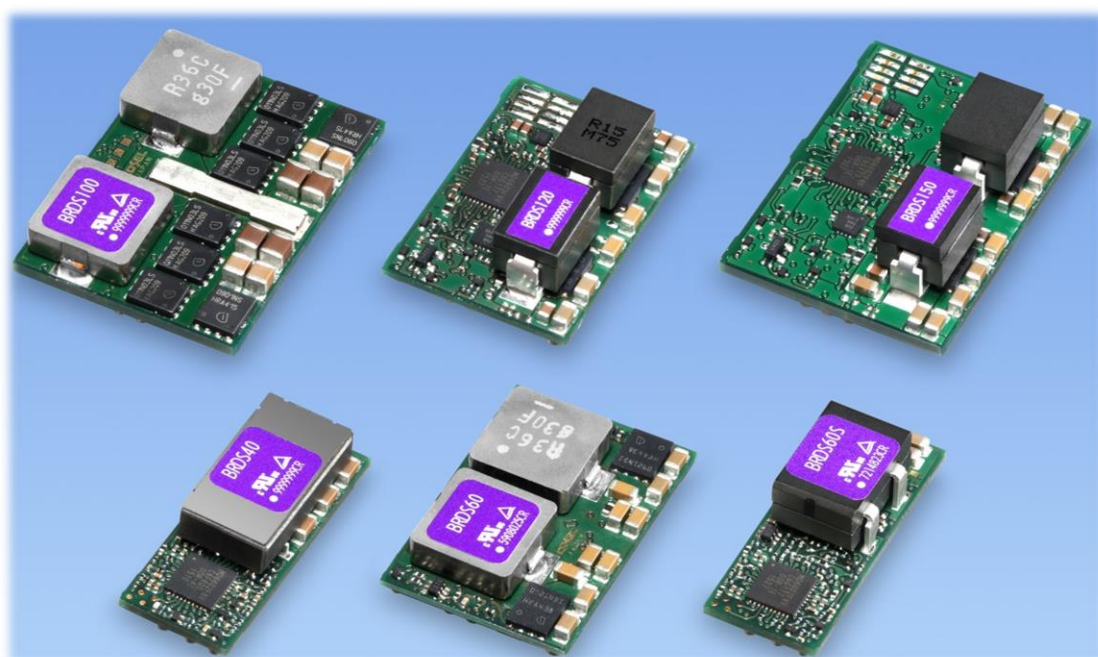


COSEL

BRDS

PMBus communication manual



BRDS

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The PMBus can be used to control and monitor the BRDS converter .

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

1. PMBus communication cabling and connection

1.1 BRDS pin assignment

The terminal name and the function of this product, it is shown in figure 1-1 and table1-1.

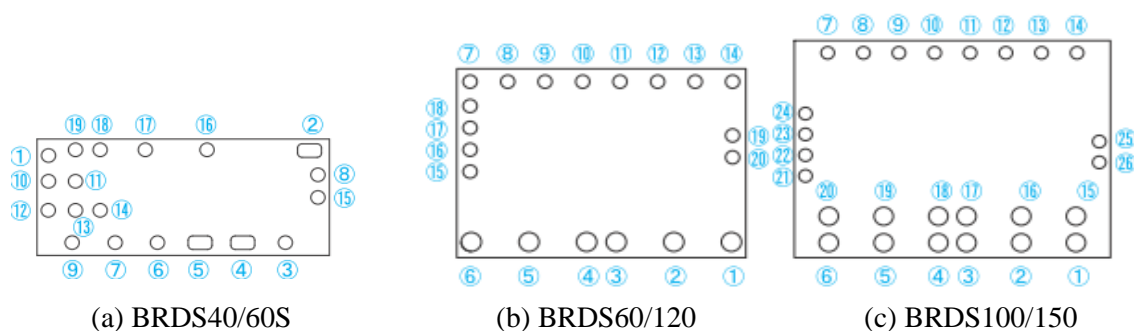


Figure 1-1. BRDS pin assignment (bottom view)

Table 1-1. Pin Descriptions

Pin No			Pin Connection	Function	Note
BRDS40 /60S	BRDS60 /120	BRDS100 /150			
1	9	9	RC	Remote ON/OFF	
2	1	1,15	+VIN	+DC input	
-	6	6,20	+VIN	+DC input	
3	7	7	SEQ	Control of Start up time and turn	
5	3	3,17	+VOUT	+DC output	
-	4	4,18	+VOUT	+DC output	
4	5	5,19	GND	GND (-DC input, -DC output)	
6	12	12	+TRM	+Adjustment of output voltage	
-	13	13	-TRM	-Adjustment of output voltage	
7	11	11	+S	+Remote sensing	
8	2	2,16	GND	GND (-DC input, -DC output)	
9	14	14	SHARE	Parallel operation	
10,11	17	23	SGND	Signal GND	
12	10	10	-S	-Remote sensing	
13	18	24	CLK	PMBus communication clock input	
14	16	22	DATA	PMBus communication data input & output	
15	-	-	NC/SYNC	NC/Switching frequency synchronization	
16	8	8	PGOOD	Power good	
17	15	21	SMBALERT	PMBus alarm output	
18	19	25	ADDR0	Address setting	
19	20	26	ADDR1	Address setting	

1.2 PMBus Communication connections method

The figure 1-2 below show the recommended resistors value for hard wiring PMBus addresses.

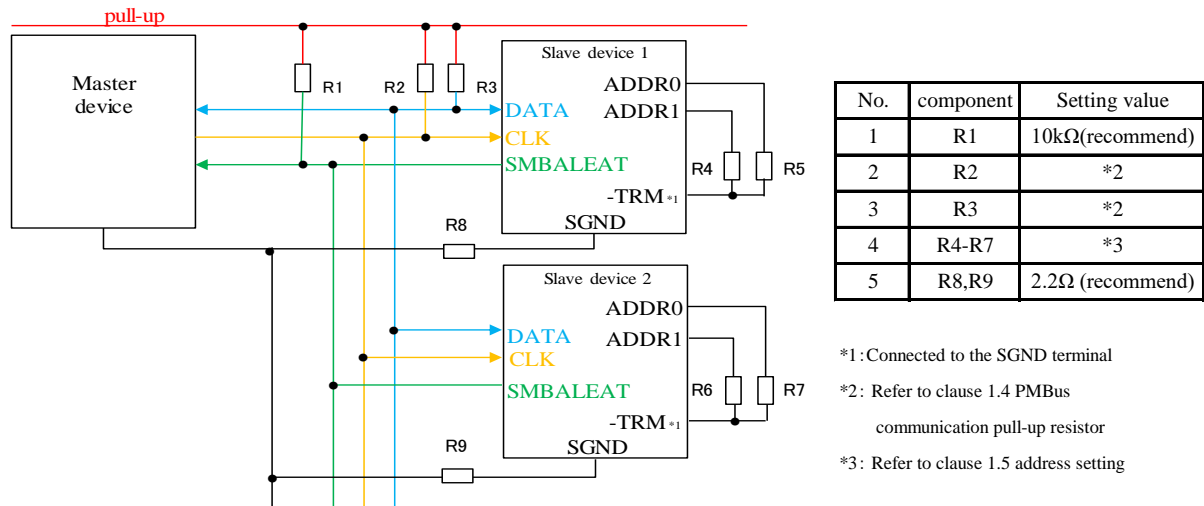


Figure 1-2. PMBus interface connection

1.3 PMBus communication cable pattern example

When connecting the PMbus communication cable, please make sure design to minimize noise from outside and crosstalk by positioning SGND between DATA bus and CLK bus as shown figure 1-3.

Also, do the right setting for pull-up resistor as parasitic capacitance is happened by way of shielding and length of cabling. (refer to clause 1.4)

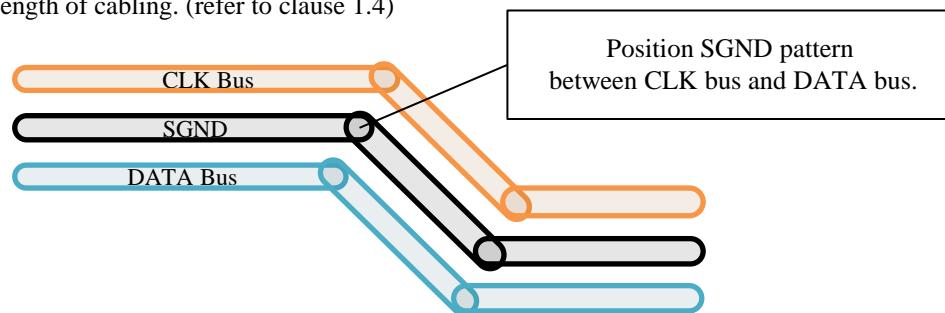


Figure 1-3. Pattern example

1.4 PMBus communication pull-up resistor value

It is necessary to connect pull-up resistor on DATA bus and CLK bus terminal of PMBus .
Recommended value of resistor(maximum value) is shown at figure 1-4.

Note: Do not exceed the rated output current of converter's terminal (clause 8-1).

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

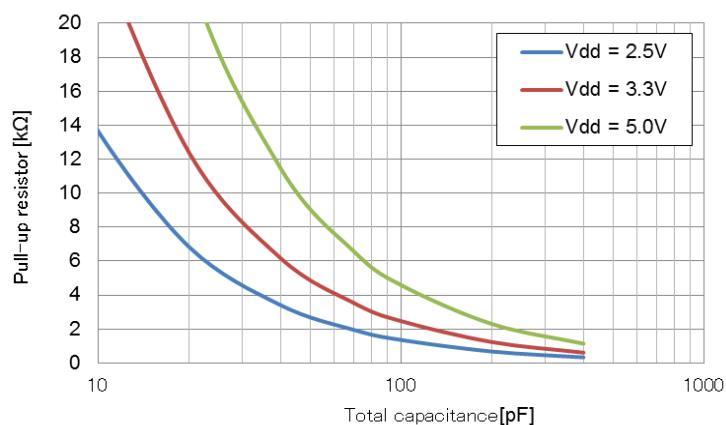


図1-4. Recommended value of pull-up resistor

1.5 Address setting

The figure and table below show recommended resistors value for hard wiring PMBus resistors with 1% tolerance are recommended.

Take 0-7 on ADDR0, ADDR1 per value of resistor and address could be assigned 0-63 per below formula when calculation result in 0-12,40,44,45,55 setting, address 127 will be return.

*1 : Address setting could not be changed after input voltage is applied .

Be sure to make setting before input voltage is applied.

$$\text{Address} = \text{Value}(\text{ADDR1}) \times 8 + \text{Value}(\text{ADDR0})$$

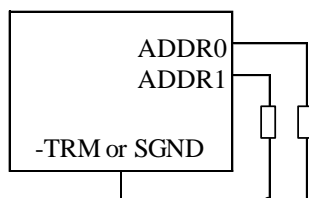


Table 1-2. Resistor value

No.	Resistor value [kΩ]	Value
1	10	0
2	15	1
3	24	2
4	36	3
5	56	4
6	82	5
7	130	6
8	220	7

Figure 1-5 Address setting

2. PMBus communication control

2.1 Overview for control block

This product has built-in RAM and ROM

Based on the memory parameter, controlling power supply and PMBus communication are implemented. Conceptual diagram shown in figure 2-1.

