MS4661A/E, MS4662A
Network Analyzer
Operation Manual
Vol.2

GPIB Remote Control

Fourth Edition

Read this manual before using the equipment.
Keep this manual with the equipment.

Measuring Instruments Division
Measurement Group

ANRITSU CORPORATION

MAR.
1997

Document No.: M-W0998AE-4.0

Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Insure that you clearly understand the meanings of the symbols BEFORE using the equipment.

Symbols used in manual

DANGER	This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.
WARNING	This indicates a hazardous procedure that could result in serious injury or death if not performed properly.
CAUTION	This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manual

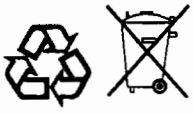
(Some or all of the following five symbols may not be used on all Anritsu equipment. In addition, there may be other labels attached to products which are not shown in the diagrams in this manual.) The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Insure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE using the equipment.

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

This indicates an obligatory safety precaution. The obligatory operation is indicated symbolically in or near the circle.

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

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



These indicate that the marked part should be recycled.

MS4661A/E, MS4662A Network Analyzer
Operation Manual Vol.2 GPIB Remote Control

September 1995 (First Edition)
February 1997 (Fourth Edition)

Printed in japan

For Safety

WARNING

1. Always refer to the operation manual when working near locations at which the alert mark shown on the left is attached. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced.
   Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.
2. When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, before supplying power to the equipment, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Repair

WARNING ⚠

3. This equipment cannot be repaired by the user. DO NOT attempt to open the cabinet or to disassemble internal parts. Only Anritsu-trained service personnel or staff from your sales representative with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision parts.

Falling Over

4. This equipment should be used in the correct position. If the cabinet is turned on its side, etc., it will be unstable and may be damaged if it falls over as a result of receiving a slight mechanical shock.

Battery Fluid

5. DO NOT short the battery terminals and never attempt to disassemble it or dispose of it in a fire. If the battery is damaged by any of these actions, the battery fluid may leak. This fluid is poisonous.
   DO NOT touch it, ingest it, or get in your eyes. If it is accidentally ingested, spit it out immediately, rinse your mouth with water and seek medical help. If it enters your eyes accidentally, do not rub your eyes, irrigate them with clean running water and seek medical help. If the liquid gets on your skin or clothes, wash it off carefully and thoroughly.

For Safety

WARNING

LCD

6. This instrument uses a Liquid Crystal Display (LCD); DO NOT subject the instrument to excessive force or drop it. If the LCD is subjected to strong mechanical shock, it may break and liquid may leak.
   This liquid is very caustic and poisonous.
   DO NOT touch it, ingest it, or get in your eyes. If it is ingested accidentally, spit it out immediately, rinse your mouth with water and seek medical help. If it enters your eyes accidentally, do not rub your eyes, irrigate them with clean running water and seek medical help. If the liquid gets on your skin or clothes, wash it off carefully and thoroughly.

CAUTION

Changing Fuse

CAUTION ⚠

1. Before changing the fuses, ALWAYS remove the power cord from the poweroutlet and replace the blown fuses. Always use new fuses of the type and rating specified on the fuse marking on the rear panel of the cabinet.

   T 6.3A indicates a time-lag fuse.

   There is risk of receiving a fatal electric shock if the fuses are replaced with the power cord connected.

2. Keep the power supply and cooling fan free of dust.

   Cleaning

   - Clean the power inlet regularly. If dust accumulates around the power pins, there is a risk of fire.
   - Keep the cooling fan clean so that the ventilation holes are not obstructed. If the ventilation is obstructed, the cabinet may overheat and catch fire.

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

Check Terminal

4. Never input a signal of more than + 26 dBm RF ± 7 V DC MAX (MS4661A/E), + 24 dBm RF ± 40 V DC MAX (MS4662A). Input of an excessive signal may damage the equipment.

Equipment Certificate

Anritsu Corporation certifies that this equipment was tested before shipment using calibrated measuring instruments with direct traceability to public testing organizations recognized by national research laboratories including the Electrotechnical Laboratory, the National Research Laboratory and the Communication Research laboratory, and was found to meet the published specifications.

Anritsu Warranty

Anritsu Corporation will repair this equipment free-of-charge if a malfunction occurs within 1 year after shipment due to a manufacturing fault, provided that this warranty is rendered void under any or all of the following conditions.

- The fault is outside the scope of the warranty conditions described in the operation manual.
- The fault is due to misoperation, misuse, or unauthorized modification or repair of the equipment by the customer.
- The fault is due to severe usage clearly exceeding normal usage.
- The fault is due to improper or insufficient maintenance by the customer.
- The fault is due to natural disaster including fire, flooding and earthquake, etc.
- The fault is due to use of non-specified peripheral equipment, peripheral parts, consumables, etc.
- The fault is due to use of a non-specified power supply or in a non-specified installation location.

In addition, this warranty is valid only for the original equipment purchaser. It is not transferable if the equipment is resold.

Anritsu Corporation will not accept liability for equipment faults due to unforeseen and unusual circumstances, nor for faults due to mishandling by the customer.

Anritsu Corporation Contact

If this equipment develops a fault, contact the head office of Anritsu Corporation at the address in the operation manual, or your nearest sales or service office listed on the following pages.

'IBM' is a registered trademark of the IBM Corporation.
'HP' is a registered trademark of the Hewlett-Packard Company.
'MS-DOS' is a registered trademark of the Microsoft Corporation.
'NEC' is a registered trademark of the NEC Corporation.

Replacing the Memory Backup Battery

This unit uses a graphite fluoride lithium battery as a memory backup battery. It is replaceable only by our service personnel. Request its replacement from the nearest Anritsu office or your dealer.

Storage Media

This unit uses a plug-in memory card (PMC) and backup memory as external storage media for data and programs.

Valuable data and programs stored on the storage media could be lost if the media are handled incorrectly or fail.
Backup is recommended to guard against this risk.

Anritsu will not indemnify the user for the loss of stored data and programs.

Please take full notice of the instructions below. Especially, be careful not to remove the plug-in memory card (PMC) from the unit while it is being accessed. For more details refer to Chapter 2 of the manual.

(PMC)

- Damage to the PMC could result if it is exposed to static electricity.
- The SRAM plug-in memory card (PMC) has a limited battery life. Remember to replace the battery periodically.

(Memory with battery backup)

- Damage to the memory could result if it is exposed to static electricity.

Note: The battery used in the unit has a life of about seven years. Replace the battery before this time expires.

Disposal

The unit uses compound semiconductors that contain arsenic. Observe the relevant local regulations in disposing of the semiconductors.

CE Marking

Anritsu affix the CE Conformity Marking on the following product (s) accordance with the Council Directive 93/68/EEC to indicate that they conform with the EMC directive of the European Union (EU).

CE Conformity Marking

CE

1. Product Name/Model Name

Product Name: Network Analyzers

Model Name: MS4661A/E and MS4662A

2. Applied Directive

EMC: Council Directive 89/336/EEC

Safety: Council Directive 73/23/EEC

3. Applied Standards

EMC:

Electromagnetic radiation:

EN55011 (ISM, Group 1, Class A equipment)

Immunity:

EN50082-1

		Performance Criteria*
IEC801-2 (ESD)	4 kVCD, 8 kVAD	B
IEC801-3 (Rad.)	3 V/m	A
IEC801-4 (EFT)	1 kV	B

*: Performance Criteria

A: No performance degradation or function loss

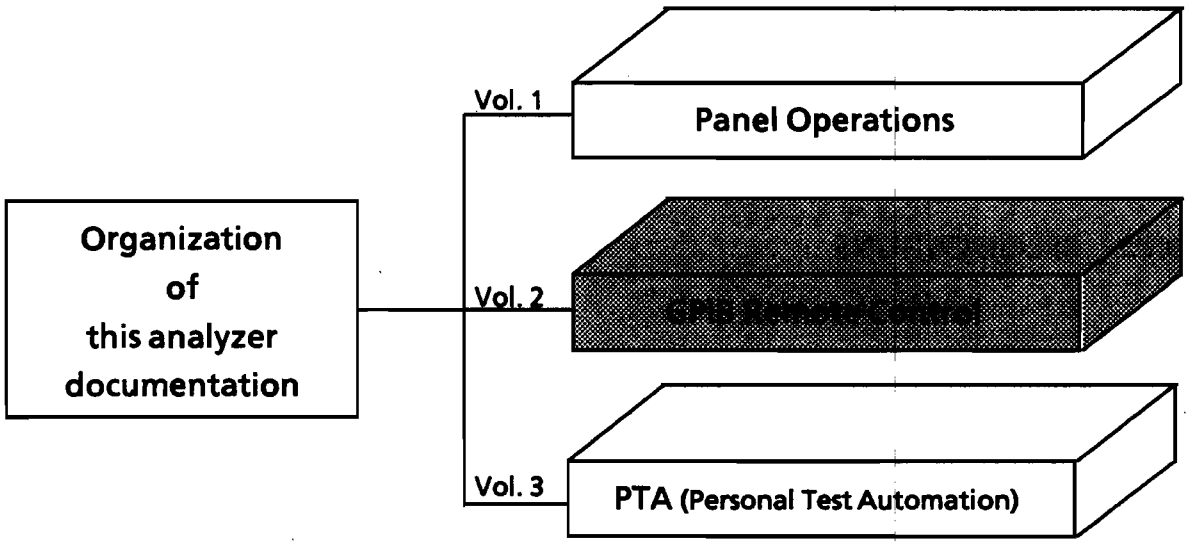
B: Self-recovered temporary degradation of performance or temporary loss of function

Safety: EN61010-1 (Installation Category Ⅱ, Pollution Degree 2)

PREFACE

(1) Organization of documentation

The documentation supplied with this Network Analyzer is divided into three manuals (Vol. 1, Vol. 2, and Vol. 3). Read these manuals as needed.



Panel Operations: Presents summary information about this analyzer, including preparations and basic panel operations, and proceeds to introduce panel operations other than automatic measurement, such as performance testing.

GPIB Remote Control: Explains the concepts of GPIB remote control pursuant to the specifications of IEEE-488.2, with which this analyzer is compliant. Sample programs written with reference to our PACKET V Series technical computer are provided.

PTA (Personal Test Automation): Explains how to program high-speed control and high-speed arithmetic operations that are directly linked to a testing system in the high-level language PTL. The programmed operations are executed by the personal computer built in this analyzer. Called PTA (Personal Test Automation), this scheme of programming promotes the progress of test automation, together with GPIB remote control mentioned above.

(2) GPIB Basic Guide (sold separately)

In addition to the three volumes listed above, the GPIB Basic Guide is available as a separately sold manual. It provides a basic insight into the concepts of GPIB and contains GPIB control statements written in our PACKET V computer language.

TABLE OF CONTENTS

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SECTION 1
GENERAL

This section gives a general description on the changes that have been made to the GPIB Standard and the functions of the GPIB.

TABLE OF CONTENTS

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1.1 Development of the GPIB Standard

This analyzer is combined with an external controller to constitute a system bus, allowing you to make measurements automatically. This analyzer comes standard with an GPIB interface bus (IEEE Standard 488.2-1987), a measurement bus.

The GPIB (General Purpose Interface Bus) was established by the IEEE (Institute of Electric and Electronics Engineers) in 1975 as a standard digital interface bus for programmable measuring instruments. The original version was announced in 1975 under the name IEEE std. 488-1975.

A revised version, called IEEE std. 488-1978, was issued in 1978. As this version only stipulated hardware specifications for the interface side, IEEE std. 728-1982, which stipulated software specifications for the device side, was added in 1982.

Though IEEE std. 728-1982 standardized the formats for sending device messages, it was lacking in its concept of software sharing on the user side. So, in 1987, the IEEE std. 488. 2-1987 (hereafter IEEE 488.2) version, which aimed to overcome the shortcomings, was introduced. This version strengthened the standardization of message exchange protocol, message date code, device input/output formats and common commands.

With the introduction of IEEE 488.2, the name of IEEE std. 488-1978 (hereafter IEEE 488) was changed to IEEE std. 488. 1-1987 (hereafter IEEE 488.1). The table below summarizes the development of the GPIB standard.

Object of standard	Former standard	New standard	Remarks
Hardware	IEEE 488	IEEE 488.1	IEEE 488.1 is identical to IEEE 488
Software	IEEE 728	IEEE 488.2	IEEE 488.2 is the revised version of IEEE 728

Devices which support IEEE 488.2 must also have compatibility with IEEE 488.1; however, devices which support IEEE 488.1 (IEEE 488) are not guaranteed to be compatible to IEEE 488.2.

1.2 Outline of Functions of GPIB for This Analyzer

This analyzer comes standard with a GPIB interface.

All GPIB functions except those listed below can be controlled externally.

- POWER switch
- LOCAL key
- 10 MHz reference signal switching (INT/EXT)

The screen display can display characters and graphics as a personal computer terminal. Connecting a personal computer or any other measuring device allows you to configure an automatic measurement system easily.

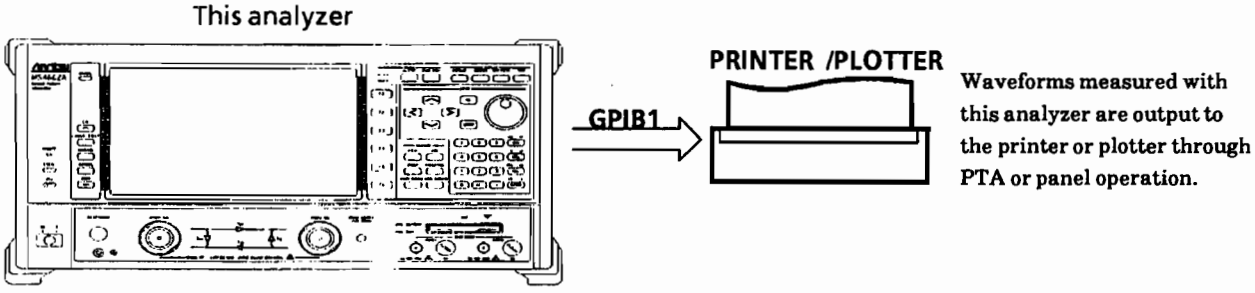
With the installed PTA2 (Personal Test Automation), this analyzer can be used as a controller, allowing an automatic measurement system to be constructed without a personal computer.

To use this analyzer as the controller or device for the current GPIB system, set the CONT DIP switch next to the address DIP switches on the rear panel. The current GPIB port is named "GPIB1" so that one more port can be added in the future.

The GPIB1 port can be used like a single port of a measuring device. When the power is turned on or during ordinary measurements, this port functions as a device port. With the PTA, this analyzer can function as a system controller that controls other devices (when a system controller function is selected).

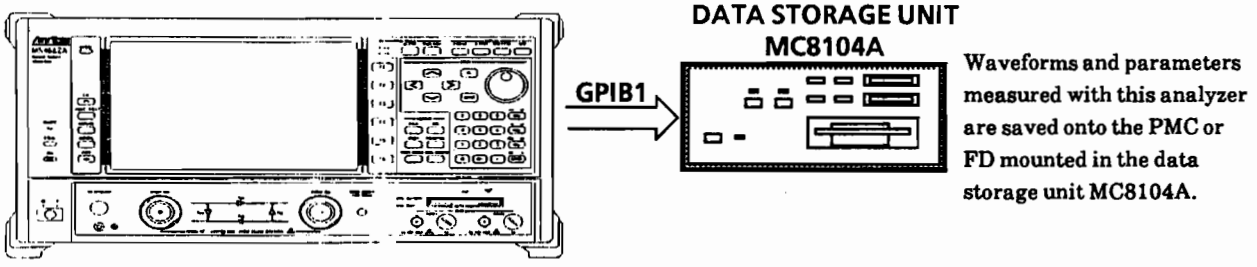
Examples of System Configurations Using GPIB1

(1) Stand-alone type (1)····· PTA/panel operation



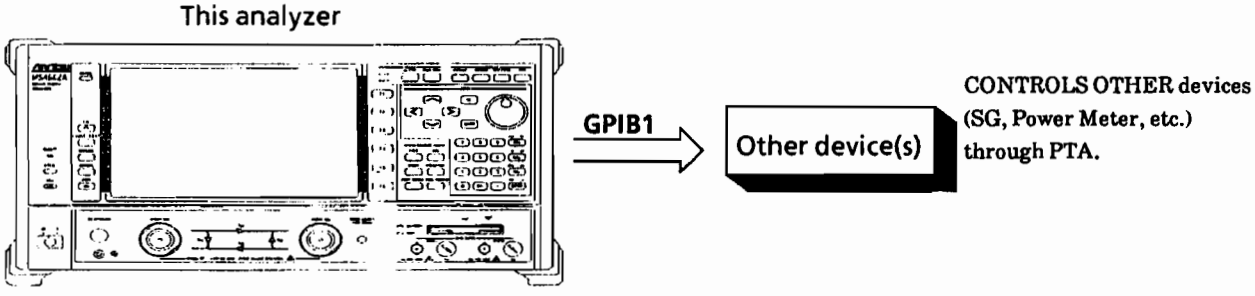
Waveforms measured with this analyzer are output to the printer or plotter through PTA or panel operation.

(2) Stand-alone type (2)····· PTA/panel operation



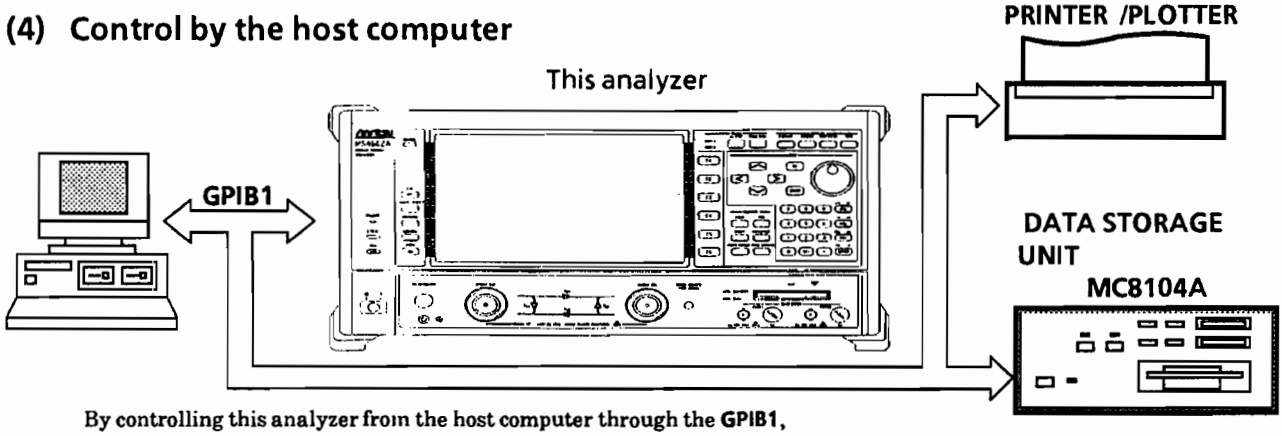
Waveforms and parameters measured with this analyzer are saved onto the PMC or FD mounted in the data storage unit MC8104A.

(3) Stand-alone type (3)····· PTA



CONTROLS OTHER devices (SG, Power Meter, etc.) through PTA.

(4) Control by the host computer



By controlling this analyzer from the host computer through the **GPIB1**, measured waveforms and parameters can be:

- Output to the printer or plotter.
- Saved onto the PMC or FD mounted in the data storage unit MC8104A.

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SECTION 2
SPECIFICATIONS

This section explains the interface functions and device messages included in the GPIB standard.

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2.1 Interface Functions

IEEE 488.2 sets down a minimum requirement for subsets of the GPIB interface functions specified in IEEE 488.1 that must be provided by measuring instruments used in a GPIB system.

The GPIB of this analyzer has the subsets listed in the code column.

GPIB Interface Functions

<table>
<tr><th>Code</th><th>Interface function</th><th>IEEE 488.2 standard</th></tr>
<tr><td>SH1</td><td>All source handshake functions are provided. Synchronizes the timing of data transmission.</td><td>All functions are provided as standard. The device must have a complete set of source handshake functions.</td></tr>
<tr><td>AH1</td><td>All acceptor handshake functions are provided. Synchronizes the timing for receiving data.</td><td>All functions are provided as standard. The device must have a complete set of acceptor handshake functions.</td></tr>
<tr><td>T6</td><td>Basic talker functions are provided. The serial poll function is provided. The talk-only function is not provided. The talker can be canceled by MLA.</td><td>Devices must have one of the T5, T6, TE5 or TE6 subsets. The talk-only function is out of the scope of the IEEE 488.2 standard.</td></tr>
<tr><td>L4</td><td>Basic listener functions are provided. The listen-only function is not provided. The listener can be canceled by MTA.</td><td>Devices must have one of the L3, L4, LE3 or LE4 subsets. The listen-only function is out of the scope of the IEEE 488.2 standard.</td></tr>
<tr><td>SR1</td><td>All service request and status byte functions are provided.</td><td>All functions are provided as standard.</td></tr>
<tr><td>RL1</td><td>All remote/local functions are provided. The local lockout function is provided.</td><td>RL0 (functions not provided) or RL1 (all functions provided)</td></tr>
<tr><td>PP0</td><td>Parallel poll functions are not provided.</td><td>PP0 (functions not provided) or PP1 (all functions provided)</td></tr>
<tr><td>DC1</td><td>All device clear functions are provided.</td><td>All functions are provided as standard.</td></tr>
<tr><td>DT1</td><td>Device trigger functions are provided.</td><td>DT0 (functions not provided) or DT1 (all functions provided)</td></tr>
<tr><td>C1 to C4, C24</td><td>Controller functions are provided.</td><td>C0 (functions not provided) or C4 and C5 or any of C7, C9, C11
C1: System controller
C2: IFC sending, controller in charge
C3: REN sending
C4: Response to SRQ
<table>
<tr><th>Function</th><th>C5</th><th>C7</th><th>C9</th><th>C11</th><th>C24</th></tr>
<tr><td>Sends interface message</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Receives control</td><td>○</td><td>○</td><td>○</td><td>○</td><td>×</td></tr>
<tr><td>Transfers control</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Receives or transfers control from/to itself</td><td>○</td><td>○</td><td>×</td><td>×</td><td>×</td></tr>
<tr><td>Parallel poll function</td><td>○</td><td>×</td><td>○</td><td>×</td><td>×</td></tr>
<tr><td>Controls handshaking</td><td>○</td><td>○</td><td>○</td><td>○</td><td>×</td></tr>
</table></td></tr>
<tr><td>E2</td><td>Uses a tristate bus driver.</td><td></td></tr>
</table>

Refer to Section 1, "GPIB Basic Information" in the attached GPIB Basic Guide (sold separately) for details of the interface function subset.

2.2 Device Message List

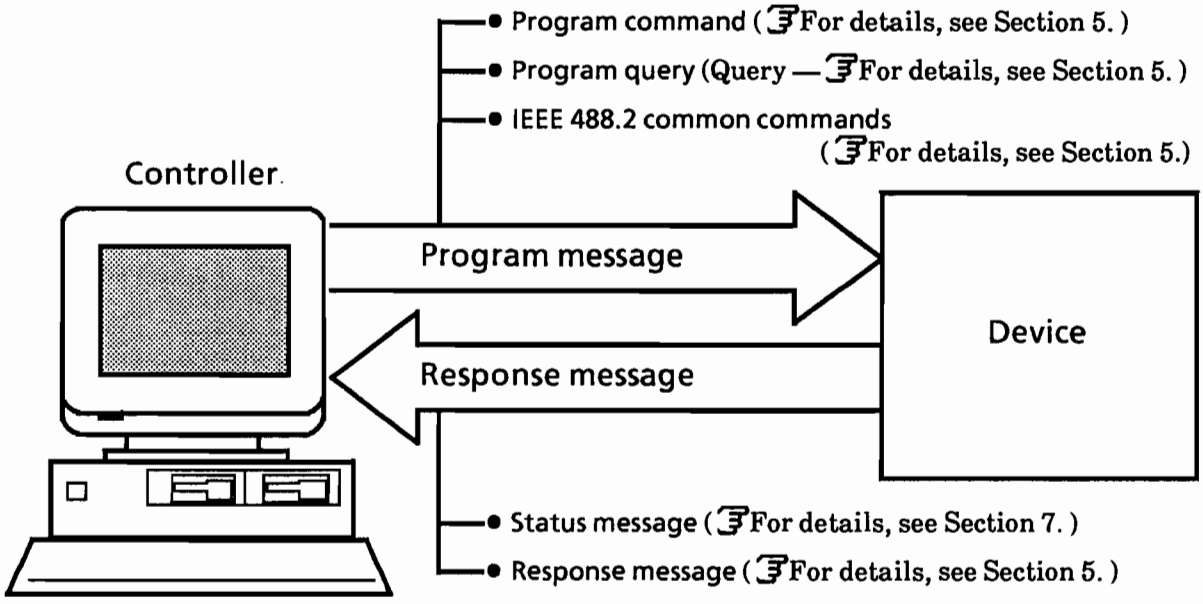
Device messages are message that are transmitted between the controller and the device via the system interface in the bus mode, i.e. when the ATN line is false. There are two types: program messages and response messages. Program messages are ASCII data message transferred from controller to device. There are two types of program message: program commands and program queries. These two types of message are listed on the following pages.

Program commands consist of commands specific to devices which are used exclusively for the control of the MS4661A/E, MS4662A and IEEE 488.2 common commands. The latter are common commands used for, in addition to the MS4661A/E, MS4662A, any measuring instrument conforming to the IEEE 488.2 standard.

There are two types of program commands: device-dependent commands used to control this controller only and IEEE 488.2 common commands. The IEEE 488.2 common commands are applied to this analyzer and other IEEE 488.2-based measuring devices connected to the bus.

Program queries are commands used to obtain response message from a device. A program query is transferred from the controller to the device so that the controller can receive a response message from the device later on.

Response messages are ASCII data messages sent from device to controller. Status messages and response messages for program queries are listed on the following pages.



Regarding data messages, program data and response messages may have a suffix (unit of measured data) attached to the end of the numeric data.

The messages described above are transferred via the input and output buffers of the device. The output buffer is also referred to as an output queue. The following table gives a brief explanation of input and output buffers.

Input buffer	Output buffer
A FIFO (First In First Out) memory area where DAB (program messages or query messages), whose syntax has been analyzed, are temporarily stored before they are executed. The input buffer size of this analyzer is 256 bytes.	A FIFO-type queue memory area. All DAB (response messages) output to a device from the controller are all stored in this area until the controller has read each of them. The output queue size of this analyzer is 256 bytes.

2.2.1 GPIB suffix code

For the suffixes used by this analyzer, see 5.2 (7) on page 5-7.

2.2.2 IEEE 488.2 common commands and MS4661A/E, MS4662A supported commands

The table below lists 39 types of common commands specified in the IEEE 488.2 standard. IEEE 488.2 common commands used by this analyzer are marked with ◎. All are for port 1.

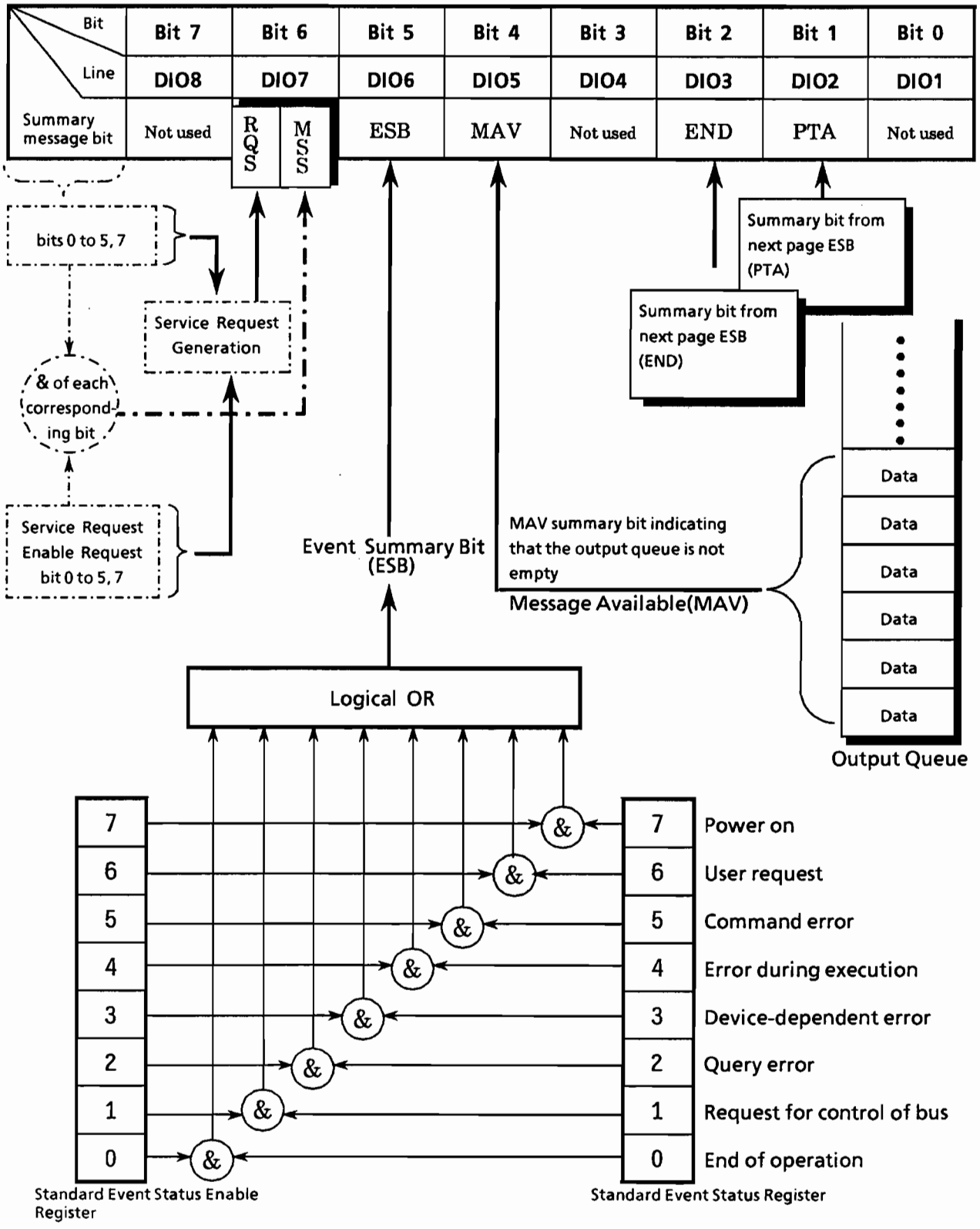
Mnemonic	Command name	IEEE488.2 Standard	MS4661A/E, MS4662A supported commands (this analyzer)
*AAD	Accept Address Command	Optional	
*CAL?	Calibration Query	Optional	
*CLS	Clear Status Command	Mandatory	◎
*DDT	Define Device Trigger Command	Optional	
*DDT?	Define Device Trigger Query	Optional	
*DLF	Disable Listner Function Command	Optional	
*DMC	Define Macro Command	Optional	
*EMC	Enable Macro Command	Optional	
*EMC?	Enable Macro Query	Optional	
*ESE	Standard Event Status Enable Command	Mandatory	◎
*ESE?	Standard Event Status Enable Query	Mandatory	◎
*ESR?	Standard Event Status Register Query	Mandatory	◎
*GMC?	Get Macro Contents Query	Optional	
*IDN?	Identification Query	Mandatory	◎
*IST?	Individual Status Query	Optional	
*LMC?	Learn Macro Query	Optional	
*LRN?	Learn Device Setup Query	Optional	
*OPC	Operation Complete Command	Mandatory	◎
*OPC?	Operation Complete Query	Mandatory	◎
*OPT?	Option Identification Query	Optional	
*PCB	Pass Control Back Command	Mandatory if other than CO	◎
*PMC	Purge Macro Command	Optional	
*PRE	Parallel Poll Register Enable Command	Optional	
*PRE?	Parallel Poll Register Enable Query	Optional	
*PSC	Power On Status Clear Command	Optional	◎
*PSC?	Power On Status Clear Query	Optional	◎
*PUD	Protected User Data Command	Optional	
*PUD?	Protected User Data Query	Optional	
*RCL	Recall Command	Optional	◎
*RDT	Resource Description Transfer Command	Optional	
*RDT?	Resource Description Transfer Query	Optional	
*RST	Reset Command	Mandatory	◎
*SAV	Save Command	Optional	◎
*SRE	Service Request Enable Command	Mandatory	◎
*SRE?	Service Request Enable Query	Mandatory	◎
*STB?	Read Status Byte Query	Mandatory	◎
*TRG	Trigger Command	Mandatory if DT1	◎
*TST?	Self Test Query	Mandatory	◎
*WAI	Wait to Continue Command	Mandatory	◎

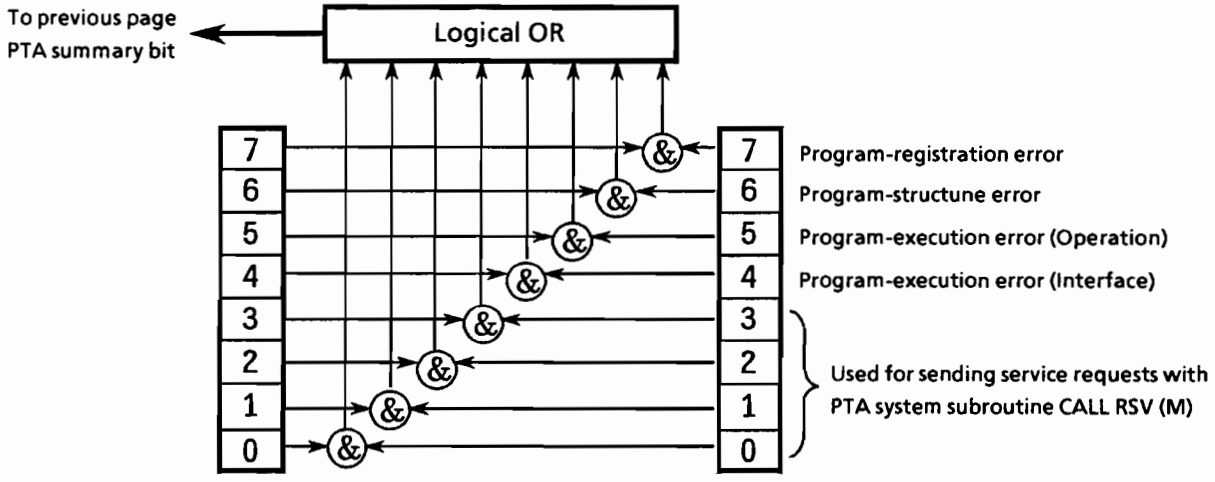
☞ All IEEE488.2 common commands begin with *. For details, see Section 6.

2.2.3 Status messages

The structure of the service request summary message set in the status byte register of this analyzer is shown below.

Status Byte Register Summary Bit Composition



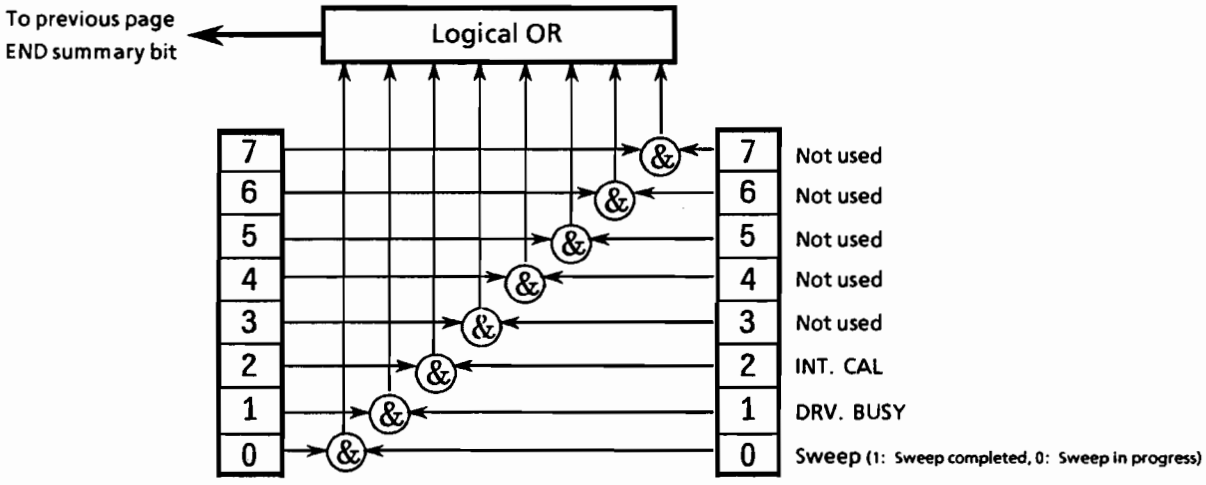


Extended PTA Event Status Enable Register

ESE1<NRf> triggers setting.
ESE1? triggers read.

Extended PTA Event Status Register

ESR1? triggers read.



Extended END Event Status Enable Register

ESE2<NRf> triggers setting.
ESE2? triggers read.

Extended END Event Status Register

ESR2? triggers read.

2.2.4 Device messages of this analyzer (alphabetical order)

Device messages expressing program commands and queries of this analyzer in simple form are listed in alphabetical order on the following pages. For details on parameter items, program data, and response data, see Section 8.

In the list,

- ␣ indicates a one-character-long space.
- Ø indicates a zero.

