NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input 0.75 Vdc - 5.0 Vdc/3 A Output

VRBA-03E1Ax RoHS Compliant Rev.A

- Non-Isolated
- Fixed Frequency
- High Efficiency
- High Power Density
- Under-voltage Lockout (UVLO)
- OCP/SCP
- Remote On/Off
- Wide Trim Range
- Wide Input Range
- Active Low/High (Option)

Description

The Bel VRBA-03E1Ax modules are a series of non-isolated dc/dc converters that deliver up to 3 A of output current with full load efficiency of 93% at 5.0 Vdc output. These modules provide precisely regulated voltage programmable via external resistor from 0.75 Vdc to 5.0 Vdc over a wide range of input voltage. Their open-frame construction and small footprint enable designers to develop cost and space-efficient solutions. Standard features include remote On/Off, programmable output voltage and over current protection.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency at 5.0V	Model Number Active High	Model Number Active Low
0.75 V - 5 V[1]	4.5 V - 14 V	3 A	15 W	93%	VRBA-03E1A0	VRBA-03E1AL

Notes: 1. These modules use a buck topology, so the output voltages must be 0.5 V less than the input voltage.
2. Add “G” to the end of the Model Number to indicate Tray Packaging.
3. 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	

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

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
Vo set=5 V	7.0 V	12 V	14 V	
Vo set≤3.3 V	4.5 V	12 V	14 V	
Input Current (full load)				
Vo=5.0 V	-	1.35 A	3.70 A	
Vo=3.3 V	-	1.00 A	2.50 A	
Vo=0.75 V	-	0.25 A	0.65 A	
Input Current (no load)				
Vo=5.0 V	-	65 mA	80 mA	
Vo=3.3 V	-	50 mA	60 mA	
Vo=0.75 V	-	15 mA	20 mA	
Remote Off Input Current	-	3 mA	6 mA	
Input Reflected Ripple Current (pk-pk)				Tested with simulated source
Vo=5.0 V	-	150 mA	200 mA	impedance of 1 uH, 5 Hz to 20 MHz and
Vo=3.3 V	-	100 mA	150 mA	two 100 uF/25 V external input
Vo=0.75 V	-	35 mA	60 mA	Tantalum capacitors.

Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
Input Reflected Ripple Current (rms) Vo=5.0 V Vo=3.3 V Vo=0.75 V	 - - -	 50 mA 30 mA 12 mA	 70 mA 50 mA 20 mA	Tested with simulated source impedance of 1 uH, 5 Hz to 20 MHz and two 100 uF/25 V external input Tantalum capacitors.
I^2t Inrush Current Transient	-	0.01 A^2s	0.02 A^2s	
Turn-on Voltage Threshold Vo set=5 V Vo set≤3.3 V	 - -	 5.5 V 4.3 V	 6.5 V 4.5 V	
Turn-off Voltage Threshold Vo set=5 V Vo set≤3.3 V	 3.8 V 3.8 V	 5.5 V 4.0 V	 6.0 V 4.3 V	

