GDC800D2854-PC DC-DC Converter

Technical Manual

Issue 1.0

Date 2020-12-25

HUAWEI TECHNOLOGIES CO., LTD.

About This Document

Purpose

This document describes the GDC800D2854-PC DC-DC converter, including its electrical fin features, applications, and communication.

The figures provided in this document are for reference only.

Intended Audience

This document is intended for:

- Sales personnel
- Technical support engineers
- System engineers
- Software engineers
- Hardware engineers

Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results. NOTICE is used to address practices not related to personal injury.
NOTE	Supplements the important information in the main text. NOTE is used to address information not related to personal injury, equipment damage, and environment deterioration.

Change History

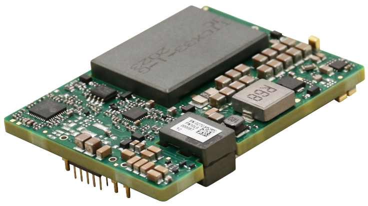
Changes between document issues are cumulative. The latest document issue contains all the changes made in earlier issues.

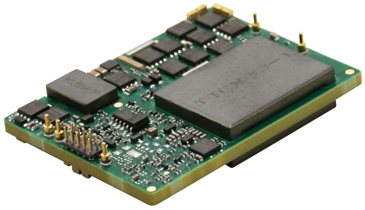
Issue 1.0 (2020-12-25)

This issue is the first release.

Contents

1 Product Overview





Product Description

The GDC800D2854-PC is a new generation non-isolated DC-DC converter that uses an industry nonstandard-brick structure, featuring high efficiency and power density with low output ripple and noise. It operates from an input voltage range of 36 V to 60 V, and provides the rated output voltages of 28 V and 5.4 V as well as the rated output power of 800 W.

Features

- Efficiency: 95% (T_B = 25°C, V_{in} = 48 V, I_{28V} = 16.07 A, I_{5V4} = 11.11 A)
- Length x Width x Height: 64.8 mm x 50.0 mm x 9.5 mm (2.55 in. x 1.97 in. x 0.37 in.)
- Weight: 90 g
- Input undervoltage protection (28V and 5V4), output overcurrent protection, output short circuit protection, output overvoltage protection, overtemperature protection
- Remote on/off, PMBus communication
- UL certification
- UL 60950-1, UL 62368-1, and C22.2 No. 60950-1 compliant
- RoHS6 and China RoHS compliant

Model Naming Convention

GDC	800	*D*	2854	–	*P*	*C*
1	2	3	4		5	6

1 — 48 V input, high performance, digital control nonstandard brick

2 — Output power: 800 W

3 — Two outputs

4 — Output voltage: 28 V, 5.4 V

5 — PMBus

6 — Extension code

Applications

- Servers
- Telecom and data communication applications
- Industrial equipment

2 Electrical Specifications

2.1 Absolute Maximum Ratings

Table 2-1 Absolute maximum ratings

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Input voltage ● Continuous ● Transient (100 ms)	 - -	 - -	 60 80	 V V	 - Not damaged; restart is allowed
Operating ambient temperature (T_A)	–40	-	85	°C	1. Module would trigger OTP in the ambient temperature of 85°C without radiator. 2. Module can meet all specifications of requirement before triggering OTP in the ambient temperature of 85°C.
Storage temperature	–40	-	125	°C	-
Operating humidity	5	-	95	% RH	Non-condensing
Altitude	-	-	5000	m	-
External voltage applied to PMBus port	-	-	3.6	V	-

2.2 Input

Table 2-2 Input specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Operating input voltage	36	48	60	V	-
Maximum input current	-	-	28	A	V_{in} = 0–60 V; I_{out} = I_{omax}
	-	-	26	A	V_{in} = 36–60 V; I_{out} = I_{omax}
No-load loss	-	8	11	W	T_A = 25°C, V_{in} = 48 V, I_{28V} = 0 A, I_{5V4} = 0 A
Input capacitance	1000	-	-	μF	Aluminum electrolytic capacitor; ESR < 300 mohm

NOTE

The module should be cooperated with RRU. It is recommended that adding at least 1 μH input inductor after input capacitance.

2.3 Output

Table 2-3 Output specifications

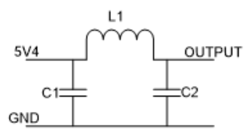
Parameter	Output	Minimum	Typical	Maximum	Unit	Notes & Conditions
Output voltage setpoint	28V	27.72	28.00	28.28	V	V_{in} = 48 V; I_{out} = 50% I_{onom}; T_A = 25°C
	5V4	5.24	5.40	5.56	V	
Output current	28V	0	16	24	A	Constant current, FDD load
	5V4	2	16.1	18.5	A	-
Output power	28V	0	450	670	W	Constant current , FDD load
	5V4	10.8	87	100	W	-

Parameter	Output	Minimum	Typical	Maximum	Unit	Notes & Conditions
Output line regulation	28V	–1	-	1	%	V_{in} = 36–60 V; I_{out} = I_{onom}
	5V4	–1	-	1	%	
Output load regulation	28V	–1	-	1	%	V_{in} = 48 V; I_{out} = I_{omin} – I_{onom}
	5V4	–1	-	1	%	
Regulated voltage precision	28V	–3	-	3	%	V_{in} = 36–60 V; I_{out} = I_{omin} – I_{onom}
	5V4	–3	-	3	%	
Temperature coefficient	28V	–0.02	-	0.02	%/°C	-
	5V4	–0.02	-	0.02	%/°C	
External capacitance (see **Note**)	28V	2700	-	4000	µF	FDD load. 28V output capacitors should contain at least 17.6 µF ceramic capacitor. The ESR of 28 V output capacitor should be less than 350 mohm.
	5V4 (see **Note**)	300		1500	µF	5V4 output capacitor should be aluminum capacitor. If 5V4 is not used, the external capacitance can be 330 µF. The external capacitance here refers to the capacitance of C1.
Output voltage ripple and noise (peak-to-peak)	28V	-	-	320	mV	T_A > 0°C, oscilloscope bandwidth: 20 MHz 28V output capacitors should contain at least 17.6 µF ceramic capacitor.
		-	-	380	mV	$T_A \leq$ 0°C, oscilloscope bandwidth: 20 MHz 28V output capacitors should contain at least 17.6 µF ceramic capacitor.

