CHS300/400/500-I
PMBus communication manual

CHS300/400/500-I series

For CHS300/400/500-I series

The PMBus can be used to control and monitor the CHS300/400/500 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 Terminal function
1.1.1 Terminal function on CHS300-I

The figure and the table below show terminal function and name of pins on CHS300-I.
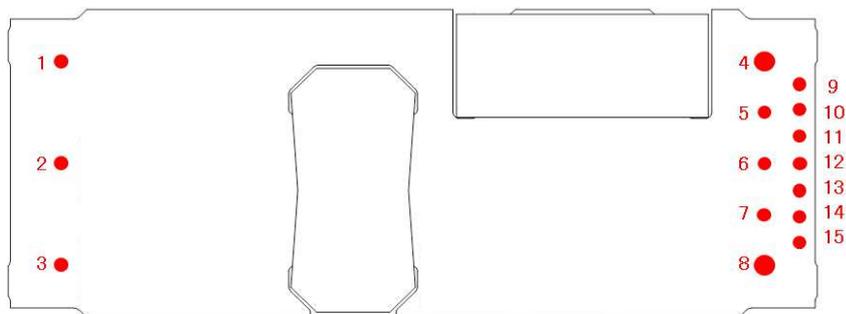
Figure 1-1.1. pin assignment in CHS300-I (top view)

Table 1-1.1. Pin Descriptions on CHS300-I

#		name	function	Note
1	Input terminal	+VIN	DC input(+)	
2		RC	Remote control (first side）	
3		-VIN	DC input(-)	
4	Output terminal	+VOUT	DC output (+)	
5		+S	Remote sensing (+)	
6		TRM	Output voltage adjustment	
7		-S	Remote sensing (-)	
8		-VOUT	DC output (-)	
9	PMBus communication terminal	Addr0	Address setting	
10		NC	Not connected	
11		Clock	PMBus communication clock input	
12		SMBAlert	Alarm output	
13		Data	PMBus communication data input&output	
14		Sig_GND	PMBus communication signal ground	
15		C2	Power_Good or remote control (secondary side）	

1.1.2 Terminal function on CHS400/500-I

The figure and the table below show terminal function and name of pins on CHS400/500-I.
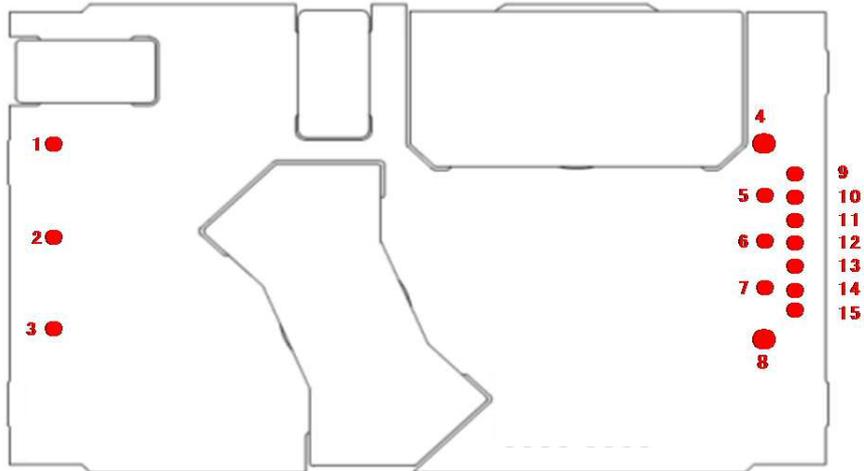
Figure 1-1.2. pin assignment in CHS400/500-I (top view)

Table 1-1.2. Pin Descriptions on CHS400/500-I

#		name	function	Note
1	Input terminal	+VIN	DC input(+)	
2		RC	Remote control (first side)	
3		-VIN	DC input(-)	
4	Output terminal	+VOUT	DC output (+)	
5		+S	Remote sensing (+)	
6		TRM	Output voltage adjustment	*1
7		-S	Remote sensing (-)	
8		-VOUT	DC output (-)	
9	PMBus communication terminal	Addr0	Address setting	
10		Addr1	Address setting	
11		Clock	PMBus communication clock input	
12		SMBAlert	Alarm output	
13		Data	PMBus communication data input&output	
14		Sig_GND	PMBus communication signal ground	
15		C2	Power_Good or remote control (secondary side)	

*1: Do not use when adjusting output voltage with PMBus communication.

For CHS300/400/500-I series

1.2 PMBus Communication connections method

The figure and table below show recommended resistors value for hard wiring PMBus addresses.

#	component	Setting value
1	R1	10kΩ (recommend) *1
2	R2	10kΩ (recommend)
3	R3	*2
4	R4	*2
5	R5,R7	*3
6	R6,R8	*3

*1：Connecting C2 as Power-Good function

*2：Refer to clause 1.4 PMBus communication
　　pull-up resistor

*3：refer to clause 1.5 address setting
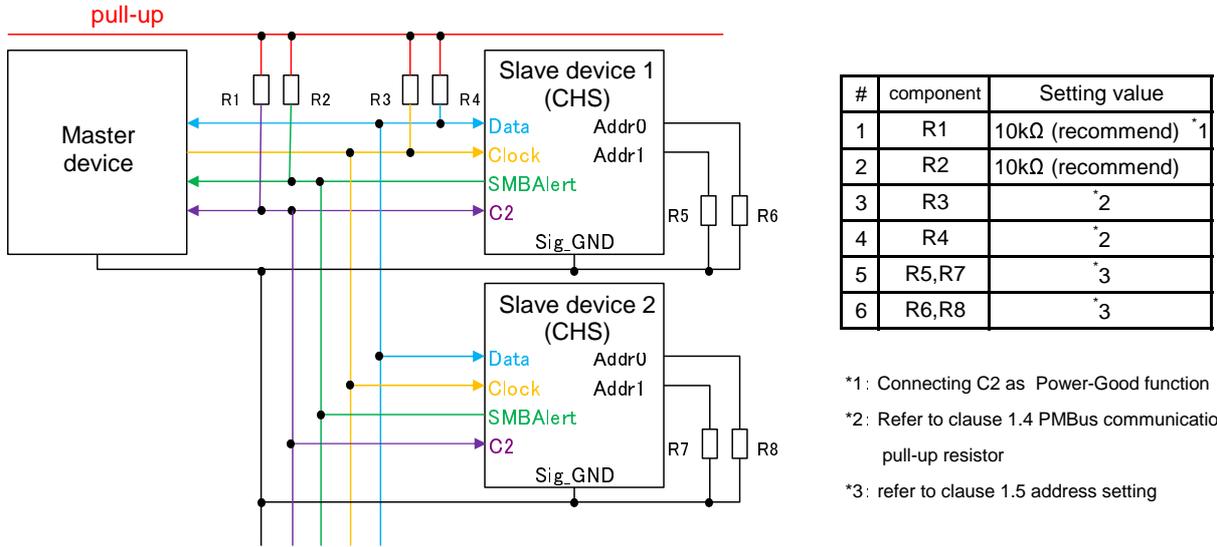
Figure 1-2　PMBus interface cable chart

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 Sig_GND between Data bus and Clock 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)
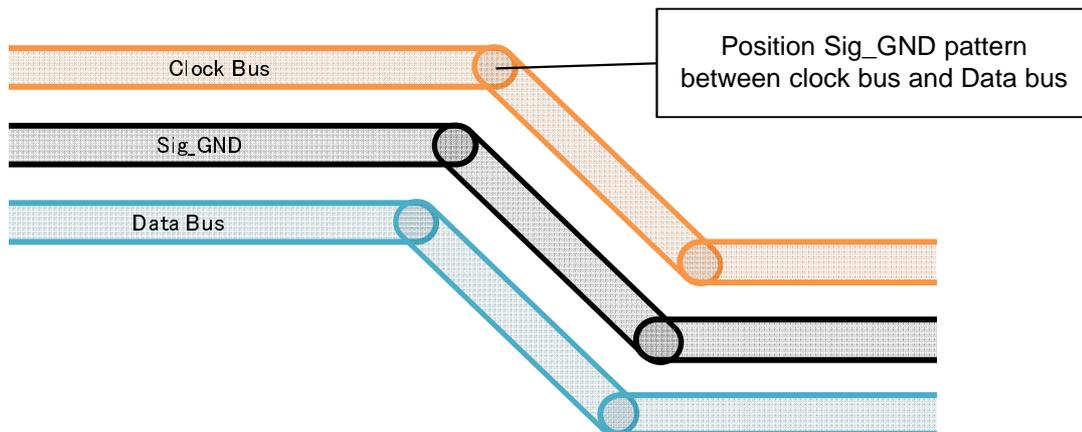
Figure 1-3　Pattern example

1.4 PMBus communication pull-up resistor value

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

Note1: Do not exceed the rated output current of converter's terminal (clause 8-1).

Note2: Total of parasitic capacitance and input capacitance should be less 400pF.
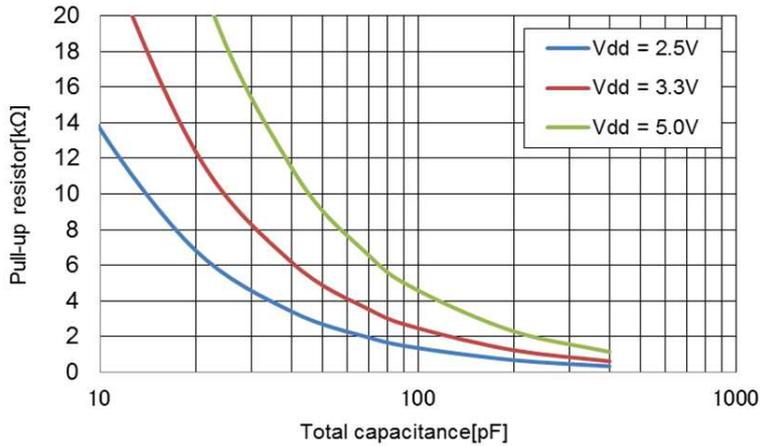
Figure 1-4 Recommended value of pull-up resistor

1.5 address setting

The figure and table below show recommended resistors value for hard wiring PMBus addresses.
Resistors with 1% tolerance are recommended. [1] [2]
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.

*2: Addr1 is only CHS400/500-I.

