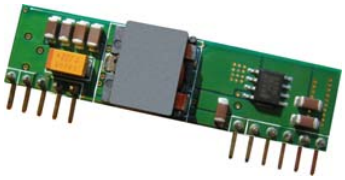
NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input 0.75 Vdc - 3.63 Vdc/10 A Output

VRBC-10F2Ax RoHS Compliant Rev.A

- Non-Isolated
- High Efficiency
- High Power Density
- Fixed Frequency (300kHz)
- OCP/SCP
- Flexible Output Voltage Sequencing
- Over Temperature Protection
- Under-Voltage Lockout (UVLO)
- Wide Input Range
- Wide Trim Range
- Remote On/Off
- Remote Sense
- Converter Can Sink and Source Current
- Active Low/High (Option)



Description

The Bel VRBC-10F2Ax modules are a series of non-isolated dc/dc converters that deliver up to 10 A of output current with full load efficiency of 94% at 3.3 Vdc output. These modules provide precisely regulated voltage programmable via external resistor from 0.75 Vdc to 3.63 Vdc over a wide range of input voltage (2.4 Vdc - 5.5 Vdc). These modules have a sequencing feature that enables designers to implement various types of output voltage sequencing when powering multiple voltages on a board. The open-frame construction and small footprint enable designers to develop cost and space-efficient solutions. Standard features include remote On/Off, remote sense, over current protection, short current protection, wide input, and programmable output voltage.

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[1]	2.4 V - 5.5 V	10 A	36.3 W	94%	VRBC-10F2AL	VRBC-10F2A0

Notes: 1. These modules use a buck topology, so the output voltages must be 0.5 V less than the input voltage.
2. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers.
3. Add “G” to the end of the Model Number to indicate Tray Packaging.

Absolute Maximum Ratings

Parameter	Min	Typ	Max	Notes
Input Voltage (continuous)	-0.3 V	-	5.8 V	
Output Enable Terminal Voltage	-0.3 V	-	5.8 V	
Sequencing Voltage [1]	-0.3 V	-	Vin	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-55 °C	-	125 °C	

Notes: All specifications are typical at 25 °C unless otherwise stated.
1. VRBC-10F2Ax series of modules include a sequencing feature that enables users to implement various types of output voltage sequencing in their applications. This is accomplished via an additional sequencing pin. When the sequencing feature is not used, tie the SEQ pin to Vin or leave the SEQ pin floating.

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	2.4 V	-	5.5 V	Vo, set ≤ Vin-0.5 V
Input Current (full load) Vo=3.3 V Vo=1.8 V Vo=0.75 V	 - - -	 7.0 A 4.04 A 1.89 A	 8.06 A 6.98 A 4.06 A	
Input Current (no load)	-	80 mA	-	
Remote Off Input Current	-	15 mA	22 mA	
Input Reflected Ripple Current (pk-pk)	-	120 mA	-	Tested with two 100 uF/10 V tantalum input capacitors (P/N: TPSC107K010R0075 AVX) & simulated source impedance of 1 uH, 5 Hz to 20MHz.
Input Reflected Ripple Current (rms)	-	35 mA	-	
I^2t Inrush Current Transient	-	-	0.2 A^2s	
Turn-on Voltage Threshold	-	2.2 V	-	
Turn-off Voltage Threshold	-	2.0 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=5 V, Io=Iomax full load
Output Voltage Set Point	-3%Vo,set	-	3%Vo,set	Over all operating input voltages, resistive loads and temperature conditions
Load Regulation	-	0.4%Vo,set	-	Io=Iomin to Iomax
Line Regulation	-	0.3%Vo,set	-	Vin=Vinmin to Vinmax
Regulation Over Temperature (-40 °C to +85 °C)	-	0.5%Vo,set	-	Tref=Tamin to Tamax
Output Current	0 A	-	10 A	
Current Limit Threshold	15 A	-	30 A	
Short Circuit Surge Transient	-	-	2 A^2s	
Ripple and Noise (pk-pk)	-	25 mV	50 mV	Tested with 0-20MHz, 10uF/16V tantalum capacitor & 1uF/10V TDK ceramic capacitor at the output
Ripple and Noise (rms)	-	8 mV	15 mV	
Turn on Time	-	4 mS	8 mS	
Overshoot at Turn on	-	0%Vo,set	3%Vo,set	
Output Capacitance ESR ≥ 1mohm ESR ≥ 10mohm	 0 uF 0 uF	 - -	 1000 uF 4700 uF	
Transient Response				
50% ~ 100% Max Load	All	-	200 mV	-	di/dt=2.5 A/uS; Vin=5 V; and with 10 uF/16 V tantalum capacitor & 1uF/10V ceramic capacitor at the output
Settling Time		-	25 uS	-	
100% ~ 50% Max Load		-	200 mV	-	
Settling Time		-	25 uS	-	
50% ~ 100% Max Load	All	-	120 mV	-	di/dt=2.5 A/uS; Vin=5 V; and with two 150 uF/10 V tantalum capacitors & 1 uF/10 V ceramic capacitor at the output
Settling Time		-	50 uS	-	
100% ~ 50% Max Load		-	120 mV	-	
Settling Time		-	50 uS	-	

