

## NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/60 A Output

Mar. 23, 2010

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

**VRP3-60E1A0**

**RoHS Compliant**

**Rev.D**

### Features

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



### Applications

- Networking
- Computers and peripherals
- Telecommunications

### Description

The VRP3-60E1A0 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 60 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 ( $V_o=1.8 \text{ Vdc}$ )	Model Number Active High
0.6 Vdc - 5.0 Vdc	5 Vdc - 13.8 Vdc	60 A	300 W	88%	VRP3-60E1A0

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

### Part Number Explanation

V R P3 - 60 E 1A 0  
1 2 3 4 5 6 7

- 1---Vertical mount
- 2---RoHS 6, change "R" to "7" means RoHS 5
- 3---Series name (SIP)
- 4---Series code (output current 60A)
- 5---Input range (5-13.8V)
- 6---Output voltage (0.6-5.0V)
- 7---Suffix

# NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/60 A Output



Mar. 23, 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)	-	-	40 A	
Input Reflected Ripple Current (pk-pk)	-	20	35	With simulated source impedance of 1 uH, 5 Hz to 20 MHz. Use a 1000 uF/16 V electrolytic capacitor with ESR=0.1 ohm max, at 100 kHz at 25°C.
Input Reflected Ripple Current (rms)	-	5	10	
$I^2t$ Inrush Current Transient	-	-	1 A <sup>2</sup> s	
Turn-on Voltage Threshold	-	4.6 V	4.8 V	
Under Voltage Threshold	-	4.3 V	4.5 V	

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

## Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point				
$V_o \geq 1 \text{ V}$	-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% $V_o/C$	
Output Current	0 A	-	60 A	
Current Limit Threshold	110% $I_o$	130% $I_o$	160% $I_o$	
Output Ripple and Noise (pk-pk)				
$V_o = 5.0 \text{ V}$	-	-	60 mV	Test conditions: 0-20 MHz BW, with a 1 µF ceramic capacitor and a 10 uF Tantalum cap at output.
$V_o = 3.3 \text{ V}$	-	-	60 mV	
$V_o = 2.5 \text{ V}$	-	-	40 mV	
$V_o = 1.5 \text{ V}$	-	-	40 mV	
$V_o = 1.0 \text{ V}$	-	-	30 mV	
$V_o = 0.6 \text{ V}$	-	-	30 mV	

## NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input      0.6 Vdc - 5.0 Vdc/60 A Output



Mar. 23, 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: 0-20 MHz BW, with a 1 $\mu$ F ceramic capacitor and a 10 $\mu$ F Tantalum cap at output.	
Vo=5.0 V	-	-	30 mV		
Vo=3.3 V	-	-	30 mV		
Vo=2.5 V	-	-	20 mV		
Vo=1.5 V	-	-	20 mV		
Vo=1.0 V	-	-	15 mV		
Vo=0.6 V	-	-	15 mV		
Turn On Time	-	-	10 mS		
Rise Time	-	-	3 mS		
Overshoot at Turn on and off	-	-	0.5%		
Output Capacitance					
ESR $\geq$ 1 m $\Omega$	0 $\mu$ F	-	4700 $\mu$ F		
<b>Transient Response</b>					
0% ~ 50% Max Load	Vo=All	-	-	300 mV	Test conditions: di/dt = 10 A/ $\mu$ S; Vin = 12 V;
Settling Time		-	-	100 $\mu$ S	
50% ~ 0% Max Load		-	-	300 mV	
Settling Time		-	-	100 $\mu$ S	

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

### General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				Measured at Vin=12 V, full load.
Vo=5.0 V	91%	94%	-	
Vo=3.3 V	89%	91%	-	
Vo=2.5 V	87%	90%	-	
Vo=1.8 V	84%	88%	-	
Vo=1.5 V	82%	87%	-	
Vo=1.2 V	79%	84%	-	
Vo=1.0 V	76%	81%	-	
Vo=0.6 V	68%	74%	-	
Switching Frequency	-	333 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	2,576,000 hours			Calculated Per Bell Core SR-332 (Io = 80%Iomax; Vin=12 V; Ta = 25 °C)
Dimensions				
Inches (L x W x H)	2.58 x 1.25 x 0.608			
Millimeters (L x W x H)	65.53 x 31.75 x 15.44			
Weight	-	38 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/60 A Output



