**Industry Standard 1/4 brick:**
**48Vin 3.3Vout 12A；1.2Vout 25A**

**Options:**
- Positive/Negative and Remote on/off
- Sprayed Conformal coating

**Features:**
- Industry standard 1/4brick package & footprint
- (2.28"×1.45"×0.44")
- High power density: 47.8 W/in$^3$
- High efficiency
- 2:1 Input voltage range
- Low output noise & ripple
- Remote sense
- Constant frequency
- Over-temperature protection: Auto-recovery
- Output over-voltage: shutdown, locked
- Dual Output (Adjustable Voltage): +25%/-25%
- Output over-current protection
- Wide baseplate operating temperature range -40 to -100℃
- EN60950-1 Certified
- RoHS (2002/95/EC) complaint

## Numbering Convention

**QSR 40–48 D 3V3 1V2 –L B -C G5**
1 2 3 4 5 6 7 8 9 10

| NO | Features | Descriptions |
|---|---|---|
| 1 | Product Series | Open-frame 1/4 brick series |
| 2 | Output Current | 3.3V/12A; 1.2V/25A |
| 3 | Typical Input Voltage | Typical Input Voltage: 48V |
| 4 | Number of Outputs | D - Double Output |
| 5 | Output I | 3V3 - Typical Output Voltage: 3.3V |
| 6 | Output II | 1V2 - Typical Output Voltage: 1.2V |
| 7 | Remote on/off Logic | L - Negative Logic |
| | | H or Default - Positive Logic |
| 8 | Aluminum Heat Sink | B – Heat Sink |
| | | Default - No Heat Sink |
| 9 | Sprayed conformal coating | C - Sprayed Conformal coating |
| | | Default - No Sprayed Conformal coating |
| 10 | ROHS | G - lead-free, ROHS6 |
| | | G5-ROHS5 |
| | | Default - lead |





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## 1 Description

The QSR40-48D3V31V2 series power modules are open-frame DC-DC converters in an industry 1/4 brick packaging & footprint equipped with an option of baseplate (heat sink). The converters can provide two outputs: 3.3V/12A and 1.2V/25A. The converters feature wide input voltage range, high efficiency, excellent thermal performance, high isolation voltage, and are well suited for telecommunication, industrial automation and test equipments, etc.

**2 Technical Specifications** (Unless otherwise stated, all specifications are typical at nominal input, full load, 25°C. and a wind speed of 1m/S. Externally add two capacitors to the test tooling, one 100μF/100V electrolytic capacitor for the input, and one 220μF/10V tantalum capacitor for the output )

| Parameter | | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **2.1 Absolute Maximum Ratings** | | | | | | |
| Input Voltage (Vi) | | Non-operating, continuous | 0 | — | 80 | Vdc |
| | | transient (100ms) | — | — | 100 | Vdc |
| Max Output Power (Pomax) | | allowable operating conditions | — | — | 70 | W |
| **2.2 Input Specifications** | | | | | | |
| Typical Input Voltage (Vinom) | | — | — | 48 | — | Vdc |
| Input Voltage Range | | — | 36 | — | 75 | Vdc |
| Input Under-voltage Protection | | Ionom | 30 | — | 34 | Vdc |
| Input Under-voltage Recovery Point | | Ionom | 32 | — | 36 | Vdc |
| Maximum Input Current (Iimax) | | Vimin, Vonom,Ionom | — | — | 2.35 | A |
| No-load Input Current (Iio) | | Vinom, Io＝0A | — | 90 | 100 | mA |
| Quiescent Input Current (Iiof) | | Vinom, remote output shutdown | — | — | 20 | mA |
| No-load Power Loss | | Vinom, Io=0A | — | 4.32 | 4.8 | W |
| Inrush Transient current | | Io=Ionom | — | — | 1 | $A^2S$ |
| Input Reflected Ripple Current (peak-to-peak) | | 5Hz~20MHz, 12μH Absorption Inductor, 0.1μF ceramic capacitor, 100μF electrolytic capacitor | — | — | 50 | mA |
| Remote | On | Rem:connected to –Vin or below 1.8V (reference to –Vin); Current: 0.5~2mA | | | | |
| | Off | Rem: open circuit or 3.5V~12V(reference to –Vin); | | | | |
| **2.3 Output Specifications** | | | | | | |
| Output voltage Set-point (Vonom) | | Vinom,Ionom, Vo1 | 3.3 | 3.33 | 3.38 | Vdc |
| | | Vinom,Ionom, Vo2 | 1.2 | 1.22 | 1.24 | Vdc |
| Output Current (Ionom) | | Io1 | — | 12 | — | A |
| | | Io2 | — | 25 | — | A |
| Output Current Range (Io) | | Po≤70W,Io1 | 0 | — | 12 | A |
| | | Po≤70W,Io2 | 0 | — | 25 | A |





