MODEL
360B
VECTOR NETWORK ANALYZER

GPIB PROGRAMMING 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 and later 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.

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NOTICE

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6	***Supplements*** This tab section includes application notes pertaining to 360B GPIB programming.
7	***GPIB Command Function Index*** This index lists the GPIB commands for the 360B by function. The paragraph number and page number for each of 28 GPIB command function categories are referenced.
8	***GPIB Quick Reference Guide*** This Quick Reference Guide is an alphabetical list of the GPIB commands for the 360B. The listing for each command includes a brief description of the command function and attributes (such as associated parameters). This document is also an alphabetical index to the 360B Vector Network Analyzer GPIB Programming Manual. The listing for each command includes a reference to the paragraph in the programming manual that includes the complete description of the command.
Appendix A	***Installation and Configuration Instructions for the National Instruments GPIB Card*** This appendix provides installation and configuration instructions for the National Instruments GPIB-PCII/IIA card and software.
Appendix B	***"OCF" Command Binary String Data*** This appendix contains an index listing of the data string that is returned in response to sending the OCF command.

Chapter 1
General GPIB Information

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Chapter 1 General GPIB Information

1-1 INTRODUCTION

This manual describes remote operation of the ANRITSU 360B Vector Network Analyzer using IEEE-488 Interface Function Messages and 360B GPIB Commands (i.e., Product Specific Commands).

Included is a description of the IEEE-488 General Purpose Interface Bus (GPIB) hardware and the bus data transfer and control functions. Also included is a brief introduction to GPIB programming, including considerations for preparing GPIB programs for the 360B Vector Network Analyzer (VNA). All 360B VNA GPIB commands currently used are listed and described.

The programming information and examples presented in this manual assume that the external computer/controller used with the 360B is IBM-XT, AT, or PS/2 compatible, or a Hewlett Packard 9000 or Vectra series computer. The computer/controller must be equipped with an IEEE-488 GPIB interface (built-in or add-in peripheral card) with appropriate driver software. The National Instruments GPIB-PCII/IIA IEEE-488 interface card is assumed for all IBM compatible computers. (Information and instructions for installing the National Instruments GPIB-PCII/IIA IEEE-488 interface card is contained in Appendix A at the rear of this manual.)

The information about the IEEE-488 interface bus presented in this manual is general in nature. For complete and specific information, refer to the ANSI/IEEE Std 488-1978 document entitled "IEEE Standard Digital Interface for Programmable Instrumentation." This document precisely defines the set of dedicated hardware signal lines, interface functions, protocols, and messages for the interface bus.

In several chapters, especially Chapter 5, computer programs that illustrate use of various commands are used. Some of these programs can be obtained on diskette by contacting ANRITSU Customer Service at 408-778-2000.

Relationship of This Manual to Other 360B VNA Manuals

This manual is intended to be used in conjunction with the 360B Vector Network Analyzer System Operation Manual. Refer to that manual for general information about the 360B VNA, including equipment set up and manual mode operating instructions. Chapter 1 of that manual lists and describes all 360B VNA documentation set manuals, including test set and software manuals.

How to Use This Manual

Only information pertinent to 360B VNA GPIB programming is provided in this manual. Familiarity with manual (front panel) operation of the 360B VNA is assumed. System operating details are given in this manual only if they are unique to the GPIB operating mode, or are different than when operated in the normal manual mode.

This chapter describes the manual and contains a brief description of the GPIB hardware and the GPIB data transfer and control functions. If you are already familiar with this material, this section may be skipped. The remainder of the manual is organized as follows:

Chapter 2 — Introduction to GPIB Programming for the 360B VNA — contains a brief introduction to GPIB programming techniques and describes procedures to be used when preparing GPIB programs for the 360B VNA. If you are already familiar with this material, this section may be skipped.

Chapters 3, 4, and 5— describe the 360B GPIB commands used for Basic Front Panel Functions, Calibration Functions and Advanced Programming/GPIB Unique Functions, respectively. The programming information and tables containing the command descriptions are grouped *by function* in these sections. Use this information as a tutorial and for reference when preparing programs.

The Functional Index Of Commands — lists the 360B GPIB commands by function and references the paragraph and page number where the descriptions for that group of commands are located in Chapters 3 thru 5.

360B GPIB Quick Reference Guide — This separately bound document is located behind the last section tab of this manual. It lists the 360B GPIB commands *alphabetically* and references the location in Chapters 3 thru 5 of this manual where information for each command is located. The listing in this guide for each command includes a brief description of the command function and associated parameters. Use this guide as a quick reference when preparing programs.

Command Categories Used in This Manual

The 360B VNA GPIB interface responds to more than 400 commands to implement the set of 360B network analyzer functions. For descriptive purposes, these commands are organized into the following functional classifications:

Basic Front Panel Functions
These commands produce basic 360B VNA measurement operations identical to those produced by the corresponding key functions on the 360B front panel. These commands are described in Chapter 3.

Calibration Functions
The set of calibration commands can be used to set up the calibration parameters under program control and to guide an operator through the 360B VNA calibration process. These commands are described in Chapter 4.

GPIB Unique Functions
These commands produce 360B VNA operations that are unique to the GPIB mode of operation or are operations that are best done using computer control of the system. They are described in Chapter 5.

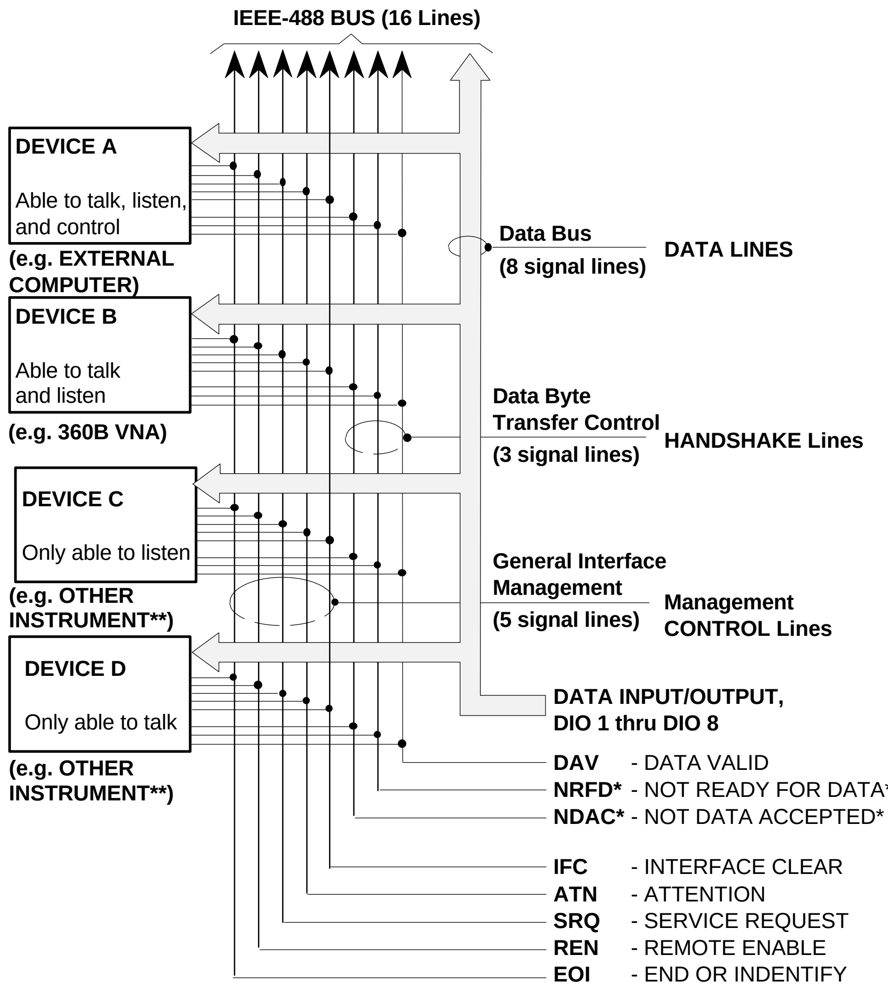
1-2 DESCRIPTION OF THE IEEE-488 (IEC-625) INTERFACE BUS

The IEEE-488 General Purpose Interface Bus (GPIB) is an instrumentation interface for integrating instruments, computers, and other controllers into systems. The bus uses 16 signal lines to effect transfer of data and commands to all instruments connected on the bus.

No more than 15 instruments may be connected to the interface bus (however, a system may contain more than one interface bus). The maximum total accumulative cable length for one interface bus may not exceed twice the number of instruments connected (in meters) , or 20 meters—whichever is less.

The instruments on the bus are connected in parallel, as shown in Figure 1-1. Eight of the signal lines (DIO 1 thru DIO 8) are used for the transfer of data and other messages in a byte-serial, bit-parallel form. The remaining eight lines are used for communications timing (handshake), control, and status information. Data are transmitted on the eight GPIB data lines as a series of eight-bit characters, referred to as bytes.

Data transfer is by means of an interlocked handshake technique (Figure 1-2). This technique permits asynchronous communications over a wide range of data rates. The following paragraphs provide an overview of the data, and handshake buses, and describe how these buses interface with the 360B VNA.



Note: The configuration shown in this diagram depicts an external computer connected via GPIB to a 360B VNA and other microwave instruments. The second dedicated GPIB that is part of the 360B VNA is not shown (refer to Figure 2-1 in the next section).

* NEGATION IS REPRESENTED BY LOW STATE ON THESE TWO LINES

**IF USED

Figure 1-1. *Interface Connections and Bus Structure*

IEEE-488 Hardware Interface

The IEEE-488 interface bus hardware implementation is made up of 16 signal lines that comprise three functional groups (Figure 1-1).

- Data Bus (8 lines)
- Data Byte Transfer Control Bus (3 lines)
- General Interface Management Bus (5 lines)

The signal lines in each of the three groups are designated according to function. Table 1-1 lists these designations.

Data Byte Transfer Control Bus Description

Control of information transfer on the GPIB data Bus is accomplished by a technique called the "three-wire handshake", which involves the three signal lines of the Data Byte Transfer Control Bus. This technique is described briefly below and is depicted in Figure 1-2. For further information, refer to the ANSI/IEEE Std 488-1978 document.

DAV (Data Valid)

This line goes TRUE (arrow 1) when the talker has (1) sensed that NRFD is FALSE, (2) placed a byte of data on the bus, and (3) waited an appropriate length of time for the data to settle.

NRFD (Not Ready For Data)

This line goes TRUE (arrow 2) when a listener indicates that valid data has not yet been accepted. The time between the events shown by arrows 1 and 2 is variable and depends upon the speed with which a listener can accept the information.

Table 1-1. *Interface Bus Signal Line Designations*

Bus Type	Signal Line Name	Function
Data Bus	DIO1–DIO8	Data Input/Output, 1 thru 8
Data Byte Transfer and Control	DAV NRFD NDAC	Data Available Not Ready For Data Not Data Accepted
General Interface Control	ATN IFC SRQ REN EOI	Attention Interface Clear Service Request Remote Enable End Or Identify

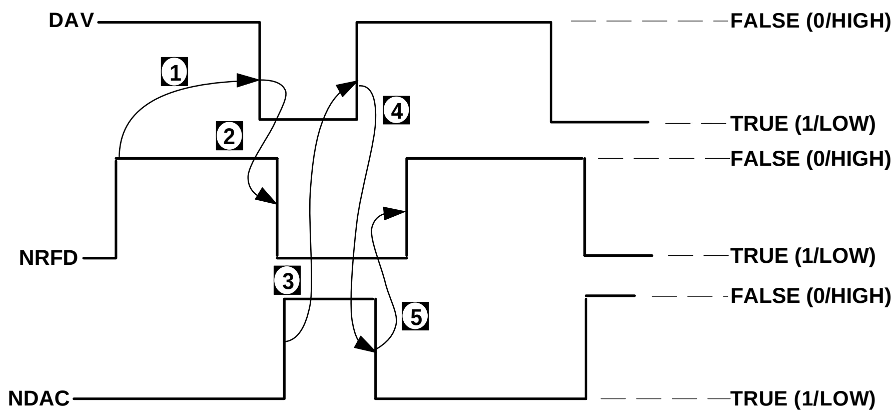


Figure 1-2. *Typical GPIB Handshake Operation*

NDAC (Not Data Accepted)
This line goes FALSE to indicate that a listener has accepted the current data byte for internal processing. When the data byte has been accepted, the listener releases its hold on NDAC and allows the line to go FALSE. However, since the GPIB is constructed in a wired-OR configuration, NDAC will not go FALSE until all listeners participating in the interchange have also released the line. As shown by arrow 3, when NDAC goes FALSE, DAV follows suit a short time later. The FALSE state of DAV indicates that valid data has been removed; consequently, NDAC goes LOW in preparation for the next data interchange (arrow 4).

Arrow 5 shows the next action in time: NRFD going FALSE after NDAC has returned TRUE. The FALSE state of NRFD indicates that all listeners are ready for the next information interchange. The time between these last two events is variable and depends on how long it takes a listener to process the data byte. In summation, the wired-OR construction forces a talker to wait for the slowest instrument to accept the current data byte before placing a new data byte on the bus.

IEEE-488 Interface Functions and Protocols

The IEEE-488 standard document describes a total of 11 different possible interface functions. Each of these interface functions acts in accordance with a specific protocol defined in the standard. This set of functions and protocols define every possible manner that information and control can be passed between devices connected to the GPIB.

Specific instruments, such as the 360B VNA, are implemented using only a portion, or subset, of the total set of interface functions defined by the standard. Table 1-2 lists the functional subset supported by the 360B VNA.

Table 1-2. *360B VNA GPIB Interface Function Subset Capability*

Function Identifier	Function	360B Capability
AH1	Acceptor Handshake	Complete Capability
SH1	Source Handshake	Complete Capability
T6	Talker	No Talk Only (TON)
TE0	Talker With Address Only	No Capability
L4	Listener	No Listen Only (LON)
LE0	Listener With Address Only	No Capability
C0	Controller	No Capability
SR1	Service Request	Complete Capability
RL1	Remote/Local	Complete Capability
PP1	Parallel Poll	Complete Capability
DC1	Device Clear	Complete Capability
DT1	Device Trigger	Complete Capability

IEEE-488 Message Types

There are three types of information transmitted over the GPIB:

IEEE Interface Function Messages
These messages are sent on the data lines and interface management lines to control the state of the interface and the manner in which it responds to commands. These messages are used to maintain control of the interface. The user generally has control over these signals; however, the extent of user control is implementation-dependent and varies with the specific hardware and software used with the external controller.

Product-Specific Commands
These commands are mnemonic codes sent by the external computer to the 360B VNA to control the setup and measurement operations of the 360B VNA. The function and contents of these commands are not specified by the IEEE-488 standard. They are unique and specific to the ANRITSU 360B VNA and are described in Chapters 3, 4, and 5 of this manual.

These commands (also referred to as "360B GPIB commands") are transmitted over the data bus of the GPIB interface to the 360B VNA in the form of ASCII strings containing one or more codes. They are decoded by the *internal 360B VNA controller* and cause the various measurement functions of the system to be performed. (The 360B VNA GPIB interface does not decode these commands; it only acts as the transmission channel to the internal controller.)

Data and Instrument Status Messages
These messages are sent by the 360B VNA to the external computer via the GPIB. They contain measurement data, setup information, or system status information that the 360B VNA transmits over the data bus in response to specific commands from the external computer requesting the data. The contents of these messages are specific to the 360B VNA. They may be in the form of ASCII strings, or binary data.

In some cases data messages will be transmitted from the external computer to the 360B VNA. For example, messages to load calibration data.

An SRQ (service request) is an interface function message sent *from the 360B VNA* to the external computer to request service from the computer, usually due to some predetermined system condition or error. To send this message, the 360B VNA sets the SRQ bit of the General Interface Management Bus true and then sends a status byte on the data bus lines.

An SRQ interface function message is also sent by the 360B VNA in response to a serial poll message from the computer, or upon receiving either an OEB or OPB command from the computer. The protocols associated with the SRQ functions are defined in the ANSI/IEEE Std 488-1978 document. The 360B GPIB commands for these functions along with the SRQ status byte format information is contained in Paragraph 5-6 — SRQ Status Bytes: Commands — in this manual.

The manner in which Interface Function Messages and Product-Specific Commands are invoked in programs is implementation specific for the GPIB interface used with the external computer. Even though both message types are represented by mnemonics, they are implemented and used in different ways.

The Interface Function Messages normally are sent automatically by the GPIB driver software in response to invocation of a software function. For example, to send the SDC interface function message, one would call the ibclr function of the National Instruments software driver. On the other hand, the 360B GPIB command RST is sent in a string message to the addressed device (e.g. 360B VNA). In the case of the National Instruments example, this would be done by using the ibwrt function call.

1-3 360B VNA GPIB OPERATION

All of the front panel control functions of the 360B VNA, except for LINE ON/OFF, are controllable using 360B GPIB commands sent from the external computer. When in the GPIB operating mode, the 360B VNA functions as both a listener and a talker (Table 1-2).

Setting Default GPIB Operating Parameters

The 360B VNA GPIB address value is set to 6 at the factory. This value may be changed via the GPIB SETUP MENU (from the UTILITY MENU); refer to Appendix 1 (A1) of the 360B Vector Network Analyzer System Operation Manual. The data delimiting terminator is set as CR-LF at the factory. This may also be changed via the GPIB SETUP MENU.

Response to GPIB Interface Function Messages

Table 1-3 lists the set of IEEE–488 Interface Function Messages that the 360B VNA will recognize. With the exception of the DCL and SDC messages, these messages affect only the operation of the 360B VNA GPIB interface. The response of the 360B VNA GPIB interface for each message is included in Table 1-3.

Interface function messages are transmitted on the GPIB data lines and interface management lines as either unaddressed or addressed commands. The manner in which these messages are invoked in programs is implementation dependent. For programming information, refer to the documentation included with the GPIB Interface for the external computer used.

360B VNA Response To GPIB Error Conditions

The following paragraphs describe how the 360B VNA responds to error conditions during the GPIB mode of operation

Syntax Error
The 360B beeps and sends a Service Request (SRQ) to the external computer (if SRQs are enabled). The 360B also ignores any further commands until it is programmed to talk or be unlistened.

Table 1-3. 360B VNA Response to IEEE-488 Interface Function Messages

Interface Function Message	Message Function	Addressed Command	360B VNA Response
DCL SDC	Device Clear Selected Device Clear	No Yes	Resets the 360B to its default state. Equivalent to the RST command.
GTL	Go To Local	Yes	Returns the 360B to local (control panel) control.
GET	Group Execute Trigger	Yes	Executes a string of commands defined by the DEF...END mnemonics. **NOTE** The GET command is buffered and executed in-line with other commands.
IFC	Interface Clear	No	Stops the 360B GPIB from talking/listening.
LLO	Local Lockout	No	Disables the control panel RETURN TO LOCAL key
REN	Remote Enable	No	Places the 360B in remote when addressed to listen
SPE	Serial Poll Enable	No	Outputs the binary status byte
SPD	Serial Poll Disable	No	Disables the serial poll function
PPC	Parallel Poll Configure	Yes	Sets the assigned bus line to reflect its SRQ status
PPE	Parallel Poll Enable	Yes	Enables the 360B for parallel poll operation
PPU	Parallel Poll Unconfigure	No	Cancels any previous parallel poll configurations
PPD	Parallel Poll Disable	Yes	Disables the parallel polling function

Note: These are *not* Device Specific Commands. These messages are implementation dependent — refer to the documentation included with the GPIB Interface for the external computer used.

Parameter Out Of Range Error
Upon detecting this condition, the 360B moves the cursor adjacent to the erroneous entry, beeps, and displays the entry in red. It also sends an SRQ (if enabled) to the external computer. The error is cleared upon execution of the next instruction.

Action Requested Not Possible
The 360B sends an SRQ (if enabled) to the external computer and ignores the command.

Chapter 2
Introduction to GPIB Programming for the 360B VNA

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Chapter 2
Introduction to GPIB Programming for the 360B VNA

2-1 INTRODUCTION

This chapter contains a brief introduction to GPIB programming techniques and describes procedures to be used when preparing GPIB programs for the 360B VNA. It includes information about equipment requirements and configuration for GPIB control of the 360B VNA, 360B GPIB command syntax, and programming tips. Example programs are provided that familiarize the user with the most frequently used 360B GPIB commands.

Familiarity with manual (front panel) operation of the 360B is assumed. (Throughout this section, the 360B VNA is referred to simply as "360B".) A complete description of front panel operation is contained in the 360B Vector Network Analyzer System Operation Manual.

2-2 EQUIPMENT AND CONFIGURATION

The programming examples contained in this tutorial assume that the equipment listed below is present and configured as described.

Required Equipment

The following equipment represents a minimum GPIB controllable 360B VNA system:

1. A 360B Vector Network Analyzer consisting of:
   - A 360B Network Analyzer unit
   - A 36XXA Series Test Set
   - A compatible ANRITSU Signal Source (360SSXX, 66XXB, 67XXB, etc)
2. A computer/controller that supports the IEEE-488 GPIB standard. The examples in this section address the following two computer types:
   - IBM XT, AT, and PS/2 compatibles
   - Hewlett Packard 9000 and Vectra series

3. An IEEE-488 GPIB interface (built in, or add-in peripheral card) with appropriate driver software. The National Instruments GPIB-PCII/IIA IEEE-488 interface card is assumed for all IBM compatible computers. (Information and instructions for installing the National Instruments GPIB-PCII/IIA IEEE-488 interface card is contained in Appendix A at the rear of this manual.)

4. Appropriate software:

   - ☐ Microsoft QuickBASIC, version 4.0 (or later);
   - ☐ Microsoft "C", version 5.1 or later; or:
   - ☐ HP BASIC, version 5.0 or later (for HP computers).
   - ☐ Any other programming language that supports the National Instruments GPIB-PCII/IIA IEEE-488 interface card (Pascal, Fortran, etc).

5. A GPIB cable (preferably 2 meters long).

Configuration

Configure the 360B as shown in Figure 2-1. Apply power to the 360B and allow the system software to load from disk. Once the software has finished loading, the 360B is ready to be remotely controlled via the GPIB. It is important to note that *the 360B will not respond to GPIB commands until the 360B system software has been loaded.*

If not previously done, connect a GPIB cable from the computer/controller to the "360 GPIB" connector on the rear panel of the 360B Network Analyzer.

NOTE

The 360B Network Analyzer has two GPIB buses: the "360 GPIB" that connects the 360B Network Analyzer unit to the computer/controller and the "SYSTEM CONTROL" bus (which connects to the signal source(s) and a system plotter—if used).

Apply power to the computer/controller and load the appropriate programming language software (QuickBASIC, "C", or HP BASIC). This tutorial contains programming examples written in each of these three languages, as explained in paragraph 2-4.

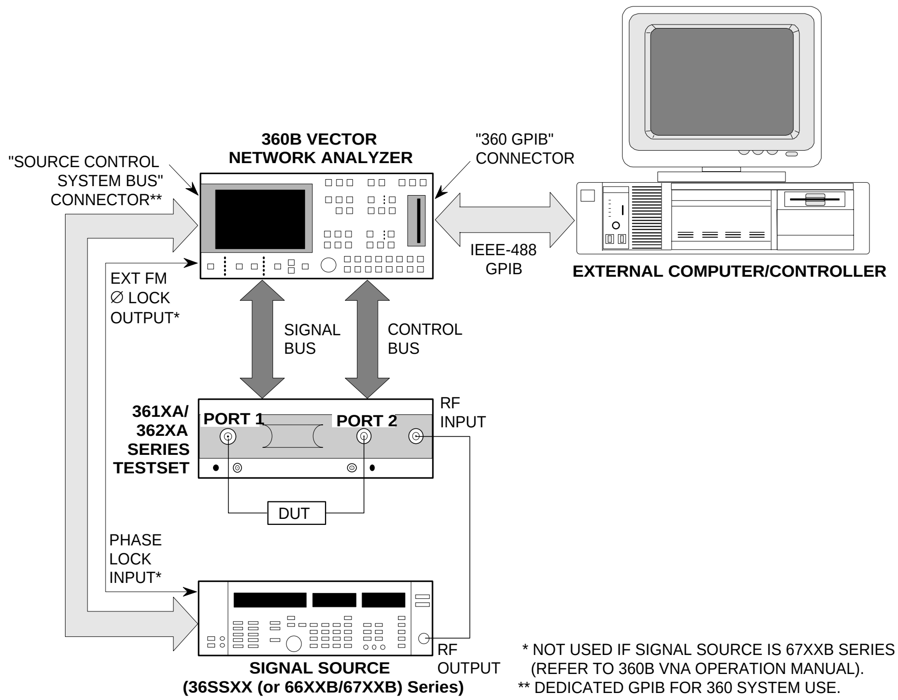

Figure 2-1. *Minimum 360B VNA Configuration with GPIB Control*

Default GPIB Operating Parameters

The default GPIB address for the 360B is 06, and the default data delimiting terminator is CR-LF. The default values for these GPIB operating parameters may be changed via the GPIB SETUP MENU (from the UTILITY MENU); refer to Appendix 1 (A1) of the 360B Vector Network Analyzer System Operation Manual.

2-3 360B GPIB PROGRAMMING BASICS

In the "remote" mode of operation, the 360B is controlled using IEEE-488 Product Specific Commands and Interface Function Messages. The Product Specific Commands are a set of pre-defined mnemonics that are unique to the ANRITSU Model 360B Vector Network Analyzer. (Refer to Chapter 1 for further information.) In this manual, they are referred to as "360B GPIB commands" or simply "commands".

These commands may be issued one at a time or in a sequence (i.e., a command string). Commands, command strings, and IEEE-488 Interface Function Messages can be included as part of a program run on an external computer/controller to remotely stimulate the 360B to perform particular microwave measurement operations.

360B GPIB Command Set

There are approximately four hundred 360B GPIB commands. These commands allow the user to program every front panel and menu function of the 360B. These many commands reflect the ability of the 360B to perform many specialized functions; however, typical programs written for ATE applications usually use a small subset of these.

The list of GPIB commands may seem intimidating at first glance; however, it can actually be broken down into a few, easy-to-remember categories that reflect the major functions and operations of the 360B. The GPIB Command Function Index located behind its section tag at the rear of this manual provides an overview (and index to) these command group categories. A complete listing and description of all 360B GPIB commands is provided in Chapters 3, 4, and 5.

Command Syntax

The 360B GPIB commands are nothing more than a shorthand method for representing instrument commands. Most 360B GPIB commands are three character contractions of their titles or descriptions; for example: `RST` (reset). Depending on function, some commands must be followed by a numeric value and terminator code; example: `SRT 2 GHZ` (start frequency = 2 GHz).

The commands for all numeric entry, such as frequency, scale, reference position, etc, include a data entry followed by a terminator code. All commands that require data *must* have a valid terminator code following the data entry.

The 360B will accept multiple commands in string format. Separator characters may be used to improve program readability, but they are not required.

Terminator Codes
These terminators are codes that perform the same function as the termination keys located on the front panel of the 360B. Example: To enter a start frequency using the 360B front panel keys, type **"40"**; then press the "MHz" terminator key. Likewise, a numeric entry in a GPIB program must be terminated by one of the terminator codes listed in Chapter 3, Table 3-2.

Separator Characters
Separator characters may be used between commands and between data or other mnemonics to improve program readability. Their use is optional. The more common permitted separator characters are: space, comma, and semicolon.

Programming Tips

The 360B is a "channel-based" instrument, which means that most commands apply only to the current active channel. Therefore, to set up a desired state for multiple channels, a CH1 - CH4 command should precede the setup. For example:

"D14 CH1 S11 SMI CH2 S12 MPH CH3 S21 MAG CH4 S22 ISM"

This command string sets up a quad display (D14) and then sets the S-parameter and graph type desired for each Channel:

- Channel 1: S11, Smith chart
- Channel 2: S12, log magnitude and phase
- Channel 3: S21, log magnitude
- Channel 4: S22, inverted Smith chart

Other commands are "global" in their extent, meaning they apply to all channels. Examples of these commands: start/stop frequency (SRT,STP), averaging (AVG,AOF), and source power (PWR).

2-4 TYPICAL GPIB PROGRAM STRUCTURE

A typical GPIB program may be composed of the following basic functional program groups:

- Preliminary GPIB Control Establishment
- Calibration
- Front Panel Setup
- Measurement
- Data Transfer

Each of these topics will be covered in detail in order to give you the basic tools needed to develop complete programs. This tutorial contains programming examples written in three languages: QuickBASIC, Microsoft C, and HP BASIC. The language used is stated for each example.

Also included with this manual are two application notes, AN360-8 and AN360-9, which are located behind the tab labeled “Supplements” at the rear of the manual. Application Note AN360-8 lists and describes an example main program and associated program functions written in “C” that initialize the 360B and perform calibration, measurement and data output functions. Application Note AN360-9 contains a similar example of a main program and associated subprograms written in HP BASIC.

Establishing GPIB Control The first step in any GPIB program should be the initialization of the GPIB interface and any attached instruments. This step insures that:

- Communication has been established between the computer/controller and the instrument(s).
- Instrument(s) are restored to a “known” initial state.

In order for communication to take place over the GPIB, the controlling program must contain correct GPIB addresses for the 360B and any other controlled instruments. Also, the data delimiting terminator used (i.e., CR/CR–LF) must be correct for the GPIB interface used with the external computer/controller; refer to paragraph 2-2.

The process used to initialize the 360B will differ, depending on the computer/controller used. Examples of initialization routines written in QuickBASIC and “C” for use with the National Instruments GPIB-PCII/IIA card and HP BASIC for the Hewlett-Packard GPIB interface are shown in Figure 2-2.

QuickBASIC example:

```
CALL IBFIND ("DEV6", vna%)
CALL IBCLR
```

Microsoft C example:

```
int vna;
vna = ibfind("DEV6");
ibclr(vna);
```

HP BASIC example:

```
100 ASSIGN @gpib TO 7
110 ASSIGN @vna TO 706
120 FORMAT OFF
130 REMOTE @gpib
140 ABORT @gpib
150 CLEAR @vna
```

Figure 2-2. *Example Initialization Routines*

Front Panel Setup

Front panel setup involves the configuration of the 360B for a particular measurement. In the “Setup” subroutine, the 360B is set up to display all four S-Parameters (D14). The graph type for all four channels is set to Log Magnitude and Phase (MPH). The S-parameters are displayed as follows:

- Channel 1 (CH1): S11 (S11)
- Channel 2 (CH2): S12 (S12)
- Channel 3 (CH3): S21 (S21)
- Channel 4 (CH4): S22 (S22)

The start frequency is set to 40.0 MHz (SRT 40.0 MHZ) and the stop frequency is set to 20.0 GHz (STP 20.0 GHZ). Examples of front panel setup routines are shown in Figure 2-3.