Device Messages of This Analyzer (Alphabetical Order) (1/14)

Device message		Parameter	
Command	Query	Function item	Description
ACTR␣m(m: Ø,1)	ACTR?	Trace screen selection	Active trace
ADV␣m(m: Ø to 3)	ADV?	Marker function	Admittance display marker value
APF␣f	APF?	Delay setting	Aperture frequency
AU1␣m(m: Ø,1)	AU1?	Sweep function	SWEEP TIME AUTO
AVG␣r	AVG?	Averaging	Averaging count
AVT␣m(m: Ø to 2)	AVT?	Averaging	Averaging method
BEEP	–	Beep	Sounds a beep
BIN␣m(m:Ø,1)	BIN?	Trace data transfer format	ASCII/binary transfer
BKP␣r	BKP?	Averaging	Breakpoint
BPON␣m(m:0,1)	BPON␣m	Beep	Beep ON/OFF control
CAL	CAL?	Calibration function	CAL data calculation
CAL␣m(m: Ø)		Calibration function	CAL data measurement (X-S)
CAL␣m (m: Ø to 2)		Calibration function	CAL data measurement (ONE PORT)
CAL␣m (m: Ø to 3)		Calibration function	CAL data measurement (TWO PORT)
CAL␣m (m: Ø to 3)		Calibration function	CAL data measurement (1 PATH 2 PORT)
CALC␣m,m1,m2	CALC?	Calculation	Arithmetic operation between memories
CBAR␣M (M=Ø,1)	CBAR?	Graphic screen control	Color bar display
CCØ␣ r1 CC1␣ r1 CC2␣ r1 CC3␣ r1	CCØ? CC1? CC2? CC3?	Calibration function	Open device stray capacitance
CDST␣m (m:Ø to 5)	CDST?	Arithmetic operation	Arithmetic operation between memories Specification of destination
CEXE␣m (m:Ø to 8)		Arithmetic operation	Execution of arithmetic operation between source (S) and destination (D)

Device Messages of This Analyzer (Alphabetical Order) (2/14)

Device message		Parameter	
Command	Query	Function item	Description
CFL␣m(m=Ø to 6)		Graphic screen control	Screen clearing
CNF␣f	CNF?	Frequency setting	Center frequency
CNST␣m,r1,r2,p	CNST?	Arithmetic operation	Constant setting
CMA1␣m1,m2(,n)	CMA1?␣m1, m2(,n)	Waveform data read/write	Trace-A side S21T
CMA2␣m1,m2(,n)	CMA2?␣m1, m2(,n)	Waveform data read/write	Trace-A side S12T
CMA3␣m1,m2(,n)	CMA3?␣m1, m2(,n)	Waveform data read/write	Trace-A side S11L
CMA4␣m1,m2(,n)	CMA4?␣m1, m2(,n)	Waveform data read/write	Trace-A side S21L
CMA5␣m1,m2(,n)	CMA5?␣m1, m2(,n)	Waveform data read/write	Trace-A side S12L
CMA6␣m1,m2(,n)	CMA6?␣m1, m2(,n)	Waveform data read/write	Trace-A side S22L
CMA7␣m1,m2(,n)	CMA7?␣m1, m2(,n)	Waveform data read/write	Trace-A side S11O
CMA8␣m1,m2(,n)	CMA8?␣m1, m2(,n)	Waveform data read/write	Trace-A side S22S
CMA9␣m1,m2(,n)	CMA9?␣m1, m2(,n)	Waveform data read/write	Trace-A side S11S
CMAA␣m1,m2(,n)	CMAA?␣m1, m2(,n)	Waveform data read/write	Trace-A side S22O
CMB1␣m1,m2(,n)	CMB1?␣m1, m2(,n)	Waveform data read/write	Trace-B side S21T
CMB2␣m1,m2(,n)	CMB2?␣m1, m2(,n)	Waveform data read/write	Trace-B side S12T
CMB3␣m1,m2(,n)	CMB3?␣m1, m2(,n)	Waveform data read/write	Trace-B side S11L
CMB4␣m1,m2(,n)	CMB4?␣m1, m2(,n)	Waveform data read/write	Trace-B side S21L
CMB5␣m1,m2(,n)	CMB5?␣m1, m2(,n)	Waveform data read/write	Trace-B side S12L
CMB6␣m1,m2(,n)	CMB6?␣m1, m2(,n)	Waveform data read/write	Trace-B side S22L

Device Messages of This Analyzer (Alphabetical Order) (3/14)

Device message		Parameter	
Command	Query	Function item	Description
CMB7␣m1,m2(,n)	CMB7?␣m1, m2(,n)	Waveform data read/write	Trace-B side S11O
CMB8␣m1,m2(,n)	CMB8?␣m1, m2(,n)	Waveform data read/write	Trace-B side S22S
CMB9␣m1,m2(,n)	CMB9?␣m1, m2(,n)	Waveform data read/write	Trace-B side S11S
CMBA␣m1,m2(,n)	CMBA?␣m1, m2(,n)	Waveform data read/write	Trace-B side S22O
CMK␣r	CMK?	Marker function	Marker movement
CON␣m (m:1 to 12)	CON?	Calibration function	Setting of CAL device parameters by connector type
CONN␣m,n (m:2,n:1 to 12)	CONN?␣2	Calibration function	Port 2 connector type
CONN␣m,n (m:1,n:1 to 12)	CONN?␣1	Calibration function	Port 1 connector type
COO␣r2	COO?	Calibration function	Open device offset length
COOR␣m (m: Ø to 4)	COOR?	Screen coordinate system selection	Screen coordinate system setting (BAND PASS or LOW PASS)
COOR␣m (m: Ø to 6)	COOR?	Screen coordinate system selection	Screen coordinate system setting (S_{21} or S_{12})
COOR␣m (m: Ø to 8)	COOR?	Screen coordinate system selection	Screen coordinate system setting (S_{11} or S_{22})
COPY␣m(m=Ø,1)		Printer/plotter control	Instruction of copy start/stop
	COPY?	Printer/plotter control	Copying status detection
COS␣r2	COS?	Calibration function	Short device offset length
COT␣r	COT?	Calibration function	Setting of through line offset length
CPL␣AVG,OFF	CPL?␣AVG	Calibration function	Electrical length coupling OFF
CPL␣AVG,ON	CPL?␣AVG	Calibration function	Electrical length coupling ON
CPL␣AVG,OFF	CPL?␣AVG	Delay setting	Delay range coupling OFF
CPL␣AVG,ON	CPL?␣AVG	Delay setting	Delay range coupling ON
CPL␣AVG,OFF	CPL?␣AVG	Averaging	Smoothing coupling OFF

Device Messages of This Analyzer (Alphabetical Order) (4/14)

Device message		Parameter	
Command	Query	Function item	Description
CPL␣AVG,ON	CPL?␣AVG	Averaging	Smoothing coupling ON
CPL␣AVG,OFF	CPL?␣AVG	Averaging	Averaging method coupling OFF
CPL␣AVG,ON	CPL?␣AVG	Averaging	Averaging method coupling ON
CPL␣AVG,OFF	CPL?␣AVG	Averaging	Averaging count coupling OFF
CPL␣AVG,ON	CPL?␣AVG	Averaging	Averaging count coupling ON
CPL␣AVG,OFF	CPL?␣AVG	Averaging	Measurement point count coupling OFF
CPL␣AVG,ON	CPL?␣AVG	Averaging	Measurement point count coupling ON
CPL␣AVG,OFF	CPL?␣AVG	Averaging	Breakpoint coupling OFF
CPL␣AVG,ON	CPL?␣AVG	Averaging	Breakpoint coupling ON
CPL␣AVG,OFF	CPL?␣AVG	Resolution bandwidth coupling	RBW coupling
CPL␣AVG,ON	CPL?␣AVG	Resolution bandwidth coupling	RBW coupling
CPL␣MKR,OFF	CPL?␣MKR	Marker function	Marker coupling OFF
CPL␣MKR,ON	CPL?␣MKR	Marker function	Marker coupling ON
CPL␣SWP,OFF	CPL?␣SWP	Delay setting	Delay range coupling OFF
CPL␣SWP,ON	CPL?␣SWP	Delay setting	Delay range coupling ON
CPL␣SWP,OFF	CPL?␣SWP	Frequency setting	Center frequency coupling OFF
CPL␣SWP,ON	CPL?␣SWP	Frequency setting	Center frequency coupling ON
CPL␣SWP,OFF	CPL?␣SWP	Input range	Channel A input ATT coupling OFF
CPL␣SWP,ON	CPL?␣SWP	Input range	Channel A input ATT coupling ON
CPL␣SWP,OFF	CPL?␣SWP	Input range	Channel B input ATT coupling OFF
CPL␣SWP,ON	CPL?␣SWP	Input range	Channel B input ATT coupling ON
CPL␣SWP,OFF	CPL?␣SWP	Level setting	Output level coupling OFF
CPL␣SWP,ON	CPL?␣SWP	Level setting	Output level coupling ON
CPL␣SWP,OFF	CPL?␣SWP	Frequency setting	Stop frequency coupling OFF

Device Messages of This Analyzer (Alphabetical Order) (5/14)

Device message		Parameter	
Command	Query	Function item	Description
CPL␣SWP,ON	CPL?␣SWP	Frequency setting	Stop frequency coupling ON
CPL␣SWP,OFF	CPL?␣SWP	Frequency setting	Span frequency coupling OFF
CPL␣SWP,ON	CPL?␣SWP	Frequency setting	Span frequency coupling ON
CPL␣SWP,OFF	CPL?␣SWP	Frequency setting	Start frequency coupling OFF
CPL␣SWP,ON	CPL?␣SWP	Frequency setting	Start frequency coupling ON
CPL␣SWP,OFF	CPL?␣SWP	Sweep function	Sweep specification coupling OFF
CPL␣SWP,ON	CPL?␣SWP	Sweep function	Sweep specification coupling ON
CPL␣SWP,OFF	CPL?␣SWP	Sweep function	Sweep mode coupling OFF
CPL␣SWP,ON	CPL?␣SWP	Sweep function	Sweep mode coupling ON
CPL␣SWP,OFF	CPL?␣SWP	Sweep function	Sweep time coupling OFF
CPL␣SWP,ON	CPL?␣SWP	Sweep function	Sweep time coupling ON
CPLL␣M,N (M=Ø to 15) (N=Ø to 15)	CPLL?␣M	Graphic screen control	Color palette color specification
CSCE␣m (m:Ø to 5)	CSCE?	Arithmetic operation	Arithmetic operation between memories Specification of source memory
CSW␣m(m: Ø to 2)	CSW?	Sweep function	List sweep measured value calculation method
DAR X,Y,R,θ1,θ2 M(,N) X =−4Ø95 to 4734 Y=−4Ø95 to 4494 R =1 to 4Ø96 θ1=−18Ø.ØØ to 18Ø.ØØ θ2=−18Ø.ØØ to 18Ø.ØØ M=1 to 6 N=Ø to 3		Graphic screen control	Drawing of arc
DATE␣YY,MM,DD	DATE?	System setting	Date setting

Device Messages of This Analyzer (Alphabetical Order) (6/14)

Device message		Parameter	
Command	Query	Function item	Description
DCH X,Y,T$,M(,N) X =Ø to 639 Y =Ø to 399 T$ =Max.80 characters M =Ø to 6 N =Ø,1		Graphic screen control	Character display
DCR X,Y,R, M(,N) X = −4095 to 4734 Y = −4095 to 4494 R =1 to 4096 M= 1 to 6 N =0 to 3		Graphic screen control	Drawing of circle
DF1␣m,n (m:Ø to 2 n:Ø to2)	DF1?␣m	Display function	Grid display
DF2␣m(m:Ø to 3)	DF2?	Display function	Chart display mode
DF3␣m or CER␣m(m:Ø to 13)		Display function	Screen display OFF (clearing)
DF4␣m or CRN␣m(m:Ø to 13)		Display function	Screen display ON (display)
DIR␣(T$)	DIR?	SAVE/RECALL	Display of directory information
DLM␣m(m=Ø to 9)		SAVE/RECALL	Deletion of measurement parameters
DLN X_0,Y_0, X_1,Y_1,M(,N) X_0 = Ø to 639 $Y_Ø$ = Ø to 399 X_1 = Ø to 639 Y_1 = Ø to 399 M = 1 to 6 N = Ø to 3		Graphic screen control	Drawing of line
DRC X_0,Y_0, X_1,Y_1,M(,N) X_0 = Ø to 639 Y_0 = Ø to 399 X_1 = Ø to 639 Y_1 = Ø to 399 M = Ø to 6 N = Ø to 3		Graphic screen control	Drawing of square
	DRCL?	SAVE/RECALL	Monitoring of directory information display

Device Messages of This Analyzer (Alphabetical Order) (7/14)

Device message		Parameter	
Command	Query	Function item	Description
DRCL		SAVE/RECALL	Clearing of directory information
DRDN		SAVE/RECALL	Scroll of directory information
DRG␣m (m: Ø to 22)	DRG?	Delay setting	Delay measurement range
DRUP		SAVE/RECALL	Scroll of Directory information
ECL␣m(m:Ø to 3)	ECL?	Calibration function	CAL method
ELG␣r	ELG?	Calibration function	Electrical length
FQM␣m1,m2	FQM?␣m1, m2	Frequency table read/write	Active trace side
FQMA␣m1,m2	FQMA?␣ m1,m2	Frequency table read/write	Trace-A side
FQMB␣m1,m2	FQMB?␣ m1,m2	Frequency table read/write	Trace-B side
FRQ␣m(m: Ø,1)	FRQ?	Sweep function	Sweep mode
FSHP␣m(m=Ø to 3)	FSHP?	Time domain	Filter shape setting
GSHP␣m(m=Ø to 3)	GSHP?	Time domain	Gate shape setting
GTM␣m (m=Ø to 99999)	GTM?	GPIB port 1 parameter	GPIB time-out time setting
HDRG␣f	HDRG?	Delay setting	Measurement of high speed delay
I1AT␣m,n (m=Ø to2,n:0,20)	I1AT?␣m	Port 1 attenuator	Setting of port 1 attenuator
I2AT␣m,n	I2AT?␣m	Port 2 attenuator	Setting of port 2 attenuator
	IDC?	Module control	D code read
IMV␣m(m: Ø to 3)	IMV?	Marker function	Impedance display marker value
INDX␣m(m=Ø,1)	INDX?	SAVE/RECALL	Instruction of INDEX RECALL display
INI		System setting	Initialization
LCLU␣m,n m:Ø to 2,n:Ø,1	–	Limit line	Clearing of upper limit line
LCLL␣m,n m:Ø to 2,n:Ø,1	–	Limit line	Clearing of lower limit line
LFM␣m(m:Ø,1)	LFM?	Sweep function	List sweep
LFPF␣f	LFPF?	Sweep function	List sweep stop frequency
LFPM␣m(m:Ø,1)	LFPM?	Sweep function	List sweep stop frequency setting

Device Messages of This Analyzer (Alphabetical Order) (8/14)

Device message		Parameter	
Command	Query	Function item	Description
LFRF␣f	LFRF?	Sweep function	List sweep step frequency setting
LFSF␣f	LFSF?	Sweep function	List sweep start frequency
LFSM␣m(m:Ø,1)	LFSM?	Sweep function	List sweep start frequency setting
LMTP␣m,n (m:0 to 2,n:0,1)	LMTP?␣m	Limit line	Limit line type setting Single or segmented
LOG␣m(m:Ø,1)	LOG?	Sweep function	LOG/LIN sweep
LSIU␣m,n (m:0 to 2,n:data)	LSIU?␣m	Limit line	Single upper limit data setting
LSIL␣m,n (m:0 to 2,n:data)	LSIU?␣m	Limit line	Single lower limit data setting
LIMT␣m,n (m:0 to 2,n:0,1)	LIMT?␣m	Limit line	Limit test ON/OFF control
LSW␣m(m:Ø,1)	LSW?	Sweep function	Level sweep
LVMA␣m1,m2	LVMA?␣ m1,m2	Level sweep table read/write	Trace-B side
LVMB␣m1,m2	LVMB?␣ m1,m2	Level sweep table read/write	Trace-B side
LVM␣m1,m2	LVM?␣m1, m2	Level sweep table read/write	Active trace side
	MA3?	SAVE/RECALL	Built-in PMC battery check
MA4		SAVE/RECALL	Format specification
	MA4?	SAVE/RECALL	Monitoring of formatting state
MDC␣n1 (n1=Ø to 255)	MDC?	Module control	Control status register setting
MDD␣n2 (n2=Ø to 255)	MDD?	Module control	Data register setting
MDL␣m(m=Ø to 63)	MDL?	Module control	Module address setting
	MDR?	Module control	Data read
MDW␣n1,n2 (n1=Ø to 255) (n2=Ø to 255)		Module control	Simultaneous setting of control status register and data register
MEA␣m,n (m:Ø to 3) (n:Ø to 21)	MEA? m	Target data search	Target data search
MEP␣m(m:Ø to 6)	MEP?	Averaging	Number of measurement points

Device Messages of This Analyzer (Alphabetical Order) (9/14)

Device message		Parameter	
Command	Query	Function item	Description
MKDR		SAVE/RECALL	Directory making
	MKF?	Marker function	Read of active marker point frequency for active tracing
MKD␣m(m:Ø,1)	MKD?	Marker function	Marker display
–	MKF?␣m,n	Marker	Read of marker point frequency
–	MKV?␣m,n	Marker	Read of marker value
MKR␣m(m:Ø to 12)	MKR?	Marker function	Marker function
	MPA?	Target data search	Read of target data search value, trace-A side
	MPB?	Target data search	Read of target data search value, trace-B side
LMTU␣m,n,X_1, Y_1,X_2,Y_2 m:Ø to 2,n:1to1Ø, XY:Data	LMTU?␣m,n	Limit line	Setting of segmented upper limit data
LMTL␣m,n,X_1, Y_1,X_2,Y_2 m:Ø to 2,n:1to1Ø, XY:Data	LMTL?␣m,n	Limit line	Setting of segmented lower limit data
–	LMTS?␣m (m:0,1)	Limit line	Read of limit test result Pass/fail
MRST␣r (r:Ø to 9)		Marker function	Multimarker resetting
	MRST?␣1	Marker function	Marker ON/OFF information
	MRST?␣2	Marker function	Active marker number
MSET␣m,r,(d) (m:Ø,1, r:Ø to 9)	MSET?␣m,r	Marker function	Multimarker setting
	MVA?	Marker function	Read of active marker value TRACE-A side
	MVB?	Marker function	Read of active marker value TRACE-B side
OATT␣m m:Ø to 6Ø dB/10dBstep	OATT?	Output attenuator	Output attenuator setting

Device Messages of This Analyzer (Alphabetical Order) (10/14)

Device message		Parameter	
Command	Query	Function item	Description
OFLN␣m,n (m:Øto2 n:Øto10)	OFLN?␣m	Scale function	Screen offset reference line
OFST␣r	OFST?	Scale function	Offset
OOFS␣m (m:±99.99dB/ ØØ.1 step)	OOFS?	Output level offset	Output level offset setting
OPL␣r	OPL?	Power setting	Test port power setting
	OVL?	UNCAL/NORMAL	Monitoring of overload status
OVP␣m(m:Ø,1)	OVP?	Display function	Trace-A and trace-B overlapping display
OVPA␣m(m:Ø,1)	OVPA?	Display function	Trace-A overlapping display
OVPB␣m(m:Ø,1)	OVPB?	Display function	Trace-B overlapping display
PCA␣m (m:Ø to 4)	PCA?␣m1	Calculation function	Programming of calculation function
	PER?	SAVE/RECALL	Media error read
PFF␣m(m:Ø, 1)	PFF?	Printer/plotter control	Specification of printer output position
PHOF␣m	PHOF?	Calibration function	Phase offset setting
PLF␣m(m=Ø,1)	PLF?	Printer/plotter control	Plotter output form size
PLI␣m(m=Ø to 2)	PLI?	Printer/plotter control	Plotter output item selection
PLPS␣m (m=Ø to 4)	PLPS?	Printer/plotter control	Specification of plotter output position
PLTA␣m	PLTA?	Printer/plotter control	Plotter's GPIB address setting
PLTD␣m(m=Ø,1)	PLTD?	Printer/plotter control	Copy device setting
PLTM␣m(m=Ø,1)	PLTM?	Printer/plotter control	Plotter selection
PLTM␣m(m=Ø) PRIM␣m(m=Ø to 3)	PLIM? PRIM?	Printer/plotter control	Printer selection
PMCA␣m	PMCA?	SAVE/RECALL	DSU address setting
PMCS␣m(m:Ø to 4)	PMCS?	SAVE/RECALL	Selection of save/recall drive

Device Messages of This Analyzer (Alphabetical Order) (11/14)

Device message		Parameter	
Command	Query	Function item	Description
	PMY?␣m1, m2	System setting	Input from dual port memory
PMY␣m1,c		System setting	Output to dual port memory
PNT␣X,Y,M,N (X=Ø to 639) (Y=Ø to 399) (M=Ø to 7) (N=Ø to 7)		Graphic screen control	Painting
PRIA␣m (m:Ø to 3Ø)	PRIA?	Printer/plotter control	Printer's GPIB address setting
PTL␣m(m:Ø,1)		System setting	PTA program loading
PTA␣m(m:Ø,1)		System setting	PTA ON/OFF
	PTA?	System setting	PTA execution status read
PTL␣m(m:2)	PTL?	System setting	PTA program output request
RBW␣m (m:Ø to 7,12)	RBW?	Resolution bandwidth setting	RBW
RC1␣m(m=Ø to 9)		SAVE/RECALL	Measurement parameter display (LIST)
RC2		SAVE/RECALL	Storage item display (LIST ALL)
RC3		SAVE/RECALL	Measured waveform display
RCM␣m		SAVE/RECALL	Function parameter recall
RCPG␣m (m=1 to 22)	RCPG?	SAVE/RECALL	Specification of display page (LIST)
	RFA?	Marker function	Reference marker measurement value read, trace-A side
RSPS␣m(m=Ø,1)	RSPS?	Time domain	Time axis waveform setting
	RFB?	Marker function	Reference marker measurement value read, trace-B side
RMKR␣m (m:−2 to 9)	RMKR?	Marker function	Specification of reference marker
*RST		System setting	System resetting
SAU		Scale function	AUTO SCALE
SCAL␣m (m:Ø to 11)	SCAL?	Scale function	Scale

Device Messages of This Analyzer (Alphabetical Order) (12/14)

Device message		Parameter	
Command	Query	Function item	Description
SCRN␣M,N (M=Ø to 4) (N=Ø to 15)	SCRN?␣m	Graphic screen control	Specification of palette for screens 1 to 5
SCRN␣5,n (n=Ø to 7)	SCRN?␣5	Graphic screen control	Specification of palette for screen 6
SEL␣r	SEL?	Sweep function	Level sweep step level
SERS␣m,r (m=Ø to 2, r: Resolution data)	SERS?␣m	Control extraction	Specification of resolution for picking and ripple search
SOF␣f	SOF?	Frequency setting	Stop frequency
SOL␣r	SOL?	Sweep function	Level sweep stop level
SMB␣m1,m2(,n)	SMB?␣m1, m2(,n)	Waveform data read/write	Trace-B side S memory
SMA␣m1,m2(,n)	SMA?␣m1, m2(,n)	Waveform data read/write	Trace-A side S memory
SMT␣r	SMT?	Averaging	Smoothing
SPDS␣r4	SPDS?	Time domain	Analysis interval setting
SPF␣f	SPF?	Frequency setting	Span frequency
SPTM␣r2	SPTM?	Time domain	Analysis time interval setting
SPWR␣m m:+23 to +3/Ø.Ø1 step	SPWR?	Source power	Source power setting
STDS␣r3	STDS?	Time domain	Analysis start position setting
STF␣f	STF?	Frequency setting	Start frequency
STL␣r	STL?	Sweep function	Level sweep start level
STOR␣m(m:Ø,1)	STOR?	Waveform data control	Storage of displayed waveform
STTM␣r1	STTM?	Time domain	Analysis start time setting
SV1␣m(m:Ø,1)	SV1?	SAVE/RECALL	Function parameter save item selection Measurement parameter
SV2␣m	SV2?	SAVE/RECALL	Function parameter save item selection S memory
SV3␣m	SV3?	SAVE/RECALL	Function parameter save item selection X memory

Device Messages of This Analyzer (Alphabetical Order) (13/14)

Device message		Parameter	
Command	Query	Function item	Description
SV4␣m	SV4?	SAVE/RECALL	Function parameter save item selection Frequency table
SV5␣m	SV5?	SAVE/RECALL	Function parameter save item selection Level table
SV6␣m	SV6?	SAVE/RECALL	Function parameter save item selection CAL data
SVDM␣m,n (m:4,n:1,Ø)	SVDM?␣4	SAVE/RECALL	Function parameter save item selection Work memory 4
SVDM␣m,n (m:1,n:1,Ø)	SVDM?␣1	SAVE/RECALL	Function parameter save item selection Work memory 1
SVDM␣m,n (m:3,n:1,Ø)	SVDM?␣3	SAVE/RECALL	Function parameter save item selection Work memory 3
SVDM␣m,n (m:2,n:1,Ø)	SVDM?␣2	SAVE/RECALL	Function parameter save item selection Work memory 2
SVM␣m		SAVE/RECALL	Function parameter saving
SW1␣m(m:Ø,1)	SW1?	Sweep function	Sweep range
SW3␣m(m:Ø to 2)	SW3?	Sweep function	Sweep stop
SWP␣m(m:Ø,1)	SWP?	Sweep function	Execution of sweep
SWT␣t	SWT?	Sweep function	SWEEP TIME
TAMD␣m(m=Ø,1)	TAMD?	Time domain	Setting of unit of horizontal axis
TEN␣T$	TEN?	Display function	Title input
TIME␣hh,mm,ss	TIME?	System setting	Time setting
TMDM␣m(m:Ø,1)	TMDM?	Time domain	Time domain function ON/OFF
TMGT␣m(m=Ø,1)	TMGT?	Time domain	Gate ON/OFF
TMSG		Time domain	Gate setting
TRFC␣m,n (m:0 to 2, n:0 to 5)	TRFC?␣m	Trace screen selection	Measurement item switching S11, S21, S12, S22, GPDLY. LEVEL

Device Messages of This Analyzer (Alphabetical Order) (14/14)

Device message		Parameter	
Command	Query	Function item	Description
TRM␣m(m=Ø,1)	TRM?	GPIB port 1 parameter	Specification of terminator at talker output
TSPT␣m,n (m:Ø to 2,n:Øto5)	TSPT?␣m	Analysis port selection	Measurement port switching RATIO, TA, TB, R
TTL␣m(m:Ø,1)	TTL?	Display function	Title display ON/OFF
UDEF␣MKRn,m (n:2,3,4 m:Ø to 12)	UDEF?␣MKRn	Marker function	User definition, marker function, Fn key definition
WM1␣m1,m2(,n)	WM1?␣m1, m2(,n)	Waveform data read/write	Work memory WM1
WM2␣m1,m2(,n)	WM2?␣m1, m2(,n)	Waveform data read/write	Work memory WM2
WM3␣m1,m2(,n)	WM3?␣m1, m2(,n)	Waveform data read/write	Work memory WM3
WM4␣m1,m2(,n)	WM4?␣m1, m2(,n)	Waveform data read/write	Work memory WM4
XDBF␣r	XDBF?	Target data search	X dB FREQ
XDBW␣r	XDBW?	Target data search	X dB BW
XDEG␣r	XDEG?	Target data search	X deg FREQ
XMA␣m1,m2(,n)	XMA?␣m1, m2(,n)	Waveform data read/write	Trace-A side X memory
XMB␣m1,m2(,n)	XMB?␣m1, m2(,n)	Waveform data read/write	Trace-B side X memory
ZNA␣m,g1,g2	ZNA?␣m	Marker function	Specification of trace-A zone
ZNB␣m,g1,g2	ZNB?␣m	Marker function	Specification of trace-B zone
	ZRA?	Marker function	Zero marker value read, trace-A side
	ZRB?	Marker function	Zero marker value read, trace-B side

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SECTION 3
PREPARATION FOR USING GPIB

This section explains how to connect GPIB cables and set the GPIB address before using the GPIB. This section also explains how to set GPIB functions using the panel. For details on hard copy, refer to Section 9 in the Panel Operation Manual.

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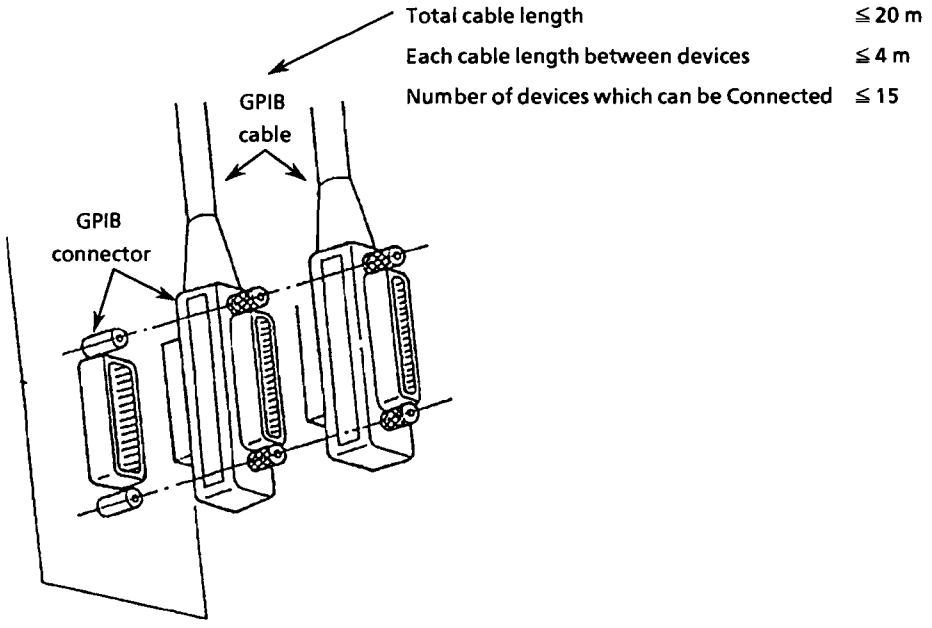
3.1 Connecting Devices with GPIB Cables

The rear panel has connectors for connecting GPIB cables. The cables must be connected before the power is switched on.

A maximum of 15 devices, including the controller, can be connected to one system. The restrictions indicated at the right of the diagram below should be observed when connecting many devices to one system.

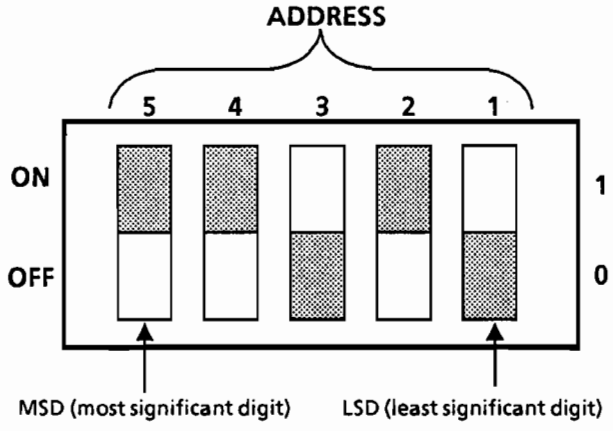


3.2 Setting and Confirming the GPIB Address

To specify the GPIB address of this analyzer, set the address switches on the rear panel before turning on the power. The factory-set address is 1. When using the analyzer with the GPIB address set at 1, the address switches need not be set. The values set with the address switches are read into the memory at power-on.

3.2.1 Setting the GPIB address

The GPIB address switches (5 to 1) on the rear panel are shown below.



To change address 1, set a desired address (0-30 in the right-hand table) by setting the address switches. To set a bit to 1, set the corresponding address switch to the upper position (ON). To set a bit to 0, set the corresponding address switch to the lower position (OFF). An example of changing address 1 to address 26 is shown below.

① Set the POWER switch on the front panel to OFF.

② According to the right-hand table, address 26 (decimal) is binary 11010.Set the address switches corresponding to bits 5, 4, and 2 to the upper position (1) and set the address switches corresponding to bits 3 and 1 to the lower position (0).

③ Setting the POWER switch to ON will display the current GPIB address 26 (decimal). (☞ See the next page.)

Note: If a new address is set with the address switches after the power has been turned on, it is ignored and the previous setting is applied. Remember to set the address switches before setting the POWER switch to ON. Do not set A1 to A5 to all 1s (ON) which mean UNL or UNT.

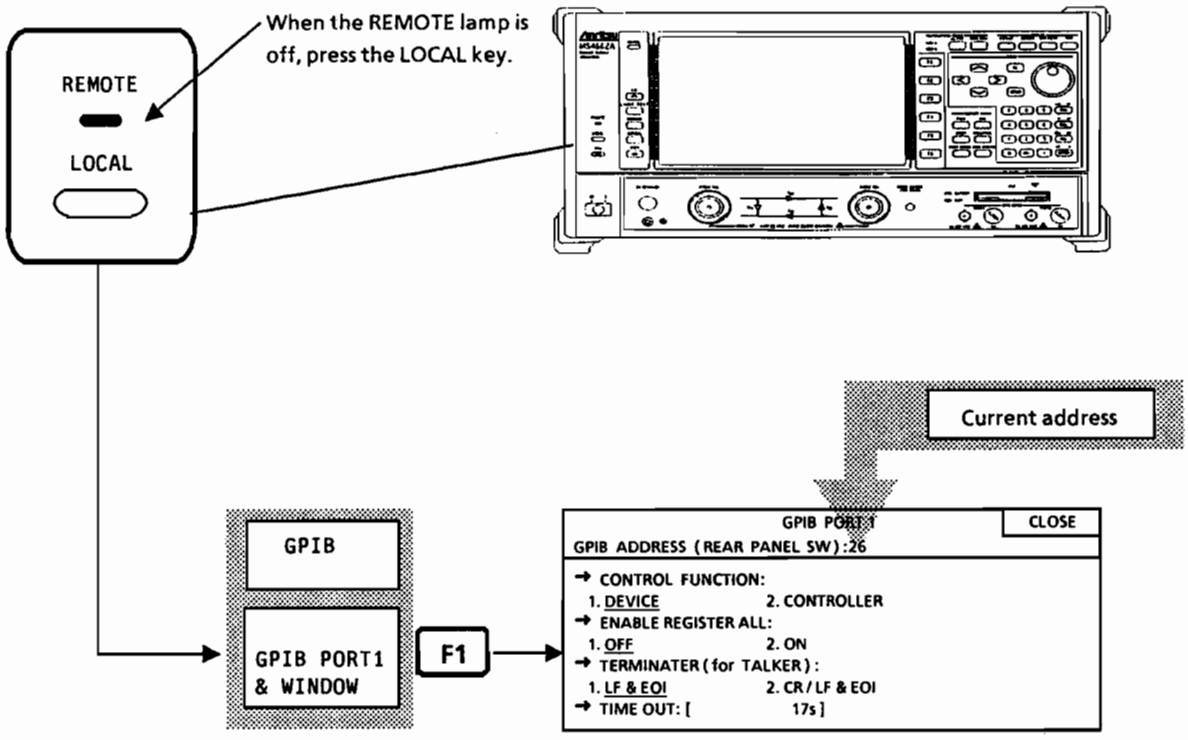
Address Allocation Table

Address character		Address switch setting					Primary address
Talk	Listen	5	4	3	2	1	
b_7 b_6	b_7 b_6	b_5	b_4	b_3	b_2	b_1	
1 0	0 1	↓	↓	↓	↓	↓	decimal integer
@	SP	0	0	0	0	0	0
A	!	0	0	0	0	1	1
B	"	0	0	0	1	0	2
C	#	0	0	0	1	1	3
D	$	0	0	1	0	0	4
E	%	0	0	1	0	1	5
F	&	0	0	1	1	0	6
G	'	0	0	1	1	1	7
H	(	0	1	0	0	0	8
I	)	0	1	0	0	1	9
J	*	0	1	0	1	0	10
K	+	0	1	0	1	1	11
L	,	0	1	1	0	0	12
M	−	0	1	1	0	1	13
N	.	0	1	1	1	0	14
O	/	0	1	1	1	1	15
P	0	1	0	0	0	0	16
Q	1	1	0	0	0	1	17
R	2	1	0	0	1	0	18
S	3	1	0	0	1	1	19
T	4	1	0	1	0	0	20
U	5	1	0	1	0	1	21
V	6	1	0	1	1	0	22
W	7	1	0	1	1	1	23
X	8	1	1	0	0	0	24
Y	9	1	1	0	0	1	25
Z	:	1	1	0	1	0	26
[	;	1	1	0	1	1	27
\	<	1	1	1	0	0	28
]	=	1	1	1	0	1	29
↑	>	1	1	1	1	0	30
←	?	1	1	1	1	1	31†

UNL (Unlisten), UNT(Untalk)

3.2.2 Confirming the current GPIB address

The procedure for confirming the current GPIB address (decimal) is as follows:

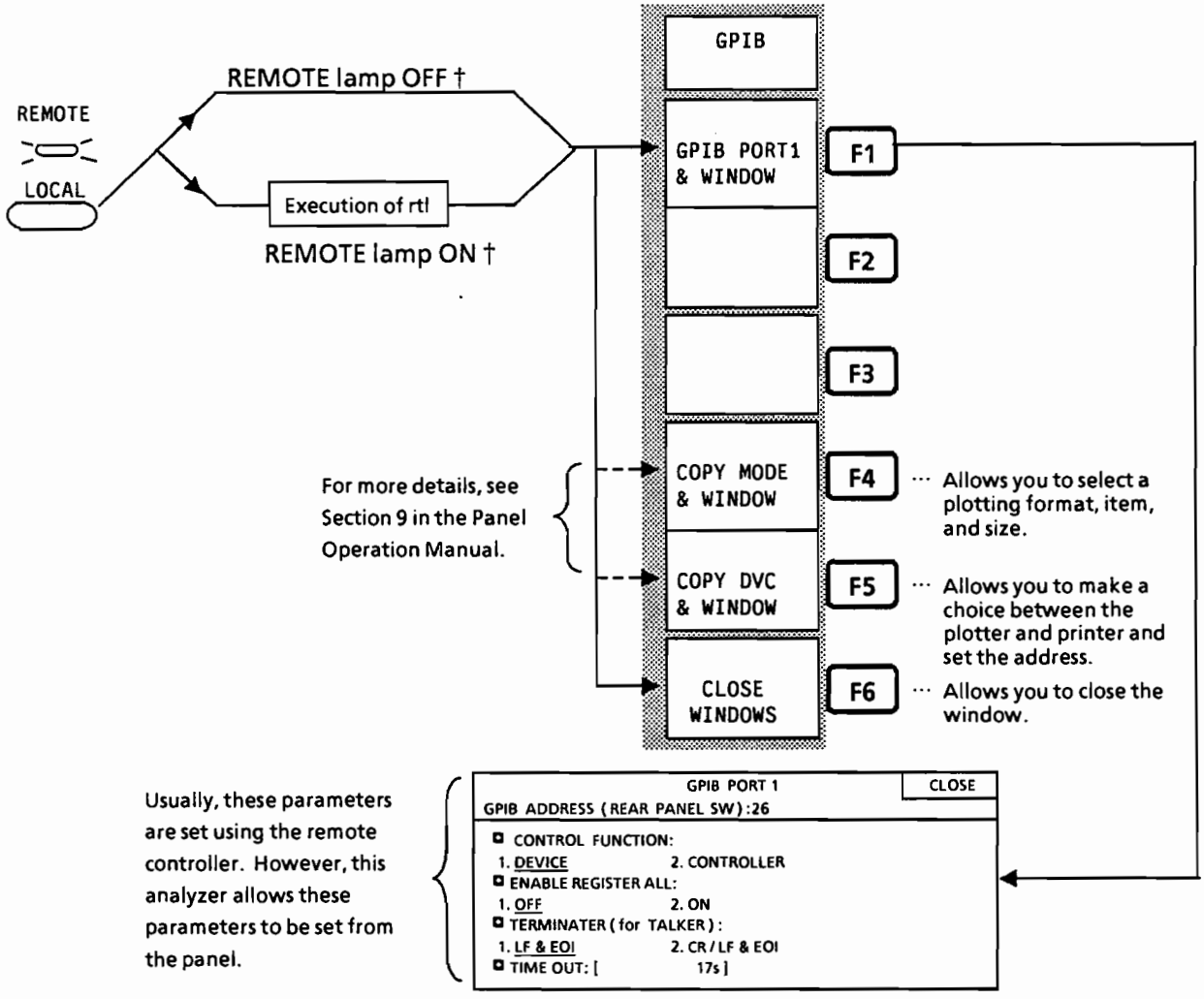


Pressing the F1 key displays the GPIB PORT1 window. The current address (26 in this example) is displayed after "GPIB ADDRESS (REAR PANEL SW)."

Note: When the REMOTE lamp is lit to indicate that this analyzer is locked out by the controller, pressing the LOCAL key will not display the GPIB menu. In this case, execute rtl (return to Local) to turn off the REMOTE lamp and then press the LOCAL KEY. In the usual REMOTE mode in which this analyzer is not locked out locally, pressing the LOCAL key allows you to enter the local mode. For more details on the GPIB menu, see 3.3.

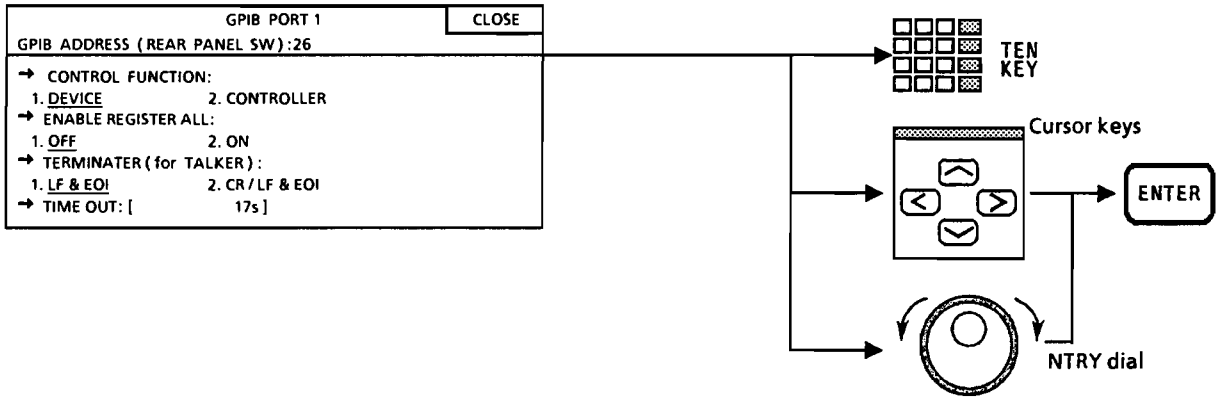
3.3 Setting GPIB Functions Using the Panel

The GPIB function excluded from remote control is the LOCAL key stated in 3.3.2.If you invoke the GPIB menu with the LOCAL key, you will be able to open the window with soft keys F1, F4, and F5.Parameters included in the window can be set through panel



Let's take a look at the GPIB PORT1 window used to select parameters for setting GPIB functions. For the COPY window displayed when the F4 or F5 key is pressed, refer to Section 9 in the Panel Operation Manual.

† See Notes on the previous page.



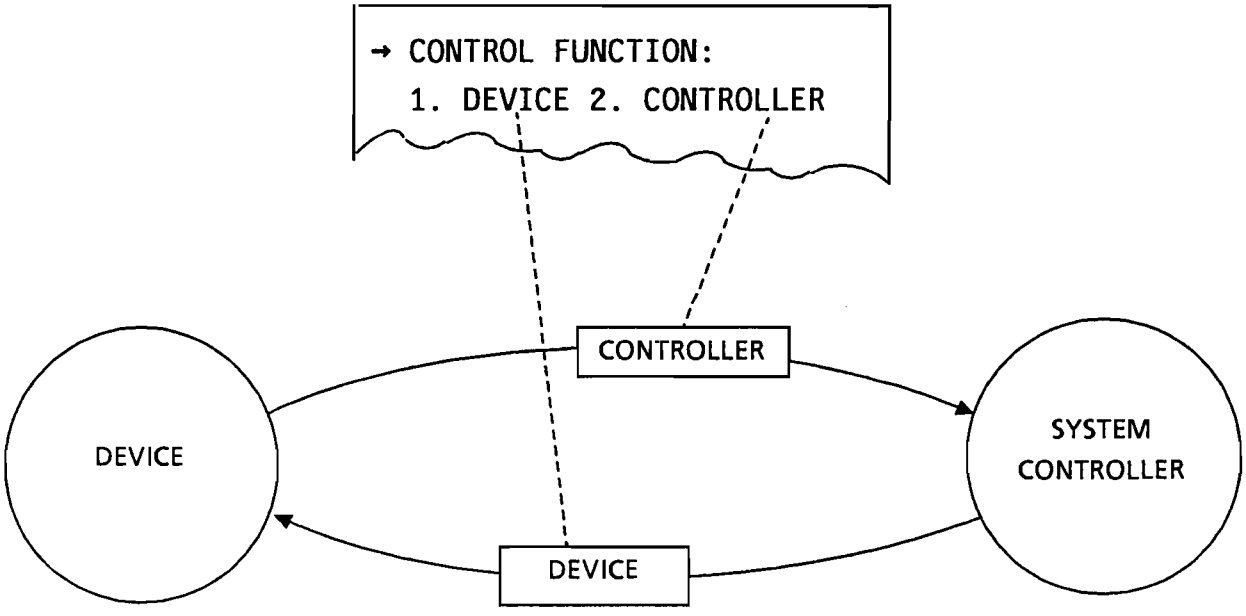
Move the cursor to a desired parameter using numeric keys, arrow keys, or ENTRY dial, then press the ENTER key.

3.3.1 Switching between device and controller (CONTROL FUNCTION)

Determine whether the GPIB port 1 will be used as a device port or system controller port. This determination can be made using the address switches on the rear panel or software.

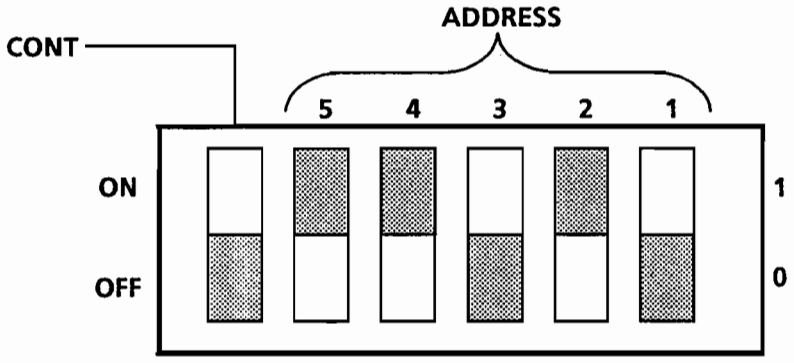
(1) Switching in the GPIB PORT1 window

Selecting DEVICE or CONTROLLER brings about the following state:



(2) Switching with the address switches on the rear panel

Setting the CONT switch located at the left of the address switches to ON and then turning on the power allows you to use the GPIB port 1 as a system controller port.



