COSEL

PCA Series
Extended-UART Manual

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PCA 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 PCA 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 PCA series

Tables 2.1 and 2.2 show the pin names and functions of this product, related to the Extended-UART.

Table 2.1 CN1, CN2 Extended-UART related pin function

Pin number	Pin name	Function
7	INFO	Extended-UART signal
10	SGND	Signal ground

* Each terminal of CN1 and CN2 are connected inside PCA series.

Table 2.2 CN4 Extended-UART related pin function

Pin number	Pin name	Function
5	ADDR0	Address bit 0
6	ADDR1	Address bit 1
7	ADDR2	Address bit 2
8	SGND	Signal ground

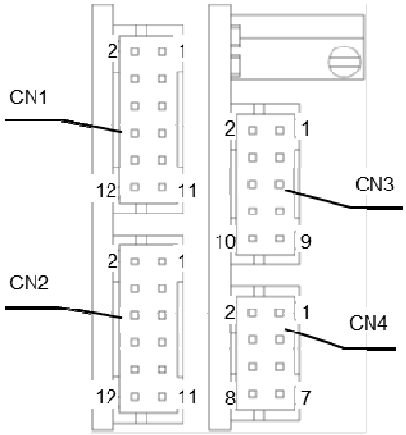
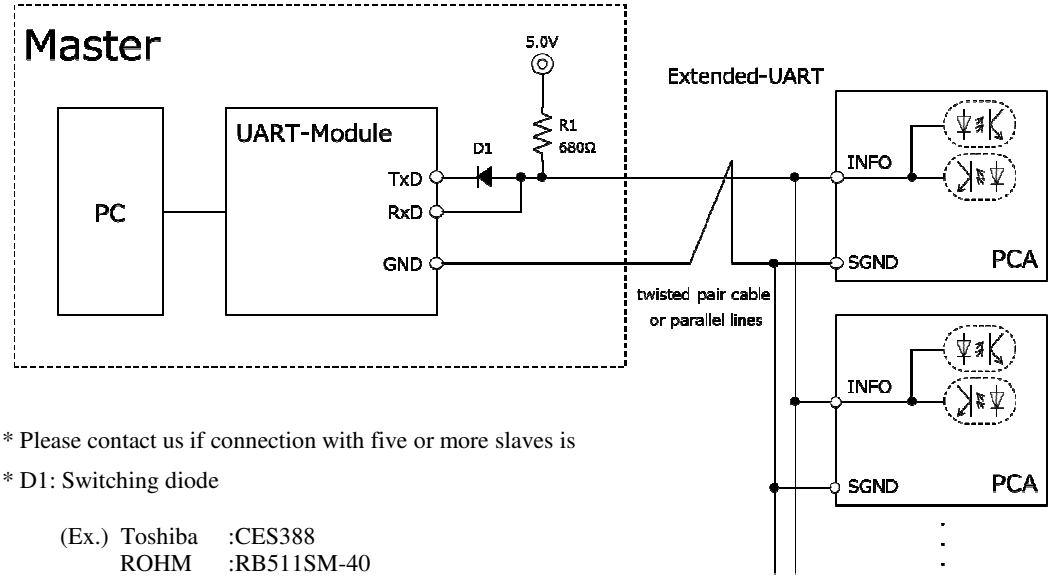


Figure 2.1 PCA series connector

2.2 Connection method

Figure 2.2 shows an example of connection using the Extended-UART.



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

* D1: Switching diode

(Ex.) Toshiba :CES388
ROHM :RB511SM-40
Panasonic :DB2S30900L

* 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 2.2 Example of Extended-UART connection

2.3 Internal circuit and pull-up recommended value

2.3.1 Internal circuit

Figure 2.3 shows internal circuit of INFO.
The communication function terminals (INFO/SGND) are isolated from the various function terminals (except DS/ADDR), and input, output, FG, and AUX terminals.

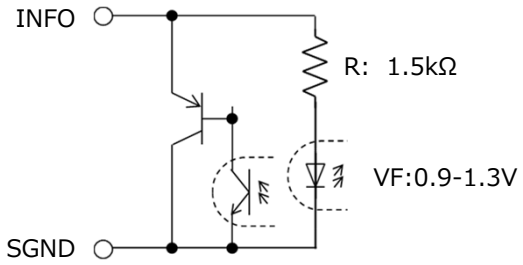


Figure 2.3 Internal circuit of INFO

2.3.2 Pull-up recommended value

A pull-up resistor must be connected to the communication line.
Table 2.3 shows recommended values of pull-up voltage and pull-up resistor.

Table 2.3 Pull-up recommended value

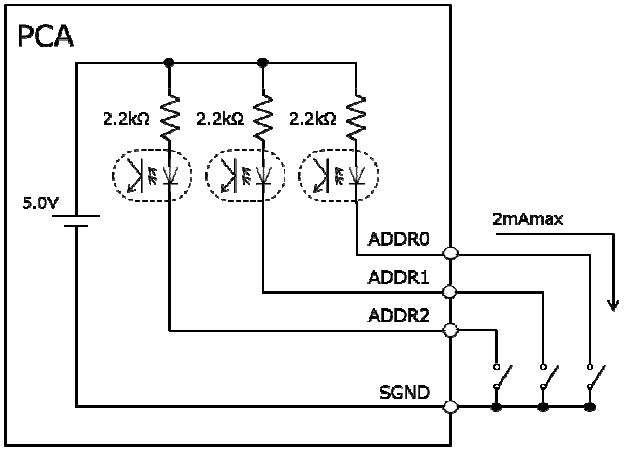
No.	Item	Unit	Value	Remark
1	Pull-up voltage	V	5	
2	Pull-up resistance	Ω	680	

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

Table 2.4 Voltage of high level by number of connedtions

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

2.4 Address setting



ADDR2	ADDR1	ADDR0	Address
0	0	0	-
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

0：Short 1：Open

Figure 2.3 Method of address setting

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

The address can be set by selecting the connection between the address setting pins (ADDR0, ADDR1, ADDR2) and the signal ground (SGND).

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 bit
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 3ms after receiving the reply packet.
If the wait time is short, the slave cannot 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.

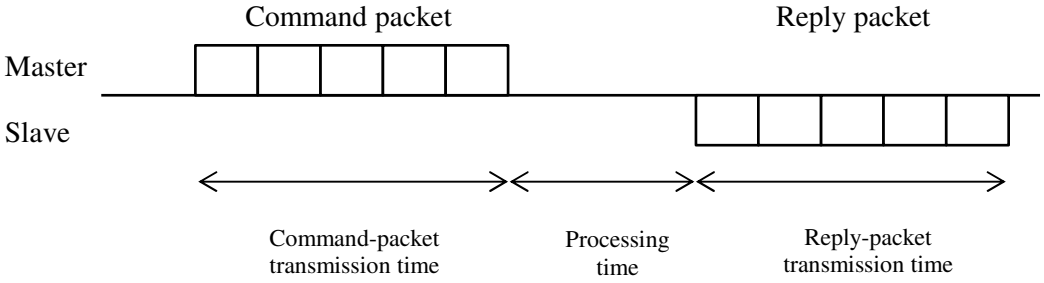


Figure 4.1 Overview of communication operation

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).

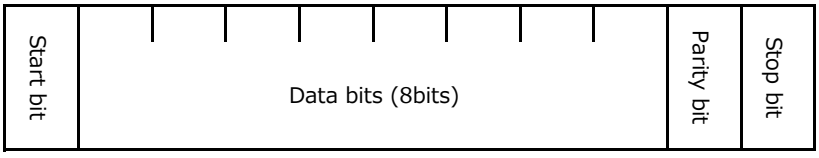


Figure 4.2 Structure of communication frame

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.

