NON-ISOLATED DC/DC CONVERTERS

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

Nov. 02, 2010

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

xRP2-50E3A0 RoHS Compliant PRELIMINARY Rev.A

Features

- Non-Isolated
- High Efficiency
- Fixed Switching Frequency
- Power Good Signal
- Low Output Ripple
- Remote On/Off
- Wide Input Voltage Range (5Vdc-13.8Vdc)
- Output Voltage Trim (0.6Vdc-5Vdc)
- Output Overvoltage Shut Down
- OCP/SCP
- Excellent Thermal Performance
- Low Cost
- Class 1, Category 2, Non-Isolated DC/DC Converter (refer to IPC-9592)

Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The xRP2-50E3A0 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 (Vo=1.8 Vdc)	Model Number Active High	Model Number Active High
0.6 V - 5 V	5 V - 13.8 V	50 A	250 W	88.8%	VRP2-50E3A0	0RP2-50E3A0

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

Part Number Explanation

V	R	P2	–	50	E	3A	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, 50A output
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)	-	-	32.0	A	
Input Current (no load)	-	200	400	mA	
Remote Off Input Current	-	30	50	mA	
Input Reflected Ripple Current (rms)	-	5	8	mA	With simulated source impedance of 10 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°C.
Input Reflected Ripple Current (pk-pk)	-	20	35	mA	
I^2t Inrush Current Transient	-	-	1	A^2s	
Turn-on Voltage Threshold	-	4.6	4.8	V	
Turn-off Voltage Threshold	3.9	4.1	-	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≥2.5 V Vo＜2.5 V	 - -	 - -	 0.6 12	 %Vo mV	
Line Regulation Vo≥2.5 V Vo＜2.5 V	 - -	 - -	 0.3 9	 %Vo mV	
Regulation Over Temperature (-40 deg.C-85deg.C)	-	-	0.02	%Vo/C	
Ripple and Noise (pk-pk) Vo=5.0 V Vo=3.3 V Vo=2.5 V Vo=1.8 V Vo=1.2 V Vo=0.6 V	 - - - - - -	 55 50 50 50 40 25	 110 100 100 90 80 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=1.8 V Vo=1.2 V Vo=0.6 V		 - - - - - -	 10 12 12 12 10 8	 30 35 25 25 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	over all operating input voltage, load and ambient temperature condition
Output Current Range		0	-	50	A	
Output DC Current Limit		55	65	75	A	
Rise Time		1	-	2	mS	
Turn on Time		-	4	7	mS	Enable form Vin
		-	4	7	mS	Enable form ON/OFF
Overshoot at Turn on		-	0	3	%	
Output Capacitance		0	-	4700	uF	
Transient Response						
△V50%~100% of Max Load	Overshoot	-	200	300	mV	Test conditions: di/dt=2.5A/us, Vin=12Vdc, Vo=1.5Vdc, Ta=25°C, with a 1µF ceramic capacitor and a 10uF Tantalum cap at output.
	Settling Time	-	50	100	uS	
△V100%~50% of Max Load	Overshoot	-	200	300	mV	
	Settling Time	-	50	100	uS	

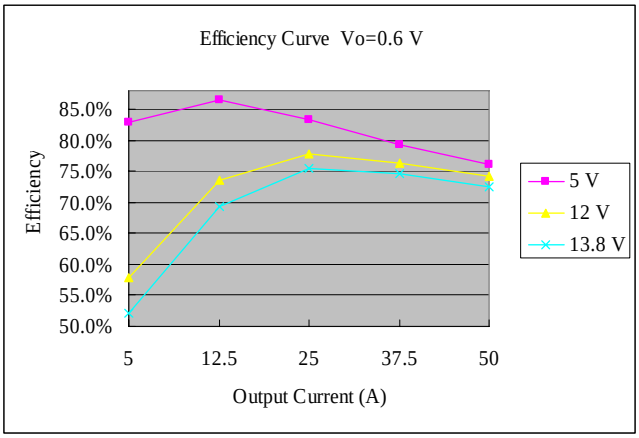
Note: All specifications are typical at nominal input, full load at 25°C unless otherwise stated.