Turning on the CONT switch to OFF and then turning on the power allows you to use the GPIB port 1 as a device port.

(3) Switching under software

The PTA loaded in this analyzer has GPIB subroutines, i.e., system subroutines executed with CALL statements. Among these subroutines, CALL DEV and CALL IFC subroutines are used for switching between the device and the controller.

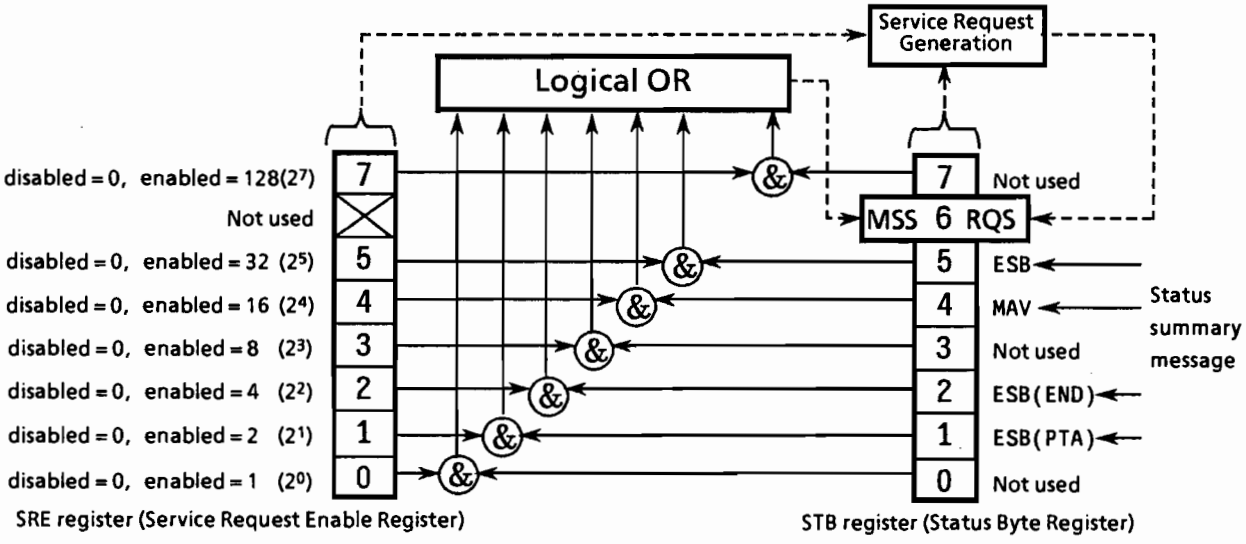
Subroutine	Description
CALL DEV	When the GPIB1 port is used as a system controller port, executing this subroutine switches it to the device port.
CALL IFC	Executing this subroutine switches the GPIB1 port to the system controller port and outputs interface clear signals to the devices connected to the GPIB1.

For more details on the switching under software, refer to the PTA User's Guide.

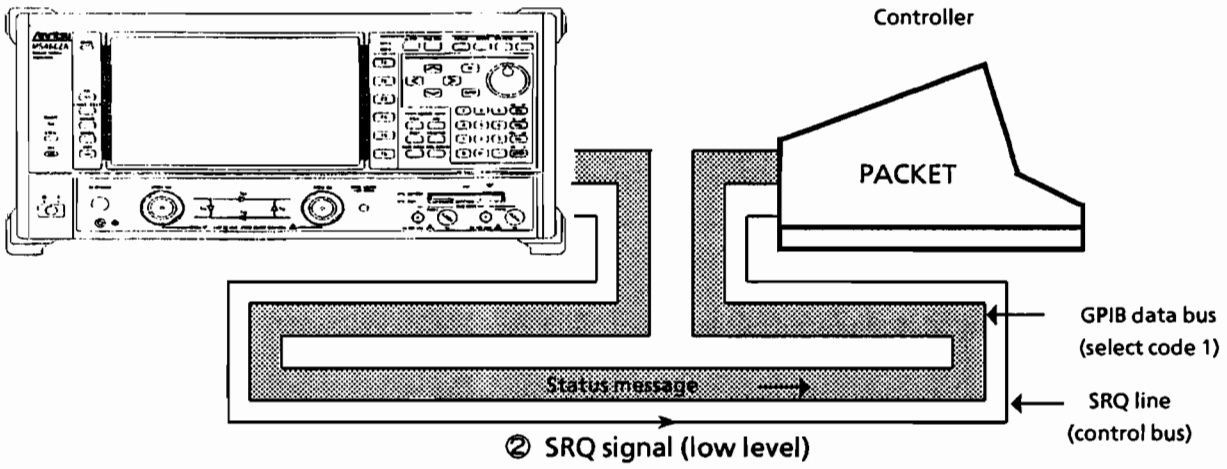
3.3.2 Turning ON/OFF the service request function (ENABLEREGISTER ALL)

Selecting ENABLE REGISTER ALL allows you to turn on/off the service request function.

ENABLE REGISTER ALL:	
OFF	**ON**
All of the service request enable (SRE) register bits 0 to 7 shown below are disabled (set to 0s), allowing a status summary message to be sent to the status byte (STB) register. A service request (SRQ) cannot be issued to the controller if any of STB register bits is set to 1.	All of the service request enable (SRE) register bits 0 to 7 shown below are enabled (set to 1s), allowing a status summary message to be sent to the status byte (STB) register. A service request (SRQ) is issued to the controller each time any of STB register bits is set to 1.



When a service request (SRQ) is turned on, the current status of this analyzer (whether sweep is being performed or it has been completed, whether the analyzer is in the UNCAL status, etc.) can be reported to the external computer (controller). This request is called a status message; in other words, it is a device function for injecting an interrupt into the controller.

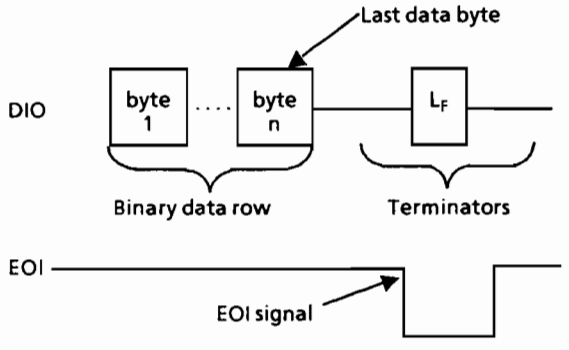
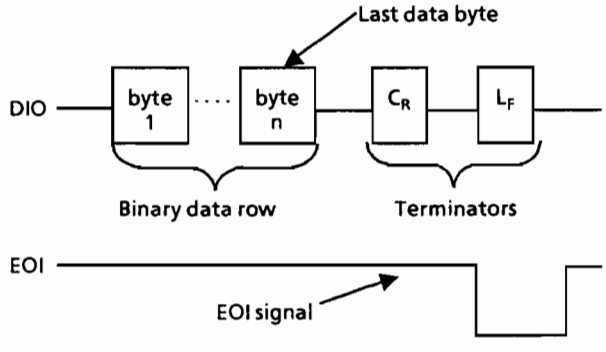


Status message sending

When the RQS bit (bit 6) of the status byte register (STB) is set to 1 by the SRQ, the level of the SRQ line shown above becomes low. This low level is used as a service request signal (SRQ = 1) for causing an interrupt from the device to the controller. Upon reception of this signal (SRQ = 1), the job currently being executed is terminated and devices are searched sequentially to determine the device that issued the SRQ. This process is called serial polling. After completion of serial polling, the device that issued the service request is assigned as a talker and the controller is assigned as a listener, causing the device to send a status message to the controller. For more details on the SRQ function, refer to Section 7, "Status Structure."

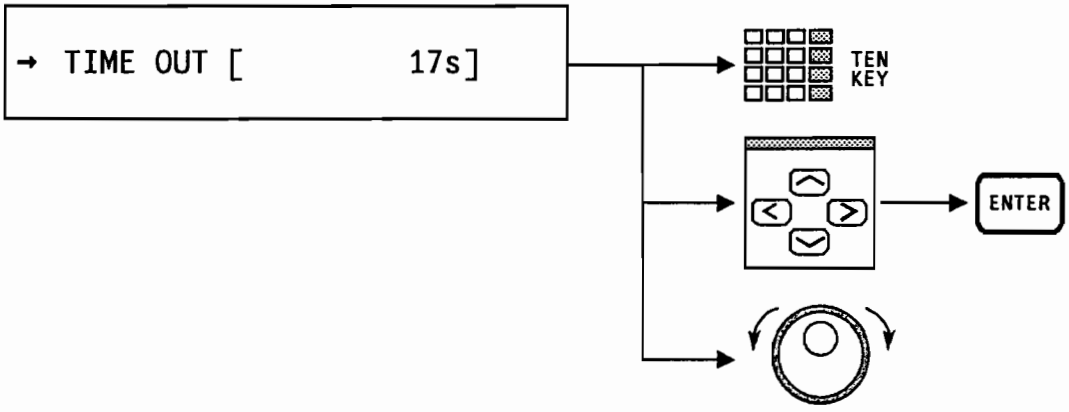
3.3.3 Selecting a terminator (TERMINATOR)

Selecting TERMINATOR allows you to determine whether CR is to be added to the terminator LF.

TERMINATOR (for TALKER)	
LF&EOI	**CR/LF&EOI**
To send out an EOI signal and terminator LF at the same time, select LF & EOI.	To send out an EOI signal and terminator LF after the CR code, select CR/LF & EOI.
	

3.3.4 Time-out (TIME OUT)

Selecting TIME OUT allows you to set the GPIB time-out time in seconds (s). If the first response message is not sent out within the time specified in response to the query from the controller, the relation between the query and the response is cancelled.



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SECTION 4
INITIAL SETTINGS

There are 3 levels of initialization for the GPIB interface system. The first level is bus initialization in which the system bus is in the idle state. The second level is initialization for message exchange in which devices are able to receive program message. The third level is device initialization in which device functions are initialized. These levels of initialization prepare a device for operation.

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The IEEE 488.1 standard stipulates the following two levels for the initialization of the GPIB system.

- Bus initialization ..... All interface functions connected to the bus are initialized by IFC messages from the controller.
- Device initialization ... The DCL GPIB bus command returns all devices to their initial states while the SDC GPIB bus command returns designated devices only to their stipulated initial states.

In the IEEE 488.2 standard the initialization levels are divided into three, with bus initialization as the highest level. The second level is initialization for message exchange and third device initialization. This standard also stipulates that a device must be set to a known state when the power is turned on. The above details are summarized in the table below.

Level	Initialization type	Description	Level combination and sequence
1	Bus initialization	All interface functions connected to the bus are initialized by **IFC** messages from the controller	Can be combined with other levels, but level 1 must come before level 2.
2	Initialization for the exchange of messages	The **DCL** and **SDC** GPIB bus commands perform initialization for message exchange for all devices and designated devices, respectively, as well as nullifying the function to report the end of operation to the controller.	Can be combined with other levels, but level 2 must come before level 3.
3	Device initialization	The ***RST** reset command resets only specified devices, from among those connected to the GPIB, to their known states regardless of the conditions under which they were previously being used.	Can be combined with other levels, but level 3 must come after levels 1 and 2.

The following mainly explains the instructions used to execute levels 1, 2, and 3, and the initialization objects resulting from the instructions. The following also explains the known states to be set at power-on.

4.1 Bus Initialization by the IFC Statement

■ Syntax

```
IFC␣@select code
```

■ Example

```
IFC @1
```

■ Explanation

The IFC line of the GPIB in the stipulated select code is kept active for approximately 100 μs (electrically low level state).

When **IFC@** is executed, the interface functions of all devices connected to the bus line of the GPIB in the select code are initialized. Only the system controller can send this command.

The initialization of interface functions involves erasing the settings made by the controller and resetting them to their initial states. In the table below, ○ indicates the functions which are initialized; ␣ indicates the functions which are partially initialized.

No	Function	Symbol	Initialization by IFC
1	Source handshake	SH	○
2	Acceptor handshake	AH	○
3	Talker or extended talker	T or TE	○
4	Listener or extended listener	L or LT	○
5	Service request	SR	␣
6	Remote/local	RL	
7	Parallel poll	PP	
8	Device clear	DC	
9	Device trigger	DT	
10	Controller	C	○

Even if the IFC statement is True (the level of the IFC line is set to low by execution of the IFC @ statement), levels 2 and 3 initialization are not performed, so, it does not affect devices operating conditions (frequency setting, LEDs ON/OFF, etc.).

The following lists the effect of the IFC statement on some device functions taken from the table above.

① Talker/listener ..... All talkers and listeners are put in the idle state (TIDS, LIDS) within 100μs.

② Controller ..... The controller is put in the idle state (CIDS - Controller Idle State) within 100μs if it is not active (SACS - System Control Active State).

③ Return of control ..... If the system controller (the device on the GPIB initially designated as controller) has given up its control function to another device, executing IFC @ returns the control function to the system controller. The system controller's RESET key causes it to output an IFC message.

④ Service request devices ..... The IFC statement has no effect on a device sending an SRQ message to the controller (the SRQ line in the figure below is set to low level by the device), but it does clear the condition that the controller has put all devices connected to the system bus into serial poll mode.

⑤ Devices in the remote state ..... The IFC statement has no effect on devices in the remote state.

4.2 Initialization for Message Exchange by DCL and SDC Bus Commands

■ Syntax

DCL␣@select code [primary address] [secondary address]

■ Example

DCL @1 ..... Initializes all devices under the bus for message exchange (sending DCL).
DCL @1Ø3 ..... Initializes only the device whose address is 3 for message exchange (sending SDC).

■ Explanation

This statement carries out the initialization for message exchange for all devices on the GPIB of the specified select code or that for specified devices only.

The purpose of initialization for message exchange is to prepare devices to receive new commands from the controller when the sections of devices used for the exchange of messages are in an inappropriate state to be controlled by the controller as the result of the execution of other programs, etc. There is no need to change the panel settings, however.

■ When only the select code is specified

This carries out the initialization for message exchange of all devices on the GPIB of the specified select code. **DCL@** sends a DCL (Device Clear) bus command to the GPIB.

■ When the address is specified

Performs initialization for message exchange for the specified device. After clearing the listeners on the GPIB of the specified select code, the specified device only is set to listener and an SDC (Selected Device Clear) bus command is output.

■ Items to be initialized for message exchange

① Input buffer and output queue ..... Cleared

② Parser, execution controller and response formatter ..... Reset

③ Device commands including ***RST** ..... All commands that interfere with the execution of these commands are cleared.

④ Coupled-parameter program messages ..... All commands (in the execution pending sections and queries) are discarded because they are coupled parameters.

⑤ Processing the ***OPC** command ..... Puts a device in OCIS (Operation Complete Idle State). As a result, the operation complete bit cannot be set in the standard event status register. (☞ P6-8)

⑥ Processing the ***OPC?** query ..... Puts a device in OQIS (Operation Complete Query Idle State). As a result, the operation complete bit cannot be set in the output queue. The MAV bit is cleared. (☞ P6-8)

⑦ Automation of system construction .... The ***ADD** and ***DLF** common commands are nullified. (These commands are not supported by this analyzer.)

⑧ Device functions ..... Functions for message exchange are put in the idle state. The device continues to wait for a message from the controller.

CAUTION

Device clear is prohibited from carrying out the followings.

① *Changing the current device settings or stored data.*

② *Interrupting front panel I/O*

③ *Changing any other status bit except clearing the MAV bit, when clearing the output queue.*

④ *Interrupting or having any effect on the device that is currently operating.*

■ Transmission sequence of GPIB bus commands by the DCL@ statement.

The transmission sequence of the DCL and SDC GPIB bus commands by the **DCL@** statement is shown in the table below.

Statement	Bus command transmission sequence (at ATN line "LOW")	Data (at ATN LINE "HIGH")
DCL@ select code	UNL, DCL	———
DCL@ device number	UNL, LISTEN address, [secondary address], SDC	———

4.3 Device Initialization by the *RST Command

■ Syntax

```
*RST
```

■ Example

```
WRITE @103:"*RST" ..... Initializes only the device of the address 3 with level 3.
```

■ Explanation

The ***RST (Reset)** is an IEEE 488.2 common command which resets a device with level 3.

Normally devices are set to various states using the commands specific to each device (device messages). The *RST command is one of these and is used to reset a device to a specific known state. The function of nullifying of the end of operation is the same as for level 2.

■ Specifying device number in WRITE@ statement

The device with the specified address is initialized with level 3.

After clearing the listeners on the GPIB of the specified select code while the ATN line is active, only the specified device is set to listener.

When the ATN line is false, the *RST command is sent.

■ Device Initialization Items

① Device-dependent functions and states ..... A device is returned to a known state regardless of its current condition. (☞ See the next page for the list.)

② Processing of the ***OPC** command ..... The device is put into OCIS (Operation Complete Idle State). As a result, the operation complete bit cannot be set in the standard event status register.

③ Processing the **OPC?** query ..... The device is put into OQIS (Operation Complete Query Idle State). As a result, the operation complete bit cannot be set in the output queue. The MAV bit is cleared.

④ Macro commands ..... Disables macro operations and puts a device in a mode in which it cannot receive macro commands. Also, the definition of macros is returned to the state specified by the system designer.

Note: The *RST command does not affect the items listed below.

① IEEE 488.1 interface state

② Device address

③ Output queue

④ Service Request Enable Register

⑤ Standard Event Status Enable Register

⑥ Power-on-status-clear flag setting

⑦ Calibration data affecting device specification

⑧ Macros defined by the DMC (Define Macro Contents) command

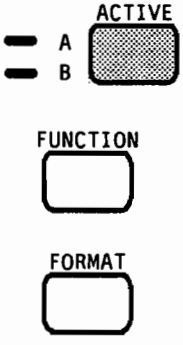
⑨ Response messages for the PUD (Protect User Data) query

⑩ Response messages for the RDT (Resource Description Transfer) query

In addition to the above parameters, this analyzer has unique parameters for setting external device control.
(☞ For parameters ③, ④, and ⑤, see Section 7. Parameters ⑧ to ⑩ are not supported by this analyzer.)

The following table lists initial settings (defaults) of the functions and states unique to this analyzer (see item ① above).

List of Default Values (1/5)

Key group	Major parameter	Command	Initial setting (default)
	ACTIVE TRACE	ACTR	TRACE-A
	S-PRM (TRACE A)	SPRM	S_{11}
	S-PRM (TRACE B)	SPRM	S_{21}
	S-PRM-TIME (TRACE A)	TDMA	BAND PASS
	S-PRM-TIME (TRACE B)	TDMA	S_{21}
	COORDINATE (TRACE A)	COOR	LOG MAG
	COORDINATE (TRACE B)	COOR	LOG MAG
	IMPD MARKER VALUE	IMV	|Z|/θ
	ADMT MARKER VALUE	ADV	|Y|/θ

List of Default Values (2/5)

Key group	Major parameter	Command	Initial setting (default)
MKR MKR FCTN	ACTIVE MKR No.	MSET	MK_0
	INACTIVE MKR No.		MK_1 to 9
	ZONE (LEFT & RIGHT) MKR:	CPL_ZNAB	ON
	ZONE LEFT POINT (TRACE A)	ZNA_Ø	(MEP† – 1)/4
	ZONE LEFT POINT (TRACE B)	ZNB_Ø	(MEP† – 1)/4
	ZONE RIGHT POINT (TRACE A)	ZNA_Ø	(MEP† – 1)/4
	ZONE RIGHT POINT (TRACE B)	ZNB_Ø	(MEP† – 1)/4
	ZONE LEFT FREQUENCY (TRACE A)	ZNA_1	744 ··· GHz
	ZONE LEFT FREQUENCY (TRACE B)	ZNB_1	744 ··· GHz
	ZONE RIGHT FREQUENCY (TRACE A)	ZNA_1	2.25 ··· GHz
	ZONE RIGHT FREQUENCY (TRACE B)	ZNB_1	2.25 ··· GHz
	MKR TRACE-A, B COUPLE	CPL_MKR	ON
	MKR POINT MKR 0 to 9	MSET_Ø	MKR 0 to 9: 125
	MKR FUNCTION (TRACE A/B)	MKR	NORMAL
	REFERENCE MKR No.(TRACE A/B)	RMKR	MK_O
	ACTIVE MKR FREQUENCY VALUE	MKF?	1.5 ··· GHz
	ACTIVE MKR DISTANCE VALUE	MKF?	Depends on setting
	ACTIVE MKR TIME VALUE	MKF?	Depends on setting
	SCALE (TRACE A)	SCAL	10 dB/ (LOG MAG)
	SCALE (TRACE B)	SCAL	10 dB/ (LOG MAG)
	OFFSET (TRACE A)	OFST	0.000 dB (LOG MAG)
	OFFSET (TRACE B)	OFST	0.000 dB (LOG MAG)
SCREEN	DUAL TRACE MODE	DF2	OFF (SINGLE)
	TRACE-A OVERLAP ON/OFF	OVPA OVP	OFF
	TRACE-B OVERLAP ON/OFF	OVPB OVP	OFF
	GRID MODE	DF1	ALL
	OFFSET LINE	OFS	5
	DISPLAY ITEM CODE	DF3 DF4	Displays all items
	TRCE-A, B STORAGE ON/OFF	STOR	OFF

† Measurement Point

List of Default Values (3/5)

Key group	Major parameter		Command	Initial setting (default)
FREQ	TRACE-A, B COUPLE ON/OFF	CENTER FREQUENCY	CPL␣SWP	ON, 1.5 GHz
		SPAN FREQUENCY	CPL␣SWP	ON, 2 GHz
		START FREQUENCY	CPL␣SWP	ON, 100 kHz
		STOP FREQUENCY	CPL␣SWP	ON, 3 GHz
		RBW	CPL␣AVG	ON, AUTO
	FREQUENCY SWEEP MODE		FRQ	START/STOP
	DISTANCE/TIME SELECT		TAMD	TIME
	START TIME		STTM	−0.010 μs
	SPAN TIME		SPTM	0.050 μs
SWEEP	REPEAT/SINGLE SWEEP (TRACE A/B)		SW2 SWP	REPEAT SWEEP
	SWEEP TIME (TRACE A/B)		SWT	AUTO: 125 ms
	SWEEP LOG/LIN MODE (TRACE A/B)		LOG	LINEAR
	SWEEP RANGE MODE (FULL/MKR) (TRACE A/B)		SW1	FULL SWEEP
PORT POWER	TRACE-A, B COUPLE ON/OFF	PORT1 INPUT ATT	CPL␣SWP	ON, 0 dBm
		PORT2 INPUT ATT	CPL␣SWP	ON, 0 dBm
		DELAY RANGE	CPL␣SWP	ON, 400 ms
		HSDLY DISTANCE	CPL␣SWP	ON, 1 %
	PORT1 INPUT		IATA	0 dB
	PORT2 INPUT		IATB	0 dB
	TEST PORT POWER		OPL	0 dBm
	SOURCE POWER		SPWR	+13 dBm
	OUTPUT ATT		OATT	0 dB
	OUTPUT OFFSET		OOFS	−13 dB
	POWER SWEEP ON/OFF		LSW	OFF
	POWER SWEEP START LEVEL (TRACE A/B)		STL	0 dBm
	POWER SWEEP STOP LEVEL (TRACE A/B)		SOL	+10 dBm
	POWER SWEEP STEP LEVEL (TRACE A/B)		SEL	1.00 dB
	POWER LEVEL TRACE-A, B COUPLE ON/OFF		CPL␣SWP	ON

List of Default Values (4/5)

Key group	Major parameter	Command	Initial setting (default)
PORT POWER	APERTURE FREQUENCY (TRACE A/B)	APF	24 MHz
	DELAY RANGE SETTING MODE (TRACE A/B)	——	DELAY RANGE
FREQ/TIME	TIME DOMAIN ON/OFF	TMDM	TIME DOMAIN OFF
TIME DOMAIN	GATE ON/OFF		OFF
	RESPONSE	RSPS	IMPULSE
	GATE SHAPE	GSHP	RECTANGULAR
	FILTER SHAPE	FSHP	RECTANGULAR
AVG	AVERAGE TYPE (TRACE A/B)	AVT	SUM
	AVERAGE NUMBER (TRACE A/B)	AVG	1
	SMOOTHING (TRACE A/B)	SMT	0 %
CAL	CAL ON/OFF (X → S, X-S)	CAL	X → S OFF
	X-S ON/OFF	CXS	X-S OFF
	CAL METHOD	ECL	X-S
PACKAGE	BREAK POINT (TRACE A/B)	BKP	1001
	TITLE	TEN	ALL SPACES
	TITLE ON/OFF	TTL	OFF
	MEASURE POINT (TRACE A/B)	MEP	251
	SOURCE MEMORY	CSCE	TRACE-A
	DISTINATION MEMORY	CDST	TRACE-A
	CALCULATION	CEXE	D+S
	INITIAL FORMAT	——	0 CLEAR
	REAL PART	CNST	1.00000
	IMAGINARY PART	CNST	0.00000
	INITIALIZE EXECUTED	——	END
	ELECTRIC LENGTH	CPL_ELG	0.000 m

List of Default Values (5/5)

Key group	Major parameter	Command	Initial setting (default)
SAV/RCL	DATA STORAGE UNIT PORT SELECT	PMCA	PORT-2
	DATA STORAGE UNIT GPIB ADDRESS	PMCA	19
	DRIVE SELECT CODE	PMCS	INT PMC
	RECALL FUNCTION No. CODE	RCM	MEMORY 0
	SAVE FUNCTION No. CODE	SVM	MEMORY 0
	SAVE S-MEMORY ON/OFF	SV2	OFF
	SAVE X-MEMORY ON/OFF	SV3	OFF
	SAVE CALIBRATION MEMORY ON/OFF	SV6	OFF
	WORK MEMORY ON/OFF	SVDM␣m (m:1~4)	OFF
LOCAL	REMOTE/LOCAL FUNCTION	GTLT	LOCAL†
	GPIB OUTPUT TERMINATOR (PORT-1)	TRM	LF & EOI
	GPIB TIME OUT (PORT-1)	GTM	20 s
	DEVICE SELECT (PRINTER or PLOTTER)	PLTD	PRINTER
	PRINTER ADDRESS	PRIA	17
	PRINTER DEVICE SELECT	PRIM	UA-455A
	PLOTTER ADDRESS	PLTA	17
	PLOTTER DEVICE SELECT	PLTM	GP-GL
	PLOT SIZE	PLF	A4 SIZE
	FORM FEED	PFF	FF IS NOT OUTPUT
	PLOT POSSION CODE	PLPS	ALL
	PLOT ITEM	PLI	ALL ITEM
	GPIB SRQ ON/OFF	SRQ	OFF
	GPIB OUTPUT TERMINATOR	TRM	LF & EOI
	GPIB TIME OUT	GTM	20 s
PTA	PTA ON/OFF	PTA	OFF
	PTA PROGRAM INPUT/OUTPUT	PTL	OFF
	PTA BUSY/NORMAL	PTA?	NORMAL

† GTL is a bus command (interface message). To place the device in the local mode by executing this command, use an LCL@ statement.

4.4 Device Initialization by the INI Command

■ Syntax

```
INI
```

■ Example (program message)

```
WRITE @103:"INI"  .....  Initializing only the device assigned address 3 with level 3.
```

■ Description

The **INI** command is one of device messages unique to this analyzer. It is sent from the controller to the device as a program message to reset the specified device at level 3.

This command functions the same as the *RST command except PTA functions.

■ Specifying a device number in the WRITE@ statement

Initializes a device assigned to a specific address provided that it is at level 3.

The sequence of issued out commands is as follows; first, the listener (s) with the specified selection code is (are) released by the GPIB when the ATN line becomes true, then only the designated device (s) is (are) reestablished as listener (s). When the ATN line becomes false, the INI command is output to the newly established listener (s).

■ Device parameters to be initialized

The device parameters that need to be initialized are the same as those described for the ***RST** command.

The parameters related to PTA control do not need to be reinitialized.

4.5 Device Status at Power-on

When the power is switched on:

① The state (backup state) set when the power was turned off last is restored.

② The input buffer and output queue are cleared.

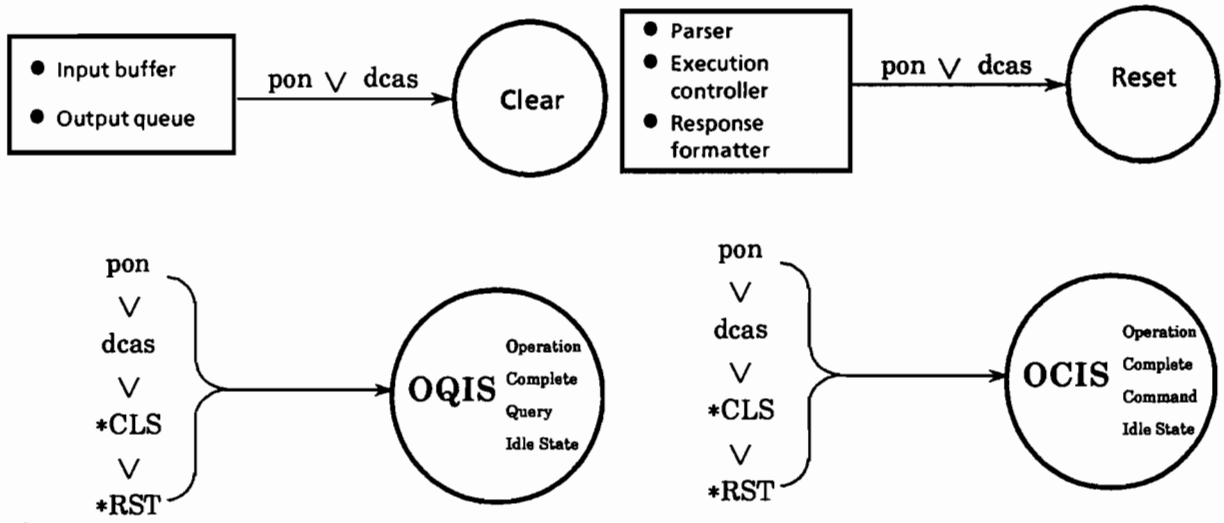
③ The parser, execution control and response formatter are reset.

④ The device is put into the OCIS (Operation Complete Command Idle State). (☞ P6-8)

⑤ The device is put into the OQIS (Operation Complete Query Idle State). (☞ P6-8)

⑥ Since this analyzer does not support a ***PSC** command, the standard event status register and standard event status enable register are cleared. Events are stored after these registers have been cleared.

If there is no backup data as an exceptional case of ①, the device state is restored according to the default table given on pages 4-9 to 4-13. The diagram below shows the transition states fo items ② to ⑤.



■ Items which do not change at power-on

① Address

② Related calibration data

③ Data or states which are changed by responses to the common queries listed below.

*IDN? (☞ P7-6)

*OPT? (Not supported by this analyzer)

*PSC? (Not supported by this analyzer)

*PUD? (Not supported by this analyzer)

*RDT? (Not supported by this analyzer)

■ Items related to power-on-status-clear (PSC) flag

The PSC flag has no effect on the Service Request Enable Register (☞ P87-10), Standard Event Status Enable Register (☞ P7-12) or Parallel Poll Enable Register when it is false. These registers are cleared when it is true or the ***PSC** command is not being executed.
(☞ The PSC command is not supported by this analyzer)

■ Items which change at power on

① Current device function state

② Status information

③ ***SAV/*RCL** registers (Not supported by this analyzer.)

④ Marco-definition defined by the ***DDT** command
(Not supported by this analyzer.)

⑤ Marco-definition defined by ***DMC** command
(Not supported by this analyzer.)

⑥ Macros enabled by the ***EMC** command (Not supported by this analyzer.)

⑦ Addresses received by the ***PCB** command (Not supported by this analyzer.)

SECTION 5
DEVICE MESSAGE FORMATS

This section explains the formats of device messages transmitted between the controller and devices through the GPIB. Device messages are the data transmitted between the controller and devices and they are classified into program messages (data sent from the controller to this analyzer) and response messages (data sent from this analyzer to the controller).

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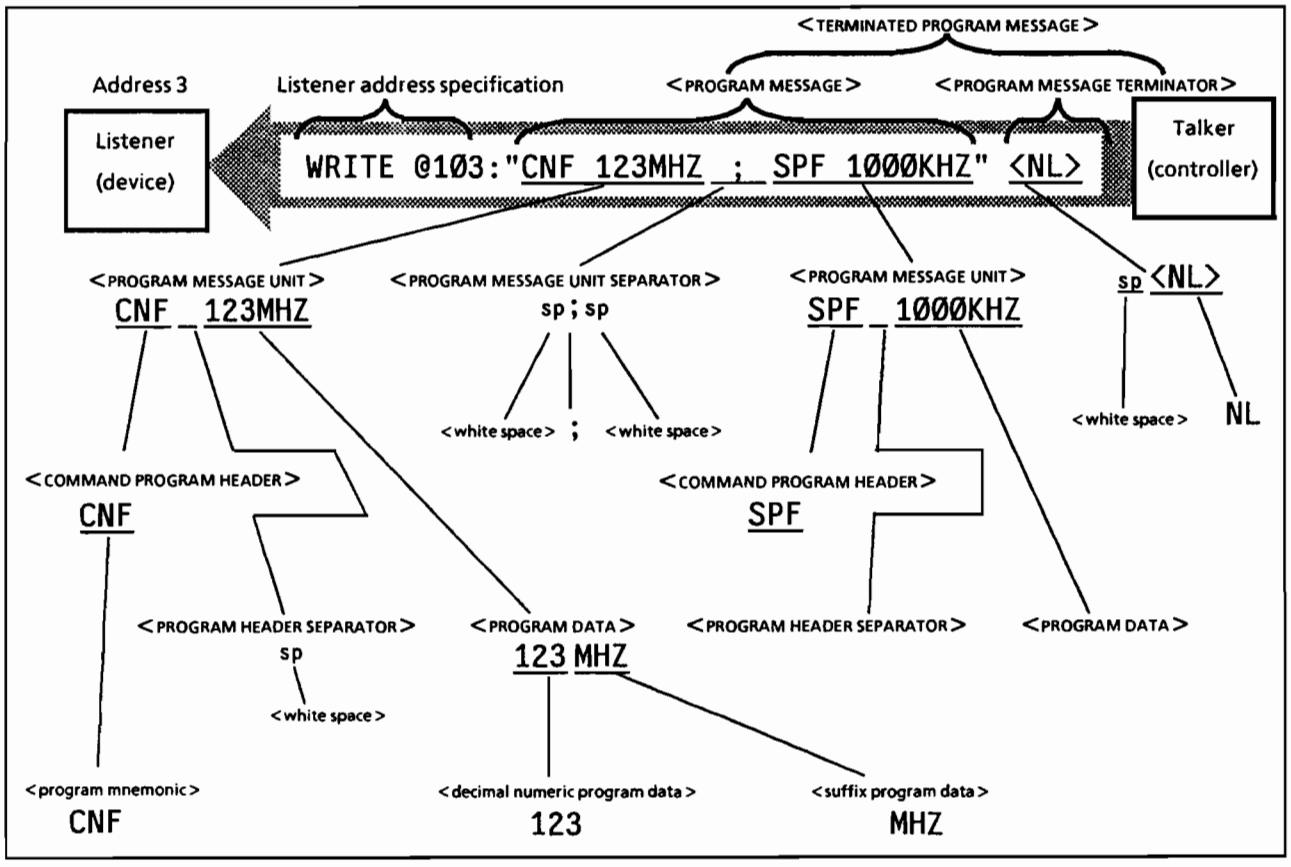
5.1 Outline of Program Message

A program message is a sequence of program message units. These units consist of a program command used to set device parameters or to specify processing and a query for asking about parameters and measurement result.

Program messages comprise a sequence of program message units which are either program commands or program queries. In the diagram below, in which the center frequency is set to 123 MHz and the span to 1000 kHz, the controller sends a program message, composed of two program units – **CNF 123 MHz** and **SPF 1000 kHz** – linked by a program-message unit separator to a device.



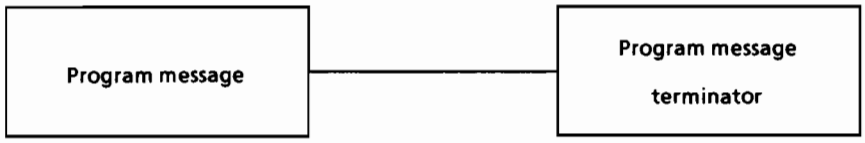
The program message format is a sequence of functional elements which are the minimum requirement for indicating a function. The groups of upper-case alphabetic characters enclosed by < > in the diagram above are examples of functional elements. Functional elements can be further divided into "encoded elements". The groups of lower-case alphabetic characters enclosed by < > in the diagram above are examples of encoded elements.

A diagram indicating the selection of functional elements on a specific path is called a functional syntax diagram, while a diagram indicating the selection of encoded elements on a specific path is called an encoded syntax diagram. The following pages explain program message format using these two diagrams.

Encoded elements represent encoded elements of the actual bus required to send functional element data bytes to a device. Listeners (which receive the functional element data bytes) determine whether they conform to the rules for encoding. If they do not, the listener does not recognize them as functional elements and generates a command error.

5.2 Program Message Format

When a program message is output from the controller program to this analyzer in response to a WRITE statement or the like, the following format is used:

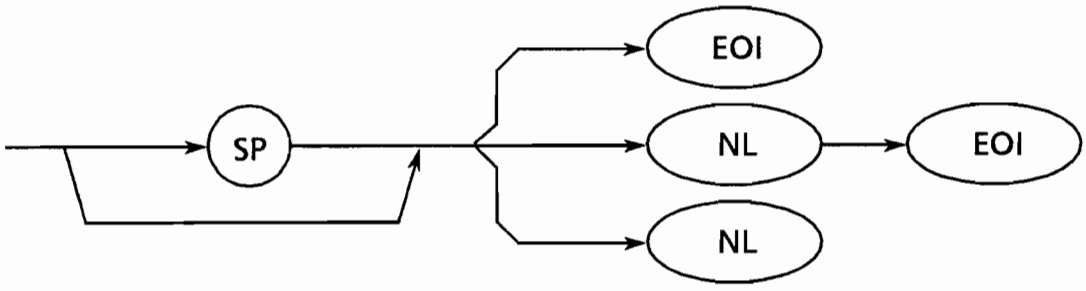



```
WRITE @1Ø3;"CNF 4GHZ"
```

Program message

When the program message is output from the controller to this analyzer, a specified terminator is added.

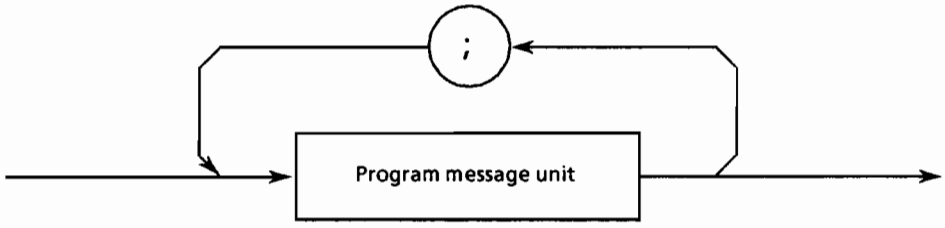
(1) Program message terminators



NL : New line or LF (line feed)

CR (carriage return) is not handled as a terminator but it is ignored.

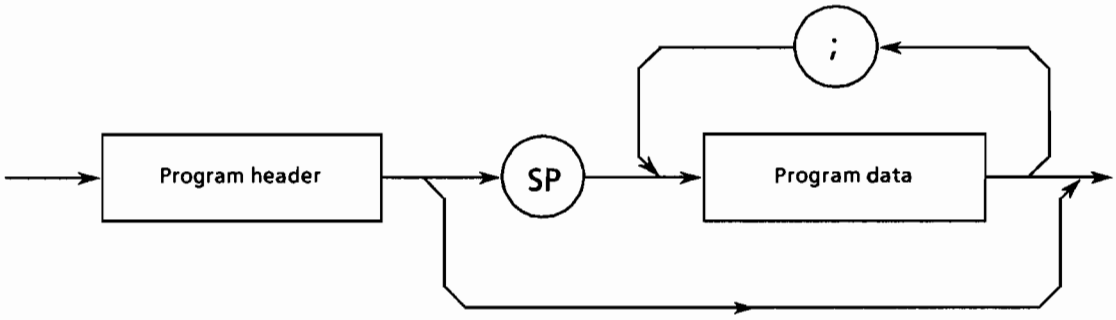
(2) Program message



More than one command is able to output, with commands separated by semicolons (;).

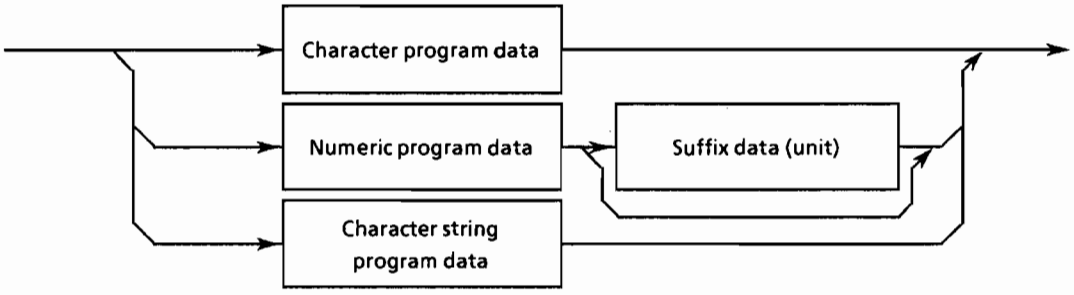
Example: WRITE @103:"CNF 123MHZ ; SPF 1000KHZ" <NL>

(3) Program message units



- The program header of an IEEE 488.2 command program is preceded by *.
- The program header of a program query ends with a question mark (?).

