PCA Series (-I option)
PMBus Communication Manual

ver1.1E 2021.7.30

PCA series ---*PMBus*---

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1. Overview

With this product, monitoring of the operational status of the power supply and changing of various set values are possible using the PMBus.

In addition, the non-volatilization memory in PCA can maintain various set values and information even if input voltage is shut off.

After the communication completion, do the communication after waiting more than 300μs.

For detail, refer to PMBus standard spec manual : PMBus Power System Management Protocol Specification
Part I (Revision1.2) and Part II (Revision1.2).

2. PMBus Wiring and Connection

2.1 PMBus pin function of PCA series

Tables 2.1 show the pin names and functions of this product, related to the PMBus.

Table 2.1 CN4 PMBus related pin function

Pin number	Pin name	Function
1	SDA	Serial data
2	SGND	Signal ground
3	SCL	Serial clock
4	SMBA	SMBALERT
5	ADDR0	Address bit 0
6	ADDR1	Address bit 1
7	ADDR2	Address bit 2
8	SGND	Signal ground

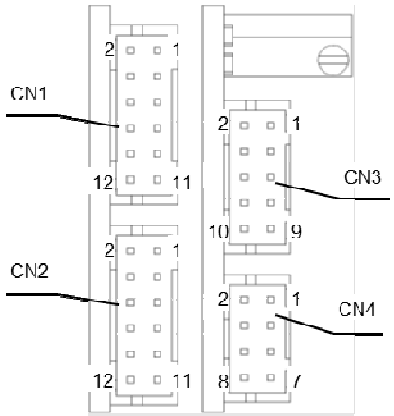
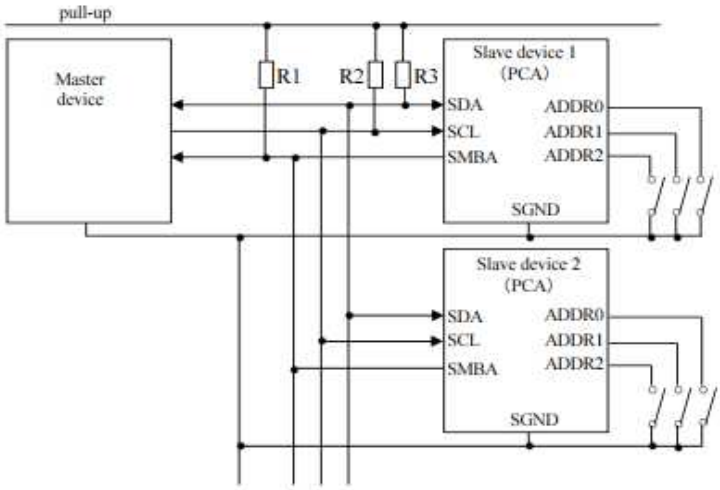


Figure 2.1 PCA series connector

2.2 Connection method

Figure 2.2 shows an example of connection when using PMBus.



No.	component	Setting value
1	R1	10kΩ(recommend)
2	R2	*1
3	R3	*1

*1 : Refer to section 2.4 PMBus communication pull-up resistor.

Figure 2.2 Example of PMBus connection

2.3 PMBus communication cable pattern example

When connecting the PMBus communication cable, please make sure to minimize noise from outside and crosstalk by positioning Signal ground between Serial data bus and Serial clock bus as shown Figure 2.3.

Also, make sure of the right setting for the pull-up resistor as parasitic capacitance can happen by way of shielding and length of cabling. (refer to clause 2.4)

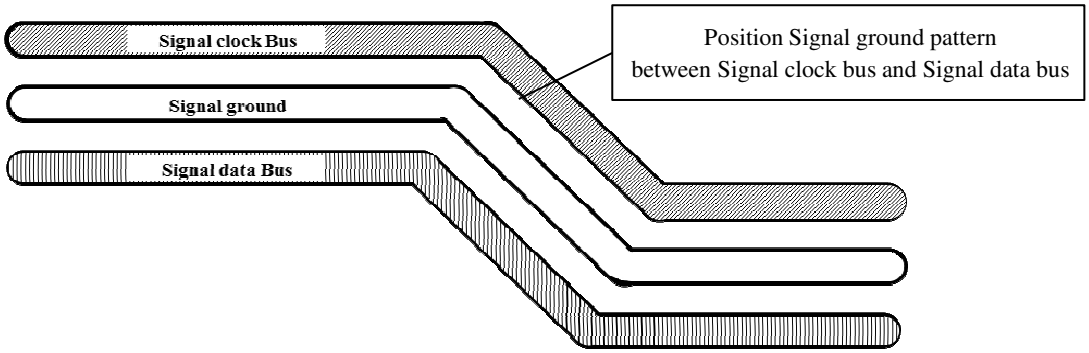


Figure 2.3 Pattern example

2.4 PMBus communication pull-up resistor value

It is necessary to connect pull-up resistor on Signal data bus and Signal clock bus terminal of PMBus Recommended value of resistor(maximum value) is shown at figure 2.4.

Note: Do not exceed the rated output current of converter's terminal (Section 5.1).

Note: Total parasitic capacitance and input capacitance should be less 400pF.

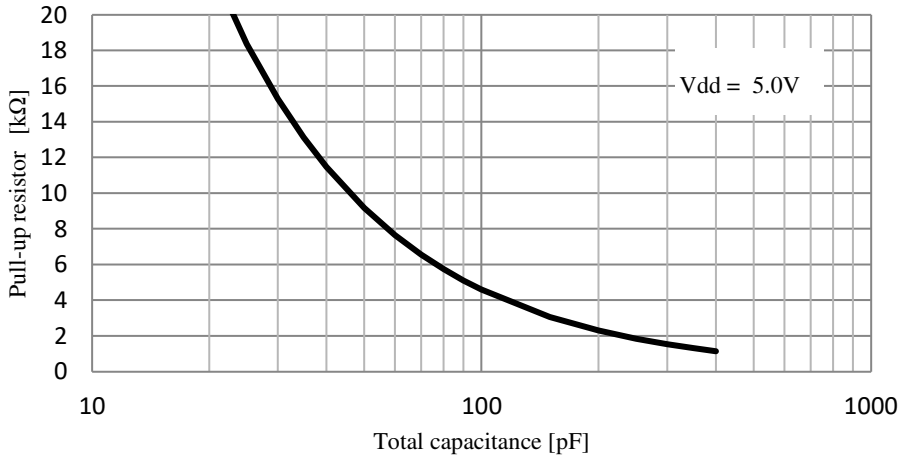
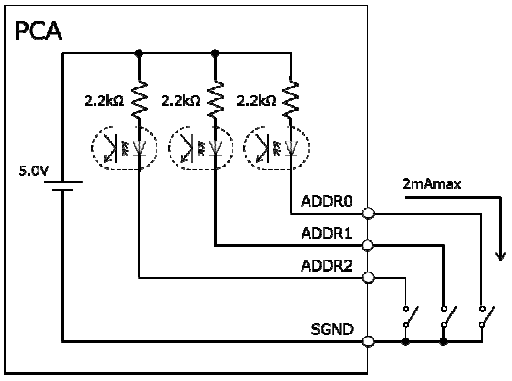


Figure 2.4 Recommended value of pull-up resistor

2.5 Address setting

The address can be set to be one of the eight types from "16" to "23" .