Mar. 23, 2010

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

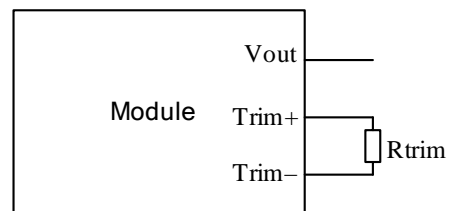
### Control Specifications

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

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

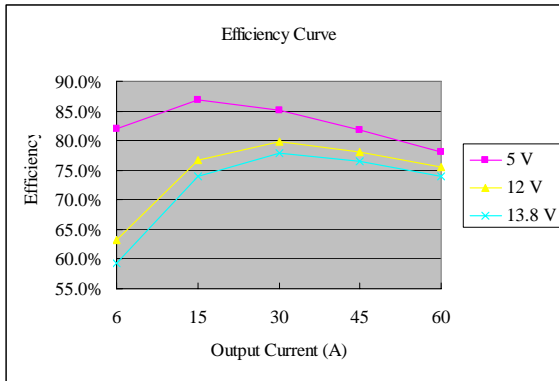
0.6 Vdc - 5.0 Vdc/60 A Output



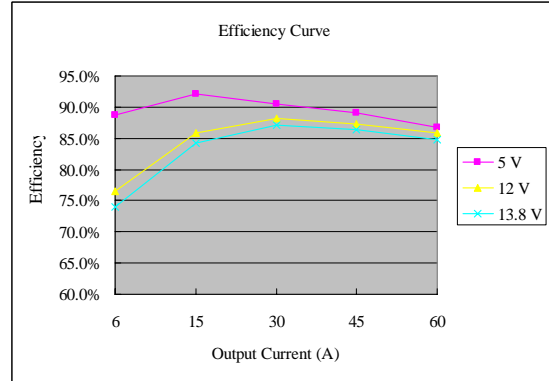
Mar. 23, 2010

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

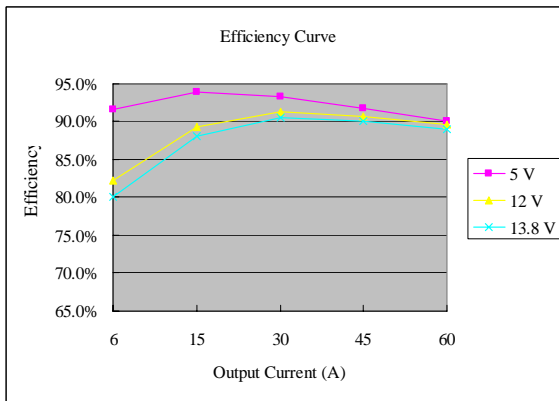
## Efficiency Data



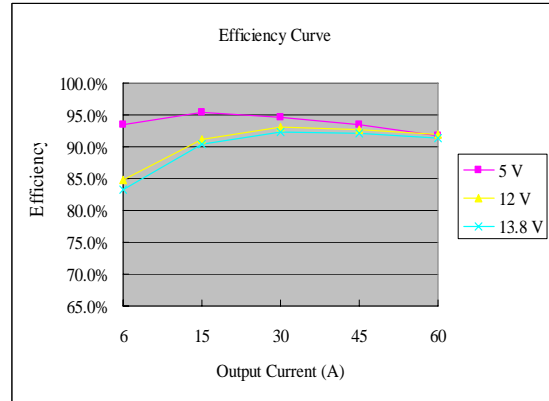
$V_{out} = 0.6\text{ V}$



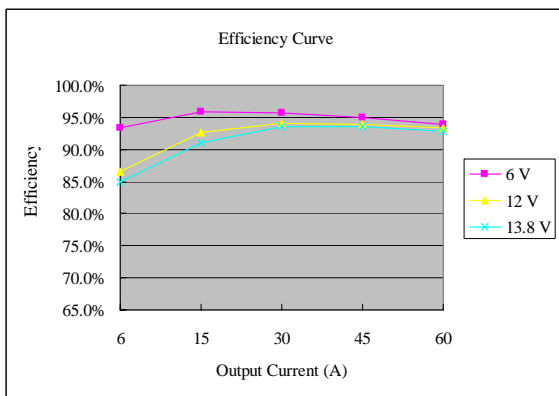
