

OREB-C2T12

Isolated DC-DC Converter

The OREB-C2T12 is an isolated DC-DC converter that operates from a nominal 48 V source. This converter provides up to 120 W of output power. This unit is designed to be highly efficient and low cost. Features include remote on/off, short circuit protection, over current protection, over-temperature protection, output over-voltage protection, input under-voltage / over-voltage protection.



RoHS
Compliant

Key Features & Benefits

- Isolated
- High Efficiency
- Fixed Frequency (400 kHz)
- High Power Density
- Low Cost
- Input Under-Voltage Protection
- Input Over-Voltage Protection
- Output Over-Voltage Protection
- OCP/SCP
- Over Temperature Protection
- Remote On/Off
- Approved to IEC/EN 62368-1 (TBC)
- Class II, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)

Applications

- Networking
- Computers and Peripherals
- Telecommunications

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
0REB-C2T12LG	12 VDC	36 – 75 VDC	10 A	120 W	93%
0REB-C2T120G					

PART NUMBER EXPLANATION

0	R	EB	-	C2	T	12	x	G
Mounting Type	RoHS Status	Series Name		Series Code	Input Range	Output Voltage	Active Logic	Package Type
Through hole mount	RoHS	1/8 th brick		-	36 – 75 VDC	12 V	L – Active low, open frame 0 – Active high, open frame	Tray package

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous non-operating Input Voltage		-0.3	-	80	V
Input Transient Voltage	100 ms maximum	-	-	100	V
Remote On/Off		-0.3	-	18	V
I/O Isolation Voltage		-	-	2250	V
Operating Temperature		-40	-	85	°C
Storage Temperature		-55	-	125	°C
Altitude		-	-	5000	m

NOTE: Ratings used beyond the maximum ratings may cause a reliability degradation of the converter or may permanently damage the device.

3. INPUT SPECIFICATIONS

All specifications are typical at 25°C unless otherwise stated.

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Operating Input Voltage		36	48	75	V
Input Current (full load)		-	-	3.8	A
Input Current (no load)		-	80	120	mA
Remote Off Input Current		-	10	20	mA
Input Reflected Ripple Current (rms)	With simulated source impedance of 10 μ H, 5 Hz to 20 MHz. Use a 100 μ F/100 V electrolytic capacitor with ESR = 1 ohm max, at 200 kHz @ 25°C.	-	2	5	mA
Input Reflected Ripple Current (pk-pk)		-	15	25	mA
I ² t Inrush Current Transient		-	-	0.5	A ² s
Turn-on Voltage Threshold		-	35	36	V
Turn-off Voltage Threshold	V _{UVLO}	31	32	-	V
Turn-on Voltage Threshold		76	78	-	V
Turn-off Voltage Threshold	V _{OVL0}	-	80	83	V

CAUTION: This converter is not internally fused. An input line fuse must be used in application. Recommend a fast-acting fuse with maximum rating of 5 A on system board. Refer to the fuse manufacture's datasheet for further information.

NOTE: This converter has internal L-C (1 μ H-3 μ F) filter.

4. OUTPUT SPECIFICATIONS

All specifications are typical at nominal input, full load at 25°C unless otherwise stated.

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Output Voltage Set Point	Vin = 48 V, Io = 50% load	11.82	12	12.18	V
Load Regulation	Vin = 48 V, Io = 0~100% load	-	0.1	0.2	% Vo,set
Line Regulation	Vin = 36 ~ 75 V, Io = 100% load	-	0.1	0.2	% Vo,set
Regulation Over Temperature		-	-	1.5	% Vo,set
Output Ripple and Noise (Pk-Pk)	Vin = 48 V, Io = 100% load at 25°C ambient, 0 – 20 MHz BW, with a 1 µF ceramic capacitor, a 10 µF Tan cap and a 270 µF OSCON cap at output.	-	60	-	mV
Output Ripple and Noise (RMS)		-	15	-	mV
Output Current Range		0	-	10	A
Output DC Current Limit		10.5	12	15	A
Short Circuit Surge Transient		-	1.2	2	A ² s
Rise Time		-	-	15	ms
Turn on Time	Enable form Vin	-	-	45	ms
	Enable form ON/OFF	-	-	25	ms
Overshoot at Turn on		-	0	3	%
Output Capacitance		270	-	3300	µF
Transient Response					
ΔV 50%~75% of Max Load		-	160	-	mV
Settling Time	di/dt = 0.1 A/µs, Vin = 48 VDC, Ta = 25°C, with a 1 µF ceramic capacitor, a 10 µF Tan cap and a 270 µF OSCON cap at output.	-	200	-	µs
ΔV 75%~50% of Max Load		-	160	-	mV
Settling Time		-	200	-	µs

5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vin = 48 V, full load	91	93	-	%
Switching Frequency		-	400	-	kHz
Over Temperature Protection		-	125	-	°C
Output Voltage Trim Range		80	-	110	%
Remote Sense Range		-	-	10	%
Over Voltage Protection (Static)	This voltage is achieved by trimming up output slowly. (Latch)	-	14.6	-	V
Over Voltage Protection (Dynamic)	The transient over voltage is achieved by connecting the Trim pin to Vout+ pin through a 205 K resistor. (Latch)	-	15	-	V
FIT ²	Calculated Per Bell Core SR-332 (Vin = 48 V, Vo = 12 V, Io = 8 A, Ta = 40°C, FIT = 10 ⁹ /MTBF)	-	117.8	-	-
Weight		-	20.9	-	g
Dimensions (L x W x H)			2.30 x 0.90 x 0.41		inch
			58.42 x 22.86 x 10.50		mm
Isolation characteristics					
Input to Output		-	-	2250	VDC
Isolation Capacitance		-	3300	-	pF
Isolation Resistance		10M	-	-	Ohm

NOTE: All specifications are typical at 25 °C unless otherwise stated.

