Digital Indicator

SD24 Series

Communication Interface (RS-232C/RS-485)

Instruction Manual

Please be sure to provide the end user with these instructions.

Contents

Preface

Thank you for purchasing a Shimaden product.
After making sure the product you have is the one you specified, get a good understanding of the instructions to ensure proper operation and handling.
This document provides information concerning the communication function for users of SD24 Series communication interfaces (optional). For details on SD24 operation and parameters, see the main instruction manual.
Safety precautions and precautions concerning equipment damage and other additional explanations are provided under the following labeling.

WARNING	Matters that could result in injury or death if instructions are not followed.
Caution	Matters that could result in equipment damage if instructions are not followed.

Note	Additional explanations or matters requiring special attention.

MSD24-E02-A
October 2009

1. Overview

This device supports two types of communication (RS-232C and RS-485). You can use the communication function to set and import various types of data from a computer.
RS-232C and RS-485 are the data communication standards established by the Electronic Industries Association of the U.S. (EIA). These standards apply to hardware but do not stipulate data transmission software. The customer must therefore get a good understanding of data transmission specifications and procedures prior to using the equipment.

2. Specifications

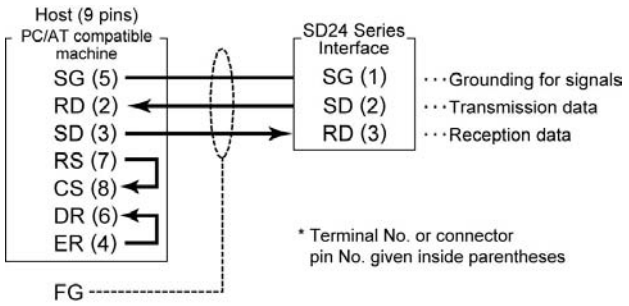
Communication type		EIA RS-232C/RS-485-compliant
Communication system		RS-232C: 3-line half duplex system RS-485: 2-line half duplex multidrop (bus) system
Synchronization system		Half duplex start-stop synchronization system
Communication distance		RS-232C: max. 15 m RS-485: Total max. 500 m (differs according to conditions)
Communication speed		2400, 4800, 9600, 19200 bps
Transmission procedure		No procedure
Communication address		1 – 255
Number of connections		Max. 31 units (RS-485)
Delay		1 – 100 msec
Communication protocol		Shimaden standard protocol, MODBUS ASCII, MODBUS RTU
Shimaden standard	Data format	7E1, 7E2, 7N1, 7N2, 8E1, 8E2, 8N1, 8N2
	Control code	STX_ETX_CR, @_:_CR
	Checksum (BCC)	1. Add operation from start character to text end 2. Add operation from start character to text end and complement of 2 of the result 3. Exclusive disjunction (XOR) operation of add operation immediately after start character to text end 4. No BCC operation
	Communication code	ASCII code
MODBUS ASCII	Data format	7E1, 7E2, 7N1, 7N2
	Control code	_CRLF
	Error check	LRC check
	Communication code	ASCII code
MODBUS RTU	Data format	8E1, 8E2, 8N1, 8N2
	Control code	Not equipped
	Error check	CRC check
	Communication code	Binary code
Isolation		Isolation for all

3. Connection with host

3.1 RS-232C

The communication interface is not equipped with a control signal terminal to be used as an input/output terminal (only equipped with ground terminal for transmission data, reception data and signals). Control signals must therefore be processed by the host. The following is a way to process control signals provided as an example. In practice, you must adjust according to the service environment and specifications.

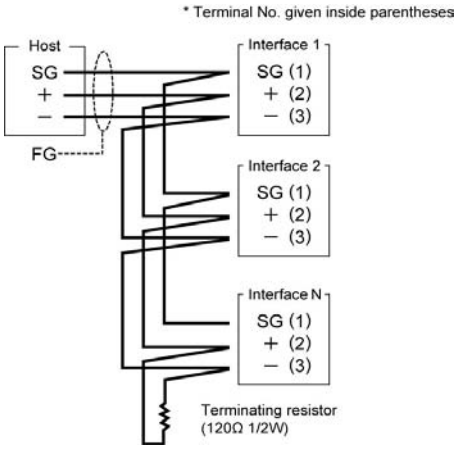
Connection diagram



3.2 RS-485

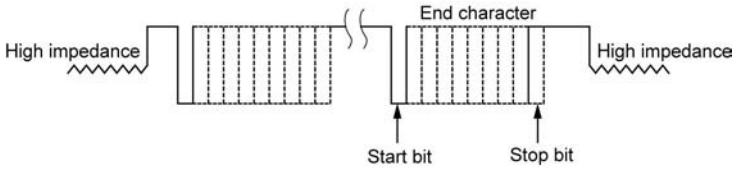
Using an RS-485 interface enables you to connect to more than one SD24. If using an RS-485 interface with a computer, use a commercially available RS-485 converter.
An RS-485 interface requires a terminating resistor to be mounted on the terminal indicator. Connect a terminating resistor (approx. 1/2 W, 120Ω) between terminals 2 and 3.
The interface terminal of the device operates at high impedance until just before transmission starts. For details, see "3.3 State output control."

Connection diagram



3.3 State output control

In order to avoid collision of transmitted signals, transmission output is always high impedance while communication is not conducted or during reception. Status changes from high to normal impedance immediately prior to transmission, and reverts to high impedance as soon as transmission is complete. Up to 1 msec delay occurs after end character stop bit transmission is complete until impedance reverts to high impedance. If starting transmission when signal reception on the host side is complete, you should provide a delay of several msec.



