

## NON-ISOLATED DC/DC CONVERTERS

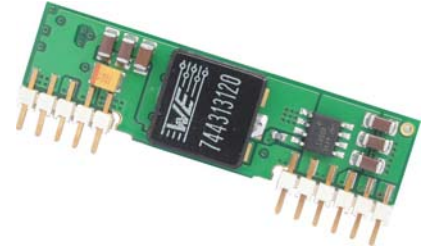
4.5 Vdc - 5.5 Vdc Input

3.3 Vdc / 6 A Output

**bel**  
POWER PRODUCTS

### VRPB-06F33H RoHS Compliant PRELIMINARY Rev.A

- Non-Isolated
- High Efficiency
- High Power Density
- Fixed Frequency (300 kHz)
- Power Good Output Signal
- Converter Can Sink & Source Current
- Under Voltage Lockout (UVLO)
- OCP/SCP
- Remote On/Off
- Remote Sense
- Trim Function



### Description

The Bel VRPB-06F33H modules are a series of non-isolated high density open frame dc/dc converters that can deliver up to 6 A of output current with full load efficiency of 94% at 3.3 Vdc output. Their open-frame construction and small footprint enable designers to develop cost and space-efficient solutions. Standard features include remote On/Off, power good output signal, over current protection and short circuit protection.

### Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number
3.3 Vdc	4.5 Vdc - 5.5 Vdc	6 A	20 W	94%	VRPB-06F33H

**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	-	5.8 V	
Output Enable Terminal Voltage	-0.3 V	-	5.5 V	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-55 °C	-	125 °C	

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

### Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	4.5 V	-	5.5 V	
Input Current (full load)	-	4.21 A	-	
Input Current (no load)	-	100 mA	-	
Remote Off Input Current	-	5 mA	-	
Input Reflected Ripple Current (pk-pk)	-	60 mA	-	Tested with simulated source impedance of 1uH, 5 Hz to 20 MHz, a 1000 uF/16 V electrolytic capacitor, a 220 uF/10 V Tantalum capacitor and 2.2 uF/10 V ceramic capacitor at the input.
Input Reflected Ripple Current (rms)	-	20 mA	-	
I <sup>2</sup> t Inrush Current Transient	-	-	0.04 A <sup>2</sup> s	
Turn-on Voltage Threshold	-	3.6 V	4.0 V	
Turn-off Voltage Threshold	3.4 V	3.5 V	-	

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

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### Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point	-2% Vo,set	-	2% Vo,set	Vin=5 V, 50% full load
Output Voltage Set Point	-3% Vo,set	-	3% Vo,set	Over all operating input voltage, resistive load, and temperature conditions
Load Regulation	-	0.4% Vo,set	-	Io=Io min to 50% Io max
Line Regulation	-	0.3% Vo,set	-	Vin=Vin min to Vin max
Temperature Regulation	-	0.4% Vo, set	-	Tref=Ta min to Ta max
Output Current	0 A	-	6 A	
Current Limit Threshold	7 A	-	18 A	
Short Circuit Surge Transient	-	0.64 A <sup>2</sup> s	-	
Ripple and Noise (pk-pk)	-	30 mV	50 mV	Tested with 0-20 MHz, with external 10 uF Tantalum capacitor, 220 uF Tantalum capacitor and 2.2 uF/10 V ceramic capacitor at the output.
Ripple and Noise (rms)	-	10 mV	20 mV	
Turn on Time	-	4 mS	8 mS	
Overshoot at Turn on	-	-	3% Vo	
External Load Capacitance	-	100 uF/A	-	
<b>Transient Response</b>				
50% ~ 100% Max Load	Vo =3.3 V	-	150 mV	Test conditions: di/dt=2.5 A/uS; Vin=5 V; with external 10 uF Tantalum capacitor, 220 uF Tantalum capacitor and 2.2 uF/10 V ceramic capacitor at the output.
Settling Time		-	40 uS	
100% ~ 50% Max Load		-	150 mV	
Settling Time		-	40 uS	

