

NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 13.8 Vdc Input 0.591 Vdc - 6.0 Vdc/20 A Output



VRP1-20E2A0 RoHS Compliant PRELIMINARY Rev. D

- Non-Isolated
- High Efficiency
- Fixed Frequency
- High Power Density
- Low Cost
- Wide Output Trim Range
- Wide Input Voltage Range
- Wide Operating Temperature Range
- Output Over-Voltage Shutdown
- OCP/SCP
- Under Voltage Lockout
- Remote Sense
- Power Good Signal
- Remote On/Off



Description

The Bel VRP1-20E2A0 is part of the non-isolated dc/dc converter Power Module series. The modules use a SIP package. These converters are available in a range of output voltages from 0.591 Vdc to 6.0 Vdc over a wide range of input voltage ($V_{in} = 4.5 \text{ Vdc} - 13.8 \text{ Vdc}$). The efficiency is typically 94.5% @ 12 Vin and 5.5 Vout at full load.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency ($V_o=5.5 \text{ Vdc}$)	Model Number Active High
0.591 Vdc - 6.0 Vdc	4.5 Vdc - 13.8 Vdc	20 A	120 W	94.5%	VRP1-20E2A0

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	4.5 V	12 V	13.8 V	
Input Current (full load)	-	-	20 A	An input line fuse must always be used.
Input Current (No load)	-	150 mA	300 mA	
Remote Off Input Current	-	50 mA	-	
Input Reflected Ripple Current (pk-pk)	-	50 mA	100 mA	Use a 1000uF AL-Cap on the input.
Input Reflected Ripple Current (rms)	-	20 mA	40 mA	
I^2t Inrush Current Transient	-	-	1 A ² s	
Turn-on Voltage Threshold	-	4.2 V	-	A 30.1K resistor is connected from Enable to Vin
Turn-off Voltage Threshold	-	3.9 V	-	

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

NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 13.8 Vdc Input 0.591 Vdc - 6.0 Vdc/20 A Output



Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point Accuracy	-1.5 % Vo	-	+1.5 % Vo	Vin=12 V, Iout=half load
Load Regulation	-	-	1% Vo	
Line Regulation	-	-	0.5% Vo	
Regulation Over Temperature (-40 °C to +85 °C)	-	-	1% Vo	
Output Current	0 A	-	20 A	
Current Limit Threshold	-	150% Iomax	-	
Output Ripple and Noise (pk-pk)	-	80 mV	120 mV	Test conditions: 0-20MHz BW, with a 10 uF tantalum cap and a 1 uF ceramic at the output.
Output Ripple and Noise (rms)	-	20 mV	40 mV	
Short Circuit Surge Transient	-	1 A ² s	3 A ² s	
Turn On Time	-	2 mS	10 mS	
Overshoot at Turn on and off	-	-	5%	
Output Capacitance	0 uF	-	1000 uF	
Transient Response				
50% ~ 100% Max Load	Vo=All	-	250 mV	Test conditions: di/dt =1 A/uS; Vin =12 V; with 10 uF tantalum cap and 1 uF ceramic at the output, Ta=25 °C
Settling Time		-	-	
100% ~ 50% Max Load		-	250 mV	
Settling Time		-	-	

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

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency Vo=5.5 V Vo=3.3 V Vo=2.5 V Vo=1.2 V Vo=0.591 V	- - - - -	94.5% 92% 90% 83% 70%	- - - - -	Measured at Vin=12 V, full load.
Switching Frequency	-	500 kHz	-	
Over Temperature Shutdown	-	130 °C	-	
Output Voltage Trim Range	0.591 V	-	6.0 V	
Remote Sense Compensation	-	-	0.2 V	Vin=12 V, Io=full load.
MTBF	TBD			Calculated Per Bell Core SR-332 (Io = 80%Iomax; Vin=12 V; Ta = 25 °C)
Dimensions Inches (L × W × H) Millimeters (L × W × H)	1.45 x 0.61 x 0.35 36.83 x 15.49 x 8.88			
Weight	-	9.7 g	-	