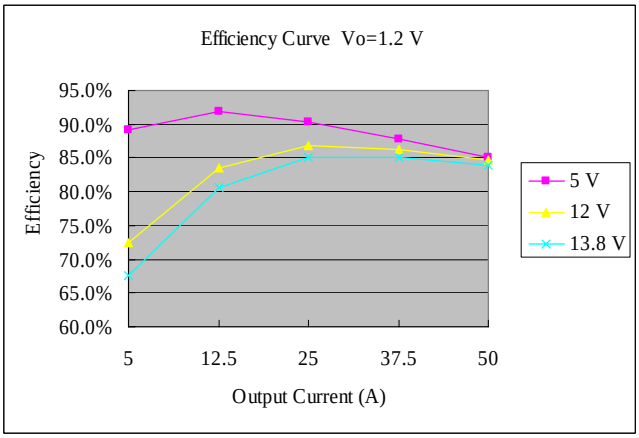
General Specifications (continued)

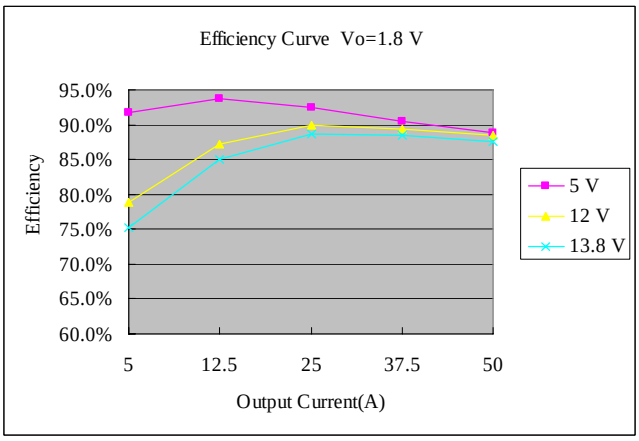
Parameter	Min	Typ	Max	Unit	Notes
Efficiency Vo=5.0 V Vo=1.8 V Vo=0.6 V	 92 86 72	 94.2 88.8 74	 - - -	 % % %	Vin=12V, full load
Switching Frequency	-	330	-	kHz	
Over Voltage Protection	-	125	130	%Vo	
Weight	-	25	-	g	
Dimensions Inches (L × W × H) Millimeters (L × W × H)	1.45 x 1.1 x 0.783 36.83 x 27.94 x 19.89			-	Through Hole Mount 0RP2-50E3A0
Dimensions Inches (L × W × H) Millimeters (L × W × H)	1.45 x 1.1 x 0.743 36.83 x 27.94 x 18.87			-	Vertical Mount VRP2-50E3A0

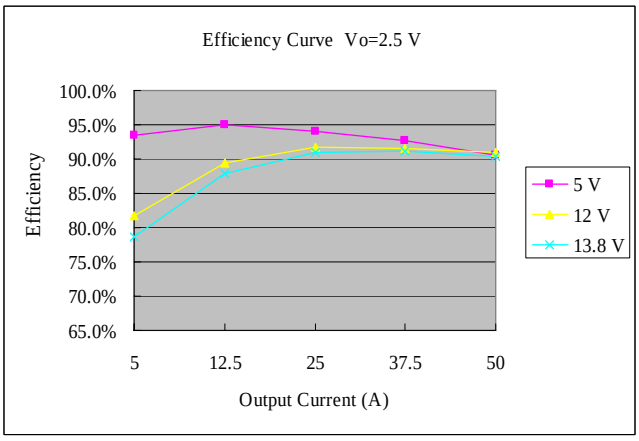
Note: All specifications are typical at 25 °C unless otherwise stated.