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| Parameter | | Test Condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Line Regulation (Vov) | | Vimin-Vimax,Ionom,Vo1 | | — | ±0.5 | ±1 | %Vo1 |
| | | Vimin-Vimax,Ionom,Vo2 | | — | — | ±10 | mV |
| Load Regulation (Vol) | | 0-100%Ionom,Vinom,Vo1 | | — | ±0.5 | ±1 | %Vo1 |
| | | 0-100%Ionom,Vinom,Vo2 | | — | — | ±20 | mV |
| Cross Regulation | | Vo1, Full voltage, Full Lead, Room Temperature | | — | — | 1.5 | %Vo1 |
| | | Vo2, Full voltage, Full Lead, Room Temperature | | — | — | 20 | mV |
| Output Voltage Trim Range (Voadj) | | Io1≤12A,Io2≤25A (Output II: adjustable; Output I: not adjustable) | | -25 | — | +25 | %Vo2 |
| Output Over-voltage Protection | Protection Mode | —— | | No-load or light load, lockout, power on to recovery | | | — |
| | Threshold | Po<Pomax, Vo1 | | 4 | | 5 | Vdc |
| | | Po<Pomax , Vo2 (0.9V~1.5V) | | 120 | | 150 | %Vo2 |
| Output Over-current Protection | Protection Mode | —— | | Hiccup, Auto-recovery | | | — |
| | Threshold | Vo1: over-current(Vo2: full load) | | 16 | | 23 | A |
| | | Vo2: over-current(Vo1: full load) | | 28 | | 50 | A |
| Output Short-circuit Protection | Protection Mode | —— | | Hiccup, Auto-recovery | | | — |
| Dynamic Load Response | Peak Deviation | 25%-50%-25%Ionom, 50%-75%-50%Ionom, ΔIo/Δt=0.1A/μS, Vinnom, Co1=220μF | | — | — | 5% | Vo1/2 |
| | Settling Time | | | — | — | 200 | μs |
| | Peak Deviation | 0%-100%-0%Ionom, ΔIo/Δt=0.1A/μS, Vinnom, Co2=220μF | | — | — | 50% | Vo1/2 |
| | Settling Time | | | — | — | 800 | μs |
| Output Ripple & Noise (Peak-to-Peak ) | | ① | Vo1p-p (20MHz) | — | — | 60 | mV |
| | | | Vo2p-p (20MHz) | — | — | 50 | mV |
| | | ① | Vo1p-p (100MHz) | — | — | 200 | mV |
| | | | Vo2p-p (100MHz) | — | — | 200 | mV |
| External Output Capacitance (Co) | | $V_{INMIN}$~$V_{INMAX}$,0~100%$I_O$, Vo1 | | 220 | — | 5000 | μF |
| | | $V_{INMIN}$~$V_{INMAX}$,0~100%$I_O$, Vo2 | | 220 | — | 10000 | μF |
| Turn-on/off Peak Deviation | | Vinom,Ionom, Vo1 | | — | — | ±5 | %Vo1 |
| | | Vinom,Ionom, Vo2 | | — | — | 50 | mV |
| Turn-on Delay Time | | 90%Vinnom-- 10%Vonom | | 0 | 5 | 30 | mS |
| Turn-on Rise Time | | 10%Vonom---90%Vonom | | 0 | 5 | 20 | mS |
| Remote Voltage Sampling | | — | | Avaliable | | | |
| **2.4 Safety Specifications** | | | | | | | |





