

NON-ISOLATED DC/DC CONVERTERS

9.0 Vdc - 18 Vdc Input

5 Vdc - 12 Vdc/1A Output

bel
POWER PRODUCTS

xRAH-01K Series RoHS Compliant Rev.A

- Non-Isolated
- High Efficiency
- Fixed Frequency (450kHz)
- UL60950-1 Recognized (UL/cUL)
- Low Profile Package
- Remote On/Off
- Active Low/High



Description

The Bel xRAH-01Kxxx is a part of the low cost non-isolated dc/dc converter Power Module series. The modules use a SMD or SIP package for ease of layout and space savings. The output is closely regulated and the efficiency of 9 Vdc output module is typically 86% 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 |
|----------------|---------------|---------------------|-------------------|--------------------|---------------------------|----------------------------|
| 5 V | 9 V - 18 V | 1 A | 5 W | 81% | SRAH-01K50x | VRAH-01K50x |
| 9 V | 9 V - 18 V | 1 A | 9 W | 86% | SRAH-01K90x | VRAH-01K90x |
| 12 V | 9 V - 18 V | 1 A | 12 W | 87% | SRAH-01KX2x | VRAH-01KX2x |

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. Use "0" to replace "x" in the above part number to indicate Active High, and "L" to indicate Active Low.
3. 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 | - | 24 V | |
| Remote On/Off | -0.3 V | - | 24 V | |
| Ambient Temperature | -40 °C | - | 85 °C | |
| Storage Temperature | -40 °C | - | 125 °C | |

Input Specifications

| Parameter | Min | Typ | Max | Notes |
|---|-------|------------------------|-----------------------|---|
| Input Voltage | 9 V | - | 18 V | |
| Remote Off Input Current | - | 18 mA | 25 mA | |
| Input Current (no load) | - | 30 mA | 45 mA | |
| Input Current (full load) | | | | |
| Vo=5 V | - | - | 0.8 A | |
| Vo=9 V | - | - | 1.3 A | |
| Vo=12 V | - | - | 1.8 A | |
| Input Reflected Ripple Current (pk-pk) | | | | |
| Vo=5 V | - | 55 mA | 80 mA | With simulated source impedance of 500 nH, 5 Hz to 20 MHz; Use one 100 uF/25 V tantalum capacitor at the input. |
| Vo=9 V | - | 75 mA | 110 mA | |
| Vo=12 V | - | 95 mA | 130 mA | |
| Input Reflected Ripple Current (rms) | | | | |
| Vo=5 V | - | 15 mA | 25 mA | |
| Vo=9 V | - | 20 mA | 30 mA | |
| Vo=12 V | - | 30 mA | 40 mA | |
| I ² t Inrush Current Transient | - | 0.003 A ² s | 0.01 A ² s | |
| Turn-on Voltage Threshold | 8.0 V | 8.5 V | 8.8 V | |
| Turn-off Voltage Threshold | 7.2 V | 7.6 V | 8.2 V | |

