GBE30S3V3-E DC-DC Converter

Technical Manual

Issue 1.0

Date 2020-12-03

HUAWEI TECHNOLOGIES CO., LTD.

About This Document

Purpose

This document describes the GBE30S3V3-E DC-DC converter, including its electrical specifications, 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

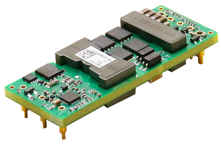
Changes between document issues are cumulative. The latest document issue contains all the changes made in earlier issues.

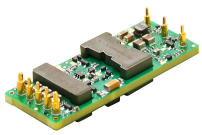
Issue 1.0 (2020-12-3)

This issue is the first release.

Contents

1 Product Overview





Product Description

The GBE30S3V3-E is a new generation isolated DC-DC converter that uses an industry standard eighth-brick structure, featuring high efficiency and power density with low output ripple and noise. It operates over an input voltage range of 36 V to 75 V, and provides the rated output voltage of 3.3 V as well as the maximum output current of 30 A.

Features

- Efficiency: 92.5% (T_A = 25°C, V_{in} = 48 V, 100% load)
- Length x Width x Height: 57.9 mm x 22.9 mm x 10.3 mm (2.28 in. x 0.90 in. x 0.41 in.)
- Weight: 27 g
- Input undervoltage protection, output overvoltage protection (hiccup mode), output overcurrent protection (hiccup mode), output short circuit protection (hiccup mode), overtemperature protection (self-recovery)
- Remote on/off and output voltage trim communication
- UL, CE certification
- UL 60950-1, UL 62368-1, EN 60950-1 and EN 62368-1
- RoHS6 compliant

Model Naming Convention

GBE	30	S	3V3	-	E
1	2	3	4		5

1 — 48 V input, high performance, analog control, eighth-brick

2 — Output current: 30 A

3 — Single output

4 — Output voltage: 3.3 V

5 — 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)	 - -	 - -	 80 100	 V V	When the input voltage is 75 V to 80 V, the converter must not be damaged. Not all the characteristic parameters should be conformed to the specification.
Operating ambient temperature (T_A)	–40	-	85	°C	-
Storage temperature	–55	-	125	°C	-
Operating humidity	5	-	95	% RH	Non-condensing
External voltage applied to ON/OFF	-	-	12	V	-
External voltage applied to Trim	-	-	3.5	V	-
Altitude	–60	-	5000	m	When the altitude above 1800 m, T_C derating applies decreases by 1°C for each additional 220 m.

2.2 Input

Table 2-2 Input specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Operating input voltage	36	48	75	V	-
Maximum input current	-	-	3.7	A	V_{in} = 0–75 V; I_{out} = 30 A
No-load loss	-	3.5	5	W	V_{in} = 48 V; I_{out} = 0 A
Input capacitance	100	100	-	μF	Aluminum electrolytic capacitor
Input transient response	-	-	-	V	0.25 V/μs input transient; 36 V to 48 V or 48 V to 75 V, at full load

2.3 Output

Table 2-3 Output specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Output voltage setpoint	3.23	3.30	3.37	V	V_{in} = 48 V; I_{out} = 15 A, T_A = 25°C
Output current	0	-	30	A	The maximum output current is 30 A when the output voltage is below 3.3 V, and the maximum output power is 99 W when the output voltage is above 3.3 V.
Output power	0	-	99	W	
Output line regulation	–0.3	-	0.3	%	V_{in} = 36–75 V; I_{out} = 30 A
Output load regulation	–0.5	-	0.5	%	V_{in} = 48 V; I_{out} = 0–30 A
Regulated voltage precision	–3	-	3	%	V_{in} = 36–75 V; I_{out} = 0–30 A

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Temperature coefficient	–0.02	-	0.02	%/°C	T_A = –40°C to +85°C (–40°F to +185°F)
External capacitance	470	470	5000	µF	470 µF: solid aluminum capacitor, and the layout distance of minimum capacitor must be within 3 cm, T_A = –40°C to +85°C
Output voltage ripple and noise (peak-to-peak)	-	-	100	mV	Bandwidth: 20 MHz
Output voltage Trim range	3.0	-	3.6	V	-
Output voltage overshoot	-	-	8	%	Output power ≤ 70 W, the board need a diode with reverse input current protection. The output voltage overshoot ≤ 15% in all operating condition, the output voltage overshoot is worsen in case of DIP of the input voltage.
Output voltage delay time	-	-	200	ms	From V_{in} connection to 10% V_{out}
Output voltage rise time	-	-	20	ms	The output voltage is from 0.33 V to 2.97 V
Switching frequency	-	380	-	kHz	-

