

ISOLATED DC/DC CONVERTERS

48 Vdc Input 1.2-2.5 Vdc/80 A, 3.3 Vdc/70 A, 5 Vdc/48 A, 12 Vdc/20 A Output

bel
POWER PRODUCTS

0RHB-D0T Series

RoHS Compliant

Rev.A

- Isolated
- High Efficiency
- High Power Density
- Low Cost
- Input Under Voltage Lockout
- Fixed frequency (330 kHz)
- Basic Isolation
- Input Over Voltage Lockout
- Output Over Voltage Shutdown
- OCP/SCP
- Over Temperature Protection
- Remote On/Off
- Output Voltage Trim
- Positive/Negative Remote Sense
- Remote On/Off Logic (option)
- UL60950-1 Recognized (UL/cUL)



Description

The 0RHB-D0T Series are isolated dc/dc converters that operate from a nominal 48 Vdc source. These units provide up to 200 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 half-brick package.

Part Selection

| Output Voltage | Input Voltage | Max. Output Current | Max. Output Power | Typical Efficiency | Model Number Active High | Model Number Active Low |
|----------------|---------------|---------------------|-------------------|--------------------|--------------------------|-------------------------|
| 12.0 V | 36 V - 75 V | 20 A | 240 W | 94% | 0RHB-D0T120 | 0RHB-D0T12L |
| 5.0 V | 36 V - 75 V | 48 A | 240 W | 92.5% | 0RHB-D0T050 | 0RHB-D0T05L |
| 3.3 V | 36 V - 75 V | 70 A | 231 W | 92% | 0RHB-D0T033 | 0RHB-D0T03L |
| 2.5 V | 36 V - 75 V | 80 A | 200 W | 91% | 0RHB-D0T025 | 0RHB-D0T02L |
| 1.8 V | 36 V - 75 V | 80 A | 144 W | 89% | 0RHB-D0TV80 | 0RHB-D0TV8L |
| 1.5 V | 36 V - 75 V | 80 A | 120 W | 87% | 0RHB-D0TV50 | 0RHB-D0TV5L |
| 1.2 V | 36 V - 75 V | 80 A | 96 W | 85% | 0RHB-D0TV20 | 0RHB-D0TV2L |

- Notes:** 1. Add "G" suffix at the end of the model number to indicate Tray Packaging.
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 | |
| Remote On/Off | -0.3 V | - | 18 V | |
| I/O Isolation Voltage | - | - | 2000 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) | | | | |
| Vo=12.0 V | - | - | 7.5 A | |
| Vo=5.0 V | - | - | 7.5 A | |
| Vo=3.3 V | - | - | 7.3 A | |
| Vo=2.5 V | - | - | 6.4 A | |
| Vo=1.8 V | - | - | 4.7 A | |
| Vo=1.5 V | - | - | 4.0 A | |
| Vo=1.2 V | - | - | 3.3 A | |
| Input Current (no load) | - | 120 mA | 180 mA | |
| Remote Off Input Current | | 5 mA | 10 mA | |
| Input Reflected Ripple Current (pk-pk) | - | 20 mA | 40 mA | Tested with simulated source impedance of 10 uH, 5 Hz to 20 MHz; use a 100 uF/100 V electrolytic capacitor with ESR = 1 ohm max. at 200 kHz at 25 °C. |
| Input Reflected Ripple Current (rms) | - | 5 mA | 10 mA | |
| I ² t Inrush Current Transient | - | 0.05 A ² s | 0.1 A ² s | |
| Turn-on Voltage Threshold | 32 V | 34 V | 35 V | |
| Turn-off Voltage Threshold | 30 V | 32 V | 34 V | |
| Input Over Voltage Lockout | 76 V | 78 V | 80 V | |

Output Specifications

| Parameter | Min | Typ | Max | Notes |
|--|----------|----------|----------|---------------------------------------|
| Output Voltage Set Point | | | | |
| Vo=12.0 V | 11.760 V | 12.000 V | 12.240 V | Vin=48 V, Io=50% full load, Ta=25 °C. |
| Vo=5.0 V | 4.925 V | 5.000 V | 5.075 V | |
| Vo=3.3 V | 3.250 V | 3.300 V | 3.350 V | |
| Vo=2.5 V | 2.462 V | 2.500 V | 2.538 V | |
| Vo=1.8 V | 1.773 V | 1.800 V | 1.827 V | |
| Vo=1.5 V | 1.477 V | 1.500 V | 1.523 V | |
| Vo=1.2 V | 1.176 V | 1.200 V | 1.224 V | |
| Line Regulation | | | | |
| Vo=12.0 V | - | ±12 mV | ±24 mV | |
| Vo=5.0 V | - | ±5 mV | ±10 mV | |
| Vo=3.3 V | - | ±3 mV | ±7 mV | |
| Vo=1.2 V - 2.5 V | - | ±3 mV | ±6 mV | |
| Load Regulation | | | | |
| Vo=12.0 V | - | ±30 mV | ±60 mV | |
| Vo=5.0 V | - | ±10 mV | ±20 mV | |
| Vo=3.3 V | - | ±7 mV | ±15 mV | |
| Vo=2.5 V | - | ±6 mV | ±13 mV | |
| Vo=1.8 V | - | ±5 mV | ±9 mV | |
| Vo=1.5 V | - | ±4 mV | ±8 mV | |
| Vo=1.2 V | - | ±3 mV | ±6 mV | |
| Regulation Over Temperature (-40 °C to +85 °C) | | | | |
| Vo=12.0 V | - | ±60 mV | ±100 mV | |
| Vo=5.0 V | - | ±45 mV | ±75 mV | |
| Vo=3.3 V | - | ±30 mV | ±50 mV | |
| Vo=2.5 V | - | ±25 mV | ±45 mV | |
| Vo=1.8 V | - | ±20 mV | ±40 mV | |
| Vo=1.5 V | - | ±20 mV | ±35 mV | |
| Vo=1.2 V | - | ±15 mV | ±30 mV | |

