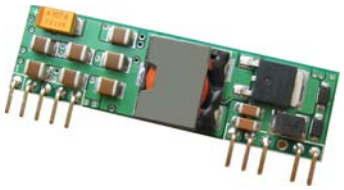
NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 13.2 Vdc Input 0.9 Vdc - 5.0 Vdc/10 A Output

VRPB-10D Series RoHS Compliant Rev.A

- Non-Isolated
- High Efficiency
- High Power Density
- Excellent Thermal Performance
- Low Cost
- Remote On/Off
- Under-voltage Lockout (UVLO)
- OCP/SCP
- Wide Input



Description

The Bel VRPB-10Dxxx is part of the low cost non-isolated dc/dc power converter series. The modules use a SIP package for ease of layout and space savings. The output is closely regulated and the efficiency is typically 93% at full load. Typical features include Remote On/Off, under-voltage lockout, over-current protection and short circuit protection.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typ. Efficiency at Vin=12V	Model Number Active Low	Model Number Active High
5.0 Vdc	8.0 Vdc - 13.2 Vdc	10 A	50.0 W	93%	VRPB-10D50L	VRPB-10D50S
3.3 Vdc	4.5 Vdc 13.2 Vdc	10 A	33.0 W	91%	VRPB-10D33L	VRPB-10D33S
2.5 Vdc	3.1 Vdc - 13.2 Vdc	10 A	25.0 W	89%	VRPB-10D25L	VRPB-10D25S
1.8 Vdc	3.0 Vdc - 13.2 Vdc	10 A	18.0 W	86%	VRPB-10D18L	VRPB-10D18S
1.5 Vdc	3.0 Vdc - 13.2 Vdc	10 A	15.0 W	84%	VRPB-10D15L	VRPB-10D15S
1.2 Vdc	3.0 Vdc - 13.2 Vdc	10 A	12.0 W	81%	VRPB-10D12L	VRPB-10D12S
0.9 Vdc	3.0 Vdc - 13.2 Vdc	10 A	9.0 W	78%	VRPB-10D09L	VRPB-10D09S

Notes: 1. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers.
2. Add “G” suffix at the end of the model numbers listed above 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	-40 °C	-	125 °C	

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
Vo=5.0 V	8 V		13.2 V	
Vo=3.3 V	4.5 V	-	13.2 V	
Vo=2.5 V	3.1 V		13.2 V	
Vo=0.9-1.8 V	3.0 V		13.2 V	
Input Current (full load)				
Vin=3.3 V	-	-	10.0 A	
Vin=5.0 V	-	-	8.8 A	
Vin=13.2 V	-	-	5.5 A	
Input Current (no load)				
Vin=3.3 V	-	-	200 mA	
Vin=5.0 V	-	-	200 mA	
Vin=13.2 V	-	-	150 mA	

Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
Input Reflected Ripple Current (pk-pk)	-	-	250 mA	Tested with a 22 uF tantalum input capacitor & simulated source impedance of 500 nH, 5 Hz to 20 MHz.
Input Reflected Ripple Current (rms)	-	-	70 mA	
I^2t Inrush Current Transient	-	0.04 A^2s	0.08 A^2s	
Turn-on Voltage Threshold	-	2.9 V	-	
Turn-off Voltage Threshold				
Vo=5.0 V	-	-	5.5 V	
Vo=3.3 V	-	-	3.8 V	
Vo=0.9-2.5 V	-	-	2.95 V	

Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point				
Vo=5.0 V	4.900 V	5.0 V	5.100 V	
Vo=3.3 V	3.247 V	3.3 V	3.353 V	
Vo=2.5 V	2.460 V	2.5 V	2.540 V	Test condition:
Vo=1.8 V	1.772 V	1.8 V	1.828 V	Vin=12 V, Iout=full load
Vo=1.5 V	1.476 V	1.5 V	1.524 V	
Vo=1.2 V	1.181 V	1.2 V	1.219 V	
Vo=0.9 V	0.886 V	0.9 V	0.914 V	
Load Regulation				
Vo=5.0 V	-	10 mV	20 mV	
Vo=3.3 V	-	6 mV	16 mV	
Vo=2.5 V	-	6 mV	12 mV	
Vo=1.8 V	-	5 mV	9 mV	
Vo=1.5 V	-	3 mV	7 mV	
Vo=1.2 V	-	3 mV	6 mV	
Vo=0.9 V	-	3 mV	5 mV	
Line Regulation				
Vo=5.0 V	-	2 mV	10 mV	
Vo=3.3 V	-	2 mV	10 mV	
Vo=2.5 V	-	2 mV	8 mV	
Vo=1.8 V	-	2 mV	5 mV	
Vo=1.5 V	-	2 mV	5 mV	
Vo=1.2 V	-	2 mV	5 mV	
Vo=0.9 V	-	2 mV	5 mV	
Regulation Over Temperature (-40 °C to 85 °C)				
Vo=5.0 V	-	8 mV	35 mV	
Vo=0.9-3.3 V	-	5 mV	35 mV	
Output Current	0 A	-	10 A	
Current Limit Threshold	13 A	-	25 A	
Short Circuit Surge Transient	-	0. 8 A^2s	1.5 A^2s	
Ripple and Noise Vin=12 V (Test condition: 0-20 MHz BW, 22 uF tantalum capacitor on output)				
Vo=5.0 V	-	75 mV	120 mV	
Vo=3.3 V	-	75 mV	100 mV	
Vo=2.5 V	-	60 mV	80 mV	pk-pk
Vo=1.5-1.8 V	-	45 mV	60 mV	
Vo=0.9-1.2 V	-	40 mV	55 mV	
Vo=5.0 V	-	25 mV	50 mV	
Vo=3.3 V	-	25 mV	40 mV	
Vo=2.5 V	-	20 mV	35 mV	rms
Vo=1.5-1.8 V	-	15 mV	25 mV	
Vo=0.9-1.2 V	-	12 mV	20 mV	

Output Specifications (continued)

Parameter		Min	Typ	Max	Notes
Ripple and Noise Vin=5.0 V (Test condition: 0-20 MHz BW, 22 uF tantalum capacitor on output)					
Vo=1.5-3.3 V Vo=0.9-1.2 V		- -	35 mV 30 mV	70 mV 70 mV	pk-pk
Vo=0.9-3.3 V		-	10 mV	15 mV	rms
Ripple and Noise Vin=3.3 V (Test condition: 0-20 MHz BW, 22 uF tantalum Capacitor on output)					
Vo=2.5 V Vo=1.8 V Vo=1.2-1.5 V Vo=0.9 V		- - - -	15 mV 20 mV 25 mV 30 mV	70 mV 70 mV 70 mV 70 mV	pk-pk
Vo=2.5 V Vo=1.8 V Vo=0.9-1.5 V		- - -	5 mV 6 mV 8 mV	15 mV 15 mV 15 mV	rms
Turn on Time		-	-	80 mS	
Overshoot at Turn on		-	-	5%Vo,set	
Output Capacitance		0 uF	-	3300 uF	
Transient Response Vin=12 V					
50% ~ 100% Max Load	Vo=5 V	-	100 mV	150 mV	di/dt = 0.5 A/uS; Vin = 12 V; Ta = 25 °C and with a 470 uF Aluminum capacitor at the output
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load		-	100 mV	150 mV	
Settling Time		-	50 uS	80 uS	
50% ~ 100% Max Load	Vo=3.3 V	-	80 mV	120 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	60 mV	100 mV	
Settling Time		-	40 uS	80 uS	
50% ~ 100% Max Load	Vo=2.5 V	-	60 mV	100 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	40 mV	80 mV	
Settling Time		-	40 uS	80 uS	
50% ~ 100% Max Load	Vo=1.8 V	-	60 mV	100 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	40 mV	80 mV	
Settling Time		-	40 uS	80 uS	
50% ~ 100% Max Load	Vo=1.5 V	-	60 mV	90 mV	
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load		-	40 mV	80 mV	
Settling Time		-	50 uS	80 uS	
50% ~ 100% Max Load	Vo=1.2 V	-	60 mV	90 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	40 mV	80 mV	
Settling Time		-	40 uS	80 uS	
50% ~ 100% Max Load	Vo=0.9 V	-	40 mV	80 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	40 mV	80 mV	
Settling Time		-	40 uS	80 uS	