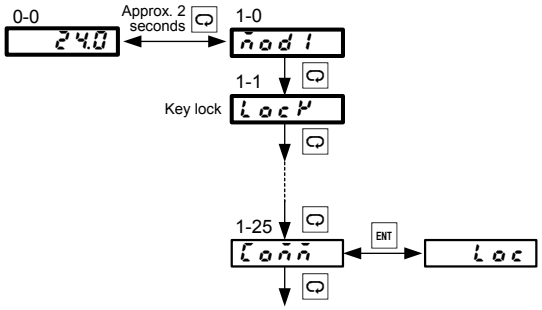
4. Communication parameters

This section provides information on parameters related to communication for the interface.

4.1 Communication parameter screen display

Communication parameters are set/displayed by screens 1-25 to 1-32 of the mode 1 screen group. To switch from the basic screen (screen 0-0) to the first communication parameter screen (screen 1-25), perform the following procedure.

1. Press and hold the ⟲ key on the basic screen (screen 0-0) for at least 2 seconds.
2. When the initial screen (screen 1-0) of the mode 1 screen group is displayed, press the ⟲ key several times. The number of times to press the key depends on the number of optional functions the device is equipped with and their settings.
3. Pressing several times displays communication parameters communication mode screen (screen 1-25).
4. To switch to various setting screens, press the ENT key.



4.2. Communication parameters

This section provides information on parameters related to communication.

1-25 Communication mode

Sets/displays communication mode.

LOC : Local mode. Enables reading of data through communication.
COM : Communication mode. Enables setting and reading of data through communication.

Note	If you set communication mode to COM through communication, setting can no longer be carried out by front panel keys. You can however change from COM to LOC.

Range LOC, COM Init. LOC

1-26 Communication protocol

Sets/displays communication protocol.

SHIM : Shimaden standard protocol
ASC : MODBUS ASCII
RTU : MODBUS RTU

Range SHIM, ASC, RTU Init. SHIM

1-27 Communication address

Sets/displays communication address.

In the case of an RS-485 interface, you can connect up to 31 SD24s, but actual communication is carried out with one unit at a time. Communication addresses are set to distinguish units from one another.

Range 1 – 255 Init. 1

1-28 Communication data format

Sets/displays data format for communications.

The parameter consists of a 3-digit number.
Left digit : Data length (bits) 7 or 8
Middle digit : Parity E (even) or N (none)
Right digit : Stop bit 1 or 2

Note	Only 7-bit format can be set for MODBUS ASCII. The initial setting is 7E1. Only 8-bit format can be set for MODBUS RTU. The initial setting is 8E1.

Range 7E1, 7E2, 7N1, 7N2, 8E1, 8E2, 8N1, 8N2 Init. 7E1

1-29 Communication start character

Sets/displays communication start character.

STX	Start character	STX (02H)
	Text end	ETX (03H)
	End character	CR (0DH)
ATT	Start character	@ (40H)
	Text end	: (3AH)
	End character	CR (0DH)

Note	Start character is not used for MODBUS ASCII or RTU.

Range STX, ATT Init. STX

1-30 BCC operating method

Sets/displays BCC operating method.

1: Add operation from start character to text end
2: Add operation from start character to text end and complement of 2 of the result
3: Exclusive disjunction (XOR) operation of add operation from start character to text end
4: No BCC operation

Note	BCC is not used for MODBUS ASCII or RTU.

Range 1 – 4 Init. 1

1-31 Communication speed

Sets/displays communication speed.

Note	

Range 2400, 4800, 9600, 19200 bps Init. 9600

1-32 Delay time

Sets/displays minimum delay time from when communication command is received till transmission.
Delay (msec) = Setting value (count) x 1.0 (msec)

Note	In the case of RS-485, it may take a while for 3-state control by line converter and signal collision may occur in some cases. This can be avoided by setting longer delay time. Actual delay time from when the communication command is received until transmission is the total of the delay time and time it takes software to process the command.

Range 1 – 100 msec Init. 20

5. Shimaden standard protocol

This section contains information concerning Shimaden standard protocol.

5.1 Communication structure

Communication is carried out in block units. The computer/PLC (host) always functions as the master and the SD24 as the slave. Communication starts when a transmission command is sent from the host, and ends when the slave responds to the command. There may however be no response from the slave in the event of an error such as a data format error.

Note	If end character reception is not completed within approximately 1 second after the start character is received from the host, the communication times out and the interface then stands by for the next command (start character). Therefore, set at least 1 second for the time out time on the host side.

5.2 Recommended format

The interface supports all communication/data formats. The following are however recommended from the standpoint of convenience and to avoid confusion when setting.

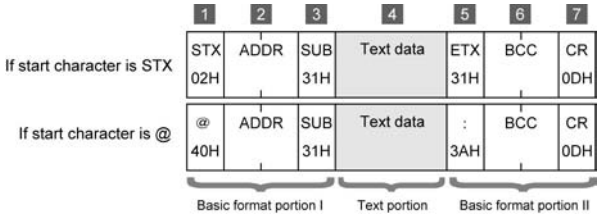
Data format	7E1 (data length: 7 bits, parity: E, stop bits: 1
Control code	STX（STX_ETX_CR）
Checksum（BCC）	1 (add operation)

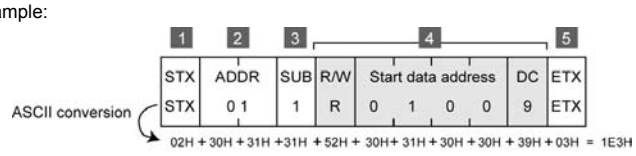
5.3 Communication format overview

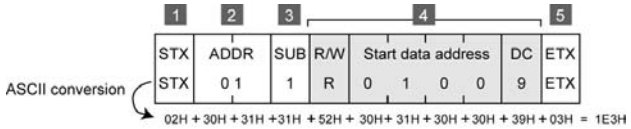
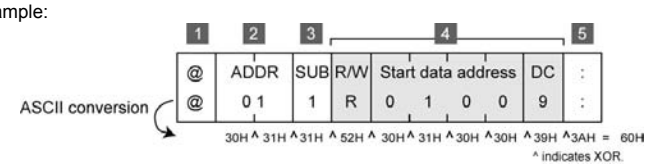
Shimaden standard protocol consists of basic format portion I, text portion and basic format portion II. The format is same for data sent by the host and data sent back from the slave. The text portion format differs from BCC operating results.

