

# 0RQB-C2Q12x

## Isolated DC-DC Converter

The 0RQB-C2Q12x is an isolated dc/dc converter that operates from a nominal 24 VDC source. This unit will provide up to 156 W of output power from a nominal 24 VDC input.

This unit is designed to be highly efficient and low cost. Features include remote on/off, over current protection and overvoltage protection.

The converter is provided in an industry standard quarter brick package.



### Key Features & Benefits

- 9-36 VDC Input
- 12 VDC @ 13 A Output
- 1/4th Brick Converter
- Fixed Frequency
- High Efficiency
- High Power Density
- Low cost
- Input Under Voltage Lockout
- Input over voltage lockout
- OCP/SCP
- Output Over-voltage Protection
- Over Temperature Protection
- Remote On/Off
- Baseplate
- Basic Isolation
- Approved to UL/CSA 62368-1
- Approved to IEC/EN 62368-1
- 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
0RQB-C2Q120	12 VDC	9-36 VDC	13A	156 W	94%
0RQB-C2Q12L	12 VDC	9-36 VDC	13A	156 W	94%

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

### PART NUMBER EXPLANATION

0	R	QB	-	C2	Q	12	x	y
Mounting Type	RoHS Status	Series Name		Output Power	Input Range	Output Voltage	Active Logic	Package Type
Through hole mount	RoHS	1/4th Brick		156 W	9-36V	12 V	L – active low, with base plate 0– active High, with base plate	G – Tray package

## 2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous non-operating Input Voltage		-0.3	-	36	V
Input Transient Voltage	100ms maximum	-	-	50	V
Input withstand Voltage	100ms for working, 1 minute for non-work without damage.	-	-	48	V
Remote On/Off		-0.3	-	18	V
I/O isolation voltage		-	-	1500	V
Ambient temperature		-40	-	85	°C
Storage Temperature		-55	-	125	°C
Relative humidity range		10	-	90	%
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

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Operating Input Voltage		9	24	36	V
Input Current (full load)	Test at 9V input voltage	-	-	20.0	A
Input Current (no load)		-	200	240	mA
Remote Off Input Current		-	25	35	mA
Input Reflected Ripple Current (rms)	With simulated source impedance of 10 $\mu$ H, 5Hz to 20MHz. Use a 2*220 $\mu$ F/100V electrolytic capacitor with ESR=1 ohm max, at 200KHz@25°C.	-	5	10	mA
Input Reflected Ripple Current (pk-pk)		-	30	40	mA
I <sup>2</sup> t Inrush Current Transient		-	0.05	0.1	A <sup>2</sup> s
Turn-on Voltage Threshold	Input UVLO	9.5	10	10.5	V
Turn-off Voltage Threshold	Input UVLO	7.5	8	8.5	V
Turn-on Voltage Threshold	Input OVLO	36.5	38	39	V
Turn-off Voltage Threshold	Input OVLO	38.5	39.5	40.5	V
<b>Other Information:</b>					
Input capacitance	4*4.7 $\mu$ F/50V ceramic capacitor		18.8		$\mu$ F

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

**CAUTION:** This converter is not internally fused. An input line fuse must be used in application. Recommend a input fast-acting fuse with Typical of 30A on system board. Refer to the fuse manufacture's datasheet for further information.

## 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=24 V, Io=50% load at 25°C ambient.	11.8	12.04	12.28	V
Load Regulation	Vin=24V, Io=0~100% load at 25°C ambient.	-	±15	±30	mV
Line Regulation		-	±15	±30	mV
Regulation Over Temperature		-	±100	±200	mV
Output Ripple and Noise(Pk-Pk)	Vin=24V ,Full load ,0-20MHz BW, with a 1µF ceramic capacitor and a 10µF Tantalum cap and 220µF Tantalum cap at output.	-	100	150	mV
Output Ripple and Noise(RMS)		-	25	40	mV
Output Current Range	The 0RQB-C2Q12x module can start up with 17A for 100ms at Vin>12V.	0	-	13	A
Output DC Current Limit		15	20	25	A
Short Circuit Surge Transient		-	-	5	A²s
Rise time		-	12	20	ms
Turn on Time	Ton(Enable form Vin)	-	30	40	ms
	Ton(Enable form ON/OFF)	-	30	40	ms
Overshoot at Turn on		0	-	3	%
Output Capacitance	Note: The minimum output capacitance(220µF) must be low ESR capacitance, such as Tantalum capacitance or POSCAP, and the total ESR must bigger than 3mΩ.	220	-	5000	µF
<b>Transient Response</b>					
Δ V 50%~75% of Max Load		-	400	500	mV
Settling Time	di/dt=0.1A/µs, Vin=24VDC, Ta=25°C, with a 1µF ceramic capacitor, a 10µF Tantalum cap and 220µF Tantalum cap at output.	-	200	300	µs
Δ V 75%~50% of Max Load		-	400	500	mV
Settling Time		-	200	300	µs

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

**5. GENERAL SPECIFICATIONS**

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency max	Vin=24 V Io=Io, The efficiency is measured at Vin=24V, full load and Ta=25°C.	92	94	-	%
Switching Frequency		-	200	-	kHz
Over Temperature Protection		-	125	130	°C
Over Voltage Protection(Static)	This voltage is achieved by trimming up output slowly.		15.3	15.8	V
FIT	Calculated Per Bell Core SR-332 (Vin=24 V, Vo=12 V, Io=10.4 A, Ta = 58°C, FIT=10 <sup>9</sup> /MTBF)	-	546	-	-
Weight		-	64	-	g
Dimensions (L x W x H)		2.30 x 1.45 x 0.50 58.42 x 36.83 x 12.68			inch mm
<b>Isolation Characteristics</b>					
Input to Output		-	-	1500	V
Input to Case		-	-	1500	V
Output to Case		-	-	500	V
Isolation Resistance		10M	-	-	Ohm
Isolation Capacitance		-	3900	-	pF

