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Programming Manual

HP 5371A Frequency and Time Interval Analyzer

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PROGRAMMING MANUAL

HP 5371A

Frequency and Time Interval Analyzer

MANUAL APPLICABILITY

This manual applies directly to an HP 5371A having the serial number prefix listed below. (The firmware revision number is displayed at the bottom of the screen, obtained by pressing the front-panel SYSTEM hardkey when the instrument is on.)

If your instrument serial prefix number is lower than the serial prefix number above, check its firmware revision number.

If the firmware revision number is the same as that listed above, use this Programming Manual (HP Part Number 05371-90032).

If the firmware revision number is higher than that listed above, use this manual with the "Manual Updating Changes" included with it. If your instrument serial prefix number and firmware revision number are both lower than those listed above (respectively), refer to HP 5371A Programming Manual having HP Part Number 05371-90014.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY THIS MANUAL in the Introduction.

SERIAL NUMBER: Prefix 3018
FIRMWARE REVISION: 3018A

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CERTIFICATION

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

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

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

LIMITATION OF WARRANTY

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

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THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

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

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed. Refer to instructions in this appendix.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the mains power source to the product input wiring terminals or supplied power cable.

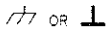
SAFETY SYMBOLS



Instruction manual symbol; the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual.



Indicates hazardous voltages.



Indicates terminal is connected to chassis when such connection is not apparent.



Alternating current.



Direct current.

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

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

SAFETY INFORMATION

WARNING

Any interruption of the protective grounding conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.)

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the earthed pole terminal (neutral) of the power source.

Instructions for adjustments while covers are removed and for servicing are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform such adjustments or servicing unless qualified to do so.

For continued protection against fire, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay). Do not use repaired fuses or short-circuited fuseholders.

When measuring power line signals, be extremely careful and always use a step-down isolation transformer whose output voltage is compatible with the input measurement capabilities of this product. This product's front and rear panels are typically at earth ground, so **NEVER TRY TO MEASURE AC POWER LINE SIGNALS WITHOUT AN ISOLATION TRANSFORMER.**

ACOUSTIC NOISE EMISSION:

LpA 56 dB at operator position, at normal operation, tested per ISO 7779. All data are the results from type test.

GERAeUSCHEMISSION:

LpA 56 dB am Arbeits platz, normaler Betrieb, gepuert nach DIN 45635 Teil 19. Die Angaben behruhen auf Ergebnissen von Typprueeffungen.

PRINTING HISTORY

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional pages and replacement pages to be merged into the manual by the user. Title page dates change only when a new edition or a new update is published.

Many product updates and improvements do not require manual changes and, conversely, manual corrections are sometimes independent of product changes. Therefore, there will not be a one-to-one correspondence between product updates and manual updates.

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Edition 2	4/88	05371-90014	E1288
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INTRODUCTION

This section contains programming information for remotely operating the HP 5371A Frequency and Time Interval Analyzer through the Hewlett-Packard Interface Bus (HP-IB). The information in this section includes a basic description of the HP-IB, and descriptions of the 5371A interface capabilities, remote operation characteristics, status reporting structure, and output formats.

NOTE

Refer to Section 2 for a description of all the 5371A HP-IB programming commands, and program examples.

The HP 5371A Frequency and Time Interval Analyzer can be operated through the Hewlett-Packard Interface Bus (HP-IB). All menu functions and front panel controls (excluding the power switch) are programmable through the HP-IB. At the simplest level, the HP 5371A can transmit data in the "talk only" mode to output devices such as a printer or plotter. In more sophisticated systems, a controller or computer can program the 5371A to perform a specific type of measurement and direct it to process and transfer the results.

Most of the 5371A remote programming operations are extensions of the front panel functions. Other operations, such as teach/learn and instrument identification, are only available in remote operation.

An appropriate controller for the 5371 is one that is compatible with HP BASIC 4.0 or later, such as a Hewlett-Packard Series 200 or 300 technical computer. All program examples given in this manual are written assuming an HP 9000 Series 200/300 Computer as the controller. Refer to Appendix A for information about connecting a controller to the 5371A.

HP-IB DESCRIPTION

The Hewlett-Packard Interface Bus (HP-IB) is a high speed parallel interface bus. All devices on the bus are capable of being addressed at one time, however, only one device may respond at a time. The controller is used to command a specific device to respond, and to maintain the flow of data and interface functions.

The HP-IB system uses a party-line structure (devices share signal lines). A maximum of 15 devices may be connected in an HP-IB system, in virtually any configuration desired. There must be an uninterrupted path to every device operating on the bus. Sixteen signal lines and eight control lines are used to interconnect devices in parallel arrangement and maintain an orderly flow of device and interface related information.

Interface System Terms

The following list defines the terms and concepts used to describe HP-IB system operations.

Address: Each device on the interface is assigned an address. The address is used to specify which device will receive information or send information.

Byte: A byte is a unit of information consisting of eight binary digits called bits.

Device: Any instrument or unit that is HP-IB compatible is called a device.

Device-Independent Command: A command predefined by the interface standard to have a specified bit pattern and resulting action.

Device-Dependent Command: A command that is specific to a particular instrument or family of instruments, which is not predefined by the interface standard. Device-dependent commands are usually sent as ASCII strings of characters.

Polling: Polling is a process typically used by a controller to locate a device that requires service from the controller. There are two types of polling, Serial Poll and Parallel Poll:

1. **Serial Poll:** When the controller executes a serial poll, the addressed device sends one byte of operational information called a status byte. If more than one device on the interface is capable of requesting service, each device on the interface must be polled until the device that requested service is located.
2. **Parallel Poll:** The HP 5371A does not have parallel poll capability.

Major Interface Functions

Each device on the interface bus may have one or more of the following major device capabilities: Controller, Talker, or Listener. The controller has the responsibility of controlling interface activity, and must be equipped with the proper interface module. Controllers transmit all device-independent commands to other devices in the interface and usually have Talker and Listener capabilities. Only one device on the interface may be the active controller at any one time. The HP 5371A has no controller capabilities.

Talkers are devices that have the ability to send data or device-dependent commands through the interface. Note that a talker will not actually send data or information until the appropriate command is sent by the controller. The HP 5371A has Talker capabilities. When the instrument is talking on the interface, or is addressed to talk, the TLK LED on the front panel will turn on. In special situations, a device may be classified as a Talk Only device, and send information to Listen Only devices. Such a system has no controller. For example, the 5371A can be configured to "talk only" and send measurement results to a printer by setting the instrument to the TALK ONLY mode.

Listeners are devices with capability to receive information over the interface. When the instrument is listening, or addressed to listen, the LSN LED on the front panel will turn on. Listeners must also be enabled by the controller to receive data or information.

5371A INTERFACE CAPABILITIES

The capabilities of a device connected to the bus are specified by its interface function. These functions provide the means for a device to receive, process, and send messages over the bus.

Table 1-1 lists the HP-IB interface functions defined by the IEEE 488-1978 standard, including the name, mnemonic, and a brief description. Also listed in the table are the subset identifiers (the interface function mnemonic followed by a number) which indicate the specific HP-IB interface function capabilities of the HP 5371A.

Table 1-1. HP 5371A HP-IB Interface Function Capabilities

Name and Mnemonic	General Description	Subset Identifier	Specific HP 5371A Capability
Source Handshake (SH)	Capability to properly translate a multiline message.	SH1	The 5371A can generate messages.
Acceptor Handshake (AH)	Capability to guarantee proper reception of remote multiline messages.	AH1	The 5371A can interpret received messages.
Talker (T)	Capability to transmit data over the bus when addressed.	T5	The 5371A can function as a talker. In addition, it can operate as a Talk Only instrument and will respond to serial poll. It will unlisten if addressed as a talker.
Extended Talker (TE)	Talker capability with address extension.	TE0	The 5371A cannot function as an extended talker.
Listener (L)	Capability to receive data over the bus when addressed.	L4	The 5371A can function as a listener. In addition, it will untalk if addressed as a listener.
Extended Listener (LE)	Listener capability with address extension.	LE0	The 5371A cannot function as an extended listener.
Service Request (SR)	Capability permitting a device to asynchronously request service from the controller.	SR1	The 5371A can generate a service request.
Remote/Local (RL)	Capability to select between two sources of input information: local (front panel controls) and remote (input information from the bus).	RL1	The 5371A can operate both in remote and local modes. In addition, it can respond to local lockout.

Table 1-1. HP 5371A HP-IB Interface Function Capabilities (Continued)

Name and Mnemonic	General Description	Subset Identifier	Specific HP 5371A Capability
Parallel Poll (PP)	Provides capability for a device to uniquely identify itself if it requires service and the controller is requesting a response. This capability differs from service request in that it requires a commitment of the controller to periodically conduct a parallel poll.	PP0	The 5371A does not support parallel poll.
Device Clear (DC)	This function allows a device to be initialized to a predefined state.	DC1	The 5371A supports both the Device Clear (DCL) and Selected Device Clear (SDC) commands.
Device Trigger (DT)	This function permits a device to have its basic operation initiated by the talker on the bus.	DT1	The 5371A can be remotely triggered.
Controller (C)	This function permits a device to send addresses, universal commands, and addressed commands to other devices on the HP-IB. It may also include the ability to conduct polling to determine devices requiring service.	C0	The 5371A cannot function as a controller.
Drivers (E)	This code describes the type of electrical drivers used in a device.	E2	The 5371A has three-state drivers.

Nearly all controls on the instrument can be programmed remotely, and data from the measurements can be sent to the controller through the HP-IB. The HP 5371A operates as both a talker and a listener, as described in *Table 1-1*. The instrument's output format is the same regardless of the mode (Talk Only/Addressable). The following paragraphs describe the basic programming capability of the HP 5371A.

TALK: The 5371A can be addressed to TALK by a controller or by setting the instrument to the TALK ONLY mode. When addressed as a Talker, the instrument will send data to other devices on the bus. This data may be the result of a measurement, error messages, diagnostic results, or other operations.

LISTEN: When addressed as a Listener, the instrument will accept any number of commands from a controller on the bus. These commands are used to program the instrument operation.

- SERVICE REQUEST:** A Service Request (SRQ) will be generated on the interface when an enabled status bit is set. The 5371A has the capability to request service asynchronously from the controller in charge of the bus.
- REMOTE/LOCAL:** At power-up, the instrument is under front panel (local) control. When the 5371A receives a programming command, it switches to Remote. Once in Remote, programmable functions cannot be affected by the front panel controls. The LOCAL key may be used to manually return to local control only if the Local Lockout (LLO) is off. If Local Lockout is on, the LOCAL key is ignored, and the bus command LOCAL must be sent to disable LLO.
- PARALLEL POLL:** The 5371A does not respond to parallel poll.
- DEVICE CLEAR:** When a universal or selected Device Clear is received, the 5371A clears any errors present, clears all input and output buffers, and resets the hardware for a new measurement.
- DEVICE TRIGGER:** When a Device Trigger is received, the instrument will start a new measurement, if the sample rate is set to SINGLE. If the sample rate is set to REPETITIVE, the Device Trigger command is ignored.
- CONTROLLER:** The 5371A cannot be used as a controller.

Front Panel Interface Status LEDs

The remote status of the HP 5371A is indicated by four Interface Status LED annunciators (REM, LSN, TLK, SRQ) in the upper right corner of the front panel, as follows:

- RMT:** Turns on to indicate that instrument is under remote control.
- LSN:** Turns on to indicate that instrument is addressed to listen (receive commands) or is an active listener.
- TLK:** Turns on to indicate that instrument is addressed to talk (send data) or is an active talker.
- SRQ:** Turns on to indicate that the instrument is requesting service from the interface controller.

HP-IB ADDRESS SELECTION

To use the HP 5371A in an HP-IB system, the instrument must be set to the desired HP-IB address. The address is used by the controller to identify the 5371A. The range of permissible addresses is "0" to "30", inclusive. The address is saved when the 5371A is off or unplugged. If this address cannot be recalled due to memory or battery failure, a default address of "3" will be used.

The HP-IB address for the 5371A is set via the front panel keyboard. To set the HP-IB address, press the front panel SYSTEM key. On the SYSTEM menu screen, the "Addressing Mode" field should display TALK/LISTEN. Press the down arrow key to move the menu cursor to the "Device Address" field and use the "Increment Value" or "Decrement Value" softkeys to select the address.

Whenever a controller is used in a system, the 5371A functions both as a talker and a listener. When the 5371A is operating without a controller on the bus, it can be set to Talk Only mode to output results to another device on the bus, such as a printer or plotter. In the Talk Only mode, the 5371A functions only in an output condition, and the receiving device must be set to Listen Only.

INTERFACE COMMANDS

The 5371A recognizes two classes of commands: device-independent commands and device-dependent commands. Device-independent commands are defined by the interface standard document and are the same for all instruments. Device-dependent commands are unique to the instrument and are defined by the instrument designer.

The device-independent commands are described in the following paragraphs, while the device-dependent commands are described in Section 2, HP-IB PROGRAMMING COMMANDS.

Device-Independent Commands

Device-independent commands are identified by three-letter mnemonics such as GTL, which represents Go To Local. Device-independent commands are sent as encoded bytes on the interface bus and not as ASCII strings, thus these commands cannot be sent from the controller using the OUTPUT statement. Many controllers, however, do incorporate a command of the form SEND7;CMDnnn, where nnn is the decimal equivalent to the bit pattern corresponding to a particular device-independent command.

Table 1-2 lists the mnemonic, full name, and a brief description of the instrument response for each supported device-independent command.

Table 1-2. Device-Independent Commands

Mnemonic	Command Name	Description
ATN	Attention	Alerts the instrument of each device independent message being sent, so the instrument is ready to accept data and interpret them as commands.
DCL	Device Clear	This command clears all errors, aborts all partially completed commands and pending send data commands, and clears all input and output buffers.
EOI	End Or Identify	If ATN is false and the instrument is a listener, EOI acts as a message delimiter, and indicates the last data byte of a multibyte sequence.
GET	Group Execute Trigger	If the instrument is addressed to listen, GET aborts the current measurement, and triggers the next measurement immediately.
GTL	Go To Local	If the instrument is addressed to listen, GTL returns the instrument to front panel (local) operation. Local Lockout is not cleared.
IFC	Interface Clear	The instrument untalks and unlistens, and the interface initializes to an idle state (no activity on the bus).
LAD _n	Listen Address n	If n matches the instrument address, the instrument becomes a listener.
LLO	Local Lockout	The front panel LOCAL key is disabled if the instrument is in remote mode.
MLA	My Listen Address	MLA is the listen address (LAD _n) that matches the instrument address.
MTA	My Talk Address	MTA is the talker address (TAD _n) that matches the instrument address.
NRE	Not Remote Enable	The instrument returns to front panel (local) operation; Local Lockout is cleared.
NUL	Null	No effect when received by the instrument.
REN	Remote Enable	The instrument enters the remote state, and is enabled to respond to interface commands when addressed as a listener.
SDC	Selected Device Clear	If the instrument is a listener, will cause the same response as DCL.

Table 1-2. Device-Independent Commands (Continued)

Mnemonic	Command Name	Description
SPD	Serial Poll Disable	Terminates serial polling, and returns the instrument to a normal talker state to output device dependent data rather than status information.
SPE	Serial Poll Enable	Establishes serial polling, and enables the instrument to send the serial poll status byte when addressed to talk.
TAD _n	Talk Address <i>n</i>	If <i>n</i> matches the instrument address, the instrument becomes a talker.
UNL	Unlisten	The instrument is unaddressed and terminates listening. A single device cannot be unaddressed without unaddressing all listeners.
UNT	Untalk	Unaddresses the instrument, if currently a talker, and terminates talking. Addressing another talker on the interface automatically unaddresses any current talker.

Meta Messages

To simplify the use of the HP-IB interface, Hewlett-Packard has developed what is called the Meta Message concept. Rather than require the user to remember all the device-independent messages and their interactions, useful sequences of these commands have been integrated into a single command on many of Hewlett-Packard's controllers. For example, to clear the instrument at address 3 using the device-independent commands, it would be necessary to send the sequence ATN, UNL, MTA, LAD 3, SDC. The HP 9836 command "CLEAR 3" sends the same sequence with no further user interaction required, thus greatly simplifying the use of the interface.

Many of the messages implemented on the HP 9836 may be sent in either of two forms, with addressing and without addressing. The form with addressing will normally address a particular device to listen. For example, the command "REMOTE 7" will send REN without making any device a listener, while the command "REMOTE 703" will send REN and make the device at address 3 a listener.

Through meta messages, devices on the bus can exchange control and measurement information. *Table 1-3* provides a description of these messages, and the response of the HP 5371A to each message. Also included in the table is the typical interface message sequence that corresponds to each meta message. The interface message sequences are typical in that different controllers may send different sequences for a given meta message, but will produce the same result.

Table 1-3. Meta Messages

Meta Message	Command Sequence	General Description	Specific HP 5371A Response
DATA	UNL, MTA, LADn, data	Transfers device dependent information from one device to one or more devices on the bus.	The 5371A sends measurement data as defined by the device dependent command received from the controller.
TRIGGER	UNL, MTA, LADn, GET	Causes a group of selected devices to simultaneously initiate a set of device dependent actions.	Starts a new measurement.
CLEAR	UNL, MTA, LADn, SDC	Causes the instrument to be set to a predefined state, such as a certain range or function.	Causes the 5371A to clear any errors present, clears all input and output buffers, and resets the hardware for a new measurement.
REMOTE	REN, UNL, MTA, LADn	Permits selected devices to be set to remote operation, allowing parameters and device characteristics to be controlled by bus messages.	Causes the 5371A to go to remote operation if REN is true, and if instrument is addressed to listen. Locks out all front panel keys except LOCAL; instrument is controlled by bus messages. Until changed via the bus, remote operation is according to state of front panel settings just prior to going to remote.
LOCAL	UNL, MTA, LADn, GTL	Causes selected devices to return to local (front panel) operation.	Returns the 5371A to front panel control. Instrument status is that set just prior to receipt of the Local message.
LOCAL LOCKOUT	LLO	Disables local (front panel) controls of selected devices.	Disables LOCAL key. The 5371A remains in remote operation until a Local message is received on the bus.
LOCAL/ CLEAR LOCAL LOCKOUT	LCLL	Returns all devices to local (front panel) control and simultaneously clears the Local Lockout message.	Returns 5371A to local control and clears Local Lockout message.

Table 1-3. Meta Messages (Continued)

Meta Message	Command Sequence	General Description	Specific HP 5371A Response
SERVICE REQUEST	SRQ	Indicates a device's need for interaction with the controller.	The 5371A will send a Service Request message to the controller under certain conditions, as defined by the settings of the Event Status Enable and Hardware Status Enable registers. This message is ignored by the 5371A when received.
STATUS BYTE	UNL, MLA, TADn, SPE, data, SPD, UNT	Presents status information of a particular device; one bit indicates whether or not the device currently requires service, the other seven bits (optional) are used to indicate the type of service required.	The 5371A sends status information to the controller. The assignment of the bits in the Status Byte are shown in <i>Table 1-6</i> .
STATUS BIT	Not applicable	A single bit of device-dependent status information which may be logically combined with status bit information from other devices on the controller.	The 5371A does not use this message.
PASS CONTROL	Not applicable	Passes bus controller responsibilities from the current controller to a device which can assume the bus supervisory role.	The 5371A does not use this message.
ABORT	IFC	Unconditionally terminates bus communications and returns control to the system controller.	All HP-IB activity terminated and control returns to the system controller. Talk and Listen are cleared for the 5371A and all other devices on the bus, which terminates all bus communications. The 5371A status remains as it was just prior to receipt of the Abort message. Any partially entered HP-IB data message is aborted.

REMOTE OPERATION

When the 5371A is operated in the remote mode, all front panel controls, except the power switch and the LOCAL key (if Local Lockout is not active) are disabled. The 5371A will respond to programming commands when addressed to listen and it can send data messages and the Status Byte when addressed to talk.

Switching from Local to Remote Operation

The 5371A will switch from Local to Remote when it receives one of the following messages:

- Its listen address, while the REN (Remote Enable) control line is true.
- The REMOTE programming command, while REN is true.

The instrument settings remain unchanged during local-to-remote transitions. The front panel RMT LED will be on while the 5371A is in the Remote mode.

Switching from Remote to Local Operation

The 5371A will switch from Remote to Local when it receives one of the following messages:

- The GTL (Go To Local) interface command.
- The REN (Remote Enable) line goes false, i.e., the Clear Lockout/Set Local message.
- The LOCAL programming command.
- An internal return-to-local message, generated by the front panel LOCAL key only if Local Lockout is not active.

The 5371A settings remain unchanged during remote-to-local transitions. The front panel RMT LED will be off while the 5371A is in the Local mode.

Talk-Only Mode

When the 5371A is set to the Talk-Only mode, it is configured as a talker and does not respond to programming or interface commands.

Receiving the Device Clear Message

In response to either the Device Clear message or the Selected Device Clear message, the 5371A will:

- Clear the input and output buffers.
- Reset the command parser to enable parsing of the next message.
- Discard all deferred commands and queries.
- Terminate any measurement or acquisition process.

Receiving the Group Execute Trigger Message

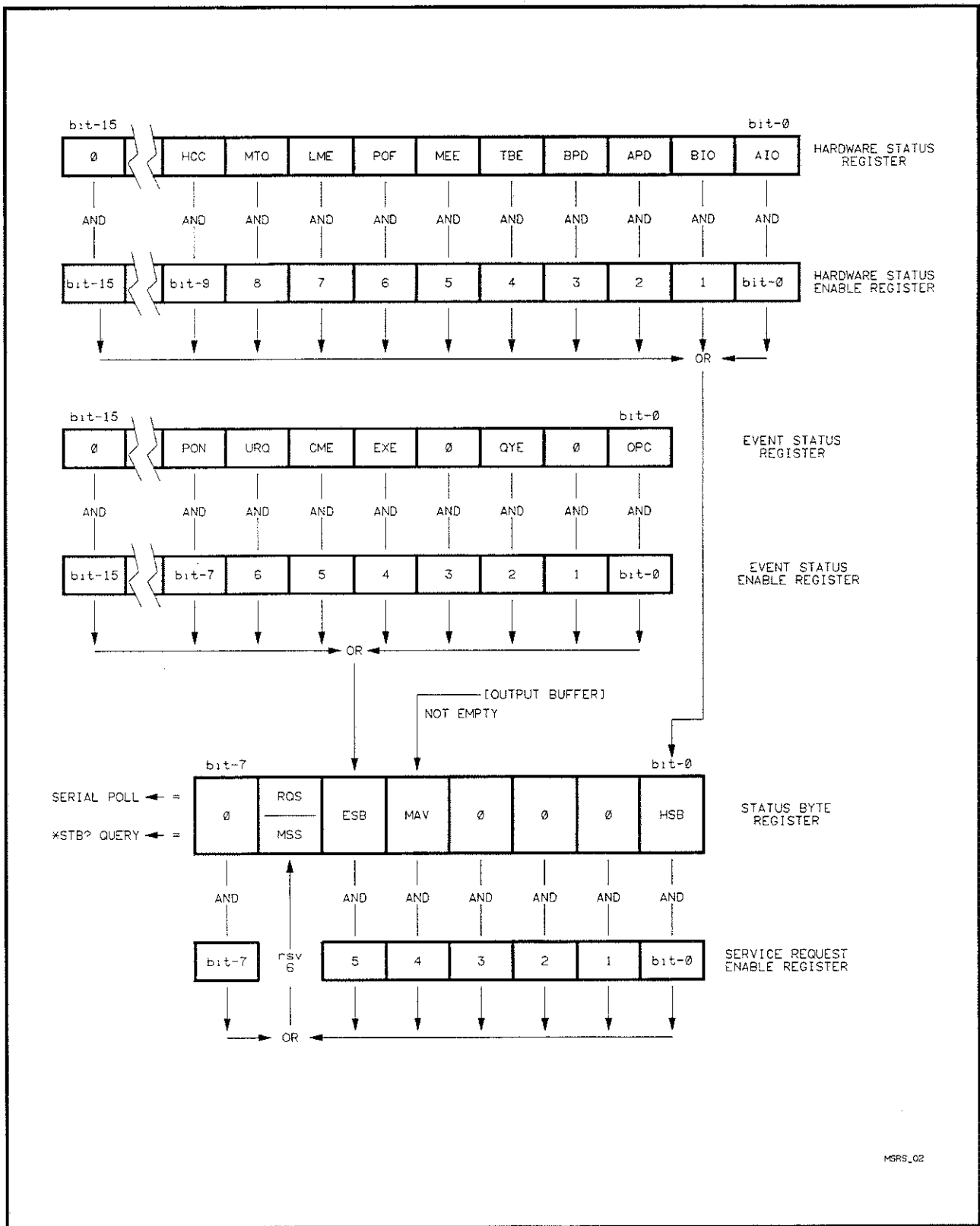
The 5371A responds to the Group Execute Trigger GET command by triggering a measurement (i.e., the instrument responds exactly as if it had received the *TRG or REStart command to restart a measurement).

STATUS REPORTING AND SERVICE REQUEST

The 5371A can send a Service Request (SRQ) to the controller to indicate the need for attention, and can interrupt the current sequence of events. Typically, the status reporting structure of the 5371A will send an SRQ to indicate that data is ready to be transmitted and/or an abnormal condition exists.

The status reporting structure of the 5371A consists of three status registers containing single-bit summary messages representing current hardware status or the occurrence of an event. Each of the status registers has a corresponding enabling register to allow the user to set the conditions under which the 5371A will generate an SRQ.

Figure 1-1 shows the status reporting structure of the 5371A.



MGRS_02

Figure 1-1. 5371A Status Reporting Structure

Status Registers

The three status registers of the 5371A are:

- **Hardware Status Register** – indicates status of the measurement and input amplifier circuitry.
- **Event Status Register** – indicates parsing and execution errors.
- **Status Byte Register** – contains the summary messages from the Event Status and Hardware Status Registers. In addition, the Status Byte Register reports the status of the Output Buffer.

Status Enabling Registers

The three Status Enabling Registers are used to set the conditions under which the 5371A will generate an SRQ. The 5371A sends an SRQ to the controller after a 0-to-1 transition of an enabled condition. The Enable Registers are:

- **Hardware Status Enable Register**
- **Event Status Enable Register**
- **Service Request Enable Register**

Each bit in an Enable Register is logical-ANDed with the corresponding bit in the associated Status Register (see *Figure 1-1*). To enable a condition to generate an SRQ, the bit in the enable register corresponding to the desired condition must be set to 1.

All the bits of a given enable register are logical-ORed with each other; the resultant summary of either the Hardware Status Register or the Event Status Register appears in the Status Byte Register (HSB, bit 0 and ESB, bit 5, respectively). The summary resulting from the logical-OR of the bits of the Status Byte Register, if equal to 1, will generate an SRQ.

HARDWARE STATUS REGISTER

The Hardware Status Register is a 16-bit register that reflects the status of the measurement hardware. These status conditions are summarized by the Hardware Status Bit (HSB) summary message, which appears in bit 0 of the Status Byte register.

Table 1-4 defines the status bits in the Hardware Status Register.

Table 1-4. 5371A Hardware Status Register

Bit #	Binary Weight	Status Bit Condition
15 - 10	-----	Not used; set to zero
9	512	Hardcopy Complete (HCC) - High indicates that a hardcopy output (printer or plotter) is completed.
8	256	Measurement Timeout Error (MTO) - High indicates that a measurement timeout occurred.
7	128	Limits Error (LME) - High indicates that a measurement limit testing error occurred.
6	64	Power-On Failure (POF) - High indicates that a power-on failure occurred.
5	32	Missing Event Error (MEE) - High indicates that time interval measurement events were lost.
4	16	Time Base Error (TBE) - High indicates that the timebase oscillator is out of lock.
3	8	Channel B Pod (BPD) - High indicates that the Channel B input pod has been removed.
2	4	Channel A Pod (APD) - High indicates that the Channel A input pod has been removed.
1	2	Channel B Input Overload (BIO) - High indicates that the Channel B input amplitude exceeds the maximum level.
0	1	Channel A Input Overload (AIO) - High indicates that the Channel A input amplitude exceeds the maximum level.

Reading the Hardware Status Register

The Hardware Status Register is read with the *HSR? query. This query returns an integer value representing the sum of the binary-weighted values of the register's bits. For example, a returned integer value of 68 (64 + 4) would indicate that bit 6 (POF: Power-On Failure) and bit 2 (APD: Channel A Pod) of the Hardware Status Register were set to 1.

When the Hardware Status Register is read, all bits of the register are cleared.

Clearing the Hardware Status Register

The Hardware Status Register is cleared by any one of the following:

- The *CLS command
- A power-on transition
- The read operation initiated by the *HSR? query.

HARDWARE STATUS ENABLE REGISTER

The Hardware Status Enable Register is a 16-bit register that allows one or more events in the Hardware Status Register to be reflected in the Hardware Status Bit (HSB) summary message. Each bit of the Enable register is ANDed with its corresponding bit in the Hardware Status Register; the Enable register bits are ORed to determine the summary HSB message. The HSB message appears at bit 0 of the Status Byte Register. If HSB is set to 1, and bit 0 of the Service Request Enable Register is set to 1, an SRQ is generated.

Reading the Hardware Status Enable Register

The Hardware Status Enable Register is read with the *HSE? query. This query returns an integer value representing the sum of the binary-weighted values of the register's bits, as previously described for the Hardware Status Register. For example, a returned integer value of 68 (64+4) indicates that bit 6 and bit 2 of the Hardware Status Enable Register are set to 1, thus enabling bit 6 (POF: Power-On Failure) and bit 2 (APD: Channel A Pod) of the Hardware Status Register.

Writing to the Hardware Status Enable Register

The Hardware Status Enable Register is written to with the *HSE command. The numeric argument of this command must be the integer representation of the sum of the binary-weighted values of the enabled bits. Using the example of the previous paragraph, an integer value of 68 would be written to the register to set bit 6 and bit 2 to 1.

Clearing the Hardware Status Enable Register

The Hardware Status Enable Register is cleared by:

- Sending the *HSE command with a numeric data value of zero.
- A power-on transition, if *PSC is true.

EVENT STATUS REGISTER

The Event Status Register is a 16-bit register that reflects generic error conditions and operating states. These status conditions are summarized by the Event Status Bit (ESB) summary message, which appears in bit 5 of the Status Byte Register.

Table 1-5 defines the status bits contained in the Event Status Register, as well as the specific 5371A implementation. Note that the 5371A uses only some of the available bits in the register; those not used are always set to zero.

Table 1-5. 5371A Event Status Register

Bit #	Binary Weight	Name and Defined Event	5371A Implementation
15 - 8	-----	(Reserved by IEEE)	Not used; set to zero
7	128	Power-On (PON) - High indicates that the ac power has been cycled.	(same)
6	64	User Request (URQ) - High indicates that Local control has been activated.	LOCAL key pressed
5	32	Command Error (CME) - High indicates that a syntax or semantic error has occurred.	(same)
4	16	Execution Error (EXE) - High indicates that invalid range values or conflicting settings have been selected.	(same)
3	8	Device-Dependent Error (DDE) - Not defined.	Not used; set to zero
2	4	Query Error (QYE) - High indicates that no output is present or pending.	(same)
1	2	Request Control (RQC) - High indicates that Controller mode is requested by the instrument.	Not used; set to zero
0	1	Operation Complete (OPC) - High indicates that parsing is completed.	(same)

Reading the Event Status Register

The Event Status Register is read with the *ESR? query. This query returns an integer value representing the sum of the binary-weighted values of the register's bits. For example, a returned integer value of 36 (32+4) would indicate that bit 5 (CME: Command Error) and bit 2 (QYE: Query Error) of the Event Status Register were set to 1.

When the Event Status Register is read, all bits are cleared.

Clearing the Event Status Register

The Event Status Register is cleared by:

- The *CLS command
- A power-on transition
- The read operation initiated by the *ESR? query.

EVENT STATUS ENABLE REGISTER

The Event Status Enable Register is a 16-bit register that allows one or more events in the Event Status Register to be reflected in the Event Status Bit (ESB) summary message. Each bit of the Enable register is ANDed with its corresponding bit in the Event Status Register; the Enable register bits are ORed to determine the summary ESB message. The ESB message appears at bit 5 of the Status Byte Register. If ESB is set to 1, and bit 5 of the Status Byte Enable Register is set to 1, an SRQ is generated.

Reading the Event Status Enable Register

The Event Status Enable Register is read with the *ESE? query. This query returns an integer value representing the sum of the binary-weighted values of the register bits, as previously described for the Event Status Register. For example, a returned integer value of 36 (32+4) indicates that bit 5 and bit 2 of the Event Status Enable Register are set to 1, thus enabling bit 5 (CME: Command Error) and bit 2 (QYE: Query Error) of the Event Status Register.

Writing to the Event Status Enable Register

The Event Status Enable Register is written to with the *ESE command. The numeric argument of this command must be the integer representation of the sum of the binary-weighted values of the enabled bits. Using the example of the previous paragraph, an integer value of 36 would be written to the register to set bit 5 and bit 2 to 1.

Clearing the Event Status Enable Register

The Event Status Enable Register is cleared by:

- Sending the *ESE command with a numeric data value of zero.
- A power-on transition, if *PSC is true.

STATUS BYTE REGISTER

The Status Byte Register is an 8-bit register containing the summary messages generated by the Hardware Status Register, the Event Status Register, Output Buffer, and other instrument conditions. It also contains the Request Service (ROS)/Master Status Summary message (in bit 6).

Table 1-6 defines the bits on the Status Byte Register.

Table 1-6. 5371A Status Byte Register

Bit #	Binary Weight	Status Bit Condition
7	128	Not used.
6	64	RQS/MSS (Request Service/Master Status Summary) - High indicates that the 5371A has a reason for requesting service.
5	32	Event Status Summary (ESB) - High indicates that an event in the Event Status Register (ESR) has occurred.
4	16	Message Available (MAV) - High indicates that the 5371A is ready to output data.
3	8	Not used.
2	4	Not used.
1	2	Not used.
0	1	Hardware Status Summary (HSB) - High indicates that an event in the Hardware Status Register (HSR) has occurred.

Summary Messages

As shown in *Table 1-6*, four bits in the Status Byte Register contain summary messages reflecting instrument status. The summary messages are defined below.

MASTER STATUS SUMMARY (MSS) MESSAGE

When high, the MSS summary message indicates that the 5371A has a reason for requesting service.

The MSS message appears in bit 6 of the Status Byte Register. The other 7 bits of the Status Byte Register are ANDed with the corresponding bits in the Service Request Enable Register (see *Figure 1-1*), and the resulting values are ORed to determine the MSS summary message.

Although the MSS message is sent as bit 6 of the response to the *STB? query, it is not sent in response to a serial poll. Instead, the RQS (Request For Service) message is returned when the 5371A is serial polled.

EVENT STATUS BIT (ESB) SUMMARY MESSAGE

When high, the ESB summary message indicates that one or more enabled events in the Event Status Register occurred since this register was last read or cleared.

The ESB message appears in bit 5 of the Status Byte Register. The bits of the Event Status Register are ANDed with the corresponding bits of the Event Status Enable Register (see *Figure 1-1*), and the resulting values are ORed to determine the ESB message.

MESSAGE AVAILABLE (MAV) MESSAGE

When high, the MAV summary message indicates that the 5371A is ready to accept a request by the controller to output data bytes. The MAV message will be set Low when the output buffer is empty.

The MAV message appears in bit 4 of the Status Byte Register. This message can be used to synchronize data transfers with the controller. After sending a query to the 5371A, the controller can enable the MAV bit (by setting the Service Request Enable Register) to generate a request for service when data becomes available. During this time, the HP-IB interface is available for other use, since it is not suspended by the 5371A.

HARDWARE STATUS BIT (HSB) SUMMARY MESSAGE

When high, the HSB summary message indicates that one or more enabled events in the Hardware Status Register occurred since this register was last read or cleared.

The HSB message appears in bit 0 of the Status Byte Register. The bits of the Hardware Status Register are ANDed with the corresponding bits of the Hardware Status Enable Register (see *Figure 1-1*), and the resulting values are ORed to determine the HSB message.

Reading the Status Byte Register

The Status Byte Register may be read by a serial poll or with the *STB? query. Both methods will return an integer value representing the sum of the binary-weighted values of the bits of the register, as described for the Hardware Status and Event Status Registers. The values returned for bit 6, however, will depend on the method used:

- When serial polled, bit 6 is the RQS message, indicating whether the 5371A is actively requesting service (by asserting the SRQ interface signal). The RQS message will be set Low (False) following a serial poll.
- When queried with the *STB? query command, the MSS message is sent as bit 6, in place of the RQS message.

In either case, reading the Status Byte Register does not alter the summary messages in the register.

Clearing the Status Byte Register

The Status Byte Register can be cleared indirectly by sending the *CLS command. Since the *CLS command clears all event registers, their corresponding summary messages will also be cleared. The output buffer and the MAV summary message are exceptions; they are not cleared by *CLS.

SERVICE REQUEST ENABLE REGISTER

The Service Request Enable Register is an 8-bit register that enables corresponding summary messages in the Status Byte Register. When enabled, a summary message will generate a request-for-service message.

Reading the Service Request Enable Register

The Service Request Enable Register is read with the *SRE? query. The *SRE? query returns an integer value representing the sum of the binary-weighted values of the bits of the register. For example, a returned value of 48 (32 + 16) indicates that bit 5 and bit 4 of the Service Request Enable Register are set to 1, thus enabling bit 5 (ESB) and bit 4 (MAV) of the Status Byte Register. Note that the value of bit 6 will always be zero.

Writing to the Service Request Enable Register

The Service Request Enable Register is written to by the *SRE command. The numeric argument of the *SRE command must be the integer representation of the sum of the binary-weighted values of the enabled bits. Using the example of the previous paragraph, an integer value of 48 would be written to the register to set bit 5 and bit 4 to 1.

Clearing the Service Request Enable Register

The Service Request Enable Register is cleared by:

- Sending the *SRE command with a data value of zero.
- A power-on transition, if *PSC is true.

PROGRAM MESSAGES

The 5371A responds to program messages while it is in the remote operating state and addressed to listen. Two types of program messages are defined: commands and queries. Command messages direct the 5371A to change its configuration or perform a measurement operation. Query messages are used to interrogate the 5371A for information describing its current state.

The 5371A programming commands are divided into three structures:

- System Commands control general instrument functions. System commands may be issued at any time; they do not change the subsystem selector.
- Subsystem Selectors specify the subsystem to which all future subsystem commands will refer. These commands may be issued at any time, with one important exception: some subsystem selector mnemonics are the same as some subsystem command mnemonics. In this case, the function of a particular mnemonic will depend on the context in which it is used.
- Subsystem Commands are used to change specific instrument settings and may be issued only after a subsystem has been selected.

NOTE

The following paragraphs describe general rules and information for 5371A programming messages, including program message format, arguments, parameter formats, and delimiters. Refer to Section 2 for a detailed description of the 5371A command structure, and a description of each of the 5371A commands and queries.

PROGRAM COMMAND FORMAT

The following paragraphs describe command abbreviations (mnemonics), alpha and numeric argument formats, delimiters, and 5371A output formats. The command mnemonics are covered in detail in Section 2, HP-IB PROGRAMMING COMMANDS, and are only briefly discussed here. Refer to Section 2 for command descriptions, information about specific arguments and parameters for individual commands, and 5371A query responses.

Command Mnemonics

In general, a command consists of a message header followed, if applicable, by a parameter field. The message header may be sent in long or abbreviated form (referred to as longform or shortform). This allows the choice of creating self-documenting programs by using longform commands or programs that minimize the amount of required memory space by using shortform commands.

For example, the longform for the Continuous Time Interval command is CTINTERVAL and the shortform is CTIN. Other examples are:

SLOPE abbreviates to SLOP

CHANNEL abbreviates to CHAN

ERROR? abbreviates to ERR?

ARMING abbreviates to ARM

Refer to COMMAND MNEMONICS in Section 2 for information on how to derive shortform and longform command mnemonics.

Alpha and Numeric Arguments

Commands that require "ON" and "OFF" parameters may use either alpha or numeric arguments. The alpha argument "OFF" can be represented by "0" and the argument "ON" can be represented by "1". Note that queries of binary parameters are returned as "1" for values of "ON" and "0" for values of "OFF" (the numeric representations are defined by IEEE standards as the "shortforms" for the alpha characters "ON" and "OFF").

Parameter Formats

The parameter field following a command can be composed of words or numbers. A parameter field must be one of four types:

Numeric An integer, floating point, or exponential value. When sending an exponent, the characters `<E>` or `<e>` must be used to delimit the mantissa. The syntax follows the integer (NR1), decimal (NR2), or exponential (NR3) formats shown in format, *Figure 1-2*.

Alpha ASCII strings that start with an alpha character and are followed by any printable character except `<space>`, `<;>`, `<, >`, `<#>`, `<">`, or `<_>`. An apostrophe `<'>` is allowed. Examples of alpha arguments are "OFF" and "ON".

String Any collection of ASCII characters delimited by quotation marks `<">`, except that embedded quotation parameter marks are not allowed.

Block A block of binary data defined as:

`<#> <length> <length bytes> <DAB> <DAB> ...`

where `<length>` is a single byte which contains the number of `<length bytes>`. The number specified by `<length bytes>` represents the number of data bytes `<DAB>` that follow.

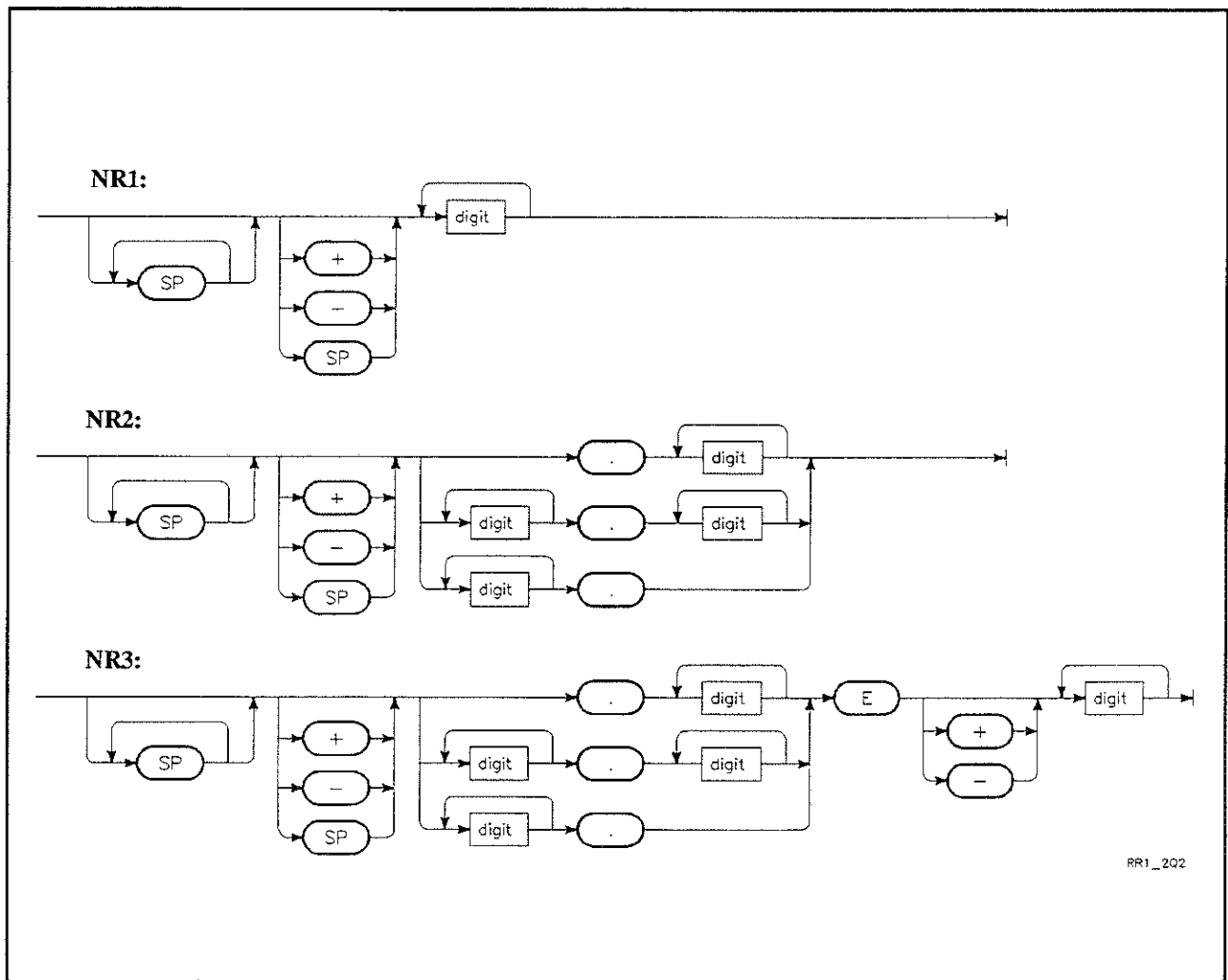


Figure 1-2. Numeric Program Data Format

Command Formatting General Rules

The general rules for program command formatting are:

- All program messages (except binary types) are interpreted as standard 7-bit ASCII code.
- No distinction is made between upper and lower case letters.
- The instrument responds equally to longform and shortform message headers.
- The instrument responds equally to alpha and numeric arguments in the case of commands requiring “ON” and “OFF” as arguments.
- Command headers and multiple arguments must be explicitly delimited.

Message Delimiters

A program message is a string of one or more program commands followed by an End-of-String (EOS) message. The use of delimiters in a program message is governed by the following rules:

- Multiple arguments for a program command must be delimited by commas `<,>` or spaces `<SP>`.
- Program commands must be delimited by a semicolon `<;>`.
- A new line `<NL>` or EOI (End Or Identify signal) must be used as the EOS message. Each program message must be terminated either by a `<NL>` or by asserting the EOI signal with the last byte in the message.
- One or more carriage returns `<CR>` immediately preceding a new line character `<NL>` are ignored by the instrument.

Processing Considerations

Program commands which comprise a data message string are not executed until the entire string is sent. The commands in the string are then interpreted and processed in the order received. Commands preceding an error in a multi-command message are executed up to the point where the error occurred.

MEASUREMENT MESSAGES

The 5371A is capable of sending measurement messages when it is addressed to talk or set to the talk-only mode. Measurement messages convey the result of a measurement operation or the status of the 5371A to a controller or another system device. The following paragraphs describe the specific content and format of measurement messages.

Measurement Message Overview

Measurement messages include measured parameters, instrument settings, and status information. Information contained within these messages is represented by one of three data types: numeric, block, or character. In general, the 5371A sends measurement results in either numeric or block formats, and sends status information in the character format.

MEASUREMENT RESULT FORMATS

The 5371A uses one of three measurement result formats to transmit output data: ASCII, binary, and floating point. The following paragraphs describe each format and provide examples of typical 5371A measurement result messages. Refer to Appendix G for programming examples showing the various output formats.

ASCII Measurement Result Format

The ASCII measurement result format is used to transmit processed measurement data. To accommodate a wide range of values, the ASCII measurement results are formatted as shown in the syntax diagrams in *Figure 1-3*.

Each ASCII measurement result consists of a fixed-length, 21-character data field. Leading spaces are used to right-justify the number within the field in order to maintain a constant length. Embedded or trailing spaces are suppressed.

Leading spaces, if any, are followed by the algebraic sign of the number. For positive values and zero, the sign is sent as the ASCII space <SP> character; otherwise, a minus sign <-> precedes the first digit of the number. All representations of zero are expressed as "<SP>0.0E+00" (there is no representation for negative zero in binary floating point arithmetic).

A decimal point <.> is always sent as part of the ASCII measurement result message.

The exponent field consists of exactly two digits. It is expressed in scientific format, and unscaled units are always assumed.

A single message unit is terminated by the concurrent transmission of the EOI signal with the ASCII new line <NL> character, represented in the format examples in this manual by "<NL> ^END". When multiple message units are contained within a measurement message, these data fields are explicitly delimited by the ASCII semicolon <;>. When several data elements comprise a message unit, each data element is delimited by the ASCII comma <, >. To terminate the complete message, the <NL>, ^END sequence is sent at the end of the final message unit.

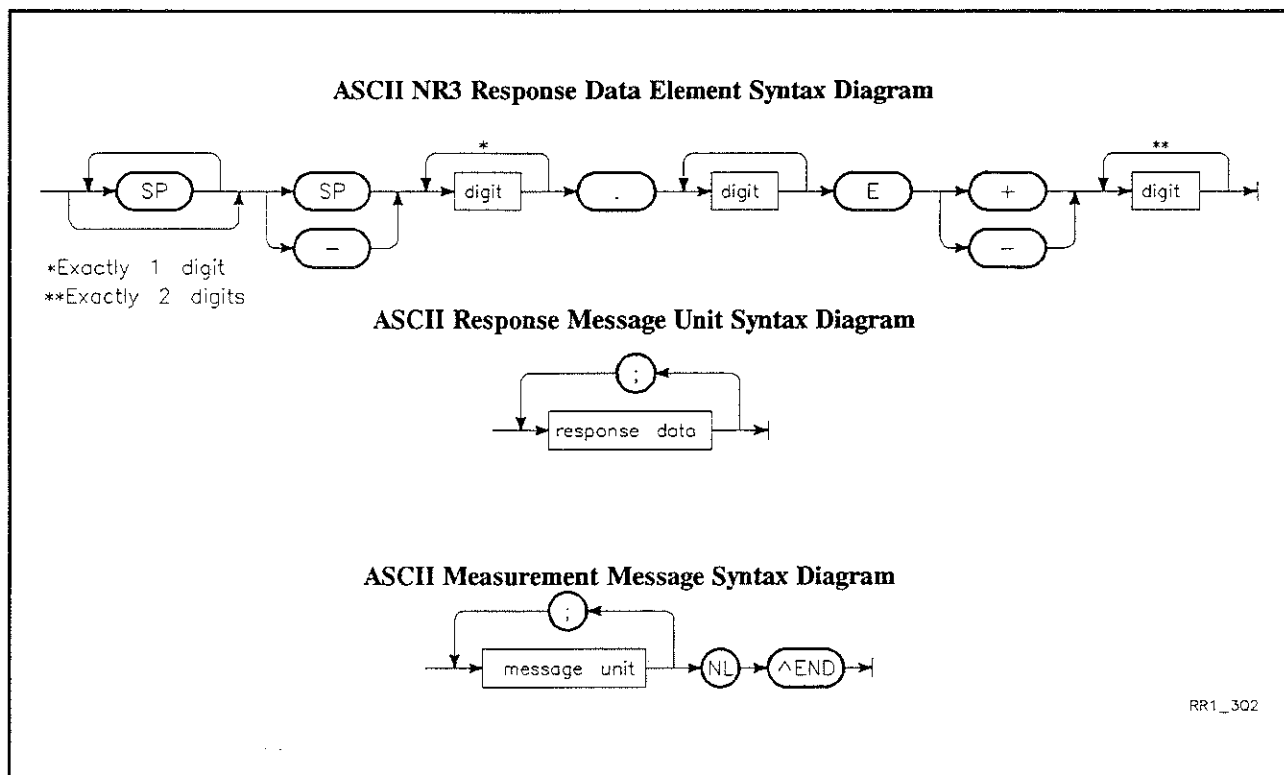


Figure 1-3. ASCII Measurement Result Syntax Diagrams

NOTES TO FIGURE 1-3:

1. In the Response Data Element syntax diagram, DIGIT represents one of the 7-bit ASCII codes from 48 through 57 (decimal), which corresponds to the numerals 0 through 9, respectively.
2. Total length of the Response Data Element is 21 characters.
3. RESPONSE DATA in the Message Unit syntax diagram is defined by the Response Data Element syntax diagram at the top of *Figure 1-3*.
4. MESSAGE UNIT in the Measurement Message syntax diagram is defined by the Response Message Unit syntax diagram in the middle of *Figure 1-3*.
5. <NL> ^END represents the assertion of the EOI signal with the ASCII new line character.

ASCII Measurement Result Format Examples

The following ASCII output format examples are divided into two groups. In the first group, specific numeric values are shown to illustrate formatting of results. In the second group, alphanumeric descriptions (such as <result A>) are used to simplify the examples.

FIRST GROUP:

Single Result:

```
<SPs> 1.23456789E+08 <NL> ^END      Frequency A = 123.456789 MHz
      <SPs> -5.371E-03 <NL> ^END      Scaled Period B = -5.371E-03
      <SPs> 1.0E-09 <NL> ^END         Time Interval A→B = 1 ns
      <SPs> 0.0E+00 <NL> ^END         Time Interval A→B = 0 ns
```

Note that <SPs> denotes one or more leading spaces.

Multiple Results:

Continuous Frequency A:

```
<SPs> 2.04E+07 <,>                  Frequency A [#1] = 20.4 MHz
<SPs> 2.05E+07 <,>                  Frequency A [#2] = 20.5 MHz
      .
      .
      .
<SPs> 2.01E+07 <NL> ^END            Frequency A [#n] = 20.1 MHz
```

Continuous Frequency A&B:

```
<SPs> 2.04E+07 <,>                  Frequency A [#1] = 20.4 MHz
<SPs> 5.00E+03 <,>                  Frequency B [#1] = 5.00 kHz
<SPs> 2.05E+07 <,>                  Frequency A [#2] = 20.5 MHz
<SPs> 4.99E+03 <,>                  Frequency B [#2] = 4.99 kHz
      .
      .
      .
<SPs> 2.01E+07 <,>                  Frequency A [#n] = 20.1 MHz
<SPs> 5.20E+03 <NL> ^END            Frequency B [#n] = 5.20 kHz
```

NOTE

Dual channel results are transferred in the sequence A,B for a simultaneous Channel A and B measurement.

SECOND GROUP:

In the following examples, a simplified notation is used to represent the different formats of elements of the response. To receive this data, the Numeric screen must be in either NUMERIC, BOLD, or SPLIT mode. In the following examples:

<res A> = result for the primary measurement channel

<res B> = result for the secondary measurement channel

<limit A, limit B> = "PASS", "HIGH", "LOW", or "INS"

<gate A> = gate time for the primary measurement channel

<gate B> = gate time for the secondary measurement channel

<mean>...<allan variance> = the statistical values available

<low values A, low values B> = the number of values which fell below the low limit

<pass values A, pass values B> = the number of values which fell between the low and high limits

<high values A, high values B> = the number of values which fell above the high limit

<inside values A, inside values B> = the number of values which fell inside the reversed limits

Single Result with Limit Testing:

```
<res A> <,> <limit A> <,>
.
.
.
<res A> <,> <limit A> <NL>^END
```

Single Result with Gate Time Data:

```
<res A> <,> <gate A> <,>
.
.
.
<res A> <,> <gate A> <NL>^END
```

Single Result with Limit Testing and Gate Time Data:

```
<res A> <,> <limit A> <,> <gate A> <,>
.
.
.
<res A> <,> <limit A> <,> <gate A> <NL>^END
```

Dual Result with Limit Testing:

```
<res A> <,> <limit A> <,> <res B> <,> <limit B> <,>
.
.
<res A> <,> <limit A> <,> <res B> <,> <limit B> <NL>^END
```

Dual Result with Gate Time Data:

```
<res A> <,> <res B> <,> <gate A> <,> <gate B> <,>
.
.
<res A> <,> <res B> <,> <gate A> <,> <gate B> <NL>^END
```

Dual Result with Limit Testing and Gate Time Data:

```
<res A> <,> <limit A> <,> <res B> <,> <limit B> <,> <gate A> <,> <gate B> <,>
.
.
<res A> <,> <limit A> <,> <res B> <,> <limit B> <,> <gate A> <,> <gate B>
<NL>^END
```

When Statistics mode is enabled and the 5371A is displaying the STATISTICS Numeric screen, the statistical data shown below will be sent instead of the measurement results data. Note that when the 5371A is displaying the SPLIT Numeric screen (which displays results plus four of the statistical values: Maximum, Mean, Minimum, and Standard Deviation), all eight statistical values will still be returned over the bus, after the applicable measurement results (as shown above) have been sent.

Single Result Statistics:

```
<mean A> <,> <std dev A> <,> <max A> <,> <min A> <,> <variance A> <,> <root
allan variance A> <,> <rms A> <,> <allan variance A> <NL>^END
```

Dual Result Statistics:

```
<mean A> <,> <std dev A> <,> <max A> <,> <min A> <,> <variance A> <,> <root
allan variance A> <,> <rms A> <,> <allan variance A> <,>
<mean B> <,> <std dev B> <,> <max B> <,> <min B> <,> <variance B> <,> <root
allan variance B> <,> <rms B> <,> <allan variance B> <NL>^END
```

When the 5371A is displaying the LIMITS screen, the statistical data above is not available. Instead, information about the number of measurements which passed and failed the limit testing (high, low, and inside limits) is sent. The format is:

Single Result in LIMIT Screen:

```
<low values A> <,> <pass values A> <,> <inside values A> <,> <high values A>
<,> <NL>^END
```

Dual Result in LIMIT Screen:

```
<low values A> <:> <pass values A> <:> <inside values A> <:> <high values A>  
<:> <low values B> <:> <pass values B> <:> <inside values B> <:> <high values  
B> <NL>^END
```

Binary Measurement Result Format

The Binary Measurement Format facilitates the transfer of measurement data from the counting hardware to the HP-IB without processor intervention. Time and/or event data, as well as interpolator data, are presented in 8-bit binary form using the block message syntax shown in *Figure 1-4*.

A binary message is initiated by the definite-length block preamble code, consisting of two bytes, <#> and <6>. The six digits represent an unsigned binary integer which specifies the number of data bytes that follow. The length of the binary message will vary according to the number of counting registers used, which in turn is dependent on the type of measurement performed.

