High Performance Inverter

Doesa

VF1A series

RS-485 Communication User's Manual

Preface

The versatility of the inverter unit can be expanded with functions such as RS-485 communication using an RJ-45 connector (modular jack) for connecting the inverter touch panel, a terminal block for RS-485 communication, and a RS485 communication card (option). Operation can also be performed remotely by using an RJ-45 connector to connect the touch panel.

This manual describes the functional expansion. For the handling of the inverter, see each User's Manual and Instruction Manual.

Please read through this user's manual to familiarize yourself with proper use. Improper handling or misuse may result in malfunction, shorter service life or failure.

The following shows relevant documents. Use the documents according to your purpose.

Doesa VF1A series

Name	Document number	Description
Doesa VF1A series User's Manual	B-2302	Overview of the product, how to operate the touch panel, control block diagram, peripheral equipment selection, capacity selection, specifications, function codes, outline drawings, options etc.
Doesa VF1A series Instruction Manual	B-2300	Inspection when product arrives, product installation and wiring, touch panel operation method, troubleshooting, maintenance and inspection, specifications, etc.

These documents are subject to revision as appropriate. Obtain the latest versions when using the product.

■ Safety Precautions

Prior to installation, connection (wiring), operation, maintenance or inspection, read through this user's manual as well as the instruction and installation manuals to ensure proper operation of the product. Familiarize yourself with all information required for proper use, including knowledge relating to the product, safety information, and precautions.

This user's manual classifies safety precautions as shown below according to the severity of the accident that may occur if you fail to observe the precaution:

⚠ **WARNING**	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in death or serious bodily injuries.
⚠ **CAUTION**	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in minor or light bodily injuries and/or substantial property damage.

Failure to heed the information contained under the CAUTION title can also result in serious consequences. These safety precautions are of utmost importance and must be observed at all times.

⚠ **CAUTION**
This inverter is not designed or manufactured for use in devices or machinery and equipment involving human life. Consult the sales desk before considering this inverter for use in nuclear power control, aerospace, medical applications, or traffic equipment, or for special purposes such as machinery and equipment used for these applications. When using the product for equipment in which failure of the product is expected to affect human life or result in serious material loss, be sure to install safety devices.

Wiring

⚠ **WARNING**
- Before starting wiring, confirm that the power is turned OFF (open). **An electric shock may result.**

⚠ **CAUTION**
- The product cannot be connected directly to an RS-232C interface of a personal computer. - Before connecting wiring to the RJ-45 connector (modular jack) for connecting the keypad, equipped on the inverter or the RJ-45 connector (modular jack) on the RS-485 communications card (option), confirm the wiring of the device to be connected. For further information, see "2.2 Connections" under Chapter 2 of this manual.

Operation

⚠ **WARNING**
- Note that the inverter starts to supply power to the motor and the motor runs upon resetting of an alarm with the operation command ON (closed). **An accident may result.**

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CHAPTER 1 OVERVIEW

This chapter describes the functions that can be realized by performing RS-485 communications.

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1.1 Features

The functions listed below can be implemented using RS-485 communications.

- The keypad can be mounted on the easy-to-access front of control panel with an extension cable (option).
- The function code data of the inverter can be edited and the operation status of the inverter can be monitored by connecting it to a personal computer on which inverter support software runs (see the "VFD Doesa-Loader Instruction Manual").
- The inverter can be controlled as a subordinate device (slave) by connecting it to an upper level device (host (master)) such as a PLC or personal computer.

The Modbus RTU protocol widely used by many devices, and the Doesa general-purpose inverter protocol, a common protocol for Doesa VF1A series inverters are available as protocols for controlling inverter communication.

Modbus RTU protocol

The Modbus RTU protocol is a set of communications specifications defined to connect Modicon's PLCs (Programmable Logic Controllers) in a network. A network is established between PLCs or between a PLC and another slave unit(s) (inverter(s), etc.). The main functions include:

- supporting both a query-response format and a broadcast format for messages.
- enabling the host unit as the master to transmit queries to each inverter as a slave, and each slave to send back responses to the queries to the master.
- The standard Modbus protocol has an RTU transmission mode and an ASCII transmission mode. The Doesa VF1A Series supports the high transmission density RTU mode only.
- performing an error check through a CRC (cyclic redundancy check) to ensure accurate data transmission.

Doesa general-purpose inverter protocol

This is a common protocol used for all Doesa general-purpose inverters. The main functions are as follows.

- This is a common protocol, and therefore all Doesa VF1A series inverters can be run and stopped with a similar host device program. (The specification differs for each model, and therefore function code editing is generally not possible.)
- adopting fixed-length transmission frames as standard frames to facilitate developing communications control programs for hosts.
- reducing the communications time in response to operation commands and frequency setting which are required quick response by using optional transmission frames.

- Since the protocol switches to the keypad dedicated protocol automatically by connecting the keypad, it is not necessary to set up the communications- related functions.
- VFD Doesa-Loader also uses a dedicated protocol for loader commands, but it is necessary to set some communication conditions. (Refer to the "VFD Doesa-Loader Instruction Manual" for details.)

1.2 List of Functions

The functions listed below become available by operating the appropriate function codes from the host controller.

The chapters that follow describe these functions in detail.

Table 1.1 List of RS-485 communications functions

Function	Description	Related function code
Operation	The functions equivalent to the terminal functions shown below can be executed through communications: -Forward operation command "FWD" and reverse operation command "REV" -Digital input commands ([FWD], [REV], [X1] - [X9] terminals) (The number of X terminals varies with the inverter model.) -Alarm reset command ("RST")	S codes (dedicated to communi-cations)
Frequency setting	Either of the following three setting methods can be selected: -Set up as "±20000/maximum frequency." -Frequency (adjustable unit: 0.01 Hz) without polarity -Rotation speed (1 min^{-1} increments), with polarity	
PID command	-Set up as "±20000/100%."	
Operation monitor	The items below can be monitored: -Frequency command -Actual values (frequency, current, voltage, etc.) -Operation status, information on general-purpose output terminals, etc.	M codes W codes X codes Z codes (dedicated to communica-tions)
Maintenance monitor	The items below can be monitored: -Cumulative operation time, DC link voltage -Information to determine the service life of parts to be periodically replaced (main circuit capacitor, PC board capacitor, cooling fan) -Model codes, capacity codes, ROM version, etc.	
Alarm monitor	The items below can be monitored: -Monitoring alarm history (last four alarms) -Monitoring information when an alarm occurs (last four alarms) Operation information (output/set frequencies, current, voltage, etc.) Operation status, information on general-purpose output terminals Maintenance information (cumulative operation time, DC link voltage, heat sink temperature, etc.)	
Function code	All types of function code data can be monitored and changed.	All function codes other than above

CHAPTER 2
COMMON SPECIFICATIONS

This chapter describes specifications common to the Modbus RTU protocol, Doesa inverter protocol, and loader protocol. Specifications unique to each protocol are described in detail in “CHAPTER 3 Modbus RTU PROTOCOL” and “CHAPTER 4 Doesa INVERTER PROTOCOL”.

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2.1 Specifications of RS-485 Communications

Table 2.1 shows the specifications of RS-485 communications.

Table 2.1 RS-485 communications specifications

Item	Specification		
Protocol	Doesa-BUS	Modbus RTU	Loader commands
Complying with	Doesa inverter protocol	Modicon Modbus RTU-compliant (only in RTU mode only)	Special commands dedicated to inverter support loader software (not disclosed)
No. of supporting stations	Host device: 1 Inverters: up to 31		
Physical level	EIA /RS-485		
Connection to RS-485	Connect using an 8-wire RJ-45 connector or terminal block		8-wire RJ-45 connector
Synchronization method of character	Start-Stop system		
Transmission mode	Half-duplex		
Transmission speed (bps)	2400, 4800, 9600, 19200 and 38400		
Maximum transmission cable length	500m		
No. of available station addresses	1 to 31	1 to 247	1 to 255
Message frame format	Doesa-BUS	Modbus RTU	Loader command
Synchronization method of transmission frames	Detection SOH (Start Of Header) character (SOH 01_H)	Detection of no-data transmission time for 3 byte period	Start code 96H detection
Frame length	Normal transmission: 16 bytes (fixed) High-speed transmission: 8 or 12 bytes	Variable length	Variable length
Maximum transfer data	Write: 1 word Read: 1 word	Write: 100 words Read: 100 words	Write: 41 words Read: 41 words
Messaging system	Polling/Selecting/Broadcast		Command message
Transmission character format	ASCII	Binary	Binary
Character length	8 or 7 bits (selectable by the function code)	8 bits (fixed)	8 bits (fixed)
Parity	Even, Odd, or None (selectable by the function code)		Even
Stop bit length	1 or 2 bits (selectable by the function code)	No parity: 2 bits Even or Odd parity: 1 bit	1 bit (fixed)
Error checking	Sum-check	CRC-16	Sum-check

Table 2.2 Connection method and applicable protocol for Doesa VF1A series

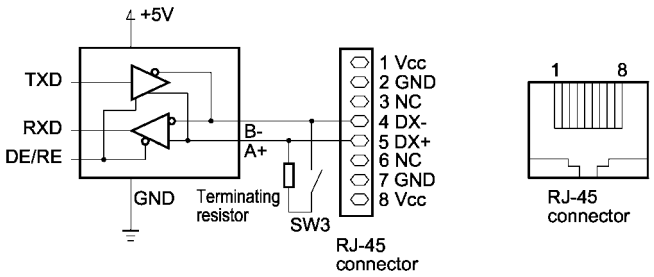
Model	Communications means	Connection port	Hardware specifications for connection port	Port type	Applicable protocol			
					Keypad (VF1A-PH1)	Loader	Modbus RTU	Doesa general-purpose inverter protocol
Doesa VF1A series	Inverter-keypad coupling connector	RJ-45 connector	See 2.1.1.	Standard port	○	○	○	○
	Inverter unit RS-485 communication connector	Terminal block	See 2.1.3.	Extension port	×	○	○	○
	RS-485 communications card (option)	RJ-45 connector for function expansion (2 pc)	See 2.1.2.	Extension port	×	○	○	○

2.1.1 Specification of the RJ-45 connector for RS-485 communications (modular jack)

The RS-485 communications port for connecting the keypad equipped on the RJ-45 connectors with the pin assignment shown below.

Pin No.	Signal name	Function	Remarks
1, 8	Vcc	Power source for the keypad	5V
2, 7	GND	Reference voltage level	Ground (0V)
3, 6	NC	No connection	–
4	DX-	RS-485 communications data (-)	A terminating resistor of 112Ω is incorporated. Connection/ cut off is selected by a switch*1.
5	DX+	RS-485 communications data (+)	

*1 For the details of the switch, refer to 2.2.2 [2] “About terminating resistors”.



CAUTION A power supply for the keypad is connected to the RJ-45 connector for RS-485 communications (via pins 1, 2, 7, and 8). Note that the pins assigned to the power supply must not be connected when connecting the inverter with another device.

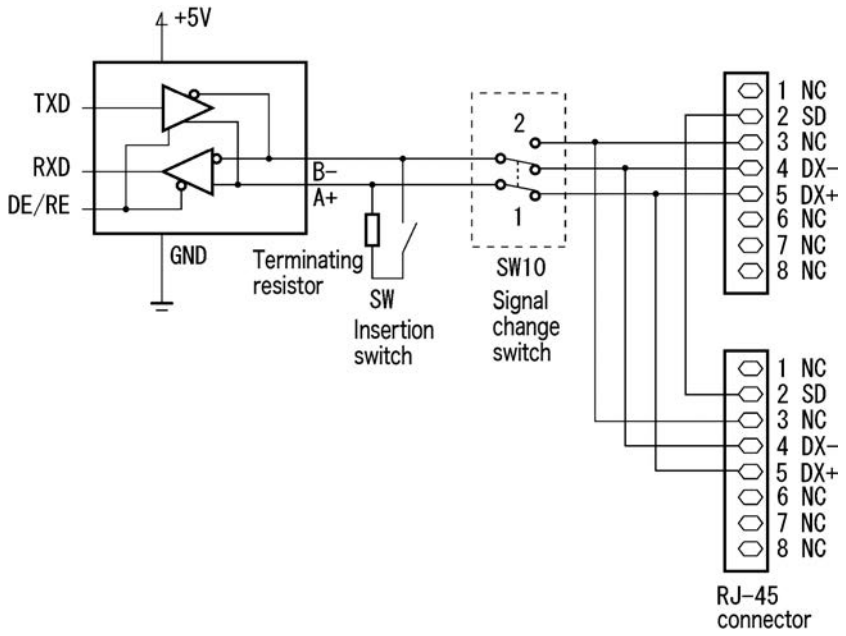
2.1.2 RJ-45 connector (modular jack) for function expansion

RS-485 communications card for VF1A Doesa series (option: VF1A-RS485)

Two RJ-45 connectors for function expansion are provided for connection with the multi-drop circuit. The terminal symbol, terminal name, and functions are shown in the table below. RS-485 port of this option card cannot be connected to the keypad.

Pin No.	Signal name	Description	Remarks
1, 6, 7, 8	NC	Unused	–
2	SD	Communications cable shielded terminal	Terminal for relaying the shield of the shielded cable. The 2nd terminals of the two RJ-45 connectors are internally connected with each other.
3	–	Unused	The 3rd terminals of the two RJ-45 connectors are internally connected with each other.
4	DX-	RS-485 communications data (-) terminal	Negative terminal for RS-485 communications data
5	DX+	RS-485 communications data (+) terminal	Positive terminal for RS-485 communications data

CAUTION The RJ-45 connector for function expansion differs in terminal functions from the RJ-45 connected with the keypad built in the inverter.



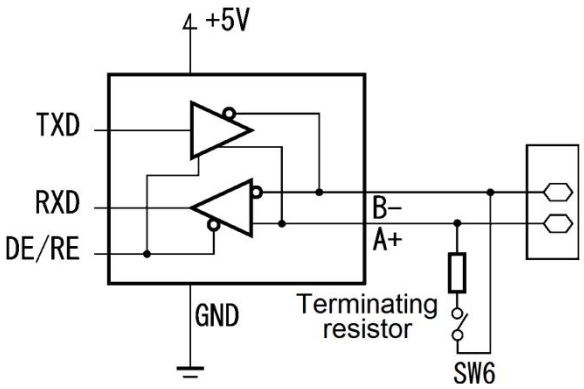
* For details regarding terminator insertion switch (insertion SW), see "2.2.2 Cautions [2] About terminating resistors."

2.1.3 Specifications for RS-485 connection (terminal block)

The VF1A of inverters has terminals for RS-485 communication in the control circuit terminal. The details of each terminal are shown below.

Terminal symbol	Description	Remarks
SD	Shield terminal	
DX-	RS-485 signal, low side	Built-in terminating resistor: 112 Ω Open/close with SW6*
DX+	RS-485 signal, high side	

* Refer to “[2] About terminating resistors” in “2.2.2 Connection procedures” for details on the terminating resistor insertion switch (insertion SW).



2.1.4 Specification of connection cable for RS-485 terminal

[1] RJ-45 connector

The specification of the connection cable is as follows to ensure the reliability of connection.

	Specifications
Common specification	Straight cable for 10BASE-T/100BASE-TX, satisfying the US ANSI/TIA/EIA-568A category 5 standard (commercial LAN cable)

Use an 8-core straight cable if connecting the touch panel. Use a commercially available LAN cable (within 20 m) for the extension cable.

Recommended LAN cable

Maker: Sanwa Supply (JAPAN)

Type: KB-10T5-01K (1 m)

KB-STP-01K (1-m shielded cable: Compliant with EMC Directives)

[2] Cable specifications for connection with terminals

To secure the reliability in connection, use the twisted pair shielded cable AWG16 to 26 for long-distance transmission.

Recommended cable

Maker: Furukawa Electric's AWM2789 long-distance cable

Type(Product code): DC23225-2PB

2.2 Connections

2.2.1 Basic connection

When connecting the keypad with the inverter or connecting the inverter with a host such as personal computer or PLC, use a standard LAN cable (straight for 10BASE-T). A converter is necessary to connect a host not equipped with RS-485 interface.

(1) Connection with the remote keypad (VF1A-PH1)

The keypad mounted on the inverter as standard must be removed.

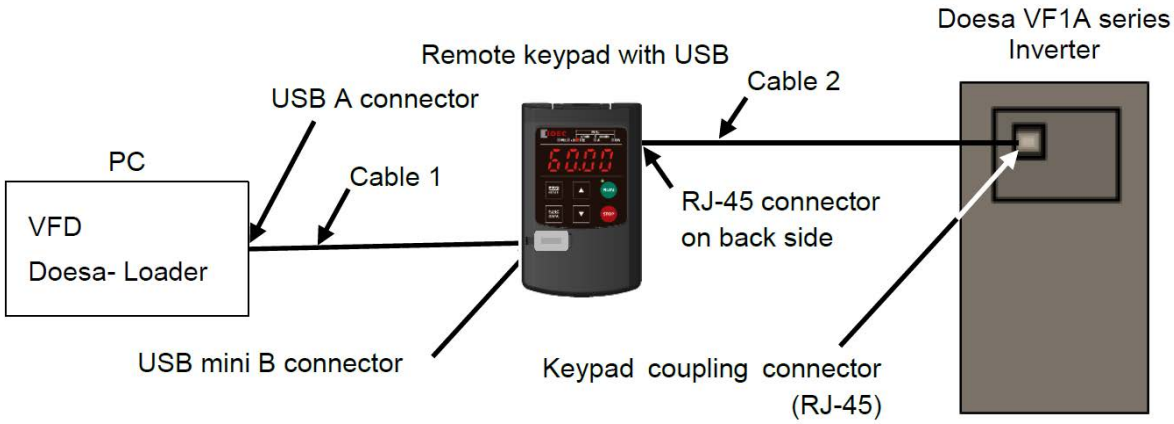


Figure 2.1 Connection with the remote keypad (VF1A-PH1)

Devices used	Description
Remote keypad with USB	For the inverter models that support the remote keypad with USB as an optional item, the keypad needs to be purchased separately.
Cable 1	Use a commercially available USB cable (mini B connector).
Cable 2	Use a commercially available LAN cable (straight).

CAUTION
- For the keypad, be sure to turn off the terminating resistor.
- For LAN cable, keep wiring length 20m or less.

(2) Multidrop connection using the RJ-45 connector

The figure below shows a connecting example to the multi-drop circuit with RJ-45 connector. RJ-45 needs a multi-drop branch adaptor as an external device for relaying. The adaptor for relaying is not necessary for the inverter with RJ-45 connector for function expansion. Set the terminator insertion switch of the terminating inverter to ON. For the terminator insertion switch ON/OFF switch, see "2.2.2 Cautions [2] About terminating resistors."

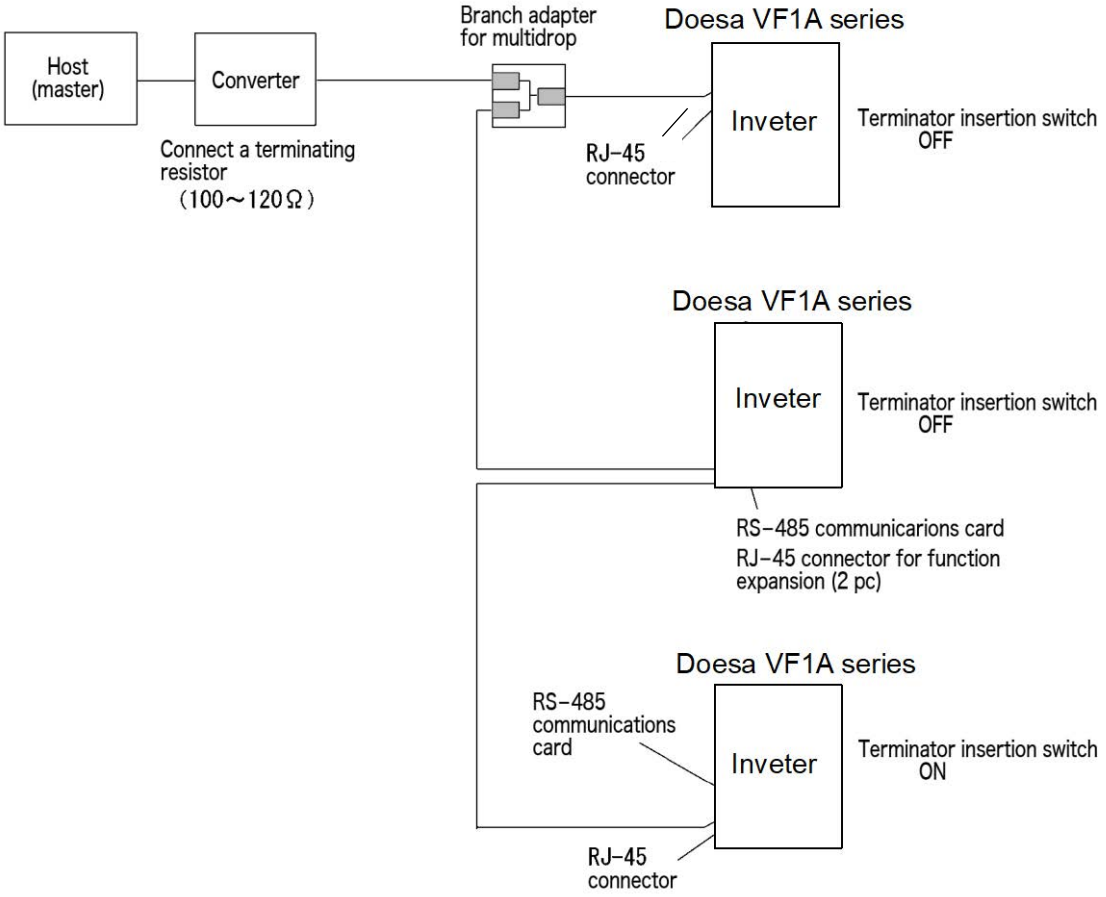


Figure 2.2 Multidrop connection diagram (connection via the RJ-45 connector)

Converter:	Not necessary if the host is equipped with RS-485 interface.
Branch adapter for multidrop:	Useful when implementing 1:n multidrop configuration using a cable with a RJ-45 connector.
Cable:	Use a connection cable meeting the specification. (Refer to 2.1.4.)

CAUTION

- A power supply for the keypad is connected to the RJ-45 connector of the inverter (via pins 1, 2, 7, and 8). When connecting the inverter with another device, do not use the pins assigned to the power supply but use the signal pins (pins 4 and 5).
- When selecting additional devices to prevent the damage or malfunction of the control PCB caused by external noises or eliminate the influence of common mode noises, be sure to see section 2.2.3 "Devices for connection."
- Keep the total wiring length 500m max.

(3) Multidrop connection using terminal block

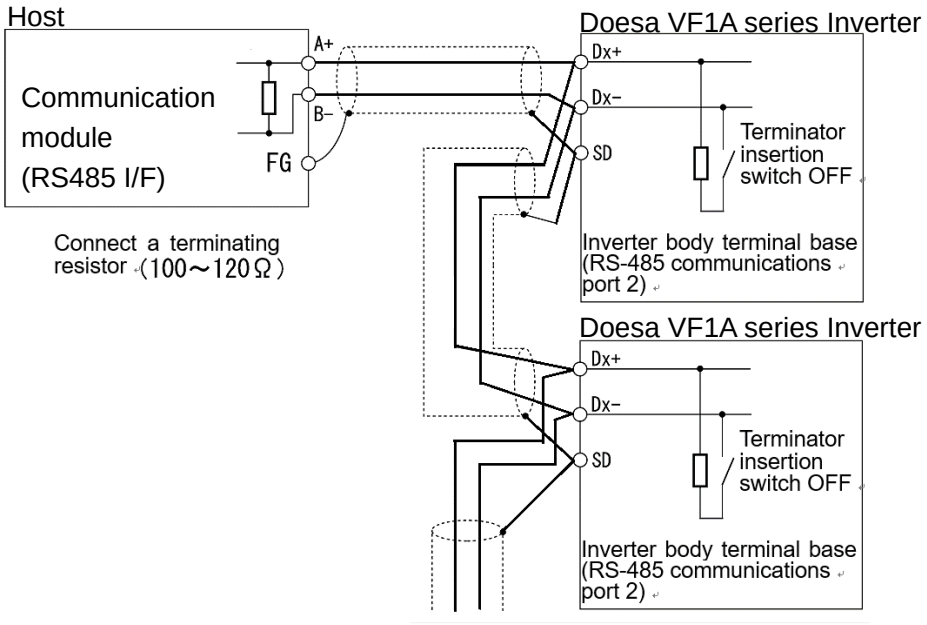


Figure 2.3 Multidrop connection diagram (terminal block connection)

For the switch used to insert the terminal resistance, refer to [2] About terminating resistors in "2.2.2 Connection procedures."

CAUTION
- When selecting additional devices to prevent the damage or malfunction of the control PCB caused by external noises or eliminate the influence of common mode noises, be sure to see section 2.2.3 "Devices for connection."
- Keep the total wiring length 500m max.

2.2.2 Connection procedures

This section describes the knowledge necessary for connecting with a host.

[1] RJ-45 connector (modular jack) pin layout

To facilitate connection with a typical RS232C to RS-485 converter, the assigned pin No. 4 to DX- signals and pin No. 5 to DX+ signals.

CAUTION Pins 1, 2, 7, and 8 are assigned to the power supply for the keypad. Do not use these pins when connecting the inverter with another device via the RJ-45 connector but use signal pins (pins 4 and 5) only.

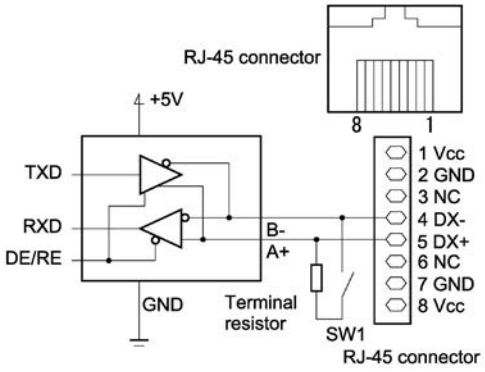


Figure 2.4 Pin layout of RJ-45 connector

⚠ WARNING
RJ-45 connector for communications through RS-485 is connected with the keypad power (pin No. 1, 2, 7, and 8). When connecting with the other equipment, be careful not to connect with the pins assigned as the power supply.

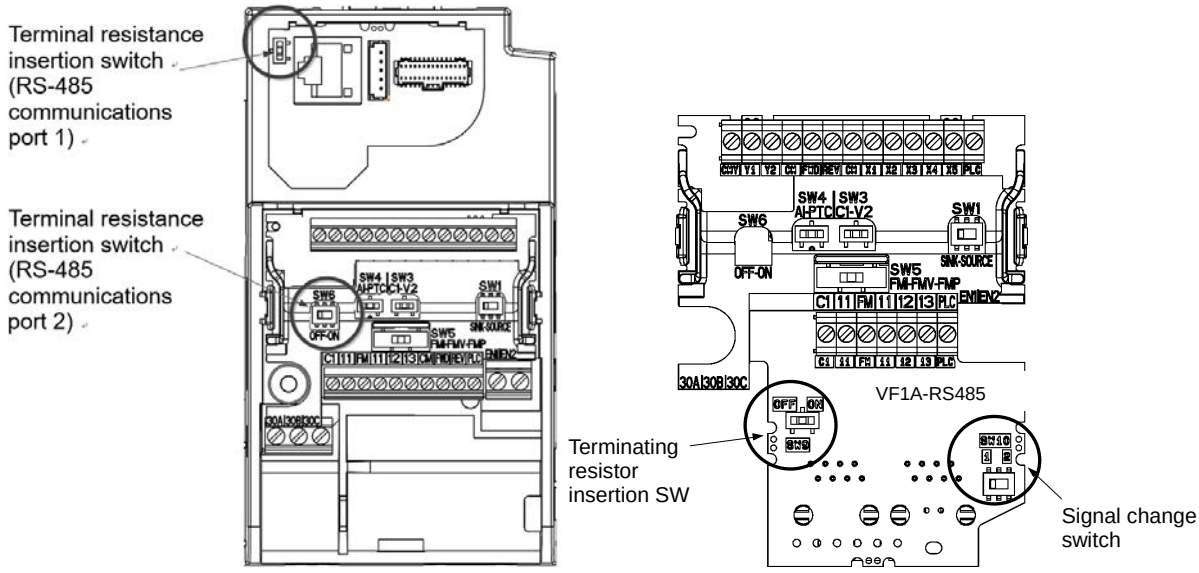
[2] About terminating resistors

Insert a terminating resistor (100 to 120Ω) into both the ends of the connection cable. This allows controlling signal reflection and reducing noises.

Be sure to insert a terminating resistor into the terminating host side and the side of the device connected to the final stage, in short, both the terminating devices configuring the network. Terminating resistors are inserted into total two positions. Note that the current capacity of signals may be insufficient if terminating resistors are inserted into three or more devices.

If the inverter is used as a terminating device, turn on the switch for terminal resistor insertion.

Model	Objective PCB	Switch No.	Layout
VF1A-G****S4	Body (printed circuit board)	SW2, SW6	See Figure 2.5(h).
VF1A-RS485	RS-485 communications card	SW9	See Figure 2.5(i).



(h) Printed circuit board (VF1A-G****S4) (i) RS-485 communications card (VF1A-RS485)

Figure 2.5 Switch arrangement for insertion of a terminal resistance

[3] Connection with a four-wire host

Although uses two-wire cables, some hosts adopt only four-wire cables. Connect to such a host by connecting the driver output with the receiver input with a crossover cable on the host side to change the wiring method to two-wire.

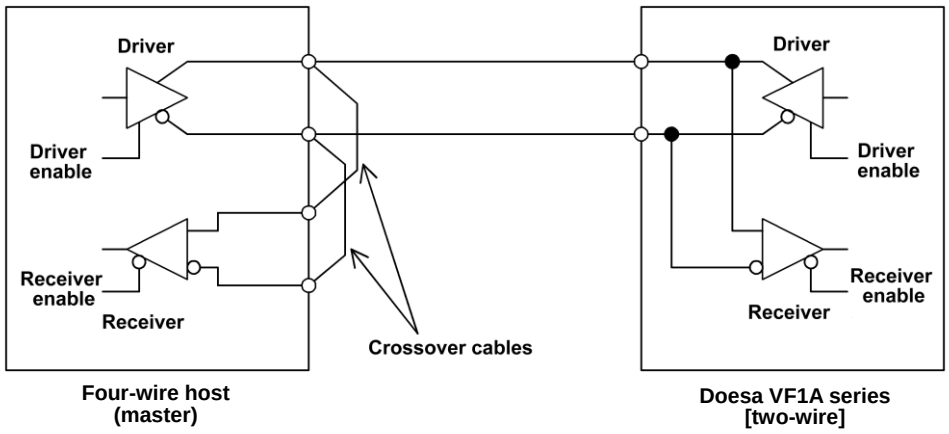


Figure 2.6 Connection with a four-wire host

CAUTION

- The driver circuit on the host side must have a function to set the driver output to high impedance (driver enable: OFF). Though products conforming to RS-485 normally has this function, check the specifications of the host.
- Keep the output of the driver circuit on the host side in the status of high impedance except when the host is transmitting data (driver enable: OFF).
- Keep the receiver circuit of the host device deactivated (receiver enable: OFF) while the host is transmitting data to prevent the host from receiving the data it transmitted. If the receiver cannot be deactivated, program the host so that the data transmitted by the host is discarded.

2.2.3 Devices for connection

This section describes the devices necessary for connecting a host not equipped with RS-485 interface, such as a personal computer, or for multidrop connection.

[1] Converter

In general, personal computers are not equipped with an RS-485 port. An RS-232C to RS-485 converter or USB to RS-485 converter is therefore required. Use a converter meeting the following recommended specifications for proper operation. Note that proper performance may not be expected from a converter other than the recommended one.

Specifications of the recommended converter

Transmission/receiving switching system: Automatic switching by monitoring transmission data on the personal computer side (RS-232C)

Isolation: The RS-232C side of the converter must be isolated from the RS-485 side.

Failsafe: Equipped with a failsafe function (*1)

Other requirements: The converter must have enough noise immunity for successful communications.

*1 The failsafe function means a function that keeps the RS-485 receiver's output at high logic level even when the RS-485 receiver's input is open or short-circuited or when all the RS-485 drivers are inactive.

Recommended converter

System Sacom Sales Corporation (Japan) : KS-485PTI (RS-232C to RS-485 converter)
: USB-485I RJ45-T4P (USB to RS-485 converter)

Transmission/receiving switching system

Since RS-485 communications adopts the half-duplex system (two-wire system), the converter must have a transmission/receiving switching function. The following two systems are available as the switching system.

(1) Automatic turnaround of the transceiver buffer

(2) Switching with the flow control signal (RTS or DTR) from the personal computer

In the case of VFD Doesa-Loader, the (2) switching system is not supported by Windows 98 or earlier operating systems, and therefore the (1) switching system converter should be used.

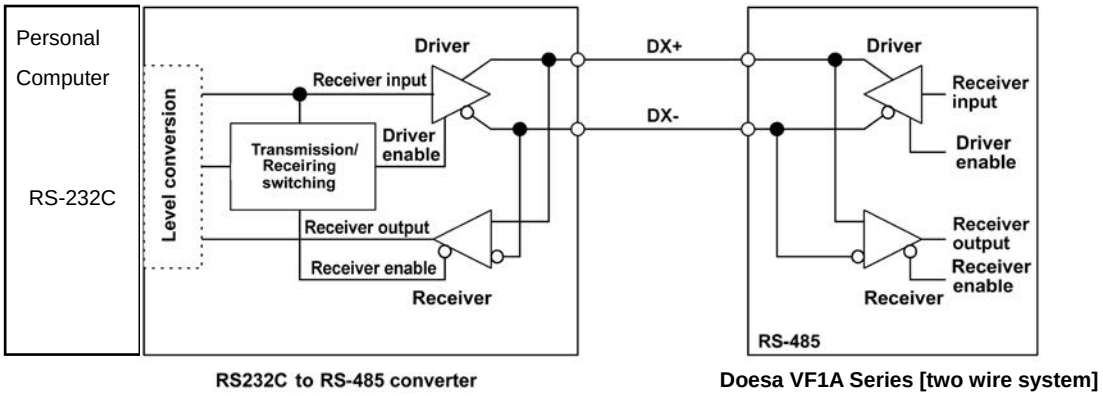


Figure 2.7 Communications level conversion

[2] Branch adapter for multidrop

When a slave unit has only 1 port of RJ-45 connector (moduler jack), a branch adaptor is necessary for multidrop connection using standard LAN cables.

Recommended branch adapter

SK Kohki (Japan): MS8-BA-JJJ

2.2.4 Measures against noise

Depending on the operating environment, normal communications cannot be performed or instruments and converters on the host side may malfunction due to the noise generated by the inverter. This section describes measures to be taken against such problems. Consult Appendix A "Advantageous Use of Inverters (Notes on electrical noise)" in User's Manual of each inverter type.

