NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input 0.6 Vdc - 5.0 Vdc/50 A Output

April 17, 2009

Bel Power, Inc. , a subsidiary of Bel Fuse, Inc.

xRP2-50E2A0 RoHS Compliant PRELIMINARY Rev.B

Features

- Non-Isolated
- High Efficiency
- Fixed Switching Frequency
- Low Cost
- Wide Input Voltage Range
- Wide Output Trim Range
- Output Over-Voltage Shutdown
- OCP/SCP
- Excellent Thermal Performance
- Low Output Ripple
- Power Good Signal
- Remote On/Off
- Class 1, Category 2, Non-Isolated DC/DC Converter (refer to IPC-9592)
- TUV EN60950-1 Recognized (Pending)
- UL60950-1 Recognized (UL/cUL) (Pending)

Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The xRP2-50E2A0 is a non-isolated dc/dc converter that operates over a wide range of input voltage (Vin = 5 Vdc - 13.8 Vdc). This unit can provide a precisely regulated output voltage from 0.6 Vdc to 5.0 Vdc and can deliver up to 50 A of output current. This unit is designed to be highly efficient and low cost. The converter is provided in an industry standard package.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active High	Model Number Active High
0.6 Vdc - 5 Vdc	5 Vdc - 13.8 Vdc	50 A	250 W	86%	VRP2-50E2A0	0RP2-50E2A0

Notes: Add “G” suffix at the end of the model number to indicate Tray Packaging.

Part Number Explanation

V	R	P2	–	50	E	2A	0
1	2	3		4	5	6	7

1---Vertical mount, change “V” to “0” means through hole mount
2---RoHS 6, change “R” to “7” means RoHS 5
3---Series name, SIP
4---Series code
5--- Wide input range (5-13.8V)
6---Wide output range (0.6-5V)
7---Enable, active high

Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Notes
Continuous Input Voltage	-0.3	-	15	V	
Remote On/Off	-0.3	-	15	V	
Ambient Temperature	0	-	70	°C	
Storage Temperature	-55	-	125	°C	

Note: Ratings used beyond the maximum ratings may cause a reliability degradation of the converter or may permanently damage the device.

Input Specifications

Parameter	Min	Typ	Max	Unit	Notes
Operating Input Voltage Vo≤ 2.8 V Vo > 2.8 V	 5 1.8*Vo	 12 12	 13.8 13.8	 V V	
Input Current (full load)	-	-	38	A	
Remote Off Input Current	-	10	25	mA	
Input Reflected Ripple Current (rms)	-	10	-	mA	With simulated source impedance of 1 uH, 5 Hz to 20 MHz. Use a 1000 uF/16 V electrolytic capacitor with ESR=0.1 ohm max, at 100 kHz at 25℃.
Input Reflected Ripple Current (pk-pk)	-	35	-	mA	
I^2t Inrush Current Transient	-	-	1	A^2s	
Turn-on Voltage Threshold	4.4	4.6	4.8	V	
Turn-off Voltage Threshold	4.0	4.3	4.6	V	

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

Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Output Voltage Set Point Vo≥1 V Vo<1 V	 -1.5 -10	 - -	 +1.5 +10	 %Vo mV	Vin=Vinmin, Io=Iomax
Load regulation Vo≥1 V Vo<1 V	 - -	 - -	 0.6 12	 %Vo mV	
Line Regulation Vo≥1 V Vo<1 V	 - -	 - -	 0.3 9	 %Vo mV	
Regulation Over Temperature (0deg.C-70deg.C)	-	-	0.02	%Vo/C	
Ripple and Noise (pk-pk) Vo=5.0 V Vo=3.3 V Vo=2.5 V Vo=1.5 V Vo=1.0 V Vo=0.6 V	 - - - - - -	 - - - - - -	 110 100 100 80 60 60	 mV mV mV mV mV mV	Test conditions: 0-20MHz BW, with a 1µF ceramic capacitor and a 10 uF Tantalum cap at output.

Output Specifications (continued)

Parameter		Min	Typ	Max	Unit	Notes
Ripple and Noise (rms) Vo=5.0 V Vo=3.3 V Vo=2.5 V Vo=1.5 V Vo=1.0 V Vo=0.6 V		 - - - - - -	 - - - - - -	 35 35 35 30 25 25	 mV mV mV mV mV mV	Test conditions: 0-20MHz BW, with a 1µF ceramic capacitor and a 10 uF Tantalum cap at output.
Ripple and Noise (pk-pk) under worst case		-	-	150	mV	Vo=5V, over all operating input voltage, load and temperature conditions.
Output Current Range		0	-	50	A	
Output DC Current Limit		105	130	180	%Io	
Turn on Time		-	-	10	mS	
Rise Time		-	-	3	mS	
Overshoot at Turn on		-	-	0.5	%	
Output Capacitance ESR≥1 mΩ		0	-	4700	uF	
Transient Response						
△V50%~100% of Max Load	Overshoot	-	-	300	mV	Test conditions: di/dt = 10 A/uS; Vin =12 V; Co=0 uF.
	Settling Time	-	-	100	uS	
△V100%~50% of Max Load	Overshoot	-	-	300	mV	
	Settling Time	-	-	100	uS	

Note: All specifications are typical at nominal input, full load at 25℃ unless otherwise stated.

General Specifications

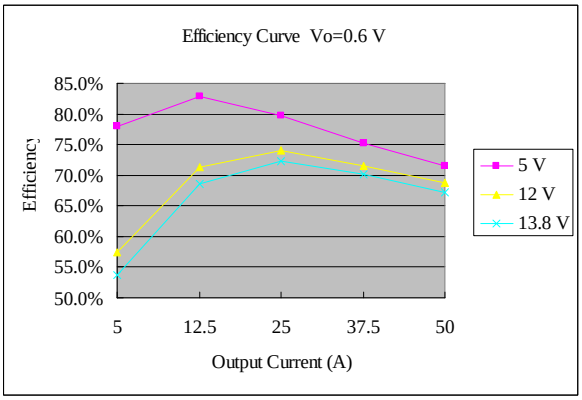
Parameter	Min	Typ	Max	Unit	Notes
Efficiency Vo=5.0 V Vo=3.3 V Vo=2.5 V Vo=1.8 V Vo=1.5 V Vo=1.2 V Vo=1.0 V Vo=0.6 V	 - - - - - - - -	 93 91 88 86 84 82 75 68	 - - - - - - - -	 % % % % % % % %	Vin=12V, full load
Switching Frequency	-	330	-	kHz	
Output Voltage Trim Range	0.6	-	5	V	Trim pin is open, Vo = 0.6 V.
Over Voltage Protection	110	115	130	%Vo	Vin=12 V, Io=full load.
Weight	-	28.5	-	g	
FIT		297		-	Calculated Per Bell Core SR-332 (Io =40 A, Vo=1.92 V; Vin=12 V; Ta = 25 °C, 100LFM forced air flow, FIT=10^9/MTBF)

