PROGRAMMABLE AC/DC POWER SOURCE

P-STATION/ES series

PROGRAMMABLE AC POWER SOURCE

ES-E series

INSTRUCTION MANUAL (INTERFACE)

NF Corporation

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PROGRAMMABLE AC/DC POWER SOURCE

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INSTRUCTION MANUAL (INTERFACE)

Preface

This manual explains the interfaces of the P-STATION/ES series Programmable AC/DC Power Source and the ES-E series Programmable AC Power Source. For the basic operation of the equipment from a controller, refer to the instruction manual for the main unit.

■ Caution symbols

Notices marked with the caution symbol such as shown below appear in this manual. These notices concern the safety of persons who use the equipment or physical damage to the equipment, so be sure to take the measures described in the notices.

⚠ CAUTION

Information on how to prevent injury to users of the equipment or physical damage to the equipment is described here.

- **The chapters of this manual are organized as follows.**

  If you are reading this manual for the first time, please begin with chapter 1, “Preparation for Use”.

1. Preparation for Use

This chapter describes connection to an external control unit and how to set up the main unit for use.

2. Interface Control Commands

This chapter explains the control commands issued from the external control device that are accepted by the power supply unit.

3. Status Output

This chapter explains status output.

4. Modulation Signal Input

This chapter explains input of modulation signals.

5. If You Need Help

This chapter explains error messages and events that may indicate equipment failure and what to do when they occur.

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1. Preparation for Use

1.1 Connecting the interface cables

Connect a GPIB or RS-232 interface cable to the interface panel of the main unit.
The connector on the main unit is equipped with holes that accept screws to hold the cable in place. Use an interface cable that has a connector that is equipped for screws.
The connectors on the main unit are described below

- GPIB

  24-pin connector (receptacle)
  (DDK 57LE-20240 or equivalent; M3.5 set screws)

- RS-232

  D-sub 25-pin connector (socket contact)
  (JAE DBLC-J25S or equivalent; M2.6 set screws)

⚠ CAUTION

- To prevent damage, turn off the power on the main unit before connecting a cable.
- To prevent unintentional disconnection of the connector, use screws to hold the connector in place.
- For both GPIB and RS-232, metal shell-type connectors are used as a measure against external noise. Use metal shell connectors on the interface cable as well to reduce the effects of external noise.

1.2 Main unit settings

To enable external control, turn on the main unit power and set the parameters required to enable external control. The parameters are set by using the controller section of the main unit.

First, use an interface cable to connect the external device to the GPIB or RS-232 connector, and then set the required parameters.

The parameters do not change when the power is turned off and are not affected by memory store or retrieve.

1.2.1 GPIB settings

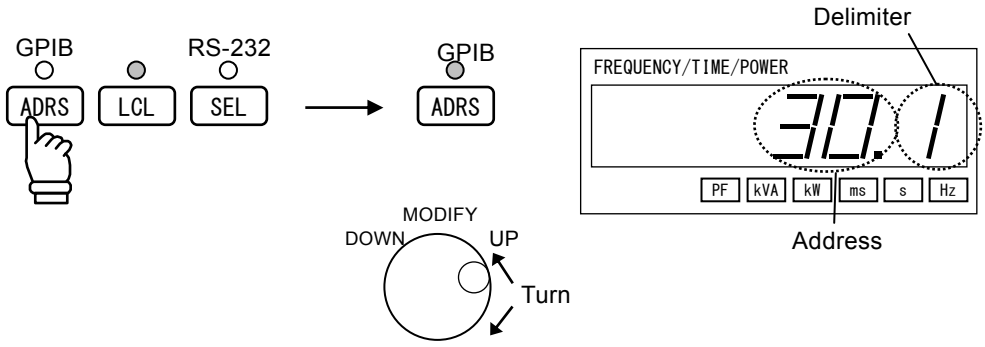
Set the "Address" and the "Transmission delimiter". In the setting state, use the left and right arrow keys [◀] [▶] to move to the specified digit and then use the modifier dial to adjust the parameter value.

■ Operating procedure

Press the [ADRS] button. The light lights up to indicate the setting state.

Lit lights are indicated by shading in the figure.

The current address and delimiter settings are displayed.



Select an address value of from 0 to 30. For the delimiter, select either 0 or 1. The default settings are 2 for the address and 0 for the delimiter.

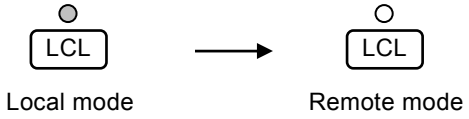
Table 1-1 Delimiter settings

	Display	Description
Delimiter	0	CR LF
	1	CR

Select values for the address and the delimiter and then press the [ENTER] key. The light turns off and the setting state ends.

Notes

- The LCL light is lit when the unit is in local operation mode. The light is not lit when the unit is in remote operation mode via GPIB or RS-232, and the unit cannot be operated from the panel (except for operation of the LCL key).



- To change the operating mode from remote via GPIB to local via panel keys, press the LCL key. However, in the local lockout mode (LLO), the LCL key is disabled. When the unit is in the local lockout mode, the LCL light is blinking.

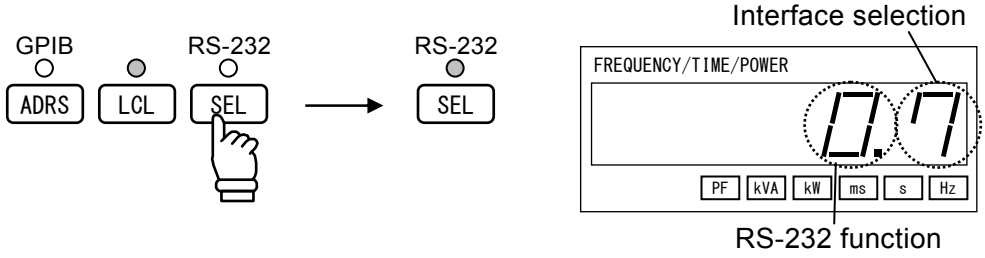
1.2.2 RS-232 settings

The settings for “Interface selection”, “Transfer speed”, “Transmission delimiter”, “Stop bits”, “Parity”, and “Character length” are described here. After selecting the setting mode, Use the left and right arrow keys ◀ ▶ to move to the relevant digit and then use the modify dial to adjust the parameter.

■ Operating procedure

Press the SEL key. The light lights up to indicate the setting mode.

The current parameter setting is displayed.



- Interface selection

The single digit on the right side of the display indicates the interface that is currently selected. If the RS-232 interface is being used, the digit on the right side is set to a value from 2 to 7. If the ES4474A Remote Terminal is being used, the digit is set to 1.
The default setting is GPIB.

Table 1-2 Relationship of right-most digit of the display and the interface

Value of the first digit on the right side of the display	Interface		Comments
0	GPIB and panel		The default mode setting value is 0.
1	ES4474A Remote Terminal		RS-232 and ES4474A cannot be used at the same time.
2	RS-232	300 bps	Select according to the transfer speed (baud rate).
3		600 bps	
4		1200 bps	
5		2400 bps	
6		4800 bps	
7		9600 bps	

- RS-232 functions

The two digits on the left side of the display are a code that represents the RS-232 function. The transmission delimiter, stop bits, parity, and character length are set. The default setting value is 0.

Table 1-3 Relationship of the two-digit number on the left side of the display and the RS-232 functions

Value of the two-digit number on the left side of the display	Setting description		
16	Transmission delimiter	CR/LF	
0		CR	
0	Stop bits	1	
8		2	
0	Parity	None	
4		Yes	Odd number
6			Even number
1	Character length	7 bits	
0		8 bits	

Example: A 0 value for the left-most two digits (default setting) indicates the following settings.

Transmission delimiter:	CR	(0)
Stop bits:	1 bit	(0)
Parity:	None	(0)
Character length:	8 bits	(0)

Notes

- RS-232 and GPIB cannot be used at the same time. It is necessary to select which interface to use.
- The default mode (the mode set when the product was shipped) is GPIB.
- RS-232 and the Remote Terminal (ES4474A) cannot be used at the same time.
- When the unit is set for remote operation by GPIB, all of the keys other than the LCL (local mode) key in the controller section and the OUTPUT "ON" and "OFF" keys are disabled.
- When RS-232 is selected, all keys other than the RS-232 "SEL" key in the controller section and the OUTPUT "ON" and "OFF" keys are disabled.

Interface parameters

The parameters related to the interface are kept in main memory until reset (memory battery backup). In the case described below, however, they are forcibly returned to the default settings when the main unit is powered up.

- The parameters are reset to the default values if the backup data is lost or corrupted, as may happen when the unit is not used for a long time. That can also happen if the backup battery deteriorates. ☞ Refer to 6 Maintenance, in the instruction manual for the main unit.

Differences between the RS-232 and GPIB interfaces

Control with the GPIB differs from control with the RS-232 in the ways listed below.

- Parallel connection of devices is not possible.
- Data communication is one-to-one, so no addresses are set.
- No service request (SRQ) functions are available.
- No remote/local functions are available.

1.2.3 RS-232 connector wiring

There is no standard cable for RS-232 as there is for GPIB, so the connection must be made according to the specifications of the equipment you are using.

An example of connecting this product to data terminal equipment is shown below. Check the equipment specifications well before making the actual connection.

⚠ **CAUTION**

Do not connect anything to pin 9 or pin 10 of the connector of this product.

