

# 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 60950-1, 2nd +A2 version(TBD)
- 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           | F – active low, with base plate<br>E– 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                | 1min maximum, the module may turn off, but will survive 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                               |                                                                         | -    | -   | 2000 | 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                 |                                                                                                                                                  | 9.5 | 10   | 10.5 | V                |
| Turn-off Voltage Threshold                |                                                                                                                                                  | 7.5 | 8    | 8.5  | 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.

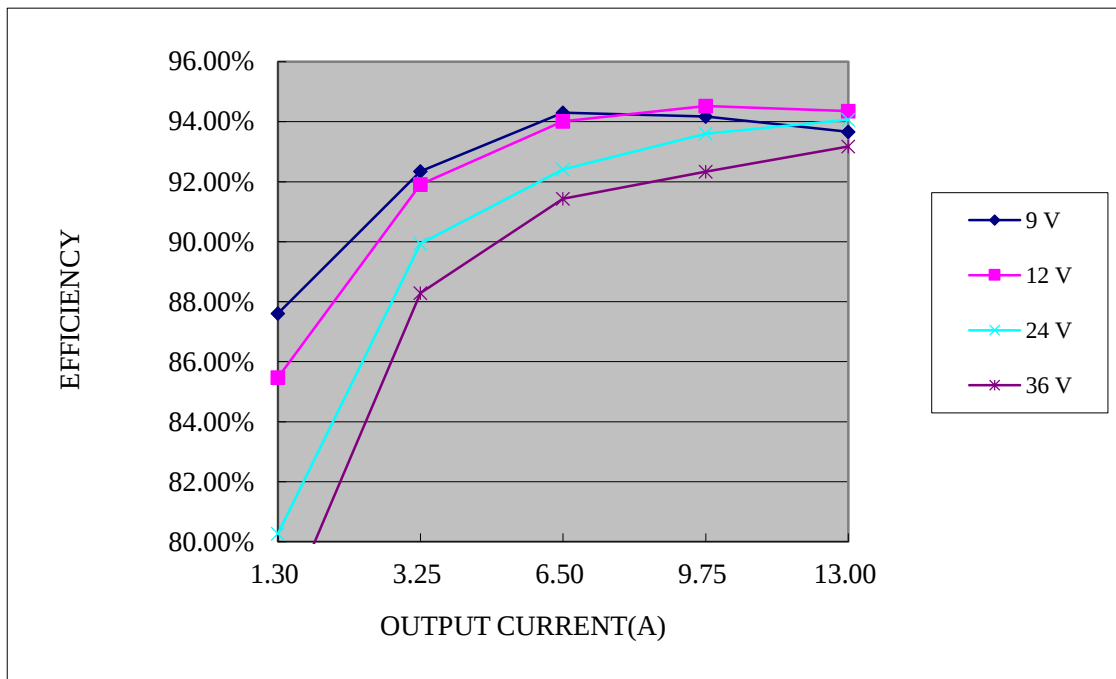
| PARAMETER                      | DESCRIPTION                                                                                                                                               | MIN  | TYP   | MAX   | UNIT |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|-------|------|
| 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>      |                                                                                                                                                           |      |       |       |      |
| ΔV 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   |
| ΔV 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                       | Vin=24 V<br>Io=Io, max | 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 × W × H)           |                        |                                                                                                      |     | 2.30 x 1.45 x 0.50<br>58.42 x 36.83 x 12.68 |      | inch<br>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         |