Note: All specifications are typical at nominal input (Vin=5 V), full load at 25 °C unless otherwise stated.

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency Vo=3.3 V Vo=1.8 V Vo=0.75 V	 91% 86% 77%	 94% 89% 80%	 - - -	Measured at Vin=5 V, full load (current source)
Switching Frequency	250 kHz	300 kHz	350 kHz	
Over Temperature Shutdown	-	125 °C	-	
Output Trim Range (Wide Trim)	0.7525 V	-	3.63 V	Total adjustment of trim, setpoint and remote sense combined should not exceed 3.63 V. Vo=0.7525 V when trim pin open
Remote Sense Compensation	-	-	10%	
MTBF	6,900,000 hours			Calculated Per Bell Core SR-332 (Io = Nominal; Ta = 25°C)
Dimensions Inches (L × W × H) Millimeters (L × W × H)	 2.0 x 0.5 x 0.36 50.8 x 12.7 x 9.2			
Weight	-	8.3g	-	

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

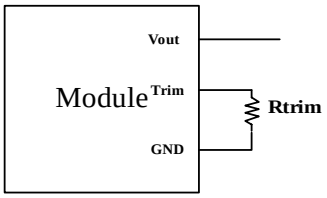
Control Specifications

Parameter	Min	Typ	Max	Notes
Signal Low (Unit Off)	-0.3 V	-	0.3 V	VRBC-10F2A0; Remote On/Off pin open, Unit on.
Signal High (Unit On)	1.5 V	-	5.8 V	
Signal Low (Unit On)	-0.3 V	-	0.3 V	VRBC-10F2AL; Remote On/Off pin open, Unit on.
Signal High (Unit Off)	1.5 V	-	5.8 V	
Sequencing Voltage	0.05 V	-	Vin	Sequencing Voltage applied on SEQ should be higher than output voltage.
Sequencing Slew Rate Capability	-	-	2 V/mS	
Sequencing Delay Time	10 mS	-	-	Delay from Vin, min to application of voltage on SEQ pin
Tracking Accuracy Power-Up Power-Down	 - -	 100mV 200mV	 200mV 400mV	

Output Trim Equations

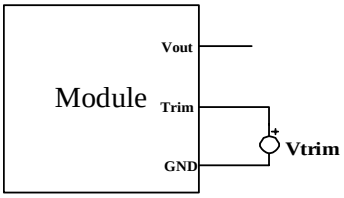
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

$$R_{trim} = \frac{21.07}{V_{adj} - 0.7525} - 5.11$$

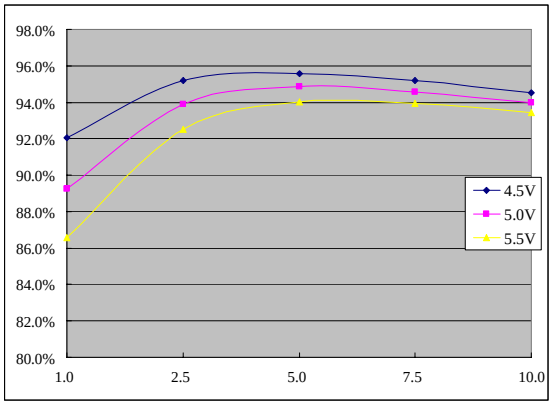


Equation for calculating the trim voltage (in V) given the desired adjusted voltage (Vadj) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

