

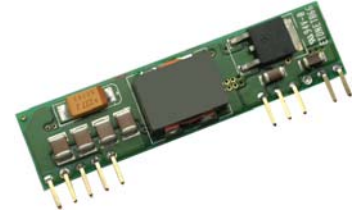
NON-ISOLATED DC/DC CONVERTERS

4.5 V - 14 V Input 0.75 V - 3.63 V/10 A Output

bel
POWER PRODUCTS

VRBC-10E1Ax Series RoHS Compliant

- Non-Isolated
- High Efficiency
- Fixed Frequency
- Remote Sense
- Low Cost
- Under-Voltage Lockout (UVLO)
- Over Temperature Shutdown
- Wide Input
- Wide trim
- OCP/SCP
- Remote On/Off
- Active Low/High (option)
- Industrial Temperature Range



Description

The Bel VRBC-10E1Ax is part of the non-isolate dc/dc power converter series. The modules use a SIP package. These converters are available in a range of output voltages from 0.75 V to 3.63 V over a wide range of input voltage ($V_{in} = 4.5 \text{ V} - 14 \text{ V}$). The efficiency is typically 94.3% at 3.3 V output at 5.0 V input 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	10 A	36.3 W	94.3%	VRBC-10E1AL	VRBC-10E1A0

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

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 $V_{o, \text{set}} < 3.0 \text{ V}$ $V_{o, \text{set}} \geq 3.0 \text{ V}$	4.5 V $V_{o, \text{set}} + 1.5 \text{ V}$	- -	14 V 14 V	
Input Current (full load)	-	-	8.6 A	An input line fuse must always be used.
Input Current (no load)	-	40 mA	-	
Remote Off Input Current	-	2 mA	-	
Input Reflected Ripple Current (pk-pk)	-	-	400 mA	Tested with one 1000 uF/25V AL input capacitor with ESR=0.03ohm max and 4 × 47 uF/16V Tantalum capacitors with ESR=0.013 ohm max at 100 kHz, & simulated source impedance of 1000nH, 5 Hz to 20MHz.
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	-	4.0 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% $V_{o,set}$	-	2% $V_{o,set}$	$V_{in}=5\text{ V}$ & 12 V , full load
Load Regulation	-	0.1% $V_{o,set}$	-	
Line Regulation	-	0.1% $V_{o,set}$	-	
Regulation Over Temperature (-40 °C to +85 °C)	-	0.3% $V_{o,set}$	-	$T_{ref}=T_a$, min to T_a , max
Output Current	0 A	-	10 A	
Current Limit Threshold	-	200% $I_{o,out}$	-	
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, with 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%	
Output Capacitance	0 uF	-	5600 uF	
Transient Response				
50% ~ 100% Max Load	$V_o = 0.75\text{ V} - 3.63\text{ V}$	-	160 mV	$di/dt=2.5\text{ A/uS}$; $V_{in}=5\text{ V}$ & 12 V ; and with 470 uF Tantalum capacitor at the output
Settling Time		-	50 uS	
100% ~ 50% Max Load		-	160 mV	
Settling Time		-	50 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	Vo=3.3 V	-	94.3%	-	Measured at Vin=5 V, full load
	Vo=2.5 V	-	93.0%	-	
	Vo=1.8 V	-	91.5%	-	
	Vo=1.5 V	-	90.8%	-	
	Vo=1.2 V	-	89.3%	-	
	Vo=0.75 V	-	83.0%	-	
Efficiency	Vo=3.3 V	-	93.0%	-	Measured at Vin=12 V, full load
	Vo=2.5 V	-	92.0%	-	
	Vo=1.8 V	-	90.0%	-	
	Vo=1.5 V	-	89.0%	-	
	Vo=1.2 V	-	87.5%	-	
	Vo=0.75 V	-	81.0%	-	
Switching Frequency		265 kHz	300 kHz	335 kHz	
Over Temperature Shutdown		-	130 °C	-	
Output Voltage Trim Range		0.7525 V	-	3.63 V	
Remote Sense Compensation		-	-	0.5 V	
MTBF		5,114,191 hours			Calculated Per Bell Core SR-332 (Io = 80%Io,max; Vo=3.3 V; Vin=12 V; Ta = 25 °C)
Dimensions					
Inches (L × W × H)		2.0 x 0.5 x 0.32			
Millimeters (L × W × H)		50.8 x 12.7 x 8.13			
Weight		-	7.1 g	-	