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



Fixed value (bit6~3)	ADDR2 (bit2)	ADDR1 (bit1)	ADDR0 (bit0)	PMBus Address
0010	0	0	0	16
	0	0	1	17
	0	1	0	18
	0	1	1	19
	1	0	0	20
	1	0	1	21
	1	1	0	22
	1	1	1	23

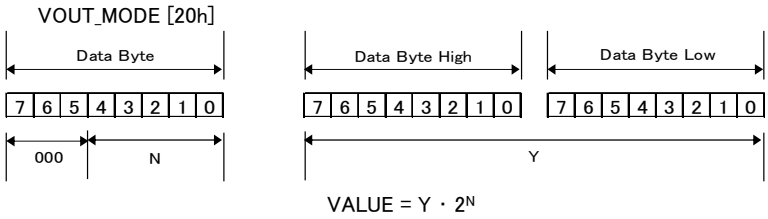
0 : Short 1 : Open

Figure 2.5 Method of address setting

3. Data format

3.1 Data format for output voltage

SUGGESTION Set and read the output voltage according to the Linear format shown below. Bits 7:5 of VOUT_MODE [20h] should read “000” for linear mode. N is a 5 bit two’s complement binary integer. The mantissa (Part Y) is a 16 bit unassigned binary integer. The voltage (in volts) is calculated by the equation VALUE= Y * 2^N



3.2 Other (except output voltage) data format

SUGGESTION: Set and read a command according to the Linear format shown below. N is a 5 bit two’s complement integer, which differs depending on the command. The mantissa (Part Y) is an 11 bit, two’s complement integer. The parameter is calculated by the equation VALUE= Y * 2^N

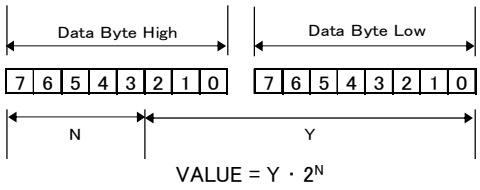


Table 3.1 Index part N value

No.	Item		Display format	Characteristics N						Unit
				5V	12V	15V	24V	32V	48V	
1	Output voltage		Linear(Vout)	-10						V
2	Output current	PCA300	Linear(Iout)	-3	-4	-4	-5	-6	-6	A
3		PCA600		-2	-3	-3	-4	-5	-5	
4		PCA1000		-1	-2	-3	-3	-4	-4	
5		PCA1500		-1	-2	-2	-3	-3	-4	
6	Output power	PCA300	Linear(Pout)	-1						W
7		PCA600		0						
8		PCA1000		1						
9		PCA1500		2						
10	Input voltage		Linear(Vin)	-1						V
11	AUX output voltage		Linear(Vout)	-10						V
12	Starting-up time（Vin）		Linear(Time_1)	6						msec
13	Starting-up time（RC）		Linear(Time_2)	2						msec
14	Temperature		Linear(Temp)	0						℃
15	Fan speed		Linear(Fan)	5						rpm
16	Input-voltage frequency		Linear(Vin_Freq)	0						Hz

4.PMBus Functions

4.1 Clock stretching

PCA has a clock stretching function.
Use a master device that can support clock stretching.

4.2 SMBALERT

SMBALERT protocol is also supported by the module. The module can alert the PMBus master that it has an active status or alarm condition. (Refer to standard manual of SMBus for details : System Management Bus(SMBus) Specification Ver 2.0)

Note: When multiple slave devices issue SMBALERT signal at the same time, it is not possible to make judgment for slave address by ARA.
(Initial state: ARA is invalid)

If alarm condition continues, execute ARA operation again after executing CLEAR_FAULTS [03h]. If it is difficult to remove the abnormal operation, perform analysis of the abnormal operation without disabling ARA with MFR_ARA_CONFIG [E0h] during power off or without executing CLEAR_FAULTS [03h].

4.3 Packet error checking (PEC)

This product supports packet error checking (PEC).
We recommend using PEC when you implement PMBus communication.
(Refer to standard manual of SMBus for details : System Management Bus(SMBus) Specification Ver 2.0)

If an error occurs in the communication data, such as the output voltage set value is written abnormal value, possibly to damage the load device.
When not using the PEC, to check that the communication error does not occur.

5. PMBus hardware specification

5.1 Absolute maximum ratings for communication terminals

Table 5.1 shows the absolute maximum ratings of the PMBus terminals.

Table 5.1 Absolute maximum ratings

No.	Item	Min	Typ	Max	Unit	Remark
1	Input voltage	-0.3	-	6.0	V	
2	Sink current	-	-	50	mA	

5.2 Electrical characteristics of communication terminals

Table 5.2 shows the electrical characteristics of the PMBus terminals.

Table 5.2 Electrical characteristics

No.	Item	Min	Typ	Max	Unit	Remark
1	Input pull-up voltage	4.5	-	5.5	V	SCL,SDA
2	Input High level voltage	2.1	-	-	V	SCL,SDA
3	Input Low level voltage	-	-	0.8	V	SCL,SDA
4	Output Low level voltage	-	-	0.5	V	SCL,SDA
5	Output High level open drain Leak current	-	-	0.25	mA	SCL,SDA
6	PMBus communication frequency range	10	-	400	kHz	

5.3 Note

Wait for more than 300us after stop-condition. If the wait time is short, the slave cannot communicaton.

6. Command specification of PMBus

6.1 Outline of each command

Table 6.1 Outline of each command (1/3)

Commands for setting output voltage			
OPERATION	01h	:Setting of ON / OFF control	R/W
MFR_OPERATION_STATE	EEh	:Returns the output ON/OFF status	R
MFR_CTL_RESET_LATCH	E1h	:Resets the latch state	S
VOUT_MODE	20h	:Returns an output voltage format form	R
VOUT_COMMAND	21h	:Specifies the output voltage	R/W
MFR_VOUT_FACTORY_SETTING	E3h	:Restores the output-voltage setting parameter to the factory default	S
MFR_VOUT_REFERENCE	EAh	:Returns the output-voltage setting parameter	R
VOUT_MAX	24h	:Sets the maximum possible value setting of the output voltage	R/W
MFR_VOUT_MIN	D3h	:Sets lower limit of the output-voltage variation	R/W
MFR_VOUT_LIMIT_FACTORY_SETTING	E5h	:Restores the upper and lower limit of output-voltage variation to the factory default	S
Commands for controlling constant current			
MFR_CC_MODE	D1h	:Sets the setting method of constant current	R/W
MFR_CC	D0h	:Specifies constant current for operation	R/W
MFR_CC_FACTORY_SETTING	E4h	:Restores the parameter of constant current operation to the factory default	S
MFR_CC_REFERENCE	EBh	:Returns the current parameter of constant current for operation	R
MFR_CC_MAX	D2h	:Specifies upper limit of constant current for operation	R/W
MFR_CC_LIMIT_FACTORY_SETTING	E6h	:Restores the upper limit of constant current for operation to the factory default	S
Output-voltage sequence commands			
MFR_TON_DELAY_RC	D9h	:Set delay time for activation by RC2 terminal	R/W
MFR_TON_DELAY_VIN	DAh	:Sets delay time for activation after input	R/W
MFR_RAMP_RATE	DBh	:Selects the change rate of the output voltage	R/W
VIN_ON	35h	:Sets the value of the start-up input voltage(AC).	R/W
VIN_OFF	36h	:Sets the value of the stop input voltage(AC)	R/W
MFR_VIN_ON_DC	DDh	:Sets the value of the start-up input voltage(DC).	R/W
MFR_VIN_OFF_DC	DEh	:Sets the value of the stop input voltage(DC)	R/W
Commands for setting Accessory function			
MFR_FAN_MODE	D6h	:Set the fan control method, automatic or full speed	R/W
MFR_AUX_VOUT	DCh	:Changes the AUX output voltage	R/W
MFR_MS	D5h	:Enables or disables switching between the master mode and the slave mode*1	R/W
MFR_MS_STATE	ECh	:Returns the current master/slave status*1	R

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

(This is not clear as to what is being referenced here)

suggestion *1 This command applies only when master-slave function is used

R : Read
W : Write
S : Send

Table 6.1 Outline of each command (2/3)

