

## NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

0.75 Vdc - 3.63 Vdc/10 A Output

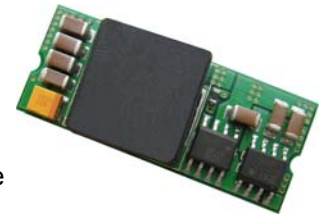
**bel**  
POWER PRODUCTS

SRBC-10F2Ax

RoHS Compliant

Rev.A

- Non-Isolated
- High Efficiency
- High Power Density
- Fixed Frequency(300 kHz)
- OCP/SCP
- Flexible Output Voltage Sequencing
- Remote Sense
- Under-Voltage Lockout (UVLO)
- Over Temperature Protection
- Wide Input Range
- Wide Trim Range
- Remote On/Off
- Converter Can Sink and Source Current
- Active Low/High (Option)



### Description

The Bel SRBC-10F2Ax modules are a series of non-isolated dc/dc converters that deliver up to 10 A of output current with full load efficiency of 95% at 3.3 Vdc output. These modules provide precisely regulated voltage programmable via external resistor from 0.75 Vdc to 3.63 Vdc over a wide range of input voltage (2.4 Vdc - 5.5 Vdc). These modules have a sequencing feature that enables designers to implement various types of output voltage sequencing when powering multiple voltages on a board. The open-frame construction and small footprint enable designers to develop cost and space-efficient solutions. Standard features include remote On/Off, remote sense, over current protection, short current protection, wide input, and programmable output voltage.

### Part Selection

| Output Voltage               | Input Voltage | Max. Output Current | Max. Output Power | Typical Efficiency | Model Number Active Low | Model Number Active High |
|------------------------------|---------------|---------------------|-------------------|--------------------|-------------------------|--------------------------|
| 0.75 V - 3.63 V <sup>1</sup> | 2.4 V - 5.5 V | 10 A                | 36.3 W            | 95%                | SRBC-10F2AL             | SRBC-10F2A0              |

**Notes:** 1. These modules use a buck topology, so the output voltages must be 0.5 V less than the input voltage.  
2. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers.  
3. Add "G" to the end of the Model Number to indicate Tray Packaging.

### Absolute Maximum Ratings

| Parameter                       | Min    | Typ | Max             | Notes |
|---------------------------------|--------|-----|-----------------|-------|
| Input Voltage (continuous)      | -0.3 V | -   | 5.8 V           |       |
| Output Enable Terminal Voltage  | -0.3 V | -   | 5.8 V           |       |
| Sequencing Voltage <sup>1</sup> | -0.3 V | -   | V <sub>in</sub> |       |
| Ambient Temperature             | -40 °C | -   | 85 °C           |       |
| Storage Temperature             | -55 °C | -   | 125 °C          |       |

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

1. SRBC-10F2Ax series of modules include a sequencing feature that enables users to implement various types of output voltage sequencing in their applications. This is accomplished via an additional sequencing pin. When the sequencing feature is not used, tie the SEQ pin to V<sub>in</sub> or leave the SEQ pin floating.

## NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

0.75 Vdc - 3.63 Vdc/10 A Output



### Input Specifications

| Parameter                              | Min   | Typ    | Max                  | Notes                                                                                                                   |
|----------------------------------------|-------|--------|----------------------|-------------------------------------------------------------------------------------------------------------------------|
| Input Voltage                          | 2.4 V | -      | 5.5 V                | $V_{o, set} \leq V_{in} - 0.5 V$                                                                                        |
| Input Current (full load)              |       |        |                      |                                                                                                                         |
| $V_o = 3.3 V$                          | -     | 7.0 A  | 8.0 A                |                                                                                                                         |
| $V_o = 2.5 V$                          | -     | 5.5 A  | 9.5 A                |                                                                                                                         |
| $V_o = 1.8 V$                          | -     | 4.0 A  | 9.0 A                |                                                                                                                         |
| $V_o = 1.5 V$                          | -     | 3.5 A  | 7.5 A                |                                                                                                                         |
| $V_o = 1.2 V$                          | -     | 3.0 A  | 6.0 A                |                                                                                                                         |
| $V_o = 0.75 V$                         | -     | 2.0 A  | 4.0 A                |                                                                                                                         |
| Input Current (no load)                | -     | 80 mA  | -                    |                                                                                                                         |
| Remote Off Input Current               | -     | 15 mA  | -                    |                                                                                                                         |
| Input Reflected Ripple Current (pk-pk) | -     | 140 mA | -                    | Tested with two 100 $\mu F$ /10 V tantalum input capacitors & simulated source impedance of 1 $\mu H$ , 5 Hz to 20 MHz. |
| Input Reflected Ripple Current (rms)   | -     | 40 mA  | -                    |                                                                                                                         |
| $I^2t$ Inrush Current Transient        | -     | -      | 0.2 A <sup>2</sup> s |                                                                                                                         |
| Turn-on Voltage Threshold              | -     | 2.2 V  | -                    |                                                                                                                         |
| Turn-off Voltage Threshold             | -     | 2.0 V  | -                    |                                                                                                                         |

