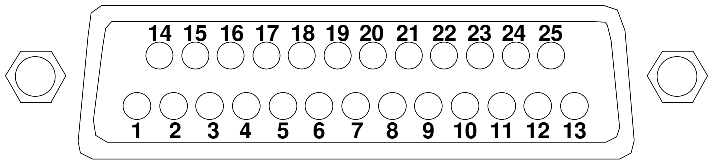


Pinout Diagram

PIN	NAME	DESCRIPTION
1	Red	Red signal
2	Green	Green signal
3	Blue	Blue signal
4	Not Used	
5	Self Test	Self test
6	Red Return	Red return
7	Green Return	Green return
8	Blue Return	Blue return
9	Not Used	
10	Digital Ground	Digital ground
11	Digital Ground	Digital ground
12	Not Used	
13	Hsync	Horizontal sync
14	Vsync	Vertical sync
15	Not Used	

Figure A2-8. *Pinout Diagram, VGA IN/OUT Connector*

OPTION I/O



PIN	SIGNAL NAME	SIGNAL DESCRIPTION
1	DATA RTN	Return for the D0-D7 data/address bus lines
2	D0	Data Bus Line. Bits are HIGH when the data signal is a logic-1 and LOW when the data signal is a logic-0.
3	D1	Same as above
4	D2	Same as above
5	D3	Same as above
6	D4	Same as above
7	D5	Same as above
8	D6	Same as above
9	D7	Same as above
10	EN1	A logic-low-signal level causes the loading of the first data word.
11	EN2	A logic-low-signal level causes the loading of the second data word.
12	READ	A logic-low-signal level causes the output of data from the module to the network analyzer.
13	Spare	
14	Spare	
15	8 RTN	Return for the +8V input
16	+8V	+8V input (from the network analyzer)
17	+18V	+18V input (from the network analyzer)
18	18 RTN	Return for the ±18V input
19	–18V	–18V input (from the network analyzer)
20	+27 RTN	Return for the +27V input
21	+27V	+27V input (from the network analyzer)
22	Spare	
23	Spare	
24	EXT A/D	External analog-to-digital converter input from the module.

Figure A2-9. *Pinout Diagram, Option I/O Connector*

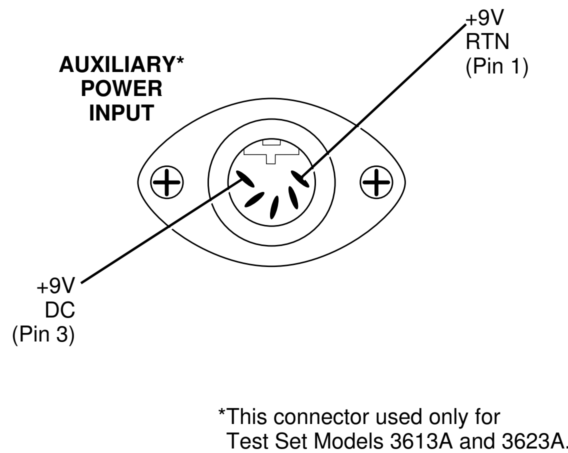


Figure A2-10. *Pinout of 3613A/3623A Test Sets Auxiliary Power Input Connector*

APPENDIX 3
PERFORMANCE SPECIFICATIONS

MEASUREMENT CAPABILITIES

Number of Channels: Four measurement channels.

Parameters: S_{11}, S_{21}, S_{22}, S_{12}; or user defined, complex input and output impedance; complex input or output admittance; and complex forward and reverse transmission. All measurements are made without the need to manually reverse the test device.

Domains: Frequency Domain, CW Draw, and optional High Speed Time (Distance) Domain.

Formats: Log Magnitude, Phase, Log Magnitude and Phase, Smith Chart (Impedance), Smith Chart (Admittance), Linear Polar, Log Polar, Group Delay, Linear Magnitude, Linear Magnitude and Phase, Real, Imaginary, Real and Imaginary, SWR.

Data Points: 501 (MAXIMUM). Can be switched to a value of 168 (NORMAL) or 85 (MINIMUM) data (frequency) points without recalibration. In addition, the system accepts an arbitrary set of N discrete data points where: $2 \leq N \leq 501$. CW mode permits selection of a single data point without recalibration.

Reference Delay: Can be entered in time or in distance (when the dielectric constant is entered). Automatic reference delay feature adds the correct electrical length compensation at the push of a button. Software compensation for the electrical length difference between reference and test is always accurate and stable since measurement frequencies are always synthesized. In addition, ANRITSU offers compensated reference phase delay for dispersive transmission media, such as waveguide and microstrip.

Markers: Six independent markers can be used to read out measurement data. In delta-reference mode, any one marker can be selected as the reference for the other five. Markers can be directed automatically to the minimum or maximum of a data trace.

Marker Sweep: Sweeps upward in frequency between any two markers. Recalibration is not required during the marker sweep.

Limits: Two limit lines per data trace to indicate test limits.

Limit Frequency: Identifies the ±X dB bandwidth of amplifiers, filters and other frequency sensitive devices. Interpolation algorithm determines the exact intersection frequencies of test data and limit lines.

Measurement Frequency Range: Frequency range of measurement can be narrowed within calibration range without recalibration. CW mode permits single frequency measurements, also without recalibration. In addition, the system accepts N discrete frequency points, where: $2 \leq N \leq 501$.

Dynamic Range: Table A3-1 (page A3-7) gives dynamic range in two manners. The first, "Receiver Dynamic Range," is defined as the ratio of the maximum signal level at Port 2 for 0.1 dB compression to the noise floor at Port 2. The second, "System Dynamic Range," is defined as the ratio of the power incident on Port 2 in a throughline connection to the noise floor at Port 2 (forward measurements only) when both test ports are terminated in 50 Ohms. In Table A3-1, the minimum IF bandwidth and 1024 averages were used in calibration and measurement.

DISPLAY CAPABILITIES

Display Channels: Four, each of which can display any S-parameter or user defined parameter in any format with up to two traces per channel for a maximum of eight traces simultaneously. A single channel, two channels (1 and 3, or 2 and 4), or all four channels can be displayed simultaneously.

CRT: Color, 7.5-inch diagonal, VGA display. Graticules are displayed in green, measurement data in red, markers and limits in blue, and overlaid trace data in yellow. Trace data stored in memory are displayed in green.