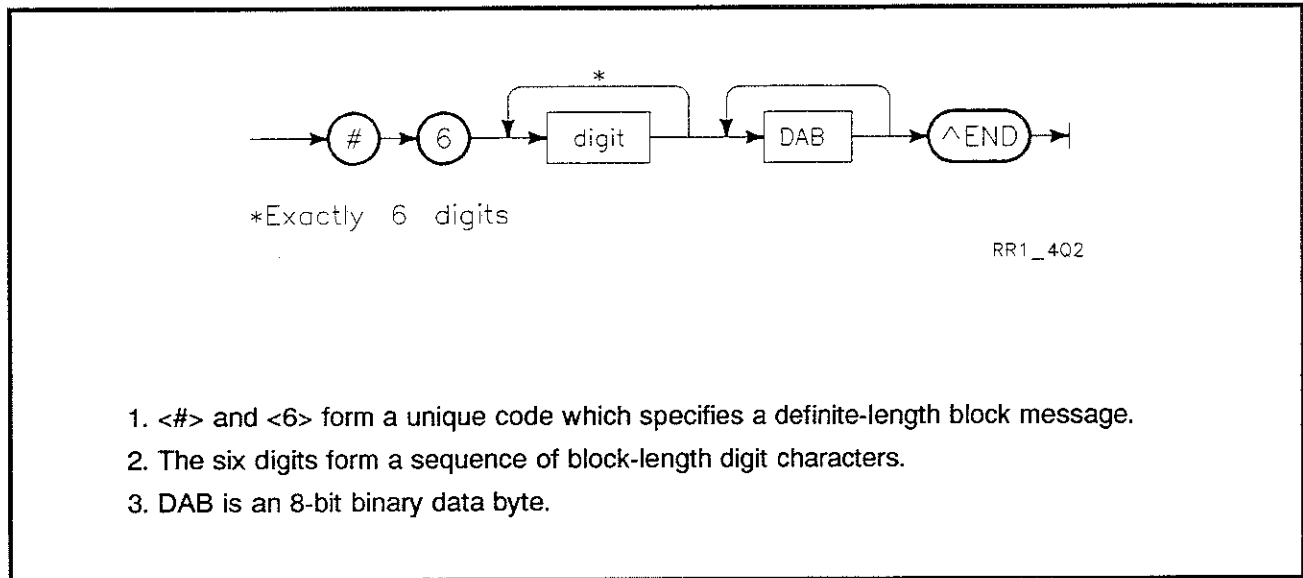
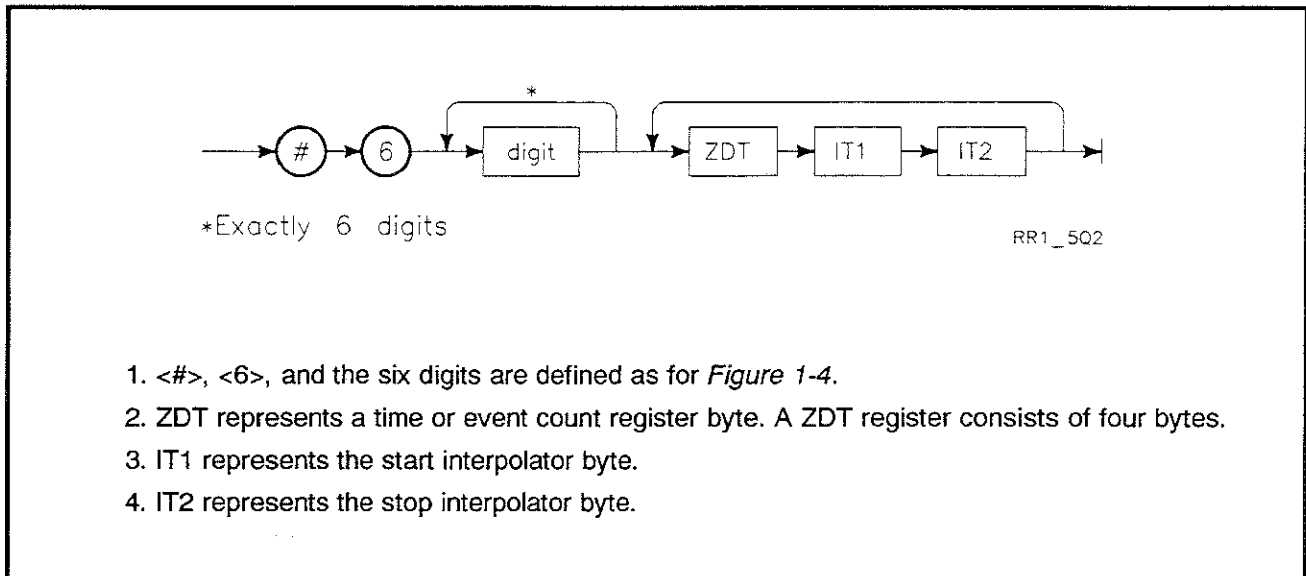


Figure 1-4. Binary Format Block Messages Syntax

Binary Data Type Formats

The data bytes of the message are the event and/or time data retrieved from the ZDTs and interpolators. The content of each 32-bit ZDT register is transferred as four consecutive bytes, with the most significant byte sent first. Interpolator data, which consists of five binary bits, is right-justified in byte form with the upper three bits being status bits. *Figure 1-5* shows the syntax for the binary measurement message.

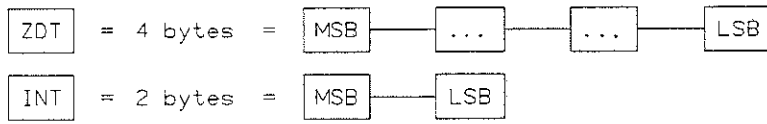


1. <#>, <6>, and the six digits are defined as for *Figure 1-4*.
2. ZDT represents a time or event count register byte. A ZDT register consists of four bytes.
3. IT1 represents the start interpolator byte.
4. IT2 represents the stop interpolator byte.

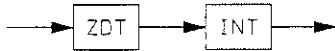
Figure 1-5. Binary Measurement Message Syntax Diagram

There are six data byte formats, as shown by the syntax diagrams in *Figure 1-6*. The various data types are listed in *Table 1-7* according to the type of measurement performed; the column labeled “FORMAT USED” refers to the formats shown in *Figure 1-6*. Note that in *Table 1-7*, “interp” means interpolators, and “nonusable” represents nonusable data.

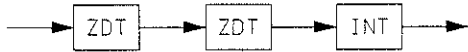
Format Types



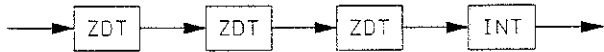
Format 1



Format 2



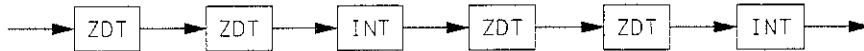
Format 3



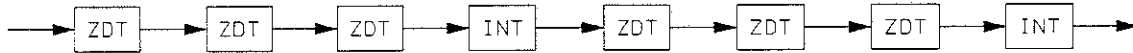
Format 4



Format 5



Format 6



FTYPES02

Figure 1-6. Binary Data Byte Format Syntax Diagrams

Table 1-7. Binary Data Type Formats

Measurement Type	Format Used	Description
Frequency, Period 1-channel measurement Arming = Automatic, Interval Sampling Cycle Sampling, Edge Sampling, Edge/Interval, Edge/Edge, Edge/Cycle	Format 2	Events, time, interp (IT2)
Frequency, Period 1-channel measurement Arming = Time/Interval, Event/Interval	Format 3	Events, nonusable, time, interp (IT2)
Frequency, Period 1-channel measurement Arming = Time Sampling, Edge/Time, Externally Gated, Edge/Event, Time/Time, Event/Event	Format 5	Start events, start time, interp (IT1) Stop events, stop time, interp (IT2)
Frequency, Period 2-channel measurement Arming = Automatic, Interval Sampling, Edge Sampling, Edge/Interval	Format 6	Nonusable, events A, time A, interp A (IT1) Events B, nonusable, time B, interp B (IT2)
Continuous Time Interval Expanded data OFF Arming = Automatic, Edge Holdoff, Time Holdoff, Event Holdoff, Interval Sampling, Repetitive Edge, Edge/Interval	Format 1	Time, interp (IT2)
Continuous Time Interval Expanded data ON Arming = Automatic, Edge Holdoff, Interval Sampling, Repetitive Edge, Edge/Interval	Format 2	Events, time, interp (IT2)
Continuous Time Interval Expanded data ON Arming = Time Holdoff, Event Holdoff	Format 3	Events, nonusable, time, interp (IT2)
Time Interval A, B Expanded data OFF Arming = Automatic, Edge Holdoff, Time Holdoff, Event Holdoff, Interval Sampling, Repetitive Edge, Edge/Interval	Format 4	Start time, interp (IT1) Stop time, interp (IT2)
Time Interval A, B Expanded data ON Arming = Automatic, Edge Holdoff, Interval Sampling, Repetitive Edge, Edge/Interval	Format 5	Start events, start time, interp (IT1) Stop events, stop time, interp (IT2)
Time Interval A, B Expanded data ON Arming = Time Holdoff, Event Holdoff	Format 6	Start events, nonusable, start time, interp (IT1) Stop events, nonusable, stop time, interp (IT2)

Table 1-7. Binary Data Type Formats (Continued)

Measurement Type	Format Used	Description
Time Interval A→B Expanded data OFF Arming = Automatic, Edge Holdoff, Time Holdoff, Event Holdoff, Interval Sampling, Repetitive Edge, Edge/Interval	Format 4	Time A, interp A (IT1) Time B, interp B (IT2)
Time Interval A→B Expanded data ON Arming = Automatic, Edge Holdoff, Interval Sampling, Repetitive Edge, Edge/Interval	Format 6	Nonusable, events A, time A, interp A (IT1) Events B, nonusable, time B, interp B (IT2)
Time Interval A→B Expanded data ON Arming = Time Holdoff, Event Holdoff	Format 6	Nonusable, nonusable, time A, interp A (IT1) Events B, nonusable, time B, interp B (IT2)
Time Interval B→A Expanded data OFF Arming = Automatic, Edge Holdoff, Time Holdoff, Event Holdoff, Interval Sampling, Repetitive Edge, Edge/Interval	Format 4	Time B, interp B (IT1) Time A, interp A (IT2)
Time Interval B→A Expanded data ON Arming = Automatic, Edge Holdoff, Interval Sampling, Repetitive Edge, Edge/Interval	Format 6	Nonusable, events B, time B, interp B (IT1) Events A, nonusable, time A, interp A (IT2)
Time Interval B→A Expanded data ON Arming = Time Holdoff, Event Holdoff	Format 6	Nonusable, nonusable, time B, interp B (IT1) Events A, nonusable, time A, interp A (IT2)
± Time Interval A, B Expanded data OFF (Expanded data ON is not available for Time/Time and Event/Event) Arming = Edge/Event, Time/Time, Event/Event	Format 4	Start time, interp (IT1) Stop time, interp (IT2)
± Time Interval A, B Expanded data ON Arming = Edge/Event	Format 5	Start events, start time, interp (IT1) Stop events, stop time, interp (IT2)
± Time Interval A→B Expanded data OFF Arming = Automatic, Edge Holdoff, Interval Sampling, Parity Sampling, Repetitive Edge, Repetitive Edge/Parity, Edge/Interval, Edge/Event, Edge/Parity, Time/Time, Event/Event	Format 4	Time A, interp A (IT1) Time B, interp B (IT2)

Table 1-7. Binary Data Type Formats (Continued)

Measurement Type	Format Used	Description
<p>± Time Interval A→B Expanded data ON (Expanded data ON is not available for Time/Time and Event/Event) Arming = Automatic, Edge Holdoff, Interval Sampling, Parity Sampling, Repetitive Edge, Repetitive Edge/Parity, Edge/Interval, Edge/Parity</p>	Format 6	Nonusable, events A, time A, interp A (IT1) Events B, nonusable, time B, interp B (IT2)
<p>± Time Interval A→B Expanded data ON Arming = Edge/Event</p>	Format 6	Nonusable, events A, time A, interp A (IT1) Nonusable, nonusable, time B, interp B (IT2)
<p>± Time Interval B→A Expanded data OFF Arming = Automatic, Edge Holdoff, Interval Sampling, Parity Sampling, Repetitive Edge, Repetitive Edge/Parity, Edge/Interval, Edge/Event, Edge/Parity, Time/Time, Event/Event</p>	Format 4	Time B, interp B (IT1) Time A, interp A (IT2)
<p>± Time Interval B→A Expanded data ON (Expanded data ON is not available for Time/Time and Event/Event) Arming = Automatic, Edge Holdoff, Interval Sampling, Parity Sampling, Repetitive Edge, Repetitive Edge/Parity, Edge/Interval, Edge/Parity,</p>	Format 6	Nonusable, events B, time B, interp B (IT1) Events A, nonusable, time A, interp A (IT2)
<p>± Time Interval B→A Expanded data ON Arming = Edge/Event</p>	Format 6	Nonusable, events B, time B, interp B (IT1) Nonusable, nonusable, time A, interp A (IT2)
<p>Totalize 1-channel measurement Arming = Interval Sampling, Edge Sampling, Edge/Interval, Edge/Edge Use TS1 (See Figure 1-7)</p>	Format 5	Events first read, time, nonusable Events second read, time, interp (IT2)
<p>Totalize 1-channel measurement Arming = Time/Interval Use TS2 (See Figure 1-7)</p>	Format 6	Events first read, nonusable, time, nonusable Events second read, nonusable, time, interp (IT2)
<p>Totalize 1-channel measurement Arming = Externally Gated, Manual Use TS1 (See Figure 1-7)</p>	Format 5	Start events first read, time, nonusable Start events second read, time, interp (IT1) Stop events first read, time, nonusable Stop events second read, time, interp (IT2)

Table 1-7. Binary Data Type Formats (Continued)

Measurement Type	Format Used	Description
Totalize 2-channel measurement Arming = Interval Sampling, Edge Sampling, Edge/Interval, Edge/Edge Use TS1 for A Use TS2 for B (see <i>Figure 1-7</i>)	Format 6	Events B first read, events A first read, time, nonusable Events B second read, events A second read, time, interp (IT2)
Totalize 2-channel measurement Arming = Externally Gated, Manual Use TS1 for A Use TS2 for B (see <i>Figure 1-7</i>)	Format 6	Start events B first read, start events A first read, time, nonusable Start events B second read, start events A second read, time, interp (IT1) Stop events B first read, stop events A first read, time, nonusable Stop events B second read, stop events A second read, time, interp (IT2)
Rise Time/Fall Time Common input channels Expanded data OFF Arming = Automatic	Format 4	Start time, interp (IT1) Stop time, interp (IT2)
Rise Time/Fall Time Common input channels Expanded data ON Arming = Automatic	Format 6	Nonusable, start events, start time, interp (IT1) Stop events, nonusable, stop time, interp (IT2)
Positive/Negative Pulse Width Common input channels Expanded data ON Arming = Automatic (Use of Expanded data ON and Format 6 is the recommended method for making pulse width measurements.)	Format 6	Nonusable, start events, start time, interp (IT1) Stop events, nonusable, stop time, interp (IT2)
Duty Cycle Common input channels Expanded data ON Arming = Automatic (Use of Expanded data ON and Format 5 is the recommended method for making duty cycle measurements.)	Format 5	Start events, start time, interp (IT1) Stop events, stop time, interp (IT2)
Phase 2-channel measurement Expanded data ON Arming = Automatic (Use of Expanded data ON and Format 6 is the recommended method for making phase measurements.)	Format 6	Nonusable, events A, time A, interp A (IT1) Events B, nonusable, time B, interp B (IT2)

Binary Measurement Result Format Examples

Single-Channel Frequency or Period Measurement:

	<#> <6> <digits 1 through 6>
(events)	(ZDT1-11) (ZDT1-12) (ZDT1-13) (ZDT1-14) ...
(time)	(ZDT3-11) (ZDT3-12) (ZDT3-13) (ZDT3-14) (IT1) (IT2) ...
	⋮
	(ZDT1-n1) (ZDT1-n2) (ZDT1-n3) (ZDT1-n4) ...
	(ZDT3-n1) (ZDT3-n2) (ZDT3-n3) (ZDT3-n4) (IT1n) (IT2n)

Notes:

1. (ZDT-i-nm) represents the m-th data byte retrieved from ZDT #i for measurement sample #n.
2. IT1n is the start interpolator value for measurement value #n.
3. IT2n is the stop interpolator value for measurement value #n.

Dual-Channel Frequency or Period Measurement:

	<#> <6> <digits 1 through 6>
(nonusable)	(ZDT1-11) (ZDT1-12) (ZDT1-13) (ZDT1-14) ...
(eventsA)	(ZDT2-11) (ZDT2-12) (ZDT2-13) (ZDT2-14) ...
(timeA)	(ZDT3-11) (ZDT3-12) (ZDT3-13) (ZDT3-14) (IT1) (IT2) ...
	⋮
(eventsB)	(ZDT1-21) (ZDT1-22) (ZDT1-23) (ZDT1-24) ...
(nonusable)	(ZDT2-21) (ZDT2-22) (ZDT2-23) (ZDT2-24) ...
(timeB)	(ZDT3-21) (ZDT3-22) (ZDT3-23) (ZDT3-24) (IT1) (IT2)

Single-Channel Totalize Measurement:

	<#> <6> <digits 1 through 6>
(first read)	(ZDT1-11) (ZDT1-12) (ZDT1-13) (ZDT1-14) ...
(time)	(ZDT3-21) (ZDT3-22) (ZDT3-23) (ZDT3-24) (IT1) (IT2) ...
	⋮
	(ZDT1-n1) (ZDT1-n2) (ZDT1-n3) (ZDT1-n4) (IT1) (IT2)

Dual-Channel Totalize Measurement:

	<#> <6> <digits 1 through 6>
(eventsB first read)	(ZDT1-11) (ZDT1-12) (ZDT1-13) (ZDT1-14) ...
(eventsA first read)	(ZDT2-11) (ZDT2-12) (ZDT2-13) (ZDT2-14) ...
(time)	(ZDT3-11) (ZDT3-12) (ZDT3-13) (ZDT3-14) (IT1) (IT2) ..
	⋮
	(ZDT1-n1) (ZDT1-n2) (ZDT1-n3) (ZDT1-n4) ...
	(ZDT2-n1) (ZDT2-n2) (ZDT2-n3) (ZDT2-n4) (IT1) (IT2)

Continuous Time Interval Measurement:

(time) <#> <6> <digits 1 through 6>
 (ZDT3-11) (ZDT3-12) (ZDT3-13) (ZDT3-14) (IT1) (IT2) ...
 .
 .
 (ZDT3-n1) (ZDT3-n2) (ZDT3-n3) (ZDT3-n4) (IT1) (IT2)

Calculating Binary Results

The method for calculating the measurement results from the binary data output is illustrated in *Figure 1-7*.

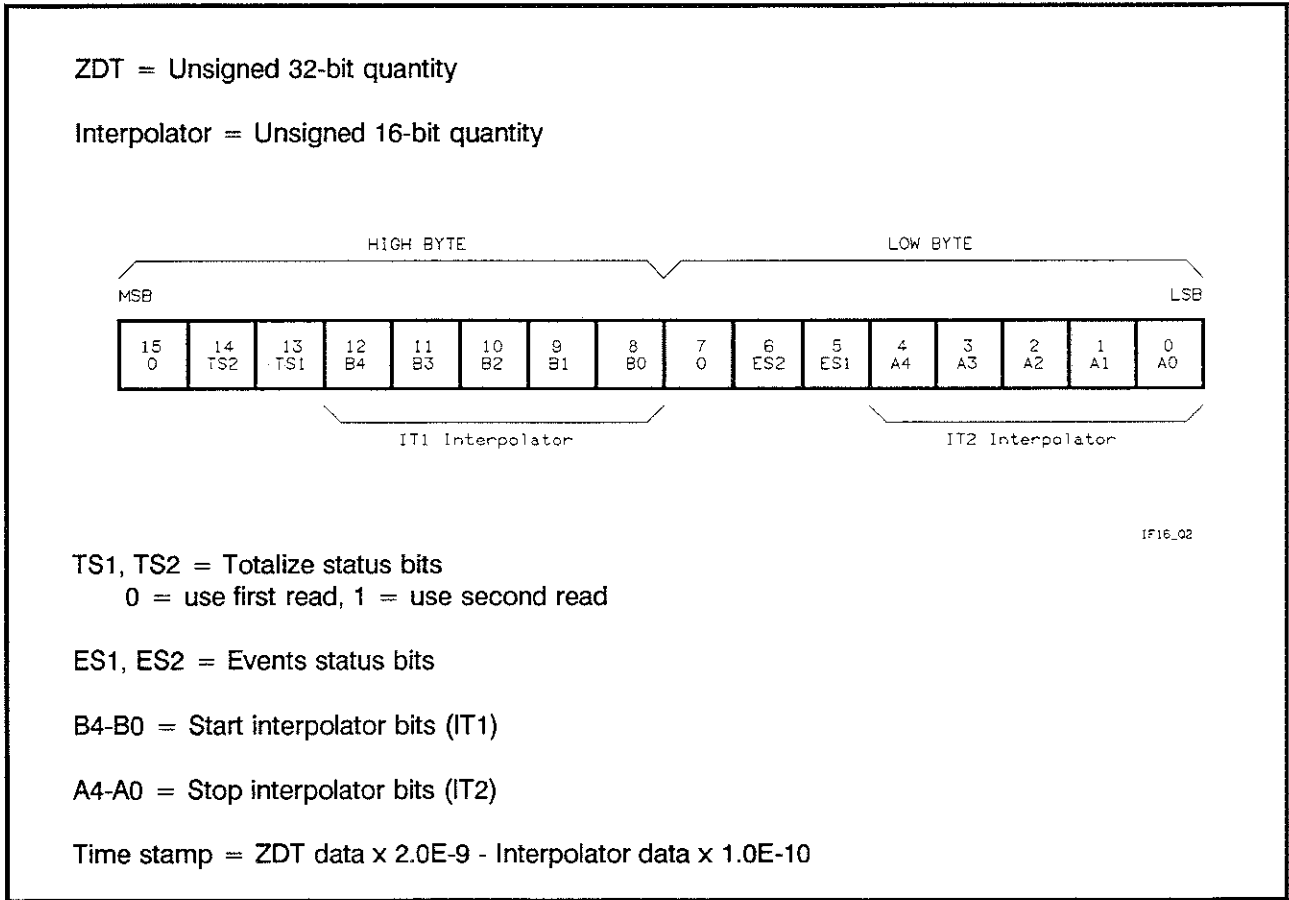


Figure 1-7. Binary Result Calculation

Internal Time Delay Offsets

For certain measurements, binary data output must be adjusted for systematic delays internal to the 5371A. The adjustment is made by algebraically adding the required value as an offset to the time result calculation. The required value depends on the type of measurement and the input configuration. Measurements requiring an offset adjustment are:

- Any non-continuous measurement
- + Time Interval measurements
- +/- Time Interval measurements
- Externally Gated (arming) Frequency measurements

Table 1-8 lists the required offset value for each input configuration for the measurements listed above.

Table 1-8. Internal Offset Values for Binary Data Output

Measurement Input Configuration	Offset Value
A→B (Both channels same attenuation)	400ps (400E-12)
A→B (A = X1, B = X2 attenuation)	-400ps (-400E-12)
A→B (A = X2, B = X1 attenuation)	1200ps (1200E-12)
A→B (COMMON inputs)	-400ps (-400E-12)
B→A (Both channels same attenuation)	800ps (800E-12)
B→A (B = X1, A = X2 attenuation)	0s (0.0E0)
B→A (B = X2, A = X1 attenuation)	1600ps (1600E-12)
B→A (COMMON inputs)	1600ps (1600E-12)
A→A, B→B	600ps (600E-12)

For example, a time result calculation for a Time Interval A→A measurement would be calculated as follows, with the required offset assigned to the variable `Offset_Value`:

$$200 \text{ Offset_Value} = 600\text{E-}12$$

$$210 \text{ Time_result}(i) = ((\text{Res_time}(i,2) - \text{Res_time}(i,1)) * 2\text{E-}9 - ((\text{Interp}(i,2) - \text{Interp}(i,1)) * 1\text{E-}10 + \text{Offset_Value}$$

Floating Point Measurement Result Format

The Floating Point Measurement Format offers faster transfer rates (compared to the ASCII rates) by sending each result in a packed, eight-byte format. The 5371A implements the double precision (64-bit) floating point representation specified by ANSI/IEEE Standard 754-1985.

Floating point response messages are sent in the block format shown in *Figure I-8*, where each measurement result consists of eight bytes. Each result is represented as follows:

```

Byte #1                                     Byte #8
SEEEEEEE EEEEEFFF FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF

```

where

S is the sign bit

E represents an 11-bit exponent biased by 1023

F represents a 52-bit fraction which, together with an implicit leading 1, yields the significant digit field "1.-"

Therefore, a real number (N) can be defined as follows:

1. If E is greater than or equal to 1, then:

$$N = (-1)^S * 2^{E-1023} * (1.F)$$

2. If E equals 0, then:

$$N = (-1)^S * 2^{-1022} * (0.F)$$

3. If E = F = 0, then:

$$N = 0$$

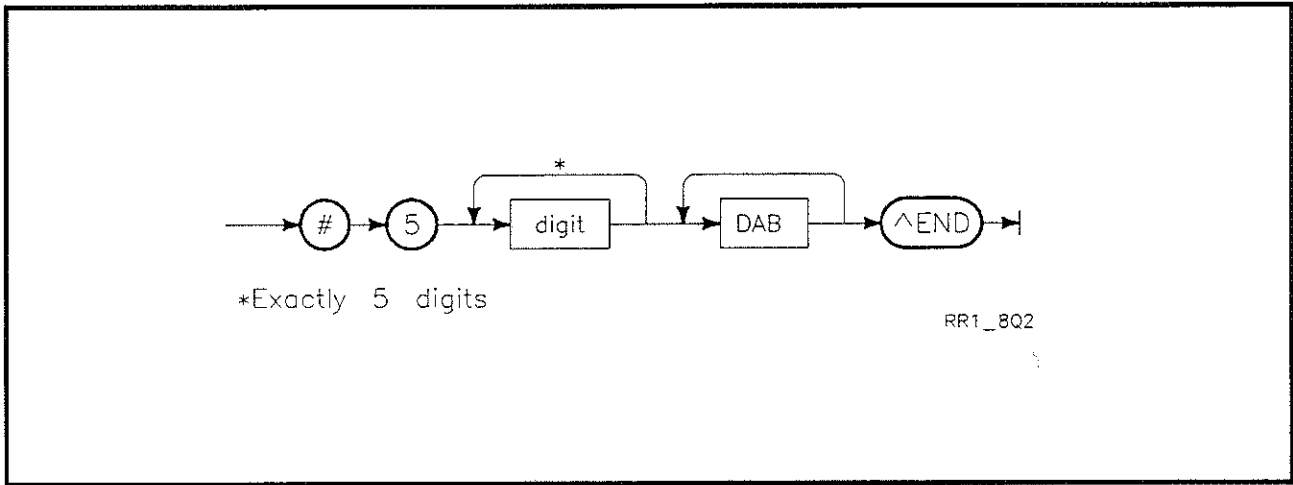


Figure 1-8. Floating Point Format Block Message Syntax

**Floating Point
Measurement Result
Format Examples**

Single Result:

Frequency A = 10 MHz:

<#>	Block
<5>	Preamble
<0>	-----
<0>	
<0>	Length byte
<0>	
<8>	-----
01000001	
01100011	
00010010	
11010000	10.0 MHz
00000000	
00000000	
00000000	
00000000	-----

Multiple Results:

Frequency A&B (Frequency A \cong 10 MHz, Frequency B \cong 5 MHz):

<#>	Block
<5>	Preamble
<0>	-----
<0>	
<0>	
<1>	Length byte
<6>	-----
01000001	
01100011	
00010010	
11010000	10.0 MHz
00000000	
00000000	
00000000	
00000000	
01000001	-----
01010011	
00010010	
11010000	5.0 MHz
00000000	
00000000	
00000000	
00000000	-----

**MEASUREMENT
OUTPUT RATES**

The 5371A sends measurements to the external HP-IB controller at the completion of each measurement block. Characteristic output rates are listed in *Table 1-9*. For example, the binary output rate for the Continuous Time Interval mode is shown in the table to be 20,000 measurements per second. This should be interpreted as "up to twenty 1000-measurement blocks can be transferred in one second to the controller."

NOTE

The values in *Table 1-9* are TYPICAL values. Performance is also affected by other instrumentation on the bus, the performance of the external controller, and the particular measurement software.

The values listed in *Table 1-9* are based on the following conditions:

- The 5371A is set to the PRESET condition, and then the appropriate measurement function is selected.
- Statistical and Math functions are disabled.
- The MANUAL input triggering mode is used to set the input voltage trigger levels.

- Except where noted in the table, a sample size of 10 blocks of 1000 measurements (10,000 total measurements) is used to obtain the values.
- All values include the measurement time as well as the transfer time of the data using an input signal of 13 MHz (76.9 ns).
- For BINARY output rates, the values represent the number of measurements sent to the controller and stored in a buffer without processing. Processing time in the controller will vary with the controller, the program language, and the particular program.

NOTES TO TABLE 1-9:

1. Ten blocks of 500 measurements (5000 total) are used for this benchmark value.
2. Ten measurements are used to characterize this value.
3. These measurement rates are the same as the "A&B" mode. Appropriate math calculations must be performed in the controller when the results are processed.
4. These measurement rates are essentially the same as the +/- Time Interval A→B mode. Appropriate math operations must be included in the controller program to compute Phase A rel B or Phase B rel A, and Duty Cycle.

The 5371A can also be configured to output binary data indefinitely to an external controller. This is achieved by configuring the 5371A for 1 block of 1 measurement, in REPETITIVE mode. A single binary result will be transferred at a TYPICAL rate of 75 measurements per second. This rate will also depend on the particular controller as well as other instruments connected to the bus.

Table 1-9. Measurement Output Rates

Measurement Mode	ASCII*	Floating Point*	Binary*
Time Interval A→A, B→B	150	350	12,500
Continuous Time Interval A→A, B→B	200	600	20,000
Time Interval A→A, B→B	130	250	12,500
Frequency A (or B)	130	275	13,000
Frequency A&B ¹	50 per channel	110 per channel	5,300 per channel
Frequency A/B, B/A	90	140	5,500 per channel
Frequency A-B, B-A, A + B ³	90	140	5,500 per channel
Period A (or B)	130	275	13,000
Period A&B ¹	50 per channel	110 per channel	5,500 per channel
Period A/B, B/A ³	90	140	5,500 per channel
Period A-B, B-A, A + B ³	90	150	5,500 per channel
Totalize A	140	275	7,500
Totalize A&B ¹	80 per channel	175 per channel	5,200 per channel
Totalize A/B, B/A ³	90	175	5,200 per channel
Totalize A-B, B-A, A + B ³	125	225	5,200 per channel
Rise/Fall Time	130	260	12,500 ⁴
Pulse Width	130	260	12,500 ⁴
Phase A rel B, B rel A	90	150	12,500 ⁴
Duty Cycle	110	200	12,500 ⁴
Peak Amplitude A, B ²	5	5	n/a

* All values are in "Readings per Second".

QUERY RESPONSES

Query responses for the 5371A consist of either string or numeric outputs to the controller. The possible return strings or numeric values for each query are described in Section 2.

The format for each numeric query response is similar to the ASCII numeric data response format and complies with IEEE standards for NR1 and NR3 numeric formats. *Figure 1-9* shows the numeric response formats for the query responses.

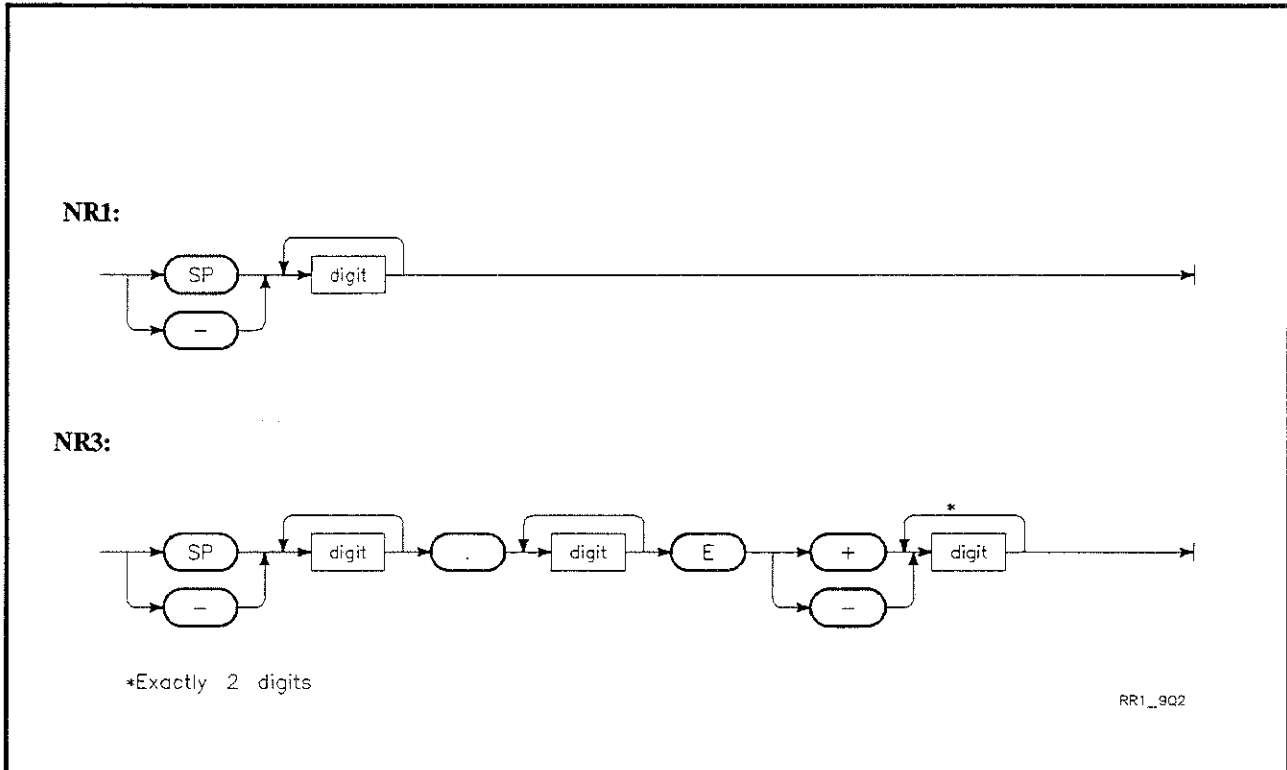


Figure 1-9. Numeric Query Response Format

Reading Query Responses

To obtain a query response, the ENTER command is used to return the response to the controller. The following program example shows how a query response can be obtained by the controller:

```
10  !Example of a QUERY command and the ENTER command necessary
20  !to print the response to the controller.
30  !
40  !Every QUERY or request for measurement will cause a
50  !value to be placed in an output queue. If this value is
60  !not read out over the bus, it may be inadvertently
70  !read later in the program.
80  !
90  OPTION BASE 1
100  Isc=7
110  Analyzer=703
120  CLEAR Isc
130  OUTPUT Analyzer;"CLE;PRES"
140  OUTPUT Analyzer;"POD?"
150  ENTER Analyzer;Pod_id$
160  PRINT "THE PODS ARE ";Pod_id$
170  END
```


2 HP-IB PROGRAMMING
COMMANDS

2

HP-IB PROGRAMMING COMMANDS

INTRODUCTION

This section describes the programming commands used to remotely operate the HP 5371A through the Hewlett-Packard Interface Bus. The information in this section consists of a description of the 5371A command structure, tables listing all of the 5371A HP-IB commands (including command functions, parameters, and mnemonics), important programming considerations, and a list of the key number assignments for selecting key functions via HP-IB.

NOTE

The information in this section is intended for those users who have read Section 1, and who are familiar with the HP-IB programming techniques, program message formats, and measurement result formats described in that section.

RECOMMENDED METHOD TO PROGRAM THE 5371A

A helpful way to write a program for the 5371A is to use the front panel of the instrument as a guide. Write the program in the same sequence you would select and set parameters to make a measurement from the front panel. Use *Table 2-1* to help make the transition from the front panel controls and displays to the commands used to write a program.

Table 2-1, 5371A Front Panel Display→ HP-IB Commands, is organized by front panel key. The order is as follows:

- FRONT PANEL KEYS (System Commands)
- FUNCTION Key Display (Measurement Subsystem)
- INPUT Key Display (Input Subsystem)
- MATH Key Display (Process Subsystem)
- INSTRUMENT STATE Key Display (Instrument State Subsystem)
- SYSTEM Key Display (Interface Subsystem)
- TEST Key Display (Diagnostic Test Subsystem)
- NUMERIC Key Display (Numeric Subsystem)
- GRAPHIC Key Display (Graphics Subsystem)

Table 2-1 can be used as an index to the programming commands and their parameters. Find the command you are interested in, note the subsystem it is under, and then use the tabs to turn to the subsystem, or look up the command in the Index at the end of this manual.

Refer to Appendix G, PROGRAMMING EXAMPLES, for sample programs using ASCII, Floating Point, and Binary output formats.

Table 2-1. 5371A Front Panel Display → HP-IB Commands

SYSTEM COMMANDS	
FRONT PANEL KEYS	HP-IB COMMANDS
CANCEL COPY	CANCEl
DEFAULT MEAS SETUP	DMSetup
FUNCTION	MENu,FUNC
GRAPH FORMAT	MENu,FORMat
GRAPHIC	MENu,GRAPhics
HELP	MENu,HELP
INPUT	MENu,INPut
INSTRUMENT STATE	MENu,ISTate
LOCAL	LOCAl
MANUAL ARM	KEY,68
MATH	MENu,MATH
NUMERIC	MENu,NUMeric
PLOT GRAPH	PLOT
PRESET	PRESet
PRINT	PRINt
RECALL	*RCL <number>
RESTART	REStArt
SAVE	*SAV <number>
SINGLE/REPET	SMOD <SING or REP>
STATUS	MENu,INFormation
SYSTEM	MENu,SYSTem
TEST	MENu,TEST

Table 2-1. 5371A Front Panel Display → HP-IB Commands (Continued)

MENU SELECTION:	
FUNCTION Key	MEASUREMENT Subsystem
FRONT PANEL DISPLAY	HP-IB COMMAND
	MEAS;
Measurement ----- (Frequency, Time Interval, Totalize, etc.)	FUNCTION <function>
Channel ----- (Measurement channel)	SOURCE <channel>
Number of blocks -----	BLOCK <number>
Number of measurements -----	MSIZE or SSIZE <number>
Arming Mode -----	ARMING <arming mode>
Block Holdoff/Start -----	START CHANNEL See Delay CHANNEL Appendix DELAY E SLOPE Table E-2
Sample Arm/Stop -----	SAMPLE CHANNEL See Delay CHANNEL Appendix DELAY E SLOPE Table E-2
INPUT Key	INPUT Subsystem
FRONT PANEL DISPLAY	HP-IB COMMAND
	INP;
Input Channels ----- (Separate/Common)	MODE <SEP or COM>
Trigger Event:	
Channel -----	SOURCE <channel>
Slope -----	SLOPE <POS or NEG>
Mode -----	TRIGGER <MAN or RAUT or SAUT>
Level -----	LEVEL <voltage number> (Manual Trigger or External Arm) RLEVEL <percentage number> (Auto Trigger)
Bias -----	BIAS <ECL or GND>
Attenuation -----	ATTENUATION <X1 or X2>

Table 2-1. 5371A Front Panel Display → HP-IB Commands (Continued)

MENU SELECTION:	
MATH Key	PROCESS Subsystem
FRONT PANEL DISPLAY	HP-IB COMMAND
	PROC;
Channel	SOURce <channel>
Reference	SREFerence CREFerence
Statistics	STATistics <ON or OFF>
Math	MATH <ON or OFF>
Offset	OFFSet <number>
Normalize	NORMAlize <number>
Scale	SCALE <number>
Limits	LIMit <ON or OFF>
High	HLIMit <number>
Low	LLIMit <number>

Table 2-1. 5371A Front Panel Display → HP-IB Commands (Continued)

MENU SELECTION:	
INSTRUMENT STATE Key	INSTRUMENT STATE Subsystem
FRONT PANEL DISPLAY	HP-IB COMMAND
	IST;
Write Protect -----	REGister <number>
Erase Register Data -----	PROTeCt <ON or OFF>
	ERASe <number>
SYSTEM Key	INTERFACE Subsystem
FRONT PANEL DISPLAY	HP-IB COMMAND
	INT;
HP-IB Configuration:	
Talk Only Print source -----	PSourCe <DISP or MEAS>
	(Print Source)
Result Format -----	OUTPut <ASC or BIN or FPO>
Response Timeout -----	MTStatuS <ON or OFF>
	(Measurement Timeout Status)
	MTValuE <number>
	(Measurement Timeout Value)
System Clock:	
DATE -----	DATE <yr, month, day>
TIME -----	TODay <hr, min, sec>
TEST Key	DIAGNOSTIC TEST Subsystem
FRONT PANEL DISPLAY	HP-IB COMMAND
	DIAG;
Run -----	TEST <number>
Pause -----	PAUSe
	CONTInue
	(Continues execution of a test suspended by the PAUSe command)
Until Fail -----	UFAil <ON or OFF>
STOP -----	STOP

Table 2-1. 5371A Front Panel Display → HP-IB Commands (Continued)

RESULTS:	
NUMERIC Key	NUMERIC Subsystem
FRONT PANEL DISPLAY	HP-IB COMMAND
	NUM;
Result Displays	
Result -----	DISP,NUMeric
Statistics -----	DISP,STATistics
Result/Statistics -----	DISP,SPLit
Limit Status -----	DISP,LIMit
Bold -----	DISP,BOLD
Gate Data -----	EXPand <ON or OFF> (Expand data)
Scroll keys* -----	SCRoll <DOWN or UP>
*These are the Up/Down Cursor/Scroll front panel keys.	
GRAPHIC Key	GRAPHICS Subsystem
FRONT PANEL DISPLAY	HP-IB COMMAND
	GRAP;
To select particular graph for display -----	GDISplay <HISTogram or TVARiation or ETIMe>
Show Graph -----	SGRaph <MAIN or MEMory or BOTH>
Copy Main graph to Memory -----	COPY
Select active marker color -----	SMARker <BLACK or WHITE>
Active marker orientation -----	MORient <VERTical or HORIZontal>
To move active vertical marker left -----	MLEFT <number>
To move active vertical marker right -----	MRIGHT <number>
To move active horizontal marker up -----	MUP <number>
To move active horizontal marker down -----	MDOWn <number>
Marker →Max -----	MMAXimum
Marker →Min -----	MMINimum
Move inactive marker to position of active marker -----	MMOVE
Marker Display Mode -----	MDMode <MARKer or DELTA or STATistics or MODulation>
Marker Next Mode -----	MNEXT <MEASurement or PIXEL>
Screen scroll graph (scroll using arrow keys) -----	SSCRoll <LEFT or RIGHT>
Zoom in, out or return to full scale -----	ZOOM <IN or OUT or FULL>
Outline status -----	OUTLine <ON or OFF>
Grid status -----	GRID <ON or OFF>
Y-axis scaling mode -----	YSCale <LOG or LINEar>

Table 2-1. 5371A Front Panel Display → HP-IB Commands (Continued)

RESULTS (Continued):	
GRAPHIC Key	GRAPHICS Subsystem
FRONT PANEL DISPLAY	HP-IB COMMAND
<p>Update mode (selects display mode mode for multiple-pass measurements). Connect on or off View channel for dual-channel measurements (Frequency, Period, Totalize A and B)</p>	<p>GRAP; UPDate <WHILe or AFTEr> CDATa <ON or OFF> < A or B></p>
<p>Histogram graph (HIST) Measurement/X-Axis: X-axis Manual scaling status X-axis Auto Range Hold X-axis Marker Range Hold X Minimum value Bin Width value Event/Y-Axis: Y-axis Manual scaling status Y-axis Auto Range Hold Y-axis Marker Range Hold Y Maximum value</p>	<p>GRAP;HIST; XMSCale <ON or OFF> XARHold XMRHold XMINimum <number> BWIDth <number> YMSCale <ON or OFF> YARHold YMRHold YMAXimum <number></p>
<p>Time Variation graph (TVAR) Time/X-Axis: X-axis Manual scaling status X-axis Auto Range Hold X-axis Marker Range Hold X Minimum value X Maximum value Measurement/Y-Axis: Y-axis Manual scaling status Y-axis Auto Range Hold Y-axis Marker Range Hold Y Minimum value Y Maximum value</p>	<p>GRAP;TVAR; XMSCale <ON or OFF> XARHold XMRHold XMINimum <number> XMAXimum <number> YMSCale <ON or OFF> YARHold YMRHold YMINimum <number> YMAXimum <number></p>
<p>Event Timing graph (ETIM) Time/X-Axis: X-axis Manual scaling status X-axis Auto Range Hold X-axis Marker Range Hold X Minimum value X Maximum value</p>	<p>GRAP;ETIM; XMSCale <ON or OFF> XARHold XMRHold XMINimum <number> XMAXimum <number></p>

5371A HP-IB COMMAND STRUCTURE

The 5371A uses a hierarchical program command structure, with programming commands divided into three types: system commands, subsystem selectors, and subsystem commands. A programming command tree is shown in *Figure 2-1*, and a programming command cross-reference is shown in *Table 2-2*.

System Commands

System commands control general instrument functions and may be issued at any time. They do not change the subsystem selection. Some examples of system commands are ABORT, RESTART, and *TRG.

System commands are divided into two subgroups: 5371A-specific commands and IEEE common commands. The IEEE common commands include an asterisk (*) as part of their command mnemonic. The IEEE common commands function in the same way as system commands, except that they do not have longform command mnemonics.

The IEEE common commands are defined by IEEE standards and have the same function in all instruments (i.e., they are device-independent).

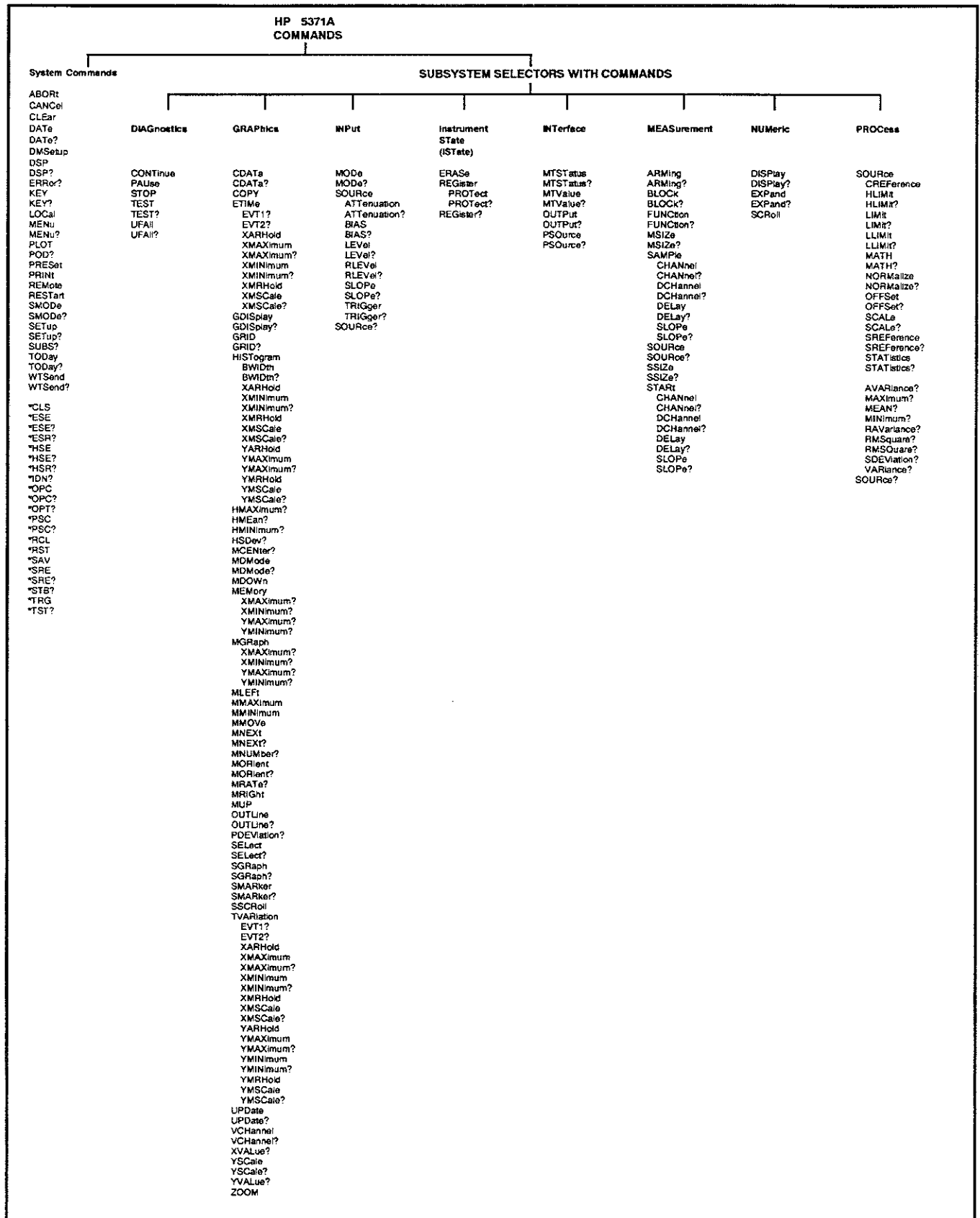


Figure 2-1. 5371A Programming Command Tree

Table 2-2. 5371A Programming Command Cross-Reference

COMMAND	WHERE USED	COMMAND	WHERE USED	COMMAND	WHERE USED
ABORT	System command	MEMory	Graphic subsystem	SOURce?	Input subsystem
ARMinG	Measurement subsystem	MENu	System command	MeASurement subsystem	Measurement subsystem
ARMinG?	Measurement subsystem	MENu?	System command	PRocess subsystem	Process subsystem
ATTenuation	Input subsystem	MGRaph	Graphic subsystem	PRocess subsystem	Process subsystem
ATTenuation?	Input subsystem	MINimum?	Process subsystem	SRCroll	Graphic subsystem
AVARiance?	Process subsystem	MLEft	Graphic subsystem	SSize	Measurement subsystem
BIAS	Input subsystem	MMAximum	Graphic subsystem	SSize?	Measurement subsystem
BIAS?	Input subsystem	MMINimum	Graphic subsystem	START	Measurement subsystem
BLOCK	Measurement subsystem	MNOVe	Graphic subsystem	STATistics	Process subsystem
BLOCK?	Measurement subsystem	MNEXt?	Graphic subsystem	STATistics?	Process subsystem
BWIDth	Graphic subsystem	MNUMber?	Graphic subsystem	STOP	Diagnostics subsystem
BWIDth?	Graphic subsystem	MODe	Input subsystem	SUBS?	System command
CANcEl	System command	MODe?	Input subsystem	TEST	Diagnostics subsystem
CDATa	Graphic subsystem	MORient	Graphic subsystem	TEST?	Diagnostics subsystem
CDATa?	Graphic subsystem	MORient?	Graphic subsystem	TODay	System command
CHANnel	Measurement subsystem	MRATe?	Graphic subsystem	TODay?	System command
CHANnel?	Measurement subsystem	MRIght	Graphic subsystem	TRIGger	Input subsystem
CLEar	System command	MSIZe	Measurement subsystem	TRIGger?	Input subsystem
CONtinue	Diagnostics subsystem	MSIZe?	Measurement subsystem	TVARiation	Graphic subsystem
COPY	Graphic subsystem	MTStatuS	Interface subsystem	UFail	Diagnostics subsystem
CREference	Process subsystem	MTStatuS?	Interface subsystem	UFail?	Diagnostics subsystem
DATE	System command	MTValue	Interface subsystem	UPDate	Graphic subsystem
DATE?	System command	MTValue?	Interface subsystem	UPDate?	Graphic subsystem
DCHannel	Measurement subsystem	MUP	Graphic subsystem	VARIance?	Process subsystem
DCHannel?	Measurement subsystem	NORMalize	Process subsystem	VCHannel	Graphic subsystem
DELay	Measurement subsystem	NORMalize?	Process subsystem	VCHannel?	Graphic subsystem
DELay?	Measurement subsystem	OFFSet	Process subsystem	WTSend	System command
DISPlay	Numeric subsystem	OFFSet?	Process subsystem	WTSend?	System command
DISPlay?	Numeric subsystem	OUTLine	Graphic subsystem	XARHold	Graphic subsystem
DMSetup	System command	OUTLine?	Graphic subsystem	XMAXimum	Graphic subsystem
DSP	System command	OUTPut	Interface subsystem	XMAXimum?	Graphic subsystem
DSP?	System command	OUTPut?	Interface subsystem	XMINimum	Graphic subsystem
ERASe	Instrument state	PAUSe	Diagnostics subsystem	XMINimum?	Graphic subsystem
ERRor?	System command	PDEviation?	Graphic subsystem	XMRHold	Graphic subsystem
ETIMe	Graphic subsystem	PLOT	System command	XMSCale	Graphic subsystem
EVT1?	Graphic subsystem	POD?	System command	XMSCale?	Graphic subsystem
EVT2?	Graphic subsystem	PRESet	System command	XVALue?	Graphic subsystem
EXPand	Numeric subsystem	PRINt	System command	YARHold	Graphic subsystem
EXPand?	Numeric subsystem	PROtect	Instrument state	YMAXimum	Graphic subsystem
FUNcTion	Measurement subsystem	PROtect?	Instrument state	YMAXimum?	Graphic subsystem
FUNcTion?	Measurement subsystem	PSourCe	Interface subsystem	YMINimum	Graphic subsystem
GDISplay	Graphic subsystem	PSourCe?	Interface subsystem	YMINimum?	Graphic subsystem
GDISplay?	Graphic subsystem	RAVariance?	Process subsystem	YMRHold	Graphic subsystem
GRID	Graphic subsystem	REGister	Instrument state	YMSCale	Graphic subsystem
GRID?	Graphic subsystem	REGister?	Instrument state	YMSCale?	Graphic subsystem
HISTogram	Graphic subsystem	REMOte	System command	YSCale	Graphic subsystem
HLIMit	Process subsystem	REStart	System command	YSCale?	Graphic subsystem
HLIMit?	Process subsystem	RLEVel	Input subsystem	YVALue?	Graphic subsystem
HMAXimum?	Graphic subsystem	RLEVel?	Input subsystem	ZOOM	Graphic subsystem
HMEAn?	Graphic subsystem	RMSquare?	Process subsystem	*CLS	System command
HMINimum?	Graphic subsystem	RMSquare?	Process subsystem	*ESE	System command
HSDev?	Graphic subsystem	SAMPle	Measurement subsystem	*ESE?	System command
KEY	System command	SCALe	Process subsystem	*ESR?	System command
KEY?	System command	SCALe?	Process subsystem	*HSE	System command
LEVel	Input subsystem	SCRoll	Numeric subsystem	*HSE?	System command
LEVel?	Input subsystem	SDEviation?	Process subsystem	*HSR?	System command
LIMit	Process subsystem	SELEct	Graphic subsystem	*IDN?	System command
LIMit?	Process subsystem	SELEct?	Graphic subsystem	*OPC	System command
LLIMit	Process subsystem	SEtup	System command	*OPC?	System command
LLIMit?	Process subsystem	SEtup?	System command	*OPT?	System command
LOCAl	System command	SGRaph	Graphic subsystem	*PSC	System command
MATH	Process subsystem	SGRaph?	Graphic subsystem	*PSC?	System command
MATH?	Process subsystem	SLOPe	Input subsystem	*RCL	System command
MAXimum?	Process subsystem	SLOPe?	Input subsystem	*RST	System command
MCENter?	Graphic subsystem	SMARker	Measurement subsystem	*SAV	System command
MDMode	Graphic subsystem	SMARker?	Graphic subsystem	*SRE	System command
MDMode?	Graphic subsystem	SMDDe	System command	*SRE?	System command
MDOWn	Graphic subsystem	SMDDe?	System command	*STB?	System command
MEAN?	Process subsystem	SOURce	Input subsystem	*TRG	System command
			Measurement subsystem	*TST?	System command
			Process subsystem		

Subsystem Selectors

Subsystem selectors specify the subsystem to which all future subsystem commands will refer until another subsystem is selected. Only one subsystem may be selected at any given time. A subsystem selector can be issued at any time, with one important exception: certain subsystem selector mnemonics are the same as some subsystem command mnemonics. In this case, the function of a particular mnemonic will depend on the context in which it is used. For example, GRAP is the mnemonic for the Graphics subsystem selector and also for the Graphics parameter for the Menu command ("MEN,GRAP").

The 8 subsystems are:

Diagnostics:	Provides access to a number of diagnostic tests.
Graphics:	Displays Histogram, Time Variation, and Event Timing graphs and provides options for examining the graphics data.
Input:	Controls input conditioning parameters, trigger levels, and slopes.
Instrument State:	Displays status information about each State: save/recall register.
Interface:	Controls the configuration of the HP-IB interface.
Measurement:	Controls measurement, arming, and gating modes.
Numeric:	Controls display of numerical results, with options for scrolling and large character fonts.
Process:	Controls post-measurement options, such as math and statistical functions and limit testing.