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

### Output Specifications

| Parameter                                      | Min              | Typ               | Max                  | Notes                                                                                                                                         |
|------------------------------------------------|------------------|-------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Output Voltage Set Point                       | -2% $V_{o, set}$ | -                 | 2% $V_{o, set}$      | $V_{in} = 5 V$ , $I_o = I_{o, max}$ full load                                                                                                 |
| Output Voltage Set Point                       | -3% $V_{o, set}$ | -                 | 3% $V_{o, set}$      | Over all operating input voltages, resistive loads and temperature conditions                                                                 |
| Load Regulation                                | -                | 0.4% $V_{o, set}$ | -                    | $I_o = I_{o, min}$ to $I_{o, max}$                                                                                                            |
| Line Regulation                                | -                | 0.3% $V_{o, set}$ | -                    | $V_{in} = V_{in, min}$ to $V_{in, max}$                                                                                                       |
| Regulation Over Temperature (-40 °C to +85 °C) | -                | 0.5% $V_{o, set}$ | -                    | $T_{ref} = T_{amin}$ to $T_{amax}$                                                                                                            |
| Output Current                                 | 0 A              | -                 | 10 A                 |                                                                                                                                               |
| Current Limit Threshold                        | 15 A             | -                 | 27 A                 |                                                                                                                                               |
| Short Circuit Surge Transient                  | -                | -                 | 1.5 A <sup>2</sup> s |                                                                                                                                               |
| Ripple and Noise (pk-pk)                       | -                | 25 mV             | 50 mV                | Tested with 0-20 MHz, 10 $\mu F$ /16 V tantalum capacitor & 1 $\mu F$ /10 V TDK ceramic capacitor at the output                               |
| Ripple and Noise (rms)                         | -                | 8 mV              | 15 mV                |                                                                                                                                               |
| Turn on Time                                   | -                | 4 mS              | 8 mS                 |                                                                                                                                               |
| Overshoot at Turn on                           | -                | 0% $V_{o, set}$   | 3% $V_{o, set}$      |                                                                                                                                               |
| Output Capacitance                             |                  |                   |                      |                                                                                                                                               |
| $ESR \geq 1m \text{ ohm}$                      | 0 $\mu F$        | -                 | 1000 $\mu F$         |                                                                                                                                               |
| $ESR \geq 10m \text{ ohm}$                     | 0 $\mu F$        | -                 | 4700 $\mu F$         |                                                                                                                                               |
| <b>Transient Response</b>                      |                  |                   |                      |                                                                                                                                               |
| 50% ~ 100% Max Load                            | $V_o = 3.3 V$    | -                 | 130 mV               | $di/dt = 2.5 A/\mu S$ ; $V_{in} = 5 V$ ; and with two 150 $\mu F$ /16 V tantalum capacitors & 1 $\mu F$ /10 V ceramic capacitor at the output |
| Settling Time                                  |                  | -                 | 50 $\mu S$           |                                                                                                                                               |
| 100% ~ 50% Max Load                            |                  | -                 | 150 mV               |                                                                                                                                               |
| Settling Time                                  |                  | -                 | 50 $\mu S$           |                                                                                                                                               |

## NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

0.75 Vdc - 3.63 Vdc/10 A Output



### Output Specifications (continued)

| Parameter                 | Min | Typ    | Max | Notes                                                                                                            |
|---------------------------|-----|--------|-----|------------------------------------------------------------------------------------------------------------------|
| <b>Transient Response</b> |     |        |     |                                                                                                                  |
| 50% ~ 100% Max Load       | -   | 130 mV | -   | di/dt=2.5 A/uS; Vin=5 V; and with two 150 uF/16 V tantalum capacitors & 1uF/10 V ceramic capacitor at the output |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 100% ~ 50% Max Load       | -   | 130 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 50% ~ 100% Max Load       | -   | 120 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 100% ~ 50% Max Load       | -   | 120 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 50% ~ 100% Max Load       | -   | 120 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 100% ~ 50% Max Load       | -   | 120 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 50% ~ 100% Max Load       | -   | 130 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 100% ~ 50% Max Load       | -   | 130 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 50% ~ 100% Max Load       | -   | 120 mV | -   | Vo=2.5 V                                                                                                         |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 100% ~ 50% Max Load       | -   | 120 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 50% ~ 100% Max Load       | -   | 120 mV | -   | Vo=1.8 V                                                                                                         |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 100% ~ 50% Max Load       | -   | 120 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 50% ~ 100% Max Load       | -   | 120 mV | -   | Vo=1.5 V                                                                                                         |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 100% ~ 50% Max Load       | -   | 120 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 50% ~ 100% Max Load       | -   | 130 mV | -   | Vo=1.2 V                                                                                                         |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 100% ~ 50% Max Load       | -   | 130 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 50% ~ 100% Max Load       | -   | 120 mV | -   | Vo=0.75 V                                                                                                        |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |
| 100% ~ 50% Max Load       | -   | 140 mV | -   |                                                                                                                  |
| Settling Time             | -   | 50 uS  | -   |                                                                                                                  |

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

### General Specifications

| Parameter                     | Min                  | Typ     | Max     | Notes                                                      |
|-------------------------------|----------------------|---------|---------|------------------------------------------------------------|
| Efficiency                    |                      |         |         | Measured at Vin=5 V, full load                             |
| Vo=3.3 V                      | 92%                  | 95%     | -       |                                                            |
| Vo=2.5 V                      | 90%                  | 93%     | -       |                                                            |
| Vo=1.8 V                      | 88%                  | 91%     | -       |                                                            |
| Vo=1.5 V                      | 87%                  | 90%     | -       |                                                            |
| Vo=1.2 V                      | 85%                  | 88%     | -       |                                                            |
| Vo=0.75 V                     | 79%                  | 82%     | -       |                                                            |
| Switching Frequency           | 250 kHz              | 300 kHz | 350 kHz |                                                            |
| Over Temperature Shutdown     | -                    | 125 °C  | -       |                                                            |
| Output Trim Range (Wide Trim) | 0.7525 V             | -       | 3.63 V  |                                                            |
| Remote Sense Compensation     | -                    | 10%     | -       |                                                            |
| MTBF                          | 6,643,156 hours      |         |         | Calculated Per Bell Core SR-332 (Io = Nominal; Ta = 25 °C) |
| Dimensions                    |                      |         |         |                                                            |
| Inches (L x W x H)            | 1.30 x 0.53 x 0.315  |         |         |                                                            |
| Millimeters (L x W x H)       | 33.02 x 13.46 x 8.00 |         |         |                                                            |
| Weight                        | -                    | 6.6 g   | -       |                                                            |