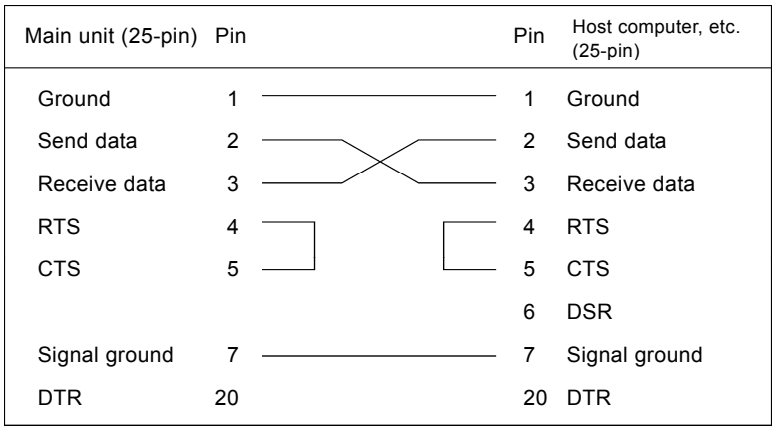


Figure 1-1 Connector wiring (minimal)

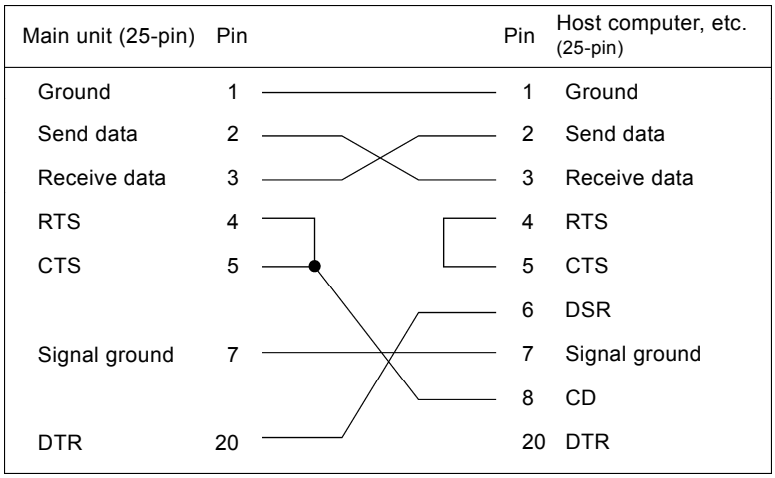


Figure 1-2 Connector wiring (wiring for checking mutual connection)

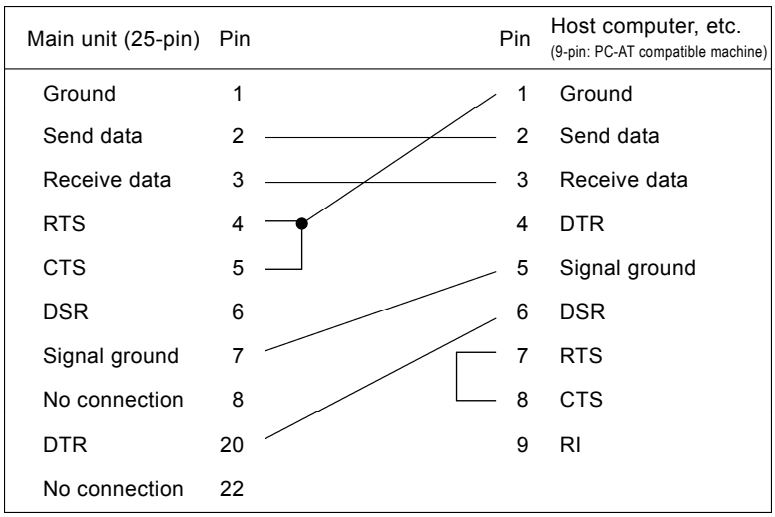


Figure 1-3 Connector wiring (connection to PC-AT compatible machines (9-pin))

Ground pin 1 and signal ground pin 7 are not isolated within this product.

2. Interface Control Commands

2.1 Overview

Control commands from an external source are sent via the interface and used to control the main unit operation.

Select the interface to be used for transferring commands and perform the necessary wiring and main unit setup. ☞ 1.2 Main unit settings.

To provide time for the internal circuits to stabilize, no commands are accepted from the interface until about 10 seconds after the power is turned on. Please note that the program is halted if a command is sent during that time.

The commands that can be used with this product and simple examples of using them are listed below.

Notes

Commands from the interface are not accepted for about 10 seconds after the power is turned on.

2.2 Main unit functions and extension functions

The interface enables command control of nearly all of the operation and setting functions that can be controlled from the controller section of the main unit (main unit functions).

The interface also makes it possible to use functions that can only be controlled by command (extension functions).

The extension functions enable an enhanced power fluctuation tests (recurring fluctuations) and output of clipped sine waveforms (crest factor function).

2.3 About the commands

The commands are the same for GPIB and RS-232.

Commands comprise a header that indicates the setting function and a parameter part that indicates the setting information.

Character case is disregarded in the header.

2.3.1 Setting commands and query commands

The two types of commands are setting commands and query commands.

The setting commands are used to configure functions and set numerical values. The query commands are used to read setting information and calculated values, etc.

Most setting commands can be changed to query commands by beginning the command with a question mark (?). The response is the setting information that is being queried.

Example:

Set the output voltage to 100 Vrms.	VLT 100.0
Query the output voltage.	?VLT
Response	VLT 100.0

Notes

- Some setting commands do not have a corresponding query form.
- When a query command is received by this product, it determines the setting state and prepares to send it. The data is sent when a talker designation is received.

2.3.2 Command parameters

The parameter value types for commands are real number, integer, boolean and no parameter.

Real number parameters:	A real number (E.g.: 100.0), exponential format (E.g.: 1.00E+2), or integer (E.g.: 100) value can be used.
Integer parameters:	Only integers can be used
Boolean parameters:	Only “1” or “0” can be used.
Parameterless form:	Command only; no parameters

Notes

If a character or numerical value other than specified for the parameter is used, a parameter error is issued.

2.3.3 Receive buffer

This product has a receive buffer that holds 255 bytes (255 characters). Delimiters, spaces, tabs, and semicolons cannot be placed in the buffer.

Commands within the buffer size can be sent consecutively, but if commands that are longer than 255 characters are received, an input buffer overflow will occur, the input buffer will be cleared, and a buffer error will be issued and the commands will not be sent.

If a command header or parameters other than those specified are encountered by the command interpreter, that command and subsequent commands will be cleared from the input buffer and will not be executed. In that case, a header error or parameter error is issued.

2.3.4 Transmission of commands

For query commands, only the command that is last sent in a transmission is effective; all query commands sent earlier are ineffective.

Example:

Query commands	?FRQ ?VLT
Response	VLT 100.0

When commands are sent during any of the operation states listed below, query commands will be accepted, but setting commands will not be accepted and an exclusion error will be issued.

- Voltage range switching operation
- Quick-change operation (QC)
- Auto-calibration

2.4 Commands (main unit functions)

This section focuses on commands that have the same functions as key operations performed on the main unit. These commands are the same for both the GBIP and RS-232 interfaces.

However, functions indicated by the “SRQ” header are disabled when the RS-232 interface is used.

You can also insert spaces or semicolons between the command header and the parameters for ease of reading. The inserted spaces or semicolons do not affect operation.

2.4.1 Setting the output voltage range and output voltage

Table 2-1 Output voltage range and output voltage setting commands

Header	Function	Parameter setting	Parameter form	Query
RNG	Set the output voltage range	0: 100 V range 1: 200 V range	Boolean	Yes
VLT	Set the output voltage *	Single-phase system, three-phase system 0 V to 300.0 V Single-phase 3-wire system 0 V to 600.0 V	Real number	Yes

* For the three-phase system, the setting is the phase voltage. For the single-phase 3-wire system, the setteing is the line voltage.

RNG: Range

VLT: Voltage

Example: Set the output voltage range to 100 V and set the output voltage to 100 Vrms.

Set the output voltage range to 100 V	RNG 0
Set the output voltage to 100 Vrms	VLT 100.0

Notes

- Setting a voltage that exceeds the output voltage of 150.0 V in the 100 V output voltage range generates a parameter error. In that case, set the output voltage range to 200 V. A parameter error is also generated if the set voltage that is sent according to the voltage setting exceeds the voltage limit. In that case, check the value of the voltage limit.
- Commands are not interpreted during the time the output voltage range is being switched. Thus, if a command that changes the range is followed by another command, an exclusion error is generated. The next command should be sent after checking the status byte to confirm completion of the range switching operation.
- The parameter type of real number can be real number (E.g., 100.0), exponential notation (E.g., 1.00E+2), or integer (E.g., 100).

2.4.2 Output frequency setting

Table 2-2 Output frequency setting command

Header	Function	Parameter setting	Parameter form	Query form
FRQ	Set the output frequency	5.00 Hz to 1100.00 Hz	Real number	Yes

FRQ: Frequency

Example:Set the output frequency to 60.00 Hz.

Set the output frequency to 60.00 Hz. FRQ 60.00

Notes

A parameter error is also generated if the set frequency that is sent according to the frequency setting exceeds the frequency limit. In that case, check the value of the frequency limit.

2.4.3 Switching output on and off

Table 2-3 Output on/off command

Header	Function	Parameter setting	Parameter form	Query form
OUT	Switch the output on and off	0: off 1: on	Boolean	Yes

OUT: Output

Example:Set output to on or off.

