

## NON-ISOLATED DC/DC CONVERTERS

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

**bel**  
POWER PRODUCTS

xRP2-50E1A0

RoHS Compliant

Rev.G

- 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



### Description

The xRP2-50E1A0 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

**Notes:** 1. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers.  
2. Add "G" suffix at the end of the model numbers listed above to indicate "Tray Packaging".

### 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	5 V 1.8* $V_o$	12 V 12 V	13.8 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 $\mu\text{F}/16 \text{ V}$ 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.

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



**Output Specifications**

Parameter	Min	Typ	Max	Notes	
Output Voltage Set Point Accuracy Vo ≥ 1 V Vo < 1 V	-1.5 % Vo -10 mV	- -	+1.5 % Vo +10 mV	Vin=Vinmin, Io=Iomax	
Load Regulation Vo ≥ 2.5 V Vo < 2.5 V	- -	- -	0.6% Vo 12 mV		
Line Regulation Vo ≥ 2.5 V Vo < 2.5 V	- -	- -	0.3% Vo 9 mV		
Regulation Over Temperature (0 °C to +70 °C)	-	-	0.02% Vo/C		
Output Current	0 A	-	50 A		
Current Limit Threshold	105% Io	130% Io	180% Io		
Output Ripple and Noise (pk-pk) Vo=5.0 V Vo=3.3 V Vo=2.5 V Vo=1.5 V Vo=1.0 V Vo=0.6 V	- - - - - -	- - - - - -	110 mV 100 mV 100 mV 80 mV 60 mV 60 mV	Test conditions: 0-20MHz BW, with a 1µF ceramic capacitor and a 10 uF Tantalum cap at output.	
Output Ripple and Noise (rms) Vo=5.0 V Vo=3.3 V Vo=2.5 V Vo=1.5 V Vo=1.0 V Vo=0.6 V	- - - - - -	- - - - - -	35 mV 35 mV 35 mV 30 mV 25 mV 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 uF	-	4700 uF		
<b>Transient Response</b>					
50% ~ 100% Max Load	Vo=All	-	-	300 mV	Test conditions: di/dt = 10 A/uS; Vin =12 V; Co=0 uF.
Settling Time		-	-	100 uS	
100% ~ 50% Max Load		-	-	300 mV	
Settling Time		-	-	100 uS	

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

# NON-ISOLATED DC/DC CONVERTERS

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



## 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 x W x H)	1.45 x 1.1 x 0.783			
Millimeters (L x W x H)	36.83 x 27.94 x 19.9			
Dimensions (vertical mount)				
Inches (L x W x H)	1.45 x 1.1 x 0.743			
Millimeters (L x W x H)	36.83 x 27.94 x 18.87			
Weight	-	28.5 g	-	

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

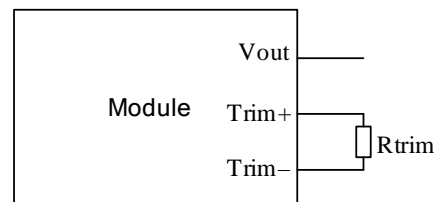
## Control Specifications

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	-	Vin,max	
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

The Trim resistor should be connected between the Trim+ pin and Trim- pin.

