

NON-ISOLATED DC/DC CONVERTERS

8.3 Vdc - 14 Vdc Input

0.75 Vdc - 5.0 Vdc/3 A Output

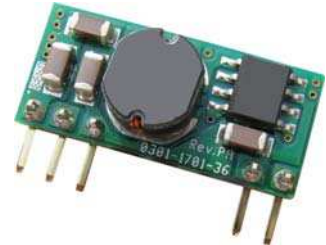
bel
POWER PRODUCTS

VRBA-03A1Ax

RoHS Compliant

Rev.A

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



Description

The Bel VRBA-03A1Ax 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 5.5 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, over-temperature protection, over current protection, short circuit protection, and under-voltage lockout.

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 - 5.0 V	8.3 V - 14 V	3 A	15 W	93%	VRBA-03A1A0	VRBA-03A1AL

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	8.3 V	12 V	14 V	
Input Current (full load)				
Vo=5.0 V	-	1.35 A	2.00 A	
Vo=3.3 V	-	0.90 A	1.37 A	
Vo=0.75 V	-	0.24 A	0.37 A	
Input Current (no load)				
Vo=5.0 V	-	55 mA	65 mA	
Vo=3.3 V	-	40 mA	50 mA	
Vo=0.75 V	-	15 mA	20 mA	

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Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
Remote Off Input Current	-	3 mA	6 mA	
Input Reflected Ripple Current (pk-pk) Vo=5.0 V	-	70 mA	100 mA	Tested with two 100 uF/25 V tantalum input capacitors & simulated source impedance of 1uH, 5 Hz to 20 MHz.
Vo=3.3 V	-	60 mA	90 mA	
Vo=0.75 V	-	25 mA	40 mA	
Input Reflected Ripple Current (rms) Vo=5.0 V	-	20 mA	60 mA	
Vo=3.3 V	-	15 mA	30 mA	
Vo=0.75 V	-	6 mA	15 mA	
I ² t Inrush Current Transient	-	0.01 A ² s	0.02 A ² s	
Turn-on Voltage Threshold	7.6 V	7.9 V	8.2 V	
Turn-off Voltage Threshold	7.0 V	7.8 V	8.1 V	

Output Specifications

Parameter		Min	Typ	Max	Notes
Output Voltage Set Point		-2%Vo,set	-	2%Vo,set	Vin=12 V, Io=Iomax, 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		0.5%Vo,set	0.4%Vo,set	0.5%Vo,set	Io=Iomin to Iomax
Line Regulation		0.4%Vo,set	0.3%Vo,set	0.4%Vo,set	Vin=Vinmin to Vinmax
Regulation Over Temperature (-40 °C to +85 °C)		-	0.5%Vo,set	0.8%Vo,set	
Output Current		0 A	-	3 A	
Current Limit Threshold		4.2 A	-	11 A	
Short Circuit Surge Transient		-	0.1 A ² s	-	
Ripple and Noise (pk-pk) Vo=5.0 V Vo=3.3 V Vo=0.75 V		- - -	80 mV 55 mV 25 mV	120 mV 80 mV 45 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=5.0 V Vo=3.3 V Vo=0.75 V		- - -	25 mV 15 mV 5 mV	45 mV 25 mV 10 mV	
Turn on Time		-	5 mS	8 mS	
Overshoot at Turn on		-	0%	3%	
Output Capacitance		0 uF	-	1200 uF	
Transient Response					
50% ~ 100% Max Load	All	-	200 mV	300 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	80 uS	
100% ~ 50% Max Load		-	200 mV	300 mV	
Settling Time		-	50 uS	80 uS	

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

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General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				
Vo=5.0 V	89%	93%	-	Measured at Vin=12 V, full load (Current Source)
Vo=3.3 V	86%	90%	-	
Vo=0.75 V	73%	77%	-	
Switching Frequency	-	300 kHz	-	
Over Temperature Shutdown	-	135 °C	-	
MTBF	8,791,825 hours			Calculated Per Bell Core SR-332 (Io = 80% load; Ta = 25 °C)
Dimensions (Vertical Mount)				
Inches (L × W × H)	0.9 x 0.4 x 0.243			
Millimeters (L × W × H)	22.9 x 10.2 x 6.16			
Weight	-	2.5 g	-	

