LCR METER

ZM2376

Instruction Manual
(Alternative Commands)

NF Corporation

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ZM2376

**Instruction Manual
(Alternative Commands)**

Preface

This instruction manual describes the alternative commands of ZM2376.

■ The following instruction manuals are provided for ZM2376.

   ● ZM2376 Instruction Manual (Basics)

      This manual describes basic items such as how to operate ZM2376 from the panel, specifications, and maintenance.

   ● ZM2376 Instruction Manual (Remote Control)

      This manual describes the remote control of ZM2376.

      It includes the description of standard commands.

      Standard commands are used in the operation mode 0 (initial value).

   ● ZM2376 Instruction Manual (Alternative Commands)

      This manual describes the alternative commands of ZM2376.

      Alternative commands are used in the operation mode 1.

      If you find the alternative commands easier to use than the standard commands, use them.

      However, the alternative commands provides limited functions.

   "ZM2376 Instruction Manual (Remote Control)" and "ZM2376 Instruction Manual (Alternative Commands)" are included in the attached CD-ROM.

■ This instruction manual has the following chapters.

1. PREPARATIONS BEFORE USE

   Describes the setting and precautions of the interfaces.

2. RESPONSE TO INTERFACE MESSAGE

   Lists the responses to main IEEE-488.1 interface messages.

3. ALTERNATIVE COMMAND LIST AND COMMAND TREE

   Describes the overview of all the alternative commands.

4. ALTERNATIVE COMMAND EXPLANATION

   Describes the details of individual alternative commands.

5. STATUS SYSTEM

   Describes the status system in the operation mode 1.

6. TRIGGER SYSTEM

   Describes the overview of the trigger system and the measurement procedure of the remote control.

7. ERROR MESSAGE

   Describes the error messages of the remote control.

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Attached Figures and Tables

1.   PREPARATIONS BEFORE USE

1.1 Outline of Operation Mode 1

In ZM2376, you can switch the operation mode to use the alternative command instead of the standard command. Use the operation mode 1 when the alternative command is easier to use for you. However, the alternative command does not support all of the functions in ZM2376.

Operation mode 1 also provides the same operation from the panel. However, if you operate a function unsupported by the alternative command from the panel, unintended operation may be caused. It is recommended that you only use functions that are available from the initial settings with the alternative command in the operation mode 1.

1.2 Switching of operation mode

The initial value of the operation mode is 0 (standard command mode).

To use the alternative command, switch the operation mode of ZM2376 to 1 (alternative command mode). The operation mode is not initialized by the power on/off and the full initialization by the SHIFT + [INIT] key operation or from the system setting menu.

SHIFT + [SYSTEM]

Press the SHIFT + [SYSTEM] keys to display the system setting menu.

```
SYSTEM settings
0)INTERFACE   1)BEEPER                    >NEXT
```
Options (first page)

Press the - 2 3 0 0 keys in this order to display the operation mode setting menu as shown below. (This option is not displayed in the system menu.)

```
Operation mode:0
0)Mode 0   1)Mode 1
```
Current setting
Options

Press the 1 key to enter the operation mode 1.

When the operation mode is set, the initialization equivalent to "INITIALIZE ALL" in each operation mode is executed.

In the operation mode 1, the underline cursor is displayed at the end of second line of the display.

Operation mode 0
```
• • • • • • •        1.00000k
• • • • • • •            1.00 V
```

Operation mode 1
```
• • • • • • •        1.00000k
• • • • • • •            1.00 V
```
← Underline

1.3 Initial Value (Operation Mode1)

Initial values specific to the operation mode 1 are as follows. The other initial values are the same as the operation mode 0.

Table 1-1 Initial value (specific to operation mode 1)

Setting item	Parameter range	Initial value	INIT	*RST	Setting memory	Resume
:MEASure? response parameter		5, 0 (equivalent to Z, θ)	←	←	○	○
GPIB response terminator	{LF+EOI | CR,LF+EOI}	0	×	×	×	◎

The GPIB response terminator is initialized by operating the full initialization in the system setting menu or switching the operation mode.

■ Remarks

Initial value   Set when full initialization is executed with the system setting menu.

INIT   Set when initialization is executed with the initialize menu (SHIFT + [INIT]).

*RST   Set when *RST command of remote control is executed

←   Same as left (initial values)

×   Function not provided. (No influence)

○   Function provided.

◎   Function provided. However, it is saved independently from general resume target (○).

2. RESPONSE TO INTERFACE MESSAGE

The responses to main IEEE-488.1 interface messages are as listed below.

Table 2-1   Responses to interface messages (operation mode 1)

Message	Function
IFC	< InterFace Clear > Initializes the GPIB interface. Releases the specified listener and talker.
DCL,SDC	< Device CLear >, < Selected Device Clear > Clears the input buffer and stops interpretation and execution of a command. Clears the output buffer and clears the bit 4 (MAV) of status byte register. Releases the overlap command queuing by *WAI, *OPC, and *OPC? commands.
LLO	< Local LockOut > Disables the transition from remote state to local state by pressing the LOCAL key on the panel.
GTL	< Go To Local > Selects the local state.
GET	< Group Execute Trigger > Executes the trigger. Same function as *TRG command.

How to send an interface message from the controller is different depending on the device driver. For details, see the manual of each driver.

3.   ALTERNATIVE COMMAND LIST AND COMMAND TREE

ZM2376 alternative commands are separated into the common commands defined by IEEE488.2 and subsystem commands which reflect instrument-specific functions.
The common commands and subsystem commands provided by ZM2376 are listed below.
The meanings of symbols used in the list are as follows:

•   Keywords shown in square brackets ([ ]) are omissible. (Implicit Keywords)

•   The vertical bar (|) indicates the possibility to select a keyword from several keywords.

•   It is possible to omit the lowercase part of each keyword.

Table 3-1   Common command list (operation mode1)

Command	Name	Function
*CLS	Clear Staus Command	Clears status data.
*ESE *ESE?	Standard Event Status Enable Command / Query	Sets/queries the standard event status enable register.
*ESR?	Standard Event Status Register Query	Queries the standard event status register contents.
*IDN?	Identification Query	Queries the device identification information (model name etc).
*OPC *OPC?	Operation Complete Command / Query	Requests to set the Standard Event Status register's OPC bit to 1 when all command operations are completed. In response to query, it returns 1 when all operations are completed.
*RST	Reset Command	Resets the instrument to restore the initial setting values.
*SRE *SRE?	Service Request Enable Command / Query	Sets/queries the service request enable register.
*STB?	Read Status Byte Query	Queries the status byte.
*TRG	Trigger Command	Applies the trigger to perform measurement once, when the instrument waits for trigger.
*TST?	Self-Test Query	Queries the self-diagnosis result. "0" (no error) is returned, if normal.
*WAI	Wait-to-Continue Command	Waits for executing the following commands until all of the preceding command operations are completed.

