Digital Controller

CB100/CB400/CB500/CB700/CB900

Communication Quick Manual

IMCB31-E1

Thank you for purchasing this RKC product. In order to achieve maximum performance and ensure proper operation of your new instrument, carefully read all the instructions in this manual. Please place this manual in a convenient location for easy reference.

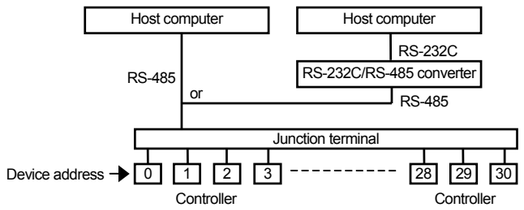
This manual describes the connection method with host computer, communication parameters and communication data (except for parameters in Initial setting) of the CB100/CB400/CB500/CB700/FB900.

For the detail host communication such as protocol description, see the **Communication Instruction Manual (IMCB03-E□).**

The **Communication Instruction Manual** can be download from our website:
URL: http://www.rkcinst.com/english/manual_load.htm

1. OUTLINE

Digital Controller CB100/CB400/CB500/CB700/CB900 (hereafter, called controller) interfaces with the host computer via RKC communication protocols.
Up to 32 controllers including the host computer can be connected if multi-drop connected by RS-485.



2. WIRING

WARNING

To prevent electric shock or instrument failure, turn off the power before connecting or disconnecting the instrument and peripheral equipment.

Conduct wiring so that the power supply terminals (screw heads) do not touch the communication terminal lugs in CB100. Especially when two lugs are connected to one communication terminal for the use of multi-drop connection, much care should be exercised not to touch the power supply terminals with the lugs.

The cable must be provided by the customer.

2.1 Communication terminal number and signal details

■ **CB100/CB400/CB500/CB900**

Terminal No.	Signal name	Symbol
13	Signal ground	SG
14	Send data/Receive data	T/R (A)
15	Send data/Receive data	T/R (B)

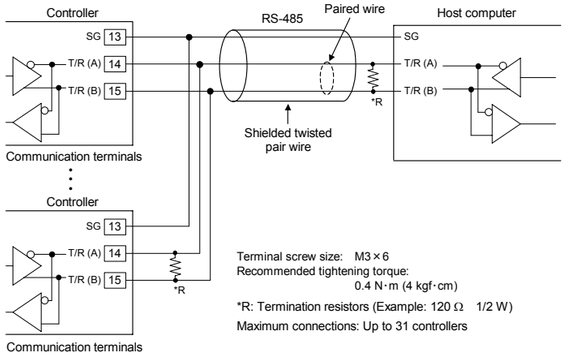
■ **CB700**

Terminal No.	Signal name	Symbol
7	Signal ground	SG
8	Send data/Receive data	T/R (A)
9	Send data/Receive data	T/R (B)

2.2 Wiring method

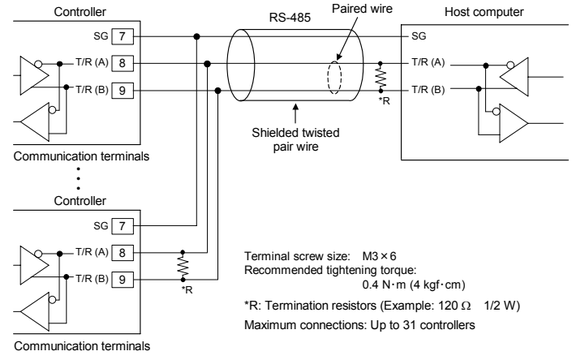
■ **CB100/CB400/CB500/CB900**

● **When host computer interface is RS-485**



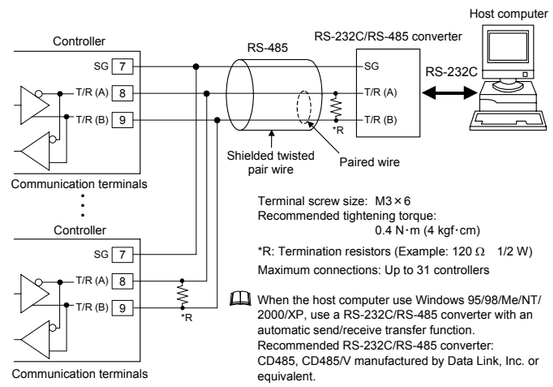
Terminal screw size: M3 × 6
Recommended tightening torque: 0.4 N·m (4 kgf·cm)
*R: Termination resistors (Example: 120 Ω 1/2 W)
Maximum connections: Up to 31 controllers