[1] Measures for devices subjected to noise

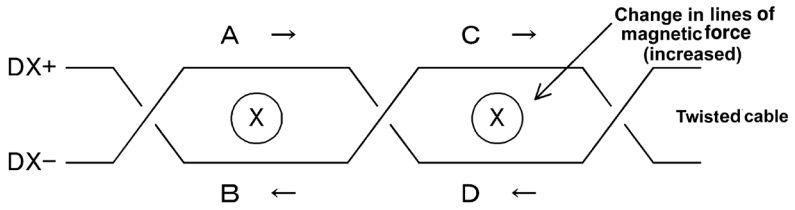
Using an isolated converter

An isolated converter suppresses common mode noise that exceeds the specified operating voltage range of the receiver in case of long-distance wiring. However, since the isolated converter itself may malfunction, use a converter insusceptible to noise.

Using a category 5 compliant LAN cable

Category 5 compliant LAN cables are generally used for RS-485 communications wiring. To obtain an improved preventive effect on electromagnetically induced noise, use Category 5 conformed LAN cables with four twisted-pair-cores and apply one twisted pair, DX+ and DX-. To ensure a high preventive effect on electrostatically induced noise, use Category 5 conformed LAN cables with four shielded-and-twisted-pair-cores, and ground the shield at the master-side end.

Effect of twisted pair cables



A uniform magnetic flux directing from the face to back of the paper exists, and if it increases, electromotive force in the direction of → is generated. The electromotive forces of A to D are the same in intensity, and their directions are as shown in the above figure. In the cable DX+, the direction of electromotive forces B is reverse to that of electromotive force C, then the electromotive forces B and C offset each other, and so do electromotive forces A and D in the cable DX-. So, normal mode noise caused by electromagnetic induction does not occur. However, noise cannot be completely suppressed under such conditions as an uneven twist pitch. In the case of twisted cables, the normal mode noise is considerably reduced. But in the case of parallel cables, there may be a case where noises are not sufficiently reduced.

Shield effect

1) When the shield is not grounded,
   the shield functions as an antenna and receives noise.
2) When the shield is grounded at both ends,
   if the grounding points are separated from each other, the ground potential may be different between them, and the shield and the ground form a loop circuit in which a current flows and may cause noise. Additionally, the magnetic flux within the loop may vary and generate noise.
3) When the shield is grounded at either end,
   the effect of electrostatic induction can be completely eliminated within the shielded section.

Connecting terminating resistors

Insert a resistor equivalent to the characteristic impedance of the cables (100 to 120Ω) into both end terminals of the wiring (network) to prevent ringing due to the reflection of signals.

Separating the wiring

Separate the power lines (input L1/R, L2/S, and L3/T and output U, V, and W) from the RS-485 communications line, because induced noise can be prevented.

Separating the grounding

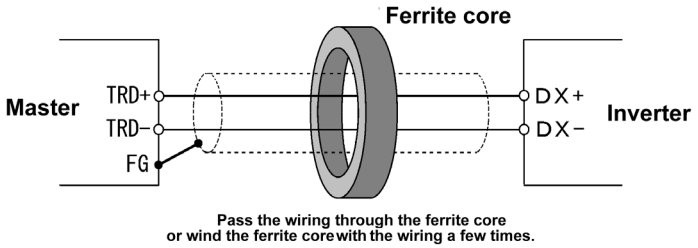
Do not ground instruments and the inverter together. Noise may conduct through the grounding wire. Use as a thick wire as possible for grounding.

Isolating the power supply

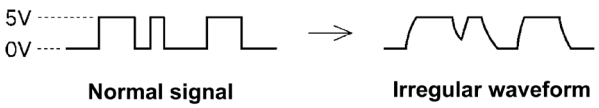
Noise may carry through the power supply line to instruments. It is recommended that the distribution system be separated or a power isolation transformer (TRAFY) or noise suppression transformer be used to isolate the power supply for such instruments from the power supply for the inverter.

Adding inductance

Insert a chalk coil in series in the signal circuit, or pass the signal wiring through a ferrite core, as shown in the figure below. This provides the wiring higher impedance against high-frequency noise, and suppresses the propagation of high-frequency noise.



CAUTION If an inductance is added, the signal waveform may become irregular and a transmission error may result during communications at a high baud rate. In this case, reduce the baud rate by changing the setting of function code y04.



[2] Measures against noise sources

Reducing carrier frequency

By lowering data of function code F26 "motor sound (carrier frequency)," the noise level can be reduced. However, reducing the carrier frequency increases the motor sound.

Installing and wiring an inverter

Passing the power lines through metal conduit or adopting metal control panels can suppress radiation or induction noise.

Isolating the power supply

Using a power isolation transformer on the line side of the inverter can cut off the propagation (transmission) of noise.

[3] Additional measures to reduce the noise level

Consider using a zero-phase reactor or EMC compliance filter. The measures described in [1] and [2] above can generally prevent noise. However, if the noise does not decrease to the permissible level, consider additional measures to reduce the noise level. Refer to the User's Manual for details.

2.3 Switching to Communications

2.3.1 Functions for the switching

Figure 2.8 below shows a block diagram via communications for frequency setting and operation commands.

This block diagram indicates only the base of the switching section, and some settings may be given higher priority than the blocks shown in this diagram or details may be different due to functional expansion and so on. Refer to the User's Manual for details. (Chapter 8)

CAUTION Operation commands herein include digital input signals via communications.

According to the setting of function code H30 link function (operation selection), the command system when communications is valid is selected.

Even if digital input is set to link enable (LE), when the link becomes invalid ("LE" = OFF), the command system switches from communications to other settings including digital input signal. In short, the frequency setting, forward operation command, and X1 signal in Figure 2.8 switch from communications dedicated function codes S01, S05, and S06 to terminals [12], [FWD], and [X1], respectively.

Function code data can be read and written through communications regardless of the setting function code H30 (link function (operation selection)).

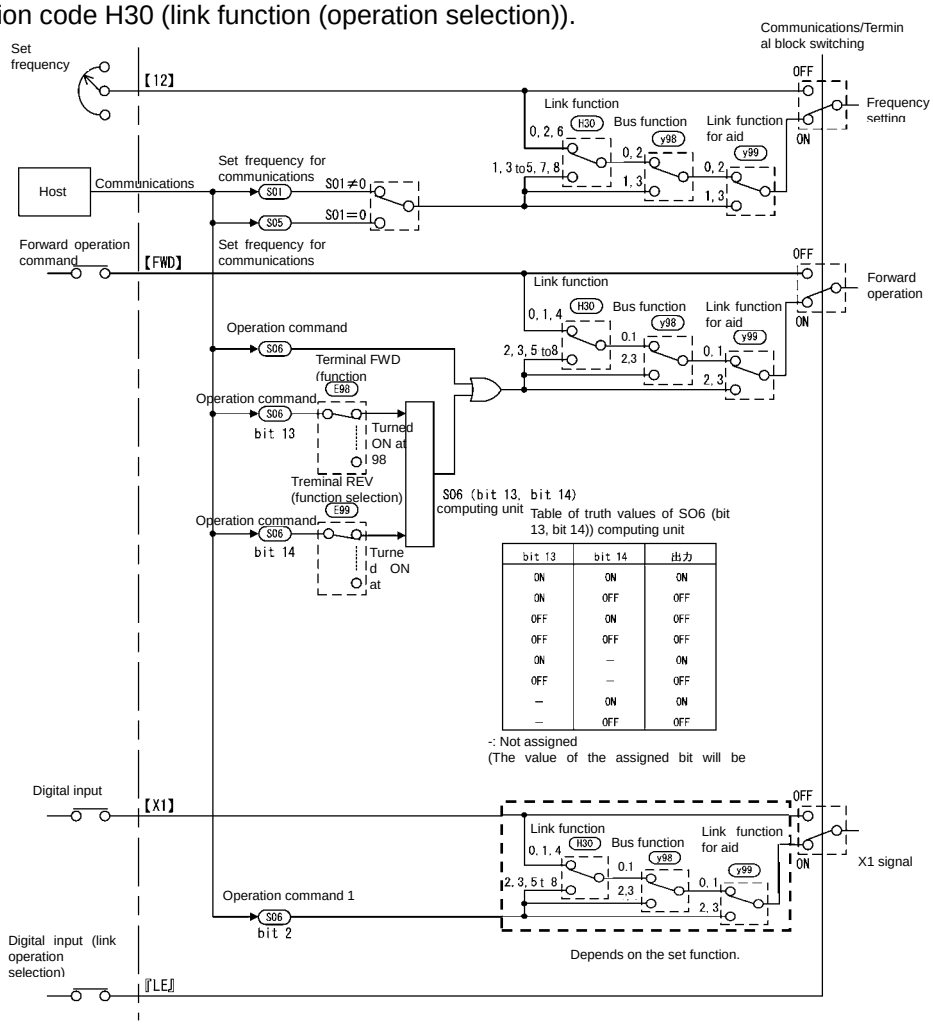


Figure 2.8 Operation command block diagram via communications

2.3.2 Link functions (operation selection)

According to the setting of function code H30: Serial link (function select), the frequency setting and the operation command source (via-communications command or command selected by function codes F01/C30 and F02 when communications is valid can be selected.

Frequency setting done when the communications is valid and selection of operation source are influenced by the settings at y98, y99. For details, see Fig 2.7.

Table 2.3 Link function H30 (operation selection)

Data of link function H30	When communications are valid	
	Frequency setting	Operation command
0	Inverter itself	Inverter itself
1	RS-485 communications (via standard RJ-45 or port 1)	Inverter itself
2	Inverter itself	RS-485 communications (via standard RJ-45 or port 1)
3	RS-485 communications (via standard RJ-45 or port 1)	RS-485 communications (via standard RJ-45 or port 1)
4	RS-485 communications (via option or port 2)	Inverter itself
5	RS-485 communications (via option or port 2)	RS-485 communications (via standard RJ-45 or port 1)
6	Inverter itself	RS-485 communications (via option or port 2)
7	RS-485 communications (via standard RJ-45 or port 1)	RS-485 communications (via option or port 2)
8	RS-485 communications (via option or port 2)	RS-485 communications (via option or port 2)

HINT By selecting continuous communications valid without setting any digital input terminal, and switching the data of H30 to communications valid/invalid (external signal input valid), communications valid/invalid can be switched in the same manner as switching at the digital input terminal. See the next section or later.

2.3.3 How to switch communications enabled/disabled

To issue a frequency setting or operation command through communications to control the inverter, select "Through RS-485 communications" by function code H30: link function (operation selection).

In addition, when switching control through communications with control from the terminal block (frequency setting from terminal [12], operation command from terminal [FWD] and so on) to switch remote operations with operations on the inverter body, assign "link operation selection" (data = 24: "LE") to the function code related to the digital input terminal (one of E01-E05: terminals [X1] to [X5], E98: terminal [FWD], or E99: terminal [REV]). Control can be switched by the terminal to which "link operation selection" (data = 24: "LE") is assigned.

Communications automatically becomes valid when link operation selection is not assigned to any digital input terminal.

Table 2.4 Digital input terminal settings and communications statuses

Input terminal	Status
OFF	Communications invalid
ON (short-circuited to the terminal [CM])	Communications valid

CAUTION

- Via-communications command data and operation data must be rewritten from the host (controller) because the memory is initialized when the power is turned ON.
- Although command data and operation data can be written even if communications is invalid, they will not be validated because the switch is made invalid by link operation selection. If communications is made valid with no operation data written (operation command OFF, frequency setting = 0Hz) during operation, the running motor decelerates to a stop and may exert impact on the load depending on the set deceleration time. Operation can be switched without causing impact to the load by setting data in communications invalid mode in advance and then switching the mode to valid.
- If negative logic is set as Link enable (data 1024), the logical value corresponding to the ON/OFF status of the command "LE" will be reversed.
- The product has a field bus option for other than RS-485 communication. The field bus option may be given priority over RS-485 communication depending on the option settings. Refer to the function code y98 bus operation (mode selection) for each model for details.

2.3.4 Link functions for supporting data input (operation select)

According to the setting of function code y99: link function for supporting data input (operation select), the frequency setting and the operation command source (via-communications command or command specified by function code H30 and y98) when communications is valid can be selected individually.

CAUTION
- This function code is for inverter support software such as VFD Doesa-Loader, and forcibly enables communication without having to change the H30 setting. Do not change the current setting unless otherwise required.
- The data of this function code cannot be saved in the inverter and will return to 0 when the power supply is turned off.

Table 2.5 Link functions for supporting data input

Link function y99	When communications is valid	
	Frequency setting	Operation command
0	Frequency setting specified by H30 and y98	Operation command specified by H30 and y98
1	Communications valid (S01, S05)	
2	Frequency setting specified by H30 and y98	Communications valid (S06)
3	Communications valid (S01, S05)	

2.4 Making RS-485-related Settings

2.4.1 Link function (RS-485 setting)

Use function codes (y01 to y10 and y11 to y20) to make settings for RS-485 communications functions. Use the codes y01 to 10 for port 1 and the codes y11 to 20 for port 2.

Station address (y01, y11)

Set a station address for RS-485 communications. The setting range depends on the protocol.

Table 2.6 RS-485 setting (station addresses)

Protocol	Range	Broadcast
Modbus RTU protocol	1 to 247	0
Protocol for loader commands	1 to 255	–
Doesa inverter protocol	1 to 31	99

CAUTION
- No response is expected if an address number out of the specified range is set.
- Ensure that the settings when VFD Doesa-Loader is connected are the same as those at the computer.

Operation made selection when an error occurs (y02, y12)

Set the operation performed when an RS-485 communications error occurs.

RS-485 communications errors are logical errors such as an address error, parity error, or framing error, transmission error, and communications disconnection error set by y08 and y18. In any case, error is detected only while the inverter is running in the link operation made for both the operation command and frequency setting. If neither the operation command nor frequency setting is sent through RS-485 communications or the inverter is not running, error is ignored.

Table 2.7 RS-485 setting (operations when an error has occurred)

y02, y12 data	Function
0	Indicates an RS-485 communications error (Er8 for port 1 and ErP for port 2), and stops operation immediately (alarm stop).
1	Runs during the time set on the error processing timer (y03, y13), and then displays an RS-485 communications error (Er8 for port 1 and ErP for port 2) and stops operation (alarm stop).
2	Runs during the time set on the error processing timer (y03, y13). If communications are recovered, continues operation. Otherwise, displays an RS-485 communications error (Er8 for port 1 and ErP for port 2) and stops operation (alarm stop).
3	Continues operation even after a communications error has occurred.

Timer for y02 and y12 (y03, y13)

Set a timer for error detection.

It is judged as an error that the response to a request is not received within time set because of no response of the other end and so on. See the section of "Communications disconnection detection time (y08, y18)."

- Data input range: 0.0 to 60.0 (s)

Baud rate (y04, y14)

Set a baud rate.

- Settings when VFD Doesa-Loader is connected
  Match the baud rate with that of the personal computer.

Table 2.8 Baud rate

Data	Baud rate
0	2400 bps
1	4800 bps
2	9600 bps
3	19200 bps
4	38400 bps

Data length (y05, y15)

Set a character length.

- Settings when VFD Doesa-Loader is connected
  This code does not need to be set because it is automatically set to eight bits (as in the Modbus RTU protocol).

Table 2.9 Data length

Data	Function
0	8 bits
1	7 bits

Parity check (y06, y16)

Set a parity bit.

- Settings when VFD Doesa-Loader is connected
  This code does not need to be set because it is automatically set to even parity.

Table 2.10 Parity check

Data	Function	RTU Stop bits (auto setting)
0	No parity bit	2 bits
1	Even parity	1 bit
2	Odd parity	1 bit
3	No parity bit	1 bit

Stop bits (y07, y17)

Set a stop bit.

- Settings when VFD Doesa-Loader is connected
  This code does not need to be set because it is automatically set to 1.

- In the Modbus RTU protocol, this code does not need to be set because it is automatically determined in conjunction with the parity bit.

Table 2.11 Stop bits

Data	Function
0	2 bits
1	1 bit

No response error detection time (y08, y18)

In a system designed to be sure to access a station (inverter) managed by a host within a specific period of time, access may be lost during RS-485 communications due to wire disconnections. In such a case, the inverter starts the operation of communications error set up by y02 and y12 if the inverter detects the symptom and access is still lost even after the communications disconnection detection time has passed.

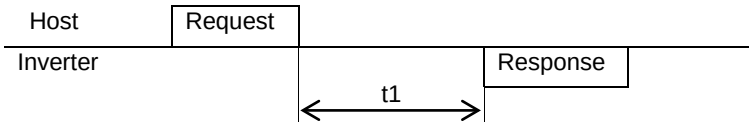
Table 2.12 No response error detection time

Data	Function
0	No response error detection disabled
1 to 60	Detecting time from 1 to 60 seconds

Response interval (y09, y19)

Set the time from the completion of receipt of a request from the host, to the return of response to it. Even in a slow processing device, timing can be adjusted by changing the response interval time.

- Data setting range: 0.00 to 1.00 (second)



t1 = Response interval time + α

α: The processing time within the inverter. It depends on the timing and command given. For further information, see the procedure for each protocol on the host below:
Modbus RTU protocol → Chapter 3 "3.2 Host Side Procedures"
Doesa inverter protocol → Chapter "4.2 Host Side Procedures"

- Settings when VFD Doesa-Loader is connected
  Set the response interval time according to the performance and conditions of the personal computer and converter (RS-232C TO RS-485 converter, etc.).
  (Some converters monitor the communications status and use a timer to switch transmission/receiving.)

Protocol select (y10, y20)

Select a communications protocol.

- Settings when VFD Doesa-Loader is connected
  Select the protocol for VFD Doesa-Loader commands (y10 = 1).

Table 2.13 Protocol select

Data	Protocol
0	Modbus RTU
1	VFD Doesa-Loader (supported by y10 only)
2	Doesa inverter protocol

2.5 Selecting the Method of Storing Communications Data

Selecting the method of storing communications data (y97)

The times of data writing onto the inverter memory are limited (100 thousand to 1 million times). If the data is overwritten too many times, data change or storage may be disabled. If you frequently rewrite the data obtained via communications, the data can be temporarily stored without being written in the memory. Doing so prevents increase of data rewriting times and memory failure.

As a means of storing temporarily stored data onto the memory, the inverter is provided with the function for transferring the temporarily stored data to a nonvolatile memory (by the ALL SAVE command).

To change the data of function code y97, perform the double-key operation; (STOP) key + (▲) / (▼) key.

y97 data	Functions
0	Data is stored in the nonvolatile memory (with the limit in the number of data writing times).
1	Data is stored in the temporary memory (without the limit in the number of data writing times.)
2	Data is transferred from the temporary memory to the nonvolatile memory. (After execution of ALL SAVE command, data storage method returns to the state where data 1 is set at y97.

CHAPTER 3

Modbus RTU PROTOCOL

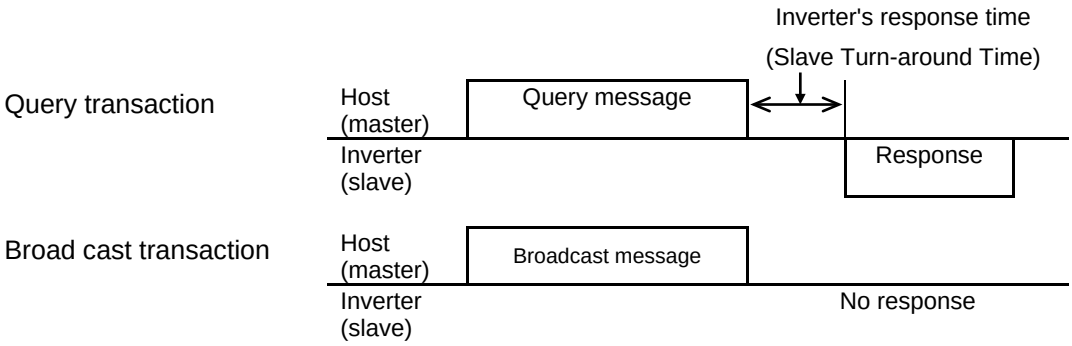
This chapter describes the Modbus RTU protocol, as well as the host side procedure for using this protocol and error processing.
The Modbus RTU protocol was a set of specifications developed in the United States.

Table of Contents

3.1 Messages

3.1.1 Message formats

The regular formats for transmitting RTU messages are shown below:



If the inverter receives from the host a message in the standby status and considers it properly received, it executes a transaction in response to the request and sends back normal response.
If the inverter judges that the message has not been received properly, it returns error response.
The inverter does not send back any response in the case of broadcast transactions.

3.1.2 Message types

Message types are classified into four types; query, normal response, error response, and broadcast.

Query

The host sends messages to an inverter.

Normal response

After the inverter received a query from the host, the inverter executes a transaction in response to the request, and sends back corresponding normal response.

Error response

If the inverter receives a query but cannot execute the requested function because an invalid function code is specified or for other reasons, it sends back error response.
The error response is accompanied by a message describing the reason the request cannot be executed.
The inverter cannot send back any response in case of a CRC or physical transmission error (parity error, framing error, overrun error).

Broadcast

The host uses address 0 to send messages to all slaves. All slaves, which receive a broadcast message, execute the requested function. This transaction will be terminated upon timeout of the host.
In the broadcast communications, only S01, S05, S06, S13, S14, or S19 can be selected from the standard frame.

3.1.3 Message frames

As shown below, a transmission frame consists of four blocks, which are called fields. Details depend on FC (RTU function codes). To make a clear distinction between RTU function codes and the inverter's function codes, the former will be hereinafter referred to as 'FC'.

1 byte	1 byte	Up to 105 bytes	2 bytes
Station address	FC (RTU function code)	Information	Error check

Station address

The station address field is one byte long, in which a station address between 0 and 247 can be selected.
Selecting address 0 means the selection of all slave stations and a broadcast message.

'FC' (RTU function code)

The 'FC' field is one byte long, in which a function code is defined with a number from 0 to 255. The 'FCs' in the shaded rows are available. Do not use any unavailable (unused) 'FC'. Failure to observe this rule results in error response.

Table 3.1 List of 'FC'

'FC'	Description	Support
		VF1A
0	Unused	−
1	Read Coil Status	○
2	Unused	−
3	Read Holding Registers	○
4	Unused	−
5	Force Single Coil	○
6	Preset Single Register	○
7	Unused	−
8	Diagnostics	○
9 to 14	Unused	−
15	Force Multiple Coils	○
16	Preset Multiple Registers (100 registers maximum)	○
17 to 127	Unused	−
128 to 255	Reserved for exception response	−

Information

The information field contains all information (function code, byte count, number of data, data, etc.). For further information about the information field for each message type (broadcast, query, normal response, error response), see "3.1.4 Message categories."

Error check

The error check field is a CRC-16 check system and two bytes long. Since the length of the information field is variable, the frame length required for calculating the CRC-16 code is calculated based on the 'FC' and the byte count data.
For further information about CRC-16 calculations and algorithm, see "3.4 CRC-16."
For byte counts, see "3.1.4 Message categories."

Character format

Each byte of a message is transmitted as a character. Character formats are described on the following page.
A character comprises a start bit (logical value 0), 8-bit data, an additional (optional) parity bit, and a stop bit (logical value 1).

A character always consists of eleven bits, and the number of stop bits varies depending on whether parity exists.

Without parity

LSB MSB

0	1	2	3	4	5	6	7	8	9	10
Start	Data								Stop	

With parity

LSB MSB

0	1	2	3	4	5	6	7	8	9	10
Start	Data								Parity (optional)	Stop

CAUTION - Modbus RTU protocol uses the above character format as a rule, but some devices use the format “No parity” + “Stop bit: 1 bit”. VF1A supports parity bit selection y06 = 3. VF1A also supports parity bit selection y06 and y16 = 3.
When 3 is specified for y06 and y16, the following character format is used.

LSB MSB

0	1	2	3	4	5	6	7	8	9
Start	Data								Stop

3.1.4 Message categories

There are eight RTU message categories; read holding registers, preset single register, preset multiple registers, diagnostics, read coil status, force single coil, force multiple coils and error response.
Each category is described below:

[1] Read holding registers

Query

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	03_H	Function code	Number of read data	Error check
		Hi Lo	Hi Lo	

Normal response

1 byte	1 byte	1 byte	2 to 200 bytes	2 bytes
Station address	03_H	Byte count	Read data	Error check
			Hi, Lo (data 0); Hi, Lo (data 1); ·····	

How to set a query

- This request is not available for broadcast transactions. Station address 0 will become invalid (no response).
- 'FC' = 3 (03_H)
- The function code is two bytes long. The Hi byte indicates the function code group (see Table 3.2), and the Lo byte represents a function code identification number (0 to 99).

(Example) When the function code is E15, the Hi byte is 01_H and the Lo byte is $0F_H$.

Table 3.2 Function code group/code conversion table

Group	Code		Name	Group	Code		Name
F	0	00_H	Fundamental function	o	6	06_H	Operational function
E	1	01_H	Extension terminal function	M	8	08_H	Monitor data
C	2	02_H	Control function of frequency	J	13	$0D_H$	Application function 1
P	3	03_H	Motor1 parameter				
H	4	04_H	High performance function	d	19	13_H	Application function 2
A	5	05_H	Motor2 parameter	y	14	$0E_H$	Link function
b	18	12_H	Motor3 parameter	W	15	$0F_H$	Monitor 2
r	10	$0A_H$	Motor4 parameter	X	16	10_H	Alarm 1
S	7	07_H	Command/ Function data	Z	17	11_H	Alarm 2

- The length of the read data is up to 100 words (2 byte each).
- If the read data contains an unused function code, 0 will be read, which will not result in an error.
- Data does not extend over two or more function code groups. If, for example, reading of 40 words is specified from F40 but only function codes up to F40 are available, the data of F40 will be set at the first word, and the other 49 words will be 0.

Interpretation of normal response

- The data range of byte counts is between 2 and 200. A byte count is double the number of read data (1 - 100 data) of the response.
- The read data contains each word data in order of Hi byte and Lo byte, and each word data is sent back in order of the data of the function code (address) requested by the query, the data of that address number plus 1, the data of that number address number plus 2 ... If two or more function data are read and the second or any of the following data contains an unused function code (F19, etc.), the read data will become 0.

[2] Preset single register

Query

1 byte	1 byte	2 bytes		2 bytes		2 bytes
Station address	06_H	Function code		Write data		Error check
		Hi	Lo	Hi	Lo	

Normal response

1 byte	1 byte	2 bytes		2 bytes		2 bytes
Station address	06_H	Function code		Write data		Error check

How to set a query

- When address 0 is selected, broadcast is available. In this case, all inverters do not respond even if a broadcast request is executed.
- 'FC' = 6 (06_H)
- The function code is two bytes long. The Hi byte indicates the function code group (see Table 3.2), and the Lo byte represents a function code identification number (0 to 99).
- The written data field is fixed two bytes long. Set the data on the function code to be written.

Interpretation of normal response

The frame is the same as the query.

[3] Preset multiple registers

Query

1 byte	1 byte	2 bytes		2 bytes		1 byte	2 to 200 bytes	2 bytes
Station address	10_H	Function code		Number of write data		Byte count	Write data	Error check
		Hi	Lo	Hi	Lo		Hi, Lo; Hi, Lo…	

Normal response

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	10_H	Function code	Number of write data	Error check

How to set a query

- When the station address 0 is selected, broadcast is available. In this case, all inverters do not respond even if a broadcast request is executed.
- 'FC' = 16 (10_H)
- The function code is two bytes long. The Hi byte indicates the function code group (see Table 3.2), and the Lo byte represents a function code identification number (0 to 99).
- The number of write data is two bytes long, and the setting range is from 1 to 100. If 101 or a higher value is set, error response will result.
- The byte count field is one byte long, and the setting range is from 2 to 200. Set a value equivalent to the double of the number of write data.
- Set the lowest order code (the data on the function code requested by the query) at the first two bytes of the write data, and the higher order data (address plus 1, address plus 2 ...) at the following bytes.
- If the write data contains an unused function code, the writing will be ignored, which will not result in an error.

Interpretation of normal response

- With regard to the function code and the number of write data, the same values as those of the query will be sent back.

[4] Diagnostics

Query

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	08_H	Sub function code 0000_H	Write data	Error check
		Hi Lo	Hi Lo	

Normal response

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	08_H	Sub function code 0000_H	Write data	Error check

How to set a query

- This request cannot use broadcast. Station address 0 will become invalid (no response).
- 'FC' = 8 (08_H)
- Set the sub function code field to be 2 bytes long fixed 0000_H. Error response will result if data other than 0000_H is set.
- The write data field is two bytes long, and any contents of data can be set.

Interpretation of normal response

- The frame is the same as the query.

[5] Read coil status

Query

1 byte	1 byte	2 bytes		2 bytes		2 bytes
Station address	01_H	Coil address		No. of coils		Error check
		Hi	Lo	Hi	Lo	

Normal response

1 byte	1 byte	1 byte	1 to 10 bytes	2 bytes
Station address	01_H	Byte count	Read data	Error check

How to set a query

- Broadcast with station address 0 is not usable. If this address is used, no response is returned.
- 'FC'=1 (01_H)
- Read out a coil (bit data) by specifying the top address of the coil to be read out and the number of points read out (number of coils).
- For the assignment of a coil (bit data), see table 3.3. For each content, refer to the S and M codes in the remarks column.

Table 3.3 Description of coil (bit data)

Coil number	+7	+6	+5	+4	+3	+2	+1	+0	Remarks
1	X6	X5	X4	X3	X2	X1	REV	FWD	S06: Run operation command (Read/Write)
9	RST	XR	XF	–	–	X9	X8	X7	
17	VL	TL	NUV	BRK	INT	EXT	REV	FWD	M14: Run status (Read only)
25	BUSY	WR		RL	ALM	DEC	ACC	IL	
33	FAN	KP	OL	IPF	SWM2	RDY	FDT	FAR	M70: Run status 2 (Read only)
41	–	–	IDL	ID	OPL	LIFE	OH	TRY	
49	X6	X5	X4	X3	X2	X1	REV	FWD	M13: Run operation command (final command) (Read only)
57	RST	XR	XF	–	–	X9	X8	X7	
65	–	–	–	Y5	Y4	Y3	Y2	Y1	M15: General-purpose output terminal information (Read only)
73	–	–	–	–	–	–	–	30	

- The "–" symbols in the table mean that the bit is reserved and always zero.
- Coil addresses are 0 to 79, calculated by subtracting one from coil numbers. If a coil address is 80 or more, an error occurs because of an incorrect address.
- The number of coils is 1 to 80. If the number of coils exceeds the range, an error occurs because of an incorrect address.
- No error occurs even if the sum of the numbers of coil addresses and coils exceeds the coil range.

Interpretation of normal response

- Data are stored from the LSB (the rightmost bit in the table above) in ascending order of coil number. When a coil is turned on, the data becomes one, and all the remaining bits are changed to zero.
- The byte length of the read data is filled in the byte count field.
- For a data example, see table 3.4.

Table 3.4 Example of coil address = 13 and the number of coils = 9

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data's 1st byte	BRK	INT	EXT	REV	FWD	RST	XR	XF
Data's 2nd byte	0	0	0	0	0	0	0	NUV

[6] Force single coil

Query

1 byte	1 byte	2 bytes		2 bytes		2 bytes
Station address	05_H	Coil address		Data		Error check
		Hi	Lo	Hi	Lo	

Normal response

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	05_H	Coil address	Data	Error check

How to set a query

- Broadcast with station address 0 is not usable. If used, no response is returned.
- 'FC' = 5 (05_H)
- Turn on/off a coil (bit data) by specifying only a bit.
- For the assignment of a coil (bit data), see table 3.5. For each content, refer to the S and M codes in the remarks column.

Table 3.5 Description of coil (bit data)

Coil number	+7	+6	+5	+4	+3	+2	+1	+0	Remarks
1	X6	X5	X4	X3	X2	X1	REV	FWD	S06: Run operation command (Read/Write)
9	RST	XR	XF	–	–	X9	X8	X7	

- The "–" symbol in the table means that the bit is reserved, and writing is ignored.
- The coil address is 0 to 15, calculated by subtracting one from the coil number. If a coil address is 16 or more, an error occurs because of an incorrect address.
- When a coil is turned off, data are 0000_H. When a coil is turned on, data are $FF00_H$.

Interpretation of normal response

- The format of normal response is the same as that of inquiry.
- No response is returned to the broadcast command.

[7] Force multiple coils

Query

1 byte	1 byte	2 bytes	2 bytes	1 byte	1 to 2 bytes	2 bytes
Station address	$0F_H$	Coil address	No. of coils	Byte account	Write data	Error check
		Hi Lo	Hi Lo		Hi Lo	

Normal response

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	$0F_H$	Coil address	No. of coils	Error check
		Hi Lo	Hi Lo	

How to set a query

- Broadcast with station address 0 is not usable. If is used, no response is returned.
- 'FC' = 15 ($0F_H$)
- Write a coil (bit data) by specifying the top address of the coil to be written, the number of points written (number of coils), and data to be written.
- For the assignment of a coil (bit data), see table 3.6. For each content, refer to the S and M codes in the remarks column.

Table 3.6 Description of coil (bit data)

Coil number	+7	+6	+5	+4	+3	+2	+1	+0	Remarks
1	X6	X5	X4	X3	X2	X1	REV	FWD	S06: Run operation command (Read/Write)
9	RST	XR	XF	–	–	X9	X8	X7	

- The "-" symbol in the table means that the bit is reserved and always zero.
- The coil address is 0 to 15, calculated by subtracting one from the coil number. If a coil address is 16 or more, an error occurs because of an incorrect address.
- If the byte count is 0 or 3 or more, an error occurs because of an incorrect data.
- The number of coils is 1 to 16. If 0 or 17 or more, an error occurs because of an incorrect address.
- No error occurs even if the coil address plus number of coils exceeds the coil range.
- If the number of coils is 9 or more and the byte count is 1 or less, an error occurs because of an incorrect data.
- If the number of coils is 8 or less and the byte count is 2, no error occurs.
- Data are stored from the LSB (the rightmost bit in the table above) in ascending order of coil number. When a coil is turned on, the data becomes one. When a coil is turned off, the data becomes zero. All the remaining bits are ignored.
- The byte count field indicates the byte length of the write data.
- For a data example, see table 3.7.

Table 3.7 Example of coil address = 2 and the number of coils = 9

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data's 1st byte	X8	X7	X6	X5	X4	X3	X2	X1
Data's 2nd byte	0	0	0	0	0	0	0	X9

Interpretation of normal response

- The forms of coil address and number of coils are the same as the forms of query.
- No response is returned to the broadcast command.

[8] Error response

If the inverter receives an improper query, it will not execute it, which will result in error response.

Error response

1 byte	1 byte	1 byte	2 bytes
Station address	Exception function	Subcode	Error check

Interpretation of error response

- The station address is the same as that of the query.
- The exception function is a value obtained by adding 80_H to the 'FC' of the query message (or the value of the 'FC' if the 'FC' is larger than 80_H).
  For example, when the 'FC' is 3, the exception function is 3 + 128 = 131 (83_H).
- The subcode represents the code of the reason for the improper query.

Table 3.8 Subcodes

Subcode	Item		Description	Order of priority
1	Improper 'FC'		The inverter received an unsupported FC. (See table 3.1.)	1
2	Improper address	Improper function code	An unused function code or a function code out of range was received. When the read/write data (except the first one) containing an unused function code. - During function reading Zero (0) will be read, which will not result in an error. - During continuous function writing The writing will be ignored, which will not result in an error.	2
		Improper number of data	- When the number of read/write data is not between 1 and 100. - No error will result when the value of the function code plus the number of data is beyond the setting range of the function code.	
		Diagnostic code error (maintena-nce code)	A value other than 0 was received although the subfunction code as the diagnostics was fixed to 0.	
3	Improper data	Data range error	The write data is beyond the permissible write range.	3*1
7	NAK	No right of writing	No right of writing by H30/y98/y99	
		Write disable	- Writing was attempted to the functions to which writing from RTU is prohibited or to which writing is disabled during operation. - Writing was attempted to a function code (other than S01, S05, S06, S13, and S14) that could not be written when the voltage was insufficient.	