Parameter	Output	Minimum	Typical	Maximum	Unit	Notes & Conditions
	5V4	0	-	50	mV	Oscilloscope bandwidth: 20 MHz; FDD load (see **Note**)
		0	-	120	mV	Oscilloscope bandwidth: 20 MHz, for equipment test
Output voltage	28V	17	-	32	V	Voltage adjustment using PMBus. The output voltage can be regulated on line. V_{out} ≥ 28 V, P_{omax} = 670 W; V_{out} < 28 V, I_{omax} = 24 A
	5V4	95	-	105	%	Contact to -V_o, output1 voltage increasing; Contact to +V_o, output1 voltage decreasing (see **5 Output Voltage Trim**)
Output voltage overshoot	28V	-	-	5	%	Full range of V_{in}, I_{out} and T_A
	5V4	-	-	5	%	
Output voltage delay time	28V	200	-	5000	ms	-
	5V4	-	-	100	ms	
Output voltage rise time	28V	-	-	200	ms	From 10% V_{out} to 90% V_{out}
	5V4	-	-	50	ms	
Switching frequency	28V	-	250	300	kHz	-
	5V4	-	400	480	kHz	-

NOTE

- During the equipment test (T_A = 25°C, V_{out1}=28 V/V_{out2} = 5.4 V), the layout distance of minimum capacitor can be extended to less than 15 cm.
- 5V4 output should be connected with a filter like the circuit below. It commend that 300 µF ≤ C1 ≤ 1500 µF, 100 µF (solid aluminum or ceramic capacitor) + 44 µF (ceramic capacitor) ≤ C2, L1 ≥ 0.1 µH and (C1 + C2) ≤ 2000 µF. For the voltage ripple test, FDD mode: 990 µF ≤ C1 ≤ 1500 µF.



2.4 Efficiency

Table 2-4 Efficiency specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Maximum load	93.5	94.5	-	%	V_{in} = 48 V; T_B = 25°C; I_{28V} = 23.93 A; I_{5V4} = 18.52 A
Normal load	94	95	-	%	V_{in} = 48 V; T_B = 25°C; I_{28V} = 16.07 A; I_{5V4} = 11.11 A
Light load	92	93.5	-	%	V_{in} = 48 V; T_B = 25°C; I_{28V} = 3 A; I_{5V4} = 10 A

2.5 Protection

Table 2-5 Input protection

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Input undervoltage protection (28V)					
Protection threshold	29.5	31.5	33.5	V	-
Recovery threshold	31.5	33.5	35.5	V	-
Hysteresis	2	3	4	V	-
Input undervoltage protection (5V4)					
Protection threshold	25	29	32	V	-
Recovery threshold	28	33	35	V	-
Hysteresis	1.5	4	6	V	-

Table 2-6 Output protection

Parameter	Output	Minimum	Typical	Maximum	Unit	Notes & Conditions
Output overcurrent protection	28V	28.8	-	36.0	A	V_{in} = 36–60 V; Hiccup mode
	5V4	22.2	-	33.0	A	

Parameter	Output	Minimum	Typical	Maximum	Unit	Notes & Conditions
Output short-circuit protection	28V	-	-	-	All output can be shorting continuously	Hiccup mode; Self-recovery
	5V4	-	-	-		Hiccup and self-recovery when the short circuit current less than 70 A.
Output overvoltage protection	28V	35	-	39	V	Hiccup mode (for 28V@5V4)
	5V4	5.94	-	7.00	V	
Overtemperature protection Threshold Hysteresis	 - -	 110 5	 120 -	 130 -	 °C °C	Self-recovery The values are obtained by measuring the temperature of the PCB near the temperature sensor.

2.6 Dynamic Characteristics

Table 2-7 Dynamic characteristics

Parameter	Output	Minimum	Typical	Maximum	Unit	Notes & Conditions
Overshoot amplitude Recovery time (FDD)	28V	-	-	1400	mV	T = 1 ms Current change rate: 1 A/µs Load: 25%–50%–25%
		-	-	200	µs	
	5V4	-	-	270	mV	T = 1 ms Current change rate: 0.1 A/µs Load: 25%–50%–25%; 50%–75%–50%
		-	-	200	µs	

NOTE

- Larger than 80% load step, there is no special standard.
- The converter should be cooperated with RRU.

2.7 Other Characteristics

Table 2-8 Other characteristics

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
N10V_FAULT voltage low level	0	-	0.8	V	Low level effective; High level in normal mode; low level in abnormal mode. The duration time must be greater than 200 µs.
N10V_FAULT voltage high level	2.8	-	3.6	V	
N10V_FAULT current low level	–4	-	-	mA	-
N10V_FAULT current high level	-	-	4	mA	-
PWR_I2C_RESET voltage low level	0	-	0.8	V	High level effective The duration time must be greater than 700 ms for the PMBus signal to reset. 10 kΩ internal resistor connected to the ground.
PWR_I2C_RESET voltage high level	2.8	-	3.6	V	
PWR_I2C_RESET current low level	–4	-	-	mA	-
PWR_I2C_RESET current high level	-	-	4	mA	-
REMOTE_POWER_OFF voltage low level	0	-	0.8	V	High level effective (each output should be reset). The duration time must be greater than 150 ms for the converter to reset. All output would keep down at least 200 ms before restart.

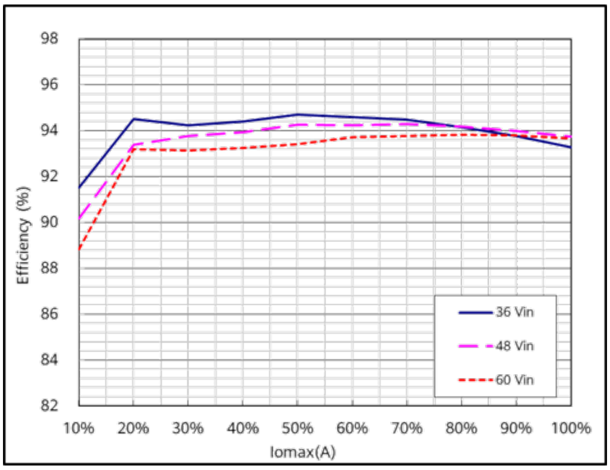
Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
REMOTE_POWER_OFF voltage high level	2.8	-	3.6	V	10 kΩ internal resistor connected to the ground.
REMOTE_POWER_OFF current low level	–4	-	-	mA	-
REMOTE_POWER_OFF current high level	-	-	4	mA	-
PWR_ALARM voltage low level	0	-	0.8	V	High level: normal; Low level: abnormal The alarm voltage can be cleared by PMBus command 0x03. Open drain output. The minimum value of the pull-down resistor is 35 kΩ, The maximum leakage current is 10 µA. Effective faults: • OCP@short of 28V output; • OTP of 28V output; • OVP of 28V output; • UVP of input voltage; • N10V_FAULT low level; • ACF FAULT of 5V4 output
PWR_ALARM voltage high level	2.8 (see **Note**)	-	3.6	V	
PWR_ALARM current low level	–4	-	-	mA	-
PWR_ALARM current high level	-	-	4	mA	-