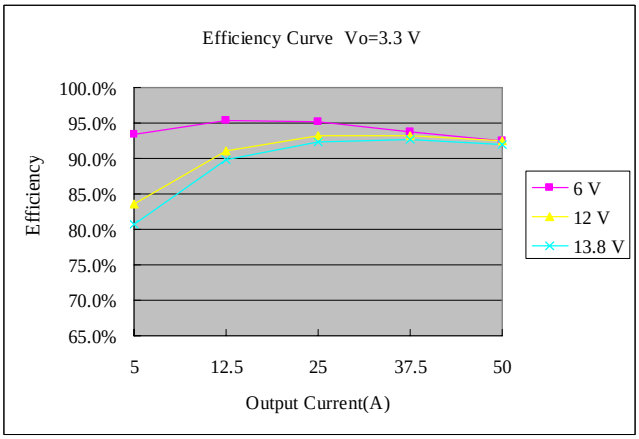
Efficiency Data

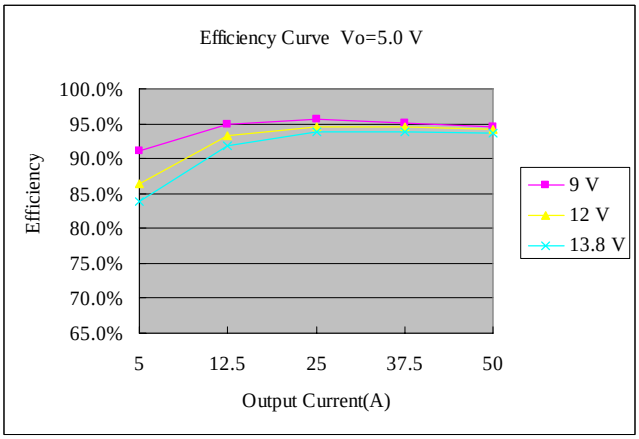




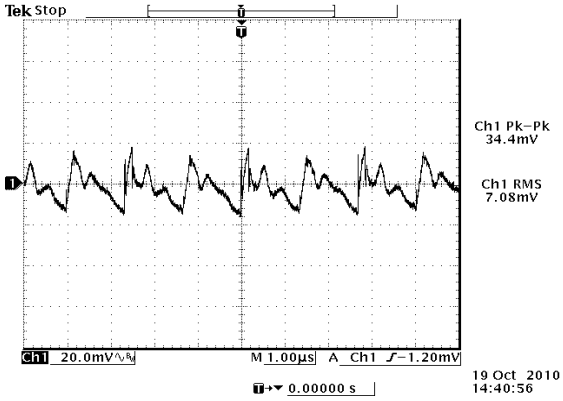




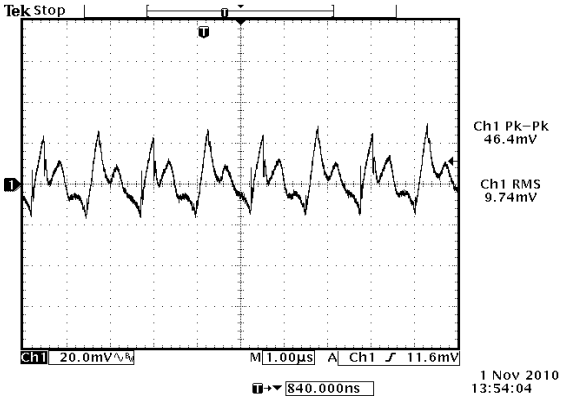




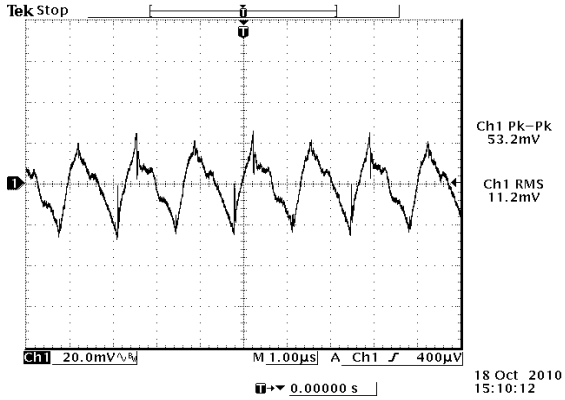
Ripple and Noise Waveforms



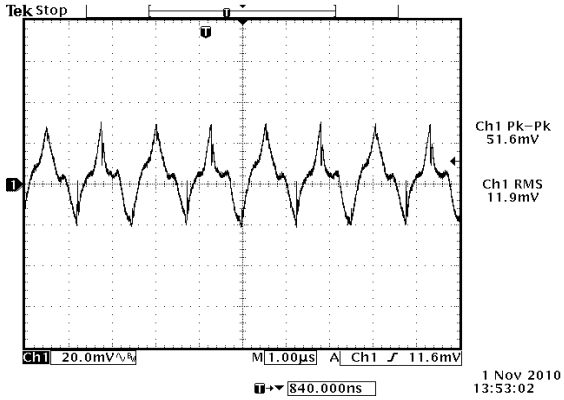
12 Vdc input, 0.6 Vdc/50 A output



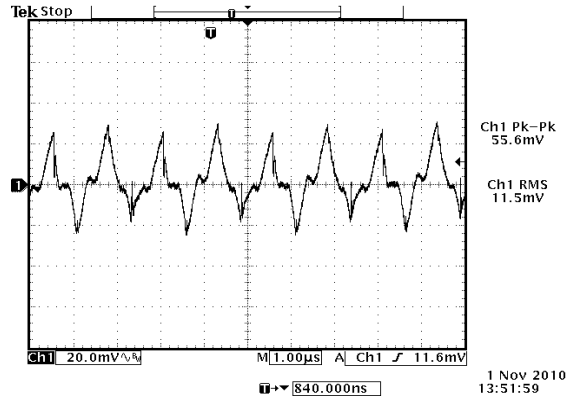
