

# NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



Jan. 21, 2010

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

**xRP2-50E1Ax      RoHS Compliant      Rev.H**

### Features

- Non-Isolated
- High Efficiency
- Fixed Switching Frequency
- Low Cost
- Excellent Thermal Performance
- Wide Input Voltage Range
- Output Over-Voltage Shutdown
- OCP/SCP
- Low Output Ripple
- Power Good Signal
- Remote On/Off
- Wide Output Trim Range



### Applications

- Networking
- Computers and peripherals
- Telecommunications

### Description

The xRP2-50E1Ax is a non-isolated dc/dc converter that operates over a wide range of input voltage ( $V_{in} = 5 \text{ Vdc} - 13.8 \text{ Vdc}$ ). This unit can provide a precisely regulated output voltage from 0.6 Vdc to 5.0 Vdc and can deliver up to 50 A of output current. This unit is designed to be highly efficient and low cost. The converter is provided in an industry standard package.

### Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency ( $V_o=1.8 \text{ Vdc}$ )	Part Number Horizontal Mount	Part Number Vertical Mount
0.6 V - 5.0 V	5.0 V - 13.8 V	50 A	250 W	86%	0RP2-50E1A0	VRP2-50E1A0
0.6 V - 5.0 V	5.0 V - 13.8 V	50 A	250 W	86%	0RP2-50E1A1	VRP2-50E1A1

**Note:** Add "G" suffix at the end of the model numbers listed above to indicate "Tray Packaging".

### Part Number Explanation

x R P2 - 50 E 1A x  
 1 2 3 4 5 6 7

- 1---Using "0" means horizontal mount, and using "V" means Vertical mount
- 2---RoHS 6, change "R" to "7" means RoHS 5
- 3---Series name (SIP)
- 4---Series code (output current 50A)
- 5---Input range (5-13.8V)
- 6---Output voltage (0.6-5.0V)
- 7---Suffix, "0" means model has a trim resistor equation  
 "1" means model has a trim voltage equation

# NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



Jan. 21, 2010

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

## Absolute Maximum Ratings

Parameter	Min	Typ	Max	Notes
Input Voltage (continuous)	-0.3 V	-	15 V	
Output Enable Terminal Voltage	-0.3 V	-	15 V	
Ambient Temperature	0 °C	-	70 °C	
Storage Temperature	-55 °C	-	125 °C	

## Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
$V_o \leq 2.8 \text{ V}$	5 V	12 V	13.8 V	
$V_o > 2.8 \text{ V}$	$1.8 \cdot V_o$	12 V	13.8 V	
Input Current (full load)	-	-	38 A	
Input Reflected Ripple Current (pk-pk)	-	35 mA	-	With simulated source impedance of 1 $\mu\text{H}$ , 5 Hz to 20 MHz. Use a 1000 $\mu\text{F}$ /16 V electrolytic capacitor with ESR=0.1 ohm max, at 100 kHz at 25°C.
Input Reflected Ripple Current (rms)	-	10 mA	-	
$I^2t$ Inrush Current Transient	-	-	1 A <sup>2</sup> s	
Turn-on Voltage Threshold	4.4 V	4.6 V	4.8 V	
Under Voltage Threshold	4.0 V	4.3 V	4.6 V	

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

## Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point Accuracy				
$V_o \geq 1 \text{ V}$	-1.5 % $V_o$	-	+1.5 % $V_o$	$V_{in} = V_{inmin}$ , $I_o = I_{omax}$
$V_o < 1 \text{ V}$	-10 mV	-	+10 mV	
Load Regulation				
$V_o \geq 2.5 \text{ V}$	-	-	0.6% $V_o$	
$V_o < 2.5 \text{ V}$	-	-	12 mV	
Line Regulation				
$V_o \geq 2.5 \text{ V}$	-	-	0.3% $V_o$	
$V_o < 2.5 \text{ V}$	-	-	9 mV	
Regulation Over Temperature (0 °C to +70 °C)	-	-	0.02% $V_o/\text{C}$	
Output Current	0 A	-	50 A	
Current Limit Threshold	105% $I_o$	130% $I_o$	180% $I_o$	
Output Ripple and Noise (pk-pk)				
$V_o = 5.0 \text{ V}$	-	-	110 mV	Test conditions: 0-20MHz BW, with a 1 $\mu\text{F}$ ceramic capacitor and a 10 $\mu\text{F}$ Tantalum cap at output.
$V_o = 3.3 \text{ V}$	-	-	100 mV	
$V_o = 2.5 \text{ V}$	-	-	100 mV	
$V_o = 1.5 \text{ V}$	-	-	80 mV	
$V_o = 1.0 \text{ V}$	-	-	60 mV	
$V_o = 0.6 \text{ V}$	-	-	60 mV	

# NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



Jan. 21, 2010

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

## Output Specifications (continued)

Parameter	Min	Typ	Max	Notes	
Output Ripple and Noise (rms)				Test conditions: 0-20MHz BW, with a 1µF ceramic capacitor and a 10 µF Tantalum cap at output.	
Vo=5.0 V	-	-	35 mV		
Vo=3.3 V	-	-	35 mV		
Vo=2.5 V	-	-	35 mV		
Vo=1.5 V	-	-	30 mV		
Vo=1.0 V	-	-	25 mV		
Vo=0.6 V	-	-	25 mV		
Turn On Time	-	-	10 mS		
Rise Time	-	-	3 mS		
Overshoot at Turn on and off	-	-	0.5%		
Output Capacitance					
ESR ≥ 1 mΩ	0 µF	-	4700 µF		
<b>Transient Response</b>					
50% ~ 100% Max Load	Vo=All	-	-	300 mV	Test conditions: di/dt = 10 A/µS; Vin = 12 V; Co=0 µF.
Settling Time		-	-	100 µS	
100% ~ 50% Max Load		-	-	300 mV	
Settling Time		-	-	100 µS	