Monitor commands			
	READ_VIN	88h	:Returns the measured value of the input voltage	R
	MFR_READ_VIN_FREQUENCY	E9h	:Returns the measured value of input-voltage frequency	R
	READ_VOUT	8Bh	:Returns the measured value of the output voltage	R
	READ_IOUT	8Ch	:Returns the measured value of the output current	R
	READ_POUT	96h	:Returns the output power	R
	READ_FAN_SPEED_1	90h	:Returns the fan speed	R
	READ_TEMPERATURE_1	8Dh	:Returns the temperature of internal elements	R
State acquisition commands			
	CLEAR_FAULTS	03h	:Clear the" STATUS Register" after any fault occurs and reset the SMBALERT signal	S
	SMBALERT_MASK	1Bh	:Prevent a warning or fault condition from asserting the SMBALERT signal	R/W
	STATUS_BYTE	78h	:Returns the error state	R/W
	STATUS_WORD	79h	:Returns the error state	R/W
	STATUS_VOUT	7Ah	:Returns the output voltage error state	R/W
	STATUS_IOUT	7Bh	:Returns the output current error state	R/W
	STATUS_TEMPERATURE	7Dh	:Returns the temperature error state	R/W
	STATUS_CML	7Eh	:Returns the communication error state	R/W
	STATUS_MFR_SPECIFIC	80h	:Returns specific error state (For what error?)	R/W
	STATUS_FANS_1_2	81h	:Returns the built-in fan error state	R/W
	MFR_ARA_CONFIG	E0h	:Sets the SMBAleat configure	R/W
	MFR_STOP_CODE	FCh	:Returns the code indicating the stop status	R
	MFR_READ_TOTAL_INPUT_TIME_1	EFh	:Returns the cumulative time of input voltage applied (minutes)	R
	MFR_READ_TOTAL_INPUT_TIME_2	F0h	:Returns the cumulative time of input voltage applied (lower 16 bits of hour)	R
	MFR_READ_TOTAL_INPUT_TIME_3	F1h	:Returns the cumulative time of input voltage applied (high-order 16 bits of hour)	R
	MFR_READ_TOTAL_OUTPUT_TIME_1	F2h	:Returns the cumulative output time (minutes)	R
	MFR_READ_TOTAL_OUTPUT_TIME_2	F3h	:Returns the cumulative output time (lower 16 bits of hour)	R
	MFR_READ_TOTAL_OUTPUT_TIME_3	F4h	:Returns the cumulative output time (high-order 16 bits of hour)	R
Commands for setting addresses, memories, and communications			
	CAPABILITY	19h	:Returns the support status of the communication	R
	WRITE_PROTECT	10h	:Control writing to the PMBus interface device	R/W
	STORE_USER_ALL	15h	:The Operating Memory data is written to the FLASHROM	S
	RESTORE_DEFAULT_ALL	12h	:Restore the initial setting of the PMBus	S
	MFR_ACCUMULATE_MODE	F6h	:Enables or disables switching accumulation mode	R/W
	MFR_ACCUMULATE_EXEC	F7h	:Execution command in the accumulation mode	S
	MFR_READ_ACCUMULATE_DATA	F8h	:Returns buffer in the accumulation mode	R
	MFR_CLEAR_ACCUMULATE_DATA	F9h	:Erases buffer in the accumulation mode	S
	MFR_ADDRESS	D4h	:Sets communication address	R/W
	MFR_READ_ADDRESS	EDh	:Returns the communication address	R

R : Read
W : Write
S : Send

Table 6.1 Outline of each command (3/3)

Product information commands			
PMBUS_REVISION	98h	:Returns the revision of the PMBus implemented	R
MFR_SERIAL	9Eh	:Returns the product Lot/serial number（ASCII）	R
MFR_MODEL	9Ah	:Returns the product name（ASCII）	R
MFR_LOCATION	9Ch	:Returns manufacturing location of the product	R
MFR_RATED_VOUT	FAh	:Returns the rated voltage of the model	R
MFR_RATED_IOUT	FBh	:Returns the rated current of the model	R

R : Read
W : Write
S : Send

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

6.2 Output-voltage setting commands

6.2.1 OPERATION [01h] R/W Byte

The command to control ON/OFF of the output voltage (remote control function).
With this command, the output voltage can be turned ON or OFF.
When OFF is specified by the RC2 terminal, the output voltage will not turn ON.

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	1	0	0	0	0	0	0	0	80h
Access	R/W	R	R	R	R	R	R	R	

No.	setting				Output	Overview
	bit7-6	bit5-4	bit3-2	bit1-0		
1	00	XX	XX	XX	OFF	Power supply stops (No DC Output)
2	01	XX	XX	XX	OFF	Stop by sequence TOFF_DELAY [64h]、TOFF_FALL [65h] (not supported)
3	10	00	XX	XX	ON	Set output voltage to value of VOUT_COMMAND [21h]
4	10	01	01	XX	ON	Set output voltage value of VOUT_MARGIN_LOW [26h] (not supported)
5	10	01	10	XX	ON	Set output voltage value of VOUT_MARGIN_LOW [26h] (not supported)
6	10	10	01	XX	ON	Set output voltage value of VOUT_MARGIN_HIGH [25h] (not supported)
7	10	10	10	XX	ON	Set output voltage value of VOUT_MARGIN_HIGH [25h] (not supported)

XX : Ignore

6.2.2 MFR_OPERATION_STATE [EEh] Read Byte

Returns the ON/OFF status of the output voltage.

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	0	0	0	0	1	01h
Access	R	R	R	R	R	R	R	R	

No.	bit	Value	Overview
1	bit 7-1	0000000	None
2	bit 0	0	Output voltage is OFF
3		1	Output voltage is ON

6.2.3 MFR_CTL_RESET_LATCH [E1h] Send

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

6.2.4 VOUT_MODE [20h] Read Byte

It reads an output voltage format form.

The characteristic N (bit4-0) of the Linear mode becomes a fixation at -10

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	1	0	1	1	0	16h
Access	R	R	R	R	R	R	R	R	

No.	bit	Value	Overview
1	bit7-5	000	Vo format is linear mode
2		001	Vo format is VID mode (not supported)
3		010	Vo format is Direct mode (not supported)
4	bit4-0	10110	It shows the index parts N of the Linear mode by 2 of complement

6.2.5 VOUT_COMMAND [21h] R/W Word

Sets the output voltage.

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 VOUT_MAX [24h].

It is not possible to specify a value less than or equal to the lower limit set by MFR_VOUT_MIN [D3h].

Display format	Linear (Vout)

The voltage set by this command becomes effective, regardless of the voltage adjustment of the potentiometer on the main unit.

The output voltage can be adjusted by the potentiometer 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 of the potentiometer remains effective.

Table 6.2.1 "VOUT_COMMAND" Operation example （PCA600F-12-I）

	Operation	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	Set output voltage to 10.0V by VOUT_COMMAND	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

6.2.6 MFR_VOUT_FACTORY_SETTING [E3h] Send

Restores the output voltage set by VOUT_COMMAND [21h] to the Factory Default value set at time of shipping.

This command cannot reset adjustment of the potentiometer.

Table 6.2.2 "MFR_VOUT_FACTORY_SETTING" Operation example of a 12V unit (PCA600F-12-I)

	Operation	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	Set output voltage to 10.0V by VOUT_COMMAND	10.0V	
4	Adjust output voltage to 10.2V by volume	10.2V	+0.2V by volume
5	Send "MFR_VOUT_FACTORY_SETTING"	12.5V	+0.3V & +0.2V=>+0.5V

The output voltage recorded in the nonvolatile memory by command STORE_USER_ALL [15h] remains unaffected.

6.2.7 MFR_VOUT_REFERENCE [EAh] Read Word

Returns the output-voltage control value.

Display format	Linear (Vout)

* If the state has changed by potentiometer adjustment, etc., it will be different from the value set by VOUT_COMMAND [21h].

6.2.8 VOUT_MAX [24h] R/W Word

Sets the upper limit of variation of the output voltage.

This setting is applied to all operations of the voltage variation (volume, VTRM terminal, command VOUT_COMMAND [21h]).

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 MFR_VOUT_MIN [D3h].

A value exceeding 120% of the rated voltage cannot be specified.

Display format	Linear (Vout)

6.2.9 MFR_VOUT_MIN [D3h] R/W Word

Sets the lower limit of variation of the output voltage.

This setting is applied to all operations of the voltage variation (volume, VTRM terminal, command VOUT_COMMAND [21h]).

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 VOUT_MAX [24h].

Display format	Linear (Vout)

6.2.10 MFR_VOUT_LIMIT_FACTORY_SETTING [E5h] Send

Restores the settings by VOUT_MAX [24h] and MFR_VOUT_MIN [D3h] to the factory defaults.

The output voltage recorded in the nonvolatile memory by command STORE_USER_ALL [15h] remains unaffected.

6.3 Constant-current control command

6.3.1 MFR_CC_MODE [D1h] R/W Byte

Setting method for constant current operation.

