COSEL

RB Series
Extended-UART Manual

RB series   *---Extended-UART---*

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1. Overview

 Extended-UART is a communication protocol that enables single-wire and bi-directional communications among multiple machines using a software instead of the general-purpose communication standard UART.
 With this product, monitoring of the operational status of the power supply and changing of various set values are possible using the Extended-UART.
 In addition, the non-volatilization memory in RB can maintain various set values and information even if input voltage is shut off.

 The communication system consists of a master and slaves.
 At most, four slaves (this product) can be connected to one master (a UART module prepared by the customer, etc.).
 Communication partner is specified by the "address" set for each slave.

2. Extended-UART Wiring and Connection

2.1 Extended-UART pin function of RB series

Table 2.1 shows the pin names and functions of this product, related to the Extended-UART.

Table 2.1 Extended-UART related pin function

Pin number	Pin name	Function
2	INFO	Extended-UART signal
3	SGND	Signal ground

*Refer to instruction manual 9.1.

2.2 Connection method

Figure 2.1 shows an example of connection using the Extended-UART.

* Please contact us if connection with five or more slaves is necessary.

* D1: Switching diode

    (Ex.) Toshiba   :CES388
             ROHM   :RB511SM-40
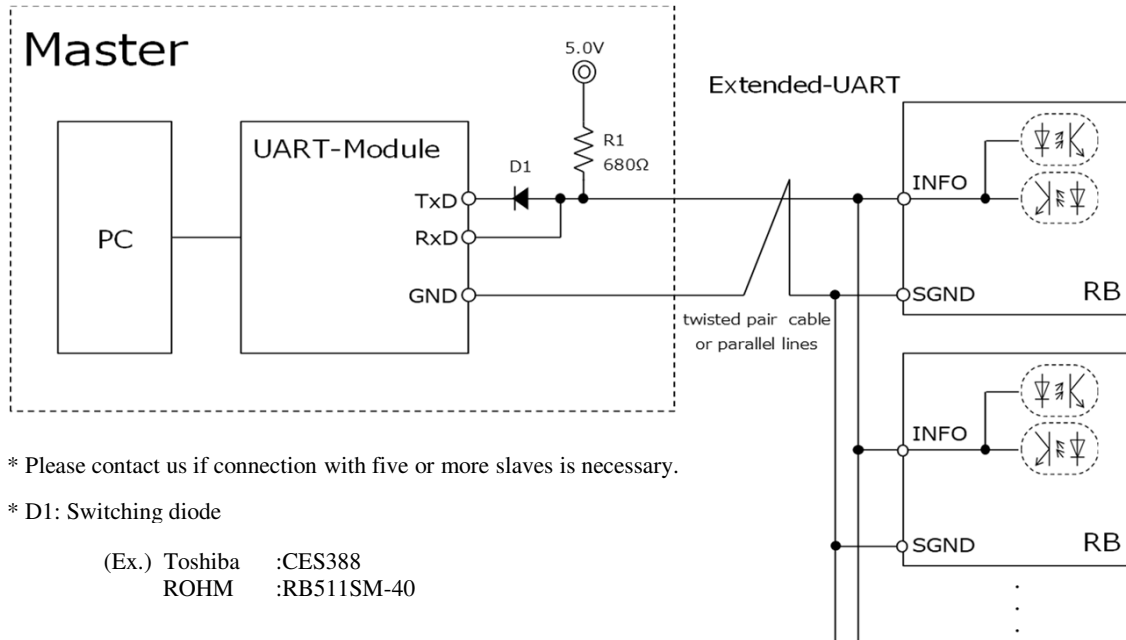
* D1 is irrelevant if TxD uses an open collector UART module.
  Please connect TxD and RxD directly.

* Depending on the type of UART module, the internal impedance may be high and
  the low level may not satisfy the specification directly.

    Operation confirmed UART module
      UB232R (FTDI Chip)

      AE-UM232R (AKIZUKI DENSHI TSUSHO)

Figure 2.1 Example of Extended-UART connection

2.3 Internal circuit and pull-up recommended value

2.3.1 Internal circuit
Figure 2.2 shows internal circuit of INFO.
The communication function terminals (INFO/SGND) are isolated from input, output and FG.
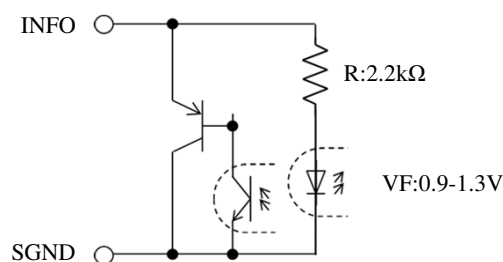
Figure 2.2 Internal circuit of INFO

2.3.2 Pull-up recommended value

A pull-up resistor must be connected to the communication line.
Table 2.2 shows recommended values of pull-up voltage and pull-up resistor.

Table 2.2 Pull-up recommended value

No.	Item	Unit	Value	Remark
1	Pull-up voltage	V	5	
2	Pull-up resistance	Ω	680	

High level voltage value changes depending on the number of units connected.
Check the threshold voltage of the UART module to be used.

Table 2.3 Voltage of high level by number of connedtions

No.	Number of connections	High level (V)	Pull-up condition	
1	1	3.8		
2	2	3.1	Pull-up voltage	：5V
3	3	2.7	Pull-up resistance	：680Ω
4	4	2.5		

2.4 Address setting

The address can be set to be one of the seven types from "1" to "7" ("0" can not be used).
The factory default setting is "7".

3. Communication specification

3.1 Communication specification

Table 3.1 shows the communication specifications of this product.
The master (UART module) prepared by customer should be set up according to Table 3.1.

Table 3.1 Communication specifications

No.	Item	Specification	
1	Communication method	Single-wire half-duplex	
2	Synchronization scheme	Start-stop synchronization	
3	Connection configuration	1 : N　（Master : Slave)	
4	Maximum number of connections	4*	
5	Communication speed	2400 bps	
6	Flow control	None	
7	Data format	Data length	8 bits
8		Stop bit	1 bits
9		Parity	1 bit, Even parity
10		Transfer direction	LSB first

* Please contact us if connection with five or more slaves is necessary.

3.2 Note

Wait for more than 3msec after receiving the reply packet.
If the wait time is short, the slave cannnot communication.

4. Communication Protocol

4.1 Overview

The communication operation in the Extended-UART starts when the master transmits a command packet to a slave, and ends when the corresponding slave (this product) transmits a reply packet to the master.
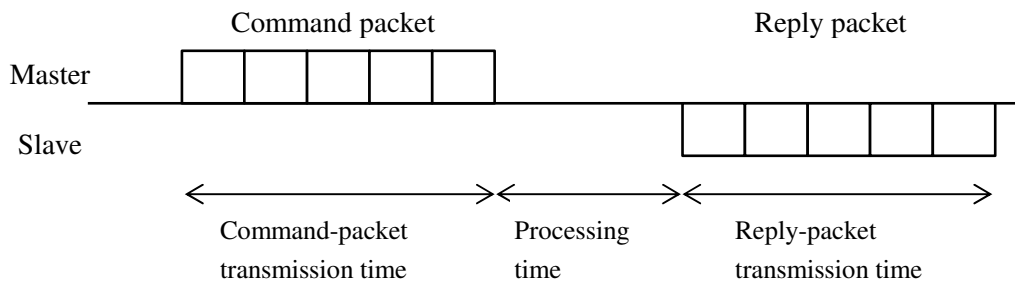
Figure 4.1 Overview of communication operation

Command-packet transmission time	: The transmission time should be within 250 msec. If the transmission time exceeds 250 msec, the slave fails with a timeout error and enters into the receipt wait-state.
Processing time	: Maximum 150 msec
Reply-packet transmission time	: Maximum 25 msec

If the address contained in the received command packet matches its own address, the slave sends a reply-packet, but if it does not match, it will not send anything.
Extended-UART is half-duplex communication, do not transmit command packets during reply packet transmission.

4.2 Communication frames and packets

Both the command packet and the reply packet are composed of five frames.
Each communication frame has a total of 11 bits, consisting of a start bit, data bits (8 bits), a parity bit, and a stop bit (see Figure 4.2).

Figure 4.2 Structure of communication frame

ver1.1E 2021.03.04

4.3 Structure of data bit

For all communication frames, the upper three bits contain the address and the lower five bits contain data.