5.4 Basic format portion

This section contains information concerning basic format portion I and II.



1	Start character Communication format start STX (02H) or @ (40H)
2	Communication address number of slave Communication addresses 1 – 255 are divided into 4 upper bits and 4 lower bits, and are converted to ASCII data. Example: If address is 100 (64H), the upper 4 bits is 36H and the lower 4 bits is 34H.
3	Sub-address number Set to 1 (31H) and cannot be changed.
4	Text data Actual reception/transmission data For details, see "5.5 Text portion."
5	Text end character End of text portion ETX (03H) or : (34H)
6	BCC operating results For details concerning 4 (text portion) of the following figure, see "5.5 Text portion."
	1. Add operation Addition is performed by ASCII data 1 character (1 byte) unit from start character (1) to text end character (5). Example:  In this example, the lower 1 byte of 1E3H, E and 3 are converted to ASCII, and enter the upper and lower portions of BCC respectively.

	2. Complement of 2 following add operation Addition is performed by ASCII data 1 character (1 byte) unit from start character (1) to text end character (5), and includes the complement of 2 of the lower 1 byte of the results. Example:  In this example, the lower 1 byte of 1E3H, complement of 2 of E3H are 1DH; the lower 1 byte, 1 and D are converted to ASCII and enter the upper and lower portions of BCC respectively.
	3. Exclusive disjunction (XOR) operation Addition is performed by exclusive disjunction (XOR) operation in ASCII data 1 character (1 byte) unit immediately after start character (2) to text end character (5), Example:  In this example, the lower 1 byte of 60H of exclusive disjunction (XOR) operation results, 6 and 0 are converted to ASCII, and enter the upper and lower portions of BCC respectively.
	4. No BCC operation BCC operation not executed. BCC operation field (6) is omitted.
7	End character Communication format ends. CR (0DH)

5.5 Text portion

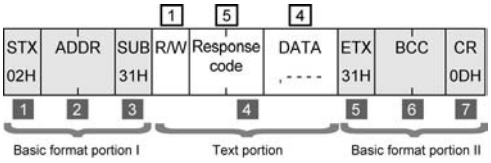
This section contains information concerning the text portion. The 4 portion explained above applies to this. The format of the text portion differs for master and slave.

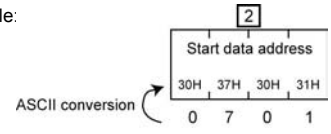
Communication command format (master)

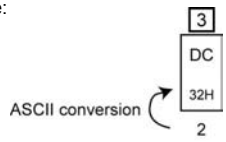
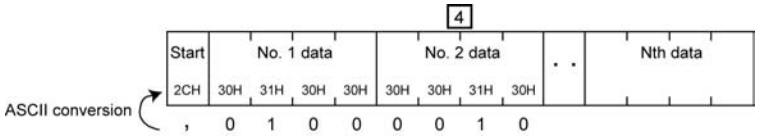
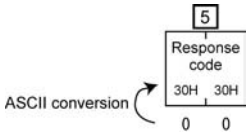
This section contains information concerning format of data sent from master (host).

Communication response format (slave)

This section contains information concerning format of data sent from slave.



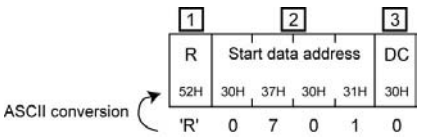
1	Command 'R' (52H) or 'W' (57H) 'R' (read): Reading of various types of slave data (received by host) 'W' (write): Writing of various types of data to slave (sent from host)
2	Start data address First data address of read source / write destination. For details on communication data addresses, see "7. Communication data addresses." Example:  This example shows the address of PV bias.
3	Number of data items Number of read/write data items In the case of a series of continuous data addresses, can be set for the entire series of addresses. Values that can be specified in the case of R (read) are 0 – 9 (1 – 10 units); in the case of W (write), 0 (1 unit) can be specified (the actual number of data items however is the specified value plus 1).

	Example:  In this example, 3 items of data are specified from the address including the address specified by [2].
[4]	Data Actual transmission/reception data The number of data items specified by [3] are transmitted/received as 1 block of data. The data format always displays data in descending order beginning from the comma (2CH). There is no character to separate data items. Example:  In this example, 100H is contained in the first data item and 10H in the second, with actual transmission/reception data up to the Nth data item.
[5]	Response code Response code from slave Example:  For details, see "5.8 Response code."

5.6 Read command

The 'R' (read) command is used to import data from the master to the slave.

Communication command format (master)



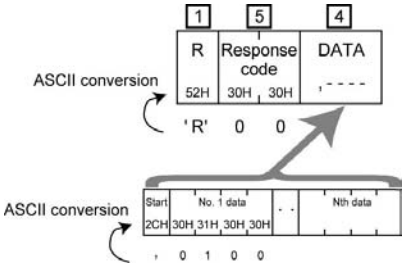
[1] Indicates read command. 'R' (52H)

[2] Start address of read data

[3] Number of read data items 0 - 9 can be specified. In the case of a series of continuous data addresses, can be set for the entire series of addresses. The actual number of data items is one more than the specified value.

