NewMAC10 Series Digital Controller
Communication Interface
(RS - 485)
Instruction Manual

Thank you for purchasing SHIMAX product. Please check that the product is the one you ordered. Please operate after you read the instruction manual and fully understand it.

This instructions manual describes the communication interface, or option function of digital controller MAC10. See the attached main body's instructions manual about operation of MAC10, and the details of each parameter.

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SHIMAX CO.,LTD.

NMAC10C-1BE November, 2020

1. Outline

The MAC10 communication interface has adopted the communication method of RS-485.
The various data can be set up with the signal based on EIA standard, or it can read with the personal computer etc.

RS-485 is the data communication standard decided by the Electronic Industries Alliance (EIA).
This standard specified so-called electric and mechanical hardware.
The software portion of the data transmission procedure is not specified.
Therefore, the set with the same interface cannot always communicate each other.
Therefore, the customer fully needs to understand specification and the transmission procedure beforehand.

Use of RS-485 makes it possible to carry out parallel connection of two or more MAC10.
Not many personal computers seem to support this interface.

RS-232C ⟺ RS-485

However, use of the line converter makes it possible.

2. Specification

Protocol	: MODBUS ASCII, MODBUS RTU
Signal level	: in conformity with EIA RS-485
Communication method	: RS-485 Two-wire system Half duplex Multidrop (bus) system
Synchronic system	: Start-stop Synchronous system
Communication range	: RS-485 Maximum 500m totally (depends on the environmental condition)
Transmission speed	: 9600 and 19200 bps
Transmission procedure	: No procedure
Start bit	: 1 bit
Data length	: MODBUS ASCII: 7 or 8 bits, MODBUS RTU: 8 bits
Parity bit	: nothing, the even number, odd number
Stop bit	: 1 bit, 2 bits
Communication code	: ASCII code (MODBUS ASCII) Binary code (MODBUS RTU)
Connectable maxim number	: 32 (Including a host controller)
Insulation	: A communication circuit and other circuits are insulated(Basic or Functional insulation). MAC10 is basic insulation to various input and output, and electric power source

*MODBUS is a registered trademark of Schneider Electric.

3. Connection with Host Computer

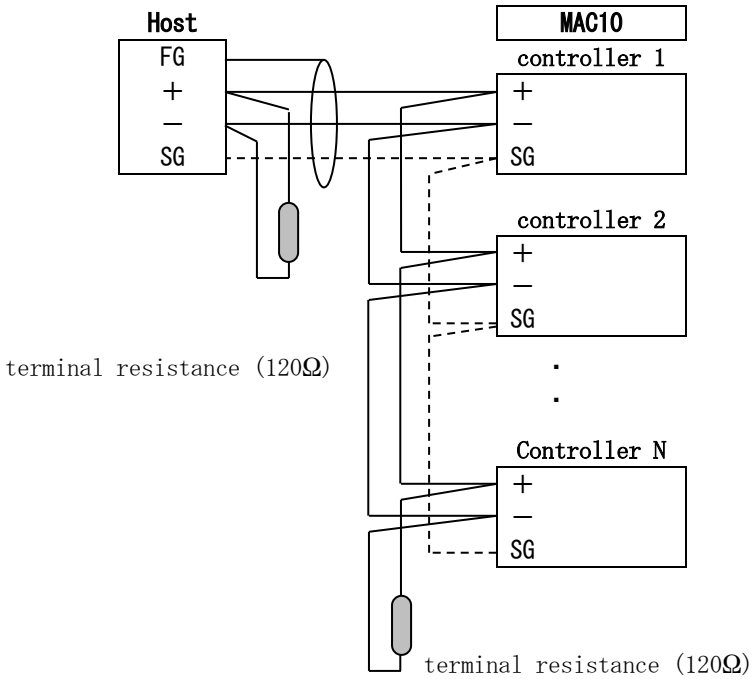
3-1. RS-485

The input-and-output logic level of MAC10 is fundamentally as follows.

mark (1) state	- terminal	<	+ terminal
mark (0) state	- terminal	>	+terminal

However, + terminal and - terminal of the controller are high impedance until just before starting transmission, the above-mentioned level is output. (See **3-2. Control of Three State Control**)

[RS-485]



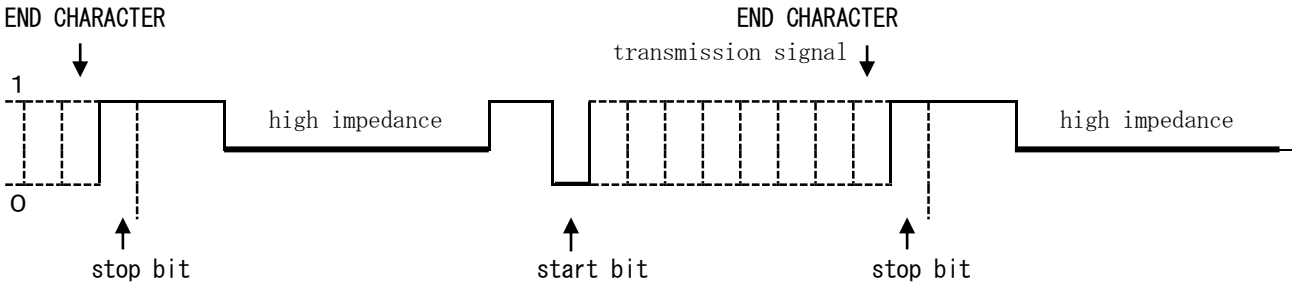
	MAC10 terminal number		
	MAC10A/B	MAC10C	MAC10D
+	[2]	[23]	[17]
−	[1]	[24]	[18]
SG	[3]	[22]	[16]

Note 1: Attach 1/2W 120Ω terminal resistance of between the host side and one end terminal equipment (between + and -) at the time of operation.