(4) Program data



(5) Character program data

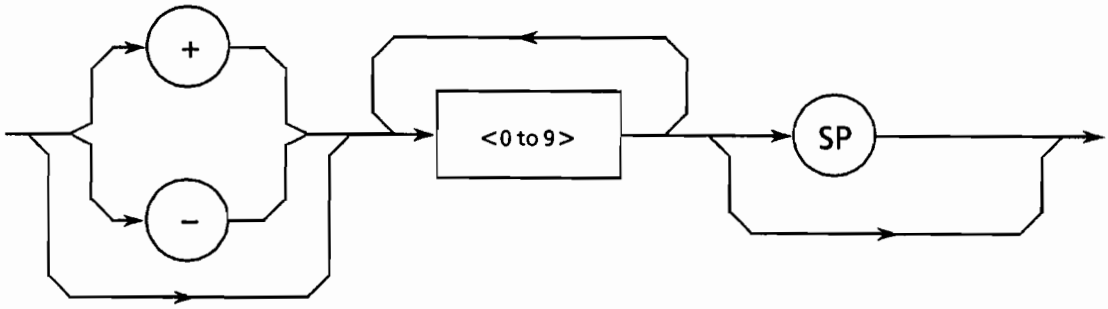
Character program data is a character string consisting of alphabetic characters (A to Z and/or a to z), numeric characters 0 to 9, and an underline(s) (_).

Example: WRITE @103; "CPL MKR,ON" ..... Turns on the marker function coupling.

(6) Numeric program data

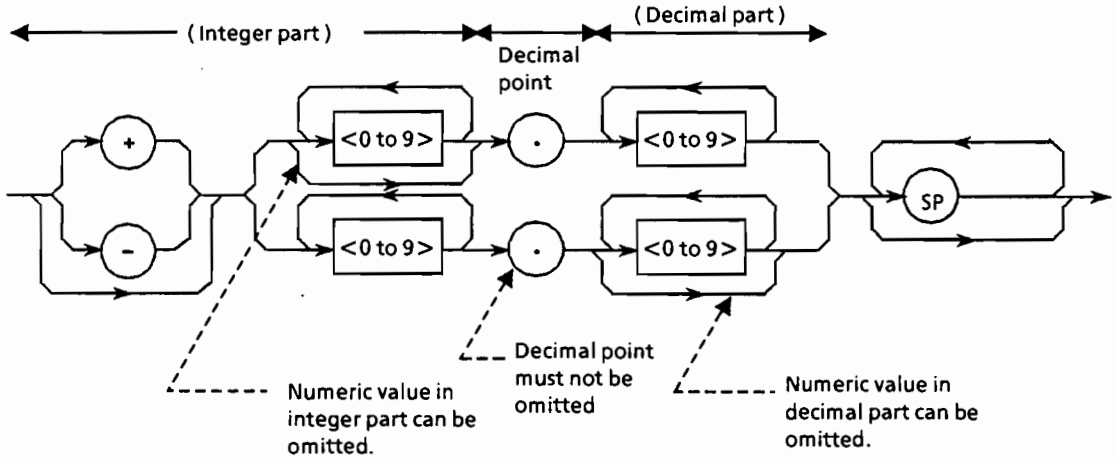
There are two types of numeric program data: integer data (NR1) and fixed point data (NR2).

< Integer data (NR1) >



- Zero (0) can be inserted before a numeric value. → 005, +000045
- A space cannot be inserted between a sign (+or−) and numeric value. → +5, + ␣5 (×)
- Space can be inserted after a numeric value. → +5␣␣␣
- Positive numeric values need not be prefixed with the + sign. → +5, 5
- Commas must not be used to delimit digits. → 1,234,567 (×)

< Fixed point data (NR2) >



- Numeric value representation in integer format applices to (Integer part).
- A space must not be inserted between a numeric value and decimal point.→ +753␣.123 (×)
- Space can be inserted after a numeric value in (decimal part) → +753.123␣␣␣␣
- Fractional values can be represented without whole number values before the decimal point. → .05
- Signs can be fixed before the decimal point. → +.05, −.05
- Numeric values ending with the decimal point are acceptable. → 12.

(7) Suffix data (unit)

When this analyzer is set in the default state, the following suffix codes are used:

Suffix Codes

Classification	Unit	Suffix code	Name
Frequency	Hz	HZ	Hertz
Time	s	S	Second
Length (meter)	m	M	Meter
Capacitance	F	F	Farad
Inductance	H	H	Henry
Conductance	S	S	Siemens
Angle (degree)	deg	DEG	Degree
Decibel	dB	DB	Decibel
Power	dBm	DBM	Decibel milliwatt
Resistance	Ω	OHM	Ω
Voltage	V	V	Volt
Ratio (percent)	%	PCT	%

When the analyzer is not in the default state, the above suffix codes are combined with the following suffix multiplier if it is necessary to handle larger units of measure.

Suffix Multipliers

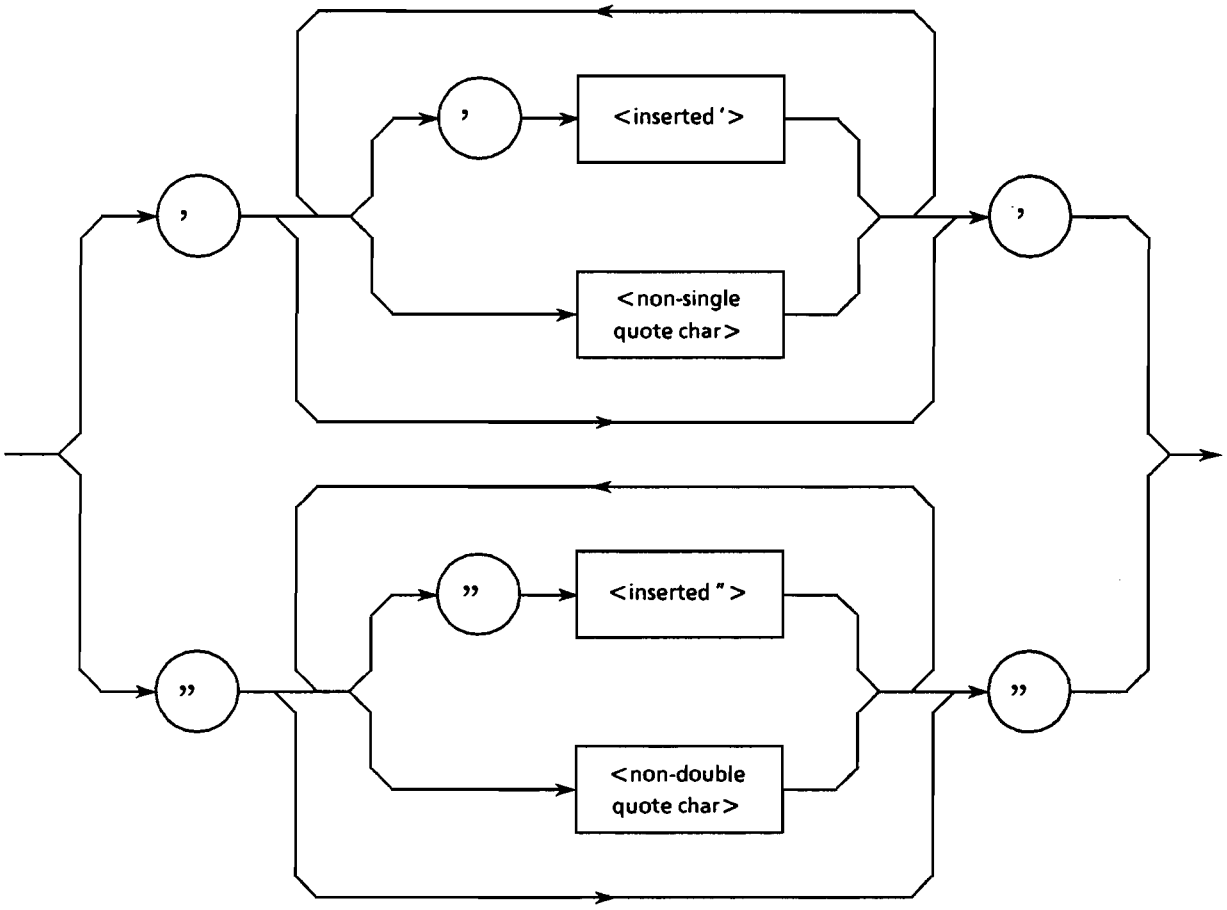
Multiplier	Mnemonic	Name
1E18	EX	EXA
1E15	PE	PETA
1E12	T	TERA
1E9	G	GIGA
1E6	MA	MEGA
	(see Note on next page)	
1E3	K	KILO
1E-3	M	MILLI
	(see Note on next page)	
1E-6	U	MICRO
1E-9	N	NANO
1E-12	P	PICO
1E-15	F	FEMTO
1E-18	A	ATTO

Note: HZ $\times 10^6$ is represented as MHZ (megahertz) and OHM $\times 10^6$ as MOHM (megaohms). When M is used, the portions indicating 10^{-3} are directly expressed with 1E-3 or 1E3U to prevent confusion with M = 10^{-3}. (See the table below.)

Classification	Unit	Suffix code
Frequency	GHz	GHZ
	MHz	MHZ
	kHz	KHZ
Time	ms	1E-3S or 1E3US
	μs	US

(8) <STRING PROGRAM DATA>

<STRING PROGRAM DATA> is program data specially for character strings. All of the ASCII 7-bit codes can be used. Single or double quotation mark used in a character string must be written in pairs of the same type, one immediately after the other.



- Both ends of a character string must have single or double quotation mark regardless of whether there are quotation mark within the character string.
  Example:

```
It's a nice day.        → "It's a nice day."
                        → 'It's a nice day.'
```

- If both ends of a character string have single quotation mark, single quotation mark used within the character string must be repeated. Other characters, including double quotation mark, can be left as they are.
  Example:

```
"I shouted,'Shame'."    → '"I shouted,''Shame''."'
```

- If both ends of a character string have double quotation mark, double quotation mark used within the character string must be repeated. Other characters, including single quotation mark, can be left as they are.
  Example:
  `"I shouted,'Shame'."` → `""""I shouted,'Shame'."""`
- <'> is a single ASCII code byte of 27 (decimal 39 = ') and <"> is a single ASCII code byte of 22 (decimal 34 = "). The <non-single quote character> and <non-double quote character> are both single ASCII symbols.

Example: Use the header TTLD to record a title character string. (Valid only when the MS2802A is used)

1) When sending character strings using program data enclosed in single quotation marks

① Source program data → `ANRITSU "MS4662A"`

② TTLD command and the data → `TTLD 'ANRITSU "MS4662A"'`

③ `WRITE @` statement data → `"TTLD 'ANRITSU ""MS4662A""'"`

④ Program → `WRITE @101:"TTLD 'ANRITSU ""MS4662A""'"`

When data is sent using the `WRITE @` statement, a colon is placed to the left of the character string expression. If a character string constant is to be used as one of the character string, double quotation mark must be written at both ends of it. Where there are double quotation marks within a character string data, two sets of quotation marks must be used.

2) When sending character strings using program data enclosed in double quotation mark

① Source program data → `ANRITSU "MS4662A"`

② TTLD command and the data → `TTLD "ANRITSU ""MS4662A"""`

③ `WRITE @` statement data → `"TTLD ""ANRITSU """"MS4662A""""""""`

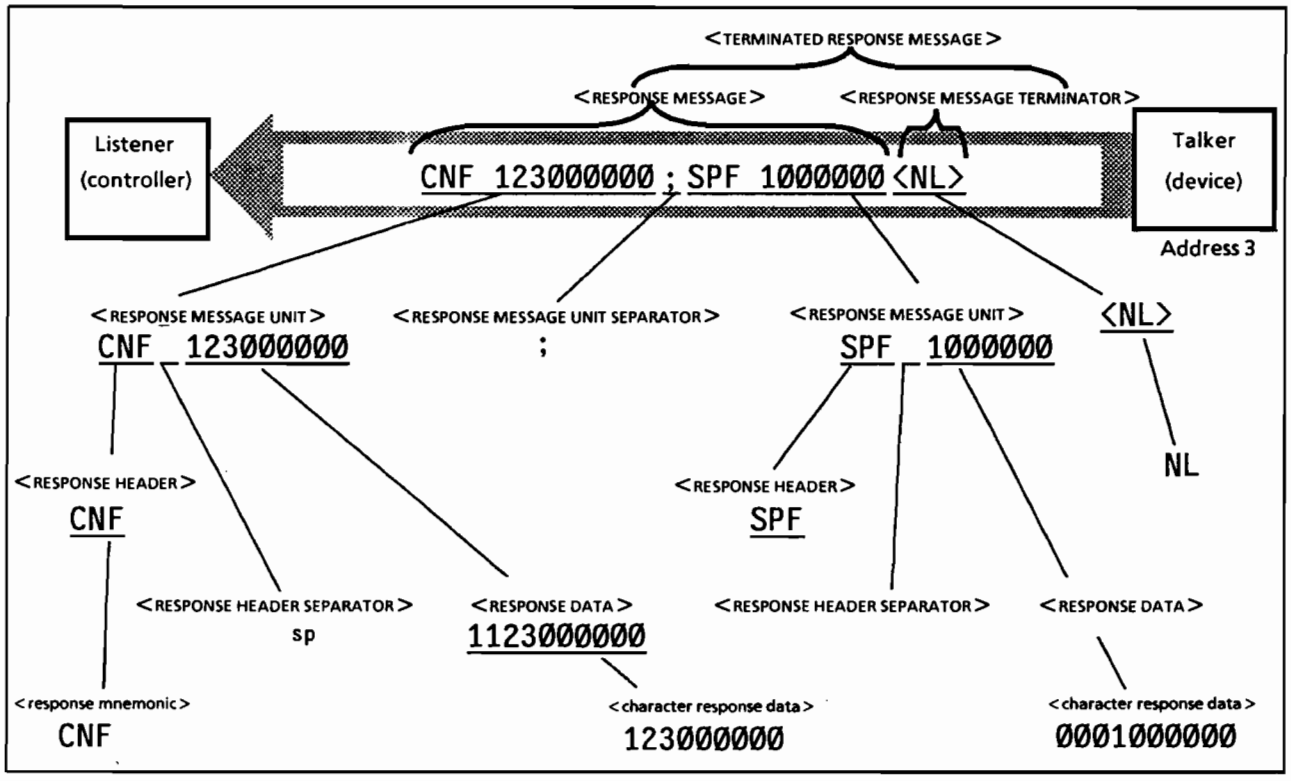
④ Program → `WRITE @101:"TTLD ""ANRITSU """"MS4662A""""""""`

On account of the controller software, the number of quotation marks used in ③ and ④ of 1) and 2) (except those used at either end of the character string) are double the number used in ②.

5.3 Outline of Response Message

In the bus data mode, i.e. when the ATN line is false, two types of data message are transmitted between the controller and a device via the system interface: program messages and response messages. This section describes the format of the response messages sent by a talker device to the controller.

Typical response messages are measured results, setting conditions and status information. Response messages may or may not have a header. In the diagram below, ASCII character string response messages with headers are sent from a device to the controller in response to the center-frequency query message unit **CNF?** and the span-frequency query message unit **SPF?**



The program for the above would be as follows:

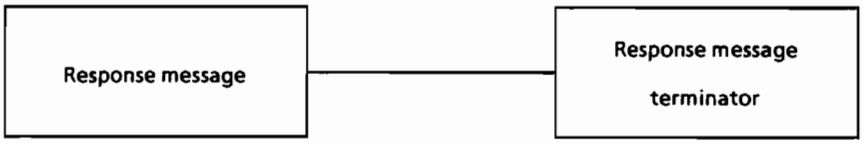
```
100 WRITE @103:"CNF? "! ..... Center frequency query message unit
110 READ @103:A$! ..... When a terminator "NL" is detected, the response message
                        "CNF 1230000000000" is read into A$.
120 WRITE @103:"SPF? "! ..... Span frequency query message unit
130 READ @103:B$! ..... Reads span frequency response message into B$
```

As for program messages, response messages are made up of a sequence of functional elements which are the minimum unit capable of expressing function. The upper-case alphabetic character items inside < > in the diagram above are examples of functional elements. Functional elements can be further subdivided into coded elements. The lower-case alphabetic character items inside < > in the diagram above are examples of coded elements. Thus, the way of expressing items on functional syntax diagrams is the same for talker and listener.

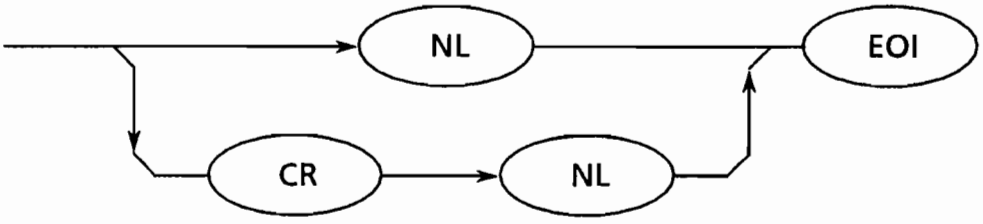
The following pages explain the talker device output format focussing on the differences between it and the listener device input format.

5.4 Response Message Format

When the controller inputs a response message from this analyzer using a READ statement or the like, the following response message format is used:

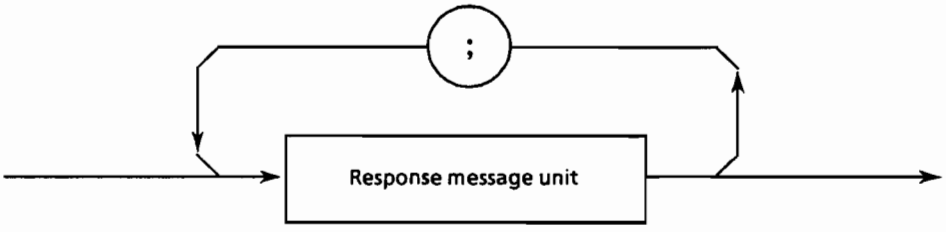


(1) Response message terminator



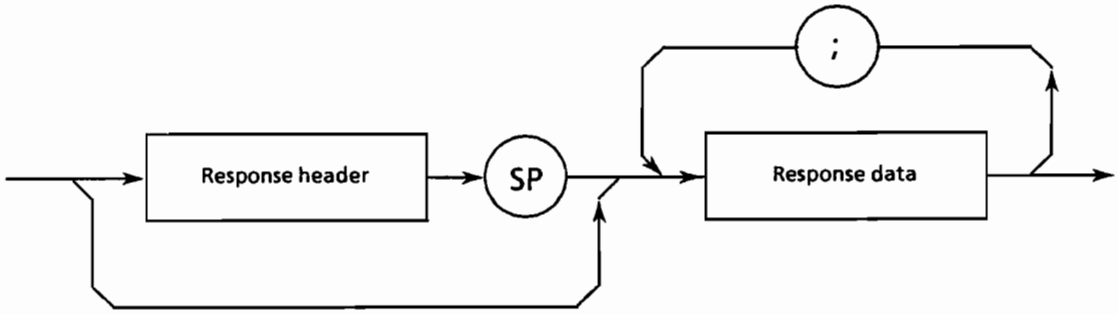
Use a TRM command to determine which response message terminator is to be used.

(2) Response message

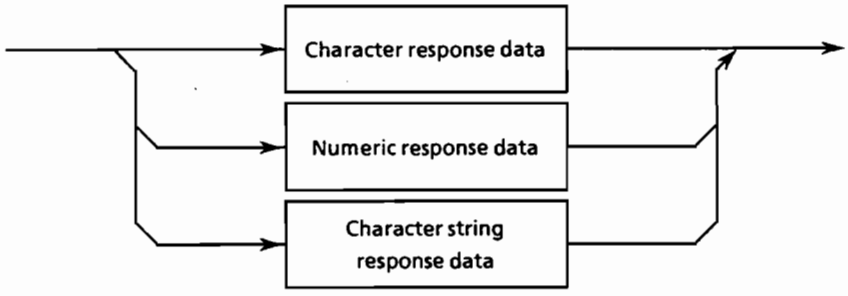


A response message consists of one or more response message units corresponding to one or more program queries made with a WRITE statement.

(3) Ordinary response message unit



(4) Response data

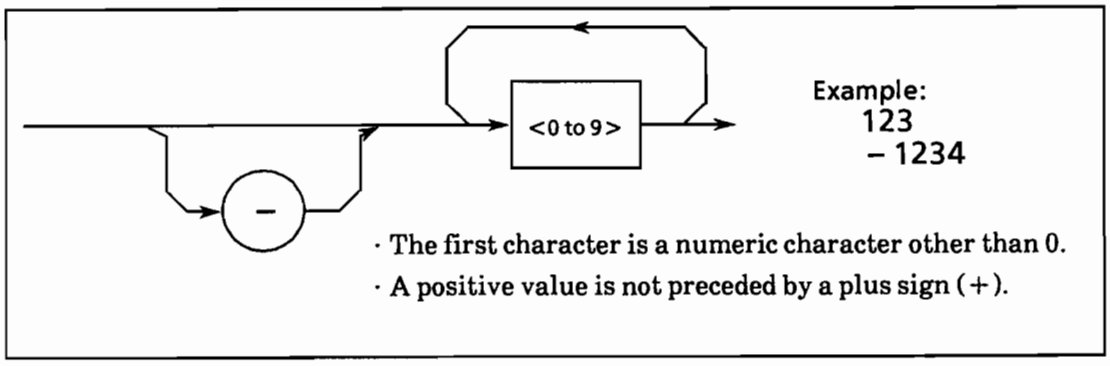


(5) Character response data

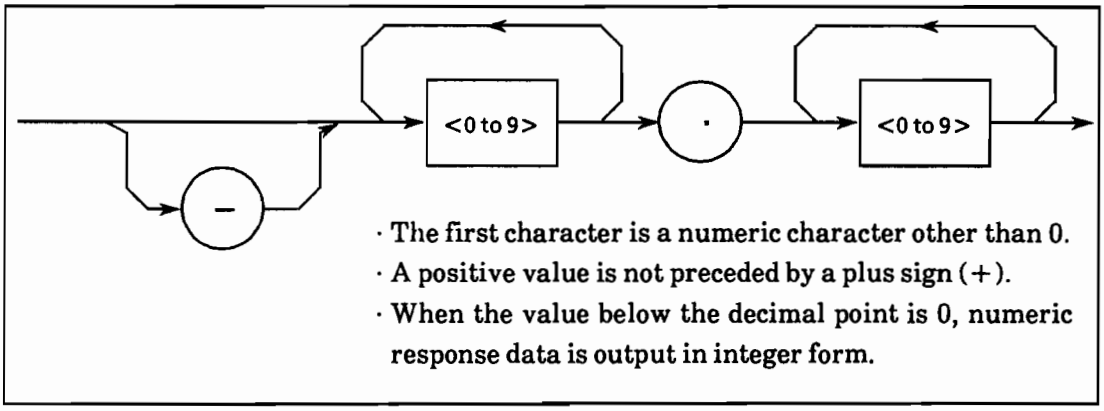
Character response data is a character string consisting of alphabetic characters (A to Z and/or a to z), numeric characters 0 to 9, and an underline(s) (_).

(6) Numeric response data

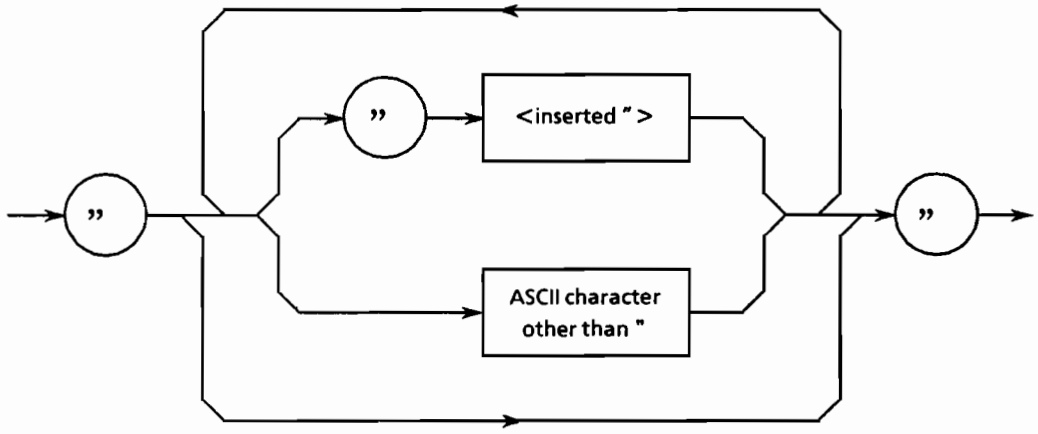
<Integer data (NR1)>



<Fixed point data (NR2)>



(7) Character string response data



The data is output in ASCII string with " signs on both ends.

(8) Waveform data input response message represented by binary data

See 8.18, "Trace Data Transfer and Write."

5.5 Examples of Descriptions of Program Data and Response Data

Data	Code
Meaning	The value of this code indicates an associated value or state.
Kinds	m, n, p
Actual description	DRG␣Ø5 (␣ indicates a space.)
General description example	DRG m m = 00 to 22 6 characters (Number of output characters including those in program header and program data)

Data	Real number
Meaning	The value itself indicates a certain value.
Kinds	r, r1, r2, ...
Actual description	OFS␣␣␣␣1ØØ, OFS␣␣␣-1ØØ (␣ indicates a space.)
General description example	OFS r r=−32000 to 32000 10 characters (Number of output characters including those in program header and program data, or number of characters in program data)

Data	Exponent
Meaning	The value itself indicates a certain value. When many characters are required to represent a real number to be output, it is represented using an exponent.
Kinds	e, e1, e2, ...
Actual description	␣7.ØØØØØE-Ø5, -3.3Ø227E+Ø4 (␣ indicates a space.)
General description example	e1, e2 25 characters (Number of characters in response data)

Data	Frequency (data represented in Hz)
Meaning	Used to output a frequency value. It is represented in the same manner irrespective of the output format.
Kinds	f (The number of characters output as a frequency value is always 14) f1 (The number of characters output as a frequency value is always 15) f2 (The number of characters output as a frequency value is always 11)
Actual description	CNF␣␣-5ØØØØØØØØØ.ØØØ (␣ indicates a space.)
General description example	CNF f f=0 Hz to 3 GHz 18 characters (Number of output characters including those in program header and program data)

Data	Electrical length (data represented in m)
Meaning	Used to output an electrical length value.
Kinds	1
Actual description	FLG␣␣␣␣-100.0000000 (␣ indicates a space.)
General description example	ELG ℓ ℓ = −999999.9999999m to +999999.999999m 19 characters (Number of output characters including those in program header and program data)

Data	Text
Meaning	A character string representing data
Kinds	T$
Actual description	TEN␣ANRITSU MS4662A NWA (␣ indicates a space.)
General description example	TEN T$ (Text data is output as it is.) 24 characters (Number of output characters including those in program header and program data)

Data	Time
Meaning	Used to output time data.
Kinds	t
Actual description	TFRQ␣␣␣28.031400 (␣ indicates a space.)
General description example	TFRQ t t = −999.999999 μs to +999.999999 μs 16 characters (Number of output characters including those in program header and program data)

Data	Date and time
Meaning	Used to set and output the last two digits of Gregorian year, month, day, hour, and minute.
Kinds	YY MM DD hh mm
Actual description	DATA␣91,07,21 (␣ indicates a space.)
General description example	DATA␣YY,MM,DD YY = 00 to 99 MM = 01 to 12 DD = 01 to 31 13 characters (Number of output characters including those in program header and program data)

Data	Bit representation
Meaning	Used to output ON/OFF information inclusively as status.
Kinds	h
Actual description	Ø1Ø111110Ø1Ø
General description example	h h = 0000000000 to 1111111111 10 characters (Number of characters in response data)

Data	Others (horizontal-axis coordinates read)
Meaning	The output format of the marker display value depends on the unit of measure used for horizontal coordinates, so it is represented by a fixed character.
Kinds	d,d2
Detailed explanation	Unit of measure used for horizontal coordinates : Output format Frequency : f-format s : t-format m : 1-format * Extracted feature value read The output format of the extracted feature value depends on the unit of measure used for vertical-/horizontal-axis coordinates, so alphabetic characters are represented using exponents. (For the horizontal coordinate output format, see the explanation of marker-related measured value read.) Vertical-axis coordinate data : Same as output format Frequency : Hz Power : dB Time : s Voltage : V Length : m Absolute number : 1 (NUMERIC)

Data	Output data change variable
Meaning	Data meaning changes with the state and data request.
Kinds	d1,g1,g2,....
Actual description	ZNA␣Ø, ␣175, ␣325 (␣ indicates a space.)
General description example	ZNA m, g1, g2 [When m = 0] 15 characters (Number of characters including those in program header and program data)ZNA m, g1, g2 ZNA m, g1, g2 [When m = 1] 35 characters (Number of characters including those in program header and program data)

Data	Coordinates
Meaning	Used to indicate X/Y coordinates with CRT CONTROL.
Kinds	X, XØ, X1, Y, YØ, Y1
Actual description	DLN Ø, Ø, 5, 1Ø, 2 (,3)
General description example	DLN XØ YØ, X1, Y1, m (,n)

SECTION 6
COMMON COMMANDS

This section describes the common commands and common query commands specified in the IEEE 488.2 standard. These common commands are not the bus commands used in interface messages. Like device messages, common commands are a type of data message used in the bus data mode, i.e. when the ATN line is false. They can be used for all measuring instruments, including those made by other companies, as long as they conform to the IEEE 488.2 standard. IEEE 488.2 common commands must start with an *.

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6.1 Common Command Functions (by Group) Supported by This Analyzer

The table below lists IEEE 488.2 common command functions by group. Supported commands are listed on the following pages in alphabetical order.

Group	Function	Mnemonic
System data	Data specific to each device connected to the GPIB system, e.g. manufacturer, model, serial number, etc.	*IDN?
Internal operation	Device internal control: ① Resetting device in level 3 (See Section 4) ② Device self testing and error detection	*RST *TST?
Synchronization	Synchronization of device to controller by: ① Waiting for a service request ② Waiting for a response from the device output queue ③ Forced sequential execution	*OPC *OPC? *WAI
Status and event	A status byte consists of a status summary message. The summary bits of the message are supplied by the standard event register, the output queue and the extended event register or extended queue. Three commands and four queries are available to set or clear the data in the registers and queues, to enable or disable them and to obtain the settings status of the registers.	*CLS *ESE *ESE? *ESR? *SRE *SRE? *STB?
Device trigger	Defines the commands to be executed when the IEEE 488.2 GET bus command is received by a device.	*TRG
Save/recall	The current state of the device is saved in the built-in local memory, or the data previously saved in the built-in local memory is recalled.	*SAV *RCL

*CLS Clear Status Command

(Clear status byte register)

■ Format

*CLS

■ Example

```
30 WRITE @ADR:"*CLS"
40 WRITE @ADR:"CNF 300MHZ;SPF 1KHZ;*CLS"
```

■ Explanation

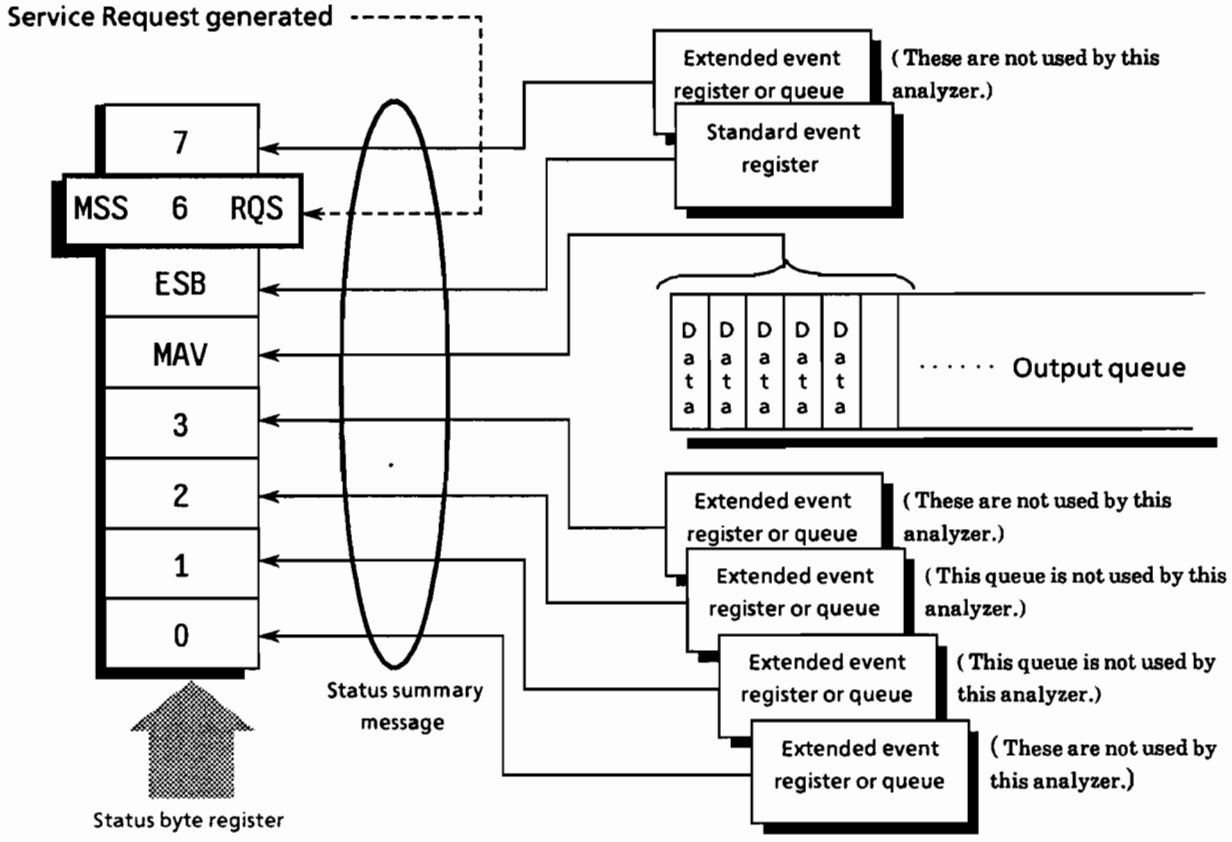
The ***CLS** common command clears all status data structures (i.e their event registers and queues) except for the output queue and its **MAV** summary messages. It also clears the summary messages corresponding to these structures.

In the example below, the output queue and its **MAV** summary messages are also cleared.

```
30 WRITE @ADR:"CNF 300MHZ;SPF 1KHZ"
40 WRITE @ADR:"*CLS;CNF?"
```

That is to say, if a ***CLS** command is sent after a <PROGRAM MESSAGE TERMINATOR> or before <QUERY MESSAGE UNIT> elements, all status bytes are cleared. This command also clears all unread messages in the output queue.

***CLS** has no effect on settings in enable registers.



*ESE Standard Event Status Enable Command

(Sets or clears the standard event status enable register)

■ Format

*ESE <HEADER SEPARATOR> <DECIMAL NUMERIC PROGRAM DATA>

In this format:

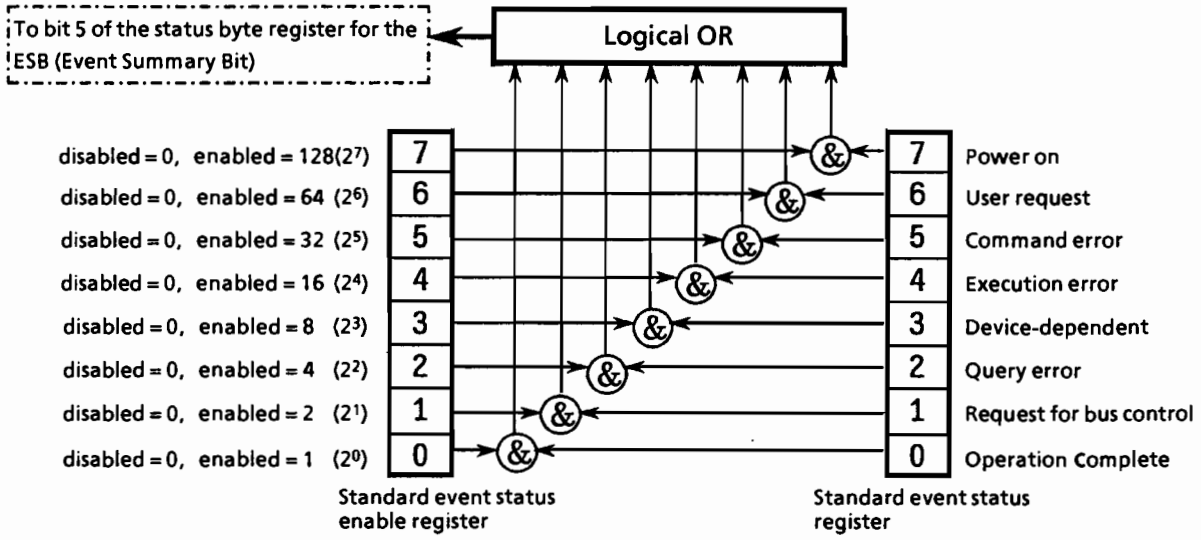
<DECIMAL NUMERIC PROGRAM DATA> = Value rounded to an integer from 0 to 255 (Binary weighted with a base value of 2)

■ Example

```
WRITE @ADR:"*ESE 20"!
```
Sets bits 2 and 4 of enable register

■ Explanation

The program data is the sum of weighted bit-digit values when the weighted value for bits to be enabled are selected from among the values $2^0=1$, $2^1=2$, $2^2=4$, $2^3=8$, $2^4=16$, $2^5=32$, $2^6=64$ or $2^7=128$; corresponding to the enable register bits 0, 1, 2, 3, 4, 5, 6 or 7. The value of bits to be disabled is 0.



*ESE? Standard Event Status Enable Query

(Reterns current value of standard event status enable register)

■ Format

*ESE?

■ Example

20 is the response if *ESE? is sent after executing *ESE 20

■ Explanation

Returns NR1, the value of the standard event status enable register

■ Response message

NR1 = 0 to 255

*ESR? Standard Event Status Register Query

(Returns the current value in the standard event status register)

■ Format

*ESR?

■ Example

```
30 WRITE @ADR:"*ESR?"
40 READ @ADR:STEVET! A command error is issued if the value of the variable is 32
50 PRINT STEVET
```

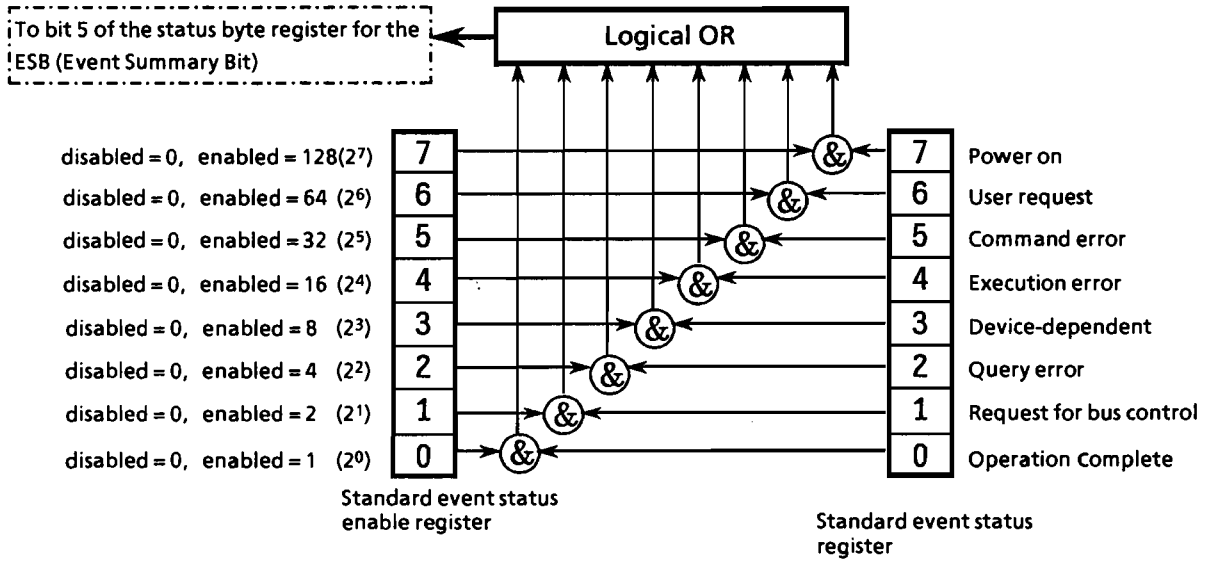
■ Response Message

NR1 = 0 to 255

■ Explanation

The current value of the standard event status register is returned by NR1. NR1 is the total of weighted bit-digit values of bits (enabled by the standard event status enable register) which are selected from among the values $2^0=1$, $2^1=2$, $2^2=4$, $2^3=8$, $2^4=16$, $2^5=32$, $2^6=64$ or $2^7=128$: corresponding to the standard event status register bits 0, 1, 2, 3, 4, 5, 6 or 7.

This register is cleared when the response is read (e.g. line 40).



*IDN? Identification Query

(Returns the manufacturer name, model name etc. of the product.)

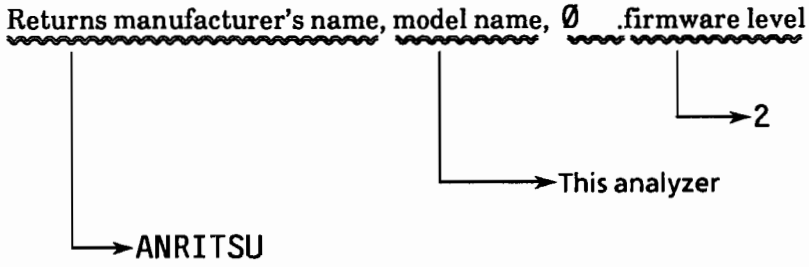
■ Format

```
*IDN?
```

■ Example

```
30 WRITE @ADR:"*IDN?"
40 READ @ADR:IDEN$! Stores names of manufacturer, model, etc.
```

■ Explanation



When an ***IDN?** common query is sent to a device, a response message comprising the four fields shown above is returned.

① Field 1 ..... Manufacturer's name (Anritsu)

② Field 2 ..... Model name (this analyzer)

③ Field 3 ..... (usually Ø)

④ Field 4 ..... Firmware version (In the case of Anritsu, versions are from 1 to 99)

■ Response message

A Response message comprising the four fields above separated by commas is sent by <ARBITRARY ASCII RESPONSE DATA>.