Communication response format (slave)

Under normal circumstances

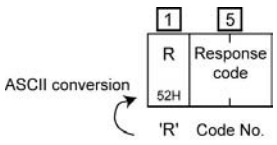


[1] Indicates read command. R (52H)

[5] Response code 00 (30H 30H) under normal circumstances

[4] Actual read data
Always starts with command symbol: , (2CH)
Data of the value specified by the master communication command format [3] (number of data items) + 1 is read.

Under abnormal circumstances



[1] Indicates read command. R (52H)

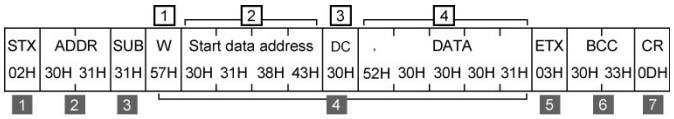
[5] Response code
Code number is inserted according to the state. For details, see "5.8 Response code."

5.7 Write command

The W (write) command is used to export data from the master to the slave.

Note

In order to use the write command, the communication mode must be COM. The front panel keys however cannot be used to switch the communication mode from LOC to COM. You can switch from LOC to COM by transmitting the following command.



1 Start character. STX (02H) specified in the example. 40H in the case of @.

2 Communication address number. 01 (30H 31H) is specified in the example.

3 Sub-address number. Set to 01 (31H) and cannot be changed.

4 [1] W (Write command)

[2] Communication mode data address 018C (30H 31H 38H 43H)

[3] Number of data items. Only 1 data item can be written, so specify 0 (30H).

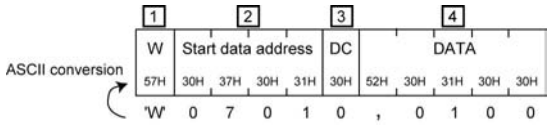
[4] Write data. COM is specified by 0001 (30H 30H 30H 31H) following the comma symbol (, 52H) that indicates the beginning of data.

5 Text end character. If STX is specified for **1**, ETX (03H). If @ is specified: (34H)

6 BCC checking results

7 End character. CR (0DH) for this device

Communication command format (master)



[1] Indicates write command. W (57H)

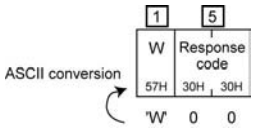
[2] Start address of write data

[3] Number of write data items. The value is always 0 (number of write data items is always 1).

[4] Actual write data
Always starts with command symbol: , (2CH). There is only 1 write data item.

Communication response format (slave)

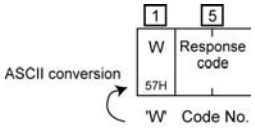
Under normal circumstances



[1] Indicates write command. W (57H)

[5] Response code. 00 (30H 30H) under normal circumstances

Under abnormal circumstances



[1] Indicates write command. W (57H)

[5] Response code.
Code number is inserted according to the state. For details, see "5.8 Response code."

5.8 Response code

Response code for Shimaden standard protocol is as follows. Error code except for 00H (30H 30H).

Response code	Condition	Description
00H (30H 30H)	Normal response	Normal response code for command
07H (30H 37H)	Format error	Format of the text portion differs from the established format
08H (30H 38H)	Address / number of data items error	Differs from established data address and number of data items
09H (30H 39H)	Data error	Write data outside setting range
0AH (30H 41H)	Execution command error	Execution command cannot be accepted
0BH (30H 42H)	Write mode error	Data including write prohibited data was written.
0CH (30H 43H)	Optional item error	Data including data of option the device is not equipped with was read/written.

Note

With the response code, the lower the number the higher the priority ranking is. If more than one error occurs at the same time, only the response code with the lowest number is returned.

5.9 No response processing

If any of the following errors occurs while data is being received from the host, the slave waits for the next data from the host without sending response data.

- Hardware error occurs (framing, overrun, parity).
- Communication address number does not match.
- Other than specified start character (STX or @).
- Sub-address is other than 1 (31H).
- Command type is other than 'R' or 'W.'
- Other than specified text end character (EXT or :).
- BCC operating results differ.
- End character is other than CR (0DH).

6. MODBUS protocol

This section contains information concerning MODBUS protocol.

6.1 Communication structure

MODBUS protocol is communication protocol developed for PLC by Modicon Inc. (AEG Schneider Automation International S.A.S.).

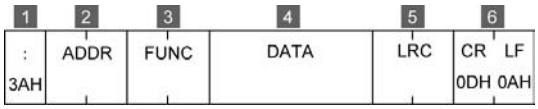
MODBUS protocol includes ASCII and RTU transmission modes. With ASCII mode, 8-bit binary command data is divided into 4-bit segments and converted to ASCII before sending. With RTU mode, parity data is sent without converting it to ASCII. Devices connected to the same network must be set to the same mode.

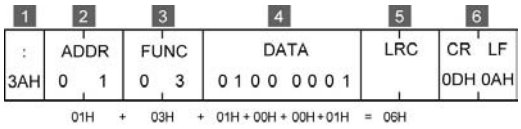
With MODBUS protocol as well, the host is the master and SD24 device is the slave; communication is always started by the host and ended by response from the slave.

6.2 Message format

MODBUS ASCII mode

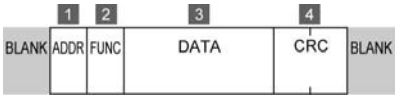
MODBUS ASCII mode message format is as follows.