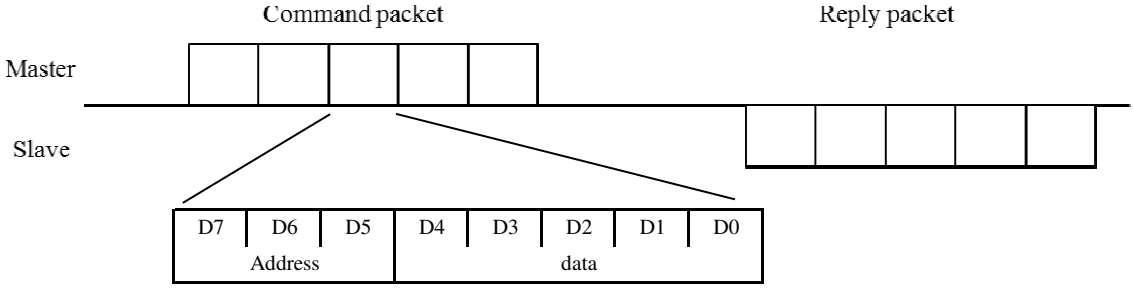


Figure 4.3 Structure of data bit

【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.

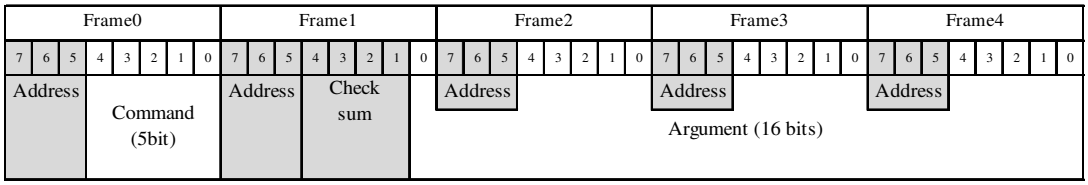


Figure 4.6 Data format of 5-bit command

(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.

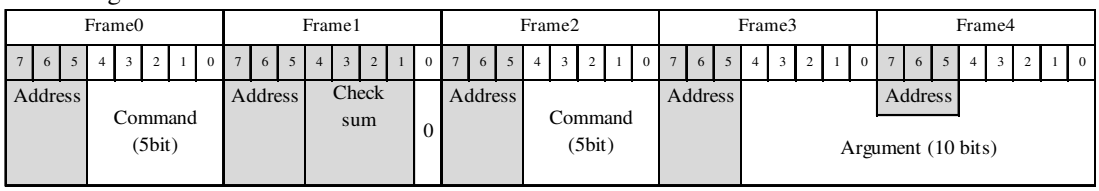


Figure 4.7 Data format of 10-bit command

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.

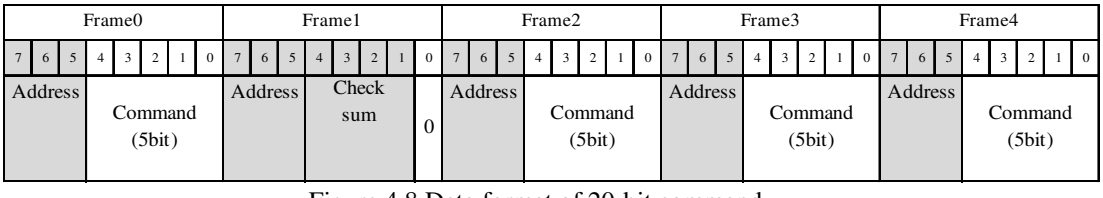


Figure 4.8 Data format of 20-bit command

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.

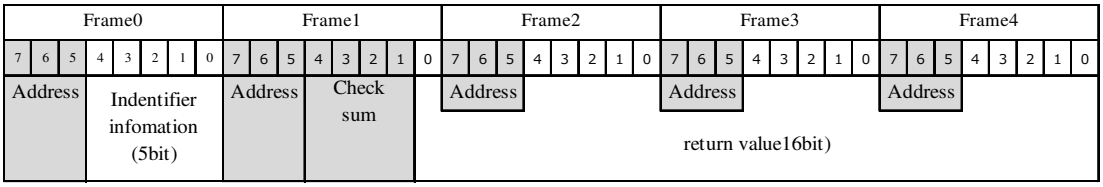


Figure 4.9 Data format of reply packet

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.

because 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	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 the various function terminals (except DS/ADDR), and input, output, FG, and AUX terminals.

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 parasiti 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.

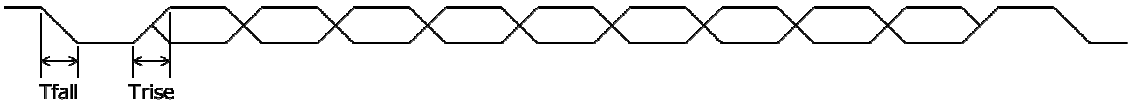


Figure 5.1 Communication waveform

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 Outline of each command (1/3)

Commands for output-voltage ON/OFF		
CTL_REMOTE_ON	:Turns on the power output	W
CTL_REMOTE_OFF	:Turns off the power output	W
READ_REMOTE_PRM	:Returns the power-output ON/OFF setting parameter by communication	R
READ_REMOTE_CONTROL	:Returns the output ON/OFF status	R
CTL_RESET_LATCH	:Resets the latch state	W
Commands for setting output voltage		
SET_VOUT	:Specifies the output voltage	W
READ_VOUT_PRM	:Returns the output-voltage setting parameter	R
SET_VOUT_FACTORY_SETTING	:Restores the output-voltage setting parameter to the factory default	W
READ_VOUT_REFERENCE	:Returns the output-voltage control parameter	R
SET_VOUT_UPPER_LIMIT	:Sets upper limit of the output-voltage variation	W
READ_VOUT_UPPER_LIMIT_PRM	:Returns the current parameter for the upper limit of the output-voltage variation	R
SET_VOUT_LOWER_LIMIT	:Sets lower limit of the output-voltage variation	W
READ_VOUT_LOWER_LIMIT_PRM	:Returns the current parameter for the lower limit of the output-voltage variation	R
SET_VOUT_LIMIT_FACTORY_SETTING	:Restores the upper and lower limit of output-voltage variation to the factory default	W
Commands for controlling constant current		
SET_CC_MODE_ITRM	:Selects the mode in which constant current for operation is specified by ITRM terminal voltage	W
SET_CC_MODE_INFO	:Selects the mode in which constant current for operation is specified by communication function	W
READ_CC_MODE_PRM	:Returns the mode of specifying constant current for operation	R
SET_CC	:Specifies constant current for operation	W
READ_CC_PRM	:Returns the current parameter of constant current for operation	R
SET_CC_FACTORY_SETTING	:Restores the parameter of constant current for operation to the factory default	W
READ_CC_REFERENCE	:Returns the current parameter of constant current for operation	R
SET_CC_UPPER_LIMIT	:Specifies upper limit of constant current for operation	W
READ_CC_UPPER_LIMIT_PRM	:Returns the current upper limit of constant current for operation	R
SET_CC_LIMIT_FACTORY_SETTING	:Restores the upper limit of constant current for operation to the factory default	W

R：Read command　W：Write command

Table 6.1 Outline of each command (2/3)