The formula for CHS300-I

Address =	16	+ Value(Addr0)

The formula for CHS400/500-I

Address = Value(Addr1) × 8 + Value(Addr0)
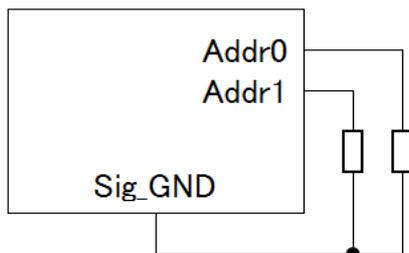
Figure 1-5 Address setting

Table 1-2 Resistor value

#	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

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.
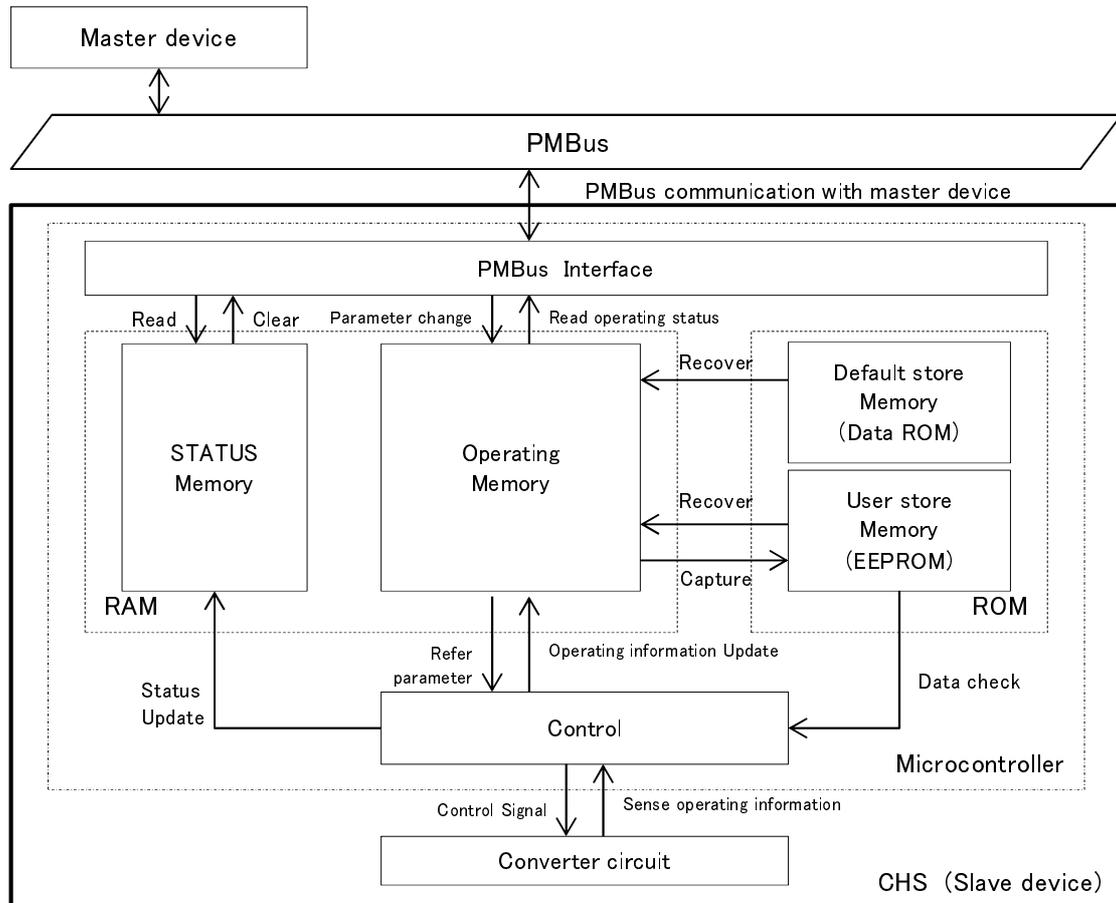
Figure 2-1   Conceptual diagram of communication control

2.2 RAM

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

You can check status of power supply by reading status memory(command [78h]-[7Eh]).
Corresponding bit on Status memory is set to 1 when power supply has something abnormal.
It will be clear by implementing command of CLEAR_FAULTS [03h], blocking input voltage,
stopping ON/OFF operation (refer to clause 6.1).

2.3 ROM

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 after input voltage is insulated. Information is restored by implementing
RESTORE_USER_ALL [16h] command and when power supply is started-up. *1
Information within operating memory is preserved in user store memory by implementing
STORE_USER_ALL [15h] command. *2
> *1: Valid only for power supply operation is stopped.
> Cannot receive command when power supply is operated. SMBAlert is operated.
> *2: Please do not insulate input voltage over 3 seconds when command is being implemented.
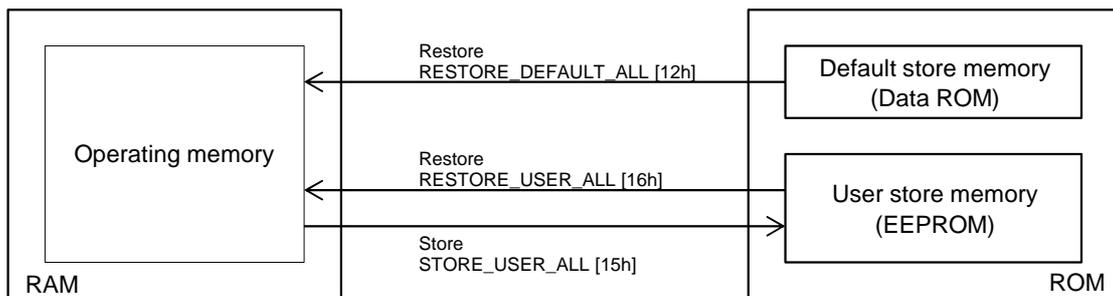
Figure 2-2 Restore and preserving operation for command and parameter

2.4 Retaining the number of protecting operation

When each protective function are operated, the number of information(0-255times) 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

#	Command	Code	Note
1	MFR_READ_VOUT_OV_FAULT_COUNT	F0h	Read the number of overvoltage protective operation
2	MFR_READ_VOUT_UV_FAULT_COUNT	F1h	Read the number of low output voltage protective operation
3	MFR_READ_OT_FAULT_COUNT	F2h	Read the number of overheating protective operation
4	MFR_READ_UT_FAULT_COUNT	F3h	Read the number of low temperature protective operation
5	MFR_READ_TON_MAX_FAULT_COUNT	F4h	Read the number of over star-up time protective operation
6	MFR_READ_VIN_OV_FAULT_COUNT	F8h	Read the number of over input voltage protective operation
7	MFR_READ_VIN_UV_FAULT_COUNT	F9h	Read the number of low input voltage protective operation
8	MFR_CLEAR_FAULT_CNT	F5h	Reset the number of operation at F0h~F7h to "00h".

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

For CHS300/400/500-I series

3. Data format

3.1 Data format for output voltage

Please set output voltage and read per shown linear format below.
Data byte Low 5 bit of VOUT MODE [20h] is complement notation by 2 and represents index part N with code and is fixed -12.
Mantissa part Y is represented 16 bit data without code.

VOUT_MODE [20h]

Data Byte	Data Byte High	Data Byte Low
7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0
000 | N	Y	
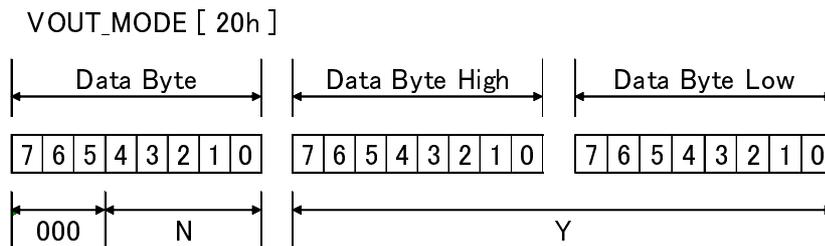
$$VALUE = Y \cdot 2^N$$

3.2 Other（except output voltage）data format

In compliance with below linear format, please make setting and reading.
Date dyte High 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. *1

Data Byte High	Data Byte Low
7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0
N	Y
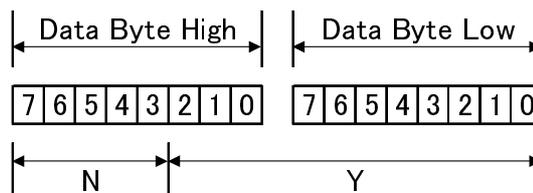
$$VALUE = Y \cdot 2^N$$

Table 3-1 Index part N value

#	Item	Data format	N(5bit)	Characteristics N (*1)	Unit
1	Output voltage	Linear(Vo)	10100	-12	V
2	Input voltage	Linear(Vin)	11101	-3	V
3	Output current	Linear(Iout)	11101	-3	A
5	Input wattage	Linear(Pin)	00000	0	W
6	Temperature	Linear(Temp)	11110	-2	℃
7	Starting-up time	Linear(Time)	11111	-1	ms
8	Count	Linear(Count)	00000	0	times

*1: Index part N value is fixed.

For CHS300/400/500-I series

4. C2 Terminal function

C2 terminal can select Power_Good function and remote control (secondary side)function.
Please select function by MFR_C2_ARA_CONFIG [E0h] Initial setting is Power_Good function.

4.1 Power_Good function

Power_Good terminal output is open drain. When you use Power_Good function, please
connect C2 terminal with pull-up resistor. Initial setting of Power_Good signal is negative.
(Please make logic setting by MFR_PGOOD_POLARITY [E2h])
If output voltage is beyond setting value of POWER_GOOD_ON [5Eh] , C2 terminal
will be low.
If output voltage is lower than the setting value of POWER_GOOD_OFF [5Fh] ,
C2 terminal will be high.
Also, during 10ms in charging input voltage, voltage level on C2 terminal is unstable.

4.2 Remote control (Secondary side) function

Initial setting of Remote control (secondary side) function is negative and is invalid
when you select function.
Selecting logic and setting for invalid or valid function can be made by MFR_C2_LOGIC [E1h].