12 Vdc input, 1.2 Vdc/50 A output



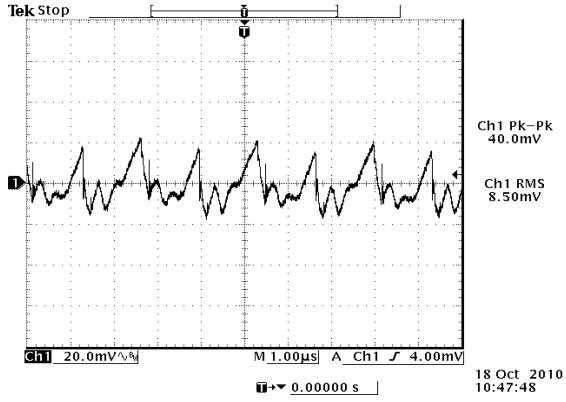
12 Vdc input, 1.8 Vdc/50 A output



12 Vdc input, 2.5 Vdc/50 A output



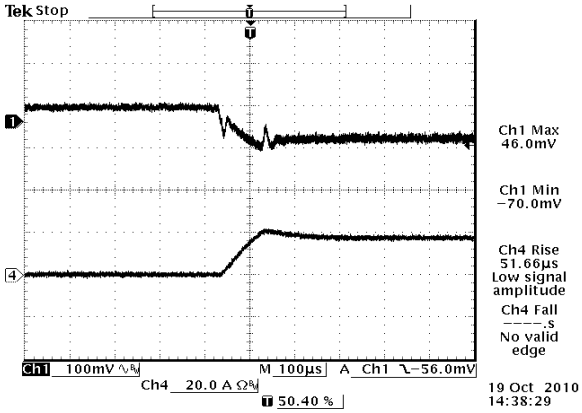
12 Vdc input, 3.3 Vdc/50 A output



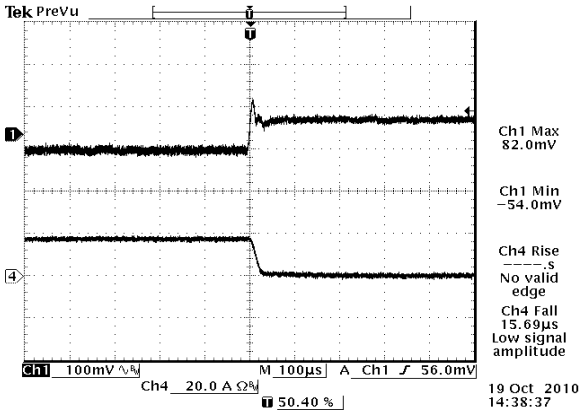
12 Vdc input, 5.0 Vdc/50 A output

Note: Ripple and noise at full load, 12 Vdc input and Ta=25 deg C.