Set output to on OUT 1

Set output to off OUT 0

2.4.4 Switching the output mode

Table 2-4 AC/DC commands

Header	Function	Parameter setting	Parameter form	Query
DCM	Switch the mode between AC and DC	0: AC mode 1: DC mode	Boolean	Yes

DCM: DC mode

Example: Set the mode to AC or DC.

DC mode DCM 1

AC mode DCM 0

2.4.5 Measurement functions

Table 2-5 Measurement function commands (querying measured values)

Header	Function	Parameter setting	Parameter form	Query
MVL	Query the result of voltage measurement	None	None	Query only
MCU	Query the result of current measurement	None	None	Query only
MVA	Query the result of apparent power measurement	None	None	Query only
MWT	Query the result of the active power measurement	None	None	Query only
MPF	Query the result of power factor measurement	None	None	Query only
PEK	Select measurement of effective value or peak value Select the item to be displayed in the measurement section of the main unit	0: Effective value 1: Peak value	Boolean	Yes
UVW	Select the phase to be measured Select the phase to be displayed in the measurement section of the main unit	0: L1 (U) phase 1: L2 (V) phase 2: L3 (W) phase 3: Between lines (L1 (U)-L2 (V)) 4: Between lines (L2 (V)-L3 (W)) 5: Between lines (L3 (W)-L1 (U))	Integer	Yes

MVL: Measurement Voltage
MCU: Measurement Current
MVA: Measurement VA
MWT: Measurement Wattage
MPF: Measurement Power_Factor
PEK: Peak
UVW: L1 (U)/L2 (V)/L3 (W)

Table 2-6 Measurement function commands (selecting the items to be displayed on the main unit)

Header	Function	Parameter setting	Parameter form	Query
DSP	Select the item to be displayed on the main unit	0: Display the set value 1: Display the measured value	Boolean	Yes
VWP	Select the item to be displayed in the main unit measurement section (apparent power, active power, power factor, or frequency)	0: Apparent power 1: Active power 2: Power factor 3: Frequency	Integer	Yes

DSP: Display
VWP: VA/Wattage/Power_Factor

Examples of querying measured values for a single-phase system, a three-phase system, and a single-phase 3-wire system. For the three-phase system and the single-phase 3-wire system, the phase must be set.

- Single-phase system

Example: Measured value query

Query effective voltage	PEK0 ?MVL
Query peak voltage	PEK1 ?MVL
Query effective current	PEK0 ?MCU
Query active power	?MWT

- Three-phase system and Single-phase 3-wire system

Example: Measured value query

Query L1 (U) phase effective voltage	UVW0 PEK0 ?MVL
Query L1 (U) phase peak voltage	UVW0 PEK1 ?MVL
Query L1 (U) phase effective current	UVW0 PEK0 ?MCU
Query L1 (U) phase active power	UVW0 ?MWT

Notes

- When querying voltage and current measurements, specify the effective value or peak value (PEK 0 for peak value) before sending the command.
- When querying measurements for three-phase systems and single-phase 3-wire system, specify the phase (“UVW 0” for L1 (U)) before sending the command.
- The PEK and UVW commands select the item to be displayed as well as the measurement to read.
- When “between lines” is set with the UVW command, the display values are as listed below.

Voltage:	Line to line voltage
Current:	Phase current (L1 (U)- L2 (V) for the L1 (U) phase current)
Apparent power, active power:	Sum of the respective phase power values
Power factor:	Power factor calculated from sum of the respective phase power values

2.4.6 Status display

The system state and configuration at the time the power is turned on can be known from the status display.

Table 2-7 Status display commands

Header	Function	Parameter setting	Parameter form	Query
IDX	Outputs the model name	None	None	Query only
VER	Outputs the ROM version	None	None	Query only
OPR	Outputs the hardware configuration	None	None	Query only

IDX: ID code X

VER: Version

OPR: Operation

The model name response codes are explained below.

For the P-STATION/ES series:

ES2000S for when the master unit is an ES2000S unit or for a single-phase cabinet system

ES2000U for when the master unit is an ES2000U unit or for a three-phase cabinet system

For the ES-E series:

ES2000S for single-phase output models (ES020ES, ES040ES, and ES060ES)

ES2000U for the single-phase 3-wire output model (ES040ED) or the three-phase output model (ES060ET)

Querying the ROM version

Example: Version query ?VER

Response for when the version is 1.00 VER 1.00

The hardware configuration states are listed in the following table.

For queries, total values for the item expressed in decimal form are output.

Table 2-8 Hardware configuration states

Item	Numerical value (decimal)	Bit	Bit value	Meaning
Signal input	128	Bit 7 (MSB)	1	External
	0		0	Internal (normal)
(Not used)	64	Bit 6	0	No meaning (fixed values)
	32	Bit 5	0	
	16	Bit 4	1	
	8	Bit 3	1	
	4	Bit 2	0	
	2	Bit 1	0	
System configuration*1	1	Bit 0 (LSB)	1	Three-phase system Single-phase 3-wire system
	0		0	Single-phase system

*1 With the three-phase/single-phase switching function, the output is as for a three-phase system, even if used in single-phase mode.

Querying the hardware configuration status

Example:

Query the configuration state ?OPR

Response for a three-phase system or a single-phase 3-wire system with external input

OPR 153 (128+16+8+1, for a total of 153)

2.4.7 Setting limit values

Limits can be set for the output voltage and output frequency setting ranges.

Table 2-9 Limit value setting commands

Header	Function	Parameter setting	Parameter form	Query
VUP	Set the upper limit for voltage	0 V to 300.0 V	Real number	Yes
FUP	Set the upper limit for frequency	5.00 Hz to 1100.00 Hz	Real number	Yes
FLW	Set the lower limit for frequency	5.00 Hz to 1100.00 Hz	Real number	Yes
LMV	Maximum output voltage value for external signal input (100 V range)	0 V to 150.0 V	Real number	Yes
HMV	Maximum output voltage value for external signal input (200 V range)	0 V to 300.0 V	Real number	Yes

VUP: Voltage Upper limit LMV: Low_range Max Voltage

FUP: Frequency Upper limit HMV: High_range Max Voltage

FLW: Frequency Lower limit

Example: Limit the maximum output voltage to 220 V in the maximum frequency to 65 Hz.

Set the upper limit for the output voltage to 220 V. VUP 220.0

Set the upper limit for the output frequency to 65 Hz. FUP 65.00

Notes

- Setting a voltage upper limit value that is lower than the present setting generates a parameter error.
- Setting a frequency upper limit value that is lower than the present setting or lower than the frequency lower limit value that has already been set generates a parameter error.
- Setting a frequency lower limit value that is higher than the present setting or higher than the frequency upper limit value that has already been set generates a parameter error.
- For a three-phase system and a single-phase 3-wire system, the output voltage upper limit value is effective for the phase voltage of all phases.

2.4.8 Line synchronization

The output frequency can be synchronized with the frequency of the commercial power supply to which the main unit is connected.

Table 2-10 Line synchronization commands

Header	Function	Parameter setting	Parameter form	Query
LSY	Turn the line synchronization function on or off	0: Off 1: On	Boolean	Yes

LSY: Line Sync.

Example: Set the line synchronization to on.

Set line synchronization on LSY 1

Notes

- If the output frequency limit settings result in a frequency range that does not include 55 Hz, line synchronization is not set and an exclusion error is issued.
- The line synchronization function cannot be switched on or off if the equipment is in the output on state. Turn the output off before setting line synchronization.
- The frequency range for which line synchronization is possible is from 48 Hz to 62 Hz. Use the function within that range.

2.4.9 Memory

Settings or modes can be saved to the built-in battery-powered backup memory of the equipment and retrieved from the memory. The memory has 121 addresses numbered zero through 120.

Table 2-11 Memory commands

Header	Function	Parameter setting	Parameter form	Query
STO	Save the current settings in the specified address	1 to 120 (memory address)	Integer	None
RCL	Retrieve settings from the specified address	0 to 120 (memory address)	Integer	None

STO: Store

RCL: Recall

Example: Save the current setting values in memory address 2 and retrieve the content of memory address 2.

Store the current settings values in memory address 2 STO 2

Retrieve the content of memory address 2 RCL 2

Notes

- When settings are stored in memory by command, the stored data does not change, even if operations are performed from the operation section of the main unit. For that reason, the equipment may operate in unexpected ways when the data is retrieved or there is a sudden change. When changing from interface control to manual control of a main unit, restoration of the default settings by "Restore from address 0" is recommended.
- The data stored in memory address 0 is the default settings. It is read-only and the default setting values cannot be changed. ☞ Refer to 2.6.3 Memory store and initial settings.
- Memory address 1 is read each time the power is turned on. The settings that are normally used can be saved to this address, making it unnecessary to set them each time the equipment is used.
- The GPIB address and other interface parameters are not saved to or retrieved from the memory. ☞ Refer to 1.2.1 GPIB settings.
- Some settings cannot be saved to or retrieved from the memory ☞ Refer to 2.6.3 Memory store and initial settings.

2.4.10 Power fluctuation tests

Various types of abnormal phenomena that occur in power lines are generated quantitatively and the immunity of the equipment to those phenomena is tested.

■ Voltage quick-change (frequency unchanged)

Instantaneous changes in the state of the power supply are referred to as "quick-change" (QC).

An operation to restore the voltage to the voltage prior to a sudden change is performed a certain amount of time after the voltage is instantaneously interrupted, decreased, or increased by the output voltage quick-change function.