QuickBASIC example:

```
SUB Setup
CALL IBWRT(vna%, "D14 CH1 S11 MPH CH2 S12 MPH")
CALL IBWRT(vna%, "CH3 S21 MPH CH4 S22 MPH")
CALL IBWRT(vna%, "SRT 40.O MHZ STP 20.0 GHZ")
SUB END
```

Microsoft C example:

```
Setup (vna)
int vna;
{
ibwrt (vna, "D14 CH1 S11 MPH CH2 S12 MPH", 27);
ibwrt (vna, "CH3 S21 MPH CH4 S22 MPH", 23);
ibwrt (vna, "SRT 40.0 MHZ STP 20.0 GHZ", 25);
}
```

HP BASIC example:

```
500 SUB Setup(@vna)
510 OUTPUT @vna;"D14 CH1 S11 MPH CH2 S12 MPH"
520 OUTPUT @vna;"CH3 S21 MPH CH4 S22 MPH"
530 OUTPUT @vna;"SRT 40.0 MHZ STP 20.0 GHZ"
```

Figure 2-3. *Example Front Panel Setup Routines*

Calibration

Calibration, as it applies to network analysis, is a technique used to remove most measurement errors due to imperfections in the measurement system. The calibration process characterizes the systematic measurement errors. The resulting data is stored and subtracted from subsequent measurement data to yield the correct measurement data for the device-under-test.

As performed using the 360B front panel controls, the calibration process requires the user to define the characteristics of the test set test ports, perform the calibration steps, and then verify the quality of the calibration. (Refer to Chapter 8, "Measurement Calibration" in the 360B Vector Network Analyzer System Operation Manual.)

As shown in the example programs contained in Chapter 4 of this manual, it is possible to use the external computer to guide the system operator through the calibration process using a suitably written program. The various 360B GPIB commands that are used to perform the calibration process are described in the first portion of Chapter 4. Listings of example HP BASIC and "C" program segments for 360B calibration are also presented in Chapter 4.

Measurement and Data Output

The commands that control the measurement functions of the 360B VNA are listed and described in paragraph 3-4, "Measurement Control Commands." These commands mimic the measurement operations that are performed using the 360B front panel keys and menus.

Data Transfer Programming

The commands that control the transfer of data to and from the 360B are listed and described in paragraph 5-3, "Data Transfer Commands." The functions performed by many of these commands are unique—most do not have direct counterparts when operating from the front panel keys and menus.

Figures 2-4 through 2-7 contain listings of an example program written in "C". This example is a complete program that automates data transfer to/from the 360B. The four parts of the program shown in the figures are described below.

Programming Considerations
When writing a program for data transfer to/from the 360B, the following items should be considered:

- **Data Transfer Sequence —** Data may be transferred *from the 360B* to the external computer in any order. However, the 360B should be put in HOLD to prevent the data from being overwritten.

  Data should be transferred from the external computer *to the 360B* in the following order:
  Front Panel Setup
  Measurement Frequencies
  Calibration Coefficients
  Measurement Data.

- **Front Panel Setup and Measurement Frequency Data —** Front panel setup data, including frequency information, is contained in the data transfers performed by the OFP and IFP commands. However, when Discrete Fill is used to enter frequency data, or when access to individual frequency values is important, the OFV and IFV commands must be used.

- **Data Transfer Formats —** Use of the FMA and FMB commands is the preferred method of data transfer for Binary floating point data. ASCII data transfer is significantly slower than for binary floating point data. Also, ASCII data must be converted to a numeric format using a suitable "C" program to be useful for most applications.

Example Program: Variable Declaration
The program segment shown in Figure 2-4 contains the variable declarations for the example program. These variable declarations define and initialize the variables common to the main program and program functions.

Example Main Program
The main program shown in Figure 2-5 performs the following operations:

1. The 360B and GPIB are initialized to a known state by the first two program functions so that the program starts under identical conditions each time it is run:

   - GPIB function ibfind() enables the GPIB to control the 360B (this assumes that the 360B address is set to 6.)
   - GPIB function ibclr() instructs the 360B to reset to the default state. It is used before 360B parameters are established by the program.

2. The program function xfr_from_360B() is called to transfer data from the 360B.

3. The program function xfr_to_360B() is called to transfer data to the 360B.

4. The last program function of the main program, ibloc(), instructs the external computer to return the 360B to local operation and end program execution.

```
/***************************************************************/
/*              Program to Transfer Data over the GPIB              */
/*           to/from a ANRITSU 360 Vector Network Analyzer         */
/*   using an IBM AT Computer with National Instruments GPIB   */
/*                          Written in Microsoft C                       */
/***************************************************************/
#include <stdio.h>
/*----------------------------------------------------------
            Variable Declaration
  Define and Initialize variables common to all functions.
-----------------------------------------------------------*/
int ans, vna, count, points;
char freq[12800], setup[5000];
struct header
 {
  char preamble [2];
  int size;
 }
 cal_headr, data_headr;
struct cal
 {
  double real;
  double imag;
 }
 cal1[512], cal2[512], cal3[512];
struct data
 {  float real;
  float imag;
 }
data[512];
```

Figure 2-4. Variable Declaration for Example Data Transfer Program (Microsoft "C")

```
/*----------------------------------------------------------
                                        Main Program
            Initialize GPIB and put 360 under GPIB control,
                call program functions to transfer data,
                    and return 360 to local operation.
---------------------------------------------------------*/
main()
  {
   vna = ibfind("DEV6"); /*enables GPIB to control 360*/
   ibclr(vna);              /*resets 360 to default parameters*/
      xfr_from_360(vna);   /*calls data output function*/
      xfr_to_360(vna);      /*calls data input function*/
   ibloc(vna);               /*returns 360 to_local control*/
   }                              /*ends program*/
```

Figure 2-5. Main Program for Example Data Transfer Program (Microsoft "C")

Data Transfer from the 360B VNA to the External Computer

The program function xfr_from_360B() shown in Figure 2-6 performs the following operations:

1. The GPIB function ibwrt() instructs the 360B to return to local operation (RTL).

2. The operator is instructed to perform a Reflection Only calibration, set up the front panel as desired and install the device to be measured. They are then instructed to press any key on the external computer keyboard to output data from the 360B.

3. The next ibwrt() function sends instructions to the 360B to trigger a sweep (TRS), wait a full sweep (WFS) and hold (HLD).

4. The 360B is then instructed to output the data types listed below to the external computer. The external computer reads the data sent from the 360B using multiple ibrd() functions. The data types transferred are:

   - Front panel setup data in binary string format (OFP).
   - Measurement frequency values (OFV) in ASCII format (FMA).
   - Calibration coefficients (OC1, OC2, and OC3) in binary floating point - double precision (FMB) with the least significant byte first (LSB).
   - Corrected measurement data (OCD) from the active channel in binary floating point - single precision (FMC) with the least significant byte first (LSB).

5. When the data transfer is completed, the 360B is again returned to local operation.

```
/*------------------------------------------------------------
                              Data Output Function
              Setup, calibrate and measure a_device,
              transfer data from 360 to controller,
                and return 360 to local operation.
------------------------------------------------------------*/
xfr_from_360(vna)
 {
    ibwrt(vna,"RTL",3);
 printf("\n\t\t*                    INSTRUCTIONS                    *");
 printf("\n\t\t*   Perform a Reflection Only calibration,     *");
 printf("\n\t\t*        set up front panel as desired,          *");
 printf("\n\t\t*     and connect device to be measured._     *\n");
 printf("\n\t\t*    PRESS ANY KEY TO OUTPUT DATA FROM 360     *\n");
    ans = getch();
    ibwrt(vna,"TRS WFS HLD",11);

 printf("\n\t\tTransferring front panel setup to controller...");
    ibwrt(vna,"OFP",3);
    ibrd(vna,setup,sizeof(setup));

 printf("\n\t\tTransferring frequencies to controller...");
    ibwrt(vna,"FMA OFV",7);
    ibrd(vna,freq,sizeof(freq));

 printf("\n\t\tTransferring cal coefficients to controller...");
    ibwrt(vna,"FMB LSB OC1 OC2 OC3",19);
    ibrd(vna,&cal_headr,4);
    ibrd(vna,&cal1[0],cal_headr.size);
    ibrd(vna,&cal_headr,4);
    ibrd(vna,&cal2[0],cal_headr.size);
    ibrd(vna,&cal_headr,4);
    ibrd(vna,&cal3[0],cal_headr.size);

 printf("\n\t\tTransferring measurement data to controller...");
    ibwrt(vna,"FMC LSB OCD",11);
    ibrd(vna,&data_headr,4);
    ibrd(vna,&data[0],data_headr.size);

 printf("\n\n\t\t     --- 360 returned to local operation.---\n");
    ibwrt(vna,"RTL",3);
```

Figure 2-6. *Output Data Transfer Program Function for Example Data Transfer Program (Microsoft "C")*

Data Transfer from the External Computer to the 360B VNA

The program function xfr_to_360B() shown in Figure 2-7 performs the following sequence of operations:

1. The operator is instructed to press any key on the external computer keyboard to output data to the 360B.

2. The program function prn_data() (shown in Figure 2-7, sheet 2) then displays the measurement frequency data and calibration coefficients on the external computer monitor (Figure 2-8).

3. The 360B is then instructed to input the data types listed below from the external computer. The external computer sends the data to the 360B using multiple ibwrt() functions. The data types transferred are:

   - Front panel setup (IFP) in binary string format.
   - Frequency values (IFV) in ASCII format (FMA).
   - Calibration coefficients (IC1, IC2 and IC3) in binary floating point - double precision (FMB) with the least significant byte first (LSB).
   - Corrected measurement data (ICD) from the active channel in binary floating point - single precision (FMC) with the least significant byte first (LSB).

4. The 360B is instructed to simulate a Reflection Only calibration (AFR) before it is sent the calibration coefficients (IC1, IC2 and IC3). The calibration is then applied (CON), and the corrected data is displayed on the 360B monitor.

```
/*--------------------------------------------------------
                         Data Input Function
                  Reset 360 to default parameters,
                transfer data from controller to 360,
                      and turn on calibration.
---------------------------------------------------------*/
xfr_to_360(vna)
 {
 printf("\n\t\t*                PRESS ANY KEY               *");
 printf("\n\t\t* TO DISPLAY CAL DATA AND OUTPUT DATA TO 360*\n");
    ans = getch();
    ibwrt(vna,"RST",3);

 prn_data();

 points=data_headr.size/8;

 printf("\n\t\tTransferring front panel setup to 360...");
    ibwrt(vna,"IFP",3);
    ibwrt(vna,setup,sizeof(setup));

 printf("\n\t\tTransferring frequencies to 360...");
    ibwrt(vna,"FMA IFV",7);
    ibwrt(vna,freq,points*25);

 printf("\n\t\tTransferring cal coefficients to 360...");
    ibwrt(vna,"ARF FMB LSB IC1 IC2 IC3",24);
    ibwrt(vna,&cal_headr,4);
    ibwrt(vna,&cal1[0],cal_headr.size);
    ibwrt(vna,&cal_headr,4);
    ibwrt(vna,&cal2[0],cal_headr.size);
    ibwrt(vna,&cal_headr,4);
    ibwrt(vna,&cal3[0],cal_headr.size);
    ibwrt(vna,"CON",3);

 printf("\n\t\tTransferring measurement data to 360...");
    ibwrt(vna,"FMC LSB ICD",11);
    ibwrt(vna,&data_headr,4);
    ibwrt(vna,&data[0],data_headr.size);
```

Figure 2-7. *Input Data Transfer Program Function for Example Data Transfer Program (1 of 2)*

```
   printf("\ n\ n\ t\ t      ---    360  data  transfer  completed    ---");
   }
 prn_data()
    {
    points=cal_headr.size/16;

    printf("\ n\ n\ n\ t\ t          ---  CALIBRATION   COEFFICIENTS  ---");
    printf("\ nFREQUENCY                    CAL1                                  CAL2");
    printf("                                CAL3\ n");
    printf("    (GHz)         (Real)        (Imag)          (Real)        (Imag)");
    printf("            (Real)         (Imag)\ n");

    for  (count=0;count<points;count=count  +  1)
        printf("     %c.%c%c        %9.4f  %9.4f     %9.4f  %9.4f     %9.4f  %9.4f\ n",
            freq[count*25+3],
            freq[count*25+5],freq[count*25+6],
            cal1[count].real,   cal1[count].imag,
            cal2[count].real,   cal2[count].imag,
            cal3[count].real,   cal3[count].imag);
    }
```

Figure 2-7. *Input Data Transfer Program Function for Example Data Transfer Program (2 of 2)*

- - - CALIBRATION COEFFICIENTS - - -

FREQUENCY	CAL1		CAL2		CAL3	
(GHz)	(Real	(Imag	(Real	(I mag	(Real	(Imag
1.00	–0.0092	0.0010	0.0332	–0.0096	0.1188	–0.2103
1.10	–0.0062	0.0079	0.0334	–0.0221	0.2540	–0.0178
1.20	–0.0052	0.0086	0.0280	–0.0505	0.1614	–0.2134
1.30	–0.0126	0.0019	0.0032	–0.0661	0.8899	–0.2584
1.40	–0.0058	0.0132	0.0149	–0.0290	0.2714	–0.0803
1.50	–0.0100	0.0113	0.0253	–0.0245	0.2306	–0.1893
1.60	–0.0180	0.0050	0.0019	–0.0472	0.0326	–0.3096
1.70	–0.0068	0.0201	0.0318	–0.0208	0.2822	–0.1468
1.80	–0.0143	0.0170	0.0097	–0.0396	0.2833	–0.1616
1.90	–0.0240	0.0030	0.0482	–0.0528	0.0120	–0.3308

Figure 2-8. *Frequency and Calibration Data Displayed on External Computer Monitor by* xfr_to_360()

Chapter 3 Front Panel Functions

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Chapter 3 Front Panel Functions

3-1 INTRODUCTION

This chapter describes the GPIB Product Specific Commands that control the basic test and measurement functions associated with the 360B VNA front panel controls and menus. In this chapter, these messages are referred to as “360B GPIB commands” or simply “commands”.

The various 360B GPIB commands and codes associated with standard front panel functions are described in Paragraphs 3-2 through 3-17. This information is grouped by control function; example: Data Entry Commands, Hard Copy Commands, etc., (see Table of Contents, page 3-1).

To find command information not in this chapter, refer to the GPIB Command Function Index for a listing of *all* 360B GPIB commands, grouped by function. Refer also to the 360B Quick Reference Guide, which lists all commands alphabetically and includes a brief description of the function of each command. (See section tabs at the rear of this manual.)

3-2 CHANNEL CONTROL COMMANDS

The commands listed in Table 3-1 set up the current display mode and active channel for the 360B VNA. Commands CH1–CH4 select the active channel. The active channel is that channel to which any channel-based changes are applied. Commands D13, D14, D24, DSP, T13, and T24 select which channels are displayed. Commands T13 and T24 each produce a single display frame containing traces for two channels (Table 3-1).

3-3 DATA ENTRY TERMINATOR CODES

The codes listed in Table 3-2 are used as terminator statements in conjunction with commands that require numeric values. (Almost all commands that require numeric values *also* require the use of an appropriate terminator.) The appropriate terminators for commands requiring them are listed along with the description of the command in the tables throughout this chapter and in Chapters IV and V.

Table 3-1. *Channel Control Commands*

Command	Description
CH1	Selects channel 1 as active channel.
CH2	Selects channel 2 as active channel.
CH3	Selects channel 3 as active channel.
CH4	Selects channel 4 as active channel.
D13	Selects dual channel display, chans 1 & 3.
D14	Selects quad display, all four channels.
D24	Selects dual channel display, chans 2 & 4.
DSP	Selects single channel of active display.
T13	Selects overlaid dual channel display (one display frame), channels 1 & 3.
T24	Selects overlaid dual channel display (one display frame), channels 2 & 4.

Table 3-2. *Data Entry Termina-*

Code	Terminates in
CMT	Centimeters (cm)
DBL	dB log
DBM	dBm
DEG	Degrees
GHZ	Gigahertz (GHz)
IMU	Imaginary units
KHZ	Kilohertz (kHz)
MHZ	Megahertz (MHz)
MMT	Millimeters (mm)
MTR	Meters (m)
NSC	Nanoseconds (ns)
PSC	Picoseconds (ps)
REU	Real units
USC	Microseconds (µs)
VLT	Volts (V)
XM3	Unitless x 10E-3
XX1	Unitless x 1
XX3	Unitless x 10E+3

3-4 MEASUREMENT CONTROL COMMANDS

The commands listed in Table 3-3 control the parameter being measured on the active channel (S11, S21, S22, and S12) and the basic measurement setup. All commands except S11, S21, S22, and S12 are global; that is, they apply to the entire instrument.

Table 3-3. *Measurement Control Commands (1 of 2)*

Command	Description
AH0	Turns off DUT/AUT protection feature. When on, this featue blanks the RF upon power-up, at reset and initialization, and between recalls from memory and disk.
AH1	Turns on DUT/AUT protection feature (see AH0 above).
BH0	Sets bias off while in hold.
BH1	Sets bias on while in hold.
CTN	Continues sweeping *from* current point.
CWF (value)	Turns CW on and sets CW frequency to a frequency that falls between start and stop frequency. Entry is terminated in GHz, MHz, or kHz.
DA1	Selects a1=Ra as denominator for parameter being defined.
DA2	Selects a2=Rb as denominator for parameter being defined.
DB1	Selects b1=Ta as denominator for parameter being defined.
DB2	Selects b2=Tb as denominator for parameter being defined.
DE1	Selects unity as denominator for parameter being defined.
FHI	Sets data points to maximum.
FLO	Sets data points to minimum.
FME	Sets data points to normal.
HLD	Holds instrument *at* current point.
LA1	Selects a1=Ra as phase lock for parameter being defined.
LA2	Selects a2=Rb as phase lock for parameter being defined.
NA1	Selects a1=Ra as numerator for parameter being defined.
NA2	Selects a2=Rb as numerator for parameter being defined.
NB1	Selects b1=Ta as numerator for parameter being defined.
NB2	Selects b2=Tb as numerator for parameter being defined.
NU1	Selects unity as numerator for parameter being defined.
PW2 (value)	Sets source 2 power level in dBm. Value depends on power range of source. Terminates in DBM, XX1, XX3, XM3.
PWR (value)	Sets source 1 power level in dBm. Value depends on power range of source. Terminates in DBM, XX1, XX3, XM3.
RH0	Sets RF off while in hold
RH1	Sets RF on while in hold
S11	Measures S_{11} on active channel
S12	Measures S_{12} on active channel

Table 3-3. Measurement Control Commands (2 of 2)

Command	Description
S21	Measures S_{21} on active channel
S22	Measures S_{22} on active channel
SA1 (value) SA2 (value)	Sets source attenuator for port 1 or port 2. Values can range from 0 dB to 70 dB. Terminates in DBL, DBM, XX1, XX3, XM3. These commands can only be used with the Models 3620A, 3621A, 3622A, and 3636A Test Sets (i.e., test sets with attenuators). Note that the two source attenuators have ranges of 0 to 70 dB while the test attenuator has a range of 0 to 40 dB.
SRT (value)	Sets start to any frequency between start and stop frequency. Terminates in GHZ, MHZ, KHZ.
STP (value)	Sets stop to any frequency between start and stop frequency. Terminates in GHZ, MHZ, KHZ.
SWP	Places the 360B into a continuous swept mode.
TA1 (value) TA2 (value)	Sets test set test port 1 and test port 2 attenuators. Possible values are from 0 to 100, depending on test set in use. Terminates in DBL, DBM, XX1, XX3, XM3. These commands can only be used with the Models 3620A, 3621A and 3622A Test Sets (i.e., test sets with attenuators). Command TA1 (only) can be used with 3636A test set. Note that the two source attenuators have ranges of 0 to 70 dB while the test attenuator has a range of 0 to 40 dB.
TRS	Restarts the sweep (continuous sweep mode) or triggers a single sweep (in hold mode).
US1-US4	Measures user parameter 1-4 on active channel.
USL (string)	Lets you enter a parameter label string (5 characters max).

3-5 DISPLAY CONTROL COMMANDS

The commands listed in Table 3-4 set up the graph type on the active channel. Most of these commands are straightforward with the exception of SME, ISE, SMC and ISC.

Both the SME and ISE commands require values and terminators to be included with the command (Table 3-4). The allowable values for these commands are 10, 20, and 30.

> *Example:* **"SME 20 DBL"** This code selects a 20 dB expanded Smith chart on the active channel.

Commands SMC and ISC also require values and terminators. Presently, only the value 3 is allowed.

> *Example:* **"SMC 3 DBL"** This code selects a 3 dB compressed Smith chart on the active channel.

Additional considerations for commands SCL and REF are as follows:

SCL Command — This command sets the scaling-per-division characteristics of the graph on the active channel. Notice that for graph types with two types of information, the unitless terminators always apply to the *first* type of information. The first type of information is always displayed on the top graph

> *Example:* **"MPH SCL 10 XX1"** This code will select a log magnitude and phase display on the active channel and set the magnitude scaling to 10 dB/div. The only way to scale the degrees part of the graph is by explicit use of the DEG terminator.

> *Example:* **"MPH SCL 45 DEG"** This code selects a log magnitude and phase display on the active channel and sets the phase scaling to 45 degrees/div.

NOTE

Smith charts and inverted Smith charts can not be scaled using the SCL command—the different charts are selected using the SME, ISE, SMC, and ISC commands.

REF Command — This command selects which graticule line will be considered the "reference." Notice that for graphs with one type of information—such as MAG or PHA—the allowable reference line values are

0 to 8, while for graphs with two types of information the reference line value can only be 0 to 4.

NOTE

As with the SCL command, the unitless terminators apply to the first type of information for graphs with two types of information presented. There is no reference line defined for Smith charts, inverted Smith charts, linear polar, or log polar displays.

Table 3-4. *Display Control Commands (1 of 2)*

Command	Description	Values	Terminators
APR (value)	Sets group delay aperture for display on active channel	0 to 20	XX1, XX3, XM3
ASC	Sets autoscale display for active channel	N/A	N/A
ASP (value)	Sets polar stop sweep position angle	0 to 360 (–360 to +360)	DEG
AST (value)	Sets polar start sweep position angle	0 to 360 (–360 to +360)	DEG
DLA	Selects group delay display for active channel	N/A	N/A
IMG	Selects imaginary display for active channel	N/A	N/A
ISC (value)	Selects inverted compressed Smith chart for active channel	3	DBL, XX1
ISE (value)	Selects inverted expanded Smith chart for active channel	10, 20, 30	DBL, XX1
ISM	Selects normal inverted Smith chart for active channel	N/A	N/A
LIN	Selects linear magnitude display for active channel	N/A	N/A
LPH	Selects linear magnitude and phase display for active channel	N/A	N/A
MAG	Selects log magnitude display for active channel	N/A	N/A
MPH	Selects log magnitude and phase display for active channel	N/A	N/A

Table 3-4. Display Control Commands (2 of 2)

Command	Description	Values	Terminators
OFF (value)	Sets offset for display on active channel. Mag offset: Phase offset: Polar offset: Lin polar offset:	 –999.99 to 999.99 –360 to +360 0 – 999.99 $5E^{-9}$ – 1000.0	Depends on graph type
PCP	Selects measurement phase polar chart mode	N/A	N/A
PCS	Selects sweep position polar chart mode	N/A	N/A
PHA	Selects phase display for active channel	N/A	N/A
PHO (value)	Sets phase offset for display on active channel	0 to 360 (–360 to +360)	Depends on graph type
PLG	Selects log polar display for active channel	N/A	N/A
PLR	Selects linear polar display for active channel	N/A	N/A
REF (value)	Sets reference line for display on active channel. If single graph: If two graphs:	 1–8 1–4	Depends on graph type
REL	Selects real display for active channel	N/A	N/A
RIM	Selects real and imaginary display for active channel	N/A	N/A
SCL (value)	Sets resolution for display on active channel Mag Resolution: Phase resolution: Polar resolution: Lin polar resolution:	 0.001 – 50 0.01 – 90 $1E^{-9}$ – 999.99 200 max	Depends on graph type

3-6 ENHANCEMENT COMMANDS

The commands listed in Table 3-5 control the data enhancement functions of the 360B VNA. These include IF bandwidth, averaging, and smoothing. Note that for the averaging function the maximum averaging number is 4095. For the smoothing function, the maximum smoothing number is 20 (%).

Table 3-5. *Enhancement Commands*

Command	Description	Values	Terminators
AOF	Turns off averaging.	N/A	N/A
AVG (value)	Turns on averaging and sets to value.	1 to 4095	XX1, XX3, XM3
IFM	Selects minimum I.F. bandwidth.	N/A	N/A
IFN	Selects normal I.F. bandwidth.	N/A	N/A
IFR	Selects reduced I.F. bandwidth.	N/A	N/A
SOF	Turns off smoothing.	N/A	N/A

3-7 REFERENCE DELAY COMMANDS

The commands listed in Table 3-6 are used to set up both the reference delay applied to a channel and the relative dielectric constant of the system. Note that commands RDD, RDT, and RDA change the active channel reference delay while commands DIA, DIT, DIP, DIM, and DIE change the system dielectric constant—which is a global change. The command RDA should only be used if at least one valid sweep has been previously completed.

Table 3-6. *Reference Delay Commands*

Command	Description	Values	Terminators
DIA	Selects air as active dielectric	N/A	N/A
DIE (value)	Sets active dielectric to value	1 to 999.999	XX1, XX3, XM3
DIM	Selects microporous teflon as active dielectric (1.69)	N/A	N/A
DIP	Selects polyethylene as active dielectric (2.26)	N/A	N/A
DIT	Selects teflon as active dielectric (2.1)	N/A	N/A
RDA	Sets automatic reference delay calculation	N/A	N/A
RDD (value)	Sets reference delay in distance for active channel	–999.999 to 999.999	MMT, CMT, MTR

3-8 TRACE MEMORY COMMANDS

The commands listed in Table 3-7 control the trace memory function on the active channel and the trace math that can be applied to it. Before using the commands MEM, DTM or DNM to view a display that involves trace memory, or to store trace memory to disk, the data from the selected channel must first be stored to memory using the STD command.

Example: **"WFS STD DIV DNM"**

This example code causes the 360B to:

- Wait a full sweep until data is valid (WFS).
- Store data to memory (STD).
- Select complex division as the trace math (DIV).
- Display the data normalized to memory using this trace math (DNM).

NOTE

The SDK and RCK commands that are used to store and retrieve the active channel trace memory to and from the disk are described in Chapter V.

Table 3-7. *Trace Memory Commands*

Command	Description
ADD	Selects addition as trace math for active channel.
DAT	Displays measurement data on active channel.
DIV	Selects division as trace math for active channel.
DNM	Displays data normalized to trace memory on active channel.
DTM	Displays measurement data and trace memory on active channel.
MEM	Displays trace memory on active channel.
MIN	Selects subtraction as trace math for active channel.
MUL	Selects multiplication as trace math for active channel.
STD	Stores trace to memory.

3-9 MARKER COMMANDS

The commands listed in Table 3-8 control the location and display of the markers and the functions related to the markers. The MK1–MK6 commands are used to set a marker to a desired frequency, time, or distance. The terminator mnemonics used must match the active channel domain (frequency point, time, or distance)—Otherwise, an action-not-possible error will result.

> *Example:* **"MK1 1.0000 NSC"** trying to use this code for a frequency domain channel will generate an "action-not-possible" error.

Markers can be individually turned *off* using the MO1–MO6 commands. These commands remove the specified marker *and the readout* from the screen display.

All markers can be *disabled* using the MOF command. This command removes the marker from the display, but the marker readout remains.

A marker is turned on whenever any of the following conditions occur:

- When the marker is set to a value.
  Example: **"MR2 20 GHZ"**
- When the marker is selected for readout.
  Example: **"MR2"**
- When the marker is selected as the delta reference marker (left).
  Example: **"MK2 4.5632 GHZ".**

The MMN and MMX commands move the active marker to the minimum and maximum trace values on the active channel, respectively. There must be an active marker selected for these command to execute.

> *Example:* **"WFS MR1 MMX M1S"**

The M1S–M6S, M1E–M6E and M1C–M6C command are used to define a marker sweep using the specified marker for either the start, stop, or CW frequency. This code sequence causes the 360B to:

- Wait for a full sweep of data to be present (WFS).
- Turn on marker 1 and select it for readout (MR1).
- Move marker 1 to the maximum value of the trace on the active channel (MMX).
- Set the start frequency equal to the marker frequency (M1S).

Table 3-8. Marker Commands

Command	Description
DR1-DR6	Selects marker 1 - 6 as delta reference marker.
DRF	Turns delta reference mode on.
DRO	Turns delta reference mode off.
M1C-M6C	Sets marker 1-6 sweep CW frequency.
M1E-M6E	Sets marker 1-6 sweep/zoom end frequency, time or distance.
M1S-M6S	Sets marker 1-6 sweep/zoom start frequency, time or distance.
MK1 (value) – MK6 (value)	Turns on marker 1-6 and set to value, which is limited to current sweep/zoom range.
MMN	Sets active marker to minimum trace value
MMX	Sets active marker to maximum trace value
MO1-MO6	Turns off marker 1-6
MOF	Sets Marker display off
MON	Sets Marker display on
MR1-MR6	Sets Read-out frequency at marker 1-6 (through GPIB)

3-10 LIMITS COMMANDS

The Limits Commands listed in Table 3-9:

- ☐ Set up the upper and lower limit values for the active channel.
- ☐ Set the limit delta for the limit frequency readout function. The range of values and allowable terminator mnemonics are dependent on the graph type of the active channel, much like the SCL and REF commands described in paragraph 3-5.

For graph types that display two types of information, the unitless terminators always apply to the *first* type of information. The first type of information is always displayed on the top graph. The second type of limit line value is accessed by explicit use of the appropriate data terminator mnemonic. Examples:

> *Example 1:* **"LUP 20 XX1"** for a log magnitude and phase display: sets the upper limit on the magnitude display to 20 dB.
>
> *Example 2:* **"LUP 45 DEG"** must be used to set the upper limit on the phase graph.

The LFR, LFP, and LFD commands that define limit frequency readouts, are only available on the following graph types: log magnitude (MAG), log magnitude and phase (MPH), phase (PHA), linear magnitude (LIN), linear magnitude and phase (LPH), standing wave ratio (SWR), and group delay (DLA). The active channel must be a frequency domain channel.

The LFP command can be used to select phase limit frequency readouts on log magnitude and phase and linear magnitude and phase graph types. If the LFR command is used for either of these graph types, the magnitude limit frequency readout menu for the channel is displayed.

Table 3-9. *Limits Commands*

Command	Description
LFD (value)	Sets limit frequency read-out delta value. Value and terminator depend on the graph type.
LFP	Selects limit frequency read-out for phase displays
LFR	Selects limit frequency read-out for active channel
LLO (value)	Turns on lower limit and set to value. Value and terminator depend on the graph type.
LOF	Turns limits display off
LON	Turns limits display on
LUP (value)	Turns on upper limit and set to value. Value and terminator depends on the graph type.

3-11 HARD COPY COMMANDS

The commands concerned with hard copy output are listed in Tables 3-10 and 3-11. These commands are straightforward with the exception of commands PT0–PT9. The PT0–PT9 commands are used to:

- Specify the density of tabular data points output to the printer when using the PTB and PMT commands, and
- Specify the number of data points included in the output file used with the TDD command.