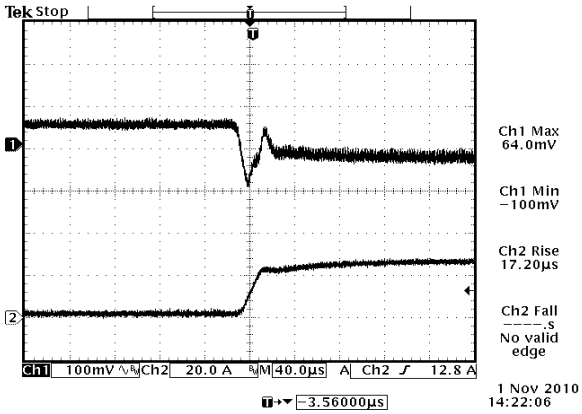
Transient Response Waveforms



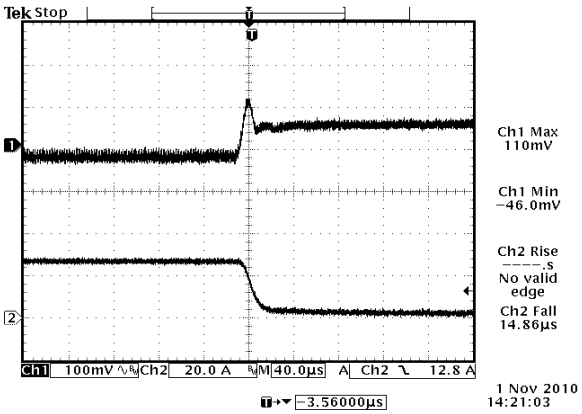
Vout= 0.6 V 0%-50% Load Transient



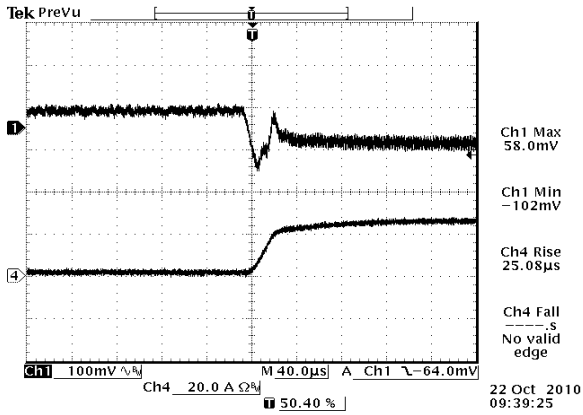
Vout=0.6 V 50%-0% Load Transient



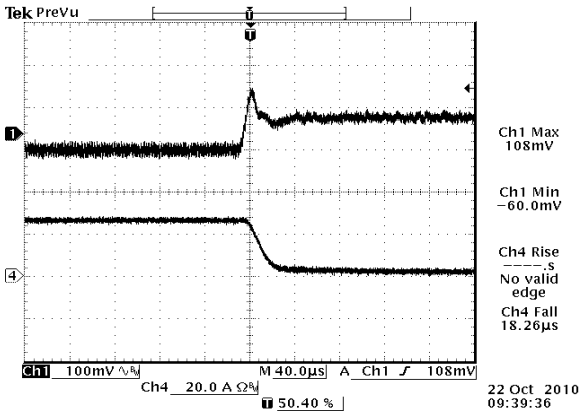
Vout=1.2 V 0%-50% Load Transient



Vout=1.2 V 50%-0% Load Transient

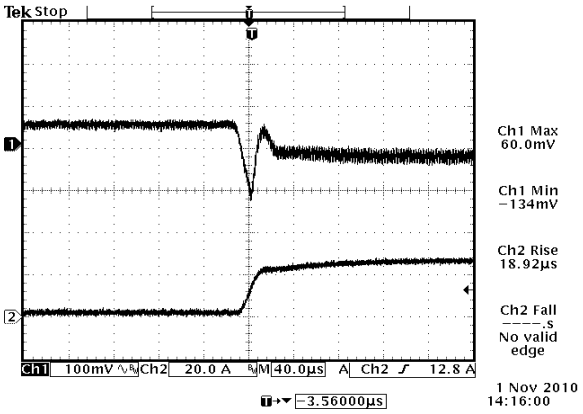


Vout=1.8 V 0%-50% Load Transient

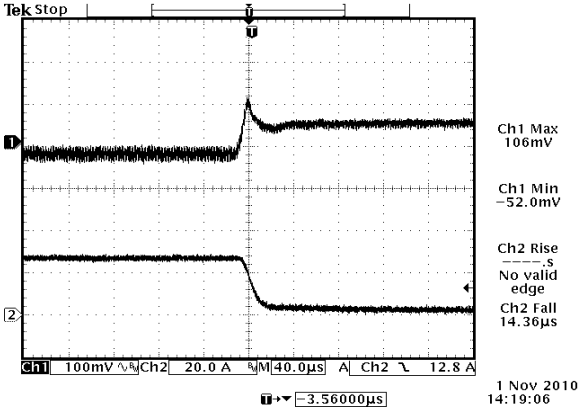


Vout=1.8 V 50%-0% Load Transient

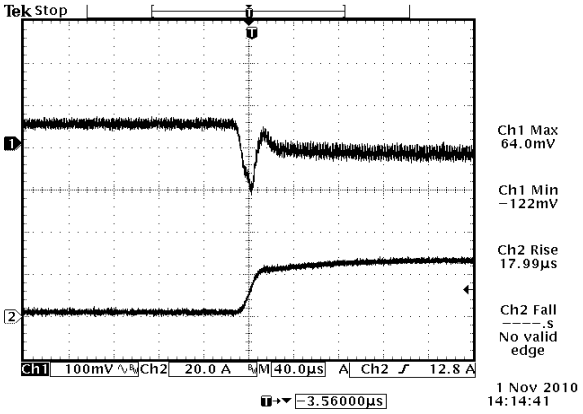
Transient Response Waveforms (continued)