Subsystem Commands

Subsystem commands are used to change specific instrument settings and may only be issued after a subsystem has been selected. For example, once the Graphics subsystem (GRAP) has been selected, the Histogram command (HIST) may be issued. Some subsystem commands are used in more than one subsystem. In these cases, the action initiated by the command will depend on which subsystem has been selected. Some examples of subsystem commands are SOURce (used in the Input, Measurement, and Process subsystems), SCROLL (used in the Graphics and Numeric subsystems), and TEST (used only in the Diagnostics subsystem).

COMMAND MNEMONICS

The 5371A will accept both shortform and longform versions of the programming commands and queries. The commands listed in *Figure 2-1* and *Table 2-2* are shown in mixed upper and lower case letters (for example, MEASurement). The upper case letters comprise the shortform of the command, while the complete word is the longform. The following paragraphs describe the rules for forming both shortform and longform versions of the commands, and also describe alternate versions for certain command mnemonics.

Shortform and Longform Command Mnemonics

The shortform mnemonics shown in *Figure 2-1* and *Table 2-2* are the minimum required mnemonics accepted by the 5371A. Shortform mnemonics always consist of three or four characters, with a question mark (?) appended to form query commands, where applicable. Shortform command mnemonics are recommended where conserving memory space is a consideration.

The 5371A will also accept longform commands and queries, thus allowing program listings to be more understandable through the use of English-like commands.

The longform command mnemonics are generally formed according to the following rule:

If a function description is one word only, the longform is the entire word.

For example,

DISPLAY for the Display function

RESTART for the Restart function

If a function description is more than one word, the longform is the first letter of each of the words (except for the last), with the entire last word appended.

For example,

MSIZE for Measurement Size

CTINTERVAL for Continuous Time Interval

Shortform commands are derived by truncating the longform according to the following rule:

If the longform is four characters, no truncation is necessary unless the last character is a vowel. In this case, the fourth character is dropped (for example, DATE would abbreviate to DAT).

If the longform has more than four characters, and if the fourth character is a vowel, then truncate to three characters. Otherwise, truncate to four characters.

For example:

SLOPE abbreviates to SLOP

CHANNEL abbreviates to CHAN

ERROR? abbreviates to ERR?

ARMING abbreviates to ARM

There are some exceptions to the above rules for forming shortform and longform mnemonics due to the need to maintain compatibility with industry standards or to avoid two longforms starting with the same four letters.

The command mnemonics are derived from the functional descriptor for each command and query, and are described in COMMAND DESCRIPTIONS later in this section. In a few cases, the functional descriptor is clarified by additional words which are not part of the actual command mnemonic. In these cases, the extra words are shown in parentheses. Refer to COMMAND DESCRIPTIONS for information about the derivations of the command mnemonics.

Alternate Command Mnemonics

The 5371A will accept alternate forms of certain shortform command mnemonics to permit programming with industry-accepted standards or variations. For example, either RIS, RISE, or RTIM may be used for the Rise Time parameter. All alternate shortform command mnemonics are listed in *Table 2-3*.

Table 2-3. Alternate Command Mnemonics

Function or Parameter	Mnemonics
Common	COM or COMM (Longform: COMMON)
Duty cycle	DUTY or DCYC (Longform: DCYCLE)
Fall time	FALL or FTIM (Longform: FALLTIME, FTIME)
Rise time	RIS, RISE, or RTIM (Longforms: RISETIME, RTIME)
Time interval	TIM, TIME, or TINT (Longform: TINTERVAL)
Measurement size/sample size (these functions are identical)	MSIZ or SSIZ (Longforms: MSIZE, SSIZE)
Ground	GRO or GND (Longform: GROUND)
Root Mean Square	RMS or RMSQ (Longform: RMSQUARE)

PROGRAMMING CONSIDERATIONS

When programming the 5371A, the following points must be considered:

- The 5371A will accept a maximum command line length of 80 characters, including delimiters. If a line of greater than 80 characters is sent, the extra characters are truncated and an error message appears on the status line of the display.

NOTE

If using an HP-85B Computer as the controller, a false error will occur when sending command lines from 64 to 80 characters in length. If a line length greater than 63 characters and up to 80 characters is sent, the 5371A will still process all commands up to the 80 character length. An error message will be generated, but can be ignored if the command line length is known to be equal, to or less than 80 characters.

- All commands are of the form `COMMAND {modifier}` or `COMMAND,{modifier}`. Refer to Section 1 for information about delimiters.
- Some subsystem commands are referred to as subcommands, in that they must follow a particular subsystem command in order for the instrument to properly perform the subcommand. These subcommands are shown in *Figure 2-1* as indented commands. For example, in *Figure 2-1*, the `PROtection` command and `PROtection?` query are indented to show that they must be preceded by the `REGister` subsystem command to be parsed by the instrument.
- The command structure allows command sequences to be sent in different program lines as long as the overall sequence is correct. For example, the following program segment:

```
10 OUTPUT 703;"PRES;MEAS;FUNC,FREQ;SOUR,A"
```

```
20 OUTPUT 703;"ARM,AUT;INP;MOD,SEP"
```

is equivalent to the following sequence:

10 OUTPUT 703;"PRES"	Presets the instrument
20 OUTPUT 703;"MEAS"	Selects Measurement subsystem
30 OUTPUT 703;"FUNC,FREQ"	Sets the function to Frequency
40 OUTPUT 703;"SOUR,A"	Selects Channel A as measurement source channel

50 OUTPUT 703;"ARM,AUT" Selects Automatic arming

60 OUTPUT 703;"INP" Selects Input subsystem

70 OUTPUT 703;"MOD,SEP" Selects Separate mode for Channel A and Channel B

- All <number> arguments are entered as real numbers; integers are also accepted.
- A query form is available for many of the commands. Some commands are "query-only", i.e., no parameter entry or non-query mode exists for the command. Query-only examples are ERR?, MNUMBER?, and *ESR?.
- Where possible, command mnemonics have been assigned according to the standard rules for forming shortform and longform rules (refer to SHORTFORM AND LONGFORM COMMAND MNEMONICS). Some modifications and/or exceptions have been made.
- The 5371A will also accept a few alternate command mnemonics. Refer to the ALTERNATE COMMAND MNEMONICS description for information about alternate command mnemonics.
- The subsystem selectors and commands are not always identical or interchangeable with the displayed menu or menu commands. For example, the Interface subsystem is equivalent to the System menu, and the Measurement subsystem is equivalent to the Function menu.
- Changing the subsystem via the HP-IB never changes the displayed menu, and changing the displayed menu via HP-IB never changes the subsystem.
- Queries are not allowed while the instrument is in the Binary output mode. Any responses from the instrument while in the Binary output mode will be in binary form; queries requiring a string response will appear to be incorrect to the controlling program.
- When returning to a previously displayed menu screen, the screen cursor will be in the position it was in before leaving the menu.

5371A COMMAND DESCRIPTIONS

The following paragraphs describe the 5371A programming commands. The descriptions begin with the System commands, followed by the subsystem commands grouped according to subsystem in alphabetical order. In most cases, commands within a subsystem are in alphabetical order, except in those cases where functional grouping provides easier reference.

Syntax diagrams for commands within a given subsystem are shown at the beginning of each subsystem group. Each syntax diagram includes the subcommands and parameters for each command.

Each command description includes the shortform and longform mnemonics, the functional descriptor from which the mnemonics are derived (in [brackets]), a brief description of the command function, operation, and required parameters and their ranges, plus an example using HP Series 200/300 BASIC 4.0. All examples assume that the instrument address is set to 03.

In a few cases, the function descriptor is clarified by additional words which are not part of the command mnemonics. In these cases, the extra words are shown in parentheses within the brackets. For example:

Shortform: MATH [MATH (modifiers)]

Shortform: REST [REStart (measurement)]

SYSTEM
COMMANDS

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SYSTEM COMMANDS

The System commands control general instrument functions and may be issued at any time, i.e., they can be called from any subsystem. System commands do not change the subsystem selection; when the system command has been executed, the 5371A will return to the subsystem that it was in before the system command was executed.

System commands are divided into two subgroups: 5371A-specific commands and IEEE common commands. The IEEE common commands include an asterisk (*) as part of their command mnemonic. The IEEE common commands function in the same way as system commands, except that they do not have longform command mnemonics. For ease of reference, all of the IEEE common commands are grouped together after all of the 5371A-specific commands, with each subgroup being in alphabetical order.

Refer to *Figure 2-2* for system command syntax diagrams.

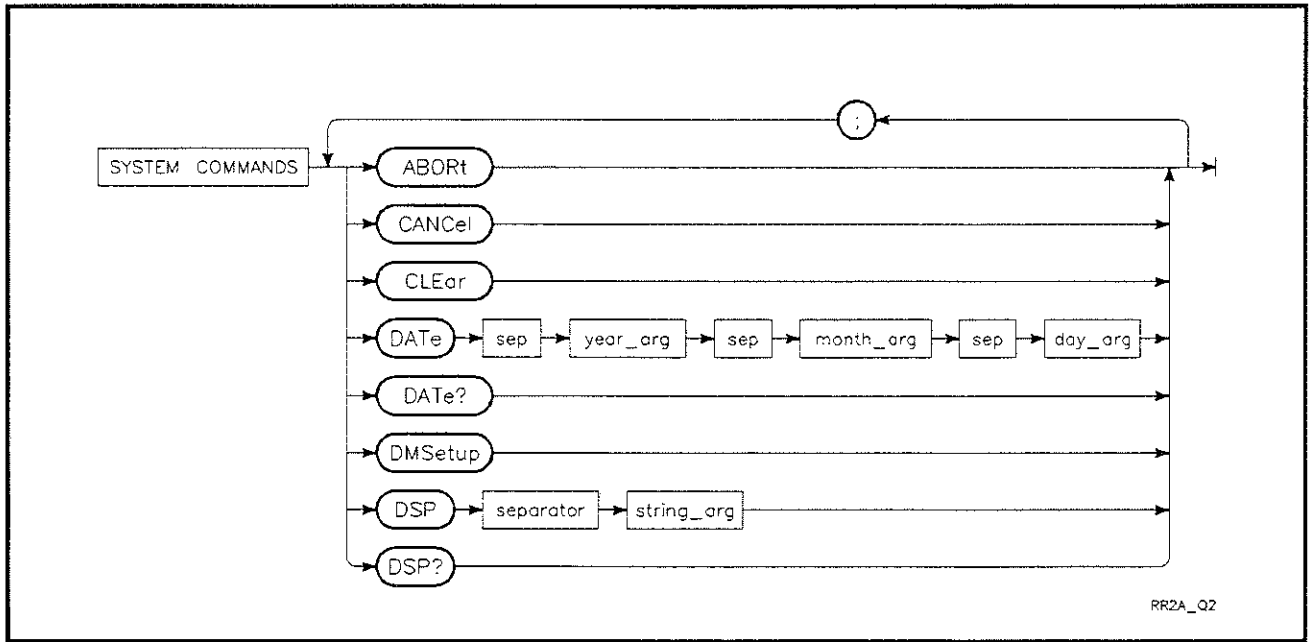
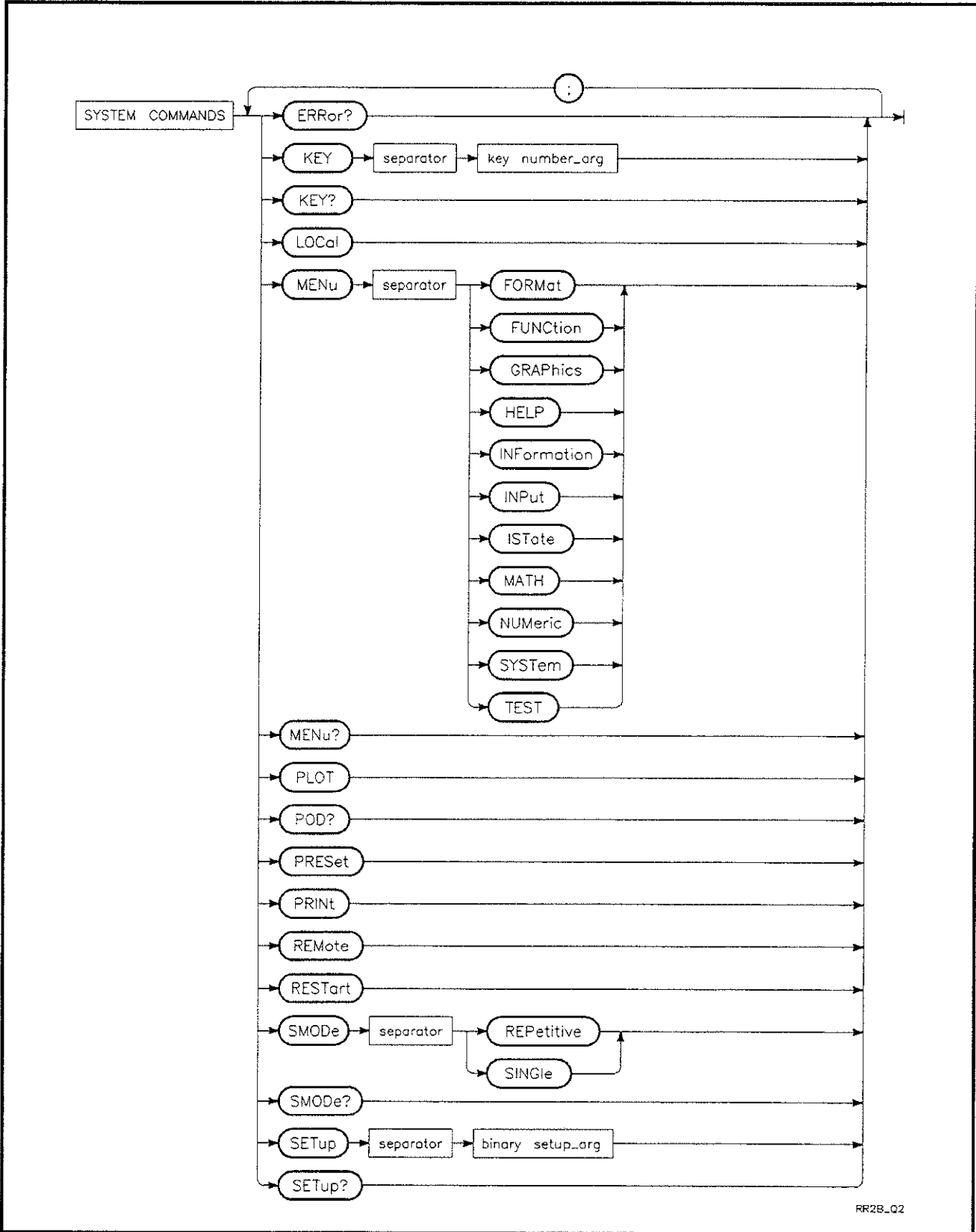


Figure 2-2. System Command Syntax Diagrams



RR2B_Q2

Figure 2-2. System Command Syntax Diagrams (Continued)

**ABOR - Abort
(command)**

Shortform: ABOR [ABORt]
Longform: ABORT

The ABORt command aborts a measurement before it is finished. After an ABORT command is sent, measurement data can be retrieved normally by making the 5371A a talker. A new measurement can be started by sending the REStart command (the aborted measurement cannot be continued).

The HP 5371A will accept an ABORT command only when it is in SINGLE mode; it will respond to the command only when it is making a measurement (i.e., when the measurement gate is open). At all other times ABORT will either not be accepted or will be ignored. SINGLE measurement mode and open measurement gate are indicated by lighting of their respective LEDs in the INSTRUMENT CONTROL portion of the HP 5371A front panel.

Example: OUTPUT 703;"ABOR" - Tells the 5371A to stop the current measurement process.

**CANC - Cancel
Hardcopy
(command)**

Shortform: CANC [CANCel (hardcopy)]
Longform: CANCEL

The CANC command is used to cancel the hardcopy output initiated by the Print (PRIN) or Plot (PLOT) commands. When the 5371A receives the CANC command, the current printer or plotter output is immediately stopped. Refer to the PRIN and PLOT command descriptions for additional information.

Example: The following example shows how to use the CANC command with an HP 9836 computer as the controller. Note that sending "OUTPUT 703;CANC" will not work because the 5371A is in Talk Only mode while printing or plotting and cannot respond without first being set to Listen mode by the controller.

```
10 SEND 7;UNT MTA LISTEN 3 DATA "CANC",CHR$(13),CHR$(10)
20 SEND 7;UNT TALK 3
30 WRITEIO 7,23;11
40 END
```

**CLE - Clear
(command)**

Shortform: CLE [CLEar]
Longform: CLEAR

The CLEar command performs an operation similar to a Device Clear<DCL> or Selected Device Clear <SDC>. In response to either the CLEar,<DCL>, or <SDC> message, the 5371A will:

- Clear the input and output buffers.
- Discard all deferred commands and queries.
- Terminate any measurement or acquisition process.

Note that the <DCL> and <SDC> messages (but not the CLEar command) will also clear a static failure condition and clear the Event Status and Hardware Status registers.

The CLE command is provided for use by controllers that have a limited HP-IB control capability. If available, the HP-IB <DCL> or <SDC> messages are the preferred method for performing a device clear.

Example: OUTPUT 703;"CLE" - Terminates measurements, clears input and output buffers, and discards all deferred commands and queries.

**DAT - System Clock
Date
(command/query)**

Shortform: DAT [(system clock) DATE]

Longform: DATE

The DAT command sets the system clock date. The format for setting the date is:

DAT, yyyy mm dd

where yyyy is the year number (19yy), mm is the month number (1 through 12), and dd is the day number (1 through 31).

The DAT? query returns a string in the format dd mmm yyyy (where mmm is the three-letter month abbreviation rather than a number).

Example: OUTPUT 703;"DAT,1987,8,19" - Sets the system clock date to August 19, 1987.

OUTPUT 703;"DAT?" - Queries the 5371A for the current system clock date.

**DMS - Default
Measurement Setup
(command)**

Shortform: DMS [Default Measurement Setup]

Longform: DMSETUP

The DMS command sets various setup values to default conditions and is equivalent to pressing the front panel SHIFT, PRESET keys. The default values set by the DMS command set up the optimum instrument configuration for the currently chosen Measurement function. Defaults are set for such values as source channel, sample size, arming (plus associated arming parameters), as well as input channel specifications (trigger modes, levels).

Both general conditions (applying to all measurement types) and specific conditions (applying only to certain measurement types) are set. The general conditions set are:

- The previous setup is saved in Register 0
- Math modifiers are disabled
- Statistics are enabled
- Limit Testing is disabled
- Reference values are set to 0
- Channel A Trigger mode is set to Repetitive Auto trigger
- Channel B Trigger mode is set to Repetitive Auto trigger
- Channel A Attenuation is set to X1
- Channel B Attenuation is set to X1
- The Numeric display is chosen, showing Results + Statistics
- Measurement Sample Size is set to 50 (measurements per block) except for Peak Amplitude measurements where Measurement Sample Size is set to 1.
- Block Size is set to 1 (number of measurement blocks)

Refer to Appendix B for the specific default conditions set by the DMS command for each measurement type.

Example: OUTPUT 703;"DMS" - Sets default conditions for current measurement function.

DSP - Display (command/query)

Shortform: DSP [DiSPlay]

Longform: DSP

The DSP command writes a quoted string, not including quotes, to the status line at the top of each menu screen. The DSP? query returns the string last written to the status line. The returned string may be one that was written with the DSP command or an internally generated advisory message. Note that two sets of quotation marks ("...") are required for sending the display string within the command string.

Examples: OUTPUT 703;"DSP ""Hello"" - Tells the 5371A to display "Hello" at the top line of the display.

OUTPUT 703;"DSP?" - Queries the status line of the display.

ERR? - Error?
(query only)

Shortform: ERR? [ERRor?]

Longform: ERROR?

This query pulls the next error number out of the error queue and returns it. The 5371A has an error queue that is 16 errors deep and operates on a first-in first-out basis. Successively sending the ERR? query returns error numbers in the order that they occurred until the queue is empty. Any further queries then return "0" until another error is detected. See Appendix C for a list of error numbers and a description of each error.

Example: OUTPUT 703;"ERR?" - Queries the 5371A for the next error number in the error queue.

KEY - Key Simulation
(command/query)

Shortform: KEY [KEY simulation]

Longform: KEY

The KEY command simulates the pressing of a front panel key. Keys may be pressed in any order that is legal for normal front panel operation. When using this command, be sure that the instrument is in the desired state before "pressing" a key. The key codes and their front panel function equivalents are listed in *Table 2-4*.

The KEY? query returns a list of the last 20 keys that have been pressed (or less if 20 keypresses have not occurred). If more than 20 keys have been pressed, only the last 20 keypresses are returned; those previous to the last 20 are lost. If no keys have been pressed (such as after power-up) or if a PRESET is performed, the KEY? query will return "NONE".

Examples: OUTPUT 703;"KEY,39" - "Presses" the HELP menu key.

OUTPUT 703;"KEY?" - Queries the 5371A for the last 20 keys that were pressed.

NOTE

The MANUAL ARM key (key 68 in *Table 2-4*) provides two functions:

- Provides manual control of the measurement gate for totalize measurements using MANUAL arming mode. This is the only measurement and arming mode for which this key performs a manual arm function.
 - Aborts a measurement in progress. The Abort function will be performed for all measurement and arming modes other than the one described above. This function is identical to using the ABORt command.
-

Table 2-4. Key Number Assignments

Key Number	Key Function	Key Number	Key Function
1-23, 30-31	not used	53	EXP
24	softkey 1	54	BACKSPACE
25	softkey 2	55	LAST VALUE
26	softkey 3	56	UP cursor
27	softkey 4	57	RIGHT cursor
28	softkey 5	58	DOWN cursor
29	softkey 6	59	LEFT cursor
32	FUNCTION menu	60	NUMERIC menu
33	MATH menu	61	GRAPHICS menu
34	INSTRUMENT STATE menu	62	STATUS menu
35	TEST menu	63	PRINT
36	INPUT menu	64	SHIFT
37	GRAPH FORMAT menu	65	LOCAL
38	SYSTEM menu	66	RESTART
39	HELP menu	67	SINGLE/REPET
40-49	digits 0-9	68	MANUAL ARM (see note)
50	. (decimal point)	69	SAVE
51	+/- (plus/minus)	70	RECALL
52	ENTER	71	PRESET

**LOC - Local
(command)**

Shortform: LOC [LOCa]
Longform: LOCAL

The LOC command returns the instrument to Local (front panel) operation. The LOCAL command performs a similar operation to the Clear Lockout/Set Local HP-IB message. This command is provided for controllers with limited HP-IB control capability. The HP-IB Clear Lockout/Set Local message is the preferred method of switching the instrument from Remote to Local and clearing the Local Lockout.

Example: OUTPUT 703;"LOCAL" - Switches the 5371A from Remote to Local and clears the Local Lockout condition.

**MEN - Select Menu
(command/query)****Shortform:** MEN [(select) MENu]
Longform: MENU

The MEN command is used to select one of 11 different menus to be displayed on the screen. The Menu command parameters and their corresponding screen menus are:

Parameter	Screen Menu Displayed
FORMat	Graph Format
FUNCTion	Function
GRAPhics	Graphics
HELP	Help
INFormation	Status
INPut	Input
Instrument SState	Instrument State
MATH	Math
NUMeric	Numeric
SYSTem	System
TEST	Diagnostics

The MEN? query returns the name of the currently displayed menu screen.

Examples: OUTPUT 703;"MEN,GRAP" - Tells the 5371A to display the Graphics menu on the screen.

OUTPUT 703;"MEN?" - Queries the 5371A for the currently displayed menu screen.

**PLOT - Plot Screen
(command)****Shortform:** PLOT [PLOT (screen)]
Longform: PLOT

The PLOT command copies the currently displayed graph to any attached HP plotter which supports HP-GL (Hewlett-Packard Graphics Language). This command is available only for Graphics screens, and is equivalent to pressing the PLOT GRAPH (SHIFT, PRINT) front panel keys. The CANC (CANCel hardcopy) command can be used to abort the current plot output.

To use the PLOT command, select DISPLAY data to be the print source (refer to the PSO command description).

Example: The following example shows a method for using the PLOT command with an HP 9836 computer as the controller:

```
10 SEND 7;MTA LISTEN 3 DATA "PLOT",CHR$(13),CHR$(10)
20 SEND 7;UNL
30 SEND 7;LISTEN 1
40 SEND 7;TALK 3
50 WRITEIO 7,23;11
60 END
```

**POD? - Pods
Installed?
(query only)**

Shortform: POD? [PODs (installed)?]
Longform: POD?

The POD? query returns a string indicating which input pods are currently installed (if any) in the front panel. The string returned is:

“HPnnnnnA,HPnnnnnA”

where nnnnn is the Hewlett-Packard model number: 54001, 54002, or 54003. The first name in the string is the Channel A pod and the second name is the Channel B pod. If no pod is installed in a given slot, “NONE” is returned in the appropriate string position.

If Option 060 (Rear Panel Inputs) is installed, the POD? query will return “060”.

Example: OUTPUT 703;"POD?" - Queries the 5371A for the currently installed input pods.

**PRES - Preset
Instrument
(command)**

Shortform: PRES [PRESet (instrument)]
Longform: PRESET

The PRESet command resets the instrument to its default settings. This command performs the same function as the *RST command. Refer to *Table 2-5* for a list of the 5371A preset conditions. Note that the PRESet command will clear the key queue, but will not clear the error queue (refer to the ERR? and KEY command descriptions for more information).

Example: OUTPUT 703;"PRES" - Presets the 5371A to default conditions.

Table 2-5. 5371A Preset Conditions

Function, Mode, or Value	Preset State
Measurement Function Measurement Channel	Time Interval Channel A
Arming Mode Block Size Measurement Size	Automatic 1 100
Input Mode	Separate Inputs
Channel A Trigger Slope Channel B Trigger Slope Channel A Bias Level Channel B Bias Level	Positive Positive GND GND
Channel A Attenuation Channel B Attenuation	1:1 (0 dB) 1:1 (0 dB)
Channel A Trigger Mode Channel B Trigger Mode Channel A Manual Trigger Level Channel B Manual Trigger Level Channel A Auto Trigger Level Channel B Auto Trigger Level External Arm Trigger Level	Single Auto Trigger Single Auto Trigger 0 V 0 V 50 % of peak-to-peak amplitude 50 % of peak-to-peak amplitude 0 V
Math Functions (Chan. A) Math Functions (Chan. B) Statistics (Chan. A) Statistics (Chan. B) Limit testing (Chan. A) Limit testing (Chan. B) Offset Value (Chan. A) Offset Value (Chan. B) Normalize Value (Chan. A) Normalize Value (Chan. B) Scale Value (Chan. A) Scale Value (Chan. B) Reference Value (Chan. A) Reference Value (Chan. B) Upper Limit Value (Chan. A) Lower Limit Value (Chan. A) Upper Limit Value (Chan. B) Lower Limit Value (Chan. B)	Off Off Off Off Off Off 0 0 1 1 1 1 0 0 0 0 0 0 0 0
Measurement Memory	Cleared
Acquisition Mode	Repetitive

**PRIN - Print Screen
(command)****Shortform:** PRIN [PRINt (screen)]**Longform:** PRINT

The PRIN command copies either measurement results or a bit-map of the currently displayed menu to any attached HP printer with graphics capability. This command is available for all menu screens, and is equivalent to pressing the front panel PRINT key. The CANC (CANCel hardcopy) command is available to abort the print output.

To use the PRINt command, use the PSO (Print SOurce) command to select DISPlay for a copy of the screen menu, or MEASurement for a copy of the measurement results.

Example: The following example shows a method for using the PRIN command with an HP 9836 computer as the controller:

```
10 SEND 7;MTA LISTEN 3 DATA "PRIN",CHR$(13),CHR$(10)
20 SEND 7;UNL
30 SEND 7;LISTEN 1
40 SEND 7;TALK 3
50 WRITEIO 7,23;11
60 END
```

**REM - Remote
(command)****Shortform:** REM [REMote]**Longform:** REMOTE

The REM command sets the 5371A to the Remote mode and sets the Local Lockout. The REM command performs an operation similar to the HP-IB Remote message followed by the HP-IB Local Lockout message. This command is provided for use by controllers that have a limited HP-IB capability. If available, the HP-IB Remote and Local Lockout messages are the preferred method of switching the 5371A from Local to Remote and setting Local Lockout. If the REN (remote enable) control line is false, the 5371A REM command will have no effect.

Example: OUTPUT 703;"REM" - Switches the 5371A from Local to Remote and sets Local Lockout.

**REST - Restart
Measurement
(command)****Shortform:** REST [RESTart (measurement)]**Longform:** RESTART

The REST command performs the same function as the front panel RESTART key. When received, this command restarts the measurement process and clears cumulative results and error messages (the error queue is cleared). The RESTart command will not clear the key queue and will have no effect on a previously entered data value.

Example: OUTPUT 703;"REST" - Tells the 5371A to restart a measurement.

SET - Instrument Setup (command/query)

Shortform: SET [(instrument) SETup]

Longform: SETUP

The SET command and SET? query are used to send and receive a learn string from the instrument. The SET? query returns a learn string containing the instrument setup, in block data format, to the controller (the returned sequence of bytes must be saved in an array). The returned string uses the same format as required by the SET command, thus no modifications need be made to the string between the time it is received after the SET? query and the time it is sent back to the instrument using the SET command.

Sending the learn string to the instrument with the SET command is similar to recalling an instrument setup using the *RCL command. Note that the SET? and SET commands should only be used by experienced programmers. The *SAV and *RCL commands are easier to use for saving and recalling instrument setups.

The SET command restores the settings defined by the array of bytes returned by the SET? query. The SET command must be followed by a carriage return <CR> and line feed to signal the instrument that the next data to follow on the bus is the byte sequence. The setup byte sequence must immediately follow; if something else is sent (another command or some other form of data), an error will occur.

The setup data is sent as a binary block in the following form:

```
<#><non-zero digit><length_word> <DAB>...<DAB>^END
```

The <non-zero digit> is a single ASCII numeral specifying the number of words in <length_word>.

The <length_word> is an unsigned binary integer that is x digits in length (where x is specified by the <non-zero digit>) representing the number of Data Bytes (DAB).

The SET? query causes the 5371A to transmit the current measurement setup to the external controller in the form of a binary block of data. The binary block will be in the form described above, except that the <non-zero digit> will always be the number 6 and the <length_word> will, of course, always be 6 digits in length.

Examples: The program example on the next page shows how the SET? query and SET command can be used to save and restore an instrument setup:

```

10 !Example of learn mode using the SET? query and the SET command
20 !
30 !The SET? query reads information from the 5371A that specifies
40 !all instrument settings for a particular measurement.
50 !The SET command sends the same information that was received
60 !by the SET? query to the instrument—thereby “remembering” the
70 !instrument setups.
80 !
90 !THE “SET?” AND “SET” COMMANDS SHOULD ONLY BE USED BY THE
100 !EXPERIENCED HP-IB PROGRAMMER. THE “SAVE” AND “RECALL”
110 !COMMANDS ARE EASIER TO USE AND MAY SERVE YOUR NEEDS.
120 !
130     OPTION BASE 1
140     Isc=7
150     Analyzer=703
160     CLEAR Isc
170     OUTPUT Analyzer;"CLE;PRES"
180     PRINT "MANUALLY SET THE 5371A TO THE DESIRED SETTINGS,"
190     PRINT "PRESS CONTINUE WHEN FINISHED....."
200     PAUSE
210     ASSIGN @Analyzer TO 703;FORMAT OFF
220     ASSIGN @Setup_buffer TO BUFFER [500]
230     OUTPUT Analyzer;"SET?"
240     ENTER Analyzer USING "%,5A";A$
260     TRANSFER @Analyzer TO @Setup_buffer;END,WAIT
261     STATUS @Setup_buffer,4;Bytes_received
270     PRINT "MANUALLY CHANGE THE 5371A TO DIFFERENT SETTINGS,"
280     PRINT "PRESS CONTINUE AND CHECK FOR CORRECT SETTINGS."
290     PAUSE
300     OUTPUT Analyzer;"SET"
310     Header$="#3"&VAL$(Bytes_received)
320     CONTROL @Setup_buffer,5;1
330     OUTPUT Analyzer USING "#,5A";Header$
340     TRANSFER @Setup_buffer TO @Analyzer
350     PRINT "SET COMMAND FINISHED"
360     END

```

**SMOD - Sample Mode
(command/query)****Shortform:** SMOD [Sample MODe]**Longform:** SMODE

The SMOD command is used to determine how often the measurement will be displayed. This command is equivalent to the front panel SINGLE/REPET key function. Selecting the REPetitive sample rate will cause the instrument to make measurements as quickly as possible. Selecting the SINGle sample rate will cause the instrument to hold off a measurement indefinitely, until triggered. In this case, the instrument will display the previous measurement and halt until one of the following occurs:

- The 5371A receives the *TRG or GET (Group Execute Trigger) command.
- The 5371A receives the REST (Restart) or PRES (Preset) command.

The SMOD? query returns the currently selected sample mode: "SING" for single or "REP" for repetitive.

Parameters: {SINGle | REPetitive}**Examples:** OUTPUT 703;"SMOD,SING" - Tells the 5371A to display previous measurement and halt until triggered.

OUTPUT 703;"SMOD?" - Queries the 5371A for the currently selected sample mode.

**SUBS? - Subsystem?
(query only)****Shortform:** SUBS? [SUBSystem?]**Longform:** SUBS?

The SUBS? query returns a string indicating the currently selected subsystem. The string returned will be one of the following:

"DIAG"	- Diagnostics subsystem
"GRAP"	- Graphics subsystem
"INP"	- Input subsystem
"INT"	- Interface subsystem
"IST"	- Instrument State subsystem
"MEAS"	- Measurement subsystem
"NUM"	- Numeric subsystem
"PROC"	- Process subsystem

Example: OUTPUT 703;"SUBS?" - Queries the 5371A for the currently active subsystem.

**TOD - System Clock
Time of Day
(command/query)**

Shortform: TOD [Time Of Day]
Longform: TODAY

The TOD command sets the system clock time. The format is:

TOD, hh, mm, ss

where hh is the hour number (0 through 23), mm is the minutes number (0 through 59), and ss is the seconds number (0 through 59).

The TOD? query returns the current system time in the format hh:mm:ss.

Example: OUTPUT 703;"TOD,11,20,15" - Sets the 5371A system time clock to 11:20 plus 15 seconds.

OUTPUT 703;"TOD?" - Queries the 5371A for the current setting of the system time clock.

**WTS - Wait to Send
(command/query)**

Shortform: WTS [Wait To Send]
Longform: WTSEND

The WTS command controls the placement of measurement results into the output buffer. When the Wait To Send mode is off, and more than one block of measurements is requested, only the last block of measurement data will be placed in the output buffer. When Wait To Send mode is on, each block of measurement data will be placed in the output buffer; the next block will not be started until the last block has been sent.

In Repetitive sample mode (SMOD,REP), with Wait To Send off, the next measurement will start as soon as the current measurement data has been placed in the output buffer. When Wait To Send is on, the next measurement will start only after the current measurement data has been sent out over the HP-IB.

The WTS? query returns the current on/off status of the Wait To Send mode: "1" (ON) or "0" (OFF).

Parameters: {ON | OFF}

Example: OUTPUT 703;"WTS,ON" - Turns on the Wait To Send mode.

OUTPUT 703;"WTS?" - Queries the 5371A for the on/off status of the Wait To Send mode.

***CLS - Clear Status
(command)**

Shortform: *CLS [Clear Status]
Longform: *CLS

The *CLS command is used to clear the Event Status Register and the Hardware Status Register, setting all bits in these registers to zero. When the Event and Hardware Status registers are cleared, the corresponding summary messages are also cleared, thus indirectly clearing the Status Byte Register.

Example: OUTPUT 703;"*CLS" - Clears Event and Hardware Status registers.

***ESE - Event Status
Enable
(command/query)**

Shortform: *ESE [Event Status Enable]
Longform: *ESE

The *ESE command is used to set selected bits of the Event Status Enable register. An enabled (set to 1) bit in the Enable register is ANDed with its corresponding bit in the Event Status Register to generate a Service Request if an enabled condition occurs. To enable the register bits, send the *ESE command with an integer parameter (range 0 to 255) representing the binary-weighted values of the bits to be set. For example, to set bits 2 and 4, send the decimal integer 20 (4 + 16) as the parameter.

The *ESE? query returns an integer (NR1 format) that is the decimal equivalent of the binary-weighted values of the bits that are currently set to 1.

Refer to Section 1 for information about the Event Status Register and Event Status Enable Register.

Range: 0 to 255

An *ESE command with an out-of-range value will not cause an HP 5371A or HP-IB error, but is not recommended.

Examples: OUTPUT 703;"*ESE,36" - Sets bits 2 and 5 of the Event Status Enable register, thus enabling bit 2 (Query Error) and bit 5 (Command Error) of the Event Status Register.

OUTPUT 703;"*ESE?" - Queries the 5371A for the contents of the Event Status Enable register.

***ESR? - Event Status
Register?
(query only)**

Shortform: *ESR? [Event Status Register?]
Longform: *ESR?

The *ESR? query returns the contents of the Event Status Register. The value returned is an integer (NR1 format) that is the decimal equivalent of the binary-weighted values of the register bits. For example, a value of 36 indicates that bit 2 (Query Error) and bit 5 (Command Error) are set to 1. Upon reading the Event Status Register, all bits in the register are cleared (set to 0).

Example: OUTPUT 703;"*ESR?" - Queries the 5371A for the contents of the Event Status Register, and clears the register.

***HSE - Hardware Status Enable (command/query)**

Shortform: *HSE [Hardware Status Enable]

Longform: *HSE

The *HSE command is used to set selected bits of the Hardware Status Enable register. An enabled (set to 1) bit in the Enable register is ANDed with its corresponding bit in the Hardware Status Register to generate a Service Request if an enabled condition occurs. To enable the register bits, send the *HSE command with an integer parameter (range 0 to 1023) representing the binary-weighted values of the bits to be set. For example, to set bits 2 and 4, send the decimal integer 20 (4 + 16) as the parameter.

The *HSE? query returns an integer (NR1 format) that is the decimal equivalent of the binary-weighted values of the bits that are currently set to 1.

Refer to Section 1 for information about the Hardware Status Register and Hardware Status Enable Register.

Range: 0 to 1023

An *HSE command with an out-of-range value will not cause an HP 5371A or HP-IB error, but is not recommended.

Examples: OUTPUT 703;"*HSE,80" - Sets bits 4 and 6 of the Hardware Status Enable Register, thus enabling bit 4 (Time Base Error) and bit 6 (Power-On Failure) of the Hardware Status Register.

OUTPUT 703;"*HSE?" - Queries the 5371A for the contents of the Hardware Status Enable register.

***HSR? - Hardware Status Register (query only)**

Shortform: *HSR? [Hardware Status Register?]

Longform: *HSR?

The *HSR? query returns the contents of the Hardware Status Register. The value returned is an integer (NR1 format) that is the decimal equivalent of the binary-weighted values of the register bits. For example, a value of 80 indicates that bit 4 (Time Base Error) and bit 6 (Power-On Failure) are set to 1. Upon reading the Hardware Status Register, all bits in the register are cleared (set to 0).

Example: OUTPUT 703;"*HSR?" - Queries the 5371A for the contents of the Hardware Status Register, and clears the register.

***IDN? - Instrument Identification? (query only)**

Shortform: *IDN? [(instrument) IDeNtification]

Longform: *IDN?

The *IDN? query returns a string containing the model number and firmware revision code in the form:

"Hewlett-Packard,5371A,0,xxxx"

- where "xxxx" is the datecode of the installed firmware revision.

Example: OUTPUT 703;"*IDN?" - Queries the 5371A for its model number and firmware revision code.

***OPC - Operation Complete
(command/query)**

Shortform: *OPC [Operation Complete]
Longform: *OPC

The *OPC command causes the instrument to generate the Operation Complete message (OPC, bit 0) in the Event Status Register when all pending selected device operations have been finished.

The *OPC? query returns a "1" when an operation is complete. Note that the value returned will always be "1" because the *OPC query is not parsed until all previous commands have been completed.

Examples: OUTPUT 703;"*OPC" - Tells the 5371A to set the OPC bit in the Event Status Register to 1 when all operations are finished.

OUTPUT 703;"*OPC?" - Queries the 5371A for operation completion.

***OPT? - Installed Options?
(query only)**

Shortform: *OPT? [(installed) OPTions?]
Longform: *OPT?

The *OPT? query returns a string indicating which options are installed in the 5371A. The string returned is either "NONE" (no options installed) or "060" (Option 060 Rear Panel Inputs installed).

Example: OUTPUT 703;"*OPT?" - Queries the 5371A for installed options.

***PSC - Power-On Status Clear
(command/query)**

Shortform: *PSC [Power-on Status Clear]
Longform: *PSC

The *PSC command controls the automatic power-on clearing of the Service Request Enable register, Event Status Enable register, and the Hardware Status Enable register. Sending the *PSC command with any number that rounds to a non-zero value causes the 5371A to clear (set to 0) all bits in the registers at power-on. Sending "*PSC,0" allows the 5371A to send a Service Request at power-on if required (and if the appropriate register bits have been enabled).

The *PSC? query returns the value of the Power-On-Clear flag. A returned value of "0" indicates that the Service Request Enable, Event Status Enable, and Hardware Status Enable registers will retain their status when power is restored to the instrument. A returned value of "1" indicates that the three registers will be cleared when power is restored.

Parameters: {0 | (any non-zero number)}

Examples: OUTPUT 703;"*PSC,1" - Tells the 5371A to clear the Service Request Enable, Event Status Enable, and Hardware Status Enable registers at power-on.

OUTPUT 703;"*PSC?" - Queries the 5371A for the value of the power-on clear flag.

***RCL - Recall Register (command)**

Shortform: *RCL [ReCaLl (register)]

Longform: *RCL

The *RCL command restores the instrument to a previously saved configuration from a specified save/recall register. This command is equivalent to the front panel RECALL key function.

Registers 0 through 9 may be specified. Specifying Register 0 recalls the instrument setup that existed just prior to invoking the PRES (Preset) or DMS (Default Measurement Setup) functions. Refer to the *SAV command description for information about saving to the registers.

Parameters: {0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9}

Example: OUTPUT 703;"*RCL,1" - Tells the 5371A to recall a setup from save-recall register 1.

***RST - Reset (command)**

Shortform: *RST [ReSeT]

Longform: *RST

The *RST command resets the instrument to its default settings. This command performs the same function as the PRESET command. Refer to *Table 2-5* for a list of the 5371A preset conditions.

Note that the *RST command will clear the key queue, but will not clear the error queue (refer to the ERR? and KEY command descriptions for more information).

Example: OUTPUT 703;"*RST" - Resets the 5371A to default conditions.

***SAV - Save Register (command)**

Shortform: *SAV [SAVe (register)]

Longform: *SAV

The *SAV command saves an instrument setup to a specified save/recall register. This command performs the same function as the front panel SAVE key. All instrument settings, except the HP-IB configuration, are saved. Registers 1 through 9 may be specified.

Register 0 cannot be specified because it is reserved for automatically storing the instrument setup that existed just prior to invoking the PRES (Preset) or DMS (Default Measurement Setup) functions. Register 0 can be recalled (refer to the *RCL command description for information about recalling registers).

Parameters: {1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9}

Example: OUTPUT 703;"*SAV,1" - Tells the 5371A to save the current setup in register 1.

***SRE - Service Request Enable (command/query)**

Shortform: *SRE [Service Request Enable]
Longform: *SRE

The *SRE command sets the bits of the Service Request Enable register. The command must be sent with a decimal number representing the binary-weighted values of the bits to be set. For example, sending “*SRE,32” sets bit 5 of the register to 1, thus enabling bit 5 (Event Status Bit) of the Status Byte register to generate a Service Request if an event occurs.

The *SRE? query returns the value of the bits in the Service Request Enable register. The returned value is a decimal number representing the binary-weighted value of the register bits.

Refer to Section 1 for information about using the Status Byte and Service Request Enable registers.

Range: 0 to 255

Examples: OUTPUT 703;"*SRE,16" - Sets bit 4 of the Service Request Enable register to 1, thus enabling bit 4 (Message Available) of the Status Byte register.

OUTPUT 703;"*SRE?" - Queries the 5371A for the contents of the Service Request Enable register.

***STB? - Read Status Byte (query only)**

Shortform: *STB? [(read) SStatus Byte]
Longform: *STB?

The *STB query is used to read the Status Byte register and the Master Summary Status (MSS) bit. The returned value is an integer representing the binary-weighted values of the register bits. For example, a returned value of “32” indicates that bit 5 (Event Status Bit) of the Status Byte register is set to 1. Sending the *STB query does not alter the contents of the register.

Example: OUTPUT 703;"*STB?" - Queries the 5371A for the contents of the Status Byte register.

***TRG - Trigger (command)**

Shortform: *TRG [TRiGger]
Longform: *TRG

The *TRG command is used to trigger a measurement. This command, with one exception, has the same effect as the GET (Group Execute Trigger) command. The exception is for Manual Arm (Totalize) measurements, where the *TRG command performs the same function as the front panel MANUAL ARM key.

Example: OUTPUT 703;"*TRG" - Tells the 5371A to take a measurement.

***TST? - Self-Test
(query only)**

Shortform: *TST? [(self) TeST]
Longform: *TST?

The *TST? query initiates a series of self tests which exercise various parts of the 5371A, and is equivalent to the Self Test selection in the Diagnostic Test screen. All of the tests performed require no user interaction and do not affect data stored in RAM. The *TST? query returns a "0" when all tests pass, or returns the number and associated message of the first test that fails.

Refer to Appendix D for a description of the tests and their response messages.

Example: OUTPUT 703;"*TST?" - Initiates the self test routine and returns the pass/fail result.

**SUBSYSTEM
SELECTORS AND
COMMANDS**

The following paragraphs describe the subsystem commands, grouped by subsystem selector in alphabetical order. In most cases, commands within a subsystem are in alphabetical order, with a few exceptions where functional grouping provides easier reference (for example, the commands relating to statistical functions in the PROCess subsystem).

Syntax diagrams for commands within a given subsystem are shown at the beginning of each subsystem group. For ease of reference, syntax diagrams for the subsystem selectors are shown in *Figure 2-3*, with references to the syntax diagram figures for each of the subsystem command groups.

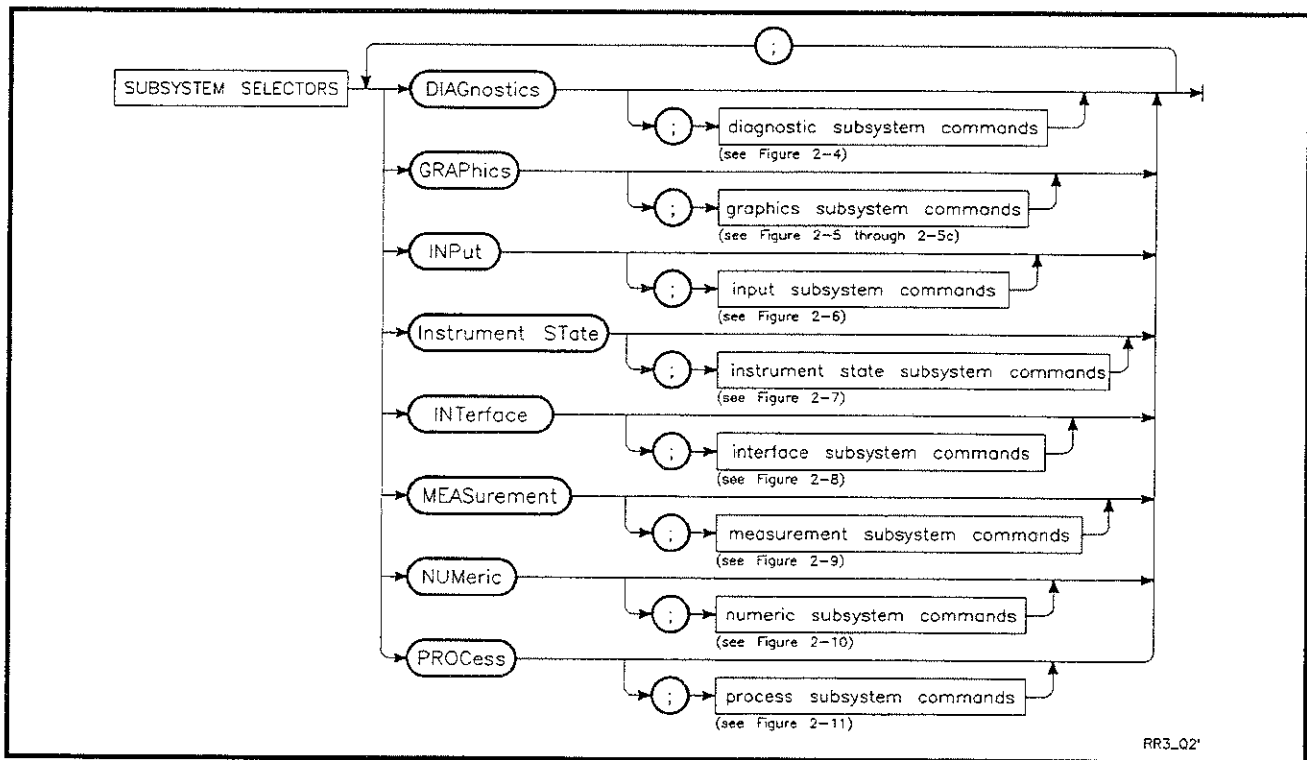


Figure 2-3. Subsystem Selector Syntax Diagrams

DIAGNOSTIC TEST (DIAG) SUBSYSTEM COMMANDS

The Diagnostic Test (DIAG) subsystem performs many diagnostic tests on the 5371A to verify functionality and identify faulty parts or assemblies. These diagnostic functions are identical to those available via the front panel TEST menu screen. A subset of these tests is automatically executed during the power-on initialization of the 5371A.

Syntax diagrams for the Diagnostic Test subsystem commands are shown in *Figure 2-4*. The following paragraphs describe how to use the Diagnostic Test subsystem commands to control diagnostic testing of the instrument. Refer to Appendix D for a description of the tests which can be executed.

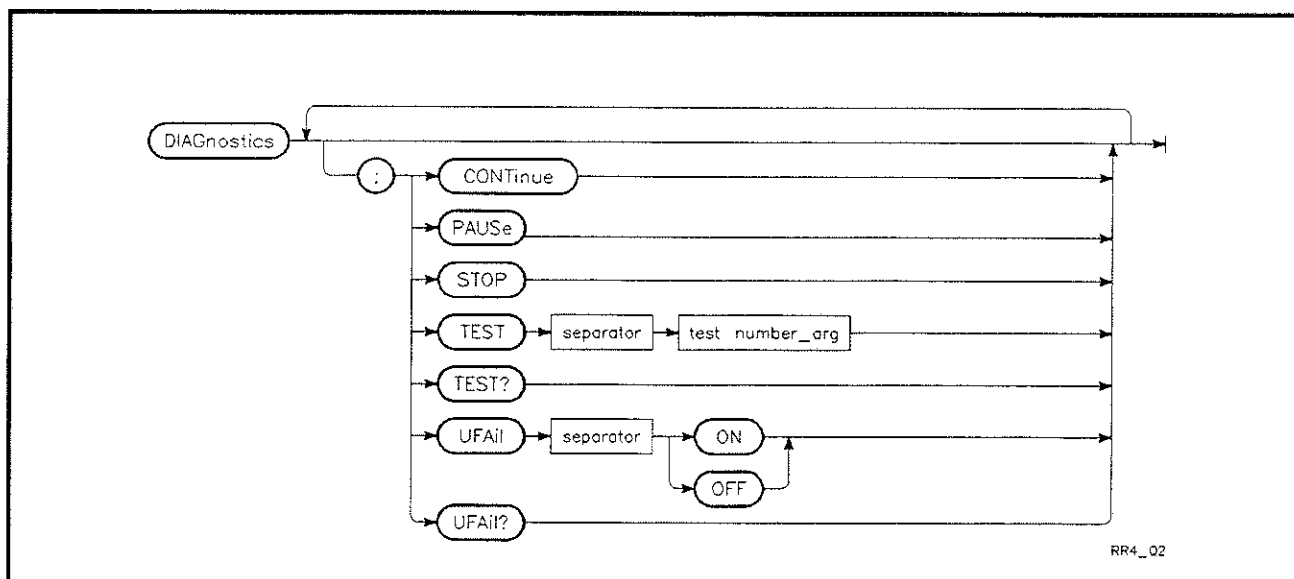


Figure 2-4. Diagnostic Subsystem Syntax Diagrams

CONT - Continue Test (command)

Shortform: CONT [CONTInue (test)]
Longform: CONTINUE

The CONTInue command continues execution of a test suspended by the PAUSE command.

Example: OUTPUT 703;"DIAG;CONT" - Tells the 5371A to continue the last diagnostic test before the PAUSE command.

PAUS - Pause Test (command)

Shortform: PAUS [PAUSE (test)]
Longform: PAUSE

The PAUSE command pauses the currently running test until a CONTInue command is received.

Example: OUTPUT 703;"DIAG;PAUS" - Tells the 5371A to pause the current diagnostic test.

STOP - Stop Test (command)

Shortform: STOP [STOP]
Longform: STOP

The STOP command terminates the execution of the currently running diagnostic test.

Example: OUTPUT 703;"DIAG;STOP" - Tells the 5371A to terminate the currently running test.

TEST - Run Test (command/query)

Shortform: TEST [(run) TEST]
Longform: TEST

The TEST command executes the diagnostic corresponding to the test number sent with the command. The test numbers are:

Test Number	Test Name	Test Number	Test Name
1	Self Test	12	CRT RAM
2	Time Base	13	LED Latch
3	Input Pods	14	CRT Controller
4	Input Amplifiers	15	Key Controller
5	Count ICs	16	DMA Controller
6	Gate Timer	17	Front Panel
7	Measurement RAM	18	CRT Adjustment
8	System ROM	19	CRT Video Pattern
9	System RAM	20	External Amplifier
10	Timer	21	Calibrate Interpolator
11	Real Time Clock		

The TEST? query returns the PASS/FAIL status and message of the last diagnostic test that was run.

Examples: OUTPUT 703;"DIAG;TEST,12" - Tells the 5371A to execute the CRT RAM diagnostic test.

OUTPUT 703;"DIAG;TEST?" - Queries the 5371A for the status and message of the last test.

UFA - Run Until Fail (command/query)

Shortform: UFA [(run) Until FAil]

Longform: UFAIL

The UFA command is used to select the Until Fail testing mode. In this mode, the 5371A will continue running a diagnostic test until a failure occurs, at which point the test is paused. To enable the Until Fail mode, send "ON"; to turn off the mode, send "OFF".

After a test has been paused, it can be continued by sending the CONTINUE command or by pressing the "Run" softkey on the displayed test screen.

The UFA? query returns the current on/off status of the Until Fail mode: "1" (ON) or "0" (OFF).

Parameters: {ON | OFF}

Examples: OUTPUT 703;"DIAG;UFA,ON" - Tells the 5371A to run the currently selected diagnostic test and pause if a failure occurs.

OUTPUT 703;"DIAG;UFA?" - Queries the 5371A for the current on/off status of the Until Fail mode.

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GRAPHICS

**GRAPHICS (GRAP)
SUBSYSTEM
COMMANDS**

The Graphics (GRAP) subsystem provides the ability to display measurement results in histogram, time variation, or event timing graphs. Also provided are options for examining graph data and changing graph display parameters. The graphics subsystem functions are equivalent to the functions available via the front panel GRAPHICS menu screen. Syntax diagrams for the Graphics subsystem commands are shown in *Figure 2-5* through *Figure 2-5c*.

NOTE

For most commands, "1" and "0" will be accepted interchangeably for "ON" and "OFF". However, this is not true for commands of the GRAP subsystem. For these commands "ON" and "OFF" must be used. Using "1" or "0" will cause an error.