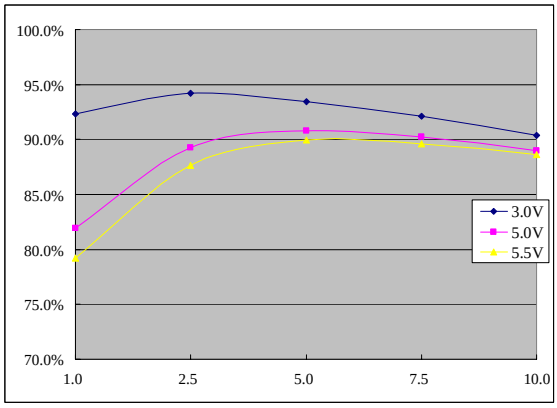
$$V_{rim} = 0.7 - 0.1698 \times (V_{adj} - 0.7525)$$



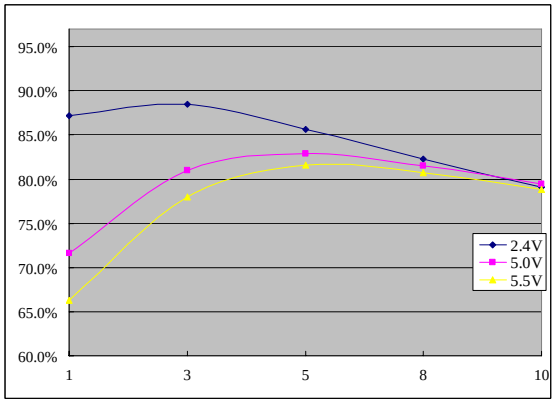
Efficiency Data



Vo=3.3 V

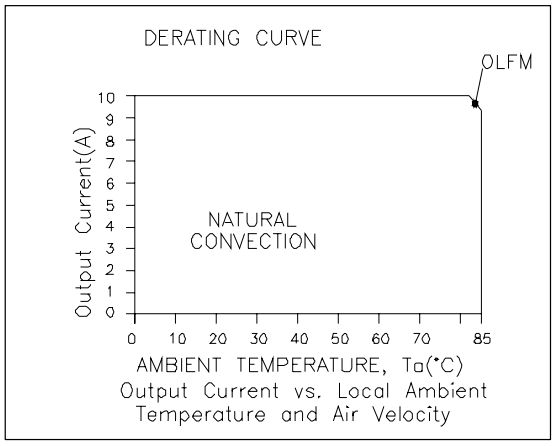


Vo=1.8 V

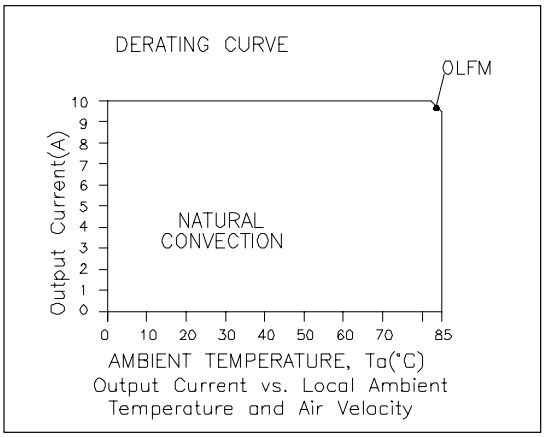


Vo=0.75 V

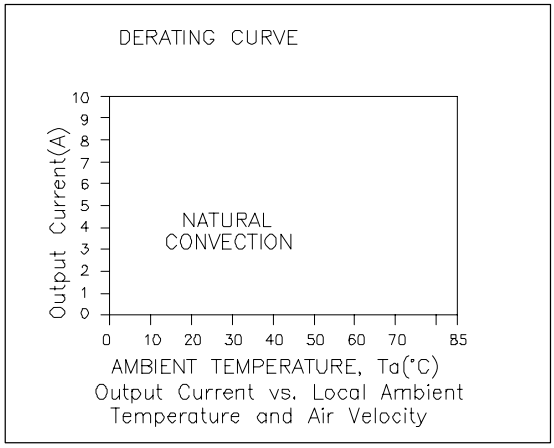
Thermal Derating Curves



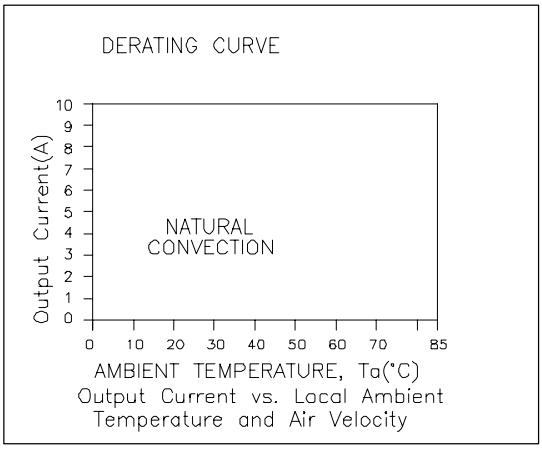