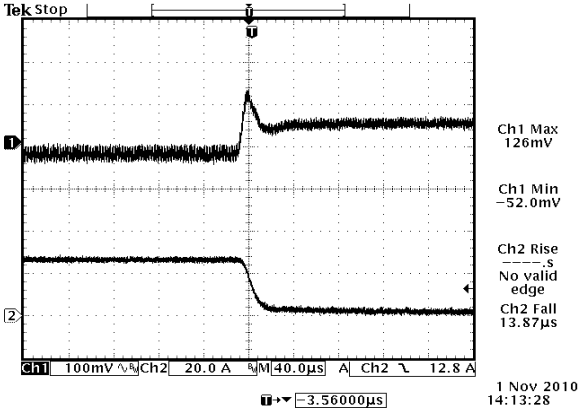
Vout= 2.5 V 0%-50% Load Transient



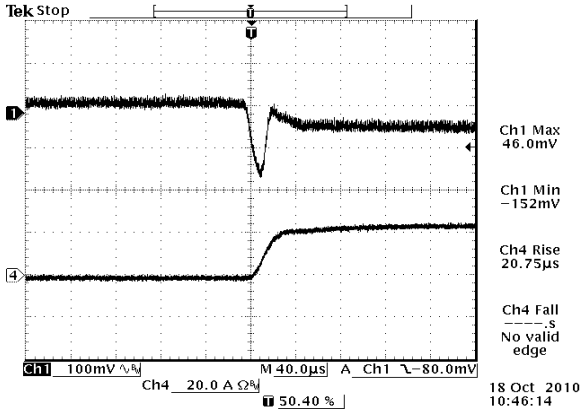
Vout=2.5 V 50%-0% Load Transient



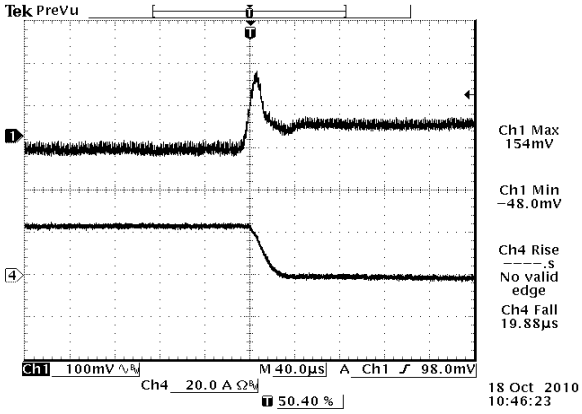
Vout=3.3 V 0%-50% Load Transient



Vout=3.3 V 50%-0% Load Transient



Vout=5 V 0%-50% Load Transient

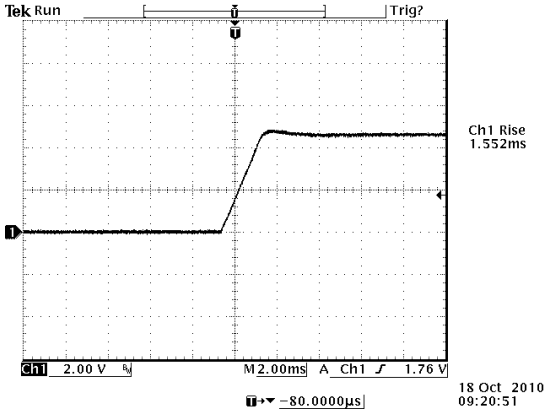


Vout=5 V 50%-0% Load Transient