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

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4.5 V - 14 V Input 0.75 V - 3.63 V/10 A Output



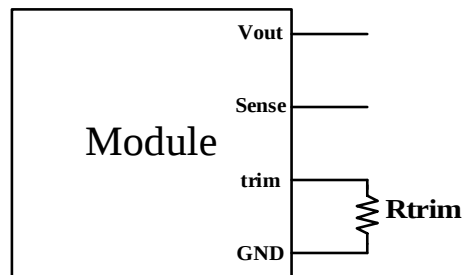
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.2 V	-	0.3 V	VRBC-10E1A0; Remote On/Off pin open, Unit on.
Signal High (Unit On)	-	-	V _{in, max}	
Signal Low (Unit On)	-0.2 V	-	0.3 V	VRBC-10E1AL; Remote On/Off pin open, Unit on.
Signal High (Unit Off)	2.5 V	-	V _{in, max}	

Output Trim Equations

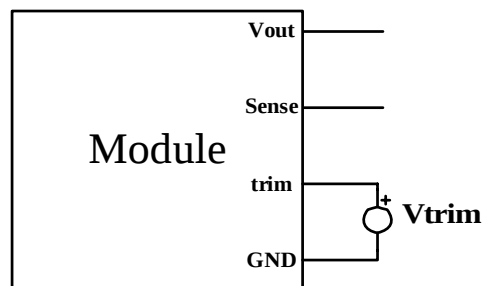
Equation for calculating the trim resistor (in Ω) given the desired output voltage (V_o) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

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



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.

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



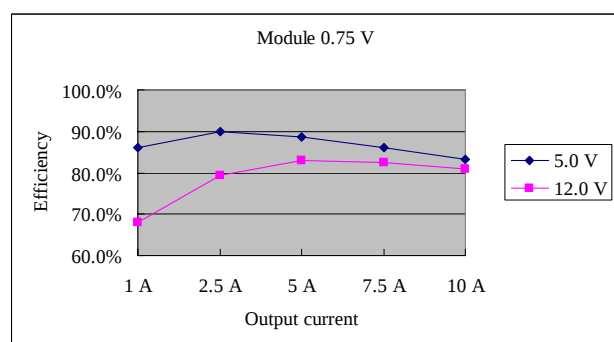
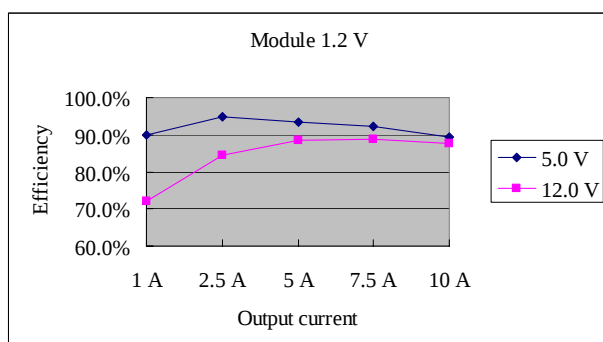
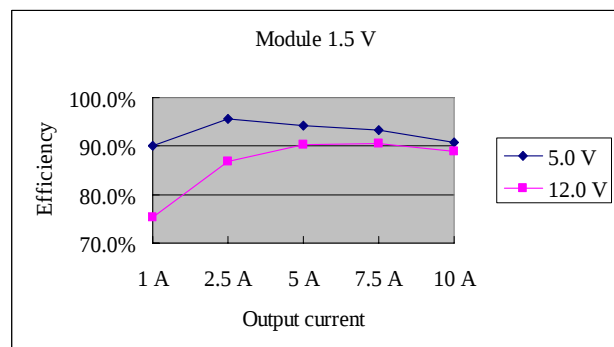
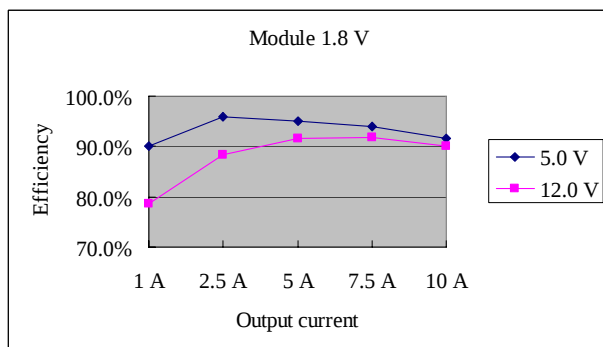
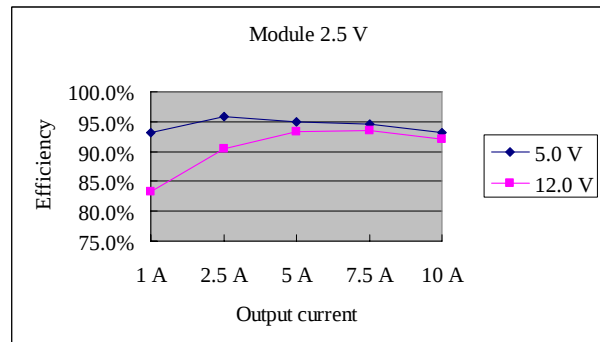
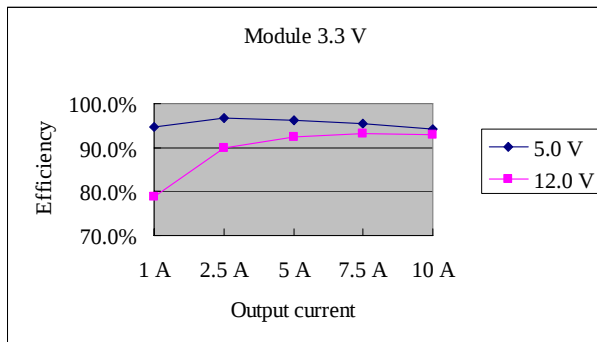
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4.5 V - 14 V Input

