NON-ISOLATED DC/DC CONVERTERS

10 Vdc - 14 Vdc Input 0.75 Vdc - 6.0 Vdc/6 A Output

VRBA-06A1Ax RoHS Compliant Rev.A

- Non-Isolated
- High Efficiency
- High Power Density
- Fixed Frequency
- Under-Voltage Lockout (UVLO)
- OCP/SCP
- Remote On/Off
- Wide Trim Range

Description

The Bel VRBA-06A1Ax modules are a series of non-isolated dc/dc converters that can deliver up to 6 A of output current with full load efficiency of 92% at 6.0 Vdc output. These modules provide precisely regulated voltage programmable via external resistor from 0.75 Vdc to 6.0 Vdc over input voltage (10 Vdc - 14 Vdc). 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 6.0 Vdc	Model Number Active Low	Model Number Active High
0.75 V - 6.0 V	10 V - 14 V	6 A	36W	92%	VRBA-06A1AL	VRBA-06A1A0

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	

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

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	10 V	12 V	14 V	
Input Current (full load)				
Vo=6.0 V	-	3.5 A	-	
Vo=5.0 V	-	2.8 A	-	
Vo=3.3 V	-	1.9 A	-	
Vo=2.5 V	-	1.5 A	-	
Vo=1.8 V	-	1.1 A	-	
Vo=0.75 V	-	0.55 A	-	
Input Current (no load)				
Vo=6.0 V	-	-	100 mA	
Vo=0.75 V	-	-	20 mA	
Remote Off Input Current	-	3 mA	5 mA	

Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
Input Reflected Ripple Current (pk-pk)	-	120 mA	-	Tested with two 100 uF/25 V tan input capacitors & simulated source impedance of 1uH, 5 Hz to 20 MHz.
Input Reflected Ripple Current (rms)	-	40 mA	-	
I^2t Inrush Current Transient	-	0.002 A^2s	0.02 A^2s	
Turn-on Voltage Threshold	-	9.5 V	9.8 V	
Turn-off Voltage Threshold	-	9.0 V	9.5 V	

Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point	-2%Vo,set	-	2%Vo,set	Vin=12 V, full load
Output Voltage Set Point	-2.5%Vo,set	-	3.5%Vo,set	Over all operating input voltages, resistive loads and temperature conditions
Load Regulation	-	0.4%Vo,set	-	Io=Io, min to Io, max
Line Regulation	-	0.3%Vo,set	-	Vin=Vin, min to Vin, max
Regulation Over Temperature (-40 °C to +85 °C)	-	0.5%Vo,set	-	Tref=Ta, min to Ta, max
Output Current	0 A	-	6 A	
Current Limit Threshold	7 A	-	15 A	
Short Circuit Surge Transient	-	0.25 A^2s	-	
Ripple and Noise (pk-pk) Vo=6.0 V Vo=5.0 V Vo=3.3 V Vo=2.5 V Vo=1.8 V Vo=0.75 V	 - - - - - -	 85 mV 75 mV 60 mV 50 mV 40 mV 20 mV	 - - - - - -	Tested with 0-20 MHz, with 10 uF/10 V tantalum capacitor and 1uF/10 V ceramic capacitor at the output
Ripple and Noise (rms) Vo=6.0 V Vo=5.0 V Vo=3.3 V Vo=2.5 V Vo=1.8 V Vo=0.75 V	 - - - - - -	 30 mV 25 mV 20 mV 15 mV 12 mV 7 mV	 - - - - - -	
Turn on Time	-	15 mS	25 mS	
Overshoot at Turn on	-	0%	3%	
Output Capacitance ESR ≥ 1mohm ESR ≥ 10mohm	 0 uF 0 uF	 - -	 1000 uF 3300 uF	
Transient Response				
50% ~ 100% Max Load	Vo = 0.75 V - 6.0 V	-	200 mV	-	di/dt=2.5 A/uS; Vin=12 V; and with 10 uF/10 V tantalum capacitor and 1uF/10 V ceramic capacitor at the output
Settling Time		-	50 uS	-	
100% ~ 50% Max Load		-	200 mV	-	
Settling Time		-	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=6.0 V	-	92%	-	Measured at Vin=12 V, full load
Vo=5.0 V	-	90%	-	
Vo=3.3 V	-	88%	-	
Vo=2.5 V	-	85%	-	
Vo=1.8 V	-	83%	-	
Vo=0.75 V	-	71%	-	
Switching Frequency	280 kHz	300 kHz	320 kHz	
Over Temperature Shutdown	-	135 °C	-	
MTBF	3,266,517 hours			Calculated Per Bell Core SR-332 (Io = Nominal; Ta = 25 °C)
Dimensions				
Inches (L × W × H)	1.0 x 0.5 x 0.243			
Millimeters (L × W × H)	25.4 x 12.7 x 6.16			
Weight	-	3 g	-	