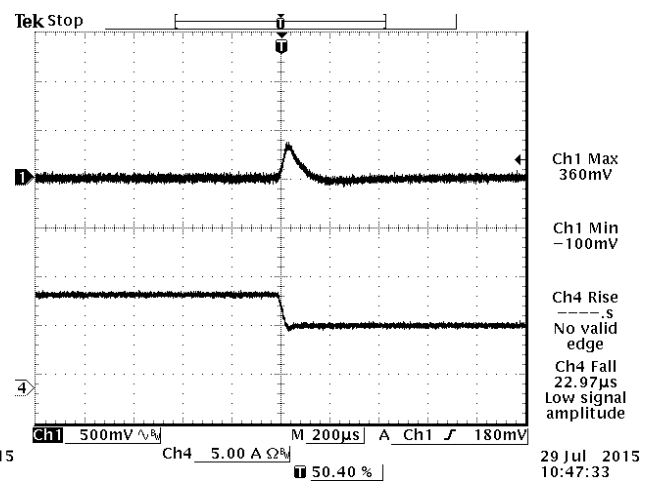
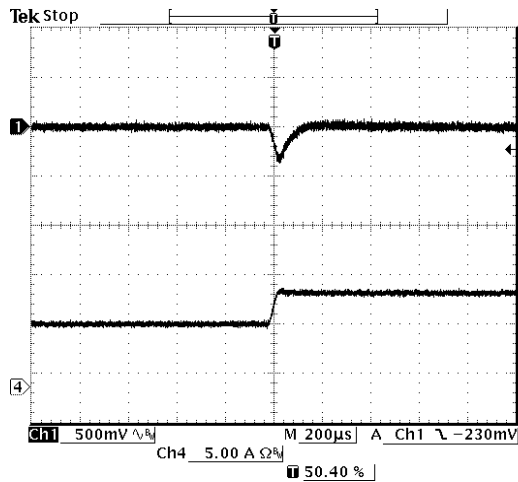
## 6. EFFICIENCY DATA





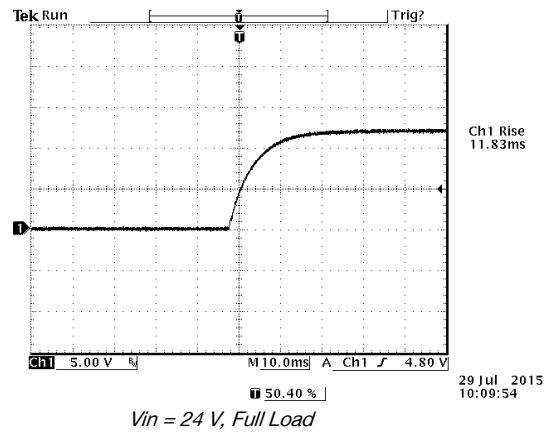
## 9. TRANSIENT RESPONSE WAVEFORMS

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

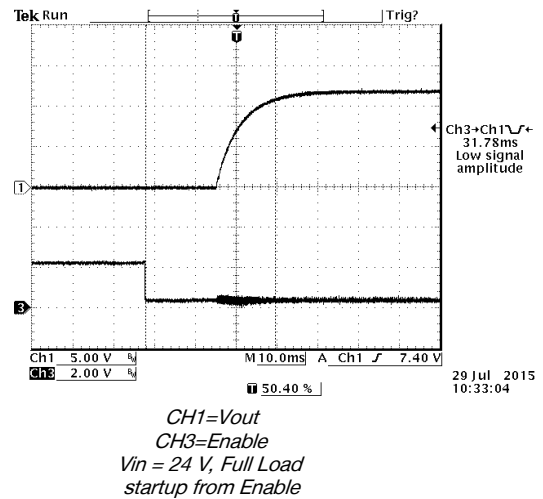
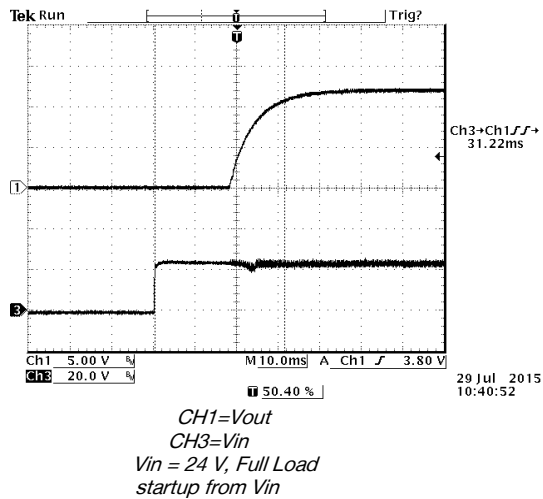