Table 3-2   Subsystem command list (operation mode1)

1/2

Command	Function / Operation target
:APPLication:DISPlay:LIGHt	(Backlight on/off. Always on)
:APPLication:DISPlay:MONItor	Displays voltage/current monitored value
:AVERaging	Averaging count
:BEEPer:COMParator	Enables beeper of comparator
:BEEPer:KEY	(Enables beeper of key entry. Always off)
:CABLe	Cable length correction
:COMParator	Enables limit comparison
:COMParator:FLIMit:ABSolute	Upper and lower limit values of primary parameter
:COMParator:FLIMit:DEViation	Reference value and upper and lower limit values of primary parameter
:COMParator:FLIMit:MODE	Limit comparison mode of primary parameter
:COMParator:FLIMit:PERcent	= :COMParator:FLIMit:DEViation
:COMParator:SLIMit:ABSolute	Upper and lower limit values of secondary parameter
:COMParator:SLIMit:DEViation	Reference value and upper and lower limit values of secondary parameter
:COMParator:SLIMit:MODE	Limit comparison mode of secondary parameter
:COMParator:SLIMit:PERcent	= :COMParator:SLIMit:DEViation
:CORRection:DATA?	Queries spot correction value
:CORRection:OPEN	OPEN correction
:CORRection:SHORt	SHORT correction
:DISPlay:MONItor?	Queries voltage/current monitored value
:ERRor?	(Queries RS-232 error. Always returns 0)
:ESE0	Event status enable register 0
:ESR0?	Queries event status register 0
:ESR1?	Queries event status register 1
:FREQuency	Measurement frequency
:IO:OUTPut:DELay	(/EOM delay time. Fixed)
:LEVel	Signal level mode
:LEVel:CCURRent	Constant current level
:LEVel:CVOLTage	Constant voltage level
:LEVel:VOLTage	Open voltage
:LIMiter	(Enables signal level limit. Always off)
:LIMiter:CURRent	(Signal current limiting value. Always maximum value)
:LIMiter:VOLTage	(Signal voltage limiting value. Always maximum value)
:LOAD	Recalls settings and correction value
:MEASure?	Reads measured value
:MEASure:ITEM	Specifies measured value to be read

Table 3-2   Subsystem command list (operation mode 1)

2/2

Command	Function / Operation target
:PARameter1	Primary parameter and its equivalent circuit
:PARameter2	(Nothing is set)
:PARameter3	Secondary parameter and its equivalent circuit
:PARameter4	(Nothing is set)
:PARameter:DIGit	(Number of measured value display digits. Always auto)
:RANGe / :RANGe?	Sets/queries measurement range
:RANGe:AUTO	Enables automatic selection of measurement range
:SAVE	Saves settings and correction value
:SPEEd	Measurement speed
:TRANsmit:TERMinator	GPIB response message terminator
:TRIGger	Trigger mode
:TRIGger:DELAy	Trigger delay time
:USER:IDENtity	(Fixed. Nothing is changed even if set)

Supplement: A command that makes inquiry is called "query" and it ends with a question mark.

The operation mode 1 (alternative command mode) does not support most queries.

Queries not described in this table or detailed explanation below cannot be used.

The subsystem command tree of ZM2376 is shown below.

Command tree (operation mode 1)

```
<Root>

    ├── :APPLication ─────── :DISPlay ──────┬── :LIGHt
    │                                        └── :MONItor
    ├── :AVERaging
    ├── :BEEPer ─────────┬── :COMParator
    │                    └── :KEY
    ├── :CABLe
    ├── :COMParator
    │           └──────────┬── :FLIMit ──────┬── :ABSolute
    │                       │                 ├── :DEViation
    │                       │                 ├── :MODE
    │                       │                 └── :PERcent
    │                       └── :SLIMit ──────┬── :ABSolute
    │                                         ├── :DEViation
    │                                         ├── :MODE
    │                                         └── :PERcent
    ├── :CORRection ─────┬── :DATA?
    │                    ├── :OPEN
    │                    └── :SHORt
    ├── :DISPlay ─────────── :MONItor?
    ├── :ERRor?
    ├── :ESE0
    ├── :ESR0?
    ├── :ESR1?
    ├── :FREQuency
    ├── :IO ─────────────── :OUTPut ─────────── :DELay
    ├── :LEVel
    │         └────────────┬── :CCURRent
    │                      ├── :CVOLTage
    │                      └── :VOLTage
    ├── :LIMiter
    │           └──────────┬── :CURRent
    │                      └── :VOLTage
    ├── :LOAD
    ├── :MEASure?
    ├── :MEASure ─────────── :ITEM
    ├── :PARameter ───────── :DIGit
    ├── :PARameter1
    ├── :PARameter2
    ├── :PARameter3
    ├── :PARameter4
    ├── :RANGe?
    ├── :RANGe
    │         └──────────────── :AUTO
    ├── :SAVE
    ├── :SPEEd
    ├── :TRANsmit ────────── :TERMinator
    ├── :TRIGger
    │           └──────────── :DELAy
    └── :USER ────────────── :IDENtity
```

4. ALTERNATIVE COMMAND EXPLANATION

4.1 Outline of Command Language

4.1.1 Subsystem Commands

Commands are divided into groups depending on their function. Subsystem commands are arranged in a hierarchy. The colon (:) is defined as the path separator.

4.1.2 Path Separator

The path separator (:) separates the current keyword from the keywords one level lower. In a command character string, each colon (:) indicates a displacement to the path one level below the current path.

When the colon (:) is found at the beginning of a command character string it means "to set the current path to root". The current path is also set to root by the power on, *RST command, or message terminator. The beginning of a program message is always set to root. A colon (:) at the beginning of a command character string is omissible arbitrarily.

$$:LEV:VOLT \quad 1$$
$$\uparrow \uparrow \quad \uparrow \quad\quad \uparrow$$
$$① ② \quad ③ \quad\quad ④$$

①Set current path to root (Omissible)

②LEVel subsystem command (LEVel is a root command)

③LEVel subsystem attached VOLTage command

④A space is required between the header and the parameters

By separating the commands with a semicolon (;), plural command character strings can be put together into one program message.

:COMP:FLIM:DEV 2.2E-6, -3, +3 **;** **:COMP:FLIM:**MODE PER

Command 1   Command 2

The above example shows one program message equivalent to the following two program messages.

:COMP:FLIM:DEV 2.2E-6, -3, +3   Current path after execution is **:COMP:FLIM:**

:COMP:FLIM:MODE PER

If a colon (**:**) is omitted in the second and subsequent command character strings, the subsystem command on the same level is accessible without changing the current path.

:COMP:FLIM:DEV 2.2E-6, -3, +3 **;** MODE PER   In the second command string,

                                                  :COMP:FLIM: is omissible

In both cases, the program message terminator at the end is omitted.

4.1.3 Keywords Simplification

In this Instruction Manual, a keyword indicating a command or parameter is expressed with a combination of uppercase and lowercase alphabets. Uppercase characters are used for short form (abbreviation). Even if lowercase character part is all omitted, it has the same function as long form that includes all the lowercase character part. However, only a part of lowercase character part cannot be omitted.

Uppercase and lowercase characters are used only as an expedient means to explicit the form that can be shortened but instrument makes no distinction whatsoever between the two. It is possible to use both simultaneously.

Ex.) Command notation   :DISPlay:MONItor?   (○ Acceptable, × Error)

→   :display:monitor?   ○ Long form, all lowercase character

:Disp:Moni?   ○ Short form, mixed uppercase/lowercase characters

:**DISPL**:MONI?   × Wrong intermediary abbreviated form

:DISP:**MON**?   × Omission over-abbreviated

4.2 Overlap Commands and Sequential Commands

Some commands allow the following commands to be executed simultaneously during execution of them, and some commands do not allow.

■ Overlap commands

During execution of that command, the following command can be executed.

■ Sequential commands

After execution of that command finished, the following command is executed.

Note that executing multiple overlap commands will result in an operation failure.

Use *WAI, *OPC, and *OPC? commands when you do not want to execute the following commands or query until the execution of overlap commands finished.

The commands given below are overlap commands. Other commands are all sequential commands.