● **When host computer interface is RS-485**



Terminal screw size: M3 × 6
Recommended tightening torque: 0.4 N·m (4 kgf·cm)
*R: Termination resistors (Example: 120 Ω 1/2 W)
Maximum connections: Up to 31 controllers

● **When host computer interface is RS-232C**



Terminal screw size: M3 × 6
Recommended tightening torque: 0.4 N·m (4 kgf·cm)
*R: Termination resistors (Example: 120 Ω 1/2 W)
Maximum connections: Up to 31 controllers

When the host computer use Windows 95/98/Me/NT/2000/XP, use a RS-232C/RS-485 converter with an automatic send/receive transfer function.
Recommended RS-232C/RS-485 converter: CD485, CD485/V manufactured by Data Link, Inc. or equivalent.

3. SETTING

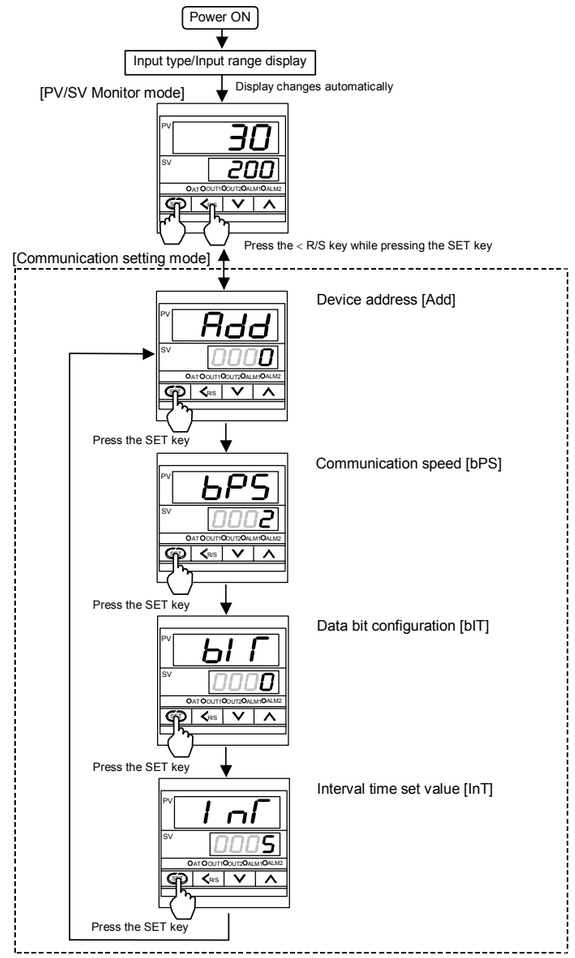
To establish communication parameters between host computer and controller, it is necessary to set the device address, communication speed, data bit configuration and interval time on each controller in the Communication setting mode.

When the communication parameter was changed, always turn on the power again. Otherwise, no communication is performed by using the changed value.

This instrument returns to the PV/SV monitor screen if no key operation is performed for more than one minute.

This section describes the parameters to need setting for host communication. For the screen operation and key operation, see the **Instruction Manual (IMCB25-E□)**.

3.1 Display flowcharts



3.2 Description of each parameter

Symbol	Name	Data Setting	Description	Factory set value
Add (Add)	Device address	0 to 99	Do not use the same device address for more than one controller in multi-drop connection. Each controller must have a unique address in multi-drop connection.	0
bPS (bPS)	Communi-cation speed	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps	Set the same communication speed for both the controller and the host computer.	2
bIT (bIT)	Data bit configuration	0 to 5 See data bit configuration table	Set the same data bit configuration for both the controller and the host computer.	0
InT (InT)	Interval time set value	0 to 150 *	Sets the value to set the interval time. [1]	5

* Interval time = Interval time set value × 1.666 ms

[1] The interval time for the controller should be set to provide a time for host computer to finish sending all data including stop bit and to switch the line to receive status for the host. If the interval time between the two is too short, the controller may send data before the host computer is ready to receive it. In this case, communication transmission cannot be conducted correctly. For a successful communication sequence to occur, the controller's interval time must match the specifications of the host computer.

Data bit configuration table

Set value	Data bit	Parity bit	Stop bit
0	8	Without	1
1	8	Without	2
2	7	Even	1
3	7	Even	2
4	7	Odd	1
5	7	Odd	2

3.3 Communication Requirements

■ **Processing times during data send/receive**

When the host computer is using either the polling or selecting procedure for communication, the following processing times are required for controller to send data:
- Response wait time after controller sends BCC in polling procedure
- Response wait time after controller sends ACK or NAK in selecting procedure

Response send time is time at having set interval time in 0 ms.