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	0	0	0	0	0	00h
Access	R	R	R	R	R	R	R	R/W	

No.	bit	Value	Overview
1	bit 7-1	0000000	None
2	bit 0	0	Sets by Itrm terminal
3		1	Sets by MFR_CC [D0h] command

6.3.2 MFR_CC [D0h] R/W Word

Specify the setting of constant current operation.
It is not possible to specify a value larger than or equal to the upper limit set by MFR_CC_MAX [D2h] .
A value larger than the rated current can not be specified.

Display format	Linear (Iout)

At time of factory shipment, the value set for constant current operation is to be specified by the ITRM terminal voltage.
By sending command MFR_CC_MODE [D1h], the value set by this command becomes the new setting.
The order of sending command MFR_CC_MODE [D1h] and MFR_CC [D0h] is irrelevant.

6.3.3 MFR_CC_FACTORY_SETTING [E4h] Send

Restores the setting of constant current operation set by command MFR_CC [D0h] to the factory default.
The setting of constant current operation recorded in the nonvolatile memory by command STORE_USER_ALL [15h] remains unaffected.

6.3.4 MFR_CC_REFERENCE [EBh] Read Word

Returns the setting for constant current operation.

Display format	Linear (Iout)

* When the state has changed by protection-function operation, etc., the returned value will be different from the value set by MFR_CC [D0h].

6.3.5 MFR_CC_MAX [D2h] R/W Word

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.

Display format	Linear (Iout)

6.3.6 MFR_CC_LIMIT_FACTORY_SETTING [E6h] Send

The value set by command MFR_CC_MAX [D2h] is restored to the factory default.
The setting of constant current operation recorded in the nonvolatile memory by command STORE_USER_ALL [15h] remains unaffected.

6.4 Output-voltage sequence commands

6.4.1 MFR_TON_DELAY_RC [D9h] R/W Word

Sets the delay time [msec] from the RC2 terminal operation to the start of the start operation (Figure 6.4.1).
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.

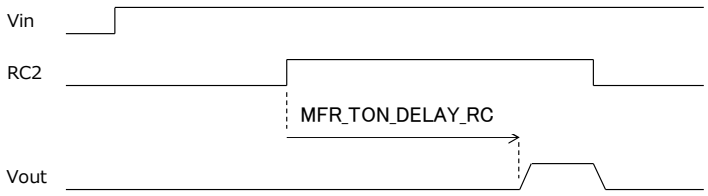


Figure 6.4.1 Timing diagram MFR_TON_DELAY_RC

Specified range	0 - 3900
Display format	Linear (Time_1)

6.4.2 MFR_TON_DELAY_VIN [DAh] R/W Word

Sets the delay time [msec] from the power-up of input voltage to the start of the output operation startup (Figure 6.4.2).

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

After sending this command, send command STORE_USER_ALL [15h] and block input for more than 10 seconds.

The setting will become effective from the next startup.

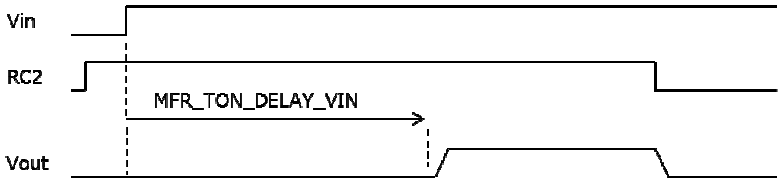
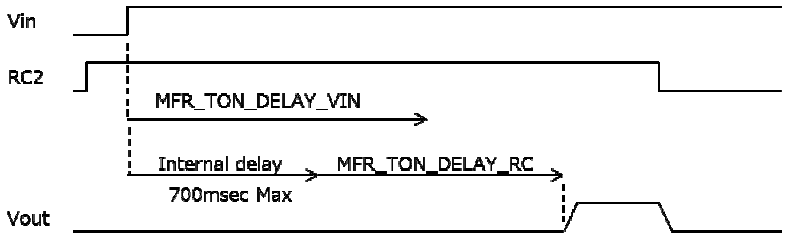


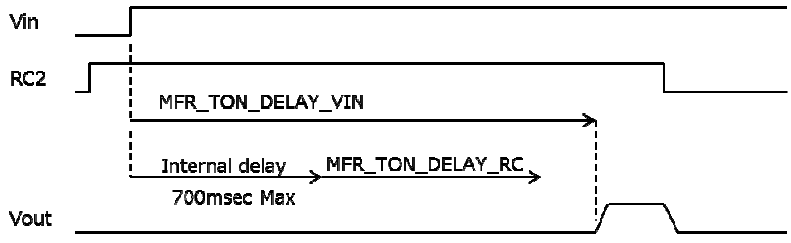
Figure 6.4.2 Timing diagram MFR_TON_DELAY_VIN

Specified range	Specifications of start-up time* - 64000 ※PCA600F：700
Display format	Linear (Time_2)

In this case, the value larger between the time specified in MFR_TON_DELAY_RC [D9h] and MFR_TON_DELAY_VIN [DAh] will be chosen (Figure 6.4.3).



(a)When following "MFR_TON_DELAY_RC" setting



(b)When following "MFR_TON_DELAY_VIN" setting

Figure 6.4.3 Timing diagram when specified in MFR_TON_DELAY_RC and MFR_TON_DELAY_VIN

6.4.3 MFR_RAMP_RATE [DBh] R/W Byte

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 VOUT_COMMAND [21h].

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	0	0	0	0	0	00h
Access	R	R	R	R	R	R	R/W	R/W	

No.	bit	Value	Overview	
1	bit7-0	00000000	Default	(Fast)
2		00000001	10%-90%(rated voltage) / approx.100msec	(Slow)
3		00000010	10%-90%(rated voltage) / approx.500msec	(Very slow)

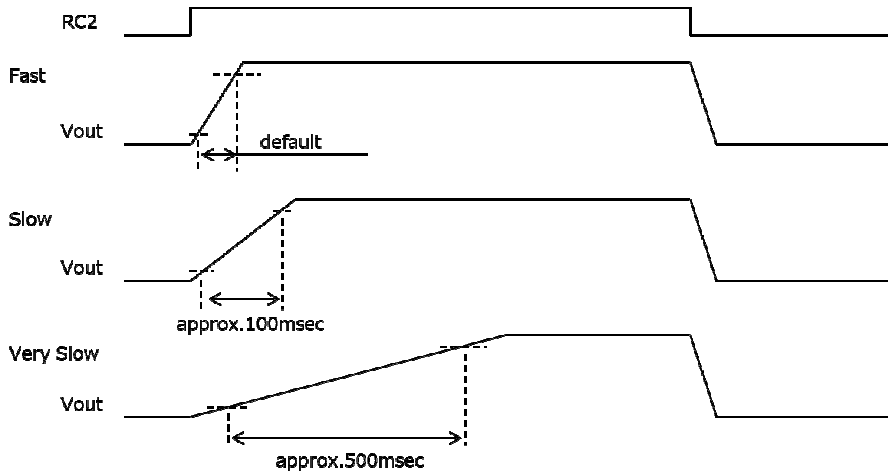


Figure 6.4.4 Timing diagram activation by the remote control

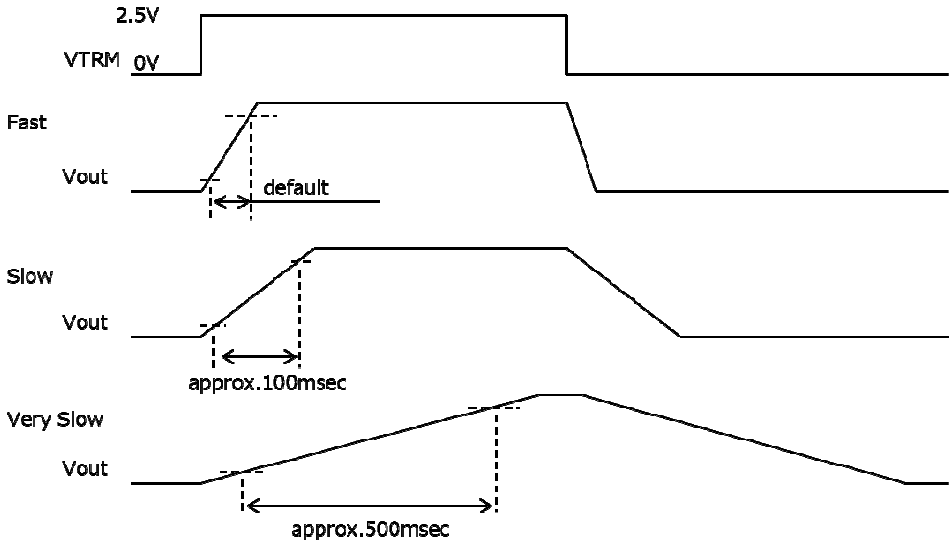


Figure 6.4.5 Timing diagram activation by the VTRM terminal

6.4.4 VIN_ON [35h] R/W Word

Specifies the starting voltage for AC input.
After sending this command, send command STORE_USER_ALL [15h] 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 VIN_OFF [36h]+ 5 V or less.
If specified, this command is not accepted and an error is returned.