Overlap commands :

:CORRection:OPEN

:CORRection:SHORt

4.3 Alternative Command Details

The function and syntax of each command shown in "Table 3-1 Common command list (alternative command)" and "Table 3-2 Subsystem command list (alternative command)" are explained below.

[Meaning of symbols]

- Keywords shown in square brackets (**[ ]**) are omissible.(Implicit Keywords)
- Curly braces (**{ }**) indicate parameters in the command character string.
- The vertical bar (|) indicates possibilities to select a keyword from several options.
- Comparison marks (< >) indicate that a parameter such as numerical values and character strings need to be set.

These symbols are used for description only. They are not used in actual commands.

| Description | [:ABCDe][:FGHijk]:COMMandx   {ON|OFF} |
| Actual command | :ABCDe:FGHijk:COMMandx   ON |

[Parameters data format]

Symbol	Format	ex.
NR1	Integer (numeric value)	123
NR2	Decimal point format no having exponent (numeric value)	0.075
NR3	Decimal point format having exponent (numeric value)	4.99E+06
CRD	Character strings	ALL
SRD	Character strings in double quotation marks	"No error"
bool	Logical value	ON, OFF, 1, 0

- Unless otherwise specified individually, a numeric value in any format is accepted and it is rounded to the nearest value if exceeding the specified resolution.
- Unless otherwise specified individually, a numeric value is set to minimum value if below the minimum value, or set to maximum value if above the maximum value.
- For numeric value parameters in which the description is made so that MAX / MIN can be used, a numeric value is set to maximum value if MAX (or MAXIMUM) is given, or set to minimum value if MIN (or MINIMUM) is given.
- When the response is a numeric value, and the range, resolution and unit are omitted, it is same as a setting. Unless otherwise specified individually, the mantissa of response in NR3 format is 6 digits.
- For the commands in which the parameter type varies depending on the format setting, even if a numeric value exceeding the range mentioned below is given, it is rounded to the same range as displayed on panel or resolution. For the range of actually set value, see the description of operation panel.
- Character strings in quotation marks are accepted in single or double quotation marks.

[Remarks]

- Both commands and queries are called commands here.
  The keyword attached with "**?**" at the end is a query.
- Response messages to commands do not come with headers. They cannot have headers.

4.3.1 Common Commands

*CLS

Description:	Clears the following statuses.
	• Standard event status register
	• Extension event status register
	• Status Byte
	• Error queue
	Also, the error display on the panel is reset.
Setting example:	*CLS
Remarks:	The *CLS command does not directly clears the status byte register. Except for the MAV bit and the RQS bit, the status byte is indirectly cleared. It is possible to indirectly clear the MAV bit by clearing the input buffer with a device clear. It is possible to clear the RQS bit by reading out the status with the serial pole.

*ESE <mask>
*ESE?

Description:	Sets/Queries the standard event status enable register.
Parameter:	<mask> {numeric value, range 0 to 255} Out of range value causes an error.
	Details • • • ☞ "5.3 Standard Event Status"
Setting example:	*ESE 255
	Sets 255 to the standard event status enable register.
Response:	<mask> {numeric value, format NR1, range 0 to 255}
Query example:	*ESE?
Response example:	+255
	The content of standard event status enable register is 255.

*ESR?

Description:	Queries the standard event status register contents.
	The query clears all the standard event status register bits to 0.
Response:	<register contents> {numeric value, format NR1, range 0 to 255}
	Details • • • ☞ "5.3 Standard Event Status"
Query example:	*ESR?
Response example:	+128
	The content of standard event status register is 128.

*IDN?

Description:	Queries the model name etc.
Response:	{"<name of manufacturer>, <model name>, <serial number>, <firmware version>"}
	format SRD
Query example:	*IDN?
Response example:	"NF Corporation,ZM2376,9055552,Ver1.00"

*OPC
*OPC?

|	
Description:	Confirms that the execution of all the preceding commands is completed.
Setting example:	*OPC
	Makes setting so that OPC bit of standard event status register is set to "1" when the execution of all the preceding commands is completed. By monitoring the status, the completion of command execution can be known.
Response:	1
	1 is returned when the execution of all the preceding commands is completed.
Query example:	*OPC?
Response example:	1
	The execution of all commands is completed.
Remarks:	The OPC bit of standard event status register is not cleared by *OPC?. To clear it, use the device clear, *CLS, or *RST command.
	You can also generate SRQ when the OPC bit is changed to 1.

*RST

Description:	Resets to initial setting state.
	Details • • • ☞ "Table 1-1 Initial value (specific to operation mode 1)"
Setting example:	*RST
Remarks:	Beware of the following points:
	• OPEN, SHORT, and LOAD correction values are initialized. When using previous correction values, save them in advance, and recall them after *RST.
	☞• • • :SAVE, :LOAD commands
	• The initial value of trigger delay time is not zero.

*SRE \<SRQ mask\>

*SRE?

Description:	Sets/Queries the service request enable register.
Parameter:	\<SRQ mask\> {numeric value, range 0 to 255} Out of range value causes an error.
	Details • • • ☞ "5.1 Outline of Status System"
Setting example:	*SRE 32
Response:	{numeric value, format NR1, range 0 to 255}
Query example:	*SRE?
Response example:	+32
	The content of service request enable register is 32.

*STB?

Description:	Queries the content of status byte register.
Response:	\<register contents\> {numeric value, format NR1, range 0 to 255}
	Details • • • ☞ "5.2 Status Byte"
Query example:	*STB?
Response example:	+32
	The content of status byte register is 32.

*TRG

Description:	Applies the trigger to perform measurement once, when the instrument waits for trigger. When the instrument does not wait for a trigger, a trigger is not applied, causing an error.
Setting example:	*TRG
	Apply the trigger.

*TST?

Description:	Queries the self-diagnosis results.
	ZM2376 conducts the self-diagnosis and returns its result.
Response:	{numeric value, format NR1, range 0 to 4}
	0: Pass (no abnormality is found)
	1: Hardware failed (whole measurement circuits are faulty)
	2: Oscillator failed (drive signal source is faulty)
	3: Analyzer failed (voltage & current measurement section is faulty)
	4: HF failed (error of high-frequency internal impedance bridge)
Query example:	TST?
Response example:	+0
	No abnormality was found in the self-diagnosis.

*WAI

Description: Waits for executing the following commands until all of the preceding command operations are completed.

Example: Overlap command 1 ; Overlap command 2 ; *WAI ; following command
<program message terminator>
After the execution of both overlap command 1 and overlap command 2 finished, the following commands are executed.

Remarks: The waiting caused by the *WAI command can be canceled with device clear.

4.3.2 Alternative Subsystem Commands

:APPLication:DISPlay:LIGHt   {ON|OFF}

Description: Sets the backlight.

This command is accepted, but the backlight is always on regardless of the parameter.

Remarks: When the parameter is {ON|OFF}, 1 and 0 can be used for ON and OFF respectively.

:APPLication:DISPlay:MONItor   {ON|OFF}

Description: Sets whether to display the current and voltage monitored values or the measurement conditions on the second line of the measurement screen.

Parameter: ON   Displays the current and voltage monitored values.

OFF   Displays the measurement conditions (initial value).

Remarks: In the panel operation, more display parameters are available.

:AVERaging   {OFF|numeric value 1 to 256}

Description: Sets the averaging count.

Parameter: OFF   Disables the averaging function (initial value).

Numeric value 1 to 256   Sets the averaging count and enables the averaging function.

:BEEPer:COMParator

Description: Sets the beep function of the comparator.