## 10. STARTUP&SHUTDOWN

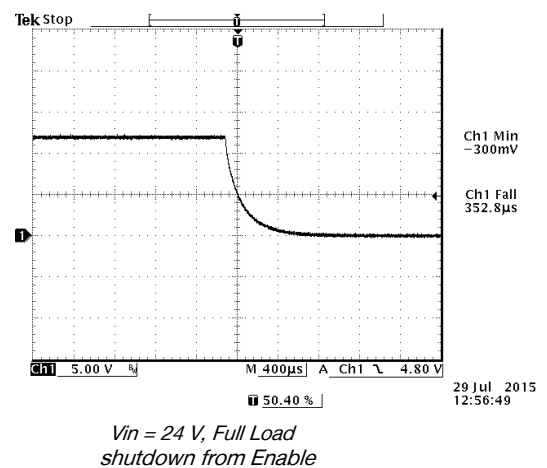
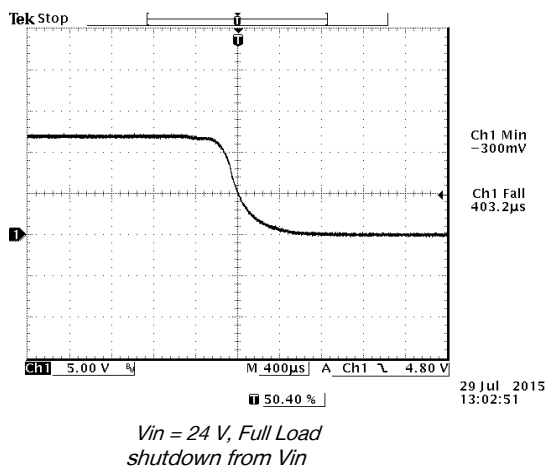
### Rise time



### Startup time



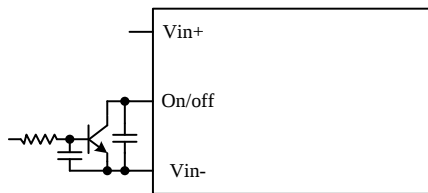
### Shutdown



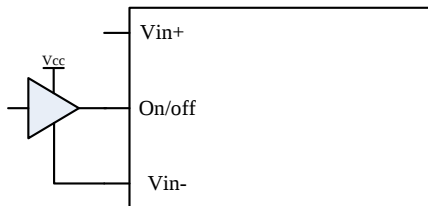
## 11. REMOTE ON/OFF

| 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   |

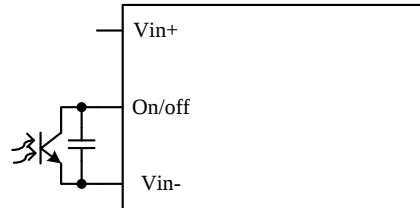
Recommended remote on/off circuit for active low



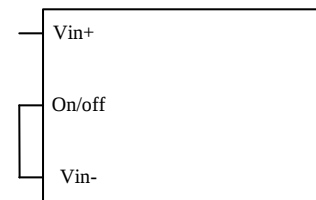
Control with open collector/drain circuit



Control with logic circuit

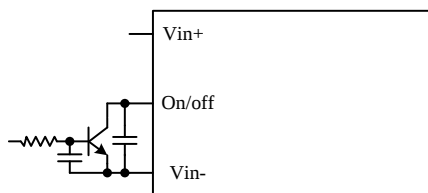


Control with photocoupler circuit

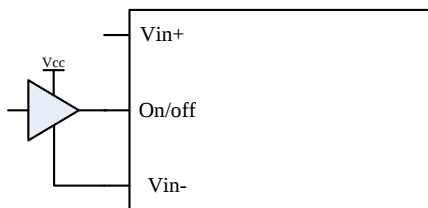


Permanently on

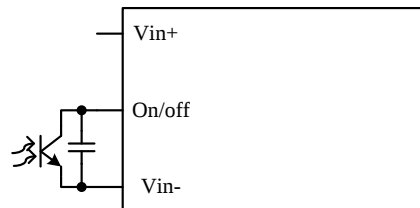
Recommended remote on/off circuit for active high



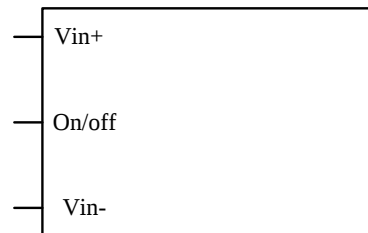
Control with open collector/drain circuit



Control with logic circuit



Control with photocoupler circuit



Permanently on

## 12. OUTPUT TRIM EQUATIONS

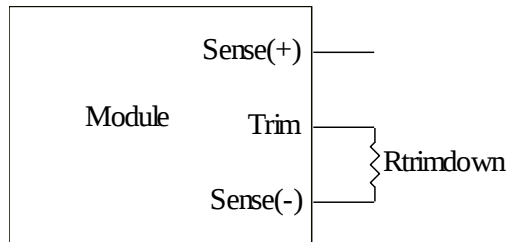
Equations for calculating the trim resistor are shown below. The Trim Down resistor should be connected between the Trim pin and Sense (-) pin. The Trim Up resistor should be connected between the Trim pin and the Sense (+). Only one of the resistors should be used for any given application.

