

NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.75 Vdc - 3.63 Vdc/16 A Output

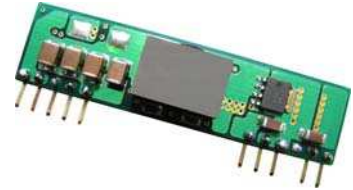
bel
POWER PRODUCTS

VRBC-16E1Ax

RoHS Compliant

Rev.A

- Non-Isolated
- High Efficiency
- Fixed Frequency
- Low Cost
- Industrial Temperature Range
- Logic Low/High (Option)
- Over Temperature Shutdown
- Under-voltage Lockout (UVLO)
- OCP/SCP
- Wide Trim
- Wide Input
- Remote Sense
- Remote On/Off



Description

The Bel VRBC-16E1Ax is part of the non-isolated dc/dc converter series. The modules use a SIP package. These converters are available in a range of output voltages from 0.75 Vdc to 3.63 Vdc over a wide range of input voltage ($V_{in} = 4.5 \text{ Vdc} - 14 \text{ Vdc}$). The efficiency is typically 92% at 3.3 Vdc output at full load.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active Low	Model Number Active High
0.75 V - 3.63 V	4.5 V - 14 V	16 A	58 W	92%	VRBC-16E1AL	VRBC-16E1A0

Notes: 1. Add "G" suffix at the end of the model number to indicate Tray Packaging.

2. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers.

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	-55 °C	-	125 °C	

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage $V_{o, \text{set}} < 3.0$ $V_{o, \text{set}} \geq 3.0$	4.5 V $V_{o, \text{set}} + 1.5 \text{ V}$	- -	14 V 14 V	
Input Current (full load)	-	-	15 A	This power module is not internally fused. An input line fuse must always be used
Input Current (no load)	-	100 mA	-	
Remote Off Input Current	-	2 mA	-	
Input Reflected Ripple Current (pk-pk)	-	-	400 mA	Tested with one 1000 uF / 25 V AL input capacitor with ESR=0.03 ohm max and 6 × 47 uF/16 V Tantalum capacitors with ESR=0.013 ohm max at 100 kHz, & simulated source impedance of 1000 nH, 5 Hz to 20 MHz.
Input Reflected Ripple Current (rms)	-	-	150 mA	
I^2t Inrush Current Transient	-	0.2 A ² s	0.4 A ² s	
Turn-on Voltage Threshold	-	4.3 V	-	
Turn-off Voltage Threshold	3.7 V	-	4.2 V	

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Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point	-2%Vo,set	-	2%Vo,set	Vin=12 V, full load
Load Regulation	-	0.2%Vo,set	-	
Line Regulation	-	0.3%Vo,set	-	
Regulation Over Temperature (-40°C to +85°C)	-	0.3%Vo,set	-	
Output Current	0 A	-	16 A	
Current Limit Threshold	-	180% Io,out	-	
Short Circuit Surge Transient	-	1 A ² s	3 A ² s	
Ripple and Noise (pk-pk)	-	30 mV	80 mV	Tested with 0-20 MHz, 10 uF tantalum capacitor & 1 uF ceramic capacitor at the output
Ripple and Noise (rms)	-	12 mV	35 mV	
Turn on Time	-	8 mS	20 mS	
Overshoot at Turn on	-	-	1%Vo,set	
Output Capacitance	0 uF	-	5600 uF	
Transient Response				
50% ~ 100% Max Load	All	-	100 mV	di/dt=0.5 A / uS; Vin=12 V and and without any external capacitor at the output.
Settling Time		-	80 uS	
100% ~ 50% Max Load		-	100 mV	
Settling Time		-	80 uS	

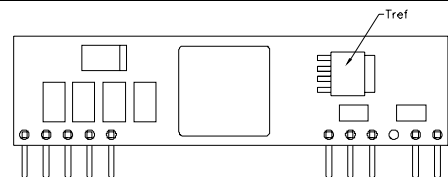
Note: All specifications are typical at nominal input, full load at 25 °C unless otherwise stated.