*1 The priority between sub code 3 and 7 depending on a cause of sub code 7.

- If response is sent back to an improper query, a subcode will be set in an error code (that can be referred to with M26).

3.1.5 Communications examples

Typical communications examples are shown below (the station address is 5 in all cases).

(Example 1) M06: Reading actual frequency and speed

Query (host ⇒ inverter)

05	03	08	06	00	01	67	EF

Normal response (inverter ⇒ host)

05	03	02	27	10	A3	B8

The detected speed value is 2710_H, or 10000_d. The actual frequency is 30 Hz according to the expression shown below:

$$10000 \times \frac{\text{Maximum frequency}}{20000} = 30\ (\text{Hz})$$ (Maximum frequency: 60 Hz)

(Example 2) S01: The value of 15Hz will be written to frequency command (maximum frequency: 60 Hz).

According to the expression shown below, the value to be written is 1388_H.

$$15\text{Hz} \times \frac{20000}{60\ (\text{Hz})} = 5000_d = 1388_H$$

Query (host ⇒ inverter)

05	06	07	01	13	88	D5	AC

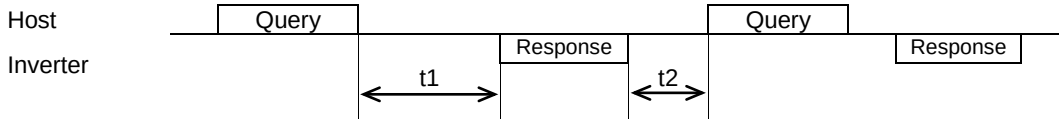
Normal response (inverter ⇒ host)

05	06	07	01	13	88	D5	AC

3.2 Host Side Procedures

3.2.1 Inverter's response time

Upon receipt of a query from the host, the inverter executes the queried transaction and sends back response after the response time shown below:



t1: Response interval time

The response interval time is the longest time out of the time setting by a function code(1), 3-character time(2), or inverter's processing time(3).

(1) y09/y19: setting of response interval time
0.00-1.00(s), factory shipment setting: 0.01(s)
You can set the time from receiving a request issued from a host to starting to send a response. By setting a response interval time, even the host side which is slower than the inverter can meet timing.

(2) 3-character time (maximum value)

Table 3.9 3-character time (maximum time)

Baud rate (bps)	2400	4800	9600	19200	38400
3-character time (ms)	15	10	5	5	5

(3) Inverter processing time (The data volume shown below indicates the number of words.)
1) Read holding registers, read coil status, multiple read holding registers

Table 3.10 Inverter processing time

Data count	Inverter processing time (minimum to maximum)
1 to 7	5 to 10 (ms)
8 to 16	10 to 15 (ms)
n	Int ((n-1)/8)×5 to int ((n-1)/ 8)×5+5 (ms)

2) Preset single register, preset multiple registers, force single coil, and force multiple coils

Table 3.11 Inverter processing time

Data count	Inverter processing time (minimum to maximum)
1	25 to 30 (ms)
2	45 to 50 (ms)
3	65 to 70 (ms)
4	85 to 90 (ms)
n	n×20+5 to n×20+10 (ms)

If the data is written in H03=1, the inverter processing time is a maximum of 5 seconds. If the data is written in H03=2(*1) or in P02(*1), the processing time is a maximum of 500 (ms). (*1) With VF1A, H03 = 2 or 3 and P02, A16, and with VF1A, H03 = 2, 3, 11, or 12 and P02.

3) Maintenance code: 10 (ms)

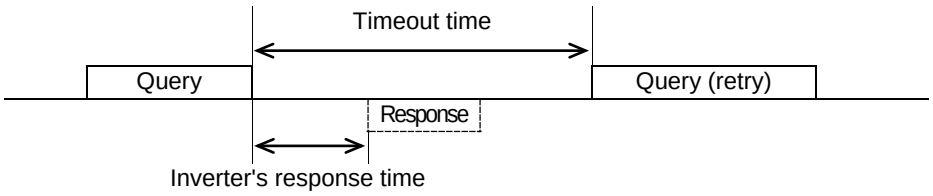
t2: Receiving preparation time

See section 3.2.3 "Receiving preparation complete time and message timing from the host."

3.2.2 Timeout processing

To read/write data from/to the host, transmit the next frame after confirming response. If response is not transmitted from the inverter for more than a specified period of time (timeout time), it is a timeout, and perform a retry. (If a retry begins before a timeout time elapses, the requested frame cannot be received properly.)

The timeout time must be set longer than the response time of the inverter. In case of a timeout, retransmit the same frame or read details of the error (M26) to confirm whether the inverter sends back normal response. If normal response is returned, this indicates that some transient transmission error occurred due to noise or for other reasons, and subsequent communications is normal. (However, if this phenomenon frequently occurs even when normal response is sent back, some problem may exist. Perform a close investigation.) In case of no response, perform another retry. If the number of retries exceeds the set value (generally about three times), there may be a problem with the hardware and the software of the host. Investigate and correct the cause.



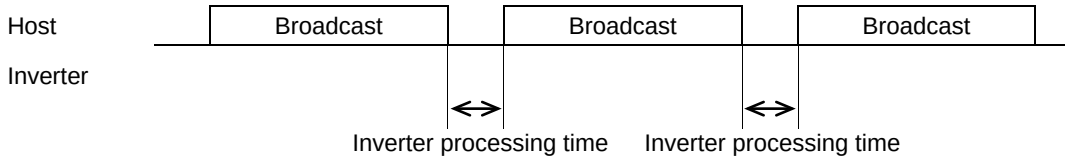
3.2.3 Receiving preparation complete time and message timing from the host

The time from the return of response by the inverter until the completion of receiving preparation of the communications port (switching from transmission to receiving) is called a receiving preparation complete time.
Transmit the following messages after the receiving preparation complete time:

Receiving preparation complete time: 3-character time

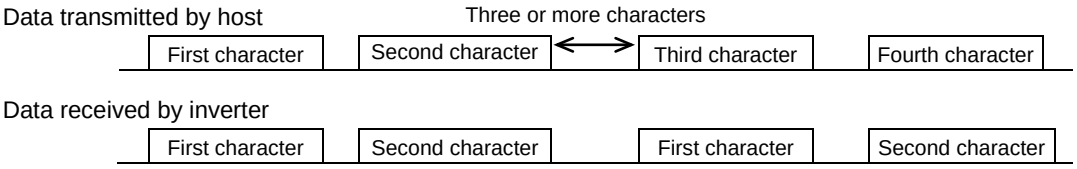
In the case of broadcast

Upon receipt of a query message from the host by broadcast, the inverter executes the query and enters the receiving enabled status.
When sending a message from the host after broadcast is performed, send the message after the inverter processing time shown in section 3.2.1 "Inverter response time" has passed.



3.2.4 Frame synchronization method

Since the RTU transmits and receives binary data without using header characters for frame synchronization, a frame synchronization system is defined as a time without data to identify the head of the frame.
If data communications does not occur for a period equal to three characters (33 bits including the start and stop bits) at the current transmission speed during receiving standby, initialize the frame information, and consider the first received data the first byte of the frame. If a character interval reaches the length of three characters or more while a frame is received, the frame is discarded.
For this reason, the host must transmit data at a time interval of three or less characters between two characters.



With regard to data to another station, messages from the host and response from that station will be received. In response transmission to identify the head of the frame, a waiting time of three characters (33 bits including the start and stop bits) is required between the completion of data receipt by the station and the start of transmission.
Any devices multidropped also requires such a waiting time.

3.3 Communications Errors

3.3.1 Categories of communications errors

The communications-related errors the inverter detects are listed below:

Table 3.12 Communications errors detected by inverter

Error category	Error name	Description	Error code (M26 or M67)
Logical error	Improper 'FC'	See "Table 3.8 Subcodes" shown in 3.1.4 [8].	1(01_H)
	Improper address		2(02_H)
	Improper data		3(03_H)
	NAK		7(07_H)
Transmission error	CRC error	The frame to the local station is found unmatched in CRC collation.	71(47_H)
	Parity error	The parity is unmatched.	72(48_H)
	Other errors	Receiving errors other than the abovementioned (framing error, overrun error)	73(49_H)
Communica-tions disconnection error	Communications disconnection error	The inverter did not receive a normal frame addressed to local or to other stations within the communications disconnection time set with the function code.	—

Logical error (error codes 1 to 7)

When a logical error is detected, an error response frame reports it. For further information, see "3.1.4 [8] Error response."

Transmission error (error codes 71 to 73)

When a transmission error occurs eight straight times, it is handled as a communications error. However, the inverter does not return response in order to avoid overlapping of response from multiple inverters. The count of eight straight times will be cleared upon normal receipt of a frame to another station or to the local inverter (station) itself.

Communications disconnection error

If the inverter in operation does not receive a normal frame to itself or to other stations when it has received a normal frame more than once and is operating via communications (frequency command or operation command), this status is considered disconnected.
If the status of disconnection continues for the communications disconnection time set up by function code (y08, y18), error processing is performed as a communications error.

1) Communications disconnection detection time (y08, y18): 0 (without detection), 1 to 60 (seconds)

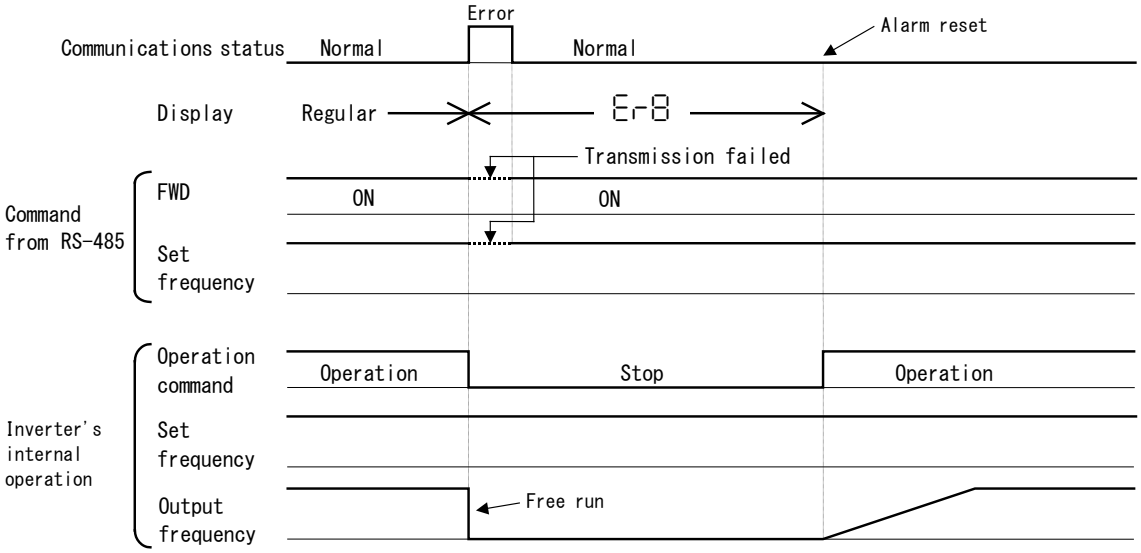
2) Condition to clear communications disconnection detection timer:
It will be cleared in a status other than disconnection.

When it is necessary to take action against errors by factor, the factor can be identified by reading M26 or M67. (M26 or M67 stores the latest communications error codes.)

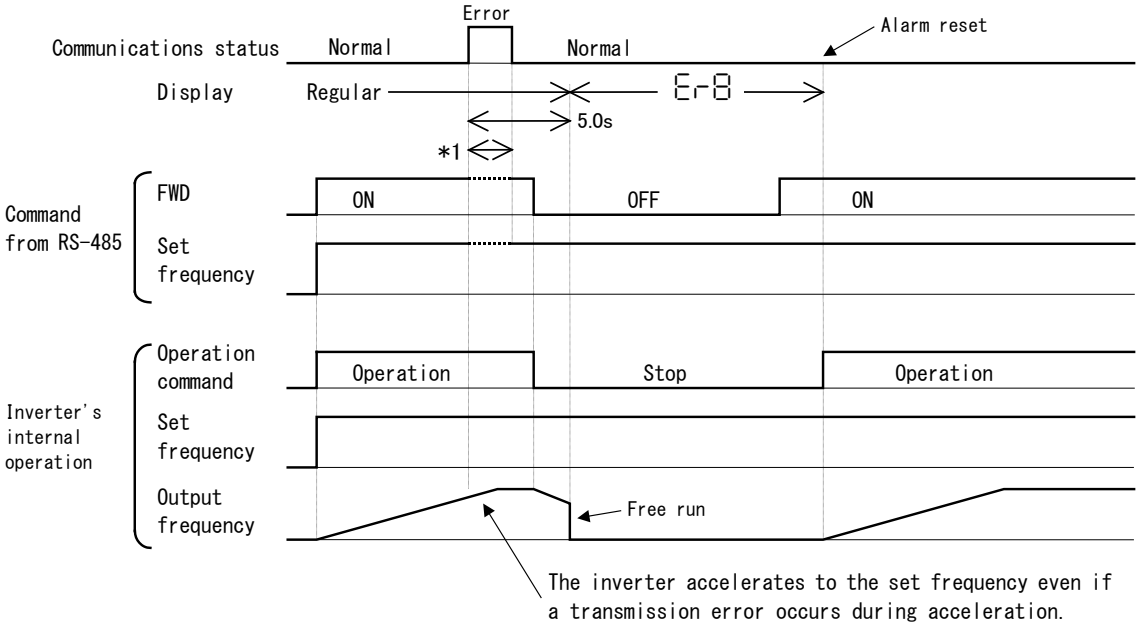
3.3.2 Operations in case of errors

The action when a transmission or communications disconnection error occurs can be selected with function code y02, y12. (For further information, see "2.4 Making RS-485-related Settings.") This section shows specific examples of action by different settings of function code y02. (The same operation is performed for y12 as well. In this case, the y02 and y03 in the figure are replaced with y12 and y13, and the error indication becomes Er-P.

When y02 = 0 (mode in which the inverter is forced to immediately stop in case of communications error)



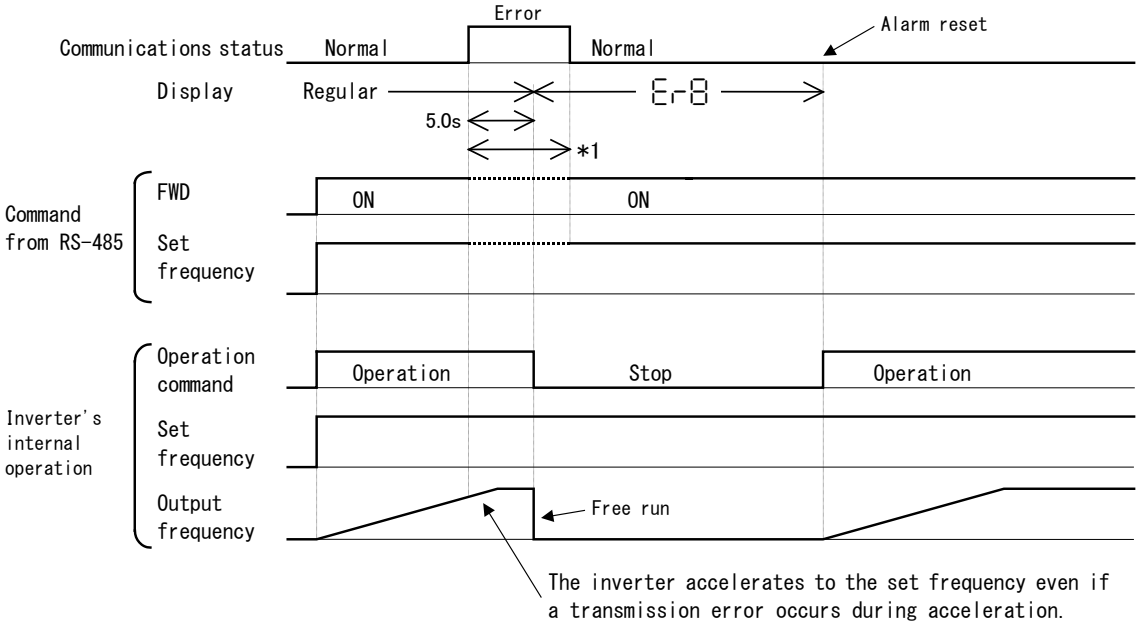
When y02 = 1 and y03 = 5.0 (seconds) (mode in which the inverter is forced to stop five seconds after a communications error occurred)



*1 For the period until communications is recovered, the command (command data, operation data) executed just before the communications error had occurred is retained.

When y02 = 2 and y03 = 5.0 (seconds)

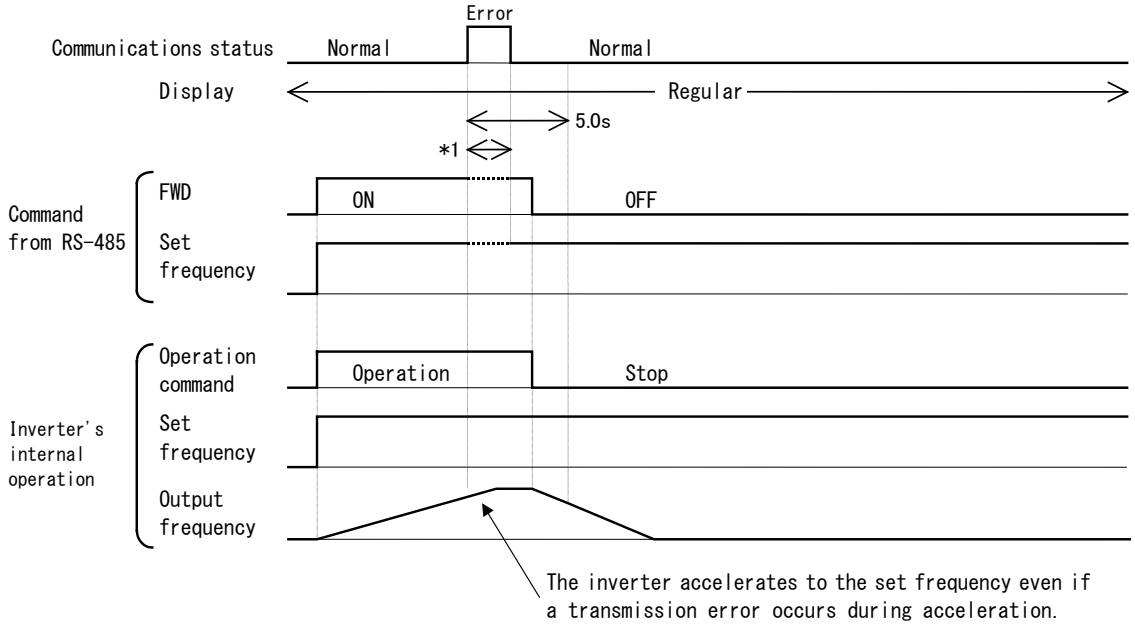
(when communications is not recovered although five seconds elapsed from the occurrence of a communications error, and an *εrδ* trip occurs)



*1 For the period until communications is recovered, the command (command data, operation data) executed just before the communications error had occurred is retained.

When y02 = 2 and y03 = 5.0 (seconds)

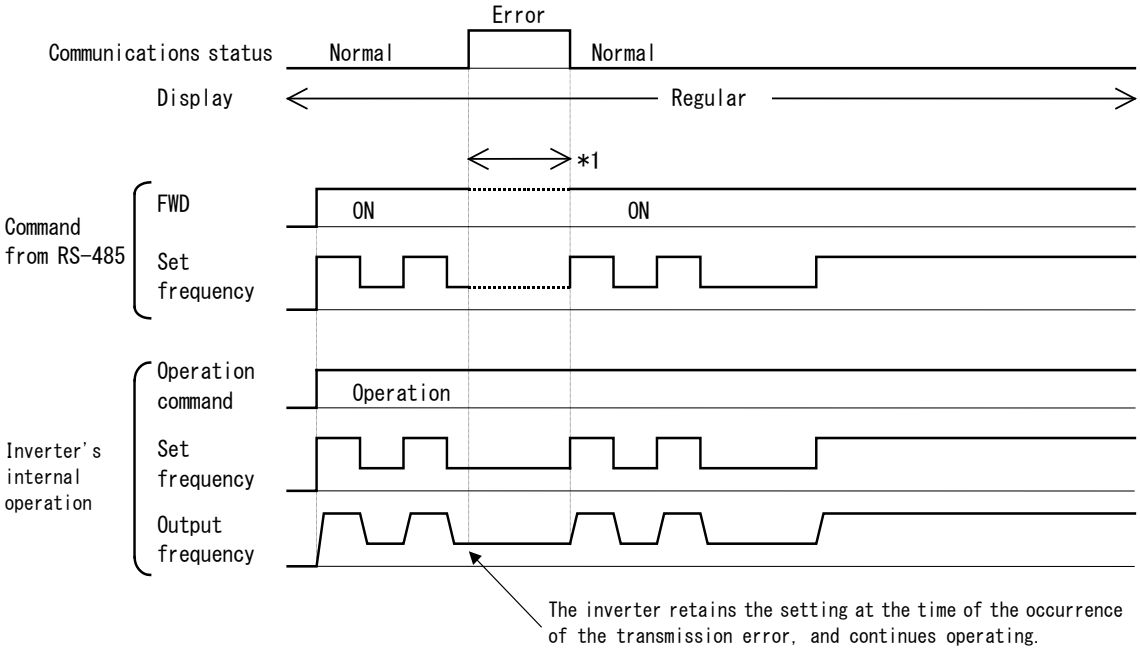
(when a communications error occurred but communications was recovered within five seconds)



*1 For the period until communications is recovered, the command (command data, operation data) executed just before the communications error had occurred is retained.

When y02 = 3

(mode in which the inverter continues operating when a communications error occurs)



*1 For the period until communications is recovered, the command (command data, operation data) executed just before the communications error had occurred is retained.

3.4 CRC-16

3.4.1 Overview of the CRC-16

The CRC (cyclic redundancy check) is a system to confirm whether there is any error in the communications frame during data transmission.
The CRC is among the most effective error check systems. The transmission station calculates and adds CRC data to the last block of the frame, and the receiving station also calculates CRC data against the data received, and compares them with each other.

Steps to calculate CRC data

- Divide data expressed as a polynomial (for example, 0000 0001 0000 0011 0000 0011 0000 0010 0000 0000 0001 0100, the 48-bit data shown in section 3.4.3 "Calculation example" → $X^{40}+X^{33}+X^{32}+X^{25}+X^{24}+X^{17}+X^{4}+X^{2}$) by a generative polynomial expression (17 bits; $X^{16}+X^{15}+X^{2}+1$). CRC data is the remainder (16 bits) of this division.
- Ignore the quotient, and send a message with the remainder added to the final two characters of the data.
- The receiving station divides this message (with the CRC added) by the generative polynomial expression, and considers the transmitted message to have been received without any error if the "remainder" is 0.

CRC-16

The generative polynomial expression is expressed as a multiplier of X, such as $X^3 + X^2 + 1$, in place of the description of binary code 1101. Although any prime polynomial expression is acceptable as the generative polynomial expression, some standard generative polynomial expressions for optimizing error detection are defined and proposed. The RTU protocol uses the generative polynomial expression ($X^{16} + X^{15} + X^2 + 1$) corresponding to binary code 1 (1000 0000 0000 0101). In this case, the CRC generated is well known as CRC-16.

3.4.2 Algorithm

Figure 3.1 on the following page shows the algorithm for calculating CRC-16. Consult it together with the calculation example that follows.

In this figure, the transmission station calculates CRC data and finally adds it to the transmission frame as a check code.

The receiving station uses the same algorithm to perform a transaction. However, it collates the CRC data it calculated with the transmitted CRC data.

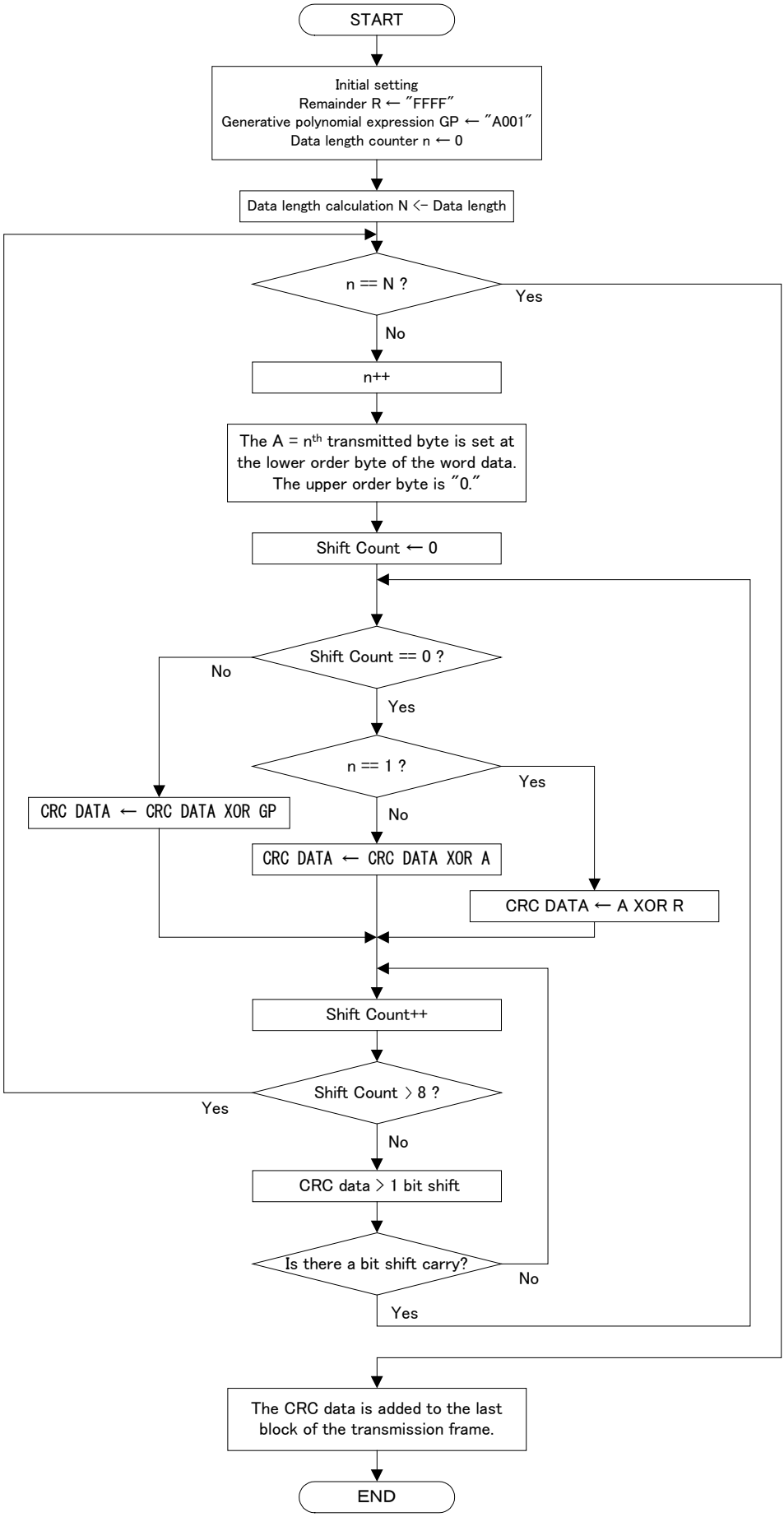


Figure 3.1　CRC algorithm

3.4.3 Calculation example

Example of transmitting read data

Station address = 1, 'FC' = 3, function code = P02 (P = 03_H, 02 = 02_H), number of read data = 20, GP = generative polynomial expression(1010 0000 0000 0001)

Station address	'FC'	Function code		Number of read data	
01_H	03_H	03_H	02_H	00_H	14_H

Table 3.13 CRC data calculation table

N	PROCESS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Flag
1	Initial data R = "FFFF"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
2	1st data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
3	CRC = No.1 Xor No.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	
4	Shift > 2 (up to flag = 1)	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	CRC = No.4 Xor GP	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	
6	Shift > 2	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1
7	CRC = No.6 Xor GP	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	
8	Shift > 2	0	0	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1
9	CRC = No.8 Xor GP	1	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	
10	Shift > 2 (shift of No. 8 terminated)	0	0	1	0	0	0	0	0	0	1	1	1	1	1	1	1	1
11	CRC = No.10 Xor GP	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	
12	2nd data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
13	CRC = No.11 Xor No.12	1	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	
14	Shift > 1	0	1	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1
15	CRC = No.14 Xor GP	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	
16	Shift > 1	0	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1
17	CRC = No.16 Xor GP	1	1	0	1	0	0	0	0	0	0	0	1	1	1	1	0	
18	Shift > 2	0	0	1	1	0	1	0	0	0	0	0	0	0	1	1	1	1
19	CRC = No.18 Xor GP	1	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	
20	Shift > 2	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	1
21	CRC = No.20 Xor GP	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
22	Shift > 2 (shift of No. 8 terminated)	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0
23	3rd data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
24	CRC = No.22 Xor No.23	0	0	1	0	0	0	0	1	0	1	0	0	0	0	1	1	
25	Shift > 1	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	1	1
26	CRC = No.25 Xor GP	1	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	
27	Shift > 6	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1	0	1
28	CRC = No.27 Xor GP	1	0	1	0	0	0	1	0	1	1	0	0	0	0	1	1	
29	Shift > 1	0	1	0	1	0	0	0	1	0	1	1	0	0	0	0	1	1
30	CRC = No.29 Xor GP	1	1	1	1	0	0	0	1	0	1	1	0	0	0	0	0	
31	4th data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
32	CRC = No.30 Xor No.31	1	1	1	1	0	0	0	1	0	1	1	0	0	0	1	0	
33	Shift > 2	0	0	1	1	1	1	0	0	0	1	0	1	1	0	0	0	1
34	CRC = No.33 Xor GP	1	0	0	1	1	1	0	0	0	1	0	1	1	0	0	1	
35	Shift > 1	0	1	0	0	1	1	1	0	0	0	1	0	1	1	0	0	1
36	CRC = No.35 Xor GP	1	1	1	0	1	1	1	0	0	0	1	0	1	1	0	1	
37	Shift > 1	0	1	1	1	0	1	1	1	0	0	0	1	0	1	1	0	1

(To be continued)

Table 3.13 CRC data calculation table (Continued)

N	PROCESS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Flag
38	CRC = No.37 Xor GP	1	1	0	1	0	1	1	1	0	0	0	1	0	1	1	1	
39	Shift > 1	0	1	1	0	1	0	1	1	1	0	0	0	1	0	1	1	1
40	CRC = No.39 Xor GP	1	1	0	0	1	0	1	1	1	0	0	0	1	0	1	0	
41	Shift > 2	0	0	1	1	0	0	1	0	1	1	1	0	0	0	1	0	1
42	CRC = No.41 Xor GP	1	0	0	1	0	0	1	0	1	1	1	0	0	0	1	1	
43	Shift > 1	0	1	0	0	1	0	0	1	0	1	1	1	0	0	0	1	1
44	CRC = No.43 Xor GP	1	1	1	0	1	0	0	1	0	1	1	1	0	0	0	0	
45	5th data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
46	CRC = No.44 Xor No.45	1	1	1	0	1	0	0	1	0	1	1	1	0	0	0	0	
47	Shift > 5	0	0	0	0	0	1	1	1	0	1	0	0	1	0	1	1	1
48	CRC = No.47 Xor GP	1	0	1	0	0	1	1	1	0	1	0	0	1	0	1	0	
49	Shift > 2	0	0	1	0	1	0	0	1	1	1	0	1	0	0	1	0	1
50	CRC = No.49 Xor GP	1	0	0	0	1	0	0	1	1	1	0	1	0	0	1	1	
51	Shift > 1	0	1	0	0	0	1	0	0	1	1	1	0	1	0	0	1	1
52	CRC = No.51 Xor GP	1	1	1	0	0	1	0	0	1	1	1	0	1	0	0	0	
53	6th data byte	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	
54	CRC = No.52 Xor No.53	1	1	1	0	0	1	0	0	1	1	1	1	1	1	0	0	
55	Shift > 3	0	0	0	1	1	1	0	0	1	0	0	1	1	1	1	1	1
56	CRC = No.55 Xor GP	1	0	1	1	1	1	0	0	1	0	0	1	1	1	1	0	
57	Shift > 2	0	0	1	0	1	1	1	1	0	0	1	0	0	1	1	1	1
58	CRC = No.57 Xor GP	1	0	0	0	1	1	1	1	0	0	1	0	0	1	1	0	
59	Shift > 2	0	0	1	0	0	0	1	1	1	1	0	0	1	0	0	1	1
60	CRC = No.59 Xor GP	1	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0	
61	Shift > 1 (shift of No. 8 terminated)	0	1	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0
	Transmitted CRC data	*4*				*1*				*E*				*4*				

From the above calculation, the transmitted data is as shown below:

Station address	'FC'	Function code		Number of read data		CRC check	
01_H	03_H	03_H	02_H	00_H	14_H	$E4_H$	41_H

3.4.4 Frame length calculation

To calculate CRC-16, it is necessary to know the length of variable length messages. The length of all types of messages can be determined according to Table 3.14 Lengths of response messages.

Table 3.14 Length of response messages

'FC'	Description	Query/Broadcast message length (except CRC code)	Length of response message (except CRC code)
1	Read coil status	6 bytes	3+(3rd) bytes*1
3	Read holding registers	6 bytes	3 + (3 rd) bytes*1
5	Force single coil	6 bytes	6 bytes
6	Preset single register	6 bytes	6 bytes
8	Diagnostics	6 bytes	6 bytes
15	Force multiple coils	7 + (7th) bytes*1	6 bytes
16	Preset multiple registers	7 + (7 th) bytes*1	6 bytes
128 to 255	Exception function	Unused	3 bytes

*1 7th, 3rd: The 7th and 3 rd byte count values stored in the frame.

CHAPTER 4

Doesa INVERTER PROTOCOL

This chapter describes the Doesa inverter protocol, a protocol common to Doesa VF1A series inverters.
It also describes the procedure for the host side when using this protocol, and how to handle errors.

