

NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

0.8 Vdc - 3.63 Vdc/12 A Output

bel
POWER PRODUCTS

xRAH-12F1A0

RoHS Compliant

Rev.A

- Non-Isolated
- Wide Trim
- Fixed Frequency (300 kHz)
- Remote Sense (SMD Module)
- OCP/SCP
- Remote On/Off
- Under Voltage Lockout (UVLO)
- UL60950-1 Recognized (UL/cUL)



Description

The Bel xRAH-12F1A0 modules are a series of non-isolated, step down dc/dc power converters that operate from 3.0 Vdc to 5.5 Vdc source. These converters are available in a range of output voltages from 0.8 Vdc to 3.63 Vdc. It is packaged in a compact, overmolded package rated at 12 A. Optional lead forming provides a vertical mount product for minimal footprint or a surface mount option for a very low profile. The output is closely regulated and the efficiency is typically 94% at 3.3 Vdc output full load.

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 | 12 A | 39.6 W | 94% | SRAH-12F1A0 | VRAH-12F1A0 |

- 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 | -55 °C | - | 125 °C | |

Input Specifications

| Parameter | Min | Typ | Max | Notes |
|---|-----|-----------------------|----------------------|---|
| Input Voltage | 3 V | - | 5.5 V | |
| Input Current (no load) | - | 100 mA | 150 mA | |
| Input Current (full load) | | | | |
| Vo=3.3 V | - | - | 11 A | |
| Vo=2.5 V | - | - | 10.5 A | |
| Vo=1.8 V | - | - | 9.0 A | |
| Vo=1.5 V | - | - | 8.1 A | |
| Vo=1.2 V | - | - | 6.5 A | |
| Vo=0.9 V | - | - | 5.2 A | |
| Remote Off Input Current | - | 4 mA | 8 mA | |
| Input Reflected Ripple Current (pk-pk) | - | 250 mA | 400 mA | With simulated source impedance of 500 nH, 5 Hz to 20 MHz; use a 270 uF/16 V cap with ESR=0.0018 ohm max at 100 kHz |
| Input Reflected Ripple Current (rms) | - | 80 mA | 120 mA | |
| I ² t Inrush Current Transient | - | 0.09 A ² s | 0.2 A ² s | |
| Turn on Voltage Threshold | | 2.1 V | - | |
| Turn off Voltage Threshold | - | 2 V | - | |

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

NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

0.8 Vdc - 3.63 Vdc/12 A Output



Output Specifications

| Parameter | Min | Typ | Max | Notes | | |
|--|---------------|----------------------|----------------------|---|--------|--|
| Output Voltage Set Point | | | | Vin=5 V, Io= 50% load | | |
| Vo=3.3 V | 3.234 V | 3.3 V | 3.366 V | | | |
| Vo=2.5 V | 2.45 V | 2.5 V | 2.55 V | | | |
| Vo=1.8 V | 1.764 V | 1.8 V | 1.836 V | | | |
| Vo=1.5 V | 1.47 V | 1.5 V | 1.53 V | | | |
| Vo=1.2 V | 1.176 V | 1.2 V | 1.224 V | | | |
| Vo=0.9 V | 0.882 V | 0.9 V | 0.981 V | | | |
| Line Regulation | - | ±3 mV | ±6 mV | | | |
| Load Regulation | - | ±4 mV | ±8 mV | | | |
| Regulation Over Temperature (-40 °C to +85 °C) | - | ±10 mV | ±20 mV | | | |
| Output Current | 0 A | - | 12 A | | | |
| Current Limit Threshold | 15 A | - | 30 A | | | |
| Short Circuit Surge Transient | - | 0.3 A ² s | 0.6 A ² s | | | |
| Ripple and Noise (rms) | - | 15 mV | 25 mV | Test conditions: 0-20 MHz BW; 1 uF ceramic capacitor and 10 uF aluminum capacitor at the output. | | |
| Ripple and Noise (pk-pk) | - | 50 mV | 100 mV | | | |
| Turn on Time | - | 5 mS | 10 mS | | | |
| Overshoot at Turn on | - | 0% | 3% | | | |
| Output Capacitance | 330 uF | - | 4800 uF | | | |
| Transient Response | | | | | | |
| 50% ~ 100% Max Load | Overshoot | All | - | 150 mV | 250 mV | Test conditions: di/dt=0.5 A/us, Vin=5 V, with 330 uF external load capacitance. |
| | Settling Time | | - | 30 uS | 60 uS | |
| 100% ~ 50% Max Load | Overshoot | | - | 150 mV | 250 mV | |
| | Settling Time | | - | 30 uS | 60 uS | |

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

General Specifications

| Parameter | Min | Typ | Max | Notes |
|---------------------------|-----------------|---------|---------|--|
| Efficiency | | | | Vin=5 V, full load |
| Vo=3.3 V | 91% | 94% | - | |
| Vo=2.5 V | 89% | 92% | - | |
| Vo=1.8 V | 87% | 90% | - | |
| Vo=1.5 V | 85% | 88% | - | |
| Vo=1.2 V | 83% | 86% | - | |
| Vo=0.9 V | 81% | 84% | - | |
| Efficiency | | | | Vin=3.3 V, full load |
| Vo=1.8 V | 87% | 90% | - | |
| Vo=1.5 V | 85% | 88% | - | |
| Vo=1.2 V | 83% | 86% | - | |
| Vo=0.9 V | 81% | 84% | - | |
| Switching Frequency | 250 kHz | 300 kHz | 350 kHz | |
| Output Trim Range | 90%Vo | - | 403%Vo | Wide Trim |
| | 90%Vo | - | 110%Vo | Narrow Trim |
| Remote Sense Compensation | - | - | 0.2 V | SMD module |
| MTBF | 7,501,004 hours | | | Calculated Per Bell Core SR-332 (Vin=5 V; Vo=1.8 V; Io = 9.6 A; Ta = 25 °C) |

NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input 0.8 Vdc - 3.63 Vdc/12 A Output

bel
POWER PRODUCTS

General Specifications (continued)

| Parameter | Min | Typ | Max | Notes |
|----------------------------|-----|----------------------|-----|-------|
| 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 | - | 6 g | - | |

Control Specifications

| Parameter | Min | Typ | Max | Notes |
|-----------------------|--------|-----|-------|----------------------------------|
| Remote On/Off | | | | |
| Signal Low (Unit Off) | -0.3 V | - | 0.8 V | Remote on/off pin open, unit on. |
| Signal High (Unit On) | 2.2 V | - | 5.5 V | |

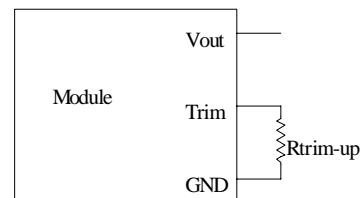
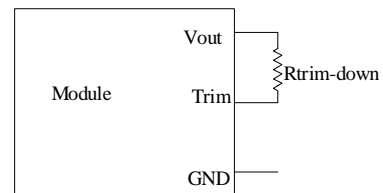
Output Trim Equations

Equations for calculating the trim resistor given the desired adjusted voltage (V_{adj}) and the nominal output voltage of the converter (V_o) 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.

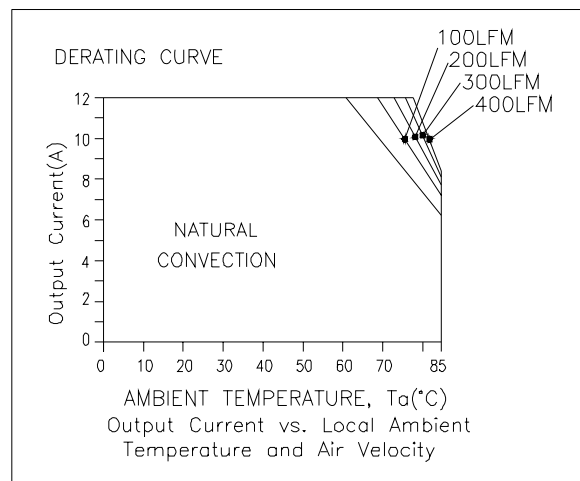
$$R_{trim_down} = \left(\frac{2.0058}{V_o - V_{o,adj}} - 10.197 \right) \text{Kohm}$$

$$R_{trim_up} = \left(\frac{7.007}{V_{o,adj} - V_o} - 0.187 \right) \text{Kohm}$$

Note: $V_o=0.9$ V.



Thermal Derating Curve



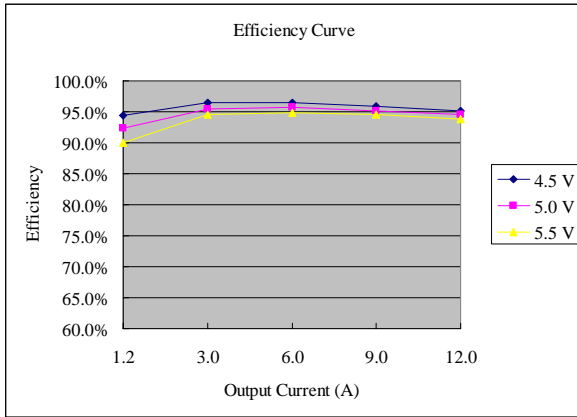
NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

