

# OREB-C2T07L

## Isolated DC-DC Converter

The OREB-C2T07L is an isolated DC/DC converter that operates from a nominal 48V source. This converter provides up to 112.5W 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.

### 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



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## 1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
OREB-C2T07L	7.5 VDC	36 -75 VDC	15 A	112.5 W	89.5%

**NOTE:** Add "G" suffix at the end of the model number to indicate Tray Packaging.

### PART NUMBER EXPLANATION

0	R	EB	-	C2	T	07	L	G
Mounting Type	RoHS Status	Series Name	-	Series Code	Input Range	Output Voltage	Active Logic	Package Type
Through hole mount	RoHS	1/8 <sup>th</sup> brick	-	-	36 - 75 VDC	7.5 V	Active Low, 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		-	-	1500	V
Operating Temperature		-40	-	85	°C
Storage Temperature		-55	-	125	°C
Altitude		-	-	4000	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)		-	40	60	mA
Remote Off Input Current		-	10	20	mA
Input Reflected Ripple Current (rms)	With simulated source impedance of 10 $\mu$ H, 5 Hz to 20 MHz. Use a 100 $\mu$ F/100 V electrolytic capacitor with ESR=1 ohm max, at 200 kHz @ 25°C.	-	2	5	mA
Input Reflected Ripple Current (pk-pk)		-	10	20	mA
I <sup>2</sup> t Inrush Current Transient		-	-	0.5	A <sup>2</sup> 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	$V_{OVLO}$	-	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 5A on system board. Refer to the fuse manufacturer's datasheet for further information.

**NOTE:** This converter has internal L-C (1  $\mu$ H – 3  $\mu$ 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	V <sub>in</sub> = 48 V, I <sub>o</sub> = 50% load	7.387	7.5	7.612	V
Load Regulation	V <sub>in</sub> = 48 V, I <sub>o</sub> = 0~100% load	-	0.1	0.2	% V <sub>o,set</sub>
Line Regulation	V <sub>in</sub> = 36~75V, I <sub>o</sub> = 100% load	-	0.1	0.2	% V <sub>o,set</sub>
Regulation Over Temperature		-	-	2	% V <sub>o,set</sub>
Output Ripple and Noise (pk-pk)	V <sub>in</sub> = 48 V, I <sub>o</sub> = 100% load at 25°C ambient, 0-20 MHz BW, with a 1 µF ceramic capacitor, a 10µF Tan cap and a 270 µF OSCON cap at output.	-	80	-	mV
Output Ripple and Noise (rms)		-	20	-	mV
Output Current Range		0	-	15	A
Output DC Current Limit		-	18	-	A
Short Circuit Surge Transient		-	1.2	2	A <sup>2</sup> s
Rise Time		-	-	6	ms
Turn On Time	Enable form V <sub>in</sub>	-	-	40	ms
	Enable form ON/OFF	-	-	20	ms
Overshoot at Turn on		-	0	3	%
Output Capacitance		270	-	3300	µF
<b>Transient Response</b>					
ΔV 50%~75% of Max Load		-	280	-	mV
Settling Time	di/dt = 0.1 A/µs, V <sub>in</sub> =48 VDC, T <sub>a</sub> = 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		-	280	-	mV
Settling Time		-	200	-	µs

## 5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vin = 48 V, full load	88	89.5	-	%
Switching Frequency		-	400	-	kHz
Over Temperature Protection		-	130	-	°C
Output Voltage Trim Range		95	-	110	%
Remote Sense Range		-	-	10	%
Over Voltage Protection (Static)	This voltage is achieved by trimming up output slowly. (Latch)	-	9.3	-	V
Over Voltage Protection (Dynamic)	The transient over voltage is achieved by connecting the Trim pin to Vout+ pin through a 100K resistor. (Latch)	-	9.5	-	V
FIT <sup>2</sup>	Calculated Per Bell Core SR-332 (Vin = 48 V, Vo = 7.5 V, Io = 12 A, Ta = 40°C, FIT=10 <sup>9</sup> /MTBF)	-	116.2	-	-
Weight		-	20.9	-	g
Dimensions (L x W x H)		2.30 x 0.90 x 0.41 58.42 x 22.86 x 10.50			inch mm
<b>Isolation characteristics</b>					
Input to Output		-	-	1500	Vdc
Isolation Capacitance		-	3300	-	pF
Isolation Resistance		10M	-	-	Ohm