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

NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 13.8 Vdc Input 0.591 Vdc - 6.0 Vdc/20 A Output



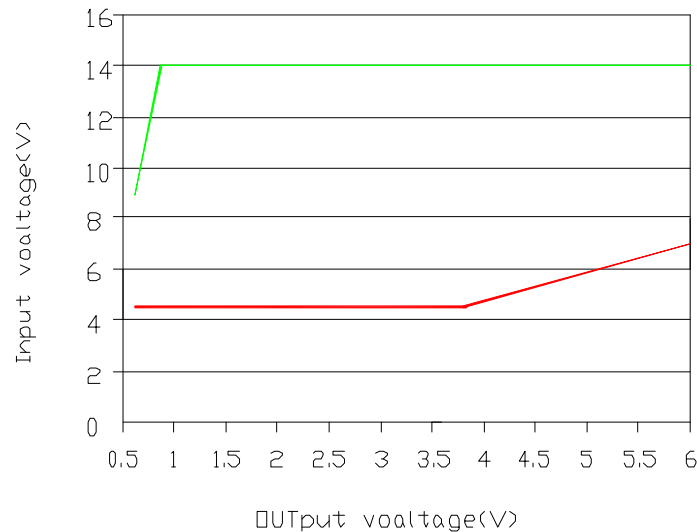
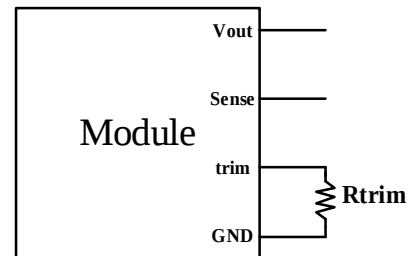
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off (Active High)				
Signal Low (Unit Off)	-0.3 V	-	0.4 V	Remote On/Off pin is open, unit is on.
Signal High (Unit On)	1 V	-	5.5 V	

Output Trim Equation

The Rtrim resistor should be connected between the Trim pin and GND pin.

$$R_{\text{trim}} = \left[\frac{1.182}{V_o - 0.591} \right] \text{ k}\Omega$$



Output Voltage vs. Input Voltage Set Point

Area plot showing limits where the output voltage can be set for different input voltages.

For output voltages of 0.9V and lower, the input voltage must be lower than the maximum of 14V. The Lower Limit curve shows that for output voltages of 3.8V and higher, the input voltage needs to be larger than the minimum of 4.5V.