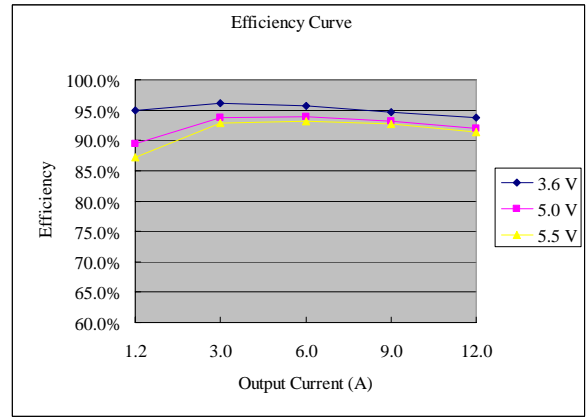
0.8 Vdc - 3.63 Vdc/12 A Output



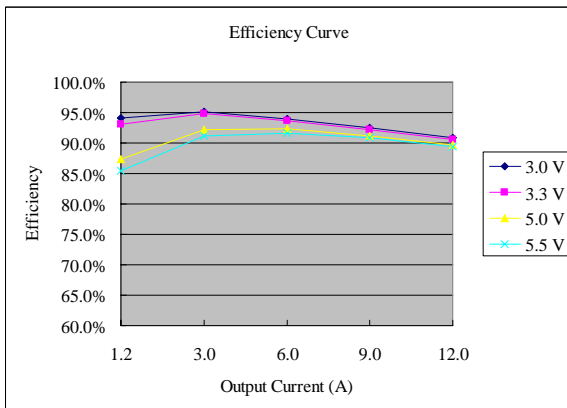
Efficiency Data



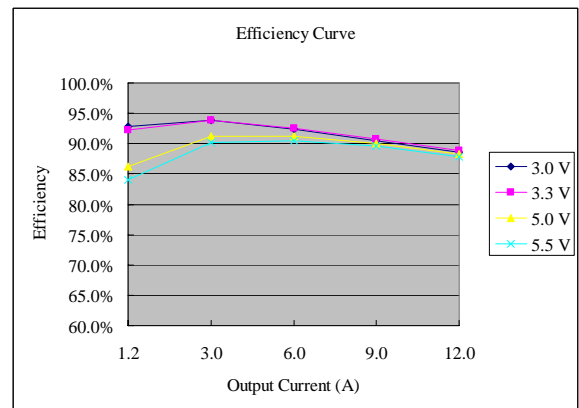
Vo=3.3 V



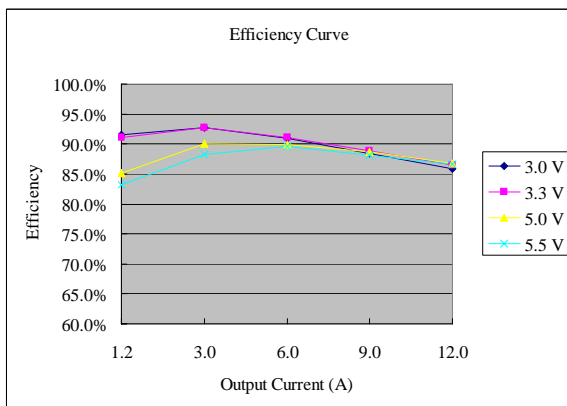
Vo=2.5 V



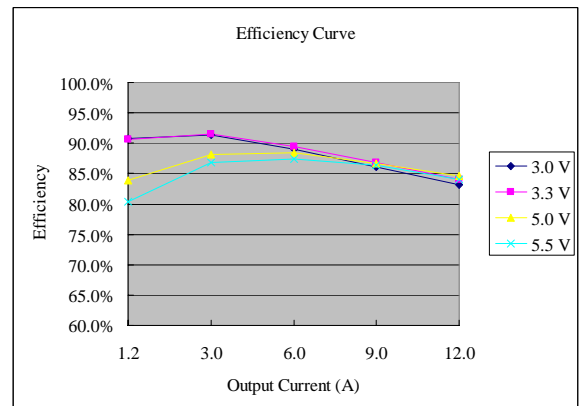
Vo=1.8 V



Vo=1.5 V



Vo=1.2 V



Vo=0.9 V

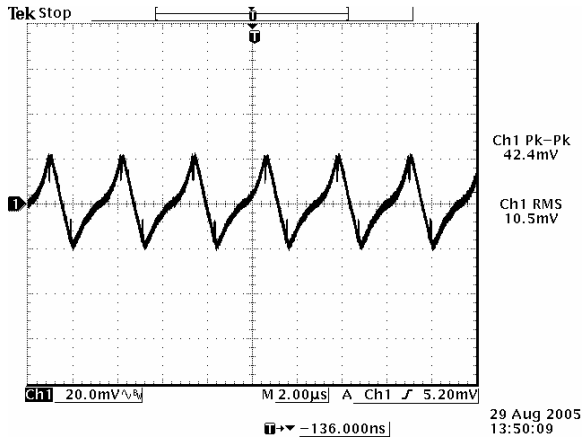
NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

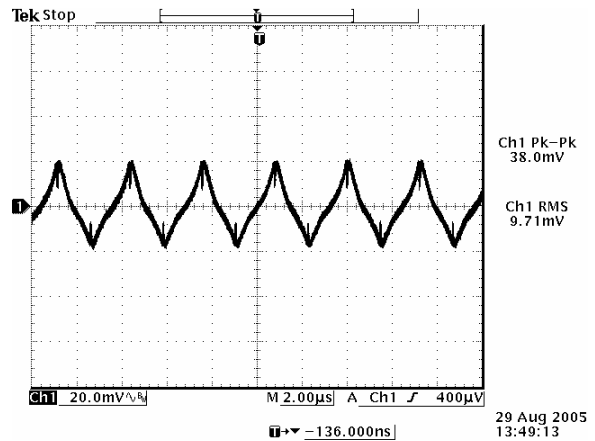
0.8 Vdc - 3.63 Vdc/12 A Output



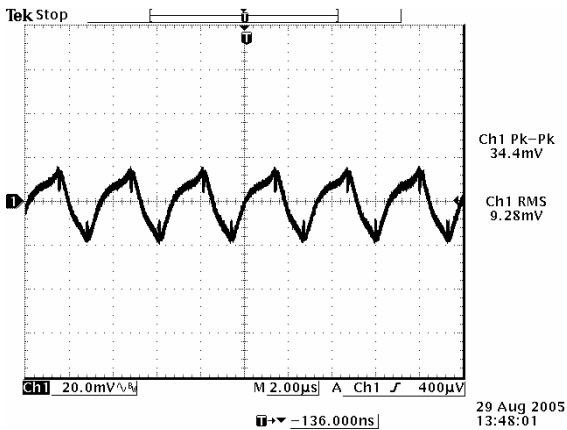
Ripple and Noise Waveforms



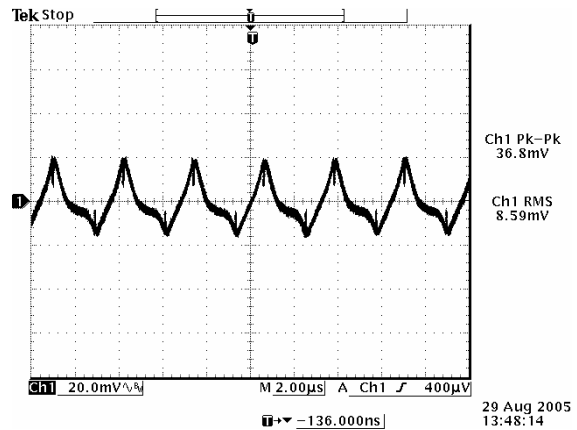
Ripple and noise at max load $V_{in}=5\text{ V}$, $V_o=3.3\text{ V}$



