

## NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input      0.75 Vdc - 3.63 Vdc/10 A Output



Jan. 25, 2013

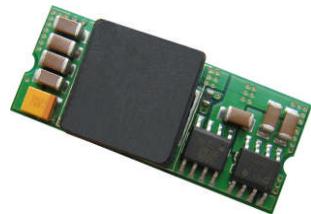
*Bel Power, Inc. , a subsidiary of Bel Fuse, Inc.*

**SRBC-10F2Ax**

**RoHS Compliant**

**Rev.C**

- Non-Isolated
- High Efficiency
- High Power Density
- Fixed Frequency(300 kHz)
- OCP/SCP
- Flexible Output Voltage Sequencing
- Remote Sense
- Certificated to UL60950-1/CSA C22.2 No.60950-1, 2rd edition, am1
- Under-Voltage Lockout (UVLO)
- Over Temperature Protection
- Wide Input Range
- Wide Trim Range
- Remote On/Off
- Converter Can Sink and Source Current



### Applications

- Networking
- Computers and peripherals
- Telecommunications

### 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. Add "G" to the end of the Model Number to indicate Tray Packaging.

### Part Number Explanation

**S R BC - 10 F 2A x**  
1 2 3 4 5 6 7

1---Surface mount

2---RoHS 6, change "R" to "7" means RoHS 5

3---Series name

4---Series code

5---Wide input range (2.4-5.5V)

6---Wide trim

7---Option, "x" of the model part number to be 0-9, A-Z, which will represent the special request of customer.

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### 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 | -   | Vin    |       |
| Ambient Temperature             | -40 °C | -   | 85 °C  |       |
| Storage Temperature             | -55 °C | -   | 125 °C |       |

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

- 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 Vin or leave the SEQ pin floating.

### Input Specifications

| Parameter                                 | Min   | Typ    | Max                  | Notes  |
|---|-------|--------|----------------------|--|
| Input Voltage                             | 2.4 V | -      | 5.5 V                | Vo, set ≤ Vin-0.5 V  |
| Input Current (full load)                 |       |        |                      |  |
| Vo=3.3 V                                  | -     | 7.0 A  | 8.0 A                |  |
| Vo=2.5 V                                  | -     | 5.5 A  | 9.5 A                |  |
| Vo=1.8 V                                  | -     | 4.0 A  | 9.0 A                |  |
| Vo=1.5 V                                  | -     | 3.5 A  | 7.5 A                |  |
| Vo=1.2 V                                  | -     | 3.0 A  | 6.0 A                |  |
| Vo=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 uF/10 V tantalum input capacitors & simulated source impedance of 1uH, 5 Hz to 20 MHz. |
| Input Reflected Ripple Current (rms)      | -     | 40 mA  | -                    |  |
| I <sup>2</sup> t 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% Vo,set | -           | 2% Vo,set            | Vin=5 V, Io=lomax full load   |
| Output Voltage Set Point                       | -3% Vo,set | -           | 3% Vo,set            | Over all operating input voltages, resistive loads and temperature conditions                       |
| Load Regulation                                | -          | 0.4% Vo,set | -                    | Io=lomin to lomax   |
| Line Regulation                                | -          | 0.3% Vo,set | -                    | Vin=Vinmin to Vinmax  |
| Regulation Over Temperature (-40 °C to +85 °C) | -          | 0.5% Vo,set | -                    | Tref=Tamin to Tamax   |
| 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 uF/16 V tantalum capacitor & 1 uF/10 V TDK ceramic capacitor at the output |
| Ripple and Noise (rms)                         | -          | 8 mV        | 15 mV                |   |

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**Output Specifications (continued)**

| Parameter                 |           | Min | Typ       | Max       | Notes   |
|---------------------------|-----------|-----|-----------|-----------|---|
| Turn on Time              |           | -   | 4 mS      | 8 mS      | Turn on Time  |
| Overshoot at Turn on      |           | -   | 0% Vo,set | 3% Vo,set | Overshoot at Turn on  |
| Output Capacitance        |           |     |           |           | Output Capacitance  |
| ESR ≥ 1m ohm              | 0 uF      |     | -         | 1000 uF   | ESR ≥ 1m ohm  |
| ESR ≥ 10m ohm             | 0 uF      |     | -         | 4700 uF   | ESR ≥ 10m ohm   |
| <b>Transient Response</b> |           |     |           |           |   |
| 50% ~ 100% Max Load       | Vo=3.3 V  | -   | 130 mV    | -         |   |
| Settling Time             |           | -   | 50 uS     | -         |   |
| 100% ~ 50% Max Load       |           | -   | 150 mV    | -         |   |
| Settling Time             |           | -   | 50 uS     | -         |   |
| 50% ~ 100% Max Load       | Vo=2.5 V  | -   | 130 mV    | -         |   |
| Settling Time             |           | -   | 50 uS     | -         |   |
| 100% ~ 50% Max Load       |           | -   | 130 mV    | -         |   |
| Settling Time             |           | -   | 50 uS     | -         |   |
| 50% ~ 100% Max Load       | Vo=1.8 V  | -   | 120 mV    | -         |   |
| Settling Time             |           | -   | 50 uS     | -         |   |
| 100% ~ 50% Max Load       |           | -   | 120 mV    | -         |   |
| Settling Time             |           | -   | 50 uS     | -         |   |
| 50% ~ 100% Max Load       | Vo=1.5 V  | -   | 120 mV    | -         | di/dt=2.5 A/uS; Vin=5 V; and<br>with two 150 uF/16 V tantalum<br>capacitors & 1uF/10 V ceramic<br>capacitor at the output |
| Settling Time             |           | -   | 50 uS     | -         |   |
| 100% ~ 50% Max Load       |           | -   | 120 mV    | -         |   |
| Settling Time             |           | -   | 50 uS     | -         |   |
| 50% ~ 100% Max Load       | Vo=1.2 V  | -   | 130 mV    | -         |   |
| Settling Time             |           | -   | 50 uS     | -         |   |
| 100% ~ 50% Max Load       |           | -   | 130 mV    | -         |   |
| Settling Time             |           | -   | 50 uS     | -         |   |
| 50% ~ 100% Max Load       | Vo=0.75 V | -   | 120 mV    | -         |   |
| 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.

