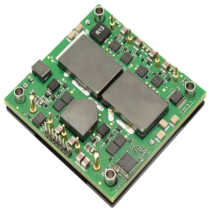
Descriptions

1300W isolated，DC/DC Converter





RoHS

Features

- Wide input voltage range：36-75VDC
- High efficiency up to 96.5%
- Basic insulation, i/o isolation test voltage 2250VDC
- Operating ambient temperature range：-40℃ to +85℃
- Input under-voltage protection. Output over-voltage. over-current, output short circuit protection, over-temperature protection
- Built-in PMBus communication function
- Industry standard package: 1/2brick
- Meets EN62368 standards

Applications

- Communications
- Battery-powered equipment
- Industrial control
- Electric power
- Instrumentation
- Intelligent robots

Selection Guide

Certification	Part No.①	Input Voltage (VDC)		Output		Nominal Efficiency(%) 50%Io / 100%Io	Capacitance Load (μF)Max.
		Nominal (Range)	Max.②	Voltage③ (VDC)	Current (A) 50%Io / 100%Io.		
--	DOHB1300-F4850PN	48 (36-75)	78	50	13000/26000	97/96.5	3300

Notes:
①Use suffix "P" for product without current sharing function, suffix "N" for negative logic;
②The input voltage cannot exceed this value, otherwise it may cause permanent irreversible damage, in order to improve product reliability. By default, if Vin exceeds 78VDC (Typ.) product will shut down the power output;
③The output voltage is tested under the conditions of nominal input and no-load output.

Specifications

Product Specifications	Item		Operating Conditions③	Min.	Typ.	Max.	Unit
Input Specifications	Input Current (full load)			--	--	28.5	A
	No Load Input Loss			--	9.6	14	W
	Surge Voltage (100msec. max.)			-0.5	--	100	VDC
	Max input Voltage			--	--	78	
	Input Start-up Voltage			33	34	35	
	Input Under-voltage Protection			31	--	33	
	Input Filter			Pi filter			
	Hot Plug			Unavailable			
	Ctrl ①	Module turn-on		0	--	1.2	VDC
		Module turn-off		3.3	--	5	
		Input current②		--	0.3	--	mA
		Input loss during shutdown		--	1	--	W
		Start-up Delay Time	All operating Temperaturer ange	--	1	--	ms
Output ③ Specifications	Output Current Range			0	--	100	%Io
	Voltage Accuracy		Room temperature,Vin = 36-75 V, 0%-100%Io	--	±1	±2	%
	Linear Regulation		Room temperature,Vin = 36-75 V, 100%Io	--	±0.2	±0.5	
	Load Regulation		Room temperature, Vin = 48 V, 0%-100%Io	--	±0.4	±1	
	Transient Recovery Time		Vin = 48V, 25-75-25% Io, di/dt = 1A/μs	--	300	500	μs
	Transient Response Deviation		Vin = 48 V, 25-75-25% Io, di/dt = 1 A/μs	--	±1	±3	%
			Vin = 48 V, 10-100-10% Io, di/dt = 1 A/μs	--	--	±8	
	Temperature Coefficient		100%Io	--	--	±0.03	%/℃
	Ripple & Noise④		Room temperature,Vin = 36-75 V, 0%-100%Io	--	40	500	mVp-p
	Trim			25	--	55	V
	Sense			--	--	105	%Vo
	Over-temperature Protection		Product sur PCB face max. temperature	--	110	125	℃
	Over-voltage Protection		Vin = 36-75 V	58	59	60	V
	Over-current Protection			28	32	36	A
	Short-circuit Protection			Hiccup, continuous, self-recovery			
	Start-up Time		Vin = 48 V, Constant resistance load	--	150	500	ms
	Output Voltage Rise Time		Room temperature,Vin = 48 V,0%-100%Io	--	100	150	
	Power-off hold Time		Room temperature,Vin = 48 V,0%-100%Io	--	5	--	
General Specifications	Isolation		Electric Strength Test for 1 minute with a leakage current of 1mA max — Input-output	2250	--	--	VDC
			Input-case	750	--	--	
			Output-case	750	--	--	
	Insulation Resistance		Input-output, resistance at 500VDC	100	--	--	MΩ
	Isolation Capacitance		Input-output, 100KHz/0.1V	--	5000	--	pF

	Operating Temperature		-40	--	+85	℃
	Storage Temperature		-55	--	+125	
	Storage Humidity	Non-condensing	5	--	95	%RH
	Pin Soldering Resistance Temperature	Wave soldering welding, 10 seconds	--	--	260	℃
		Soldering spot is 1.5mm away from case for 10 seconds	--	--	300	
	Shock and Vibration		10-500Hz, 0.07g2/HZ, 10min. along X, Y and Z			
	MTBF	Telcordia SR-332@25℃	4700	--	--	K hours
Mechanical Specifications	Case Material	Aluminum alloy case				
	Dimension	61.0×57.9×12.7mm				
	Weight	118.0g (Typ.)				
	Cooling Method	Free air convection cooling or forced air cooling				

Notes:

① The voltage of the CTRL control pin is relative to the input pin -Vin, the l input voltage should not exceed 5VDC, otherwise permanent and unrecoverable damage may be caused;

② External circuit current capacity required for CTRL enable.

③ All output characteristics are tested in accordance with Design Reference Fig.1;

④ The ripple & noise is tested in accordance with Design Reference Fig. 2.

Electromagnetic Compatibility (EMC)

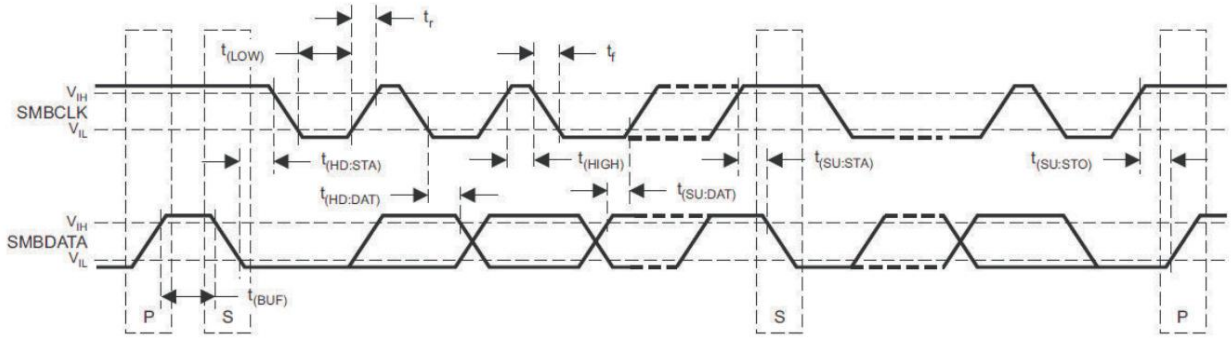
EMI	CE	CISPR32/EN55032 CLASS B (see Fig.4 for recommended circuit)	
	RE	CISPR32/EN55032 CLASS B (see Fig.4 for recommended circuit)	
EMS	ESD	IEC/EN61000-4-2 Contact ±4KV/Air ±6KV (see Fig.5 for recommended circuit)	perf. Criteria B
	RS	IEC/EN61000-4-3 10V/m (see Fig.4 for recommended circuit)	perf. Criteria A
	EFT	IEC/EN61000-4-4 100kHz ±2kV (see Fig.4 for recommended circuit)	perf. Criteria B
	Surge	IEC/EN61000-4-5 line to line ±2kV (see Fig.4 for recommended circuit)	perf. Criteria B
	CS	IEC/EN61000-4-6 3 Vr.m.s (see Fig.4 for recommended circuit)	perf. Criteria A

PMBus Electrical specification

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Logic Output Low Signal Level (V_{OL})	SCL, SDA, SYNC, SALERT, PG IOH= 4 mA		--	--	DGND +0.25	VDC
Logic Output High Signal Level (V_{OH})			VDD-0.6	--	--	
Logic Output High Source Current (I_{OH})			--	--	4	mA
Logic Output Low Sink Current (I_{OL})			-4	--	--	
Logic Input High Threshold (V_{IH})	VDD=3V		2.1	--	--	VDC
Logic Input Low Threshold (V_{IL})			--	--	1.1	
Parasitic Capacitance			--	--	400	pF
SYNC Pin Capacitance	Parallel interleaving		--	100	--	
Internal Pull-up Resistance	PMBus CTRL		--	47	--	KΩ
PMBus Operating Frequency	Operating frequency range	Slave mode: 50% duty cycle	100	400	1000	KHz

	Default operating frequency		--	400	--	
STOP TO START Min Time $t_{(BμF)}$	See System Management Bus Specification Version 3.0 for detail		--	1.3	--	μs
START Continue Time $t_{(HD:STA)}$			--	0.6	--	
Repeat START Time $t_{(SU:STA)}$			--	0.6	--	
STOP Continue Time $t_{(SU:STO)}$			--	0.6	--	
Data Continue Time $t_{(HD:DAT)}$			--	0	--	
Data Set Time $t_{(SU:DAT)}$			--	100	--	
Error Signal Time $t_{(TIMEOUT)}$			--	--	35	ms
Clock Low Level Time $t_{(LOW)}$			--	1.3	--	μs
Clock High Level Time $t_{(HIGH)}$			--	0.6	--	
Clock Low Level Accumulated Time $t_{(LOW:SEXT)}$			--	--	25	ms

Note: This data is obtained at 25℃, VCC=3.3V, 400kHz; The test data is applicable to all functional pins of PMBus, and the sequence diagram is as follows:



PMBus Design specification

Item		Operating Conditions	Min.	Typ.	Max.④	Unit
Power Good, PG	PG Threshold	PMBus configurable Rising	--	22	--	VDC
		PMBus configurable Falling	--	15	--	
	PG Threshold Range	POWER_GOOD_ON VOUT_UV_FAULT_LIMIT	0	--	100	%Vout
	PG Delay	VO to POWER_GOOD_ON to PG set	--	139	--	μs
Input Under Voltage Protection, IUVP	IUVP Threshold	PMBus configurable	--	33	--	VDC
	IUVP Threshold Range	VIN_UV_FAULT_LIMIT	30	--	75	
	IUVP Back-difference voltage	PMBus cannot be configured	--	2③	--	
	Set Point Accuracy		--	--	--	%
	IUVP Response Delay		--	500	--	μs
	Fault Response	PMBus configurable VIN_UV_FAULT_RESPONSE	Output off, self-recover when input voltage normal			
Input over-voltage Protection, IOVP	IOVP Threshold	PMBus The default over-voltage protection value is entered	--	78	--	VDC
	IOVP Threshold Range	VIN_OV_FAULT_LIMIT	0	--	100	%Vin
	IUVP Backlash voltage	PMBus cannot be configured	--	5③	--	VDC
	Set Point Accuracy		--	1	--	%

