

NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.8 Vdc - 5.5 Vdc/8 A Output

bel
POWER PRODUCTS

xRAH-08E Series RoHS Compliant Rev.A

- Non-Isolated
- Fixed Frequency
- High Efficiency
- High Power Density
- Low Cost
- Remote On/Off
- Under-voltage Lockout (UVLO)
- OCP/SCP
- Wide Trim Range
- UL60950-1 Recognized (UL/cUL)



Description

The Bel xRAH-08Exxx modules are a series of non-isolated, step down dc/dc converters that operate from 4.5 Vdc to 14 Vdc source. These converters are available in a range of output voltages from 0.8 Vdc to 5.5 Vdc. It is packaged in a compact, overmolded package rated at 8 A. Optional lead forming provides a vertical mount product for minimal footprint or a surface mount option for a very low profile. The output is closely regulated and the efficiency for 5 Vdc output is typically 93% at full load.

Part Selection

| Output Voltage | Input Voltage | Max. Output Current | Max. Output Power | Typical Efficiency | Part Number Surface Mount | Part Number Vertical Mount |
|----------------|---------------|---------------------|-------------------|--------------------|---------------------------|----------------------------|
| 0.8 V - 3.63 V | 4.5 V - 14 V | 8 A | 26.4 W | 91% | SRAH-08E1A0 | VRAH-08E1A0 |
| 4.5 V - 5.5 V | 8 V - 14 V | 8 A | 44 W | 93% | SRAH-08E500 | VRAH-08E500 |

Notes: 1. Add "0" suffix at the end of the model number to indicate "Tube Packaging", and "R" for "Reel Packaging", and "G" for "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 | - | 15 V | |
| Output Enable Terminal Voltage | -0.3 V | - | 14 V | |
| Ambient Temperature | -40 °C | - | 85 °C | |
| Storage Temperature | -55 °C | - | 125 °C | |

Input Specifications

| Parameter | Min | Typ | Max | Notes |
|--|-------|--------|--------|--|
| Input Voltage | | | | |
| Vo=4.5 V-5.5 V | 8.0 V | - | 14 V | |
| Vo=0.9 V-3.63 V | 4.5 V | - | 14 V | |
| Input Current (full load) | | | | |
| Vo=5.0 V | - | - | 5.4 A | |
| Vo=3.3 V | - | - | 6.7 A | |
| Vo=2.5 V | - | - | 5.3 A | |
| Vo=1.8 V | - | - | 3.2 A | |
| Vo=1.5 V | - | - | 3.0 A | |
| Vo=1.2 V | - | - | 2.8 A | |
| Vo=0.9 V | - | - | 2.0 A | |
| Input Current (no load) | - | - | 100 mA | |
| Remote Off Input Current | - | 3 mA | 10 mA | |
| Input Reflected Ripple Current (pk-pk) | - | 250 mA | - | With simulated source impedance of 500 nH, 5 Hz to 20 MHz; use two 47 uF/16 V low ESR Tantalum capacitors. |
| Input Reflected Ripple Current (rms) | - | 70 mA | - | |

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0.8 Vdc - 5.5 Vdc/8 A Output



Input Specifications (continued)

| Parameter | Min | Typ | Max | Notes |
|---|-----|------------------------|-----------------------|-------------|
| I ² t Inrush Current Transient | - | 0.006 A ² s | 0.02 A ² s | |
| Turn-on Voltage Threshold | - | 4.3 V | - | xRAH-08E1A0 |
| | - | 7.6 V | - | xRAH-08E500 |
| Turn-off Voltage Threshold | - | 4.0 V | - | xRAH-08E1A0 |
| | - | 6.2 V | - | xRAH-08E500 |