ISOLATED DC/DC CONVERTERS

48 Vdc Input 1.2-2.5 Vdc/80 A, 3.3 Vdc/70 A, 5 Vdc/48 A, 12 Vdc/20 A Output



Output Specifications (continued)

| Parameter | | Min | Typ | Max | Notes | |
|-------------------------------|-------------------|------------------|--------------------|--------------------|---|--|
| Output Current | Vo=12.0 V | 0 A | - | 20 A | | |
| | Vo=5.0 V | 0 A | - | 48 A | | |
| | Vo=3.3 V | 0 A | - | 70 A | | |
| | Vo=1.2 V - 2.5 V | 0 A | - | 80 A | | |
| Current Limit Threshold | Vo=12.0 V | 21 A | 25 A | 30 A | Hiccup Mode | |
| | Vo=5.0 V | 50 A | 58 A | 66 A | | |
| | Vo=3.3 V | 74 A | 84 A | 94 A | | |
| | Vo=1.2 V - 2.5 V | 86 A | 96 A | 106 A | | |
| Short Circuit Surge Transient | | - | 3 A ² s | 5 A ² s | | |
| Ripple and Noise (rms) | Vo=12.0 V | - | 30 mV | 50 mV | Test conditions: 0-20 MHz BW, with a 1 uF ceramic capacitor and a 10 uF Tantalum capacitor at the output. | |
| | Vo=5.0 V | - | 25 mV | 50 mV | | |
| | Vo=3.3 V | - | 20 mV | 40 mV | | |
| | Vo=1.2 V - 2.5 V | - | 15 mV | 30 mV | | |
| Ripple and Noise (pk-pk) | Vo=12.0 V | - | 100 mV | 150 mV | | |
| | Vo=5.0 V | - | 80 mV | 150 mV | | |
| | Vo=3.3 V | - | 55 mV | 100 mV | | |
| | Vo=1.2 V - 2.5 V | - | 40 mV | 80 mV | | |
| Turn on Time | Vo=5.0 V - 12.0 V | 10 mS | - | 30 mS | | |
| | Vo=3.3 V | 8 mS | - | 20 mS | | |
| | Vo=1.2 V - 2.5 V | 5 mS | - | 15 mS | | |
| Overshoot at Turn on | | - | 0% | 5% | | |
| Output Capacitance | Vo=12.0 V | 0 uF | - | 2200 uF | | |
| | Vo=5.0 V | 0 uF | - | 10000 uF | | |
| | Vo=1.2 V - 3.3 V | 0 uF | - | 20000 uF | | |
| Transient Response | | | | | | |
| 50% ~ 75% Max Load | Overshoot | Vo=12.0 V | - | 600 mV | 800 mV | Test conditions: di/dt = 0.1 A/uS, Vin=48 V, Ta=25 °C with a 1 uF ceramic capacitor and a 10 uF Tantalum capacitor at the output. |
| | Settling Time | | - | 300 uS | 500 uS | |
| 75% ~ 50% Max Load | Overshoot | Vo=12.0 V | - | 600 mV | 800 mV | |
| | Settling Time | | - | 300 uS | 500 uS | |
| 50% ~ 75% Max Load | Overshoot | Vo=5.0 V | - | 250 mV | 400 mV | |
| | Settling Time | | - | 250 uS | 400 uS | |
| 75% ~ 50% Max Load | Overshoot | Vo=5.0 V | - | 250 mV | 400 mV | |
| | Settling Time | | - | 250 uS | 400 uS | |
| 50% ~ 75% Max Load | Overshoot | Vo=3.3 V | - | 150 mV | 200 mV | |
| | Settling Time | | - | 200 uS | 300 uS | |
| 75% ~ 50% Max Load | Overshoot | Vo=3.3 V | - | 150 mV | 200 mV | |
| | Settling Time | | - | 200 uS | 300 uS | |
| 50% ~ 75% Max Load | Overshoot | Vo=1.2 V - 2.5 V | - | 100 mV | 200 mV | |
| | Settling Time | | - | 200 uS | 300 uS | |
| 75% ~ 50% Max Load | Overshoot | Vo=1.2 V - 2.5 V | - | 100 mV | 200 mV | |
| | Settling Time | | - | 200 uS | 300 uS | |

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

ISOLATED DC/DC CONVERTERS

48 Vdc Input 1.2-2.5 Vdc/80 A, 3.3 Vdc/70 A, 5 Vdc/48 A, 12 Vdc/20 A Output



General Specifications

| Parameter | Min | Typ | Max | Notes |
|-----------------------------|--|---------|---------|---|
| Efficiency | | | | Vin=48 V, full load, Ta=25 °C |
| Vo=12.0 V | 91% | 94% | - | |
| Vo=5.0 V | 89% | 92.5% | - | |
| Vo=3.3 V | 89% | 92% | - | |
| Vo=2.5 V | 88% | 91% | - | |
| Vo=1.8 V | 86% | 89% | - | |
| Vo=1.5 V | 84% | 87% | - | |
| Vo=1.2 V | 82% | 85% | - | |
| Switching Frequency | 280 kHz | 330 kHz | 380 kHz | |
| Isolation capacitance | - | 1500 pF | - | |
| Remote Sense Compensation | - | - | 10% Vo | The total voltage increased by trim and remote sense should not exceed 10%Vo. |
| Output Voltage Trim Range | 80% Vo | - | 110% Vo | |
| Over Temperature Protection | - | 125 °C | - | |
| Over Voltage Protection | - | 130% Vo | - | Vin=48V, full load, Hiccup mode |
| MTBF | 1,113,071 hours | | | Calculated Per Bell Core SR-332 (Vin=48 V; Vo=2.5 V, Io = 80%Iomax; Ta = 25 °C) |
| Dimensions | Inches millimeters | | | |
| | 2.28 x 2.4 x 0.42 57.51 x 60.98 x 10.67 | | | |
| Weight | - | 76 g | - | |

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

Control Specifications

| Parameter | Min | Typ | Max | Notes | |
|------------------------|-------------|--------|---------|-------|--|
| Remote On/Off | | | | | |
| Signal Low (Unit On) | Active Low | -0.3 V | - | 0.8 V | 0RHB-D0TxxL. The remote on/off pin open, Unit off. |
| Signal High (Unit Off) | | 2.4 V | - | | |
| Signal Low (Unit Off) | Active High | -0.3 V | - | 0.8 V | 0RHB-D0Txx0. The remote on/off pin open, Unit on. |
| Signal High (Unit On) | | 2.4 V | - | 18 V | |
| Current Sink | 0 mA | - | 0.75 mA | | |

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Output Trim Equations

Equations for calculating the trim resistor (in kΩ) are shown below. 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.

