



**THE DATASHEET OF  
SRAH-03F1A00**



## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

0.9 Vdc - 3.3 Vdc/3 A Output

**bel**  
POWER PRODUCTS

xRAH-03F1A0

RoHS Compliant

Rev.A

- Non-Isolated
- High Efficiency
- Fixed Frequency (300 kHz)
- Low Cost
- UL60950-1 Recognized (UL/cUL)
- Remote On/Off
- Input Under Voltage Lockout
- OCP/SCP
- Wide Range Trim



### Description

The Bel xRAH-03F1A0 module is a non-isolated, step down dc/dc converter that operates from 3.0 Vdc to 5.5 Vdc source. This converter is available in a range of output voltages from 0.9 Vdc to 3.3 Vdc. It is packaged in a compact, overmolded package rated at 3 A. Optional lead forming provides a vertical mount product for minimal footprint or a surface mount option for a very low profile. The efficiency of 3.3 Vdc module is typically 92% at 5 Vdc input and full load. 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 |
|-------------------|-------------------|---------------------|-------------------|--------------------|---------------------------|----------------------------|
| 0.9 Vdc - 3.3 Vdc | 3.0 Vdc - 5.5 Vdc | 3 A                 | 10 W              | 92%                | SRAH-03F1A0               | VRAH-03F1A0                |

- 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 | -   | 6 V    |       |
| Output Enable Terminal Voltage | -0.3 V | -   | 6 V    |       |
| Ambient Temperature            | -40 °C | -   | 85 °C  |       |
| Storage Temperature            | -40 °C | -   | 125 °C |       |

### Input Specifications

| Parameter                              | Min   | Typ   | Max   | Notes   |
|--|-------|-------|-------|---|
| Input Voltage                          |       |       |       |   |
| Vo=3.3 V                               | 4.5 V | -     | 5.5 V |   |
| Vo=2.5 V                               | 3.6 V | -     | 5.5 V |   |
| Vo=0.9 V-1.8 V                         | 3.0 V | -     | 5.5 V |   |
| Input Current (no load)                | -     | -     | 70 mA |   |
| Input Current (full load)              |       |       |       |   |
| Vo=3.3 V                               | -     | -     | 2.5 A |   |
| Vo=2.5 V                               | -     | -     | 2.4 A |   |
| Vo=1.8 V                               | -     | -     | 2.2 A |   |
| Vo=1.5 V                               | -     | -     | 1.9 A |   |
| Vo=1.2 V                               | -     | -     | 1.6 A |   |
| Vo=0.9 V                               | -     | -     | 1.3 A |   |
| Remote Off Input Current               | -     | 5 mA  | 10 mA |   |
| Input Reflected Ripple Current (pk-pk) | -     | 75 mA | -     | Tested with simulated source impedance of 500 nH, 5 Hz to 20 MHz and two 270 uF/16 V Oscon caps with ESR=0.018 ohm max at 100 kHz |
| Input Reflected Ripple Current (rms)   | -     | 25 mA | -     |   |

## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input      0.9 Vdc - 3.3 Vdc/3 A Output



### Input Specifications (continued)

| Parameter                                 | Min   | Typ                    | Max                    | Notes                                  |
|---|-------|------------------------|------------------------|--|
| I <sup>2</sup> t Inrush Current Transient | -     | 0.004 A <sup>2</sup> s | 0.008 A <sup>2</sup> s |  |
| Turn on Voltage Threshold                 | -     | -                      | 2.9 V                  | Only for 0.9 V - 1.8 V output modules. |
| Turn off Voltage Threshold                | 2.2 V | 2.4 V                  | -                      |  |