**Note:** All specifications are typical at nominal input (Vin=5 V), full load at 25 °C unless otherwise stated.

### General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency (Current Source)	91%	94%	-	Measured at Vin=5 V, Io=Io-max
Switching Frequency	250 kHz	300 kHz	350 kHz	
Output Voltage Trim Range	90% Vo	-	110% Vo	
Remote Sense Compensation	-	-	10% Vo	
MTBF	TBD			Calculated Per Bell Core SR-332 (Io =80%load; Ta = 25 °C)
Dimensions	Inches (L x W x H) Millimeters (L x W x H)			
	2.0 x 0.55 x 0.29 50.80 x 13.97 x 7.35			
Weight	-	7.5 g	-	

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

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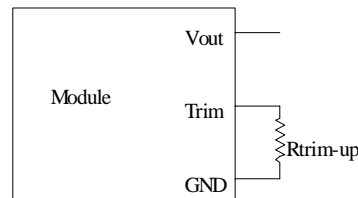
### Control Specifications

Parameter	Min	Typ	Max	Notes
<b>Remote On/Off</b>				
Signal Low (Unit On)	-0.2 V	-	0.5 V	VRPB-06F33H, Remote On/Off pin open, Unit on.
Signal High (Unit Off)	4.5 V	-	5.5 V	
<b>Power Good Levels</b>				
High Level	2.1 V	-	-	
Low Level	-	-	1.05 V	

### Output Trim Equations

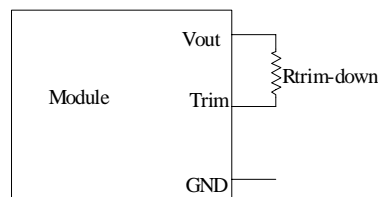
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage ( $V_{up}$ ) is shown below. The Trim resistor should be connected between the Trim pin and Ground.

$$R_{trim-up} = \frac{2.1264}{V_{up} - V_o} - 1$$

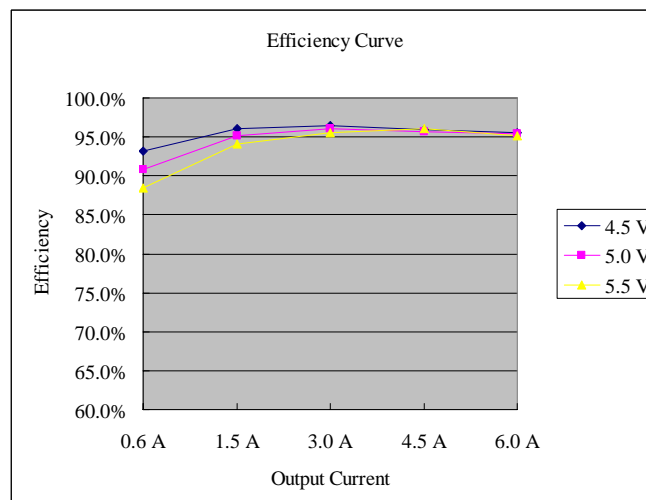


Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage ( $V_{down}$ ) is shown below. The Trim resistor should be connected between the Trim pin and Vout.

$$R_{trim-down} = \left[ \frac{(V_{down} - 0.96) \cdot 2.215}{V_o - V_{down}} \right] - 1$$



