

NON-ISOLATED DC/DC CONVERTER

4.5 Vdc - 32 Vdc Input

1.2 Vdc - 3.3 Vdc/1 A Output

bel
POWER PRODUCTS

xRAH-01H1A0

RoHS Compliant

Rev.A

- Non-Isolated
- Trim Function
- Low Profile Package (7.82 mm)
- UL60950-1 Recognized (UL/cUL)
- Remote On/Off
- OCP/SCP
- Under-Voltage Lockout (UVLO)



Description

The Bel xRAH-01H1A0 is part of the low cost non-isolated dc/dc converter series. The modules use a SMD or vertical mount package for ease of layout and space savings. The output is widely trimmed from 1.2 Vdc to 3.3 Vdc. Typical features include remote on/off, input under voltage lockout, over current protection and short circuit protection.

Part Selection

| Output Voltage | Input Voltage | Max. Output Current | Max. Output Power | Typical Efficiency | Part Number Surface Mount | Part Number Vertical Mount |
|----------------|---------------|---------------------|-------------------|--------------------|---------------------------|----------------------------|
| 1.2 V - 3.3 V | 4.5 V - 32 V | 1 A | 3.3 W | 86% | SRAH-01H1A0 | VRAH-01H1A0 |

- 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 | - | 34 V | |
| Output Enable Terminal Voltage | -0.3 V | - | 12 V | |
| Ambient Temperature | -40 °C | - | 85 °C | |
| Storage Temperature | -40 °C | - | 125 °C | |

Input Specifications

| Parameter | Min | Typ | Max | Notes |
|---|-------|-----------------------|----------------------|---|
| Input Voltage | 4.5 V | 20 V | 32 V | |
| Input Current (no load) | - | 5 mA | 8 mA | |
| Input Current (full load) | | | | |
| Vo=3.3 V | - | - | 0.20 A | |
| Vo=2.5 V | - | - | 0.16 A | |
| Vo=1.8 V | - | - | 0.12 A | |
| Vo=1.5 V | - | - | 0.11 A | |
| Vo=1.2 V | - | - | 0.09 A | |
| Remote Off Input Current | - | 2 mA | 5 mA | |
| Input Reflected Ripple Current (pk-pk) | - | 300 mA | 420 mA | Tested with simulated source impedance of 500 nH, 5 Hz to 20 MHz and one 100 F/50 V electrolytic capacitor and a 3.3 uF/50 V ceramic capacitor at the input |
| Input Reflected Ripple Current (RMS) | - | 100 mA | 160 mA | |
| I ² t Inrush Current Transient | - | 0.02 A ² s | 0.1 A ² s | |
| Turn on Voltage Threshold | - | 4.1 V | 4.5 V | |
| Turn off Voltage Threshold | - | 3.3 V | 4.0 V | |