Parameter: IN   Sounds the beeper when the limit comparison result is passed (IN) or the bin sorting result is BIN1 to 14.

NG   Sounds the beeper when the limit comparison result is failed (not IN) or the bin sorting result is other than BIN1 to 14.

OFF   Disables the beeper (initial value).

:BEEPer:KEY   {ON|OFF}

Description: Sets the beeper of the key entry.

This command is accepted, but the beeper at the key entry is always disabled (OFF) regardless of parameters.

:CABLe   <cable length>

Description: Sets the cable length.

Parameter: <cable length> {numeric value, range 0, 1, 2, 4, unit: m}

A numeric value is rounded to 0 (initial value), 1, 2, or 4, whichever nearest.

:COMParator   {ON|OFF}

Description: Sets the limit comparison.

Parameter: ON   Enables the limit comparison of both the primary parameter and secondary parameter.

                          OFF Disables the limit comparison of both the primary parameter and secondary parameter (initial value).

:COMParator:FLIMit:ABSolute   <lower limit value>, <upper limit value>

Description: Sets the upper and lower limits used in the limit comparison of primary parameter. The upper and lower limits are interpreted as absolute value or deviation % according to the comparison mode. The upper and lower limits are shared by absolute value and deviation %. Separate values cannot be set. Setting one overwrites the other.

Parameter: <lower limit value> {OFF | numeric value, range 0, $\pm$(1E-16 to 9.99999E+11)}

                        <upper limit value> {OFF | numeric value, range 0, $\pm$(1E-16 to 9.99999E+11)}

:COMParator:FLIMit:DEViation <reference value>, <lower limit value>, <upper limit value>

Description: Sets the reference value of the primary parameter used in comparison with the deviation % and the upper and lower limits used in the limit comparison of the primary parameter.

                    To use the deviation % comparison, set the comparison mode to deviation % separately.

             ☞• • •   :COMParator:FLIMit:MODE command

Parameter: <reference value> {numeric value, range 0, $\pm$(1E-16 to 9.99999E+11)}

                        <lower limit value> {OFF | numeric value, range 0, $\pm$(1E-16 to 9.99999E+11)}

                        <upper limit value> {OFF | numeric value, range 0, $\pm$(1E-16 to 9.99999E+11)}

Remarks: The initial values of the :COMParator:FLIMit subsystem and :COMParator:SLIMit subsystem are:

                    reference value = 0, lower limit value = OFF, upper limit value = OFF.

:COMParator:FLIMit:MODE   {ABSolute|PERcent|DEViation}

Description: Sets the limit comparison mode of primary parameter.

Parameter: ABSolute Specifies the absolute value display and comparison (initial value).

                    PERcent Specifies the deviation % display and comparison.

                              (Absolute value display and deviation % comparison cannot be combined)

                    DEViation Specifies the deviation % display and comparison.

:COMParator:FLIMit:PERcent   <reference value>, <lower limit value>, <upper limit value>

Description: Same as :COMParator:FLIMit:DEViation.

:COMParator:SLIMit:ABSolute   <lower limit value>, <upper limit value>

Description:	Sets the upper and lower limits used in the limit comparison of secondary parameter. The upper and lower limits are interpreted as absolute value or deviation % according to the comparison mode. The upper and lower limits are shared by absolute value and deviation %. Separate values cannot be set. Setting one overwrites the other.
Parameter:	<lower limit value> {OFF | numeric value, range 0, ±(1E-16 to 9.99999E+11)} <upper limit value> {OFF | numeric value, range 0, ±(1E-16 to 9.99999E+11)}

:COMParator:SLIMit:DEViation   <reference value>, <lower limit value>, <upper limit value>

Description:	Sets the reference value of the secondary parameter used in comparison with the deviation % and the upper and lower limits used in the limit comparison of the secondary parameter. To use the deviation % comparison, set the comparison mode to deviation % separately. ☞••• COMParator:SLIMit:MODE command
Parameter:	<reference value> {numeric value, range 0, ±(1E-16 to 9.99999E+11)} <lower limit value> {OFF | numeric value, range 0, ±(1E-16 to 9.99999E+11)} <upper limit value> {OFF | numeric value, range 0, ±(1E-16 to 9.99999E+11)}

:COMParator:SLIMit:MODE   {ABSolute|PERcent|DEViation}

Description:	Sets the limit comparison mode of secondary parameter.	
Parameter:	ABSolute	Specifies the absolute value display and comparison (initial value).
	PERcent	Specifies the deviation % display and comparison. (Absolute value display and deviation % comparison cannot be combined)
	DEViation	Specifies the deviation % display and comparison.

:COMParator:SLIMit:PERcent   <reference value>, <lower limit value>, <upper limit value>

Description:	Same as :COMParator:SLIMit:DEViation.

:CORRection:DATA?

Description:	Queries the spot SHORT correction value and the spot OPEN correction value.
Response:	Zshort, θshort, Zopen, θopen

Zshort   SHORT correction value |Z|

θshort   SHORT correction value θ

Zopen   OPEN correction value |Z|

θopen   OPEN correction value θ

|Z| {OFF | numeric value NR3, 6 digits, range 0, ±(1E-16 to 9.99999E+11), unit: Ω}

θ   {OFF | numeric value NR3, 6 digits, range 0, ±(1E-16 to 9.99999E+11), unit: °}

OFF   The correction is disabled, or the spot correction frequency is different from the current measurement frequency.

:CORRection:OPEN   {OFF|ALL|<frequency>}

Description:	Sets the OPEN correction.	
Parameter:	OFF	Disables the OPEN correction.
	ALL	Measures the global OPEN correction value. Frequency range is 40Hz to 5.5MHz (initial value).
	<frequency>	{numeric value, range 0.02 to 5.5E+6, unit: Hz} Sets the measurement frequency, enables the SPOT correction, and measures the SPOT OPEN correction values.

When the measurement of correction value is completed, the OPEN correction is enabled.

Remarks:	The global correction range can be changed by the panel operation.

The command to measure the correction value is an overlap command. The *OPC? query or *WAI command allows you to wait for completion of the correction measurement.

Using the ?ESR query to frequently check the OPC bit of the standard status register increases internal processes to slow down the operation.

Using the OPC bit to generate SRQ causes an overhead by the SRQ processing. This method is not recommended except for simultaneous measurement with two or more instruments.

:CORRection:SHORt   {OFF|ALL|<frequency>}

Description: Sets the SHORT correction.

Parameter: OFF   Disables the SHORT correction (initial value).

ALL   Measures the global SHORT correction value.

Frequency range is 40Hz to 5.5MHz (initial value).

<frequency>   {numeric value, range 0.02 to 5.5E+6, unit: Hz}

Sets the measurement frequency,

enables the SPOT correction, and

measures the SPOT SHORT correction value.

When the measurement of correction value is completed, the SHORT correction

is enabled.

Remarks: The global correction range can be changed by the panel operation.

:DISPlay:MONItor?

Description: Queries the voltage/current monitored values.

Response: <voltage monitored value>, <current monitored value>

<voltage monitored value> {numeric value NR3, 6 digits, range 0,

$\pm$(1E-16 to 9.99999E+11), unit: Vrms }

<current monitored value>

{numeric value NR3, 6 digits, range 0, $\pm$(1E-16 to 9.99999E+11), unit: Arms}

:ERRor?

Description: Queries any RS-232 error.

This command is accepted, but it always returns 0 (zero).

ESE0   <mask 0>

Description: Sets the event status enable register 0.