Output Specifications (continued)

Parameter		Min	Typ	Max	Notes
Transient Response Vin=5.0 V					
50% ~ 100% Max Load	Vo=2.5-3.3 V	-	120 mV	160 mV	di/dt = 0.5 A/uS; Vin = 5 V; Ta = 25 °C and with a 470 uF Aluminum capacitor at the output
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load		-	120 mV	160 mV	
Settling Time		-	50 uS	80 uS	
50% ~ 100% Max Load	Vo=1.8 V	-	110 mV	150 mV	
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load		-	110 mV	150 mV	
Settling Time		-	50 uS	80 uS	
50% ~ 100% Max Load	Vo=0.9-1.5 V	-	80 mV	120 mV	
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load		-	80 mV	120 mV	
Settling Time		-	50 uS	80 uS	
Transient Response Vin=3.3 V					
50% ~ 100% Max Load	Vo=2.5 V	-	150 mV	200 mV	di/dt = 0.5A/uS; Vin = 3.3V; Ta = 25°C and with a 470uF Aluminum capacitor at the output
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load		-	150 mV	200 mV	
Settling Time		-	50 uS	80 uS	
50% ~ 100% Max Load	Vo=1.8 V	-	130 mV	180 mV	
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load		-	130 mV	180 mV	
Settling Time		-	50 uS	80 uS	
50% ~ 100% Max Load	Vo=1.5 V	-	120 mV	160 mV	
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load		-	120 mV	160 mV	
Settling Time		-	50 uS	80 uS	
50% ~ 100% Max Load	Vo=1.2 V	-	140 mV	180 mV	
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load		-	140 mV	180 mV	
Settling Time		-	50 uS	80 uS	
50% ~ 100% Max Load	Vo=0.9 V	-	120 mV	160 mV	
Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load		-	120 mV	160 mV	
Settling Time		-	50 uS	80 uS	

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

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency (Vin=12 V, Io=Io-max)				
Vo=5.0 V	90%	93%	-	
Vo=3.3 V	87%	91%	-	
Vo=2.5 V	85%	89%	-	
Vo=1.8 V	81%	86%	-	
Vo=1.5 V	80%	84%	-	
Vo=1.2 V	77%	81%	-	
Vo=0.9 V	73%	78%	-	
Efficiency (Vin=5.0 V, Io=Io-max)				
Vo=3.3 V	89%	92%	-	
Vo=2.5 V	87%	90%	-	
Vo=1.8 V	83%	87%	-	
Vo=1.5 V	82%	85%	-	
Vo=1.2 V	78%	81%	-	
Vo=0.9 V	74%	77%	-	
Efficiency (Vin=3.3 V, Io=Io-max)				
Vo=2.5 V	89%	92%	-	
Vo=1.8 V	84%	88%	-	
Vo=1.5 V	82%	86%	-	
Vo=1.2 V	80%	84%	-	
Vo=0.9 V	77%	80%	-	
Switching Frequency				
Vo=0.9 V	163 kHz	170 kHz	187 kHz	
Vo=1.2-5.0 V	180 kHz	200 kHz	220 kHz	
Output Trim Range				
Vo=0.9 V	-	-	120%Vo	
Vo=1.2-5.0 V	90%Vo	-	110%Vo	
MTBF	2,140,721 hours			Calculated Per Bell Core SR-332 (Io =80%Iomax; Vo=1.8 V; Vin=12 V; Ta = 25 °C)
Dimensions				
Inches (L × W × H)	2.0 x 0.55 x 0.387			
Millimeters (L × W × H)	50.8 x 13.97 x 9.84			
Remote sense compensation	-	-	10%	
Weight	-	10 g	-	

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

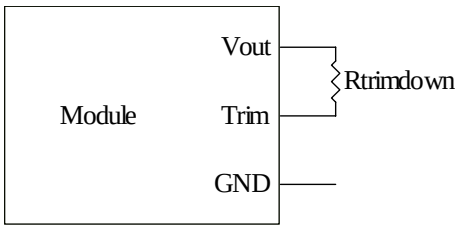
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.3 V	-	0.4 V	VRPB-10DxxS
Signal High (Unit On)	2.8 V	-	13.2 V	
Signal Low (Unit On)	-0.3 V	-	0.4 V	VRPB-10DxxL
Signal High (Unit Off)	2.8 V	-	13.2 V	

