

TOHO ELECTRONICS INC.

Operation Manual, Communications

Model: TTM-10L Series

Designation: Digital Board Controller

Thank you very much for purchasing a TTM-10L Series (with communications). Please read this operation manual carefully and use this product correctly.

Contents

- 1. Before using the product 3
 - 1.1 On this operation manual
 - 1.2 Conditions for communications
 - 1.3 What can be done with communications
 - 1.4 Positioning communications (priority ranking)
 - 1.5 Setting before communications

- 2. Settings regarding communications 4
 - 2.1 Overview
 - 2.2 Setting a communications type
 - 2.3 Setting a data length
 - 2.4 Setting a stop bit length
 - 2.5 Setting a parity
 - 2.6 Setting whether to conduct a BCC check
 - 2.7 Setting a communications speed
 - 2.8 Setting an address
 - 2.9 Setting a response delay time

- 3. Communications control 6
 - 3.1 Communications procedure
 - 3.2 Message types
 - 3.3 Composition of a request message (transmitted from a high-level computer to this product)
 - 3.4 Composition of a response message (transmitted from this product to a high-level computer)
 - 3.5 Description of codes
 - 3.6 Communications precautions

- 4. Examples of communications 13
 - 4.1 Examples of communications to be read
 - 4.2 Examples of communications to be written

- 5. Specifications 15
 - 5.1 Communications standard category
 - 5.2 Communications specifications

- 6. Connections 16
 - 6.1 Connecting TTM-10L in RS-485
 - 6.2 Connecting TTM-10L in RS-232C

- 7. Table of identifiers (codes) 17

- 8. Table of ASCII codes 19

1. Before using the product

1.1 On this operation manual

This is an operation manual regarding communications with a TTM-10L Series (hereinafter referred to as "this product").

1.2 Conditions for communications

The communications function of this product is optionally specified. For that reason, you should specify a communications option (RS-485 or RS-232C) in purchasing this product.

1.3 What can be done with communications

With this product, users can write and read items specified in "7. Table of identifiers (codes)," such as "reconfiguring, starting, or stopping items that are operable with the front keys" and "reading information displayable on the display."

However, reading and writing with ordinary commands are performed with regarding to the RAM in this product. Written data can be turned back into the values before the writing (the values stored on the EEPROM) by turning power off and on again. To store the written data on the EEPROM of this product, execute a store request message. (See "Communications precautions" in chapter 3.6.)

Settings regarding options not added and other unnecessary settings cannot be read or written.

1.4 Positioning communications (priority ranking)

Data and parameters in this product can be changed with keys while in operation in the communications mode.

(Note that any modification related to communications is not permitted.)

While this product is in operation without use of the communications function, readout or setting change of the data or parameters cannot be executed through communications.

Switchover of the communications type cannot be key-locked.

1.5 Setting before communications

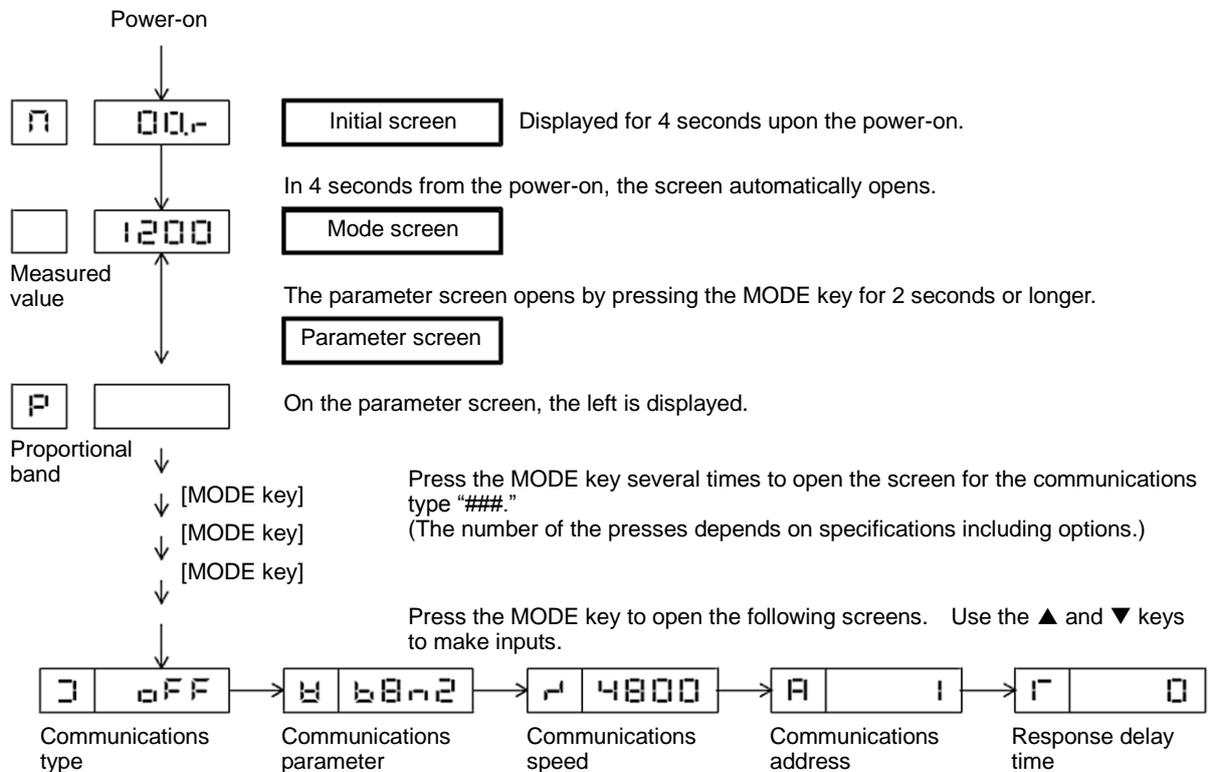
Before performing communications, this product must be set. See "2. Settings regarding communications."