	IOVP Response Delay		--	500	--	μs
	Fault Response	PMBus configurable VIN_OV_FAULT_RESPONSE	Output off, self-recover when input voltage normal			
Output Voltage Over/under-voltage Protection, OVP / UVP	UVP Threshold	PMBus configurable	--	0	--	VDC
	UVP Threshold Range	VOUT_UV_FAULT_LIMIT	0	--	100	%Vout
	OVP Threshold	PMBus configurable	--	59	--	VDC
	OVP Threshold Range	VOUT_OV_FAULT_LIMIT	0	--	59	
	OVP&UVP response time		--	1 & 139	--	μs
	Fault Response	PMBus configurable VOUT_UV_FAULT_RESPONSE	Default off type, can be configured to hicuup, self-recovery			
		PMBus configurable VOUT_OV_FAULT_RESPONSE				
Over-current Protection	OCP Threshold①	PMBus configurable	--	32	--	A
	OCP Threshold Range	IOUT_OC_FAULT_LIMIT	0	--	36	
	Protection delay		--	8 & 1	--	ms
Over-temperature Protection	OTP Threshold	PMBus configurable	--	87	--	℃
	OTP temperature return difference	PMBus cannot be configured		5③		
	OTP Threshold Range	OT_FAULT_LIMIT	-40	--	87	
	Fault Response	PMBus configurable OT_FAULT_RESPONSE	3s after the system shuts down, the OTP sampling point temperature returns to the "Threshold - Temp. Return Difference" , and the system automatically restarts if no fault occurs			
Monitoring Accuracy	Input voltage READ_VIN	Room temperature	--	±1	--	V
	Output voltage READ_VOUT	Room temperature	--	±1	--	
	Output current READ_IOUT		--	3	--	A
	Duty cycle READ_DUTY_CYCLE		No tolerance, Read value is the actual value applied by PWM controller			
	Temperature READ_TEMPERATURE_1	Temperature sensor, -30~125℃	--	±10	--	℃

Note:

① When the product is working at current sharing mode, over-current will cause the product to be directly turned off, and the PMBus cannot be configured;

② The product over-temperature protection point is set at the MCU temperature, which has a certain temperature difference with the maximum internal temperature of the product; If the maximum operating temperature is to be considered, the temperature rise assessment is required before specific debugging;

③ Hysteretic parameters of some protection features are fixed and cannot be configured. Details are as follows:

A. The hysteretic voltage of the input under-voltage protection is fixed to 2V, that is, the input voltage must be higher than the input under-voltage protection threshold of 2V before starting. The starting voltage is defined in accordance with instruction 0X35 VIN ON;

B. The hysteretic voltage of the input over-voltage protection is fixed to 5V, that is, the input voltage must be lower than the input over-voltage protection threshold of 5V before starting;

C. The hysteretic temperature of over-temperature protection is fixed to 5℃, that is, 3s after the system shuts down, the OTP sampling point temperature returns to the "Threshold - Temp. Return Difference" , and the system automatically restarts if no fault occurs;

④ The PMBus setting limit has a specified maximum value. When the setting value is higher than the maximum value, the maximum value is set.

Characteristic Curve

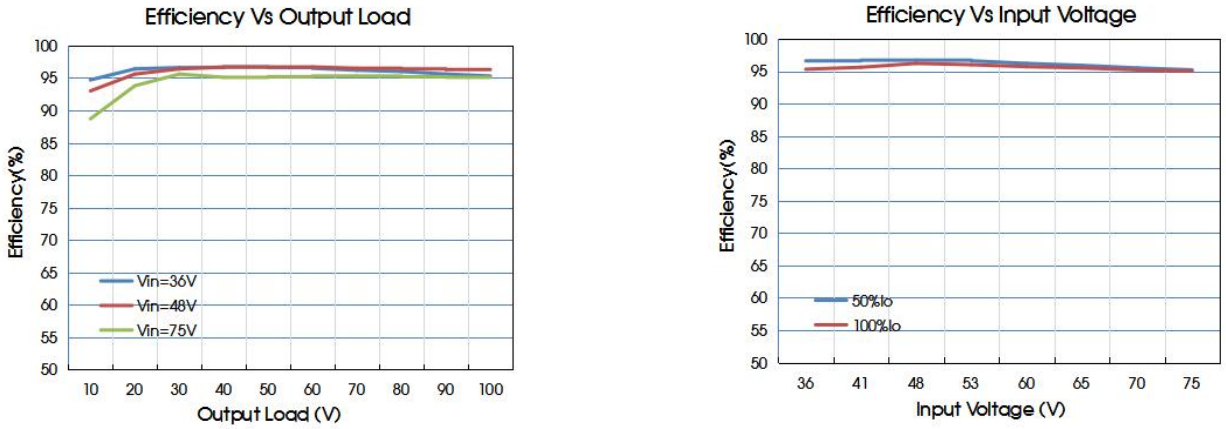


Fig. 1

Design Reference

1. Typical application circuit

The input voltage ranges from 36 to 75VDC. When the input voltage exceeds 75VDC,

If the customer does not use our EMC recommended circuits, the input must be connected with an electrolytic capacitor of at least 470μF to suppress the potential surge voltage at the input and ensure that the transient voltage does not exceed the value specified in the input surge voltage.

In addition, the impedance of both the input source and the load will interact with the impedance of the product, requiring the input source to have a low impedance characteristics. It is recommended that the minimum capacitance of the external input can be guaranteed to be 470 μF at low temperature. In some applications, performance can be enhanced by adding external capacitors.

The output end must be connected with an electrolytic capacitor larger than the minimum capacitive load capacity to stabilize the output state of the product.

If it is required to further reduce the input/output ripple, the external input/output capacitors Cin and Cout can be increased or a capacitor with small series equivalent impedance value can be selected, but the capacitance value should not be greater than the maximum capacitive load of the product.



Fig. 2

Capacitors / Output Voltage / Value	Cin	Cout (typ.)
50V	470uF/100V	1620uF/100V

① It is recommended to carry out peripheral design according to the typical value of capacitive load, and use aluminum electrolytic capacitors or solid electrolytic capacitors.

2. Ripple noise test circuit

In addition to the "1. Typical Application Circuit" capacitors, 10μF/100V tantalum capacitors and 0.1μF/100V ceramic capacitors should be added to the ripple noise test. It is recommended to use the following recommended peripheral circuit, and set the probe bandwidth to 20MHz

during the test.

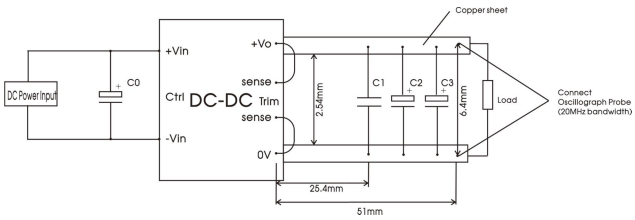


Fig. 3

Components	Recommended Componen
C0	470μF/100V electrolytic capacitors
C1	0.1μF/100V ceramic capacitanc
C2	10μF/100V Tantalum capacitor
C3	1620μF/100V aluminum electrolytic capacitor

3. EMC compliance circuit

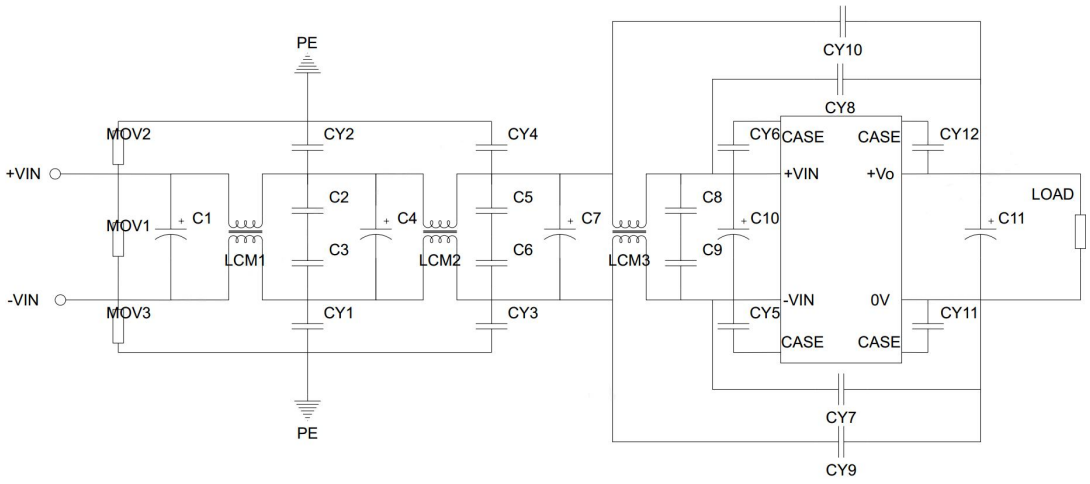


Fig. 4

Components	Recommended Component
MOV1/MOV2/MOV3	20D101K voltage sensitive resistor
C1/C4/C7/C10	680uF/100V aluminum electrolytic capacitor
C2/C3/C8/C9	4*4.7uF/100V
C5/C6	8*4.7uF/100V
C11	2*470uF/100V+680uF/100V aluminum electrolytic capacitor
CY1/CY2	2*4.7nF/Y2+1nF/Y1
CY3/CY4	2*4.7nF/Y2
CY5/CY6	4.7nF/Y2
CY7/CY8	2.2nF/Y1
CY9/CY10	4.7nF/Y2
CY11/CY12	4.7nF/Y2+2.2nF/Y1
LCM1	1.4mH
LCM2	75uH
LCM3	10uH

Note: If there is a surge level requirement, MOV1, MOV2, MOV3 must be added.