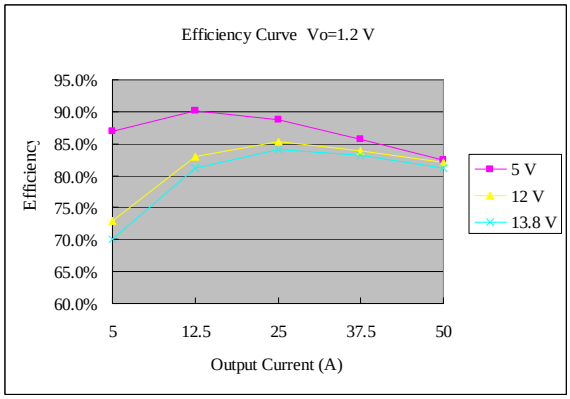
General Specifications (continued)

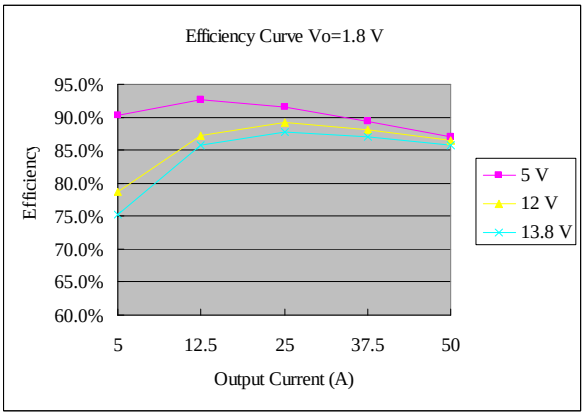
Parameter	Min	Typ	Max	Unit	Notes
Dimensions Inches (L × W × H) Millimeters (L × W × H)		1.45 x 1.1 x 0.73 36.83 x 27.94 x 18.5		-	Through Hole Mount
Dimensions Inches (L × W × H) Millimeters (L × W × H)		1.45 x 1.1 x 0.69 36.83 x 27.94 x 17.53		-	Vertical Mount

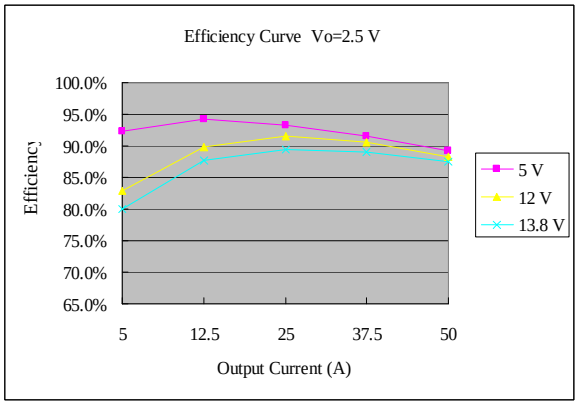
Note: All specifications are typical at 25 °C unless otherwise stated.