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

## 6. EFFICIENCY DATA

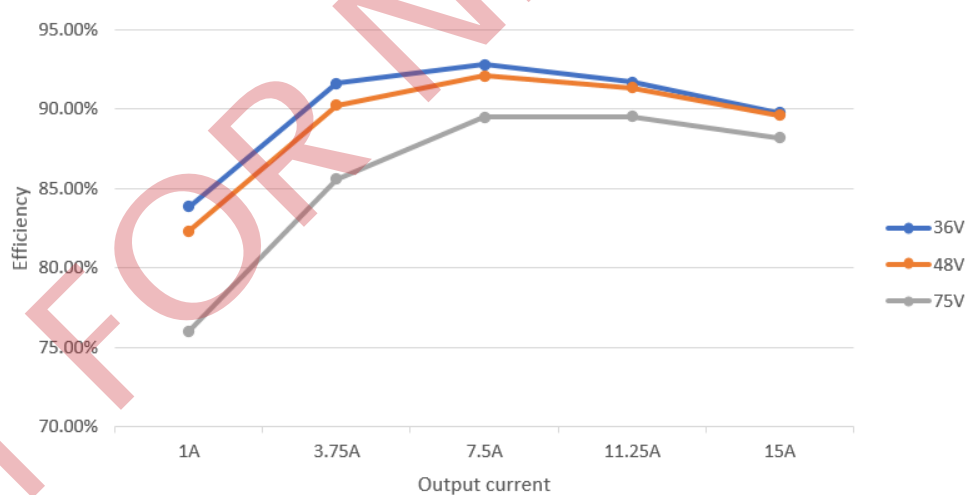


Figure 1. Efficiency data

7. REMOTE ON/OFF

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Signal Low (Unit On)	Active Low	-0.3	-	0.8	V
Signal High (Unit Off)		2.4	-	18	V
Current Sink		0	-	1	mA

Recommended remote on/off circuit for active low

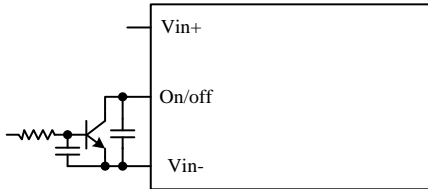


Figure 2. Control with open collector/drain circuit

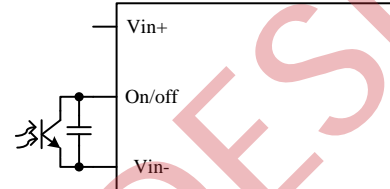


Figure 3. Control with photocoupler circuit

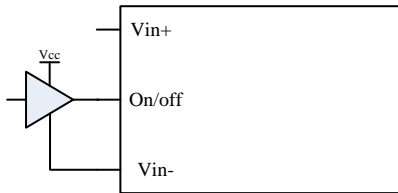


Figure 4. Control with logic circuit

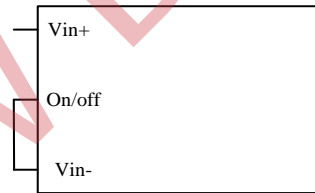


Figure 5. Permanently on

## 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 carries 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 0.1uF 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.

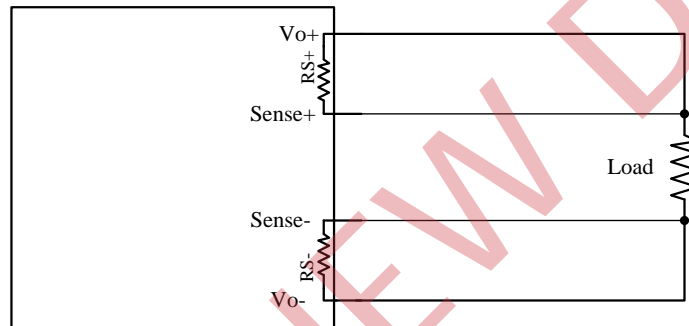


Figure 6.

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

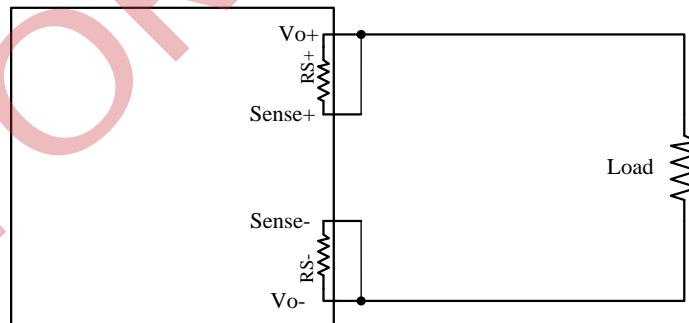


Figure 7.

9. TRANSIENT RESPONSE WAVEFORMS

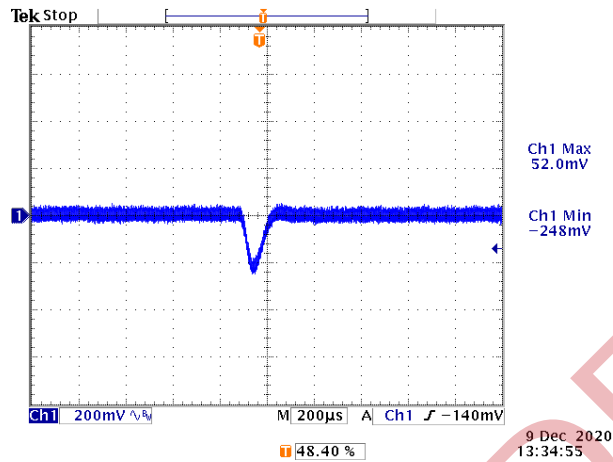


Figure 8.  $V_{out} = 7.5$ , 50%-75% Load Transients at  $V_{in} = 48\text{ V}$  @  $T_a = 25^\circ\text{C}$

