MODBUS-RTU

COSEL

HCA Series (-I4 option)
MODBUS Communication Manual

Ver1.1E 2024.8.9

Communication Manual COSEL

HCA series ---MODBUS-RTU---

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Note: The contents described in this document are those available at the time of publication and are subject to change without prior notice due to product improvement and corresponding changes in the specifications. Please check the homepage of COSEL for the latest version.

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Ver1.1E 2024.8.9

Communication manual

For HCA series

1. Overview

This product (-I4 option) can monitor the operating status of the power supply and change various settings through MODBUS-RTU communication. In addition, by saving various setting values in the non-volatile memory inside the main unit, it is possible to retain them even if the input voltage is cut off.

Power for the communication line is supplied from AUX. Therefore, communication is not possible if an error occurs that causes AUX to stop.

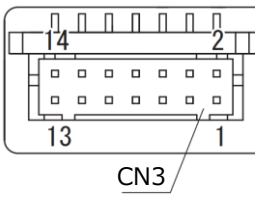
2. Wiring and Connection

2.1 HCA series communication terminal

Table 2.1 shows the pin numbers and functions of the communication terminals.
Table 2.2 shows the method of the communication address setting by using address

Table 2.1 Function of CN3

Pin No.	Function		GND Level
1	AUXG	Signal ground (Same potential as SGND)	AUXG
2	SGND	Signal ground (Same potential as AUXG)	SGND
4	B	RS485_differential signal(－、Inverted)	SGND
5	A	RS485_differential signal(＋、Non-inverting)	SGND
6	ADDR1	Address bit 1	SGND
8	ADDR0	Address bit 0	SGND



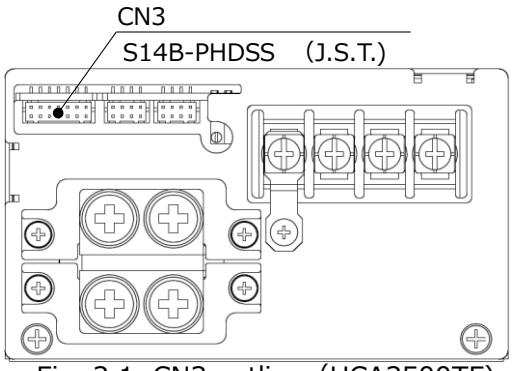


Fig. 2.1 CN3 outline（HCA3500TF)

Table 2.2 Communication address setting

Terminal status		Communication address
ADDR1	ADDR0	
1	1	3
1	0	2
0	1	1
0	0	4

1 : Open
0 : Short to AUXG or SGND

The address can be set from "1" to "4" by the terminal status.
(The address can be set from "1" to "247" by using the holding register.)

Table 2.3 Matching connectors and terminals on CN3

Connector		Mating Connector	Terminal	Mfr.
CN3	S14B-PHDSS	PHDR-14VS	Strip form : SPHD-001T-P0.5 SPHD-002T-P0.5 Loose piece : BPHD-001T-P0.5 *1 BPHD-002T-P0.5 *1	J.S.T.

*1 The manufacturer can only use ratchet hand tool.

2.2 Connection method

Connect terminal A on master (+, non-inverting) to terminal A on CN3 of HCA, connect terminal B on master (- , inverting) to terminal B on CN3 of HCA and connect terminal SG on master to terminal SGND on CN3 of HCA as shown in Fig. 2.2.

We recommend using shielded twisted pair cables. Connect the shielded cable to terminal SGND on Master.

Note that the polarity of A and B terminals on master may be inverted depending on the manufacturer. (Ensure that the non-inverting terminal on master shall be connected to non-inverting terminal on HCA each other, and inverting terminal on master shall be connected to inverting terminal on HCA likewise.)

Connect a terminating resistor to both ends of the bus line. If there is no terminating resistor on the master side, connect a terminating resistor to the bus line on the master side. Also, connect a terminating resistor to the bus line of the power supply farthest from the master (Fig. 2.2).

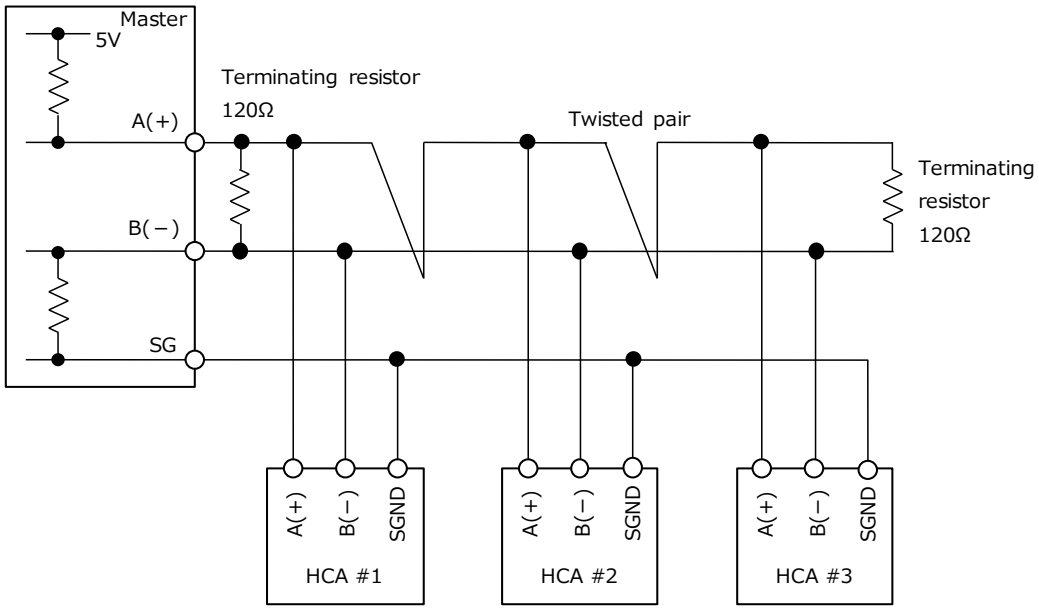


Fig2.2 Connected to multiple units example

2.3 Setting the communication address

HCA communication operates as a slave. When connecting other slave devices, set the communication address so that they do not overlap. If the communication address is duplicated, the master cannot get a correct response.

The factory default setting of the address depends on terminal ADDR0/1 status. When terminal ADDR0/1 are both open, address "3" is set.

When changing the communication address, use terminal ADDR0/1 (Table 2.2), or operate the Holding register (register address: 53). Also, by performing the operation to save the setting value (register address of the Holding register: 51), the changed communication address setting will remain valid even after the HCA input voltage is turned off and restarted. Refer to section "6.2 Holding register details" for more details of address setting.

Communication address "0" is reserved for broadcast, so it cannot be used.

3. Communication specifications

3.1 Electrical specifications

Table 3.1 shows the Electrical specifications.

Table 3.1 Electrical specifications

No.	Name	Specifications
1	Power supply	Powered by AUX Functional isolation from secondary output (+Vo/-Vo)
2	Transceiver voltage	5V
3	Transmission standard	TIA/EIA-485
4	Allowable transmission wire length	100m
5	Maximum number of devices	32max

3.2 Transmission specifications

Table 3.2 shows the transmission specifications.

