GDQ75S12B-4P
DC-DC Converter Technical Manual V1.1

Standard quarter-brick DC-DC Converter	36 V to 75 V Input	12 V Output Voltage	75 A Output Current	Negative Logic

Description

The GDQ75S12B-4P is a new generation isolated DC-DC converter that uses an industry standard quarter-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 75 V, and provides the rated output voltage of 12 V as well as the maximum output current of 75 A.

GDQ75S12B-4P

Operational Features

- Input voltage: 36 V to 75 V
- Maximum output current: 75 A
- Efficiency: 96.5% (V_{in} = 48 V, I_{out} = 37.5 A; V_{in} = 36 V, I_{out} = 37.5 A)

Mechanical Features

- Industry standard quarter-brick (L x W x H): 57.9 x 36.8 x 13.4 mm (2.28 x 1.45 x 0.53 in.)
- Weight: 85 g

Control Features

- Remote On/Off
- PMBus communication

Protection Features

- Input undervoltage protection
- Output overcurrent protection (hiccup mode)
- Output short circuit protection (hiccup mode)
- Output overvoltage protection (hiccup mode)
- Overtemperature protection (self-recovery)

Safety Features

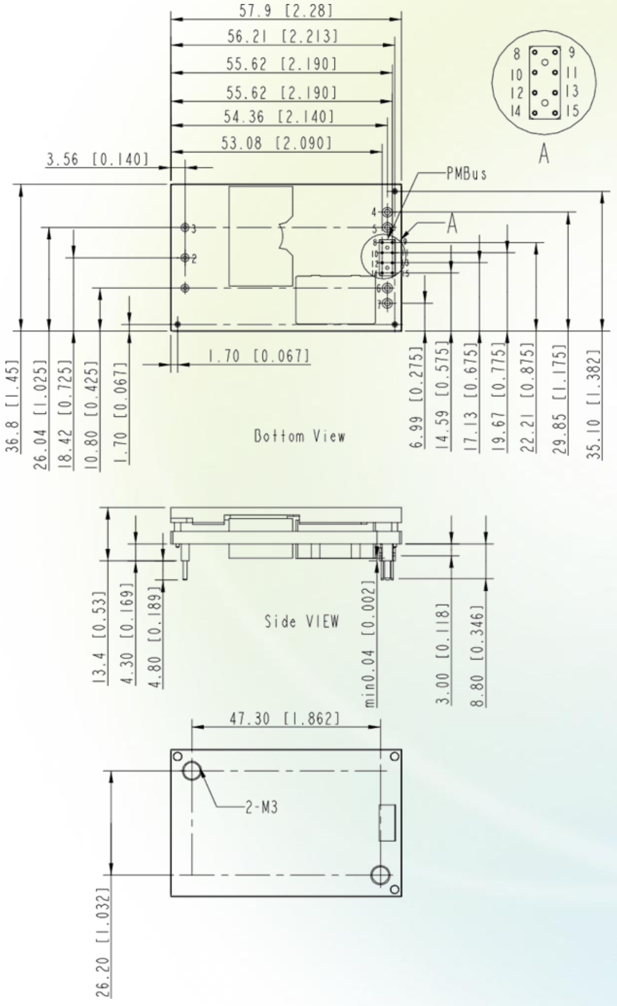
- UL certification
- UL 60950-1, C22.2 No. 60950-1 compliant
- RoHS6 compliant

Model Naming Convention

<u>GDQ</u>	<u>75</u>	<u>S</u>	<u>12</u>	<u>B</u>	-	<u>4</u>	<u>P</u>
1	2	3	4	5		6	7

1 — 48 V input, high performance, digital control, standard quarter-brick
2 — Output current: 75 A
3 — Single output
4 — Output voltage: 12 V
5 — With a baseplate
6 — Pin length: 4.8 mm
7 — PMBus

Mechanical Diagram



Pin Description

Pin No.	Function	Pin No.	Function
1	V_{in} (+)	**9**	SA0
2	On/Off	**10**	SYNC
3	V_{in} (–)	**11**	SA1
4	V_{out} (–)	**12**	PMBus_CTL
5	V_{out} (–)	**13**	ISHARE
6	V_{out} (+)	**14**	PMBus_SCL
7	V_{out} (+)	**15**	PMBus_SDA
8	GND		

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 1–3 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 4–7 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. Pins 8-15 are 0.50±0.05 mm [0.020±0.002 in.] diameter standoff shoulders.
3. M3 screw used to bolt unit is baseplate to other surfaces (such as heats ink) must not exceed 4.0 mm [0.157 in] depth blow the surface of baseplate.

Electrical Specifications

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Absolute maximum ratings					
Input voltage Continuous Transient (≤ 100 ms)	- -	- -	80 100	V V	When the input voltage is in the range of 75 V to 80 V, the converter must not be damaged.
Ambient operating temperature	–40	-	85	°C	See the thermal derating curve.
Storage temperature	–55	-	125	°C	-
Operating humidity	10	-	95	% RH	Non-condensing
External voltage applied to On/Off	-	-	12	V	-
External voltage applied to PMBus	-	-	3.6	V	-
Input characteristics					
Operating input voltage	36	48	75	V	-
Maximum input current	-	-	35	A	V_{in} = 0–75 V; I_{out} = I_{onom}
No-load power	-	8	11	W	V_{in} = 48 V, I_{out} = 0 A, T_A = 25°C
Input capacitance	440	680	-	μF	Aluminum electrolytic capacitor
Response to input transient	-	1.5	2.0	V	0.5 V/μs input transient; V_{in} = 43 V–75 V; I_{out} = 100% load
	-	-	3	V	0.5 V/μs input transient; V_{in} = 36 V–75 V; I_{out} = 100% load
Output characteristics					
Output voltage setpoint	11.88	12.00	12.12	V	V_{in} = 48 V; I_{out} = 50%I_{onom}
Output voltage range	11.64	-	12.36	V	V_{in} = 43–75 V; I_{out} = I_{onom}
	9.80	-	12.36	V	V_{in} = 36–43 V; I_{out} = I_{onom}
Output current	0	-	75	A	-
Output power	0	-	900	W	-
Line regulation	–0.5	-	0.5	% V_{out}	V_{in} = 43–75 V; I_{out} = I_{onom}
	–17		17	% V_{out}	V_{in} = 36–43 V; I_{out} = I_{onom}
Load regulation	–3	-	3	% V_{out}	V_{in} = 48 V; I_{out} = I_{omin}–I_{onom}
Output voltage regulation precision	–5	-	5	%	V_{in} = 43–75 V; I_{out} = I_{omin}–I_{onom}
	–18	-	18	%	V_{in} = 36–43 V; I_{out} = I_{omin}–I_{onom}
Output temperature coefficient	–0.02	-	0.02	%/°C	T_A = –40°C to +85°C