2.4 Protection

Table 2-4 Input protection

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Input undervoltage protection startup threshold	31	34	36	V	-

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Input undervoltage protection shutdown threshold	30	32	35	V	-
Input undervoltage protection hysteresis	1	2	3	V	-

Table 2-5 Output protection

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Output overvoltage protection	115	-	150	% V_{oset}	Hiccup mode The output overvoltage protection function will not be triggered when the Trim pin and the Sense (+) pin are short-circuited.
Output short-circuit protection	-	-	-	-	Hiccup mode
Output overcurrent protection	110	-	160	% I_{omax}	
Overtemperature protection threshold	105	115	130	°C	Self-recovery The values are obtained by measuring the temperature of the PCB near the thermistor Rt.
Overtemperature protection hysteresis	5	-	-	°C	

2.5 Dynamic Characteristics

Table 2-6 Dynamic characteristics

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Overshoot amplitude	-	-	150	mV	Current change rate: 0.1 A/μs; load: 25%–50%–25%, 50%–75%–50%
Overshoot recovery time	-	-	200	μs	
Overshoot amplitude	-	-	180	mV	Current change rate: 1 A/μs; with 1000 μF external output

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Overshoot recovery time	-	-	300	µs	aluminum electrolytic capacitor load: 25%–50%–25%, 50%–75%–50%

NOTE

Larger than 80% load step, there is no special standard.

2.6 Efficiency

Table 2-7 Efficiency specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
100% load	91.0	92.5	-	%	T_A = 25°C; V_{in} = 48 V; V_{out} = 3.3 V
50% load	90.5	92.0	-	%	
25% load	86.0	87.5	-	%	

2.7 Insulation Characteristics

Table 2-8 Insulation characteristics

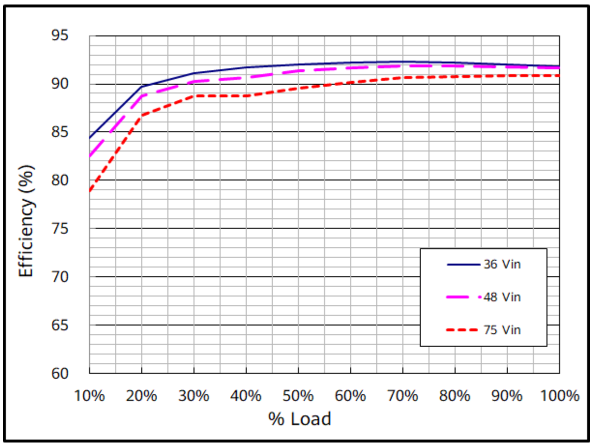
Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Input-output insulation voltage	-	-	1500	V	Basic insulation (1-minute test); altitude: 3000 m (70 kPa); leakage current < 1 mA; without arc or breakdown
Input-output insulation voltage	-	-	1500	V	Functional insulation (1-minute test); altitude: 5000 m (54 kPa); leakage current < 1 mA; without arc or breakdown

2.8 Other Characteristics

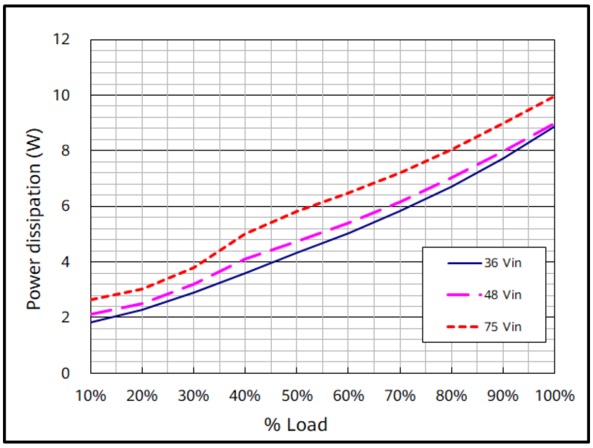
Table 2-9 Other characteristics

Parameter	Minimum	Typical	Maximum	Unit	Notes & Conditions
Remote On/Off voltage low level	–0.7	-	0.75	V	Negative logic
Remote On/Off voltage high level	3.5	-	12.0	V	
On/Off current low level	-	-	1.0	mA	-
On/Off current high level	-	-	-	μA	
+SENSE	-	-	-	% V_o	1. If the sense compensation function is not used, the Sense pin and the V_{out} pin need to be short-circuited nearby. 2. The maximum port voltage of the module should not exceed 3.6 V when the sense compensation function is used.
-SENSE	-	-	-	% V_o	
Mean time between failures (MTBF)	-	2.5	-	Million hours	Telcordia, SR332 Method 1 Case 3; 80% load, normal input/rated output; T_A = 40°C; 300 LFM