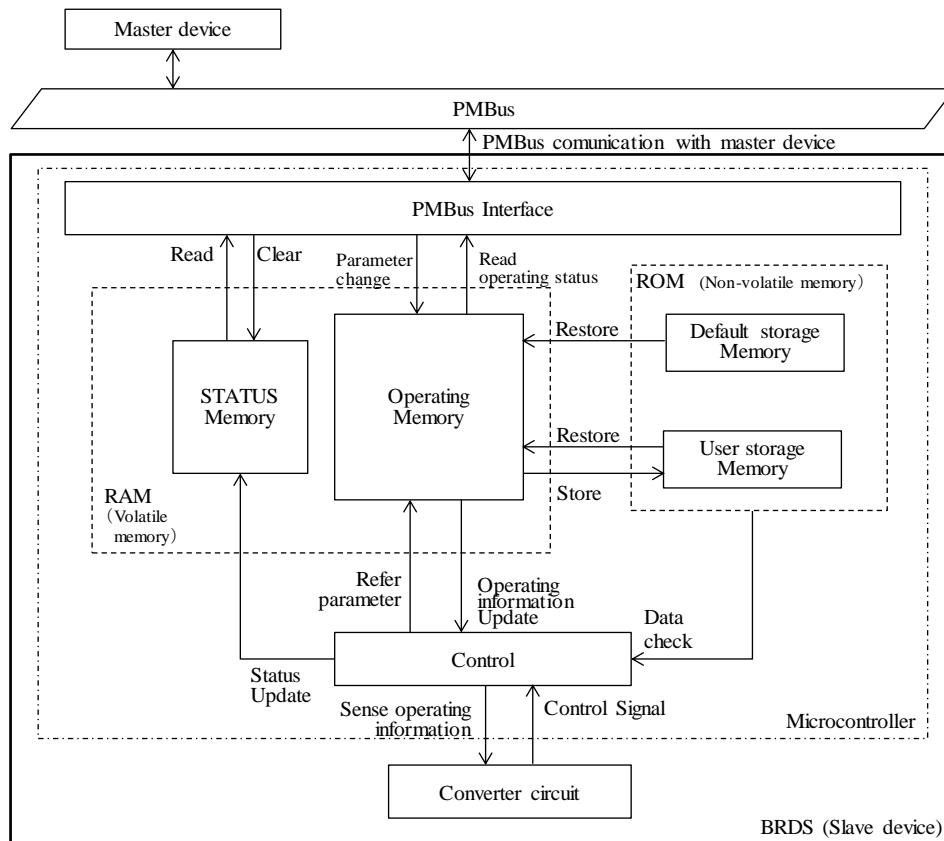


Figure 2-1. Conceptual diagram of communication control

2.2 RAM (Volatile memory)

2.2.1 Operating memory

When power supply is being operated, it refers to setting value of operating memory with RAM and control it. Since setting change by PMBus communication command is preserved in operating memory, the setting will be lost after a reset unless they are stored to data flash.

2.2.2 Status memory

BRDS status is stored in the status memory(command [78h]-[7Eh]).

Corresponding bit on Status memory is set to 1 when power supply has something abnormal.

It can clear status memory by implementing command of CLEAR_FAULTS [03h] or input voltage is lower than stop voltage (refer to clause 6.1).

2.3 ROM(Non-volatile memory)

2.3.1 Default store memory

Default store memory preserves initial parameter in factory shipment.

Restored information to operating memory is being done by implementing
RESTORE_DEFAULT_ALL [12h] command . *1

2.3.2 User store memory

It is memory to preserve the content of operating memory rewritten by master device after input voltage is insulated. Information is restored by implementing RESTORE_USER_ALL [16h] command and when power supply is started-up.

Information within operating memory is preserved in user store memory by implementing
STORE_USER_ALL [15h] command. *2

Note1 : This command is executed when the output voltage off

Note2: Please do not insulate input voltage over 0.5 seconds when command is being implemented.

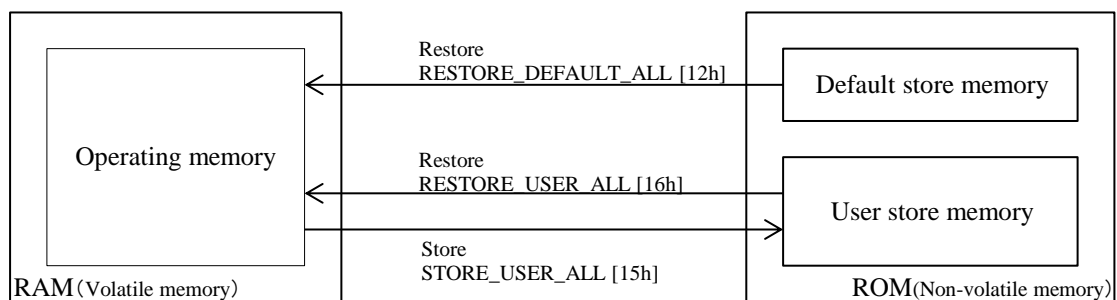


Figure 2-2 Restore and preserving operation for command and parameter

STORE_USER_ALL[15h] is less than or equal to 5 times. It does not execute the command if it exceeds five times. Please clear the user store memory data by executing MFR_CLEAR_USER_DATA [F5h] if the writing of more than 5 times.

2.4 Retaining the number of protecting operation

When each protective function are operated, the number of information(0-128 times) is preserved in ROM. Command shown in table 2-1 can read the number of protective operation and delete the number of counts.

Table 2-1 Reading command for the number of stopping abnormal power supply

No	Command	Code	Note
1	MFR_READ_VOUT_OV_FAULT_COUNT*3	F0h	Read the number of overvoltage protective operation
2	MFR_READ_VOUT_UV_FAULT_COUNT*3	F1h	Read the number of low output voltage protective operation
3	MFR_READ_OT_FAULT_COUNT*3	F2h	Read the number of overheating protective operation
4	MFR_READ_UT_FAULT_COUNT*3	F3h	Read the number of low temperature protective operation
5	MFR_READ_VIN_OV_FAULT_COUNT*3	F6h	Read the number of over input voltage protective operation
6	MFR_READ_VIN_UV_FAULT_COUNT*3	F7h	Read the number of low input voltage protective operation
7	MFR_CLEAR_USER_DATA*4	F5h	Reset the number of operation at F0h~F7h to "00h".

Note3 : Note: In case response of protective operation is auto recovery, it is counted every time this function is operated after recovery.

Note4 : DATA saved in USER_STORE_ALL[15h] will also be cleared.

By the following methods, non volatile memory to store the number of times protection.

- (1) Execution of MFR_STORE_FAULT_COUNT [FDh]
- (2) Execution of STORE_USER_ALL [15h]
- (3) 1) Set bit 6-7 of VIN_UV_FAULT_RESPONSE [5Ah] to 11.
2)After the input voltage falls below the VIN_UV_FAULT_RESPONSE [5Ah], and more than 4.5V to Vin · 0.5 seconds hold.

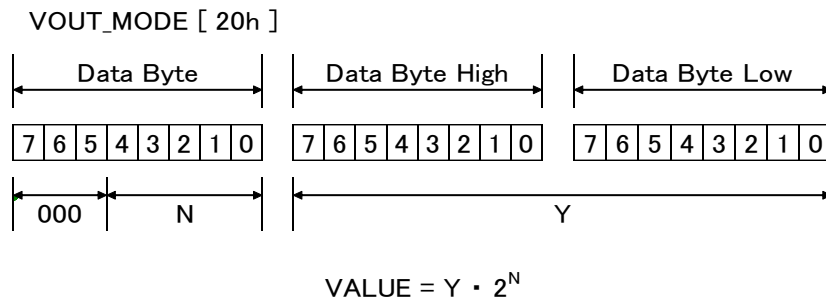
3. Data format

3.1 Data format for output voltage

That make the setting and reading of the output voltage code by using a linear format.

Data byte Low 5 bit of VOUT_MODE[20h] is complement notation by 2 and represents index part N with code and is fixed -10.

Mantissa part Y is represented 16 bit data without code.



3.2 Other (except output voltage) data format

That make the setting and reading of the other code by using a linear format. Date high byte 5 bit is complement notation by 2 and represents index part N with code and varies with data.

Mantissa part Y is complement notation by 2 with code and represents 11 bit data.

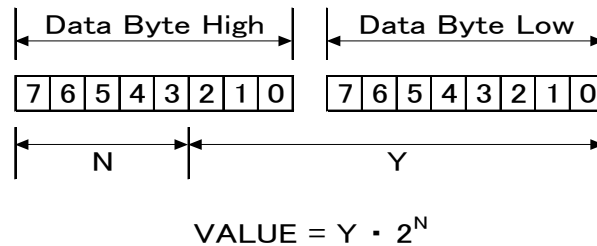


Table 3-1 Index part N value

No.	Item	Characteristics N *1			Unit
		BRDS40	BRDS60/60S/100	BRDS120/150	
1	Output voltage	-10			V
2	Input voltage	-5			V
3	Output current	-4	-3	-2	A
4	Temperature	0			°C
5	Starting-up time	-4			ms

Note1: Index part N value is fixed.

4. Communication possible time

4.1 Communication possible time when the output voltage off PMBus communication can be time are as follows.

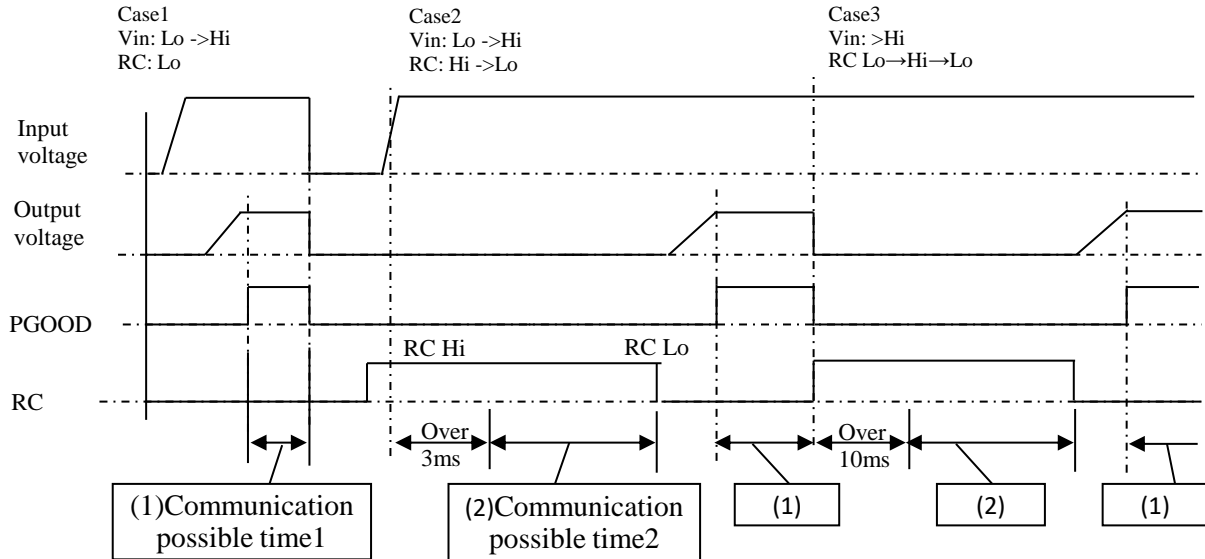


图4.1 Communication possible time

1) Communication possible time1

If at the time of the input voltage is turned on and BRDS can be output. BRDS output voltage is rising, after the power good terminal becomes HI-Impedance, and will enable communication.

2) Communication possible time 2

If at the time of the input voltage is turned on and BRDS can't be output. From the BRDS of the input voltage is greater than startup-voltage, it enables communication after 3ms. After BRDS satisfies the starting conditions, it can not communicate until the PGOOD pin goes HI.

3) Other can not communicate time

It is not able to communicate the time of 10ms from BRDS will start a stop operation. The input voltage is 4.5V or less, it can not to communicate.

4.2 Communication disable time when the command running

The following running command can not be communication. Refer to clause 10 PMBus commands.