0.75 V - 3.63 V/10 A Output

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Efficiency Data



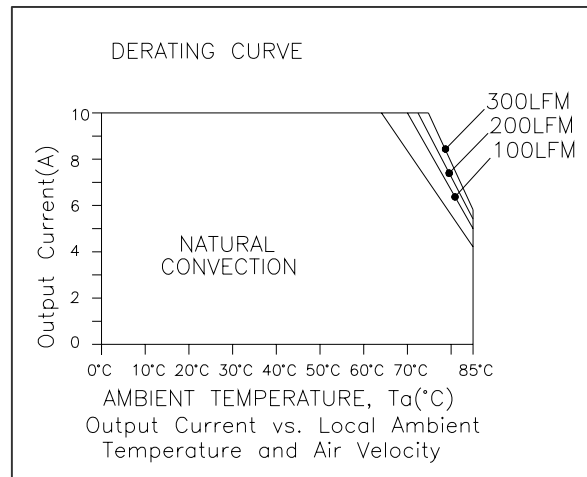
NON-ISOLATED DC/DC CONVERTERS

4.5 V - 14 V Input

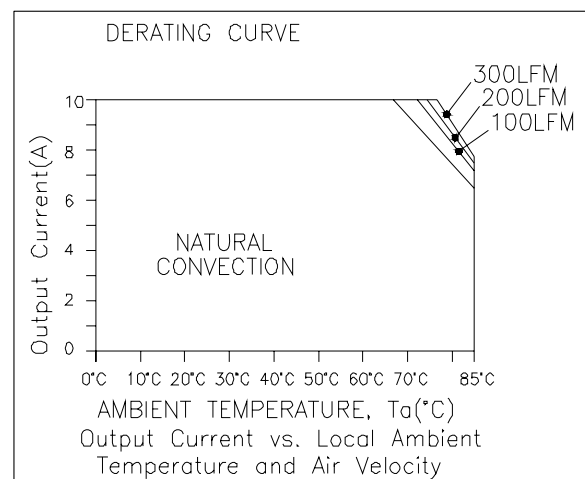
0.75 V - 3.63 V/10 A Output

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Thermal Derating Curves



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



$V_{in}=5\text{ V}$, $V_o = 3.3\text{ V}$

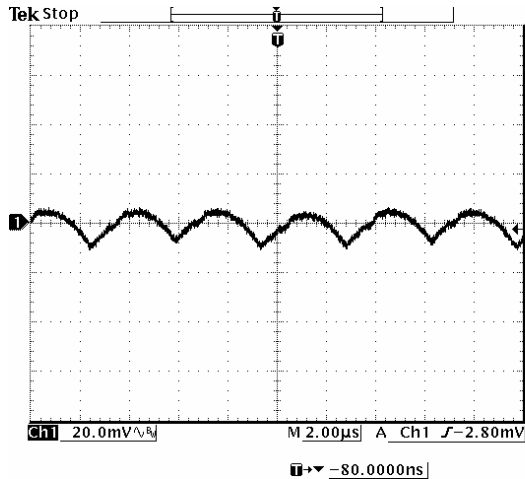
NON-ISOLATED DC/DC CONVERTERS