$$R_{trimdown} = \frac{100}{|\delta|} - 2$$

1.5 V-12 V:

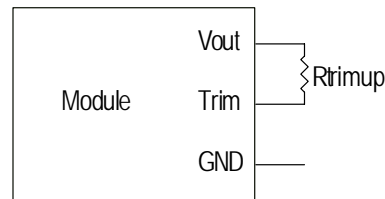
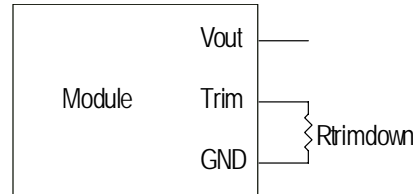
$$R_{trimup} = \frac{(100 + \delta) \cdot V_o - 122.5}{1.225 \cdot \delta} - 2$$

1.2 V:

$$R_{trimup} = \frac{(100 + \delta) \cdot V_o - 61.25}{0.6125 \cdot \delta} - 2$$

Notes:

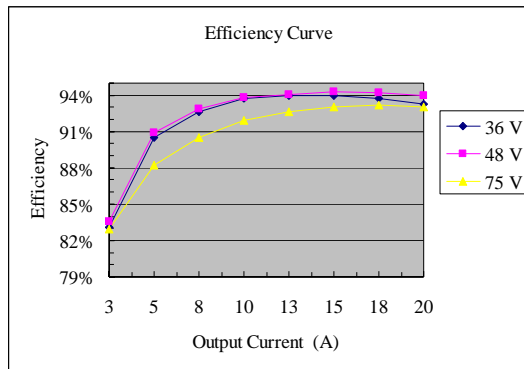
$$\delta = \frac{(V_o_{req} - V_o)}{V_o} \times 100[\%]$$



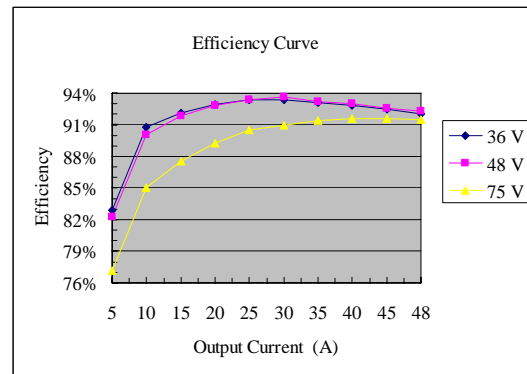
V_o_{req} =Desired(trimmed) output voltage[V]

Output voltage V_o =3.308 V for 3.3 V output; V_o =5.000 V for 5.0 V; V_o =12.000 V for 12 V output

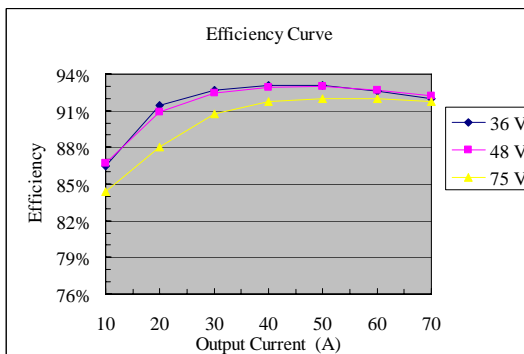
Efficiency Data



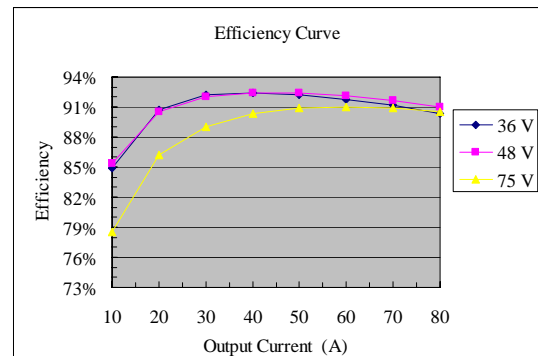
ORHB-D0T12x



ORHB-D0T05x



ORHB-D0T03x



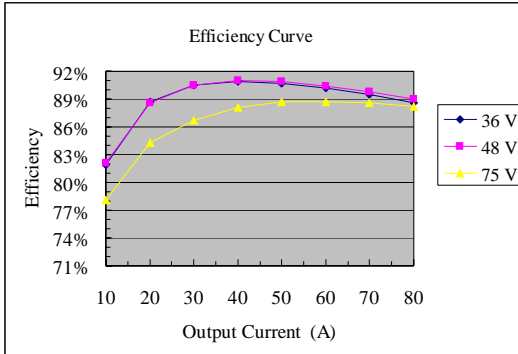
ORHB-D0T02x

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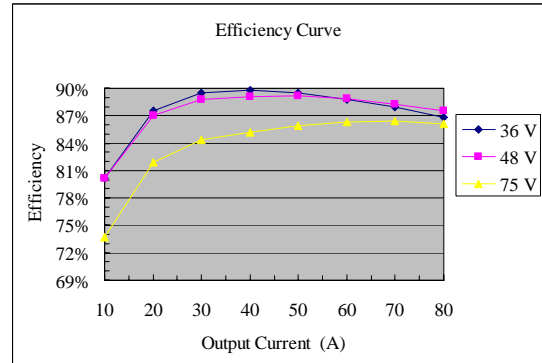
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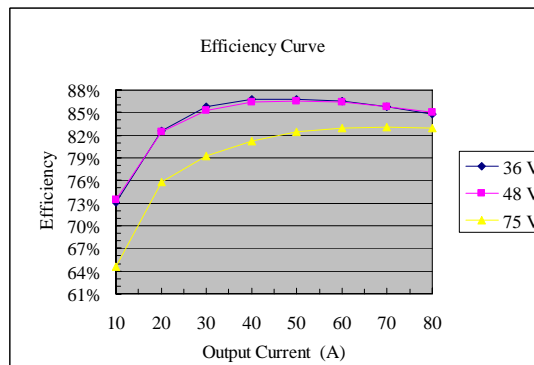
Efficiency Data (continued)