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

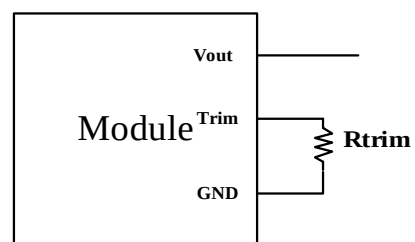
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.3 V	-	0.4 V	VRBA-03A1A0; 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-03A1AL; 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	-	5.0 V	

Output Trim Equations

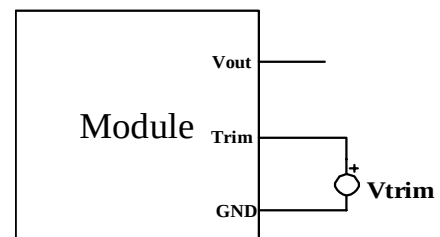
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

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



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.

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



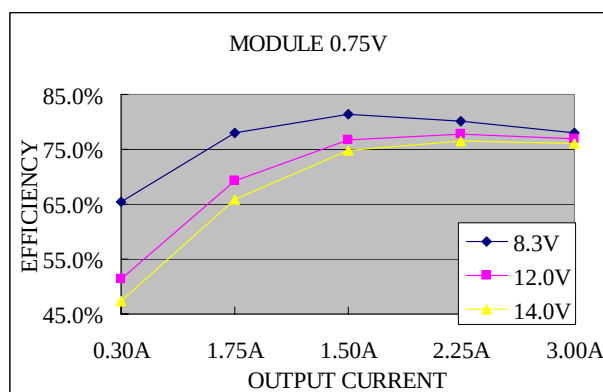
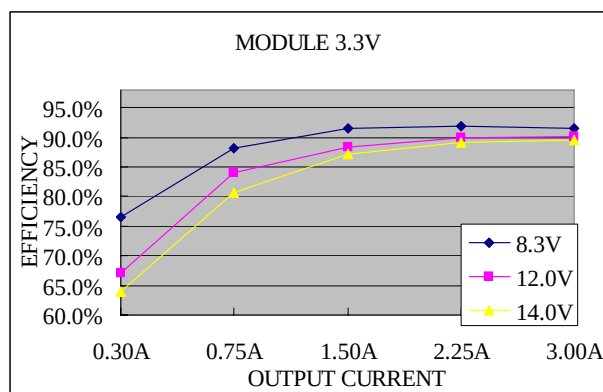
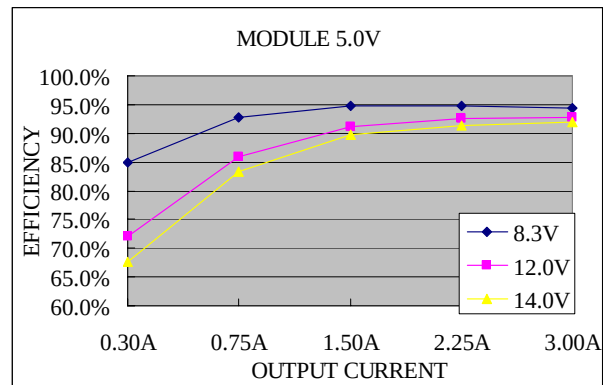
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Efficiency Data



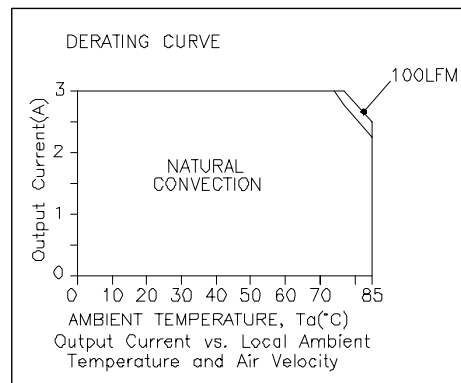
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8.3 Vdc - 14 Vdc Input