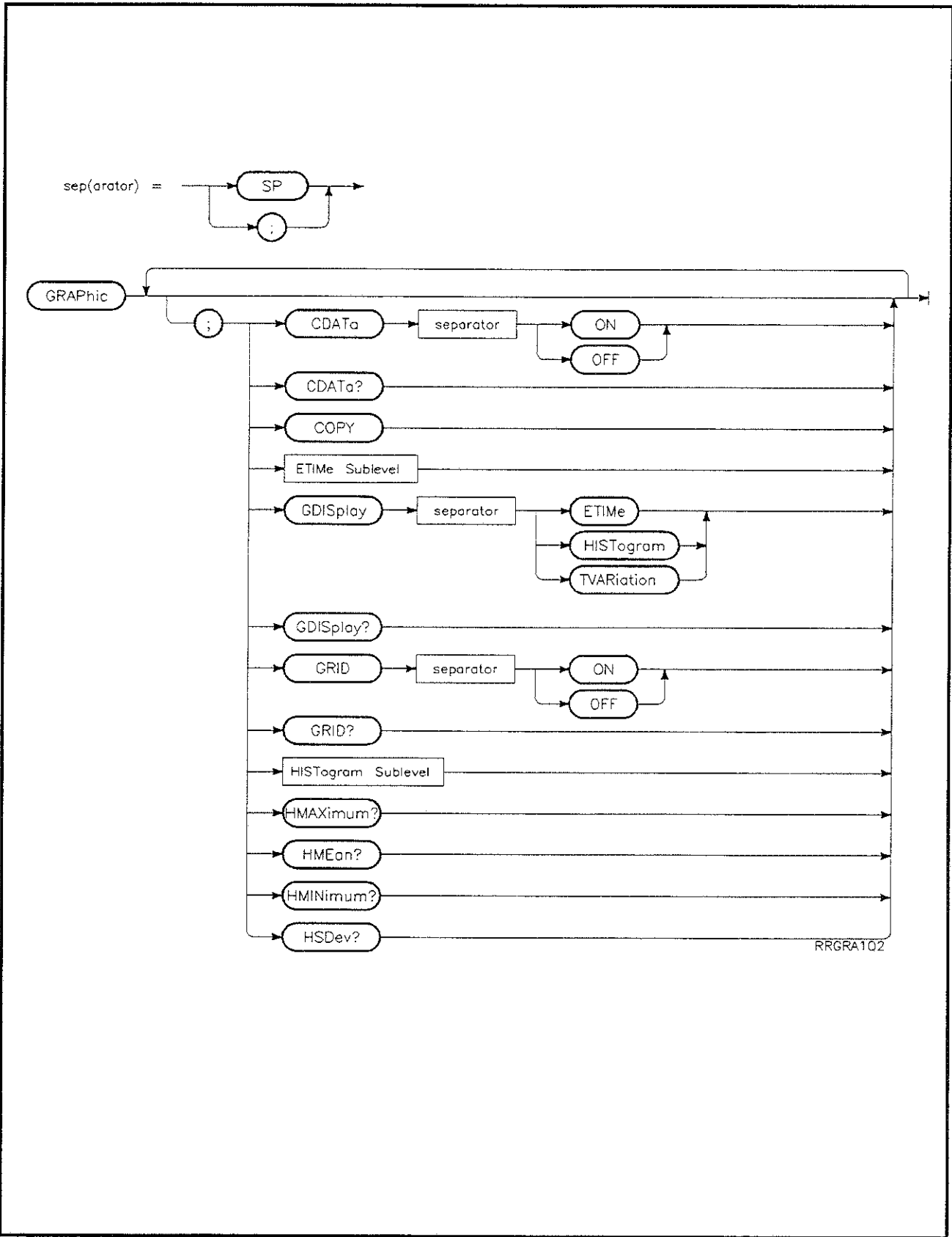


Figure 2-5. Graphic Subsystem Syntax Diagrams

CONTINUED

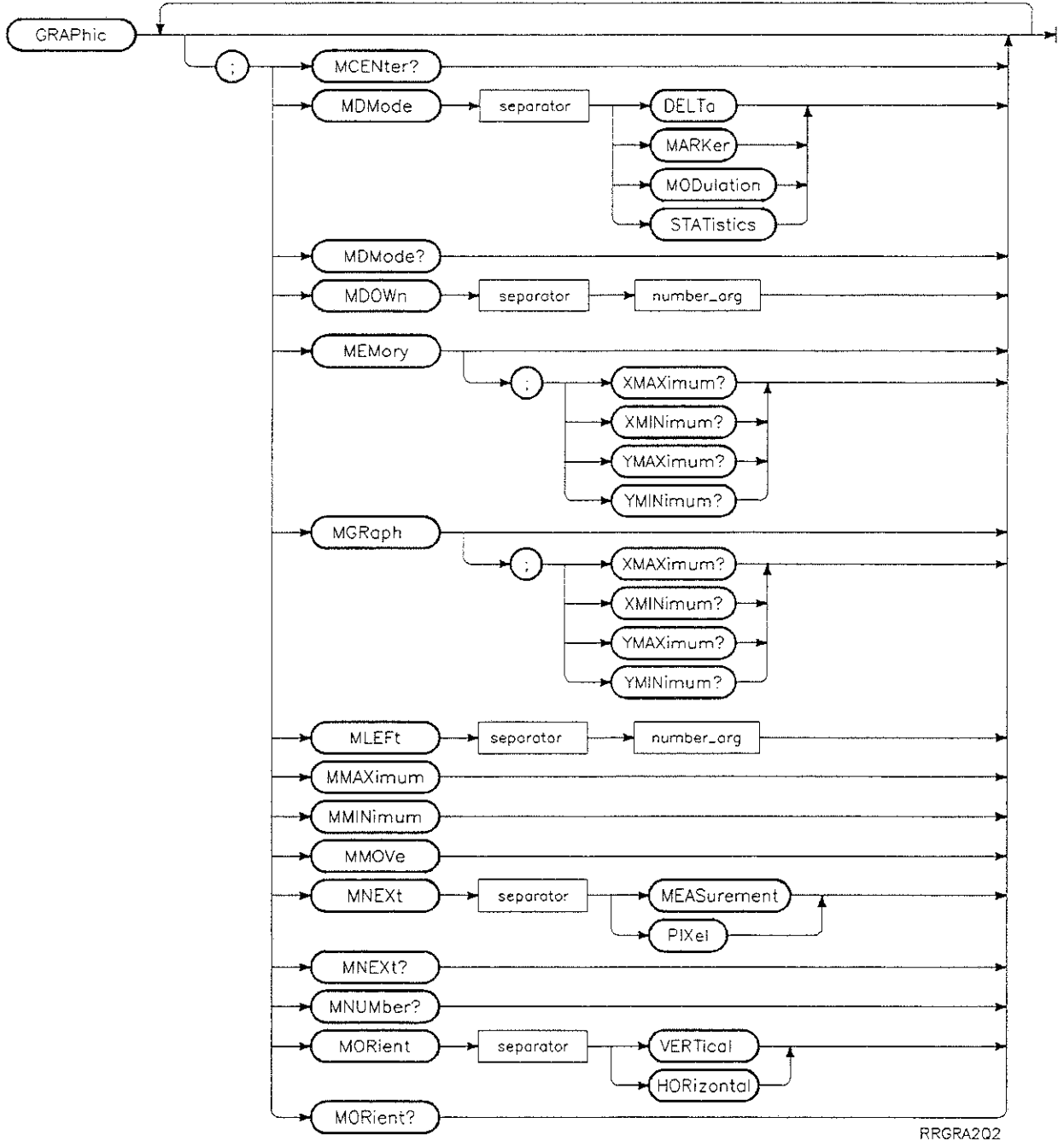


Figure 2-5. Graphic Subsystem Syntax Diagrams (Continued)

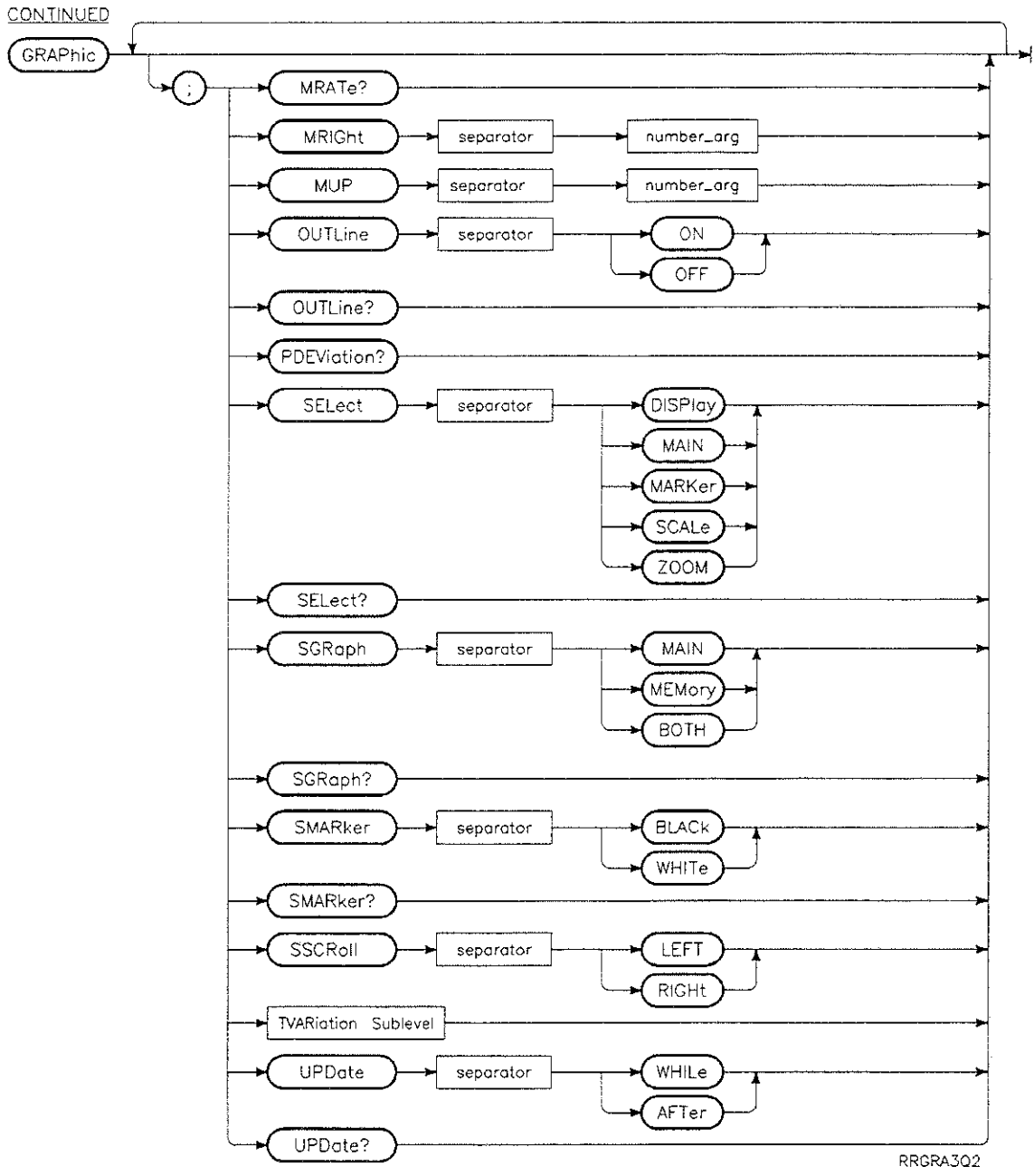


Figure 2-5. Graphic Subsystem Syntax Diagrams (Continued)

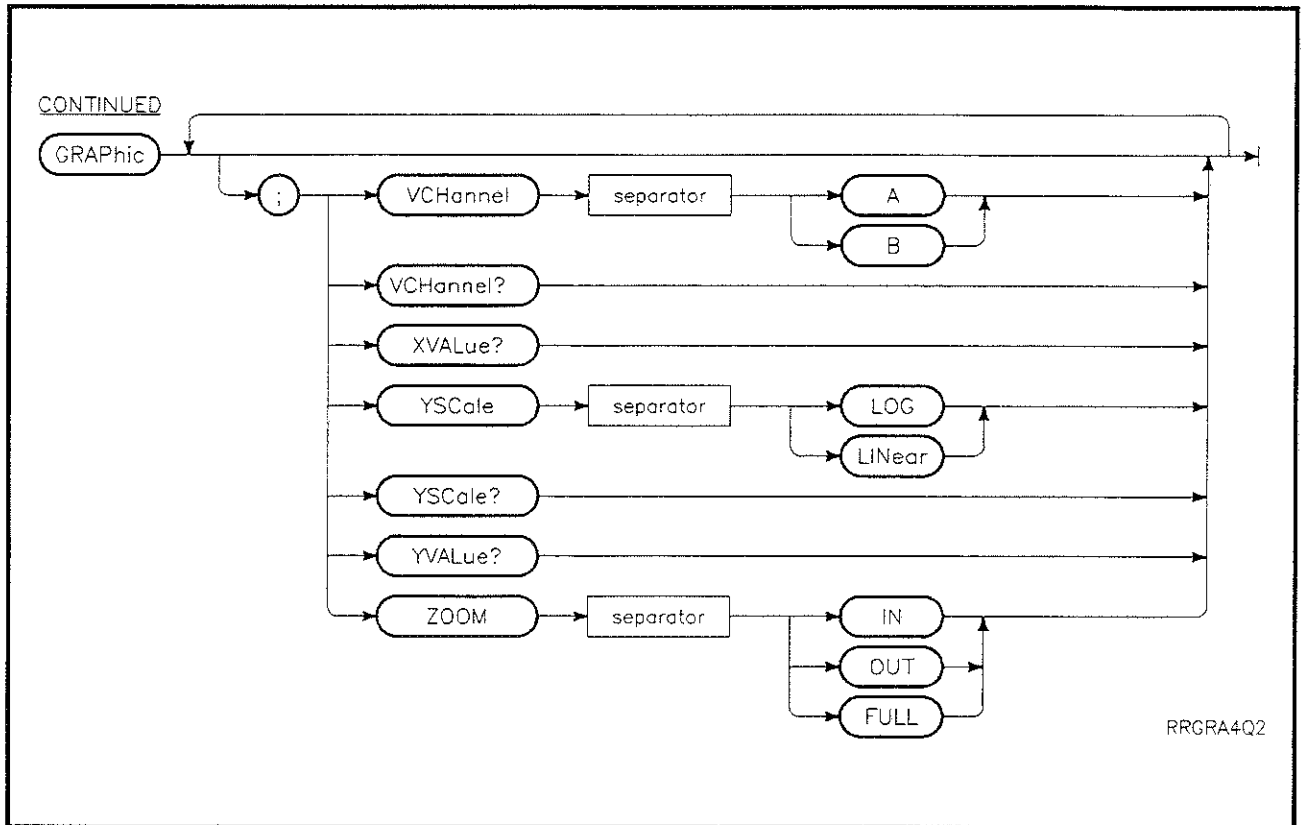


Figure 2-5. Graphic Subsystem Syntax Diagrams (Continued)

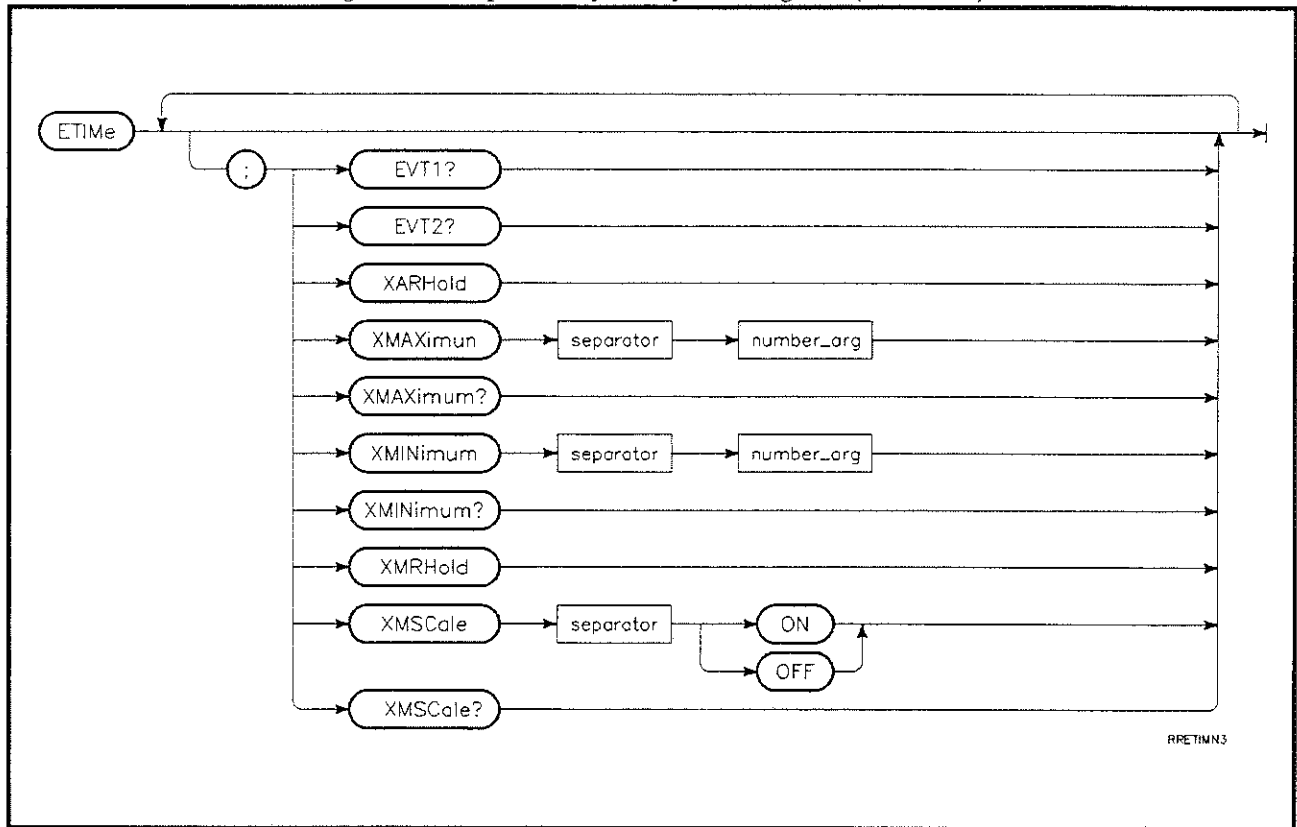


Figure 2-5a. Graphic Subsystem, Etime Sublevel

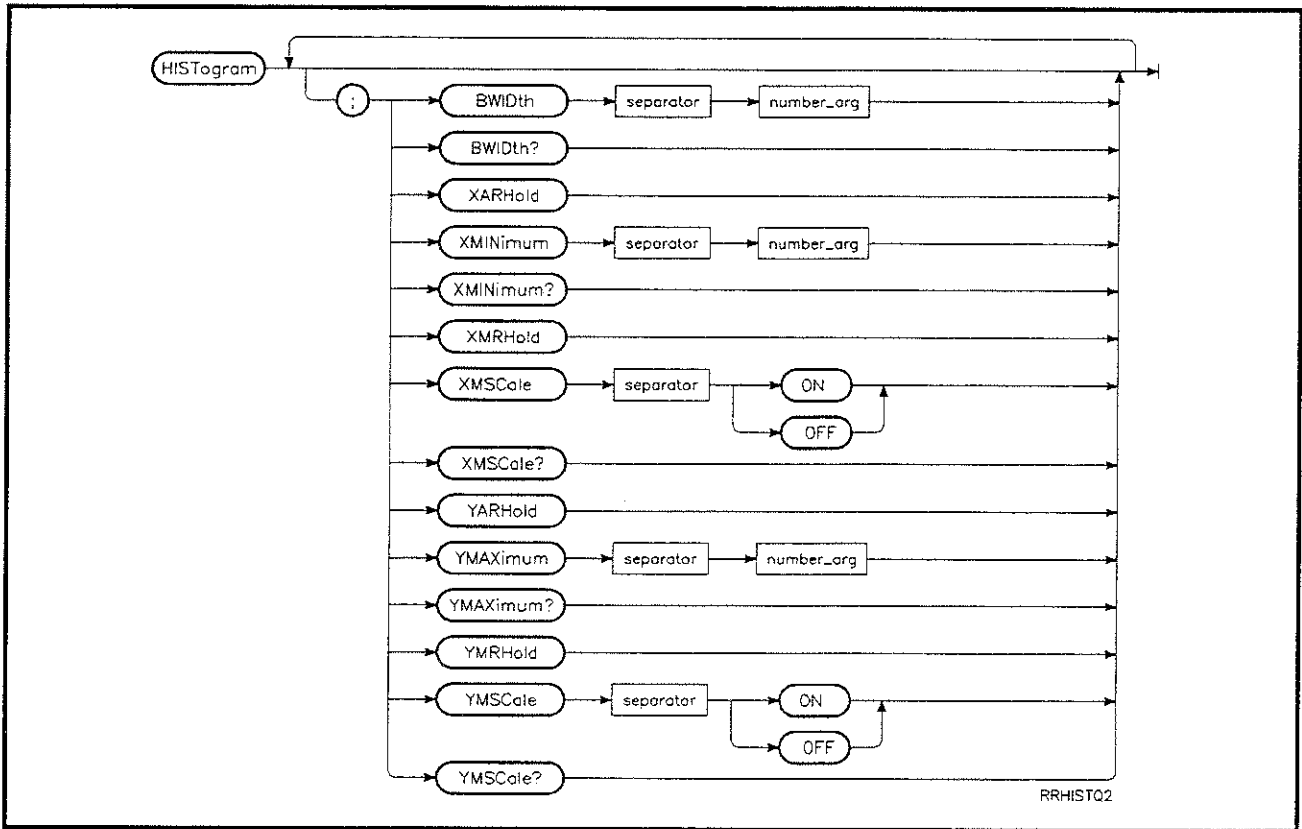


Figure 2-5b. Graphic Subsystem, Histogram Sublevel

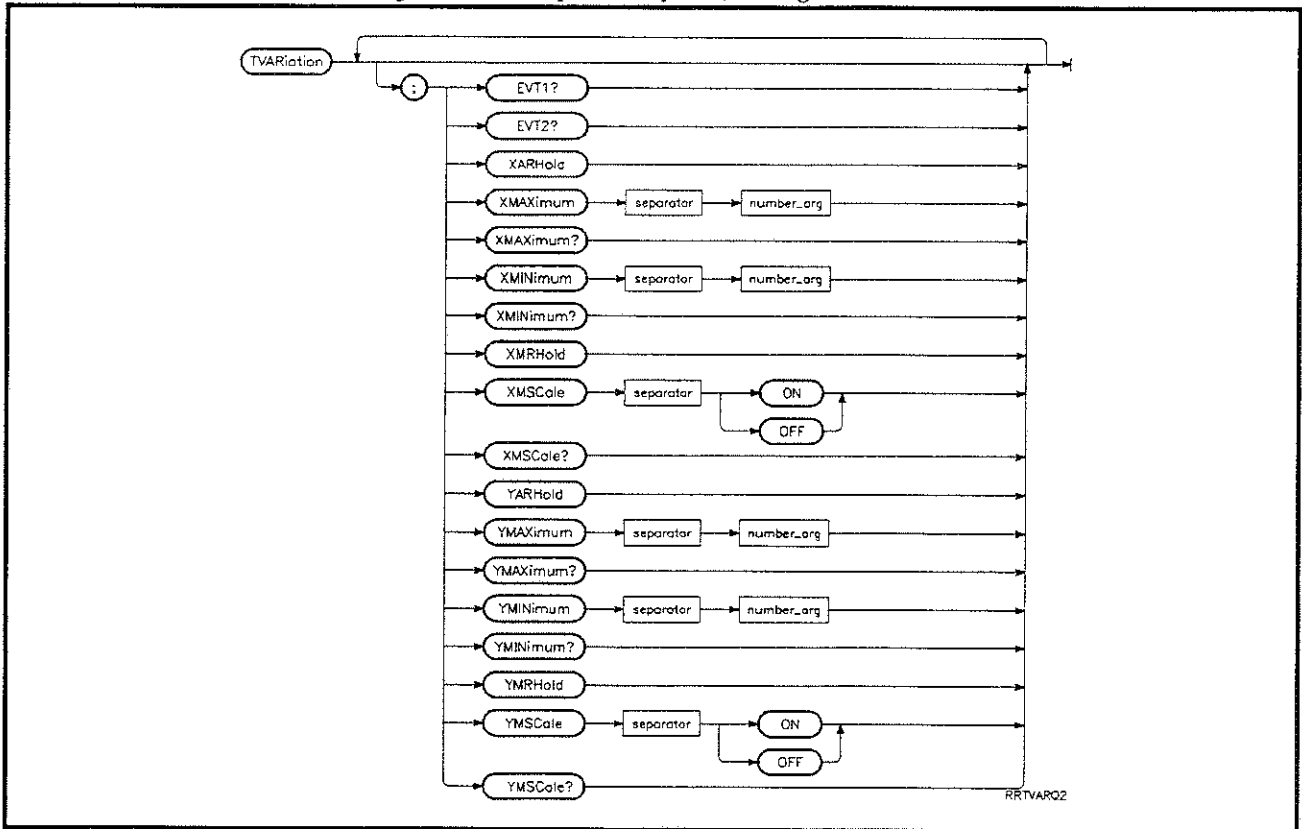


Figure 2-5c. Graphic Subsystem, Tvariation Sublevel

CDAT
Connect data on/off
(command/query)

Shortform: CDAT [(turn) Connect DATA (on or off)]
Longform: CDATA

The CDATA command enables or disables data connection on the Time Variation graph. When Connect Data is on, successive measurement data points within a block are connected.

The CDATA? query returns the currently selected Connect Data Mode.

Parameters: {ON | OFF}

Examples: OUTPUT 703;"GRAP;CDAT,ON" - Turns the Connect Data feature on.

OUTPUT 703;"GRAP;CDAT?" - Queries for current Connect Data status.

COPY
Copy Graph to
Memory
(command)

Shortform: [COPY (main graph to memory)]
Longform: COPY

The COPY command copies the currently displayed Main graph to memory. Any applied zooming and scrolling attributes are stored. Later, you can re-display a stored graph using the SGRaph command. You can re-display a single stored graph or if you operate in dual-display mode you can choose to display both main and memory graphs.

Example: OUTPUT 703;"GRAP;COPY" Copies the current Main display graph to memory.

ETIME
Event Time
(command)

Shortform: ETIM [Event TIME]
Longform: ETIME

The ETIME command selects the Event Time graph sublevel. Additional sublevel commands control Event Time graph features

An Event Time graph plots measurement start and stop occurrences versus time. This graph is only available for Time Interval measurements.

Example: OUTPUT 703;"GRAP;ETIM;XMSC,ON" - Sets Event Time as graph sublevel and sets the X-axis Manual Scale mode on.

EVT1?
Event Count on
First Channel
(query only)

Shortform: EVT1? [EVEN T 1?]
Longform: EVT1?

The EVT1? query returns the current event count on the first channel. The first channel is defined as the first channel in the source equation (for instance A is the first channel in the source equation A→B).

Example: OUTPUT 703;"GRAP;ETIM;EVT1?" - Queries for the current event count of the first channel.

EVT2?
Event Count on
Second Channel
(query only)

Shortform: EVT2? [EVENt 2?]
Longform: EVT2?

The EVT2? query returns the current event count on the second channel. The second channel is defined as the second channel in the source equation (for instance B is the second channel in the source equation A→B).

Example: OUTPUT 703;"GRAP;ETIM;EVT2?" - Queries for the current event count of the second channel.

XARH
X-axis Auto Range
Hold (command)

Shortform: XARH [X-axis Auto Range Hold]
Longform: XARHOLD

Use the XARHold command to copy the current X-axis values to the Manual Scaling parameters.

Example: OUTPUT 703;"GRAP;ETIM;XARH" - Copies current X-axis values to the Manual Scaling parameters.

XMAX
Set X-axis Maximum
(command/query)

Shortform: XMAX [X-axis MAXimum (value)]
Longform: XMAXIMUM

Use the XMAXimum command to set the X-axis maximum value.

The XMAXimum? query returns the X-axis maximum value.

Range: 0 to 1E+8 seconds

Examples: OUTPUT 703;"GRAP;ETIM;XMAX,2.0" - Sets the X-axis maximum value to 2.0 seconds.

OUTPUT 703;"GRAP;ETIM;XMAX?" - Queries for the current X-axis maximum value.

XMIN
Set X-axis Minimum
(command/query)

Shortform: XMIN [X-axis MINimum (value)]
Longform: XMINIMUM

Use the XMINimum command to set the X-axis minimum value.

The XMINimum? query returns the X-axis minimum value.

Range: 0 to 1E+8 seconds

Examples: OUTPUT 703;"GRAP;ETIM;XMIN,0" - Sets the minimum X-axis value to 0.0 seconds.

OUTPUT 703;"GRAP;ETIM;XMIN?" - Queries for the current X-axis minimum value.

XMRH
X-axis Marker
Range Hold
(command)

Shortform: XMRH [X-axis Marker Range Hold]
Longform: XMRHOLD

Use the XMRHold command to copy marker values to Manual Scaling parameters.

Example: OUTPUT 703;"GRAP;ETIM;XMRH" - Copy marker values to Manual Scaling parameters.

XMSC
X-axis Manual Scale
(command/query)

Shortform: XMSC [X-axis Manual Scaling]
Longform: XMSCALE

Use the XMScale command to set the X-axis Manual Scaling on or off.

The XMScale? query returns the current Manual Scaling status.

Parameter: {ON | OFF}

Examples: OUTPUT 703;"GRAP;ETIM;XMSC,ON" - Sets X-axis Manual Scaling on.

OUTPUT 703;"GRAP;ETIM;XMSC?" - Queries for the current Manual Scaling status.

GDIS
Graphic Display
(command/query)

Shortform: GDIS [Graphic DISplay]
Longform: GDISPLAY

Use the GDISplay command to choose the displayed graph.

Parameters: {HISTogram | TVARiation | ETIMe }

Examples: OUTPUT 703;"GRAP;GDIS,HIST" - Selects Histogram as the displayed graph.

OUTPUT 703;"GRAP;GDIS?" - Queries for the currently displayed graph.

GRID
Grid
(command/query)

Shortform: GRID
Longform: GRID

Use the GRID command to turn the Grid display on or off. The GRID? query returns the currently selected Grid display mode.

Parameters: {ON | OFF}

Examples: OUTPUT 703;"GRAP;GRID,ON" - Turn the Grid display on.

OUTPUT 703;"GRAP;GRID?" - Queries for the current status of grid display.

HIST
Histogram
(command)

Shortform: HIST [HISTogram]

Longform: HISTOGRAM

The HISTogram command selects the Histogram sublevel. Additional sublevel commands control Histogram graph features.

Example: OUTPUT 703;"GRAP;HIST;YMSC,ON" - Turns Y-axis Manual Scaling on.

BWID
Set Bin Width
(command/query)

Shortform: BWID [(set) Bin WIDth]

Longform: BWIDTH

Use the BWIDth command to set the desired Bin Width for Histogram graphs.

Range: 2E-10 to 1E+24

Examples: OUTPUT 703;"GRAP;HIST;BWID,2E-10" - Sets Bin Width to 200 pS.

OUTPUT 703;"GRAP;HIST;BWID?" - Queries for the current Bin Width value.

XARH
X-axis Auto Range
Hold (command)

Shortform: XARH [X-axis Auto Range Hold]

Longform: XARHOLD

Use XARHold to copy the current X-axis values to manual scaling parameters. This copies the X-axis minimum and maximum values and uses them to set up XMINimum and BWIDth parameters.

Example: OUTPUT 703;"GRAP;HIST;XARH" - Copies current X-axis values to the Manual Scaling parameters.

XMIN
Set X-Axis Minimum
(command/query)

Shortform: XMIN? [X-axis MINimum (value)]

Longform: XMINIMUM

Use the XMINimum command to set the Histogram X-axis minimum value.

The XMINimum? query returns the current X-axis minimum value.

Positive Range: 1E-12 to 1E+24 and 0

Negative Range: -1E24 to -1E-12

Examples: OUTPUT 703;"GRAP;HIST;XMIN,1E+6" - Sets the X-axis minimum value to 1E+6.

OUTPUT 703;"GRAP;HIST;XMIN?" - Queries for the current X-axis minimum value.

XMRH
X-axis Marker
Range Hold
(command)

Shortform: XMRH [X-axis Marker Range Hold]

Longform: XMRHOLD

The XMRHold command presets XMINimum and XMAXimum to the vertical marker values.

Example: OUTPUT 703;"GRAP;HIST;XMRH" - Copies marker values to Manual Scaling parameters.

XMSC
X-axis Manual Scale
(command/query)

Shortform: XMSC [X-axis Manual Scale]

Longform: XMSCALE

Use the XMScale command to turn X-axis Manual Scaling on or off.

The XMScale? query requests the current X-axis Manual Scaling status.

Examples: OUTPUT 703;"GRAP;HIST;XMSC,ON" - Sets Manual Scaling on.

OUTPUT 703;"GRAP;HIST;XMSC?" - Queries for the current X-axis Manual Scaling status.

YARH
Y-axis Auto
Range Hold
(command)

Shortform: YARH [Y-axis Auto Range Hold]

Longform: YARHOLD

Use YARHold to copy the current Y-axis values to the Manual Scaling parameters.

Example: OUTPUT 703;"GRAP;HIST;YARH" - Copy Y-axis values to Manual Scaling parameters.

YMAX
Y-axis
Maximum Value
(command/query)

Shortform: YMAX [Y-axis MAXimum (value)]

Longform: YMAXIMUM

Use the YMAXimum command to set the Histogram Y-axis maximum value.

The YMAXimum? query returns the current Y-axis maximum value.

Range: 5 to 1E+12

Examples: OUTPUT 703;"GRAP;HIST;YMAX,1000" - Sets Y-axis maximum value to 1000.

OUTPUT 703;"GRAP;HIST;YMAX?" - Queries for the current Y-axis maximum value.

YMRH
Y-axis Marker
Range Hold
(command)

Shortform: YMRH [Y-axis Marker Range Hold]

Longform: YMRHOLD

Use the YMRHold command to copy marker values to Manual Scaling parameters.

Example: OUTPUT 703;"GRAP;HIST;YMRH" - Copy markers.

YMSC
Y-axis Manual
Scaling
(command/query)

Shortform: YMSC [Y-axis Manual SCaling]

Longform: YMSCALE

Use YMSCale to turn the Y-axis Manual Scaling on or off.

The YMSCale? query returns the current Y-axis Manual Scaling status.

Parameters:{ON | OFF}

Examples: OUTPUT 703;"GRAP;HIST;YMSC,ON" Sets Y-axis Manual Scaling on.

OUTPUT 703;"GRAP;HIST;YMSC?" - Queries for the current Y-axis Manual Scaling status.

HMAX?
Histogram Maximum
Value
(query only)

Shortform: HMAX? [Histogram MAXimum (value)]

Longform: HMAXIMUM?

Use HMAXimum? to query the current Histogram maximum value. This query returns valid results only when the Marker Display Mode (MDM) is STATistics.

Example: OUTPUT 703;"GRAP;HMAX?" - Queries for the current Histogram maximum x-axis value of a bin with data between the markers.

HME?
Histogram Mean
Value
(query only)

Shortform: HME? [Histogram MEan (value)]

Longform: HMEAN?

Use HMEan? to query the statistical mean of a Histogram. The mean is calculated on the data between the markers. This query returns valid results only when the Marker Display Mode (MDM) is STATistics.

Example: OUTPUT 703;"GRAP;HME?" - Queries for the current Histogram Mean value.

HMIN?
Histogram
Minimum Value
(query only)

Shortform: HMIN? [Histogram MINimum (value)]

Longform: HMINIMUM?

Use HMINimum? to query the current Histogram minimum value. This query returns valid results only when the Marker Display Mode (MDM) is STATistics.

Example: OUTPUT 703;"GRAP;HMIN?" - Queries for the current Histogram minimum x-axis value of a bin with data between the markers.

HSD?
**Histogram Standard
Deviation Value
(query only)**

Shortform: HSD? [Histogram Standard Deviation]
Longform: HSDEV?

Use HSDeviation? to query the Histogram standard deviation value. The standard deviation is calculated on the data between the markers. This query returns valid results only when the Marker Display Mode (MDM) is STATistics.

Example: OUTPUT 703;"GRAP;HSD?" - Queries for the current Histogram Standard Deviation value.

MCEN?
**Modulation
Center Value
(query only)**

Shortform: MCEN? [Modulation CENTER (value)]
Longform: MCENTER?

The MCENter? query returns the modulation center value. The result is obtained by analyzing the data between the vertical display markers for maximum Y-axis peaks. The center value is the midpoint between the peaks. It is calculated as one of the results when MDMode equals MODulation.

Example: OUTPUT 703;"GRAP;MCEN?" - Queries for the Modulation Center value.

MDM
**Marker
Display Mode
(command/query)**

Shortform: MDM [Marker Display Mode]
Longform: MDMODE

The MDMode command sets the Marker Display Mode to MARKer, DELTa, STATistics or MODulation.

MARKer – Marker coordinates (X and Y)

DELTa – marker values (Delta X and Y between the two markers)

STATistics – (between the two markers)

MODulation – parameters (between the two markers)

Parameters: {MARKer | DELTa | STATistics |
MODulation}

Examples: OUTPUT 703;"GRAP;MDM,MARK" - Sets Marker Display Mode to Marker.

OUTPUT 703;"GRAP;MDM?" - Queries for current Marker Display Mode.

MDOW
Move Marker Down
(command)

Shortform: MDOW [(move) Marker DOWN]
Longform: MDOWN

Use MDOWN to move the graphics display marker down. This simulates using the front panel knob. The complementary command is MUP.

Range: 1 to 180

Example: OUTPUT 703;"GRAP;MDOW,40" - Moves marker down 40 pixels.

MEM
Memory Graph
(command)

Shortform: MEM [MEMory (graph)]
Longform: MEMORY

The MEMory command selects the Memory Graph sublevel.

Example: OUTPUT 703;"GRAP;MEM" - Selects the Memory Graph sublevel.

XMAX?
X-Axis Maximum
(query only)

Shortform: XMAX? [X-axis Maximum (value)]
Longform: XMAXIMUM?

Use XMAXimum? to query the X-axis maximum value for the Memory Graph.

Example: OUTPUT 703;"GRAP;MEM;XMAX?" - Queries for current X-axis maximum value.

XMIN?
X-Axis Minimum
(query only)

Shortform: XMIN? [X-axis MINimum (value)]
Longform: XMINIMUM?

Use XMINimum? to query the X-axis minimum value for the Memory Graph.

Example: OUTPUT 703;"GRAP;MEM;XMIN?" - Queries for current X-axis minimum value.

YMAX?
Y-Axis Maximum?
(query only)

Shortform: YMAX? [Y-axis MAXimum (value)]
Longform: YMAXIMUM?

Use YMAXimum? to query the Y-axis maximum value for the Memory Graph.

Example: OUTPUT 703;"GRAP;MEM;YMAX?" - Queries for current Y-axis maximum value.

YMIN?
Y-Axis Minimum?
(query only)

Shortform: YMIN? [Y-axis MINimum (value)]
Longform: YMINIMUM?

Use YMINimum? to query the Y-axis minimum value for the Memory Graph.

Example: OUTPUT 703;"GRAP;MEM;YMIN?" - Queries for current Y-axis minimum value

MGR
Main Graph
(command)

Shortform: MGR [Main GRaph]
Longform: MGRAPH

The MGRaph command selects the Main graph sublevel.

Example: OUTPUT 703;"GRAP;MGR" - Selects the Main Graph sublevel.

XMAX?
X-Axis Maximum?
(query only)

Shortform: XMAX? [X-axis MAXimum (value)]
Longform: XMAXIMUM?

Use XMAXimum? to query the X-axis maximum value for Main Graph.

Examples: OUTPUT 703;"GRAP;MGR;XMAX?" - Queries for current X-axis maximum value.

XMIN?
X-Axis Minimum?
(query only)

Shortform: XMIN? [X-axis MINimum (value)]
Longform: XMINIMUM?

Use XMINimum? to query the X-axis minimum value for the Main Graph.

Example: OUTPUT 703;"GRAP;MGR;XMIN?" - Queries for current X-axis minimum value.

YMAX?
Y-Axis Maximum?
(query only)

Shortform: YMAX? [Y-axis MAXimum (value)]
Longform: YMAXIMUM?

Use YMAXimum? to query the Y-axis maximum value for the Main Graph.

Example: OUTPUT 703;"GRAP;MGR;YMAX?" - Queries for current Y-axis maximum value.

YMIN?
Y-Axis Minimum?
(query only)

Shortform: YMIN? [Y-axis MINimum (value)]
Longform: YMINIMUM?

Use YMINimum? to query the Y-axis minimum value for the Main Graph.

Example: OUTPUT 703;"GRAP;MGR;YMIN?" - Queries for current Y-axis minimum value

MLEF
Move Marker Left
(command)

Shortform: MLEF [(move) Marker LEFt]
Longform: MLEFT

Use MLEFt to move the graphics display marker left. This simulates using the front panel knob. The complementary command is MRIGHt.

Range: 1 to 248

Example: OUTPUT 703;"GRAP;MLEF,80" - Moves the marker left 80 display points. For Histograms, this is 80 bins, for Time Variation or Event Time this is 80 display columns.

NOTE

If MNEXT,PIXEL is set before the MLEF command is issued, the MLEF command moves the marker N pixels to the left, where N is the parameter sent with the MLEF command.

If MNEXT,MEAS is set before the MLEF command is issued, the MLEF command moves the marker one data point to the left, and the parameter sent with MLEF is ignored.

MMAX **Move Marker to** **Maximum Value** **(command)**

Shortform: MMAX [(move) Marker (to) MAXimum]
Longform: MMAXIMUM

Use the MMAXimum command to move the marker to the maximum value displayed. For a Histogram, this is the maximum bin height displayed; for a Time Variation graph this is the maximum Y-value, which is the maximum measured value

Example: OUTPUT 703;"GRAP;MMAX" - Move marker to maximum value.

MMIN **Move Marker to** **Minimum Value** **(command)**

Shortform: MMIN [(move) Marker (to) MINimum]
Longform: MMINIMUM

Use the MMINimum command to move the marker to the minimum value displayed. For a Histogram, this is the minimum bin height displayed; for a Time Variation graph this is the minimum Y-value, which is the minimum measured value.

Example: OUTPUT 703;"GRAP;MMIN" - Move marker to minimum value.

MMOV **Copy Inactive Marker** **to Active** **(command)**

Shortform: MMOV [Marker MOVE (to position of active marker)]
Longform: MMOVE

Use the MMOVE command to move the inactive marker to the active marker position.

Example: OUTPUT 703;"GRAP;MMOV" - Move inactive marker to active marker position.

MNEX
Set Marker Next
Mode
(command/query)

Shortform: MNEX [Marker NEXt]
Longform: MNEXT

Use the MNEXt command to set the marker control mode to move-marker-to-next where next means either a pixel or a data point. On a Time Variation graph, if data points are far apart and you always want the marker on a data point, use (next) MEASurement. Conversely, to get the marker in a place between data points, use (next) PIXel.

The MNEXt? query returns the Marker Next status.

Parameters: {MEASurement | PIXel}

Examples: OUTPUT 703;"GRAP;MNEX,PIX" - Sets marker to move to next pixel.

OUTPUT 703;"GRAP;MNEX?" - Queries for the current Marker Next mode.

MNUM?
Get Measurement
Number
(query only)

Shortform: MNUM? [Measurement NUMber]
Longform: MNUMBER?

The MNUMber? query requests the measurement number associated with the active vertical marker. This command is only relevant for Time Variation or Event Time graphs.

Example: OUTPUT 703;"GRAP;MNUM?" - Queries for the current measurement number associated with the active vertical marker.

MOR
Marker Orientation
(command/query)

Shortform: MOR [Marker ORientation]
Longform: MORIENT

The MORient command is used to select the vertical or horizontal marker orientation.

The MORient? query returns the current marker orientation.

Parameters: {VERTical | HORizontal}

Examples: OUTPUT 703;"GRAP;MOR,VERT" - Sets Marker Orientation to vertical.

OUTPUT 703;"GRAP;MOR?" - Queries for the current Marker Orientation.

MRAT?
Get Modulation Rate
(query only)

Shortform: MRAT? [(get) Modulation RATE]
Longform: MRATE?

The MRATE? query returns the Modulation Rate value. This result is obtained by analyzing the data between the vertical display markers to arrive at an estimate of the modulation rate. Partial periods between the markers do not detract from the accuracy of this estimate. Modulation parameters are calculated when the Marker Display Mode has been set to Modulation.

If the HP 5371A cannot compute the modulation rate, the value -1 is returned.

Example: OUTPUT 703;"GRAP;MRAT?" - Queries for the Modulation Rate.

MRIG
Move Marker Right
(command)

Shortform: MRIG [(move) Marker RIGht]
Longform: MRIGHT

Use MRIGht to move the graphics display marker right. This simulates using the front panel knob. The complementary command is MLEFt.

Range: 1 to 248

Example: OUTPUT 703;"GRAP;MRIG,40" - Moves the marker right 40 display points.

NOTE

If MNEXT,PIXEL is set before the MRIG command is issued, the MRIG command moves the marker N pixels to the right, where N is the parameter sent with the MRIG command.

If MNEXT,MEAS is set before the MRIG command is issued, the MRIG command moves the marker one data point to the right, and the parameter sent with MRIG is ignored.

MUP
Move Marker Up
(command)

Shortform: MUP [(move) Marker UP]
Longform: MUP

Use MUP to move the graphics display marker up. This simulates using the front panel knob. The complementary command is MDOWn.

Range: 1 to 180

Example: OUTPUT 703;"GRAP;MUP,40" - Moves marker up 40 pixels.

OUTL
Outline Mode
(command/query)

Shortform: OUTL [OUTLine (mode)]
Longform: OUTLINE

This command applies to Histograms. It turns outline mode on or off. When OUTLine is on, the instrument displays only the silhouette of a Histogram (Meaning only the tops of the Histogram bins are drawn, connected vertically as required.) Conversely, setting OUTLine off draws lines from the top of each respective bin to the Histogram base (stated another way, the right and left sides of the bin extend from top to bottom). The query form asks for the current setting.

The panorama graph is always drawn in OUTLine on mode.

The OUTLine? query returns the Outline Mode status.

Parameters:{ON | OFF}

Examples: OUTPUT 703;"GRAP;OUTL,ON" - Turns Outline Mode on.

OUTPUT 703;"GRAP;OUTL?" - Queries for current Outline Mode.

PDEV?
Peak Deviation
(query only)

Shortform: PDEV? [Peak DEVIation]
Longform: PDEViation?

Use the PDEViation? query to obtain the peak deviation value. This result is obtained by analyzing the data between the vertical display markers to arrive at an estimate of the maximum Y-axis peaks. The returned value is the (maximum positive peak) minus (maximum negative peak).

Modulation parameters are calculated when the Marker Display Mode has been set to Modulation.

Example: OUTPUT 703;"GRAP;PDEV?" - Queries for current Peak Deviation value.

SEL
Select Graph Menu
Level
(command/query)

Shortform: SEL [SElect (graph menu)]
Longform: SELECT

Use the SElect command to select the graph menu level. Five options are available.

- MAIN
- MARKer
- ZOOM
- SCALE
- DISPlay

The SElect? query requests current the menu level displayed.

Parameters: {MAIN | MARKer | ZOOM | SCALE | DISPLAY}

Examples: OUTPUT 703;"GRAP;SEL,ZOOM" - Selects ZOOM level softkeys.

OUTPUT 703;"GRAP;SEL?" - Queries for current Graph menu softkey level.

SGR
Show Graph
(command/query)

Shortform: SGR [Show GRaph]

Longform: SGRAPH The SGRaph command selects from three types of displays:

- Main graph only
- Memory graph only
- Main and Memory simultaneously.

The SGRaph? query returns the current graph display selection.

Parameters: {MAIN | MEM | BOTH}

Examples: OUTPUT 703;"GRAP;SGR,MAIN" - Selects display of Main graph.

OUTPUT 703;"GRAP;SGR?" - Queries for current graph display selection.

SMAR
Select Active Marker
(command/query)

Shortform: SMAR [Select (active) MARKer]

Longform: SMARKER

The SMARker command selects the active marker. There are two choices.

- BLACK
- WHITE

The SMAR? query returns the current active marker color.

Parameters:{BLACK | WHITE}

Examples: OUTPUT 703;"GRAP;SMAR,BLAC" - Sets active marker to Black.

OUTPUT 703;"GRAP;SMAR?" - Queries for current active marker color.

SSCR
Screen Scroll
(command)

Shortform: SSCR [Screen SCRoll]
Longform: SSCROLL

The SSCRoll command scrolls the screen one “page’s” worth — a page is defined by the portion of the total graph currently displayed. The command controls the scrolling of a screen from left to right or vice versa.

Parameters: {LEFT | RIGHT}

Example: OUTPUT 703;“GRAP;SSCR,LEFT” - Scrolls screen to the left.

TVAR
(command)

Shortform: TVAR [Time VARIation]
Longform: TVARIATION

The TVARiation command selects the Time Variation graph sublevel. Additional sublevel commands control Time Variation graph features.

Example: OUTPUT 703;“GRAP;TVAR;XARH” - Copies the current X-axis values to the manual scaling parameters.

EVT1?
Event Count on
First Channel
(query only)

Shortform: EVT1? [EVENt 1?]
Longform: EVT1?

The EVT1? query returns the current event count on the first channel. The first channel is defined as the first channel in the source equation (for instance A is the first channel in the source equation A/B).

Example: OUTPUT 703;“GRAP;TVAR;EVT1?” - Queries for the current event count on the first channel.

EVT2?
Event Count on
Second Channel
(query only)

Shortform: EVT2? [EVENt 2?]
Longform: EVT2?

The EVT2? query returns the current event count on the second channel. The second channel is defined as the second channel in the source equation (for instance, B is the second channel in the source equation A/B).

Example: OUTPUT 703;“GRAP;TVAR;EVT2?” - Queries for the current event count on the second channel.

XARH
X-axis Auto Range
Hold (command)

Shortform: XARH [X-axis Auto Range Hold]
Longform: XARHOLD

Use the XARHold command to copy the current X-axis values to the Manual Scaling parameters.

Example: OUTPUT 703;“GRAP;TVAR;XARH” - Copies current X-axis values to the Manual Scaling parameters.

XMAX
Set X-axis Maximum
(command/query)

Shortform: XMAX [X-axis MAXimum (value)]

Longform: XMAXIMUM

Use the XMAXimum command to set the X-axis maximum value.

The XMAXimum? query returns the current X-axis maximum value.

Range: 0 to 1E+8 seconds

Examples: OUTPUT 703;"GRAP;TVAR;XMAX,2.0" - Sets maximum X-axis value to 2.0 seconds.

OUTPUT 703;"GRAP;TVAR;XMAX?" - Queries for the current X-axis maximum value.

NOTE

The XMAX? query outputs different formats depending on whether the graph addressed is main graph (MGR) or memory graph (MEM). The main graph query returns data in numeric format, while the memory graph query returns data in string format. For example:

If the XMAX for MGR and MEM are both 746.4782 μ s

GRAP;MGR;XMAX? returns the numeric value 746.4782E-06

GRAP;MEM;XMAX? returns the string value 746.4782 μ s.

XMIN
Set X-axis Minimum
(command/query)

Shortform: XMIN [X-axis MINimum (value)]

Longform: XMINIMUM

Use the XMINimum command to set the X-axis minimum value.

The XMINimum? query returns the current X-axis minimum value.

Range: 0 to 1E+8 seconds

Examples: OUTPUT 703;"GRAP;TVAR;XMIN,0.0" - Sets minimum X-axis value to zero seconds.

OUTPUT 703;"GRAP;TVAR;XMIN?" - Queries for the current setting.

NOTE

The *XMIN?* query outputs different formats depending on whether the graph addressed is main graph (MGR) or memory graph (MEM). The main graph query returns data in numeric format, while the memory graph query returns data in string format. For example:

If the *XMIN* for MGR and MEM are both 746.4782 μ s

GRAP;MGR;XMIN? returns the numeric value 746.4782E-06

GRAP;MEM;XMIN? returns the string value 746.4782 μ s.

XMRH **X-axis Marker** **Range Hold** **(command)**

Shortform: XMRH [X-axis MaRker Hold]

Longform: XMRHOLD

The XMRHold command presets XMINimum and XMAXimum to the vertical marker values.

Example: OUTPUT 703;"GRAP;TVAR;XMRH" - Copies marker values to Manual Scaling parameters.

XMSC **X-axis Manual Scale** **(command/query)**

Shortform: XMSC [X-axis Manual SCale]

Longform: XMSCALE

Use the XMSCale command to turn X-axis Manual Scaling on or off.

The XMSCale? query returns the current X-axis Manual Scaling status.

Examples: OUTPUT 703;"GRAP;TVAR;XMSC,ON" - Sets Manual Scaling on.

OUTPUT 703;"GRAP;XMSC?" - Queries for the current X-axis Manual Scaling status.

YARH **Y-axis Auto Range** **Hold (command)**

Shortform: YARH [Y-axis Auto Range Hold]

Longform: YARHOLD

Use YARHold to copy the current Y-axis values to the Manual Scaling parameters.

Example: OUTPUT 703;"GRAP;TVAR;YARH" - Copies current Y-axis values to the Manual Scaling parameters.

YMAX
Set Y-axis Maximum
(command/query)

Shortform: YMAX [Y-axis MAXimum (value)]

Longform: YMAXIMUM

Use the YMAXimum command to set the Y-axis maximum value.

Positive Range: $1E-12 \leq n \leq 1E+24$, and 0

Negative Range: $-1E+24 \leq n \leq -1E-12$

Examples: OUTPUT 703;"GRAP;TVAR;YMAX,1E6" - Sets Y-axis maximum value to 1E6.

OUTPUT 703;"GRAP;TVAR;YMAX?" - Queries for the current Y-axis maximum value.

NOTE

The YMAX? query outputs different formats depending on whether the graph addressed is main graph (MGR) or memory graph (MEM). The main graph query returns data in numeric format, while the memory graph query returns data in string format. For example:

If the YMAX for MGR and MEM are both 746.4782 μ s

GRAP;MGR;YMAX? returns the numeric value 746.4782E-06

GRAP;MEM;YMAX? returns the string value 746.4782 μ s.

YMIN
Set Y-axis Minimum
(command/query)

Shortform: YMIN [Y-axis MINimum (value)]

Longform: YMINIMUM

Use the YMINimum command to set the Y-axis minimum value.

Positive Range: $1E-12 \leq n \leq 1E+24$, and 0

Negative Range: $-1E+24 \leq n \leq -1E-12$

Examples: OUTPUT 703;"GRAP;TVAR;YMIN,1E+6" - Sets Y-axis minimum value to 1E+6.

OUTPUT 703;"GRAP;TVAR;YMIN?" - Queries for the current Y-axis minimum value.

NOTE

The `YMIN?` query outputs different formats depending on whether the graph addressed is main graph (MGR) or memory graph (MEM). The main graph query returns data in numeric format, while the memory graph query returns data in string format. For example:

If the `YMIN` for MGR and MEM are both 746.4782 μ s

`GRAP;MGR;YMIN?` returns the numeric value 746.4782E-06

`GRAP;MEM;YMIN?` returns the string value 746.4782 μ s.

YMRH **Y-axis Marker** **Range Hold** **(command)**

Shortform: YMRH [Y-axis Marker Range Hold]

Longform: YMRHOLD

The YMRHold command presets YMINimum and YMAXimum to the horizontal marker values.

Example: OUTPUT 703;"GRAP;TVAR;YMRH" - Copies marker values to Manual Scaling parameters.

YMSC **Y-axis Manual Scale** **(command/query)**

Shortform: YMSC [Y-axis Manual SCaling]

Longform: YMSCALE

Use the YMScale command to turn the Y-axis Manual Scaling on or off.

The YMScale? query returns the current Y-axis Manual Scaling status.

Parameter: {ON | OFF}

Examples: OUTPUT 703;"GRAP;TVAR;YMSC,ON" - Sets Y-axis Manual Scaling on.

OUTPUT 703;"GRAP;TVAR;YMSC?" - Queries for the current Y-axis Manual Scaling status.

UPD
Set Update Mode
(command/query)

Shortform: UPD [UPDate (mode)]
Longform: UPDATE

Use the UPDate command to set the graphic update mode to update the display after each data acquisition pass (WHILe) or after the final pass (AFTer). Accordingly, the command only applies to multiple-pass measurements.

The UPDate? query returns the currently selected Update mode.

Parameters: {WHILe | AFTer}

Examples: OUTPUT 703;"GRAP;UPD,WHIL" - Sets graph updating to occur after each pass.

OUTPUT 703;"GRAP;UPD?" - Queries for the current Update mode.

VCH
View Channel
(command/query)

Shortform: VCH [View CHannel]
Longform: VCHANNEL

Use the VCHannel command to select the View Channel for dual-channel, dual-result measurements. These measurements are: Frequency, Period, or Totalize, A&B.

The VCHannel? query returns the currently selected View Channel.

Parameters: {A | B }

Examples: OUTPUT 703;"GRAP;VCH,A" - Selects channel A as the view channel.

OUTPUT 703;"GRAP;VCH?" - Queries for the current view channel selection.

XVAL?
Get X-axis Value
(query only)

Shortform: XVAL? [X-axis VALue]
Longform: XVALUE?

TheXVALue? query returns the current X-value for Marker or Delta Marker Display Mode Values.

Example: OUTPUT 703;"GRAP;XVAL?" - Queries for the current Marker or Delta X-values.

YSC
Y-axis Scale
(command/query)

Shortform: YSC [Y-axis SCale]

Longform: YSCALE

The YSCale command sets the Y-axis scaling mode for Histograms. The scale choices are LOG or LINear.

The YSCale? query returns the current Y-axis scaling mode.

Parameters: {LOG | LINear}

Examples: OUTPUT 703;"GRAP;LOG" - Sets Y-axis scale to logarithmic scale.

OUTPUT 703;"GRAP;YSC?" - Queries for the current Y-axis scaling mode.

YVAL?
Get Y-axis Value
(query only)

Shortform: YVAL? [Y-axis VALue]

Longform: YVALUE?

The YVALue? query returns the current Y-value for Marker or Delta Marker Display Mode values.

Example: OUTPUT 703;"GRAP;YVAL?" - Queries for the current Marker or Delta Y-values.

ZOOM
Zoom a Graph
(command)

Shortform: ZOOM [ZOOM]

Longform: ZOOM

This control zooms (magnifies) any graph. Three views are possible: in, out, and full. ZOOM IN gives you increased resolution, ZOOM OUT gives you more of the "big picture". ZOOM FULL returns the graph to full scale (original acquisition picture).

Parameters: {IN | OUT | FULL}

Examples: OUTPUT 703;"GRAP;ZOOM,FULL" - Sets display for full scale.

INPUT

11-2

INPUT (INP) SUBSYSTEM COMMANDS

The Input (INP) subsystem commands provide control of the input characteristics and signal conditioning for the input channels and the external arm channel. The Input subsystem command functions are equivalent to those available via the front panel INPUT menu screen. Syntax diagrams for the Input subsystem commands are shown in *Figure 2-6*.