4. Electrostatic solutions - Recommended circuits

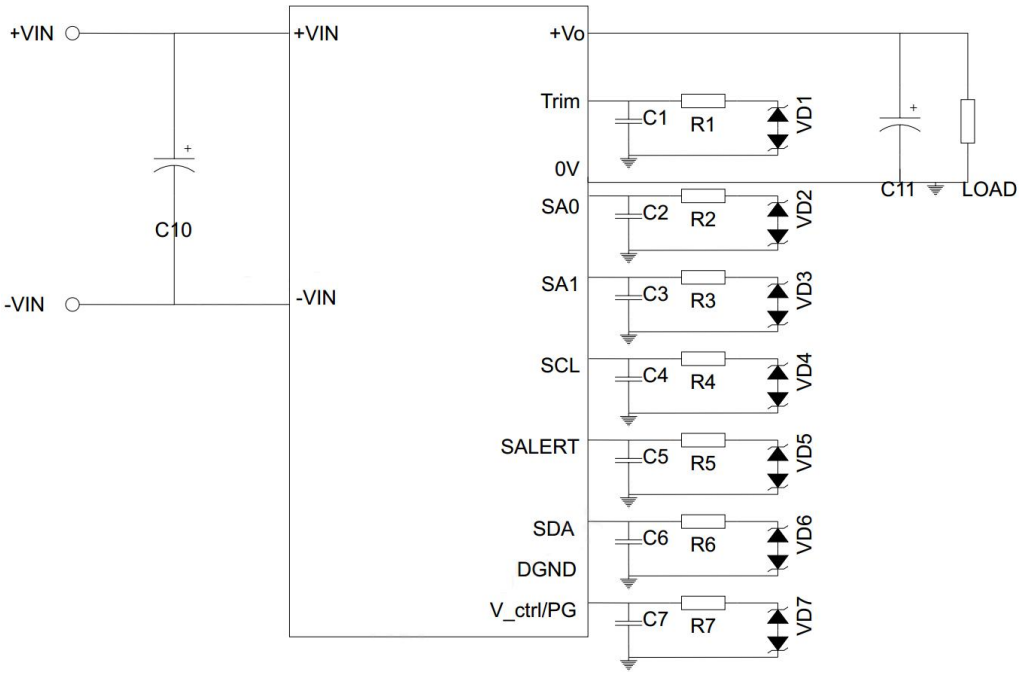
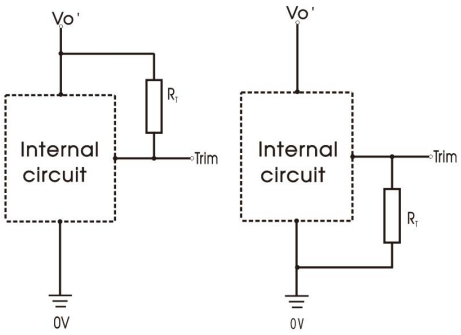


Fig. 5

Components	Recommended Component
C1, C2, C3, C4, C5, C6, C7	1nf/25V Ceramic capacitor
R1,R2, R3, R4, R5, R6, R7	10KΩPatch resistance
VD1,VD2,VD3,VD4,VD5,VD6,VD7	5V bi-directional TVS
C10	680uF/100V aluminum electrolytic capacito
C11	2*470uF/100V+680uF/100V aluminum electrolytic capacito

Note: If there is a static level requirements, please be sure to connect the electrostatic protection periphery.

5. Trim function for output voltage adjustment (open if unused)



Trim up Trim down

TRIM resistor connection (dashed line shows internal resistor network)

Calculating Trim resistor values:

Trim up

$$Radj = \left(\frac{50 \times (100 + \Delta\%)}{1.225 \times \Delta\%} - \frac{100}{\Delta\%} - 2 \right) \text{ k}\Omega$$

Trim down

$$Radj = \left(\frac{100}{\Delta\%} - 2 \right) \text{ k}$$

Note:

R_{adj}= Trim Resistor value

$$\Delta\% = \left| \frac{V_{nom} - V_{out}}{V_{nom}} \right| \times 100$$

V_{nom} = nominal output voltage

V_{out} = desired output voltage

Examples:

voltage up 10% to 55V, serial resistance:

$$\Delta\% = \left| \frac{50 - 55}{50} \right| * 100 = 10 \qquad R_T = \frac{50 * (100 + 10)}{1.225 * 10} - \frac{100}{10} - 2 = 436.98K\Omega$$

Voltage down 44% to 28V, serial resistor:

$$\Delta\% = \left| \frac{50 - 28}{50} \right| * 100 = 44 \qquad R_T = \frac{100}{44} - 2 = 0.2727K\Omega$$

6. High temperature design reference

Recommendations for high temperature with load of the product refer to Fig 6. The maximum temperature rise of the shell should be used to evaluate the allowable load of the product under the corresponding conditions. The maximum temperature of the shell should be controlled below the corresponding horizontal coordinate temperature at the corresponding load point.

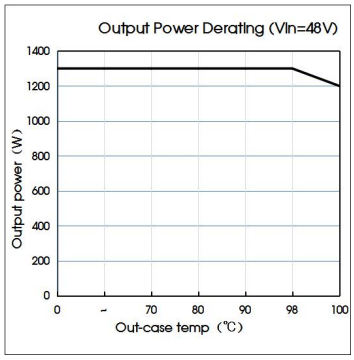


Fig. 6

7. Recommended solution for thermal testing

In the process of application, product thermal design can be evaluated by combining product temperature derating curve, or determine the stable working range of the product by testing the temperature of each temperature test point of P1, P2, P3 in Fig 7. When the P1 temperature of each point is lower than 105℃, the P2, P3 temperature of each point is lower than 100℃. it is the stable working range of the product.

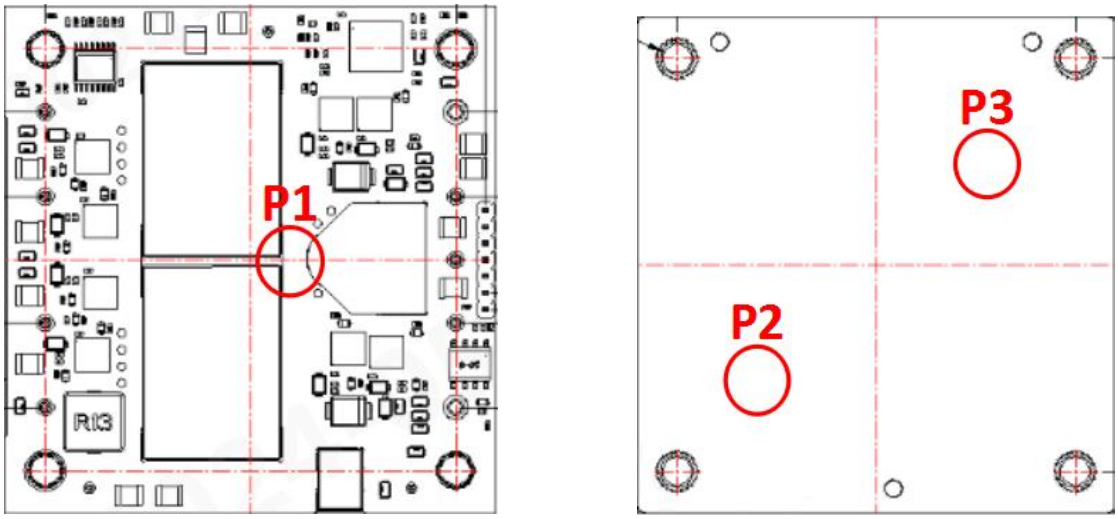


Fig. 7

8. The on/off input voltage

The product contains an input voltage sampling circuit, which has been set to sample the input voltage, and set the input starting voltage and under-voltage turn-off voltage. Generally, the input starting voltage is set to be slightly higher than the under-voltage turn-off voltage, in order to avoid repeated start up of the product caused by input voltage disturbance.

9. Remote Switch Control (CTRL)

The product is equipped with remote control function, the reference ground for the input power negative input terminal (-Vin), compatible with the design of negative and positive logic options, the default is negative logic, In cases where a control signal or switch is not required and the product is desired to be enabled automatically, the CTRL pin should be connected directly to the -Vin. The CTRL function allows the product to be turned on/off by an external device, such as a semiconductor or mechanical switch.

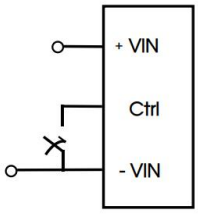


Fig. 8

External equipment must provide the minimum current absorption capacity required. 0.5 mA to ensure that the voltage of the CTRL pin meets the enable voltage specification (see Input Characteristics). Enable or disable the product by using the CTRL pin, and hold the CTRL input signal for at least △T1=1ms.

Power Management

1. Overview

The product is equipped with PMBus interface that enables power management such as monitoring or configuration with fewer external components. In addition, the product includes protection to continuously protect the load from unexpected system failures that simultaneously set SALERT pins. The host can continuously monitoring the following product parameters: input voltage, output voltage, output current, duty cycle, internal temperature, etc.

The product is delivered with the default configuration suitable for the maximum range of input voltage, output voltage and load operation. The configuration is stored in an internal Non-Volatile Memory (NVM). All power management functions can be reconfigured through the PMBus interface. A detailed description of each command is provided in the appendix at the end of this specification.

The associated software suite can be used to configure and monitor the product through the PMBus interface. Contact your local sales representative for more information.

2. PMBus interface

The product provides a PMBus digital interface that users can configure devices operation as well as monitor input and output voltages, output currents, and device temperature. The product can be compatible with any standard two-wire I2C(master must allow for clock stretching) or PMBus host device. For the communication protocol operation guide, refer to SMBus Specification Version 3.0. In addition, the product is compatible with PMBus version 1.3 and includes an SALERT line to help mitigate bandwidth constraints associated with continuous failure monitoring. The product only supports 100 kHz and 400 kHz bus clock frequency. The PMBus signals, SCL, SDA, and SALERT require passive pull-up resistors as specified in the SMBus specification. To ensure the rise time, a pull-up resistor is needed:

$$\tau = R_P C_P \leq 1\text{us}$$

here, Rp is the pull-up resistance and Cp is the parasitic capacitance of the bus. For details, see "PMBus Electrical Specifications". The maximum allowed bus capacitance is 400pF. The pull-up resistor should be connected to an external power supply between 2.7-3.8V.