For CHS300/400/500-I series

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 : System Management Bus(SMBus) Specification Ver 2.0)
(URL: http://smbus.org/specs/)

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 low level.
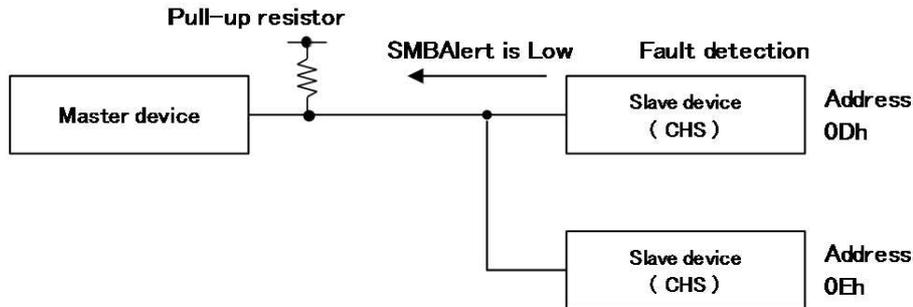
Figure 5-1 Example of operation on SMBAlert

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.
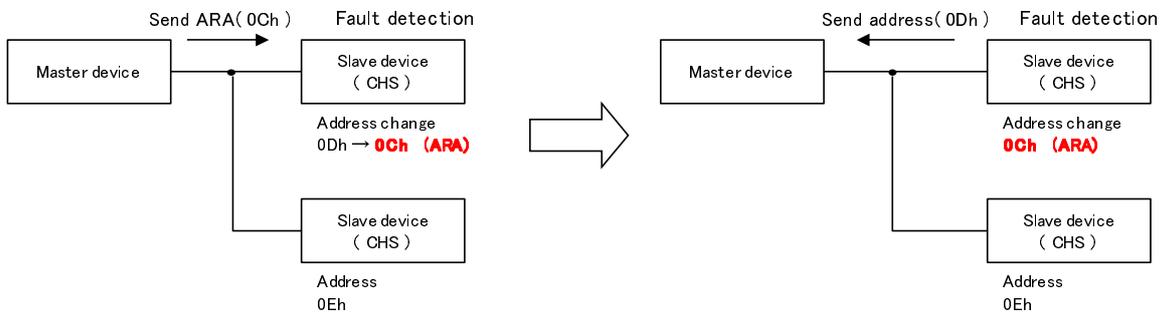
Diagram 5-2   Identifying Slave using ARA

*1: When receiving READ communication using ARA, SMBAlert will be cancelled .
In order to enable the SMBAlert signal, it is necessary to send CLEAR_FAULTS [03h].

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 ARA regardless returning original address.
In case setting is made to response only ARA by MFR_C2_ARA_CONFIG [E0h] , communication other than ARA is not available as address on power supply is set for only ARA.
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 CHS300/400/500 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

#	ON/OFF function	logical setting (initial value)	Note
1	OPERATION [01h] command ON/OFF function	-	
2	Remote control (primary side) function	Negative (invalid for change)	*1
3	Remote control (secondary side) function	Negative (valid for change)	*2

*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 [35h] (*1)
and is stopped when falling below set value of VIN_OFF [36h] .
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 [35h] and VIN_OFF [36h] 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 [61h] command can set. rising up time.(only CHS400-I)
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.)
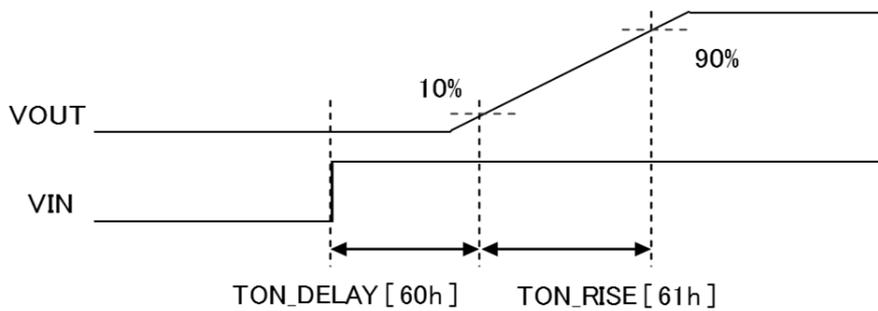
Figure 6-1   Setting for starting-up sequence (example for Vin start-up)

6.4 Output voltage setting (only CHS400/500-I)

You can set output voltage of power supply by command as shown Table 6-2.

Table 6-2 Function of output voltage setting

#	Output voltage setting	Note
1	VOUT_COMMAND [21h]	*1
2	VOUT_MARGIN_HIGH [25h]	*1
3	VOUT_MARGIN_LOW [26h]	*1
4	VOUT_TRIM [22h]	Please use this as slight adjustment for output voltage.

*1: Switching by OPERATION [01h] command. Initial value is VOUT_COMMAND [21h].

Output voltage becomes value shown in below format.

Output voltage of power supply = VOUT_TRIM [22h] value of setting +
- VOUT_COMMAND [21h] Value of setting
- or VOUT_MARGIN_HIGH [25h] Value of setting
- or VOUT_MARGIN_LOW [26h] Value of setting

6.5 Protective operation for output overvoltage

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.

6.6 Protective operation for output undervoltage

Output undervoltage protection function is operated when the output voltage becomes low.
The operation threshold and the way of the output under voltage protection function can be
changed respectively by 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.

6.7 Protective operation for overtemperature

The overtemperature 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℃.
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.
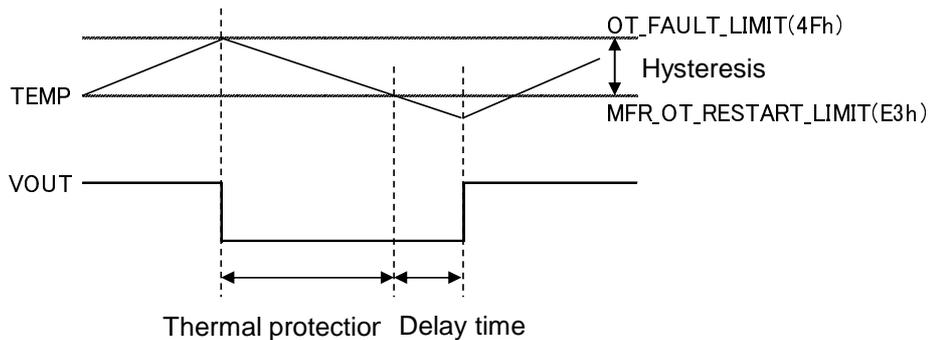
Figure 6-2. overtemperature protection restart

6.8 Protective operation for undertemperature

The undertemperature 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 [53h] and UT_FAULT_RESPONSE respectively.
The change of going out is possible.
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 [E4h] and then does a restart via the delay time which is set at UT_FAULT_RESPONSE [54h].
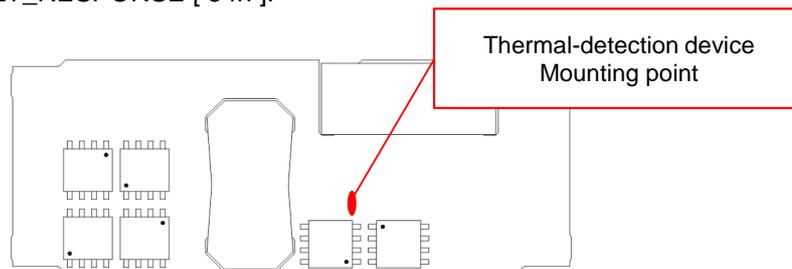
Figure 6-3.1 Temperature measuring point for CHS300-I (top view)
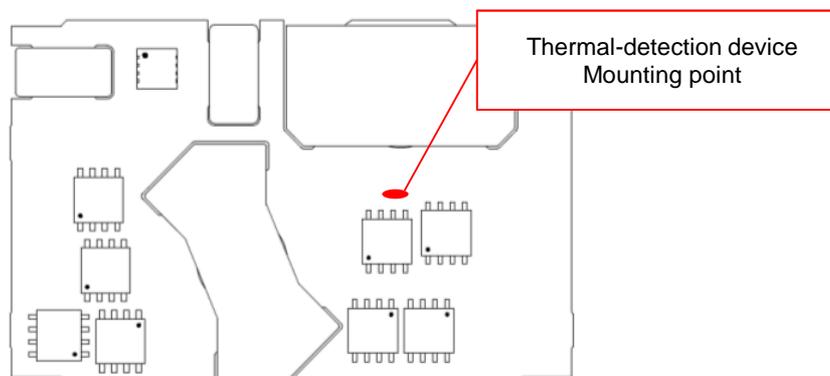
Figure 6-3.2 Temperature measuring point for CHS400-I (top view)
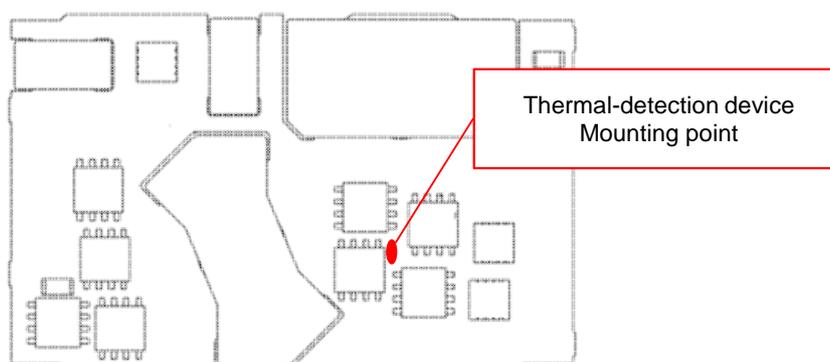
Figure 6-3.3 Temperature measuring point for CHS500-I (top view)

6.9 Protecting operation for over start-up time

When the time of reaching output voltage to VOUT_UV_FAULT_LIMIT [44h] is lower than threshold which is set to TON_MAX_FAULT_LIMIT [62h], protection function for over start-up is activated.
The operation threshold and the way of stopping protection for over start-up time can be changed TON_MAX_FAULT_LIMIT [62h] and TON_MAX_FAULT_RESPONSE [63h] respectively.
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 specified number of times.
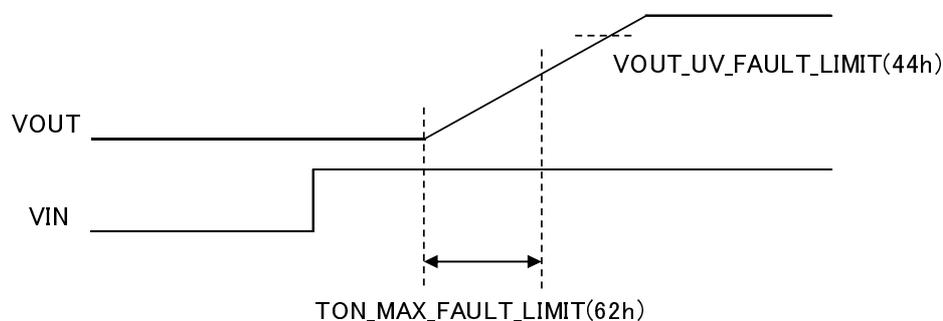
Table 6-4   Protection for exceeding start-up time (example for Vin start-up)

6.10 Prohibit re-writing parameter

WRITE_PROTECT [10h] 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 [10h] are not limited.