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

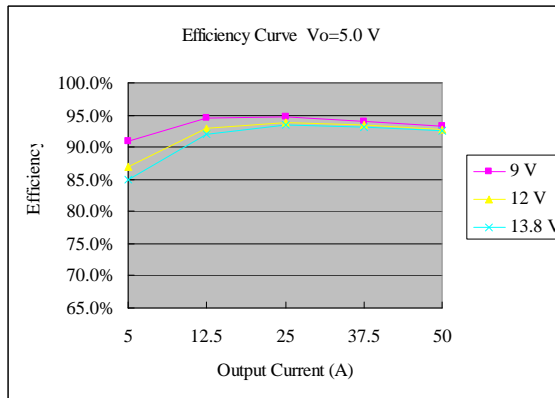
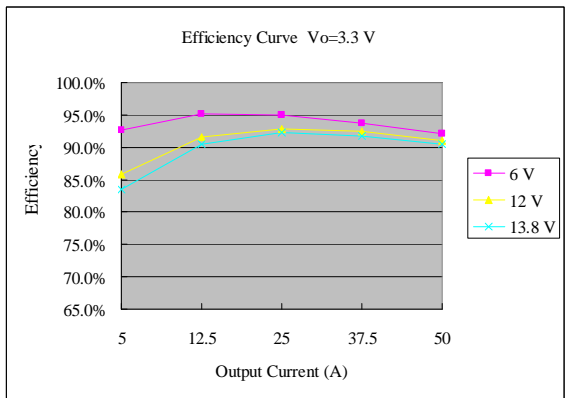
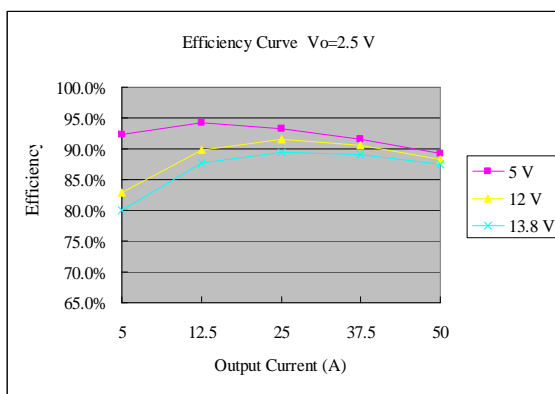
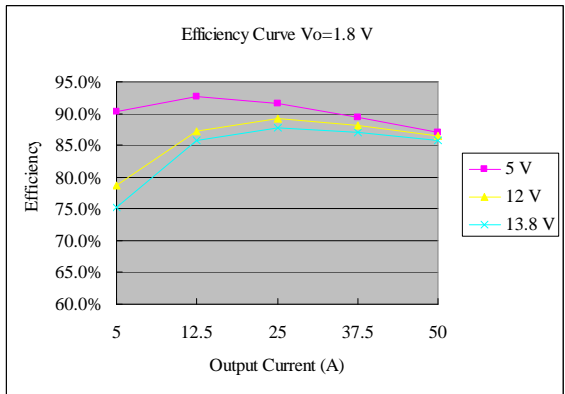
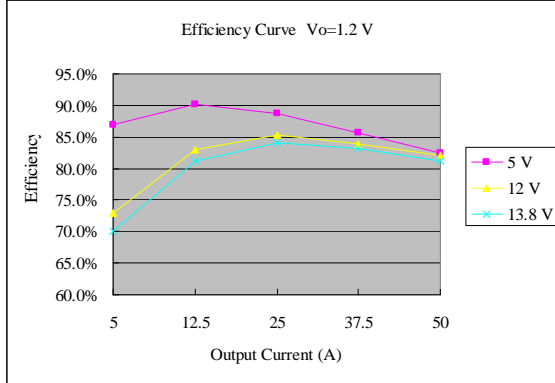
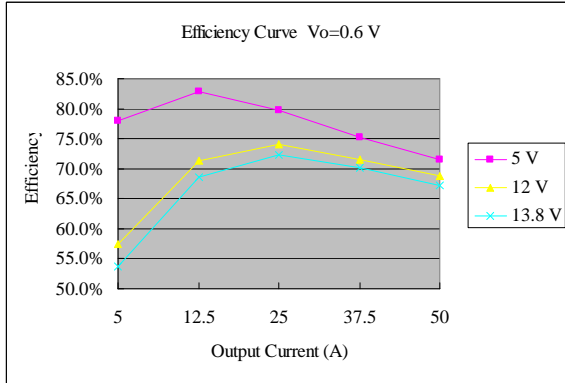