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

Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point	-2%Vo,set	-	2%Vo,set	Vin=12 V, Io=Iomax,
Output Voltage Set Point	-3.5%Vo,set	-	2.5%Vo,set	Over all operating input voltage, resistive load, and temperature conditions
Load Regulation	0.4%Vo,set	0.3%Vo,set	0.4%Vo,set	Io=Iomin to Iomax
Line Regulation	0.5%Vo,set	0.3%Vo,set	0.5%Vo,set	Vin=Vinmin to Vinmax
Regulation Over Temperature	-	0.5%Vo,set	-	-40 °C to +85 °C
Output Current	0 A	-	3 A	
Current Limit Threshold	5 A	-	9.5 A	
Short Circuit Surge Transient	-	0.1 A^2s	0.2 A^2s	
Ripple and Noise (pk-pk) Vo=5.0 V Vo=3.3 V Vo=0.75 V	 - - -	 130 mV 100 mV 35 mV	 150 mV 120 mV 45 mV	Test conditions: 0-20 MHz BW, with external 10 uF/ 10 V Tantalum capacitor and 1 uF/ 10 V ceramic capacitor at the output.
Ripple and Noise (rms) Vo=5.0 V Vo=3.3 V Vo=0.75 V	 - - -	 40 mV 30 mV 10 mV	 50 mV 40 mV 20 mV	
Ripple and Noise (pk-pk) Vo=5.0 V Vo=3.3 V Vo=0.75 V	 - - -	 70 mV 55 mV 20 mV	 85 mV 70 mV 30 mV	Test conditions: 0-20 MHz BW, with external 10 uF/ 10 V Tantalum capacitor 1 uF/10 V ceramic capacitor and two 22 uF/10 V ceramic capacitors at the output.
Ripple and Noise (rms) Vo=5.0 V Vo=3.3 V Vo=0.75 V	 - - -	 20 mV 15 mV 5 mV	 30 mV 25 mV 10 mV	
Turn on Time	-	8 mS	12 mS	
Overshoot at Turn on	-	0%	3%	
Output Capacitance	0 uF	-	1200 uF	
Transient Response				
50% ~ 100% Max Load	All	-	200 mV	300 mV	Test conditions: di/dt = 2.5 A/uS, Vin=12 V, and with external 10 uF/ 10 V Tantalum capacitor and 1 uF/ 10 V ceramic capacitor at the output.
Settling Time		-	20 uS	50 uS	
100% ~ 50% Max Load		-	200 mV	300 mV	
Settling Time		-	20 uS	50 uS	

Note: All specifications are typical at nominal input (Vin=12 V), full load at 25 °C unless otherwise stated.

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency Vo=5.0 V Vo=3.3 V Vo=0.75 V	 90% 88% 77%	 93% 91% 80%	 - - -	Measured at Vin=12 V, full load
Switching Frequency	200 kHz	230 kHz	250 kHz	
Output Voltage Trim Range (Wide Trim)	0.7525 V	-	5 V	
MTBF	7,900,000 hours			Calculated Per Bell Core SR-332 (Io = 80% load; Ta = 25 °C)
Dimensions (Vertical Mount) Inches (L × W × H) Millimeters (L × W × H)	 1.0 x 0.5 x 0.27 25.41 x 12.7 x 6.85			
Weight	-	2.5 g	-	

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

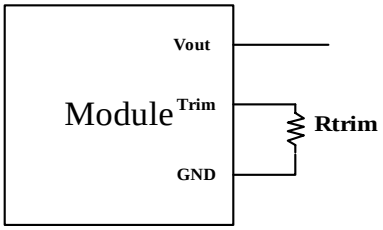
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.3 V	-	0.4 V	Remote On/Off pin open, Unit on.
Signal High (Unit On)	2.5 V	-	14 V	
Signal Low (Unit On)	-0.3 V	-	0.4 V	
Signal High (Unit Off)	2.5 V	-	14 V	

Output Trim Equations

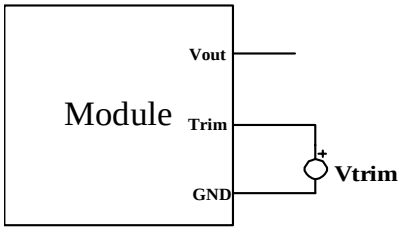
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