7. Packet error checking (PEC)

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

For CHS300/400/500-I series

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 / Clock / Addr0 / Addr1 / C2 / SMBAlert are terminal

Table 8-1　Spec of maximum rate

#	Parameter	Min	Max	Unit	Note
1	Input voltage	-0.3	5.2	V	
2	Maximum output current	-12	-	mA	only sink

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

#	Parameter	Condition of measurement	Min	Max	Unit	Note
1	Input pull-up voltage (Clock, Data)		2.5	5	V	
2	Input High level voltage (Clock, Data)		2.1	-	V	
3	Input Low level voltage (Clock, Data)		-	0.8	V	
4	Input High level current (Clock, Data)		-1.0	+1.0	µA	
5	Input Low level current (Clock, Data)		-1.0	+1.0	µA	
6	Output Low level voltage (Clock, Data, SMBAlert)	IOUT=8mA	-	0.6	V	
7	Output High level open drain Leak current (Data, SMBAlert)		-	1	µA	
8	PMBus communication frequency range		10	400	kHz	
9	Communication interval		270	-	us	*2

*2: Bus free time between Stop and Start Condition

9. PMBus software specifications

9.1 List of supported PMBus command set

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

Table 9-1 Supported command and setting

#	PMBus command	Code (*1)	Type (*2)	Data length (*3)	Data format	Initial setting	Unit	Note
1	OPERATION	01 h	R/W	Byte	-	80 h	-	
2	ON_OFF_CONFIG	02 h	R/W	Byte	-	1D h	-	
3	CLEAR_FAULTS	03 h	Send	-	-	-	-	
4	WRITE_PROTECT	10 h	R/W	Byte	-	00 h	-	
5	RESTORE_DEFAULT_ALL	12 h	Send	-	-	-	-	
6	STORE_USER_ALL	15 h	Send	-	-	-	-	
7	RESTORE_USER_ALL	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 (8bit)			Byte	-	08 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	-	14 h	-	
11	VOUT_COMMAND	21 h	R/W	Word	Linear(Vo)	*4	[V]	only CHS400/500-I
12	VOUT_TRIM	22 h	R/W	Word	Linear(Vo)	*4	[V]	only CHS400/500-I
13	VOUT_MAX	24 h	R/W	Word	Linear(Vo)	*4	[V]	only CHS400/500-I
14	VOUT_MARGIN_HIGH	25 h	R/W	Word	Linear(Vo)	*4	[V]	only CHS400/500-I
15	VOUT_MARGIN_LOW	26 h	R/W	Word	Linear(Vo)	*4	[V]	only CHS400/500-I
16	VIN_ON	35 h	R/W	Word	Linear(Vin)	34.5	[V]	
17	VIN_OFF	36 h	R/W	Word	Linear(Vin)	32.0	[V]	
18	VOUT_OV_FAULT_LIMIT	40 h	R/W	Word	Linear(Vo)	*4	[V]	
19	VOUT_OV_FAULT_RESPONSE	41 h	R/W	Byte	-	B8 h	-	
20	VOUT_OV_WARN_LIMIT	42 h	R/W	Word	Linear(Vo)	*4	[V]	
21	VOUT_UV_WARN_LIMIT	43 h	R/W	Word	Linear(Vo)	*4	[V]	
22	VOUT_UV_FAULT_LIMIT	44 h	R/W	Word	Linear(Vo)	*4	[V]	
23	VOUT_UV_FAULT_RESPONSE	45 h	R/W	Byte	-	B8 h	-	
24	IOUT_OC_WARN_LIMIT	4A h	R/W	Word	Linear(Iout)	*4	[A]	
25	OT_FAULT_LIMIT	4F h	R/W	Word	Linear(Temp)	139	[°C]	

Table 9-1 Supported command and setting (sequel)

#	PMBus command	Code (*1)	Type (*2)	Data length (*3)	Data format	Initial setting	Unit	Note
26	OT_FAULT_RESPONSE	50 h	R/W	Byte	-	C0h	-	
27	OT_WARN_LIMIT	51 h	R/W	Word	Linear(Temp)	129	[°C]	
28	UT_WARN_LIMIT	52 h	R/W	Word	Linear(Temp)	-40	[°C]	
29	UT_FAULT_LIMIT	53 h	R/W	Word	Linear(Temp)	-45	[°C]	
30	UT_FAULT_RESPONSE	54 h	R/W	Byte	-	00 h	-	
31	VIN_OV_FAULT_LIMIT	55 h	R/W	Word	Linear(Vin)	100	[V]	
32	VIN_OV_FAULT_RESPONSE	56 h	R/W	Byte	-	C0 h	-	
33	VIN_OV_WARN_LIMIT	57 h	R/W	Word	Linear(Vin)	100	[V]	
34	VIN_UV_WARN_LIMIT	58 h	R/W	Word	Linear(Vin)	32	[V]	
35	VIN_UV_FAULT_LIMIT	59 h	R/W	Word	Linear(Vin)	32	[V]	
36	VIN_UV_FAULT_RESPONSE	5A h	R/W	Byte	-	C0 h	-	
37	POWER_GOOD_ON	5E h	R/W	Word	Linear(Vo)	*4	[V]	
38	POWER_GOOD_OFF	5F h	R/W	Word	Linear(Vo)	*4	[V]	
39	TON_DELAY	60 h	R/W	Word	Linear(Time)	0	[ms]	
40	TON_RISE	61 h	R/W	Word	Linear(Time)	0	[ms]	only CHS400-I
41	TON_MAX_FAULT_LIMIT	62 h	R/W	Word	Linear(Time)	30	[ms]	
42	TON_MAX_FAULT_RESPONSE	63 h	R/W	Byte	-	00 h	-	
43	STATUS_BYTE	78 h	R/W	Byte	-	00 h	-	
44	STATUS_WORD	79 h	R/W	Word	-	00 h	-	
45	STATUS_VOUT	7A h	R/W	Byte	-	00 h	-	
46	STATUS_IOUT	7B h	R/W	Byte	-	00 h	-	
47	STATUS_INPUT	7C h	R/W	Byte	-	00 h	-	
48	STATUS_TEMPERATURE	7D h	R/W	Byte	-	00 h	-	
49	STATUS_CML	7E h	R/W	Byte	-	00 h	-	
50	READ_VIN	88 h	Read	Word	Linear(Vin)	-	[V]	
51	READ_VOUT	8B h	Read	Word	Linear(Vo)	-	[V]	
52	READ_IOUT	8C h	Read	Word	Linear(Iout)	-	[A]	
53	READ_TEMPERATURE_1	8D h	Read	Word	Linear(Temp)	-	[°C]	
54	READ_PIN	97 h	Read	Word	Linear(Pin)	-	[W]	
55	PMBUS_REVISION	98 h	Read	Byte	-	22 h	-	
56	MFR_MODEL	9A h	Read	Block	-	-	-	
57	MFR_REVISION	9B h	Read	Block	-	-	-	
58	MFR_LOCATION	9C h	Read	Block	-	-	-	
59	MFR_SERIAL	9E h	Read	Block	-	-	-	
60	MFR_C2_ARA_CONFIG	E0 h	R/W	Byte	-	01 h	-	
61	MFR_C2_LOGIC	E1 h	R/W	Byte	-	00 h	-	
62	MFR_PGOOD_POLARITY	E2 h	R/W	Byte	-	00 h	-	
63	MFR_OT_RESTART_LIMIT	E3 h	R/W	Word	Linear(Temp)	90	[°C]	

Table 9-1 Supported command and setting(sequel)

#	PMBus command	Code (*1)	Type (*2)	Data length (*3)	Data format	Initial setting	Unit	Note
64	MFR_UT_RESTART_LIMIT	E4 h	R/W	Word	Linear(Temp)	-40	[C]	
65	MFR_VOUT_OV_FAULT_COUNT	F0 h	Read	Word	Linear(Count)	0	[times]	
66	MFR_VOUT_UV_FAULT_COUNT	F1 h	Read	Word	Linear(Count)	0	[times]	
67	MFR_OT_FAULT_COUNT	F2 h	Read	Word	Linear(Count)	0	[times]	
68	MFR_UT_FAULT_COUNT	F3 h	Read	Word	Linear(Count)	0	[times]	
69	MFR_TON_MAX_FAULT_COUNT	F4 h	Read	Word	Linear(Count)	0	[times]	
70	MFR_CLEAR_FAULT_COUNT	F5 h	Send	-	-	-	-	
71	MFR_VIN_OV_FAULT_COUNT	F8 h	Read	Word	Linear(Count)	0	[times]	
72	MFR_VIN_UV_FAULT_COUNT	F9 h	Read	Word	Linear(Count)	0	[times]	

*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

#	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: Refer to 『10. PMBus commands』

For CHS300/400/500-I series

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.

Table 9-2 Setting range and accuracy by command

#	PMBus command	Code (*1)	Setting / Reading range (*2)			Setting / Reading accuracy	Note
			Min	Max	Unit		
1	VOUT_COMMAND	21 h	*3	*3	[V]	±2% Vo	only CHS400/500-I
2	VOUT_TRIM	22 h	*3	*3	[V]	±2% Vo	only CHS400/500-I
3	VOUT_MAX	24 h	*3	*3	[V]	±2% Vo	only CHS400/500-I
4	VOUT_MARGIN_HIGH	25 h	*3	*3	[V]	±2% Vo	only CHS400/500-I
5	VOUT_MARGIN_LOW	26 h	*3	*3	[V]	±2% Vo	only CHS400/500-I
6	VIN_ON	35 h	32.0	46.0	[V]	±3% Vin	
7	VIN_OFF	36 h	32.0	46.0	[V]	±3% Vin	
8	VOUT_OV_FAULT_LIMIT	40 h	*3	*3	[V]	±2% Vo	
9	VOUT_OV_WARN_LIMIT	42 h	*3	*3	[V]	±2% Vo	
10	VOUT_UV_WARN_LIMIT	43 h	*3	*3	[V]	±2% Vo	
11	VOUT_UV_FAULT_LIMIT	44 h	*3	*3	[V]	±2% Vo	
12	IOUT_OC_WARN_LIMIT	4A h	*3	*3	[A]	±2 A	Rated input
						±3 A	
13	OT_FAULT_LIMIT	4F h	-45	139	[C]	±5C	
14	OT_WARN_LIMIT	51 h	-45	139	[C]	±5C	
15	UT_WARN_LIMIT	52 h	-45	20	[C]	±5C	
16	UT_FAULT_LIMIT	53 h	-45	20	[C]	±5C	
17	VIN_OV_FAULT_LIMIT	55 h	32	100	[V]	±3% Vin	
18	VIN_OV_WARN_LIMIT	57 h	32	100	[V]	±3% Vin	
19	VIN_UV_WARN_LIMIT	58 h	32	100	[V]	±3% Vin	
20	VIN_UV_FAULT_LIMIT	59 h	32	100	[V]	±3% Vin	
21	POWER_GOOD_ON	5E h	*3	*3	[V]	±2%	
22	POWER_GOOD_OFF	5F h	*3	*3	[V]	±2%	
23	TON_DELAY	60 h	0	500	[ms]	±5%	
24	TON_RISE	61 h	0	500	[ms]	±5%	only CHS400-I
25	TON_MAX_FAULT_LIMIT	62 h	30	500	[ms]	±5%	
26	READ_VIN	88 h	0	128	[V]	±3% Vin	
27	READ_VOUT	8B h	0	16	[V]	±2% Vo	
						±3% Vo	-40～0℃(only CHS3004810-I)
28	READ_IOUT	8C h	0	127	[A]	±2 A	Rated input
						±3 A	
29	READ_TEMPERATURE_1	8D h	-256	-256	[C]	±5℃	
30	READ_PIN	97 h	0	1023	[W]	±5% Pin or ±10W	Rated input and output, 50～100%Io (only CHS400/500-I)
						±7% Pin or ±10W	Rated input and output, 50～100%Io
						±10% Pin or ±15W	