Vin= 5.0 V, Vo= 3.3 V



Vin= 5.0 V, Vo= 1.8 V

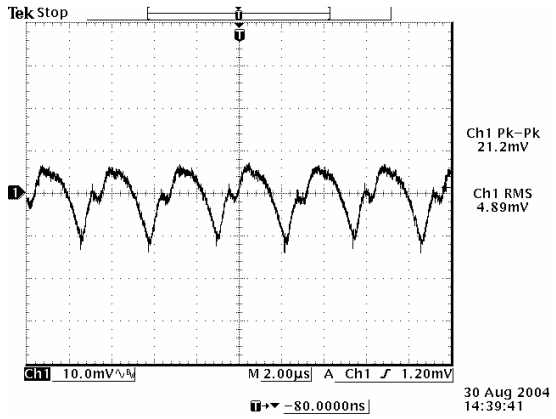


Vin=5.0 V, Vo=0.75 V

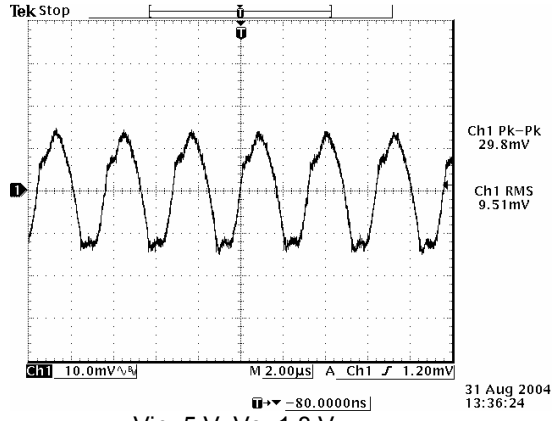


Vin=3.3 V, Vo=0.75 V/1.8 V/2.5 V

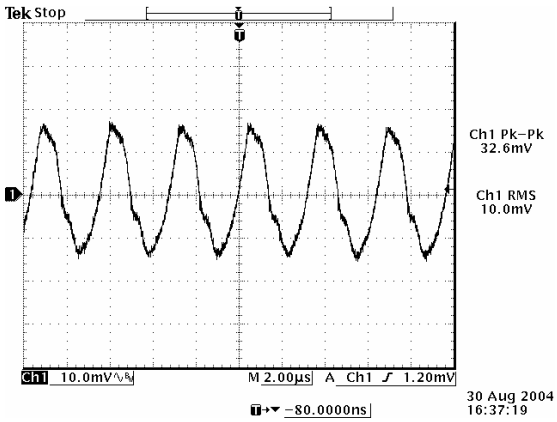
Ripple and Noise Waveforms



Vin=5 V, Vo=0.75 V



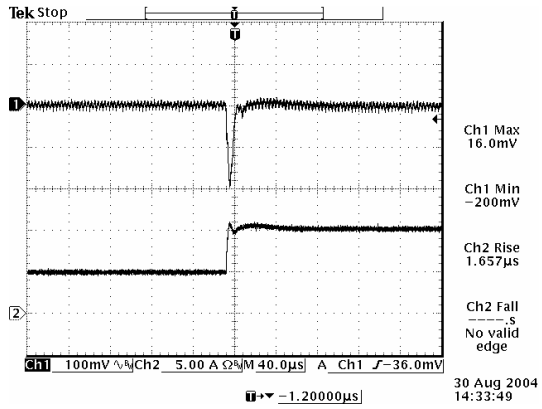
Vin=5 V, Vo=1.8 V



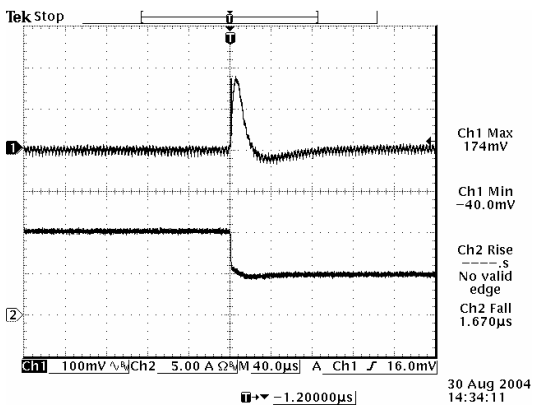
Vin=5 V, Vo=3.3 V