Specified range	60～240VAC
Display format	Linear (Vin)

When using at 95V or less, additional load derating is required(Figure 6.4.6).

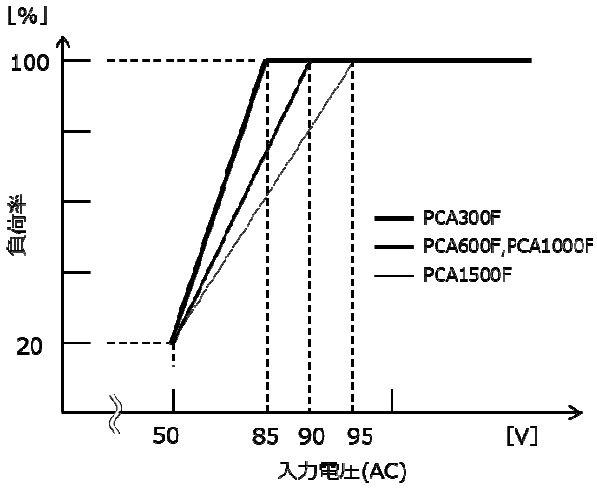


Figure 6.4.6 Input voltage derating curve (AC)

6.4.5 VIN_OFF [36h] R/W Word

Specifies the stop voltage for AC input.
After sending this command, send command STORE_USER_ALL [15h] 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 VIN_ON [35h] - 5 V or more.
If specified, this command is not accepted and an error is returned.

Specified range	50～200VAC
Display format	Linear (Vin)

When using at 95 V or less, additional load derating is required(Figure 6.4.6).

6.4.6 MFR_VIN_ON_DC [DDh] R/W Word

Specifies the starting voltage for DC input (excluding PCA1000F,PCA1500F).

After sending this command, send command STORE_USER_ALL [15h] 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 MFR_VIN_OFF_DC [DEh] + 10 V or less. If specified, this command is not accepted and an error is returned.

Specified range	80～340VDC
Display format	Linear (Vin)

When using at 110 V or less, additional load derating is required (Figure 6.4.7).

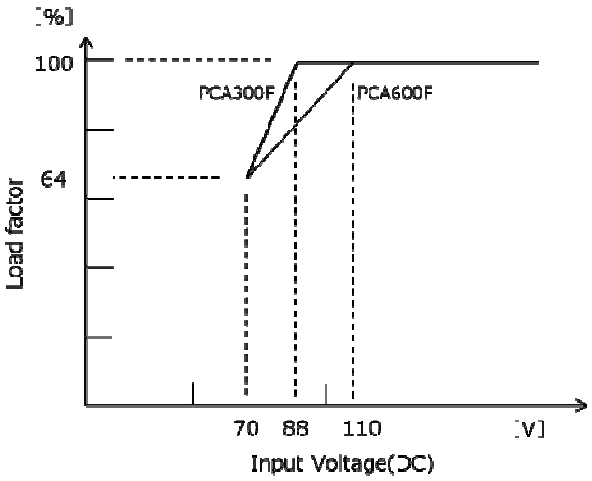


Figure 6.4.7 Input voltage derating curve (DC)

6.4.7 MFR_VIN_OFF_DC [DEh] R/W Word

Sets the stop voltage for DC input to the value specified by the argument (excluding PCA1000F,PCA1500F).

After sending this command, send command STORE_USER_ALL [15h] 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 MFR_VIN_ON_DC [DDh] -10V or more.

When specified, this command is not accepted and an error is returned.

Specified range	70～280VDC
Display format	Linear (Vin)

When using at 110 V or less, additional load derating is required (Figure 6.4.7).

6.5 Commands for setting Accessory function

6.5.1 MFR_FAN_MODE [D6h] R/W Byte

Set the fan control method.

At time of factory shipment, Automatic control is set as the default.

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	0	0	0	0	0	00h
Access	R	R	R	R	R	R	R	R/W	

No.	bit	Value	Overview
1	bit 7-1	0000000	None
2	bit 0	0	Automatic control of the rotation speed of the built-in air cooling fan
3		1	Fixes the rotation speed of the built-in air cooling fan at the maximum.

6.5.2 MFR_AUX_VOUT [DCh] R/W Word

Sets the AUX output voltage.

At time of factory shipment, 12V is set as the default.

Specified range	4.7 ～ 12.6V
Display format	Linear (Vout)

The rated output current of AUX changes with the output voltage(Figure 6.5.1).

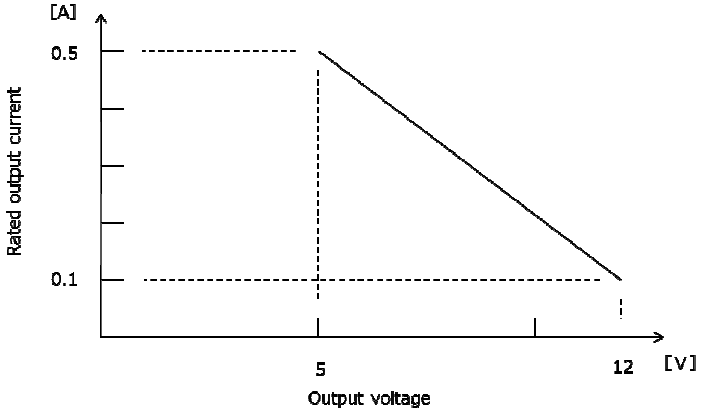


Figure 6.5.1 The rated output current of AUX

6.5.3 MFR_MS [D5h] R/W Byte

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

Selects the setting status of the master mode and the slave mode.
After sending this command, send command STORE_USER_ALL [15h] and block input for more than 10 seconds.
The settings will be effective from the next startup.
The setting at time of factory shipment is "Selection by SLV_EN terminal".

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	0	0	0	0	0	00h
Access	R	R	R	R	R	R	R/W	R/W	

No.	bit	Value	Overview
1	bit7-2	000000	None
2	bit1-0	00	Selection by SLV_EN terminal
3		10	
4		01	Specifies master mode
5		11	Specifies slave mode

6.5.4 MFR_MS_STATE [ECh] Read Byte

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

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

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	0	0	0	0	0	00h
Access	R	R	R	R	R	R	R	R	

No.	bit	Value	Overview
1	bit7-1	0000000	None
2	bit0	0	Specifies master mode
3		1	Specifies slave mode

6.6 Monitor commands

6.6.1 READ_VIN [88h] Read Word

Returns the effective value of the input voltage. AC and DC are automatically distinguished internally.
Correct values may not be returned for input with distorted waveforms.

Display format	Linear (Vin)

6.6.2 MFR_READ_VIN_FREQUENCY [E9h] Read Word

Returns the frequency of the input voltage.
"0" is returned for DC input.
It will remain unsettled for about five seconds from input.

Display format	Linear(Vin_Freq)

6.6.3 READ_VOUT [8Bh] Read Word

Returns the output voltage (voltage between the sensing terminals).

Display format	Linear (Vout)

6.6.4 READ_IOUT [8Ch] Read Word

Returns the output current.

Display format	Linear (Iout)

6.6.5 READ_POUT [96h] Read Word

Returns the output power.

Display format	Linear (Pout)

6.6.6 READ_FAN_SPEED_1 [90h] Read Word

Reads out the fan speed.

Display format	Linear (Fan)

6.6.7 READ_TEMPERATURE_1 [8Dh] Read Word

Returns the internal-element temperature.

Display format	Linear (Temp)

6.7 State acquisition commands

6.7.1 CLEAR_FAULTS [03h] Send

This command is used to clear the" STATUS Register" after any fault occurs and reset the SMBALERT signal.