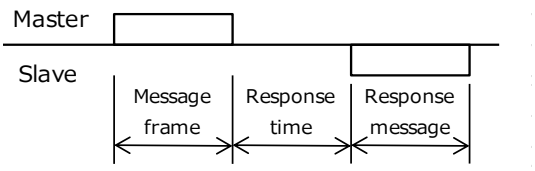
Table 3.2 Transmission specifications

No.	Name		Specifications
1	Communication method		Half duplex
2	Synchronous system		Start stop synchronization
3	Connection configuration		1: N (Master: Slave)
4	Communication speed		19200 bps ±2% error tolerance
5	Flow control		NA
6	Data configuration	Data length	8 bits
7		Stop bit	1 bit
8		Parity	Even
9		Transfer direction	LSB first

3.3 Protocol specifications

Table 3.3 shows the protocol specifications.

Table 3.3 Protocol specifications

No.	Name	Specifications
1	Message type	MODBUS-RTU
2	Character	T = 11bit/19200bps =572.9μsec
3	Character transfer interval	1.5T or less (When receiving, any character spacing exceeding 1.5T will discard the message frame.)
4	Message interval	7T or more (4msec or more)
5	Response time	Read (FC3, FC4) Max 10msec Write (FC6) Max 60msec (From message frame end to response message start) 
6	Turn around time	60msec or more
7	Unicast timeout period on the master side	60msec or more

4. Communication protocol

4.1 Communication protocol overview

The communication protocol is MODBUS-RTU.

MODBUS is a master/slave (1: N) protocol. Communication is always initiated by the master. For unicast (transmission to individual slaves), the master transmits a message frame to the slave, and the specified slave transmits a response message to the master after completing the requested processing.

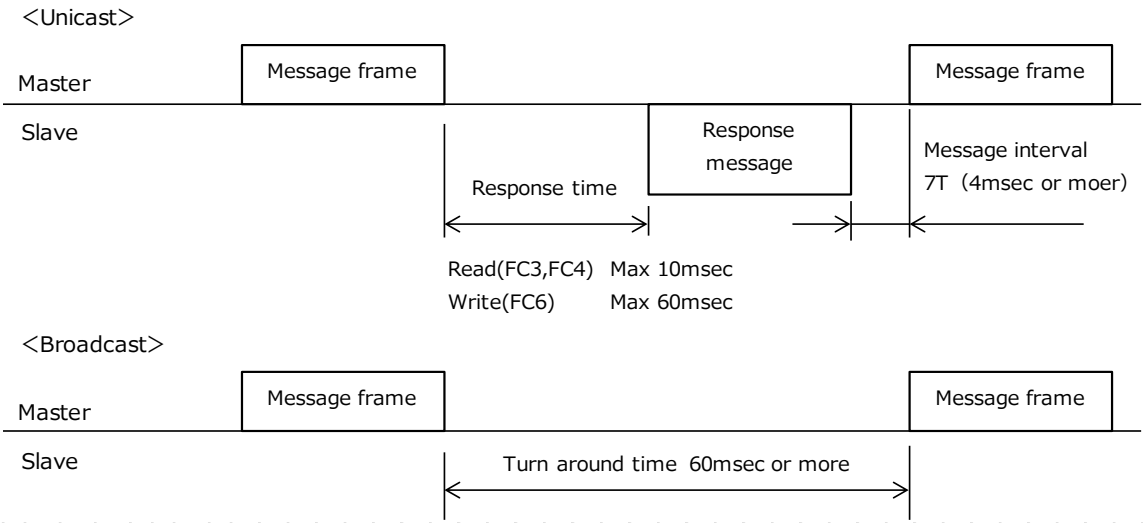
The slave does not communicate with other slaves.

If the requested process ends abnormally, an exception response message is transmitted.

If a transmission error occurs in the message frame from the master, the slave does not return a response message. In this case, the master should detect the communication timeout and take appropriate action.

Set the master communication timeout to 60msec or more, in consideration of the slave response processing time.

When broadcasting (transmission to all slaves), each slave performs only the requested processing and does not reply with a response message, so the master should send a message frame after the turnaround time (more than 60msec) has elapsed before sending the next message frame.



For detailed specifications of the MODBUS protocol, please refer to the documents shown below.

Publisher : Modbus Organization(http://modbus.org/)

MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b

MODBUS over Serial Line Specification and Implementation Guide V1.02

4.2 Message frame structure

Numerical values

A number ending with "h" indicates a hexadecimal number. A number ending in "b" indicates a binary number. A number without "h" or "b" indicates a decimal number.

Communication address	:	1 byte specifying the address of the power supply to be communicated with (numerals from 0 to 247 can be selected)
FC (function code)	:	"3", "4" or "6" are available
Data	:	Data field (Order from big endian, upper byte and lower byte)
CRC check	:	16-bit cyclic redundancy check from communication address to data Generation polynomial : A001h CRC initial value : FFFFh Note that only the CRC check field is little endian (Order from lower byte and upper byte). For CRC calculation, refer to "MODBUS over Serial Line Specification and Implementation Guide" recognized as MODBUS specifications.

(1) Message frame from master to slave

Communication address	FC	Data	CRC check
1 byte	1 byte	N bytes	2 bytes

(2) Response message frame from slave to master

Communication address	FC	Data	CRC check
1 byte	1 byte	N bytes	2 bytes

FC has the same value as the FC of the message frame from the master.

(3) Message frame for an exception response

Communication address	FC	Exception code	CRC check
1 byte	1 byte	1 byte	2 bytes

FC value becomes "80h" + FC of the message frame from the master.
The exception code indicates the contents of the exception in 1 byte.

Table 4.1 Exception codes

Exception code	Name	Content
1	ILLEGAL FUNCTION	Unsupported function code (ie. other than FC: 3, 4, 6)
2	ILLEGAL DATA ADDRESS	Undefined register address
3	ILLEGAL DATA VALUE	Incorrect data
4	SLAVE DEVICE FAILURE	Slave device error/Slave device busy *1

*1 Even if there is a reply with exception code 4, the sent settings may still be applied.

4.3 FC: 4 Input register "Read"

Read register contents from Input register. Broadcast is disabled.

(1) Master to slave message frame

Field	Communication address	FC	Starting address	Qty of registers	CRC check	
Qty of bytes	1 byte	1 byte	2 bytes	2 bytes	2 bytes	
Field value	1-247(F7h)	4(04h)	See the register list	1~16(0010h)	LSB	MSB

Starting address : Specifies the address of the Input register to start reading from.
Qty of registers : Specifies the quantity of registers read from the starting address.

By specifying the start address and the quantity of registers, consecutive register values can be read from the Input register.

An exception response (exception code: 02h) is returned when a starting address not in the Input register list is specified.

An exception response (exception code: 03h) is returned when the message frame length is not 8 bytes.

(2) Slave to master response message frame

Field	Communication address	FC	Byte count	Register value	CRC check	
Qty of bytes	1 byte	1 byte	1 byte	2×N bytes	2 bytes	
Field value	1-247(F7h)	4(04h)	2×N	Read data	LSB	MSB

N: quantity of registers specified in the message frame from master to slave

Byte count : Returns the byte count of the register value in the response message.
Register value : Register values for the specified quantity of registers are returned from the start address specified in the message frame from the master.