**6. EFFICIENCY DATA**

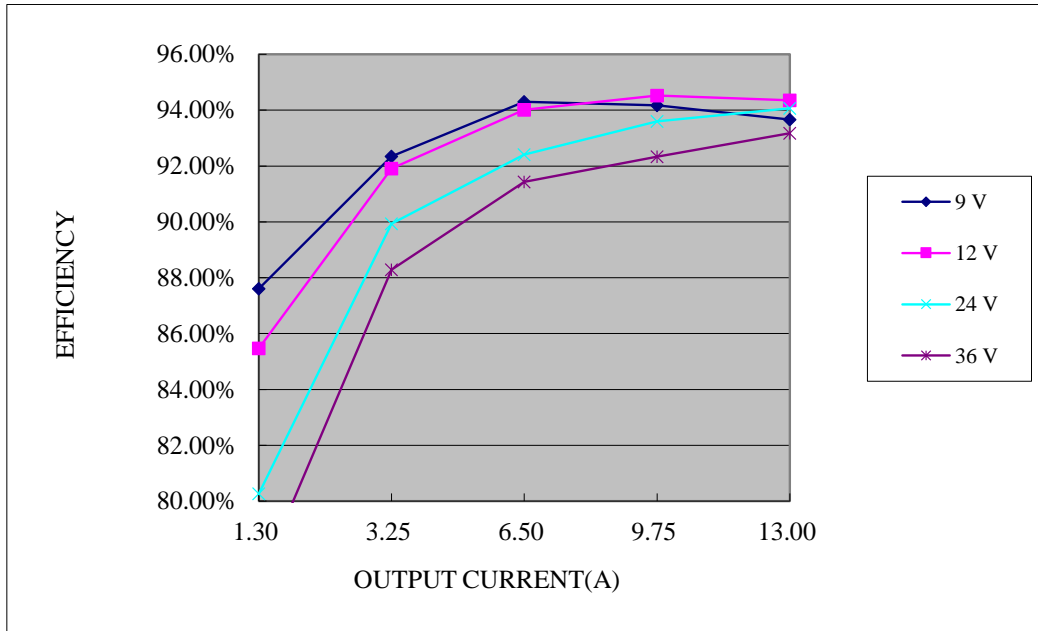


Figure 1. Efficiency data

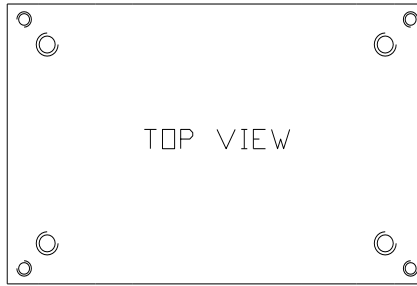


Asia-Pacific  
+86 755 298 85888

Europe, Middle East  
+353 61 225 977

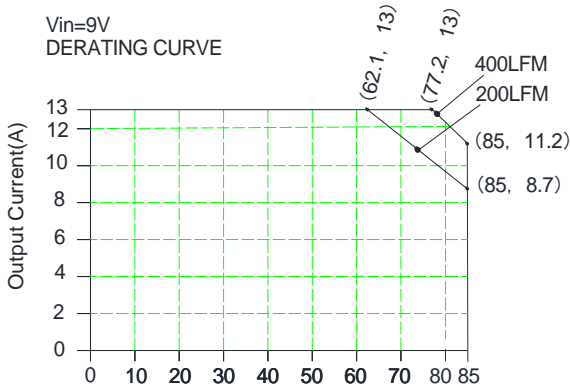
North America  
+1 408 785 5200

7. THERMAL DERATING CURVE



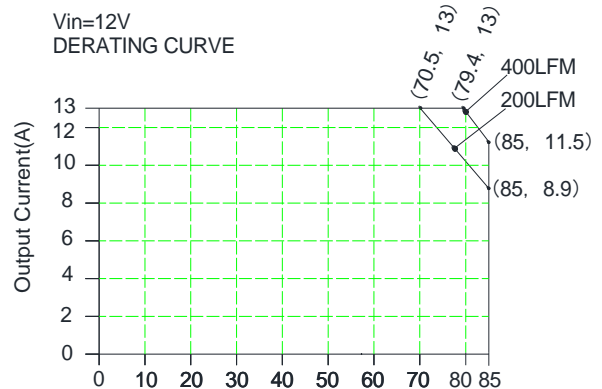
↑  
Forced Airflow Direction

Figure 2. Airflow direction



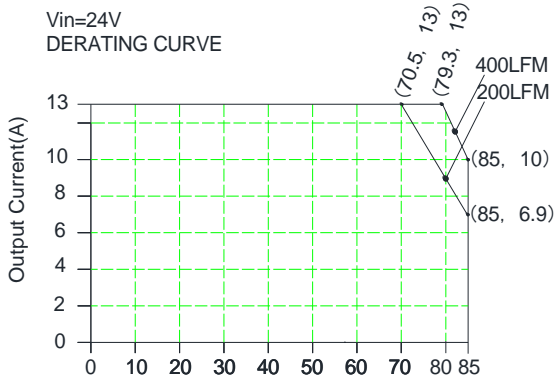
AMBIENT TEMPERATURE, Ta(°C)  
Output Current vs. Local Ambient Temperature and Air Velocity

Figure 3. Derating curve @Vin=9V



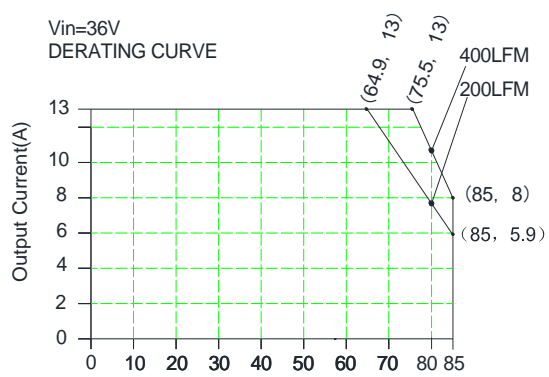
AMBIENT TEMPERATURE, Ta(°C)  
Output Current vs. Local Ambient Temperature and Air Velocity

Figure 4. Derating curve @Vin=12V



AMBIENT TEMPERATURE, Ta(°C)  
Output Current vs. Local Ambient Temperature and Air Velocity

Figure 5. Derating curve @Vin=24V



AMBIENT TEMPERATURE, Ta(°C)  
Output Current vs. Local Ambient Temperature and Air Velocity