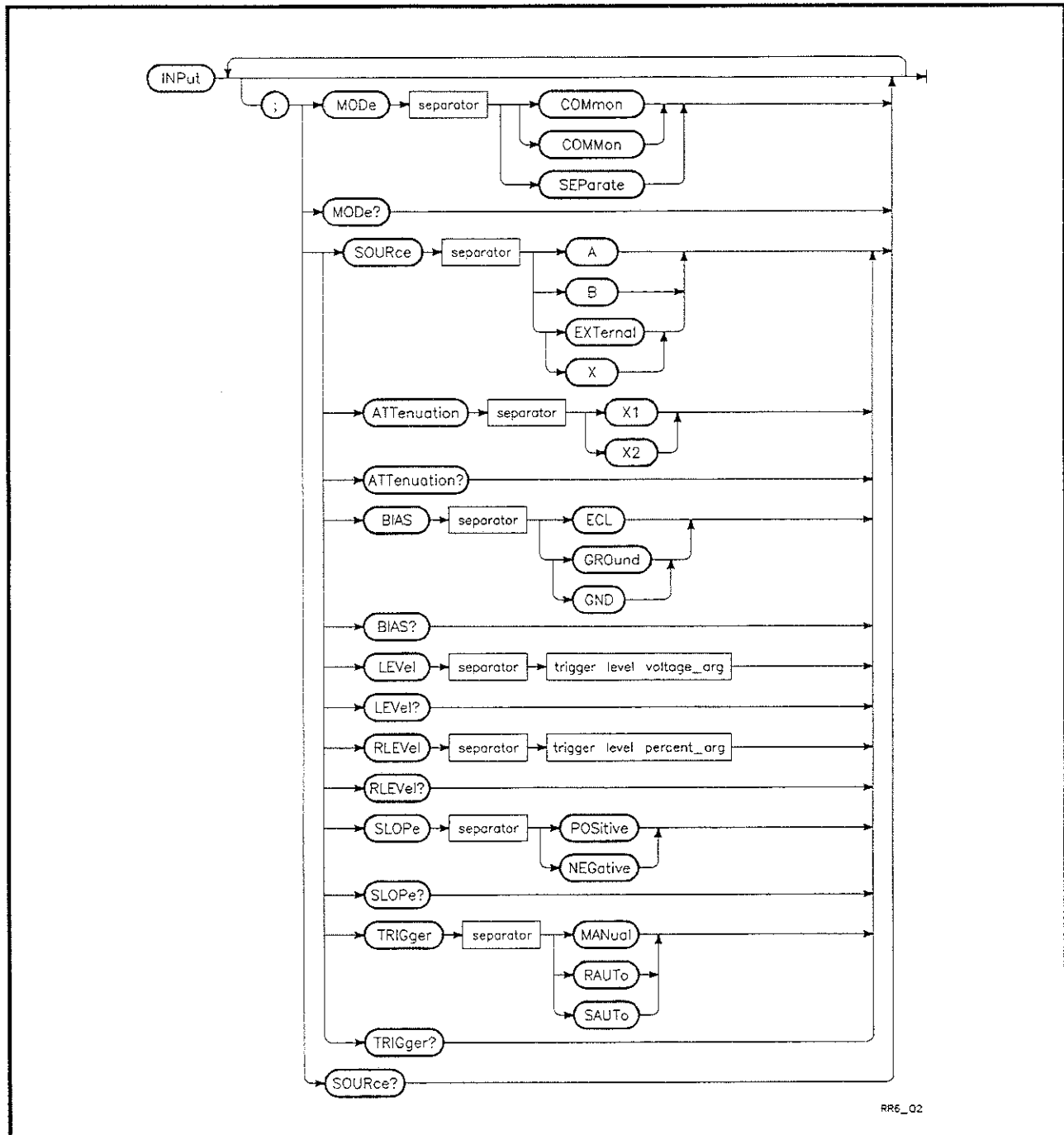


Figure 2-6. Input Subsystem Syntax Diagrams

**MOD - Input Mode
(command/query)**

Shortform: MOD [(input) MODe]
Longform: MODE

The MOD command selects the input mode for Channels A and B. Select Common (COM or COMM) to simultaneously route the input signal to Channel A and Channel B, or Separate (SEP) to use each channel individually. The input impedance and sensitivity specifications are the same for either Separate or Common mode.

The MOD? query returns the value of the input mode setting: SEP for Separate or COMM for common.

Parameters: {COMmon | COMMOn | SEParate}

Examples: OUTPUT 703;"INP;MOD,SEP" - Sets the input mode to Separate to allow Channel A and Channel B to be used individually.

OUTPUT 703;"INP;MOD?" - Queries the 5371A for the current input mode.

**SOUR - Input Source
(command/query)**

Shortform: SOUR [(input) SOURce]
Longform: SOURCE

The SOUR command for the Input subsystem selects the input channel for which subsequent input function selections (such as attenuation, slope, and trigger level, etc.) will apply until the source selection is changed. Channel A, Channel B, or External Gate Arm may be selected.

The SOUR? query returns the current source selection: "A", "B", or "EXT".

Parameters: {A | B | X (or) EXTernal}

Examples: OUTPUT 703;"INP;SOUR,B" - Selects Channel B as the input source to which subsequent input function selections apply.

OUTPUT 703;"INP;SOUR?" - Queries the 5371A for the channel input source.

The Input Source command has six subcommands: ATTenuation, BIAS, LEVel, Relative LEVel, SLOPe, and TRIGger. These subcommands are described below:

**ATT - Attenuation
(command/query)**

Shortform: ATT [ATTenuation]
Longform: ATTENUATION

The ATT command sets the attenuation value for the input channels. Channel A or B can be individually set to one of two values: X1 for 0 dB attenuation, or X2 for 8 dB attenuation which allows a signal having an amplitude 2.5 times the normal operating range to be applied to the input channel.

Note that attenuation may not be selectable depending on the currently installed pod.

The ATT? query returns the value of the current attenuation setting: "X1" for 0 dB attenuation or "X2" for 8 dB attenuation.

Parameters: {X1 | X2}

Examples: OUTPUT 703;"INP;SOUR,A;ATT,X2" - Sets Channel A input attenuation to 8 dB.

OUTPUT 703;"INP;SOUR,A;ATT?" - Queries the 5371A for the current attenuation setting of Channel A.

**BIAS - Termination Bias
(command/query)**

Shortform: BIAS [(termination) BIAS]

Longform: BIAS

The BIAS command sets the termination (bias) voltage for the 50 Ω impedance provided by the standard (HP 54002A) input pod. Either ECL (ECL) or ground (GRO or GND) may be selected. Selecting ECL sets the bias voltage to -2 V to preserve fidelity of ECL input signals. Selecting GRO or GND sets the bias voltage to 0 V. When other pods (1 Ω or 10 k Ω) are installed in place of the standard pod, the termination voltage is automatically set to 0 V and the BIAS command will have no effect.

The BIAS? query returns the value of the current termination voltage: "ECL" for -2 V or "GRO" for 0 V.

Parameters: {ECL | GND (or) GROund}

Examples: OUTPUT 703;"INP;SOUR,A;BIAS,ECL" - Sets termination voltage to -2 V.

OUTPUT 703;"INP;SOUR,A;BIAS?" - Queries the 5371A for the current termination voltage of Channel A.

**LEV - Trigger Level
(command/query)**

Shortform: LEV [(trigger) LEV]

Longform: LEVEL

The LEV command sets the trigger level for the previously selected input channel when the 5371A is in the Manual trigger mode (refer to the TRIG command description). The desired trigger level in volts is sent with the command. If the 5371A is in Repetitive Auto or Single Auto mode, this command is ignored if a normally correct trigger level value is sent. If an incorrect value is sent, an error message is displayed.

The LEV? query returns the value of the current trigger level for the selected input channel.

54002A Range: X1 attenuation: -2.0 Vdc to +2.0 Vdc in 2 mV steps
NOMINAL
X2.5 attenuation: -5.0 Vdc to +5.0 Vdc in 5 mV steps
NOMINAL

54001A Range: -20.0 Vdc to +20.0 Vdc in 20 mV steps NOMINAL

External Arm Gate Range: -5.0 Vdc to +5.0 Vdc in 20 mV steps NOMINAL

Examples: OUTPUT 703;"INP;SOUR,A;LEV,-1" - Sets the Channel A trigger level to -1 V.

OUTPUT 703;"INP;SOUR,B;LEV?" - Queries the 5371A for the current Channel B trigger level.

**RLEV - Relative
Trigger Level
(command/query)**

Shortform: RLEV [Relative (trigger) LEV]

Longform: RLEVEL

The RLEV command sets the relative trigger level in either Repetitive Auto or Single Auto mode for the selected input channel. The desired relative trigger level (in percentage) is sent with the command. If the 5371A is in manual trigger mode, this command is ignored if a normally correct relative trigger level value is sent. If an incorrect value is sent, an error message is displayed.

The trigger points are determined by the following formula:

$$\text{Trigger point} = \text{minimum peak} + (\text{maximum peak} - \text{minimum peak}) \times \text{percentage}$$

Thus a selected relative trigger level of 20 % for Channel A and 80 % for Channel B would cause a signal with a maximum peak of +1 V and a minimum peak of -1 V (2 V p-p) to have trigger points of +0.6 V and -0.6 V, respectively.

The RLEV? query returns the value of the current trigger level for the selected input channel.

Preset: NOMINALLY set to 50 % point of input signal

Range: NOMINALLY between maximum and minimum peaks of input signal, in 1 % steps

Level Resolution: X1 attenuation: 2mV steps NOMINAL
X2.5 attenuation: 5 mV steps NOMINAL

Examples: OUTPUT 703;"INP;SOUR,A;RLEV,20" - Sets the Channel A relative trigger level to 20 % of the maximum and minimum peaks of the input signal.

OUTPUT 703;"INP;SOUR,B;RLEV?" - Queries the 5371A for the current Channel B relative trigger level.

**SLOP - Slope
(command/query)**

Shortform: SLOP [SLOPe]
Longform: SLOPE

The SLOP command in the Input subsystem selects the positive (rising) or negative (falling) edge of the selected input signal for use as an event for triggering measurements. This trigger slope selection is independent of the arming and gating slope selections.

The SLOP? query returns the current slope setting for the selected channel, "POS" or "NEG".

Parameters: {POSitive | NEGative}

Examples: OUTPUT 703;"INP;SOUR,A;SLOP,POS" - Selects the rising edge of the Channel A input signal for triggering measurements.

OUTPUT 703;"INP;SOUR,B;SLOP?" - Queries the 5371A for the currently selected slope for Channel B.

**TRIG - Trigger
(command/query)**

Shortform: TRIG [TRIGger]
Longform: TRIGGER

The TRIG command selects the form of triggering for the selected input channel. In Manual mode, the LEVel command can be used to set the trigger level voltage; in Repetitive Auto or Single Auto mode, the trigger level is set automatically based on the relative level (in percent) specified using the RLEVel command.

In Single Auto (SAUT) mode, triggering occurs only once when initially selected; in Repetitive Auto (RAUT) mode, triggering occurs immediately before each measurement.

Note that repetitive auto triggering will slow down the overall measurement rate because time measurements cannot be made during the peak amplitude measurement phase of auto triggering.

The TRIG? query returns the current trigger level mode: "MAN" for manual, "RAUT" for repetitive auto, or "SAUT" for single auto.

Parameters: {MANual | RAUTo | SAUTo}

Examples: OUTPUT 703;"INP;SOUR,A;TRIG,MAN" - Sets the Channel A input trigger mode to manual.

OUTPUT 703;"INP;SOUR,A;TRIG?" - Queries the 5371A for the current Channel A input trigger mode.

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INSTRUMENT
STATE

INSTRUMENT STATE (IST) SUBSYSTEM COMMANDS

The Instrument State (IST) subsystem commands provide the ability to check the status of stored setup configuration data and to write-protect the saved data. The commands in this subsystem are equivalent to the front panel INSTRUMENT STATE menu screen. Syntax diagrams for the Instrument State subsystem commands are shown in *Figure 2-7*.

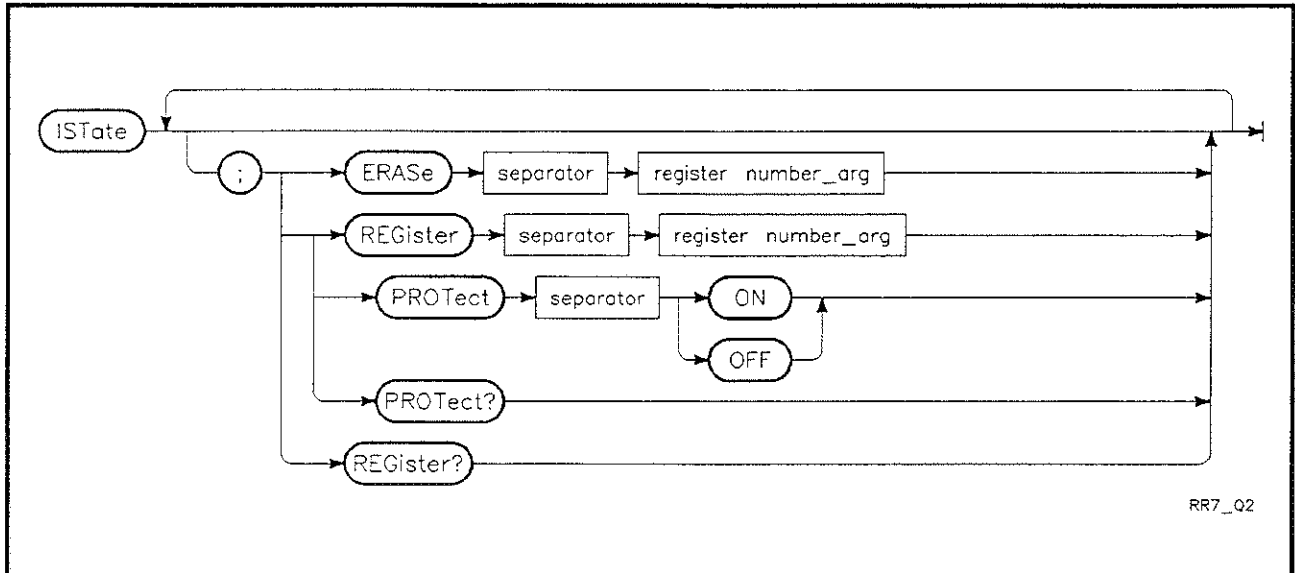


Figure 2-7. Instrument State Subsystem Syntax Diagrams

ERAS - Erase Register (command)

Shortform: ERAS [ERASe (register)]

Longform: ERASE

The ERAS command is used to erase a specified non-protected register. If a protected register is specified, a "Register protected" error will occur. If Register 0 is specified, a "Register out of range" error will occur.

Parameters: {1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9}

Example: OUTPUT 703;"IST;ERAS,3" - Erases register 3 if that register is not protected.

**REG - Register
(command/query)**

Shortform: REG [REgister]
Longform: REGISTER

The REG command specifies the register to be protected by the PROTection command. Register 1 through 9 may be specified for protection. Register 0 is always protected; if specified, a "Register out of range" error occurs.

Refer to the *SAV and *RCL system commands for information about using the registers for saving and recalling instrument setup information.

The REG? query returns the number of the currently specified register.

Parameters: {1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9}

Examples: OUTPUT 703;"IST;REG,1" - Specifies the register for the PROTection command.

OUTPUT 703;"IST;REG?" - Queries the 5371A for the currently specified register.

The Register command has the following subcommand:

**PROT - Protect Register
(command/query)**

Shortform: PROT [PROTection (register)]
Longform: PROTECT

The PROT command selects the protection status for the register specified by the REGister command. A protected register cannot be erased with the ERASe command or written to with the *SAV command. If a protected register is specified with the ERAS or *SAV commands, a "Register protected" error will occur.

Registers 1 through 9 can be specified for protection. Register 0 is always protected; if specified, a "Register out of range" error occurs.

The PROT? query returns the protection status of the currently specified register.

Parameters: {ON | OFF}

Examples: OUTPUT 703;"IST;REG,3;PROT,ON" - Turns on protection for register 3.

OUTPUT 703;"IST;REG,3;PROT?" - Queries the 5371A for the protection status of register 3.

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INTERFACE

INTERFACE (INT) SUBSYSTEM COMMANDS

The Interface (INT) subsystem controls the type of output data format, the print source for printing or plotting measurement data, and the setting of measurement timeout values. The functions in this subsystem are equivalent to the front panel SYSTEM menu screen (except that the HP-IB address cannot be selected over the bus). Syntax diagrams for the Interface subsystem commands are shown in *Figure 2-8*.

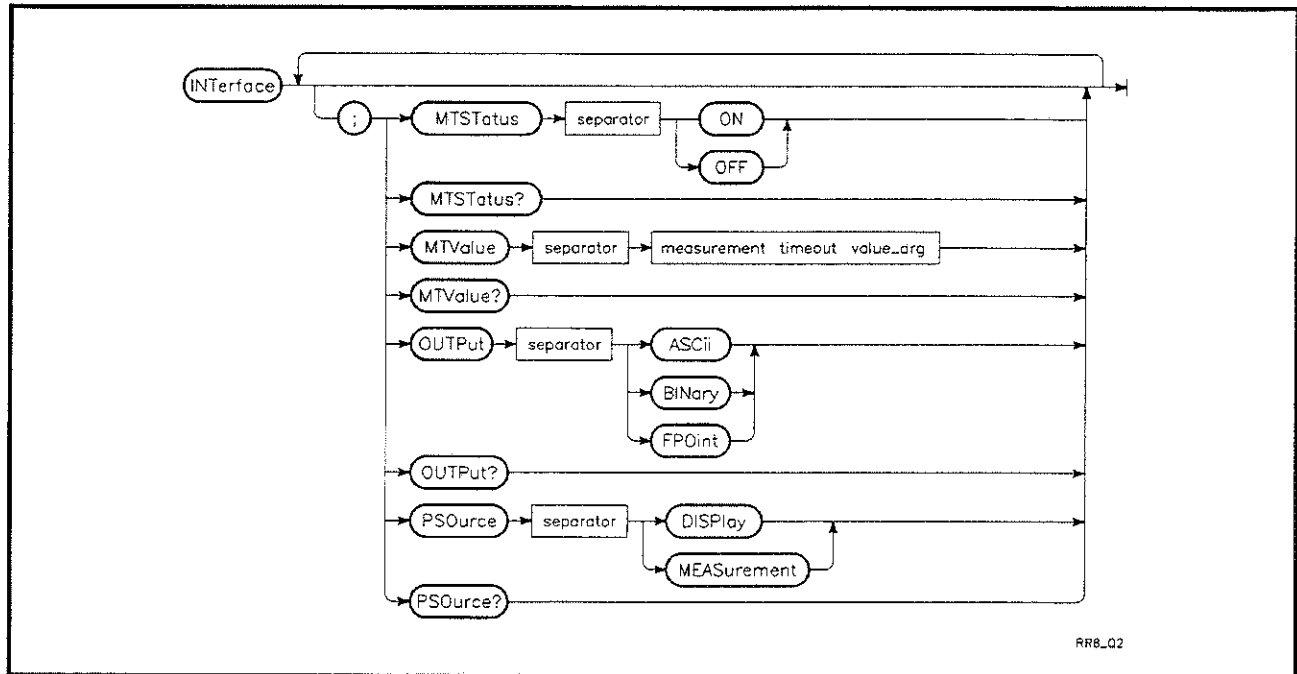


Figure 2-8. Interface Subsystem Syntax Diagrams

MTST - Measurement Timeout Status (command/query)

Shortform: MTST [Measurement Timeout Status]

Longform: MTSTATUS

The MTST command enables the Measurement Timeout Status function. When MTST is turned ON, a measurement timeout value up to 36000 seconds may be selected using the MTV command. When the measurement time exceeds the specified timeout value, a message is displayed on the screen to indicate that the measurement is not completed. When MTST is turned OFF, no measurement timeout message is displayed.

The MTST? query returns the current status of the measurement timeout: "1" (ON) or "0" (OFF).

Parameters: {ON | OFF}

Examples: OUTPUT 703;"INT;MTST,ON" - Turns on the measurement timeout status function.

OUTPUT 703;"INT;MTST?" - Queries the 5371A for the current measurement timeout status.

**MTV - Measurement
Timeout Value
(command/query)**

Shortform: MTV [Measurement Timeout Value]

Longform: MTVALUE

The MTV command is used to set the measurement timeout value. A time value up to 36000 seconds may be set. When the selected timeout value is exceeded, a timeout message is displayed on the screen. For example, if a timeout value of 5 seconds is specified and the total measurement time is 10 seconds, a message will be displayed after 5 seconds indicating that the measurement is not completed. The MTST function must be turned on for the MTV command to be used.

The MTV? query returns the previously set measurement timeout value.

Range: 0 seconds to 36000 seconds, in 1 second steps.

Examples: OUTPUT 703;"INT;MTV,100" - Sets the 5371A measurement timeout value to 100 seconds.

OUTPUT 703;"INT;MTV?" - Queries the 5371A for the measurement timeout value.

**OUTP - Output
Format
(command/query)**

Shortform: OUTP [OUTPut (format)]

Longform: OUTPUT

The OUTP command selects the output format for sending data to the controller. Either ASCII, floating point, or binary can be selected. Changing the output format will change subsequent data outputs; any data currently in the output buffer will remain in the format that it originated in. Note that switching to binary output format will empty the output buffer.

The OUTP? query returns the selected output format: "ASC" (ASCII) or "FPO" (floating point). Note that queries are not allowed when in binary output mode, therefore, the response to the OUTP? query will never indicate the binary output format.

Parameter: {ASCii | Floating PPoint | BINary}

Examples: OUTPUT 703;"INT;OUTP,ASC" - Tells the 5371A to output data to the controller in ASCII measurement format.

OUTPUT 703;"INT;OUTP?" - Queries the 5371A for the selected output format.

**PSO - Print Source
(command/query)**

Shortform: PSO [Print Source]

Longform: PSOURCE

The PSO command selects the data source for generating a hardcopy output using the PRINT or PLOT commands. When using the PRINT command, MEASurements can be selected to get a copy of the measurements results, or DISPlay can be selected to get a copy of the current screen. When using the PLOT command, only DISPlay can be chosen as the data source.

The PSO? query returns the currently selected data source: "DISP" (display) or "MEAS" (measurement results).

Parameters: {DISPlay | MEASurement}

Examples: OUTPUT 703;"INT;PSO,DISP" - Selects the screen as the data source for printing.

OUTPUT 703;"INT;PSO?" - Queries the 5371A for the selected data source.

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MEASUREMENT

**MEASUREMENT
(MEAS)
SUBSYSTEM
COMMANDS**

The Measurement (MEAS) subsystem controls the HP 5371A measurement modes, arming modes, measurement size, and measurement holdoff (start) and sampling (stop) conditions. The commands in this subsystem are equivalent to those available via the front panel FUNCTION menu screen. Syntax diagrams for the Measurement subsystem commands are shown in Figure 2-9.

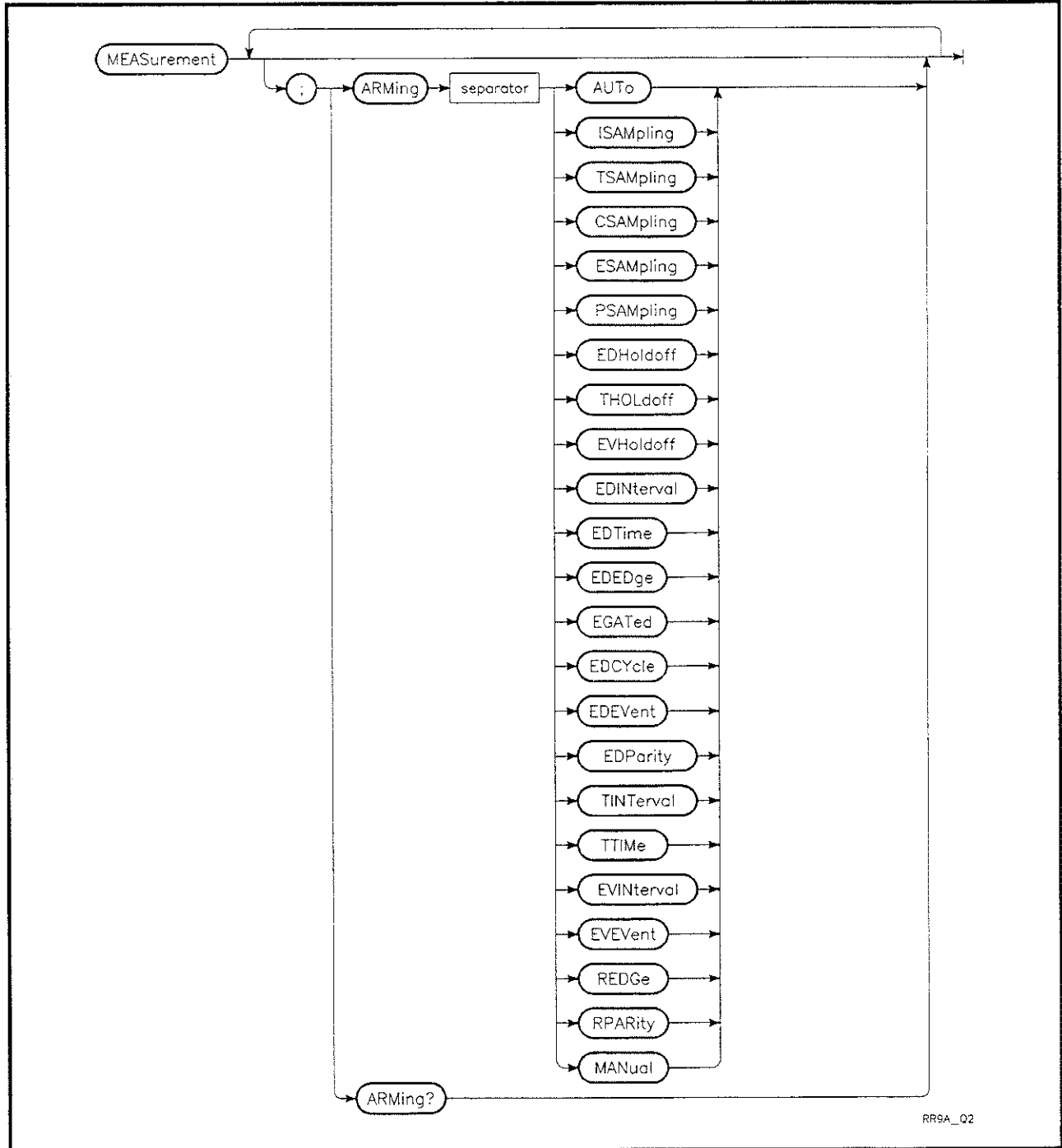
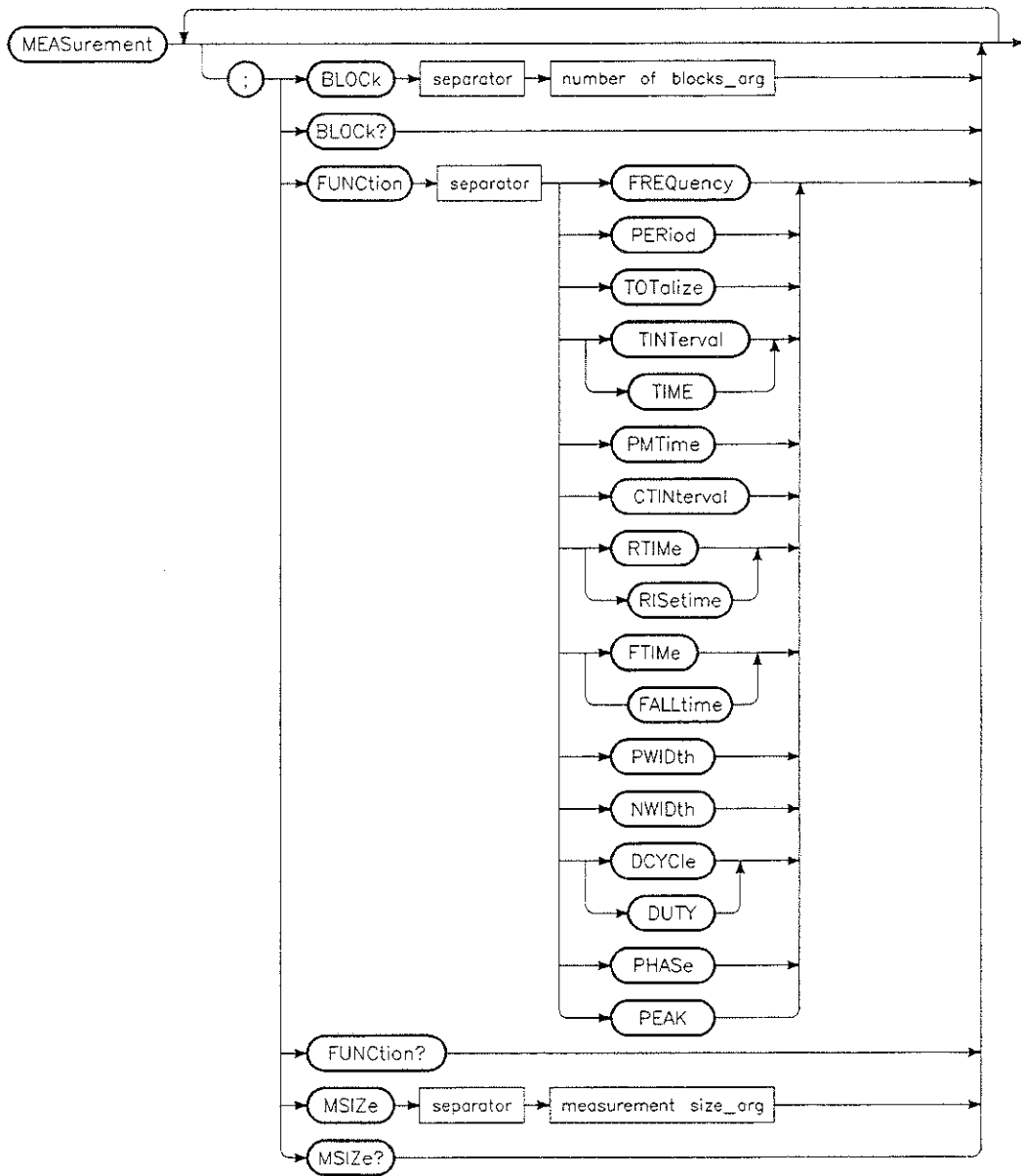
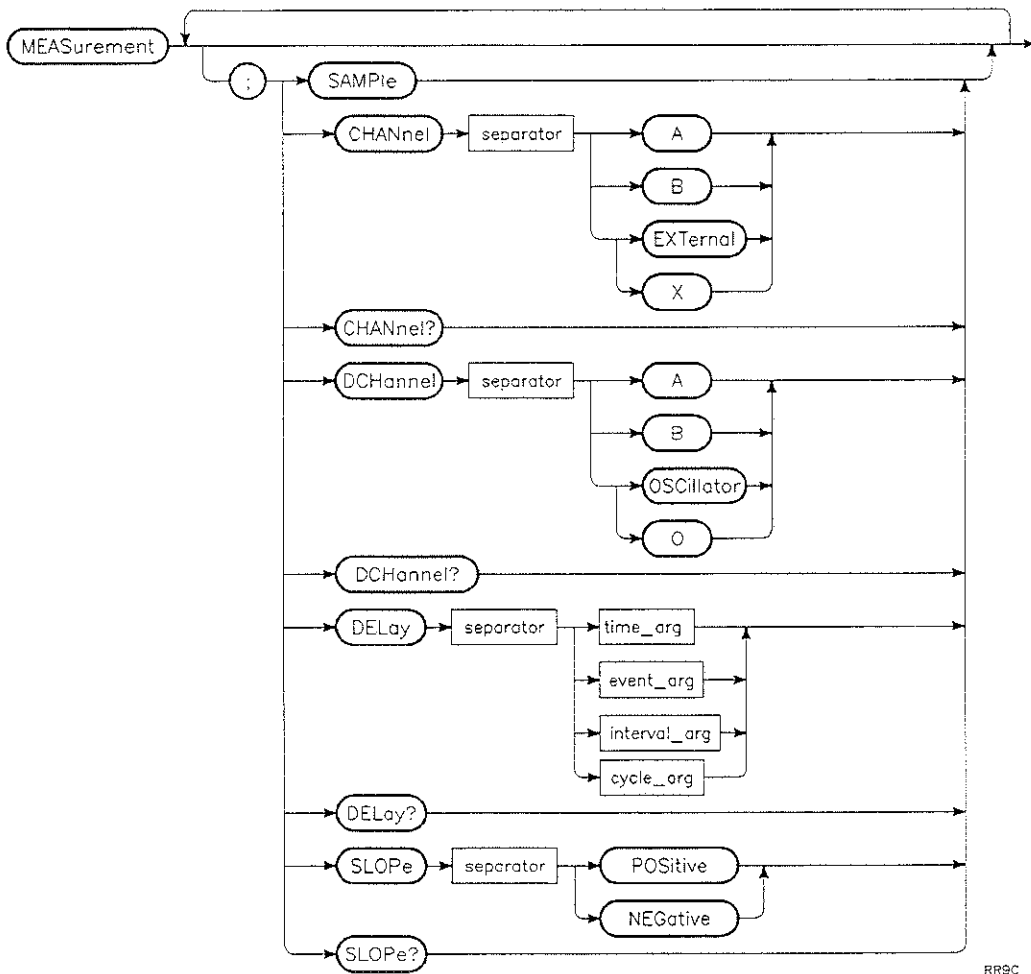


Figure 2-9. Measurement Subsystem Syntax Diagrams



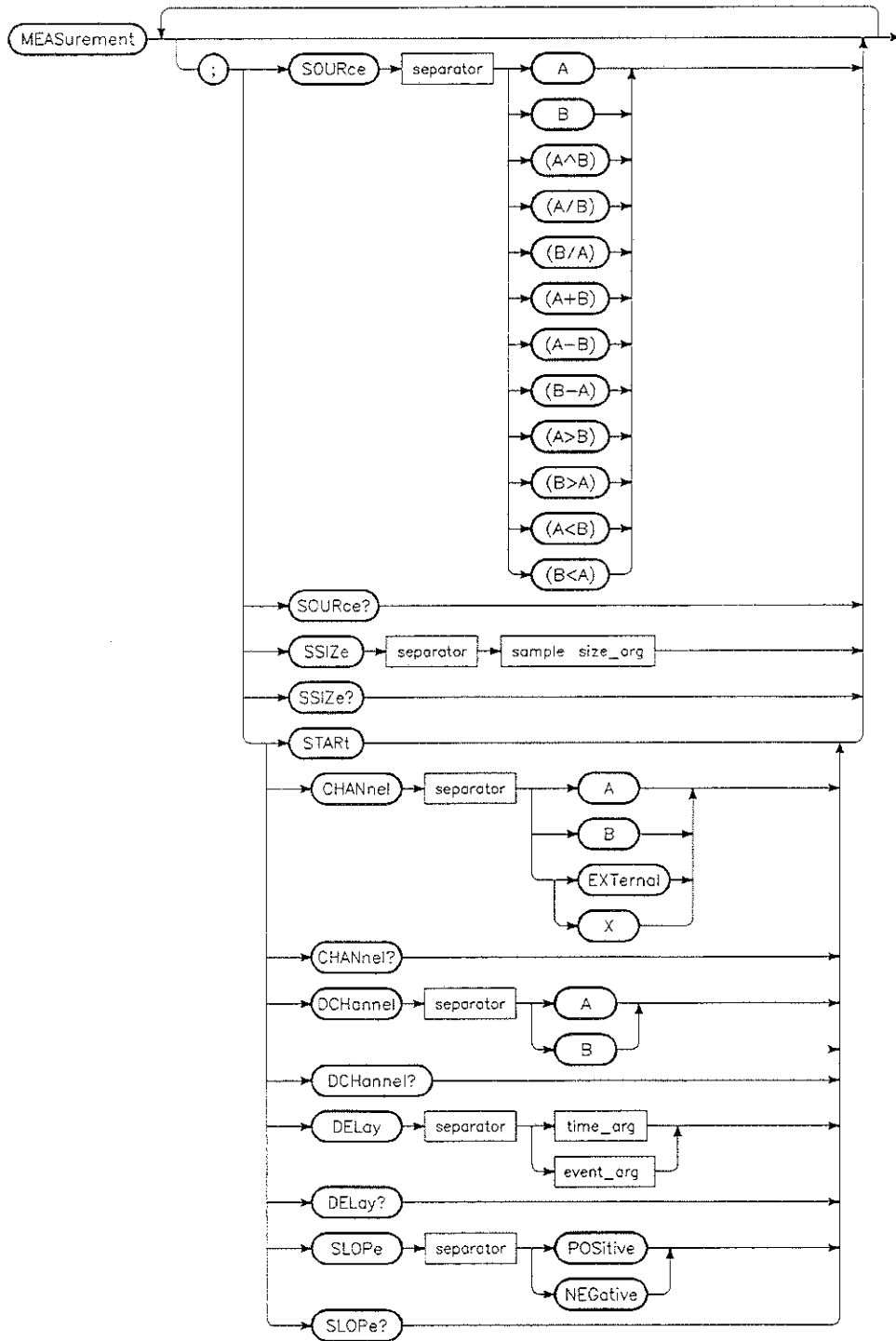
RR98_Q2

Figure 2-9. Measurement Subsystem Syntax Diagrams (Continued)



RR9C_02

Figure 2-9. Measurement Subsystem Syntax Diagrams (Continued)



RR9D_02

Figure 2-9. Measurement Subsystem Syntax Diagrams (Continued)

**ARM - Arming
(command/query)**

Shortform: ARM [ARMinG]
Longform: ARMinG

The ARM command selects the type of arming for measurement of input signals. Only certain arming modes are allowed for a given measurement function. Refer to Appendix E for information about the allowed combinations of measurement functions and arming modes.

Refer to the 5371A Operating Manual, Section 5, for detailed descriptions of the arming modes.

The ARM? query returns the currently active arming mode.

Parameters: All of the 5371A arming combinations are listed below:

AUTOMATIC: {AUTO}

HOLDOFF OPTIONS: (Auto Sampling)

Parameter	Options	Long/Short Command Form
Automatic	—	AUTO
Holdoff	Edge Time Event	EDHoldoff THOLdoff EVHoldoff
Sampling (No Holdoff)	Interval Time Cycle Edge Parity Repetitive Edge Repetitive Parity	ISAMpling TSAMpling CSAMpling ESAMpling PSAMpling REDGe RPARity

Parameter	Options	Long/Short Command Form
Holdoff Sampling	Edge Interval Edge Time Edge Edge Externally Gated Edge Cycle Edge Event Edge Parity Time Interval Time Time Event Interval Event Event Manual	EDINterval EDTime EDEDge EGATed EDCYcle EDEvent EDParity TINterval TTIME EVINterval EVEvent MANual

SAMPLING OPTIONS: {Interval SAMpling | Time SAMpling |
(No Holdoff) Cycle SAMpling | Edge SAMpling |
Parity SAMpling | Repetitive EDGE |
Repetitive PARity}

HOLDOFF SAMPLING {EDGE INterval | EDGE Time | EDGE EDGE |
OPTIONS: Externally GATED | EDGE CYcle | EDGE EVENT |
EDGE Parity | Time INterval | Time TIME |
EVENT INterval | EVENT EVENT | MANual}

NOTE

The four arming categories above correspond to the ARMinG softkey selections on the FUNCTION menu screen: "Default [AUTO]", "Holdoff Options", "Sampling Options", and "Hold/Sampl Options", respectively.

Example: OUTPUT 703;"MEAS;ARM,AUT" - Tells the 5371A to use automatic arming (start the measurement on the next trigger edge, and repetitively sample on each trigger edge).

OUTPUT 703;"MEAS;ARM?" - Queries the 5371A for the currently selected arming mode.

**BLOC - Block Size
(command/query)**

Shortform: BLOC [BLOCK]
Longform: BLOCK

The BLOC command sets the number of blocks of measurements to be taken (referred to as block size). Up to $2E+9$ blocks may be specified, with each block containing up to 1000 measurements as set by the Measurement Size (MSIZ) command. The product of the block size and the measurement size must not exceed $2E+9$ measurements. For example, if MSIZ = 1000, then maximum block size = $2E+6$.

The BLOC? query returns the current block size (number of blocks).

Range: 1 to $2E+9$

Examples: OUTPUT 703;"MEAS;BLOC,10" - Tells the 5371A to take 10 blocks of measurements, each block consisting of the number of measurements set by the MSIZ command.

OUTPUT 703;"MEAS;BLOC?" - Queries the 5371A for the number of blocks.

**FUNC - Function
(command/query)**

Shortform: FUNC [FUNCTION]
Longform: FUNCTION

The FUNC command selects the measurement function to be performed.

The FUNC? query returns the currently selected measurement function.

Parameter: The possible function selections are listed below:

- FREQuency
- PERiod
- TOTALize
- TIME or TINTerval (time interval)
- PMT (plus or minus time interval)
- CTINTerval (continuous time interval)
- RISetime or RTIME
- FALLtime or FTIME
- PWIDth (positive pulse width)
- NWIDth (negative pulse width)
- DUTY or DCYCLE (duty cycle)
- PHASe
- PEAK (peak amplitude)

Examples: OUTPUT 703;"MEAS;FUNC,TOT" - Sets the 5371A to the totalize measurement mode.

OUTPUT 703;"MEAS;FUNC?" - Queries the 5371A for the currently selected measurement function.

MSIZ - Measurement Size
(command/query)

Shortform: MSIZ [Measurement SIZE]
Longform: MSIZE

The MSIZ command sets the number of measurements to be taken within each measurement block, up to 1000 per block. The block size (number of blocks) is set by the BLOC command, up to a maximum of 2E+9 blocks. The product of the measurement size and the number of blocks must not exceed 2E+9.

The MSIZ? query returns the current measurement size.

Range: 1 to 1000 (1 to 4095 for binary output mode)

Examples: OUTPUT 703;"MEAS;MSIZ,100" - Sets the number of measurements within each measurement block to 100.

OUTPUT 703;"MEAS;MSIZ?" - Queries the 5371A for the currently selected measurement size.

SAMP - Sample Arm Sublevel
(command)

Shortform: SAMP [SAMPlE (arm sublevel)]
Longform: SAMPLE

The SAMP command selects the arming mode sublevel for selecting sampling arming conditions (for continuous gating measurements) or stop arming conditions (for non-continuous gating measurements). After SAMP is selected, four subcommands (CHANnel, Delay CHannel, DELay value, and SLOPe) can be used to configure various sample or stop arming conditions.

Example: OUTPUT 703;"MEAS;SAMP" - Selects the SAMPlE arm sublevel for setting up sample arm or stop arm conditions.

The Sample Arm Sublevel command has four subcommands: CHANnel, Delay CHannel, DELay value, and SLOPe. These subcommands are described below:

CHAN - Arming Channel
(command/query)

Shortform: CHAN [(arming) CHANnel]
Longform: CHANNEL

The CHAN command for the sample arm sublevel selects the input channel to be the source of the sampling or stop arming signal.

The CHAN? query returns the currently selected arming source for sample arming or stop arming, "A" for Channel A, "B" for Channel B, and "EXT" for the External Arm channel.

Parameters: {A | B | X (or) EXTernal}

Examples: OUTPUT 703;"MEAS;SAMP;CHAN,A" - Selects Channel A to be the sampling or stop arming signal source.

OUTPUT 703;"MEAS;SAMP;CHAN?" - Queries the 5371A for the sample arming or stop arming source.

**DCH - Delay Channel
(command/query)**

Shortform: DCH [Delay CHannel]
Longform: DCHANNEL

The DCH command for the sample arm sublevel selects the input channel to be the source of a delayed arming signal for sampling arming or stop arming.

The DCH? query returns the currently selected source for the delay arming signal, "A" for Channel A, "B" for Channel B, and "OSC" for the internal time base oscillator.

NOTE

The oscillator parameter (O or OSC) for the sample arm DCH command can only be selected for cycle sampling (CSAMpling) arming. For all other types of arming, only A or B parameters can be selected.

Parameters: {A | B | O (or) OSCillator}

Examples: OUTPUT 703;"MEAS;SAMP;DCH,OSC" - Selects the 5371A timebase oscillator as the source of a delayed sample arming or stop arming signal.

OUTPUT 703;"MEAS;SAMP;DCH?" - Queries the 5371A for the input channel source of the delay arming signal.

**DEL - Delay Value
(command/query)**

Shortform: DEL [DELay (value)]
Longform: DELAY

The DEL command for the sample arm sublevel selects the number of occurrences required to satisfy the selected sample arm or stop arm conditions (time, events, interval, or cycles). Refer to Appendix E for information about allowable arming modes.

The DEL? query returns the currently selected delay value.

Parameters: The ranges for each type of sample arming and stop arming condition are listed below:

TIME: 2 nanoseconds to 8 seconds
(resolution = 2 ns)

EVENTS: 1 to 4E+9 events

INTERVAL:	600 nanoseconds to 8 seconds (resolution varies; see note below)
CYCLES:	$2^4, 2^8, 2^{12}, 2^{16}, 2^{20}, 2^{24}, 2^{28}$ (see note below)

NOTE

An entered Time value greater than 8 seconds will default to 8 seconds.

The Interval resolution varies according to the selected gate time, as follows:

gate time \leq 0.01 s :	200 ns
0.01 s \leq gate time < 0.1 s :	2 μ s
0.1 s \leq gate time < 1.0 s :	20 μ s
1.0 s \leq gate time < 8.0 s :	200 μ s

The number of Cycles is further restricted by a minimum input frequency requirement for each selected cycle value. The minimum input frequency for a given cycle selection is determined by the 8 second Time range upper limit. If the specified number of cycles multiplied by the period of the input frequency exceeds the 8 second limit, the measurement results will be incorrect. For example, if 2^8 cycles are specified, the maximum period for each cycle would be 31.25 ms. Thus, to measure 2^8 cycles, the minimum input frequency must be 32 Hz. The minimum input frequencies for each cycle parameter are listed below:

2^{28}	33,554,432 Hz
2^{24}	2,097,152 Hz
2^{20}	131,072 Hz
2^{16}	8,192 Hz
2^{12}	512 Hz
2^8	32 Hz
2^4	2 Hz

Examples: OUTPUT 703;"MEAS;SAMP;DEL,10" - If Event sample arming is currently selected, this example tells the 5371A to sample arm for 10 events. If Time sample arming is currently selected, the time value of 10 would default to the Time range upper limit of 8 seconds.

OUTPUT 703;"MEAS;SAMP;DEL?" - Queries the 5371A for the current delay value.

**SLOP - Slope
(command/query)**

Shortform: SLOP [SLOPe]
Longform: SLOPE

The SLOP command for the sample arm sublevel selects the slope of the sample arming or stop arming signal.

The SLOP? query returns the currently selected arming channel slope.

Parameters: {POSitive | NEGative}

Examples: OUTPUT 703;"MEAS;SAMP;CHAN,A;SLOP,POS" - Selects positive edge of Channel A signal for sample arming or stop arming.

OUTPUT 703;"MEAS;SAMP;CHAN,A;SLOP?" - Queries the 5371A for the Channel A arming slope for sample or stop arming.

**SOUR -
Measurement Source
(command/query)**

Shortform: SOUR [(measurement) SOURce]
Longform: SOURCE

The SOUR command for the Measurement subsystem selects the input channel configuration for which the measurement is to be performed. The selections allowed depend on the type of measurement to be taken. For example, The A/B combination may only be selected for frequency, period, and totalize measurements. Refer to the 5371A Operating Manual for more information about allowable input configurations for setting sample arm and stop arm conditions.

The SOUR? query returns the currently selected measurement source configuration.

Parameter: The possible input channel combinations are listed below:

Selection	Can be chosen for the following measurements
A	Frequency, time interval, \pm time interval, period, totalize, peak amplitude, rise time, fall time, duty cycle, positive pulse width, negative pulse width
B	Frequency, time interval, \pm time interval, period, totalize, peak amplitude
(A ^ B)	Frequency, period, totalize (see note below)
(A/B)	Frequency, period, totalize
(B/A)	Frequency, period, totalize
(A + B)	Frequency, period, totalize
(A-B)	Frequency, period, totalize
(B-A)	Frequency, period, totalize
(A > B)	Time interval, \pm time interval
(B > A)	Time interval, \pm time interval
(A < B)	Phase (see note below)
(B < A)	Phase (see note below)

NOTE

The (A ^ B) parameter above is equivalent to the "A&B" softkey on the display screen, and the (A < B) and (B < A) parameters are equivalent to the "A rel B" and "B rel A" softkeys, respectively. Note also that the (A > B) and (B > A) parameters are equivalent to the "A → B" and "B → A" softkeys, respectively.

Examples: OUTPUT 703;"MEAS;SOUR,(A>B)" - Selects Channel A>B "A → B" input configuration for making a time interval or ± time interval measurement.

OUTPUT 703;"MEAS;SOUR?" - Queries the 5371A for the currently selected input configuration.

SSIZ - Sample Size (command/query)

Shortform: SSIZ [Sample SIZE]

Longform: SSIZE

The SSIZ command performs the same function as the MSIZ command. The SSIZ command sets the number of measurements to be taken within each measurement block, up to 1000 per block. The block size (number of blocks) is set by the BLOC command, up to a maximum of 2E+9 blocks. The product of the sample size and the number of blocks must not exceed 2E+9. (See also MSIZ command.)

The SSIZ? query returns the current sample (measurement) size.

Range: 1 to 1000 (1 to 4000 for binary output mode)

Examples: OUTPUT 703;"MEAS;SSIZ,100" - Sets the sample size within each measurement block to 100.

OUTPUT 703;"MEAS;SSIZ?" - Queries the 5371A for the currently selected sample (measurement) size.

STAR - Start Arm Sublevel (command)

Shortform: STAR [STARt (arm sublevel)]

Longform: START

The STAR command selects the arming mode sublevel for selecting block holdoff conditions (for continuous gating measurements) or start arming conditions (for non-continuous gating measurements). After STAR is selected, four subcommands (CHANnel, Delay CHannel, DELay (value), and SLOPe) can be used to configure various block holdoff or start arming conditions.

Example: OUTPUT 703;"MEAS;STAR" - Selects the STARt arm sublevel for setting up block holdoff or start arm conditions.

The Start Arm Sublevel command has four subcommands: CHANnel, Delay CHannel, DELay (value), and SLOPe. These subcommands are described below:

**CHAN - Channel
(command/query)**

Shortform: CHAN [CHANnel]
Longform: CHANNEL

The CHAN command for the start arm sublevel selects the input channel to be the source of the block holdoff or start arming signal.

The CHAN? query returns the currently selected arming source for block holdoff or start arming, "A" for Channel A, "B" for Channel B, and "EXT" for the External Arm channel.

Parameters: {A | B | X (or) EXTernal}

Examples: OUTPUT 703;"MEAS;STAR;CHAN,A" - Selects Channel A to be the block holdoff or start arming signal.

OUTPUT 703;"MEAS;STAR;CHAN?" - Queries the 5371A for the block holdoff or start arming source.

**DCH - Delay Channel
(command/query)**

Shortform: DCH [Delay CHannel]
Longform: DCHANNEL

The DCH command for the start arm sublevel selects the input channel to be the source of a delayed arming signal for block holdoff or start arming.

The DCH? query returns the currently selected source for the delay arming signal: "A" for Channel A or "B" for Channel B.

Parameters: {A | B}

Examples: OUTPUT 703;"MEAS;STAR;DCH,B" - Selects Channel B as the source of a delayed block holdoff or start arming signal.

OUTPUT 703;"MEAS;STAR;DCH?" - Queries the 5371A for the input channel source of the delay arming signal.

**DEL - Delay
(command/query)**

Shortform: DEL [DELay]
Longform: DELAY

The DEL command for the start arm sublevel selects the number of occurrences required to satisfy the selected block holdoff or start arm conditions (time or events). Refer to Appendix E for information about allowable arming modes.

The DEL? query returns the currently selected delay value.

Parameters: The ranges for each type of block holdoff and start arming condition are listed below:

TIME: 2 nanoseconds to 8 seconds
(resolution = 2 ns)

EVENTS: 1 to 4E +9 events

NOTE

An entered Time value greater than 8 seconds will default to 8 seconds.

Examples: OUTPUT 703;"MEAS;STAR;DEL,10" - If Event sample arming is currently selected, this example tells the 5371A to holdoff for 10 events. If Time holdoff is currently selected, the entered value of 10 would default to 8 seconds.

OUTPUT 703;"MEAS;STAR;DEL?" - Queries the 5371A for the current delay value.

**SLOP - Slope
(command/query)**

Shortform: SLOP [SLOPe]

Longform: SLOPE

The SLOP command for the start arm sublevel selects the slope of the block holdoff or start arming signal.

The SLOP? query returns the currently selected arming channel slope.

Parameters: {POSitive | NEGative}

Examples: OUTPUT 703;"MEAS;STAR;CHAN,A;SLOP,POS" - Selects positive edge of Channel A signal for block holdoff or start arming.

OUTPUT 703;"MEAS;STAR;CHAN,A;SLOP?" - Queries the 5371A for the Channel A arming slope for block holdoff or start arming.

**NUMERIC (NUM)
SUBSYSTEM
COMMANDS**

The Numeric (NUM) subsystem controls the format for displaying measurement result data. The functions in this subsystem are equivalent to those available via the NUMERIC menu screen. Syntax diagrams for the Numeric subsystem commands are shown in *Figure 2-10*.

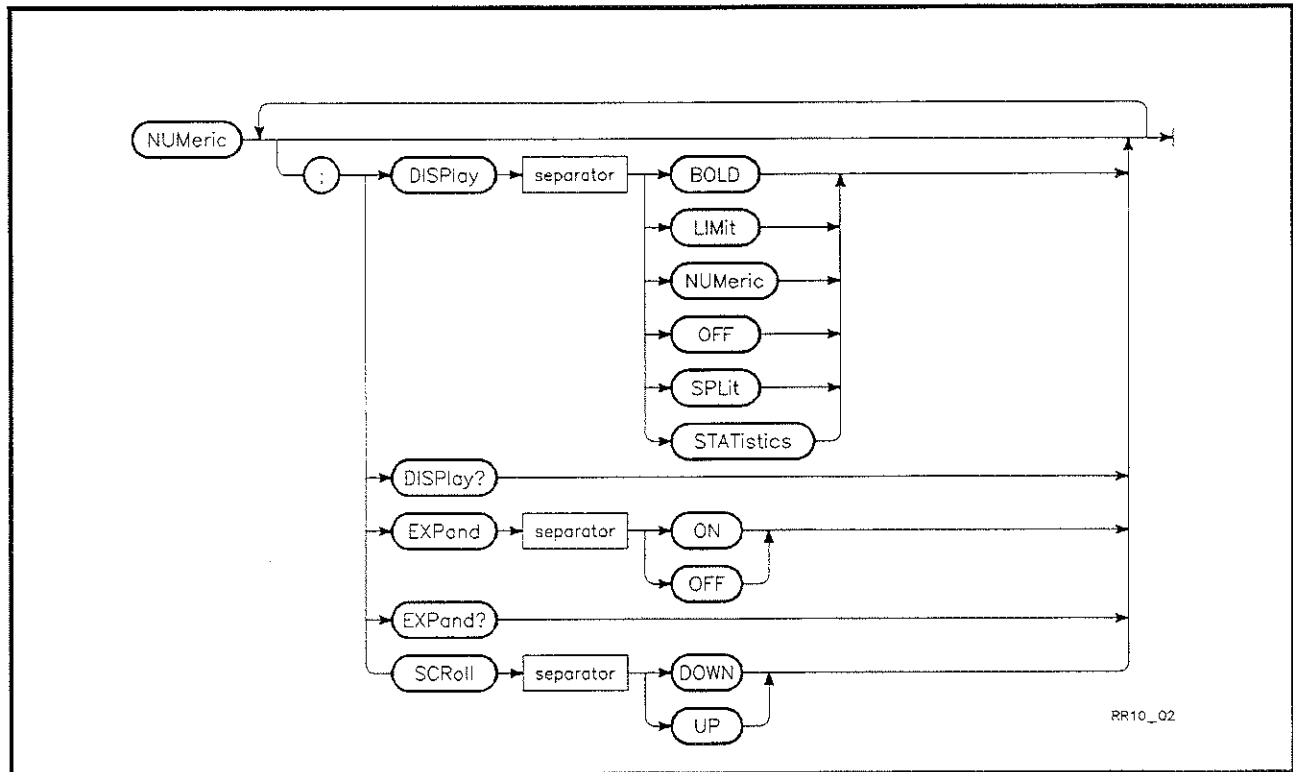


Figure 2-10. Numeric Subsystem Syntax Diagrams

**DISP - Display Type
(command/query)**

Shortform: DISP [DISPlay (type)]
Longform: DISPLAY

The DISP command selects the type of numeric display for screening the results of a measurement. This command also determines the type of data that is returned over the bus, which generally will correspond to the type of data being displayed on the screen. The parameters are:

- BOLD** Selects a bold font for displaying measurement results in larger, easier-to-read characters.
- LIMit** Displays results for limit testing measurements.
- NUMeric** Displays measurement results.
- OFF** Turns off the numeric result display and goes to the "CONCEALED RESULT" screen. Send a MENU command such as: "MENU,NUM", to exit Security Mode.

SPLit	Displays numeric results and statistical results (Maximum, Mean, Minimum, and Standard Deviation only) on the screen simultaneously.
STATistics	Displays all eight statistical results on the screen (Allan Variance, Maximum, Mean, Minimum, Root Allan Variance, Root Mean Square, Standard Deviation, and Variance).

The DISP? query returns the currently selected display type.

Parameter: {BOLD | OFF | LIMit | NUMeric | SPLit | STATistics}

Examples: OUTPUT 703;"NUM;DISP,BOLD" - Tells the 5371A to display measurement results in large character format.