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

NON-ISOLATED DC/DC CONVERTER

4.5 Vdc - 32 Vdc Input

1.2 Vdc - 3.3 Vdc/1 A Output



Output Specifications

| Parameter | | Min | Typ | Max | Notes | |
|--|---------------|----------|-----------------------|----------------------|--|---|
| Output Voltage Set Point | Vo=3.3 V | 3.234 V | 3.3 V | 3.366 V | Test conditions: Vin=20 V, Io=50% full load | |
| | Vo=2.5 V | 2.450 V | 2.5 V | 2.550 V | | |
| | Vo=1.8 V | 1.764 V | 1.8 V | 1.836 V | | |
| | Vo=1.5 V | 1.470 V | 1.5 V | 1.530 V | | |
| | Vo=1.2 V | 1.176 V | 1.2 V | 1.224 V | | |
| Line Regulation | Vo=3.3 V | - | ±3 mV | ±6 mV | | |
| | Vo=2.5 V | - | ±2 mV | ±5 mV | | |
| | Vo=1.8 V | - | ±2 mV | ±4 mV | | |
| | Vo=1.5 V | - | ±1 mV | ±3 mV | | |
| | Vo=1.2 V | - | ±1 mV | ±2 mV | | |
| Load Regulation | Vo=3.3 V | - | ±3 mV | ±6 mV | | |
| | Vo=2.5 V | - | ±2 mV | ±5 mV | | |
| | Vo=1.8 V | - | ±2 mV | ±4 mV | | |
| | Vo=1.5 V | - | ±1 mV | ±3 mV | | |
| | Vo=1.2 V | - | ±1 mV | ±2 mV | | |
| Regulation Over Temperature (-40 °C to +85 °C) | | - | ±10 mV | ±20 mV | | |
| Output Current | | 0 A | - | 1 A | | |
| Current Limit Threshold | | 2 A | - | 3 A | | |
| Short Circuit Surge Transient | | - | 0.02 A ² s | 0.1 A ² s | | |
| Ripple and Noise (rms) | | - | 6 mV | 10 mV | Test condition: 0-20 MHz BW | |
| Ripple and Noise (pk-pk) | | - | 60 mV | 100 mV | | |
| Turn on Time | | - | 6 mS | 30 mS | | |
| Overshoot at Turn on | | - | 2% | 5% | | |
| Output Capacitance | | 0 uF | - | 400uF | | |
| Transient Response | | | | | | |
| 50% ~ 100% Max Load | Overshoot | Vo=3.3 V | - | 80 mV | 120 mV | Test conditions: di/dt = 0.5 A/uS; Vin = 20 V |
| | Settling Time | | - | 150 uS | 200 uS | |
| 100% ~ 50% Max Load | Overshoot | Vo=3.3 V | - | 80 mV | 120 mV | |
| | Settling Time | | - | 150 uS | 200 uS | |
| 50% ~ 100% Max Load | Overshoot | Vo=2.5 V | - | 70 mV | 110 mV | |
| | Settling Time | | - | 120 uS | 160 uS | |
| 100% ~ 50% Max Load | Overshoot | Vo=2.5 V | - | 70 mV | 110 mV | |
| | Settling Time | | - | 120 uS | 160 uS | |
| 50% ~ 100% Max Load | Overshoot | Vo=1.8 V | - | 60 mV | 100 mV | |
| | Settling Time | | - | 100 uS | 130 uS | |
| 100% ~ 50% Max Load | Overshoot | Vo=1.8 V | - | 60 mV | 100 mV | |
| | Settling Time | | - | 100 uS | 130 uS | |
| 50% ~ 100% Max Load | Overshoot | Vo=1.5 V | - | 60 mV | 100 mV | |
| | Settling Time | | - | 100 uS | 130 uS | |
| 100% ~ 50% Max Load | Overshoot | Vo=1.5 V | - | 60 mV | 100 mV | |
| | Settling Time | | - | 100 uS | 130 uS | |
| 50% ~ 100% Max Load | Overshoot | Vo=1.2 V | - | 60 mV | 100 mV | |
| | Settling Time | | - | 100 uS | 130 uS | |
| 100% ~ 50% Max Load | Overshoot | Vo=1.2 V | - | 60 mV | 100 mV | |
| | Settling Time | | - | 100 uS | 130 uS | |

Note: All specifications are typical at 20 V input, full load at 25 °C unless otherwise stated.