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

## General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				
Vo=5.0 V	-	93%	-	
Vo=3.3 V	-	91%	-	
Vo=2.5 V	-	88%	-	
Vo=1.8 V	-	86%	-	
Vo=1.5 V	-	84%	-	
Vo=1.2 V	-	82%	-	
Vo=1.0 V	-	75%	-	
Vo=0.6 V	-	68%	-	
Switching Frequency	-	330 kHz	-	
Output Voltage Trim Range	0.6 V	-	5 V	Trim pin is open, Vo = 0.6 V.
Over Voltage Protection	110% Vo,set	115%Vo,set	130%Vo,set	Vin=12 V, Io=full load.
MTBF	3,361,100 hours			Calculated Per Bell Core SR-332 (Io =40 A, Vo=1.92 V; Vin=12 V; Ta = 25 °C, 100LFM forced air flow.)
Dimensions (horizontal mount)				
Inches (L × W × H)	1.45 x 1.1 x 0.783			
Millimeters (L × W × H)	36.83 x 27.94 x 19.9			
Dimensions (vertical mount)				
Inches (L × W × H)	1.45 x 1.1 x 0.743			
Millimeters (L × W × H)	36.83 x 27.94 x 18.87			
Weight	-	28.5 g	-	

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

**NON-ISOLATED DC/DC CONVERTERS**  
 5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



Jan. 21, 2010

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

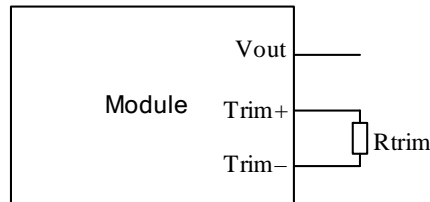
**Control Specifications**

Parameter	Min	Typ	Max	Notes
<b>Remote On/Off (Active High)</b>				
Signal Low (Unit Off)	-0.3 V	-	0.8 V	Remote On/Off pin is open, unit is off.
Signal High (Unit On)	2 V	-	V <sub>in,max</sub>	
Current Source/Sink	0 mA	-	3.3 mA	
<b>PwGood (PowerGood)</b>				
PwGood = High = Power Good	2.4 V	-	5.25 V	
	-	-	2 mA	
PwGood = Low = Power Not Good	0 V	-	0.4 V	
	-	-	4 mA	

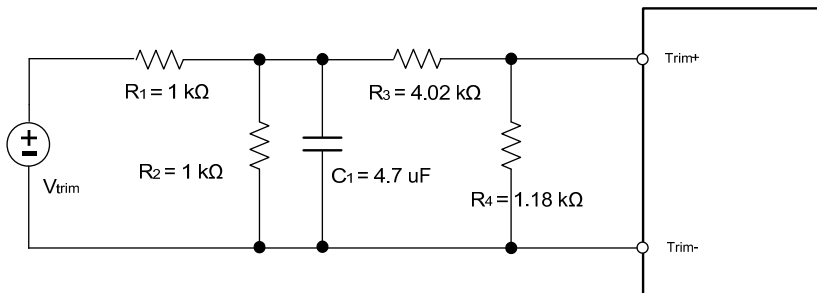
**Output Trim Equation**

**xRP2-50E1A0---** Trim resistor equation

$$R_{trim} = \frac{1.2}{V_o - 0.6} (K\Omega)$$



**xRP2-50E1A1---** Trim voltage equation



$$V_o = 1.8824 - 0.2212 V_{trim} (V)$$

V<sub>o</sub> = 1.847V when V<sub>trim</sub> is open.

