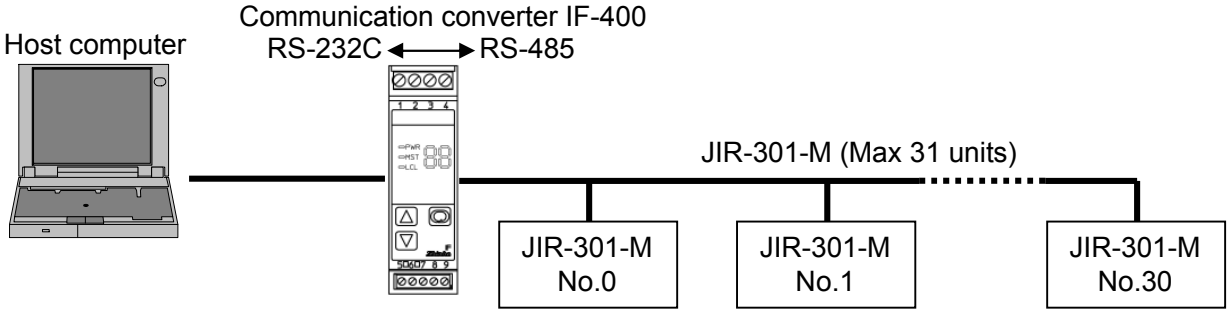
No.JIR3CE3 2006.09

To prevent accidents arising from the misuse of this controller, please ensure the operator receives this manual.

⚠ Warning

Turn the power supply to the instrument off before wiring or checking it.
Working or touching the terminal with the power switched on may result in severe injury or death due to Electric Shock.

1. System configuration

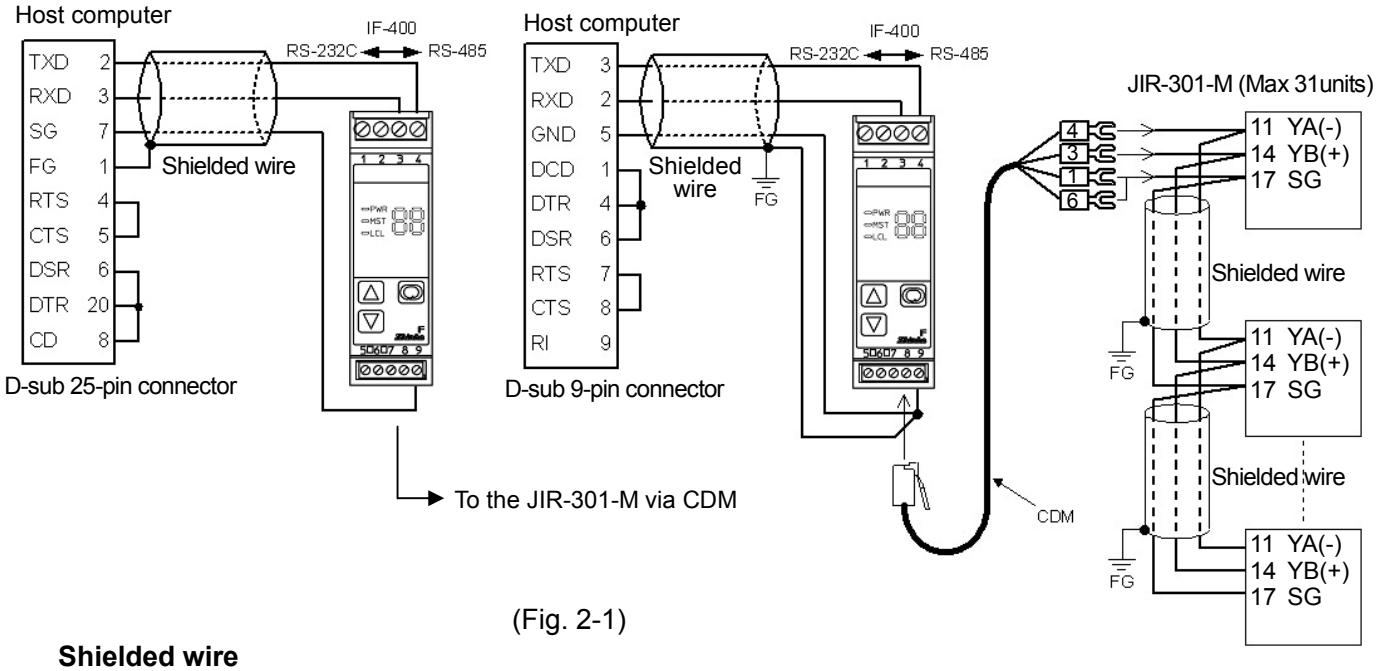


(Fig. 1-1)

2. Wiring

Wiring example when using communication converter IF-400

• Connector: D-sub 25-pin • Connector: D-sub 9-pin



(Fig. 2-1)

Shielded wire

Connect only one side of the shielded wire to the FG terminal so that current cannot flow to the shielded wire. If both sides of the shielded wire are connected to the FG terminal, the circuit will be closed between the shielded wire and the ground. As a result, current will run through the shielded wire and this may cause noise.

Be sure to ground FG terminal.

Recommended cable: OTSC-VB 2PX0.5SQ (made by Onamba Co., Ltd.) or equivalent
(Use a twisted pair cable.)