NON-ISOLATED DC/DC CONVERTER

4.5 Vdc - 32 Vdc Input 1.2 Vdc - 3.3 Vdc/1 A Output



General Specifications

| Parameter | Min | Typ | Max | Notes |
|----------------------------|----------------------|---------|---------|---|
| Efficiency | | | | Measured at Vin=20 V, full load. |
| Vo=3.3 V | 83% | 86% | - | |
| Vo=2.5 V | 80% | 83% | - | |
| Vo=1.8 V | 76% | 79% | - | |
| Vo=1.5 V | 73% | 76% | - | |
| Vo=1.2 V | 70% | 73% | - | |
| Switching Frequency | | | | |
| Vo=3.3 V | 270 kHz | 290 kHz | 310 kHz | |
| Vo=2.5 V | 190 kHz | 220 kHz | 250 kHz | |
| Vo=1.8 V | 150 kHz | 170 kHz | 190 kHz | |
| Vo=1.5 V | 130 kHz | 150 kHz | 170 kHz | |
| Vo=1.2 V | 100 kHz | 120 kHz | 140 kHz | |
| Output Trim Range | 1.2 V | - | 3.3 V | Vo=1.2 V when trim pin open. |
| MTBF | 8,040,762 hours | | | Calculated Per Bell Core SR-332 (Io =0.8 A, Vin=20 V; Ta = 25 °C) |
| Dimensions (surface mount) | | | | |
| Inches (L x W x H) | 0.78 x 0.70 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) | 0.70 x 0.308 x 0.65 | | | |
| Millimeters (L x W x H) | 17.78 x 7.82 x 16.51 | | | |
| Weight | - | 5.1 g | - | |

Note: All specifications are typical at 20V input, full load at 25 °C unless otherwise stated.

Control Specifications

| Parameter | Min | Typ | Max | Notes |
|------------------------|--------|-----|------|----------------------------------|
| Remote On/Off | | | | |
| Signal Low (Unit On) | -0.3 V | - | 1 V | Remote on/off pin open, unit on. |
| Signal High (Unit Off) | 2.8 V | - | 12 V | |

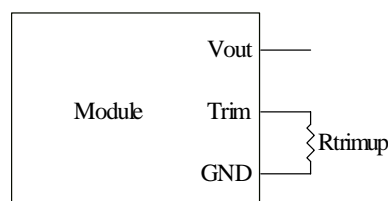
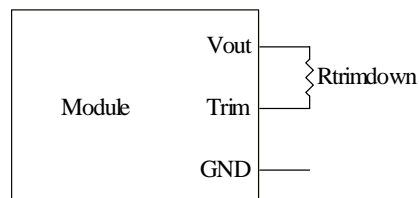
Output Trim Equations

Equations for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) and the nominal output voltage of the converter (Vo) 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.

$$R_{TrimDown} = \frac{8.7}{V_o - V_{adj}} - 21.5$$

$$R_{TrimUp} = \frac{17.2}{V_{adj} - V_o}$$

Note: Output voltage Vo=1.205 V

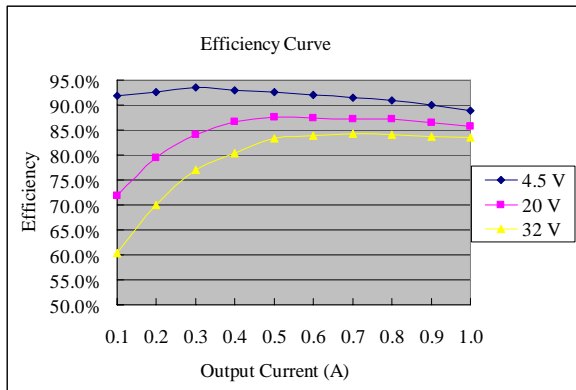


NON-ISOLATED DC/DC CONVERTER

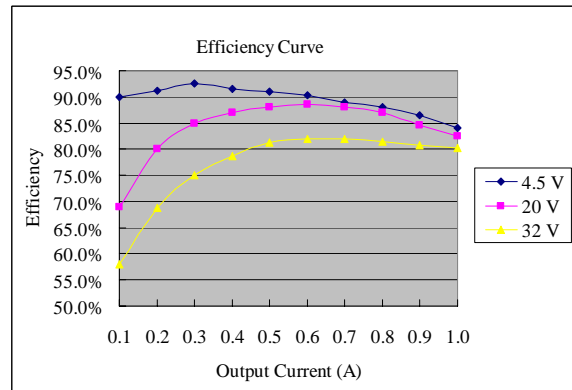
4.5 Vdc - 32 Vdc Input 1.2 Vdc - 3.3 Vdc/1 A Output