2. Settings regarding communications

2.1 Overview

Before communications is performed, initial settings must be made on this product. Enter such settings with the keys on the front panel.

(No change can be made during communications.)



Upon completion of the settings, press the MODE key for 2 seconds or longer; the screen returns to the measured value screen.

The parameters shown above are initial values.

MODE key: Press the MODE key once to change a screen.

2.2 Setting a communications type

Press and set the first digit using the ▲ and ▼ keys. The initial setting is "###."

- When RS-485 is specified

	Not used (off)
	RS-485 (on)

- When RS-232C is specified

	Not used (off)
	RS-232C (on)

* This screen is not key-locked.

No switchover between RS-232C and RS-485 is possible. (Must be specified at the time of purchase.)

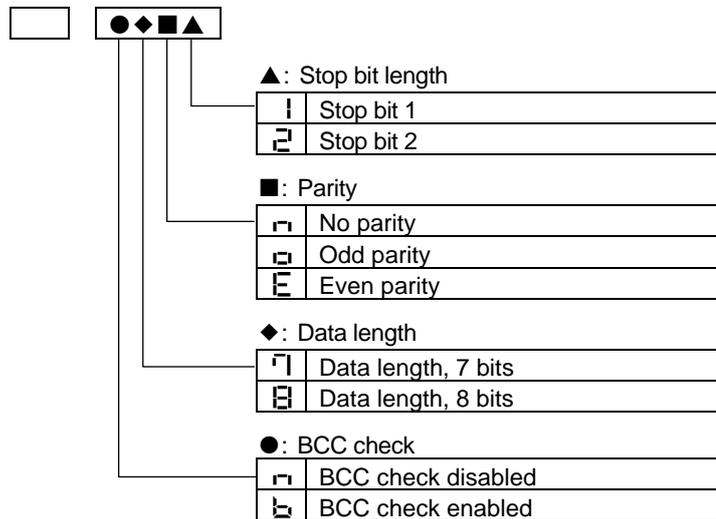
2.3 Setting a data length

2.4 Setting a stop bit length

2.5 Setting a parity

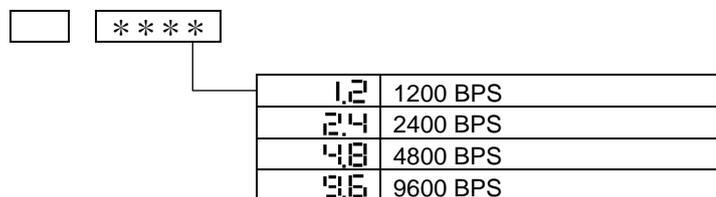
2.6 Setting whether to conduct a BCC check

Operate the ▲ and ▼ keys to make the settings. The initial value is 0000.



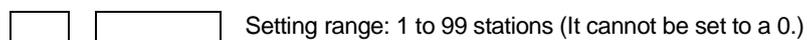
2.7 Setting a communications speed

Operate the ▲ and ▼ keys to make the settings. The initial value is 00.



2.8 Setting an address

Operate the ▲ and ▼ keys to make the settings. The initial value is 0.