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*Bel Power, Inc., a subsidiary of Bel Fuse, Inc.***General Specifications**

| Parameter   | Min   | Typ     | Max     | Notes  |
|---|---|---------|---------|--|
| Efficiency<br>Vo=3.3 V<br>Vo=2.5 V<br>Vo=1.8 V<br>Vo=1.5 V<br>Vo=1.2 V<br>Vo=0.75 V | 92%   | 95%     | -       | Measured at Vin=5 V, full load                             |
|   | 90%   | 93%     | -       |  |
|   | 88%   | 91%     | -       |  |
|   | 87%   | 90%     | -       |  |
|   | 85%   | 88%     | -       |  |
|   | 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<br>Inches (L × W × H)<br>Millimeters (L × W × H)                         | 1.30 x 0.53 x 0.315<br>33.02 x 13.46 x 8.00 |         |         |  |
| Weight  | -   | 6.6 g   | -       |  |

**Note:** All specifications are typical at 25 °C unless otherwise stated.**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 | -                | Vin              | Sequencing Voltage should be higher than output voltage. |
| Sequencing Slew Rate Capability             | -      | -                | 2 V/mS           |  |
| Sequencing Delay Time                       | 10 mS  | -                | -                | Delay from Vin, min to application of voltage on SEQ pin |
| Tracking Accuracy<br>Power-Up<br>Power-Down | -      | 100 mV<br>200 mV | 200 mV<br>400 mV |  |

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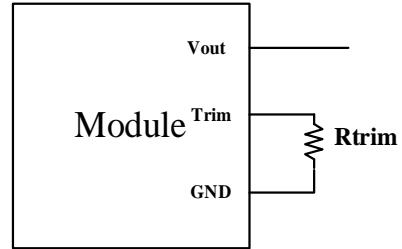
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### Output Trim Equations

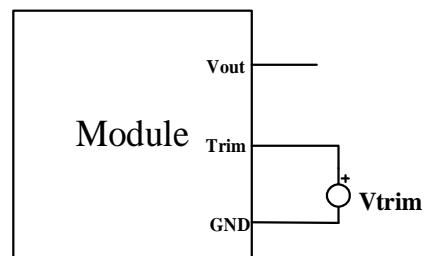
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage ( $V_{adj}$ ) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

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



Equation for calculating the trim voltage (in V) given the desired adjusted voltage ( $V_{adj}$ ) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

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



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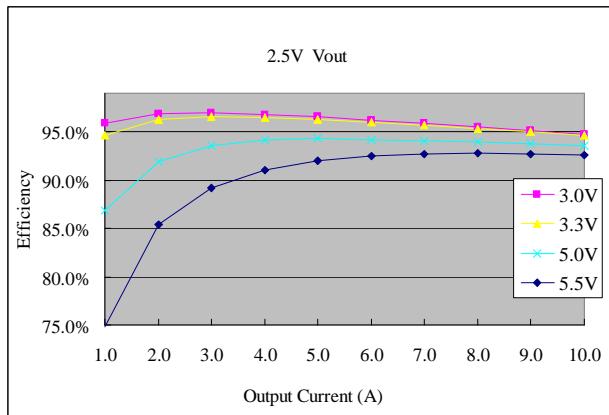
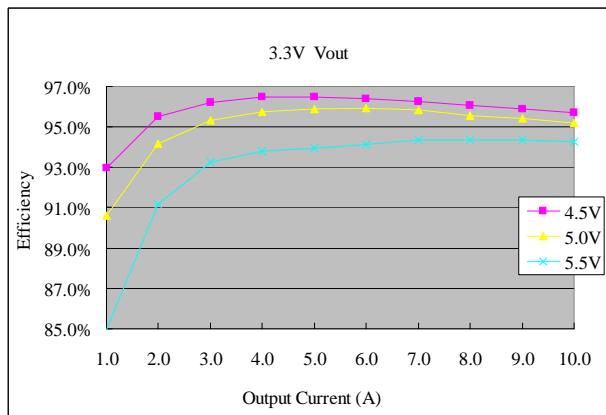
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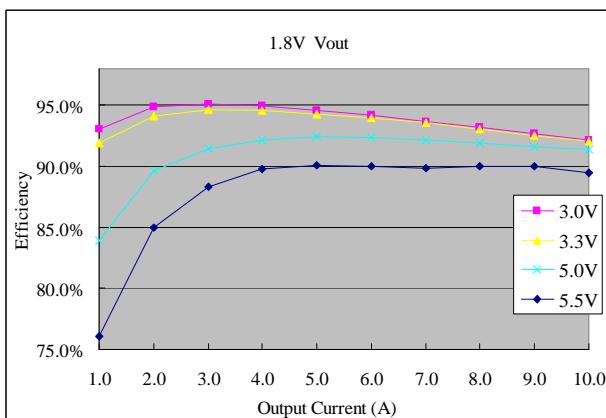
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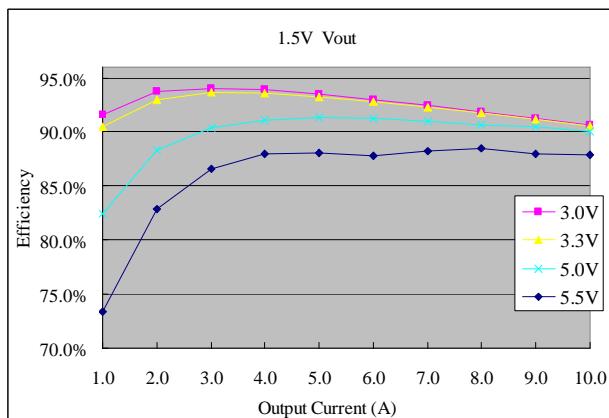
### Efficiency Data