Trace Overlay: Displays two traces on the active channel's graticule simultaneously. The overlaid trace is displayed in yellow and the primary trace is displayed in red.

Trace Memory: A separate memory for each channel can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data.

Scale Resolution (minimum):

Log Magnitude: 0.001 dB/div	**Linear Magnitude:** 1 pU
Phase: 0.01 degrees/div	**Group Delay:** 0.001 ps
Time: 0.001 µs	**Distance:** 0.001 µm
SWR: 1 pU	

Autoscale: Automatically sets Resolution and Offset to fully display measurement data.

Reference Position: Can be set at any graticule line.

Annotation: Type of measurement, vertical and horizontal scale resolution, start and stop frequencies, and reference position.

MEASUREMENT ENHANCEMENT

Data Averaging: Averaging of 1 to 4095 averages can be selected. Averaging can be toggled on/off with front-panel button. Front-panel LED indicates when averaging is active.

Video IF Bandwidth: Front-panel switch selects three levels of video IF bandwidth. NORMAL, REDUCED, and MINIMUM selections correspond to approximately 10 kHz, 1 kHz, and 100 Hz, respectively.

Trace Smoothing: Functions similarly to Data Averaging but computes an average over a percentage range of the data trace. The percentage of trace to be smoothed can be selected from 0 to 20% of trace. Front-panel button turns smoothing on/off, and front-panel LED indicates when smoothing is active.

SOURCE CONTROL

Compatibility: The 360B is compatible with the ANRITSU 360SS System Sources and the 6600B Sweep Generators. The output frequency of both is phase locked by the 360B to the internal 10 MHz crystal standard, providing synthesizer stability. Phase-lock time is typically 2 ms. Frequency resolution is 100 kHz. The 360B is also compatible with the 6700B Series Swept Frequency Synthesizers which offer 1 kHz frequency resolution.

Source Power Level: The source power (dBm) may be set from a 360B front panel menu. For active device test sets, the signal level at Port 1 or Port 2 can be controlled using the test set's internal step attenuators.

Power Flatness Correction: The 360B corrects for test port power variations and slope using an external Hewlett-Packard 437B power meter. The 360B measures the power level at the test port, calculates the flatness correction offset at each frequency, and then passes the offset array to the 360B signal source. Once the test port power has been flattened, its level may be changed within the remaining power adjustment range of the signal source.

Dual Source Control Capability: Dual Source Control capability allows a user to separately control the frequency of up to two sources and a receiver without the need for an external controller. The frequency ranges and output powers of the two sources may be specified. A frequency sweep may be comprised of up to five separate bands, each with independent source and receiver settings, for convenient testing of frequency translation devices such as mixers. Up to five subbands may be tested in one sweep. Dual Source Control enables users to easily test mixers, up/down converters, multipliers, and other frequency conversion devices.

Source #1: Any one of ANRITSU's family of 360SS signal sources or any one of ANRITSU's family of 67XXB synthesizers

Source #2: Any of ANRITSU's family of 67XXB synthesizers

Receiver: Any one of ANRITSU's family of 36XXA Series Test Sets.

SOURCE FREQUENCY ACCURACY

Time Base Freq. Accuracy: Same as internal or external time base.

Internal 10 MHz Time Base Stability:

With Aging: $<\pm 1 \times 10^{-9}$/day

With Temperature: $<\pm 5 \times 10^{-9}$ over 0° to +55°C range

TEST PORT CHARACTERISTICS

The specifications in Table A3-2 (page A3-8) apply when the proper Model 34U or 34Y Universal Adapters are connected. Connection, with or without phase-equal insertables, is made to the test set ports and calibrated with the appropriate ANRITSU or other designated calibration kit. Calibration is at 23°C ±3°C, using the OSL calibration method with a sliding load to achieve 12-Term error correction.

GROUP DELAY CHARACTERISTICS

Group Delay is measured by computing the phase change in degrees across a frequency step by applying the formula:

$$\tau_g = -1/360\ d\phi/df$$

Aperture: Defined as the frequency span over which the phase change is computed at a given frequency point. The aperture can be changed without recalibration. The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range without recalibration. The frequency width of the aperture and the percent of the frequency range are displayed automatically.

Range: The maximum delay range is limited to measuring no more than ±180 degrees of phase change within the aperture set by the number of frequency points. A frequency step size of 100 kHz corresponds to 10 µs.

Measurement Repeatability (sweep to sweep): For continuous measurement of a through connection, RSS fluctuations due to phase and FM noise are:

$$\pm \frac{1.41\ \{(\text{Phase Noise in deg})^2 + (\tau_g \times \text{Residual FM Noise in Hz})^2\}^{1/2}}{360\ (\text{Aperture in Hz})}$$

$$\text{Error in } \tau_g = \frac{\dfrac{\text{Error in Phase (deg)}}{360} + (\tau_g \times \text{Aperture Frequency Error (Hz)})}{\text{Aperture (Hz)}}$$

Accuracy

VECTOR ERROR CORRECTION

There are three methods of calibration:

1) A standard Open-Short-Load (OSL) calibration method using short circuits, open circuits, and terminations (fixed or sliding);

2) Offset-Short (waveguide) calibration; and

3) LRL/LRM — Line-Reflect-Line or Line-Reflect-Match calibration.

There are four vector error correction models available:

1) Full 12-Term
2) One Path/Two Port
3) Frequency Response (Transmission/Reflection)
4) Reflection Only

Full 12-Term can always be used, if desired, since all S-Parameter test sets automatically reverse the test signal. Front-panel LEDs indicate the type of calibration that is stored in memory. Front-panel button selects whether calibration is to be applied, and an LED lights when error correction data are being applied.

Calibration Sequence: Prompts the user to connect the appropriate calibration standard to Port 1 and/or Port 2. Calibration standards may be measured simultaneously or individually.

Calibration Standards: For coaxial calibrations the user selects SMA, GPC–3.5, GPC–7, Type N, 2.4 mm, TNC, K Connector, or V Connector from a calibration menu. Use of fixed or sliding load can be selected for each connector type. Open circuit offset length and capacitance coefficients can be modified. Short circuit offset length may be modified. Through-line parameters may be modified by entering an offset length and/or by entering the dc coefficient (A), frequency coefficient (B), and frequency exponent (C) for a throughline loss equation as follows: ($A + B \times Frequency^C$). In general, all calibration parameters may be modified manually or through the GPIB interface.