6. EFFICIENCY DATA

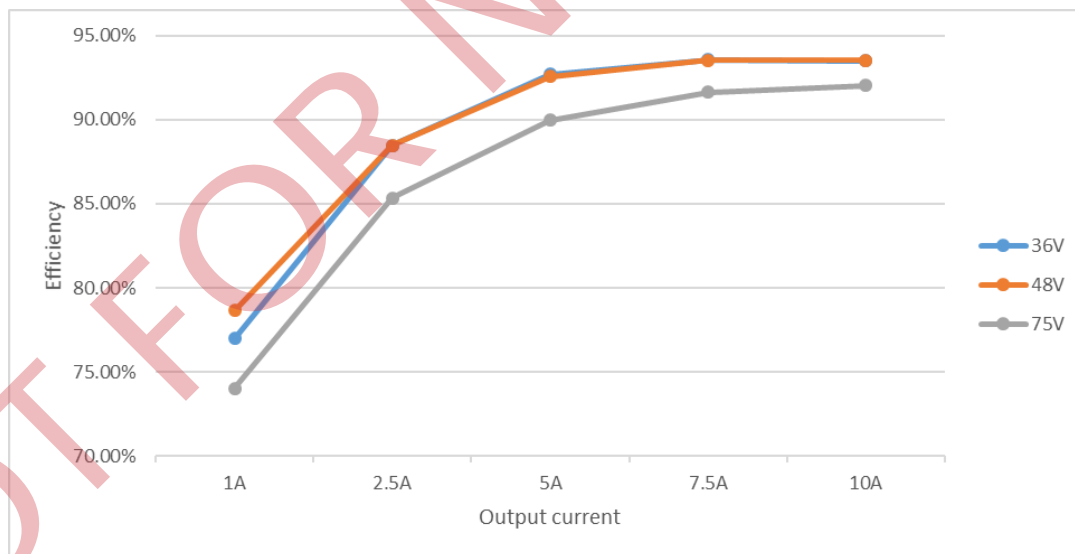


Figure 1. Efficiency data

7. REMOTE ON/OFF

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Signal Low (Unit On)	Active Low	The remote on/off pin open, Unit off.	-0.3	-	0.8	V
Signal High (Unit Off)			2.4	-	18	V
Signal Low (Unit Off)	Active High	The remote on/off pin open, Unit on.	-0.3	-	0.8	V
Signal High (Unit On)			2.4	-	18	V
Current Sink			0	-	1	mA

Recommended remote on/off circuit for active low

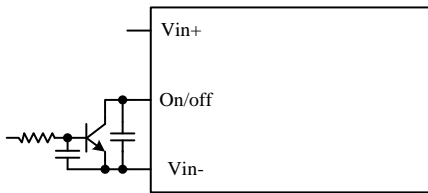


Figure 2. Control with open collector/drain circuit

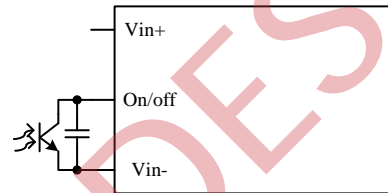


Figure 3. Control with photocoupler circuit

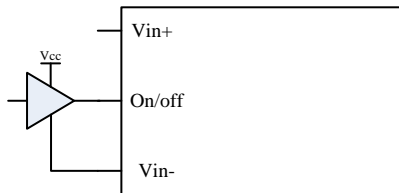


Figure 4. Control with logic circuit

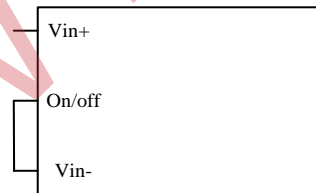


Figure 5. Permanently on

Recommended remote on/off circuit for active high

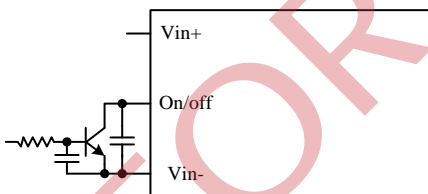


Figure 6. Control with open collector/drain circuit

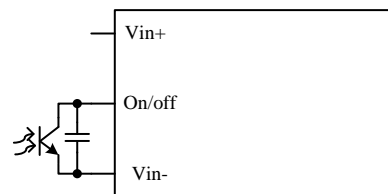


Figure 7. Control with photocoupler circuit

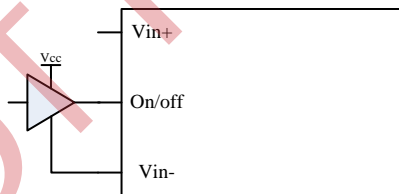


Figure 8. Control with logic circuit

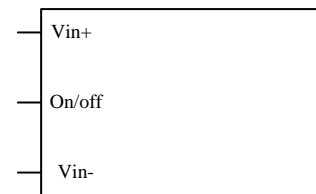


Figure 9. Permanently on

8. REMOTE SENSE

This module has remote sense compensation feature. It can minimize the effects of resistance between output and load in system layout and facilitate accurate voltage regulation at load terminals or other selected point.

1. The remote sense lines carry very little current and hence do not require a large cross-sectional area.
2. This module compensates for a maximum drop of 10% of the nominal output voltage.
3. If the unit is already trimmed up, the available remote sense compensation range should be correspondingly reduced. The total voltage increased by trim and remote sense should not exceed 10% of the nominal output voltage.
4. When using remote sense compensation, all the resistance, parasitic inductance and capacitance of the system are incorporated within the feedback loop of this module which can make an effect on the module's compensation, affecting the stability and dynamic response. A 0.1 μ F ceramic capacitor can be connected at the point of load to de-couple noise on the sense wires.
5. Recommend the connection of remote sense compensation as below figure. There are a resistor RS+ (51.1 ohm) from Vo+ to Sense+ and a resistor RS- (51.1 ohm) from Vo- to Sense- inside of this module.

