

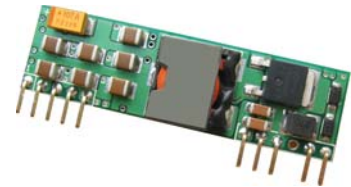
## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 13.2 Vdc Input    0.9 Vdc - 5.0 Vdc/10 A Output

**bel**  
POWER PRODUCTS

### VRPB-10D Series    RoHS Compliant    Rev.A

- Non-Isolated
- High Efficiency
- High Power Density
- Excellent Thermal Performance
- Low Cost
- Remote On/Off
- Under-voltage Lockout (UVLO)
- OCP/SCP
- Wide Input



### Description

The Bel VRPB-10Dxxx is part of the low cost non-isolated dc/dc power converter series. The modules use a SIP package for ease of layout and space savings. The output is closely regulated and the efficiency is typically 93% at full load. Typical features include Remote On/Off, under-voltage lockout, over-current protection and short circuit protection.

### Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typ. Efficiency at Vin=12V	Model Number Active Low	Model Number Active High
5.0 Vdc	8.0 Vdc - 13.2 Vdc	10 A	50.0 W	93%	VRPB-10D50L	VRPB-10D50S
3.3 Vdc	4.5 Vdc - 13.2 Vdc	10 A	33.0 W	91%	VRPB-10D33L	VRPB-10D33S
2.5 Vdc	3.1 Vdc - 13.2 Vdc	10 A	25.0 W	89%	VRPB-10D25L	VRPB-10D25S
1.8 Vdc	3.0 Vdc - 13.2 Vdc	10 A	18.0 W	86%	VRPB-10D18L	VRPB-10D18S
1.5 Vdc	3.0 Vdc - 13.2 Vdc	10 A	15.0 W	84%	VRPB-10D15L	VRPB-10D15S
1.2 Vdc	3.0 Vdc - 13.2 Vdc	10 A	12.0 W	81%	VRPB-10D12L	VRPB-10D12S
0.9 Vdc	3.0 Vdc - 13.2 Vdc	10 A	9.0 W	78%	VRPB-10D09L	VRPB-10D09S

- 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	-40 °C	-	85 °C	
Storage Temperature	-40 °C	-	125 °C	

### Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	Vo=5.0 V	8 V	13.2 V	
	Vo=3.3 V	4.5 V	13.2 V	
	Vo=2.5 V	3.1 V	13.2 V	
	Vo=0.9-1.8 V	3.0 V	13.2 V	
Input Current (full load)	Vin=3.3 V	-	10.0 A	
	Vin=5.0 V	-	8.8 A	
	Vin=13.2 V	-	5.5 A	
Input Current (no load)	Vin=3.3 V	-	200 mA	
	Vin=5.0 V	-	200 mA	
	Vin=13.2 V	-	150 mA	

## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 13.2 Vdc Input      0.9 Vdc - 5.0 Vdc/10 A Output



### Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
Input Reflected Ripple Current (pk-pk)	-	-	250 mA	Tested with a 22 uF tantalum input capacitor & simulated source impedance of 500 nH, 5 Hz to 20 MHz.
Input Reflected Ripple Current (rms)	-	-	70 mA	
I <sup>2</sup> t Inrush Current Transient	-	0.04 A <sup>2</sup> s	0.08 A <sup>2</sup> s	
Turn-on Voltage Threshold	-	2.9 V	-	
Turn-off Voltage Threshold	-	-	-	
Vo=5.0 V	-	-	5.5 V	
Vo=3.3 V	-	-	3.8 V	
Vo=0.9-2.5 V	-	-	2.95 V	

### Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point				Test condition: Vin=12 V, Iout=full load
Vo=5.0 V	4.900 V	5.0 V	5.100 V	
Vo=3.3 V	3.247 V	3.3 V	3.353 V	
Vo=2.5 V	2.460 V	2.5 V	2.540 V	
Vo=1.8 V	1.772 V	1.8 V	1.828 V	
Vo=1.5 V	1.476 V	1.5 V	1.524 V	
Vo=1.2 V	1.181 V	1.2 V	1.219 V	
Vo=0.9 V	0.886 V	0.9 V	0.914 V	
Load Regulation				
Vo=5.0 V	-	10 mV	20 mV	
Vo=3.3 V	-	6 mV	16 mV	
Vo=2.5 V	-	6 mV	12 mV	
Vo=1.8 V	-	5 mV	9 mV	
Vo=1.5 V	-	3 mV	7 mV	
Vo=1.2 V	-	3 mV	6 mV	
Vo=0.9 V	-	3 mV	5 mV	
Line Regulation				
Vo=5.0 V	-	2 mV	10 mV	
Vo=3.3 V	-	2 mV	10 mV	
Vo=2.5 V	-	2 mV	8 mV	
Vo=1.8 V	-	2 mV	5 mV	
Vo=1.5 V	-	2 mV	5 mV	
Vo=1.2 V	-	2 mV	5 mV	
Vo=0.9 V	-	2 mV	5 mV	
Regulation Over Temperature (-40 °C to 85 °C)				
Vo=5.0 V	-	8 mV	35 mV	
Vo=0.9-3.3 V	-	5 mV	35 mV	
Output Current	0 A	-	10 A	
Current Limit Threshold	13 A	-	25 A	
Short Circuit Surge Transient	-	0.8 A <sup>2</sup> s	1.5 A <sup>2</sup> s	
<b>Ripple and Noise Vin=12 V</b> (Test condition: 0-20 MHz BW, 22 uF tantalum capacitor on output)				
Vo=5.0 V	-	75 mV	120 mV	pk-pk
Vo=3.3 V	-	75 mV	100 mV	
Vo=2.5 V	-	60 mV	80 mV	
Vo=1.5-1.8 V	-	45 mV	60 mV	
Vo=0.9-1.2 V	-	40 mV	55 mV	
Vo=5.0 V	-	25 mV	50 mV	rms
Vo=3.3 V	-	25 mV	40 mV	
Vo=2.5 V	-	20 mV	35 mV	
Vo=1.5-1.8 V	-	15 mV	25 mV	
Vo=0.9-1.2 V	-	12 mV	20 mV	

# NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 13.2 Vdc Input      0.9 Vdc - 5.0 Vdc/10 A Output



## Output Specifications (continued)

Parameter	Min	Typ	Max	Notes	
<b>Ripple and Noise Vin=5.0 V</b> (Test condition: 0-20 MHz BW, 22 uF tantalum capacitor on output)					
Vo=1.5-3.3 V	-	35 mV	70 mV	pk-pk	
Vo=0.9-1.2 V	-	30 mV	70 mV		
Vo=0.9-3.3 V	-	10 mV	15 mV	rms	
<b>Ripple and Noise Vin=3.3 V</b> (Test condition: 0-20 MHz BW, 22 uF tantalum Capacitor on output)					
Vo=2.5 V	-	15 mV	70 mV	pk-pk	
Vo=1.8 V	-	20 mV	70 mV		
Vo=1.2-1.5 V	-	25 mV	70 mV		
Vo=0.9 V	-	30 mV	70 mV		
Vo=2.5 V	-	5 mV	15 mV	rms	
Vo=1.8 V	-	6 mV	15 mV		
Vo=0.9-1.5 V	-	8 mV	15 mV		
Turn on Time	-	-	80 mS		
Overshoot at Turn on	-	-	5%Vo,set		
Output Capacitance	0 uF	-	3300 uF		
<b>Transient Response Vin=12 V</b>					
50% ~ 100% Max Load	Vo=5 V	-	100 mV	150 mV	di/dt = 0.5 A/uS; Vin = 12 V; Ta = 25 °C and with a 470 uF Aluminum capacitor at the output
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load	Vo=5 V	-	100 mV	150 mV	
Settling Time		-	50 uS	80 uS	
50% ~ 100% Max Load	Vo=3.3 V	-	80 mV	120 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	60 mV	100 mV	
Settling Time		-	40 uS	80 uS	
50% ~ 100% Max Load	Vo=2.5 V	-	60 mV	100 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	40 mV	80 mV	
Settling Time		-	40 uS	80 uS	
50% ~ 100% Max Load	Vo=1.8 V	-	60 mV	100 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	40 mV	80 mV	
Settling Time		-	40 uS	80 uS	
50% ~ 100% Max Load	Vo=1.5 V	-	60 mV	90 mV	
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load		-	40 mV	80 mV	
Settling Time		-	50 uS	80 uS	
50% ~ 100% Max Load	Vo=1.2 V	-	60 mV	90 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	40 mV	80 mV	
Settling Time		-	40 uS	80 uS	
50% ~ 100% Max Load	Vo=0.9 V	-	40 mV	80 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	40 mV	80 mV	
Settling Time		-	40 uS	80 uS	

## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 13.2 Vdc Input      0.9 Vdc - 5.0 Vdc/10 A Output



### Output Specifications (continued)

Parameter	Min	Typ	Max	Notes
<b>Transient Response Vin=5.0 V</b>				
50% ~ 100% Max Load	-	120 mV	160 mV	di/dt = 0.5 A/uS; Vin = 5 V; Ta = 25 °C and with a 470 uF Aluminum capacitor at the output
Settling Time	-	50 uS	80 uS	
100% ~ 50% Max Load	-	120 mV	160 mV	
Settling Time	-	50 uS	80 uS	
50% ~ 100% Max Load	-	110 mV	150 mV	
Settling Time	-	50 uS	80 uS	
100% ~ 50% Max Load	-	110 mV	150 mV	
Settling Time	-	50 uS	80 uS	
50% ~ 100% Max Load	-	80 mV	120 mV	
Settling Time	-	50 uS	80 uS	
100% ~ 50% Max Load	-	80 mV	120 mV	
Settling Time	-	50 uS	80 uS	
<b>Transient Response Vin=3.3 V</b>				
50% ~ 100% Max Load	-	150 mV	200 mV	di/dt = 0.5A/uS; Vin = 3.3V; Ta = 25°C and with a 470uF Aluminum capacitor at the output
Settling Time	-	50 uS	80 uS	
100% ~ 50% Max Load	-	150 mV	200 mV	
Settling Time	-	50 uS	80 uS	
50% ~ 100% Max Load	-	130 mV	180 mV	
Settling Time	-	50 uS	80 uS	
100% ~ 50% Max Load	-	130 mV	180 mV	
Settling Time	-	50 uS	80 uS	
50% ~ 100% Max Load	-	120 mV	160 mV	
Settling Time	-	50 uS	80 uS	
100% ~ 50% Max Load	-	120 mV	160 mV	
Settling Time	-	50 uS	80 uS	
50% ~ 100% Max Load	-	140 mV	180 mV	
Settling Time	-	50 uS	80 uS	
100% ~ 50% Max Load	-	140 mV	180 mV	
Settling Time	-	50 uS	80 uS	
50% ~ 100% Max Load	-	120 mV	160 mV	
Settling Time	-	50 uS	80 uS	
100% ~ 50% Max Load	-	120 mV	160 mV	
Settling Time	-	50 uS	80 uS	