(3) Exception response message frame

Field	Communication address	FC	Exception code	CRC check	
Qty of bytes	1 byte	1 byte	1 byte	2 bytes	
Field value	1-247(F7h)	132(84h)	See table 4.1	LSB	MSB

FC : "132 (84h)" is returned. It is the value of "4(04h)" + "128 (80h)".
Exception code : An exception code is returned indicating the reason for the error detected during processing. (See Table 4.1 for exception codes)

(4) Example message

Communication address : 3(03h)　Starting address : 0(00h)　Qty of register : 1(01h)

Master to slave message frame

Message frame	Communication address	FC	Starting address		Qty of registers		CRC check	
			Upper	Lower	Upper	Lower	Lower	Upper
	3 (03h)	4 (04h)	0 (00h)	0 (00h)	0 (00h)	1 (01h)	48 (30h)	40 (28h)

Slave to master response message frame

Response message	Communication address	FC	Byte count	Register value		CRC check	
				Upper	Lower	Lower	Upper
	3 (03h)	4 (04h)	2 (02h)	2 (02h)	93 (5Dh)	0 (00h)	105 (69h)

The starting address "0 (0000h)" of the master message is the monitored value of the input voltage, and the register value of the response message can be read as follows:

025Dh = 605 → 60.5V

4.4 FC : 3 Holding register "Read"

Read register contents from Holding register. Broadcast is disabled.

(1) Master to slave message frame

Field	Communication address	FC	Starting address	Qty of registers	CRC check	
Qty of bytes	1 byte	1 byte	2 bytes	2 bytes	2 bytes	
Field value	1-247(F7h)	3(03h)	See the register list	1~4(0004h)	LSB	MSB

Starting address : Specifies the address of the Holding register to start reading from.
Qty of registers : Specifies the quantity of registers to read from the starting address.

By specifying the start address and the quantity of registers, consecutive register values can be read from the Holding register.

An exception response (exception code: 02h) is returned when a starting address not in the Holding register list is specified.

An exception response (exception code: 03h) is returned when the message frame total is not 8 bytes.

(2) Slave to master response message frame

Field	Communication address	FC	Byte count	Register value	CRC check	
Qty of bytes	1 byte	1 byte	1 byte	2×N bytes	2 bytes	
Field value	1-247(F7h)	3(03h)	2×N	Read data	LSB	MSB

N: quantity of registers specified in the message frame from master to slave

Byte count : Returns the byte count of the register value in the response message.
Register value : Register values for the specified quantity of registers are returned from the start address specified in the message frame from the master.

(3) Exception response message frame

Field	Communication address	FC	Exception code	CRC check	
Qty of bytes	1 byte	1 byte	1 byte	2 bytes	
Field value	1-247(F7h)	131(83h)	See table 4.1	LSB	MSB

FC : "131 (83h)" is returned. It is the value of "128 (80h)" + FC code "3 (03h)".
Exception code : An exception code is returned indicating the reason for the error detected during processing. (See Table 4.1 for exception codes)

(4) Example message

Communication address : 3(03h) Starting address : 8(0008h)

Master to slave message frame

Message frame	Communication address	FC	Starting address		Qty of registers		CRC check	
			Upper	Lower	Upper	Lower	Lower	Upper
	3 (03h)	3 (03h)	0 (00h)	8 (08h)	0 (00h)	1 (01h)	4 (04h)	42 (2Ah)

Slave to master response message frame

Response message	Communication address	FC	Byte count	Register value		CRC check	
				Upper	Lower	Lower	Upper
	3 (03h)	3 (03h)	2 (02h)	2 (02h)	93 (5Dh)	1 (01h)	29 (1Dh)

The starting address "8 (0008h)" of the master message is the set value of the output voltage, and the register value of the response message can be read as follows:
025Dh = 605 → 60.5V

4.5 FC : 6 Holding register "Write"

Writes the contents of one register in the Holding register.
Broadcast enabled.

(1) Master to slave message frame

Field	Communication address	FC	Register address	Register value	CRC check	
Qty of bytes	1 byte	1 byte	2 bytes	2 bytes	2 bytes	
Field value	0-247(F7h)	6(06h)	See the register list	Write data	LSB	MSB

Register address : Specifies the address of the Holding register to be written to.
Register value : Specifies the data to be written to the Holding register specified by the register address.

An exception response (exception code: 02h) is returned when a register address not in the Holding register list is specified.
If the register data is out of the allowable range, an exception response (exception code: 03h) is returned.
When broadcasting, no response message will be returned.
An exception response (exception code: 03h) is returned when the message frame length is not 8 bytes.

(2) Slave to master response message frame

Field	Communication address	FC	Register address	Register value	CRC check	
Qty of bytes	1 byte	1 byte	2 bytes	2 bytes	2 bytes	
Field value	1-247(F7h)	6(06h)	See the register list	Write data	LSB	MSB

Register address : The register address specified in the master message frame is returned.
Register value : The register value specified in the master message frame is returned.

(3) Exception response message frame

Field	Communication address	FC	Exception code	CRC check	
Qty of bytes	1 byte	1 byte	1 byte	2 bytes	
Field value	1-247(F7h)	134(86h)	See table 4.1	LSB	MSB

FC : "134 (86h)" is returned. It is the value of "128 (80h)" + FC code "6 (06h)".
Exception code : An exception code is returned indicating the reason for the error detected during processing. (See Table 4.1 for exception codes)

(4) Example message

Communication address : 3(03h)　Register address : 8(0008h)　Register value : 605(025Dh)

Master to slave message frame

Message frame	Communication address	FC	Register address		Register value		CRC check	
			Upper	Lower	Upper	Lower	Lower	Upper
	3 (03h)	6 (06h)	0 (00h)	8 (08h)	2 (02h)	93 (5Dh)	201 (C9h)	115 (73h)

Slave to master response message frame

Message frame	Communication address	FC	Register address		Register value		CRC check	
			Upper	Lower	Upper	Lower	Lower	Upper
	3 (03h)	6 (06h)	0 (00h)	8 (08h)	2 (02h)	93 (5Dh)	201 (C9h)	115 (73h)

The response message returns the same message to the master.

5. MODBUS-RTU register List

5.1 Input register list

The Input register is a read-only 16-bit register.

Broadcast is disabled.

An exception response (exception code: 02h) is returned if a start address other than that shown in Table 5.1 is specified.

The maximum number of registers that can be read consecutively in the input register is 16.

Table 5.1 Input register list

No.	Register name	Starting address	Qty of register	Register description
1	Output voltage monitor	0 (0000h)	1	Indicates the monitor value of the output voltage
2	Output current monitor	1 (0001h)	1	Indicates the monitor value of the output current
3	Input voltage monitor	2 (0002h)	3	Indicates the monitor value of the input voltage
4	Internal temperature monitor	6 (0006h)	1	Indicates the monitor value of the internal temperature
5	Output stop cause	16 (0010h)	1	Indicates the code at present which shows the causes of output stop
6	Output stop history	17 (0011h)	1	Indicates the code at the last output stop event which shows the causes of output stop
7	Alarm state	32 (0020h)	2	Indicates the detection status of the protection function
8	Warning state	34 (0022h)	2	Indicates the detection status of the warning function
9	Lot number	45 (002Dh)	2	Indicates lot number
10	Model name	48 (0030h)	16	Indicates the model name in ASCII code

5.2 Holding register list

The Holding register is a 16-bit Read/Write register.

Broadcast is disabled when FC=3 (Read).