2.9 Setting a response delay time

Set a time from the time when the high-level computer finished sending a "request message" until the time when it delivers the line and enters an input state.

Operate the ▲ and ▼ keys to make the settings. The initial value is ###.



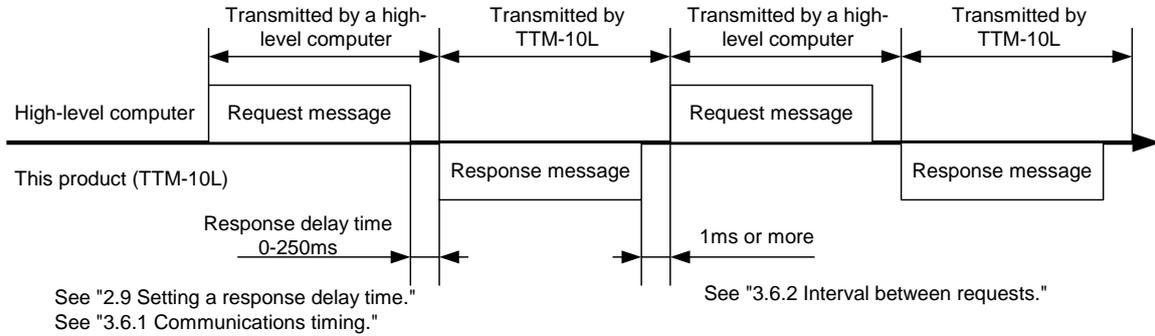
* If the response delay time is set to a short setting, the communications may not be conducted normally.

* In a real operation, the processing time for this product will be added, in addition to the response delay time.

3. Communications control

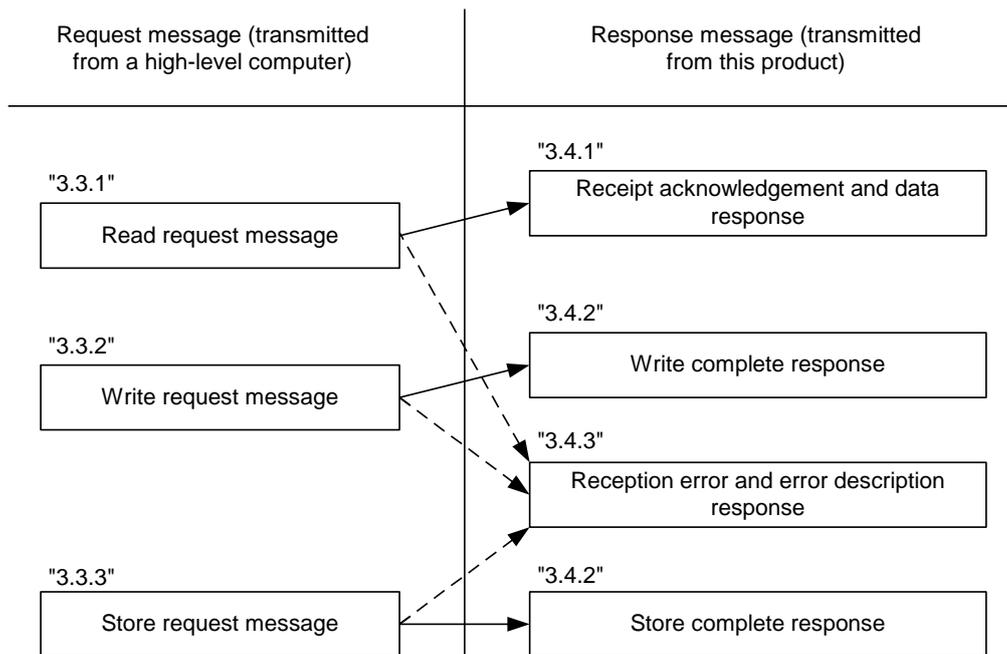
3.1 Communications procedure

This product returns a "response message" in response to a "request message" from a high-level computer. It therefore does not initiate a transmission.



3.2 Message types

- Messages are roughly divided into the following types:

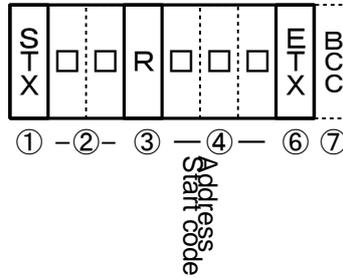


- All codes (except for BCC) from STX and data to ETX are expressed in ASCII codes.
- In assembling a program for a high-level computer, see "7. Table of identifiers (codes)" and "8. Table of ASCII codes" at the end of this manual.