Output Specifications

| Parameter | Min | Typ | Max | Notes | |
|--|-----------------------------|----------------------|---------|----------|---|
| Output Voltage Set Point | V _o =5.0 V | 4.900 V | 5.0 V | 5.100 V | Test condition: V _{in} =12 V, I _{out} =50% full load |
| | V _o =3.3 V | 3.234 V | 3.3 V | 3.366 V | |
| | V _o =2.5 V | 2.450 V | 2.5 V | 2.550 V | |
| | V _o =1.8 V | 1.764 V | 1.8 V | 1.836 V | |
| | V _o =1.5 V | 1.470 V | 1.5 V | 1.530 V | |
| | V _o =1.2 V | 1.176 V | 1.2 V | 1.224 V | |
| | V _o =0.9 V | 0.882 V | 0.9 V | 0.918 V | |
| Line Regulation | V _o =5.0 V | - | ±15 mV | ±25 mV | |
| | V _o =3.3 V | - | ±10 mV | ±16.5 mV | |
| | V _o =2.5 V | - | ±8 mV | ±12.6 mV | |
| | V _o =1.8 V | - | ±5 mV | ±9 mV | |
| | V _o =1.5 V | - | ±5 mV | ±9 mV | |
| | V _o =1.2 V | - | ±4 mV | ±8 mV | |
| Load Regulation | V _o =5.0 V | - | ±15 mV | ±25 mV | |
| | V _o =3.3 V | - | ±10 mV | ±16.5 mV | |
| | V _o =2.5 V | - | ±8 mV | ±12.5 mV | |
| | V _o =1.8 V | - | ±5 mV | ±9 mV | |
| | V _o =1.5 V | - | ±5 mV | ±9 mV | |
| | V _o =1.2 V | - | ±4 mV | ±8 mV | |
| Regulation Over Temperature (-40 °C to 85 °C) | - | 30 mV | 50 mV | | |
| | - | 30 mV | 50 mV | | |
| Output Current | 0 A | - | 8 A | | |
| Current Limit Threshold | 10 A | - | 20 A | | |
| Short Circuit Surge Transient | - | 0.2 A ² s | - | | |
| Ripple and Noise (rms) | V _o =5.0 V | - | 30 mV | 50 mV | BW = 0-20 MHz; with a 1 uf ceramic capacitor and a 10 uF/10 V Tantalum capacitor at the output. |
| | V _o =3.3 V-0.9 V | - | 15 mV | 30 mV | |
| Ripple and Noise (pk-pk) | V _o =5.0 V | - | 100 mV | 150 mV | |
| | V _o =3.3 V-0.9 V | - | 50 mV | 80 mV | |
| Turn on Time | - | 8 mS | 20 mS | | |
| Overshoot at Turn on | - | 0% | 3% | | |
| Output Capacitance | 0 uF | - | 3200 uF | | |

NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.8 Vdc - 5.5 Vdc/8 A Output



Output Specifications (continued)

| Parameter | | Min | Typ | Max | Notes | | |
|---------------------------|---------------|----------|--------------------|--------|--------|--|--------|
| Transient Response | | | | | | | |
| 50% ~ 100% Max Load | Overshoot | Vo=5.0 V | - | 200 mV | 300 mV | di/dt = 0.5 A/uS; Vin = 12 V; with a 1 uF ceramic capacitor and a 10 uF/10 V Tantalum capacitor at the output. | |
| | Settling Time | | - | 50 uS | 80 uS | | |
| 100% ~ 50% Max Load | Overshoot | | - | 200 mV | 300 mV | | |
| | Settling Time | | - | 50 uS | 80 uS | | |
| 50% ~ 100% Max Load | Overshoot | | Vo=3.3 V- 0.9 V | - | 120 mV | | 180 mV |
| | Settling Time | | | - | 50 uS | | 80 uS |
| 100% ~ 50% Max Load | Overshoot | - | | 120 mV | 180 mV | | |
| | Settling Time | - | | 50 uS | 80 uS | | |

Note: All specifications are typical at 12 V input, full load at 25 °C unless otherwise stated.

General Specifications

| Parameter | Min | Typ | Max | Notes |
|----------------------------|----------------------|---------|--------|--|
| Efficiency | | | | Measured at Vin=12 V, full load |
| Vo=5.0 V | 89% | 93% | - | |
| Vo=3.3 V | 87% | 91% | - | |
| Vo=2.5 V | 86% | 90% | - | |
| Vo=1.8 V | 84% | 88% | - | |
| Vo=1.5 V | 82% | 86% | - | |
| Vo=1.2 V | 81% | 85% | - | |
| Vo=0.9 V | 76% | 80% | - | |
| Switching Frequency | - | 330 kHz | - | |
| Output Trim Range | 90%Vo | - | 403%Vo | x7AH-08E1A0 ¹ |
| | 90%Vo | - | 110%Vo | x7AH-08E500 ² |
| Remote Sense Compensation | - | - | 0.2V | |
| MTBF | 7,801,334 hours | | | Calculated Per Bell Core SR-332 (Io = Nominal; Ta = 25 °C) |
| Dimensions (surface mount) | | | | |
| Inches (L x W x H) | 0.78 x 0.7 x 0.32 | | | |
| Millimeters (L x W x H) | 19.81 x 17.78 x 8.13 | | | |
| Dimensions (vertical) | | | | |
| Inches (L x W x H) | 0.7 x 0.308 x 0.65 | | | |
| Millimeters (L x W x H) | 17.78 x 7.82 x 16.51 | | | |
| Weight | - | 6 g | - | |

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

1. The output voltage is 0.9 V at trim pin is open.
2. The output voltage is 5.0 V at trim pin is open.

Control Specifications

| Parameter | Min | Typ | Max | Notes |
|-----------------------|--------|-----|-------|----------------------------------|
| Remote On/Off | | | | |
| Signal Low (Unit Off) | -0.3 V | - | 0.8 V | Remote on/off pin open, unit on. |
| Signal High (Unit On) | 2.4 V | - | 14 V | |

NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.8 Vdc - 5.5 Vdc/8 A Output

bel
POWER PRODUCTS

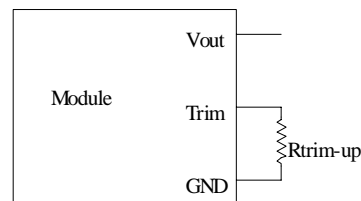
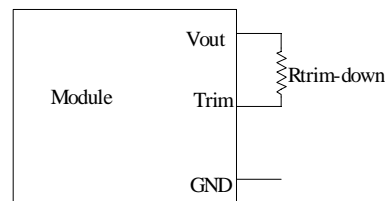
Output Trim Equations