Figure 6. Derating curve @Vin=36V

### 8. RIPPLE AND NOISE WAVEFORM

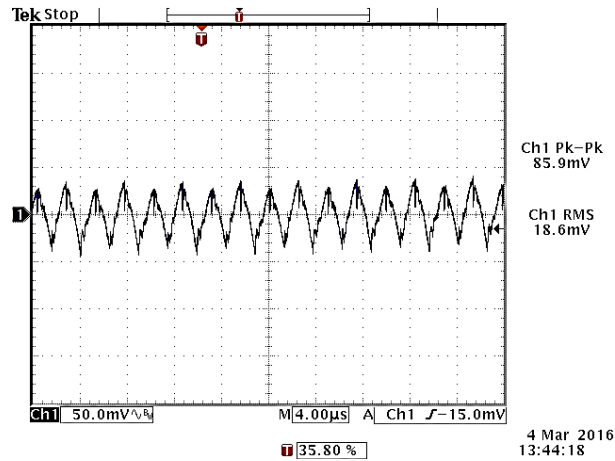


Figure 7. Ripple and noise waveform

Ripple and noise at full load, 24VDC input, 12VDC/13A output and  $T_a=25^\circ\text{C}$ , and with a 1µF ceramic cap and a 10 µF Tantalum cap and 220µF Tantalum cap at output.

### 9. TRANSIENT RESPONSE WAVEFORMS

$di/dt=0.1\text{A}/\mu\text{S}$ , a 1µF ceramic capacitor, a 10µF Tantalum cap and 220µF Tantalum cap at output.