To perform the test, three settings must be made in advance: the QC voltage, the QC start phase, and the QC time. After the values have been set, set the QC enable mode and use the QC start command to perform the test.

The focus here is on functions that can be used by operations performed in the main unit, but extension functions can be used to perform tests that are more complex. ☞ Refer to 2.5 Commands (extension functions).

Table 2-12 Power supply fluctuation (main unit function) commands

Header	Function	Parameter setting	Parameter form	Query
QCE	Sets and cancels the QC (quick-change) enable mode	0: Cancels enable mode 1: Sets enable mode	Boolean	Yes
QCP	Set the QC start phase	0° to 360°	Real number	Yes
QCT	Set QC (quick-change) time	0.0001 s to 600.00 s	Real number	Yes
QCV	Set QC level A (quick change voltage)	0 V to 300.0 V	Real number	Yes
QCS	Start QC (quick-change) operation	None	None	None
QCB	The QC (quick-change) operation ends at the output level of the time the command is received	None	None	None

QCE: QC Enable QCV: QC Voltage
QCP: QC Phase QCS: QC Start
QCT: QC Time QCB: QC Break

Example: Perform the sudden voltage change described below.

- QC voltage: 0 V (sudden power failure)
- QC start phase: 45°
- QC time: 50 ms

Set QC parameters	QCP 45 QCV 0 QCT 0.05
Set QC enabled	QCE 1
Start QC	QCS

Notes

- To perform a voltage quick-change, it is necessary to send the QCE 1 command to set the QC enable mode. Also, it takes some time after the QC enable mode is set for the main unit to enter the state in which QC operation is possible, so send the QCS command to begin QC operation from 1 to 2 seconds after sending the QCE 1 command.
- In the QC enable mode, the parameters cannot be changed. To change parameters, the mode must be canceled.
- An exclusion error results when any command is sent other than OUT, which sets the output to on or off during voltage quick change operation, QCE, which enables QC operation, or QCB, which ends the QC operation at the level of the time the command is received during voltage QC.

■ Voltage sweep 1 (frequency variation)

"Sweep" (namely, linearly changing output voltage and output frequency over a set time) is performed by using the memory function and transition-time setting. Besides being possible to change voltage and frequency independently, it is also possible to change both simultaneously.

Table 2-13 Power supply fluctuation (voltage sweep 1) commands

Header	Function	Parameter setting	Parameter form	Query
TRT	Set the transition time for voltage and frequency change	0 s to 99.9 s	Real number	Yes

TRT: Transition Time

Example: Perform a sweep (change) from an output voltage of 10 V and output frequency of 5 Hz to an output voltage of 100 V and output frequency of 200 Hz over a time of 30 seconds. It is assumed that the parameters after the change are saved to memory address 2.

Set the output voltage and frequency after change and set the output to on	VLT 100 FRQ 200.00 OUT1
Save the setting to memory after the change	STO 2
Set the transition time (change duration)	TRT 30.0
Set the output voltage and frequency before the change	VLT 10.0 FRQ 5.00
Sweep start command (retrieved from memory)	RCL 2

Notes

- Sending a command other than the OUT command for turning the output on or off during the transition will produce an exclusion error.
- If the output is not set to on when parameters are saved to memory, the output will be off when the parameters are retrieved from memory. Also, the output may be off, depending on the settings before and after retrieval from memory, and there may be a quick change without the sweep being performed.

2.4.11 Precision mode and high-stability mode settings

Setting the output compensation mode is described here.

Setting the precision mode can suppress fluctuations in the output voltage with respect to changes in the load current to a low level. Setting the high-stability mode results in a slightly higher output voltage fluctuation, but stability with respect to the capacitive load is improved.

Table 2-14 Output compensation mode setting commands

Header	Function	Parameter setting	Parameter form	Query
PRC	Switch between the high-stability mode and the precision mode	0: High-stability mode 1: Precision mode	Boolean	Yes

PRC: Precision

Example: Set the output compensation mode to the high-stability mode.

Set the high-stability mode PRC 0

2.4.12 Auto calibration (output-voltage calibration function)

This function corrects the output voltage value that has been set to match the measured value. This makes it possible to compensate for the voltage drop in the output cable and the decrease in load regulation that occurs when the load is connected.

The correction coefficient is stored in internal memory with battery backup. The value does not change until the command is sent again.

Table 2-15 Auto-calibration commands

Header	Function	Parameter setting	Parameter form	Query
CAL	Perform auto-calibration	None	None	None

CAL: Calibration

Example: Correct for a voltage drop.

Enable auto-calibration CAL

Notes

- When the difference between the set value and the measured value is excessive or it is not possible to end the correction operation within a certain time, the correction coefficient is set to the default value (no correction) and the function exits. This case is likely to occur if the output voltage is relatively low (20 V or less).
- Auto-calibration cannot be performed when QC is enabled or the crest factor function is enabled. Disable those functions before sending this command.
- Auto-calibration cannot be performed for frequencies of less than 40 Hz. Sending this command in that case will produce an exclusion error

2.5 Commands (extension functions)

This section focuses on commands for extended functions, which cannot be executed from the main unit alone.

The extended function commands make it possible to use output with repeatedly occurring voltage fluctuations and clipped sine wave output, etc.

2.5.1 Power fluctuation tests

The test items that can be performed from the main unit controller and by control commands from the interface are listed in Table 2-16. For information on voltage sweep 1 and voltage quick-change, refer to "Power fluctuation tests" under "Main unit functions". ☞ Refer to 2.4.10 Power fluctuation tests.

Table 2-16 Power fluctuation operations

Operation type		QC phase setting	QC/sweep frequency	Repeated operation	Configuration	
					Main unit only	Interface
Voltage sweep 1 (voltage and frequency change)	Perform the change one time from the start level to the stop level	No	Yes	No	Yes	Yes
Voltage sweep 2 (voltage change but no frequency change)	Perform the change from the start level to level A, and then any number of times from level A to level B, to level A, … .	No	No	Yes	No	Yes
Voltage QC	Perform quick-change from the start level to level A and then return to the start level. The operation is performed one time.	Yes	No	No	Yes	Yes
	Perform the above operation any number of times.			Yes	No	

Configuration Main unit only: Operation from the controller of the AC power supply main unit
Interface: Control via GPIB or RS-232

Table 2-17 Power fluctuation parameters

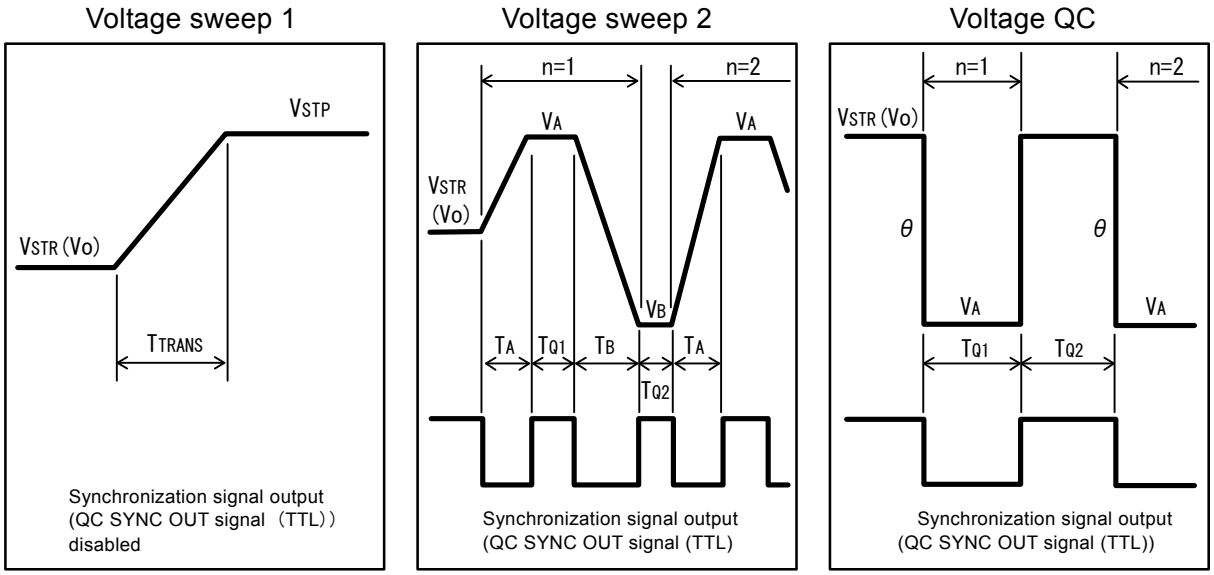
Operation		Configura-tion	Voltage parameter	Time parameters					Phase parameters	Repetitions
Operation name	Description		Start level Stop level [QC LEVEL A, B]	T_{TRANS} [TRANS TIME]	T_A [SWP TM A]	T_B [SWP TM B]	T_{Q1} [QC TIME]	T_{Q2} [QC INTVL]	θ [QC PHASE]	n [QC N]
Voltage sweep 1	Change from the start level to the stop level one time	Main unit only ES 4474A	0 to 300 V	0.0 to 99.9 s	No parameters applicable to this operation					1
Voltage sweep 2	Change from the start level to level A. Change From level A to level B and then from level B to level A. Repeat the last step any number of times	Main unit only	Not applicable							
		ES 4474A	0 to 300 V		0.000 to 999.999 s		0.1 ms to 600 s and ∞	1 ms to 999.999 s	Not applicable unless T_A=0	1 to 99 and ∞
Voltage QC	Change from the start level to level A. Return to the start level after an arbitrary amount of time.	Main unit only	0 to 300 V		Not applicable		0.1ms to 600s	Not applicable	0 to 360°	1
		ES 4474A			Set to 0 in either case		0.1 ms to 600 s and ∞	1 ms to 999.999 s		1 to 99 and ∞

Note: Concerning voltage and frequency change

Voltage sweep 1: Voltage and frequency can be changed simultaneously.