1) xRAH-08E1A0

Equations for calculating the trim resistor (in kΩ) given the desired adjusted voltage (V_{adj}) and the nominal output voltage of the converter (V_{nom}) are shown below. The Trim Down resistor should be connected between the Trim pin and Vout. The Trim Up resistor should be connected between the Trim pin and Ground. Only one of the resistors should be used for any given application.

$$R_{trim-down} = \frac{1.076}{V_o - V_{adj}} - 5.631$$

$$R_{trim-up} = \frac{3.759}{V_{adj} - V_o} - 0.261$$



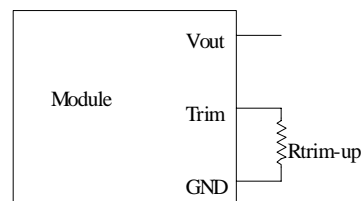
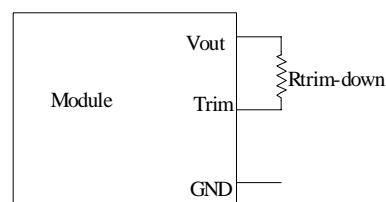
Note: Output voltage $V_o=0.9$ V when Rtrim_up is not connected.

2) xRAH-08E500

Equations for calculating the trim resistor (in kΩ) given the desired adjusted voltage (V_{adj}) and the nominal output voltage of the converter (V_{nom}) are shown below. The Trim Down resistor should be connected between the Trim pin and Vout. The Trim Up resistor should be connected between the Trim pin and Ground. Only one of the resistors should be used for any given application.

$$R_{trim-down} = \frac{23.100}{V_o - V_{adj}} - 5.631$$

$$R_{trim-up} = \frac{3.759}{V_{adj} - V_o} - 0.261$$



Note: Output voltage $V_o=5$ V when Rtrim_up is not connected.

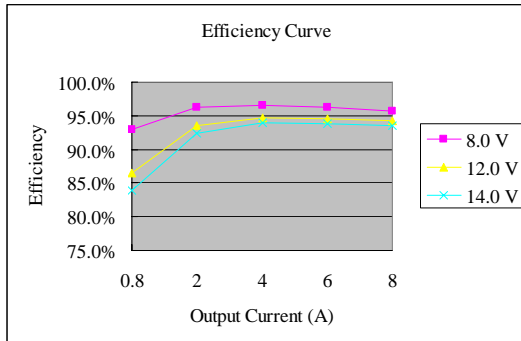
NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