Output-voltage sequence commands		
SET_TON_DELAY_RC	:Set delay time for activation by RC2 terminal	W
READ_TON_DELAY_RC_PRM	:Returns the current delay time for activation by RC2 terminal	R
SET_TON_DELAY_VIN	:Sets delay time for activation after input	W
READ_TON_DELAY_VIN_PRM	:Returns the current delay time for activation after input	R
SET_RAMP_RATE	:Selects the change rate of the output voltage	W
READ_RAMP_RATE_PRM	:Returns the current change rate of the output voltage	R
SET_START_UP_VIN_AC	:Sets starting voltage for AC input	W
READ_START_UP_VIN_AC_PRM	:Returns the current parameter of the starting voltage for AC input	R
SET_STOP_VIN_AC	:Sets stop voltage for AC input	W
READ_STOP_VIN_AC_PRM	:Returns the current stop voltage for AC input	R
SET_START_UP_VIN_DC	:Sets starting voltage for DC input	W
READ_START_UP_VIN_DC_PRM	:Returns the current parameter of starting voltage for DC input	R
SET_STOP_VIN_DC	:Sets stop voltage for DC input	W
READ_STOP_VIN_DC_PRM	:Returns the current stop voltage for DC input	R
Commands for setting Accessory function		
SET_FAN_MODE_AUTO	:Specifies automatic control of the rotation speed of the built-in air cooling fan	W
SET_FAN_MODE_FIXED_SPEED	:Sets the speed of the built-in air cooling fan at the maximum value	W
READ_FAN_MODE_PRM	:Returns the current setting of the rotation-speed control of the built-in air cooling fan	R
SET_AUX_VOUT	:Changes the AUX output voltage	W
READ_AUX_VOUT_PRM	:Returns the current AUX output voltage	R
SET_MS	:Enables or disables switching between the master mode and the slave mode*1	W
READ_MS_PRM	:Returns the current parameter for switching between the master mode and the slave mode*1	R
READ_MS	:Returns the current master/slave status*1	R
Monitor commands		
MON_VIN	:Returns the value of input voltage	R
MON_VIN_FREQUENCY	:Returns the input-voltage frequency	R
MON_VOUT	:Returns the output voltage	R
MON_IOUT	:Returns the output current	R
MON_OUTPUT_POWER	:Returns the output power	R
MON_FAN_SPEED	:Reads the fan speed	R
MON_TEMPERATURE_1	:Returns the temperature of internal elements	R

R：Read command　W：Write command

*1 This command is valid for the option to add master-slave function

Table 6.1 Outline of each command (3/3)

State acquisition commands		
READ_STOP_CODE	:Returns the code indicating the stop status	R
TOTAL_INPUT_TIME_1	:Returns the cumulative time of input voltage loading (minutes)	R
TOTAL_INPUT_TIME_2	:Returns the cumulative time of input voltage loading (lower 16 bits of hour)	R
TOTAL_INPUT_TIME_3	:Returns the cumulative time of input voltage loading (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
Commands for setting addresses, memories, and communications		
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
READ_ADDRESS	:Returns 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
READ_PRODUCT_CODE_H	:Returns the product code indicating the model number (high-order 16 bits)	R
READ_PRODUCT_CODE_L	:Returns the product code indicating the model number (lower 16 bits)	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
READ_VOUT_POINT	:Returns the decimal-point position of the returned value of command MON_VOUT	R
READ_IOUT_POINT	:Returns the decimal-point position of the returned value of command MON_IOUT	R

R：Read command　W：Write command

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

Notation

6.x.x **MON_VOUT** **[1Eh] [08h] [01h] [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, the output voltage turns ON.
When OFF is specified by the RC2 terminal, the output voltage will not turn ON.
At time of factory shipment, this mode is set as the default.

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, the output voltage turns OFF.
The output voltage will turn OFF, regardless of the specification by the RC2 terminal.

Return value	0

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

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

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

6.2.4 READ_REMOTE_CONTROL [1Eh] [09h] [1Eh] [01h]

Returns the ON/OFF status of the output voltage.

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

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

The command to release the state of the output latch stop activated by the protection function for overvoltage or overheat.
Release should be executed after removal of the abnormal condition.

Return value	0

6.3 Output-voltage setting commands

6.3.1 SET_VOUT [0Ah][Argument]

Sets the output voltage.
Sets the output voltage [V] to "Argument/1000".
When the output-voltage setting function by the VTRM terminal is enabled, the setting by this command has no effect.
A value exceeding 120% of the rated voltage can not be specified.
It is not possible to specify a value larger than or equal to the upper limit set by SET_VOUT_UPPER_LIMIT.
It is not possible to specify a value less than or equal to the lower limit set by SET_VOUT_LOWER_LIMIT.

Examples of argument	Argument:5010 => 5.010 V
Return value	Argument value

The voltage set by this command becomes effective, regardless of the volume adjustment of the main unit.
The output voltage can be adjusted by the volume of the main unit even after this command is sent.
When the input voltage is cut off, the setting by this command is reset but the adjustment by the volume remains effective.

Table 6.3.1 "SET_VOUT" Operation example (PCA600F-12)

	Operation	Return value	PCA Output	Remark
1	Input voltage on	–	12.0V	
2	Adjust output voltage to 12.3V by volume	–	12.3V	+0.3V by volume
3	Send "**SET_VOUT**" & "10000"	10000	10.0V	
4	Adjust output voltage to 10.2V by volume	–	10.2V	+0.2V by volume
5	Input voltage off	–	0V	
6	Input voltage on	–	12.5V	+0.3V & +0.2V => +0.5V

6.3.2 READ_VOUT_PRM [1Eh] [09h] [1Bh] [10h]

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

6.3.3 SET_VOUT_FACTORY_SETTING [1Eh] [09h] [0Bh] [1Fh]

Restores the output voltage set by command SET_VOUT to the value set at time of factory shipping.
This command cannot reset adjustment by the volume.

Return value	0

Table 6.3.2 "SET_VOUT_FACTORY_SETTING" Operation example (PCA600F-12)

	Operation	Return value	PCA Output	Remark
1	Input voltage on	–	12.0V	
2	Adjust output voltage to 12.3V by volume	–	12.3V	+0.3V by volume
3	Send "**SET_VOUT**" & "10000"	10000	10.0V	
4	Adjust output voltage to 10.2V by volume	–	10.2V	+0.2V by volume
5	Send "**SET_VOUT_FACTORY_SETTING**"	0	12.5V	+0.3V & +0.2V => +0.5V

The output voltage recorded in the nonvolatile memory by command SYS_STORE_USER_SETTING remains unaffected.

6.3.4 READ_VOUT_REFERENCE [1Eh] [09h] [1Bh] [00h]

Returns the output-voltage control value.

Examples of return value	Return value:5010 => 5.010V

* If the state has changed by volume adjustment, etc., it will be different from the value set by SET_VOUT.

6.3.5 SET_VOUT_UPPER_LIMIT [17h] [04h] [Argument]

Sets the upper limit of variation of the output voltage.
The upper-limit voltage [V] of variation of the output voltage is set to be "Argument/10".
This setting is applied to all operations of the voltage variation (volume, VTRM terminal, command SET_VOUT).
Voltages exceeding this upper limit are not outputted even in the constant current operation.
When the specified value is lower than the current output voltage, it is not possible to set a value less than or equal to the lower limit specified by SET_VOUT_LOWER_LIMIT.
A value exceeding 120% of the rated voltage cannot be specified.

Examples of argument	Argument:241 ⇒ 24.1V
Return value	Argument value

6.3.6 READ_VOUT_UPPER_LIMIT_PRM [1Eh] [09h] [1Bh] [14h]

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

6.3.7 SET_VOUT_LOWER_LIMIT [17h] [05h][Argument]

Sets the lower limit of variation of the output voltage.
The lower-limit voltage [V] of the variation of the output voltage is set to be "Argument/10".
This setting is applied to all operations of the voltage variation (volume, VTRM terminal, command SET_VOUT).
During constant-current operation, the output voltage may become lower than this setting.
It is not possible to specify a value greater than or equal to the upper limit set by SET_VOUT_UPPER_LIMIT.