- 1) RESTORE_DEFAULT_ALL [12H]
- 2) STORE_USER_ALL [15H]
- 3) RESTORE_USER_ALL [16H]

4.3 Clock stretching

BRDS has a clock stretching function. The use of master devices in response to the clock stretching.

5. Explanation for terminal function of SMBAlert

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

5.1 Connecting SMBALERT terminal

Output terminal of SMBALERT is open drain. When you use function of SMBALERT, connect pull-up resistor with SMBALERT terminal.

When something abnormal is happened in slave device, Slave device which detects something abnormal will make SMBALERT signal (low level).

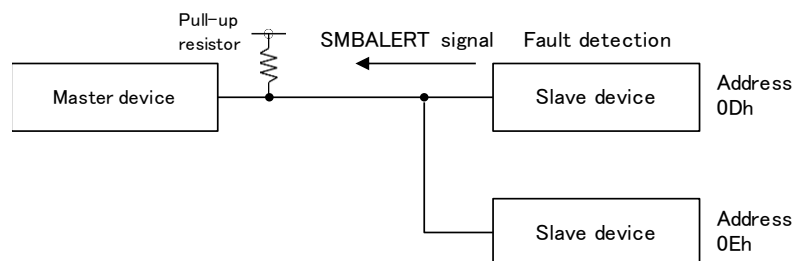


Figure 5-1 Detection of errors devices using ARA

5.2 Identifying slave device issuing SMBALERT signal

Master-device can identify which slave device has something abnormal.

By receiving READ communication (*1) using ARA from master device, Power supply with something abnormal sends original address.

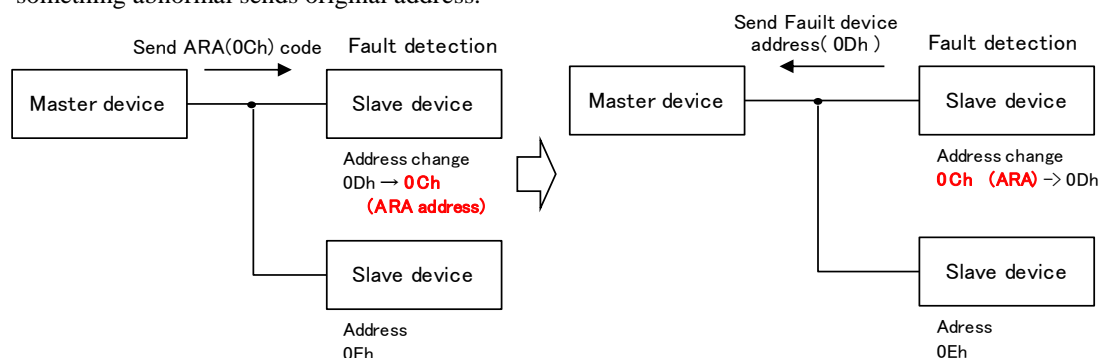


Diagram 5-2 Identifying Slave using ARA

Note1: When receiving READ communication using ARA, all information of STATUS will be cancelled after sending address.

Address change by ARA is changed from the completion of communication with 0.5ms (typ).

If SMBALERT pin is open, the address change does not occur.

ARA is enabled by setting the MFR_ARA_CONFIG [E0h].

To CLEAR_FAULTS[03h] is executed, ARA function and Change of SMBALERT terminal state are disabled.

5.3 In case multiple slave devices issue SMBALERT signal

When multiple slave devices issue SMBALERT single at the same time, it is not possible to make judgment for slave address by ARA. When you restore, please communicate by ARA and release with SMBALERT.

5.4 How to do when SMBALERT is issued repeatedly

When abnormal status such as automatic recovery situation keeps going, SMBALERT is being operated again by READ communication with using ADA regardless returning original address. If ARA is enabled, BRDS can communicate only ARA address when an error occurs. When this situation is on going, normal communication is possible by freeing ARA after stopping power supply with ON/OFF function (refer to 6.1).

6. Explanation of several functions

6.1 ON/OFF operation

Three ON/OFF functions are available with the BRDS as shown in table 6-1. in order to control starting-up and insulating power supply by external signal.

When either setting is "OFF", power supply will be stopped.

Table 6-1 Output ON/OFF function

No.	ON/OFF function	logical setting (initial value)	Note
1	OPERATION [01h] command ON/OFF function	-	-
2	Remote control function	Negative	possible change logic *1

*1 : When operating by positive logics, it is optional.

*2 : When invalid setting is made by command, it will be status of "ON" compulsory.

6.2 Start-stop voltage

Power supply is started-up when the input voltage exceeds set value of VIN_ON [35 h] (*1) and is stopped when falling below set value of VIN_OFF [36 h] . When changing a set value with start-up voltage and stop voltage, have an equal to or more than 2.5 V hysteresis between VIN_ON [35 h] and VIN_OFF [36 h] to avoid the operation which repeats a start-up and a stop.

*1: Be sure to set VIN_ON [35h] > VIN_OFF [36h]

6.3 Start-up sequence (starting-up delay / rising up)

TON_DELAY[60h] can set start-up delay time until output voltage is risen up after input condition is met. When setting more shortly than the start-up delay-characteristics of the power, there is not a change in the start-up delay time. TON_RISE [61 h] command can set. rising up time. But, when setting is more shortly than the start characteristic of the power, there is not a change in the start time. (For the details of the value setting, refer to clause 10.)

The parallel operation TON_RISE [61h] command is disabled.

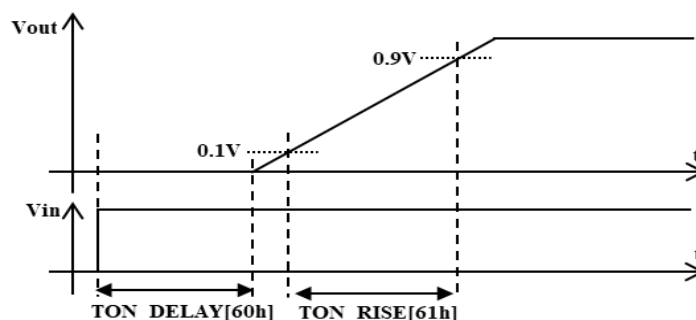


Figure 6-1 Setting for starting-up sequence (example for Vin start-up)

6.4 Output voltage setting

Output voltage of BRDS can be set by the TRM resistance value. The set the voltage value as a reference, the output voltage can be changed in the table6-2 of command.

Table 6-2 Function of output voltage setting

No.	Output voltage setting	Note
1	VOUT_MARGIN_HIGH [25h]	*1 Until the voltage $\pm 0.5V$ set by the TRM resistance value
2	VOUT_MARGIN_LOW [26h]	*1 Until the voltage $\pm 0.5V$ set by the TRM resistance value
3	VOUT_TRIM [22h]	For fine adjustment of the output voltage

*1: Switching by OPERATION [01h] command. Initial value is set by the TRM resistance.

Output voltage becomes value shown in below format.

Output voltage of power supply

= **VOUT_TRIM [22h]** value of setting +

TRM resistance Value of setting

Or **VOUT_MARGIN_HIGH [25h]Value of setting**

Or **VOUT_MARGIN_LOW [26h]Value of setting**

6.5 Over output voltage protective operation

Output overvoltage protection function is operated when the output voltage becomes high. The operation threshold and the way of the output over voltage protection function can be changed respectively at VOUT_OV_FAULT_LIMIT [40h] and VOUT_OV_FAULT_RESPONSE [41h] .

In case the way of stopping latch stop, Power Supply does not restore until restored operation is done by ON/OFF function(clause 6.1) or re-invert after insulating input.

When the number of automatic recovery is set by 1-6 times, latch stop will be happened without situation of abnormal power supply is recovered during re-starting up by specific number of times.

When the VOUT_OV_FAULT_LIMIT [40h] values and VOUT_OV_WARN_LIMIT[42h] value to the same value, it may VOUT_OV_WARN_LIMIT[42h] does not operate.

6.6 Low output voltage protective operation

Output low voltage protection function is operated when the output voltage becomes low. The operation threshold and the way of the output over voltage protection function can be changed respectively at VOUT_UV_FAULT_LIMIT [44h] and VOUT_UV_FAULT_RESPONSE [45h] .

In case the way of stopping latch stop, Power Supply does not restore until restored operation is done by ON/OFF function(clause 6.1) or re-invert after insulating input.

When the number of automatic recovery is set by 1-6 times, latch stop will be happened without situation of abnormal power supply is recovered during re-starting up by specific number of times.

When the VOUT_UV_FAULT_LIMIT [44h] values and VOUT_UV_WARN_LIMIT[43h] value to the same value, it may VOUT_UV_WARN_LIMIT[43h] does not operate.

6.7 Over input voltage protective operation

Input overvoltage protection function is operated when the output voltage becomes high. The operation threshold and the way of the output over voltage protection function can be changed respectively at VIN_OV_FAULT_LIMIT [55h] and VIN_OV_FAULT_RESPONSE [56h] .

In case the way of stopping latch stop, Power Supply does not restore until restored operation is done by ON/OFF function(clause 6.1) or re-invert after insulating input.

When the number of automatic recovery is set by 1-6 times, latch stop will be happened without situation of abnormal power supply is recovered during re-starting up by specific number of times.

When the VIN_OV_FAULT_LIMIT [55h] values and VIN_OV_WARN_LIMIT[57h] value to the same value, it may VIN_OV_WARN_LIMIT[57h] does not operate.

6.8 Low input voltage protective operation

Input low voltage protection function is operated when the output voltage becomes low. The operation threshold and the way of the output over voltage protection function can be changed respectively at VIN_UV_FAULT_LIMIT [59h] and VIN_UV_FAULT_RESPONSE [5Ah] .

In case the way of stopping latch stop, Power Supply does not restore until restored operation is done by ON/OFF function(clause 6.1) or re-invert after insulating input.

When the number of automatic recovery is set by 1-6 times, latch stop will be happened without situation of abnormal power supply is recovered during re-starting up by specific number of times.

When the VIN_UV_FAULT_LIMIT [59h] values and VIN_UV_FAULT_RESPONSE [5Ah] value to the same value, it may VIN_UV_FAULT_RESPONSE [5Ah] does not operate.

6.9 Protective operation for over temperature protection

The Over temperature protection feature works when the temperature detecting-element temperature which is shown in figure 6-3 becomes high. In protection operation, power supply will be stopped and re-start via delaying time originally to be set after abnormal status is cancelled. The operation threshold and the way of stopping overheating is changed by OT_FAULT_LIMIT [4Fh] and OT_FAULT_RESPONSE[50h] respectively. The return temperature of the overheating protection is set to MFR_OT_RESTART_LIMIT [E3h] and status of stopping is canceled by being below this threshold. Set temperature difference with operating temperature and return temperature to equal to or more than 10°C. In case the way of stopping latch stop, Power Supply does not restore until restored operation is done by ON/OFF function(clause 6.1) or re-invert after insulating input.

When the OT_FAULT_LIMIT [4Fh] values and OT_WARN_LIMIT [51h] value to the same value, it may OT_WARN_LIMIT [51h] does not operate.

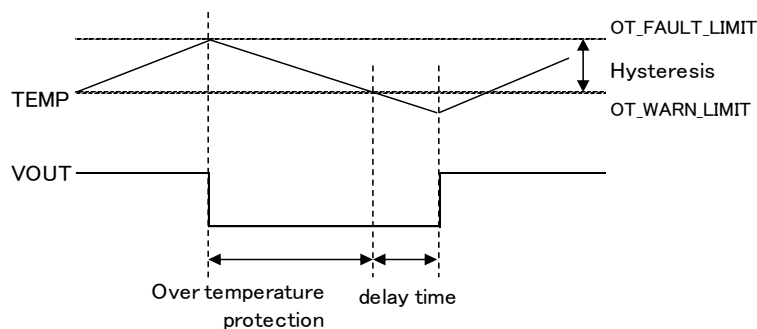


Figure 6-2. Over temperature protection restart

6.10 Protective operation for under temperature

The low temperature protection feature works when the temperature of the temperature detecting element which is shown in figure 6-3 becomes low. The operation threshold and the way of stopping low temperature protection are changed at UT_FAULT_LIMIT [53 h] and UT_FAULT_RESPONSE [54 h] respectively.