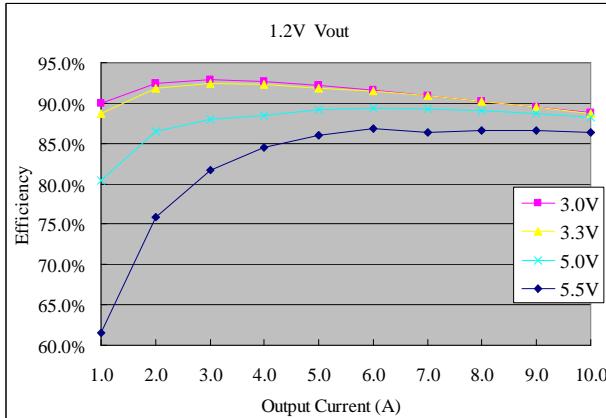
V<sub>O</sub>=3.3 V



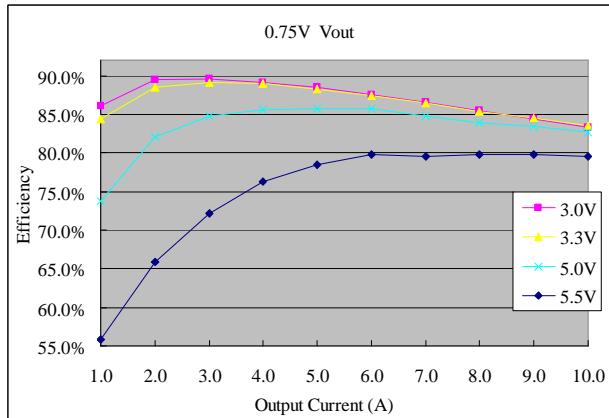
V<sub>O</sub>=1.8 V



V<sub>O</sub>=1.5 V



V<sub>O</sub>=1.2 V



V<sub>O</sub>=0.7525 V

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2.4 Vdc - 5.5 Vdc Input

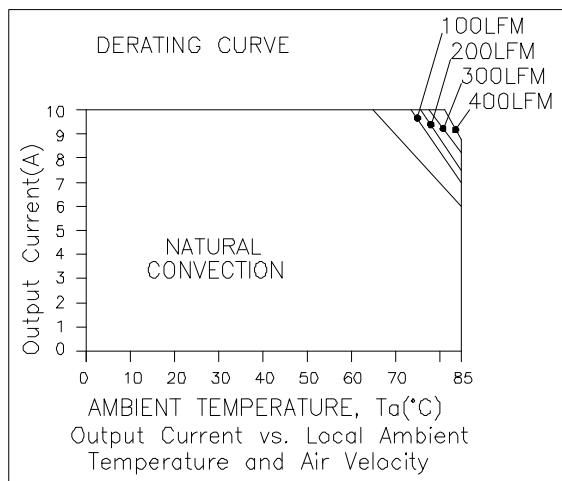
0.75 Vdc - 3.63 Vdc/10 A Output



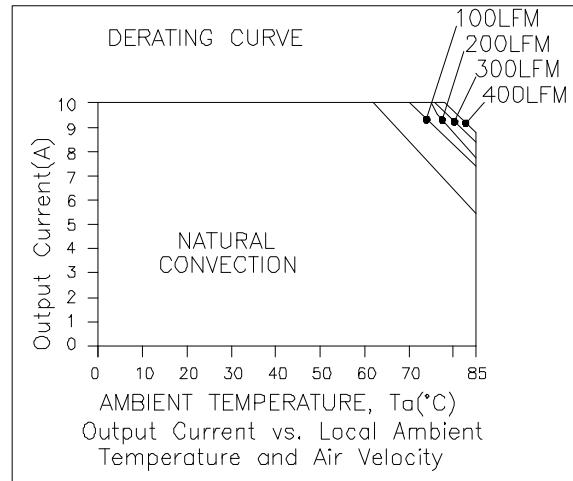
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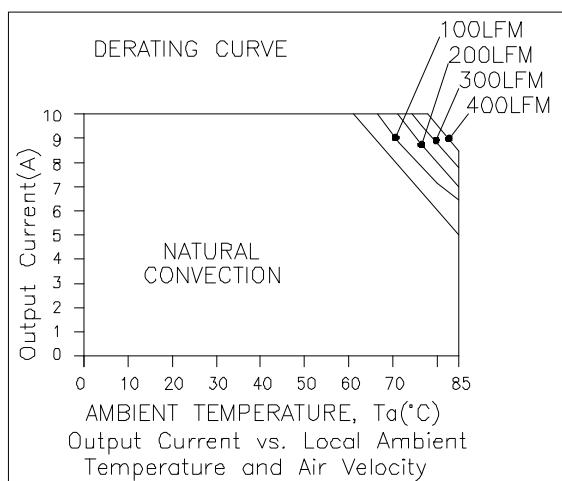
### Thermal Derating Curves



