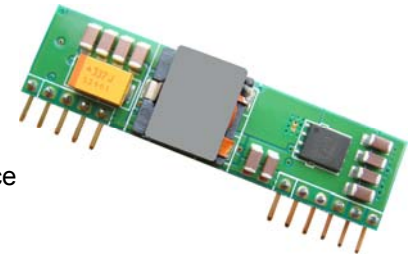
NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input 0.75 Vdc - 3.63 Vdc/16 A Output

VRBC-16F2Ax RoHS Compliant Rev.A

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



Description

The Bel VRBC-16F2Ax modules are a series of non-isolated dc/dc converters that can deliver up to 16 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. 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	Model Number Active Low	Model Number Active High
0.75 V -3.63 V[1]	2.4 V -5.5 V	16 A	58.1 W	94%	VRBC-16F2AL	VRBC-16F2A0

Notes: 1. These modules use a buck topology, so the output voltages must be 0.8 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-16F2Ax 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.

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bel POWER PRODUCTS

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
Vo≤1.5 V	2.4 V	-	5.5 V	
Vo=1.8-2.5 V	3.0 V	-	5.5 V	
Vo=3.3 V	4.5 V	-	5.5 V	
Input Current (full load)				
Vo=3.3 V	-	11.23 A	12.89 A	
Vo=1.8 V	-	6.47 A	13.55 A	
Vo=0.75 V	-	3.08 A	6.67 A	
Input Current (no load)	-	80 mA	-	
Remote Off Input Current	-	10 mA	22 mA	
Input Reflected Ripple Current (pk-pk)	-	100 mA	-	Tested with two 100 uF/10 V tantalum input capacitors (P/N: TPSC107K010R0075 AVX) & simulated source impedance of 1 uH, 5 Hz to 20 MHz.
Input Reflected Ripple Current (rms)	-	40 mA	-	
I^2t Inrush Current Transient	-	0.15 A^2s	0.3 A^2s	
Turn-on Voltage Threshold	-	2.2 V	-	
Turn-off Voltage Threshold	-	2.0 V	-	

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	-	16 A	
Current Limit Threshold	19 A	-	35 A	
Short Circuit Surge Transient	-	1.6 A^2s	2 A^2s	
Ripple and Noise (pk-pk)	-	25 mV	50 mV	Tested with 0-20 MHz, 10 uF/16 V tantalum capacitor & 1 uF/10 V TDK ceramic capacitor at 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	0 uF	-	1000 uF	
ESR ≥ 10mohm	0 uF	-	5000 uF	
Transient Response				
50% ~ 100% Max Load	Vo=0.75 V - 3.3 V	-	300 mV	-	di/dt=2.5 A/ uS; Vin=5 V; and with 10 uF/16 V tantalum capacitor & 1 uF/10 V ceramic capacitor at output
Settling Time		-	50 uS	-	
100% ~ 50% Max Load		-	300 mV	-	
Settling Time		-	50 uS	-	
Transient Response				
50% ~ 100% Max Load	Vo=0.75 V - 3.3 V	-	150 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 output
Settling Time		-	100 uS	-	
100% ~ 50% Max Load		-	150 mV	-	
Settling Time		-	100 uS	-	

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

NON-ISOLATED DC/DC CONVERTERS

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General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency Vo=3.3 V Vo=1.8 V Vo=0.75 V	 91% 86% 75%	 94% 89% 78%	 - - -	Measured at Vin=5 V, full load
Switching Frequency	250 kHz	300 kHz	350 kHz	
Over Temperature Shutdown	-	125 °C	-	
Output Trim Range (Wide Trim)	0.7525 V	-	3.63 V	
Remote Sense Compensation	-	-	5%	
MTBF	5,109,613 hours			Calculated Per Bell Core SR-332 (I_O = Nominal; T_a = 25 °C)
Dimensions Inches (L × W × H) Millimeters (L × W × H)	 2.0 x 0.5 x 0.363 50.80 x 12.7 x 9.23			
Weight	-	8.3 g	-	

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

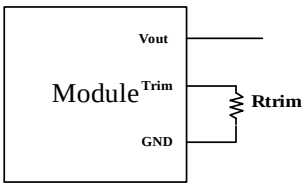
Control Specifications

Parameter	Min	Typ	Max	Notes
Signal Low (Unit Off)	-0.3 V	-	0.3 V	VRBC-16F2A0; 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-16F2AL; 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 should be higher than output voltage.
Sequencing Slew Rate Capability	-	-	2 V/mS	
Sequencing Delay Time	10 mS	-	-	Delay from Vinmin to application of voltage on SEQ pin
Tracking Accuracy Power-Up Power-Down	 - -	 100 mV 200 mV	 200 mV 400 mV	