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

## NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

0.75 Vdc - 3.63 Vdc/10 A Output



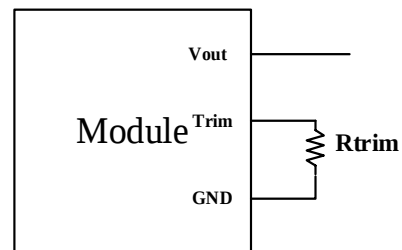
### Control Specifications

| Parameter                       | Min    | Typ    | Max             | Notes                                                                 |
|---------------------------------|--------|--------|-----------------|-----------------------------------------------------------------------|
| Signal Low (Unit Off)           | -0.3 V | -      | 0.3 V           | SRBC-10F2A0; Remote On/Off pin open, Unit on.                         |
| Signal High (Unit On)           | 1.5 V  | -      | 5.8 V           |                                                                       |
| Signal Low (Unit On)            | -0.3 V | -      | 0.3 V           | SRBC-10F2AL; Remote On/Off pin open, Unit on.                         |
| Signal High (Unit Off)          | 1.5 V  | -      | 5.8 V           |                                                                       |
| Sequencing Voltage              | 0.05 V | -      | V <sub>in</sub> | Sequencing Voltage should be higher than output voltage.              |
| Sequencing Slew Rate Capability | -      | -      | 2 V/mS          |                                                                       |
| Sequencing Delay Time           | 10 mS  | -      | -               | Delay from V <sub>in</sub> , min to application of voltage on SEQ pin |
| Tracking Accuracy               |        |        |                 |                                                                       |
| Power-Up                        | -      | 100 mV | 200 mV          |                                                                       |
| Power-Down                      | -      | 200 mV | 400 mV          |                                                                       |

### Output Trim Equations

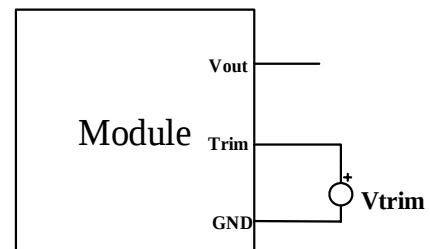
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage (V<sub>adj</sub>) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

$$R_{trim} = \frac{21.07}{V_{adj} - 0.7525} - 5.11$$



Equation for calculating the trim voltage (in V) given the desired adjusted voltage (V<sub>adj</sub>) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

$$V_{trim} = 0.7 - 0.1698 \times (V_{adj} - 0.7525)$$



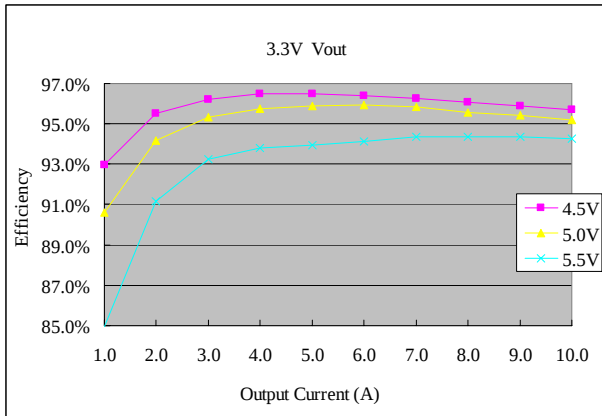
# NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