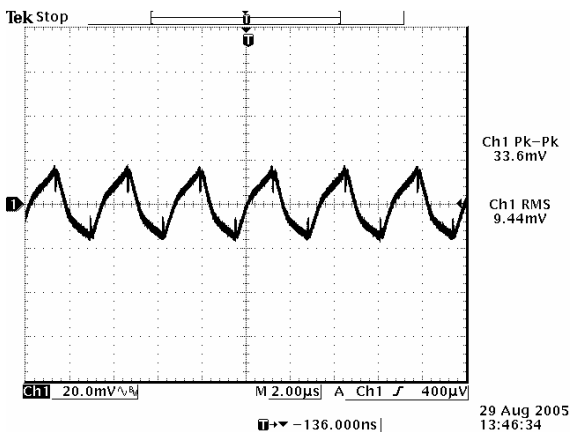
Ripple and noise at max load $V_{in}=5\text{ V}$, $V_o=2.5\text{ V}$



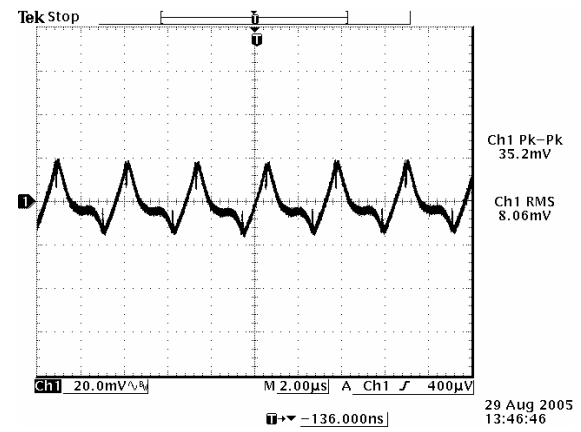
Ripple and noise at max load $V_{in}=3.3\text{ V}$, $V_o=1.8\text{ V}$



Ripple and noise at max load $V_{in}=5\text{ V}$, $V_o=1.8\text{ V}$



Ripple and noise at max load $V_{in}=3.3\text{ V}$, $V_o=1.5\text{ V}$



Ripple and noise at max load $V_{in}=5\text{ V}$, $V_o=1.5\text{ V}$

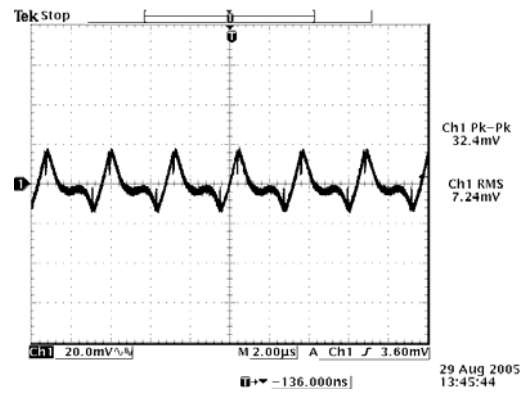
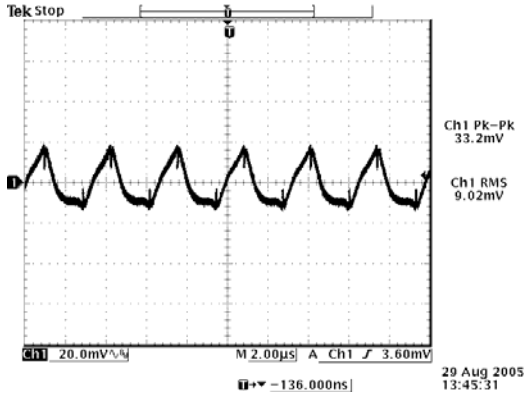
NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

0.8 Vdc - 3.63 Vdc/12 A Output

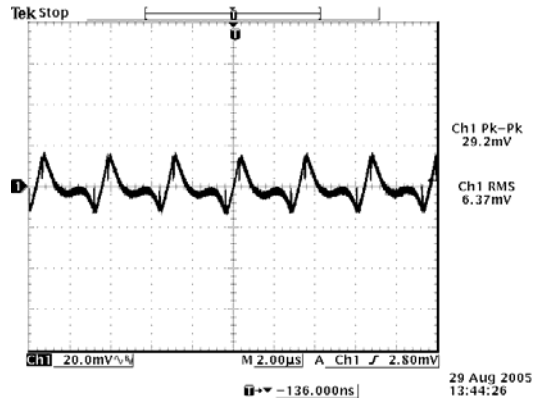
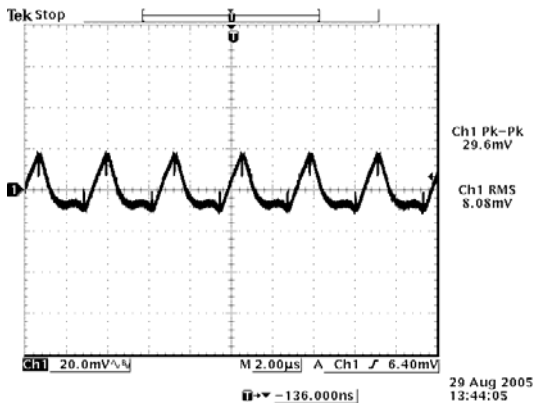


Ripple and Noise Waveforms (continued)