6.7.2 SMBALERT_MASK [1Bh] Write Word / Block Write - Read Process Call

The SMBALERT_MASK command may be used to prevent a warning or fault condition from asserting the SMBALERT signal. That is set to "1" to the bit to be masked.

No.	Status command of possible mask setting	Code	Word/Byte	Initial value
1	STATUS_BYTE	78h	Byte	02h
2	STATUS_WORD(high-order 8bits)	79h	Byte	00h
3	STATUS_VOUT	7Ah	Byte	00h
4	STATUS_IOUT	7Bh	Byte	00h
5	STATUS_TEMPERATURE	7Dh	Byte	00h
6	STATUS_CML	7Eh	Byte	FFh
7	STATUS_MFR_SPECIFIC	80h	Byte	00h
8	STATUS_FANS_1_2	81h	Byte	00h

The details of the data format is described in PMBus standard specification manual：PMBus Power System Management Protocol Specification Part Ⅱ . BLOCK COUNT be always set to "1"

6.7.3 STATUS_BYTE [78h] R/W Byte

This command read the error state.

Error is cleared by writing a 1 to the error bit (only bit7). All of the error bit is cleared in CLEAR_FAULTS [03h].

Initial setting :00h

No.	bit	Overview
1	bit7	It sets when the device can not reply in use.
2	bit6	It sets by output OFF status (not supportive).
3	bit5	An output overvoltage fault has occurred.
4	bit4	An output overcurrent fault(intermittent current protection) has occurred.
5	bit3	An input under voltage fault has occurred (not supportive).
6	bit2	A temperature fault has occurred (STATUS_TEMPERATURE [7Dh])
7	bit1	A communications, memory or logic fault has occurred (STATUS_CML [7Eh])
8	bit0	A fault or warning not listed in bits [7:1] has occurred (not supportive).

6.7.4 STATUS_WORD [79h] R/W Word

This command read the error state.

Error is cleared by writing a 1 to the error (only bit8) bit. All of the error bit is cleared in CLEAR_FAULTS [03h].

Initial setting :00h

No.	bit	Overview
1	bit15	An output voltage fault has occurred (STATUS_VOUT [7Ah]).
2	bit14	An output current fault has occurred (STATUS_IOUT [7Bh])
3	bit13	An input voltage fault has occurred (not supportive).
4	bit12	A manufacturer specific fault has occurred (STATUS_MFR_SPECIFIC [80h])
5	bit11	POWER_GOOD signal is output (not supportive).
6	bit10	A fan or airflow fault has occurred (STATUS_FANS_1_2 [81h])
7	bit9	A bit in STATUS_OTHER is set (not supportive).
8	bit8	A fault type not given in bits [15:1] of the SATUS_WORD has been.
9	bit7-0	Same STATUS_BYTE [78h].

6.7.5 STATUS_VOUT [7Ah] R/W Byte

This command read the output voltage error state.

Error is cleared by writing a 1 to the error bit. All of the error bit is cleared in CLEAR_FAULTS [03h].

Initial setting :00h

No.	bit	Overview
1	bit7	VOUT_OV_FAULT
2	bit6	VOUT_OV_WARNING (not supportive).
3	bit5	VOUT_UV_WARNING (not supportive).
4	bit4	VOUT_UV_FAULT (not supportive).
5	bit3	VOUT_MAX Warning (not supportive). ※
6	bit2	TON_MAX_FAULT (not supportive).
7	bit1	TOFF_MAX_WARNING (not supportive).
8	bit0	–

6.7.6 STATUS_IOUT [7Bh] R/W Byte

This command read the output current error state.

Error is cleared by writing a 1 to the error bit. All of the error bit is cleared in CLEAR_FAULTS [03h].

Initial setting :00h

No.	bit	Overview
1	bit7	IOUT_OC_FAULT
2	bit6	IOUT_OC_LV_FAULT (not supportive).
3	bit5	The output current exceeds the rated current.
4	bit4	IOUT_UC_FAULT (not supportive).
5	bit3	–
6	bit2	In Power Limiting Mode (not supportive).
7	bit1	POUT_OP_FAULT (not supportive).
8	bit0	POUT_OP_WARNING (not supportive).

6.7.7 STATUS_TEMPERATURE [7Dh] R/W Byte

This command read the temperature error state.
Error is cleared by writing a 1 to the error bit. All of the error bit is cleared in CLEAR_FAULTS [03h].

Initial setting :00h

No.	bit	Overview
1	bit7	OT_FAULT
2	bit6	OT_WARNING (not supportive).
3	bit5	UT_WARNING (not supportive).
4	bit4	UT_FAULT (not supportive).
5	bit3	–
6	bit2	–
7	bit1	–
8	bit0	–

6.7.8 STATUS_CML [7Eh] R/W Byte

This command read the communication error state.
Error is cleared by writing a 1 to the error bit. All of the error bit is cleared in CLEAR_FAULTS [03h].

Initial setting :00h

No.	bit	Overview
1	bit7	Invalid Or Unsupported Command Received
2	bit6	Invalid Or Unsupported DATA Received
3	bit5	Packet Error Check Failed
4	bit4	Memory Fault Detected (not supportive)
5	bit3	Processor Fault Detected
6	bit2	–
7	bit1	A communication fault other than the ones listed in this table has occurred
8	bit0	–

6.7.9 STATUS_MFR_SPECIFIC [80h] R/W Byte

This command read the specific error state .
Error is cleared by writing a 1 to the error bit. All of the error bit is cleared in CLEAR_FAULTS [03h]

Initial setting :00h

No.	bit	Overview
1	bit7	–
2	bit6	–
3	bit5	–
4	bit4	–
5	bit3	–
6	bit2	Stops due to use of outside derating
7	bit1	Stops due to non-spec pulse load
8	bit0	Stops due to DS terminal connection error

6.7.10 STATUS_FANS_1_2 [81h] R/W Byte

This command read the built-in air cooling fan error state.
Error is cleared by writing a 1 to the error bit. All of the error bit is cleared in CLEAR_FAULTS [03h]

Initial setting :00h

No.	bit	Overview
1	bit7	Fan 1 Fault
2	bit6	Fan 2 Fault (not supportive)
3	bit5	Fan 1 Warning (not supportive)
4	bit4	Fan 2 Warning (not supportive)
5	bit3	Fan 1 Speed Overridden (not supportive)
6	bit2	Fan 2 Speed Overridden (not supportive)
7	bit1	Airflow Fault (not supportive)
8	bit0	Airflow Warning (not supportive)

6.7.11 MFR_ARA_CONFIG [E0h] R/W Byte

This command sets the SMBALERT configure.

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	0	0	0	0	0	00h
Access	R	R	R	R/W	R	R	R	R	

No.	bit	Value	Overview
1	bit7-5	000	None
2	bit4	0	It does not change the address at the time of SMBALERT signal output
3		1	It do change the ARA address at the time of SMBALERT signal output
4	bit3-0	0000	None

6.7.12 MFR_STOP_CODE [FCh] Read Byte

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 OPERATION[01h]
010	Stops due to input voltage drop
020	
050	tops 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.

6.7.13 MFR_READ_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 MFR_READ_TOTAL_INPUT_TIME_1 [EFh] represents "minute", which is reset to "0" every 60 minutes.

The returned values of MFR_READ_TOTAL_INPUT_TIME_2 [F0h] and MFR_READ_TOTAL_INPUT_TIME_3 [F1h]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.

MFR_READ_TOTAL_INPUT_TIME_1 [EFh] Read Word

Range	0 ～ 59 minute

MFR_READ_TOTAL_INPUT_TIME_2 [F0h] Read Word
MFR_READ_TOTAL_INPUT_TIME_3 [F1h] Read Word

Range	0 ~ 2^{32}-1 hour（Theoretical value）	
Constitution	Lower 16 bits	:MFR_READ_TOTAL_INPUT_TIME_2 (0-65,535hours)
	High-order 16 bits	:MFR_READ_TOTAL_INPUT_TIME_3

6.7.14 MFR_READ_TOTAL_OUTPUT_TIME

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

The returned value of MFR_READ_TOTAL_OUTPUT_TIME_1 [F2h] represents "minute", which is reset to "0" every 60 minutes.