OUTPUT 703;"NUM;DISP?" - Queries the 5371A for the currently selected display type.

EXP - Expand data (command/query)

Shortform: EXP [EXPand (data)]
Longform: EXPAND

The EXP command causes the 5371A to display expanded results data on the screen for each measurement taken. The expanded data is either gate time or events, depending on the type of measurement being performed.

The EXP? query returns the status of the expanded data format: "1" (ON) or "0" (OFF).

Examples: OUTPUT 703;"NUM;EXP,ON" - Tells the 5371A to display gate time or events data for each measurement.

OUTPUT 703;"NUM;EXP?" - Queries the 5371A for the on/off status of the expanded data format.

SCR - Scroll Results (command)

Shortform: SCR [SCRoll (results)]
Longform: SCROLL

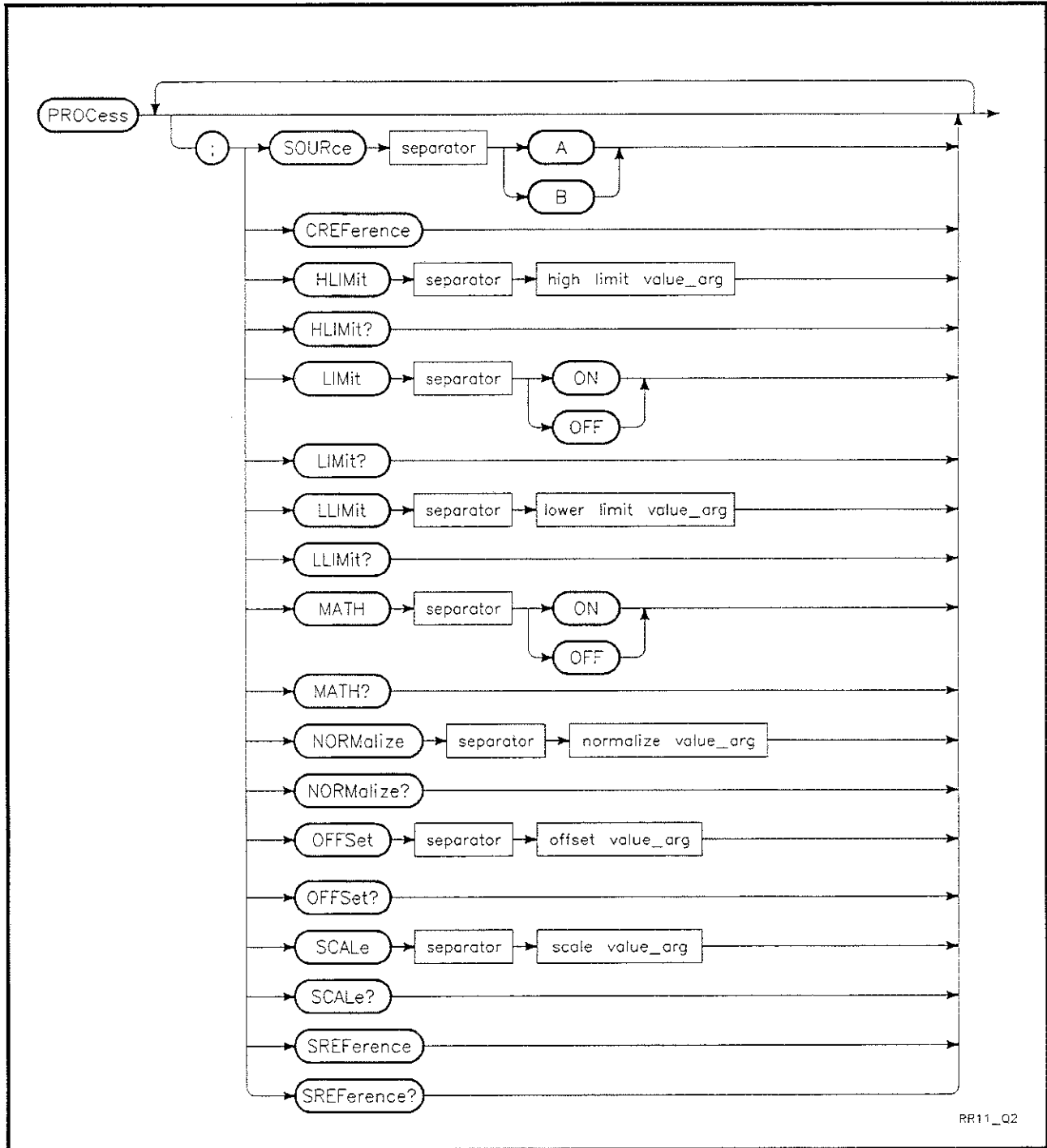
The SCR command scrolls the results on the measurement result screen up or down one measurement at a time. Specifying "DOWN" will scroll the results toward previous measurements, while specifying "UP" will scroll toward later measurements.

Example: OUTPUT 703;"NUM;SCR,DOWN" - Scrolls the 5371A numeric result screen to display the next measurement.

2-99

**PROCESS (PROC)
SUBSYSTEM
COMMANDS**

The Process (PROC) subsystem controls math and statistical functions and the setting of test limit values. The functions in this subsystem are equivalent to those available via the MATH menu screen. Syntax diagrams for the Process subsystem commands are shown in *Figure 2-11*.



RR11_Q2

Figure 2-11. Process Subsystem Syntax Diagrams

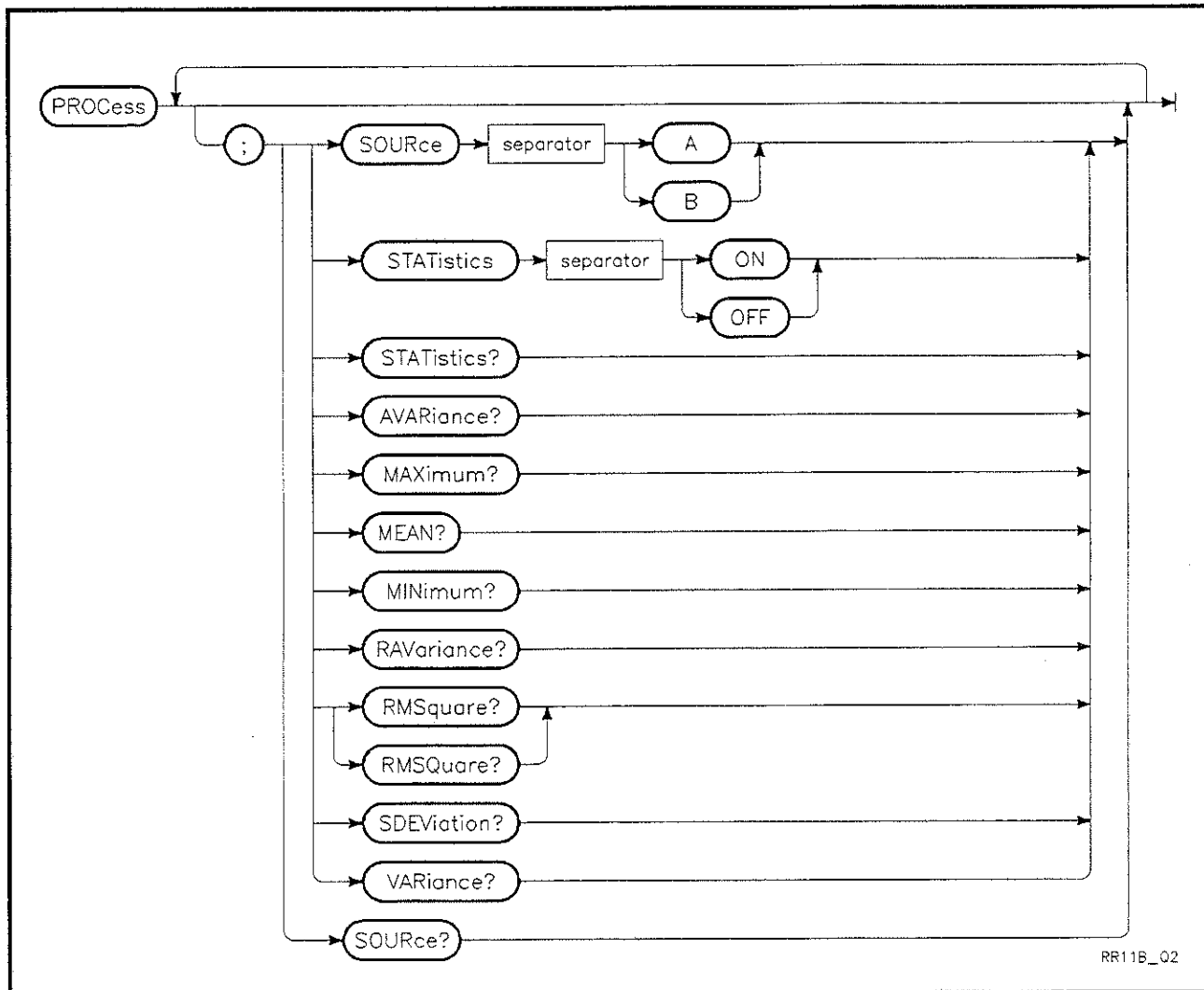


Figure 2-11. Process Subsystem Syntax Diagrams (Continued)

**SOUR - Source
(command/query)**

Shortform: SOUR [SOURce]
Longform: SOURCE

The Process subsystem SOUR command selects the input channel signal (Channel A or Channel B) to which all subsequent processing function commands will apply.

The SOUR? query returns a string indicating the current signal source, "A" for Channel A and "B" for Channel B.

Parameters: {A | B}

Examples: OUTPUT 703;"PROC;SOUR,A" - Selects Channel A as the signal source for subsequent processing functions.

OUTPUT 703;"PROC;SOUR?" - Queries the 5371A for the current signal source.

The PROCess subsystem SOURce command has 18 subcommands: CREference, High LIMit, LIMit, Low LIMit, MATH, NORMalize, OFFSet, SCALE, SREference, STATistics, AVARiance?, MAXimum?, MEAN?, MINimum?, Root Allan Variance?, Root Mean Square?, Standard DEVIation?, and VARiance?. These subcommands are described below:

**CREF - Clear Reference
(command)**

Shortform: CREF [Clear REference]
Longform: REFERENCE

The CREF command sets the Reference value to 0. Reference values for each channel are set separately using the SREF (Set REference) command.

Example: OUTPUT 703;"PROC;SOUR,A;CREF" - Sets Channel A reference value to 0.

**HLIM - High Limit
(command/query)**

Shortform: HLIM [High LIMit]
Longform: HLIMIT

The HLIM command sets the upper limit for limit testing of the processed results. HLIM values are set for each channel separately.

Positive Range: $+1E-12 \leq n \leq +1E+12$, and 0

Negative Range: $-1E+12 \leq n \leq -1E-12$

Resolution: $1E-12$

The HLIM? query returns the value of the current High Limit. The value is returned in exponential form (NR3 format).

Examples: OUTPUT 703;"PROC;SOUR,A;HLIM,+1E-9" - Sets the High Limit value to 1×10^{-9} for limit testing of Channel A results.

OUTPUT 703;"PROC;SOUR,B;HLIM?" - Queries the 5371A for the current High Limit value for Channel B.

**LIM - Limit Testing
(command/query)**

Shortform: LIM [LIMit (testing)]
Longform: LIMIT

The LIM command selects the limit test mode for setting upper and lower limits on the processed results. Both upper and lower limits can be specified using the HLIM and LLIM commands. When a result falls outside the set limits, this will be indicated on the display and over the HP-IB (an SRQ is generated if at least one value is out of range). In this case, the Limit Error bit (LME, bit 7) in the Hardware Status Register will be set to indicate that a limit error has occurred, thus setting the HSB bit (bit 0) in the Status Byte.

The LIM? query returns the current status of the limit testing mode, "1" if limit testing is enabled and "0" if limit testing is disabled.

Parameters: {ON | OFF}

Examples: OUTPUT 703;"PROC;SOUR,A;LIM,ON" - Enables limit testing mode for Channel A.

OUTPUT 703;"PROC;SOUR,A;LIM?" - Queries the 5371A as to whether limit testing for Channel A is on or off.

**LLIM - Lower Limit
(command/query)**

Shortform: LLIM [Lower LIMit]
Longform: LLIMIT

The LLIM command sets the lower limit for limit testing of the processed results. LLIM values are set for each channel separately.

Positive Range: $+1E-12 \leq n \leq +1E+12$, and 0

Negative Range: $-1E+12 \leq n \leq -1E-12$

Resolution: $1E-12$

The LLIM? query returns the value of the current Lower Limit. The value is returned in exponential form (NR3 format).

Examples: OUTPUT 703;"PROC;SOUR,A;LLIM,-1E-9" - Sets the Lower Limit value to -1×10^{-9} for limit testing of Channel A results.

OUTPUT 703;"PROC;SOUR,B;LLIM?" - Queries the 5371A for the current Lower Limit value for Channel B.

**MATH - Math Modifiers
(command/query)**

Shortform: MATH [MATH (modifiers)]
Longform: MATH

The MATH command turns on various math options for modifying the measurement results. The 5371A normally calculates measurement results in fundamental units of Seconds, Hertz, and Volts. Selecting MATH provides the option of using offset, normalize, and scaling functions to modify the results.

To enable the Math modifiers, send "ON"; to disable them, send "OFF". Math modifiers are enabled and disabled separately for each channel. Math modifier values are also set separately for each channel.

The three functions, Offset, Normalize, and Scale, are applied (together with the reference set by the SREF command) as follows:

$$\text{Math result} = [(\text{Measurement result} - \text{Reference} / \text{Normalize}) + \text{Offset}] \times \text{Scale}$$

If no reference is set (reference = 0), the above formula is equivalent to:

$$\text{Math result} = [\text{Measurement result} / \text{Normalize}] + \text{Offset}] \times \text{Scale}$$

The MATH? query returns the current status of the Math modifiers, "1" if the Math modifiers are enabled and "0" if the Math modifiers are disabled.

Parameters: {ON | OFF}

Examples: OUTPUT 703;"PROC;SOUR,A;MATH,ON" - Enables the Math modifiers for Channel A.

OUTPUT 703;"PROC;SOUR,B;MATH?" - Queries the 5371A for the current on/off status of Math modifiers for Channel B.

**NORM - Normalize
(command/query)**

Shortform: NORM [NORMALize]

Longform: NORMALIZE

The NORM command allows raw measurement data to be divided by a user-entered normalization constant.

Positive Range: $+1E-12 \leq n \leq +1E+12$

Negative Range: $-1E+12 \leq n \leq -1E-12$

Resolution: $1E-12$

Note that if zero is entered, the value will default to $1E-12$.

The NORM? query returns the value of the current normalization constant in exponential form (NR3 format).

Examples: OUTPUT 703;"PROC;SOUR,A;NORM,60" - Sets Channel A normalization constant to a value of 60.

OUTPUT 703;"PROC;SOUR,B;NORM?" - Queries the 5371A for the current normalization value for Channel B.

**OFFS - Offset
(command/query)**

Shortform: OFFS [OFFSet]

Longform: OFFSET

After the application of the normalization constant (refer to NORMALize command description), the OFFS command can be used to enter an offset constant to be added to a measurement value. Offset values are set separately for Channel A and Channel B.

Positive Range: $+1E-12 \leq n \leq +1E+12$, and 0

Negative Range: $-1E+12 \leq n \leq -1E-12$

Resolution: $1E-12$

The OFFS? query returns the value of the current offset in exponential form.

Example: OUTPUT 703;"PROC;SOUR,A;OFFS,-10E-9" - Sets a Channel A offset of -10×10^{-9} .

OUTPUT 703;"PROC;SOUR,A;OFFS?" - Queries the 5371A for the Channel A offset value.

**SCAL - Scale
(command/query)**

Shortform: SCAL [SCALe]
Longform: SCALE

The SCAL command sets a scaling factor for multiplication of the result value. The scaling factor is applied after normalization and offset have been applied. Scaling factors for Channel A and Channel B are set separately. Refer to the MATH command description for information about how the scaling factor relates to normalization and offset values.

The SCAL? query returns the value of the current scaling factor. The returned value will be in exponential format.

Positive Range: $+1E-12 \leq n \leq +1E+12$, and 0

Negative Range: $-1E+12 \leq n \leq -1E-12$

Resolution: 1E-12

Example: OUTPUT 703;"PROC;SCAL,1E+3" - Sets the scaling factor to 1000.

**SREF - Set Reference
(command/query)**

Shortform: SREF [Set REFerence]
Longform: SREFERENCE

The SREF command is used to assign a reference value based on the current measurement size and statistics mode. The reference value can be thought of as a negative number added to the measured result, giving a delta value between the measurement and reference value.

If Statistics are enabled, the reference value will be set to the mean of the last sample set. If Statistics are not enabled, the reference value will be set to the last measured value (which will be the last one in a group of measurements if in a continuous measurement mode).

If SREF is selected with Math and Statistics already enabled, the statistical mean used as the reference value is the mean of the measurement results before any math processing.

There is no numeric entry for this command. If a reference value other than the last sample or mean is required, the OFFSet command can be used.

Reference values are set separately for Channel A and Channel B. If the SREF command is sent for a channel which is not currently being measured, the reference will be set to zero.

Example: OUTPUT 703;"PROC;SOUR,A;SREF" - Sets reference value for Channel A.

**STAT - Statistics
(command/query)**

Shortform: STAT [STATistics]
Longform: STATISTICS

The STAT command enables and disables the statistical functions of the 5371A. When enabled, all statistical measurements are calculated, even if they are not observed on the currently displayed screen. The results displayed depend on the currently selected menu screen. Any of the eight statistical values may be queried independently of the currently displayed menu screen.

The values calculated are:

- Mean value
- Minimum value
- Maximum value
- Variance
- Standard Deviation
- RMS (Root Mean Square)
- Allan Variance
- Root Allan Variance

Statistics mode is enabled for Channel A and Channel B separately.

The STAT? query returns the current on/off status of Statistics mode: "1" (ON) or "0" (OFF).

Parameters: {ON | OFF}

Example: OUTPUT 703;"PROC;SOUR,B;STAT,ON" - Enables the Statistics mode.

NOTE

For ease of reference, all Process subsystem query-only commands relating to STATistics are grouped together below instead of in the previous alphabetical listing.

There are eight queries relating to Statistics: Allan VARiance?, MAXimum?, MEAN?, MINimum?, Root Allan Variance?, Root Mean SQUARE?, Standard DEVIation?, and VARiance?. The eight query descriptions below are based on the following terms and definitions:

X(i)	is an individual measurement
N	is the number of measurements
Mean	is the arithmetic mean

For all formulas (except the Allan Variance formula), summations over Σ are from $i = 1$ to N . For the Allan Variance formula, the summation over Σ is from $i = 2$ to N .

Note also that in all calculations except Minimum, Maximum, and Allan Variance, the random variables are "centered" by subtracting $X(1)$ from all $X(i)$.

AVAR? - Allan Variance? (query only)

Shortform: AVAR? [Allan VARiance?]
Longform: AVARIANCE?

The AVAR? query returns the value of the Allan Variance. The Allan variance is calculated by taking the sum of squares of differences between consecutive measurements. The formula is:

$$\text{Allan Variance} = \frac{\sum_{i=2}^N (X_i - X_{i-1})^2}{2(N-1)}$$

where the summation is done from $i = 2$ to N .

Example: OUTPUT 703;"PROC;SOUR,A;AVAR?" - Queries the 5371A for the Allan Variance value.

MAX? - Maximum? (query only)

Shortform: MAX? [MAXimum?]
Longform: MAXIMUM?

The MAX? query returns the maximum value for the last set of measurements. The result is returned in exponential form (NR3 format).

Example: OUTPUT 703;"PROC;SOUR,A;MAX?" - Queries the 5371A for the maximum values for the last set of measurements.

MEAN? - Mean?
(query only)

Shortform: MEAN? [MEAN?]
Longform: MEAN?

The MEAN? query returns the value of the arithmetic mean. The arithmetic mean is calculated by summing all measurement results and dividing by the number of measurements. The formula is:

$$\text{Mean} = \frac{\sum_{i=1}^N X_i}{N}$$

NOTE

For arithmetic mean, the first measurement of the group is subtracted from each measurement for the calculation and then added back at the end of the calculation.

A different method for calculating the mean is used in the following situations:

- The measurement function is Frequency or Period
- A continuous arming mode is selected

Continuous arming is explained in chapter 5. An easy method for identifying continuous arming is to look for the terms "Block Holdoff" and "Sample Arm" on the Function menu below the Arming Mode field. If these terms appear, the arming mode is continuous.

- The number of measurements per block is 3 or more

When the above conditions are met, the Bicentroid Mean method is used. This is an algorithm which calculates mean frequency by estimating the Least Squares Fit of a line to the events vs. time data. The slope of this line is a constant frequency. This mean estimate more accurately represents the characteristics of the collected data as compared to the simple arithmetic mean.

Example: OUTPUT 703;"PROC;SOUR,A;MEAN?" - Queries the 5371A for the arithmetical mean.

**MIN? - Minimum?
(query only)**

Shortform: MIN? [MINimum?]
Longform: MINIMUM?

The MIN? query returns the minimum value for the last set of measurements. The result is returned in exponential form (NR3 format).

Example: OUTPUT 703;"PROC;SOUR,B;MIN?" - Queries the 5371A for the minimum values for the last set of measurements.

**RAV? - Root Allan
Variance?
(query only)**

Shortform: RAV? [Root Allan Variance?]
Longform: RAVARIANCE?

The RAV? query returns the value of the Root Allan Variance (the square root of the Allan Variance). The result will be in exponential form (NR3 format). The formula is:

$$\text{Root Allan Variance} = \sqrt{\text{Allan Variance}}$$

Example: OUTPUT 703;"PROC;SOUR,B;RAV?" - Queries the 5371A for the Root Allan Variance value.

**RMS? / RMSQ? - Root
Mean Square?
(query only)**

Shortform: RMS? [Root Mean Square]
RMSQ? [Root Mean Square]
Longform: RMSQUARE?

The RMS? (or RMSQ?) query returns the value of the Root Mean Square. The value is returned in exponential form (NR3 format). The formula used is:

$$\text{RMS} = \frac{\sum_{i=1}^N X_i^2}{N}$$

Note that the first measurement in the group is subtracted from each of the measurements for the calculation and then added back at the end of the calculation.

Example: OUTPUT 703;"PROC;SOUR,B;RMS?" - Queries the 5371A for the Root Mean Square value.

**SDEV? - Standard
Deviation
(query only)**

Shortform: SDEV? [Standard DEVIation?]
Longform: SDEVIATION?

The SDEV? query returns the value of the standard deviation. The formula is:

$$\text{Standard Deviation} = \sqrt{\text{Variance}}$$

Example: OUTPUT 703;"PROC;SOUR,A;SDEV?" - Queries the 5371A for the Standard Deviation value.

VAR? - Variance?
(query only)

Shortform: VAR? [Variance?]
Longform: VARIANCE?

The VAR? query returns the variance value. The value returned is in exponential form (NR3 format). The formula is:

$$\text{Variance} = \frac{\sum_{i=1}^N X_i^2 - \frac{\left(\sum_{i=1}^N X_i\right)^2}{N}}{N - 1}$$

Note that the first measurement in the group is subtracted from each of the measurements for the calculation; the first measurement is not added back at the end of the calculation.

Example: OUTPUT 703;"PROC;SOUR,B;VAR?" - Queries the 5371A for the variance value.

A HP-IB CONNECTION

**CONNECTING
THE 5371A TO
A CONTROLLER**

The HP 5371A can be connected to a controller by simply installing an HP-IB cable (such as an HP 10833A cable) between the two units as shown in *Figure A-1*.

The 5371A has two HP-IB operating modes:

- Talk/Listen — This mode is for bi-directional communication. The 5371A can receive commands and setups from the controller, and can output data and measurement results.
- Talk Only — In this mode, the 5371A can output data and measurement results; it cannot receive commands or setups from the controller.

Refer to the HP 5371A Operating Manual for instructions on how to change the HP-IB operating modes. Refer to Section 1 of this Programming Manual for instructions on how to set the 5371A HP-IB address.

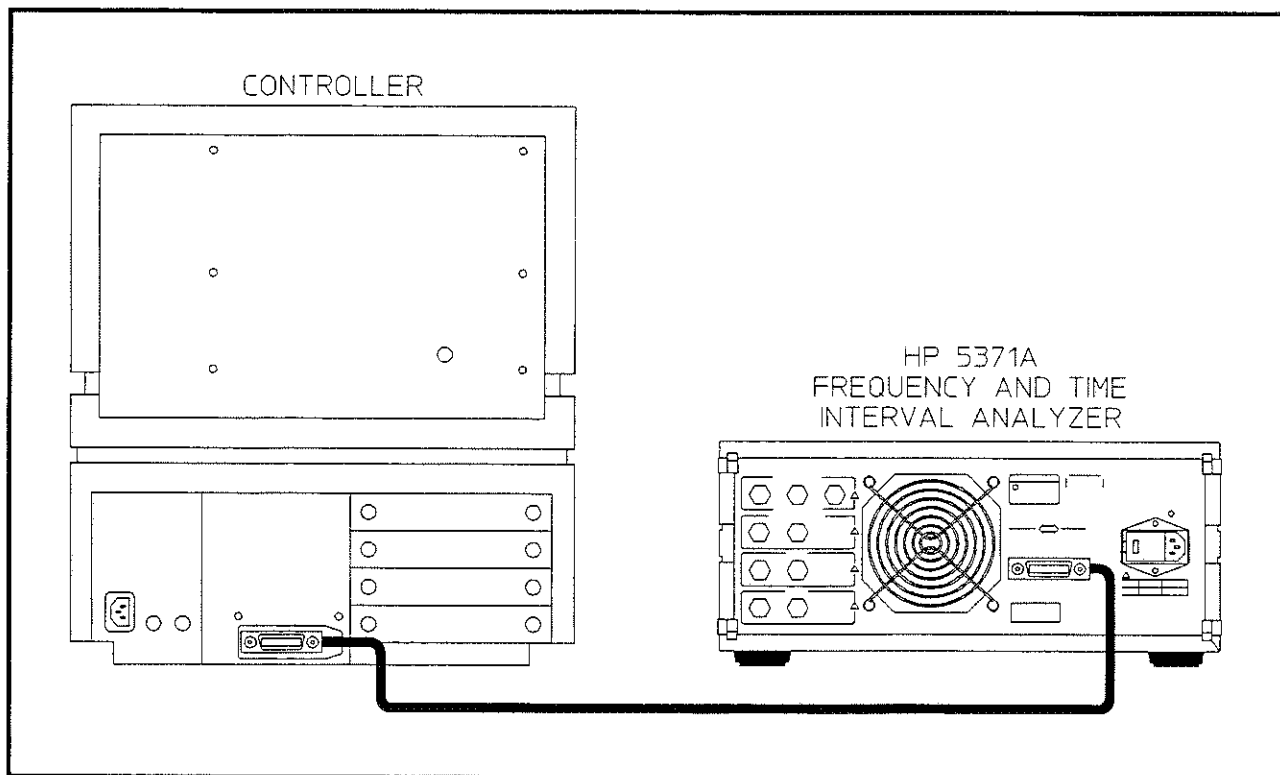


Figure A-1. Connecting the HP 5371A to a Controller

HP-IB Cable Connection

Figure A-2 provides interconnection data about the rear panel HP-IB connector on the HP 5371A. This connector is compatible with the HP 10833A/B/C/D cables listed in *Table A-1*. Up to 15 HP-IB compatible instruments (including the controller) can be interconnected in a system. The HP-IB cables have identical “piggy-back” connectors on both ends (see *Figure A-3*) so that several cables can be connected to a single source without special adapters or switch boxes. System components and devices may be connected in virtually any configuration desired. There must, of course, be a path from the controller to every device operating on the bus.

CAUTION

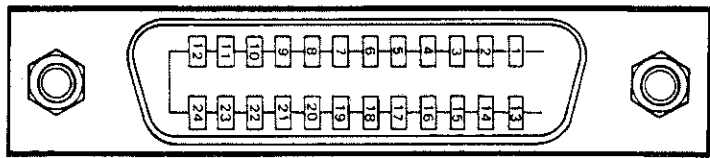
AVOID stacking more than three or four cables on any one connector. If the stack gets too large, the force on the stack produces leverage which can damage the connector mounting.

DO NOT USE a screwdriver to tighten the connector lock screw. Each connector should be firmly (finger-tight) screwed in place to keep it from working loose during use. Damage to the threads inside the head of the lock screw may result if a screwdriver is used.

Table A-1. HP-IB Cable Descriptions

Model Number	Cable Length
10833A	1 metre (3.3 ft.)
10833B	2 metres (6.6 ft.)
10833C	4 metres (13.2 ft.)
10833D	0.5 metres (1.6 ft.)

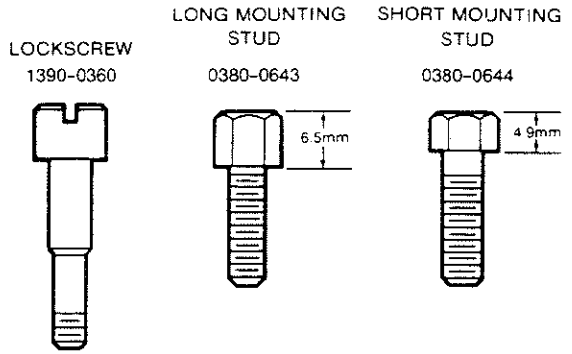
PIN	LINE
1	DIO1
2	DIO2
3	DIO3
4	DIO4
13	DIO5
14	DIO6
15	DIO7
16	DIO8
5	EOI
17	REN
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	SHIELD-CHASSIS GROUND
18	P/O TWISTED PAIR WITH PIN 6
19	P/O TWISTED PAIR WITH PIN 7
20	P/O TWISTED PAIR WITH PIN 8
21	P/O TWISTED PAIR WITH PIN 9
22	P/O TWISTED PAIR WITH PIN 10
23	P/O TWISTED PAIR WITH PIN 11
24	ISOLATED DIGITAL GROUND



THESE PINS
ARE
INTERNALLY
GROUNDED

CAUTION

The 5371A contains metric threaded HP-IB cable mounting studs as opposed to English threads. Metric threaded HP 10833A, B, C, or D HP-IB cable lock screws must be used to secure the cable to the instrument. Identification of the two types of mounting studs and lock screws is made by their color. English threaded fasteners are colored silver and metric threaded fasteners are colored black. DO NOT mate silver and black fasteners to each other or the threads of either or both will be destroyed. Metric threaded HP-IB cable lock screw illustration and part number follow.



Logic Levels

The Hewlett-Packard Interface Bus logic levels are TTL compatible, i.e., the true (1) state is 0.0V dc to 0.4V dc and the false (0) state is +2.5V dc to +5.0V dc.

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

HP 10631A, 1 metre (3.3 ft.), HP 10631B, 2 metres (6.6 ft.),
HP 10631C, 4 metres (13.2 ft.), HP 10631D, 1/2 metre (1.6 ft.).

Cabling Restrictions

1. A Hewlett-Packard Interface Bus System may contain no more than 2 metres (6.6 ft.) of connecting cable per instrument.
2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus System is 20.0 metres (65.6 ft.).
3. The maximum number of instruments in one system is fifteen.

Figure A-2. Hewlett-Packard Interface Bus Connection

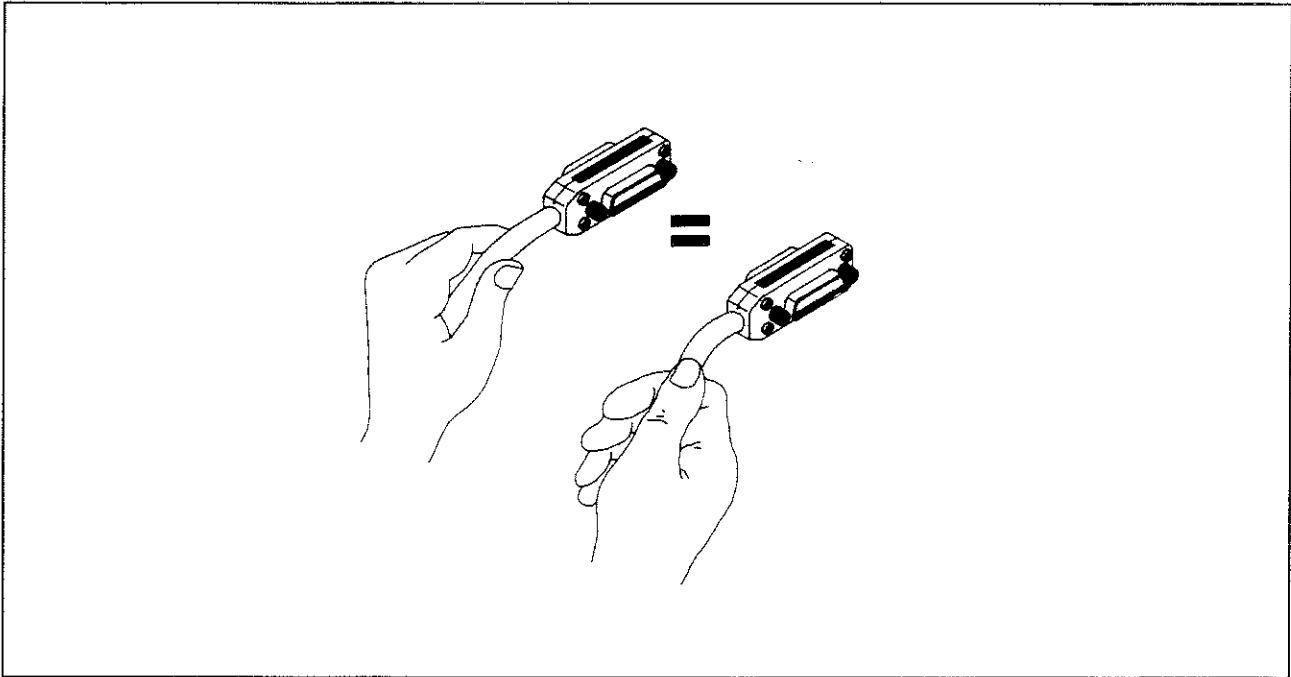


Figure A-3. System Interconnection

CONNECTING TO A PRINTER OR PLOTTER

The 5371A can be connected to a printer or a plotter either with or without a controller. If a controller is connected, the printer or plotter may be operated under program control by the controller. If no controller is connected the 5371A becomes the controller for the printer or plotter.

When operating a printer or plotter without a controller, the 5371A's HP-IB mode must be set to Talk Only. When operating in this mode, the printer or plotter must be in Listen Only or Listen Always mode, and may be set to output a service request (SRQ). Refer to the manual for the printer or plotter for these settings.

B DEFAULT MEASUREMENT
SETUPS

**DEFAULT
MEASUREMENT
SETUP**

The Default Measurement Setup function (DMS command) is designed to set up a configuration most likely to give valid results for the currently chosen measurement function. When the DMS function is selected (using the DMS command or the front panel SHIFT, PRESET keys), a number of values are preset to default conditions. These conditions include source channel, sample size, arming (and the associated arming parameters), and input channel specifications (trigger modes, levels). Math modifiers are disabled, Statistics mode is enabled, and the Numeric "Results + Statistics" screen is displayed. With a single keypress, a measurement is set up and valid measurement results plus statistical analysis results can be obtained.

General Conditions

When going into DMS mode, the following conditions are true for all measurement types:

- The previous setup is saved in Register 0.
- Math Modifiers are disabled.
- Statistics are enabled.
- Limit Testing is disabled.
- Reference values are set to 0.
- Channel A Trigger mode is set to Repetitive Auto trigger.
- Channel B Trigger mode is set to Repetitive Auto trigger.
- Channel A Attenuation is set to X1.
- Channel B Attenuation is set to X1.
- The NUMERIC Display is chosen, showing Results + Statistics.
- Measurement Sample size is set to 50 (measurements per block) except for Peak Amplitude measurements where Measurement Sample Size is set to 1.
- Block size is set to 1 (number of measurement blocks).

Default Setup Values

The default setup values for each measurement type are listed below:

Time Interval:

Arming set to Automatic.
Source Channel set to A
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

+/- Time Interval:

Arming set to Automatic.
Source Channel set to A→B.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Continuous Time Interval:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Frequency:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Period:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Totalize:

Arming set to Interval Sampling.
Interval Time set to 10.0 μ s.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Positive Pulse Width:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (negative slope).
Input Mode set to Common.

Negative Pulse Width:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (negative slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Common.

Risetime:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 20% (positive slope).
Channel B Trigger Level set to 80% (positive slope).
Input Mode set to Common.

Falltime:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 80% (negative slope).
Channel B Trigger Level set to 20% (negative slope).
Input Mode set to Common.

Duty Cycle:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (negative slope).
Input Mode set to Common.

Phase:

Arming set to Automatic.
Start on Positive edge of Channel A.
Source Channel set to A relative to B (A rel B).
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.

Peak Amplitude:

Arming set to Automatic.
Source Channel set to A.
Channel A Trigger Level set to 50% (positive slope).
Channel B Trigger Level set to 50% (positive slope).
Input Mode set to Separate.



**STATUS AND
ERROR MESSAGES**

INTRODUCTION

Five types of messages appear on the CRT Status Line of the HP 5371A to indicate errors, failures, and general information. This appendix contains a complete list of all messages in alphabetical order. The messages have a priority order; from the lowest to the highest priority, they are:

- Static Status Messages
- Momentary Status Messages
- Momentary Warning Messages
- Static Error Messages
- Static Failure Messages

These messages are acknowledged in different ways, depending on whether the instrument can continue operating and making measurements. Some messages are only warnings, and normal operation can continue without user response. Others are intended to notify the user that operation has been suspended until the error condition is acknowledged and/or corrected.

Displayed messages are replaced with ones of higher priority. For example, a Static Error Message will overwrite a Momentary Warning Message. If another message occurs with the same priority as the current message, overwriting occurs only if both are Status or if both are Momentary messages. Otherwise, the second message will be ignored.

In addition to the messages listed above, Graphics Subsystem messages appear in the Status Line, but these messages are not described in this manual.

STATIC STATUS MESSAGES

These are information messages to inform you of the condition of the instrument. Static Status Messages are cleared when the condition in the instrument changes, or when the RESTART key is pressed.

MOMENTARY STATUS MESSAGES

These are information messages to alert you to a particular condition in the instrument. They will clear automatically after three seconds.

MOMENTARY WARNING MESSAGES

These are warning messages to alert you to an illegal operation that was attempted. They will clear automatically after three seconds. Examples of actions that generate a Momentary Warning Message are: pressing an undefined softkey, or pressing a non-numeric key while entering a numeric value. An error number will be placed in the Error Queue for each Momentary Warning Message.

STATIC ERROR MESSAGES

Static errors convey improper operating states or errors generated by HP-IB. Pressing a valid key clears these errors. HP-IB errors are cleared on the transition from REMOTE to LOCAL. Examples of Static Errors are: sending an invalid HP-IB command, or attempting to query the instrument while it is in Binary output mode. An error number will be placed in the Error Queue for each Static Error Message.

STATIC FAILURE MESSAGES

These are failures which prevent the instrument from operating properly. They convey "catastrophic" hardware-related failure conditions. Static failures must be

acknowledged by pressing the RESTART key or by correcting the failure condition. Examples of Static Failures are: applying too much voltage to the Channel A or B input pods, or neglecting to power-down the instrument before removing one of the input pods. An error number will be placed in the Error Queue for each Static Failure Message.

ERROR QUEUE QUERY COMMAND

The Error Queue query command ("ERR?") allows an HP-IB system controller to request the contents of the HP 5371A's Error Queue. The Error Queue contains a maximum of 16 error numbers, represented by integer values, which identify operator or hardware errors. If more than 16 errors have been queued but not queried, then the 16th one is replaced with Error -350 (which is the HP standard error number indicating that "too many errors have occurred"). Successively sending the query "ERR?" returns error numbers in the order that they occurred, until the queue is empty. Additional queries return an error of "0" until another error condition is generated. Only messages of the type Momentary Warning, Static Error and Static Failure have error numbers that are entered into the Error Queue.

STATUS AND ERROR MESSAGE DESCRIPTIONS

The following list describes the HP 5371A system-wide status and error messages in alphabetical order. HP standard numbers, which are consistently defined for all HP instruments, are listed under "Error", and are preceded with a minus sign (for example, "Error -120: Numeric argument error"). All of the other error messages with positive numbers are unique to the HP 5371A. Messages with numbers are used to indicate actual events which have occurred which should be logged in the Error Queue. Messages without error numbers are intended for status information only.

Note that there are also some localized messages in the Graphics screens which are not covered here in detail. Those messages are intended to give the user feedback on the current Graph status, but are not generally considered errors of global concern, and do not generate error number entries in the Error Queue. Examples are: the number of measurements between the markers, the status indication while the graph display is being recalculated (due to a GRAPHic command), or an indication that some action has completed (such as a Graph copy to memory). These messages are considered to be self-explanatory and therefore are not listed here.

Abort only allowed in Single.

*Type:*Momentary Status *Associated With:*Measurement

This message occurs when the "ABORT" HP-IB command is received or the Abort (MANUAL ARM) key is pressed while the HP 5371A is in the Repetitive Sample mode. The Abort command is valid only when the HP 5371A is in Single Sample mode, so no action takes place.

Alternate Timebase selected. Press RESTART.

*Type:*Static Failure *Associated With:*Rear Panel External
Reference Input
*Error Number:*105

The HP 5371A will display this message and stop the measurement process when an external timebase reference is connected to, or disconnected from, the rear panel EXTERNAL INPUT connector. Press the front-panel RESTART key or send the HP-IB "RESTART" command to restart measurements. If the message was caused by connecting the external reference, the restarted measure-

ments will be based on that external reference, otherwise, they will be based on the Internal Timebase.

Arming has changed.

Type: Momentary Status

Associated With: Parameter Coupling

This message occurs when the Arming selection has been changed to resolve conflict with another parameter that has been entered (such as changing Measurement Function).

Arming parameter changed.

Type: Momentary Status

Associated With: Parameter Coupling

This message occurs when an Arming parameter has been changed to resolve conflict with another parameter that has been entered. Examples of Arming parameters that might be changed are: Arming channel or delay value.

Arming, input parameters changed.

Type: Momentary Status

Associated With: Parameter Coupling

This message occurs when both the Arming selection and one or more Input menu parameters have been changed to resolve conflict with another parameter that has been entered. Examples of Input menu parameters that might change are: Trigger Mode, Trigger Slope or Trigger Level.

Arming, measurement source have changed.

Type: Momentary Status

Associated With: Parameter Coupling

This message occurs when both the Arming selection and Measurement Source channel have been changed to resolve conflict with the Measurement Function that has been entered.

Limits, Binary output may have been disabled.

Type: Momentary Status

Associated With: Parameter Coupling

Limits testing and HP-IB binary output mode are turned off when the Peak Amplitude function is selected. If the HP-IB output mode was binary, it is changed to ASCII.

Block or Measurement size changed.

Type: Momentary Status

Associated With: Parameter Coupling

This message occurs if a Block Size or Measurement Size is entered which causes the total number of measurements to exceed 2E+9. When this happens, the entered parameter is allowed, but the other is defaulted to keep the total acquisition size less than 2E+9 measurements. For example, if the Measurement Size is 100 measurements, the maximum Block Size enterable is 20,000,000 (to insure that the total does not exceed 2E+9). If the Measurement Size is increased (so that it is greater than 100), the corresponding Block Size is decreased to keep the total from exceeding 2E+9 measurements.

Calculating measurements.

Type: Static Status

Associated With: System Operation

This message is displayed while the HP 5371A is calculating the measurement results. It is erased when the calculation process is complete.

Decimal point entry disallowed.

Type: Momentary Status

Associated With: Numeric Entry

This message occurs when a decimal point is not allowed at this point in the current numeric entry sequence, because the exponent value has already been specified (e.g. the value currently being entered is "1.2E+01").

Decimal point previously entered.

Type: Momentary Status

Associated With: Numeric Entry

This message occurs when a decimal point is not allowed at this point in the current numeric entry sequence, because a decimal point has already been entered (e.g. the value currently being entered is "1.2").

Enter register number.

Type: Static Status

Associated With: Save/Recall

This message appears after pressing the SAVE or RECALL keys, prompting the user to select one of the saved configuration registers.

Error -100: Unrecognized command.

Type: Static Error

Associated With: Standard HP Error

This message occurs when an invalid command has been sent via HP-IB. Examples are: commands not valid for the currently specified subsystem, commands not allowed for the current measurement setup, or commands containing syntax errors.

Error -120: Numeric Argument error.

Type: Static Error

Associated With: Standard HP Error

This message occurs when an attempt has been made to enter a Stop arming value less than the corresponding Start arming value in TIME/TIME or EVENT/EVENT Arming modes. Examples are: entering a Start time greater than a Stop time, or entering a Start event count greater than a Stop event count.

Error -151: Query not allowed. Binary format.

Type: Static Error

Associated With: Standard HP Error

This message occurs when output data is requested from the HP 5371A while it is in the Binary output mode. The HP 5371A cannot be queried or send formatted numeric data via HP-IB while in Binary output mode. To process queries, switch to ASCII or Floating Point output modes.

Error 100: No Listeners on bus.

Type: Momentary Warning

Associated With: HP-IB

This message occurs when there are no listeners present on the bus, and an attempt has been made to have the HP 5371A send output. This is specific to the Talk/Listen mode of operation.

Error 101: Talker, no listeners.

Type: Momentary Warning

Associated With: HP-IB

This message occurs when the HP 5371A is addressed to talk, but there are no listeners present on the bus. This is specific to the Talk-only mode of operation.

Error 102: Bus conflict: Talk-only.	<i>Type:Static Error</i> <i>Associated With:HP-IB</i>
	This message occurs when an attempt is made to send HP-IB commands to the HP 5371A while it is in Talk-Only mode. The instrument cannot accept commands via HP-IB while in this mode. To allow the HP 5371A to accept commands, return to Talk/Listen mode.
Error 103: Key ignored in Remote.	<i>Type:Momentary Warning</i> <i>Associated With:HP-IB</i>
	This message occurs when a front-panel key is pressed while the HP 5371A is in Remote mode, but not in Local Lockout (LLO) mode. While in Remote, all front-panel keys except LOCAL are disabled.
Error 104: Key ignored in LLO.	<i>Type:Momentary Warning</i> <i>Associated With:HP-IB</i>
	This message occurs when any HP 5371A front-panel key is pressed while the HP 5371A is in Remote, and in Local Lockout mode. In Local Lockout mode, the LOCAL key is disabled.
Error 107: Timebase unlocked. Press RESTART.	<i>Type:Static Failure</i> <i>Associated With:Hardware Error</i>
	This message occurs when the oscillator is out of lock. Any measurements made while this message is on the screen may not be accurate.
Error 108: Ch A and B Overvoltage.	<i>Type:Static Failure</i> <i>Associated With:Hardware Error</i>
	This message occurs when an overvoltage condition is present on both Input Channels A and B. To eliminate the error-causing condition, you can do one or both of the following: 1) change the signal Bias or Attenuation on the Input menu, then restart the measurement; 2) decrease the input signal level.
Error 109: Ch A Overvoltage.	<i>Type:Static Failure</i> <i>Associated With:Hardware Error</i>
	This message occurs when an overvoltage condition is present on Input Channel A. To eliminate the error-causing condition, you can do one or both of the following: 1) change the signal Bias or Attenuation on the Input menu; 2) decrease the input signal level. Restarting the measurement erases the error message.
Error 110: Ch B Overvoltage.	<i>Type:Static Failure</i> <i>Associated With:Hardware Error</i>
	This message occurs when an overvoltage condition is present on Input Channel B. To eliminate the error-causing condition, you can do one or both of the following: 1) change the signal Bias or Attenuation on the Input menu; 2) decrease the input signal level. Restarting the measurement erases the error message.
Error 111: Power-down before removing pods.	<i>Type:Static Failure</i> <i>Associated With:Hardware Error</i>
	This message occurs when an input pod is removed while the HP 5371A is powered on. The instrument should be powered down before input pods are removed.

Error 130: Only graphs can be plotted.	<i>Type: Momentary Warning</i> <i>Associated With: Plot</i>
	This message occurs when an attempt is made to plot a display other than Graphics. Plots are only allowed of Graphic displays. To get a hardcopy of any other menu, use the PRINT function, which outputs the current display to an attached printer.
Error 131: Plot/meas data conflict.	<i>Type: Momentary Warning</i> <i>Associated With: Plot</i>
	This message occurs when the PLOT key is pressed while Graphics are available, but the output source chosen on the System menu is Measurement instead of Display. In this case, the HP 5371A has been configured to output measurement results instead of display data. Set the output source to Display before plotting.
Error 140: Register protected.	<i>Type: Momentary Warning</i> <i>Associated With: Save/Recall or Erase</i>
	This message occurs when you try to save to or erase a register (0 through 9) whose Write Protect is On. Save to another register, or set Write Protect for the desired register to Off. Write Protect status is shown on the Instrument State Menu.
Error 141: Register not saved yet.	<i>Type: Momentary Warning</i> <i>Associated With: Save/Recall</i>
	This message occurs when an attempt has been made to recall a saved instrument configuration from a register that has not yet been saved.
Error 142: Register out of range.	<i>Type: Momentary Warning</i> <i>Associated With: Save/Recall</i>
	This message occurs when a register number outside the valid range has been entered. Valid register numbers are 0-9 for RECALL, and 1-9 for SAVE or ERASE.
Error 150: Parameter conflict.	<i>Type: Static Error</i> <i>Associated With: HP-IB</i>
	This message occurs when an HP-IB command was sent which conflicts with the current instrument configuration.
Events occurred which were not timed.	<i>Type: Momentary Status</i> <i>Associated With: Measurement</i>
	This message occurs when the measurement acquisition process is not able to timestamp every event sample individually. All measurement results displayed are still valid in this case; no user-intervention is required.
Exponent entry disallowed.	<i>Type: Momentary Status</i> <i>Associated With: Numeric Entry</i>
	This message occurs for one of two reasons: an attempt was made to enter an integer parameter using exponent format, but the menu field is too small to adequately handle that format (not enough space to specify digits plus the "E+00" notation), or the EXP key was pressed without having entered any digits in the current numeric entry sequence.

Exponent disallowed due to mantissa.

*Type:*Momentary Status

*Associated With:*Numeric Entry

This message occurs if there is not enough space left in the numeric entry field to show "E+00" when the EXP key is pressed. In this case, the exponent entry mode is valid for the parameter in question, but there is not enough space left in the field because too many digits have already been entered. There must be at least four character spaces available to show "E+xx" in the field. The BACK-SPACE key may be used to clear enough character spaces to allow exponent entry.

Gate open.

*Type:*Static Status

*Associated With:*Manual Totalize Measurement

This message appears while the manually controlled gate is open during a Manually armed Totalize measurement. When the gate is closed to complete the measurement, the message is erased and the measurement result is displayed.

Graphics not allowed for this meas.

*Type:*Momentary Status

*Associated With:*Manual Totalize and Peak Amplitude Measurements

Graphics displays are not allowed when the HP 5371A is making Manually armed Totalize or Peak Amplitude measurements.

Input line truncated to first 80 chars.

*Type:*Momentary Status

*Associated With:*HP-IB

This message occurs when an HP-IB string of more than 80 characters is entered from the controller. The parser truncates the string to the first 80 characters, and continues processing.

Input parameters may have changed.

*Type:*Momentary Status

*Associated With:*Parameter Coupling

This message occurs when parameters on the Input menu have been changed to resolve conflict with another parameter that has been entered. In this case, no Arming mode or Arming parameter changes have occurred.

Measurement Aborted.

*Type:*Momentary Status

*Associated With:*Measurement

This message occurs when the "ABORT" HP-IB command is received or the Abort (MANUAL ARM) key is pressed while a measurement is in progress, and enough samples have been taken to give at least one valid measurement result. The Abort command is valid only when the HP 5371A is in Single Sample mode.

Measurement terminated, no data.

*Type:*Momentary Status

*Associated With:*Measurement

This message occurs when the "ABORT" HP-IB command is received or the Abort (MANUAL ARM) key is pressed while a measurement is in progress, and not enough samples have been taken to give at least one valid measurement result. The Abort command is valid only when the HP 5371A is in Single mode.

**No digits specified,
entry aborted.**

*Type:*Momentary Status *Associated With:*Numeric Entry

This message occurs when the ENTER key is pressed, without having specified a numeric value containing any digits.

**Non-numeric key
ignored.**

*Type:*Momentary Status *Associated With:*Numeric Entry

This message occurs in numeric entry when pressing any non-numeric key before pressing ENTER or LAST VALUE. Non-numeric keys are keys other than 0 to 9, . (decimal point), EXP, +/-, or BACKSPACE.

**Not in Talk-only,
see System Menu.**

*Type:*Momentary Status *Associated With:*Print/Plot Graph keys

This message occurs when an attempt is made to print a screen or plot a graph without first setting the HP 5371A to Talk-Only mode on the System menu screen.

**Number must be
positive.**

*Type:*Momentary Status *Associated With:*Numeric Entry

This message occurs when an attempt is made to change an enterable parameter to a negative value, and that parameter is only allowed to be positive. Examples are: Measurement Size, or Arming on event or time values.

**Numeric entry
aborted.**

*Type:*Momentary Status *Associated With:*Numeric Entry

This occurs if you do any one of the following after you have begun entering a number using the DATA ENTRY keys: 1) press the LAST VALUE key; 2) turn the ENTRY/MARKER knob; 3) press any of the RESULTS keys; 4) press any of the MENU SELECTION keys; 5) press any INSTRUMENT CONTROL key except PRESET. The parameter that was being entered is restored to its last previous value.

Plot/Print aborted.

*Type:*Momentary Status *Associated With:*Plot/Print

The current plot or print output action in progress has been canceled (at user request).

**Response timeout
occurred, see
System Menu.**

*Type:*Momentary Warning *Associated With:*System Operation
Error Number:-303

This message occurs when the Response Timeout feature is enabled and a measurement is in progress but has not completed within the specified time period. The instrument will proceed with the measurement acquisition to completion if possible.

**Result Format
must be ASCII,
see System menu.**

*Type:*Momentary Status *Associated With:*HP-IB

This message occurs when an attempt is made to send data out on the HP-IB while in Talk Only, and the output format is binary or floating point. The output format should be changed to ASCII on the System menu.

Sending output to plotter...	<i>Type:Static Status</i>	<i>Associated With:Plot</i>
	This message occurs while the current Graphics screen display is being output to the attached plotter.	
Sending output to printer...	<i>Type:Static Status</i>	<i>Associated With:Print</i>
	This message occurs while the current screen display is being output to the attached printer.	
Source channel has changed.	<i>Type:Momentary Status</i>	<i>Associated With:Parameter Coupling</i>
	This message occurs when the Measurement Source channel has been changed to resolve conflict with another parameter that has been entered (such as changing the Measurement Function).	
Source, input parameters changed.	<i>Type:Momentary Status</i>	<i>Associated With:Parameter Coupling</i>
	This message occurs when the Measurement Source channel and one or more Input menu parameters have been changed to resolve conflict with another parameter that has been entered (such as changing the Measurement Function).	
Undefined key.	<i>Type:Momentary Status</i>	<i>Associated With:Key entries</i>
	This message occurs when an invalid or undefined key is pressed. An example is an undefined softkey.	
Value out of range: set to maximum.	<i>Type:Momentary Status</i>	<i>Associated With:Numeric Entry</i>
	This message occurs when the entered parameter value is above the maximum allowable value. The parameter is defaulted to that maximum value.	
Value out of range: set to minimum.	<i>Type:Momentary Status</i>	<i>Associated With:Numeric Entry</i>
	This message occurs when the entered parameter value is below the minimum allowable value. The parameter is defaulted to that minimum value.	
Waiting for Manual Arm...	<i>Type:Static Status</i>	<i>Associated With:Measurement Status</i>
	This message appears when a Totalize measurement with Manual arming is started. The HP 5371A is waiting for the MANUAL ARM key to be pressed which will open the gate.	
WARNING: Both freqs out of auto-trigger range.	<i>Type:Momentary Warning</i>	<i>Associated With:System Operation Error Number:182</i>
	This message occurs when the instrument is in Auto-trigger mode, and the input signals on both Channel A and B are outside the Auto-trigger frequency range. One input signal is below 1 kHz and one signal is above 200 MHz.	

WARNING:
Frequency too high
for auto-trigger.

Type: Momentary Warning

Associated With: System Operation

Error Number: 180

This message occurs when the instrument is in Auto-trigger mode, and the input signal is above 200 MHz. The Auto-trigger frequency range is 1 kHz to 200 MHz.

WARNING:
Frequency too low
for auto-trigger.

Type: Momentary Warning

Associated With: System Operation

Error Number: 181

This message occurs when the instrument is in Auto-trigger mode, and the input signal is below 1 kHz. The Auto-trigger frequency range is 1 kHz to 200 MHz.

SUMMARY OF NUMERIC ERROR CODES

An Error Queue query command addressed to the HP 5371A will return a numeric value representing an error that has been logged. (See "ERROR QUEUE QUERY COMMAND" on page C-2.) A numerical order listing of error codes that may be returned by the HP 5371A is provided in *Table C-1*.