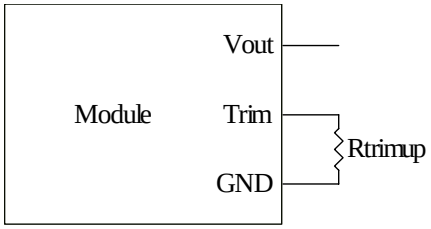
Output Trim Equations

Equations for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) and the nominal output voltage of the converter (Vnom) are shown below. The Trim Down resistor should be connected between the Trim pin and Vout. The Trim Up resistor should be connected between the Trim pin and Ground. Only one of the resistors should be used for any given application.

$$R_{TrimDown} = \frac{A}{V_{nom} - V_{adj}} - B$$

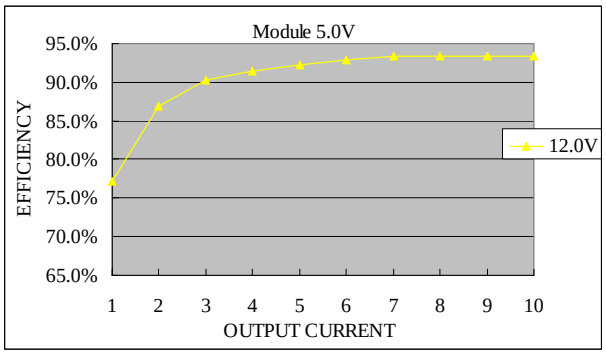


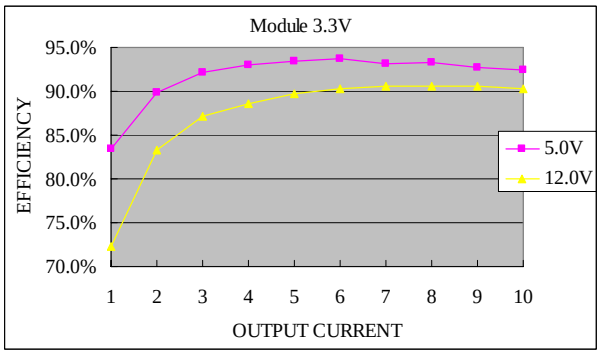
$$R_{TrimUp} = \frac{C}{V_{adj} - V_{nom}} - D$$

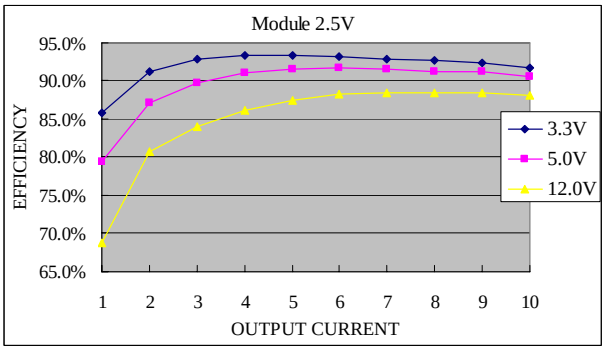


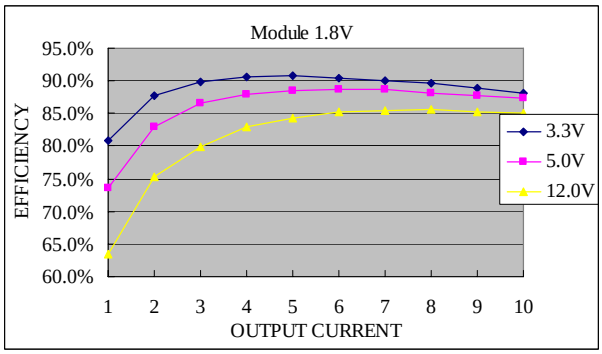
Vnom	A	B	C	D
5.5	31.58	17.51	6.01	10.00
3.3	11.63	13.74	3.72	9.09
2.5	7.92	13.74	3.72	9.09
1.8	4.69	21.55	3.72	16.90
1.5	3.25	21.55	3.72	16.90
1.2	1.78	9.07	3.54	4.64
0.9	-	-	1.46	0.909