4.5 V - 14 V Input

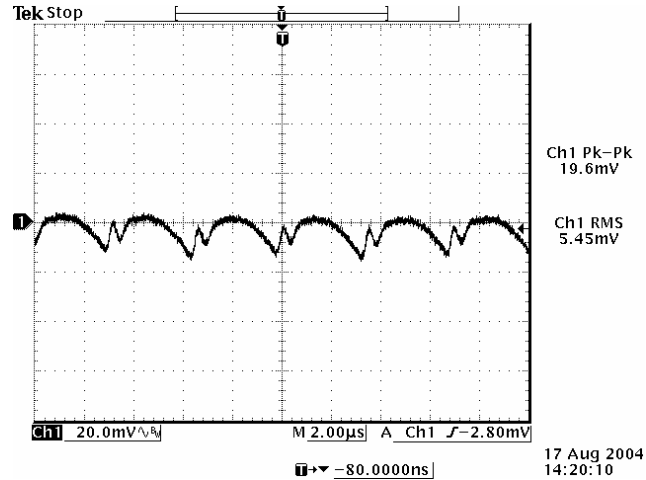
0.75 V - 3.63 V/10 A Output

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POWER PRODUCTS

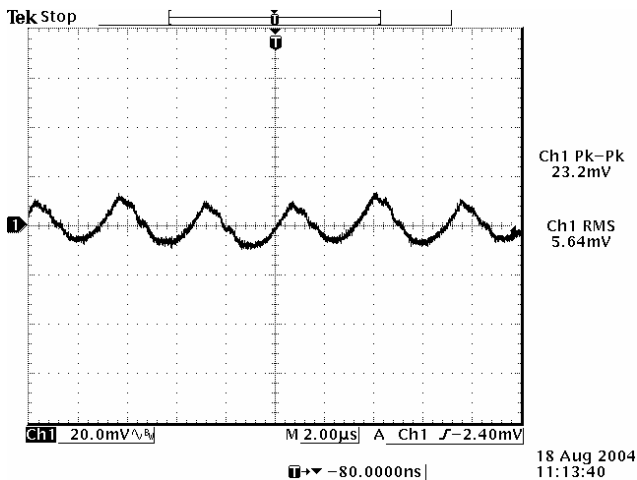
Ripple and Noise Waveforms



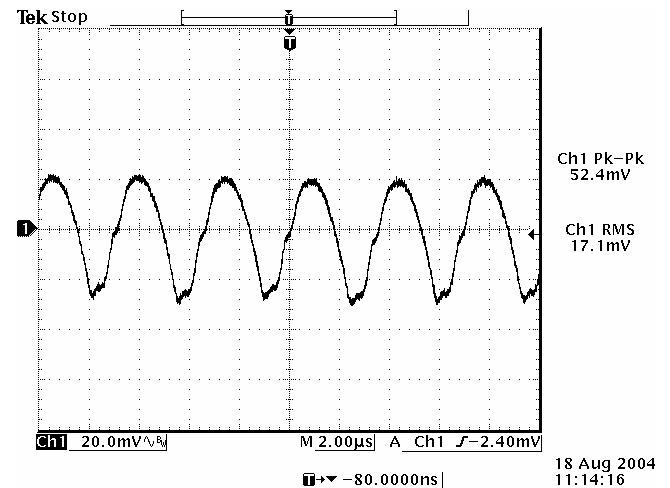
Vin=5 V, Vo=0.75 V



Vin=12 V, Vo=0.75 V



Vin=5 V, Vo=3.3 V



Vin=12 V, Vo=3.3 V

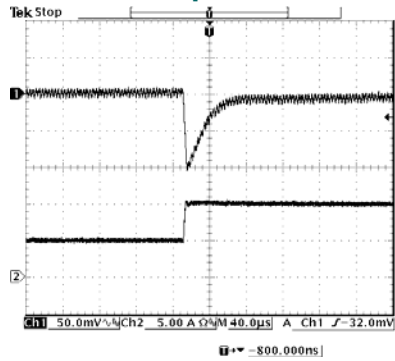
Note: Ripple and noise at full load, external load with 10 µF tantalum capacitor and 1 µF ceramic at the output, and Ta=25 deg C.