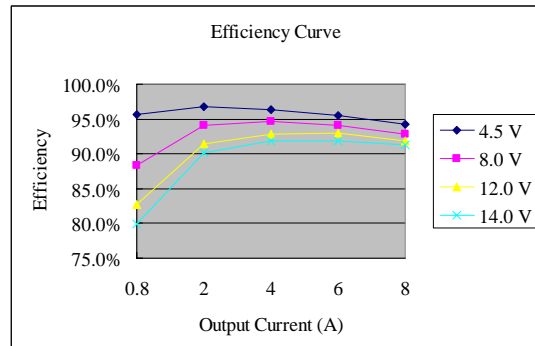
0.8 Vdc - 5.5 Vdc/8 A Output



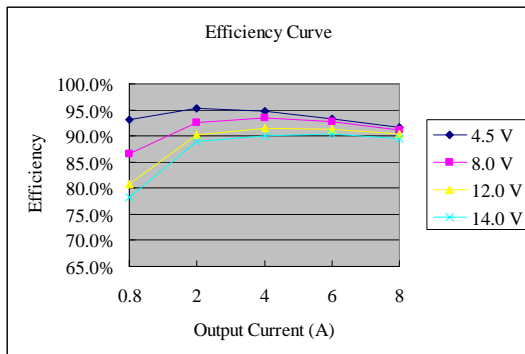
Efficiency Data



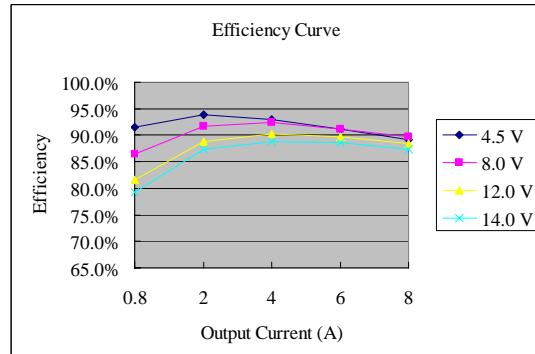
$V_o = 5.0\text{ V}$



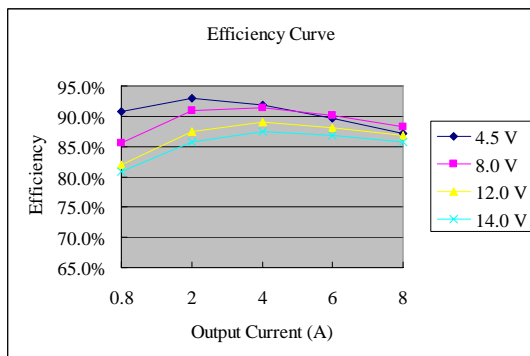
$V_o = 3.3\text{ V}$



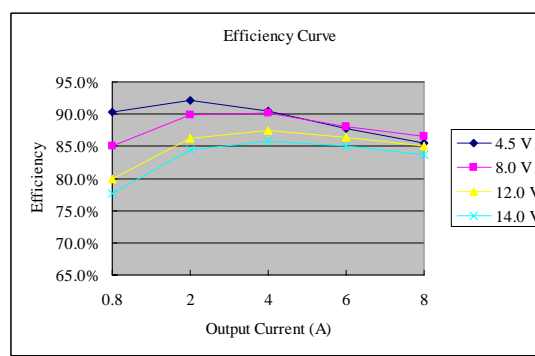
$V_o = 2.5\text{ V}$



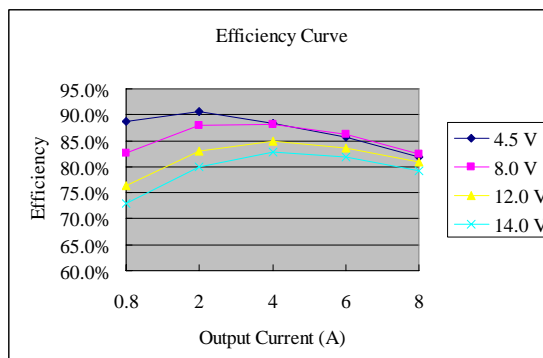
$V_o = 1.8\text{ V}$



$V_o = 1.5\text{ V}$



$V_o = 1.2\text{ V}$



$V_o = 0.9\text{ V}$

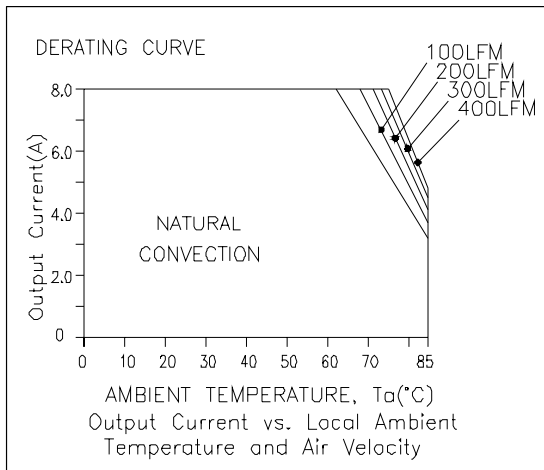
NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