Table C-1. Summary of Numeric Error Codes

Number	Meaning/Message
-100	Unrecognized command.
-120	Numeric Argument error.
-151	Query not allowed.
-303	Response timeout occurred, see System Menu.
-350	Too many errors. (See "ERROR QUEUE QUERY COMMAND", page C-2).
100	No Listeners on bus.
101	Talker, no listeners.
102	Bus conflict: Talk-only.
103	Key ignored in Remote.
104	Key ignored in LLO.
105	Alternate Timebase selected. Press RESTART.
106	Alternate Timebase selected. Press RESTART. Error Number 105 indicates that a signal source has been connected to the HP 5371A's rear-panel EXTERNAL INPUT connector. Error Number 106 indicates that a signal source has been disconnected from the HP 5371A's rear-panel EXTERNAL INPUT connector (and that the internal timebase reference will be used).
107	Timebase unlocked. Press RESTART.
108	Ch A and B Overvoltage.
109	Ch A Overvoltage.
110	Ch B Overvoltage.
111	Power-down before removing pods.
130	Only graphs can be plotted.
131	Plot/meas conflict.
140	Register protected.
141	Register not saved yet.
142	Register out of range.
150	Parameter conflict.
180	WARNING: Frequency too high for auto-trigger.
181	WARNING: Frequency too low for auto-trigger.
182	WARNING: Both freqs out of auto-trigger range.

D
DIAGNOSTICS

INTRODUCTION

There are three HP-IB commands for implementing diagnostic testing: the TEST command and the TEST? and *TST? queries. The following paragraphs briefly describe each command, followed by a description of the individual diagnostic tests which can be performed.

HP-IB COMMANDS FOR CALLING DIAGNOSTIC TESTS

The TEST command executes the diagnostic corresponding to the test number sent with the command. The test numbers are:

Test Number	Test Name	Test Number	Test Name
1	Self Test	12	CRT RAM
2	Time Base	13	LED Latch
3	Input Pods	14	CRT Controller
4	Input Amplifiers	15	Key Controller
5	Count ICs	16	DMA Controller
6	Gate Timer	17	Front Panel
7	Measurement RAM	18	CRT Adjustment
8	System ROM	19	CRT Video Pattern
9	System RAM	20	External Amplifier
10	Timer	21	Calibrate Interpolators
11	Real Time Clock		

The TEST? query returns the PASS/FAIL status and message of the last diagnostic test that was run.

The *TST? query initiates a series of self tests which exercise various parts of the 5371A, and is equivalent to the Self Test selection in the Diagnostic Test screen. All of the tests performed require no user interaction and do not affect data stored in RAM. The *TST query returns "PASS" when all tests pass, or returns the number and associated message of the first test that fails.

TEST DESCRIPTIONS

The following paragraphs describe each diagnostic test, including possible messages and results.

Test 1 — Self Test

The Self-Test is a series of tests which exercise various parts of the 5371A. All of the tests performed require no user interaction and are non-destructive to data stored in RAMs.

The results of the tests executed are displayed on the Self-Test screen. Each test is listed on the screen, grouped by board number (indicated inside square brackets: [1]), and is followed by the word PASS or FAIL indicating whether or not the test passed. The name of the test that is currently being run is highlighted on the Self-Test screen. The screen also displays the message as-

sociated with the last observed failure and the time at which the failure occurred. It keeps a running total of the number of times the Self-Test has been performed and the number of times the Self-Test failed. The following tests are executed by the Self-Test:

- Test 2 – Time Base Test
- Test 3 – Input Pod Test
- Test 4 – Input Amplifier Test
- Test 5 – Count ICs Test
- Test 6 – Gate Timer Test
- Test 7 – Measurement RAM Test
- Test 8 – System ROM Test
- Test 9 – System RAM Test
- Test 10 – Timer Test
- Test 11 – Real Time Clock Test
- Test 12 – CRT RAM Test
- Test 13 – LED Latch Test
- Test 14 – CRT Controller Test
- Test 15 – Key Controller Test
- Test 16 – DMA Test

Test 2 – Time Base Test

This test reads a status byte from the reference oscillator board to determine the state of the 5371A time base. The test passes only if the oscillator is locked and if only one of the sources, either external or internal, is present. The time base test also indicates in the return message whether the oscillator source is generated internally or externally.

Messages:

Reference Oscillator PASSED Source: [EXTERNAL]

Reference Oscillator FAILED - Unlocked Source: [INTERNAL]

Indicates that the oscillator is not locked.

Reference Oscillator FAILED - Ext & Int Source: [EXTERNAL INTERNAL]

The status bit indicates that both an external and an internal source are present. This condition should never occur; if it does, bad data is being read from the status register.

Reference Oscillator FAILED - No Source Source: []

The status bit indicates that neither an external nor an internal source is present. This condition should never occur; if it does, bad data is being read from the status register.

Test 3 – Input Pods Test

This test checks to see if both input pods are inserted properly in the 5371A. The test reads three ID bits for each pod location to determine which type of pod, if any, is installed. The test passes only if there are pods in both pod locations. The type of pod found in each location is shown in the return message. If the 5371A has rear panel inputs only, the pod test is not performed.

Messages:

Pods Present A: [54002] B: [54001]
Pod Missing A: [NO_POD] B: [NO_POD]
Rear panel inputs installed, POD test not performed.

Test 4 – Input Amplifier Test

A series of tests is performed on the input amplifier circuit:

1. The input amplifier comparators are tested to check that they do not toggle when no input signal is applied. The trigger levels and input bias are set to 0 V on both channels. The counting circuitry is set to count pulses coming from each comparator. If any pulses are counted on either channel, the test fails.
2. The auxiliary comparator outputs are tested by forcing them low and then high. This is done by setting the input biases to 0 V, then setting the trigger levels first to 1 V, then to -1 V. With the trigger set to 1 V, the auxiliary comparators should indicate that the signal is below the trigger level. With the trigger level set to -1 V, the auxiliary comparators should indicate that the signal is above the trigger level.
3. The slope controls are tested by changing them from positive to negative. With the input bias still at 0 V and the trigger level still at -1 V, the output of the auxiliary comparators should change.
4. This test checks that the counting circuitry detects the correct number (approximately) of events from the input amplifier. The counting circuitry is set up to count events from the channel being tested. A forced latch is performed and the count is saved. Then 100 pulses are generated using the signal from the bias MUX that is controlled by the trigger trigger level DAC of the other channel. Approximately 100 events should be counted. A second forced latch is then performed and a second set of approximately 100 events is counted and added to the first set. If the difference between the two forced latch values is within 15 % of 100, the test passes. This test is performed once for each channel.
5. Input Switching Test 1: Relays K2, K3, and K4 are tested together. The relays are set up so that the input level to Channel A of the input amplifier is 1 V. A peak search is performed on the input level; if it is within 15 % of the expected value, the test passes.
6. Input Switching Test 2: Relay K2 is tested. Relays K1 and K2 are switched from the previous setup so that the input level to Channel A is 575 mV. A peak search is performed on the input level; if it is within 15 % of the expected value, the test passes. If this test fails, and the previous tests passed, relay K2 is at fault.
7. Input Switching Test 3: Relay K3 is tested. Relay K3 is switched from the previous setup so that the input level to Channel A is 0 V. A peak search is performed on the input level; if it is within 15 % of the expected value, the test passes. If this test fails, and previous tests passed, K3 is at fault.
8. Input Switching Test 4: Relay K4 is tested. The relays are setup so that the input level to Channel A of the input amplifier is -2 V. A peak search is performed on the input level; if it is within 15 % of the expected value, the

test passes. If this test fails and previous tests have passed, relay K4 is at fault.

9. **Input Switching Test 5:** Relays K6, K7, and K8 are tested. The relays are set up so that the input level to Channel B of the input amplifier is 575 mV. A peak search is performed on the input level; if it is within 15 % of the expected value, the test passes.
10. **Input Switching Test 6:** Relay K8 is tested. Relay K8 is switched from the previous setup so that the input level to Channel B is 1 V. A peak search is performed on the input level; if it is within 15 % of the expected value, the test passes. If this test fails and previous tests have passed, relay K8 is at fault.
11. **Input Switching Test 7:** Relay K7 is tested. Relay K7 is switched from the previous setup so that the input level to Channel A is 575 mV. A peak search is performed on the input level; if it is within 15 % of the expected value, the test passes. If this test fails and previous tests have passed, relay K7 is at fault.
12. **Input Switching Test 8:** Relay K6 is tested. Relays K5 and K6 are switched from the previous setup so that the input level to Channel A is 1 V. A peak search is performed on the input level; if it is within 15 % of the expected value, the test passes. If this test fails and previous tests have passed, relay K6 is at fault.
13. **The bias MUXes are tested.** Each input of a bias MUX is sent to the appropriate input channel. A peak search is performed on each of the levels to determine if they are within an acceptable range. The four MUX inputs are -2 V, 1 V, 0 V, and the DAC control level (set to 2 V). The expected voltage level is 1/10 of the 2 V DAC control level (200 mV). Ten bias tests are performed; tests 1, 3, 5, and 7 check the -2 V, 1 V, 0 V, and DAC bias, respectively, for Channel A, while tests 2, 4, 6, and 8 check the same voltage levels for Channel B.

When both the relay (input switching) and bias tests are completed, a message is returned indicating whether one or the other type of test has failed (or both types, if applicable).

Messages:

Input Amp Test PASSED

Input Amp Test FAILED - Input Amp Oscillating A[313] B[0]

The input amplifier is oscillating with no input signal. The number of counts detected for each channel is returned in the error message.

Input Amp Test FAILED - Bad comparator result A: Stuck High B: Stuck Low

The auxiliary comparators returned bad results. The results are returned in the error message along with the expected results in parentheses.

Input Amp Test FAILED - Slope control failed: [Channel A] [Channel B]

The input amplifier slope control failed. The results are returned in the error message along with the expected results in parentheses. Both comparators should change to the low state.

Input Amp Test FAILED - Bad counts A[0] B[100]

An incorrect number of events was detected by the counting circuitry. (100 events are expected on each channel). The actual number of counts detected on each channel is returned in brackets in the error message.

Input Amp Test FAILED - Input Switching Failure]

This message is returned if any of the relay tests fail.

Input Amp Test FAILED - Input Bias Failure

This message is returned if any of the bias tests fail.

Input Amp Test FAILED - Input Switching or Input Bias Failure

This message is returned if any of the relay tests or bias tests fail.

Intermediate Messages:

Input Switching Test 1: Max: 1038 (Min: 1040) [1115 1360]

If a relay test fails, an intermediate message containing the DAC result followed by the acceptable range in brackets is displayed. The minimum peak level is also searched for and returned if an error is detected.

Input Bias Test 5: Max: 2072 (Min: 2070) [2191 2235]

If a bias test fails, an intermediate message containing the DAC result followed by the acceptable range in brackets is displayed. The minimum peak level is also searched for and returned if an error is detected.

Test 5 – Count ICs Test

This test exercises the Sequencer and ZDT ICs. The Sequencer is programmed to send the 500 MHz oscillator signal to the Event Counter ZDTs. The oscillator signal is hardwired to the Timing Counter ZDT. Each of the three ZDT counting chains are then exercised. The following tests are performed on each of the ZDT chains:

1. The data paths to the ZDTs are tested. The ZDTs are preset to the value AAAAH. This stops them from counting and sets the internal count value to AAAAH. Forced latches are then performed on latches 1 and 2. The results are then read back and compared to the initial preset value. This test is then repeated for the pattern 5555H.
2. The latch status bits for latch1 and latch2 are checked. They should be set since the last action performed by the previous test was a forced latch.

3. The ZDTs are reset and the latch status bits are checked again. The bits should now be cleared.
4. The terminal count bits are tested. First a reset is performed. This should clear the terminal count bits. The ZDTs are then preset to FFFFH. ZDTxB is then programmed to FF00H to cause a carry out from the first stage of ZDTxB. This should cause the terminal count bit of ZDTxB to be set. ZDTxA is then programmed to FF00H to cause a carry out from the first stage of ZDTxA. This should cause the terminal count bit of ZDTxA to be set.
5. The ZDTs are tested to see if they count. The ZDTs are preset to 0 and a reset is performed to enable counting. A software delay loop is executed and then latches 1 and 2 are forced. The values of the latches should be different from the initial preset value.
6. The latches are read a second time to see if they have held the latched values. The values read the second time should be the same as the values read the first time.
7. The enable latch function is tested. The latches are enabled, a software delay loop is executed, and latches 1 and 2 are forced. These values should be different from the values of the latches before they were enabled.
8. Two Totalize measurements using the Gate Timer are performed to test the accuracy of the count chips. The 500 MHz signal is driven to each of the ZDT chains. A measurement with a 4.6 μ S gate time and one with a 4.1902 mS gate time are made on each ZDT chain. The 4.6 μ S gate time measurements should return a result of 8FC (hexadecimal) ± 3 , while the 4.1902 mS gate time measurement should return a result of 1FF7FC (hexadecimal) ± 3 .

Messages:

Count ICs PASSED
 Count ICs FAILED: ZDT1A, ZDT1B, ZDT2A, ZDT2B, ZDT3A,
 ZDT3B,

Intermediate Messages:

ZDT1A FAILED: Read bad preset value through forced latch1 RD :
 FFFF WR : AAAA
 ZDT1A FAILED: Read bad preset value through forced latch2 RD :
 FFFF WR : AAAA
 ZDT1A FAILED: Latch1 status bit not set after forced latch RD :
 FFFF WR : 0
 ZDT1A FAILED: Latch2 status bit not set after forced latch RD :
 FFFF WR : 0
 ZDT1A FAILED: Latch1 status bit set after ZDTs reset RD : FFFF
 WR : 0
 ZDT1A FAILED: Latch2 status bit set after ZDTs reset RD : FFFF
 WR : 0
 ZDT1A FAILED: Terminal Count not cleared after reset RD : FFFF
 WR : 0
 ZDT1A FAILED: Terminal Count not set after 0FFFFH preset RD :
 FFFF WR : 0

ZDT1A FAILED: Latch1 is not changing after a reset RD : FFFF WR : 0
ZDT1A FAILED: Latch2 is not changing after a reset RD : FFFF WTR : 0
ZDT1A FAILED: Latch1 is changing after a forced latch RD : FFFF WR : 0
ZDT1A FAILED: Latch2 is changing after a forced latch RD : FFFF WR : 0
ZDT1A FAILED: Latch1 is not changing after an enable latch RD : FFFF WR : 0
ZDT1A FAILED: Latch2 is not changing after an enable latch RD : FFFF WR : 0
ZDT1 chain FAILED - incorrect count total [4.6 μ S gate]: 7FE[8FC]

Test 6 – Gate Timer Test

This test exercises the gate timer chip. The data path to the gate timer is tested by writing and reading AAAAH and 5555H to alarm register 1. Two timers contained in the gate timer IC are tested in the following manner. Each timer is loaded with an initial value of 200000 and is then allowed to count down for about 10 ms (determined by a software loop). The current count is then latched into the hold registers and compared with an expected value of about 100000. If the latched count is within 11% (± 11000) of the expected value, the timer passes. The latched count is included as part of the return message.

Messages:

Gate Timer 1 PASSED : count = [100000] Gate Timer 2 PASSED : count = [100000] Gate Timer FAILED W : AAAA R : FFFF

If the data path test fails, the values that were written and read are returned in the error message.

Gate Timer 1 FAILED : count = [200000] Gate Timer 2 FAILED : count = [0]

If the latched count is not within the acceptable range, the test fails and the bad count is included in the return message.

Test 7 – Measurement RAM Test

The RAMs that are used to store measurement data output by the ZDTs and the interpolator are tested by writing and reading back the bit patterns AAAAH and 5555H from each 16-bit memory location.

NOTE

This test always destroys data in the RAM regardless of whether it is run at power-up, from the diagnostics menu, or via HP-IB.

The contents of all memory locations are initially set to AAAAH. Each location is then tested (read AAAAH, write 5555H, read 5555H) and set to 8888H. If any two locations are mapped to the same memory location, the pattern 8888H will be read back instead of the expected AAAAH.

Messages:

Measurement RAM PASSED
Measurement RAM FAILED : 1A 1B 2A 2B 3A 3B INT

A list of RAMs that failed is returned.

Intermediate Messages:

Measurement RAM 1A [Fail] : 800 W : AAAA R: 8888

If a memory failure is detected, the address at which the failure occurred and the data that was written and read are displayed in an intermediate message.

**Test 8 –
System ROM Test**

The ROMs on the microprocessor board are tested by performing a checksum on each ROM chip. The checksums for all of the ROMs are stored in the last two ROMs. The last two ROMs are tested only up to, but not including, these checksums.

Messages:

System ROM PASSED
System ROM FAILED : U45 U44 U49 U48 U51 U50

A list of ROMs with incorrect checksums is returned.

Intermediate Messages:

System ROM U28 [Fail] Sum = 582E2A [593FB2]

If an incorrect checksum is detected, it is displayed in an intermediate message along with the expected checksum in brackets.

**Test 9 –
System RAM Test**

The RAMs on the microprocessor board are tested by writing and reading back the bit patterns AAH and 55H from each 8-bit memory location.

When this test is run from the Diagnostics menu or via HP-IB, it is run in a mode that is non-destructive to the data in the RAM. The current contents of each memory location are saved before that location is tested. After the test, the original contents are restored.

When the test is run at instrument power-up, a destructive test that establishes uniqueness between memory locations is performed. The contents of all memory locations are initially set to AAH.

Each location is then tested (read AAH, write 55H, read 55H) and set to 88H. If any two locations are mapped to the same memory location, the pattern 88H will be read back instead of the expected AAH.

Messages:

System RAM PASSED
System RAM FAILED : U45 U44 U49 U48 U51 U50

A list of RAMs that failed is returned.

Intermediate Messages:

System RAM U45 [Fail] : 1E72 W : AA R : 88

If a memory failure is detected, the address at which the failure occurred and the data that was written and read are displayed in an intermediate message.

**Test 10 –
Timer Test**

One of the counters of the timer chip is set up to count down to zero and is loaded with an initial value (20000). The counter is then allowed to count down for about 10 ms (determined by a software loop). After the 10 ms wait period, the count is latched and compared to an expected value (10000). If the latched count is within an acceptable range ($\pm 11\%$), the timer test passes. The latched count is included as part of the returned message.

Messages:

Timer PASSED count = [10000]
Timer FAILED count = [0]

If the latched count is not within the acceptable range, the test fails and the bad count is included in the return message.

**Test 11 –
Real Time Clock Test**

This test looks at the tenths-of-a-second register of the Real Time Clock IC to see if it is incrementing. The number of times the wait loop gets executed before a change in the tenths register is detected is included in the return message.

Messages:

Real-time Clock PASSED: Count = [245] 21 Aug 1987 09:54:55
Real-time Clock FAILED: Not Responding - Timeout Occurred.

If no change is detected in the tenths register within the timeout period, the Not Responding error message is returned.

Real-time Clock FAILED: Non-consecutive Increment [1] [3] Count = [244]

If the value in the tenths register changes by any amount other than +1, the Non-consecutive Increment error message is returned. The two numbers in square brackets displayed before the count are the contents of the tenths register before and after executing the wait loop.

**Test 12 –
CRT RAM Test**

The RAMs that are used to hold the bit-mapped CRT image are tested by writing and reading back the bit patterns AH and 5H from each 4-bit memory location. Each word of CRT memory is stored in four, 4-bit wide RAMs. The

test is set up to test each RAM individually, thus the memory is tested in bit blocks of four.

When this test is run from the Diagnostics menu or via HP-IB, it is run in a mode that is non-destructive to the data in the RAM. The current contents of each memory location are saved before that location is tested. After the test, the original contents are restored.

When the test is run at instrument power-up, a destructive test that establishes uniqueness between memory locations is performed. The contents of all memory locations are initially set to AH. Each location is then tested (read AH, write 5H, read 5H) and set to 8H. If any two locations are mapped to the same memory location, the pattern 8H will be read back instead of the expected AH.

Messages:

CRT RAM PASSED
CRT RAM FAILED : U19 U15 U27 U23

A list of RAMs that failed is returned.

Intermediate Messages:

CRT RAM U19 [Fail] : 0 W : A R : FF

If a memory failure is detected, the address at which the failure occurred and the data that was written and read are displayed in an intermediate message.

**Test 13 –
LED Latch Test**

The bit patterns 10101010 and 01010101 are written and read from the 8-bit LED latch. The test passes only if the data that is read back is the same as the data that was written.

Messages:

LED Latch PASSED
LED Latch FAILED W : AA R : FF

**Test 14 –
CRT Controller Test**

This test verifies that the CRT Controller is present and is accepting commands by writing and reading data from one of its cursor registers. The bit patterns 10101010 and 01010101 are written and read from the controller. If the test fails, the bit patterns that were written and read are displayed in hexadecimal in the return message.

If the CRT Controller is failing or is removed, the CRT will not function correctly because it is not receiving the proper vertical and horizontal sync signals. The CRT RAM test could also fail because the dynamic CRT RAM ICs are not being refreshed properly. The 5371A will still be able to power-up, but will not be able to make measurements properly.

Messages:

CRT Controller PASSED
CRT Controller FAILED W : AA R : FF

**Test 15 –
Front Panel Key
Controller Test**

The bit patterns AAH and 55H are written to and read from the match value registers of the Front Panel Controller. This checks the data path to the controller and verifies that it is present and accepting commands.

To write data to the controller, a write command is sent to the controller followed by the data. To read data from the controller, a query command is sent to the controller and when the controller is ready to return the requested data, it interrupts the processor. The data can then be read from the controller's data buffer.

Messages:

Front Panel Controller PASSED
Front Panel Controller FAILED Front Panel Controller Not Responding

Before sending a command to the front panel controller, the software must wait for bit 1 of the status register to be set to 0 by the controller. If this does not occur within the timeout period, the Not Responding error message is returned.

Front Panel Controller FAILED Front Panel Controller Not Interrupting

When reading a parameter from the controller, the software sends it a query command and then waits for the controller to interrupt the processor. When this happens, the requested data is retrieved from the data register of the controller. If the interrupt does not occur within the timeout period, the Not Interrupting error message is returned.

Front Panel Controller FAILED W : AA R : 00 W : 55 R : 00

If the wrong bit pattern is read back from the controller, the data read is displayed along with the data written in the error message.

**Test 16 –
DMA Controller Test**

The data path to the DMA Controller IC is tested by writing and reading the bit patterns AAAAH and 5555H to the Channel 0 Current Address Register. The controller is then functionally tested by exercising it in verify mode. In this mode, the DMA Controller IC performs the DMA transfer routine with the memory and the I/O lines inactive (i.e., no data is actually transferred).

In the verify mode, the DMA Controller is set up to "transfer" 10 bytes on channel 1. The transfer is started and the test goes into a loop that polls the status of the DMA Controller. If the transfer is not completed after a certain maximum delay time, the loop is exited and a failure message is returned. If the transfer finishes, the count is read from the controller; the count should be -1. The address is then read from the controller; the address should be 11. The controller passes only if both the count and address conditions are true.

Messages:

DMA Controller PASSED

DMA Controller FAILED W : AAAA R : EAAA

If the data path test fails, the value that was written and the value that was read are returned in the error message.

DMA Controller FAILED : Not Responding

If the DMA controller does not signal that it has completed the test transfer within the timeout period, the Not Responding error message is returned.

DMA Controller FAILED : Bad Count [0]

After the test transfer, the byte count register should be set to -1. If it is not -1, the Bad Count message is returned along with the contents of the count register.

DMA Controller FAILED : Bad Address [0]

After the test transfer, the current address register should be set to 11. If it is not 11, the Bad Address message is returned along with the contents of the current address register.

DMA Controller Test STOPPED

This message is returned if the DMA Controller test never has a chance to run before a STOP command is received. This situation could occur if the HP-IB is tying up the DMA controller. This test returns a PASSED status even though no test was run.

Intermediate Messages:

DMA Controller busy, waiting...

If the HP-IB is being used, an intermediate wait message is displayed.

Test 17 — Front Panel Test

This test is for checking that the keys and the rotary pulse generator (RPG or Data Entry Knob) are working. A drawing of the 5371A front panel is displayed on the CRT with each key location highlighted. When a key is pressed, that key location on the display is turned off. When the RPG is turned, the arrow pointing in the direction that the knob is being turned will disappear from the screen. The test passes only when all of the keys have been pressed at least once and when the RPG has been turned in both directions. The test is aborted if no key presses or RPG turns are detected after about 10 seconds. Also, the LEDs that are controlled by the microprocessor are turned on and can be checked visually.

Test 18 — CRT Adjustment Pattern

A pattern is displayed that will aid in the adjustment of the CRT. Lines marking the border of the active display area and the vertical and horizontal centers of the screen are displayed. Two solid rectangles are displayed, one at the full-bright and one at the half-bright intensity, to aid in the brightness adjustments. The pattern is displayed until any key is pressed.

Test 19 — CRT Video Pattern

A pattern of alternating full-bright and half-bright vertical lines is displayed on the CRT. Each line is one pixel wide, separated from the next pixel by a space one pixel wide. Each line runs from the top to the bottom of the display area. Enough lines are drawn to fill up the entire display area. This pattern causes the video data line that goes to the CRT to be a series of pulses alternating in amplitude between the full-bright voltage level and the half-bright voltage level. The pattern is displayed until any key is pressed.

Test 20 — External Amplifier Test

This test monitors the output of the external amplifier comparator. A simulated scope diagram showing whether the comparator is set high or low is shown on the CRT. The test runs until any key is pressed.

Test 21 — Interpolator Calibration Routine

This routine is used to aid in the calibration of the interpolators during production. The Sequencer is set up so that the interpolator trigger outputs are driven by the signal coming in on channel A. Eight hundred samples of interpolator data are taken and saved in the interpolator RAM. Portions of this data are then processed and displayed graphically on the CRT screen.

When the frequency of the signal coming in on channel A comes close to a multiple of the 500 MHz reference oscillator, the data read from the interpolators stabilizes. To calibrate the interpolators, a signal is chosen so that the data changes slowly. When graphed, this appears as a stair-step pattern.

The interpolator stages are adjusted so that all of the steps in the stair-step pattern are the same. Vertical reference lines are displayed to mark the expected length of the stair-step pattern.

A total of 800 data samples are taken, but only 302 are actually graphed. The data read from the interpolators ranges from zero to nine. The routine starts graphing from the first occurrence of a nine-to-zero transition. If this is not found, it then starts graphing from the first occurrence of a nonzero-to-zero transition. If this is not found, it then starts graphing from data sample 1.

By pressing the AVERAGING ON/OFF softkey, the routine can be put into an averaging mode that displays the average segment lengths for the last 10 measurements. The data that is used in the averaging comes from the first set of data that cycles from zero through nine. The averaging feature has been included because the pattern that is displayed is sometimes unstable. Averaging makes it easier to make fine-tuned adjustments to the interpolator stages.

This test is performed on both interpolators in the 5371A. When the routine is run, it first shows the data patterns that are being generated by Interpolator 1. When the INTERP 2 softkey is pressed, it displays the data patterns that are being generated by Interpolator 2.

E
ARMING MODES

This appendix contains the following:

1. *Table E-1*, Supported Arming Modes (page E-2)
 2. Conventions used in *Table E-2* (page E-3)
 3. *Table E-2*, Arming Mode Programming Commands (page E-4)
 4. *Table E-2* Programming Examples (page E-6)
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TABLE E-1

Table E-1 lists the arming modes available for each of the HP 5371A measurement functions. The arming modes are shown in the left-most column of the table, and the measurements are listed across the top.

Here is an explanation of how to use *Table E-1*:

1. Pick a measurement column at the top of the table.
2. Scan down that column until you come to a box with an entry.
3. Each box with an entry indicates an arming mode (on the left) that can be used to make the selected measurement.

Use the Key at the end of the table for an explanation of the entry.

For information about measurements and arming modes, refer to the Operating Manual, Sections 2 through 5.

Table E-1. HP 5371A Supported Arming Modes

Arming Mode	Measurement Function										
	Time Interval	Continuous Time	±Time Interval		Frequency, Period		Totalize		Pos Width, Neg Width, Rise Time, Fall Time, Duty Cycle	Phase	Peak Amplitude
	A	A	A	A→B	A	A&B	A	A&B	A	A rel B	A
	B	B	B	B→A	B	A/B	B	A/B		B rel A	B
	A-B					B/A		B/A			
	B-A					A+B		A+B			
						A-B		A-B			
						B-A		B-A			
Automatic											
Automatic	C* #	C* #		C* #	C* g	C* g			C* #	C* -	N* -
Holdoff											
Edge Holdoff	C #	C #		C #							
Time Holdoff	C #	C #									
Event Holdoff	C #	C #									
Sampling											
Interval Sampling	C #	C #		C #	C g	C g	C* g	C* g			
Time Sampling					N g						
Cycle Sampling					C g						
Edge Sampling					C g	C g	C g	C g			
Parity Sampling				C #							
Repetitive Edge	C #	C #		C #							
Repetitive Edge/Parity				C #							
Holdoff/Sampling											
Edge /Interval	C #	C #		C #	C g	C g	C g	C g			
Edge/Time					N g						
Edge/Edge					C g		C g	C g			
Externally Gated					N g		N g	N g			
Edge/Cycle					C g						
Edge/Event			N #	N #	N g						
Edge/Parity				C #							
Time/Interval					C g		C g				
Time/Time			N -	N -	N g						
Event/Interval					C g						
Event/Event			N* -	N -	N g						
Manual							N g	N g			

- C = Continuous Measurements (Block/Measurement Arming)
- N = Non-continuous Measurement (Start/Stop Arming)
- * = Default Arming
- # = missed events
- g = gate time
- = no expanded data

Arming Categories

Category	Holdoff	Sampling
Automatic	None (Automatic)	Automatic
Holdoff	User-defined	Automatic
Sampling	None (Automatic)	User-defined
Holdoff/Sampling	User-defined	User-defined

TABLE E-2

Table E-2 summarizes the programming commands for each of the arming modes and their default arming settings. The arming modes are shown in the left-most column of the table, and the programming commands are listed across the top.

Here is an example of how to use *Table E-2* to help write a program:

1. Specify the measurement and source channel. A frequency measurement on Channel B is used here.

```
OUTPUT 703; "MEAS; FUNC, FREQ; SOUR, B"
```

2. Find a supported arming mode for frequency from *Table E-1*. Event/Event is used here.
3. Specify the arming mode from *Table E-2*. In this case, it is number 22, Event/Event.

```
OUTPUT 703; "ARM, EVEV"
```

4. Specify the start arm sublevel commands by adding to the previous program line.

```
OUTPUT 703; "ARM, EVEV; STAR; SLOP, POS; CHAN, A; DEL, 5; DCH, B"
```

This program line now sets the measurement to begin after a positive edge on Channel A, followed by 5 events on Channel B.

5. Specify the stop arm sublevel commands.

```
OUTPUT 703; "SAMP; DEL, 15; DCH, B"
```

This program line sets the measurement to end after 15 events on Channel B. Note that the start and stop delay events are both referenced to the positive edge on Channel A specified in Step 4. The measurement result will be the frequency of 10 events measured on Channel B.

Conventions used in Table E-2

1. The programming shortform for each of the arming modes is listed in the left column.
2. In the column called, "Arming Sublevel Command," STAR is the shortform for START, and SAMP is the shortform for SAMPLE.
3. The programming commands are listed across the top of the table in the same order as the menu fields programmed by these commands are displayed on the FUNCTION screen.
4. Lines in the boxes indicate that the command is not recognized for that particular arming mode.
5. () = Default setting. These default values are set by the HP-IB "PRESET" command or by pressing the PRESET key on the front panel, when in Local.

Table E-2. Arming Mode Programming Commands

Arming Mode	Arming Sublevel Command	SLOPe	CHANnel	DELay	Delay CHannel
1. Automatic AUT	—	—	—	—	—
2. Edge Holdoff EDH	STAR	(POS)	(A)	—	—
3. Time Holdoff THOL	STAR	(POS)	(A)	(2 ns)	—
4. Event Holdoff EVH	STAR	(POS)	(A)	(1 event)	(A)
5. Interval Sampling ISAM	SAMP	—	—	(10 μ s)	—
6. Time Sampling TSAM	SAMP	—	—	(1 s)	—
7. Cycle Sampling CSAM	SAMP	—	—	(16 cycles)	(A)
8. Edge Sampling ESAM	SAMP	(POS)	(A)	—	—
9. Parity Sampling PSAM	—	—	—	—	—
10. Repetitive Edge REDG	STAR	(POS)	(A)	—	—
11. Repetitive Edge/ Parity RPAR	STAR	(POS)	(A)	—	—
12. Edge/Interval EDIN	STAR	(POS)	(A)	—	—
	SAMP	—	—	(10 μ s)	—
13. Edge/Time EDT	STAR	(POS)	(A)	—	—
	SAMP	—	—	(1 s)	—
14. Edge/Edge EDED	STAR	(POS)	(A)	—	—
	SAMP	(POS)	(A)	—	—
15. Externally Gated EGAT	STAR	(POS)	(A)	—	—
16. Edge/Cycle EDCY	STAR	(POS)	(A)	—	—
	SAMP	—	—	(16 cycles)	(A)

Table E-2. Arming Mode Programming Commands (Continued)

Arming Mode	Arming Sublevel Command	SLOPe	CHANnel	DELAy	Delay CHannel
17. Edge/Event EDEV	STAR	(POS)	(A)	—	—
	SAMP	—	—	(1 event)	(A)
18. Edge/Parity EDP	STAR	(POS)	(A)	—	—
19. Time/Interval TINT	STAR	(POS)	(A)	(2 ns)	—
	SAMP	—	—	(10 μ s)	—
20. Time/Time TTIM	STAR	(POS)	(A)	(2 ns)	—
	SAMP	—	—	(1 s)	—
21. Event/Interval EVIN	STAR	(POS)	(A)	(1 event)	(A)
	SAMP	—	—	(10 μ s)	—
22. Event/Event EVEV	STAR	(POS)	(A)	(1 event)	(A)
	SAMP	—	—	(10 events)	(A)
23. Manual MAN	—	—	—	—	—

**Table E-2
Programming
Examples**

Here are more examples of how this table is used for programming. Compare the arming commands used in these examples with the way the commands are listed in the table:

NOTE

The HP 5371A will accept a maximum program line length of 80 characters, including delimiters. The programming examples below are shown with shorter line lengths to make them easier to describe.

AUTOMATIC Arming Mode —

OUTPUT 703; "MEAS; FUNC, FREQ; SOUR, A; ARM, AUT"

This program line selects a Channel A frequency measurement with Automatic arming. *Figure E-1* shows the 5371A as it would be programmed.

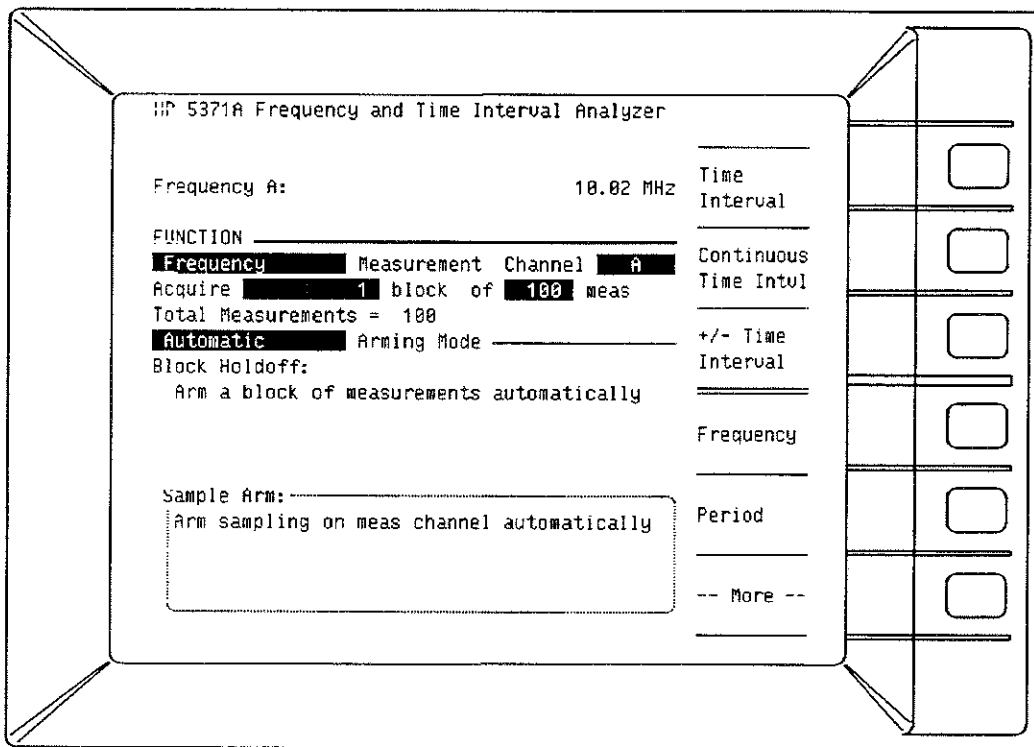


Figure E-1. Automatic Arming Mode

EVENT HOLDOFF Arming Mode —

OUTPUT 703; "MEAS; FUNC, TINT; SOUR, (A>B); ARM, EVH"

OUTPUT 703; "STAR; SLOP, NEG; CHAN, A; DEL, 25; DCH, B"

The first program line selects a time interval measurement, Channel A to Channel B, with Event Holdoff arming.

The second line sets the measurement to begin after a negative edge on Channel A, followed by 25 events on Channel B. *Figure E-2* shows the 5371A as it would be programmed.

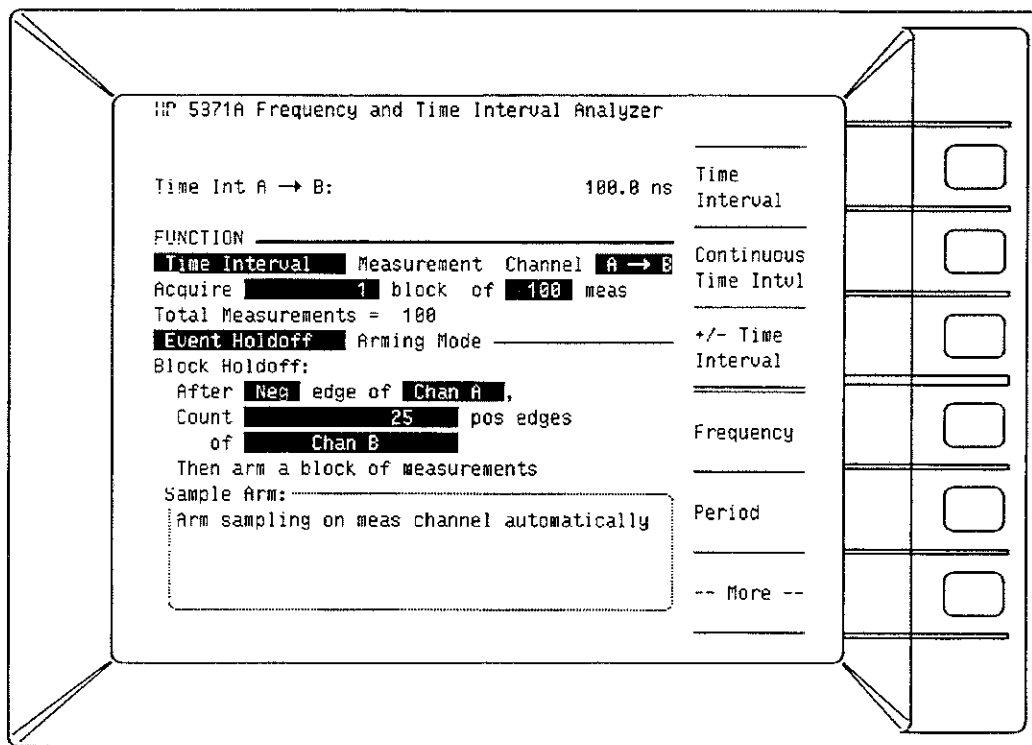


Figure E-2. Event Holdoff Arming Mode

INTERVAL SAMPLING Arming Mode —

OUTPUT 703; "MEAS; FUNC, FREQ; SOUR, A; ARM, ISAM; SAMP;
DEL, 100E-6"

This program line selects a Channel A frequency measurement with Interval Sampling arming. The interval is set to 100 microseconds. *Figure E-3* shows the 5371A as it would be programmed.

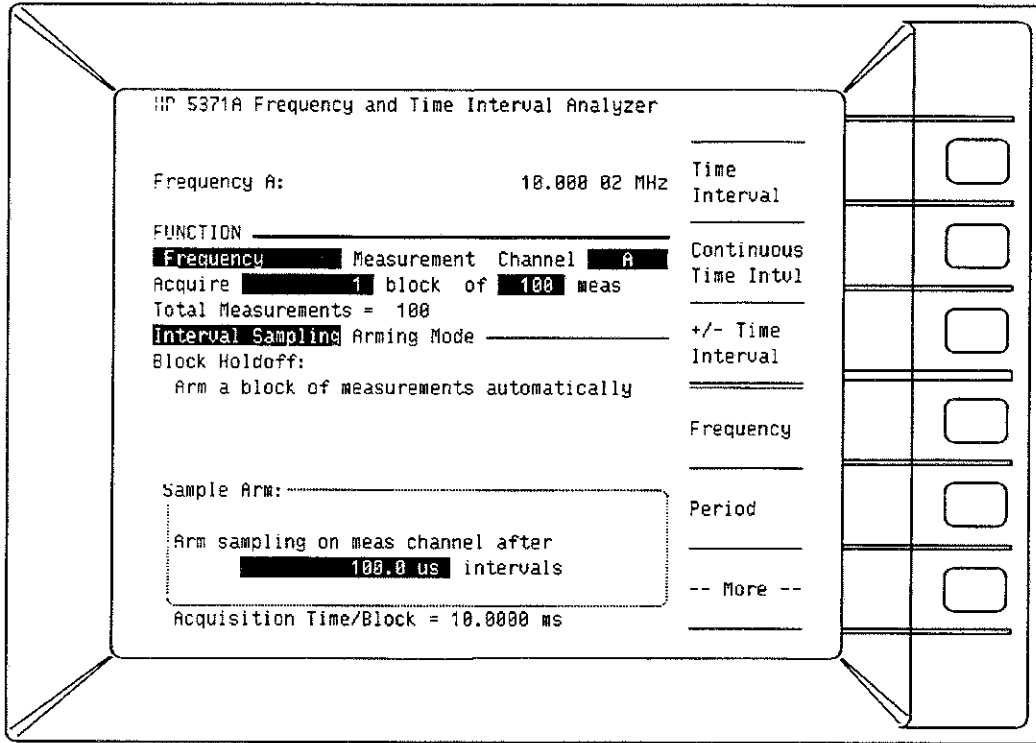


Figure E-3. Interval Sampling Arming Mode

EVENT/INTERVAL Arming Mode —

OUTPUT 703; "MEAS; FUNC, FREQ; SOUR, B; BLOC, 1; MSIZ, 164"

OUTPUT 703; "ARM, EVIN; STAR; SLOP, NEG; CHAN, B; DEL, 40; DCH, A"

OUTPUT 703; "SAMP; DEL, 10E-3"

The first program line selects a frequency measurement on Channel B. One block of 164 measurements will be collected.

The second line selects the Event/Interval arming mode. The measurement begins after a negative edge on Channel B, followed by 40 events on Channel A.

The third line sets measurement samples to be taken on the trigger event after every 10 milliseconds. *Figure E-4* shows the 5371A as it would be programmed.

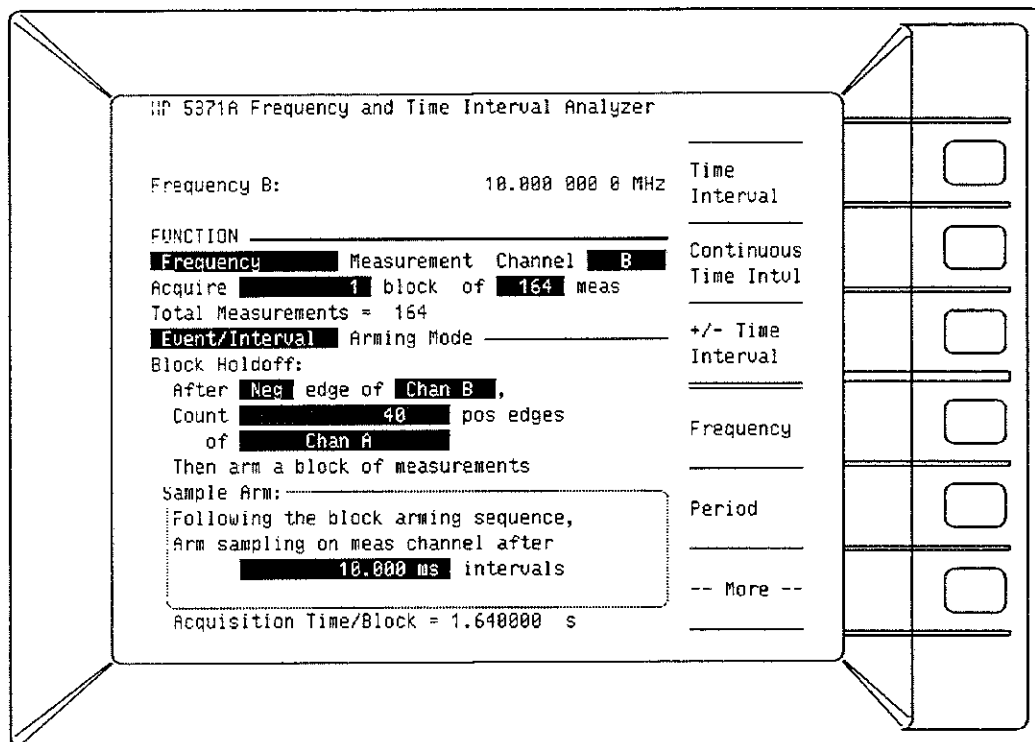


Figure E-4. Event/Interval Arming Mode

For a detailed explanation of all the arming modes, refer to the Operating Manual, Section 5, ARMING.

F
5370B PROGRAM
CONVERSION

INTRODUCTION

This appendix describes how to convert commands in a 5370B program to 5371A commands. The commands for the 5370B are listed below, in the same order as the list shown in *Table 3-4* of the 5370B Operating and Programming Manual, pages 3-22 through 3-24. The list of command conversions in this appendix contains a description of the corresponding 5371A function and command string (if appropriate) for each 5370B command. Each command conversion description is in the following format (with "COMMAND", "Command", "XX" replaced by the appropriate command or characters):

XX - COMMAND

Command description as used in the 5370B.

Modes:

XX1 - what XX1 does in the 5370B.

5371A command: "XXXX"

Comments on how the two commands relate.

XX2 - what XX2 does in the 5370B.

5371A command: "XXXX"

Comments on how the two commands relate.

Other comments or notes on this command.

FN - FUNCTION

Function determines which measurement or function result is to be used. The actual query output format is determined by the ST command.

Modes:

FN1 - sets function to Time Interval.

5371A command: "FUNC,TIM" or "FUNC,TINT"

The 5371A Time Interval result may be viewed in any menu screen except HELP or DIAG.

Recommendation: use the NUMERIC screen to see measurement as well as statistics results. The following commands may be used:

"MENU,NUM" sets the 5371A to the series of NUMERIC screens.

"DISP,NUM" displays only a list of measurement results.

"DISP,SPL" displays a shorter list of results, as well as the basic statistics (minimum, maximum, mean, standard deviation).

"DISP,STAT" displays only a list of statistical results.

FN2 - sets function to Trigger Levels.

Trigger levels on the 5371A are not included in the same function set as measurement type (TI, FREQ, PER). To display trigger levels, select either the STATUS screen ("MENU, INFO") or the INPUT screen ("MENU, INPUT") where the trigger levels are actually set.

NOTE

Since trigger levels are not considered part of the fundamental measurement set, they are not queried as for other measurement results. See the TRIGger and LEVel commands in the Input (INP) subsystem for details on how to read the trigger level.

FN3 - sets function to Frequency.

5371A command: "FUNC,FREQ"

See above comments for FN1.

FN4 - sets function to Period.

5371A command: "FUNC,PER"

See above comments for FN1.

GT - GATE TIME

Gate Time determines the gate time to be used for Frequency or Period measurements.

Modes:

GT1 - sets gate time to SINGLE PERIOD.

5371A command: "MEAS;FUNC,FREQ;ARM,AUTO"

The 5371A has a "SINGLE PERIOD" frequency measurement, using the AUTOMATIC arming type. This is the default arming type for frequency measurements.

GT2 - sets gate time to 0.01 second.

5371A command: "FUNC,FREQ;ARM,ISAM;SAMP;DELAY, 0.01"

The Interval Sampling (ISAM) arming type is used with Frequency measurements to allow a periodic sampling based on a user-specified time interval. To set the interval sampling time, use this arming mode, and set the delay value to the desired interval.

GT3 - sets gate time to 0.1 second.

5371A command: "FUNC,FREQ;ARM,ISAM;SAMP;DELAY,0.1"

See above comments for GT2.

GT4 - sets gate time to 1.0 second.

5371A command: "FUNC,FREQ;ARM,ISAM;SAMP;DELAY,1.0"

See above comments for GT2.

NOTE

The gate time used in the Interval Sampling arming mode is not limited to the values 0.01, 0.1, 1.0 seconds. Any values between 600 ns and 8.0 s (inclusive) may be used.

ST - STATISTICS

Statistics sets the statistical (measurement) value to be calculated, displayed and output over the bus for each measurement.

Modes:

ST1 - sets result to Mean value.

5371A command: "PROC;SOUR A;MEAN?" {read mean value}

The 5371A displays the statistical results on the NUMERIC screens (see FN1 for more details). To query the mean value of the last set of measurements, use the query format as shown above. Note that once in the PROCESS subsystem and the Source A sub-subsystem, it is not necessary to repeat those commands. As an example, to query MEAN, then MINIMUM, then MAXIMUM, use the following programming sequence:

"PROC; SOUR A;MEAN?"	{read mean}
"MIN?"	{read minimum}
"MAX?"	{read maximum}

ST2 - sets result to Standard Deviation value.

5371A command: "PROC;SOUR A;SDEV?"

See above comments about ST1.

ST3 - sets result to Minimum value.

5371A command: "PROC;SOUR A;MIN?"

See above comments about ST1.

ST4 - sets result to Maximum value.

5371A command: "PROC;SOUR A;MAX?"

See above comments about ST1.

ST5 - sets result to Display Reference value.

5371A command: "PROC;SOUR,A;SREF?"

To query the Reference value, use the SREF command query. To display this value, go to the MATH menu using the "MENU,MATH" command.

ST6 - clears Reference value (immediate execution).

5371A command: "PROC;SOUR,A;CREF"

The CREF command clears the Reference value for the specified channel. Reference values may be cleared for either channel, regardless of which channel is currently being measured.

ST7 - sets result to Display Events value.

5371A command: "MEAS;SSIZ?" {read number of measurements in block} "BLOC?" {read number of blocks}

This command in the 5370B displays the number of measurements taken. To read the number of measurements taken on the 5371A, the SSIZ and BLOC commands must be used together, to read the number of samples within a block, and the number of blocks of the measurement. The total number of measurement samples is the product of these two numbers.

Note that the 5371A SSIZ and MSIZ commands are functionally identical.

ST8 - Sets Reference value (immediate execution).

5371A command: "PROC;SOUR,A;SREF"

The SREF command sets the Reference value for the specified channel. Note that if the specified channel is not currently being measured, the Reference value cannot be set. This is based on the fact that the Reference value is set to the last measured value on the specified channel.

SS - SAMPLE SIZE

Sample Size determines the sample size (number of measurements) to be used for statistical calculations.

Modes:

SS1 - sets sample size to 1.

5371A command: "MSIZ,1;BLOC,1"

Statistics will be calculated on single blocks of one measurement each. Measurement size is set to one (one measurement per block), and Block size is set to one. Each measurement sample set

consists of one measurement, and Statistics are calculated on that measurement set.

SS2 - sets sample size to 100.

5371A command: "MSIZ,100;BLOC,1"

Statistics will be calculated on single blocks of 100 measurements each. See above comments about SS1.

SS3 - sets sample size to 1000.

5371A command: "MSIZ,1000;BLOCK,1"

Statistics will be calculated on single blocks of 1000 measurements each. See above comments about SS1.

SS4 - sets sample size to 10000.

5371A command: "MSIZ,1000;BLOC,10"

Statistics will be calculated on the total samples contained in 10 blocks of 1000 measurements each. See above comments about SS1.

SS5 - sets sample size to 100000.

5371A command: "MSIZ,1000;BLOC,100"

Statistics will be calculated on the total samples contained in 100 blocks of 1000 measurements each. See above comments about SS1.

NOTE

The 5371A does not have the same sample size restrictions as the 5370B. Any number of samples between 1 and $2E+9$ may be taken. Refer to the Measurement (MEAS) subsystem command descriptions for details and limitations on different measurement modes.

MD - DISPLAY MODE

Display Mode controls the display update rate, or measurement sample acquisition rate.

Modes:

MD1 - Front panel display rate control is functional.

5371A command: "SMOD,REP"

The 5370B uses this command to set sample rate control to the value chosen by the front panel Data Entry (RPG) knob. The 5371A has only two allowable update rates, "as fast as possible" [REPETITIVE] and "single" [SINGLE]. In Single, mode, individual (sets of) measurements are initiated by pressing the RESTART key or sending the HP-IB commands "RESTART" or

“*TRG”. In REPETITIVE mode, samples are taken and processed as quickly as possible. Note that MD1, MD3, and MD4 all appear the same as far as the 5371A is concerned.

MD2 - Display rate hold until MR (or measurement trigger) command.

5371A command: “SMOD,SING”

MD3 - Display rate fast, only if addressed to talk.

5371A command: “SMOD,REP”

See above comments about MD1.

The 5371A does not distinguish between “only if addressed to talk” and “wait until addressed to talk”. Therefore, there is no difference between MD3 and MD4.

MD4 - Display rate fast, wait until addressed to talk.

5371A command: “SMOD,REP”

See above comments about MD1.

IN - INPUT SELECTION

Input Selection controls the input selection mode.

Modes:

IN1 - Start event = Start channel input
Stop event = Stop channel input

5371A command: “INP;MODE,SEP”

NOTE

The 5371A and 5370B hardware implementations of this concept are NOT identical. All measurements should be checked to see if the measured results are as expected. The 5371A implementation of SEPARATE does use the Start channel input to measure start events, and the Stop channel input to measure stop events, but internal switching of the input circuit paths is not identical.

IN2 - Start event = Stop channel input
Stop event = Stop channel input

This input condition cannot be emulated by the 5371A.

IN3 - Start event = Start channel input

Stop event = Start channel input

5371A command: "INP;MODE,COM"

NOTE

The 5371A and 5370B hardware implementations of this concept are NOT identical. All measurements should be checked to see if the measured results are as expected. The 5371A implementation of SEPARATE does use the Start channel input to measure start events, and the Stop channel input to measure stop events, but internal switching of the input circuit paths is not identical.

IN4 - Start event = Stop channel input

Stop event = Start channel input

This input condition cannot be emulated by the 5371A.

SA - START CHANNEL SLOPE SELECT

Start Channel Slope Select selects the slope of the Start measurement channel.

Modes:

SA1 - Set Start Channel Slope positive.

5371A command: "INP;SOUR,A;SLOP,POS"

The slopes of Channels A and B are set on the INPUT menu. For a Time Interval A→B measurement, Channel A is considered the "start" channel, and Channel B is considered the "stop" channel. For a Time Interval B→A measurement, Channel B is considered the "start" channel, and Channel A is considered the "stop" channel. The commands used to set the slopes must be based on which type of measurement is being made.

SA2 - Set Start Channel Slope negative.

5371A command: "INP;SOUR,A;SLOP,NEG"

See above comments about SA1.

SO - STOP CHANNEL SLOPE SELECT

Stop Channel Slope Select selects the slope of the Stop measurement channel.

Modes:

SO1 - Set Stop Channel Slope positive.

5371A command: "INP;SOUR,B;SLOP,POS"

See above comments about SA1 (Start Channel Slope Select).

SO2 - Set Stop Channel Slope negative.

5371A command: "INP;SOUR,B;SLOP,NEG"

See above comments about SA1.

SE - EXTERNAL ARM SLOPE SELECT

External Arm Slope Select selects the slope of the External Arming channel.

Modes:

SE1 - Set External Arm Slope positive.

5371A command: "MEAS;ARM,EDH;START;CHAN,X;SLOP,
POS"

The External arm slope is set using the FUNCTION menu, which specifies the arming to be used for the measurement. When an external arm signal is used as the trigger edge, there is a slope field on the menu, allowing selection of positive or negative slope. The above command is the complete chain to specify EDGE HOLD-OFF arming, using the EXTERNAL arm channel (X) as the EDGE.

SE2 - Set External Arm Slope negative.

5371A command: "MEAS;ARM,EDH;START;CHAN,X;SLOP,
NEG"

See above comments about SE1.

AR - ARM SELECT

Arm Select selects the Time Interval measurement arming type.

Modes:

AR1 - Select +Time Interval arming only.

5371A command: "MEAS;FUNC,TINT"

Use the 5371A Time Interval (or Continuous Time Interval, "FUNC,CTIN") measurements to select +TI arming capabilities.

AR2 - Select +/-Time Interval arming.

5371A command: "MEAS;FUNC,PMT"

Use the 5371A Plus or Minus Time Interval measurement to select +/-TI arming capabilities.

EH - EXTERNAL HOLDOFF

External Holdoff enables and disable External Holdoff.

Modes:

EH0 - Disable External Holdoff.

EH1 - Enable External Holdoff.

The 5371A cannot emulate these commands.

EA - EXTERNAL ARM

External Arm enables and disable External Arming.

Modes:

EA0 - Disable External Arm.

EA1 - Enable External Arm.

The 5371A cannot emulate these commands.

IA - INTERNAL ARM

Internal Arm selects the arming channel (with respect to input phase relation); with +/-Time Interval measurements only.

Modes:

IA1 - Internal Arm Auto.