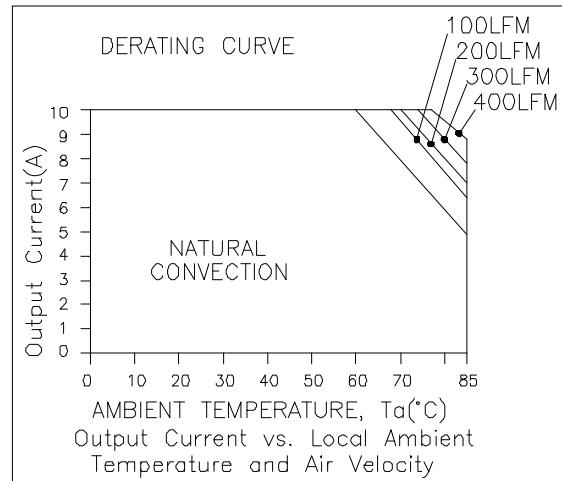
Vin=5.0 V, Vo=0.75 V



Vin=5.0 V, Vo=1.5 V



Vin=5.0 V, Vo=2.5 V



Vin=5.0 V, Vo=3.3 V

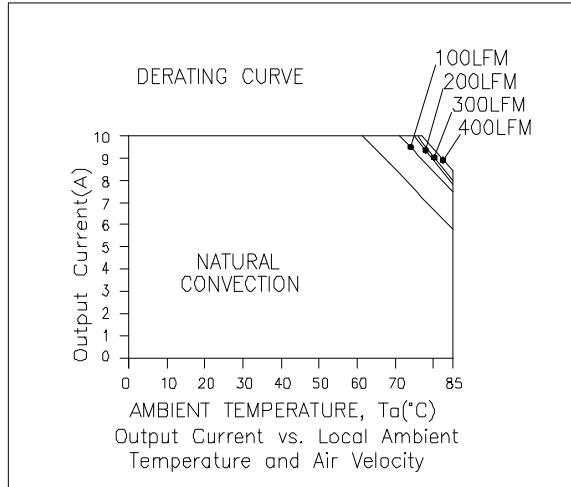
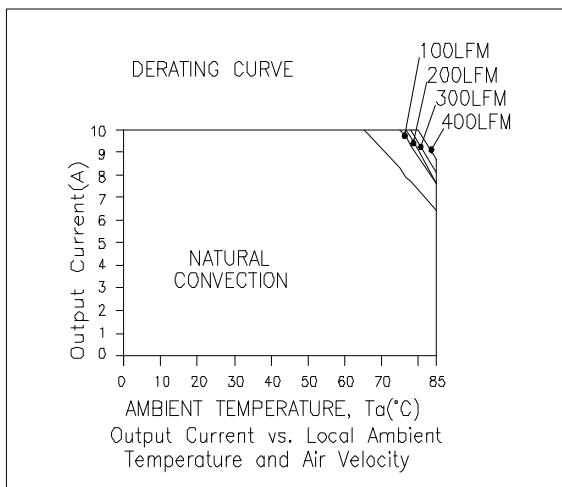
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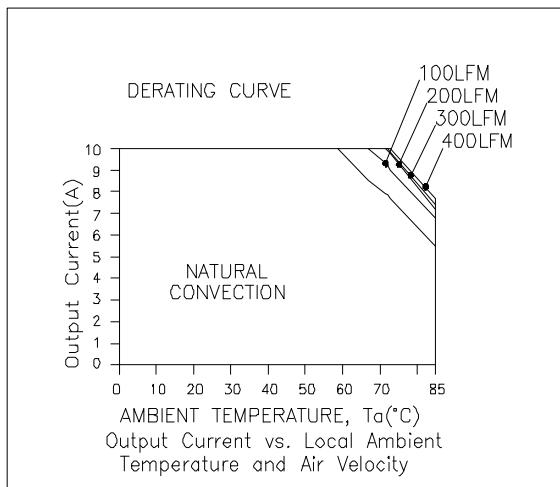
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**Thermal Derating Curves (continued)**