When making a way of stopping a restart, the return temperature of the low temperature protection is cancelled by exceeding the threshold which was set in MFR_UT_RESTART_LIMIT [4Eh] and then does a restart via the delay time which is set at UT_FAULT_RESPONSE [54 h].

When the UT_FAULT_LIMIT [53h] values and UT_WARN_LIMIT [52h] value to the same value, it may UT_WARN_LIMIT [52h] does not operate.

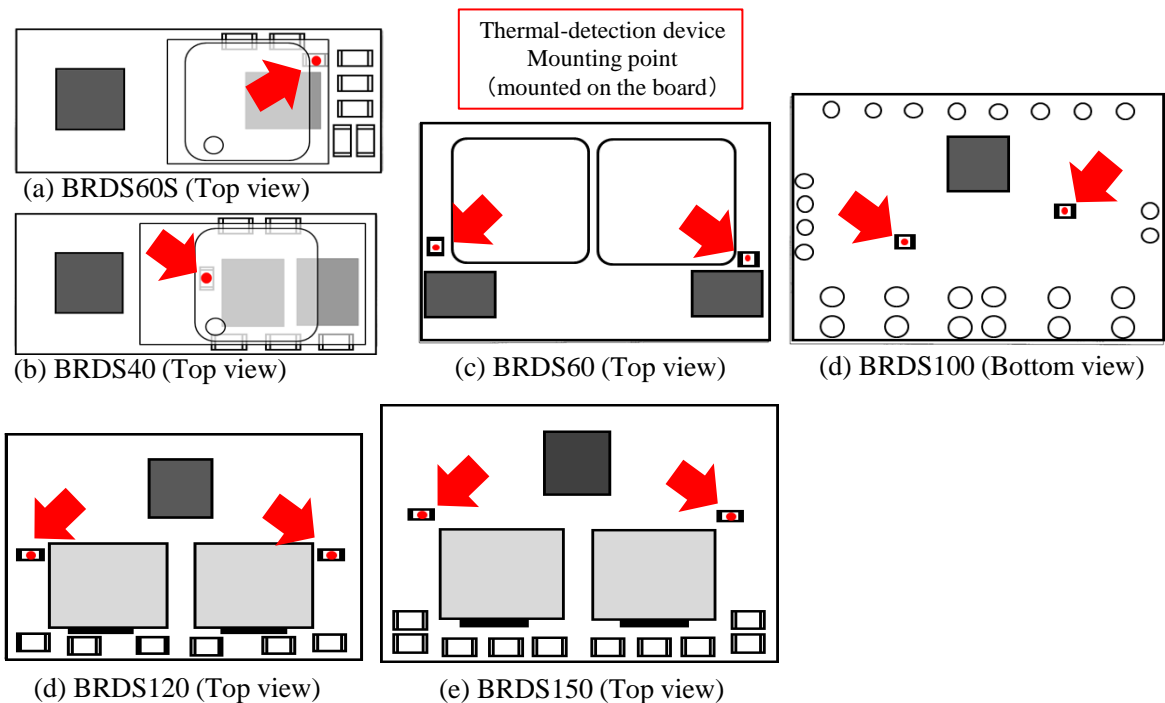


Figure 6-3 Temperature measuring point

6.11 Prohibit re-writing parameter

WRITE_PROTECT [10 h] command communication can be limited the command communication (*1). This can be protected not to change setting value which is not intended. Writing in all of the command to be supported is possible at setting of a default.

*1: Reading (the READ communication) of the set value and rewriting WRITE_PROTECT [10 h] are not limited.

7. Packet error checking (PEC)

This product supports packet error checking(PEC).

We recommend using PEC when you implement PM bus communication.

(SMBus standard manual for the details. Refer to 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.

8. PMBus hardware specifications

8.1 Ultimate maximum rated on communication terminal

PMBus maximum rate of communication terminal(*1) is shown at table 8-1.

*1: DATA / CLK / ADDR0 / ADDR1 / SMBALERT

Table 8-1 Spec of maximum rate

No.	Parameter	Min	Max	Unit	Note
1	Input voltage	-0.3	5.5	V	
2	Maximum output current	-4	-	mA	Sink only

8.2 Spec of electrical characteristics on communication terminal

Spec of electrical characters on this product is shown at Table 8-2.

Table 8-2 Spec of electrical characteristics

No.	Parameter	Condition	Min	Max	Unit	Note
1	Input pull-up voltage (CLK,DATA)		2.7	5.5	V	
2	Input High level voltage (CLK,DATA)		2	-	V	
3	Input Low level voltage (CLK,DATA)		-	0.8	V	
4	Input High level current (CLK, DATA)		-2.0	+2.0	μA	
5	Input Low level current (CLK,DATA)		-2.0	+2.0	μA	
6	Output Low level voltage (CLK,DATA,SMBALERT)	IOUT=4mA	-	0.4	V	CLK,DATA, SMBALERT
7	Output High level open drain Leak current (DATA,SMBALERT)		-	2	μA	
8	PMBus communication frequency range		10	400	kHz	

9. PMBus software specifications

9.1 List of corresponding PMBus command set

The following shows the list of PMBus command to be supported.

Table 9-1 Support command and setting

No.	PMBus command	Code *1	Type *2	DATA byte *3	DATA format	Initial sertting				Unit	Note
						BRDS40	BRDS60/ BRDS60S	BRDS100	BRDS120/ BRDS150		
1	OPERATION	01 h	R/W	Byte	-	00 h				-	
2	ON_OFF_CONFIG	02 h	R/W	Byte	-	15 h				-	
3	CLEAR_FAULTS	03 h	Send	-	-	-				-	
4	WRITE_PROTECT	10 h	R/W	Byte	-	00 h				-	
5	RESTORE_DEFAULT_ALL*4	12 h	Send	-	-	-				-	
6	STORE_USER_ALL*4	15 h	Send	-	-	-				-	
7	RESTORE_USER_ALL*4	16 h	Send	-	-	-				-	
8	CAPABILITY	19 h	Read	Byte	-	B0 h				-	
9	SMBALERT_MASK	1B h	R/W	-	-	-				-	
	STATUS_BYTE			Byte	-	02 h				-	
	STATUS_WORD(上位8bit)			Byte	-	00 h				-	
	STATUS_VOUT			Byte	-	00 h				-	
	STATUS_IOUT			Byte	-	00 h				-	
	STATUS_INPUT			Byte	-	00 h				-	
	STATUS_TEMPERATURE			Byte	-	00 h				-	
	STATUS_CML			Byte	-	FF h				-	
10	VOUT_MODE	20 h	Read	Byte	-	16 h				-	N = -10 (Linear Vo)
11	VOUT_TRIM*5	22 h	R/W	Word	Linear(Vo)	0				[V]	
12	VOUT_MAX	24 h	R/W	Word	Linear(Vo)	2.3			2.1	[V]	
13	VOUT_MARGIN_HIGH*5	25 h	R/W	Word	Linear(Vo)	1.32				[V]	
14	VOUT_MARGIN_LOW*5	26 h	R/W	Word	Linear(Vo)	1.08				[V]	
15	VIN_ON	35 h	R/W	Word	Linear(N=-2)	4.25				[V]	
16	VIN_OFF	36 h	R/W	Word	Linear(N=-2)	4.00				[V]	
17	IOUT_CAL_OFFSET	39 h	R/W	Word	Linear(N= BRDS40 : -4 BRDS60/100: -3 BRDS120/150:-2)	0				[A]	
18	VOUT_OV_FAULT_LIMIT*5	40 h	R/W	Word	Linear(Vo)	2.5			2.3	[V]	
19	VOUT_OV_FAULT_RESPONSE	41 h	R/W	Byte	-	BB h				-	
20	VOUT_OV_WARN_LIMIT*5	42 h	R/W	Word	Linear(Vo)	2.2			2.0	[V]	
21	VOUT_UV_WARN_LIMIT*5	43 h	R/W	Word	Linear(Vo)	0.5				[V]	
22	VOUT_UV_FAULT_LIMIT*5	44 h	R/W	Word	Linear(Vo)	0.1				[V]	
23	VOUT_UV_FAULT_RESPONSE	45 h	R/W	Byte	-	BB h				-	
24	IOUT_OC_FAULT_LIMIT	46 h	R/W	Word	Linear(N=-1)	46	69	120	144/ 178	[A]	
25	IOUT_OC_FAULT_RESPONSE	47 h	R/W	Byte	-	B8 h				-	
26	IOUT_OC_WARN_LIMIT	4A h	R/W	Word	Linear(N=-1)	44	65	115	132/ 165	[A]	
27	OT_FAULT_LIMIT	4F h	R/W	Word	Linear(N=0)	130				[°C]	

Table 9-1 Support command and setting (sequel)

No.	PMBus command	Code *1	Type *2	DATA byte *3	DATA format	Initial setting				Unit	Note
						BRDS40	BRDS60/ BRDS60S	BRDS100	BRDS120/ BRDS150		
28	OT_FAULT_RESPONSE	50 h	R/W	Byte	-	B9h				-	
29	OT_WARN_LIMIT	51 h	R/W	Word	Linear(N=0)	125				[°C]	
30	UT_WARN_LIMIT	52 h	R/W	Word	Linear(N=0)	-45				[°C]	
31	UT_FAULT_LIMIT	53 h	R/W	Word	Linear(N=0)	-45				[°C]	
32	UT_FAULT_RESPONSE	54 h	R/W	Byte	-	39 h				-	
33	VIN_OV_FAULT_LIMIT	55 h	R/W	Word	Linear(N=5)	14.5				[V]	
34	VIN_OV_FAULT_RESPONSE	56 h	R/W	Byte	-	B9 h				-	
35	VIN_OV_WARN_LIMIT	57 h	R/W	Word	Linear(N=5)	14.5				[V]	
36	VIN_UV_WARN_LIMIT	58 h	R/W	Word	Linear(N=5)	3.5				[V]	
37	VIN_UV_FAULT_LIMIT	59 h	R/W	Word	Linear(N=5)	3.5				[V]	
38	VIN_UV_FAULT_RESPONSE	5A h	R/W	Byte	-	B9 h				-	
39	POWER_GOOD_ON*5	5E h	R/W	Word	Linear(Vo)	0				[V]	Vo(set)±12.5%
40	POWER_GOOD_OFF*5	5F h	R/W	Word	Linear(Vo)	0				[V]	Vo(set)±12.5%
41	TON_DELAY	60 h	R/W	Word	Linear(N=4)	3.0				[ms]	
42	TON_RISE	61 h	R/W	Word	Linear(N=4)	2.0				[ms]	
43	STATUS_BYTE	78 h	R/C	Byte	-	00 h				-	
44	STATUS_WORD	79 h	R/C	Word	-	00 h				-	
45	STATUS_VOUT	7A h	R/C	Byte	-	00 h				-	
46	STATUS_IOUT	7B h	R/C	Byte	-	00 h				-	
47	STATUS_INPUT	7C h	R/C	Byte	-	00 h				-	
48	STATUS_TEMPERATURE	7D h	R/C	Byte	-	00 h				-	
49	STATUS_CML	7E h	R/C	Byte	-	00 h				-	
50	READ_VIN	88 h	Read	Word	Linear(N=5)	-				[V]	
51	READ_VOUT	8B h	Read	Word	Linear(Vo)	-				[V]	
52	READ_IOUT	8C h	Read	Word	Linear(N=BRDS40 : -4 BRDS60/100: -3 BRDS120/150: -2)	-				[A]	
53	READ_TEMPERATURE_1	8D h	Read	Word	Linear(N=0)	-				[°C]	
54	PMBus_REVISION	98 h	Read	Byte	-	22 h				-	
55	MFR_VIN_MIN	A0 h	Read	Word	Linear(N=2)	4.5				[V]	
56	MFR_VOUT_MIN	A4 h	Read	Word	Linear(Vo)	0.6	0.7 ₊₁	0.6		[V]	Note: BRDS60/100
57	MFR_MODULE_NAME	D0 h	Read	Word	-	120h	140h/ 1A0h	180h	1E0h/ 1F0h	-	
58	MFR_VOUT_CAL_OFFSET	D4 h	R/W	Word	Linear(Vo)	0				[mV]	
59	MFR_VIN_CAL_OFFSET	D6 h	R/W	Word	Linear(N=5)	0				[V]	
60	MFR_ARA_CONFIG	E0 h	R/W	Byte	-	00h				-	
61	MFR_OT_RESTART_LIMIT	E3 h	R/W	Word	Linear(N=0)	90				[°C]	
62	MFR_UT_RESTART_LIMIT	E4 h	R/W	Word	Linear(N=0)	-40				[°C]	