ORHB-D0TV8x



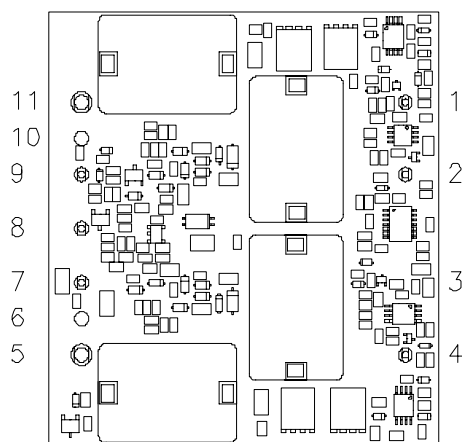
ORHB-D0TV5x



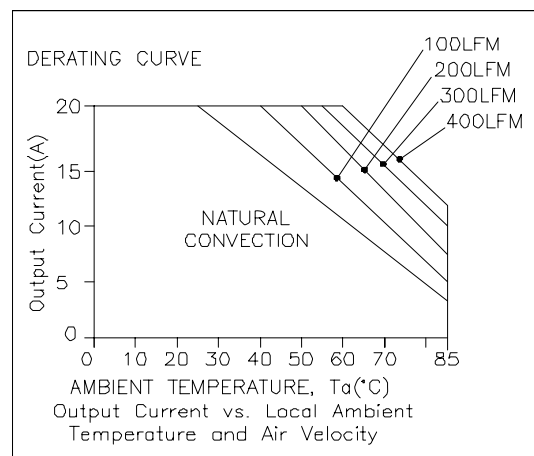
ORHB-D0TV2x

Thermal Derating Curves

FORCED AIRFLOW DIRECTION



BOTTOM VIEW



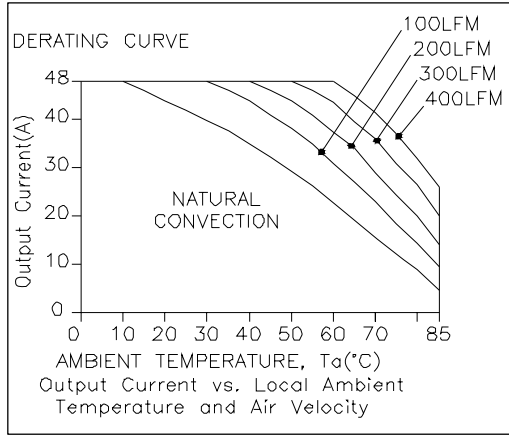
ORHB-D0T12x

ISOLATED DC/DC CONVERTERS

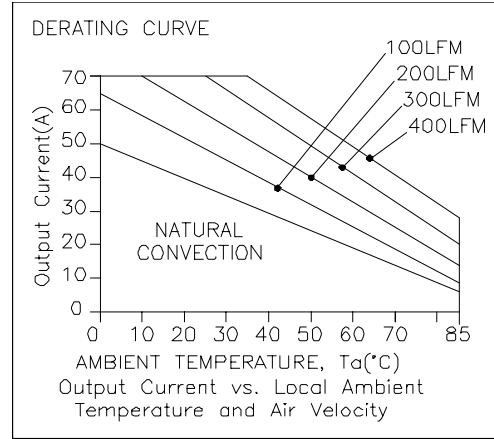
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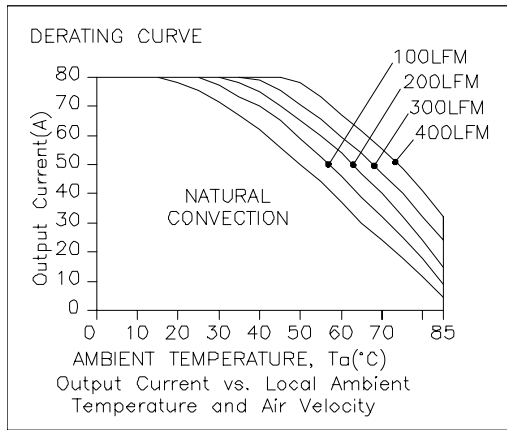
Thermal Derating Curves (continued)