V<sub>in</sub>=3.3 V, V<sub>o</sub>=0.75 V

V<sub>in</sub>=3.3 V, V<sub>o</sub>=1.5 V



V<sub>in</sub>=3.3 V, V<sub>o</sub>=2.5 V

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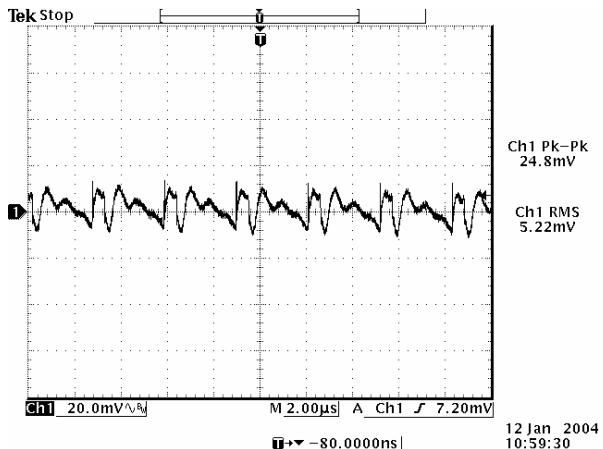
0.75 Vdc - 3.63 Vdc/10 A Output



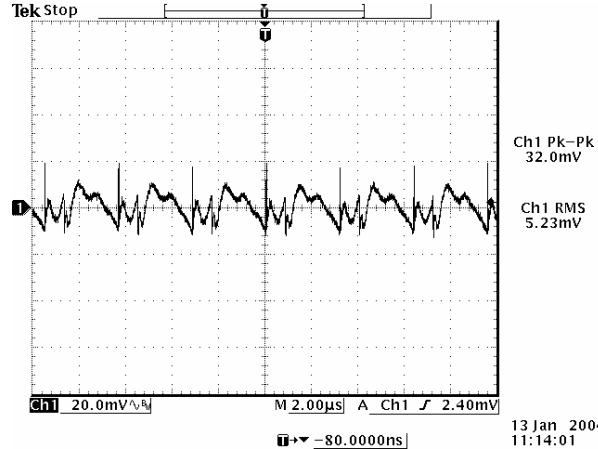
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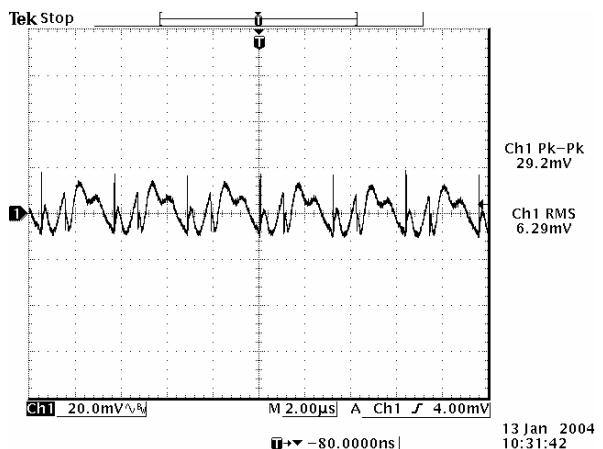
### Ripple and Noise Waveforms



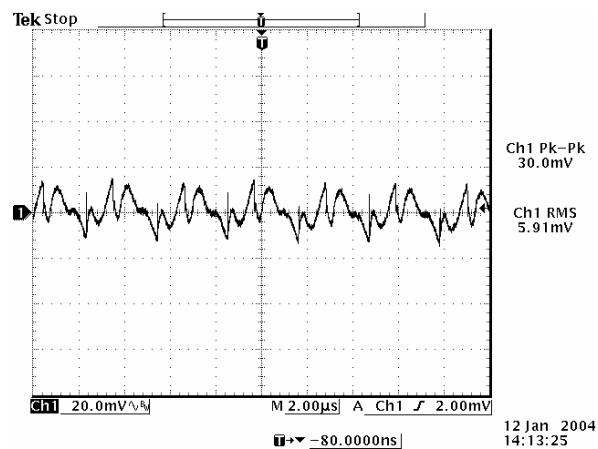
Ripple and noise at full load, 0.75 V output



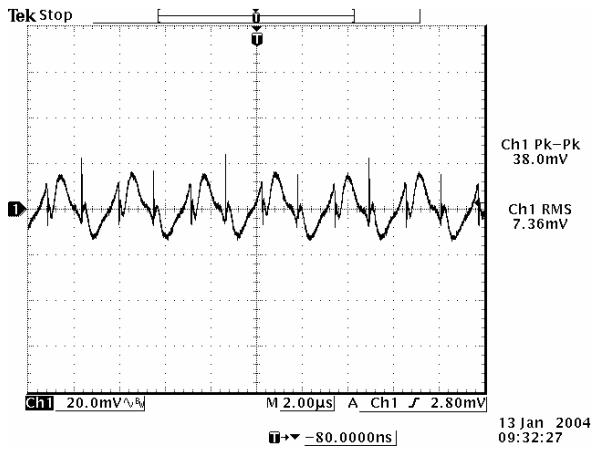
Ripple and noise at full load, 1.2 V output



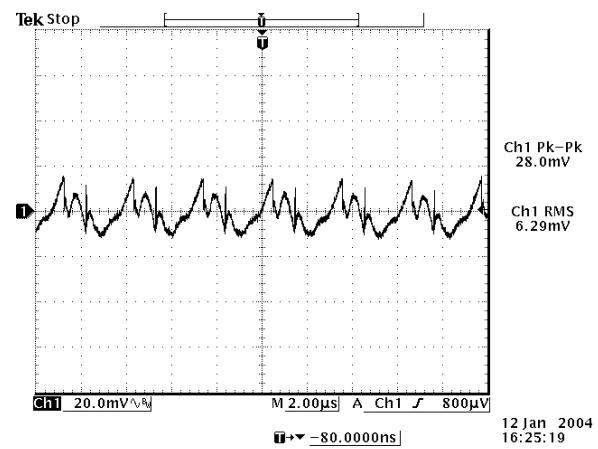
Ripple and noise at full load, 1.5 V output



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 uF/16 V tantalum cap and 1uF/10 V ceramic capacitor, Ta=25 deg C.