The register defines the power supply setting. The set data will be cleared when input voltage is shut down. Use to the register address 51(0033h) to keep the settings data after the input voltage shut down.

An exception response (exception code: 02h) is returned if a register address other than that shown in Table 5.2 is specified.

The maximum number of registers that can be read consecutively in the Holding register is 4.

Table 5.2 Holding register list

No.	Register name	Register address	Qty of register	Timing to reflect *	Register description
1	Remote control	0 (0000h)	1	receive	Controls ON/OFF of power supply output by communication
2	Output voltage setting value	8 (0008h)	1	receive	Sets the output voltage value
3	Output voltage upper limit setting value	10 (000Ah)	1	receive	Sets upper limit value of the output voltage variation
4	Output voltage lower limit setting value	11 (000Bh)	1	receive	Sets lower limit value of the output voltage variation
5	Input start delay time setting value	16 (0010h)	1	reboot	Sets startup delay time from turning on input
6	RC startup delay time setting value	17 (0011h)	1	receive	Sets the startup delay time from RC operation
7	RC stop delay time setting value	18 (0012h)	1	receive	Sets the stop delay time from RC operation
8	Startup voltage setting value (AC)	19 (0013h)	1	reboot	Sets the startup voltage setting value (AC voltage) of the power supply
9	Stop voltage setting value (AC)	21 (0015h)	1	reboot	Sets the stop voltage setting value (AC voltage) of the power supply
10	RC pin logic setting value	23 (0017h)	1	reboot	Sets the RC pin logic value
11	VTRM function setting	24 (0018h)	1	reboot	Sets the function of VTRM pin
12	Output overvoltage warning threshold setting	44 (002Ch)	1	receive	Sets the output overvoltage warning threshold
13	Output low voltage warning Threshold setting	45 (002Dh)	1	receive	Sets the output low voltage warning threshold
14	Output low voltage protection threshold setting	49 (0031h)	1	receive	Sets the output low voltage protection threshold
15	Save settings	51 (0033h)	1	receive	Saves the setting of the Holding register
16	Initialize settings	52 (0034h)	1	reboot	Restores the value of the Holding register to the factory default after reboot
17	Communication address	53 (0035h)	1	receive	Sets communication address
18	Write protection mode	54 (0036h)	1	receive	Selects write protection/release for Holding register

* Timing to reflect
receive : Reflected in power supply operation at the timing of reception
reboot : Reflected at restart after 2 minutes or more from input stop

6. Register details

6.1 Input register details

Register name	Output voltage monitor	
Starting address	0(0000h)	Qty of register : 1
Register description	Indicates the monitor value of the output voltage	
Register value	Register value/10 → Output voltage value [V] Ex. 480(01E0h) → 48.0V	
Content details	Resolution : 0.1V Accuracy : ±2%FS（Ta=25℃）	

Register name	Output current monitor	
Starting address	1(0001h)	Qty of register : 1
Register description	Indicates the monitor value of the output current	
Register value	Register value/10 → Output current value [A] Ex. 730(02DAh) → 73.0A	
Content details	Resolution : 0.1A Accuracy : ±3%FS（Ta=25℃, 10% or more of rated output current）	

Register name	Input voltage monitor	
Starting address	2(0002h)、3(0003h)、4(0004h)	Qty of register : 3
Register description	Indicates the monitor value of the input voltage	
Register value	2(0002h) Register value/10 → Input voltage between L1-L2 [VAC] 3(0003h) Register value/10 → Input voltage between L2-L3 [VAC] 4(0004h) Register value/10 → Input voltage between L3-L1 [VAC] Ex. 2000(07D0h) → 200.0VAC	
Content details	Resolution : 0.1V Accuracy : ±2%FS（Ta=25℃） If the input voltage is distorted, the register value may show a value that is out of accuracy.	

Register name	Internal temperature monitor	
Starting address	6(0006h)	Qty of register : 1
Register description	Indicates the monitor value of the internal temperature	
Register value	Register value − 60 → Internal temperature [℃] Ex. 90(005Ah) − 60 → 30℃	
Content details	Resolution : 1℃ Measurement range : 0℃～70℃	

Register name	Output stop cause	
Starting address	16(0010h)	Qty of register : 1
Register description	Indicates the code at present which shows the causes of output stop.	

Register value

Code	Cause of stop
0 (00h)	The output doesn't stop
1 (01h)	Stopped by RC pin operation
2 (02h)	Stopped by communication operation (Holding register address 0)
10 (0Ah)	Stopped by input voltage drop
80 (50h)	Stopped by internal circuit error
81 (51h)	Stopped by internal circuit error
101 (65h)	Stopped by output overvoltage protection operation
102 (66h)	Stopped by output overcurrent protection or low voltage protection operation
105 (69h)	Stopped by output overcurrent protection operation
106 (6Ah)	Stopped by overheat protection operation
107 (6Bh)	
108 (6Ch)	
142 (8Eh)	
143 (8Fh)	
145 (91h)	
146 (92h)	
147 (93h)	
149 (95h)	
242 (F2h)	Stopped by output overvoltage protection operation

Content details	Indicates the present status of the power supply. Indicates "0" when the output doesn't stop and other codes when the output stops. If a code which aren't listed above is displayed, there is a possibility that the power supply is failed.

<table>
<tr><td>Register name</td><td colspan="2">Output stop history</td></tr>
<tr><td>Starting address</td><td>17(0011h)</td><td>Qty of register : 1</td></tr>
<tr><td>Register description</td><td colspan="2">Indicates the code at the last output stop event which shows the causes of output stop.</td></tr>
<tr><td>Register value</td><td colspan="2">
<table>
<tr><th>Code</th><th>Cause of stop</th></tr>
<tr><td>0 (00h)</td><td>The output doesn't stop</td></tr>
<tr><td>1 (01h)</td><td>Stopped by RC pin operation</td></tr>
<tr><td>2 (02h)</td><td>Stopped by communication operation
(Holding register address 0)</td></tr>
<tr><td>10 (0Ah)</td><td>Stopped by input voltage drop</td></tr>
<tr><td>80 (50h)</td><td>Stopped by internal circuit error</td></tr>
<tr><td>81 (51h)</td><td>Stopped by internal circuit error</td></tr>
<tr><td>101 (65h)</td><td>Stopped by output overvoltage protection operation</td></tr>
<tr><td>102 (66h)</td><td>Stopped by output overcurrent protection or low voltage protection operation</td></tr>
<tr><td>105 (69h)</td><td>Stopped by output overcurrent protection operation</td></tr>
<tr><td>106 (6Ah)</td><td rowspan="10">Stopped by overheat protection operation</td></tr>
<tr><td>107 (6Bh)</td></tr>
<tr><td>108 (6Ch)</td></tr>
<tr><td>142 (8Eh)</td></tr>
<tr><td>143 (8Fh)</td></tr>
<tr><td>145 (91h)</td></tr>
<tr><td>146 (92h)</td></tr>
<tr><td>147 (93h)</td></tr>
<tr><td>149 (95h)</td></tr>
<tr><td>242 (F2h)</td><td>Stopped by output overvoltage protection operation</td></tr>
</table>
</td></tr>
<tr><td>Content details</td><td colspan="2">Indicates the last stop event status of the power supply.
If a code which aren't listed above is displayed, there is a possibility that the power supply is failed.</td></tr>
</table>