# NON-ISOLATED DC/DC CONVERTERS

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



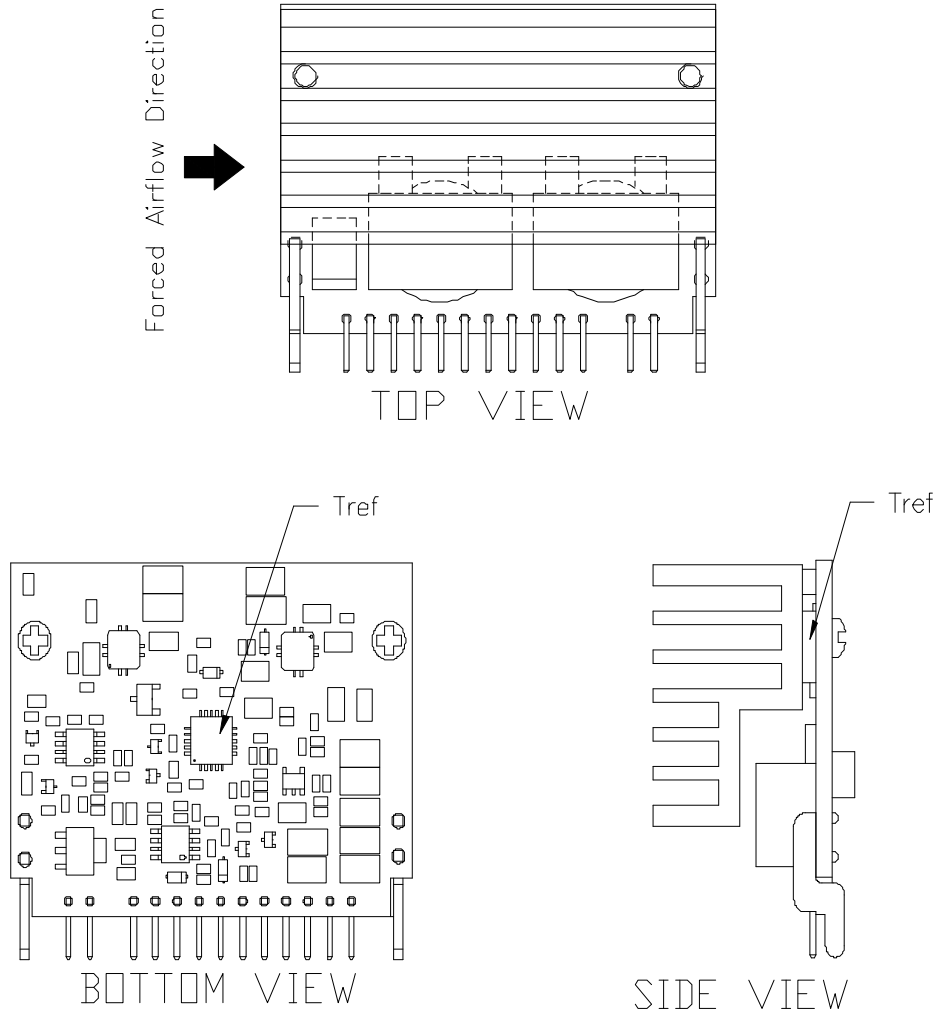
## Efficiency Data



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



**Thermal Derating Curves**

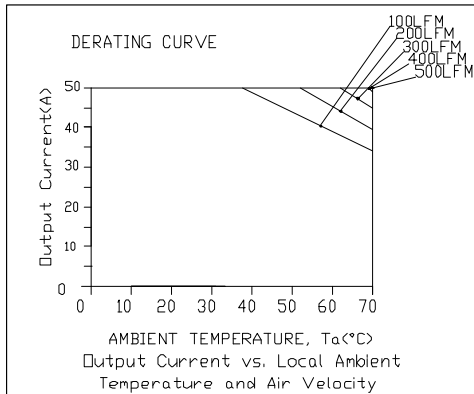


The thermal reference point Tref is shown above. For reliable operation this temperature should not exceed 115°C. The output power of the module should not exceed the rated power for the module.

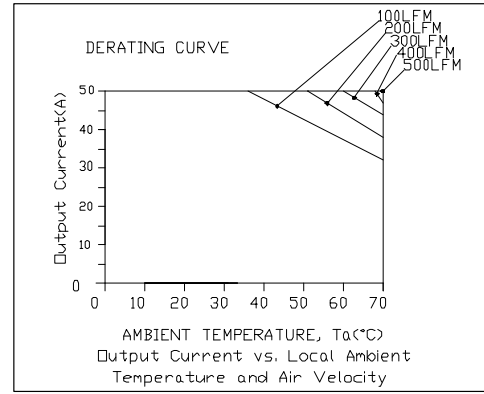
**NON-ISOLATED DC/DC CONVERTERS**  
 5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