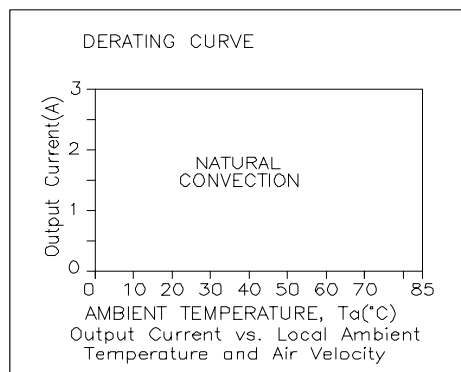
0.75 Vdc - 5.0 Vdc/3 A Output

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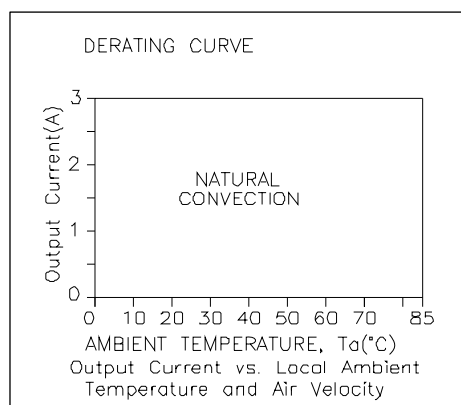
Thermal Derating Curves



$V_{in}=12\text{ V}$, $V_o=5.0\text{ V}$



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



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

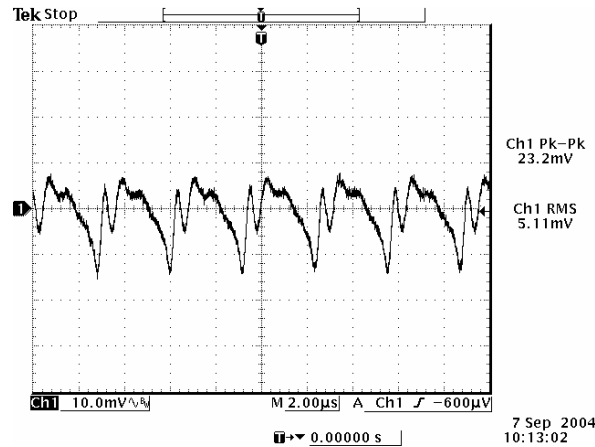
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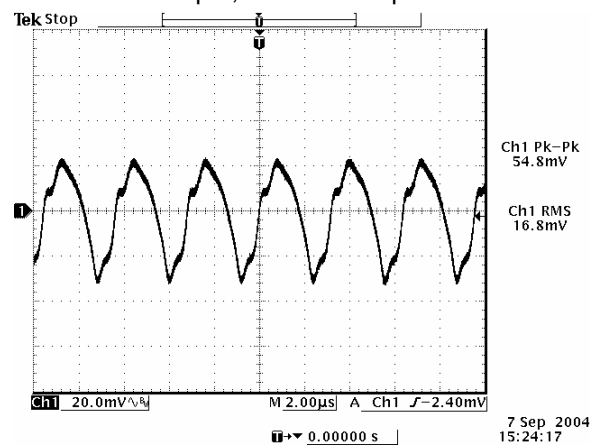
0.75 Vdc - 5.0 Vdc/3 A Output



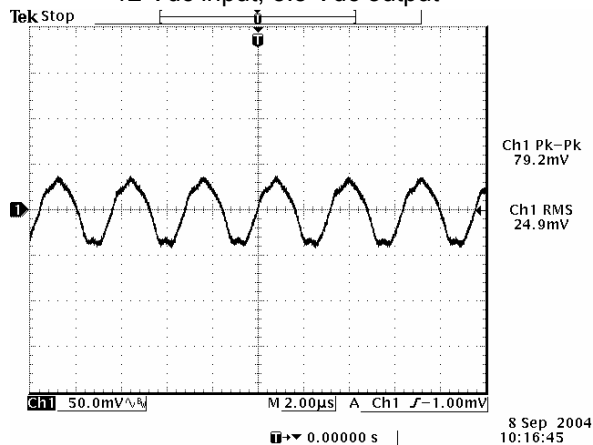
Ripple and Noise Waveforms



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 µF/10 V tantalum cap and 1 µF/10 V ceramic cap at the output, and $T_a=25$ deg C.