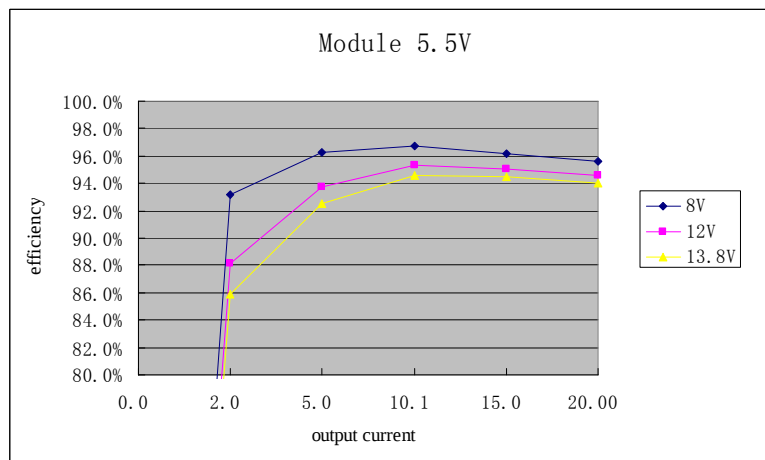
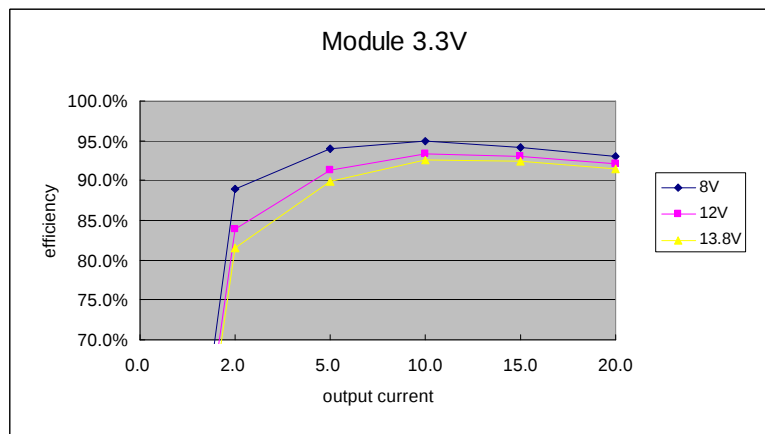
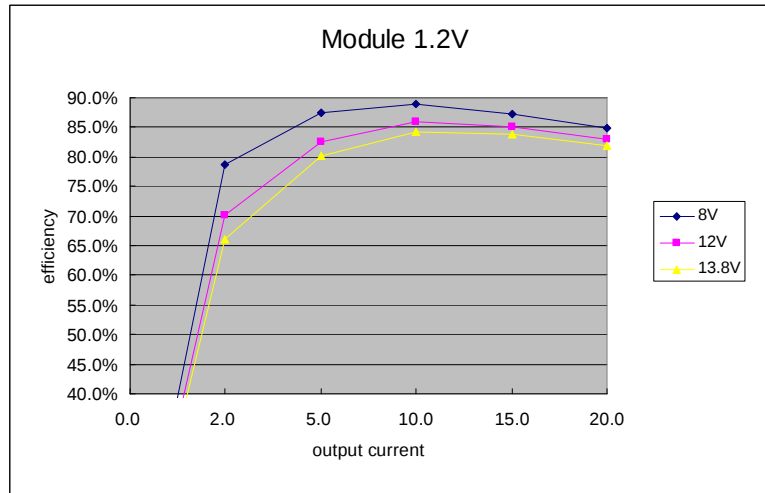
NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 13.8 Vdc Input

0.591 Vdc - 6.0 Vdc/20 A Output



Efficiency Data



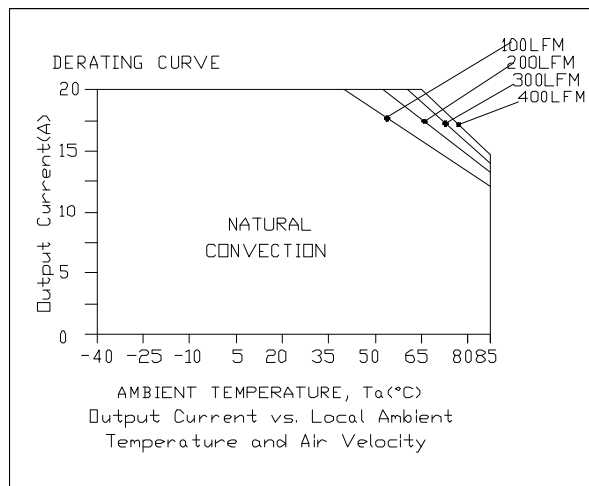
NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 13.8 Vdc Input