Voltage sweep 2: Voltage is changed but frequency is not changed.

Voltage QC: Voltage is changed quickly but frequency is not changed.



V_{STR} (Vo): start level
V_{STP}: stop level
(voltage setting value after retrieval from memory)
V_A: level A [QC LEVEL A]
V_B: level B [QC LEVEL B]
T_A: sweep time A [SWP TM A]
T_B: sweep time B [SWP TM B]
T_{Q2}: interval time [QC INTVL]
T_{Q1}: QC continuation time [QC TIME]
T_{TRANS}: transition time [TRANS TIME]
θ: QC start phase [QC PHASE]
n: number of repetitions [QC N]

Figure 2-1 QC voltage operation sequence pattern

Notes

- The voltage QC $T_{Q1}=\infty$ or T_{Q2} and voltage sweep 2 cannot be set from the main unit controller, and the value of n for voltage QC is fixed at 1.

- When memory is accessed for a sweep and one or more of the conditions listed below apply, the output is set to off, even if the output on setting is stored in memory.
  - The state is set output off prior to the memory access.
  - The output voltage range values are different before and after the memory access.
  - The line synchronization on/off settings are different before and after the memory access.
  - The QC enable mode is set either before or after the memory access.
  - The crest factor function is set to on either before or after the memory is accessed.
  - The output mode is different before and after the memory access.
- If the condition listed below applies when memory is accessed for a sweep, the QC (transition time 0) setting is effective, even if a transition time has been set.
  - The precision/high-stability (compensation mode) setting is different before and after the memory access.
- If an "OUT 0" command is sent during operation, operation is stopped at the level and frequency for the time at which the command is received.

■ Voltage change (frequency unchanged): voltage sweep 2

Adding parameters to the output voltage QC function makes it possible to execute a change over a certain time (sweep) in addition to an instantaneous change in power supply voltage (QC).
☞ Refer to 2.5.1 Power fluctuation tests.

Table 2-18 Power supply fluctuation (voltage sweep 2 and voltage QC extension functions) commands

Header	Function	Parameter setting	Parameter form	Query
QCE	Sets and cancels the QC/sweep enable mode.	0: Cancels enable mode 1: Sets enable mode	Boolean	Yes
QCP	Set the QC start phase (θ).	0° to 360°	Real number	Yes
QCT	Set the QC (quick change/sweep) time (T_{Q1}).	0.0001 s to 600.00 s	Real number	Yes
QCF	Set the QC (quick change/sweep) time to infinitely large).	0: QCT enabled 1: QCT disabled (infinitely large)	Boolean	Yes
QCV	Set the QC level A (V_A).	0 V to 300.0 V	Real number	Yes
QCA	Set the QC level B (V_B).	0 V to 300.0 V	Real number	Yes
STA	Set sweep Time A (T_A).	0.000 s to 999.999 s	Real number	Yes
STB	Set sweep Time B (T_B).	0.000 s to 999.999 s	Real number	Yes
QCI	Set the interval time (T_{Q2}).	0.000 s to 999.999 s	Real number	Yes
QCN	Set the number of repetitions (n).	1 to 99	Integer	Yes
QCC	Set the number of repetitions to infinitely large.	0: QCN enabled 1: QCN disabled (infinitely large)	Boolean	Yes
QCS	Start the QC/sweep operation.	None	None	None
QCB	Stop the QC/sweep operation at the output level of the time at which the command is received.	None	None	None

QCE: QC Enable
QCP: QC Phase
QCT: QC Time
QCV: QC Voltage
STA: Sweep Time A
STB: Sweep Time B
QCI: QC Interval
QCN: QC Number
QCC: QC Count
QCS: QC Start
QCB: QC Break

Example: The voltage sweep 2 specified below is performed repeatedly

- Start level (V_{STR}): 100 V
- Level A (V_A): 120 V
- Level B (V_B): 80 V
- Sweep time A (T_A): 20 s
- Sweep Time B (T_B): 30 s
- Number of repetitions (n): 3
- Interval time (T_{Q2}): 5 s

Level A (V_A) setting	QCV 120.0
Level B (V_B) setting	QCA 80.0
Sweep time A (T_A) setting	STA 20.000
Sweep time B (T_B) setting	STB 30.000
Repetitions (n) setting	QCN 3
Interval time (T_{Q2}) setting	QCI 5.000
Start level (V_{STR}) setting	VLT 100.0
QC/sweep enable mode setting	QCE 1
Start command setting	QCS

Notes

The operation for when various commands are sent during voltage QC and voltage sweep 2 operation is as listed below.

Voltage QC

"OUT 0"	Operation stops at the start level.
"QCE 0"	Operation stops at the start level.
"QCB"	Operation stops at the level of the time at which the command is received.

Voltage sweep 2

"OUT 0"	Operation stops at QC level B.
"QCE 0"	Operation stops at the start level.
"QCB"	Operation stops at the level of the time the command is received.

Notes

- To perform a voltage sweep 2 and voltage QC operations, it is necessary to send the QCE 1 command to set the QC/sweep enable mode. Also, it takes some time after the QC/sweep enable mode is set for the main unit to enter a state in which the QC/sweep operation is possible, so send the QCS command to begin QC/sweep operation from 1 to 2 seconds after sending the QCE 1 command.
- In the QC/sweep enable mode, the parameters cannot be changed. To change parameters, the mode must be canceled.
- An exclusion error results when any command other than OUT, which sets the output to on or off, QCE, which enables or disables voltage QC operation, or QCB, which ends the QC operation at the level of the time the command is received is sent during voltage sweep 2 or voltage QC operation.
- The start level is the value of the output voltage level setting immediately before the start command is received.
- If the sweep time setting is T_A= 0 or T_B= 0, a quick-change is performed on the output voltage. If the setting is T_A= 0, it is possible to set the phase angle at which the quick-change occurs.
- For three-phase system and single-phase 3-wire system, the voltage is set to the same value for each phase.
- For three-phase system and single-phase 3-wire system, the QC start phase is defined relative to the phase of the L1 (U) phase voltage. Also, the quick-change occurs at the same time for the three phases.

■ Use of related options

The related options can be used to perform other types of power fluctuation tests. For more information, refer to the instructions for each option.

ES0406D Immunity Test Software:

This option supports various types of immunity testing with generation of clipped sine waves, superimposition of harmonics, generation of voltage with QC phase, and generation of phases with sudden voltage change, etc.

2.5.2 Crest factor (CF)

This function is for clipping the output voltage sine wave of a single-phase system. The clipping factor (CF, the ratio of the peak value to the effective value of the output waveform) can be set to an arbitrary value in the range from 1.10 to 1.41 with a resolution of 0.01.

The setting is effective only when the crest factor function has been enabled.
The function cannot be switched on or off and the setting value cannot be changed when the equipment is in the output on state.

The effective output voltage remains constant, even if the value of crest factor is changed.

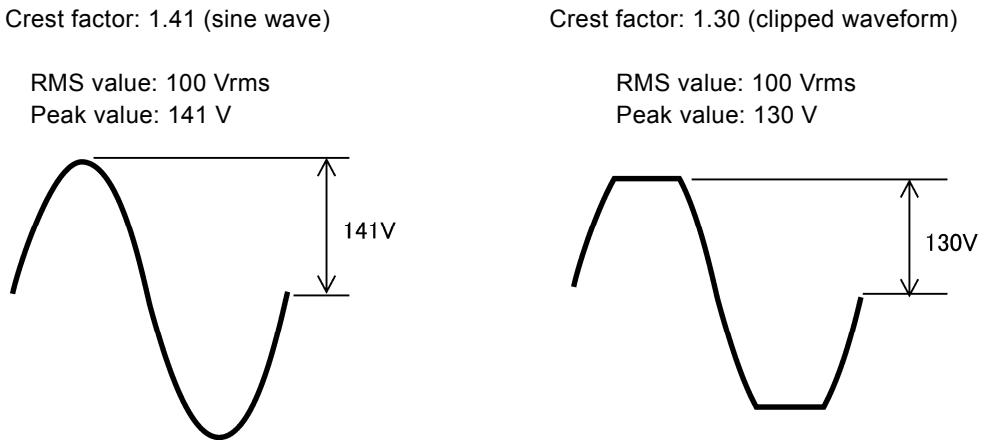


Figure 2-2 Crest factor setting waveform

Table 2-19 Crest factor function commands

Header	Function	Parameter setting	Parameter form	Query
CFM	Switch the crest factor function between enabled and disabled	0: Disabled 1: Enabled	Boolean	Yes
CFL	Set the crest factor value	1.10 to 1.41 Resolution: 0.01	Real number	Yes

CFM: CF Mode

CFL: CF Level

Example: Set the crest factor to 1.30.