Note: Ripple and noise tested at 0-20 MHz BW, 10 uF/16 V tantalum capacitor and 1 uF/10 V ceramic capacitor, full load, and Ta=25 deg C.

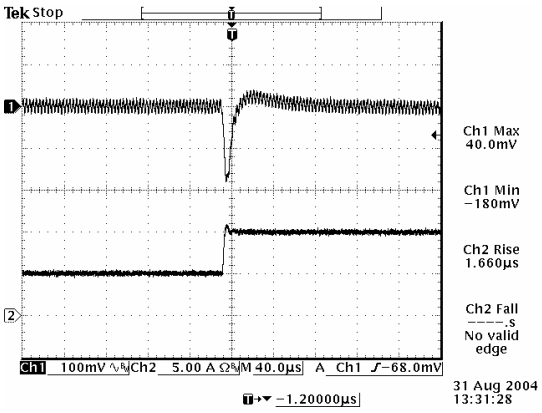
Transient Response Waveforms



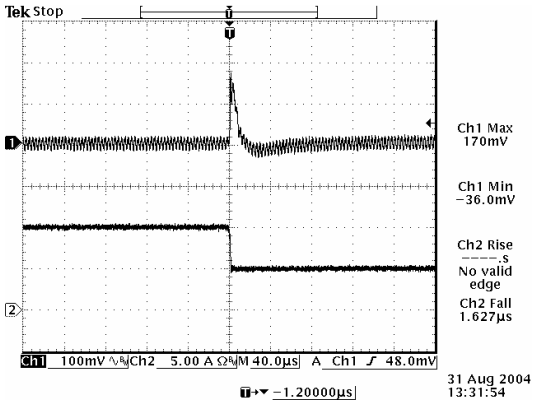
50% to 100% load step at Vin=5 V, Vo=0.75 V



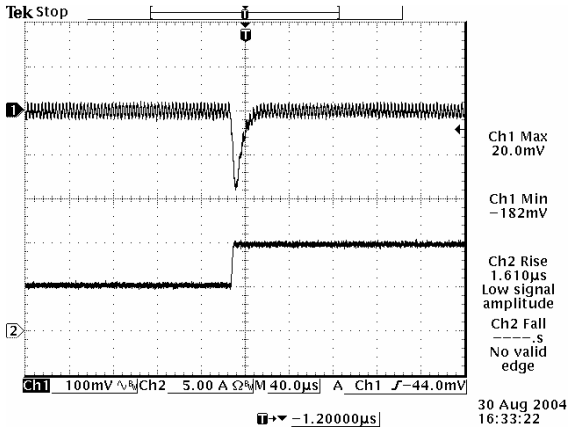
100% to 50% load step at Vin=5 V, Vo=0.75 V