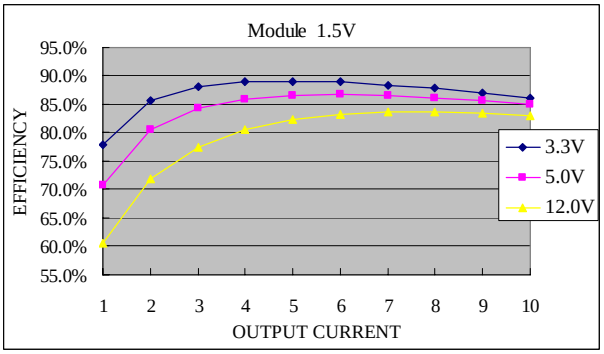
Efficiency Data

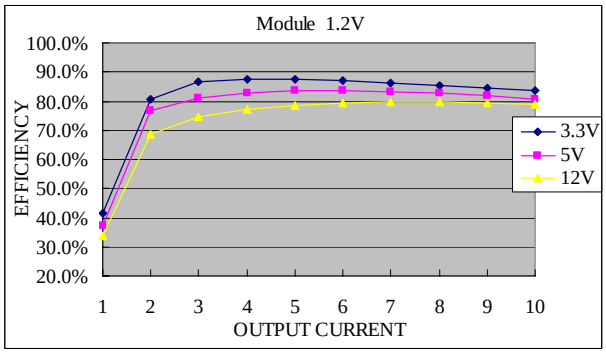


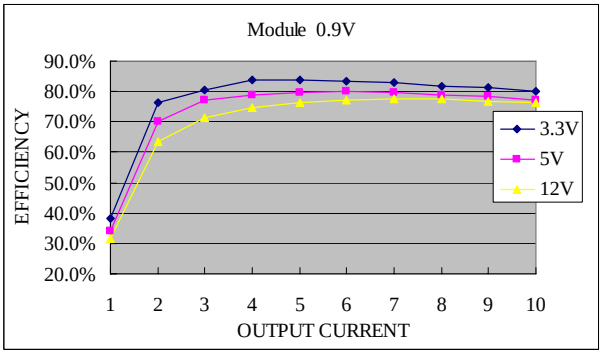




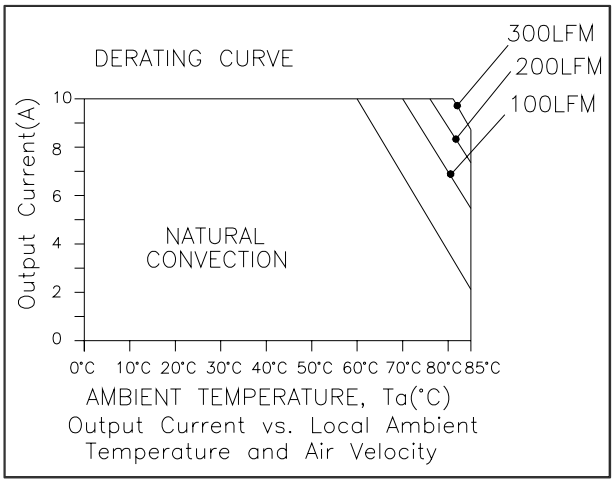




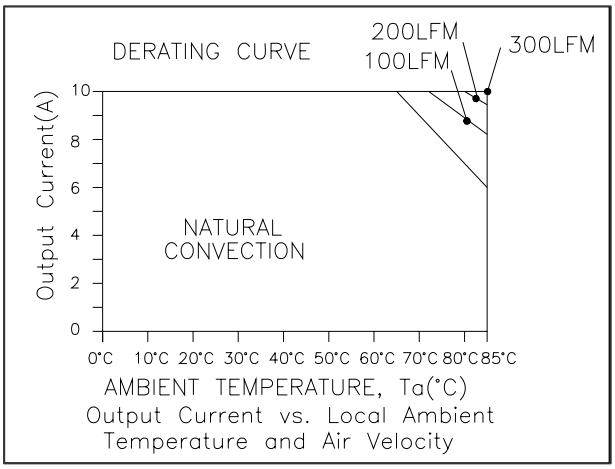




Thermal Derating Curves

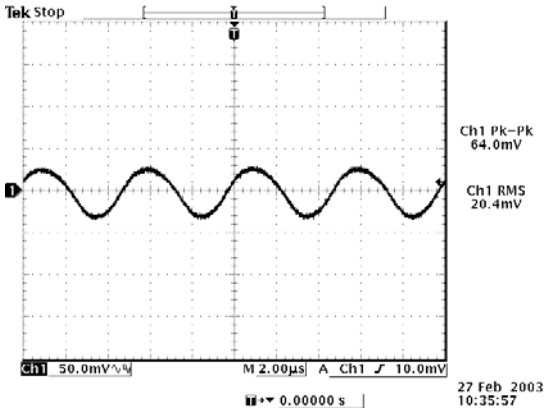


Vin=13.2 V



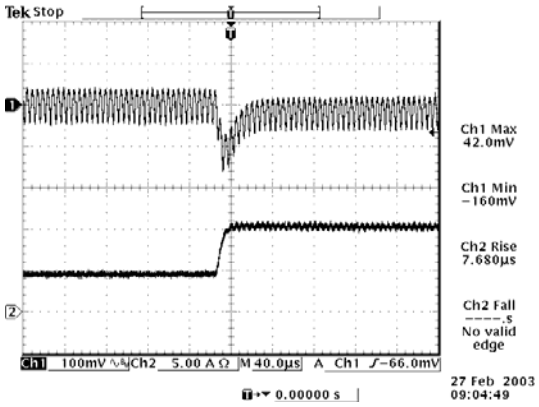
Vin=5.5 V & Vin=3.63 V

Ripple and Noise Waveform

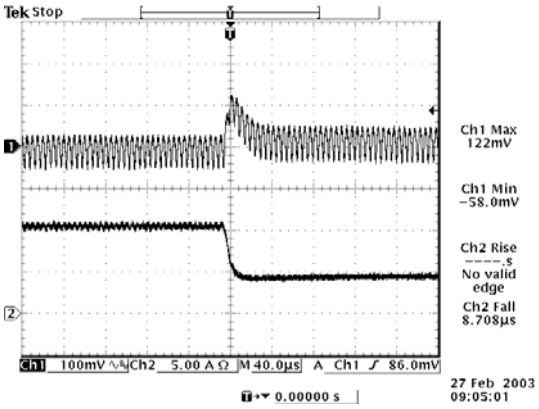