Reference Impedance: Modify the reference impedance of the measurement to other than 50Ω.

LRL/LRM Calibration Capability: The LRL calibration technique uses the characteristic impedance of a length of transmission line as the calibration standard. A full LRL calibration consists merely of two transmission line measurements, a high reflection measurement, and an isolation measurement. The LRM calibration technique is a variation of the LRL technique that utilizes a precision termination rather than a second length of transmission line. A third optional standard, either Line or Match, may be measured in order to extend the frequency range of the calibration. This extended calibration range is achieved by mathematically concatenating either two LRL, two LRM, or one LRL and one LRM calibraton(s). Using these techniques, full 12-term error correction can be performed on the 360B VNA.

LRL/LRM Calibration Performance:

Calibration Performed: LRL + Isolation, or LRM + Isolation; two-line, one-line/one-match, or concatenated calibration (LRLL, LRLM, LRML, or LRMM).

Dispesion Compensation: Selectable as Coaxial (non-dispersive), Waveguide, or Microstrip.

Reference Plane: Selectable as Middle of line 1 or Ends of line 1.

Corrected Impedance: Determined by Calibration Standards.

Accuracy: Determined by calibration components. For a GPC–7 calibration, when properly calibrated with an appropriate Maury Microwave LRL calibration kit, the specifications in Table A3-2 (page A3-8) apply.

HARD COPY

Printer: Menu selects full screen, graphical, tabular data, and printer type. The number of data points of tabular data can be selected as well as data at markers only. Compatible with the 2225C Ink Jet, HP QuietJet, HP DeskJet, HP LaserJet, and Epson compatible printers with Parallel (Centronics) interfaces.

GPIB Plotter: The 360B is compatible with HP Models 7440A, 7470A, 7475A, and 7550A and Tektronix Model HC100 plotters. Menu selects plotting of full or user-selected portions of graphical data. Plotter is connected to the dedicated system bus, which also controls the system signal source.

Buffer: Hard-copy printed data are loaded into buffer memory in approximately 12 seconds. Full front-panel operation and measurement capability is then restored to the user during the remainder of the hard-copy generation.

STORAGE

Internal Memory: Up to four front panel states (setup/calibration) can be stored and recalled from non-volatile memory locations. The current front panel setup is automatically stored in non-volatile memory at instrument power-down. When power is applied, the instrument returns to its last front panel setup (with no calibration or normalization data applied).

Internal Disk Drive: A 3.5-inch microdiskette drive with 1.44 MBytes formatted capacity is used to load measurement programs and to store and recall measurement and calibration data and front-panel setups. This disk drive will also read from and write to 720 KByte MS–DOS formatted disks. All files are MS–DOS compatible. File names can be from 1-to-8 characters long.

Disk Drive File Size:

Measurement Data: 25.6K bytes per 501 point S-parameter
data file.
Calibration Data: 61K bytes per 501 point (12-term cal+setup).
Trace Memory File: 4K bytes per 501 point channel.

REMOTE PROGRAMMING

Interface: GPIB (IEEE–488)
Addressing: Address can be set from the front panel and can range from 0 to 30. Defaults to address 6.
Transfer Formats: ASCII, 32-bit floating point, or 64-bit floating point.
Speed: 40K bytes/s
Interface Function Codes: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP1, DT1, DC0, C0.

MEASUREMENT ACCURACY

The graphs on the following pages give measurement accuracy after 12-term vector error correction. The errors are worst case contributions of residual directivity, load and source match, frequency response, isolation, network analyzer dynamic accuracy, and connector repeatability. In the graphs beginning on page A3-8, minimum video/IF bandwidth and averaging of 1024 points were used. Changes in the video IF bandwidth or averaging can result in variations at low levels.

GENERAL

360 Rear Panel Connectors and Controls:
CRT INTEN: Continuous control of CRT intensity.
CRT DEGAUSS: Pushbutton control degausses CRT.
PRINTER: Centronics interface for an external printer.
VGA IN: Accepts standard 15-pin external VGA signal input.
LINE SELECTION: Sets 110V, 120V, 220V, or 240V operation.
VGA OUT: Provides VGA output of 360 video display.
10 MHz REF IN: Connects to external reference frequency standard, 10 MHz, +5 dBm to –5 dBm, 50 ohms, BNC female.
10 MHz REF OUT: Connects to internal reference frequency standard, 10 MHz, 0 dBm, 50 ohms, BNC female.
EXTERNAL DIGITAL CONTROL: External triggering for 360B measurement, BNC female. ±1V trigger. 10 kΩ input impedance.
EXT FM PHASE LOCK OUTPUT: Connects to 6600B Series or 360SS signal source for phase locking.
SYSTEM BUS: Dedicated IEEE–488 interface for the system signal source, plotter, and power meter.
TEST SET SIGNAL: Interconnects system components.
TEST SET CONTROL: Interconnects system components.
360B GPIB: IEEE-488 interface

Test Set Rear Panel Connectors and Controls:
BIAS INPUTS, Ports 1 and 2: 0.5 A maximum. BNCs on test set front and rear panels.
REFERENCE EXTENSION: Provides access to reference samplers, K Connector, female.
360B SIGNAL: Interconnects system components.
360B CONTROL: Interconnects system components.
OPTION I/O: Dedicated I/O port for 360B module support.

Frequency Converter Rear Panel Connectors and Controls:
PORT 2 SOURCE ATTENUATOR: 14-pin DIP socket, used to control external ANRITSU Step Attenuator.
PORT 2 TEST ATTENUATOR: 14-pin DIP socket, used to control external ANRITSU Step Attenuator.
TRANSFER SWITCH: Connector used to control an external ANRITSU transfer switch.
360B SIGNAL: Interconnects system components.
360B CONTROL: Interconnects system components.
OPTION I/O: Dedicated I/O port for 360B module support.

Temperature Range:
Operating: 0°C to 50°C (45°C maximum for disk drive)
Storage: –40°C to 75°C

Power Requirements:
Network Analyzer: 100V/120V/220V/240V +5%, –10%, 48–63 Hz, 350 VA maximum
System Sources: 100V/120V/220V/240V +5%, –10%, 48–63 Hz, 250 VA maximum
Test Sets & Freq. Converter: None; power supplied by 360B.