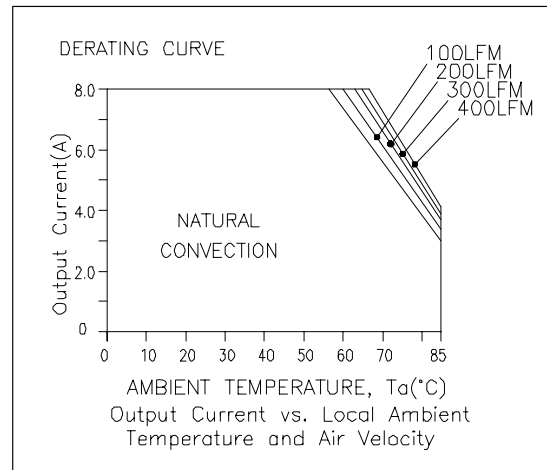
0.8 Vdc - 5.5 Vdc/8 A Output



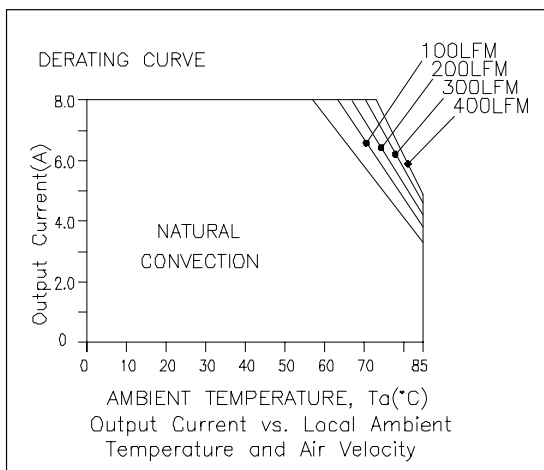
Thermal Derating Curves



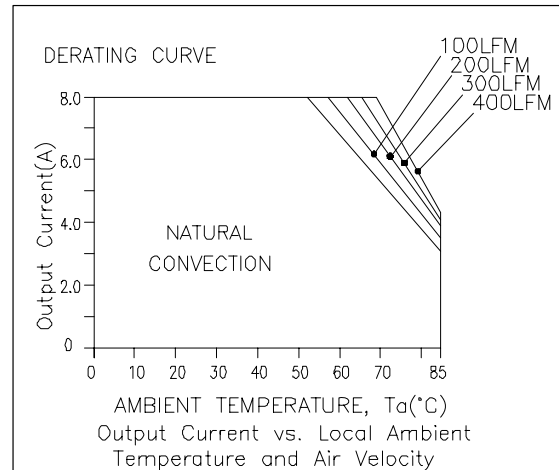
VRAH-08E1A0



SRAH-08E1A0



VRAH-08E500



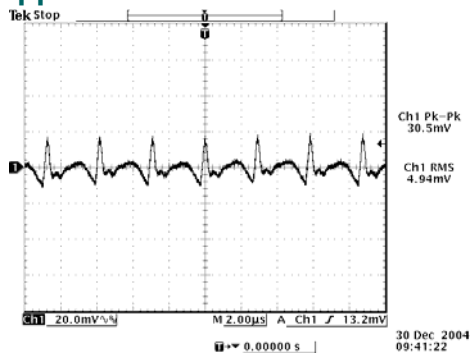
SRAH-08E500

NON-ISOLATED DC/DC CONVERTERS

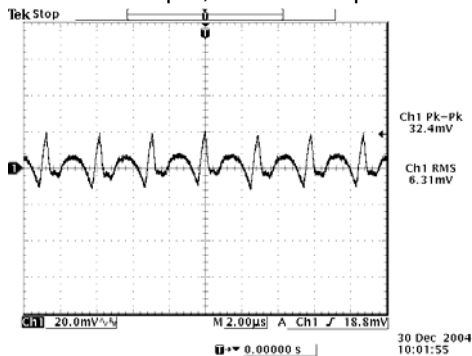
4.5 Vdc - 14 Vdc Input 0.8 Vdc - 5.5 Vdc/8 A Output



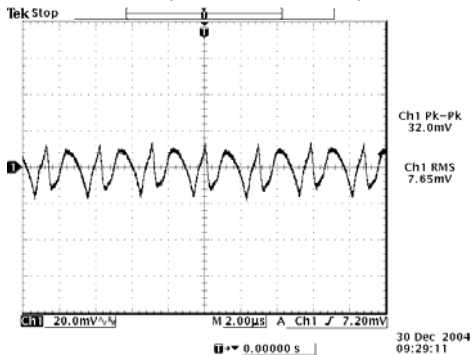
Ripple and Noise Waveforms



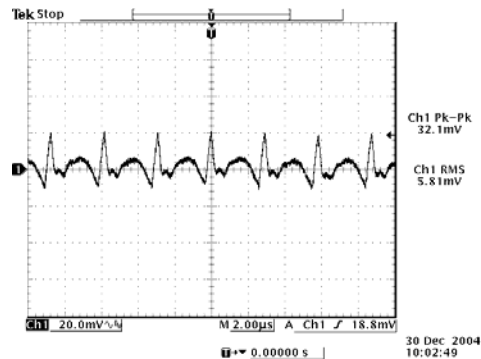
12 Vdc Input, 0.9 Vdc Output



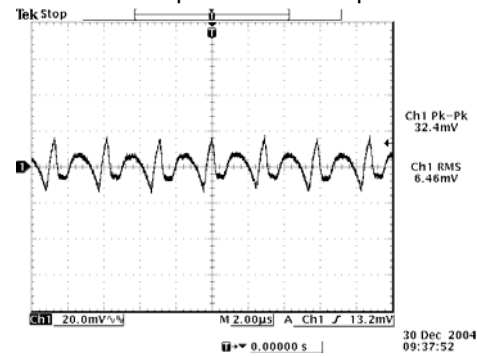
12 Vdc Input, 1.5 Vdc Output



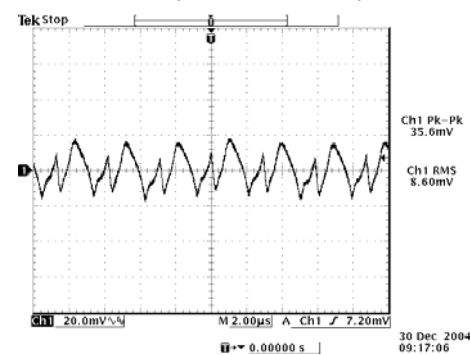
12 Vdc Input, 2.5 Vdc Output



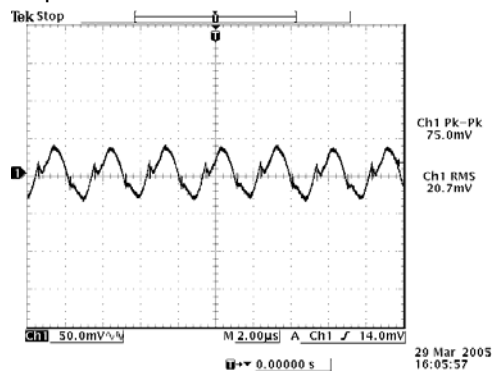
12 Vdc Input 1.2 Vdc Output



12 Vdc Input 1.8 Vdc Output



12 Vdc Input 3.3 Vdc Output



12 Vdc Input, 5 Vdc Output

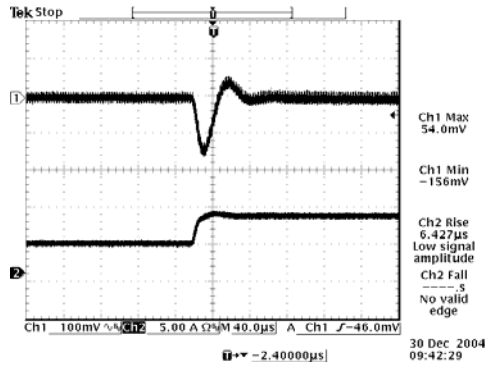
Note: Ripple and noise at full load, with a 1uF ceramic cap and a 10uF tan cap, Ta=25 deg C.