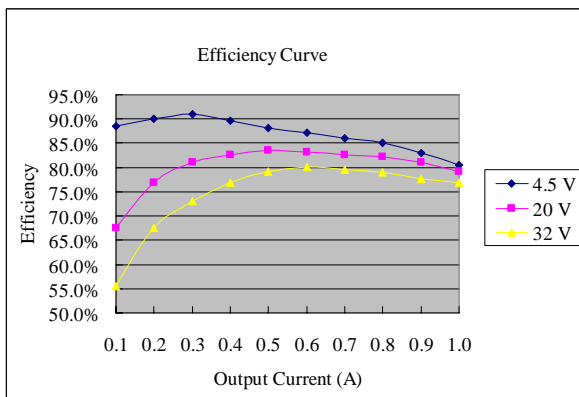
Efficiency Data



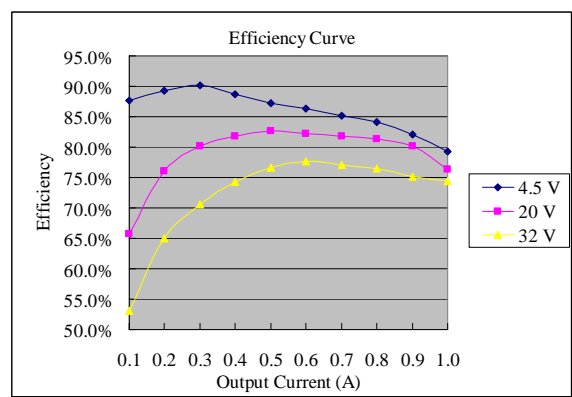
Vo = 3.3 V



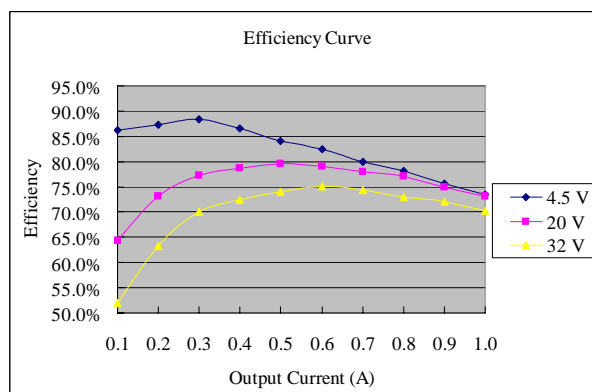
Vo = 2.5 V



Vo = 1.8 V



Vo = 1.5 V



Vo = 1.2 V

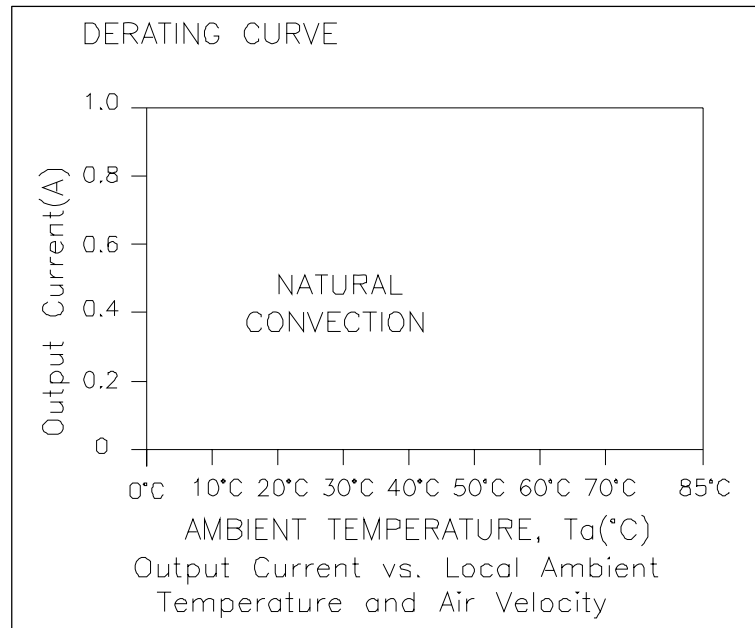
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POWER PRODUCTS