NON-ISOLATED DC/DC CONVERTERS

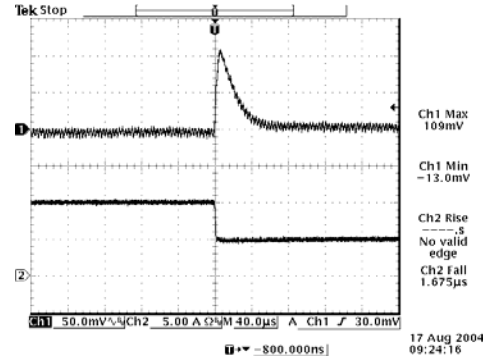
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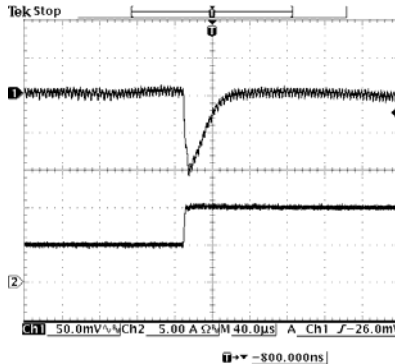
Transient Response Waveforms



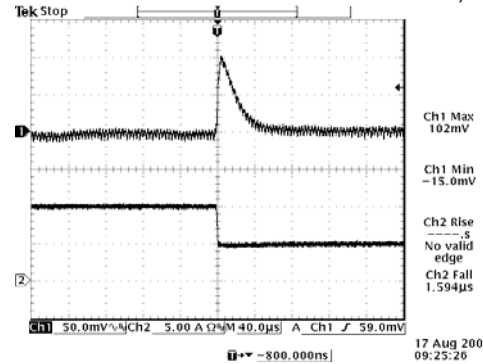
50% to 100% load Transient at $V_{in}=5$ V, $V_o=0.75$ V



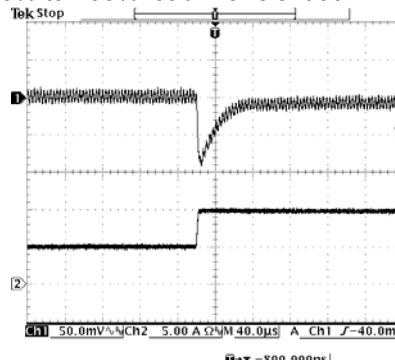
100% to 50% load Transient at $V_{in}=5$ V, $V_o=0.75$ V



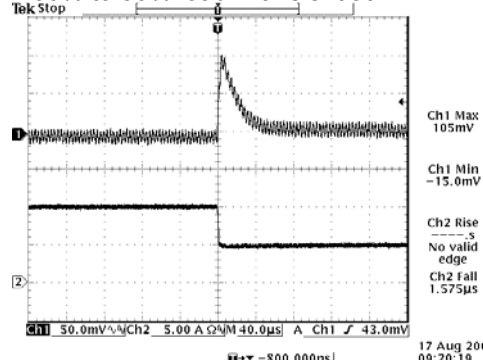
50% to 100% load Transient at $V_{in}=12$ V, $V_o=0.75$ V