Minimum trim down voltage is 10.8V

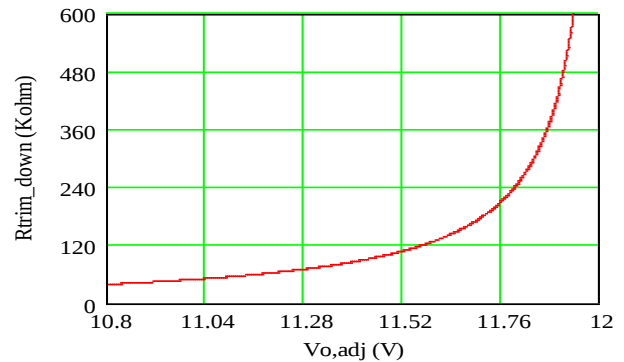
Maximum trim up voltage is 13.2V.

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

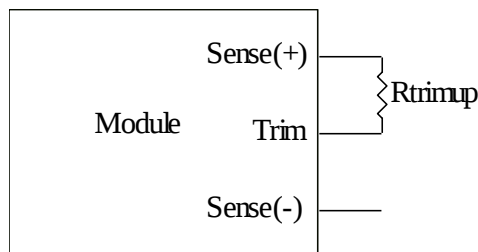
### Trim down test circuit



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

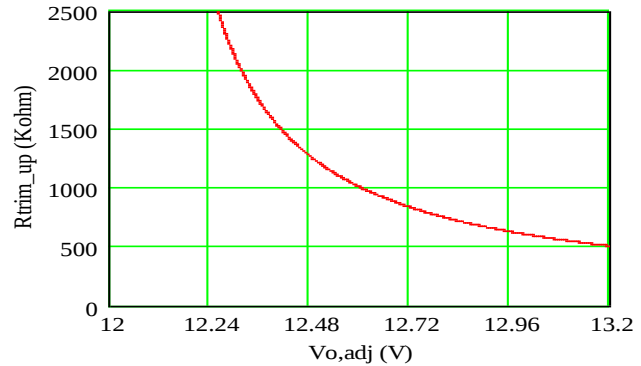


### Trim up test circuit



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

$$\Delta = \frac{(V_{o\_req} - V_o)}{V_o} \times 100 [\%]$$



**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.

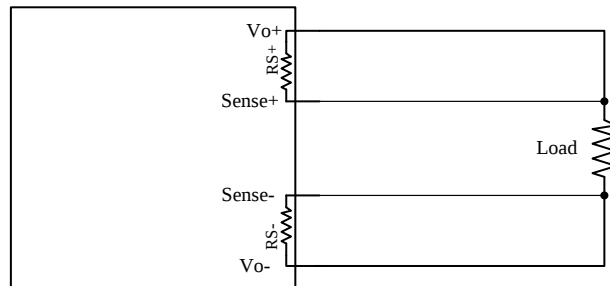
The remote sense lines carry very little current and hence do not require a large cross-sectional area.

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

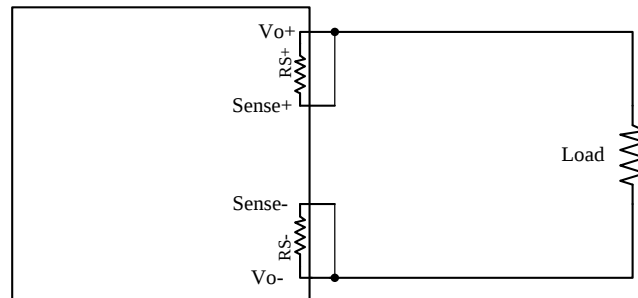
If the unit is already trimmed up, the available remote sense compensation range should be correspondingly reduced. The total voltage increased by trim and remote sense should not exceed 10% of the nominal output voltage.

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.