$$R_{trim} = \frac{10.507}{V_{adj} - 0.7525} - 1$$

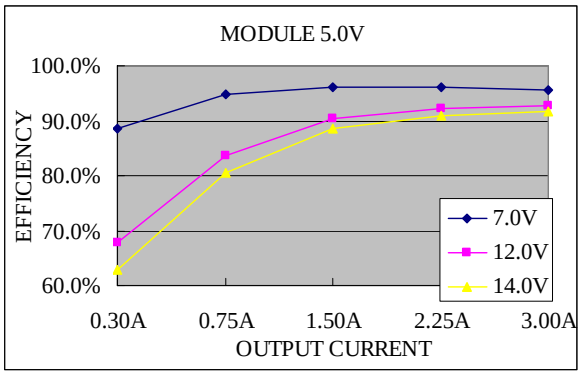


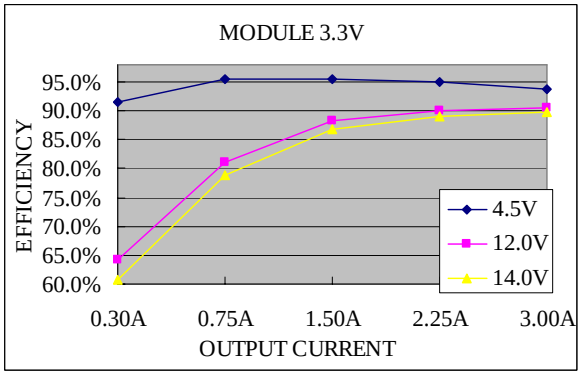
Equation for calculating the trim voltage (in V) given the desired adjusted voltage (Vadj) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

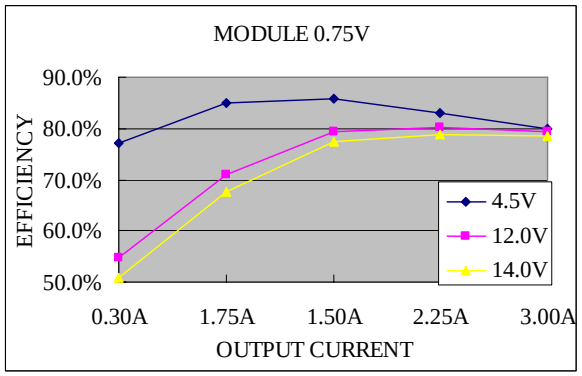
$$V_{trim} = 0.7 - 0.0667 \times (V_{adj} - 0.7525)$$