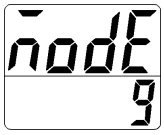
Note 2: Please be sure to connect one side of a shield to the ground.
When wiring by a shielding wire cannot be performed, the customer should take the measure against lightning surge.

3-2. Control of Three State Output

RS-485 is a multidrop system. Transmitting output is always high impedance at the time of un-communicating and reception, in order to avoid the collision of a transmitted signal.
Just before transmitting, it changes to a normal output state from high impedance. And it returns to high impedance again at the same time transmission is completed.
However, the control of 3 state control has about 2 msec (MAX.) time-lag. Set up more than several msec delay time, when the host side starts transmission immediately after the end of reception.



4. Setup Concerning Communication



MAC10 has 8 kinds of parameters concerning communication after Mode 9.
These cannot perform setting change by communication except for a communication memory mode setup.
Perform it by a front key.

MENU key

4-1. Setup of Communication Speed

Initial value : 96
Setting range : 96 (9600bps) , 192 (19200bps),

The transmission speed for transmitting data to a host is chosen and set up.

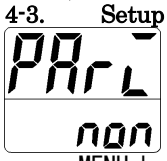
MENU key

4-2. Setup of Communication Data Length

Initial value : 8
Setting range : 7, 8
Communication data bit length is chosen and set up. (Fixed at 8 bits at the time of MODBUS RTU setup)

MENU key

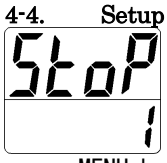
4-3. Setup of Communication Parity



Initial value : none
Setting range : none, odd number, even number
Communication parity is chosen and set up.

MENU key

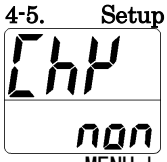
4-4. Setup of Communication Stop Bit



Initial value : 1
Setting range : 1,2
Communication stop bit is chosen and set up.

MENU key

4-5. Setup of BCC Operation Type

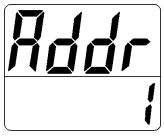


Initial value : Cr16
Setting range : LrC,Cr16
BCC operation type is chosen. **The content selected here determines the protocol.**

MENU key

choice	operation method	protocol
LrC	LRC	MODBUS ASCII
Cr16	CRC-16	MODBUS RTU

4-6. Setup of Communication Address (Slave Address)

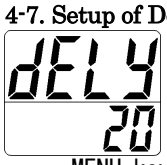


Initial value : 1
Setting range : 1～255
RS-485 adopts the multidrop system and up to 31 equipments (maximum) are connectable.
By allotting an address (machine No.) to the each equipment, only specified-address holding equipment can respond.

MENU key

Note 1: An address can be set up to 1～255.However, the maximum number of connectable equipment is 31.
Note 2: The numbers of addresses you can appoint as a slave is 1～247 in the specification of MODBUS. (Since appointment is possible in 1～255)

4-7. Setup of Delay Time



Initial value : 20
Setting range : 1～250(msec)
The minimum delay time, from receiving a communication command to actual transmission, can be set up.

MENU key

Note 1: A certain line converter may require longer time for 3 state control, and a signal collision may occur in the case of RS-485.
If delay time is lengthened, it is avoidable.

Note 2: The actual delay time, from receiving communication command to actual transmission, is the sum total of the above-mentioned delay time, and the processing time by software.
Especially in the case of write command, command processing time may require around 400 msec.

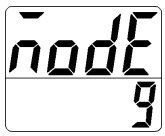
4-8. Setup in Communication Memory Mode

Initial value : RAM
Setting range : RAM,MIX,EEP
Since write cycle of nonvolatile memory EEPROM is limited, the life of EEPROM becomes shorter when data is frequently rewritten by communication.

MENU key

Set up RAM mode when data is frequently rewritten by communication. Life of EEPROM can be lengthened, if only RAM data is rewritten without rewriting EEPROM.
* Data address "05B0"(Communication memory mode) is always written in at an EEPROM regardless of this setting.

choice	content of processing
RAM	In this mode, in changing data by communication, only RAM is rewritten. RAM data will be eliminated if power is turned OFF without rewriting to EEPROM. If power is turned on again, it will start by the data memorized by EEPROM.
MIX	In this mode, the data of FIX-SV 1-4 and OUT 1 manual output value is written only in RAM, and the other data are written in RAM and EEPROM.
EEP	Everytime the data is changed by communication, rewriting of RAM and EEPROM is performed. The data is saved even if power is turned off.



5. Outline of MODBUS Communication Protocol

MODBUS has two kinds of modes or RTU mode and ASCII mode, and according to the setting content of **4-5. Setup of BCC Operation Type**, it changes automatically.