For CHS300/400/500-I series

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

#	PMBus command	Code (*1)	Setting / Reading range (*2)			Setting / Reading accuracy	Note
			Min	Max	Unit		
31	MFR_OT_RESTART_LIMIT	E3 h	-45	90	[C]	±5C	
32	MFR_UT_RESTART_LIMIT	E4 h	-45	20	[C]	±5C	
33	MFR_VOUT_OV_FAULT_COUNT	F0 h	0	255	[times]	-	
34	MFR_VOUT_UV_FAULT_COUNT	F1 h	0	255	[times]	-	
35	MFR_OT_FAULT_COUNT	F2 h	0	255	[times]	-	
36	MFR_UT_FAULT_COUNT	F3 h	0	255	[times]	-	
37	MFR_TON_MAX_FAULT_COUNT	F4 h	0	255	[times]	-	
38	MFR_CLEAR_FAULT_COUNT	F5 h	0	255	[times]	-	
39	MFR_VIN_OV_FAULT_COUNT	F8 h	0	255	[times]	-	
40	MFR_VIN_UV_FAULT_COUNT	F9 h	0	255	[times]	-	

*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 6 of STATUS_CML is set.

*3: Refer to 『10. PMBus commands set』

10. PMBus commands

In the following sections of this document, each of the commands that are used in the CHS300/400-I converter are described in detail.

OPERATION [01h] R/W Byte

This command is used, in conjunction with the hardwired ON/OFF control, to turn the module output voltage ON/OFF (Margin).

It also used to set the margin state (margin high, margin low, no margin) of the output voltage.

Display format : -
Initial setting : 80 h
Range of setting and reading : -

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

#	setting			Output	Overview
	bit7-6	bit5-4	bit3-2	bit1-0		

#	bit7-6	bit5-4	bit3-2	bit1-0	Output	Overview
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	Power supply starts *1
4	10	01	01	XX	ON	Set output voltage value of VOUT_MARGIN_LOW [26h] (LVP invalid) (not supported)
5	10	01	10	XX	ON	Set output voltage value of VOUT_MARGIN_LOW [26h] *2
6	10	10	01	XX	ON	Set output voltage value of VOUT_MARGIN_HIGH [25h] (OVP invalid) (not supported)
7	10	10	10	XX	ON	Set output voltage value of VOUT_MARGIN_HIGH [25h] *2

XX: Ignore

*1: set output voltage to value of VOUT_COMMAND [21h] (only CHS400/500-I)

*2: only CHS400/500-I

ON_OFF_CONFIG [02h] R/W Byte

Remote control(primary side) and operation setting on OPERATION [01h] command *1

Display format   : -
Initial setting   : 1D h
Range of setting and reading   : -

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

#	bit	Number	Overview
1	bit7-5	000	Spare
2	bit4	0	Invalid all ON/OFF function (not supported)
		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(primary side) function (not supported)
		1	Valid remote control function (primary side)
5	bit1	0	Set remote control function(primary side) negative logic
		1	Set remote control function(primary side) positive logic (not supported ：positive logic is optional)
6	bit0	0	It stops by the sequence of the shut down period, TOFF_DELAY [64h], 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.

*1: The setting of a remote control (secondary side) feature is made by MFR_C2_ARA_CONFIG [E0h]
    and MFR_C2_LOGIC [E1h] command.

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 : -
Range of setting and reading : -

#	STATUS command	Code	Data
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 provides an alternative way of globally write protecting commands.

It is used with data according to Table below:

Display format : -
Initial setting : 00 h
Range of setting and 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/W	R/W	R/W	R/W	R/W	R/W

#	bit	Value	Overview
1		10000000	Wring is impossible except WRITE_PROTECT [10h]
2	bit7-0	01000000	Writing is impossible except the above + OPERATION [01h] impossible.
3		00100000	Writing is impossible except the above + ON_OFF_CONFIG [02h], VOUT_COMMAND [21h]
4		00000000	Writing in all command to be supported is possible.

For CHS300/400/500-I series

RESTORE_DEFAULT_ALL [12h] Send

Restores PMBus settings that were stored using RESTORE_DEFAULT_ALL.

This command is automatically performed at power up.

Display format : -
Initial setting : -
Range of setting and reading : -

Note1: While power supply works, the command is invalid. The output needs to be disabled.

Note2: During command execution (100ms), it isn't possible to do the start-up power supply.

Note3: It starts up after the execution ends.

STORE_USER_ALL [15h] Send

The Operating Memory data is written to the EEPROM

Display format : -
Initial setting : -
Range of setting and reading : -

Note1: To avoid the risk of the data damage, during STORE_USER_ALL [15h] command is implemented, a delay of 3 seconds should be allowed while the device is busy before the next command is transmitted to this device.

Note2: During STORE_USER_ALL [15h] command execution, it isn't possible to communicate with PMBus.

Note3: It is possible to rewrite up to 1000 times.

RESTORE_USER_ALL [16h] Send
Restores the Operating Memory to the user settings(EEPROM).

      Display format   : -
      Initial setting   : -
      Range of setting and reading   : -

Note1: The output needs to be disabled during the EEPROM read.

Note2: During command execution a delay of 100ms should be allowed before starting up the converter.

CAPABILITY [19h] Read
It reads the support status of the communication.

      Display format   : -
      Initial setting   : B0 h
      Range of setting and 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

#	bit	Value	Overview
1	bit7	0	Packet error checking is not supported
2		1	Packet error checking is supported
3	bit6-5	00	Supported Maximum Bus speed is 100kHz
		01	Supported Maximum Bus speed is 400kHz
		10	Spare
		11	Spare
4	bit4	0	SMBAlert is not supported
		1	SMBAlert is supported
5	bit3-0	0000	Spare

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

It sets a mask to the Alert signal of the SMBAlert terminal.

After command sending, it sets "1" to the corresponding command of STATUS and the bit of the mask.

Display format   : -
Initial setting   : -
Range of setting and reading   : -

#	Status command of possible mask setting	Code	Data	Initial value
1	STATUS_BYTE	78h	Byte	02 h
2	STATUS_WORD	79h	Byte	08 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	FF h

VOUT_MODE [20h] Read

It reads an output voltage format form.

The characteristic N (bit4-0) of the Linear mode becomes a fixation at -12.

Display format   : -
Initial setting   : 14 h
Range of setting and reading   : -

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

#	bit	Value	Overview
1		000	Vo format is linear mode
2	bit7-5	001	Vo format is VID mode (not supported)
3		010	Vo format is Direct mode (not supported)
4	bit4-0	10100	It shows the index parts N of the Linear mode by 2 of complement.

VOUT_COMMAND [21h] R/W Word (only CHS400/500-I)
The output voltage can be programmed within the setting range

    Display format   : Linear(Vo)
    Initial setting   : 12 [V]
    Range of setting and reading   : 10.8 - 13.2 [V]   *1

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

VOUT_TRIM [22h] R/W Word (only CHS400/500-I)
Sets output voltage trim value. The two bytes are formatted as a two's complement binary mantissa,
sets in conjunction with the exponent set in VOUT_MODE.

    Display format   : Linear(Vo)
    Initial setting   : 0 [V]
    Range of setting and reading   : ±5.1 [V]   *1

*1: When either VOUT_COMMAND [21h], VOUT_MARGIN_HIGH [25h], VOUT_MARGIN_LOW [26h] adds
     on VOUT_TRIM [22h] becomes out of the range, it is not possible to be set.

VOUT_MAX [24h] R/W Word (only CHS400/500-I)
Sets the maximum possible value setting of the output voltage.
It isn't possible to change the maximum setting value.

    Display format   : Linear(Vo)
    Initial setting   : 15.0 [V]
    Range of setting and reading   : 8.1 - 15.0 [V]

VOUT_MARGIN_HIGH [25h] R/W Word (only CHS400/500-I)

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

To change the operation to output margin high, please refer to the operation command.

   Display format   : Linear(Vo)

   Initial setting   : 13.2 [V]

   Range of setting and reading : 10.8 - 13.2 [V]   *1

 *1: The value added VOUT_TRIM [22h] becomes the upper limit.

   Also, the value which exceeds VOUT_MAX [24h] can not be set.

VOUT_MARGIN_LOW [26h] R/W Word (only CHS400/500-I)

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

To change the operation to output margin low, please refer to the OPERATION [01h] command.

   Display format   : Linear(Vo)

   Initial setting   : 10.8 [V]

   Range of setting and reading : 8.1 - 13.2 [V]   *1

 *1: The value added VOUT_TRIM [22h] becomes the upper limit.

   Also, the value which exceeds VOUT_MAX [24h] can not be set.

VIN_ON [35h] R/W Word

Sets the input voltage at which the module should start power conversion.

Display format	: Linear(Vin)
Initial setting	: 34.5 [V]
Range of setting and reading	: 32 - 46 [V] *1

*1: It isn't possible to set to the value below [36h].

VIN_OFF [36h] R/W Word

Sets the threshold of input voltage below which the output voltage is always disabled.