<field 1>, <field 2>, <field 3>, <field 4>

In the above example, the message takes the form ANRITSU, This unit, Ø, 2

The total length of a response message is ≦72 characters

*OPC Operation Complete Command

(Sets the status of bit 0 of the standard event status register when device operation is completed)

■ Format

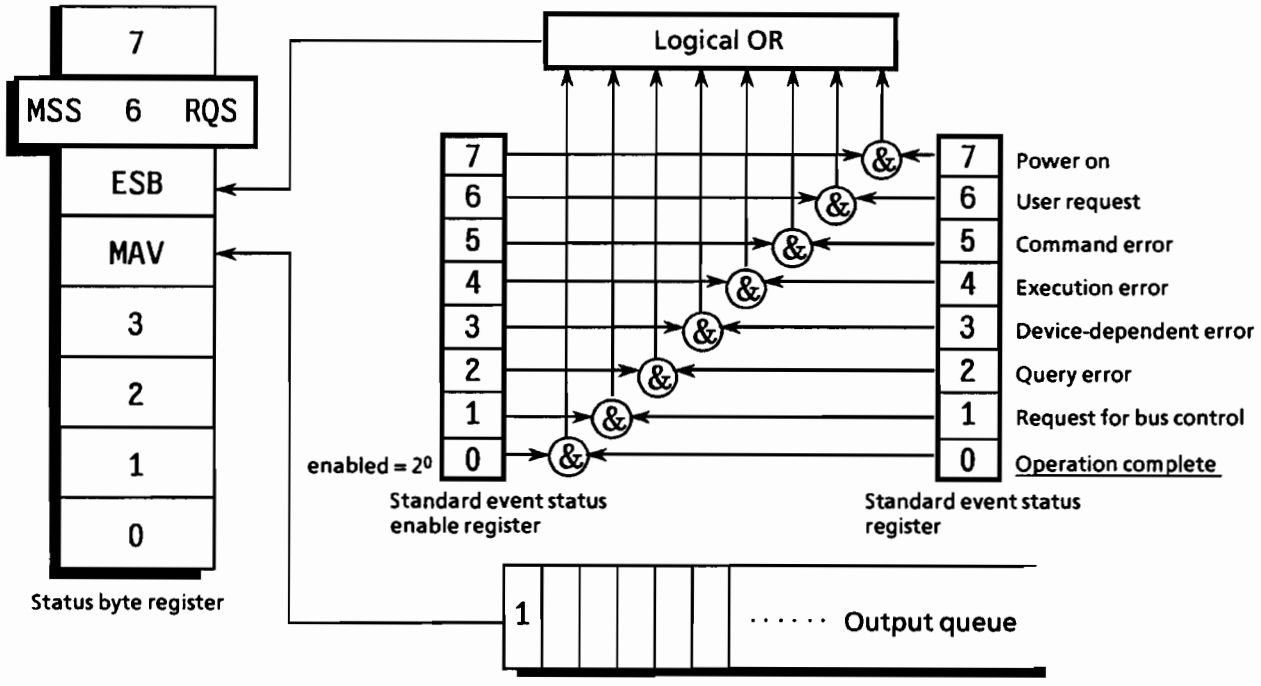
*OPC

■ Example

```
WRITE @ADR:"*OPC"
```

■ Explanation

Sets the status of bit 0, i.e. the operation complete bit, of the standard event status register when all pending operations of the selected device have been completed. This is an overlap command.



*OPC? Operation Complete Query

(Sets 1 in the output queue to generate a MAV summary message when device operation has been completed)

■ Format

*OPC?

■ Example

```
WRITE @ADR:"*OPC?"
```

■ Explanation

When all pending operations of the selected device have been completed, sets 1 in the output queue and waits for the MAV summary message to be generated.

■ Response message

A 1 is returned by <NR1 NUMERIC RESPONSE DATA>.

*RCL Recall Command

(Recalls data from built-in memory)

■ Format

*RCL <HEADER SEPARATOR> <DECIMAL NUMERIC PROGRAM DATA>

In this format:
<DECIMAL NUMERIC PROGRAM DATA> = 0 to device-specified upper limit

■ Example

```
WRITE @ADR:"*RCL␣4" ..... Recalls the data in memory No. 4
```

■ Explanation

Previously saved data is recalled from the memory with the specified memory number. The memory number, program data, must be specified with a decimal integer. To recall special data (for example, set-up data at power-on), it is recommended that memory number 0 be specified.

*RST Reset Command

(Resets (initializes) device in level 3)

■ Format

*RST

■ Example

```
WRITE @ADR:"*RST"        Resets devices in level 3
```

■ Explanation

The ***RST** command resets a device in level 3. (☞P4-3) The items that are reset in level 3 are as follows.

① The functions and conditions specific to a device are reset to a known initial state regardless of the settings up to that point.

② Macros defined by the ***DDT** command are reset to the state defined for the device.

③ Macro operation is inhibited and the device can no longer receive macros. And, macro definition is reset to the state designated by the system designer.

④ The device is put into OCIS (Operation Complete Command Idle State). As a result, the operation complete (end) bit cannot be set in the standard event status register.

⑤ The device is put into OQIS (Operation Complete Query Idle State). As a result, the operation complete bit cannot be set in the output queue. The MAV bit is cleared.

The ***RST** command has no effect on the following.

① The state of the IEEE 488.1 interface
② Device address
③ Output queue
④ Service request enable register
⑤ Standard event status enable register
⑥ Power-on-status-clear flag setting
⑦ Calibration data which affects device specifications

*SAV Save Command

(Saves data in the built-in memory)

■ Format

*SAV<HEADER SEPARATOR><DECIMAL NUMERIC PROGRAM DATA>

In this format:
<DECIMAL NUMERIC PROGRAM DATA> = 0 to device-specified upper limit

■ Example

```
WRITE @ADR:"*SAV␣4"
```
..... Saves data in memory No. 4.

■ Explanation

The device state (main unit) is saved in the memory with the specified memory number. The memory number (program data) must be specified with a decimal integer.

*SRE Service Request Enable Command

(Set status of bits in the service request enable register)

■ Format

*SRE <HEADER SEPARATOR><DECIMAL NUMERIC PROGRAM DATA>

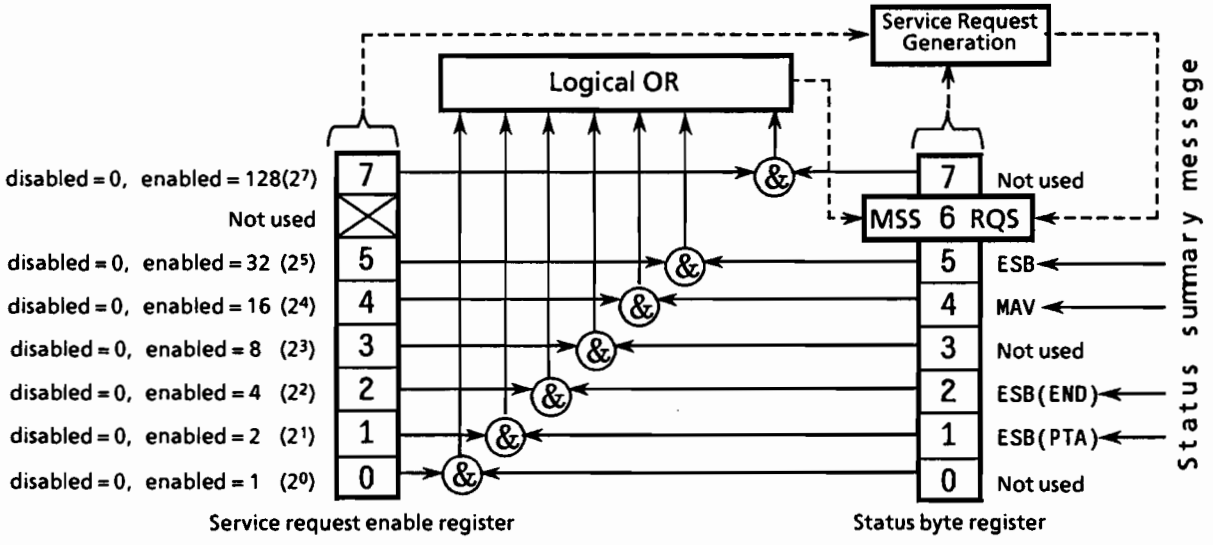
In this format:
<DECIMAL NUMERIC PROGRAM DATA> = Values rounded to an integer from 0 to 255 (binary weighted with a base value of 2)

■ Example

```
WRITE @ADR:"*SRE␣16"!
```
Sets bit 4 of the enable register

■ Explanation

The program data is the sum of weighted bit-digit values when the weighted value for bits to be enabled are selected from among the values $2^0=1$, $2^1=2$, $2^2=4$, $2^3=8$, $2^4=16$, $2^5=32$ or $2^7=128$: corresponding to the service request enable register bits 0, 1, 2, 3, 4, 5, or 7. The value of bits to be disabled is 0.



*SRE? Service Request Enable Query

(Returns the current value of the service request enable register)

■ Format

*SRE?

■ Example

A 16 is sent in response if *SRE? is sent after executing *SRE 16.

■ Explanation

NR1, the value of the service request enable register, is returned.

■ Response message

As NR1 (bit 6 : RQS bit) cannot be set, NR1 = 0 to 63 or 128 to 191)

*STB? Read Status Byte Command

(Returns the current values of status bytes including MSS bits)

■ Format

*STB?

■ Example

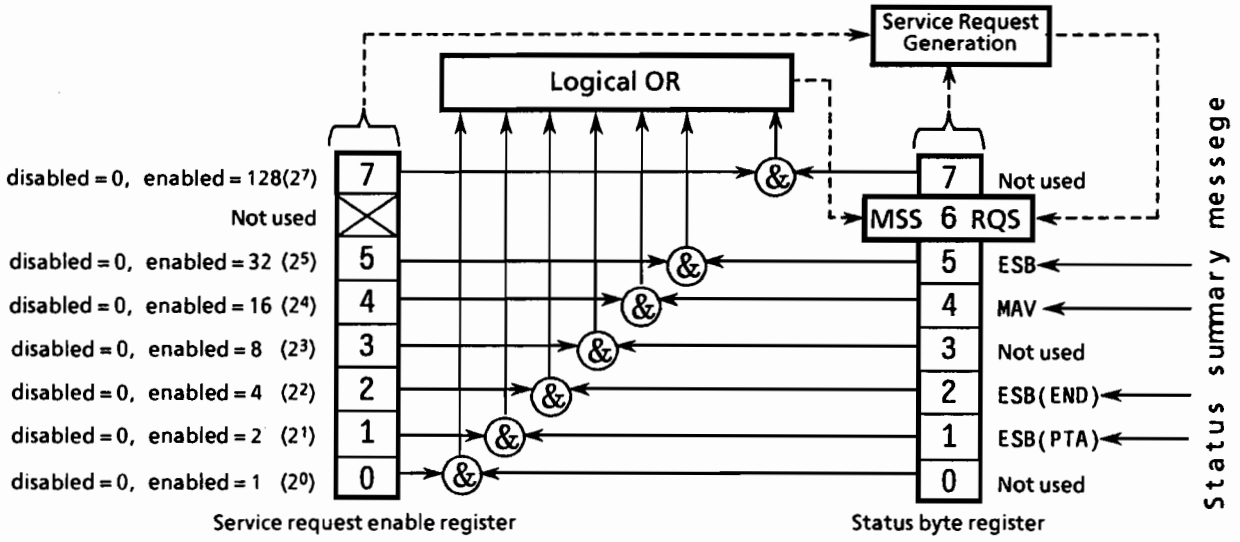
```
30 WRITE @ADR:"*STB?"
40 READ @ADR:STBV
50 PRINT STBV
```

■ Explanation

The ***STB?** query returns the total of the binary weighted values of the status byte register and of the MSS summary message with <NR1 NUMERIC RESPONSE DATA>.

■ Response message

The response message is a <NR1 NUMERIC RESPONSE DATA> integer in the range 0 to 255 representing the total of the binary weighted values of the bits in the status byte register. Status byte register bits 0 to 5 and 7 are weighted to 1, 2, 4, 8, 16, 32 and 128, respectively, and the MSS (Master Summary Status) bit to 64. MSS message indicates that a request has at least one cause. Status byte register conditions are listed in the table below.



Bit	Bit weight	Bit name	Status-byte-register conditions
7	128	——	0 = Not used
6	64	MSS	0 = Service not requested 1 = Service requested
5	32	ESB	0 = Event status not generated 1 = Event status generated
4	16	MAV	0 = No data in output queue 1 = Data in output queue
3	8	——	0 = Not used
2	4	ESB(END)	0 = Event status not generated 1 = Event status generated
1	2	ESB(PTA)	0 = Event status not generated 1 = Event status generated
0	1	——	0 = Not used

*TRG Trigger Command

(The same function as that of IEEE 488.1 GET-Group Execute Trigger-bus command)

■ Format

```
*TRG
```

■ Example

```
WRITE @ADR:"*TRG"
```

■ Explanation

The ***TRG** common command has the same function as the IEEE 488.1 **GET** – Group Execute Trigger-bus command. This analyzer does not support the *DDT command.

Like the device message **SWP** ␣ **1**, this analyzer performs single sweep when the ***TRG** command is executed.

This analyzer performs single sweep in both of the following cases:

```
WRITE @ADR:"*TRG"
WRITE @ADR:"SWP 1"
```

*TST? Self-Test Query

(Executes self-test and returns the results of error present/absent.)

■ Format

*TST?

■ Example

```
30 WRITE @ADR:"*TST?"
40 READ @ADR:TEST
50 PRINT TEST
```

■ Explanation

The *TST? query executes the self-test of the internal cirucit in device(s). The test result is set in the output queue. Data in the output queue indicates whether or not the test has been completed without error occurrence. Opeator intervention is not required to execute the self-test.

This analyzer conducts a self-test for the following blocks:

- MAIN CPU BLOCK
- DISP CPU BLOCK
- MEAS CPU BLOCK
- PTA CPU BLOCK

■ Response message

The response message is sent by <NR1 NUMERIC RESPONSE DATA>. The data range is −32767 to 32767.

NR1=0 ..... Indicates no errors

NR1≠0 ..... Indicates that errors have occurred

*WAI Wait-to-Continue Command

(Keeps the next command on stand-by if the device is currently executing a command)

■ Format

```
*WAI
```

■ Example

```
WRITE @ADR:"*WAI"
```

■ Explanation

The ***WAI** common command executes overlap commands as sequential commands. An command or query (sent from the controller to a device) is called an overlap command if the next command can start execution while it is executing some function in the device.

Executing the ***WAI** command (after an overlap command) set the next command on hold and permits it to execute its function once the first command has finished. This is the same as sequential commands.

However, since this analyzer does not support an overlap command, the WAI command is not required.

SECTION 7
STATUS STRUCTURE

This section describes device status reports and their data structure as defined in the IEEE 488.2 standard and explains the techniques for synchronizing the controller and devices.

In order to obtain more detailed status information, the IEEE 488.2 standard has more common commands and common queries than the IEEE 488.1 standard.

Refer to Section 6 for a detailed explanation of these common commands and queries.

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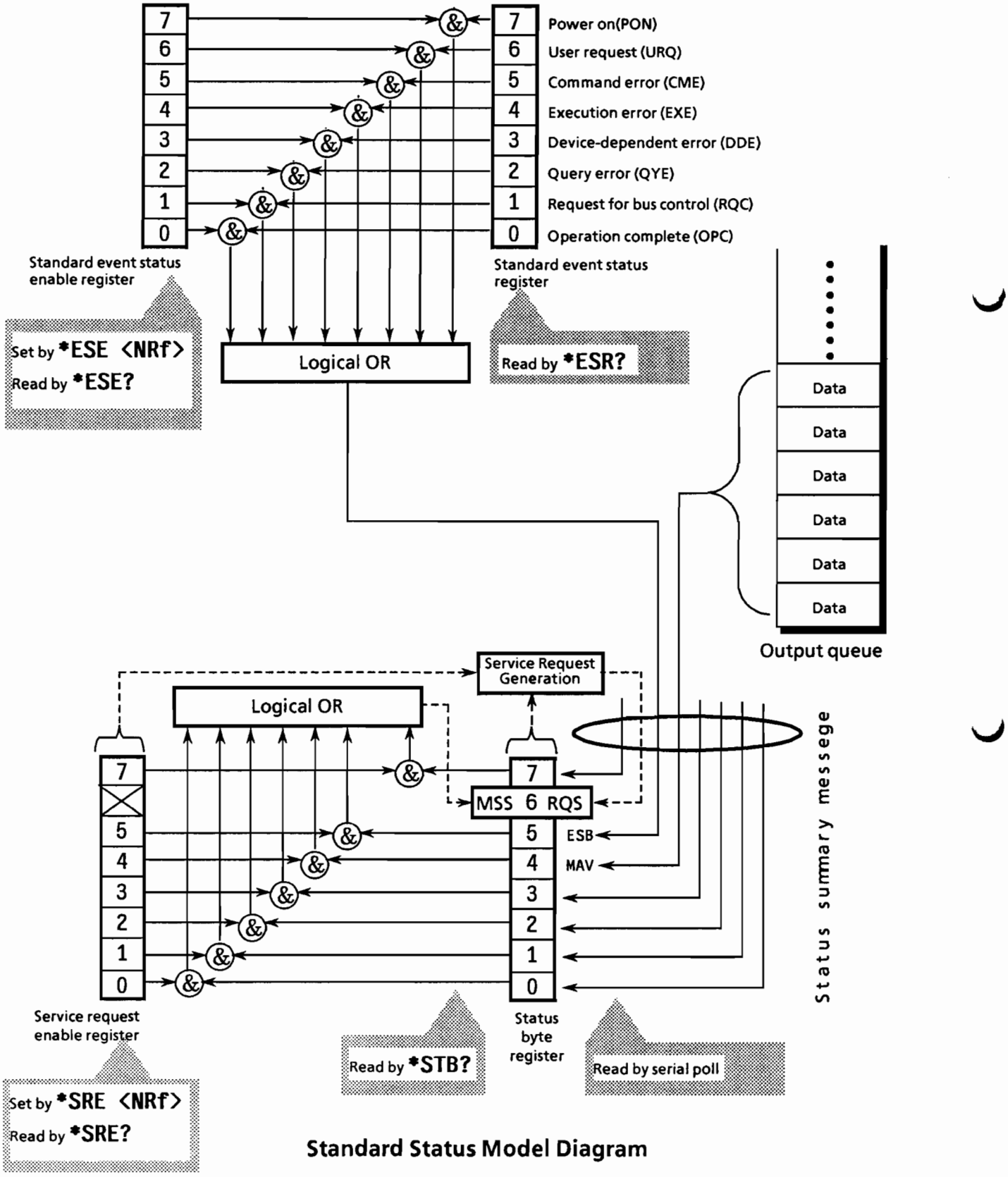
The Status Byte (STB) sent by the controller is based on the IEEE 488.1 standard. The bits comprising it are called a status summary message because they represent a summary of the current data contained in registers and queues.

The following pages explain the status summary message and the structure of the status data that constitutes the status summary message bits as well as techniques for synchronizing the devices and controller, which use these status messages.

7.1 IEEE 488.2 Standard Status Model

The diagram below shows the standard model for the status data structure stipulated in the IEEE 488.2 standard.



Standard Status Model Diagram

The IEEE 488.1 status byte is used in the status model. This status byte is composed of 7 summary message bits given from the status data structure. For creating the summary message bits, there are 2 models for the data structure – the register model and the queue model.

Register model	Queue model
The register model consists of the two registers used for recording events and conditions encountered by a device. These two registers are the Event Status Register and Event Status Enable Register. When the results of the AND operation of both register contents is not 0, the corresponding bit of the status bit becomes 1. In other cases, it becomes 0. And, when the result of their Logical OR is 1, the summary message bit becomes also 1. If the Logical OR result is 0, the summary message bit becomes 0 too.	The queue in the queue model is for sequentially recording the waiting status values and data. The queue structure is such that the relevant bit is set to 1 when there is data in it and 0 when it is empty.

In IEEE 488.2, there are 3 standard models for status data structure - 2 register models and 1 queue model - based on the register model and queue model explained above. They are:

① Standard Event Status Register and Standard Event Status Enable Register
② Status Byte Register and Service Request Enable Register
③ Output queue

Standard Event Status Register	Status Byte Register	Output Queue
The Standard Event Status Register has the structure of the previously described register model. In this register, bits are set for 8 types of standard event encountered by a device, viz. ① Power on, ② User request, ③ Command error, ④ Execution error, ⑤ Device-dependent error, ⑥ Query error, ⑦ Request for bus control and ⑧ Operation complete. The Logical OR output bit is represented by Status Byte Register bit 5 (DIO6) as a summary message for the Event Status Bit (ESB).	The Status Byte Register is a register in which the RQS bit and the 7 summary message bits from the status data structure can be set. It is used together with the Service Request Enable Register. When the results of the OR operation of both register contents is not 0, SRQ becomes ON. To indicate this, bit 6 of the Status Byte Register (DIO7) is reserved by the system as the RQS bit which means that there is a service request for the external controller. The mechanism of SRQ conforms to the IEEE 488.1 standard.	The Output Queue has the structure of the queue model mentioned above. Status Byte Register bit 4 (DIO5) is set as a summary message for Message Available (MAV) to indicate that there is data in the output queue.

7.2 Status Byte (STB) Register

The STB register consists of device STB and RQS (or MSS) messages. The IEEE 488.1 standard defines the method of reporting STB and RQS messages but not the setting and clearing protocols or the meaning of STB. The IEEE 488.2 standard defines the device status summary message and the Master Summary Status (MSS) which is sent to bit 6 together with STB in response to an *STB? common query.

7.2.1 ESB and MAV summary messages

The following is a description of the ESB and MAV summary messages.

(1) ESB summary messages

The ESB (Event Summary Bit) summary message is a message defined by IEEE 488.2, which is represented by bit 5 of the STB register. This bit indicates whether at least one of the events defined in IEEE 488.2 has occurred or not when the service request enable register is set so that events are enabled after the final reading or clearing of the standard event status register. The ESB summary message bit becomes true when the setting permits events to occur if any one of the events recorded in standard event status register is true. Conversely, it is false if none of the recorded events occurs even if events are set to occur.

(2) MAV summary messages

The MAV summary message is a message defined in IEEE 488.2 and represented by bit 4 in the STB register. This bit indicates whether the output queue is empty or not. The MAV summary message bit is set to 1 (true) when a device is ready to receive a request for a response message from the controller and to 0 (false) when the output queue is empty. This message is used to synchronize the exchange of information with the controller. For example, it can be used get the controller to wait till MAV is true after it has sent a query command to a device. While the controller is waiting for a response from the device, it can process other jobs.

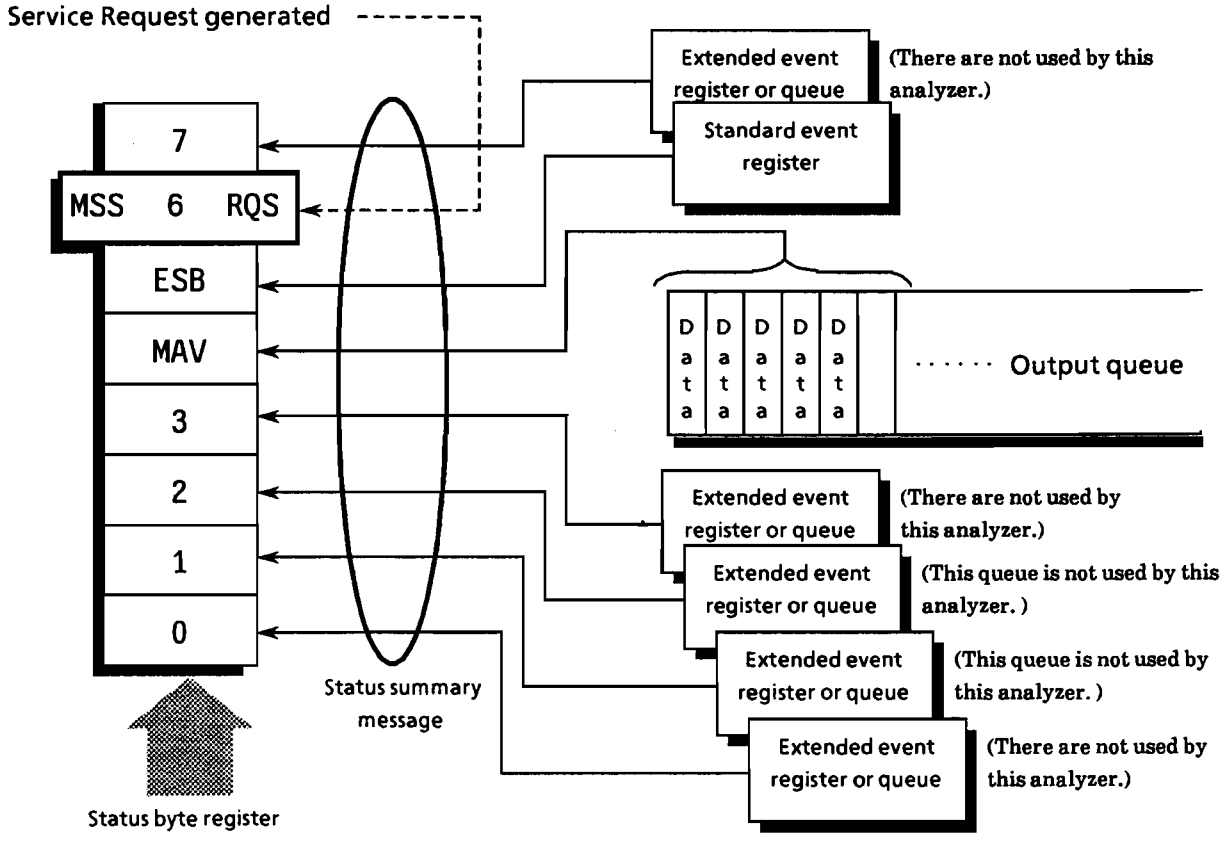
Reading the output queue without first checking MAV will cause all system bus operations to be delayed until the device responds.

7.2.2 Device-dependent summary messages

The IEEE 488.2 standard does not specify whether bits 7 (DIO8) and 3 (DIO4) to 0 (DIO1) of the status byte register are used as status register summary bits, or used to indicate that there is data in a queue. These bits can be used as device-dependent summary messages.

Device-dependent summary messages have the respective status data structures of the register model or the queue model. Thus, the status data structure may be either the register to report events and status in parallel or the queue to report conditions and status in sequence. The summary bit represents a summary of the current status of the corresponding data structure. In the case of the register model, the summary bit is true when there is an event set to permit the occurrence of more than one true; while in the case of the queue model, it is true if the queue is not empty.

As shown below, the MS4661A//E, MS4662A does not use bits 0, 3 and 7. As it uses bits 1 and 2 as the summary bits of the status register, it has 3 register model types (, where 2 types extended) and one queue model type - an output queue with no extension.



7.2.3 Reading and clearing the STB register

Serial poll or the ***STB?** common query are used to read the contents of STB register. STB messages conforming to IEEE 488.1 can be read by either method, but the value sent to bit 6 is different for each of them.
The STB register can be cleared using the ***CLS** command.

(1) Reading by serial poll

When using the serial poll conforming to IEEE 488.1, the device must return a 7-bit status byte and an RQS message bit which conforms to IEEE 488.1.

According to IEEE 488.1, the **RQS** message indicates whether the device sent **SRQ** as true or not. The value of the status byte is not changed by serial poll. The device must set the RQS message to false immediately after being polled. As a result, if the device is again polled before there is a new cause for a service request, the **RQS** message is false.

(2) Reading by the *STB? common query

The ***STB?** common query requires the device to send the contents of the STB register and one <NR1 NUMERIC RESPONSE DATA> from the **MSS** (Master Summary Status) summary message. The response represents the total binary weighted value of the STB register and the MSS summary message. The STB-register bits 0 to 5 and 7 are weighted to 1, 2, 4, 8, 16, 32, and 128; and the **MSS** to 64, respectively. Thus, excepting the fact that bit 6 represents the MSS summary message instead of the **RQS** message, the response to ***STB?** is identical to that for serial poll.

(3) Definition of MSS (Master Summary Status)

MSS indicates that there is at least one cause for a service request. The MSS message is represented at bit 6 in a device response to the ***STB?** query but it is not produced as a response to serial poll. In addition, it is not part of the status byte specified by IEEE 488.1. **MSS** is produced by the logical OR operation of STB register with SRQ enable (SRE) register. In concrete terms, MSS is defined as follows.

(STB Register bit0 AND SRE Register bit0)

OR

(STB Register bit1 AND SRE Register bit1)

OR

:

:

(STB Register bit5 AND SRE Register bit5)

OR

(STB Register bit7 AND SRE Register bit7)

As bit-6 status of the STB and SRQ enable registers are ignored in the definition of MSS, it can be considered that bit-6 status are always being 0 when calculating the value of MSS.

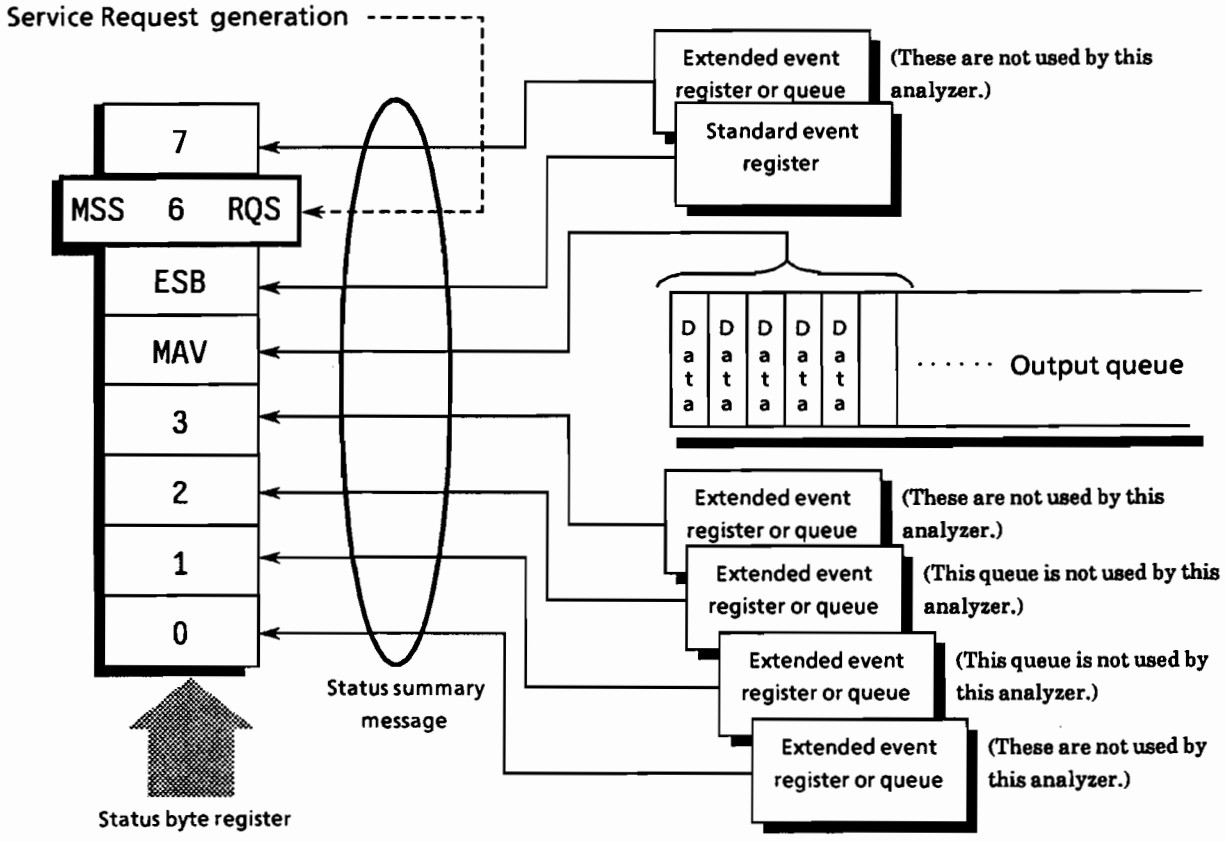
(4) Clearing the STB register by the *CLS common command

With the exception of the output queue and its **MAV** summary message, the ***CLS** common command clears all status data structures (status event registers and queues) as well as the summary messages corresponding to them.

In the following case, the output queue and its **MAV** summary message are both cleared.

```
30 WRITE @ADR:"CNF 300MHZ;SPF 1KHZ"
40 WRITE @ADR:"*CLS;CNF?"
```

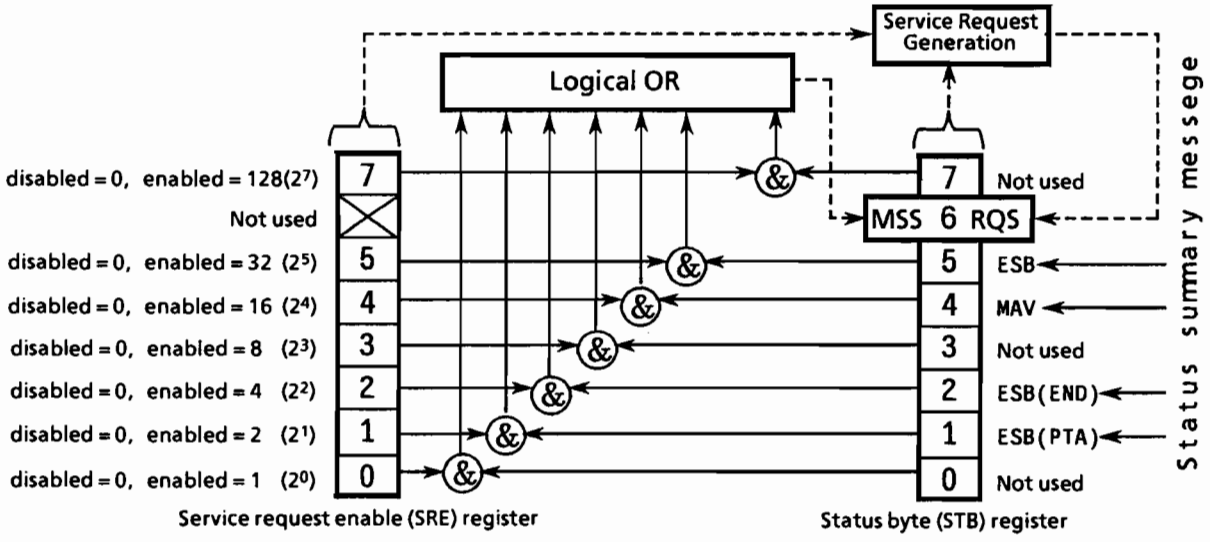
That is to say, sending a ***CLS** command (after a <PROGRAM MESSAGE TERMINATOR> or before <QUERY MESSAGE UNIT> elements) clears all status bytes. This clears all unread messages in the output queue and sets the **MAV** message to false. The MSS message is also set to false when a response is made to ***STB?**. The ***CLS** command does not affect settings in the enable registers.



7.3 Enabling SRQ

All types of summary message in the STB register can be enabled or disabled for service requests by using the SRQ enable function. The service request enable (SRE) register is used for this function to select summary messages as shown in the diagram below.

Bits in the service request enable register correspond to bits in the status byte register. If a bit in the status byte corresponding to an enabled bit in the service request enable register is set to 1, a device makes a service request to the controller with the RQS bit set to 1. For example, if bit 4 (MAV) in the service request enable register is enabled, the device makes a request for service to the controller each time the MAV bit is set to 1 when there is data in the output queue.



(1) Reading the SRE register

The contents of the SRE register are read using the ***SRE?** common query. The response message to this query is a <NR1 NUMERIC RESPONSE DATA> integer from 0 to 255 which is the sum of the bit digit weighted values in the SRE register. SRE register bits 0 to 5 and 7 are respectively weighted to 1, 2, 4, 8, 16, 32 and 128. The unused bit 6 must always be set to 0.

(2) Updating the SRE register

The SRE register is written to using the ***SRE** common command. <DECIMAL NUMERIC PROGRAM DATA> elements follow the *SRE common command. <DECIMAL NUMERIC PROGRAM DATA> is a rounded integer expressed in binary which represents the sum of the binary weighted value of each bit of SRE register. A bit value of 1 indicates enabled and a bit value of 0 disabled. The value of bit 6 must always be ignored.

(3) Clearing the SRE register

The SRE register can be cleared by executing the ***SRE** common command or turn the power off and it on again.

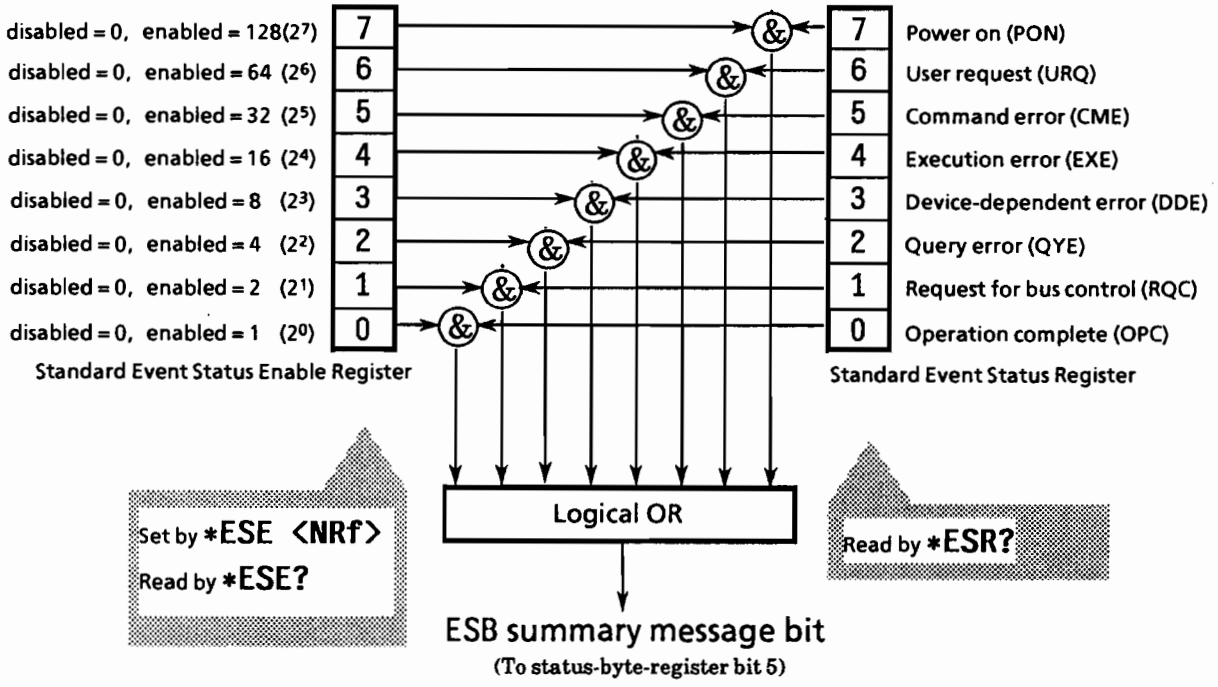
Using the ***SRE** common command, the SRE register is cleared by setting the value of the <DECIMAL NUMERIC PROGRAM DATA> element to 0. Clearing the register stops status information from generating rsv local messages, and service requests are no longer generated.

When the power is turned on again, the power-on-status-clear flag becomes true, so, the SRE register is cleared because there is no ***PSC** command to block the clearing operation.

7.4 Standard Event Status Register

7.4.1 Bit definition of standard event status register

The standard event status register must be available on all devices conforming to the IEEE 488.2 standard. The diagram below shows the operation of the standard event status register model. Because the operation of the model is the same as that for the other models explained up till now, the following only explains the meaning of each bit in the standard event status register as defined in the IEEE 488.2 standard.



Bit	Event name	Description
7	PON–Power on	The power is turned to on
6	URQ–User Request	Request for local control (rtl). This bit is produced regardless of whether a device is in remote or local mode. This bit is not used by this analyzer, so it is always 0.
5	CME–Command Error	An illegal program message, a misspelt command or a GET command within a program is received.
4	EXE–Execution Error	A legal program message, which cannot be executed, is received
3	DDE–Device-dependent Error	An error caused by other than CME, EXE or QYE occurred.
2	QYE–Query Error	An attempt is made to read data in the output queue though there is none there, or data is lost from the output queue due to any reason, e.g. overflow etc..

Bit	Event name	Description
1	RQC-Request Control	A device is requesting control of the bus. This bit is not used by this analyzer, so it is always 0.
0	OPC-Operation Complete	A device has completed operations which were pending and is ready to receive new commands. This bit is only set in response to the ***OPC** command.

7.4.2 Query error details

No.	Item	Description
1	Incomplete program messages	If a device receives an MTA from the controller before it receives the terminator of the program message it is receiving, it aborts the incomplete program message and waits for the next one. In order to abort the incomplete message, the device clears its input buffer and output queue, reports a query error and sets bit 2 in the standard status register to indicate the query error.
2	Interruption of response message	If a device receives an MLA from the controller before it has sent the terminator of the response message it is sending, it automatically interrupts the response message and waits for the next program message. In order to interrupt the response message, the device clears its output queue, reports a query error and sets bit 2 in the standard status register to indicate the query error.
3	Sending the next program message without reading the previous response message	When a device becomes unable to send a response message because the controller has sent another program message immediately following a program or query message, the device aborts the response message and waits for the next program message.
4	Output queue overflow	When several program and query messages are executed in succession, there may be too many response messages for the output queue (256 bytes). If further query messages are received when the output queue is full, the output queue cannot send responses to them because an overflow situation exists in it. If there is an overflow in the output queue, the device clears it and resets the section where response messages are created. Then it sets bit 2 in the standard event status register to indicate a query error.