3 Characteristic Curves



Efficiency curve
(T_A = 25°C; V_{in} = 36 V, 48 V, or 75 V)



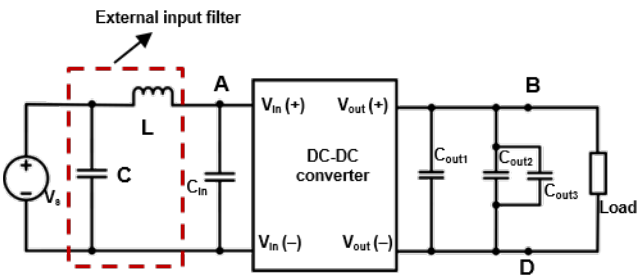
Power dissipation curve
(T_A = 25°C; V_{in} = 36 V, 48 V, or 75 V)

4 Typical Waveforms

NOTE

- During the test of input re lected ripple current, the input terminal must be connected to the external input fflter (include a 12 μH inductor and a 220 μF electrolytic capacitor), which is not required in other tests.
- Points B and D, which are used for testing the output voltage ripple, are 25 mm (0.98 in.) away from the V_{out} (+) pin and the V_{out} (–) pin, respectively.
- The DC-DC converter should be applied to the board with a diode with reverse input current protection.

Figure 4-1 Test set-up diagram



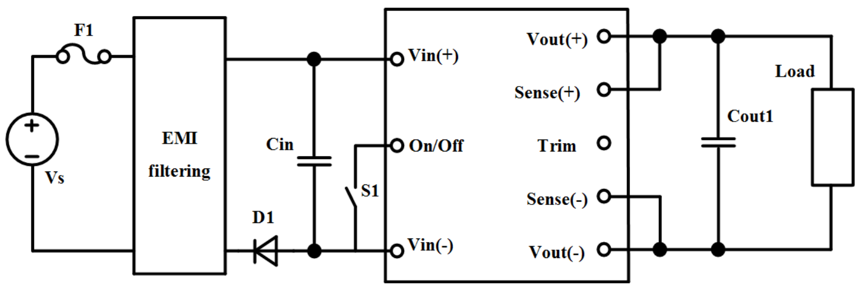
C_{in}: The 100 μF aluminum electrolytic capacitor is recommended.

C_{out1}: The 470 μF solid aluminum capacitor is recommended.

C_{out2}: The 0.1 μF ceramic capacitor is recommended.

C_{out3}: The 10 μF electrolytic capacitor is recommended.

Figure 4-2 Typical circuit applications



F_1: 7 A fuse (fast blowing).

C_{in}: The 100 μF aluminum electrolytic capacitor is recommended.

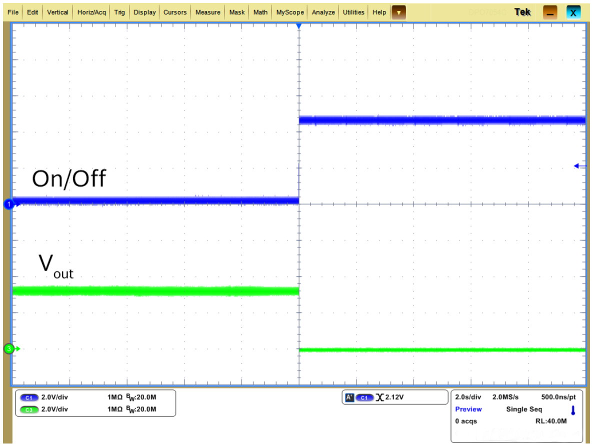
C_{out1}: The 470 μF solid aluminum capacitor is recommended.

D1: Fast recovery diode, 300 V/10 A recommended (The specifications can be selected based on the actual situation.)