Terminator (Terminal resistor)

Communication converter IF-400 (sold separately) has a built-in terminator.

The terminator is mounted at the end of the wire when connecting a personal computer with multiple peripheral devices. The terminator prevents signal reflection and disturbance.

Do not connect terminator with the communication line because each JIR-301-M has built-in pull-up and pull-down resistors instead of a terminator.

3. Communication parameters setting

Set Communication parameters using front keypad. (Refer to the Instruction manual for each controller.)

(1) Communication protocol selection

Select a communication protocol. (Default: Shinko protocol)

(2) Instrument number setting

Set an instrument number to each of the JIR-301-M units individually when communicating by connecting plural units. (Default: 0)

(3) Communication speed selection

Select a communication speed for the JIR-301-M according to that of the host computer. (Default: 9600bps)

(4) Parity selection (Only Modbus protocol)

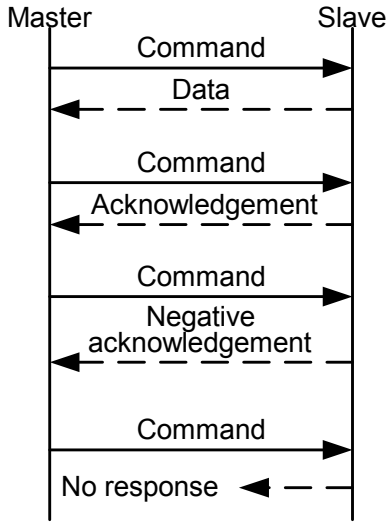
Select parity. (Default: Even parity)

(5) Stop bit selection (Only Modbus protocol)

Select stop bit. (Default: 1)

4. Communication procedure

Communication starts with command transmission from the host computer (hereafter Master) and ends with the response of the JIR-301-M (hereafter Slave).



(Fig.4-1)

- **Response with data**
  When the master sends the reading command, the slave responds with the corresponding set value or current status.
- **Acknowledgement**
  When the master sends the setting command, the slave responds by sending the acknowledgement after the processing is terminated.
- **Negative acknowledgement**
  When the master sends a non-existent command or value out of the setting range, the slave returns a negative acknowledgement.
- **No response**
  The slave will not respond to the master in the following cases:
  - Global address (Shinko protocol) is set.
  - Broadcast address (Modbus protocol) is set.
  - Communication error (framing error, parity error)
  - Checksum error (Shinko protocol), LRC discrepancy (Modbus ASCII mode), CRC-16 discrepancy (Modbus RTU mode)

Communication timing of the RS-485 (C5 option)

Master side (Notice on programming)

Set the program so that the master can disconnect the transmitter from the communication line within a 1 character transmission period after sending the command in preparation for reception of the response from the slave.

To avoid the collision of transmissions between the master and the slave, send the next command after carefully checking that the master received the response.

Slave side

When the slave starts transmission through a communication line, the slave is arranged so as to provide an idle status (mark status) transmission period of 1 or more characters before sending the response to ensure synchronization on the receiving side.

The slave is arranged so as to disconnect the transmitter from the communication line within a 1 character transmission period after sending the response.

5. Shinko protocol

5.1 Transmission mode

Shinko protocol is composed of ASCII codes.

Hexadecimal (0 to 9, A to F), which is divided into high order (4-bit) and low order (4-bit) out of 8-bit binary data in command is transmitted as ASCII characters.

Data format Start bit : 1 bit
Data bit : 7 bits
Parity : Even
Stop bit : 1 bit

Error detection: Checksum

5.2 Command configuration

All commands are composed of ASCII.
The data (set value, decimal number) is represented with hexadecimal number.
The negative numbers are represented with 2's complement.
Numerals written below the command represent number of characters.

(1) Setting command

Header (02H)	Address	Sub address (20H)	Command type (50H)	Data item	Data	Checksum	Delimiter (03H)
1	1	1	1	4	4	2	1

(2) Reading command

Header (02H)	Address	Sub address (20H)	Command type (20H)	Data item	Checksum	Delimiter (03H)
1	1	1	1	4	2	1

(3) Response with data

Header (06H)	Address	Sub address (20H)	Command type (20H)	Data item	Data	Checksum	Delimiter (03H)
1	1	1	1	4	4	2	1

(4) Acknowledgement

Header (06H)	Address	Checksum	Delimiter (03H)
1	1	2	1

(5) Negative acknowledgement

Header (15H)	Address	Error code	Checksum	Delimiter (03H)
1	1	1	2	1

Header : Control code to represent the beginning of the command or the response.
ASCII codes are used.
Setting command, Reading command : STX (02H) fixed
Response with data, Acknowledgement : ACK (06H) fixed
Negative acknowledgement : NAK (15H) fixed

Instrument number (Address): Numbers by which the master discerns each slave.
Instrument number 0 to 94 and Global address 95.
ASCII codes (20H to 7FH) are used by adding 20H to instrument numbers 0 to 95 (00H to 5FH).
95 (7FH) is called Global address, which is used when the same command is sent to all the slaves connected. However, the response is not returned.

Sub address : 20H fixed

Command type : Code to discern Setting command (50H) and Reading command (20H)

Data item : Data classification of the command object.
Composed of hexadecimal 4 digits (Refer to “7. Communication command table”.)

Data : The contents of data (set value) depend on the setting command.
Composed of hexadecimal 4 digits (Refer to “7. Communication command table”.)

