

## ISOLATED DC/DC CONVERTERS

48 Vdc Input, 1.2 Vdc - 12 Vdc / 15 A - 3 A Outputs, 1/16 Brick Converter

Apr. 09, 2010

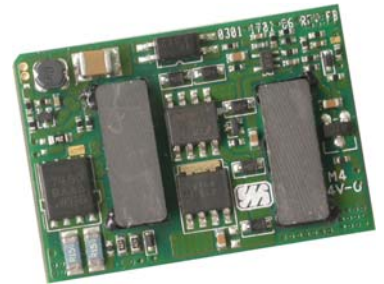
*Bel Power Inc., a subsidiary of Bel Fuse Inc.*

**xRSB-30T Series**

**RoHS Compliant**

**Rev.B**

- Isolated
- Fixed Frequency (550 kHz)
- High Efficiency
- High Power Density
- Low Cost
- Output Voltage Trim
- Basic Insulation
- UL60950-1 Recognized (UL/cUL)
- Input Under-Voltage Lockout
- Output Over-Voltage Shutdown
- OCP/SCP
- Over Temperature Protection
- Remote On/Off (Option)
- Positive/Negative Remote Sense
- Through Hole and SMT(Option)



### Description

The xRSB-30T series are isolated dc/dc converters that operate from a nominal 48 Vdc source. These units will provide up to 30 W of output power from a nominal 48 Vdc input. These units are designed to be highly efficient and low cost. Features include remote on/off, over current protection and under voltage lockout. These converters are provided in an industry standard sixteenth brick package.

### Part Selection

| Output Voltage | Input Voltage   | Max. Output Current | Max. Output Power | Typical Efficiency | Model Number Active Low | Model Number Active High |
|----------------|-----------------|---------------------|-------------------|--------------------|-------------------------|--------------------------|
| 1.2 Vdc        | 36 Vdc - 75 Vdc | 15 A                | 18 W              | 84%                | xRSB-30TV2L             | xRSB-30TV20              |
| 1.5 Vdc        | 36 Vdc - 75 Vdc | 13 A                | 19.5 W            | 86%                | xRSB-30TV5L             | xRSB-30TV50              |
| 1.8 Vdc        | 36 Vdc - 75 Vdc | 13 A                | 23 W              | 86%                | xRSB-30TV8L             | xRSB-30TV80              |
| 2.5 Vdc        | 36 Vdc - 75 Vdc | 10 A                | 25 W              | 89%                | xRSB-30T02L             | xRSB-30T025              |
| 3.3 Vdc        | 36 Vdc - 75 Vdc | 10 A                | 30 W              | 90%                | xRSB-30T03L             | xRSB-30T033              |
| 5.0 Vdc        | 36 Vdc - 75 Vdc | 7 A                 | 35 W              | 90%                | xRSB-30T05L             | xRSB-30T050              |
| 12 Vdc         | 36 Vdc - 75 Vdc | 3 A                 | 36 W              | 89%                | xRSB-30T12L             | xRSB-30T120              |

**Notes:** 1. Add "G" suffix at the end of the model number to indicate Tray Packaging. Replace "x" with "S" to indicate SMT package, or "0" to indicate through hole package.

2. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers

### Absolute Maximum Ratings

| Parameter                        | Min    | Typ | Max    | Notes |
|----------------------------------|--------|-----|--------|-------|
| Input Voltage (continuous)       | -0.3 V | -   | 80 V   |       |
| Input Voltage Transient (100 ms) | -0.3 V |     | 100 V  |       |
| Remote On/Off                    | -0.3 V | -   | 18 V   |       |
| I/O Isolation Voltage            | -      | -   | 1500 V |       |
| Ambient Temperature              | -40 °C | -   | 85 °C  |       |
| Storage Temperature              | -55 °C | -   | 125 °C |       |

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## Input Specifications

| Parameter                                 | Min  | Typ                   | Max                   | Notes  |
|---|------|-----------------------|-----------------------|--|
| Input Voltage                             | 36 V | 48 V                  | 75 V                  |  |
| Input Current (full load)                 | -    | -                     | 1.6 A                 |  |
| Input Current (no load)                   | -    | 30 mA                 | 120 mA                |  |
| Remote Off Input Current                  | -    | 2 mA                  | 6 mA                  |  |
| Input Reflected Ripple Current (pk-pk)    | -    | 20 mA                 | 50 mA                 | Tested with simulated source impedance of 15 $\mu$ H, 5 Hz to 20 MHz; use a 100 $\mu$ F/100 V electrolytic capacitor with ESR=1 ohm max at 200 kHz at the input. |
| Input Reflected Ripple Current (rms)      | -    | 3 mA                  | 7 mA                  |  |
| I <sup>2</sup> t Inrush Current Transient | -    | 0.01 A <sup>2</sup> s | 0.02 A <sup>2</sup> s |  |
| Turn On Voltage Threshold                 | 31 V | 33 V                  | 35 V                  |  |
| Turn Off Voltage Threshold                | 28 V | 32 V                  | 35 V                  |  |

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

## Output Specifications

| Parameter                                      | Min      | Typ     | Max      | Notes                                     |
|--|----------|---------|----------|---|
| Output Voltage Set Point                       |          |         |          | Test conditions:<br>Vin=48 V; Io=50% load |
| Vo=1.2 V                                       | 1.182 V  | 1.2 V   | 1.218 V  |   |
| Vo=1.5 V                                       | 1.478 V  | 1.5 V   | 1.523 V  |   |
| Vo=1.8 V                                       | 1.773 V  | 1.8 V   | 1.827 V  |   |
| Vo=2.5 V                                       | 2.463 V  | 2.5 V   | 2.538 V  |   |
| Vo=3.3 V                                       | 3.250 V  | 3.3 V   | 3.350 V  |   |
| Vo=5.0 V                                       | 4.900 V  | 5.0 V   | 5.100 V  |   |
| Vo=12 V  | 11.750 V | 12.0 V  | 12.250 V |   |
| Line Regulation                                |          |         |          |   |
| Vo=1.2 - 1.8 V                                 | -        | ±0.5 mV | ±3 mV    |   |
| Vo=2.5 V                                       | -        | ±2.0 mV | ±6 mV    |   |
| Vo=3.3 V                                       | -        | ±3.0 mV | ±8 mV    |   |
| Vo=5.0 V                                       | -        | ±4.0 mV | ±9 mV    |   |
| Vo=12 V  | -        | ±6.0 mV | ±20 mV   |   |
| Load Regulation                                |          |         |          |   |
| Vo=1.2 - 2.5 V                                 | -        | ±3 mV   | ±5 mV    |   |
| Vo=3.3 - 5.0 V                                 | -        | ±4 mV   | ±9 mV    |   |
| Vo=12 V  | -        | ±5 mV   | ±10 mV   |   |
| Regulation Over Temperature (-40 °C to +85 °C) |          |         |          |   |
| Vo=1.2 - 1.8 V                                 | -        | ±7 mV   | ±15 mV   |   |
| Vo=2.5 - 3.3 V                                 | -        | ±9 mV   | ±16 mV   |   |
| Vo=5.0 V                                       | -        | ±15 mV  | ±30 mV   |   |
| Vo=12 V  | -        | ±20 mV  | ±35 mV   |   |
| Output Current                                 |          |         |          |   |
| Vo=1.2 V                                       | 0 A      | -       | 15 A     |   |
| Vo=1.5 V                                       | 0 A      | -       | 13 A     |   |
| Vo=1.8 V                                       | 0 A      | -       | 13 A     |   |
| Vo=2.5 V                                       | 0 A      | -       | 10 A     |   |
| Vo=3.3 V                                       | 0 A      | -       | 10 A     |   |
| Vo=5.0 V                                       | 0 A      | -       | 7 A      |   |
| Vo=12 V  | 0 A      | -       | 3 A      |   |