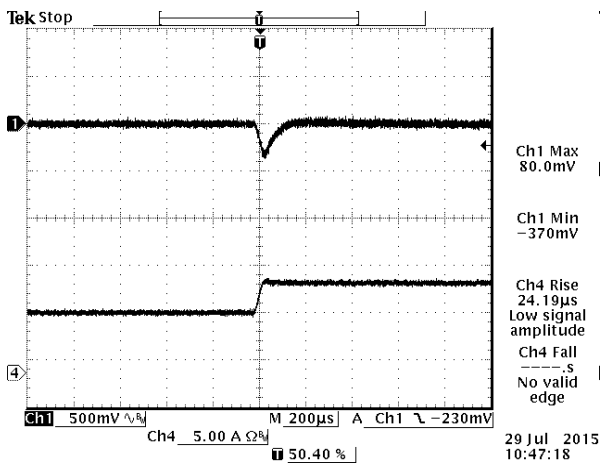


Figure 8.  
CH1=Vout  
CH4=Iout

Vout= 12V 50%-75% Load Transients  
at Vin=24V@Ta=25°C

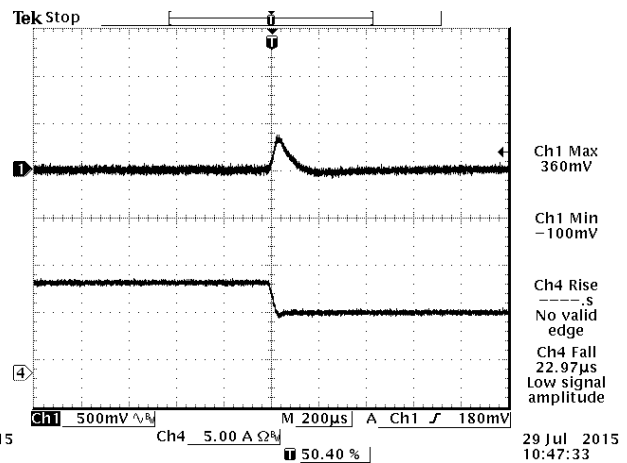


Figure 9.  
CH1=Vout  
CH4=Iout

Vout= 12V 75%-50% Load Transients  
at Vin=24V@Ta=25°C

## 10. STARTUP&SHUTDOWN

### Rise time

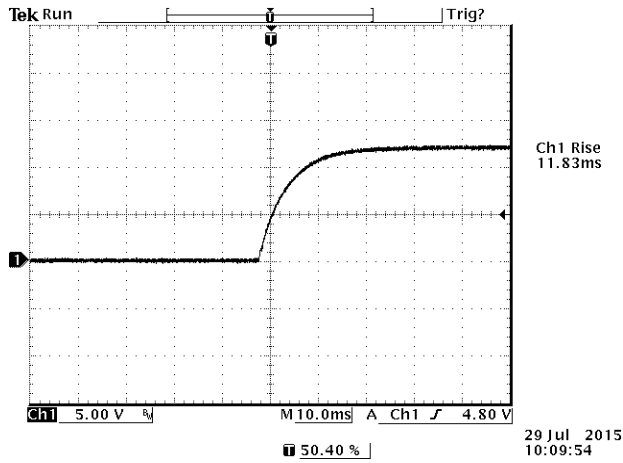


Figure 10. Rise time @Vin = 24 V, Full Load

### Startup time

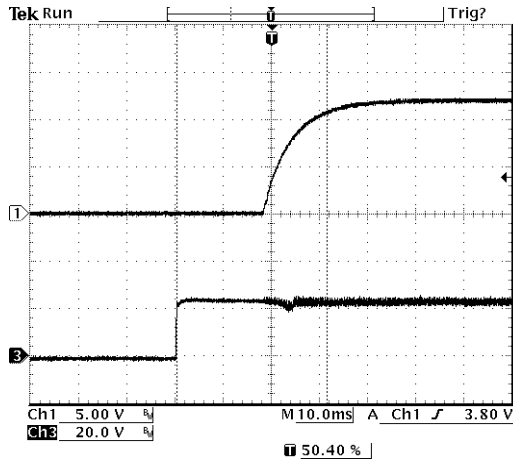


Figure 11.  
CH1=Vout  
CH3=Vin  
Vin = 24 V, Full Load  
startup from Vin

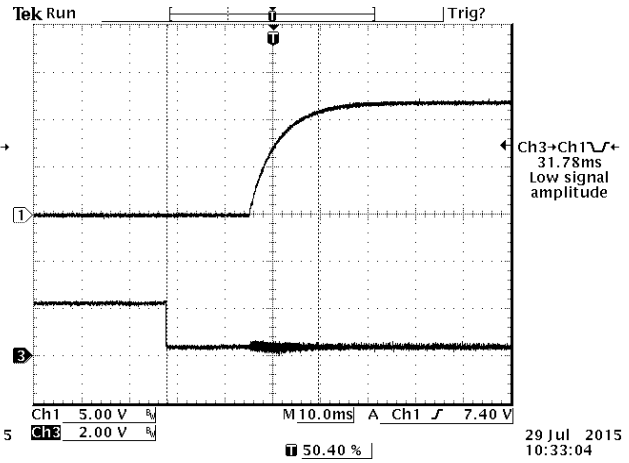


Figure 12.  
CH1=Vout  
CH3=Enable  
Vin = 24 V, Full Load  
startup from Enable

**STARTUP&SHUTDOWN (CONTINUED)**

**Shutdown**

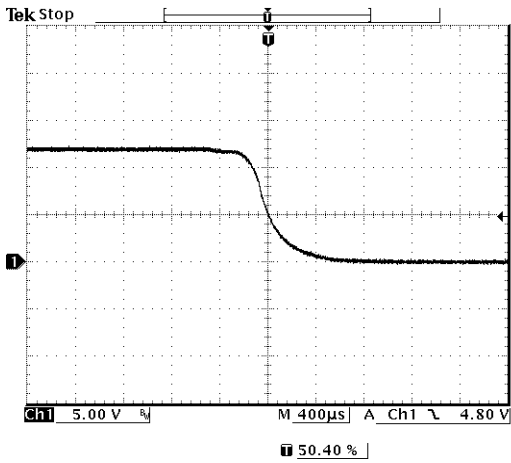


Figure 13.  
*V<sub>in</sub> = 24 V, Full Load  
 shutdown from V<sub>in</sub>*

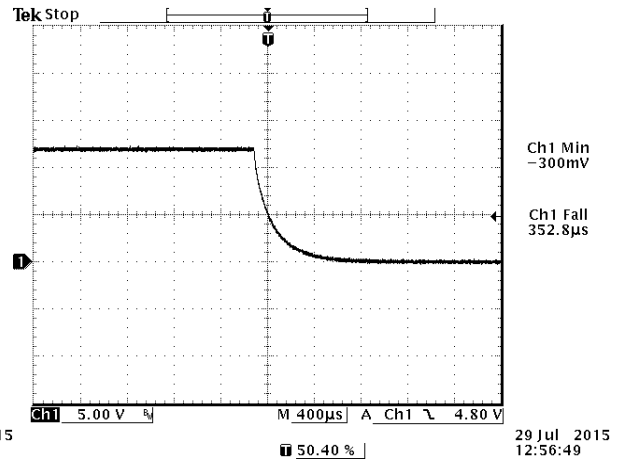


Figure 14.  
*V<sub>in</sub> = 24 V, Full Load  
 shutdown from Enable*

11. REMOTE ON/OFF

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

Recommended remote on/off circuit for active low

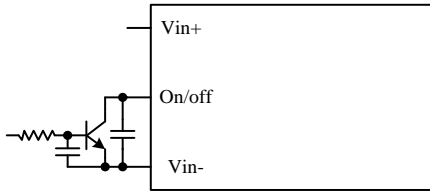


Figure 15. Control with open collector/drain circuit

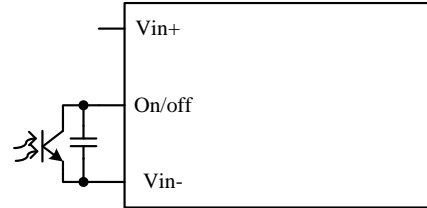


Figure 16. Control with photocoupler circuit

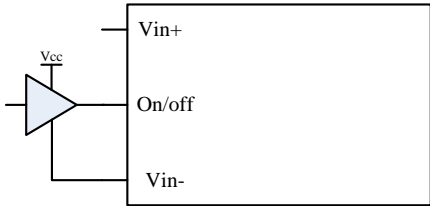


Figure 17. Control with logic circuit

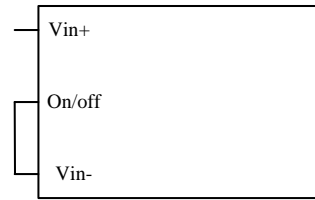


Figure 18. Permanently on

Recommended remote on/off circuit for active high

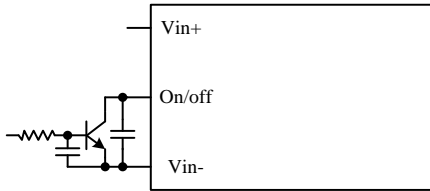


Figure 19. Control with open collector/drain circuit

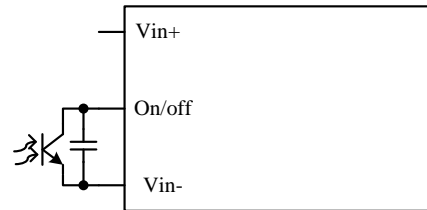


Figure 20. Control with photocoupler circuit

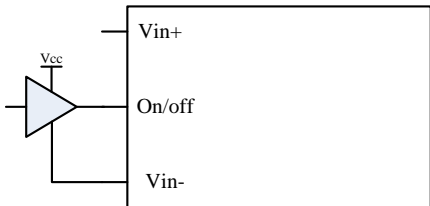


Figure 21. Control with logic circuit

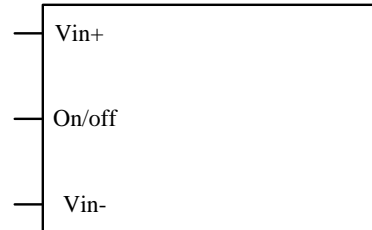


Figure 22. Permanently on

## 12. 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 10.8V

Maximum trim up voltage is 13.2V.