Dimensions:
360B VNA:
222H x 432W x 603D mm (8.75x17x23.75 in.)
System Sources:
133H x 432W x 476D mm (5.25x17x18.75 in.)
Test Sets and Frequency Converter:
133H x 432W x 603D mm (5.25x17x23.75 in.)
Printer: 89H x 292W x 203D mm (3.5x11.5x8 in.)
System Cabinet:
572H x 559W x 699D mm (22.5x22x27.5 in.)
System Console:
1245H x 559W x 699D mm (49x22x27.5 in.)

Weight:
Network Analyzer: 25 kg (55 lb.)
System Sources: 16 kg (35.4 lb.)
Test Sets and Frequency Converter:
14.3 kg (31.5 lb.)
Printer: 3.2 kg (7 lb.)
System Cabinet (empty): 40.8 kg (90 lb.)
System Console (empty): 88.4 kg (195 lb.)

OPTION 2A — HIGH SPEED TIME (DISTANCE) DOMAIN MEASUREMENT CAPABILITY

Option 2A, High Speed Time (Distance) Domain software allows the conversion of reflection or transmission measurements from the frequency domain to the time domain. Measured S-Parameter data is converted to the time domain by application of a Fast Fourier Transform (FFT) using the Chirp Z-Transform technique. Prior to conversion any one of several selectable windowing functions may be applied. Once the data is converted to the time domain, a gating function may be applied to select the data of interest. The processed data may then be displayed in the time domain with display start and stop times selected by the user, or in the distance domain with display start and stop distance selected by the user. The data may also be converted back to the frequency domain with a time gate to view the frequency response of the gated data.

Lowpass Mode: This mode displays a response equivalent to the classic "TDR" (Time Domain Reflectometer) response of the device under test. Lowpass response may be displayed in either the impulse or step mode. This type of processing requires a sweep over a harmonic series of frequencies and an extrapolated or user-entered dc value.

Bandpass Mode: This mode displays a response equivalent to the time response of the device under test to a band limited impulse. This type of processing may be used with any arbitrary frequency sweep range, limited only by the test set range or device under test response.

Phasor Impulse Mode: This mode displays a response similar to the Lowpass impulse response, using data taken over an arbitrary (band limited) sweep range. Detailed information, similar to that contained in the lowpass impulse response may be used to identify the nature of impedance discontinuities in the device under test. Now, with Phasor Impulse, it is possible to characterize complex impedances on band-limited devices.

Windowing: Any one of four window functions may be applied to the initial frequency data, to counteract the effects of processing data with a finite bandwidth. These windows provide a range of tradeoffs of main lobe width versus side-lobe level (ringing). The general type of function used is the Blackman-Harris window, with the number of terms being varied from one to four. Typical performance follows:

Type of Window (Number of Terms)	First Side Lobe Relative to Peak	Impulse Width①
Rectangular (1)	–13 dB	1.2 W
Nominal-Hamming (2)	–43 dB	1.8 W
Low Side Lobe, Blackman-Harris (3)	–67 dB	2.1 W
Minimum Side Lobe, Blackman-Harris (4)	–92 dB	2.7 W

①W(Bin Width) = 1/2Δf sweep width. Example: when Δf = 40 MHz to 40 GHz, W = 12.5 ps.

Gating: A selective gating function may be applied to the time domain data to remove the responses of all but one desired time range. This gating function may be chosen as the convolution of any of the above window types with a rectangular gate of user defined position and width. The gate may be specified by entering start and stop times or center and span. The gated data may be displayed in the time domain, or converted back to the frequency domain.

Time Domain Display: Data processed to time domain may be displayed as a function of time or as a function of distance, provided the dielectric constant of the transmission media is entered correctly. In the case of dispersive media such as waveguide or microstrip, the true distance to a discontinuity is displayed in the distance mode. The time display may be set to any arbitrary range by specifying either the start and stop times or the center time and span. The unaliased (non-repeating) time range is given by the formula:

$$\text{Unaliased Range (nd)} = \frac{\text{Number of Frequency Data Points}}{\text{Frequency Sweep Range (GHz)}}$$

The resolution is given by the formula:

$$\text{Main Lobe Width (null–null) in ns} = \frac{\text{Kw}}{\text{Frequency Sweep Range (GHz)}}$$

Where Kw is two times the number of window terms, (for example, four for a two-term window)

For a 40 GHz sweep range with 501 data points, the unaliased range is 12.525 nanoseconds.

Frequency with Time Gate: Data that has been converted to time domain and selected by the application of gating function may be converted back to the frequency domain. This allows the display of the frequency response of a single element contained in the device under test. Frequency response accuracy is a function of window and gate type, and gate width. For a full reflection, minimum gate and window accuracy is within 0.2 dB of the ungated response over a 40 GHz range.

OPTION 5 — RECEIVER MODE CAPABILITY

Option 5 for the ANRITSU 360B VNA allows a user to select the mode in which an incoming signal is coherently detected. A user may select one of three modes of phase-lock operation:

Source Lock Mode: In this mode, the 360B can phase lock any frequency source capable of being controlled by an analog output. The 360B detects the frequency error of the source, and sends a dc correction voltage to the External Phase Lock Input of the 360B System Signal Source. The constraints imposed on the signal source analog output are

1) >10 kΩ input impedance,
2) <100 pF input capacitance,
3) >500 kHz 3 dB Bandwidth,
4) –6 MHz/volt sensitivity.

The absolute accuracy of the signal source must also be better than ±25 MHz. Source lock can only be achieved if the source frequency is available to one of the reference receive channels. The power level needed at the sampler input is –10 to –30 dBm. All other receive channels will operate over their full dynamic range. Due to the inherent resolution of the 360B's synthesized local oscillators, frequency resolution is limited to 100 kHz intervals over the full frequency range of the test set.

Tracking Mode: This mode is used to phase lock the 360B receivers to a known frequency source. Specifically, the 360B steers its local oscillator frequencies to phase lock itself to a reference signal from the signal source. Typically, the signal source is a swept frequency synthesizer. The accuracy of the source must be within ±10 MHz of the desired receive frequency to achieve 360B phase lock. The source frequency must be available to one of the reference receive channels for phase lock to occur. The power level needed at the sampler input is –10 to –30 dBm. All other receive channels will operate over their full dynamic range. Frequency resolution is determined by the resolution of the signal source. This resolution is available over the full frequency range of the test set.