**Note:** All specifications are typical at nominal input (5 V), full load at 25 °C unless otherwise stated.

### Output Specifications

| Parameter                                     | Min           | Typ                    | Max                    | Notes   |        |   |
|---|---------------|------------------------|------------------------|---|--------|---|
| Output Voltage Set Point                      |               |                        |                        | Test conditions:<br>Vin=5 V, Io=50% full load |        |   |
| Vo=3.3 V                                      | 3.217 V       | 3.3 V                  | 3.383 V                |   |        |   |
| Vo=2.5 V                                      | 2.437 V       | 2.5 V                  | 2.563 V                |   |        |   |
| Vo=1.8 V                                      | 1.755 V       | 1.8 V                  | 1.845 V                |   |        |   |
| Vo=1.5 V                                      | 1.462 V       | 1.5 V                  | 1.538 V                |   |        |   |
| Vo=1.2 V                                      | 1.170 V       | 1.2 V                  | 1.230 V                |   |        |   |
| Vo=0.9 V                                      | 0.877 V       | 0.9 V                  | 0.923 V                |   |        |   |
| Line Regulation                               |               |                        |                        |   |        |   |
| Vo=3.3 V                                      | -             | 10 mV                  | 20 mV                  |   |        |   |
| Vo=2.5 V                                      | -             | 8 mV                   | 16 mV                  |   |        |   |
| Vo=1.8 V                                      | -             | 6 mV                   | 12 mV                  |   |        |   |
| Vo=1.5 V                                      | -             | 5 mV                   | 10 mV                  |   |        |   |
| Vo=1.2 V                                      | -             | 4 mV                   | 8 mV                   |   |        |   |
| Vo=0.9 V                                      | -             | 3 mV                   | 6 mV                   |   |        |   |
| Load Regulation                               |               |                        |                        |   |        |   |
| Vo=3.3 V                                      | -             | 17 mV                  | 33 mV                  |   |        |   |
| Vo=2.5 V                                      | -             | 13 mV                  | 25 mV                  |   |        |   |
| Vo=1.8 V                                      | -             | 9 mV                   | 18 mV                  |   |        |   |
| Vo=1.5 V                                      | -             | 8mV                    | 15 mV                  |   |        |   |
| Vo=1.2 V                                      | -             | 6 mV                   | 12 mV                  |   |        |   |
| Vo=0.9 V                                      | -             | 5 mV                   | 9 mV                   |   |        |   |
| Regulation Over Temperature(-40 °C to +85 °C) |               |                        |                        |   |        |   |
| Vo=3.3 V                                      | -             | 72 mV                  | 97 mV                  |   |        |   |
| Vo=2.5 V                                      | -             | 54 mV                  | 72 mV                  |   |        |   |
| Vo=1.8 V                                      | -             | 39 mV                  | 52 mV                  |   |        |   |
| Vo=1.5 V                                      | -             | 32 mV                  | 43 mV                  |   |        |   |
| Vo=1.2 V                                      | -             | 26 mV                  | 40 mV                  |   |        |   |
| Vo=0.9 V                                      | -             | 19 mV                  | 40 mV                  |   |        |   |
| Output Current                                | 0 A           | -                      | 3 A                    |   |        |   |
| Current Limit Threshold                       | 5 A           | -                      | 12 A                   |   |        |   |
| Short Circuit Surge Transient                 | -             | 0.022 A <sup>2</sup> s | 0.044 A <sup>2</sup> s |   |        |   |
| Ripple and Noise (rms)                        |               |                        |                        | Test condition: 0-20 MHz BW                   |        |   |
| Vo=1.2 V-3.3 V                                | -             | 15 mV                  | 25 mV                  |   |        |   |
| Vo=0.9 V                                      | -             | 10 mV                  | 20 mV                  |   |        |   |
| Ripple and Noise (pk-pk)                      |               |                        |                        |   |        |   |
| Vo=1.2 V-3.3 V                                | -             | 50 mV                  | 70 mV                  |   |        |   |
| Vo=0.9 V                                      | -             | 40 mV                  | 60 mV                  |   |        |   |
| Turn on Time                                  | -             | 7 mS                   | 12 mS                  |   |        |   |
| Overshoot at Turn on                          | -             | 0%                     | 3%                     |   |        |   |
| Output Capacitance                            | 0 uF          | -                      | 1200 uF                |   |        |   |
| <b>Transient Response</b>                     |               |                        |                        |   |        |   |
| 50% ~ 100% Max Load                           | Overshoot     | All                    | -                      | 150 mV  | 200 mV | Test conditions:<br>di/dt = 0.5 A/uS; Vin = 5 V |
|   | Settling Time |                        | -                      | 20 uS   | 40 uS  |   |
| 100% ~ 50% Max Load                           | Overshoot     |                        | -                      | 150 mV  | 200 mV |   |
|   | Settling Time |                        | -                      | 20 uS   | 40 uS  |   |

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

## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input      0.9 Vdc - 3.3 Vdc/3 A Output



### General Specifications

| Parameter                     | Min                  | Typ     | Max     | Notes  |
|-------------------------------|----------------------|---------|---------|--|
| Efficiency                    |                      |         |         | Measured at Vin=5 V, full load and Ta=25 °C                                    |
| Vo=3.3 V                      | 88%                  | 92%     | -       |  |
| Vo=2.5 V                      | 86%                  | 90%     | -       |  |
| Vo=1.8 V                      | 83%                  | 87%     | -       |  |
| Vo=1.5 V                      | 80%                  | 84%     | -       |  |
| Vo=1.2 V                      | 77%                  | 81%     | -       |  |
| Vo=0.9 V                      | 75%                  | 79%     | -       |  |
| Switching Frequency           | 250 kHz              | 300 kHz | 360 kHz |  |
| Output Trim Range (wide trim) | 100%Vo               | -       | 403%Vo  | Vo=0.9 V   |
| MTBF                          | 9,159,999 hours      |         |         | Calculated Per Bell Core SR-332 (Vin=5 V; Vo=3.3 V; Io = 80% load; 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 g     | -       |  |