Table 9-1 Support command and setting(sequel)

No.	PMBus command	Code *1	Type *2	DATA byte *3	DATA format	Initial setting				Unit	Note
						BRDS40	BRDS60/ BRDS60S	BRDS100	BRDS120/ BRDS150		
63	MFR_VOUT_OV_FAULT_COUNT	F0 h	Read	Word	Linear(N=0)	0				[Times]	
64	MFR_VOUT_UV_FAULT_COUNT	F1 h	Read	Word	Linear(N=0)	0				[Times]	
65	MFR_OT_FAULT_COUNT	F2 h	Read	Word	Linear(N=0)	0				[Times]	
66	MFR_UT_FAULT_COUNT	F3 h	Read	Word	Linear(N=0)	0				[Times]	
67	MFR_CLEAR_USER_DATA*4	F5 h	Send	-	-	-				-	
68	MFR_VIN_OV_FAULT_COUNT	F8 h	Read	Word	Linear(N=0)	0				[Times]	
69	MFR_VIN_UV_FAULT_COUNT	F9 h	Read	Word	Linear(N=0)	0				[Times]	
70	MFR_STORE_FAULT_COUNT*4	FD h	Send	-	-	-				-	

*1 : It shows being a numeric-representation in the hexadecimal number when end "h" is added.

*2 : The setting notation corresponds to the contents of the following table.

Table 9-1.1

No.	notation	Note
1	R/W	It corresponds both for reading and writing in.
2	Send	It corresponds only for sending a command
3	Read	It corresponds only for reading.

*3 : It shows that "Byte" is 1 byte data and it shows that "Word" is 2 byte data.

*4 : This command it can be executed only when the BRDS output off.

*5 : It does not work in slave of parallel operation. Setting is to be done in a master.

9.2 Setting and reading value for PMBus command

Possible range and accuracy on setting and reading each PMBus command to be supported is shown at Table 9-2. Outside the input voltage ,output voltage and temperature specification range, setting / reading accuracy of the value of the table 9-2 is not guaranteed.

Table 9-2 Range of setting and accuracy by command

No.	PMBus command	Code *1	Setting /Reading range *2					Setting/ Reading accuracy	Setting/ Reading increments	Note	
			Min	Max							
				BRDS40	BRDS60/ BRDS60S	BRDS100	BRDS120/ BRDS150				Unit
1	VOUT_TRIM	22 h	-0.4	0.4				[V]	±3% Vo	0.98 [mV]	
2	VOUT_MAX	24 h	0.5	2.3			2.1	[V]	±3% Vo	0.98 [mV]	
3	VOUT_MARGIN_HIGH	25 h	0.5	2.3			2.1	[V]	±5% Vo	0.98 [mV]	
4	VOUT_MARGIN_LOW	26 h	0.5	2.3			2.1	[V]	±5% Vo	0.98 [mV]	
6	VIN_ON	35 h	3.25	14.00				[V]	±3% Vin	250 [mV]	
7	VIN_OFF	36 h	3.00	13.75				[V]	±3% Vin	250 [mV]	
9	IOUT_CAL_OFFSET	39 h	-4/-8 /-16	3.93	7.88		15.75	[A]	±15% Io rated	62.5/125/ 250[mV]	
10	VOUT_OV_FAULT_LIMIT	40 h	0	2.5			2.3	[V]	±3% Vo	0.98 [mV]	
11	VOUT_OV_WARN_LIMIT	42 h	0	2.5			2.3	[V]	±3% Vo	0.98 [mV]	
12	VOUT_UV_WARN_LIMIT	43 h	0	2.0			1.8	[V]	±3% Vo	0.98 [mV]	
13	VOUT_UV_FAULT_LIMIT	44 h	0	2.0			1.8	[V]	±3% Vo	0.98 [mV]	
14	IOUT_OC_FAULT_LIMIT	46 h	0.5	46	69	120	120	[A]	±15% Io rated	0.5 [A]	
15	IOUT_OC_WARN_LIMIT	4A h	0.5	46	69	120	120	[A]	±15% Io rated	0.5 [A]	
16	OT_FAULT_LIMIT	4F h	-45	130				[°C]	±5°C	1 [°C]	
17	OT_WARN_LIMIT	51 h	-45	130				[°C]	±5°C	1 [°C]	
18	UT_WARN_LIMIT	52 h	-45	130				[°C]	±5°C	1 [°C]	
19	UT_FAULT_LIMIT	53 h	-45	130				[°C]	±5°C	1 [°C]	
20	VIN_OV_FAULT_LIMIT	55 h	3.28	14.5				[V]	±3% Vin	31.25 [mV]	
21	VIN_OV_WARN_LIMIT	57 h	3.00	14.5				[V]	±3% Vin	31.25 [mV]	
22	VIN_UV_WARN_LIMIT	58 h	3.00	14.5				[V]	±3% Vin	31.25 [mV]	
23	VIN_UV_FAULT_LIMIT	59 h	3.00	14.0				[V]	±3% Vin	31.25 [mV]	
24	POWER_GOOD_ON	5E h	0	2.1				[V]	±5% Vo	0.98 [mV]	
25	POWER_GOOD_OFF	5F h	0	2.1				[V]	±5% Vo	0.98 [mV]	
26	TON_DELAY	60 h	0	63				[ms]	±20%	0.06 [ms]	
27	TON_RISE	61 h	0	19.5				[ms]	±20%	0.06 [ms]	
28	READ_VIN	88 h	0	32				[V]	±3% Vin	31.25 [mV]	
29	READ_VOUT	8B h	0	64				[V]	±3% Vo	0.98 [mV]	
30	READ_IOUT	8C h	minus max value	64	128		256	[A]	±10% Io rated	62.5/125/ 250[mV]	
31	READ_TEMPERATURE_1	8D h	-60	150				[°C]	±5°C	1 [°C]	
32	MFR_VOUT_CAL_OFFSET	D4 h	-123	124				[mV]	-	0.98 [mV]	
33	MFR_VIN_CAL_OFFSET	D6 h	-2.00	1.97				[V]	-	31.25 [mV]	
34	MFR_OT_REST ART_LIMIT	E3 h	-45	130				[°C]	±5 °C	1 [°C]	
35	MFR_UT_REST ART_LIMIT	E4 h	-45	130				[°C]	±5 °C	1 [°C]	

Table 9-2 Setting range and accuracy by command (sequel)

No.	PMBus command	Code *1	Setting /Reading range *2					Setting/ Reading accuracy	Setting/ Reading increments	Note	
			Min	Max							
				BRDS40	BRDS60/ BRDS60S	BRDS100	BRDS120/ BRDS150				Unit
36	MFR_VOUT_OV_FAULT_COUNT	F0 h	0	128				[Times]	-	1 [Time]	
37	MFR_VOUT_UV_FAULT_COUNT	F1 h	0	128				[Times]	-	1 [Time]	
38	MFR_OT_FAULT_COUNT	F2 h	0	128				[Times]	-	1 [Time]	
39	MFR_UT_FAULT_COUNT	F3 h	0	128				[Times]	-	1 [Time]	
40	MFR_VIN_OV_FAULT_COUNT	F8 h	0	128				[Times]	-	1 [Time]	
41	MFR_VIN_UV_FAULT_COUNT	F9 h	0	128				[Times]	-	1 [Time]	

*1 : It shows being a numeric-representation in the hexadecimal number when end "h" is added.

*2 : It is communication error when setting a value is out of the setting range in value setting and corresponding bit 7 of STATUS_CML is set.

10. PMBus commands

OPERATION [01h] R/W Byte

Make the setting of ON / OFF control and VOUT_MARGIN setting.

Display format : -
 Initial setting : 00 h
 Setting and range of reading : -

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

No.	setting				Output	Overview
	bit7-6	bit5-4	bit3-2	bit1-0		
1	00	XX	XX	XX	OFF	Power supply stops
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] (LVP invalid) *1
5	10	01	10	XX	ON	Set output voltage value of VOUT_MARGIN_LOW [26h]
6	10	10	01	XX	ON	Set output voltage value of VOUT_MARGIN_HIGH [25h] (OVP invalid) *1
7	10	10	10	XX	ON	Set output voltage value of VOUT_MARGIN_HIGH [25h]

XX: Ignore

*1 WARN and FAULT is invalid

ON_OFF_CONFIG [02h] R/W Byte

Remote control and operation setting on OPERATION [01h] command *1

Display format : -
 Initial setting : 15 h
 Setting and range of reading : -

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

No.	bit	Value	Overview
1	bit7-5	000	None
2	bit4	0	Invalid all ON/OFF function
		1	Valid all ON/OFF function
3	bit3	0	Invalid ON/OFF function by OPERATION [01h] command
		1	Valid ON/OFF function by OPERATION [01h] command
4	bit2	0	Invalid remote control function
		1	Valid remote control function
5	bit1	0	Set remote control function negative logic
		1	Set remote control function positive logic
6	bit0	0	It stops by the sequence of the shut down period, TOFF_DELAY [64 h], TOFF_FALL [65h] by the remote control (primary side) feature. (not supported)
		1	In the stop order by the remote control (primary side) feature, it stops operation immediately

CLEAR_FAULTS [03h] Send

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

Display format : -
 Initial setting : -
 Setting and range of reading : -

No.	STATUS command	Code	WORD/BYTE
1	STATUS_BYTE	78h	Byte
2	STATUS_WORD	79h	Word
3	STATUS_VOUT	7Ah	Byte
4	STATUS_IOUT	7Bh	Byte
5	STATUS_INPUT	7Ch	Byte
6	STATUS_TEMPERATURE	7Dh	Byte
7	STATUS_CML	7Eh	Byte

WRITE_PROTECT [10h] R/W Byte

This command is used to control writing to the PMBus interface device.

Display format : -
 Initial setting : 00 h
 Setting and range of reading : -

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

No.	bit	Value	Overview
1	bit7-0	10000000	Writing 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] (not supported)
4		00000000	Writing in all command to be supported is possible

RESTORE_DEFAULT_ALL [12h] Send

Restore the initial setting of the PMBus.

Display format : -
 Initial setting : -
 Setting and range of reading : -

Note1 : During power supply operation command is invalid. It is performed in output off.