Ripple and noise at max load $V_{in}=3.3$ V, $V_o=1.2$ V

Ripple and noise at max load $V_{in}=5$ V, $V_o=1.2$ V

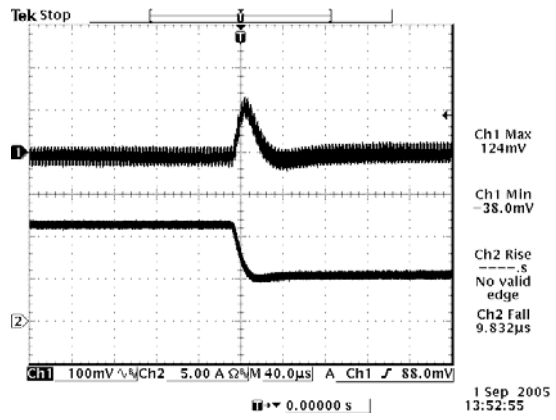
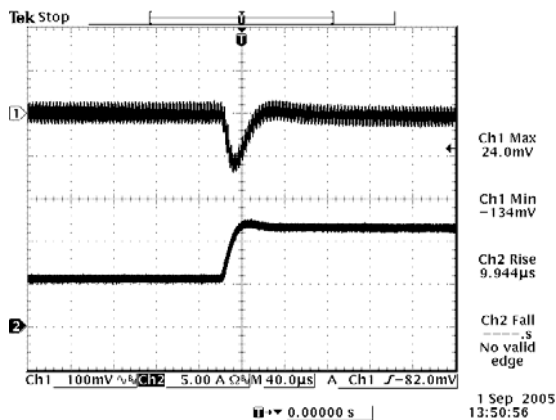


Ripple and noise at max load $V_{in}=3.3$ V, $V_o=0.9$ V

Ripple and noise at max load $V_{in}=5$ V, $V_o=0.9$ V

Note: Ripple and Noise with a 10 μ F aluminum cap and 1 μ F ceramic cap at the output, $T_a=25$ deg C.

Transient Response Waveforms



Transients 50% to 100% load $V_{in}=5$ V, $V_o=3.3$ V

Transients 100% to 50% load $V_{in}=5$ V, $V_o=3.3$ V

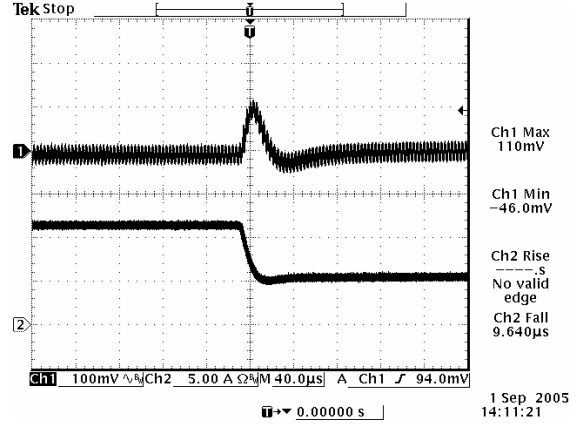
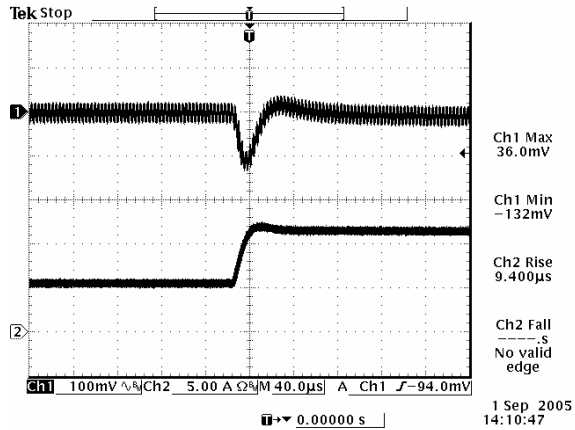
NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

0.8 Vdc - 3.63 Vdc/12 A Output

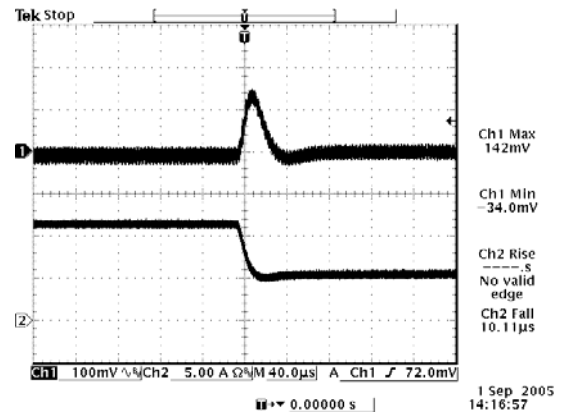
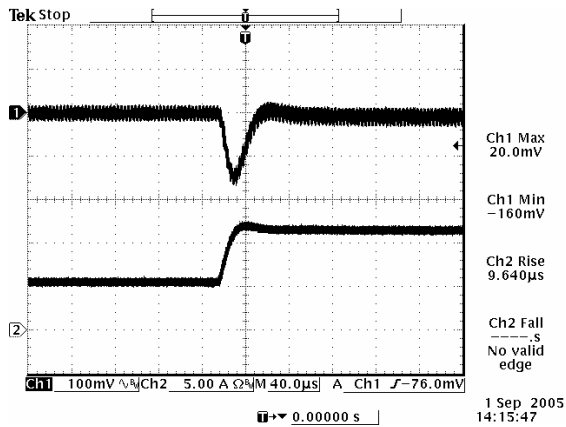


Transient Response Waveforms (continued)