Examples of argument	Argument:175 ⇒ 17.5V
Return value	Argument value

6.3.8 READ_VOUT_LOWER_LIMIT_PRM [1Eh] [09h] [1Bh] [15h]

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

6.3.9 SET_VOUT_LIMIT_FACTORY_SETTING [1Eh] [09h] [0Bh] [1Eh]

Restores the settings by SET_VOUT_UPPER_LIMIT and SET_VOUT_LOWER_LIMIT to the factory defaults.

Return value	0

The output voltage recorded in the nonvolatile memory by command SYS_STORE_USER_SETTING remains unaffected.

6.4 Constant-current control command

6.4.1 SET_CC_MODE_ITRM [1Eh] [09h] [0Ah] [00h]

The setting by the ITRM terminal voltage is applied as the setting of constant current operation.
At time of factory shipment, this mode is set as the default.

Return value	0

6.4.2 SET_CC_MODE_INFO [1Eh] [09h] [0Ah] [01h]

The setting by command SET_CC is used for constant current operation.

Return value	1

6.4.3 READ_CC_MODE_PRM [1Eh] [09h] [1Ah] [18h]

Returns the method of specifying the setting of constant current operation.

Status	Return value:0	=>	by ITRM terminal voltage
	Return value:1	=>	by command SET_CC

6.4.4 SET_CC [0Ch][Argument]

Specify the setting of constant current operation.
The value [A] set for constant current operation is "Argument/100".
It is not possible to specify a value larger than or equal to the upper limit set by SET_CC_UPPER_LIMIT.
A value larger than the rated current can not be specified.

Examples of argument	Argument:11550 => 115.50 A
Return value	Argument value

At time of factory shipment, the value set for constant current operation is to be specified by the ITRM terminal voltage.
By sending command SET_CC_MODE_INFO, the value set by this command becomes effective.
The order of sending command SET_CC_MODE_INFO and SET_CC is irrelevant.

6.4.5 READ_CC_PRM [1Eh] [09h] [1Ah] [10h]

Return the value (argument value) set by command SET_CC.

6.4.6 SET_CC_FACTORY_SETTING [1Eh] [09h] [0Ah] [1Fh]

Restores the setting of constant current operation set by command SET_CC to the factory default.

Return value	0

The setting of constant current operation recorded in the nonvolatile memory by command SYS_STORE_USER_SETTING remains unaffected.

6.4.7 READ_CC_REFERENCE [1Eh] [09h] [1Ah] [00h]

Returns the setting for constant current operation.

Examples of return value	Return value:11550 => 115.50A

* When the state has changed by protection-function operation, etc., the returned value will be different from the value set by SET_CC.

6.4.8 SET_CC_UPPER_LIMIT [18h] [04h] [Argument]

Specifies the upper limit of the setting of constant current operation.
The upper limit [A] of the setting of the constant current operation is specified by the argument.
A value exceeding the rated current can not be specified.

Examples of argument	Argument:115 => 115A
Return value	Argument value

6.4.9 READ_CC_UPPER_LIMIT_PRM [1Eh] [09h] [1Ah] [14h]

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

6.4.10 SET_CC_LIMIT_FACTORY_SETTING [1Eh] [09h] [0Ah] [1Eh]

The value set by command SET_CC_LIMIT is restored to the factory default.

Return value	0

The setting of constant current operation recorded in the nonvolatile memory by command SYS_STORE_USER_SETTING remains unaffected.

6.5 Output-voltage sequence commands

6.5.1 SET_TON_DELAY_RC [0Fh] [Argument]

Sets the delay time [msec] from the RC2 terminal operation to the start of the start operation (Figure 6.5.1).

The factory default setting is "0".

The setting by this command is also applied to the remote control by communication, but some delay can occur due to signal transmission.

When being inputted with the RC 2 terminal ON,an internal delay (700 msec Max) is added.

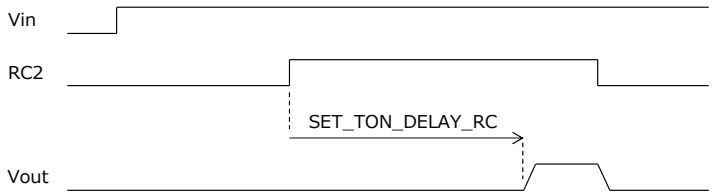


Figure 6.5.1 Timing diagram "SET_TON_DELAY_RC"

Specified range	0 - 3900
Examples of argument	Argument:900 => 900 msec
Return value	Argument value

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

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

6.5.3 SET_TON_DELAY_VIN [0Eh] [Argument]

Sets the delay time [msec] from the power-up of input voltage to the start of the output operation startup (Figure 6.5.2).

Specification value of the start time is set as the delay time at time of factory shipment.

After sending this command, send command SYS_STORE_USER_SETTING and block input for more than 10 seconds.

The setting will become effective from the next startup.

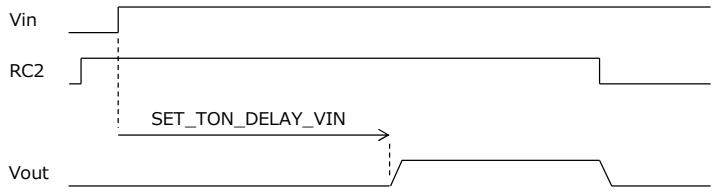
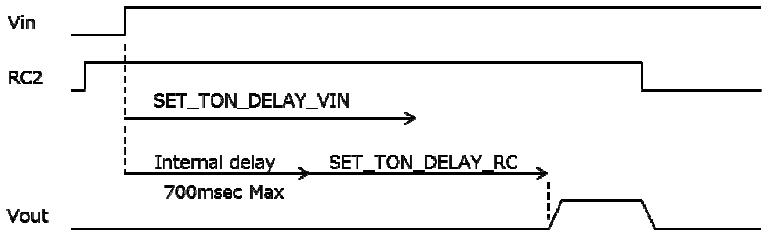


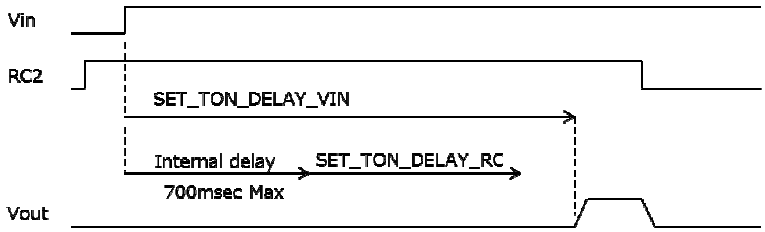
Figure 6.5.2 Timing diagram "SET_TON_DELAY_VIN"

Specified range	Specifications of start-up time* - 65535 *PCA600F :700
Examples of argument	Argument:900 => 900 msec
Return value	Argument value

In this case, the value larger between the time specified in SET_TON_DELAY_RC and SET_TON_DELAY_VIN will be chosen (Figure 6.5.3).



(a)When following "SET_TON_DELAY_RC" setting



(b)When following "SET_TON_DELAY_VIN" setting

Figure 6.5.3 Timing diagram when specified in SET_TON_DELAY_RC and SET_TON_DELAY_VIN

6.5.4 READ_TON_DELAY_VIN_PRM [1Eh] [09h] [1Dh] [00h]

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

6.5.5 SET_RAMP_RATE [1Ah] [03h] [Argument]

Selects the change rate of the output voltage.
The setting at time of factory shipment is "0".
This setting is applied to the startup by turning on the power, activation by the remote control, voltage variation by the VTRM terminal, and voltage adjustment by command SET_VOUT.