The robustness of the communication data is maintained by the specification that all communication frames have the address information.

Command packet   Reply packet

Master

Slave

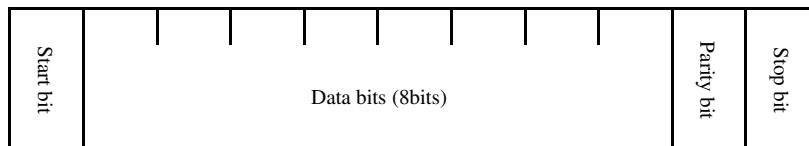| D7	D6	D5	D4	D3	D2	D1	D0
Address			data				
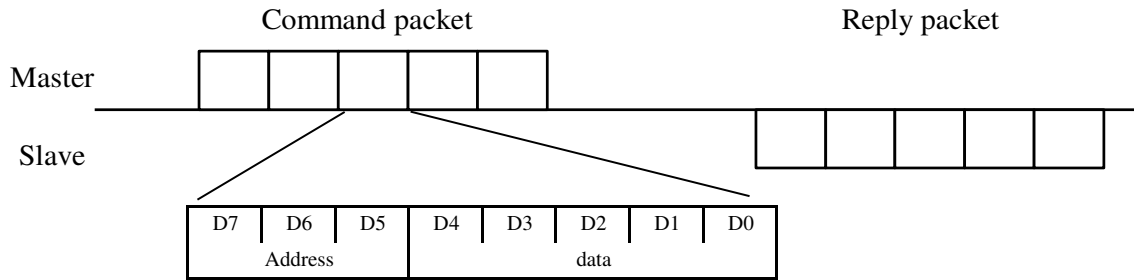
Figure 4.3   Structure of data bit

【Example of address setting】
When communicating with the slave at address "6"

"6"   →   110b

D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	Data				

Figure 4.4 Example of address setting

4.4 Check sum

Both the command packet and reply packet have a checksum for detecting communication errors.

The data parts of the communication frames 0, 2, 3, 4 excluding the addresses are summed up and the lower 4 bits of the result is stored in the 1-4 bits of the communication frame 1.

The checksum configuration is shown in Figure 4.5.

Frame0		Frame1			Frame2		Frame3		Frame4	
7 6 5	4 3 2 1 0	7 6 5	4 3 2 1	0	7 6 5	4 3 2 1 0	7 6 5	4 3 2 1 0	7 6 5	4 3 2 1 0
Address	Data0	Address	Check sum	-	Address	Data2	Address	Data3	Address	Data4
(110b)	(11110b)	(110b)	(0111b)	0	(110b)	(01000b)	(110b)	(00000b)	(110b)	(00001b)

Total value 100111b → Lower 4 bit   0111b

| 11110b | + | 01000b | + | 00000b | + | 00001b |
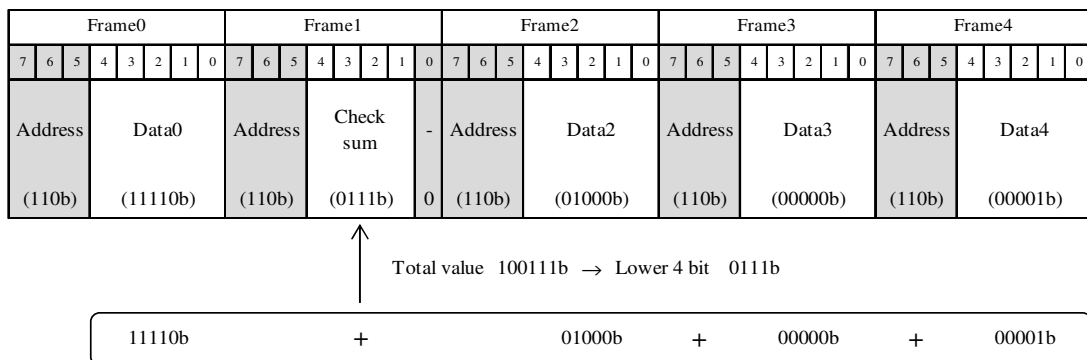
* An example is shown in ( ).

Figure 4.5 Structure of checksum

4.5 Data format of command packet

The command in the Extended-UART command packet has a variable length format shown in Table 4.1.

Table 4.1 Command types

No.	Type	Argument length	Remark
1	5-bit command	16 bits	The command can send numerical value from 0 to 65535 to a slave.
2	10-bit command	10 bits	The command can send numerical value from 0 to 1023 to a slave.
3	20-bit command	None	The command can't send numerical value.

(1) Format of 5-bit command

Assign a 5-bit command to the data part of communication frame 0.

The 16-bit argument is assigned as follows: The first bit is assigned to 0 bit of communication frame 1 and the remaining 15 bits are divided into three with 5 bits and each assigned to the data part of communication frame 2,3,4.

Figure 4.6 shows the format for a 5-bit command.
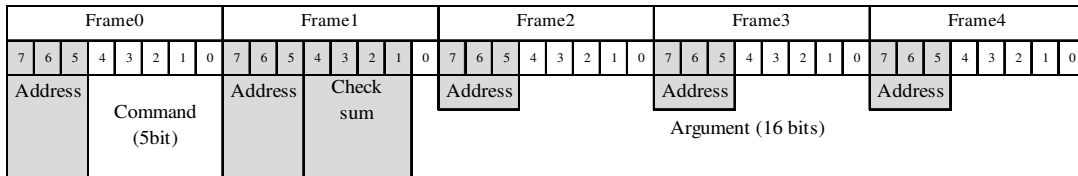
Figure 4.6 Data format of 5-bit command

(2) Format of 10-bit command

A 10-bit command is divided into two with 5 bits and they are assigned to the data part of communication frames 0 and 2.

A 10-bit argument is divided into two with 5 bits and they are assigned to the data part of communication frames 3 and 4.

Figure 4.7 shows the format for a 10-bit command.

Figure 4.7 Data format of 10-bit command

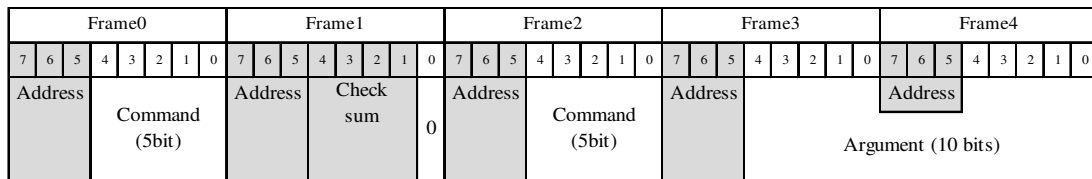Specify "0" for bit 0 of communication frame 1.

(3) 20-bit command

A 20-bit command is divided into four with 5 bits and they are assigned to the data parts of communication frames 0, 2, 3, and 4. There is no argument.

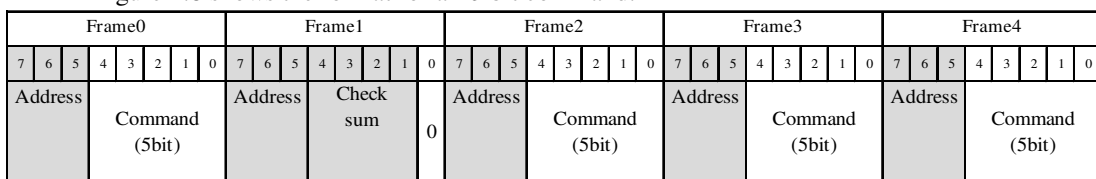Figure 4.8 shows the format for a 20-bit command.

Figure 4.8 Data format of 20-bit command

Specify "0" for bit 0 of communication frame 1.

4.6 Data format of reply packet

An Extended-UART reply packet consists of the address information, identifier information, checksum, and return value.

The format of the reply packet is shown in Figure 4.9.