NON-ISOLATED DC/DC CONVERTERS

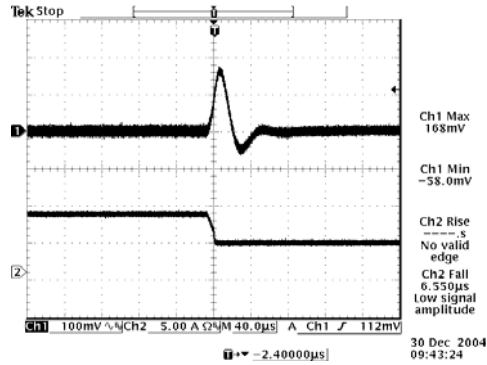
4.5 Vdc - 14 Vdc Input 0.8 Vdc - 5.5 Vdc/8 A Output



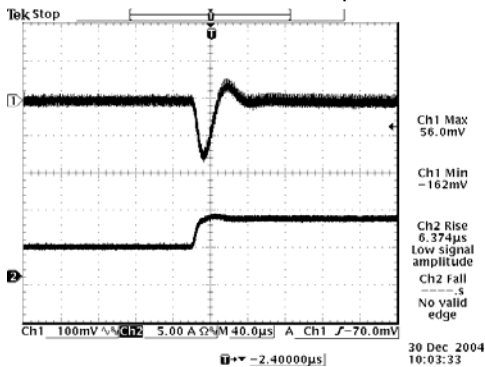
Transient Response Waveforms



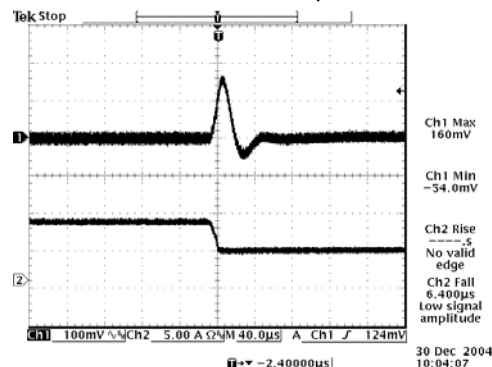
50% to 100% load 12 Vdc Input 0.9 Vdc Output



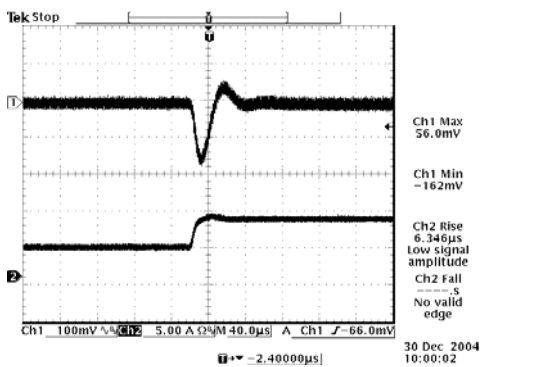
100% to 50% load 12 Vdc Input 0.9 Vdc Output



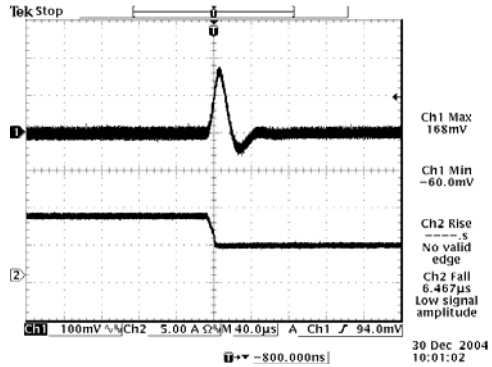
50% to 100% load 12 Vdc Input 1.2 Vdc Output



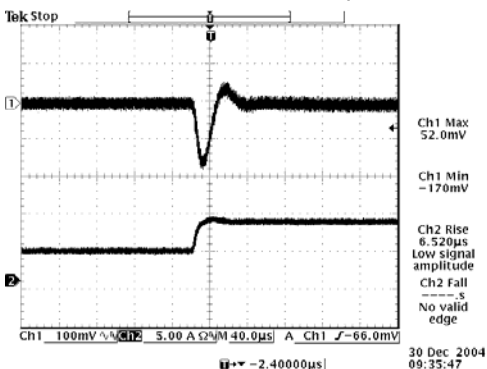
100% to 50% load 12 Vdc Input 1.2 Vdc Output