The value used with the PT0–PT9 commands specifies the number of points that are *skipped* during printing. Therefore, PT0 selects the *densest* printing mode while PT9 gives the *fewest* number of data points. The HD0 command disables headers and page formatting for tabular printouts. The HD1 command enables headers and page formatting.

The hard copy output commands consist of two categories: *action* and *setup:*

- *Action* commands actually initiate a plot for the subset of the display specified by the setup commands. These commands are described in Table 3-10.
- *Setup* commands are those that specify the desired size and location of the plot and the pen numbers for each element of the plot. These commands are described in Table 3-11 (next page).

The LMS, LID, LDT, and LNM commands require a string of characters to be sent over the GPIB along with the command. A string input to the 360 *must* have the quote characters (“ ”) surrounding the desired characters for the string and *cannot* exceed the maximum number of characters specified for the command. An example of embedding quote characters in a string sent to the 360B is shown in Figure 3-1. This example is written in HP 85 BASIC.

Table 3-10. *Action Commands for Hard Copy Output*

Command	Description
PFS	Prints full screen image
PGR	Prints graph area screen image
PGT	Plots graticule
PLD	Plots data area only
PLH	Plots header
PLM	Plots markers and limits
PLS	Plots entire screen
PLT	Plots data traces only
PMK	Prints tabular data for markers
PMN	Plots menu
PMT	Prints tabular data for traces and markers
PST	Stop print/plot
PTB	Prints tabular data for displayed traces

```
10 ! EXAMPLE OF USE OF STRINGS
20 Q$=CHR$(34) ! QUOTE SYMBOL
30 M$="4_TO_8_FILTR" ! MODEL
40 I$="456789" ! I.D.
50 D$="8/25/87" ! DATE
60 O$="GPIB_WHIZ" ! OPERATOR
70 OUTPUT 706 "LMS"Q$&M$&Q$
80 OUTPUT 706 "LID"&Q$&I$&Q$
90 OUTPUT 706 "LDT"&Q$&D$&Q$
100 OUTPUT 706 "LNM"&Q$&O$&Q$
110 END
```

Figure 3-1. *An Example of Hard Copy Code Using Embedded Quotes*

The TDD and TTB commands enable the user to store tabular data to the disc and recall it for output to the printer with the tabular printout points controlled by commands PT0–PT9. These commands are described in Chapter 5.

Table 3-11. *Setup Commands for Hard Copy Output*

Command	Description	Values	Terminators
DPN (value)	Defines pen number for data.	1 to 8	XX1
FFD	Sends form feed command to printer (also stops print/plot).	N/A	N/A
GPN (value)	Defines pen number for graticule	1 to 8	XX1
HD0	Turns off tabular data headers and page formatting.	N/A	N/A
HD1	Turns on tabular data headers and page formatting.	N/A	N/A
HPN (value)	Defines pen number for header.	1 to 8	XX1
LDT (string)	Defines label string for operator’s name. String may be up to 12 characters in length.	N/A	N/A
LID (string)	Defines label string for device I.D. String may be up to 12 characters in length.	N/A	N/A
LMS (string)	Defines label string for model/serial number. String may be up to 12 characters in length.	N/A	N/A
LNM (string)	Defines label string for operator’s name. String may be up to 12 characters in length.	N/A	N/A
MPN (value)	Defines pen number for markers and limits.	1 to 8	XX1
PBL	Selects quarter-size plot, bottom left corner.	N/A	N/A
PBR	Selects quarter-size plot, bottom right corner	N/A	N/A
PFL	Selects full-size plot.	N/A	N/A
PT0-PT9	Selects tabular printout points skipped, 0-9.	N/A	N/A
PTL	Selects quarter-size plot, top left corner.	N/A	N/A
PTR	Selects quarter-size plot, top right corner.	N/A	N/A
SPD (value)	Defines pen speed percentage.	10 to 100	XX1, XX3, XM3

3-12 SYSTEM STATE COMMANDS

Table 3-12 lists the system state commands. These commands are used to specify CRT display parameters, information display format, and other parameters that control the operation of the system. The function of approximately half of these commands is to display test set connector type information on the system screen.

Table 3-12. System State Commands (1 of 2)

Command	Description	Notes
ACF	Accepts 360B system configuration.	N/A
BC0	Sets CRT blanking on (screen blanked).	Sets display for a totally blank screen. The 360B is fully operational over the GPIB but nothing appears on display. This code is useful for security reasons.
BC1	Sets CRT blanking off (screen active).	Turns off screen blanking.
BLU	Selects blue as “blue” color.	Defines blue as the “blue” display color for markers, limits, and some menu annotations.
CYN	Selects cyan as “blue” color.	Defines cyan as the “blue” display color for markers, limits, and some menu annotations.
DC1	Displays channel 1 and 2 operating parameters.	Displays operating parameters for channels 1 and 2 in screen data area.
DC3	Displays channel 3 and channel 4 operating parameters.	Displays operating parameters for channels 3 and 4 in screen data area.
DCP	Displays calibration parameters.	Displays calibration parameters in the screen data area.
DF2	Displays 2.4 mm female connector information.	N/A
DF3	Displays GPC-3.5 female connector information.	N/A
DFK	Displays K female connector information.	N/A
DFN	Displays TYPE N female connector information.	N/A
DFP	Displays front panel instrument state.	Displays global operating parameters in the data area of the screen.
DFS	Displays SMA female connector information.	N/A
DFT	Displays TNC female connector information.	N/A

Table 3-12. System State Commands (2 of 2)

Command	Description	Notes
DFV	Displays V female connector information.	N/A
DG7	Displays GPC-7 male connector information.	N/A
DGS	Displays GPIB status information.	Displays the GPIB system parameters in the data area of the screen.
DM2	Displays 2.4 mm male connector information.	N/A
DM3	Displays GPC-3.5 male connector information.	N/A
DMK	Displays K male connector information.	N/A
DMN	Displays TYPE N male connector information.	N/A
DMS	Displays SMA male connector information.	N/A
DMT	Displays TNC male connector information.	N/A
DMV	Displays V male connector information.	N/A
DWG	Displays waveguide parameters.	N/A
FOF	Causes frequency information to be blanked.	Instructs the 360B to blank any frequency information from the screen and any hard copy output. This code is useful for security reasons.
FON	Turns on frequency information display.	Frequency information blanking is turned off by this code.
INT	Initialize (format) data-only disk in drive.	See Chapter 5.
RST	Resets 360B to default parameters.	Similiar to pressing the “DEFAULT PROGRAM” key.
RTL	Return to local (front panel) control.	Performs same function as RETURN TO LOCAL key. Has no effect if the 360 is in local lockout mode.
TST	Perform self test	Performs the same error reporting function as performed by the ERROR REPORT selection from the DIAGNOSTICS menu (DG3). Returns a string of 20 zeros if pass, or up to 20 error codes if fail. Refer to error codes in “Error and Status Messages” in the 360B VGA Operation Manual.

3-13 TEST SET MULTIPLEXER CONTROL COMMANDS

Table 3-13 list the test set multiplexer commands. These commands control the 360B Test Set Multiplexer during remote (GPIB) system operation.

Command ACF—Accept 360B System Configuration—is normally used in conjunction with these commands (refer to paragraph 3-12). Commands SFA and SFB are used to control an external A/B RF switch (if used).

NOTE

The 360 Test Set Multiplexer is an option to the 360B VNA. The external A/B RF switch is customer supplied.

Table 3-13. *Test Set Multiplexer Control Commands*

Command	Definition
MP0	Sets non-selected test set standby power off.
MP1	Sets non-selected test set standby power on.
RFA	Sets RF switch to A position.
RFB	Sets RF switch to B position.
SRA	Sets signal source to A.
SRB	Sets signal source to B.
TSA	Sets test set to A.
TSB	Sets test set to B.

3-14 VIDEO SWITCH CONTROL COMMANDS

Table 3-14 list the video output control commands that control the internal 360B video switching paths. These switching paths are shown in Figure 3-2.

The video output control commands perform the same functions as the U7 menu selections. (The U7 menu is invoked from the VIDEO CONFIGURATION selection of the U1 Utility Menu; refer to the 360B Vector Network Analyzer Operation Manual.)

Table 3-14. *Video Output Redirection Control Codes*

Command	Definition
VEE	Connects external video signal to external monitor.
VEI	Connects external video signal to internal screen.
VIE	Connects internal video signal to external monitor.
VII	Connects internal video signal to internal screen.

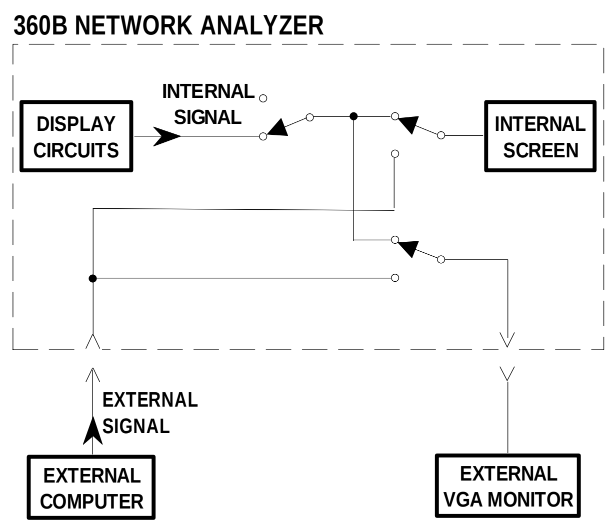

Figure 3-2. *360B VNA Video Signal Paths*

3-15 PULSE SYSTEM COMMAND

The PMC command is the only command used with the 360PS20A Pulsed VNA system. This command provides control of the 3636A Pulsed/CW Test Set pulse modulators by writing a control byte image to the modulator control register of the test set (via the 360B VNA). Refer to the 360PS20A Pulsed/CW Vector Network Analyzer Operation Manual for further information about operation of the 360PS20A Pulsed VNA system and system components.

The bit assignment of the control register byte image is shown in Figure 3-3; note that only the upper nibble (i.e, four most significant bits) are used. (Note that this byte structure is shown in hexadecimal format.) If bit = 1, the corresponding modulator will be turned on full to override the profile pulse. If bit = 0, the profile pulse will control the modulator.

The example code shown below is a program function that turns on all four modulators in the 3636A Test Set. (It is written in Microsoft "C".)

Program Function Example:

```
unsigned char control_byte;
ibwrt(pna, "PMC", 3);            /* send mnemonic to 360B VNA */
control_byte = 0xF0;             /* all modulators Ta, Ra, Tb,
                                    and Rb full on */
ibwrt(pna, &control_byte, 3);    /* send byte to 360B */
```

Rb	Tb	Ra	Ta	0	0	0	0
7	6	5	4	3	2	1	0
Upper Nibble				Lower Nibble			

Figure 3-3. *Pulse System Control Byte Bit Structure*

3-16 NOISE FIGURE SYSTEM COMMANDS

The commands listed in Table 3-15 are used to control the functions of the 3642A Noise Figure Module and to read the status byte from that module. The 3642A Noise Figure Module is part of the 360NF20A Noise Figure Vector Network Analyzer System. Refer to the 360NF20A Noise Figure/Vector Network Analyzer Operation Manual for information about the bit structure and bit functions of the control registers affected by these commands.

Table 3-15. *Noise Figure System Commands*

Command	Description	Values
MC1 (value)	Writes control byte to 3642A Noise Figure Module Primary Control Register.	Binary, 8 bit
MC2 (value)	Writes control byte to 3642A Noise Figure Module Secondary Control Register.	Binary, 8 bit
RSB (value)	Reads Status Register (ID byte.)	Binary, 8 bit

3-17 MILLIMETER-WAVE TEST SET COMMANDS

The commands listed in Table 3-16 control the functions of the 3635A Millimeter Wave Test Set when operated in the GPIB mode.

Table 3-16. *Millimeter-Wave Test Set Commands*

Command	Description
LDM	Loads new modules (must be specified for the band and head changes that are to take place). The mnemonic “LDM” must be specified after band.
E12	Selects E band (60-90 GHz) with WR-12.
P2A	Selects model number 3640 for port 2.
P2B	Selects model number 3641 for port 2.
Q22	Selects Q band (33-50 GHz) with WR-22.
U19	Selects U band (40-60 GHz) with WR-19.
V15	Selects V band (50-75 GHz) with WR-15.

Chapter 4
Calibration Functions

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Chapter 4 Calibration Functions

4-1 INTRODUCTION

This chapter describes the GPIB Product Specific Commands used to perform system calibration functions. In this chapter, these messages are referred to as "360B GPIB commands" or simply "commands". These commands perform the following functions.

- ☐ Specify the calibration method desired.
- ☐ Specify the type of calibration desired.
- ☐ Specify the calibration standards to be used.
- ☐ Specify the transmission line type and associated characteristics.
- ☐ Control the calibration data-taking process.

4-2 DESCRIPTION OF CALIBRATION COMMANDS

Table 4-2 located at the rear of this chapter lists all GPIB commands that are used to perform the 360B VNA calibration function under remote control. This table provides a brief description of the function for each command and lists permissible values and terminators, if required. Programming examples showing typical usage of these commands are provided in paragraphs following the table.

NOTE

The 360B VNA calibration function requires operator intervention. However, it is possible to use the external controller to guide the operator through the calibration process using a suitable program containing the calibration commands described in this chapter.

Major Calibration Commands

The following paragraphs provide detailed descriptions of the major GPIB commands used for calibration. They also provide programming information and techniques for the use of these commands.

NOC — Specify Normal 501 Point Calibration

This command sets up a normal frequency range calibration.

SRT — Enter Start Frequency for Normal Calibration

This command sets the *lower limit* of the range of frequencies used for the calibration process.

STP — Enter Stop Frequency for Normal Calibration

This command sets the *upper limit* of the range of frequencies used for the calibration process.

DFC — Specify Discrete Frequency Calibration

This command sets up a calibration at discrete frequencies only. Only the points entered using the DFQ, IFV, FRS, FRI, FRP, or FIL commands are used in calibration ($2 \le$ number of points ≤ 501) .

The IFV command allows for a frequency list input of calibration frequencies. Refer to paragraph 5-3, Data Transfer Commands, for more details.

The DFQ, FRS, FRI, FRP, FIL, and DFO commands can also be used to specify frequencies outside of calibration. Usage of any of these commands will cause prior calibration data to be lost.

CWC — Specify CW Calibration

This command sets up a *continuous wave* (CW) calibration.

P1C — Set up to Specify Port One Calibration Standards

This command specifies port one as the port to which subsequent connector-related commands will apply.

P2C — Set up to Specify Port Two Standards

This command specifies port two as the port to which subsequent connector-related commands will apply.

Example:

“P1C CFK P2C CMK”

This sequence of commands sets up a female K connector for port 1 (P1C CFK) and a male K connector for port 2 (P2C CMK).

Other Connector Specification (CND)

This command allows a non-standard connector to be specified. This is the same as selecting OTHER from the control panel menu. When specifying the CND command, the connector offset for the open and/or short device and the capacitance coefficients for the open device are entered to characterize the connector.

SLD — Specify Sliding Load for Calibration

This command specifies a sliding load. If specifying the SLD command, the data-taking process for the load includes six slide positions. If any frequencies are below 2 GHz, you *must* use a broadband load.

Required Command Sequence

The program used to control the calibration process *must* follow a specific order for the GPIB calibration commands. Table 4-1 lists this acceptable order.

Other Calibration Related Commands

The following commands are used for special types of calibrations, to invoke options and non-standard calibration procedures, and to simulate a calibration process.

Commands A12, A8T, ARF, AFR, AFT, and ARL

These commands simulate the completion of a calibration. When used in this manner, commands associated with calibration coefficients (IC1–IC9, ICA–ICC, OC1–OC9, OCA–OCC) are matched with the corresponding error terms. For additional information, refer to Chapter V, paragraph 5-3, Data Transfer Commands.

NOTE

The A8T, A12, ARF, AFR, AFT, and ARL commands match up with corresponding calibration type commands. These commands can be used for advanced applications that input calibration coefficients into the 360B (refer to Chapter V, paragraph 5-3).

Commands CON and COF

These commands are not used during calibration. They are used during normal measurements to apply the current calibration (CON) or to turn off any applied calibration (COF).

Commands LM2 and LM3*

These commands are used to select a match for the second or the third device respectively during a LRM type calibration. Example:

```
ibwrt(pna, "LM2", 3);/∗ match as second
        device ∗/
```

Commands MAT and MIX

The MAT (MATched) command changes the measurement sequence for the standard 12 term, coaxial, two-channel calibration so that the "open" measurements are performed in sequence, followed by the "short" measurements. The MIX (MIXed) command returns to the normal sequence for a two-channel 12 term calibration.

Commands TC1 and TC2

Command TC1 takes calibration data for the current (calibration) standard for port 1 using a separate forward measurement sweep. Command TC2 performs the same function for port 2 using a separate (reverse) sweep. (Note that command TCD performs these identical operations, using consecutive forward and reverse measurement sweeps.) Using the TC1 and TC2 commands allows one calibration standard of each type to be used for both ports.

NOTE

When making two port measurements with commands TC1 and TC2, both must be used before the NCS command can be used.

Commands U10, U15, and U25

These commands are used to select 10, 15, or 25 mil UTF calibration kits respectively. These calibration kits are used to perform a 360B calibration for microstrip device measurements. Example:

```
ibwrt(pna, "U10", 3);/∗ select 10 mil
        calibration ∗/
```

* LRM Calibration Method of Rohde & Schwarz, Germany

Table 4-1. Calibration Command Ordering

Order	Item	Typical Commands Used	Req'd/Opt'l
1	Calibration Method	SCM, OCM, LCM	O
2	Line Type	LTC, LTW, LTU	O
3	Waveguide Param's	WK1, WKD, WCO, SH1, SH2	O
3	Calibration Type	C12, C8T, CRF, CFR, CFT, CFL	R
4	Isolation Usage	ISN, ISF	O
5	Data Points	NOC, DFC, TDC, CWG	O
6	Frequency:		
	Range	SRT, STP	O
	Discrete *	DFQ, DFD, IFV, FRS, FRI, FRP, FIL, FRC,	R
	CW	CWF	O
7	Connector Type , and Offset Short Values	P1C, P2C, CMS, CFS, CMK, CFK, CMV, CFV, CMC, CFC, CM2, CF2, CMN, CFN, CM3, CF3, CNG, CND, COO, COS, CC0, CC1, CC2, CC3, SH1, SH2	O
8	Reflection Pairing	MAT, MIX	O
9	Reference Impedance	LLZ	O
10	Load Type	SLD, BBL	O
11	Through Param's	TOL, TDL, TFL, TFE	O
12	LRL Band	LR2, LR3	O
13	LRL Parameters	RM1, RRP, LL1, LL2, LL3, LM2, LM3, BPF	O
14	Microstrip Parameters	U10, U15, U25, USW, SBT, SBD, USE, USZ	O
15	Flat Test Port Calibration **	TP1, TP2. PSP, PTP, PTS, SFC, FP0, FP1	O
16	Begin Calibration (Data Collection)	BEG	R

* Required commands if DEC command previously issued. Command CND must be issued before sending CCO–CC3, and COS.

** May be done as part of regular calibration, or seperately.

A Simple Example Program

The following is an example program to set up a typical calibration sequence for the 360B VNA:

"SCM LTC C12 DFC FRS 1.0 GHZ FRI 100MHZ FRP 41 XX1 FIL DFD P1C CFK P2C CMK BBL BEG"

This example code sets up a calibration using standard calibration mode (SCM), coax cable media (LTC), and 12-term calibration type (C12). A discrete set of points is defined for frequency operation starting at 1 GHz (FRS 1.0 GHZ), spaced 100 MHz apart (FRI 100MHZ), at 41 consecutive points (FRP 41 XX1). This range is confirmed or "filled" (FIL), then completed (DFD).

The Port 1 test port connector is defined as a female type K connector (P1C CFK) and the Port 2 test port connector is defined as a male K type connector (P2C CMK). Broadband loads are selected as the default load type (BBL). The BEG command instructs the 360B to begin the calibration-data-taking-process.

The calibration control program should contain commands to control the data-collection portion of the calibration process. Typical commands used for this process are:

- Take Calibration Data for Current Standard (TCD, or TC1, or TC2)
- Go on to the Next Calibration Step (NCS)
- Averaging On and Set to Value (AVG)
- Averaging Off (AOF)
- Set IF Bandwith to Normal (IFN)
- Set IF Bandwith to Reduced (IFR)
- Set IF Bandwith to Minimum (IFM)
- Any Graph Type Specification or Scaling Change
- Active Channel Specification (CH1–CH4)

The TCD (or TC1, or TC2) and NCS commands control the data-taking process. Commands AVG, AOF, IFN, IFR, and IFM control the data-enhancement function used for a particular measurement (refer to Chapter 3, paragraph 3-6, Enhancement Commands).

Before the TCD (or TC1, or TC2) and NCS commands are invoked in the program, the system operator must be instructed to perform the *exact* steps necessary to setup the calibration sequence for the type of 360B calibration to be used. An example program segment to continue the 12-term calibration started in the previous example is shown in Figure 4-2. This example program segment is in written in HP-BASIC.

The calibration control program should determine if the 360B is ready for the next step of the calibration sequence before prompting the system operator to connect new calibration standards to the test ports. This can be done by monitoring the status of the 360B or by requesting “dummy” data output from the 360B after executing the NCS command.

For example, the commands in the following example instruct the 360B to take calibration data (TCD), go to the next calibration step (NCS), and output the number of points it is measuring (ONP). When the controller is able to read the points string from the 360B, the calibration step is complete.

```
260 OUTPUT 706;"TCD NCS ONP"
270 ENTER 706; N$   ! READ #POINTS WHEN
        STEP IS COMPLETE
280 DISP “CALIBRATION STEP COMPLETE”
```

Flat Test Port Calibration

Signal source power correction data produced during this type of 360B calibration is used to flatten the signal power output from the test set port(s) over a specified frequency range. This feature is used to provide flat test stimulus signals to the device-under-test while performing normal measurements. The Flat Test Port Calibration procedure is described in detail in Application Note AN360B–1, “Flat Test Port Power Correction”. This application note is included as a supplement to the 360B Vector Network Analyzer Operation Manual.

As with the standard 360B calibration procedure, the system operator is guided through a sequence of operations and measurements that make up the flat test port calibration sequence. However, this operating sequence is more complex than for a standard calibration. Therefore, before attempting to write a GPIB controlled program to produce this calibration sequence, first become thoroughly familiar with the manual procedure.

Flat test port calibrations require considerably more time to perform than standard calibrations. The time required is dependant upon the number of points selected; a 501 point one-sweep calibration requires approximately 23 minutes to perform. For these calibrations, the GPIB timeout value must be increased accordingly, or the control program must generate an appropriate time delay before executing subsequent commands.

The commands listed below are used to invoke and control flat test port calibrations. These commands perform functions analogous to those invoked by the menu selection sequence for flat test port calibration that are initiated from the **"TEST SIGNALS"** menu.

Commands TP1 and TP2

Command TP1 selects test port 1 for flat test port calibration. Command TP2 performs the identical function for test port 2.

Command PSP

This command is used to select the number of power measurement sweeps (1 – 5) that are to be performed during the calibration. The external power meter measures the power at each frequency point during each sweep (as described in Application Note 360-13). The data for each frequency point measured are averaged. The more sweeps used, the better the accuracy will be; however, significantly more time will be required.

Command PTP

This command is used to set the power level at the test set port for measurements set up using flat test port calibration. The permissible range of the "value" parameter used with this command is determined by the following factors:

- The flattened test set power level set by the flat test port calibration.
- The signal source attenuator setting (if different from that used during the calibration.)
- The signal source power level adjustment range (as related to the source power setting during calibration).

Example — The following setup conditions yield a permissible value parameter range of −27 dBm to −15 dBm:

Test set power leveled to −10 dBm by the calibration, with the source output set for 0 dBm, and

Signal source attenuator set for (additional) 10 dBm, and

Signal source power level range from −7 dBm to +5 dBm.

Command PTS

This command is used to select the number of frequency points (1 – 50) to be skipped between each measured point on the power measurement sweep. It therefore determines the number of points measured on each sweep (refer to Application Note 360-13).

Command SFC

This command begins the flat test port calibration sequence.

CommandS FP0 and FP1

Command FP1 causes the flat test port power correction data to be used during normal measurement mode. Command FP0 turns off use of this data.

4-3 AN EXAMPLE "C" PROGRAM FUNCTION

An example "C" program function, "cal_12_term()", is shown in Figure 4-1. This program function performs the same 12 term calibration sequence described in the paragraph entitled "A Simple Example Program" (page 4-8). In Figure 4-1, the program function "cal_data()" instructs the 360B to take calibration data (TCD) and advance to the next step (NCS) after determining if the 360B is ready.

An example of a main program that calls this and other "C" subprogram functions is described in application note, AN360-9, which is included behind the Supplements tab in this manual.

```
/*-------------------------------------------------------
                Calibration Function
  Setup for a 12-Term Calibration and prompt the operator
          to install cal devices as required.
 --------------------------------------------------------*/
cal_12_term(vna)
 int vna;
 {
 static char
   a[]="LTC SCM C12 ISN DFC FRS 1 GHZ FRI 100 MHZ FRP 41 XX1",
   b[]="FIL DFD P1C CFK P2C CMK BBL BEG ONP",
   point_str[40];

 printf("\n\t\t\t\tCALIBRATION\n");
 ibwrt(vna,a,sizeof(a));
 ibwrt(vna,b,sizeof(b));
 ibrd(vna,point_str,40);
 printf("\nConnect ISOLATION DEVICES to Port 1 and Port 2:\n");
 cal_data(vna);
 printf("\nConnect BROADBAND LOADS to Port 1 and Port 2:\n");
 cal_data(vna);
 printf("\nConnect OPEN to Port 1 and SHORT to Port 2:\n");
 cal_data(vna);
 printf("\nConnect SHORT to Port 1 and OPEN to Port 2:\n");
 cal_data(vna);
 printf("\nConnect Port 1 to Port 2:\n");
 cal_data(vna);
 printf("\n\t\t      12-Term Calibration Complete\n");
 }
```

Figure 4-1. Example "C" Program Function to Perform a 12 Term Calibration (1 of 2)

```
cal_data(vna)      /* function to take cal data */
 int vna;
 {
 static char
   key,
   c[]="TCD NCS ONP",
   point_str[40];

 printf("\ tPress ENTER key to Take Cal Data\ n");
 while((key = getch())!='\ r');
 printf("Taking Calibration Data...\ n");
 ibwrt(vna,c,sizeof(c));
 ibrd(vna,point_str,40);
 }
```

Figure 4-1. *Example "C" Program Function to Perform a 12 Term Calibration (2 of 2)*

4-4 AN EXAMPLE HP-BASIC SUBPROGRAM

A listing of an example calibration subprogram that is written in HP BASIC is shown in Figure 4-2. This program guides the 360B system operator through a 12 term calibration sequence. The calibration is performed at 41 discrete frequencies with 100 MHz spacing from 1 to 5 GHz (see explanation of line 330 in the paragraph entitled “A Simple Example Program” (page 4-8). In Figure 4-2, the same technique is used as described in the simple example program to determine if the 360B is ready for the next calibration step.