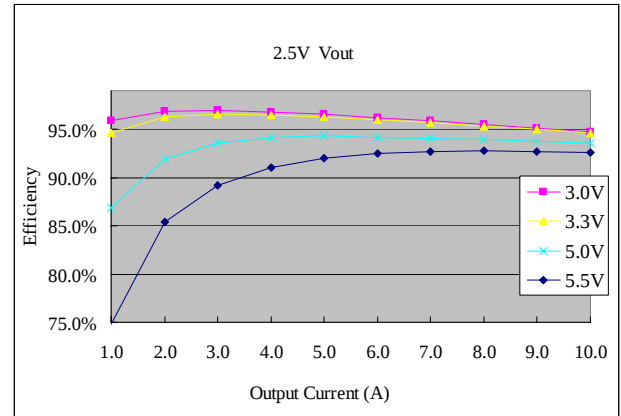
0.75 Vdc - 3.63 Vdc/10 A Output



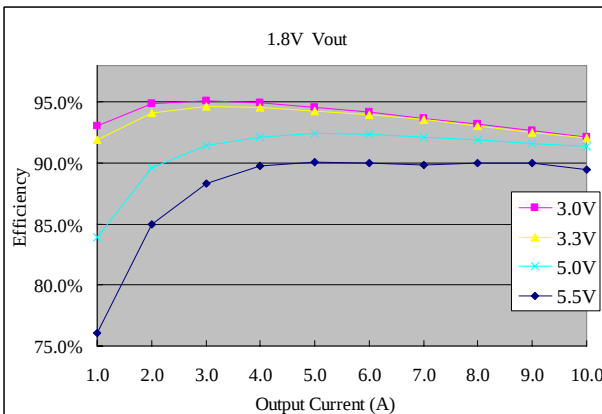
## Efficiency Data



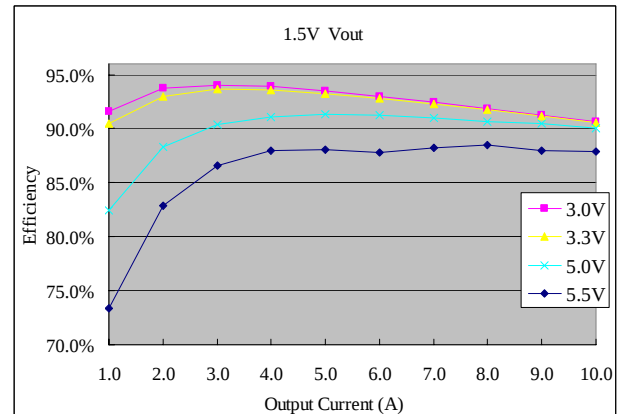
Vo=3.3 V



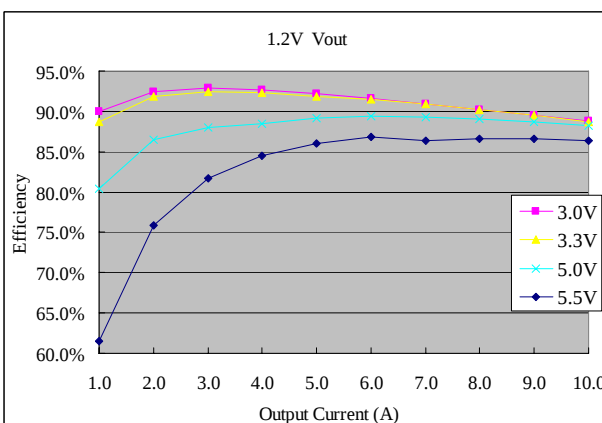
Vo=2.5 V



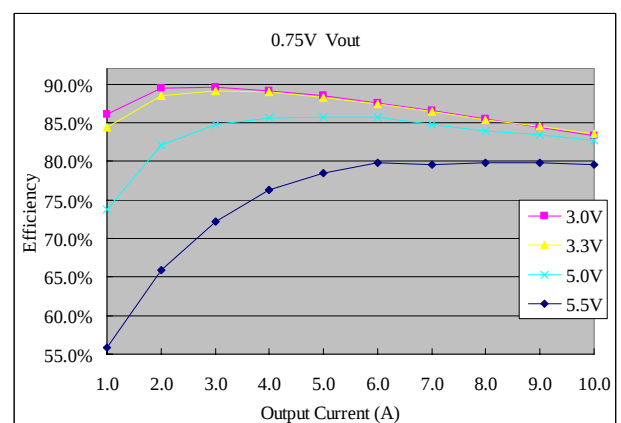
Vo=1.8 V



Vo=1.5 V



Vo=1.2 V



Vo=0.7525 V

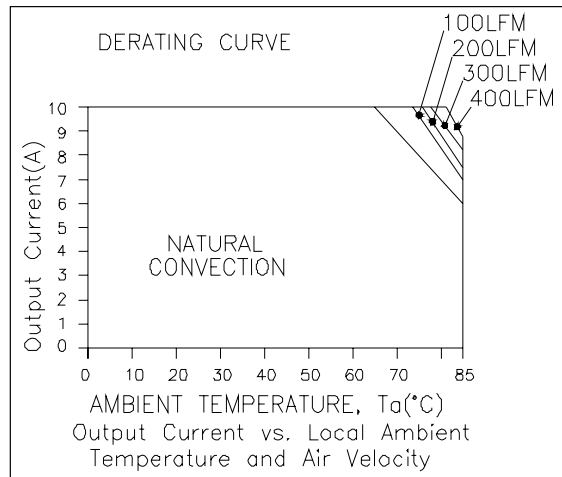
## NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

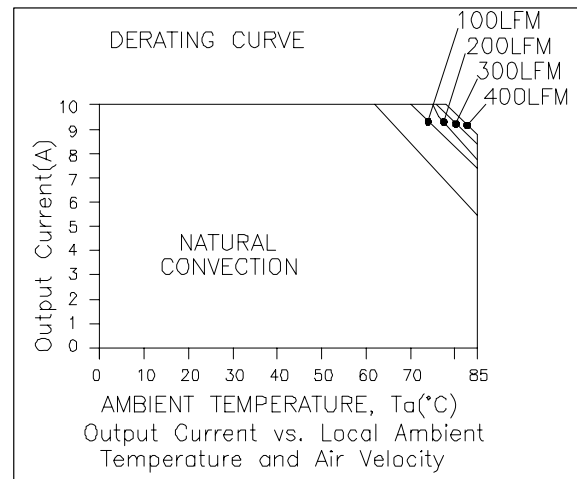
0.75 Vdc - 3.63 Vdc/10 A Output

**bel**  
POWER PRODUCTS

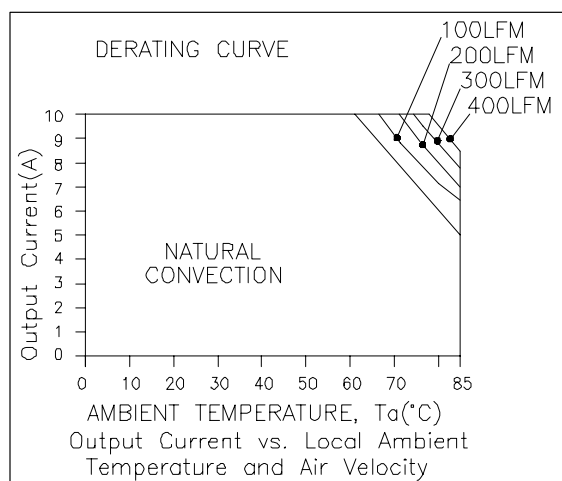
### Thermal Derating Curves



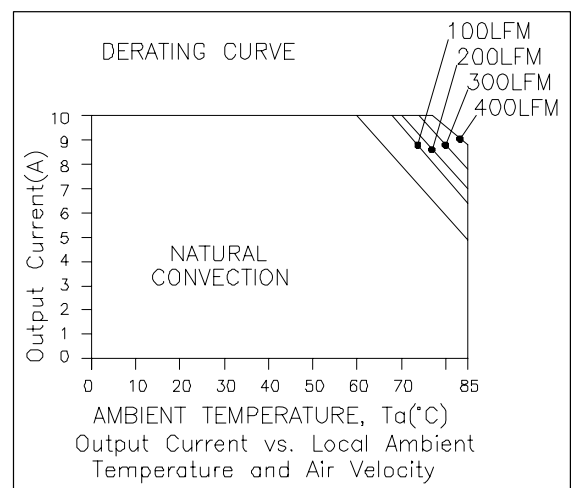
Vin=5.0 V, Vo=0.75 V



Vin=5.0 V, Vo=1.5 V



Vin=5.0 V, Vo=2.5 V



Vin=5.0 V, Vo=3.3 V

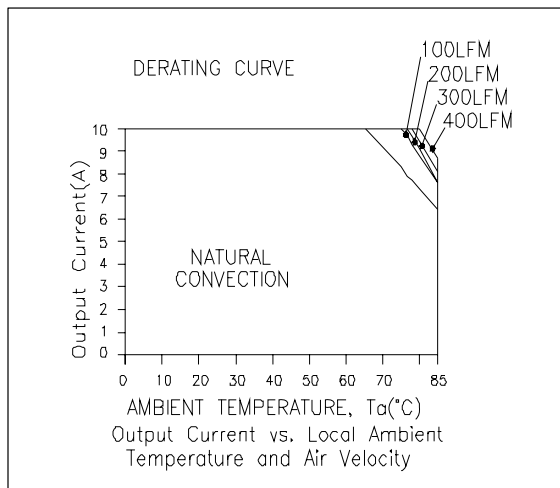
## NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