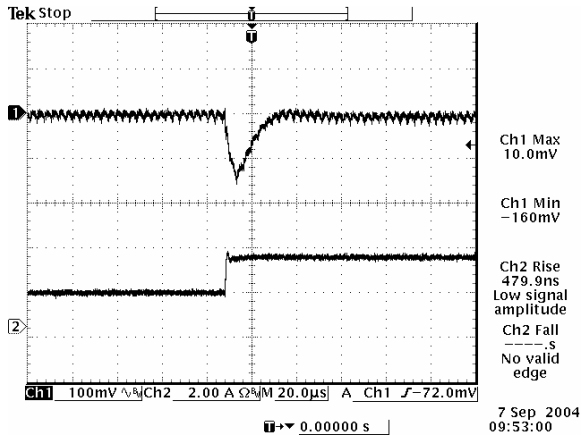
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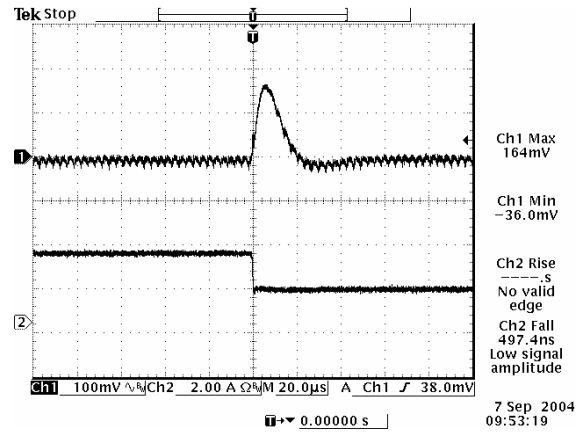
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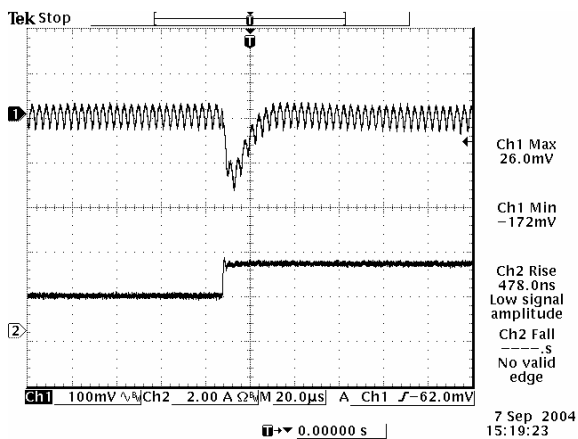
Transient Response Waveforms



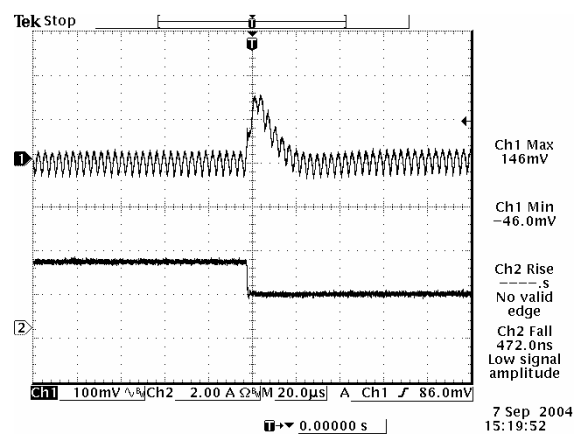
Transients 50% to 100% load 0.75 Vdc output



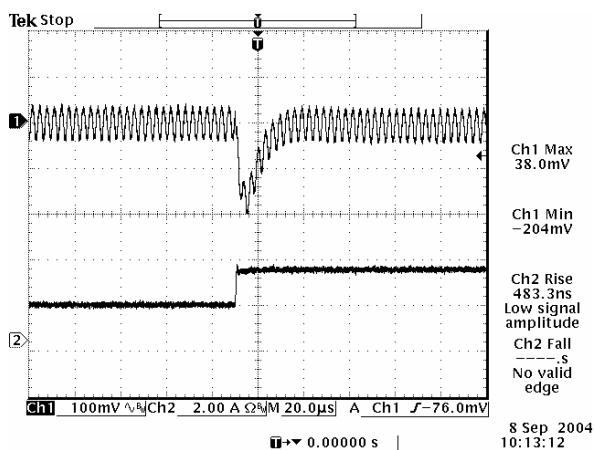
Transients 100% to 50% load 0.75 Vdc output