Note: Transient response at Vin=12 V, di/dt =2.5 A/uS, 1uF ceramic cap and 10uF aluminum cap at output, and Ta=25 deg C.

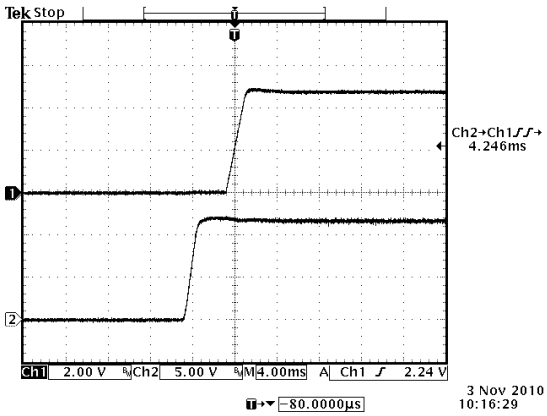
Startup & Shutdown

Rise Time

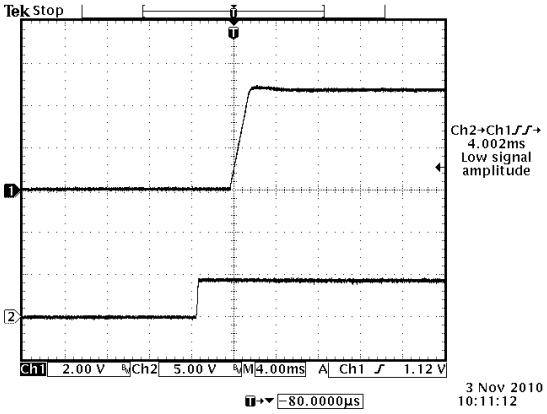


Test Condition: 12Vdc input, 5Vdc/50A output, Ta=25 deg C

Startup time

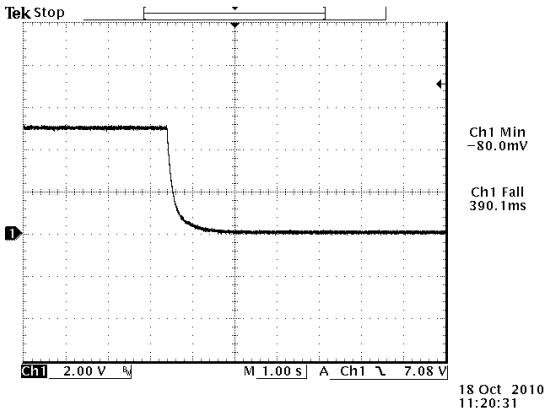


Startup from Vin
Ch1: Vo
Ch2: Vin
Test Condition:
12Vdc input, 5Vdc/50A output, Ta=25 deg C