Thermal Derating Curve

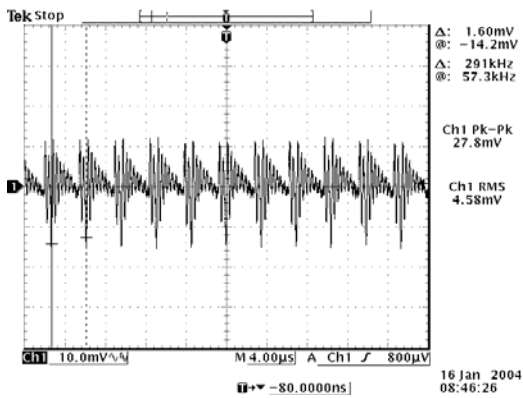


Test Condition: Derating curve is tested at nominal input voltage.

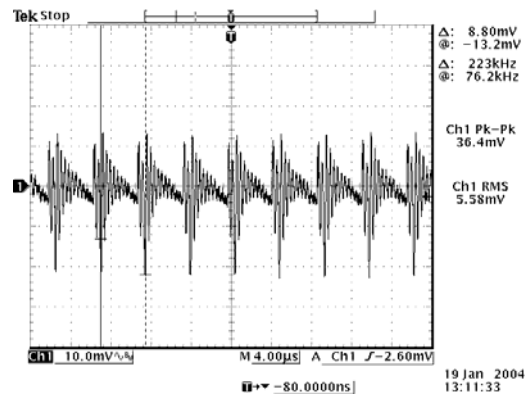
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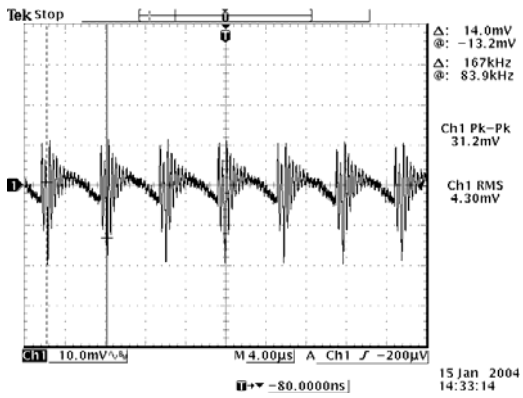
Ripple and Noise Waveforms