3.3 Composition of a request message (transmitted from a high-level computer to this product)

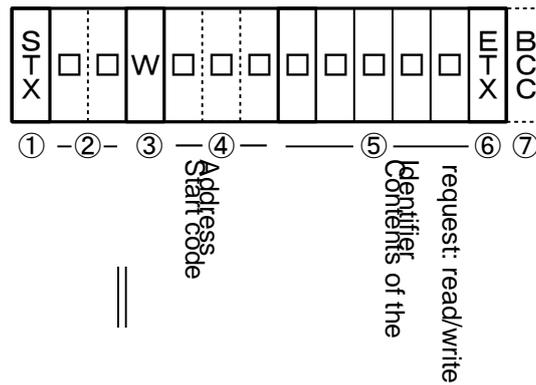
- For codes ① to ⑩, see "3.5 Description of codes."
- For specific examples of request messages, see "4.1 Examples of communications to be read" and "4.2 Examples of communications to be written."

3.3.1 Composition of a read request message



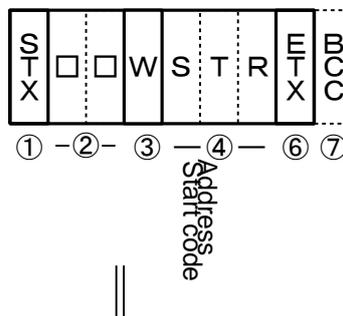
||

3.3.2 Composition of a write request message



||

3.3.3 Composition of a store request message

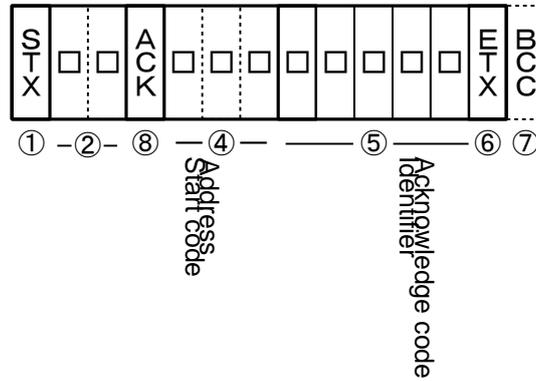


||

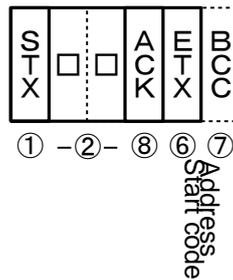
3.4 Composition of a response message (transmitted from this product to a high-level computer)

- For codes ① to ⑩, see "3.5 Description of codes."
- For specific examples of request messages, see "4.1 Examples of communications to be read" and "4.2 Examples of communications to be written."

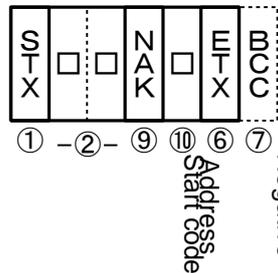
3.4.1 Response message in response to a read request message



3.4.2 Response message in response to a write/store request message



3.4.3 Response message in the case of an error



3.5 Description of codes

- The codes from ① STX, ② address to ⑩ ERR type as indicated below are expressed in ASCII codes.
- For the ASCII codes, see "8. Table of ASCII codes."
- For conversion to ASCII codes, see "4. Examples of communications."

① STX

This code is needed for the receiver to detect the top of the message. It is affixed to the top of a character string to be sent.

② Address

This is the address of the party (this product) with whom a high-level computer communicates. The address in the response message from this product indicates the sender of the response message.

③ Contents requested

Enter a code R or W.

R: to read data from this product

W: to write or store data in this product

④ Identifier

An identifier is a classification code (identifier) for data to be read or written and expressed in a three-digit alphanumerical ASCII code. See "7. Table of identifiers (codes)."

⑤ Numerical data

These are data to be read or written, and are all expressed in five digits regardless of the type.

Negative data: The "-" (minus) sign is in a single digit at the largest digit.

Position of the decimal point: 5-digit data does not include a decimal point.

Example: The table below indicates the significances of 5-digit numerical data 00010.

Example	Significance of the value
Proportional band (P)	→1.0%
Data (PV), etc, whose decimal point can be shifted	
When the decimal point setting (DP) is 0	→10
When the decimal point setting (DP) is 0.1	→1.0

Even when "###" is set to "0" on a model with a platinum resistance temperature detector, a communications data is transmitted with a decimal point.

