

## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 3.6 Vdc Input

5.0 Vdc/1.5 A Output

**bel**  
POWER PRODUCTS

xRAH-02C50x

RoHS Compliant

- Non-Isolated
- High Efficiency
- Fixed Frequency (550 kHz)
- Low Profile Package
- Trim Function (Option)
- Allows Burst Mode Operation at Low Load Currents for xRAH-02C500, Burst Mode Operation Disabled for Lower Output Ripple at Light Loads for xRAH-02C50B
- UL60950 Recognized (UL/cUL)



### Description

The Bel xRAH-02C50x is a part of the low cost non-isolated dc/dc converter series. The modules use a SMD or SIP package for ease of layout and space savings. The output is closely regulated and the efficiency is typically 87% 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 |
|----------------|-------------------|---------------------|-------------------|--------------------|---------------------------|----------------------------|
| 5.0 Vdc        | 3.0 Vdc - 3.6 Vdc | 1.5 A               | 7.5 W             | 87%                | SRAH-02C50x               | VRAH-02C50x                |

**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. Replace "x" with "0" to allow burst mode operation at low load currents, or with "B" to disable burst mode operation at light loads.

### Absolute Maximum Ratings

| Parameter                  | Min    | Typ | Max    | Notes |
|----------------------------|--------|-----|--------|-------|
| Input Voltage (continuous) | 2.8 V  | -   | 4.0 V  |       |
| Ambient Temperature        | -40 °C | -   | 85 °C  |       |
| Storage Temperature        | -40 °C | -   | 125 °C |       |

### Input Specifications

| Parameter                                 | Min   | Typ                   | Max                   | Notes                                                                                                                         |
|-------------------------------------------|-------|-----------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Input Voltage                             | 3.0 V | -                     | 3.6 V                 |                                                                                                                               |
| Input Current                             | -     | -                     | 3.3 A                 |                                                                                                                               |
| Input Reflected Ripple Current (rms)      | -     | 30 mA                 | 60 mA                 | With simulated source impedance of 500 nH, 5 Hz to 20 MHz; Use one 270 uF/16 V capacitor with ESR = 0.018 ohm max. at 100 kHz |
| Input Reflected Ripple Current (pk-pk)    | -     | 100 mA                | 150 mA                |                                                                                                                               |
| I <sup>2</sup> t Inrush Current Transient | -     | 0.02 A <sup>2</sup> s | 0.05 A <sup>2</sup> s |                                                                                                                               |
| Turn-on Voltage Threshold                 | -     | 2.8 V                 | 2.9 V                 |                                                                                                                               |

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### Output Specifications

| Parameter                                                        | Min     | Typ            | Max     | Notes                                                |                                                                         |
|------------------------------------------------------------------|---------|----------------|---------|------------------------------------------------------|-------------------------------------------------------------------------|
| Output Voltage Set Point                                         | 4.825 V | 5.0 V          | 5.175 V | Vin=3.3V, Io= full load                              |                                                                         |
| Load Regulation                                                  | -       | 25 mV          | 40 mV   |                                                      |                                                                         |
| Line Regulation                                                  | -       | 20 mV          | 30 mV   |                                                      |                                                                         |
| Regulation Over Temperature<br>(0 °C to 70 °C)                   | -       | 45 mV          | 80 mV   |                                                      |                                                                         |
| Output Current                                                   | 0 A     | -              | 1.5 A   |                                                      |                                                                         |
| Ripple and Noise (RMS)                                           | -       | 15 mV          | 25 mV   | 0-20MHz BW, with1uF ceramic capacitor at the output. |                                                                         |
| Ripple and Noise (pk-pk)                                         | -       | 50 mV          | 100 mV  |                                                      |                                                                         |
| Ripple and Noise (pk-pk) (No Load)<br>xRAH-02C500<br>xRAH-02C50B | -<br>-  | 50 mV<br>18 mV | -<br>-  |                                                      |                                                                         |
| Overshoot at Turn on                                             | -       | 0%             | 5%      |                                                      |                                                                         |
| Output Capacitance                                               | 0 uF    | -              | 600 uF  |                                                      |                                                                         |
| Transient Response                                               |         |                |         |                                                      |                                                                         |
| 50% ~ 100% Max Load                                              | Vo=5 V  | -              | 100 mV  | 150 mV                                               | di/dt = 0.5 A/uS; Vin = 3.3 V;<br>Ta = 25 °C without external capacitor |
| Settling Time                                                    |         | -              | 50 uS   | 100 uS                                               |                                                                         |
| 100% ~ 50% Max Load                                              |         | -              | 100 mV  | 150 mV                                               |                                                                         |
| Settling Time                                                    |         | -              | 50 uS   | 100 uS                                               |                                                                         |