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

## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 13.2 Vdc Input

0.9 Vdc - 5.0 Vdc/10 A Output



### General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency (Vin=12 V, Io=Io-max )				
Vo=5.0 V	90%	93%	-	
Vo=3.3 V	87%	91%	-	
Vo=2.5 V	85%	89%	-	
Vo=1.8 V	81%	86%	-	
Vo=1.5 V	80%	84%	-	
Vo=1.2 V	77%	81%	-	
Vo=0.9 V	73%	78%	-	
Efficiency (Vin=5.0 V, Io=Io-max)				
Vo=3.3 V	89%	92%	-	
Vo=2.5 V	87%	90%	-	
Vo=1.8 V	83%	87%	-	
Vo=1.5 V	82%	85%	-	
Vo=1.2 V	78%	81%	-	
Vo=0.9 V	74%	77%	-	
Efficiency (Vin=3.3 V, Io=Io-max)				
Vo=2.5 V	89%	92%	-	
Vo=1.8 V	84%	88%	-	
Vo=1.5 V	82%	86%	-	
Vo=1.2 V	80%	84%	-	
Vo=0.9 V	77%	80%	-	
Switching Frequency				
Vo=0.9 V	163 kHz	170 kHz	187 kHz	
Vo=1.2-5.0 V	180 kHz	200 kHz	220 kHz	
Output Trim Range				
Vo=0.9 V	-	-	120%Vo	
Vo=1.2-5.0 V	90%Vo	-	110%Vo	
MTBF	2,140,721 hours			Calculated Per Bell Core SR-332 (Io =80%Iomax; Vo=1.8 V; Vin=12 V; Ta = 25 °C)
Dimensions				
Inches (L x W x H)	2.0 x 0.55 x 0.387			
Millimeters (L x W x H)	50.8 x 13.97 x 9.84			
Remote sense compensation	-	-	10%	
Weight	-	10 g	-	

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

### Control Specifications

Parameter	Min	Typ	Max	Notes
<b>Remote On/Off</b>				
Signal Low (Unit Off)	-0.3 V	-	0.4 V	VRPB-10DxxS
Signal High (Unit On)	2.8 V	-	13.2 V	
Signal Low (Unit On)	-0.3 V	-	0.4 V	VRPB-10DxxL
Signal High (Unit Off)	2.8 V	-	13.2 V	

## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 13.2 Vdc Input

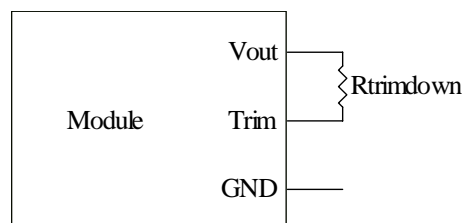
0.9 Vdc - 5.0 Vdc/10 A Output

**bel**  
POWER PRODUCTS

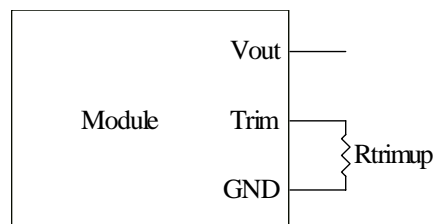
### Output Trim Equations

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

$$R_{TrimDown} = \frac{A}{V_{nom} - V_{adj}} - B$$



$$R_{TrimUp} = \frac{C}{V_{adj} - V_{nom}} - D$$



Vnom	A	B	C	D
5.5	31.58	17.51	6.01	10.00
3.3	11.63	13.74	3.72	9.09
2.5	7.92	13.74	3.72	9.09
1.8	4.69	21.55	3.72	16.90
1.5	3.25	21.55	3.72	16.90
1.2	1.78	9.07	3.54	4.64
0.9	-	-	1.46	0.909