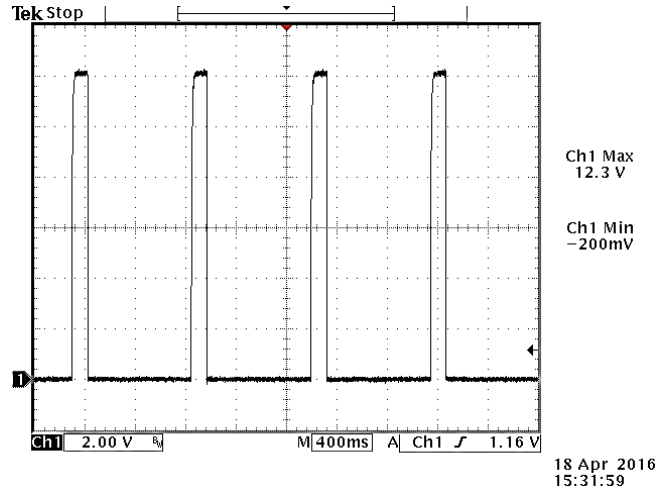


If not using remote sense compensation, please connect sense directly to output at module's pin, that is, connect sense+ to Vo+ and sense- to Vo- at module's pin, the shorter the better. see below figure.



## 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.

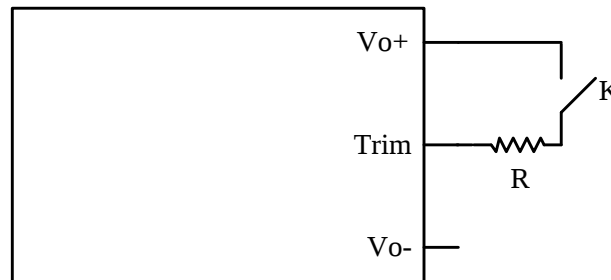


$V_{in} = 24 V$ ,  $I_{out} OCP$

## 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.

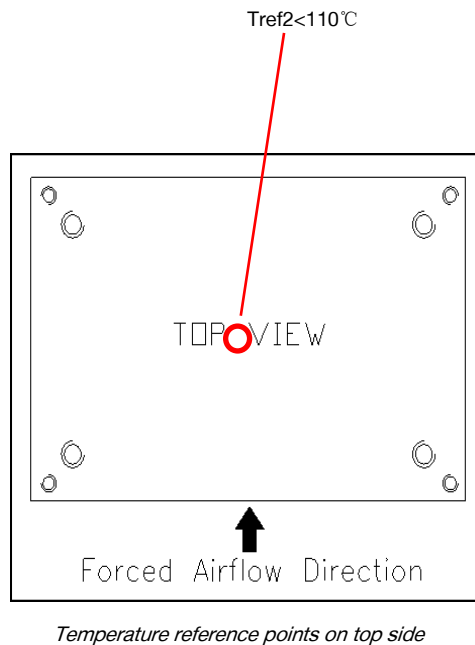
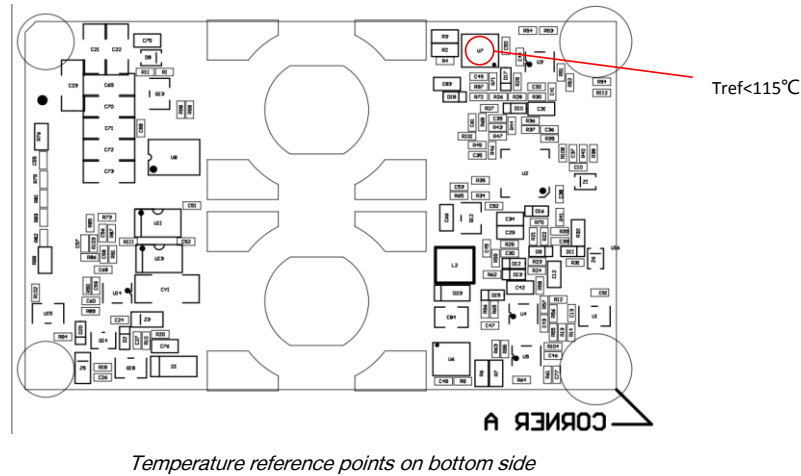
Test Setup:



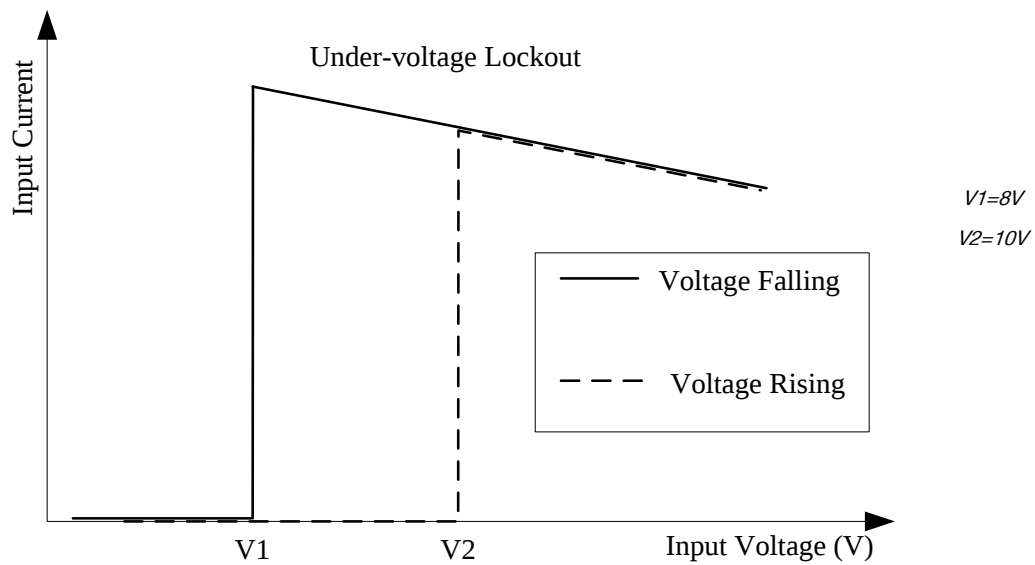
$R=150K\Omega$

## 16.OTP

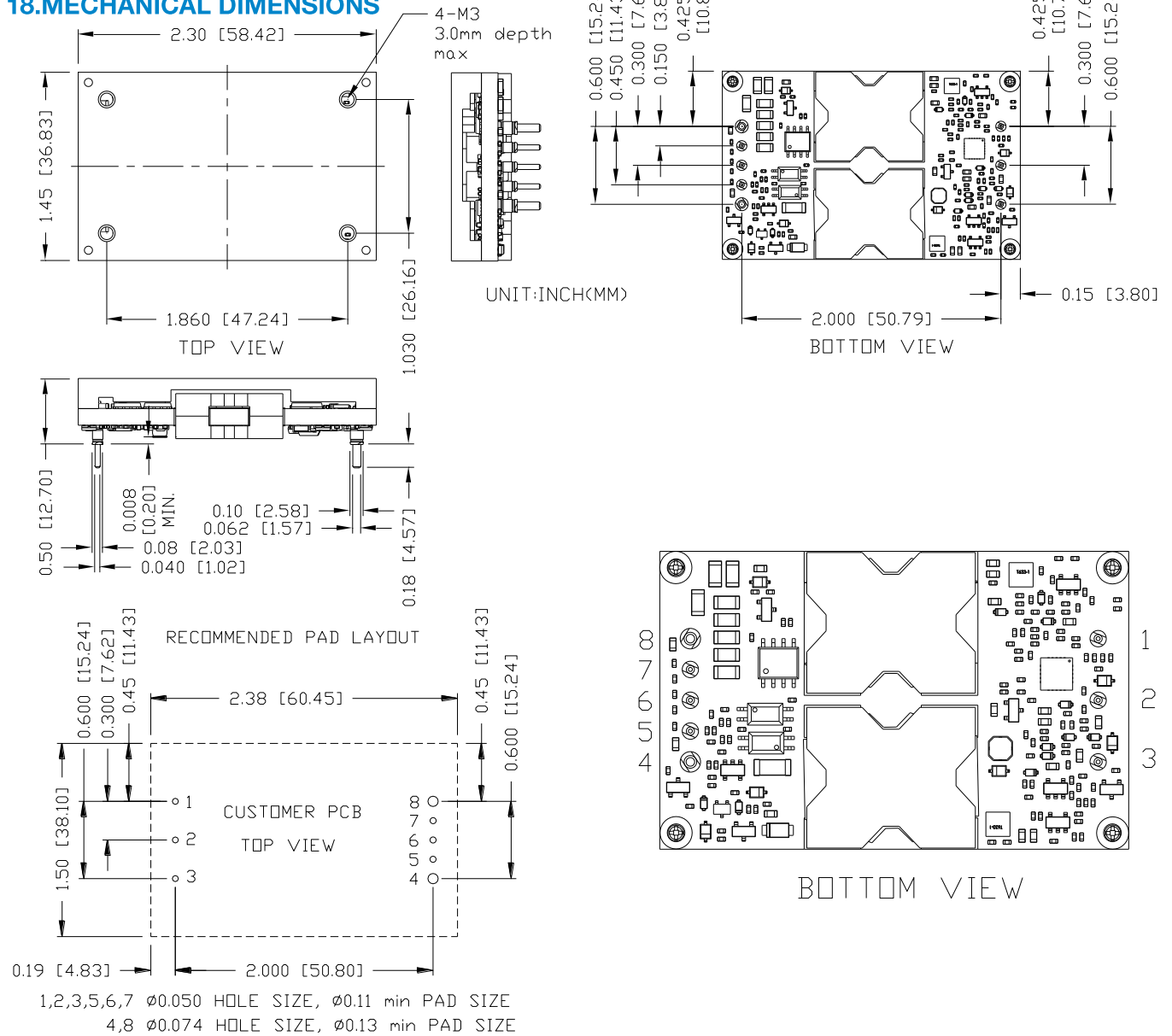
The OTP is achieved by thermistor RT and the threshold is set at 120°C in non-latch mode; the hottest component (bottom side) U7 reaches 115°C or the base plate (top side) reaches 110°C with 200LFM air flow correspondingly. It will restart automatically when the temperature falls down to 110°C. The protecting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