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				Measured at Vin=12 V, Io=Io-max
Vo=3.3 V	-	91.7%	-	
Vo=2.5 V	-	90.4%	-	
Vo=1.8 V	-	87.5%	-	
Vo=1.5 V	-	86%	-	
Vo=1.2 V	-	85%	-	
Vo=0.75 V	-	79%	-	
Efficiency				Measured at Vin=5 V, Io=Io-max
Vo=3.3 V	-	93.5%	-	
Vo=2.5 V	-	91.5%	-	
Vo=1.8 V	-	88.4%	-	
Vo=1.5 V	-	87%	-	
Vo=1.2 V	-	86%	-	
Vo=0.75 V	-	80%	-	
Switching Frequency	250 kHz	280 kHz	310 kHz	
Over Temperature Shutdown ¹	-	130 °C	-	
Output Trim Range (Wide Trim)	0.7525 V	-	3.63 V	Total adjustment of trim, setpoint and remote sense combined should not exceed 3.63 V. Vo=0.7525 V when trim pin open
Remote Sense Compensation	-	-	0.5 V	
MTBF	4,619,490 hours			Calculated Per Bell Core TR-332 (Io = 80%Io,max; Vin=12 V; Vo=3.3 V; Ta = 25°C)
Dimensions				
Inches (L × W × H)	2.0x 0.5 x 0.32			
Millimeters (L × W × H)	50.8 x 12.7 x 8.13			
Weight	-	7.1 g	-	

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

1. The Tref temperature measurement location:



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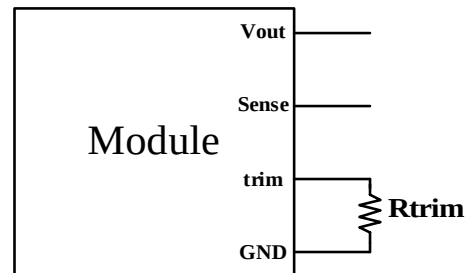
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.2V	-	0.3V	VRBC-16E1A0; Remote On/Off pin open, Unit on.
Signal High (Unit On)	-	-	Vin, max	
Signal Low (Unit On)	-0.2V	-	0.3V	VRBC-16E1AL; Remote On/Off pin open, Unit on.
Signal High (Unit Off)	2.5V	-	Vin, max	

Output Trim Equations

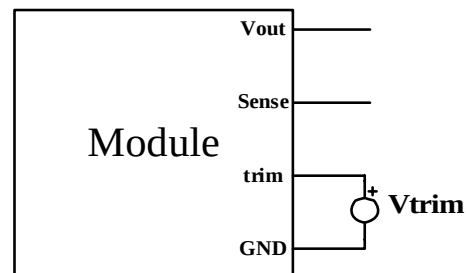
Equation for calculating the trim resistor (in Ω) given the desired output voltage (V_o) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

$$R_{trim} = \frac{10500}{V_o - 0.7525} - 1000$$



Equation for calculating the trim voltage (in V) given the desired output voltage (V_o) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