Checksum : 2-character data to detect communication errors. (Refer to “5.4 Checksum calculation”.)

Delimiter : Control code to represent the end of command. 03H fixed

Error code : Represents an error type. Composed of hexadecimal 1 digit.
1 (31H)-----Non-existent command
2 (32H)-----Not used
3 (33H)-----Setting outside the setting range
4 (34H)-----Unsettable status (e.g. AT is performing)
5 (35H)-----During setting mode by keypad

5.3 Command example

(1) Reading (Address 1, PV)

• Reading command from the master

Header	Address	Sub address	Command type	Data item [0080H]	Checksum	Delimiter
(02H)	(21H)	(20H)	(20H)	(30H 30H 38H 30H)	(44H 37H)	(03H)

• A response from the slave in normal status [When PV=25℃ (0019H)]

Header	Address	Sub address	Command type	Data item [0080H]	Data [0019H]	Checksum	Delimiter
(06H)	(21H)	(20H)	(20H)	(30H 30H 38H 30H)	(30H 30H 31H 39H)	(30H 44H)	(03H)

(2) Reading (Address 1, A1)

• Reading command from the master

Header	Address	Sub address	Command type	Data item [0001H]	Checksum	Delimiter
(02H)	(21H)	(20H)	(20H)	(30H 30H 30H 31H)	(44H 45H)	(03H)

• A response from the slave in normal status [When A1=600℃ (0258H)]

Header	Address	Sub address	Command type	Data item [0001H]	Data [0258H]	Checksum	Delimiter
(06H)	(21H)	(20H)	(20H)	(30H 30H 38H 30H)	(30H 32H 35H 38H)	(30H 46H)	(03H)

(3) Setting (Address 1, A1) [when setting A1 to 600℃ (0258H)]

• Setting command from the master

Header	Address	Sub address	Command type	Data item [0001H]	Data [0258H]	Checksum	Delimiter
(02H)	(21H)	(20H)	(50H)	(30H 30H 30H 31H)	(30H 32H 35H 38H)	(44H 46H)	(03H)

• A response from the slave in normal status

Header	Address	Checksum	Delimiter
(06H)	(21H)	(44H 46H)	(03H)

5.4 Checksum calculation

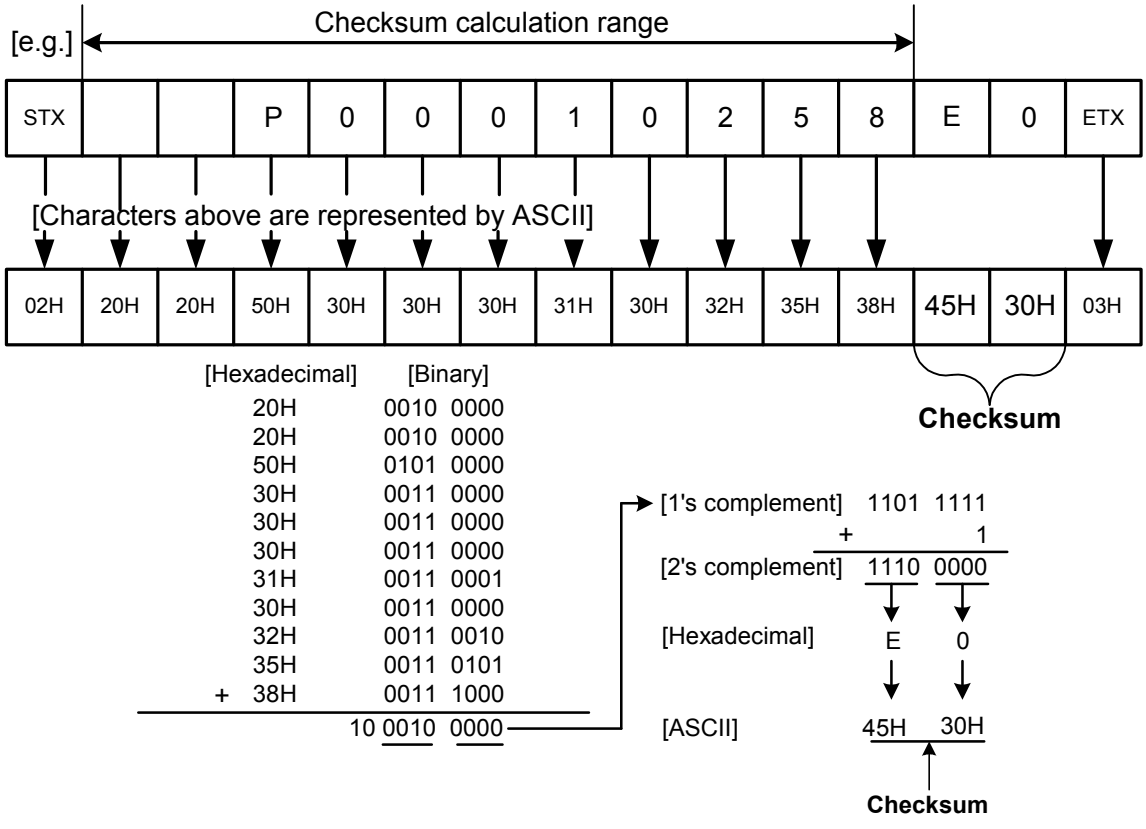
Checksum is used to detect receiving errors in the command or data.
Set the program for the master side as well to calculate the checksum of the response data from the slaves so that the communication errors can be checked.