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## Output Specifications (continued)

| Parameter                     |                | Min            | Typ                  | Max                | Notes  |   |
|-------------------------------|----------------|----------------|----------------------|--------------------|--|---|
| Current Limit Threshold       | Vo=1.2 V       | 18 A           | 24 A                 | 30 A               |  |   |
|                               | Vo=1.5 V       | 14 A           | 20 A                 | 26 A               |  |   |
|                               | Vo=1.8 V       | 14 A           | 19 A                 | 24 A               |  |   |
|                               | Vo=2.5 V       | 11 A           | 16 A                 | 21 A               |  |   |
|                               | Vo=3.3 V       | 10.5 A         | 15.5 A               | 25 A               |  |   |
|                               | Vo=5.0 V       | 7.5 A          | 9.5 A                | 14 A               |  |   |
|                               | Vo=12 V        | 3.5 A          | 4.5 A                | 6 A                |  |   |
| Short Circuit Surge Transient |                | -              | 0.5 A <sup>2</sup> s | 1 A <sup>2</sup> s |  |   |
| Ripple and Noise (rms)        | Vo=1.2 - 2.5 V | -              | 10 mV                | 20 mV              | Tested at 0-20 MHz BW, with a 1 uF ceramic capacitor and a 10 uF Tantalum capacitor at the output. |   |
|                               | Vo=3.3 V       | -              | 15 mV                | 30 mV              |  |   |
|                               | Vo=5.0 - 12 V  | -              | 30 mV                | 55 mV              |  |   |
| Ripple and Noise (pk-pk)      | Vo=1.2 - 2.5 V | -              | 40 mV                | 70 mV              |  |   |
|                               | Vo=3.3 V       | -              | 65 mV                | 110 mV             |  |   |
|                               | Vo=5.0 V       | -              | 90 mV                | 150 mV             |  |   |
|                               | Vo=12 V        | -              | 80 mV                | 140 mV             |  |   |
| Turn on Time                  |                | -              | 35 mS                | 70 mS              |  |   |
| Overshoot at Turn on          |                | -              | 0%                   | 5%                 |  |   |
| Output Capacitance            | Vo=1.2 - 1.5 V | 220 uF         | -                    | 15000 uF           |  |   |
|                               | Vo=1.8 V       | 220 uF         | -                    | 10000 uF           |  |   |
|                               | Vo=2.5 V       | 220 uF         | -                    | 6800 uF            |  |   |
|                               | Vo=3.3 V       | 0 uF           | -                    | 4700 uF            |  |   |
|                               | Vo=5.0 V       | 0 uF           | -                    | 2200 uF            |  |   |
|                               | Vo=12 V        | 0 uF           | -                    | 330 uF             |  |   |
| <b>Transient Response</b>     |                |                |                      |                    |  |   |
| 25% ~ 50%<br>Max Load         | Overshoot      | Vo=1.2 V       | -                    | 100 mV             | 150 mV   | Test conditions: di/dt = 0.1 A/uS, Vin=48 V, with a 1uF ceramic capacitor and a 10 uF Tantalum capacitor at the output. |
|                               | Settling Time  |                | -                    | 100 uS             | 150 uS   |   |
| 50% ~ 25%<br>Max Load         | Overshoot      | Vo=1.2 V       | -                    | 100 mV             | 150 mV   |   |
|                               | Settling Time  |                | -                    | 100 uS             | 150 uS   |   |
| 25% ~ 50%<br>Max Load         | Overshoot      | Vo=1.5 - 1.8 V | -                    | 150 mV             | 200 mV   |   |
|                               | Settling Time  |                | -                    | 120 uS             | 200 uS   |   |
| 50% ~ 25%<br>Max Load         | Overshoot      | Vo=1.5 - 1.8 V | -                    | 150 mV             | 200 mV   |   |
|                               | Settling Time  |                | -                    | 120 uS             | 200 uS   |   |
| 25% ~ 50%<br>Max Load         | Overshoot      | Vo=2.5 V       | -                    | 200 mV             | 300 mV   |   |
|                               | Settling Time  |                | -                    | 100 uS             | 150 uS   |   |
| 50% ~ 25%<br>Max Load         | Overshoot      | Vo=2.5 V       | -                    | 200 mV             | 300 mV   |   |
|                               | Settling Time  |                | -                    | 100 uS             | 150 uS   |   |
| 25% ~ 50%<br>Max Load         | Overshoot      | Vo=3.3 V       | -                    | 200 mV             | 350 mV   |   |
|                               | Settling Time  |                | -                    | 200 uS             | 350 uS   |   |
| 50% ~ 25%<br>Max Load         | Overshoot      | Vo=3.3 V       | -                    | 200 mV             | 350 mV   |   |
|                               | Settling Time  |                | -                    | 200 uS             | 350 uS   |   |
| 25% ~ 50%<br>Max Load         | Overshoot      | Vo=5.0 V       | -                    | 350 mV             | 500 mV   |   |
|                               | Settling Time  |                | -                    | 200 uS             | 350 uS   |   |
| 50% ~ 25%<br>Max Load         | Overshoot      | Vo=5.0 V       | -                    | 350 mV             | 500 mV   |   |
|                               | Settling Time  |                | -                    | 200 uS             | 350 uS   |   |
| 25% ~ 50%<br>Max Load         | Overshoot      | Vo=12 V        | -                    | 270 mV             | 450 mV   |   |
|                               | Settling Time  |                | -                    | 110 uS             | 200 uS   |   |
| 50% ~ 25%<br>Max Load         | Overshoot      | Vo=12 V        | -                    | 270 mV             | 450 mV   |   |
|                               | Settling Time  |                | -                    | 110 uS             | 200 uS   |   |