When communicating via PMBus, it is recommended to always use PEC(Packet Error Checking) to increase the robustness of communication.

3. PMBus addressing

The following address resistor connection diagram and table show the recommended resistor values for the minimum and maximum voltage range of hard-wiring PMBus addresses. (±1% tolerance resistor is recommended)

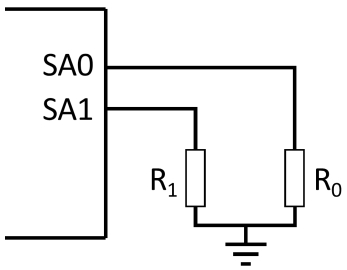


Fig. 9

SA0/SA1Index	R_0 (KΩ)	R_1 (KΩ)
0	24.9	24.9
1	49.9	49.9
2	75	75
3	100	100
4	124	124
5	150	150
6	174	174
7	200	200

The PMBus address can be configured by SA0 and SA1 pins. The formula is as follows:

PMBus address (decimal) = 8 x SA0 index + SA1 index

If the calculated PMBus address is 0, 11, or 12, the PMBus address is assigned instead as 127. From a system perspective, users should also be aware of further restrictions on addresses as described in the PMBus specification. It is not recommended to keep the SA0 and SA1 pins left open.

4. I2C/SMBus -timing

See Fig. 10 below for setting and holding time timing.

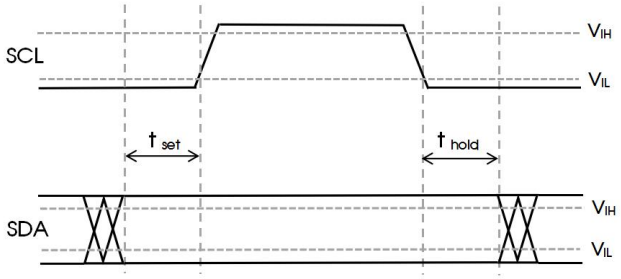


Fig. 10

The setup time, t_{set}, is the time data, SDA, must be stable before the rising edge of the clock signal, SCL. The hold time thold, is the time data, SDA, must be stable after the rising edge of the clock signal, SCL. If these times are violated incorrect data may be captured or meta-stability may occur and the bus communication may fail. All standard SMBus protocols must be followed, including clock stretching. This product supports the BUSY flag in the status commands to indicate product being too busy for SMBus response. A bus-free time delay between every SMBus transmission (between every stop & start condition) must occur. Refer to the SMBus specification, for SMBus electrical and timing requirements. Note that an additional delay of 5 ms has to be inserted in case of storing the RAM content into the internal non-volatile memory.

5. Monitoring through PMBus

It is possible to continuously monitor a wide variety of parameters through the PMBus interface. These include, but are not limited to, the parameters listed in the table below.

Parameter	PMBus Command
Input Voltage	READ_VIN
Output Voltage	READ_VOUT
Output Current	READ_IOUT
Temperature	READ_TEMPERATURE_1
Switching Frequency	READ_FREQUENCY
Duty Cycle	READ_DUTY_CYCLE

6. Fault monitoring

Fault conditions can be detected using the SALERT pin, which will be asserted low when any number of pre-configured fault or warning conditions occurs. The SALERT pin will be held low until faults and/or warnings are cleared by the CLEAR_FAULTS command, or until the output voltage has been re-enabled. It is possible to mask which fault conditions should not assert the SALERT pin by the command SMBALERT_MASK. In response to the SALERT signal, the user may read a number of status commands to find out what fault or warning condition occurred, see table below.

Fault or Warning Status	PMBus Command
General Condition Of Equipment	STATUS_BYTE、STATUS_WORD
Output Voltage	STATUS_VOUT
Output Current	STATUS_IOUT
Input Voltage	STATUS_INPUT
Temperature	STATUS_TEMPERATURE

PMBus Communication	STATUS_CML

7. Non-volatile memory (NVM)

The product contains a non-volatile memory region for storing PMBus command values. NVM preloads the defaults, which are writable and customizable, and can be restored with the command RESTORE_DEFAULT_ALL (0x12). Values in NVM are loaded during initialization.

8. PMBus switch control (PMBus CTRL)

PMBus CTRL can be configured as a switch control through the PMBus interface. PMBus CTRL is disabled and suspended by default. The logical options controlled by PMBus CTRL can be positive or negative, and are configured using the OPERATION(0x02) command. When this feature is not used, it is recommended that the CTRL pin be connected to DGND.

9. PMBus configuration and support

The product provides a PMBus digital interface that allows users to configure devices, monitor input and output parameters, and more. The associated software suite can be used to configure and monitor the product through the PMBus interface. Contact your local sales representative for more information.

10. PMBus adjust the output voltage

The output voltage of the product can be reconfigured using the PMBus command VOUT_COMMAND (0x21) or VOUT_OFFSET (0x23). This can be used to adjust the output voltage above or below the initial setting of the output voltage to a certain level. See Design Reference -6 Controllable Output Voltage Curve for an understanding of the adjustable range of output characteristics. When increasing the output voltage, the input voltage must remain within the region plotted, as shown in the figure below. The output voltage setting must be kept below the over-voltage protection threshold (OVP) to prevent product downtime.

The following figure marks the adjustable range of output voltage of the product under the condition of input voltage. Within this range, it is not fully guaranteed that the output voltage characteristics of the product will respond according to the response index of the "Output Characteristics" technical manual, please refer to Figure 7. Secondly, the output voltage shall not be lower than 25V.

11. Use CTRL/PMBus_CTRL to enable output

The default rise time for a single product is 10 milliseconds. When the input supply voltage remains constant, use the CTRL/PMBus_CTRL pin function to enable the output. The rise and fall of the output voltage and the time of the output control can be configured through the soft start and soft off functions (cannot be configured when the current is uniform). This can be used to control the starting impulse current and manage the power sequence of multiple controllers. The rise time TON_RISE (0x61) is the time it takes the output to reach its target voltage, while the fall time TOFF_FALL (0x65) is the time it takes the output to fall from its target voltage to 1V (the fall time below 1V is determined by the output load and the output capacitive load). TON_DELAY (0x60) sets the delay from output enable until output voltage begins to rise, and TOFF_DELAY (0x64) sets the delay from output disable until output voltage begins to fall.

In general, the TOFF_DELAY (0x64) command is only used to control when the output of the product is turned off by CTRL or PMBus_CTRL, and the supply voltage Vin of the product remains constant. The output voltage is turned Off by the input voltage under-voltage or over-voltage, which cannot control the Off Delay time and Off Ramp time of the down time.

When the power module is started by applying the input voltage, there is a minimum 18ms delay from the input voltage to the output voltage (△T3 -- △T4, normally 40ms), which is not affected by the CTRL/PMBus_CTRL function. By default, the soft stop is off. When the output is off, the adjustment of the output voltage stops immediately. The output voltage drop time is determined by the output load and the output capacitive load.Soft shutdown performance can be enabled by using the PMBus command ON_OFF_CONFIG (0x02). You can use the PMBus commands TON_DELAY (0x60), TON_RISE (0x61), TOFF_DELAY (0x64), and TOFF_FALL (0x65) to set the delay time and rise/fall time.

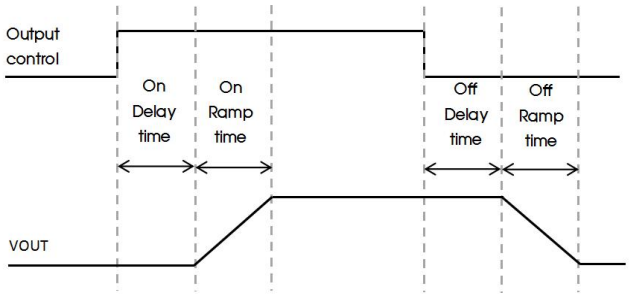


Fig. 11

12. Pre-bias start-up

The product has a Pre-bias start up functionality and will not sink current during start up if a pre-bias source is present at the output terminals. If the Pre-bias voltage is lower than the target value set in VOUT_COMMAND (0x21), the product will ramp up to the target value. If the Pre-bias voltage is higher than the target value set in VOUT_COMMAND (0x21), the product will ramp down to the target value and in this case sink current for a time interval set by the command TOFF_MAX_WARN_LIMIT (0x66).

Do not allow the output terminal of the product to be directly connected to the output terminal of other voltage regulator devices in parallel. In this case, the pre-bias start up performance may become invalid and the parallel device may be damaged.

13. Over-temperature Protection

The product includes an internal temperature sensor that protects the product from thermal overload. The product will shut down output when the temperature is higher than the temperature threshold set by the OT_WARN_LIMIT (0x51) command. When the temperature falls below the temperature threshold set by the OT_WARN_LIMIT (0x51) command, the product will continuously attempt to start and automatically return to normal. OTP fault limitation and fault response can be configured using PMBus.

Note:

① Using fault response "ignore fault" may cause permanent damage to the product;

② Due to the limitation of sampling points, OTP can not protect the products which are overheated due to instantaneous high power output in high temperature environment;

③ The recovery temperature of OTP protection has a fixed return difference of 5℃, and the recovery temperature is lower than the protection temperature of 5℃ to avoid output voltage oscillation caused by temperature fluctuations at the over-temperature protection point.

14. Input Under-voltage Protection

The product can be input under-voltage protection through the PMBus configuration, with response latency of 500us. This can be configured with the VIN_UV_FAULT_RESPONSE (0x5A) directive.By default, the VIN_ON (0x35) and VIN_OFF (0x36) commands are used to set the input under-voltage shutdown break point. The VIN_ON (0x35) and VIN_OFF (0x36) commands are recommended for input under-voltage protection.

Note: To avoid repeated start up of output voltage caused by input disturbance, it is recommended that the hysteretic voltage of 2V be reserved when the input start up voltage and under-voltage shutdown voltage are configured using VIN_ON (0x35) and VIN_OFF (0x36) commands corresponding to PMBus.