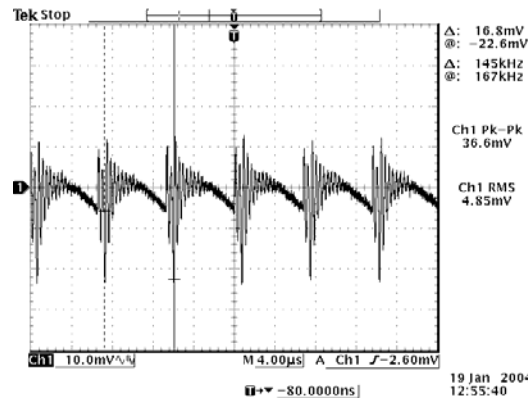
20 Vdc input, 3.3 Vdc output



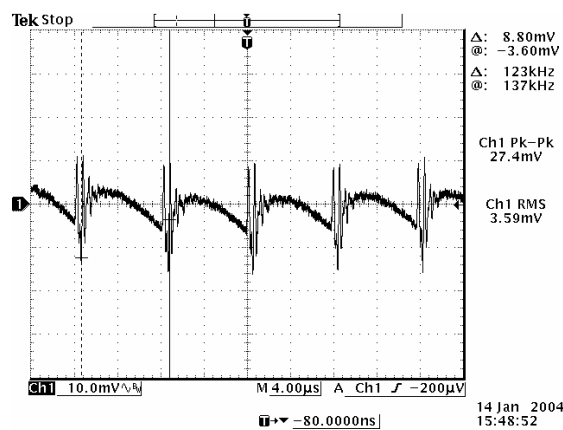
20 Vdc input, 2.5 Vdc output



20 Vdc input, 1.8 Vdc output



20 Vdc input, 1.5 Vdc output



20 Vdc input, 1.2 Vdc output

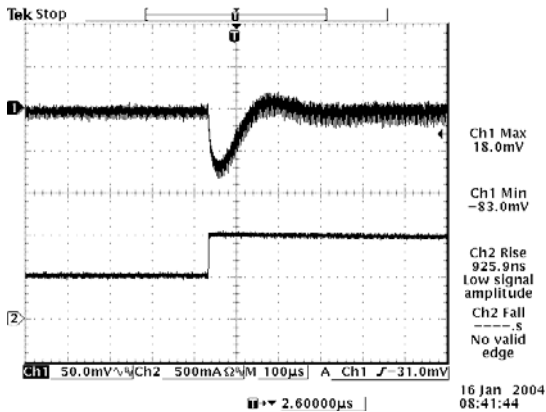
Note: Ripple and noise at max load, 0-20MHz BW, Ta=25 deg C.

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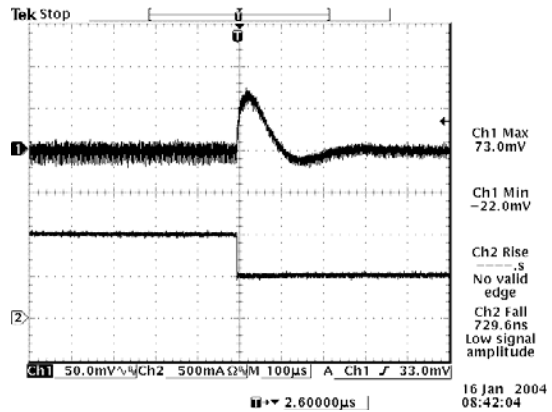
4.5 Vdc - 32 Vdc Input 1.2 Vdc - 3.3 Vdc/1 A Output