NOTE

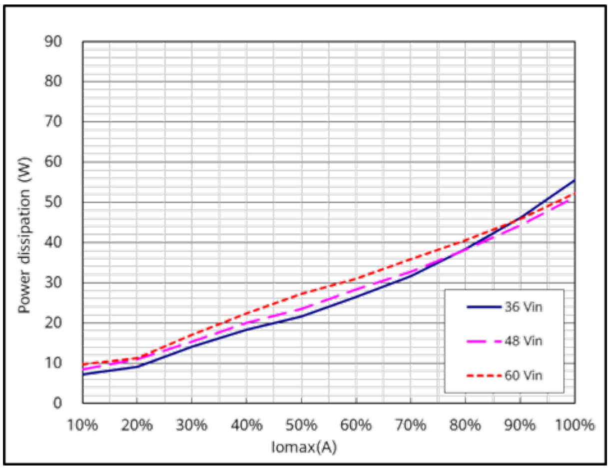
- Test conditions for external pull-up 3.3 V.

3 Characteristic Curves

Conditions: T_A = 25°C unless otherwise specified



Efficiency



Power dissipation

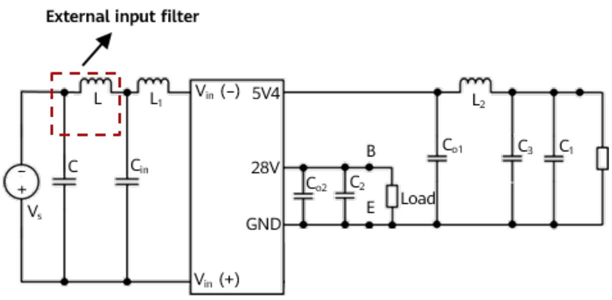
4 Typical Waveforms

NOTE

1.During the test of input reflected ripple current, the input must be connected to an external input filter (including a 12 μH inductor and a 220 μF electrolytic capacitor), which is not required in other tests.

2.Points A, B and E are used for testing the output voltage ripple.

Figure 4-1 Test setup diagram



C_{in}: The 1000 μF aluminum electrolytic capacitor is recommended. ESR < 300 mohm.

C_{o1}: The 300 μF solid aluminum capacitor is recommended.

C_{o2}: The 2700 μF capacitor is recommended. The ESR of C_{o2} should be less than 350 milliohms.

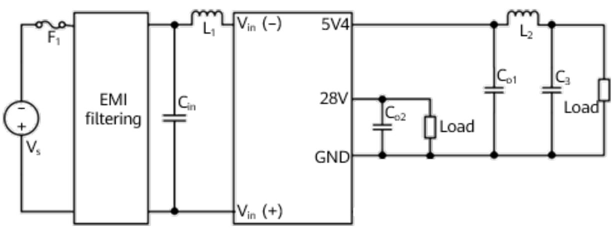
C_1, C_2: The 0.1 μF ceramic capacitor and 10 μF aluminum electrolytic capacitor connected in parallel are recommended.

C_3: The 100 μF solid aluminum or ceramic capacitor and 44 μF ceramic capacitor are recommended.

L_1: SMT inductor, 1.0 μH

L_2: Power inductor, 0.1 μH

Figure 4-2 Typical circuit applications



F_1: 45 A fuse (fast-blow)

C_3: The 100 μF solid aluminum or ceramic capacitor and 44 μF ceramic capacitor are recommended.

C_{in}: The 1000 μF aluminum electrolytic capacitor is recommended. ESR < 300 mohm.

L1: SMT inductor, 1.0 μH

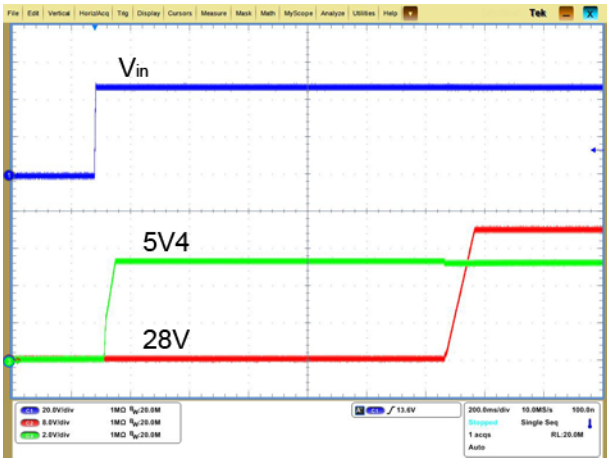
C_{o1}: The 300 μF solid aluminum capacitor is recommended.

L2: Power inductor, 0.1 μH

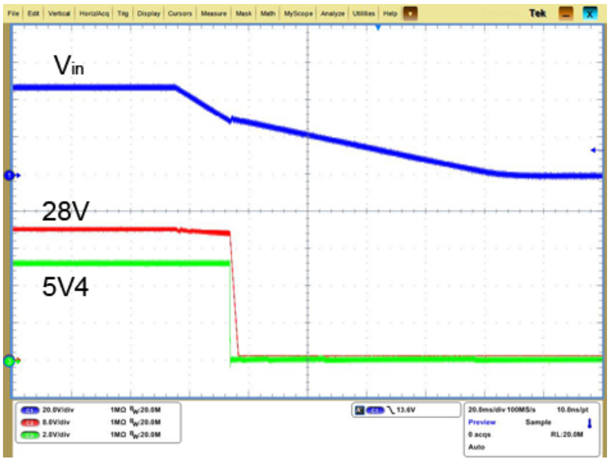
C_{o2}: The 2700 μF capacitor is recommended. The ESR of C_{o2} should be less than 350 milliohms.