⑥ ETX

This code is needed for the receiver to detect the end of a message. It is affixed to the end of a character string to be sent (except for BCC).

⑦ BCC

This is a check code for error detection and is the exclusive OR (EX-OR) of all characters from STX to ETX.

If the BCC check is set to "Disabled" in the communications settings in this product, this code (BCC) will not be incorporated in the response message. See "2. Settings regarding communications."

⑧ ACK

It is an acknowledge code. If a message received by this product is error-free, this code will be incorporated in the "response message" from this product and returned.

⑨ NAK

It is a negative acknowledge code. If a "request message" received by this product is error-ridden, this code will be incorporated in the "response message" from this product and returned.

If the "request message" received is error-ridden, the error contents (⑩ ERR type) will be incorporated in the "response message" from this product, following NAK.

⑩ ERR type

If a "request message" received from this product is error-ridden, the error contents (either of the numbers in the table below) will be incorporated in the "response message" from this product, following "⑨ NAK."

The error number 0 is an instrument error (memory error or A/D conversion error). It will be incorporated in the "response message" regardless of whether there is an error in the "request message."

The error number 9 is an AT error. It will therefore be incorporated in the "response message" regardless of whether there is an error in the "request message." Remove the cause of the error immediately and start the AT again.

If there are two or more errors occurring at the same time, the largest error number will be incorporated.

The table below indicates the error contents and classifications.

Error No.	Error contents in the "request message" received by this product
0	Instrument error (memory error or A/D conversion error)
1	The numerical data deviated from the "range of settings designated specifically with setting items."
2	The change of requested items is disabled or there are no items to be read.
3	An ASCII code other than the numerical data was specified in the field of numerical data. An ASCII code other than "0" and "-" was specified in the field of codes.
4	Format error
5	BCC error
6	Overrun error
7	Framing error
8	Parity error
9	A PV error occurred during AT. Or AT will not end 3 hours later.

3.6 Communications precautions

3.6.1 Communications timing

Set a sufficient response delay time to make sure that this product is switched over from transmission to reception with regard to a high-level computer in using RS-232C and RS-485. See the figure in "3.1 Communications procedure" and "2.9 Setting a response delay time."

3.6.2 Interval between requests

In transmitting a series of "request messages" from a high-level computer, allow for an interval of 1msec or more from the reception of a "response message" from this product to a next transmission.

3.6.3 Response conditions

This product will not return a "response message" unless it receives a "request message" containing an STX and ETX (BCC).

If, therefore, the "request message" is error-ridden, this product will not return a "response message" (error reply) containing a NAK and ERR unless the conditions mentioned above are met.

Therefore, the high-level computer transmits the necessary "request message" again if a "request message" is sent to this product but the latter does not return a "response message" at the end of an appropriate period.

The moment this product receives an STX, it clears all codes received before that.

3.6.4 Errors in address specification

This product will not respond to any "request message" that specifies an address other than that specified for itself. If, therefore, the address portion of a "request message" is error-ridden, none of the mobile units will return a "response message."

Therefore, the high-level computer transmits the necessary "request message" again if a "request message" is sent to this product but the latter does not return a "response message" at the end of an appropriate period.

The moment this product receives an STX, it clears all codes received before that.

3.6.5 Number of digits in data and the decimal position

See "3.5 Description of codes, ⑤ Numerical data."

3.6.6 Operation after receiving a store request message

This product starts to store data after correctly receiving a store request message from a high-level computer.

This product only stores data different from the contents of the EEPROM (data that is changed). The time (TW) required for storing data is within 500ms.

This product transmits a storage-complete reply (ACK) when the data is stored.

This product will not guarantee that the data is stored if this product is turned off during a storage operation. Do not turn off this product for 500ms after transmitting a store request message.

3.6.7 Operation after turning on the power

This product will not perform communications (no response) for about 4 seconds after it is turned on. Allow for a delay until communications is started after this product is turned on.

3.6.8 Storing data other than a store request message

Store all parameters in the EEPROM in either of the three cases described below, even if no store request message is received.

- 1) If a parameter is changed by key operation in the communications mode
- 2) If auto-tuning is started and stopped normally in the communications mode
- 3) If the communications mode is switched to the local mode

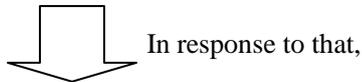
3.6.9 Changing the settings (SV or SV2) by communications during auto-tuning

If a change of the setting (SV or SV2) used in control is attempted through communications during the auto-tuning, "NAK" and "2" are responded.