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

### General Specifications

| Parameter                                                                   | Min                                        | Typ     | Max     | Notes                                                                          |
|-----------------------------------------------------------------------------|--------------------------------------------|---------|---------|--------------------------------------------------------------------------------|
| Efficiency                                                                  | 84%                                        | 87%     | -       | Vin=3.3V, full load                                                            |
| Switching Frequency                                                         | 500 kHz                                    | 550 kHz | 650 kHz |                                                                                |
| Output Trim Range                                                           | 95% Vo                                     | -       | 110% Vo |                                                                                |
| MTBF                                                                        | 14,455,458 hours                           |         |         | Calculated Per Bell Core SR-332<br>(Vin=3.3 V; Vo=5 V; Io = 1.2 A; Ta = 25 °C) |
| Dimensions (surface mount)<br>Inches (L × W × H)<br>Millimeters (L × W × H) | 0.78 x 0.7 x 0.32<br>19.81 x 17.78 x 8.13  |         |         |                                                                                |
| Dimensions (vertical)<br>Inches (L × W × H)<br>Millimeters (L × W × H)      | 0.7 x 0.308 x 0.65<br>17.78 x 7.82 x 16.51 |         |         |                                                                                |
| Weight                                                                      | -                                          | 5.2 g   | -       |                                                                                |

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

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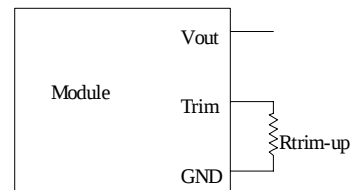
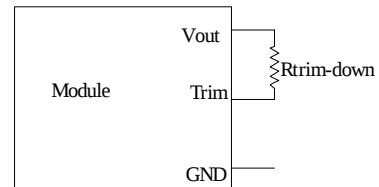
### Output Trim Equations

Equations for calculating the trim resistor 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  $V_{out}$ . 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.

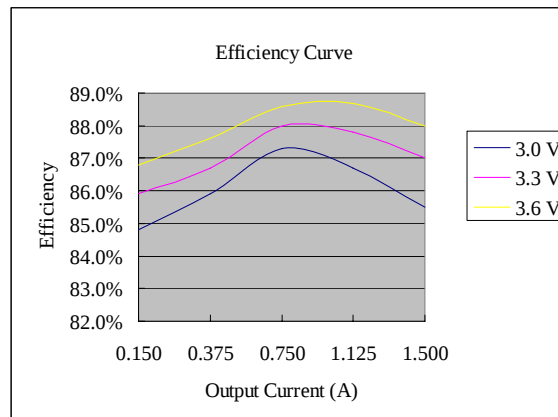
$$R_{trim\_down} = \left( \frac{44.144}{V_o - V_{o,adj}} - 12.5 \right) \text{Kohm}$$

$$R_{trim\_up} = \left( \frac{8.4}{V_{o,adj} - V_o} - 2 \right) \text{Kohm}$$

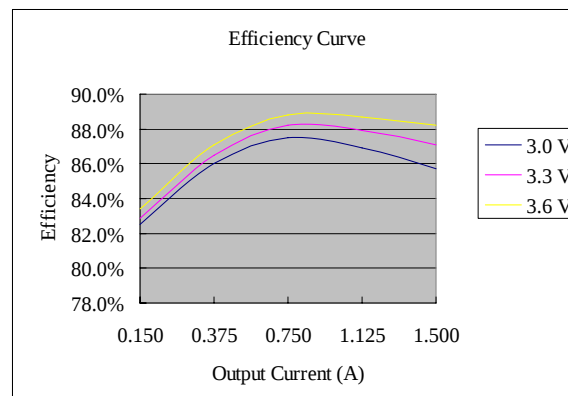
**Note:** Output voltage  $V_o = 5.004$  V when  $R_{trim}$  is open.