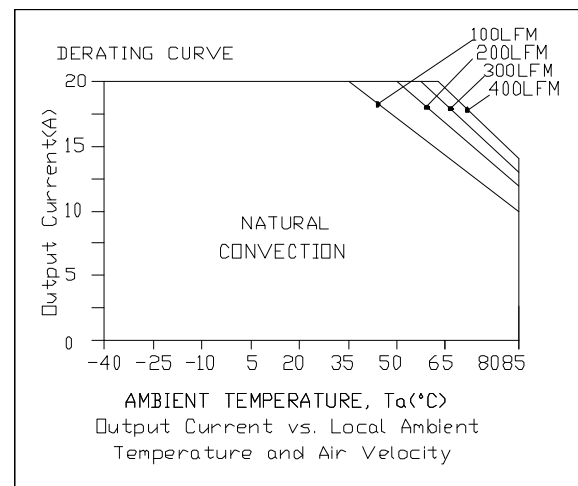
0.591 Vdc - 6.0 Vdc/20 A Output

bel
POWER PRODUCTS

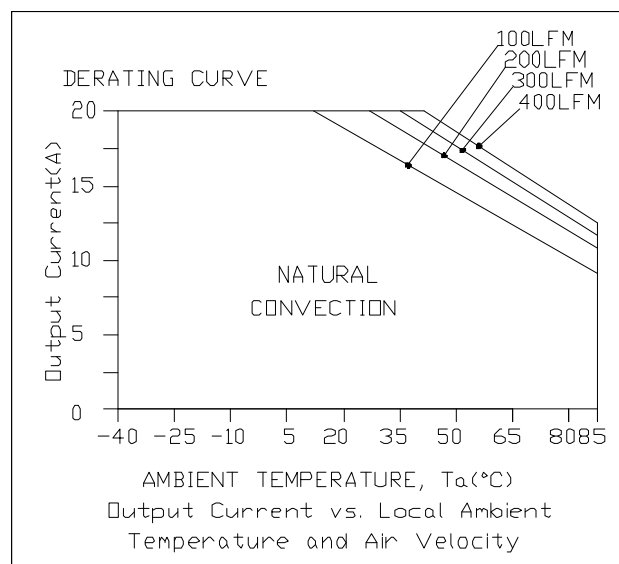
Thermal Derating Curves



Vout=1.2 V



Vout=3.3 V



Vout=6.0 V

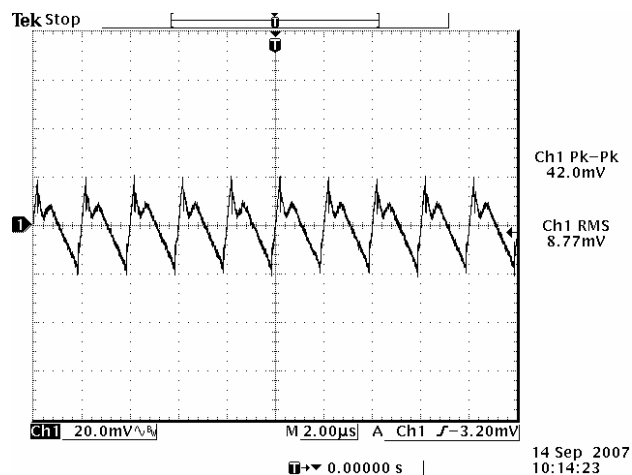
NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 13.8 Vdc Input