Set-On Mode: In this mode, the source lock circuitry of the 360B is completely disabled, allowing all four samplers to operate over their full dynamic range. All of the 360B's internal local oscillators are locked to its internal ovenized crystal reference oscillator. A reference signal from the signal source is no longer necessary for system operation. Only synthesized sources may be used in this mode. The lack of a reference signal to derive frequency correction prevents the use of the 360SS Series signal source. The 360B 10 MHz time base must be common to the synthesized source's time base for coherent detection to occur. The inherent resolution of the 360B's synthesized local oscillators limit the receiver resolution to 100 kHz. This resolution is available over the full frequency range of the test set. Transmission Frequency Tracking is typically degraded by 0.1 dB (see Table A3-2 on page A3-8). This feature is valuable for applications in which the signal source must be located a great distance away from the 360B Network Analyzer. Additionally, the 360B receivers can be tuned to measure the harmonic content of a test device at a known source frequency. When used in conjunction with the Dual Source Control Capability, the 360B receivers can be set at a fixed offset from the source frequency to provide swept harmonic level measurement.

Table A3-1. Test Set Dynamic Range Summary

Test Set Model	Frequency (GHz)	Max. Signal Into Port 2 (dBm)	Noise Floor (dBm)	Receiver Dynamic Range (dB)	Port 1 Power (dBm, typical)	System Dynamic Range (dB)
3610A Reversing Test Set	0.04	+20	–95	115	–4	91
	1	0	–113	113	–5	108
	20	0	–108	108	–7	101
3611A Reversing Test Set	0.04	+20	–92	112	–6	86
	1	+3	–109	112	–7	102
	20	+3	–105	108	–9	96
	40	+3	–101	104	–15	86
3612A Reversing Test Set	0.04	+20	–95	115	–10	85
	1	+3	–112	115	–11	101
	20	+3	–108	111	–17	91
	40	+3	–105	108	–22	83
	50	+3	–90	93	–15	75
	60	+3	–87	90	–17	70
	62.5①	+3	–85	88	–18	67
3613A Reversing Test Set	0.04	+20	–95	115	–10	85
	1	+3	–112	115	–11	101
	20	+3	–108	111	–17	91
	40	+3	–105	108	–22	83
	60	+3	–87	90	–17	70
	65②	+3	–83	86	–20	63
3620A Active Device Test Set	0.04	+30	–98	128	–4	94
	1	+30	–115	145	–5	110
	20	+30	–110	140	–8	102
3621A Active Device Test Set	0.04	+30	–95	125	–6	89
	1	+30	–112	142	–7	105
	20	+30	–107	137	–10	97
	40	+30	–103	133	–18	85
3622A Active Device Test Set	0.04	+30	–95	125	–10	85
	1	+30	–112	142	–11	101
	20	+30	–107	137	–18	89
	40	+30	–103	133	–24	79
	50	+30	–89	119	–19	70
	60	+30	–86	116	–21	65
	62.5①	+30	–84	114	–22	62
3623A Active Device Test Set	0.04	+30	–95	125	–10	85
	1	+30	–112	142	–11	101
	20	+30	–107	137	–18	89
	40	+30	–103	133	–24	79
	60	+30	–86	116	–21	65
	65②	+30	–82	112	–22	60
3630A Frequency Converter	0.01	–10	–117	107	n/a	n/a
	1	–10	–117	107		
	20	–10	–115	105		
	40	–10	–107	97		
3631A Frequency Converter	0.01	–10	–117	107	n/a	n/a
	1	–10	–117	107		
	20	–10	–115	105		
	40	–10	–107	97		
	50	–10	–95	85		
	60	–10	–90	80		

① Available on 3612A and 3622A test sets with Test Set Option 5, 62.5 GHz Frequency Coverage.

② With 3613A and 3622A test sets

Table A3-2. Test Port Characteristics

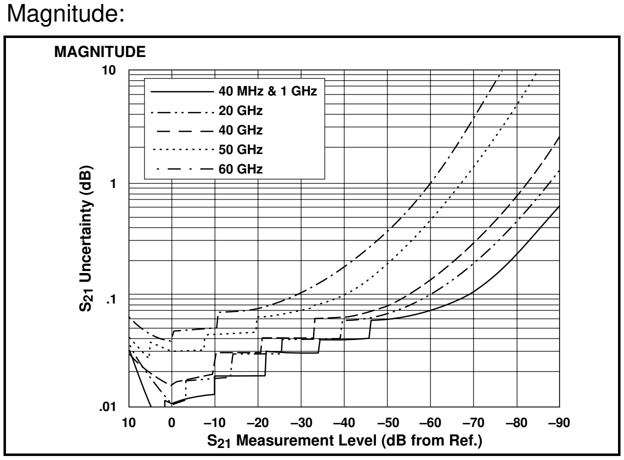
Connector	Frequency (GHz)	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Frequency Tracking (dB)	Transmission Frequency Tracking (dB)	Isolation (dB)
GPC–7	0.04 1.0 18	>52 >52 >52	>44 >44 >42	>52 >52 >52	±0.003 ±0.003 ±0.004	±0.004 ±0.004 ±0.012	>105 >115 >112
GPC–7① LRL Calibration	2 18	>60 >60	>60 >60	>60 >60	±0.001 ±0.001	±0.001 ±0.001	>115 >112
3.5 mm	0.04 1.0 20 26.5	>44 >44 >44 >44	>40 >40 >38 >34	>44 >44 >44 >44	±0.005 ±0.005 ±0.006 ±0.006	±0.030 ±0.030 ±0.050 ±0.070	>105 >115 >110 >102
K	0.04 1.0 20 40	>42 >42 >42 >38	>40 >40 >38 >33	>42 >42 >42 >38	±0.005 ±0.005 ±0.006 ±0.006	±0.030 ±0.050 ±0.070 ±0.080	>105 >115 >110 >100
V	0.04 1.0 20 40 50 60 62.5② 65③	>40 >40 >40 >36 >34 >34 >34 >32	>38 >38 >36 >32 >28 >28 >26 >26	>40 >40 >40 >36 >34 >34 >34 >32	±0.005 ±0.005 ±0.008 ±0.008 ±0.015 ±0.015 ±0.015 ±0.025	±0.030 ±0.050 ±0.050 ±0.080 ±0.100 ±0.100 ±0.100 ±0.120	>105 >115 >110 >97 >85 >77 >75 >72

① When used with an appropriate Maury Microwave Calibration Kit (or equivalent).