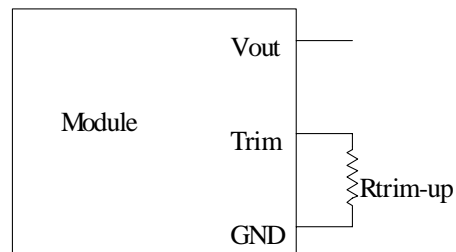
### Control Specifications

| Parameter             | Min    | Typ | Max   | Notes                            |
|-----------------------|--------|-----|-------|----------------------------------|
| <b>Remote On/Off</b>  |        |     |       |                                  |
| Signal Low (Unit Off) | -0.3 V | -   | 0.8 V | Remote on/off pin open, unit on. |
| Signal High (Unit On) | 2.8 V  | -   | 6 V   |                                  |

### Output Trim Equations

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

$$R_{trim\_up} = \left( \frac{3.712}{V_{adj\_up} - V_o} - 1 \right) K\Omega$$

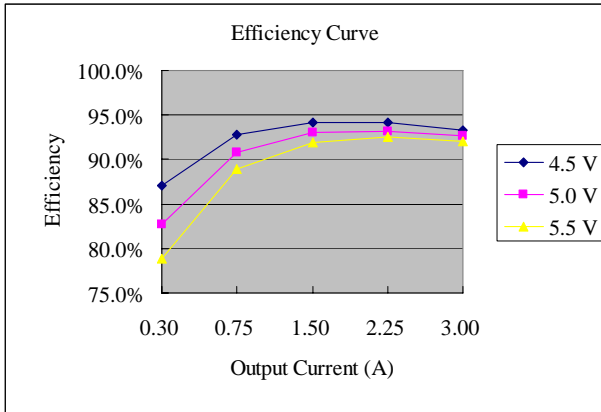


**Note:** Output voltage Vo=0.902V when Ttrim-up is not connected.

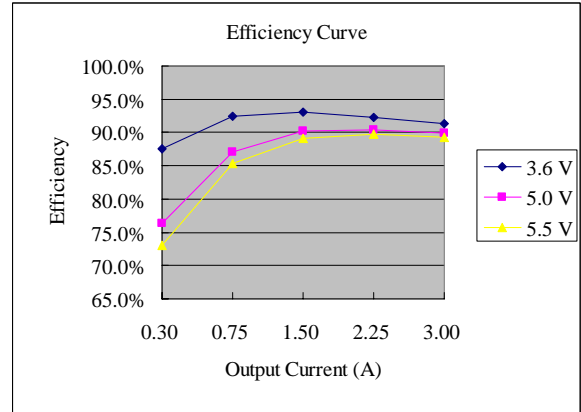
**NON-ISOLATED DC/DC CONVERTERS**  
 3.0 Vdc - 5.5 Vdc Input      0.9 Vdc - 3.3 Vdc/3 A Output