Comparison of RTU and ASCII mode

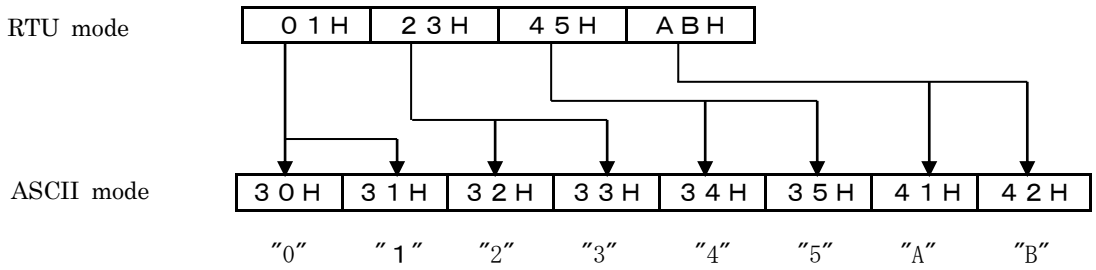
Item	RTU	ASCII
transmission code	binary 8 bits	ASCII
error-checking	CRC-16	LRC
start bit	1 bit	
data length	8 bits	7 or 8 bits
parity bit	none / even number / odd number	
stop bit	1 or 2 bits	
start character	none	":"(3AH)
end character	none	CR(0DH)+LF(0AH)
time interval of data	below time to be equivalent to 28 bits	one second or less

5-1. Communication Procedure

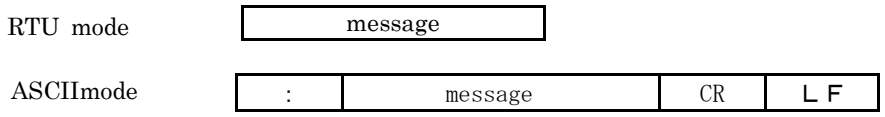
1) Relation between master and slave
- A personal computer and PLC (host) side is master side.
- MAC10 is slave side.
- Communication is started by communication command from master side, and completed by communication answer from slave side.
  However, a communication answer is not performed when abnormalities, such as communication format error or BCC error etc., have been recognized.

2) Communication procedure
The slave side answers the master side, a transmitting right is transferred by turns, and a communication procedure is performed.

3) Communication data
RTU mode is 8-bit binary transmission.
In ASCII mode, 8-bit binary of RTU is converted to the two-letter ASCII code and transmitted.



4) Message frame composition
RTU mode consists of only messages.
ASCII mode is consists of start character":" (3AH) + message + end character, CR (0DH) +LF (0AH).
message



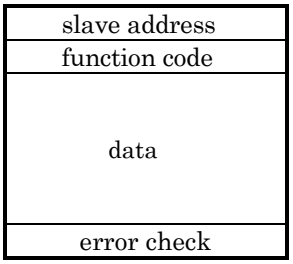
5) Timeout
- RTU mode
  When message stopps during time equivalent to 28 bits, it is regarded as the end of message.
  When a blank arises during time equivalent to 28 bits in the middle of message transmitting, it is judged as the end of message.It is an imperfect message, therefore slave performs no response.
  * Reference: time equivalent to 28 bits (unit = msec)
    9600bps:3.0 19200bps:1.5
- ASCII mode
  After receiving start character, it results in timeout when reception of end character is not completed within 1 second. And it waits for the other command (new start character).

5-2. Communication Format

1) Composition of message

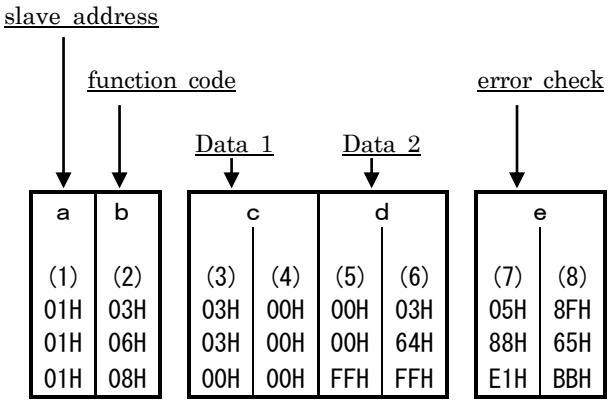
The MODBUS message has the following composition in RTU and ASCII mode.

All the message components are treated not by a decimal number but by a hexadecimal number.



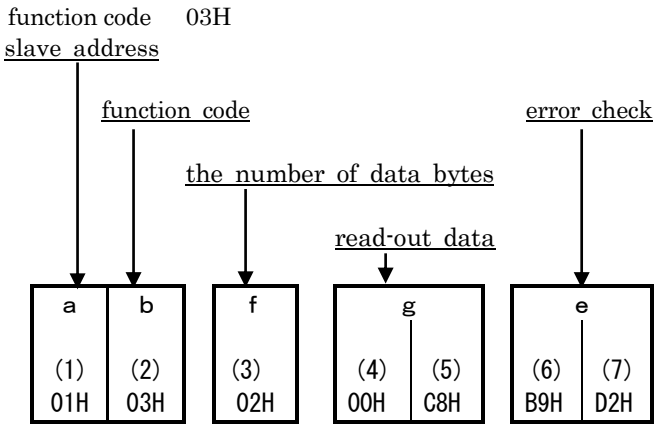
2) Communication command format (MODBUS: Described by RTU because RTU is foundation)

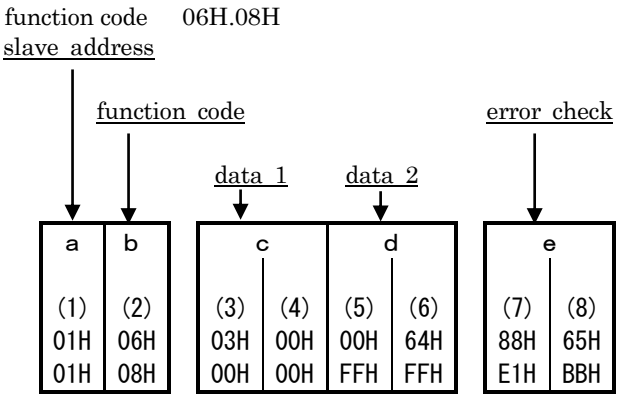
- As for the message from master, message length is being fixed regardless of the function code.