### Efficiency Data



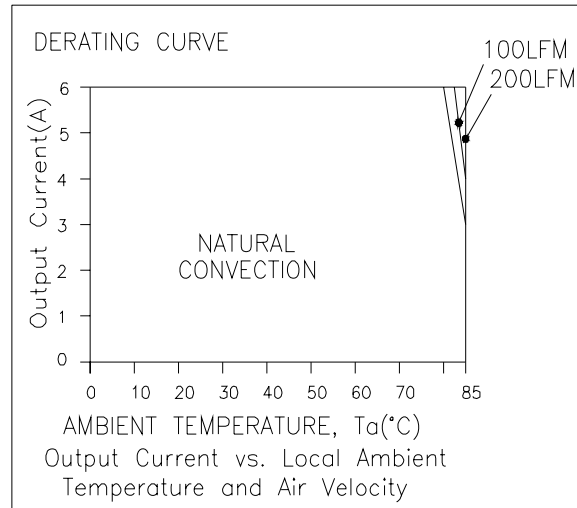
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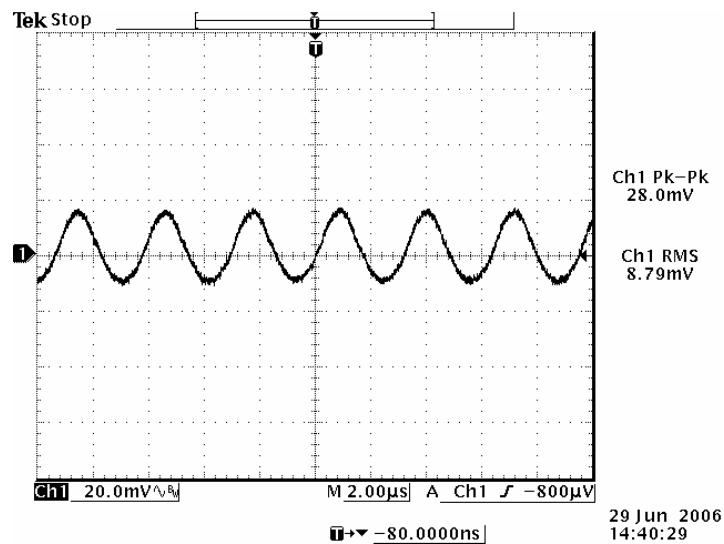
3.3 Vdc / 6 A Output

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### Thermal Derating Curve



### Ripple and Noise Waveform



Ripple and noise at full load  $V_o=3.3$  V

**Note:** Ripple and Noise at 5.0 Vdc input, 0-20 MHz BW, with a 220  $\mu$ F/10 V and a 10  $\mu$ F/10 V tantalum cap and 2.2  $\mu$ F/10 V ceramic capacitor at the output,  $T_a=25$  deg C.

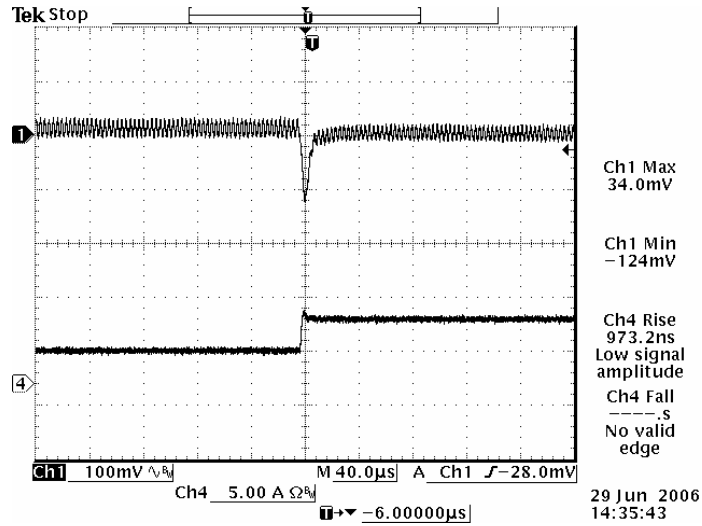
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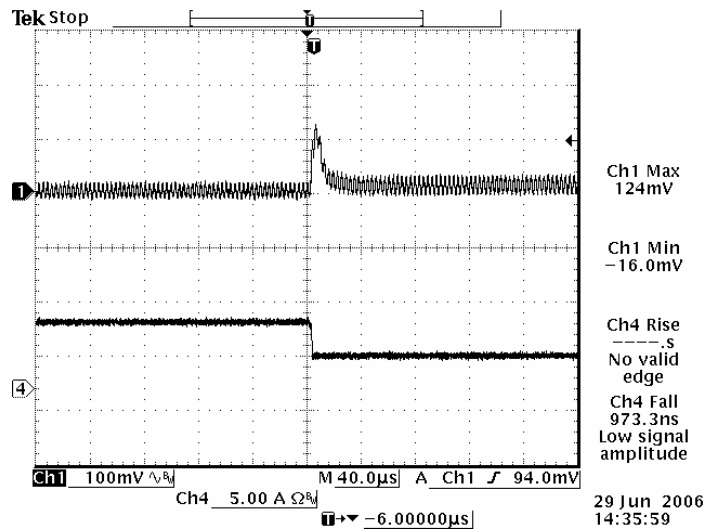
3.3 Vdc / 6 A Output



## Transient Response Waveforms



Transients 50% to 100% load 3.3 Vdc output



Transients 100% to 50% load 3.3 Vdc output

**Note:** Transient Response at 5.0 V input,  $di/dt=2.5$  A/ $\mu$ s, with a 220  $\mu$ F/10 V and a 10  $\mu$ F/10 V tantalum cap and 2.2  $\mu$ F/10 V ceramic capacitor at the output,  $T_a=25$  deg C.