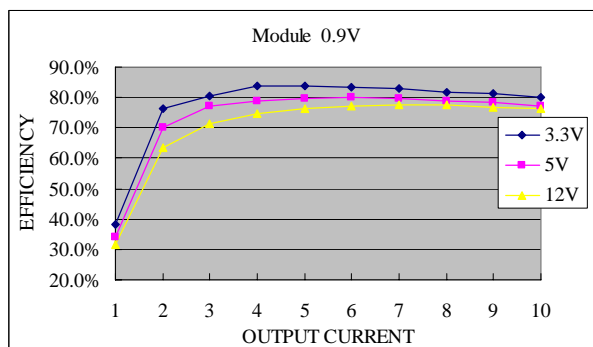
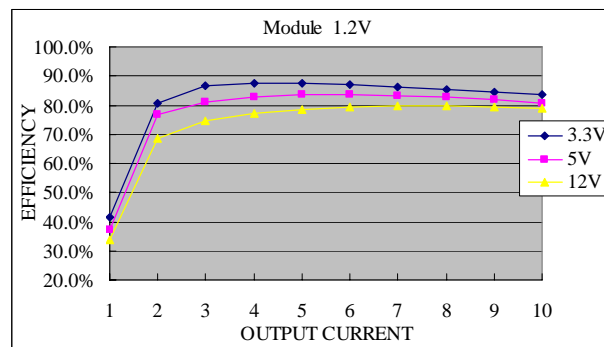
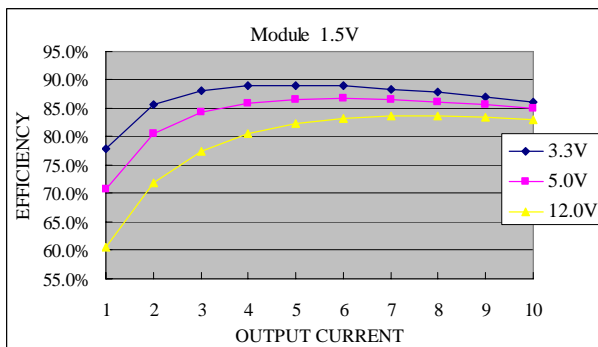
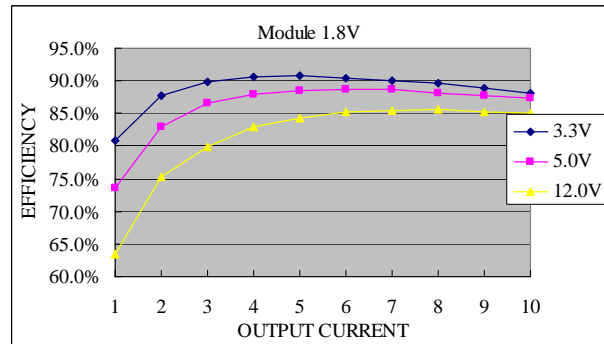
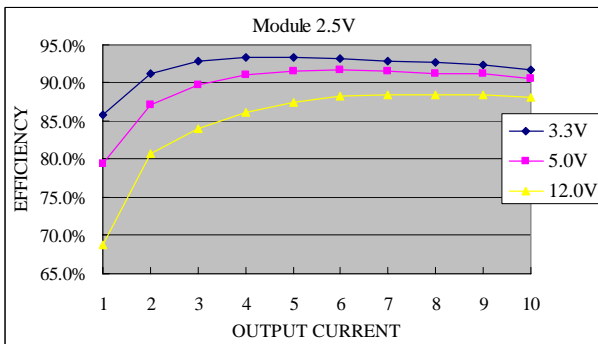
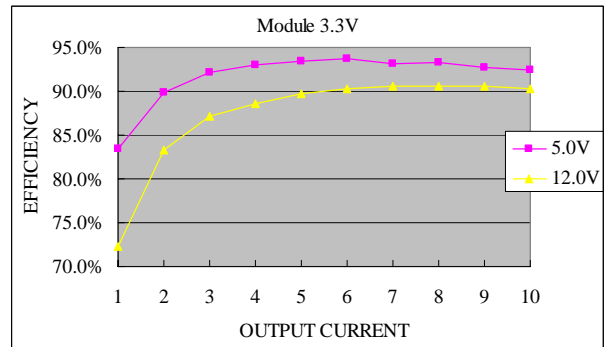
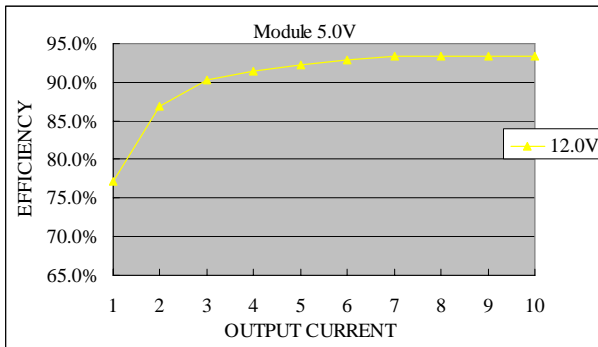
# NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 13.2 Vdc Input