4.1 Turn-on/Turn-off

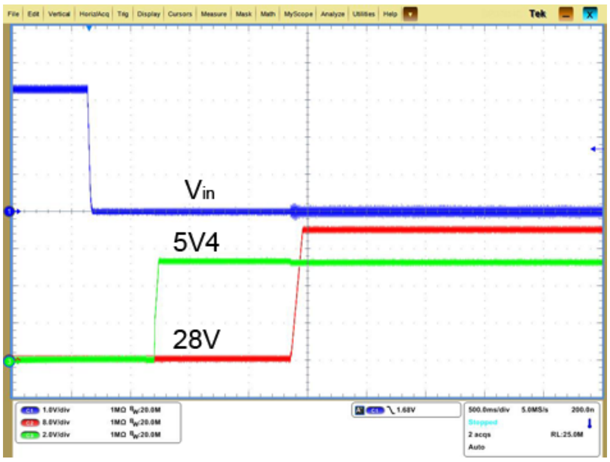
Conditions: T_A = 25°C unless otherwise specified



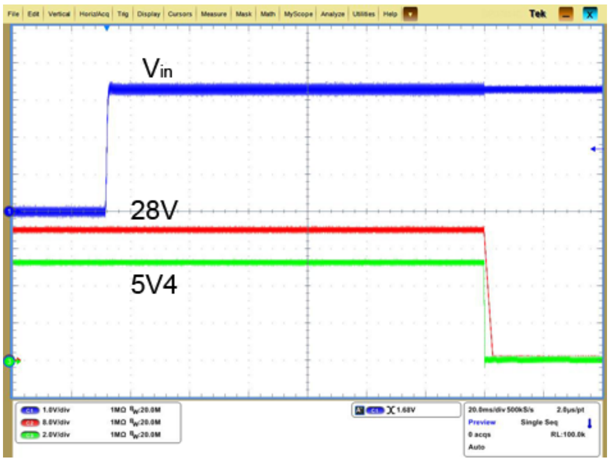
Startup by power-on



Shutdown by power-off



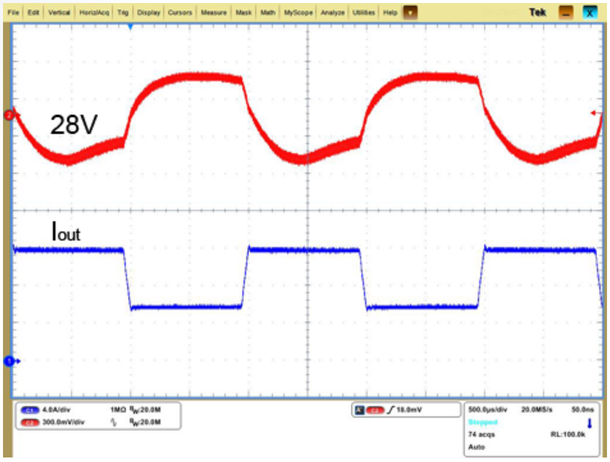
Remote power-on



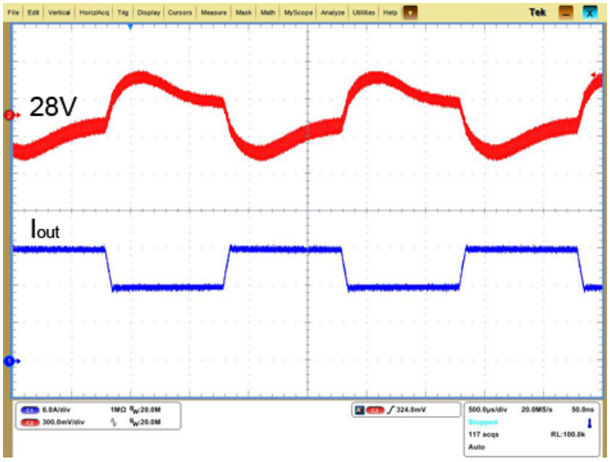
Remote power-off

4.2 Output Voltage Dynamic Response

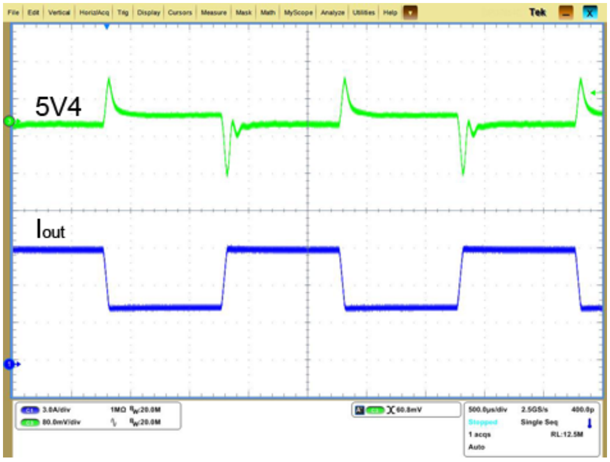
Conditions: T_A = 25°C unless otherwise specified



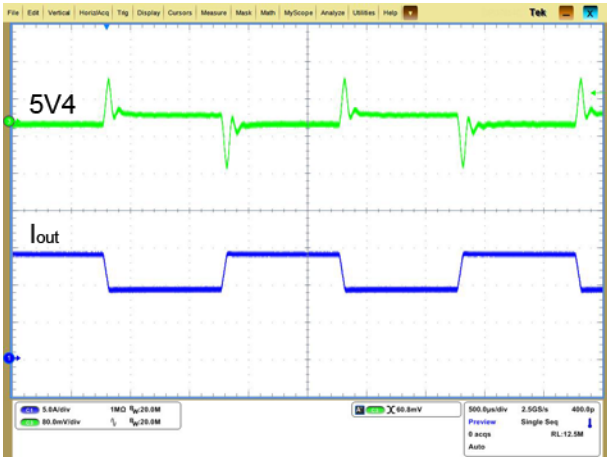
Output voltage dynamic response (28V)
(load: 25%–50%–25%, di/dt = 1 A/µs, T = 1 ms)



Output voltage dynamic response (28V)
(load: 50%–75%–50%, di/dt = 1 A/µs, T = 1 ms)

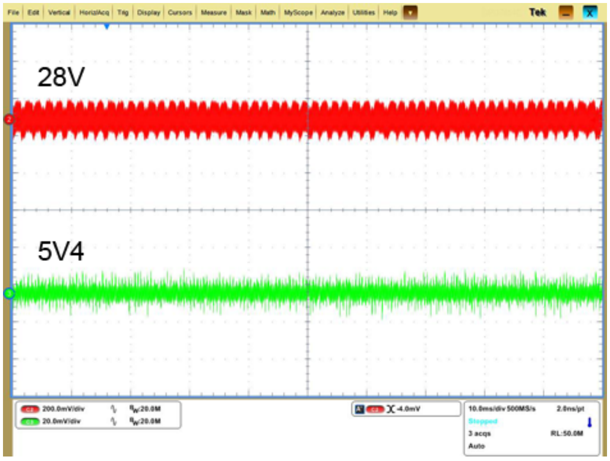


Output voltage dynamic response (5V4)
(load: 25%–50%–25%, di/dt = 0.1 A/µs,
T = 1 ms)