Electrical Specifications

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Output characteristics					
Output external capacitance	660	-	10^4	μF	• SMD aluminum solid capacitor or chip aluminum capacitor, ESR < 30 mΩ. • If T_A is lower than –5ºC, it is recommended that two output SMD aluminum solid capacitors be used.
Output voltage ripple and noise (peak to peak)	-	180	500	mV	Bandwidth: 20 MHz
Output voltage adjustment range	8.4	-	12.2	V	V_{in} = 43–75 V, Adjusted by PMBus, V_{out} can be adjusted online from 11.1 V to 12.2 V. If V_{out} set by the command is beyond this range, the module will restart immediately to enable the parameter to take effect. see PMBus Communication
	8.4	-	0.315 V_{in} – 1.5	V	V_{in} = 36–43 V, Adjusted by PMBus, Adjusted by PMBus, V_{out} can be adjusted online from 11.1 V to 12.2 V. If V_{out} set by the command is beyond this range, the module will restart immediately to enable the parameter to take effect. see PMBus Communication
Turn-on output voltage overshoot	-	-	5	%	Full range of V_{in}, I_{out}, and T_A
Turn-on output voltage delay time	-	50	100	ms	From V_{in} to 10% V_{out}
Output voltage rise time	-	50	100	ms	V_{in} = 43–75 V, from 10% V_{out} to 90% V_{out}, see Figure 18
Switching frequency	-	180	-	kHz	-
Protection characteristics					
Input undervoltage protection					
Protection threshold	30	32	34	V	-
Recovery threshold	32	34	36	V	-
Hysteresis	1	2	3	V	-
Auxiliary input undervoltage protection					
Protection threshold	22.5	26.0	29.5	V	-
Recovery threshold	25.5	28.0	30.5	V	-
Hysteresis	0.7	1.9	3.0	V	-
Output overcurrent protection	110	-	140	$\%I_{omax}$	Hiccup mode
Output short circuit protection	-	-	-	-	Reports overvoltage protection Hiccup mode
Output overvoltage protection	120	-	140	$\%V_{oset}$	Hiccup mode

Electrical Specifications

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Protection characteristics					
Overtemperature protection Threshold Hysteresis	 105 5	 120 -	 130 -	 °C °C	Self-recovery; The overtemperature protection hysteresis is obtained by measuring the temperature of the PCB near the temperature sensor.
Parallel characteristics					
Maximum parallel output power	0	-	1700	W	Vin = 43–75 V; number of parallel modules: 2
	0	-	1700	W	Vin = 43–75 V; number of parallel modules: 4; 2+2 backup mode
	0	-	2400	W	Vin = 43–75 V; number of parallel modules: 4
	0	-	300 x n	W	Vin = 43–75 V; number of parallel modules (n) > 4; supports hot backup
	0	-	600 x n	W	Vin = 43–75 V; number of parallel modules (n) > 4
Current share imbalance	–6	-	6	%	V_{in} = 43–75 V; 300 W ≤ P_{out} ≤ 360 W (single module)
	–5	-	5	%	V_{in} = 43–75 V; P_{out} > 360 W (single module)
	-	-	I_{avg}+4.5	A	V_{in} = 36–43 V; P_{out} ≥ 50%P_{onom} (single module), I_{avg} is the average load of parallel
Maximum parallel start load	-	-	2000	W	V_{in} = 43–75 V; CR mode, number of parallel modules > 2 pcs
Maximum output voltage delay time	-	-	8	S	V_{in} = 36–75 V
Current share adjustment	-	-	0.24	V	V_{in} = 36–75 V; P_{out} = 0–100%$P_{onom;}$ Current equalization adjustment refers to the adjustment of the difference between the output voltages of modules with 48 V input and 50% load output.
Output ripple and noise	-	300	500	mV	V_{in} = 36–75 V; P_{out} = 0–100%P_{onom}; Bandwidth: 20 MHz
PMBus signal interface characteristics					
Logic Input Low (V_{IL})	-	-	0.8	V	-
Logic Input High (V_{IH})	2.1	-	3.6	V	-
Logic output Low (V_{OL})	-	-	0.25	V	I_{oL} = 6 mA
Logic output High (V_{OH})	0.6	-	3.6	V	I_{oH} = 6 mA
PMBus setting-up time	250	-	-	nS	See Figure 26
PMBus holding time	300	-	-	nS	

Electrical Specifications

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
PMBus detection precision					
Input voltage detection precision	–2	-	2	V	V_{in} = 36–75 V; $I_{out} = I_{omin} – I_{onom}$; T_A = –40°C to +85°C
Output voltage detection precision	–0.2	-	0.2	V	
Output current detection precision	–2	-	2	A	
Temperature detection precision	–5	-	5	°C	V_{in} = 36–75 V; $I_{out} = I_{omin} – I_{onom}$; T_A = –40°C to +125°C
Dynamic characteristics					
Overshoot amplitude Recovery time	- -	- -	600 200	mV µs	V_{in} = 43–75 V; Current change rate: 0.1 A/µs, Load: 25%–50%–25%; 50%–75%–50%
Overshoot amplitude Recovery time	- -	- -	1200 500	mV µs	V_{in} = 43–75 V; Current change rate: 1 A/µs, Load: 25%–50%–25%; 50%–75%–50% With an additional 1000 µF output external capacitor
Efficiency					
100% load	94.5	95.5	-	%	T_A = 25°C, V_{in} = 48 V
50% load	95.5	96.5	-	%	
20% load	94.0	95.0	-	%	
100% load	94.0	95.0	-	%	T_A = 25°C, V_{in} = 36 V
50% load	95.5	96.5	-	%	
100% load	93.5	94.5	-	%	T_A = 25°C, V_{in} = 75 V
50% load	94.0	95.0	-	%	
Insulation characteristics					
Input to output insulation voltage	-	-	1500	V DC	Basic insulation (1-minute test) leakage current < 1 mA, altitude = 3000 m
Input to output insulation voltage	-	-	1500	V DC	Functional insulation (1-minute test) leakage current < 1 mA, altitude = 5000 m
Input to baseplate insulation voltage	-	-	750	V DC	
Output to baseplate insulation voltage	-	-	750	V DC	

Electrical Specifications

Parameter	Min.	Typ.	Max.	Unit	Notes & Conditions
Other characteristics					
Remote On/Off voltage Low level High level	 –0.7 3.5	 - -	 1.2 12	 V V	Negative logic
On/Off current Low level High level	 - -	 - -	 1.0 -	 mA μA	-
PMBus_CTL voltage Low level High level	 0 2.1	 - -	 0.8 3.3	 V V	High level effective
PMBus_CTL current Low level	 -	 -	 1	 mA	-
Reliability characteristics					
Mean time between failures (MTBF)	-	2.5	-	Million hours	Telcordia, SR332 Method 1 Case 3; 80% load, normal input/rated output; airflow rate = 1.5 m/s (300 LFM); T_A = 40˚C

Specifications are subject to change without notice.