0.9 Vdc - 5.0 Vdc/10 A Output



## Efficiency Data



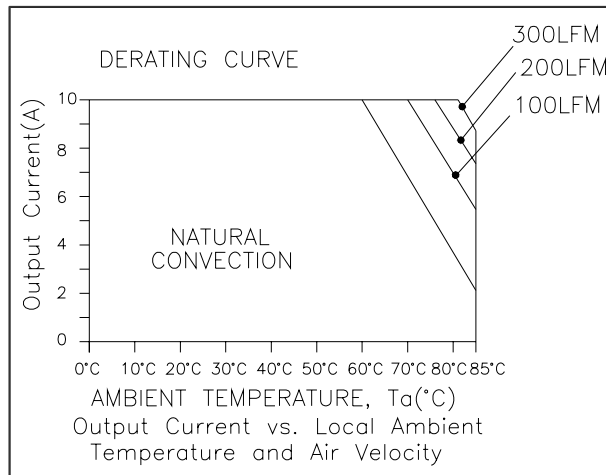
# NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 13.2 Vdc Input

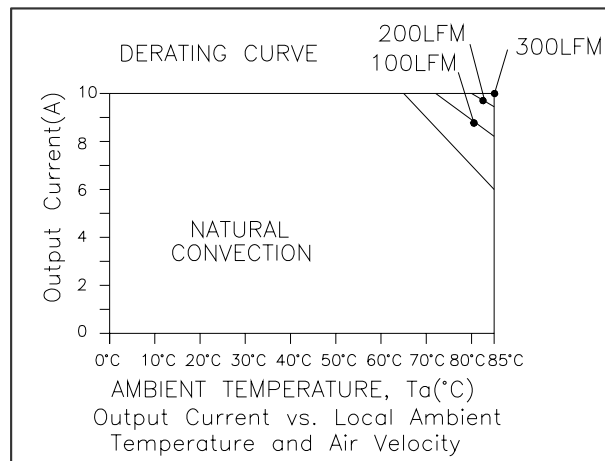
0.9 Vdc - 5.0 Vdc/10 A Output



## Thermal Derating Curves



Vin=13.2 V



Vin=5.5 V & Vin=3.63 V

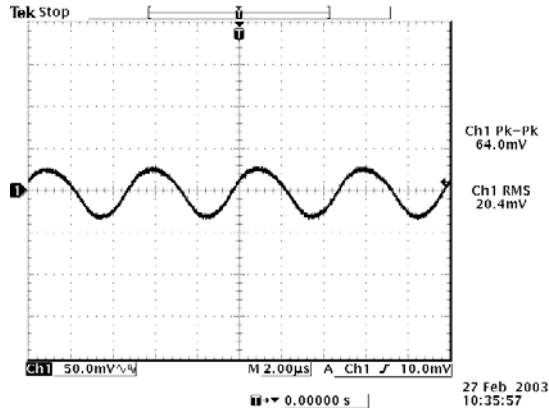


# NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 13.2 Vdc Input    0.9 Vdc - 5.0 Vdc/10 A Output

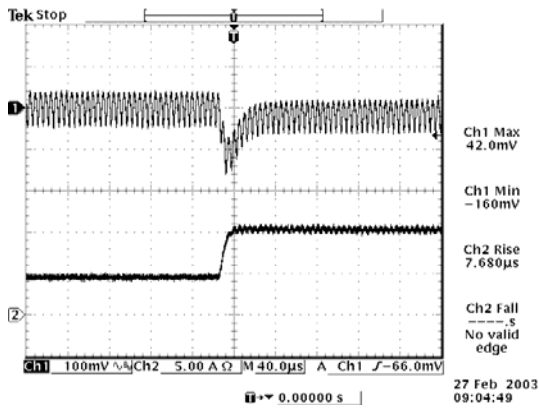


## Ripple and Noise Waveform

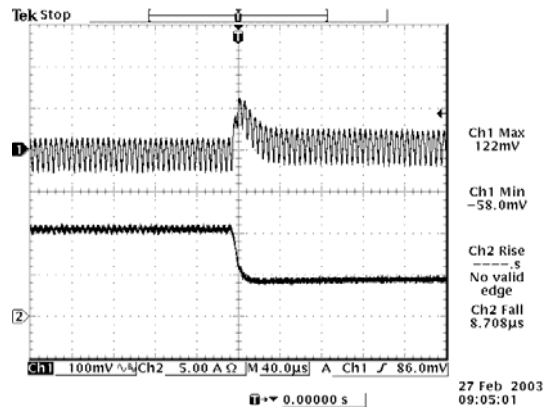