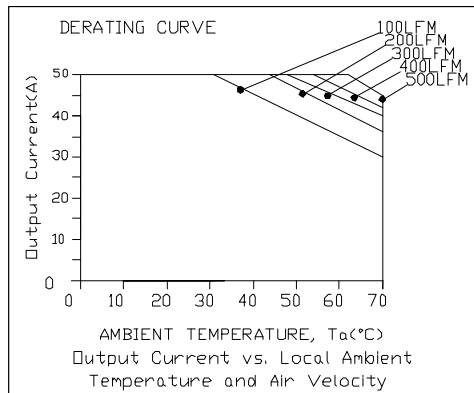
**Thermal Derating Curves (continued)**



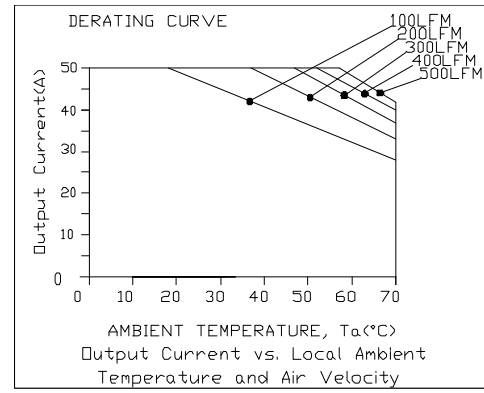
Vin=12 V, Vo=0.6 V



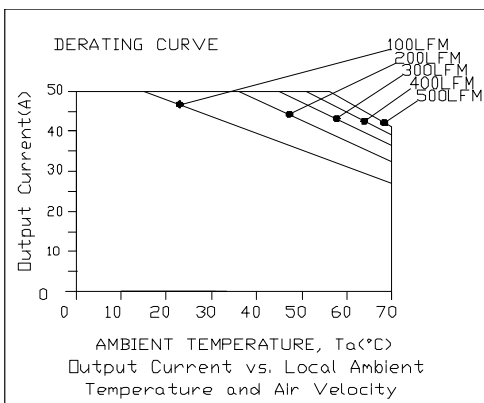
Vin=12 V, Vo=1.2 V



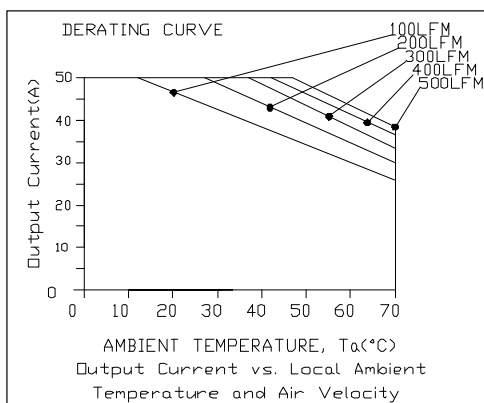
Vin=12 V, Vo=1.8 V



Vin=12 V, Vo=2.5 V



Vin=12 V, Vo=3.3 V

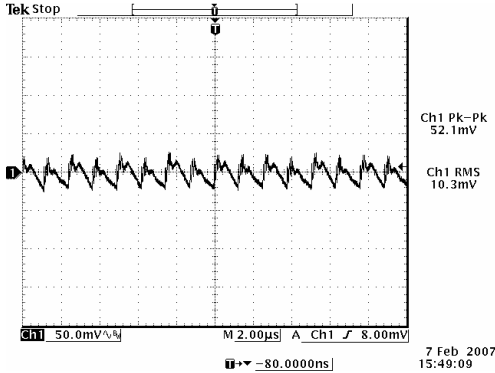


Vin=12 V, Vo=5.0 V

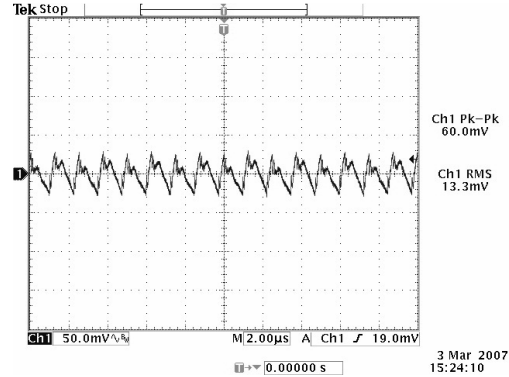
**NON-ISOLATED DC/DC CONVERTERS**  
 5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