Characteristic Curves

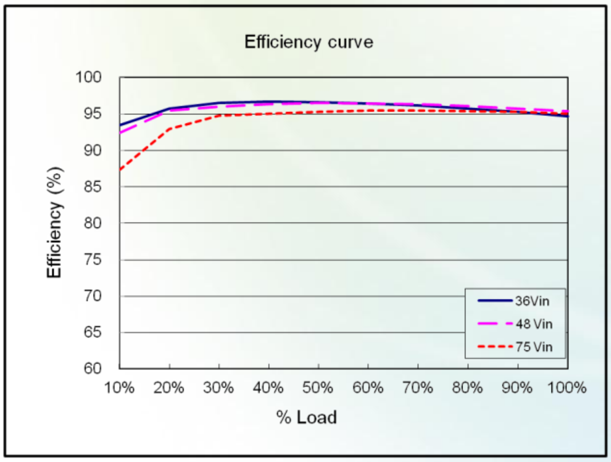


Figure 1: Efficiency (T_A = 25ºC; V_{in} = 36 V, 48 V, or 75 V)

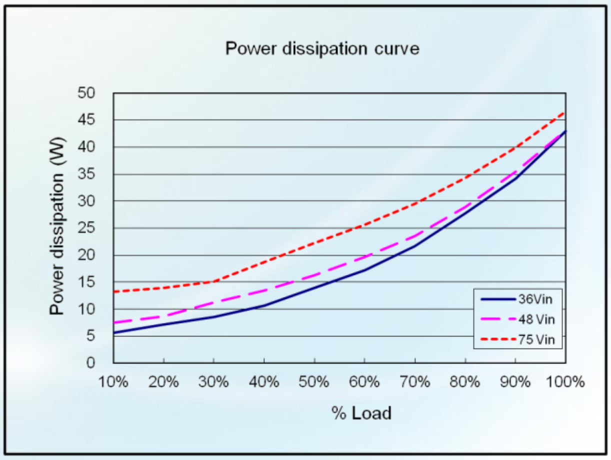


Figure 2: Power dissipation (T_A = 25ºC; V_{in} = 36 V, 48 V, or 75 V)

Characteristic Curves

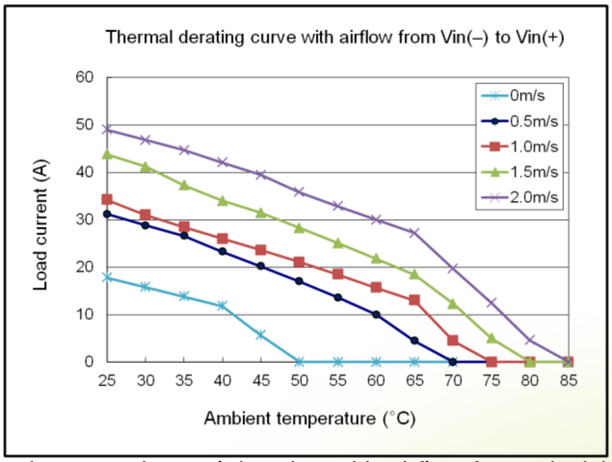


Figure 3: Thermal derating with airflow from Vin (–) to Vin (+) (V_{in} = 48 V)

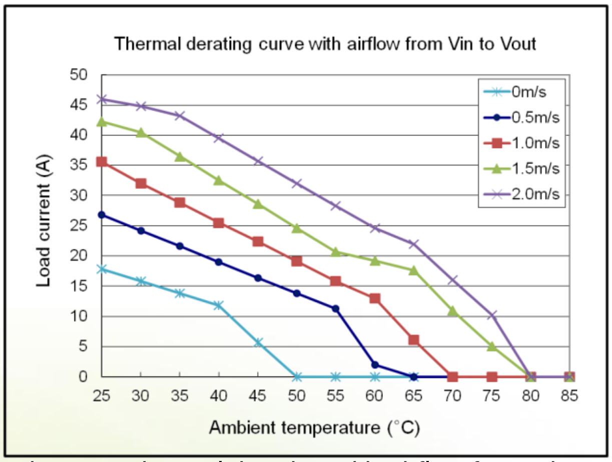


Figure 4: Thermal derating with airflow from Vin to Vout (V_{in} = 48 V)

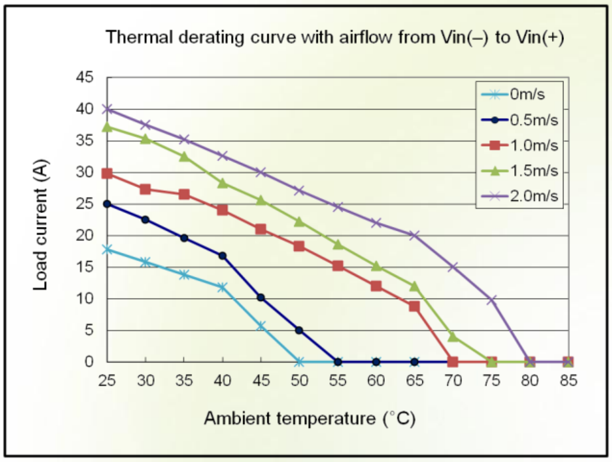


Figure 5: Thermal derating with airflow from Vin (–) to Vin (+) (V_{in} = 60 V)

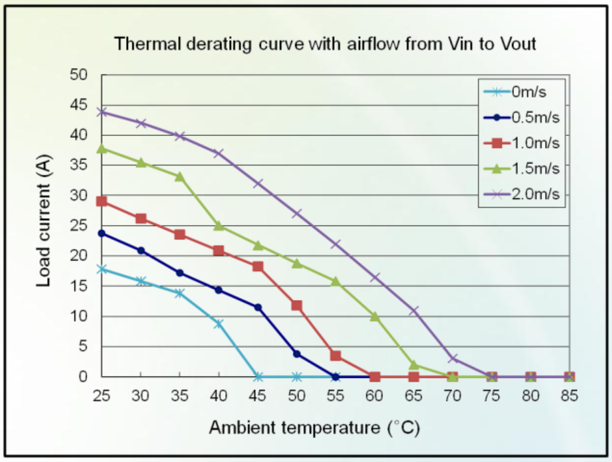


Figure 6: Thermal derating with airflow from Vin to V_{out} (V_{in} = 60 V)

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 B and C are for testing the output voltage ripple.