Parameter: <mask 0> {numeric value, range 0 to 255}

Sets the following 8 bits (1 byte) in decimal notation:

Bit		Content
7(MSB)	- - -	Always 0
6	AER	ALC error
5	NC	Contact failure
4	ERR	Measurement error
3	CER	Correction error CORR Err
2	EOM	Normal measurement was finished
1	EOM	Normal measurement was finished (same as the bit 2)
0(LSB)	EOC	Correction value measurement was finished

Remarks: Initial value of mask is 0.

If a bit is set to 1, the summary bit ESB0 of the status byte is set to 1 when the

corresponding event occurs.

:ESR0?

    Description: Queries the event status register 0 contents.

    Response: <Measurement status 0> {numeric value, range 0 - 255}

                        Returns the following 8 bits (1 byte) in decimal notation:

Bit		Content
7(MSB)	- - -	Always 0
6	AER	ALC error
5	NC	Contact failure
4	ERR	Measurement error
3	CER	Correction error CORR Err
2	EOM	Normal measurement and comparison were finished
1	EOM	Normal measurement and comparison were finished
0(LSB)	EOC	Correction value measurement was finished

    Remarks: Each bit is set to 1 when the corresponding event occurs.

                        Each bit of the event status register 0 / 1 is cleared to 0 by query of the register, the *CLS command, or power-on.

:ESR1?

    Description: Queries the event status register 1 contents.

                        The content is the limit comparison result.

    Response: <Measurement status 1> {numeric value, range 0 - 255}

                        Returns the following 8 bits (1 byte) in decimal notation:

Bit		Content
7(MSB)	- - -	Always 0
6	IN	Pass (both the primary parameter and secondary parameter are within the range)
5	S-LO	Secondary parameter is too low
4	S-IN	Secondary parameter is passed
3	S-HI	Secondary parameter is too high
2	P-LO	Primary parameter is too low
1	P-IN	Primary parameter is passed
0(LSB)	P-HI	Primary parameter is too high

    Remarks: Each bit is set to 1 when the comparison is determined.

:FREQuency   <frequency>

    Description: Sets the measurement frequency.

    Parameter: <frequency> {numeric value, range 20E-3 to 5.5E+6, unit: Hz}

                        Initial value 1kHz.

:IO:OUTPut:DELay   <delay time>

    Description: Sets the delay time from /INDEX to /EOM (0 to 0.0999 s).

                        This command is accepted, but the delay is constant (100µs min) regardless of the parameter.

:IORESult:RESet   {ON|OFF}

Description: Sets the reset timing of the comparison output.

This command is accepted, but the comparison output is reset when the /INDEX signal is changed from the high level to the low level regardless of the parameter.

:LEVel   {V|CV|CC}

Description: Sets the signal level mode.

Parameter: V   Open voltage (initial value)

Disables the constant voltage drive and constant current drive to allow the signal level to be set by open voltage.

CC   Constant voltage

Enables the constant voltage drive. The constant current drive is disabled.

CC   Constant current

Enables the constant current drive. The constant voltage drive is disabled.

:LEVel:CCURRent   <current>

Description: Sets the constant current level.

To drive the constant current, the signal level mode must be set separately.

   ☞•••   :LEVel   CC

Parameter: <current> {numeric value, range 1E-6 to 200E-3, unit: Arms}

Initial value 1mArms

:LEVel:CVOLTage   <voltage>

Description: Sets the constant voltage level.

To drive the constant voltage, the signal level mode must be set separately.

   ☞•••   :LEVel   CV

Parameter: <voltage> {numeric value, range 0.010 to 5.00, unit: Vrms}

Common to the open voltage level. A separate setting is not possible. Setting one overwrites the other.

:LEVel:VOLTage   <voltage>

Description: Sets the open voltage level.

Parameter: <voltage> {numeric value, range 0.010 to 5.00, unit: Vrms}.

Initial value 1Vrms.

:LIMiter   {ON|OFF}

Description: Sets the limit function of the signal level.

This command is accepted, but the limit function of the signal level is always disabled (OFF) regardless of the parameter.

:LIMiter:CURRent   <current limit>

Description: Sets the limiting value of the signal current (0 to 200E-3 Arms).

This command is accepted, but the current limit is always 200mArms regardless of the parameter.

:LIMiter:VOLTage   <voltage limit>

Description: Sets the limiting value of the signal voltage (0 to 5 Vrms).

This command is accepted, but the voltage limit is always 5Vrms regardless of the parameter.

:LOAD   <memory number>

Description: Recalls the settings and correction values from the specified memory.

Parameter: <memory number> {numeric value, range 0 - 31}

:MEASure?

Description:	Reads the measured value.
	Use the :MEASure:ITEM command to specify the type of measured value in advance.
Response:	When limit comparison is disabled
	measured value 1 (, measured value 2, • • •)
	When limit comparison is enabled
	total comparison flag, primary parameter measured value, primary parameter comparison flag, secondary parameter measured value, secondary parameter comparison flag

Measured value

{numeric value, format NR3, range ±9.99999E+11}

9.9E+37 at a measurement error.

Comparison flag {0|1|-1}

Primary parameter comparison flag, secondary parameter comparison flag

- 0   Within the range (P-IN, S-IN)
- 1   Over the upper limit (P-HI, S-HI)
- -1   Under the lower limit (P-LO, S-LO)

Total comparison flag

- 0   Within the total range (IN: both primary and secondary parameters are passed)
- 1   Out of the total range

Remarks:	To read new measured value, use the following command string:
	:*TRG;:MEAS?

:MEASure:ITEM   <MR0>, <MR1>

Description:	Specifies the response parameter of :MEASure? parameter.
Parameter:	Both <MR0> and <MR1> {numeric value, range 0 to 255}
	Specifies the response parameter by bits in binary notation.
	The measured values corresponding to bits set to 1 are output.
	The output order is from LSB of MR0 to MSB of MR1.

	(MSB)						(LSB)
MR0	Lp	Ls	D	Cp	Cs	θ	Y	Z
MR1	--	--	B	X	Rp	G	Rs	Q

Initial value is 5, 0 (output in the order of Z, θ).

:PARameter1   {Z|Y|CS|CP|LS|LP|RS|RP|G|OFF}

Description:	Sets the primary parameter. The equivalent circuit is specified simultaneously.
Parameter:	Specifies one of Z, Y, Cs, Cp, Ls, Lp, Rs, Rp, and G.
	If OFF is set, it is ignored, and the previous setting is held.
	Once set, the automatic selection function of the measurement parameter is disabled.
Remarks:	Initial value is automatic selection for all of the primary parameter, secondary parameter, and equivalent circuit.
	Automatic selection cannot be set by the alternative command.

:PARameter2   {Z|Y|PHASe|CS|CP|D|LS|LP|Q|RS|G|RP|X|B|OFF}

Description:	This command is accepted, but nothing is set.

:PARameter3   {PHASe|D|Q|G|RS|RP|X|B|LP|OFF}

Description:	Sets the secondary parameter. The equivalent circuit is specified simultaneously.
Parameter:	Specifies one of θ, D, Q, G, Rs, Rp, X, B, and Lp.
	If OFF is set, it is ignored, and the previous setting is held.
	Once set, the automatic selection function of the measurement parameter is disabled.

:PARameter4   {Z|Y|PHASe|CS|CP|D|LS|LP|Q|RS|G|RP|X|B|OFF}

Description:	This command is accepted, but nothing is set.

:PARameter:DIGit   <3|4|5>

Description:	Sets the number of displayed digits of the measured value.
	This command is accepted, but the number of displayed digits is always set automatically.