# NON-ISOLATED DC/DC CONVERTERS

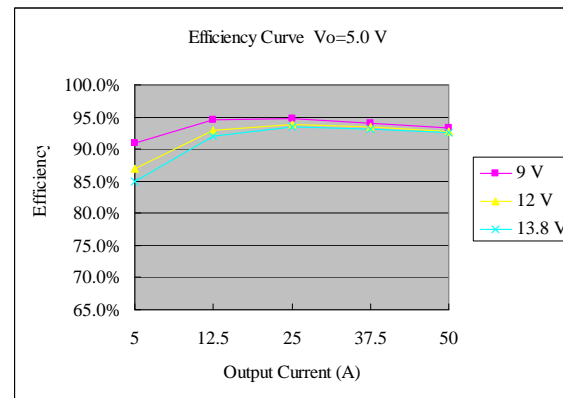
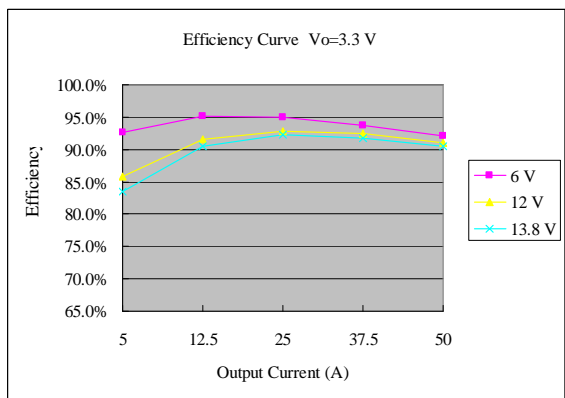
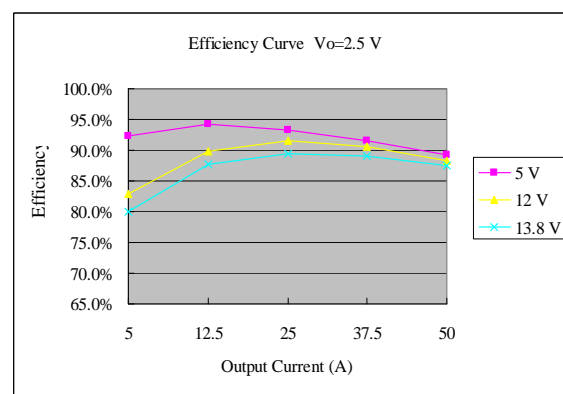
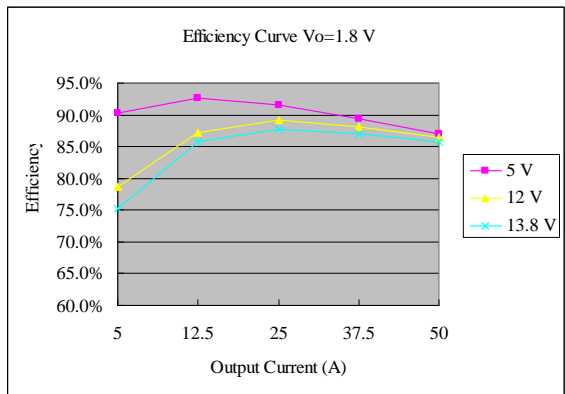
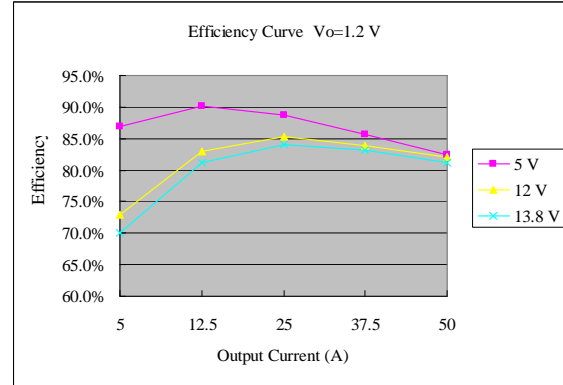
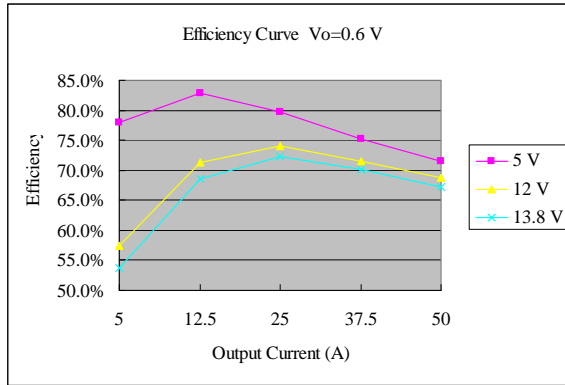
5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



Jan. 21, 2010

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

## Efficiency Data



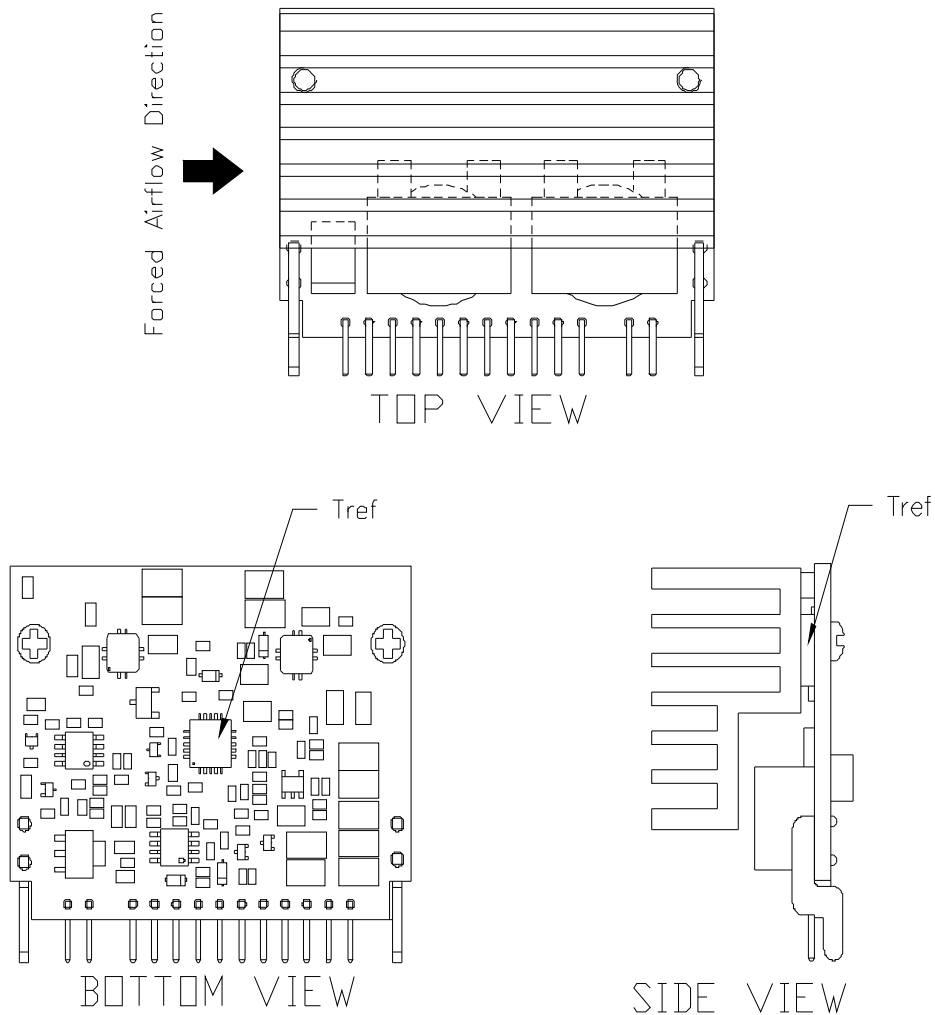
**NON-ISOLATED DC/DC CONVERTERS**  
5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