Output voltage dynamic response (5V4)
(load: 50%–75%–50%, di/dt = 0.1 A/µs,
T = 1 ms)

4.3 Output Voltage Ripple



Output voltage ripple
(for points AE, BE in the test set-up diagram, V_{in} = 48 V)

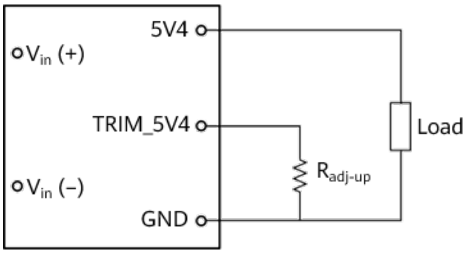
5 Output Voltage Trim

The 28V output voltage can be adjusted using the PMBus port.

The 5V4 output voltage can be adjusted within the trim range by using the TRIM_5V4 pin.

Trim Up

The output voltage can be increased by connecting an external resistor to the GND pin.



Relationship between R_{adj-up} and V_{5V4}:

$$R_{adj-up} = \frac{308.276 - 17.2184 \times V_{5V4}}{8.6092 \times V_{5V4} - 46.523} (k\Omega)$$

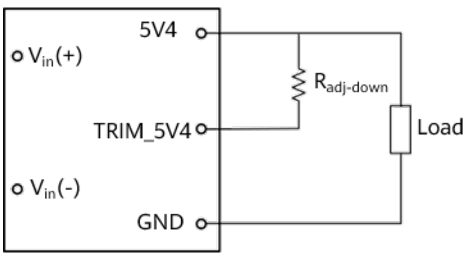
5.4 V < V_{5V4} ≤ 5.67 V

NOTE

If the TRIM_5V4 pin is not used, it should be left open.

Trim Down

The output voltage can be decreased by connecting an external resistor to the 5V4 pin.



Relationship between $R_{adj\text{-}down}$ and V_{5V4}:

$$R_{adj-down} = \frac{308.276 - 103.3104 \times V_{5V4}}{8.6092 \times V_{5V4} - 46.523} (k\Omega)$$

$5.13\ V \le V_{5V4} < 5.4\ V$

6 Protection Characteristics

- **Input Undervoltage Protection**

  The converter will shut down after the input voltage drops below the undervoltage protection threshold. The converter will start to work again after the input voltage reaches the input undervoltage recovery threshold. For the hysteresis, see **Input protection**.
- **Output Overvoltage Protection**

  When the output voltage exceeds the output overvoltage protection threshold, the converter will enter hiccup mode. When the fault condition is removed, the converter will automatically restart.
- **Output Overcurrent Protection**

  The converter equipped with current limiting circuitry can provide protection from an output overload or short circuit condition. If the output current exceeds the output overcurrent protection setpoint, the converter enters hiccup mode. When the fault condition is removed, the converter will automatically restart.
- **Overtemperature Protection**

  A temperature sensor on the converter senses the average temperature of the converter. It protects the converter from being damaged at high temperatures. When the temperature exceeds the overtemperature protection threshold, the output will shut down. It will allow the converter to turn on again when the temperature of the sensed location falls by the value of the overtemperature protection hysteresis.

7 Communication

7.1 Signal Specifications

Table 7-1 PMBus signal interface characteristics

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Logic input low (V_{IL})	-	-	0.8	V	-
Logic input high (V_{IH})	2.1	-	3.6	V	-
Logic output low (V_{OL})	-	-	0.4	V	I_{OL} = –13 mA
Logic output high (V_{OH})	2.4	-	3.6	V	I_{OH} = 10 mA
PMbus setting-up time (T_{set})	250	-	-	ns	For details about the values of T_{set} and T_{hold}, see 7.2.3 Data Transmission Mode.
PMBus holding time (T_{hold})	300	-	-	ns	

Table 7-2 PMBus detection precision

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Input voltage detection precision	–1.5	-	1.5	V	V_{in} = 36–60 V
Output voltage detection precision	–1.5	-	1.5	V	
Output current detection precision	–2	-	2	A	
Temperature detection precision	–5	-	5	°C	V_{in}= 36–60 V; I_{out} = I_{max}; T_A = –40°C to +125°C

7.2 Data Link Layer Protocol

The link layer uses the PMBus V1.2 protocol and complies with *PMBus_Specification_Part_I_Rev_1-2_20100906* and *PMBus_Specification_Part_II_Rev_1-2_20100906*.

7.2.1 PMBus Address

The following table describes the mapping between the Address and PMBus address. If the ADDRESS pin is not used, it should be left open and the default PMBus address is 0x5B. Relationship between PMBus address and Address:

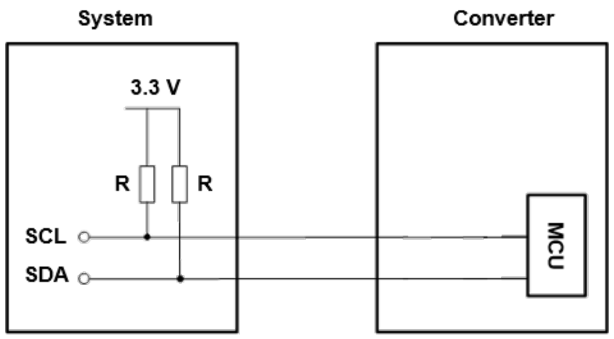
D = 12 x 7 + Address

R_{ADR} (kΩ)	Pin Voltage (V)	Address	PMBus address
1–15	0–0.165	0	0x54
22	0.198–0.242	1	0x55
30	0.270–0.330	2	0x56
51	0.459–0.561	3	0x57
80.6	0.725–0.887	4	0x58
113	1.017–1.243	5	0x59
150	1.350–1.650	6	0x5A
Left open	1.980–2.500	7	0x5B

7.2.2 SCL and SDA

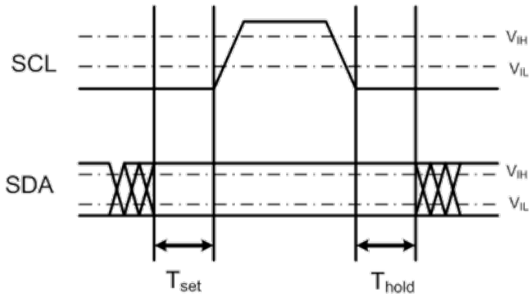
The SCL and SDA are each connected to a pull-up resistor and connected to the communication bus through the fault isolation circuit. Figure 7-1 shows the interconnect diagram of SCL and SDA.