:RANGe   <measurement range number>
:RANGe?

Description:	Sets/Queries the measurement range.
Parameter:	<measurement range number> {numeric value, range 1 to 10}
	1: 0.1Ω, 2: 1Ω, 3: 10Ω, 4: 100Ω, 4: 100Ω, 5: 1kΩ, 6: 10kΩ,
	7: 100kΩ, 8: 1MΩ, 9: 1MΩ, 10: 1MΩ
	Specifying a range number 9 or 10 means the 1MΩ range, the same as 8.
Response:	{numeric value, range 1 to 8}
Remarks:	The measurement range may be limited automatically depending on the measurement conditions such as frequency. Initial value is 4: 100Ω.

:RANGe:AUTO   {ON|OFF}

Description:	Sets the automatic selection of the measurement range.
Parameter:	ON Enables the automatic selection. (Initial value)
	OFF Disables the automatic selection.

:SAVE   <memory number>

Description:	Saves the settings and correction values in the specified memory.
Parameter:	<memory number> {numeric value, range 0 - 31}

:SPEEd   {RAPid|FAST|NORMal|SLOW|SLOW2}

Description:	Sets the measurement speed.
Parameter:	Corresponding panel setting

RAPid	RAPid
FAST	FAST
NORMal(Initial value)	MED
SLOW	SLOW
SLOW2	VSLO

:TRANsmit:TERMinator   <0|1>

Description:	Sets the terminator of GPIB response message.	
Parameter:	0	LF+EOI (initial value)
	1..255	CR, LF+EOI
Remarks:	This setting is enabled the next time the power is turned on.	

:TRIGger   {INTernal|EXTernal}

Description:	Sets the trigger mode.	
Parameter:	INTernal	Internal trigger (initial value)
	EXTernal	Trigger is accepted from any of the following trigger sources:
		• External (trigger signal of handler interface)
		• Manual (panel TRIG key)
		• Remote control (*TRG, GET commands)
Remarks:	EXTernal is displayed as EXT in the panel.	
	When the trigger source (INT/MAN/EXT/BUS) is set from the panel, the operation is the same as the operation mode 0. However, *TRG and GET are accepted except for INT.	

:TRIGger:DELAy   <delay time>

Description:	Sets the trigger delay time.
Parameter:	<delay time> {numeric value, 0 to 999.9999, unit: s}
	Initial value 8 ms

:USER:IDENtity   <ID>
:USER:IDENtity?

Description:	Sets/Queries the user ID.
	This command is accepted, but nothing is set.
Parameter:	<ID> {string, format CRD, number of characters: maximum 256 characters}
Response:	Always returns the string NF-nnnnnnn (10 characters).
	nnnnnnn contains 7-digit serial number.

5. STATUS SYSTEM

5.1 Outline of Status System

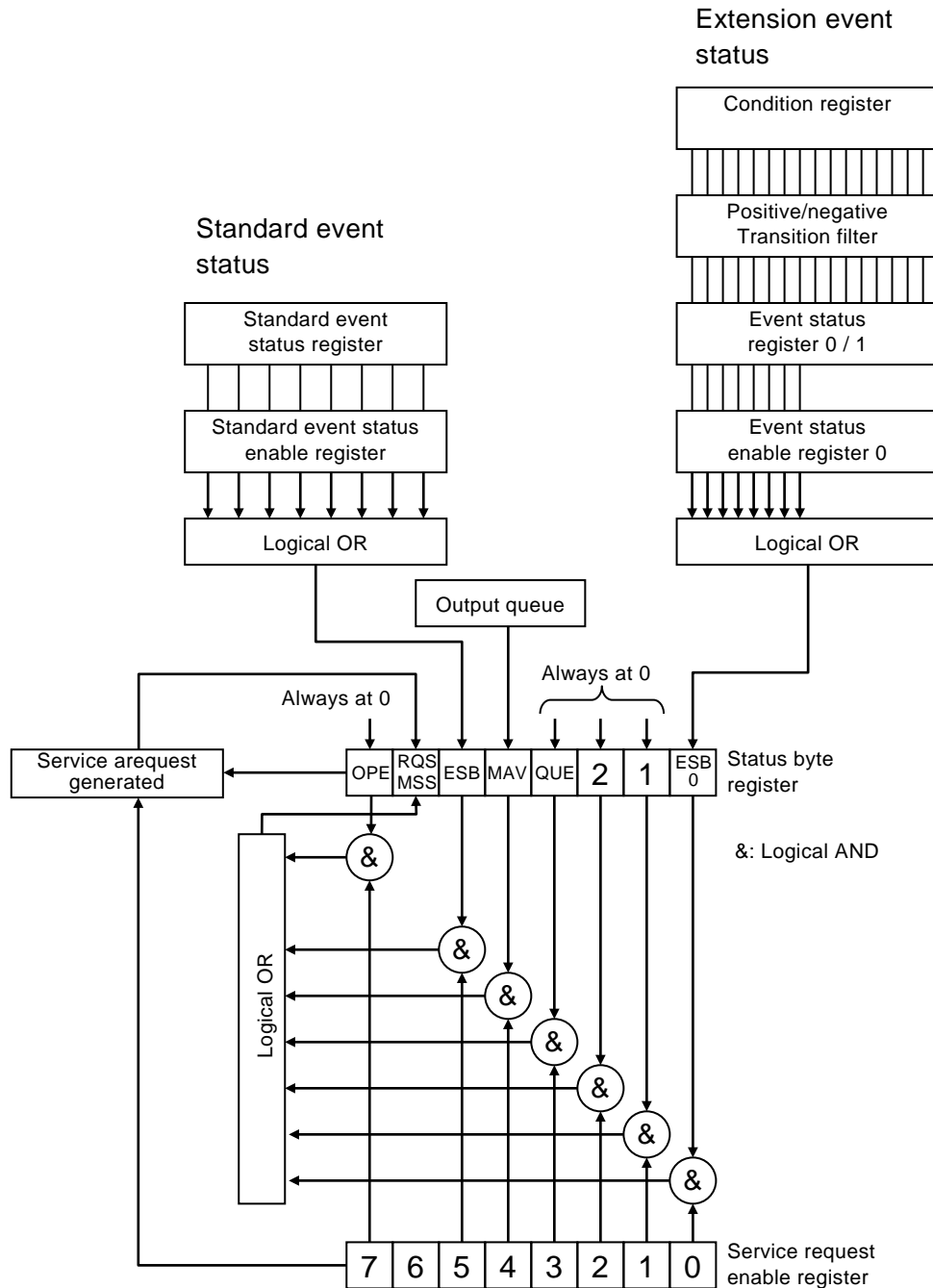Status system in the operation mode 1 is shown in Figure 5-1.

Figure 5-1   Status system

5.2 Status Byte

The definition of the status byte register is shown in Table 5-1. The status byte can be read by serial polling or *STB? query. However, bit 6 becomes RQS (Request Service).

Table 5-1   Status byte register definition

Bit		Weight	Condition for setting to 1	Condition for resetting to 0
OPE	7	128	-	Always at 0 (unused)
RQS	6	64	When SRQ is sent	・ When device clear was received ・ When status byte was read by serial polling
MSS				・ When device clear was received ・ When master summary bits were all cleared to 0
ESB	5	32	When any valid bit of the standard event status register is set to 1.	When all the valid bits of the standard event status register are set to 0.
MAV	4	16	When the response to the query is ready to be output.	When all of the responses have been output and there remains not to be output.
QUE	3	8	-	Always at 0 (unused)
-	2	4	-	Always at 0 (unused)
-	1	2	-	Always at 0 (unused)
ESB0	0	1	When any of valid bits of the event status register 0 is set to 1	When all of the original events are cleared to 0

■ Related commands / queries

*STB?