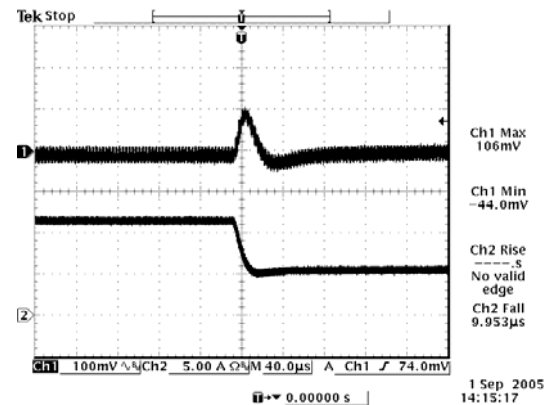
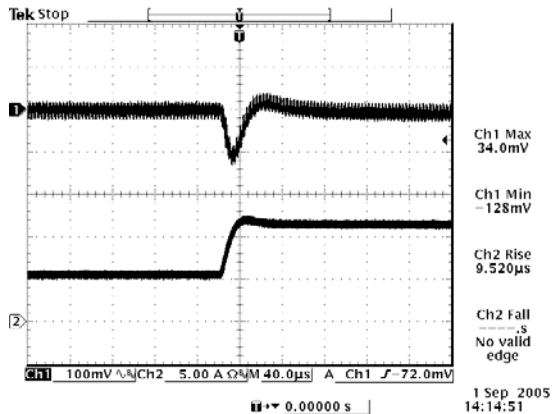
Transients 50% to 100% load $V_{in}=5\text{ V}$, $V_o=2.5\text{ V}$

Transients 100% to 50% load $V_{in}=5\text{ V}$, $V_o=2.5\text{ V}$



Transients 50% to 100% load $V_{in}=3.3\text{ V}$, $V_o=1.8\text{ V}$

Transients 100% to 50% load $V_{in}=3.3\text{ V}$, $V_o=1.8\text{ V}$



Transients 50% to 100% load $V_{in}=5\text{ V}$, $V_o=1.8\text{ V}$

Transients 100% to 50% load $V_{in}=5\text{ V}$, $V_o=1.8\text{ V}$

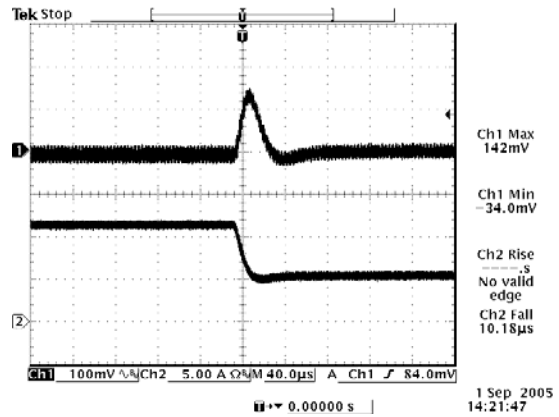
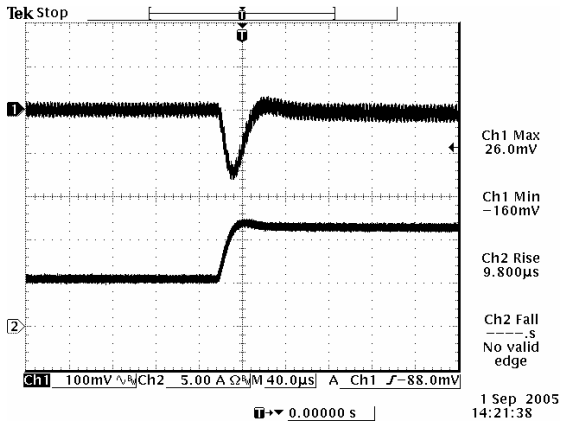
NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

0.8 Vdc - 3.63 Vdc/12 A Output

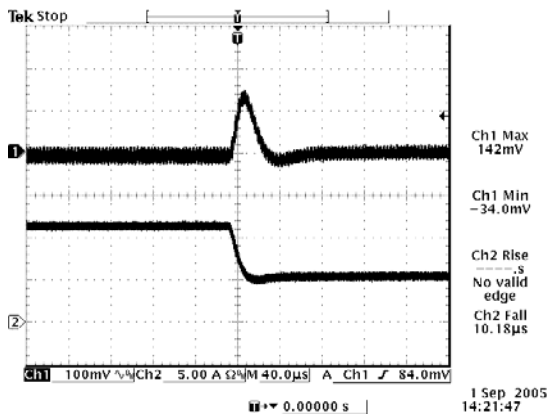
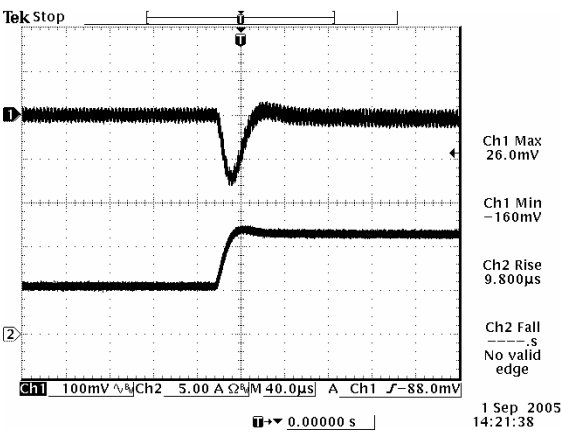


Transient Response Waveforms (continued)