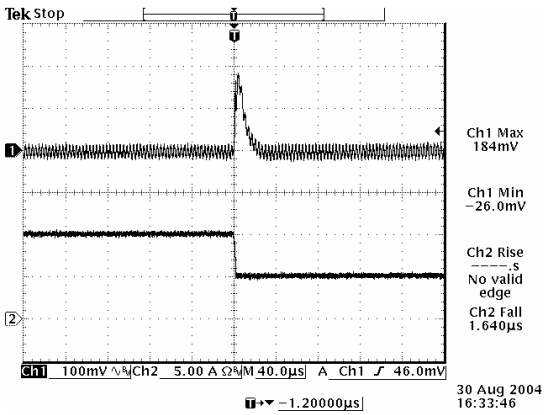
50% to 100% load step at Vin=5 V, Vo=1.8 V



100% to 50% load step at Vin=5 V, Vo=1.8 V



50% to 100% load step at Vin=5 V, Vo=3.3 V



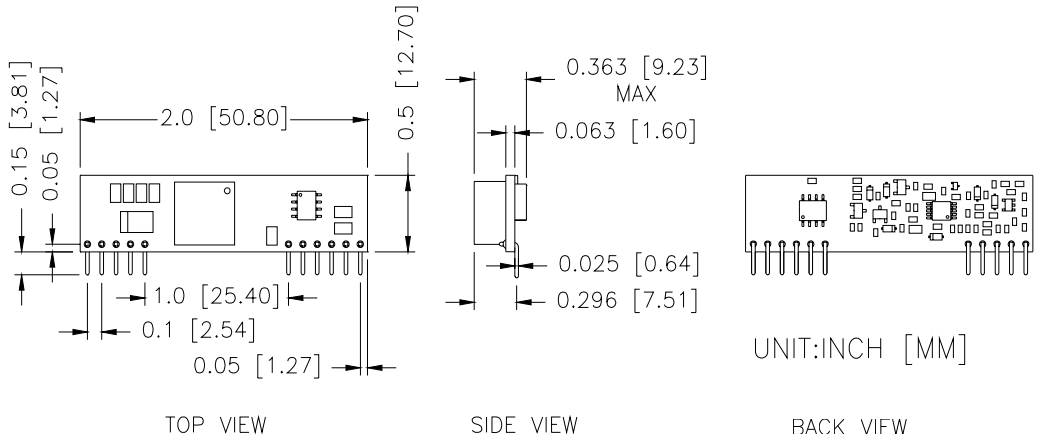
100% to 50% load step at Vin=5 V, Vo=3.3 V

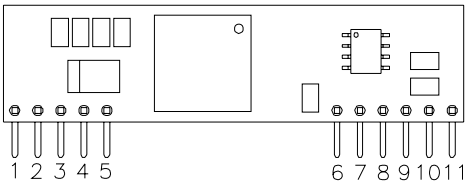
Note: Transient response tested at di/dt=2.5 A/uS, with 10 uF/16 V Tantalum capacitor and 1 uF/10 V ceramic capacitor, and Ta=25 deg C.

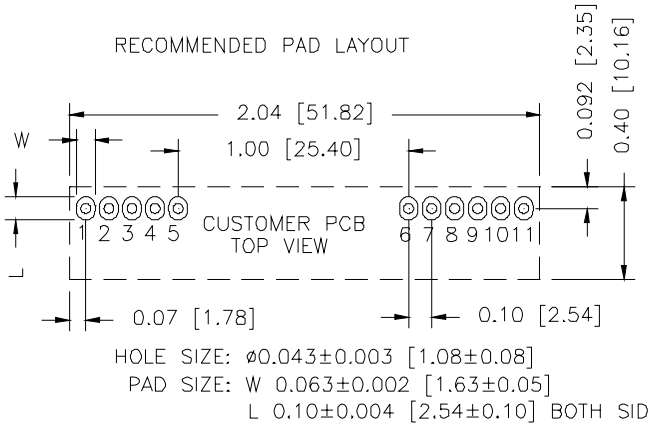
NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input 0.75 Vdc - 3.63 Vdc/10 A Output

Mechanical Outline







Pin Connections

Pin	Function
1	Vout
2	Vout
3	Remote Sense
4	Vout
5	Ground
6	Ground
7	Vin
8	Vin
9	SEQ
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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