Jan. 21, 2010

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

**Thermal Derating Curves**



The thermal reference point Tref is shown above. For reliable operation this temperature should not exceed 115°C. The output power of the module should not exceed the rated power for the module.

# NON-ISOLATED DC/DC CONVERTERS

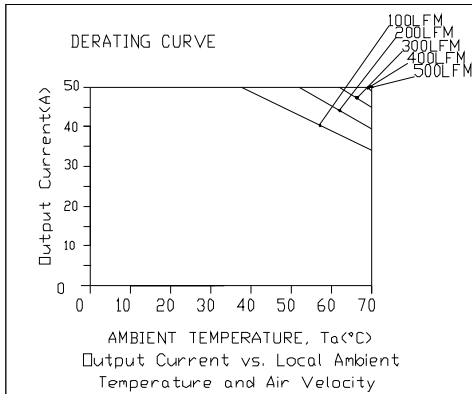
5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



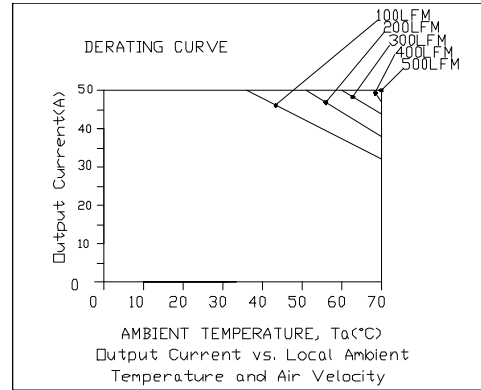
Jan. 21, 2010

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

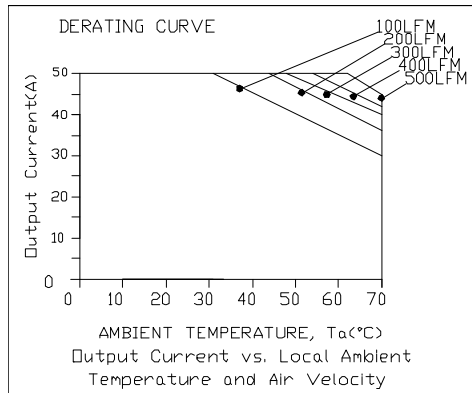
## Thermal Derating Curves (continued)



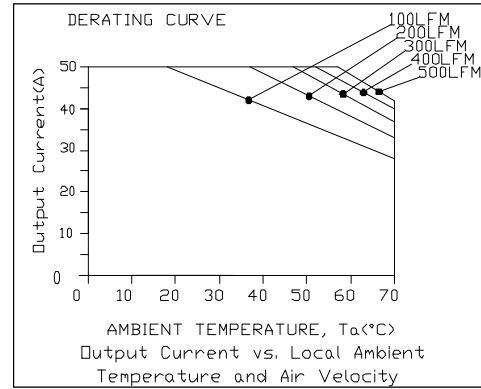
Vin=12 V, Vo=0.6 V



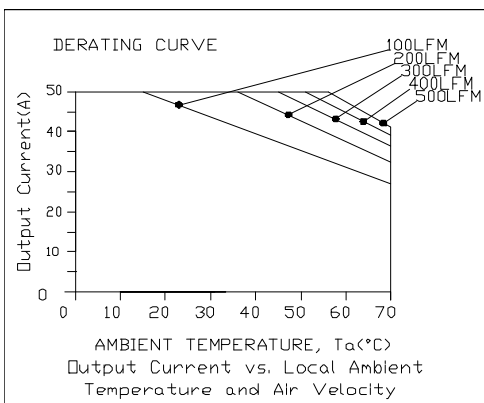
Vin=12 V, Vo=1.2 V



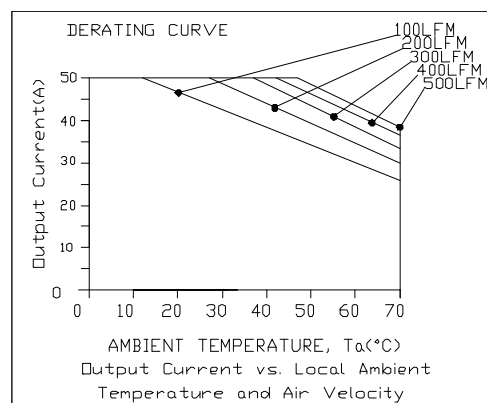
Vin=12 V, Vo=1.8 V



Vin=12 V, Vo=2.5 V



Vin=12 V, Vo=3.3 V



Vin=12 V, Vo=5.0 V

# NON-ISOLATED DC/DC CONVERTERS

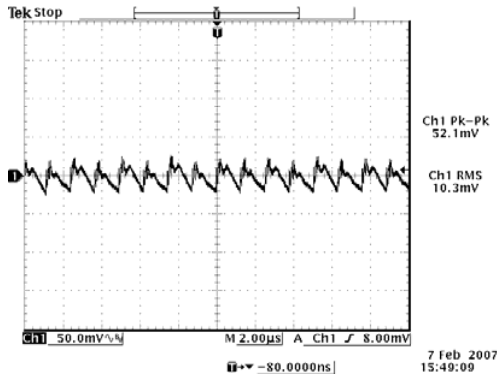
5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