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

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Output Specifications

| Parameter | Min | Typ | Max | Notes | |
|--|---------------|--------|---------|---|--|
| Output Voltage Set Point | | | | Test condition: Vin=12 V, Iout=full load | |
| Vo=5 V | 4.90 V | 5 V | 5.10 V | | |
| Vo=9 V | 8.82 V | 9 V | 9.18 V | | |
| Vo=12 V | 11.76 V | 12 V | 12.24 V | | |
| Line Regulation | | | | | |
| Vo=5 V | - | 8 mV | 15 mV | | |
| Vo=9 V | - | 15 mV | 25 mV | | |
| Vo=12 V | - | 20 mV | 35 mV | | |
| Load Regulation | | | | | |
| Vo=5 V | - | 15 mV | 25 mV | | |
| Vo=9 V | - | 25 mV | 45 mV | | |
| Vo=12 V | - | 35 mV | 60 mV | | |
| Regulation Over Temperature (-40°C to +85 °C) | | | | | |
| Vo=5 V | - | 50 mV | 80 mV | | |
| Vo=9 V | - | 70 mV | 100 mV | | |
| Vo=12 V | - | 90 mV | 140 mV | | |
| Output Current | 0.005 A | - | 1 A | | |
| Output DC Current Limit | 1.1 A | - | 1.8 A | | |
| Ripple and Noise (rms) | | | | Test conditions: BW = 0-20 MHz; with π filter (Co1=10 uF, L=0.47 uH, Co2=10 uF) at the output | |
| Vo=5 V | - | 3 mV | 5 mV | | |
| Vo=9 V | - | 3 mV | 5 mV | | |
| Vo=12 V | - | 4 mV | 6 mV | | |
| Ripple and Noise (pk-pk) | | | | Test conditions: BW = 0-20 MHz; with two 10 uF ceramic capacitors at the output. | |
| Vo=5 V | - | 10 mV | 15 mV | | |
| Vo=9 V | - | 15 mV | 20 mV | | |
| Vo=12 V | - | 20 mV | 30 mV | | |
| Ripple and Noise (rms) | | | | Test conditions: BW = 0-20 MHz; with two 10 uF ceramic capacitors at the output. | |
| Vo=5 V | - | 15 mV | 25 mV | | |
| Vo=9 V | - | 25 mV | 35 mV | | |
| Vo=12 V | - | 35 mV | 50 mV | | |
| Ripple and Noise (pk-pk) | | | | Test conditions: BW = 0-20 MHz; with two 10 uF ceramic capacitors at the output. | |
| Vo=5 V | - | 40 mV | 70 mV | | |
| Vo=9 V | - | 70 mV | 100mV | | |
| Vo=12 V | - | 110 mV | 160mV | | |
| Turn On Time | | | | | |
| Vo=5 V | - | 20 mS | 30 mS | | |
| Vo=9 V | - | 30 mS | 45 mS | | |
| Vo=12 V | - | 30 mS | 45 mS | | |
| Overshoot at Turn on | - | 0% | 5% | | |
| Output Capacitance | 0 uF | - | 47 uF | | |
| Transient Response | | | | | |
| 50% ~ 75% Max Load | Overshoot | 5.0 V | - | 200mV | di/dt = 0.5 A/uS; Vin = 12 V; and with two 10 uF ceramic capacitors at the output |
| | Settling Time | | - | 100uS | |
| 75% ~ 50% Max Load | Overshoot | 9.0 V | - | 200mV | |
| | Settling Time | | - | 100uS | |
| 50% ~ 75% Max Load | Overshoot | 9.0 V | - | 300mV | |
| | Settling Time | | - | 150uS | |
| 75% ~ 50% Max Load | Overshoot | 9.0 V | - | 300mV | |
| | Settling Time | | - | 150uS | |
| 50% ~ 75% Max Load | Overshoot | 12.0 V | - | 350mV | |
| | Settling Time | | - | 150uS | |
| 75% ~ 50% Max Load | Overshoot | 12.0 V | - | 350mV | |
| | Settling Time | | - | 150uS | |

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

NON-ISOLATED DC/DC CONVERTERS

9.0 Vdc - 18 Vdc Input

5 Vdc - 12 Vdc/1A Output



General Specifications

| Parameter | Min | Typ | Max | Notes |
|----------------------------|----------------------|---------|---------|---|
| Efficiency | | | | |
| Vo=5 V | 77% | 81% | - | Measured at Vin=12 V, full load |
| Vo=9 V | 82% | 86% | - | |
| Vo=12 V | 83% | 87% | - | |
| Switching Frequency | 400 kHz | 450 kHz | 480 kHz | |
| MTBF | 14,760,000 hours | | | Calculated Per Bell Core TR-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 | - | 5 g | - | |

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

Control Specifications

| Parameter | Min | Typ | Max | Notes |
|------------------------|--------|-----|-------|--|
| Remote On/Off | | | | |
| Signal Low (Unit On) | -0.3 V | - | 0.4 V | xRAH-01KxxL, Remote On/Off pin open, unit off. |
| Signal High (Unit Off) | 2.5 V | - | Vin | |
| Signal Low (Unit Off) | -0.3 V | - | 0.4 V | xRAH-01Kxx0, Remote On/Off pin open, unit on. |
| Signal High (Unit On) | 2.5 V | - | Vin | |