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

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### General Specifications

| Parameter                   | Min                  | Typ     | Max     | Notes  |
|-----------------------------|----------------------|---------|---------|--|
| Efficiency                  |                      |         |         |  |
| Vo=1.2 V                    | 81%                  | 84%     | -       | Vin=48 V, full load  |
| Vo=1.5 V                    | 83%                  | 86%     | -       |  |
| Vo=1.8 V                    | 83%                  | 86%     | -       |  |
| Vo=2.5 V                    | 84%                  | 87%     | -       |  |
| Vo=3.3 - 5.0 V              | 87%                  | 90%     | -       |  |
| Vo=12 V                     | 86%                  | 89%     | -       |  |
| Switching Frequency         | 500 kHz              | 550 kHz | 600 kHz |  |
| Isolation Capacitance       | -                    | 3900 pF | -       |  |
| Output Voltage Trim Range   | 90% Vo               | -       | 110% Vo |  |
| Over Temperature Protection | 120 °C               | -       | 140 °C  |  |
| Over Voltage Protection     | -                    | 130% Vo | 160% Vo | Test conditions: Vin=48 V, full load and short the feedback optocoupler. |
| MTBF                        | TBD                  |         |         | Calculated Per Bell Core SR-332 (Io = Nominal; Ta = 25 °C)               |
| Dimensions                  |                      |         |         |  |
| Inches (L x W x H)          | 1.3 x 0.9 x 0.364    |         |         | SMT Package  |
| Millimeters (L x W x H)     | 33.02 x 22.86 x 9.24 |         |         |  |
| Dimensions                  |                      |         |         |  |
| Inches (L x W x H)          | 1.3 x 0.9 x 0.388    |         |         | Through Hole Package   |
| Millimeters (L x W x H)     | 33.02 x 22.86 x 9.85 |         |         |  |
| Weight                      | -                    | 13 g    | -       |  |

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

### Control Specifications

| Parameter              | Min    | Typ  | Max   | Notes  |
|------------------------|--------|------|-------|--|
| <b>Remote On/Off</b>   |        |      |       |  |
| Signal Low (Unit On)   | -0.3 V | -    | 0.8 V | When Remote On/Off pin is open, for active low option, unit is off; for active high option, unit is on |
| Signal High (Unit Off) |        |      |       |  |
| Signal Low (Unit Off)  | -0.3 V | -    | 0.8 V |  |
| Signal High (Unit On)  |        |      |       |  |
| Current Sink           | -      | 0 mA | 1 mA  |  |

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### Output Trim Equations

Equations for calculating the trim resistor are shown below (Unit: kΩ). The Trim Down resistor should be connected between the Trim pin and Ground pin. The Trim Up resistor should be connected between the Trim pin and the Vout. Only one of the resistors should be used for any given application.

#### 1) Trim Equations for Vo=1.2 V

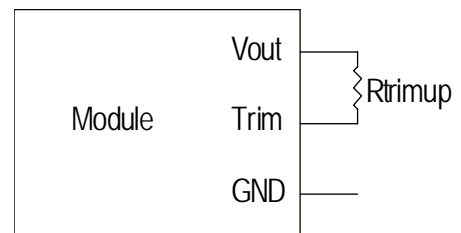
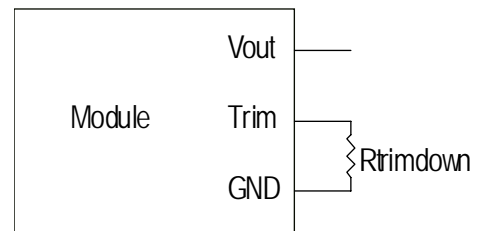
$$R_{trimdown} = \frac{511}{|\delta|} - 10.22$$

$$R_{trimup} = \frac{(100 + \delta) \cdot V_o \cdot 5.11 - 313}{0.6125 \cdot \delta} - 10.22$$

**Note:**

$$\delta = \frac{(V_o_{req} - V_o)}{V_o} \times 100[\%]$$

V<sub>o\_req</sub>=Desired (trimmed) output voltage [V] V<sub>o</sub>=1.202 V



#### 2) Trim Equations for Vo=1.5 V - 12 V

$$R_{trimdown} = \frac{511}{|\delta|} - 10.22$$

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

**Note:**

$$\delta = \frac{(V_o_{req} - V_o)}{V_o} \times 100[\%]$$

V<sub>o\_req</sub>=Desired (trimmed) output voltage [V]

V<sub>o</sub>=1.503 V for 1.5 V output; V<sub>o</sub>=1.804 V for 1.8 V output; V<sub>o</sub>=2.505 V for 2.5 V output; V<sub>o</sub>=3.308 V for 3.3 V output; V<sub>o</sub>=5.002 V for 5 V output; V<sub>o</sub>=12.007 V for 12 V output.

# ISOLATED DC/DC CONVERTERS

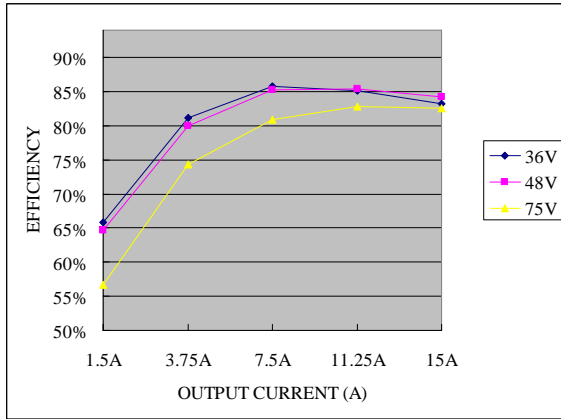
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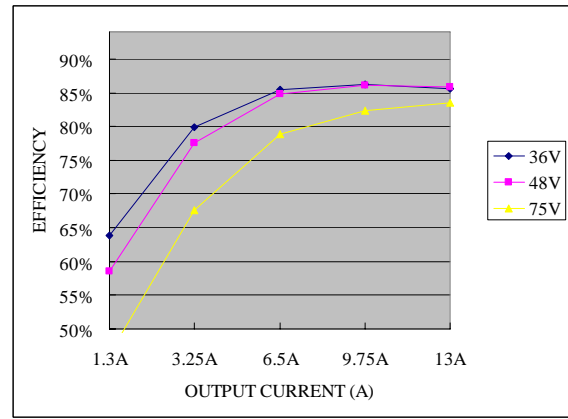
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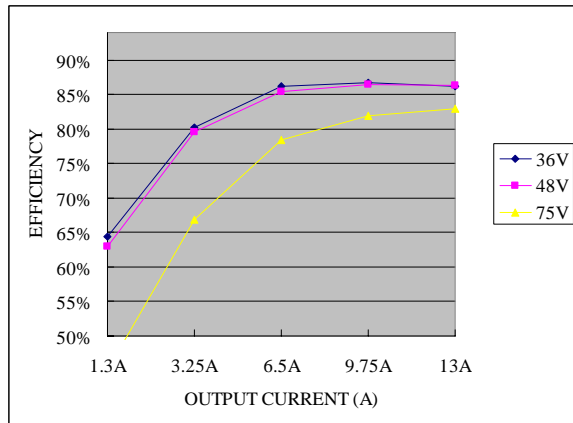
## Efficiency Data