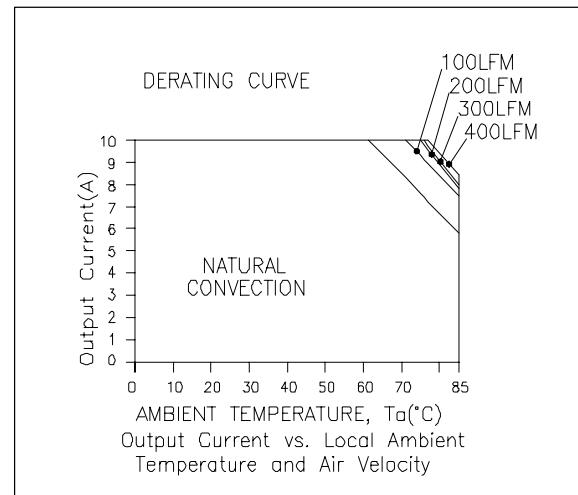
0.75 Vdc - 3.63 Vdc/10 A Output

**bel**  
POWER PRODUCTS

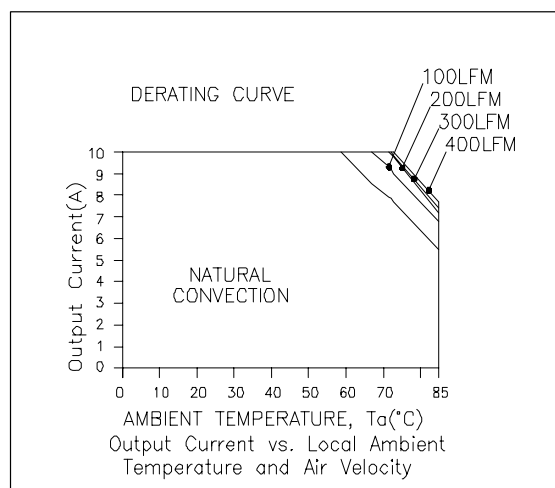
### Thermal Derating Curves (continued)



$V_{in}=3.3\text{ V}$ ,  $V_o=0.75\text{ V}$



$V_{in}=3.3\text{ V}$ ,  $V_o=1.5\text{ V}$



$V_{in}=3.3\text{ V}$ ,  $V_o=2.5\text{ V}$

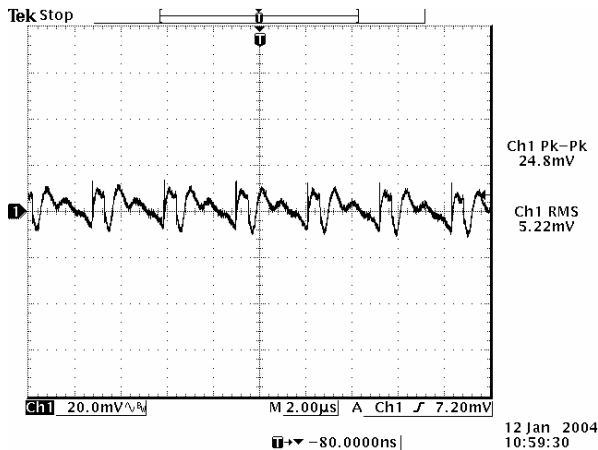
## NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

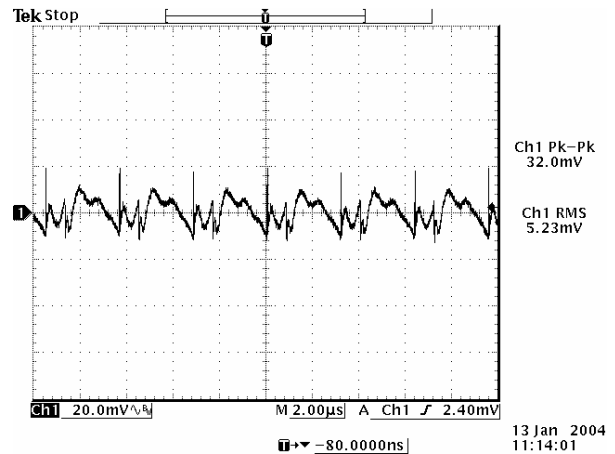
0.75 Vdc - 3.63 Vdc/10 A Output

**bel**  
POWER PRODUCTS

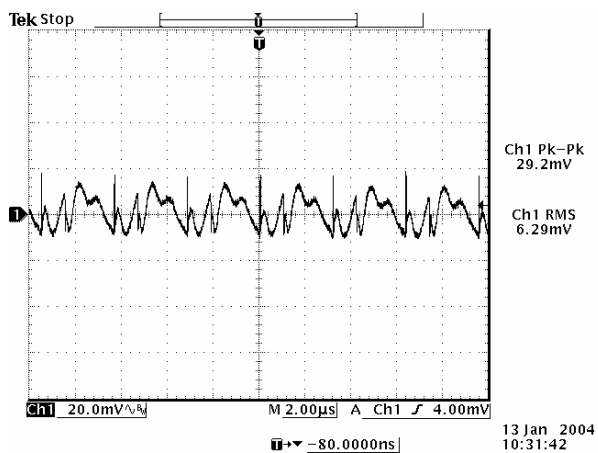
### Ripple and Noise Waveforms



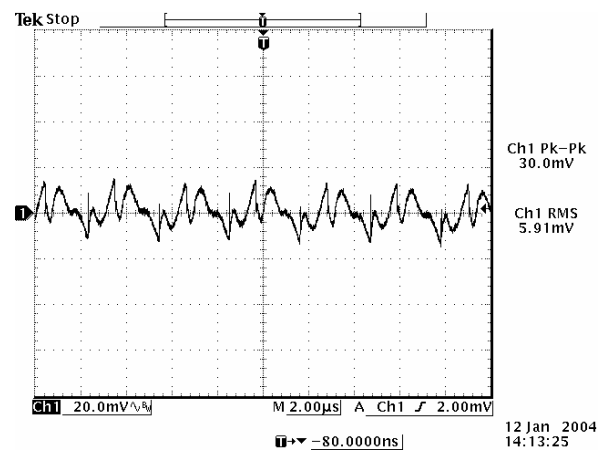
Ripple and noise at full load, 0.75 V output