Set the crest factor to 1.30.	CFL 1.30
Enable the crest factor function.	CFM 1

Notes

- The crest factor function cannot be enabled or disabled and the crest factor value cannot be changed in the output on state. Set the output off state before changing the settings.
- The crest factor function cannot be enabled or disabled in the QC enabled state. Disable QC before changing the crest factor function setting.
- The auto-calibration function cannot be used when the crest factor function is enabled.
- The crest factor function can be used only for single-phase systems.
- Sending a QCE command to enable QC or sending a CAL command to begin auto-calibration when the crest factor function is enabled will produce an error.

2.5.3 Interface commands

The interface commands set the state of the main unit and the output format for queries.

Table 2-20 Interface commands

Header	Function	Parameter setting	Parameter form	Query
SRQ	Set the SRQ mask	0 to 63	Integer	Yes
STS	Serial poll status	None	None	Query only
ERS	Error status	None	None	Query only
HDR	Response code header control	0: header off 1: header on	Boolean	Yes

SRQ: Service Request

STS: Status

ERS: Error Status

HDR: Header

2.5.4 Service requests (SRQ)

The service request (SRQ) function provides an interrupt by an external computer or other device when any of the SRQ causes specified for this product occur.

This function is effective only when the GPIB interface is used.

The SRQ causes for this equipment are listed in Table 2-21.

Table 2-21 SRQ causes

SRQ cause	
Busy state ends	The three busy states are listed below. ● Output voltage range switching operation ● Quick-change (QC) operation ● Auto-calibration operation
Data output preparation complete	The data output preparation complete state is listed below. ● It is the state in which the preparation for response data output for a query command (?MVL, etc.) has finished.
Error	When various types of errors occur
Overload	When an overload occurs

The SRQ is masked by specifying a numerical value that corresponds to each SRQ cause, as listed in Table 2-22.

For masked items, the SRQ does not send an interrupt to the controller, even if an SRQ cause occurs.

Table 2-22 Numerical values for SRQ causes

SRQ cause	Value
Error	32
Data output preparation complete	16
Busy state end	2
Overload	1

Example: Mask error and busy state end causes

Masked setting SRQ 34 (32+2 = 34)

Notes

After masking, and SRQ is not issued, even if the causing event occurs, but the event that actually occurs is indicated by the status byte.

2.5.5 Status byte

When the serial poll status command is sent, the status byte represented as a decimal number as shown in Table 2-23 is output as the response data.

Table 2-23 Bit structure of the status byte

Bit	Value	Bit value	Description
Bit 7 (MSB)	128	1	Undefined
		0	
Bit 6	64	1	SRQ was generated
		0	SRQ was not generated
Bit 5	32	1	An error occurred
		0	An error did not occur
Bit 4	16	1	Data output preparation completed
		0	Data output preparation not completed
Bit 3	8	0 0 1 1	
Bit 2	4	0 1 0 1	
		└ QC (QC/sweep) operation in progress (Busy state) └ Auto-calibration operation in progress (Busy state) └ Voltage range switching operation in progress (Busy state) └ Other cases (not busy state)	
Bit 1	2	1	Busy state has ended
		0	Other states
Bit 0 (LSB)	1	1	If overload
		0	If not overload

Example: Query the serial poll status

Query	?STS
Response code for voltage range switching in progress and overload	STS 5 (4+1 = 5)

Notes

- The values of status bytes bits 0, 1, and 4 through 6 are not cleared until the SRQ is canceled and the status byte is read with the ?STS command.
- The values of bits 2 and 3 do not change, even if the status byte is cleared.
- When an error occurs, a description of the error can be known from the numerical value in the response for the ?ERS query command.

2.5.6 Errors

You can obtain a description of errors that have occurred by querying the error status. Information on the errors can be known from the total of the respective numerical values that represent the error descriptions that appears in the query response.

If an error occurs when the GPIB interface is being used, a service request is issued.

If you query the status with the error status query command ?ERS, a numerical value that indicates the error is output and the error status is canceled.

The error messages are listed in Table 2-24.

Table 2-24 Error messages

Value	Error Description
1	Header error (The header that was sent is not in the list of commands.)
6	Parameter error (One of the conditions listed below applies to the parameters that were sent.) • Outside the specified range • Includes characters other than numerals and the decimal point.
8	Buffer error (A command that is longer than 255 characters was sent.)
16	Exclusion error (one of the following conditions applies) • One of the commands listed below was sent while the QC function was enabled (QCE 1). QCP, QCT, QCV, STA, STB, QCI, QCF, QCN, QCC, CFM, CAL, QCA • One of the commands listed below was sent while the CF function was enabled. QCE, CAL • A setting command was sent during a voltage range switching operation. • A setting command other than those listed below was sent during an auto-calibration operation. OUT, DSP, PEK, VWP, UVW • A setting command other than those listed below was sent during a QC/sweep operation. OUT, QCE, QCB (for voltage sweep 1, a command other than OUT) • One of the following commands was sent in the output on state. CFM, LSY • A FRQ command was sent when line synchronization was on. • A CAL command was sent when the output frequency was less than 40.00 Hz. • An LSY command was sent when the frequency range defined by the upper limit and lower limit did not contain 55 Hz. • A RNG0 command was sent when the voltage range was set to 200 V and the output voltage and QC level were set to values above 150 V. • A UVW command was sent for a single-phase system.
32	Auto-calibration error (Auto-calibration did not execute normally because of output overload, etc.)
64	Output off error (Output was turned off by the operation of a main unit internal protection circuit.)
128	Reserved (Do not use. Reserved for a future functional expansion.)

Example: Perform an error status query.

Error status query setting	?ERS
Response code for a parameter error	ERS 6

2.5.7 Response codes for query commands

The response code format for queries made using commands for which “query” is set is described here.

The header included in the response code varies according to the header control command (HDR).

If the header setting is “on”, a numerical value is output after the header, following a single character space; if the setting is “off”, only the numerical value is output.

Example 1: Set the response code header on.

Set the header on	HDR 1
Query the error status	?ERS
If the return value is 6	ERS 6

Example 2: Set the response code header to off.

Set the header to off	HDR 0
Query the error status	?ERS
If the return value is 6	6

2.6 Commands

2.6.1 Query command quick-look table

Table 2-25 Response text formats for queries

Query item	Format	Number type	Characters	Decimal places
Output voltage	VLT 100.0	Fixed-point decimal	5	1
Output voltage range	RNG 0000	Integer	4	----
Output frequency	FRQ 0123.00	Fixed-point decimal	7	2
Output on/off	OUT 0001	Integer	4	----
Output mode	DCM 0001	Integer	4	----
Measured voltage	MVL 020.3	Fixed-point decimal	5	1
Measured current	MCU 008.2	Fixed-point decimal	5	1 *2
Phase selection to be measured	UVW 0002	Integer	4	*1
Display mode	DSP 0001	Integer	4	----
Measured value effective value/peak value	PEK 0001	Integer	4	----
Measured power selection	VWP 0001	Integer	4	----
Power selection to be measured	MVA 00.861E+03	Floating-point decimal	6 (mantissa)	*3
Measured active power	MWT 00.000E+03	Floating-point decimal	6 (mantissa)	*3
Measured power factor	MPF 0.000	Fixed-point decimal	6	3
Model name	IDX 4420	Integer	4	----
ROM version	VER 1.00	Fixed-point decimal	4	2
Hardware configuration	OPR 0055	Integer	4	----
Voltage upper limit	VUP 280.0	Fixed-point decimal	5	1
Frequency upper limit	FUP 1100.00	Fixed-point decimal	7	2
Frequency lower limit	FLW 0005.00	Fixed-point decimal	7	2
Maximum output voltage for external signal input	LMV 140.0	Fixed-point decimal	5 (100 V range)	1
Maximum output voltage for external signal input	HMV 230.0	Fixed-point decimal	5 (200 V range)	1
Line synchronization on/off	LSY 0000	Integer	4	----
QC enable/disable	QCE 0000	Integer	4	----
QC starting phase angle	QCP 0090	Integer	4	----
QC time	QCT 000.1000	Fixed-point decimal	8	4
QC time infinitely large enable/disable	QCF 0000	Integer	4	----
QC level A	QCV 120.0	Fixed-point decimal	5	1
QC level B	QCA 050.0	Fixed-point decimal	5	1
Voltage sweep 1 transition time	TRT 10.1	Fixed-point decimal	4	1
Sweep time A	STA 123.456	Fixed-point decimal	7	3
Sweep time B	STB 234.567	Fixed-point decimal	7	3
Interval time	QCI 345.678	Fixed-point decimal	7	3
QC repetitions	QCN 0010	Integer	4	----
QC repetition infinitely large enabled/disabled	QCC 0000	Integer	4	----
Output compensation mode	PRC 0001	Integer	4	----
SRQ mask	SRQ 0063	Integer	4	----
Serial poll status	STS 0016	Integer	4	----
Error status	ERS 0000	Integer	4	----
Header on/off	HDR 0001	Integer	4	----
Crest factor function	CFM 0000	Integer	4	----
Crest factor value	CFL 1.40	Fixed-point decimal	4	2

*1 Disabled for single-phase or in the CF on state

*2 Depending on the range, the number decimal places may be 2.

*3 The number of decimal places depends on the range. The exponent is always E+03.