## 17.INPUT UNDER-VOLTAGE LOCKOUT



## 18.MECHANICAL DIMENSIONS



**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].

## PIN CONNECTIONS

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

## 19.SAFETY & EMC

### SAFETY:

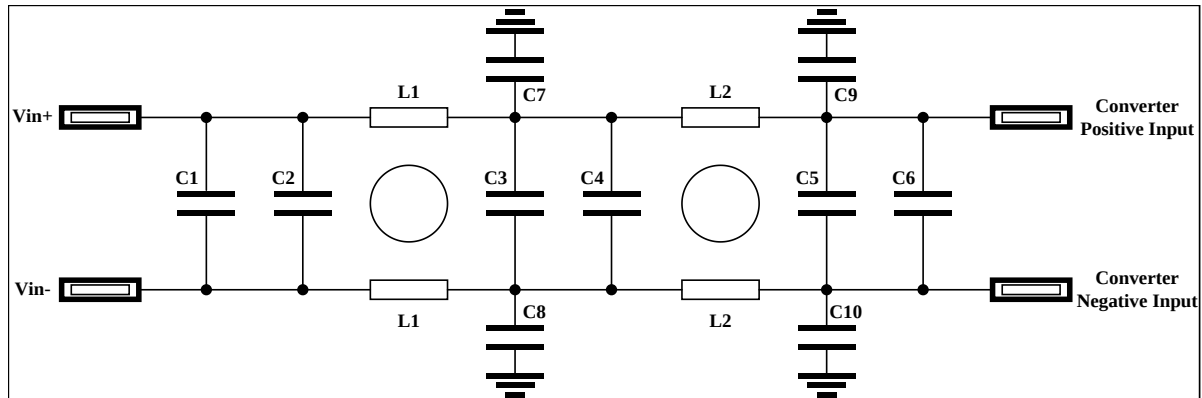
TBD

### EMC:

1. Conductive EMI: EN55022 class B

Compliance to EN55022 class B (both peak and average) with the following inductive and capacitive filter.

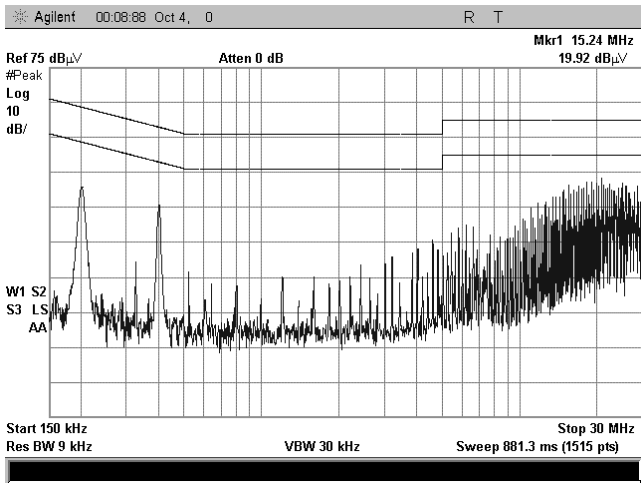
### SETUP:



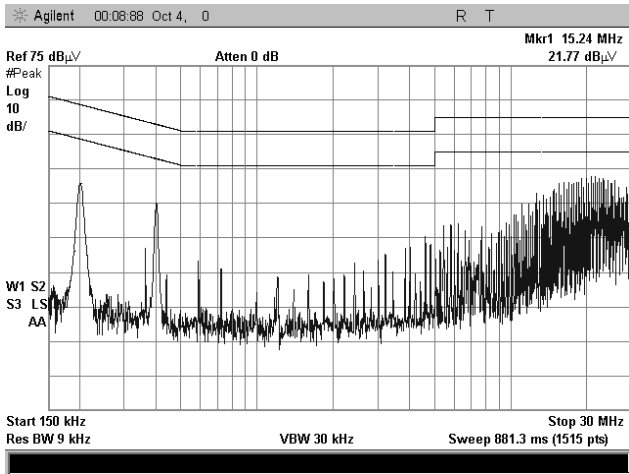
| ITEM | DESIGNATION | PARAMETER                                    | VENDOR      | VENDOR P/N         |
|------|-------------|----------------------------------------------|-------------|--------------------|
| 1    | C1          | Chip CAP X7R 4.7 $\mu$ F +/-10% 50V 1210     | MURATA      | GRM32ER71H475KA88L |
| 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:

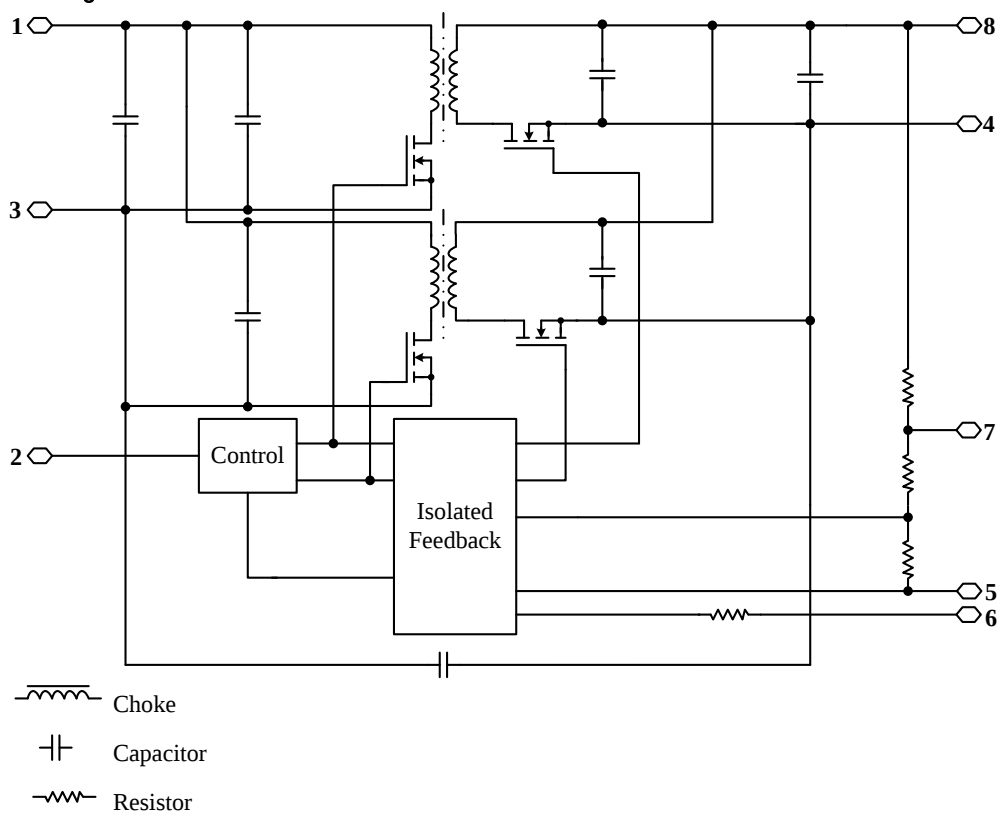


Negative:



**20.SCH**

Fundamental circuit diagram



## 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    |

**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.