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

Trim down test circuit

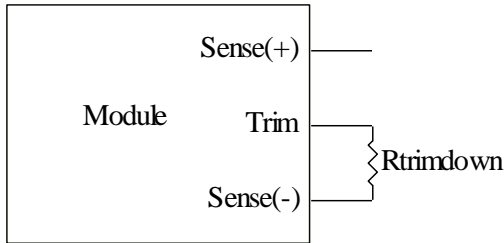


Figure 23. Trim down test circuit

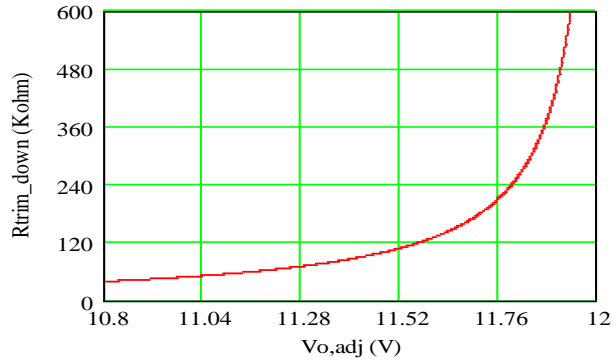


Figure 24. Trim down curve

$$R_{trimdown} = \frac{511}{|\delta|} - 10.22 [k\Omega]$$

Trim up test circuit

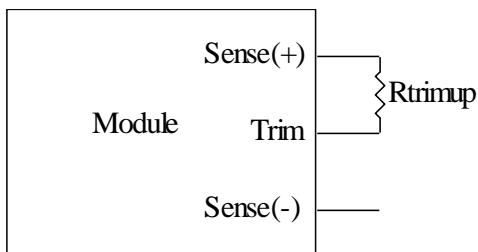


Figure 25. Trim up test circuit

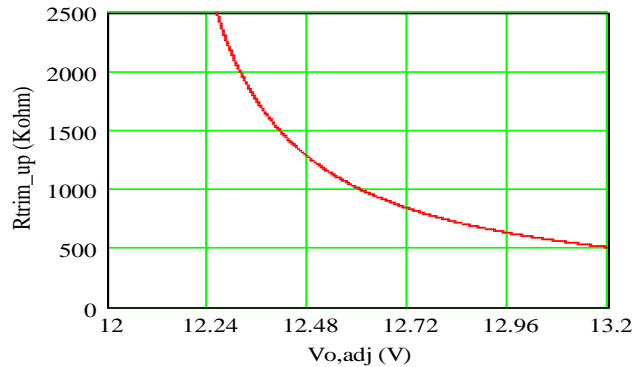


Figure 26. Trim up curve

$$R_{trimup} = \frac{(100 + \delta) \cdot V_o \cdot 5.11 - 626}{1.225 \cdot \delta} - 10.22 [k\Omega]$$

$$\delta = \frac{(V_{o\_req} - V_o)}{V_o} \times 10 [\%]$$

NOTE: Output voltage  $V_o = 12.036V$

$V_{o\_req}$  = Desired(trimmed) output voltage[V]

### 13. REMOTE SENSE

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

The remote sense lines carry very little current and hence do not require a large cross-sectional area.

This module compensates for a maximum drop of 10% of the nominal output voltage.

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.

When using remote sense compensation, all the resistance, parasitic inductance and capacitance of the system are incorporated within the feedback loop of this module. This can make an effect on the module's compensation, affecting the stability and dynamic response. A 0.1 $\mu$ F ceramic capacitor can be connected at the point of load to de-couple noise on the sense wires.

Recommend the connection of remote sense compensation as below figure. There are a resistor RS+ (30.1ohm) from Vo+ to Sense+ and a resistor RS- (30.1 ohm) from Vo- to Sense- inside of this module.

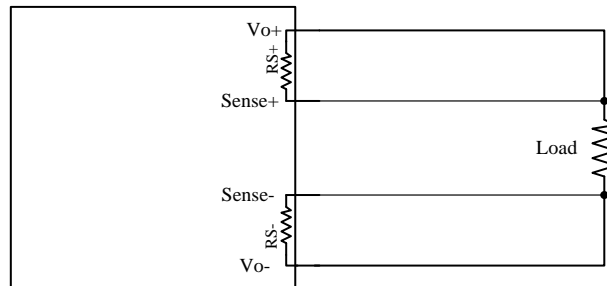


Figure 27.

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.

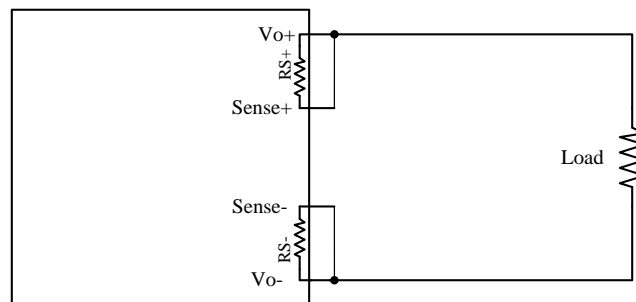


Figure 28.

### 14. OVER CURRENT PROTECTION

To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry and 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 0.8S. The module operates normally when the output current goes into specified range. The typical average output current is 20A during hiccup.

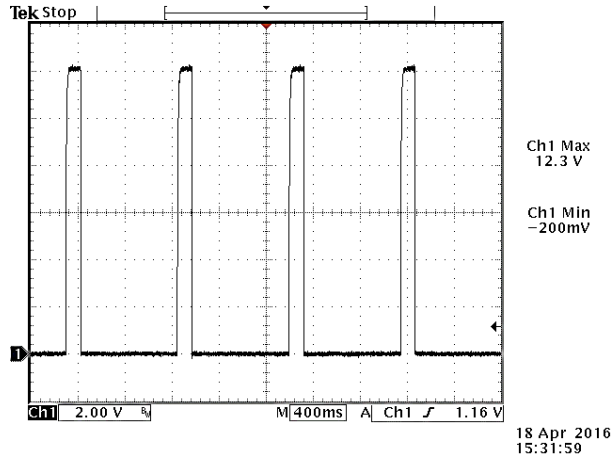


Figure 29.  $V_{in} = 24 V$ ,  $I_{out} OCP$

### 15. OUTPUT OVERVOLTAGE PROTECTION

The output overvoltage 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 shutdown into latch off mode. The overvoltage latch can be reset by either cycling the input power or toggling the on/off signal for one second at least.