An example of a main program that calls this and other HP-BASIC subprograms is described in the application note, AN360-8, which is included behind the Supplements tab in this manual.

```
290     !---CALIBRATION SUBPROGRAM---
300     !
3l0     SUB Cal_l2_term(@vna)
320     PRINT TABXY(35,1);"CALIBRATION"
330     OUTPUT @vna; "LTC SCM C12 DFC FRS 1 GHZ FRI 100 MHZ
        FRP 41 XXI FIL DFD P1C CFK P2C CMK BBL BEG ONP"
340     ENTER @vna;N$
350     DISP "CONNECT BROADBAND LOADS TO PORT 1 AND PORT 2"
360     GOSUB Continue
370     DISP "CONNECT OPEN TO PORT 1 AND SHORT TO PORT 2"
380     GOSUB Continue
390     DISP "CONNECT SHORT TO PORT 1 AND OPEN TO PORT 2"
400     GOSUB Continue
410     DISP "CONNECT PORT 1 TO PORT 2"
420     GOSUB Continue
430     DISP "l2 TERM CALIBRATION COMPLETE"
440     SUBEXIT
450 Continue: BEEP
460     LOOP
470     ON KEY 5 LABEL "TAKE CAL DATA" GOTO 490
480     END LOOP
490     DISP "TAKING CALIBRATION DATA..."
500     OUTPUT @vna;"TCD NCS ONP"
510     ENTER @vna;N$
520     RETURN
530     SUBEND
540     !
```

Figure 4-2. *Example Program Segment to Control Calibration Data Collection (HP BASIC)*

Table 4-2. Calibration Commands (1 of 6)

360 GPIB Command	Description	Values	Terminators
A8T	Simulate 8-term (1-path) calibration	N/A	N/A
A12	Simulate 12-term calibration	N/A	N/A
AFR	Simulate frequency response calibration	N/A	N/A
AFT	Simulate transmission-only frequency response calibration	N/A	N/A
ARF	Simulate reflection only calibration	N/A	N/A
ARL	Simulate reflection-only frequency response calibration	N/A	N/A
BBL	Select broadband load for calibration	N/A	N/A
BEG	Begin calibration data-collection steps	N/A	N/A
BPF (value)	Break point frequency for 3 line LRL only	START freq. to STOP freq.	GHZ, MHZ, KHZ
C8T	Select 8-term (1-path) calibration	N/A	N/A
C12	Select 12-term calibration	N/A	N/A
CC0 (value) CC3 (value)	Enter capacitance coefficients 0-3 for open for user-specified connector	–9999.99 to +9999.99	XX1
CF2	Select female 2.4 mm connector for current port	N/A	N/A
CF3	Select female GPC-3.5 connector for current port	N/A	N/A
CFC	Select female TNC connector for current port	N/A	N/A
CFK	Select female K connector for current port	N/A	N/A
CFN	Select female Type N connector for current port	N/A	N/A
CFR	Select transmission and reflection frequency response calibration	N/A	N/A
CFS	Select female SMA connector for current port	N/A	N/A

Table 4-2. Calibration Commands (2 of 6)

360 GPIB Command	Description	Values	Terminators
CFT	Select transmission-only frequency response calibration	N/A	N/A
CFV	Select female V connector for current port	N/A	N/A
CM2	Select male 2.4 mm connector for current port	N/A	N/A
CM3	Select male GPC-3.5 connector for current port	N/A	N/A
CMC	Select male TNC connector for current port	N/A	N/A
CMK	Select male K connector for current port	N/A	N/A
CMN	Select male Type N connector for current port	N/A	N/A
CMS	Select male SMA connector for current port	N/A	N/A
CMV	Select male V connector for current port	N/A	N/A
CND	Select user-specified connector for current port	N/A	N/A
CNG	Select GPC-7 connector for current port	N/A	N/A
COF	Turn off vector error correction	N/A	N/A
CON	Turn on vector error correction	N/A	N/A
COO (value)	Enter offset for open for user-specified connector	–999.9999 to +999.9999	MMT, CMT, MTR
COS (value)	Enter offset for short for user-specified connector	–999.999 m to 999.999 m	MMT, CMT, MTR
CRF	Select reflection only calibration	N/A	N/A
CRL	Select reflection-only frequency response calibration	N/A	N/A
CWC	Select CW frequency calibration data points	N/A	N/A
DFC	Select discrete frequency calibration data points	N/A	N/A
DFD	Done specifying discrete frequency ranges	N/A	N/A

Table 4-2. Calibration Commands (3 of 6)

360 GPIB Command	Description	Values	Terminators
DFQ (value)	Enter single discrete frequency	START freq. to STOP freq.	GHZ, MHZ, KHZ
FIL	Fill defined discrete frequency range	N/A	N/A
FP0	Turn flat test port correction data usage off.	N/A	N/A
FP1	Turn flat test port correction data usage on.	N/A	N/A
FRC	Clear all defined discrete frequency ranges	N/A	N/A
FRI (value)	Set discrete frequency fill range increment frequency	START freq. to STOP freq.	GHZ, MHZ, KHZ
FRP (value)	Set discrete frequency fill range number of points	1 to (501 – current number of points)	XX1, XX3, XM3
FRS (value)	Set discrete frequency fill range start frequency	START freq. to STOP freq.	GHZ, MHZ, KHZ
ISF	Exclude isolation	N/A	N/A
ISN	Include isolation	N/A	N/A
KEC	Keep existing calibration data	N/A	N/A
LCM	Select LRL calibration method	N/A	N/A
LL1 (value)	Enter length of line 1 for LRL calibration	0 to +999.9999	MMT, CMT, MTR
LL2 (value)	Enter length of line 2 for LRL calibration	0 to +999.9999	MMT, CMT, MTR
LL3 (value)	Enter length of line 3 for 3 line LRL calibration	0 to +999.9999	MMT, CMT, MTR
LLZ (value)	Enter reference impedance for calibration	0.001 to 1x10E+6	XX1, XX3, XM3
LM2	Select a match for the second device during a LRM type calibration	N/A	N/A
LM3	Select a match for the third device during a LRM type calibration	N/A	N/A

Table 4-2. Calibration Commands (4 of 6)

360 GPIB Command	Description	Values	Terminators
LR2	Specify 2 line LRL	N/A	N/A
LR3	Specify 3 line LRL	N/A	N/A
LTC	Select coaxial transmission line for calibration	N/A	N/A
LTU	Select microstrip transmission line for calibration	N/A	N/A
LTW	Select waveguide transmission line for calibration	N/A	N/A
MAT	Select matched calibration reflection measurement sequence	N/A	N/A
MIX	Select mixed calibration reflection measurement sequence (standard)	N/A	N/A
NCS	Go on to next calibration step	N/A	N/A
NOC	Select normal calibration data points	N/A	N/A
OCM	Select offset short calibration method	N/A	N/A
P1C	Select port 1 for connector specification	N/A	N/A
P2C	Select port 2 for connector specification	N/A	N/A
PSP (value)	Select number of power measurement sweeps for flat test port calibration	1 to 5	XX1
PTP (value)	Set power at test set port (for measurements using flat test port calibration data).	(Refer to text)	DBM
PTS (value)	Select number of frequency points to be skipped during power measurement sweep for flat test port calibration	1 to 50	XX1
RGZ	Select reflective device greater than Z0 (LRL)	N/A	N/A
RLZ	Select reflective device less than Z0 (LRL)	N/A	N/A
RM1	Select reference plane at line 1 midpoint (LRL)	N/A	N/A

Table 4-2. Calibration Commands (5 of 6)

360 GPIB Command	Description	Values	Terminators
ROL (value)	Enter reflective device offset length for LRL calibration	–999.999 to +999.999	MMT, CMT, MTR
RPC	Repeat previous calibration	N/A	N/A
RRP	Select reference plane at reflection plane (LRL)	N/A	N/A
SBD (value)	Enter substrate dielectric for microstrip calibration	1.0 to 9999.99	XX1, XX3, XM3
SBT (value)	Enter substrate thickness for microstrip calibration	0.001 mm to 1.0 m	MMT, CMT, MTR
SCM	Select standard calibration method	N/A	N/A
SFC	Start flat test port calibration sequence	N/A	N/A
SH1 (value)	Set offset short 1 offset length	–999.999 to +999.999	MMT, CMT, MTR
SH2 (value)	Set offset short 2 offset length	–999.999 to +999.999	MMT, CMT, MTR
SLD	Select sliding load for calibration	N/A	N/A
TC1	Take calibration data for current standard on test port 1 (only)	N/A	N/A
TC2	Take calibration data for current standard on test port 2 (only)	N/A	N/A
TCD	Take calibration data for current standard (both test ports)	N/A	N/A
TDC	Select time domain harmonic frequency calibration data points	N/A	N/A
TDL (value)	Through DC coefficient for loss	–999.999 to +999.999	XX1
TFE (value)	Through frequency exponent for loss	–9.999 to +9.999	XX1
TFL (value)	Through frequency coefficient for loss	–999.999 to +999.999	XX1
TOL (value)	Through offset length	–999.9999 to +999.9999	MMT, CMT, MTR

Table 4-2. Calibration Commands (6 of 6)

360 GPIB Command	Description	Values	Terminators
TP1	Select port 1 for flat test port calibration	N/A	N/A
TP2	Select port 2 for flat test port calibration	N/A	N/A
U10	Select 10 mil UTF calibration kit for calibration for microstrip device measurements	N/A	N/A
U15	Select 15 mil UTF calibration kit for calibration for microstrip device measurements	N/A	N/A
U25	Select 25 mil UTF calibration kit for calibration for microstrip device measurements	N/A	N/A
USE (value)	Enter effective dielectric for microstrip calibration	1.0 to 9999.99	XX1, XX3, XM3
USW (value)	Enter microstrip width for microstrip calibration	0.001 mm to 1.0 m	MMT, CMT, MTR
USZ (value)	Enter microstrip impedance for microstrip calibration	1.0 to 9999.99	XX1, XX3, XM3
WCO (value)	Set waveguide cutoff frequency for user-defined kit	0 to current START freq.	GHZ, MHZ, KHZ
WKD	Select user-defined waveguide calibration kit	N/A	N/A
WKI	Select installed waveguide calibration kit	N/A	N/A

Chapter 5 Advanced/Unique Functions

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Chapter 5 Advanced/Unique Functions

5-1 INTRODUCTION

This chapter describes the GPIB Product Specific Commands that produce operations that are unique to the GPIB mode of operation. Example commands included in this group are: Data Transfer commands, Group Execute commands, etc. (see Table of Contents, page 5-1). In this chapter, these messages are referred to as “360B GPIB commands” or simply “commands”.

5-2 SAVE/RECALL COMMANDS

The Save/Recall commands listed in Table 5-1 allow the system user to save and recall:

- Front panel setup data to and from internal memory.
- Calibration and front panel setup data to/from the disk. The syntax for entering a file name string to the 360B is the same as the syntax for the strings in the LMS, LID, LDT and LNM commands described in Chapter 3, paragraph 3-11.

The double quote characters must enclose the string sent to the 360B. The 360B accepts only MS-DOS compatible file name characters. Refer to paragraph 5-5, Disk Function Commands, for more information about file naming conventions.

Table 5-1. *Save/Recall Commands*

Command	Description
SV1-SV4	Saves front panel setup to internal memory, location 1, 2, 3, or 4.
RC1-RC4	Recalls front panel setup data from internal memory, location 1, 2, 3, or 4.

5-3 DATA TRANSFER COMMANDS

Table 5-2, which begins on page 5-6, describes the data transfer commands. The 360B transfers data to and from an external computer via the GPIB in two basic formats: binary and ASCII. All ASCII data values either output by the 360B or expected as input *must* have the following form:

S x x x . y y y y y y y y y y y y y y y E s z z

Where:
S = sign, either blank or “–”
x = digits to the left of the decimal (3)
y = digits to the right of the decimal (15)
E = exponential notation indicator
s = exponent sign, either ’+’ or ’–’
z = digits for exponent (2)
. = decimal point

Separate all ASCII transfers that involve data pairs (such as real and imaginary elements) by commas. For transfers involving more than one item of information, separate each item by a line feed.

For example, the 360B response to the commands "FMA OCD" would be:

```
(Repeated Number of Points) <LF>
<Real ASCII>, <Imaginary ASCII>
EOI on Last Byte
```

Binary data transfers involving numerical values use 32-bit or 64-bit floating point numbers in IEEE-754 format. The format of string data, such as that used for front panel setup data, is not user controllable. Binary data is always sent in the standard block format shown in Figures 5-1 and 5-2.

LSB MODE:

Standard Preamble Bytes		Byte Count		Byte Count Bytes
#	A	Least Significant Byte	Most Significant Byte	Binary Data Least Significant Byte First for All Elements

EOI Coincidental With The Last Byte

MSB MODE:

Standard Preamble Bytes		Byte Count		Byte Count Bytes
#	A	Most Significant Byte	Least Significant Byte	Binary Data Least Significant Byte First for All Elements

EOI Coincidental With The Last Byte

Figure 5-1. *Binary Data Transfer Message Format*

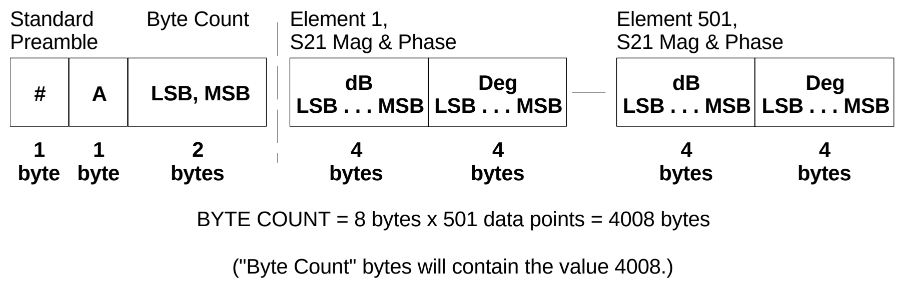


Figure 5-2. *Example of Binary Data Transfer*

The data-format commands (FMA, FMB and FMC) and the byte-ordering commands (LSB and MSB) control the format of the data that is input or output by the 360B under control of many of the data transfer commands (Table 5-2). However, the commands that transfer binary data strings and ASCII data are not affected by the data format and byte-ordering commands. (These commands always input/output binary data strings and ASCII data regardless of the currently selected data format.) Refer to Table 5-2 and Figure 5-2 for details.

The most important points to consider about data transfer are (1) the data format to use and (2) the byte ordering desired. When using the FMA data format, the byte ordering selected by the LSB or MSB commands is irrelevant.

ASCII data is not dependent on the active byte order. However, even if the 360B is using FMA format, some transfers (such as the OS1–OS4 commands) still use the binary transfer format, which is affected by the active byte ordering. Conversely, even if you select FMB or FMC data format, some transfers will always occur in ASCII and are unaffected by the LSB or MSB commands.

NOTE

The byte ordering mode (LSB or MSB) also affects the order of the two bytes that comprise the byte count portion of the standard preamble (Figure 5-1).

Table 5-2. Data Transfer Commands (1 of 2)

Command	Brief Description	Data Format
CCD	Collect corrected data for parameter of active channel	N/A
CFD	Collect final (display format) data for parameter of active channel	N/A
CRD	Collect raw data for parameter of active channel	N/A
FMA	Select ASCII data transfer format	N/A
FMB	Select IEEE-754 64-bit data transfer format	N/A
FMC	Select IEEE-754 32-bit data transfer format	N/A
IC1 (value) – IC9 (value)	Input calibration coefficient 1-9	FMA, FMB, FMC
ICA (value), ICB (value), ICC (value)	Input calibration coefficient A, B, C	FMA, FMB, FMC
ICD (value)	Input corrected data for parameter of active channel	FMA, FMB, FMC
ICF (Binary string)	Input information for front panel setup *and* calibration in binary string format	Binary string
ICL (Binary string)	Input all 12 calibration coefficients in binary string format	Binary string
IFD (value)	Input final (display format) data for parameter of active channel	FMA, FMB, FMC
IFP (Binary string)	Input information for current front panel setup in binary string format	Binary string
IFV (value)	Input frequency list	FMA, FMB, FMC
IS1 (Binary string) – IS4 (Binary string)	Input information for front panel setups in binary string format	Binary string
LSB	Select least significant byte first binary transfers	N/A
MSB	Select most significant byte first binary transfers	N/A
OAP (value)	Output active parameter value (See Figure 5-3)	ASCII
OC1 (value) – OC9 (value)	Output calibration coefficient 1–9	FMA, FMB, FMC

Table 5-2. *Data Transfer Commands (2 of 2)*

Command	Brief Description	Data Format
OCA (value), OCB (value), OCC (value)	Output calibration coefficient A, B, C	FMA, FMB, FMC
OCD (value)	Output corrected data for parameter of active channel	FMA, FMB, FMC
OCF (Binary string)	Output front panel setup *and* calibration information in a binary string format. (See Figure 5-4 and Appendix B).	Binary string
OCL (Binary string)	Output all 12 calibration coefficients in string form	Binary string
OCS	Output collected data	N/A
ODR (Binary string)	Output disk directory (See Figures 5-5 and 5-6).	Binary string
ODV (value)	Output converted distance values for time domain measurements	FMA, FMB
OFD (value)	Output final (disp. format) data for parameter of active channel	FMA, FMB, FMC
OFP (Binary string)	Output information for current front panel setup in binary string format (See Figure 5-7 and Appendix B).	Binary string
OFV (value)	Output measurement frequency values	FMA, FMB
OID (value)	Output instrument identification string	40 byte ASCII string
OKP (value)	Output number of front panel key pressed	ASCII
OM1 (value) – OM6 (value)	Output marker 1-6 value (display format)	ASCII
ONP (value)	Output number of points currently being measured. (See Figure 5-2D).	ASCII
ORD (value)	Output raw data for parameter of active channel	FMA, FMB, FMC
OS1 (Binary string) – OS4 (Binary string)	Ouput information for front panel setups (1–4) in binary string format	Binary string
OTV (value)	Output time values for time domain measurements	FMA, FMB

```
REM oap.bas
     REM
     REM A short program to demonstrate the command:
     REM     OAP - Output Active Parameter
     REM using National Instruments GPIB PCII/IIA and QuickBasic.
     REM
     REM ANRITSU CO, 1993
     REM

     REM $INCLUDE: 'qbdecl.bas'

     CLS
     i$ = SPACE$(60)
     BDNAME$ = "DEV6"
     CALL IBFIND(BDNAME$, BD%)
     CALL IBTMO(BD%, 13)
     PRINT ; "MEASUREMENT IN PROGRESS..."

     WRT$ = "ch1 mr1 mmn oap"
     CALL IBWRT(BD%, WRT$)
     CALL IBRD(BD%, i$)
     PRINT ; "Freq at CH1 trace max = "; FIX(VAL(i$)) / 1E+09; " GHz"

     WRT$ = "cwf 11.123 ghz oap swp"
     CALL IBWRT(BD%, WRT$)
     CALL IBRD(BD%, i$)
     PRINT ; "Actual CW Freq = "; FIX(VAL(i$)) / 1E+09; " GHz"

     WRT$ = "ch1 mk1 19.123 ghz oap"
     CALL IBWRT(BD%, WRT$)
     CALL IBRD(BD%, i$)
     PRINT ; "Actual ch1 marker 1 Freq = "; FIX(VAL(i$)) / 1E+09; " GHz"

     CALL IBLOC(BD%)
     END
```

Figure 5-3. *A BASIC Language Program showing use of "OAP" Command*

```
/* query.c
 *
 * Sample program to access Calibration and Front Panel Setup info
 * from 360
 * using the command: OCF - Output Calibration and Front Panel
 * Setup.
 *
 * Note that this program is 360 SW version specific. To be able to
 * easily
 * update your application to work with a different 360 SW version
 * you must:
 *     1. Follow the example set here when coding your application.
 *     2. Replace the  V402_403  in the  #define VNA_SW_REV  below
 *        to the new SW specific struct name found in the new ocf.h.
 *     3. Recompile your application with the new ocf.h file.
 *
 * ANRITSU Co, 8/1/93
 *
 */

#include <stdio.h>
#include <stdlib.h>
#include <process.h>
#include "decl.h"
#include "ocf.h"

#define VNA_SW_REV       V402_403
#define MAXTRIES         3

void main (void)
{
      int               i, vna, num_tries = 0, gpib_problem;
      float             vna_rev = 0.0f;
      static char       ocf_string[MAXBYTES];
      struct VNA_SW_REV *sys_setup = NULL;

      do  {
            /* init GPIB, read 360 setup string, return to local */
            if ( (vna = ibfind("DEV6")) < 0)
                  {
                  printf("Cannot find 360 at address 6.\n");
                  printf("Aborting program ...\n");
                  exit (1);
                  }
            ibtmo(vna, T1s);
            ibwrt (vna, "ocf", 3);
            ibrd (vna, ocf_string, MAXBYTES);
            ibloc (vna);

            /* assign beginning of vna setup data in ocf string to
               sys_setup */
            sys_setup = (struct VNA_SW_REV *) (ocf_string +
            START_OF_SETUP_DATA);
```

Figure 5-4. *A "C" Language Program showing use of "OCF" Command (1 of 2)*

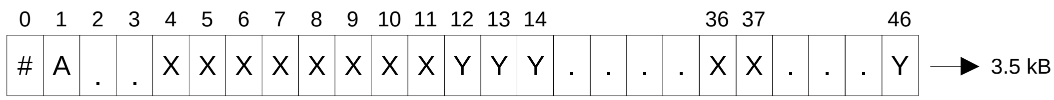
```
/* get vna version string and convert to float */
           vna_rev = (float) atof(sys_setup->pna_sw_rev_buff);
           gpib_problem = (vna_rev < MIN_REV);
     }while (gpib_problem && (num_tries++<MAXTRIES));

     if (gpib_problem)
           {
           printf("Could not output 360 setup info over GPIB.\n");
           printf("Aborting program ...\n");
           exit (1);
           }

     /* now access any desired front panel setup variable defined
        in ocf.h
        Refer to 360 GPIB Manual, OCF Command Binary String for
        info. */

     printf("\n360 SW Version = %5.2f \n", vna_rev);
     printf("\nStart freq = %Lf \n", ((long
     double)(sys_setup->strtswp)) );
     }
```

Figure 5-4. *A "C" Language Program showing use of "OCF" Command (2 of 2)*



XXXXXXXX filename = 8 characters
YYY file extension = 3 characters

Figure 5-5. *ODR Command Byte Structure*

```
/*
 * odr.c
 *
 * A short program to output disk directory from 360B.
 * The "ODR" mneumonic outputs a binary string (3.5
 * Kbytes) that contains DOS style file structures.
 * This program parces that string, extracts the
 * filenames from it, skips the deleted files, then
 * sequentially stacks them in lower part of the
 * array, overwriting the raw string data as it
 * goes. It then diplays the filenames.
 *
 * ANRITSU CO, 8/1/93
 *
 */


#include <stdio.h>
#include <stdlib.h>
#include <process.h>
#include "decl.h"

#define MAXBYTES                3600
#define BEG_OF_FILENAME_OFFSET 4
#define FILE_STRUCT_SIZE        32
#define FILE_NAME_SIZE          12
#define INITVALUE               -2

void main (void)
{
     int         vna = 0, i, j, k, numfiles;
     static char filenames[MAXBYTES];
```

Figure 5-6. *A "C" Language Program showing use of "ODR" Command (1 of 2)*

```
system ("cls");

     /* init 360 */
     printf("\nInitializing GPIB, please wait ...");
     if ( (vna = ibfind("DEV6")) < 0)
          {
          printf("\nGPIB ERROR.");
          printf("\nCould not find 360.");
          exit (1);
          }

     /* init filenames arry */
     for (i=0;i<MAXBYTES;i++)
          filenames[i] = INITVALUE;

     /* read disk directory binary string and take 360 off line */
     printf("\nReading disk directory, please wait ...");
     ibtmo(vna, T10s);
     ibwrt (vna, "odr", 3);
     ibrd (vna, filenames, sizeof(filenames));
     ibloc(vna);
     ibonl(vna, 0);
     /* quit if INITVALUE is still in array meaning ODR output was invalid */

     if (filenames[0] == INITVALUE)
          {
          printf ("\n\nDISK READ ERROR ...");
          printf("\nCould not read disk directory.\n");
          exit(1);
          }

     /* start parsing the array and retrieving non-deleted file names */
     i = BEG_OF_FILENAME_OFFSET;
     j = 0;
     numfiles = 0;
     /* in turn, check each entry and process if not empty */
     while ( (i<MAXBYTES) && (filenames[i] != '÷')
                          && (filenames[i] != '\0') )  {
          /* pull raw file name from arry and stack in lower part of arry */
          for (k=0;k<8;k++)
               filenames[j+k] = filenames[i+k];
          filenames[j+8]= '.';                /* file name separator */
          for (k=9;k<FILE_NAME_SIZE;k++)      /* file name extension */
               filenames[j+k] = filenames[i+k-1];
                                   /* k-1 because raw file name is
                                      stored without a period between
                                      the file name and its extension
                                   */
          i += FILE_STRUCT_SIZE;              /* next file struct */
          filenames[j+FILE_NAME_SIZE]= '\0';  /* make a string of the name */
          if ((filenames[j]) != ' ')          /* file deleted indicator */
               {
               j += FILE_NAME_SIZE+1;
               numfiles++;
               }
}
```

Figure 5-6. *A "C" Language Program showing use of "ODR" Command (2 of 2)*

```
/* timing.c
 *
 * Sample program to demonstrate how to wait for 360 to finish
 * time consuming tasks. It demonstrates the handling and use
 * of the commands:
 *    ONP - Output Number of Points.
 *    OAP - Output Active Parameter.
 *    WFS - Wait for Full Sweep.
 *    STO - Store Calibration File to Internal Disk.
 *    RLD - Recall Calibration File from Internal Disk.
 * and more.
 *
 * Include vnaf.h and compile and link vnaf.c with this program
 * to access the 360 vna library functions.
 *
 * WILTRON Co, 8/1/93
 *
 */

#include <stdio.h>
#include <stdlib.h>
#include "decl.h"
#include "vnaf.h"

void main (void)
{
     int   vna, num_points;
     char  store_cal[80] = "sto \"fname9\"";
     char  recall_cal[80] = "rld \"fname9\"";
     char  cmd3[80] = "avg 512 xx1 wfs mr1 mmn oap";
     char  cmd4[80] = "wfs mr2 mmx oap";
     char  data[80];


     if( (vna = vna_init("DEV6")) == VNAERROR)
          {
          printf("GPIB ERROR");
          printf("Could not establish communication with 360.");
          exit(1);
          }

     printf ("\nResetting ...");
     ibwrt(vna, "rst", 3);
     num_points = vna_wait(vna, T10s);
     if (num_points <= 0)
          {
          printf(" ====== Operation failed ======\n");
          exit(1);
          }
     else
          printf ("\nNum_points = %d", num_points);
     printf ("\nDisplay channels 1 and 3");
     ibwrt(vna, "d13", 3);

     printf ("\nStore cal file fname9.cal");
     ibwrt(vna, store_cal, sizeof(store_cal));
     num_points = vna_wait(vna, T30s);

     printf ("\nSingle channel display");
     ibwrt(vna, "dsp", 3);
```

Figure 5-7. *A “C” Language Program showing use of “ONP” Command (1 of 2)*

```
/* For cmd3 string use ibtmo() directly since the cmd3 string
          already ends with a data transfer command
          (OAP - Output Active Parameter). This will force the
          program to wait for data x-fer handshaking and thus
          work OK. Adjust the timout value (the T100s) for
          greater averages as necessary. T300s is usually OK
          for 1024 averages, T1000s may be needed for extremes
          however. See National Instruments for more details on
          ibtmo() function.
     */
     ibtmo(vna, T100s);
     printf ("\n128 averages, wait full sweep, marker 1 to min,
          \nMarker freq = ");
     ibwrt(vna, cmd3, sizeof(cmd3));
     ibrd(vna, data, sizeof(data));
     printf ("%8.5f GHz", atof(data)/1e+9);
     ibtmo(vna, T10s);       /* reset to default */

     printf ("\nRecall cal file fname9.cal");
     ibwrt(vna, recall_cal, sizeof(recall_cal));
     num_points = vna_wait(vna, T30s);

     ibtmo(vna, T30s);
     printf ("\nWait full sweep, marker 2 to max,\nMarker freq = ");
     ibwrt(vna, cmd4, sizeof(cmd4));
     ibrd(vna, data, sizeof(data));
     printf ("%8.5f GHz\n", atof(data)/1e+9);
     ibtmo(vna, T10s);       /* reset to default */

     vna_off(vna);
}
```

Figure 5-7. *A "C" Language Program showing use of "ONP" Command (2 of 2)*

Table 5-3. *Output Values Vs Vari-*

Display Type	Output Values
Log magnitude	dB, degrees
Phase	dB, degrees
Log mag & phase	dB, degrees
Linear magnitude	Lin Mag (Rho or Tau), degrees
Linear mag & phase	Lin Mag (Rho or Tau), degrees
Smith chart	Ohms, Ohms (r + jx)
Inverted Smith	Siemens, Siemens (g + jb)
Group delay	Seconds, degrees
Log polar	dB, degrees
Linear polar	Lin Mag (Rho or Tau), degrees
Real	Real, imag
Imaginary	Real, imag
Real & Imaginary	Real, imag
SWR	SWR, Degrees

Descriptions of Data Transfer Commands

A detailed description of each of the data transfer commands follows:

OM1 - OM6
These commands output the value of the trace on the active channel at marker 1–6. The output is always a pair of ASCII values and is dependent upon the graph type used for the active channel (See Table 5-3).

OAP
This command outputs the value of the active parameter as a single ASCII value. If there is no active parameter, a zero value is output.

OKP
This command outputs a single ASCII value representing the number of the key pressed on the front panel of the 360B .

OID
This command outputs a 40-byte ASCII string defining the current 360B system configuration. The format of the OID string is shown in Table 5-4.

FMA, FMB, FMC
These commands set up the current active data transfer format.When the current transfer format is unknown, it is a good practice to precede any data transfer commands which depend on these formats with the desired format command.

LSB, MSB
These two commands control the ordering of bytes for floating point data transfers. They also control the ordering of the two bytes that comprise the byte count in the standard block header for binary data transfers. LSB specifies that transfers are to be least significant byte first while MSB specifies most significant byte first.

Table 5-4. *OID Response String*

Number of Bytes					
4	9	9	6	6	6
xxxx Model No.	xx.xxxxxx Low Freq. GHZ	xx.xxxxxx High Freq. GHZ	Sxx.x Low Pwr dBM	Sxx.x High Pwr dBM	xxx.xx S.W. Rev.

IC1-IC9, ICA, ICB, ICC, OCL, ICL, OC1–OC9, OCA, OCB, OCC

These commands provide for calibration coefficient transfers. Table 5-5 shows the ordering of the calibration coefficients for various calibration types. For example, if you desire the ETF error term from an 8-term calibration, you would use the OC4 or IC4 commands.

NOTE

Calibration coefficients are output, or expected as input, only for the currently defined set of sweep frequencies. If data points are not at maximum and/or the frequency range has been zoomed-in (with error correction turned on), not all calibration coefficients will be output or used as input.

If a request is made for an unavailable calibration coefficient array, the 360B treats it as an impossible request and ignores the command.

OFV, IFV

The OFV command outputs the current 360B measurement frequencies. This command can be used to input an arbitrary list of frequencies into the 360B ($2 \leq$ number of frequencies ≤ 501). This code can be used to specify a set of frequencies to used for calibration (after a calibration type has been specified).

Table 5-5. *Calibration Coefficient Ordering, Calibration Type*

Coefficient#	12-Term C12	8-Term C8T	Reflection Only CRF	Frequency Response CFR	Transmission Frequency Response CFT	Reflection Frequency Response CRL
1	EDF	EDF	EDF	ERF	ETF	ERF
2	ESF	ESF	ESF	ETF	–	–
3	ERF	ERF	ERF	–	–	–
4	EXF	EXF	–	–	–	–
5	ELF	ETF	–	–	–	–
6	ETF	–	–	–	–	–
7	EDR	–	–	–	–	–
8	ESR	–	–	–	–	–
9	ERR	–	–	–	–	–
A	EXR	–	–	–	–	–
B	ELR	–	–	–	–	–
C	ETR	–	–	–	–	–

Command IFV can also be used in the normal measurement mode to input frequencies for a special application. In this usage, any existing calibration data is lost.

ODV, OTV
The ODV command outputs the converted distance values that are generated when performing time domain measurements. (Option 2A, High Speed Time (Distance) Domain measurement, is required to perform these measuremts; refer to the 360B Vector Network Analyzer Operation Manual.) The OTV command outputs time values from these measurements.

IFP, IS1–IS4
These commands input a binary string of data as information for stored setups (IS1– IS4), or as information for the current front panel setup (IFP). The data string must be exactly the length of the string output by the OFP or OS1–OS4 commands and is checked for validity before the operation is performed. If either the number of bytes, or the contents of the string are invalid, a *parameter out of range error* is generated.

For the IFP command, if the setup data is valid the 360B will change its setup based on the new front panel setup information.

OFP, OS1–OS4
These commands output a binary string of data from either one of the four stored setups (OS1–OS4) or from the current front panel setup (OFP). The size of a front panel setup is 3 kBytes (3072 bytes).

ODR
This command outputs a binary string that is an image of the directory table of the current disk mounted in the floppy disk drive of the 360B. If a disk error occurs, the 360B does a disk-error-status-update and transfers no data. The data string for the directory is exactly 3.5 kBytes (3584 bytes) long.

ICD, IFD, ORD, OCD, OFD
These commands transfer data for the S-parameter on the active channel. Only the *current* measurement points will be output (ORD, OCD, OFD) or expected as input (ICD, IFD).

The ORD and OCD commands both output data for the parameter on the active channel in pairs (real, imaginary). Similarly, ICD expects corrected data for the parameter on the active channel in pairs.

The OFD command outputs data values for the parameter on the active channel that depend on the current graph type being used (Table 5-3). The IFD command expects the data being input to match the graph type on the active channel in the same way.

When parameter data input to the 360B is complete (ICD and IFD) the 360B redraws the parameter on the active channel using this data. To prevent the newly drawn data from being overwritten by new measurement data the instrument should be in hold prior to inputting the data.

CRD, CCD, CFD, OCS
The CRD, CCD, and CFD commands collect data in the current data format for the parameter on the active channel until either another command is received or data buffer space has been exhausted. The OCS command outputs the collected data.

NOTE
Any command after the CRD, CCD, or CFD commands will terminate the collection mode. This includes GETs defined using the DEF...END commands. Measurement trigger GETs set up by the TIB command are permitted. Error correction must be turned off before executing CRD.

Upon receipt of the CRD, CCD, or CFD command the 360B will:
- ☐ Clear bit 7 of the main status register.
- ☐ Abort any current sweep.
- ☐ Set up for the collection sweep.