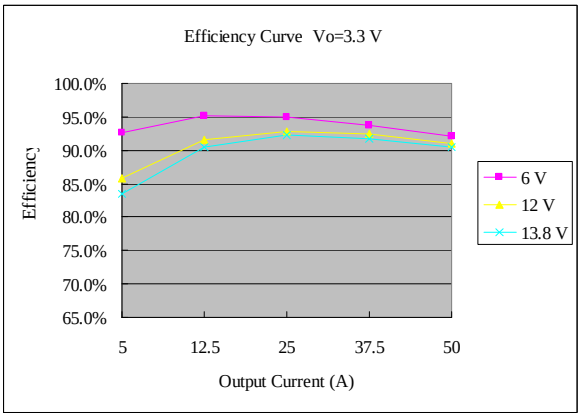
Efficiency Data

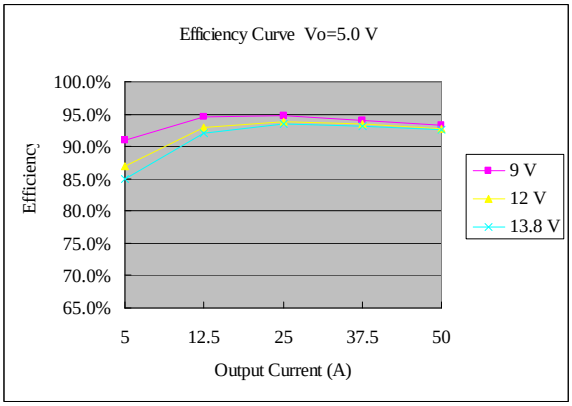




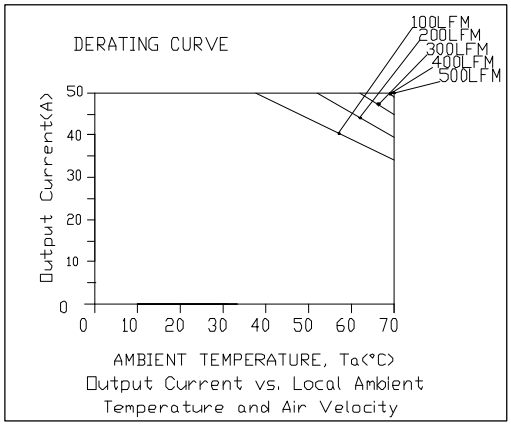




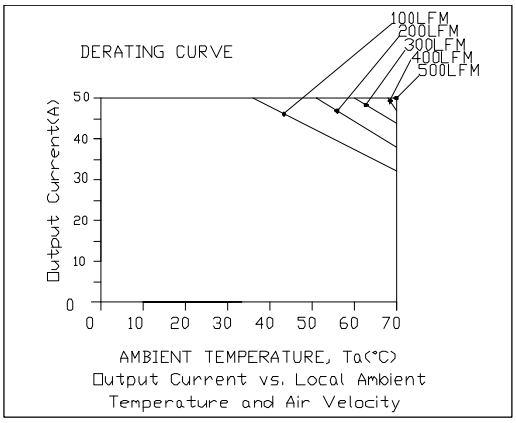




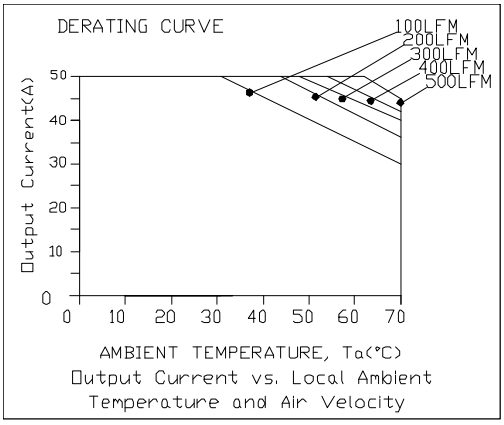
Thermal Derating Curves



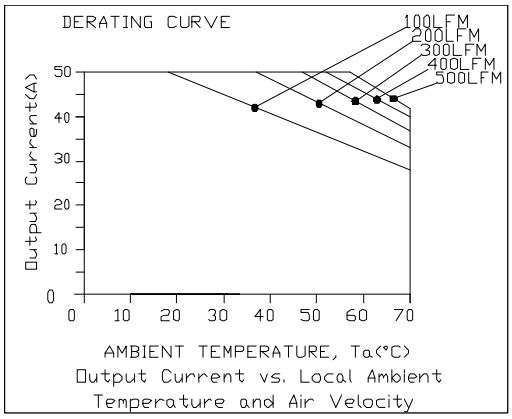
Vin=12 V, Vo=0.6 V



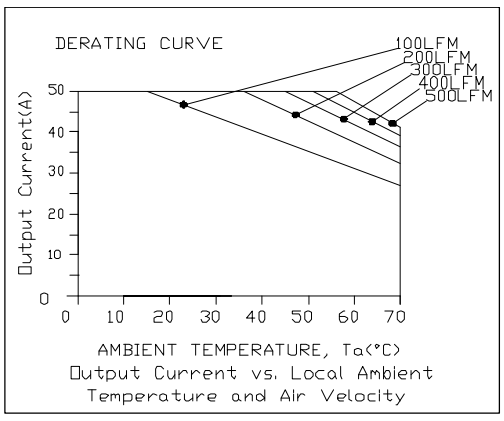
Vin=12 V, Vo=1.2 V



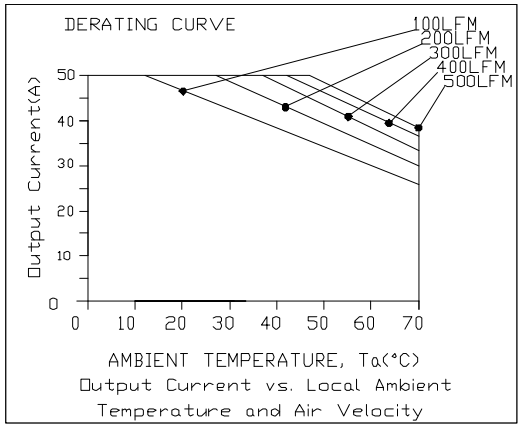
Vin=12 V, Vo=1.8 V



Vin=12 V, Vo=2.5 V



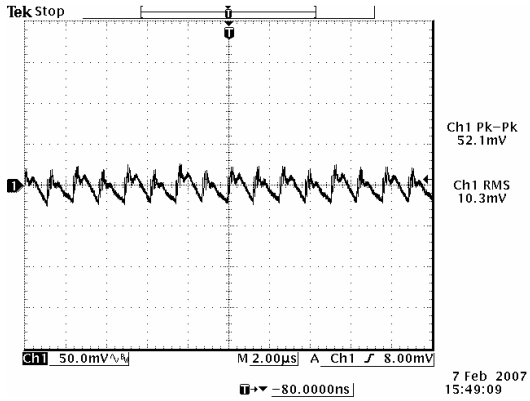
Vin=12 V, Vo=3.3 V



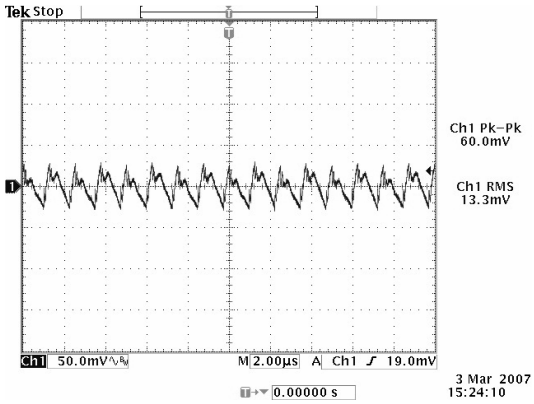
Vin=12 V, Vo=5.0 V

Note: Maximum junction temperature of semiconductors derated to 120C.