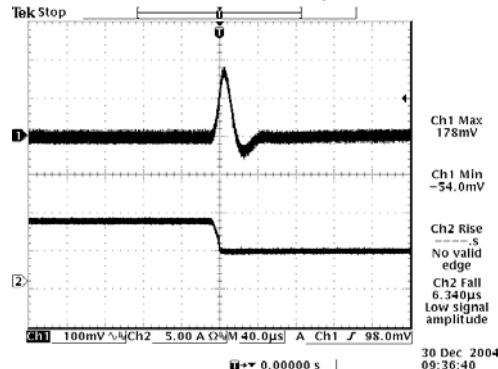
50% to 100% load 12 Vdc Input 1.5 Vdc Output



100% to 50% load 12 Vdc Input 1.5 Vdc Output



50% to 100% load 12 Vdc Input 1.8 Vdc Output



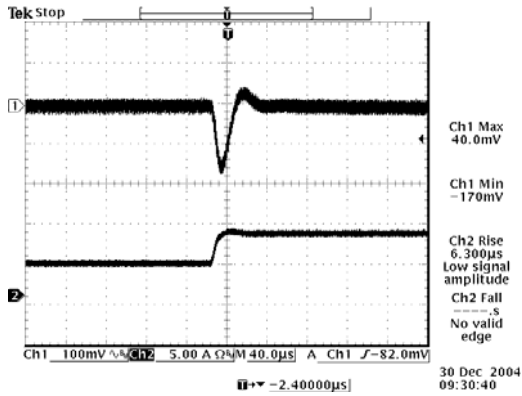
100% to 50% load 12 Vdc Input 1.8 Vdc Output

NON-ISOLATED DC/DC CONVERTERS

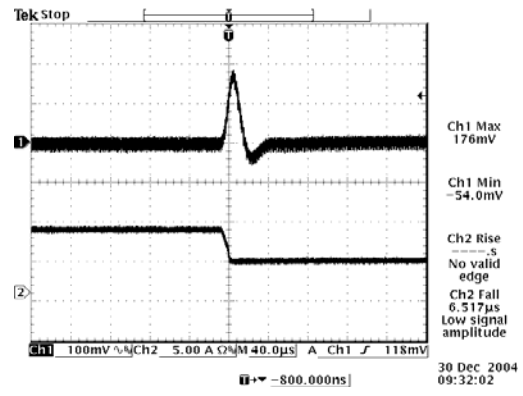
4.5 Vdc - 14 Vdc Input 0.8 Vdc - 5.5 Vdc/8 A Output



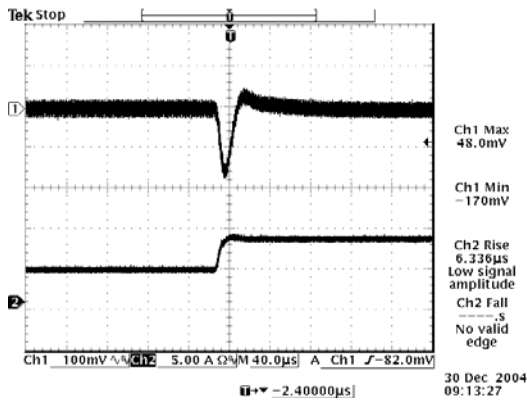
Transient Response Waveforms (continued)



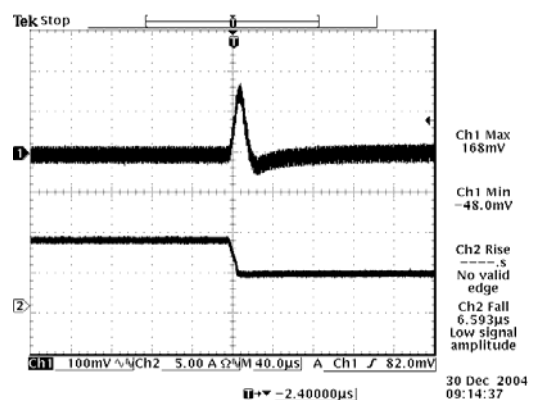
50% to 100% load 12 Vdc Input 2.5 Vdc Output



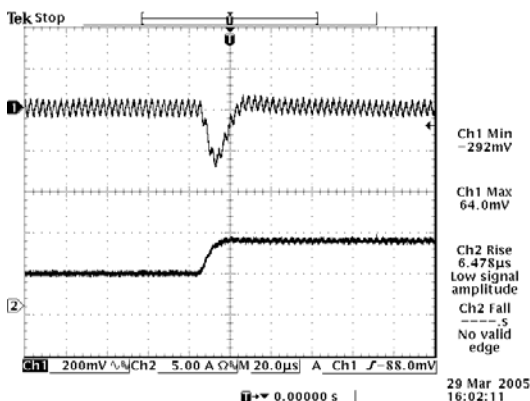
100% to 50% load 12 Vdc Input 2.5 Vdc Output