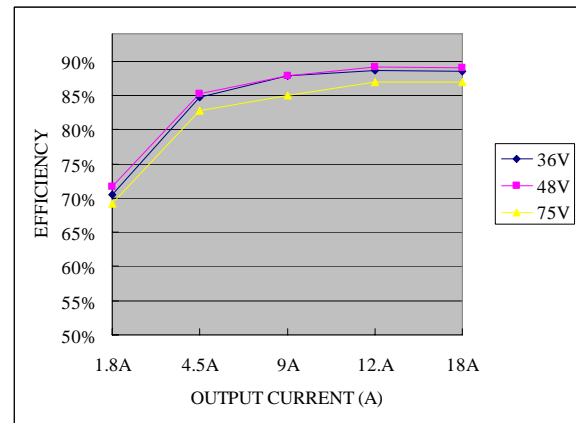
Vo=1.2 V



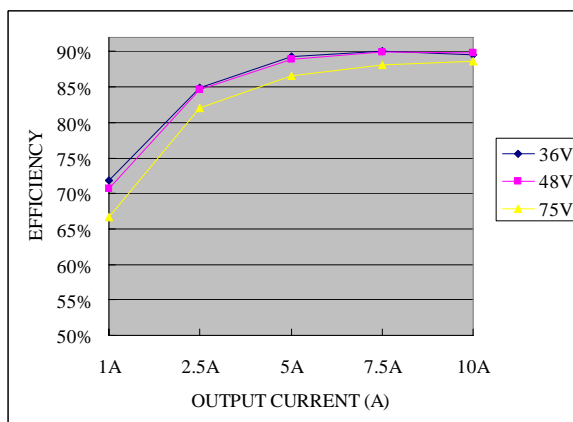
Vo=1.5 V



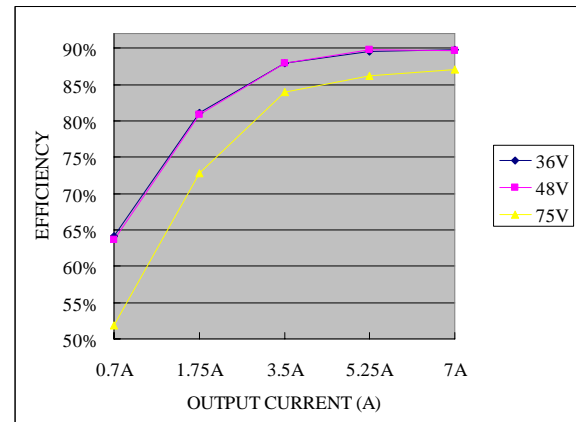
Vo=1.8 V



Vo=2.5 V



Vo=3.3 V



Vo=5.0 V

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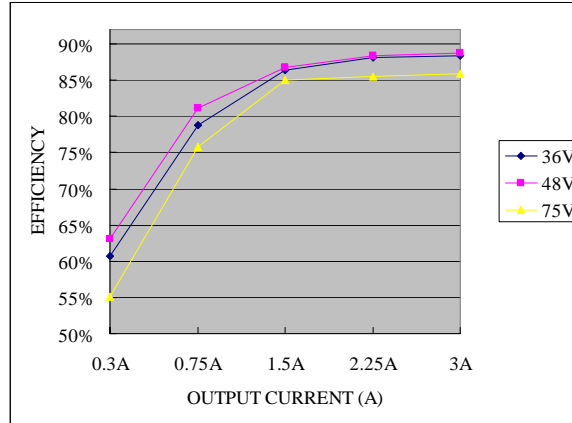
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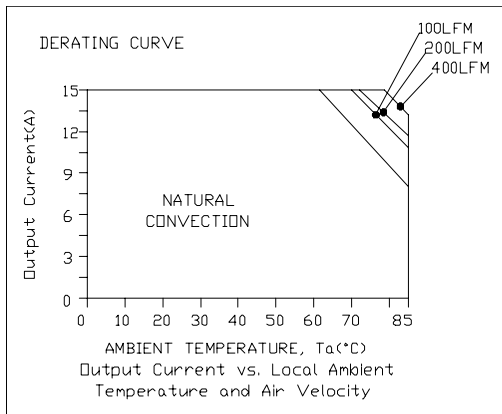
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## Efficiency Data (continued)