The ASCII code (hexadecimal) corresponding to the characters which range from the address to that before the checksum is converted to binary notation, and the total value is calculated.
The lower 2-digit of the total value are converted to 2's complements, and then to hexadecimal figures, that is, ASCII code for the checksum.

Checksum calculation example

A1: 600℃ (0258H)
Address (instrument number): 0 (20H)

• 1's complement: Reverse each binary bit. 0 will become 1 and vice versa.
• 2's complement: Add 1 to 1's complements.



6. Modbus protocol

6.1 Transmission mode

There are 2 transmission modes (ASCII and RTU) in Modbus protocol.

6.2 ASCII mode

Hexadecimal (0 to 9, A to F), which is divided into high order (4-bit) and low order (4-bit) out of 8-bit binary data in command is transmitted as ASCII characters.

Data format Start bit: 1 bit
Data bit: 7 bits
Parity : Even (Odd, No parity) Selectable
Stop bit: 1 bit (2 bits) Selectable

Error detection : LRC (Longitudinal Redundancy Check)

Data interval : 1 second or less (Max.1sec of interval between characters)

(1) Message configuration

ASCII mode message is configured to start by Header [: (colon)(3AH)] and end by Delimiter [CR (carriage return) (0DH) + LF (Line feed)(0AH)].

Header (:)	Slave address	Function code	Data	Error check LRC	Delimiter (CR)	Delimiter (LF)

Slave address

Slave address is an individual instrument number on the slave side and is set within the range 0 to 95 (00H to 5FH).

The master identifies slaves by the slave address of the requested message.

The slave informs the master which slave is responding to the master by placing its own address in the response message.

Slave address 0 (00H, broadcast address) can identify all the slaves connected. However slaves do not respond.

Function code

The function code is the command code for the slave to undertake the following action types.

Function code	Contents
03 (03H)	Reading the set value and information from slaves
06 (06H)	Setting to slaves

Function code is used to discern whether the response is normal (acknowledgement) or if any error (negative acknowledgement) is occurred when the slave returns the response message to the master.

When acknowledgement is returned, the slave simply returns the original function code.

When negative acknowledgement is returned, the MSB of the original function code is set as 1 for the response.

For example, when the master sends request message setting 10H to the function code by mistake, slave returns 90H by setting the MSB to 1, because the former is an illegal function.

For negative acknowledgement, the exception codes below are set to the data of the response message and returned to the master in order to inform it of what kind of error has occurred.

Exception code	Contents
1 (01H)	Illegal function (Non-existent function)
2 (02H)	Illegal data address (Non-existent data address)
3 (03H)	Illegal data value (Value out of the setting range)
17 (11H)	Shinko error code 4 (Unsettable status, e.g. AT is performing)
18 (12H)	Shinko error code 5 (During setting mode by keypad operation)

Data

Data depends on the function code.

A request message from the master is composed of data item, number of data and setting data.

A response message from the slave is composed of a number of bytes, data and exception codes in negative acknowledgements. The number of data to be dealt with in one message is “1”.

Therefore the number of data is fixed as (30H)(30H)(30H)(31H).

Effective range of data is -32768 to 32767 (8000H to 7FFFH).

Error check: 2-character data to detect communication errors. Refer to “(2) Error check of ASCII mode”.

(2) Error check of ASCII mode

After calculating LRC (Longitudinal Redundancy Check) from the slave address to the end of data, the calculated 8-bit data is converted to two ASCII characters and are appended to the end of message.

How to calculate LRC

① Create a message in RTU mode.
② Add all the values from the slave address to the end of data. This is assumed as X.
③ Make a complement for X (bit reverse). This is assumed as X.
④ Add a value of 1 to X. This is assumed as X.
⑤ Set X as an LRC to the end of the message.
⑥ Convert the whole message to ASCII characters.

(3) Message example of ASCII mode

① **Reading (Address 1, PV)**

• A request message from the master

The number of data means the data item to be read, and it is fixed as 1 (30H 30H 30H 31H).

Header	Slave address	Function code	Data item [0080H]	Number of data [0001H]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(30H 33H)	(30H 30H 38H 30H)	(30H 30H 30H 31H)	(37H 42H)	(0DH 0AH)

• Response message from the slave in normal status [When PV=600℃ (0258H)]

The number of response byte means the number of byte of the data which has been read, and it is fixed as 2 (30H 32H).

Header	Slave address	Function code	Number of response byte [02H]	Data [0258H]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(30H 33H)	(30H 32H)	(30H 32H 35H 38H)	(41H 30H)	(0DH 0AH)

② **Reading (Address 1, A1)**

• A request message from the master

The number of data means the data item to be read, and it is fixed as 1 (30H 30H 30H 31H).

Header	Slave address	Function code	Data item [0001H]	Number of data [0001H]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(30H 33H)	(30H 30H 30H 31H)	(30H 30H 30H 31H)	(46H 41H)	(0DH 0AH)

• Response message from the slave in normal status [When A1=600℃ (0258H)]

The number of response byte means the number of byte of the data which has been read, and it is fixed as 2 (30H 32H).