> Queries the content of status byte register.

> Bit 6 is MSS (Master Summary Status).

*SRE / *SRE?

> Sets/Queries the service request enable register.

> Cleared to 0 upon powering on. To clear this register to 0, set it to 0. When bits of the service request enable register are set to 1, the corresponding bits of the status byte register become valid. If at least one valid bit is set to 1, the service request is generated.

The parameter value of the setting message or response message to each register is the sum of the weight of all the bits having 1 as the value.

■ About verifying status when querying

Normally, once a query command is transmitted, you can receive the response correctly, if response message is received. There is no need to check the MAV bit of the status byte. When a processing is progressed while checking the MAV bit, after the query was transmitted, check by serial polling that the MAV bit of status byte becomes 1, and then read the response message, and after checking that the MAV bit becomes 0, perform the next operation.

5.3 Standard Event Status

The standard event status structure is shown in Figure 5-2. Details about status are shown in Table 5-2. When bits of the standard event status enable register are set to 1, the corresponding bits of the standard event status register become valid. When at least one valid bit is set to 1, the status bit register ESB bit is set to 1.
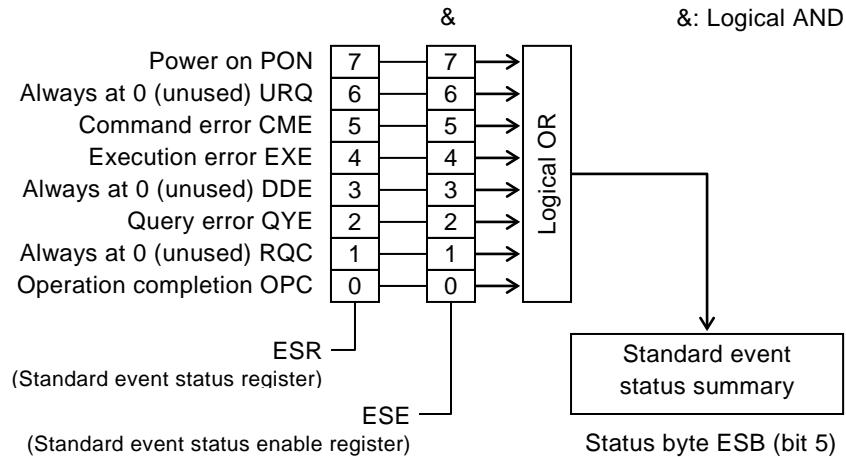
Figure 5-2   Standard event status structure

Table 5-2   Contents of standard event status register

Bit		Weight	Content
PON	7	128	Power on Set to 1 when the power is on. If cleared to 0 by a register readout, remains at 0 until the power is turned on again.
URQ	6	64	User request Always at 0 (unused).
CME	5	32	Command error Set to 1 when there is a syntax error in program code.
EXE	4	16	Execution error Set to 1 when parameters are set beyond possible range values or when settings are contradictory.
DDE	3	8	Device dependent error Set to 1 when the error queue overflows.
QYE	2	4	Query error Set to 1 when a readout has been attempted on an empty response message output buffer or when the response message output buffer data has been lost.
RQC	1	2	Request control Always at 0 (unused).
OPC	0	1	Operation complete Set to 1 when a processing of all commands up to *OPC command completed.

■ Related commands / queries

*ESR?

        Queries the standard event status register contents.

        Cleared to 0 upon query.

        Can be cleared by the *CLS command.

        Cleared to 0 upon powering on. However the PON bit is set to 1.

*ESE / *ESE?

        Sets/Queries the standard event status enable register.

        Set to 0 to clear the enable register to 0. Cannot be cleared by any other command.

        Cleared to 0 upon powering on.

The parameter value of the setting message or response message to each register is the sum of the weight of all the bits having 1 as the value.

5.4 Extension event status

The structure of the extension event status which indicates events specific to the instrument is shown in Figure 5-3.

The meaning of each event is shown in Table 5-3 and Table 5-4.

The condition register shows the status of ZM2376. The transition filter detects a condition change and generates an event. The filter setting of ZM2376 is fixed. The event status register holds the occurred event. When bits of the event status enable register 0 are set to 1, the corresponding bits of the event status register 0 become valid. When at least one valid bit is set to 1, the ESB0 bit of the status byte is set to 1.
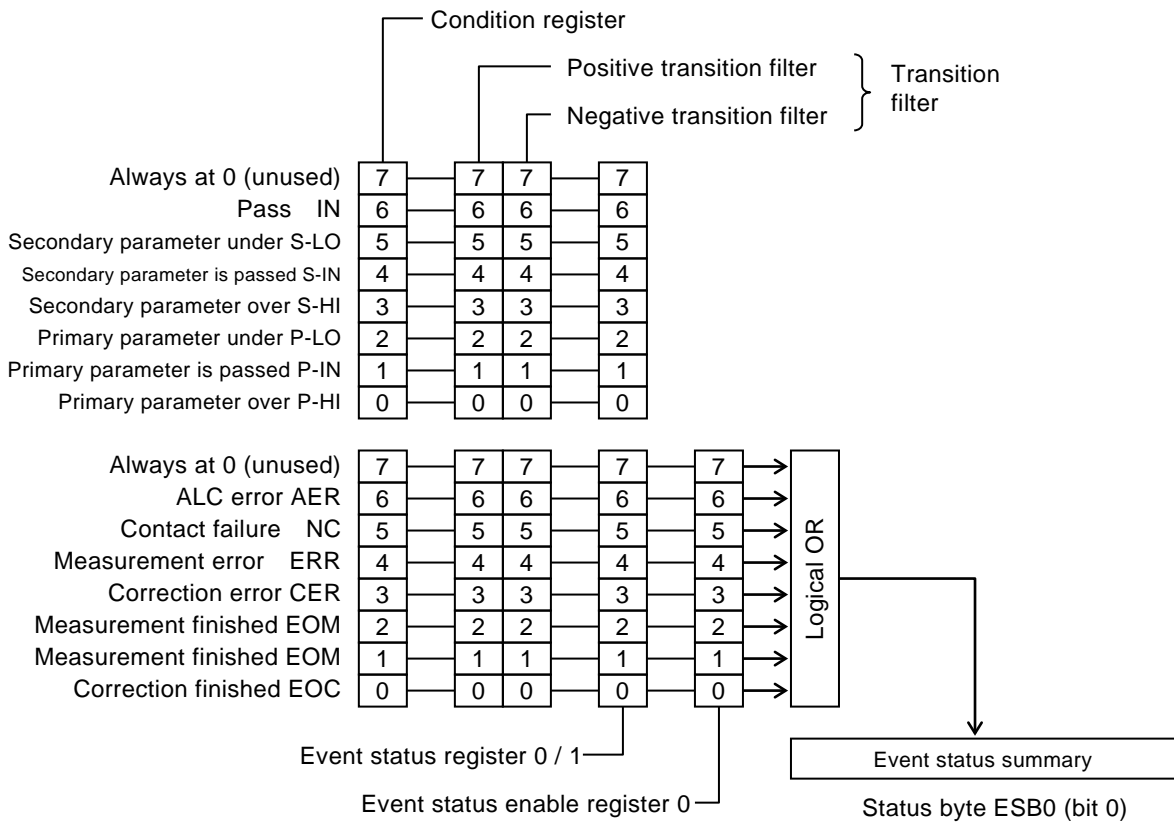
Figure 5-3   Extension event status structure