Output Trim Equations

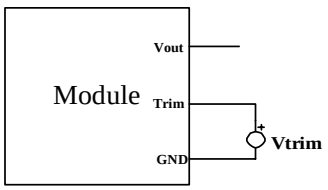
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

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

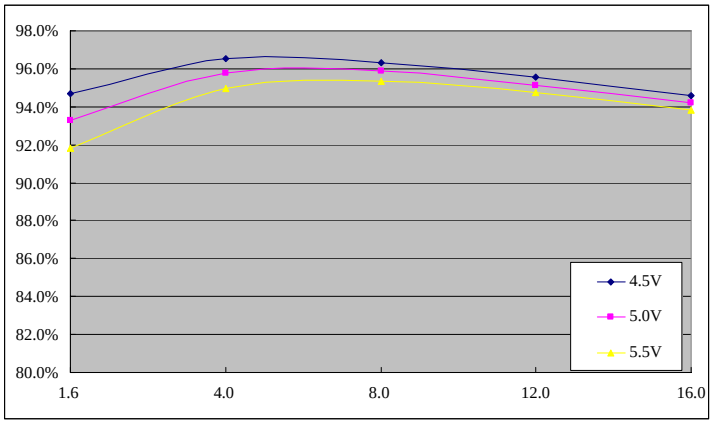


Equation for calculating the trim voltage (in V) given the desired adjusted voltage (Vadj) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

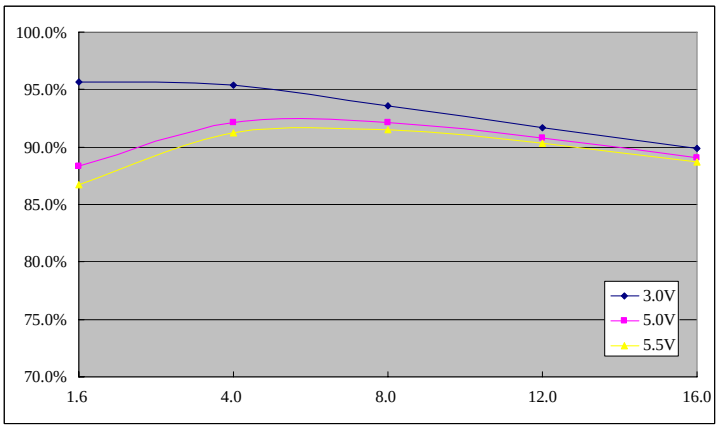
$$V_{trim} = 0.7 - 0.1698 \times (V_{adj} - 0.7525)$$