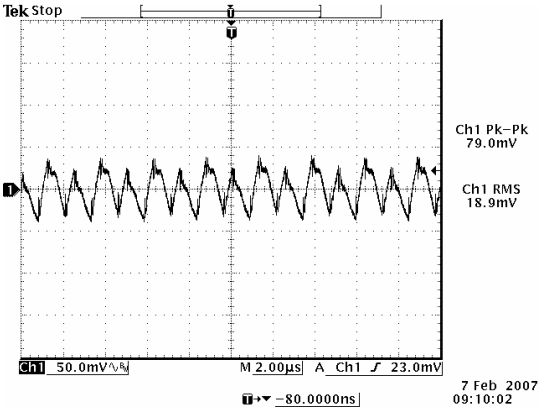
Ripple and Noise Waveforms



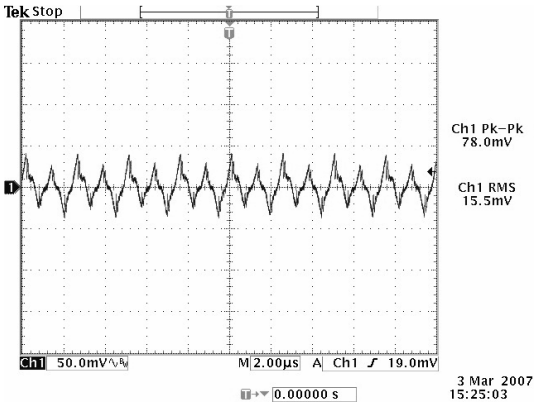
12 Vdc input, 0.6 Vdc/50 A output



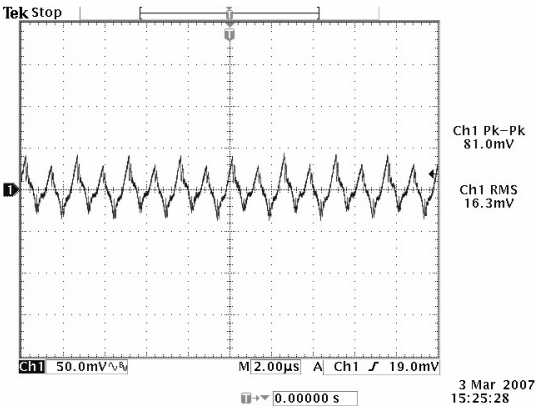
12 Vdc input, 1.2 Vdc/50 A output



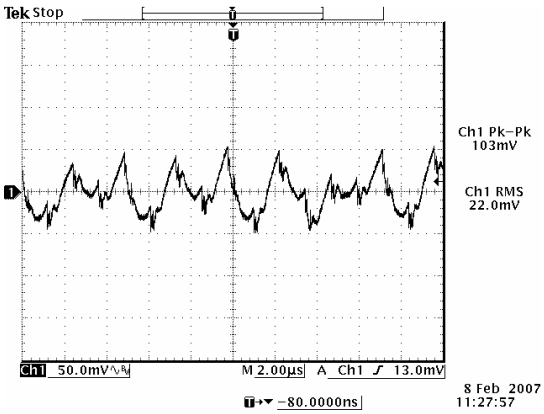
12 Vdc input, 1.8 Vdc/50 A output



12 Vdc input, 2.5 Vdc/50 A output



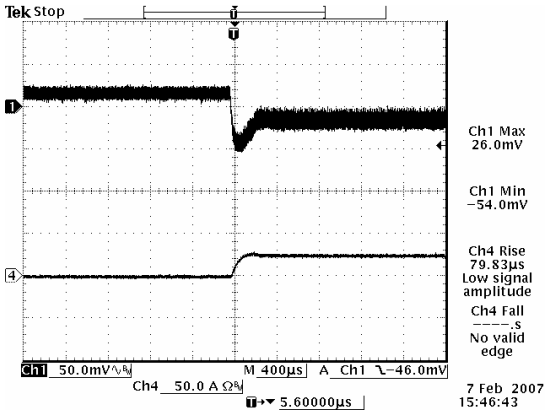
12 Vdc input, 3.3 Vdc/50 A output



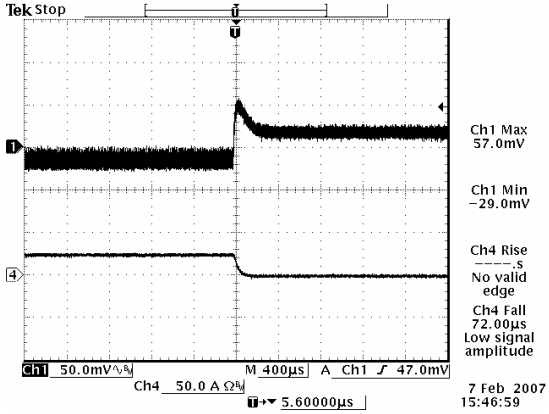
12 Vdc input, 5.0 Vdc/50 A output

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

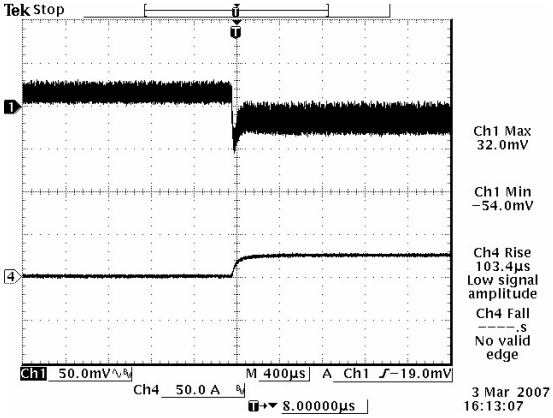
Transient Response Waveforms



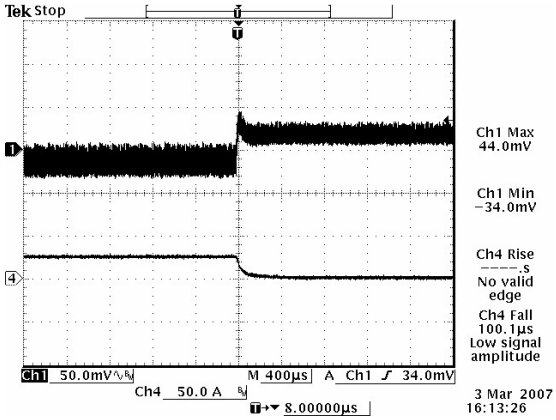
Vout= 0.6 V 0%-50% Load Transient



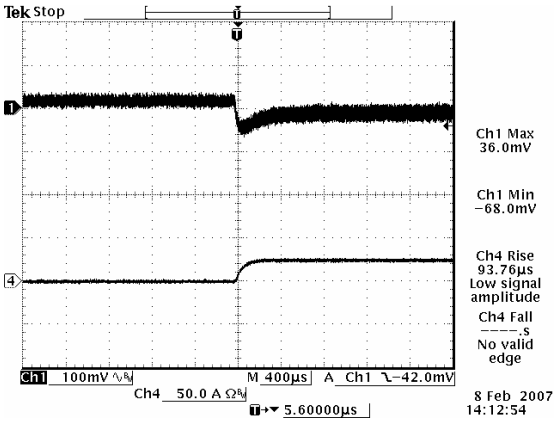
Vout=0.6 V 50%-0% Load Transient



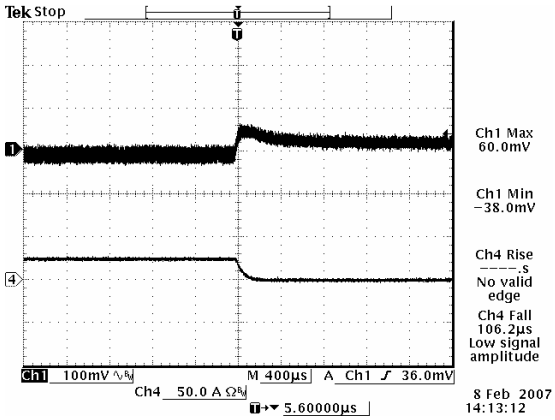
Vout=1.2 V 0%-50% Load Transient