When the system is ready to begin a new sweep, bit 7 of the main status register is set. If in CW mode, the 360B phase locks at that frequency before bit 7 of the main status register is set. The number of data points that can be collected is determined by the data format shown in Table 5-6.

Table 5-6. *Maximum Data Points vs Data Format*

Data Format	Maximum Number of Collected Points
FMC (32-bit)	6137
FMB (64-bit)	3068
FMA (ASCII)	983

ICF
This command inputs a binary string of data as information for the current front panel setup and calibration.

OCF
This command outputs the current front panel setup and calibration information in binary string data format.

ONP
This command outputs the number of data points currently being measured by the 360B as a single ASCII value.

Data Transfer Program Example and Program Notes

Data Transfer Example
Figure 5-8 is a listing of an example program written in Microsoft “C”. It uses a number of data transfer commands as well as various commands from Chapter 3. The program is written to run on an IBM-PC or compatible computer with a National Instruments GPIB-PCIIA board and “C” language interface drivers. The functions performed by the example program are:

- Reset the 360B to its default state.
- Read a full array of frequencies from the 360B.
- Input a subset of these frequencies into the 360B.
- Take S21 transmission data.
- Loop this data back into the 360B as error term ETF for a transmission frequency response calibration.

- Turn on correction in the 360B and read in a full corrected sweep of data using this as the error term.
- Print the results on the computer screen.

Data Transfer Program Notes

This program uses a large time-out value (100 seconds). This prevents the controller from quitting while the 360B is busy. For example, after sending **"TRS WFS FMC LSB ORD"** , enough time must be allocated to allow the 360B to complete a new sweep and format the data for output.

- A structure was defined (**struct std_header**) for manipulating the standard block header so that message byte counts are easily accessed.
- All transfers use LSB mode to be compatible with INTEL microprocessors.
- FMB is equivalent to **"double"** in "C", FMC is equivalent to **"float"**.
- Before measurement data is read from the 360B, the controller sends a **"WFS"** command to ensure the data is valid.
- Reads can be terminated by (1) reading the header and then using the byte count value or (2) by specifying a maximum value for the transfer count and letting the transfer terminate when the 360B sets the EOI line signaling the end of information.
- The program defines a structure for the S21 (mag, phase) data pairs output by the 360B for the OFD command. This allows for easy access to each frequency point's two data values using array indexing.
- The AFT command *must* be sent before the IC1 command so that the 360B can discern what calibration coefficient #1 corresponds to **(ETF** in this example).
- It is good practice to preface a data transfer command with a format and byte-order command (ie., **"FMB LSB OFV"**), although both the format and the byte-order carry on to the next transfer.
- A section of a string may be read (such as the header) followed by the remainder of the string. *However the entire data stream must be read before any subsequent data will be available.*

```
#include "stdio.h"
#include "decl.h"
int pna_360, etf_bytes;
unsigned char ans[10];
/*Array for frequencies in 64-bit form */
double freqs[512];
/* Array to hold the raw s21 data to be used as ETF */
unsigned char etfbufr[512*2*4];
/* Array for frequencies in 64-bit form */
struct std_header
 {
   char preambl_1;    /* '#' */
   char preambl_2;    /* 'A' */
   unsigned int msg_count;   /* byte count in message */
 };
struct std_header hedr;
struct data_pair
 {
   float dB;
   float degrees;
 };
struct data_pair s21[512];
main()
 {
   int i, num_pts;
   /* Find the 360 on the bus, assuming it's set for address 6 */
   pna_360 = ibfind("DEV6");
   if(pna_360  0)    /* problem finding a device at address 6 */
      printf("ERROR FINDING DEVICE 6");
   else
    {
      ibtmo(pna_360,T100s);   /* set the timeout at 100 seconds */
      ibwrt(pna_360,"RST FHI",7);
      /* reset to default state, go to high frequency resol. */
      /* Request frequencies in 64-bit floating point format (LSB) */
      ibwrt(pna_360,"FMB LSB OFV",11);
      /* Read in 1st 4 bytes = header: #A */
      ibrd(pna_360,&hedr.preambl_1,4);
      /* Read in rest of data as frequencies */
      ibrd(pna_360,freqs,hedr.msg_count);
      /* byte count in header tells us how much to read */
      /* Input the first 401 frequencies into the 360 */
      ibwrt(pna_360,"FMB LSB IFV",11);
      hedr.msg_count = (401 * 8);   /* each frequency is 8 bytes long */
      ibwrt(pna_360,&hedr.preambl_1,4); /* output 1st 4 bytes = header */
      ibwrt(pna_360,freqs,hedr.msg_count);
      /* output 401 points of frequency information */
      /* 360 is measuring at the inputted frequencies - set up */
      /* for S21 measurement */
      ibwrt(pna_360,"CH1 DSP S21 MPH FHI",19);
      printf("CONNECT THROUGH LINE BETWEEN PORTS.  HIT ENTER WHEN READY\n");
      scanf("%1c",ans);
      /* Get a full sweep of data and then input raw data in 32-bit form into
etfbufr[] */
      ibwrt(pna_360,"TRS WFS FMC LSB ORD",19);
```

Figure 5-8. *A "C" Language Example Program for Data Transfer Using the 360B (1 of 2)*

```
      ibrd(pna_360,etfbufr,512*4*2);  /* read entire string,
INCLUDING HEADER.  Will terminate on EOI */
      etf_bytes = ibcnt;             /* save #bytes read into buffer */
      /* Now we have a full sweep of raw transmission data.  This */
      /* can be used directly as error coefficient ETF for a      */
      /* transmission frequency response calibration.             */
      ibwrt(pna_360,"AFT FMC LSB IC1",15);
      /* "AFT" is used to "fool" the 360 into thinking it has  */
      /* done a trans. frequency response calibration so       */
      /* that cal. coefficient 1 = ETF. Send 360 the IC1 data. */
      ibwrt(pna_360,etfbufr,etf_bytes);
      /* The 360 now has a valid cal. coefficient array - turn */
      /* error correction on & get a full error corrected sweep of data */
      ibwrt(pna_360,"CON WFS FMC LSB OFD",19);
      ibrd(pna_360,&hedr.preambl_1,4);    /* read header, then S21 data */
      ibrd(pna_360,&s21[0].dB,(512*4*2)); /* read in S21 data, let read
terminate on EOI */
      /* Print out frequencies and S21 corrected (dB,degrees) data */
      printf("CORRECTED S21 DATA:\n");
      printf("\n");
      printf("  FREQUENCY         MAGNITUDE        PHASE\n");
      printf("    (Hz)              (dB)          (degrees)\n");
      num_pts = (ibcnt / 8);   /* each point is (dB,degrees) @ 4 bytes each
*/
      for(i=0; i  num_pts; i++)
         printf("%13e:  %13.6f   %13.6f\n", freqs[i], s21[i].dB,
s21[i].degrees);
    }
   return;
 }
```

Figure 5-9. A "C" Language Example Program for Data Transfer Using the 360B (2 of 2)

5-4 GROUP EXECUTE TRIGGER COMMANDS

Table 5-7. *Group Execute Trigger (GET) Commands*

Command	Description
DEF	Begin definition of group execute trigger action
END	End definition of group execute trigger action

The 360B is extremely flexible in its implementation of group execute trigger (GET) functions. The two 360B GPIB commands specifically designated for implementing the *normal* group execute trigger functions are DEF and END (Table 5-7). However, almost all 360B GPIB commands—in any combination—can be set up as part of the DEF—END response to the receipt of a GET (IEEE-488 interface function message) from the external computer.

NOTE

The DEF—END response to the receipt of a GET interface function message is turned-off by the receipt of the TIB command earlier in the program. (The TIB command provides a sweep trigger upon receipt of a GET interface function message—refer to paragraph 5-9.)

The response to the GET interface function message is set up by issuing the DEF command followed by a sequence of commands terminated with the END command. The sequence may be comprised of any sequence of 360B GPIB commands that does not include a data input command. If a data input command is included, the 360B reads the data as additional commands. This usually causes a syntax error to be issued. The entire DEF—END string is pre-parsed and compacted. The maximum compacted string size is 255 characters.

An example of the use of the DEF and END commands is shown in the following command string:

"DEF CFT NOC SRT 1 GHZ STP 18 GHZ BEG TCD NCS MR1 WFS MMX OM1 MMN OM1 END"

When this sequence of commands is sent to the 360B, it is stored as the response to the group execute trigger. The commands between the DEF and END commands will not be executed as part of the normal program flow. The DEF—END sequence will be executed every time the 360B receives a GET interface function message from the external computer *provided* that a TIB command has not been issued earlier in the program. For the example shown above, the 360B will perform the following sequence every time it is triggered by a GET interface function message:

- ☐ Perform a transmission frequency response calibration from 1 to 18 GHz (CFT NOC SRT 1 GHZ STP 18 GHZ BEG TCD NCS).
- ☐ Turn on marker (MR1).
- ☐ Wait for a full sweep of data (WFS).
- ☐ Move marker 1 to the maximum value on the trace (MMX).
- ☐ Output the maximum value (OM1).
- ☐ Move marker 1 to the minimum value on the trace (MMN).
- ☐ Output the minimum value (OM1).

Thus, every time the 360B receives a GET interface function message , it outputs the maximum and minimum values for the new calibration just performed.

NOTE

1. When the 360B is triggered via the GPIB, the 360B puts the trigger command (GET) into the command buffer behind any preceding instructions. The commands in the DEF ... END string are executed upon completion of the commands issued prior to the GET command.

2. When the TIB = GPIB coding method is used for measurement triggering, group execute triggers will not execute the commands in the DEF... END string. The group execute trigger will initiate a measurement. See paragraph 5-9, Sweep Control Commands, for more details.

5-5 DISK FUNCTION COMMANDS

The Disk Function commands listed in Table 5-8 are used for the following:

- ☐ Reading files from the disk.
- ☐ Writing files to the disk.
- ☐ Deleting files.
- ☐ Formatting a data-only disk.

Loading calibration kit information from the disk.

All of the Disk Function commands, except the INT and LKT commands, require a file name string. File name strings can be up to 8 characters long and *must* be enclosed by double quote characters (“); see the descriptions of the LMS, LDT, LID, and LNM commands in Chapter 3, paragraph 3-11. Examples of the disk function commands usage are shown in Figure 5-9.

The TDD and TTB commands enable the user to store tabular data to the disc and recall it for output to the printer with the tabular printout points controlled by commands PT0–PT9 (Commands PT0–PT9 are described in Chapter 3, paragraph 3-11).

CAUTION

The INT command immediately formats the disk loaded in the 360B floppy drive. *Any data on the disk will be destroyed.* Use this command carefully.

NOTE

The maximum file size that can be handled with the RTB command is 58 kbytes.

Only file name characters accepted by MS-DOS are valid for use with these commands. Characters that are *not* acceptable as file names are:

- .—Period/Decimal Point
- ”— Quotation Marks
- /—Slash
- \—Back slash
- **[ ]**—Brackets
- **:**—Colon
- **|** —Pipe
- >—Greater Than
- < —Less Than
- + —Plus sign

Table 5-8. *Disk Functions Commands*

Command	Description	Values
DEC(filename)	Delete calibration and front panel setup file from disk	String up to 8 characters long for file name
DED(filename)	Delete tabular printout data file from disk	String up to 8 characters long for file name
DEN(filename)	Delete trace memory file from disk	String up to 8 characters long for file name
INT	Initialize (format) disk in drive as a data-only disk	N/A
LKT	Load calibration kit information from disk	N/A
RCK(filename)	Recall active channel’s trace memory from disk file	String up to 8 characters long for file name
RLD(filename)	Recall calibration data and front panel setup information from disk file (See Figure 5-3A for example)	String up to 8 characters long for file name
RTB(filename)	Recall tabular data file from disk for output to printer	String up to 8 characters long for file name
SDK(filename)	Store active channel’s trace memory to disk file	String up to 8 characters long for file name
STO(filename)	Store calibration data and front panel setup information to disk file (See Figure 5-10)	String up to 8 characters long for file name
TDD(filename)	Store tabular printout data to ASCII disk file	String up to 8 characters long for file name

- **=** —Equal Sign
- **;** —Semicolon
- **,** —Comma
- And:All ASCII characters with a value lower than the value of the space character (32 decimal).

NOTE

Spaces are acceptable before and after the characters of a command, value or terminator. They are *not* acceptable *between* the characters of these program items.

```
! EXAMPLE 1 - SAVE CAL AND FRONT
! PANEL SETUP TO DISK
Q$ = CHR$(34)    ! DOUBLE QUOTE SYMBOL(")
C$ = "12_TERM"   ! FILE NAME FOR CAL DATA
! STORE TO DISK FILE "12_TERM.CAL"
OUTPUT 706;"STO"&Q$&C$&Q$
! EXAMPLE 2 - SAVE TABULAR DATA
! TO DISK FILE
Q$ = CHR$(34)    ! DOUBLE QUOTE SYMBOL(")
T$ = "S21_THRU"  ! FILE NAME FOR TAB DATA
! STORE TO DISK FILE "S21_THRU.DAT"
OUTPUT 706;"TDD"&Q$&T$&Q$
! EXAMPLE 3 - SAVE TRACE MEMORY
! TO DISK, RECALL IT ON A DIFFERENT
! CHANNEL AND THEN DELETE FILE
OUTPUT 706;"CH1 D13 S11 CH3 S21 FHI WFS"
OUTPUT 706;"CH1 STD" ! STORE TRACE TO MEMORY
Q$ = CHR$(34)    ! DOUBLE QUOTE SYMBOL(")
N$ = "S11TRACE"  ! FILE NAME FOR TRACE DATA
! STORE TO DISK FILE "S11TRACE.NRM"
OUTPUT 706;"SDK"&Q$&N$&Q$
! RECALL SAME DATA ON CHANNEL 3
OUTPUT 706;"CH3 RCK"&Q$&N$&Q$
! DELETE THE TRACE MEMORY FILE
OUTPUT 706;"DEN"&Q$&N$&Q$
```

Figure 5-9. *Disk Function Commands Example*

```
/*
 * sto.c
 *
 * A short program to demonstrate the use of the STO and
 * RLD commands forsaving and recalling calfiles
 * on 360 internal disk.
 *
 * ANRITSU Company, 8/1/93
 *
 */
#include <stdio.h>
#include <stdlib.h>
#include "decl.h"
void main()
{
     int vna=0;
     char dummyS[40];
     static char
          s1[]="STO \"fname\" onp";  /* use STO to store and RLD to recall.
                                        The ONP is used to synchronize the
                                        program with the 360.
                                        The \ is used to pass the " characters */
     if ( (vna = ibfind("dev6")) < 0 )
          {
          printf("Could not find 360 at address 6.");
          exit(1);
          }
     ibwrt(vna,s1,sizeof(s1));
     ibrd(vna, dummyS, 40);     /* dummy read to get ONP output string */
     ibloc(vna);
}
```

Figure 5-10. *A "C" Language Program showing use of "STO" Command*

5-6 SRQ STATUS BYTE STRUCTURE AND COMMANDS

The status of the 360B is defined by primary and secondary status bytes. The structure and contents of these status bytes are described in the following paragraphs.

Primary Status Byte

The bit structure of the primary status byte is shown in Table 5-9. The function of each bit is described below. All bits of the primary status byte are reset whenever a CSB command is received.

Table 5-9. *Primary Status Byte Bit Structure*

Bit Number							
7	6	5	4	3	2	1	0
Ready for Meas.	SRQ	2nd Byte Has Status	Action Not Possible	Out of Range	Syntax Error	Com-plete in Hold	Sweep Com-plete

- **Sweep Complete**. This bit is set when a calibration sweep is completed after the TCD command has been received.
- **Sweep Complete In Hold.** This bit is set when a full sweep is completed in hold after the TRS command has been received.
- **Syntax Error.** This bit is set is set when a syntax error occurs
- **Parameter Out Of Range.** This bit is set when data values are out of the allowable range or the data was found to be invalid.
- **Action Not Possible.** This bit is set when a command can not execute in the current instrument state.
- **2nd Byte Has Status.** This bit is set when a condition represented by a set bit in the Secondary Status Byte is true.
- **SRQ.** The Service Request bit is set during the serial poll response when the 360B is requesting service.
- **Ready for Measurement.** This bit is cleared at the start of both the GPIB measurement trigger command (TIB) and by the data collection commands (CRD, CCD, CFD). The bit is set after a point has been measured subsequent to a GET in the GPIB measurement trigger mode when the instrument is ready for data collection.

Secondary Status Byte

The bit structure of the Secondary Status Byte is shown in Table 5-10. The function of each bit is described below. All bits of the secondary status byte are reset whenever a CSB command is received.

Table 5-10. *Secondary Status Byte Bit Structure*

Bit Number							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Power On	Key Pressed	X*	X	X	Hardware Error	Self Test Fail	Disk Error

- ☐ **Disk Error.** This bit is set when a disk error occurs.
- ☐ **Self Test Failed.** This bit is set true if any portion of the self test fails.
- ☐ **Hardware Error.** This bit is set when there is a problem with the system hardware.
- ☐ **Key Pressed.** This bit is set when a key on the front panel is pressed.
- ☐ **Power On.** This bit is set when the system is first powered on.

Table 5-11 lists the status byte commands. These commands are used to:

- ☐ Output the status of the 360B to the external computer.
- ☐ Input service request enable masks.
- ☐ Clear the primary and secondary status bytes.

Table 5-11. *Status Byte Commands*

Command	Description	Values
CSB	Clear primary and secondary status bytes	N/A
IEM<byte>	Input extended (secondary) status mask	One binary byte
IPM<byte>	Input primary status mask	One binary byte
OEB	Output extended (secondary) status byte	One binary byte
OPB	Output primary status byte	One binary byte
SQ0	Disable service requests	N/A
SQ1	Enable any unmarked service requests	N/A

```
! SET UP SERVICE REQUEST SUBROUTINE AD-
DRESS
ON INTR 7 GOSUB 1000
! ENABLE SRQ CONDITION AS AN INTERRUPT
  ENABLE INTR 7;8
REMOTE 706
! ENABLE SRQ, SYNTAX, PARAM,
! OUT OF RANGE AND ACTION
! NOT POSSIBLE ERRORS = BITS
! 2,3,4 & 6
! MASK = 4+8+16+64 = 92
OUTPUT 706 USING “#,AAA,B”;"IPM",92
1000  ! SRQ SERVICE ROUTINE
1010  STATUS 7,1;A ! READ INTERRUPT
CAUSE REGISTER
1020  R=SPOLL(706)    ! POLL THE 360
1030  IF BIT(R,2)  1 THEN GOTO 1050
1040  DISP “SYNTAX ERROR”
1050  IF BIT(R,3)  1 THEN GOTO 1070
1060  DISP “PARAMETER OUT OF RANGE”
1070  IF BIT(R,4)  1 THEN GOTO 1090
1080  DISP “ACTION NOT POSSIBLE”
1090  ! READ THE PRIMARY STATUS BYTE
1100  OUTPUT 706;"OPB"
1110  ENTER 706 USING “#,B”;B
1120  DISP “PRIMARY STATUS = ”,B
```

Figure 5-11. *Example of Status-Byte-Enable-Mask Setup and Service Request Handling*

In order for the 360B to generate a service request for a particular condition, both the condition bit and the SRQ bit in the Primary Status Byte Mask must be enabled. The binary value of each bit in the byte sent will be:

$$\textit{Bit Value} = 1 - \textit{Status Condition Enabled}$$

When the 360B requests service, the serial poll response byte will show only one *enabled* bit set. The controller can then always tell which enabled condition generated the Service Request (SRQ). This also implies that the primary status byte and the serial poll response byte will not necessarily be equal. Any true bits for conditions not enabled will show up in the serial poll response byte. Figure 5-11 shows a listing of an example program that performs status-byte-enable mask setup for the primary status byte and service request handling operations.

NOTE

Data transfers for the OPB, OEB, IPM and IEM commands involve a single binary data byte. The condition mask byte for the IPM and IEM commands must immediately follow the command.

5-7 TIME DOMAIN COMMANDS

The time domain commands for the 360B are listed below in Table 5-12. Option 2A (High-Speed Time Domain [Distance] Software option) adds these commands to the 360B software.

The time domain commands are used to:

- ☐ Specify the domain of a channel.
- ☐ Set up operating modes and parameters for the selected processing type of the channel.

Table 5-12. *Time Domain Commands (1 of 2)*

Command	Description
DBP	Select distance bandpass mode for active channel
DCA	Select automatic D.C. term calculation for lowpass
DCO	Select open for D.C. term for lowpass
DCS	Select short for D.C. term for lowpass
DCV (value) *	Enter value for D.C. term for lowpass. Values are –1000 MΩ to +1000 MΩ. Terminates in units (XX1, XX3, XM3).
DCZ	Select line impedance for D.C. term for lowpass
DLP	Select distance lowpass mode for active channel
DPI	Select distance phasor impulse mode for active channel
FGT	Select frequency with time gate for active channel
FQD	Select frequency domain for active channel
GCT (value)	Set gate center value.Values are 0.0000 to 999.999 µs and 0.0000 to 999.99 mm. Time values terminate in PSC, NSC, or USC. Distance values terminate in MMT, CMT, or MTR.
GDS	Display gate symbols on active channel
GLS	Select low sidelobe gate shape
GMS	Select minimum sidelobe gate shape
GNM	Select nominal gate shape
GOF	Turn off gating on active channel
GON	Turn on gating on active channel
GRT	Select rectangular gate shape
GSN (value)	Set gate span value. Time values terminate in PSC, NSC, or USC. Distance values terminate in MMT, CMT, or MTR.
GSP (value)	Set gate stop value. Terminates in PSC, NSC, or USC.
GST (value)	Set gate start value. Terminates in PSC, NSC, or USC.
LPI	Select lowpass impulse response
LPS	Select lowpass step response
MRR	Restore original marker range

Table 5-12. Time Domain Commands (2 of 2)

Command	Description
TBP	Select time bandpass mode for active channel
TLP	Select time lowpass mode for active channel
TPI	Select time phasor impulse mode for active channel
WLS	Select low sidelobe window shape
WMS	Select minimum sidelobe window shape
WNM	Select nominal window shape
WRT	Select rectangular window shape
ZCT (value)	Set zoom range center value. Time values terminate in PSC, NSC, or USC. Distance values terminate in MMT, CMT, or MTR.
ZSN (value)	Set zoom range span value. Time values terminate in PSC, NSC, or USC. Distance values terminate in MMT, CMT, or MTR.
ZSP (value)	Set zoom range stop value
ZST (value)	Set zoom range stop value

* Certain time domain codes can only be used with particular processing types or instrument states. For example, “DCV 25 XX1" sets the d.c. term for low pass to 25 ohms. The 360 can only execute this command string if the active channel is in the time domain low pass mode (TLP or DLP) or if a valid lowpass set of frequencies exist for frequency domain (FQD) or frequency gated by time (FGT).

5-8 MULTIPLE SOURCE CONTROL COMMANDS

Table 5-13 lists the multiple source control commands. These commands are used to define up to five different “multiple source control bands”. In each, the device under test (DUT), source 1, source 2, and receiver frequency ranges may be different. The DUT frequency range is entered using any of the frequency entry commands. The MSD command puts the 360B in the DEFINE mode, which allows entry of arbitrary frequencies for the DUT. Band equations for source 1, source 2, and the receiver are then set up using the ED1, ED2, EDR, etc, commands. The band equations used are shown below. In these equations, “F” is the DUT frequency range.

For swept operation:
F = (multiplier/divisor) x (F + offset),

For CW operation: .
F = (multiplier/divisor) x (offset).

For a frequency band to be saved, the band equations must produce frequencies within the operating range of the respective system component.

Figure 5-12 shows an example program using multiple source control commands. This program is for a fixed LO, swept IF mixer measurement. The frequency values used are:

DUT range = 2 – 6 GHz
Source 1 = 2 – 6 GHz = (1/1) X (F + 0)
Source 2 = 500 MHz CW = (1/1) X (500 MHz)
Receiver = 1.5 – 5.5 GHz = (1/1) X (F – 500 MHz)

Table 5-13. Multiple Source Control Commands

Command	Description
BD1 - BD5	Select multiple source control band 1-5. Values are limited to current DUT range.
BSP (value)	Enter band stop frequency for multiple source control. Terminate entry in GHZ, MHZ, or KHZ.
BST (value)	Enter band 1 startup frequency for multiple source control. Terminate entry in GHZ, MHZ, or KHZ.
CLB	Clear all multiple source control band definitions.
ECW	Multiple source control equation in CW mode.
ED1	Edit source 1 multiple source control equation.
ED2	Edit source 2 multiple source control equation.
EDR	Edit receiver multiple source control equation.
EDV (value)	Set multiple source control equation divisor. Values are –199 to –1 or 1 to 199. Terminate entry in XX1, XX3, or XM3.
EML (value)	Set multiple source control equation multiplier. Values are –199 to –1 or 1 to 199. Terminate entry in XX1, XX3, or XM3.
EOS (value)	Set multiple source control equation offset frequency. Values are –999.9999 to 999.9999. Terminate entry in GHZ, MHZ, or KHZ.
ESW	Multiple source control equation in sweep mode
MS0	Multiple source control off
MS1	Multiple source control on
MSD	Multiple source control define model
SVB	Save multiple source control band definition

```
10 ! Multiple Source Control Example
20 OUTPUT 706; "MSD SRT 2 GHZ STP 6 GHZ"
30 OUTPUT 706; "BD1 BSP 6 GHZ"
40 OUTPUT 706; "ED1 ESW EML 1 XX1"
50 OUTPUT 706; "EDV 1 XX1 EOS 0 GHZ"
60 OUTPUT 706; "ED2 ECW EOS 500 MHZ"
70 OUTPUT 706; "EDR ESW EML 1 XX1"
80 OUTPUT 706; "EDV 1 XX1 EOS -500 MHZ"
90 OUTPUT 706; "SVB MS1"
100 END
```

Figure 5-12. *Multiple Source Control Example*

5-9 SWEEP CONTROL COMMANDS

Table 5-14 lists the 360B GPIB commands that allow control of sweep triggering. The TIN, TEX and TIB commands select the measurement trigger source, as follows:

- ☐ Command TIN selects internal triggering;
- ☐ Command TEX selects triggering via the rear-panel input connector;

Command TIB selects triggering via the group execute trigger, GET, which is an IEEE-488 interface function message that is issued by the external computer.

NOTE

The use of the TIB command turns-off the normal DEF—END response to the GET interface function message; refer to paragraph 5-4.

The HC0 command should be used to disable the internal I.F. calibration when external or GPIB triggering is used (so that triggers are not missed while the instrument performs an I.F. calibration). The HC1 command can then be used to enable and initiate an immediate I.F. calibration, when desired.

Table 5-14. *Sweep Control Commands*

Command	Description
HC0	Disable Internal I.F. Calibration
HC1	Enable and Trigger Internal I.F. Calibration
TEX	Select External Measurement Triggering
TIB	Select Measurement Triggering Via Group Execute Trigger
TIN	Select Internal Measurement Triggering

5-10 REAR PANEL OUTPUT CONTROL COMMANDS

Table 5-15 lists the commands for controlling the rear-panel voltage output of the 360B. The RV1 command enables the output and command RV0 disables it. The orientation of the output can be set to either horizontal (RVH), vertical (RVV), or lock direction (RVL).

In the horizontal mode, the voltage output is a digital ramp starting at the voltage start value set by command VST and ending at the voltage stop value set by command VSP. The start value corresponds to the first point of the sweep and the stop value corresponds to last point of the sweep. In the vertical mode, the output voltage is a measure of the instantaneous data point value. The output voltage is related to the scaling of the graph for channel 1. The reference line corresponds to the zero volt value and each graticle line is equal to a ±1 volt value span. The values set by the VST and VSP commands have no effect in the vertical mode.

In the lock direction mode, the start voltage value is output for forward sweeps (lock to Ra). The stop voltage value is output for reverse sweeps (lock to Rb).

The RP0 command is used to set an intermediate voltage value that is output at the rear panel connector. This command can be executed only if the normal rear panel output voltage is disabled.

Table 5-15. *Rear Panel Output Control Commands*

Command	Description
RPO (value)	Set value for direct rear panel voltage. Values are –10.000V to +9.996V. Terminate entry in VLT.
RV0	Disable rear panel output voltage
RV1	Enable rear panel output voltage
RVH	Select horizontal rear output voltage mode
RVL	Select lock direction output voltage mode
RVV	Select verticle rear output voltage mode
VSP (value)	Set stop value for rear panel output voltage. Terminate entry in VLT.
VST (value)	Set start value for rear panel output voltage

5-11 SCREEN DRAW COMMANDS

The commands listed in Table 5-16 control the screen drawn functions of the 360B in the GPIB mode of operation.

Table 5-16. *Screen Draw Commands*

Command	Description
CWP (value)	Enter number of points drawn in CW. Values are 1 – 501. Terminate entry in XX1.
DD0	Turn off data drawing
DD1	Turn on data drawing

5-12 RECEIVER MODE COMMANDS

The commands listed in Table 5-17 control the 360B receiver mode functions in the GPIB mode of operation.