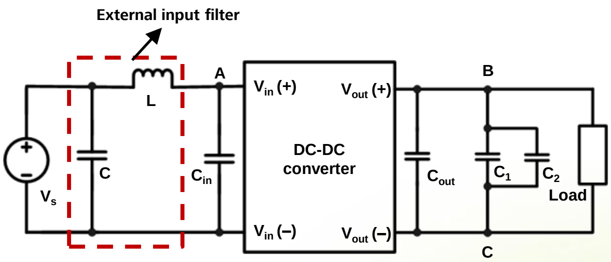


Figure 7: Test set-up diagram

C_{in}: The 440 μF aluminum electrolytic capacitor is recommended.
C_{out}: The 660 μF SMD aluminum solid capacitor or chip aluminum capacitor is recommended (ESR < 30 mΩ).
C_1: The 0.1 μF ceramic capacitor is recommended.
C_2: The 10 μF aluminum electrolytic capacitor is recommended.

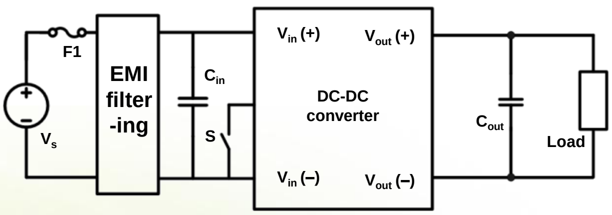


Figure 8: Typical circuit applications

F1: The 50 A fuse (fast-blow)
C_{in}: The 440 μF aluminum electrolytic capacitor is recommended.
C_{out}: The 660 μF SMD aluminum solid capacitor or chip aluminum capacitor is recommended (ESR < 30 mΩ).

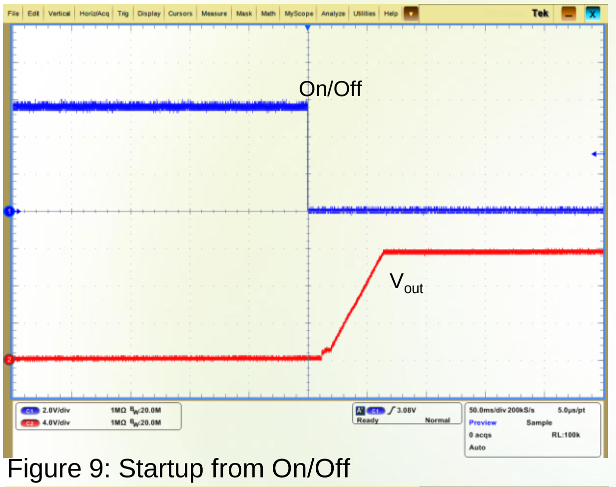


Figure 9: Startup from On/Off

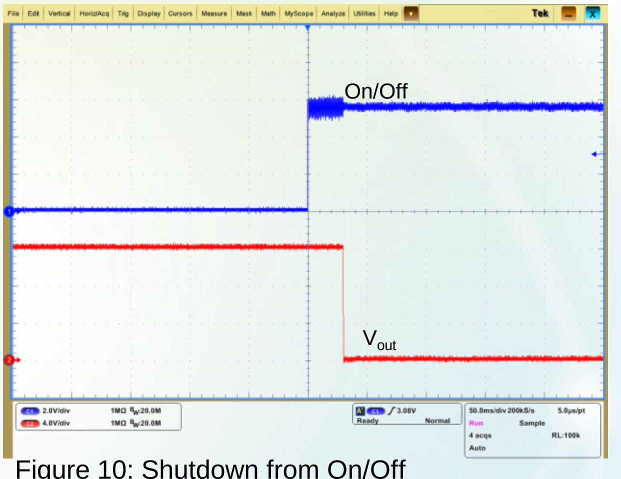


Figure 10: Shutdown from On/Off

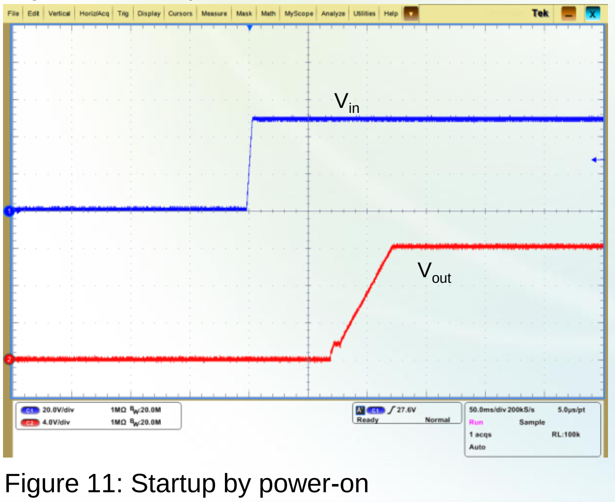


Figure 11: Startup by power-on

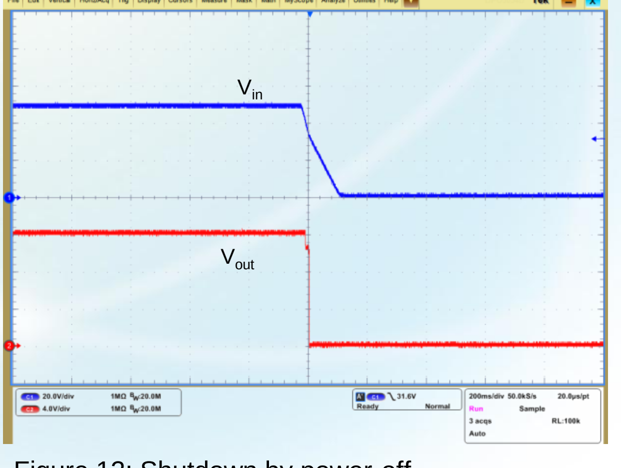


Figure 12: Shutdown by power-off

Typical Waveforms

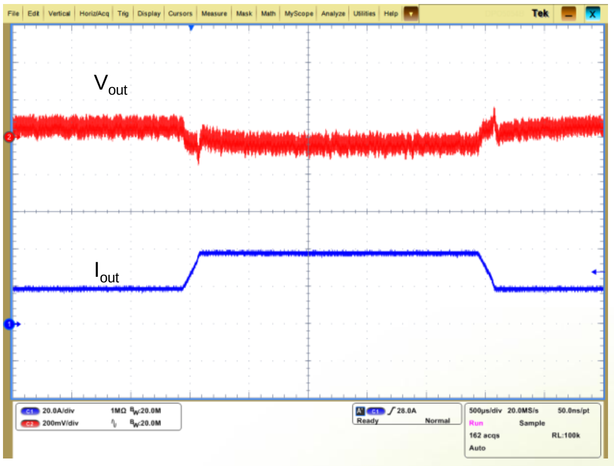


Figure 13: Output voltage dynamic response (load: 25%–50%–25%, di/dt = 0.1 A/µs)