Frame0								Frame1								Frame2								Frame3								Frame4							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Address			Identifier information (5bit)					Address			Check sum					Address			return value (16bit)					Address								Address							
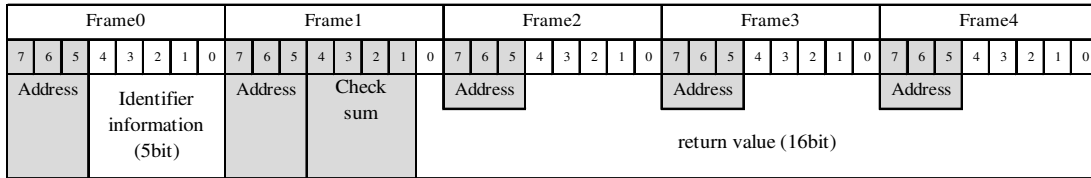
Figure 4.9 Data format of reply packet

Identifier information: If normal communication is performed, the command value contained in the communication frame 0 of the corresponding command packet is returned.

4.7 Reply packet in case of communication error

(1) Hardware error

If the following hardware error occurs, a reply packet is not sent.

The slave cannot recognize command packet.

    1) Parity error

    2) Frame error

    3) Timeout (see Section 4.1)

(2) Software error

If there is an error in the command packet sent from the master, a reply packet indicating an error is sent.

Identifier information: 11111b (5bit)

Return value : Error code shown in Table 4.2

Table 4.2 Error codes

No.	Error code	Error description	Remark
1	0	No corresponding command	
2	1	Argument outside setting range	
3	2	Argument is inconsistent	
4	3 224	The specified command is not valid	
5	4	Internal process busy	
6	5	Command to empty slot	
7	256	Checksum mismatch	

5. Hardware Specification of Extended-UART

5.1 Absolute maximum ratings for communication terminals

Table 5.1 shows the absolute maximum ratings of the Extended-UART terminals.

Table 5.1 Absolute maximum ratings

Terminal	Item	Min	Max	Unit	Remark
INFO - SGND	Applied voltage	-0.3	5.5	V	

5.2 Electrical characteristics of communication terminals

Table 5.2 shows the electrical characteristics of the Extended-UART terminals.

Table 5.2 Electrical characteristics

Terminal		Item	Min	Max	Unit	Remark
INFO - SGND	Signal output	High level output-voltage	open (No output)			
		High level output-current	open (No output)			
		Low level output-voltage	-	1.0	V	
		Low level output-current	-	-12.0	mA	
	Signal input	High level input-voltage	2.5	-	V	
		High level input-current	1.0	-	mA	
		Low level input-voltage	-	0.8	V	
		Low level input-current	-	0.5	mA	

The communication function terminals (INFO/SGND) are isolated from input, output and FG.

5.3 Wiring length

Table 5.3 shows the allowable wiring length for connecting the Extended-UART terminal and the master device.

Table 5.3 Allowable wire length

Terminal	Item	Min	Max	Unit	Remark
INFO/ SGND	Connection wiring length	-	20	m	

Use low inductance wiring such as twisted pair wire or parallel wire.
Because the communication signal may be delayed due to the parasitic capacitance and parasitic inductance depending on the wiring type, confirm that the delay is less than the rise and fall times shown in Section 5.4.

5.4 Electrical characteristics of communication signal

Table 5.4 shows the communication speed (baud rate) characteristics in the Extended-UART.

The allowable rise and fall times in the input signal (signal from master to slave) is shown in Table 5.5, and the rise and fall times in the output signal (signal from slave to master) is shown in Table 5.6.
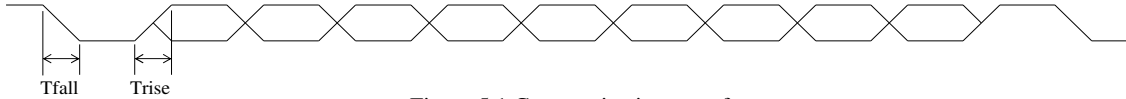
Figure 5.1 Communication waveform

Table 5.4 Specification of communication speed (baud rate)

Item	typ	Tolerance	Unit	Remark
Communication speed (baud rate)	2400	±2%	bps	

Table 5.5 Specification of input signal

Terminal	Item		Min	Max	Unit	Remark
INFO - SGND	Trise	Rise time	-	150	us	Time corresponding to change from 5% to 95%
	Tfall	Fall time	-	150	us	Time corresponding to change from 95% to 5%

In the case of signal input exceeding the allowable time, communication error may occur.

Table 5.6 Specification of output signal

Terminal	Item		Min	Max	Unit	Remark
INFO - SGND	Trise	Rise time	-	150	us	Time corresponding to change from 5% to 95%
	Tfall	Fall time	-	150	us	Time corresponding to change from 95% to 5%

6. Command specification of Extended-UART

6.1 Outline of each command

Table 6.1 shows the Command specification of Extended-UART.

Table 6.1 Outline of each command (1/2)

Command	Description	R/W
Commands for output-voltage ON/OFF		
CTL_REMOTE_ON	:Turns on the power output	W
CTL_REMOTE_OFF	:Turns off the power output	W
CTL_CH_REMOTE_ON	:Turns on the power output of the selected slots	W
CTL_CH_REMOTE_OFF	:Turns off the power output of the selected slots	W
READ_REMOTE_PRM	:Returns the output ON/OFF setting parameter of selected slot	R
READ_REMOTE_CH_PRM	:Returns the output ON/OFF setting parameter of all slots	R
READ_REMOTE_START_UP_PRM	:Returns the output ON/OFF setting initial parameter of all slots at AC input	R
CTL_RESET_LATCH	:Resets the latch state	W
Output-voltage sequence commands		
SET_TON_DELAY_RC	:Sets delay time for activation by communication	W
READ_TON_DELAY_RC_PRM	:Returns the current delay time for activation by communication	R
SET_TOFF_DELAY_RC	:Sets delay time for stopping by communication	W
READ_TOFF_DELAY_RC_PRM	:Returns the current delay time for stopping by communication	R
SET_START_UP_VIN_AC	:Sets the value of the start-up input voltage (AC)	W
READ_START_UP_VIN_AC_PRM	:Returns the current value of the start-up input voltage (AC)	R
SET_STOP_VIN_AC	:Sets the value of the stop input voltage (AC)	W
READ_STOP_VIN_AC_PRM	:Returns the current value of the stop input voltage (AC)	R
SET_ABN_STOP_CH	:Sets slots interlocking abnormal stop slot	W
READ_ABN_STOP_CH	:Returns the setting of the slots interlocking abnormal stop slot	R
Monitor commands		
MON_VIN	:Returns the value of input voltage	R
MON_VIN_FREQUENCY	:Returns the input-voltage frequency	R
MON_TEMPERATURE_1	:Returns the temperature of internal elements	R
State acquisition commands		
READ_STOP_CODE	:Returns the code indicating the stop status	R
READ_ALERT_CH	:Returns a slot in abnormal stop status	R
TOTAL_INPUT_TIME_1	:Returns the cumulative time of input voltage applied (minutes)	R
TOTAL_INPUT_TIME_2	:Returns the cumulative time of input voltage applied (lower 16 bits of hour)	R
TOTAL_INPUT_TIME_3	:Returns the cumulative time of input voltage applied (high-order 16 bits of hour)	R
TOTAL_OUTPUT_TIME_1	:Returns the cumulative output time (minutes)	R
TOTAL_OUTPUT_TIME_2	:Returns the cumulative output time (lower 16 bits of hour)	R
TOTAL_OUTPUT_TIME_3	:Returns the cumulative output time (high-order 16 bits of hour)	R

R : Read command　　W : Write command

Table 6.1 Outline of each command (2/2)

Commands for setting addresses, memories, and communications		
SET_SELECTION_CH	:Selects the slot for setting	W
READ_SELECTION_CH	:Returns the selected slot for setting	R
SET_WRITE_PROTECT_ON	:Enables protection for the Write command	W
SET_WRITE_PROTECT_OFF	:Disables protection for the Write command	W
READ_WRITE_PROTECT_PRM	:Returns protection parameters for the Write command	R
SYS_STORE_USER_SETTING	:Saves settings to the internal nonvolatile memory	W
SYS_RESTORE_FACTORY_SETTING	:Restores the setting to the factory default	W
CTL_ACCUMULATE_MODE_ON	:Enables the accumulation mode	W
CTL_ACCUMULATE_MODE_OFF	:Disables the accumulation mode	W
READ_ACCUMULATE_MODE	:Returns the setting status of the accumulation mode	R
CTL_ACCUMULATE_EXEC	:Execution command in the accumulation mode	W
CTL_ACCUMULATE_CLEAR	:Erases buffer in the accumulation mode	W
SET_ADDRESS	:Sets communication address	W
READ_ADDRESS_PRM	:Returns setting parameters of the communication address	R
Product information commands		
READ_SERIAL	:Returns the product serial number	R
READ_LOT_H	:Returns the upper three digits of the product lot number	R
READ_LOT_L	:Returns the lower four digits of the product lot number	R
Commands for product rated values		
READ_RATED_VOUT	:Returns the rated voltage of the model	R
READ_RATED_IOUT	:Returns the rated current of the model	R
READ_VIN_POINT	:Returns the decimal point position of the return value of command MON_VIN	R

R : Read command　　　W : Write command

The function and the setting method for each command are shown below.