**Note:** Ripple and noise at full load, 8 Vdc input, 3.3 V output, with external load capacitor  $C_o=22 \mu\text{F}$  (Tantalum capacitor) and  $T_a=25 \text{ deg C}$ .

## Transient Response Waveforms

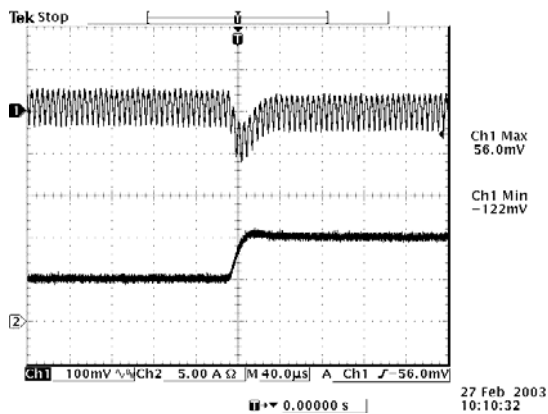


50% to 100% load Transient at 12 V input

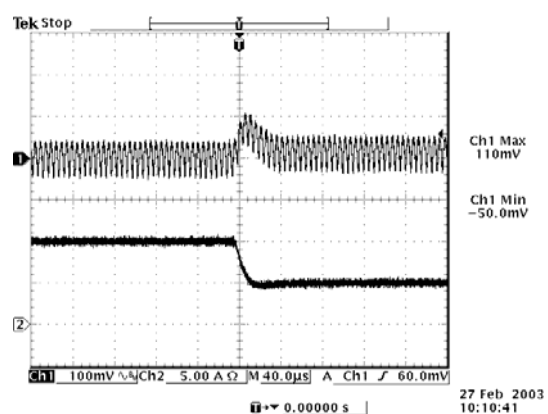


100% to 50% load Transient at 12 V input

**Note:** Transient Response at  $di/dt=0.5 \text{ A}/\mu\text{S}$ , with external load capacitor  $C_o=22 \mu\text{F}$ (tantalum ).