3) Communication answer format (MODBUS: Described by RTU because RTU is foundations)

- The answer from a slave differs in message length along with a function code.





a: Slave address
- The message which the master sent is received by all the connected equipment. Only the slave congruous with message's slave address answers the message.
- In MAC10, 1～255 (01 H～FFH) can be appointed as slave address.
  Note: In MODBUS specification, address which can be appointed to slave is 1～247 (01 H～F 7H)

b: Function code
- A code number shows the function to perform.

function code	function
0 3 H	data read-out
0 6 H	data writing
0 8 H	loopback test

c: Data 1
- Composition of data differs along with function code.

d: Data 2
- Composition of data differs along with function code.

function code	data 1 content	data 2 content
0 3 H	data address	the number of read-out
0 6 H	data address	write-in data
0 8 H	fixed as 0000H	arbitrary data

e: Error checking
- Error-checking system differs along with MODBUS mode.
  RTU mode : CRC-16
  ASCII mode : LRC
- See **5-3. Error Checking** about details concerning error checking.

f: The number of data bytes
- The number of read-out data bytes at the time of data read-out.
- Read-out demand is word unit; therefore it is twice of the number of read-out.

The number of read-out		The number of data bytes	
decimal number	hexa-decimal number	decimal number	hexa-decimal number
1	01H	2	02H
2	02H	4	04H
3	03H	6	06H
4	04H	8	08H
5	05H	10	0AH
6	06H	12	0CH
7	07H	14	0EH
8	08H	16	10H
9	09H	18	12H
10	0AH	20	14H

g: Read-out data
- The data along with read-out demand is inserted.
- Along with the number of read-out, data length varies and there is no data breaking.
  The number of read-out is: 1 = 2 bytes, 3 = 6 bytes, and 10 = 20 bytes.

5-3. Error Checking

Error checking is calculated by the sending side and the result is attached to the end of outgoing message.
Error checking of incoming message is calculated by the reception side.
The result is checked if it is the same as received error checking.
If the check results met, incoming message is judged to be right, and answer operation to reception is started.
If it differs, data is judged as abnormal, and slave performs no response.

(1)CRC-16

CRC-16 is 2 bytes (16 bits) of error-checking code.
CRC-16 is calculated in the following procedures from slave address to the end of data.

1. to initialize CRC register by FFFFH.
2. Exclusive OR with CRC register and the first 1 byte of message.
   A calculation result is written in CRC register.
3. Shift 1 bit of CRC registers to the right.
4. If carry fragment (shift-out bit) is 1, exclusive OR with CRC register and A001H.
   The calculation result is written in CRC register.
5. Repeat 3. and 4. until it shifts eight times.
6. Exclusive OR with CRC register and 1 byte next to message.
   The calculation result is written in CRC register.
7. 3.～ 6. is repeated to all the data except CRC.
8. Data byte is calculated to the end. The computed CRC register value is assigned to a message in order of low rank and high rank.

(2) LRC

LRC calculates from slave address to the end of data in the following procedures.
(Note: LRC calculation is performed by RTU binary,the antecedent method of ASCII binary)

1. Addition, from the lead of data (slave address) to the end, is carried out.
When a calculation result exceeds FFH, the value beyond 100H is omitted.(153H is treated as 53H)
2. The complement of addition's result (bit reversal) is taken, and 1 is added to the result.
3. The above-mentioned value works as the LRC code.
4. The LRC code is assigned to the end of message, and the whole is converted into the ASCII character.

5-4. Data Read-out (Function Code 03H) Details

Function code 03H is used on occasions when it reads (takes in) various data from a personal computer, PLC, etc.

(1) Data read-out format

- The format at the time of data read-out is as follows.

a	b	c		d		e	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
01H	03H	04H	00H	00H	03H	04H	FBH

error checking in ASCII mode
the portion of (7), (8) is as follows
LRC:F5H

a: Slave address
b: Data read-out function code
c: Read-out lead data address
d: The number of read-out data from lead data address
* The numbers of data which can be read is 1～10.
Therefore, binary code permitted here is 0001H～000AH, and error code is returned if value other than the above is appointed.
e: Error checking

- The above-mentioned command is as follows.
Read-out lead data address = 0400H (hexadecimal number)
The number of read-out data = 0003H (hexadecimal number)
Three data read-out is appointed from data address 0400H

(2) The normal answer format at the time of data read-out

- The normal answer format to function code 03H is as follows.

a	b	f	g						e	
			0400H		0401H		0402H			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
01H	03H	06H	00H	1EH	00H	78H	00H	1EH	89H	66H

error checking in ASCII mode
the portion of (10), (11) is as follow
LRC:42H

a: Slave address
b: Function code
f: The number of read-out data bytes
* three data read-out, so 6 bytes read-out. Therefore, it is 06H.
g: Read-out data
1. The same number of data as that of read-out data is inserted from read-out's data of lead data address, in order.
2. Nothing is inserted between data.
3. One data consists of binary digit 16 bits data(1 word) except for a decimal point.
4. Each data has position of peculiar decimal point.

e: Error checking

read-out lead data address (0400H) → number of read-out data (0003H : 3) { 1, 2, 3

data address 16 bits (1 word)	data 16 bits (1 word)	
hexadecimal number	hexadecimal number	decimal number
0400	001E	30
0401	0078	120
0402	001E	30

(3) The abnormal answer format at the time of data read-out

a	b	h	e	
(1)	(2)	(3)	(4)	(5)
01H	83H	03H	01H	31H

error checking at the time of the ASCII mode
the portion of (4), (5) is as follow
LRC: 79H

a: Slave address
b: Function code
* At the time of error, reception function code +80H is shown. It informs abnormal answer.
h: Error code
* See **5-8. Error Message Details** about details of error code.
e: Error checking

5-5. Data Write-in (Function Code 06H) Details

Function code 06H is used on occasions when it writes in (changes) various data from a personal computer, PLC, etc.