2.6.2 Setting command quick-look table

Table 2-26 Setting commands

Setting	Example command	Parameter type
Output voltage	VLT 100.0	Real number
Output voltage range	RNG 0	Boolean
Output frequency	FRQ 123.00	Real number
Output on/off	OUT 1	Boolean
Phase selection to be measured	UVW 2	Integer
Display mode	DSP 1	Boolean
Output mode	DCM 1	Boolean
Measured value effective value/peak value	PEK 1	Boolean
Power selection to be measured	VWP 1	Integer
Voltage upper limit	VUP 280.0	Real number
Frequency upper limit	FUP 1100.00	Real number
Frequency lower limit	FLW 5.00	Real number
Maximum output voltage for external signal input	LMV 140.0	Real number
Maximum output voltage for external signal input	HMV 230.0	Real number
Line synchronization on/off	LSY 0	Boolean
Memory store	STO 2	Integer
Memory recall	RCL 3	Integer
Voltage sweep 1 transition time	TRT 10.1	Real number
QC enable/disable	QCE 0	Boolean
QC starting phase angle (θ)	QCP 90	Real number
QC time (T_{Q1})	QCT 000.1	Real number
QC time infinitely large enable/disable	QCF 0	Boolean
QC level A (V_A)	QCV 120.0	Real number
QC level B (V_B)	QCA 50.0	Real number
Sweep time A (T_A)	STA 123.456	Real number
Sweep time B (T_B)	STB 234.567	Real number
Interval time (T_{Q2})	QCI 345.678	Real number
QC repetitions	QCN 10	Integer
QC repetition infinitely large enabled/disabled	QCC 0	Boolean
QC/sweep start	QCS	None
QC/sweep stop	QCB	None
Output compensation mode	PRC 1	Boolean
Auto-calibration	CAL	None
Crest factor function	CFM 0	Boolean
Crest factor value	CFL 1.40	Real number
SRQ mask	SRQ 63	Integer
Header on/off	HDR 1	Boolean

2.6.3 Memory store and initial settings

Table 2-27 Memory store and initial settings

Setting		Default setting (retrieved from address 0)	Corresponding setting command
Output voltage		0.0 V	VLT 0.0
Output voltage range		100 V range	RNG 0
Output frequency		50.00 Hz	FRQ 50.00
Output on/off		Off *1	OUT 0
Output mode		AC mode	DCM 0
Switch between measured value display for effective value and peak value		Effective value	PEK 0
Select display item from measured power, measured power factor and frequency setting		Frequency setting	VWP 3
Select phase to be measured		U phase *2	UVW 0
Limit	Voltage upper limit	300.0	VUP 300.0
	Frequency upper limit	1100.00 Hz	FUP 1100.00
	Frequency lower limit	5.00 Hz	FLW 5.00
Maximum output voltage for external signal input	100 V range	100.0 V *3	LMV 150.0
	200 V range	200.0 V *3	HMV 300.0
Line synchronization		Off	LSY 0
Voltage QC (frequency unchanged)	QC enable mode	Canceled	QCE 0
	QC level A (QC voltage)	0.0 V	QCV 0.0
	QC start phase	0°	QVP 0
	QC time	0.1 ms	QCT 0.0001
Voltage sweep (frequency unchanged)	QC time infinitely large setting	Disabled	QCF 0
	QC level B	0.0 V	QCA 0.0
	Sweep time A	0 ms	STA 0.000
	Sweep time B	0 ms	STB 0.000
	Interval time	10 ms	QCI 0.01
	Repetitions	1 time	QCN 1
	Infinite number of repetitions	Disabled	QCC 0
Voltage sweep (frequency variation) transition time		0.0 s	TRT 0.0
Crest factor	Enabled/disabled	Disabled	CFM 0
	Value	1.41	CFL 1.41
Precision/high-stability mode		Precision mode	PRC 1

*1: The output is necessarily turned off when the power is turned on, even if output on is stored in memory address 1.

*2: This item is effective only for three-phase system or single-phase 3-wire system.

*3: This item is effective only for operation with external signal input.

Table 2-28 Settings that cannot be stored in memory

Setting	Default value (retrieved from memory)	Corresponding setting command
Switch between setting and measurement display	Necessarily setting display	DSP 0

3. Status Output

3.1 Overview

This function outputs a signal that indicates the operating state of the main unit. The output is at the high/low logic level at assigned pins of the CONTROL SIGNAL D-sub connector of this product.

This function is useful for sending main unit output states such as output on or off and the voltage range to an external device for display with large light indicators for safety purposes.

3.2 Use

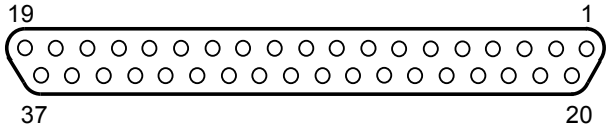
The mapping of the CONTROL SIGNAL D-sub connector pin numbers in the status signals are shown in Table 3-1.

The output level is in the level of TTL logic.

The output is updated at 20 ms intervals.

Table 3-1 Status output details

Pin No.	Status		
		H	L
1	Signal input	External	Internal
3	AGC fault	Fault	Normal
4	Overload	Yes	No
5	None	None	None
6	QC/range switching/auto-calibration	Executing	Not executing
7	Voltage range	200 V	100 V
8	Output	On	Off
28	Status GND signal (Same potential as the chassis)	-	



(D-sub connector: view from the panel side)

Figure 3-1 Pin number arrangement of the CONTROL SIGNAL D-sub connector

■ Internal circuit

The status circuit diagram is illustrated in Figure 3-2.

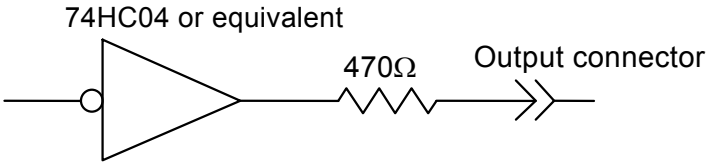


Figure 3-2 Status output circuit

■ Accessory connector

The D-sub connector of the cable for connecting the CONTROL SIGNAL to this product is included with the product.

Attention should be given to the items listed below when using the connector.

- The connector has solder pots for soldered connections. The connections should be soldered so that no excess solder flows out from the solder pots. Use a 40 W soldering iron.
- Use AWG 20 or thinner twisted wire. Strip the insulation from the wire to a length of from 2.8 to 3.3 mm. Covering exposed wire with an insulation tube prevents accidental contact.
- After completing the wiring, use the provided connector clamp to hold the wires in place and cover with the hood.
- When connecting the cable, insert the connector firmly and use screws to hold the connector and the hood of the connecting cable to the product in place.

⚠ CAUTION

- Connector pins 2, 9, 10, 11, 18 through 27, 29, 36, and 37 output signals for extended functions, so do not connect anything to those pins.
- The connector that is provided with the product uses soldered connections. Unintended connection between adjacent pins, etc. may result in damage to the product or to equipment that is connected to the product.
- The status output is updated every 20 ms. The actual state of the main unit may vary during the time between updates.
- The output circuit is equivalent to 74HC04. Because the current is insufficient for powering the lamps and driving the relays, etc., connect an external driver circuit according to the required current.

4. Modulation Signal Input

4.1 Overview

It is possible to add an external analog signal to the output voltage waveform (ADD function) by inputting an external analog signal. The external analog signal can be used for controlling the amplitude of the output voltage (VCA, voltage controlled amplitude). The external signal input is assigned to the CONTROL SIGNAL D-sub connector of the product.

The addition input can be used to output a signal that is generated by superimposing a pulse or harmonics on the normal sine wave output.

Also, the VCA function can be used to change the output voltage without operation of the main unit. That function is useful for performing tests such as “specified voltage ±10%” on the production line.

The functions described above cannot be used when the main unit is in external input mode.

4.2 Addition input (ADD function)

This function makes it possible to add (superimpose) an analog signal that is input to the addition input pin of the CONTROL SIGNAL D-sub connector to the output signal of the main unit.
For the level of signal addition (superimposition), the 1 V input signal is in 10% proportion to the output voltage. The polarities of the add signal and the output voltage waveform are the same.
The maximum value of the added signal is 40% (added input ±4 V).
The relationship of the add signal and the output voltage waveform is illustrated in Figure 4-1.
The add signal is input to the U-phase signal input for a single-phase system and to the respective phase for a three-phase system and a single-phase 3-wire system.

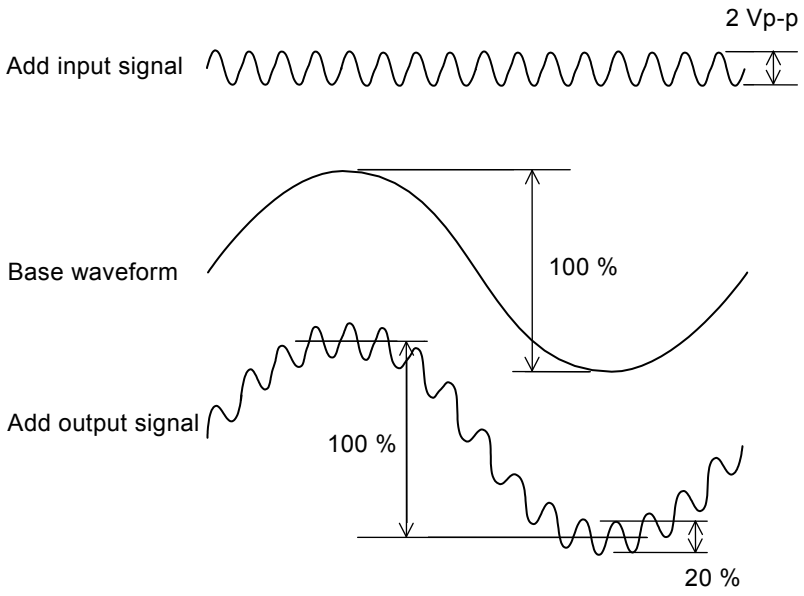


Figure 4-1 Relationship of the add signal and the output voltage waveform

⚠ CAUTION

- Take care that the added input signal does not exceed ±4 V.
- The frequency range for the added input signal is from 10 Hz to 1 kHz
- It is not possible to add a DC voltage.
- This function cannot be used when the main unit is in the external input mode.
- The input impedance of the added input signal pin is 20 kΩ. Use an added input signal source for which the impedance is sufficiently small relative to 20 kΩ.