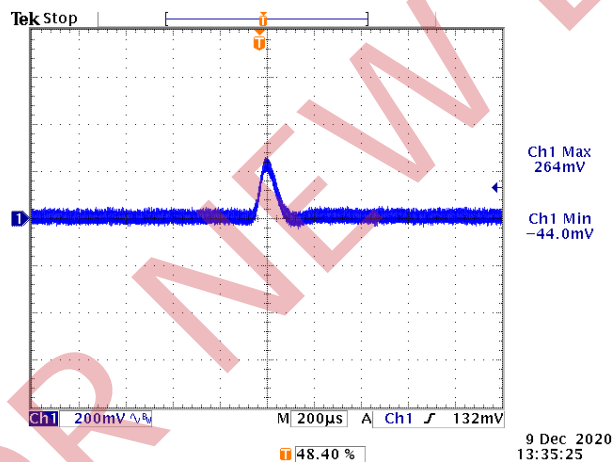


Figure 9.  $V_{out} = 7.5\text{ V}$ , 75%-50% Load Transients at  $V_{in} = 48\text{ V}$  @  $T_a = 25^\circ\text{C}$

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

### 10. STARTUP & SHUTDOWN

#### Rise time

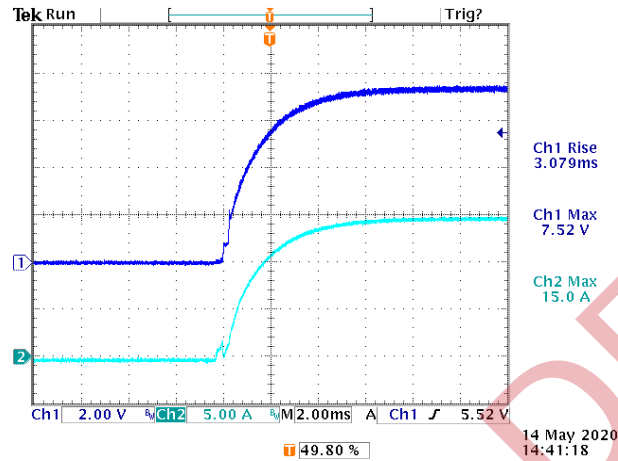


Figure 10. Rise time at  $V_{in} = 48\text{ V}$ ;  $V_o = 7.5\text{ V}$ ;  $I_o = 15\text{ A}$

#### Startup time

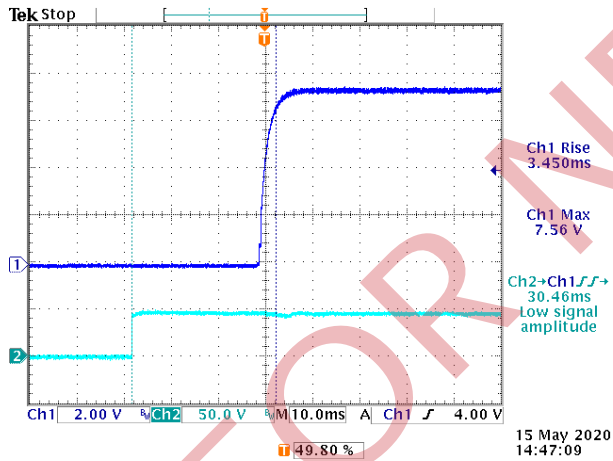


Figure 11. Startup from  $V_{in}$   
Ch1:  $V_o$  Ch2:  $V_{in}$   
 $V_{in} = 48\text{ V}$ ;  $V_o = 7.5\text{ V}$ ;  $I_o = 15\text{ A}$

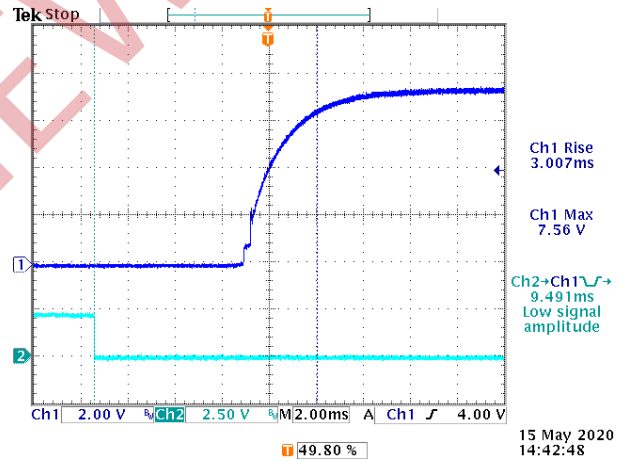


Figure 12. Startup from on/off  
Ch1:  $V_o$  Ch2: on/off  
 $V_{in} = 48\text{ V}$ ;  $V_o = 7.5\text{ V}$ ;  $I_o = 15\text{ A}$