Specified range	0, 1, 2
Status	Argument:0 ⇒ Default (Fast) Argument:1 ⇒ 10%-90%(rated voltage) / approx.100 (Slow) Argument:2 ⇒ 10%-90%(rated voltage) / approx.500 (Very slow)
Return value	Argument value

6.5.6 READ_RAMP_RATE_PRM [1Eh] [09h] [1Dh] [03h]

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

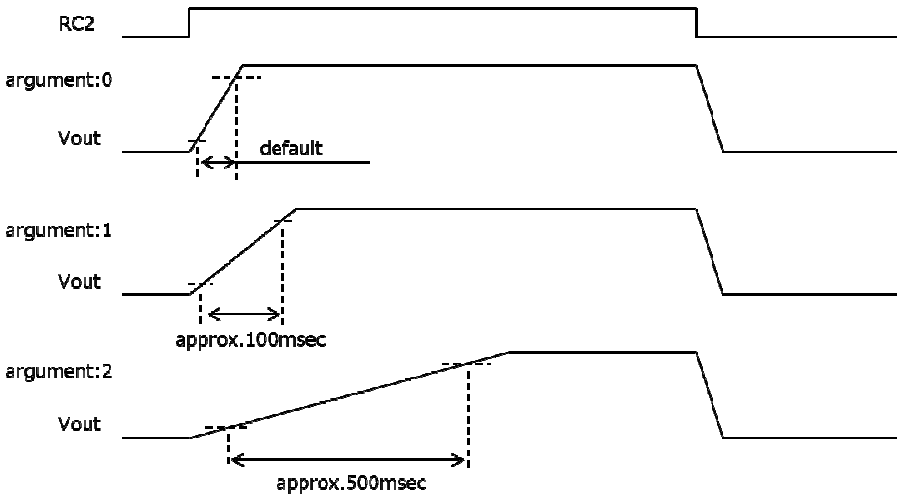


Figure 6.5.4 Timing diagram activation by the remote control

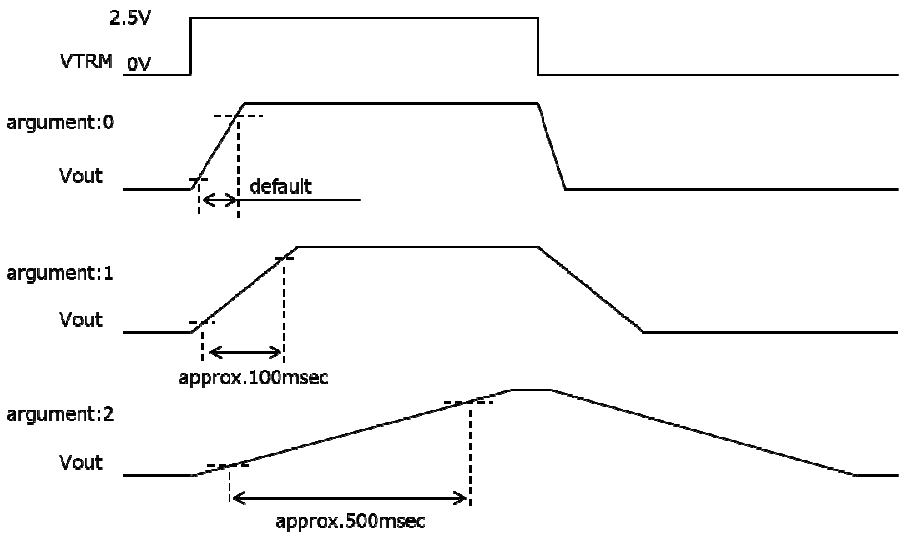


Figure 6.5.5 Timing diagram activation by the VTRM terminal

6.5.7 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 10 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 + 10 V or less.
If specified, this command is not accepted and an error is returned.

Specified range	60 - 240VAC
Examples of argument	Argument:170 => 170VAC
Return value	Argument value

When using at low input voltage, additional load derating is required(Figure 6.5.6).

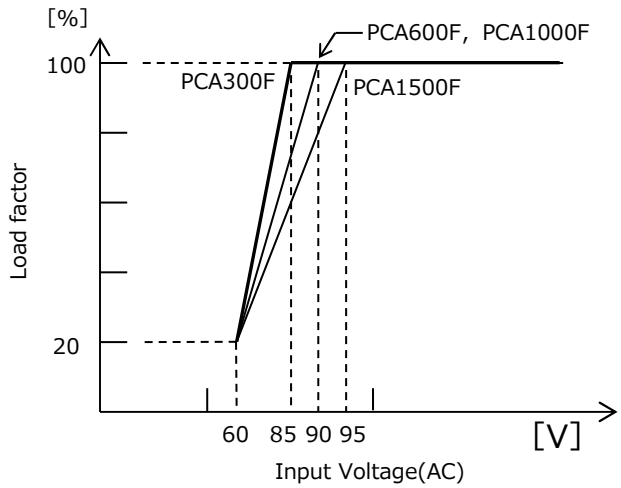


Figure 6.5.6 Input voltage derating curve (AC)

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

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

6.5.9 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 10 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 - 10 V or more.
If specified, this command is not accepted and an error is returned.

Specified range	50 - 200VAC
Examples of argument	argument:150 => 150VAC
Return value	argument value

When using at low input voltage, additional load derating is required(Figure 6.5.6).

6.5.10 READ_STOP_VIN_AC_PRM [1Eh] [09h] [1Ch] [01h]

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

6.5.11 SET_START_UP_VIN_DC [17h] [02h] [Argument]

Specify the starting voltage for DC input (excluding PCA1000F,PCA1500F).
After sending this command, send command SYS_STORE_USER_SETTING and block input for more than 10 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_DC + 10 V or less.
If specified, this command is not accepted and an error is returned.

Specified range	80 - 340VDC
Examples of argument	Argument:120 => 120VDC
Return value	Argument value

When using at low input voltage, additional load derating is required(Figure 6.5.7).

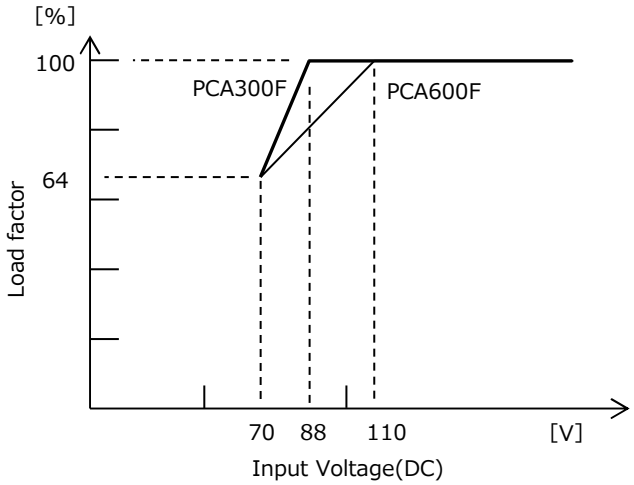


Figure 6.5.7 Input voltage derating curve (DC)

6.5.12 READ_START_UP_VIN_DC_PRM [1Eh] [09h] [1Ch] [02h]

Returns the value (argument value) set by command SET_START_UP_VIN_DC (excluding PCA1000F,PCA1500F).