Note2: During command execution (2 ms), it isn't possible to do the start-up power supply.

STORE_USER_ALL [15h] Send

The Operating Memory data is written to the FLASHROM.

Display format : -
 Initial setting : -
 Setting and range of reading : -

Note1 : During output on can receive a command. But save operation is not performed. Saving operation is performed when the power supply is stopped.

Note2 : STORE_USER_ALL during command execution be input voltage more than 4.5V more than 0.5 seconds.

Note3 : STORE_USER_ALL during command execution will not be able to communicate in the PMBus.

Note4 : Stored count is up to five times. It does not accept the command if Stored the number had more than five times.

RESTORE_USER_ALL [16h] Send

Restores the Operating Memory to the user settings.

Display format : -
 Initial setting : -
 Setting and range of reading : -

Note1 : During output on can receive a command. Restore operation is performed when the power supply is stopped.

Note2 : During the command execution is not possible start of the power supply. It is ready to start after the end of execution.

CAPABILITY [19h] Read Byte

It reads the support status of the communication.

Display format : -
 Initial setting : B0 h
 Setting and range of reading : -

bit	7	6	5	4	3	2	1	0
Initial setting	1	0	1	1	0	0	0	0
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
		01	Supported Maximum Bus speed is 400kHz
		10	None
		11	None
4	bit4	0	SMBALERT is not supportive
		1	SMBALERT is supportive
5	bit3-0	0000	None

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.

Display format : -
 Initial setting : -
 Setting and range of reading : -

No.	Status command of possible mask setting	Code	WORD/BYTE	Initial value
1	STATUS_BYTE	78h	Byte	02 h
2	STATUS_WORD	79h	Byte	00 h
3	STATUS_VOUT	7Ah	Byte	00 h
4	STATUS_IOUT	7Bh	Byte	00 h
5	STATUS_INPUT	7Ch	Byte	00 h
6	STATUS_TEMPERATURE	7Dh	Byte	00 h
7	STATUS_CML	7Eh	Byte	FFh

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"

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.

Display format : -
 Initial setting : 16h
 Setting and range of reading : -

bit	7	6	5	4	3	2	1	0
Initial setting	0	0	0	1	0	1	1	0
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

VOUT_TRIM [22h] R/W Word

The output voltage can be programmed within the setting range .

Display format	: Linear(Vo)	
Initial setting	: 0 [V]	
Setting and range of reading	: ± 0.4 [V]	*1

*1 : The value which added VOUT_TRIM [22 h] becomes the upper limit. The value which exceeds VOUT_MAX [24 h] can not be set.

$$VOUT_TRIM < VOUT_MAX - VOUT_MARGIN_HIGH \text{ or } VOUT_MARGIN_LOW \text{ or } VOUT(SET)$$

The output voltage is not set to a voltage lower than 0.5V.

VOUT_MAX [24h] R/W Word

Sets the maximum possible value setting of the output voltage. It isn't possible to change the maximum setting value. If the output voltage is changed by the TRM pin it may become an output voltage deviates from the upper limit.

Display format	: Linear(Vo)	
Initial setting	: BRDS40•60•60S•100/120•150 2.3 [V] / 2.1[V]	
Setting and range of reading	: BRDS40•60•60S•100/120•150 0.5 ~ 2.3 [V] / 0.5 ~ 2.1 [V]	

VOUT_MARGIN_HIGH [25h] R/W Word

Sets the value of the output voltage during the margin high operation state.

Display format	: Linear(Vo)	
Initial setting	: 1.32 [V]	
Setting and range of reading	: BRDS40•60•60S•100/120•150 0.5 ~ 2.3 [V] / 0.5 ~ 2.1 [V]	*1

*1: The output voltage can be set within ± 0.5 [V] of TRM resistance setting.
It is impossible to VOUT_MAX value greater than.

VOUT_MARGIN_LOW [26h] R/W Word

Sets the value of the output voltage during the margin low operation state.

Display format	: Linear(Vo)	
Initial setting	: 1.08 [V]	
Setting and range of reading	: BRDS40•60•60S•100/120•150 0.5 ~ 2.3 [V] / 0.5 ~ 2.1 [V]	*1

*1: The output voltage can be set within ± 0.5 [V] of TRM resistance setting.

It is impossible to VOUT_MAX value greater than.

VIN_ON [35h] R/W Word

The VIN_ON command sets the value of the start-up input voltage.

Display format	: Linear(N= -2)	
Initial setting	: 4.25 [V]	
Setting and range of reading	: 3.25 ~ 14.00 [V]	*1

*1: It can not be set to a value of less than VIN_OFF [36h] +0.25[V].

If the setting value is set to following values 4.3V, start-up voltage will be 4.3V.

When VIN_ON [35h] the difference between the VIN_OFF [36h] is small, there is a possibility to repeat the start-stop.

VIN_OFF [36h] R/W Word

The VIN_OFF command sets the value of the stop input voltage.

Display format	: Linear(N=-2)	
Initial setting	: 4.00 [V]	
Setting and range of reading	: 3.00 ~ 13.75 [V]	

*1: It can not be set to a value of less than VIN_ON [35h] -0.25[V].

If the setting value is set to following values 4.0V, stop voltage will be 4.0V.

When VIN_ON [35h] the difference between the VIN_OFF [36h] is small, there is a possibility to repeat the start-stop.

IOUT_CAL_OFFSET [39h] R/W Word

IOUT_CAL_OFFSET will offset the READ_IOUT [8Ch] value.

Display format	: BRDS40/60•60S•100/120•150 Linear(N= -4)/(N= -3)/(N= -2)	
Initial setting	: 0 [A]	
Setting and range of reading	: BRDS40/60•60S•100/120•150 -4.00~3.93 [A]/-8.00~7.88 [A]/-16.00~15.75[A]	

*1 : Offset it does no effect on IOUT_OC_FAULT_LIMIT[46h] and IOUT_OC_WARN_LIMIT[4Ah].

VOUT_OV_FAULT_LIMIT [40h] R/W Word

Sets the output overvoltage fault threshold.

When the output voltage exceeds this threshold, it does the operation to specify at

VOUT_OV_FAULT_RESPONSE [41 h]. It does not work in slave of parallel operation.

Display format	: Linear(Vo)
Initial setting	: BRDS40•60•60S•100/120•150 2.5 [V] / 2.3[V]
Setting and range of reading	: BRDS40•60•60S•100/120•150 0.0 ~ 2.5 [V] / 0.0 ~ 2.3 [V]

VOUT_OV_FAULT_RESPONSE [41h] R/W Byte

Make the settings for the stop and return method of VOUT_OV_FAULT_LIMIT [40h] operation.

It does not work in slave of parallel operation.

Display format	: -
Initial setting	: BB h
Setting and range of reading	: -
Delay time of the automatic recovery	: 8ms + 200ms × (bit2-0)

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

No.	bit	Value	Overview
1	bit7-6	00	It continues operation
2		01	It continues operation to the delay time which is prescribed in bit2-0 and in case of being an abnormal condition behind the delay time, too, it does the return processing to specify in bit5-3 (not supportive).
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	It stops in the case of abnormal continuation. It will restarts the operation in the case of abnormal release (not supportive).
5	bit5-3	000	Stop the output (latch stop)
6		110 ~001	Automatic return operation do the number of bit3-5 (1 to 6 times). After the automatic return number of times, the latch stop if abnormal state. Automatic return interval I set in the bit2-0.
7		111	To continue the automatic return operation. Automatic return interval I set in the bit2-0.
8	bit2-0	111~000	Set the delay time of the automatic recovery

*1 : Automatic recovery count is reset to normal operation in 30 seconds.

VOUT_OV_WARN_LIMIT [42h] R/W Word

Sets the output overvoltage warning threshold. When the output voltage exceeds this threshold it outputs an alert. It does not work in slave of parallel operation.

Display format	: Linear(Vo)
Initial setting	: BRDS40•60•60S•100/120•150 2.2 [V] / 2.0[V]
Setting and range of reading	: BRDS40•60•60S•100/120•150 0.0 ~ 2.5 [V] / 0.0 ~ 2.3 [V]

VOUT_UV_WARN_LIMIT [43h] R/W Word

Sets the low output warning threshold.

Sets the low output warning threshold. When the output voltage under this threshold it outputs an alert. It does not work in slave of parallel operation.

Display format : Linear(Vo)
 Initial setting : 0.5 [V]
 Setting and range of reading : BRDS40•60•60S•100/120•150
 0.0 ~ 2.0 [V] / 0.0 ~ 1.8 [V]

VOUT_UV_FAULT_LIMIT [44h] R/W Word

Sets the output overvoltage fault threshold.

When the output voltage less than this threshold, it does the operation to specify at

VOUT_UV_FAULT_RESPONSE [45h]. It does not work in slave of parallel operation.

Display format : Linear(Vo)
 Initial setting : 0.1 [V]
 Setting and range of reading : BRDS40•60•60S•100/120•150
 0.0 ~ 2.0 [V] / 0.0 ~ 1.8 [V]

VOUT_UV_FAULT_RESPONSE [45h] R/W Byte

Make the settings for the stop and return method of VOUT_UV_FAULT_LIMIT [44h] operation.

It does not work in slave of parallel operation.

Display format : -
 Initial setting : BB h
 Setting and range of reading : -
 Delay time of the automatic recov : 8ms + 200ms × (bit2-0)

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

No.	bit	Value	Overview
1	bit7-6	00	It continues operation
2		01	It continues operation to the delay time which is prescribed in bit2-0 and in case of being an abnormal condition behind the delay time, too, it does the return processing to specify in bit5-3 (not supportive).
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	It stops in the case of abnormal continuation. It will restarts the operation in the case of abnormal release (not supportive).
5	bit5-3	000	Stop the output (latch stop)
6		110 ~001	Automatic return operation do the number of bit3-5 (1 to 6 times). After the automatic return number of times, the latch stop if abnormal state. Automatic return interval I set in the bit2-0.
7		111	To continue the automatic return operation. Automatic return interval I set in the bit2-0.
8	bit2-0	111~000	Set the delay time of the automatic recovery

*1 : Automatic recovery count is reset to normal operation in 30 seconds.

IOUT_OC_FAULT_LIMIT [46h] R/W Word

Sets the output overcurrent fault threshold.

When the output current exceeds this threshold, it does the operation to specify at

VOUT_OV_FAULT_RESPONSE [47h].

Display format	: Linear(N=-1)
Initial setting	: BRDS40/60•60S/100/120/150 46 [A]/ 69 [A]/ 120[A]/ 144[A]/ 178[A]
Setting and range of reading	: BRDS40/60•60S/100/120/150 0.5[A]~46 [A]/ 69 [A]/ 120[A]/ 144[A]/ 178[A]

IOUT_OC_FAULT_RESPONSE [47h] R/W Byte

Make the settings for the stop and return method of IOUT_OC_FAULT_LIMIT [46h] operation.

Display format	: -
Initial setting	: B8 h
Setting and range of reading	: -
Delay time of the automatic recovery	: 1200ms + 800ms × (bit2-0)

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

No.	bit	Value	Overview
1	bit7-6	00	It continues operation (not supportive).
2		01	It continues operation to the delay time which is prescribed in bit2-0 and in case of being an abnormal condition behind the delay time, too, it does the return processing to specify in bit5-3 (not supportive).
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	It stops in the case of abnormal continuation. It will restarts the operation in the case of abnormal release (not supportive).
5	bit5-3	000	Stop the output (latch stop)
6		110 ~001	Automatic return operation do the number of bit3-5 (1 to 6 times). After the automatic return number of times, the latch stop if abnormal state. Automatic return interval I set in the bit2-0.
7		111	To continue the automatic return operation. Automatic return interval I set in the bit2-0.
8	bit2-0	111~000	Set the delay time of the automatic recovery

*1 : Automatic recovery count is reset to normal operation in 30 seconds.