Shutdown

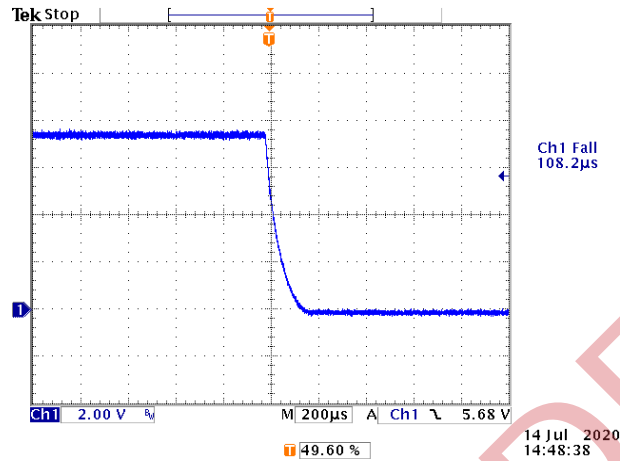


Figure 13. Shutdown at  $V_{in}=48V$   $V_o=7.5V$   $I_o=15A$

11. RIPPLE AND NOISE WAVEFORMS

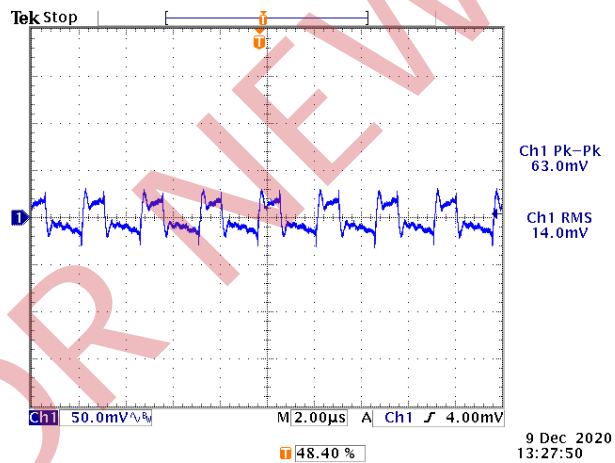


Figure 14. 36 Vdc input, 7.5 Vdc/15 A output

**NOTE:** Ripple and noise at full load, with a 1uF ceramic cap, a 10uF Tan cap and a 270uF OSCON cap at output,  $T_a=25$  deg C.

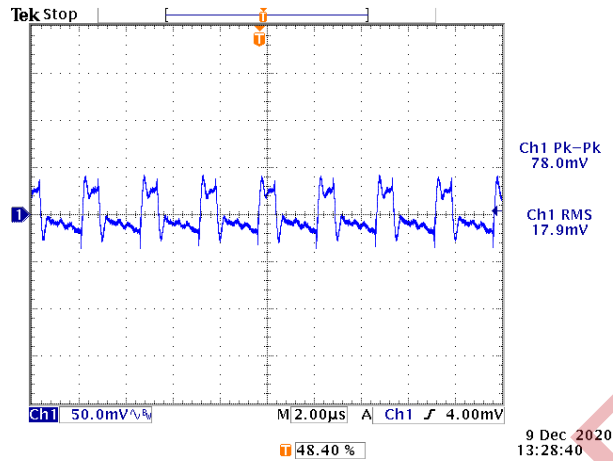


Figure 15. 48 Vdc input, 7.5 Vdc/15 A output

**NOTE:** Ripple and noise at full load, with a 1uF ceramic cap, a 10uF Tan cap and a 270uF OSCON cap at output, Ta=25 deg C.

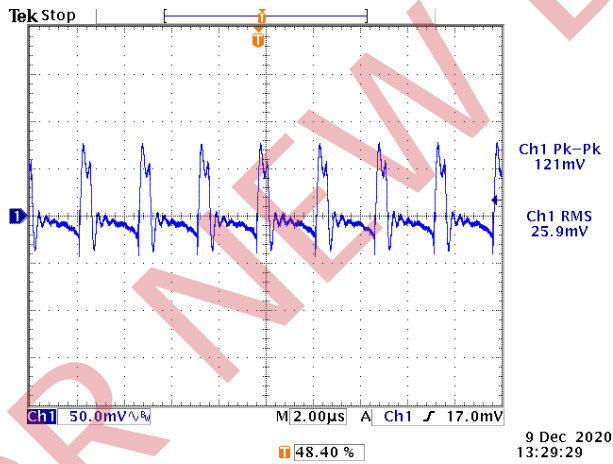


Figure 16. 75 Vdc input, 7.5 Vdc/15 A output

**NOTE:** Ripple and noise at full load, with a 1 uF ceramic cap, a 10 uF Tan cap and a 270 uF OSCON cap at output, Ta = 25 deg 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 input voltage for the module to operate normally when the fault is cleared.