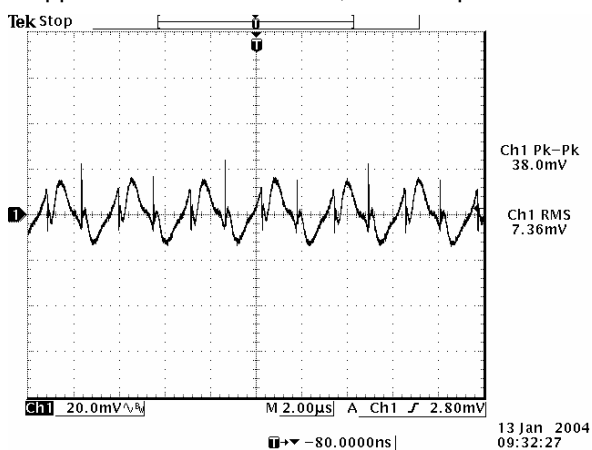
Ripple and noise at full load, 1.2 V output



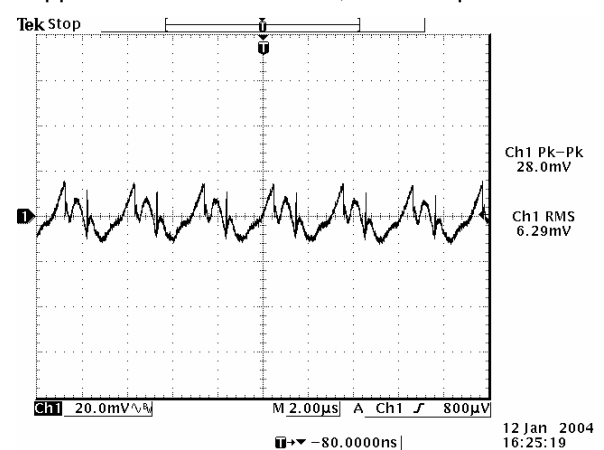
Ripple and noise at full load, 1.5 V output



Ripple and noise at full load, 1.8 V output



Ripple and noise at full load, 2.5 V output



Ripple and noise at full load, 3.3 V output

**Note:** Ripple and noise at 5.0 V input, 0-20MHz BW, 10 µF/16 V tantalum cap and 1µF/10 V ceramic capacitor, Ta=25 deg C.

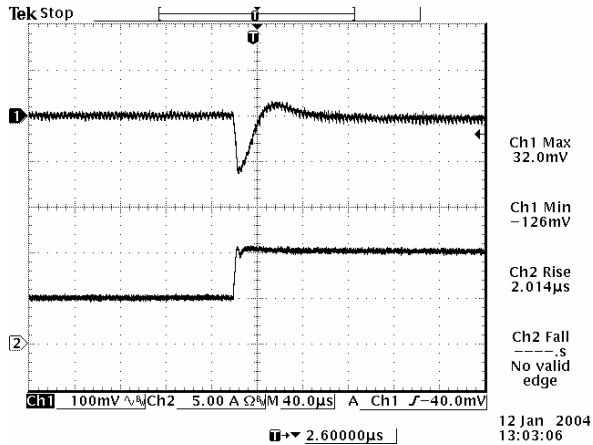
# NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