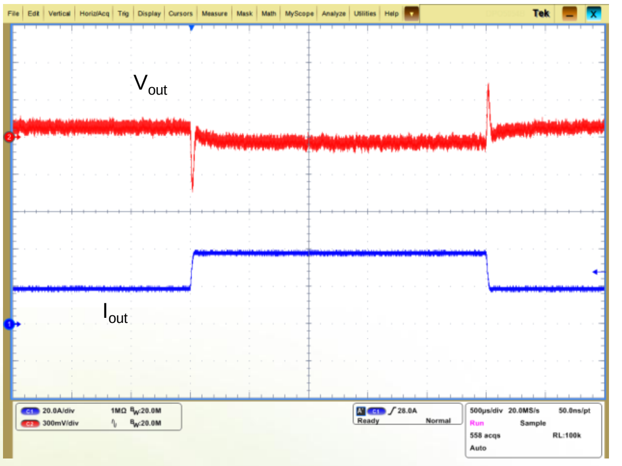


Figure 14: Output voltage dynamic response (load: 25%–50%–25%, di/dt = 1 A/µs)

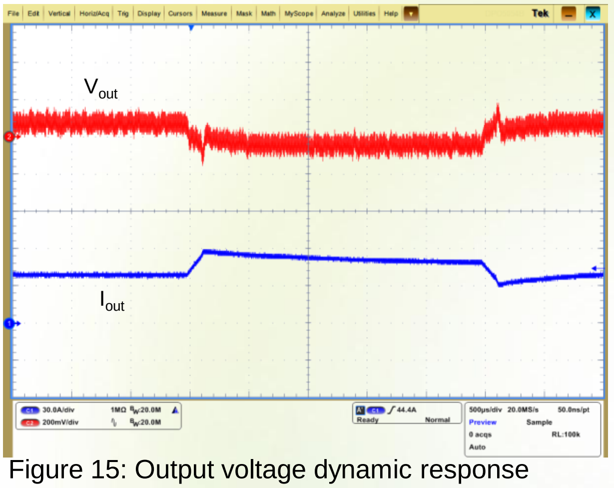


Figure 15: Output voltage dynamic response (load: 50%–75%–50%, di/dt = 0.1 A/µs)

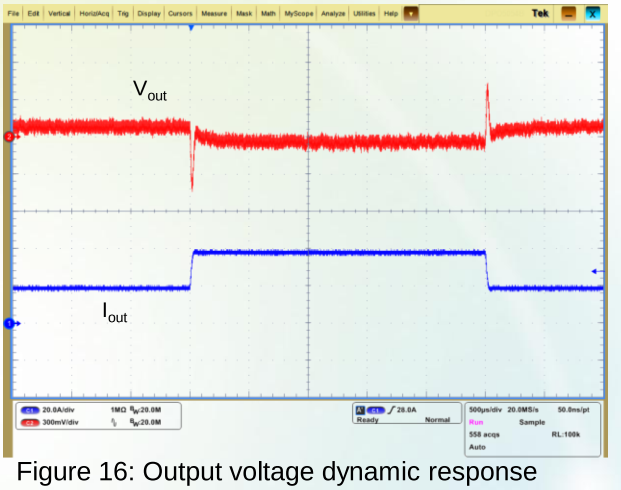


Figure 16: Output voltage dynamic response (load: 50%–75%–50%, di/dt = 1 A/µs)

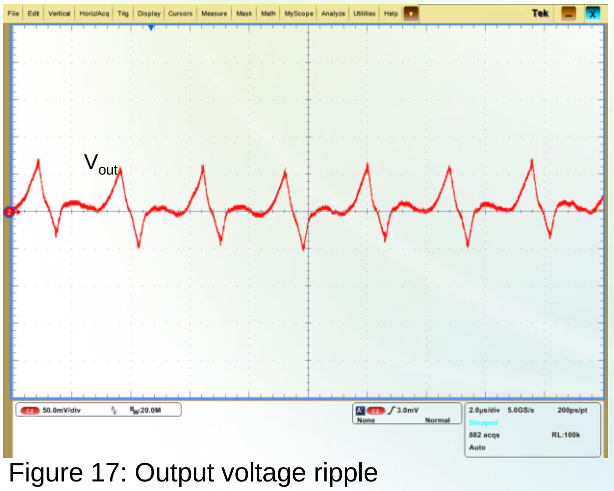


Figure 17: Output voltage ripple (for points B and C in the test set-up diagram, V_{in} = 48 V, V_{out} = 12 V, I_{out} = 75 A)

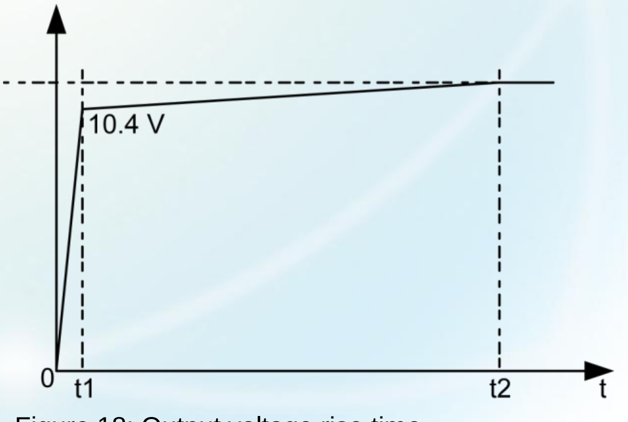


Figure 18: Output voltage rise time
When the rising slop of V_{in} is below 0.3 V/ms, V_{out} rises to 10.4 V within 50 ms and then rises to terminal value at the rate of 0.033 V/s.

Input Anti-resonance Application Guide

In the input remote power supply application, the parasitic inductor of the remote power supply cable and the input capacitor as well as the power brick may resonate, causing the power input voltage to be unstable. As a result, the PSU may experience a power outage due to undervoltage. Therefore, it is recommended that input capacitors be selected according to the input capacitor ESR conditions shown in Figure 19 to Figure 22. Select the appropriate curve based on the application scenario, and ensure that the input capacitor ESR is within the upper and lower limits in the curve. Then there will be no input resonance.