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

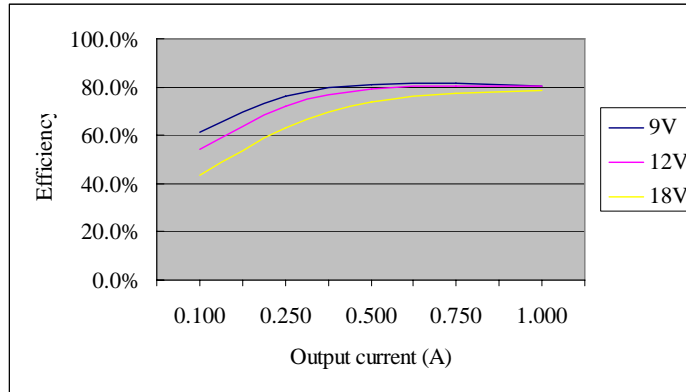
NON-ISOLATED DC/DC CONVERTERS

9.0 Vdc - 18 Vdc Input

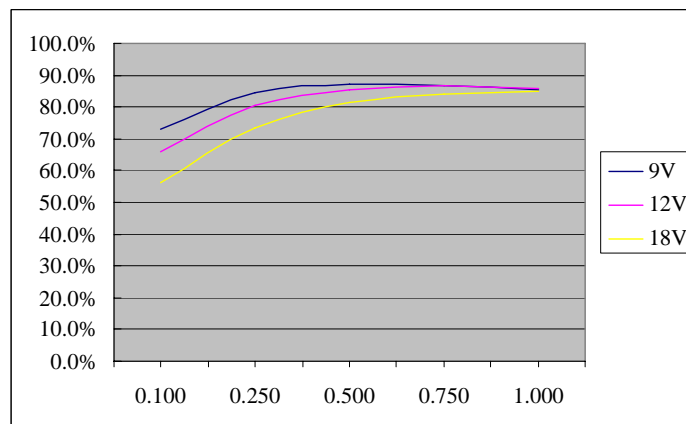
5 Vdc - 12 Vdc/1A Output



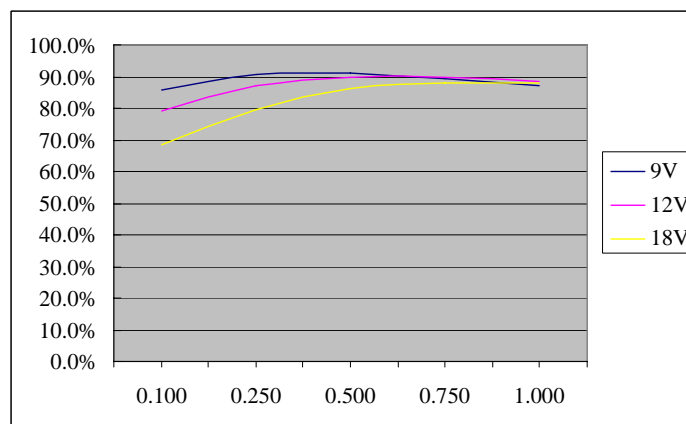
Efficiency Data



x7AH-01K500



x7AH-01K900



x7AH-01KX20

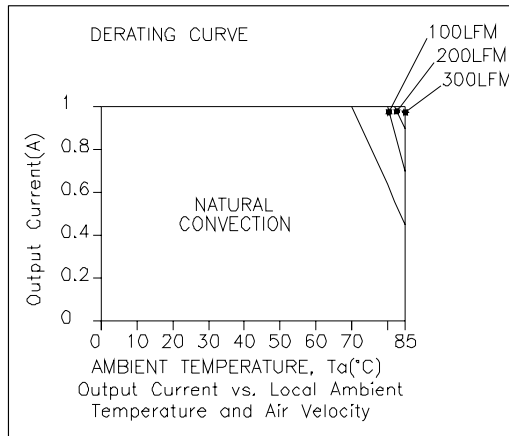
NON-ISOLATED DC/DC CONVERTERS

9.0 Vdc - 18 Vdc Input

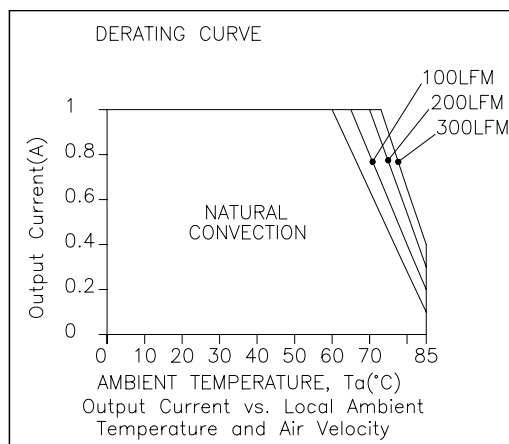
5 Vdc - 12 Vdc/1A Output



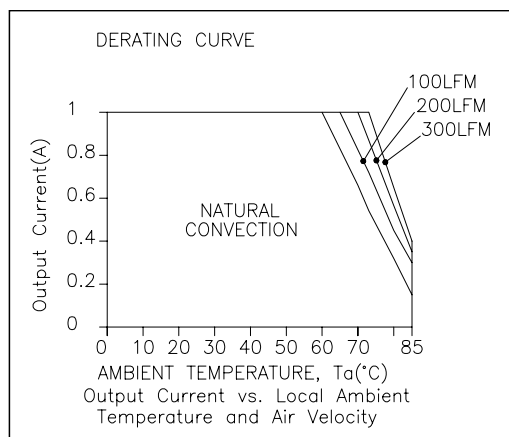