$V_{out} = 1.2\text{ V}$



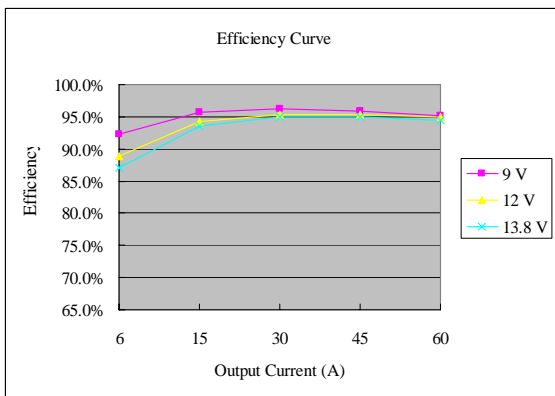
$V_{out} = 1.8\text{ V}$



$V_{out} = 2.5\text{ V}$



$V_{out} = 3.3\text{ V}$



$V_{out} = 5.0\text{ V}$

# NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input

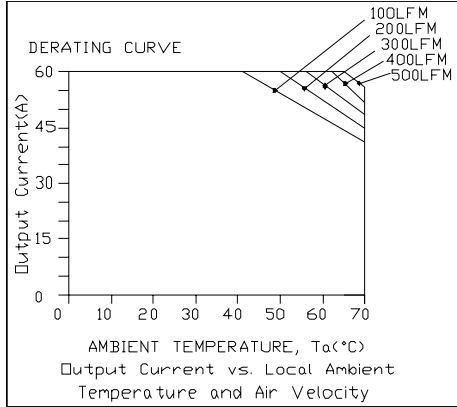
0.6 Vdc - 5.0 Vdc/60 A Output



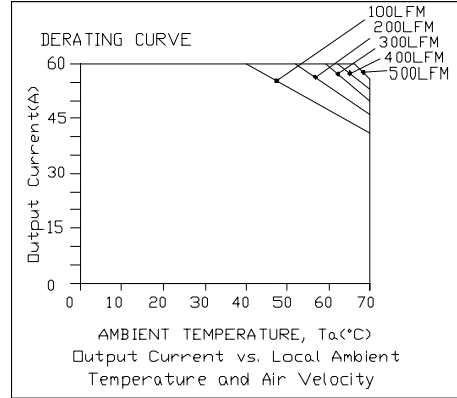
Mar. 23, 2010

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

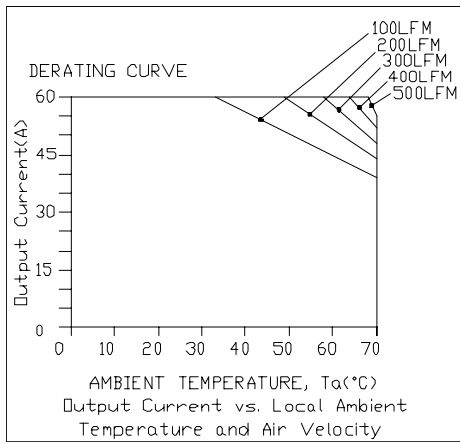
## Thermal Derating Curves



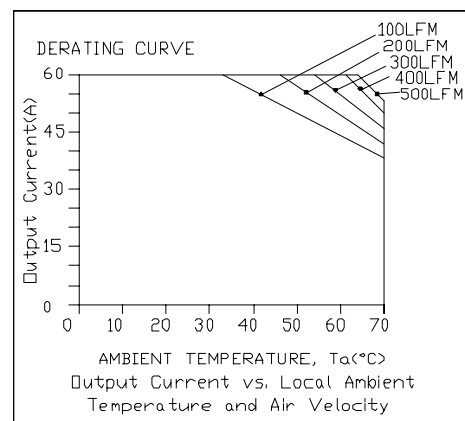
Vin=12 V, Vo=0.6 V



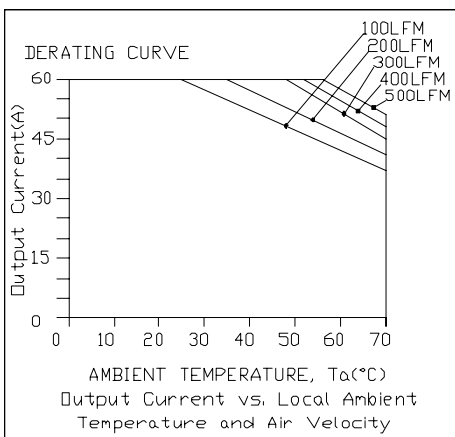