Test Setup:

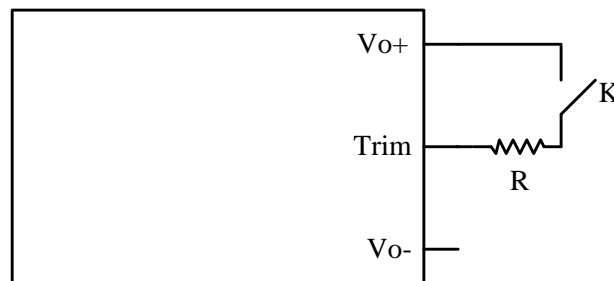


Figure 30. Test setup

$R=150K\Omega$

## 16. OVER TEMPERATURE PROTECTION

The OTP is achieved by thermistor RT and the threshold is set at 120°C in non-latch mode; the hottest component (bottom side) U7 reaches 115°C or the base plate (top side) reaches 110°C with 200LFM air flow correspondingly. It will restart automatically when the temperature falls down to 110°C. The protecting point will be varied a little under different conditions (air flow, ambient temperature, input voltage, load...).

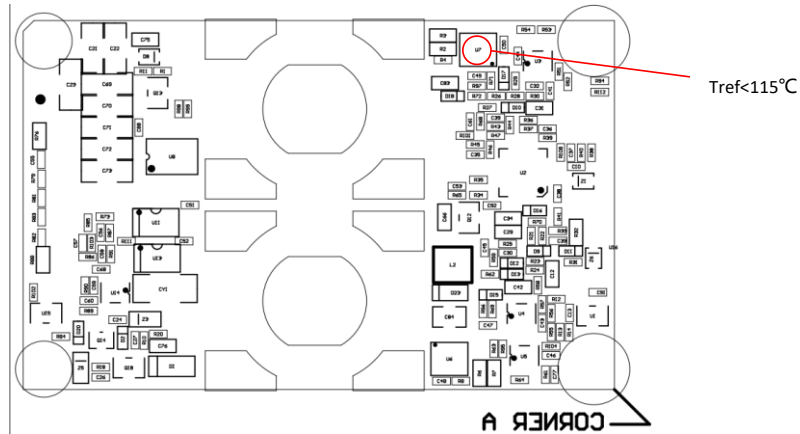


Figure 31. Temperature reference points on bottom side

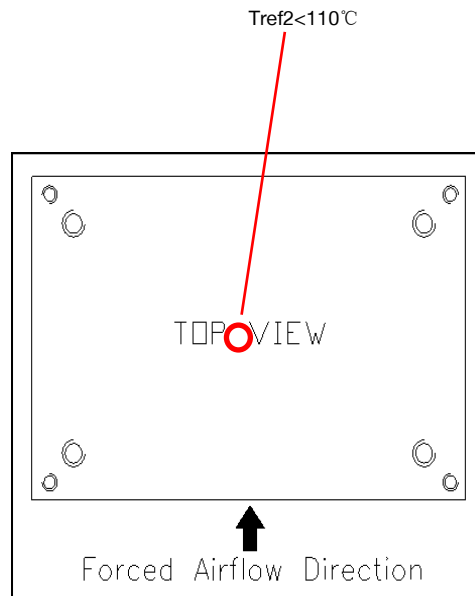


Figure 32. Temperature reference points on top side

17. INPUT UNDER-VOLTAGE LOCKOUT

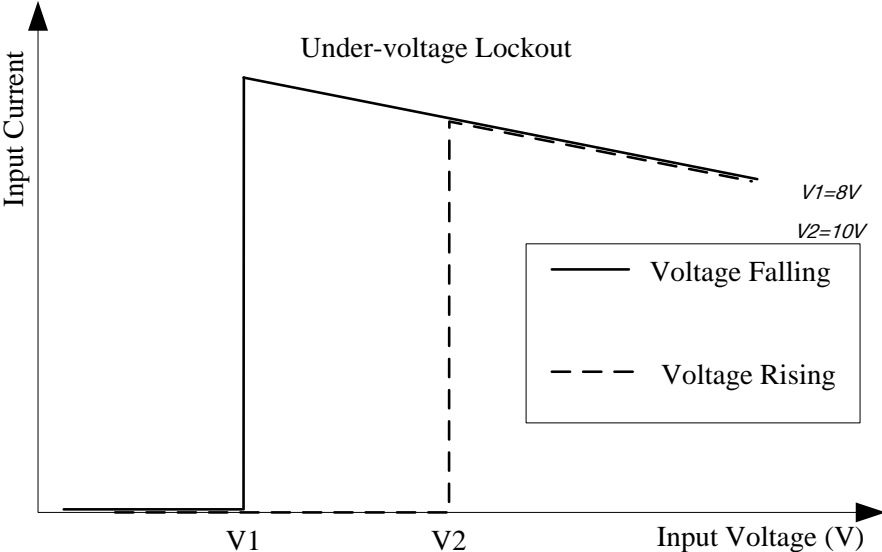


Figure 33. Input under-voltage lockout

**18. MECHANICAL DIMENSIONS**  
**OUTLINE**

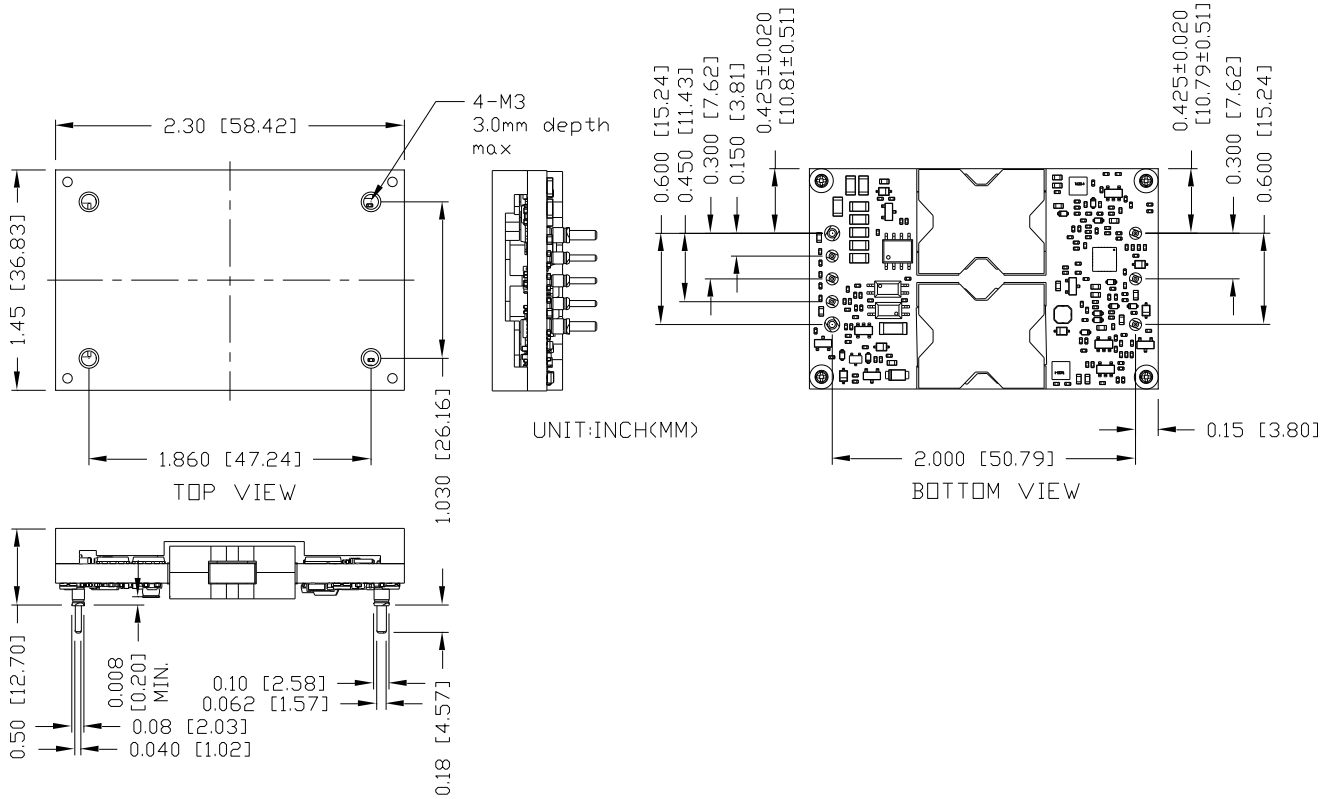


Figure 34. Outline

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:

- All Pins: Material - Copper Alloy;
- Finish - 3 micro inches minimum Gold over 50 micro inches minimum Nickel plate.
- 1) Undimensioned components are shown for visual reference only.
- 2) All dimensions in inches; Tolerances: x.xx +/-0.02 in [0.51 mm]. x.xxx +/-0.010 in [0.25 mm].

**MECHANICAL DIMENSIONS (CONTINUED)**

**PIN DEFINITIONS**

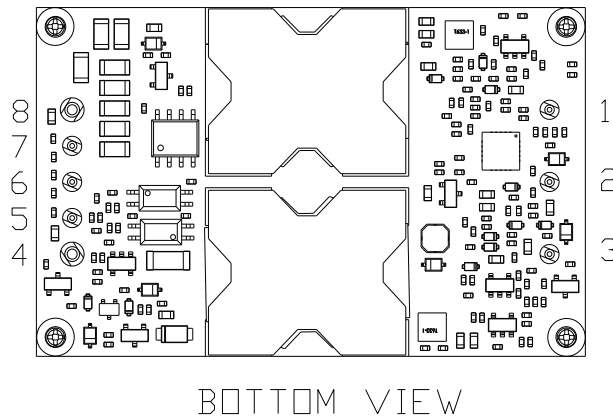