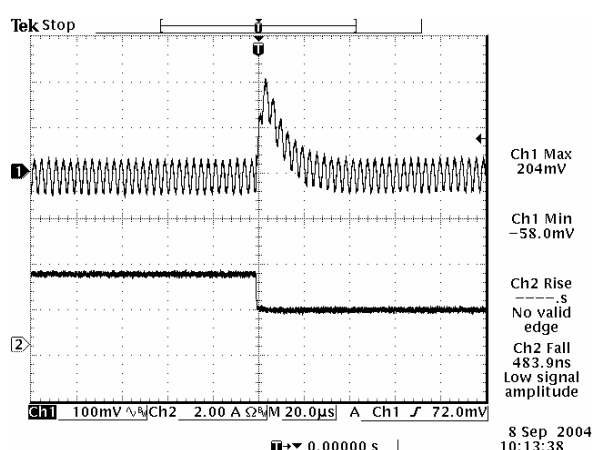
Transients 50% to 100% load 3.3 Vdc output



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, $T_a=25$ deg C.

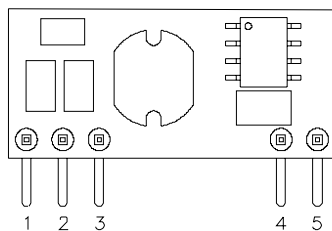
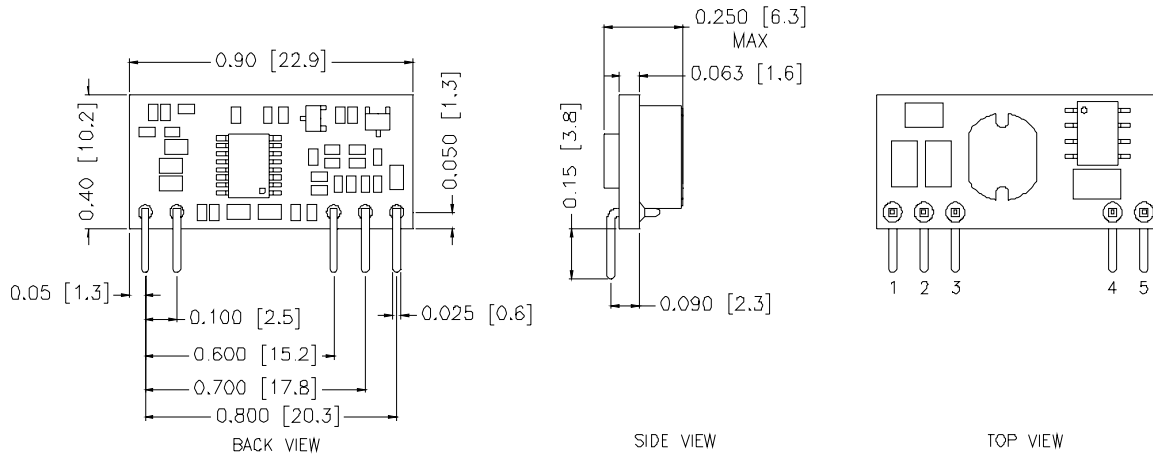
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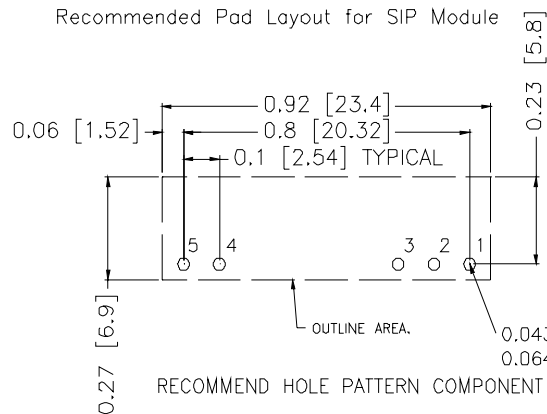
0.75 Vdc - 5.0 Vdc/3 A Output



Mechanical Outline



Recommended Pad Layout for SIP Module



PIN	FUNCTION
1	Vout
2	Trim
3	GND
4	Vin
5	ON/OFF

Pin Connections

Pin	Function
1	Vout
2	Trim
3	Ground
4	Vin
5	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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