4.3 Amplitude modulation input (VCA function)

Amplitude modulation can be applied to the output voltage of the product by an analog signal input to the VCA input pin of the CONTROL SIGNAL D-sub connector.

The degree of modulation is +10% (–10%) when the modulation input is +1 V (–1 V). The degree of modulation remains constant, even if the output voltage changes.

The maximum degree of modulation is 40% (modulation input of ±4 V).

The relationship between the amplitude modulation signal and the output waveform is illustrated in Figure 4-2.

For a single-phase system, the amplitude modulation signal is input to the U-phase signal input. For a three-phase system and a single-phase 3-wire system, the modulation signal is input to the respective phase signal input.

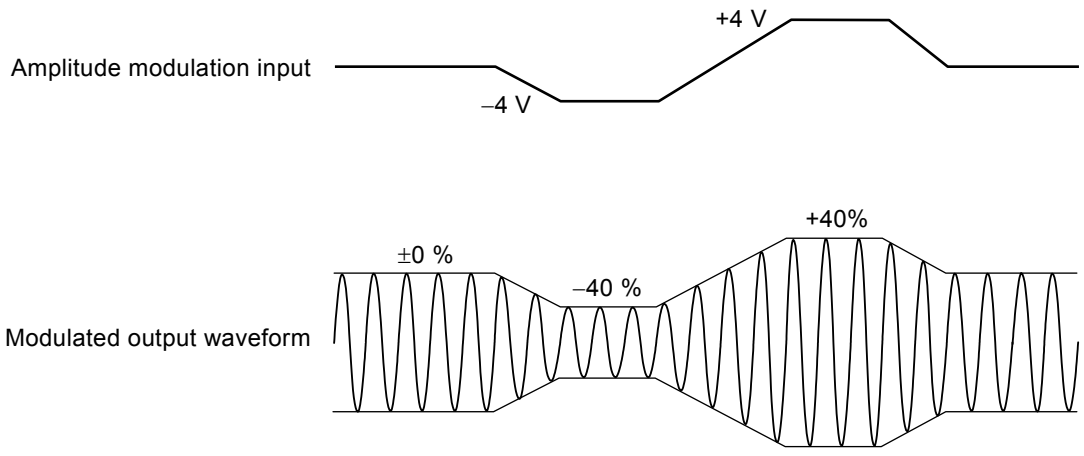


Figure 4-2 Relationship between the amplitude modulation signal input and the output waveform

⚠ CAUTION

- Take care that the modulation signal does not exceed ±4 V.
- The frequency range for the modulation signal is from DC (direct current) to 100 Hz.
- This function cannot be used when the main unit is in the external input mode.
- The input impedance of the modulation signal pin is 20 kΩ. Use a modulation signal source for which the impedance is sufficiently small relative to 20 kΩ.

4.4 Connections

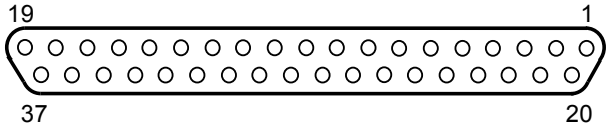
Table 4-1 Add signal connector pin numbers

Pin	Signal	Function
31	ADD SIG (L1 (U))	Single-phase system, three-phase system and single-phase 3-wire system L1 (U) phase add signal input
13	ADD GND (L1 (U))	
33	ADD SIG (L2 (V))	Three-phase system and single-phase 3-wire system L2 (V) phase add signal input
15	ADD GND (L2 (V))	
35	ADD SIG (L3 (W))	Three-phase system L3 (W) phase add signal input
17	ADD GND (L3 (W))	

Table 4-2 Modulation signal input connector pin numbers

Pin	Signal	Function
30	VCA SIG (L1 (U))	Single-phase system, three-phase system and single-phase 3-wire system L1 (U) phase modulation signal input
12	VCA GND (L1 (U))	
32	VCA SIG (L2 (V))	Three-phase system and single-phase 3-wire system L2 (V) phase modulation signal input
14	VCA GND (L2 (V))	
34	VCA SIG (L3 (W))	Three-phase system L3 (W) phase modulation signal input
16	VCA GND (L3 (W))	

Each ground signal (GND) has the same potential as the chassis.



(D-sub connector: view from the panel side)

Figure 4-3 Pin number arrangement of the CONTROL SIGNAL D-sub connector

■ Accessory connector

The D-sub connector of the cable for connecting the CONTROL SIGNAL to this product is included with the product.

Attention should be given to the items listed below when using the connector.

- The connector has solder pots for soldered connections. The connections should be soldered so that no excess solder flows out from the solder pots. Use a 40 W soldering iron.
- Use AWG 20 or thinner twisted wire. Strip the insulation from the wire to a length of from 2.8 to 3.3 mm. Covering exposed wire with an insulation tube prevents accidental contact.
- After completing the wiring, use the provided connector clamp to hold the wires in place and cover with the hood.
- When connecting the cable to the product, insert the connector firmly and use screws to hold the connector and the hood of the cable to the product in place.

⚠ CAUTION

- Connector pins 2, 9, 10, 11, 18 through 27, 29, 36, and 37 output signals for extended functions, so do not connect anything to those pins.
- The connector that is provided with the product uses soldered connections. Unintended connection between adjacent pins, etc. may results in damage to the product or to equipment that is connected to the product.

5. If You Need Help

5.1 Overview

If you think that a malfunction has occurred while using the product, refer to the troubleshooting information provided below to determine whether the problem is an actual malfunction or the result of error in operation or use or incorrect connection.

You can also refer to the troubleshooting section of the instruction manual for the main unit.

If none of those cases apply, product malfunction is a possibility. Continuing to use the product may result in secondary problems, so do not turn on the power and contact the NF Corporation or an authorized agent.

5.2 Troubleshooting

■ Sending commands

Problem	Cause or Condition	Explanation or Measures to Take
No commands are received.	Is the power turned on for the AC Power Supply Unit?	Turn the power on.
No commands are received. Some commands are not received.	Is the condition of the external device and interface cable normal?	Check for normal conditions.
	Is the cable between the product and the external device securely connected?	Check for a secure connection
	Are the interface parameters set properly?	Set the parameters to match the interface that is being used. ☞ Refer to 1.2 Main unit settings.
Some commands are not received.	Are commands being sent consecutively?	If the command interpreter encounters an unspecified command, subsequent commands are cleared and not executed. ☞ Refer to 2.4 Commands (main unit functions).

■ A specific command is sent

Problem	Cause or Condition	Explanation or Measures to Take
Sending a setting command has no effect	Was the query command received?	Setting commands are not accepted when a voltage range switching operation is in progress, a QC/sweep operation is in progress, or auto-calibration is in progress. ☞ Refer to 2.3.4 Transmission of commands.
There is no response to a query	Does the command have the query format?	Some commands do not have a query form. ☞ Refer to 2.3.1 Setting commands and query commands.
	Were query commands sent consecutively?	For query commands, only the last command sent in one transmission is valid. ☞ Refer to 2.3.4 Transmission of commands.
An “output on” command is sent, but the output is immediately turned off and cannot be turned on	Was the command sent immediately after a voltage range switching operation?	The protection circuit of the main unit may function immediately after the operation is completed, turning the output off. ☞ Refer to 2.5.6 Errors. In that case, send an “output on” command after a wait time or confirm that the output state is on after sending the command.

■ Interface parameter problems

Problem	Cause or Condition	Explanation or Measures to Take
The interface parameters are not saved to memory. (The values in memory return to the default settings.)	Was the main unit kept in an unpowered state for a long time?	The memory back-up battery of the main unit has fully discharged. Connect the main unit to a power supply to recharge the battery. For more information, refer to the instruction manual for the main unit.
	Did the problem occur a number of times, even though the condition described above did not apply?	The memory back-up battery of the main unit has deteriorated. For more information, refer to the instruction manual for the main unit.

■ Error and interface problems

Problem	Cause or Condition	Explanation or Measures to Take
An error occurred.		Use the error status query to obtain information about the error. ☞ Refer to 2.5.6 Errors.
It looks like an exclusion error has occurred, but the situation is not consistent with the explanation in the error status.	Has an operation such as voltage range switching, QC/sweep, or auto-calibration been performed?	It takes time for such operations to finish (before the next command can be accepted). Use the status byte to determine when the next command can be accepted and time the sending accordingly. ☞ Refer to 2.5.5 Status byte.
The status byte cannot be used because the RS-232 interface is in use.		Take measures such as setting a wait time before sending a command, etc. Factors such as time lags and states in which commands are not accepted, such as during the voltage switching operation, vary from system to system, so you should confirm the conditions for each system that you use.

WABUN: (DA000066065-001)

If there are any misplaced or missing pages, we will replace the manual. Contact the sales representative.

NOTES

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P-STATION/ES SERIES and ES-E SERIES
INSTRUCTION MANUAL (INTERFACE)

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