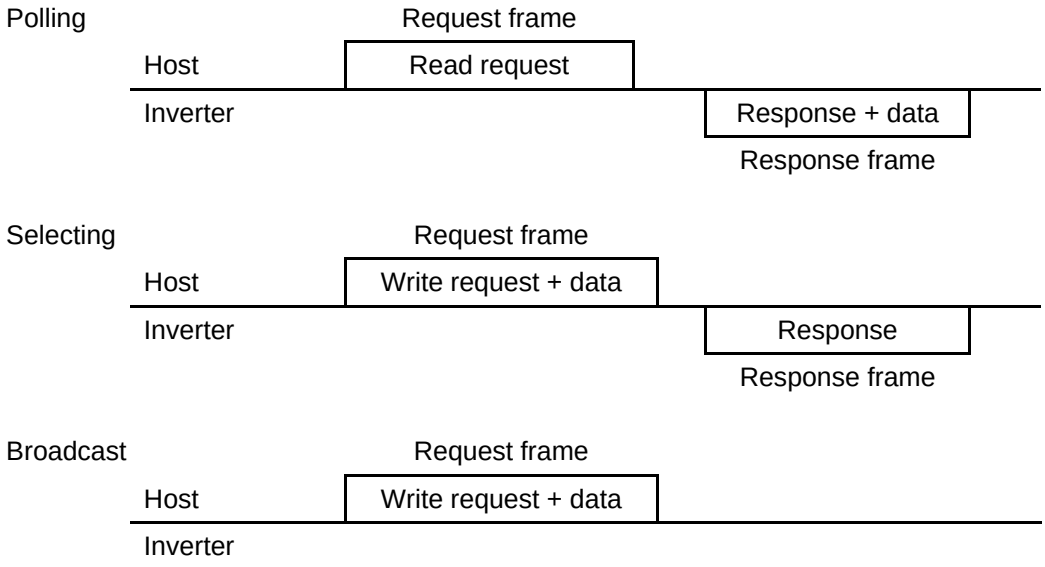
Table of Contents

4.1 Messages

4.1.1 Message formats

The polling/selecting system is used to transmit and receive messages. The inverter always waits for selecting (write requests) or polling (read requests) from a host such as a personal computer or PLC.
When the inverter in the standby status receives a request frame from the host addressed to itself (local station) and considers the request frame to have been normally received, the inverter executes the transaction in response to the request, and sends back an acknowledgement (ACK) frame (or response and data in the case of polling). If the inverter judges that the receiving failed, it returns negative acknowledgment (NAK) frame. In the case of broadcast (all station batch selecting), the inverter does not send back response.

(Each frame is described in "4.1.2 Transmission frames.")



Broadcast (all station batch selecting)

A frame with the station address set to 99 is treated by all inverters as broadcast.
By using broadcast, operation or frequency commands can be simultaneously assigned to all inverters.
In broadcast communications, only selecting of S01, S05, S06, S13, S14, and S19 in the standard frame, and commands (W, E, a, e, f, and m) in the optional frame are valid.

4.1.2 Transmission frames

Transmission frames are classified into two types; standard fames with which all communications functions are available, and optional frames, allowing high-speed communications, but whose function is limited to issuing commands to and monitoring the inverter.

All characters (including BCC) comprising both standard and optional frames are represented by ASCII codes. The lengths of standard and optional frames are as shown in Table 4.1 below:

Table 4.1 Lengths of transmission frames

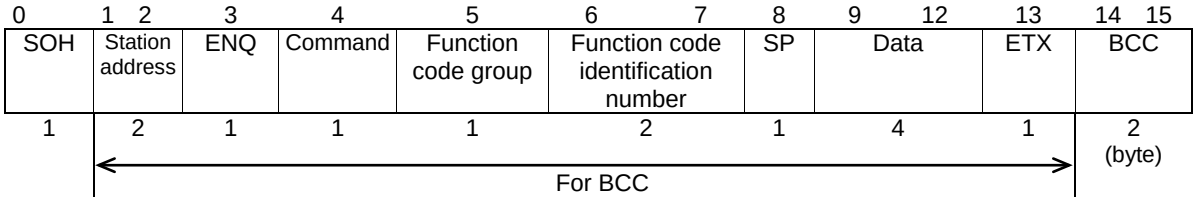
Frame type			Frame length
Standard frame	Selecting	Request	16 bytes
		Response	16 bytes
	Polling	Request	16 bytes
		Response	16 bytes
Optional frame	Selecting	Request	12 bytes
		Response	8 bytes
	Polling	Request	8 bytes
		Response	12 bytes

[1] Standard frame

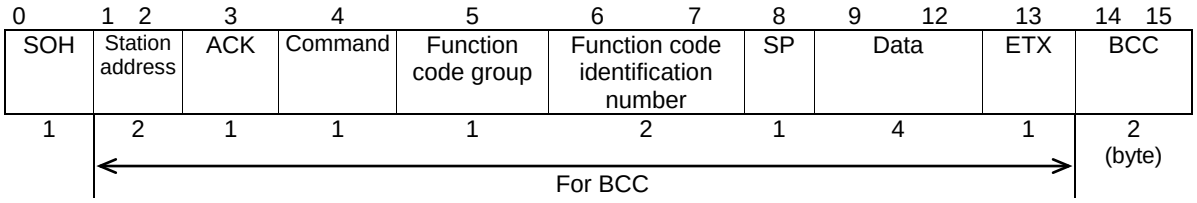
Standard frames are classified into request frame, ACK frame, and NAK frame, and their frame configurations are as shown below.

For the meanings of the fields comprising each frame, see the tables shown on the pages that follow.

Request frame [host ⇒ inverter]



ACK frame [inverter ⇒ host]



NAK frame [inverter ⇒ host]

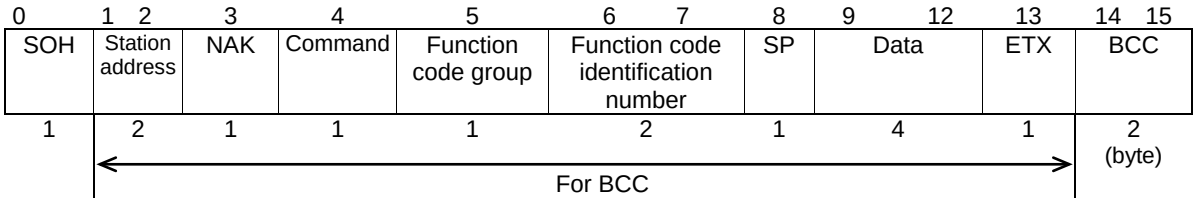


Table 4.2 Request frame

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3, 9	30_H to 33_H 39_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ENQ	ENQ	05_H	Transmission request
4	Command	R W A E	52_H 57_H 41_H 45_H	Request command Polling (read) Selecting (write) High-speed response selecting (write) *2 Alarm reset
5	Function code group *1	F E C P H H1 A b r J J1 d U U1 y K o o1 S M M1 W X Z	46_H 45_H 43_H 50_H 48_H 81_H 41_H 42_H 52_H $4A_H$ $A6_H$ 44_H 55_H 89_H 59_H $4B_H$ $4F_H$ 87_H 53_H $4D_H$ $8B_H$ 57_H 58_H $5A_H$	Function code group *3 Fundamental function Extension terminal function Control function of frequency Motor1 parameter High performance function High performance function Motor2 parameter Motor3 parameter Motor4 parameter Application function 1 Application function 1 Application function 2 Application function 3 Application function 3 Link function Touch panel function Option function Option function Command data Monitor data 1 Monitor data 1 Monitor data 2 Alarm data 1 Alarm data 2
6	Function code identification number *1	0 to 9	30_H to 39_H	Function code identification number (decimal: ten's figure)
7		0 to 9	30_H to 39_H	Function code identification number (decimal: one's figure)
8	Special additional data	SP	20_H	Unused (space fixed)
9	Data	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Data's first character (hexadecimal: thousand's figure)
10				Data's second character (hexadecimal: hundred's figure)
11				Data's third character (hexadecimal: ten's figure)
12				Data's fourth character (hexadecimal: one's figure)
13	ETX	ETX	03_H	End of message
14	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
15				Checksum 2 (hexadecimal: one's figure)

*1 A space (SP = 20_H) will be set for an alarm reset command.

*2 Use high-speed response selecting to read the monitor when a command, which takes time for selecting (see Table 4.13 in "4.2 Host Side Procedures"), is written. The inverter does not respond to the regular write command W until writing is completed. With regard to high-speed response command A, the inverter sends back response upon receipt of a write request and communications can, therefore, continue even during writing. To confirm whether writing is completed in this case, read the BUSY flag (M14: 15 bits). If additional writing is performed during writing, NAK (error during writing) will result.

*3 Function codes are divided into function codes that can be edited from the keypad of the inverter, and communications dedicated function codes.

1) Function codes editable from the keypad

Fundamental function:	F code
Extension terminal function:	E code
Control function of frequency:	C code
Motor1 parameter:	P code
High performance function:	H code
High performance function:	H1 code
Motor2 parameter:	A code
Motor3 parameter:	b code
Motor4 parameter:	r code
Application function 1:	J code
Application function 1:	J1 code
Application function 2:	d code
Application function 3:	U code
Application function 3:	U1 code
Link function:	y code
Touch panel function:	K code
Option function:	o code
Option function:	o1 code

Refer to “2.4 Making RS-485-related Settings” in Chapter 2 and the Doesa VF1A series User's Manual (Chapter 5) for details on function codes.

2) Communications dedicated function codes

Command data:	S code
Monitor data 1:	M code
Monitor data 1:	M1 code
Monitor data 2:	W code
Alarm data 1:	X code
Alarm data 2:	Z code

For further information about these codes, see "Chapter 5 Function Codes and Data Formats."

Table 4.3 ACK frame

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ACK	ACK	06_H	Transmission response Acknowledgement: There was no receiving or logical error.
4	Command	 R W A E	 52_H 57_H 41_H 45_H	Answerback of request command Polling (read) Selecting (write) High-speed response selecting (write) Alarm reset
5	Function code group *1	 F E C P H A b r J d y o S M W X Z	 46_H 45_H 43_H 50_H 48_H 41_H 42_H 52_H $4A_H$ 44_H 59_H $4F_H$ 53_H $4D_H$ 57_H 58_H $5A_H$	Function code group Fundamental function Extension terminal function Control function of frequency Motor1 parameter High performance function Motor2 parameter Motor3 parameter Motor4 parameter Application function 1 Application function 2 Link function Option function Command data Monitor data 1 Monitor data 2 Alarm data 1 Alarm data 2
6	Function code identification number *1	0 to 9	30_H to 39_H	Function code identification number (decimal: ten's figure)
7		0 to 9	30_H to 39_H	Function code identification number (decimal: one's figure)
8	Special additional data	SP -	20_H $2D_H$	Fixed to "sp (space)" normally. "-" for negative data
9	Data	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Data's first character (hexadecimal: thousand's figure)
10				Data's second character (hexadecimal: hundred's figure)
11				Data's third character (hexadecimal: ten's figure)
12				Data's fourth character (hexadecimal: one's figure)
13	ETX	ETX	03_H	End of message
14	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
15				Checksum 2 (hexadecimal: one's figure)

*1 A space (SP = 20_H) will be set for an alarm reset command.

Table 4.4 NAK frame

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	NAK	NAK	15_H	Transmission response Negative acknowledgement: There was a logical error in the request.
4	Command *1			Answerback of request command
		R	52_H	Polling (read)
		W	57_H	Selecting (write)
		A	41_H	High-speed response selecting (write)
		E	45_H	Alarm reset
5	Function code group *1			Function code group
		F	46_H	Fundamental function
		E	45_H	Extension terminal function
		C	43_H	Control function of frequency
		P	50_H	Motor1 parameter
		H	48_H	High performance function
		A	41_H	Motor2 parameter
		b	42_H	Motor3 parameter
		r	52_H	Motor4 parameter
		J	$4A_H$	Application function 1
		d	44_H	Application function 2
		y	59_H	Link function
		o	$4F_H$	Option function
		S	53_H	Command data
		M	$4D_H$	Monitor data 1
		W	57_H	Monitor data 2
		X	58_H	Alarm data 1
		Z	$5A_H$	Alarm data 2
6	Function code identification number *1	0 to 9	30_H to 39_H	Function code identification number (decimal: ten's figure)
7		0 to 9	30_H to 39_H	Function code identification number (decimal: one's figure)
8	Special additional data	SP	20_H	Unused (space fixed)
9	Data	SP	20_H	Unused (space fixed)
10		SP	20_H	Unused (space fixed)
11		0 to 9, A to F	30_H to 39_H 41_H to 46_H	Communications error code higher order (hexadecimal: ten's figure)
12				Communications error code lower order (hexadecimal: one's figure)
13	ETX	ETX	03_H	End of message
14	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
15				Checksum 2 (hexadecimal: one's figure)

*1 The field contents of command type, function code group, function code identification number vary at the format error or command error.

[2] Optional frame

This section describes the structure and meaning of each optional frame.

Selecting request frame [host ⇒ inverter]

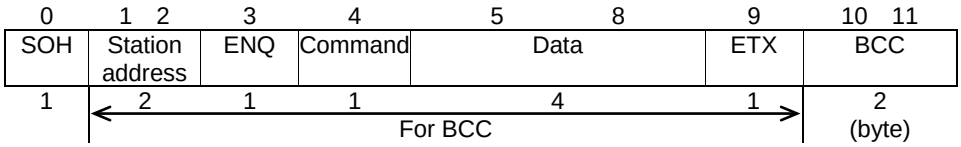


Table 4.5 Selecting request frame

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3, 9	30_H to 33_H 39_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ENQ	ENQ	05_H	Transmission request
4	Command	 a e f m	 61_H 65_H 66_H $6D_H$	Request command Speed setting (S01) Frequency command (S05) Operation command (S06) Reset command (The data part is all zero)
5	Data	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Data's first character (hexadecimal: thousand's figure)
6				Data's second character (hexadecimal: hundred's figure)
7				Data's third character (hexadecimal: ten's figure)
8				Data's fourth character (hexadecimal: one's figure)
9	ETX	ETX	03_H	End of message
10	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
11				Checksum 2 (hexadecimal: one's figure)

Selecting response frame [inverter ⇒ host]

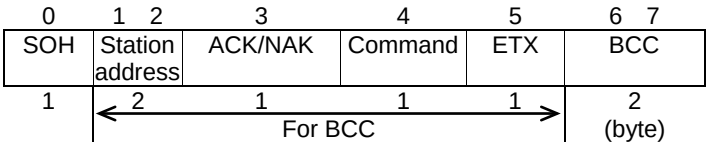


Table 4.6 Selecting response frame (ACK/NAK)

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ACK/NAK	ACK	06_H	Transmission response Acknowledgement: There was no receiving or logical error.
		NAK	15_H	Negative acknowledgment: There was a logical error in the request.
4	Command			Request command
		a	61_H	Speed setting (S01)
		e	65_H	Frequency command (S05)
		f	66_H	Operation command (S06)
		m	$6D_H$	Reset command
5	ETX	ETX	03_H	End of message
6	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
7				Checksum 2 (hexadecimal: one's figure)

Polling request frame [host ⇒ inverter]

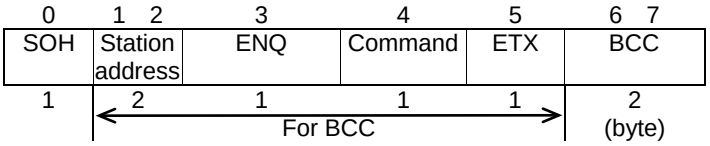


Table 4.7 Polling request frame

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ENQ	ENQ	05_H	Transmission request
4	Command			Request command
		g	67_H	Actual frequency, actual speed (M06)
		j	$6A_H$	Output frequency monitor (M09)
		k	$6B_H$	Operation status monitor (M14)
		h	68_H	Torque monitor (M07)
		i	69_H	Torque current monitor (M08)
5	ETX	ETX	03_H	End of message
6	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
7				Checksum 2 (hexadecimal: one's figure)

Polling response frame [inverter ⇒ host]

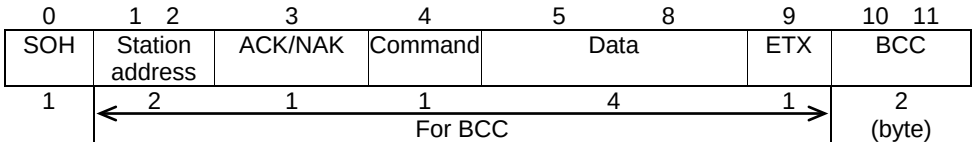


Table 4.8 Polling response frame (ACK)

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ACK/NAK	ACK	06_H	Transmission request Acknowledgement: There was no receiving or logical error.
4	Command	g j k h i	67_H $6A_H$ $6B_H$ 68_H 69_H	Request command Actual frequency, actual speed (M06) Output frequency monitor (M09) Operation status monitor (M14) Torque monitor (M07) Torque current monitor (M08)
5	Data	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Data's first character (hexadecimal: thousand's figure)
6				Data's second character (hexadecimal: hundred's figure)
7				Data's third character (hexadecimal: ten's figure)
8				Data's fourth character (hexadecimal: one's figure)
9	ETX	ETX	03_H	End of message
10	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
11				Checksum 2 (hexadecimal: one's figure)

Table 4.9 Polling response frame (NAK)

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ACK/NAK	NAK	15_H	Transmission request Negative acknowledgment: There was a logical error in the request.
4	Command	g j k h i	67_H $6A_H$ $6B_H$ 68_H 69_H	Request command Actual frequency, actual speed (M06) Output frequency monitor (M09) Operation status monitor (M14) Torque monitor (M07) Torque current monitor (M08)
5	Data	SP	20_H	Unused (fixed space)
		SP	20_H	Unused (fixed space)
		0 to 9, A to F	30_H to 39_H 41_H to 46_H	Communications error code high-order digit (hexadecimal: ten's figure)
				Communications error code low-order digit (hexadecimal: one's figure)
9	ETX	ETX	03_H	End of message
10	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
11				Checksum 2 (hexadecimal: one's figure)

[3] NAK frame

When the response frame length is determined by the command type and the command type character is correctly identified, response will be given according to the frame length specified by the command in principle. Concerning all the request frames, if the inverter failed to detect ETX after detecting request-to-send character with the specified 3-byte position until reaching the15-byte position, the inverter returns no response.

Table 4.10 Negative acknowledgment (NAK) frame

No.	Frame/ Command type	Cause of error	NAK response frame	Error code (M26)
1	Standard frame Optional frame	The ENQ was not detected in the specified position.	Standard fame (16 bytes long)	Format error [74]
2	Selecting command (a, e, f, m)	The ETX was not detected in the specified position.	Optional frame (8 bytes long)	Format error [74]
3	Polling command (g, j, k, h, i)	The ETX was not detected in the specified position.	Optional frame (12 bytes long)	Format error [74]
4	Other than specified commands	A command other than the specified commands (R, W, A, E, a, e, f, g, j, k, h, i, m) was detected.	Standard frame (16 bytes long)	Command error [75]

CAUTION When negative acknowledgement (NAK) for a format or command error is returned with the standard format as in the case of No. 1 and No. 4, the contents of the command type, function code group, and function code identification number fields will be undefined.

4.1.3 Descriptions of fields

[1] Command field

The table below shows command types. The applicable frame is different among the command types.

Table 4.11 Command formats

Command	Description	Applicable frame
ASCII R	Reads function code data (polling).	Standard frame
ASCII W	Writes function code data (selecting).	
ASCII A	Writes function code data at high speed (writing that does not wait for writing to be completed).	
ASCII E	Resets an alarm.	
ASCII a	Gives a frequency command (S01). *1	Optional frame
ASCII e	Gives a frequency command (S05). *1	
ASCII f	Gives an operation command (S06). *1	
ASCII g	Reads the output frequency (M06). *1	
ACCII h	Reads the torque monitor (M07). *1	
ACCII i	Reads the torque current monitor (M08) *1	
ASCII j	Reads the output frequency (M09). *1	
ASCII k	Reads the operation status monitor (M14). *1	
ASCII m	Resets an alarm.	

*1 The above commands "a" to "k" are used to read or write data in the function code data format specified in parentheses.

[2] Data field

Standard frame

8	9	10	11	12
Special additional data	Data's first character	Data's second character	Data's third character	Data's fourth character

Optional frame

9	10	11	12
Data's first character	Data's second character	Data's third character	Data's fourth character

All data, except for some special ones, are treated as 16 bits long. In the data field of the communications frame, data is hexadecimal (0000_H – $FFFF_H$), and each digit is represented by an ASCII code. Negative integer data (signed data) is treated as a complement of 2 of the integer data without the sign.

CAUTION
- The alphabetic characters A to F of hexadecimal data must be uppercase.
- Set 0 in all the data fields of the request frame for polling.
- In selecting, the data field of the ACK frame will be undefined.

(Example) When setting 20Hz with function code S01 (speed setting 1) (maximum frequency = 60Hz)

1) Calculate the set value according to the data format of S01 (±20000/maximum frequency).
   Data = 20Hz x ±20000/60Hz (+ for forward rotation, – for reverse rotation)
   =±6666.6
   ≈±6667

2) Convert the data into hexadecimal (a complement of 2 in the case of negative data).
   Data = 6667 ..... (forward rotation)
   $=1A0B_H$
   Data = –6667 ..... (reverse rotation)
   = 0 – 6667
   Thus,
   65536 – 6667 = 58869 = $E5F5_H$

3) Set the data.

Position	Set value (forward rotation)	Set value (reverse rotation)
Data's first character	ASCII 1	ASCII E
Data's second character	ASCII A	ASCII 5
Data's third character	ASCII 0	ASCII F
Data's fourth character	ASCII B	ASCII 5

[3] Checksum field

The data in this field is intended to check whether there is any error in the communications frame at the time of data transmission. Calculate the data by adding one byte to all fields, except for S0H and the checksum field, treating the last byte of the result as a two-digit hexadecimal value, and converting each digit into an ASCII code.

(Example) When the result of addition is 0123_H

Position	Set value (forward rotation)
Checksum 1	ASCII 2
Checksum 2	ASCII 3

4.1.4 Communications examples

Typical communications examples are shown below (the station number is 12 in all cases):

[1] Standard frame

(Example 1) Selecting S01: speed setting 1 (write)

10Hz command x 20,000/maximum frequency 50Hz = 4000d = $0FA0_H$

Request frame (host ⇒ inverter)

SOH	1	2	ENQ	W	S	0	1	SP	0	F	A	0	ETX	7	D

ACK frame (inverter ⇒ host)

SOH	1	2	ACK	W	S	0	1	SP	0	F	A	0	ETX	7	E

NAK frame (inverter ⇒ host) ... Link priority error

SOH	1	2	NAK	W	S	0	1	SP	SP	SP	4	C	ETX	5	D

(Example 2) Polling of M09: output frequency (read)

Request frame (host ⇒ inverter)

SOH	1	2	ENQ	R	M	0	9	SP	0	0	0	0	ETX	5	3

ACK frame (inverter ⇒ host)

SOH	1	2	ACK	R	M	0	9	SP	0	B	B	8	ETX	8	0

[2] Optional frame

(Example 1) Selecting of operation command (write)

Request frame (host ⇒ inverter) ... FWD command

SOH	1	2	ENQ	f	0	0	0	1	ETX	9	2

ACK frame (inverter ⇒ host)

SOH	1	2	ACK	f	ETX	D	2

NAK frame (inverter ⇒ host)

The cause of the error can be confirmed with function code M26 (transmission error transaction code).

SOH	1	2	NAK	f	ETX	E	1

(Example 2) Selecting of operation command in broadcast (write)

Request frame (host ⇒ inverter) ... REV command

SOH	9	9	ENQ	f	0	0	0	2	ETX	A	2

The inverter does not respond to broadcast.

Table 4.12 ASCII code table

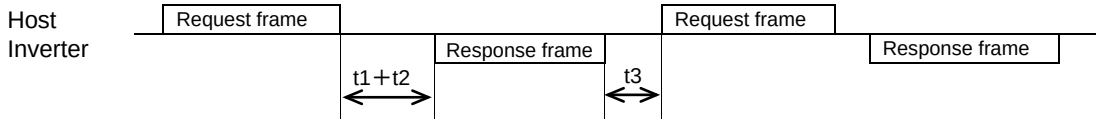
	00H	10H	20H	30H	40H	50H	60H	70H
0H	NUL	DLE	SP	0	@	P	`	p
1H	SOH	DC1	!	1	A	Q	a	q
2H	STX	DC2	“	2	B	R	b	r
3H	ETX	DC3	#	3	C	S	c	s
4H	EOT	DC4	$	4	D	T	d	t
5H	ENQ	NAK	%	5	E	U	e	u
6H	ACK	SYN	&	6	F	V	f	v
7H	BEL	ETB	‘	7	G	W	g	w
8H	BS	CAN	(	8	H	X	h	x
9H	HT	EM	)	9	I	Y	i	y
AH	LF	SUB	*	:	J	Z	j	z
BH	VT	ESC	+	;	K	[	k	{
CH	FF	FS	,	<	L	\	l	|
DH	CR	GS	–	=	M	]	m	}
EH	SO	RS	.	>	N	-	n	~
FH	SI	US	/	?	O	_	o	DEL

The shaded codes are used for this communications protocol.

4.2 Host Side Procedures

4.2.1 Inverter's response time

Upon receipt of a query request from the host, the inverter executes the requested command, and sends back response after the response time shown below:



t1 + t2: Inverter's response time

t1: Response interval time (function code: y09)
The time until the inverter starts to send response to the request from the host can be set. Setting the response interval time enables even the host side with a slow transaction execution speed to adjust timing.

t2: Inverter's transaction time
This is the time until the inverter executes the request and sends back response as shown in Table 4.13 below.

t3: See "4.2.3 Receiving preparation complete time and message timing from the host."

Table 4.13 Inverter's transaction time

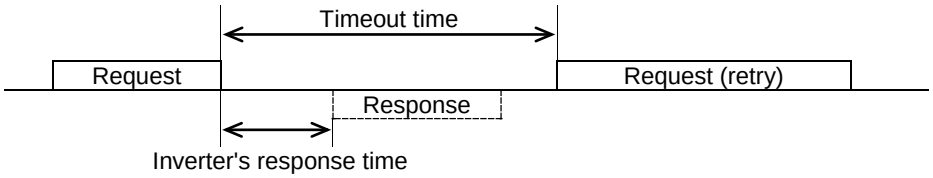
Command	Transaction	Description	t2	Timeout time (recommended)
R	Function code read data		≤10ms	0.1 sec
W	Function code write data	S code commands other than S08 or S09	≤10ms	0.1 sec
		Motor parameter initialization	≤500ms	1.0 sec
		Data initialization: H03 = 1	≤5s	10.0 sec
		Function code other than above	≤100ms	0.5 sec
A	Function code data high-speed writing		≤10ms	0.1 sec
E, m	Alarm reset		≤10ms	0.1 sec
a, e, f	Specific function code write data		≤10ms	0.1 sec
g, h, i, j, k	Specific function code read data		≤10ms	0.1 sec

4.2.2 Timeout processing

To read/write data from/to the host, transmit the next frame after confirming response. If response is not transmitted from the inverter for more than a specified period of time (timeout time), it is a timeout, and perform a retry. (If a retry begins before a timeout, the requested frame cannot be received properly.)

The timeout time must be set longer than the response time of the inverter. Table 4.13 above mentioned shows recommended timeout times when no response interval time is set.

In case of a timeout, retransmit the same frame or perform polling (M26) for reading details of an error to confirm whether the inverter sends back normal response. If normal response is returned, this indicates that some transient transmission error occurred due to noise or other reasons, and subsequent communications is normal. (However, if this phenomenon frequently occurs even when normal response is sent back, some problem may exist. Perform a close investigation.) In case of no response, perform another retry. If the number of retries exceeds the set value (generally about three times), there may be a problem with the hardware and the software for the host controller. Investigate and correct the cause.



4.2.3 Receiving preparation complete time and message timing from the host

The time from the return of response by the inverter to the completion of receiving preparation of the communications port (switching from transmission to receiving) is called a receiving preparation complete time.

Transmit the following messages after the receiving preparation complete time:

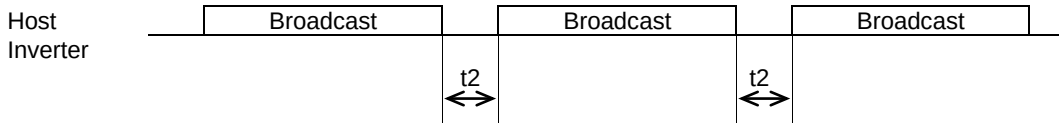
Receiving preparation complete time: 5ms or less

Message timing from the host (t3): t3 > 5ms

In the case of broadcast

Upon receipt of a request for a query message from the host by broadcast, the inverter executes the command and enters the receiving enabled status.

Transmit the next message from the host following broadcast after the transaction time (t2) of the inverter.



4.3 Communications Errors

4.3.1 Categories of communications errors

The communications-related errors the inverter detects are listed below:

Table 4.14 Communications errors detected by inverter

Error category	Error name	Description	Error code (M26)	Order of priority
Transmission error	Checksum error	The frame to the local station is found unmatched in checksum collation.	71(47_H)	–
	Parity error	The parity is unmatched.	72(48_H)	–
	Other errors	Receiving errors other than the abovementioned (framing error, overrun error)	73(49_H)	–
Logical error	Format error	- The characters of the transmission request are incorrect. - The last character of the message is not in the specified position.	74($4A_H$)	1
	Command error	A command that does not exist was transmitted.	75($4B_H$)	2
	Link priority error	A frequency command, PID command, or change command of the run command (writing request to S01, S05, S06, and S13) are sent through the communications route other than that specified with H30.	76($4C_H$)	3
	Function code error	A function code that does not exist was requested.	78($4E_H$)	4
	Write disabled error	An attempt was made during operation to write the function code for write disabled or for write disabled during operation.	79($4F_H$)	5
	Data error	The write data is beyond the writable range.	80(50_H)	6
	Error during writing	An attempt was made to write another function data during function writing with command A.	81(51_H)	7
Communi-cations disconnec-tion error	Communicati ons disconnection error	The inverter did not receive a normal frame addressed to local station or to other stations within the communications disconnection detection time set with the function code.	–	–

Transmission error (error codes 71 to 73)

When a transmission error occurs eight straight times, it is handled as a communications error. However, the inverter does not return response in order to avoid overlapping of response from multiple inverters. The count of eight straight times will be cleared upon normal receipt of a frame to another station or to the local inverter (station) itself.

Logical error (error codes 74 to 81)

When a logical error is detected, a negative acknowledgment (NAK) frame reports it. For further information, see the NAK response of each frame. The table 4.14 shows the order of priority of logical error. If the alarm is caused by two or more factors, the factor with the highest priority (smallest number) is indicated as an error code.
Concerning all the request frames, if the inverter failed to detect ETX after detecting request-to-send character with the specified 3-byte position until reaching the15-byte position, the inverter returns no response.

Communications disconnection error

If the inverter in operation does not receive a normal frame to itself (local station) or to another station when it has received a normal frame more than once and is operating via communications (frequency command or operation command), this status is considered disconnected.
When a disconnection status is set and remains over the setting time of function code y08, y18 (communications disconnection detection time), it is treated as a communications error.

1) Communications disconnection detection time (y08, y18): 0 (without detection), 1 to 60 (seconds)
2) Condition to clear communications disconnection detection timer: It will be cleared in a status other than disconnection.

When it is necessary to take action against errors by factor, the factor can be identified by reading M26. (M26 stores the latest communications error codes.)

4.3.2 Operations in case of communications errors

Operations in case of a transmission or communications disconnection error are the same as those of the Modbus RTU protocol. See "3.3.2 Operations in case of errors" in Chapter 3 Modbus RTU Protocol.

CHAPTER 5 FUNCTION CODES AND DATA FORMATS

This chapter describes communications dedicated function codes and the data formats of communications frames. Support different function codes. For details, see the description of each function code.

Table of Contents

5.1 Communications Dedicated Function Codes

5.1.1 About communications dedicated function codes

Communications dedicated function codes are available to monitor the operation and status of the inverter via communications. They are classified into the groups shown in Table 5.1 below:

Table 5.1 Types of communications dedicated function codes

Communications dedicated function code group	Function
S	Command data
M	Monitor data 1 (for reading only)
W	Monitor data 2 (for reading only)
X	Alarm information (for reading only)
Z	

The sections that follow describe communications dedicated function codes of each group.

5.1.2 Command data

[1] List of command data

A list of function codes (S codes) for command data is shown below. The “Support” field in the table indicates whether each function code is supported. ○ indicates that the function code is supported, and × indicates that it is not supported.

Table 5.2 List of command data

Code	Name	Function	Permissible setting range	Min. step	Unit	R/W *1	Support VF1A
S01	Frequency reference (p.u.)	Frequency command issued through communications (the reference value for maximum frequency)	-32768 to 32767 (Max frequency: at +/- 20000)	1	–	R/W	○
S02	Torque command	Torque command from communication function	-327.68 to 327.67	0.01	%	R/W	○
S03	Torque current command	Torque current command from communication function	-327.68 to 327.67	0.01	%	R/W	○
S05	Frequency reference	Frequency command issued through communications (in units of 0.01 Hz)	0.00 to 655.35	00.1	Hz	R/W	○
S06	Operation command	Operation command issued through communications [general input terminal functions (X1 to X9, XF (FWD), R (REV)) and FWD, REV, RST only through communications]	0000_H to $FFFF_H$	1	–	R/W	○
S07	Universal DO	Command issued to DO terminal through communications	0000_H to $FFFF_H$	1	–	R/W	○
S08	Acceleration time F07	Each data is set with the code or communications format common to all the inverter types.	0.0 to 6000.0	0.1	s	R/W	○
S09	Deceleration time F08		0.0 to 6000.0	0.1	s	R/W	○
S10	Torque limit level 1 F40		20 to 200, 999	1	%	R/W	×
	Torque limit value 1-1		-300.00 to 300.00, 999	0.01			○
S11	Torque limit level 2 F41		20 to 200, 999	1	%	R/W	×
	Torque limit value 1-2		-300.00 to 300.00, 999	0.01			○
S12	Universal AO	Command issued to AO terminal through communications	-32768 to 32767 (Full scale: at +/- 20,000)	1	–	R/W	○
S13	PID command	PID command issued through communications	-32768 to 32767 (+/- 20000 corresponds to +/- 100%)	1	–	R/W	○

*1 Legends in R/W column...R: Readable, W: Write-enable, R/W: Read/write possible

Table 5.2 List of command data (Continued)

Code	Name	Function	Permissible setting range	Min. step	Unit	R/W *1	Support VF1A
S14	Alarm reset command	Alarm reset command issued through communications	0 or 1	1	–	R/W	○
S19	Speed command	Speed command issued via communications	-32768 to 32767	1	min^{-1}	R/W	○

*1 Legends in R/W column...R: Readable, W: Write-enable, R/W: Read/write possible

[2] Frequency and PID command data

Table 5.3 Function codes for frequency and PID command data

Code	Name	Function	Permissible setting range	Min. step	Unit	R/W *1
S01	Frequency reference (p.u.)	Frequency command via communications (value based on the maximum frequency)	-32768 to 32767 (±20,000 = maximum frequency)	1	–	R/W
S05	Frequency reference	Frequency command from communications (by 0.01Hz)	0.00 to 655.35	0.01	Hz	R/W
S13	PID command	PID command from communications	-32768 to 32767 (±100% at ±20,000)	1	–	R/W
S19	Speed command	Speed command issued via communications	-32768 to 32767	1	r/min	R/W

*1 Legends in R/W column...R: Readable, W: Write-enable, R/W: Read/write possible

1) If both S01 and S05 have been set, the S01 command takes priority when S01 ≠ 0. If both S05 and S19 have been set, the S05 command takes priority when S05 ≠ 0.
2) The actual operation specified by each command is limited by internal processing of the inverter. For example, a value over 20,000 can be written to S01, but the actual frequency is limited to the maximum frequency or to the upper limit frequency set with another function code.
3) When an attempt is made to read the command data shown here, the data previously directed by communications, not the command value for actual operation, will be read. (Obtain the latest command value by reading the M code.)
4) At S01, set a value based on ±20,000 as the maximum frequency. For example, when the maximum frequency is 60Hz, set 20,000 at S01 with a set frequency of 60Hz, or 10,000 with a set frequency of 30Hz.