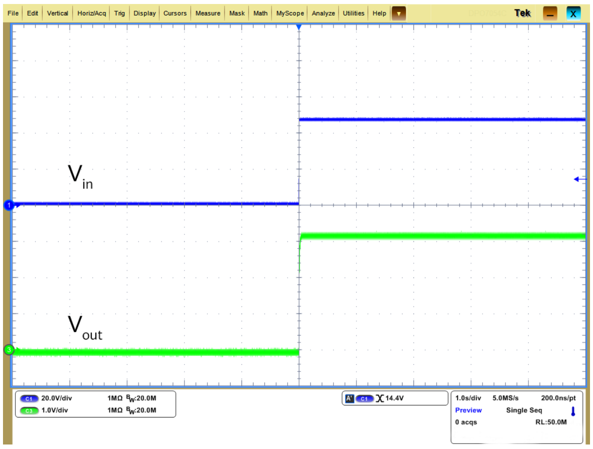
4.1 Turn-on/Turn-off

Conditions: T_A = 25°C, V_{in} = 48 V

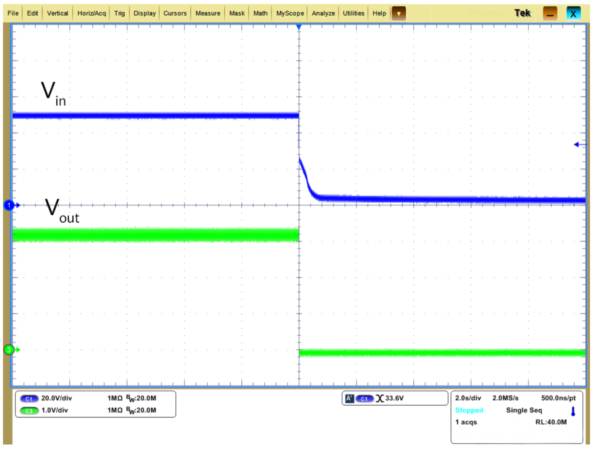
Startup from On/Off



Shutdown from On/Off

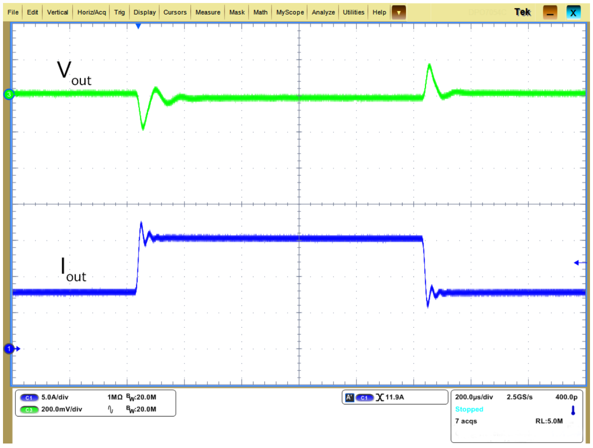


Startup by power-on

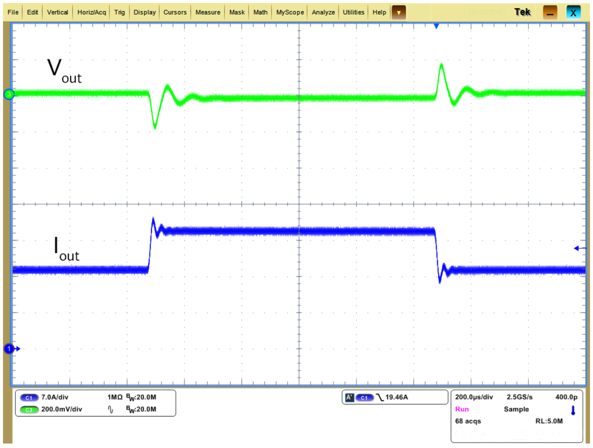


Shutdown by power-off

4.2 Output Voltage Dynamic Response

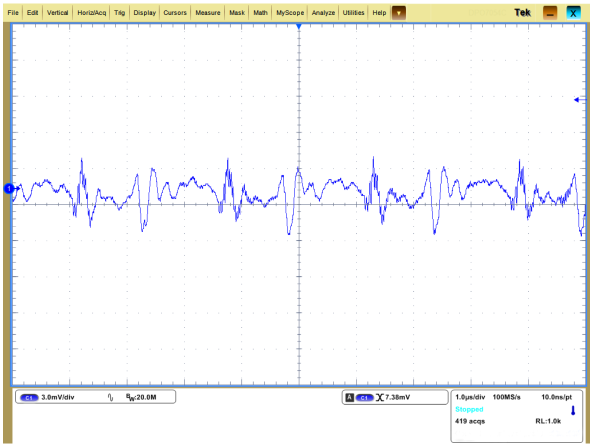


Output voltage dynamic response
(Load: 25%–50%–25%, di/dt = 0.1 A/μs)