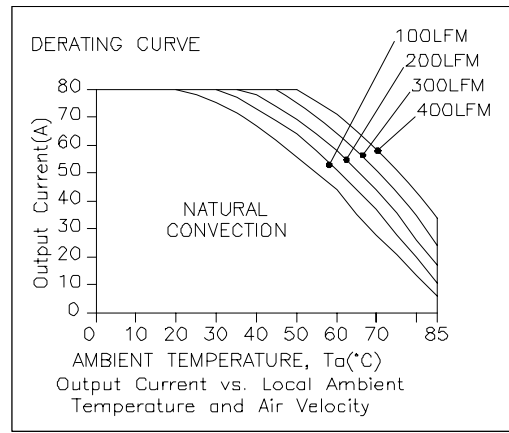
0RHB-D0T05x



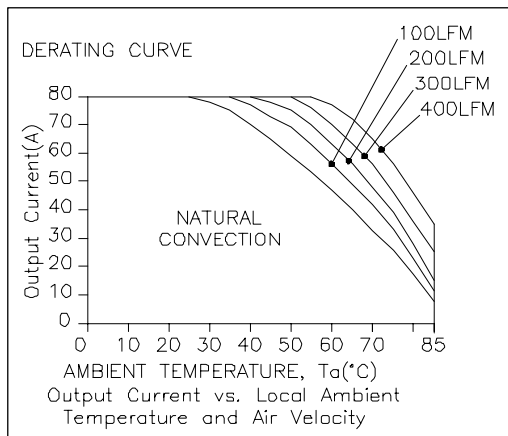
0RHB-D0T03x



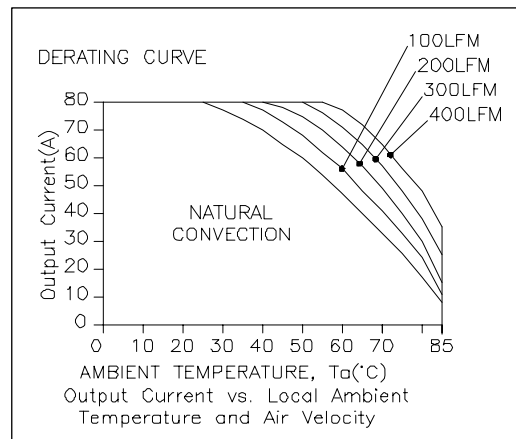
0RHB-D0T02x



0RHB-D0TV8x



0RHB-D0TV5x



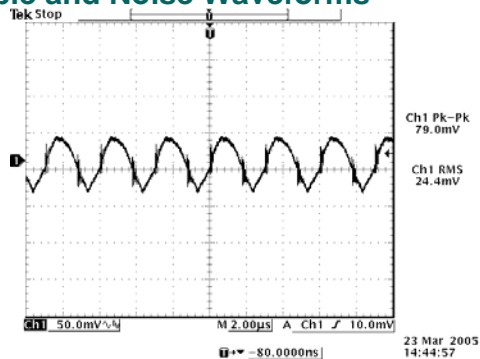
0RHB-D0TV2x

ISOLATED DC/DC CONVERTERS

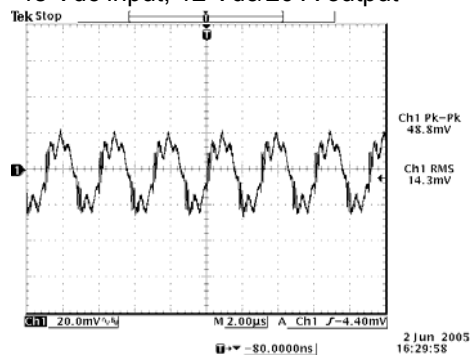
48 Vdc Input 1.2-2.5 Vdc/80 A, 3.3 Vdc/70 A, 5 Vdc/48 A, 12 Vdc/20 A Output



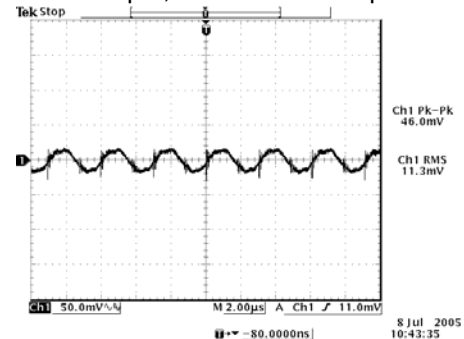
Ripple and Noise Waveforms



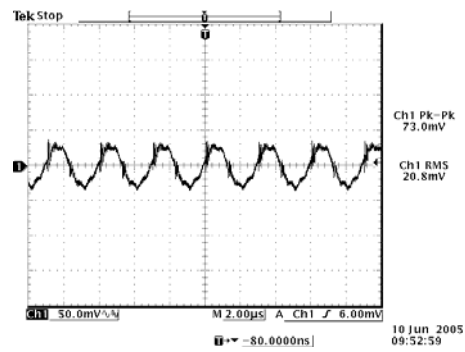
48 Vdc input, 12 Vdc/20 A output



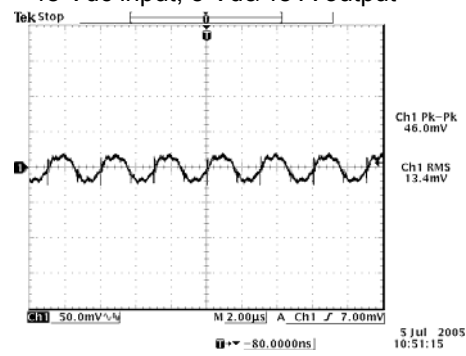
48 Vdc input, 3.3 Vdc/70 A output



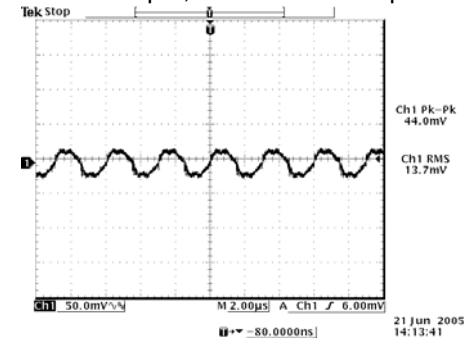
48 Vdc input, 1.8 Vdc/80 A output



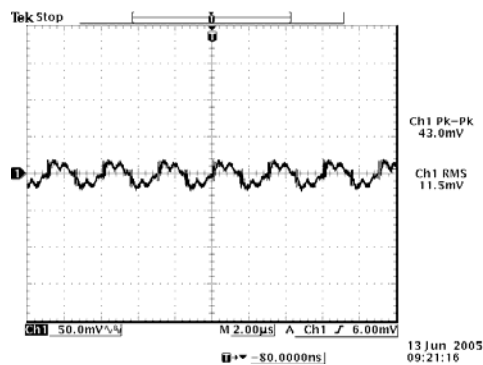
48 Vdc input, 5 Vdc/48 A output



48 Vdc input, 2.5 Vdc/80 A output



48 Vdc input, 1.5 Vdc/80 A output



48 Vdc input, 1.2 Vdc/80 A output

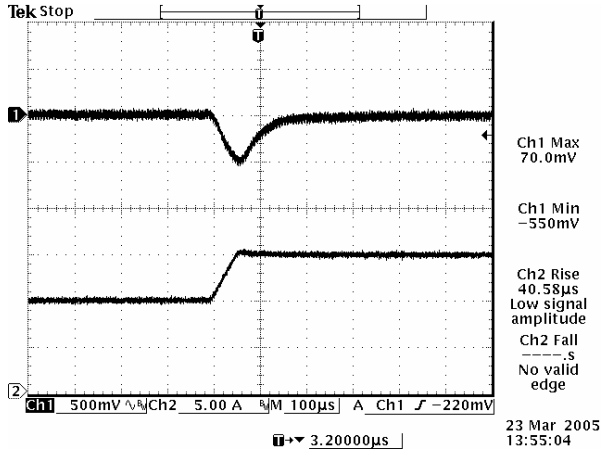
Note: Ripple and noise at full load, with a 1uF ceramic cap and a 10 uF Tantalum cap at output, Ta=25 deg C.