Display format	: Linear(Vin)
Initial setting	: 32 [V]
Range of setting and reading	: 32 - 46 [V] *1

*1: It isn't possible to set to the value which exceeds VIN_ON [35h].

VOUT_OV_FAULT_LIMIT [40h] R/W Byte

Sets the output overvoltage fault threshold.
Set higher than VOUT_COMMAND [21h].
When the output voltage exceeds this threshold, it does the operation to specify at
VOUT_OV_FAULT_RESPONSE [41h].

Display format	: Linear(Vo)
Initial setting,	: 12.5 [V] , 6.6 - 12.5 [V] (CHS3004810-I)
Range of setting and reading	: 15.0 [V] , 8.1 - 15.0 [V] (CHS3004812-I)
	: 15.0 [V] , 8.1 - 15.0 [V] (CHS4004812-I)
	: 15.0 [V] , 8.1 - 15.0 [V] (CHS5004812-I)

For CHS300/400/500-Ⅰ series

VOUT_OV_FAULT_RESPONSE [41h] R/W Byte

Configures the output overvoltage fault response.

Display format   : -
Initial setting   : B8 h
Range of setting and reading   : -
Delay time for automatic recovery   : 200ms + 50ms × (bit2-0)

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

#	bit	Value	Overview
1	bit7-6	00	It continues operation. (not supported)
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 supported)
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	In case of the extraordinary continuation, it stops output and it resumes operation by the abnormal cancellation. (not supported)
5	bit5-3	000	It stops output.
6		110 - 001	It stops if an automatic-reset is worked in the number of times (- 6 times) of bit5-3 and a malfunction isn't canceled (In the automatic-reset interval, it is prescribed in bit2-0).*1
7		111	Until off operation is done, an automatic-reset is worked (In the automatic-reset interval, it is prescribed in bit2-0).
8	bit2-0	111 - 000	It sets the delay time of the automatic-reset.

*1: When continuing normal operation of equal to or more than another 30 seconds of automatic-resets
about the number of times of the automatic-reset operation, it is reset.

VOUT_OV_WARN_LIMIT [42h] R/W Word

Sets the output overvoltage warning threshold.

When the output voltage exceeds this threshold, it outputs an alarm.

Display format	: Linear(Vo)
Initial setting,	: 12.5 [V] , 6.6 - 12.5 [V] (CHS3004810-I)
Range of setting and reading	: 15.0 [V] , 8.1 - 15.0 [V] (CHS3004812-I)
	: 15.0 [V] , 8.1 - 15.0 [V] (CHS4004812-I)
	: 15.0 [V] , 8.1 - 15.0 [V] (CHS5004812-I)

VOUT_UV_WARN_LIMIT [43h] R/W Word

Sets the output under voltage warning threshold.

When the output voltage is below this threshold, it outputs an alarm.

Display format	: Linear(Vo)
Initial setting,	: 6.6 [V] , 6.6 - 12.5 [V] (CHS3004810-I)
Range of setting and reading	: 8.1 [V] , 8.1 - 15.0 [V] (CHS3004812-I)
	: 8.1 [V] , 8.1 - 15.0 [V] (CHS4004812-I)
	: 8.1 [V] , 8.1 - 15.0 [V] (CHS5004812-I)

VOUT_UV_FAULT_LIMIT [44h] R/W Word

Sets the output undervoltage fault threshold

When the output voltage is below this threshold, it does the operation to specify
at VOUT_UV_FAULT_RESPONSE [45h].

Display format	: Linear(Vo)
Initial setting,	: 6.6 [V] , 6.6 - 12.5 [V] (CHS3004810-I)
Range of setting and reading	: 8.1 [V] , 8.1 - 15.0 [V] (CHS3004812-I)
	: 8.1 [V] , 8.1 - 15.0 [V] (CHS4004812-I)
	: 8.1 [V] , 8.1 - 15.0 [V] (CHS5004812-I)

VOUT_UV_FAULT_RESPONSE [45h] R/W Byte

Configures the output undervoltage fault response.

Display format	: -
Initial setting	: B8 h
Range of setting and reading	: -
Delay time for automatic recovery	: 200ms + 50ms × (bit2-0)

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

#	bit	Value	Overview
1	bit7-6	00	It continues operation. (not supported)
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 supported)
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	In case of the extraordinary continuation, it stops output and it resumes operation by the abnormal cancellation. (not supported)
5	bit5-3	000	It stops output.
6		110 - 001	It stops if an automatic-reset is worked in the number of times (- 6 times) of bit5-3 and a malfunction isn't canceled (In the automatic-reset interval, it is prescribed in bit2-0).*1
7		111	Until off operation is done, an automatic-reset is worked (In the automatic-reset interval, it is prescribed in bit2-0).
8	bit2-0	111 - 000	It sets the delay time of the automatic-reset.

*1: When continuing normal operation of equal to or more than another 30 seconds of automatic-resets
about the number of times of the automatic-reset operation, it is reset.

IOUT_OC_WARN_LIMIT [4Ah] R/W Word

Sets the current value that will trigger an overcurrent warning condition
if the output current exceeds this set value.

Display format	: Linear(Iout)
Initial setting,	: 33.0 [A] , 10.00 - 36.00 [A] (CHS3004810-I)
Range of setting and reading	: 27.5 [A] , 10.00 - 30.00 [A] (CHS3004812-I)
	: 36.3 [A] , 10.00 - 39.75 [A] (CHS4004812-I)
	: 48.3 [A] , 10.00 - 50.50 [A] (CHS5004812-I)

OT_FAULT_LIMIT [4Fh] R/W Word

Sets the over-temperature fault threshold.
When temperature exceeds this value, setting of OT_FAULT_RESPONSE [50h] is activated.

Display format	: Linear(Temp)
Initial setting,	: 139 [℃] , -45 - 139 [℃] (CHS3004810-I)
Range of setting and reading	: 139 [℃] , -45 - 139 [℃] (CHS3004812-I)
	: 139 [℃] , -45 - 139 [℃] (CHS4004812-I)
	: 126 [℃] , -45 - 126 [℃] (CHS5004812-I)

OT_FAULT_RESPONSE [50h] R/W Byte

Configures the over-temperature fault response.

Note: The delay time is the time between restart attempts.

Display format	: -
Initial setting	: C0 h
Range of setting and reading	: -
Delay time for automatic recovery	: 200ms + 50ms × (bit2-0)

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

#	bit	Value	Overview
1	bit7-6	00	It continues operation. (not supported)
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 supported)
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	In case of the extraordinary continuation, it stops output and it resumes operation at the temperature which was set in MFR_OT_RESTART_LIMIT [E3h]
5	bit5-3	000	It stops output.
6		110 - 001	It stops if an automatic-reset is worked in the number of times (- 6 times) of bit5-3 and a malfunction isn't canceled (In the automatic-reset interval, it is prescribed in bit2-0).*1
7		111	Until off operation is done, an automatic-reset is worked (In the automatic-reset interval, it is prescribed in bit2-0).
8	bit2-0	111 - 000	It sets the delay time of the automatic-reset. (not supported)

*1: When continuing normal operation of equal to or more than another 30 seconds of automatic-resets

about the number of times of the automatic-reset operation, it is reset.

OT_WARN_LIMIT [51h] R/W Word

Sets the over-temperature warning threshold.

When the temperature detecting-element temperature exceeds this threshold, it outputs an alarm.

Display format : Linear(Temp)
Initial setting, : 129 [℃] , -45 - 139 [℃] (CHS3004810-I)
   Range of setting and reading : 129 [℃] , -45 - 139 [℃] (CHS3004812-I)
: 129 [℃] , -45 - 139 [℃] (CHS4004812-I)
: 116 [℃] , -45 - 126 [℃] (CHS5004812-I)

UT_WARN_LIMIT [52h] R/W Word

Sets the under-temperature warning threshold.

When the temperature detecting-element temperature falls below this threshold, it outputs an alarm.

Display format : Linear(Temp)
Initial setting : -40 [℃]
Range of setting and reading : -45 - 20 [℃]

UT_FAULT_LIMIT [53h] R/W Word

Sets the undertemperature fault threshold.

When the temperature detecting-element temperature is below this threshold,

it does the operation to specify at UT_FAULT_RESPONSE [54h].

Display format : Linear(Temp)
Initial setting : -45 [℃]
Range of setting and reading : -45 - 20 [℃]

UT_FAULT_RESPONSE [54h] R/W Byte

Configures the undertemperature fault response.

Note: The delay time is the time between restart attempts.

Display format	: -
Initial setting	: 00 h
Range of setting and reading	: -
Delaying time for auto recovery	: 200ms + 50ms × (bit2-0)

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

#	bit	value	overview
1	bit7-6	00	It continues operation. (not supported)
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 supported)
3		10	It does the return processing to specify in bit5-3 after stop. (not supported)
4		11	In case of the extraordinary continuation, it stops output and it resumes operation at the temperature which was set in MFR_OT_RESTART_LIMIT [E4h]
5	bit5-3	000	It stops output.
6		110 - 001	It stops if an automatic-reset is worked in the number of times (- 6 times) of bit5-3 and a malfunction isn't canceled (In the automatic-reset interval, it is prescribed in bit2-0). (not supported) *1
7		111	Until off operation is done, an automatic-reset is worked (In the automatic-reset interval, it is prescribed in bit2-0). (not supported)
8	bit2-0	111 - 000	It sets the delay time of the automatic-reset. (not supported)

*1: When continuing normal operation of equal to or more than another 30 seconds of automatic-resets
about the number of times of the automatic-reset operation, it is reset.

VIN_OV_FAULT_LIMIT [55h] R/W Word

Sets the VIN overvoltage fault threshold.

Display format	: Linear(Vin)
Initial setting	: 100 [V]
Range of setting and reading	: 32 - 100 [V]

VIN_OV_FAULT_RESPONSE [56h] R/W Byte

Configures the VIN overvoltage fault response.

Note: The delay time is the time between restart attempts

Display format	: -
Initial setting	: C0 h
Range of setting and reading	: -
Delaying time for auto recovery	: 200ms + 50ms × (bit2-0)

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

#	bit	value	overview
1	bit7-6	00	It continues operation. (not supported)
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 supported)
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	In case of the extraordinary continuation, it stops output and it resumes operation by the abnormal cancellation.
5	bit5-3	000	It stops output.
6		110 - 001	It stops if an automatic-reset is worked in the number of times (- 6 times) of bit5-3 and a malfunction isn't canceled (In the automatic-reset interval, it is prescribed in bit2-0). *1 (not supported)
7		111	Until off operation is done, an automatic-reset is worked (In the automatic-reset interval, it is prescribed in bit2-0). (not supported)
8	bit2-0	111 - 000	It sets the delay time of the automatic-reset. (not supported)

*1: When continuing normal operation of equal to or more than another 30 seconds of automatic-resets about the number of times of the automatic-reset operation, it is reset.