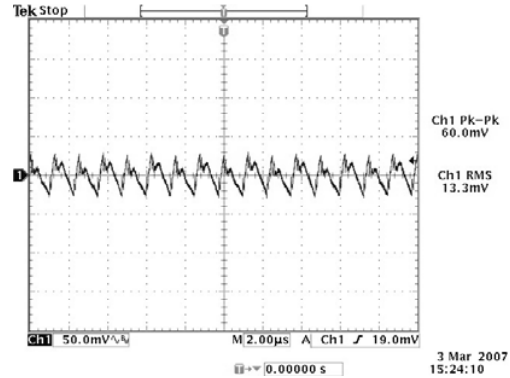
Jan. 21, 2010

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

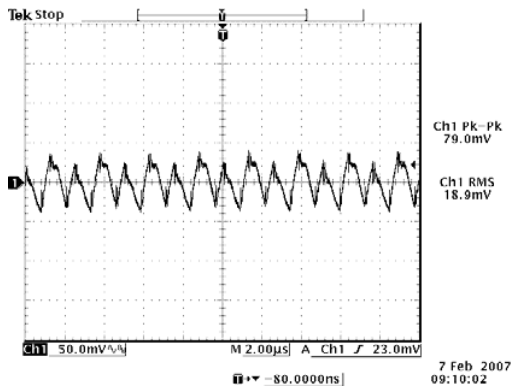
## Ripple and Noise Waveforms



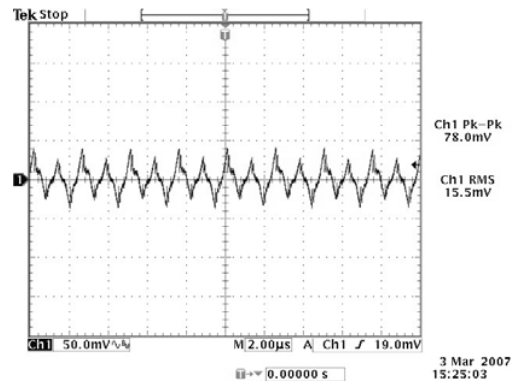
12 Vdc input, 0.6 Vdc/50 A output



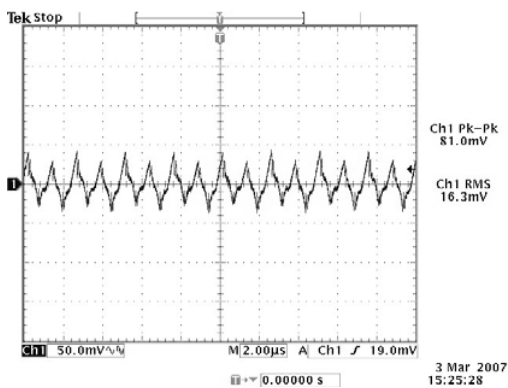
12 Vdc input, 1.2 Vdc/50 A output



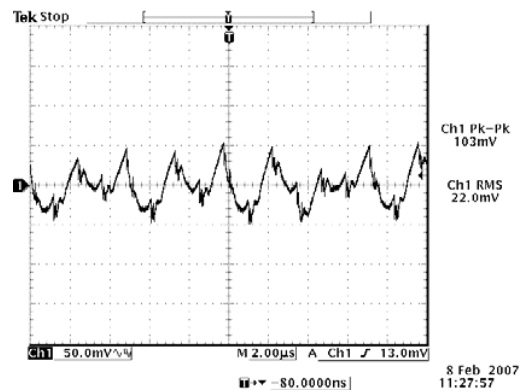
12 Vdc input, 1.8 Vdc/50 A output



12 Vdc input, 2.5 Vdc/50 A output



12 Vdc input, 3.3 Vdc/50 A output



12 Vdc input, 5.0 Vdc/50 A output

**Note:** Ripple and noise at full load, 0-20 MHz BW, with a 10 µF and a 1µF ceramic cap at the output, and Ta=25 deg C.



# NON-ISOLATED DC/DC CONVERTERS

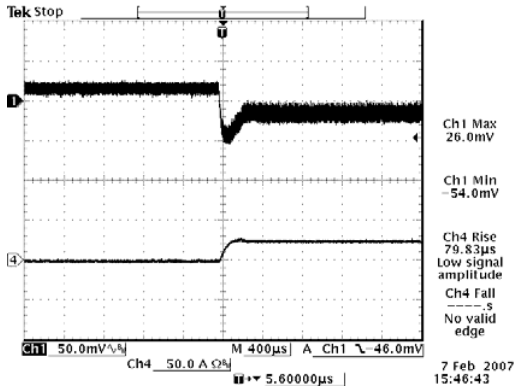
5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