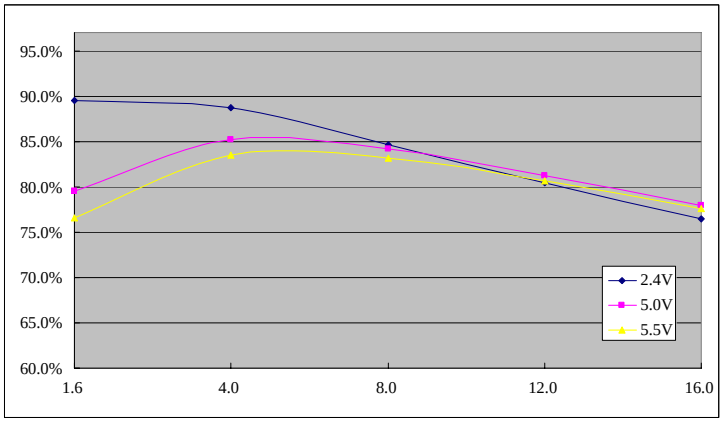
Efficiency Data



Vo=3.3 V

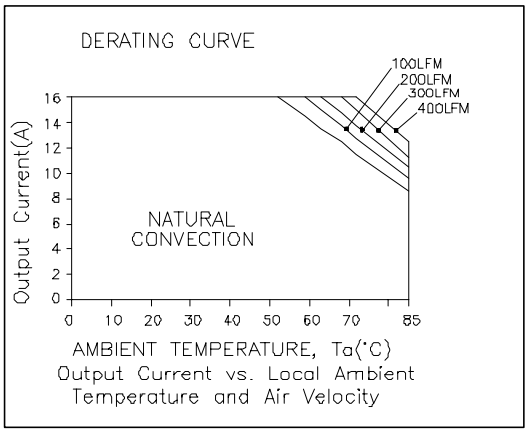


Vo=1.8 V

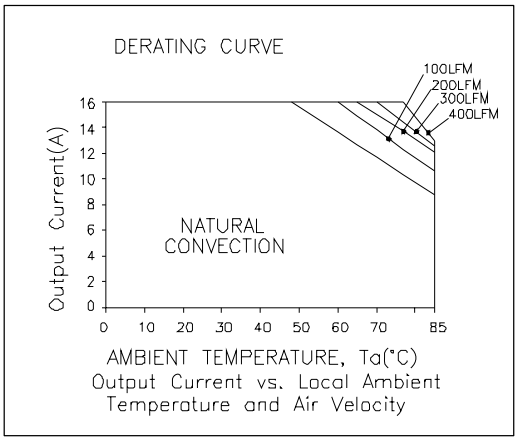


Vo=0.75 V

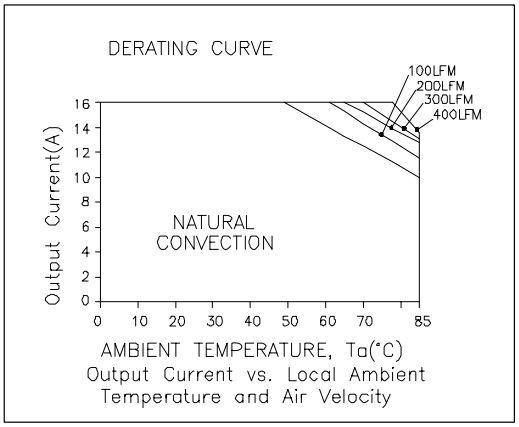
Thermal Derating Curves



Vo=3.3 V

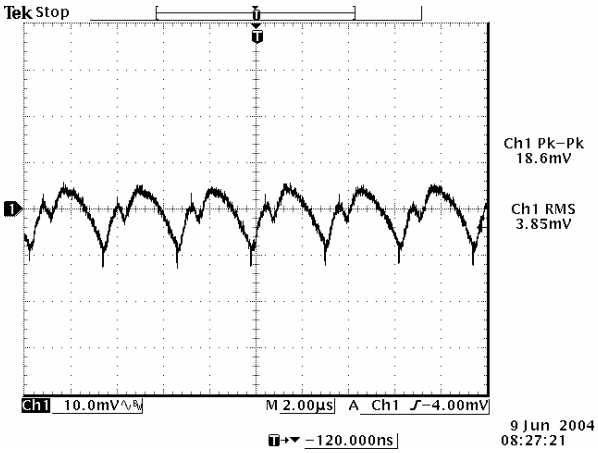


Vo=1.8 V

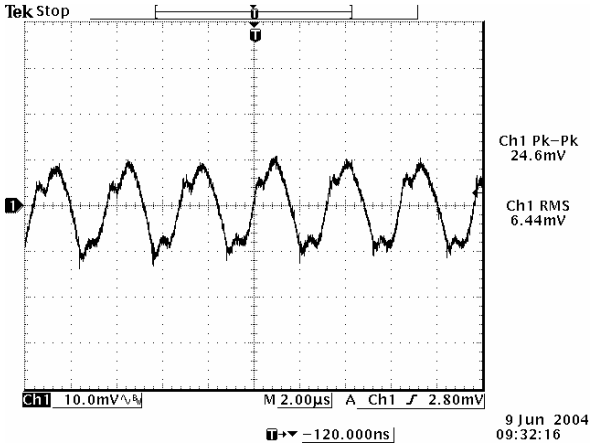


Vo=0.7525 V

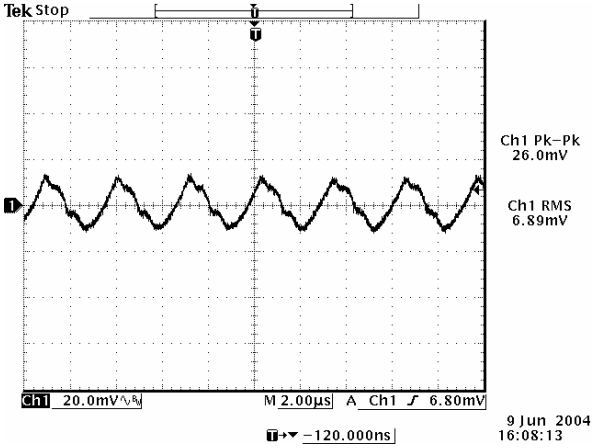
Ripple and Noise Waveforms



Ripple and noise at full load, 5.0 V input, 0.75 V output and Ta=25 degC



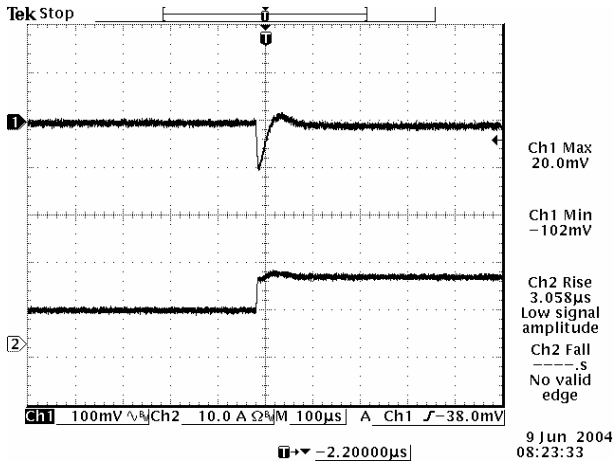