● Polling procedure

Procedure details	Time (ms)		
	MIN	TYP	MAX
Response send time after controller receives ENQ	1.5	2.0	3.0
Response send time after controller receives ACK	1.5	2.0	3.5
Response send time after controller receives NAK	1.0	1.5	3.0
Response send time after controller sends BCC *	—	0.7	1.0

* Data-link is terminated sending [EOT], if no response within about 3 sec after BCC send.

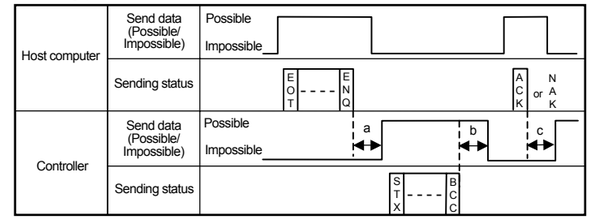
● Selecting procedure

Procedure details	Time (ms)		
	MIN	TYP	MAX
Response send time after controller receives BCC	2.0	3.0	4.0
Response wait time after controller sends ACK	—	0.7	1.0
Response wait time after controller sends NAK	—	0.7	1.0

■ **RS-485 send/receive timing**

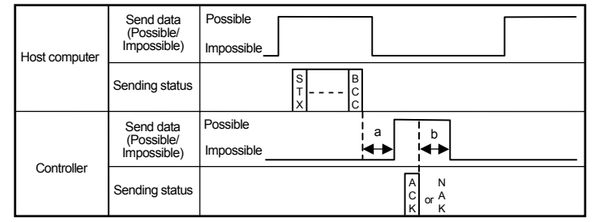
RS-485 communication is conducted through two wires, therefore, the transmission and reception of data requires precise timing.

● Polling procedure



a: Response send time after the controller receives [ENQ] + Interval time
b: Response send time after the controller sends BCC
c: Response send time after the controller receives [ACK] + Interval time or Response send time after the controller receives [NAK] + Interval time

● Selecting procedure



a: Response send time after the controller receives BCC + Interval time
b: Response wait time after the controller sends ACK or Response wait time after the controller sends NAK

To switch the host computer from transmission to reception, send data must be on line.

The following processing times are requires for the controller to process data:
- In polling procedure, Response wait time after the controller sends BCC
- In selecting procedure, Response wait time after the controller sends ACK or NAK

■ **Fail-safe**

A transmission error may occur with the transmission line disconnected, shorted or set to the high-impedance state. In order to prevent the above error, it is recommended that the fail-safe function be provided on the receiver side of the host computer. The fail-safe function can prevent a framing error from its occurrence by making the receiver output stable to the MARK (1) when the transmission line is in the high-impedance state.

■ **Data backup**

The nonvolatile memory (EEPROM) for data backup has limitations on the number of memory rewrite times (approx. 100,000 times). Avoid using the memory to frequently change the set value via communication.

4. COMMUNICATION DATA LIST

- Attribute
  RO: Read only data
  R/W: Read and write data
- Data
  ASCII code data of 6 digits

■ Communication data

No.	Name	Identifier	Attribute	Data range	Factory set value
1	Measured value (PV) monitor	M1	RO	Within input range See ■ **Input range table**	—
2	Current transformer 1 (CT1) input value monitor [1]	M2	RO	0.0 to 100.0 A	—
3	Current transformer 2 (CT2) input value monitor [2]	M3	RO		—
4	Alarm 1 state monitor [3]	AA	RO	0: OFF 1: ON	—
5	Alarm 2 state monitor [1]	AB	RO		—
6	Burnout state monitor	B1	RO	0: OFF 1: ON	
7	Error code	ER	RO	0 to 255 Any number other than "0" indicates errors (RAM write error, etc.) detected by the controller self-diagnosis function. Please contact RKC sales office or the agent.	—
8	RUN/STOP transfer	SR	R/W	0: RUN (Control start) 1: STOP (Control stop)	0
9	Set value (SV)	S1	R/W	Within input range	0
10	Alarm 1 set value [3]	A1	R/W	Temperature input: Process alarm, deviation alarm, SV alarm: −1999 to +9999 °C [°F] or −199.9 to +999.9 °C [°F] Voltage/ current inputs:	Temperature input: 50 or 50.0 Voltage/ current inputs: 5.0
11	Alarm 2 set value [1]	A2	R/W	Deviation alarm: −span to +span (Within 9999) Process alarm, SV alarm: Within input range	Temperature input: 50 or 50.0 Voltage/ current inputs: 5.0
12	Heater break alarm 1 (HBA1) setting [1]	A3	R/W	0.0 to 100.0 A	0.0
13	Heater break alarm 2 (HBA2) setting [2]	A4	R/W		0.0
14	Control loop break alarm (LBA) time [1, 3]	A5	R/W	0.1 to 200.0 minutes (0.0: Unused)	8.0
15	LBA deadband [1, 3]	A6	R/W	Temperature input: 0 to 9999 °C [°F] Voltage/ current inputs: 0 to 100 % of span	0
16	Autotuning (AT)	G1	R/W	0: Autotuning (AT) end or suspension 1: Autotuning (AT) start Change to "0" automatically at the end of Autotuning.	0