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

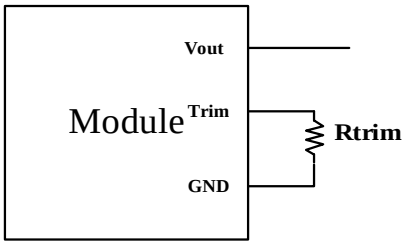
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.3 V	-	0.4 V	VRBA-06A1A0; 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	VRBA-06A1AL; Remote On/Off pin open, Unit on.
Signal High (Unit Off)	2.5 V	-	14 V	
Output Voltage Trim Range (Wide Trim)	0.7525 V	-	6.3 V	

Output Trim Equations

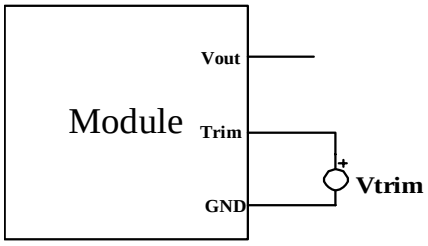
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

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

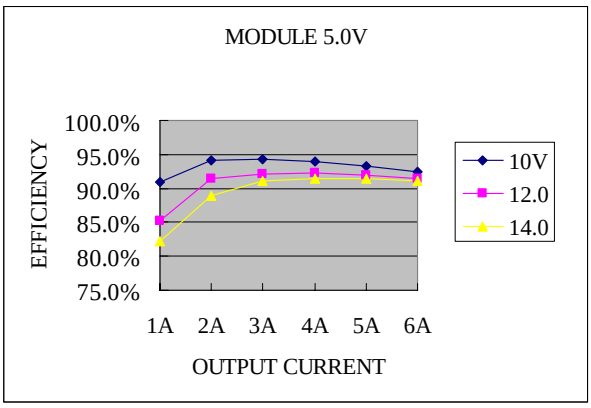


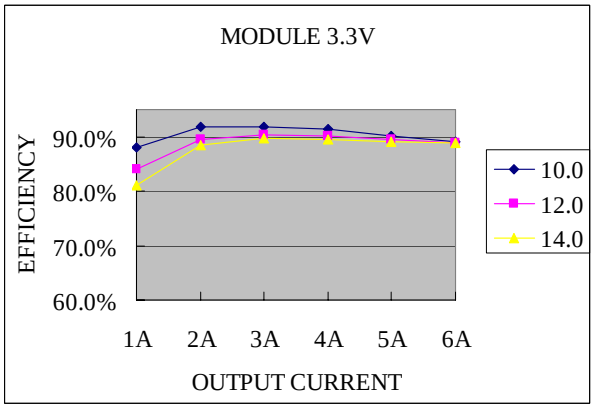
Equation for calculating the trim voltage (in V) given the desired adjusted voltage (Vadj) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

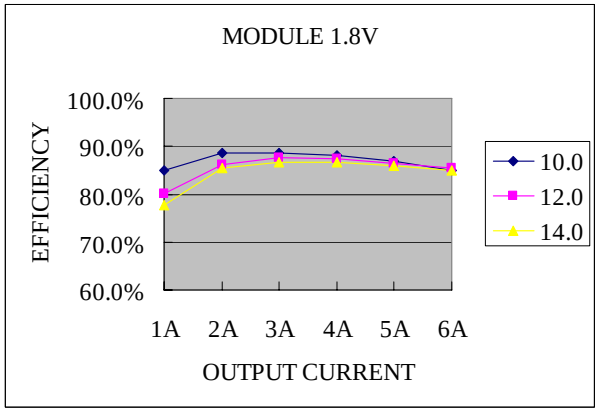
$$V_{trim} = 0.7 - 0.0667 \times (V_{adj} - 0.7525)$$