IOUT_OC_WARN_LIMIT [4Ah] R/W Word

Sets the output overcurrent warning threshold. When the output current exceeds this threshold it outputs an alert.

Display format	: Linear(N=-1)
Initial setting	: BRDS40/60•60S/100/120/150 44 [A]/ 65 [A]/ 115[A]/ 132[A]/ 165[A]
Setting and range of reading	: BRDS40/60•60S/100/120/150 0.5[A]~46 [A]/ 69 [A]/ 120[A]/ 144[A]/ 178[A]

OT_FAULT_LIMIT [4Fh] R/W Word

Sets the over temperature fault threshold.

When the temperature exceeds this threshold, it does the operation to specify at

OT_FAULT_RESPONSE [50h]

Display format : Linear(N=0)
 Initial setting : 130 [°C]
 Setting and range of reading : -45 ~ 130 [°C]

OT_FAULT_RESPONSE [50h] R/W Byte

Make the settings for the stop and return method of OT_FAULT_LIMIT [4Fh] operation.

Display format : -
 Initial setting : B9 h
 Setting and range of reading : -
 Delay time of the automatic recovery : 8ms + 200ms × (bit2-0)

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

No.	bit	Value	Overview
1	bit7-6	00	It continues operation (not supportive).
2		01	It continues operation to the delay time which is prescribed in bit2-0 and in case of being an abnormal condition behind the delay time, too, it does the return processing to specify in bit5-3 (not supportive).
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	It stops in the case of abnormal continuation. It will restarts the operation in the case of abnormal release (not supportive).
5	bit5-3	000	Stop the output (latch stop)
6		110 ~001	Automatic return operation do the number of bit3-5 (1 to 6 times). After the automatic return number of times, the latch stop if abnormal state. Automatic return interval I set in the bit2-0.
7		111	To continue the automatic return operation. Automatic return interval I set in the bit2-0.
8	bit2-0	111~000	Set the delay time of the automatic recovery

*1 : Automatic recovery count is reset to normal operation in 30 seconds.

OT_WARN_LIMIT [51h] R/W Word

Sets the over temperature warning threshold. When the temperature exceeds this threshold it outputs an alert.

Display format : Linear(N=0)
 Initial setting : 125 [°C]
 Setting and range of reading : -45 ~ 130 [°C]

UT_WARN_LIMIT [52h] R/W Word

Sets the under temperature warning threshold. When the temperature under this threshold it outputs an alert.

Display format : Linear(N=0)
 Initial setting : -45 [°C]
 Setting and range of reading : -45 ~ 130 [°C]

UT_FAULT_LIMIT [53h] R/W Word

Sets the output over temperature fault threshold.

When the temperature exceeds this threshold, it does the operation to specify at OT_FAULT_RESPONSE [50h]

Display format : Linear(N=0)
 Initial setting : -45 [°C]
 Setting and range of reading : -45 ~ 130 [°C]

UT_FAULT_RESPONSE [54h] R/W Byte

Make the settings for the stop and return method of UT_FAULT_LIMIT [53h] operation.

Display format : -
 Initial setting : 39 h
 Setting and range of reading : -
 Delay time of the automatic recovery : 8ms + 200ms × (bit2-0)

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

No.	bit	Value	Overview
1	bit7-6	00	It continues operation.
2		01	It continues operation to the delay time which is prescribed in bit2-0 and in case of being an abnormal condition behind the delay time, too, it does the return processing to specify in bit5-3 (not supportive).
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	It stops in the case of abnormal continuation. It will restarts the operation in the case of abnormal release (not supportive).
5	bit5-3	000	Stop the output (latch stop)
6		110 ~001	Automatic return operation do the number of bit3-5 (1 to 6 times). After the automatic return number of times, the latch stop if abnormal state. Automatic return interval I set in the bit2-0.
7		111	To continue the automatic return operation. Automatic return interval I set in the bit2-0.
8	bit2-0	111~000	Set the delay time of the automatic recovery

*1 : Automatic recovery count is reset to normal operation in 30 seconds.

VIN_OV_FAULT_LIMIT [55h] R/W Word

Sets the output overvoltage fault threshold.

When the output voltage exceeds this threshold, it does the operation to specify at

VIN_OV_FAULT_RESPONSE [56h]. This value must be greater than VIN_ON[35h]

Display format : Linear(N=-5)
 Initial setting : 14.5 [V]
 Setting and range of reading : 3.28 ~ 14.50 [V]

VIN_OV_FAULT_RESPONSE [56h] R/W Byte

Make the settings for the stop and return method of VIN_OV_FAULT_LIMIT [55h] operation.

Display format : -
 Initial setting : B9 h
 Setting and range of reading : -
 Delay time of the automatic recov : 3ms + 200ms × (bit2-0)

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

No.	bit	Value	Overview
1	bit7-6	00	It continues operation.
2		01	It continues operation to the delay time which is prescribed in bit2-0 and in case of being an abnormal condition behind the delay time, too, it does the return processing to specify in bit5-3 (not supportive).
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	It stops in the case of abnormal continuation. It will restarts the operation in the case of abnormal release (not supportive).
5	bit5-3	000	Stop the output (latch stop)
6		110 ~001	Automatic return operation do the number of bit3-5 (1 to 6 times). After the automatic return number of times, the latch stop if abnormal state. Automatic return interval I set in the bit2-0 (not supportive).
7		111	To continue the automatic return operation. Automatic return interval I set in the bit2-0.
8	bit2-0	111~000	Set the delay time of the automatic recovery

VIN_OV_WARN_LIMIT [57h] R/W Word

Sets the input overvoltage warning threshold. When the input voltage exceeds this threshold it outputs an alert.

Display format : Linear(N=-5)
 Initial setting : 14.5 [V]
 Setting and range of reading : 3.0 ~ 14.5 [V]

VIN_UV_WARN_LIMIT [58h] R/W Word

Sets the input overvoltage warning threshold. When the input voltage exceeds this threshold it outputs an alert. This command is enabled when the input voltage exceeds the value of VIN_ON [35h]

Display format : Linear(N=-5)
 Initial setting : 3.5 [V]
 Setting and range of reading : 3.0 ~ 14.5 [V]

VIN_UV_FAULT_LIMIT [59h] R/W Word

Sets the input overvoltage warning threshold. This command is enabled when the input voltage exceeds the value of VIN_ON [35h]. This value must be lower than VIN_ON[35h].

Display format : Linear(N=-5)
 Initial setting : 3.5 [V]
 Setting and range of reading : 3.0 ~ 14.0 [V]

VIN_UV_FAULT_RESPONSE [5Ah] R/W Byte

Make the settings for the stop and return method of VIN_UV_FAULT_LIMIT [59h] operation.

Display format : -
 Initial setting : B9 h
 Setting and range of reading : -
 Delay time of the automatic recov : 3ms + 200ms × (bit2-0)

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

No.	bit	Value	Overview
1	bit7-6	00	It continues operation.
2		01	It continues operation to the delay time which is prescribed in bit2-0 and in case of being an abnormal condition behind the delay time, too, it does the return processing to specify in bit5-3 (not supportive).
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	Error count is stored by the MFR_STORE_FAULT_COUNT [FDh] after output off. Restart after saving.
5	bit5-3	000	Stop the output (latch stop)
6		110 ~001	Automatic return operation do the number of bit3-5 (1 to 6 times). After the automatic return number of times, the latch stop if abnormal state. Automatic return interval I set in the bit2-0.
7		111	To continue the automatic return operation. Automatic return interval I set in the bit2-0.
8	bit2-0	111~000	Set the delay time of the automatic recovery

*1 : Automatic recovery count is reset to normal operation in 30 seconds.

POWER_GOOD_ON [5Eh] R/W Word

This command sets the voltage threshold for Power-Good indication.

When set to 0V, it is set to the output voltage $\pm 12.5\%$ set by the TRM resistance. Setting to a lower value than the output voltage set by TRM resistors.

If the output voltage is changed larger than 10% by TRM terminal, it does not operate at the correct value. In that case, to start and stop the remote control function. It is also possible to re-set to the same value. It does not work in slave of parallel operation.

Display format	: Linear(V_o)
Initial setting	: 0.0 [V]
Setting and range of reading	: 0.0 ~ 2.1 [V]

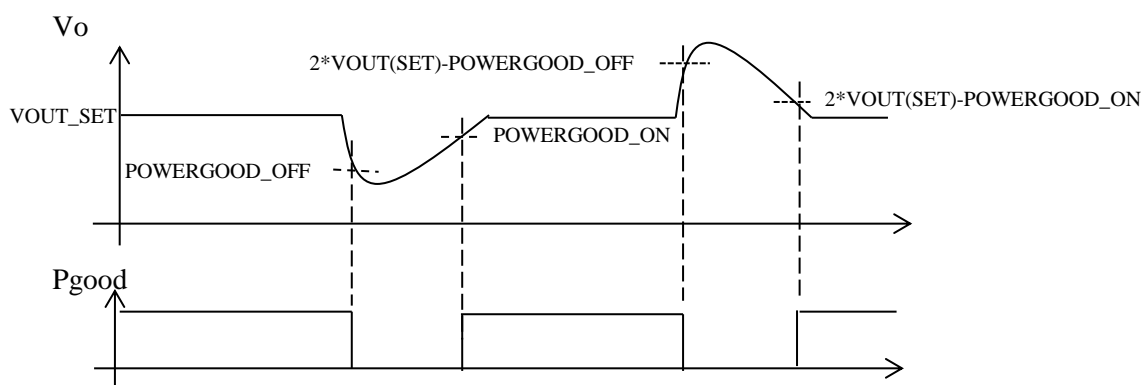


Fig.10.1 POWER GOOD setting

PGOOD signal to detect the output voltage error during the transient.

POWER_GOOD_OFF [5Fh] R/W Word

Setting the threshold to stop the power-good signal.

Setting referring to the POWER_GOOD_ON [5Eh].

It does not work in slave of parallel operation.

Display format	: Linear(V_o)
Initial setting	: 0.0 [V]
Setting and range of reading	: 0.0 ~ 2.1 [V]

TON_DELAY [60h] R/W Word

This command sets the delay time to start of the rise of the output voltage. If the delay time is set lower than the initial value (3ms), the initial value is set. Calculate the startup delay time using the following formula.

$$\text{Startup delay time [ms]} = \text{TON_DELAY[60h]} + V_{OSET} \times 0.125 \times \text{TON_RISE[61h]}$$

Display format	: Linear(N=-4)
Initial setting	: 3 [ms]
Setting and range of reading	: 0 ~ 63 [ms]

TON_RISE [61h] R/W Word

Sets the vout voltage rise time of start-up. Time that the output voltage is from 0.1V to 0.9V (slew rate) to set. If the rise time is set lower than the initial value (2ms), the initial value is set.

It must be open the SEQ terminal, if this command is set.

In the case of parallel operation, to adjust the rise time in SEQ pin.

$$\text{Rise time [ms]} = \frac{V_{oset}}{1[V]} \times T_{on_RISE}$$

Display format	: Linear(N=-4)
Initial setting	: 2.0 [ms]
Setting and range of reading	: 0.0 ~ 19.5 [ms]

STATUS_BYTE [78h] R/C Byte

This command read the error state.