4. Examples of communications

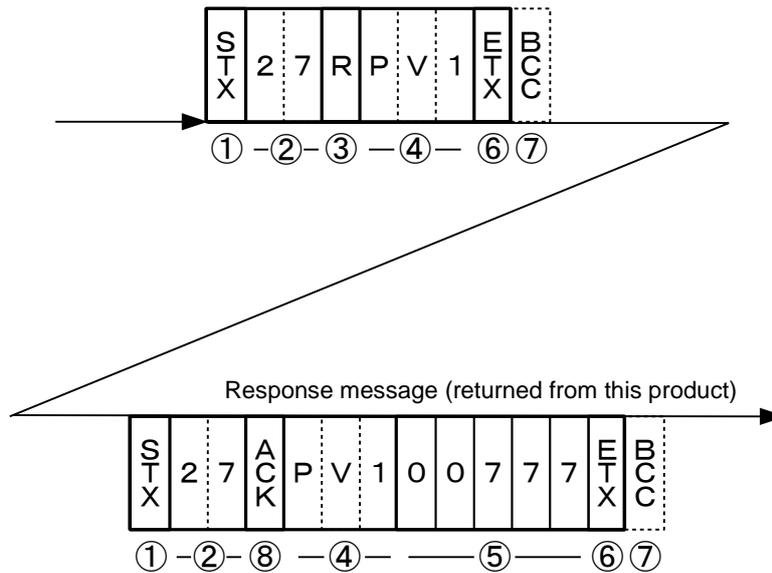
4.1 Examples of communications to be read

Example: Request message: This requests this product set at address 27 to read the PV.
(High-level computer)



Response message: This returns PV data (00777).
(This product)

Read request message (transmitted from the high-level computer)



Code	Code, data	ASCII code, note 2)
① Start code	STX	02H
② Address	27	32H 37H
③ Request contents	R (Read)	52H
④ Identifier, note 1)	PV1	50H 56H 31H
⑤ Numerical data	00777	30H 30H 37H 37H 37H
⑥ End code	ETX	03H
⑦ BCC data request		61H
response		02H
⑧ Acknowledge code	ACK	06H

Note 1): See "7. Table of identifiers (codes)."

Note 2): For the ASCII codes, see "8. Table of ASCII codes."

4.2 Examples of communications to be written

Example: Request message: This requests this product set at address 03 to set "the A1F setting to 135" (write 135).

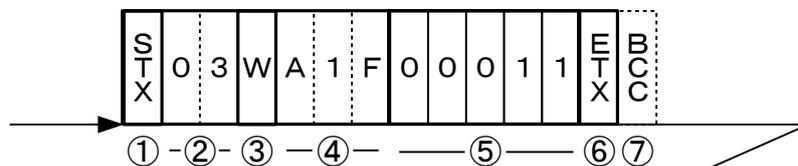
(Set the event 1 function to the following: Error alarm type to be PV error alarm 1, alarm type to be deviation lower limit alarm 3 and additional function to be alarm hold + standby sequence (5).)

↓
In response to that,

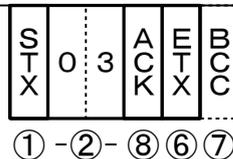
Response message: This returns a notice that the request message has been received.
(This product)

*Check that it has been written by reading the data separately.

Write request message (transmitted from a high-level computer)



Response message (returned from this product)



Code	Code, data	ASCII code, note 2)
① Start code	STX	02H
② Address	03	32H 33H
③ Request contents	W (Write)	57H
④ Identifier, note 1)	A2F	41H 33H 46H
⑤ Numerical data	00135	30H 30H 31H 33H 35H
⑥ End code	ETX	03H
⑦ BCC data request		56H
response		04H
⑧ Acknowledge code	ACK	06H

Note 1): See "7. Table of identifiers (codes)."

Note 2): For the ASCII codes, see "8. Table of ASCII codes."