Vout=1.2 V 50%-0% Load Transient

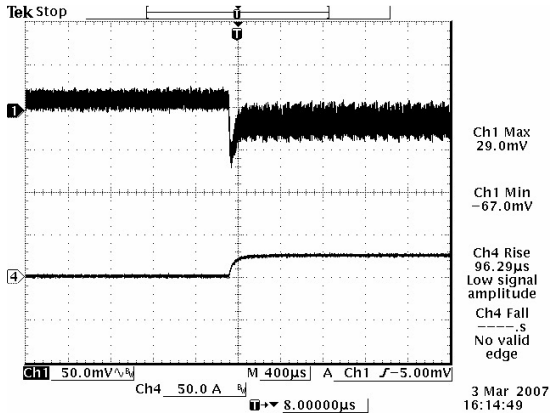


Vout=1.8 V 0%-50% Load Transient

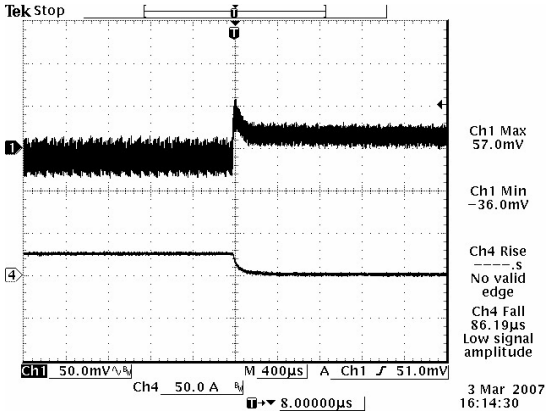


Vout=1.8 V 50%-0% Load Transient

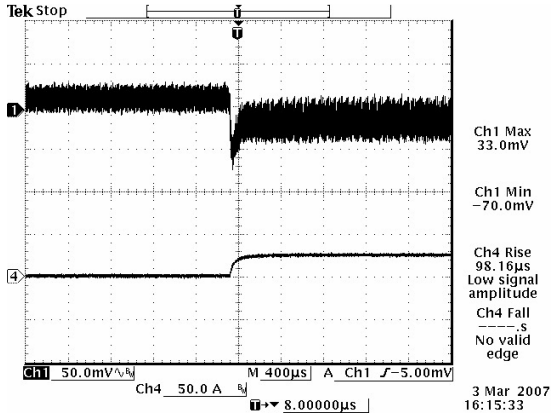
Transient Response Waveforms (continued)



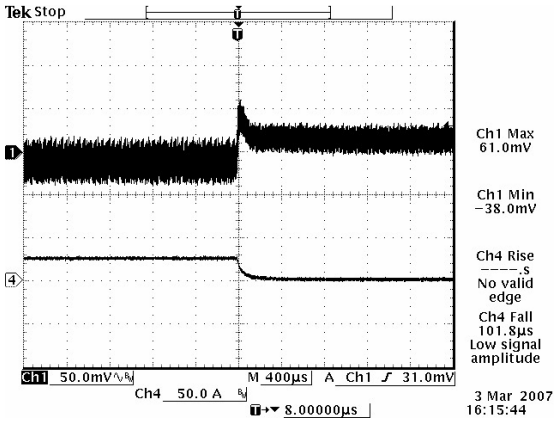
Vout= 2.5 V 0%-50% Load Transient



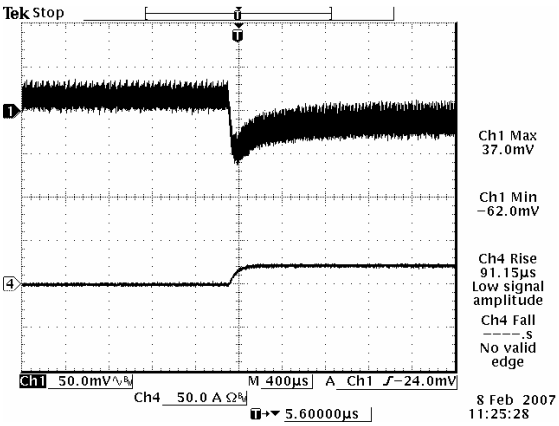
Vout=2.5 V 50%-0% Load Transient



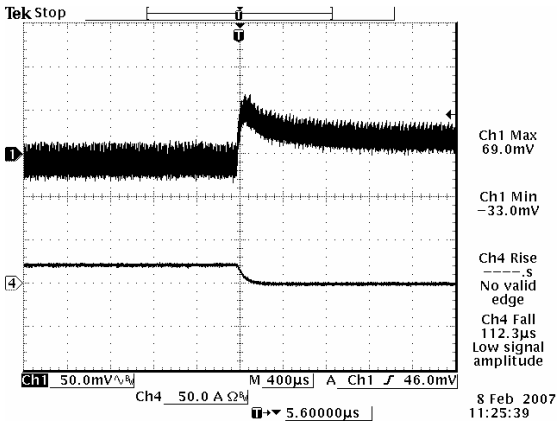
Vout=3.3 V 0%-50% Load Transient



Vout=3.3 V 50%-0% Load Transient



Vout=5 V 0%-50% Load Transient



Vout=5 V 50%-0% Load Transient

Note: Transient response at di/dt = 10 A/uS, with extemal electrolytic cap 4700 uF, and Ta=25 deg C.

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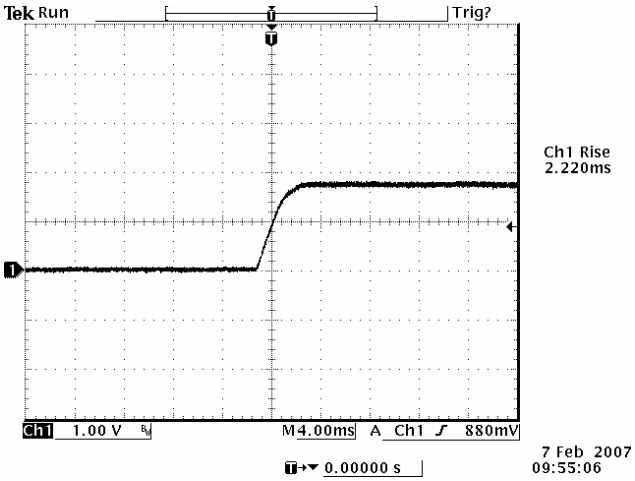
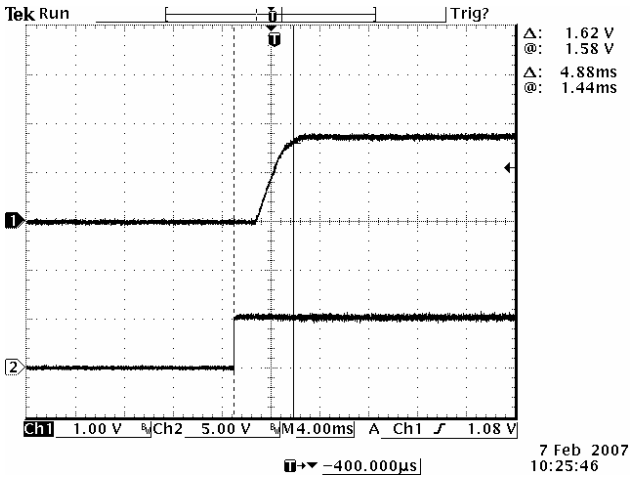
Startup & Shutdown