7.4.3 Reading, writing to and clearing the standard event status register

Reading	The register is destructively read by the ***ESR?** common query, i.e. it is cleared after being read. The response message is an NR1 value obtained by binary weighting the event bit and converting it to a decimal number.
Writing	With the exception of clearing, writing operations cannot be performed externally.
Clearing	The register is only cleared in the following cases. ① A ***CLS** command is received ② The power is turned on when the power-on-status-clear flag is true. Devices (for which the power-on sequence is being executed) first clear their standard event status registers but later record events that occurred during the sequence in them. (e.g. the setting of the PON event bit, etc.) ③ An event is read for the ***ESR?** query command

7.4.4 Reading, writing to and clearing the standard event status enable register

Reading	The register is non-destructively read by the ***ESE?** common query, i.e. it is not cleared after being read. The response message is returned by NR1 after having been binary weighted and converted to decimal.
Writing	The register is written to by the ***ESE** common command. As bits 0 to 7 of the register are respectively binary weighted to 1, 2, 4, 8, 16, 32, 64 and 128; data to be written is sent by <DECIMAL NUMERIC PROGRAM DATA> which is the digit total of the bits selected from these bits.
Clearing	The register is cleared in the following cases. ① A ***ESE** command with a data value of 0 is received ② The power is turned on when the power-on-status-clear flag is true, or it is turned on when the ***PSC** command is not available. The event status enable register is not affected by the following. ① Changes of the status of the IEEE 488.1 device clear function ② A ***RST** common command is received ③ A ***CLS** common command is received

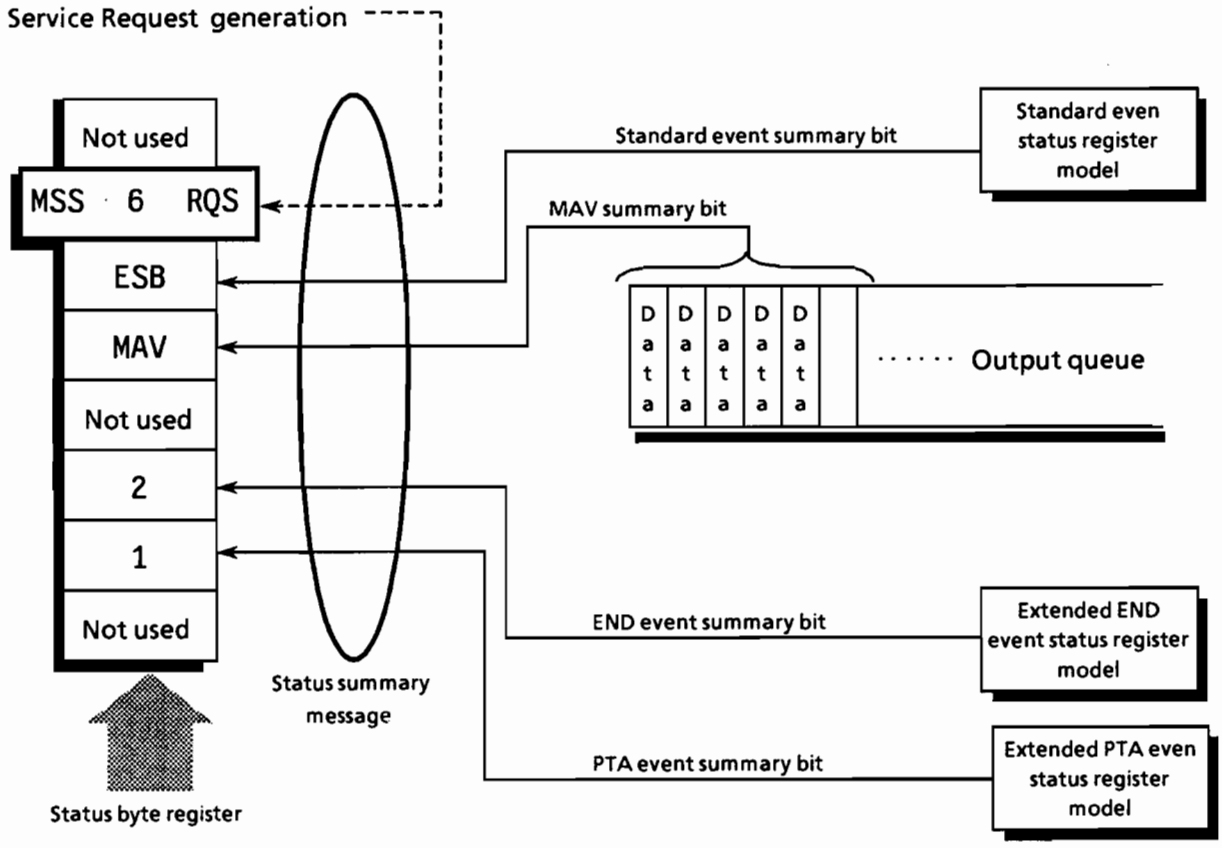
7.5 Extended Event Status Register

The register models of the status byte register, standard event status register and enable registers are mandatory for equipment conforming to the IEEE 488.2 standard.

In IEEE 488.2, status-byte-register bits 7 (DIO8), 3 (DIO4) to 0 (DIO1) are assigned to status- summary bits supplied by the extended-register and extended-queue models.

For the MS4661A/E, MS4662A, as shown in the diagram below, bits 7, 3 and 0 are unused and bits 1 and 2 are assigned to the END and PTA summary bits as the status-summary bits supplied by the extended- register model.

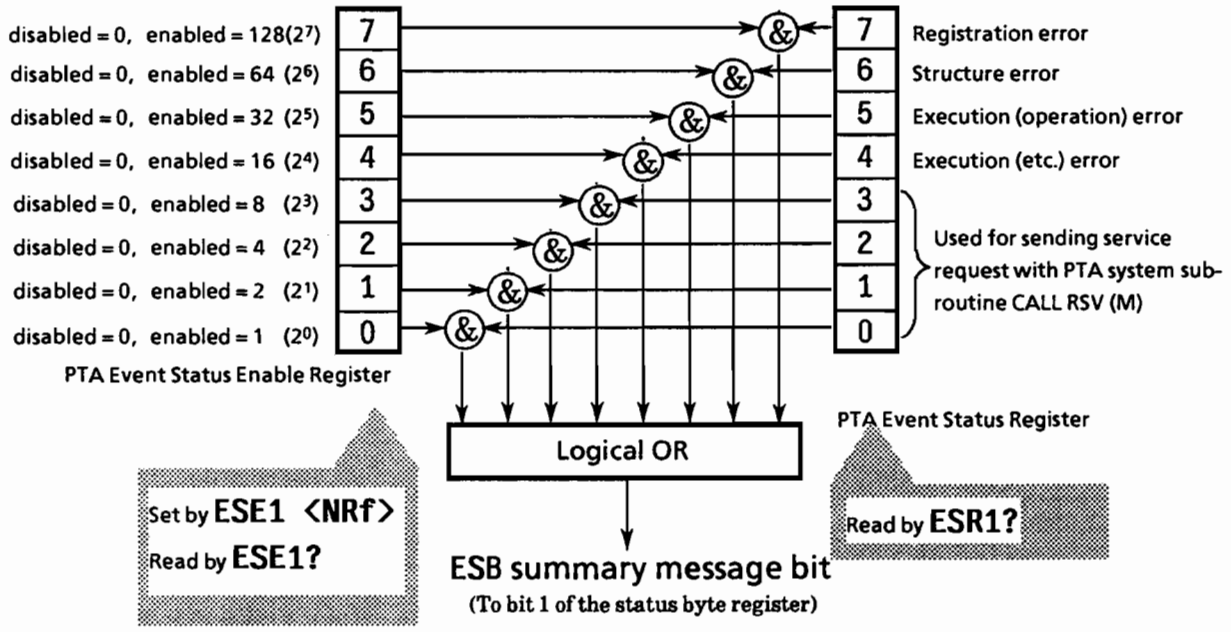
As the queue model is not extended, there is only one type of queue - the output queue.



The following pages describe bit definition, the reading, writing to and clearing of registers for the PTA and END extended event register models.

7.5.1 Definition of extended PTA event status register bits

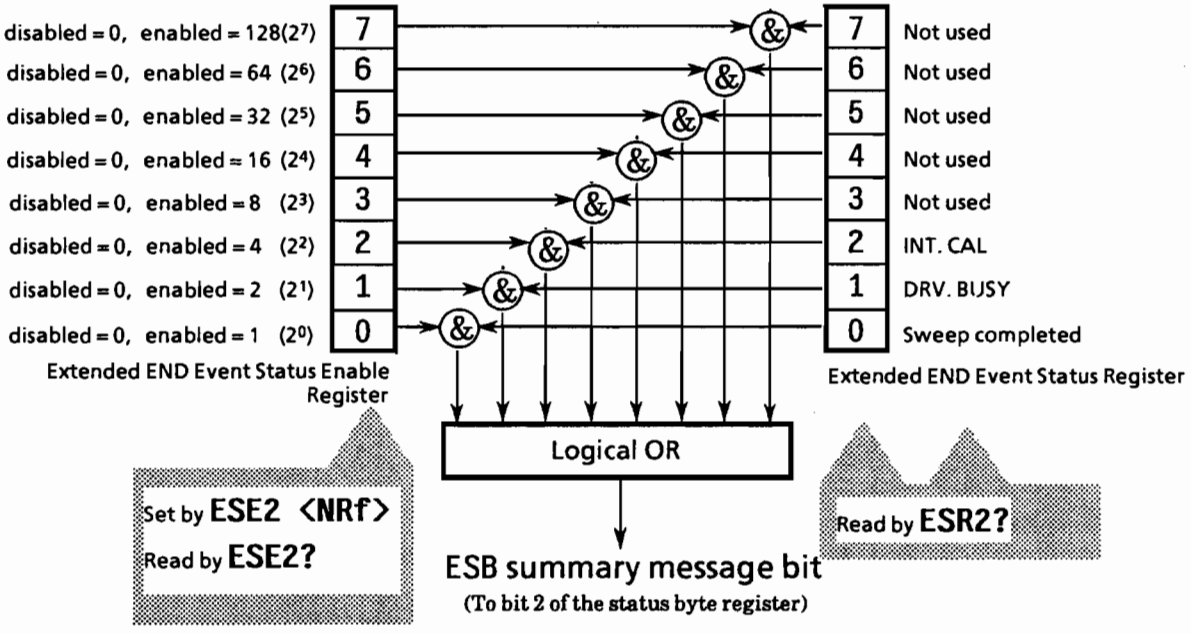
The following describes the operation of the PTA event status register model, the naming of its event bits and what they mean.



Bit	Event name	Description
7	Registration error	Error at program registration
6	Structure error	Error on program structure
5	Execution (operation) error	Error at operation on program execution
4	Execution (etc.) error	Error at other than program operation
3	SRQ send	Used for sending service request with PTA subroutine CALL RSV (M)
2	SRQ send	Used for sending service request with PTA subroutine CALL RSV (M)
1	SRQ send	Used for sending service request with PTA subroutine CALL RSV (M)
0	SRQ send	Used for sending service request with PTA subroutine CALL RSV (M)

7.5.2 Definition of extended END event status register bits

The following describes the operation of the END event status register model, the naming of its event bits and what they mean.



The END event status enable registers on the left side indicates whether or not the summary message will be true, and if so, when which bit of the corresponding event register is on.

Bit	Event name	Description
7	Not used	Not used
6	Not used	Not used
5	Not used	Not used
4	Not used	Not used
3	Not used	Not used
2	INT. CAL	End of internal calibration
1	DRV. BUSY	
0	Sweep completed	Single sweep is completed or standby status (1: Sweep end, 0: During sweep)

7.5.3 Example of Interrupt Caused by Status Message

Example: After sweep of a device (MS4662A address 1), the controller executes the next statement. The controller is informed of completion of sweep when it receives a status message, an interrupt.

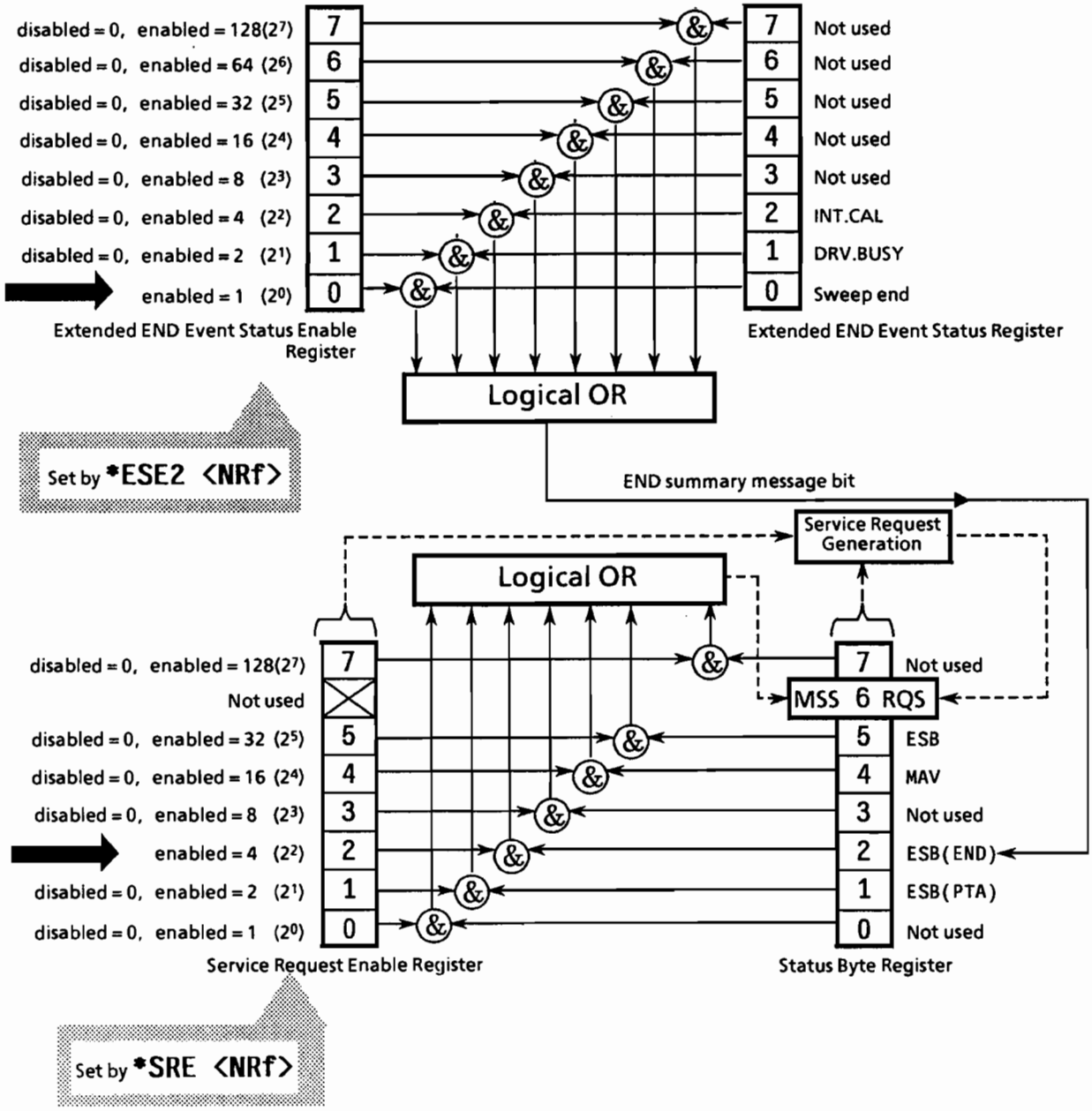
①

An "ESE2 1" message is transferred to the device to enable bit 0 of the extended END event status register shown below. ..... `WRITE @101:"ESE2 1"`

②

By transferring 'SRE 4' to enable bit 2 of the service request enable register, the RQS bit of the status byte register is set to 1 at generation of the END summary bit.
..... `WRITE @101:"SRE 4"`

To ③ on next page



③ When the END bit is set to 1, bit 6 is also set to 1.

Status Byte Register

BIT / LINE	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1
Summary message bit	Not used	RQS	ESB	MAV	Not used	END	PTA	Not used
Bit string	0	1	0	0	0	1	0	0
Weight	0	64	0	0	0	4	0	0

④ The SRQ line becomes 1 (low level).

⑤ The controller knows that an interrupt signal has arrived.

⑥ When the controller finds that the device whose DIO7 (bit 6) is 1 is this analyzer, this analyzer is assigned as a talker and the controller is assigned as a listener and a status message is sent to the controller.

⑦ Status bits are 01000100 and the weight value (64 + 4 = 68) is received by the controller.

⑧ The controller finds that sweep has been completed according to the bit string, weight value, and enable bit of the enable register.

⑨ The controller performs "sweep end" processing.

7.5.4 Reading, writing to and clearing the extended event status register

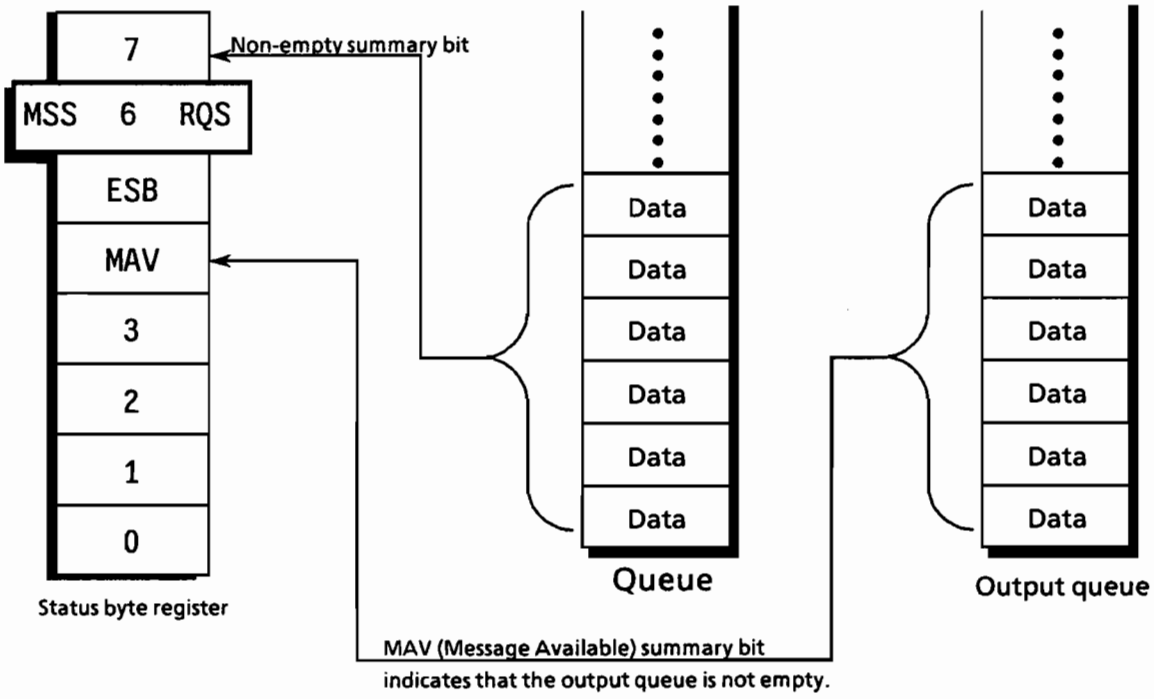
Reading	The register is destructively read by the a query, i.e. it is cleared after being read. The PTA and END event status registers are read by the ESR1?? and ESR2? queries. The read value, <NR1>, is obtained by binary weighting the event bit and converting it to decimal.
Writing	With the exception of clearing, writing operations cannot be performed externally.
Clearing	The register is cleared in the following cases. ①A *CLS command is received ②The power is turned on when the power-on-status-clear flag is true. ③An event is read for a query command

7.5.5 Reading, writing to and clearing the extended event status enable register

Reading	The register is non-destructively read by a query, i.e. it is not cleared after being read. The PTA and END event status registers are read by the ESE1? and ESE2? queries. The read value, returned by <NR1>, is obtained by binary weighting the event bit and converting it to decimal.
Writing	The PTA and END event status registers are written to by the ESE1 and ESE2 program commands. As bits 0 to 7 of the registers are respectively binary weighted to 1, 2, 4, 8, 16, 32, 64 and 128, data to be written is sent by <DECIMAL NUMERIC PROGRAM DATA>, the digit total weighted value of the bits selected from among them.
Clearing	The register is cleared in the following cases. ① ESE1 and ESE2 program commands with a data values of 0 are received by the PTA and END event status registers. ② The power is turned on when the power-on-status-clear flag is true, or it is turned on when the *PSC command is not available. The extended event status enable register is not affected by the followings: ① Changes of the status of the IEEE 488.1 device clear function ② A *RST common command is received ③ A *CLS common command is received

7.6 Queue Model

The status-data-structure queue model is shown at the right of the diagram below. A queue is data structure including data lists arranged in sequence which provides a means of reporting sequential status and other information. The existence of such information in the queue is indicated by summary messages. The queue contents are read by the handshake when a device is in TACS (Talker Active State).



The output queue, which is mandatory, is the queue that outputs the MAV summary message to bit 4 of the status byte. A queue (which can output the MAV summary message to any of bits 0 to 3 or 7 of the status byte register) is an option and is simply called a "queue".

As the summary messages from the register model can also be connected to bits 0 to 3 or 7 of the status byte register, the types of summary messages vary with the device.

Though Anritsu assigns bit 7 of the status byte register for the use of summary message bits from "queues", it is not used when the output queue is sufficient.

The output queue is compared with an ordinary queue on the next page.

Comparison of Output and Ordinary Queues

Item	Output queue	Ordinary Queue
Data input/output operation	FIFO (First-In First-Out)	Need not always be FIFO
Read	The type (paragraph 6.2.9) of response message unit read is determined by the query.	Read by device-dependent query commands. The response messages read must be of the same type(paragraph 6.2.9).
Writing	<PROGRAM MESSAGE> elements cannot be written directly to the output queue.	<PROGRAM MESSAGE> elements cannot be written directly to a queue. They indicate encoded device information.
Summary message	Is true (1) when the output queue is not empty and false (0) when the output queue is empty. The MAV summary message is used to synchronize the exchange of information between a device and the controller.	Is true (1) when the queue is not empty and false (0) when the queue is empty.
Clearing	The output queue is cleared in the following cases: ① All items in it have been read ② A DCL bus command is received to initialize message exchange ③ PON is true at power on	A queue is cleared in the following cases: ① All items in it have been read ② A *CLS command is received ③ Other device-dependent methods are used

7.7 Techniques for Synchronizing Devices with the Controller

There are 3 ways of synchronizing devices with the controller.

① Forced sequential execution ..... (Using the ***WAI** command)
② Wait for a response from the device's output queue ..... (Using the ***OPC?** query)
③ Wait for a service request ..... (Using the ***OPC** command/***OPC?** query)

7.7.1 Forced sequential execution

Device-dependent commands are divided into 2 types - sequential commands and overlap commands.

- Sequential commands — Sequential commands are commands or queries that do not start the execution of newly received commands while the device is still executing a previous command sent by the controller.
- Overlap commands — Overlap commands are commands or queries that start the execution of newly received commands while the device is still executing a previous command sent by the controller. This analyzer does not support an overlap command.

Forced sequential execution is a synchronization technique that forces a command, that originally functioned as an overlap command, to operate sequentially, so, a process is not initiated until the previous one has finished. This synchronization technique uses the ***WAI** command.

Using the ***WAI** command is the simplest and surest way to force a device to execute operations sequentially. However, since the sweep start command (**SWP** or **SW2**) ends when This analyzer starts sweeping, it cannot be used for making judgment as to whether sweep has been completed, using a ***WAI** command.

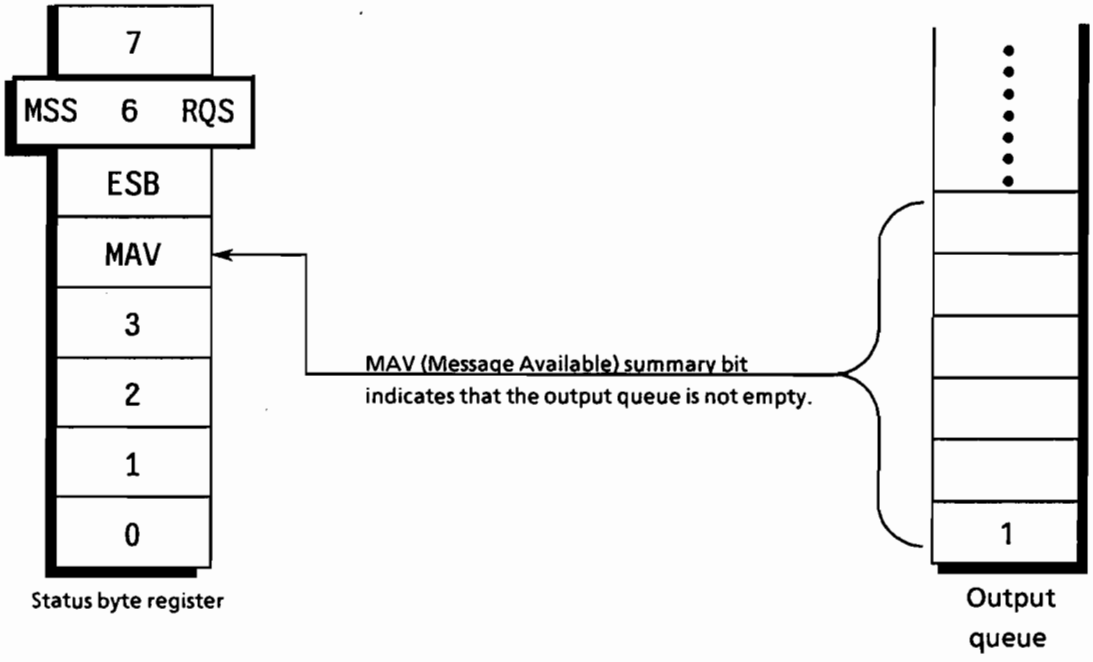
In such a case, use the flag (**SWP?** or **SW3?**) indicating that sweep is being performed.

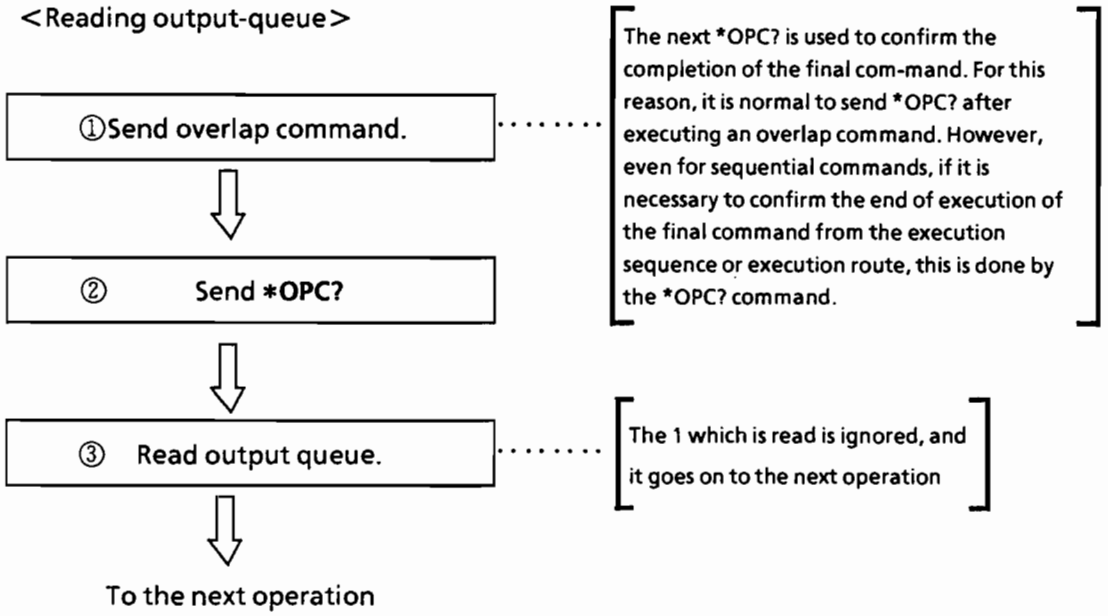
7.7.2 Wait for a response from the output queue

Executing the ***OPC?** query sets a 1 in the output queue to generate a MAV summary message when a device has completed all of its pending operations.

In this technique, a device is synchronized with the controller by reading the 1 set in the output queue as described above or the MAV summary message bit.

As the MAV summary message bit is used in the "wait for a service request" technique, it will be explained in the next paragraph. The following explains synchronization by reading the output queue.

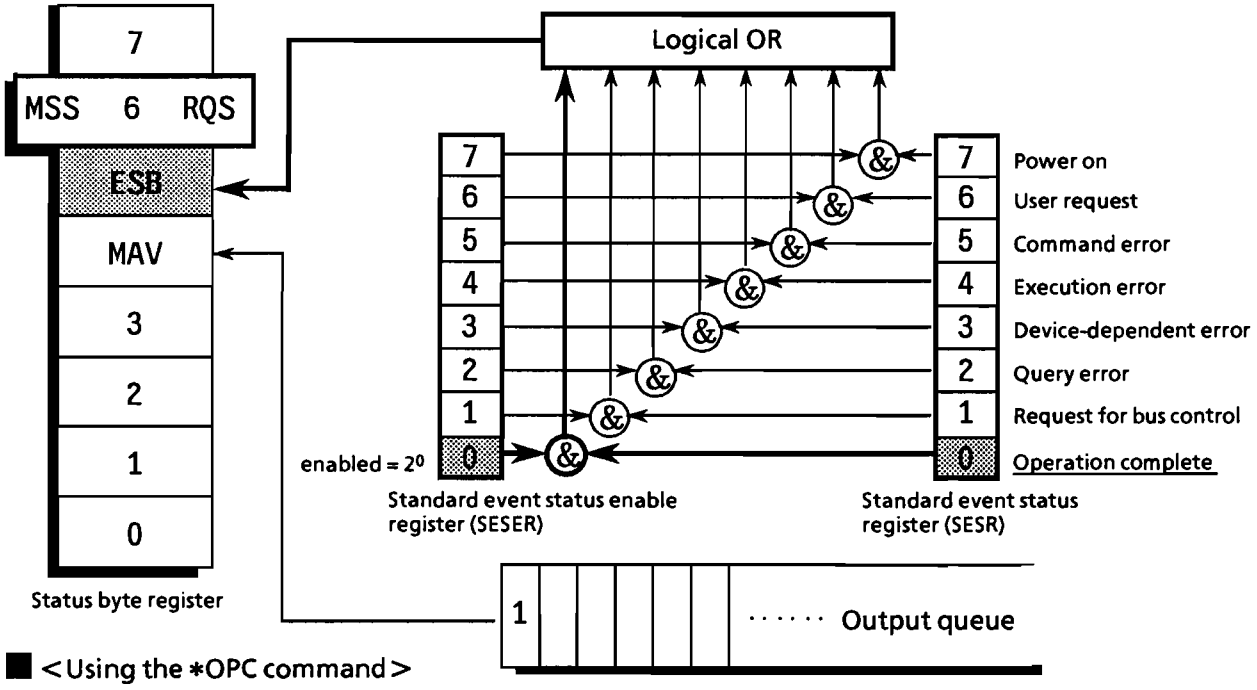




7.7.3 Wait for a service request

In this technique, the controller is momentarily interrupted by an SRQ signal from a device to process a status message from the device.

In a normal interrupt, the device would make a request to the controller at any time regardless of what the controller is doing. However, in using it as a technique for synchronizing the device with the controller, the controller sends an ***OPC** command or an ***OPC?** query to the device to check whether the device's operation has been completed or not. While waiting for the SRQ signal from the operation complete event, the controller carries on with some other useful task, and when it detects the operation complete event, the controller processes the designated task.



■ <Using the *OPC command>

① Enable the 2^0 bit of the standard event status enable register. — `WRITE @1Ø3:"*ESE 1"`

⇩

② Enable the 2^5 bit of the service request enable register. — `WRITE @1Ø3:"*SRE 32"`

⇩

③ Make the device execute the specified operation. — `WRITE @1Ø3:<PROGRAM MESSAGE >`

⇩

④ Execute the *OPC command.
(Since it is an overlap command, the next command is also executed) — `WRITE @1Ø3:"*OPC"`

⇩

⑤ Wait for an SRQ interrupt. (ESB summary message) · · · · Value of the status byte: $2^6 + 2^5 = 96$

■ <Using the *OPC? query>

① Enable the 2^4 bit of the service request enable register. WRITE @1Ø3:"*SRE 16"

⇩

② Make the device execute the specified operation. WRITE @1Ø3:<PROGRAM MESSAGE>

⇩

③ Send the *OPC? query. (Wait until the operation in ② has been completed) WRITE @1Ø3:"*OPC?"

⇩

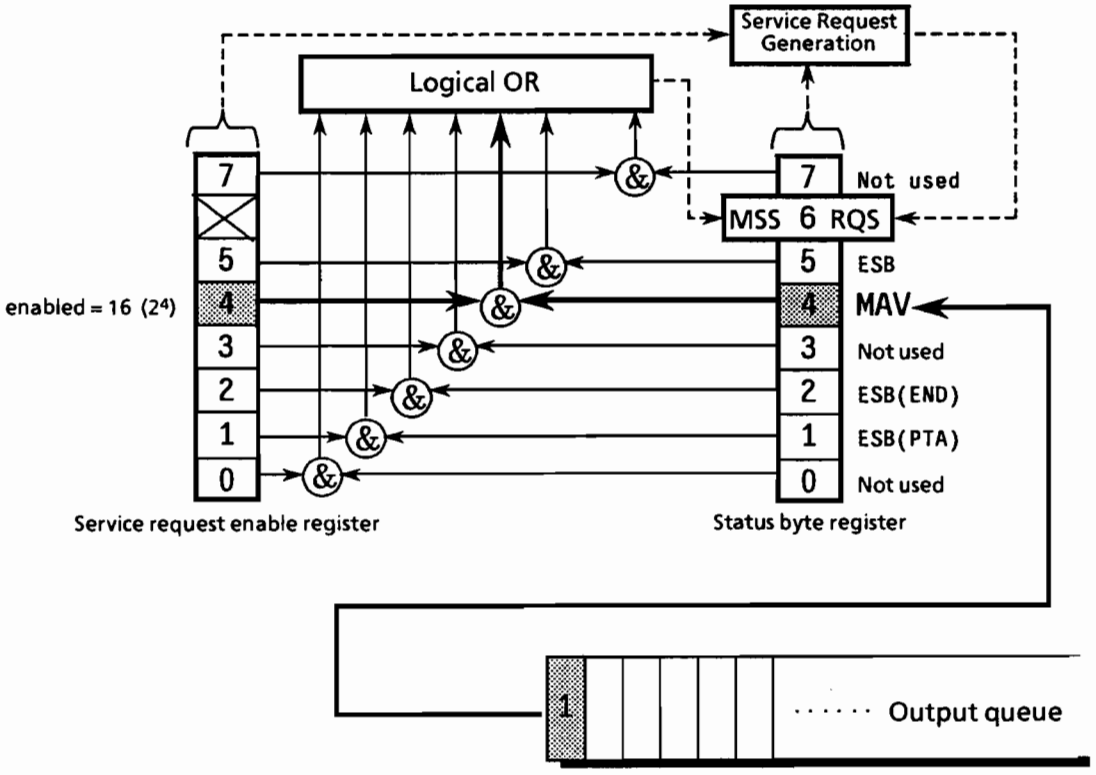
④ Read the ASCII character 1 in the output queue and discard it.

⇩

⑤ Wait for the SRQ interrupt (MAV summary message) · · · · Value of the status byte: $2^6 + 2^4 = 80$

⇩

To the next operation



SECTION 8
DETAILS ON DEVICE MESSAGES

This section provides detailed information on device messages listed in Section 2 (☞pages 10 to 25) with the exception of common commands.

TABLE OF CONTENTS

8.1 System Setting

Parameter		Device message		
Item	Control item	Command	Query	Response
System resetting		*RST		
Initialization		INI		
Date setting Year (YY), month (MM), and day (DD). (YY = 0 to 99) (MM= 0 to 12) (DD = 1 to 31)		DATE␣YY,MM,DD	DATE?	DATE␣YY,MM,DD (13 characters) (YY = 00 to 99) (MM = 01 to 12) (DD = 01 to 31)
Time setting Set hour (hh)d, minute (mm), and second (ss). (hh = 0 to 23) (mm = 0 to 59) (ss = 0 to 59)		TIME␣hh,mm,ss	TIME?	DATE␣hh,mm,ss (13 characters) (hh = 00 to 23) (mm = 00 to 59) (ss = 00 to 59)
PTA ON/OFF	OFF ON	PTA␣Ø PTA␣1		
PTA execution state or read state	NORMAL BUSY		PTA? PTA?	PTA␣Ø PTA␣1
PTA program loading	OFF Loadable	PTL␣Ø PTL␣1		
PTA program output request After the program output request PTL?, output the PTA program line by line in text$ form.			PTL?	text$
Output to dual port memory Write data c in dual port memory m1. (m1 = 0 to 31) (c = Alphacetic or numeric character)		PMY␣m1,c		
Input from dual port memory Read two pieces of data T$ from dual port memory m1. (m1 = 0 to 31) (m2 = 1 to 32)			PMY?␣m1,m2	T$

8.2 Trace Screen Selection

Parameter		Device message		
Item	Control item	Command	Query	Response
Active trace	TR-A TR-B	ACTR␣Ø ACTR␣1	ACTR? ACTR?	ACTR␣Ø ACTR␣1
Measurement item switching	S_{11} S_{21} S_{12} S_{22}	TRFC␣m,Ø TRFC␣m,1 TRFC␣m,2 TRFC␣m,3	TRFC?␣m	TRFC␣m,n
	GPDLY LEVEL	TRFC␣m,4 TRFC␣m,5	TRFC␣m TRFC␣m	TRFC␣m,n TRFC␣m,n
Time domain ON/OFF NORM_TIME (TRACE-A)	Time domain ON Time domain OFF	TMDM␣Ø TMDM␣1	TMDM? TMDM?	TMDM␣Ø TMDM␣1
Analysis port selection	ATIO TA TB R	TSPT␣m,Øto2 TSPT␣m,3 TSPT␣m,4 TSPT␣m,5	TSPT?␣m TSPT?␣m TSPT?␣m TSPT?␣m	TSPT␣m,Ø TSPT␣m,3 TSPT␣m,4 TSPT␣m,5

m: Trace type specification 0: Trace A and trace B
1: Trace A
2: Trace B

n: Measurement item

8.3 Screen Coordinate System Selection

Parameter		Device message		
Item	Control item	Command	Query	Response
(S_{21} or S_{12})	LOGMAG	COOR␣Ø	COOR?	COOR␣Ø
	PHASE	COOR␣1	COOR?	COOR␣1
	MAG	COOR␣2	COOR?	COOR␣2
	REAL	COOR␣3	COOR?	COOR␣3
	IMAG	COOR␣4	COOR?	COOR␣4
	POLAR	COOR␣5	COOR?	COOR␣5
	HSDELAY	COOR␣6	COOR?	COOR␣6
(S_{11} or S_{22})	LOGMAG	COOR␣Ø	COOR?	COOR␣Ø
	PHASE	COOR␣1	COOR?	COOR␣1
	MAG	COOR␣2	COOR?	COOR␣2
	REAL	COOR␣3	COOR?	COOR␣3
	IMAG	COOR␣4	COOR?	COOR␣4
	POLAR	COOR␣5	COOR?	COOR␣5
	IMPD	COOR␣6	COOR?	COOR␣6
	ADMT	COOR␣7	COOR?	COOR␣7
	VSWR	COOR␣8	COOR?	COOR␣8
(BAND PASS or LOW PASS)	LOGMAG	COOR␣Ø	COOR?	COOR␣Ø
	PHASE	COOR␣1	COOR?	COOR␣1
	MAG	COOR␣2	COOR?	COOR␣2
	REAL	COOR␣3	COOR?	COOR␣3
	IMAG	COOR␣4	COOR?	COOR␣4

8.4 Frequency Setting

Parameter		Device message		
Item	Control item	Command	Query	Response
Center frequency Set center frequency f in Hz. (100000 ≦ f and f ≦ 8500000000) Minimum resolution: 1 mHz		CNF␣f	CNF?	CNF␣f (18 characters)
Coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Span frequency Set span frequency f in Hz. (0 ≦ f ≦ 8499900000) Minimum resolution: 1 Hz		SPF␣f	SPF?	SPF␣f (14 characters)
Coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Start frequency Set start frequency f in Hz. (10000 ≦ f and f ≦ 8500000000) Minimum resolution: 1 Hz		STF␣f	STF?	STF␣f (14 characters)
Coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Stop frequency Set stop frequency f in H. (10000 ≦ f and f ≦ 8500000000) Minimum resolution: 1 Hz		SOF␣f	SOF?	SOF␣f
Coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF

8.5 Sweep Function

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Parameter		Device message		
Item	Control item	Command	Query	Response
Sweep time Set sweep time t in ms. AUTO setting t = 0 (10 ≦ t ≦ 99000000) Minimum resolution: 1 ms		SWT␣t	SWT?	SWT␣t (12 characters)
Sweep time coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWT	CPL␣SWP,ON CPL␣SWP,OFF
SWEEP TIME AUTO	OFF ON	AU1␣Ø AU1␣1	AU1? AU1?	AU1␣Ø AU1␣1
Sweep time coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Sweep mode	REPEAT SINGLE	SW2␣Ø SW2␣1	SW2? SW2?	SW2␣Ø SW2␣1
Sweep specification coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Sweep execution	REPEAT SINGLE Sweep stop state Sweep execution state	SWP␣Ø SWP␣1	 SWP? SWP?	 Ø 1
Sweep specification coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Sweep stop	STOP RESET CONTINUE Sweep stop state Sweep execution state	SW3␣Ø SW3␣1 SW3␣2	 SW3? SW3?	 Ø 1
Sweep specification coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Sweep range	FULL SWEEP MKR SWEEP	SW1␣Ø SW1␣1	SW1? SW1?	SW1␣Ø SW1␣1
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Sweep mode	CENTER/SPAN START/STOP	FRQ␣Ø FRQ␣1	FRQ? FRQ?	FRQ␣Ø FRQ␣1
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON PL␣SWP,OFF