Thermal Derating Curves



Vin=12 V, Vo=5 V



Vin=12 V, Vo=9 V



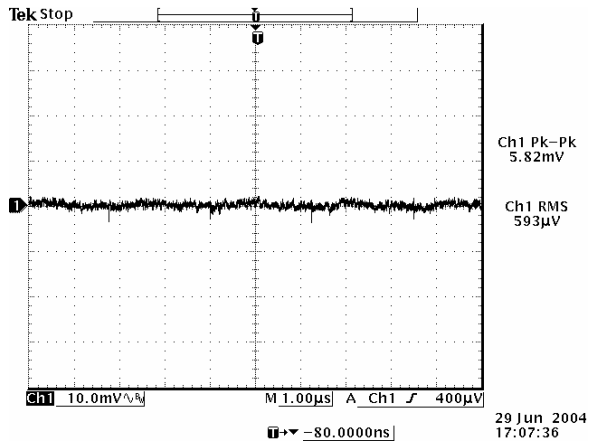
Vin=12 V, Vo=12 V

NON-ISOLATED DC/DC CONVERTERS

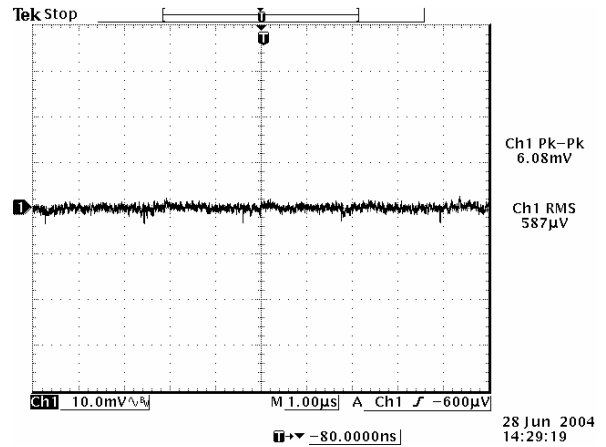
9.0 Vdc - 18 Vdc Input 5 Vdc - 12 Vdc/1A Output



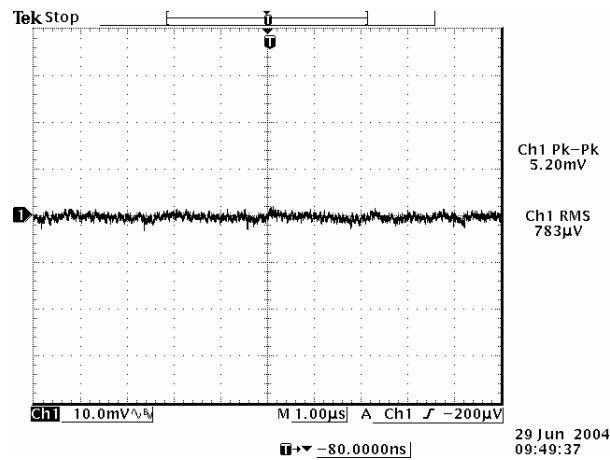
Ripple and Noise Waveforms



12 Vdc input, 5 Vdc output



12 Vdc input, 9 Vdc output



12 Vdc input, 12 Vdc output

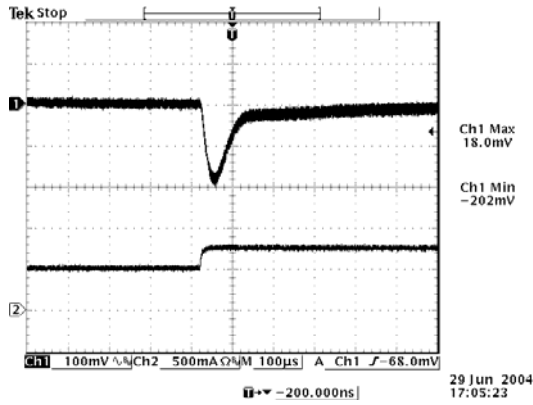
Note: Ripple and noise at no load, with two 10 uF ceramic capacitors at the output, and Ta=25 deg C.