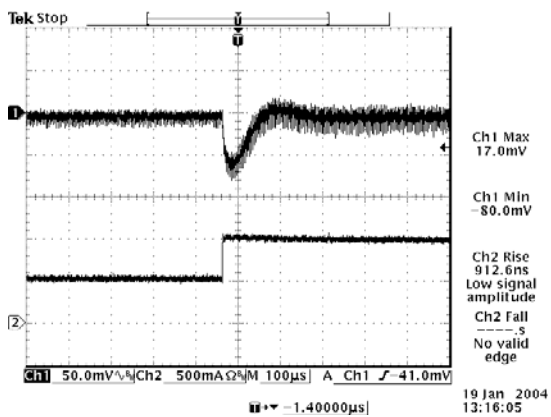
Transient Response Waveforms



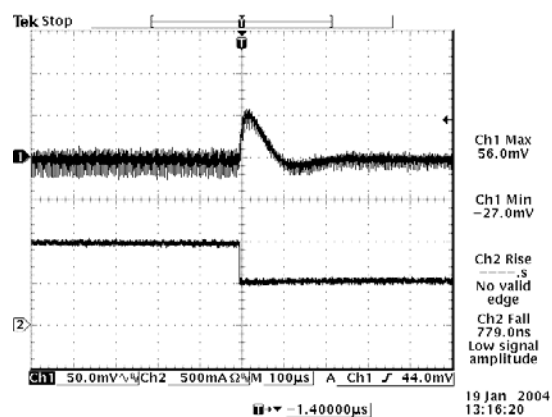
50% to 100% load, 3.3 Vdc output



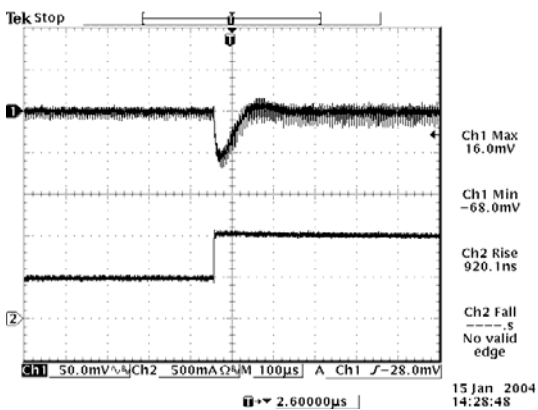
100% to 50% load, 3.3 Vdc output



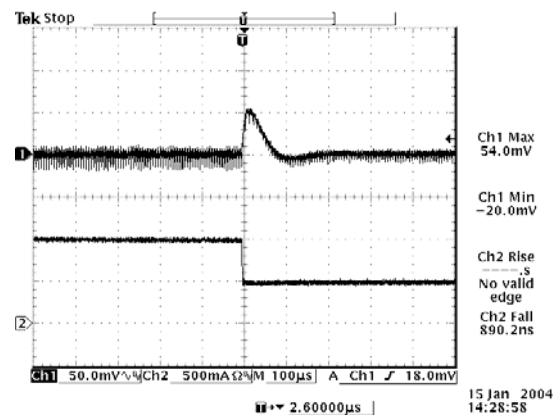
50% to 100% load, 2.5 Vdc output



100% to 50% load, 2.5 Vdc output



50% to 100% load, 1.8 Vdc output

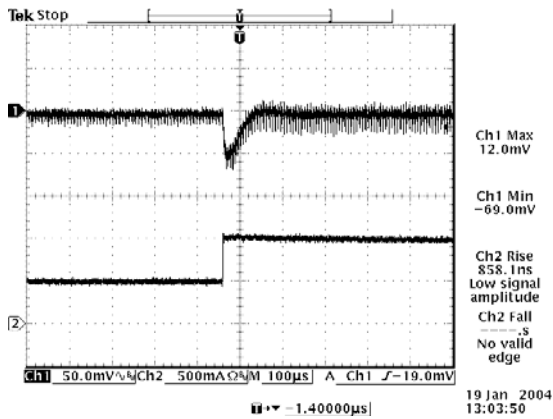


100% to 50% load, 1.8 Vdc output

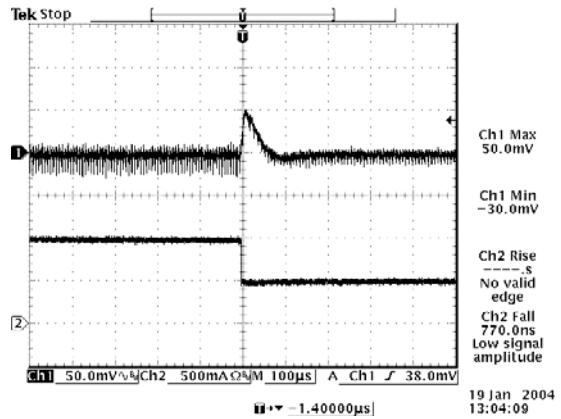
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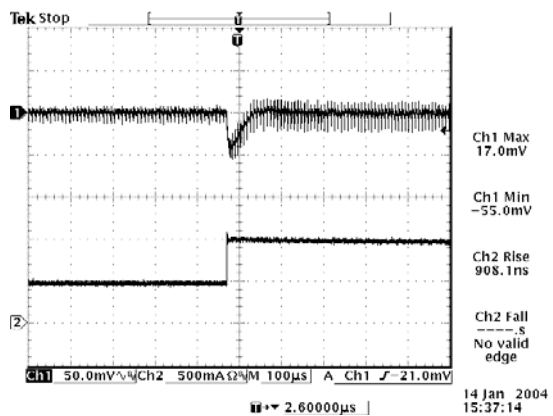
Transient Response Waveforms (continued)



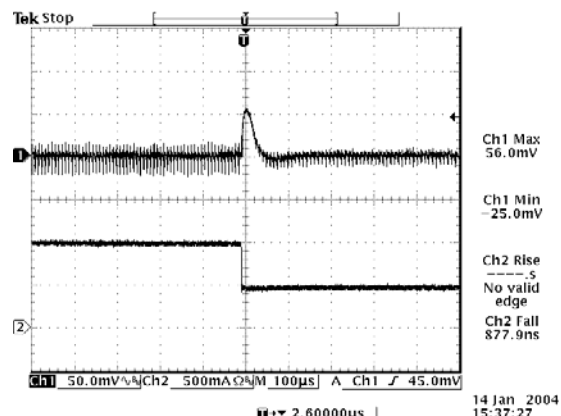
50% to 100% load, 1.5 Vdc output



100% to 50% load, 1.5 Vdc output



50% to 100% load, 1.2 Vdc output



100% to 50% load, 1.2 Vdc output

Note: Transient Response at 20 Vdc input, di/dt=0.5 A/uS, Ta=25 deg C.