Figure 7-1 Interconnect diagram of SCL and SDA



7.2.3 Data Transmission Mode

The converter supports both 100 kHz (default) and 400 kHz clock rates. T_{set} is the duration for which SDA keeps its value unchanged before SCL increases. T_{hold} is the duration for which SDA keeps its value unchanged after SCL decreases. Communication will fail if the time is not consistent with the specifications.



7.3 Network Layer Protocol

7.3.1 Slave Addressing Method

The converter serves as the slave device, and the converter address is identified by the hardware and assigned in static mode. The master device accesses slave devices independently based on the slave device addresses determined by the hardware.

7.3.2 Checksum

To ensure data integrity and accuracy during communication, the converter uses the 8-bit CRC checksum mechanism.

The last byte sent for each communication is the CRC checksum for the communication data. For example, the last byte of the data returned by the converter is the checksum.

The CRC checksum is generated using the multinomial: CRC8.

7.3.3 Data Transmission

The converter complies with standard PMBus communication data formats. The data in each PMBus communication data format carries the CRC checksum.

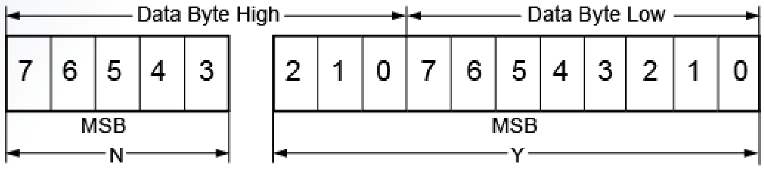
7.4 Application Layer Protocol

7.4.1 Data Format

Linear 11 Data Format

The linear data format is a two-byte value with a 11-bit binary signed mantissa (two's complement) and a 5-bit binary signed exponent (two's complement), as shown in the following figure.

Figure 7-2 Linear 11 data format



The relationship between N, Y, and actual value X is given by the following equation:

$$X = Y \times 2^N$$

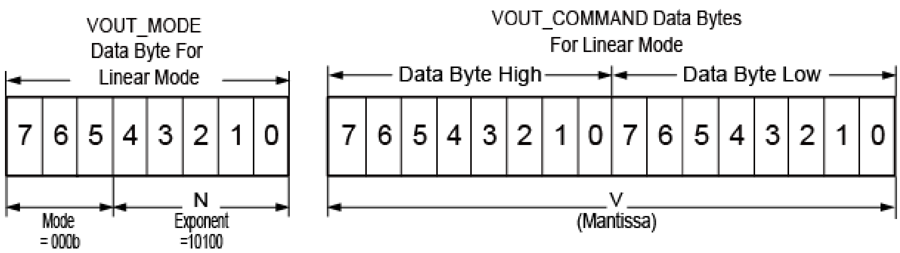
Where:

- Y is the 11-bit, binary signed mantissa (two's complement).
- N is the 5-bit, binary signed exponent (two's complement).

Linear 16 Data Format

The linear data format consists of two parts, with a 16-bit binary unsigned mantissa and a 5-bit binary signed exponent (two's complement), as shown in the following figure.

Figure 7-3 Linear 16 data format



The output voltage is calculated as follows:

$$Voltage = V \times 2^N$$

Where:

- Voltage is the output voltage value.
- V is the 16-bit unsigned integer.
- N is the 5-bit signed integer (two's complement). N = –12

7.4.2 Commands

Hex Code	Command Name	Data Type	Data Format
0x00	PAGE	Read Byte	Unsigned
0x01	OPERATION	Read/Write Word	Unsigned

Hex Code	Command Name	Data Type	Data Format
0x03	CLEAR_FAULTS	Sent Byte	-
0x11	STORE_DEFAULT_ALL	Sent Byte	-
0x20	VOUT_MODE	Read Byte	Unsigned
0x21	VOUT_COMMAND	Read/Write Word	Linear 16 Q9
0x78	STATUS_BYTE	Read Byte	Unsigned
0x79	STATUS_WORD	Read Word	Unsigned
0x7A	STATUS_VOUT	Read Byte	Unsigned
0x7B	STATUS_IOUT	Read Byte	Unsigned
0x7C	STATUS_INPUT	Read Byte	Unsigned
0x7D	STATUS_TEMPERATURE	Read Byte	Unsigned
0x80	MFR_SPECIFIC	Read Byte	Unsigned
0x88	READ_VIN	Read Word	Linear 11
0x89	READ_IIN	Read Word	Linear 11
0x8B	READ_VOUT	Read Word	Linear 16 Q9
0x8C	READ_IOUT	Read Word	Linear 11
0x8D	READ_TEMPERATURE	Read Word	Linear 11
0xEA	rw_bbox_frame_id	Read/Write Word	Unsigned
0xEB	read_bbox_frame_data	Read Block	Unsigned
0xEC	bbox_sys_time	Read/Write Block	Unsigned
0xEF	read_bbox_frame_num	Read Word	Unsigned
0xF3	SOFTWARE_VERSION	Read Word	Unsigned
0xF7	SOFTWARE_VERSION_2	Read Word	Unsigned
0xFB	SOFTLOAD_INFO	Read/Write Block	ASCII
0xFC	SOFTLOAD_CTRL	Read/Write Word	Unsigned
0xFD	MFR_DEVICE_ID	Read/Write Block	R: ASCII W: Unsigned

7.4.3 Command Descriptions

PAGE (0x00)

Used by the 50 V output of the converter for communication using PMBus.

CLEAR_FAULTS (0x03)

Clears all fault flags after a fault occurs.

STORE_DEFAULT_ALL (0x11)

Saves configuration parameters of users into Dflash.

VOUT_MODE (0x20)

Determines the data type and parameters.

VOUT_COMMAND (0x21)

Changes the output voltage of the converter. The default value is 28 V. Voltage adjustment range: 17–32 V.

SOFTWARE_VERSION_2 (0xF7)

Obtains the primary-side software version number. If the read value is 0000h, it indicates that there is no software on the primary side.