[3] Operation command data

Table 5.4 Function codes for operation command data

Code	Name	Function	Permissible setting range	Min. step	Unit	R/W *1
S06	Operation command	Operation command via communications (general-purpose input terminal functions (X1 – X9, XF (FWD), XR (REV)) and communications dedicated command (FWD, REV, RST)	0000_H to $FFFF_H$	1	–	R/W
S14	Alarm reset command	Alarm reset command via communications	0 or 1	1	–	R/W

*1 Legends in R/W column...R: Readable, W: Write-enable, R/W: Read/write possible

1) To make alarm resetting with S06, bit 15 must be set to 1 and then set back to 0. Alarm resetting is impossible unless the communications side is made valid by the settings of function codes H30, y98, and y99 and the "LE" assigned terminal.
2) S14 does not require the operation described in 1) above, and writing 1 permits alarm resetting (because writing the value once turns ON the reset command that will be turned OFF after a specific period of time). This command is 0 whenever it is read, and is always valid, irrespective of function codes H30, y98, and y99 and the status of the "LE" assigned terminal.
3) X1 – X5, XF (FWD), and XR (REV) operate according to the functions set with function codes E01 – E05, E98, and E99.
   General-purpose input terminals X4 and X5 and function codes E04 and E05 are not supported by the inverter.
4) When giving operation command S06 via communications, the relation between S06 and the inverter terminal (external signal input) command is shown in Table 5.4 on the next page. The "Support" column of the table indicates whether each function is supported by the respective models or not. ○ indicates the function is supported, and × indicates the function is not supported.

⚠ WARNING

If alarm resetting is performed with the operation command (S06) uncleared, the inverter will start to operate just upon alarm resetting. Before alarm resetting, confirm that the operation command is cleared.

Otherwise, an accident may result.

Table 5.5 Relation between operation command (S06) and inverter terminal command (external signal input)

Function				When not assigned (positive logic)	Function active direction *1	Command		Support
Type	Assign-ment number	Internal operation command symbol	Name			Com-munic-ations	Terminal block	VF1A
Fixed function	–	FWD	Forward operation/stop command	–	ON	Valid	Invalid	○
		REV	Reverse operation/stop command	–	ON			○
		RST	Alarm reset	–	ON			○
General-purpose input	0	SS1	Multistep frequency selection (0 to 1steps)	OFF	ON	Valid	Invalid	○
	1	SS2	Multistep frequency selection (0 to 3steps)	OFF	ON			○
	2	SS4	Multistep frequency selection (0 to 7steps)	OFF	ON			○
	3	SS8	Multistep frequency selection (0 to 15steps)	OFF	ON			○
	4	RT1	Acceleration/deceleration time selection (2steps)	OFF	ON			○
	5	RT2	Acceleration/deceleration time selection (4steps)	OFF	ON			○
	6	HLD	3-wire operation stop command	OFF	ON	Invalid		○
	7	BX	Coast-to-stop command	OFF	ON	Valid		○
	8	RST	Alarm reset	OFF	ON			○
X1	9	THR	Trip command (External fault)	ON	OFF	Invalid	Valid	○
X2	10	JOG	Jogging operation	OFF	ON	Invalid		○
X3	11	Hz2/Hz1	Frequency setting 2/1 switching command	OFF	ON	Valid	Invalid	○
X4	12	M2/M1	Motor 2 /motor 1	OFF	ON	Valid	Invalid	×
X5		M2	Motor selection 2	OFF	ON	Valid	Invalid	○
XF (FWD)	13	DCBRK	DC braking command	OFF	ON	Valid	Invalid	○
	14	TL2/TL1	Torque limit 2/torque limit 1	OFF	ON			○
XR (REV)	15	SW50	Switching to commercial power supply (50Hz)	OFF	ON			○
	16	SW60	Switching to commercial power supply (60Hz)	OFF	ON			○
	17	UP	UP command	OFF	ON	Invalid	Valid	○
	18	DOWN	DOWN command	OFF	ON			○
	19	WE-KP	Write enable for keypad	ON	ON	Valid		○
	20	Hz/PID	PID control cancel	OFF	ON	Valid	Invalid	○
	21	IVS	Normal/Inverse mode changeover	OFF	ON			○
	22	IL	Interlock	OFF	ON	Invalid	Valid	○
	24	LE	Link operation enable	ON	ON			○
	25	U-DI	Universal DI	OFF	ON			○
	26	STM	Start characteristic selection	ON	ON	Valid		×
				OFF	ON	Valid		○

*1 ON: Function active when 1, OFF: Function active when 0 Commands from the communication function operate based on positive logic, regardless of the positive logic/negative logic setting.

Table 5.5 Relation between operation command (S06) and inverter terminal command (external signal input) (Continued)

Function				When not assigned (positive logic)	Function active direction *1	Command		Support
Type	Assign-ment number	Internal operation command symbol	Name			Com-munic-ations	Terminal block	VF1A
General-purpose input X1 X2 X3 X4 X5 XF (FWD) XR (REV)	30	STOP	Forced stop	ON	OFF*2	Valid		○
	32	EXITE	Preparatory excitation	OFF	ON	Valid	Invalid	○
	33	PID-RST	PID integration/differential reset	OFF	ON	Valid	Invalid	○
	34	PID-HLD	PID integration hold	OFF	ON	Valid	Invalid	○
	35	LOC	Local (keypad) command selection	OFF	ON	Invalid	Valid	○
	36	M3	Motor selection 3	OFF	ON	Valid	Invalid	×
	37	M4	Motor selection 4	OFF	ON			×
	38	RE	Run enable	ON	ON	Valid	Invalid	×
	39	DWP	Condensation protection	OFF	ON			×
	40	ISW50	Switching to commercial power supply incorporated sequence (50Hz)	ON	OFF			×
	41	ISW60	Switching to commercial power supply incorporated sequence (60Hz)	ON	OFF			×
	42	LS	Zero limit switch	OFF	ON	Valid	Valid	○
	43	S/R	Start/reset	OFF	ON			○
	44	SPRM	Serial pulse receive mode	OFF	ON			○
	45	RTN	Return mode	OFF	ON			○
	46	OLS	Overload stop valid command	OFF	ON	Valid	Invalid	○
	47	LOCK	Servo lock command	OFF	ON	Valid	Invalid	○
	48	PIN	Pulse train input	OFF	ON	Invalid	Valid	○
	49	SIGN	Pulse train sign	OFF	ON	Invalid	Valid	○
	59	BATRY	Effective battery operation life	OFF	ON	Valid	Valid	○
	60	TB1	Torque bias command 1	OFF	ON	Valid	Invalid	○
	61	TB2	Torque bias command 2	OFF	ON	Valid	Invalid	○
	62	H-TB	Hold torque bias	OFF	ON	Valid	Invalid	○
	65	BRKE	Brake check	OFF	ON	Valid	Invalid	○
	70	Hz/LSC	Cancel line speed control	OFF	ON	Valid	Invalid	○
	71	LSC-HLD	Hold line speed control frequency in the memory	OFF	ON	Valid	Invalid	○
	72	CRUN-M1	Input during operation by commercial power (Motor 1)	OFF	ON	Valid	Valid	○
	73	CRUN-M2	Input during operation by commercial power (Motor 2)	OFF	ON			○
	74	CRUN-M3	Input during operation by commercial power (Motor 3)	OFF	ON			×
	75	CRUN-M4	Input during operation by commercial power (Motor 4)	OFF	ON			×

*1 ON: Function active when 1, OFF: Function active when 0 Commands from the communication function operate based on positive logic, regardless of the positive logic/negative logic setting.

*2 If issuing the S06 operation command from the communication function, “STOP” commands will be valid both from terminal block input and from the communication function. If a “STOP” signal is input only with terminal block input, it is necessary to set the relevant bit for commands issued with the communication function to 1. Furthermore, if inputting a “STOP” signal only with the communication function, it is necessary to input a signal to the inactive side for the relevant terminal block input.

Table 5.5 Relation between operation command (S06) and inverter terminal command (external signal input) (Continued)

Function				When not assigned (positive logic)	Function active direction *1	Command		Support
Type	Assign-ment number	Internal operation command symbol	Name			Com-munic-ations	Terminal block	VF1A
General-purpose input X1 X2 X3 X4 X5 XF (FWD) XR (REV)	76	DROOP	Droop selection	OFF	ON	Valid	Invalid	○
	77	PG-CCL	PG alarm cancel	OFF	ON	Valid	Invalid	×
	78	MPRM1	Speed control parameter selection 1	OFF	ON	Valid	Invalid	○
	79	MPRM2	Speed control parameter selection 2	OFF	ON	Valid	Invalid	○
	80	CLC	Cancel customizable logic	OFF	ON	Valid	Invalid	○
	81	CLTC	Clear all customizable logic timers	OFF	ON	Valid	Invalid	○
	82	AR-CCL	Cancel anti-regenerative control	OFF	ON	Valid	Invalid	○
	87	FR2/FR1	Run command 2/run command 1	OFF	ON	Valid	Invalid	×
	88	FWD2	Forward run/stop command 2	OFF	ON			×
	89	REV2	Reverse run/stop command 2	OFF	ON			×
	98	FWD *2	Forward operation/stop command	OFF	ON			○
	99	REV *2	Reverse operation/stop command	OFF	ON			○
	100	NONE	No assignment	–	–	–	–	○
	110	SLG2	Servo lock gain selection	OFF	ON	Valid	Invalid	×
	111	STOP-T	Force to stop	ON	OFF	Invalid	Valid	×
	171	PID-SS1	PID control multistage command 1	OFF	ON	Valid	Invalid	○
	172	PID-SS2	PID control multistage command 2	OFF	ON	Valid	Invalid	○

*1 ON: Function active when 1, OFF: Function active when 0 Commands from the communication function operate based on positive logic, regardless of the positive logic/negative logic setting.

*2 Terminals FWD/REV only

[4] Function data

Table 5.6 Function code and data (S08, S09, S10, S11)

Code	Name	Function	Permissible setting range	Min. step	Unit	R/W*1
S08	Acceleration time F07	Set data with common code numbers and in common communications formats to models.	0.0 to 6000.0	0.1	s	R/W
S09	Deceleration time F08		0.0 to 6000.0	0.1	s	R/W
S10	Torque limit level 1-1 F40		0.00 to 300.00, 999	0.01	%	R/W
S11	Torque limit level 1-2 F41		0.00 to 300.00, 999	1 0.01	%	R/W

*1 Legends in R/W column...R: Readable, W: Write-enable, R/W: Read/write possible

1) When an attempt is made to enter a value out of the appropriate permissible setting range, an out-of-range error will result.

2) The S08, S09, S10, and S11 acceleration/deceleration time, and the torque limiting level are set in F07 (Acceleration time 1), F08 (Deceleration time 1), F40 (Torque limiting level 1 (Driving)), and F41 (Torque limiting level 1 (Control)), respectively.
(If the function code is changed at the touch panel, etc., changes will also be reflected to S08 to S11.)

3) The figures below the fourth place figure of the S08 acceleration time and the S09 deceleration time are omitted within the inverter. (If, for example, 123.4s is written, 123.0s is entered.)

[5] Universal DO and universal AO

Table 5.7 Function code and data (S07, S12)

Code	Name	Function	Permissible setting range	Min. step	Unit	R/W *1
S07	Universal DO	Command from communications function to terminal DO	0000_H to $FFFF_H$	1	–	R/W
S12	Universal AO	Command from communications function to terminal AO	-32768 to 32767 (Full scale by ±20000)	1	–	R/W

*1 Legends in R/W column...R: Readable, W: Write-enable, R/W: Read/write possible

1) A host can control the output terminal of the inverter through the communications function to issue commands to peripheral devices.

2) When universal DO and universal AO are assigned to the following signals, the signals operate as simple output regardless of inverter's operation.
Universal DO: Transistor output (Y1, Y2, Y3, Y4), relay output (Y5A/C, 30A/B/C)
Universal AO: Analog output (FMA), pulse output (FMP)

5.1.3 Monitor data 1

Function codes for monitor data 1 (M codes) are described in the four tables (1 to 4) below. These function codes are for reading only.

These function codes are for reading only. The "Support" column of the table indicates whether each function is supported by the respective models or not. ○ indicates the function is supported, and × indicates the function is not supported.

Table 5.8 Monitor data 1 function codes (1)

Code	Name	Description	Monitor range	Min. step	Unit	Corresponding LED indicator	Support
							VF1A
M01	Frequency reference (p.u.) (Final command)	Frequency command based on the maximum frequency	-32768 to 32767 (±20,000 = maximum frequency)	1	–	–	○
M02	Torque command (Final command)	Torque command based on the motor rated torque (100%)	-327.68 to 327.67	0.01	%	–	○
M03	Torque current command (Final command)	Torque current command based on the motor rated torque current (100%)	-327.68 to 327.67	0.01	%	–	○
M04	Flux command	Flux command based on the rated motor flux (100%)	-327.68 to 327.67	0.01	%	–	○
M05	Frequency reference (Final command)	Frequency command with min. step 0.01Hz	0.00 to 655.35	0.01	Hz	–	○
M06	Output frequency 1 (p.u.)	Output frequency based on the maximum frequency (before slip compensation)	-32768 to 32767 (±20,000 = maximum frequency)	1	–	–	○
M07	Torque real value	Motor output torque based on the motor's rated torque (100%)	-327.68 to 327.67	0.01	%	–	○
M08	Torque current	Torque current based on the rated torque current of the motor (100%)	-327.68 to 327.67	0.01	%	–	○
M09	Output frequency	Output frequency with min. step 0.01Hz	Doesa: -655.35 to 655.35 RTU: 0.00 to 655.35	0.01	Hz	–	○
M10	Input power	Power consumption value based on the "nominal applicable motor output" (100%)	0.00 to 399.99	0.01	%	–	○
M11	Output current effective value	Output current effective value based on the inverter rated current	0.00 to 399.99 (100% = inverter rated current)	0.01	%	–	○
M12	Output voltage effective value	Output voltage effective value (min. step: 1.0V)	0.0 to 1000.0	0.1 *1	V	–	○
M13	Operation command (Final command)	Displays the final command created by information from the keypad, terminal block, and communications, and transmitted to the inverter inside.	0000_H to $FFFF_H$	1	–	–	○

*1 Since M12 does not have any data after the decimal point, the minimum step is 1.0.

Table 5.9 Monitor data 1 function codes (2)

Code	Name	Description	Monitor range	Min. step	Unit	Corresponding LED indicator	Support VF1A
M14	Operation status	Displays the operation status in bit signal.	0000_H to $FFFF_H$	1	–	–	○
M15	General-purpose output terminal information	General-purpose output terminal information is monitored.	0000_H to $FFFF_H$	1	–	–	○
M16	Latest alarm contents	Display alarm contents in the form of code.	0 to 254	1	–	–	○
M17	Last alarm contents						
M18	Second last alarm contents						
M19	Third last alarm contents						
M20	Cumulative operation time	–	0 to 65535	1	h	–	○
M21	DC link circuit voltage	Displays the DC link circuit voltage of the inverter.	0 to 1000	1	V	–	○
M22	Motor temperature	Motor temperature is displayed.	-30 to 200	1	°C	3_C4	×
M23	Model code	Displays the series, generation, model, and voltage series in four-digit HEX data.	0000_H to $FFFF_H$	1	–	–	○
M24	Capacity code	Displays the capacity of the inverter.	0 to 65535	1	–	–	○
M25	ROM version	Displays the ROM version used in the inverter.	0 to 9999	1	–	–	○
M26	Transmission error transaction code	Communications error code of RS-485	0 to 127	1	–	–	○
M27	Frequency reference on alarm (p.u.) (Final command)	Data equivalent to M01 on alarm	-32768 to 32767 (±20,000 = maximum frequency)	1	–	–	○
M28	Torque command on alarm (Final command)	Data equivalent to M02 on alarm	-327.68 to 327.67	0.01	%	–	○
M29	Torque current command on alarm (Final command)	Data equivalent to M03 on alarm	-327.68 to 327.67	0.01	%	–	○
M30	Flux command on alarm (Final command)	Data equivalent to M04 on alarm	-327.68 to 327.67	0.01	%	–	○
M31	Frequency reference on alarm (Final command)	Data equivalent to M05 on alarm	0.00 to 655.35	0.01	Hz	–	○
M32	Output frequency 1 on alarm (p.u.)	Data equivalent to M06 on alarm	-32768 to 32767 (±20,000 = maximum frequency)	1	–	–	○

Table 5.10 Monitor data 1 function codes (3)

Code	Name	Description	Monitor range	Min. step	Unit	Corresponding LED indicator	Support VF1A
M33	Torque real value on alarm	Data equivalent to M07 on alarm	-327.68 to 327.67	0.01	%	–	O
M34	Torque current on alarm	Data equivalent to M08 on alarm	-327.68 to 327.67	0.01	%	–	O
M35	Output frequency on alarm	Data equivalent to M09 on alarm	Doesa: -655.35 to 655.35 RTU:	0.01	Hz	–	O
M36	Input power on alarm	Data equivalent to M10 on alarm	0.00 to 399.99	0.01	%	–	O
M37	Output current effective value on alarm	Data equivalent to M11 on alarm	0.00 to 399.99 (100% = inverter rated current)	0.01	%	–	O
M38	Output voltage effective value on alarm	Data equivalent to M12 on alarm	0.0 to 1000.0	0.1	V	–	O
M39	Operation command on alarm	Data equivalent to M13 on alarm	0000_H to $FFFF_H$	–	–	–	O
M40	Operation status on alarm	Data equivalent to M14 on alarm	0000_H to $FFFF_H$	–	–	–	O
M41	Output terminal information on alarm	Data equivalent to M15 on alarm	0000_H to $FFFF_H$	–	–	–	O
M42	Cumulative operation time on alarm	Data equivalent to M20 on alarm	0 to 65535	1	h	–	O
M43	DC link circuit voltage on alarm	Data equivalent to M21 on alarm	0 to 1000	1	V	–	O
M44	Inverter internal air temperature on alarm	Air temperature inside the inverter on alarm	0 to 255	1	°C	–	O
M45	Heat sink temperature on alarm	Data equivalent to M62 on alarm	0 to 255	1	°C	–	O
M46	Life of main circuit capacitor	The capacity of the main circuit capacitor is 100% when delivered from the factory	0.0 to 100.0	0.1	%	–	O
M47	Life of PC board electrolytic capacitor	Cumulative operation time of the capacitor packaged on the PC board	0 to 65535	1	h	–	O
M48	Life of heat sink	Cumulative operation time of the heat sink	0 to 65535	1	h	–	O
M49	Input terminal voltage [12]	Input voltage of terminal [12] (-20,000/-10V, 20,000/10V)	-32768 to 32767	1	–	–	O
M50	Input terminal current [C1]	Input current of terminal [C1] (0/0mA, 20,000/20mA)	0 to 32767	1	–	–	O
M52	Input terminal voltage [32]	Input voltage of terminal [32] (-20,000/-10V, 20,000/10V)	-32768 to 32767	1	–	–	O

Table 5.11 Monitor data 1 function codes (4)

Code	Name	Description	Monitor range	Min. step	Unit	Corresponding LED indicator	Support VF1A
M53	Input terminal current [C2]	Input current of terminal [C2] (0/0mA, 20,000/20mA)	0 to 32767	1	–	–	O
M54	Input terminal voltage [V2]	Input voltage of terminal [V2] (-20000/10V to 20000/10V)	-32768 to 32767	1	–	–	O
M61	Inverter internal air temperature	Current temperature inside the inverter	0 to 255	1	°C	5_24	O
M62	Heat sink temperature	Current temperature of the heat sink within the inverter	0 to 255	1	°C	5_25	O
M63	Load factor	Load rate based on the motor rating	-327.68 to 327.67	0.01	%	–	O
M64	Motor output	Motor output based on the motor's rated output (kW)	-327.68 to 327.67	0.01	%	–	O
M65	Motor output on alarm	Data equivalent to M64 on alarm	-32768 to 32767	1	–	–	O
M66	Speed detection	Detected speed	-32768 to 32767	1	–	–	O
M67	Transmission error processing code	Error processing code for data transfer	0 to 127	–	–	–	O
M68	PID final command	±20000/±100%	–32768 to 32767	1	–	–	O
M69	Inverter rated current	Doesa	0.00 to 9999	Variable	A	–	O
		RTU (inverter capacity 22kW (30HP) or less)	0.00 to 655.35	0.01	A	–	O
		RTU (inverter capacity 30kW (40HP) or more)	0.0 to 6553.5	0.1	A	–	O
M70	Operation status 2	Displays the operation status in the form of a bit signal.	0000_H to $FFFF_H$	1	–	–	O
M71	Input terminal information	Operation command information from the terminal block and communications	0000_H to $FFFF_H$	1	–	–	O
M72	PID feedback value	PID feedback based on 100% of analog input (±20000/100%)	–32768 to 32767	1	–	–	O
M73	PID output	PID output based on the maximum frequency (F03) (±20000/100%)	–32768 to 32767	1	–	–	O
M74	Operating status 2	Displays the operation status in the form of a bit signal.	0000_H to $FFFF_H$	1	–	3_23	O
M76	Main circuit capacitor life (elapsed time)	Main circuit capacitor use time	0 to 65535 (in units of 10 hours)	1	10h	5_26	O
M77	Main circuit capacitor life (remaining time)	Main circuit capacitor remaining life	0 to 65535 (in units of 10 hours)	1	10h	5_27	O

Table 5.12 Monitor data 1 function codes (5)

Code	Name	Description	Monitor range	Min. step	Unit	Corresponding LED indicator	Support VF1A
M78	Rotation speed command	Rotation speed command in 1 min^{-1} units	-327.68 to 327.67	1	min^{-1}	–	O
M79	Rotation speed	Output rotation speed in 1 min^{-1} units	-327.68 to 327.67	1	min^{-1}	–	O
M81	Remaining time before maintenance (M1)	Time before the next maintenance	0 to 65535 (in units of 10 hours)	1	10h	S_31	O
M85	No. of starting times before maintenance (M1)	Allowable starting times before the next maintenance	0 to 65535	1	Times	S_35	O
M86	Light alarm (latest)	Latest light alarm indicated with a code	0 to 254	1	–	S_36	O
M87	Light alarm (last)	Last light alarm indicated with a code	0 to 254	1	–	S_37	O
M88	Light alarm (second last)	Second last light alarm indicated with a code	0 to 254	1	–	S_38	O
M89	Light alarm (third last)	Third last light alarm indicated with a code	0 to 254	1	–	S_39	O

5.1.4 Information displayed on the keypad

The function codes used to read, via RS-485, information displayed on the keypad are classified into W codes, X codes, and Z codes. All of these function codes are for read only.

The function codes shown in Tables 5.14 to 5.16 correspond to the menu numbers displayed on the LEDs on the keypad shown in the "LED display" field. The "Support" column of the table indicates whether each function is supported by the respective models or not. ○ indicates the function is supported, and × indicates the function is not supported.

For details about the keypad display, see "Chapter 3 OPERATION USING THE KEYPAD" in the instruction manual of each inverter type.

RTU and Doesa in the “Remarks” field represent the Modbus RTU protocol and Doesa general-purpose inverter protocol, respectively.

Table 5.13 Keypad-related function code (W codes)

Code	Name	Monitor range	Min step	Unit	LED display	Support VF1A	Remarks
W01	Operation status	0000_H to $FFFF_H$	1	–	3_06 3_07	○	
W02	Frequency reference	0.00 to 655.35	0.01	Hz	3_05	○	
W03	Output frequency (before slip compensation)	0.00 to 655.35	0.01	Hz	3_00	○	
W04	Output frequency (after slip compensation)	0.00 to 655.35	0.01	Hz	3_01	○	
W05	Output current	0.00 to 9999	Variable	A	3_02	○	Doesa
		0.00 to 655.35	0.01	A	3_02	○	RTU (inverter capacity 22kW (30HP) or less)
		0.0 to 6553.5	0.1	A	3_02	○	RTU (inverter capacity 30kW (40HP) or more)
W06	Output voltage	0.0 to 1000.0	0.1	V	3_03	○	
W07	Torque	-999 to 999	1	%	3_04	○	
W08	Rotation speed	0.00 to 99990	Variable	min^{-1}	3_08	○	
W09	Load rotation speed	0.00 to 99990	Variable	min^{-1}	3_09	○	
W10	Line speed	0.00 to 99990	Variable	m/min	3_15	○	
W11	PID process command	-999 to 9990	Variable	–	3_10	○	PID command value or PID feedback value converted to the physical quantity of the control target by E40 and E41
W12	PID feedback value	-999 to 9990	Variable	–	3_11	○	
W13	Level of torque value 1	0 to 1000	1	%	3_12	○	
W14	Level of torque value 2	0 to 1000	1	%	3_13	○	
W15	Ratio value	0.00 to 655.35	0.01	%	3_14	○	
W16	Rotation speed set value	0.00 to 99990	Variable	min^{-1}	Speed monitor (Set with E43 or E48)	○	
W17	Load speed set value	0.00 to 99990	Variable	min^{-1}		○	
W18	Line speed set value	0.00 to 99990	Variable	min^{-1}		○	
W19	Constant feed time set value	0.00 to 999.9	Variable	min		○	
W20	Constant feed time	0.00 to 999.9	Variable	min		○	
W21	Input power	0.00 to 9999	Variable	kW	Operation status monitor (Set with E43)	○	
W22	Motor output	0.00 to 9999	Variable	kW		○	
W23	Load rate	-999 to 999	1	%		○	
W24	Torque current	-999 to 999	1	%		○	
W26	Flux command value	-999 to 999	1	%	3_22	○	
W27	Timer operation remaining time	0 to 9999	1	s	Operation status monitor (Set with E43)	○	
W28	Operation command source	0 to 23	1	–	–	○	*1
W29	Frequency and PID command source	0 to 36	1	–	–	○	*2
W30	Speed set value at percentage	0.00 to 100.00	0.01	%	Speed monitor (Set with E43 or E48)	○	
W31	Speed set value at percentage	0.00 to 100.00	0.01	%		○	
W32	PID output	0 to 150.0	0.1	%	3_21	○	
W33	Analog input monitor	-999 to 9990	Variable	–	Operation status monitor (Set with E43)	○	
W35	Teminal [32] input voltage	-12.0 to 12.0	0.1	V	4_20	○	
W36	Teminal [C2] input current	0.0 to 30.0	0.1	mA	4_21	○	

Table 5.13 Keypad-related function code (W codes) (Continued)

Code	Name	Monitor range	Min step	Unit	LED display	Support Doesa	Remarks
W37	Teminal [A0] output voltage	-12.0 to 12.0	0.1	V	4_22	○	
W38	Teminal [CS] output current	0.0 to 30.0	0.1	mA	4_23	○	
W39	[X7] pulse input monitor	-327.68 to 327.67	0.01	–	4_11	○	Unit: kp/s
W40	Control circuit terminal (input)	0000_H to $FFFF_H$	1	–	4_00	○	
W41	Control circuit terminal (Output)	0000_H to $FFFF_H$	1	–	4_00	○	
W42	Communications control signal (input)	0000_H to $FFFF_H$	1	–	4_01	○	
W43	Communications control signal (output)	0000_H to $FFFF_H$	1	–	4_01	○	
W44	Terminal [12] input voltage	0.0 to 12.0	0.1	V	4_02	○	
W45	Terminal [C1] input current	0.0 to 30.0	0.1	mA	4_03	○	
W46	FMA output voltage	0.0 to 12.0	0.1	V	4_04	○	
W47	FMP output voltage	0.0 to 12.0	0.1	V	4_05	○	
W48	FMP output frequency	0 to 6000	1	p/s	4_06	○	The output pulse rate of terminal FMP expressed by (p/s)
W49	V2 terminal input voltage	0.0 to 12.0	0.1	V	4_07	○	
W50	FMA output current	0.0 to 30.0	0.1	mA	4_08	○	
W51	Situation of input terminals on DIO option	0000_H to $FFFF_H$	1	–	4_10	○	
W52	Situation of output terminals on DIO option	0000_H to $FFFF_H$	1	–	4_10	○	
W53	Pulse input（Master - side A/B phase)	-327.68 to 327.67	0.01	–	4_15	○	Unit: kp/s
W54	Pulse input（Master - side Z phase)	0 to 6000	1	p/s	4_16	○	
W55	Pulse input(Slave - side A/B phase)	-327.68 to 327.67	0.01	–	4_17	○	Unit: kp/s
W56	Pulse input(Slave - side Z phase)	0 to 6000	1	p/s	4_18	○	
W57	Current Position Pulse(Upper column)	-999 to 999	1	–	3_18	○	
W58	Current Position Pulse(Lower column)	0 to 9999	1	–	3_18	○	

*1 Operation command source code

Indicates the current source of operation commands.

Code	Description	VF1A
0	Run by the keypad (rotation direction: depends on the terminal input)	○
1	Run by the terminals	○
2	Run by the keypad (forward rotation)	○
3	Run by the keypad (reverse rotation)	○
4	Run command 2 (when FR2/FR1 is ON)	×
20	Port 1 (RS-485 channel 1)	○
21	Port 2 (RS-485 channel 2)	○
22	Bus option	○
23	Loader	○

*2 Frequency command source/PID command source code

Code	Description	VF1A
0	Keypad key operations	○
1	Voltage input (terminal 12)	○
2	Current input (terminal C1)	○
3	Voltage input (terminal 12) + current input (terminal C1)	○
4	Inverter volume	×
5	Voltage input (terminal V2)	○
7	UP/DOWN	○
8	Touch panel key operation (Balanceless/bumpless)	○
11	Digital input option	○
12	Pulse train input option	○
20	Port 1 (RS-485 channel 1) (Note)	○
21	Port 2 (RS-485 channel 2) (Note)	○
22	Bus option	○
23	Loader	○
24	Multi-step frequency	○
25	JOG operation	○
30	PID keypad command	○
31	PID analog command 1	○
33	PID UP/DOWN command	○
34	PID communications process command	○
36	PID multi-step command	○

VF1A : Indicates a PID command source if PID is effective (code 30 or later).
Indicates a frequency command source if PID is not effective (code 29 or less).

(Note) RS-485 port (channel)

	VF1A
Port 1 (channel 1)	Keypad connection connector on the inverter
Port 2 (channel 2)	Inverter unit terminal block or RS485 communication card (Option: VF1A-RS485)

Table 5.13 Keypad-related function code (W codes) (Continued)

Code	Name	Monitor range	Min step	Unit	LED display	Support VF1A	Remarks
W59	Stop Position Pulse(Upper column)	-999 to 999	1	–	3_17	○	
W60	Stop Position Pulse(Lower column)	0 to 9999	1	–	3_17	○	
W61	Difference Pulse of Position(Upper column)	-999 to 999	1	–	3_19	○	
W62	Difference Pulse of Position(Lower column)	0 to 9999	1	–	3_19	○	
W63	Positioning Status	0 to 10	1	–	3_20	○	
W66	Deviation for SY synchronization	-999.9 to 999.9	0.1	deg	3_25	○	
W67	Cumulative operation time of electrolytic	0 to 9999	1	10h	5_06	○	
W68	Cumulative operation time of cooling fan	0 to 9999	1	10h	5_07	○	
W69	Peripheral speed monitor	0.00 to 99990	0.01	m/min	3_16	×	
W70	Cumulative operation time	0 to 65535	1	h	5_00	○	
W71	DC link circuit voltage	0 to 1000	1	V	5_01	○	
W72	Internal air highest temperature	0 to 255	1	°C	5_02	○	
W73	Heat sink maximum temperature	0 to 255	1	°C	5_03	○	
W74	Maximum effective current value	0.00 to 9999	Variable	A	5_04	○	Doesa
		0.00 to 655.35	0.01	A	5_04	○	RTU (inverter capacity 22 kW (30 HP) or less
		0.0 to 6553.5	0.0	A	5_04	–	RTU (inverter capacity 30 kW (40 HP) or less
W75	Main circuit capacitor's capacitor	0.0 to 100.0	0.1	%	5_05	○	
W76	Cumulative ope. time of capacitor on PC board	0 to 65535	1	h	5_06	○	
W77	Cumulative ope. time of cooling fan	0 to 65535	1	h	5_07	○	
W78	Number of startups	0 to 65535	1	Times	5_08	○	
W79	Cumulative ope. time of motor	0 to 65535	1	h	5_23	×	
W80	Standard fan life	0 to 65535	1	h	–	×	
W81	Integrating electric power	0.000 to 9999	Variable	–	5_09	×	Value calculated by assuming an integral power consumption of 100kWh as one (100kWh when W81=1)
		0.0 to 999900	Variable	kWh	5_09	○	
W82	Data used integrating electric power	0.000 to 9999	Variable	–	5_10	○	Value calculated as integral power consumption (kWh) multiplied by function code E51
W83	Number of RS485 ch1 errors	0 to 9999	1	Times	5_11	○	
W84	Contents of RS485 ch1 error	0 to 127	1	–	5_12	○	
W85	Number of RS485 ch2 errors	0 to 9999	1	Times	5_17	○	

Table 5.13 Keypad-related function code (W codes) (Continued)

Code	Name	Monitor range	Min step	Unit	LED display	Support VF1A	Remarks
W86	Number of option communications errors	0 to 9999	1	Times	5_41	×	
W87	Inverter's ROM version	0 to 9999	1	–	5_14	○	
W88	Inverter's ROM version (CPU2)	0 to 9999	1	-	5_15	○	
W89	Remote keypad's ROM version	0 to 9999	1	–	5_16	○	
W90	Option1 ROM version	0 to 9999	1	–	5_19	○	
W91	Option2 ROM version	0 to 9999	1	–	5_20	×	
W92	Option3 ROM version	0 to 9999	1	–	5_21	×	
W94	Contents of RS485 ch2 error	0 to 127	1	–	5_18	○	
W95	Number of option communications errors	0 to 9999	1	Times	5_13	○	
	Option 1 (A-port) No. of communications errors					×	
W96	Content of option communications error	0 to 9999	1	–	–	○	
	Option 1 (A-port) communications error content				5_40	×	*1
W97	Option 2 (B-port) communications error content	0 to 9999	1	–	5_42	×	*1
W98	Option 3 (C-port) communications error content	0 to 9999	1	Times	5_43	×	
W99	Option 3 (C-port) communications error content	0 to 9999	1	–	5_44	×	*1

*1 Indicates the content of a communications error between the inverter and an option card. For details, see the manual of each option.