This command is used to toggle the polarity of the +/-Time Interval measurement. The 5371A does not have the option to control the measurement arming in this way. For +TI measurements, the first channel specified (i.e., Channel A in A→B measurements) is always the start channel. For +/-TI measurements, either channel may start the measurement. If the first channel specified is the start channel, the result is positive. If the second channel specified is the start channel, the result is negative.

IA2 - Start Channel Arm.

See above comments about IA1.

IA3 - Stop Channel Arm.

See above comments about IA1.

MR - MANUAL RATE

Manual Rate is used to initiate a sample of measurements.

Mode:

MR - Manual Rate.

5371A command: "RESTART" or "*TRG"

Either the front panel RESTART key or the "*TRG" bus command may be used to restart, or trigger, a new (series of) measurements on the 5371A.

MI - MANUAL INPUT

Manual Input is used to manually arm the counter (used with controller “wtb” command). This command performs the same functions as the front panel MANUAL INPUT key.

Mode:

MI - Manual Input

5371A command: “RESTART” or “*TRG”

The 5371A does not handle “wtb” commands (which require “parsing-on-the-fly” of binary input command bytes) without carriage returns or line feeds to signify end of input lines.

SL - SLOPE LOCAL

Slope Local sets the slope control to local (front panel) operation.

NOTE

The 5371A does not allow the choice between local and remote operation of any front panel parameters while in remote mode. All values are selectable/settable via either remote or local operation, but not at the same time. While in remote, front panel keys are locked out, and no changes can be made until in local mode again.

To change slopes remotely, see the information under SA (Start channel slope) and SO (Stop channel slope) commands.

SR - SLOPE REMOTE

Slope Remote sets the slope control to remote operation.

See note under SL command.

To change slopes remotely, see the information under SA (Start channel slope) and SO (Stop channel slope) commands.

TL - TRIGGER LOCAL

Trigger Local sets the trigger level controls to local (front panel) operation.

See note under SL command.

To change slopes remotely, see the information under TA (Start channel trigger level) and TO (Stop channel trigger level) commands.

TR - TRIGGER REMOTE

Trigger Remote sets the trigger level controls to local (front panel) operation.

See note under SL command.

To change slopes remotely, see the information under TA (Start channel trigger level) and TO (Stop channel trigger level) commands.

TE - TEACH

Teach causes the instrument, when addressed to talk, to transfer all front panel information (or remotely programmed information) from its memory into the controller's memory.

Mode:

TE - Teach

5371A command: "SET?"

NOTE

The 5371A does not have the capability to emulate the same teach string which the 5370B outputs. The 5371A does have its own teach string, which may be read using the "SET?" command. The end result is the same: the instrument setup is translated into a string of binary bytes and sent to the controller.

PC - PERIOD COMPLEMENT

Period Complement switches the polarity of the Time Interval measurement from +TI to -TI and vice versa.

This command applies only when using the IA1/2/3 commands, and is not applicable to the 5371A.

TB - TIME INTERVAL BINARY OUTPUT

Time Interval Binary Output is used to output raw measurement in a binary format.

Mode:

TB - Time Interval Binary Output

5371A command: "INT;OUTP,BIN"

The 5371A has a binary output format, but it is not compatible with the 5370B binary output format. Refer to Section 1 in this programming manual for information about the 5371A output formats. The 5371A output format is set in the front panel SYSTEM menu or via the HP-IB Interface (INT) subsystem.

SB - SAMPLE SIZE BINARY

Sample Size Binary allows a theoretical setting of sample sizes from 1 to 16,777,215, entered in binary format (for use with the controller "wtb" command).

Mode:

SB - Sample Size Binary

5371A command: "MEAS;MSIZE, < number >"

The 5371A does not handle "wtb" commands (which require "parsing-on-the-fly" of binary input command bytes) without

carriage returns or linefeeds to signify end of input lines. However, the sample size may be set using the MSIZE or SSIZE command. Refer to the MSIZE, SSIZ, and BLOCK command descriptions in this programming manual for information about combinations of measurement and block size, and how they specify total measurement set size.

LN - LEARN

Learn enters program information into the 5370B (RAM memory) that was stored into the controller with an earlier TEACH (TE) command.

Mode:

LN - Learn

5371A command: "SET"

NOTE

The 5371A does not have the capability to emulate the same teach string which the 5370B outputs. The 5371A does have its own teach string, which may be read using the "SET?" command. The end result is the same: the instrument setup is translated into a string of binary bytes and sent to the controller. If the learn command, "SET", is used with the 5371A, it has the same result as the 5370B: it sends the string read using the "SET?" command back to the controller.

TA - TRIGGER START

Trigger Start sets the trigger level of the START channel from -2V to +2V.

Mode:

TA - Trigger Start

5371A command: "INP;SOUR,A;TRIG,MAN;LEVEL,<value>"

The manual trigger levels are set on the INPUT menu. Note that the 5371A also supports AUTOMATIC trigger level settings. In addition, while in AUTOMATIC trigger modes, the levels are expressed as percentages from 0% to 100%. If the desired channel already has manual trigger mode specified, it is not necessary to re-program it, so the command may be shortened to "INP;SOUR,A;LEVEL,<value>".

TO - TRIGGER STOP

Trigger Stop sets the trigger level of the STOP channel from -2V to +2V.

Mode:

TO - Trigger Stop

5371A command: "INP;SOUR,B;TRIG,MAN;LEVEL, < value >"

See above comments about TA.

NOTE

For \pm Time Interval measurements where the source channel is B→A, slopes for B and A are still set in the same way on the INPUT menu (start and stop are not associated with Channels A and B on that menu).

INTRODUCTION

This appendix contains example programs, some for the advanced programmer, showing various measurement routines and formats. Four program listings are included, one for ASCII output, one for Floating Point output, and two for Binary data output.

ASCII Data Output Examples

The first program shows three different result formats for a frequency measurement:

- Measurement results for Channel A.
- Measurement results, limit test, and statistics for Channel A.
- Measurement results and gate data for Channels A and B.

The arrays for holding the data from the HP 5371A are dimensioned at the beginning of the program.

```

130  !LAST UPDATE 11/02 [1s]
140  !-----
150  !Dimension arrays which will be reading data from the 5371A.
160  DIM Meas_a$(10)[22]      !MEASUREMENT DATA
170  DIM Meas_b$(10)[22]
180  DIM Gate_a$(10)[22]     !GATE DATA
190  DIM Gate_b$(10)[22]
200  DIM Limit_a$(10)[5]     !LIMIT TEST RESULTS
210  DIM Stats_a$(10)[22]   !STATISTICAL RESULTS
220  !-----
230  !Initialize constants
240  Counter=703
250  Sample_size=10
260  Nr_of_stats=8
270  !=====
280  CLEAR Counter
290  OUTPUT Counter;"PRESET"           !PRESET the 5371A
300  OUTPUT Counter;"SMOD SINGLE"     !SINGLE sample mode
310  OUTPUT Counter;"MEAS;FUNC FREQ;ARM ISAM" !FREQ, INTERVAL SAMPLING arm
320  OUTPUT Counter;"SSIZE ";Sample_size !SET SAMPLE SIZE
330  OUTPUT Counter;"INT;OUTPUT ASCII" !OUTPUT format = ASCII
340  OUTPUT Counter;"MENU NUM"       !go to NUMERIC menu screen
350  OUTPUT Counter;"NUM;DISP NUM;EXP OFF" !turn off EXPANDED DATA
360  !
370  GOSUB Example_1                  !Meas results
380  GOSUB Example_2                  !Meas, limits, stats results
390  GOSUB Example_3                  !Meas, gate results
400  !
410  GOTO End_of_program
420  !=====

```

```

430 Example_1:  !
440  !Read just measurement results on Channel A
450  PRINT
460  PRINT "EXAMPLE 1: MEAS RESULTS FOR CHANNEL A"
470  TRIGGER Counter
480  !
490  FOR I=1 TO Sample_size           !Read measurement results
500    ENTER Counter USING "%,K";Meas_a$(I)
510    PRINT I,Meas_a$(I)
520  NEXT I
530  RETURN
540  !=====
550 Example_2:  !
560  !Read measurement results, limit test results and statistics on Channel A
570  PRINT
580  PRINT "EXAMPLE 2: MEAS, LIMIT, AND STATS RESULTS FOR CHANNEL A"
590  OUTPUT Counter;"PROC;SOUR A;LIM ON;STAT ON" !Turn limits and stats on
600  OUTPUT Counter;"NUM;DISP SPLIT"           !Display results and stats
610  !
620  TRIGGER Counter
630  FOR I=1 TO Sample_size           !Read measurement and limit test results
640    ENTER Counter USING "%,K";Meas_a$(I),Limit_a$(I)
650    PRINT I,Meas_a$(I),Limit_a$(I)
660  NEXT I
670  !
680  PRINT
690  PRINT "STATISTICS"
700  FOR I=1 TO Nr_of_stats           !Read statistical results
710    ENTER Counter USING "%,K";Stats_a$(I)
720    PRINT I;Stats_a$(I)
730  NEXT I
740  RETURN
750  !=====
760 Example_3:  !
770  !Read measurement results and gate data for Channels A and B
780  PRINT
790  PRINT "EXAMPLE 3: MEASUREMENT AND GATE RESULTS FOR CHANNELS A AND B"
800  !
810  OUTPUT Counter;"MEAS;SOUR (A^B)"           !Source = A & B
820  OUTPUT Counter;"PROC;SOUR A;LIM OFF;STAT OFF" !Turn limits, stats off
830  OUTPUT Counter;"NUM;DISP NUM;EXP ON"       !Expanded data on
840  !
850  TRIGGER Counter
860  FOR I=1 TO Sample_size           !Read measurement and gate results
870    ENTER Counter USING "%,K";Meas_a$(I),Meas_b$(I),Gate_a$(I),Gate_b$(I)
880    PRINT I,Meas_a$(I),Meas_b$(I),Gate_a$(I),Gate_b$(I)
890  NEXT I
900  RETURN
910  !=====
920 End_of_program:  !
930  END

```

Floating Point Data Output Examples

This program demonstrates the same three result formats as the ASCII program, but the measurement type is time interval, instead of frequency. The three result formats are:

- Measurement results for Channel A to Channel B measurement.
- Measurement results, limit test, and statistics for a Channel A to Channel B measurement.
- Measurement results and event data for a Channel A to Channel B measurement.

The arrays for holding the data from the HP 5371A are dimensioned at the beginning of the program.

```
10  !Program to demonstrate several format combinations for FLOATING POINT
20  !data output on the 5371A.
30  !The data taken in this program uses TIME INTERVAL measurements, and
40  !needs input sources for both Channels A and B.
50  !
60  !This program covers 3 examples:
70  ! 1. Measurement results only,
80  ! 2. Measurement and limit test results, with statistical results,
90  ! 3. Measurement and gate data results for both channels.
100 !
110 !LAST UPDATE 4/06 [bg]
120 !-----
130 OPTION BASE 1
140 !Dimension arrays which will be reading data from the 5371A.
150 DIM Meas_a(1000)  !MEASUREMENT DATA
160 DIM Meas_b(1000)
170 DIM Event_a(1000) !GATE DATA
180 DIM Event_b(1000)
190 DIM Limit_a(1000) !LIMIT TEST RESULTS
200 DIM Stats_a(1000) !STATISTICAL RESULTS
210 DIM Buff(1000) BUFFER
220 !-----
230 !Initialize constants
240 Counter=703
250 ASSIGN @Counter TO 703;FORMAT OFF
260 ASSIGN @Controller_buf TO BUFFER Buff(*);FORMAT OFF
270 Sample_size=10
280 !
290 !
300 Hi_lim=4.40E-7 ! Enter limit values here
310 Lo_lim=4.30E-7
320 !=====
```

```

330 CLEAR Counter
340 OUTPUT Counter;"PRESET" !PRESET the 5371A
350 OUTPUT Counter;"SMOD SINGLE" !SINGLE sample mode
360 OUTPUT Counter;"MEAS;FUNC TINT;SOUR (A>B)" !TI, AUTO arming, SOURCE A->B
370 OUTPUT Counter;"SSIZE ";Sample_size !SET SAMPLE SIZE
380 OUTPUT Counter;"INT;OUTPUT FPO" !OUTPUT format = FLOATING PT
390 OUTPUT Counter;"MENU NUM" !go to NUMERIC menu screen
400 OUTPUT Counter;"NUM;DISP NUM;EXP OFF" !turn off EXPANDED DATA
410 !
420 GOSUB Example_1 !Meas results
430 GOSUB Example_2 !Meas, limits, stats results
440 GOSUB Example_3 !Meas, gate results
450 !
460 GOTO End_of_program
470 !=====
480 Example_1: !
490 !Read just measurement results
500 PRINT
510 PRINT "EXAMPLE 1: MEAS RESULTS "
520 !
530 TRIGGER Counter
540 GOSUB Read_header !Read block data header
550 RESET @Controller_buf
560 TRANSFER @Counter TO @Controller_buf;COUNT Num_bytes
570 FOR I=1 TO Sample_size
580 PRINT I, Buff(I)
590 NEXT I
600 RETURN
610 !=====
620 Example_2: !
630 !Read measurement results, limit test results and statistics.
640 PRINT
650 PRINT "EXAMPLE 2: MEAS, LIMIT, AND STATS RESULTS"
660 OUTPUT Counter;"PROC;SOUR A;LIM ON;STAT ON" !Turn limits and stats on
670 OUTPUT Counter;"PROC;SOUR A;HLIM ";Hi_lim
680 OUTPUT Counter;"PROC;SOUR A;LLIM ";Lo_lim
690 OUTPUT Counter;"NUM;DISP SPLIT" !Display results and stats
700 !
710 TRIGGER Counter
720 GOSUB Read_header !Read block data header
730 RESET @Controller_buf
740 TRANSFER @Counter TO @Controller_buf;COUNT Num_bytes ! Read measurement
750 ! and limit test results.
760 J=1
770 PRINT "High Limit= ";Hi_lim;" "; "Low Limit= ";Lo_lim
780 PRINT
790 PRINT "MEAS # MEAS RESULT LIMIT RESULT"
800 PRINT " " ! =HIGH, 0=PASS, -1=LOW"
810 FOR I=1 TO Sample_size
820 PRINT I, Buff(J)," "; Buff(J+1)!Print measurement number,
830 J=J+2 ! result, and limit test result
840 NEXT I

```

```

850 PRINT
860 PRINT "STATISTICS"
870 PRINT !Print statistical results
880 PRINT "Mean ";Buff((Sample_size*2)+1)
890 PRINT "Std Dev ";Buff((Sample_size*2)+2)
900 PRINT "Maximum ";Buff((Sample_size*2)+3)
910 PRINT "Minimum ";Buff((Sample_size*2)+4)
920 PRINT "Variance ";Buff((Sample_size*2)+5)
930 PRINT "Root Allan Variance ";Buff((Sample_size*2)+6)
940 PRINT "RMS ";Buff((Sample_size*2)+7)
950 PRINT "Allan Variance ";Buff((Sample_size*2)+8)
960 RETURN
970 !=====
980 Example_3: !
990 !Read measurement results and gate data.
1000 PRINT
1010 PRINT "EXAMPLE 3: MEASUREMENT AND EVENT RESULTS FOR CHANNELS A AND B"
1020 !
1030 OUTPUT Counter;"PROC;SOUR A;LIM OFF;STAT OFF" !Turn limits, stats off
1040 OUTPUT Counter;"NUM;DISP NUM;EXP ON" !Expanded data on
1050 !
1060 TRIGGER Counter
1070 GOSUB Read_header !Read block data header
1080 !
1090 !*** NOTE: FOR TI AND +/-TI, THERE IS NO EVENT DATA FOR LAST MEASUREMENT,
1100 !*** SINCE EVENT DATA NEEDS TWO 'ENDPOINTS' FOR EACH MEASUREMENT.
1110 !
1120 RESET @Controller_buf
1130 TRANSFER @Counter TO @Controller_buf;COUNT Num_bytes ! Read measurement
1140 ! and gate results
1150 PRINT
1160 PRINT "Meas # Meas Result Event A Event B"
1170 J=1
1180 FOR I=1 TO Sample_size-1 !Read measurement and gate results
1190 Meas_a(I)=Buff(J)
1200 Event_a(I)=Buff(J+1)
1210 Event_b(I)=Buff(J+2)
1220 PRINT I," ",Meas_a(I)," ",Event_a(I)," ",Event_b(I)
1230 J=J+3
1240 NEXT I
1250 RETURN
1260 !=====
1270 Read_header: !Read block data header
1280 ENTER Counter USING "#,7A";Header$
1290 Num_bytes=VAL(Header$[3])
1300 PRINT Num_bytes;" BYTES EXPECTED"
1310 RETURN
1320 !=====
1330 End_of_program: !
1340 END

```

Binary Data Output Examples

Below are two program listings that demonstrate the use of the binary measurement format of the HP 5371A. The programs illustrate the setup, capture, transfer, and results of measurements made at the Channel A input of the HP 5371A. Refer to Sections 1 and 2 of this programming manual for detailed explanations of programming commands and data conversion techniques.

BINARY EXAMPLE #1

The first program contains three subroutines. Each subroutine makes a different type of measurement:

Meas_1: 10 Time Interval measurements on Channel A. The measurement is made from the rising edge on Channel A to the next rising edge on Channel A. Binary format 5 (see the Programming Manual, Section 1, Binary Measurement Result Format, for details on format types).

Meas_2: 10 Frequency measurements using Cycle Sampling arming on Channel A. Binary format 2 is used.

Meas_3: 10 Totalize measurements using Edge/Interval arming on Channel A. The interval is one second. Binary format 5 is used.

Meas_1 uses a TRANSFER statement to read the data from the HP 5371A. This is the fastest way to transfer data using an HP 9000 Series 200/300 computer and HP-IB. The two other subroutines use ENTER statements to read the data. ENTER statements are generally slower, but less complex to program and interpret.

A printout of the program results is shown in *Figure G-1*. The signal used for this measurement was a 19 MHz square wave with an amplitude of 1.0 volt peak-to-peak.

```

*****
MEAS 1  TI A -> A  AUTOMATIC ARMING  EXPANDED DATA ON
SAMPLE          TI A -> A          MISSED EVENTS
1              5.26E-8              3
2              5.26E-8              3
3              5.26E-8              3
4              5.26E-8              3
5              5.26E-8              3
6              5.26E-8              3
7              5.26E-8              3
8              5.28E-8              3
9              5.26E-8              3
10             5.26E-8              3
                                     TI MEASUREMENT COMPLETE

```

```

*****
MEAS 2  FREQUENCY A  CYCLE=65536 SAMPLING ARMING
SAMPLE          FREQUENCY          TIME DATA          EVENT1 DATA
1              1.90003815338E+7      .00013105           2490
2              1.90004729142E+7      .000131102          2491
3              1.90009614944E+7      .000131046          2490
4              1.90007627765E+7      .0001311           2491
5              1.90003815338E+7      .00013105           2490
6              1.90007627765E+7      .0001311           2491
7              1.90006715097E+7      .000131048          2490
8              1.90004729142E+7      .000131102          2491
9              1.90003815338E+7      .00013105           2490
10             1.90006715097E+7      .000131048          2490

```

```

*****
MEAS 3 TOTALIZE A, EDGE(A)/INTERVAL=1sec (TAKES APPROX. 10 SECONDS)
SAMPLE          TOTALIZE          GATE TIME
1              1.9000524E+7           1.0000000784
2              1.9000521E+7           .999999999
3              1.9000522E+7           1.000000001
4              1.9000522E+7           .9999999988
5              1.9000522E+7           1.0000000014
6              1.9000522E+7           .9999999988
7              1.9000522E+7           1.000000001
8              1.9000521E+7           .999999999
9              1.9000522E+7           1.0000000012
10             1.9000522E+7           .9999999988

```

```

*****
PROGRAM HALT

```

Figure G-1. Binary Example #1 Measurement Results


```

10  !*****
20  ! FILE: DEMO_5371
30  !
40  ! THIS PROGRAM WILL SET UP A HP5371A TO TRANSFER AND PROCESS BINARY DATA*
50  ! FOR THE FOLLOWING MEASUREMENTS:
60  !
70  !     1.  TI A, AUTOMATIC ARMING, EXPANDED DATA ON
80  !     2.  FREQUENCY A, CYCLE SAMPLING ARMING
90  !     3.  TOTALIZE A, EDGE/INTERVAL ARMING
100 !
110 !
120 ! TO RUN THE DEMO, CONNECT A SINE OR SQUARE WAVE OF APPROXIMATELY 1 VOLT*
130 ! PEAK TO THE CHANNEL A INPUT.  THE FREQUENCY CAN BE UP TO 500 MHz. FOR *
140 ! THE MOST MEANINGFUL RESULTS, USE A FREQUENCY BETWEEN 1 MHz AND 100 MHz*
150 !
160 ! HP-IB ADDRESS OF THE HP5371A SHOULD BE 3
170 !
180 ! THE DEMO RUNS THROUGH ALL THREE EXAMPLES, DISPLAYING RESULTS AS IT
190 ! GOES. FOR MORE INFORMATION ON THE MEASUREMENTS AND RESULTS, CONSULT *
200 ! THE HP5371A OPERATING MANUAL AND THE HP5371A PROGRAMMING MANUAL.
210 !*****
220 ! INITIALIZE VARIABLES
230 !*****
240 OPTION BASE 1
250 PRINT USING "@":
260 Isc=7
270 Full_cntr_addr=703
280 DIM Time_result(1000),Res_time(1001,2),Res_event1(1001,2)
290 DIM Res_event2(1001,2),Interp(1001,2),Event_result1(1000)
300 DIM Event_result2(1000),Time_result2(1000),Tot_stat(1001,2)
310 DIM Input_data(15000)
320 INTEGER Data_buf(28000) BUFFER
330 CLEAR Full_cntr_addr
340 WAIT .01
350
360 RESET 7
370 ASSIGN @Counter TO Isc
380 ASSIGN @Buf TO BUFFER Data_buf(*)
390 Ovf_const=4.294967296E+9
400 GOSUB Meas_1
410 GOSUB Meas_2
420 GOSUB Meas_3
430 GOSUB Label_end
440 !
450 STOP
460 !
470 !*****
480 ! SUBROUTINE MEAS_1 TI A -> A; AUTOMATIC ARMING; EXPANDED DATA ON
490 !*****
500 Meas_1: REM
510 PRINT
520 PRINT "*****"
530 PRINT "MEAS 1 TI A -> A AUTOMATIC ARMING EXPANDED DATA ON"
540 REMOTE Full_cntr_addr
550 OUTPUT Full_cntr_addr;"PRES"
560 OUTPUT Full_cntr_addr;"MEAS;FUNC TINT;SOUR A"
570 OUTPUT Full_cntr_addr;"ARM,AUTO"
580 OUTPUT Full_cntr_addr;"SSIZE 10"
590 OUTPUT Full_cntr_addr;"NUM;EXP,ON"
600 OUTPUT Full_cntr_addr;"INT;OUTP BIN"
610 TRIGGER Full_cntr_addr
620 GOSUB Get_tran_data

```

```

A
630 REM
640 REM PROCESS THE RAW DATA FOR MEASUREMENT 1
650 REM
660 J=1
670 FOR I=1 TO Num_of_bytes/20
680   Res_event1(I,1)=((Data_buf(J)+2^16*(Data_buf(J)<0))+(Data_buf(J+1)<0))
690   Res_event1(I,1)=Res_event1(I,1)*2^16+Data_buf(J+1)
700   Res_time(I,1)=((Data_buf(J+2)+2^16*(Data_buf(J+2)<0))+(Data_buf(J+3)<0)
   )
710   Res_time(I,1)=Res_time(I,1)*2^16+Data_buf(J+3)
720   Interp(I,1)=BINAND(31,SHIFT(Data_buf(J+4),8))
730   Res_event1(I,2)=((Data_buf(J+5)+2^16*(Data_buf(J+5)<0))+(Data_buf(J+6)<
   0))
740   Res_event1(I,2)=Res_event1(I,2)*2^16+Data_buf(J+6)
750   Res_time(I,2)=((Data_buf(J+7)+2^16*(Data_buf(J+7)<0))+(Data_buf(J+8)<0)
   )
760   Res_time(I,2)=Res_time(I,2)*2^16+Data_buf(J+8)
770   Interp(I,2)=BINAND(31,Data_buf(J+9))
780   J=J+10
790 NEXT I
800 REM
810 REM PROCESS ANY OVERFLOWS THAT MAY HAVE OCCURRED DURING THE MEASUREMENTS
820 REM
830   FOR I=1 TO Num_of_bytes/20
840     IF (Res_time(I,2)<Res_time(I,1)) THEN
850       Res_time(I,2)=Res_time(I,2)+Ovf_const
860       FOR J=I+1 TO Num_of_bytes/20
870         Res_time(J,1)=Res_time(J,1)+Ovf_const
880         Res_time(J,2)=Res_time(J,2)+Ovf_const
890       NEXT J
900     END IF
910     IF (Res_event1(I,2)<Res_event1(I,1)) THEN
920       Res_event1(I,2)=Res_event1(I,2)+Ovf_const
930       FOR J=I+1 TO Num_of_bytes/20
940         Res_event1(J,1)=Res_event1(J,1)+Ovf_const
950         Res_event1(J,2)=Res_event1(J,2)+Ovf_const
960       NEXT J
970     END IF
980   NEXT I
990 REM
1000 REM PROCESS ANY OVERFLOWS THAT MAY HAVE OCCURRED BETWEEN MEASUREMENTS
1010 REM
1020   FOR I=2 TO Num_of_bytes/20
1030     IF (Res_time(I,1)<Res_time(I-1,1)) THEN
1040       FOR J=I TO Num_of_bytes/20
1050         Res_time(J,1)=Res_time(J,1)+Ovf_const
1060       NEXT J
1070     END IF
1080     IF (Res_time(I,2)<Res_time(I-1,2)) THEN
1090       FOR J=I TO Num_of_bytes/20
1100         Res_time(J,2)=Res_time(J,2)+Ovf_const
1110       NEXT J
1120     END IF
1130     IF (Res_event1(I,1)<Res_event1(I-1,1)) THEN
1140       FOR J=I TO Num_of_bytes/20
1150         Res_event1(J,1)=Res_event1(J,1)+Ovf_const
1160       NEXT J
1170     END IF
1180     IF (Res_event1(I,2)<Res_event1(I-1,2)) THEN
1190       FOR J=I TO Num_of_bytes/20
1200         Res_event1(J,2)=Res_event1(J,2)+Ovf_const
1210       NEXT J

```

```

1220     END IF
1230     NEXT I
1240     REM
1250     REM CALCULATE THE RESULTS OF MEASUREMENT 1
1260     REM
1270     PRINT "SAMPLE          TI A -> A          MISSED EVENTS"
1280     Offset=6.00E-10 ! OFFSET FOR A->A;SEPARATE MODE;NO ATTENUATION
1290     FOR I=1 TO Num_of_bytes/20
1300         Time_result(I)=((Res_time(I,2)-Res_time(I,1))*2.E-9)
1310         Time_result(I)=Time_result(I)-((Interp(I,2)-Interp(I,1))*1.E-10)
1320         Time_result(I)=Time_result(I)+Offset
1330         IF (I<Num_of_bytes/20) THEN
1340             Event_result1(I)=Res_event1(I+1,1)-Res_event1(I,2)-1.0E+0
1350             PRINT I,TAB(20),Time_result(I),TAB(45),Event_result1(I)
1360         ELSE
1370             PRINT I,TAB(20),Time_result(I),TAB(45),"TI MEASUREMENT COMPLETE"
1380         END IF
1390     NEXT I
1400     RETURN
1410     !*****
1420     ! SUBROUTINE MEAS_2    FREQUENCY A, CYCLE SAMPLING ARMING          *
1430     !*****
1440     Meas_2: REM
1450     PRINT
1460     PRINT "*****
*****"
1470     PRINT "MEAS 2    FREQUENCY A    CYCLE=65536 SAMPLING ARMING"
1480     REMOTE Full_cntr_addr
1490     OUTPUT Full_cntr_addr;"PRES"          ! SET THE 5371A IN A KNOWN STATE
1500     OUTPUT Full_cntr_addr;"MEAS;FUNC FREQ;SOUR A" ! SET FREQUENCY A
1510     OUTPUT Full_cntr_addr;"ARM,CSAM"      ! SET CYCLE SAMPLING ARMING
1520     OUTPUT Full_cntr_addr;"SAMP;DCH,OSC"   ! SET CYCLE CHANNEL TO OSCILLATOR
1530     OUTPUT Full_cntr_addr;"SAMP;DEL,40000" ! SET DELAY TO 40000 EVENTS
1540     ! THIS WILL BE ROUNDED TO 65536
1550     OUTPUT Full_cntr_addr;"SSIZE 10"      ! SET SAMPLE SIZE TO 10
1560     OUTPUT Full_cntr_addr;"INT;OUTP BIN"  ! OUTPUT IN BINARY MODE
1570     TRIGGER Full_cntr_addr                ! START MEASUREMENT
1580     GOSUB Get_dump_data                    ! GET RAW MEASUREMENT DATA
1590     REM
1600     REM PROCESS THE RAW DATA FOR MEASUREMENT 2
1610     REM
1620     J=1
1630     FOR I=1 TO Num_of_bytes/10
1640         Res_event1(I,1)=Input_data(J)*65536+Input_data(J+1) !EVNT DATA FROM RA
M
1650         Res_time(I,1)=Input_data(J+2)*65536+Input_data(J+3) !TIME DATA FROM RA
M
1660         Interp(I,1)=BINAND(31,Input_data(J+4))              !INRP DATA FROM RA
M
1670         J=J+5
1680     NEXT I
1690     REM
1700     REM PROCESS ANY OVERFLOWS THAT MAY HAVE OCCURRED
1710     REM
1720     FOR I=2 TO Num_of_bytes/10
1730         IF (Res_time(I,1)<Res_time(I-1,1)) THEN
1740             FOR J=I TO Num_of_bytes/10
1750                 Res_time(J,1)=Res_time(J,1)+Ovf_const
1760             NEXT J
1770         END IF
1780         IF (Res_event1(I,1)<Res_event1(I-1,1)) THEN
1790             FOR J=I TO Num_of_bytes/10
1800                 Res_event1(J,1)=Res_event1(J,1)+Ovf_const
1810             NEXT J

```

```

1820     END IF
1830     NEXT I
1840     PRINT "SAMPLE          FREQUENCY          TIME DATA          EVENT1 D
ATA"
1850     FOR I=1 TO Num_of_bytes/10-1
1860         Time_result(I)=((Res_time(I+1,1)-Res_time(I,1))*2.E-9)
1870         Time_result(I)=Time_result(I)-((Interp(I+1,1)-Interp(I,1))*1.E-10)
1880         Event_result1(I)=Res_event1(I+1,1)-Res_event1(I,1)
1890         PRINT I,TAB(12),Event_result1(I)/Time_result(I),TAB(40),Time_result(I)
,TAB(61),Event_result1(I)
1900     NEXT I
1910     RETURN
1920     !*****
1930     ! SUBROUTINE MEAS_3  TOTALIZE A,  EDGE/INTERVAL  ARMING          *
1940     !*****
1950     Meas_3:  REM
1960     PRINT
1970     PRINT "*****
*****"
1980     PRINT "MEAS 3  TOTALIZE A,  EDGE(A)/INTERVAL=1sec  (TAKES APPROX.  10 SECOND
S)"
1990     REMOTE Full_cntr_addr
2000     OUTPUT Full_cntr_addr;"PRES"          ! PUT 5371A IN A KNOWN STATE
2010     OUTPUT Full_cntr_addr;"MEAS;FUNC TOT;SOUR A"  ! SET TOTALIZE A
2020     OUTPUT Full_cntr_addr;"ARM,EDIN"          ! SET EDGE/INTERVAL ARMING
2030     OUTPUT Full_cntr_addr;"SSIZE 10"         ! SET SAMPLE SIZE TO 10
2040     OUTPUT Full_cntr_addr;"STAR;CHAN,A"      ! SET START CHANNEL TO A
2050     OUTPUT Full_cntr_addr;"SAMP;DEL,1E0"     ! SET SAMPLE INTERVAL TO 1 SECOND
2060     OUTPUT Full_cntr_addr;"INT;OUTP BIN"     ! OUTPUT IN BINARY MODE
2070     J=1
2080     TRIGGER Full_cntr_addr          ! START MEASUREMENT
2090     GOSUB Get_dump_data             ! GET RAW MEASUREMENT DATA
2100     REM
2110     REM PROCESS THE RAW DATA FOR MEASUREMENT 3
2120     REM
2130     FOR I=1 TO Num_of_bytes/20
2140         Res_event1(I,1)=Input_data(J)*65536+Input_data(J+1) ! FIRST READ EVNT
2150         Res_time(I,1)=Input_data(J+2)*65536+Input_data(J+3) ! FIRST READ TIME
2160         Res_event1(I,2)=Input_data(J+5)*65536+Input_data(J+6) ! 2ND READ EVNT
2170         Res_time(I,2)=Input_data(J+7)*65536+Input_data(J+8)  ! 2ND READ TIME
2180         Tot_stat(I,1)=Input_data(J+9)          ! INTERPOLATOR STATUS
2190         Interp(I,2)=BINAND(31,Input_data(J+9)) ! INTERPOLATOR DATA
2200         J=J+10
2210     NEXT I
2220     FOR I=1 TO Num_of_bytes/20
2230         IF (BINAND(8192,Tot_stat(I,1))<>0) THEN ! DETERMINE WHICH READ IS VALI
D
2240             Res_time(I,1)=Res_time(I,2)          ! STORE CORRECT TIME DATA
2250             Res_event1(I,1)=Res_event1(I,2)     ! STORE CORRECT EVNT DATA
2260         END IF
2270     NEXT I
2280     REM
2290     REM PROCESS ANY OVERFLOWS THAT MAY HAVE OCCURRED
2300     REM
2310     FOR I=2 TO Num_of_bytes/20
2320         IF (Res_time(I,1)<Res_time(I-1,1)) THEN
2330             FOR J=I TO Num_of_bytes/20
2340                 Res_time(J,1)=Res_time(J,1)+Ovf_const
2350             NEXT J
2360         END IF
2370         IF (Res_event1(I,1)<Res_event1(I-1,1)) THEN
2380             FOR J=I TO Num_of_bytes/20
2390                 Res_event1(J,1)=Res_event1(J,1)+Ovf_const
2400             NEXT J

```

```

2410     END IF
2420 NEXT I
2430 PRINT "SAMPLE          TOTALIZE          GATE TIME"
2440 FOR I=1 TO Num_of_bytes/20-1
2450     Event_result1(I)=Res_event1(I+1,1)-Res_event1(I,1)
2460     Time_result(I)=((Res_time(I+1,1)-Res_time(I,1))*2.E-9)
2470     Time_result(I)=Time_result(I)-((Interp(I+1,2)-Interp(I,2))*1.E-10)
2480     PRINT I,TAB(15),Event_result1(I),TAB(40),Time_result(I)
2490 NEXT I
2500 RETURN
2510 !*****
2520 ! SUBROUTINE GET_DUMP_DATA *
2530 !*****
2540 Get_dump_data:REM GET THE DUMP MODE DATA
2550 ENTER Full_cntr_addr USING "#,A";Character$
2560 IF Character$<>"#" THEN
2570     BEEP
2580     DISP "BAD FIRST CHARACTER."
2590     PRINT CHR$(128)
2600     CONTROL 1,5;139
2610     STOP
2620 END IF
2630 ENTER Full_cntr_addr USING "#,A";Character$
2640 IF Character$<>"6" THEN
2650     BEEP
2660     DISP "BAD SECOND CHARACTER."
2670     PRINT CHR$(128)
2680     CONTROL 1,5;139
2690     STOP
2700 END IF
2710 ENTER Full_cntr_addr USING "#,6A";A$
2720 Num_of_bytes=VAL(A$)
2730 Number_of_bytes=Num_of_bytes
2740 FOR I=1 TO (Num_of_bytes/2)
2750 ! CAN'T USE #,W BECAUSE IT WILL ENTER A SIGNED NUMBER
2760     ENTER Full_cntr_addr USING "#,B";Input_data(I)
2770     ENTER Full_cntr_addr USING "#,B";Temp_byte
2780     Input_data(I)=Input_data(I)*256+Temp_byte
2790 NEXT I
2800 RETURN
2810 !*****
2820 ! SUBROUTINE GET_TRAN_DATA *
2830 !*****
2840 Get_tran_data:REM GET THE DUMP MODE DATA USING A TRANSFER STATEMENT
2850 ENTER Full_cntr_addr USING "#,A";Character$
2860 IF Character$<>"#" THEN
2870     BEEP
2880     DISP "BAD FIRST CHARACTER."
2890     PRINT CHR$(128)
2900     CONTROL 1,5;139
2910     STOP
2920 END IF
2930 ENTER Full_cntr_addr USING "#,A";Character$
2940 IF Character$<>"6" THEN
2950     BEEP
2960     DISP "BAD SECOND CHARACTER."
2970     PRINT CHR$(128)
2980     CONTROL 1,5;139
2990     STOP
3000 END IF
3010 ENTER Full_cntr_addr USING "#,6A";A$
3020 Num_of_bytes=VAL(A$)
3030 TRANSFER @Counter TO @Buf;END, WAIT
3040 RETURN

```

```

3050 !*****
3060 ! SUBROUTINE LABEL_END *
3070 !*****
3080 Label_end:REM
3090 PRINT
3100 PRINT "*****"
*****
3110 PRINT
3120 PRINT "PROGRAM HALT"
3130 RETURN
3140 END

```

BINARY EXAMPLE #2

This second binary output program is an example of using the binary format to make a single block of 4095 measurements. Unless the binary format is used, a maximum of 1000 measurements can be made in one block.

The following program makes frequency measurements and then displays a graph of the frequency vs. time results on the controller CRT (see *Figure G-2* for an example of the graphic display). The signal used for this measurement example was a 19 MHz input signal. A one millisecond gate time (sample interval) was selected.

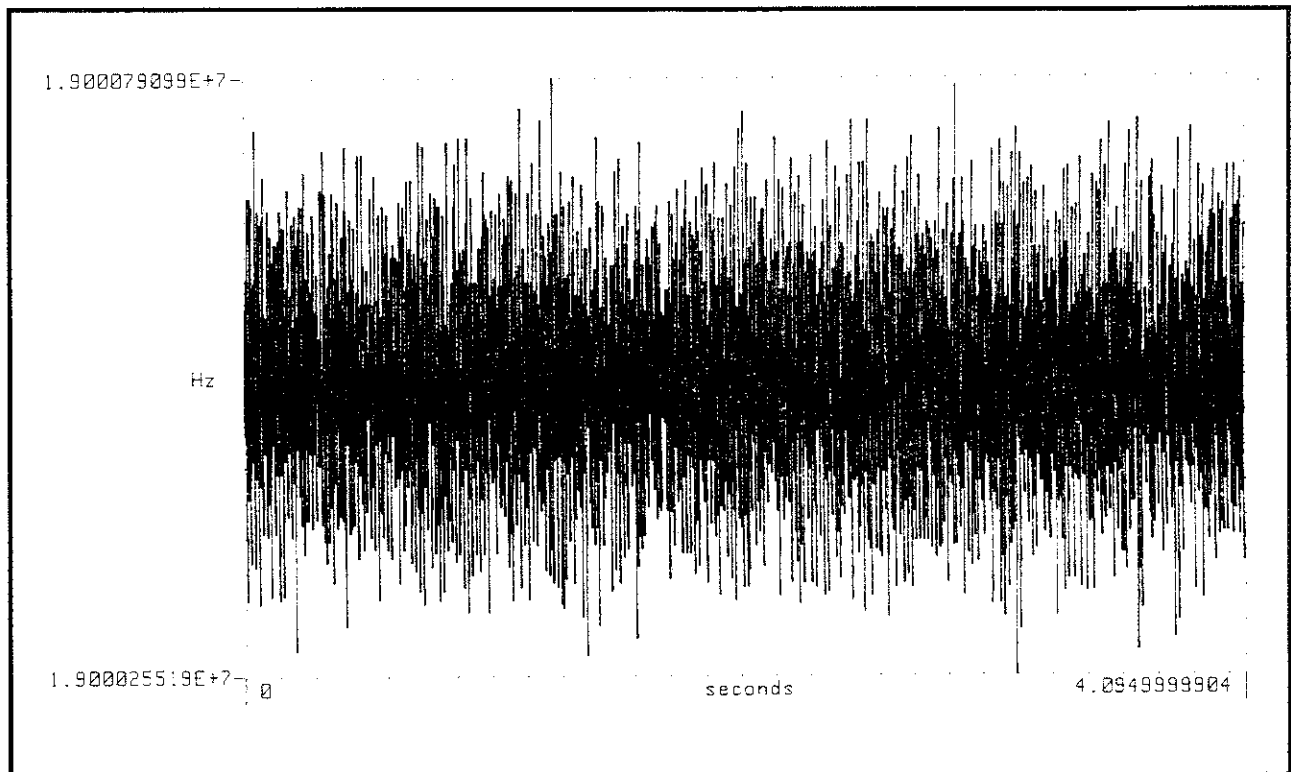


Figure G-2. Binary Example #2 Graphic Display

Here is the sequence that the program follows:

- The program is started using the RUN command.
- The user is prompted for a Gate Time. If "0" is entered, the HP 5371A will use Automatic arming and make measurements as quickly as possible. If other than "0" is used, for example "100E-6" is entered, then the HP 5371A will use Interval Sampling arming with a sample interval of 100 microseconds.
- The controller programs the HP 5371A.
- The user is prompted to press <RETURN> to start the measurement when ready.
- Data is collected by the HP 5371A, sent to the controller, and the frequency results are calculated.
- A graph is displayed. The X-axis is the total measurement time. The Y-axis is scaled from the minimum frequency to the maximum frequency measured.

```

10  INTEGER Buff(1:4096,1:5) BUFFER,Block_size
20  REAL Freq(1:4095),Time(1:4095)
30  COM /Constants/ Format_bytes,Two_exp16,Two_exp32
40  Block_size=4095 ! As an input parameter, this specifies the number of
50                  ! MEASUREMENTS requested. As an output parameter, it
60                  ! Specifies the number of time stamps returned
70                  ! (usually MEASUREMENTS+1, unless system was aborted).
80                  !
90  Two_exp16=2^16 ! SET UP CONSTANTS
100 Two_exp32=2^32
110 Format_bytes=10 ! EVENTS (4 BYTES), TIME (4 BYTES), INTERP (2 BYTES)
120                  !
130 Gate_time=0
140 OUTPUT KBD;Gate_time;CHR$(255)&"H";
150 INPUT "ENTER GATE TIME. (0 FOR AUTOMATIC ARMING)",Gate_time
160 Transfer_data(Gate_time,Block_size,Buff(*))
170 Convert_bin71(Block_size,Buff(*),Time(*),Freq(*))
180 Plot_data(Time(*),Freq(*))
190 END
200 SUB Transfer_data(Gate_time,INTEGER Block_size,Data_buff(*) BUFFER)
210 Transfer_data:! Sets up and transfers a block of data from the HP5371A.
220   DISP "Setting up measurement."
230   Format_bytes=10
240   ASSIGN @Hp5371a TO 703
250   OUTPUT @Hp5371a;"PRES"           ! PRESET
260   OUTPUT @Hp5371a;"REM"           ! REMOTE
270   OUTPUT @Hp5371a;"MEN,INF"       ! STATE MENU
280   OUTPUT @Hp5371a;"SMODE,SING"    ! SINGLE MEASUREMENT MODE
290   OUTPUT @Hp5371a;"INP;MOD,COM"    ! COMMON INPUTS
300   OUTPUT @Hp5371a;"INT;OUTP,BIN"  ! BINARY OUTPUT
310   OUTPUT @Hp5371a;"MEAS;FUNC,FREQ"! FREQUENCY
320   OUTPUT @Hp5371a;"MSIZE,"&VAL$(Block_size)
330   IF Gate_time THEN
340     OUTPUT @Hp5371a;"ARM,ISAM"     ! INTERVAL SAMPLING
350     OUTPUT @Hp5371a;"SAMP;DEL,"&VAL$(Gate_time)! DELAY GATE TIME
360   END IF
370   INPUT "Press <RETURN> to RE-START measurement.",A$
380   OUTPUT @Hp5371a;"REST"          ! START MEASUREMENT
390   ASSIGN @Buff TO BUFFER Data_buff(*)
400   DISP "Waiting for completion of measurement."
410   ENTER @Hp5371a USING "#,8A";Header$
420   Block_size=VAL(Header$[3]) DIV Format_bytes
430   Tot_byte_count=Format_bytes*Block_size
440   TRANSFER @Hp5371a TO @Buff;COUNT Tot_byte_count,WAIT
480   OUTPUT @Hp5371a;"LOC"          ! PUT IN LOCAL
490   DISP

```

```

500 SUBEND ! Transfer_data
510 !
520 !
530 SUB Convert_bin71(INTEGER Block_size, Buff(*) BUFFER, REAL Time(*), Freq(*))
540 Convert_bin71!! Converts binary 5371A data to Frequency and Time arrays.
550 COM /Constants/ Format_bytes, Two_exp16, Two_exp32
560 INTEGER I, Format_words
570 REAL Time0, Time1, Event0, Event1, Time_ovfl, Time0_offset
580 !
590 ! Time0 is the previous 32-bit unsigned integer time count.
600 ! Event0 is the " " " " event count.
610 ! Time1 is the current " " " " time count.
620 ! Event1 is the " " " " event count.
630 ! Format_words is the number of 16-bit words used for each measurement.
640 ! Time_ovfl increments by 2^32 every time the time counters overflow.
650 ! It essentially adds more bits to the time counter.
660 ! This measurement does not need to keep track of cumulative
670 ! event overflows, only relative ones.
680 ! Time0_offset is the value of the time counter at time t=0. It is
690 ! subtracted from every time value.
700 ! Event0 is the previous
710 !
720 Format_words=Format_bytes DIV 2 ! FORMAT IN 16 BIT WORDS
730 Time_ovfl=0
740 !
750 ! REDIMENSION ARRAYS TO ALLOW FOR CONVENIENT INDEXING.
760 REDIM Buff(0:Block_size-1, 1:Format_words), Time(1:Block_size-1), Freq(1:Block_size-1)
770 GOSUB Disp_update
780 !
790 ! GET FIRST EVENT AND TIME VALUES. THESE ARE ASSOCIATED WITH TIME=0.
800 Event0=FNGet_4byte_val(0, 1, Buff(*))
810 Time0=FNGet_4byte_val(0, 3, Buff(*))
820 Time0_offset=Time0*2.E-9-Buff(0, 5) MOD 32*1.E-10
830 !
840 ! GET FIRST MEASUREMENT. THIS IS OUTSIDE THE LOOP TO AVOID INDEXING
850 ! BEFORE THE FIRST MEASUREMENT.
860 Event1=FNGet_4byte_val(1, 1, Buff(*))
870 Time1=FNGet_4byte_val(1, 3, Buff(*))
880 IF Event1<Event0 THEN Event1=Event1+Two_exp32 ! Overflow occurred.
890 IF Time1<Time0 THEN Time_ovfl=Time_ovfl+Two_exp32 ! " "
900 Time(1)=(Time1+Time_ovfl)*2.E-9-Buff(1, 5) MOD 32*1.E-10-Time0_offset
910 Freq(1)=(Event1-Event0)/Time(1)
920 Event0=Event1
930 Time0=Time1
940 IF VAL(SYSTEM$( "VERSION:CLOCK" )) THEN ON CYCLE 1 GOSUB Disp_update ! Do
this only if CLOCK binary is loaded.
950 FOR I=2 TO Block_size-1
960 Event1=FNGet_4byte_val(I, 1, Buff(*))
970 Time1=FNGet_4byte_val(I, 3, Buff(*))
980 IF Event1<Event0 THEN Event1=Event1+Two_exp32 ! Overflow
990 IF Time1<Time0 THEN Time_ovfl=Time_ovfl+Two_exp32 ! "
1000 Time(I)=(Time1+Time_ovfl)*2.E-9-Buff(I, 5) MOD 32*1.E-10-Time0_offset
1010 Freq(I)=(Event1-Event0)/(Time(I)-Time(I-1))
1020 Event0=Event1
1030 Time0=Time1
1040 NEXT I
1050 REDIM Buff(1:Block_size, 1:Format_words), Time(1:Block_size-1), Freq(1:Block_size-1)
1060 OFF CYCLE
1070 SUBEXIT
1080 Disp_update: DISP "Converting binary data. "; I; " of "; Block_size; " completed."
1090 RETURN
1100 SUBEND ! Convert_bin71
1110 !

```



```

1120 DEF FNGet_4byte_val(INTEGER Index1,Index2,Buff(*) BUFFER)
1130 Get_4byte_val:!! Converts two BASIC INTEGER types into an unsigned 32 bit n
umber.
1140   COM /Constants/ Format bytes,Two_expl6,Two_exp32
1150   RETURN (Buff(Index1,Index2)+(Buff(Index1,Index2)<0)*Two_expl6+(Buff(Ind
ex1,Index2+1)<0))*Two_expl6+Buff(Index1,Index2+1)
1160 FNEND ! Get_4byte_val
1170 !
1180 !
1190 SUB Plot_data(Time(*),Freq(*))
1200 Plot_data:!! Plots Frequency vs. Time
1210   INTEGER I
1220   OUTPUT KBD;CHR$(255)&"K";! Clear ALPHA screen
1230   GINIT
1240   GCLEAR
1250   GRAPHICS ON
1260   VIEWPORT 25,100*RATIO,30,98
1270   CSIZE 3,.5
1280   PEN 7
1290   LINE TYPE 3
1300   FRAME
1310   LINE TYPE 1
1320   CLIP OFF
1330   Min_freq=MIN(Freq(*))
1340   Max_freq=MAX(Freq(*))
1350   IF Max_freq=Min_freq THEN
1360     Max_freq=Max_freq+1.E-5*ABS(Max_freq)
1370     Min_freq=Min_freq-1.E-5*ABS(Min_freq)
1380   END IF
1390   WINDOW 0,1,0,1
1400   MOVE 0,1
1410   LOG 8
1420   LABEL VAL$(DROUND(Max_freq,10))&"-"
1430   MOVE 0,.5
1440   LABEL "Hz  "
1450   MOVE 0,0
1460   LABEL VAL$(DROUND(Min_freq,10))&"-"
1470   MOVE 0,0
1480   LOG 6
1490   LABEL "| "
1500   MOVE 0,0
1510   LOG 3
1520   LABEL 0
1530   MOVE .5,0
1540   LOG 6
1550   LABEL "seconds"
1560   MOVE 1,0
1570   LABEL "| "
1580   MOVE 1,0
1590   LOG 9
1600   LABEL PROUND(Time(SIZE(Time,1)),-12)
1610   CLIP ON
1620   PENUP
1630   PEN 3
1640   WINDOW 0,Time(SIZE(Time,1)),Min_freq,Max_freq
1650   PLOT 0,Freq(1)
1660   FOR I=1 TO SIZE(Time,1)-1
1670     PLOT Time(I),Freq(I)
1680     PLOT Time(I),Freq(I+1)
1690   NEXT I
1700   PLOT Time(I),Freq(I)
1710 SUBEND

```

PROGRAM CONVERSION (EARLIER 5371As)

INTRODUCTION

This appendix lists conversions for Graphics subsystem commands for an HP 5371A with firmware having revision number 2828 or below to commands that can be used with the firmware described in this manual. Some entries may also include additional comments.

Commands for the earlier HP 5371As are listed in the same general order as they were given in the “Graphics Subsystem Commands” portion of Section 2 of the HP 5371A Programming Manual.

Table H-1. Graphics Subsystem Command Conversions for Firmware Upgrade.

Old Command	New Command
CHANnel A CHANnel B CHANnel?	VCHannel A VCHannel B VCHannel?
DELTA ON DELTA OFF	MDMode DELTa MDMode MARKer MODulation STATistics
DISPlay ON DISPlay OFF DISPlay?	SGRaph MAIN MEMory BOTH No equivalent. SGRaph? Possible Responses are: MAIN, MEM, BOTH.
ETIME Sublevel: AEVents? BEVents? EVENTs ON OFF EVENTs?	EVT1? EVT2? NOTE: Old and new commands are not equivalent. Channel 1 is not always Chan A. EVT1? EVT2? Old and new commands are not equivalent. Channel B is not always Channel 2. No equivalent. Event data is always displayed if in MDMode MARKer or Delta. No equivalent.

Table H-1. Graphics Subsystem Command Conversions for Firmware Upgrade. (Continued)

Old Command	New Command
<p>XAUToscale ON OFF</p> <p>XMAXimum <value_arg></p> <p>XMINimum <value_arg></p>	<p>XMSCale OFF ON</p> <p>Note the reversal of ON/OFF logic between the old and new commands.</p> <p>XMSCale ON; XMAXimum <number_arg></p> <p>NOTE: Manual scaling must be on when XMAXimum number is sent to HP 5371A, in order for XMAXimum to be accepted.</p> <p>XMSCale ON; XMINimum <number_arg></p> <p>NOTE: Manual scaling must be on when XMINimum number is sent to HP 5371A, in order for XMINimum to be accepted.</p>
<p>HISTogram Sublevel:</p> <p>BINS <bins_arg></p> <p>XMAXimum <value_arg> XMAXimum?</p> <p>XMINimum <value_arg></p> <p>YAUToscale ON OFF</p> <p>YAUToscale?</p>	<p>No exact equivalent. Substitute the combination of commands below.</p> <p>XMSCale ON XMINimum <number_arg> BWIDth <number_arg></p> <p>NOTE: Manual scaling must be on when XMINimum or BWIDth number is sent to HP 5371A, in order for XMINimum or BWIDth to be accepted.</p> <p>No exact equivalent. Substitute the combination of commands below.</p> <p>XMSCale ON XMINimum <number_arg> BWIDth <number_arg></p> <p>NOTE: Manual scaling must be on when XMINimum or BWIDth number is sent to HP 5371A, in order for XMINimum or BWIDth to be accepted.</p> <p>XMSCale ON; XMINimum <number_arg></p> <p>NOTE: Manual scaling must be on when XMINimum number is sent to HP 5371A, in order for XMINimum to be accepted.</p> <p>YMSCale OFF ON</p> <p>Note the reversal of ON/OFF logic between the old and new commands.</p> <p>YMSCale?</p>
<p>LIMit ON OFF</p> <p>LIMit?</p>	<p>No equivalent. Limit lines are displayed whenever they are enabled via the MATH menu.</p> <p>No equivalent.</p>

Table H-1. Graphics Subsystem Command Conversions for Firmware Upgrade. (Continued)

Old Command	New Command
MARKer X O MARKer? CENTer LEFT <amount_arg> RIGHT <amount_arg>	SMARker BLACK WHITE SMARker? No equivalent. MLEft <number_arg> MRIGHt <number_arg>
MEMory ON OFF MEMory?	SGRaph MEMory BOTH MAIN SGRaph? Possible responses are: MEM, BOTH, MAIN.
REScale	ZOOM FULL
SCRoll LEFT RIGHT	SSCRoll LEFT RIGHT
STATistics MINimum? MAXimum? MEAN? SDEViation?	MDModeSTATistics HMINimum? HMAXimum? HMEan? HSDeviation?
TVARiation Sublevel: AEVents? BEVents? EVENTs ON OFF EVENTs? XAUToscale ON OFF XMAXimum <value_arg>	EVT1? EVT2? NOTE: Old and new commands are not equivalent. Channel 1 is not always Chan A. EVT1? EVT2? Old and new commands are not equivalent. Channel B is not always Channel 2. No equivalent. Event data is always displayed if in MDMode MARKer or Delta. No equivalent. XMSCale OFF ON Note the reversal of ON/OFF logic between the old and new commands. XMSCale ON; XMAXimum <number_arg>

Table H-1. Graphics Subsystem Command Conversions for Firmware Upgrade. (Continued)

Old Command	New Command
<p>XMINimum <value_arg></p> <p>YAUToscale ON OFF</p> <p>YAUToscale?</p> <p>YMAXimum <value_arg></p> <p>YMINimum <value_arg></p>	<p>NOTE: Manual scaling must be on when XMAXimum number is sent to HP 5371A, in order for XMAXimum to be accepted.</p> <p>XMSCale ON; XMINimum <number_arg></p> <p>NOTE: Manual scaling must be on when XMINimum number is sent to HP 5371A, in order for XMINimum to be accepted.</p> <p>YMSCale OFF ON</p> <p>Note the reversal of ON/OFF logic between the old and new commands.</p> <p>YMSCale?</p> <p>YMSCale ON; YMAXimum <number_arg></p> <p>NOTE: Manual scaling must be on when YMAXimum number is sent to HP 5371A, in order for YMAXimum to be accepted.</p> <p>YMSCale ON; YMINimum <number_arg></p> <p>NOTE: Manual scaling must be on when YMINimum number is sent to HP 5371A, in order for YMINimum to be accepted.</p>
<p>UPDate FINAl BETween OFF</p> <p>UPDate?</p>	<p>UPDate AFTer WHILe</p> <p>UPDate?</p>
<p>VAUToscale</p>	<p>No equivalent.</p>
<p>XDELTA?</p>	<p>No exact equivalent. Substitute the combination of commands below.</p> <p>MDMode DELTA; XVAL?</p>
<p>YDELTA?</p>	<p>No exact equivalent. Substitute the combination of commands below.</p> <p>MDMode DELTA; YVAL?</p>
<p>XMARKer?</p>	<p>No exact equivalent. Substitute the combination of commands below.</p> <p>MDMode MARKer; XVAL?</p>
<p>YMARKer?</p>	<p>No exact equivalent. Substitute the combination of commands below.</p> <p>MDMode MARKer; YVAL?</p>

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