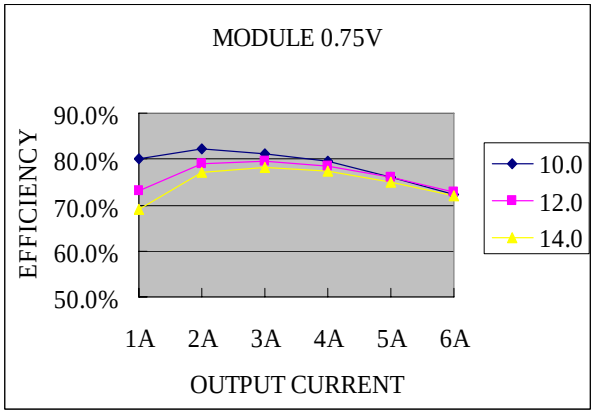


Efficiency Data

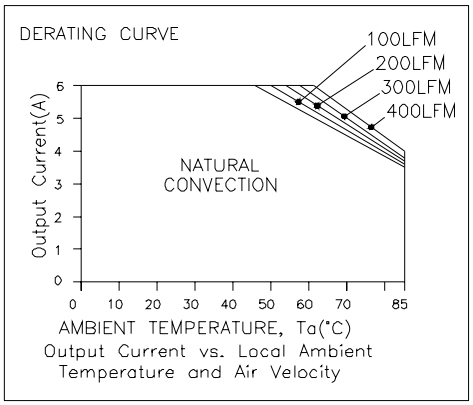




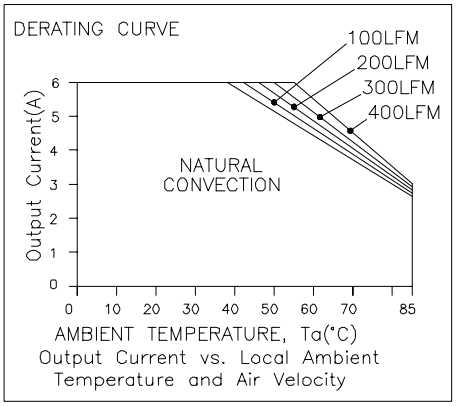




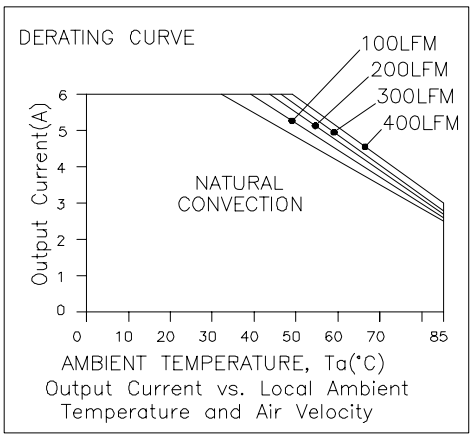
Thermal Derating Curves



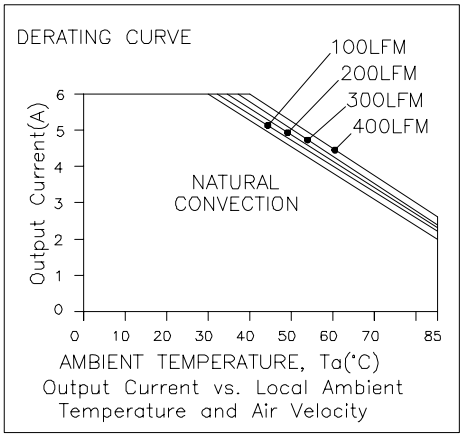
Vin=12 V, Vo=0.75 V



Vin=12 V, Vo=2.5 V