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| Parameter | | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Isolation Voltage | Input to output | Leak Current≤1mA, 1min | 1500 | — | — | Vdc |
| Isolation Resistance ($R_{ISO}$) | | $500V_{DC}$ | 50 | — | — | MΩ |
| Safety Certificate | | EN60950-1 Recognized | | | | |
| **2.5 Reliability** | | | | | | |
| Vibration Test(sine) | | ΔIo/Δt=: 10~55Hz<br>Amplitude: 0.35mm<br>Acceleration: 10m/s$^2$<br>Cycle: X,Y,Z 30min each axis | After being tested, no damage to the converter and its components, the appearance, output voltage and output ripple and noise (p-to-p) meet the data sheet requirements. | | | |
| Impact Test (half-sine) | | Peak Acceleration: 300m/s$^2$<br>Duration: 6ms<br>6 times for three perpendicular directions | After being tested, no damage to the converter and its components, the appearance, output voltage and output ripple and noise (p-to-p) meet the data sheet requirements. | | | |
| MTBF | | ≥2×10$^6$h Bellcore TR-332 (Ta=25°C) | | | | |
| | | ≥1×10$^6$h Bellcore TR-332 (Ta=50°C) | | | | |
| **2.6 Environmental Specifications** | | | | | | |
| Relative Humidity | | (40±2) ℃, No dew | — | — | 95 | %RH |
| Cooling | | — | Conduction Cooling (Forced-air cooling or heat sink) | | | |
| Over-temperature protection | | — | 85℃~100℃ (Thermistor Temperature, Auto-recovery) | | | |
| Operating Ambient Temperature | | See the derating curve | -40 | — | +85 | ℃ |
| Storage Temperature (Tst) | | | -40 | — | +125 | ℃ |
| **2.7 General Specifications** | | | | | | |
| Switching Frequency | | —— | — | 300 | — | k Hz |
| Temperature Coefficient (Tcoeff) | | -40℃~+85℃ | — | — | ±0.02 | %/℃ |
| Efficiency (η) | | Vinom,100% (IO1+Io2) | 85.5 | 86 | — | % |
| | | Vinom,20% (IO1+Io2) | | 78 | | % |
| | | Vinom,50% (IO1+Io2) | | 86 | | % |
| | | Vinom,80% (IO1+Io2) | | 86.5 | | % |
| Weight | | — | | 35 | | g |
| RoHS | | 2002/95/EC Directive | | | | |
| Anti-sulfuration feature | | With a suffix "C" in model number | Sprayed conformal coating | | | |

Note:

① 20MHz, besides the 220μF capacitors (one for each output) on the test tooling, add a 10μF/10V tantalum capacitor to the ripple test tooling for Vo1, and a 1μF ceramic capacitor for Vo2, at ambient temperature -25°C to +55°C; for other ambient temperature, 3.3V: 100mV Ripple & Noise, 1.2V: 100mV Ripple & Noise.





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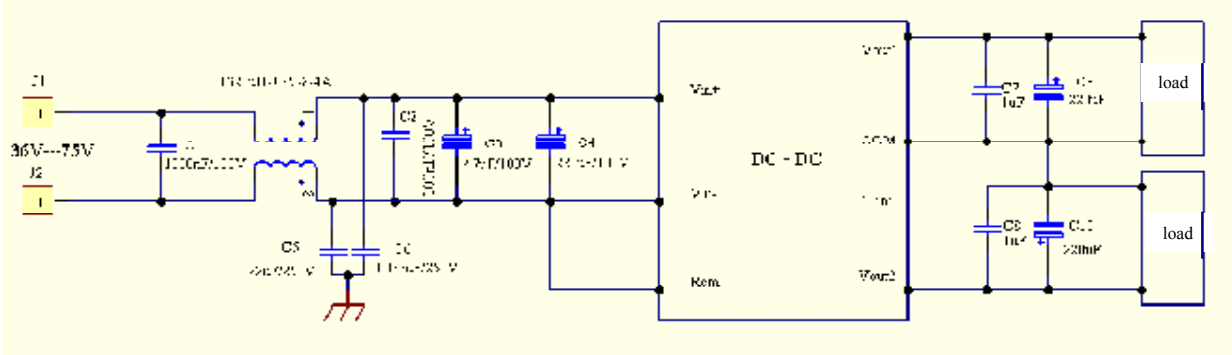
**3 Basic Application Circuit and Considerations**

**3.1 Typical Application (Negative Remote on/off)**




Fuse: 5.0A; C1: 100V, ≥100μF; C2:1μF/10V (Monolithic Capacitor); C3: 220μF/6.3V (Tantalum Capacitor); C4: 1μF/10V (Monolithic Capacitor); C5: 220μF/6.3V (Tantalum Capacitor);

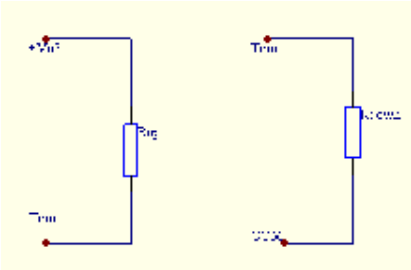
3.2 Input Voltage up to 80Vdc for long time or reverse input polarity would cause the module damaged.