Ripple and noise at full load, 5.0 V input, 1.8 V output and Ta=25 degC



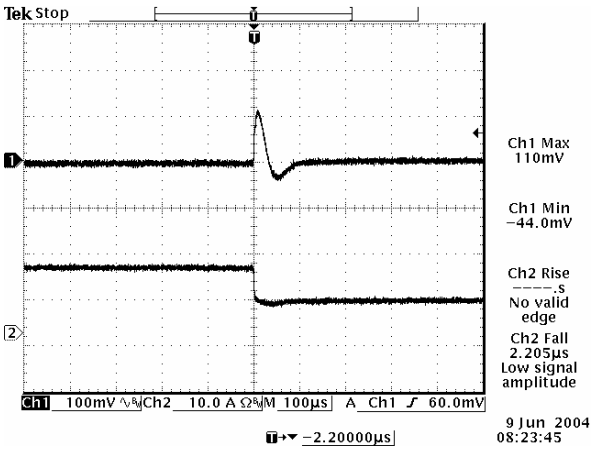
Ripple and noise at full load, 5.0 V input, 3.3 V output and Ta=25 degC

Note: Ripple and noise is tested at 0-20 MHz BW, 10 uF/16 V tantalum capacitor and 1 uF/10 V ceramic capacitor at the output.

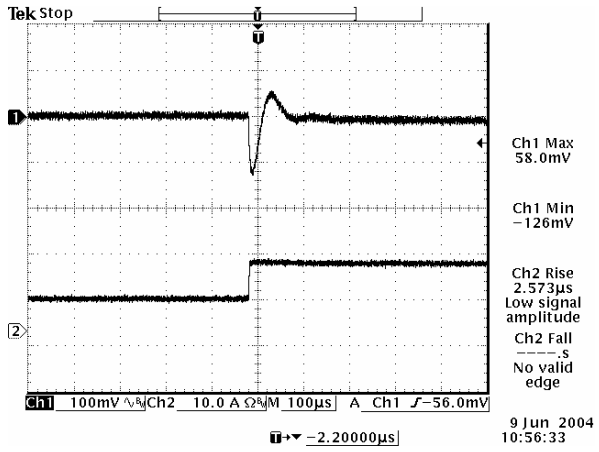
Transient Response Waveforms



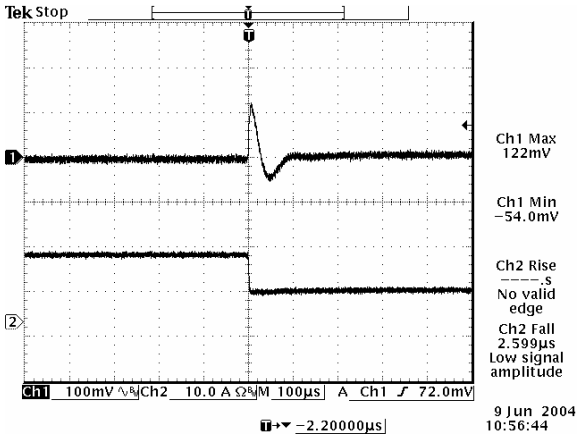
50% to 100% load step at Vin=5 V, Vo= 0.75 V



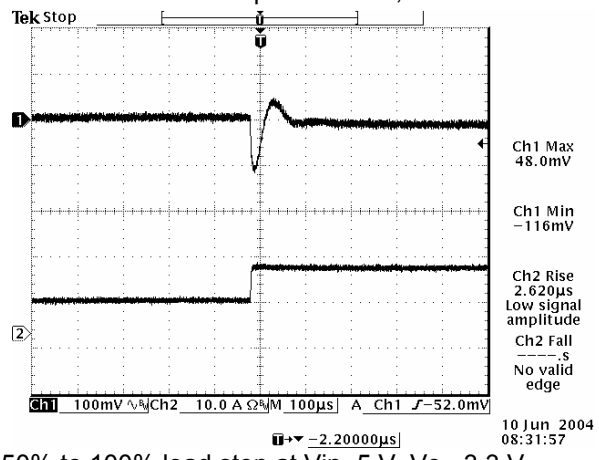
100% to 50% load step at Vin=5 V, Vo= 0.75 V