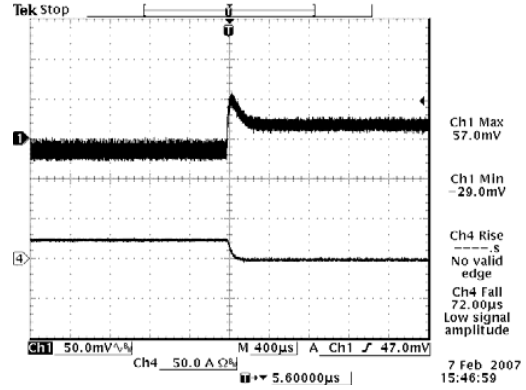
Jan. 21, 2010

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

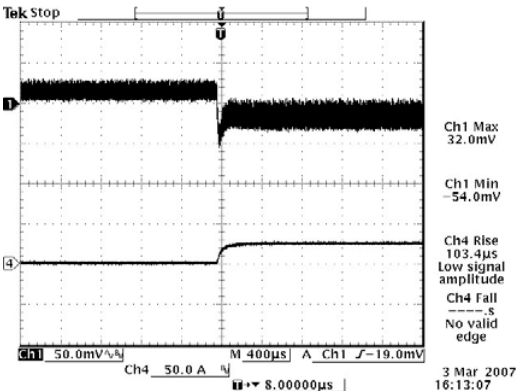
## Transient Response Waveforms



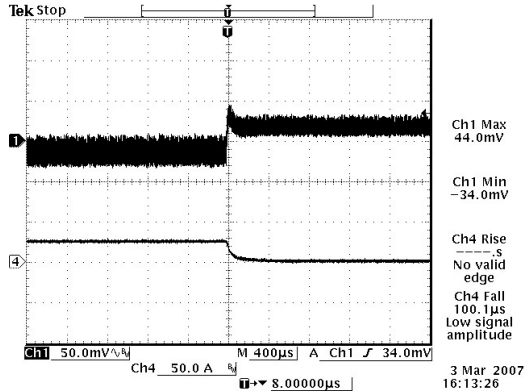
Vout= 0.6 V 0%-50% Load Transient



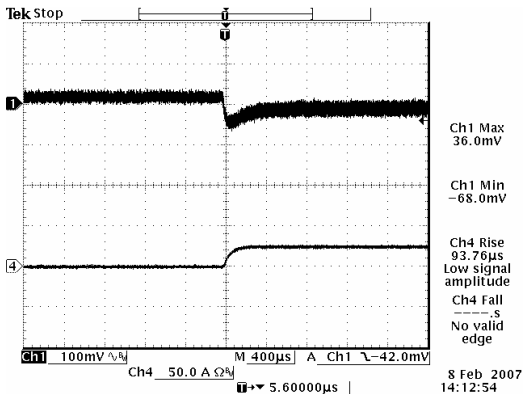
Vout=0.6 V 50%-0% Load Transient



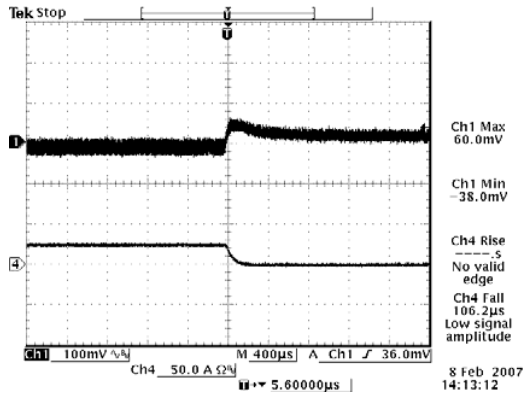
Vout=1.2 V 0%-50% Load Transient



Vout=1.2 V 50%-0% Load Transient



Vout=1.8 V 0%-50% Load Transient



Vout=1.8 V 50%-0% Load Transient

# NON-ISOLATED DC/DC CONVERTERS

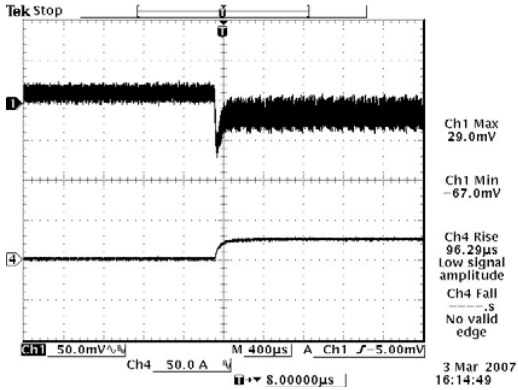
5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



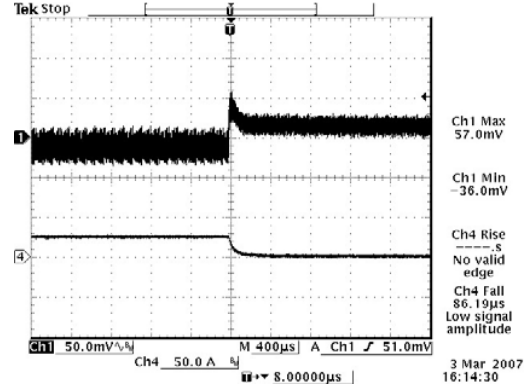
Jan. 21, 2010

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

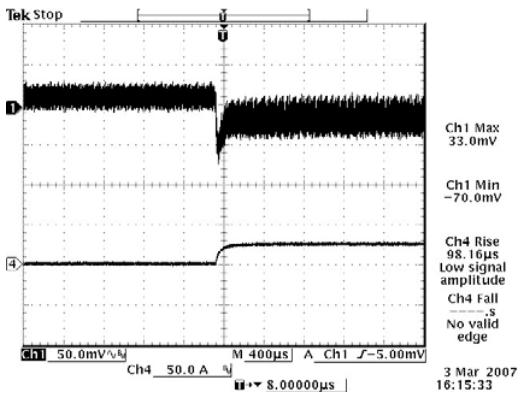
## Transient Response Waveforms (continued)