Figure 35. Pins

PIN	FUNCTION	PIN SIZE	PIN	FUNCTION	PIN SIZE
1	Vin+	0.040"	5	Sense-	0.040"
2	On/Off	0.040"	6	Trim	0.040"
3	Vin-	0.040"	7	Sense+	0.040"
4	Vout-	0.060"	8	Vout+	0.060"

**RECOMMENDED PAD LAYOUT**

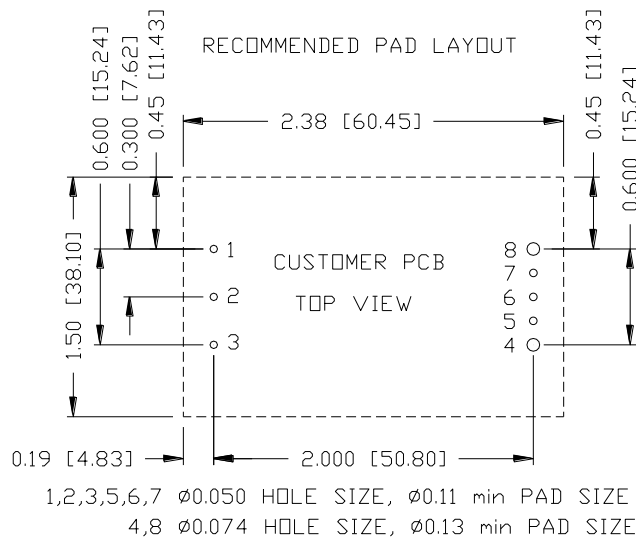


Figure 36. Recommended pad layout

## 19. SAFETY & EMC

### SAFETY:

1. Material flammability UL94V-0
2. Nemko certification EN 62368-1
3. CSA certification CSA/UL 62368-1
4. CB certification IEC/EN 62368-1

### EMC:

1. Conductive EMI: EN55032 class B

Compliance to EN55032 class B (both peak and average) with the following inductive and capacitive filter.

### SETUP:



Figure 37.

ITEM	DESIGNATION	PARAMETER	VENDOR	VENDOR P/N
1	C1	Chip CAP X7R 4.7 $\mu$ F +/-10% 50V 1210	MURATA	GRM32ER71H475KA88L
2	C2	Chip CAP X7R 4.7 $\mu$ F +/-10% 50V 1210	MURATA	GRM32ER71H475KA88L
3	C3	NOT USED		
4	C4	NOT USED		
5	C5	100 $\mu$ F/100V 105 10*20	Nichicon	UVZ2A101MPD
6	C6	100 $\mu$ F/100V 105 10*20	Nichicon	UVZ2A101MPD
7	C7	EMI Suppression Cap Y2 MKP 33nF+/-20% 300VAC	EPCOS	B32022A3333M289
8	C8	EMI Suppression Cap Y2 MKP 33nF+/-20% 300VAC	EPCOS	B32022A3333M289
9	C9	EMI Suppression Cap Y2 MKP 33nF+/-20% 300VAC	EPCOS	B32022A3333M289
10	C10	EMI Suppression Cap Y2 MKP 33nF+/-20% 300VAC	EPCOS	B32022A3333M289
11	L1	1.47mH/30A	core: Laird	core: 40T0984-00H
12	L2	320 $\mu$ H/30A	core: Laird	core: 40T0711-00H