Output voltage dynamic response
(Load: 50%–75%–50%, di/dt = 0.1 A/μs)

4.3 Output Voltage Ripple



Output voltage ripple

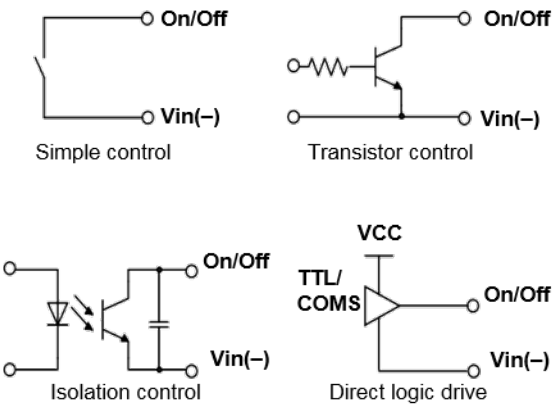
5 Control Characteristic

5.1 Remote On/Off

The main output of module can be turned on or turned off by On/Off signal.

Logic Enable	On/Off Pin Level	Status
Negative logic	Low level	On
	High level	Off

Figure 5-1 Various circuits for driving the On/Off pin

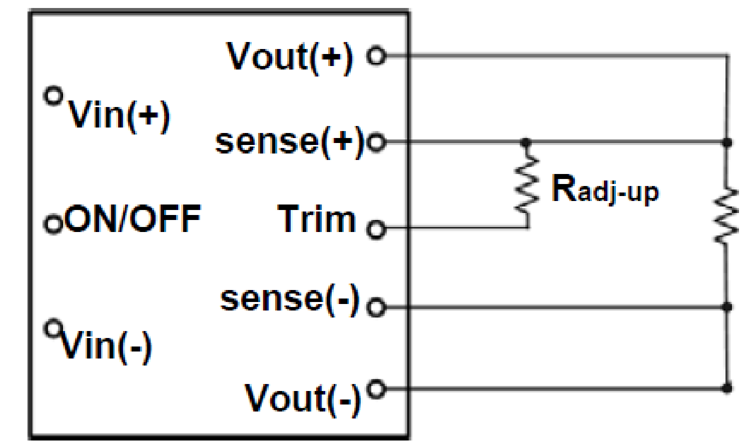


5.2 Output Voltage Trim

Trim Up

The output voltage can be increased by installing an external resistor between the Trim pin and the Sense (+) pin.

Figure 5-2 Configuration diagram for Trim up



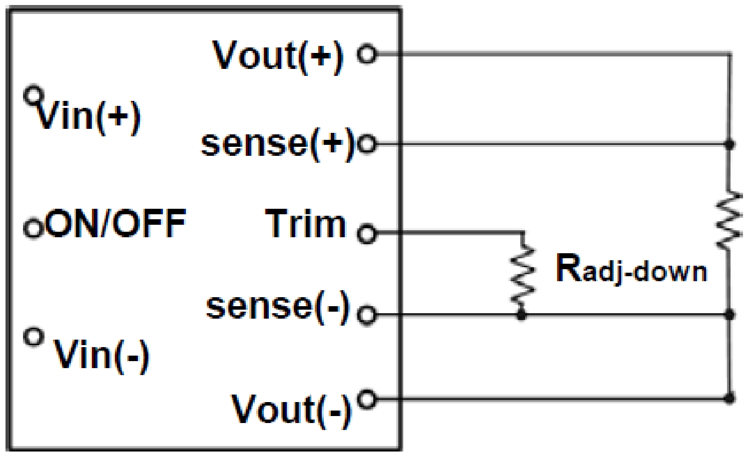
The relationship between R_{adj-up} and V_{out}:

$$R_{adj-up} = \frac{5.11 \times V_{nom} \times (100+\Delta)}{2.5 \times \Delta} - \frac{511}{\Delta} - 10.22\ (k\Omega)$$

$$\Delta = \frac{V_{out} - V_{nom}}{V_{nom}} \times 100$$

Trim Down

Figure 5-3 Configuration diagram for Trim down



The relationship between $R_{adj-down}$ and V_{out}:

$$R_{adj-down} = \frac{511}{\Delta} - 10.22\ (k\Omega)$$

$$\Delta = \frac{V_{nom} - V_{out}}{V_{nom}} \times 100$$

NOTE

1. If the Trim pin is not used, it should be left open.
2. Ensure that the output voltage trim range and actual output power do not exceed the maximum value when raising the voltage.