NON-ISOLATED DC/DC CONVERTERS

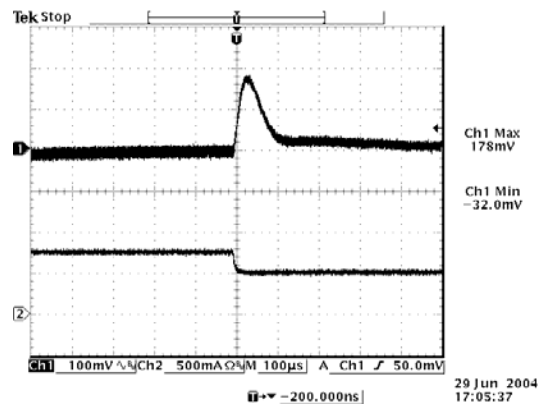
9.0 Vdc - 18 Vdc Input 5 Vdc - 12 Vdc/1A Output



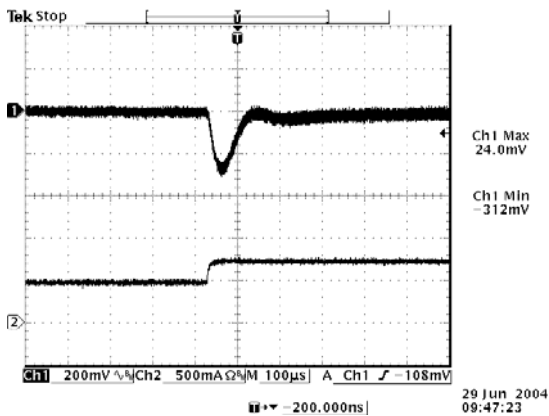
Transient Response Waveforms



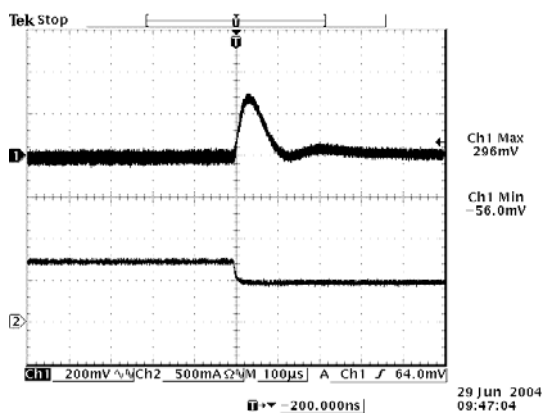
50% to 75% load transient at 5 Vdc output



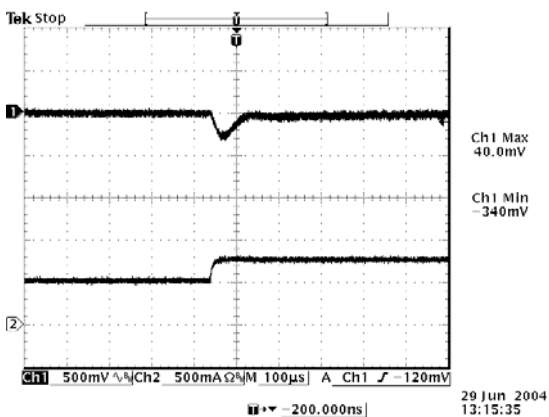
75% to 50% load transient at 5 Vdc output



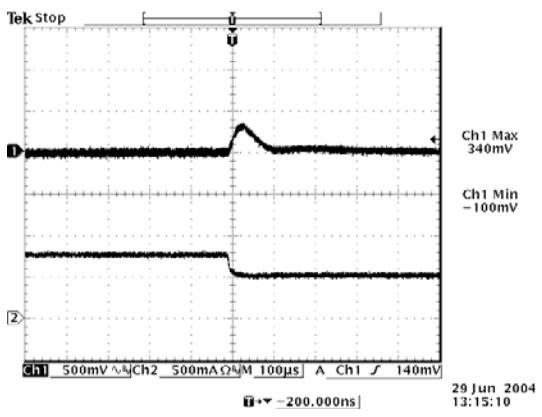
50% to 75% load transient at 9 Vdc output



75% to 50% load transient at 9 Vdc output



50% to 75% load transient at 12 Vdc output



75% to 50% load transient at 12 Vdc output

Note: Transient response at 12 Vdc input, $di/dt=0.5 \text{ A}/\mu\text{S}$, with two 10 μF ceramic capacitors at the output, and $T_a=25 \text{ deg C}$.