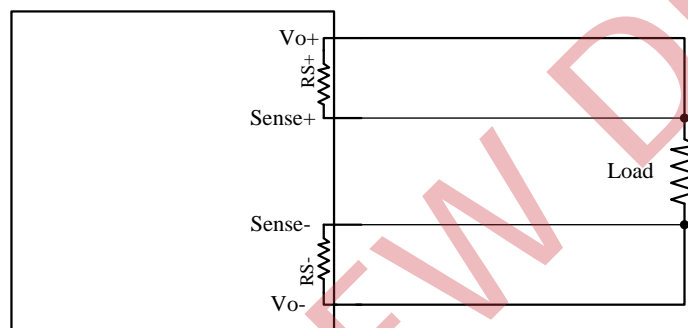


Figure 10.

6. If not using remote sense compensation, please connect sense directly to output at module's pin, that is, connect sense+ to Vo+ and sense- to Vo- at module's pin, the shorter the better. See below figure.

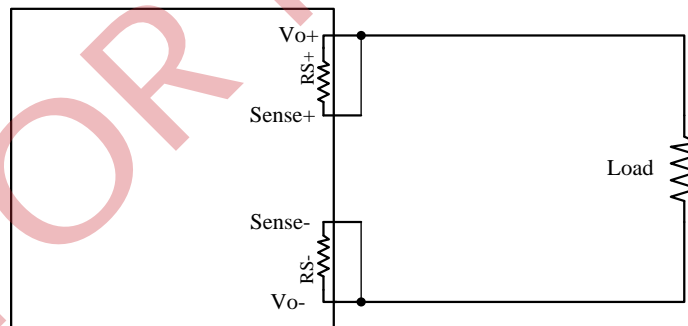


Figure 11.

9. TRANSIENT RESPONSE WAVEFORMS

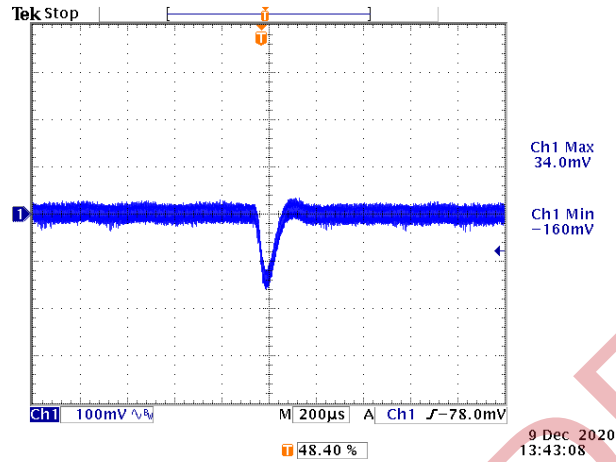


Figure 12. $V_{out} = 12\text{ V}$, 50%-75% Load Transients at $V_{in} = 48\text{ V}$ @ $T_a = 25^\circ\text{C}$

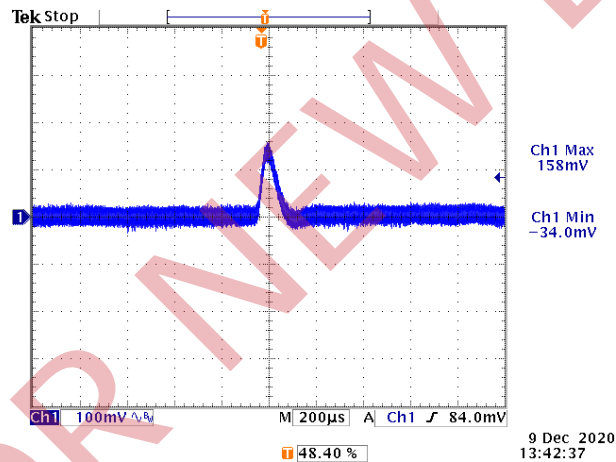


Figure 13. $V_{out} = 12\text{ V}$, 75%-50% Load Transients at $V_{in} = 48\text{ V}$ @ $T_a = 25^\circ\text{C}$

Note: Transient Response: $di/dt = 0.1\text{ A}/\mu\text{s}$, $1 \times 1\ \mu\text{F}$ ceramic cap, $1 \times 10\ \mu\text{F}$ Tan cap, and $1 \times 270\ \mu\text{F}$ OSCON cap at output.

10. STARTUP & SHUTDOWN

Rise time

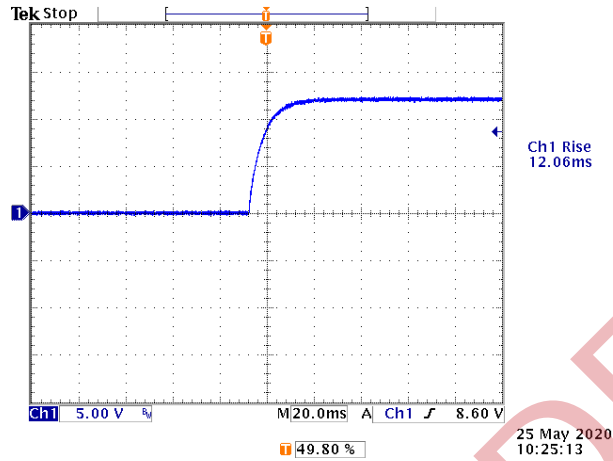


Figure 14. $V_{in} = 48\text{ V}$ $V_o = 12\text{ V}$ $I_o = 10\text{ A}$

Startup time

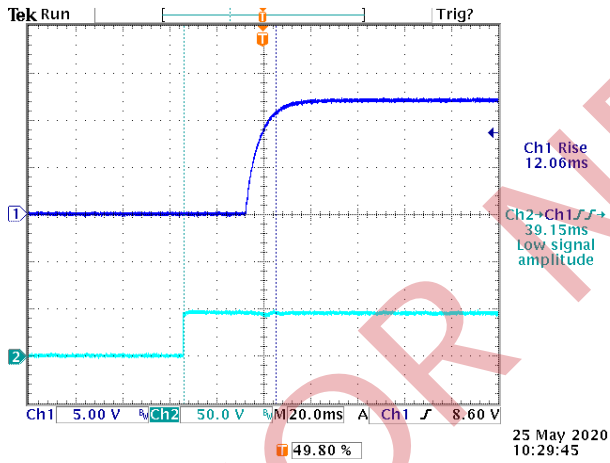


Figure 15. Startup from V_{in}
Ch1: V_o Ch2: V_{in}
 $V_{in} = 48\text{ V}$ $V_o = 12\text{ V}$ $I_o = 10\text{ A}$