5. Specifications

5.1 Communications standard category

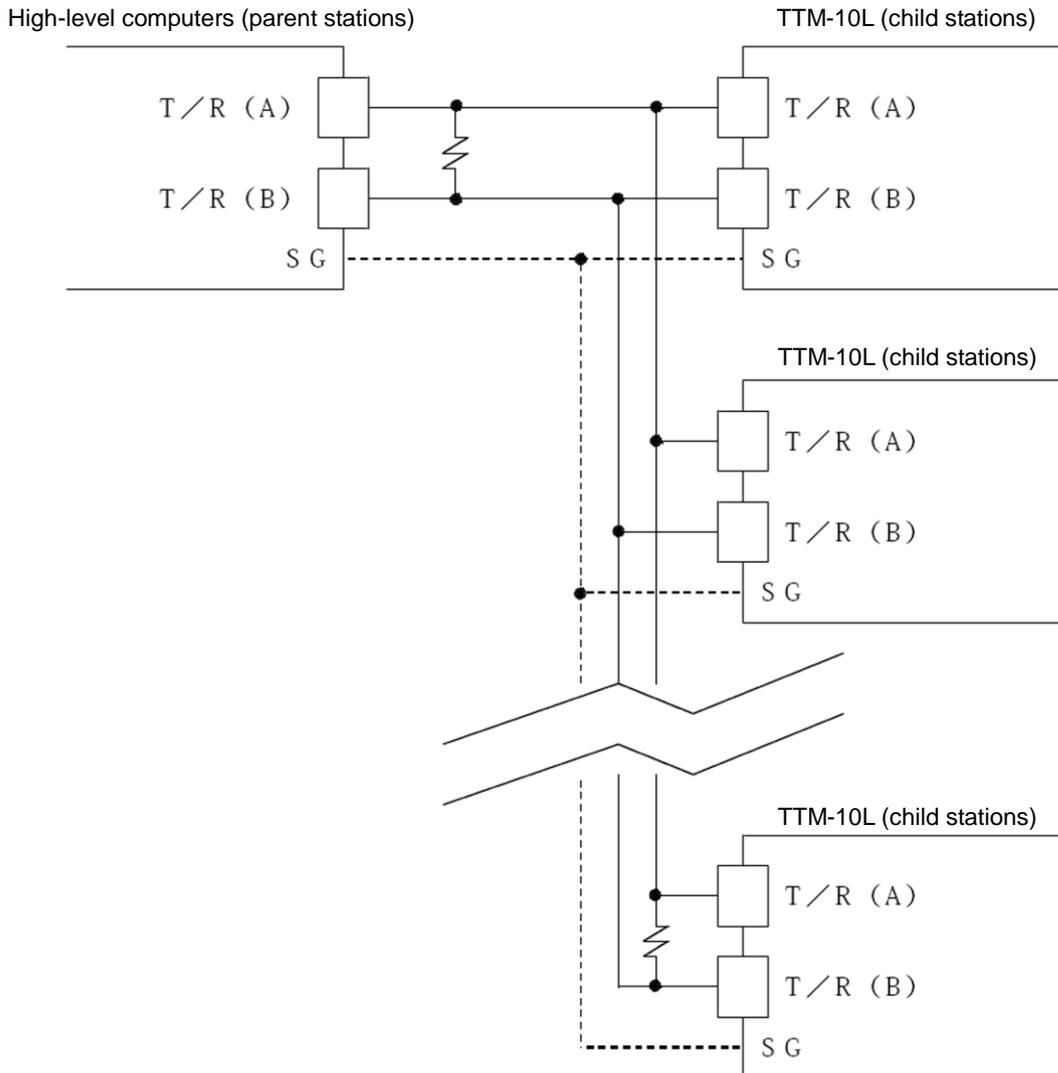
Compliant with RS-485 and RS-232C

5.2 Communications specifications

Communications type		RS-485	RS-232C
Communications system	Network	Compliant with RS-485	Compliant with RS-232C
		Up to 1 pair, 31 stations	1 pair, 1 station
	Information system	Half duplex	
	Synchronization system	Asynchronous	
	Transmission code	ASCII code	
Interface system	Signal line	2-line type	3-line type (2 for transmission and reception, and SG)
	Communications speed	1,200, 2,400, 4,800 and 9,600 bps	
Character	Start bit length	Fixed at 1 bit	
	Stop bit length	Either 1 or 2 bit can be selected.	
	Data length	Either 7 or 8 bit can be selected.	
	Parity	No, odd or even number can be selected.	
	BCC check	Yes or no can be selected.	
	Communications address	1 to 99	