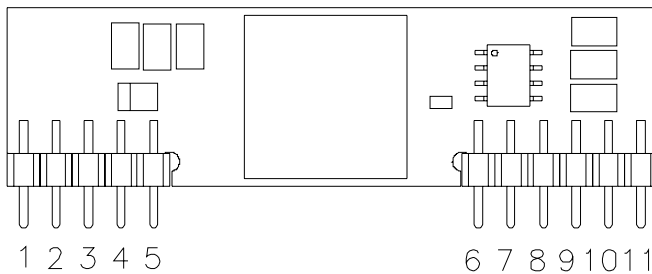
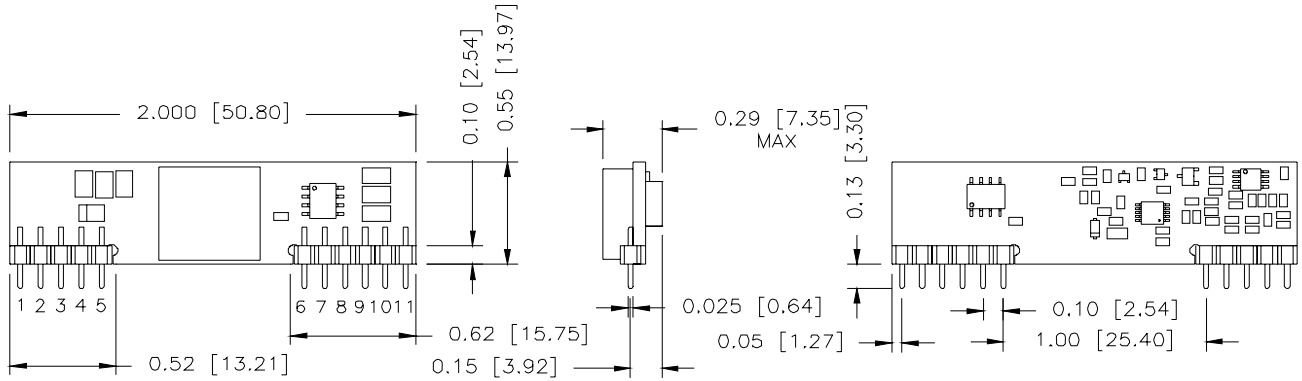
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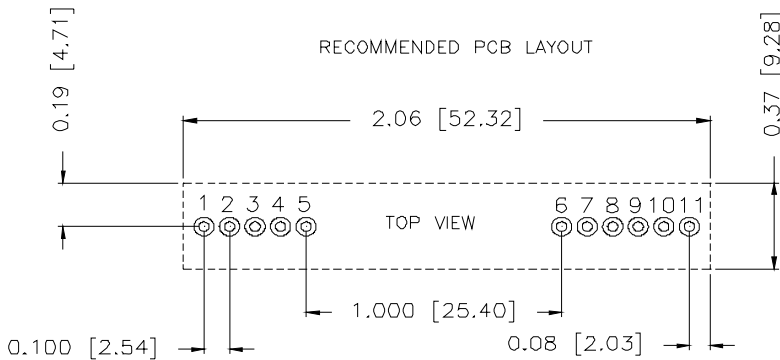
## Mechanical Outline



## Pin Connections

Pin	Function
1	+Vout
2	+Vout
3	Remote Sense
4	+Vout
5	Ground
6	Ground
7	+Vin
8	+Vin
9	Power Good
10	Trim
11	Remote On/Off

## RECOMMENDED PCB LAYOUT



HOLE SIZE:  $\varnothing 0.040 \pm 0.003$  [1.02  $\pm$  0.08]

PAD SIZE:  $\varnothing 0.079 \pm 0.002$  [2.00  $\pm$  0.05]

## RoHS Compliance

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



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