Header	Slave address	Function code	Number of response byte [02H]	Data [0258H]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(30H 33H)	(30H 32H)	(30H 32H 35H 38H)	(41H 30H)	(0DH 0AH)

• Response message from the slave in exception (error) status (When a data item has been mistaken)

The function code MSB is set to 1 for the response message in exception (error) status [83H (38H 33H)].

The exception code 02H (30H 32H: Non-existent data address) is returned (error).

Header	Slave address	Function code	Exception code [02H]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(38H 33H)	(30H 32H)	(37H 41H)	(0DH 0AH)

③ **Setting (Address 1, A1)** [When setting A1 to 600℃ (0258H)]

• A request message from the master

Header	Slave address	Function code	Data item [0001H]	Number of data [0258H]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(30H 36H)	(30H 30H 30H 31H)	(30H 32H 35H 38H)	(39H 45H)	(0DH 0AH)

• Response message from the slave in normal status

Header	Slave address	Function code	Data item [0001H]	Data [0258H]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(30H 36H)	(30H 30H 30H 31H)	(30H 32H 35H 38H)	(39H 45H)	(0DH 0AH)

• Response message from the slave in exception (error) status (When a value out of the setting range is set)

The function code MSB is set to 1 for the response message in exception (error) status [86H (38H 36H)].

The exception code 03H (30H 33H: Value out of the setting range) is returned (error).

Header	Slave address	Function code	Exception code [03H]	Error check LRC	Delimiter CR+LF
(3AH)	(30H 31H)	(38H 36H)	(30H 33H)	(37H 36H)	(0DH 0AH)

6.3 RTU mode

8-bit binary data in command is transmitted as it is.

Data format Start bit : 1 bit
Data bit : 8 bits
Parity : No parity (Even, Odd) Selectable
Stop bit : 1 bit (2 bits) Selectable

Error detection : CRC-16 (Cyclic Redundancy Check)

Data interval : 3.5 character transmission times or less
To transmit continuously, an interval between characters which consist of one message, must be within 3.5 character transmission times.

(1) Message configuration

RTU mode is configured to start after idle time is processed for more than 3.5 character transmissions and end after idle time is processed for more than 3.5 character transmissions.

3.5 idle characters	Slave address	Function code	Data	Error check CRC-16	3.5 idle characters

Slave address

Slave address is an individual instrument number on the slave side and is set within the range 0 to 95 (00H to 5FH).

The master identifies slaves by the slave address of the requested message.

The slave informs the master which slave is responding to the master by placing its own address in the response message.

Slave address 0 (00H, broadcast address) can identify all the slaves connected. However slaves do not respond.

Function code

The function code is the command code for the slave to undertake the following action types.

Function code	Contents
03 (03H)	Reading the set value and information from slaves
06 (06H)	Setting to slaves

Function code is used to discern whether the response is normal (acknowledgement) or if any error (negative acknowledgement) has occurred when the slave returns the response message to the master.

When acknowledgement is returned, the slave simply returns the original function code.

When negative acknowledgement is returned, the MSB of the original function code is set as 1 for the response.

For example, when the master sends request message setting 10H to the function code by mistake, slave returns 90H by setting the MSB to 1, because the former is an illegal function.

For negative acknowledgement, the exception codes below are set to the data of the response messages and returned to the master in order to inform it of what kind of error has occurred.

Exception code	Contents
1 (01H)	Illegal function (Non-existent function)
2 (02H)	Illegal data address (Non-existent data address)
3 (03H)	Illegal data value (Value out of the setting range)
17 (11H)	Shinko error code 4 (Unsettable status, e.g. AT is performing)
18 (12H)	Shinko error code 5 (During setting mode by keypad operation)

Data

Data depends on the function code.

A request message from the master side is composed of data item, number of data and setting data.

A response message from the slave side is composed of a number of byte, data and exception codes in negative acknowledgements.

The number of data to be dealt with in one message is “1”. Therefore the number of data is fixed as (0001H).

The number of response byte is (02H).

Effective range of data is –32768 to 32767 (8000H to 7FFFH).

Error check: 16 bit data to detect communication errors. Refer to “(2) Error check of RTU mode” below.

(2) Error check of RTU mode

After calculating CRC-16 (Cyclic Redundancy Check) from the slave address to the end of data, the calculated 16-bit data is appended to the end of message in sequence from low order to high order.

How to calculate CRC

In the CRC system, the information is divided by the polynomial series. The remainder is added to the end of the information and transmitted. The generation of polynomial series is as follows.

(Generation of polynomial series: $X^{16} + X^{15} + X^2 + 1$)

① Initialize the CRC-16 data (assumed as X) (FFFFH).
② Calculate exclusive OR (XOR) with the 1st data and X. This is assumed as X.
③ Shift X one bit to the right. This is assumed as X.
④ When a carry is generated as a result of the shift, XOR is calculated by X of ③ and the fixed value (A001H). This is assumed as X. If a carry is not generated, go to step ⑤.
⑤ Repeat steps ③ and ④ until shifting 8 times.
⑥ XOR is calculated with the next data and X. This is assumed as X.
⑦ Repeat steps ③ to ⑤.
⑧ Repeat steps ③ to ⑤ up to the last data.
⑨ Set X as CRC-16 to the end of message in sequence from low order to high order.

(3) Message example of RTU mode

① **Reading (Address 1, PV)**

• Request message from the master

The number of data means the data item to be read, and it is fixed as 1 (0001H).