6.5.13 SET_STOP_VIN_DC [17h] [03h] [Argument]

Sets the stop voltage for DC input to the value specified by the argument (excluding PCA1000F,PCA1500F).
After sending this command, send command SYS_STORE_USER_SETTING and block input for more than 10 seconds.The settings will be effective from the next startup.
In this command, it is not possible to specify a value set by command SET_START_UP_VIN_DC - 10 V or more.
When specified, this command is not accepted and an error is returned.

Specified range	70 - 280VDC
Examples of argument	Argument:90 => 90VDC
Return value	Argument value

When using at low input voltage, additional load derating is required(Figure 6.5.7).

6.5.14 READ_STOP_VIN_DC_PRM [1Eh] [09h] [1Ch] [03h]

Returns the value (argument value) set by command SET_STOP_VIN_DC (excluding PCA1000F,PCA1500F).

6.6 Commands for setting Accessory function

6.6.1 SET_FAN_MODE_AUTO [1Eh] [09h] [07h] [00h]

Automatic control of the rotation speed of the built-in air cooling fan.
At time of factory shipment, this mode is set as the default.

Return value	0

6.6.2 SET_FAN_MODE_FIXED_SPEED [1Eh] [09h] [07h] [01h]

Fixes the rotation speed of the built-in air cooling fan at the maximum.

Return value	1

6.6.3 READ_FAN_MODE_PRM [1Eh] [09h] [17h] [00h]

Returns the current fan-speed control setting.

Status	Return value:0	=>	Automatic control
	Return value:1	=>	Fixes the rotation speed

6.6.4 SET_AUX_VOUT [17h] [10h] [Argument]

Sets the AUX output voltage.
"Argument/10" is set to the AUX output voltage [V]. At time of factory shipment, 12V is set as the default.

Specified range	4.7 - 12.6V
Examples of argument	Argument:50 => 5.0V
Return value	Argument value

The rated output current of AUX changes with the output voltage(Figure 6.6.1).

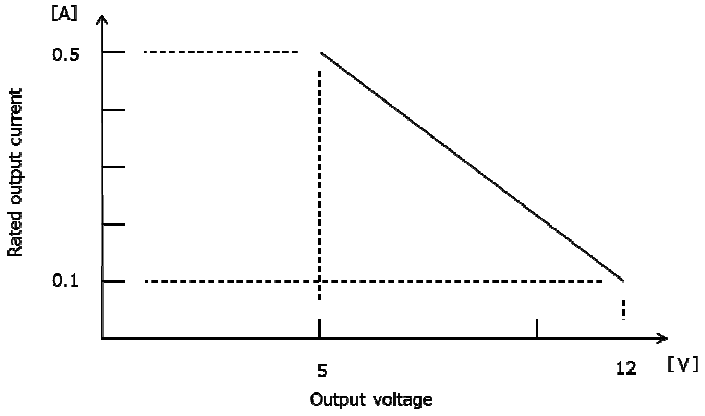


Figure 6.6.1 The rated output current of AUX (PCA series)

6.6.5 READ_AUX_VOUT_PRM [1Eh] [09h] [18h] [00h]

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

6.6.6 SET_MS [1Ah] [0Ah][Argument]

[This command is valid for the option to add master-slave function.]

Specifies the master mode or the slave mode.
After sending this command, send command SYS_STORE_USER_SETTING and block input for more than 10 seconds.
The setting becomes effective from the next startup.
At time of factory shipment, "selection by the SLV_EN terminal" is chosen as the default.

Status	Argument:0 => Selection by SLV_EN terminal Argument:1 => Specifies master mode Argument:2 => Specifies slave mode

6.6.7 READ_MS_PRM [1Eh] [09h] [14h] [10h]

[This command is valid for the option to add master-slave function.]

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

6.6.8 READ_MS [1Eh] [09h] [14h] [00h]

[This command is valid for the option to add master-slave function.]

Returns the setting status of the master mode and the slave mode.

Status	Argument:0 => Specifies master mode Argument:1 => Specifies slave mode

6.7 Monitor commands

6.7.1 MON_VIN [1Eh] [08h] [00h] [01h]

Returns the effective value of the input voltage. AC and DC are automatically distinguished internally.
"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

6.7.2 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.
"0" is returned for DC input.
It will remain unsettled for about five seconds from input.

Examples of return value	Return value:481 => 48.1Hz

6.7.3 MON_VOUT [1Eh] [08h] [01h] [00h]

Returns the output voltage (voltage between the sensing terminals).
"Returned value / 1000" is the output voltage [V].

Examples of return value	Return value:24200 => 24.200V

6.7.4 MON_IOUT [1Eh] [08h] [05h] [00h]

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

Examples of return value	Return value:1350 => 13.50A

6.7.5 MON_OUTPUT_POWER [1Eh] [08h] [08h] [10h]

Returns the output power.
"Returned value / 10" is the output power [W].

Examples of return value	Return value:6000 => 600.0W

6.7.6 MON_FAN_SPEED [1Eh] [08h] [0Ch] [00h]

Reads out the fan speed.
The returned value is the rotation speed [rpm] of the fan.

Examples of return value	Return value:7500 => 7500rpm

6.7.7 MON_TEMPERATURE_1 [1Eh] [08h] [0Eh] [00h]

Returns the internal-element temperature.
The returned value (signed hexadecimal number) is the temperature [℃].

Range	-30 ～ 100℃
Examples of return value	Return value: ”0000 0000 0001 100⌋⇒ +25℃
	Return value: ”1111 1111 1110 011⌋⇒ -25℃

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

Returns the code indicating the cause of the stop.

Stop code	Cause of stop
000	Has not stopped
001	Stops by RC2 terminal operation
002	Stops by command CTL_REMOTE_OFF
010	Stops due to input voltage drop
020	
050	Stops by activation of overcurrent protection
051	
054	Stops due to abnormal fan rotation
060	Stops due to DS terminal function
061	
101	Stops due to output overvoltage
106	Stops by activation of overheat protection
210	Stops due to non-spec pulse load
230	Stops due to DS terminal connection error
233	Stops due to use of outside derating

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

6.8.2 TOTAL_INPUT_TIME

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

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 minute
Examples of return value	Return value:57 ⇒ 57 minute

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

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

6.8.3 TOTAL_OUTPUT_TIME

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

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 minute
Examples of return value	Return value:57 ⇒ 57 minute

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

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

6.9 Commands for setting address, memory, and communication

6.9.1 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, and CTL_ACCUMULATE_EXEC are accepted.

Return value	1

6.9.2 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

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

Returns the current write-protection mode

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

Table 6.9.1 "SET_WRITE_PROTECT_ON" Operation example （PCA600F-12）

	Operation	Return value	PCA Output	Remark
1	Input voltage on	–	12.0V	
2	Send "**SET_VOUT**" & "10000"	10000	10.0V	
3	Send "**SET_WRITE_PROTECT_ON**"	1	10.0V	
4	Send "**SET_VOUT**" & "8000"	224 *	10.0V	
5	Send "**SET_WRITE_PROTECT_OFF**"	0	10.0V	
6	Send "**SET_VOUT**" & "9000"	9000	9.0V	

*Error code 224 :The specified command is not valid

6.9.4 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 PCA.

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

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.

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

The values and settings recorded in the nonvolatile memory of the PCA, 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.

Table 6.9.2 "SYS_STORE_USER_SETTING" Operation example （PCA600F-12）

	Operation	Return value	PCA Output	Remark
1	Input voltage on	–	12.0V	
2	Send "**SET_VOUT**" & "10000"	10000	10.0V	
3	Send "**SYS_STORE_USER_SETTING**"	1	10.0V	
4	Input voltage off	–	0V	
5	Input voltage on	–	10.0V	
6	Send "**SYS_RESTORE_FACTORY_SETTING**"	0	10.0V	
7	Input voltage off	–	0V	
8	Input voltage on	–	12.0V	

6.9.6 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.