Notation
6.x.x   **CTL_REMOTE_ON**   **[1Eh] [08h] [1Ch] [00h]**

Command name   Command parameters in communication frame
[0][2][3][4], hexadecimal

6.2 Output voltage ON/OFF commands

6.2.1   CTL_REMOTE_ON   [1Eh] [08h] [1Ch] [00h]

The command to control ON/OFF of the output voltage (remote control function).

With this command, all output voltages turn ON.

The setting at time of factory shipment is "all outputs are ON".

Return value	1

6.2.2   CTL_REMOTE_OFF   [1Eh] [08h] [1Ch] [01h]

The command to control ON/OFF of the output voltage (remote control function).

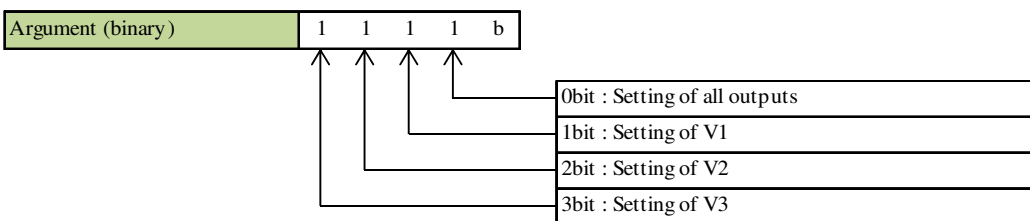With this command, all output voltages turn OFF.

Return value	0

6.2.3   CTL_CH_REMOTE_ON   [1Ah] [1Eh] [Argument]

The command to control ON/OFF of the output voltage (remote control function).

With this command, the output voltages of the selected slot turn ON. Sets the the slot by the argument.

The relationship between the argument (binary) and the controlled slots is shown below.

Argument (binary)	1	1	1	1	b

0bit : Setting of all outputs
1bit : Setting of V1
2bit : Setting of V2
3bit : Setting of V3

bit value	value : 1 => ON
	value : 0 => OFF

Specified range	0001 - 1111b		
Examples of argument	Argument : 0110b	=>	V1, V2 ON
	Argument : 0001b	=>	V1, V2, V3 ON
	Argument : 0100b	=>	V2 ON
Return value	Argument value		

If specified to only an empty slot, this command is not accepted and an error is returned. Error code (5 : Command to empty slot)

6.2.4　CTL_CH_REMOTE_OFF　　　[1Ah] [1Fh] [Argument]

The command to control ON/OFF of the output voltage (remote control function).

With this command, the output voltages of the selected slot turn OFF. Sets the the slot by the argument.

The relationship between the argument (binary) and the controlled slots is shown below.

Argument (binary)	1	1	1	1	b

- 0bit : Setting of all outputs
- 1bit : Setting of V1
- 2bit : Setting of V2
- 3bit : Setting of V3

bit value	value : 1	=>	OFF
	value : 0	=>	ON

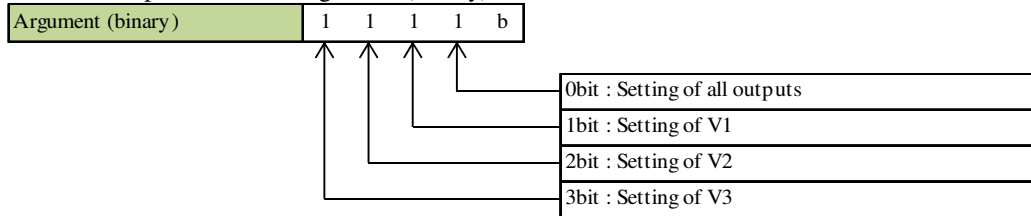| Specified range	0001 - 1111b		
Examples of argument	Argument : 1100b	=>	V2, V3　OFF
	Argument : 0001b	=>	V1, V2, V3　OFF
	Argument : 1000b	=>	V3　OFF
Return value	Argument value		

If specified to only an empty slot, this command is not accepted and an error is returned. Error code (5 : Command to empty slot)

6.2.5　READ_REMOTE_PRM　[1Eh] [09h] [1Eh] [08h]

SELECT

Returns the ON/OFF control status of the output voltage set by communication.

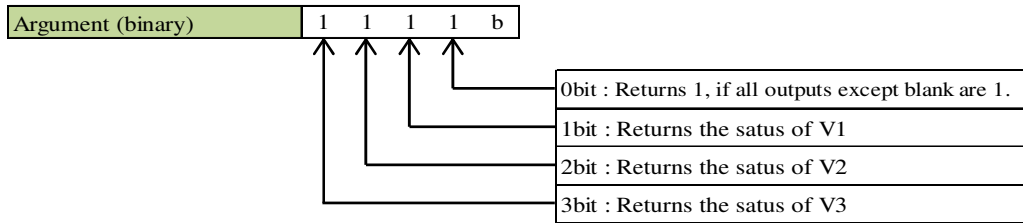| Status	Return value : 0	=>	OFF
	Return value : 1	=>	ON

After selecting the slot with the SET_SELECTION_CH command, returns the ON/OFF control status of the selected slot by sending this command.

The setting at time of factory shipment is "Slot1 (V1)".

6.2.6 READ_REMOTE_CH_PRM [1Eh] [09h] [1Eh] [09h]

Returns the ON/OFF control status of all output voltage set by communication.

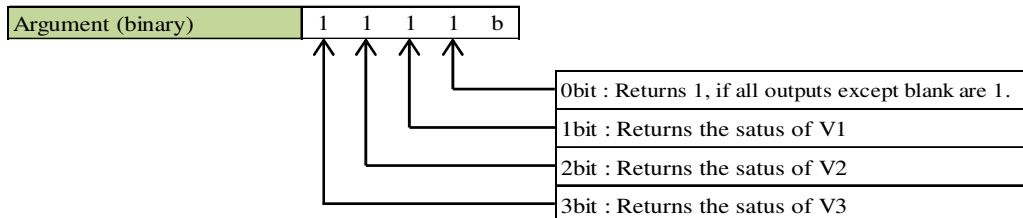The relationship between the argument (binary) and the controlled slots is shown below.

Argument (binary)	1	1	1	1	b

- 0bit : Returns 1, if all outputs except blank are 1.
- 1bit : Returns the satus of V1
- 2bit : Returns the satus of V2
- 3bit : Returns the satus of V3

Status	Return value : 0	=>	OFF
	Return value : 1	=>	ON
Return value	Argument : 1010b	=>	V1, V3 ON
	Argument : 1011b	=>	V1, V3 ON
			*If V2 is blank.
	Argument : 1111b	=>	V1, V2, V3 ON

6.2.7 READ_REMOTE_START_UP_PRM [1Eh] [09h] [1Eh] [0Ah]

Returns the ON/OFF control initial status of all output voltage at AC input.

The relationship between the argument (binary) and the controlled slots is shown below.

Argument (binary)	1	1	1	1	b

- 0bit : Returns 1, if all outputs except blank are 1.
- 1bit : Returns the satus of V1
- 2bit : Returns the satus of V2
- 3bit : Returns the satus of V3

Status	Return value:0	⇒	OFF
	Return value:1	⇒	ON
Return value	Argument: 1010b	⇒	V1, V3 ON
	Argument: 1011b	⇒	V1, V3 ON
			*If V2 is blank.
	Argument: 1111b	⇒	V1, V2, V3 ON

6.2.8 CTL_RESET_LATCH [1Eh] [08h] [1Eh] [1Fh]

The command to release the state of all outputs latch stop activated by the protection function for overvoltage.

Release should be executed after removal of the abnormal condition.