The returned values of MFR_READ_TOTAL_OUTPUT_TIME_2 [F3h] and MFR_READ_TOTAL_OUTPUT_TIME_3 [F4h] 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.

MFR_READ_TOTAL_OUTPUT_TIME_1 [F2h] Read Word

Range	0 ～ 59 minute

MFR_READ_TOTAL_OUTPUT_TIME_2 [F3h] Read Word
MFR_READ_TOTAL_OUTPUT_TIME_3 [F4h] Read Word

Range	0 ~ 2^{32}-1 hour（Theoretical value）	
Constitution	Lower 16 bits	:MFR_READ_TOTAL_OUTPUT_TIME_2 (0-65,535hours)
	High-order 16 bits	:MFR_READ_TOTAL_OUTPUT_TIME_3

6.8 Commands for setting addresses, memories, and communications

6.8.1 CAPABILITY [19h] Read Byte

It reads the support status of the communication.

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	1	0	1	1	0	0	0	0	B0h
Access	R	R	R	R	R	R	R	R	

No.	bit	Value	Overview
1	bit7	0	Packet error check is not supportive
2		1	Packet error check is supportive
3	bit6-5	00	Supported Maximum Bus speed is 100kHz
4		01	Supported Maximum Bus speed is 400kHz
5		10	None
6		11	None
7	bit4	0	SMBALERT is not supportive
8		1	SMBALERT is supportive
9	bit3-0	0000	None

6.8.2 WRITE_PROTECT [10h] R/W Byte

Disables the Write command (see Table 6.1).

As an exception, commands WRITE_PROTECT [10h], STORE_USER_ALL [15h], and MFR_ACCMULATE_EXEC [F7h] are accepted.

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	0	0	0	0	0	00h
Access	R/W	R/W	R/W	R	R	R	R	R	

No.	bit	Value	Overview
1	bit7-0	10000000	Wring is impossible except WRITE_PROTECT [10 h]
2		01000000	Writing is impossible except the above +OPERATION [01 h] impossible.
3		00100000	Writing is impossible except the above + ON_OFF_CONFIG [02 h], VOUT_COMMAND [21 h]
4		00000000	Writing in all command to be supported is possible

6.8.3 STORE_USER_ALL [15h] Send

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.

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.

6.8.4 RESTORE_DEFAULT_ALL [12h] Send

The values and settings recorded in the nonvolatile memory of the PCA, using command SYS_STORE_USER_ALL [15h], are reset to the factory defaults.

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 6.8.1 "STORE_USER_ALL" Operation example （PCA600F-12-I）

Operation		PCA Output
1	Input voltage on	12.0V
2	Set output voltage to 10.0V by VOUT_COMMAND	10.0V
3	Send " STORE_USER_ALL"	10.0V
4	Input voltage off	0V
5	Input voltage on	10.0V
6	Send "RESTORE_DEFAULT_ALL"	10.0V
7	Input voltage off	0V
8	Input voltage on	12.0V

6.8.5 MFR_ACCMULATE_MODE [F6h] R/W Byte

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 MFR_ACCMULATE_EXEC [F7h] and MFR_CLEAR_ACCMULATE_DATA [F8h] are immediately executed.

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	0	0	0	0	0	00h
Access	R	R	R	R	R	R	R	R/W	

No.	bit	Value	Overview
1	bit7-1	0000000	None
2	bit0	0	Disables the accumulation mode
3		1	Enables the accumulation mode

In the accumulate mode, the Write command is buffered internally and is not immediately reflected in the product operation. By sending command MFR_ACCMULATE_EXEC [F7h], 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.

6.8.6 MFR_ACCMULATE_EXEC [F7h] Send

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

6.8.7 MFR_READ_ACCMULATE_DATA [F8h] Read Word

When accumulation mode is enabled, sending this command will return the arguments of the buffered command. If the buffered command is in the Write Byte format (argument 8 bits), the lower 8 bits of the 16 bits to be returned will be the argument, The upper 8 bits are 00h.
When the buffered command is Send format (no argument), the lower 8 bits of 16 bits to be returned are buffered It becomes a command code, and the upper 8 bits become 00h.
If this command is sent while the buffer is empty, a communication error will occur.

'able 6.8.2 "MFR_READ_ACCUMULATE_DATA" Operation example (PCA600F-12-I)

Operation		Return value	PCA Output
1	Input voltage on		12.0V
2	Set output voltage to 10.0V by "VOUT_COMMAND"		10.0V
3	Enable accumulate mode by "MFR_ACCMULATE_MODE"		10.0V
4	Set output OFF by "OPERATION"		10.0V
5	Set output voltage to 8.0V by "VOUT_COMMAND"		10.0V
6	Send "MFR_READ_ACCUMULATE_DATA"	8.0V	10.0V
7	Send "MFR_ACCMULATE_EXEC"		8.0V

6.8.8 MFR_CLEAR_ACCMULATE_DATA [F9h] Send

Deletes contents of the buffer.

6.8.9 MFR_ADDRESS [D4h] R/W Byte

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.

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	1	0	1	1	1	17h
Access	R/W	R	R	R	R	R/W	R/W	R/W	

No.	bit	Value	Overview
1	bit7	0	Corresponds to the ADDR terminal setting
2		1	Corresponds to the ADDR bit6-0 setting
3	bit6-3	0010	PMBus address (7bit) of High-order 4 bits (Fixed value)
4	bit2-0	000~ 111	PMBus address (7bit) of Lower 3 bits

6.8.10 MFR_READ_ADDRESS [EDh] Read Byte

Returns current communication address.

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	0	1	0	1	1	1	17h
Access	R	R	R	R	R	R	R	R	

No.	bit	Value	Overview
1	bit7	0	None
2	bit6-3	0010	PMBus address (7bit) of High-order 4 bits（Fixed value）
3	bit2-0	000~ 111	PMBus address (7bit) of Lower 3 bits

6.9 Product information commands

6.9.1 PMBUS_REVISION [98h] Read Byte

This command returns the revision of the PMBus implemented in the converter.

bit	7	6	5	4	3	2	1	0	Remark
Initial setting	0	0	1	0	0	0	1	0	22h
Access	R	R	R	R	R	R	R	R	

No.	bit	Value	Overview
1	bit7-4	0000	Part Ⅰ Revision 1.0
2		0001	Part Ⅰ Revision 1.1
3		0010	Part Ⅰ Revision 1.2
4	bit3-0	0000	Part Ⅱ Revision 1.0
5		0001	Part Ⅱ Revision 1.1
6		0010	Part Ⅱ Revision 1.2

6.9.2 MFR_SERIAL [9Eh] Block Read

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

Display format	ASCII
Examples of return value	9999999-999

6.9.3 MFR_MODEL [9Ah] Block Read

This command returns the model name of the converter.

Display format	ASCII
Examples of return value	PCA600F-24-I

6.9.4 MFR_LOCATION [9Ch] Block Read

Returns manufacturing location of the product.

Display format	ASCII
Examples of return value	COSEL CO.,LTD_TOYAMA

6.9.5 MFR_RATED_VOUT [FAh] Read Word

Returns the rated voltage of the model.

Display format	Linear (Vout)

6.9.6 MFR_RATED_IOUT [FBh] Read Word

Returns the rated current of the model.