Vin=12 V, Vo=1.2 V



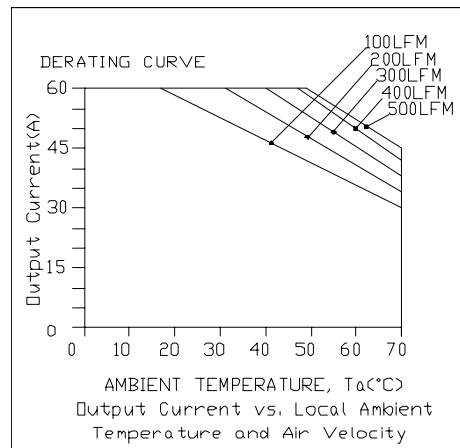
Vin=12 V, Vo=1.8 V



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

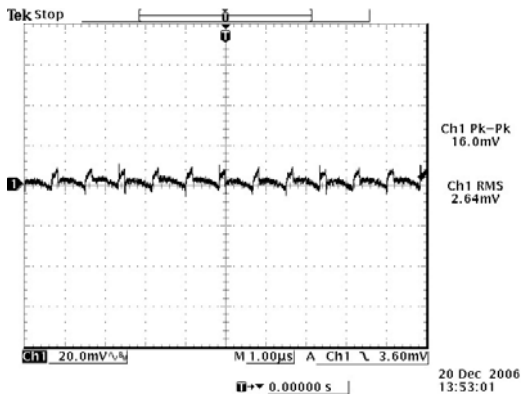
0.6 Vdc - 5.0 Vdc/60 A Output



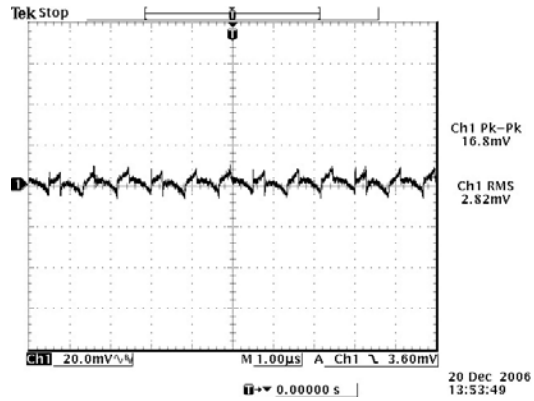
Mar. 23, 2010

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

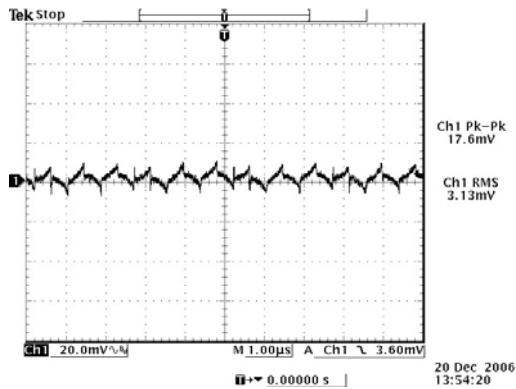
## Ripple and Noise Waveforms



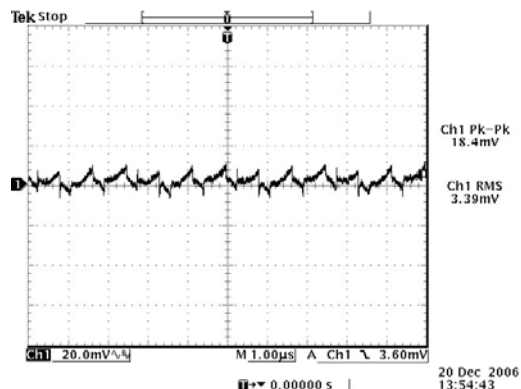
12 Vdc input, 0.6 Vdc/60 A output



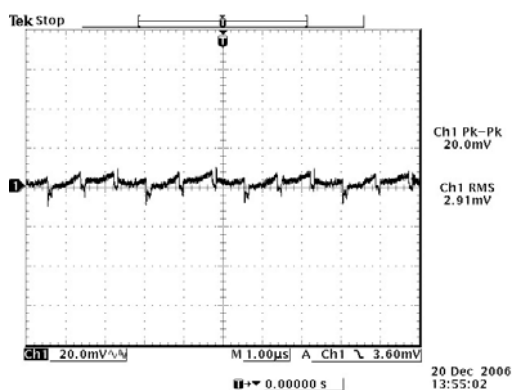
12 Vdc input, 1.2 Vdc/60 A output



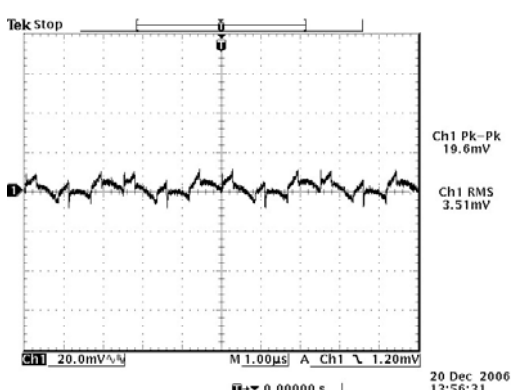