Return value	0

6.3 Output-voltage sequence commands

6.3.1   SET_TON_DELAY_RC   [0Fh] [Argument]

SELECT

 Sets the delay time [msec] from command reception from the master to activation
(Figure 6.3.1).

 The factory default setting is "0".

 The setting by this command causes a delay due to the processing time of the slave (RBC200F).
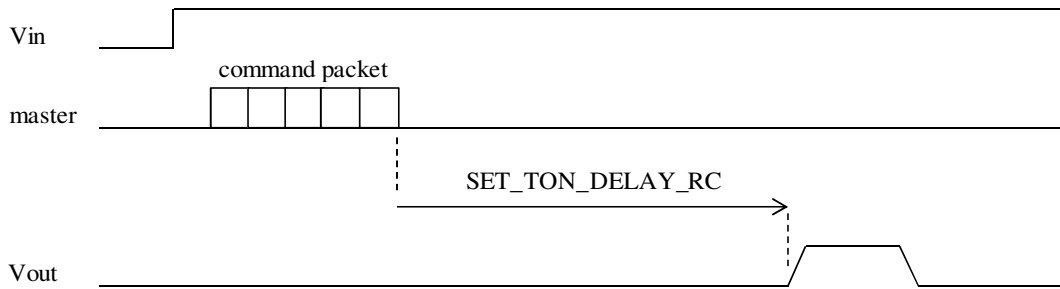
Figure 6.3.1 Timing diagram "SET_TON_DELAY_RC"

Specified range	0 - 39000
Examples of argument	Argument : 900 => 900 msec
Return value	Argument value

After selecting the slot with the SET_SELECTION_CH command, set delay time for activation by communication.

 When shipped from the factory, this command is set to slot 1 (V1).

6.3.2   READ_TON_DELAY_RC_PRM   [1Eh] [09h] [1Dh] [01h]

SELECT

 Returns the value (the argument value) set by the SET_TON_DELAY_RC command.

After selecting the slot with the SET_SELECTION_CH command, returns the current delay time for activation by communication.

The setting at time of factory shipment is "Slot1 (V1)".

6.3.3 SET_TOFF_DELAY_RC   [10h] [Argument]

`SELECT`

Sets the delay time [msec] from command reception from the master to stop (Figure 6.3.2).

The factory default setting is "0".

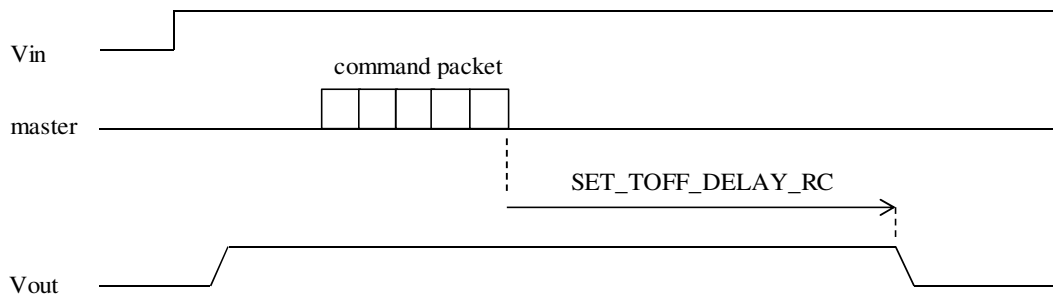The setting by this command causes a delay due to the processing time of the slave (RBC200F).

Figure 6.3.2 Timing diagram "SET_TOFF_DELAY_RC"

Specified range	0 - 39000
Examples of argument	Argument : 900 => 900 msec
Return value	Argument value

After selecting the slot with the SET_SELECTION_CH command, set delay time for stopping by communication.

The setting at time of factory shipment is "Slot1 (V1)".

6.3.4 READ_TOFF_DELAY_RC_PRM   [1Eh] [09h] [1Dh] [02h]

`SELECT`

Returns the value (the argument value) set by command SET_TOFF_DELAY_RC.

After selecting the slot with the SET_SELECTION_CH command, returns the current delay time for stopping by communication.

The setting at time of factory shipment is "Slot1 (V1)".

6.3.5 SET_START_UP_VIN_AC   [17h] [00h] [Argument]

Specifies the starting voltage for AC input.

After sending this command, send command SYS_STORE_USER_SETTING and block input for more than 20 seconds.

The settings will be effective from the next startup.

In this command, it is not possible to specify the value set by command SET_STOP_VIN_AC +5 V or less.

If specified, this command is not accepted and an error is returned. Error code (1 : Argument outside setting range)

Specified range	80 ~ 240VAC
Examples of argument	Argument : 170 => 170VAC
Return value	Argument value

When used at an input voltage of 90 V or less, additional load derating is required.

For details, refer to the RB series instruction manual.

6.3.6 READ_START_UP_VIN_AC_PRM [1Eh] [09h] [1Ch] [00h]

Returns the value (the argument value) set by command SET_START_UP_VIN_AC.

6.3.7 SET_STOP_VIN_AC [17h] [01h] [Argument]

Specifies the stop voltage for AC input.

After sending this command, send command SYS_STORE_USER_SETTING and block input for more than 20 seconds.

The settings will be effective from the next startup.

In this command, it is not possible to specify the value set by command SET_START_UP_VIN_AC - 5 V or more.

If specified, this command is not accepted and an error is returned. Error code (1 : Argument outside setting range)

Specified range	75 ~ 150VAC
Examples of argument	argument : 90 => 90VAC
Return value	argument value

When used at an input voltage of 90 V or less, additional load derating is required.

For details, refer to the RB series instruction manual.

6.3.8 READ_STOP_VIN_AC_PRM [1Eh] [09h] [1Ch] [01h]
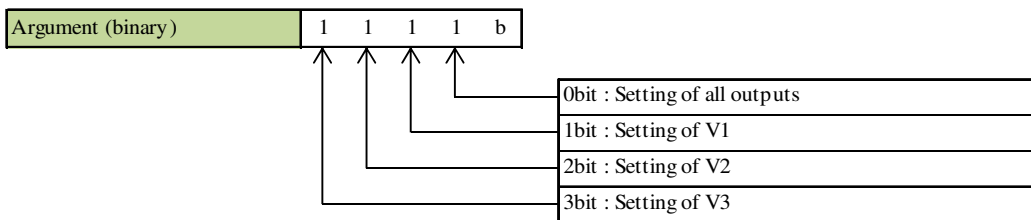
Returns the value (the argument value) set by command SET_STOP_VIN_AC.

6.3.9 SET_ABN_STOP_CH [1Ah] [1Dh] [Argument] SELECT

After selecting the slot with the SET_SELECTION_CH command, set the status of slots to be latch stopped interlockingly when the selected slot is abnormally stopped.

The setting at time of factory shipment is "Slot1 (V1)".

Argument (binary)	1	1	1	1	b

0bit : Setting of all outputs
1bit : Setting of V1
2bit : Setting of V2
3bit : Setting of V3

bit value	Return value : 0 => not latch stop interlockingly
	Return value : 1 => latch stop interlockingly

Examples of argument	Select : 1, Argument : 1000b
	                => V3 latch stops when V1 stops abnormally.
	 Select : 3, Argument : 0001b
	                => V1, V2 latch stops when V3 stops abnormally.

If specified to only an empty slot, this command is not accepted and an error is returned. Error code (5 : Command to empty slot)

6.3.10 READ_ABN_STOP_CH [1Eh] [09h] [1Eh] [1Ch] SELECT

After selecting the slot with the SET_SELECTION_CH command, returns the setting of the slots interlocking abnormal stop slot.

The setting at time of factory shipment is "Slot1 (V1)".

6.4 Monitor commands

6.4.1   MON_VIN   [1Eh] [08h] [00h] [01h]
Returns the effective value of the input voltage.
"Returned value / 100" becomes the input voltage [V].
Correct values may not be returned for input with distorted waveforms.

Examples of return value	Return value : 24010 => AC240.10V

6.4.2   MON_VIN_FREQUENCY   [1Eh] [08h] [00h] [1Fh]
Returns the frequency of the input voltage.
"Returned value / 10" is the frequency [Hz] of the input voltage.
It will remain unsettled for about five seconds from input.