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

Display format	: -
Initial setting	: 00 h
Setting and range of reading	: -

No.	bit	Value	Overview
1	bit7	0	It sets when the device can not reply in use (not supportive).
2	bit6	0	It sets by output OFF status (not supportive).
3	bit5	0	An output overvoltage fault has occurred (VOUT_OV_FAULT_LIMIT [40h]).
4	bit4	0	An output overcurrent fault has occurred (IOUT_OC_FAULT_LIMIT [4Ah]).
5	bit3	0	An input undervoltage fault has occurred (VIN_UV_FAULT_LIMIT [59h]).
6	bit2	0	A temperature fault or warning has occurred (STATUS_TEMPERATURE [7Dh]).
7	bit1	0	A communications, memory or logic fault has occurred (STATUS_CML [7Eh]).
8	bit0	0	A fault or warning not listed in bits [7:1] has occurred.

STATUS_WORD [79h] R/C Word

This command read the error state.

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

Display format : -
 Initial setting : 00 h
 Setting and range of reading : -

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

STATUS_VOUT [7Ah] R/C 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 A CLEAR_FAULTS [03h]

Display format : -
 Initial setting : 00 h
 Setting and range of reading : -

No.	bit	Value	Overview
1	bit7	0	VOUT_OV_FAULT (VOUT_OV_FAULT_LIMIT [40h])
2	bit6	0	VOUT_OV_WARNING (VOUT_OV_WARN_LIMIT [42h])
3	bit5	0	VOUT_UV_WARNING (VOUT_UV_WARN_LIMIT [43h])
4	bit4	0	VOUT_UV_FAULT (VOUT_UV_FAULT_LIMIT [44h])
5	bit3	0	VOUT_MAX Warning (VOUT_MAX [24h])
6	bit2	0	TON_MAX_FAULT (not supportive).
7	bit1	0	TOFF_MAX_WARNING (not supportive).
8	bit0	0	-

STATUS_IOUT [7Bh] R/C 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 A CLEAR_FAULTS [03h]

Display format : -
 Initial setting : 00 h
 Setting and range of reading : -

No.	bit	Value	Overview
1	bit7	0	IOUT_OC_FAULT(OUT_OC_FAULT_LIMIT[46h])
2	bit6	0	IOUT_OC_LV_FAULT (not supportive).
3	bit5	0	IOUT_OC_WARNING (IOUT_OC_WARN_LIMIT [4Ah])
4	bit4	0	IOUT_UC_FAULT (not supportive).
5	bit3	0	-
6	bit2	0	In Power Limiting Mode (not supportive).
7	bit1	0	POUT_OP_FAULT (not supportive).
8	bit0	0	POUT_OP_WARNING (not supportive).

STATUS_INPUT [7Ch] R/C Byte

This command read the input voltage error state.

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

Display format : -
 Initial setting : 00 h
 Setting and range of reading : -

No.	bit	Value	Overview
1	bit7	0	VIN_OV_FAULT (VIN_OV_FAULT_LIMIT [55h])
2	bit6	0	VIN_OV_WARNING (VIN_OV_WARN_LIMIT [57h])
3	bit5	0	VIN_UV_WARNING (VIN_UV_WARN_LIMIT [58h])
4	bit4	0	VIN_UV_FAULT (VIN_UV_FAULT_LIMIT [59h])
5	bit3	0	Unit Off For Insufficient Input Voltage (not supportive).
6	bit2	0	IIN_OC_FAULT (not supportive).
7	bit1	0	IIN_OC_WARNING (not supportive).
8	bit0	0	PIN_OP_WARNING (not supportive).

STATUS_TEMPERATURE [7Dh] R/C 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 A CLEAR_FAULTS [03h]

Display format : -
 Initial setting : 00 h
 Setting and range of reading : -

No.	bit	Value	Overview
1	bit7	0	OT_FAULT (OT_FAULT_LIMIT [4Fh])
2	bit6	0	OT_WARNING (OT_WARN_LIMIT [51h])
3	bit5	0	UT_WARNING (UT_WARN_LIMIT [52h])
4	bit4	0	UT_FAULT (UT_FAULT_LIMIT [53h])
5	bit3	0	None
6	bit2	0	None
7	bit1	0	None
8	bit0	0	None

STATUS_CML [7Eh] R/C 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 A CLEAR_FAULTS [03h]

Display format : -
 Initial setting : 00 h
 Setting and range of reading : -

No.	bit	Value	Overview
1	bit7	0	Invalid Or Unsupported Command Received
2	bit6	0	Invalid Or Unsupported DATA Received
3	bit5	0	Packet Error Check Failed
4	bit4	0	Memory Fault Detected
5	bit3	0	Processor Fault Detected (not supportive).
6	bit2	0	-
7	bit1	0	A communication fault other than the ones listed in this table has occurred
8	bit0	0	-

*1 PMBus setting data may be corrupted. To verify the set value.

READ_VIN [88h] Read Word

This command returns the measured value of the input voltage.

Display format	: Linear(N=-5)
Initial setting	: 00 h
Setting and range of reading	: 0 ~ 32 [V]

READ_VOUT [8Bh] Read Word

This command returns the measured value of the output voltage.

Display format	: Linear(Vo)
Initial setting	: -
Setting and range of reading	: 0 ~ 64 [V]

READ_IOUT [8Ch] Read Word

This command returns the measured value of the output current. During the BRDS stop becomes 0A.

Display format	: BRDS40/60•60S•100/120•150 Linear(N= -4)/(N= -3)/(N= -2)
Initial setting	: -
Setting and range of reading	: BRDS40/60•60S•100/120•150 ± 64 [A]/ ±128 [A]/ ±256 [A]

READ_TEMPERATURE_1 [8Dh] Read Word

This command returns the measured value of the converter temperature

Display format	: Linear(N=0)
Initial setting	: -
Setting and range of reading	: -60 ~ 150 [°C]

PMBus_REVISION [98h] Read Byte

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

Display format : -
 Initial setting : 22h
 Setting and range of reading : -

bit	7	6	5	4	3	2	1	0
Initial setting	0	0	1	0	0	0	1	0
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

MFR_VIN_MIN [A0h] Read Word

This command returns the minimum input voltage.

Display format : Linear(N=-2)
 Initial setting : 4.5
 Setting and range of reading : -

MFR_VOUT_MIN [A4h] Read Word

This command returns the minimum output voltage.

Display format : Linear(Vo)
 Initial setting : BRDS40•60S•120•150/60•100 : 0.6[V]/ 0.7[V]
 Setting and range of reading : -

For BRDS

MFR_MODULE_NAME [D0h] Read Word

This command returns the model number of the converter.

Display format : -
 Initial setting : BRDS40/60/60S/100/120/150
 120h/140h/1A0h/180h/1E0h/1F0h
 Setting and range of reading : -

No.	bit	Value	Overview
1	bit0-1	00	-
2	bit2-7	001000/ 010000/ 101000/ 100000/ 111000/ 111100	Module Name : BRDS40 / BRDS60/ BRDS60S BRDS100 BRDS120 BRDS150
3	bit8-9	01	Manufacture ID : 01 COSEL
4	bit15-10	000000	Module Revision Number : None

MFR_VOUT_CAL_OFFSET [D4h] R/W Word

This command sets the offset value of READ_VOUT [8Bh] value. Not offset value is applied to the protection settings.

Display format : Linear(Vo)
 Initial setting : 0
 Setting and range of reading : -123 ~ 124 [mV]

MFR_VIN_CAL_OFFSET [D6h] R/W Word

This command sets the offset value of READ_VIN [88h] value. Not offset value is applied to the protection settings.

Display format : Linear(N=-5)
 Initial setting : 0
 Setting and range of reading : -2.00 ~ 1.97[V]

MFR_ARA_CONFIG [E0h] R/W Byte

This command sets the SMBAlert configure.

Display format : -
 Initial setting : 00 h
 Setting and range of reading : -

bit	7	6	5	4	3	2	1	0
Initial setting	0	0	0	0	0	0	0	0
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

MFR_OT_RESTART_LIMIT [E3h] R/W Word

It does the setting of the return threshold of the overheating protection and a reading. It does an automatic-reset when the temperature of the temperature detecting-element is below this threshold when the return mode is an automatic-reset.

Display format : Linear(N=0)
 Initial setting : 90 [°C]
 Setting and range of reading : -45 ~ 130 [°C]

MFR_UT_RESTART_LIMIT [E4h] R/W Word

It does the setting of the return threshold of the cry protection and a reading. It does an automatic-reset when the temperature detecting-element temperature exceeds this threshold when the return mode is automatic-reset.

Display format : Linear(N=0)
 Initial setting : -40 [°C]
 Setting and range of reading : -45 ~ 130 [°C]

MFR_VOUT_OV_FAULT_COUNT [F0h] Read Word

It reads the number of times stooping by the low voltage protection feature

Display format : Linear(N=0)
 Initial setting : 0 [Times]
 Setting and range of reading : 0 ~ 128 [Times]

bit	Value	Overview
bit7-0	00000000	It reads the number of times stopping by the overvoltage protection. (0~128 times)

MFR_VOUT_UV_FAULT_COUNT [F1h] Read Word

It reads the number of times stooping by the low voltage protection feature. Saving and erasing of the number of errors, refer to Section 2.4.

Display format : Linear(N=0)
 Initial setting : 0 [Times]
 Setting and range of reading : 0 ~ 128 [Times]

bit	Value	Overview
bit7-0	00000000	It reads the number of times stopping by the low voltage protection. (0 - 128 times)

MFR_OT_FAULT_COUNT [F2h] Read Word

It reads the number of times stopping by the overheating protection feature. Saving and erasing of the number of errors, refer to Section 2.4.

Display format : Linear(N=0)
 Initial setting : 0 [Times]
 Setting and range of reading : 0 ~ 128 [Times]

bit	Value	Overview
bit7-0	00000000	It reads the number of times stopping by the overheating protection. (0 - 128 times)

MFR_UT_FAULT_COUNT [F3h] Read Word

It reads the number of times stopping by the cry protection feature. Saving and erasing of the number of errors, refer to Section 2.4.

Display format : Linear(N=0)
 Initial setting : 0 [Times]
 Setting and range of reading : 0 ~ 128 [Times]

bit	Value	Overview
bit7-0	00000000	It reads the number of times stopping by the overheating protection. (0 - 128 times)

MFR_CLEAR_USER_DATA [F5h] Send

Reset the user save data and the number of errors.

Note1 : It does not receive the command during the output voltage on.

Display format : -
 Initial setting : -
 Setting and range of reading : -

MFR_VIN_OV_FAULT_COUNT [F8h] Read Word

It reads the number of times stopping by the input overvoltage protection feature. Saving and erasing of the number of errors, refer to Section 2.4.

Display format : Linear(N=0)
 Initial setting : 0 [Times]
 Setting and range of reading : 0 ~ 128 [Times]

bit	Value	Overview
bit7-0	00000000	It reads the number of times stopping by input overvoltage protection. (0~128 times)

MFR_VIN_UV_FAULT_COUNT [F9h] Read Word

It reads the number of times stopping by low input voltage protection feature. Saving and erasing of the number of errors, refer to Section 2.4.

Display format : Linear(N=0)
 Initial setting : 0 [Times]
 Setting and range of reading : 0 ~ 128 [Times]

bit	Value	Overview
bit7-0	00000000	It reads the number of times stopping by the low input voltage protection. (0 - 128 times)

MFR_STORE_FAULT_COUNT [FDh] Send

This command does the stored of the number of errors.

By setting the VIN_UV_FAULT_RESPONSE [5Ah], automatically run this command in the input voltage drop.

Note1 : During output on can receive a command. But save operation is not performed. Saving operation is performed when the power supply is stopped.

Note2 During this command execution be input voltage more than 4.5V more than 0.5 seconds.

Note3 : Can not PMBus communication during this command execution

Note4 : It is in the following settings

VIN_OFF[36h] < VIN_UV_FAULT_LIMIT[59h] < VIN_ON[35h]

Display format	: -
Initial setting	: -
Setting and range of reading	: -