Note: Ripple and noise at full load, 8 Vdc input, 3.3 V output, with external load capacitor Co=22 uF (Tantalum capacitor) and Ta=25 deg C.

Transient Response Waveforms

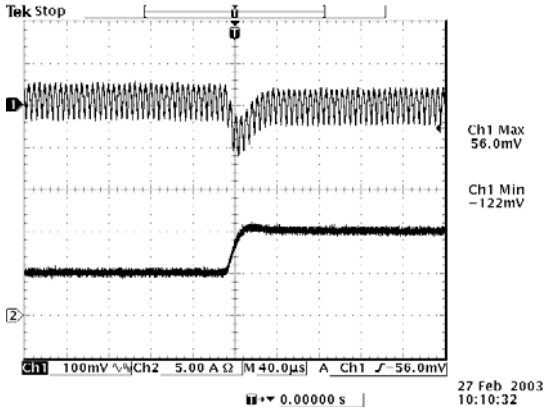


50% to 100% load Transient at 12 V input

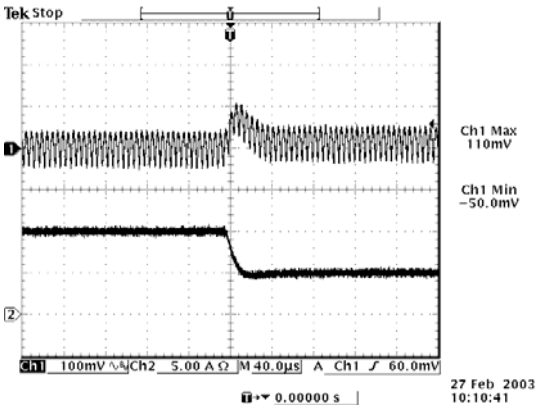


100% to 50% load Transient at 12 V input

Note: Transient Response at di/dt=0.5 A/uS, with external load capacitor Co=22 uF(tantalum).