Rise Time



Test Condition:
12Vdc input,
1.8Vdc/50A output,
Co=0uF,
Ta=25 deg C

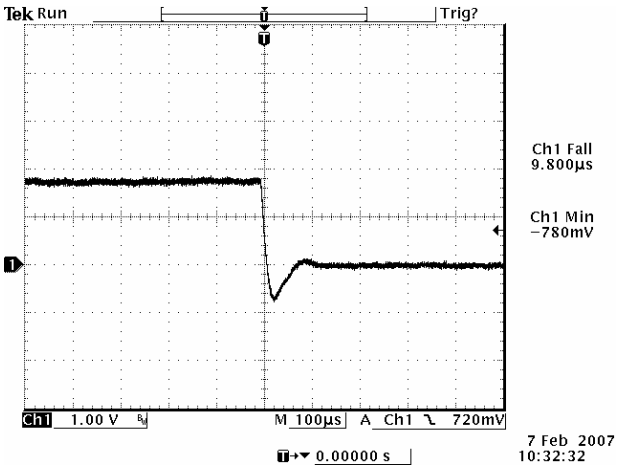
Startup time



Startup from on/off
Ch1: Vo
Ch2: on/off

Test Condition:
12Vdc input,
1.8Vdc/50A output
Co=0uF,
Ta=25 deg C

Shutdown

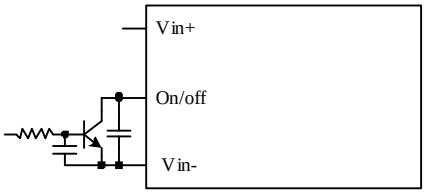


Test Condition:
12Vdc input,
1.8Vdc/50A output,
Co=0uF,
Ta=25 deg C

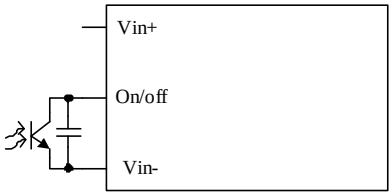
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off (Active High)				
Signal Low (Unit Off)	-0.3 V	-	0.8 V	Remote On/Off pin is open, unit is off.
Signal High (Unit On)	2 V	-	Vin,max	
Current Source/Sink	0 mA	-	3.3 mA	
PwGood (PowerGood)				
PwGood = High = Power Good	2.4 V	-	5.25 V	
	-	-	2 mA	
PwGood = Low = Power Not Good	0 V	-	0.4 V	
	-	-	4 mA	

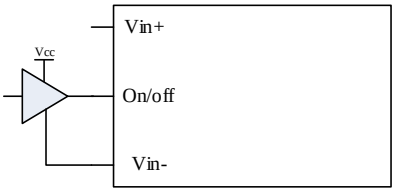
Recommended remote on/off circuit for active high



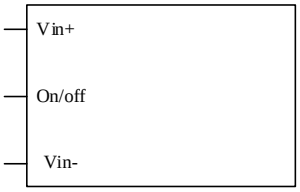
Control with open collector/drain circuit



Control with photocoupler circuit



Control with logic circuit

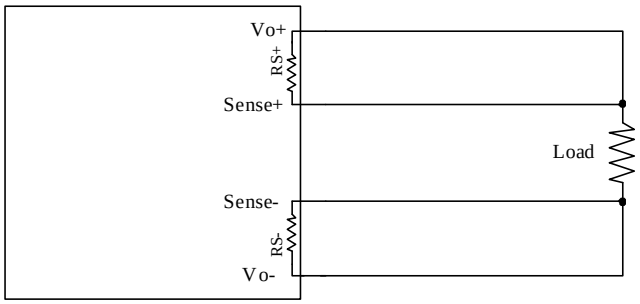


Permanently off

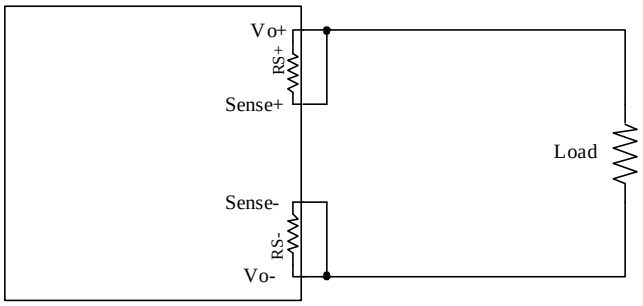
Remote Sense

This module has remote sense compensation feature. It can minimize the effects of resistance between module's output and load in system layout and facilitates accurate voltage regulation at load terminals or other selected point.

1. The remote sense lines carries very little current and hence do not require a large cross-sectional area.
2. This module compensates for a maximum drop of 10% of the nominal output voltage.
3. If the unit is already trimmed up, the available remote sense compensation range should be correspondingly reduced. The total voltage increased by trim and remote sense should not exceed 10% of the nominal output voltage.
4. When using remote sense compensation, all the resistance, parasitic inductance and capacitance of the system are incorporated within the feedback loop of this module. It can make an effect on the module's compensation, affecting the stability and dynamic response. A 0.1uF ceramic capacitor can be connected at the point of load to de-couple noise on the sense wires.
5. Recommend the connection of remote sense compensation as below figure. There are a resistor RS+ (51.1 ohm) from Vo+ to Sense+ and a resistor RS- (51.1 ohm)) from Vo- to Sense- inside of this module.



6. If not using remote sense compensation, please connect sense directly to output at module's pin, that is, connect sense+ to Vo+ and sense- to Vo- at module's pin, the shorter the better. see below figure.