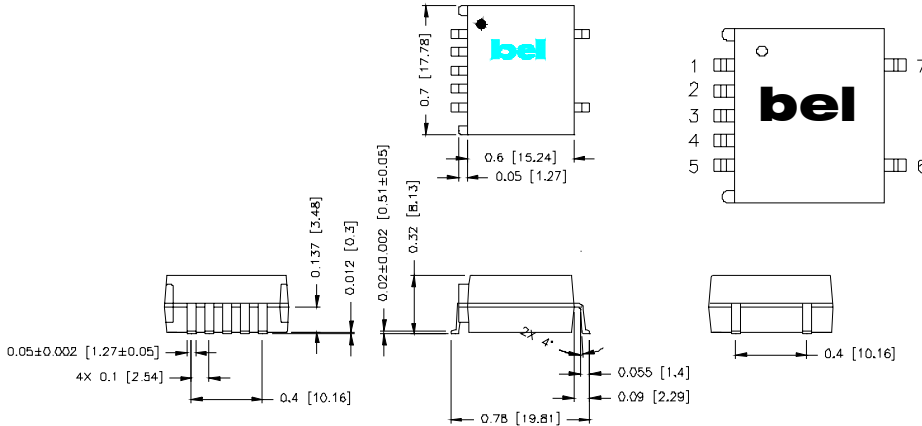
NON-ISOLATED DC/DC CONVERTERS

9.0 Vdc - 18 Vdc Input 5 Vdc - 12 Vdc/1A Output



Mechanical Outline

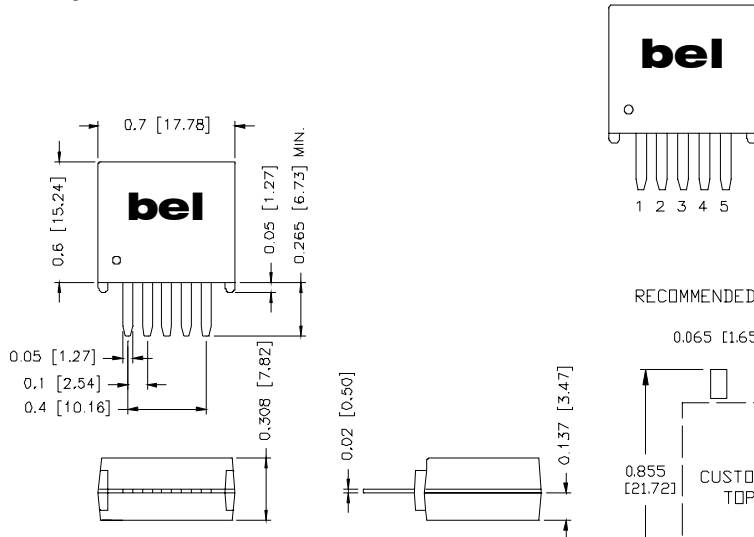
SRAH-01Kxxx



Pin Connections

| Pin | Function |
|-----|----------|
| 1 | On/Off |
| 2 | Vin |
| 3 | Ground |
| 4 | Vout |
| 5 | N/A |
| 6 | N/A |
| 7 | N/A |

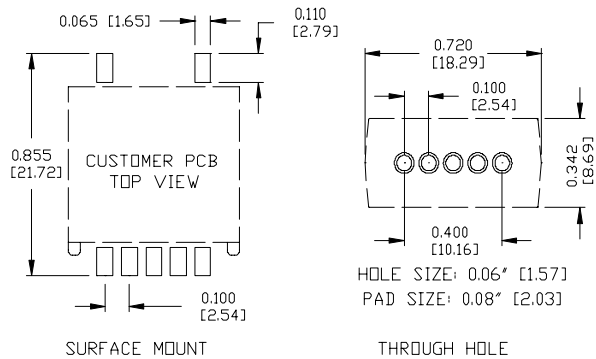
VRAH-01Kxxx



Pin Connections

| Pin | Function |
|-----|----------|
| 1 | On/OFF |
| 2 | Vin |
| 3 | Ground |
| 4 | Vout |
| 5 | N/A |

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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