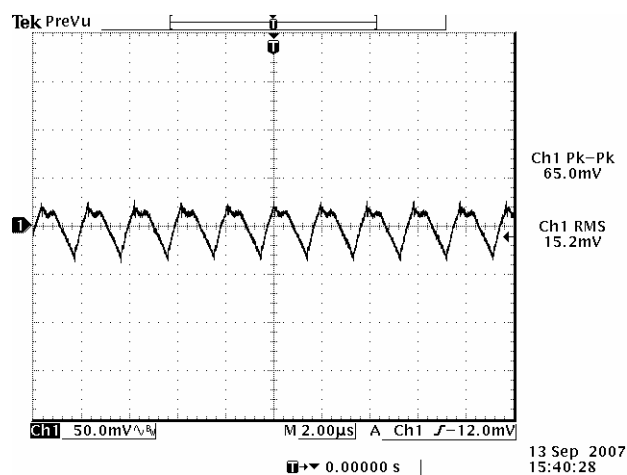
0.591 Vdc - 6.0 Vdc/20 A Output

bel
POWER PRODUCTS

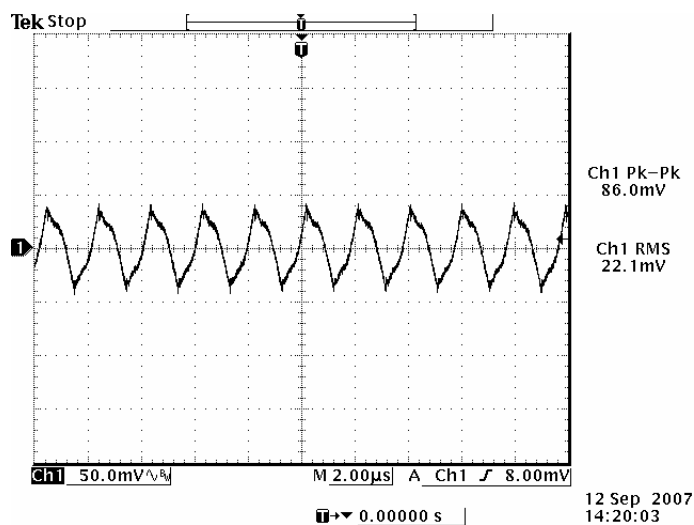
Ripple and Noise Waveforms



12 Vdc input, 1.2 Vdc output



12 Vdc input, 3.3 Vdc output



12 Vdc input, 5.5 Vdc output

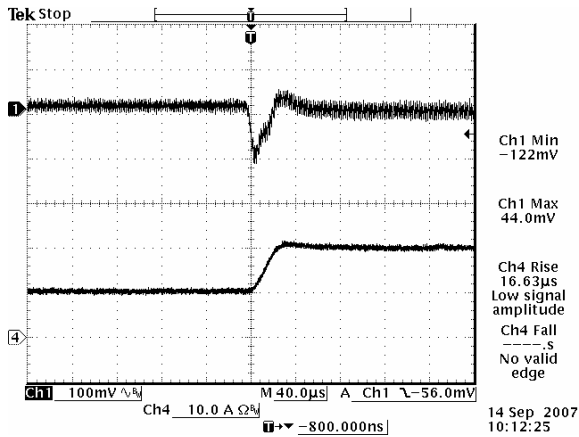
Note: Ripple and noise at full load, 0-20 MHz BW, with a 10 uF tantalum cap and a 1 uF ceramic cap, and Ta=25 deg C.

NON-ISOLATED DC/DC CONVERTERS

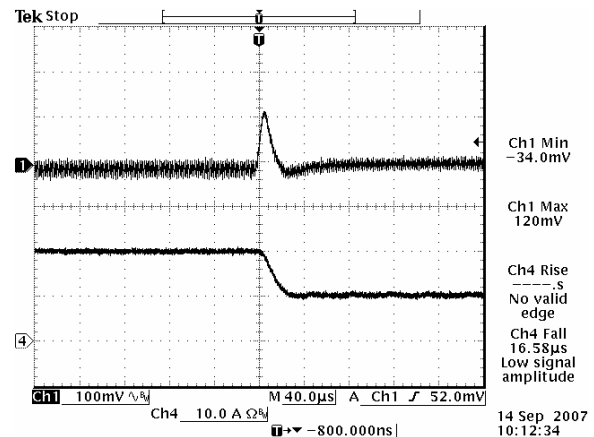
4.5 Vdc - 13.8 Vdc Input 0.591 Vdc - 6.0 Vdc/20 A Output