12 Vdc input, 1.8 Vdc/60 A output



12 Vdc input, 2.5 Vdc/60 A output



12 Vdc input, 3.3 Vdc/60 A output



12 Vdc input, 5.0 Vdc/60 A output

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

# NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input

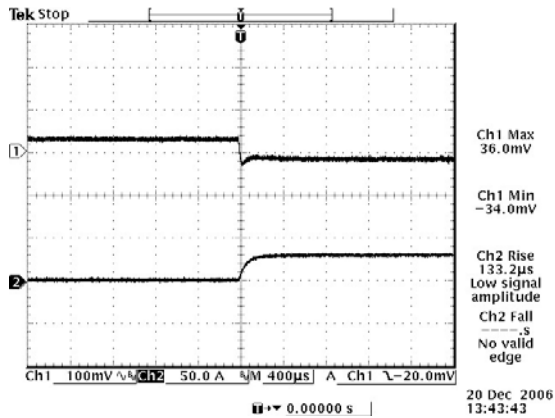
0.6 Vdc - 5.0 Vdc/60 A Output



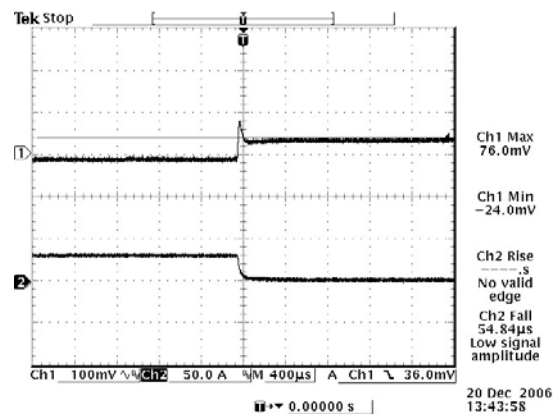
Mar. 23, 2010

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

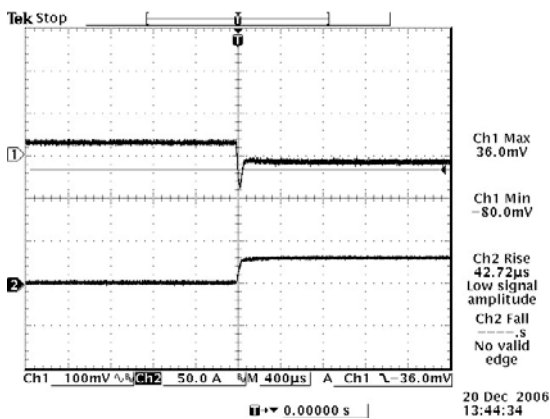
## Transient Response Waveforms



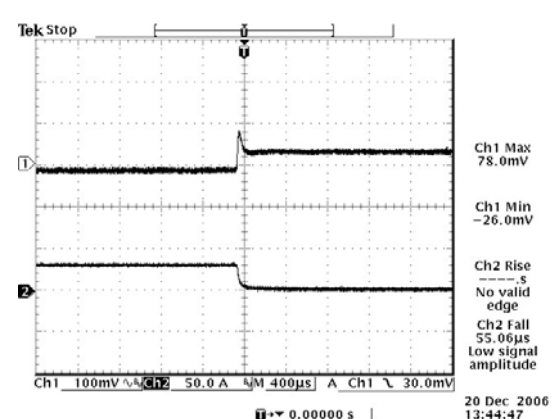
Vout=0.6 V 0%-50% Load Transients