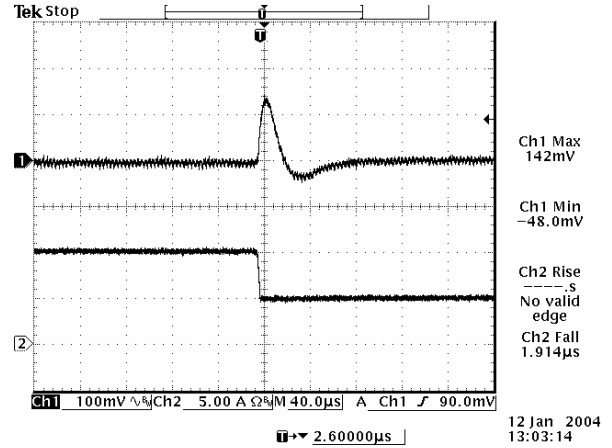
0.75 Vdc - 3.63 Vdc/10 A Output



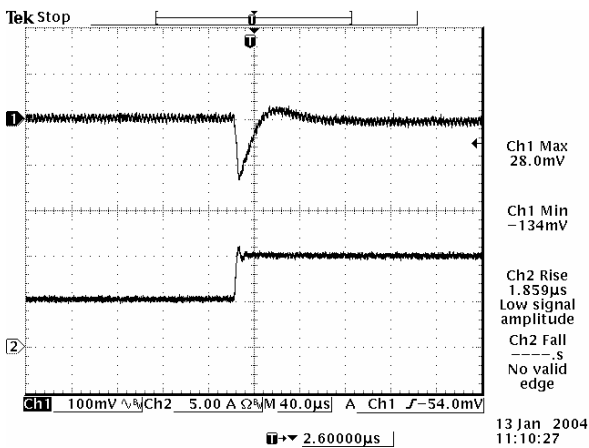
## Transient Response Waveforms



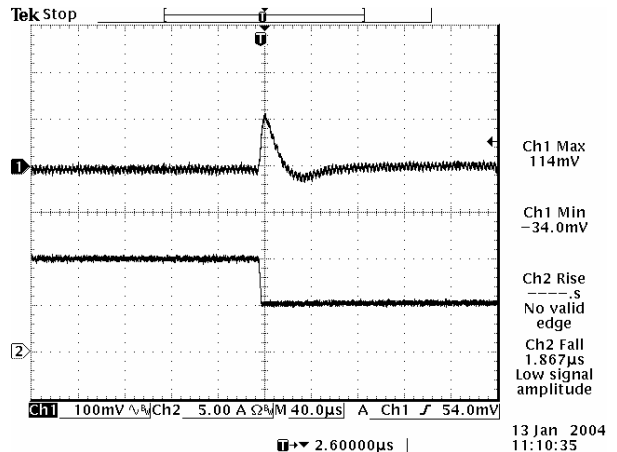
50% to 100% load step at 0.75 V output



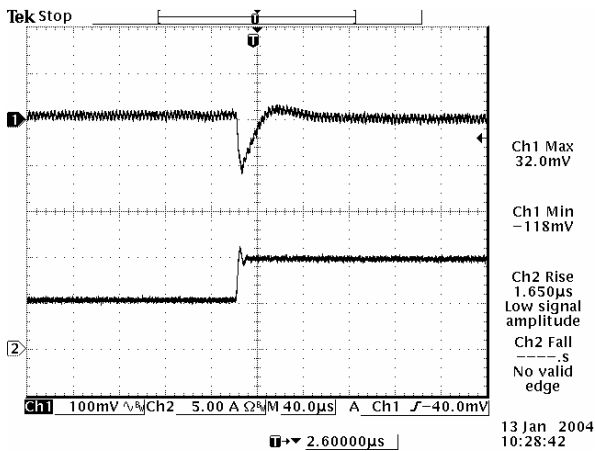
100% to 50% load step at 0.75 V output



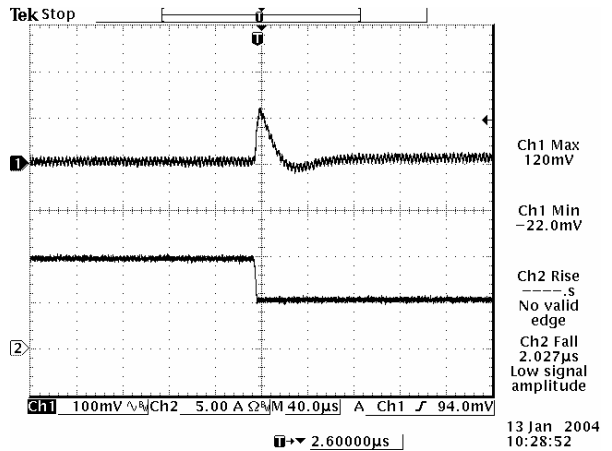
50% to 100% load step at 1.2 V output



100% to 50% load step at 1.2 V output



50% to 100% load step at 1.5 V output



100% to 50% load step at 1.5 V output

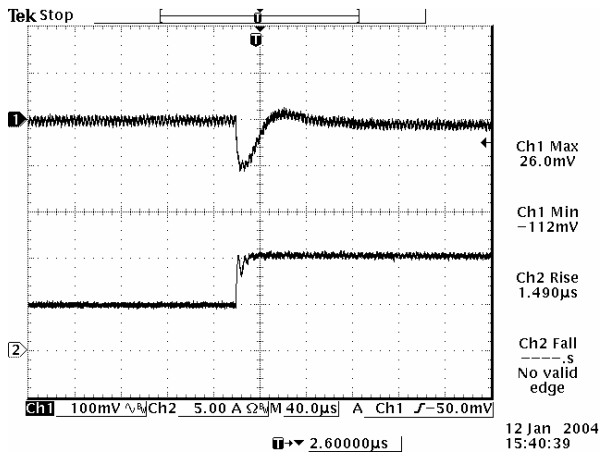
# NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

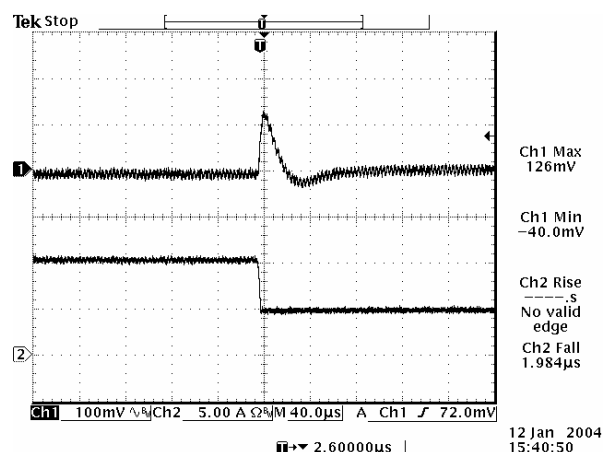
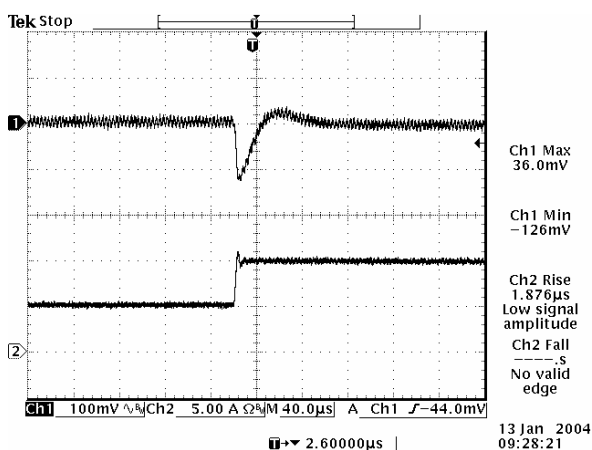
0.75 Vdc - 3.63 Vdc/10 A Output