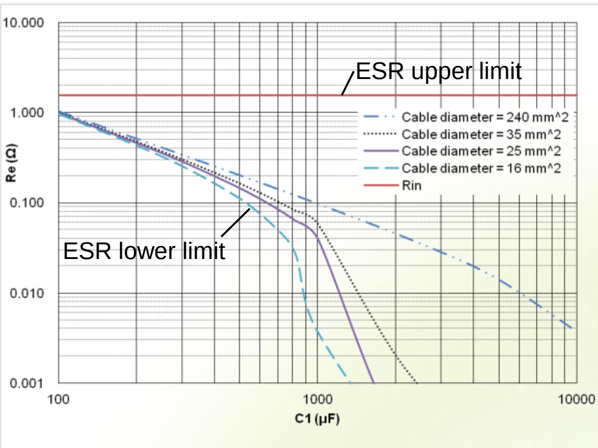


Figure 19: Input capacitors with different cross-sectional areas and ESR configuration boundary
Cable length = 60 m, V_{in} = 36 V, I_{out} = 75 A, T_A = –40ºC

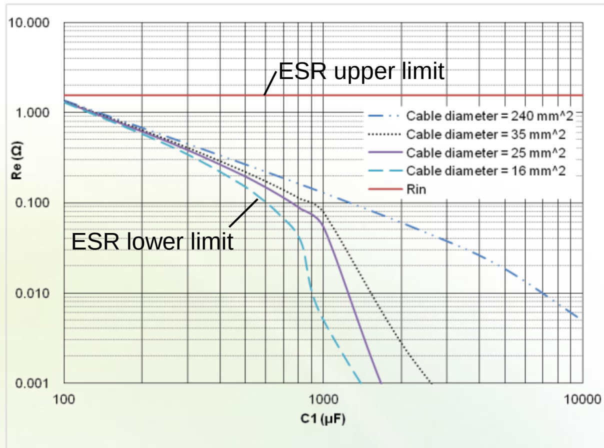


Figure 20: Input capacitors with different cross-sectional areas and ESR configuration boundary
Cable length = 80 m, V_{in} = 36 V, I_{out} = 75 A, T_A = –40ºC

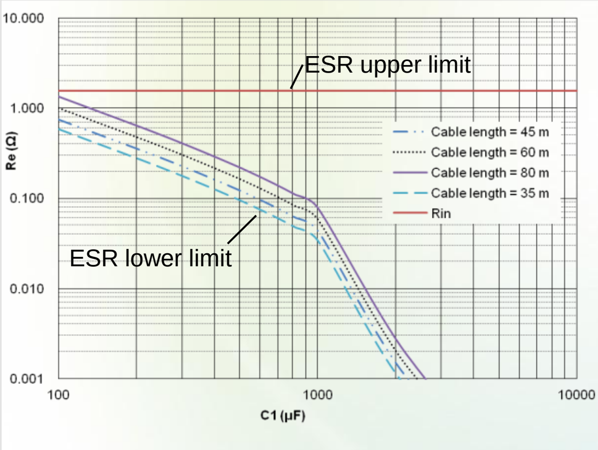


Figure 21: Input capacitors and ESR configuration boundary
Cable diameter = 35 mm^2, V_{in} = 36 V, I_{out} = 75 A, T_A = –40ºC

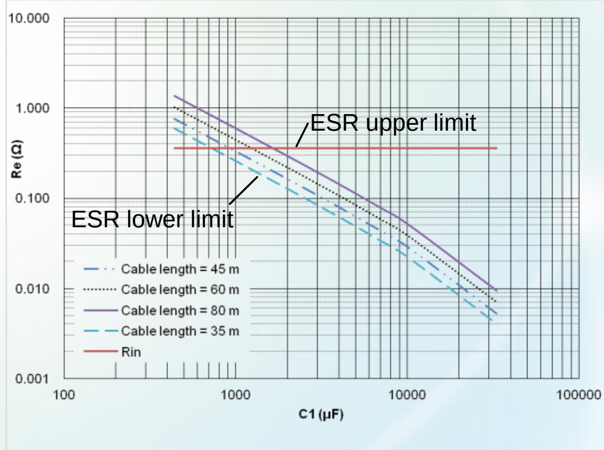


Figure 22: Input capacitors and ESR configuration boundary (parallel mode)
Cable diameter = 240 mm^2, V_{in} = 36 V, I_{out} = 300 A, T_A = –40ºC

Remote On/Off

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

On/Off Pin Level	Status
Low level [–0.7 V, 1.2 V]	On
High level [3.5 V, 12.0 V]	Off

On/Off Signal	Min.	Typ.	Max.
On/Off current (high level)	-	-	1 mA

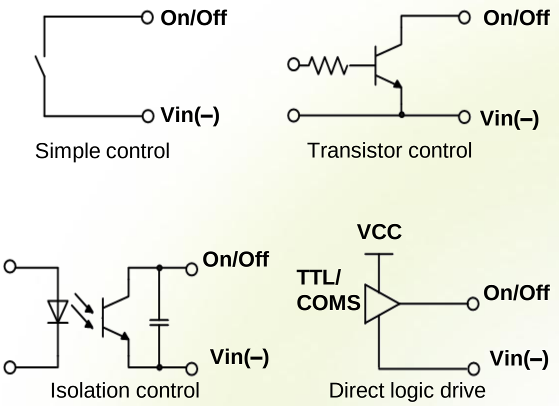


Figure 23: Various circuits for driving the On/Off pin

Hot Plug

One module is working, of which output voltage is V_{out}. When another module is hot-plugged, the time for both output voltage to rise to 12 V is expressed as T_{rise}, which can be written as follows:

- T_{rise} = 62s ($V_{out} \le 10$ V)
- T_{rise} = (12–V_{out}) x 31s (10 V < V_{out} < 12 V)

Parallel Operation

In constant resistance mode (CR mode), the maximum number of parallel modules is 12. In constant current mode (CC mode), the maximum number of parallel modules is 4.

- When modules are connected in parallel, connect the SYNC pins of all the modules and connect the ISHARE pins. If one of the modules powers off or is faulty, disconnect its SYNC and ISHARE pins from the bus, as shown in Figure 24.
- The module cannot start up at CC load without SYNC.