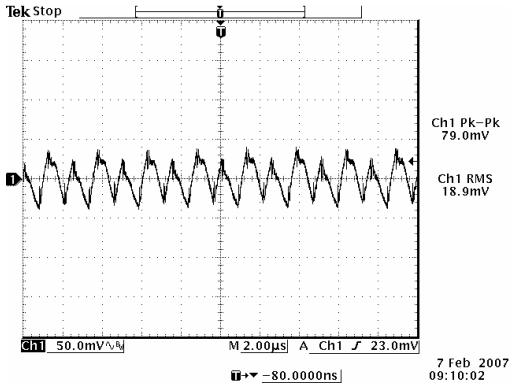
**Ripple and Noise Waveforms**



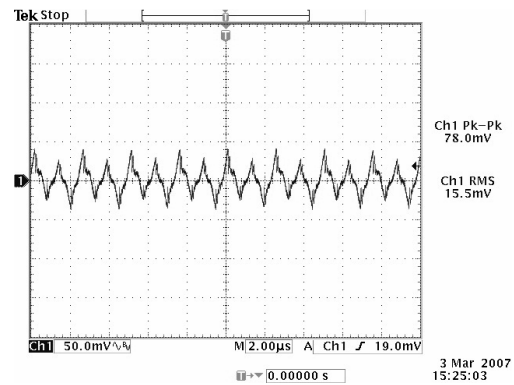
12 Vdc input, 0.6 Vdc/50 A output



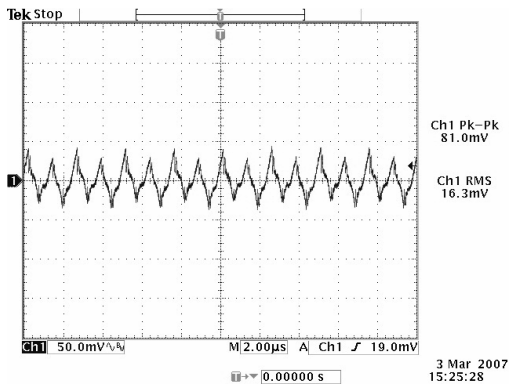
12 Vdc input, 1.2 Vdc/50 A output



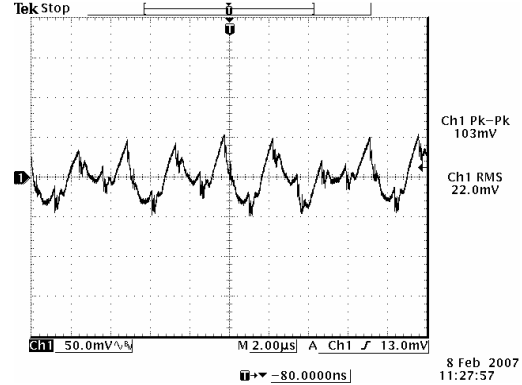
12 Vdc input, 1.8 Vdc/50 A output



12 Vdc input, 2.5 Vdc/50 A output



12 Vdc input, 3.3 Vdc/50 A output



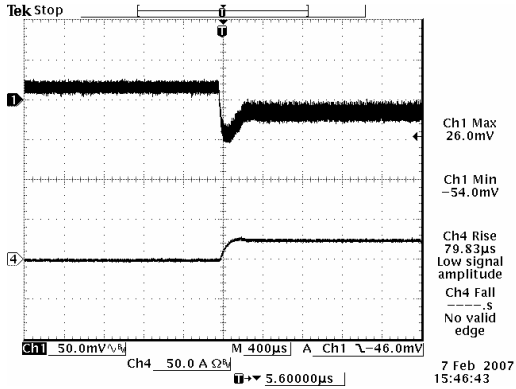
12 Vdc input, 5.0 Vdc/50 A output

**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.

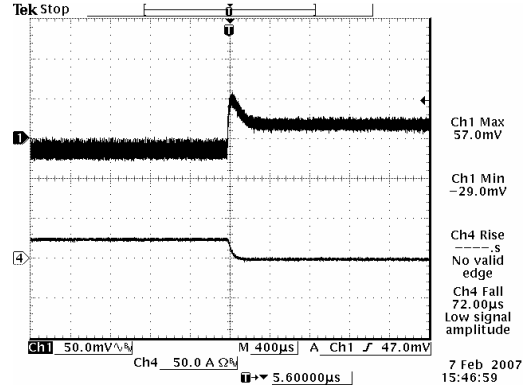
**NON-ISOLATED DC/DC CONVERTERS**  
 5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