6.9.7 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

6.9.8 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

6.9.9 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

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

Deletes contents of the buffer.

Return value	0

Table 6.9.3 "CTL_ACCUMULATE_MODE_ON" Operation example (PCA600F-12)

	Operation	Return value	PCA Output	Remark
1	Input voltage on	–	12.0V	
2	Send "**SET_VOUT**" & "10000"	10000	10.0V	
3	Send "**CTL_ACCUMULATE_MODE_ON**"	1	10.0V	
4	Send "**CTL_REMOTE_OFF**"	0	10.0V	
5	Send "**SET_VOUT**" & "8000"	8000	10.0V	
6	Send "**CTL_ACCUMULATE_EXEC**"	8000	8.0V	

6.9.11 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.
However, when the argument is "128", the address becomes the value specified by the ADDR terminal.
The address of the reply packet is that specified by this command.
At time of factory shipment, the argument is set to "128" corresponding to the ADDR terminal setting.

Specified range	1 - 7 , 128		
Examples of argument	Argument:1	=>	Address is 1
	Argument:128	=>	Corresponds to the ADDR terminal setting

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

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

6.9.13 READ_ADDRESS [1Eh] [09h] [19h] [00h]

Returns current communication address.

Range	1 - 7

6.10 Product information commands

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

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

Range	000～999

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

Returns the upper three digits of the product lot number.

Range	001～954

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

Returns the lower four digits of the product lot number.

Range	0000～9999

6.10.4 READ_PRODUCT_CODE

READ_PRODUCT_CODE_H [1Eh] [09h] [10h] [03h]

READ_PRODUCT_CODE_L [1Eh] [09h] [10h] [04h]

Returns the product code specific to the model number.

The returned values of READ_PRODUCT_CODE_H and READ_PRODUCT_CODE_L represent the product code as 32 bits data in such a way that the upper 16 bits are contained in the former and lower 16 bits in the latter.

Appendix 3 shows the list of product codes for each model number.

Range	000000～999999
Examples of return value	Return value:145688 => PCA600F-5
	Return value:145689 => PCA600F-12

6.10.5 READ_RATED_VOUT [1Eh] [09h] [11h] [00h]

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

6.10.6 READ_RATED_IOUT [1Eh] [09h] [11h] [01h]

Returns the rated current of the model.

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

Examples of return value	Return value:12000 => 120A
	Return value:4300 => 43A

6.10.7 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

6.10.8 READ_VOUT_POINT [1E] [09] [12] [01]

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

Return value	3

6.10.9 READ_IOUT_POINT [1Eh] [09h] [12h] [02h]

Returns the position of the decimal point of the returned value of command MON_IOUT 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 (1/3)

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	
READ_REMOTE_PRM	20bit	1Eh 09h 1Eh 08h	
READ_REMOTE_CONTROL	20bit	1Eh 09h 1Eh 01h	
CTL_RESET_LATCH	20bit	1Eh 08h 1Eh 1Fh	
Output-voltage setting commands			
SET_VOUT	5bit	0Ah [Argument]	
READ_VOUT_PRM	20bit	1Eh 09h 1Bh 10h	
SET_VOUT_FACTORY_SETTING	20bit	1Eh 09h 0Bh 1Fh	
READ_VOUT_REFERENCE	20bit	1Eh 09h 1Bh 00h	
SET_VOUT_UPPER_LIMIT	10bit	17h 04h [Argument]	
READ_VOUT_UPPER_LIMIT_PRM	20bit	1Eh 09h 1Bh 14h	
SET_VOUT_LOWER_LIMIT	10bit	17h 05h [Argument]	
READ_VOUT_LOWER_LIMIT_PRM	20bit	1Eh 09h 1Bh 15h	
SET_VOUT_LIMIT_FACTORY_SETTING	20bit	1Eh 09h 0Bh 1Eh	
Constant-current control commands			
SET_CC_MODE_ITRM	20bit	1Eh 09h 0Ah 00h	
SET_CC_MODE_INFO	20bit	1Eh 09h 0Ah 01h	
READ_CC_MODE_PRM	20bit	1Eh 09h 1Ah 18h	
SET_CC	5bit	0Ch [Argument]	
READ_CC_PRM	20bit	1Eh 09h 1Ah 10h	
SET_CC_FACTORY_SETTING	20bit	1Eh 09h 0Ah 1Fh	
READ_CC_REFERENCE	20bit	1Eh 09h 1Ah 00h	
SET_CC_UPPER_LIMIT	10bit	18h 04h [Argument]	
READ_CC_UPPER_LIMIT_PRM	20bit	1Eh 09h 1Ah 14h	
SET_CC_LIMIT_FACTORY_SETTING	20bit	1Eh 09h 0Ah 1Eh	
Output-voltage sequence commands			
SET_TON_DELAY_RC	5bit	0Fh [Argument]	
READ_TON_DELAY_RC_PRM	20bit	1Eh 09h 1Dh 01h	
SET_TON_DELAY_VIN	5bit	0Eh [Argument]	
READ_TON_DELAY_VIN_PRM	20bit	1Eh 09h 1Dh 00h	
SET_RAMP_RATE	10bit	1Ah 03h [Argument]	
READ_RAMP_RATE_PRM	20bit	1Eh 09h 1Dh 03h	
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_START_UP_VIN_DC	10bit	17h 02h [Argument]	
READ_START_UP_VIN_DC_PRM	20bit	1Eh 09h 1Ch 02h	
SET_STOP_VIN_DC	10bit	17h 03h [Argument]	
READ_STOP_VIN_DC_PRM	20bit	1Eh 09h 1Ch 03h	

Appendix 1 Lists of Extended UART commands (2/3)

Extended-UART commands	Command type	code [Hexadecimal]				Remark
Commands for setting Accessory function						
SET_FAN_MODE_AUTO	20bit	1Eh	09h	07h	00h	
SET_FAN_MODE_FIXED_SPEED	20bit	1Eh	09h	07h	01h	
READ_FAN_MODE_PRM	20bit	1Eh	09h	17h	00h	
SET_AUX_VOUT	10bit	17h	10h	[Argument]		
READ_AUX_VOUT_PRM	20bit	1Eh	09h	18h	00h	
SET_MS	10bit	1Ah	0Ah	[Argument]		
READ_MS_PRM	20bit	1Eh	09h	14h	10h	
READ_MS	20bit	1Eh	09h	14h	00h	
Monitor commands						
MON_VIN	20bit	1Eh	08h	00h	01h	
MON_VIN_FREQUENCY	20bit	1Eh	08h	00h	1Fh	
MON_VOUT	20bit	1Eh	08h	01h	00h	
MON_IOUT	20bit	1Eh	08h	05h	00h	
MON_OUTPUT_POWER	20bit	1Eh	08h	08h	10h	
MON_FAN_SPEED	20bit	1Eh	08h	0Ch	00h	
MON_TEMPERATURE_1	20bit	1Eh	08h	0Eh	00h	
Status commands						
READ_STOP_CODE	20bit	1Eh	09h	1Eh	10h	
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	
Commands for setting address, memory, and communication						
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	
READ_ADDRESS	20bit	1Eh	09h	19h	00h	

Appendix 1 Lists of Extended UART commands (3/3)