### Efficiency Data



xRAH-02C500



xRAH-02C50B

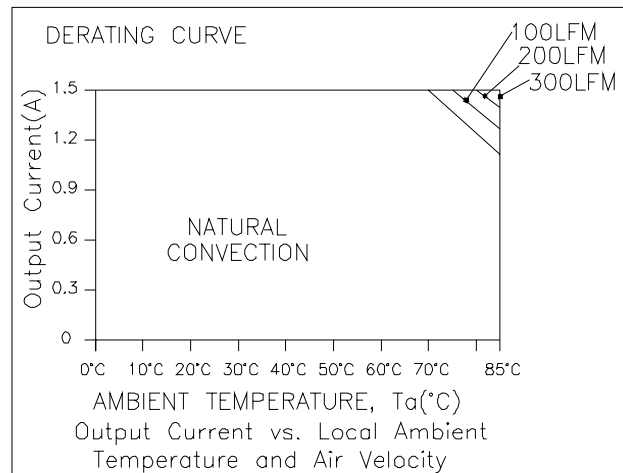
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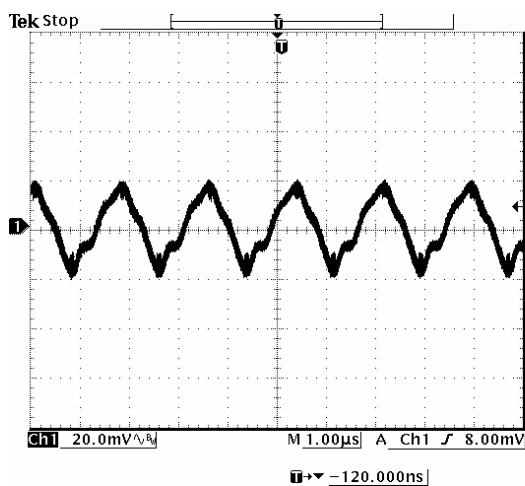
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### Thermal Derating Curve

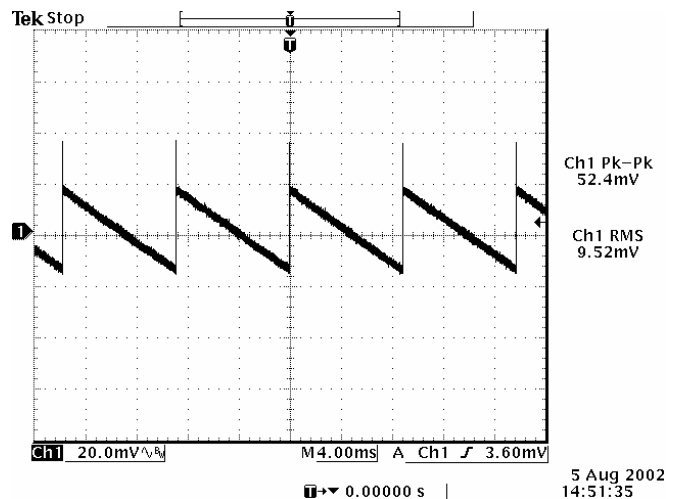


xRAH-02C50x

### Ripple and Noise Waveforms



Ripple and noise at full load,  $V_{in}=3.3\text{ V}$ ,  $V_o=5\text{ V}$



Ripple and noise at no load,  $V_{in}=3.3\text{ V}$ ,  $V_o=5\text{ V}$

**Note:** Ripple and noise tested with 1  $\mu\text{F}$  ceramic capacitor at the output,  $T_a=25\text{ deg C}$ .

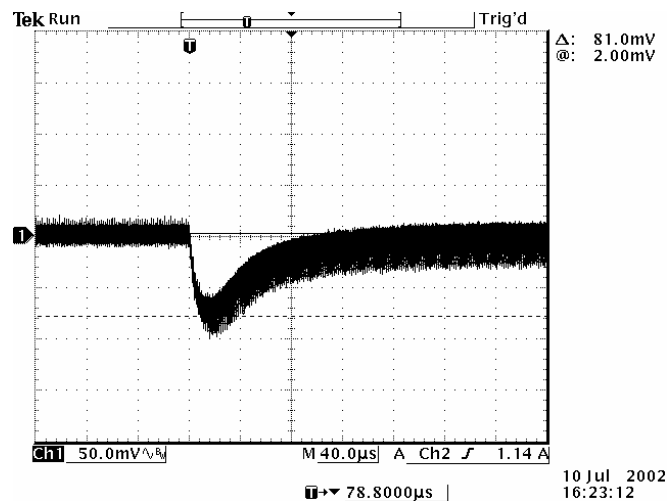
## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 3.6 Vdc Input