Table 5-17. *Receiver Mode Control Commands*

Command	Description
SDR	Select standard receiver mode
SL0	Select source lock mode with GPIB source control off
SL1	Select source lock mode with GPIB source control on
ST0	Select set on mode with GPIB source control off
ST1	Select set on mode with GPIB source control on
TK0	Select tracking mode with GBIB source control off
TK1	Select tracking mode with GBIB source control on

APPENDIX A
Installation and Configuration Instructions for the National Instruments GPIB-PCII/IIA Card and NI-488 MS-DOS Handler Software

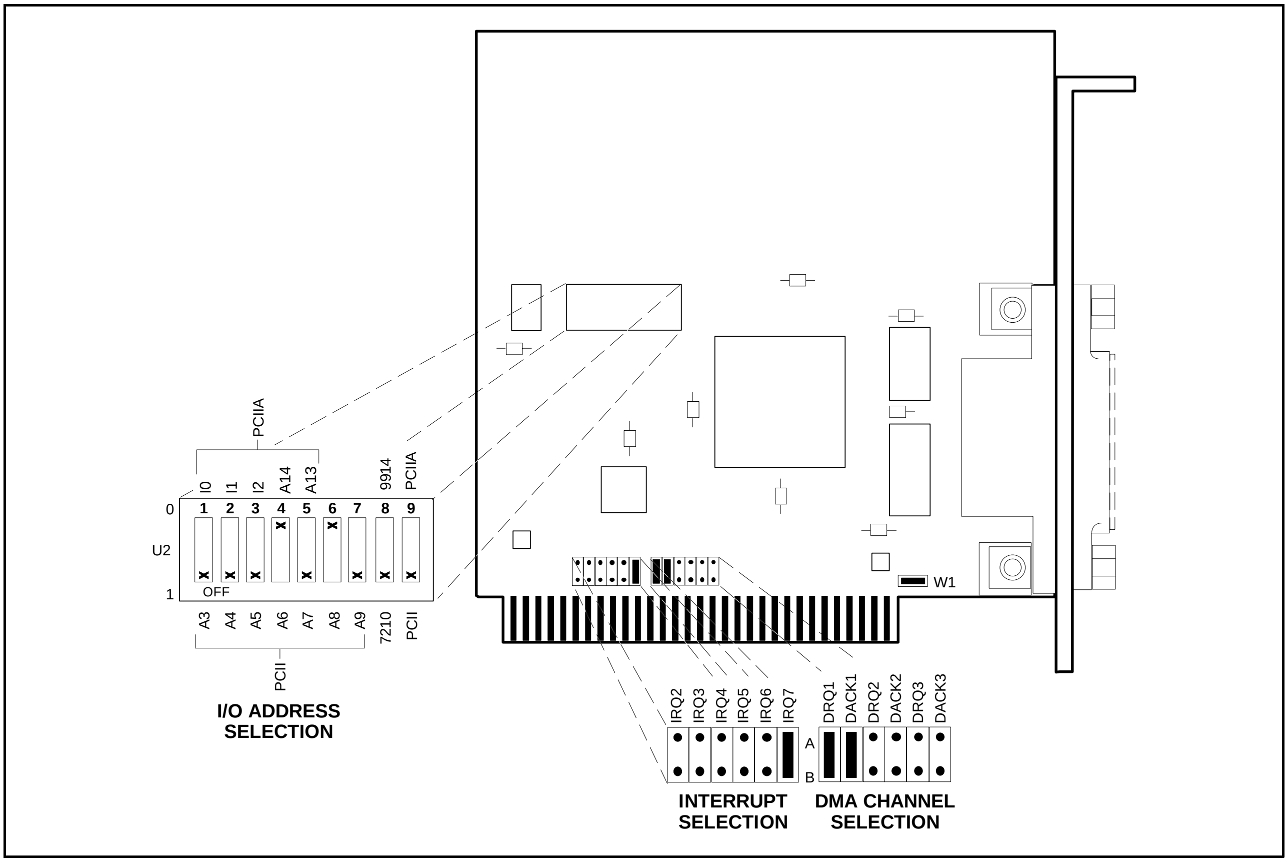


Figure A-1. GPIB-PCII/IIA Hardware Configuration

A-1 INSTALLING THE GPIB-PCII/IIA CARD

The following steps provide detailed instructions for installing the National Instruments GPIB-PCII/IIA Interface Card (P/N 181065-02) into a personal computer.

1. Before installation, set the switches and jumpers on the GPIB-PCII/IIA card as shown in Figure A-1.

2. Turn off the computer and unplug the power cord from the power source.

3. Remove the top cover from the computer and install the GPIB-PCII/IIA card into any unused slot. Install the card with the IEEE-488 connector protruding out of the back panel.

4. Secure the card by fastening the GPIB-PCII/IIA mounting bracket to the back panel rail with a screw, then replace the computer cover.

5. Plug the power cord into the power source and power up (boot) the computer.

A-2 INSTALLING AND CONFIGURING THE NI-488 MS-DOS HANDLER SOFTWARE

The following steps provide detailed instructions for installing the NI-488 MS-DOS Handler software in support of the GPIB-PCII/IIA card and for changing the default software configuration options of the handler.

NOTE

> When installing the MS-DOS Handler software, use ***only*** the National Instruments NI-488 Distribution Disk for GPIB-PCII/PCIIA MS-DOS Handler, P/N 420039-09, Revision C.11. Use of any other versions of the GPIB handler software can cause interfacing problems between the handler and the devices on the bus.

1. Insert the NI-488 Distribution Disk for the GPIB-PCII/IIA MS-DOS Handler into the disk drive. At the DOS prompt:
   Type: A:
   Press: <ENTER> (The A:\DOS prompt will appear.)

2. Run the installation program IBSTART and specify the start up (boot) drive. For example, if C: is the boot drive, at the DOS prompt:
   Type: IBSTART C:
   Press: < ENTER>

3. Follow the instructions on the display. The installation program first copies the files, GPIB.COM and IBCONF.EXE, from the distribution disk to the root directory of the boot drive, then creates the directory GPIB-PC on the boot drive and copies all the files on the distribution disk into this directory. Next the program adds the line, DEVICE = GPIB.COM, to the computer's CONFIG.SYS file so that DOS will load the handler whenever the computer is booted. The program then prompts you to run the hardware diagnostic program (IBDIAG) to insure the GPIB-PCII/IIA card is installed and working properly.

4. Run the software program (IBCONF) to change the default software configuration options of the GPIB handler. At the DOS prompt:
   Type: IBCONF
   Press: <ENTER>

5. Follow the instructions on the display. The program firsts displays a device map for the GPIB card (Figure A-2). Select the GPIB-PCII/IIA Card or device whose parameters you wish to display, then press the function key, F8. Change the configuration of the GPIB-PC-II/IIA card to that shown in Figure A-3 and verify the configuration of the device DEV6 matches Figure A-4.

6. Reboot your computer to install the GPIB handler software and the software configuration changes.

7. Run the software diagnostic program (IBTEST) to verify that the GPIB handler software is installed correctly. To do this, at the DOS prompt:
   Type: CD\ GPIB-PC
   Press: <ENTER>
   Type: IBTEST
   Press: <ENTER>
   If errors are encountered, refer to Appendix B of the GPIB-PC Users Manual, that accompanied your GPIB board, for an explanation of the errors and their solutions.

```
National Instruments   Device Map for Board GPIB0   IBM PC-AT

 GPIB0        * Use cursor control keys to select a device or board.
              * Use function keys below to select desired action.
              * Use PgUp/PgDn to display maps for other boards.

  0 DEV1     0 DEV5     0 DEV9      0 DEV13
  0 DEV2     0 DEV6     0 DEV10     0 DEV14
  0 DEV3     0 DEV7     0 DEV11     0 DEV15
  0 DEV4     0 DEV8     0 DEV12     0 DEV16

F1: Help   F4: Rename   F5: (Dis)connect   F8: Edit   F9: Exit
```

Figure A-2. Device Map for the GPIB-PCII/IIA Card

```
National Instruments   Board Characteristics   IBM PC-AT

Board: GPIB0                          SELECT (use right/left arrow keys):

Primary GPIB Address          ↔ 0     0 to 30
Secondary GPIB Address ........ NONE
Timeout setting ............... T10s
EOS byte ...................... 00H
Terminate Read on EOS ......... no
Set EOI with EOS on Write ..... no
Type of compare on EOS ........ 7-bit
Set EOI w/last byte of Write .. yes
GPIB-PC Model ................. PC2
Board is System Controller .... yes
Local Lockout on all devices .. yes
Disable Auto Serial Polling ... yes
Disable Device Unaddressing ... no
High-speed timing ............. no
Interrupt jumper setting ...... NONE
Base I/O Address .............. 2B8H
DMA channel ................... NONE
Internal Clock Freq (in MHz) .. 8

F1: Help   F2: Explain Field   F6: Reset Value   F9: Return to Map
```

Figure A-3. GPIB-PCII/IIA Card Configuration Parameters

```
National Instruments  ||  Device Characteristics  ||  IBM PC-AT

Device: DEV6          Access: GPIB0   | SELECT (use right/left arrow keys):
                                      |
Primary GPIB Address           ↔ 6    | 0 to 30
Secondary GPIB Address ........ NONE  |
Timeout setting ............... T10s  |
EOS byte ...................... 0AH   |
Terminate Read on EOS ......... no    |
Set EOI with EOS on Write ..... no    |
Type of compare on EOS ........ 7-bit |
Set EOI w/last byte of Write .. yes   |

F1: Help      F2: Explain Field       F6: Reset Value      F9: Return to Map
```

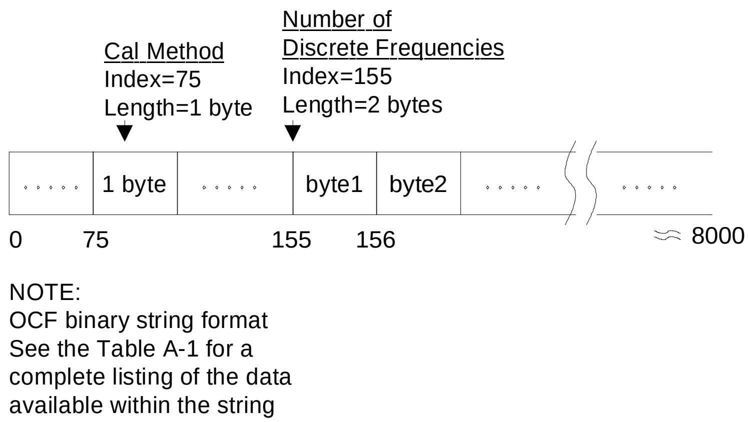
Figure A-4. GPIB Device 6 (360 VNA) Configuration Parameters

APPENDIX B
"OCF" COMMAND BINARY STRING DATA

This appendix contains an index listing (Figure B-1) of the approximately 8 kB string that is returned in response to sending the OCF command. In addition to the index listing, Figure B-2 ("ocf.h"*) provides this information in a header file that should prove helpful to programmers.

Figure B-1 Legend:

Index - Byte position within the OCF string
Length: Number of bytes used
Description: Description of the data
Response: Meaning of the data responses



Graphic description of OCF Data String

* See sample disk "query.c" program and "oct.h" file.

NOTES:
1. This table applies to software versions 4.02/4.03
2. In the response column, FALSE = 00H and TRUE = FFH (or any valu
3. Index and Length column units are in bytes.

Index	Length	Description	Response
		CALIBRATION PARAMETERS	
75	1	Calibration Method	0=Standard, 1=Offset Short, 2=LRL/LRM
76	1	Calibration Line Type	0=Coaxial, 1=Waveguide, 2=Microstrip
77	1	Calibration Sweep Type	0=Normal(501), 1=CW, 2=N-discrete, 3=Time Domain Harmonic
78	1	Calibration Type	0=12-Term, 1=1 Path-2 Port, 2=Refl. Only, 3=Freq. Resp., 4=None
79	1	Include/Exclude Isolation	FALSE=include, TRUE=exclude
80	1	Frequency Response Cal Type	0=transmission, 1=reflection, 2=both
81	1	Load Type	0=sliding, 1=broadband
82	1	Reflection Pairing	0=mixed, 1=matched
83	8	Through Line Offset (m)	value
91	8	dc Coefficient for Through Line Loss	value
99	8	'B' Coefficient (dB/m*Freq^C)	value
107	8	'C' exponent	value
115	8	Coaxial Line Impedance	value
123	8	Calibration Start Frequency (Hz)	value
131	8	Calibration Stop Frequency (Hz)	value
139	8	Calibration CW Frequency (Hz)	value
147	8	Approx. Stop Frequency for Harmonic Sweep (Hz)	value
155	2	Number of Discrete Frequencies	value
614	8	Calibration Source 1 Power	value
622	8	Calibration Source 2 Power	value
630	1	Port 1 Source Attenuator Setting During Cal	Attenuator Value/10
631	1	Port 1 Test Attenuator Setting During Cal	Attenuator Value/10
632	1	Port 2 Source Attenuator Setting During Cal	Attenuator Value/10
633	1	Port 2 Test Attenuator Setting During Cal	Attenuator Value/10
634	1	Flat Power Enabled	0=off, 1=on
635	1	Port 1 Connector Type	0=SMA(M), 1=SMA(F), 2=K(M), 3=K(F) 4=N(M), 5=N(F), 6=GPC-3.5(M), 7=GP(3.5(F), 8=GPC-7, 9=Other, 10=V(M), 11=V(F), 12=TNC(M), 13=TNC(F), 14=2.4mm(M), 15=2.4mm(F)
636		Port 2 Connector Type	0=SMA(M), 1=SMA(F), 2=K(M), 3=K(F) 4=N(M), 5=N(F), 6=GPC-3.5(M), 7=GP(3.5(F), 8=GPC-7, 9=Other, 10=V(M), 11=V(F), 12=TNC(M), 13=TNC(F), 14=2.4mm(M), 15=2.4mm(F)

Figure B-1. "OCF" Command Binary Format, Firmware Version 4.03 (1 of 10)

Index	Length	Description	Response
		MEASUREMENT PARAMETERS	
1093	8	Start Frequency (Hz)	value
1101	8	Stop Frequency (Hz)	value
1110	8	CW Frequency (Hz)	value
1118	1	CW Mode On/Off	0=off, 1=on
1119	8	Source 1 Power (dBm)	value
1127	8	Source 2 Power (dBm)	value
1135	1	Port 1 Source Attenuator Setting (x10 dB)	Attenuator Value/10
1136	1	Port 1 Test Attenuator Setting (x10 dB)	Attenuator Value/10
1137	1	Port 2 Source Attenuator Setting (x10 dB)	Attenuator Value/10
1138	1	Port 2 Test Attenuator Setting (x10 dB)	Attenuator Value/10
1139	1	Data Point Resolution	0=low, 1=medium, 2=high
1140	1	Hold On/Off	0=hold off, 1 = hold on
1141	1	Hold Button Function	0=hold/continue, 1=hold/restart, 2=single sweep/hold
1144	1	Bias Turned On/Off During Hold	during hold
1145	1	RF Turned On/Off During Hold	hold
		FLAT TEST PORT POWER PARAMETERS	
1146	1	Flat Power Correction On/Off	0=off, 1=on
1147	8	Source 1 Power Level (dBm)	value
1155	1	Port 1 Source Attenuator Setting During Cal	Attenuator Value/10
1156	1	Port 1 Test Attenuator Setting During Cal	Attenuator Value/10
1157	1	Port 2 Source Attenuator Setting During Cal	Attenuator Value/10
1158	1	Port 2 Test Attenuator Setting During Cal	Attenuator Value/10
1159	8	Flattened Test Port Power Level (dBm)	value
1167	1	Flat Power Test Port	0=port 1 cal, 1=port 2 cal
1168	1	Number of Power Points Skipped + 1	value+1
1169	8	Number of Power Sweeps	value
		CHANNEL PARAMETERS	
1177	1	Active Channel	0=CH1, 1=CH2, 2=CH3, 3=CH4
1178	1	Channel Display Mode	3=Four Channel
1179	1	Trace Overlay Mode On/Off	FALSE=off, TRUE=on
		DISPLAY PARAMETERS	
1180	1	Channel 1 S-Parameter	0=S21, 1=S11, 2=S12, 3=S22
1181	1	Channel 2 S-Parameter	0=S21, 1=S11, 2=S12, 3=S22
1182	1	Channel 3 S-Parameter	0=S21, 1=S11, 2=S12, 3=S22
1183	1	Channel 4 S-Parameter	0=S21, 1=S11, 2=S12, 3=S22
1184	1	Channel 1 User-Defined On/Off	FALSE=Sxx, TRUE=USERx
1185	1	Channel 2 User-Defined On/Off	FALSE=Sxx, TRUE=USERx
1186	1	Channel 3 User-Defined On/Off	FALSE=Sxx, TRUE=USERx
1187	1	Channel 4 User-Defined On/Off	FALSE=Sxx, TRUE=USERx

Figure B-1. "OCF" Command Binary Format, Firmware Version 4.03 (2 of 10)

Index	Length	Description	Response
1224	2	Channel 1 Graph Type	8=log plr, 9=lin plr,10=log m&p,11=lin m&p,20=phs,40=log m,41=lin m, 80=smith,81=smith10,82=smith20,83 =smith30,84=smith comp,100=inv smith,101=inv smith10,102=inv smith20,103=inv smith30,104=inv smith comp,200=delay,400=r&i,800=imag,1 000=real,2000=swr
1226	2	Channel 2 Graph Type	8=log plr, 9=lin plr,10=log m&p,11=lin m&p,20=phs,40=log m,41=lin m, 80=smith,81=smith10,82=smith20,83 =smith30,84=smith comp,100=inv smith,101=inv smith10,102=inv smith20,103=inv smith30,104=inv smith comp,200=delay,400=r&i,800=imag,1 000=real,2000=swr
1228	2	Channel 3 Graph Type	8=log plr, 9=lin plr,10=log m&p,11=lin m&p,20=phs,40=log m,41=lin m, 80=smith,81=smith10,82=smith20,83 =smith30,84=smith comp,100=inv smith,101=inv smith10,102=inv smith20,103=inv smith30,104=inv smith comp,200=delay,400=r&i,800=imag,1 000=real,2000=swr
1230	2	Channel 4 Graph Type	8=log plr, 9=lin plr,10=log m&p,11=lin m&p,20=phs,40=log m,41=lin m, 80=smith,81=smith10,82=smith20,83 =smith30,84=smith comp,100=inv smith,101=inv smith10,102=inv smith20,103=inv smith30,104=inv smith comp,200=delay,400=r&i,800=imag,1 000=real,2000=swr
1272	1	Group Delay On/Off	FALSE=group delay off, TRUE=group delay on
1273	8	Channel 1 Group Delay Aperature (%)	value
1281	8	Channel 2 Group Delay Aperature (%)	value
1289	8	Channel 3 Group Delay Aperature (%)	value

Figure B-1. "OCF" Command Binary Format, Firmware Version 4.03 (3 of 10)

Index	Length	Description	Response
1297	8	Channel 4 Group Delay Aperature (%)	value
1305	8	Channel 1 Reference Delay Length (m)	value
1313	8	Channel 2 Reference Delay Length (m)	value
1321	8	Channel 3 Reference Delay Length (m)	value
1329	8	Channel 4 Reference Delay Length (m)	value
1337	1	Dielectric Type	3=micorporous teflon, 4=other
1338	8	Other Dielectric Constant	value
1346	1	Channel 1 Normalization	0=view data, 1=view memory, 2=view data&memory, 3=view data normalized with memory, 4=no selection
1347	1	Channel 2 Normalization	0=view data, 1=view memory, 2=view data&memory, 3=view data normalized with memory, 4=no selection
1348	1	Channel 3 Normalization	0=view data, 1=view memory, 2=view data&memory, 3=view data normalized with memory, 4=no selection
1349	1	Channel 4 Normalization	0=view data, 1=view memory, 2=view data&memory, 3=view data normalized with memory, 4=no selection
1350	1	Channel 1 Trace Math	0=add, 1=subtract, 2=multiply, 3=divide
1351	1	Channel 2 Trace Math	0=add, 1=subtract, 2=multiply, 3=divide
1352	1	Channel 3 Trace Math	0=add, 1=subtract, 2=multiply, 3=divide
1353	1	Channel 4 Trace Math	0=add, 1=subtract, 2=multiply, 3=divide
		SCALING PARAMETERS	
1354	8	Channel 1 LOG MAG offset (dB)	value
1362	8	Channel 2 LOG MAG offset (dB)	value
1370	8	Channel 3 LOG MAG offset (dB)	value
1378	8	Channel 4 LOG MAG offset (dB)	value
1386	8	Channel 1 LOG MAG resolution (dB)	value
1394	8	Channel 2 LOG MAG resolution (dB)	value
1402	8	Channel 3 LOG MAG resolution (dB)	value
1410	8	Channel 4 LOG MAG resolution (dB)	value

Figure B-1. "OCF" Command Binary Format, Firmware Version 4.03 (4 of 10)

Index	Length	Description	Response
1418	1	Channel 1 LOG MAG reference line position	value
1419	1	Channel 2 LOG MAG reference line position	value
1420	1	Channel 3 LOG MAG reference line position	value
1421	1	Channel 4 LOG MAG reference line position	value
1422	1	Channel 1 LIN MAG offset (units)	value
1430	1	Channel 2 LIN MAG offset (units)	value
1438	1	Channel 3 LIN MAG offset (units)	value
1446	1	Channel 4 LIN MAG offset (units)	value
1454	8	Channel 1 LIN MAG resolution (units)	value
1462	8	Channel 2 LIN MAG resolution (units)	value
1470	8	Channel 3 LIN MAG resolution (units)	value
1478	8	Channel 4 LIN MAG resolution (units)	value
1486	1	Channel 1 LIN MAG reference line position	value
1487	1	Channel 2 LIN MAG reference line position	value
1488	1	Channel 3 LIN MAG reference line position	value
1489	1	Channel 4 LIN MAG reference line position	value
1490	8	Channel 1 PHASE offset (degrees)	value
1498	8	Channel 2 PHASE offset (degrees)	value
1506	8	Channel 3 PHASE offset (degrees)	value
1514	8	Channel 4 PHASE offset (degrees)	value
1522	8	Channel 1 PHASE resolution (degrees)	value
1530	8	Channel 2 PHASE resolution (degrees)	value
1538	8	Channel 3 PHASE resolution (degrees)	value
1546	8	Channel 4 PHASE resolution (degrees)	value
1554	1	Channel 1 PHASE reference line position	value
1555	1	Channel 2 PHASE reference line position	value
1556	1	Channel 3 PHASE reference line position	value
1557	1	Channel 4 PHASE reference line position	value
1558	8	Channel 1 PHASE shift (degrees)	value
1566	8	Channel 2 PHASE shift (degrees)	value
1574	8	Channel 3 PHASE shift (degrees)	value
1582	8	Channel 4 PHASE shift (degrees)	value
1590	8	Channel 1: LOG POLAR offset (dB)	value
1598	8	Channel 2: LOG POLAR offset (dB)	value
1606	8	Channel 3: LOG POLAR offset (dB)	value
1614	8	Channel 4: LOG POLAR offset (dB)	value
1622	8	Channel 1: LOG POLAR resolution (dB)	value
1630	8	Channel 2: LOG POLAR resolution (dB)	value
1638	8	Channel 3: LOG POLAR resolution (dB)	value
1646	8	Channel 4: LOG POLAR resolution (dB)	value

Figure B-1. "OCF" Command Binary Format, Firmware Version 4.03 (5 of 10)

Index	Length	Description	Response
1654	8	Channel 1: LIN POLAR offset (units)	value
1662	8	Channel 2: LIN POLAR offset (units)	value
1670	8	Channel 3: LIN POLAR offset (units)	value
1678	8	Channel 4: LIN POLAR offset (units)	value
1686	8	Channel 1: LIN POLAR resolution (units)	value
1694	8	Channel 2: LIN POLAR resolution (units)	value
1702	8	Channel 3: LIN POLAR resolution (units)	value
1710	8	Channel 4: LIN POLAR resolution (units)	value
1718	8	Channel 1: GROUP DELAY offset	value
1726	8	Channel 2: GROUP DELAY offset	value
1734	8	Channel 3: GROUP DELAY offset	value
1742	8	Channel 4: GROUP DELAY offset	value
1750	8	Channel 1: GROUP DELAY resolution	value
1758	8	Channel 2: GROUP DELAY resolution	value
1766	8	Channel 3: GROUP DELAY resolution	value
1774	8	Channel 4: GROUP DELAY resolution	value
1782	1	Channel 1: GROUP DELAY reference line positi	value
1783	1	Channel 2: GROUP DELAY reference line positi	value
1784	1	Channel 3: GROUP DELAY reference line positi	value
1785	1	Channel 4: GROUP DELAY reference line positi	value
1786	8	Channel 1: REAL offset	value
1794	8	Channel 2: REAL offset	value
1802	8	Channel 3: REAL offset	value
1810	8	Channel 4: REAL offset	value
1818	8	Channel 1: REAL resolution	value
1826	8	Channel 2: REAL resolution	value
1834	8	Channel 3: REAL resolution	value
1842	8	Channel 4: REAL resolution	value
1850	1	Channel 1: REAL reference line position	value
1851	1	Channel 2: REAL reference line position	value
1852	1	Channel 3: REAL reference line position	value
1853	1	Channel 4: REAL reference line position	value
1854	8	Channel 1: IMAGINARY offset	value
1862	8	Channel 2: IMAGINARY offset	value
1870	8	Channel 3: IMAGINARY offset	value
1878	8	Channel 4: IMAGINARY offset	value
1886	8	Channel 1: IMAGINARY resolution	value
1894	8	Channel 2: IMAGINARY resolution	value
1902	8	Channel 3: IMAGINARY resolution	value
1910	8	Channel 4: IMAGINARY resolution	value
1918	1	Channel 1: IMAGINARY reference line position	value

Figure B-1. "OCF" Command Binary Format, Firmware Version 4.03 (6 of 10)

Index	Length	Description	Response
1919	1	Channel 2: IMAGINARY reference line position	value
1920	1	Channel 3: IMAGINARY reference line position	value
1921	1	Channel 4: IMAGINARY reference line position	value
1922	8	Channel 1: SWR offset	value
1930	8	Channel 2: SWR offset	value
1938	8	Channel 3: SWR offset	value
1946	8	Channel 4: SWR offset	value
1954	8	Channel 1: SWR resolution	value
1962	8	Channel 2: SWR resolution	value
1970	8	Channel 3: SWR resolution	value
1978	8	Channel 4: SWR resolution	value
1986	1	Channel 1: SWR reference line position	value
1987	1	Channel 2: SWR reference line position	value
1988	1	Channel 3: SWR reference line position	value
1989	1	Channel 4: SWR reference line position	value
1998	1	Channel 1: SMITH CHART scaling	0=Normal, 1=10 dB, 2=20dB, 3=30 dB, 4=Compressed
1999	1	Channel 2: SMITH CHART scaling	0=Normal, 1=10 dB, 2=20dB, 3=30 dB, 4=Compressed
2000	1	Channel 3: SMITH CHART scaling	0=Normal, 1=10 dB, 2=20dB, 3=30 dB, 4=Compressed
2001	1	Channel 4: SMITH CHART scaling	0=Normal, 1=10 dB, 2=20dB, 3=30 dB, 4=Compressed
2002	1	Channel 1: ADMITTANCE CHART scaling	0=Normal, 1=10 dB, 2=20dB, 3=30 dB, 4=Compressed
2003	1	Channel 2: ADMITTANCE CHART scaling	0=Normal, 1=10 dB, 2=20dB, 3=30 dB, 4=Compressed
2004	1	Channel 3: ADMITTANCE CHART scaling	0=Normal, 1=10 dB, 2=20dB, 3=30 dB, 4=Compressed
2005	1	Channel 4: ADMITTANCE CHART scaling	0=Normal, 1=10 dB, 2=20dB, 3=30 dB, 4=Compressed
2006	1	Polar Chart Mode	0=polar meas(mag,phase), 1=polar position (mag, sweep position)
2007	8	Start Angle for Polar Position Chart (degrees)	value
2015	8	Stop Angle for Polar Position Chart (degrees)	value
ENHANCEMENT PARAMETERS			
2023	1	Averaging On/Off	FALSE=Off, TRUE=On
2024	8	Averaging Factor	value

Figure B-1. “OCF” Command Binary Format, Firmware Version 4.03 (7 of 10)

Index	Length	Description	Response
2032	1	Smoothing On/Off	FALSE=Off, TRUE=On
2033	8	Smoothing Factor (% of span)	value
2041	1	IF Bandwidth	0=10 kHz (Normal), 1=1 kHz (Reduced), 2=100 Hz (Minimum)
		DUAL SOURCE MODE PARAMETERS	
2042	1	Dual Source Mode	0=Off, 1=Define, 2=On
2043	1	Number of Bands Defined	0=None, 1-5
		SWEEP OPTION PARAMETERS	
2499	1	Data Drawing On/Off	FALSE = Off, TRUE = On
2500	2	Number of CW DRAW Data Points	value
2502	1	Trigger Source	0=internal, 1=external w/I.F. Cal, 2=external w/o I.F. Cal, 3=GPIB
		REAR PANEL OUTPUT PARAMETERS	
2503	1	Rear Panel Output On/Off	0=horizontal, 1=vertical, 2=phase lock
2504	1	Rear Panel Output Mode	value
2505	8	Start or Phase Lock (a1) Voltage	value
2513	8	Stop or Phase Lock (a2) Voltage	value
		MARKER PARAMETERS	
2521	1	Marker Display On/Off	FALSE=Off, TRUE=On
2522	1	Marker 1 On/Off	FALSE=Off, TRUE=On
2523	1	Marker 2 On/Off	FALSE=Off, TRUE=On
2524	1	Marker 3 On/Off	FALSE=Off, TRUE=On
2525	1	Marker 4 On/Off	FALSE=Off, TRUE=On
2526	1	Marker 5 On/Off	FALSE=Off, TRUE=On
2527	1	Marker 6 On/Off	FALSE=Off, TRUE=On
2528	8	Marker 1 Frequency Value (Hz)	value
2536	8	Marker 2 Frequency Value (Hz)	value
2544	8	Marker 3 Frequency Value (Hz)	value
2552	8	Marker 4 Frequency Value (Hz)	value
2560	8	Marker 5 Frequency Value (Hz)	value
2568	8	Marker 6 Frequency Value (Hz)	value
2576	8	Marker 1 CW Point Value	value
2584	8	Marker 2 CW Point Value	value
2592	8	Marker 3 CW Point Value	value
2600	8	Marker 4 CW Point Value	value
2608	8	Marker 5 CW Point Value	value
2616	8	Marker 6 CW Point Value	value
2624	8	Time Domain Marker 1 Value (sec.)	value
2632	8	Time Domain Marker 2 Value (sec.)	value
2640	8	Time Domain Marker 3 Value (sec.)	value

Figure B-1. "OCF" Command Binary Format, Firmware Version 4.03 (8 of 10)

Index	Length	Description	Response
2648	8	Time Domain Marker 4 Value (sec.)	value
2656	8	Time Domain Marker 5 Value (sec.)	value
2664	8	Time Domain Marker 6 Value (sec.)	value
2720	1	Active Marker	0=MKR 1, 1=MKR 2, 2=MKR 3, 3=MKR 4, 4=MKR 5, 5=MKR 6
2721	1	Delta Reference Mode On/Off	FALSE=Off, TRUE=On
2722	1	Marker Display Mode	0=MKR 1 Delta Ref, 1=MKR 2 Delta Ref, 2=MKR 3 Delta Ref, 3=MKR 4 Delta Ref, 4=MKR 5 Delta Ref, 5=MKR 6 Delat Ref
		LIMIT PARAMETERS	
2723	1	Channel 1 Limits On/Off	FALSE=Off, TRUE=On
2724	1	Channel 2 Limits On/Off	FALSE=Off, TRUE=On
2725	1	Channel 3 Limits On/Off	FALSE=Off, TRUE=On
2726	1	Channel 4 Limits On/Off	FALSE=Off, TRUE=On
		VIDEO DISPLAY PARAMETERS	
3379	1	Frequency Blanking On/Off	FALSE=Off, TRUE=On
3380	1	Alternate Blue (Cyan) On/Off	FALSE=Off, TRUE=On
3381	1	Display On/Off	FALSE=Off, TRUE=On
3382	1	Internal CRT Display Connection	0=Internal Signal, 1=VGA IN Externa Signal
3383	1	Rear Panel VGA OUT Connection	0=Internal Signal, 1=VGA IN Externa Signal
		OUTPUT PARAMETERS	
3384	1	Output Device	0=Printer, 1=Plotter
3385	1	Printed Output Format	0=Full Screen, 1=Graph Only, 2=Tabular Data
3386	1	Number of Points Skipped+1 on Tabular Data C	value+1
3389	16	MODEL String	string
3405	16	DEVICE ID String	string
3421	16	DATE String	string
3437	16	OPERATOR String	string
3453	1	Type of Plot	BITWISE: 1=header, 2=menu, 4=Markers/Limits, 8=Graticule, 10=Data Trace(s)
3454	1	Plot Location	0=full size, 1=upper left, 2=upper right, 3=lower left, 4=lower right
3455	1	Assigned Data Pen	value
3456	1	Assigned Overlay Data Pen	value