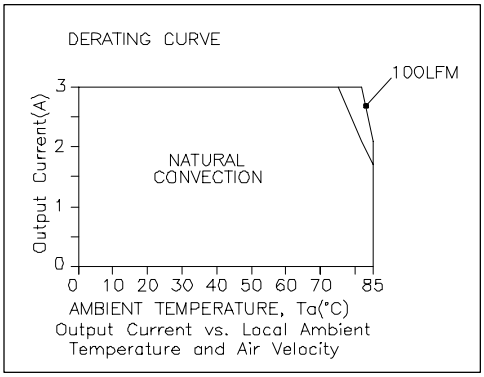
Efficiency Data



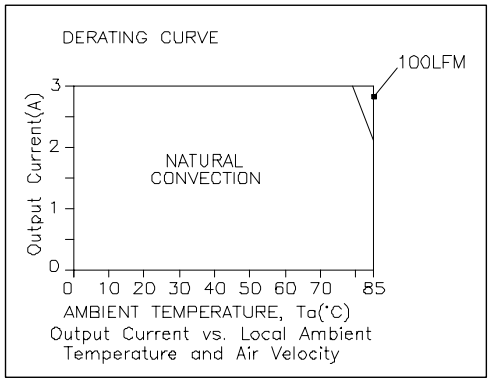




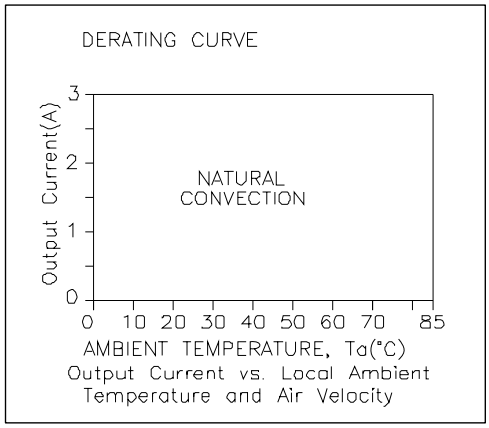
Thermal Derating Curves



Vin=12 V, Vo=5.0 V

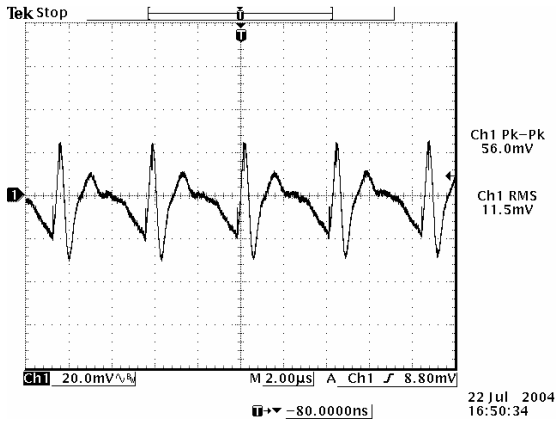


Vin=12 V, Vo=3.3 V

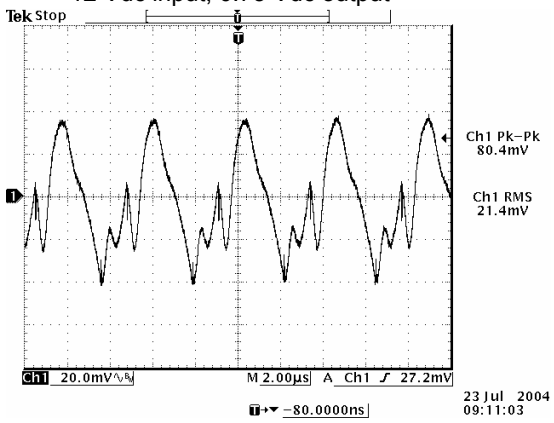


Vin=12 V, Vo=0.75 V

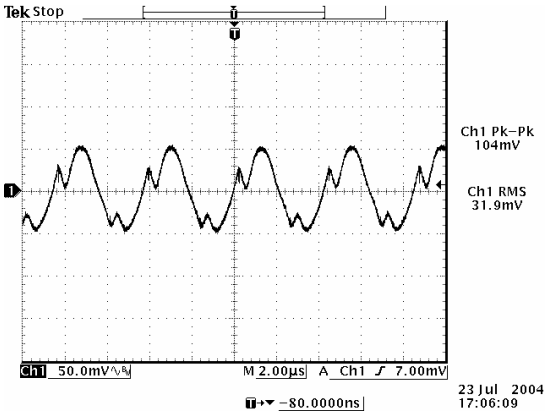
Ripple and Noise Waveforms



12 Vdc input, 0.75 Vdc output



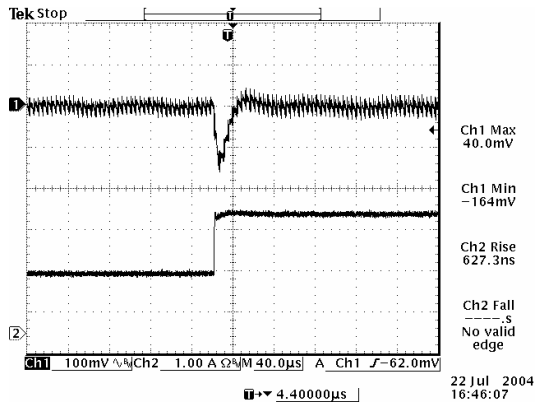