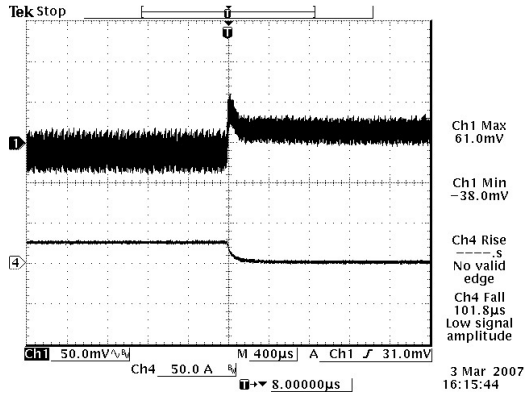
Vout= 2.5 V 0%-50% Load Transient



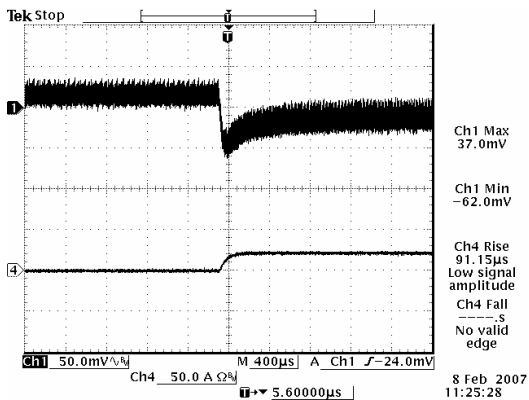
Vout=2.5 V 50%-0% Load Transient



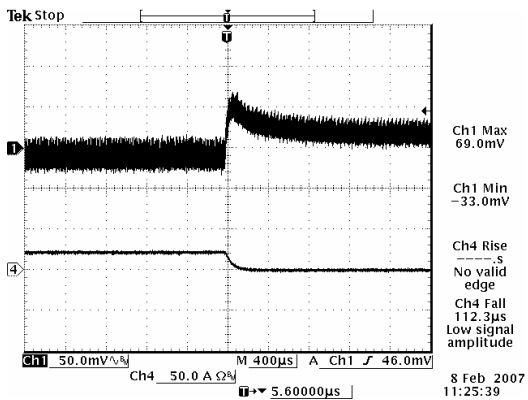
Vout=3.3 V 0%-50% Load Transient



Vout=3.3 V 50%-0% Load Transient



Vout=5 V 0%-50% Load Transient



Vout=5 V 50%-0% Load Transient

**Note:** Transient response at di/dt = 10 A/uS, with external electrolytic cap 4700 uF, and Ta=25 deg C.

**NON-ISOLATED DC/DC CONVERTERS**  
 5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output

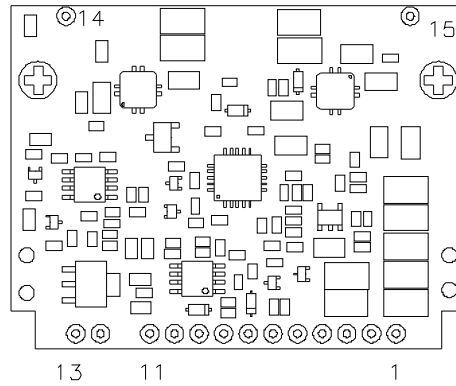
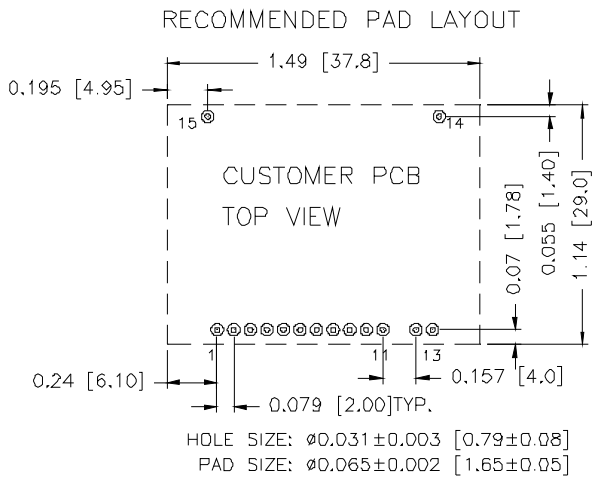
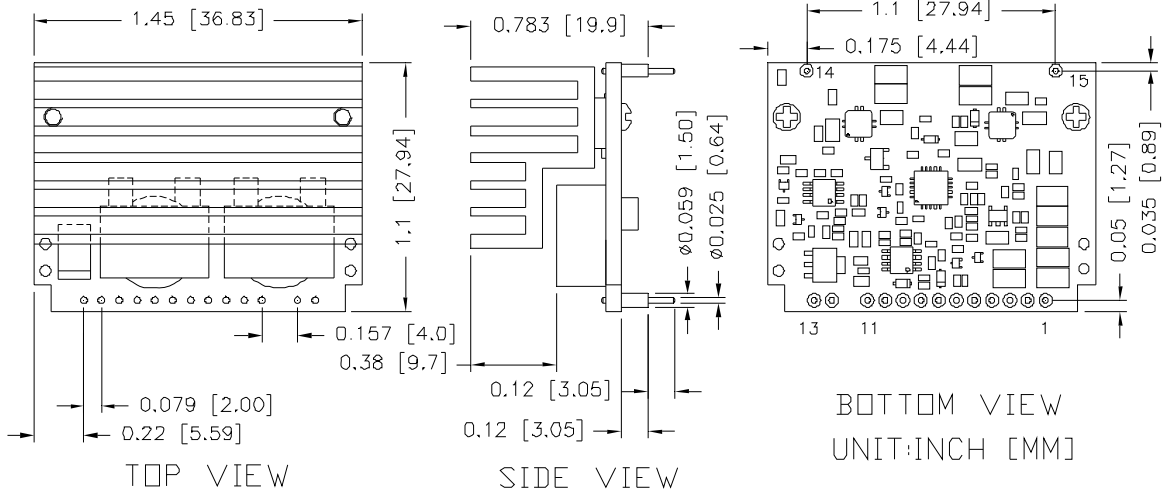