5.3 Remote Sense

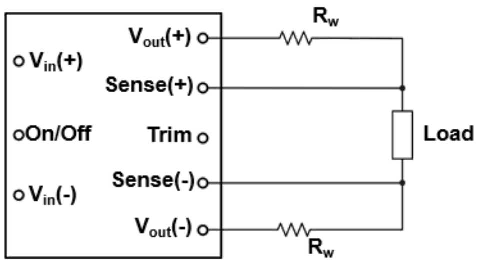
This function is used to compensate for voltage drops on R_w, which indicates the line impedance between the output and the load. Sense (+), Sense (–), V_{out} (+), and V_{out} (–) should meet the following requirements:

3.3 V ≤ |V_{out} (+) –V_{out} (–)| ≤ 3.6 V

NOTE

1. The maximum port voltage of the module should not exceed 3.6 V when the sense compensation function is used.
2. V_{nom} is the rated output voltage.

Figure 5-4 Configuration diagram for remote sense



R_w indicates the line impedance between the output terminal and the load.

If the remote sense function is disabled, the Sense (+) terminal directly connects to the V_{out} (+) terminal and the Sense (–) terminal directly connects to the V_{out} (–) terminal.

6 Protection Characteristic

- **Input Undervoltage Protection**

  The converter will shut down after the input voltage drops below the undervoltage protection threshold for shutdown. The converter will start to work again after the input voltage reaches the input undervoltage protection threshold for startup. For the hysteresis, see **Table 2-4**.

- **Output Overvoltage Protection**

  When the voltage directly across the output pins exceeds the output overvoltage protection threshold, the converter will enter hiccup mode. When the fault condition is removed, the converter will automatically restart, see **Table 2-5**.

- **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 threshold, 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 module. 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 Overtemperature Protection Hysteresis.