(1) Data write-in format

- The format at the time of data writing is as follows.

a	b	c		d		e	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
01H	06H	03H	00H	00H	64H	88H	65H

error checking at the time of ASCII mode
the portion of (7), (8) is as follows
LRC: 92H

a: Slave address
b: Data write-in function code
c: A write-in data address
d: Write-in data
1. Data consists of binary digit 16 bits data (1 word) except for a decimal point.
2. Each data has position of peculiar decimal point.

e: Error checking

- The above-mentioned command is as follows.

write-in lead data address = 0300H (hexadecimal number)
write-in data = 0064H (hexadecimal number)
= 100 (decimal number)

Writing of the data addresses, 0300H (100:10 decimal numbers), is appointed.

address (0300H) →
write-in data (0064H)

data address 16 bits (1 word)	data 16 bits (1 word)	
hexadecimal number	hexadecimal number	decimal number
0300	0064	100
0301	0000	0
0302	0000	0

(2) The normal answer format at the time of data writing

- The normal answering format to function code 06H is as follows.

a	b	c		d		e	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
01H	06H	03H	00H	00H	64H	88H	65H

error checking at the time of ASCII mode
the portion of (7), (8) is as follows
LRC: 92H

* The same one as the outgoing message from master is answered.

(3) The abnormal answer format at the time of data writing

a	b	h	e	
(1)	(2)	(3)	(4)	(5)
01H	86H	02H	C3H	A1H

error chcking at the time of ASCII mode
the portion of (4), (5) is as follows
LRC: 77H

a: Slave address
b: Function code
* At the time of error, reception function code +80H is shown. It informs abnormal answer.
h: Error code
* See **5-8. Error Message Details** about error code details.
e: Error checking

5-6. Loopback Test (Function Code 08H) Details

The function code 08H returns the message from master as response massage as it is.
It is used as communication diagnosis between master and slave.

(1) Loopback format
- The format at the time of a loopback test is as follows.

a	b	c		d		e	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
01H	08H	00H	00H	FFH	FFH	E1H	BBH

error checking at the time of ASCII mode
the portion of(7), (8) is as follows
LRC:F9H

a: Slave address
b: Loopback test function code
c: Test code
* Fixed as 0000H
d: Arbitrary data
* arbitrary 16 bit data of 0000H～FFFFH
e: Error checking

(2) Loopback normal answer format
- The normal answer format to the function code 08H is as follows.

a	b	c		d		e	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
01H	08H	00H	00H	FFH	FFH	E1H	BBH

error checking at the time of ASCII mode
the portion of(7), (8) is as follows
LRC:F9H

* The same one as the outgoing message from master is answered.

(3) The abnormal answer format at the time of loopback

a	b	h	e	
(1)	(2)	(3)	(4)	(5)
01H	88H	02H	C7H	C1H

error checking at the time of ASCII mode
the portion of(4), (5) is as follows
LRC:75H

a: Slave address
b: Function code
* At the time of error, reception function code +80H is shown. It informs abnormal answer.
h: Error code
* See **5-8. Error Message Details** about error code details.
e: Error checking

5-7. No Response Conditions

Slave does not answer when the following abnormalities have been recognized.
- when hardware error takes place (overrun, framing, parity error)
- when slave address differs from its own address
- when the data interval of message is long.
(RTU: time to be equivalent to 28 bits or more, ASCII: one second or longer)
- when CRC-16 or LRC differs.
- when the message from master is not regulated one (Message is too long etc.,)

5-8. Error Message Details

Error code corresponding to the type of error is answered, when error other than no response condition is detected.

(1) Abnormal answer format

a	b	h	e	
(1)	(2)	(3)	(4)	(5)
01H	83H	03H	01H	31H

error checking at the time of ASCII mode
the portion of (4), (5) is as follows
LRC:79H

a: Slave address
b: Function code
1. At the time of error, reception function code +80H is shown. It informs abnormal answer.
2. +80H is not shown at the time of function code beyond 80H, and returned as it is.

h: Error code
* See the following table.

e: Error checking

Error Code	Content of Errors
01H	Function code error - when function code other than regulated one is received (All other than three sorts,< 03H, 06H, 08H>, correspond to this category)
02H	Address error - when it is written in the address only for reading - when the address only for writing is read - when a test code is not 0000H at the time of loopback test - when non-existing address is appointed in the lead of read-out or write-in address. (not yet added option etc. is included)
03H	Data error - when write-in data exceeds the writable data range (when ones other than 0 and 1 are written in AUTO/MANU switching etc.) - when the written-in value had been already filled by other one, in the item only for an exclusion setup. - when the number of read-out data and the number possible to read-out is different.(In MAC10, read-out is permitted between 1～10.) An error code is answered when read-out is 0, or over 11. - when parameter is rewritten under circumstances a change is not permitted (Items such as:at the time of change by key operation, a screen displays nothing or a change is impossible)

(2) The priority of error code

The priority of error code becomes high as the value of error code becomes small. On occasions when plural error codes occur, the high priority error code is returned.

Example: Even if there are data error and address errors, 01H is returned when function code error is detected.

5-9. Communication Data Address Details

(1) Data address
- As for data address, binary digit (16 bit data) is expressed with hexadecimal number every 4 bits.