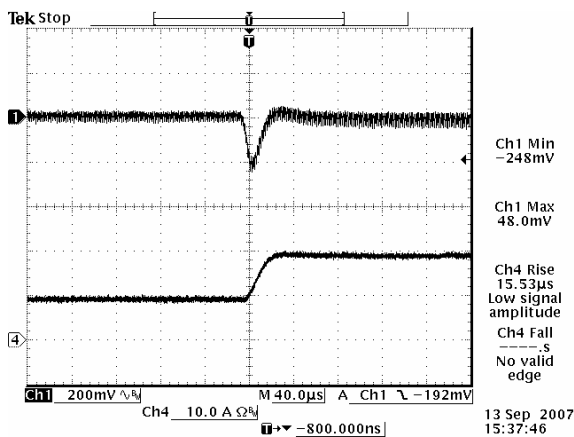
Transient Response Waveforms



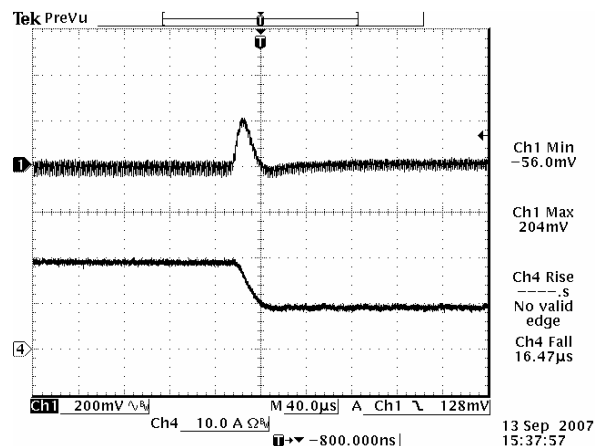
Vout= 1.2 V 50%-100% Load Transients



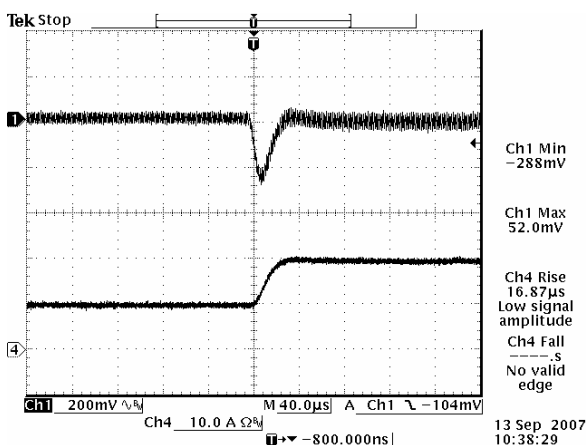
Vout=1.2 V 100%-50% Load Transients



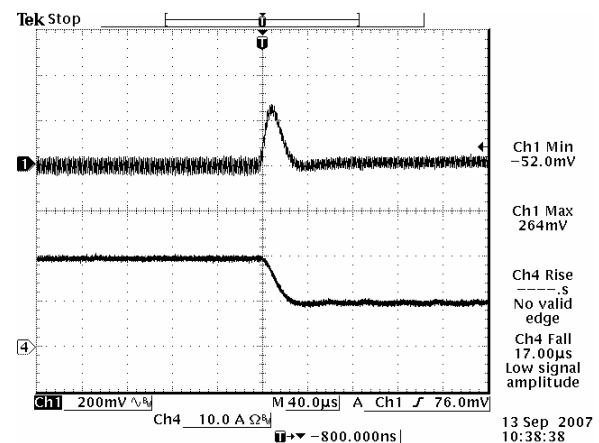
Vout= 3.3 V 50%-100% Load Transients



Vout=3.3 V 100%-50% Load Transients



Vout= 5.5 V 50%-100% Load Transients



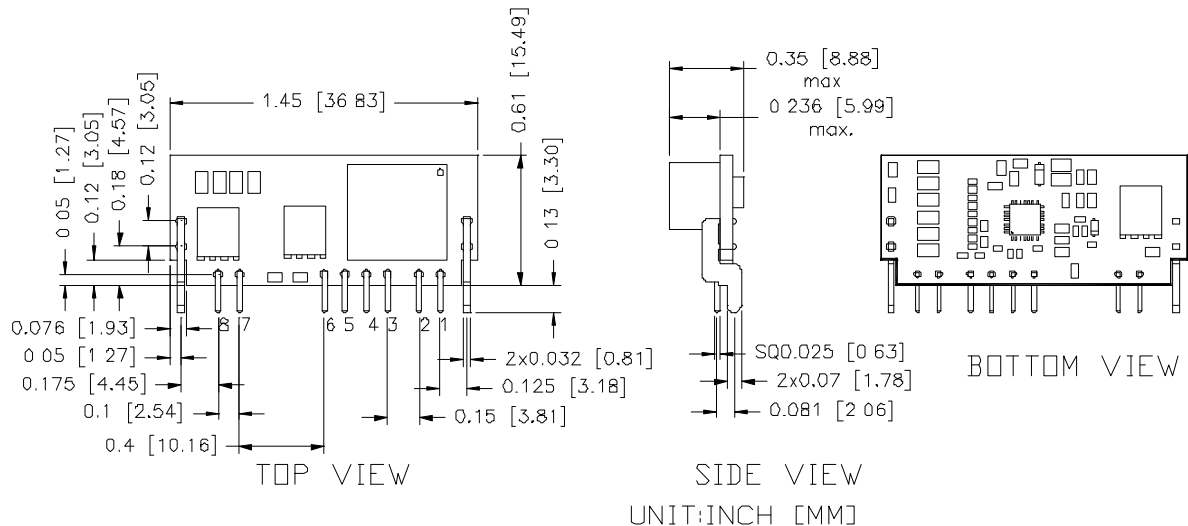
Vout=5.5 V 100%-50% Load Transients

Note: Transient response at $di/dt = 1 \text{ A}/\mu\text{s}$, 10 μF tantalum cap and a 1 μF ceramic cap, and $T_a=25 \text{ deg C}$.

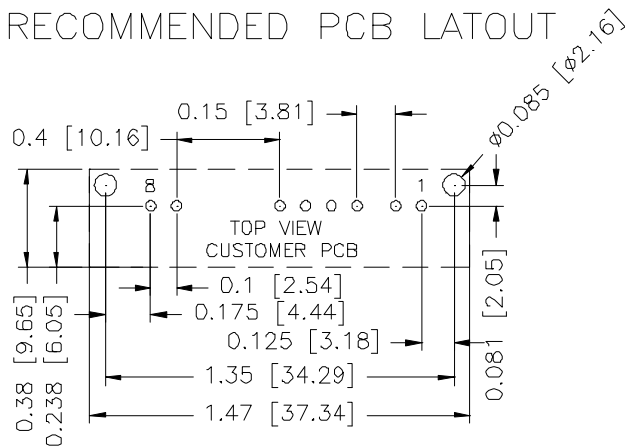
4.5 Vdc - 13.8 Vdc Input 0.591 Vdc - 6.0 Vdc/20 A Output



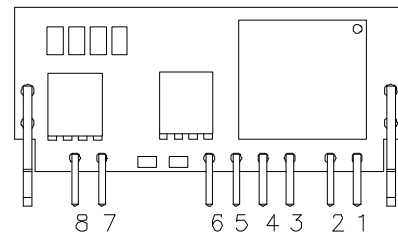
Mechanical Outline



RECOMMENDED PCB LATOUT



2 SUPPORT PAD HOLES: $\phi 0.085$ [2.16] BOTH SIDES
8 PIN PAD HOLES: $\phi 0.04$ [1.00] BOTH SIDES



Pin Connections

Pin	Function
1	Vout
2	Trim+
3	GND
4	PwGOOD
5	Enable
6	Vin
7	Sense+
8	Sense-

RoHS Compliance

Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products.



©2009 Bel Fuse Inc. Specifications subject to change without notice. 052009

CORPORATE

Bel Fuse Inc.
206 Van Vorst Street
Jersey City, NJ 07302
Tel 201-432-0463
Fax 201-432-9542
www.belfuse.com

FAR EAST

Bel Fuse Ltd.
8F/ 8 Luk Hop Street
San Po Kong
Kowloon, Hong Kong
Tel 852-2328-5515
Fax 852-2352-3706
www.belfuse.com

EUROPE

Bel Fuse Europe Ltd.
Preston Technology Management Centre
Marsh Lane, Suite G7, Preston
Lancashire, PR1 8UD, U.K.
Tel 44-1772-556601
Fax 44-1772-888366
www.belfuse.com