15. Over-voltage Protection

The product includes an output over-voltage protection function to protect the load. The default over-voltage protection threshold is 30% above the nominal output voltage. If the output voltage exceeds the threshold limit, the product can respond in different ways. The default response to an over-voltage fault is to turn off the output. The device constantly checks for the presence of the fault state and restarts when the fault state no longer exists. The over-voltage protection threshold and fault response can be configured using the PMBus interface. For details, see the PMBus command in the Appendix.

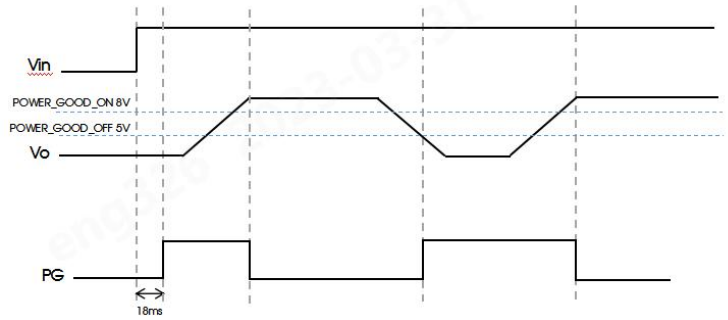
Note: The product over-voltage protection function only applies when the output voltage of the product exceeds the limit voltage. In this case, the product power level output is turned off to protect the power module and avoid secondary damage. This function cannot protect other power supply devices connected to the output end.

16. Over-current Protection

The product has a current limiting circuit for continuous overload protection. When the current sharing mode is not set, there will be a continuous 8ms without over-current protection judgment, at this time, I/O can exceed the over-current current value, but the output short-circuit protection is continuous and effective. When the starter current is overflowing, it is likely to trigger short-circuit protection and cause output shutdown. When the bus current sharing function is enabled, the overcurrent protection of the device will be directly turned off and locked, and the overcurrent protection can be escaped by turning off the current sharing function or restarting the IC.

After the overload is removed, the product will resume normal work. Load distribution should be designed for the specified maximum output short-circuit current. The overcurrent protection of this product can be configured through the PMBus interface, see Appendix PMBus commands.

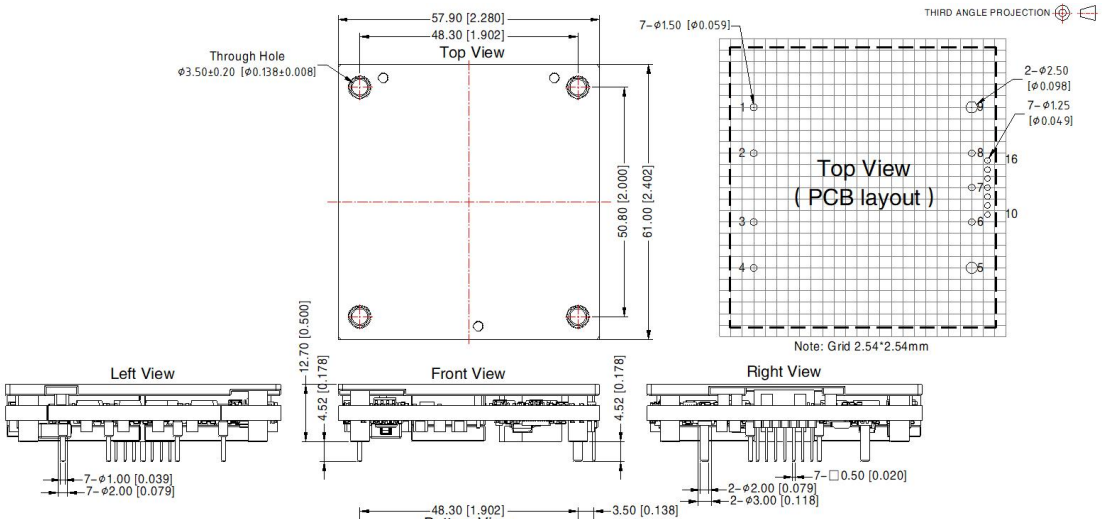
17. Power Good Judgment



The power good pin (PG) indicates when the product is ready to provide output voltage to the load. PG remains high in the up and down state. By default, the rise time ends. If the output voltage rises above the PG threshold (typical 22V), PG is set to low. If the output voltage falls below the PG threshold (typical 15V), PG is reset. You can use the PMBus commands POWER_GOOD_ON (0x5E) and POWER_GOOD_OFF (0x5F) to change the PG threshold. PG pin defaults to push-pull output and is active at low level. By default, the PG pin is the Power Good function. When the Number of Interleave (0x37) is not 0, the PG pin is reused as the Interleave function.

If the output voltage is lower than the PG threshold and the TON_MAX_FAULT_LIMIT time persists, the start up timeout will be triggered. The device is shut down and locked. After the fault is cleared, the system recovers.

Dimensions and Recommended



Pin-Out			
Pin	Function	Pin	Function
1	+Vin	9	+Vo
2	Ctrl	10	Ctrl/PG
3	NC	11	DGND
4	-Vin	12	SDA
5	0V	13	SALERT
6	-Sense	14	SCL
7	Trim	15	SA1
8	+Sense	16	SA0

Note:
Unit: mm[inch]
Pin section tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]
PIN 1/2/3/4/6/7/8: ø1.0mm; PIN 5/9: ø2.0mm
The layout of the device is for reference only, please refer to the actual product

Standard configuration PMBus command summary and factory defaults

The factory defaults provided in the following table are valid for standard configurations.

Code	Command	Function	Transfer type	DOHB1300-F4850PN	
				Default value	Default value description
0x01	OPERATION	Switch enable	R/W byte	0x88	
0x02	ON_OFF_CONFIG	Switch configuration	R/W Byte	0x0E	
0x03	CLEAR_FAULTS	Clear the fault	W Byte		
0x10	WRITE_PROTECT	Command write protection	R/W Byte	0x00	
0x11	STORE_DEFAULT_ALL	Store to NVM	W Byte		
0x12	RESTORE_DEFAULT_ALL	Remove from NVM	W Byte		
0x19	CAPABILITY	Equipment capacity	R Byte	0xB0	
0x20	VOUT_MODE	Output voltage data format	R Byte	0x16	Ulinear16,N=-10
0x21	VOUT_COMMAND	Set output voltage	R/W Word	0xC800	50.0V
0x23	VOUT_CAL_OFFSET	The output voltage is offset	R/W Word	0x0000	0.0V
0x24	VOUT_MAX	Maxi output voltage can be set	R/W Word	0xDC00	55V
0x27	VOUT_TRANSITION_RATE	Output voltage adjustment rate	R/W Word	0x007A	0.12V/ms
0x32	MAX_DUTY	Set the maxi duty cycle	R/W Word	0xEB18	99%
0x33	FREQUENCY_SWITCH	Set switching frequency	R/W Word	0xEBC0	120KHz
0x35	VIN_ON	Set starting voltage	R/W Word	0xE220	34V
0x36	VIN_OFF	Set off voltage	R/W Word	0xE200	32V
0x37	INTERLEAVE	Parallel interleaving	R/W Word	0x0000	
0x40	VOUT_OV_FAULT_LIMIT	Output over-voltage fault value	R/W Word	0xEC00	59V
0x41	VOUT_OV_FAULT_RESPONSE	Output over-voltage protection action	R/W Byte	0xFC	
0x42	VOUT_OV_WARN_LIMIT	Output over-voltage alarm value	R/W Word	0xE400	57V
0x43	VOUT_UV_WARN_LIMIT	Output under-voltage alarm value	R/W Word	0x0000	0.0V
0x44	VOUT_UV_FAULT_LIMIT	Output under-voltage fault value	R/W Word	0x0000	0.0V
0x45	VOUT_UV_FAULT_RESPONSE	Output under-voltage protection action	R/W Byte	0xFC	
0x46	IOUT_OC_FAULT_LIMIT	Output the over-current fault value	R/W Word	0xE200	32A
0x47	IOUT_OC_FAULT_RESPONSE	Output over-current protection action	R/W Byte	0xBC	
0x4A	IOUT_OC_WARN_LIMIT	Output an over-current alert value	R/W Word	0xDBA0	29A
0x4F	OT_FAULT_LIMIT	Over-temperature fault value	R/W Word	0xEAB8	87℃
0x50	OT_FAULT_RESPONSE	Over-temperature fault protection action	R/W Byte	0xC0	
0x51	OT_WARN_LIMIT	Over-temperature alarm value	R/W Word	0xEA90	82℃
0x55	VIN_OV_FAULT_LIMIT	Enter the over-voltage fault value	R/W Word	0xEA70	78V

Code	Command	Function	Transfer type	DOHB1300-F4850PN	
				Default value	Default value description
0x56	VIN_OV_FAULT_RESPONSE	Enter the over-voltage protection action	R/W Byte	0xC0	
0x57	VIN_OV_WARN_LIMIT	Enter the over-voltage alarm value	R/W Word	0xEA68	77V
0x58	VIN_UV_WARN_LIMIT	Enter the under-voltage alarm value	R/W Word	0xE210	33V
0x59	VIN_UV_FAULT_LIMIT	Enter the under-voltage fault value	R/W Word	0xE200	32V
0x5A	VIN_UV_FAULT_RESPONSE	Enter the under-voltage protection action	R/W Byte	0xC0	
0x5E	POWER_GOOD_ON	Voltage good start threshold	R/W Word	0x5800	22V
0x5F	POWER_GOOD_OFF	Voltage good off threshold	R/W Word	0x3C00	15V
0x60	TON_DELAY	Output start up delay time	R/W Word	0xBA00	1ms
0x61	TON_RISE	Output start up rise time	R/W Word	0xEB20	100ms
0x62	TON_MAX_FAULT_LIMIT	Start up timeout threshold	R/W Word	0xEB70	110ms
0x64	TOFF_DELAY	Output shutdown delay time	R/W Word	0xBA00	1ms
0x65	TOFF_FALL	Output shutdown drop time	R/W Word	0xD280	10ms
0x66	TOFF_MAX_WARN_LIMIT	Disable the descending fault threshold	R/W Word	0xD3C0	15ms
0x78	STATUS_BYTE	Total byte read status	R Byte		
0x79	STATUS_WORD	Word read total status	R Word		
0x7A	STATUS_VOUT	Read the output voltage status	R Byte		
0x7B	STATUS_IOUT	Read the output current status	R Byte		
0x7C	STATUS_INPUT	Read the input voltage status	R Byte		
0x7D	STATUS_TEMPERATURE	Read temperature status	R Byte		
0x7E	STATUS_CML	Read command/logical status	R Byte		
0x88	READ_VIN	Read-input voltage	R Word		
0x8B	READ_VOUT	Read-output voltage	R Word		
0x8C	READ_IOUT	Read-output current	R Word		
0x8D	READ_TEMPERATURE_1	Read-temperature	R Word		
0x94	READ_DUTY_CYCLE	Read-duty cycle	R Word		
0x95	READ_FREQUENCY	Read-switch frequency	R Word		
0x98	PMBus_REVISION	Read the PMBus version number	R Byte	0x33	
0x99	MFR_ID	Read the company name	R/W Block	/	
0x9A	MFR_MODEL	Read device type	R/W Block	/	
0x9B	MFR_REVISION	Read device version	R/W Block	/	
0x9C	MFR_LOCATION	Read company address	R/W Block	/	
0x9D	MFR_DATE	Read production date	R/W Block	/	
0x9E	MFR_SERIAL	Read serial number	R/W Block	/	