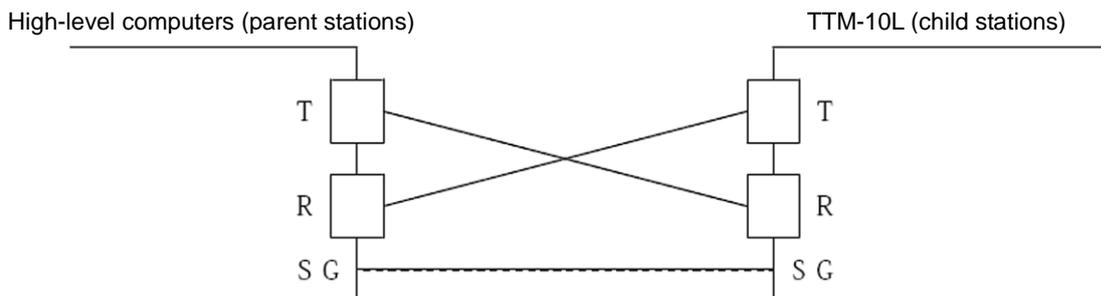
6. Connections

6.1 Connecting TTM-10L in RS-485



Install an end of line resistor at both of the farthest devices in the parent station and the mobile unit. For a resistance value, use one that matches the characteristic impedance of the cable. Provided that the synthesis is set to at least 75Ω .

6.2 Connecting TTM-10L in RS-232C



For actual use, the following connection is required inside the connector in the parent stations: CS (transmission permission) and ER (data terminal ready), and RS (transmission request) and DR (data set ready) and CD (reception carrier detection).

a)	Identifier	Character	Name	R/W	Description
13	A1F		EV function	R/W	<p>R/W the EV function *7</p> <p>0 0 0 0 0</p> <p>Additional function 0: None 1: Event output hold 2: Standby sequence 3: Event output + standby sequence</p> <p>PV event output 0: None 1: Deviation upper/lower limit event output 2: Deviation upper limit event output 3: Deviation lower limit event output 4: Deviation upper/lower limit range event output 5: Absolute value upper/lower limit event output 6: Absolute value upper limit event output 7: Absolute value lower limit event output 8: Absolute value upper/lower limit range event output</p> <p>PV error event output 0: None 1: PV error event output</p>
14	ALC		EV sensitivity	R/W	R/W the EV sensitivity *7
15	<input type="checkbox"/> DP		Decimal point position	R/W	<p>R/W the decimal point position *8</p> <p>0: 00000 0.0: 00001 0.00: 00002</p>
16	<input type="checkbox"/> CF		Switchover between °C and °F	R/W	<p>R/W the switchover between °C and °F *9</p> <p>°C: 00000 °F: 00001</p>
17	LOC		Lock setting	R/W	<p>R/W the lock setting</p> <p>OFF: 00000 All lock: 00001 Parameter lock: 00002</p>
18	<input type="checkbox"/> CJ		Cold junction compensation temperature	R	<p>Used as a monitor for the cold junction compensation temperature.</p> <p>Indication range: -20 to 80 °C When overscale: HHHHH When underscale: LLLLL</p>
19	PV2		With a decimal point for a measured value (PV)	R	<p>Used as a monitor for "with a decimal point for a measured value (PV)"</p> <p>Indication range: -199.9 to 999.9 When overscale: HHHHH When underscale: LLLLL</p>
20	OM1		Output status monitor	R	<p>0 0 0 0 0</p> <p>1: ON 0: OFF</p>
21	STR		Data store	W	Stores a changed data.

- *1 On a model without control, "NAK" and "2" are responded.
- *2 When the control output is of an ON/OFF control, "NAK" and "2" are responded.
- *3 On a model without EV, "NAK" and "2" are responded.
- *4 When the alarm type for EV is not "lower limit alarm or upper/lower limit alarm," "NAK" and "2" are responded.
- *5 When the alarm type for EV is not "upper limit alarm or upper/lower limit alarm," "NAK" and "2" are responded.
- *6 When the control output is of a PID control, "NAK" and "2" are responded.
- *7 A model without EV responds "NAK" and "2."
- *8 A model of a thermocouple input responds "NAK" and "2."
- *9 A model of current and voltage inputs responds "NAK" and "2."
- *10 Only R for output type: The input type cannot be changed for over "----."

8. Table of ASCII codes

ASCII code	02H	03H	06H	15H						
Use symbols	STX	ETX	ACK	NAK						

ASCII code	30H	31H	32H	33H	34H	35H	36H	37H	38H	39H
Use numerical characters	0	1	2	3	4	5	6	7	8	9

2DH	20H									
- Minus	SP Space									

ASCII code	41H	42H	43H	44H	45H	46H	47H	48H	49H	4AH
Use characters	A	B	C	D	E	F	G	H	I	J

4BH	4CH	4DH	4EH	4FH	50H	51H	52H	53H	55H
K	L	M	N	O	P	Q	R	S	T

55H	56H	57H	58H	59H	5AH	20H			
U	V	W	X	Y	Z	SP Space			



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