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Parameter		Device message		
Item	Control item	Command	Query	Response
LOG/LIN sweep	LINEAR LOGARITHM	LOG␣Ø LOG␣1	LOG? LOG?	LOG␣Ø LOG␣1
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
List sweep	OFF ON	LFM␣Ø LFM␣1	LFM? LFM?	LFM␣Ø LFM␣1
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
List sweep start Frequency setting	DIRECT SET START FRQ	LFSM␣Ø LFSM␣1	LFSM? LFSM?	LFSM␣Ø LFSM␣1
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
List sweep start frequency Set list sweep start frequency f in Hz. (100000.000 ≦ f and f ≦ 8500000000.000) Minimum resolution: 1 mHz		LFSF␣f	LFSF?	LFSF␣f (19 characters)
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
List sweep start Frequency setting	DIRECT SET STOP FRQ	LFPM␣Ø LFPM␣1	LFPM? LFPM?	LFPM␣Ø LFPM␣1
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
List sweep start frequency Set list sweep start frequency f in Hz. (100000.000 ≦ f and f ≦ 8500000000.000) Minimum resolution: 1 mHz		LFPF␣f	LFPF?	LFPF␣f (19 characters)
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
List sweep start frequency Set list sweep start frequency f in Hz. (100000.000 ≦ f and f ≦ 8500000000.000) Minimum resolution: 1 mHz		LFRF␣f	LFRF?	LFRF (19 characters)
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF

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Parameter		Device message		
Item	Control item	Command	Query	Response
List sweep measurement calculation method	MAX MIN MEAN	CSW␣Ø CSW␣1 CSW␣2	CSW? CSW? CSW?	CSW␣Ø CSW␣1 CSW␣1
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Level sweep	OFF ON	LSW␣Ø LSW␣1	LSW? LSW?	LSW␣Ø LSW␣1
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Level sweep start level Set level sweep start level r in dBm. Continuous variation range: 20 dB Minimum resolution: 0.01 dB		STL␣r	STL?	STL␣r (10 characters)
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Level sweep stop level Set level sweep stop level r in dB. Continuous variation range: 20 dB Minimum resolution: 0.01 dB		SOL␣r	SOL?	SOL␣r (10 characters)
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF
Level sweep step level Set level sweep step level r in dB. Continuous variation range: 20 dB Minimum resolution: 0.01 dB		SEL␣r	SEL?	SEL␣r (10 characters)
Sweep mode coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF

8.6 Test Port Power

Parameter		Device message		
Item	Control item	Command	Query	Response
Test port power Set test port power r in dBm. The setting range depends on the ATT value. Minimum resolution: 0.01 dB		OPL␣r	OPL?	OPL␣r (10 characters)
Source power Set source power r in dBm. (+3.00≦ r ≦ +23.00) Minimum resolution: 0.01 dB		SPWR␣r	SPWR?	SPWR␣r
Output attenuator Set output attenuator r in 10 dB steps. (0 to 60 dB/10 dB)		OATT␣r	OATT?	OATT␣r
Output offset Set output offset value r in dB. (±99.99 dB/0.01 dB)		OOFS␣r	OOFS?	OOFS␣r
Coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF

8.7 Calibration Function

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Parameter		Device message		
Item	Control item	Command	Query	Response
CAL method	X–S ONE PORT OSL TWO PORT OSL THRU-OSL	ECL␣Ø ECL␣1 ECL␣2 ECL␣3	ECL? ECL? ECL? ECL?	ECL␣Ø ECL␣1 ECL␣2 ECL␣3
CAL data calculation	SATART END BUSY	CAL	 CAL? CAL?	 Ø 1
CAL data obtainment state	END BUSY		CAL? CAL?	Ø 1
CAL data calculation	START	CAL		
CAL data measurement (X-S)	X-S (S data)	CAL␣Ø		
(ONE PORT)	OPEN SHORT LOAD	CAL␣Ø CAL␣1 CAL␣2		
(TWO PORT)	THRU LOAD/LOAD OPEN/SHORT SHORT/OPEN	CAL␣Ø CAL␣1 CAL␣2 CAL␣3		
(1 PATH 2PORT)	OPEN SHORT LOAD THRU	CAL␣Ø CAL␣1 CAL␣2 CAL␣3		
CAL ON/OFF	OFF ON	CXS␣Ø CXS␣1	CXS? CXS?	CXS␣Ø CXS␣1
CAL range confirmation	Whole Part		CBW? CBW?	0 1
Electrical length Set electrical length r in meters (m). (−999999.9999999 ≦ r and r ≦ 999999.9999999) Minimum resolution: 100 nm		ELG␣r	ELG?	ELG␣r (19 characters)
Coupling	ON OFF	CPL␣AVG,ON CPL␣AVG,OFF	CPL?␣AVG CPL?␣AVG	CPL␣AVG,ON CPL␣AVG,OFF

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Parameter		Device message		
Item	Control item	Command	Query	Response
Port 1 connector type	SMA (M)	CONN␣1,1	CONN?␣1	CONN␣1,Ø1
	SMA (F)	CONN␣1,2	CONN?␣1	CONN␣1,Ø2
	K-CONN (M)	CONN␣1,3	CONN?␣1	CONN␣1,Ø3
	K-CONN (F)	CONN␣1,4	CONN?␣1	CONN␣1,Ø4
	TYPE N (M)	CONN␣1,5	CONN?␣1	CONN␣1,Ø5
	TYPE N (F)	CONN␣1,6	CONN?␣1	CONN␣1,Ø6
	GPC-3.5 (M)	CONN␣1,7	CONN?␣1	CONN␣1,Ø7
	GPC-3.5 (F)	CONN␣1,8	CONN?␣1	CONN␣1,Ø8
	GPC-7	CONN␣1,9	CONN?␣1	CONN␣1,Ø9
	USER (1)	CONN␣1,1Ø	CONN?␣1	CONN␣1,1Ø
	USER (2)	CONN␣1,11	CONN?␣1	CONN␣1,11
	USER (3)	CONN␣1,12	CONN?␣1	CONN␣1,12
Port 2 connector type	SMA (M)	CONN␣2,1	CONN?␣2	CONN␣2,Ø1
	SMA (F)	CONN␣2,2	CONN?␣2	CONN␣2,Ø2
	K-CONN (M)	CONN␣2,3	CONN?␣2	CONN␣2,Ø3
	K-CONN (F)	CONN␣2,4	CONN?␣2	CONN␣2,Ø4
	TYPE N (M)	CONN␣2,5	CONN?␣2	CONN␣2,Ø5
	TYPE N (F)	CONN␣2,6	CONN?␣2	CONN␣2,Ø6
	GPC-3.5 (M)	CONN␣2,7	CONN?␣2	CONN␣2,Ø7
	GPC-3.5 (F)	CONN␣2,8	CONN?␣2	CONN␣2,Ø8
	GPC-7	CONN␣2,9	CONN?␣2	CONN␣2,Ø9
	USER (1)	CONN␣2,1Ø	CONN?␣2	CONN␣2,1Ø
	USER (2)	CONN␣2,11	CONN?␣2	CONN␣2,11
	USER (3)	CONN␣2,12	CONN?␣2	CONN␣2,12

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Parameter		Device message		
Item	Control item	Command	Query	Response
Setting CAL device parameters by connector type	SMA (M) SMA (F) K-CONN (M) K-CONN (F) TYPE N (M) TYPE N (F) GPC-3.5 (M) GPC-3.5 (F) GPC-7 USER (1) USER (2) USER (3)	CONN␣1 CONN␣2 CONN␣3 CONN␣4 CONN␣5 CONN␣6 CONN␣7 CONN␣8 CONN␣9 CONN␣10 CONN␣11 CONN␣12	CON? CON? CON? CON? CON? CON? CON? CON? CON? CON? CON? CON?	CONN␣Ø1 CONN␣Ø2 CONN␣Ø3 CONN␣Ø4 CONN␣Ø5 CONN␣Ø6 CONN␣Ø7 CONN␣Ø8 CONN␣Ø9 CONN␣10 CONN␣11 CONN␣12
Set parameter r1 (absolute number) and r2 (millimeter: mm) specified by CONm for each connector. r1 = −999.999 to 999.999 Minimum resolution: 0.001 2 = −9999.99 to 9999.99 Minimum resolution: 100 nm				
Open device stray capacitance	C0 (1E-15) C1 (1E-27) C2 (1E-36) C3 (1E-45)	CCØ␣r1 CC1␣r1 CC2␣r1 CC3␣r1	CCØ? CC1? CC2? CC3?	CCØ␣,r1 CC1␣,r1 CC2␣,r1 CC3␣,r1 (12 characters)
Open device offset length		COO␣r2	COO?	COO␣r2 (14 characters)
Short device offset length		COS␣r2	COS?	COS␣r2 (14 characters)
Through line offset length setting Set through line offset length r in millimeters (mm). r1 = −999.999 to 999.999 Minimum resolution: 100 nm		COT␣r	COT?	COT␣r (14 characters)

8.8 Resolution Bandwidth Setting

Parameter		Device message		
Item	Control item	Command	Query	Response
RBW	3 Hz	RBW␣Ø	RBW?	RBW␣ØØ
	10 Hz	RBW␣1	RBW?	RBW␣Ø1
	30 Hz	RBW␣2	RBW?	RBW␣Ø2
	100 Hz	RBW␣3	RBW?	RBW␣Ø3
	300 Hz	RBW␣4	RBW?	RBW␣Ø4
	1 kHz	RBW␣5	RBW?	RBW␣Ø5
	3 kHz	RBW␣6	RBW?	RBW␣Ø6
	10 kHz	RBW␣7	RBW?	RBW␣Ø7
	AUTO	RBW␣12	RBW?	RBW␣12
Coupling	ON	CPL␣AVG,ON	CPL?␣AVG	CPL␣AVG,ON
	OFF	CPL␣AVG,OFF	CPL?␣AVG	CPL␣AVG,OFF

8.9 Delay Setting

Parameter		Device message		
Item	Control item	Command	Query	Response
Delay measurement range	DRG setting mode	DLYF␣Ø	DLYF?	DLYF␣Ø
	APF setting mode	DLYF␣1	DLYF?	DLYF␣1
	40 ns	DRG␣0	DRG?	DRG␣ØØ
	100 ns	DRG␣1	DRG?	DRG␣Ø1
	200 ns	DRG␣2	DRG?	DRG␣Ø2
	400 ns	DRG␣3	DRG?	DRG␣Ø3
	1 us	DRG␣4	DRG?	DRG␣Ø4
	2 us	DRG␣5	DRG?	DRG␣Ø5
	4 us	DRG␣6	DRG?	DRG␣Ø6
	10 us	DRG␣7	DRG?	DRG␣Ø7
	20 us	DRG␣8	DRG?	DRG␣Ø8
	40 us	DRG␣9	DRG?	DRG␣Ø9
	100 us	DRG␣1Ø	DRG?	DRG␣1Ø
	200 us	DRG␣11	DRG?	DRG␣11
	400 us	DRG␣12	DRG?	DRG␣12
	1 ms	DRG␣13	DRG?	DRG␣13
	2 ms	DRG␣14	DRG?	DRG␣14
	4 ms	DRG␣15	DRG?	DRG␣15
	10 ms	DRG␣16	DRG?	DRG␣16
	20 ms	DRG␣17	DRG?	DRG␣17
	40 ms	DRG␣18	DRG?	DRG␣18
	100 ms	DRG␣19	DRG?	DRG␣19
	200 ms	DRG␣2Ø	DRG?	DRG␣2Ø
	400 ms	DRG␣21	DRG?	DRG␣21
Delay range coupling	ON	CPL␣AVG,ON	CPL?␣AVG	CPL␣AVG,ON
	OFF	CPL␣AVG,OFF	CPL?␣AVG	CPL␣AVG,OFF
Delay range AUTO		AU4		
Delay range coupling	ON	CPL␣AVG,ON	CPL?␣AVG	CPL␣AVG,ON
	OFF	CPL␣AVG,OFF	CPL?␣AVG	CPL␣AVG,OFF
Aperture frequency Set aperture frequency f in Hz. (1 ≦ f ≦ 400000000) Minimum frequency: Two significant digits		APF␣f	APF?	APF␣f (13 characters)
Delay range coupling	ON	CPL␣AVG,ON	CPL?␣AVG	CPL␣AVG,ON
	OFF	CPL␣AVG,OFF	CPL?␣AVG	CPL␣AVG,OFF
High speed delay measurement Set measurement range r in percents (%). (1 ≦ r ≦ 10) Minimum resolution: 1%		HDRG␣f	HDRG?	HDRG␣f (7 characters)
Delay range coupling	ON	CPL␣AVG,ON	CPL?␣AVG	CPL␣AVG,ON
	OFF	CPL␣AVG,OFF	CPL?␣AVG	CPL␣AVG,OFF

8.10 Overload

Parameter		Device message		
Item	Control item	Command	Query	Response
Overload state monitoring	NORMAL		OVL?	OVL␣0
	TRACE-A OVL		OVL?	OVL␣1
	TRACE-B OVL		OVL?	OVL␣2
	TRACE-A/B OVL		OVL?	OVL␣3

8.11 Averaging

Parameter		Device message		
Item	Control item	Command	Query	Response
Averaging method	SUM MAX MIN	AVT␣Ø AVT␣1 AVT␣2	AVT? AVT? AVT?	AVT␣Ø AVT␣1 AVT␣2
Coupling	ON OFF	CPL␣AVG,ON CPL␣AVG,OFF	CPL?␣AVG CPL?␣AVG	CPL␣AVG,ON CPL␣AVG,OFF
Averaging count Set averaging count r. (1 ≦ r ≦ 1000) Minimum resolution: 1 time		AVG␣r	AVG?	AVG␣r (8 characters)
Coupling	ON OFF	CPL␣AVG,ON CPL␣AVG,OFF	CPL?␣AVG CPL?␣AVG	CPL␣AVG,ON CPL␣AVG,OFF
Number of measurement points	11 points 21 points 51 points 101 points 201 points 501 points 1001 points	MEP␣Ø MEP␣1 MEP␣2 MEP␣3 MEP␣4 MEP␣5 MEP␣6	MEP? MEP? MEP? MEP? MEP? MEP? MEP?	MEP␣Ø MEP␣1 MEP␣2 MEP␣3 MEP␣4 MEP␣5 MEP␣6
Coupling	ON OFF	CPL␣AVG,ON CPL␣AVG,OFF	CPL?␣AVG CPL?␣AVG	CPL␣AVG,ON CPL␣AVG,OFF
Smoothing Set smoothing calculation range r in percents (%). (0 ≦ r ≦ 50) Minimum resolution: 1%		SMT␣r	SMT?	SMT␣r (6 characters)
Coupling	ON OFF	CPL␣AVG,ON CPL␣AVG,OFF	CPL?␣AVG CPL?␣AVG	CPL␣AVG,ON CPL␣AVG,OFF
Breakpoint Set breakpoint r as the sweep end point. (0 ≦ r ≦ 1001) Minimum resolution: 1 point		BKP␣r	BKP?	BKP␣r (8 characters)
Coupling	ON OFF	CPL␣AVG,ON CPL␣AVG,OFF	CPL?␣AVG CPL?␣AVG	CPL␣AVG,ON CPL␣AVG,OFF

8.12 Port 1 Attenuator and Port 2 Attenuator

Parameter		Device message		
Item	Control item	Command	Query	Response
Port 1 ATT	0 dB 20 dB	I1AT␣m,Ø I1AT␣m,20	I1AT?␣m I1AT?␣m	I1AT␣m,Ø I1AT␣m,20
Coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL␣SWP? CPL␣SWP?	CPL␣SWP,ON CPL␣SWP,OFF
Port 1 ATT	0 dB 20 dB	I2AT␣m,Ø I2AT␣m,20	I2AT?␣m I2AT?␣m	I2AT␣m,Ø I2AT␣m,20
Coupling	ON OFF	CPL␣SWP,ON CPL␣SWP,OFF	CPL?␣SWP CPL?␣SWP	CPL␣SWP,ON CPL␣SWP,OFF

m: Trace specification 0: Trace A and trace B
1: Trace A
2: Trace B

8.13 Scale Function

Parameter				Device message		
Item		Control item		Command	Query	Response
Scale	dB scale	deg scale	EU† scale			
	0.01	0.01	0.001	SCAL␣Ø	SCAL?	SCAL␣ØØ
	0.02	0.02	0.002	SCAL␣1	SCAL?	SCAL␣Ø1
	0.05	0.05	0.005	SCAL␣2	SCAL?	SCAL␣Ø2
	0.1	0.1	0.01	SCAL␣3	SCAL?	SCAL␣Ø3
	0.2	0.2	0.02	SCAL␣4	SCAL?	SCAL␣Ø4
	0.5	0.5	0.05	SCAL␣5	SCAL?	SCAL␣Ø5
	1	1	0.1	SCAL␣6	SCAL?	SCAL␣Ø6
	2	2	0.2	SCAL␣7	SCAL?	SCAL␣Ø7
	5	5	0.5	SCAL␣8	SCAL?	SCAL␣Ø8
	10	10	1	SCAL␣9	SCAL?	SCAL␣Ø9
	20	20	2	SCAL␣1Ø	SCAL?	SCAL␣1Ø
	50	50	5	SCAL␣11	SCAL?	SCAL␣11
EU: Absolute number, s, V						
Offset Set offset value r. (−8000000 ≦ r ≦ 8000000) Minimum resolution:1 dB scale: 0.001 deg scale: 0.001 EU: 0.0001				OFST␣r	OFST?	OFST␣r (13 characters)
Screen offset standard		r: 0-10/ 1 step		OFLN␣m,r	OFLN?␣m	OFLN␣m,r
AUTO SCALE				SAU		

† Engineering Unit (engineering unit)

m: Trace type specification 0: Trace A and trace B
1: Trace A
2: Trace B

8.14 Target data search

Parameter		Device message		
Item	Control item	Command	Query	Response
Feature extraction	OFF	MEA␣m,Ø	MEA?␣m	MEA␣m,ØØ
	MIN	MEA␣m,1	MEA?␣m	MEA␣m,Ø1
	MAX	MEA␣m,2	MEA?␣m	MEA␣m,Ø2
	P P	MEA␣m,3	MEA?␣m	MEA␣m,Ø3
	MEAN	MEA␣m,4	MEA?␣m	MEA␣m,Ø4
	σ	MEA␣m,5	MEA?␣m	MEA␣m,Ø5
	1st + PEAK	MEA␣m,6	MEA?␣m	MEA␣m,Ø6
	1st − PEAK	MEA␣m,7	MEA?␣m	MEA␣m,Ø7
	NEXT + PEAK	MEA␣m,8	MEA?␣m	MEA␣m,Ø8
	NEXT − PEAK	MEA␣m,9	MEA?␣m	MEA␣m,Ø9
	1dB COMP	MEA␣m,14	MEA?␣m	MEA␣m,14
	XdB BW	MEA␣m,15	MEA?␣m	MEA␣m,15
	XdB FREQ	MEA␣m,16	MEA?␣m	MEA␣m,16
	Xdeg FREQ	MEA␣m,17	MEA?␣m	MEA␣m,17
	Ripple 1	MEA␣m,18	MEA?␣m	MEA␣m,18
	Ripple 2	MEA␣m,19	MEA?␣m	MEA␣m,19
	Ripple 3	MEA␣m,2Ø	MEA?␣m	MEA␣m,2Ø
	Ripple 4	MEA␣m,21	MEA?␣m	MEA␣m,21
XdB BW Set XdB BW in r. (−180.000 ≦ r ≦ 180.000) Minimum resolution: 0.001		XDBW␣r	XDBW?	XDBW␣r (13 characters)
XdB FREQ Set XdB FREQ in r. (−180.000 ≦ r ≦ 180.000) Minimum resolution: 0.001		XDBF␣r	XDBF?	XDBF␣r (13 characters)
Xdeg FREQ Set XdB FREQr. (−180.000 ≦ r ≦ 180.000) Minimum resolution: 0.001		XDEG␣r	XDEG?	XDEG␣r (13 characters)
Search resolution Set the peak and ripple search resolution r.		SERS␣m,r	SERS?␣m	SERS␣m,r
Target data value read	Trace-A side		MPA?	e1,e2 Other than frequency (25 characters) Frequency (25 characters, where e2 = 0)
	Trace-B side		MPB?	e1,e2 Other than frequency (25 characters) Frequency (25 characters, where e2 = 0)

m: Trace type specification 0: Trace A and trace B
1: Trace A
2: Trace B

8.15 Marker Function

(1/4)

Parameter		Device message		
Item	Control item	Command	Query	Response
Marker function	NORMAL	MKR␣Ø	MKR?	MKR␣ØØ
	ΔMKR(RIGHT)	MKR␣1	MKR?	MKR␣Ø1
	0MKR	MKR␣2	MKR?	MKR␣Ø2
	MKR → MAX	MKR␣3	MKR?	MKR␣ØØ
	MKR → MIN	MKR␣4	MKR?	MKR␣ØØ
	ΔMKR(LEFT)	MKR␣5	MKR?	MKR␣Ø1
	MKR → CF	MKR␣6	MKR?	MKR␣ØØ
	Δ → SPAN	MKR␣7	MKR?	MKR␣ØØ
	MKR → OFS	MKR␣8	MKR?	MKR␣ØØ
	MKR → +PEAK	MKR␣9	MKR?	MKR␣ØØ
	MKR → −PEAK	MKR␣1Ø	MKR?	MKR␣ØØ
	TRK → +PEAK	MKR␣11	MKR?	MKR␣11
	TRK → −PEAK	MKR␣12	MKR?	MKR␣12
Marker coupling	ON	CPL␣MKR,ON	CPL?␣MKR	CPL␣MKR,ON
	OFF	CPL␣MKR,OFF	CPL?␣MKR	CPL␣MKR,OFF
Reference marker specification	ZONE LEFT	RMKR␣−2	RMKR?	RMKR␣−2
	ZONE RIGHT	RMKR␣−1	RMKR?	RMKR␣−1
	MKR 0	RMKR␣Ø	RMKR?	RMKR␣Ø
	MKR 1	RMKR␣1	RMKR?	RMKR␣1
	MKR 2	RMKR␣2	RMKR?	RMKR␣2
	MKR 3	RMKR␣3	RMKR?	RMKR␣3
	MKR 4	RMKR␣4	RMKR?	RMKR␣4
	MKR 5	RMKR␣5	RMKR?	RMKR␣5
	MKR 6	RMKR␣6	RMKR?	RMKR␣6
	MKR 7	RMKR␣7	RMKR?	RMKR␣7
	MKR 8	RMKR␣8	RMKR?	RMKR␣8
	MKR 9	RMKR␣9	RMKR?	RMKR␣9
Marker coupling	ON	CPL␣MKR,ON	CPL?␣MKR	CPL␣MKR,ON
	OFF	CPL␣MKR,OFF	CPL?␣MKR	CPL␣MKR,OFF
Marker movement Set the active marker display position with point r. (0 ≦ r ≦ 1000) Minimum frequency: 1		CMK␣r	CMK?	CMK␣r (8 characters)
Marker coupling	ON	CPL␣MKR,ON	CPL?␣MKR	CPL␣MKR,ON
	OFF	CPL␣MKR,OFF	CPL?␣MKR	CPL␣MKR,OFF

(2/4)

Parameter		Device message		
Item	Control item	Command	Query	Response
Multimarker setting Specify whether the marker is to be specified with a point or frequency in m, a marker number in r, and a marker point with point d1 or frequency d1. m = 0: POINT m = 1: FREQUENCY r = 0 to 9 0 to 9: Marker number When [m = 0] d = 0 to 1000 Minimum resolution: 1 When [m = 1] (Hz) d = 100000.000 to 8500000000.000 Minimum resolution: 1 mHz		MSET␣m,r,(d)	MSET?␣m,r	MSET␣m,r,(d) When [m = 0] (13 characters) When [m = 1] (23 characters)
Marker coupling	ON OFF	CPL␣MKR,ON CPL␣MKR,OFF	CPL?␣MKR CPL?␣MKR	CPL␣MKR,ON CPL␣MKR,OFF
Multimarker setting cancellation Cancel the setting of multimarker r set in MSET to clear the marker on the display. r = 0 to 9 0 to 9: Marker number		MRST␣r		
Marker coupling	ON OFF	CPL␣MKR,ON CPL␣MKR,OFF	CPL?␣MKR CPL?␣MKR	CPL␣MKR,ON CPL␣MKR,OFF
Marker ON/OFF information Return numeric string r indicating ON/OFF information on individual markers. r = * * * * * * * * * * Marker9 · · · · · Marker0 * = 0: OFF, * = 1: ON			MRST?␣1	h h=0000000000 ∫ 1111111111 (10 characters)
Active marker number Return active marker number r. (When there is no active marker, "r = −1" is returned.)			MRST?␣2	r (2 characters)

(3/4)

Parameter		Device message		
Item	Control item	Command	Query	Response
Trace-A side zone specification Specify whether a zone is to be specified with a point or frequency in m, the left zone of the active marker in g1, and the right zone in g2. m = 0: POINT m = 1: FREQUENCY When [m = 0] g1 and g2 = 0 to 1000 Minimum resolution: 1 When [m = 1] (Hz) g1 and g2 = 0 to 8499900000.000 Minimum frequency: 1 mHz		ZNA␣m,g1,g2	ZNA?␣m	ZNA␣m,g1,g2 When [m = 0] (15 characters) When [m = 1] (35 characters)
Marker coupling	ON OFF	CPL␣MKR,ON CPL␣MKR,OFF	CPL?␣MKR CPL?␣MKR	CPL␣MKR,ON CPL␣MKR,OFF
Trace-B side zone specification Specify whether a zone is to be specified with a point or frequency in m, the left zone of the active marker in g1, and the right zone in g2. m = 0: POINT m = 1: FREQUENCY When [m = 0] g1 and g2 = 0 to 1000 Minimum resolution: 1 When [m = 1] (Hz) g1 and g2 = 0 to 8499900000.000 Minimum frequency: 1 mHz		ZNB␣m,g1,g2	ZNB?␣m	ZNB␣m,g1,g2 When [m = 0] (15 characters) When [m = 1] (35 characters)
Marker coupling	ON OFF	CPL␣MKR,ON CPL␣MKR,OFF	CPL?␣MKR CPL?␣MKR	CPL␣MKR,ON CPL␣MKR,OFF
Marker display	ON OFF	MKD␣Ø MKD␣1	MKD? MKD?	MKD␣Ø MKD␣1
Impedance display marker value	|Z|/θ Rs/Ls,Cs Q/D R+jX	IMV␣Ø IMV␣1 IMV␣2 IMV␣3	IMV? IMV? IMV? IMV?	IMV␣Ø IMV␣1 IMV␣2 IMV␣3

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Parameter		Device message		
Item	Control item	Command	Query	Response
Admittance display marker value	|Y|/θ Rs/Lp,Cp Q/D G+jB	ADV␣Ø ADV␣1 ADV␣2 ADV␣3	ADV? ADV? ADV? ADV?	ADV␣Ø ADV␣1 ADV␣2 ADV␣3
Zero marker value read	Trace-A side Trace-B side		ZRA? ZRB?	e1,e2 e1,e2 (25 characters)
Reference marker value read	Trace-A side Trace-B side		RFA? RFB?	e1,e2 e1,e2 (25 characters)
Active marker value read	Trace-A side Trace-B side		MVA? MVB?	e1,e2 e1,e2 (25 characters)
Read of active marker value (frequency, distance, or time) for active tracing			MKF?	d
Read of value of marker other than active marker m: Trace 0: A, B1: A2: B n: Marker number			MKV?␣m,n	e,((e2),(e3),(e4))
Marker frequency read m: Trace 0: A, B1: A2: B n: Marker number			MKF?␣m,n	e,(e2)
User-defined marker function Fn key definition (n: 2, 3, 4)	NORMAL ΔMKR(RIGHT) 0MKR MKR → MAX MKR → MIN ΔMKR(LEFT) MKR → CF Δ → SPAN MKR → OFS MKR → +PEAK MKR → −PEAK TRK → +PEAK TRK → −PEAK	UDEF␣MKRn,Ø UDEF␣MKRn,1 UDEF␣MKRn,2 UDEF␣MKRn,3 UDEF␣MKRn,4 UDEF␣MKRn,5 UDEF␣MKRn,6 UDEF␣MKRn,7 UDEF␣MKRn,8 UDEF␣MKRn,9 UDEF␣MKRn,10 UDEF␣MKRn,11 UDEF␣MKRn,12	UDEF?␣MKRn UDEF?␣MKRn UDEF?␣MKRn UDEF?␣MKRn UDEF?␣MKRn UDEF?␣MKRn UDEF?␣MKRn UDEF?␣MKRn UDEF?␣MKRn UDEF?␣MKRn UDEF?␣MKRn UDEF?␣MKRn UDEF?␣MKRn	UDEF␣MKRn,Ø UDEF␣MKRn,1 UDEF␣MKRn,2 UDEF␣MKRn,3 UDEF␣MKRn,4 UDEF␣MKRn,5 UDEF␣MKRn,6 UDEF␣MKRn,7 UDEF␣MKRn,8 UDEF␣MKRn,9 UDEF␣MKRn,10 UDEF␣MKRn,11 UDEF␣MKRn,12

8.16 Display Function

(1/2)

Parameter		Device message		
Item	Control item	Command	Query	Response
Grid display	ALL GRID CENTER GRID FRAME ONLY	DF1␣Ø DF1␣1 DF1␣2	DF1? DF1? DF1?	DF1␣Ø DF1␣1 DF1␣2
Chart display mode	SINGLE SPLIT FRONT/BACK LIST MKR	DF2␣Ø DF2␣1 DF2␣2 DF2␣3	DF2? DF2? DF2? DF2?	DF2␣Ø DF2␣1 DF2␣2 DF2␣3
Screen display OFF (clear)	ALL ITEM TRACE-A LINE TRACE-B LINE MEAS PRMTR X-AXIS VALUE SOFT KEY SWEEP MKR CHART A CHART B GRAPH A GRAPH B MKR A MKR B MKR&TITLE	DF3␣Ø or CER␣Ø DF3␣1 or CER␣1 DF3␣2 or CER␣2 DF3␣3 or CER␣3 DF3␣4 or CER␣4 DF3␣5 or CER␣5 DF3␣6 or CER␣6 DF3␣7 or CER␣7 DF3␣8 or CER␣8 DF3␣9 or CER␣9 DF3␣10 or CER␣10 DF3␣11 or CER␣11 DF3␣12 or CER␣12 DF3␣13 or CER␣13		
Screen display ON (display)	ALL ITEM TRACE-A LINE TRACE-B LINE MEAS PRMTR X-AXIS VALUE SOFT KEY SWEEP MKR CHART A CHART B GRAPH A GRAPH B MKR A MKR B MKR&TITLE	DF4␣Ø or CRN␣Ø DF4␣1 or CRN␣1 DF4␣2 or CRN␣2 DF4␣3 or CRN␣3 DF4␣4 or CRN␣4 DF4␣5 or CRN␣5 DF4␣6 or CRN␣6 DF4␣7 or CRN␣7 DF4␣8 or CRN␣8 DF4␣9 or CRN␣9 DF4␣10 or CRN␣10 DF4␣11 or CRN␣11 DF4␣12 or CRN␣12 DF4␣13 or CRN␣13		
Waveform storage	ON OFF	STOR␣1 STOR␣Ø	STOR? STOR?	STOR␣1 STOR␣Ø

(2/2)

Parameter		Device message		
Item	Control item	Command	Query	Response
Trace-A overlapping display	OFF ON	OVPA␣Ø OVPA␣1	OVPA? OVPA?	OVPA␣Ø OVPA␣1
Trace-B overlapping display	OFF ON	OVPB␣Ø OVPB␣1	OVPB? OVPB?	OVPB␣Ø OVPB␣1
Trace-A and -B overlapping display	OFF ON	OVP␣Ø OVP␣1	OVP? OVP?	OVP␣Ø OVP␣1
Title display ON/OFF	OFF ON	TTL␣Ø TTL␣1	TTL? TTL?	TTL␣Ø TTL␣1
Title input Set a title in T$. T$ is a character string consisting of 20 or fewer characters.		TEN␣T$	TEN?	TEN␣T$ (24 characters)

8.17 Arithmetic Operation

Parameter		Device message		
Item	Control item	Command	Query	Response
Arithmetic operation between memories Source memory specification	TRACE-A TRACE-B WORK-1 WORK-2 WORK-3 WORK-4	CSCE␣Ø CSCE␣1 CSCE␣2 CSCE␣3 CSCE␣4 CSCE␣5	CSCE? CSCE? CSCE? CSCE? CSCE? CSCE?	CSCE␣Ø CSCE␣1 CSCE␣2 CSCE␣3 CSCE␣4 CSCE␣5
Arithmetic operation between memories Destination specification	TRACE-A TRACE-B WORK-1 WORK-2 WORK-3 WORK-4	CDST␣Ø CDST␣1 CDST␣2 CDST␣3 CDST␣4 CDST␣5	CDST? CDST? CDST? CDST? CDST? CDST?	CDST␣Ø CDST␣1 CDST␣2 CDST␣3 CDST␣4 CDST␣5
Arithmetic operation between source (S) and destination (D)	D+S D−S D*S D/S FFT (S) IFT (S) SUM (S) DIFF (S) CONJ (S)	CEXE␣Ø CEXE␣1 CEXE␣2 CEXE␣3 CEXE␣4 CEXE␣5 CEXE␣6 CEXE␣7 CEXE␣8		
Arithmetic operation between memories m: Arithmetic operation methodm1: Source area m2: Destination area specification m = 0: D+S m1, m2 = 0: TRACE-A = 1: D−S = 1: TRACE-B = 2: D*S = 2: WORK-1 = 3: D/S = 3: WORK-2 = 4: FET (S) = 4: WORK-3 = 5: IFT (S) = 5: WORK-4 = 6: SUM (S) = 7: DIFF (S) = 8: CONJ (S)		CALC␣m,m1,m2	CALC?	CALC␣m,m1,m2 (10 characters)
Constant setting Set constants r1 and r2 in the area specified in m. m= 0: TRACE-A = 1: TRACE-B = 2: WORK-1 = 3: WORK-2 = 4: WORK-3 = 5: WORK-4		CNST␣m,r1, r2,p p = 0: Values of r1 and r2 are stored. The data area contents are fixed. p = 1: Values of 11 and r2 are set in the data area.	CNST?	CNST␣m,r1,r2 (10 characters)

8.18 Trace Data Transfer and Read/Write

The trace data corresponding to the point positions on the horizontal axis can be transferred in ASCII data format by specifying Ø for the device message BIN data. If 1 is specified for the BIN data, the trace data can be transferred in binary data format.

Trace Data Transfer Format (1/1)

Parameter		Device message		
Item	Control item	Command	Query	Response
• Waveform • Frequency table • Level sweep table Format of data read	ASCII data format	BIN␣Ø	BIN?	BIN␣Ø
	Binary data format	BIN␣1	BIN?	BIN␣1
	REAL/IMAG data format	MFMT␣Ø	MFMT?	MFMT␣Ø
	Same data format as that for formatting	MFMT␣1	MFMT?	MFMT␣1

After specifying a data transfer format, data read/write points and numbers of pieces of data to be read/written must be specified.

Device messages for read/write are classified as shown below according to the type of the data indicated in the "parameter item" column in the above table.

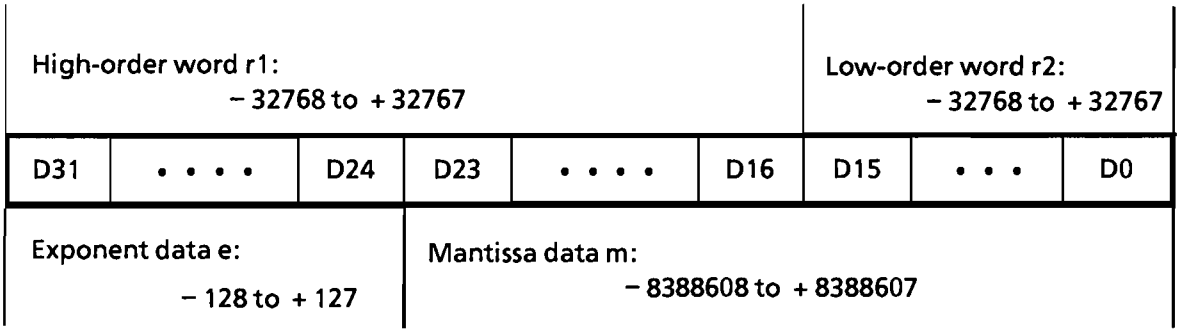
- Waveform data read/write
- Frequency table read/write
- Level sweep table read/write

8.18.1 Waveform data read/write

(1) Internal data format

Inside the measuring device, waveform data is handled as 32-bit floating-point data. When data is read or written (READ/WRITE (1)) through the GPIB, it is divided into 16-bit binary data (−32768 or 8000H to +32767 or 7FFFH) which represents high-order word r1 and 16-bit data which represents low-order word r2.

Internal data format:



The value x represented in the above format takes on

$$x = (m/2^{23}) \times 2^{e}$$

If the above equation is satisfied, m may be any value from −8388608 to +8388607.The value of x is represented by selecting e (integer) that gives a power of 2 depending on the value of m. This means that there are a number of combinations of mantissa (m) and exponent (e) which represent x, depending on the value of x. (For instance, 7864320 (m) can be combined with 7 (e) and 245760 (m) can be combined with 12 (e) when x = 120.) Generally speaking, the closer the value of the mantissa to 0, the less the number of significant digits of the mantissa. Accordingly, it is better to give an exponent (e) which will nestle the mantissa (m) into the range, −8388608 (-2^{23} = 800000H) to −4194305 (-2^{22} −1 0 BFFFFFH), 0, or +4294304 ($+2^{22}$ = 4000000H) to +8388607 ($+2^{23}-1$ = 7FFFFFH).

<Example> When waveform data = −4, $-4 = 1.0 \times 2^{2}$.

m = -2^{23}, e = 2

Exponent = 2 (Bit D25 is 1 and other bits are 0s.)

Mantissa = −8388608 (Bit D23 is 1 and other bits are 0s.)

[Data read/write through GPIB]

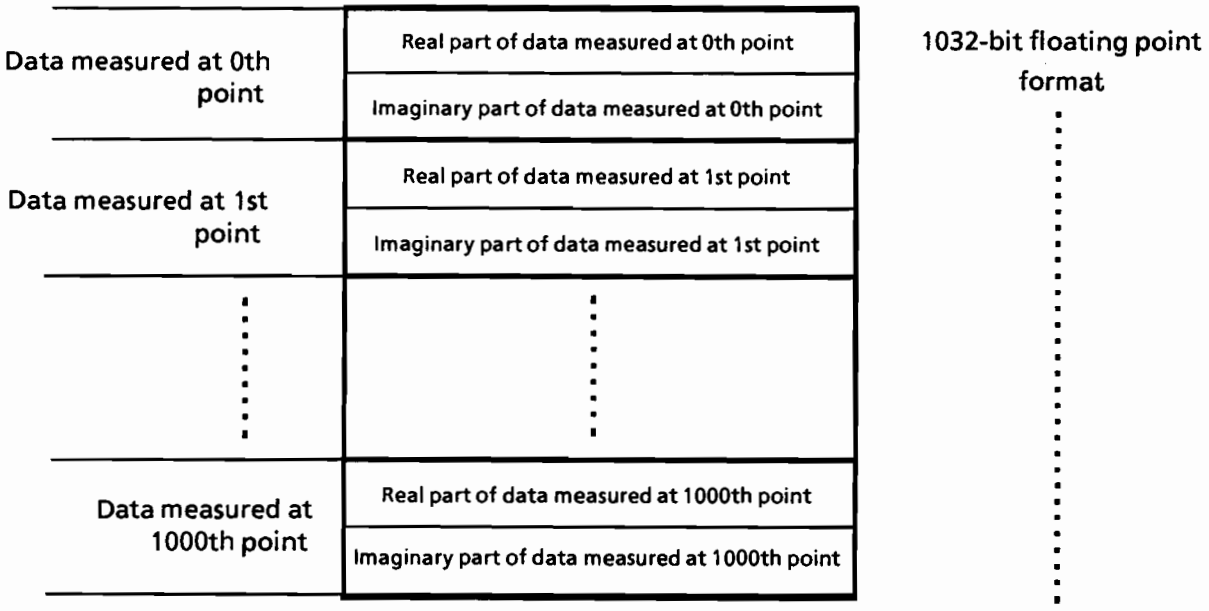
Because bits D25 and D23 are 1s, the following words are written or read:

r1 = $2^{(25-16)} + 2^{(23-16)}$ = 640

r2 = 0

(2) Waveform data storage format and input/output order

Waveform data is stored, starting with the data measured at the 0th point and ending with the data measured at the last point (max. 1000th point). For the data measured at each point, the real part is stored first and the imaginary part is stored next. For the internal data format, see (1).



■ Read/write through GPIB

Before data divisions r1 and r2 are written through GPIB, it is necessary to specify a write start point (m1), number of write points (m2), and data format (n) for the control message. Before data divisions r1 and r2 are read, it is necessary to specify a read start point (m1), number of read points (m2), and data format (n).

When real data format is specified (n = 0), mantissa parts are neither read nor written; the data transfer count should be m2 points. When complex data format is specified (N = 1), both real and imaginary parts of the data measured at each point are read or written in this order; the data transfer count should be m2 points (2 x m2 times).