8 Mechanical Overview

Figure 8-1 Mechanical overview

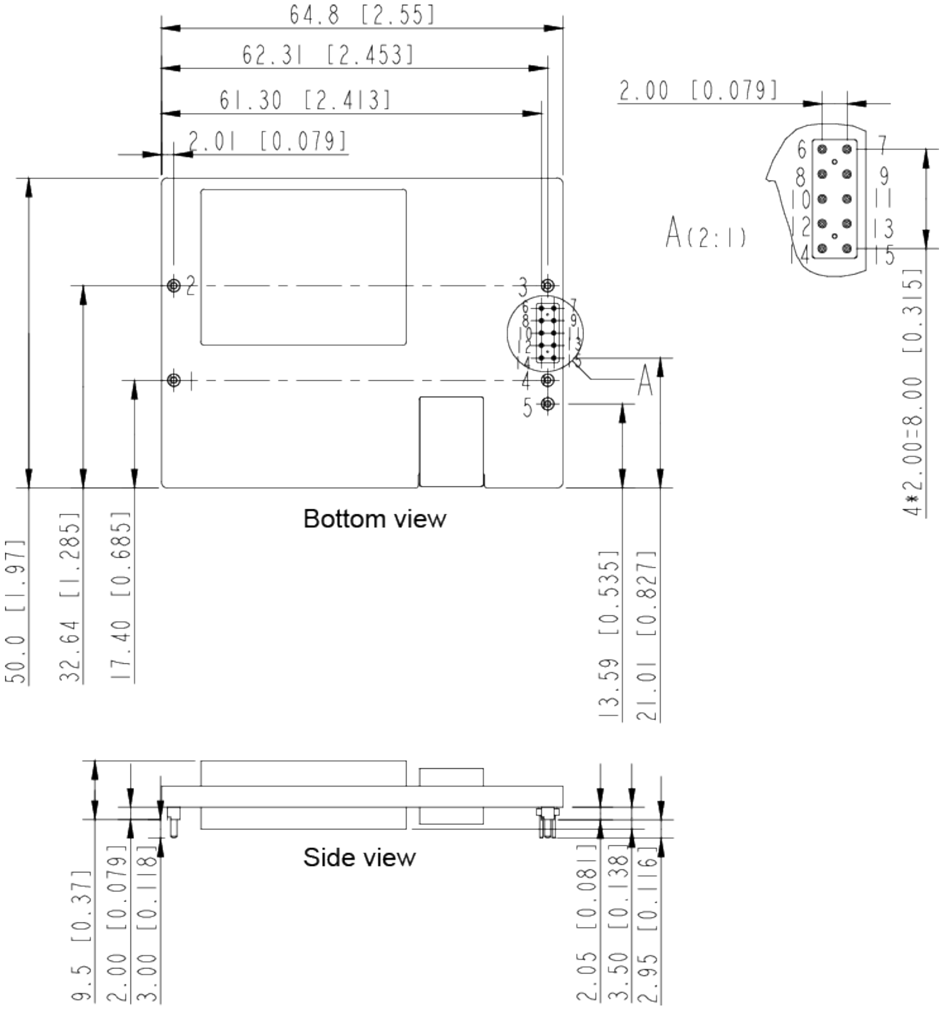


Table 8-1 Pin description

Pin No.	Pin name	Pin No.	Pin name
1	Vin+	9	AGND
2	Vin-	10	ADDRESS
3	GND	11	TRIM_5V4

Pin No.	Pin name	Pin No.	Pin name
4	28V	12	PWR_ALARM
5	5V4	13	PWR_I2C_RESET
6	REMOTE_POWER_OFF	14	PM_SCL
7	N10V_FAULT	15	PM_SDA
8	NC	-	-

NOTE

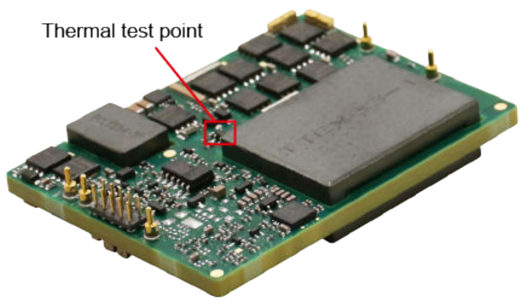
1. All dimensions in mm [in.].
   Tolerances: x.x ± 0.5 mm [x.xx ± 0.02 in.]; x.xx ± 0.25 mm [x.xxx ± 0.010 in.].
2. Pins 1–5 are 1.00 ± 0.05 mm [0.040 ± 0.002 in.] diameter with 2.00 ± 0.10 mm [0.080 ± 0.004 in.] diameter standoff shoulders. Pins 6–15 are 0.50 ± 0.05 mm [0.020 ± 0.002 in.] diameter.

9 Heat Dissipation Requirements

Thermal Test Point

Decide proper airflow to be provided by measuring the temperature of the thermal test point shown in **Figure 9-1** to protect the converter against overtemperature. The overtemperature protection threshold is obtained based on thermal test point.

Figure 9-1 Thermal test point



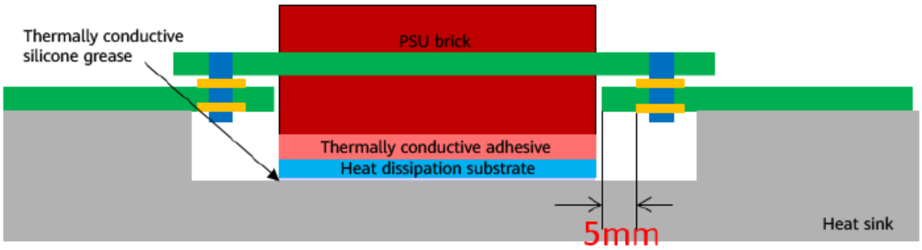
Heat Dissipation Mode

It is recommended that the converter use a shell for natural heat dissipation.

NOTE

- A layer of conformal coating must be applied to the contact surface between the heat dissipation substrate and the converter. The heat dissipation effect of the converter will be affected if multiple layers of conformal coating are applied. Converter withstand voltage: ≥ 1500 V.
- The recommended thermal conductivity of the thermal adhesive is greater than or equal to 3.5 W/mK.

Figure 9-2 Converter heat dissipation diagram



Power Dissipation

The converter power dissipation is calculated based on efficiency. The following formula reflects the relationship between the consumed power (P_d), efficiency (ŋ), and output power (P_o): $P_d = P_o (1 – ŋ)/ŋ$.