7 Mechanical Overview

Figure 7-1 Mechanical overview

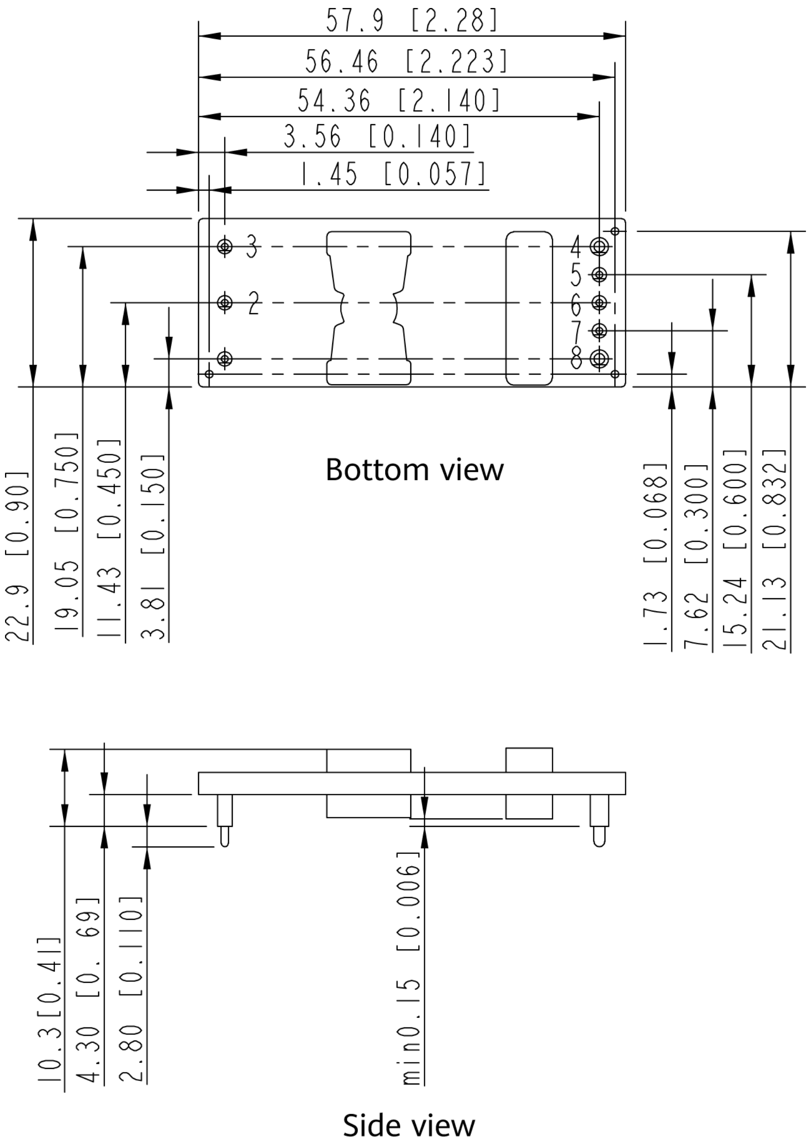


Table 7-1 Pin description

Pin No.	Function	Pin No.	Function
1	V_{in} (+)	5	Sense (–)
2	ON/OFF	6	Trim
3	V_{in} (–)	7	Sense (+)
4	V_{out} (–)	8	V_{out} (+)

NOTE

1. All dimensions are 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 1-3, 5-7 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. Pin 4 and pin 8 are 1.50 ± 0.05 mm [0.060 ± 0.002 in.] diameter with 2.50 ± 0.10 mm [0.098 ± 0.004 in.] diameter standoff shoulders.
3. Components will vary between models.

8 Safety

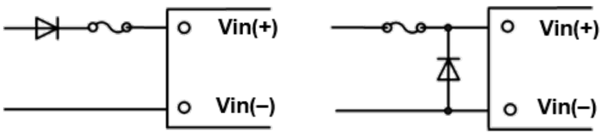
8.1 Recommended Fuse

The converter has no internal fuse. To meet safety requirements, a 7 A fuse is recommended.

8.2 Recommended Reverse Polarity Protection Circuit

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

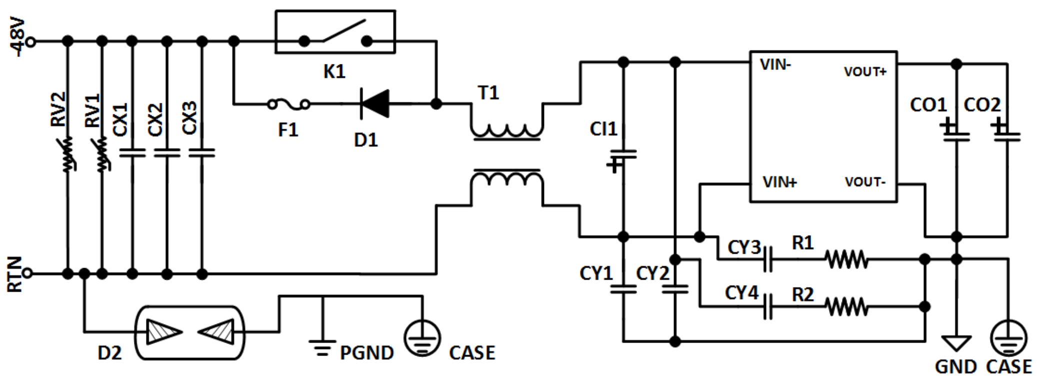
Figure 8-1 Recommended reverse polarity protection circuit



8.3 EMC Specifications

The EMC test set-up diagram shown in **Figure 8-2**. The acceptance standard must meet the requirements of the conducted emission limits of CISPR22 Class A with 6 dB margin.

Figure 8-2 EMC test set-up diagram



D1	Schottky diode, 400 V, 16 A
D2	Gas discharge tube, 90 V, 10 kA
RV1, RV2	Varistor, 100 V, 4500 A
CX1–CX3	Metalized film capacitor, 275 V, 1 μF
F1	125 V, 3 A fuse (slow blowing)
K1	30 A
T1	EMI common-mode inductor, 400 μH
CI1	Aluminum electrolytic capacitor, 100 μF
CY1, CY2	Metalized film capacitor, 275 V, 0.1 μF
CY3, CY4	Chip multilayer ceramic capacitor, 1000 V, 22 nF
R1, R2	Chip thick film resistor, 1 W, 1 Ω
CO1, CO2	Non-solid radial lead aluminum electrolytic capacitor, 220 μF

NOTE

This is a class A product. In residential areas, this product may cause radio interference. Therefore, users may be required to take appropriate measures.