② Available on 3612A and 3622A test sets with Test Set Option 5, 62.5 GHz Frequency Coverage.

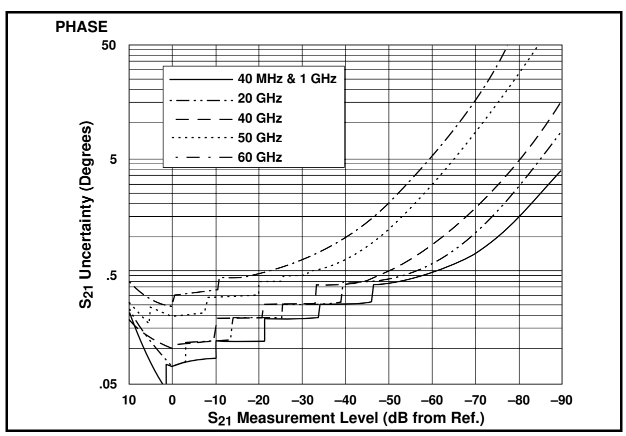
DYNAMIC ACCURACY CURVES
3630A Frequency Converter (K Connector)
and 3631A Frequency Converter (V Connector)

Magnitude:

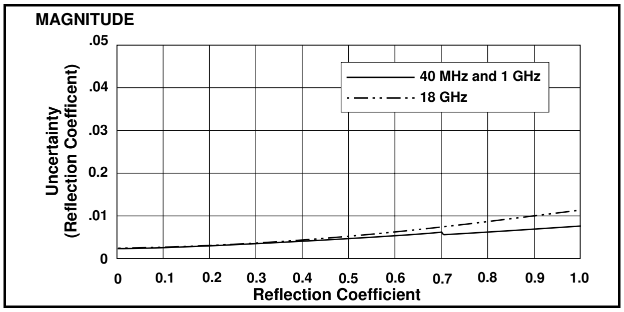


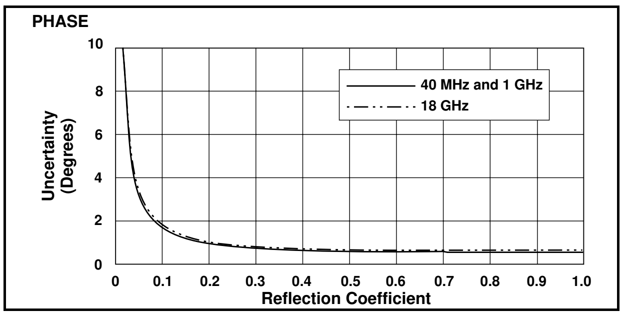
DYNAMIC ACCURACY CURVES
3630A Frequency Converter (K Connector)
and 3631A Frequency Converter (V Connector)

Phase:

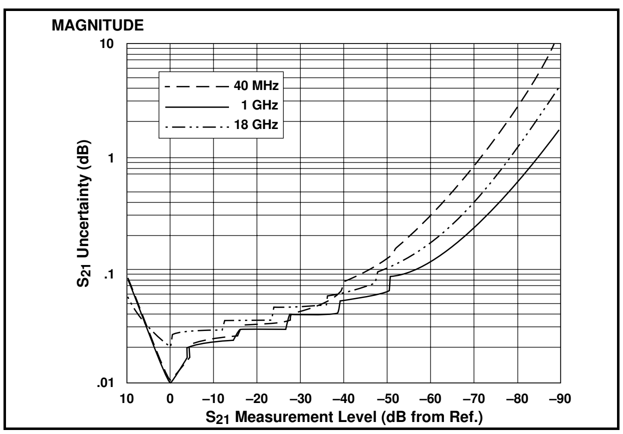


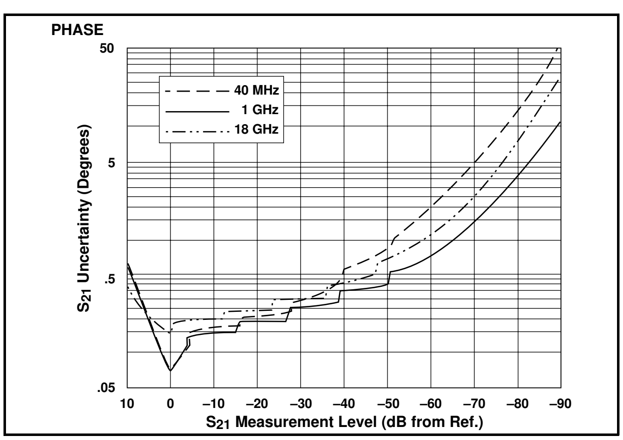
UNCERTAINTY CURVES:
Models 3610A and 3620A Test Sets (GPC-7 Connectors)
Reflection Measurements:



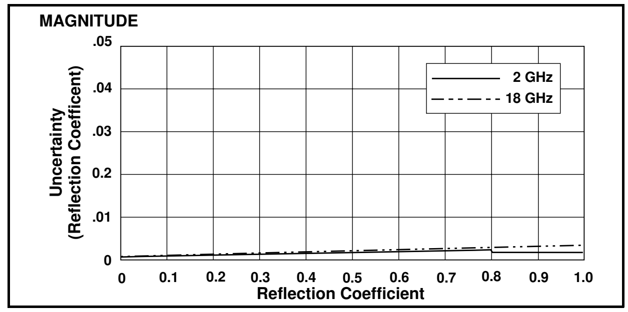


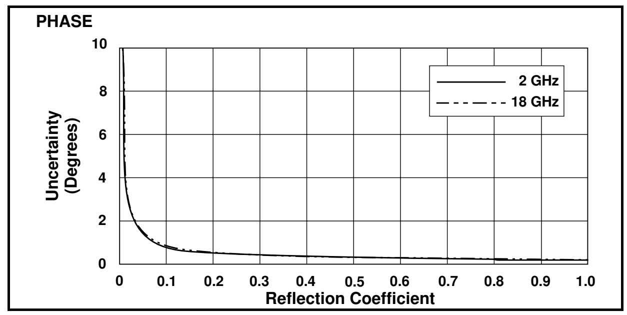
Transmission Measurements



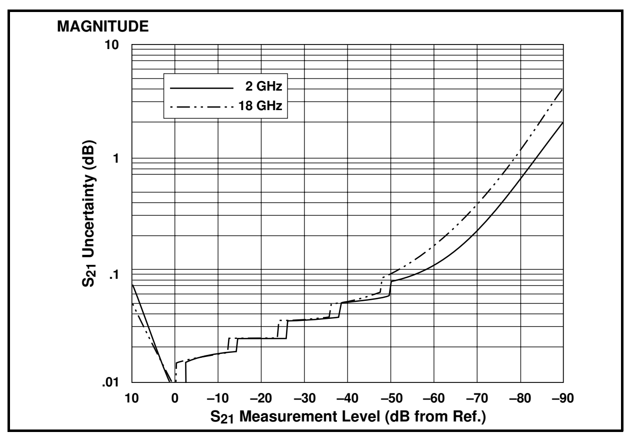


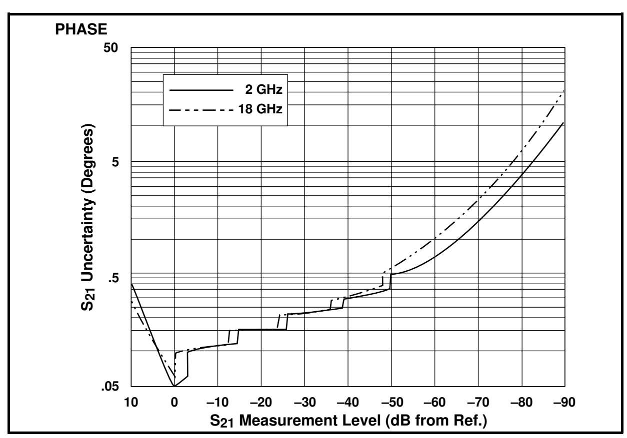
UNCERTAINTY CURVES
Models 3611A and 3621A Test Sets (With LRL Calibration GPC-7 Connectors) Reflection Measurements:



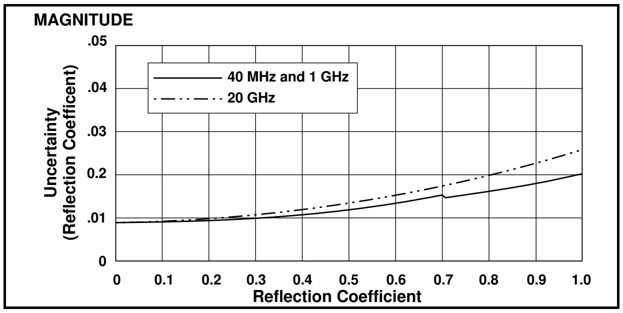


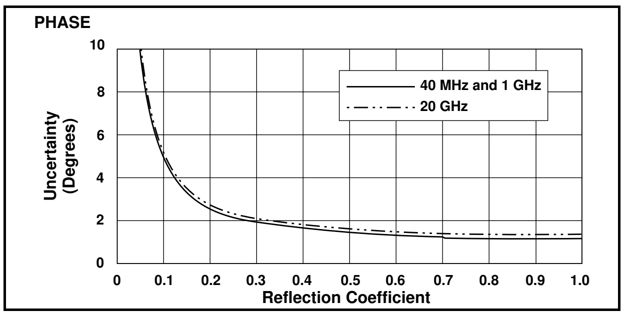
Transmission Measurements



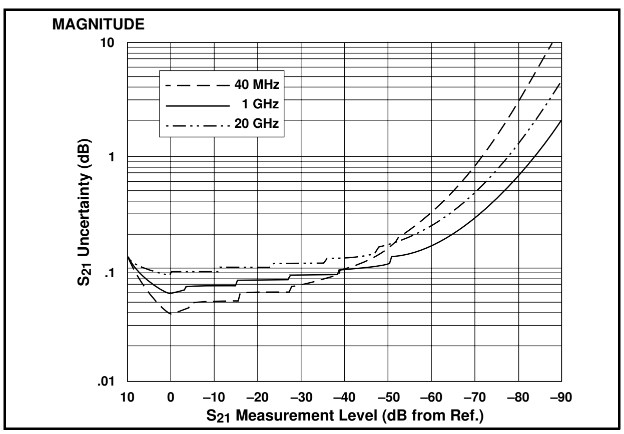


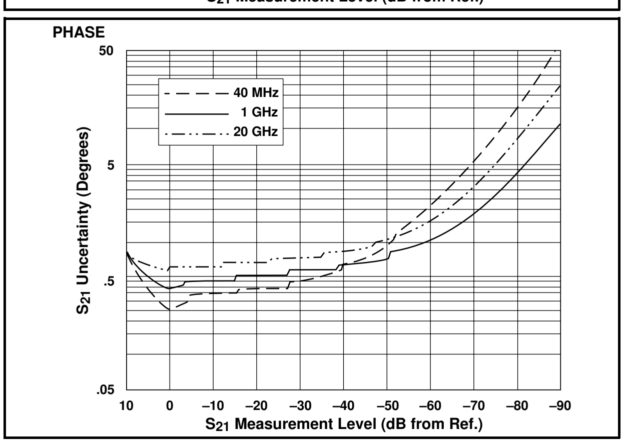
UNCERTAINTY CURVES:
Models 3610A and 3620A Test Sets (K Connectors)
Reflection Measurements:



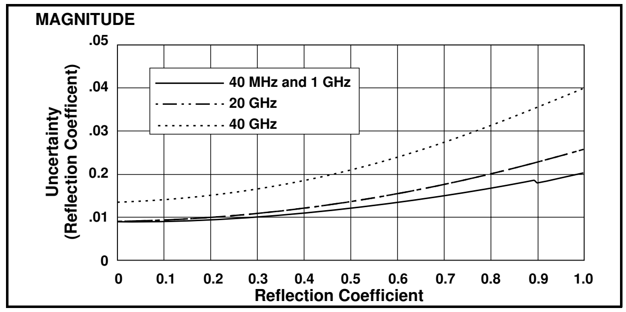


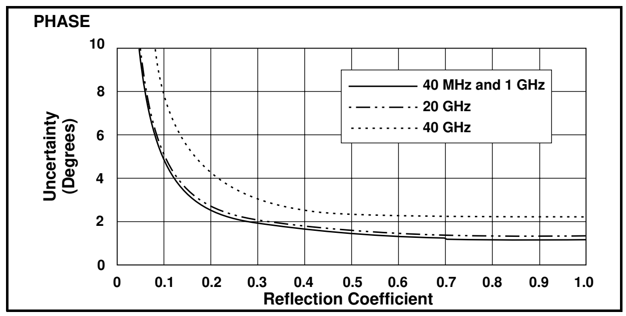
Transmission Measurements



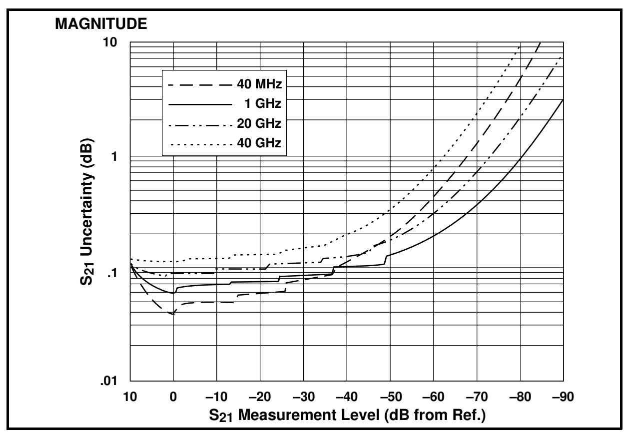


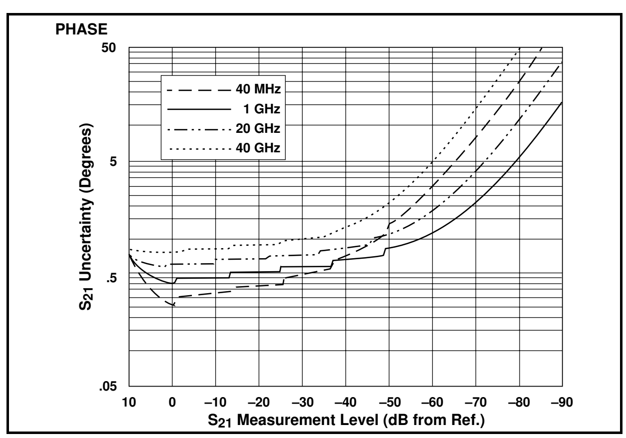
UNCERTAINTY CURVES
Models 3611A and 3621A Test Sets (K Connectors)
Reflection Measurements:





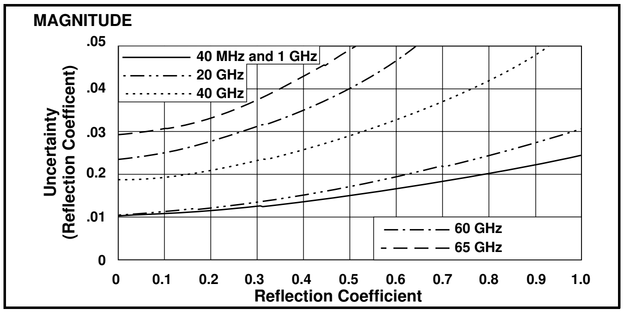
Transmission Measurements

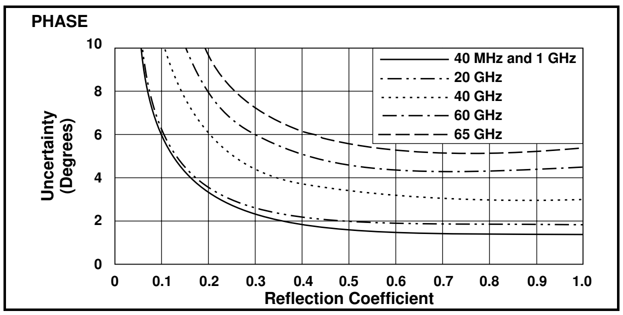




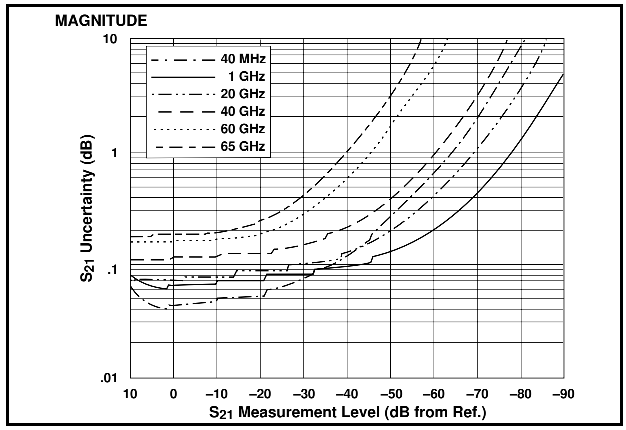
UNCERTAINTY CURVES:
Models 3612A/13A and 3622A/23A Test Sets
(V Connectors)

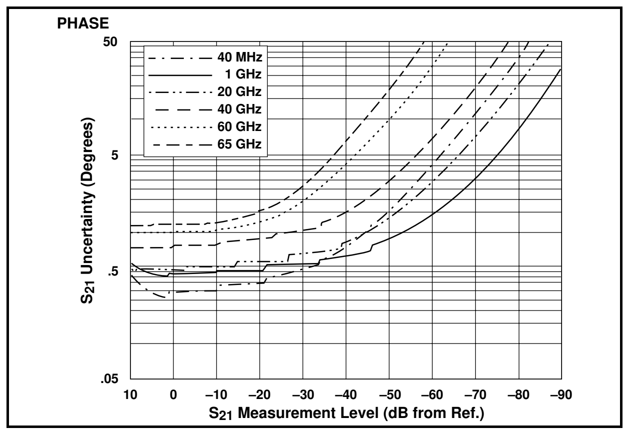
Reflection Measurements:





Transmission Measurements





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