50% to 100% load Transient at 12 V input



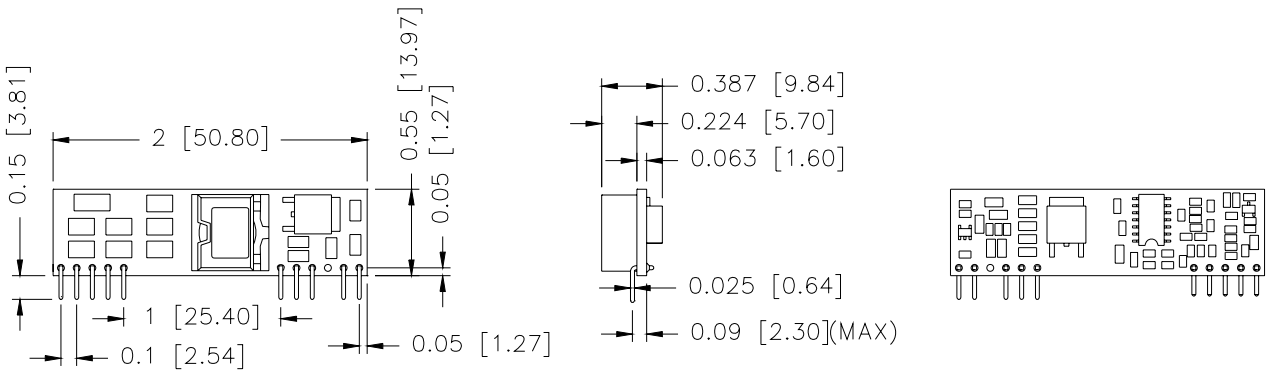
100% to 50% load Transient at 12 V input

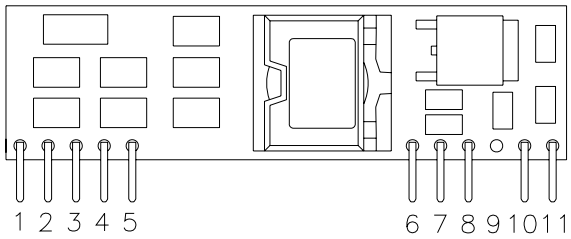
Note: Transient Response at di/dt=0.5 A/uS, with external load capacitor Co=470 uF(electrolytic).

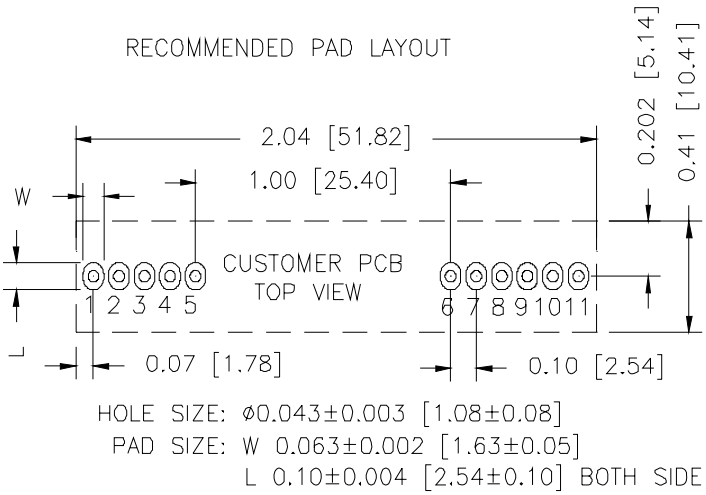
NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 13.2 Vdc Input 0.9 Vdc - 5.0 Vdc/10 A Output

Mechanical Outline







Pin Connections

Pin	Function
1	Vo+
2	Vo+
3	Opt. Remote Sense (+)
4	Vo+
5	Ground
6	Ground
7	Vin+
8	Vin+
9	Not used
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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