8.4 Qualification Testing

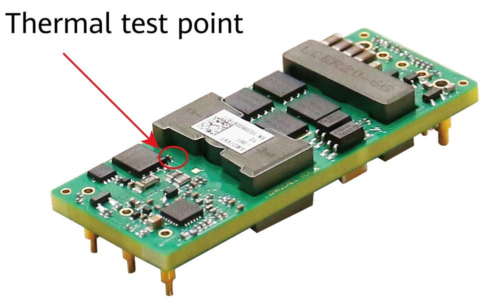
Parameter	Units	Condition
Highly accelerated life test (HALT)	6	Low temperature limit: –60°C; high temperature limit: 110°C; vibration limit: 40 G; temp change rate: 40 °C/min; vibration freq range: 10 Hz to 10000 Hz; axes of vibration: X/Y/Z
Thermal humidity bias (THB)	16	Maximum input voltage; 85°C; 85% RH; 1000 operating hours under lowest load power
High temperature operation bias (HTOB)	16	Rated input voltage; air flow: 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 (PTC)	32	Rated input voltage; 50% load; ambient temperature between –40°C and +85°C; airflow rate between 0.5 m/s (100 LFM) and 5.0 m/s (1000 LFM); 1000 cycles

8.5 Thermal Consideration

Thermal Test Point

Decide proper airflow to be provided by measuring the temperature of the PCB near the thermal resistor shown in **Figure 8-3** to protect the converter against overtemperature. The overtemperature protection threshold is also obtained based on the thermal test point.

Figure 8-3 Thermal test point



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): $P_d = P_o(1-ŋ)/ŋ$.

8.6 MSL Rating

Store and transport the converter as required by the moisture sensitivity level (MSL) rating 3 specified in the J-STD-020/033C. 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.

8.7 Mechanical Consideration

Installation

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

Soldering

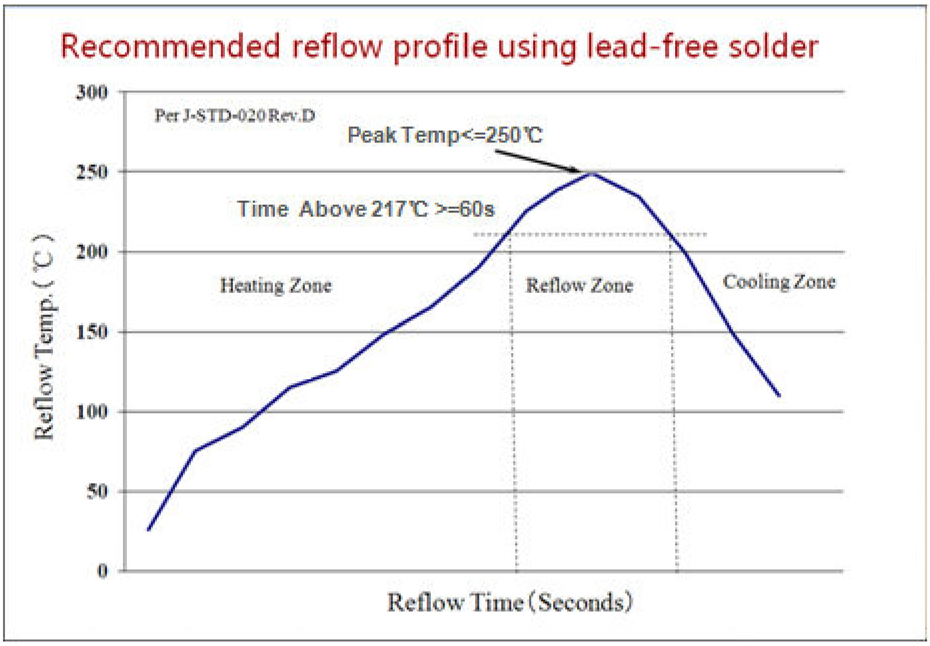
The converter is compatible with standard wave soldering, reflow soldering and hand soldering.

1. For wave soldering, the converter pins can be soldered at 260°C for less than 7 seconds.

2. For reflow soldering, the temperature on body is specified to maximum 250°C for maximum 10s.
3. 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 suitable solvents.

Figure 8-4 Recommended reflow profile using lead-free solder



Trademarks and Permissions

Notice

Huawei Technologies Co., Ltd.

Huawei Industrial Base
Bantian, Longgang
Shenzhen 518129
People's Republic of China

www.huawei.com