[1] The communicable identifier differs depending on the alarm type specified in alarm 2.
−: Communication is impossible ×: Communication is possible

Name	Identifier	The alarm type specified in alarm 2					
		Deviation alarm	Process alarm	LBA	HBA	SV alarm	No alarm
Current transformer 1 (CT1) input value monitor	M2	−	−	−	×	−	−
Alarm 2 state monitor	AB	×	×	×	×	×	−
Alarm 2 set value	A2	×	×	−	−	×	−
Heater break alarm 1 (HBA1) setting	A3	−	−	−	×	−	−
Control loop break alarm (LBA) time	A5	−	−	×	−	−	−
LBA deadband	A6	−	−	×	−	−	−

As control loop break alarm, only either the alarm 1 or alarm 2 is specified.

[2] This is an identifier which enables communication when specifying to the Z-168 specification.

[3] The communicable identifier differs depending on the alarm type specified in alarm 1.
−: Communication is impossible ×: Communication is possible

Name	Identifier	The alarm type specified in alarm 1				
		Deviation alarm	Process alarm	LBA	SV alarm	No alarm
Alarm 1 state monitor	AA	×	×	×	×	−
Alarm 1 set value	A1	×	×	−	×	−
Control loop break alarm (LBA) time	A5	−	−	×	−	−
LBA deadband	A6	−	−	×	−	−

As control loop break alarm, only either the alarm 1 or alarm 2 is specified.

No.	Name	Identifier	Attribute	Data range	Factory set value
17	Self-tuning (ST)	G2	R/W	0: Self-tuning (ST) suspension 1: Self-tuning (ST) start • In a controlled system in which ripples may be contained by the application of periodic disturbances, use this instrument with the self-tuning function turned off. • This is an identifier which enables communication with PID action with autotuning (Reverse action/Direct action).	0
18	Proportional band [heat-side] (P)	P1	R/W	Temperature input: 1 (0.1) to span or 1 (0.1) to 9999 (999.9) °C [°F] Voltage/ current inputs: 0.1 to 100.0 % of span (0 or 0.0: ON/OFF action) Cannot be set while the self-tuning (ST) function is activated. Only polling can be made.	Temperature input: 30 or 30.0 Voltage/ current inputs: 3.0
19	Integral time (I)	I1	R/W	1 to 3600 seconds (0: PD control) Cannot be set while the self-tuning (ST) function is activated. Only polling can be made.	240
20	Derivative time (D)	D1	R/W	1 to 3600 seconds (0: PI control) Cannot be set while the self-tuning (ST) function is activated. Only polling can be made.	60
21	Anti-reset windup	W1	R/W	1 to 100 % of Proportional band [heat-side] (0: Integral action OFF) Cannot be set while the self-tuning (ST) function is activated. Only polling can be made.	100
22	Proportioning cycle [heat-side]	T0	R/W	1 to 100 seconds (0: Unused) Not set if the control output is current output.	Relay contact output: 20 seconds Voltage pulse output/ Trigger output for triac driving/ Triac output: 2 seconds
23	Proportional band [cool-side]	P2	R/W	1 to 1000 % of Proportional band [heat-side] (0: Unused) This is an identifier which enables communication at heat/cool PID action with autotuning (Water cooling/Air cooling).	100
24	Overlap/Deadband	V1	R/W	Temperature input: −10 to +10 °C [°F] or −10.0 to +10.0 °C [°F] Voltage/ current inputs: −10.0 to +10.0 % of span This is an identifier which enables communication at heat/cool PID action with autotuning (Water cooling/Air cooling).	0 or 0.0
25	Proportioning cycle [cool-side]	T1	R/W	1 to 100 seconds (0: Unused) Not set if the control output is current output. This is an identifier which enables communication at heat/cool PID action with autotuning (Water cooling/Air cooling).	Relay contact output: 20 seconds Voltage pulse output/ Triac output: 2 seconds
26	PV bias	PB	R/W	−Span to +Span However, temperature input: −1999 to +9999 °C [°F] or −199.9 to +999.9 °C [°F]	0 or 0.0
27	Set data lock function	LK	R/W	0 to 7 *	0