50% to 100% load Transient at 12 V input



100% to 50% load Transient at 12 V input

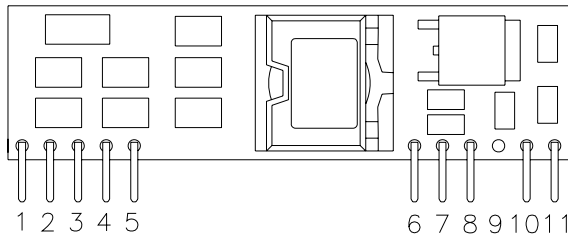
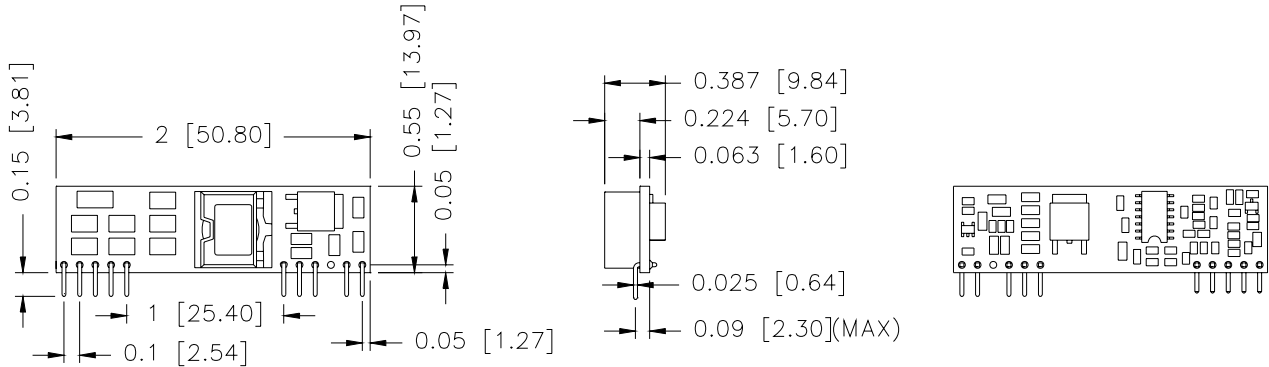
**Note:** Transient Response at  $di/dt=0.5 \text{ A}/\mu\text{S}$ , with external load capacitor  $C_o=470 \mu\text{F}$ (electrolytic).

# NON-ISOLATED DC/DC CONVERTERS

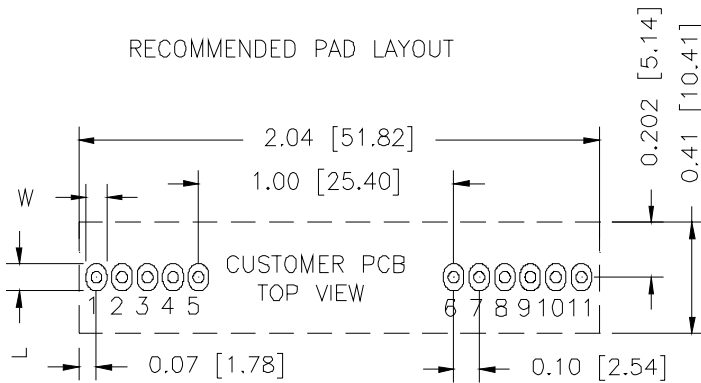
3.0 Vdc - 13.2 Vdc Input    0.9 Vdc - 5.0 Vdc/10 A Output



## Mechanical Outline



### RECOMMENDED PAD LAYOUT



HOLE SIZE:  $\varnothing 0.043 \pm 0.003$  [1.08  $\pm$  0.08]  
 PAD SIZE: W  $0.063 \pm 0.002$  [1.63  $\pm$  0.05]  
 L  $0.10 \pm 0.004$  [2.54  $\pm$  0.10] BOTH SIDE

## Pin Connections

Pin	Function
1	Vo+
2	Vo+
3	Opt. Remote Sense (+)
4	Vo+
5	Ground
6	Ground
7	Vin+
8	Vin+
9	Not used
10	Trim
11	Remote On/Off

## RoHS Compliance

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



©2007 Bel Fuse Inc. Specifications subject to change without notice. 011907

### 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)