3.5 idle characters	Slave address (01H)	Function code (03H)	Data item (0080H)	Number of data (0001H)	Error check CRC-16 (85E2H)	3.5 idle characters

• A response message from the slave in normal status [When PV=600℃ (0258H)]

The number of response byte means the number of byte of the data which has been read, and it is fixed as 2 (02H).

3.5 idle characters	Slave address (01H)	Function code (03H)	Number of response byte (02H)	Number of data (0258H)	Error check CRC-16 (B8DEH)	3.5 idle characters

② **Reading (Address 1, A1)**

• A request message from the master

The number of data means the data item to be read, and it is fixed as 1 (0001H).

3.5 idle characters	Slave address (01H)	Function code (03H)	Data item (0001H)	Number of data (0001H)	Error check CRC-16 (D5CAH)	3.5 idle characters

• Response message from the slave in normal status [When A1=600℃ (0258H)]

The number of response byte means the number of byte of the data which has been read, and it is fixed as 2(02H).

3.5 idle characters	Slave address (01H)	Function code (03H)	Number of response byte (02H)	Number of data (0258H)	Error check CRC-16 (B8DEH)	3.5 idle characters

• Response message from the slave in exception (error) status (When data item is mistaken)

The function code MSB is set to 1 for the response message in exception (error) status (83H).

The exception code (02H: Non-existent data address) is returned (error).

3.5 idle characters	Slave address (01H)	Function code (83H)	Exception code (02H)	Error check CRC-16 (C0F1H)	3.5 idle characters

③ **Setting (Address 1, A1)** [When setting A1 to 600℃ (0258H)]

• A request message from the master

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (0001H)	Number of data (0258H)	Error check CRC-16 (D890H)	3.5 idle characters

• Response message from the slave in normal status

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (0001H)	Number of data (0258H)	Error check CRC-16 (D890H)	3.5 idle characters

• Response message from the slave in exception (error) status (When a value out of the setting range is set)

The function code MSB is set to 1 for the response message in exception (error) status (86H).

The exception code (03H: Value out of the setting range) is returned (error).

3.5 idle characters	Slave address (01H)	Function code (86H)	Exception code (03H)	Error check CRC-16 (0261H)	3.5 idle characters

7. Communication command table

When the data (set value) has a decimal point, remove the decimal point and represent it as a whole number, then express it in hexadecimal figures.

Shinko command type	Modbus function code	Data item	Data
20H/50H	03H/06H	0001H: A1 value	Set value, Decimal point omitted
20H/50H	03H/06H	0002H: A2 value	Set value, Decimal point omitted
20H/50H	03H/06H	0003H: A3 value	Set value, Decimal point omitted
20H/50H	03H/06H	0004H: Set value lock	0000H: Unlock 0002H: Lock 2 0001H: Lock 1 0003H: Lock 3
20H/50H	03H/06H	0005H: Sensor correction value	Set value, Decimal point omitted
20H/50H	03H/06H	0006H: Scaling high limit	Set value
20H/50H	03H/06H	0007H: Scaling low limit	Set value
20H/50H	03H/06H	0008H: Decimal point place	0000H: XXXX (No decimal point) 0001H: XXX.X(1 digit after decimal point) 0002H: XX.XX(2 digits after decimal point) 0003H: X.XXX(3 digits after decimal point)

20H/50H	03H/06H	0009H: PV filter time constant	Set value, Decimal point omitted
20H/50H	03H/06H	000AH: A1 hysteresis	Set value, Decimal point omitted
20H/50H	03H/06H	000BH: A2 hysteresis	Set value, Decimal point omitted
20H/50H	03H/06H	000CH: A3 hysteresis	Set value, Decimal point omitted
20H/50H	03H/06H	000DH: A1 type 000EH: A2 type	0000H: No alarm action 0001H: High limit alarm 0002H: Low limit alarm 0003H: High limit alarm with standby 0004H: Low limit alarm with standby
20H/50H	03H/06H	000FH: A3 type	0000H: No alarm action 0001H: High limit alarm 0002H: Low limit alarm 0003H: High limit alarm with standby 0004H: Low limit alarm with standby 0005H: High/Low limit range alarm
20H/50H	03H/06H	0010H: Transmission output high limit	Set value
20H/50H	03H/06H	0011H: Transmission output low limit	Set value
20H/50H	03H/06H	0012H: A1 action Energized/ Deenergized	0000H: Energized 0001H: Deenergized
20H/50H	03H/06H	0013H: A2 action Energized/ Deenergized	0000H: Energized 0001H: Deenergized
20H/50H	03H/06H	0014H: A3 action Energized/ Deenergized	0000H: Energized 0001H: Deenergized
20H/50H	03H/06H	0015H: A1 action delayed timer	Set value
20H/50H	03H/06H	0016H: A2 action delayed timer	Set value
20H/50H	03H/06H	0017H: A3 action delayed timer	Set value
20H/50H	03H/06H	0019H: Input type	0000H: K [–200 to 1370℃] 0001H: K [–199.9 to 400.0℃] 0002H: J [–200 to 1000℃] 0003H: R [0 to 1760℃] 0004H: S [0 to 1760℃] 0005H: B [0 to 1820℃] 0006H: E [–200 to 800℃] 0007H: T [–199.9 to 400.0℃] 0008H: N [–200 to 1300℃] 0009H: PL-Ⅱ [0 to 1390℃] 000AH: C (W/Re5-26) [0 to 2315℃] 000BH: Pt100 [–199.9 to 850.0℃] 000CH: JPt100 [–199.9 to 500.0℃] 000DH: Pt100 [–200 to 850℃] 000EH: JPt100 [–200 to 500℃] 000FH: K [–320 to 2500℉] 0010H: K [–199.9 to 750.0℉] 0011H: J [–320 to 1800℉] 0012H: R [0 to 3200℉] 0013H: S [0 to 3200℉] 0014H: B [0 to 3300℉] 0015H: E [–320 to 1500℉] 0016H: T [–199.9 to 750.0℉] 0017H: N [–320 to 2300℉] 0018H: PL-Ⅱ [0 to 2500℉] 0019H: C (W/Re5-26) [0 to 4200℉] 001AH: Pt100 [–199.9 to 999.9℉] 001BH: JPt100 [–199.9 to 900.0℉] 001CH: Pt100 [–300 to 1500℉] 001DH: JPt100 [–300 to 900℉] 001EH: 4 to 20mA DC [–1999 to 9999] 001FH: 0 to 20mA DC [–1999 to 9999] 0020H: 0 to 1V DC [–1999 to 9999] 0021H: 0 to 5V DC [–1999 to 9999] 0022H: 1 to 5V DC [–1999 to 9999] 0023H: 0 to 10V DC [–1999 to 9999]