3.3 Output will be off when the Rem is at high level or when the Rem keeps open circuit referenced to –Vin; Output will be on when the Rem is at low level or shorted to –Vin.

3.4 Output short-circuit protection model is hiccup, automatic recovery.

3.5 Output Trim: Vo1(3.3V) is not adjustable, but Vo2(1.2V) is adjustable. Exceed the maximum output power (trim up) of Vo2 or the maximum output current (trim down) of Vo2 may cause the converter operate abnormally. The output voltage shall not exceed 1.5V (trim up) or below 0.9V (trim down), or the module may operate abnormally. See "3.6 Output Voltage Adjustment (Trim)" for details.

**3.6 Output Voltage Adjustment (Trim)**



Trim-up Trim-down

Trim-down: $R_{down} = \frac{2.82V_{o2}}{V_{o2nom} - V_{o2}} - 2.4$

Trim-up: $R_{up} = \frac{(4.75V_{o2nom} - 2.82)V_{o2}}{V_{o2} - V_{o2nom}} - 2.4$

Where $V_{o2nom}$ is the nominal output voltage of Vo2, $V_{o2}$ is the adjusted output voltage of Vo2, and Rdown and Rup are external adjusting resistors. Units: kΩ.

Note: Vo1 is not adjustable, but Vo2 is adjustable. The over-voltage protection functions if the out voltage is trimmed up higher than the threshold.





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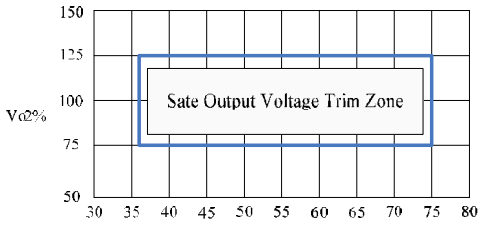



Max Output Voltage Changes vs Input Voltage

**Ripple & noise:** add a 10μF Tantalum capacitor and a 1μF ceramic capacitor to the test tooling of Vo1 and Vo2.

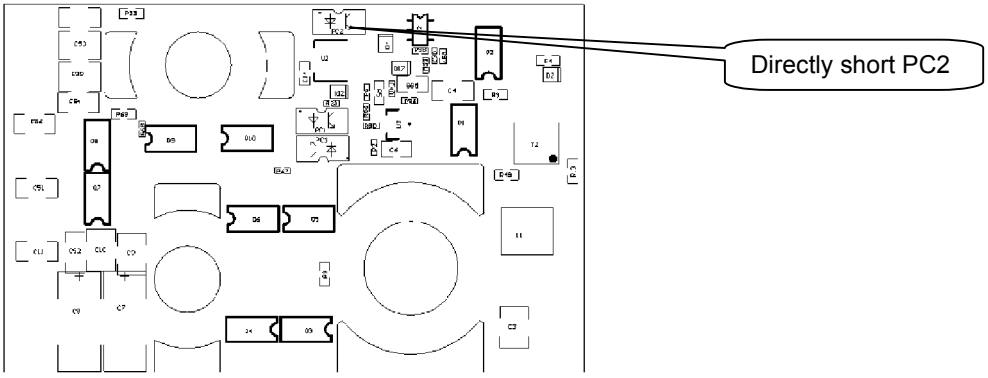
### 3.7 Over-current Protection

Operating at over-current conditions for long time may cause damage to the module; if the output is in short-circuits, the module is in hiccup mode, and the output current varies from a few mA to hundreds of mA.

### 3.8 Over-voltage Protection

The over-voltage protection of Output I and Output II will deadlock when there is no load or light load, and recover after re-power-on.

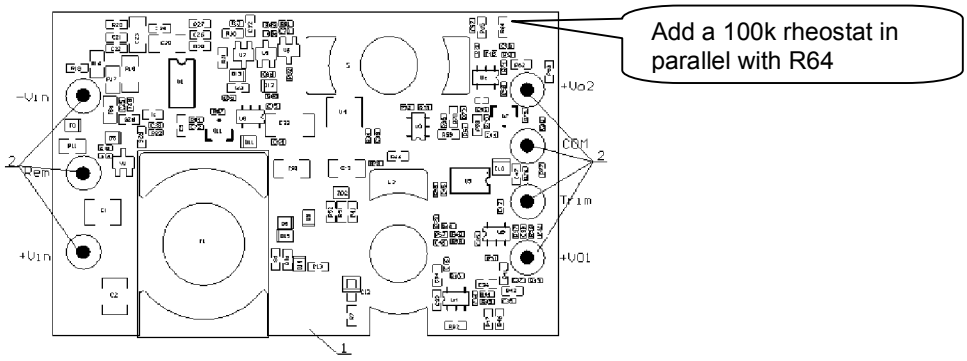
Test Methods for Output I: directly short PC2 (diode).