12 Vdc input, 3.3 Vdc output



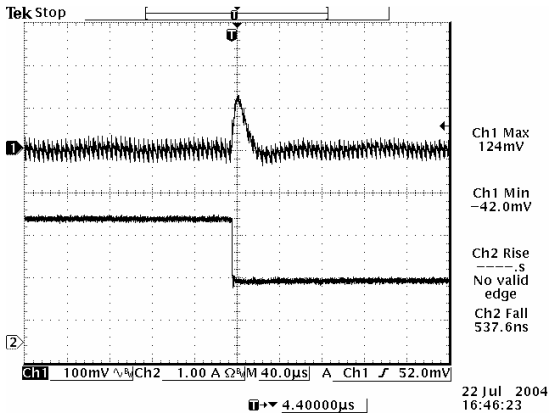
12 Vdc input, 5.0 Vdc output

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

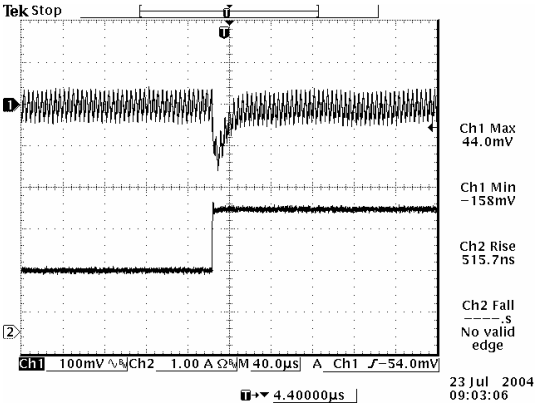
Transient Response Waveforms



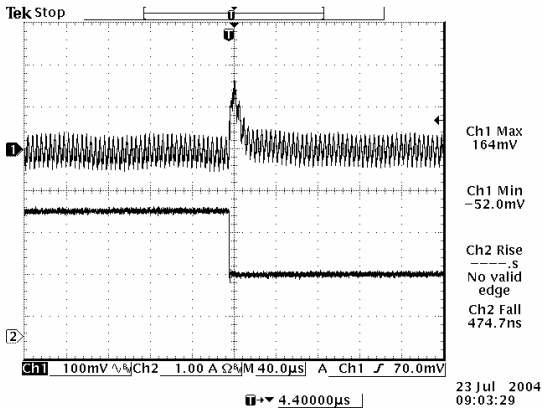
Transients 50% to 100% load 0.75 Vdc output



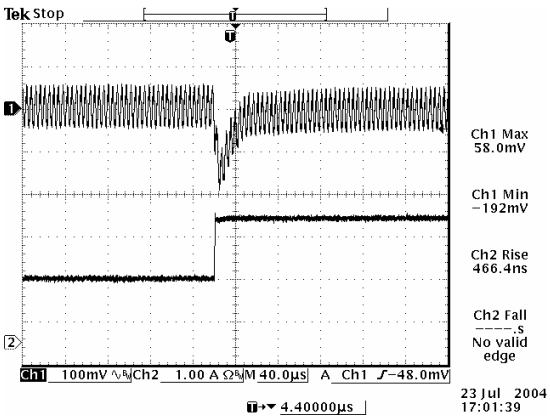
Transients 100% to 50% load 0.75 Vdc output



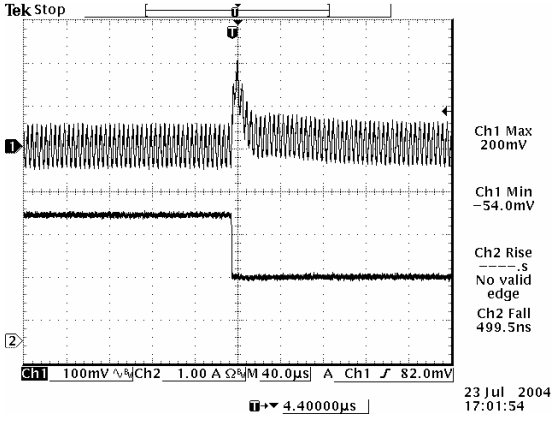
Transients 50% to 100% load 3.3 Vdc output