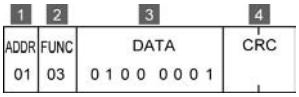


1	Header Beginning of message format. Set to 3AH and cannot be changed.
2	Communication address number of slave Communication addresses are divided into 4 upper bits and 4 lower bits, and are converted to ASCII data. For example, if address is 100 (64H), the upper 4 bits is 36H and the lower 4 bits is 34H. Communication address setting range for this device is 1 – 100.
3	Function code Command for slave. For details, see "6.5 Function code."
4	Data Actual reception/transmission data.
5	LRC check Results of LRC check (horizontal redundancy check) Check by complement of 2 following add operation. Complement of 2 following add operation Data from communication address number (2) to (4) is converted to binary data (1 byte) in 2-character (2-byte) ASCII data, added, and the complement of 2 of lower 1 byte of the results is included. Example:  In this example, the lower 1 byte of 0006H and complement of 2 of 06H are FAH; the lower 1 byte, F and A are converted to ASCII and enter the upper and lower portions of LRC.
6	Trailer End of message format. Set to CR (0DH) and LF (0AH) and cannot be changed.

MODBUS RTU Mode

MODBUS RTU mode message format is as follows.



1	Communication address number of slave Sets communication address value. For example, if address is 100 (64H), the address is 64H. Communication address setting range for this device is 1 – 100.
2	Function code Command for slave. For details, see "6.5 Function code."
3	Data Actual reception/transmission data.
4	CRC check Results of CRC check (cycle redundancy check) CRC-16 operation method Example:  In the explanation, "CR" indicates CRC data (2 bytes) during operation. 1. CR is initialized (FFFFH). 2. The XOR (exclusive OR) of CR and 1 is taken and the result is substituted for CR. 3. Checks if the lowest bit of CR is 0 or 1. If 0, CR is shifted 1 bit at a time to the right. If 1, the XOR (exclusive OR) of the value of shifting CR 1 bit at a time to the right and A001H is taken and the result is substituted for CR. 4. Step 3 is repeated 7 times more. 5. When step 3 is repeated a total of 8 times, just as with step 2, the XOR (exclusive OR) of CR and the value of the next field 2 is taken and the results is substituted for CR. 6. When step 5 is repeated 8 times, calculation is similarly executed using the value of the following field up to that last data before the CRC field (last data of 3). 7. The upper and lower 8 bits of the ultimately calculated CR value are reversed and placed in the CRC field.

Note	In MODBUS RTU mode, there is no field to indicate start of message. If blank time of at least 3.5 characters is detected, the device stands by to receive data. Data reception subsequently starts when the message passes on the same line. If blank time of at least 3.5 characters is again detected, data reception ends and the device stands by for the next message.

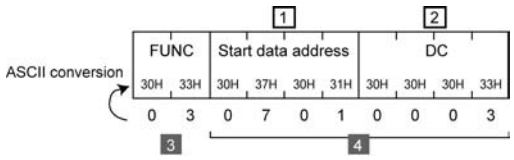
6.3 MODBUS ASCII mode commands

MODBUS ASCII mode includes read, write and loop-back commands.

Read command

The read command is used to import data from the master to the slave.

Communication command format (master)



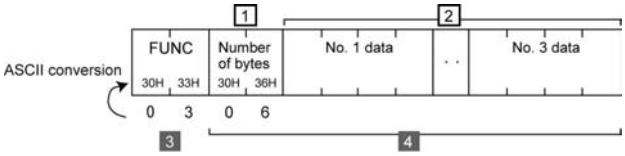
3 Function code. Indicates read command. 03H (30H 33H)

4 1 Start address of read data

2 Number of read data items 1H – AH (1 – 10 items) can be specified. In the case of a series of continuous data addresses, can be set for the entire series of addresses.

Communication response format (slave)

Under normal circumstances

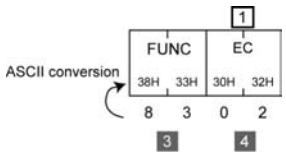


3 Function code. Indicates read command. 03H (30H 33H)

4 1 Number of read data bytes

2 Actual read data

Under abnormal circumstances



3 Function code
Indicates read command error. 83 (38H 33H)

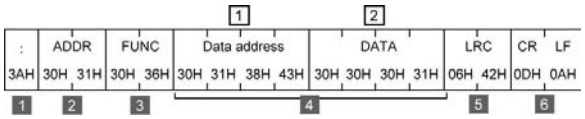
4 1 Abnormal code
For details concerning error code, see "6.5 Function code."

Write command

The write command is used to export data from the master to the slave.

Note

In order to use the write command, the communication mode must be COM. The front panel keys however cannot be used to switch the communication mode from LOC to COM. You can switch from LOC to COM by transmitting the following command.



1 Start character: (3AH)

2 Communication address number. 01 (30H 31H) is specified in the example.

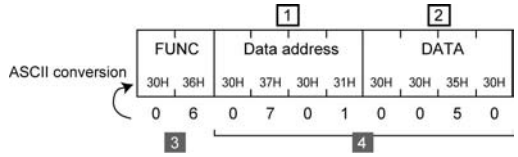
3 Function code. 06 (30H 36H)

4 1 Communication mode data address 018C (30H 31H 38H 43H)
2 Write data. Specify COM by 0001 (30H 30H 30H 31H)

5 LRC checking results

6 Trailer. CRLF (0DH 0AH)

Communication command format (master)

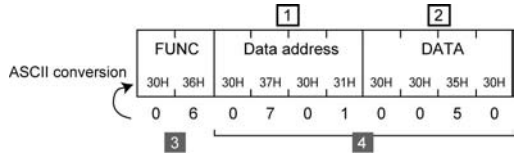


3 Function code. Indicates write command. 06H (30H 36H)

4 1 Data address of write data
2 Actual write data

Communication response format (slave)