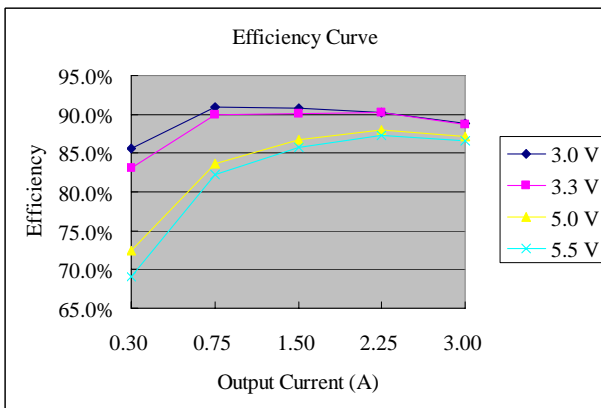
**Efficiency Data**



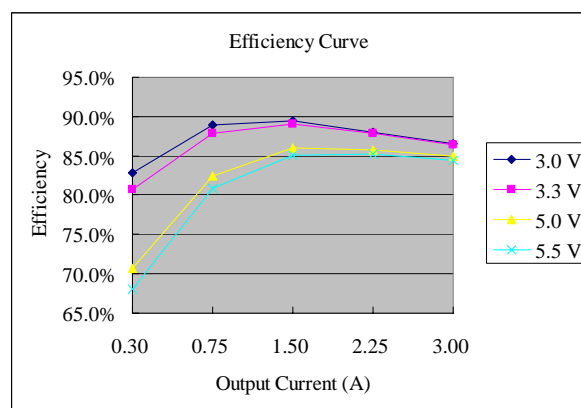
Vo=3.3 V



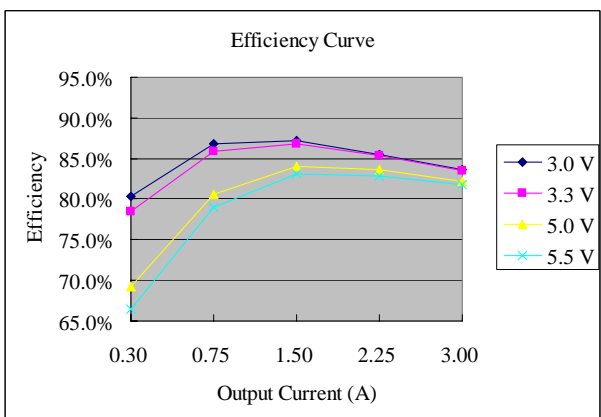
Vo=2.5 V



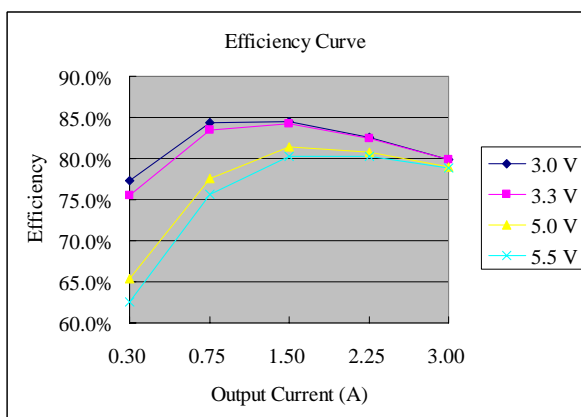
Vo=1.8 V



Vo=1.5 V



Vo=1.2 V



Vo=0.9 V

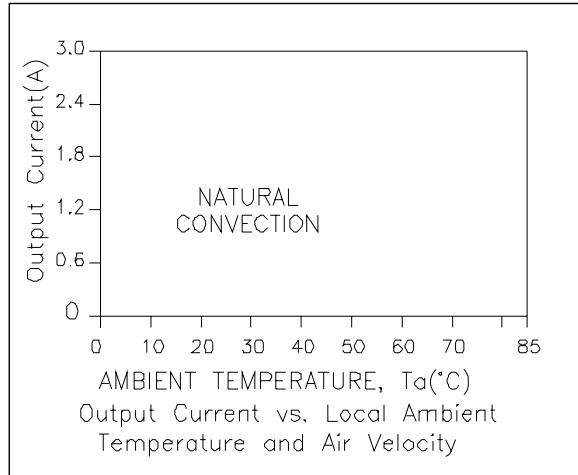
# NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