Table 5.14 Keypad-related function codes (X codes)

Code	Name	Monitor range	Min step	Unit	LED display	Support VF1A	Remarks
X00	Alarm history (latest)	0000_H to $FFFF_H$	1	–	6.AL1 6_15	○	Contents of 1 in alarm list (example: 1.OL 1)
X01	Multiple alarm 1 (latest)	0000_H to $FFFF_H$	1	–	6_16	○	
X02	Multiple alarm 2 (latest)	0000_H to $FFFF_H$	1	–	6_17	○	
X03	Sub code (latest)	0 to 9999	1	–	6_21	○	
X04	Multiple alarm 1 subcode (latest)	0 to 9999	1	–	6_25	○	
X05	Alarm history (last)	0000_H to $FFFF_H$	1	–	6.AL1 6_15	○	Contents of 2 in alarm list (example: 2.OC 1)
X06	Multiple alarm 1 (last)	0000_H to $FFFF_H$	1	–	6_16	○	
X07	Multiple alarm 2 (last)	0000_H to $FFFF_H$	1	–	6_17	○	
X08	Sub code (last)	0 to 9999	1	–	6_21	○	
X09	Multiple alarm 1 subcode (last)	0 to 9999	1	–	6_25	○	
X10	Alarm history (second last)	0000_H to $FFFF_H$	1	–	6.AL1 6_15	○	Contents of 3 in alarm list (example: 3.OC 1)
X11	Multiple alarm 1 (second last)	0000_H to $FFFF_H$	1	–	6_16	○	
X12	Multiple alarm 2 (second last)	0000_H to $FFFF_H$	1	–	6_17	○	
X13	Sub code (second last)	0 to 9999	1	–	6_21	○	
X14	Multiple alarm 1 subcode (second last)	0 to 9999	1	–	6_25	○	
X15	Alarm history (third last)	0000_H to $FFFF_H$	1	–	6.AL1 6_15	○	Contents of 4 in alarm list (example: 4.LU)
X16	Multiple alarm 1 (third last)	0000_H to $FFFF_H$	1	–	6_16	○	
X17	Multiple alarm 2 (third last)	0000_H to $FFFF_H$	1	–	6_17	○	
X18	Sub code (third last)	0 to 9999	1	–	6_21	○	
X19	Multiple alarm 1 subcode (third last)	0 to 9999	1	–	6_25	○	
X20	Latest info. on alarm (output frequency)	0.00 to 655.35	0.01	Hz	6_00	○	
X21	(output current)	0.00 to 9999	Variable	A	6_01	○	Doesa
		0.00 to 655.35	0.01	A	6_01	○	RTU (inverter capacity 22kW (30HP) or less)
		0.0 to 6553.5	0.1	A	6_01	○	RTU (inverter capacity 30kW (40HP) or more)
X22	(output voltage)	0 to 1000	1	V	6_02	○	
X23	(Torque)	-999 to 999	1	%	6_03	○	
X24	(set frequency)	0.00 to 655.35	0.01	Hz	6_04	○	
X25	(operation status)	0000_H to $FFFF_H$	1	–	6_06	○	
X26	(cumulative ope. time)	0 to 65535	1	h	6_07	○	
X27	(number of startups)	0 to 65535	1	Times	6_08	○	
X28	(DC link circuit voltage)	0 to 1000	1	V	6_09	○	

Table 5.14 Keypad-related function codes (X codes) (Continued)

Code	Name	Monitor range	Min step	Unit	LED display	Support VF1A	Remarks
X29	(internal air temperature)	0 to 255	1	°C	6_10	○	
X30	(heat sink temperature)	0 to 255	1	°C	6_11	○	
X31	(input terminal)	0000_H to $FFFF_H$	1	–	6_12 6_13	○	
X32	(output terminal)	0000_H to $FFFF_H$	1	–	6_12 6_14	○	
X33	(input terminal(com.))	0000_H to $FFFF_H$	1	–	6_18 6_19	○	
X34	(output terminal(com.))	0000_H to $FFFF_H$	1	–	6_18 6_20	○	
X35	(Input power)	0.00 to 9999	0.01	kW	–	○	
X36	(operation status 2)	0000_H to $FFFF_H$	1	–	6_22	○	
X37	(speed detection)	-32768 to 32767	1	–	6_23	○	
X38	(operation status 3)	0000_H to $FFFF_H$			6_24	○	
X60	Last info. on alarm (output frequency)	0.00 to 655.35	0.01	Hz	6_00	○	
X61	(output current)	0.00 to 9999	Variable	A	6_01	○	Doesa
		0.00 to 655.35	0.01	A	6_01	○	RTU (inverter capacity 22kW (30HP) or less)
		0.0 to 6553.5	0.1	A	6_01	○	RTU (inverter capacity 30kW (40HP) or more)
X62	(output voltage)	0 to 1000	1	V	6_02	○	
X63	(Torque)	-999 to 999	1	%	6_03	○	
X64	(set frequency)	0.00 to 655.35	0.01	Hz	6_04	○	
X65	(operation status)	0000_H to $FFFF_H$	1	–	6_06	○	
X66	(cumulative ope. time)	0 to 65535	1	h	6_07	○	
X67	(number of startups)	0 to 65535	1	Times	6_08	○	
X68	(DC link circuit voltage)	0 to 1000	1	V	6_09	○	
X69	(internal air temperature)	0 to 255	1	°C	6_10	○	
X70	(heat sink temperature)	0 to 255	1	°C	6_11	○	
X71	(input terminal)	0000_H to $FFFF_H$	1	–	6_12 6_13	○	
X72	(output terminal)	0000_H to $FFFF_H$	1	–	6_12 6_14	○	
X73	(input terminal(com.))	0000_H to $FFFF_H$	1	–	6_18 6_19	○	
X74	(output terminal(com.))	0000_H to $FFFF_H$	1	–	6_18 6_20	○	
X76	(operation status 2)	0000_H to $FFFF_H$	1	–	6_22	○	
X77	(speed detection)	-32768 to 32767	1	–	6_23	○	
X78	(operation status 3)	0000_H to $FFFF_H$			6_24	○	
X89	Customizable logic (Digital input/output)	0000_H to $FFFF_H$	1	–	–	○	
X90	(Timer monitor)	0.00 to 600.00	0.01	–	4_24	○	
X91	(Analog input 1)	-9990 to 9990	Variable	–	–	○	
X92	(Analog input 2)	-9990 to 9990	Variable	–	–	○	
X93	(Analog output)	-9990 to 9990	Variable	–	–	○	
X94	Relay output terminal information	0000_H to $FFFF_H$	1	–	–	○	
X97	Terminal (PTC) input voltage	-12.0 to 12.0	0.1	V	–	○	

Table 5.15 Keypad-related function codes (Z codes)

Code	Name	Monitor range	Min step	Unit	LED display	Support VF1A	Remarks
Z00	Second last info. on alarm (output frequency)	0.00 to 655.35	0.01	Hz	6_00	○	
Z01	(output current)	0.00 to 9999	Variable	A	6_01	○	Doesa
		0.00 to 655.35	0.01	A	6_01	○	RTU (inverter capacity 22kW (30HP) or less)
		0.0 to 6553.5	0.1	A	6_01	○	RTU (inverter capacity 30kW (40HP) or more)
Z02	(output voltage)	0 to 1000	1	V	6_02	○	
Z03	(Torque)	-999 to 999	1	%	6_03	○	
Z04	(set frequency)	0.00 to 655.35	0.01	Hz	6_04	○	
Z05	(operation status)	0000_H to $FFFF_H$	1	–	6_05	○	
Z06	(cumulative ope. time)	0 to 65535	1	h	6_07	○	
Z07	(number of startups)	0 to 65535	1	Times	6_08	○	
Z08	(DC link circuit voltage)	0 to 1000	1	V	6_09	○	
Z09	(internal air temperature)	0 to 255	1	°C	6_10	○	
Z10	(heat sink temperature)	0 to 255	1	°C	6_11	○	
Z11	(input terminal)	0000_H to $FFFF_H$	1	–	6_12 6_13	○	
Z12	(output terminal)	0000_H to $FFFF_H$	1	–	6_12 6_14	○	
Z13	(input terminal(com.))	0000_H to $FFFF_H$	1	–	6_18 6_19	○	
Z14	(output terminal(com.))	0000_H to $FFFF_H$	1	–	6_18 6_20	○	
Z16	(operation status 2)	0000_H to $FFFF_H$	1	–	6_22	○	
Z17	(speed detection)	-32768 to 32767	1	–	6_23	○	
Z18	(operation status 3)	0000_H to $FFFF_H$	1	–	6_24	○	
Z40	cumulative operation time of motor (M1)	0 to 65535 (in units of 10 hours)	1	10h	5_23	○	
Z41	cumulative operation time of motor (M2)	0 to 65535 (in units of 10 hours)	1	10h	5_28	○	
Z42	cumulative operation time of motor (M3)	0 to 65535 (in units of 10 hours)	1	10h	5_29	×	
Z43	cumulative operation time of motor (M4)	0 to 65535 (in units of 10 hours)	1	10h	5_30	×	
Z44	number of startups (M2)	0 to 65535	1	Times	5_32	○	
Z45	number of startups (M3)	0 to 65535	1	Times	5_33	×	
Z46	number of startups (M4)	0 to 65535	1	Times	5_34	×	
Z48	Retry history (latest)	0000_H to $FFFF_H$	1	–	–	○	
Z49	Retry history (last)	0000_H to $FFFF_H$	1	–	–	○	
Z50	Third last info. on alarm (output frequency)	0.00 to 655.35	0.01	Hz	6_00	○	
Z51	(output current)	0.00 to 9999	Variable	A	6_01	○	Doesa
		0.00 to 655.35	0.01	A	6_01	○	RTU (inverter capacity 22kW (30HP) or less)
		0.0 to 6553.5	0.1	A	6_01	–	RTU (inverter capacity 30kW (40HP) or more)

Table 5.15 Keypad-related function codes (Z codes) (Continued)

Code	Name	Monitor range	Min step	Unit	LED display	Support VF1A	Remarks
Z52	Third last info. on alarm (output voltage)	0 to 1000	1	V	6_02	○	
Z53	(Torque)	-999 to 999	1	%	6_03	○	
Z54	(set frequency)	0.00 to 655.35	0.01	Hz	6_04	○	
Z55	(operation status)	0000_H to $FFFF_H$	1	–	6_06	○	
Z56	(cumulative ope. time)	0 to 65535	1	h	6_07	○	
Z57	(number of startups)	0 to 65535	1	Times	6_08	○	
Z58	(DC link circuit voltage)	0 to 1000	1	V	6_09	○	
Z59	(internal air temperature)	0 to 255	1	°C	6_10	○	
Z60	(heat sink temperature)	0 to 255	1	°C	6_11	○	
Z61	(input terminal)	0000_H to $FFFF_H$	1	–	6_12 6_13	○	
Z62	(output terminal)	0000_H to $FFFF_H$	1	–	6_12 6_14	○	
Z63	(input terminal(com.))	0000_H to $FFFF_H$	1	–	6_18 6_19	○	
Z64	(output terminal(com.))	0000_H to $FFFF_H$	1	–	6_18 6_20	○	
Z66	(operation status 2)	0000_H to $FFFF_H$	1	–	6_22	○	
Z67	(speed detection)	-32768 to 32767	1	–	6_23	○	
Z68	(operation status 3)	0000_H to $FFFF_H$	1	–	6_24	○	
Z80	Speed detection	-32768 to 32767	1	min^{-1}	–	○	
Z81	Output torque	-327.68 to 327.67	0.01	%	–	○	
Z82	Load factor	-327.68 to 327.67	0.01	%	–	○	
Z83	Motor output	-327.68 to 327.67	0.01	%	–	○	
Z84	Output current	0.00 to 9999	Variable	A	–	○	Doesa
		0.00 to 327.67	0.01	A	–	○	RTU (inverter capacity of 22 kW (30 HP) or less)
		0.00 to 3276.7	0.1	A	–	○	RTU (inverter capacity of 30 kW (40 HP) or more)
Z85	PID feedback value	-999 to 9990	Variable	–	–	○	
Z86	Power consumption	0.00 to 9999	Variable	kW	–	○	
Z87	PID output	-150.0 to 150.0	0.1	%	–	○	
Z88	Integral power	0.000 to 9999	Variable	–	–	○	
Z90	Current Position Pulse(Upper column)	-999 to 999	1	–	3_27	○	Valid only when servo lock applied
Z91	Current Position Pulse(Lower column)	0 to 9999	1	–	3_27	○	
Z92	Stop Position Pulse(Upper column)	-999 to 999	1	–	3_26	○	
Z93	Stop Position Pulse(Lower column)	0 to 9999	1	–	3_26	○	
Z94	Difference Pulse of Position(Upper column)	-999 to 999	1	–	3_28	○	
Z95	Difference Pulse of Position(Lower column)	0 to 9999	1	–	3_28	○	

5.2 Data Formats

5.2.1 List of data format numbers

The following table shows the communications data format numbers for function code data. Create data according to the data format specifications described below. For the data setting range and setting unit, see the User's Manual of each inverter type (Chapter 5) The "Support" column of the table indicates whether each function is supported by the respective models or not. ○ indicates the function is supported, and × indicates the function is not supported.

RTU and Doesa in the “Format number” field represent the Modbus RTU protocol and Doesa general-purpose inverter protocol, respectively.

Table 5.16 List of data format numbers (F codes)

Code	Name	Format number	Support
			VF1A
F00	Data Protection	[1]	○
F01	Frequency command 1	[1]	○
F02	Operation method	[1]	○
F03	Maximum frequency 1	[3]	○
F04	Base frequency 1	[3]	○
F05	Rated voltage at base frequency 1	[1]	○
F06	Maximum output voltage 1	[1]	○
F07	Acceleration time 1	[12]	○
F08	Deceleration time 1	[12]	○
F09	Torque boost 1	[3]	○
F10	Electronic thermal overload protection for motor 1 (Select motor characteristics)	[1]	○
F11	(Overload detection level)	[24] (Doesa)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
F12	(Thermal time constant)	[3]	○
F14	Restart mode after momentary power failure (Mode selection)	[1]	○
F15	Frequency Limiter (High)	[3]	○
F16	(Low)	[3]	○
F18	Bias (Frequency command 1)	[6]	○
F20	DC Braking 1 (Braking starting frequency)	[3]	○
F21	(Braking level)	[1]	○
F22	(Braking time)	[5]	○
F23	Starting frequency 1	[3]	○
F24	(Holding time)	[5]	○
F25	Stopping frequency	[3]	○
F26	Motor sound (Carrier frequency)	[1] *2	○
F27	(Tone)	[1]	○
F29	Terminal [FMA] (Function selection)	[1]	×
	Terminal [FM] (Function selection)	[1]	○
F30	Terminal [FMA] (Gain to output voltage)	[1]	×
	Terminal [FM] (Gain to output voltage)	[1]	○
F31	Terminal [FMA] (Function Selection)	[1]	×
	Terminal [FM] (Function Selection)	[1]	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option.

*2 The frequency of 0.75kHz will be treated as 0.

Table 5.16 List of data format numbers (F codes) (Continued)

Code	Name	Format number	Support VF1A
F33	Terminal [FMP] (Pulse Rate)	[1]	×
	Terminal [FM] (Pulse Rate)	[1]	○
F34	Terminal [FMP] (Gain to output voltage)	[1]	×
F35	Terminal [FMP] (Function Selection)	[1]	×
F37	Load Selection/Auto Torque Boost/Auto Energy Saving Operation	[1]	○
F38	Stop Frequency (Detection System)	[1]	○
F39	(Holding Time)	[5]	○
F40	Torque limiting 1 (Driving)	[1]	○
	Torque limit value 1-1	[2]	×
F41	Torque limiting 1 (Braking)	[1]	○
	Torque limit value 1-2	[2]	×
F42	Control Mode Selection	[1]	○
F43	Current Limiter (Mode selection)	[1]	○
F44	(Level)	[1]	○
F50	Electronic Thermal Overload Protection for Braking Resistor (Discharging capability)	[1] *1	○
F51	(Allowable average loss)	[7]	×
		[45]	○
F52	(for braking resistor)	[12]	○
F80	HHD/HND/HD/ND switching	[1]	○

*1 The value of 999 will be treated as $7FFF_H$.

Table 5.17 List of data format numbers (E codes)

Code	Name	Format number	Support
			VF1A
E01	Terminal [X1] (Function Selection)	[1]	○
E02	[X2]	[1]	○
E03	[X3]	[1]	○
E04	[X4]	[1]	○
E05	[X5]	[1]	○
E06	[X6]	[1]	×
E07	[X7]	[1]	×
E08	[X8]	[1]	×
E09	[X9]	[1]	×
E10	Acceleration time 2	[12]	○
E11	Deceleration time 2	[12]	○
E12	Acceleration time 3	[12]	○
E13	Deceleration time 3	[12]	○
E14	Acceleration time 4	[12]	○
E15	Deceleration time 4	[12]	○
E16	Torque limiting 2 (Driving)	[1]	○
	Torque limit value 2-1	[2]	×
E17	Torque limiting 2 (Braking)	[1]	○
	Torque limit value 2-2	[2]	×
E20	Terminal [Y1] (Function Selection)	[1]	○
E21	[Y2]	[1]	○
E22	[Y3]	[1]	×
E23	[Y4]	[1]	×
E24	[Y5A/C]	[1]	×
E27	[30A/B/C]	[1]	○
E29	Frequency level detection delay timer	[5]	○
E30	Frequency Arrival (Hysteresis width)	[3]	○
E31	Frequency Detection (FDT) (Detection level)	[3]	○
E32	(hysteresis width)	[3]	○
E34	Overload early warning/Current detection (level)	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
E35	(timer)	[5]	○
E36	Frequency Detection 2 (FDT 2) (Detection Level)	[3]	○
E37	Current detection 2/Low current detection (Detection Level)	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
E38	(timer)	[5]	○
E39	Coefficient for Constant Feeding Rate Time	[7]	○
E40	PID Display Coefficient A	[12]	×
E41	PID Display Coefficient B	[12]	×
E42	LED Display filter	[3]	○
E43	LED Monitor (Item selection)	[1]	○
E44	(Display when stopped)	[1]	○
E45	LCD monitor (Item selection)	[1]	×
E46	(Language selection)	[1]	×
E47	(Contrast control)	[1]	×
E48	LED Monitor details (Speed monitor item)	[1]	○
E49	Torque command monitor (Polarity selection)	[1]	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

Table 5.17 List of data format numbers (E codes)(Continued)

Code	Name	Format number	Support
			VF1A
E50	Coefficient for Speed Indication	[5]	○
E51	Display Coefficient for Input Watt-hour Data	[45]	○
E52	Keypad (Menu display mode)	[1]	○
E54	Frequency detection 3 (Operation level)	[3]	○
E55	Current detection 3 (Operation level)	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
E56	(Timer time)	[5]	○
E59	Switch function of C1 terminal	[1]	○
E60	Built-in Potentiometer (Function selection)	[1]	×
E61	Terminal [12] (Extended function selection)	[1]	○
E62	Terminal [C1] (Extended function selection)	[1]	×
	Terminal [C1] (C1 function) (Extended function selection)	[1]	○
E63	Terminal [V2] (Extended function selection)	[1]	×
	Terminal [C1] (V2 function) (Extended function selection)	[1]	○
E64	Saving Digital Reference Frequency	[1]	○
E65	Reference Loss Detection	[1] *2	○
E76	DC link bus low-voltage detection level	[1]	○
E78	Torque detection 1 (Operation level)	[1]	○
E79	(Timer time)	[5]	○
E80	Detect Torque 2/Detect Low Torque 2 (Detection level)	[1]	○
E81	(Timer)	[5]	○
E98	Terminal [FWD] (Function selection)	[1]	○
E99	[REV]	[1]	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

*2 The value of 999 will be treated as $7FFF_H$.

Table 5.18 List of data format numbers (C codes)

Code	Name	Format number	Support VF1A
C01	Jump Frequency 1	[3]	○
C02	2	[3]	○
C03	3	[3]	○
C04	Width	[3]	○
C05	Multi-Frequency 1	[5]	×
		[22]	○
C06	2	[5]	×
		[22]	○
C07	3	[5]	×
		[22]	○
C08	4	[5]	×
		[22]	○
C09	5	[5]	×
		[22]	○
C10	6	[5]	×
		[22]	○
C11	7	[5]	×
		[22]	○
C12	8	[5]	×
		[22]	○
C13	9	[5]	×
		[22]	○
C14	10	[5]	×
		[22]	○
C15	11	[5]	×
		[22]	○
C16	12	[5]	×
		[22]	○
C17	13	[5]	×
		[22]	○
C18	14	[5]	×
		[22]	○
C19	15	[5]	×
		[22]	○
C20	Jogging Frequency	[5]	×
		[22]	○
C21	Pattern operation/timer operation (Mode selection)	[1]	○
C22	Pattern operation (Stage 1)	[84]	○
		[12]	×
C23	(Stage 2)	[84]	○
		[12]	×
C24	(Stage 3)	[84]	○
		[12]	×
C25	(Stage 4)	[84]	○
		[12]	×
C26	(Stage 5)	[84]	○
		[12]	×
C27	(Stage 6)	[84]	○
		[12]	×
C28	(Stage 7)	[84]	○
		[12]	×

Table 5.18 List of data format numbers (C codes) (Continued)

Code	Name	Format number	Support VF1A
C30	Frequency command 2	[1]	○
C31	Analog Input Adjustment for [12] (offset)	[4]	○
C32	(Gain)	[5]	○
C33	(Filter time constant)	[5]	○
C34	(Gain base point)	[5]	○
C35	(Polarity)	[1]	○
C36	Analog Input Adjustment for [C1] (Offset)	[4]	×
	Analog Input Adjustment for [C1] (C1 function) (Offset)	[4]	○
C37	Analog Input Adjustment for [C1] (Gain)	[5]	×
	Analog Input Adjustment for [C1] (C1 function) (Gain)	[5]	○
C38	Analog Input Adjustment for [C1] (Filter time constant)	[5]	×
	Analog Input Adjustment for [C1] (C1 function) (Filter time constant)	[5]	○
C39	Analog Input Adjustment for [C1] (Gain base point)	[5]	×
	Analog Input Adjustment for [C1] (C1 function) (Gain base point)	[5]	○
C40	Terminal [C1] (C1 function) (Range selection)	[1]	○
C41	Analog Input Adjustment for[V2] (Offset)	[4]	×
	Analog Input Adjustment for [C1]) (V2 function) (Offset)	[4]	○
C42	Analog Input Adjustment for [V2] (Gain)	[5]	×
	Analog Input Adjustment for [C1] (V2 function) (Gain)	[5]	○
C43	Analog Input Adjustment for [V2] (Filter time constant)	[5]	×
	Analog Input Adjustment for [C1] (V2 function) (Filter time constant)	[5]	○
C44	Analog Input Adjustment for [V2] (Gain base point)	[5]	×
	Analog Input Adjustment for [C1] (V2 function) (Gain base point)	[5]	○
C45	Analog input Adjustment for [V2] (Polarity)	[1]	○
C50	Bias (Frequency command 1) (Bias base point)	[5]	○
C51	Bias [PID command 1] (Bias value)	[6]	×
C52	(Bias base point)	[5]	×
C53	Selection of Normal/Inverse Operation (Frequency command 1)	[1]	○
C55	Analog input adjustment (Terminal [12]) (Bias)	[6]	○
C56	(Bias reference point)	[5]	○
C58	(Display unit)	[1]	○
C59	(Maximum scale)	[12]	○
C60	(Minimum scale)	[12]	○
C61	Analog input adjustment (Terminal [C1] (C1 function)) (Bias)	[6]	○
C62	(Bias reference point)	[5]	○
C64	(Display unit)	[1]	○
C65	(Maximum scale)	[12]	○
C66	(Minimum scale)	[12]	○
C67	Analog input adjustment (Terminal [C1] (V2 function)) (Bias)	[6]	○
C68	(Bias reference point)	[5]	○
C70	(Display unit)	[1]	○
C71	(Maximum scale)	[12]	○
C72	(Minimum scale)	[12]	○
C82	Rotation direction, acceleration/deceleration time (Stage 1)	[1]	×
C83	(Stage 2)	[1]	×
C84	(Stage 3)	[1]	×
C85	(Stage 4)	[1]	×
C86	(Stage 5)	[1]	×
C87	(Stage 6)	[1]	×
C88	(Stage 7)	[1]	×

Table 5.18 List of data format numbers (C codes) (Continued)

Code	Name	Format number	Support VF1A
C89	Frequency correction with communication function 1 (Numerator)	[2]	○
C90	Frequency correction with communication function 2 (Denominator)	[2]	○
C94	Jump frequency 4	[3]	×
C95	5	[3]	×
C96	6	[3]	×
C99	Digital setting frequency * Writing is possible only with the communication function. * The touch panel functions as a monitor only.	[22]	×

Table 5.19 List of data format numbers (P codes)

Code	Name	Format number	Support VF1A
P01	Motor 1 (No. of poles)	[1]	○
P02	(Rated Capacity)	[11]	○
	When P99 = 1	[25]	×
P03	(Rated current)	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
P04	(Auto-tuning)	[21]	○
P05	(Online Tuning)	[1]	○
P06	(No-load current)	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
P07	(%R1)	[5]	○
P08	(%X)	[5]	○
P09	(Slip compensation gain for driving)	[3]	○
P10	(Slip compensation response time)	[5]	○
P11	(Slip compensation gain (Braking))	[3]	○
P12	(Rated slip frequency)	[5]	○
P13	(Iron loss coefficient 1)	[5]	○
P14	(Iron loss coefficient 2)	[5]	×
P15	(Iron loss coefficient 3)	[5]	×
P16	(Magnetic saturation coefficient 1)	[3]	○
P17	(Magnetic saturation coefficient 2)	[3]	○
P18	(Magnetic saturation coefficient 3)	[3]	○
P19	(Magnetic saturation coefficient 4)	[3]	○
P20	(Magnetic saturation coefficient 5)	[3]	○
P21	(Magnetic saturation expansion coefficient a)	[3]	×
P22	(Magnetic saturation expansion coefficient b)	[3]	×
P23	(Magnetic saturation expansion coefficient c)	[3]	×
P30	(PMSM drive magnetic pole position detection mode)	[1]	○
P53	(%X compensation coefficient 1)	[1]	○
P54	(%X compensation coefficient 2)	[1]	×
P55	(Vector control torque current)	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
P56	(Vector control t inductitive voltage coefficient)	[1]	○
P57	(For manufacturer)	[7]	×

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

Table 5.19 List of data format numbers (P codes) (Continued)

Code	Name	Format number	Support VF1A
P60	Motor 1 (PMSM armature resistance)	[45]	○
P61	(PMSM d-axis inductance)	[24]	○
P62	(PMSM q-axis inductance)	[24]	○
P63	(PMSM induced voltage)	[1]	○
P64	(PMSM iron loss)	[3]	○
P65	(PMSM d-axis inductance magnetic saturation correction)	[3]	○
P74	(PMSM reference current at starting)	[1]	○
P83	(PMSM, for manufacturer)	[3]	○
P84	(PMSM, for manufacturer)	[3]	○
P85	(PMSM flux limiting value)	[3]	○
P86	(PMSM, for manufacturer)	[3]	○
P87	(PMSM reference current for polarity discrimination)	[1]	○
P88	(PMSM, for manufacturer)	[1]	○
P89	(PMSM, for manufacturer)	[1]	○
P90	(PMSM overcurrent protection level)	[19]	○
P91	(Damping control d-axis compensation gain)	[5]	×
P92	(Damping control q-axis compensation gain)	[5]	×
P93	(Step-out detection current detection level)	[1]	×
P99	Motor 1 Selection	[1]	○

Table 5.20 List of data format numbers (H codes)

Code	Name	Format number	Support VF1A
H02	Data initialization (Initial value selection)	[1]	○
H03	Data Initialization	[1]	○
H04	Auto-reset (times)	[1]	○
H05	(Reset interval)	[3]	○
H06	Cooling Fan ON/OFF Control	[1]	○
H07	Acceleration/Deceleration Pattern	[1]	○
H08	Rotation Direction Limitation	[1]	○
H09	Start Mode (Auto search)	[1]	○
H11	Deceleration Mode	[1]	○
H12	Instantaneous Overcurrent Limiting (Mode selection)	[1]	○
H13	Restart Mode after Momentary Power Failure (Restart time)	[3]	○
H14	(Frequency fall rate)	[5] *1	○
H15	(Holding DC voltage)	[1]	○
H16	(Allowable momentary power failure time)	[3] *1	○
H17	Start Mode (Pick up frequency)	[3] *1	×
H18	Torque control (Mode selection)	[1]	○
H26	Thermistor (Mode selection)	[1]	○
H27	(Level)	[5]	○
H28	Droop control	[4]	○
H30	Communications Link Function (Mode selection)	[1]	○
H42	Capacitance of DC Link Bus Capacitor	[1]	○
H43	Cumulative Run Time of Cooling Fan	[1]	×
		[74]	○
H44	Startup Times 1 of Motor	[1]	○
H45	Mock Alarm	[1]	○

Table 5.20 List of data format numbers (H codes) (Continued)

Code	Name	Format number	Support VF1A
H46	Restart Mode after Momentary Power Failure (Restart time)	[3]	○
H47	Initial Capacitance of DC Link Bus Capacitor	[1]	○
H48	Cumulative Run Time of Capacitors on the PCB	[1]	×
		[74]	○
H49	Starting Mode (Delay time)	[3]	○
H50	Non-linear V/f Pattern 1 (Frequency)	[3]	○
H51	(Voltage)	[1]	○
H52	Non-linear V/f 2 (Frequency)	[3]	○
H53	(Voltage)	[1]	○
H54	Acceleration/deceleration time (Jogging)	[12]	×
	Acceleration time (Jogging)	[12]	○
H55	Deceleration time (Jogging operation)	[12]	○
H56	Deceleration Time for Forced Stop	[12]	○
H57	1st S-curve range at acceleration (start)	[1]	○
H58	2nd S-curve range at deceleration (end)	[1]	○
H59	1st S-curve range at acceleration (start)	[1]	○
H60	2nd S-curve range at deceleration (end)	[1]	○
H61	UP/DOWN Control Initial frequency setting	[1]	○
H63	Low Limiter (Mode selection)	[1]	○
H64	(Lower limiting frequency)	[3]	○
H65	Non-linear V/f 3 (Frequency)	[3]	○
H66	(Voltage)	[1]	○
H67	Automatic energy saving operation (Mode selection)	[1]	×
H68	Slip Compensation 1 (Operating conditions)	[1]	○
H69	Automatic deceleration (Mode selection)	[1]	○
H70	Overload prevention control	[5] *1	○
H71	Deceleration Characteristics	[1]	○
H72	Main Power Down Detection (Mode Selection)	[1]	○
H73	Torque limiting (Operating conditions selection)	[1]	×
H74	(Control target)	[1]	○
H75	(Applicable quadrant)	[1]	×
H76	Torque Limiter (Frequency increment limit for braking)	[3]	○
H77	Main circuit capacity life (remaining hour)	[74]	○
H78	Maintenance setting time (M1)	[74]	○
H79	No. of maintenance setting starting times (M1)	[1]	○
H80	Output Current Fluctuation Damping Gain for Motor 1	[5]	○
H81	Light alarm selection 1	[1]	○
H82	Light alarm selection 2	[1]	○
H84	Pre-excitation (initial level)	[1]	○
H85	(time)	[5]	○
H86	(For manufacturer)	[1]	×
H87		[3]	×
H88		[1]	×
H89		[1]	○
H90		[1]	×
H91	PID feedback disconnection detection	[3]	○
H92	Continue to Run (P-component: gain)	[7] *1	○
H93	(I-component: time)	[7] *1	○
H94	Cumulative Motor Run Time 1	[1]	×
		[74]	○

*1 The value of 999 will be treated as $7FFF_H$.

Table 5.20 List of data format numbers (H codes) (Continued)

Code	Name	Format number	Support VF1A
H95	DC braking (Braking response mode)	[1]	○
H96	STOP key priority / Start check function	[1]	○
H97	Clear alarm data	[1]	○
H98	Protection/Maintenance Function (Mode selection)	[1]	○
H101	Destination setting	[1]	○
H111	UPS operation level	[1]	○
H114	Anti-regenerative control (Operation level)	[3]	○
H130	For manufacturer	[7]	×
H131		[7]	×
H132		[7]	×
H133		[7]	×
H134		[7]	×
H135		[7]	×
H147	Speed control (Jogging) (Feed forward gain)	[5]	○
H154	Torque bias (Function selection)	[1]	○
H155	(Setting level 1)	[2]	○
H156	(Setting level 2)	[2]	○
H157	(Setting level 3)	[2]	○
H158	(Mechanical loss compensation)	[1]	○
H159	(Startup timer)	[5]	○
H161	(Shutdown timer)	[5]	○
H162	(Limiter)	[1]	○
H173	Magnetic flux level at light load	[1]	○
H180	Brake signal (Check time for brake operation)	[5]	○
H193	User initial value (Save)	[1]	○
H194	(Protection)	[1]	○
H195	DC braking (Braking time at startup)	[5]	○
H196	For manufacturer	[7]	○
H197	User password 1 (Protection mode selection)	[1]	○
H198	(Setting/comparison)	[1]	○
H199	User password (Protection enabled)	[1]	○

Table 5.21 List of data format numbers (A codes)

Code	Name	Format number	Support VF1A
A01	Maximum frequency 2	[3]	○
A02	Base frequency 2	[3]	○
A03	Rated voltage at base frequency 2	[1]	○
A04	Maximum output voltage 2	[1]	○
A05	Torque boost 2	[3]	○
A06	Electronic thermal overload protection for motor 2 (Select motor characteristics)	[1]	○
A07	(Overload detection level)	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
A08	(Thermal time constant)	[3]	○
A09	DC Braking 2 (Braking starting frequency)	[3]	○
A10	(Braking level)	[1]	○
A11	(Braking time)	[5]	○
A12	Starting frequency 2	[3]	○
A13	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 2	[1]	○
A14	Control Mode Selection 2	[1]	○
A15	Motor 2 (No. of poles)	[1]	○
A16	(Rated Capacity)	[11]	○
A17	(Rated current)	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
A18	(Auto-tuning)	[21]	○
A19	(Online-tuning)	[1]	○
A20	(No-load current)	[24] (DOESA)	○
		[19] (RTU)	○
		[24](BUS) *1	○
A21	(%R1)	[5]	○
A22	(%X)	[5]	○
A23	(Slip compensation gain for driving)	[3]	○
A24	(Slip compensation response time)	[5]	○
A25	(Slip compensation gain for braking)	[3]	○
A26	(Rated slip frequency)	[5]	○
A27	(Iron loss coefficient 1)	[5]	○
A28	(Iron loss coefficient 2)	[5]	×
A29	(Iron loss coefficient 3)	[5]	×
A30	(Magnetic saturation coefficient 1)	[3]	○
A31	(Magnetic saturation coefficient 2)	[3]	○
A32	(Magnetic saturation coefficient 3)	[3]	○
A33	(Magnetic saturation coefficient 4)	[3]	○
A34	(Magnetic saturation coefficient 5)	[3]	○
A35	(Magnetic saturation expansion coefficient a)	[3]	×
A36	(Magnetic saturation expansion coefficient b)	[3]	×
A37	(Magnetic saturation expansion coefficient c)	[3]	×
A39	Motor 2 Selection	[1]	○
A40	Slip Compensation 2 (Operating conditions)	[1]	○
A41	Output Current Fluctuation Damping Gain 2	[5]	○
A42	Motor/parameter switching 2 (Mode selection)	[1]	×

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

Table 5.21 List of data format numbers (A codes) (Continued)

Code	Name	Format number	Support VF1A
A43	Speed control 2 (Speed command filter)	[7]	○
A44	(Speed detection filter)	[7]	○
A45	Cumulative Motor Run Time 2	[1]	×
	Speed control 2 P (Gain)	[3]	○
A46	Number of Starting Times 2	[1]	×
	Speed control 2 I (Integration time)	[7] *2	○
A47	(FF gain)	[5]	○
A48	(Output filter)	[7]	×
A49	(Notch filter resonance frequency)	[1]	○
A50	(Notch filter attenuation level)	[1]	○
A51	Cumulative Motor Run Time 2	[74]	○
A52	Startup Times of Motor 2	[1]	○
A53	Motor 2 (%X compensation efficient 1)	[1]	○
A54	(%XCompensation coefficient 2)	[1]	×
A55	(Vector control torque current)	[24] (DOESA)	○
		[19] (RTU)	○
		[24](BUS) *1	○
A56	(Vector control inductive voltage coefficient)	[1]	○
A57	(For manufacturer)	[7]	×
A98	Motor 2 (Function selection)	[1]	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

*2 The value of 999 will be treated as $7FFF_H$.