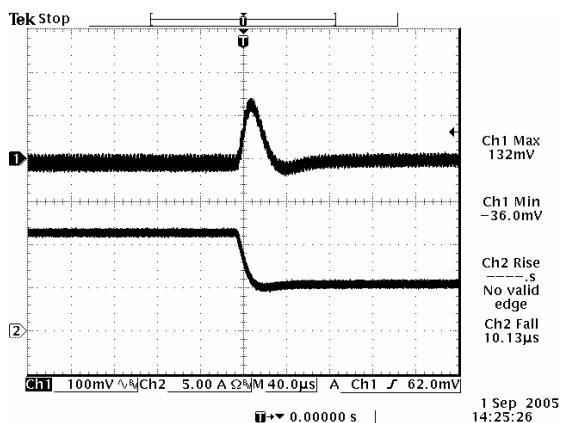
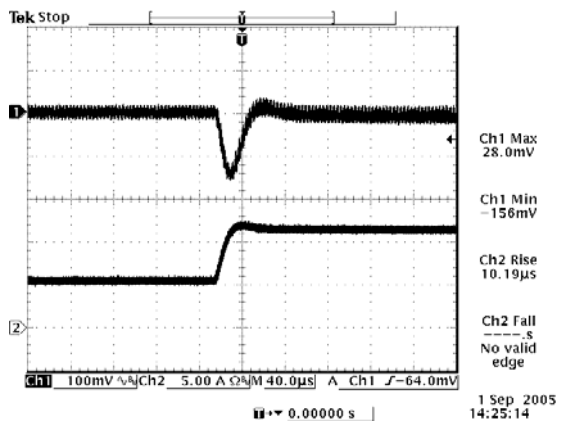
Transients 50% to 100% load $V_{in}=3.3\text{ V}$, $V_o=1.5\text{ V}$

Transients 100% to 50% load $V_{in}=3.3\text{ V}$, $V_o=1.5\text{ V}$



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

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



Transients 50% to 100% load $V_{in}=3.3\text{ V}$, $V_o=1.2\text{ V}$

Transients 100% to 50% load $V_{in}=3.3\text{ V}$, $V_o=1.2\text{ V}$

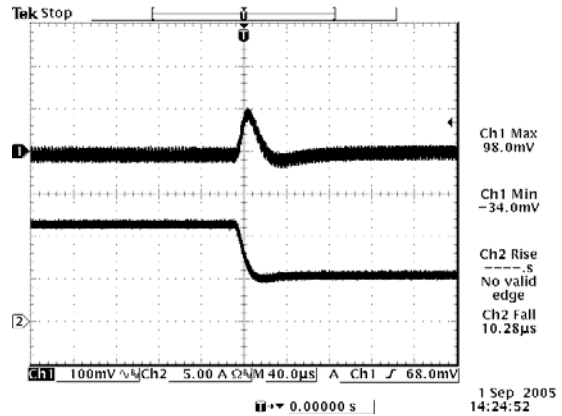
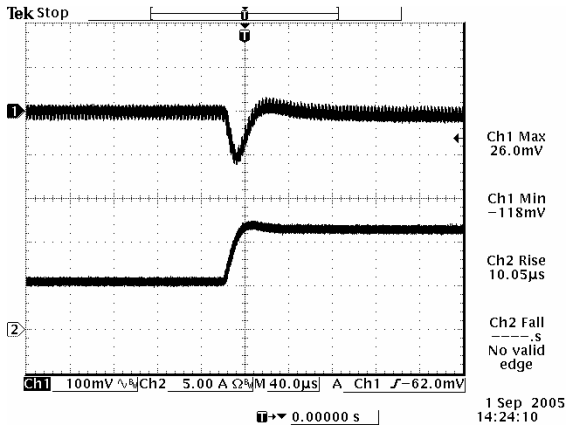
NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

0.8 Vdc - 3.63 Vdc/12 A Output

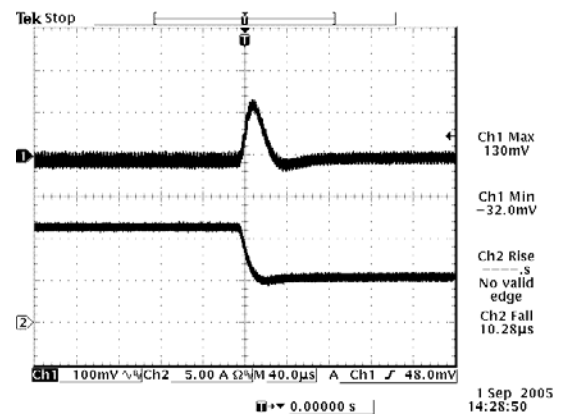
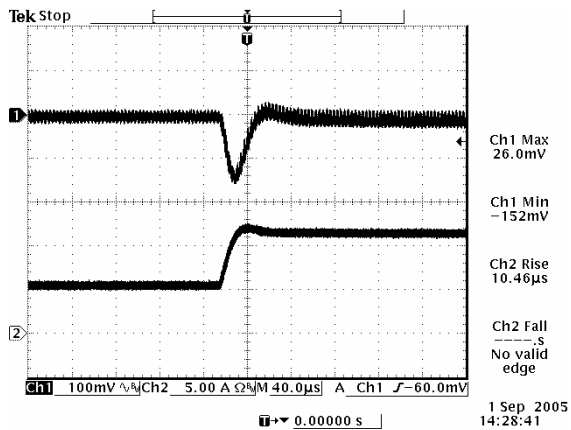


Transient Response Waveforms (continued)