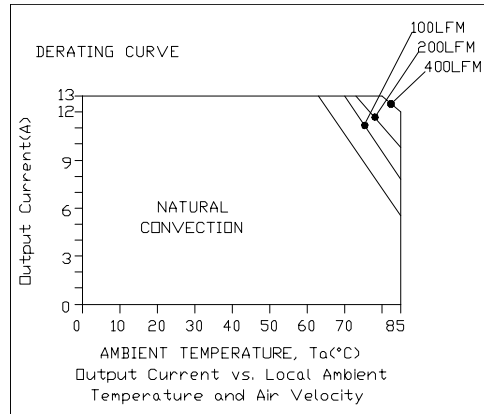


Vo=12 V

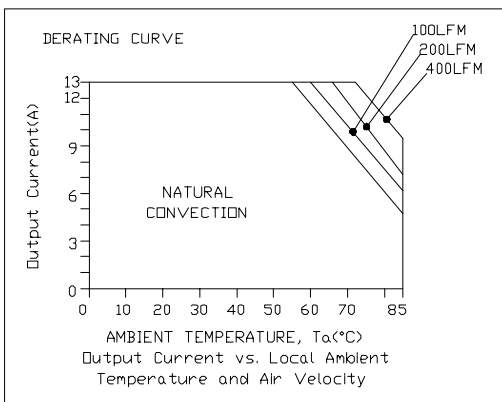
## Thermal Derating Curves



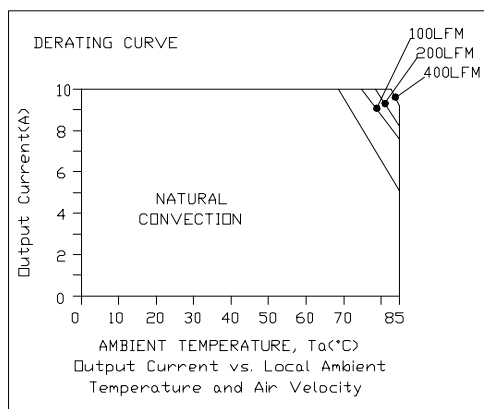
Vin=48 V, Vo=1.2 V



Vin=48 V, Vo=1.5 V



Vin=48 V, Vo=1.8 V



Vin=48 V, Vo=2.5 V

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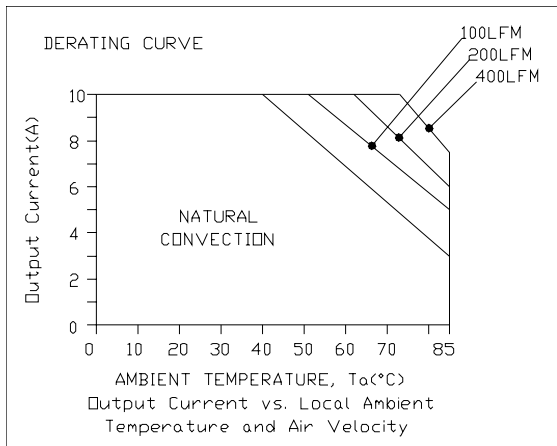
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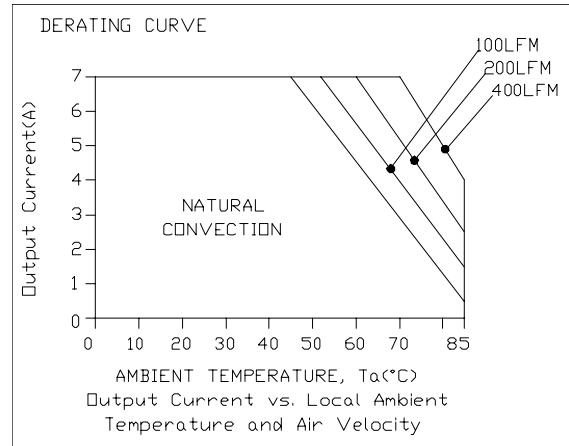
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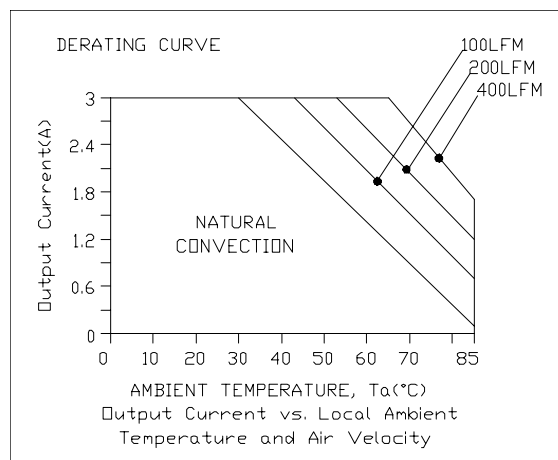
## Thermal Derating Curves (continued)



Vin=48 V, Vo=3.3 V



Vin=48 V, Vo=5.0 V



Vin=48 V, Vo=12 V



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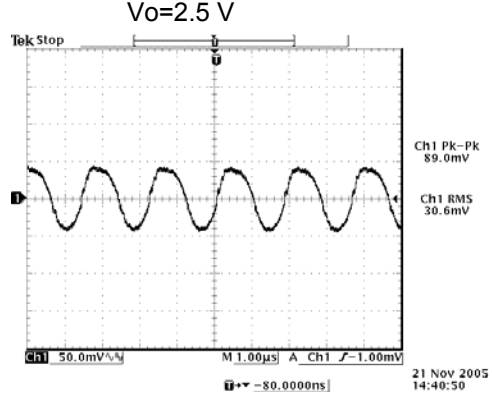
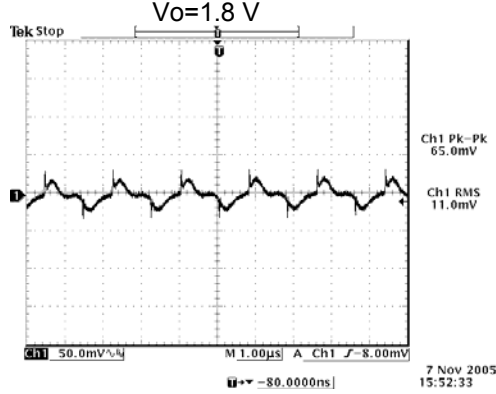
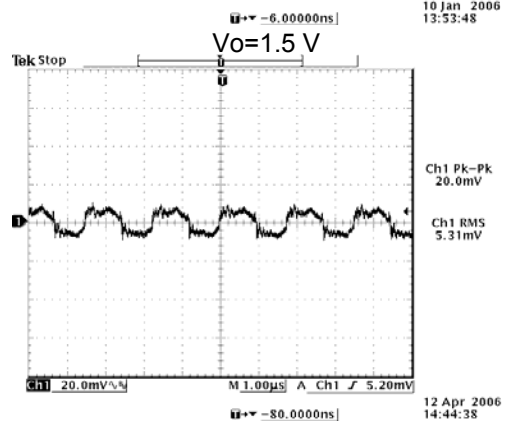
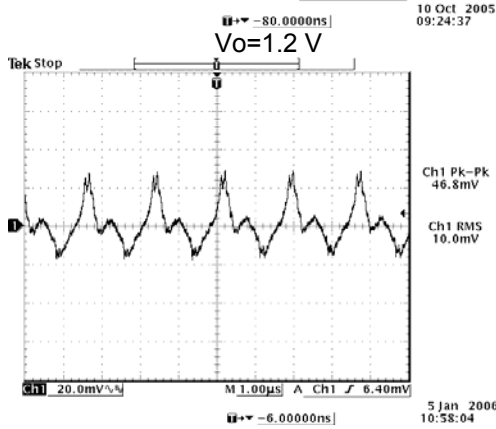
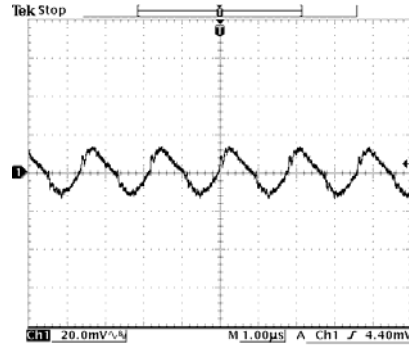
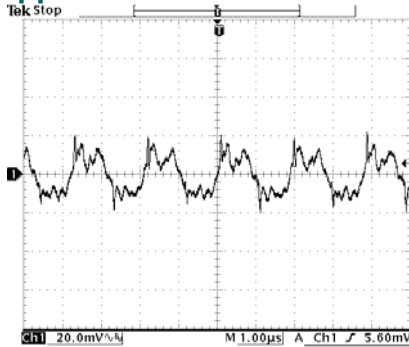
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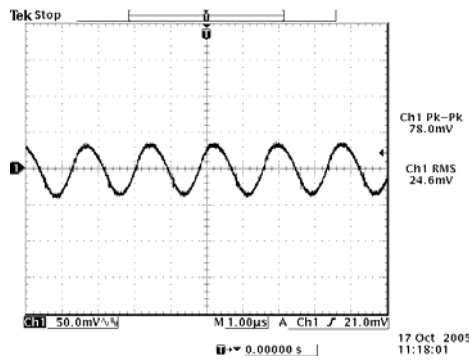
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## Ripple and Noise Waveforms



Vo=3.3 V



Vo=5.0 V

Vo=12 V

**Note:** Ripple and noise at full load, 48 V input, with a 1  $\mu$ F ceramic capacitor and a 10  $\mu$ F tantalum cap at the output, and  $T_a=25$  deg C.