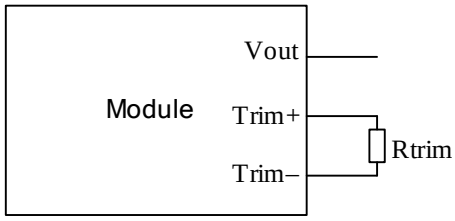


Output Trim Equations

Equations for calculating the trim resistor are shown below. The Trim Up resistor should be connected between the Trim+ pin and Trim- pin.

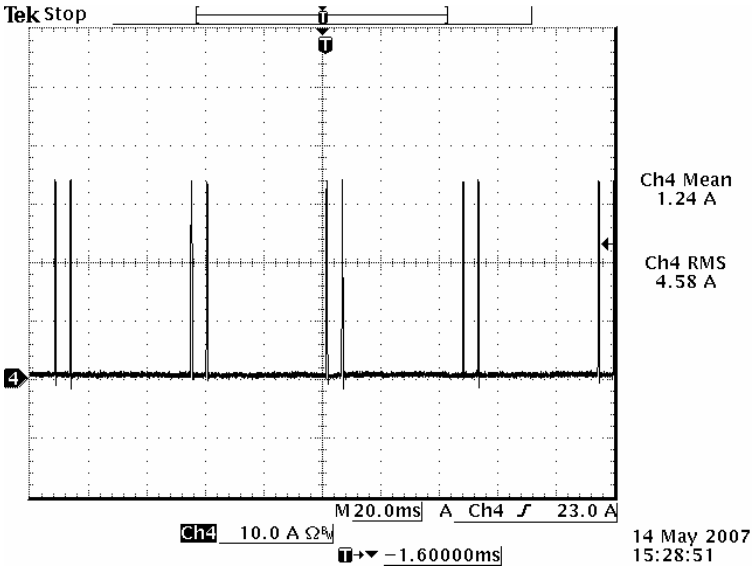
The Trim Up resistor is NIL,Vout=0.6V
Maximum trim up voltage is 5V.
The total voltage increased by trim and remote sense should not exceed 10% of the nominal output voltage.

$$R_{trim} = \frac{1.2}{Vo - 0.6}(K\Omega)$$



Over Current Protection

To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry. If the overcurrent condition persists, the module will shut down into hiccup mode and restart. The module operates normally when the output current goes into specified range.

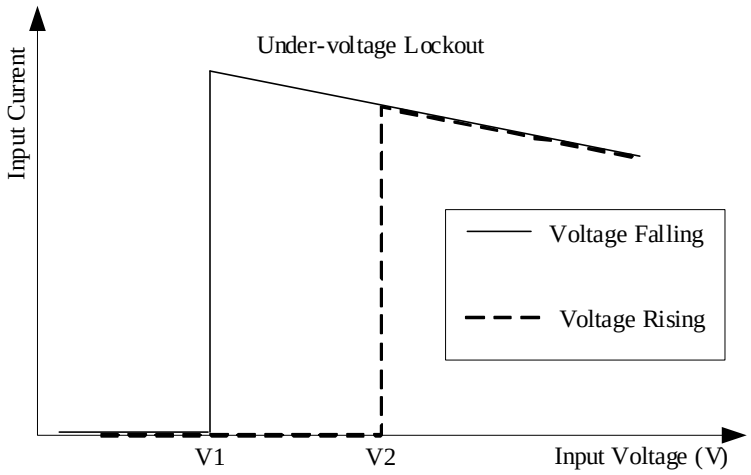


12Vdc input, 1.8Vdc output and Ta=25 deg C

Over Voltage Protection

The output overvoltage protection consists of circuitry that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over voltage protection threshold, the module will shutdown into latch off mode. The overvoltage latch can be reset by either cycling the input power or toggling the on/off signal for one second at least.