Jan. 21, 2010

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

**Mechanical Outline**

**ORP2-50E1Ax**



**Pin Connections**

Pin	Function	Pin	Function
1	Vout	9	PwGOOD
2	Vout	10	Sense-
3	Vout	11	Sense+
4	GND	12	Vin
5	GND	13	Vin
6	Enable	14	GND
7	Trim-	15	GND
8	Trim+		

**NON-ISOLATED DC/DC CONVERTERS**  
 5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output

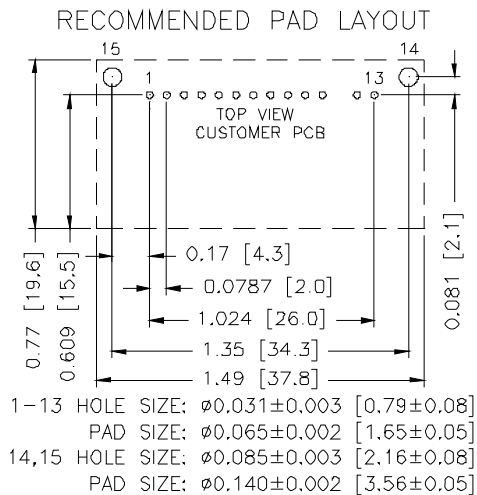
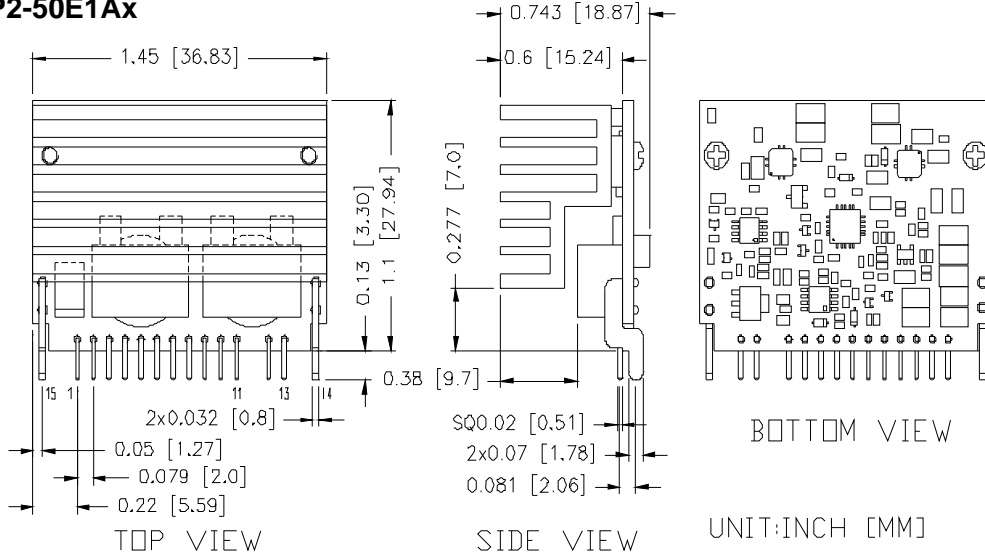


Jan. 21, 2010

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

**Mechanical Outline (continued)**

**VRP2-50E1Ax**



**Pin Connections**

Pin	Function
1	Vout
2	Vout
3	Vout
4	GND
5	GND
6	Enable
7	Trim-
8	Trim+
9	PwGOOD
10	Sense-
11	Sense+
12	Vin
13	Vin
14	GND
15	GND

**Note:** This module is recommended and compatible with Pb-Free Wave Soldering and must be soldered using a peak solder temperature of no more than 260 °C for less than 5 seconds.

**Note:**

- 1) All Pins: Material - Copper Alloy;  
 Finish – 3 micro inches minimum Gold over 50 micro inches minimum Nickel plate.
- 2) Undimensioned components are shown for visual reference only.
- 3) All dimensions in inches (mm); Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm) x.xxx +/-0.010 in. (x.xx +/-0.25mm).

**NON-ISOLATED DC/DC CONVERTERS**  
5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



Jan. 21, 2010

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

**Revision History**

Date	Revision	Changes Detail	Approval
2010-1-21	H	1. Change to Bel new datasheet format; 2. Add new part number "xRP2-50E1A1"	YF Sun

**RoHS Compliance**

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



©2010 Bel Fuse Inc. Specifications subject to change without notice. 012110

**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)