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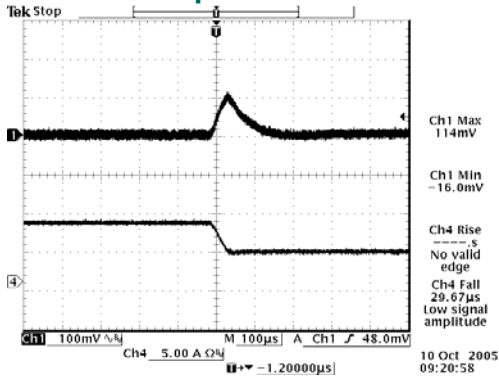
48 Vdc Input, 1.2 Vdc - 12 Vdc / 15 A - 3 A Outputs, 1/16 Brick Converter



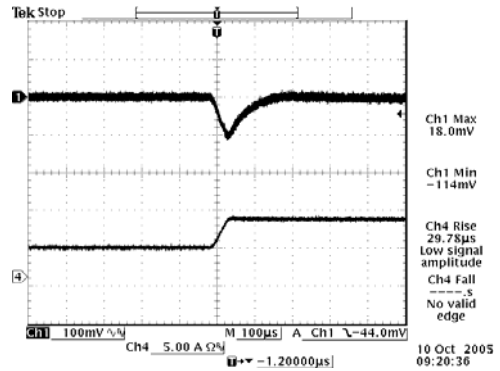
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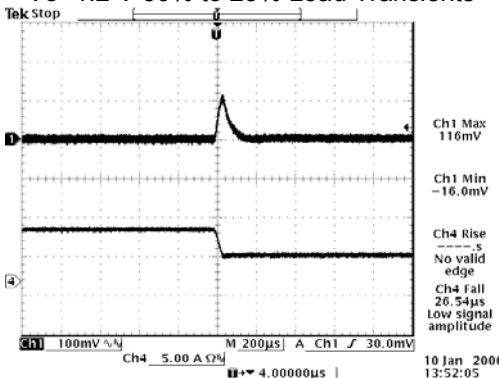
## Transient Response Waveforms



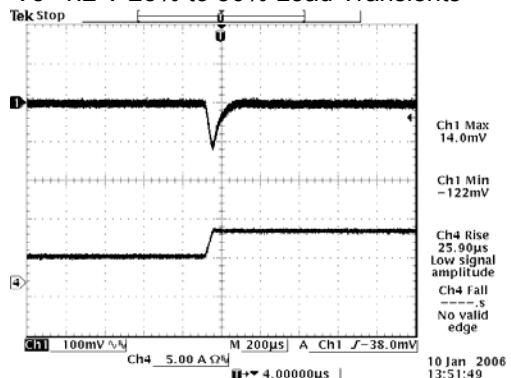
Vo=1.2 V 50% to 25% Load Transients



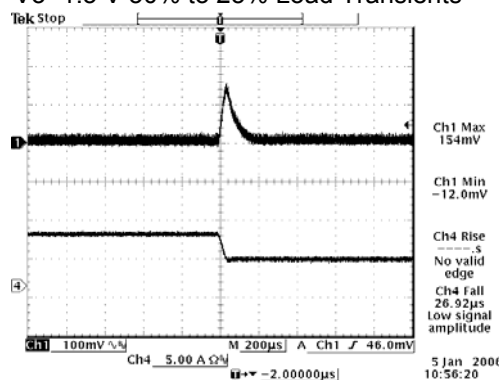
Vo=1.2 V 25% to 50% Load Transients



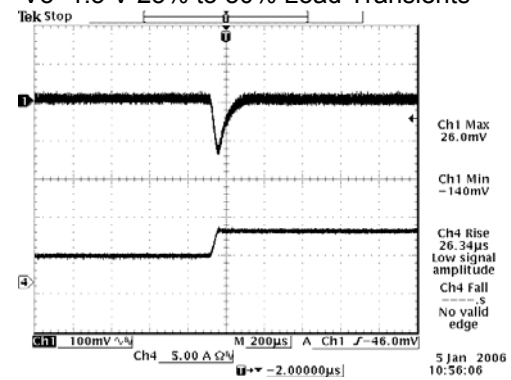
Vo=1.5 V 50% to 25% Load Transients



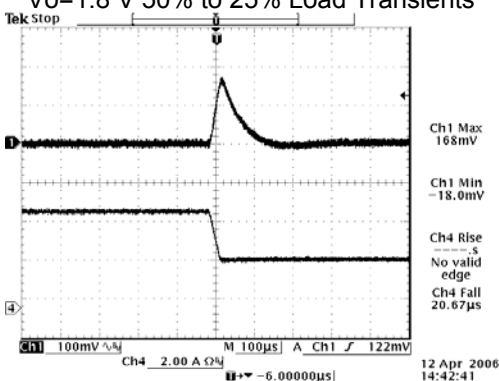
Vo=1.5 V 25% to 50% Load Transients



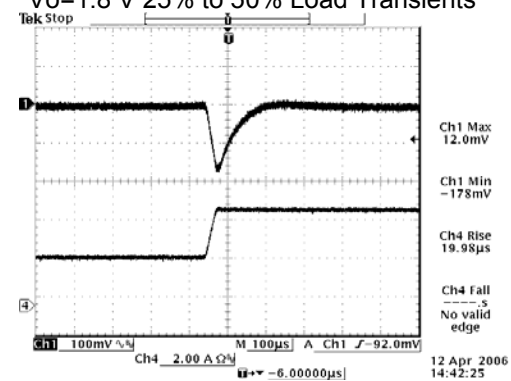
Vo=1.8 V 50% to 25% Load Transients



Vo=1.8 V 25% to 50% Load Transients



Vo=2.5 V 50% to 25% Load Transients



Vo=2.5 V 25% to 50% Load Transients

# ISOLATED DC/DC CONVERTERS

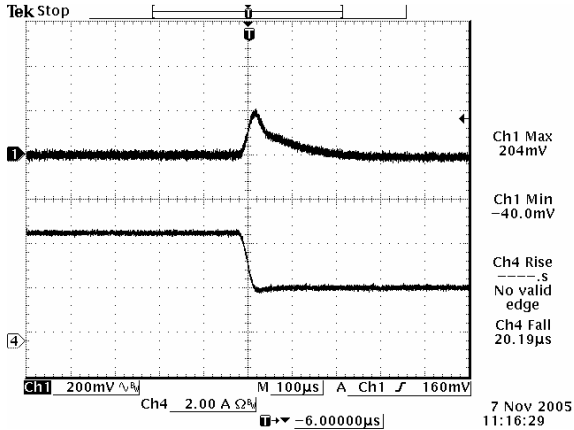
48 Vdc Input, 1.2 Vdc - 12 Vdc / 15 A - 3 A Outputs, 1/16 Brick Converter