VIN_OV_WARN_LIMIT [57h] R/W Word

Sets the VIN overvoltage warning threshold.

Display format	: Linear(Vin)
Initial setting	: 100 [V]
Range of setting and reading	: 32 - 100 [V]

VIN_UV_WARN_LIMIT [58h] R/W Word

Sets the VIN undervoltage warning threshold. If a VIN_UV_FAULT occurs, the input voltage
must rise above VIN_UV_WARN_LIMIT to clear the fault. This alarm becomes valid
when the input voltage crosses VIN_ON [35h] threshold.

Display format	: Linear(Vin)
Initial setting	: 32 [V]
Range of setting and reading	: 32 - 100 [V]

VIN_UV_FAULT_LIMIT [59h] R/W Word

Sets the VIN undervoltage fault threshold.

Display format	: Linear(Vin)
Initial setting	: 32 [V]
Range of setting and reading	: 32 - 100 [V]

VIN_UV_FAULT_RESPONSE [5Ah] R/W Byte

Configures the VIN undervoltage fault response.
    Note: The delay time is the time between restart attempts

Display format	: -
Initial setting	: C0 h
Range of setting and reading	: -
Delaying time for auto recovery	: 200ms + 50ms × (bit2-0)

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

#	bit	value	overview
1	bit7-6	00	It continues operation. (not supported)
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 supported)
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	In case of the extraordinary continuation, it stops output and it resumes operation by the abnormal cancellation. (not supported)
5	bit5-3	000	It stops output.
6		110 - 001	It stops if an automatic-reset is worked in the number of times (- 6 times) of bit5-3 and a malfunction isn't canceled (In the automatic-reset interval, it is prescribed in bit2-0).*1
7		111	Until off operation is done, an automatic-reset is worked (In the automatic-reset interval, it is prescribed in bit2-0).
8	bit2-0	111 - 000	It sets the delay time of the automatic-reset. (not supported)

*1: When continuing normal operation of equal to or more than another 30 seconds of automatic-resets
    about the number of times of the automatic-reset operation, it is reset.

POWER_GOOD_ON [5Eh] R/W Word

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

Power-Good asserts when the output voltage exceeds POWER_GOOD_ON, if the C2 terminal
is used as Power-Good.

Display format	: Linear(Vo)
Initial setting,	: 9.0 [V] , 0.0 - 12.5 [V] (CHS3004810-I)
Range of setting and reading	: 10.8 [V] , 0.0 - 15.0 [V] (CHS3004812-I)
*1	: 10.8 [V] , 0.0 - 15.0 [V] (CHS4004812-I)
	: 10.8 [V] , 0.0 - 15.0 [V] (CHS5004812-I)

*1: It can not be set to a value lower than POWER_GOOD_OFF [5Fh]

POWER_GOOD_OFF [5Fh] R/W Word

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

Power-Good de-asserts when the output voltage is less than POWER_GOOD_OFF, if the C2 terminal
is used as Power-Good.

Display format	: Linear(Vo)
Initial setting,	: 8.0 [V] , 0.0 - 12.5 [V] (CHS3004810-I)
Range of setting and reading	: 10.8 [V] , 0.0 - 15.0 [V] (CHS3004812-I)
*1	: 10.8 [V] , 0.0 - 15.0 [V] (CHS4004812-I)
	: 10.8 [V] , 0.0 - 15.0 [V] (CHS5004812-I)

*1: It can not be set to a value higher than POWER_GOOD_ON [5Eh]

TON_DELAY [60h] R/W Word

This command sets the delay time from ENABLE to start of the rise of the output voltage.

When setting more shortly than the original delay time of the power, it is fixed at the delay time.

Display format	: Linear(Time)	
Initial setting	: 0 [ms]	
Range of setting and reading	: 0 - 500 [ms]	*1

*1: The set value can be set by the 50 ms.

TON_RISE [61h] R/W Word (only CHS400-I)

This command sets the rise time of the output voltage after ENABLE and TON_DELAY.

When setting more shortly than the original start time of the power, it is fixed at the start time.

Display format	: Linear(Time)	
Initial setting	: 0 [ms]	
Range of setting and reading	: 0 - 500 [ms]	*1

*1: The set value can be set by the 50 ms.

TON_MAX_FAULT_LIMIT [62h] R/W Word

This command sets the activation time fault threshold.

When the activation time exceeds this threshold, it does the operation to specify

at TON_MAX_FAULT_RESPONSE [63h].

Display format	: Linear(Time)
Initial setting	: 30 [ms]
Range of setting and reading	: 30 - 500 [ms]

TON_MAX_FAULT_RESPONSE [63h] R/W Byte

Configures the response for fault protection configured by TON_MAX_FAULT_LIMIT [62h].

Display format	: -
Initial setting	: 00 h
Range of setting and reading	: -
Delaying time for auto recovery	: 200ms + 50ms × (bit2-0)

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/W	R/W	R/W	R/W	R/W	R/W

#	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 supported)
3		10	It does the return processing to specify in bit5-3 after stop.
4		11	In case of the extraordinary continuation, it stops output and it resumes operation by the abnormal cancellation. (not supported)
5	bit5-3	000	It stops output.
6		110 - 001	It stops if an automatic-reset is worked in the number of times (- 6 times) of bit5-3 and a malfunction isn't canceled (In the automatic-reset interval, it is prescribed in bit2-0). *1 (not supported)
7		111	Until off operation is done, an automatic-reset is worked (In the automatic-reset interval, it is prescribed in bit2-0).
8	bit2-0	111 - 000	It sets the delay time of the automatic-reset.

*1: When continuing normal operation of equal to or more than another 30 seconds of automatic-resets

about the number of times of the automatic-reset operation, it is reset.

For CHS300/400/500-I series

STATUS_BYTE [78h] R/W Byte

This command returns an abbreviated status for fast reads.

Display format	: -
Initial setting	: 00 h
Range of setting and reading	: -

#	bit	Value	Overview
1	bit7	0	It sets when the device can not reply in use.
2	bit6	0	It sets by output OFF status
3	bit5	0	It sets by VOUT_OV_FAULT_LIMIT [40h]
4	bit4	0	It sets by IOUT_OC_FAULT_LIMIT [4Ah] (not supported)
5	bit3	0	It sets by VIN_UV_FAULT_LIMIT [59h]
6	bit2	0	STATUS_TEMPERATURE Either of [7Dh] sets at 1.
7	bit1	0	STATUS_CML Either of [7Eh] sets at 1.
8	bit0	0	It sets in the error, the warning except bit7-1.

STATUS_WORD [79h] R/W Word

This command returns the general status information used to indicate subsequent
status to be read for more detail.

Display format	: -
Initial setting	: 00 h
Range of setting and reading	: -

#	bit	Value	Overview
1	bit15	0	STATUS_VOUT Either of [7Ah] sets at 1.
2	bit14	0	STATUS_IOUT Either of [7Bh] sets at 1.
3	bit13	0	STATUS_INPUT [7Ch] sets at 1.
4	bit12	0	STATUS_MFR_SPECIFIC It sets in either of [80h]. (not supported)
5	bit11	0	It sets in the range that the output voltage is Power_Good.
6	bit10	0	STATUS_FUNS [81h], It sets in either of [82h]. (not supported)
7	bit9	0	STATUS_OTHER It sets in either of [7Fh]. (not supported)
8	bit8	0	It sets when detecting the malfunction which doesn't apply to bit15-1. (not supported)
9	bit7-0	-	STATUS_BYTE It becomes the contents which are the same as [78h].

STATUS_VOUT [7Ah] R/W Byte

This command returns the output voltage related status.

Display format   : -
Initial setting   : 00 h
Range of setting and reading : -

#	bit	Value	Overview
1	bit7	0	The output voltage sets above VOUT_OV_FAULT_LIMIT [40h].
2	bit6	0	The output voltage sets above VOUT_OV_WARN_LIMIT [42h].
3	bit5	0	The output voltage sets below VOUT_UV_WARN_LIMIT [43h].
4	bit4	0	The output voltage sets below VOUT_UV_FAULT_LIMIT [44h].
5	bit3	0	The output voltage set value sets above VOUT_MAX [24h]. *1 (not supported)
6	bit2	0	Start-up time sets above TON_MAX_FAULT_LIMIT [62h].
7	bit1	0	The stop time sets above TOFF_MAX_WARN_LIMIT. (not supported)
8	bit0	0	-

*1: Bit6 of STATUS_CML [7Eh] sets at 1.

STATUS_IOUT [7Bh]   R/W Byte

This command returns the output current related status.

Display format   : -
Initial setting   : 00 h
Range of setting and reading : -

#	bit	Value	Overview
1	bit7	0	The output current sets above IOUT_OC_FAULT_LIMIT. (not supported)
2	bit6	0	The output voltage sets below IOUT_OC_UV_LIMIT in case of the over-current. (not supported)
3	bit5	0	The output current sets above IOUT_OC_WARN_LIMIT [4Ah].
4	bit4	0	The output current sets below IOUT_UC_FAULT_LIMIT. (not supported)
5	bit3	0	-
6	bit2	0	It sets when working by the constant power mode to set in POUT_MAX. (not supported)
7	bit1	0	The output power sets above POUT_OP_FAULT_LIMIT. (not supported)
8	bit0	0	The output power sets above POUT_OP_WARN_LIMIT. (not supported)

STATUS_INPUT [7Ch] R/W Byte

This command returns specific status specific to the input.

Display format : -
Initial setting : 00 h
Range of setting and reading : -

#	bit	Value	Overview
1	bit7	0	The input voltage sets above VIN_OV_FAULT_LIMIT [55h].
2	bit6	0	The input voltage sets above VIN_OV_WARN_LIMIT [57h].
3	bit5	0	The input voltage sets below VIN_UV_WARN_LIMIT [58h].
4	bit4	0	The input voltage sets below VIN_UV_FAULT_LIMIT [59h].
5	bit3	0	It sets when the input voltage is not good enough and power supply is stopped.
6	bit2	0	The input current sets above IIN_OC_FAULT_LIMIT. (not supported)
7	bit1	0	The input current sets above IIN_OC_WARN_LIMIT. (not supported)
8	bit0	0	The input-power sets above PIN_OP_WARN_LIMIT. (not supported)

STATUS_TEMPERATURE [7Dh] R/W Byte

This command returns the temperature specific status.