$$V_{trim} = 0.7 - 0.0667 \times (V_o - 0.7525)$$



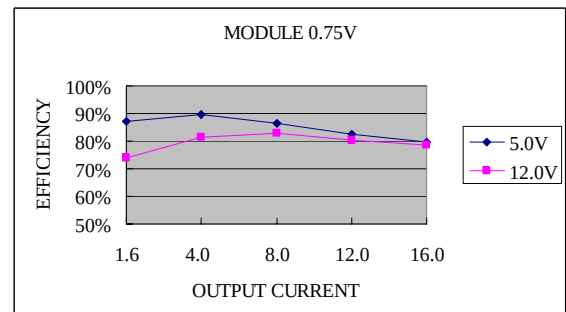
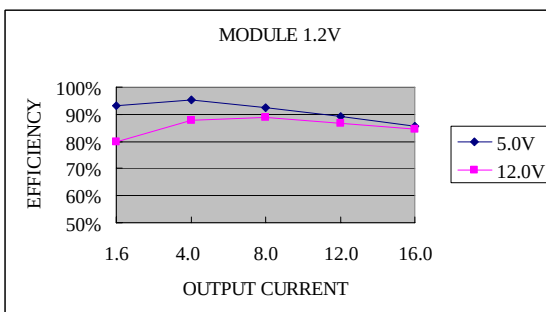
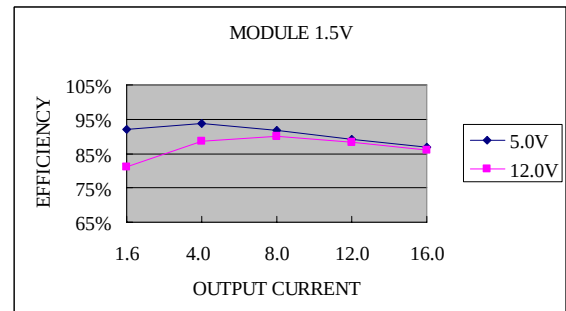
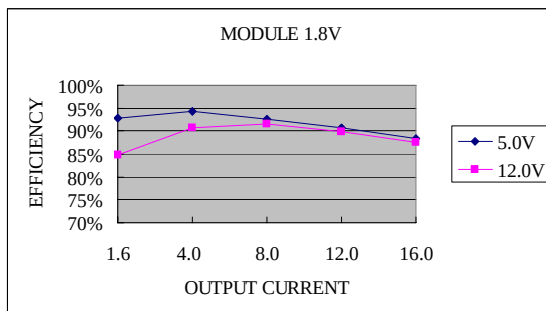
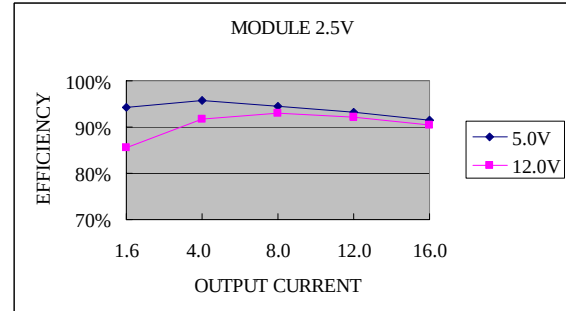
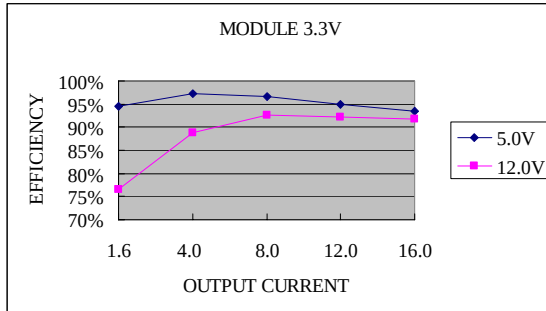
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Efficiency Data



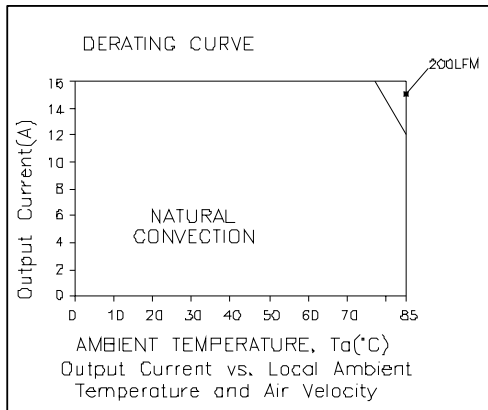
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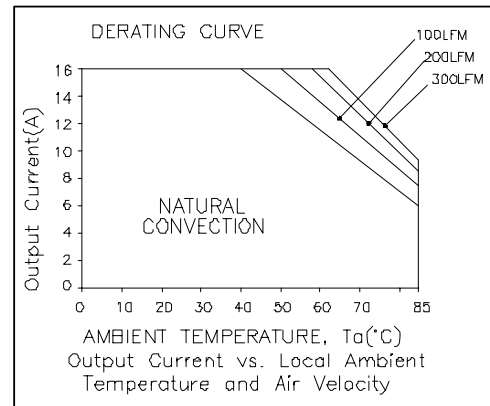
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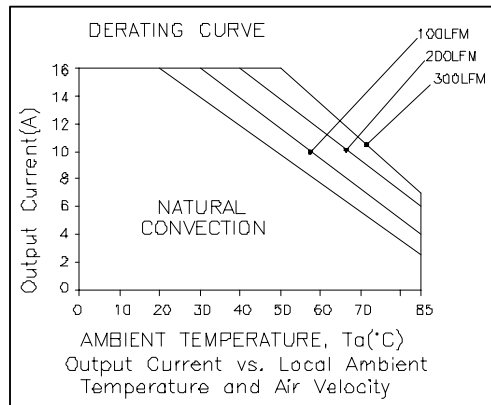
Thermal Derating Curves