* Details of set data lock level selection.
−: Un-settable (Data locked) ×: Settable (Data unlocked)

Set data	Set value (SV)	Alarm setting (Alarm 1, Alarm 2)	Other setting items [1]
0	×	×	×
1	×	×	−
2	×	−	×
3	×	−	−
4	−	×	×
5	−	×	−
6	−	−	×
7	−	−	−

[1] All setting items other than set value and alarm settings (alarm 1 or alarm 2).

The set data lock function is effective only for the setting performed by key operation. Setting items in the data lock state cannot be set by key operation, but can a always be selected via communication.

No.	Name	Identifier	Attribute	Data range	Factory set value
28	EEPROM mode [1]	EB	R/W	0: Backup mode (Set values are store to the EEPROM when set values are changed.) 1: Buffer mode (Not set values are store to the EEPROM when set values are changed.)	0
29	EEPROM state [2]	EM	RO	0: The content of the EEPROM does not coincide with that of the RAM. 1: The content of the EEPROM coincides with that of the RAM.	—

[1] The non-volatile memory (EEPROM) has limitations on the number of memory rewrite times. If the buffer mode is selected as an EEPROM storage mode, all of the set values changed are not written to the EEPROM and thus a problem of limitations on the number of memory rewrite times can be solved. When the memory is used to frequently change the set value via communication, select the buffer mode.

When selecting any EEPROM storage mode, take notice of the following.
- If power failure occurs while the buffer mode is selected, the set value returns to the value before the storage mode is selected.
- If the buffer mode is changed to the backup mode, all of the set values at that time are stored to the EEPROM. If necessary to backup the final value of each set item, select the backup mode.
- When the power is turned on, the backup mode is always set.

[2] The contents of the buffer memory and those of the EEPROM can be checked.
When data is *0*: The contents of the buffer memory do not match with those of the EEPROM.
- As data is being written to the EEPROM in backup mode, do not turn the power off. If turned off, no set values are stored.
- If the set value is changed after the backup mode is changed to the buffer mode, *0* is set (mismatch). As the set value changed is not backup, select the backup mode if necessary.

When data is *1*: The contents of the buffer memory match with those of the EEPROM. (Data write to the EEPROM is completed.)

■ Input range table

● Thermocouple input

Input type	Input range
K	0 to 200 °C
	0 to 400 °C
	0 to 600 °C
	0 to 800 °C
	0 to 1000 °C
	0 to 1200 °C
	0 to 1372 °C
	0 to 100 °C
	0 to 300 °C
	0 to 450 °C
	0 to 500 °C
	0 to 800 °F
	0 to 1600 °F
	0 to 2502 °F
	20 to 70 °F
J	0 to 200 °C
	0 to 400 °C
	0 to 600 °C
	0 to 800 °C
	0 to 1000 °C
	0 to 1200 °C
	0 to 450 °C
	0 to 800 °F
	0 to 1600 °F
	0 to 2192 °F
	0 to 400 °F
	0 to 300 °F
R	0 to 1600 °C [1]
	0 to 1769 °C [1]
	0 to 1350 °C [1]
	0 to 3200 °F [1]
	0 to 3216 °F [1]
S	0 to 1600 °C [1]
	0 to 1769 °C [1]
	0 to 3200 °F [1]
	0 to 3216 °F [1]
B	400 to 1800 °C
	0 to 1820 °C [1]
	800 to 3200 °F
	0 to 3308 °F [1]
E	0 to 800 °C
	0 to 1000 °C
	0 to 1600 °F
	0 to 1832 °F
N	0 to 1200 °C
	0 to 1300 °C
	0 to 2300 °F
	0 to 2375 °F

[1] 0 to 399 °C/0 to 751 °F:
Accuracy is not guaranteed.