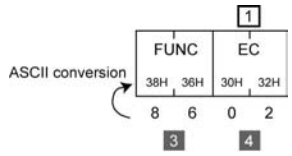
Under normal circumstances



3 Function code. Indicates write command. 06H (30H 36H)

4 1 Data address of write data
2 Actual write data

Under abnormal circumstances



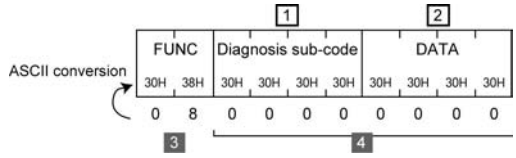
3 Function code
Indicates write command error. 86H (38H 36H)

4 1 Abnormal code
For details concerning abnormal code, see "6.5 Function code."

Loop-back command

The loop-back command sends data from the master to the slave and a response is then sent back from the slave. Used to confirm existence of transmission destination device.

Communication command format (master)

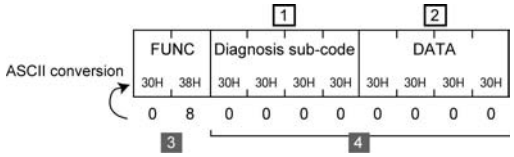


3 Function code. Indicates loop-back command. 08H (30H 38H)

4 1 Indicates diagnosis sub-code; set to 0000H（30H 30H 30H 30H）and cannot be changed.
2 Data. The device ignores this field.

Communication response format (slave)

Under normal circumstances

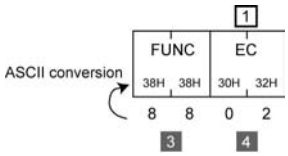


3 Function code. Indicates loop-back command. 08H (30H 38H)

4 [1] Indicates diagnosis sub-code; set to 0000H（30H 30H 30H 30H）and cannot be changed.

[2] Data. The device ignores this field.

Under abnormal circumstances



3 Function code
Indicates loop-back error. 88H (38H 38H)

4 [1] Abnormal code
For details concerning abnormal code, see "6.5 Function code."

6.4 MODBUS RTU mode commands

MODBUS RTU mode includes read, write and loop-back commands.

Read command

This section contains information concerning the read command. The read command is used to import data from the master to the slave.

Communication command format (master)

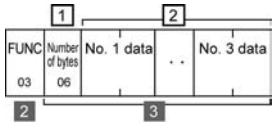
2 Function code. Indicates read command. 03H

3 [1] Start address of read data

[2] Number of read data items 0001H – 000AH (1 – 10 items) can be specified. In the case of a series of continuous data addresses, can be set for the entire series of addresses.

Communication response format (slave)

Under normal circumstances

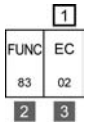


2 Function code
Indicates read command. 03H

3 [1] Number of read data bytes

[2] Actual read data

Under abnormal circumstances



2 Function code
Indicates read command error. 83H

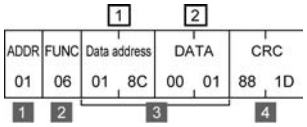
3 [1] Abnormal code
For details concerning abnormal code, see "6.5 Function code."

Write command

This section contains information concerning the write command. The write command is used to export data from the master to the slave.

Note

In order to use the write command, the communication mode must be COM. The front panel keys however cannot be used to switch the communication mode from LOC to COM. You can switch from LOC to COM by transmitting the following command.



1 Communication address number. In this example, 01 is specified.

2 Function code. 06

3 [1] Communication mode data address 018C

[2] Write data. COM specified by 0001

4 CRC checking results

Communication command format (master)

2 Function code. Indicates write command. 06H

3 1 Data address of write data

2 Actual write data

Communication response format (slave)

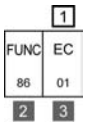
Under normal circumstances

2 Function code
Indicates write command. 06H

3 1 Data address of write data

2 Actual write data

Under abnormal circumstances



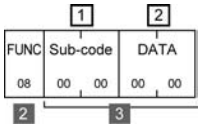
2 Function code
Indicates write command error. 86H

3 1 Abnormal code
For details concerning abnormal code, see "6.5 Function code."

Loop-back command

This section contains information concerning the loop-back command. The loop-back command sends data from the master to the slave and a response is then sent back from the slave. Used to confirm existence of transmission destination device.

Communication command format (master)



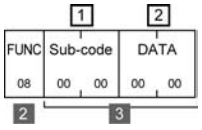
2 Function code
Indicates loop-back command. 08H

3 1 Indicates diagnosis sub-code; set to 0000H and cannot be changed.

2 Data. The device ignores this field.

Communication response format (slave)

Under normal circumstances

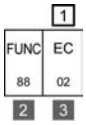


2 Function code
Indicates loop-back command. 08H

3 1 Indicates diagnosis sub-code; set to 0000H and cannot be changed.

2 Data. The device ignores this field.

Under abnormal circumstances



2 Function code
Indicates loop-back error. 88H

3 1 Abnormal code
For details concerning abnormal code, see "6.5 Function code."

6.5 Function Code

The function code specifies the type of command to the slave. If the function code sent by the master is processed by the slave without error, the slave sends the same code back. If an error occurs, a function code with the highest bit of the original code set to 1 is sent back. Under abnormal circumstances, "abnormal code" is placed in the data field and sent back.

Function code

Function codes supported by the device are as follows.

Function code	Description
03 (03H)	Read command. Slave setting value and information read
06 (06H)	Write command. Write value to slave
08 (08H)	Loop-back command. Specifies to send back transmission data as is. Used to confirm existence of slave, etc.