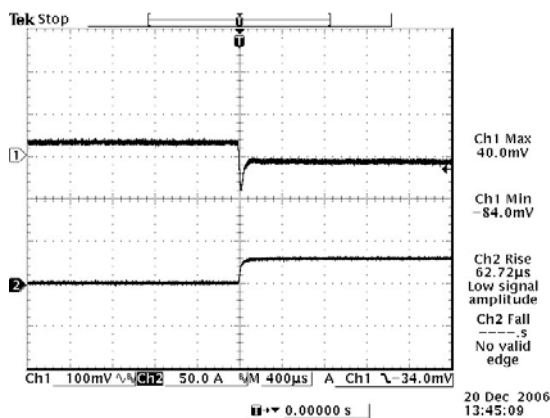
Vout=0.6 V 50%-0% Load Transients



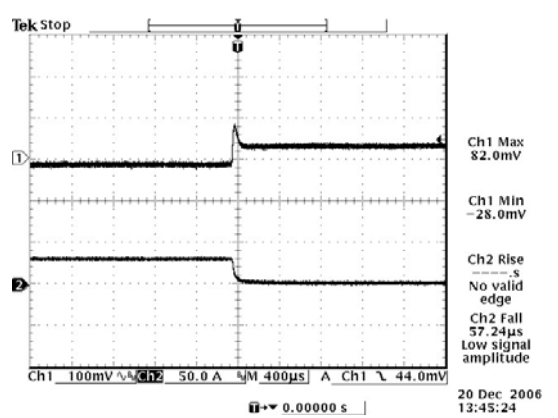
Vout=1.2 V 0%-50% Load Transients



Vout=1.2 V 50%-0% Load Transients



Vout=1.8 V 0%-50% Load Transients



Vout=1.8 V 50%-0% Load Transients



# NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input

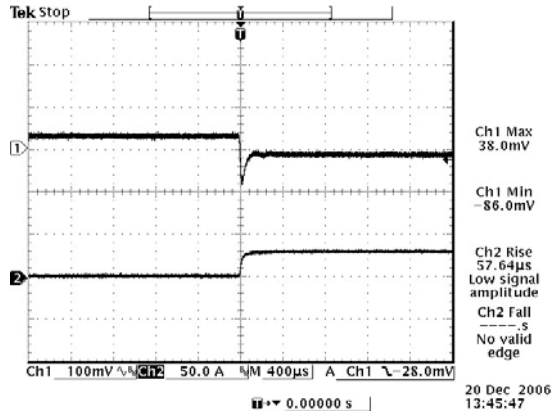
0.6 Vdc - 5.0 Vdc/60 A Output



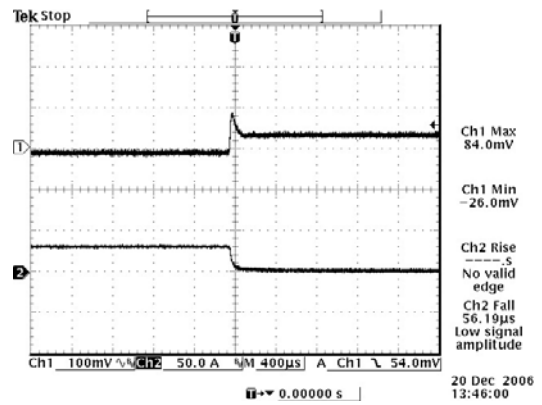
Mar. 23, 2010

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

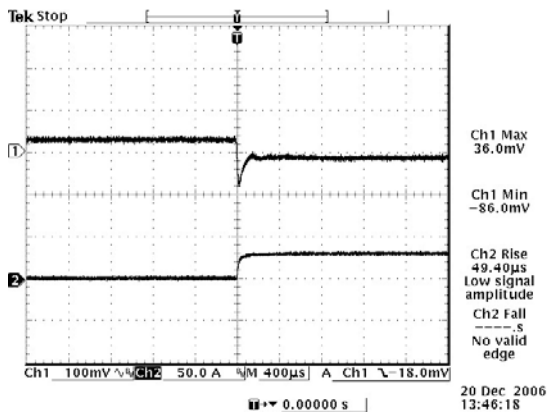
## Transient Response Waveforms (continued)