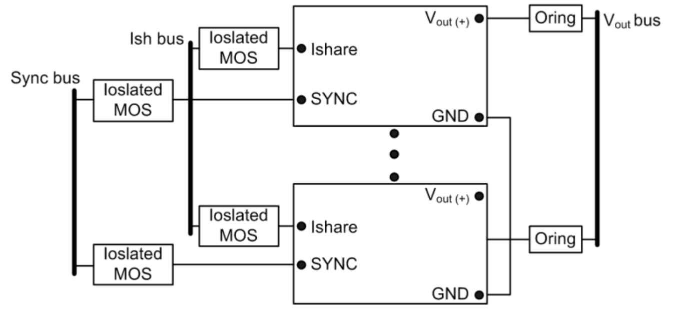


Figure 24: Parallel connection

Converter Addressing

The following table describes the mapping between the SA0, SA1 and PMBus address. When the SA0 and SA1 left open, PMBus address is 0X5B. When the SA0 and SA1 connect to GND, PMbus address is 0, which is prohibition of use. The PMBus address can be calculated as D:

D = 12 x SA1 + SA0

D is the corresponding decimal number of PMBus address data.

R_{SA1} (kΩ)	SA1 (V)	SA1 Address (DEC)
0–0.33	0–0.6	0
left open	2.2–3.3	7

R_{SA0} (kΩ)	SA0 (V)	SA0 Address (DEC)
1–15	0–0.165	0
22	0.198–0.242	1
30	0.270–0.330	2
51	0.459–0.561	3
80.6	0.7254–0.8866	4
113	1.017–1.243	5
150	1.350–1.650	6
> 220 (left open)	1.980–2.500	7

PMBus Communication

Monitoring and Fault Detection

The converter communicates with the system over the PMBus. The GDQ75S12B-4P provides the following monitoring and fault detection functions.

Monitors the following:

- Converter information
- Input voltage
- Output voltage
- Output current
- Internal temperature

Detects the following:

- Output overcurrent or short-circuit
- Overtemperature
- Output overvoltage
- Input undervoltage

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 25 shows the interconnect diagram of SCL and SDA.

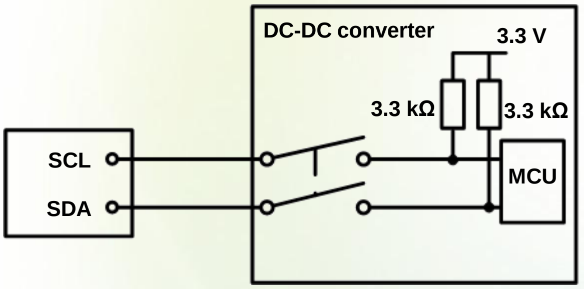


Figure 25: Interconnect diagram of SCL and SDA

SCL, SDA Signal	Min.	Typ.	Max.
Low level	-	-	0.8 V
High level	2.1 V	-	3.6 V

The converter supports the 400 kHz (default) clock rate. 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.

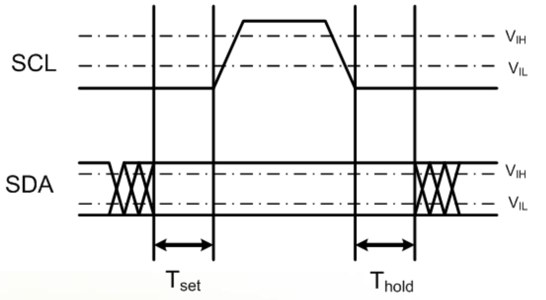


Figure 26: PMBus setup time and hold-up time

PMBus Commands

Hex Code	Command Name	Data Type	Data Bytes	Data Format
Control command				
0x01	OPERATION	ReadByte /Write	1	-
0x03	CLEAR_FAULTS	Send Byte	1	-
0x11	STORE_DEFAULT_ALL	Send Byte	1	-
Calibration command				
0x20	VOUT_MODE	Read Byte	1	Linear 16 (Q10)
0x21	VOUT_COMMAND	Read/Write Word	2	Linear 16 (Q10)
Alarm setting command				
0x40	VOUT_OV_FAULT_LIMIT	Read/Write Word	2	Linear 16 (Q10)
0x42	VOUT_OV_WARNNING_LIMIT	Read/Write Word	2	Linear 16 (Q10)
0x46	IOUT_OC_FAULT_LIMIT	Read/Write Word	2	Linear 11
0x4A	IOUT_OC_WARNNING_LIMIT	Read/Write Word	2	Linear 11
0x4F	OT_FAULT_LIMIT	Read/Write Word	2	Linear 11
0x51	OT_WARNNING_LIMIT	Read/Write Word	2	Linear 11
0x59	VIN_UV_FAULT_LIMIT	Read/Write Word	2	Linear 11
0x58	VIN_UV_WARNNING_LIMIT	Read/Write Word	2	Linear 11

PMBus Communication

PMBus Commands

Hex Code	Command Name	Data Type	Data Bytes	Data Format
Command for viewing alarm details				
0x78	STATUS_BYTE	Read Byte	1	-
0x79	STATUS_WORD	Read Word	2	-
0x7A	STATUS_VOUT	Read Byte	1	-
0x7B	STATUS_IOUT	Read Byte	1	-
0x7C	STATUS_INPUT	Read Byte	1	-
0x7D	STATUS_TEMPERATURE	Read Byte	1	-
0x7E	STATUS_CML	Read Byte	1	-
Other commands				
0x88	READ_VIN	Read Word	2	Linear 11
0x8B	READ_VOUT	Read Word	2	Linear 16 (Q10)
0x8C	READ_IOUT	Read Word	2	Linear 11
0x8D	READ_TEMPERATURE	Read Word	2	Linear 11
0x95	READ_FREQUENCY	Read Word	2	Linear 11
0x96	READ_POUT	Read Word	2	Linear 11
0x60	TON_DELAY	Read/Write Word	2	Linear 11
0x61	TON_RISE	Read Word	2	Linear 11
0xD1	SOFT_VERSION	Read Word	2	-
0xF5	ISHARE_VOUT_ADJ_LOW_LIMIT	Read/Write Word	2	Unsigned
0xF6	PCB_VERSION	Read Word	2	-
0xF9	IOUT_COMMAND	Read/Write Word	2	Linear 11
0x98	PMBUS_VERSION	Read Byte	1	-
0x99	MFR_ID	Read Block	2	ASCII
0x9A	MFR_MODEL	Read Block	8	ASCII
0x9B	MFR_REVISION	Read Block	1	ASCII
0x9C	MFR_LOCATION	Read Block	4	ASCII
0x9D	MFR_DATE	Read Block	8	ASCII
0xD0	PROTOCOL_TYPE	Read Word	2	-

PMBus Commands

Hex Code	Command Name	Data Type	Data Bytes	Data Format
0xFA	PMBUS_READ_BARCODE_HEADER	Read Block	R: 26 W: 4	-
0xFB	PMBUS_BARCODE	Read/Write Block	20	-
0xF8	SOFTLOAD_INFO	Read Block	36	ASCII
0xFC	SOFTLOAD_CTRL	Read/Write Word	2	Unsigned
0xFD	MFR_DEVICE_ID	Read/Write Block	R: 17 W: 130	R: ASCII W: binary
0xFE	SOFTLOAD_CTRL_EX	Write Block	10	Unsigned
0xEA	WRITE_BBOX_FRAME_ID	Read/Write Word	2	Unsigned
0xEB	READ_BBOX_FRAME_DATA	Read Block	34	Unsigned
0xEF	READ_BBOX_FRAME_NUM	Read Word	2	Unsigned

Data Format

●Linear 11 data format

The linear data format is a two byte value with an 11-bit, binary signed mantissa (two's complement) and a 5-bit, binary signed exponent (two's complement), as shown in Figure 27.