Display format : -
Initial setting : 00 h
Range of setting and reading : -

#	bit	Value	Overview
1	bit7	0	set when temperature is over OT_FAULT_LIMIT [4Fh].
2	bit6	0	set when temperature is over OT_WARN_LIMIT [51h].
3	bit5	0	set when temperature is less UT_WARN_LIMIT [52h] .
4	bit4	0	set when temperature is less UT_FAULT_LIMIT [53h] .
5	bit3	0	spare
6	bit2	0	spare
7	bit1	0	spare
8	bit0	0	spare

STATUS_CML [7Eh] R/W Byte

This command returns the Communication, Logic and Memory specific status.

Display format   : -
Initial setting   : 00 h
Range of setting and reading   : -

#	bit	Value	Overview
1	bit7	0	It sets when receiving the command not to be supporting. *1
2	bit6	0	It sets when receiving the data not to be supporting.
3	bit5	0	It sets with the malfunction-detection of the packet error checking.
4	bit4	0	It sets with the malfunction-detection of the internal-memory.
5	bit3	0	It is sets with the malfunction-detection of the inner controller. (not supported)
6	bit2	0	spare
7	bit1	0	It sets in the communication error except the above.
8	bit0	0	-

*1: It is also set when it is sent the command protected in WRITE_PROTECT [10h].

READ_VIN [88h] Read

This command returns the measured value of the input voltage.

Display format   : Linear(Vin)
Initial setting   : 00 h
Range of setting and reading   : 0 - 128 [V]

READ_VOUT [8Bh] Read

This command returns the measured value of the output voltage.

Display format   : Linear(Vo)
Initial setting   : -
Range of setting and reading   : 0 - 16 [V]

READ_IOUT [8Ch] Read

This command returns the measured value of the output current.

Display format   : Linear(Io)
Initial setting   : -
Range of setting and reading   : 0 - 128 [A]

READ_TEMPERTURE_1 [8Dh] Read

This command returns the measured value of the converter temperature

Display format	: Linear(Temp)
Initial setting	: -
Range of setting and reading	: -256 - 256 [℃]

READ_PIN [97h] Read_Word

It reads the present input-power.

Display format	: Linear(Pin)
Initial setting	: -
Range of setting and reading	: 0 - 1023 [W]

PMBus_REVISION [98h] Read

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

Display format	: -
Initial setting	: 22h
Range of setting and reading	: -

bit	7	6	5	4	3	2	1	0
Initial value	0	0	1	0	0	0	1	0
Access	R	R	R	R	R	R	R	R

#	bit	Value	Overview
1		0000	Part Ⅰ Revision 1.0
2	bit7-4	0001	Part Ⅰ Revision 1.1
3		0010	Part Ⅰ Revision 1.2
4		0000	Part Ⅱ Revision 1.0
5	bit3-0	0001	Part Ⅱ Revision 1.1
6		0010	Part Ⅱ Revision 1.2

MFR_MODEL [9Ah] Block Read

This command returns the model number of the converter.

Display format	: ASCII code
Initial setting	: -
Setting and range of reading	: -
Display example	: "CHS4004812-I"

MFR_REVISION [9Bh] Read

This command returns the name of the configuration file used at the factory to program the device.

Display format	: ASCII code (2 letter)
Initial setting	: -
Range of setting and reading	: "00" - "99"

MFR_LOCATION [9Ch] Block Read

This command returns COSEL's identification for the location where the converter was manufactured.

Display format	: ASCII code (20 letter)
Initial setting	: -
Range of setting and reading	: -
Display example	: "COSEL CO.,LTD_TOYAMA"

MFR_SERIAL [9Eh] Block Read

This command returns a string of 7 numbers that provides a serial number.

Display format	: ASCII code (7 letter)
Initial setting	: -
Range of setting and reading	: -
Display example	: "9527653"

MFR_C2_ARA_CONFIG [E0h] R/W Byte

It does the setting of C2 terminal feature and SMBAlert feature and a reading.

By the setting of bit4, the ARA change existence or non-existence at the time of SMBAlert can be chosen.

Also, by the setting of bit3-0, the C2 terminal can be chosen in the remote control

(secondary side) or Power_Good.

Display format	: -
Initial setting	: 01 h
Range of setting and reading	: -

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

#	bit	Value	Overview
1	bit7-5	000	Spare
2	bit4	0	At the time of SMBAlert, it replies to both of ARA and the setting address.
3		1	It uses ARA and at the time of SMBAlert, it replies only to ARA.
4	bit3-0	0001	It uses C2 terminal as the Power_Good output terminal.
5		0010	It uses C2 terminal as the remote control (secondary side) terminal.
6		0101	It uses C2 terminal as the Power_Good_IOG output terminal.

MFR_C2_LOGIC [E1h] R/W Byte

It does the setting of remote control (secondary side) and a reading.

Display format	: -
Initial setting	: 00 h
Range of setting and reading	: -

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

#	bit	Value	Overview
1	bit7-2	000000	Spare
2	bit1	0	The remote control (secondary side) feature is invalid.
3		1	The remote control (secondary side) feature is valid.
4	bit0	0	The remote control (secondary side) feature is negative-logic. (C2 input < 0.8V)
5		1	The remote control (secondary side) feature is positive-logic. (C2 input > 2.1V)

MFR_PGOOD_POLARITY [E2h] R/W Byte

It does the setting of the polarity of the Power_Good signal and a reading.

Display format	: -
Initial setting	: 00 h
Range of setting and reading	: -

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

#	bit	value	Overview
1	bit7-1	0000000	spare
2	bit0	0	Power_Good signal is negative logic (when output voltage is normal: Low)
3		1	Power_Good signal is positive (when output volte is normal: High)

MFR_OT_RESTART_LIMIT [E3h] R/W Word

It does the setting of the return threshold of the overtemperature protection and a reading.

In the case of automatic restart mode, it does an automatic-restart, when the temperature of the detecting-element is below this threshold.

Display format	: Linear(Temp)
Initial setting	: 90 [℃]
Range of setting and reading	: -45 - 90 [℃]

For CHS300/400/500-I series

MFR_UT_RESTART_LIMIT [E4h] R/W Word

It does the setting of the return threshold of the undertemperature and a reading.

In the case of automatic restart mode, it does an automatic-restart, when the temperature of the detecting-element exceeds this threshold.

Display format	: Linear(Temp)
Initial setting	: -40 [℃]
Range of setting and reading	: -45 - 20 [℃]

MFR_VOUT_OV_FAULT_COUNT [F0h] Read

It reads the stop number of times by the overvoltage protection feature.

Note1: For clear the count, use MFR_CLEAR_FAULT_COUNT [F5h].

Note2: For saving count, don't block the input voltage, between 100ms output voltage is stopped.

Display format	: Linear(Count)
Initial setting	: 0 [times]
Range of setting and reading	: 0 - 255 [times]

#	bit	value	Overview
1	bit7-0	00000000	It reads the number of times stopping by the output overvoltage fault.

MFR_VOUT_UV_FAULT_COUNT [F1h] Read

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

Note1: For clear the count, use MFR_CLEAR_FAULT_COUNT [F5h].

Note2: For saving count, don't block the input voltage, between 100ms output voltage is stopped.

Display format	: Linear(Count)
Initial setting	: 0 [times]
Range of setting and reading	: 0 - 255 [times]

#	bit	value	Overview
1	bit7-0	00000000	It reads the number of times stopping by the output undervoltage fault.

MFR_OT_FAULT_COUNT [F2h] Read

It reads the number of times stopping by the overheating protection feature.

Note1: For clear the count, use MFR_CLEAR_FAULT_COUNT [F5h].

Note2: For saving count, don't block the input voltage, between 100ms output voltage is stopped.

	Display format	: Linear(Count)
	Initial setting	: 0 [times]
	Range of setting and reading	: 0 - 255 [times]

#	bit	value	Overview
1	bit7-0	00000000	It reads the number of times stopping by the overtemperature fault.

MFR_UT_FAULT_COUNT [F3h] Read

It reads the number of times stopping by the undertemperature feature.

Note1: For clear the count, use MFR_CLEAR_FAULT_COUNT [F5h].

Note2: For saving count, don't block the input voltage, between 100ms output voltage is stopped.

	Display format	: Linear(Count)
	Initial setting	: 0 [times]
	Range of setting and reading	: 0 - 255 [times]

#	bit	value	Overview
1	bit7-0	00000000	It reads the number of times stopping by the undertemperature fault.

MFR_TON_MAX_FAULT_COUNT [F4h] Read

It reads the number of times stopping by the activation time exceeding protective function.

Note1: For clear the count, use MFR_CLEAR_FAULT_COUNT [F5h].

Note2: For saving count, don't block the input voltage, between 100ms output voltage is stopped.

	Display format	: Linear(Count)
	Initial setting	: 0 [times]
	Range of setting and reading	: 0 - 255 [times]

#	bit	value	Overview
1	bit7-0	00000000	It reads the number of times stopping by protection operation for over start-up time.

MFR_CLEAR_FAULT_COUNT [F5h] Send

It resets the number of times stopping by the protective function.

Note1: After command transmission, do not shutdown the input voltage for more than 1 second.

	Display format	: -
	Initial setting	: -
	Range of setting and reading	: -

MFR_CLEAR_FAULT_COUNT [F5h] Send

It resets the number of times stopping by the protective function.

Note1: After command transmission, do not shutdown the input voltage for more than 1 second.

Display format	: -
Initial setting	: -
Range of setting and reading	: -

MFR_VIN_OV_FAULT_COUNT [F8h] Read

It reads the number of times stopping by the input overvoltage protection feature.

Note1: For clear the count, use MFR_CLEAR_FAULT_COUNT [F5h].

Note2: For saving count, don't block the input voltage, between 100ms output voltage is stopped.

Display format	: Linear(Count)
Initial setting	: 0 [times]
Range of setting and reading	: 0 - 255 [times]

#	bit	value	Overview
1	bit7-0	00000000	It reads the number of times stopping by the input overvoltage fault.

MFR_VIN_UV_FAULT_COUNT [F9h] Read

It reads the number of times stopping by low input voltage protection feature.

Note1: For clear the count, use MFR_CLEAR_FAULT_COUNT [F5h].

Note2: For saving count, don't block the input voltage, between 100ms output voltage is stopped.

Display format	: Linear(Count)
Initial setting	: 0 [times]
Range of setting and reading	: 0 - 255 [times]

#	bit	value	Overview
1	bit7-0	00000000	It reads the number of times stopping by the input undervoltage fault.