ISOLATED DC/DC CONVERTERS

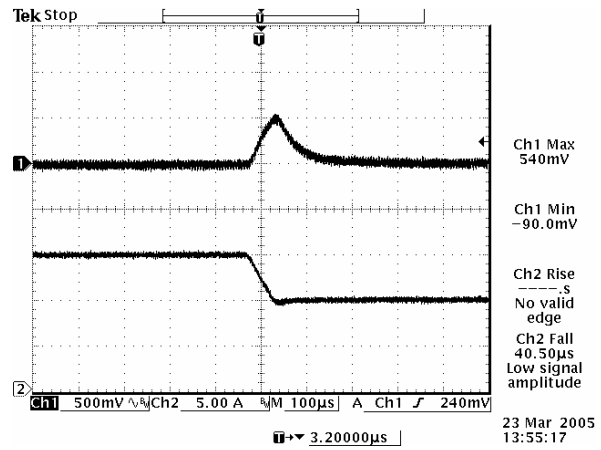
48 Vdc Input 1.2-2.5 Vdc/80 A, 3.3 Vdc/70 A, 5 Vdc/48 A, 12 Vdc/20 A Output



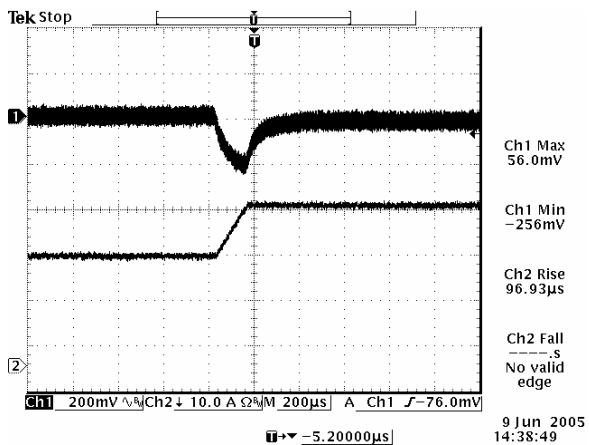
Transient Response Waveforms



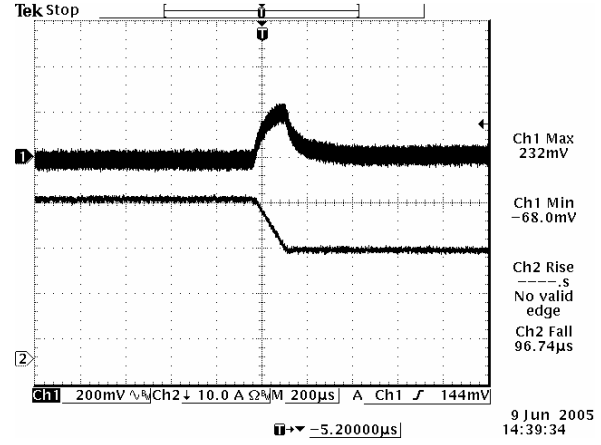
Vout=12 V, 50% to 75% Load Transients



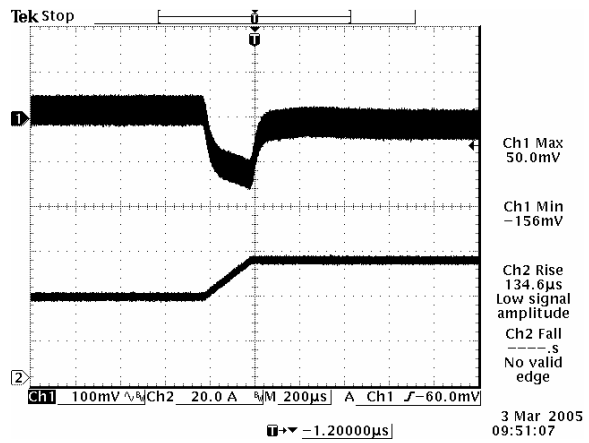
Vout=12 V, 75% to 50% Load Transients



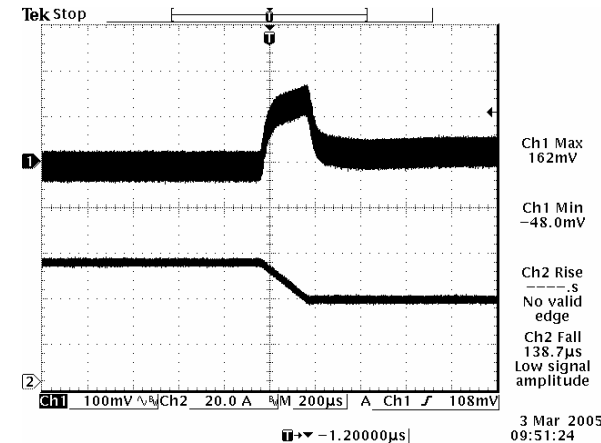
Vout=5 V, 50% to 75% Load Transients



Vout=5 V, 75% to 50% Load Transients



Vout=3.3 V, 50% to 75% Load Transients



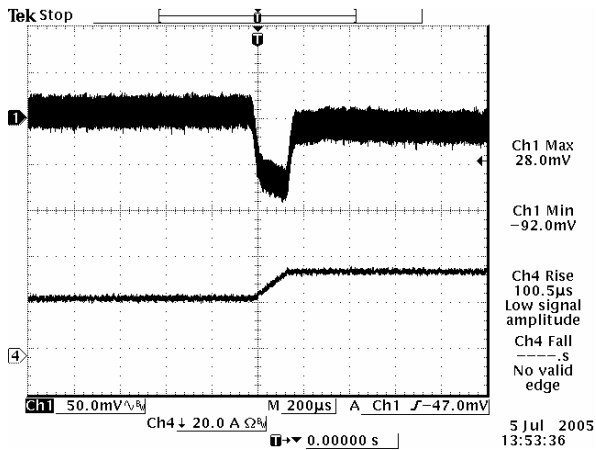
Vout=3.3 V, 75% to 50% Load Transients

ISOLATED DC/DC CONVERTERS

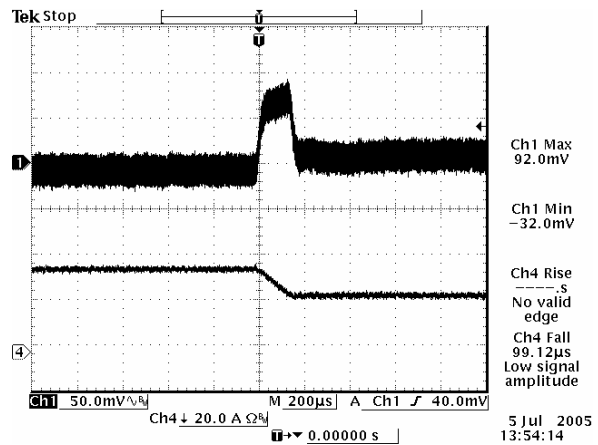
48 Vdc Input 1.2-2.5 Vdc/80 A, 3.3 Vdc/70 A, 5 Vdc/48 A, 12 Vdc/20 A Output