(2) About read-out (read)/write-in (write).
- R/W is the data in which read-out and writing are possible
- R is read-only data
- W is data only for writing.
- when the data address only for writing is appointed in data read-in (Function code 03H),
- when the read-only data address is appointed in data write-in (Function code 06H), it becomes address error and error code 02H is answered.

(3) Data address and the number of data
- When the data address, which is not described in data address, is appointed as lead data address,it becomes address error and error code 02H is answered.
- When the data address, to which the number of data is added, becomes outside of listed data address, in the area of outside-address, as data 0000 H is answered always.

(4) Data
- Since each data does not have a decimal point (16 bit data), the check of data type and decimal point is needed.
  (See the instruction manual of main body)
- In the case of the data whose unit is UNIT, measuring range determines the position of a decimal point.
- All the data is treated as binary digit with a code (16 bit data: -32768 ~ 32767).

Example: Method to express data with a decimal point

		Hexadecimal data
20.0	→ 200	→ 00C8
100.00	→ 10000	→ 2710
-40.00	→ -4000	→ F060

Example: Method to express 16 bit data

data with code	
decimal number	hexadecimal number
0	0000
1	0001
~	~
32767	7FFF
-32768	8000
-32767	8001
~	~
-2	FFFE
-1	FFFF

(5) An option-related parameter
- When the data address of the parameter, which is not listed as an option, is appointed, it results in an error both at Read command (R) and Write command (W).And error code 02H is answered

(6) The parameter which is not displayed in an operator display because of operation specification or setting specification
- The parameter, which is not displayed (not used) in an operator display because of operation specification and setup specification, is possible to read-out in communication.
  However, write-in becomes data error and error code 03H is answered.

6. Communication Data Address List

data Addr. (Hex)	Setting range	R/W
0040	Series Code 1 "M","A" 4DH,41H	R
0041	Series Code 2 "C","A" 43H,41H	R
0042	Series Code 3 Equipment Size "A","0" 41H,30H (MAC10 : "A0" only)	R
0043	Series Code 4 Input Specification + Control Output 1 (See the following parts)	R

input spec	output spec	address 0043H	
M	C	"M" 4DH	"C" 43H
I	S	"I" 49H	"S" 53H
	I		"I" 49H

0044	software version code 1	R
0045	software version code 2	R

- Software version is expressed with four-digits and a decimal point is placed between data address 0044 and 0045.

Example: Version 1.00

Address	H	L	H	L
0044	"0"	"1"	30H,	31H
0045	"0"	"0"	30H,	30H

0046	Option code 1	Event output + Option	R
0049	Option code 4	Program	R

event output	option	address 0046H	
N	N	"N" 4EH	"N" 4EH
1	R	"1" 31H	"R" 52H
2	T	"2" 32H	"T" 54H

program	address 0049H
N	"N","0" 4EH,30H
P	"P","0" 50H,30H

0100	measured value	within measuring range HHHH,CJHH,b---:7FFFH LLLL,CJLL:8000H	R
0101	execution SV value	within SV limiter	R
0102	control output 1 value	0.0～100.0 (%)	R

data Addr. (Hex)	Setting range	R/W
0104	Operation fragment D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 0 0 0 0 0 0 AT/W 0 0 0 0 0 0 STBY MAN AT * ON at the time of AT/W:AT standby ON at the time of STBY:STBY ON at the time of MAN : MANU ON at the time of AT : AT execution	R
0105	Event output fragment D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 EV2 EV1 ON at the time of EV 2: EV 2 LED lighting ON at the time of EV 1: EV 1 LED lighting	R
0106	Operation FIX-SV No. 1 - 4	R

010D	Latching status fragment D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 EV2 EV1 * In latching operating state, applicable bit turns ON at the time of event retention.	R
010E	Relay ON/OFF fragment D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 EV2 EV1 * when the contact of the event relay is closed, applicable bit is ON	R

0110	Event 1 Timer elapsed time monitor 0 – 600 -1:END	R
0112	Event 2 Timer elapsed time monitor 0 – 600 -1:END	R

0120	Programing operation fragment D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 PRG 0 0 0 0 UP LVL DW 0 0 0 0 SKIP GUA HOLD RUN * ON at the time of PRG:PROG OFF at the time of FIX UP: ON during program is ascending LVL: ON during program flatness DW: ON during program is descending SKIP:ON at the time of SKIP execution HOLD: ON at the time of HOLD execution RUN: ON at the time of RUN GUA: ON at the time of guarantee soak	R

0180	FIX-SV No. 1 - 4	W

0182	Control output 1 Manual setting value 0.0～100.0 (only at the time of manual output mode)	W
0184	AT execution OFF: 0 ON: 1	W
0185	AUTO/MANU switching AUTO: 0 MANU: 1	W
0186	RUN/STBY Switching RUN: 0 STBY:1	W

0191	HOLD Execution OFF:0 ON:1	W
0192	SKIP Execution OFF:0 ON:1	W
0198	latching release none latching release: 0 EV 1 release: 1 EV 2 release: 2 ALL release: 4	W

0300	FIX mode	SV 1 within SV limiter	R/W
0301	FIX mode	SV 2 within SV limiter	R/W
0302	FIX mode	SV 3 within SV limiter	R/W
0303	FIX mode	SV 4 within SV limiter	R/W

030A	SV limiter lower limit	within measuring range (input scaling lower limit～input scaling upper limit -1) -2000 : SV is not displayed in basic screen	R/W
030B	SV limiter upper limit	within measuring range (SV limiter lower limit +1 ～ input scaling upper limit)	R/W