Waveform Data Read/Write (1/2)

Parameter			Device message		
Item	Control item		Command	Query	Response
Waveform data read/write	Trace-A side X memory		XMA␣m1,m2 (,n)	XMA?␣m1,m2 (,n)	r1,r2 (13 characters)
	Trace-B side X memory		XMB␣m1,m2 (,n)	XMB?␣m1,m2 (,n)	r1,r2 (13 characters)
	Trace-A side S memory		SMA␣m1,m2 (,n)	SMA?␣m1,m2 (,n)	r1,r2 (13 characters)
	Trace-B side S memory		SMB␣m1,m2 (,n)	SMB?␣m1,m2 (,n)	r1,r2 (13 characters)
	Trace-A side	S21T	CMA1␣m1,m2 (,n)	CMA1?␣m1,m2 (,n)	r1,r2 (13 characters)
		S12T	CMA2␣m1,m2 (,n)	CMA2?␣m1,m2 (,n)	
		S11L	CMA3␣m1,m2 (,n)	CMA3?␣m1,m2 (,n)	
		S21L	CMA4␣m1,m2 (,n)	CMA4?␣m1,m2 (,n)	
		S12L	CMA5␣m1,m2 (,n)	CMA5?␣m1,m2 (,n)	
		S22L	CMA6␣m1,m2 (,n)	CMA6?␣m1,m2 (,n)	
		S11O	CMA7␣m1,m2 (,n)	CMA7?␣m1,m2 (,n)	
		S22S	CMA8␣m1,m2 (,n)	CMA8?␣m1,m2 (,n)	
		S11S	CMA9␣m1,m2 (,n)	CMA9?␣m1,m2 (,n)	
		S22O	CMAA␣m1,m2 (,n)	CMAA?␣m1,m2 (,n)	

Waveform Data Read/Write (2/2)

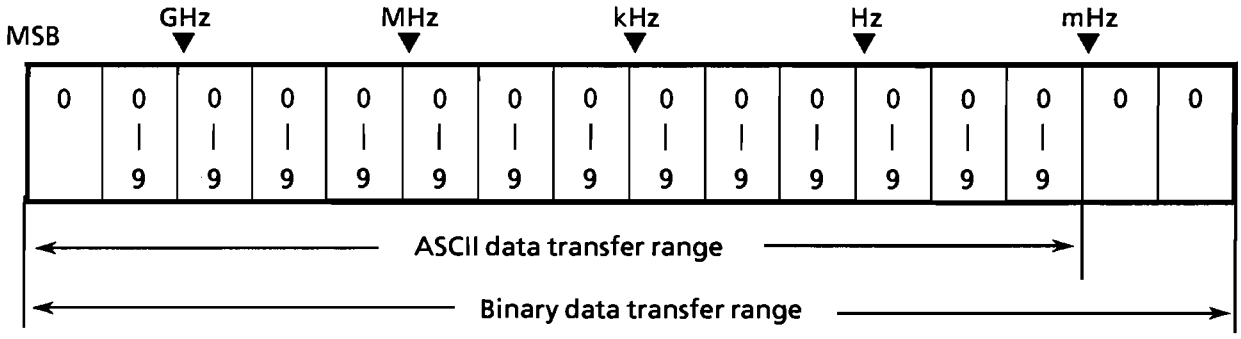
Parameter			Device message		
Item	Control item		Command	Query	Response
Waveform data read/write	Trace-B side	S21T	CMB1␣m1,m2 (,n)	CMB1?␣m1,m2 (,n)	r1,r2 (13 characters)
		S12T	CMB2␣m1,m2 (,n)	CMB2?␣m1,m2 (,n)	
		S11L	CMB3␣m1,m2 (,n)	CMB3?␣m1,m2 (,n)	
		S21L	CMB4␣m1,m2 (,n)	CMB4?␣m1,m2 (,n)	
		S12L	CMB5␣m1,m2 (,n)	CMB5?␣m1,m2 (,n)	
		S22L	CMB6␣m1,m2 (,n)	CMB6?␣m1,m2 (,n)	
		S11O	CMB7␣m1,m2 (,n)	CMB7?␣m1,m2 (,n)	
		S22S	CMB8␣m1,m2 (,n)	CMB8?␣m1,m2 (,n)	
		S11S	CMB9␣m1,m2 (,n)	CMB9?␣m1,m2 (,n)	
		S22O	CMBA␣m1,m2 (,n)	CMBA?␣m1,m2 (,n)	
	Work memory	WM1	WM1␣m1,m2 (,n)	WM1?␣m1,m2 (,n)	r1,r2 (13 characters)
		WM2	WM2␣m1,m2 (,n)	WM2?␣m1,m2 (,n)	
		WM3	WM3␣m1,m2 (,n)	WM3?␣m1,m2 (,n)	
		WM4	WM4␣m1,m2 (,n)	WM4?␣m1,m2 (,n)	

8.18.2 Frequency table read/write

(1) Internal data format

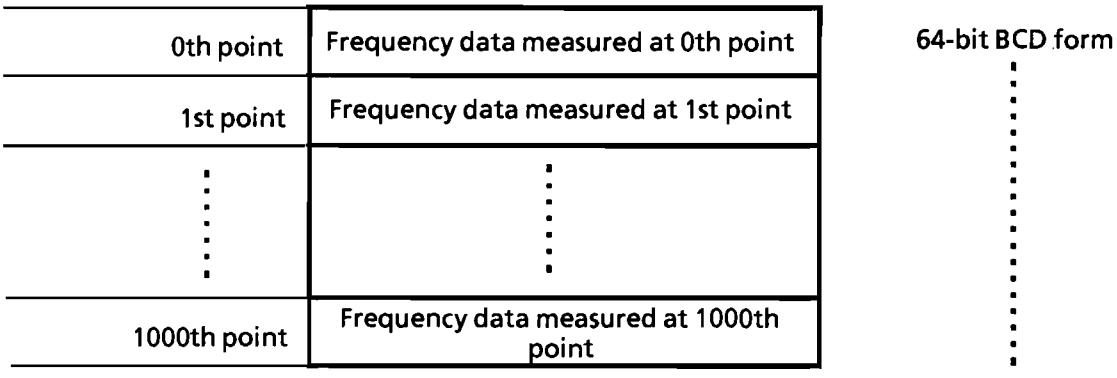
In the measuring device, the frequency table is stored in 64-bit BCD form. When table value f is read or written through GPIB, data must be sent or received in ASCII form or data must be received in binary form (sequentially, starting with the most significant digit) which allows only read.

Internal data format:



(2) Frequency table storage format and input/output order

Frequency data is stored, starting with the data measured at the 0th point and ending with the data measured at the last point (max. 1000th point).



Frequency Table Read/Write (1/1)

Parameter		Device message		
Item	Control item	Command	Query	Response
Frequency table read/write	Trace-A side	FQMA␣m1,m2	FQMA?␣m1,m2	f† (15 characters)
	Trace-B side	FQMB␣m1,m2	FQMB?␣m1,m2	
	Active trace side	FQM␣m1,m2	FQM?␣m1,m2	

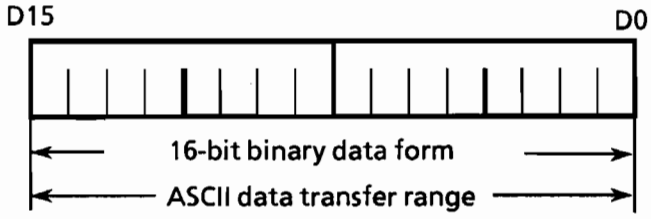
† Range of frequency f: Same as center frequency setting. The minimum set resolution is 0.001 Hz.

8.18.3 Level sweep table read/write

(1) Internal data format

In the measuring device, the level sweep table is stored as 16-bit binary data (−32768 to +32767, 1 LSB = 0.01 dB). When table value 1 is read through GPIB, data must be sent or received in ASCII form or data must be received in binary form (sequentially, starting with the most significant digit) which allows only read.

Internal data format:



(2) Level sweep table storage format and input/output order

Level sweep data is stored, starting with the data measured at the 0th point and ending with the data measured at the last point (max. 1000th point).

0th point	Level data measured at 0th point
1st point	Level data measured at 1st point
⋮	⋮
1000th point	Level data measured at 1000th point

16-bit binary form

⋮

Level Sweep Table Read/Write (1/1)

Parameter		Device message		
Item	Control item	Command	Query	Response
Level sweep table read/write	Trace-A side	FQMA␣m1,m2	FQMA?␣m1,m2	ℓ (7 characters)
	Trace-B side	FQMB␣m1,m2	FQMB?␣m1,m2	
	Active trace side	FQM␣m1,m2	FQM?␣m1,m2	

8.18.4 Read/write under PTA

When the PTA program is used to control the measurement system, PUT statements are used to transfer GPIB commands. After GPIB commands have been transferred, no header is required to transfer data. However, they are required when data is transferred using PUT statements under control of PTA. Note that response data is read without header as in the case of GPIB.

Example: Updating the frequency table (WRITE)

(GPIB)

```
 30 WRITE @ADR:"FQMA 200,10"
 40 WRITE @ADR:"100MHZ"
 50 WRITE @ADR:"200MHZ"
  :   :      :        :
130 WRITE @ADR:"1GHZ"
```

Without header

(PTA)

```
 30 PUT "FQMA 200,10"
 40 PUT "WFA 100MHZ"
 50 PUT "WFA 200MHZ"
  :   :      :
130 PUT "WFA 1GHZ"
```

With header (WFA)

Example: Reading the frequency table (READ)

(GPIB)

```
 30 WRITE @ADR:"FQMA? 200,10"
 40 READ  @ADR:F(0)
 50 READ  @ADR:F(1)
  :   :      :   :
```

(PTA)

```
 30 PUT "FQMA? 200,10"
 40 READ 1000,F(0)
 50 READ 1000,F(1)
  :   :      :
```

GPIB command headers added to the data to be transferred are as follows:

(Trace-A side data)

XMA : WXA, SMA : WSA
FQMA: WFA, LVMA : WLA
CMA1 : WCA1, CMA2 : WCA2, CMA3 : WCA3, CMA4 : WCA4, CMA5 : WCA5, CMA6 : WCA6
CMA7 : WCA7, CMA8 : WCA8, CMA9 : WCA9, CMAA: WCAA, CMAB : WCAB, CMAC : WCAC

(Trace-B side data)

XMB : WXB, SMB : WSB
FQMA: WFB, LVMA : WLB
CMB1 : WCB1, CMB2 : WCB2, CMB3 : WCB3, CMB4 : WCB4, CMB5 : WCB5, CMB6 : WCB6
CMB7 : WCB7, CMB8 : WCB8, CMB9 : WCB9, CMBA: WCBA, CMBB : WCBB, CMBC : WCBC

(Trace-A and trace-B common data)

FQM : WFQ, LVM : WLV
WM1 : WWM1, WM2 : WWM2, WM3 : WWM3, WM4 : WWM4

8.19 Saving/Recalling

(1/3)

Parameter			Device message		
Item	Control item		Command	Query	Response
Save/recall drive selection	INT PMC DSU PMC1 DSU PMC2 DSU FD		PMCS␣Ø PMCS␣1 PMCS␣2 PMCS␣3	PMCS? PMCS? PMCS? PMCS?	PMCS␣Ø PMCS␣1 PMCS␣2 PMCS␣3
DSU address setting Set the value "m" obtained by adding 100 to the GPIB address "a" of the data storage unit (DSU). m = 100 + a to 100 + a a = 00 to 30			PMCA␣m	PMCA?	PMCA␣m (8 characters)
Selection of function parameter save items ON: Saved. OFF: Not saved. m = 0: Not saved. =1: Both TR-1A and -B side parameters are saved. =2: TR-1A side parameters are saved. =3: TR-B side parameters are saved.	Measurement parameter	ON OFF	SV1␣1 SV1␣Ø	SV1? SV1?	SV1␣1 SV1␣Ø
	S memory	m	SV2␣m	SV2?	SV2␣m (5 characters)
	X memory	m	SV3␣m	SV3?	SV3␣m (5 characters)
	Frequency table	m	V4␣m	SV4?	SV4␣m (5 characters)
	Level table	m	SV5␣m	SV5?	SV5␣m (5 characters)
	CAL data	m	SV6␣m	SV6?	SV6␣m (5 characters)
	WORK memory 1	ON OFF	SVDM␣1,1 SVDM␣1,Ø	SVDM?␣1 SVDM?␣1	SVDM␣1,1 SVDM␣1,Ø
	WORK memory 2	ON OFF	SVDM␣2,1 SVDM␣2,Ø	SVDM?␣2 SVDM?␣2	SVDM␣2,1 SVDM␣2,Ø
	WORK memory 3	ON OFF	SVDM␣3,1 SVDM␣3,Ø	SVDM?␣3 SVDM?␣3	SVDM␣3,1 SVDM␣3,Ø
	WORK memory 4	ON OFF	SVDM␣4,1 SVDM␣4,Ø	SVDM?␣4 SVDM?␣4	SVDM␣4,1 SVDM␣4,Ø
Function parameter saving/calling Save or recall a file whose function number m is 0 to 9.		Saving	SVM␣m *SAV␣m		
		Re-calling	RCM␣m *RCL␣m		

(2/3)

Parameter		Device message		
Item	Control item	Command	Query	Response
Measurement parameter display (LIST) Display measurement parameters which are specified by function number m and stored on the medium (PMC or FD) mounted in the selected save/recall drive.		RC1␣m m = 0 to 9		
Measurement parameter deletion Delete measurement parameters which are specified by function number m and stored on the medium (PMC or FD) mounted in the selected save/recall drive.		DLM␣m m = 0 to 9		
Display page specification (LIST) Specify the number of the page including the measurement parameters specified by function number m.		RCPG␣m m = 1 to 22	RCPG?	RCPG␣m m = 00 to 22 (7 characters) 00: No display
Storage item display (LIST ALL) Display the items stored on the medium (PMC or FD) mounted in the selected save/recall drive, for each function number.		RC2		
Measured waveform display Switch the LIST or LIST ALL mode to the normal measured waveform display mode.		RC3		
Format specification Initialize the medium (PMC or FD) mounted in the selected save/call drive.		MA4		
Monitoring of formatting state	Normal state During formatting		MA4? MA4?	MA4␣Ø MA4␣1

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Parameter		Device message		
Item	Control item	Command	Query	Response
Directory making Make the directory for this analyzer on the formatted medium.		MKDR		
Directory information display Display directories on the medium mounted in the selected save/recall drive. Specify the display format using a T$. T$=*.*: All files T$=*.DRH: Files having a DRH attribute		DIR␣(T$)	DIR?	DIR␣T$
Scroll of directory information	ROLL UP ROLL DOWN	DRUP DRDN		
Deletion of directory information Delete the displayed directory information and return to the waveform display mode.		DRCL		
Monitoring of directory information display	Normal state Directory display		DRCL? DRCL?	DRCL␣Ø DRCL␣1
Instruction of NDEX RECALL display	CLOSE OPEN	INDX␣Ø INDX␣1	INDX? INDX?	INDX␣Ø INDX␣1
Built-in PMC battery check	With battery Without battery		MA3? MA3?	MA3␣Ø MA3␣1
Media error read	NO ERROR NO PMC or FLOPPY NO FORMAT DIFFERENT FORMAT WRITE PROTECT BAD PMC MEMORY OVER NOT FIND DIFFERENT CAN'T DEFINE NO BATTERY OTHER PMC ERROR		PER? PER? PER? PER? PER? PER? PER? PER? PER? PER? PER? PER?	ØØ Ø1 Ø2 Ø3 Ø4 Ø5 Ø6 Ø7 Ø8 Ø9 1Ø 11

8.20 Graphic Screen Control

(1/3)

Parameter		Device message		
Item	Control item	Command	Query	Response
Screen clear	All screens 1st screen 2nd screen 3rd screen 4th screen 5th screen 6th screen	CFL␣Ø CFL␣1 CFL␣2 CFL␣3 CFL␣4 CFL␣5 CFL␣6		
Character display X: Display start x-coordinate Y: Display start y-coordinate M: Screen specification N: Normal (0) or reverse (1) video specification		DCH X,Y,T$, M(,N) X = 0 to 639 Y = 0 to 399 T$ = Max.80 characters M = 0 to 6 N = 0 or 1		
Drawing of line X0: Starting point x-coordinate Y0: Starting point y-coordinate X1: Endpoint x-coordinate Y1: Endpoint y-coordinate M: Screen specification N: Line type specification		DLN X_0,Y_0, X_1,Y_1,M(,N) X_0 = 0 to 639 Y_0 = 0 to 399 X_1 = 0 to 639 Y_1 = 0 to 399 M = 0 to 6 N = 0: Drawing of solid line = 1: Erasing of solid line = 2: Drawing of spline = 3: Erasing of spline		
Drawing of square X0: Starting point x-coordinate Y0: Starting point y-coordinate X1: Endpoint x-coordinate Y1: Endpoint y-coordinate M: Screen specification N: Line type specification		DRC X_0,Y_0, X_1,Y_1,M(,N) X_0 = 0 to 639 Y_0 = 0 to 399 X_1 = 0 to 639 Y_1 = 0 to 399 M = 0 to 6 N = 0: Drawing of solid line = 1: Erasing of solid line = 2: Drawing of spline = 3: Erasing of spline		

Note: Numbers 0 to 6 specifying screen types are defined as follows:

M	Screen
0	All screens
1	1st screen (trace-A side graph, characters)
2	2nd screen (PTA)
3	3rd screen (trace-A side marker, marker value)
4	4th screen (trace-B side graph, characters)
5	5th screen (trace-B side marker, marker value)
6	6th screen (scale, window)

(2/3)

Parameter		Device message		
Item	Control item	Command	Query	Response
Drawing of circle X: Center x-coordinate Y: Center y-coordinate R: Radius M: Screen specification N: Line type specification		DCR X,Y,R, M(,N) X = −4095 to 4734 Y = −4095 to 4494 R = 1 to 4096 M = 1 to 6 N = 0: Drawing of solid line = 1: Erasing of solid line = 2: Drawing of spline = 3: Erasing of spline		
Drawing of arc X: Centerpoint x-coordinate Y: Centerpoint y-coordinate R: Radius θ1: Arc starting angle θ2: Arc end angle M: Screen specification N: Line type specification		DAR X,Y,R, θ1,θ2 M(,N) X = −4095 to 4734 Y = −4095 to 4494 R = 1 to 4096 θ1 = −180.00 to 180.00 θ2 = −180.00 to 180.00 M = 1 to 6 N = 0: Drawing of solid line = 1: Erasing of solid line = 2: Drawing of spline = 3: Erasing of spline		

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Parameter		Device message		
Item	Control item	Command	Query	Response
Color palette color specification M: Palette number specification N: Color specification N =0:Black = 8:Black =1:Dark blue = 9:Light blue =2:Dark red = 10:Light red =3:Dark violet = 11:Light violet =4:Dark green = 12:Light green =5:Dark blue = 13:Light blue =6:Dark yellow = 14:Light yellow =7:Dark white = 15:Light white		CPLL␣M,N M = 0 to 15 N = 0 to 15	CPLL?␣M M = 0 to 15	CPLL␣M,N M = 00 to 15 N = 00 to 15 (10 characters)
Specification of palette for 1st to 5th screens M: Screen specification M: =1: 1st screen =2: 2nd screen : : : =5: 5th screen N: Palette specification		SCRN␣M,N M = 1 to 5 N = 0 to 15	SCRN?␣M M = 1 to 5	SCRN␣M,N M = 1 to 5 N = 00 to 15 (9 characters)
Specification of palette for 6th screen Specify the palette to be used with a palette number "n."		SCRN␣6,N N = 0 to 7	SCRN?␣6	SCRN␣6,N N = 0 to 07
Painting X: x-coordinate Y: y-coordinate M: Specification of palette for drawing area		PNT␣X,Y,M,N X = 0 to 639 Y = 0 to 399 M = 0 to 7 N =0 to 7		(9 characters)
Color bar display	OFF ON	CBAR␣Ø CBAR␣1	CBAR? CBAR?	CBAR␣Ø CBAR␣1

8.21 GPIB Port 1 Parameters

Parameter		Device message		
Item	Control item	Command	Query	Response
Specification of terminator for talker output	LF&EOI CR/LF&EOI	TRM␣Ø TRM␣1	TRM? TRM?	TRM␣Ø TRM␣1
GPIB time-out time setting Set time-out time m in seconds (s). m = 0 to 99999 Minimum resolution: 1 s		GTM␣m	GTM?	GTM␣m (9 characters)

8.22 Printer/Plotter Control

Parameter		Device message		
Item	Control item	Command	Query	Response
Copy device setting	Plotter Printer	PLTD␣Ø PLTD␣1	PLTD? PLTD?	PLTD␣Ø PLTD␣1
Plotter selection	HP-GL GP-GL	PLTM␣Ø PLTM␣1	PLTM? PLTM?	PLTM␣Ø PLTM␣1
Printer selection	FP-850 2225 UA-455A DSU	PLTM␣Ø PRIM␣1 PRIM␣2 PRIM␣3	PLTM? PRIM? PRIM? PRIM?	PLTM␣Ø PRIM␣1 PRIM␣2 PRIM␣3
Plotter's GPIB address setting Set GPIB address m. m = 0 to 30		PLTA␣m	PLTA?	PLTA␣m (7 characters)
Printer's GPIB address setting Set the GPIB address "m" of the printer except DSU and US-455A. m = 0 to 30		PRIA␣m	PRIA?	PRIA␣m (7 characters)
Plotter output item selection	Output of all items Waveform only Scale line only	PLI␣Ø PLI␣1 PLI␣2	PLI? PLI? PLI?	PLI␣Ø PLI␣1 PLI␣2
Plotter output form size	A3 A4	PLF␣Ø PLF␣1	PLF? PLF?	PLF␣Ø PLF␣1
Plotter output position specification	ALL UPR LEFT UPR RIGHT LWR LEFT LWR RIGHT	PLPS␣Ø PLPS␣1 PLPS␣2 PLPS␣3 PLPS␣4	PLPS? PLPS? PLPS? PLPS? PLPS?	PLPS␣Ø PLPS␣1 PLPS␣2 PLPS␣3 PLPS␣4
Instruction of start/stop	Start Stop	COPY␣1 COPY␣Ø		
Copying status detection	IDLE, READY BUSY		COPY? COPY?	Ø 1
Printer output position specification	Paper feed OFF Paper feed ON	PFF␣Ø PFF␣1	PFF? PFF?	PFF␣Ø PFF␣1

8.23 Module Control

Parameter		Device message		
Item	Control item	Command	Query	Response
Module address setting Set the module address m subject to control. m = 0 to 63		MDL␣m	MDL?	m (2 characters)
Control status register setting Set control status data n1 in the control status register of the module specified by m. n1 = 0 to 255		MDC␣n1	MDC?	n1 (4 characters)
Data register setting Set data n2 in the data register of the module specified by m. n2 = 0 to 255		MDD␣n2	MDD?	n2 (4 characters)
Simultaneous setting of control status register and data register Set data n1 in the control status register of the module specified by m, and set data n2 in the data register. n1 = 0 to 255 n2 = 0 to 255		MDW␣n1,n2		
ID code read Read the ID code n of the module specified by m. n = 0000 to 0255			IDC?	n (4 characters)
Data read If the module specified by m can output data, read the data value n. n = 0000 to 0255			MDR?	n (4 characters)

8.24 Time Domain

Parameter		Device message		
Item	Control item	Command	Query	Response
Time axis waveform setting	IMPULSE STEP	RSPS␣Ø RSPS␣1	RSPS? RSPS?	RSPS␣Ø RSPS␣1
Filter shape setting	RECTANGULAR NOMINAL LOW SDELOBE MIN SIDELOB	GSHP␣Ø GSHP␣1 GSHP␣2 GSHP␣3	GSHP? GSHP? GSHP? GSHP?	GSHP␣Ø GSHP␣1 GSHP␣2 GSHP␣3
Gate shape setting	RECTANGULAR NOMINAL LOW SDELOBE MIN SIDELOB	FSHP␣Ø FSHP␣1 FSHP␣2 FSHP␣3	FSHP? FSHP? FSHP? FSHP?	FSHP␣Ø FSHP␣1 FSHP␣2 FSHP␣3
Setting of unit of horizontal axis	Time Distance	TAMD␣Ø TAMD␣1	TAMD? TAMD?	TAMD␣Ø TAMD␣1
Analysis start time setting Set start time r1 in microseconds (us). r1 = −999.999 to 999.999 Minimum resolution: 1 ns		STTM␣r1	STTM?	STTM␣r1 (13 characters)
Analysis time interval setting Set span time r2 in microseconds (us). r2 = 0 to 99.999 Minimum resolution: 1 ns		SPTM␣r2	SPTM?	SPTM␣r2 (11 characters)
Analysis start position setting Set start position r3 in meters (m). r3 = −999.999 to 999.999 Minimum resolution: 1 mm		STDS␣r3	STDS?	STDS␣r3 (13 characters)
Analysis interval setting Set analysis interval r4 in meters (m). r4 = 0 to 99.999 Minimum resolution: 1 mm		SPDS␣r4	SPDS?	SPDS␣r4 (7 characters)
Gate ON/OFF	OFF ON	TMGT␣Ø TMGT␣1	TMGT? TMGT?	TMGT␣Ø TMGT␣1
Gate setting Specify the range specified by the zone marker as a gate.		TMSG		

8.25 Limit Line Function

Parameter		Device message		
Item	Control item	Command	Query	Response
Limit line type	SINGLE	LMTP␣m,1	LMTP?␣m	LMTP␣m,0
	SEGMENTED	LMTP␣m,0	LMTP?␣m	LMTP␣m,1
Limit line setting (single)	UPPER LIMIT	LMTU␣m,S,e_1, e_2,e_3,e_4	LMTU?␣m,S	LMTU␣m,S,e_1, e_2,e_3,e_4
	LOWER LIMIT	LMTL␣m,S,e_1, e_2,e_3,e_4	LMTL?␣m,S	LMTL␣m,S,e_1, e_2,e_3,e_4
Limit line setting (segmented)	UPPER LIMIT	LSIU␣m,e	LSIU?␣m	LSIU␣m,e
	LOWER LIMIT	LSIL␣m,e	LSIL?␣m	LSIL␣m,e
Limit line clear	UPPER LIMIT CLEAR	LCLU␣m,n		
	LOWER LIMIT CLEAR	LCLL␣m,n		
Limit test ON/OFF	Limit test OFF	LIMT␣m,0	LIMT?␣m	LIMT␣m,0
	Limit test ON	LIMT␣m,1	LIMT?␣m	LIMT␣m,1
Limit test result read	Limit test pass		LMTS?␣m	0
	Limit test fail		LMTS?␣m	1
Beep function	Sounds a beep	BEEP		
	Buzzer OFF	BPON␣0	BPON?	0
	Buzzer ON	BPON␣1	BPON?	1

SECTION 9
SAMPLE PROGRAMS

This section gives some examples of the programs that control this analyzer using our PACKET V Series technical computer as a controller.

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9.1 Note on Writing GPIB Programs

Note the following points when writing GPIB control programs.

No.	Precaution	Description
1	Be sure to initialize each device.	There may be a number of the state in which each device is not proper to be actually used due to operation on its own panel or execution of other programs. It is necessary to using individual devices with a prescribed condition resulting from initializing them. Execute the following. ① Initializing the interface functions (**IFC @**) ② Initializing message exchange functions of each device (**DCL @**) ③ Initializing the functions proper to each device (INI or ***RST**)
2	Turn the device to the remote state of RWLS (Remote With Lockout State).	In a simple remote state, pressing **[LOCAL]** turns the device to the local state. Pressing a panel key in this moment causes device's automatic measurement to function improperly, thus measurement data are likely to turn out unreliable. Set the device to the locally locked out state with **LLO @** to prevent it from returning to the local state. (Turn every device to the locally controlled state with **LCL @**.)
3	Don't send any command (related to the device) other than the **READ @** statement immediately after sending a query.	If MLA is received when a command other than the **READ @** statement is sent to the controller before the response to a query is read, the output buffer is cleared, and the response message disappears. For this reason, write the **READ @** statement in immediate succession to a query.
4	Create a program that avoids an exception processing of the protocol	The processing in item 3 is also a kind of protocol exception handling. For other processing, take a pertinent measure to prevent exception handling from occurring according to 7.4.2. Avoid stoppage of execution (caused by an error) by means of providing a program with exception-processing section against exceptions that can be foreseen.
5	Confirm the interface functions of each device (subset).	Execution of program does not advance if necessary subset (s) has (have) not been prepared in the device. Be sure to confirm the subset (s) of each device. Also confirm that each device complies with IEEE488.2.

9.2 Sample Program

9.2.1 Initialization of This Analyzer

When the **[INITIAL]** key on the panel is pressed, this analyzer is placed in a known initial state. A device command that can perform the same function as the [INITIAL] command is an **INI** command.

Example 1: This analyzer is restored to the known initial state regardless of the operation history.

```
 100  LET ADR=101
 110  WRITE @ADR:"INI"
1000  END
```

Executing the above program places this analyzer in the initial state shown in the list of default values (☞ 4-9) in Section 4 (however, parameters related to PTA control are not subject to initialization). The main initial measurement parameter settings displayed on the screen are described below.

The GPIB system is initialized in three levels, and commands (☞refer to Section 4) corresponding to each level are listed below.

① To initialize the interface functions **IFC @**
② To initialize the message-exchange functions of devices **DCL @**
③ To initialize functions (for a specific device) to a certain condition **INI** or ***RST**

① is initializes the interface functions of all the devices connected to the bus. ② prepares the message exchange functions of the devices so that the controller can send a new command to the device. This command can be directed at either all the devices or at a specific device.

Thus, command ③ should be applied to the specified devices after executing of ① and ②.

Example 2: Initialize the message exchange functions of all devices and the bus, then initialize the functions of the device assigned to address 1.

```
 100  LET ADR=101
 110  IFC @1
 120  DCL @1
 130  WRITE @ADR:"*RST"
1000  END
```

The general use for the **INI** and ***RST** is to place this analyzer in the initial state and to set only the functions that are to be changed from their initial settings, thus preventing control from being performed with unnecessary functions held set.

☞ The descriptions hereafter assume that commands, **IFC @**, **DCL @**, and **INI**, have been already issued, unless otherwise stated.

9.2.2 Filter Bandpass Ripple Measurement

Example 3: When an S parameter test set is connected and a 250- MHz bandpass filter whose center frequency is 1.5 GHz is connected between ports 1 and 2, the filter pass area ripple is measured and displayed in TRACE-A. Then, this value is read by the controller and displayed on its screen.

```
100 SET @1:48 ..... Specify ACKET as the system controller at address 16
110 LET NWA=3 ..... GPIB address of network analyzer (switches on rear panel)
120 WRITE @NWA:"INI" ..... Initialize this analyzer
130 WRITE @NWA:"TRC 3" ..... Measure the S parameter
140 WRITE @NWA:"SPRM 1" ..... Measure S21
150 WRITE @NWA:"COOR 0" ..... Display LOG MAG
160 WRITE @NWA:"CNF 1.5GHZ" ..... Set a center frequency
170 WRITE @NWA:"SPF 500MHZ ..... Set a frequency span
180 WRITE @NWA:"CMK 250" ..... Specify the position of the active marker
190 WRITE @NWA:"ZNA 1,250MHZ,250MHZ" ..... Set right and left zones
200 WRITE @NWA:"MEA 18" ..... Extracts a feature in ripple format 1
210 WRITE WRITE @NWA:"SWP 1" ..... Starts single sweep
220 WRITE WRITE @NWA:"SWP?" ..... Specifies output of the sweep state
230 WRITE READ  @NWA:A ..... Read the sweep state
240 WRITE IF A=1 THEN GOTO 220 ..... Go to line 150 if sweep is not complete
250 WRITE @NWA:"MPA?" ..... Read an extracted feature value
260 READ  @NWA:R ..... Read a ripple value
200 PRINT USING "RIPPLE=###.###dB":R ..... Display the result on the controller screen
210 END
```

The coordinate setting (COOR 0) on line 150, active marker position specification (CMK 250) on line 180, left and right zone settings (ZNA, 125 MHZ, 125 MHZ) on line 190 are the same as the settings made automatically by executing the INI (initialization) on line 120 and SPRM 1 (measurement item switching) on line 140, so the results are all the same if they are omitted.

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APPENDIX

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APPENDIX A
ASCII* CODE TABLE

BITS B4 B3 B2 B1	B7 B6 B5 = 0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
	CONTROL		NUMBERS SYMBOLS		UPPER CASE		LOWER CASE	
0 0 0 0	0 NUL 0	20 DLE 16	40 SP 32	60 0 48	100 @ 64	120 P 80	140 ` 96	160 p 112
0 0 0 1	1 GTL SOH 1	21 LLO DC1 17	41 ! 33	61 1 49	101 A 65	121 Q 81	141 a 97	161 q 113
0 0 1 0	2 STX 2	22 DC2 18	42 " 34	62 2 50	102 B 66	122 R 82	142 b 98	162 r 114
0 0 1 1	3 ETX 3	23 DC3 19	43 # 35	63 3 51	103 C 67	123 S 83	143 c 99	163 s 115
0 1 0 0	4 SDC EOT 4	24 DCL DC4 20	44 S 36	64 4 52	104 D 68	124 T 84	144 d 100	164 t 116
0 1 0 1	5 PPC ENO 5	25 PPU NAK 21	45 % 37	65 5 53	105 E 69	125 U 85	145 e 101	165 u 117
0 1 1 0	6 ACK 6	26 SYN 22	46 & 38	66 6 54	106 F 70	126 V 86	146 f 102	166 v 118
0 1 1 1	7 BEL 7	27 ETB 23	47 ' 39	67 7 55	107 G 71	127 W 87	147 g 103	167 w 119
1 0 0 0	10 GET BS 8	30 SPE CAN 24	50 (40	70 8 56	110 H 72	130 X 88	150 h 104	170 x 120
1 0 0 1	11 TCT HT 9	31 SPD EM 25	51) 41	71 9 57	111 I 73	131 Y 89	151 i 105	171 y 121
1 0 1 0	12 LF A 10	32 SUB 1A 26	52 * 42	72 : 58	112 J 74	132 Z 90	152 j 106	172 z 122
1 0 1 1	13 VT B 11	33 ESC 1B 27	53 ÷ 43	73 ; 59	113 K 75	133 [91	153 k 107	173 { 123
1 1 0 0	14 FF C 12	34 FS 1C 28	54 , 44	74 < 60	114 L 76	134 \ 92	154 l 108	174 ¦ 124
1 1 0 1	15 CR D 13	35 GS 1D 29	55 − 45	75 = 61	115 M 77	135] 93	155 m 109	175 } 125
1 1 1 0	15 SO E 14	36 RS 1E 30	56 · 46	76 > 62	116 N 78	136 ^ 94	156 n 110	176 ~ 126
1 1 1 1	17 SI F 15	37 US 1F 31	57 / 47	77 UNL ? 63	117 O 79	137 UNT — 95	157 o 111	177 RUBOUT (DEL) 7F 127
	Address command	Universal command	Listen address		Talk address		Secondary address or command	

KEY octal 25 PPU / NAK / hex 15 21 — GPIB code, ASCII character, decimal

* USA Standard Code for Information Interchange

Table A-1 GPIB Interface Messages (extended)

b7 →					0	①	0		0		0		1		1		1		1		1	
b6 →					0		0		1		1		0		0		1		1		1	
b5 →					0	MSG	0	MSG	0	MSG	1	MSG	0	MSG	1	MSG	0	MSG	1	MSG	0	MSG
Bits	b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	0		1		2		3		4		5		6		7		
②	0	0	0	0	0	NUL		DLE		SP		0		@		P				p		
	0	0	0	1	1	SOH	GTL	DC1	LLO	!		1		A		Q		a		q		
	0	0	1	0	2	STX		DC2		"		2		B		R		b		r		
	0	0	1	1	3	ETX		DC3		#		3		C		S		c		s		
	0	1	0	0	4	EOT	SDC	DC4	DCL	$		4		D		T		d		t		
	0	1	0	1	5	ENQ	PPC	NAK	PPU	%		5		E		U		e		u		
	0	1	1	0	6	ACK		SYN		&		6		F		V		f		v		
	0	1	1	1	7	BEL		ETB				7		G		W		g		w		
	1	0	0	0	8	BS	GET	CAN	SPE	(		8		H		X		h		x		
	1	0	0	1	9	HT	TCT	EM	SPD	)		9		I		Y		i		y		
	1	0	1	0	A	LF		SUB		*		:		J		Z		j		z		
	1	0	1	1	B	VT		ESC		+		;		K		[		k		{		
	1	1	0	0	C	FF		FS		,		<		L		\		l		|		
	1	1	0	1	D	CR		GS		-		=		M		]		m		}		
	1	1	1	0	E	SO		RS		.		>		N		^		n		~		
	1	1	1	1	F	SI		US		/		?	UNL	O		—	UNT	o		DEL		

Listener address to be assinged to devices (MLA)

Listener address to be assinged to devices (MLA)

Talker addresses to be assinged to devices (MTA)

Talker addresses to be assinged to devices (MTA)

The meanings are definied by PCG.

The meanings are definied by PCG.

Address command group (ACG)

Universal command group (UCG)

Listen address group (LAG)

Talk address group (TAG)

Primary command group (PGG)

Secondary command group (SCG)

Notes:

① MSG = INTERFACE MESSAGE (Sent by ATN of True: Low level.)

② b_1 = DI 01 ····· b_7 = DI 07 (b_1 through b_7 correspond to DIO1 to DIO7 sequence.)

GTL	Go to Local
SDC	Select Device Clear
PPC	Parallel Poll Configure
GET	Group Execute Trigger
TCT	Take Control
LLO	Local Lockout
(ACG)	Addressed Command Group
(UCG)	Universal Command Group
(LAG)	Listen Address Group
(TAG)	Talk Address Group
(PCG)	Primary Command Group
(SGG)	Secondary Command Grout
DCL	Device Clear
PPU	Parallel Poll Unconfigure
SPE	Serial Poll Enable
SPD	Serial Poll Disable
UNL	Unlisten
UNT	Untalk

Table A-2 Interface Message Group

DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1	Interface message group (G)
×	0	0	0	b_4	b_3	b_2	b_1	Addressed command G
×	0	0	1	b_4	b_3	b_2	b_1	Universal command G
×	0	1	b_5	b_4	b_3	b_2	b_1	Listen address G
×	0	1	1	1	1	1	1	Unlisten (UNL)
×	1	0	b_5	b_4	b_3	b_2	b_1	Talker address G
×	1	0	1	1	1	1	1	Untalk (UNT)
×	1	1	b_5	b_4	b_3	b_2	b_1	Secondary command G

Table A-3 Address Assignments

Address character		Address switch setting					Primary address	Factory address set device
Talk	Listen	5	4	3	2	1		
b_7 b_6	b_7 b_6	b_5	b_4	b_3	b_2	b_1		
1 0	0 1	↓	↓	↓	↓	↓	10 Decimal	
@	SP	0	0	0	0	0	0	
A	!	0	0	0	0	1	1	
B	"	0	0	0	1	0	2	
C	#	0	0	0	1	1	3	
D	$	0	0	1	0	0	4	
E	%	0	0	1	0	1	5	
F	&	0	0	1	1	0	6	
G	'	0	0	1	1	1	7	
H	(	0	1	0	0	0	8	
I	)	0	1	0	0	1	9	
J	*	0	1	0	1	0	10	
K	+	0	1	0	1	1	11	
L	,	0	1	1	0	0	12	
M	−	0	1	1	0	1	13	Printer Plotter
N	.	0	1	1	1	0	14	
O	/	0	1	1	1	1	15	
P	0	1	0	0	0	0	16	
Q	1	1	0	0	0	1	17	
R	2	1	0	0	1	0	18	
S	3	1	0	0	1	1	19	
T	4	1	0	1	0	0	20	
U	5	1	0	1	0	1	21	
V	6	1	0	1	1	0	22	
W	7	1	0	1	1	1	23	
X	8	1	1	0	0	0	24	
Y	9	1	1	0	0	1	25	
Z	:	1	1	0	1	0	26	
[	;	1	1	0	1	1	27	
\	<	1	1	1	0	0	28	
]	=	1	1	1	0	1	29	
^	>	1	1	1	1	0	30	
?	—	1	1	1	1	1	31	UNL,UNT

(Blank)

APPENDIX B
COMPARISON TABLE OF CONTROLLERS' GPIB INSTRUCTIONS

Function	Controller			
	PACKET V	PC9800	IBM-PC	HP9000 series
Outputs data to a device	WRITE @ device number:data	PRINT @ listener address;data	CALL IBWRT( )	OUTPUT device selector; data
Output binary data to a device	BIN WRITE @ device number:data	WBYTE command; data		
Assigns data entered from a device to a variable	READ @ device number:variable	INPUT @ talker address, listener address; variable LINE INPUT @ talker address, listener address; variable	CALL IBRD( )	ENTER device selector; variable
Assigns binary data entered from a device to a variable	BIN READ @ device number:variable	RBYTE command; variable		
Initializes an interface	IFC @ select code	ISET IFC	CALL IBSIC( )	ABORT select code
Turns REN line on	REN @ select code	ISET REN	CALL IBSRE( )	REMOTE device selector (select code)
Turns REN line off	LCL @ select code (sets all devices local) LCL @ device number (sets only specified devices to listeners, and sends out GTL command)	IRESET REN WBYTE &H3F, listener address, secondary address, &HØ1;	CALL IBSRE( ) CALL IBLOC( )	LOCAL device selector (select code) LOCAL device selector (select code +primary address)

Function	Controller			
	PACKET V	PC9800	IBM-PC	HP9000 series
Outputs interface message(s) and data	COMMAND @ select code: character string for message [;data]		CALL IBCMD( ) CALL IBCMDA( ) (asynchro nous)	SEND select code; message string
Triggers a specified device	TRG @ device number	WBYTE &H3F,listener address, secondary address, &HØ8;	CALL IBTRG( )	TRIGGER device selector
Initializes devices	DCL @ select code (all devices bearing a specified select code) DCL @ device number (specified devices only)	WBYTE &H3F, &H14; WBYTE &H3F,listener address, secondary address, &HØ4;	CALL IBCLR( )	CLEAR device selector (select code) CLEAR device selector (select code +primary address)
Disables a device from being switched over from remote to local	LLO @ select code	WBYTE &H3F, &H11;	LOCAL LOCKOUT	
Transfers control to a specified device	RCT @ device number	WBYTE talker address, &HØ9;	CALL IBPCT( )	PASS CONTROL
Sends out a service request	SRQ @ select code	ISET SRQ	CALL IBRSV( )	REQUEST select code
Performs serial polling	STATUS @ device number	POLL	CALL IBRSP( )	SPOLL(device selector) (function)
Sets a terminator code	TERM IS	CMD DELIM	CALL IBEOS( ) CALL IBEOT( )	
Sets a limit value for checking a timeout		CMD TIMEOUT	CALL IBTOM( )	

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