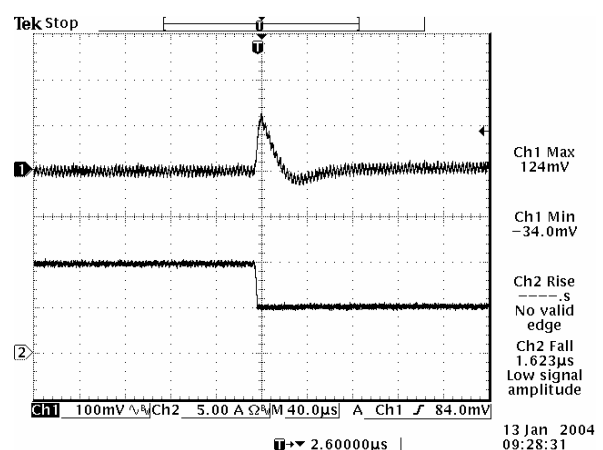
## Transient Response Waveforms (continued)



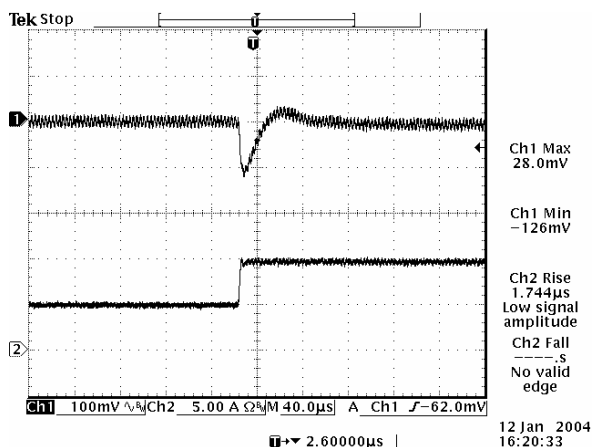
50% to 100% load step at 1.8 V output



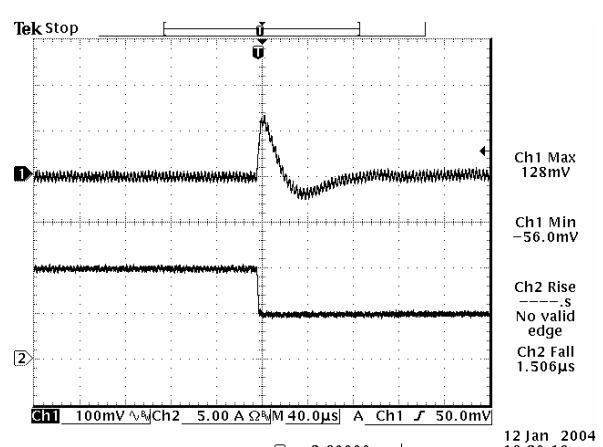
100% to 50% load step at 1.8 V output



50% to 100% load step at 2.5 V output



100% to 50% load step at 2.5 V output



50% to 100% load step at 3.3 V output

100% to 50% load step at 3.3 V output

**Note:** Transient response at 5.0 V input,  $di/dt=2.5$  A/µs, with two 150 µF/16 V tantalum capacitors and 1 µF/10 V ceramic capacitor,  $T_a=25$  deg C.

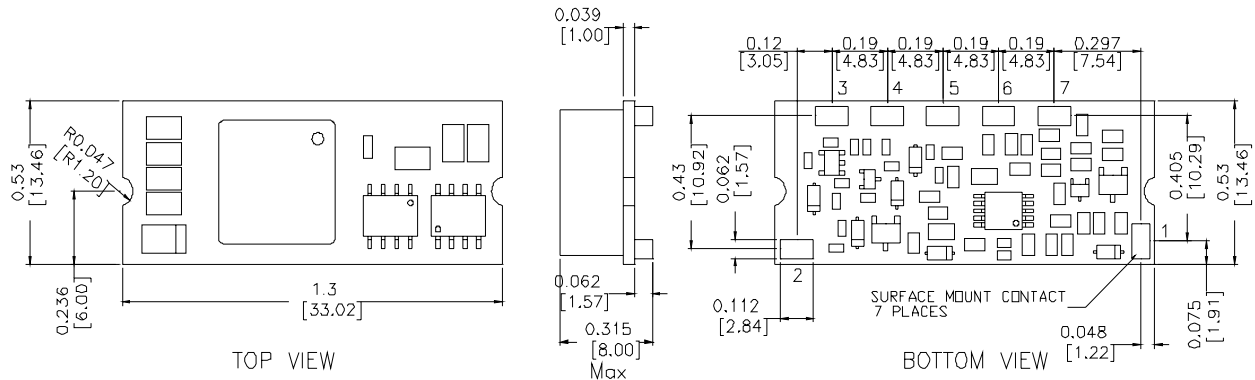
## NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

0.75 Vdc - 3.63 Vdc/10 A Output

**bel**  
POWER PRODUCTS

### Mechanical Outline



### Pin Connections

| Pin | Function      |
|-----|---------------|
| 1   | Remote On/Off |
| 2   | Vin           |
| 3   | SEQ           |
| 4   | Ground        |
| 5   | Vout          |
| 6   | Trim          |
| 7   | Remote Sense  |

### PAD SIZE:

MIN: 0.14" \* 0.095" (3.56mm \* 2.41mm)

MAX: 0.165" \* 0.11" (4.19mm \* 2.79mm)

### RoHS Compliance

Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products.



©2007 Bel Fuse Inc. Specifications subject to change without notice. 011707

#### CORPORATE

Bel Fuse Inc.  
206 Van Vorst Street  
Jersey City, NJ 07302  
Tel 201-432-0463  
Fax 201-432-9542  
[www.belfuse.com](http://www.belfuse.com)

#### FAR EAST

Bel Fuse Ltd.  
8F/ 8 Luk Hop Street  
San Po Kong  
Kowloon, Hong Kong  
Tel 852-2328-5515  
Fax 852-2352-3706  
[www.belfuse.com](http://www.belfuse.com)

#### EUROPE

Bel Fuse Europe Ltd.  
Preston Technology Management Centre  
Marsh Lane, Suite G7, Preston  
Lancashire, PR1 8UD, U.K.  
Tel 44-1772-556601  
Fax 44-1772-888366  
[www.belfuse.com](http://www.belfuse.com)