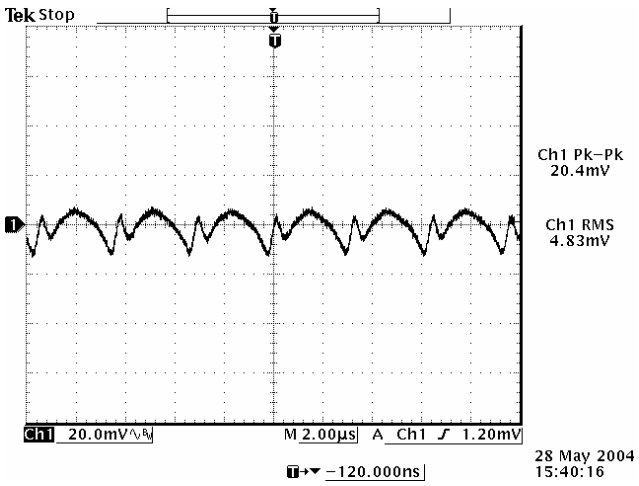


Vin=12 V, Vo=3.3 V

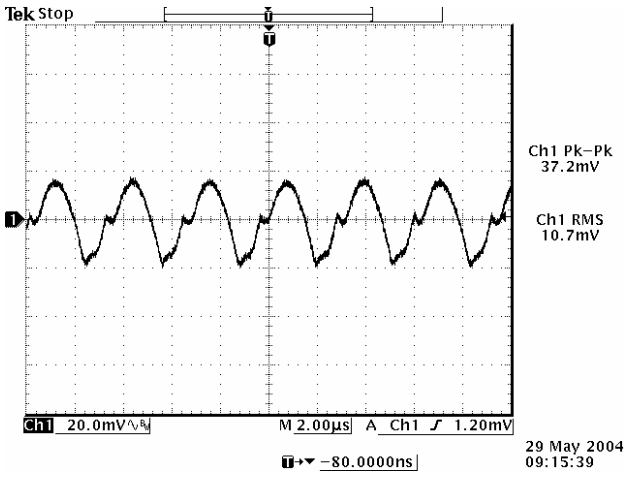


Vin=12 V, Vo=6.0 V

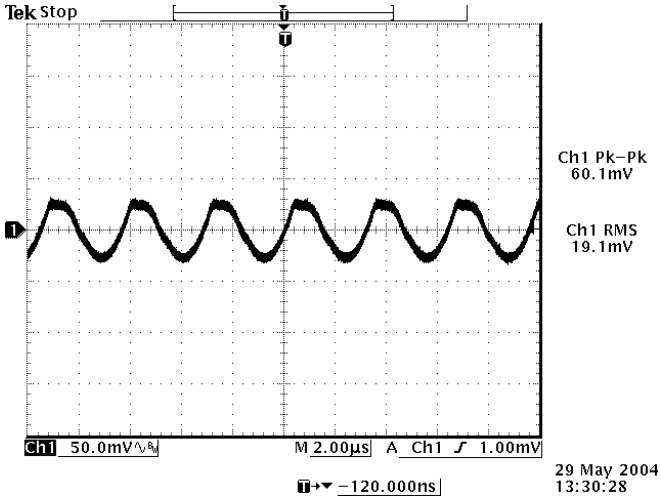
Ripple and Noise Waveforms



Ripple and noise at full load, Vin=12 V, Vo=0.75 V



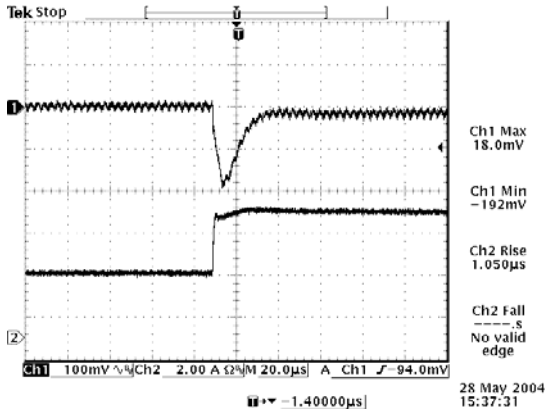
Ripple and noise at full load, Vin=12 V, Vo=2.5 V