<table>
<tr><td>Register name</td><td colspan="2">Alarm state</td></tr>
<tr><td>Starting address</td><td>32(0020h)、33(0021h)</td><td>Qty of register : 2</td></tr>
<tr><td>Register description</td><td colspan="2">Indicates the detection status of the protection function</td></tr>
<tr><td>Register value</td><td colspan="2">Each bit of register value → Status of each power supply protection function

32(0020h)
0 0 0 0 0 0 0 0 X X X 0 0 0 0 0 b
0bit : -
1bit : -
2bit : -
3bit : -
4bit : -
5bit : Overheat protection
6bit : Overheat protection
7bit : Overheat protection
8bit : -
9bit : -
10bit : -
11bit : -
12bit : -
13bit : -
14bit : -
15bit : -

33(0021h)
0 0 0 0 X X 0 0 X X X X X X X X b
0bit : Overvoltage protection
1bit : Overvoltage protection
2bit : Overcurrent / Low voltage protection
3bit : Overcurrent protection
4bit : Overheat protection
5bit : Overheat protection
6bit : Overheat protection
7bit : Overheat protection
8bit : -
9bit : -
10bit : Overheat protection
11bit : Overheat protection
12bit : -
13bit : -
14bit : -
15bit : -

Status of protection function X : 0 → No detect 1 → Detect</td></tr>
<tr><td>Content details</td><td colspan="2">When a protection function is detected, the power supply will stop.</td></tr>
</table>

Register name	Warning state	
Starting address	34(0022h)、35(0023h)	Qty of register : 2
Register description	Indicates the detection status of the warning function	
Register value	Each bit of register value → Status of each power supply warning function 34(0022h) 0 0 0 0 0 X X X X X X 0 0 X X X b 0bit : Low input voltage warning (L1-L2) 1bit : Low input voltage warning (L2-L3) 2bit : Low input voltage warning (L3-L1) 3bit : - 4bit : - 5bit : Overheat warning 6bit : Overheat warning 7bit : Overheat warning 8bit : High input voltage warning (L1-L2) 9bit : High input voltage warning (L2-L3) 10bit : High input voltage warning (L3-L1) 11bit : - 12bit : - 13bit : - 14bit : - 15bit : - 35(0023h) 0 0 0 0 X X 0 0 X X X X X X X 0 b 0bit : - 1bit : Overvoltage warning 2bit : Overcurrent / Low voltage warning 3bit : Overvoltage warning 4bit : Overheat warning 5bit : Overheat warning 6bit : Overheat warning 7bit : Overheat warning 8bit : - 9bit : - 10bit : Overheat warning 11bit : Overheat warning 12bit : - 13bit : - 14bit : - 15bit : - Status of warning function X : 0 → No detect 1 → Detect	
Content details		

Register name	Lot number	
Starting address	45(002Dh), 46(002Eh)	Qty of register : 2
Register description	Indicates lot number	
Register value	45(002Dh) Upper 16 bits of lot number 46(002Eh) Lower 16 bits of lot number Ex. Register address 45 : 0015 h → Lot Number : 1379470 Register address 46 : 0C8E h	
Content details	Lot Number range : 0000000 - 9539999 Address 45 (002Dh) indicates the upper 16 bits of the lot number and Address 46 (002Eh) indicates the lower 16 bits of the lot number. They represent the lot number as 32-bit data.	

Register name	Model name	
Starting address	48(0030h)、49(0031h)、50(0032h)、51(0033h)、 52(0034h)、53(0035h)、54(0036h)、55(0037h)、 56(0038h)、57(0039h)、58(003Ah)、59(003Bh)、 60(003Ch)、61(003Dh)、62(003Eh)、63(003Fh)	Qty of register : 16
Register description	Indicates the model name in ASCII code	
Register value	48(0030h) : ASCII code for the 1st and 2nd characters of the Model name 49(0031h) : ASCII code for the 3rd and 4th characters of the Model name 50(0032h) : ASCII code for the 5th and 6th characters of the Model name 51(0033h) : ASCII code for the 7th and 8th characters of the Model name 52(0034h) : ASCII code for the 9th and 10th characters of the Model name 53(0035h) : ASCII code for the 11th and 12th characters of the Model name 54(0036h) : ASCII code for the 13th and 14th characters of the Model name 55(0037h) : ASCII code for the 15th and 16th characters of the Model name 56(0038h) : ASCII code for the 17th and 18th characters of the Model name 57(0039h) : ASCII code for the 19th and 20th characters of the Model name 58(003Ah) : ASCII code for the 21th and 22th characters of the Model name 59(003Bh) : ASCII code for the 23th and 24th characters of the Model name 60(003Ch) : ASCII code for the 25th and 26th characters of the Model name 61(003Dh) : ASCII code for the 27th and 28th characters of the Model name 62(003Eh) : ASCII code for the 29th and 30th characters of the Model name 63(003Fh) : ASCII code for the 31th and 32th characters of the Model name Ex. HCA3500HF-48-I4（ASCII） 48(0030h) : 4843h (HC) 49(0031h) : 4133h (A3) 50(0032h) : 3530h (50) 51(0033h) : 3054h (0T) 52(0034h) : 462Dh (F-) 53(0035h) : 3438h (48) 54(0036h) : 2D49h (-I) 55(0037h) : 3400h (4) 56(0038h) : 0000h 57(0039h) : 0000h 58(003Ah) : 0000h 59(003Bh) : 0000h 60(003Ch) : 0000h 61(003Dh) : 0000h 62(003Eh) : 0000h 63(003Fh) : 0000h	
Content details	Indicates the model name with an ASCII code of up to 32 characters. The model name is placed in big endian starting from register address 48 (0030h), and the remainder at the end is a NULL character.	

6.2 Holding register details

<table>
<tr><td>Register name</td><td colspan="2">Remote control</td></tr>
<tr><td>Register address</td><td>0(0000h)</td><td>Qty of register : 1</td></tr>
<tr><td>Register description</td><td>Controls ON/OFF of power supply output by communication</td><td>Timing to reflect : receive</td></tr>
<tr><td>Register value</td><td colspan="2">
<table>
<tr><td>Digit</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Initial value</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Setting</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>X</td></tr>
</table>
X : 1 → Output ON
0 → Output OFF
</td></tr>
<tr><td>Content details</td><td colspan="2">When the RC pin is turned ON and the output setting by communication is set ON (1), the output of the power supply turns ON.
When the RC pin is turned OFF or the output setting by communication is set OFF (0), the output of the power supply turns OFF.

The register value indicates the value set by communication, not the ON/OFF status of the power supply output.

The latch stop is canceled by the following operation.
- When the RC pin is turned OFF;
- When the output setting by communication is set OFF (0);
If the cause of the latch stop has not been removed, the output will turn OFF again.