Code	Command	Function	Transfer type	DOHB1300-F4850PN	
				Default value	Default value description
0xEC	MFR_CTRL_LEVEL	Active level of CTRL pin	R/W Byte	0	CTRL is low by default
0xEF	MFR_RESTORE_OKIGIN	factory data reset	W Byte		

PMBus command detail

OPERATION (0x01)

Transfer type: R/W Byte

Function: Switch control and alarm control

Bit	Function	Description	Value	Function	Description
7	Enable	The device output function was enabled	1	Enable	Open output voltage
			0	Disable	Off output voltage
6	Soft Off	Set soft threshold	1	Enable Soft Off	Delay shutdown output
			0	Disable Soft Off	Direct off output
3:2	Enable Fault	Set the fault alert line	10	Enable SALERT	When a fault occurs, the SALERT line will be set
			01	Disable SALERT	When a fault occurs, the SALERT line will not act

ON_OFF_CONFIG (0x02)

Transfer type: R/W Byte

Function: start-up control

Bit	Function	Description	Value	Function	Description
4	Power-on setting	Set the default power-on configuration. Whether to directly start output after power-on	1	Enable Pin or PMBus	Configure the CTRL pin or OPERATION command to enable output after being powered on
			0	Enable Always	Set output to start directly after power-on
3	OPERATION enable	Set OPERATION command	1	Enable OPERATION	Enable the OPERATION command to start output
			0	Disable OPERATION	The OPERATION command cannot be used to start the output
2	CTRL enable	Set CTRL line	1	Enable CTRL	Enable the CONTROL line control output
			0	Disable CTRL	Disable power CONTROL line to control output
1:0	CTRL level	Set the active level of CTRL	10	High	CTRL high level active
			00	Low	CTRL low level active

CLEAR_FAULTS (0x03)

Transfer type: W Byte

Function: Clear all faults

WRITE_PROTECT (0x10)

Transfer type: R/W Byte

Function: PMBus write protection

Bit	Function	Description	Value	Function	Description
7:0	Write protection	Configure write protection for some PMBus commands	0x80	Disable all	All write protection except the 0x10 command
			0x40	Enable OPERATION	All write protection except commands 0x10 and 0x01
			0x20	Enable control and Vout	All commands are write protected except 0x10, 0x01, 0x02, and 0x21
			0x00	Enable all	Disable all write protection

STORE_DEFAULT_ALL (0x11)

Transfer type: Send Byte

Function: Command the device to store its configuration in the default store.

RESTORE_DEFAULT_ALL (0x12)

Transfer type: Send Byte

Function: Command the device to restore its configuration from the default storage.

CAPABILITY (0x19)

Transfer type: R Byte

Function: used to read the supported functions of the device

Bit	Function	Description	Value	Function	Description
7	PEC	Whether the device supports packet error verification	1	support	
			0	Do not support	
6:5	Bus speed	Max bus speed	11	1mHz	
			01	400kHz	
			00	100kHz	
4	Fault line	Whether the SALERT fault line function is available	1	With SALERT	
			0	Without SALERT	

VOUT_MODE (0x20)

Transfer type: R Byte

Function: Used to read the output voltage data format

Bit	Function	Description	Take Value	Function	Description
7: 5		Output voltage related commands support only Ulinear16 format	000	Ulinear16	Ulinear16 data format:$Y=X*2^N$
4:0	N value	Ulinear16 Indicates the N value of data	-12		

VOUT_COMMAND (0x21)

Transfer type: R/W Byte

Function: Set output voltage

Bit	Function	Format	Unit
15:0	Set the output voltage. The output voltage can not be adjusted online during the current sharing process, only allow to restart the machine after adjustment; The sagging current sharing model (VCB48_QBO-800WR3D-N) adjusts the output voltage setting value at no- load.	Ulinear16	V

VOUT_CAL_OFFSET (0x23)

Transfer type: R/W Byte

Function: Set the output bias voltage

Bit	Function	Format	Unit
15:0	Sets the output bias voltage	Ulinear16	V

VOUT_MAX (0x24)

Transfer type: R/W Byte

Function: Max output voltage that can be set

Bit	Function	Format	Unit
15:0	The maximum output voltage that can be set. If the voltage is set beyond this value, The output is restricted to this value and SALERT is set; This command can be responded during the operation of the product and corresponds to the limiting output voltage. When the output voltage during the operation of the product exceeds the value set by VOUT_MAX, it will be adjusted according to the voltage change rate set by instruction 0x27.	Ulinear16	V

VOUT_TRANSITION_RATE (0x27)

Transfer type: R/W Byte

Function: Set VOUT_COMMAND to adjust the voltage change rate of the output voltage

Bit	Function	Format	Unit
15:0	Set the voltage change rate, this command is to adjust the product working process, output voltage adjustment when the change slope. It is not allowed to adjust the output voltage during current sharing operation.	Ulinear16	V/ms

MAX_DUTY (0x32)

Transfer type: R/W Byte

Function: Set the maximum duty cycle

Bit	Function	Format	Unit
15:0	Set the maximum duty cycle	Linear11	%

FREQUENCY_SWITCH (0x33)

Transfer type: R/W Word

Function: Set switching frequency

Bit	Function	Format	Unit

Bit	Function	Format	Unit
15:0	Set switching frequency, (Disallow change at output time)	Linear11	kHz

VIN_ON (0x35)

Transfer type: R/W Word

Function: Set the input voltage starting point. If the input voltage reaches this value, the device starts working and the Power Good pin is set

Bit	Function	Format	Unit
15:0	Example Set the VIN_ON threshold	Linear11	V

VIN_OFF (0x36)

Transfer type: R/W Word

Function: Set the input voltage off break point. If the input voltage reaches this value, the device stops working and the Power Good pin resets

Bit	Function	Format	Unit
15:0	Example Set the VIN_OFF threshold	Linear11	V

INTERLEAVE (0x37)

Transfer type: R/W Word

Function: Parallel interleaving is used to reduce input ripple noise when multiple devices share a DC input in parallel. You need to enable the SYNC pin of the device and connect the SYNC pins of all devices in series. Multiple devices with the same input must be set to the same Group ID. The number of staggered devices in this group should be set correctly. The staggered Order of each device must be set correctly. The Order of the devices in the group cannot be repeated. Order 0 device is the host by default and is used to send SYNC pulse, while other devices are used to receive SYNC pulse.

Bit	Function	Description	Format
11:8	Group ID	The value ranges from 0 to 15. Interleaved groups are set	/
7:4	Number	The value ranges from 0 to 15. This parameter specifies the number of interleaving devices in a group	/
3:0	Order	The value ranges from 0 to 15. This parameter specifies the sequence of the device	/

VOUT_OV_FAULT_LIMIT (0x40)

Transfer type: R/W Word

Function: Set the output over-voltage fault point. After initialization, the system starts to determine whether the output voltage is over-voltage and take corresponding protection actions.

Bit	Function	Format	Unit
15:0	Set the output over-voltage fault point. When the output voltage is higher than the voltage value, the SALERT pin will detect the fault state and be set low. The SALERT pin will keep the low level and make corresponding protection action.	Ulinear16	V

VOUT_OV_FAULT_RESPONSE (0x41)

Transfer type: R/W Byte

Function: Set the output over-voltage fault protection action

Bit	Function	Description	Take Value	Function	Description

Bit	Function	Description	Take Value	Function	Description
7:6	Protective action	Hiccup protection	10	Turn off the output and try restarting	The device shuts down and responds according to the retry setting in bit [5:3].
		Turn-off protection	11	Turn-off output	Faults can be cleared in a number of ways: 1. Enable output by Ctrl/PMBus_Ctrl pin; 2. Run the OPERATION command to enable output. 3. Close and then reopen by combining the PMBus_Ctrl pin with the OPERATION command; 4. Reset the output by restarting the input power
5:3	Number of hiccups	The device attempts to restart after a hiccup. When no fault occurs, the device restarts normally. 111b indicates that the device keeps restarting	000	Hiccup 1 times	Attempts to restart the set number of times. If the restart fails, the device shuts off output
			001	Hiccup 2 times	
			010	Hiccup 4 times	
			011	Hiccup 8 times	
			100	Hiccup 16 times	
			101	Hiccup 32 times	
			110	Hiccup 64 times	
			111	Hiccup	The device attempts to restart until it is fault free
2:0	Time between hiccups	Set the interval between the falling edge of the hiccup and the next rising edge	0	1	Unit:100ms
			1	2	
			2	4	
			3	8	
			4	16	
			5	32	
			6	64	
			7	128	

VOUT_OV_WARN_LIMIT (0x42)

Transfer type: R/W Word

Function: Set the output over-voltage alarm point

Bit	Function	Format	Unit
15:0	Set the output over-voltage alarm point. When the output voltage is higher than the voltage value, the SALERT pin will detect the fault state and be set low. The SALERT pin will remain low	Ulinear16	V

VOUT_UV_WARN_LIMIT (0x43)

Transfer type: R/W Word

Function: Set the output under-voltage alarm point

Bit	Function	Format	Unit
15:0	Set the output under-voltage alarm point. When the output voltage is lower than the voltage value, the SALERT pin detects the fault state and will be set to low. The SALERT pin will remain low	Ulinear16	V

VOUT_UV_FAULT_LIMIT (0x44)

Transfer type: R/W Word

Function: Set the fault point of output under-voltage. After the soft start of output voltage is complete, determine whether the output voltage is undervoltage and take corresponding protection actions.