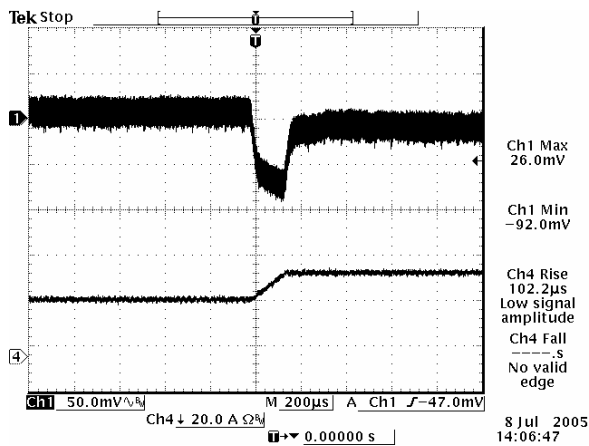
Transient Response Waveforms (continued)



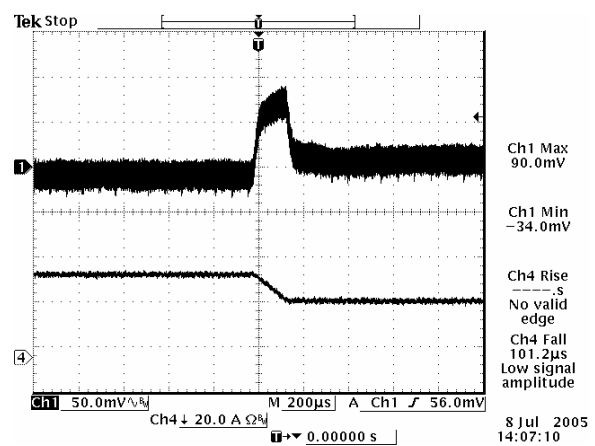
Vout=2.5 V, 50% to 75% Load Transients



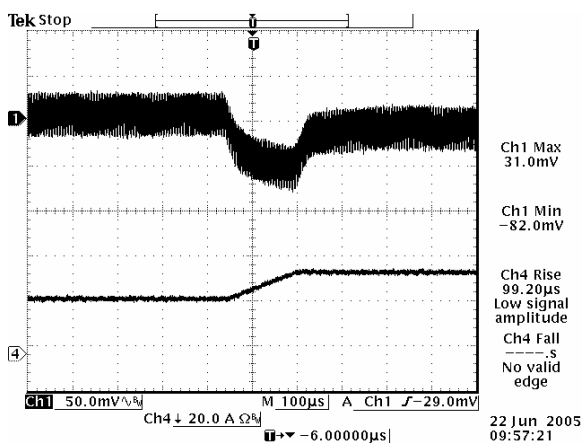
Vout=2.5 V, 75% to 50% Load Transients



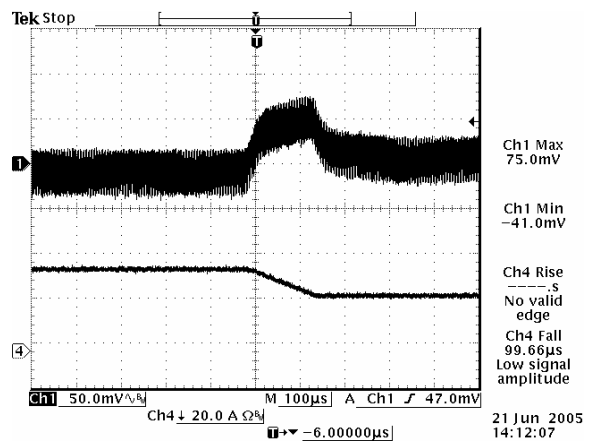
Vout=1.8 V, 50% to 75% Load Transients



Vout=1.8 V, 75% to 50% Load Transients



Vout=1.5 V, 50% to 75% Load Transients



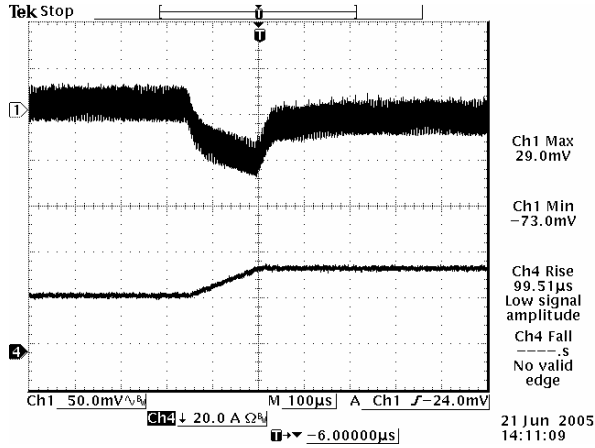
Vout=1.5 V, 75% to 50% Load Transients

ISOLATED DC/DC CONVERTERS

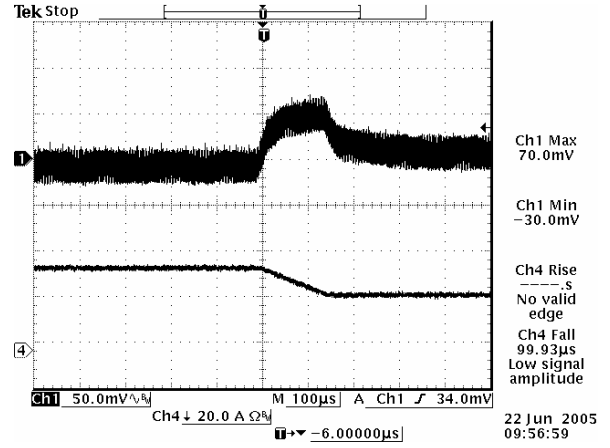
48 Vdc Input 1.2-2.5 Vdc/80 A, 3.3 Vdc/70 A, 5 Vdc/48 A, 12 Vdc/20 A Output



Transient Response Waveforms (continued)