Input Under-voltage Lockout



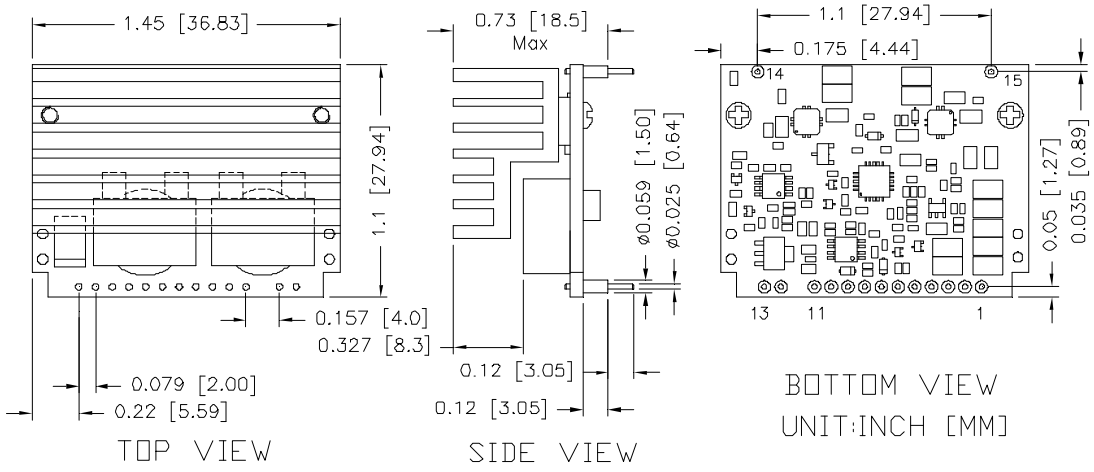
V1=4.3V
V2=4.6V

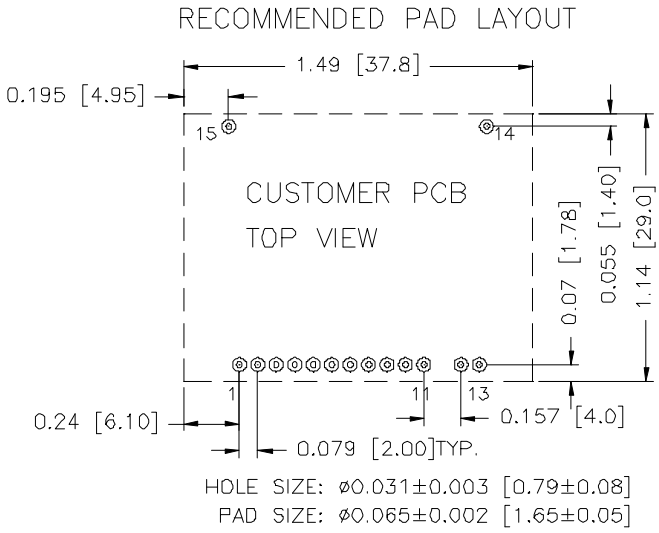
Power Good

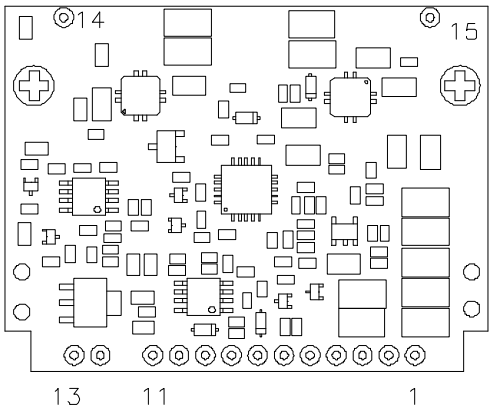
1. This module has a power good indicator output. Power good pin used positive logic and is open collector.
2. Power good pin can sink 10mA.
3. The maximum voltage pulled up externally on Power Good pin should not exceed 30V.
4. When the output reaches 90% of the nominal set-point, the power good pin will be pulled high.

Mechanical Outline

0RP2-50E2A0





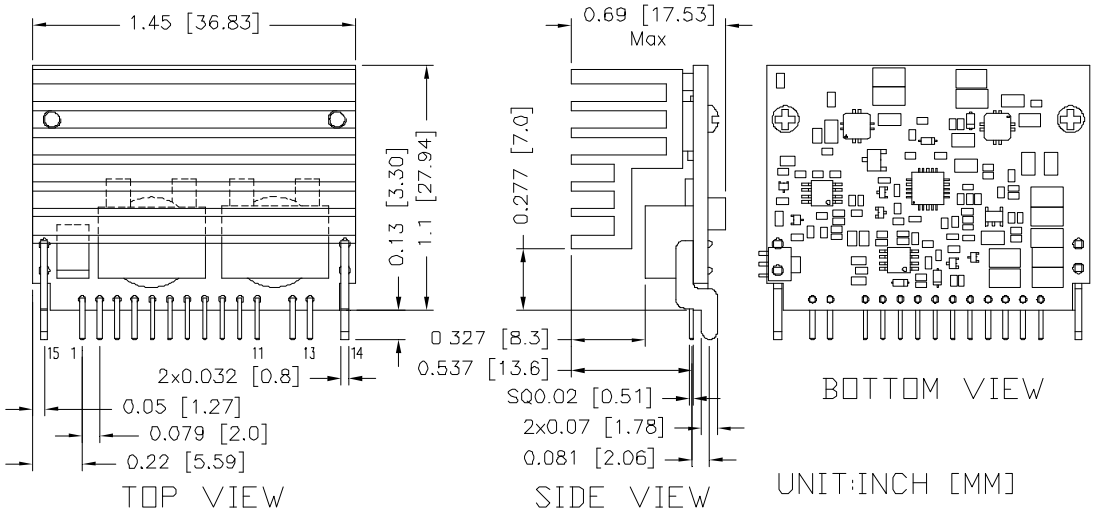


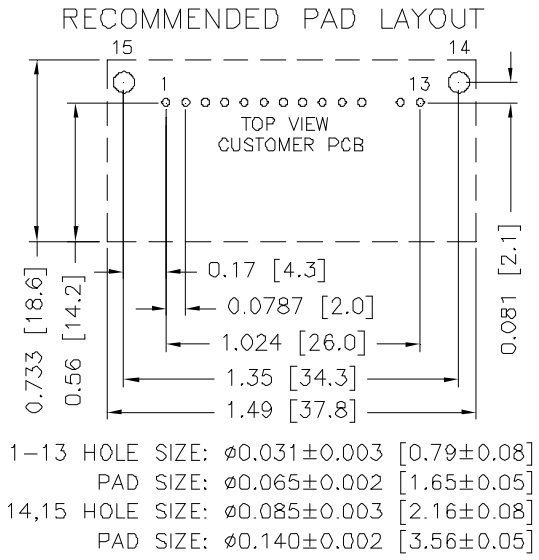
Pin Connections

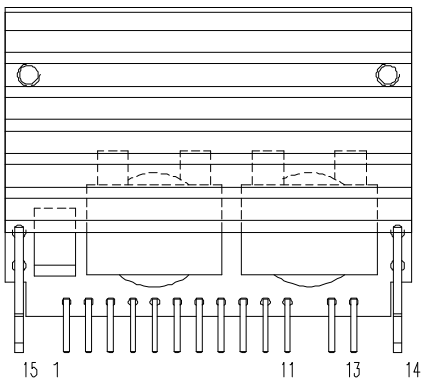
Pin	Function	Pin	Function
1	Vout	9	PwGOOD
2	Vout	10	Sense-
3	Vout	11	Sense+
4	GND	12	Vin
5	GND	13	Vin
6	Enable	14	GND
7	Trim-	15	GND
8	Trim+		

Mechanical Outline (continued)

VRP2-50E2A0







Pin Connections

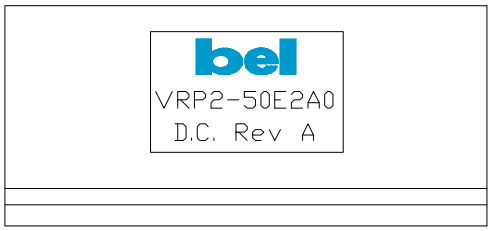
Pin	Function
1	Vout
2	Vout
3	Vout
4	GND
5	GND
6	Enable
7	Trim-
8	Trim+
9	PwGOOD
10	Sense-
11	Sense+
12	Vin
13	Vin
14	GND
15	GND

Note: This module is recommended and compatible with Pb-Free Wave Soldering and must be soldered using a peak solder temperature of no more than 260 ºC for less than 5 seconds.

Note:

1) All Pins: Material - Copper Alloy;
Finish – 3 micro inches minimum Gold over 50 micro inches minimum Nickel plate.
2) Undimensioned components are shown for visual reference only.
3) All dimensions in inches (mm); Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm) x.xxx +/-0.010 in. (x.xx +/-0.25mm).

Labeling Information



Heatsink side view

TECHNICAL REVISIONS - The appearance of products, including safety agency certifications and D.C. (Date Code) pictured on labels, may change depending on the date manufactured.

Revision History

Date	Version	Changes Detail	Approval
2009-4-9	A	First release	XF JIANG
2009-4-17	B	1. Correct error in part number explanation; 2. Remove some “TBD” information.	XF JIANG

RoHS Compliance

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

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