Figure B-1. "OCF" Command Binary Format, Firmware Version 4.03 (9 of 10)

Index	Length	Description	Response
3457	1	Assigned Graticule Pen	value
3458	1	Assigned Markers/Limits Pen	value
3459	1	Assigned Header Data Pen	value
3460	1	Pen Speed (%)	value (10-100)
		TIME DOMAIN PARAMETERS	
3468	1	Channel 1 Domain Mode	
3469	1	Channel 2 Domain Mode	
3470	1	Channel 3 Domain Mode	
3471	1	Channel 4 Domain Mode	
3472	8	Start Time	
3480	8	Stop Time	
3504	1	Window Type	
3505	8	Gate Start Time	
3513	8	Gate Stop Time	
3521	1	Gate Type	
3522	1	Channel 1 Gate Mode	
3523	1	Channel 2 Gate Mode	
3524	1	Channel 3 Gate Mode	
3525	1	Channel 4 Gate Mode	
3526	1	dc Term Exptrapolation Type	
3527	8	dc Term for "Other" Extrapolation Type	

Figure B-1. "OCF" Command Binary Format, Firmware Version 4.03 (10 of 10)

```
/* ocf.h
 *
 * Struct and variable defs for use with the 360 system setup string
 * output by the command: OCF - Output Calibration and Front Panel Setup.
 *
 * Include this file with your application.
 *
 * WILTRON Co, 8/1/93, v1.03:
 *    Supports: 360B versions 4.02 and 4.03 ONLY.
 *
 * See query.c for a recommended example program that uses this file.
 *
 ***************************************************************************
 * Refer to and use the 360 setup variables defined below in:              *
 *    struct V402_403                                                        *
 * See 360 GPIB Manual, OCF Command Binary String Description.              *
 * The string desc is divided into groups that match the struct definition.*
 * Variable sizes used in the struct def below on an intel machine:        *
 *    double = 8 bytes                                                       *
 *    int    = 2 bytes                                                       *
 *    char   = 1 byte                                                        *
 ***************************************************************************
 *                                                                           *
 *                   DO NOT ALTER ANYTHING IN THIS FILE.                     *
 *                                                                           *
 ***************************************************************************
 */

#define MIN_REV              (4.02f)
#define START_OF_SETUP_DATA   4
#define MAXBYTES              9000

struct multi_src_band_3p02
{
      double strt_band;
      double stop_band;
      char src1_cw;
      double src1_mult;
      double src1_div;
      double src1_offset;
      char src2_cw;
      double src2_mult;
      double src2_div;
      double src2_offset;
      char rcvr_cw;
      double rcvr_mult;
      double rcvr_div;
      double rcvr_offset;
};

struct param_defn_3p00
{
      char phs_lock;
      char numer;
      char denom;
      char lbl1;
      char lbl2;
      char lbl3;
      char lbl4;
      char lbl5;
      char lbl6;
};

struct V402_403              /** version 04.02/04.03 **/
{
       unsigned int check_sum;
```

Figure B-2. A "C" language header file for use with the "query.c" program (1 of 7)

```
/* * * * * * * * < < 04.02/04.03 System status buffers > > * * * * * * * */
       char pna_sw_rev_buff[10];
       char multiplexer_id_buff;
       char mux_testset_a_buff;
       char mux_source_a_buff;
       char mux_rf_switch_a_buff;
       char non_slct_tst_pwr_off_buff;
       char test_set_buff;
       char ts_module_id;
       char mmwave_band_buff;
       char mmwave_p1_head_buff;
       char mmwave_p2_head_buff;
       double tst_set_lowf_buff;
       double tst_set_highf_buff;
       char source_mod_buff[10];
       char src_sw_rev_buff[5];
       char source_2_mod_buff[10];
       char src2_sw_rev_buff[5];
       char rcvr_type_buff;
       char user_rcvr_mode_buff;
       char user_src_gpib_ctrl_buff;

/* * * * * * * * < < 04.02/04.03 Calibration  parameters > > * * * * * * * * */

       char cal_method;
       char line_type;
       char cal_pts;
       char caltype;
       char omit_isolation;
       char freqresp_type;
       char loadtype;
       char refl_pair;
       double thru_offset;
       double thru_loss_dc;
       double thru_loss_freq;
       double thru_loss_freq_exp;
       double zcoax_imped;
       double calstrtf;
       double calstopf;
       double cal_cw_freq;
       double approx_stopf;
       int num_discretes;
       char cal_multi_src_mode;
       char cal_num_bands;
       struct multi_src_band_3p02 cal_band0;
       struct multi_src_band_3p02 cal_band1;
       struct multi_src_band_3p02 cal_band2;
       struct multi_src_band_3p02 cal_band3;
       struct multi_src_band_3p02 cal_band4;
       double cal_srcpwr;
       double cal_src2_pwr;
       char cal_attenset[4];
       char cal_flat_pwr;
       char connector;
       char connector_2;
       char p1_open_serial[8];
       double capterm[4];
       double p1_open_offset;
       char p1_short_serial[8];
       double p1_short_offset;
       double p1_short_angle;
```

Figure B-2. A “C” language header file for use with the “query.c” program (2 of 7)

```
        char p2_open_serial[8];
        double capterm_2[4];
        double p2_open_offset;
        char p2_short_serial[8];
        double p2_short_offset;
        double p2_short_angle;
        char waveguide_kit;
        char waveguide_id[8];
        double waveguide_cutoff;
        double waveguide_short1;
        double waveguide_short2;
        double p1_offset_short1;
        double p1_offset_short2;
        double p2_offset_short1;
        double p2_offset_short2;
        char microstrip_kit;
        double strip_width;
        double substrate_thick;
        double substrate_diel;
        double substrate_eff_diel;
        double zc_imped;
        char lrl_lrm_3_devices;
        char lrl_ref_location;
        char lrl_refl_type;
        char lrl_lrm_device_2;
        char lrl_lrm_device_3;
        double line1_length;
        double line2_length;
        double line3_length;
        double lrl_3line_breakpoint;
        double lrl_refl_offset;
        double Othr_c_term[4];
        double Othr_open_offset;
        double Othr_short_offset;
        double Othr_c_term_2[4];
        double Othr_open_offset_2;
        double Othr_short_offset_2;
        double Othr_wg_cutoff;
        double othr_wg_short1;
        double othr_wg_short2;
        double othr_ms_width;
        double othr_ms_thick;
        double othr_ms_diel;
        double othr_ms_eff_diel;
        double othr_ms_zc_imped;

/* * * * * * * * < < 04.02/04.03 Correction  parameter > > * * * * * * */

        char cortype;

/* * * * * * * < < 04.02/04.03 Measurement  parameters > > * * * * * * */

        double strtswp;
        double endswp;
        char use_swp_flag;
        double cw_freq;
        char cw_mode;
        double srcpwr;
        double src2_pwr;
        char attenset[4];
        char fresol;
        char hold_flag;
        char hold_function;
        char sys_in_hold;
```

Figure B-2. A “C” language header file for use with the “query.c” program (3 of 7)

```
        char rest_disp_flag;
        char bias_on_hold;
        char rf_on_hold;

/* * * * * < < 04.02/04.03 Flat test port power parameters > > * * * * */

        char flat_pwr;
        double flat_srcpwr;
        char flat_attenset[4];
        double flat_tst_port_pwr;
        char flat_pwr_port;
        char flat_pwr_skp;
        double num_pwr_rdngs;

/* * * * * * * * < < 04.02/04.03 Channel  parameters > > * * * * * * * */

        char actvchan;
        char dispmode;
        char trace_overlay;

/* * * * * * * * < < 04.02/04.03 display  parameters > > * * * * * * * */

        char s_param[4];
        char user_defined[4];
        struct param_defn_3p00 user1_defn;
        struct param_defn_3p00 user2_defn;
        struct param_defn_3p00 user3_defn;
        struct param_defn_3p00 user4_defn;
        int graph[4];
        int graph_bufr[4];
        int f_fgt_graph[4];
        int lp_graph[4];
        int bp_graph[4];
        int pi_graph[4];
        char grpdlyon;
        double grp_dly_aper[4];
        double lens[4];
        char diel_type;
        double dielectric;
        char norm[4];
        char norm_math[4];

/* * * * * * * * < < 04.02/04.03 scaling  parameters > > * * * * * * * */

        double log_mag_offset[4];
        double log_mag_resol[4];
        char log_mag_refline[4];
        double lin_mag_offset[4];
        double lin_mag_resol[4];
        char lin_mag_refline[4];
        double phase_offset[4];
        double phase_resol[4];
        char phase_refline[4];
        double phase_shift[4];
        double log_pol_offset[4];
        double log_pol_resol[4];
        double lin_pol_offset[4];
        double lin_pol_resol[4];
        double delay_offset[4];
        double delay_resol[4];
        char delay_refline[4];
        double real_offset[4];
        double real_resol[4];
        char real_refline[4];
```

Figure B-2. A “C” language header file for use with the “query.c” program (4 of 7)

```
        double imag_offset[4];
         double imag_resol[4];
         char imag_refline[4];
         double swr_offset[4];
         double swr_resol[4];
         char swr_refline[4];
         char both_mag_phs[4];
         char both_re_im[4];
         char z_smith_scale[4];
         char y_smith_scale[4];
         char polar_mode;
         double polar_strt_angle;
         double polar_stop_angle;


/* * * * * * * < < 04.02/04.03 Enhancement  parameters > > * * * * * * */

         char avgon;
         double averaging;
         char smthngon;
         double smoothing;
         char ifbw;

/* * * * * < < 04.02/04.03 dual source control  parameters > > * * * * */

         char multi_src_mode;
         char num_bands;
         struct multi_src_band_3p02 band0_eqn;
         struct multi_src_band_3p02 band1_eqn;
         struct multi_src_band_3p02 band2_eqn;
         struct multi_src_band_3p02 band3_eqn;
         struct multi_src_band_3p02 band4_eqn;

/* * * * * * * * < < 04.02/04.03 sweep option parameters > > * * * * * */

         char draw_enabled;
         int num_cwpts;
         char trigr_src;

/* * * * < < 04.02/04.03 Rear panel output option parameters > > * * * */

         char rear_dac_enabled;
         char rear_dac_mode;
         double strt_a1_volts;
         double stop_a2_volts;

/* * * * * * * * * < < 04.02/04.03 Marker parameters > > * * * * * * * */

         char mrkrsen;
         char markeron[6];
         double marker[6];
         double p_marker[6];
         double t_marker[6];
         double orig_t_marker[6];
         char actvmrkr;
         char delta_ref;
         char mrkrmode;

/* * * * * * * * * < < 04.02/04.03 Limit  parameters > > * * * * * * * */

         char limitsen[4];
         char rectlmt[4];
         char smplmt[4];
         char r_i_lmt[4];
```

Figure B-2. A “C” language header file for use with the “query.c” program (5 of 7)

```
        double log_mag_l1[4];
        double log_mag_l2[4];
        double lin_mag_l1[4];
        double lin_mag_l2[4];
        double phase_l1[4];
        double phase_l2[4];
        double lin_pol_l1[4];
        double lin_pol_l2[4];
        double log_pol_l1[4];
        double log_pol_l2[4];
        double smith_l1[4];
        double smith_l2[4];
        double delay_l1[4];
        double delay_l2[4];
        double real_l1[4];
        double real_l2[4];
        double imag_l1[4];
        double imag_l2[4];
        double swr_l1[4];
        double swr_l2[4];

/* * * * * * * < < 04.02/04.03 video display  parameters > > * * * * * */

        char blankf;
        char blue_3rd_plane;
        char video_on;
        char internal_crt_connection;
        char vga_out_connection;

/* * * * * * * * * < < 04.02/04.03 output parameters > > * * * * * * * */

        char output_dev;
        char outtype;
        char print_mode;
        char outputopt;
        char outputdataen;
        char tstmodel[16];
        char tstdutid[16];
        char tstdate[16];
        char operator[16];
        char plottype;
        char plot_loc;
        char data_pen;
        char data_ovl_pen;
        char gratic_pen;
        char mrkr_pen;
        char hedr_pen;
        double pen_speed;

/* * * * * * * < < 04.02/04.03 time domain parameters  > > * * * * * * */

        char t_modflg[4];
        double t_start;
        double t_stop;
        double orig_t_start;
        double orig_t_stop;
        char t_wndw_type;
        double t_gstart;
        double t_gstop;
        char t_gate_type;
        char gate_symbl_mode[4];
        char td_extrap_flg;
        double dc_term;
        char empty[565];
```

Figure B-2. A “C” language header file for use with the “query.c” program (6 of 7)

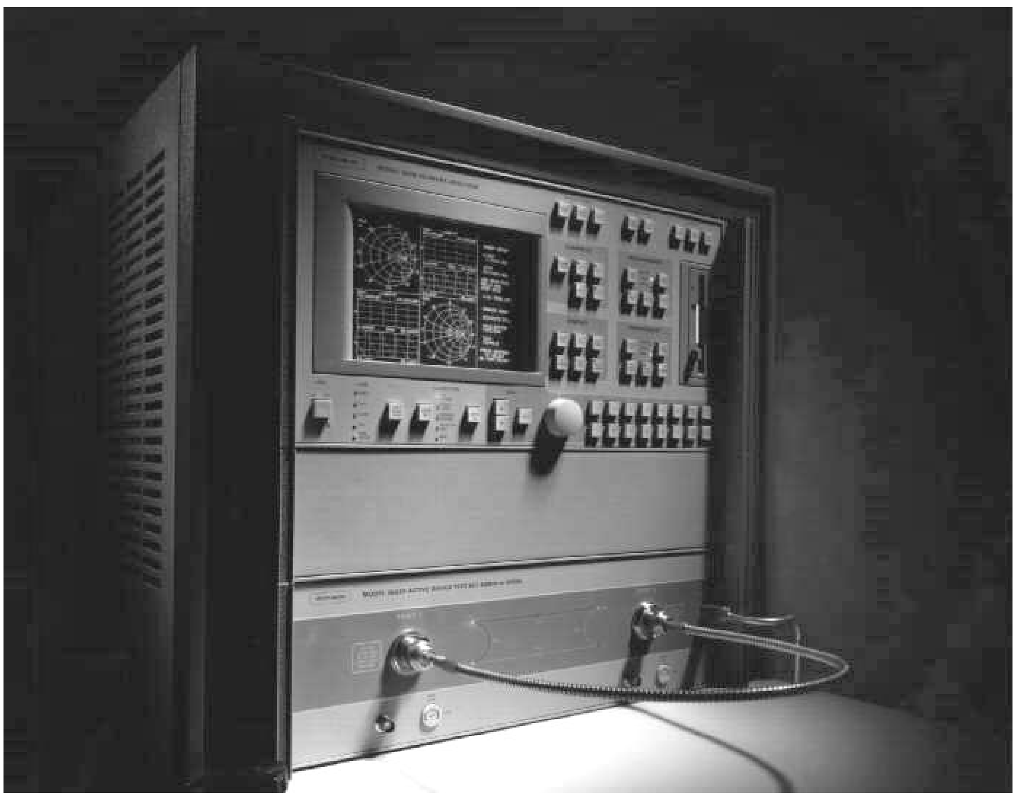
```
                double datafreq[512];
                int flatpwr [512];
                double flat_datafreq[512];
        };
```

Figure B-2. A “C” language header file for use with the “query.c” program (7 of 7)

Model 360B
Vector Network Analyzer

GPIB QUICK REFERENCE GUIDE

Software Version 4.05



This manual supplements the 360B Vector Network Analyzer GPIB Programming Manual. Insert it behind the tab marked "GPIB Quick Reference Guide" in that manual.

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This Quick Reference Guide is an alphabetical list of the GPIB Product Specific Commands for the 360B VNA. In this document, these messages are referred to as “360 GPIB commands” or simply “commands”. The listing for each command includes a brief description of the command function and attributes (such as associated parameters). This document is also an *alphabetical* index to the 360B Vector Network Analyzer GPIB Programming Manual. Each command listing includes a reference to the paragraph and page number in the programming manual that includes the complete description of the command.

Use this document as a quick reference to 360B VNA GPIB commands and their associated parameters. Use it also as an adjunct to the 360B Vector Network Analyzer GPIB Programming Manual to look up commands alphabetically. (The GPIB Command Function Index of that manual references the command groups by *function*.)

NOTE:

For information pertaining to the 360B VNA response to IEEE-488 Interface Function Messages (DCL, IFC, etc) refer to paragraph 1-3, 360B VNA GPIB Operation, in the 360B Vector Network Analyzer GPIB Programming Manual.

GPIB Commands Listed Alphabetically (1 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
A8T	Simulate 8-term (1-path) calibration	N/A	N/A	4-2 / 4-3
A12	Simulate 12-term calibration	N/A	N/A	4-2 / 4-3
ACF	Accept 360 system configuration	N/A	N/A	3-12 / 3-18
ADD	Select addition as trace math for active channel	N/A	N/A	3-8 / 3-12
AFR	Simulate frequency response calibration	N/A	N/A	4-2 / 4-3
AH0	Disable DUT/AUT protection feature	N/A	N/A	3-5
AH1	Enable DUT/AUT protection feature	N/A	N/A	3-5
AFT	Simulate transmission-only frequency response calibration	N/A	N/A	4-2 / 4-3
AOF	Turn off averaging	N/A	N/A	3-6 / 3-10
APR (value)	Set group delay aperture for display on active channel	0 to 20	XX1, XX3, XM3	3-5 / 3-7
ARF	Simulate reflection only calibration	N/A	N/A	4-2 / 4-3
ARL	Simulate reflection-only frequency response calibration	N/A	N/A	4-2 / 4-3
ASC	Set autoscale display on active channel	N/A	N/A	3-5 / 3-7
ASP (value)	Set polar stop sweep position angle	0 to 360 (–360 to +360)	DEG	3-5 / 3-7
AST (value)	Set polar start sweep position angle	0 to 360 (–360 to +360)	DEG	3-5 / 3-7
AVG (value)	Turn on averaging and set to value	1 to 4095	XX1, XX3, XM3	3-6 / 3-10
BBL	Select broadband load for calibration	N/A	N/A	4-2 / 4-3
BC0	Set CRT blanking on (screen blanked	N/A	N/A	3-12 / 3-18
BC1	Set CRT blanking off (screen active)	N/A	N/A	3-12 / 3-18
BD1-BD5	Select band 1-5 for definition	(Limited to current DUT range)	N/A	5-8 / 5-26
BEG	Begin calibration data-collection steps	N/A	N/A	4-2 / 4-3
BH0	Set bias off while in hold	N/A	N/A	3-4 / 3-5
BH1	Set bias on while in hold	N/A	N/A	3-4 / 3-5
BLU	Select blue as third color	N/A	N/A	3-12 / 3-18
BPF (value)	Enter break point frequency for 3 line LRL calibration	Start sweep freq to stop sweep freq	GHZ, MHZ, KHZ	4-2 / 4-3
BSP (value)	Enter band stop frequency	Start sweep freq to stop sweep freq	GHZ, MHZ, KHZ	5-8 / 5-26
BST (value)	Enter band 1 start frequency only	Start sweep freq to stop sweep freq	GHZ, MHZ, KHZ	5-8 / 5-26
C8T	Select 8-term (1-path) calibration	N/A	N/A	4-2 / 4-3
C12	Select 12-term calibration	N/A	N/A	4-2 / 4-3
CC0 (value) – CC3 (value)	Enter capacitance coefficients 0-3 for open for user-specified connector	–9999.99 to +9999.99	XX1	4-2 / 4-3

GPIB Commands Listed Alphabetically (2 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
CCD	Collect corrected data for active channel parameter	N/A	N/A	5-3 / 5-3
CF2	Select female 2.4 mm connector for current port	N/A	N/A	4-2 / 4-3
CF3	Select female GPC-3.5 connector for current port	N/A	N/A	4-2 / 4-3
CFC	Select female TNC connector for current port	N/A	N/A	4-2 / 4-3
CFD	Collect final (display format) data for active channel parameter	N/A	N/A	5-3 / 5-3
CFK	Select female K connector for current port	N/A	N/A	4-2 / 4-3
CFN	Select female Type N connector for current port	N/A	N/A	4-2 / 4-3
CFR	Select transmission and reflection freq. response calibration	N/A	N/A	4-2 / 4-3
CFS	Select female SMA connector for current port	N/A	N/A	4-2 / 4-3
CFT	Select transmission-only frequency response calibration	N/A	N/A	4-2 / 4-3
CFV	Select female V connector for current port	N/A	N/A	4-2 / 4-3
CH1-CH4	Select active channel 1-4	N/A	N/A	3-2 / 3-4
CLB	Clear all multiple source band definitions	N/A	N/A	5-8 / 5-26
CM2	Select male 2.4 mm connector for current port	N/A	N/A	4-2 / 4-3
CM3	Select male GPC-3.5 connector for current port	N/A	N/A	4-2 / 4-3
CMC	Select male TNC connector for current port	N/A	N/A	4-2 / 4-3
CMK	Select male K connector for current port	N/A	N/A	4-2 / 4-3
CMN	Select male Type N connector for current port	N/A	N/A	4-2 / 4-3
CMS	Select male SMA connector for current port	N/A	N/A	4-2 / 4-3
CMT	Select centimeter terminator	N/A	N/A	3-3 / 3-4
CMV	Select male V connector for current port	N/A	N/A	4-2 / 4-3
CND	Select user-specified connector for current port	N/A	N/A	4-2 / 4-3
CNG	Select GPC-7 connector for current port	N/A	N/A	4-2 / 4-3
COF	Turn off vector error correction	N/A	N/A	4-2 / 4-3
CON	Turn on vector error correction	N/A	N/A	4-2 / 4-3
COO (value)	Enter offset for open for user-specified connector	–999.9999 to +999.9999	MMT, CMT, MTR	4-2 / 4-3

GPIB Commands Listed Alphabetically (3 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
COS (value)	Enter offset for short for user-specified connector	–999.999 m to 999.999 m	MMT, CMT, MTR	4-2 / 4-3
CRD	Collect raw data for active channel parameter	N/A	N/A	5-3 / 5-3
CRF	Select reflection-only calibration	N/A	N/A	4-2 / 4-3
CRL	Select reflection-only frequency response calibration	N/A	N/A	4-2 / 4-3
CSB	Clear both status bytes	N/A	N/A	5-6 / 5-20
CTN	Continue sweeping from current point	N/A	N/A	3-4 / 3-5
CWC	Select CW frequency calibration data points	N/A	N/A	4-2 / 4-3
CWF (value)	CW turned on and CW frequency set to value	Start sweep freq to stop sweep freq	GHZ, MHZ, KHZ	3-4 / 3-5
CWP (value)	Enter number of points drawn in CW	1 – 501	XX1	5-11 / 5-30
CYN	Select cyan as third color	N/A	N/A	3-12 / 3-18
D13	Dual channel display, channels 1 and 3	N/A	N/A	3-2 / 3-4
D14	Quad display, channels 1-4	N/A	N/A	3-2 / 3-4
D24	Dual channel display, channels 2 and 4	N/A	N/A	3-2 / 3-4
DA1	Select a1=Ra as denominator for parameter being defined	N/A	N/A	3-4 / 3-5
DA2	Select a2=Rb as denominator for parameter being defined	N/A	N/A	3-4 / 3-5
DAT	Display measurement data on active channel	N/A	N/A	3-8 / 3-12
DB1	Select b1=Ta as denominator for parameter being defined	N/A	N/A	3-4 / 3-5
DB2	Select b2=Tb as denominator for parameter being defined	N/A	N/A	3-4 / 3-5
DBL	Select dB log terminator	N/A	N/A	3-3 / 3-4
DBM	Select dBm terminator	N/A	N/A	3-3 / 3-4
DBP	Select distance bandpass mode for active channel	N/A	N/A	5-7 / 5-24
DC1	Display channel 1 and 2 operating parameters	N/A	N/A	3-12 / 3-18
DC3	Display channel 3 and 4 operating parameters	N/A	N/A	3-12 / 3-18
DCA	Select automatic D.C. term calculation for lowpass	N/A	N/A	5-7 / 5-24
DCO	Select open for D.C. term for lowpass	N/A	N/A	5-7 / 5-24
DCP	Display calibration parameters	N/A	N/A	3-12 / 3-18

GPIB Commands Listed Alphabetically (4 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
DCS	Select short for D.C. term for lowpass	N/A	N/A	5-7 / 5-24
DCV (value)	Enter value for D.C. term for lowpass	–1000 MΩ to 1000 MΩ	XX1, XX3, XM3	5-7 / 5-24
DCZ	Select line impedance for D.C. term for lowpass	N/A	N/A	5-7 / 5-24
DD0	Turn off data drawing	N/A	N/A	5-11 / 5-30
DD1	Turn on data drawing	N/A	N/A	5-11 / 5-30
DE1	Select unity as denominator for parameter being defined	N/A	N/A	3-4 / 3-5
DEC (filename)	Delete calibration/front panel setup file from disk	File name string 8 characters max	N/A	5-5 / 5-17
DED (filename)	Delete tabular data file from disk	File name string 8 characters max	N/A	5-5 / 5-17
DEF	Begin definition of group execute trigger action	N/A	N/A	5-4 / 5-16
DEG	Degrees terminator	N/A	N/A	3-3 / 3-4
DEN (filename)	Delete trace memory file	File name string 8 characters max	N/A	5-5 / 5-17
DF2	Display 2.4 mm female connector information	N/A	N/A	3-12 / 3-18
DF3	Display GPC-3.5 female connector information	N/A	N/A	3-12 / 3-18
DFC	Select discrete frequency calibration data points	N/A	N/A	4-2 / 4-3
DFD	Done specifying discrete frequency ranges	N/A	N/A	4-2 / 4-3
DFK	Display K female connector information	N/A	N/A	3-12 / 3-18
DFN	Display type N female connector information	N/A	N/A	3-12 / 3-18
DFP	Display front panel instrument state	N/A	N/A	3-12 / 3-18
DFQ (value)	Enter single discrete frequency	Start sweep freq to stop sweep freq	GHZ, MHZ, KHZ	4-2 / 4-3
DFS	Display SMA female connector information	N/A	N/A	3-12 / 3-18
DFT	Display TNC female connector information	N/A	N/A	3-12 / 3-18
DFV	Display V female connector information	N/A	N/A	3-12 / 3-18
DG7	Display GPC-7 male connector information	N/A	N/A	3-12 / 3-18
DGS	Display GPIB status information	N/A	N/A	3-12 / 3-18
DIA	Select air as active dielectric	N/A	N/A	3-7 / 3-11
DIE (value)	Set active dielectric to value	1 to 999.999	XX1, XX3, XM3	3-7 / 3-11
DIM	Select microporous teflon as active dielectric (1.69)	N/A	N/A	3-7 / 3-11

GPIB Commands Listed Alphabetically (5 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
DIP	Select polyethylene as active dielectric (2.26)	N/A	N/A	3-7 / 3-11
DIT	Select teflon as active dielectric (2.1)	N/A	N/A	3-7 / 3-11
DIV	Select division as trace math for active channel	N/A	N/A	3-8 / 3-12
DLA	Select group delay display for active channel	N/A	N/A	3-5 / 3-7
DLP	Select distance lowpass mode for active channel	N/A	N/A	5-7 / 5-24
DM2	Display 2.4 mm male connector information	N/A	N/A	3-12 / 3-18
DM3	Display GPC-3.5 male connector information	N/A	N/A	3-12 / 3-18
DMK	Display K male connector information	N/A	N/A	3-12 / 3-18
DMN	Display type N male connector information	N/A	N/A	3-12 / 3-18
DMS	Display SMA male connector information	N/A	N/A	3-12 / 3-18
DMT	Display TNC male connector information	N/A	N/A	3-12 / 3-18
DMV	Display V male connector information	N/A	N/A	3-12 / 3-18
DNM	Display data normalized to trace memory on active channel	N/A	N/A	3-8 / 3-12
DPI	Select distance phasor impulse mode for active channel	N/A	N/A	5-7 / 5-24
DPN (value)	Enter pen number for data	1 to 8	XX1	3-11 / 3-16
DR1-DR6	Select marker 1-6 as delta reference marker	N/A	N/A	3-9 / 3-13
DRF	Turn delta reference mode on	N/A	N/A	3-9 / 3-13
DRO	Turn delta reference mode off	N/A	N/A	3-9 / 3-13
DSP	Select single channel display	N/A	N/A	3-2 / 3-4
DTM	Display measurement data and trace memory on active channel	N/A	N/A	3-8 / 3-12
DWG	Display waveguide parameters	N/A	N/A	3-12 / 3-18
ECW	Select CW operation for component being edited	N/A	N/A	5-8 / 5-26
E12	Selects E Band and WR12 waveguide	N/A	N/A	3-23/3-24
ED1	Edit source 1 equation	N/A	N/A	5-8 / 5-26
ED2	Edit source 2 equation	N/A	N/A	5-8 / 5-26
EDR	Edit receiver equation	N/A	N/A	5-8 / 5-26
EDV (value)	Set divisor for equation being edited	–199 to –1, 1 to 199	XX1, XX3, XM3	5-8 / 5-26
EML (value)	Set multiplier for equation being edited	–199 to 199	XX1, XX3, XM3	5-8 / 5-26
END	End definition of group execute trigger action	N/A	N/A	5-4 / 5-16