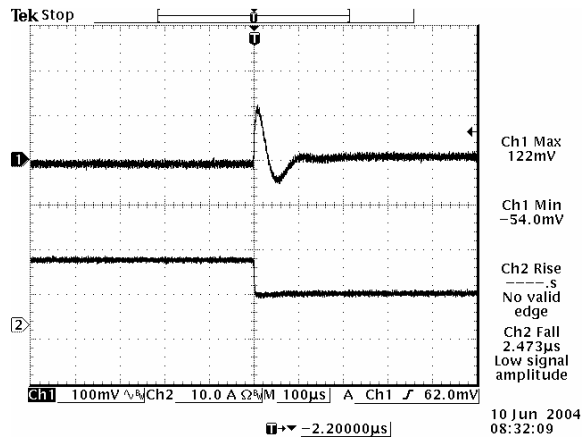
50% to 100% load step at Vin=5 V, Vo= 1.8 V



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 is tested at di/dt=2.5 A/uS, with two 150 uF/10 V tantalum capacitors and 1 uF/10 V ceramic capacitor, Ta=25 deg C.

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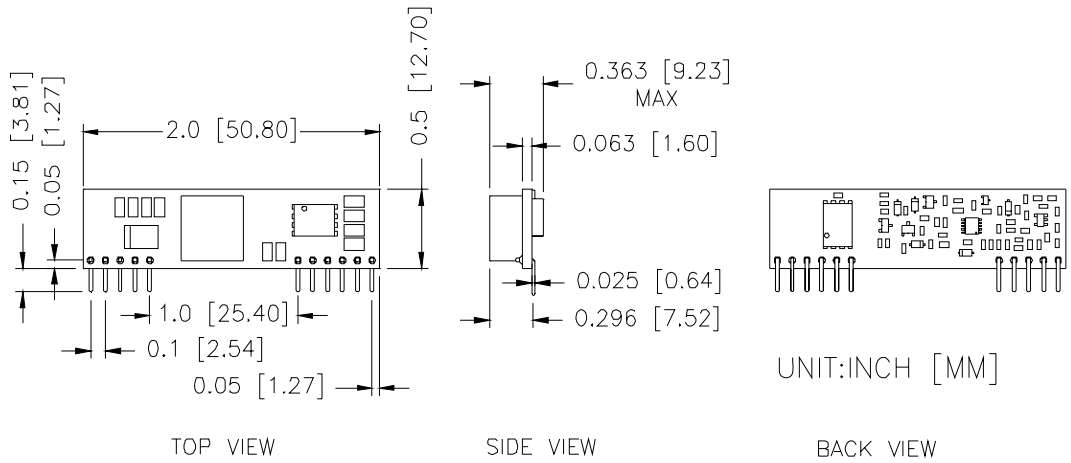
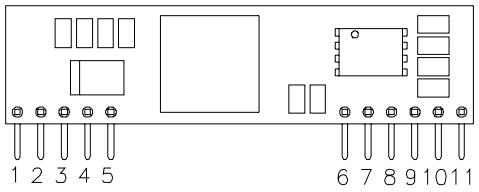
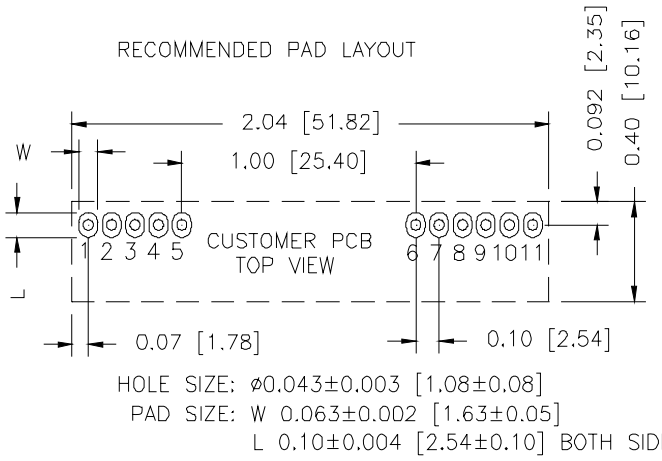
Mechanical Outline







Pin Connections

Pin	Function
1	Vout
2	Vout
3	Vo,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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