0400	OUT1-PID	proportional band	OFF:0 0.1～999.9	R/W
0401		integration time	OFF:0 1～6000	R/W
0402		derivative time	OFF:0 1～3600	R/W
0403		manual reset	-50.0～50.0	R/W
0404		lower differential gap	1～999	R/W
0405		output limiter lower limit	0.0～99.9	R/W
0406		output limiter upper limit	0.1～100.0	R/W
0407		upper differential gap	1～999	R/W

data Addr. (Hex)	Setting range		R/W
0500	EV1	Event operation mode See *Event Code Table*	R/W
0501		Event operating point See *Event Code Table* * At the time of SHIMAX standard protocol If event mode has unnecessary setting of NON, So, and Run, setting change is possible by communication. However, it is initialized at the time of event code change. The writable range in this case is -1999～9999	R/W
0502		Event differential gap 1～ 999	R/W
0503		Event standby operation OFF: 0 1 ～ 2	R/W
0505		Event latching / output characteristic D15-8 D7-0 Latching Output characteristic * ON/OFF of event latching at high 8 bits, NO/NC of output characteristic at low 8 bits Latching OFF: 0 ON: 1 Output characteristic NO: 0 NC: 1	R/W
0506		Event ON delay time 0(off) , 1 - 8000	R/W
0507		Event OFF delay time 0(off) , 1 - 8000	R/W

0508	EV2	Event operation mode See *Event Code Table*	R/W
0509		Event operating point See *Event Code Table* * At the time of SHIMAX standard protocol If event mode has unnecessary setting of NON, So, and Run, setting change is possible by communication. However, it is initialized at the time of event code change. The writable range in this case is -1999～9999	R/W
050A		Event differential gap 1～ 999	R/W
050B		Event standby operation OFF: 0 1 ～ 2	R/W
050D		Event latching / output characteristic D15-8 D7-0 Latching Output characteristic * ON/OFF of event latching at high 8 bits, NO/NC of output characteristic at low 8 bits Latching OFF: 0 ON: 1 Output characteristic NO: 0 NC: 1	R/W
050E		Event ON delay time 0(off) , 1 - 8000	R/W
050F		Event OFF delay time 0(off) , 1 - 8000	R/W

05B0	Communication memory mode RAM:0 MIX:1 EEP:2	R/W

064F	Servo Travel time 5～300	R/W
0652	Servo Deadband 0.1～20.0	R/W
0653	Servo Differential gap 0.1～10.0	R/W
065B	Servo Control periodic time 2～60	R/W
065C	Servo Motor Inversion Prohibition Time 0.0～10.0	R/W

0600	Control Output 1 Output Characteristic RA:0 DA:1	R/W
0601	Control Output 1 Proportional Period 0.5～120.0 (Reception is possible only at multiple of 0.5)	R/W
0602	Control Output 1 Output value at input error occurrence 0.0 to 100.0	R/W
060A	Control output 1 soft start OFF:0 0.5～120.0 (Reception is possible only at multiple of 0.5)	R/W

0611	Keylock OFF:0 1～3 , 5	R/W

0700	PV Gain -500～500	R/W
0701	PV Offset -500～500	R/W
0702	PV Filter 0～100	R/W

0704	Input Temperature unit ℃:0 ℉:1	R/W
0705	Measuring Range See *Measuring Range Code Table*	R/W

0707	Decimal Point Position ****:0 ***.*:1 **.**:2 *.***:3	R/W
0708	Input Scaling Lower Limit -1999～9989	R/W
0709	Input Scaling Upper Limit Input Scaling Lower Limit +10～9999	R/W
070F	Direction of open thermocouple detection High:0 Low:1	R/W

0800	FIX/PROG Switching FIX:0 PROG: 1	R/W

data Addr. (Hex)	Setting range	R/W
0903	End Step Setup 1 to 20	R/W
0906	Start SV within SV Limiter	R/W
0907	Guarantee soak zone OFF:0 1 to 2000	R/W
0909	Start Mode Setup SV:0 PV:1	R/W
090C	Setup of the number of times of execution pattern 0 to 9999	R/W
0B80	Event1 delay mode 0:DELAY 1:TIMER1 2:TIMER2	R/W
0B81	Event1 Timer ON period 1 – 600	R/W
0B82	Event1 Timer OFF period 0 – 600	R/W
0B83	Event1 Timer unit 0:second 1:minute 2:hour	R/W
0B84	Event1 Delay time unit 0:second 1:minute	R/W
0B88	Event2 delay mode 0:DELAY 1:TIMER1 2:TIMER2	R/W
0B89	Event2 Timer ON period 1 – 600	R/W
0B8A	Event2 Timer OFF period 0 – 600	R/W
0B8B	Event2 Timer unit 0:second 1:minute 2:hour	R/W
0B8C	Event2 Delay time unit 0:second 1:minute	R/W
0E00	Step1 SV within SV Limiter	R/W
0E01	Step1 Time 0 to 9999 minute	R/W
0E10	Step2 SV within SV Limiter	R/W
0E11	Step2 Time 0 to 9999 minute	R/W
0E20	Step3 SV within SV Limiter	R/W
0E21	Step3 Time 0 to 9999 minute	R/W
0E30	Step4 SV within SV Limiter	R/W
0E31	Step4 Time 0 to 9999 minute	R/W
0E40	Step5 SV within SV Limiter	R/W
0E41	Step5 Time 0 to 9999 minute	R/W
0E50	Step6 SV within SV Limiter	R/W
0E51	Step6 Time 0 to 9999 minute	R/W
0E60	Step7 SV within SV Limiter	R/W
0E61	Step7 Time 0 to 9999 minute	R/W
0E70	Step8 SV within SV Limiter	R/W
0E71	Step8 Time 0 to 9999 minute	R/W
0E80	Step9 SV within SV Limiter	R/W
0E81	Step9 Time 0 to 9999 minute	R/W
0E90	Step10 SV within SV Limiter	R/W
0E91	Step10 Time 0 to 9999 minute	R/W
0EA0	Step11 SV within SV Limiter	R/W
0EA1	Step11 Time 0 to 9999 minute	R/W
0EB0	Step12 SV within SV Limiter	R/W
0EB1	Step12 Time 0 to 9999 minute	R/W
0EC0	Step13 SV within SV Limiter	R/W
0EC1	Step13 Time 0 to 9999 minute	R/W
0ED0	Step14 SV within SV Limiter	R/W
0ED1	Step14 Time 0 to 9999 minute	R/W
0EE0	Step15 SV within SV Limiter	R/W
0EE1	Step15 Time 0 to 9999 minute	R/W
0EF0	Step16 SV within SV Limiter	R/W
0EF1	Step16 Time 0 to 9999 minute	R/W
0F00	Step17 SV within SV Limiter	R/W
0F01	Step17 Time 0 to 9999 minute	R/W
0F10	Step18 SV within SV Limiter	R/W
0F11	Step18 Time 0 to 9999 minute	R/W
0F20	Step19 SV within SV Limiter	R/W
0F21	Step19 Time 0 to 9999 minute	R/W
0F30	Step20 SV within SV Limiter	R/W
0F31	Step20 Time 0 to 9999 minute	R/W