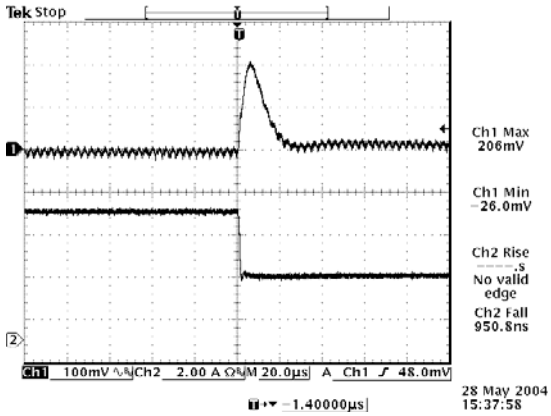
Ripple and noise at full load, Vin=12 V, Vo=6.0 V

Note: The output ripple and noise is tested at 0-20 MHz BW, 10 uF/10 V tantalum capacitor and 1 uF/10 V ceramic capacitor, Ta=25 deg C.

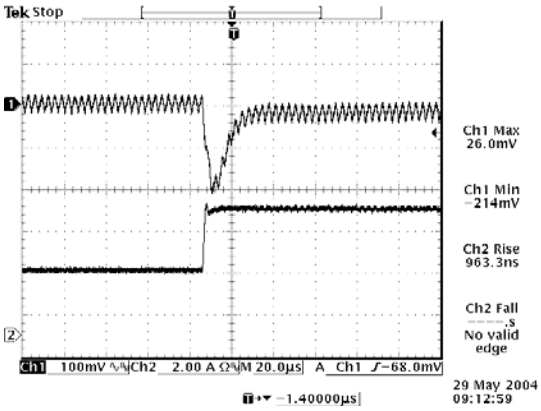
Transient Response Waveforms



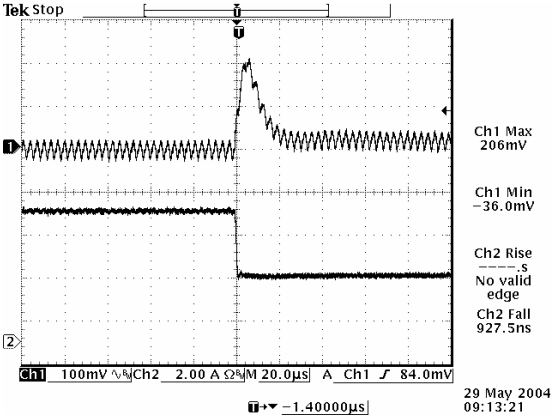
50% to 100% load step at Vin=12 V, Vo=0.75 V



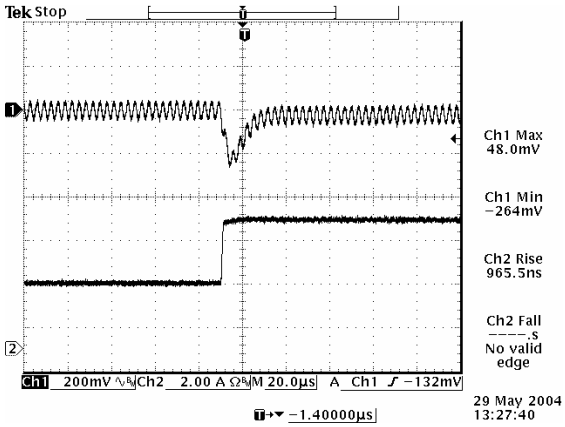
100% to 50% load step at Vin=12 V, Vo=0.75 V



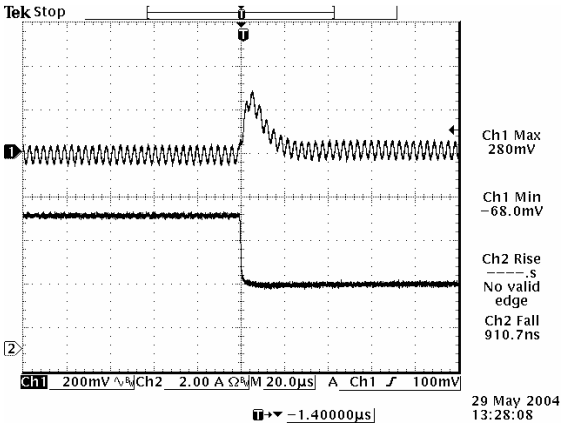
50% to 100% load step at Vin=12 V, Vo=1.8 V