0.9 Vdc - 3.3 Vdc/3 A Output

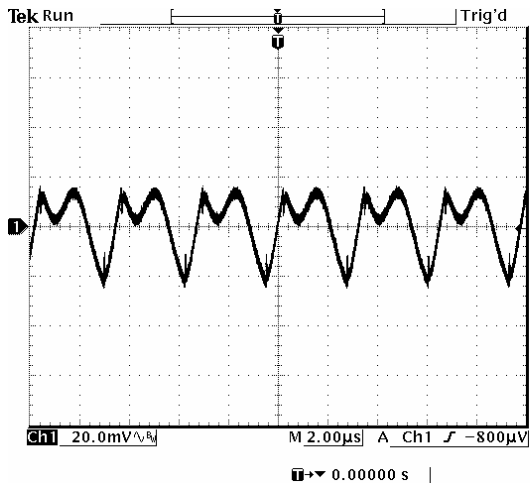


## Thermal Derating Curve

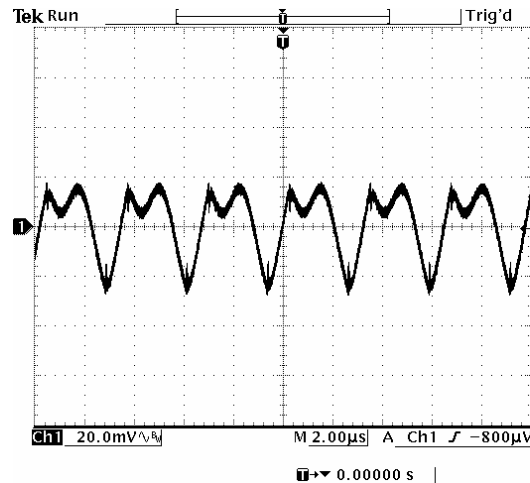


xRAH-03F1A0

## Ripple and Noise Waveforms



Vo=0.9 V

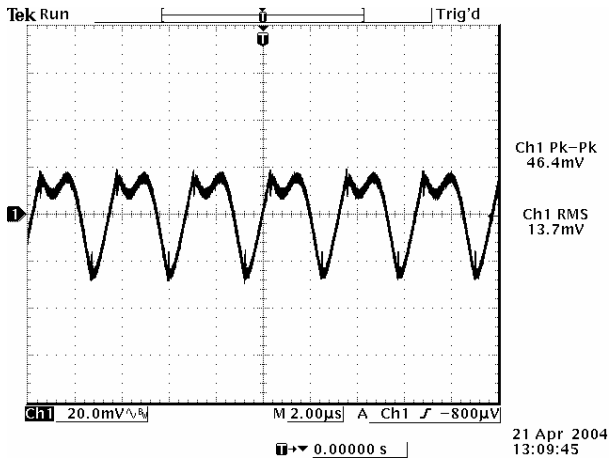


Vo=1.2 V

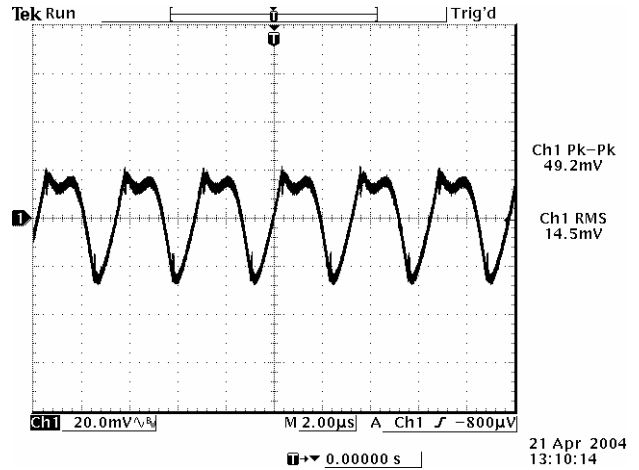
**NON-ISOLATED DC/DC CONVERTERS**  
3.0 Vdc - 5.5 Vdc Input      0.9 Vdc - 3.3 Vdc/3 A Output



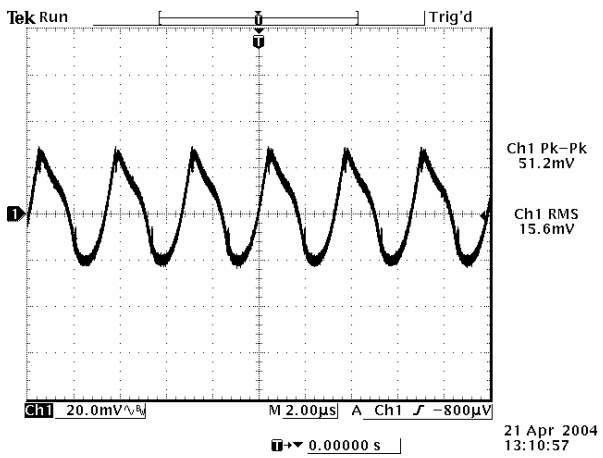
**Ripple and Noise Waveforms (continued)**



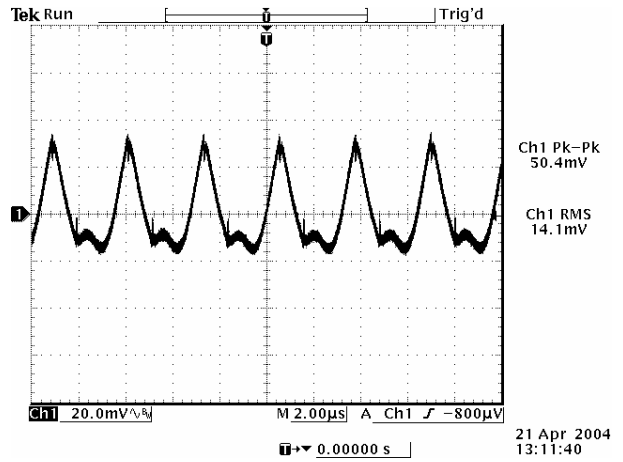
Vo=1.5 V



Vo=1.8 V



Vo=2.5 V



Vo=3.3 V

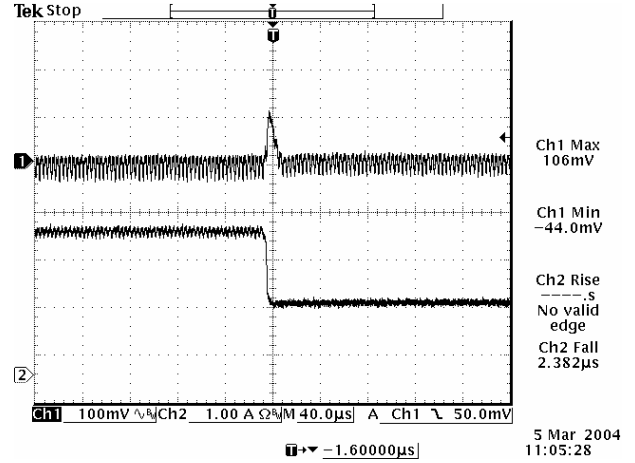
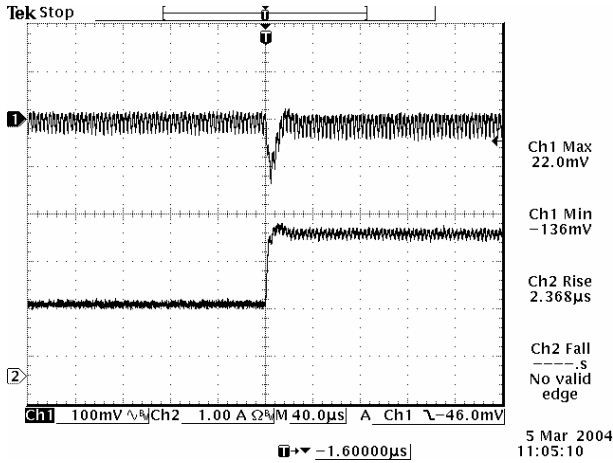
**Note:** Ripple and noise at full load, 5 Vdc input, and Ta=25 deg C.

# NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input      0.9 Vdc - 3.3 Vdc/3 A Output

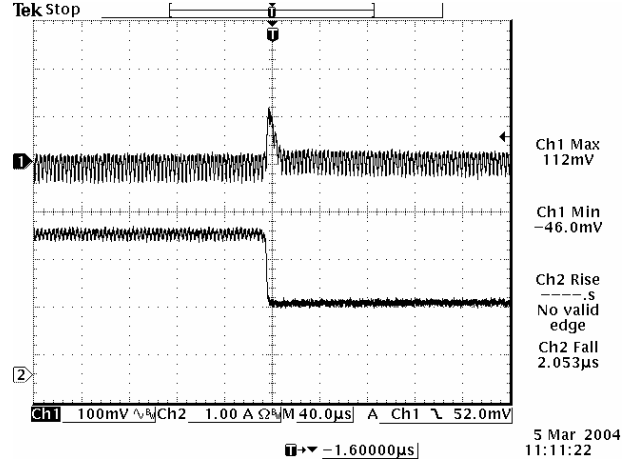
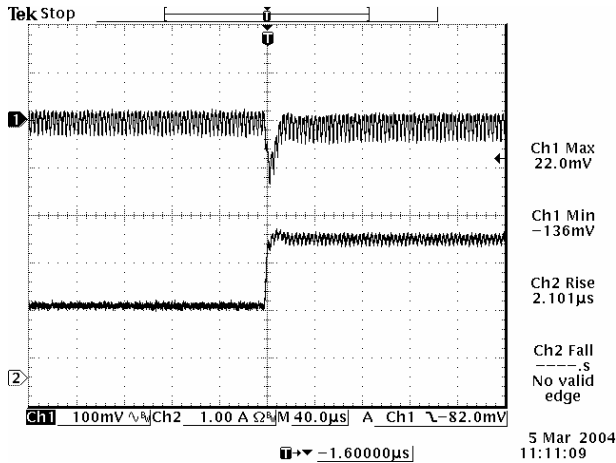


## Transient Response Waveforms



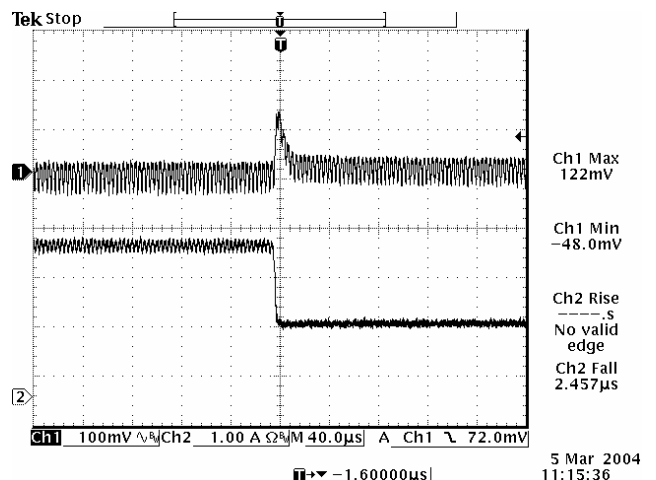
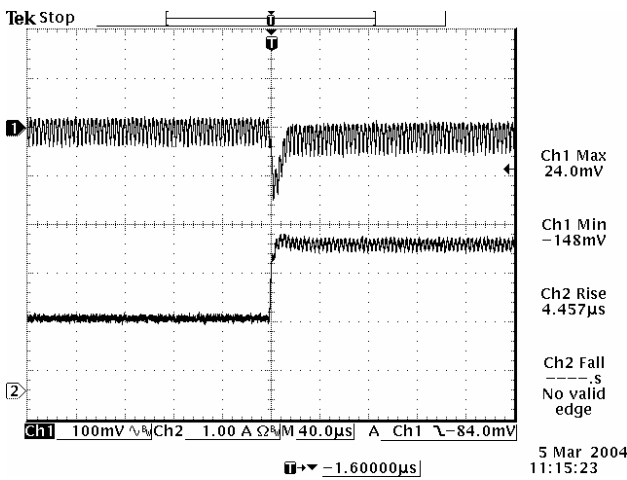
50% to 100% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=0.9\text{ V}$