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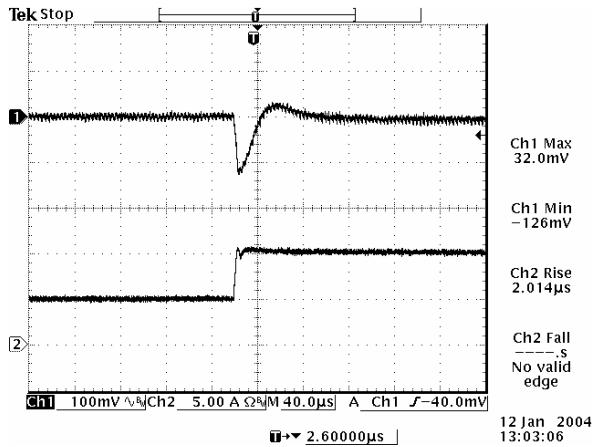
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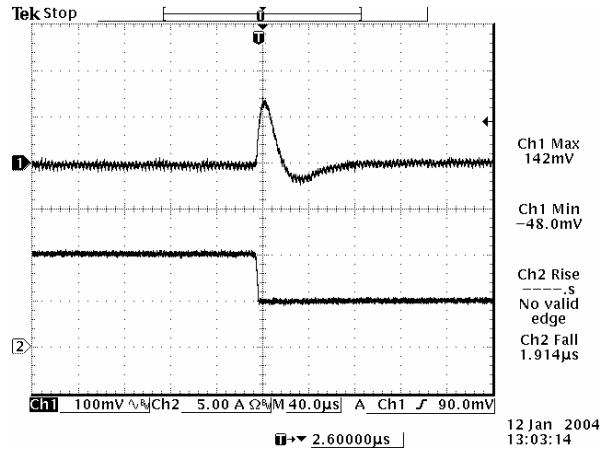
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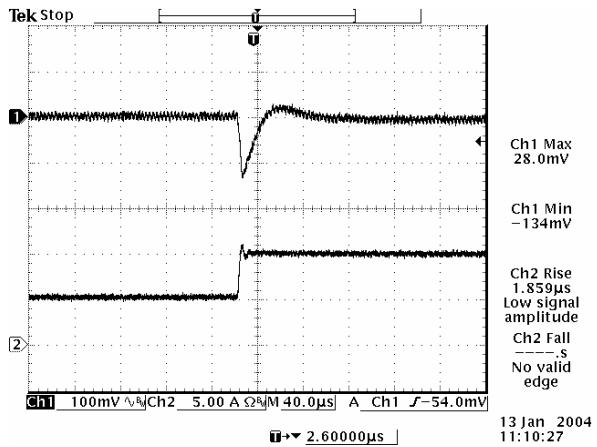
### Transient Response Waveforms