Non-pin Side

There is a bit of troubles for Output II, because the over-voltage protection threshold changes along with the output voltage of Output II. Use the test method below:

Add a 100k rheostat in parallel with R64 on the pin side, and adjust the rheostat to trim Output II up until the over-voltage protection functions (Output II off) .




Pin Side





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**3.9 Over-temperature Protection**

When the thermistor temperature is at 85℃ to 100℃, the over-temperature protection functions, and the output is off; when the thermistor temperature is 5 to 15℃ less than the protection threshold, the module recovers automatically.

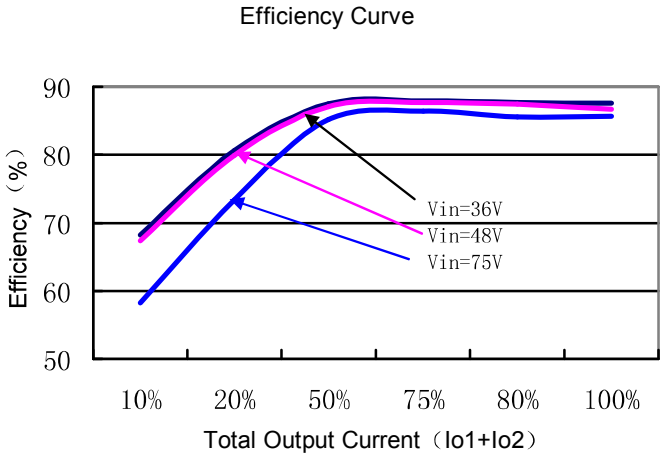
**3.10 Remote on/off (Negative logic)**

Output will be on when the Rem is shorted to –Vin or below 1.8V referenced to –Vin.

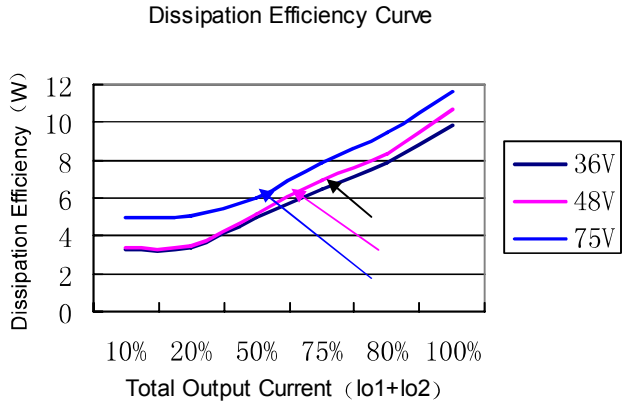
Output will be off when the Rem is higher than 1.8V referenced to –Vin or keeps open circuit.

## 4 Characteristic Curves (Ta=25℃)

### 4.1 Efficiency Curve




### 4.2 Dissipation Efficiency Curve




### 4.3 Thermal Derating Curve





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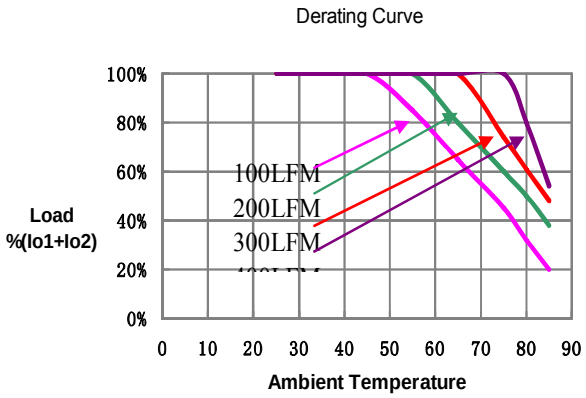
When the module operates at high temperature, the following derating curve shall be used:




Test conditions:

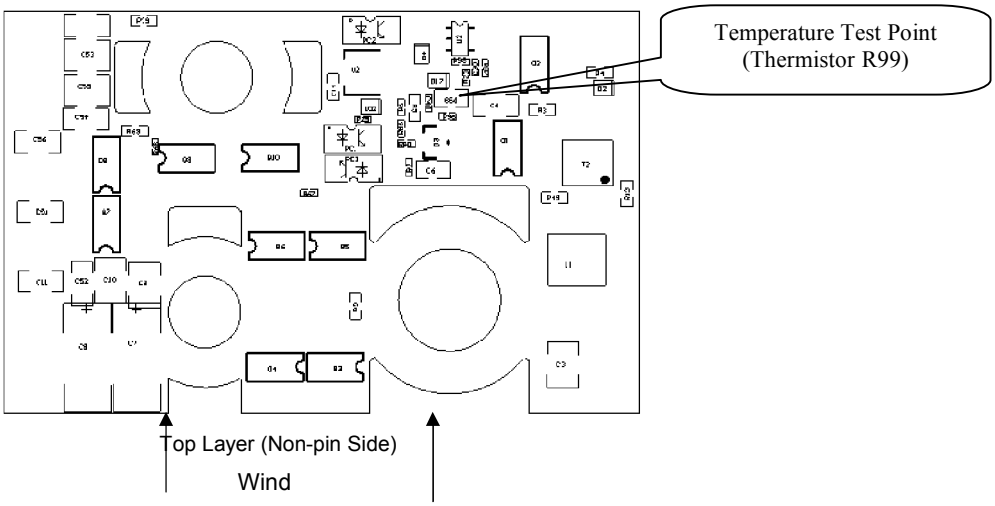
（1） The module shall be soldered on a 2.0mm standard 4-layer test board, of which the middle two layers are two-ounce copper foils.

（2） A certain gap is required between the module and test board. Keep the test board perpendicular to the horizontal direction and the long edge parallel with the horizontal plane.

（3） Put the module into a thermal test box, and test the module using infrared thermal imaging equipment and thermocouple test equipment. See Next diagram.

（4） When the module reaches thermal equilibrium state, the devices on the module can meet thermal derating requirements.

**4.4 Temperature Test Point**




**4.5 Dynamic Response**





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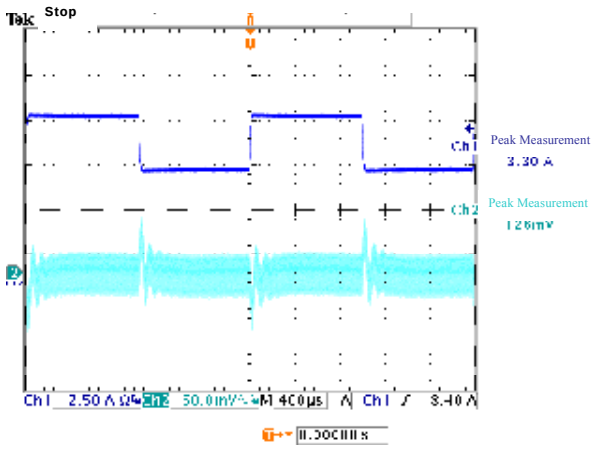
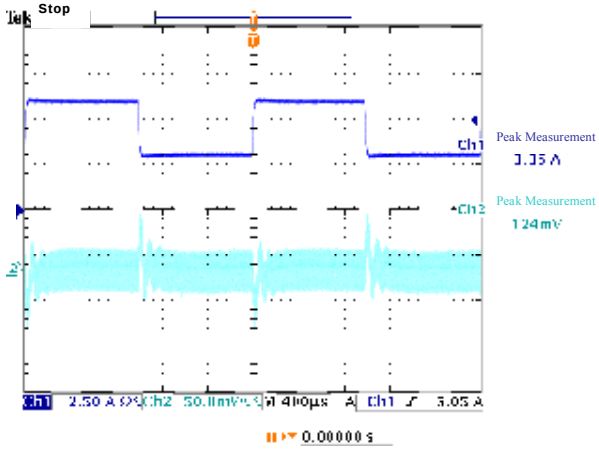
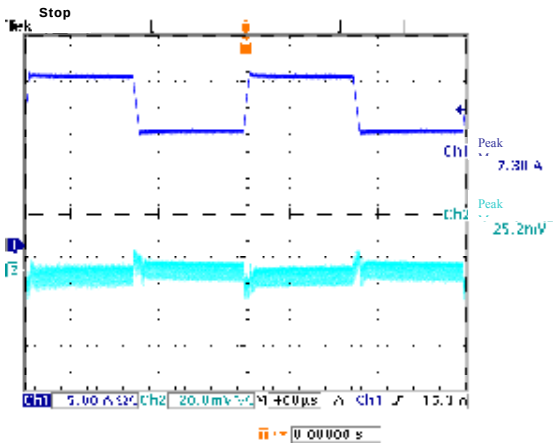
Test Condition: Ta=25℃, Vin=48V, ΔIo/Δt=1.0A/μS, add a 220uF capacitor to each output