10 Safety

Reliability Characteristics

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Mean time between failures (MTBF)	-	2.5	-	Million hours	2.5 Telcordia SR332 Method 1 Case 3; 80% load T_A = 40°C Normal input/rated output; airflow rate = 1.5 m/s (300 LFM)

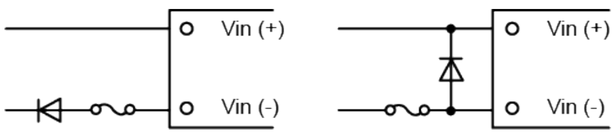
Recommended Fuse

The converter has no internal fuse. To meet safety requirements, a 45 A fuse is recommended.

Recommended Reverse Polarity Protection Circuit

Reverse polarity protection is recommended under installation and cabling conditions where reverse polarity across the input may occur.

Figure 10-1 Recommended reverse polarity protection circuit



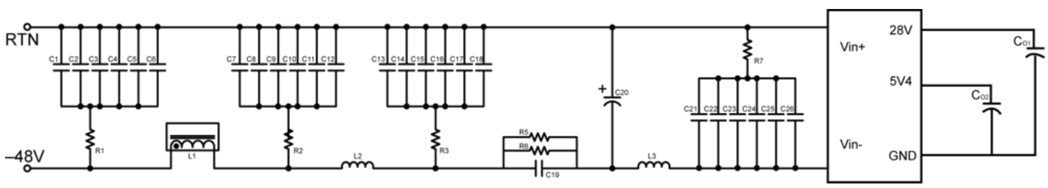
Qualification Testing

Parameter	Units	Condition
Highly accelerated life test	3	Low temperature limit: –60°C; high temperature limit: 110°C; vibration limit: 40 G; temperature change rate: 40°C per minute
Thermal shock	32	500 temperature cycles between –40°C and +125°C with the temperature change rate of 20°C per minute; lasting for 30 minutes both at –40°C and +125°C

Parameter	Units	Condition
Thermal humidity bias	32	Maximum input voltage; 85°C; 85% RH; 1000 operating hours under lowest load power
High temperature operation bias	32	Rated input voltage; airflow rate: 0.5 m/s (100 LFM) to 5 m/s (1000 LFM); ambient temperature between 45°C and 55°C; 1000 operating hours; 50% to 80% load
Power and temperature cycling test	32	Rated input voltage; airflow rate: 0.5 m/s (100 LFM) to 5 m/s (1000 LFM); ambient temperature between –40°C and +85°C; 1000 cycles; 50% load

EMC Specifications

Figure 10-2 EMC test set-up diagram



C1–C6: SMD ceramic capacitor, 1000 V, 2.2 nF

C7–C18, C21–C26: SMD ceramic capacitor, 100 V, 2.2 μF

C19: Chip multilayer ceramic capacitor, 100 V, 0.1 μF

C20: Non-solid THT aluminium capacitor, 80 V, 1000 μF

R1: Chip thick film resistor, 2 W, 0.068 Ω

R2, R3: Chip thick film resistor, 1 W, 0.02 Ω

R5, R6: Chip thick film resistor, 1 W, 0.005 Ω

L1: SMT inductor, 30 μH

L2, L3: SMT inductor, 1.4 μH

C_{O1}: 1000 μF capacitor with an ESR less than 350 milliohms

C_{O2}: Solid aluminum capacitor, 300 μF

Table 10-1 EMC specifications

Parameter	Criterion	Standard/Level
Conducted emission (CE)	CISPR 22	Criterion B
CS	0.15–80 MHz, 10 V [80% AM (1 kHz)]	IEC 61000-4-6, criterion A
DIP	40%/70%/0%	IEC 61000-4-29, criterion B

Parameter	Criterion	Standard/Level
	80%/120%	IEC 61000-4-29, criterion A
EFT/B	2 kV	IEC 61000-4-4, criterion B
Protection against lightning	Polarity: positive/negative, 5 times Common mode: 20 kA (8/20 µs) Differential mode: 10 kA (8/20 µs), 6 kA (16/40 µs)	-
ESD	8 kV	IEC 61000-4-2, criterion B
Surge	2 kV/4 kV	IEC 61000-4-5, criterion B

NOTE

The module should be cooperated with RRU to pass EMC standard.

MSL Rating

Store and transport the converter as required by the moisture sensitivity level (MSL) rating 3 specified in the IPC J-STD-020D/033C. The surface of a soldered converter must be clean and dry. Otherwise, the assembly, test, or even reliability of the converter will be negatively affected.

Mechanical Consideration

Installation

Although the converter can be mounted in any direction, free airflow must be available.

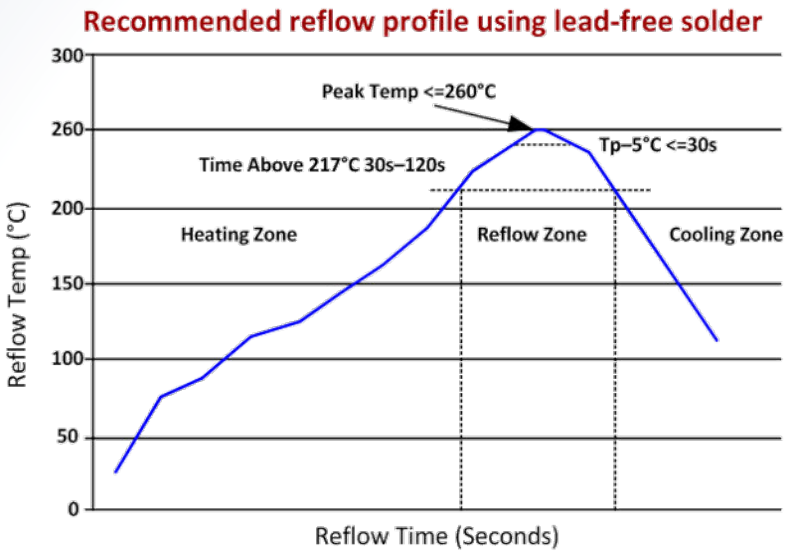
Soldering

The converter supports standard wave soldering, reflow soldering, and hand soldering.

- For wave soldering, the converter pins can be soldered at 260°C for less than 7 seconds.
- For reflow soldering, the converter pins can be soldered at 260°C.
- For hand soldering, the iron temperature should be maintained at 350°C to 420°C and applied to the converter pins for less than 10 seconds.

The converter can be rinsed using the isopropyl alcohol (IPA) solvent or other proper solvents.

Figure 10-3 Recommended reflow profile using lead-free solder



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