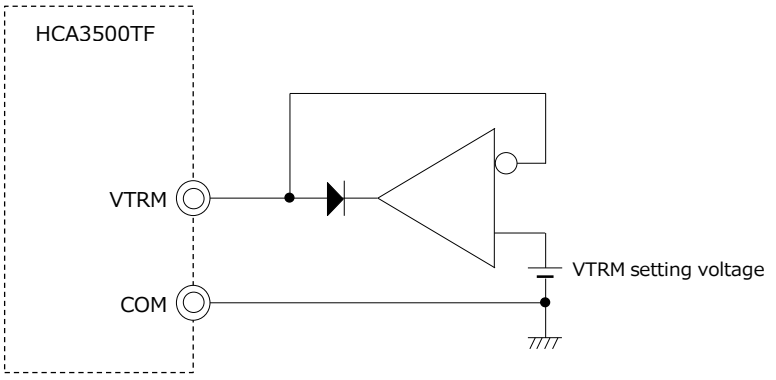
Returns an exception response (exception code: 3) at the following conditions;
- When writing anything other than "0(0000h)" or "1 (0001h)";</td></tr>
</table>

<table>
<tr><td>Register name</td><td colspan="2">Output voltage setting value</td></tr>
<tr><td>Register address</td><td>8(0008h)</td><td>Qty of register : 1</td></tr>
<tr><td>Register description</td><td>Sets the output voltage value</td><td>Timing to reflect : receive</td></tr>
<tr><td>Register value</td><td colspan="2">
<table>
<tr><td>Digit</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Initial value</td><td colspan="16">65535(FFFFh)</td></tr>
<tr><td>Setting</td><td colspan="16">Output voltage setting value</td></tr>
</table>
Output voltage setting value [V] → Register value = Setting value × 10
Ex. 48.0V → 480(01E0h)
</td></tr>
<tr><td>Content details</td><td colspan="2">Resolution : 0.1V
Accuracy : ±2%FS（Ta=25℃）
Specified range
- Upper : Output voltage upper limit setting value (register address 000Ah) or less
- Lower : Output voltage lower limit setting value (register address 000Bh) or more

Returns an exception response (exception code: 3) at the following conditions;
- When setting out-of-range value;

By writing register value "65535 (FFFFh)", the output voltage setting by communication is disabled, and the built-in potentiometer or the VTRM pin voltage setting is enabled.

When using both output voltage setting by communication and output voltage setting by the VTRM pin, use the recommended circuit below for the VTRM pin external circuit.

 
</td></tr>
</table>

Register name	Output voltage upper limit setting value	
Register address	10(000Ah)	Qty of register : 1
Register description	Sets upper limit value of the output voltage variation	Timing to reflect : receive
Register value	Digit: 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Initial value: Rated output voltage x 118% (round down after the decimal point) Setting: Output voltage upper limit setting value Output voltage upper limit setting value [V] → Register value = Setting value × 10 Ex. 48.0V × 118% = 56.64V → 566(0236h)	
Content details	Resolution : 0.1V Accuracy : ±2%FS (Ta=25℃) Specified range - Upper : Rated output voltage x 118% or less - Lower : Output voltage lower limit setting value (register address 000Bh) or more, or output voltage setting value (register address 0008h) or more (when output voltage setting is enabled) Returns an exception response (exception code: 3) at the following conditions; - When setting out-of-range value; If a steep voltage is applied to the VTRM pin, a voltage higher than the upper limit setting may be output.	

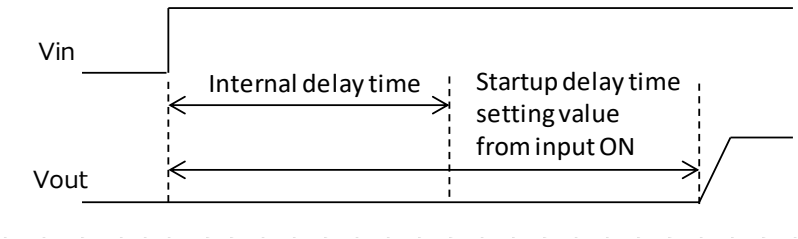
Register name	Output voltage lower limit setting value	
Register address	11(000Bh)	Qty of register : 1
Register description	Sets lower limit value of the output voltage variation	Timing to reflect : receive
Register value	Digit: 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Initial value: 0(0000h) Setting: Output voltage lower limit setting value Output voltage lower limit setting value [V] → Register value = Setting value × 10 Ex. 24.0V → 240(00F0h)	
Content details	Resolution : 0.1V Accuracy : ±2%FS (Ta=25℃) Specified range - Upper : Output voltage upper limit setting value (register address 000Ah) or less, or output voltage setting value (register address 0008h) or less (when output voltage setting is enabled) - Lower : 0 or more Returns an exception response (exception code: 3) at the following conditions; - When setting out-of-range value; If a steep voltage is applied to the VTRM pin, a voltage lower than the lower limit setting may be output.	

<table>
<tr><td>Register name</td><td colspan="2">Input start delay time setting value</td></tr>
<tr><td>Register address</td><td>16(0010h)</td><td>Qty of register : 1</td></tr>
<tr><td>Register description</td><td>Set startup delay time from turning on input</td><td>Timing to reflect : reboot</td></tr>
<tr><td>Register value</td><td colspan="2">
<table>
<tr><td>Digit</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Initial value</td><td colspan="16">0(0000h)</td></tr>
<tr><td>Setting</td><td colspan="16">Input start delay time setting value (msec)</td></tr>
</table>
Ex. 1500msec → 1500(05DCh)
</td></tr>
<tr><td>Content details</td><td colspan="2">Resolution : 1msec
Accuracy : ±2% or ±50msec
Specified range : 0, 600～60,000

Returns an exception response (exception code: 3) at the following conditions;
- When writing out-of-range value;

The settings are reflected by writing to the "Setting save register (register address 51 (0033h))" and rebooting.

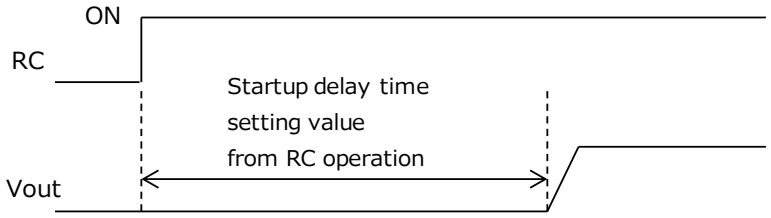
By writing register value "0", Input start delay time setting by communication is disabled, and the startup will be based on the power supply internal delay time.

 
</td></tr>
</table>

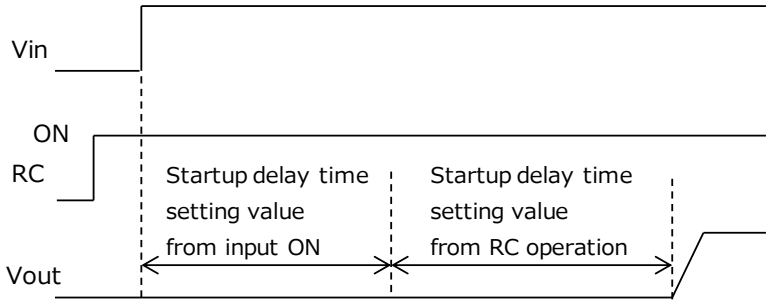
<table>
<tr><td>Register name</td><td colspan="2">RC startup delay time setting value</td></tr>
<tr><td>Register address</td><td>17(0011H)</td><td>Qty of register : 1</td></tr>
<tr><td>Register description</td><td>Sets the startup delay time from RC operation</td><td>Timing to reflect : receive</td></tr>
<tr><td>Register value</td><td colspan="2">
<table>
<tr><td>Digit</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Initial value</td><td colspan="16">0(0000h)</td></tr>
<tr><td>Setting</td><td colspan="16">RC startup delay time setting value (msec)</td></tr>
</table>
Ex. 1500msec → 1500(05DCh)
</td></tr>
<tr><td>Content details</td><td colspan="2">
Resolution : 1msec
Accuracy : ±2% or ±10msec
Specified range : 0～60,000

Returns an exception response (exception code: 3) at the following conditions;
- When writing out-of-range value;

The startup delay time from RC operation is applied when the RC pin is ON or output is set ON by communication (register address “0 (0000h)”).