Range	450 - 660 => 45.0 ~ 66.0Hz
Examples of return value	Return value : 481 => 48.1Hz

6.4.3   MON_TEMPERATURE_1   [1Eh] [08h] [0Eh] [00h]
Returns the internal-element temperature.
The internal temperature of the power supply is displayed higher than the ambient temperature,
because it receives convection from the heat generating components.
Also, the measurement temperature is greatly affected by the mounting direction of the power supply.
The returned value (signed hexadecimal number) is the temperature [℃].

Range	-30 ~ 100℃

Examples of return value	Return value : "0000 0000 0001 1001" => +25℃
	          "25" => 25℃
	Return value : "1111 1111 1110 0111" => -25℃
	          "65511" => 65511 - 65536 => -25℃

6.5 Status commands

6.5.1 READ_STOP_CODE   [1Eh] [09h] [1Eh] [10h]

SELECT

Returns the code indicating the cause of the stop.

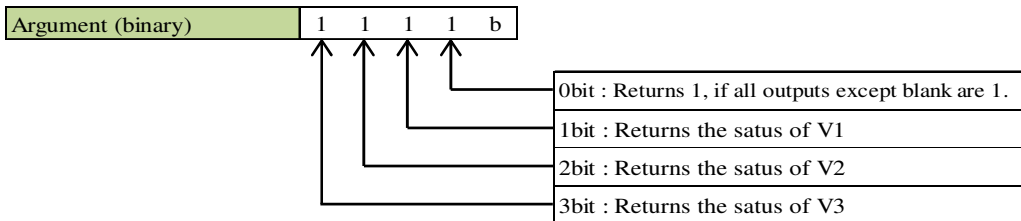| Stop code	Cause of stop
000	Has not stopped
002	Stops by command REMOTE_OFF
010	Stops due to input voltage drop
050	Stops by activation of overcurrent protection
101	Stops due to output overvoltage
242	
222	Stops by command SET_ABN_STOP_CH
240	Stops due to continuation of over current protection

In the case of a stop code not listed above, power failure may be responsible.

After selecting the slot with the SET_SELECTION_CH command, returns the code indicating the stop status of selected slot.

The setting at time of factory shipment is "Slot1 (V1)".

6.5.2 READ_ALERT_CH   [1Eh] [09h] [1Eh] [15h]

Returns the slots in the latch stop state.

Argument (binary)	1	1	1	1	b

0bit : Returns 1, if all outputs except blank are 1.

1bit : Returns the satus of V1

2bit : Returns the satus of V2

3bit : Returns the satus of V3

bit and setting	Return value : 0	=>	not latch stop
	Return value : 1	=>	latch stop
Examples of argument	Return value : 1010b	⇒	V1, V3 are latch stopped
	Return value : 1011b	⇒	V1, V3 are latch stopped *If V2 is blank.
	Return value : 1111b	⇒	V1, V2, V3 are latch stopped

6.5.3 TOTAL_INPUT_TIME

 Returns the cumulative time of input-voltage loading up to the present, recorded in the nonvolatile memory of the RB.

 The returned value of TOTAL_INPUT_TIME_1 represents "minute", which is reset to "0" every 60 minutes.

 The returned values of TOTAL_INPUT_TIME_2 and TOTAL_INPUT_TIME_3 represent the cumulative input time (units: hour) as 32 bits data in such a way that the lower 16 bits are contained in the former and the high-order 16 bits in the latter.

 Information less than one minute immediately before input cutoff may not be recorded.

TOTAL_INPUT_TIME_1   [1Eh] [08h] [10h] [00h]

Range	0 ~ 59 minutes
Examples of return value	Return value : 57 => 57 minutes

TOTAL_INPUT_TIME_2   [1Eh] [08h] [10h] [01h]
TOTAL_INPUT_TIME_3   [1Eh] [08h] [10h] [02h]

Range	0 ~ 2^{32}-1 hours (Theoretical value)	
Constitution	Lower 16 bits : TOTAL_INPUT_TIME_2 (0 ~ 65,535 hours)
	High-order 16 bits : TOTAL_INPUT_TIME_3

6.5.4 TOTAL_OUTPUT_TIME

 Returns the cumulative output time up to the present, recorded in the nonvolatile memory of the RB.

 The returned value of TOTAL_OUTPUT_TIME_1 represents "minute", which is reset to "0" every 60 minutes.

 The returned values of TOTAL_OUTPUT_TIME_2 and TOTAL_OUTPUT_TIME_3 represent the cumulative output time (units: hour) as 32 bits data in such a way that the lower 16 bits are contained in the former and the high-order 16 bits in the latter.

 Information less than one minute immediately before input cutoff may not be recorded.

TOTAL_OUTPUT_TIME_1   [1Eh] [08h] [11h] [00h]

Range	0 ~ 59 minutes
Examples of return value	Return value : 57 => 57 minutes

TOTAL_OUTPUT_TIME_2   [1Eh] [08h] [11h] [01h]
TOTAL_OUTPUT_TIME_3   [1Eh] [08h] [11h] [02h]

Range	0 ~ 2^{32}-1 hours (Theoretical value)	
Constitution	Lower 16 bits : TOTAL_OUTPUT_TIME_2 (0 ~ 65,535 hours)
	High-order 16 bits : TOTAL_OUTPUT_TIME_3

6.6 Commands for setting address, memory, and communication

6.6.1 SET_SELECTION_CH [1Ah] [1Ch] [Argument]

After selecting the target slot with this command, sending the corresponding
command enables the setting of any slot and the return of the setting status.
The setting at time of factory shipment is "Slot1 (V1)".

The following symbol marks are displayed on commands that assume input of this command.

SELECT

Example:

> 6.3.2 READ_TON_DELAY_RC_PRM [1Eh] [09h] [1Dh] [01h] SELECT
> Returns the value (the argument value) set by the SET_TON_DELAY_RC command.

The command corresponding to this command is shown below.

Extended-UART commands	Outline
READ_REMOTE_PRM	Returns all output ON/OFF status
READ_SELECTION_CH	Returns the selected slot for setting
SET_TON_DELAY_RC	Sets delay time for activation by communication
READ_TON_DELAY_RC_PRM	Returns the current delay time for activation by communication
SET_TOFF_DELAY_RC	Sets delay time for stopping by communication
READ_TOFF_DELAY_RC_PRM	Returns the current delay time for stopping by communication
SET_ABN_STOP_CH	Sets slots interlocking abnormal stop slot
READ_ABN_STOP_CH	Returns the setting of the slots interlocking abnormal stop slot
READ_STOP_CODE	Returns the code indicating the stop status
READ_RATED_VOUT	Returns the rated voltage of the model
READ_RATED_IOUT	Returns the rated current of the model

Specified range	1 - 3		
Examples of argument	Argument : 1	=>	Select slot is V1.
	Argument : 2	=>	Select slot is V2.
	Argument : 3	=>	Select slot is V3.
Return value	Argument value		

If specified to only an empty slot, this command is not accepted and an error is returned. Error
code (5 : Command to empty slot)

6.6.2 READ_SELECTION_CH [1Eh] [09h] [1Fh] [00h]

SELECT

Returns the slot selected by the SET_SELECTION_CH command

Examples of argument	Argument : 1	=>	V1 is selected.
	Argument : 2	=>	V2 is selected.
	Argument : 3	=>	V3 is selected.

6.6.3 SET_WRITE_PROTECT_ON [1Eh] [09h] [05h] [01h]

Disables the Write command (see Table 6.1).
As an exception, commands SET_WRITE_PROTECT_OFF, SYS_STORE_USER_SETTING, CTL_ACCUMULATE_EXEC, and SET_SELECTION_CH are accepted.

Return value	1

6.6.4 SET_WRITE_PROTECT_OFF [1Eh] [09h] [05h] [02h]

Removes protection set by SET_WRITE PROTECT_ON.
At time of factory shipment, this mode is set as the default.

Return value	0

6.6.5 READ_WRITE_PROTECT_PRM [1Eh] [09h] [15h] [00h]

Returns the current write-protection mode

Status	Return value : 0 => OFF
	Return value : 1 => ON

Table 6.6.1 "SET_WRITE_PROTECT_ON" Operation example (RBC200F)

	Operation	Return value	RB Output
1	Input voltage on	-	ON
2	Send "**CTL_REMOTE_OFF**"	0	OFF
3	Send "**SET_WRITE_PROTECT_ON**"	1	OFF
4	Send "**CTL_REMOTE_ON**"	224 *	OFF
5	Send "**SET_WRITE_PROTECT_OFF**"	0	OFF
6	Send "**CTL_REMOTE_ON**"	1	ON

*Error code 224 : The specified command is not valid

6.6.6 SYS_STORE_USER_SETTING [1Eh] [09h] [00h] [10h]

The values and settings set by the communication function are recorded in the nonvolatile memory of the RB.