NON-ISOLATED DC/DC CONVERTER

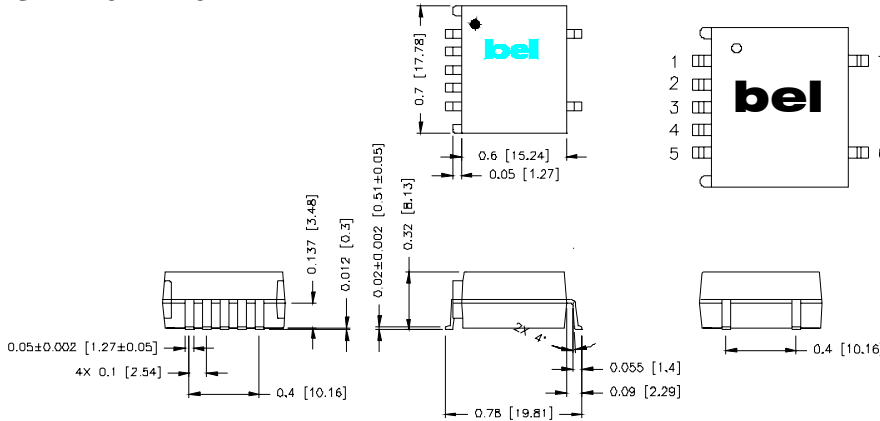
4.5 Vdc - 32 Vdc Input

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Mechanical Outline

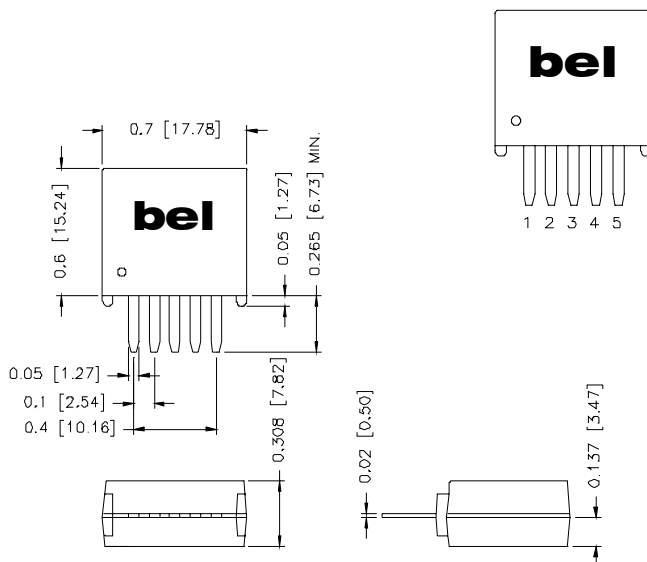
SRAH-01H1A0



Pin Connections

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

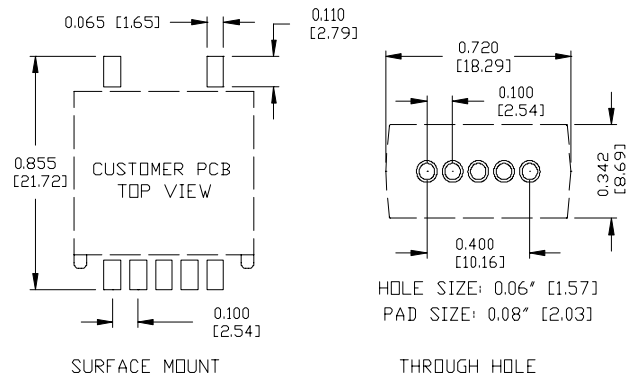
VRAH-01H1A0



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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