**SAFETY & EMC(CONTINUED)**

**Positive:**

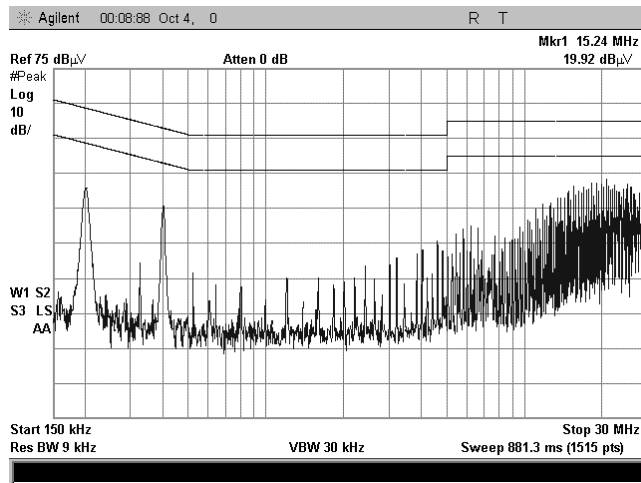


Figure 38.

**Negative:**

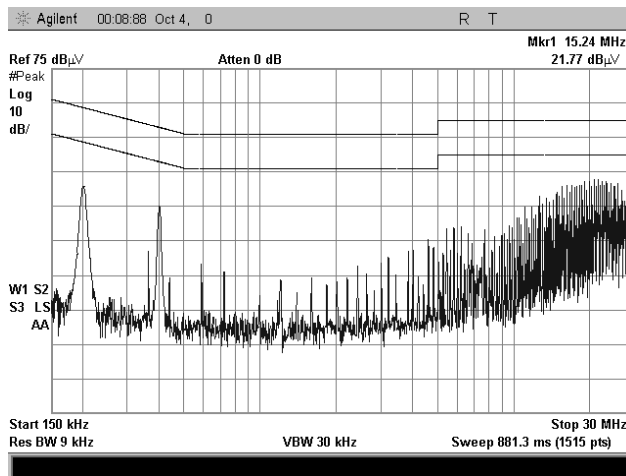


Figure 39.

### 20. SCH

Fundamental circuit diagram

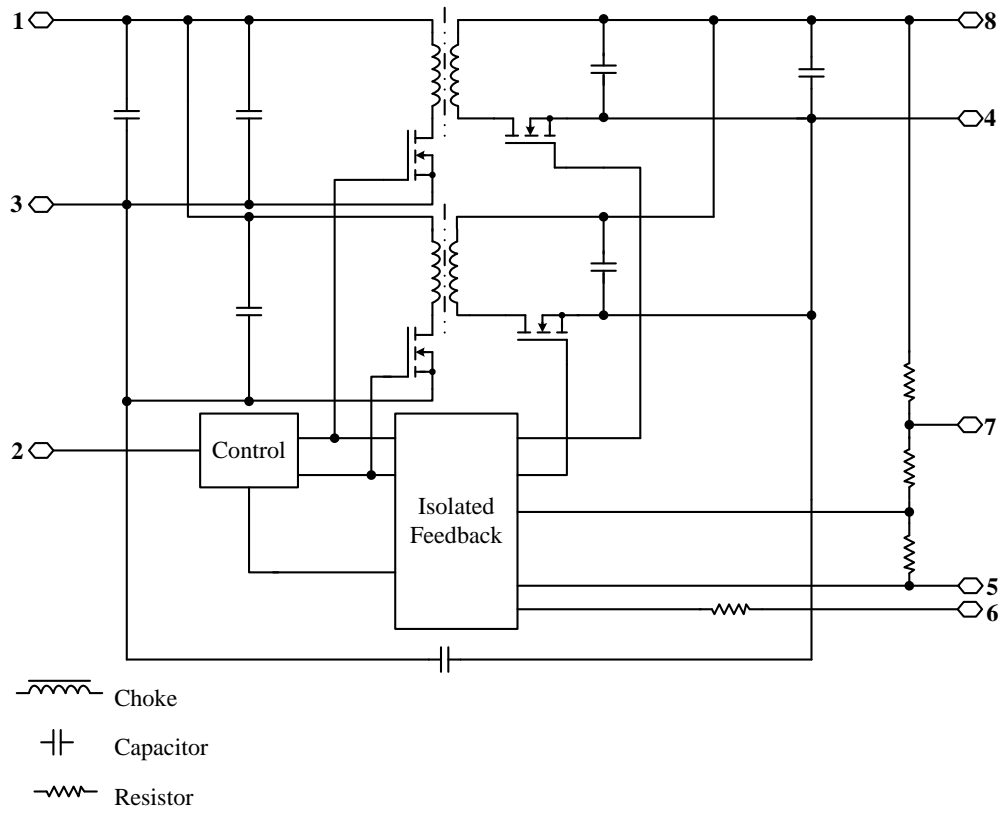


Figure 40.

## 21. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2013-04-26	A	First revision	XF Jiang
2016-04-28	B	Update the remote off input current, output ripple and noise(pk-pk), output DC current limit, rise time, output capacitance, transient response settling time, efficiency, switching frequency, isolation capacitance, add efficiency data and layout, add the wave of NR, TR, startup & shutdown, OCP, MD, safety & EMC.	XF Jiang
2016-06-27	C	Update altitude, load regulation, output current range, output capacitance, FIT, weigh, TD, OTP, add the relative humidity range.	XF Jiang
2016-10-11	AD	Add temperature reference points on top side.	XF Jiang
2017-04-13	AE	Update TD.	XF Jiang
2017-10-18	AF	Update Input withstand Voltage.	J Yao
2018-05-08	AG	Update Part number explanation.	J Yao
2020-03-25	AH	Update TD. Add input OVLO turn-on and turn-off voltage threshold.	XF Jiang
2020-05-07	AI	Add safety certificate	F.Tao

**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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