Values and settings remain effective even when the input voltage is cut off and then turned on.

The command corresponding to this command is shown below.

Extended-UART commands	Outline
CTL_REMOTE_XX	all output ON/OFF status
CTL_CH_REMOTE_XX	all output ON/OFF status
SET_TON_DELAY_RC	delay time for activation by communication
SET_TOFF_DELAY_RC	delay time for stopping by communication
SET_START_UP_VIN_AC	start-up input voltage (AC)
SET_STOP_VIN_AC	stop input voltage (AC)
SET_ABN_STOP_CH	the setting of the slots interlocking abnormal stop slot
SET_SELECTION_CH	the slot for setting
SET_WRITE_PROTECT_XX	the current write-protection mode
CTL_ACCUMULATE_MODE_XX	setting status of the accumulate mode
SET_ADDRESS	setting the communication address

XX = ON or OFF.

Return value	1

Multiple items are recorded at the same time.

However, the values set after sending this command will not be recorded.

Do not cut off input for at least five seconds after this command is executed. Otherwise, it may not properly be recorded in the nonvolatile memory.

6.6.7   SYS_RESTORE_FACTORY_SETTING   [1Eh] [09h] [01h] [1Fh]

 The values and settings recorded in the nonvolatile memory of the RB, using command SYS_STORE_USER_SETTING, are reset to the factory defaults.

Return value	0

 Even if this command is sent, the setting will not return to the factory default while the input voltage is being applied.
 The factory defaults become effective only when the input voltage is cut off and then restarted, after sending this command.
 Do not cut off the input for at least five seconds after this command is executed. Otherwise, it may not properly be recorded in the nonvolatile memory.

 Do not send the SYS_STORE_USER_SETTING command and the SYS_RESTORE_FACTORY_SETTING command continuously within 5 seconds. If the process is not complete, this command is not accepted and an error is returned. Error code (4 : Internal process busy)

Table 6.6.2 "SYS_STORE_USER_SETTING" Operation example 1 (RBC200F)

	Operation	Return value	ON/OFF setting *1
1	Input voltage on	-	1111b
2	Send "**CTL_CH_REMOTE_OFF**" & "1010b"	1010b	0100b
3	Send "**SYS_STORE_USER_SETTING**"	1	0100b
4	Input voltage off	-	-
5	Input voltage on	-	0100b
6	Send "**SYS_RESTORE_FACTORY_SETTING**"	0	0100b
7	Input voltage off	-	-
8	Input voltage on	-	1111b

*1   When confirmed by the READ_REMOTE_CH_PRM command

Table 6.6.3 "SYS_STORE_USER_SETTING" Operation example 2 (RBC200F)

	Operation	Return value	ON/OFF setting *2
1	Input voltage on	-	1111b
2	Send "**CTL_CH_REMOTE_OFF**" & "1010b"	1010b	1111b
3	Send "**SYS_STORE_USER_SETTING**"	1	0100b
4	Input voltage off	-	-
5	Input voltage on	-	0100b
6	Send "**SYS_RESTORE_FACTORY_SETTING**"	0	1111b
7	Input voltage off	-	-
8	Input voltage on	-	1111b

*2   When confirmed by the READ_REMOTE_START_UP_PRM command

6.6.8 CTL_ACCUMULATE_MODE_ON [1Eh] [08h] [1Ch] [10h]

Activates the accumulate mode.

By sending this command, the accumulate mode is set in which the Write command is not executed immediately.As an exception, commands CTL_ACCUMULATE_EXEC and CTL_ACCUMULATE_CLER are immediately executed.

Return value	1

In the accumulate mode, the Write command is buffered internally and is not immediately reflected in the product operation. By sending command CTL_ACCUMULATE_EXEC, the command in the buffer becomes effective in the operation.

The buffer is overwritten and contains only a single command.

Because no internal processing is performed at the time of buffering, software errors (see Section 4.7) other than checksum errors are not returned.

The contents of the buffer are not recorded in the nonvolatile memory.

6.6.9 CTL_ACCUMULATE_MODE_OFF [1Eh] [08h] [1Ch] [11h]

Disables the accumulation mode.

At time of factory shipment, this mode is set as the default.

Return value	0

6.6.10 READ_ACCUMULATE_MODE [1Eh] [08h] [1Ch] [12h]

Returns setting status of the accumulate mode.

Status	Return value : 0 => Disables the accumulation mode
	Return value : 1 => Activates the accumulate mode

6.6.11 CTL_ACCUMULATE_EXEC [1Eh] [08h] [1Ch] [13h]

When the accumulate mode is enabled, the command contained in the buffer is executed by sending this command. The return value is that of the buffered command.

"1Eh" indicating this command is returned for the identifier information.

If this command is sent with the buffer empty, an error will be returned.

Return value	That of the buffered command

6.6.12 CTL_ACCUMULATE_CLEAR [1Eh] [08h] [1Ch] [14h]

Deletes contents of the buffer.

Return value	0

Table 6.6.4 "CTL_ACCUMULATE_MODE_ON" Operation example (RBC200F)

	Operation	Return value	RB Output
1	Input voltage on	-	ON
2	Send "**CTL_REMOTE_OFF**"	0	OFF
3	Send "**CTL_ACCUMULATE_MODE_ON**"	1	OFF
4	Send "**CTL_REMOTE_ON**"	1	OFF
5	Send "**READ_REMOTE_PRM**"	0	OFF
6	Send "**CTL_ACCUMULATE_EXEC**"	1	ON

6.6.13　SET_ADDRESS　　[1Ah] [10h] [Argument]

Selects the method of setting the communication address and the address.

Sets the communication address to the value specified by the argument.

The address of the reply packet is that specified by this command.

The setting at time of factory shipment is "7".

Specified range	1 - 7
Examples of argument	Argument : 1　　=>　　Address is 1

6.6.14　READ_ADDRESS_PRM　[1Eh] [09h] [19h] [10h]

Returns the value (the argument value) set with command SET_ADDRESS.

6.7   Product information commands

6.7.1   READ_SERIAL   [1Eh] [09h] [10h] [00h]

Returns the serial number in the lot, unique to the product.

Range	000 - 999

6.7.2   READ_LOT_H   [1Eh] [09h] [10h] [01h]

Returns the upper three digits of the product lot number.

Range	001 - 954

6.7.3   READ_LOT_L   [1Eh] [09h] [10h] [02h]

Returns the lower four digits of the product lot number.

Range	0000 - 9999

6.7.4   READ_RATED_VOUT   [1Eh] [09h] [11h] [00h]   SELECT

Returns the rated voltage of the model.
"Returned value / 1000" is the rated output voltage [V].

Examples of return value	Return value : 12000 => 12V
	Return value : 5000 => 5V

 After selecting the slot with the SET_SELECTION_CH command, returns the rated voltage value of the selected slot.
The setting at time of factory shipment is "Slot1 (V1)".

6.7.5   READ_RATED_IOUT   [1Eh] [09h] [11h] [01h]   SELECT

 Returns the rated current of the model.
 "Returned value / 100" is the rated output current [A].

Examples of return value	Return value : 600 => 6A
	Return value : 65 => 0.65A

 After selecting the slot with the SET_SELECTION_CH command, returns the rated current value of the selected slot.
The setting at time of factory shipment is "Slot1 (V1)".

6.7.6   READ_VIN_POINT   [1Eh] [09h] [12h] [00h]

Returns the position of the decimal point of the returned value of command MON_VIN by the number of digits after the decimal point.