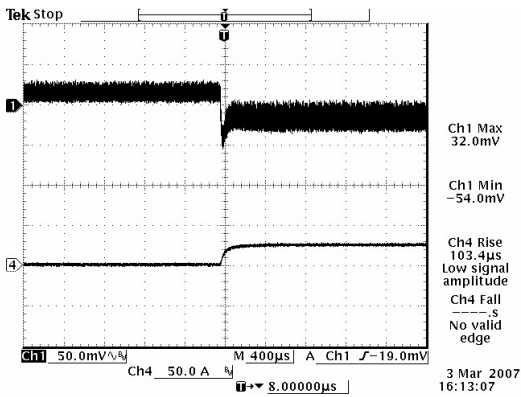
**Transient Response Waveforms**



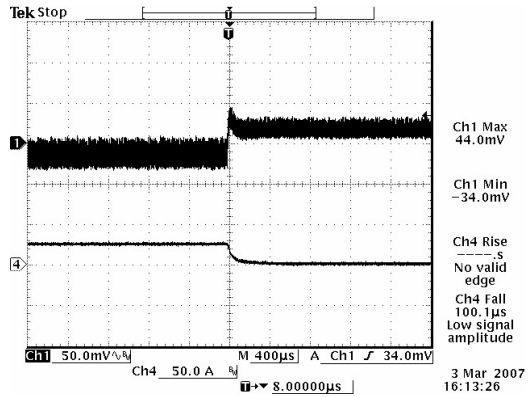
Vout= 0.6 V 0%-50% Load Transient



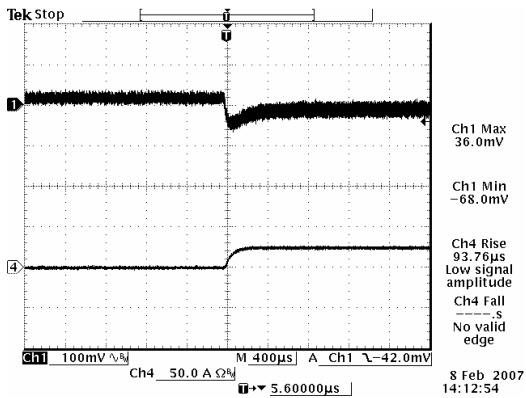
Vout=0.6 V 50%-0% Load Transient



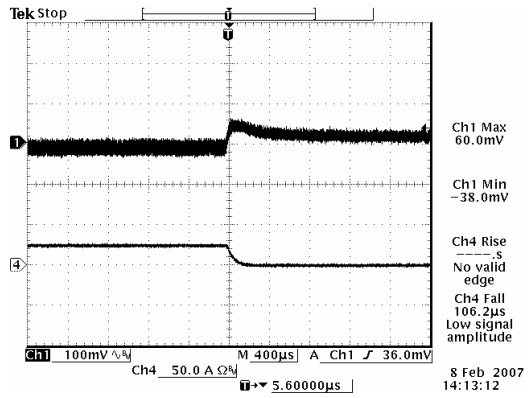
Vout=1.2 V 0%-50% Load Transient



Vout=1.2 V 50%-0% Load Transient



Vout=1.8 V 0%-50% Load Transient



Vout=1.8 V 50%-0% Load Transient

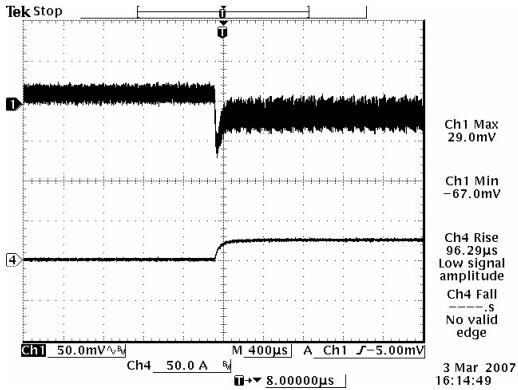


# NON-ISOLATED DC/DC CONVERTERS

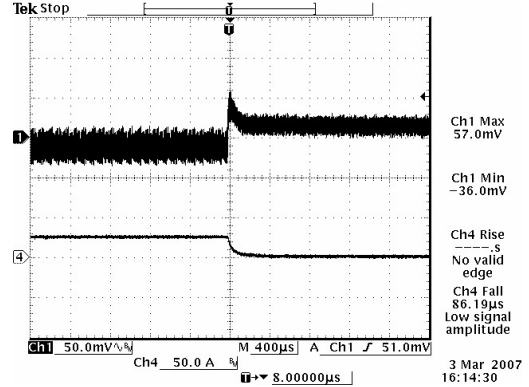
5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/50 A Output



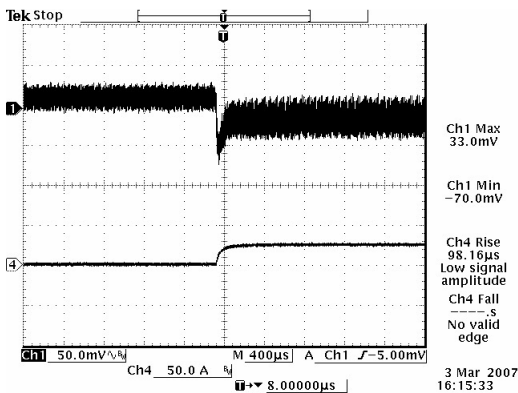
## Transient Response Waveforms (continued)