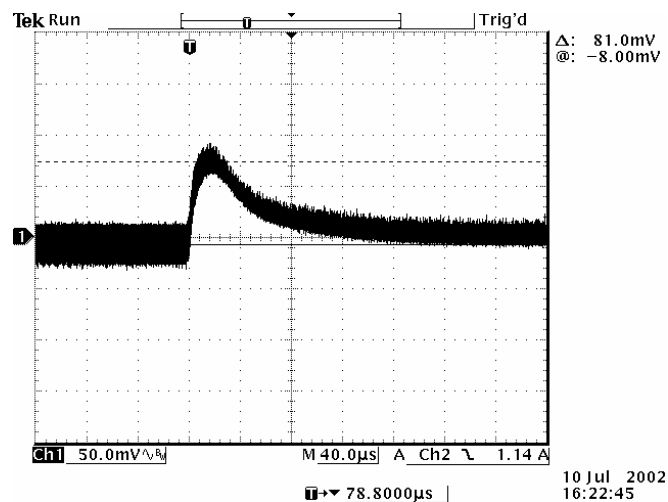
5.0 Vdc/1.5 A Output



### Transient Response Waveforms



50% to 100% load transient at  $V_{in}=3.3\text{ V}$ ,  $V_o=5\text{ V}$



100% to 50% load transient at  $V_{in}=3.3\text{ V}$ ,  $V_o=5\text{ V}$

**Note:** Transient response at  $di/dt=0.5\text{ A/uS}$ , no external load capacitor,  $T_a=25\text{ deg C}$ .

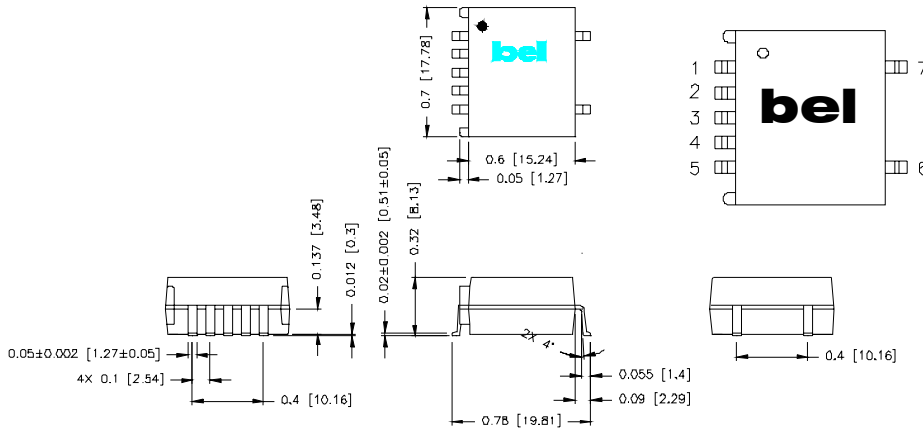
# NON-ISOLATED DC/DC CONVERTERS

3.0 V - 3.6 V Input 5.0 V/1.5 A Output



## Mechanical Outline

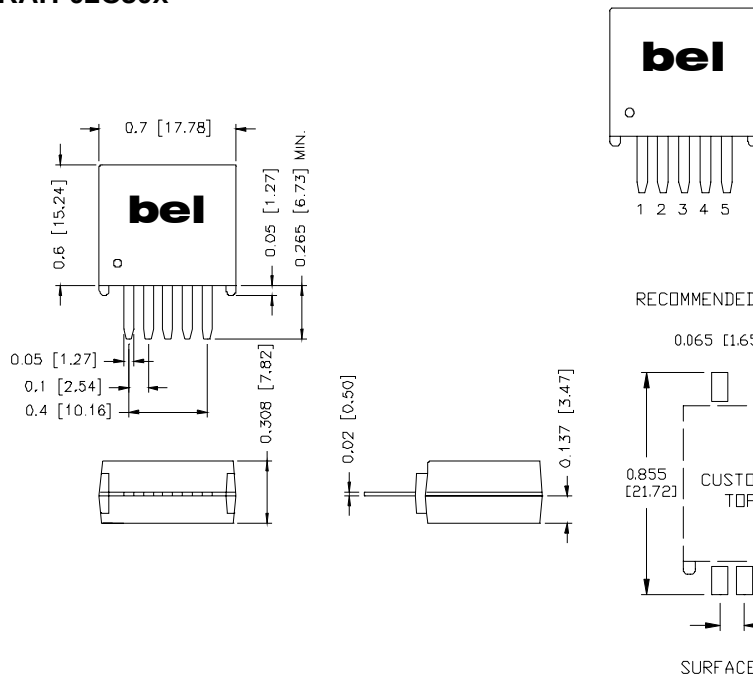
### SRAH-02C50x



## Pin Connections

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

### VRAH-02C50x



## Pin Connections

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

## 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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