100% to 50% load step at Vin=12 V, Vo=1.8 V



50% to 100% load step at Vin=12 V, Vo=6.0 V



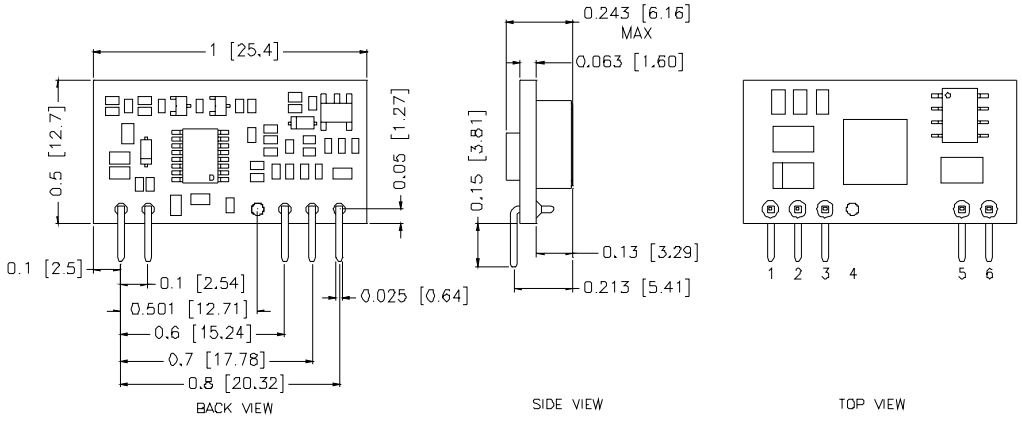
100% to 50% load step at Vin=12 V, Vo=6.0 V

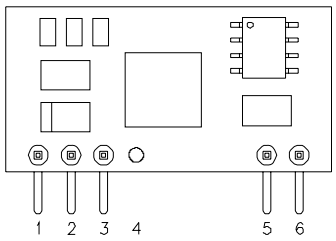
Note: Transient response is tested at di/dt=2.5 A/uS, with 10 uF/10 V tantalum capacitor and 1 uF/10 V ceramic capacitor, Ta=25 deg C.

NON-ISOLATED DC/DC CONVERTERS

10 Vdc - 14 Vdc Input 0.75 Vdc - 6.0 Vdc/6 A Output

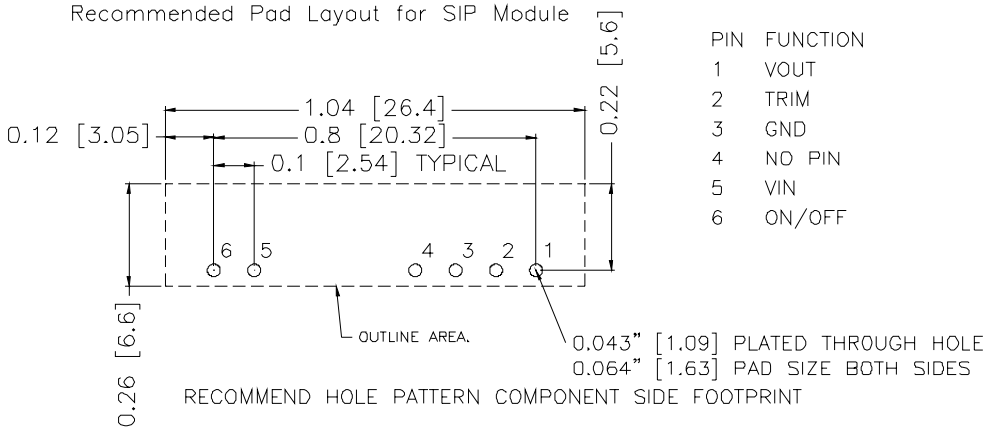
Mechanical Outline





Pin Connections

Pin	Function
1	Vout
2	Trim
3	Ground
4	No Pin
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.

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