Abnormal code

Abnormal codes supported by the device are as follows.

Abnormal code	Description
1 (01H)	Error concerning function (non-existent function, etc.)
2 (02H)	Address, number of data items error (Differs from established data address and number of data items.)
3 (03H)	Data error (Write data outside setting range)

6.6 No response processing

If any of the following errors occurs while data is being received from the host, the slave waits for the next data from the host without sending response data.

In the case of MODBUS ASCII mode, hardware error occurs (framing, overrun, parity).

- Communication address number does not match.
- If header not specified (:)
- If function code is other than 03H, 06H or 08H
- LRC operating results differ.
- If trailer is other than CR or LF (0DH 0AH)

For MODBUS RTU mode

- Hardware error occurs (framing, overrun, parity).
- Communication address number does not match.
- If data received is other than 8 bytes per frame
- If function code is other than 03H, 06H or 08H
- CRC operating results differ.

7. Communication data addresses

Supported data addresses are as follows.

- For details on parameters, see the main instruction manual.
- R in the R/W field indicates read command only is supported; W indicates write command only and R/W indicated both commands are supported.

Address	Name	R/W	Contents/value range
0040	Type code	R	0x5344-->ASCII code "SD"
0041	Type code	R	0x3234-->ASCII code "24"
0042	Type code	R	0x0000
0043	Type code	R	0x0000
0044	Version No. top	R	0x5631-->ASCII code "V1"
0045	Version No. bottom	R	0x3030-->ASCII code "00"

* If Ver. 1.00

0046 Optional item information (R)

Bit 3	Bit 2	Alarm
0	0	None
0	1	A contact (4)
1	0	C contact (2)

Bit 1	Bit 0	Input
0	0	Multi
0	1	Voltage
1	0	Current

Bit 5	Bit 4	Analog output / communication
0	0	None
0	1	Analog output
1	0	Communication

Address	Name	R/W	Remarks
0100	PV value	R	
0101	PV max. value	R	
0102	PV min. value	R	

0103 Status LED (R)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
MAX	MIN	HOLD	COM	AL1	AL2	AL3	AL4

0104 Action flag (R)

Bit 8
COM

0105 Alarm flag (R)

Bit 3	Bit 2	Bit 1	Bit 0
AL4 output	AL3 output	AL2 output	AL1 output

010d Alarm latch output (R)

Bit 3	Bit 2	Bit 1	Bit 0
AL4 latch status	AL3 latch status	AL2 latch status	AL1 latch status

Address	Name	R/W	Setting range	Remarks
018c	Communication mode	W	0: LOC 1: COM	

0198 Alarm unlatching (W, 1-15)

Bit 3	Bit 2	Bit 1	Bit 0
AL4 unlatching	AL3 unlatching	AL2 unlatching	AL1 unlatching

0199	PV max./min. value reset	W	1	Note 1

Address	Name	R/W	Setting range	Initial value	Remarks
0500	AL1 code	R/W	0 – 5	1 (HA)	

Number	0	1	2
AL1 code	Non: None	HA: Higher limit absolute value	LA: Lower limit absolute value

Number	3	4	5
AL1 code	HA_L: Higher limit absolute value with latch	LA_L: Lower limit absolute value with latch	So: Scaleover

0501	AL1 setting value	R/W	Within measuring range	Measuring range higher limit	
0502	AL1 hysteresis	R/W	1 – 9999 unit	20 unit	
0503	AL1 Standby action	R/W	0: OFF 1: ON	0 (OFF)	

0508	AL2 code	R/W	0-11/0-5	2 (LA)	

If AL1 code is 1, 2, 3 or 4

Number	AL2 code (0x0508)
0	non: None
1	HA: Higher limit absolute value
2	LA: Lower limit absolute value
3	HA_L: Higher limit absolute value with latch
4	LA_L: Lower limit absolute value with latch
5	So: Scaleover
6	dHi: Deviation higher limit
7	dLo: Deviation lower limit
8	dHL: Deviation higher/lower limit
9	dHi_L: Deviation higher limit with latch
10	dLo_L: Deviation lower limit with latch
11	dHL_L: Deviation higher/lower limit with latch

If AL1 code is 0 or 5

Number	AL2 code (0x0508)
0	non: None
1	HA: Higher limit absolute value
2	LA: Lower limit absolute value
3	HA_L: Higher limit absolute value with latch
4	LA_L: Lower limit absolute value with latch
5	So: Scaleover

0509	AL2 setting value	R/W	Within measuring range	Measuring range lower limit	
050a	AL2 hysteresis	R/W	1 – 9999 unit	20 unit	
050b	AL2 Standby action	R/W	0: OFF 1: ON	0 (OFF)	
0510	AL3 code	R/W	0 – 5	0 (non)	

Number	0	1	2
AL3 code	non: None	HA: Higher limit absolute value	LA: Lower limit absolute value

Number	3	4	5
AL3 code	HA_L: Higher limit absolute value with latch	LA_L: Lower limit absolute value with latch	So: Scaleover

0511	AL3 setting value	R/W	Within measuring range	Measuring range lower limit	
0512	AL3 hysteresis	R/W	1 – 9999 unit	20 unit	
0513	AL3 Standby action	R/W	0: OFF 1: ON	0 (OFF)	

Note 1: PV max./min. value reset (0x0199)
If "1" is written, both max. and min. values are reset simultaneously.