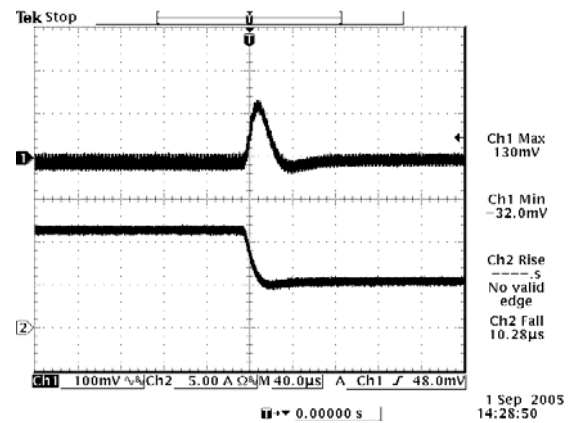
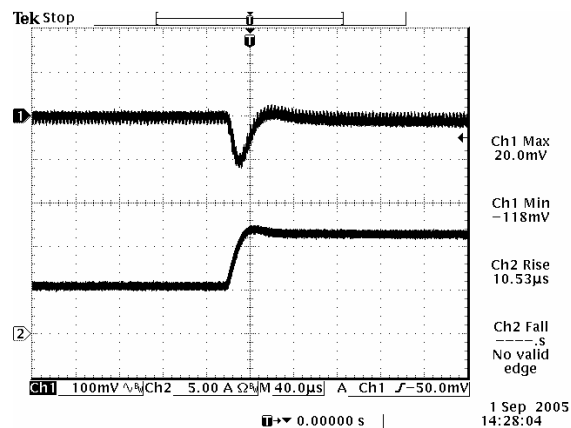
Transients 50% to 100% load $V_{in}=5\text{ V}$, $V_o=1.2\text{ V}$

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



Transients 50% to 100% load $V_{in}=3.3\text{ V}$, $V_o=0.9\text{ V}$

Transients 100% to 50% load $V_{in}=3.3\text{ V}$, $V_o=0.9\text{ V}$



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

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

Note: Transient response at $di/dt=0.5\text{ A}/\mu\text{S}$, 1 μF ceramic cap and 330 μF aluminum cap at the output, $T_a=25\text{ deg C}$.

NON-ISOLATED DC/DC CONVERTERS

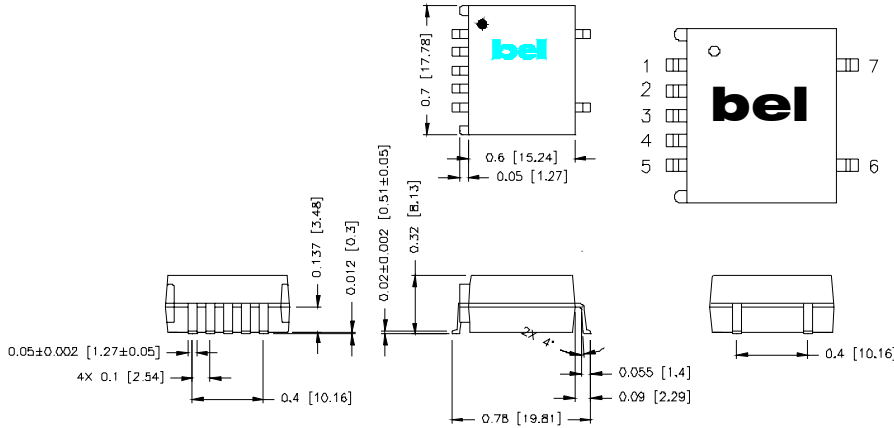
3.0 Vdc - 5.5 Vdc Input

0.8 Vdc - 3.63 Vdc/12 A Output



Mechanical Outline

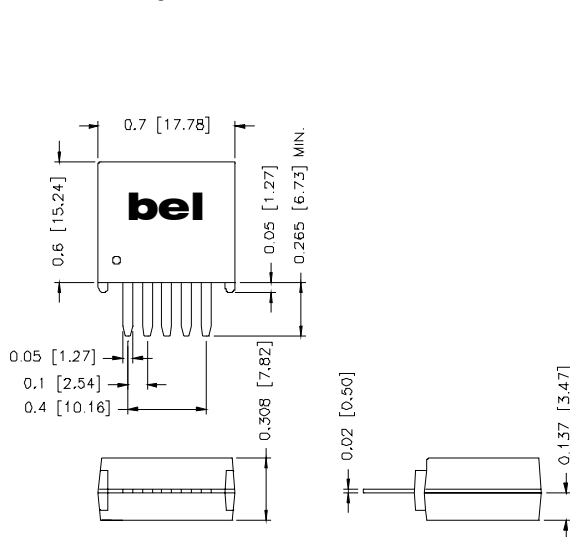
SRAH-12F1A0



Pin Connections

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

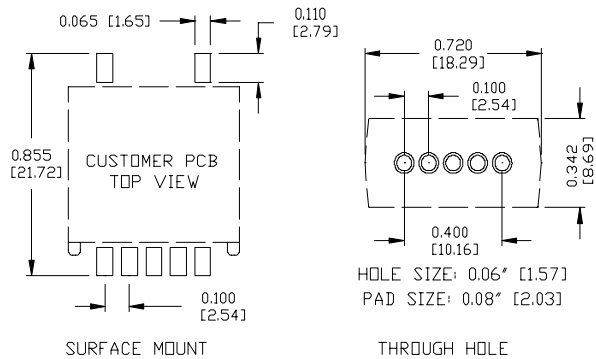
VRAH-12F1A0



Pin Connections

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

RECOMMENDED PCB PAD LAYOUT



RoHS Compliance

Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products. These parts are not however compatible with the higher temperatures associated with lead free solder processes and must be soldered using a reflow profile with a peak temperature of no more than 240 °C.



©2007 Bel Fuse Inc. Specifications subject to change without notice. 010507

CORPORATE

Bel Fuse Inc.
206 Van Vorst Street
Jersey City, NJ 07302
Tel 201-432-0463
Fax 201-432-9542
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

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