Table 5-3   Event status register 0 contents

Bit		Weight	Content: Status after measurement (1 when specified condition is fulfilled)
---	7(MSB)	128	Always 0 (unused)
AER	6	64	ALC error occurred (specified value could not be achieved)
NC	5	32	Contact failure was detected
ERR	4	16	Measurement was terminated abnormally
CER	3	8	Error occurred in the correction value measurement (CORR Err)
EOM	2	4	Normal measurement was finished
EOM	1	2	Normal measurement was finished (bits 1 and 2 are the same)
EOC	0(LSB)	1	Correction value measurement was finished

Table 5-4   Event status register 1 contents

Bit		Weight	Content: Limit comparison result (1 when specified condition is fulfilled)
---	7(MSB)	128	Always 0 (unused)
IN	6	64	Both the primary and secondary parameters were passed
S-LO	5	32	Secondary parameter was under (fail)
S-IN	4	16	Secondary parameter was passed
S-HI	3	8	Secondary parameter was over (fail)
P-LO	2	4	Primary parameter was under (fail)
P-IN	1	2	Primary parameter was passed
P-HI	0(LSB)	1	Primary parameter was over (fail)

■ Related commands / queries

:ESE0

> Sets the event status enable register 0.
>
> Set to 0 to clear the enable register to 0.
>
> Cannot be cleared by any other command.
>
> Cleared to 0 upon powering on.

:ESR0?

> Queries the event status register 0 contents.
>
> The query clears the event status register 0 to 0.
>
> Can be cleared by the *CLS command.
>
> Cleared to 0 upon powering on.

:ESR1?

> Queries the event status register 1 contents.
>
> The query clears the event status register 1 to 0.
>
> Can be cleared by the *CLS command.
>
> Cleared to 0 upon powering on.

The parameter value of the setting message or response message to each register is the sum of the weight of all the bits having 1 as the value (decimal notation).

Frequent status queries may slow down the normal operation of the instrument.

6. TRIGGER SYSTEM

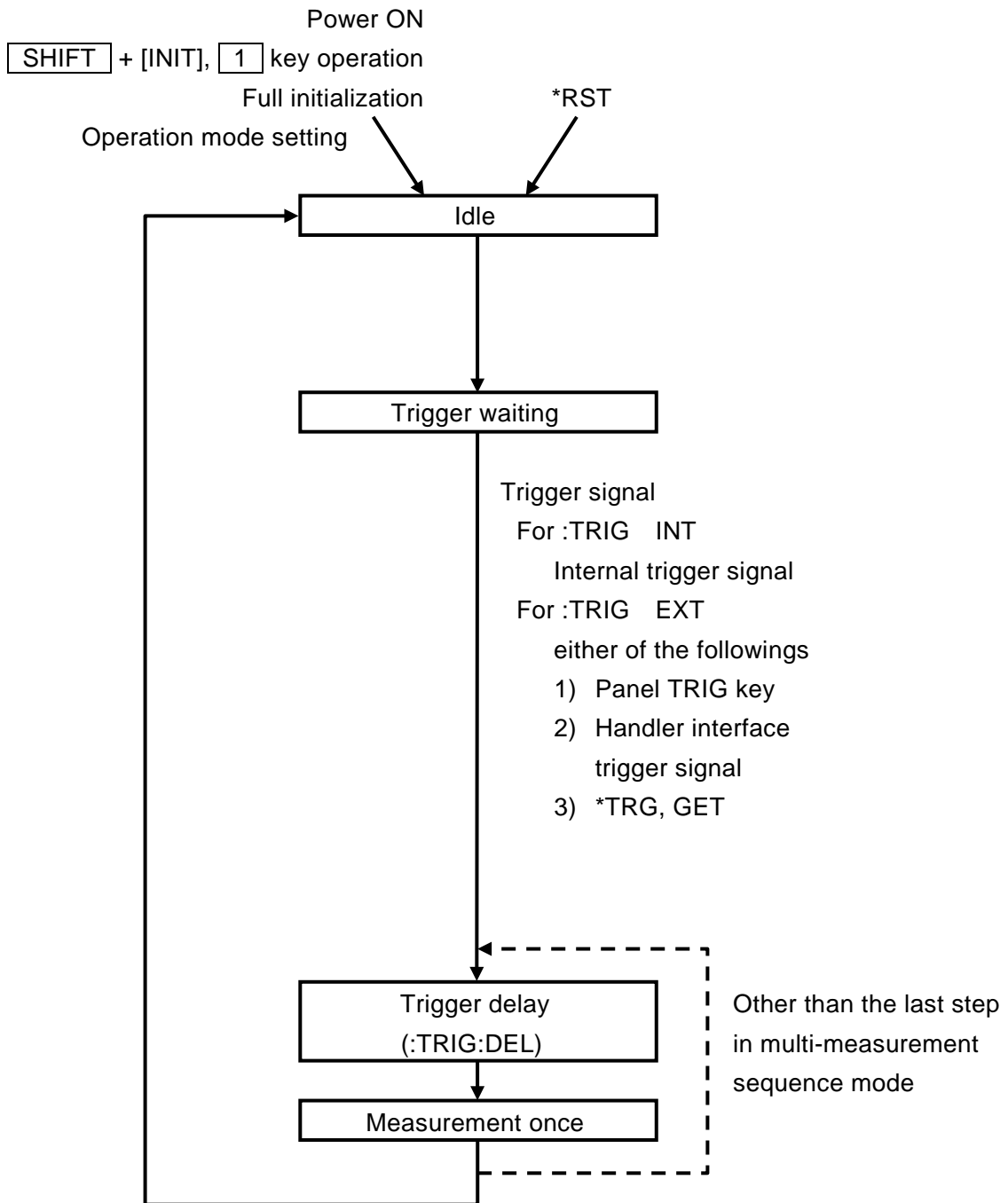The trigger system in the operation mode 1 is shown below.

Figure 6-1   Trigger system

In the operation mode 1, the multi-measurement operation is not guaranteed.

Here are typical examples in which a trigger is applied to ZM2376 to execute measurement once to obtain the measured result, and this operation is repeated.The *TRG command and :MEASure? query are used.

<Power ON>

```
                                    ' Perform initialization and settings, if necessary.
Transmit (":TRIG:SOUR EXT")         ' Set to apply the trigger by remote control.
Transmit (":MEAS:ITEM  5")          ' Specify the measured value to be read. (Example: Z-θ)
 →                                  '
Transmit ("*TRG")                   ' Apply the trigger. The following means can also be used.
                                    '   • Interface message GET
Transmit ("MEAS?")                  ' Reads the measured value.   (Note 1)
Receive (primary parameter Z, secondary parameter θ)
```

Note 1: There is no need to check the completion of measurement before transmitting the MEAS? query.

ZM2376 transmits a new measured value when it is obtained.

For simultaneous measurement with two or more instruments, it is useful to read the measurement result sequentially from the earliest completed instrument by using the SRQ and status.

When there is no measurement result due to some reason during idle or trigger waiting status, reading the measurement result returns an error (+9.90000E+37).

7. ERROR MESSAGE

Error messages at the remote control in the operation mode 1 are the same as the operation mode 0. For details of error messages, see the separate manual "ZM2376 Instruction Manual (Remote Control)".

ZM2376   Instruction Manual (Alternative Commands)

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