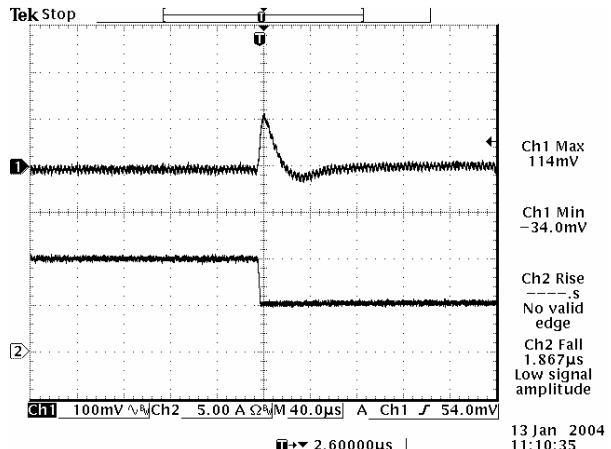
50% to 100% load step at 0.75 V output



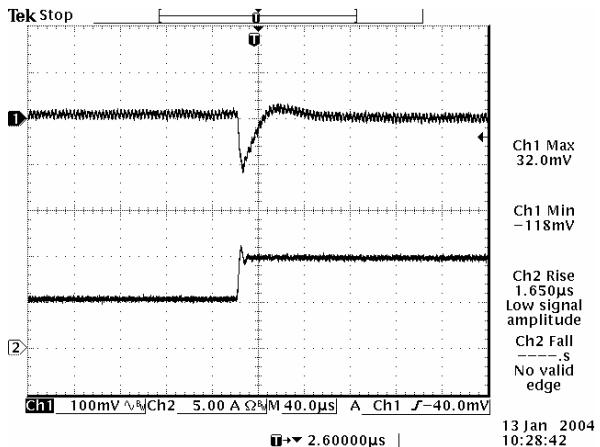
100% to 50% load step at 0.75 V output



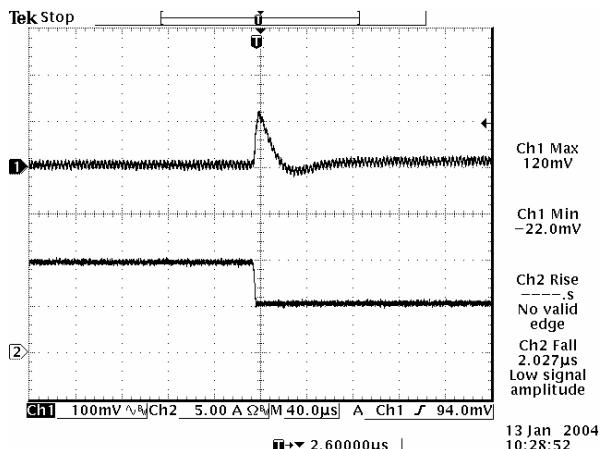
50% to 100% load step at 1.2 V output



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

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2.4 Vdc - 5.5 Vdc Input

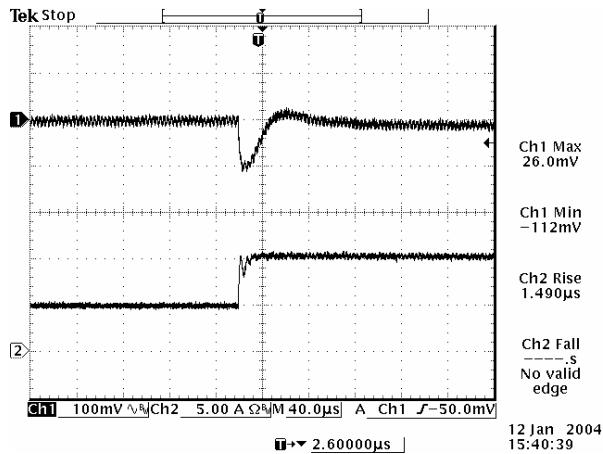
0.75 Vdc - 3.63 Vdc/10 A Output



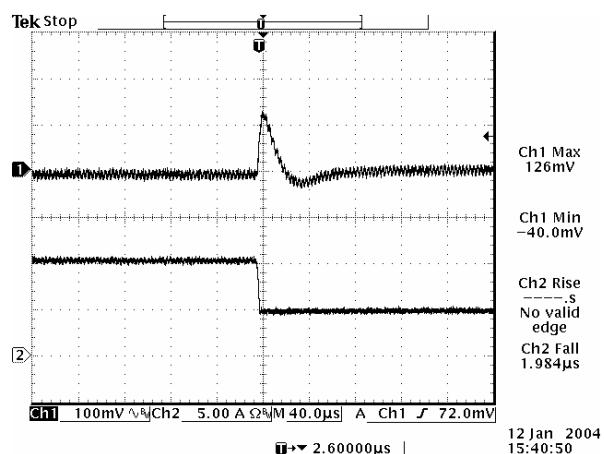
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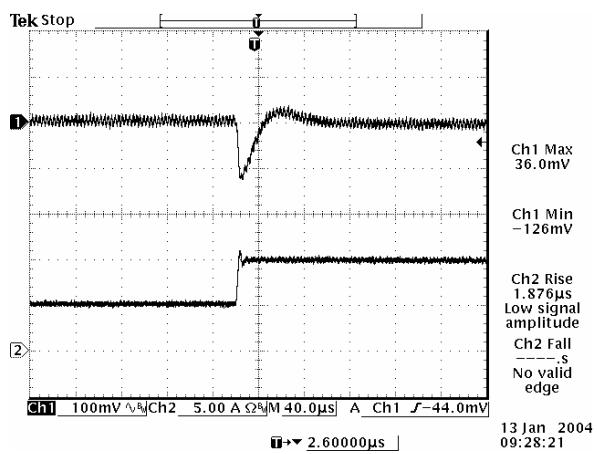
### Transient Response Waveforms (continued)