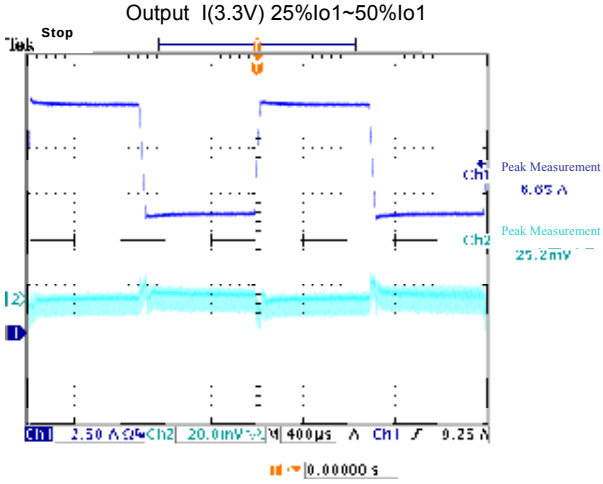

Output I(3.3V) 50%Io1~75%Io1




Output I(3.3V) 25%Io1~50%Io1



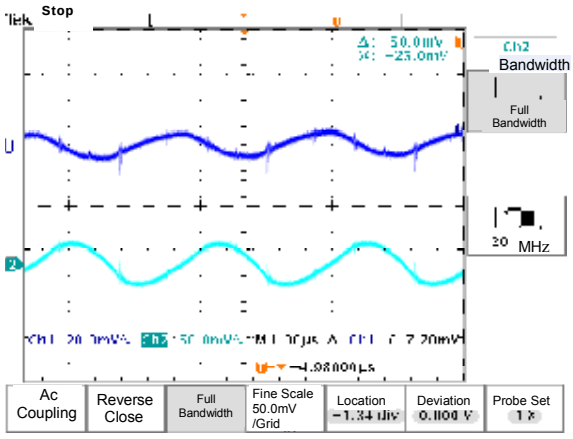

Output II (1.2V) 50%Io1~75%Io2




Output II (1.2V) 25%Io1~50%Io2

### 4.6 Output Ripple and Power-on Wave

Test Condition: Ta=25℃, Vin=48V, Io1=12A, Io2=25A, 20MHz





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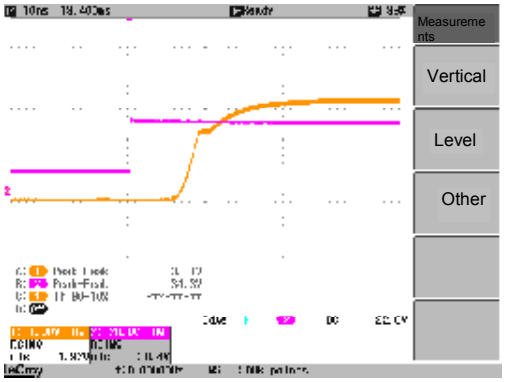
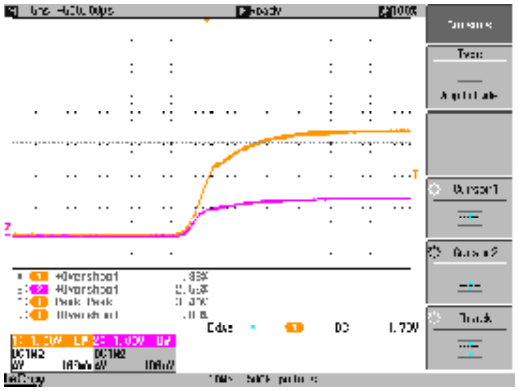