100% to 50% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=0.9\text{ V}$



50% to 100% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=1.2\text{ V}$

100% to 50% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=1.2\text{ V}$



50% to 100% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=1.5\text{ V}$

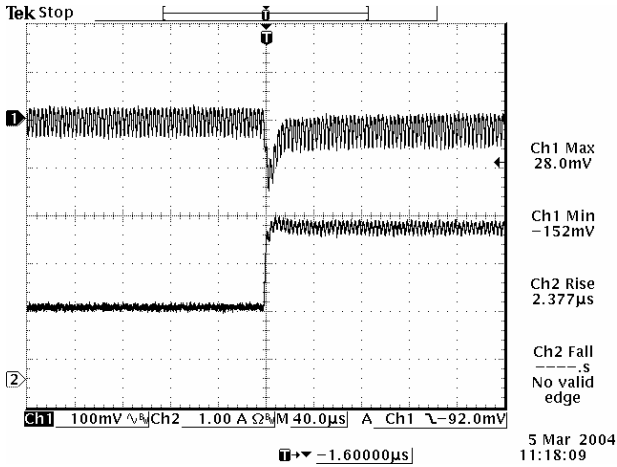
100% to 50% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=1.5\text{ V}$

# NON-ISOLATED DC/DC CONVERTERS

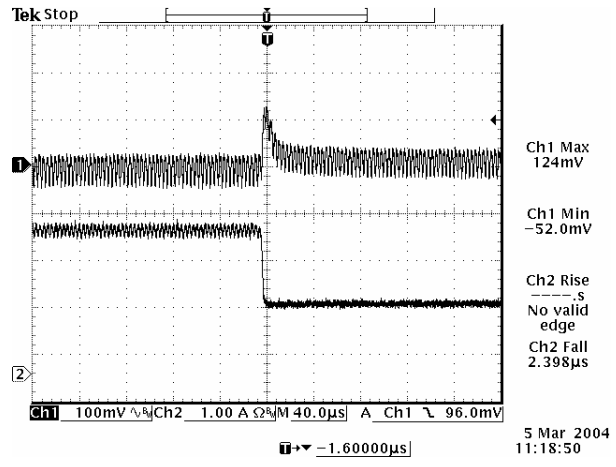
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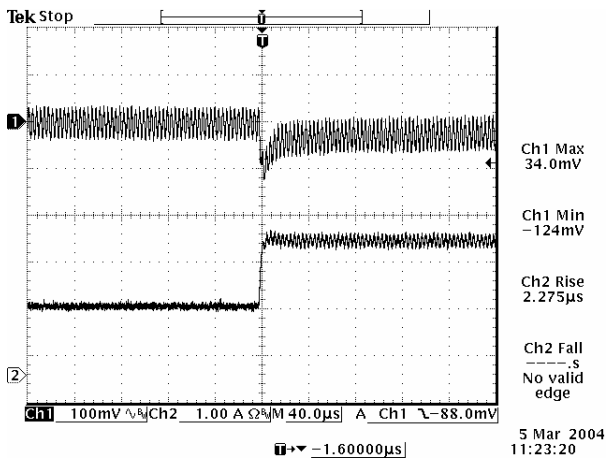
## Transient Response Waveforms (continued)



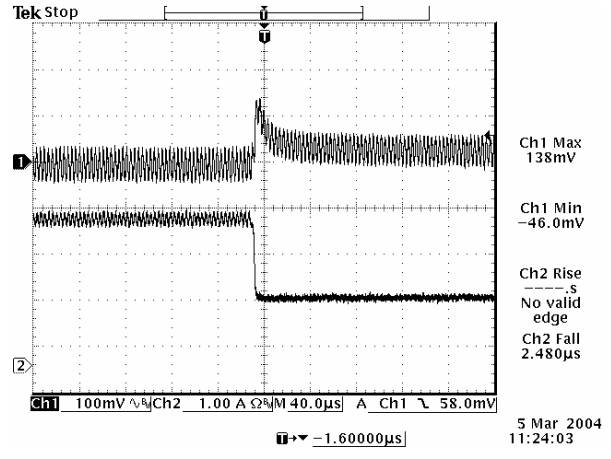
50% to 100% load Transient at Vin=5 V, Vo= 1.8 V



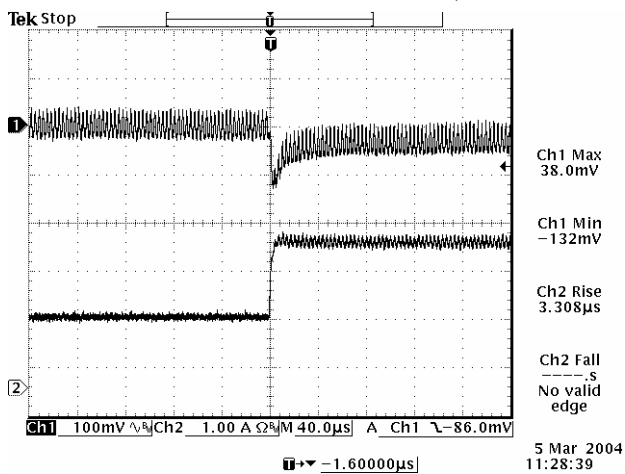
100% to 50% load Transient at Vin=5 V, Vo= 1.8 V