$V_o=0.75\text{ V}$; $V_{in}=12\text{ V}$

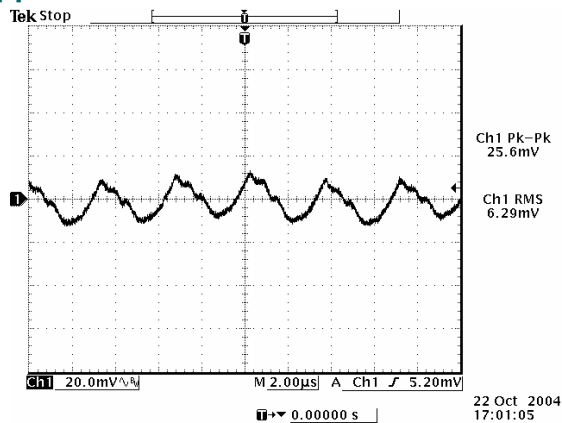


$V_o=1.8\text{ V}$; $V_{in}=12\text{ V}$

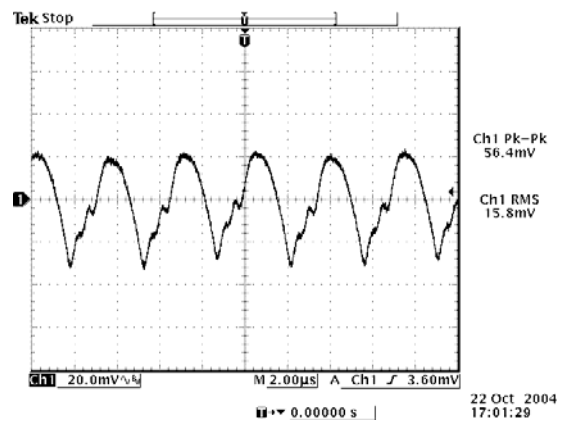


$V_o=3.3\text{ V}$; $V_{in}=12\text{ V}$

Ripple and Noise Waveforms



$V_{in}=5.0\text{ V}$, $V_o=3.3\text{ V}$



$V_{in}=12\text{ V}$, $V_o=3.3\text{ V}$

Note: External load with 10 μF tantalum capacitor and 1 μF ceramic at the output, full load, $T_a=25\text{ deg C}$.

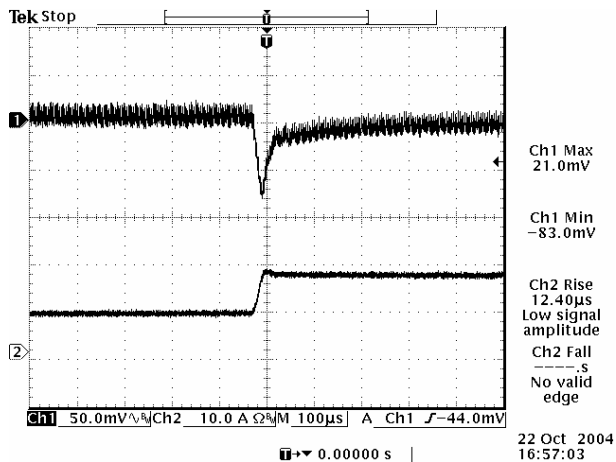
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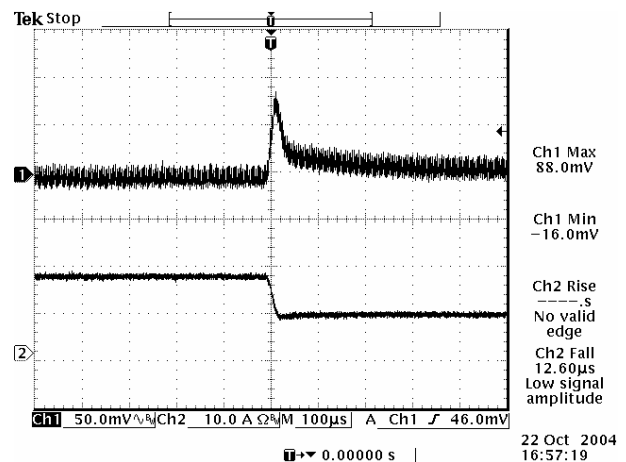
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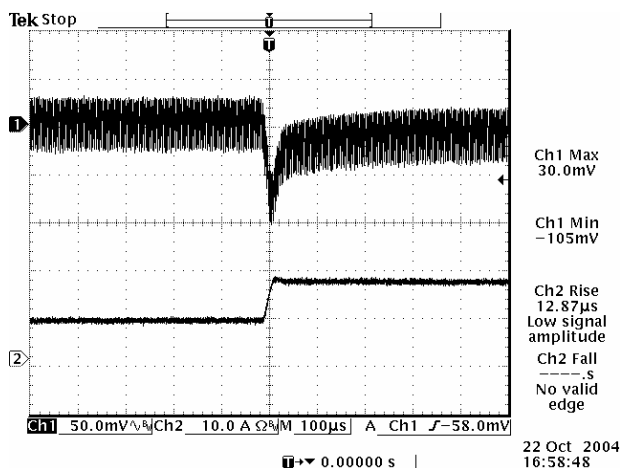
Transient Response Waveforms