GPIB Commands Listed Alphabetically (6 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
EOS (value)	Set offset frequency for equation being edited	–999.9999 GHz to 999.9999 GHz	GHZ, MHZ, KHZ	5-8 / 5-26
ESW	Select swept operation for component being edited	N/A	N/A	5-8 / 5-26
FFD	Form feed to printer/stop print/plot	N/A	N/A	3-11 / 3-16
FGT	Select frequency with time gate for active channel	N/A	N/A	5-7 / 5-24
FHI	Set data points to maximum	N/A	N/A	3-4 / 3-5
FIL	Fill defined discrete frequency range	N/A	N/A	4-2 / 4-3
FLO	Set data points to minimum	N/A	N/A	3-4 / 3-5
FMA	Select ASCII data transfer format	N/A	N/A	5-3 / 5-3
FMB	Select IEEE-754 64-bit data transfer format	N/A	N/A	5-3 / 5-3
FMC	Select IEEE-754 32-bit data transfer format	N/A	N/A	5-3 / 5-3
FME	Set data points to normal	N/A	N/A	3-4 / 3-5
FOF	Blank frequency information	N/A	N/A	3-12 / 3-18
FON	Display frequency information	N/A	N/A	3-12 / 3-18
FP0	Turn flat test port correction data usage off	N/A	N/A	4-2 / 4-3
FP1	Turn flat test port correction data usage on	N/A	N/A	4-2 / 4-3
FQD	Select frequency domain for active channel	N/A	N/A	5-7 / 5-24
FRC	Clear all defined discrete frequency ranges	N/A	N/A	4-2 / 4-3
FRI (value)	Set discrete frequency fill range increment frequency	Start sweep freq to stop sweep freq	GHZ, MHZ, KHZ	4-2 / 4-3
FRP (value)	Set discrete frequency fill range number of points	1 to (501–current number of points)	XX1, XX3, XM3	4-2 / 4-3
FRS (value)	Set discrete frequency fill range start frequency	Start sweep freq to stop sweep freq	GHZ, MHZ, KHZ	4-2 / 4-3
GCT (value)	Set gate center value	0.0000 to 999.999 µs 0.0000 to 999.999 m	PSC, NSC, USC, MMT, CMT, MTR	5-7 / 5-24
GDS	Gate symbols displayed on active channel	N/A	N/A	5-7 / 5-24
GHZ	Set gigahertz terminator	N/A	N/A	3-3 / 3-4
GLS	Select low sidelobe gate shape	N/A	N/A	5-7 / 5-24
GMS	Select minimum sidelobe gate shape	N/A	N/A	5-7 / 5-24
GNM	Select nominal gate shape	N/A	N/A	5-7 / 5-24
GOF	Turn off gating on active channel	N/A	N/A	5-7 / 5-24
GON	Turn on gating on active channel	N/A	N/A	5-7 / 5-24
GPN (value)	Enter pen number for graticule	1 to 8	XX1	3-11 / 3-16
GRT	Select rectangular gate shape	N/A	N/A	5-7 / 5-24
GSN (value)	Set gate span value	0.0000 to 999.999 µs 0.0000 to 999.999 m	PSC, NSC, USC, MMT, CMT, MTR	5-7 / 5-24

GPIB Commands Listed Alphabetically (7 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
GSP (value)	Set gate stop value	–999.9999 to +999.9999	PSC, NSC, USC	5-7 / 5-24
GST (value)	Set gate start value	–999.9999 to +999.9999	PSC, NSC, USC	5-7 / 5-24
HC0	Disable internal I.F. calibration	N/A	N/A	5-9 / 5-28
HC1	Enable/trigger internal I.F. calibration	N/A	N/A	5-9 / 5-28
HD0	Turn off tabular data headers and page formatting	N/A	N/A	3-11 / 3-16
HD1	Turn on tabular data headers and page formatting	N/A	N/A	3-11 / 3-16
HLD	Hold instrument at current point	N/A	N/A	3-4 / 3-5
HPN (value)	Enter pen number for header	1 to 8	XX1	3-11 / 3-16
IC1 (value) – IC9 (value)	Input calibration coefficient 1-9	FMA, FMB, FMC data formats	N/A	5-3 / 5-3
ICA (value), ICB (value), ICC (value)	Input calibration coefficient A, B, C	FMA, FMB, FMC data formats	N/A	5-3 / 5-3
ICD (value)	Input corrected data for parameter of active channel	FMA, FMB, FMC data formats	N/A	5-3 / 5-3
ICF (bin strg)	Input information for front panel setup *and* calibration in binary string format	Binary string	N/A	5-3 / 5-3
ICL (bin strg)	Input all 12 calibration coefficients in string form	Binary string	N/A	5-3 / 5-3
IEM<Byte>	Input extended status byte mask	One binary byte	N/A	5-6 / 5-20
IFD (value)	Input final (display format) data for parameter of active channel	FMA, FMB, FMC data formats	N/A	5-3 / 5-3
IFM	Select minimum I.F. bandwidth	N/A	N/A	3-6 / 3-10
IFN	Select normal I.F. bandwidth	N/A	N/A	3-6 / 3-10
IFP (bin strg)	Input current information for current front panel setup in binary string format	Binary string	N/A	5-3 / 5-3
IFR	Select reduced I.F. bandwidth	N/A	N/A	3-6 / 3-10
IFV (list)	Input frequency list	FMA, FMB, FMC data formats	N/A	5-3 / 5-3
IMG	Select imaginary display for active channel	N/A	N/A	3-5 / 3-7
IMU	Select imaginary units terminator	N/A	N/A	3-3 / 3-4
INT	Initialize (format) data-only disk in drive	N/A	N/A	5-5 / 5-17
IPM<Byte>	Input primary status byte mask	One binary byte	N/A	5-6 / 5-20
IS1 (bin strg) – IS4 (bin strg)	Input information for front panel setups 1-4 in binary string format	Binary string	N/A	5-3 / 5-3
ISC (value)	Select inverted compressed Smith chart for active channel	3	DBL, XX1	3-5 / 3-7

GPIB Commands Listed Alphabetically (8 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
ISE (value)	Select inverted expanded Smith chart for active channel	10, 20, 30	DBL, XX1	3-5 / 3-7
ISF	Exclude isolation	N/A	N/A	4-2 / 4-3
ISM	Select normal inverted Smith chart for active channel	N/A	N/A	3-5 / 3-7
ISN	Include isolation (for 12 term or 1-path/2-port calibrations)	N/A	N/A	4-2 / 4-3
KEC	Keep existing calibration data	N/A	N/A	4-2 / 4-3
KHZ	Kilohertz terminator	N/A	N/A	3-3 / 3-4
LA1	Select a1=Ra as phase lock for parameter being defined	N/A	N/A	3-4 / 3-5
LA2	Select a2=Rb as phase lock for parameter being defined	N/A	N/A	3-4 / 3-5
LCM	Select LRL calibration method	N/A	N/A	4-2 / 4-3
LDM	Load new modules (must be specified for the band and head changes to take place)	N/A	N/A	3-17 / 3-23
LDT (string)	Enter label string for date/time	String characters up to 12 characters long	N/A	3-11 / 3-16
LFD (value)	Set limit frequency read-out delta value	Depends on graph type	Depends on graph type	3-10 / 3-15
LFP	Select limit frequency read-out for phase displays	N/A	N/A	3-10 / 3-15
LFR	Select limit frequency read-out for active channel	N/A	N/A	3-10 / 3-15
LID (string)	Enter label string for device I.D.	String characters up to 12 characters long	N/A	3-11 / 3-16
LIN	Select linear magnitude display for active channel	N/A	N/A	3-5 / 3-7
LKT	Load calibration kit information from disk	N/A	N/A	5-5 / 5-17
LL1 (value)	Enter length of line 1 for LRL calibration	0 to +999.9999	MMT, CMT, MTR	4-2 / 4-3
LL2 (value)	Enter length of line 2 for LRL calibration	0 to +999.9999	MMT, CMT, MTR	4-2 / 4-3
LL3 (value)	Enter length of line 3 for 3 line LRL calibration	0 to +999.9999	MMT, CMT, MTR	4-2 / 4-3
LLO (value)	Turn on lower limit and set to value	Depends on graph type	Depends on graph type	3-10 / 3-15
LLZ (value)	Enter line impedance for LRL calibration	0.001 to 1x10E+3	XX1, XX3, XM3	4-2 / 4-3
LM2	Select a match for the second device during a LRM type calibration	N/A	N/A	4-2 / 4-3
LM3	Select a match for the third device during a LRM type calibration	N/A	N/A	4-2 / 4-3

GPIB Commands Listed Alphabetically (9 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
LMS (string)	Enter label string for model/serial number	String characters up to 12 characters long	N/A	3-11 / 3-16
LNM (string)	Enter label string for operator's name	String characters up to 12 characters long	N/A	3-11 / 3-16
LOF	Limits display off	N/A	N/A	3-10 / 3-15
LON	Limits display on	N/A	N/A	3-10 / 3-15
LPH	Select linear magnitude and phase display for active channel	N/A	N/A	3-5 / 3-7
LPI	Select lowpass impulse response	N/A	N/A	5-7 / 5-24
LPS	Select lowpass step response	N/A	N/A	5-7 / 5-24
LR2	Specify 2 line LRL calibration	N/A	N/A	4-2 / 4-3
LR3	Specify 3 line LRL calibration	N/A	N/A	4-2 / 4-3
LSB	Select least significant byte first binary transfers	N/A	N/A	5-3 / 5-3
LTC	Select coaxial transmission line for calibration	N/A	N/A	4-2 / 4-3
LTU	Select microstrip transmission line for calibration	N/A	N/A	4-2 / 4-3
LTW	Select waveguide transmission line for calibration	N/A	N/A	4-2 / 4-3
LUP (value)	Turn on upper limit and set to value	Depends on graph type	Depends on graph type	3-10 / 3-15
M1C-M6C	Marker 1-6 sweep CW frequency	N/A	N/A	3-9 / 3-13
M1E-M6E	Marker 1-6 sweep/zoom end frequency, time, or distance	N/A	N/A	3-9 / 3-13
M1S-M6S	Marker 1-6 sweep/zoom start frequency, time, or distance	N/A	N/A	3-9 / 3-13
MAG	Select log magnitude display for active channel	N/A	N/A	3-5 / 3-7
MAT	Select matched reflection measurement sequence for standard calibration	N/A	N/A	4-2.3 / 4-4
MIX	Select mixed reflection measurement sequence for standard calibration	N/A	N/A	4-2.3 / 4-4
MC1 (value)	Write control byte to 3642A Noise Figure Module Primary Control Register	One binary byte	N/A	3-16 / 3-23
MC2 (value)	Write control byte to 3642A Noise Figure Module Secondary Control Register	One binary byte	N/A	3-16 / 3-23
MEM	Display trace memory on active channel	N/A	N/A	3-8 / 3-12
MHZ	Select megahertz terminator	N/A	N/A	3-3 / 3-4
MIN	Select subtraction as trace math for active channel	N/A	N/A	3-8 / 3-12

GPIB Commands Listed Alphabetically (10 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
MK1 (value)- MK6 (value)	Turn on marker 1-6 and set to value	Limited to current sweep/zoom range	N/A	3-9 / 3-13
MMN	Set active marker to minimum trace value	N/A	N/A	3-9 / 3-13
MMT	Select millimeter terminator	N/A	N/A	3-3 / 3-4
MMX	Set active marker to maximum trace value	N/A	N/A	3-9 / 3-13
MO1-MO6	Turn off marker 1-6	N/A	N/A	3-9 / 3-13
MOF	Turn marker display off	N/A	N/A	3-9 / 3-13
MON	Turn marker display on	N/A	N/A	3-9 / 3-13
MP0	Set non-selected test set power off	N/A	N/A	3-13 / 3-20
MP1	Set non-selected test set power on	N/A	N/A	3-13 / 3-20
MPH	Select log magnitude and phase display for active channel	N/A	N/A	3-5 / 3-7
MPN (value)	Enter pen number for markers and limits	1 to 8	XX1	3-11 / 3-16
MR1-MR6	Select read-out marker 1-6	N/A	N/A	3-9 / 3-13
MRR	Restore original marker range	N/A	N/A	5-7 / 5-24
MS0	Turn multiple source mode off	N/A	N/A	5-8 / 5-26
MS1	Turn multiple source mode on	N/A	N/A	5-8 / 5-26
MSB	Select most significant byte first binary transfers	N/A	N/A	5-3 / 5-3
MSD	Select multiple source define mode	N/A	N/A	5-8 / 5-26
MTR	Select meter terminator	N/A	N/A	3-3 / 3-4
MUL	Select multiplication as trace math for active channel	N/A	N/A	3-8 / 3-12
NA1	Select a1=Ra as numerator for parameter being defined	N/A	N/A	3-4 / 3-5
NA2	Select a2=Rb as numerator for parameter being defined	N/A	N/A	3-4 / 3-5
NB1	Select b1=Ta as numerator for parameter being defined	N/A	N/A	3-4 / 3-5
NB2	Select b2=Tb as numerator for parameter being defined	N/A	N/A	3-4 / 3-5
NCS	Go on to next calibration step	N/A	N/A	4-2 / 4-3
NOC	Select normal calibration data points	N/A	N/A	4-2 / 4-3
NSC	Select nanoseconds terminator	N/A	N/A	3-3 / 3-4
NU1	Select unity as numerator for parameter being defined	N/A	N/A	3-4 / 3-5
OAP (value)	Output active parameter value	ASCII	N/A	5-3 / 5-3
OC1 (value) – OC9 (value)	Output calibration coefficient 1-9	FMA, FMB, FMC data formats	N/A	5-3 / 5-3

GPIB Commands Listed Alphabetically (11 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
OCA (value), OCB (value), OCC (value)	Output calibration coefficient A, B, C	FMA, FMB, FMC data formats	N/A	5-3 / 5-3
OCD (value)	Output corrected data for active channel parameter	FMA, FMB, FMC data formats	N/A	5-3 / 5-3
OCF (bin strg)	Output information for current front panel setup *and* calibration in binary string format	Binary string	N/A	5-3 / 5-3
OCL (bin strg)	Output all 12 calibration coefficients in string form	Binary string	N/A	5-3 / 5-3
OCM	Select offset short calibration method	N/A	N/A	4-2 / 4-3
OCS	Output collected data	N/A	N/A	5-3 / 5-3
ODR (bin strg)	Output disk directory	Binary string	N/A	5-3 / 5-3
ODV (value)	Output converted distance values for time domain measurements	FM and FMB data formats	N/A	5-3 / 5-3
OEB	Output extended (secondary) status byte	One binary byte	N/A	5-6 / 5-20
OFD (value)	Output final (display format) data for active channel parameter	FMA, FMB, FMC data formats	N/A	5-3 / 5-3
OFF (value)	Set offset for display on active channel	Depends on graph type	Depends on graph type	3-5 / 3-7
OFP (bin strg)	Output information for current front panel setup in binary string format	Binary string	N/A	5-3 / 5-3
OFV (value)	Output frequency values	FMA, FMB, FMC data formats	N/A	5-3 / 5-3
OID (value)	Output instrument identification string	40 byte ASCII string	N/A	5-3 / 5-3
OKP (value)	Output number of front panel key pressed	ASCII	N/A	5-3 / 5-3
OM1 (value) – OM6 (value)	Output marker 1-6 value (display format)	ASCII	N/A	5-3 / 5-3
ONP (value)	Output number of points currently being measured	ASCII	N/A	5-3 / 5-3
OPB	Output primary status byte	One binary byte	N/A	5-6 / 5-20
ORD (value)	Output raw data for active channel parameter	FMA, FMB, FMC data formats	N/A	5-3 / 5-3
OS1 (bin strg) – OS4 (bin strg)	Output front panel setup 1-4	(Binary string format)	N/A	5-3 / 5-3
OTV (value)	Output time values for time domain measurements	FM and FMB data formats	N/A	5-3 / 5-3
P1C	Select port 1 for connector specification	N/A	N/A	4-2 / 4-3
P2A	Select model number 3640 “A” for port 2	N/A	N/A	3-17 / 3-23
P2B	Select model number 3641 “B” for port 2	N/A	N/A	3-17 / 3-23
P2C	Select port 2 for connector specification	N/A	N/A	4-2 / 4-3
PBL	Select 1/4-size plot, bottom left corner	N/A	N/A	3-11 / 3-16

GPIB Commands Listed Alphabetically (12 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
PBR	Select 1/4-size plot, bottom right corner	N/A	N/A	3-11 / 3-16
PCP	Select measurement phase polar chart mode	N/A	N/A	3-5 / 3-7
PCS	Select sweep position polar chart mode	N/A	N/A	3-5 / 3-7
PFL	Select full-size plot	N/A	N/A	3-11 / 3-16
PFS	Print full screen image	N/A	N/A	3-11 / 3-16
PGR	Print graph area screen image	N/A	N/A	3-11 / 3-16
PGT	Plot graticule	N/A	N/A	3-11 / 3-16
PHA	Select phase display for active channel	N/A	N/A	3-5 / 3-7
PHO (value)	Set phase offset for display on active channel	Depends on graph type	Depends on graph type	3-5 / 3-7
PLD	Plot data area only	N/A	N/A	3-11 / 3-16
PLG	Select log polar display for active channel	N/A	N/A	3-5 / 3-7
PLH	Plot header	N/A	N/A	3-11 / 3-16
PLM	Plot markers and limits	N/A	N/A	3-11 / 3-16
PLR	Select linear polar display for active channel	N/A	N/A	3-5 / 3-7
PLS	Plot entire screen	N/A	N/A	3-11 / 3-16
PLT	Plot data traces only	N/A	N/A	3-11 / 3-16
PMC	Write contol byte image to 3636A test set modulator control register	One binary byte	N/A	3-15 / 3-22
PMK	Print tabular data for markers	N/A	N/A	3-11 / 3-16
PMN	Plot menu	N/A	N/A	3-11 / 3-16
PMT	Print tabular data for traces and markers	N/A	N/A	3-11 / 3-16
PSC	Select picoseconds terminator	N/A	N/A	3-3 / 3-4
PSP (value)	Select number of power measurement sweeps for flat test port calibration	1 to 5	XX1	4-2 / 4-3
PST	Stop print/plot	N/A	N/A	3-11 / 3-16
PT0-PT9	Select tabular printout points skipped, 0-9	N/A	N/A	3-11 / 3-16
PTB	Print tabular data for traces	N/A	N/A	3-11 / 3-16
PTL	Select 1/4-size plot, top left corner	N/A	N/A	3-11 / 3-16
PTP (value)	Set power at test port (for flat test port calibration)	(Refer to text))	DBM	4-2 / 4-3
PTS (value)	Select number of frequency points to be skippped during power measurement sweep for flat test port calibration	1 to 501	XX1	4-2 / 4-3
PTR	Select 1/4-size plot, top right corner	N/A	N/A	3-11 / 3-16

GPIB Commands Listed Alphabetically (13 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
PW2 (value)	Set source 2 power level in dBm	Depends on power range of source	DBM, XX1, XX3, XM3	3-4 / 3-5
PWR (value)	Set source 1 power level in dBm	Depends on power range of source	DBM, XX1, XX3, XM3	3-4 / 3-5
Q22	Select Q band (33-50 Ghz) with WR-22	N/A	N/A	3-17 / 3-23
RC1-RC4	Recall front panel setup from internal memory 1-4	N/A	N/A	5-2 / 5-3
RCK (filename)	Recall disk file specified into trace memory	File name string 8 characters max	N/A	5-5 / 5-17
RDA	Select automatic reference delay calculation	N/A	N/A	3-7 / 3-11
RDD (value)	Set reference delay in distance for active channel	–999.999 to +999.999	MMT, CMT, MTR	3-7 / 3-11
RDT (value)	Set reference delay in time for active channel	–999.999 to +999.999	PSC, NSC, USC	3-7 / 3-11
REF (value)	Set reference line for display on active channel	Depends on graph type	Depends on graph type	3-5 / 3-7
REL	Select real display for active channel	N/A	N/A	3-5 / 3-7
REU	Select real units terminator	N/A	N/A	3-3 / 3-4
RFA	Set RF switch to A	N/A	N/A	3-13 / 3-20
RFB	Set RF switch to B	N/A	N/A	3-13 / 3-20
RGZ	Select reflective device greater than Z_0 (LRL)	N/A	N/A	4-2 / 4-3
RH0	Set RF off while in hold	N/A	N/A	3-4 / 3-5
RH1	Set RF on while in hold	N/A	N/A	3-4 / 3-5
RIM	Select real and imaginary display for active channel	N/A	N/A	3-5 / 3-7
RLD (filename)	Recall calibration data and front panel setup from disk file	File name string 8 characters max	N/A	5-5 / 5-17
RLZ	Select reflective device less than Z_0 (LRL)	N/A	N/A	4-2 / 4-3
RM1	Select reference plane at line 1 midpoint (LRL)	N/A	N/A	4-2 / 4-3
ROL (value)	Enter reflective device offset length for LRL calibration	–999.999 to +999.999	MMT, CMT, MTR	4-2 / 4-3
RPC	Repeat previous calibration	N/A	N/A	4-2 / 4-3
RPO (value)	Direct output of voltage value to rear panel, –10.0 to +9.996 volts	–10.000V to 9.9996V	VLT	5-10 / 5-29
RRP	Select reference plane at reflection plane (LRL)	N/A	N/A	4-2 / 4-3
RSB <Byte>	Read 3642A Noise Figure Module status register (ID byte)	One binary byte	N/A	3-16 / 3-23

GPIB Commands Listed Alphabetically (14 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
RST	Reset instrument to default parameters	N/A	N/A	3-12 / 3-18
RTB (filename)	Recall tabular data from disk file specified to printer	File name string 8 characters max	N/A	5-5 / 5-17
RTL	Return to local (front panel) control	N/A	N/A	3-12 / 3-18
RV0	Rear panel output voltage OFF	N/A	N/A	5-10 / 5-29
RV1	Rear panel output voltage ON	N/A	N/A	5-10 / 5-29
RVH	Rear panel output mode = horizontal	N/A	N/A	5-10 / 5-29
RVL	Rear panel output mode = lock direction	N/A	N/A	5-10 / 5-29
RVV	Rear panel output mode = vertical	N/A	N/A	5-10 / 5-29
S11	Measure S_{11} on active channel	N/A	N/A	3-4 / 3-5
S12	Measure S_{12} on active channel	N/A	N/A	3-4 / 3-5
S21	Measure S_{21} on active channel	N/A	N/A	3-4 / 3-5
S22	Measure S_{22} on active channel	N/A	N/A	3-4 / 3-5
SA1 (value)	Set source attenuator, port 1	0 to 70 Db	DBL, DBM, XX1, XX3, XM3	3-4 / 3-5
SA2 (value)	Set source attenuator, port 2	0 to 70 Db	DBL, DBM, XX1, XX3, XM3	3-4 / 3-5
SBD (value)	Enter substrate dielectric for microstrip calibration	1.0 to 9999.99	XX1, XX3, XM3	4-2 / 4-3
SBT (value)	Enter substrate thickness for microstrip calibration	0.001 mm to 1.0 m	MMT, CMT, MTR	4-2 / 4-3
SCL (value)	Set resolution for display on active channel	Depends on graph type	Depends on graph type	3-5 / 3-7
SCM	Select standard calibration method	N/A	N/A	4-2 / 4-3
SDK (filename)	Store trace memory to disk in file specified	File name string 8 characters max	N/A	5-5 / 5-17
SDR	Select standard receiver mode	N/A	N/A	5-12 / 5-30
SFC	Start flat test port calibration sequence	N/A	N/A	4-2 / 4-3
SH1 (value)	Set offset short 1 offset length	–999.999 to +999.999	MMT, CMT, MTR	4-2 / 4-3
SH2 (value)	Set offset short 2 offset length	–999.999 to +999.999	MMT, CMT, MTR	4-2 / 4-3
SL0	Select source lock mode with GPIB source control off	N/A	N/A	5-12 / 5-30
SL1	Select source lock mode with GPIB source control on	N/A	N/A	5-12 / 5-30
SLD	Select sliding load for calibration	N/A	N/A	4-2 / 4-3
SMC (value)	Select compressed Smith chart for active channel	3	DBL, XX1	3-5 / 3-7
SME (value)	Select expanded Smith chart for active channel	10, 20 , 30	DBL, XX1	3-5 / 3-7

GPIB Commands Listed Alphabetically (15 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
SMI	Select normal Smith chart for active channel	N/A	N/A	3-5 / 3-7
SOF	Turn off smoothing	N/A	N/A	3-6 / 3-10
SON (value)	Turn on smoothing and set to value	0 to 20	XX1, XX3, XM3	3-6 / 3-10
SPD (value)	Enter pen speed percentage	10 to 100	XX1, XX3, XM3	3-11 / 3-16
SQ0	Disable SRQs	N/A	N/A	5-6 / 5-20
SQ1	Enable SRQs	N/A	N/A	5-6 / 5-20
SRA	Set GPIB source control to A, Mnemonic ACF required	N/A	N/A	3-13 / 3-20
SRB	Set GPIB source control to B, Mnemonic ACF required	N/A	N/A	3-13 / 3-20
SRT (value)	Set start frequency	Start sweep freq to stop sweep freq	GHZ, MHZ, KHZ	3-4 / 3-5
ST0	Select set on mode with GPIB source control off	N/A	N/A	5-12 / 5-30
ST1	Select set on mode with GPIB source control on	N/A	N/A	5-12 / 5-30
STD	Store trace to memory	N/A	N/A	3-8 / 3-12
STO (filename)	Save calibration data and front panel setup to disk file	File name string 8 characters max	N/A	5-5 / 5-17
STP (value)	Set stop frequency	Start sweep freq to stop sweep freq	GHZ, MHZ, KHZ	3-4 / 3-5
SV1-SV4	Save front panel setup to internal memory 1-4	N/A	N/A	5-2 / 5-3
SVB	Save current band definitions	N/A	N/A	5-8 / 5-26
SWP	Select frequency sweep mode	N/A	N/A	3-4 / 3-5
SWR	Select SWR display for active channel	N/A	N/A	3-5 / 3-7
T13	Select overlaid dual channel display (one display frame), channels 1 & 3	N/A	N/A	3-2 / 3-4
T24	Select overlaid dual channel display (one display frame), channels 2 & 4	N/A	N/A	3-2 / 3-4
TA1 (value)	Set test attenuator, port 1	0 to 100 (depends on test set)	DBL, DBM, XX1, XX3, XM3	3-4 / 3-5
TA2 (value)	Set test attenuator, port 2	0 to 100 (depends on test set)	DBL, DBM, XX1, XX3, XM3	3-4 / 3-5
TBP	Select time bandpass mode for active channel	N/A	N/A	5-7 / 5-24
TC1	Take calibration data for current standard on test port 1 (only)	N/A	N/A	4-2 / 4-3
TC2	Take calibration data for current standard on test port 2 (only)	N/A	N/A	4-2 / 4-3

GPIB Commands Listed Alphabetically (16 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
TCD	Take calibration data for current standard (both test ports)	N/A	N/A	4-2 / 4-3
TDC	Select time domain harmonic frequency calibration data points	N/A	N/A	4-2 / 4-3
TDD (filename)	Store tabular data to disk file specified	File name string 8 characters max	N/A	5-5 / 5-17
TDL (value)	Through DC coefficient for loss	–999.999 to +999.999	XX1	4-2 / 4-3
TEX	Select external measurement triggering	N/A	N/A	5-9 / 5-28
TFE (value)	Through frequency exponent for loss	-9.999 to +9.999	XX1	4-2 / 4-3
TFL (value)	Through frequency coefficient for loss	–999.999 to +999.999	XX1	4-2 / 4-3
TIB	Select measurement triggering via GET	N/A	N/A	5-9 / 5-28
TIN	Select internal measurement triggering	N/A	N/A	5-9 / 5-28
TK0	Select tracking mode with GPIB source control off	N/A	N/A	5-12 / 5-30
TK1	Select tracking mode with GPIB source control on	N/A	N/A	5-12 / 5-30
TLP	Select time lowpass mode for active channel	N/A	N/A	5-7 / 5-24
TOL (value)	Through offset length	–999.9999 to +999.9999	MMT, CMT, MTR	4-2 / 4-3
TP1	Select port 1 for flat test port calibration	N/A	N/A	4-2 / 4-3
TP2	Select port 2 for flat test port calibration	N/A	N/A	4-2 / 4-3
TPI	Select time phasor impulse mode for active channel	N/A	N/A	5-7 / 5-24
TRS	Trigger/restart sweep	N/A	N/A	3-4 / 3-5
TSA	Select test set A; mnemonic ACF required	N/A	N/A	3-13 / 3-20
TSB	Select test set B; mnemonic ACF required	N/A	N/A	3-13 / 3-20
TST	Self-test error reporting function; refer to Table 3-12.	N/A	N/A	3-12 / 3-18
U10, U15, U25	Select 10 mil UTF calibration kit for calibration for microstrip measurements. Select 15 mil calibration kit. Select 25 mil calibration kit.	N/A	N/A	4-2 / 4-3
U19	Select U band (40-60 GHz) with WR-19	N/A	N/A	3-17 / 3-23
US1-US4	Measure user parameter 1-4 on active channel	N/A	N/A	3-4 / 3-5
USC	Select microseconds terminator	N/A	N/A	3-3 / 3-4
USE (value)	Enter effective dielectric for microstrip calibration	1.0 to 9999.99	XX1, XX3, XM3	4-2 / 4-3
USL (string)	Enter user parameter label string	5 characters max.	N/A	3-4 / 3-5

GPIB Commands Listed Alphabetically (17 of 17)

360 GPIB Command	Description	Values	Terminators	Paragraph/ Page No.
USW (value)	Enter microstrip width for microstrip calibration	0.001 mm to 1.0 m	MMT, CMT, MTR	4-2 / 4-3
USZ (value)	Enter microstrip impedance for microstrip calibration	1.0 to 9999.99	XX1, XX3, XM3	4-2 / 4-3
V15	Select V band (50-75 GHz) with WR-15	N/A	N/A	3-17 / 3-23
VEE	Direct external video signal to external screen	N/A	N/A	3-14 / 3-21
VEI	Direct external video signal to internal screen	N/A	N/A	3-14 / 3-21
VIE	Direct internal video signal to external screen	N/A	N/A	3-14 / 3-21
VII	Direct internal video signal to internal screen	N/A	N/A	3-14 / 3-21
VLT	Select volts terminator	N/A	N/A	3-3 / 3-4
VSP (value)	Select voltage stop value	–10 to 9.96 volts	VLT	5-10 / 5-29
VST (value)	Select voltage start value	–10 to 9.96 volts	VLT	5-10 / 5-29
W10	Select W band (75-110 GHz) with WR-10	N/A	N/A	3-17 / 3-23
WCO (value)	Set waveguide cutoff frequency for user-defined kit	0 to current start frequency	GHZ, MHZ, KHZ	4-2 / 4-3
WFS	Wait full sweep until all display data is valid	N/A	N/A	3-4 / 3-5
WKD	Select user-defined waveguide calibration kit	N/A	N/A	4-2 / 4-3
WKI	Select installed waveguide calibration kit	N/A	N/A	4-2 / 4-3
WLS	Select low sidelobe window shape	N/A	N/A	5-7 / 5-24
WMS	Select minimum sidelobe window shape	N/A	N/A	5-7 / 5-24
WNM	Select nominal window shape	N/A	N/A	5-7 / 5-24
WRT	Select rectangular window shape	N/A	N/A	5-7 / 5-24
XM3	Select unitless terminator, x 10E-3	N/A	N/A	3-3 / 3-4
XX1	Select unitless terminator, x 1	N/A	N/A	3-3 / 3-4
XX3	Select unitless terminator, x 10E+3	N/A	N/A	3-3 / 3-4
ZCT (value)	Set zoom range center value	–999.999 to 999.999 µs –999.999 to 999.999 m	PSC, NSC, USC, MMT, CMT, MTR	5-7 / 5-24
ZSN (value)	Set zoom range span value	0 to 999.999 µs 0 to 999.999 m	PSC, NSC, USC, MMT, CMT, MTR	5-7 / 5-24
ZSP (value)	Set zoom range stop value	–999.999 to 999.999 µs –999.999 to 999.999 m	PSC, NSC, USC, MMT, CMT, MTR	5-7 / 5-24
ZST (value)	Set zoom range start value	–999.999 to 999.999 µs –999.999 to 999.999 m	PSC, NSC, USC, MMT, CMT, MTR	5-7 / 5-24