Transients 100% to 50% load 3.3 Vdc output



Transients 50% to 100% load 5.0 Vdc output



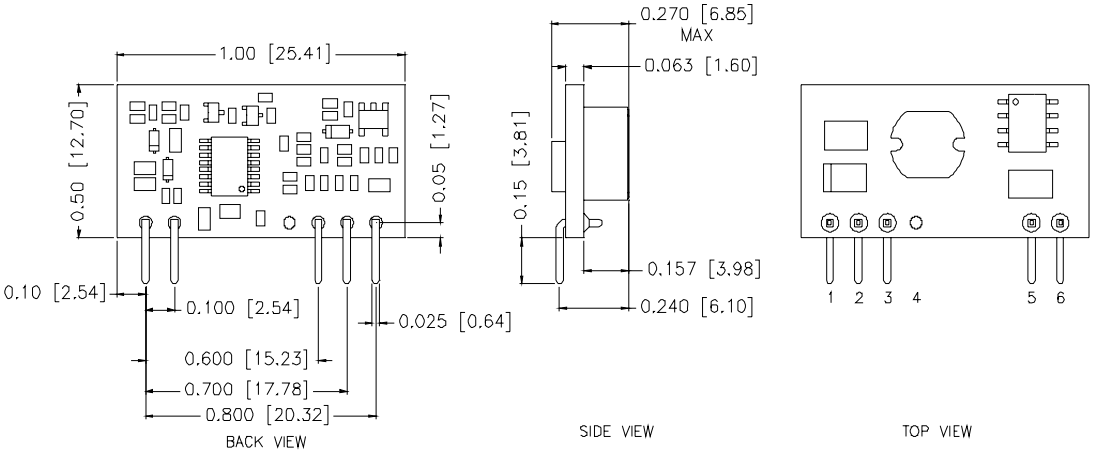
Transients 100% to 50% load 5.0 Vdc output

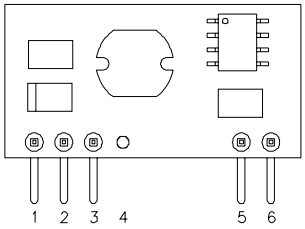
Note: Transient response at 12 Vdc input, di/dt=2.5 A/uS, with 10 uF/10 V tantalum cap and 1 uF/10 V ceramic cap at the output, Ta=25 deg C.

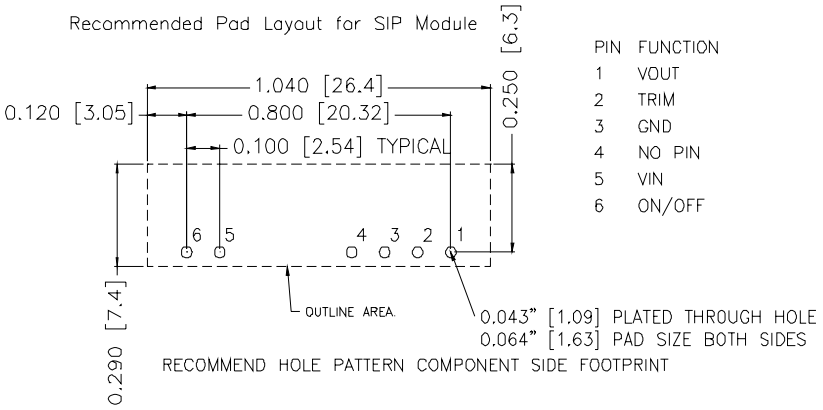
NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input 0.75 Vdc - 5.0 Vdc/3 A Output

Mechanical Outline







PIN	FUNCTION
1	VOUT
2	TRIM
3	GND
4	NO PIN
5	VIN
6	ON/OFF

Pin Connections

Pin	Function
1	Vout
2	Trim
3	Ground
4	N/A
5	Vin
6	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.

CORPORATE

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