50H	06H	0070H: Key operation change flag clearing	0000H: No action 0001H: All clearing
20H	03H	0080H: PV (input value) reading	Present PV, Decimal point omitted
20H	03H	0081H: Status flag reading	0000 0000 0000 0000 2^{15} to 2^{0} 2^{0} digit: A1 output 0: OFF 1: ON 2^{1} digit: A2 output 0: OFF 1: ON 2^{2} digit: A3 output 0: OFF 1: ON 2^{3} digit: Overscale 0: OFF 1: ON 2^{4} digit: Underscale 0: OFF 1: ON 2^{5} to 2^{14} digit: Not used (Always 0) 2^{15} digit: Key operation change 0: No 1: Yes
20H	03H	00A1H: Unit specification flag reading	0000 0000 0000 0000 2^{15} to 2^{0} 2^{0} digit: A1 function 0: Not applied 1: Applied 2^{1} digit: A2 function 0: Not applied 1: Applied 2^{2} digit: A3 function 0: Not applied 1: Applied 2^{3} digit: Communication function 0: Not applied 1: Applied 2^{4} digit: Transmission output 0: Not applied 1: Applied 2^{5} to 2^{15} digits: Not used (Always 0)

● **Data**

Note on setting, reading command

- Use hexadecimal figures for the data
- A negative number is represented by 2's complement.
- When connecting plural slaves, the address (instrument number) must not be duplicated.

Setting command

- Setting range of each item is the same as that of keypad operation.
- When the data (set value) has a decimal point, a whole number (hexadecimal) without a decimal point is used.
- When Lock 3 is selected, all set values can be changed. However, they return to their previous value after power is turned off because they are not saved in the non-volatile memory.
- If the alarm type is changed during Alarm 1 type selection (000DH), Alarm 2 type selection (000EH), and Alarm 3 type selection (000FH), the alarm value will revert to “0”. Also alarm output status will be initialized.
- The instrument numbers and communication speed of the slave cannot be set by communication function.
- When sending a command by Global address (Shinko protocol) or Broadcast address (Modbus protocol), the same command is sent to all the slaves connected. However, the response is not returned.
- The memory can store up to 1,000,000 (one million) entries.
  If the number of settings exceeds the limit, the data will not be saved. So frequent transmission via communication is not recommended.

Reading command

- When the data (set value) has a decimal point, a whole number (hexadecimal) without a decimal point is used for a response.

● **Notes on programming monitoring software**

How to speed up the scan time

When monitoring plural units of JIR-301A, set the program so that requisite minimum pieces of data such as PV (0080H), status flag (0081H), etc. can be read, and for other data, set the program so that they can be read only when their set value has changed. This will speed up the scan time.

How to read the set value change by the front keypad operation

If any set value is changed by the keypad operation, the JIR-301A sets the [Status flag (0081H) 2^{15}: Change in key operation] to [Yes (1)].

There are 2 methods of reading the set value change by the front keypad as follows.

Reading method 1

(1) On the software side, check that [Status flag (0081H) 2^{15}: Change in key operation] has been set to [Yes (1)], then read all set values.

(2) Clear the [Status flag (0081H) 2^{15}: Change in key operation], by setting the [Key operation change flag clearing (0070H)] to [All clearing (0001H)].
If [Key operation change flag clearing (0070H)] is set to [All clearing (0001H)] during the setting mode of the JIR-301A, Error code 5 (35H, Shinko protocol) or Exception Code 18 (12H, Modbus protocol) will be returned as a negative acknowledgement. And [Status flag (0081H) 2^{15}: Change in key operation] cannot be cleared. Set a program so that all set values can be read until acknowledgement is returned.

Reading method 2

(1) On the software side, check that [Status flag (0081H) 2^{15}: Change in key operation] has been set to [Yes (1)], then set the [Key operation change flag clearing (0070H)] to [All clearing (0001H)].