7. Supplementary Explanation

7-1. Measuring Range Code Table

Input Type			Range Code	Code	Measuring Range	
					Unit code C (℃)	Unit code F (℉)
Multi input	Thermo Couple	K	P 1	01	0 ~ 1200	0 ~ 2200
			P2	02	0.0 ~ 800.0	0 ~ 1500
			P3	03	-199.9 ~ 400.0	-300 ~ 700
		J	J 1	04	0 ~ 600	0 ~ 1100
			J2	05	0.0 ~ 600.0	0 ~ 1100
		E	E 1	06	0 ~ 700	0 ~ 1300
			E2	07	0.0 ~ 700.0	0 ~ 1300
		T	t 1	08	-199.9 ~ 200.0	-300 ~ 400
			t2	09	-199.9 ~ 350.0	-300 ~ 660
		B	b 1	10	0 ~ 1800	0 ~ 3300
		R	r 1	11	0 ~ 1700	0 ~ 3100
		S	S 1	12	0 ~ 1700	0 ~ 3100
		Wre 5-26	S-26	13	0 ~ 2300	0 ~ 4200
		N	n 1	14	0 ~ 1300	0 ~ 2300
	Resistance bulb Pt100		P 1	15	-100.0 ~ 200.0	-150.0 ~ 400.0
			P2	16	-100 ~ 200	-150 ~ 400
			P3	17	-199.9 ~ 300.0	-330 ~ 570
			P4	18	-200 ~ 300	-330 ~ 570
			P5	19	-199.9 ~ 600.0	-330 ~ 1100
			P6	20	-200 ~ 600	-330 ~ 1100
	Voltage (mV)	0-50	n 1	21	Setting range : -1999～9999 Span : 10～10000 Decimal point : non, 0.1, 0.01, 0.001	
		0-20	n2	22		
		0-10	n3	23		
		±10	n4	24		
Current(mA)		4-20	nA 1	25		
		0-20	nA2	26		

By scaling function, measuring range can be set up in the following range arbitrarily.

Scaling range : - 1999 ~ 9999 count

Span : 10 ~10000 count

lower limit side < upper-limit side

7-2. Event Code Table

	alarm type	code	initial value	setting range
non	None	0	－－－－－－－	－－－－－－－－－－－
HA	Upper limit absolute value	1	measuring range upper limit	within measuring range
LA	Lower limit absolute value	2	measuring range lower limit	within measuring range
So	Scaling over	3	continuously output at scaling over	
Hd	Upper-limit deviation	4	2000 unit	-1999 ~ 2000 unit
Ld	Lower limit deviation	5	-1999 unit	-1999 ~ 2000 unit
Ld	Within deviation	6	0 unit	0 ~ 2000 unit
od	Outside deviation	7	2000 unit	0 ~ 2000 unit
run	RUN signal	8	continuously output at RUN execution	
StP	step signal	11	PROG outputs for 1 second at step end	
P_E	pattern end signal	12	PROG outputs for 3 seconds at pattern end	
End	program end signal	13	PROG outputs for 3 seconds at program end	
Hold	hold signal	14	PROG continuously output at hold execution	
Prou	program signal	15	continuously output at PROG	
u_SL	up slope signal	16	PROG outputted while the program is ascending	
d_SL	down slope signal	17	PROG outputted while the program is descending	
GuA	guarantee signal	18	0 unit	0 ~ 2000 unit

8. ASCII Code Table

	b７～b５	０００	００１	０１０	０１１	１００	１０１	１１０	１１１
b４～b１		0	1	2	3	4	5	6	7
０００００	0	NUL	TC7 (DLE)	ＳＰ	0	@	P	`	p
０００１	1	TC1 (SOH)	DC1	!	1	A	Q	a	q
０００１０	2	TC2 (STX)	DC2	”	2	B	R	b	r
０００１１	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

SHIMAX CO.,LTD.

Head Office
190 shimoniiyachi, aza, yotsuya, Daisen-shi, Akita 014-0102 Japan
Phone +81-187-86-3400 FAX +81-187-62-6402
URL http://www.shimax.co.jp E-MAIL info@shimax.co.jp

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