**Power-on Wave**: Vin - Vo1



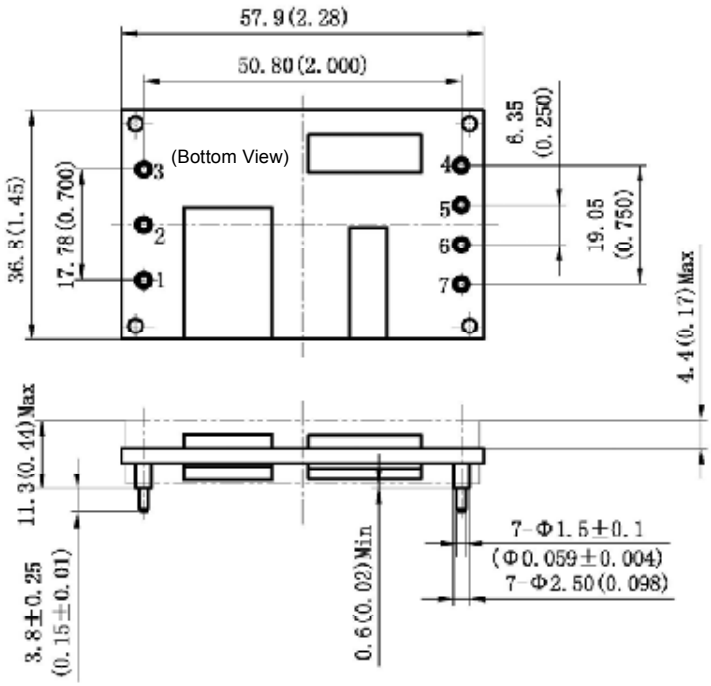
**Power-on Wave**: Vo1 - Vo2

## 5 Dimensions and Pin definition

### 5.1 Dimensions

The product is equipped with an option of Aluminum board, which includes through-threaded mounting holes, allowing for attachment of heat sinks. There are two outline designs: open-frame and aluminum baseplate.

1) Outline Diagram - Open-frame




Note:

1. Unit: mm (inch)
2. Tolerance: .X±0.5(.XX±0.02); .XX±0.25(.XXX±0.010)





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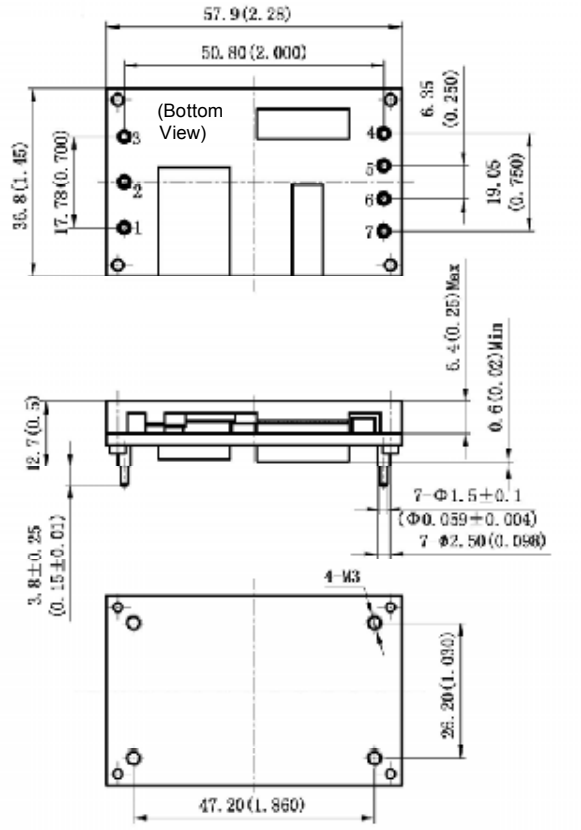
3. The maximum height (δ1) of the highest component at non-pin side is 4.4mm (0.17inch); the minimum space (δ2) between the highest component at pin side and the mounting surface of pin side is 0.6mm (0.02inch).

2) Outline Diagram - Aluminum Baseplate




Note:

1. Unit: mm (inch)

2. Tolerance: .X±0.5(.XX±0.02); .XX±0.25(.XXX±0.010)

3. The maximum height of the highest device at non-pin side is 6.4 (0.25); and the minimum space between the highest device at pin side and the mounting surface of pin side is 0.6 (0.02).

4. 4-M3 are the through-threaded mounting holes allowing for attachment of heat sinks. The length of M3 screw screwed into the aluminum baseplate shall be less than 3mm.

### 5.2 Pin Definition

| No | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Symbol | +Vin | Rem | -Vin | +Vo2 | COM | Trim | +Vo1 |
| Definition | Positive Input | Remote | Negative Input | Positive Output II | Common Terminal (Output grounding) | Trim (Output II) | Positive Output I |





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