Bit	Function	Format	Unit
15:0	Set the output under-voltage fault point. When the output voltage is lower than the voltage value, the SALERT pin will detect the fault state and be set to low. The SALERT pin will keep the low level and make corresponding protection action	Ulinear16	V

VOUT_UV_FAULT_RESPONSE (0x45)

ransmission type: R/W Byte

Function: Set the output under-voltage fault protection action

Bit	Function	Description	Value	Function	Description
7:6	Response	Hiccup protection	10	Turn off the output and try restarting	The device shuts down and responds according to the retry setting in bit [5:3].
		Turn-off protection	11	Turn-off output	Faults can be cleared in a number of ways: 1. Enable output by Ctrl/PMBus_Ctrl pin; 2. Run the OPERATION command to enable output. 3. Close and then reopen by combining the PMBus_Ctrl pin with the OPERATION command; 4. Reset the output by restarting the input power
5:3	Number of hiccups	The device attempts to restart after a hiccup. When no fault occurs, the device restarts normally. 111b indicates that the device keeps restarting.	000	Hiccup 1 times	Attempts to restart the set number of times. If the restart fails, the device shuts off output.
			001	Hiccup 2 times	
			010	Hiccup 4 times	
			011	Hiccup 8 times	
			100	Hiccup 16 times	
			101	Hiccup 32 times	
			110	Hiccup 64 times	
			111	Hiccup	The device attempts to restart until it is trouble-free
2:0	Time between hiccups	Set the interval between the	0	1	unit:100ms

Bit	Function	Description	Value	Function	Description
		falling edge of the hiccup and the next rising edge	1	2	
			2	4	
			3	8	
			4	16	
			5	32	
			6	64	
			7	128	

IOUT_OC_FAULT_LIMIT (0x46)

Transfer type: R/W Word

Function: Set the output over-current fault point. After the output voltage is softly started for 8ms (2ms if the current-sharing ACS/DLS is enabled), the system starts to determine whether the output voltage is over-current and take appropriate protection actions.

Bit	Function	Format	Unit
15:0	Set the output over-current fault point. When the output current is higher than the voltage value, the SALERT pin will detect the fault state and be set low. The SALERT pin will keep the low level and make corresponding protection action	Linear11	A

IOUT_OC_FAULT_RESPONSE (0x47)

Transfer type: R/W Byte

Function: Output over-current fault response.

Bit	Function	Description	Take Value	Function	Description
7:6	Response	Hiccup protection	10	Turn off the output and try restarting	The device shuts down and responds according to the retry setting in bit [5:3].
		Turn-off protection	11	Turn-off output	Faults can be cleared in a number of ways: 1. Enable output by Ctrl/PMBus_Ctrl pin; 2. Run the OPERATION command to enable output. 3. Close and then reopen by combining the PMBus_Ctrl pin with the OPERATION command; 4. Reset the output by restarting the input power
5:3	Hiccup Times	The device attempts to restart the number of times set by these bits. 111b means the device attempts restarting continuously	000	Hiccup 1 times	Attempts to restart the set number of times. If failed, the device will shut off
			001	Hiccup 2 times	
			010	Hiccup 4 times	
			011	Hiccup 8 times	
			100	Hiccup 16 times	
			101	Hiccup 32 times	
			110	Hiccup 64 times	

Bit	Function	Description	Take Value	Function	Description
			111	Hiccup	Attempt to restart until it is fault free
2:0	Hiccup Delay	Number of delay time units	0	1	unit:100ms
			1	2	
			2	4	
			3	8	
			4	16	
			5	32	
			6	64	
			7	128	

IOUT_OC_WARN_LIMIT (0x4A)

Transfer type: R/W Word

Function: Output over-current warning limit.

Bit	Function	Format	Unit
15:0	Set the output over-current alarm point. When the output current is higher than the voltage value, the SALERT pin will detect the fault state and be set to low. The SALERT pin will remain low	Linear11	A

OT_FAULT_LIMIT (0x4F)

Transfer type: R/W Word

Function: After setting an over-temperature fault point, the system determines whether the monitoring point is over-temperature and takes corresponding protection actions after initialization.

Bit	Function	Format	Unit
15:0	over-temperature fault limit.	Linear11	℃

OT_FAULT_RESPONSE (0x50)

Transfer type: R/W Byte

Function: over-temperature fault response.

Bit	Function	Description	Take Value	Function	Description
7:6	Response	Turn-off output	11	When the default over-temperature shutdown time is 3s and the temperature at the sampling point is 5℃ lower than the over-temperature fault point, restart the output.	Faults can be cleared in a number of ways: 1. Enable output by Ctrl/PMBus_Ctrl pin; 2. Run the OPERATION command to enable output. 3. Close and then reopen by combining the PMBus_Ctrl pin with the OPERATION command; 4. Reset the output by restarting the input power

OT_WARN_LIMIT (0x51)

Transfer type: R/W Word

Function: over-temperature warning limit.

Bit	Function	Format	Unit
15:0	Set the alarm point of over-temperature. When the temperature of the sampling point is higher than the temperature value, the SALERT pin will detect the fault state and be set to low, and the SALERT pin will remain low	Linear11	℃

VIN_OV_FAULT_LIMIT (0x55)

Transfer type: R/W Word

Function: Set the input over-voltage fault point. After initialization, the system starts to determine whether the input voltage is over-voltage and take corresponding protection actions.

Bit	Function	Format	Unit
15:0	Set the input over-voltage fault point. When the input voltage is higher than the voltage value, the SALERT pin will detect the fault state and be set low. The SALERT pin will keep the low level and make corresponding protection action.	Linear11	V

VIN_OV_FAULT_RESPONSE (0x56)

Transfer type: R/W Byte

Function: Input over-voltage fault response.

Bit	Function	Description	Take Value	Function	Description
7:6	Response	Turn-off output	11	Turn off the output, and restart the output when the default input voltage is 5V lower than the input over-voltage fault point.	Faults can be cleared in a number of ways: 1. Enable output by Ctrl/PMBus_Ctrl pin; 2. Run the OPERATION command to enable output. 3. Close and then reopen by combining the PMBus_Ctrl pin with the OPERATION command; 4. Reset the output by restarting the input power

VIN_OV_WARN_LIMIT (0x57)

Transfer type: R/W Word

Function: Input over-voltage warning limit.

Bit	Function	Format	Unit
15:0	Set the input over-voltage alarm point. When the input voltage is higher than the voltage value, the SALERT pin will detect the fault state and be set low. The SALERT pin will remain low	Linear11	V

VIN_UV_WARN_LIMIT (0x58)

Transfer type: R/W Word

Function: Input under-voltage warning limit.

Bit	Function	Format	Unit
15:0	Set the input under-voltage alarm point. When the input voltage is lower than the voltage value, the SALERT pin detects the fault state and will be set to low. The SALERT pin will remain low	Linear11	V

VIN_UV_FAULT_LIMIT (0x59)

Transfer type: R/W Word

Function: Set the input under-voltage fault point. After initialization, the system determines whether the input voltage is under-voltage and takes corresponding protection actions.

Bit	Function	Format	Unit
15:0	Set the input under-voltage fault point. When the input voltage is lower than the voltage value, the SALERT pin will detect the fault state and be set to low. The SALERT pin will keep the low level and make corresponding protection action. The minimum value of the specification is VIN_ON(0x35)-2V. If the value is lower than VIN_ON(0x35)-2V, the system automatically defines the value as VIN_ON(0x35)-2V. In addition, the higher values of "VIN_UV_FAULT_LIMIT" and "VIN_OFF" are used as the product under-voltage protection point.	Linear11	V

VIN_UV_FAULT_RESPONSE (0x5A)

Transfer type: R/W Byte

Function: Input under-voltage fault response.

Bit	Function	Description	Take Value	Function	Description
7:6	Response	Turn-off output	11	Turn off the output and restart the output when the default input voltage is higher than the VIN_ON value.	Faults can be cleared in a number of ways: 1. Enable output by Ctrl/PMBus_Ctrl pin; 2. Run the OPERATION command to enable output. 3. Close and then reopen by combining the PMBus_Ctrl pin with the OPERATION command; 4. Reset the output by restarting the input power

POWER_GOOD_ON (0x5E)

Transfer type: R/W Word

Function: Set the output starting point. If the output voltage is higher than this value, set the PG (Power Good) to low

Bit	Function	Format	Unit
15:0	Set the output start point	Ulinear16	V

POWER_GOOD_OFF (0x5F)

Transfer type: R/W Word

Function: If the output voltage is lower than this value, PG_Sync pin (Power Good) is set to high. During product start up, PG_Sync pin (Power Good) is set to high.

Bit	Function	Format	Unit
15:0	Set an output closing break point	Ulinear16	V

TON_DELAY (0x60)

Transfer type: R/W Word

Function: Set the start up delay time. Output ENABLE to the time when VOUT starts rising. The minimum value is 1ms. The delay is directly equivalent to the delay established by enabling the output signal and output voltage using the function "Ctrl, PMBus_Ctrl, OPERATION". When the input power is restarted to enable the system, the delay is added to the start up delay. The total start up delay is 39ms+TON_DELAY.

Bit	Function	Format	Unit
15:0	Set the turn-on delay time.	Linear11	ms

TON_RISE (0x61)

Transfer type: R/W Word

Function: Set the rise time of start up (not adjustable when current sharing is enabled). VOUT starts rising to the time it reaches VOUT_COMMAND. By default, the minimum value of TON_RISE is 10ms when the stream sharing function is not enabled. When the flow balancing function (including DLS or ACS) is enabled, the minimum value of TON_RISE is 200ms.

Bit	Function	Format	Unit
15:0	Sets the turn-on rise time.	Linear11	ms

TON_MAX_FAULT_LIMIT (0x62)

Transfer type: R/W Word

Function: The maximum start up time is set. If the output voltage does not reach the value set by POWER_GOOD_ON, the fault is determined. By default, the minimum value of TON_MAX_FAULT_LIMIT is TON_RISE+10ms when the current sharing function is not enabled. When the current sharing function (including DLS or ACS) is enabled, the minimum value of TON_MAX_FAULT_LIMIT is TON_RISE+200ms.