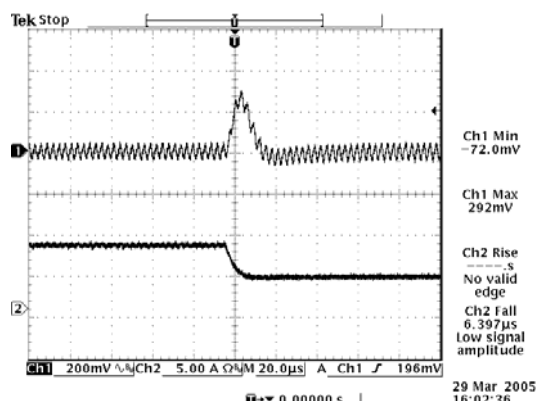
50% to 100% load 12 Vdc Input 3.3 Vdc Output



100% to 50% load 12 Vdc Input 3.3 Vdc Output



50% to 100% load 12 Vdc Input 5 Vdc Output



100% to 50% load 12 Vdc Input 5 Vdc Output

Note: Transient response at $di/dt=0.5 \text{ A/uS}$, with a 1uF ceramic cap and a 10 uF/10 V tan cap at the output, $T_a=25 \text{ deg C}$.

NON-ISOLATED DC/DC CONVERTERS

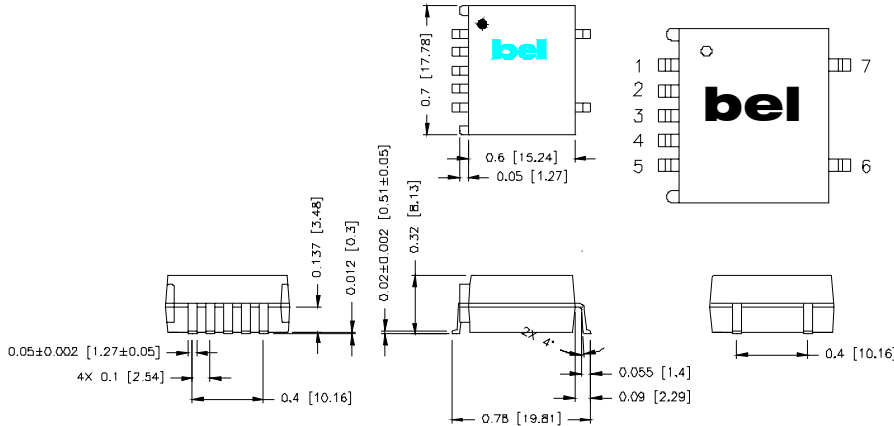
4.5 Vdc - 14 Vdc Input

0.8 Vdc - 5.5 Vdc/8 A Output



Mechanical Outline

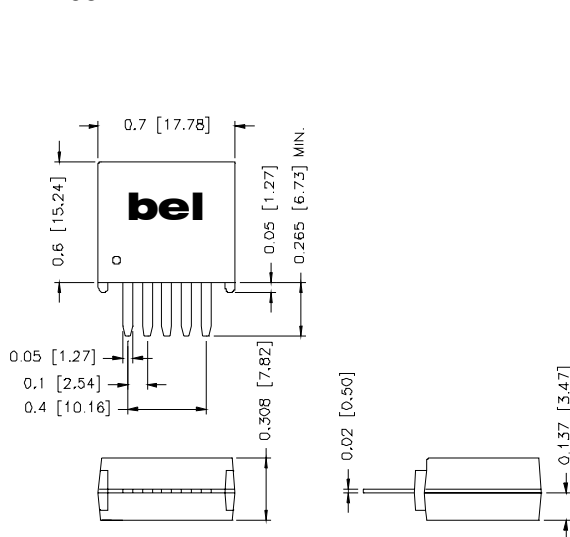
SRAH-08Exxx



Pin Connections

| Pin | Function |
|-----|------------------------|
| 1 | Remote On/Off (option) |
| 2 | Vin |
| 3 | Ground |
| 4 | Vout |
| 5 | Trim (option) |
| 6 | Sense (option) |
| 7 | N/A |

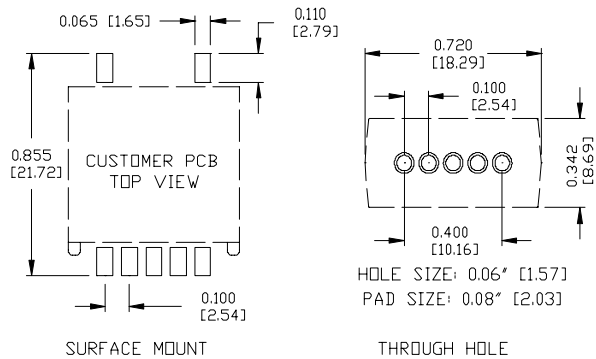
VRAH-08Exxx



Pin Connections

| Pin | Function |
|-----|------------------------|
| 1 | Remote On/Off (option) |
| 2 | Vin |
| 3 | Ground |
| 4 | Vout |
| 5 | Trim (option) |

RECOMMENDED PCB PAD LAYOUT



RoHS Compliance

Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products. These parts are not however compatible with the higher temperatures associated with lead free solder processes and must be soldered using a reflow profile with a peak temperature of no more than 240 °C.



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CORPORATE

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