Input type	Input range
T	−199.9 to +400.0 °C [2]
	−199.9 to +100.0 °C [2]
	−100.0 to +200.0 °C
	0.0 to 350.0 °C
	−199.9 to +752.0 °F [2]
	−100.0 to +200.0 °F [2]
	−100.0 to +400.0 °F [2]
	0.0 to 450.0 °F
	0.0 to 752.0 °F
W5Re/ W26Re	0 to 2000 °C
	0 to 2320 °C
	0 to 4000 °F
PL II	0 to 1300 °C
	0 to 1390 °C
	0 to 1200 °C
	0 to 2400 °F
	0 to 2534 °F
U	−199.9 to +600.0 °C [2]
	−199.9 to +100.0 °C [2]
	0.0 to 400.0 °C
	−199.9 to +999.9 °F [2]
	−100.0 to +200.0 °F [2]
	0.0 to 999.9 °F
L	0 to 400 °C
	0 to 800 °C
	0 to 1600 °F

[2] −199.9 to −100.0 °C/−199.9 to −148.0 °F:
Accuracy is not guaranteed.

● RTD input

Input type	Input range
Pt100	−199.9 to +649.0 °C
	−199.9 to +200.0 °C
	−100.0 to +50.0 °C
	−100.0 to +100.0 °C
	−100.0 to +200.0 °C
	0.0 to 50.0 °C
	0.0 to 100.0 °C
	0.0 to 200.0 °C
	0.0 to 300.0 °C
	0.0 to 500.0 °C
	−199.9 to +999.9 °F
	−199.9 to +400.0 °F
	−199.9 to +200.0 °F
	−100.0 to +100.0 °F
	−100.0 to +300.0 °F
	0.0 to 100.0 °F
	0.0 to 200.0 °F
	0.0 to 400.0 °F
	0.0 to 500.0 °F
JPt100	−199.9 to +649.0 °C
	−199.9 to +200.0 °C
	−100.0 to +50.0 °C
	−100.0 to +100.0 °C
	−100.0 to +200.0 °C
	0.0 to 50.0 °C
	0.0 to 100.0 °C
	0.0 to 200.0 °C
	0.0 to 300.0 °C
	0.0 to 500.0 °C

● Voltage input/Current input

Input type	Input range
0 to 5 V DC	0.0 to 100.0
0 to 10 V DC *	
1 to 5 V DC	
0 to 20 mA DC	
4 to 20 mA DC	

* Z-1010 Specification

5. TROUBLESHOOTING

This section lists some of the main causes and solutions for communication problems. If you can not solve a problem, please contact RKC sales office or the agent, on confirming the type name and specifications of the product.

Problem	Probable cause	Solution
No response	Wrong connection, no connection or disconnection of the communication cable	Confirm the connection method or condition and connect correctly
	Breakage, wrong wiring, or imperfect contact of the communication cable	Confirm the wiring or connector and repair or replace the wrong one
	Mismatch of the setting data of communication speed and data bit configuration with those of the host computer	Confirm the settings and set them correctly
	Wrong address setting	
	Error in the data format	Reexamine the communication program
	Transmission line is not set to the receive state after data send	
EOT return	The specified identifier is invalid	Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it
	Error in the data format	Reexamine the communication program
NAK return	Error occurs on the line (parity bit error, framing error, etc.)	Confirm the cause of error, and solve the problem appropriately. (Confirm the transmitting data, and resend data)
	BCC error	
	The data exceeds the setting range	Confirm the setting range and transmit correct data
	The specified identifier is invalid	Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it

6. SPECIFICATIONS

Interface: Based on RS-485, EIA standard

Connection method: 2-wire system, half-duplex multi-drop connection

Communication distance: 1 km max.
The maximum communication distance will be affected by the surrounding conditions.

Synchronous method: Start/stop synchronous type

Communication speed: 2400 bps, 4800 bps, 9600 bps, 19200 bps

Data bit configuration:
Start bit: 1
Data bit: 7 or 8
Parity bit: Without, Odd or Even
Stop bit: 1 or 2

Protocol: ANSI X3.28 subcategory 2.5, A4
Polling/selecting type

Error control: Vertical parity (With parity bit selected)
Horizontal parity (BCC check)

Xon/Xoff control: None

Communication code: ASCII 7-bit code

Maximum connections: 31 instruments

Termination resistor: Externally connected: 120 Ω 1/2W

Signal logic: RS-485

Signal voltage	Logic
V (A) − V (B) ≥ 2 V	0 (SPACE)
V (A) − V (B) ≤ -2 V	1 (MARK)

Voltage between V (A) and V (B) is the voltage of (A) terminal for the (B) terminal.

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