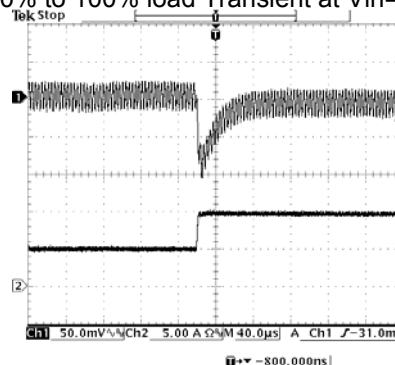
100% to 50% load Transient at $V_{in}=12$ V, $V_o=0.75$ V



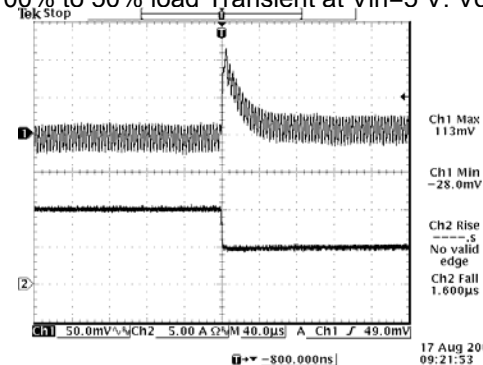
50% to 100% load Transient at $V_{in}=5$ V, $V_o=3.3$ V



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

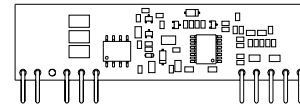
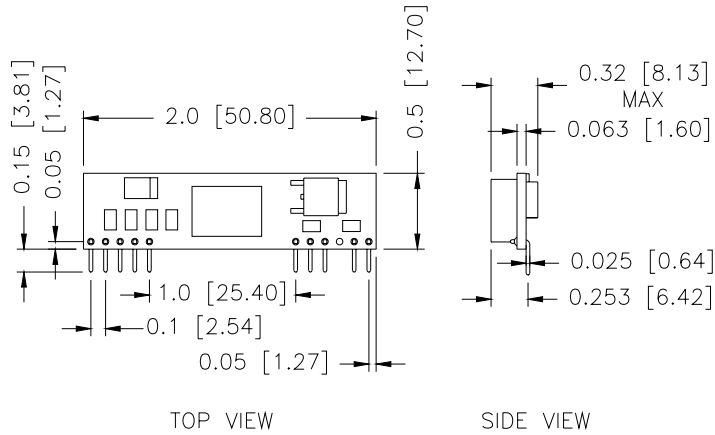
Note: Transient response at $di/dt=2.5$ A/μs, external load with 470 μF tantalum capacitor at the output.

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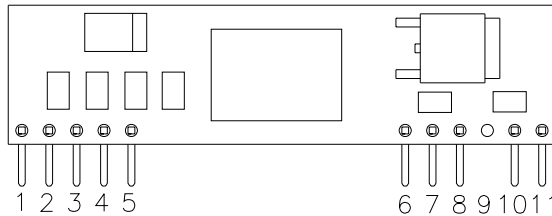
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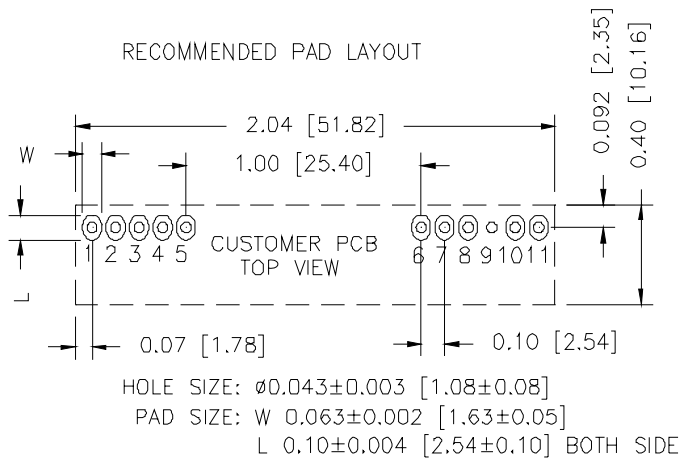
Mechanical Outline



UNIT: INCH [MM]



RECOMMENDED PAD LAYOUT



Pin Connections

Pin	Function
1	Vout
2	Vout
3	Remote Sense
4	Vout
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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