Table 5.22 List of data format numbers (b codes)

Code	Name	Format number	Support VF1A
b01	Maximum frequency 3	[3]	×
b02	Base frequency 3	[3]	×
b03	Rated voltage at base frequency 3	[1]	×
b04	Maximum output voltage 3	[1]	×
b05	Torque boost 3	[3]	×
b06	Electronic thermal overload protection for motor 3 (Select motor characteristics)	[1]	×
b07	(Overload detection level)	[24] (DOESA)	×
		[19] (RTU)	×
		[24] (BUS) *1	×
b08	(Thermal time constant)	[3]	×
b09	DC Braking 3 (Braking starting frequency)	[3]	×
b10	(Braking level)	[1]	×
b11	(Braking time)	[5]	×
b12	Starting frequency 3	[3]	×
b13	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 3	[1]	×
b14	Control Mode Selection 3	[1]	×

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

Table 5.22 List of data format numbers (b codes) (Continued)

Code	Name	Format number	Support VF1A
b15	Motor 3 (No. of poles)	[1]	×
b16	(Rated Capacity)	[11]	×
	(When b39 = 1)	[25]	×
b17	(Rated current)	[24] (DOESA)	×
		[19] (RTU)	×
		[24] (BUS) *1	×
b18	(Auto-tuning)	[21]	×
b19	(Online tuning)	[1]	×
b20	(No-load current)	[24] (DOESA)	×
		[19] (RTU)	×
		[24] (BUS) *1	×
b21	(%R1)	[5]	×
b22	(%X)	[5]	×
b23	(Slip compensation gain for driving)	[3]	×
b24	(Slip compensation response time)	[5]	×
b25	(Slip compensation gain for braking)	[3]	×
b26	(Rated slip frequency)	[5]	×
b27	(Iron loss coefficient 1)	[5]	×
b28	(Iron loss coefficient 2)	[5]	×
b29	(Iron loss coefficient 3)	[5]	×
b30	(Magnetic saturation coefficient 1)	[3]	×
b31	(Magnetic saturation coefficient 2)	[3]	×
b32	(Magnetic saturation coefficient 3)	[3]	×
b33	(Magnetic saturation coefficient 4)	[3]	×
b34	(Magnetic saturation coefficient 5)	[3]	×
b35	(Magnetic saturation expansion coefficient a)	[3]	×
b36	(Magnetic saturation expansion coefficient b)	[3]	×
b37	(Magnetic saturation expansion coefficient c)	[3]	×
b39	Motor 3 Selection	[1]	×
b40	Slip Compensation 3 (Operating conditions)	[1]	×
b41	Output Current Fluctuation Damping Gain 3	[5]	×
b42	Motor/parameter switching 3 (Mode selection)	[1]	×
b43	Speed control 3 (Speed command filter)	[7]	○
b44	(Speed detection filter)	[7]	○
b45	P (Gain)	[3]	○
b46	I (Integration time)	[7] *2	○
b47	FF (Gain)	[5]	○
b48	(Output filter)	[7]	×
b49	(Notch filter resonance frequency)	[1]	○
b50	(Notch filter attenuation level)	[1]	○
b51	Cumulative Motor Run Time 3	[74]	×
b52	Startup Times of Motor 3	[1]	×
b53	Motor 3 (%X compensation efficient 1)	[1]	×
b54	(%XCompensation coefficient 2)	[1]	×
b55	(Vector control torque current)	[24] (DOESA)	×
		[19] (RTU)	×
		[24](BUS) *1	×
b56	(Vector control inductive voltage coefficient)	[1]	×
b57	(For manufacturer)	[7]	×

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

*2 The value of 999 will be treated as $7FFF_H$.

Table 5.23 List of data format numbers (r codes)

Code	Name	Format number	Support VF1A
r01	Maximum frequency 4	[3]	×
r02	Base frequency 4	[3]	×
r03	Rated voltage at base frequency 4	[1]	×
r04	Maximum output voltage 4	[1]	×
r05	Torque boost 4	[3]	×
r06	Electronic thermal overload protection for motor 4 (Select motor characteristics)	[1]	×
r07	(Overload detection level)	[24] (DOESA)	×
		[19] (RTU)	×
		[24] (BUS) *1	×
r08	(Thermal time constant)	[3]	×
r09	DC Braking 4 (Braking starting frequency)	[3]	×
r10	(Braking level)	[1]	×
r11	(Braking time)	[5]	×
r12	Starting frequency 4	[3]	×
r13	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 4	[1]	×
r14	Control Mode Selection 4	[1]	×
r15	Motor 4 (No. of poles)	[1]	×
r16	(Rated Capacity)	[11]	×
	(When r39 = 1)	[25]	×
r17	(Rated current)	[24] (DOESA)	×
		[19] (RTU)	×
		[24] (BUS) *1	×
r18	(Auto-tuning)	[21]	×
r19	(Online tuning)	[1]	×
r20	(No-load current)	[24] (DOESA)	×
		[19] (RTU)	×
		[24] (BUS) *1	×
r21	(%R1)	[5]	×
r22	(%X)	[5]	×
r23	(Slip compensation gain for driving)	[3]	×
r24	(Slip compensation response time)	[5]	×
r25	(Slip compensation gain for braking)	[3]	×
r26	(Rated slip frequency)	[5]	×
r27	(Iron loss coefficient 1)	[5]	×
r28	(Iron loss coefficient 2)	[5]	×
r29	(Iron loss coefficient 3)	[5]	×
r30	(Magnetic saturation coefficient 1)	[3]	×
r31	(Magnetic saturation coefficient 2)	[3]	×
r32	(Magnetic saturation coefficient 3)	[3]	×
r33	(Magnetic saturation coefficient 4)	[3]	×
r34	(Magnetic saturation coefficient 5)	[3]	×
r35	(Magnetic saturation expansion coefficient a)	[3]	×
r36	(Magnetic saturation expansion coefficient b)	[3]	×
r37	(Magnetic saturation expansion coefficient c)	[3]	×

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

Table 5.23 List of data format numbers (r codes) (Continued)

Code	Name	Format number	Support VF1A
r39	Motor 4 Selection	[1]	×
r40	Slip Compensation 4 (Operating conditions)	[1]	×
r41	Output Current Fluctuation Damping Gain 4	[5]	×
r42	Motor/parameter switching 4 (Mode selection)	[1]	×
r43	Speed control 4 (Speed command filter)	[7]	○
r44	(Speed detection filter)	[7]	○
r45	P (Gain)	[3]	○
r46	I (Integration time)	[7] *2	○
r47	FF (Gain)	[5]	○
r48	(Output filter)	[7]	×
r49	(Notch filter resonance frequency)	[1]	○
r50	(Notch filter attenuation level)	[1]	○
r51	Cumulative Motor Run Time 4	[74]	×
r52	Startup Times of Motor 4	[1]	×
r53	Motor 4 (%X compensation efficient 1)	[1]	×
r54	(%XCompensation coefficient 2)	[1]	×
r55	(Vector control torque current)	[24] (DOESA)	×
		[19] (RTU)	×
		[24](BUS) *1	×
r56	(Vector control inductive voltage coefficient)	[1]	×
r57	(For manufacturer)	[7]	×

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

*2 The value of 999 will be treated as $7FFF_H$.

Table 5.24 List of data format numbers (J codes)

Code	Name	Format number	Support VF1A
J01	PID control (Mode selection)	[1]	○
J02	(Remote command)	[1]	○
J03	P (gain)	[7]	○
J04	I (Integration time)	[3]	○
J05	D (Derivative time)	[5]	○
J06	(Feedback filter)	[3]	○
J08	(Pressurized frequency)	[3]	×
J09	(Pressuring time)	[1]	×
J10	(Anti reset windup)	[1]	○
J11	(Select alarm output)	[1]	○
J12	(Upper level alarm (AH))	[2]	○
J13	(Lower level alarm (AL))	[2]	○
J15	(Stop frequency for slow flowrate)	[1]	×
		[3]	○
J16	(Slow flowrate level stop latency)	[1]	○
J17	(Starting frequency)	[1]	×
		[3]	○
J18	(Upper limit of PID process output)	[1] *1	×
		[2] *1	○
J19	(Lower limit of PID process output)	[1] *1	×
		[2] *1	○

*1 The value of 999 will be treated as $7FFF_H$.

Table 5.24 List of data format numbers (J codes) (Continued)

Code	Name	Format number	Support VF1A
J21	Dew Condensation Prevention (Duty)	[1]	×
J22	Commercial Power Switching Sequence	[1]	×
J23	PID control (Startup feedback deviation following low liquid level stop)	[3]	○
J24	(Startup delay time following low liquid level stop)	[1]	○
J56	(Speed command filter)	[5]	×
J57	(Dancer reference position)	[2]	○
J58	(Detection width of Dancer position deviation)	[1]	○
J59	P (gain) 2	[7]	○
J60	I (Integral time) 2	[3]	○
J61	D (Derivative time) 2	[5]	○
J62	(PID control block selection)	[1]	○
J63	Overload Stop (Detected value)	[1]	○
J64	(Detection level)	[1]	○
J65	(Function selection)	[1]	○
J66	(Operation condition)	[1]	○
J67	(Timer)	[5]	○
J68	Braking signal (Brake release current)	[1]	×
		[5]	○
J69	(Brake release frequency)	[3]	○
J70	(Brake release timer)	[3]	×
		[5]	○
J71	(Brake apply frequency)	[3]	○
J72	(Brake apply timer)	[3]	×
		[5]	○
J73	Position control (Start time)	[3]	○
J74	(Start point : Upper column)	[73]	○
J75	(Start point : Lower column)	[75]	○
J76	(Zero point : Upper column)	[73]	○
J77	(Zero point : Lower column)	[75]	○
J78	(Distance of low speed control : Upper column)	[1]	○
J79	(Distance of low speed control : Lower column)	[1]	○
J80	(Speed command on low speed control)	[1]	○
J81	(Objective Stop point : Upper column)	[73]	○
J82	(Objective Stop point : Lower column)	[1]	○
J83	(Permissible range of objective stop point)	[1]	○
J84	(End time)	[3]	○
J85	(Compensation of over travel)	[1]	○
J86	(Selection mode)	[1]	○
J87	(Compensation of over travel)	[1]	○
J88	(Selection mode)	[1]	○
J90	Overload Stop Function Torque Limit P (Gain)	[7]	×
J91	I (Integral time)	[7]	×
J92	(Current control level)	[3]	×
J95	Brake Signal (Release torque)	[1]	×
		[5]	○
J96	(Speed selection)	[1]	○
J97	Servo lock (Gain)	[5]	×
		[7]	○
J98	(Completion timer)	[7]	○
J99	(Completion range)	[1]	○

Table 5.24 List of data format numbers (J codes) (Continued)

Code	Name	Format number	Support VF1A
J105	PID control (Display unit)	[1]	○
J106	(Maximum scale)	[12]	○
J107	(Minimum scale)	[12]	○
J136	(Multistep command 1)	[12]	○
J137	(Multistep command 2)	[12]	○
J138	(Multistep command 3)	[12]	○

Table 5.25 List of data format numbers (d codes)

Code	Name	Format number	Support VF1A
d01	Speed control 1 (Speed command filter)	[7]	○
d02	(Speed detection filter)	[7]	○
d03	P (Gain)	[3]	○
d04	I (Integral time)	[7] *1	○
d05	(FF gain)	[5]	○
d06	(Output filter)	[7]	×
d07	(Notch filter resonance frequency)	[1]	○
d08	(Notch filter attenuation level)	[1]	○
d09	Speed control (JOG) (Speed command filter)	[7]	○
d10	(Speed detection filter)	[7]	○
d11	P (Gain)	[3]	○
d12	I (Integral time)	[7] *1	○
d13	(Output filter)	[7]	×
d14	Feedback (Feedback input) (Pulse input format)	[1]	○
d15	(Encoder pulse count)	[1]	○
d16	(Pulse scaling factor 1)	[1]	○
d17	(Pulse scaling factor 2)	[1]	○
d21	Speed agreement / PG error (Detection width)	[3]	○
d22	(Detection timer)	[5]	○
d23	PG error processing	[1]	○
d24	Zero speed control	[1]	○
d25	ASR switching time	[7]	○
d27	Servo lock (Gain switching time)	[7]	×
d28	(Gain 2)	[5]	×
d32	Torque control (Speed limiting 1)	[1]	○
d33	(Speed limiting 2)	[1]	○
d35	Over speed detection level	[1]	○
d41	Application control selection	[1]	○
d51	(For manufacturer)	[1]	○
d52		[1]	○
d53		[1]	×
d54		[1]	×
d55		[1]	○
d59	Command (Pulse train input) (Pulse input format)	[1]	○
d60	(Encoder pulse count)	[1]	○
d61	(Filter time constant)	[7]	○
d62	(Pulse scaling factor 1)	[1]	○
d63	(Pulse scaling factor 2)	[1]	○

*1 The value of 999 will be treated as $7FFF_H$.

Table 5.25 List of data format numbers (d codes) (Continued)

Code	Name	Format number	Support VF1A
d67	Starting characteristic (Auto search mode: for speed sensorless vector control)	[1]	○
d68	(For manufacturer)	[3]	×
d69		[3]	○
d70	Speed control limiter	[5]	○
d71	Master-follower operation (Main speed regulator gain)	[5]	○
d72	(APR P gain)	[5]	○
d73	(APR output +side limiter)	[1]	○
d74	(APR output -side limiter)	[1]	○
d75	(Z phase alignment gain)	[5]	○
d76	(Offset angle between master and follower)	[1]	○
d77	(Synchronous completion detection angle)	[1]	○
d78	(Excessive error detection level)	[1]	○
d79	(For manufacturer)	[1]	○
d81		[1]	×
d82	Magnetic flux weakening control (Speed sensorless vector)	[1]	×
d83	Magnetic flux weakening lower limit (Speed sensorless vector)	[1]	×
d84	(For manufacturer)	[1]	×
d85		[1]	×
d86	Acceleration/deceleration filter time constant	[7]	×
d88	(For manufacturer)	[5]	○
d90	Magnetic flux level during deceleration under vector control for IM	[1]	○
d91	(For manufacturer)	[5]	○
d92		[5]	○
d93		[5]	○
d94		[5]	○
d95		[5]	○
d96		[4]	○
d97		[4]	○
d98		[1]	×
d99	Extension function 1	[1]	○

Table 5.26 Data format number list (U code VF1A)

Code	Name	Format number	Support
			VF1A
U00	Customizable logic (Mode selection)	[1]	O
U01	Customizable logic: Step 1 (Logic circuit)	[1]	O
U02	(Input 1)	[1]	O
U03	(Input 2)	[1]	O
U04	(Function 1)	[12]	O
U05	(Function 2)	[12]	O
U06	Customizable logic: Step 2 (Logic circuit)	[1]	O
U07	(Input 1)	[1]	O
U08	(Input 2)	[1]	O
U09	(Function 1)	[12]	O
U10	(Function 2)	[12]	O
U11	Customizable logic: Step 3 (Logic circuit)	[1]	O
U12	(Input 1)	[1]	O
U13	(Input 2)	[1]	O
U14	(Function 1)	[12]	O
U15	(Function 2)	[12]	O
U16	Customizable logic: Step 4 (Logic circuit)	[1]	O
U17	(Input 1)	[1]	O
U18	(Input 2)	[1]	O
U19	(Function 1)	[12]	O
U20	(Function 2)	[12]	O
U21	Customizable logic: Step 5 (Logic circuit)	[1]	O
U22	(Input 1)	[1]	O
U23	(Input 2)	[1]	O
U24	(Function 1)	[12]	O
U25	(Function 2)	[12]	O
U26	Customizable logic: Step 6 (Logic circuit)	[1]	O
U27	(Input 1)	[1]	O
U28	(Input 2)	[1]	O
U29	(Function 1)	[12]	O
U30	(Function 2)	[12]	O
U31	Customizable logic: Step 7 (Logic circuit)	[1]	O
U32	(Input 1)	[1]	O
U33	(Input 2)	[1]	O
U34	(Function 1)	[12]	O
U35	(Function 2)	[12]	O
U36	Customizable logic: Step 8 (Logic circuit)	[1]	O
U37	(Input 1)	[1]	O
U38	(Input 2)	[1]	O
U39	(Function 1)	[12]	O
U40	(Function 2)	[12]	O
U41	Customizable logic: Step 9 (Logic circuit)	[1]	O
U42	(Input 1)	[1]	O
U43	(Input 2)	[1]	O
U44	(Function 1)	[12]	O
U45	(Function 2)	[12]	O
U46	Customizable logic: Step 10 (Logic circuit)	[1]	O
U47	(Input 1)	[1]	O
U48	(Input 2)	[1]	O
U49	(Function 1)	[12]	O
U50	(Function 2)	[12]	O

Table 5.26 Data format number list (U code VF1A) (Continued)

Code	Name		Format number	Support VF1A
U51	Customizable logic: Step 11	(Logic circuit)	[1]	O
U52		(Input 1)	[1]	O
U53		(Input 2)	[1]	O
U54		(Function 1)	[12]	O
U55		(Function 2)	[12]	O
U56	Customizable logic: Step 12	(Logic circuit)	[1]	O
U57		(Input 1)	[1]	O
U58		(Input 2)	[1]	O
U59		(Function 1)	[12]	O
U60		(Function 2)	[12]	O
U61	Customizable logic: Step 13	(Logic circuit)	[1]	O
U62		(Input 1)	[1]	O
U63		(Input 2)	[1]	O
U64		(Function 1)	[12]	O
U65		(Function 2)	[12]	O
U66	Customizable logic: Step 14	(Logic circuit)	[1]	O
U67		(Input 1)	[1]	O
U68		(Input 2)	[1]	O
U69		(Function 1)	[12]	O
U70		(Function 2)	[12]	O
U71	Customizable logic output signal 1	(Output selection)	[1]	O
U72	2		[1]	O
U73	3		[1]	O
U74	4		[1]	O
U75	5		[1]	O
U76	6		[1]	O
U77	7		[1]	O
U78	8		[1]	O
U79	9		[1]	O
U80	10		[1]	O
U81	Customizable logic output signal 1	(Function selection)	[1]	O
U82	2		[1]	O
U83	3		[1]	O
U84	4		[1]	O
U85	5		[1]	O
U86	6		[1]	O
U87	7		[1]	O
U88	8		[1]	O
U89	9		[1]	O
U90	10		[1]	O
U91	Customizable logic timer monitor	(Step selection)	[1]	O
U92	Customizable logic operation coefficient	(Mantissa of KA1)	[8]	O
U93		(Exponent part of KA1)	[2]	O
U94		(Mantissa of KB1)	[8]	O
U95		(Exponent part of KB1)	[2]	O
U96		(Mantissa of KC1)	[8]	O
U97		(Exponent part of KC1)	[2]	O

Table 5.26 Data format number list (U code VF1A) (Continued)

Code	Name	Format number	Support VF1A
U100	Task process end setting	[1]	○
U101	Customizable logic Conversion operating point (X1)	[12]	○
U102	Conversion operating point (Y1)	[12]	○
U103	Conversion operating point (X2)	[12]	○
U104	Conversion operating point (Y2)	[12]	○
U105	Conversion operating point (X3)	[12]	○
U106	Conversion operating point (Y3)	[12]	○
U107	Customizable logic (Auto calculation of coefficients of approximate formula)	[1]	○
U121	Customizable logic (User parameter 1)	[12]	○
U122	(User parameter 2)	[12]	○
U123	(User parameter 3)	[12]	○
U124	(User parameter 4)	[12]	○
U125	(User parameter 5)	[12]	○
U126	(User parameter 6)	[12]	○
U127	(User parameter 7)	[12]	○
U128	(User parameter 8)	[12]	○
U129	(User parameter 9)	[12]	○
U130	(User parameter 10)	[12]	○
U131	(User parameter 11)	[12]	○
U132	(User parameter 12)	[12]	○
U133	(User parameter 13)	[12]	○
U134	(User parameter 14)	[12]	○
U135	(User parameter 15)	[12]	○
U136	(User parameter 16)	[12]	○
U137	(User parameter 17)	[12]	○
U138	(User parameter 18)	[12]	○
U139	(User parameter 19)	[12]	○
U140	(User parameter 20)	[12]	○
U171	Customizable logic (Storage area 1)	[12]	○
U172	(Storage area 2)	[12]	○
U173	(Storage area 3)	[12]	○
U174	(Storage area 4)	[12]	○
U175	(Storage area 5)	[12]	○
U190	Customizable logic step setting (Step number)	[1]	○
U191	(Circuit selection)	[1]	○
U192	(Input 1)	[1]	○
U193	(Input 2)	[1]	○
U194	(Function 1)	[12]	○
U195	(Function 2)	[12]	○
U196	Customizable logic ROM version first 4 digits (Monitor)	[1]	○
U197	(For user)	[1]	○
U198	Customizable logic ROM version last 4 digits (Monitor)	[1]	○
U199	(For user)	[1]	○

Table 5.27 List of data format numbers (y codes)

Code	Name	Format number	Support VF1A
y01	RS-485 communication 1 (Station address)	[1]	○
y02	(Communications error processing)	[1]	○
y03	(Timer)	[3]	○
y04	(Baud rate)	[1]	○
y05	(Data length)	[1]	○
y06	(Parity check)	[1]	○
y07	(Stop bits)	[1]	○
y08	(No response error detection time)	[1]	○
y09	(Response interval)	[5]	○
y10	(Protocol selection)	[1]	○
y11	RS-485 communication 2 (Station address)	[1]	○
y12	(Communications error processing)	[1]	○
y13	(Timer)	[3]	○
y14	(Baud rate)	[1]	○
y15	(Data length)	[1]	○
y16	(Parity check)	[1]	○
y17	(Stop bits)	[1]	○
y18	(No response error detection time)	[1]	○
y19	(Response interval)	[5]	○
y20	(Protocol selection)	[1]	○
y21	(For manufacturer)	[1]	○
y24		[1]	○
y25		[1]	○
y26		[1]	○
y27		[1]	○
y28		[1]	○
y29		[1]	○
y30		[1]	○
y31		[1]	○
y32		[1]	○
y33		[1]	○
y34		[1]	○
y35		[3]	○
y36		[1]	○
y95	Data clear processing for communication error	[1]	○
y96	For manufacturer	[1]	○
y97	Communications Data Saving Method Selection	[1]	○
y98	Bus Link Function (Mode selection)	[1]	○
y99	Loader Link Function (Mode selection)	[1]	○

Table 5.28 Data format number list (o code)

Code	Name		Format number	Support VF1A
o01	Terminal [O1]	(Function selection)	[1]	O
o02	Terminal [O2]	(Function selection)	[1]	O
o03	Terminal [O3]	(Function selection)	[1]	O
o04	Terminal [O4]	(Function selection)	[1]	O
o05	Terminal [O5]	(Function selection)	[1]	O
o06	Terminal [O6]	(Function selection)	[1]	O
o07	Terminal [O7]	(Function selection)	[1]	O
o08	Terminal [O8]	(Function selection)	[1]	O
o19	DI option	(DI polarity selection)	[1]	O
o20		(DI mode selection)	[1]	O
o21	DO option	(DO mode selection)	[1]	O
o27	Transmission error	(Operation selection)	[1]	O
o28		(Timer time)	[3]	O
o30	Bus setting parameter 01		[1]	O
o31	02		[1]	O
o32	03		[1]	O
o33	04		[1]	O
o34	05		[1]	O
o35	06		[1]	O
o36	07		[1]	O
o37	08		[1]	O
o38	09		[1]	O
o39	10		[1]	O
o40	Write function code assignment 1		[1]	O
o41	2		[1]	O
o42	3		[1]	O
o43	4		[1]	O
o44	5		[1]	O
o45	6		[1]	O
o46	7		[1]	O
o47	8		[1]	O
o48	Read function code assignment 1		[1]	O
o49	2		[1]	O
o50	3		[1]	O
o51	4		[1]	O
o52	5		[1]	O
o53	6		[1]	O
o54	7		[1]	O
o55	8		[1]	O
o56	9		[1]	O
o57	10		[1]	O
o58	11		[1]	O
o59	12		[1]	O
o60	Terminal [32]	(Function selection)	[1]	O
o61		(Offset adjustment)	[4]	O
o62		(Gain adjustment)	[5]	O
o63		(Filter setting)	[5]	O
o64		(Gain reference point)	[5]	O
o65		(Polarity selection)	[1]	O

Table 5.28 Data format number list (o code) (Continued)

Code	Name		Format number	Support
				VF1A
o66	Terminal [32]	(Bias)	[1]	O
o67		(Bias reference point)	[4]	O
o69		(Display unit)	[5]	O
o70		(Maximum scale)	[5]	O
o71		(Minimum scale)	[1]	O
o75	Terminal [C2]	(Range selection)	[1]	O
o76		(Function selection)	[1]	O
o77		(Offset adjustment)	[4]	O
o78		(Gain adjustment)	[5]	O
o79		(Filter setting)	[5]	O
o81		(Gain reference point)	[5]	O
o82		(Bias)	[6]	O
o83		(Bias reference point)	[5]	O
o85		(Display unit)	[1]	O
o86		(Maximum scale)	[12]	O
o87		(Minimum scale)	[12]	O
o90	Terminal [Ao/CS2]	(Function selection)	[1]	O
o91		(Output gain)	[1]	O
o93		(Polarity selection)	[1]	O
o96	Terminal [CS/CS1]	(Function selection)	[1]	O
o97		(Output gain)	[1]	O
o101	Terminal [I1]	(Function selection)	[1]	O
o102	Terminal [I2]	(Function selection)	[1]	O
o103	Terminal [I3]	(Function selection)	[1]	O
o104	Terminal [I4]	(Function selection)	[1]	O
o105	Terminal [I5]	(Function selection)	[1]	O
o106	Terminal [I6]	(Function selection)	[1]	O
o107	Terminal [I7]	(Function selection)	[1]	O
o108	Terminal [I8]	(Function selection)	[1]	O
o109	Terminal [I9]	(Function selection)	[1]	O
o110	Terminal [I10]	(Function selection)	[1]	O
o111	Terminal [I11]	(Function selection)	[1]	O
o112	Terminal [I12]	(Function selection)	[1]	O
o113	Terminal [I13]	(Function selection)	[1]	O

*1 is as follows.

Code	Name		Format number	Support
				VF1A
o66	Terminal [C2]	(Function selection)	[1]	×
o67		(Offset adjustment)	[4]	×
o68		(Gain adjustment)	[5]	×
o69		(Filter setting)	[5]	×
o70		(Gain reference point)	[5]	×
o71	Terminal [Ao]	(Function selection)	[1]	×
o72		(Output gain)	[1]	×
o73		(Polarity selection)	[1]	×
o74	Terminal [CS]	(Function selection)	[1]	×
o75		(Output gain)	[1]	×

Table 5.29 Data format number list (K code)

Code	Name	Format number	Support
			VF1A
K01	Multi-function touch panel TP-A1 (Language selection)	[1]	○
K02	(Backlight OFF time)	[1]	○
K03	(Backlight brightness adjustment)	[1]	○
K04	(Contrast adjustment)	[1]	○
K08	(LCD monitor status display selection)	[1]	○
K15	(Sub-monitor display selection)	[1]	○
K16	(Sub-monitor 1 display selection)	[1]	○
K17	(Sub-monitor 2 display selection)	[1]	○
K20	(Bar graph 1 display selection)	[1]	○
K21	(Bar graph 2 display selection)	[1]	○
K22	(Bar graph 3 display selection)	[1]	○
K91	(< key shortcut selection)	[1]	○
K92	(> key shortcut selection)	[1]	○

K codes are function codes for use by the manufacturer. Do not change.

Table 5.30 List of data format numbers (S codes)

Code	Name	Format number	Support
			VF1A
S01	Frequency reference (p.u.)	[29]	○
S02	Torque command	[6]	○
S03	Torque current command	[6]	○
S05	Frequency reference	[22]	○
S06	Operation command	[14]	○
S07	Universal DO	[15]	○
S08	Acceleration time F07	[3]	○
S09	Deceleration time F08	[3]	○
S10	Torque limiting 1 (Driving)	[1]	×
	Torque limit value 1-1	[6]	○
S11	Torque limiting 1 (Braking)	[1]	×
	Torque limit value 1-2	[6]	○
S12	Universal AO	[29]	○
S13	PID command	[29]	○
S14	Alarm reset command	[1]	○
S19	Speed command	[2]	○

Table 5.31 List of data format numbers (M codes)

Code	Name		Format number	Support VF1A
M01	Frequency reference (p.u.)	(Final command)	[29]	○
M02	Torque command	(Final command)	[6]	○
M03	Torque current command	(Final command)	[6]	○
M04	Magnetic flux command value		[6]	○
M05	Frequency reference	(Final command)	[22]	○
M06	Output frequency 1 (p.u.)		[29]	○
M07	Torque real value		[6]	○
M08	Torque current		[6]	○
M09	Output frequency		[23] (DOESA)	○
			[22] (RTU)	○
			[22] (BUS) *1	○
M10	Input power		[5]	○
M11	Output current effective value		[5]	○
M12	Output voltage effective value		[3]	○
M13	Operation command	(Final command)	[14]	○
M14	Operation status		[16]	○
M15	General-purpose output terminal information		[15]	○
M16	Alarm details	(Latest)	[10]	○
M17		(Last)	[10]	○
M18		(Second last)	[10]	○
M19		(Third last)	[10]	○
M20	Cumulative operation time		[1]	○
M21	DC link circuit voltage		[1]	○
M22	Motor temperature		[2]	×
M23	Model code		[17]	○
M24	Capacity code		[11]	○
M25	ROM version		[35]	○
M26	Transmission error transaction code		[20]	○
M27	Frequency reference on alarm (p.u.)	(Final command)	[29]	○
M28	Torque command on alarm	(Final command)	[6]	○
M29	Torque current command on alarm	(Final command)	[6]	○
M30	Flux command on alarm	(Final command)	[6]	○
M31	Frequency reference on alarm	(Final command)	[22]	○
M32	Output frequency 1 on alarm (p.u.)		[29]	○
M33	Torque real value on alarm		[6]	○
M34	Torque current on alarm		[6]	○
M35	Output frequency on alarm		[23] (DOESA)	○
			[22] (RTU)	○
			[22] (BUS) *1	○
M36	Input power on alarm		[5]	○
M37	Output current effective value on alarm		[5]	○
M38	Output voltage effective value on alarm		[3]	○
M39	Operation command on alarm		[14]	○
M40	Operation status on alarm		[16]	○
M41	Output terminal information on alarm		[15]	○
M42	Cumulative operation time on alarm		[1]	○
M43	DC link circuit voltage on alarm		[1]	○
M44	Inverter internal air temperature on alarm		[1]	○
M45	Heat sink temperature on alarm		[1]	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

Table 5.31 List of data format numbers (M codes) (Continued)

Code	Name	Format number	Support VF1A
M46	Life of main circuit capacitor	[3]	○
M47	Life of PC board electrolytic capacitor	[1]	×
		[74]	○
M48	Life of heat sink	[1]	×
		[74]	○
M49	Input terminal voltage [12]	[29]	○
M50	Input terminal current [C1]	[29]	○
M52	Input terminal voltage [32]	[29]	○
M53	Input terminal current [C2]	[29]	○
M54	Input terminal voltage [V2]	[29]	○
M61	Inverter internal air temperature	[1]	○
M62	Heat sink temperature	[1]	○
M63	Load rate	[6]	○
M64	Motor output	[6]	○
M65	Motor output on alarm	[29]	○
M66	Speed detection	[29]	○
M67	Transmission error handling code 2	[20]	○
M68	PID final command	[29]	○
M69	Inverter rated current	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
M70	Operation status 2	[44]	○
M71	Input terminal information	[14]	○
M72	PID feedback value	[29]	○
M73	PID output	[29]	○
M74	Operating status 2	[76]	○
M76	Main circuit capacity life (Elapsed time)	[74]	○
M77	(Remaining time)	[74]	○
M78	Rotation speed command	[2]	○
M79	Rotation speed	[2]	○
M81	Maintenance (Remaining time) (M1)	[74]	○
M85	Maintenance (Starting times) (M1)	[1]	○
M86	Light alarm contents (Latest)	[10]	×
		[41]	○
M87	(Last)	[10]	×
		[41]	○
M88	(Second last)	[10]	×
		[41]	○
M89	(Third last)	[10]	×
		[41]	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

Table 5.32 List of data format numbers (W codes)

Code	Name	Format number	Support VF1A
W01	Operation status	[16]	○
W02	Frequency reference	[22]	○
W03	Output frequency (before slip compensation)	[22]	○
W04	(after slip compensation)	[22]	○
W05	Output current	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
W06	Output voltage	[3]	○
W07	Torque	[2]	○
W08	Rotation speed	[37]	○
W09	Load rotation speed	[37]	○
W10	Line speed	[37]	○
W11	PID process command	[12]	○
W12	PID feedback value	[12]	○
W13	Level of torque value A	[1]	×
		[2]	○
W14	Level of torque value B	[1]	×
		[2]	○
W15	Ratio value	[5]	○
W16	Rotation speed set value	[37]	○
W17	Load speed set value	[37]	○
W18	Line speed set value	[37]	○
W19	Constant feed time set value	[37]	○
W20	Constant feed time	[37]	○
W21	Input power	[24]	○
W22	Motor output	[24]	○
W23	Load rate	[2]	○
W24	Torque current	[2]	○
W26	Flux reference	[2]	○
W27	Timer operation remaining time	[1]	○
W28	Operation command source	[67]	○
W29	Frequency and PID command source	[68]	○
W30	Speed at percentage	[5]	○
W31	Speed set value at percentage	[5]	○
W32	PID output	[4]	○
W33	Analog input monitor	[12]	○
W35	Terminal [32] input voltage	[4]	○
W36	Terminal [C2] input current	[4]	○
W37	Terminal [A0] output voltage	[4]	○
W38	Terminal [CS] output frequency	[3]	○
W39	Pulse input monitor [X7]	[6]	○
W40	Control circuit terminal (input)	[43]	○
W41	(output)	[15]	○
W42	Communications control signal (input)	[14]	○
W43	(output)	[15]	○
W44	Terminal [12] input voltage	[4]	○
W45	Terminal [C1] input current	[3]	×
		[4]	○
W46	FMA output voltage	[3]	○
W47	FMP output voltage	[3]	○
W48	FMP output frequency	[1]	○
W49	V2 terminal input voltage	[4]	○
W50	FMA output current	[3]	○
W51	Situation of input terminals on DIO option	[77]	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

Table 5.32 List of data format numbers (W codes) (Continued)