Extended-UART commands	Command type	code [Hexadecimal]				Remark
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_PRODUCT_CODE_H	20bit	1Eh	09h	10h	03h	
READ_PRODUCT_CODE_L	20bit	1Eh	09h	10h	04h	
READ_RATED_VOUT	20bit	1Eh	09h	11h	00h	
READ_RATED_IOUT	20bit	1Eh	09h	11h	01h	
READ_VIN_POINT	20bit	1Eh	09h	12h	00h	
READ_VOUT_POINT	20bit	1Eh	09h	12h	01h	
READ_IOUT_POINT	20bit	1Eh	09h	12h	02h	

Appendix2. Support and precision

Appendix2 Support and precision (1/3)

Extended-UART commands	Support/precision(Ta=25℃ Vo:60-100%)				Remark
	PCA300F	PCA600F	PCA1000F	PCA1500F	
Output voltage ON/OFF commands					
CTL_REMOTE_ON	○	○	○	○	
CTL_REMOTE_OFF	○	○	○	○	
READ_REMOTE_PRM	○	○	○	○	
READ_REMOTE_CONTROL	○	○	○	○	
CTL_RESET_LATCH	○	○	○	○	
Output-voltage setting commands					
SET_VOUT	±0.5%FS	±0.5%FS	±0.5%FS	±0.5%FS	
READ_VOUT_PRM	○	○	○	○	
SET_VOUT_FACTORY_SETTING	○	○	○	○	
READ_VOUT_REFERENCE	○	○	○	○	
SET_VOUT_UPPER_LIMIT	○	○	○	○	
READ_VOUT_UPPER_LIMIT_PRM	○	○	○	○	
SET_VOUT_LOWER_LIMIT	○	○	○	○	
READ_VOUT_LOWER_LIMIT_PRM	○	○	○	○	
SET_VOUT_LIMIT_FACTORY_SETTING	○	○	○	○	
Constant-current control commands					
SET_CC_MODE_ITRM	○	○	○	○	
SET_CC_MODE_INFO	○	○	○	○	
READ_CC_MODE_PRM	○	○	○	○	
SET_CC	±2%FS	±2%FS	±2%FS	±2%FS	
READ_CC_PRM	○	○	○	○	
SET_CC_FACTORY_SETTING	○	○	○	○	
READ_CC_REFERENCE	○	○	○	○	
SET_CC_UPPER_LIMIT	○	○	○	○	
READ_CC_UPPER_LIMIT_PRM	○	○	○	○	
SET_CC_LIMIT_FACTORY_SETTING	○	○	○	○	
Output-voltage sequence commands					
SET_TON_DELAY_RC	±2%※2	±2%※2	±2%※2	±2%※2	※2 ±2% ±10msec
READ_TON_DELAY_RC_PRM	○	○	○	○	
SET_TON_DELAY_VIN	±2%※2	±2%※2	±2%※2	±2%※2	※2 ±2% ±50msec
READ_TON_DELAY_VIN_PRM	○	○	○	○	
SET_RAMP_RATE	○	○	○	○	
READ_RAMP_RATE_PRM	○	○	○	○	
SET_START_UP_VIN_AC	±3%FS	±3%FS	±3%FS	±3%FS	
READ_START_UP_VIN_AC_PRM	○	○	○	○	
SET_STOP_VIN_AC	±3%FS	±3%FS	±3%FS	±3%FS	
READ_STOP_VIN_AC_PRM	○	○	○	○	
SET_START_UP_VIN_DC	±3%FS	±3%FS	-	-	
READ_START_UP_VIN_DC_PRM	○	○	-	-	
SET_STOP_VIN_DC	±3%FS	±3%FS	-	-	
READ_STOP_VIN_DC_PRM	○	○	-	-	

Appendix2 Support and precision (2/3)

Extended-UART commands	Support/precision(Ta=25℃ Vo:60-100%)				Remark
	PCA300F	PCA600F	PCA1000F	PCA1500F	
Commands for setting Accessory function					
SET_FAN_MODE_AUTO	○	○	○	○	
SET_FAN_MODE_FIXED_SPEED	○	○	○	○	
READ_FAN_MODE_PRM	○	○	○	○	
SET_AUX_VOUT	±3%FS	±3%FS	±3%FS	±3%FS	
READ_AUX_VOUT_PRM	○	○	○	○	
SET_MS	○	○	○	○	
READ_MS_PRM	○	○	○	○	
READ_MS	○	○	○	○	
Monitor commands					
MON_VIN	±3%FS	±3%FS	±3%FS	±3%FS	
MON_VIN_FREQUENCY	±0.5Hz	±0.5Hz	±0.5Hz	±0.5Hz	
MON_VOUT	±1%FS	±1%FS	±1%FS	±1%FS	
MON_IOUT	±2%FS	±2%FS	±2%FS	±2%FS	
MON_OUTPUT_POWER	±2%FS	±2%FS	±2%FS	±2%FS	
MON_FAN_SPEED	±500rpm	±500rpm	±500rpm	±500rpm	
MON_TEMPERATURE_1	○	○	○	○	
Status commands					
READ_STOP_CODE	○	○	○	○	
TOTAL_INPUT_TIME_1	○	○	○	○	
TOTAL_INPUT_TIME_2	○	○	○	○	
TOTAL_INPUT_TIME_3	○	○	○	○	
TOTAL_OUTPUT_TIME_1	○	○	○	○	
TOTAL_OUTPUT_TIME_2	○	○	○	○	
TOTAL_OUTPUT_TIME_3	○	○	○	○	
Commands for setting address, memory, and communication					
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	○	○	○	○	
READ_ADDRESS	○	○	○	○	

Appendix2 Support and precision (3/3)

Extended-UART commands	Support/precision(Ta=25℃ Vo:60-100%)				Remark
	PCA300F	PCA600F	PCA1000F	PCA1500F	
Product information commands					
READ_SERIAL	○	○	○	○	
READ_LOT_H	○	○	○	○	
READ_LOT_L	○	○	○	○	
READ_PRODUCT_CODE_H	○	○	○	○	
READ_PRODUCT_CODE_L	○	○	○	○	
READ_RATED_VOUT	○	○	○	○	
READ_RATED_IOUT	○	○	○	○	
READ_VIN_POINT	○	○	○	○	
READ_VIN_POINT	○	○	○	○	
READ_IOUT_POINT	○	○	○	○	

Appendix3. List of product codes

A list of product codes is shown below.
Please refer to the list shown below for the model code of a few models.

Appendix3. List of product codes for each model number

Model number	Rated voltage					
	5	12	15	24	32	48
PCA300F-☐	150413	150414	150415	150416	150417	150418
PCA300F-☐-T	150419	150420	150421	150422	150423	150424
PCA600F-☐	145688	145689	145690	145691	147976	145692
PCA600F-☐-T	-	146831	146834	146837	148739	148740
PCA1000F-☐	150364	150365	150366	150367	150368	150369
PCA1000F-☐-T	-	-	-	150370	150371	150372
PCA1500F-☐	153477	153472	153473	153474	153475	153476

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A. Revision history

No.	Date	Ver	Page	note
1	2017.04.12	1.0E	-	First edition issued
2	2017.05.10	1.1E	2	Correction of errors
3	2017.08.09	1.2E	2	Operation confirmed UART module addtion
4	2018.07.21	2.0E	-	Full-fledged revision as PCA standard product sale (old version is separated for PCA 600 F -□- P 2)
5	2019.03.21	2.1E	1,21-24, app4-7	PCA300F and PCA1000F sale
6	2021.02.26	2.2E	4	Note addtion
			22	Figure 6.5.6 has been modified.
7	2021.03.05	2.3E	22-24, app4-7	PCA1500F sale
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