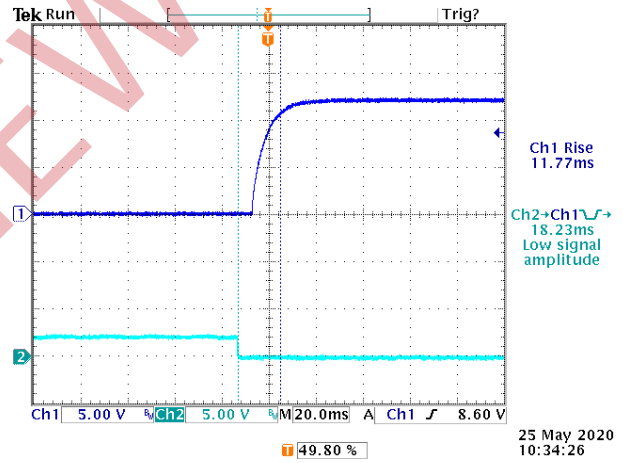


Figure 16. Startup from on/off
Ch1: V_o Ch2: on/off
 $V_{in} = 48\text{ V}$ $V_o = 12\text{ V}$ $I_o = 10\text{ A}$

Shutdown

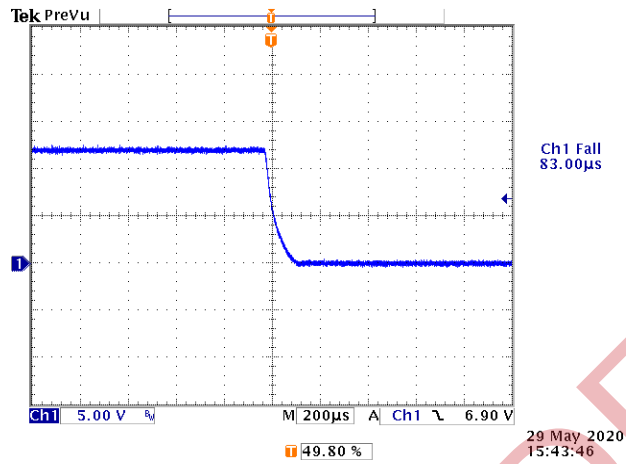


Figure 17. $V_{in} = 48 V$ $V_o = 12 V$ $I_o = 10 A$

11. RIPPLE AND NOISE WAVEFORMS

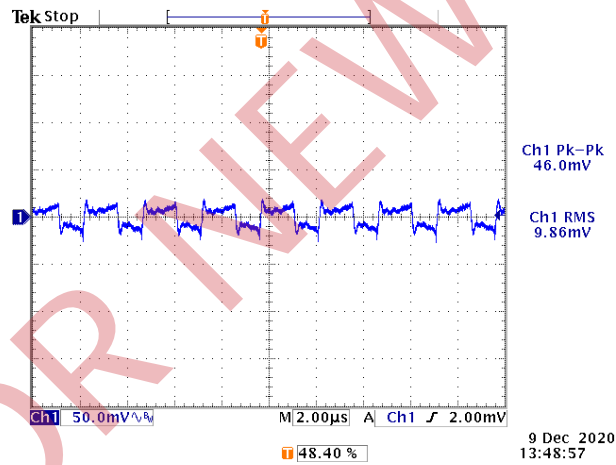


Figure 18. 36 VDC input 12 VDC/10 A output

Note: Ripple and noise at full load, with a 1 µF ceramic cap, a 10 µF Tan cap and a 270 µF OSCON cap at output, $T_a = 25\text{ }^\circ\text{C}$.

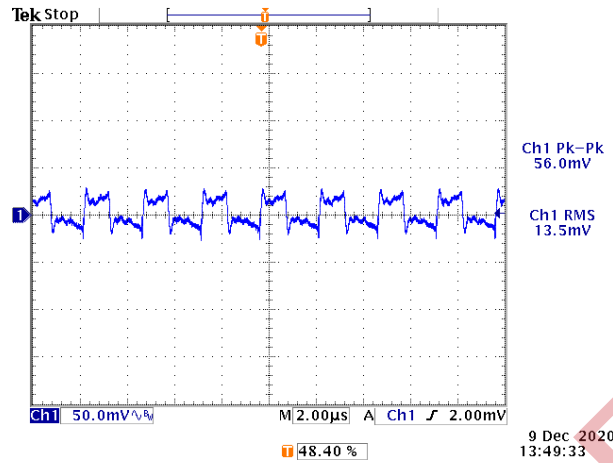


Figure 19. 48 VDC input 12 VDC/10 A output

Note: Ripple and noise at full load, with a 1 μ F ceramic cap, a 10 μ F Tan cap and a 270 μ F OSCON cap at output, Ta = 25 $^{\circ}$ C.

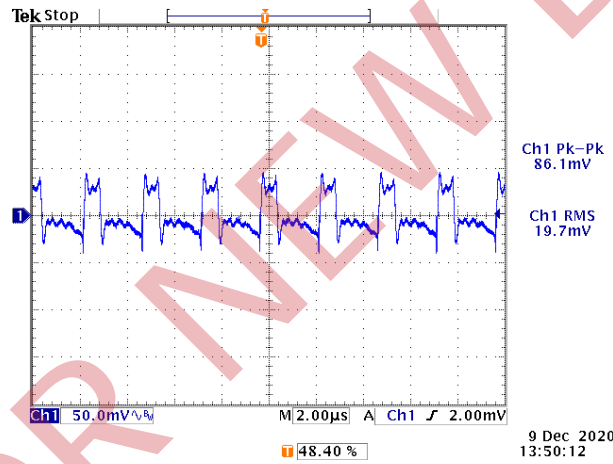


Figure 20. 75 VDC input 12 VDC/10 A output

Note: Ripple and noise at full load, with a 1 μ F ceramic cap, a 10 μ F Tan cap and a 270 μ F OSCON cap at output, Ta = 25 $^{\circ}$ C.