Address	Name	R/W	Setting range	Initial value	Remarks
0518	AL4 code	R/W	0 – 11/0 – 5	0 (non)	

If AL3 code is 1, 2, 3 or 4

Number	AL4 code (0x0518)
0	non: None
1	HA: Higher limit absolute value
2	LA: Lower limit absolute value
3	HA_L: Higher limit absolute value with latch
4	LA_L: Lower limit absolute value with latch
5	So: Scaleover
6	dHi: Deviation higher limit
7	dLo: Deviation lower limit
8	dHL: Deviation higher/lower limit
9	dHi_L: Deviation higher limit with latch
10	dLo_L: Deviation lower limit with latch
11	dHL_L: Deviation higher/lower limit with latch

If AL3 code is 0 or 5

Number	AL4 code (0x0518)
0	non: None
1	HA: Higher limit absolute value
2	LA: Lower limit absolute value
3	HA_L: Higher limit absolute value with latch
4	LA_L: Lower limit absolute value with latch
5	So: Scaleover

0519	AL4 setting value	R/W	Within measuring range	Measuring range lower limit	
051a	AL4 hysteresis	R/W	1 – 9999 unit	20 unit	
051b	AL4 Standby action	R/W	0: OFF 1: ON	0 (OFF)	
0580	Di-1 code	R/W	0 – 3	1 (HLD)	
0581	Di-2 code	R/W	0 – 3	2 (rSt)	

Number	DI-1/2 code (0x0580/0x0581)
0	non: None
1	HLD: PV display hold
2	rSt: PV max./min. value reset
3	L_rS: Alarm unlatching

05b0	Communication memory mode	R/W	0: EEP 1: RAM 2: r_E	0 (EEP)	
0611	Key lock	R/W	0: OFF 1: Lock1 2: Lock2	0 (OFF)	
0700	PV slope	R/W	0.500 – 1.500	1.000	* See note 2
0701	PV bias	R/W	-9999 – 10000 unit	0	
0702	PV filter	R/W	0 – 100 seconds	0	
0703	Reserve	R/W			
0704	Input unit	R/W	0: ℃ 1: °F	0	* See note 3
0705	Input range	R/W	According to input specifications		

Input type	Input range (0x0705) setting range	Remarks
Multi	1 – 19, 31 – 58, 71 – 77	See measuring range codes of the SD24 Series main instruction manual.
Voltage	81 – 87	
Current	94 – 95	

0706	Reserve	R/W			
0707	Input scale decimal point position	R/W	0: None 1: nnn.n 2: nn.nn 3: n.nnn	1	* See note 2
0708	Input scale lower limit	R/W	-9999 – 30000	Measuring range lower limit	
0709	Input scale higher limit	R/W	-9999 – 30000	Measuring range higher limit	
070A	Last digit display ON/OFF	R/W	0: norm 1: Shrt	0	* See note 3

Address	Name	R/W	Setting range	Initial value	Remarks
0720	Linear approximation input A1	R/W	-5.00 – 105.00	0.00	Valid only when linear approximation is ON * See note 2
0721	Linear approximation input B1	R/W			
0722	Linear approximation input A2	R/W			
0723	Linear approximation input B2	R/W			
0724	Linear approximation input A3	R/W			
0725	Linear approximation input B3	R/W			
0726	Linear approximation input A4	R/W			
0727	Linear approximation input B4	R/W			
0728	Linear approximation input A5	R/W			
0729	Linear approximation input B5	R/W			
072a	Linear approximation input A6	R/W			
072b	Linear approximation input B6	R/W			
072c	Linear approximation input A7	R/W			
072d	Linear approximation input B7	R/W			
072e	Linear approximation input A8	R/W			
072f	Linear approximation input B8	R/W			
0730	Linear approximation input A9	R/W			
0731	Linear approximation input B9	R/W			
0732	Linear approximation input A10	R/W			
0733	Linear approximation input B10	R/W			
0734	Linear approximation input A11	R/W			
0735	Linear approximation input B11	R/W			
0736	Linear approximation ON/OFF	R/W	0: OFF 1: ON	0	* See note 2
0737	Low cut	R/W	0.0 – 5.0	1.0	Valid only when square-root extraction is ON * See note 2
0738	Square-root extraction	R/W	0: OFF 1: ON	0	* See note 2
0739	Source frequency	R/W	0: 50Hz 1: 60Hz	0	

Note 2: Write possible when voltage/current input.
Note 3: Write possible when thermocouple/R.T.D. input.

8. Appendix

8.1 ASCII Codes Table

	b7 − b5	000	001	010	011	100	101	110	111
b4 − b1		0	1	2	3	4	5	6	7
0000	0	NUL	TC7 (DLE)	SP	0	@	P	`	p
0001	1	TC1 (SOH)	DC1	!	1	A	Q	a	q
0010	2	TC2 (STX)	DC2	"	2	B	R	b	r
0011	3	TC3 (ETX)	DC3	#	3	C	S	c	s
0100	4	TC4 (EOT)	DC4	$	4	D	T	d	t
0101	5	TC5 (ENQ)	TC8 (NAK)	%	5	E	U	e	u
0110	6	TC6 (ACK)	TC9 (SYN)	&	6	F	V	f	v
0111	7	BEL	TC10 (ETB)	'	7	G	W	g	w
1000	8	FE0 (BS)	CAN	(	8	H	X	h	x
1001	9	FE1 (HT)	EM	)	9	I	Y	i	y
1010	A	FE2 (LF)	SUB	*	:	J	Z	j	z
1011	B	FE3 (VT)	ESC	+	;	K	[	k	{
1100	C	FE4 (FF)	IS4 (FS)	,	<	L	\	l	|
1101	D	FE5 (CR)	IS3 (GS)	-	=	M	]	m	}
1110	E	SO	IS2 (RS)	.	>	N	^	n	~
1111	F	SI	IS1 (US)	/	?	O	_	o	DEL

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