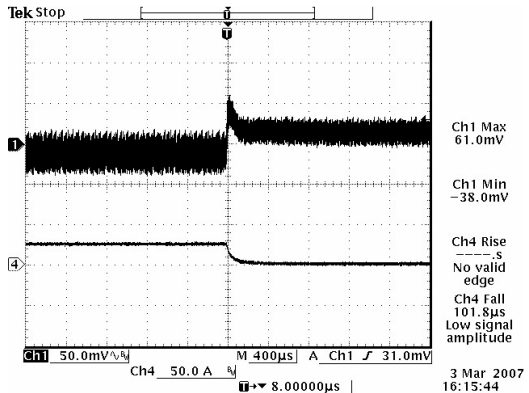
Vout= 2.5 V 0%-50% Load Transient



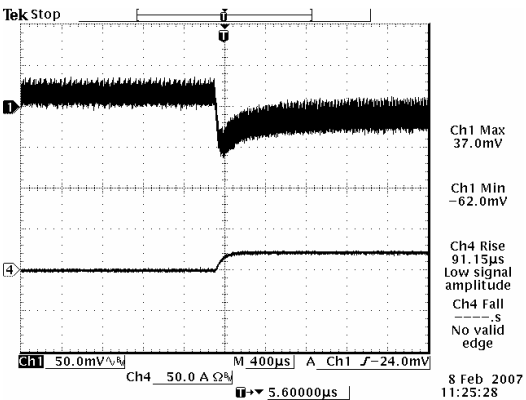
Vout=2.5 V 50%-0% Load Transient



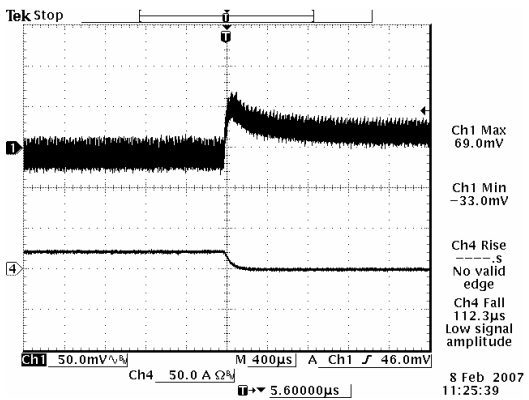
Vout=3.3 V 0%-50% Load Transient



Vout=3.3 V 50%-0% Load Transient



Vout=5 V 0%-50% Load Transient



Vout=5 V 50%-0% Load Transient

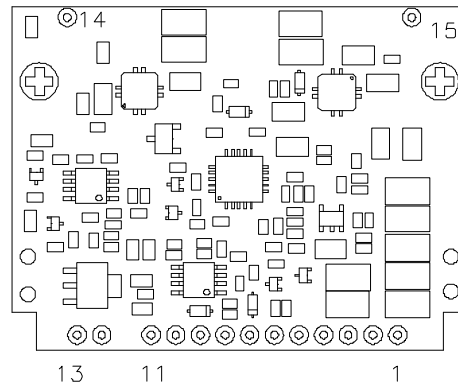
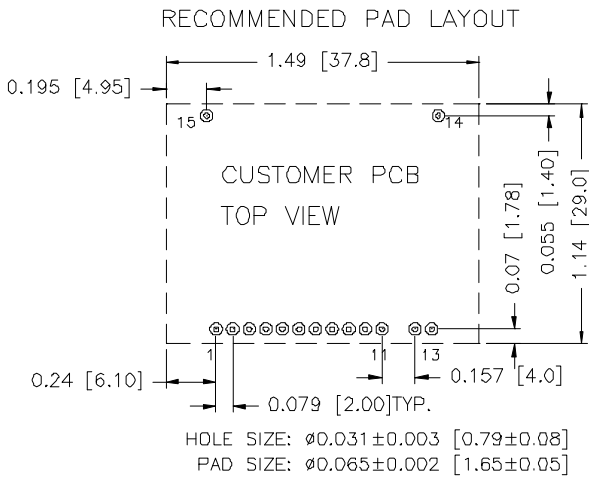
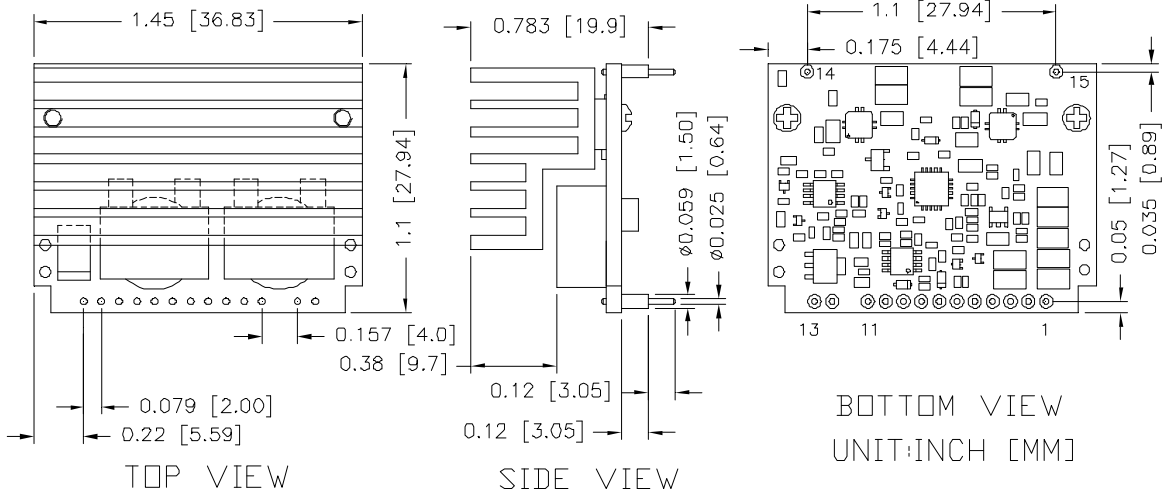
**Note:** Transient response at  $di/dt = 10 \text{ A/uS}$ , with external electrolytic cap 4700 uF, and  $T_a=25 \text{ deg C}$ .