12. OVER VOLTAGE PROTECTION

The output over voltage protection consists of circuitry that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over voltage protection threshold, the module will shut down into latch mode, and need to reset the enable or input voltage for the module to operate normally when the fault is cleared.

Test setup:

R=205K

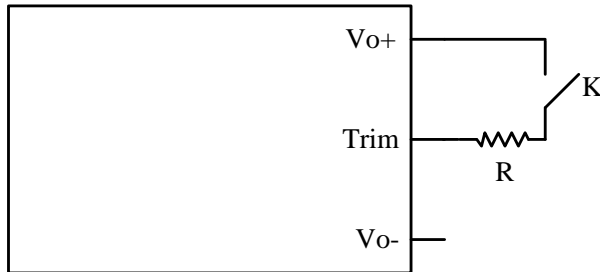


Figure 21.

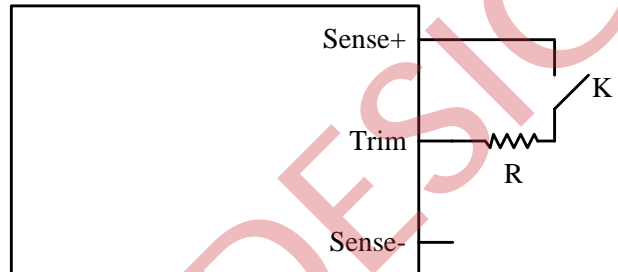


Figure 22.

Waveform:

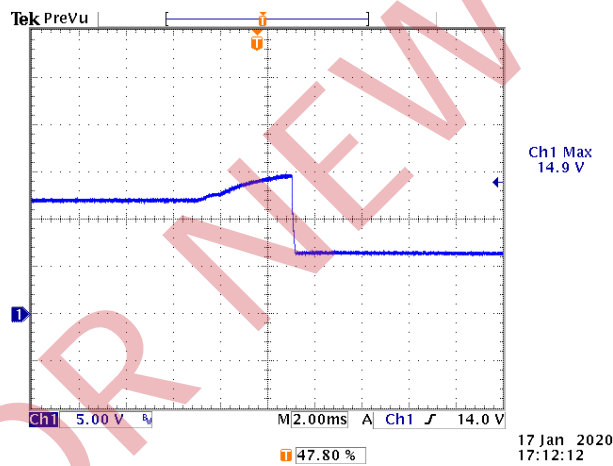


Figure 23. CH1: Output voltage waveform

13. OVER CURRENT PROTECTION

To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry which can endure current limiting for a few milliseconds. If the over current condition persists beyond a few milliseconds, the module will shut down into hiccup mode and restart once every 800 ms. The module operates normally when the output current goes into specified range. The typical average output current is 1.34 A during hiccup.

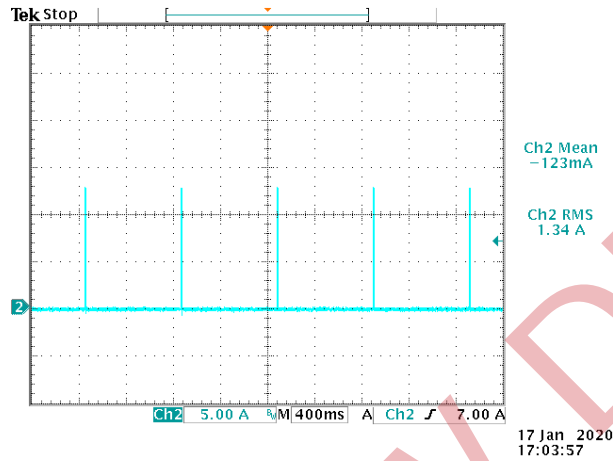


Figure 24. $V_{in} = 48 V$

14. INPUT UNDER-VOLTAGE LOCKOUT

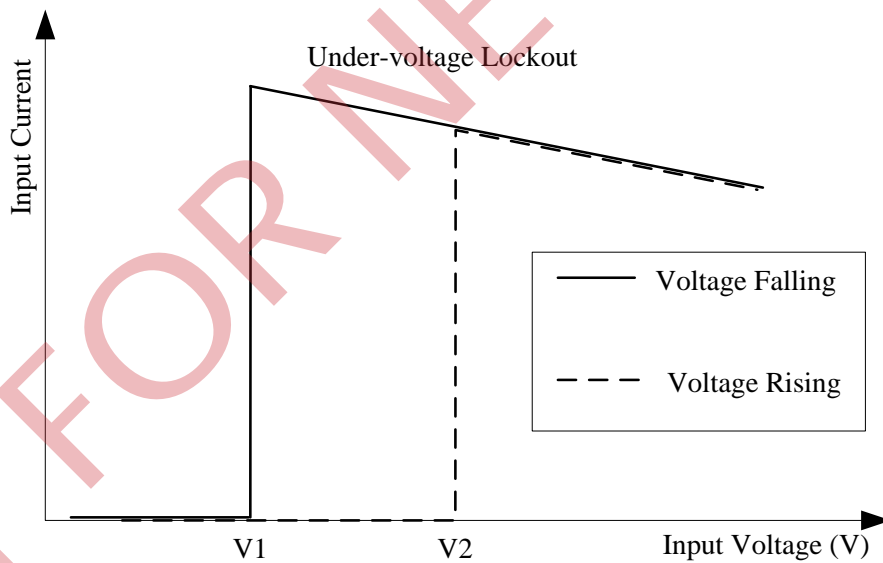


Figure 25. Input under-voltage lockout

$$V1 = 32 V$$

$$V2 = 35 V$$

15. OUTPUT TRIM EQUATIONS

Equations for calculating the trim resistor are shown below. The Trim Down resistor should be connected between the Trim pin and Sense (-) pin. The Trim Up resistor should be connected between the Trim pin and the Sense (+). Only one of the resistors should be used for any given application.