Code	Name	Format number	Support VF1A
W52	Situation of output terminals on DIO option	[1]	×
		[78]	○
W53	Pulse input (Master - side A/B phase)	[6]	○
W54	(Master - side Z phase)	[1]	○
W55	(Slave - side A/B phase)	[6]	○
W56	(Slave - side Z phase)	[1]	○
W57	Current Position Pulse (Upper column)	[73]	○
W58	(Lower column)	[1]	○
W59	Stop Position Pulse (Upper column)	[73]	○
W60	(Lower column)	[1]	○
W61	Difference Pulse of Position (Upper column)	[73]	○
W62	(Lower column)	[1]	○
W63	Positioning Status	[1]	○
W64	Deviation when servo lock applied	[2]	×
W66	Deviation for SY synchronization	[4]	○
W67	Cumulative operation time of electrolytic	[74]	○
W68	Cumulative operation time of cooling fan	[74]	○
W69	Peripheral speed monitor	[37]	×
W70	Cumulative operation time	[1]	○
W71	DC link circuit voltage	[1]	○
W72	Internal air highest temperature	[1]	○
W73	Heat sink maximum temperature	[1]	○
W74	Maximum effective current value	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
W75	Main circuit capacitor's capacitor	[3]	○
W76	Cumulative ope. time of capacitor on PC board	[1]	○
W77	Cumulative ope. time of cooling fan	[1]	○
W78	Number of startups	[1]	○
W79	Cumulative ope. time of motor driving	[1]	×
W80	Standard fan life	[1]	×
W81	Integrating electric power	[45]	×
		[93]	○
W82	Data used integrating electric power	[45]	○
W83	Number of RS485 ch1 errors	[1]	○
W84	Contents of RS485 ch1 error	[20]	○
W85	Number of RS485 ch2 errors	[1]	○
W86	Number of option communications errors	[1]	×
W87	Inverter's keypad's ROM version (CPU1)	[35]	○
W88	Inverter's keypad's ROM version (CPU2)	[35]	○
W89	Remote keypad's ROM version	[35]	○
W90	Option 1 ROM version	[35]	○
W91	Option 2 ROM version	[35]	×
W92	Option 3 ROM version	[35]	×
W94	Contents of RS485 ch2 error	[20]	○
W95	Number of option communications errors	[1]	○
W96	Option communicate error contents	[1]	○
W97	Option communicate error contents	[1]	×
W98	Number of option communications errors	[1]	×
W99	Option communicate error contents	[1]	×

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

Table 5.33 List of data format numbers (X codes)

Code	Name	Format number	Support VF1A
X00	Alarm history (latest)	[41]	○
X01	Multiple alarm 1 (latest)	[40]	○
X02	Multiple alarm 2 (latest)	[40]	○
X03	Sub code (latest)	[1]	○
X04	Multiple alarm subcode (Latest, second)	[1]	○
X05	Alarm history (last)	[41]	○
X06	Multiple alarm 1 (last)	[40]	○
X07	Multiple alarm 2 (last)	[40]	○
X08	Sub code (last)	[1]	○
X09	Multiple alarm subcode (Last, second)	[1]	○
X10	Alarm history (second last)	[41]	○
X11	Multiple alarm 1 (second last)	[40]	○
X12	Multiple alarm 2 (second last)	[40]	○
X13	Sub code (second last)	[1]	○
X14	Multiple alarm subcode (Second last, second)	[1]	○
X15	Alarm history (third last)	[41]	○
X16	Multiple alarm 1 (third last)	[40]	○
X17	Multiple alarm 2 (third last)	[40]	○
X18	Sub code (last)	[1]	○
X19	Multiple alarm subcode (Third last, second)	[1]	○
X20	Latest info. on alarm (output frequency)	[22]	○
X21	(output current)	[24]	○
		[19] (RTU)	○
		[24] (BUS) *1	○
X22	(output voltage)	[1]	○
X23	(Torque)	[2]	○
X24	(set frequency)	[22]	○
X25	(operation status)	[16]	○
X26	(cumulative ope. time)	[1]	○
X27	(number of startups)	[1]	○
X28	(DC link circuit voltage)	[1]	○
X29	(internal air temperature)	[1]	○
X30	(heat sink temperature)	[1]	○
X31	(input terminal)	[43]	○
X32	(output terminal)	[15]	○
X33	(input terminal(com.))	[14]	○
X34	(output terminal(com.))	[15]	○
X35	(Power consumption during alarm)	[24]	○
X36	(Operation status 2)	[76]	○
X37	(Speed detection)	[29]	○
X38	(Operation status 3)	[44]	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

Table 5.33 List of data format numbers (X codes) (Continued)

Code	Name	Format number	Support VF1A
X60	Last info. on alarm (output frequency)	[22]	○
X61	(output current)	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
X62	(output voltage)	[1]	○
X63	(Torque)	[2]	○
X64	(set frequency)	[22]	○
X65	(operation status)	[16]	○
X66	(cumulative ope. time)	[1]	○
X67	(number of startups)	[1]	○
X68	(DC link circuit voltage)	[1]	○
X69	(internal air temperature)	[1]	○
X70	(heat sink temperature)	[1]	○
X71	(input terminal)	[43]	○
X72	(output terminal)	[15]	○
X73	(input terminal(com.))	[14]	○
X74	(output terminal(com.))	[15]	○
X76	(Operation status 2)	[76]	○
X77	(Speed detection)	[29]	○
X78	(Operation status 3)	[44]	○
X89	Customizable logic (Digital I/O)	[95]	○
X90	(Timer monitor)	[5]	○
X91	(Analog input 1)	[12]	○
X92	(Analog input 2)	[12]	○
X93	(Analog output)	[12]	○
X94	Relay output terminal information	[91]	○
X97	Terminal (PTC) input voltage	[4]	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

Table 5.34 List of data format numbers (Z codes)

Code	Name	Format number	Support VF1A
Z00	Second last info. on alarm (output frequency)	[22]	○
Z01	(output current)	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
Z02	(output voltage)	[1]	○
Z03	(Torque)	[2]	○
Z04	(set frequency)	[22]	○
Z05	(operation status)	[16]	○
Z06	(cumulative ope. time)	[1]	○
Z07	(number of startups)	[1]	○
Z08	(DC link circuit voltage)	[1]	○
Z09	(internal air temperature)	[1]	○
Z10	(heat sink temperature)	[1]	○
Z11	(input terminal)	[43]	○
Z12	(output terminal)	[15]	○
Z13	(input terminal(com.))	[14]	○
Z14	(output terminal(com.))	[15]	○
Z16	(Operation status 2)	[76]	○
Z17	(Speed detection)	[29]	○
Z18	(Operation status 3)	[44]	○
Z40	Cumulative operation time of motor (M1)	[74]	○
Z41	(M2)	[74]	○
Z42	(M3)	[74]	×
Z43	(M4)	[74]	×
Z44	Number of starting time (M2)	[1]	○
Z45	(M3)	[1]	×
Z46	(M4)	[1]	×
Z48	Retry history (Latest)	[41]	○
Z49	Retry history (Last)	[41]	○
Z50	Third last info. on alarm (output frequency)	[22]	○
Z51	(output current)	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
Z52	(output voltage)	[1]	○
Z53	(Torque)	[2]	○
Z54	(set frequency)	[22]	○
Z55	(operation status)	[16]	○
Z56	(cumulative ope. time)	[1]	○
Z57	(number of startups)	[1]	○
Z58	(DC link circuit voltage)	[1]	○
Z59	(internal air temperature)	[1]	○
Z60	(heat sink temperature)	[1]	○
Z61	(input terminal)	[43]	○
Z62	(output terminal)	[15]	○
Z63	(input terminal(com.))	[14]	○
Z64	(output terminal(com.))	[15]	○
Z66	(Operation status 2)	[76]	○
Z67	(Speed detection)	[29]	○
Z68	(Operation status 2)	[44]	○
Z78	(For manufacturer)	[2]	○
Z79		[2]	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

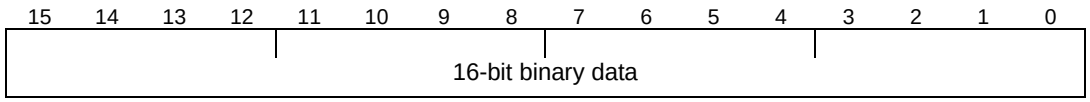
Table 5.34 List of data format numbers (Z codes) (Continued)

Code	Name	Format number	Support VF1A
Z80	Speed detection	[2]	○
Z81	Output torque	[6]	○
Z82	Load factor	[6]	○
Z83	Motor output	[6]	○
Z84	Output current	[24] (DOESA)	○
		[19] (RTU)	○
		[24] (BUS) *1	○
Z85	PID feedback value	[12]	○
Z86	Power consumption	[24]	○
Z87	PID output	[4]	○
Z88	Integral power	[45]	×
		[93]	○
Z90	Current Position Pulse (Upper column)	[73]	○
Z91	(Lower column)	[1]	○
Z92	Stop Position Pulse (Upper column)	[73]	○
Z93	(Lower column)	[1]	○
Z94	Difference Pulse of Position (Upper column)	[73]	○
Z95	(Lower column)	[1]	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option. (VF1A does not support the field bus option.)

5.2.2 Data format specifications

The data in the data fields of a communications frame are 16 bits long, binary data, as shown below.



For the convenience of description, 16-bit data is expressed in hexadecimal with one upper-order byte (eight bits from 15 to 8) and one lower-order byte (eight bits from 7 to 0).

For example, the following data is 1234H in hexadecimal and expressed as | 12_H | 34_H | .

0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0

Data format [1] Integer data (positive): Minimum step 1

(Example) When F05 (base) frequency voltage = 200V

200 = $00C8_H$ Consequently ⇒ | 00_H | $C8_H$ |

Data format [2] Integer data (positive/negative): Minimum step 1

(Example) When the value is -20

-20 = $FFEC_H$ Consequently, ⇒ | FF_H | EC_H |

Data format [3] Decimal data (positive): Minimum step 0.1

(Example) When F17 (gain frequency set signal) = 100.0%

100.0 x 10 = 1000 = $03E8_H$ Consequently, ⇒ | 03_H | $E8_H$ |

Data format [4] Decimal data (positive/negative): Minimum step 0.1

(Example) When C31 (analog input offset adjustment) = -5.0%

-5.0 x 10 = -50 = $FFCE_H$ Consequently, ⇒ | FF_H | CE_H |

Data format [5] Decimal data (positive): Minimum step 0.01

(Example) C05 (multistep frequency) = 50.25Hz

50.25 x 100 =5025 =$13A1_H$ Consequently, ⇒ | 13_H | $A1_H$ |

Data format [6] Decimal data (positive/negative): Minimum step 0.01

(Example) When M07 (actual torque value) = -85.38%

-85.38 x 100 =-8538 = $DEA6_H$ Consequently, ⇒ | DE_H | $A6_H$ |

Data format [7] Decimal data (positive): Minimum step 0.001

(Example) When F51(electronic thermal (permissible loss)) = 0.105kW

$0.105 \times 1000 = 105 = 0069_H$ Consequently, ⇒

00_H	69_H

Data format [8] Decimal data (positive/negative): Minimum step 0.001

(Example) When the data is -1.234

$-1.234 \times 1000 = -1234 = FB2E_H$ Consequently, ⇒

FB_H	$2E_H$

Data format [10] Alarm codes

Table 5.35 List of alarm codes

Code	Description		Code	Description	
0	No alarm	---	28	PG disconnection	PG
1	Overcurrent (during acceleration)	OC1	29	NTC disconnection error	nr-b
2	Overcurrent (during deceleration)	OC2	31	Memory error	Er1
3	Overcurrent (during constant speed operation)	OC3	32	Keypad communications error	Er2
5	Ground fault	EF	33	CPU error	Er3
6	Overvoltage (during acceleration)	OU1	34	Option communications error	Er4
7	Overvoltage (during deceleration)	OU2	35	Option error	Er5
8	Overvoltage (during constant speed operation or stopping)	OU3	36	Run operation error	Er6
10	Undervoltage	LU	37	Tuning error	Er7
11	Input phase loss	Lin	38	RS-485 communications error (communications port1)	Er8
14	Fuse blown	FUS	44	Motor overload: motor 3	OL3
16	Charging circuit fault	PbF	45	Motor overload: motor 4	OL4
17	Heat sink overheat	OH1	46	Output phaseloss	OPL
18	External alarm	OH2	47	Following error, excessive speed deviation	ErE
19	Internal air overheat	OH3	51	Data save error on insufficient voltage	ErF
20	Motor protection (PTC/NTC thermistor)	OH4	53	RS-485 communications error (Option/Communications port 2)	ErP
22	Braking resistor overheat	dbH	54	Hardware error	ErH
23	Motor overload	OL1	57*1	EN circuit error	ECF
24	Motor overload: motor 2	OL2	58	PID feedback disconnection detected	CoF
25	Inverter overload	OLU	59	DB transistor trouble	dbA
27	Over speed protection	OS	100	DC fan lock detected	FAL

*1 (Not applicable for VF1A.)

Code	Description		Code	Description	
101	Motor overload warning	OL	106	Low torque detected	UTL
102	Cooling fin overheat warning	OH	107	Thermistor detected (PTC)	PTC
103	Life warning	LIFE	108	Machine life (accumulated operation hours)	rTE
104	Command loss	rEF	109	Machine life (No. of starting times)	CnT
105	PID warning output	PID	254	Simulated error	Err

(Example) In the case of overvoltage (during acceleration) (OU1)

6 = 0006_H Consequently, ⇒

00_H	06_H

Data format [11] Capacity code (unit: kW)

As shown in the table below, the capacity (kW) is multiplied by 100.

Table 5.36 Capacities and data

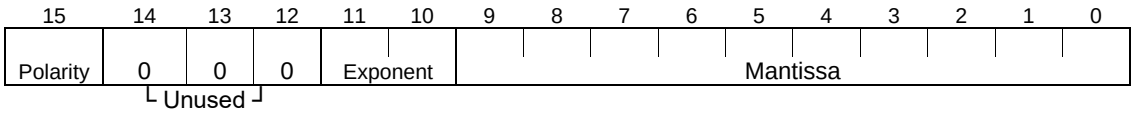
Capacity (kW)	Data	Capacity (kW)	Data	Capacity (kW)	Data
0.06	6	22	2200	280	28000
0.1	10	30	3000	315	31500
0.2	20	37	3700	355	35500
0.4	40	45	4500	400	40000
0.75	75	55	5500	450	45000
1.5	150	75	7500	500	50000
2.2	220	90	9000	550	55000
3.7	370	110	11000	600	60000
5.5	550	132	13200	650	60650
7.5	750	160	16000	700	60700
11	1100	200	20000	750	60750
15	1500	220	22000	800	60800
18.5	1850	250	25000	1000	61000

(Example) When the capacity is 2.2 kW

$2.20 \times 100 = 220 = 00DC_H$ Consequently, $\Rightarrow$

00_H	DC_H

Data format [12] Floating point data (accel./decal. time, PID display coefficient)



Polarity: 0 → Positive (+), 1 → Negative (-) Exponent: 0 to 3 Mantissa: 1 to 999

Value expressed in this form = (polarity) Mantissa x (Exponent - 2) power of 10

Value	Mantissa	Exponent	(Exponent - 2) power of 10
0.01 to 9.99	1 to 999	0	0.01
10.0 to 99.9	100 to 999	1	0.1
100 to 999	100 to 999	2	1
1000 to 9990	100 to 999	3	10

(Example) When F07 (acceleration time 1) = 20.0 seconds

$20.0 = 200 \times 0.1 \Rightarrow 0000\ 0100\ 1100\ 1000_b = 04C8_H$ $\Rightarrow$ Consequently,

04_H	$C8_H$

Data format [14] Operation command

15	14	13	12	11*1	10	9	8	7	6	5	4	3	2	1	0
RST	XR (REV)	XF (FWD)	0	EN	X9	X8	X7	X6	X5	X4	X3	X2	X1	REV	FWD
↑	General-purpose input		Unused	EN terminal	General-purpose input									FWD: Forward command	
Alarm reset														REV: Reverse command	

*1 bit11: The EN terminal is a bit dedicated for monitor and the terminal command cannot be input through communications. (Not applicable for VF1A.)

(All bits are turned ON when set to 1.)

(Example) When S06 (operation command) = FWD, X1 = ON

$0000\ 0000\ 0000\ 0101_b = 0005_H$ Consequently, ⇒

00_H	05_H

Data format [15] General-purpose output terminal

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Y3A	Y2A	Y1A	0	0	0	30	0	0	0	Y5	Y4	Y3	Y2	Y1
Unused	Relay option output (Eco only)			Unused			↑	Unused			General-purpose output				
							Alarm (general-purpose output)								

(All bits are turned ON when set to 1.)

(Example) When M15 (general-purpose output terminal) = Y1 = ON

$0000\ 0000\ 0000\ 0001_b = 0001_H$ Consequently, ⇒

00_H	01_H

Data format [16] Operation status

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
BUSY	0	0	RL	ALM	DEC	ACC	IL	VL	0	NUV	BRK	INT	EXT	REV	FWD

(All bits are turned ON or become active when set to 1.)

Bit	Symbol	Description	Support VF1A	Bit	Symbol	Description	Support VF1A
0	FWD	During forward rotation	O	8	IL	During current limiting	O
1	REV	During reverse rotation	O	9	ACC	During acceleration	O
2	EXT	During DC braking (or during pre-exciting)	O	10	DEC	During deceleration	O
3	INT	Inverter shut down	O	11	ALM	Alarm relay (for any fault)	O
4	BRK	During braking	O	12	RL	Communications effective	O
5	NUV	DC link circuit voltage established (0 = undervoltage)	O	13	0	–	×
6	TL	During torque limiting	O	14	0	–	×
7	VL	During voltage limiting	O	15	BUSY	During function code data writing	O

* The "Support" column indicates whether each inverter type supports the corresponding bit or not. The symbol "O" means the code is supported and the symbol "X" means that the code is not supported (fixed to 0).

Data format [17] Model code

15 14 13 12	11 10 9 8	7 6 5 4	3 2 1 0
Model	Generation	Destination	Input power supply

Table 5.37 List of model codes

Code	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Model				○											
Generation					○										
Destination					○ (USA)										
Input power supply				○ (Three-phase 400V)											

Data format [19] Current value

Current values are decimal data (positive). The minimum step is 0.01 for an inverter capacity of 22kW (30HP) or less and 0.1 for an inverter capacity of 30kW (40HP) or more.

When inverter capacity is 22kW (30HP) or less, any data higher than 655A cannot be written. No correct value can be read out when a direction for write data higher than 655A is issued.

Current data is rounded down on and after the fifth digit inside the inverter. (Ex.: When a writing direction of 107.54A is issued to an inverter with a capacity of 22kW (30HP), 107.5A is written.)

(Ex.) When F11 (electronic thermal operation level) = 107.0A (40HP)

$107.0 \times 10 = 1070 = 042E_H$, consequently ⇒

04_H	$2E_H$

(Ex.) When F11 (electronic thermal operation level) = 3.60A (1HP)

$3.60 \times 10 = 360 = 0168_H$, consequently ⇒

01_H	68_H

Data format [20] Communications error

Table 5.38 Communications error codes (common to both protocols)

Code	Description	Code	Description
71	Checksum error, CRC error ⇒ No response	73	Framing error, overrun error, buffer full ⇒ No response
72	Parity error ⇒ No response		

Table 5.39 Communications error codes (for Doesa inverter protocol)

Code	Description	Code	Description
74	Format error	78	Function code error
75	Command error	79	Write disabled
76	Link priority error	80	Data error
77	Function code data write right error	81	Error during writing

Table 5.40 Communications error codes (for RTU protocol)

Code	Description	Code	Description
1	Improper 'FC'	3	Improper data (range error)
2	Improper address (function code error)	7	NAK (link priority, no right, write disabled)

(Example) In case of an improper address

$2 = 0002_H$ Consequently, ⇒

00_H	02_H

Data format [21] Auto tuning

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	REV	FWD	Data part							

Not used

When FWD is 1, this data is the forward rotation command. When REV is 1, this data is the reverse rotation command. However, if both FWD and REV are 1, the command is not effective. Both FWD and REV are 0 for reading.

(Ex.) When P04 (motor 1 automatic tuning) = 1 (forward rotation),

$0000\ 0001\ 0000\ 0001_b = 0101_H$ Consequently, ⇒

01_H	01_H

Data format [22] Frequency data

Decimal data (positive): Resolution 0.01Hz

(Example) When C05 (Multistep frequency 1) = 50.25Hz

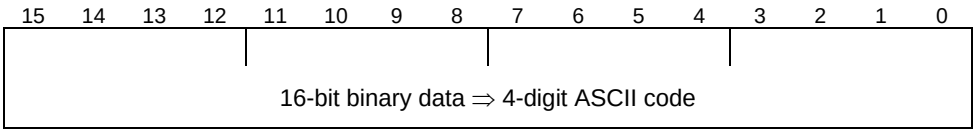
$50.25 \times 100 = 5025 = 13A1_H$, and therefore ⇒

13_H	$A1_H$

Data format [23] Polarity + decimal data (positive)

(for Doesa inverter protocol)

Decimal data (positive): Resolution 0.01Hz



For reverse rotation, add a negative sign (-) (ASCII) to the special additional data in the standard frame, or for forward rotation, enter a space (ASCII).

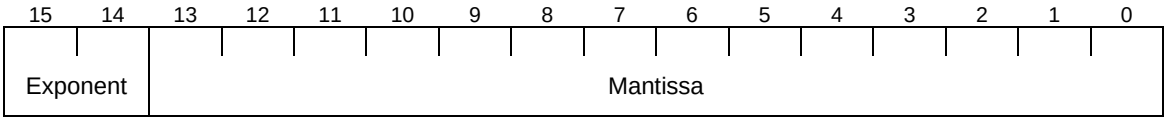
(Example) When maximum frequency = 60Hz and M09 (output frequency) = 60.00Hz (forward rotation)

60.00 x 100 = 6000 = 1770_H Consequently, ⇒

	1	7	7	0

(Positive data is in the same data format as data format [5].)

Data format [24] Floating point data



Exponent: 0-3 Mantissa: 1 to 9999

The value expressed by this format = the mantissa $\times$ $10^{(exponent-2)}$

Numeric value	Mantissa	Exponent	$10^{(exponent-2)}$
0.00 to 99.99	0 to 9999	0	0.01
100.0 to 999.9	1000 to 9999	1	0.1
1000 to 9999	1000 to 9999	2	1
10000 to 99990	1000 to 9999	3	10

Data format [25] Capacity code (for HP)

As shown in the table below, the capacity (HP) is multiplied by 100.

Table 5.41 Capacities and data (for HP)

Code	Capacity (HP)	Code	Capacity (HP)	Code	Capacity (HP)
7	0.07 (reserved)	3000	30	40000	400
15	0.15 (reserved)	4000	40	45000	450
25	0.25	5000	50	50000	500
50	0.5	6000	60	60000	600
100	1	7500	75	60700	700
200	2	10000	100	60750	750
300	3	12500	125	60800	800
500	5	15000	150	60850	850
750	7.5	17500	175	60900	900
1000	10	20000	200	60950	950
1500	15	25000	250	61000	1000
2000	20	30000	300	61050	1050
2500	25	35000	350		

(Example) When the capacity is 3HP

3 x 100 = 300 = $012C_H$ Consequently, ⇒

01_H	$2C_H$

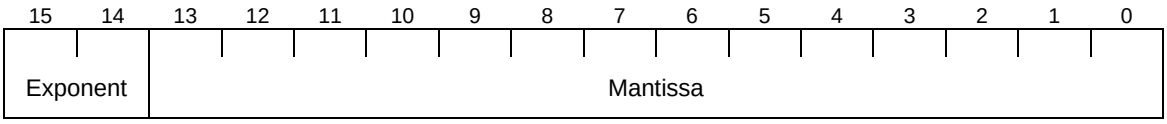
Data format [29] Positive/Negative data of values converted into standard (p.u.) with 20,000

(Example) Speed (frequency) Data of ±20,000/±maximum speed (frequency)

Data format [35] ROM version

Range: 0 to 9999

Data format [37] Floating point data (load rotation speed, etc.)



Exponent: 0-3 Mantissa: 1 to 9999

The value expressed by this format = the mantissa × $10^{(exponent-2)}$

Numeric value	Mantissa	Exponent	$10^{(exponent-2)}$
0.01 to 99.99	1 to 9999	0	0.01
100.0 to 999.9	1000 to 9999	1	0.1
1000 to 9999	1000 to 9999	2	1
10000 to 99990	1000 to 9999	3	10

Data format [40] Alarm factor

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Alarm caused by multiple factors (1 to 5)				Order of alarm occurrences (1 to 5)				Alarm code (See Table 5.35.)							

Data format [41] Alarm history

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Number of serial occurrences of same alarm								Alarm code (See Table 5.35.)							

Indicates the content of an alarm that has occurred and the number of serial occurrence times of the alarm.

Data format [43] Operation command (for I/O check)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	X9	X8	X7	X6	X5	X4	X3	X2	X1	REV	FWD
Unused						General-purpose input								General-purpose input	

(All bits are turned ON when set to 1.)

Data format [44] Operation status 2

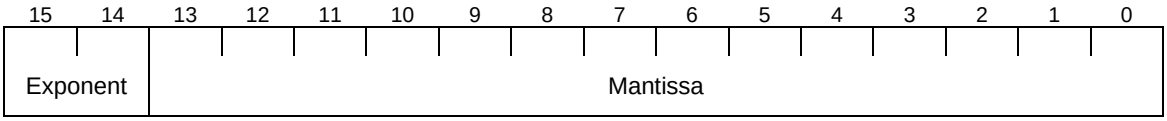
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	IDL	ID	OLP	LIFE	OH	TRY	FAN	KP	OL	IPF	0	RDY	FDT	FAR

(All bits are turned ON or become active when set to 1.)

Bit	Symbol	Description	Support	Bit	Symbol	Description	Support
			VF1A				VF1A
0	FAR	Frequency arrival signal	○	8	TRY	Retry in operation	○
1	FDT	Frequency level detection	○	9	OH	Heat sink overheat early warning	○
2	RDY	Inverter ready to run	○	10	LIFE	Lifetime alarm	○
3	SWM2	2nd motor is selected	○	11	OLP	Overload prevention control	○
4	IPF	Auto-restarting after recovery of power	○	12	ID	Current detection	○
5	OL	Motor overload early warning	○	13	IDL	Low level current detection	○
6	KP	Running per keypad	○	14	ID2	Current detection 2	○
7	FAN	Cooling fan in operation	○	15	0	–	×

* The "Support" column indicates whether each inverter type supports the corresponding bit or not. The symbol "O" means the code is supported and the symbol "X" means that the code is not supported (fixed to 0).

Data format [45] Floating point data



Exponent: 0-3 Mantissa: 0 to 9999

The value expressed by this format = the mantissa $\times$ $10^{(\text{exponent-3})}$

Numeric value	Mantissa	Exponent	$10^{(\text{exponent-3})}$
0.000 to 9.999	0 to 9999	0	0.001
10.0 to 99.9	1000 to 9999	1	0.01
100.0 to 999.9	1000 to 9999	2	0.1
1000 to 9999	1000 to 9999	3	1

Data format [67] Operation command source codes

Code	Description	Remarks
0	Keypad operation (Rotating direction: Depends on the terminal input)	Same with the selections for F02
1	Terminal operation	
2	Keypad operation (CW)	
3	Keypad operation (CCW)	
4	Operation command 2	
5 to 19	Reserved	
20	RS-485 channel1	
21	RS-485 channel2	
22	Bus option *1	
23	VFD Doesa-Loader	

*1 Bus option: VF1A does not support the field bus option.

Data format [68] Frequency command source codes

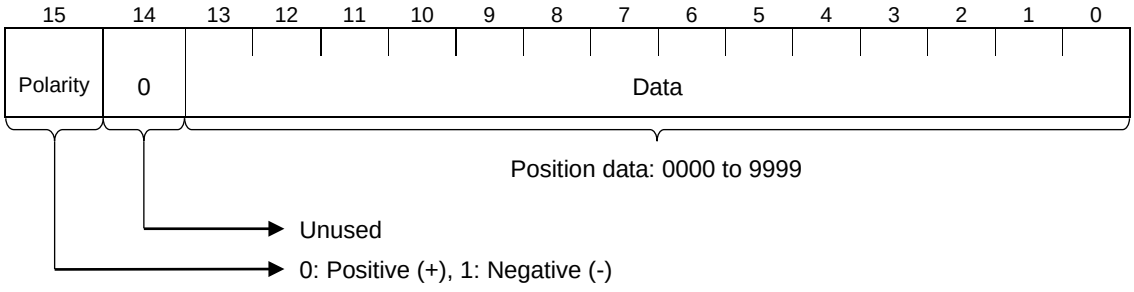
Code	Description	Remarks
0	Keypad key operation	Same with the selections for F01
1	Voltage input (Terminal [12])	
2	Current input (Terminal [C1])	
3	Voltage input (Terminal [12]) + Current input (Terminal [C1])	
4	Inverter body volume	
5	Voltage input (Terminal [V2])	
7	UP/DOWN	
8	Keypad key operation (Balanceless, bumpless functions are activated.)	
11	Digital input (option)	
12	Pulse train input	
20	RS-485 channel1	
21	RS-485 channel2	
22	Bus option *2	
23	VFD Doesa-Loader	
24	Multi-step	
25	JOG	
30 *1	PID TP	
31 *1	PID analog1	
33 *1	PID UP/DOWN	
34 *1	PID communications command	
36 *1	PID multi-step	

*1 Under the PID dancer control, the inverter monitors the PID command source although the frequency command becomes effective as the main setting.

*2 Bus option: VF1A does not support the field bus option.

Data format [73] Integer data (positive/negative sign bit)

Resolution 1 (The high-order digit of position control data)



Data format [74] Integer data (positive): by 10 hours

(Example) M81 (Maintenance remaining hours-M1) = 12340 hours

12340 ÷10 =04D2$_H$ Consequently ⇒

04$_H$	D2$_H$

Data format [75] Integer data (positive) + [P] Exception for position control

Based on the positive integer data, setting of “-1” is permitted exceptionally. When “-1” is set on the touch probe or the loader, [P] is displayed.

Data format [76] Operating status 2

15	14	13	12	11	10	9	8	7	6	5 4	3 2 1 0
Drive motor type	Performing self-diagnosis	Spare	Spare	Spare	Spare	Spare	Limiting rotation direction	Speed limit ON	Spare	Select motor	Control method

(Spares are always set to “0.”)

Signal name	Description	VF1A
Control method	The final control method including set values and terminal conditions are shown below. 0 : V/f control without slip compensation 1 : Dynamic torque-vector control 2: V/f control with slip compensation 3: V/f control with speed sensor 4: Dynamic torque-vector control with speed sensor 5: Vector control without speed sensor 6: Vector control with speed sensor 10: Torque control (vector control without speed sensor) 11: Torque control (vector control with speed sensor) Other than the above: Reserved	○
Motor selection	Selected motor is shown 00_b: motor1 01_b: motor2 10_b: motor3 11_b: motor4	○
Speed limit ON	“1” is set during speed limit.	○
Limiting rotation direction	1 when limiting rotation direction 1 when limiting torque current command direction (Vector control)	○
Performing self-diagnosis	1 for performing self-diagnosis	○
Drive motor type	0: Induction motors 1: Synchronous motors	○

Data format [77] Optional input terminals

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
I16	I15	I14	I13	I12	I11	I10	I9	I8	I7	I6	I5	I4	I3	I2	I1

Data format [78] Optional output terminals

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	08	07	06	05	04	03	02	01

Unused

Data format [84] Pattern operation

15	14	13 12	11 10	9 8 7 6 5 4 3 2 1 0
Rot-ation dire-ction	0	Time	Exponent part	Data part

Item	Description
Rotation direction	0: Forward, 1: Reverse rotation
Time	0: No. 1 acceleration/deceleration time 1: No. 2 acceleration/deceleration time 2: No. 3 acceleration/deceleration time 3: No. 4 acceleration/deceleration time
Exponent part	0: 0.01 1: 0.1 2: 1 3: 10
Mantissa	When exponent part is 0: 000 to 999 When exponent part is other than 0: 100 to 999

(Example) If C22 (Stage 1) = 10.0 s REV 2

$10.0 = 0.1 \times 100 \Rightarrow 9000_H + 0400_H + 0064_H$ = from 9464_H $\Rightarrow$

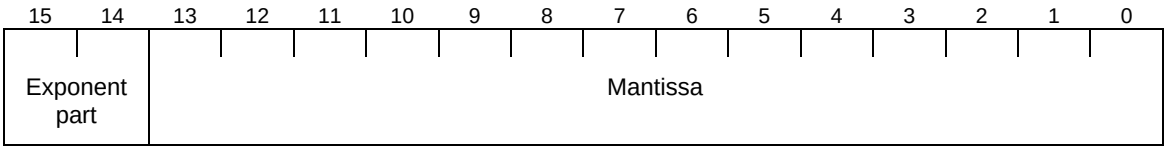
94_H	64_H

Data format [91] Relay output terminal *1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	Y12A	Y11A	Y10A	Y9A	Y8A	Y7A	Y6A	0	Y4A	Y3A	Y2A	Y1A

*1 VF1A does not support the relay output terminal.

Data format [93] Floating point data

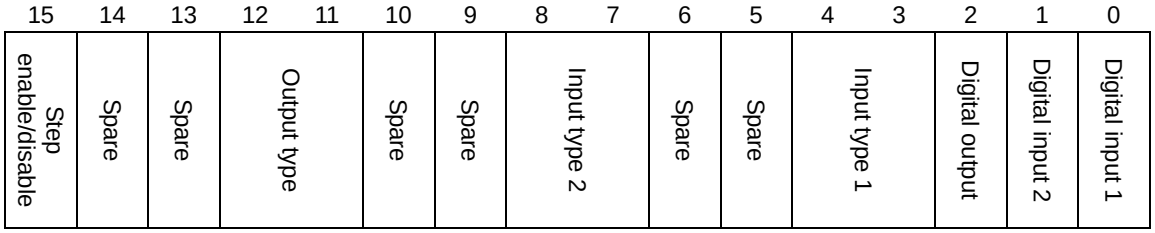


Exponent part: 0 to 3, Mantissa: 0 to 9999

Numerical value expressed with this format = Mantissa × (Exponent part-1) to the power 10

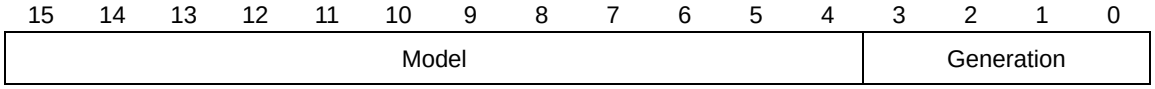
Numerical value	Mantissa	Exponent part	(Exponent part-1) to the power 10
0.0 to 999.9	0 to 9999	0	0.1
1000 to 9999	1000 to 9999	1	1
10000 to 99990	1000 to 9999	2	10
100000 to 999900	1000 to 9999	3	100

Data format [95] Customizable logic status data



Digital input 1, digital input 2, digital output 0: OFF, 1: ON
Input type 1, input type 2, output type 0: No function assigned. 1: Digital, 2: Analog
Step enable/disable 0: Disable, 1: Enable

Data format [99] Extended function code



MEMO

High Performance Inverter

Doesa

VF1A series

RS-485 Communication User's Manual

April 2022

IDEC CORPORATION

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IDEC CORPORATION

Head Office 2-6-64, Nishi-Miyahara, Yodogawa-ku, Osaka 532-0004, Japan

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B-2303(0)