### Test setup:

R=100K

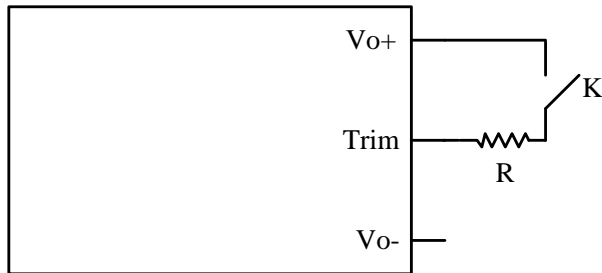


Figure 17.

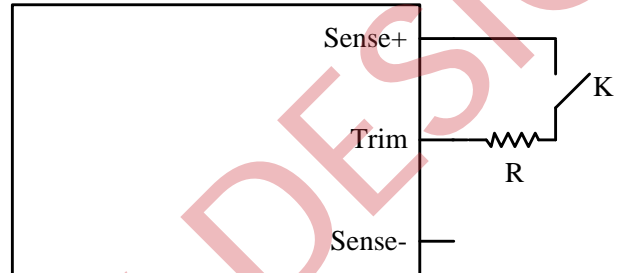


Figure 18.

### Waveform:

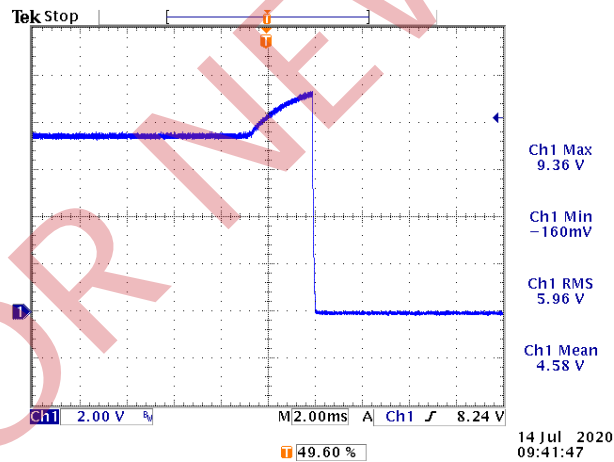


Figure 19. CH1: Output voltage waveform

### 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 overcurrent 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 2.66 A during hiccup.