Bit	Function	Format	Unit
15:0	The maximum start up time is set. If the value is set to 0, there is no maximum rise time. When the output voltage rise time is higher than this value, the SALERT pin will detect the fault state and be set to low, and the SALERT pin will remain low.	Linear11	ms

TOFF_DELAY (0x64)

Transfer type: R/W Word

Function: Set the shutdown delay time. When the input power supply voltage is stable, press Ctrl, PMBus_Ctrl, OPERATION to DISABLE the output and output the time between the disable signal and the start of VOUT decline.

Bit	Function	Format	Unit
15:0	Sets the turn-off delay.	Linear11	ms

TOFF_FALL (0x65)

Transfer type: R/W Word

Function: Set the turn-off fall time to a minimum of 10ms. When the input power supply voltage is stable, use the Ctrl, PMBus_Ctrl, OPERATION function to turn off the output, and VOUT starts to decline to a time when VOUT is lower than 1V.

Bit	Function	Format	Unit
15:0	Sets the turn-off fall time.	Linear11	ms

TOFF_MAX_WARN_LIMIT (0x66)

Transfer type: R/W Word

Function: Set the shutdown fall alarm value to TOFF_FALL+5ms minimum. When the input power supply voltage is stable, use "Ctrl, PMBus_Ctrl, OPERATION" to DISABLE output. The maximum time between output disable and VOUT descending to POWER_GOOD_OFF is required. In this case, if the output voltage continues to be higher than POWER_GOOD_OFF during the output voltage shutdown, the output voltage remains abnormal and cannot be restored.

Bit	Function	Format	Unit
15:0	Set the shutdown down time and use the function "Ctrl, PMBus_Ctrl, OPERATION" to turn off the output. When the output voltage down time is higher than this value, SALERT pin will detect the fault state and be set to low, and SALERT pin will remain low.	Linear11	ms

STATUS_BYTE (0x78)

Transfer type: R Byte

Function: Returns a brief fault/warning status byte.

Bit	Function	Description	Function	Description
5	VOUT over-voltage	An output over-voltage fault has occurred.	1	Fault
			0	No Fault
4	IOUT over-current	An output over-current fault has occurred.	1	Fault
			0	No Fault
3	VIN under-voltage	An input under-voltage fault has occurred.	1	Fault
			0	No Fault
2	over-temperature	A temperature fault of warning has occurred.	1	Fault
			0	No Fault
1	Command / Logic	A command/logic fault has occurred.	1	Fault
			0	No Fault

STATUS_WORD (0x79)

Transfer type: R Word

Function: Returns an extended fault/warning status word.

Bit	Function	Description	Function	Description
15	VOUT	An output voltage fault or warning has occurred.	1	Fault
			0	No Fault
14	IOUT	An output current fault or warning has occurred.	1	Fault
			0	No Fault
13	VIN	An input voltage fault or warning has occurred.	1	Fault
			0	No Fault

Bit	Function	Description	Function	Description
5	VOUT over-voltage	An output over-voltage fault has occurred.	1	Fault
			0	No Fault
4	IOUT over-current	An output over-current fault has occurred.	1	Fault
			0	No Fault
3	VIN under-voltage	An input under-voltage fault has occurred.	1	Fault
			0	No Fault
2	over-temperature	A temperature fault of warning has occurred.	1	Fault
			0	No Fault
1	Command / Logic	A command/logic fault has occurred.	1	Fault
			0	No Fault

STATUS_VOUT (0x7A)

Transfer type: R Byte

Function: Returns Vout-related fault/warning status bits.

Bit	Function	Description	Function	Description
7	Vout over-voltage Fault	Vout over-voltage Fault	1	Fault
			0	No Fault
6	Vout over-voltage Warning	Vout over-voltage Warning	1	Fault
			0	No Fault
5	Vout under-voltage Warning	Vout under-voltage Warning	1	Fault
			0	No Fault
4	Vout under-voltage Fault	Vout under-voltage Fault	1	Fault
			0	No Fault
3	Vout Max Warning	The output voltage set by VOUT_COMMAND getting higher than VOUT_MAX.	1	Fault
			0	No Fault
2	Ton Max Fault	Ton Max Fault	1	Fault
			0	No Fault
1	Toff Max Warning	Toff Max Warning	1	Fault
			0	No Fault

STATUS_IOUT (0x7B)

Transfer type: R Byte

Function: Returns Iout-related fault/warning status bits.

Bit	Function	Description	Function	Description
7	Iout over-current Fault	Iout over-current Fault	1	Fault
			0	No Fault
6	Iout over-current And Low Voltage Fault	Iout over-current and low voltage fault	1	Fault
			0	No Fault
5	Iout over-current Warning	Iout over-current warning	1	Fault
			0	No Fault

STATUS_INPUT (0x7C)

Transfer type: R Byte

Function: Returns VIN-related fault/warning status bits.

Bit	Function	Description	Function	Description
7	Vin over-voltage Fault	Vin over-voltage Fault	1	Fault
			0	No Fault
6	Vin over-voltage Warning	Vin over-voltage Warning	1	Fault
			0	No Fault
5	Vin under-voltage Warning	Vin under-voltage Warning	1	Fault
			0	No Fault
4	Vin under-voltage Fault	Vin under-voltage Fault	1	Fault
			0	No Fault

STATUS_TEMPERATURE (0x7D)

Transfer type: R Byte

Function: Returns the temperature-related fault/warning status bits

Bit	Function	Description	Function	Description
7	over-temperature Fault	over-temperature Fault	1	Fault
			0	No Fault
6	over-temperature Warning	over-temperature Warning	1	Fault
			0	No Fault

STATUS_CML (0x7E)

Transfer type: R Byte

Function: Returns Communication/Logic/Memory-related fault status.

Bit	Function	Description	Function	Description
7	Invalid Or Unsupported Command Received	Invalid Or Unsupported Command Received	1	Fault
			0	No Fault
6	Invalid Or Unsupported Data Received	Invalid Or Unsupported Data Received	1	Fault
			0	No Fault
5	Packet Error Check Failed	Packet Error Check Failed	1	Fault
			0	No Fault
4	Memory Fault	Memory Fault	1	Fault
			0	No Fault
1	Other Communication Fault	Other Communication Fault	1	Fault
			0	No Fault
0	Logic Fault	Logic Fault	1	Fault
			0	No Fault

READ_VIN (0x88)

Transfer type: R Word

Function: Returns the measured input voltage.

Bit	Function	Format	Unit
15:0	Returns the measured input voltage.	Linear11	V

READ_VOUT (0x8B)

Transfer type: R Word

Function: Returns the measured output voltage.

Bit	Function	Format	Unit
15:0	Returns the measured output voltage.	Ulinear16	V

READ_IOUT (0x8C)

Transfer type: R Word

Function: Returns the measured output current.

Bit	Function	Format	Unit
15:0	Returns the measured output current.	Linear11	A

READ_TEMPERATURE_1 (0x8D)

Transfer type: R Word

Function: Returns the measured temperature (internal).

Bit	Function	Format	Unit
15:0	Returns the measured temperature (internal).	Linear11	℃

READ_DUTY_CYCLE (0x94)

Transfer type: R Word

Function: Returns the measured duty cycle in percent.

Bit	Function	Format	Unit
15:0	Returns the measured duty cycle in percent.	Linear11	%

READ_FREQUENCY (0x95)

Transfer type: R Word

Function: Returns switching frequency.

Bit	Function	Format	Unit
15:0	Returns switching frequency.	Linear11	kHz

PMBus_REVISION (0x98)

Transfer type: R Byte

Function: Returns the PMBus revision number for this device.

Bit	Function	Value	Description
7:4	PMBus Revision Part1	0	Part 1 Revision 1.0
		1	Part 1 Revision 1.1
		2	Part 1 Revision 1.2
		3	Part 1 Revision 1.3

Bit	Function	Value	Description
3:0	PMBus Revision Part2	0	Part 2 Revision 1.0
		1	Part 2 Revision 1.1
		2	Part 2 Revision 1.2
		3	Part 2 Revision 1.3

MFR_ID (0x99)

Transfer type: R Block

Function: Return the Manufacturers ID

Bit	Function	Format
15:0	Return the Manufacturers ID	ASCII

MFR_MODEL (0x9A)

Transfer type: R Block

Function: Return the MFR MODEL string

Bit	Function	Format
15:0	Return the MFR MODEL string	ASCII

MFR_REVISION (0x9B)

Transfer type: R Block

Function: Return the MFR revision string.

Bit	Function	Format
15:0	Return the MFR revision string.	ASCII

MFR_LOCATION (0x9C)

Transfer type: R Block

Function: Return the MFR location string

Bit	Function	Format
15:0	Return the MFR location string.	ASCII

MFR_DATE (0x9D)

Transfer type: R Block

Function: Return the date the regulator was manufactured.

Bit	Function	Format
15:0	Return the date the regulator was manufactured.	ASCII

MFR_SERIAL (0x9E)

Transfer type: R Block

Function: Return a string that provides a unique identification of the regulator.

Bit	Function	Format
15:0	Return a string that provides a unique identification of the regulator.	ASCII

MFR_CTRL_LEVEL (0xEC)

Transfer type: R/W Byte

Function: Set the active level of CTRL

Bit	Function	Value	Description
1	Set the active level of CTRL	0	The CTRL pin is active at low level
		1	The CTRL pin is active at a high level

MFR_RESTORE_OKIGIN (0XEF)

Transfer type: W Byte

Function: factory data reset

Notes:

1. The maximum capacitive load offered were tested at Vin = 36-75V and full load;
2. Unless otherwise specified, parameters in this datasheet were measured under the conditions of Ta=25℃, humidity<75%RH with nominal input voltage and rated output load;
3. All index testing methods in this datasheet are based on company corporate standards;
4. We can provide product customization service, please contact our technicians directly for specific information;
5. Products are related to laws and regulations: see "Features" and "EMC";
6. Our products shall be classified according to ISO14001 and related environmental laws and regulations, and shall be handled by qualified units.