Minimum trim down voltage is 9.6 V.
Maximum trim up voltage is 13.2 V.

The total voltage increased by trim and remote sense should not exceed 10% of the nominal output voltage.

Trim down test circuit:

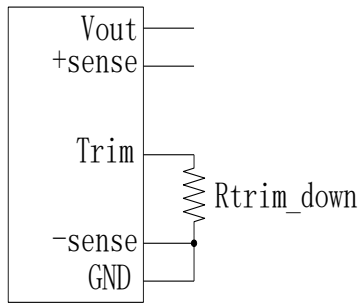


Figure 26. Trim down test circuit

$$R_{trimdown} = \frac{511}{\Delta\%} - 10.2[k\Omega]$$

Trim up test circuit:

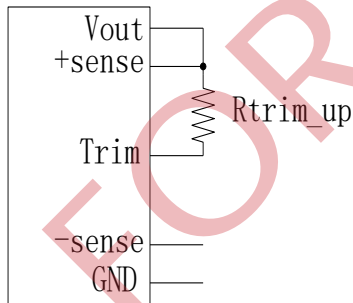


Figure 28. Trim up test circuit

$$R_{trimup} = \frac{5.11 \times V_o \times (100 + \Delta\%)}{1.225 \times \Delta\%} - \frac{510}{\Delta\%} - 10.2[k\Omega]$$

$$\Delta\% = \left| \frac{V_{DES} - V_o}{V_o} \right| \times 100$$

Note: VDES=Desired(trimmed) output voltage[V]

VO= =Normal output voltage (12 V)

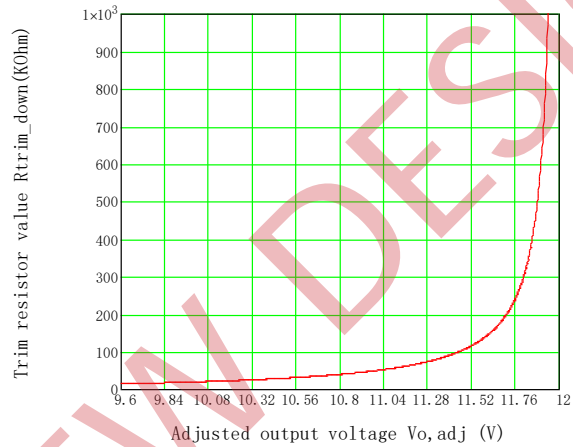


Figure 27. Trim down test curve

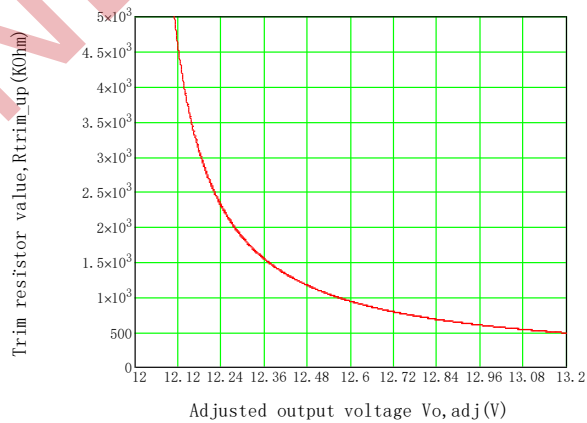


Figure 29. Trim up test curve

16. THERMAL DERATING CURVE

Thermal test is performed based on a 8"x8" 2OZ test board with cover on the module, airflow direction is from Vin+ to Vin- as shown below. The hottest spot is PCB winding when testing in Vin = 48 V. OTP is achieved by thermistor when reaching its threshold, shut down in non-latch mode, and will restart automatically when temperature falls to recovery threshold.

Maximum junction temperature of semiconductors derated to 120 °C.

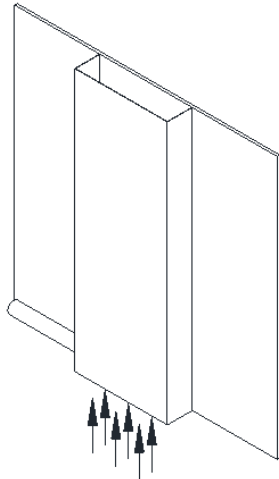


Figure 30. Airflow direction

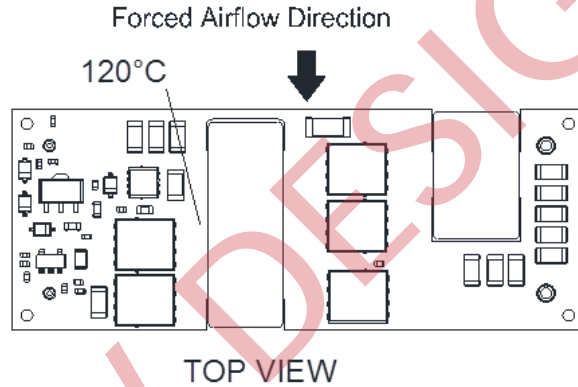
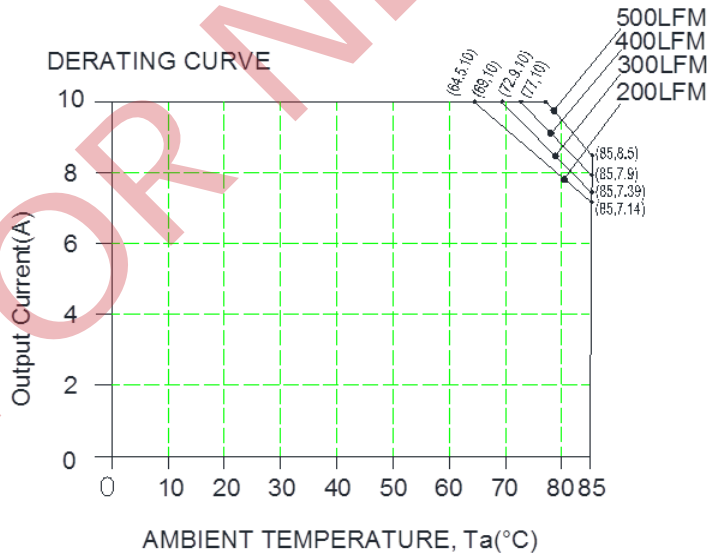