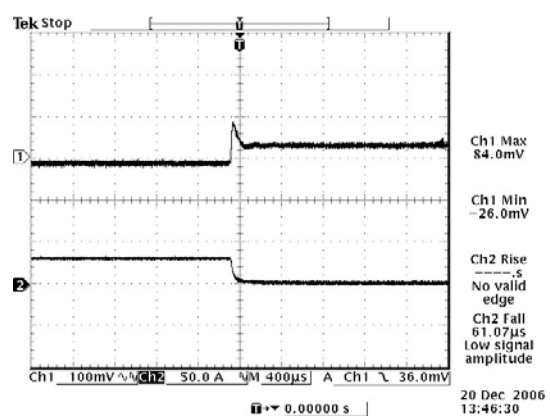
Vout= 2.5 V 0%-50% Load Transients



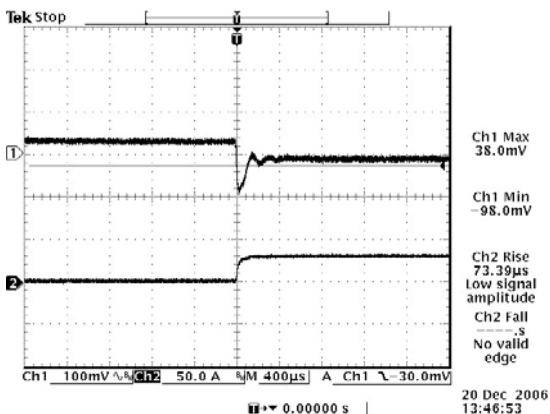
Vout=2.5 V 50%-0% Load Transients



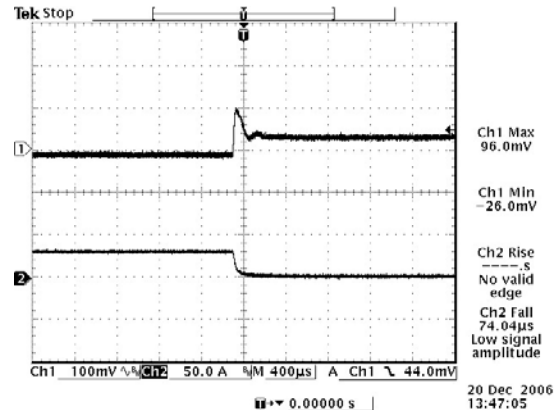
Vout=3.3 V 0%-50% Load Transients



Vout=3.3 V 50%-0% Load Transients



Vout=5 V 0%-50% Load Transients



Vout=5 V 50%-0% Load Transients

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

# NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input

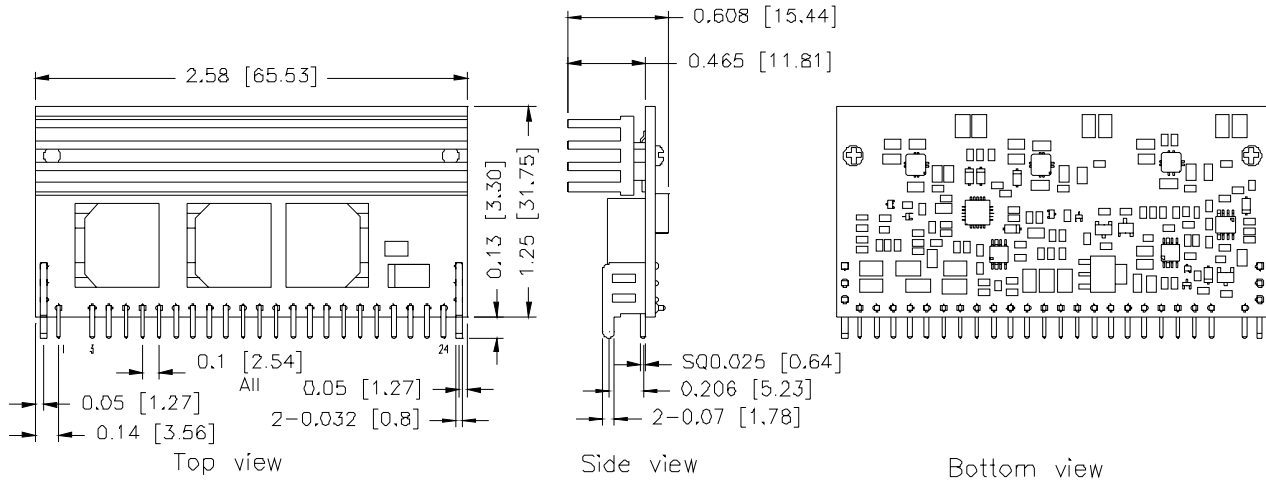
0.6 Vdc - 5.0 Vdc/60 A Output



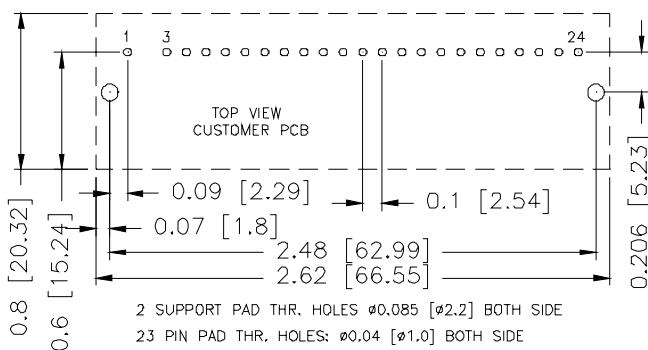
Mar. 23, 2010

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

## Mechanical Outline



### RECOMMENDED PAD LAYOUT



## Pin Connections

Pin	Function	Pin	Function	Pin	Function
1	Trim+	9	Enable	17	GND
2	N/A	10	Sense-	18	Vout
3	GND	11	Sense+	19	GND
4	PwGOOD	12	Vin	20	Vout
5	Trim-	13	Vin	21	GND
6	Ishare	14	Vin	22	Vout
7	GND	15	Vout	23	GND
8	GND	16	Vout	24	Vout

**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/60 A Output



Mar. 23, 2010

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

### Revision History

Date	Revision	Changes Detail	Approval
2010-3-23	D	1. Change to Bel new datasheet format	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. 032310

#### 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)