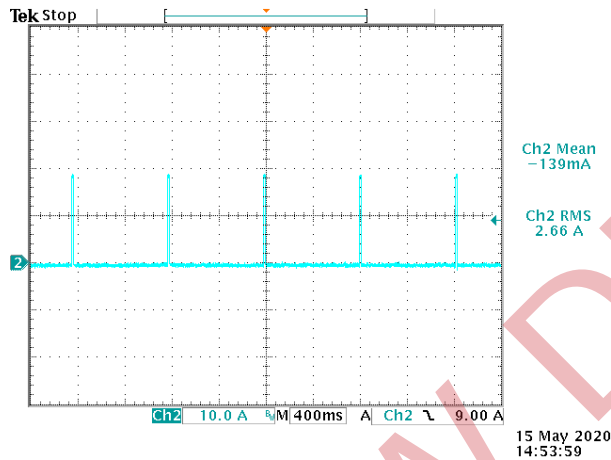


Figure 20. Over current protection at  $V_{in} = 48 V$

### 14. INPUT UNDER-VOLTAGE LOCKOUT

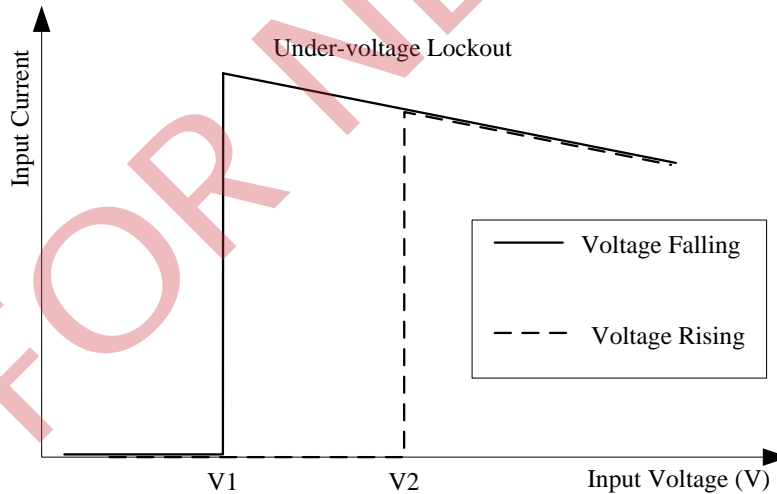


Figure 21. Input under-voltage lockout

$$V1 = 32 V$$

$$V2 = 35 V$$

### 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 7.125 V  
 Maximum trim up voltage is 8.25 V.

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

#### Trim down test circuit

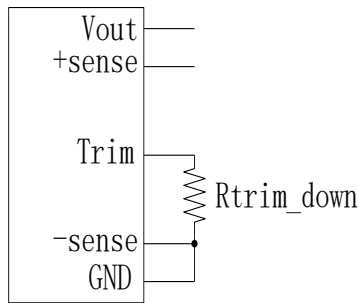


Figure 22. Trim down test circuit

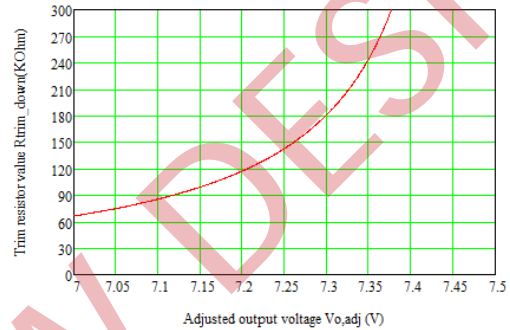


Figure 23. Trim down test curve

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

#### Trim up test circuit

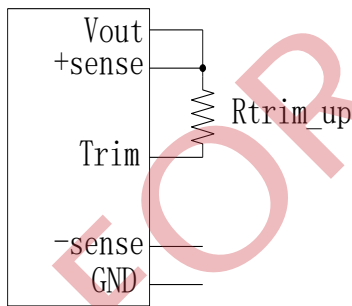


Figure 24. Trim up test circuit

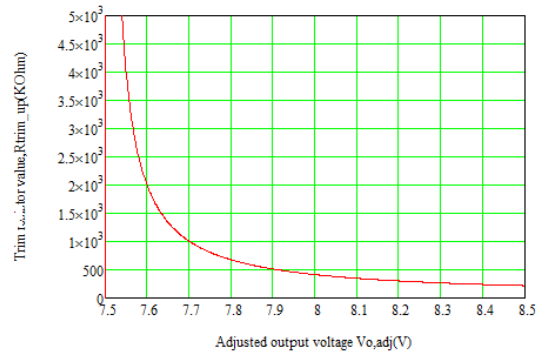


Figure 25. Trim up test curve

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

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

**NOTE:** VDES = Desired (trimmed) output voltage [V]; VO = Normal output voltage (7.5 V)

### 16. THERMAL DERATING CURVE

Thermal test is performed based on a 8" x 8" 2OZ test board with cover on the module, airflow direction is from Vin+ to Vin- as shown below. The hottest spot is secondary MOSFET 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 down to recovery threshold.

Maximum junction temperature of semiconductors derated to 120°C.

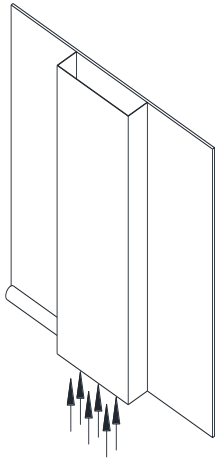


Figure 26. Airflow direction

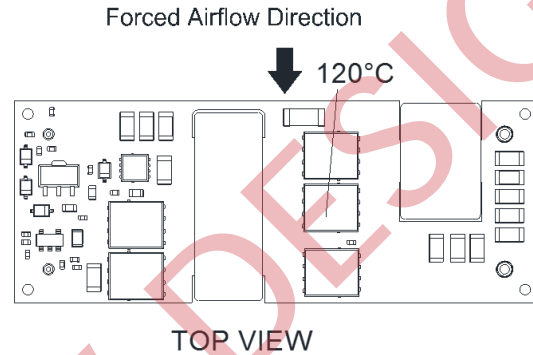
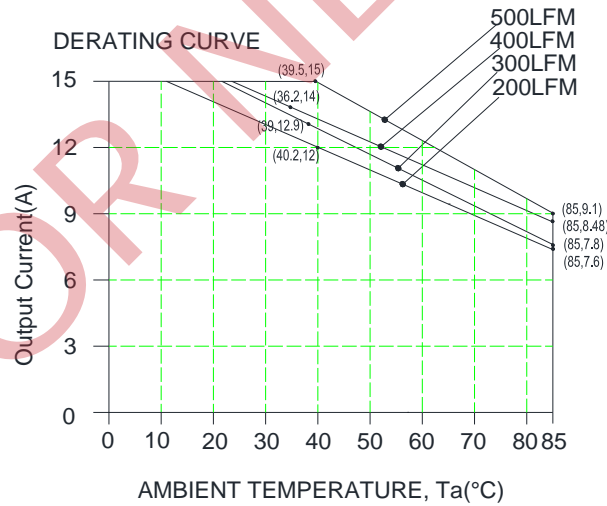


Figure 27. Hot spot

Thermal derating curve under normal input:



DERATING CURVE  
Output Current vs. Local Ambient Temperature and Air Velocity  
Figure 28. Thermal derating curve

### 17. SAFETY & EMC

**Safety :**

Material flammability: UL94V-0  
 CB certification to IEC/EN 62368-1 (TBC)

**EMC:**

1. Surge: IEC61000-4-5
  2. DC-DIP: IEC61000-4-29
  3. Conductive EMI: EN55032 class A
- Compliance to EN55032 class A (both peak and average) with the following inductive and capacitive filter