Figure 31. Hot point

Derating curve under normal input:



Output Current vs. Local Ambient Temperature and Air Velocity

Figure 32. Derating curve

17. SAFETY & EMC

Safety :

Material flammability: UL94V-0
 Safety approved to IEC/EN 62368-1(TBC)

EMC:

1. Surge: IEC 61000-4-5
2. DC-DIP: IEC 61000-4-29
3. Conductive EMI: EN 55032 class A

Compliance to EN 55032 class A (both peak and average) with the following inductive and capacitive filter

Test Setup:

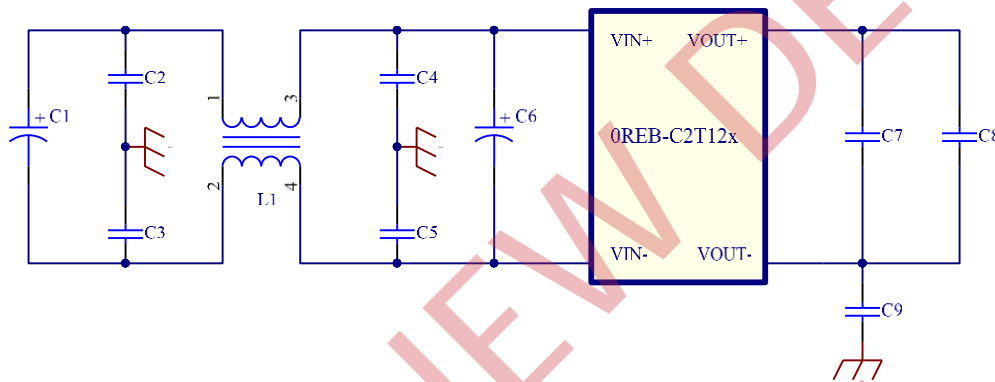


Figure 33. Test setup

ITEM	DESIGNATOR	PARAMETER	VENDOR	VENDOR P/N
1	C1	100µF/100V, AL cap	Nichicon	UVZ2A101MPD
2	C2	100pF/1KV/1206	AVX	1206AC101KAT
3	C3	100pF/1KV/1206	AVX	1206AC101KAT
4	L1	2.5mH	ITG	C20200-02
5	C4	10nF/630V/1206	TDK	C3216X7R2J103KT
6	C5	10nF/630V/1206	TDK	C3216X7R2J103KT
7	C6	100µF/100V, AL cap	Nichicon	UVZ2A101MPD
8	C9	4*10nF/630V/1206	TDK	C3216X7R2J103KT

Positive:

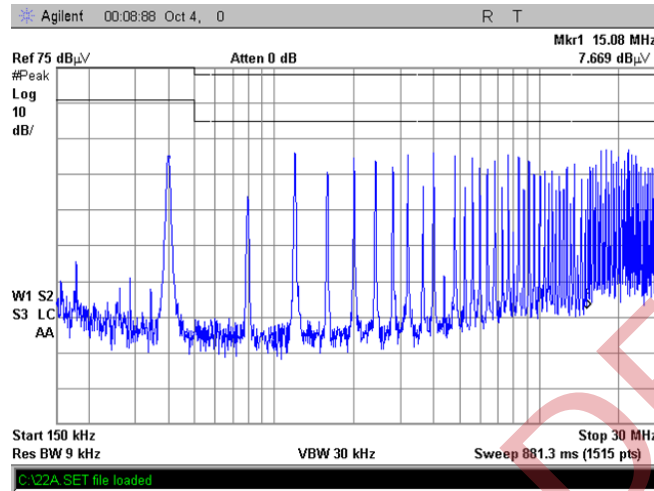


Figure 34. Positive curve

Negative:

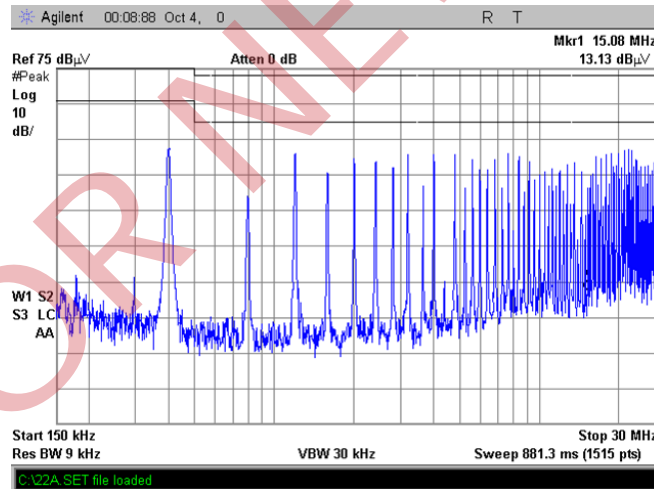


Figure 35. Negative curve

18. MECHANICAL DIMENSIONS

OUTLINE

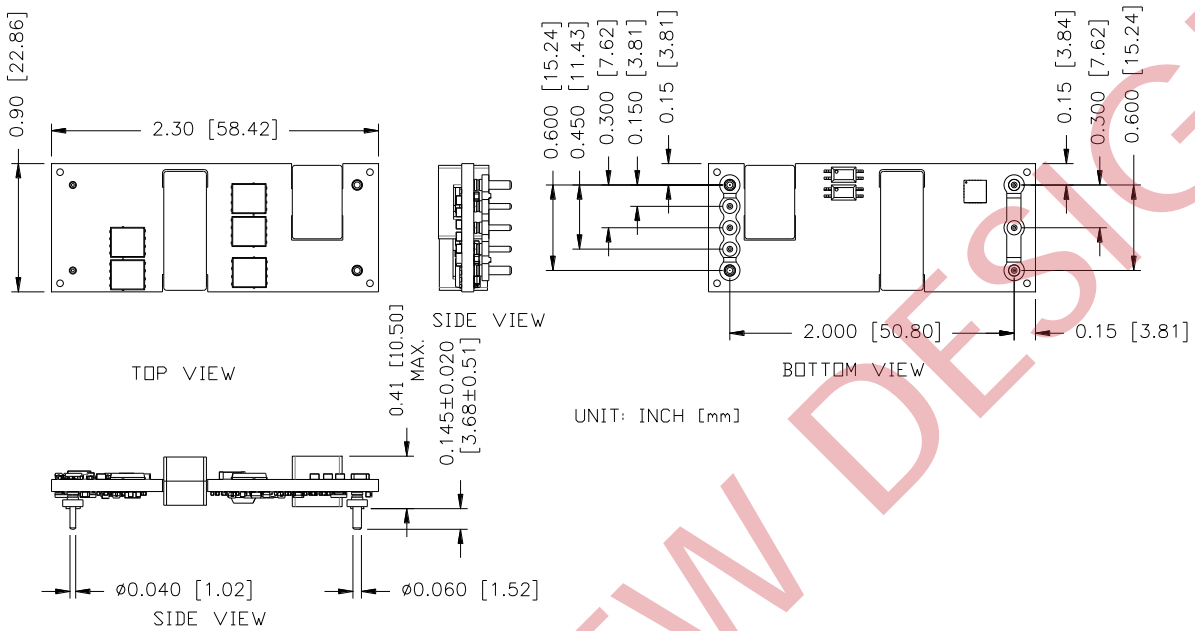


Figure 36. Outline

NOTE: This module is recommended and compatible with Pb-Free Wave Soldering and must be soldered using a peak solder temperature of no more than 260 °C for less than 5 seconds.

NOTES:

- 1) All Pins: Material - Copper Alloy;
Finish - Gold plated.
- 2) Un-dimensioned components are shown for visual reference only.
- 3) All dimensions in inch [mm]; Tolerances: x.xx +/-0.02 inch [0.5 mm]. x.xxx +/-0.01 inch [0.25 mm]. Unless otherwise stated.

PIN DEFINITIONS

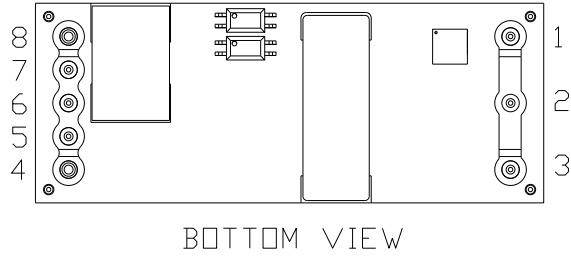
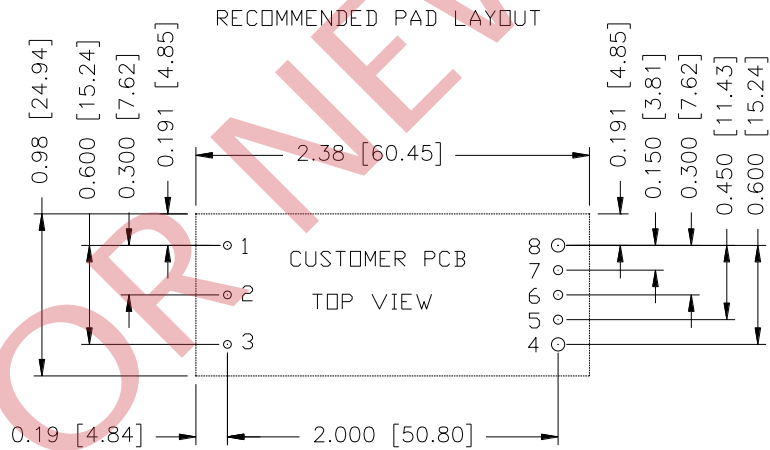


Figure 37. Pins

PIN	FUNCTION	PIN SIZE	PIN	FUNCTION	PIN SIZE
1	Vin (+)	0.040"	5	RS-	0.040"
2	ON/OFF	0.040"	6	TRIM	0.040"
3	Vin (-)	0.040"	7	RS+	0.040"
4	Vout (-)	0.060"	8	Vout (+)	0.060"

RECOMMENDED PAD LAYOUT



1,2,3,5,6,7 \varnothing 0.050 HOLE SIZE, \varnothing 0.100 min PAD SIZE
 4,8 \varnothing 0.074 HOLE SIZE, \varnothing 0.120 min PAD SIZE

Figure 38. Recommended pad layout

19. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2020-01-20	AA	First release.	XF.Jiang
2020-06-24	AB	Add thermal derating curve and safety& EMC. Update startup & shutdown waveforms, input reflected ripple current(pk-pk) and output specifications. Update altitude to 5000m.	XF.Jiang
2020-12-08	AC	Add MTBF. Update output ripple and noise, transient response, min output current limit, min output capacitance and mechanical dimensions.	XF.Jiang
2021-05-07	AD	Add object ID.	XF.Jiang

For more information on these products consult: tech.support@psbel.com

NUCLEAR AND MEDICAL APPLICATIONS - Products are not designed or intended for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems.

TECHNICAL REVISIONS - The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.



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