Display format	Linear (Iout)

Appendix. Support and precision

Appendix1 Support and precision (1/2)

PMBus commands	Support/precision(Ta=25℃ Vo:60-100%)				Remark
	PCA300F □-I	PCA600F □-I	PCA1000F □-I	PCA1500F □-I	
Output-voltage setting commands					
OPERATION	○	○	○	○	
MFR_OPERATION_STATE	○	○	○	○	
MFR_CTL_RESET_LATCH	○	○	○	○	
VOUT_MODE	○	○	○	○	
VOUT_COMMAND	±0.5%FS	±0.5%FS	±0.5%FS	±0.5%FS	
MFR_VOUT_FACTORY_SETTING	○	○	○	○	
MFR_VOUT_REFERENCE	○	○	○	○	
VOUT_MAX	○	○	○	○	
MFR_VOUT_MIN	○	○	○	○	
MFR_VOUT_LIMIT_FACTORY_SETTING	○	○	○	○	
Constant-current control command					
MFR_CC_MODE	○	○	○	○	
MFR_CC	±2%FS	±2%FS	±2%FS	±2%FS	
MFR_CC_FACTORY_SETTING	○	○	○	○	
MFR_CC_REFERENCE	○	○	○	○	
MFR_CC_MAX	○	○	○	○	
MFR_CC_LIMIT_FACTORY_SETTING	○	○	○	○	
Output-voltage sequence commands					
MFR_TON_DELAY_RC	±2%※1	±2%※1	±2%※1	±2%※1	※1 ±2%or±10msec
MFR_TON_DELAY_VIN	±2%※2	±2%※2	±2%※2	±2%※2	※2 ±2%or±50msec
MFR_RAMP_RATE	○	○	○	○	
VIN_ON	±3%FS	±3%FS	±3%FS	±3%FS	
VIN_OFF	±3%FS	±3%FS	±3%FS	±3%FS	
MFR_VIN_ON_DC	±3%FS	±3%FS	-	-	
MFR_VIN_OFF_DC	±3%FS	±3%FS	-	-	
Commands for setting Accessory function					
MFR_FAN_MODE	○	○	○	○	
MFR_AUX_VOUT	±3%FS	±3%FS	±3%FS	±3%FS	
MFR_MS	○	○	○	○	
MFR_MS_STATE	○	○	○	○	
Monitor commands					
READ_VIN	±3%FS	±3%FS	±3%FS	±3%FS	
MFR_READ_VIN_FREQUENCY	±1Hz	±1Hz	±1Hz	±1Hz	
READ_VOUT	±1%FS	±1%FS	±1%FS	±1%FS	
READ_IOUT	±2%FS	±2%FS	±2%FS	±2%FS	
READ_POUT	±2%FS	±2%FS	±2%FS	±2%FS	
READ_FAN_SPEED_1	±500rpm	±500rpm	±500rpm	±500rpm	
READ_TEMPERATURE_1	○	○	○	○	

Appendix1 Support and precision (2/2)

PMBus commands	Support/precision(Ta=25℃ Vo:60-100%)				Remark
	PCA300F □-I	PCA600F □-I	PCA1000F □-I	PCA1500F □-I	
State acquisition commands					
CLEAR_FAULTS	○	○	○	○	
SMBALERT_MASK	○	○	○	○	
STATUS_BYTE	○	○	○	○	
STATUS_WORD	○	○	○	○	
STATUS_VOUT	○	○	○	○	
STATUS_IOUT	○	○	○	○	
STATUS_TEMPERATURE	○	○	○	○	
STATUS_CML	○	○	○	○	
STATUS_MFR_SPECIFIC	○	○	○	○	
STATUS_FANS_1_2	○	○	○	○	
MFR_ARA_CONFIG	○	○	○	○	
MFR_STOP_CODE	○	○	○	○	
MFR_READ_TOTAL_INPUT_TIME_1	○	○	○	○	
MFR_READ_TOTAL_INPUT_TIME_2	○	○	○	○	
MFR_READ_TOTAL_INPUT_TIME_3	○	○	○	○	
MFR_READ_TOTAL_OUTPUT_TIME_1	○	○	○	○	
MFR_READ_TOTAL_OUTPUT_TIME_2	○	○	○	○	
MFR_READ_TOTAL_OUTPUT_TIME_3	○	○	○	○	
Commands for setting addresses, memories, and communications					
CAPABILITY	○	○	○	○	
WRITE_PROTECT	○	○	○	○	
STORE_USER_ALL	○	○	○	○	
RESTORE_DEFAULT_ALL	○	○	○	○	
MFR_ACCUMULATE_MODE	○	○	○	○	
MFR_ACCUMULATE_EXEC	○	○	○	○	
MFR_READ_ACCUMULATE_DATA	○	○	○	○	
MFR_CLEAR_ACCUMULATE_DATA	○	○	○	○	
MFR_ADDRESS	○	○	○	○	
MFR_READ_ADDRESS	○	○	○	○	
Product information commands					
PMBUS_REVISION	○	○	○	○	
MFR_SERIAL	○	○	○	○	
MFR_MODEL	○	○	○	○	
MFR_LOCATION	○	○	○	○	
MFR_RATED_VOUT	○	○	○	○	
MFR_RATED_IOUT	○	○	○	○	

Appendix. Memory Architecture

This product has built-in RAM and ROM.
Conceptual diagram shown in figure Appendix.1

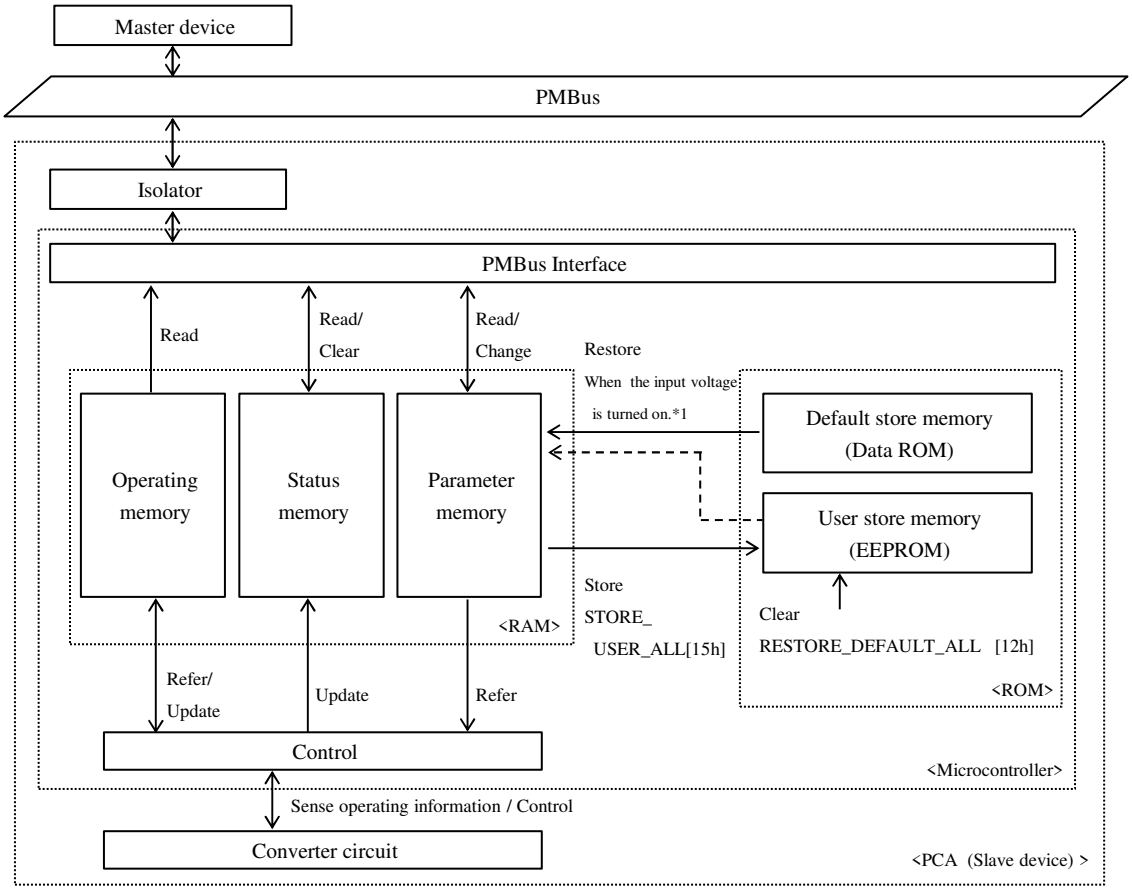


Figure Appendix.1 Conceptual diagram

*1 Parameter memory is restored from the data of Default store memory or User store memory depending on the status of User store memory.

Status of User store memory	Parameter memory	Remark
No data (factory shipment/cleared)	Default store memory	
Data exists (stored)	User store memory	

index

Alphabetical order

A. Revision history

No.	Date	Ver	Page	note
1	2019.08.30	1.0E	-	First edition issued
2	2021.07.30	1.1E	1	Overview addtion
			6	Table 5.1 has been modified
			4,17-18, app1-2	PCA1500F sale
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