**Test setup:**

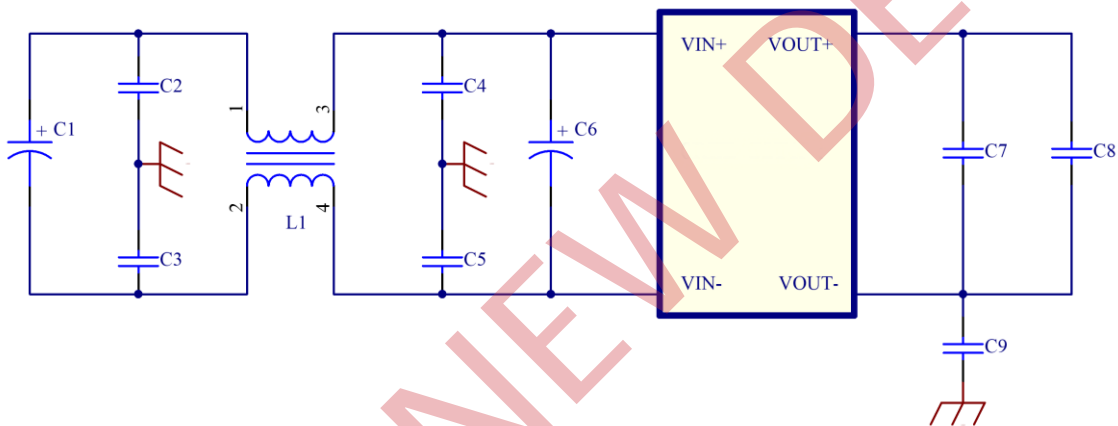


Figure 29. EMC test setup

ITEM	DESIGNATOR	PARAMETER	VENDOR	VENDOR P/N
1	C1	100uF/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	100uF/100V, AL cap	Nichicon	UVZ2A101MPD
8	C9	4*10nF/630V/1206	TDK	C3216X7R2J103KT

Positive:

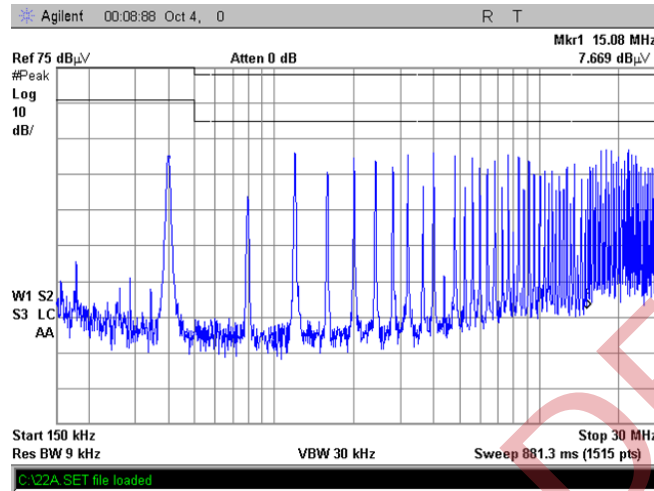


Figure 30. Positive curve

Negative:

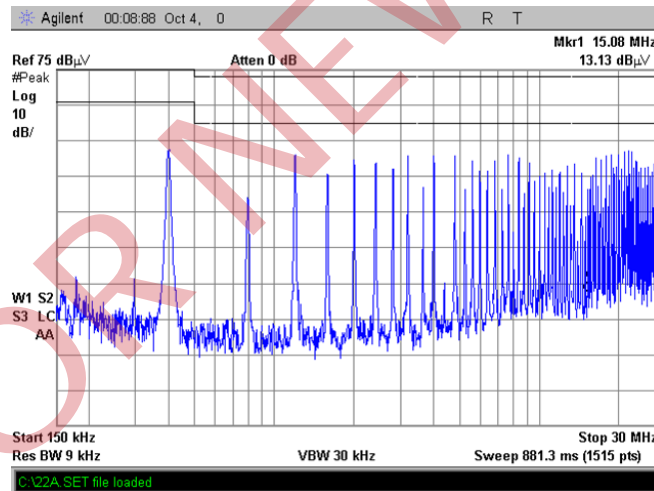


Figure 31. Negative curve

18. MECHANICAL DIMENSIONS

OUTLINE

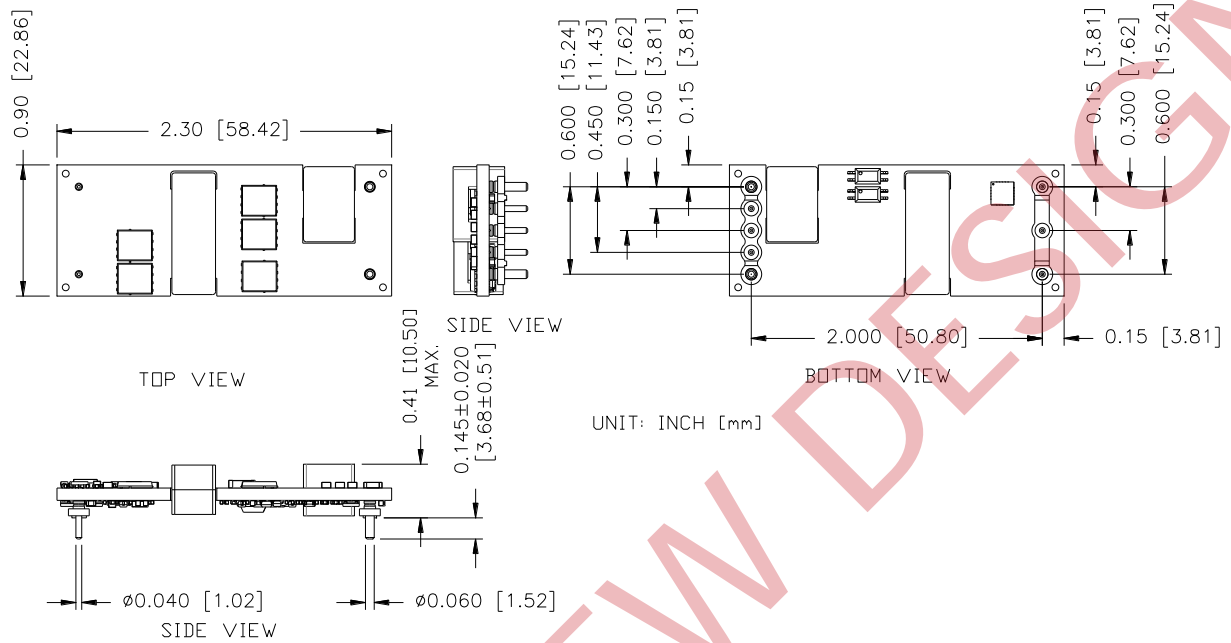


Figure 32. Outline

**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.

**NOTE:**

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

**PIN DEFINITIONS**

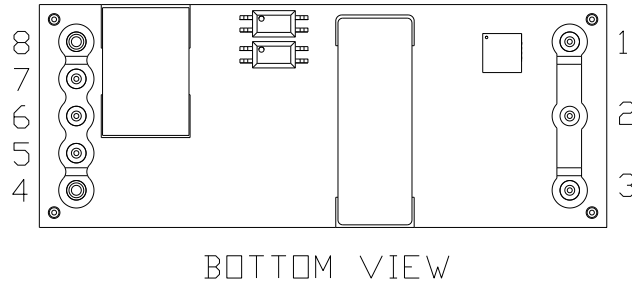


Figure 33. Pins

PIN	FUNCTION	DIAMETER	PIN	FUNCTION	DIAMETER
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**

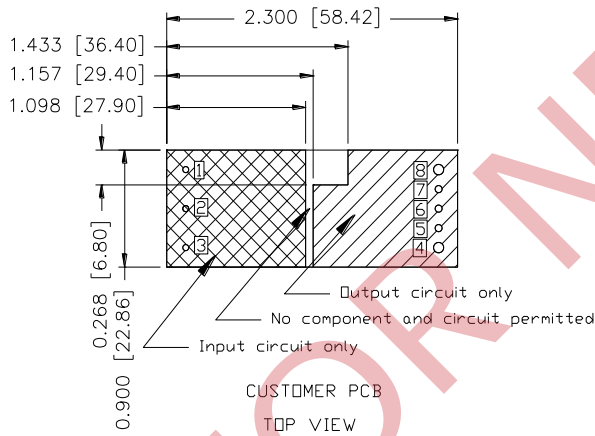


Figure 34. Recommended pad layout-1

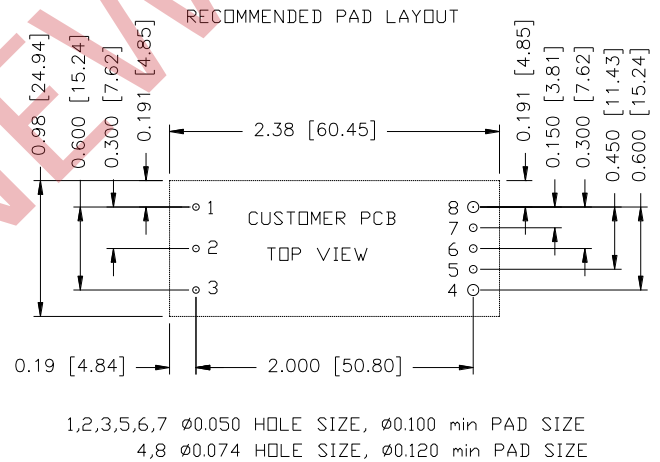


Figure 35. Recommended pad layout-2

**19. REVISION HISTORY**

DATE	REVISION	CHANGES DETAIL	APPROVAL
2020-05-15	AA	First release.	XF.Jiang
2020-05-25	AB	Add Open Frame version.	XF.Jiang
2020-07-14	AC	Add thermal derating curve, OVP waveform and module photo, remove other versions and only keep active low, open frame version.	XF.Jiang
2020-12-08	AD	Add MTBF, update output ripple and noise, transient response, min output capacitance and outline.	XF.Jiang
2021-03-15	AE	Add object ID, safety&EMC and recommended pad layout.	XF.Jiang

For more information on these products consult: [tech.support@psbel.com](mailto: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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