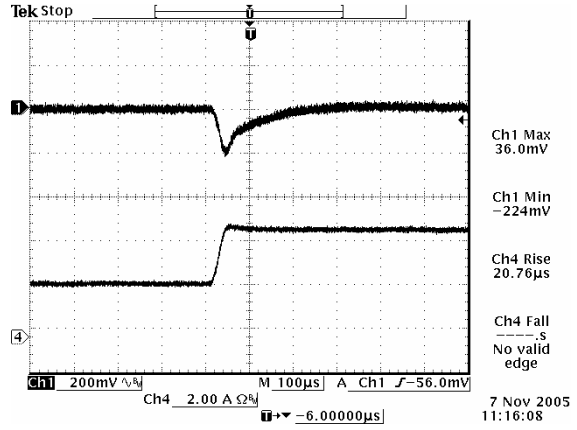
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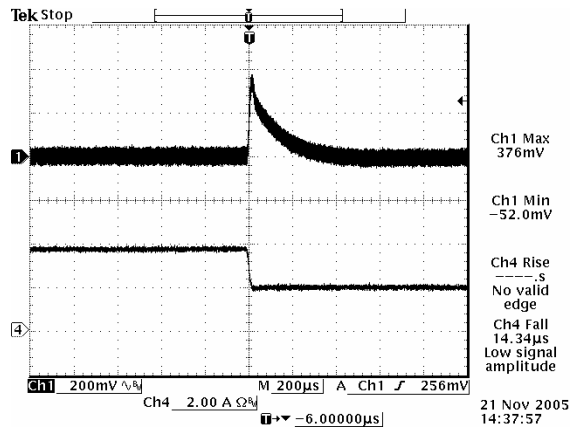
## Transient Response Waveforms (continued)



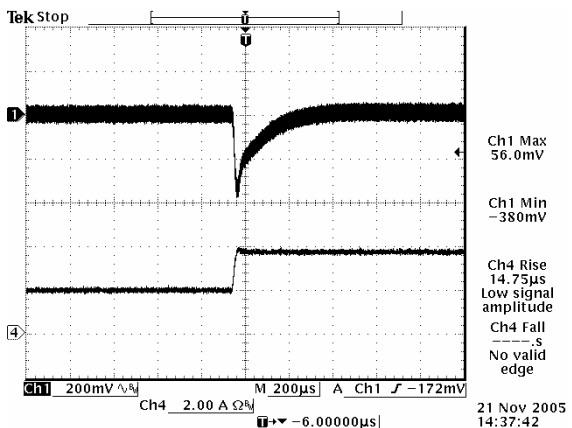
Vo=3.3 V 50% to 25% Load Transients



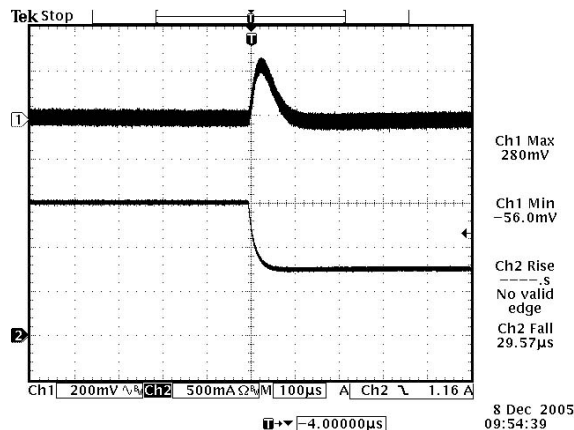
Vo=3.3 V 25% to 50% Load Transients



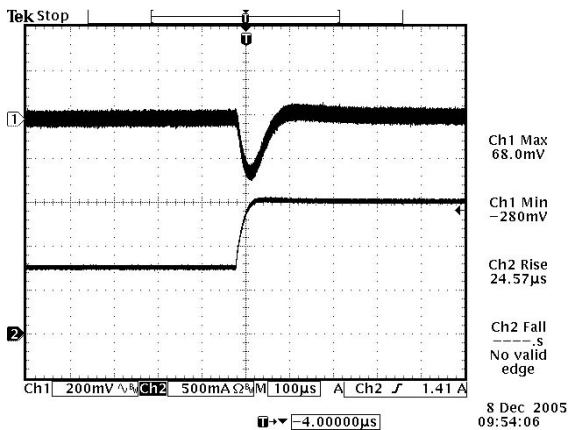
Vo=5.0 V 50% to 25% Load Transients



Vo=5.0 V 25% to 50% Load Transients



Vo=12 V 50% to 25% Load Transients



Vo=12 V 25% to 50% Load Transients

**Note:** Transient Response at Vin=48 V, di/dt=0.1A/uS, with external 220 uF tantalum capacitor and 1 uF ceramic capacitor, and Ta=25 deg C.

# ISOLATED DC/DC CONVERTERS

48 Vdc Input, 1.2 Vdc - 12 Vdc / 15 A - 3 A Outputs, 1/16 Brick Converter

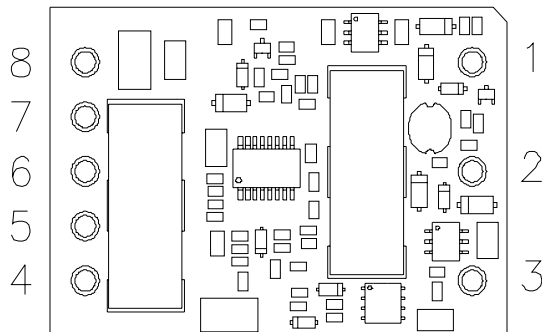
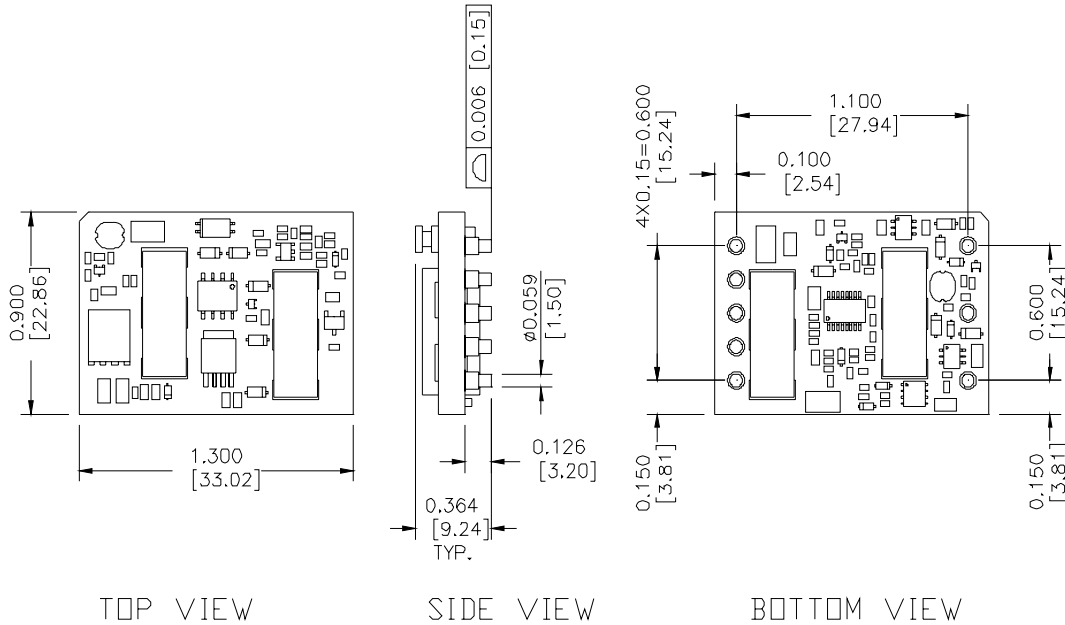