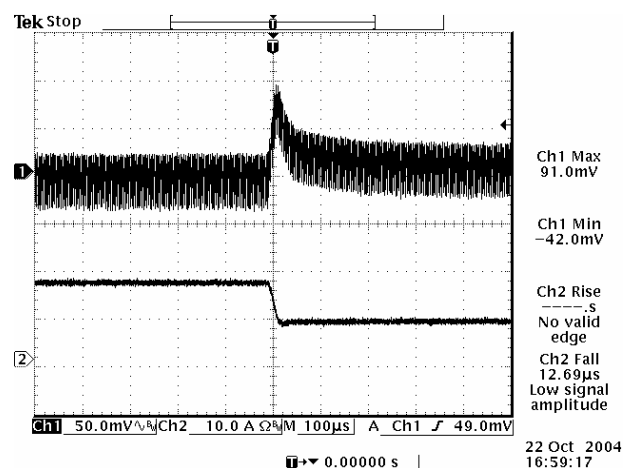
50% to 100% load Transient at $V_{in}=5$ V, $V_o=3.3$ V



100% to 50% load Transient at $V_{in}=5$ V, $V_o=3.3$ V



50% to 100% load Transient at $V_{in}=12$ V, $V_o=3.3$ V



100% to 50% load Transient at $V_{in}=12$ V, $V_o=3.3$ V

Note: External load capacitor $C_{ext}=0$ μ F, and $T_a=25$ deg C.

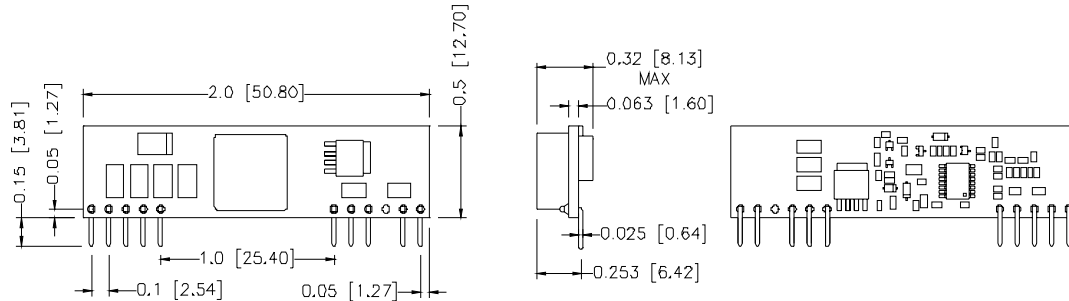
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Mechanical Outline

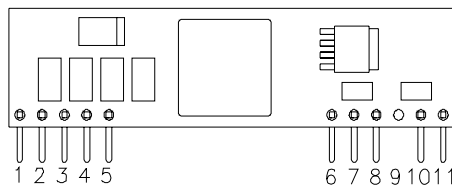


UNIT: INCH [MM]

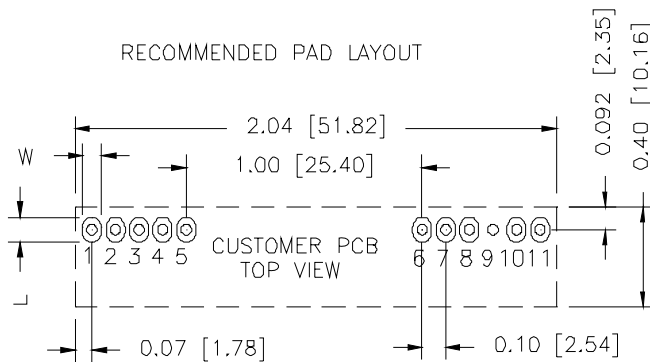
TOP VIEW

SIDE VIEW

BACK VIEW



RECOMMENDED PAD LAYOUT



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

Pin Connections

Pin	Function
1	Vo
2	Vo
3	Remote Sense
4	Vo
5	Ground
6	Ground
7	Vin
8	Vin
9	N/A
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.



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