At startup, the startup delay time from the RC pin operation is applied after the startup delay time from input ON.

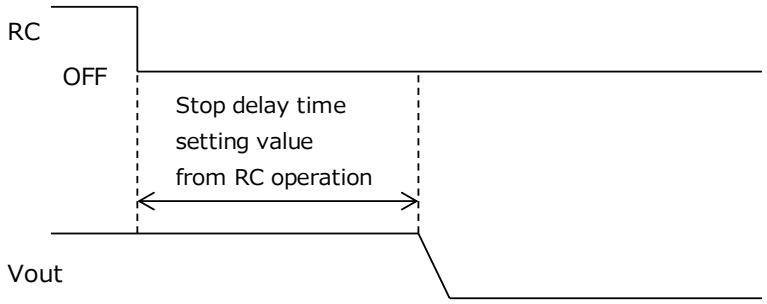


</td></tr>
</table>

<table>
<tr><td>Register name</td><td colspan="2">RC stop delay time setting value</td></tr>
<tr><td>Register address</td><td>18(0012h)</td><td>Qty of register : 1</td></tr>
<tr><td>Register description</td><td>Sets the stop delay time from RC pin operation.</td><td>Timing to reflect : receive</td></tr>
<tr><td>Register value</td><td colspan="2">
<table>
<tr><td>Digit</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Initial value</td><td colspan="16">0(0000h)</td></tr>
<tr><td>Setting</td><td colspan="16">RC stop delay time setting value (msec)</td></tr>
</table>
Ex. 1500msec → 1500(05DCh)
</td></tr>
<tr><td>Content details</td><td colspan="2">Resolution : 1msec
Accuracy : ±2% or ±10msec
Specified range :0～60,000

Returns an exception response (exception code: 3) at the following conditions;
- When writing out-of-range value;

The stop delay time from the RC operation is applied when the RC pin is OFF or output is set OFF by communication (register address “0 (0000h)”).

 
</td></tr>
</table>

<table>
<tr><td>Register name</td><td colspan="2">Startup voltage setting value (AC)</td></tr>
<tr><td>Register address</td><td>19(0013h)</td><td>Qty of register : 1</td></tr>
<tr><td>Register description</td><td>Sets the startup voltage setting value (AC voltage) of the power supply</td><td>Timing to reflect : reboot</td></tr>
<tr><td>Register value</td><td colspan="2">
<table>
<tr><td>Digit</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Initial value</td><td colspan="16">1770(06EAh)</td></tr>
<tr><td>Setting</td><td colspan="16">Startup voltage setting value (AC)</td></tr>
</table>
Startup voltage setting value (AC) [VAC] → Register value = Setting value × 10
Ex. 200VAC → 2000(07D0h)
</td></tr>
<tr><td>Content details</td><td colspan="2">Resolution : 0.1V
Accuracy : ±2%FS(Ta=25℃)
Specified range
- Upper : 4800 or less
- Lower : Stop voltage setting value (AC) (register address 0015h) or more

Returns an exception response (exception code: 3) at the following conditions;
- When writing out-of-range value;

The settings are reflected by writing to the "Setting save register (register address 51 (0033h))" and rebooting.

If the input waveform is distorted, there may be a difference between the startup voltage and the set value.</td></tr>
</table>

Register name	Stop voltage setting value (AC)	
Register address	21(0015h)	Qty of register : 1
Register description	Sets the stop voltage setting value (AC voltage) of the power supply	Timing to reflect : reboot

Register value

Digit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Initial value	1700(06A4h)															
Setting	Stop voltage setting value (AC)															

Stop voltage setting value (AC) [VAC] → Register value = Setting value × 10
Ex. 170VAC → 1700(06A4h)

Content details

Resolution : 1V
Accuracy : ±2%FS(Ta=25℃)
Specified range :
- Upper : Startup voltage setting value (AC) (register address 0013h) or less, or 4000 or less (whichever smaller value is valid)
- Lower : 1700 or more

Returns an exception response (exception code: 3) at the following conditions;
- When writing out-of-range value;

The settings are reflected by writing to the "Setting save register (register address 51 (0033h))" and rebooting.

If the input waveform is distorted, there may be a difference between the startup voltage and the set value.

Register name	RC pin logic setting value	
Register address	23(0017h)	Qty of register : 1
Register description	Sets the RC pin logic value	Timing to reflect : reboot

Register value

Digit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Initial value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Setting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X

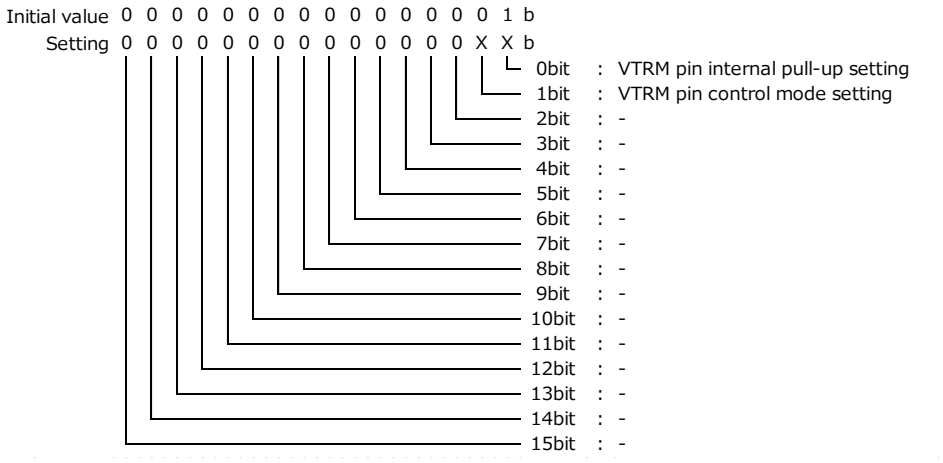
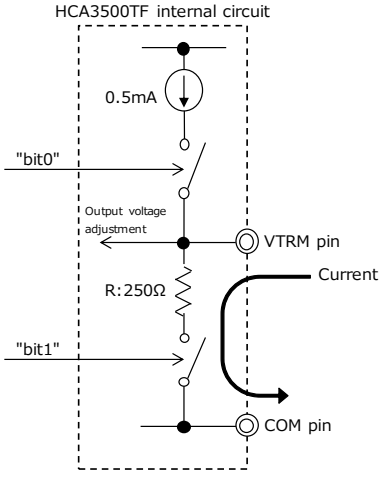
X : 0 → Output OFF when voltage is applied to RC pin
1 → Output ON when voltage is applied to RC pin

Content details

Sets the output ON/OFF logic when voltage is applied to the RC pin.