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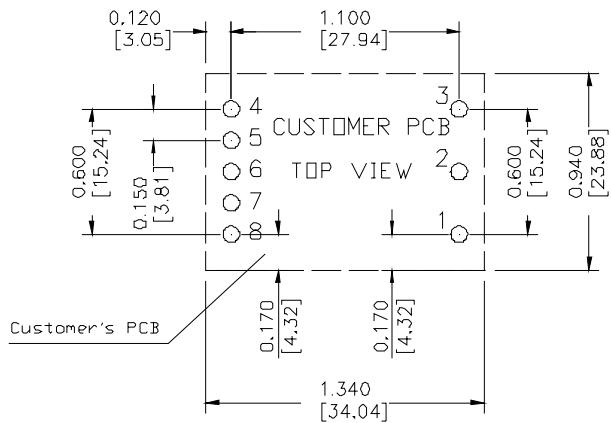
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## Mechanical Outline

### SMT Package



### RECOMMENDED PCB PAD LAYOUT



### Pin Connections

| Pin | Function         |
|-----|------------------|
| 1   | Vin (+)          |
| 2   | Remote On/Off    |
| 3   | Vin (-)          |
| 4   | Vout-            |
| 5   | Remote Sense (-) |
| 6   | Trim             |
| 7   | Remote Sense (+) |
| 8   | Vout (+)         |

Recommended Surface Mount Pads  
 Min.  $\phi 0.080$ " [2.03]  
 Max.  $\phi 0.092$ " [2.34]

# ISOLATED DC/DC CONVERTERS

48 Vdc Input, 1.2 Vdc - 12 Vdc / 15 A - 3 A Outputs, 1/16 Brick Converter

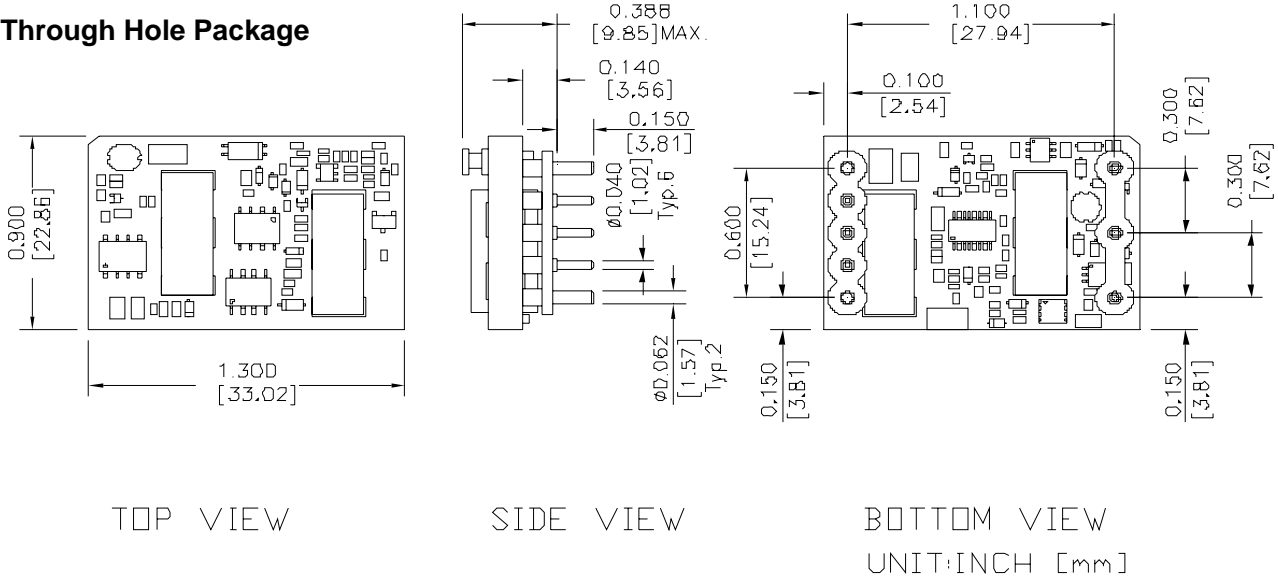


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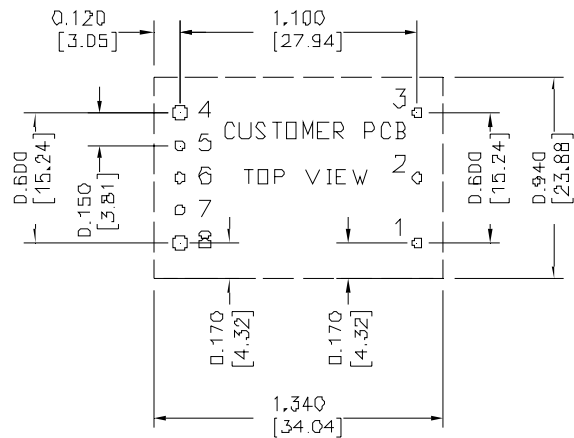
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## Mechanical Outline (continued)

### Through Hole Package



### RECOMMENDED PCB PAD LAYOUT



### Pin Connections

| Pin | Function         |
|-----|------------------|
| 1   | Vin (+)          |
| 2   | Remote On/Off    |
| 3   | Vin (-)          |
| 4   | Vout-            |
| 5   | Remote Sense (-) |
| 6   | Trim             |
| 7   | Remote Sense (+) |
| 8   | Vout (+)         |

HOLE SIZE: 1-3, 5-7  $\phi 0.047$  [1.19],  
 4,8  $\phi 0.07$  [1.78]  
 PAD SIZE: 1-3, 5-7  $\phi 0.08$  [2.03]  
 4,8  $\phi 0.10$  [2.54]

### Note:

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

## ISOLATED DC/DC CONVERTERS

48 Vdc Input, 1.2 Vdc - 12 Vdc / 15 A - 3 A Outputs, 1/16 Brick Converter



Apr. 09, 2010

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### Revision History

| Date     | Revision | Changes Detail   | Approval |
|----------|----------|--|----------|
| 2010-4-9 | B        | Update the 0RSB-30T series product height from 0.378" to 0.388". | Jack Fan |

### RoHS Compliance

Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products.



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- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
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- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
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«JONHON» (основан в 1970 г.)

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«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

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