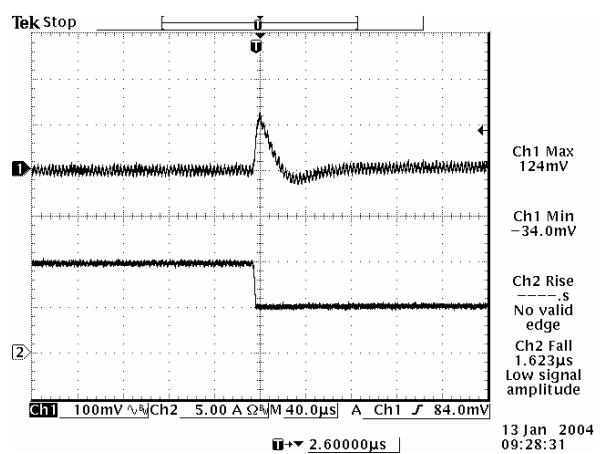
50% to 100% load step at 1.8 V output



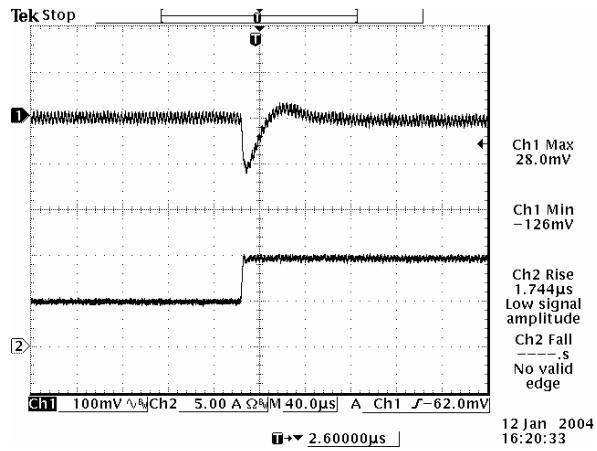
100% to 50% load step at 1.8 V output



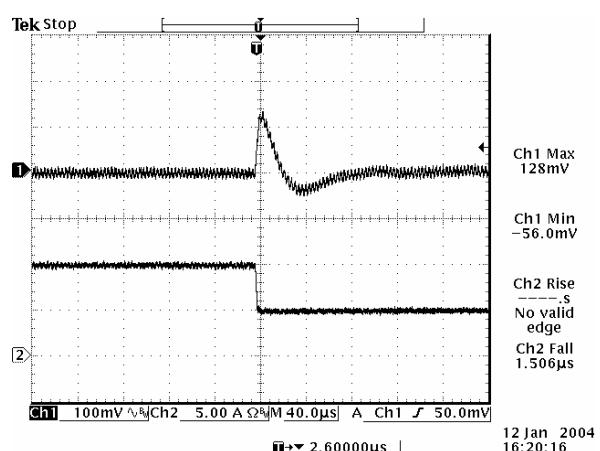
50% to 100% load step at 2.5 V output



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/uS, with two 150  $\mu$ F/16 V tantalum capacitors and 1  $\mu$ F/10 V ceramic capacitor,  $T_a=25$  deg C.

# NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

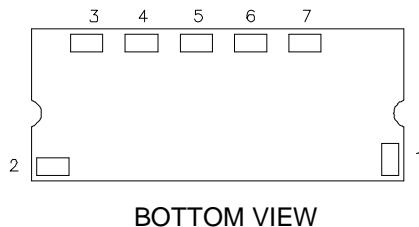
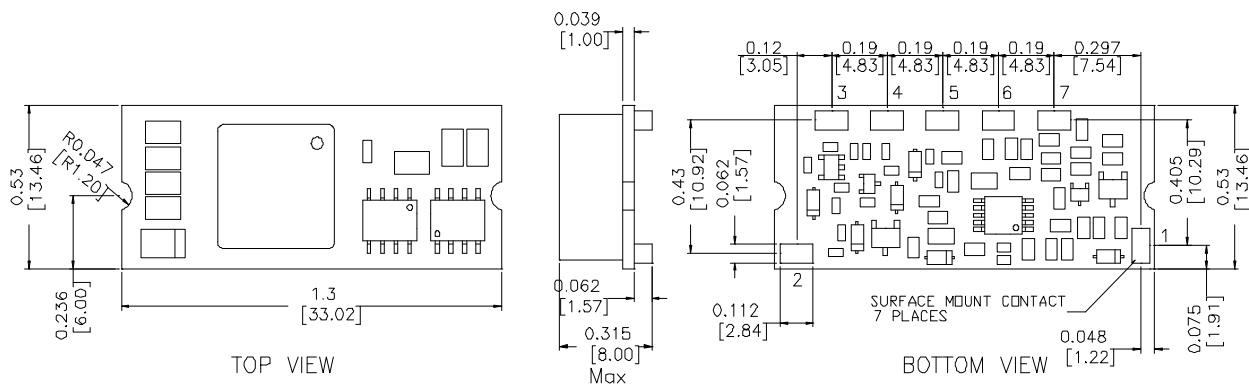
0.75 Vdc - 3.63 Vdc/10 A Output



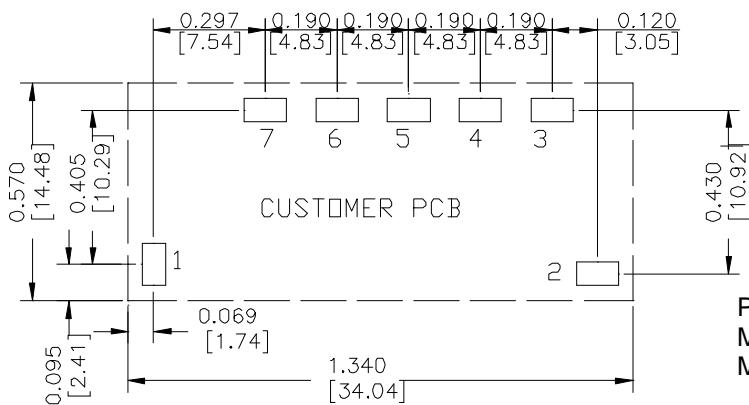
Jan. 25, 2013

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## Mechanical Outline



RECOMMENDED PAD LAYOUT



## 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)

**Note:** 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 245 °C.

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### Revision History

| Date       | Revision | Changes Detail                        | Approval |
|------------|----------|---------------------------------------|----------|
| 2007-01-17 | A        | Change version to A                   | Lynn     |
| 2011-08-25 | B        | Update the reflow solder temperature. | HL       |
| 2013-01-25 | C        | Update UL.                            | HL       |

### RoHS Compliance

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



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