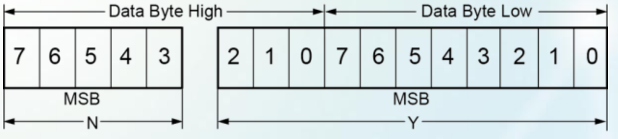


Figure 27: Linear 11 data format

The relationship between the N, Y, and the 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).

PMBus Communication

●**VOUT data format**

Commands related to output voltage are the VOUT_MODE, VOUT_COMMAND, VOUT_OV_FAULT_LIMIT, VOUT_OV_WARNNING_LIMIT and READ_VOUT. The data for these commands is a 16-bit unsigned integer, as shown in Figure 28.

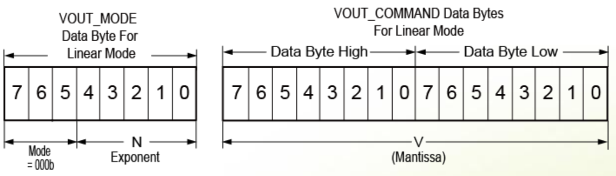


Figure 28: VOUT data format

The output voltage is calculated as follows:

$$\text{Voltage} = V \times 2^N$$

where

Voltage is the output voltage value.

V is the 16-bit unsigned integer.

N is the 5-bit signed integer (two's complement).

Command Descriptions

OPERATION (0x01): Powers on or off the converter or clears the latch-off state.

Operation	Data
ON	0x80
OFF	0x00

CLEAR_FAULTS (0x03): Clear error history fault information.

VOUT_COMMAND (0x21): Changes the output voltage of the converter. The default value is 12 V. Voltage adjustment range: 8.4 V to 12.2 V.

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 the Protection characteristics.

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.

Recommended Fuse

The converter has no internal fuse. To meet safety requirements, a 50 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.

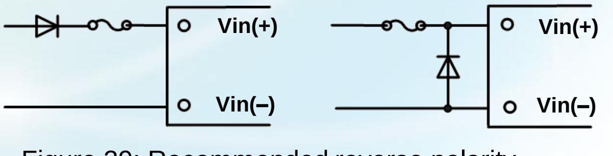


Figure 29: Recommended reverse polarity protection circuits

EMC

Figure 30 shows the EMC test set-up diagram. The acceptance standard must meet the requirements of the conducted emission limits of CISPR32 Class A with 6 dB margin.

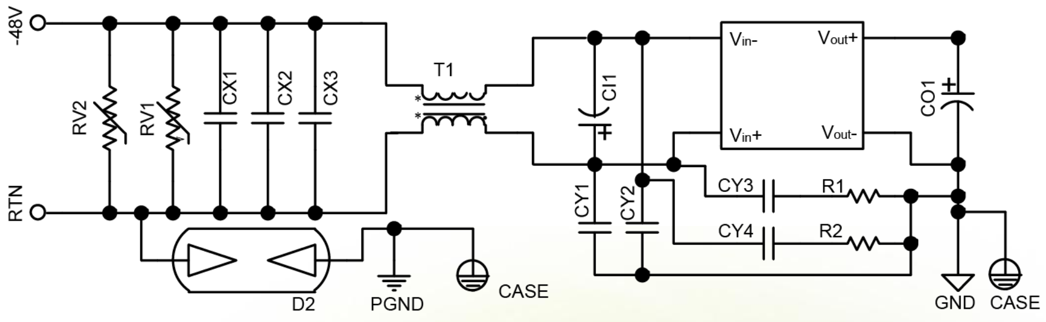


Figure 30: EMC test set-up diagram

RV1, RV2: Varistor, 100 V, 4500 A
D2: Gas discharge tube, 90 V, 10 kA

CI1: Aluminum electrolytic capacitor, 100 V, 420 µF
CO1: Non-solid radial lead aluminum electrolytic capacitor, 2 x 470 µF

CX1, CX2, CX3: Metalized film capacitor, 1µF, 275 V
CY1, CY2: Metalized film capacitor, 0.1µF, 275 V
CY3, CY4: Chip multilayer ceramic capacitor, 22 nF, 1000 V

R1, R2: Chip thick film resistor, 1 W, 1Ω
T1: Common mode inductor, single phase, 400 µH

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; vibration frequency range: 10–10000 Hz
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
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; ambient temperature between +45°C and +55°C; airflow rate = 0.5–5 m/s, 1000 operating hours; 50% to 80% load
Power and temperature cycling test	32	Rated input voltage; ambient temperature between –40°C and +85°C; airflow rate = 0.5–5 m/s, 1000 operating hours; 50% load
Long life test	32	Ambient temperature between +30°C and +60°C; 50% to 80% load, T = 6 months

Thermal Consideration

Thermal Test Point

Decide proper airflow to be provided by measuring the temperature at the middle of the baseplate shown in Figure 31 to protect the converter against overtemperature. The overtemperature protection threshold is obtained based on this thermal test point.

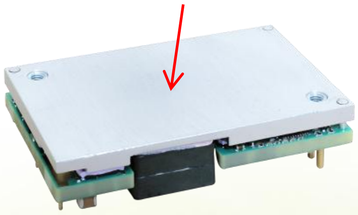


Figure 31: Thermal test point

Power Dissipation

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

MSL Rating

Store and transport the converter as required by the moisture sensitivity level (MSL) rating 1 specified in the J-STD-020/033. The surface of a soldered converter must be clean and dry. Otherwise, the assembly, test, or even reliability of the converters 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 and hand soldering. Reflow soldering is not allowed.

1. For wave soldering, the converter pins can be soldered at 260°C for less than 7 seconds.
2. 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.

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