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



**Mechanical Outline**

**ORP2-50E1A0**



**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+		

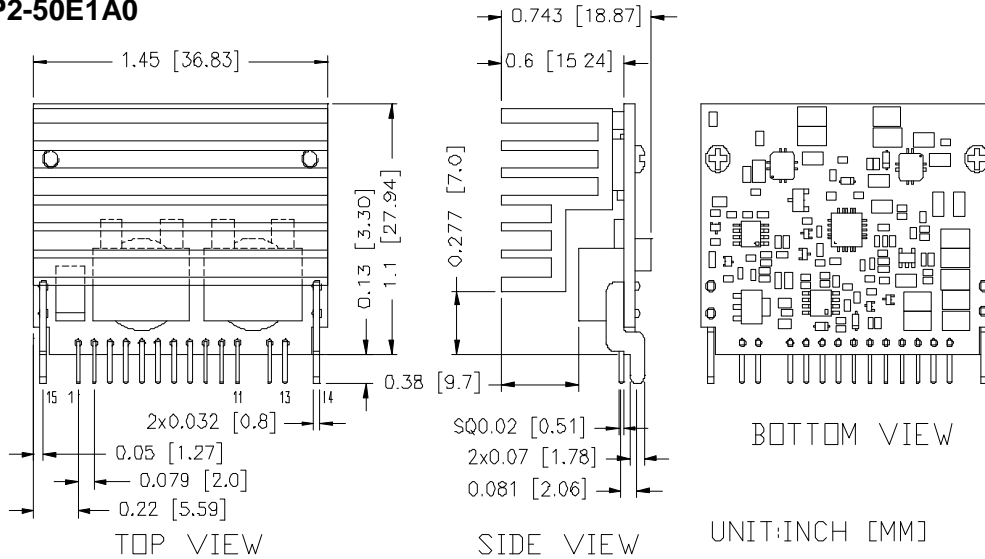
# NON-ISOLATED DC/DC CONVERTERS

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

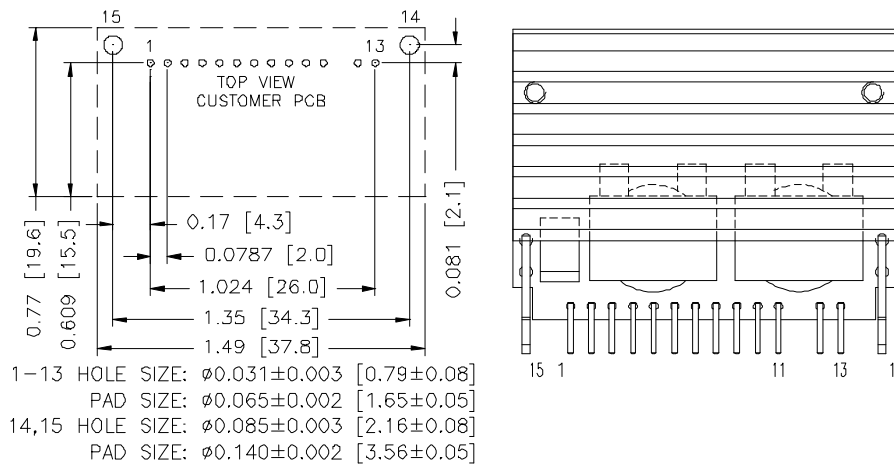


## Mechanical Outline (continued)

### VRP2-50E1A0



### RECOMMENDED PAD LAYOUT



### 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

### RoHS Compliance

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



©2009 Bel Fuse Inc. Specifications subject to change without notice. 042009

#### 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)