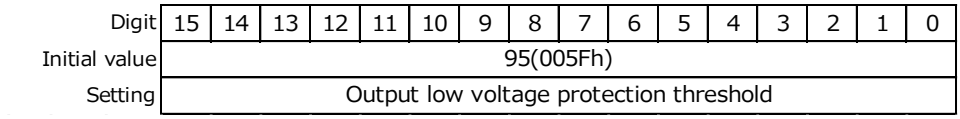
Returns an exception response (exception code: 3) at the following conditions;
- When writing anything other than "0(0000h)" or "1 (0001h)";

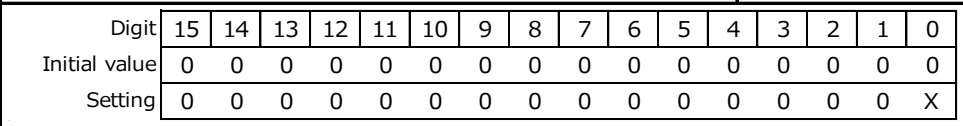
The settings are reflected by writing to the "Setting save register (register address 51 (0033h))" and rebooting.

Register name	VTRM function setting	
Register address	24(0018h)	Qty of register : 1
Register description	Sets the function of VTRM pin	Timing to reflect : reboot
Register value	 VTRM pin internal pull-up setting X : 0 → No pull-up X : 1 → With pull-up VTRM pin control mode setting X : 0 → Voltage control mode X : 1 → Current control mode	
Content details	Sets "0" to bits other than "X". Returns an exception response (exception code: 3) at the following conditions; - When writing "1" to bits other than "X"; The settings are reflected by writing to the "Setting save register (register address 51 (0033h))" and rebooting. By setting "bit0" to "0" and "bit1" to "1", the VTRM pin voltage can be changed by applying current to the VTRM pin, and the output voltage can be adjusted. In this case, the output voltage value can be calculated by the formula ① below. ① is the formula for estimating. If the accurate number is necessary, please contact us. Do not apply +5V or more or negative voltage between VTRM and COM. VTRM pin voltage [V]=The current to VTRM pin [A]×250[Ω] ・・・・・・① Refer to the instruction manual for the relationship between VTRM pin voltage and output voltage adjustment range. If the voltage or current to the VTRM pin is not controlled with "bit0" set to "0" or "bit1" set to "1", the output voltage will become hiccup mode and the power supply will not be available. 	

Register name	Output overvoltage warning threshold setting	
Register address	44(002Ch)	Qty of register : 1
Register description	Sets the output overvoltage warning threshold	Timing to reflect : receive
Register value	Digit: 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Initial value: Rated output voltage x 118% (round down after the decimal point) Setting: Output overvoltage warning threshold Output overvoltage warning threshold [V] → Register value = Setting value × 10 Ex. 48.0V × 118% = 56.64V → 566(0236h)	
Content details	Resolution : 0.1V Accuracy : ±2%FS (Ta=25℃) Specified range - Upper : Rated output voltage x 118% or less - Lower : 0 or more Returns an exception response (exception code: 3) at the following conditions; - When setting out-of-range value;	

Register name	Output low voltage warning threshold setting	
Register address	45(002Dh)	Qty of register : 1
Register description	Sets the output low voltage warning threshold	Timing to reflect : receive
Register value	Digit: 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Initial value: 98(0062h) Setting: Sets the output low voltage warning threshold Ex. 98% → 98(0062h)	
Content details	Resolution : 1% Accuracy : ±2% (Ta=25℃) Specified range - Upper : 98 or less - Lower : 0 or more Returns an exception response (exception code: 3) at the following conditions; - When setting out-of-range value; If the output drops below 49% of the rated output voltage, an output low voltage warning will be output.	

Register name	Output low voltage protection threshold setting	
Register address	49(0031h)	Qty of register : 1
Register description	Sets the output low voltage protection threshold	Timing to reflect : receive
Register value	 Ex. 95% → 95(005Fh)	
Content details	Resolution : 1% Accuracy : ±2% (Ta=25℃) Specified range - Upper : 95 or less - Lower : 0 or more Returns an exception response (exception code: 3) at the following conditions; - When setting out-of-range value; If the output drops below 47.5% of the rated output voltage, the output will become hiccup mode.	

Register name	Save settings	
Register address	51(0033h)	Qty of register : 1
Register description	Saves the setting of the Holding register	Timing to reflect : receive
Register value	 X : 1 Saves the values of the Holding register (The register value returns to "0".)	
Content details	Do not transmit "Initialize settings (register address 52 (0034h))" register and this register continuously within 5 seconds. And do not turn off the input voltage at least 5 seconds after this register is transferred. Otherwise, it may not properly be recorded in the non-volatile memory. Returns an exception response (exception code: 3) at the following conditions; - When writing anything other than "1 (0001h)"; When the register value is read, it always shows "0000h". The saved settings is loaded at the next startup.	

Register name	Communication address	
Register address	52(0034h)	Qty of register : 1
Register description	Restores the value of the Holding register to the factory default after reboot	Timing to reflect : receive
Register value	Digit 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Initial value 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 Setting 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 X X : 1 → Restore the value of the Holding register to the factory default after reboot (The register value returns to "0".)	
Content details	Do not transmit "Save settings (register address 51 (0033h))" register and this register continuously within 5 seconds. And do not turn off the input voltage at least 5 seconds after this register is transferred. Otherwise, it may not properly be recorded in the non-volatile memory. Returns an exception response (exception code: 3) at the following conditions; - When writing anything other than "1 (0001h)"; When the register value is read, it always shows "0000h". The factory default settings is loaded at the next startup. If multiple power supplies are connected to the communication line and this register is broadcast, all communication addresses will become "1" at the next startup, causing a communication error. Remove the multiple connected communication lines and set the communication address of each power supply so that the communication address does not overlap.	

Register name	Communication address	
Register address	53(0035h)	Qty of register : 1
Register description	Sets communication address	Timing to reflect : receive
Register value	Digit 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Initial value 0(0000h) Setting Sets communication address Ex. Communication address 7 → 7(0007h)	
Content details	Specified range : 0～247 Returns an exception response (exception code: 3) at the following conditions; - When writing outside the specified range; Register value "0" enables the settings of the terminal ADDR0/1 status (Table 2.2). This register does not support broadcasting to avoid incorrect setting.	

<table>
<tr><td>Register name</td><td colspan="2">Write protection mode</td></tr>
<tr><td>Register address</td><td>54(0036h)</td><td>Qty of register : 1</td></tr>
<tr><td>Register description</td><td>Selects write protection/release for Holding register</td><td>Timing to reflect : receive</td></tr>
<tr><td>Register value</td><td colspan="2">
<table>
<tr><td>Digit</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Initial value</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Setting</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>X</td></tr>
</table>
X : 1 → Write protect
0 → Release
</td></tr>
<tr><td>Content details</td><td colspan="2">Returns an exception response (exception code: 3) at the following conditions;
- When writing anything other than "0(0000h)" or "1 (0001h)";

Returns an exception response (exception code: 2) at the following conditions;
- Writing to the Holding register during the "Write protect" state;
(However, ”Write protection" state for this register, the "Save settings" register (address 51 "0033h") and the "Initialize settings" register(address 52 "0034h") are exceptions.)</td></tr>
</table>

A. Revision history

No.	Date	Ver	Page	Note
1	2024.4.19	1.0E	-	First edition issued
2	2024.8.9	1.1E	p27	"RC pin logic setting value" has been revised
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