(2) Set the program depending on the acknowledgement or negative acknowledgement as follows.
When acknowledgement is returned;
Consider it as settings completed, and read all set values.
When Error code 5 (35H, Shinko protocol) or Exception code 18 (12H, Modbus protocol) is returned as a negative acknowledgement;
Consider it as during setting mode, and read the requisite minimum pieces of data such as PV (0080H), Status flag (0081H), etc. then return to step (1).

Thus, programs which do not affect the scan time can be created using the methods described above, even if set values on the monitoring software will not be updated until settings are complete.

● **Note when sending all set values at one time**

- If alarm type is changed during Alarm 1 type selection (000DH), Alarm 2 type selection (000EH), Alarm 3 type selection (000FH), Alarm 1, Alarm 2, Alarm 3 value will revert to “0”. Alarm output status will also be initialized. First, send the selected alarm type, then send the alarm value.
- If input type is selected during Input type selection (0019H), set values such as A1, OUT1 proportional band, Alarm 1 value, etc. will be initialized. First, send the selected input type, then send other set values.

● **When communicating with a PLC**

Command example (Shinko protocol) when communicating with a Mitsubishi PLC (FX series, etc.)

- **Reading (Top D register: D100)**

Address 1, PV reading

Sending Data	(STX)(!)( )( )(0)(0)(8)(0)(D)(7)(ETX)		
Command		Register	Code
Header (STX)	02H	D100(LSB)	02H
Address	1	D100(MSB)	21H
Sub address	20H	D101(LSB)	20H
Command type	20H	D101(MSB)	20H
Data item	&H80	D102(LSB)	30H
		D102(MSB)	30H
		D103(LSB)	38H
		D103(MSB)	30H
Checksum		D104(LSB)	44H
		D104(MSB)	37H
Delimiter (ETX)	03H	D105(LSB)	03H

Communication setting [MOVP H0C86 D8120]
Reading + Setting [RS D100 K11 D108 K26]
Reading only [RS D100 K11 D106 K26]

1 [MOV H2102 D100]
2 [MOV H2020 D101]
3 [MOV H3030 D102]
4 [MOV H3038 D103]
5 [MOV H3744 D104]
6 [MOV H03 D105]

- **Setting (Top D register: D120)**

Address 1, A1 setting (When setting A1 to 600℃ [0258H])

Sending Data	(STX)(!)( )(P)(0)(0)(0)(1)(0)(2)(5)(8)(D)(F)(ETX)		
Command		Register	Code
Header (STX)	02H	D120(LSB)	02H
Address	1	D120(MSB)	21H
Sub address	20H	D121(LSB)	20H
Command type	P	D121(MSB)	50H
Data item	&H1	D122(LSB)	30H
		D122(MSB)	30H
		D123(LSB)	30H
		D123(MSB)	31H
Data item	600	D124(LSB)	30H
		D124(MSB)	32H
		D125(LSB)	35H
		D125(MSB)	38H

Checksum		D126(LSB)	44H
		D126(MSB)	46H
Delimiter (ETX)	03H	D127(LSB)	03H

Reading + Setting [RS D120 K15 D128 K26]
Reading only [RS D120 K15 D128 K22]

1 [MOV H2102 D120]
2 [MOV H5020 D121]
3 [MOV H3030 D122]
4 [MOV H3130 D123]
5 [MOV H3230 D124]
6 [MOV H3835 D125]
7 [MOV H4644 D126]
8 [MOV H03 D127]

9. Specifications

Cable length : Max. communication distance 1.2km
Cable resistance: Within 50Ω (Terminator is not necessary or 120Ω or more on one side.)
Communication interface: EIA RS-485
Communication method : Half-duplex communication start-stop synchronous
Communication speed : 2400/4800/9600/19200bps (Selectable by keypad) (Default: 9600bps)
Code form : ASCII, binary
Communication protocol: Shinko protocol/ Modbus RTU/ Modbus ASCII (Selectable by keypad)
(Default: Shinko protocol)

Data format

Communication protocol	Shinko protocol	Modbus ASCII	Modbus RTU
Start bit	1	1	1
Data bit	7	7	8
Parity	Yes (Even)	Yes (Even, Odd) No parity	Yes (Even, Odd) No parity
Stop bit	1	1 or 2	1 or 2

Number of connectable units : Maximum 31 units to 1 host computer
Error correction : Command request repeat system
Error detection : Parity, checksum(Shinko protocol), LRC(Modbus ASCII), CRC-16(Modbus RTU)

9. Troubleshooting

If any malfunctions occur, refer to the following after checking the power supply to the master and the slave.

• **Problem: Communication failure**

Check the following
The connection or wiring of the communication cable is not secure.
Burnout or imperfect contact on the communication cable and the connector.
Communication speed of the slave does not coincide with that of the master.
The data bit, parity and stop bit of the master do not accord with those of the slave.
The instrument number of the slave does not coincide with that of the command.
The instrument numbers are duplicated in multiple slaves.
Make sure that the program is appropriate for the transmission timing.

• **Problem: Although communication is occurring, the response is 'NAK'**.

Check the following
Check whether a non-existent command code has been sent or not.
The setting command data goes outside the setting range of the slave.
The controller cannot be set when functions such as AT is performing.
The operation mode is under the front keypad operation setting mode.

For further inquiries, please consult our agency or the shop where you purchased the unit.

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