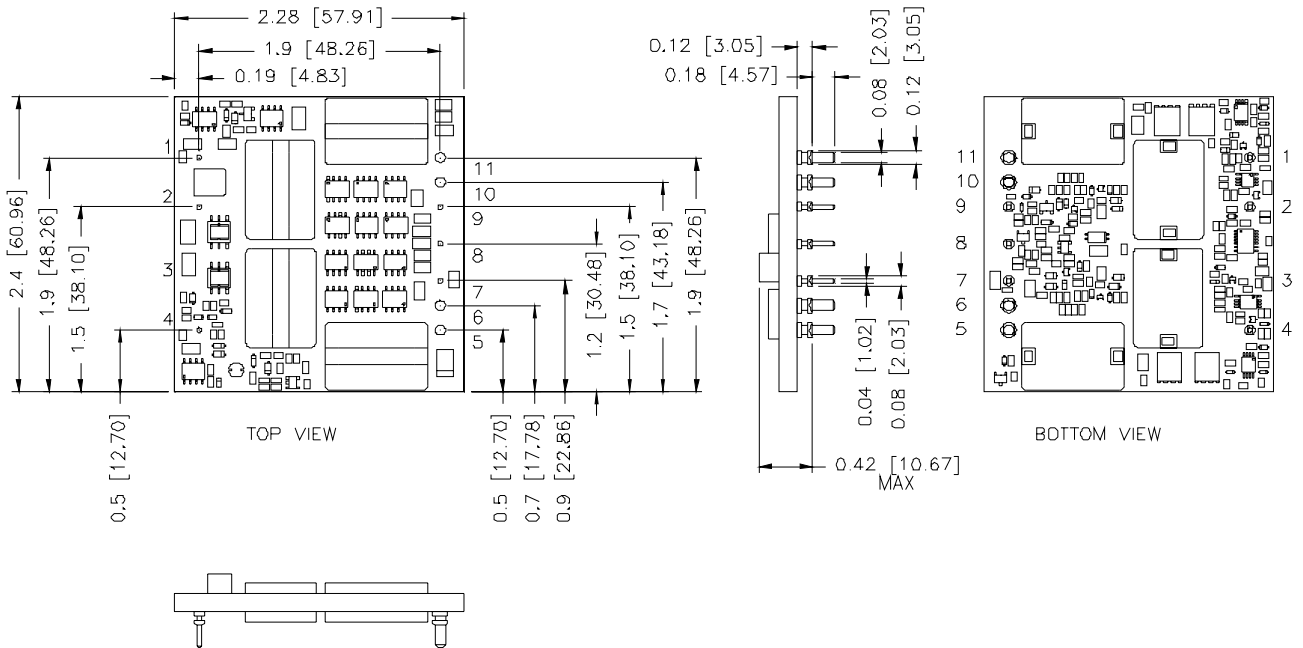
Vout=1.2 V, 50% to 75% Load Transients



Vout=1.2 V, 75% to 50% Load Transients

Note: Transient Response at $di/dt=0.1$ A/ μ s, $V_{in}=48$ Vdc, $T_a=25$ °C, with a 1 μ F ceramic capacitor and a 10 μ F tantalum capacitor at output.

Mechanical Outline

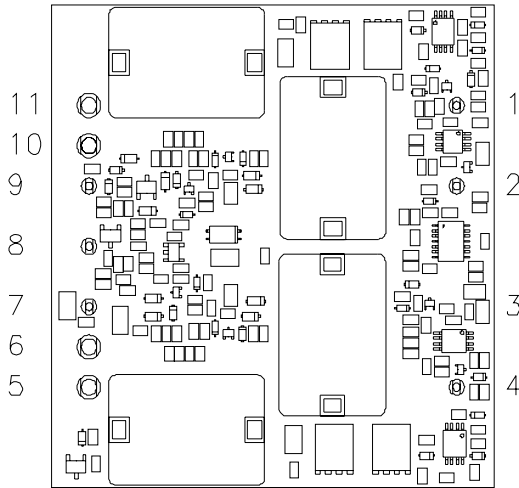


ISOLATED DC/DC CONVERTERS

48 Vdc Input 1.2-2.5 Vdc/80 A, 3.3 Vdc/70 A, 5 Vdc/48 A, 12 Vdc/20 A Output



Mechanical Outline (continued)

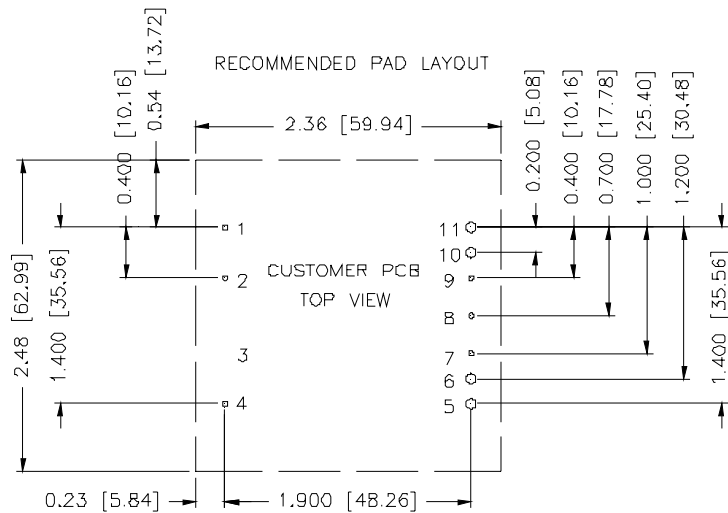


BOTTOM VIEW

Pin Connections

| pin# | function | pin size | pin# | function | pin size |
|------|----------|----------|------|----------|----------|
| 1 | +Input | 0.04" | 7 | -Sense | 0.04" |
| 2 | On/Off | 0.04" | 8 | Trim | 0.04" |
| 3 | N/A | | 9 | +Sense | 0.04" |
| 4 | -Input | 0.04" | 10 | +Output | 0.08" |
| 5 | -Output | 0.08" | 11 | +Output | 0.08" |
| 6 | -Output | 0.08" | | | |

- Notes:**
1. Pin 7 must be connected to -Output.
 2. Leave Pin 8 open for nominal voltage.
 3. Pin 9 must be connected to +Output.



- 1,2,4,7,8,9 ϕ 0.047 PAD HOLE SIZE,
 ϕ 0.08 min PAD SIZE, BOTH SIDE.
 5,6,10,11 ϕ 0.093 HOLE SIZE,
 ϕ 0.12 min PAD SIZE, BOTH SIDE.

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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