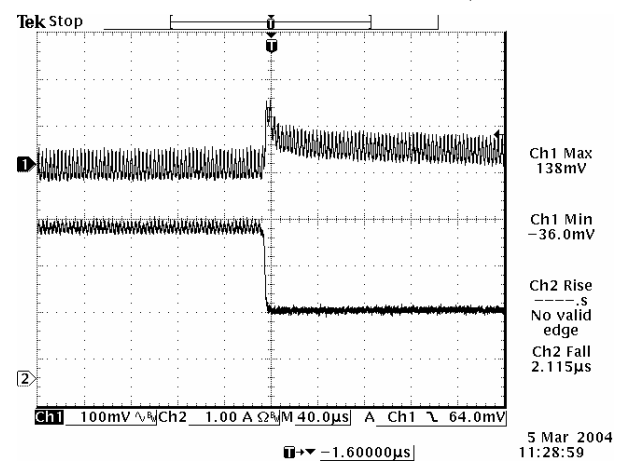
50% to 100% load Transient at Vin=5 V, Vo= 2.5 V



100% to 50% load Transient at Vin=5 V, Vo= 2.5 V



50% to 100% load Transient at Vin=5 V, Vo= 3.3 V



100% to 50% load Transient at Vin=5 V, Vo= 3.3 V

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

# NON-ISOLATED DC/DC CONVERTERS

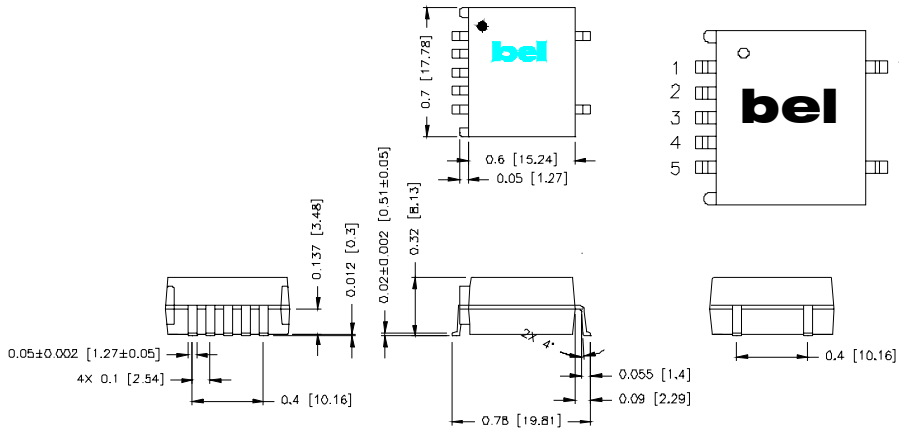
3.0 Vdc - 5.5 Vdc Input

0.9 Vdc - 3.3 Vdc/3 A Output



## Mechanical Outline

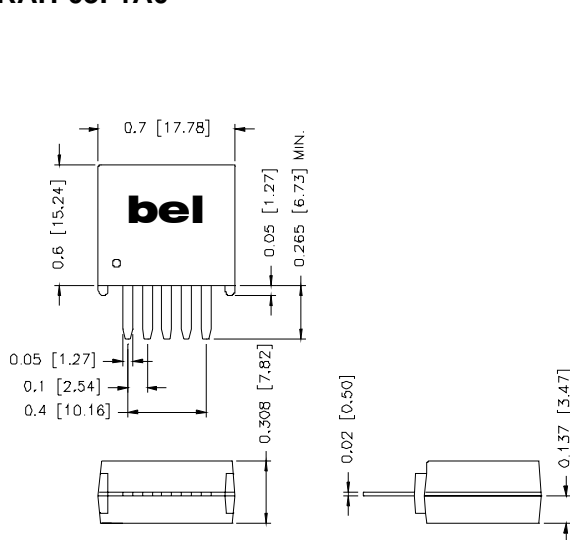
### SRAH-03F1A0



## Pin Connections

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

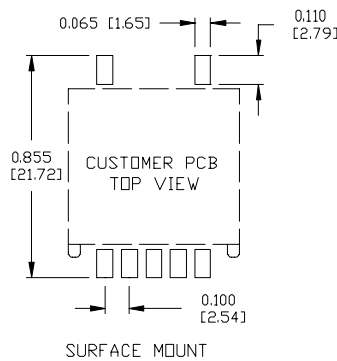
### VRAH-03F1A0



## Pin Connections

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

## RECOMMENDED PCB PAD LAYOUT



HOLE SIZE: 0.06" [1.57]  
PAD SIZE: 0.08" [2.03]

## 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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