Return value	2

Appendix1. List of Extended-UART commands

Appendix 1 Lists of Extended UART commands (1/2)

Extended-UART commands	Command type	code [Hexadecimal]				Remark
Output voltage ON/OFF commands						
CTL_REMOTE_ON	20bit	1Eh	08h	1Ch	00h	
CTL_REMOTE_OFF	20bit	1Eh	08h	1Ch	01h	
CTL_CH_REMOTE_ON	10bit	1Ah	1Eh	[Argument]		
CTL_CH_REMOTE_OFF	10bit	1Ah	1Fh	[Argument]		
READ_REMOTE_PRM	20bit	1Eh	09h	1Eh	08h	
READ_REMOTE_CH_PRM	20bit	1Eh	09h	1Eh	09h	
READ_REMOTE_START_UP_PRM	20bit	1Eh	09h	1Eh	0Ah	
CTL_RESET_LATCH	20bit	1Eh	08h	1Eh	1Fh	
Output-voltage setting commands						
SET_TON_DELAY_RC	5bit	0Fh		[Argument]		
READ_TON_DELAY_RC_PRM	20bit	1Eh	09h	1Dh	01h	
SET_TOFF_DELAY_RC	5bit	10h		[Argument]		
READ_TOFF_DELAY_RC_PRM	20bit	1Eh	09h	1Dh	02h	
SET_START_UP_VIN_AC	10bit	17h	00h	[Argument]		
READ_START_UP_VIN_AC_PRM	20bit	1Eh	09h	1Ch	00h	
SET_STOP_VIN_AC	10bit	17h	01h	[Argument]		
READ_STOP_VIN_AC_PRM	20bit	1Eh	09h	1Ch	01h	
SET_ABN_STOP_CH	10bit	1Ah	1Dh	[Argument]		
READ_ABN_STOP_CH	20bit	1Eh	09h	1Eh	1Ch	
Monitor commands						
MON_VIN	20bit	1Eh	08h	00h	01h	
MON_VIN_FREQUENCY	20bit	1Eh	08h	00h	1Fh	
MON_TEMPERATURE_1	20bit	1Eh	08h	0Eh	00h	
Status commands						
READ_STOP_CODE	20bit	1Eh	09h	1Eh	10h	
READ_ALERT_CH	20bit	1Eh	09h	1Eh	15h	
TOTAL_INPUT_TIME_1	20bit	1Eh	08h	10h	00h	
TOTAL_INPUT_TIME_2	20bit	1Eh	08h	10h	01h	
TOTAL_INPUT_TIME_3	20bit	1Eh	08h	10h	02h	
TOTAL_OUTPUT_TIME_1	20bit	1Eh	08h	11h	00h	
TOTAL_OUTPUT_TIME_2	20bit	1Eh	08h	11h	01h	
TOTAL_OUTPUT_TIME_3	20bit	1Eh	08h	11h	02h	

Appendix 1 Lists of Extended UART commands (2/2)

Extended-UART commands	Command type	code [Hexadecimal]				Remark
Commands for setting address, memory, and communication						
SET_SELECTION_CH	10bit	1Ah	1Ch	[Argument]		
READ_SELECTION_CH	20bit	1Eh	09h	1Fh	00h	
SET_WRITE_PROTECT_ON	20bit	1Eh	09h	05h	01h	
SET_WRITE_PROTECT_OFF	20bit	1Eh	09h	05h	02h	
READ_WRITE_PROTECT_PRM	20bit	1Eh	09h	15h	00h	
SYS_STORE_USER_SETTING	20bit	1Eh	09h	00h	10h	
SYS_RESTORE_FACTORY_SETTING	20bit	1Eh	09h	01h	1Fh	
CTL_ACCUMULATE_MODE_ON	20bit	1Eh	08h	1Ch	10h	
CTL_ACCUMULATE_MODE_OFF	20bit	1Eh	08h	1Ch	11h	
READ_ACCUMULATE_MODE	20bit	1Eh	08h	1Ch	12h	
CTL_ACCUMULATE_EXEC	20bit	1Eh	08h	1Ch	13h	
CTL_ACCUMULATE_CLEAR	20bit	1Eh	08h	1Ch	14h	
SET_ADDRESS	10bit	1Ah	10h	[Argument]		
READ_ADDRESS_PRM	20bit	1Eh	09h	19h	10h	
Product information commands						
READ_SERIAL	20bit	1Eh	09h	10h	00h	
READ_LOT_H	20bit	1Eh	09h	10h	01h	
READ_LOT_L	20bit	1Eh	09h	10h	02h	
READ_RATED_VOUT	20bit	1Eh	09h	11h	00h	
READ_RATED_IOUT	20bit	1Eh	09h	11h	01h	
READ_VIN_POINT	20bit	1Eh	09h	12h	00h	

Appendix2. Support and precision

Appendix 2 Support and precision (1/2)

Extended-UART commands	Support/precision (Ta=25°C Vo:100%)				Note
	RBC200F	RBC300F	-	-	
Output voltage ON/OFF commands					
CTL_REMOTE_ON	○	○	-	-	
CTL_REMOTE_OFF	○	○	-	-	
CTL_CH_REMOTE_ON	○	○	-	-	
CTL_CH_REMOTE_OFF	○	○	-	-	
READ_REMOTE_PRM	○	○	-	-	
READ_REMOTE_CH_PRM	○	○	-	-	
READ_REMOTE_START_UP_PRM	○	○	-	-	
CTL_RESET_LATCH	○	○	-	-	
Output-voltage sequence commands					
SET_TON_DELAY_RC	±2%*1	±2%*1	-	-	*1 ±2% or ±50msec
READ_TON_DELAY_RC_PRM	○	○	-	-	
SET_TOFF_DELAY_RC	±2%*1	±2%*1	-	-	*1 ±2% or ±50msec
READ_TOFF_DELAY_RC_PRM	○	○	-	-	
SET_START_UP_VIN_AC	±3%FS	±3%FS	-	-	
READ_START_UP_VIN_AC_PRM	○	○	-	-	
SET_STOP_VIN_AC	±3%FS	±3%FS	-	-	
READ_STOP_VIN_AC_PRM	○	○	-	-	
SET_ABN_STOP_CH	○	○	-	-	
READ_ABN_STOP_CH	○	○	-	-	
Monitor commands					
MON_VIN	±3%FS	±3%FS	-	-	
MON_VIN_FREQUENCY	±0.5Hz	±0.5Hz	-	-	
MON_TEMPERATURE_1	±5deg*2	±5deg*2	-	-	
Status commands					
READ_STOP_CODE	○	○	-	-	
READ_ALERT_CH	○	○	-	-	
TOTAL_INPUT_TIME_1	○	○	-	-	
TOTAL_INPUT_TIME_2	○	○	-	-	
TOTAL_INPUT_TIME_3	○	○	-	-	
TOTAL_OUTPUT_TIME_1	○	○	-	-	
TOTAL_OUTPUT_TIME_2	○	○	-	-	
TOTAL_OUTPUT_TIME_3	○	○	-	-	

*2 The value at 20 to 100°C. Indicates the accuracy to the actual temperature of the measurement point.

Appendix 2 Support and precision (2/2)

Extended-UART commands	Support/precision (Ta=25℃ Vo:100%）				Note
	RBC200F	RBC300F	-	-	
Commands for setting address, memory, and communication					
SET_SELECTION_CH	○	○	-	-	
READ_SELECTION_CH	○	○	-	-	
SET_WRITE_PROTECT_ON	○	○	-	-	
SET_WRITE_PROTECT_OFF	○	○	-	-	
READ_WRITE_PROTECT_PRM	○	○	-	-	
SYS_STORE_USER_SETTING	○	○	-	-	
SYS_RESTORE_FACTORY_SETTING	○	○	-	-	
CTL_ACCUMULATE_MODE_ON	○	○	-	-	
CTL_ACCUMULATE_MODE_OFF	○	○	-	-	
READ_ACCUMULATE_MODE	○	○	-	-	
CTL_ACCUMULATE_EXEC	○	○	-	-	
CTL_ACCUMULATE_CLEAR	○	○	-	-	
SET_ADDRESS	○	○	-	-	
READ_ADDRESS_PRM	○	○	-	-	
Product information commands					
READ_SERIAL	○	○	-	-	
READ_LOT_H	○	○	-	-	
READ_LOT_L	○	○	-	-	
READ_RATED_VOUT	○	○	-	-	
READ_RATED_IOUT	○	○	-	-	
READ_VIN_POINT	○	○	-	-	

A. Revision history

No.	Date	Ver	Page	note
1	2019.05.31	1.0E	-	First edition issued
2	2021.03.04	1.1E	1,app-3, app-4	Update for RBC300F
			2	Change of recommended component
			4	3.2 has been added
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