Startup from on/off
Ch1: Vo
Ch2: on/off
Test Condition:
12Vdc input, 5Vdc/50A output, Ta=25 deg C

Shutdown

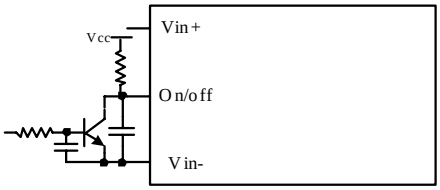


Test Condition: 12Vdc input, 5Vdc/0A output, Ta=25 deg C

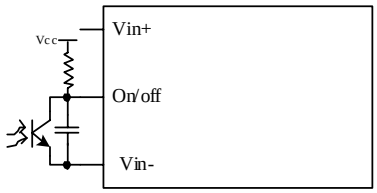
Control Specifications

Parameter	Min	Typ	Max	Unit	Notes
Remote On/Off (Active High)					
Signal Low (Unit Off)	-0.3	-	0.8	V	Remote On/Off pin is open, unit is off.
Signal High (Unit On)	2	-	Vin,max	V	
Current Source/Sink	0	-	3.3	mA	

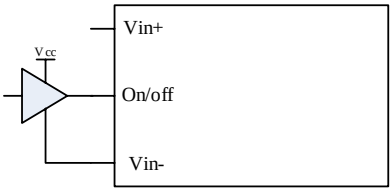
Recommended remote on/off circuit for active high



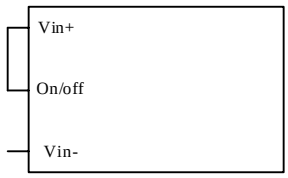
Control with open collector/drain circuit



Control with photocoupler circuit



Control with logic circuit



Permanently on

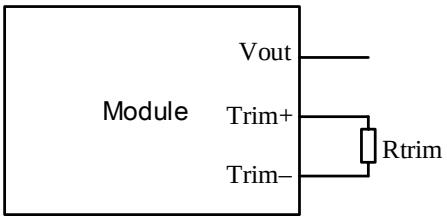
Output Trim Equations

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

Maximum duty cycle is 65%.
Minimum trim down voltage is 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.

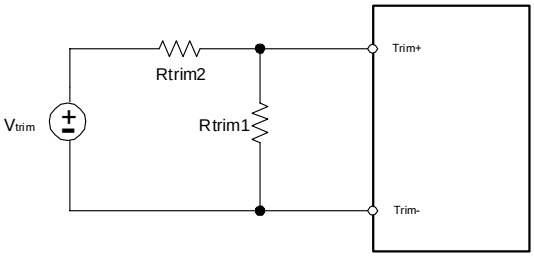
The resistor trim equation:

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



The voltage trim equation:

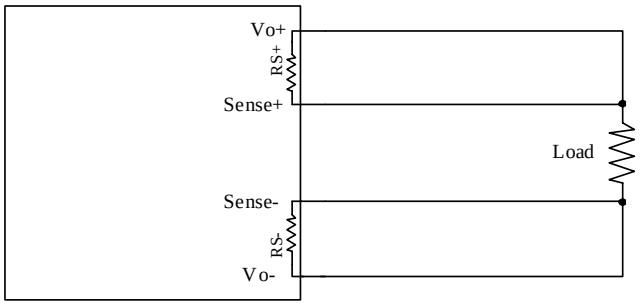
$$R_{trim2} = \frac{R_{trim1}(1.2 - 2V_{trim})}{R_{trim1}(Vo - 0.6) - 1.2}(K\Omega)$$



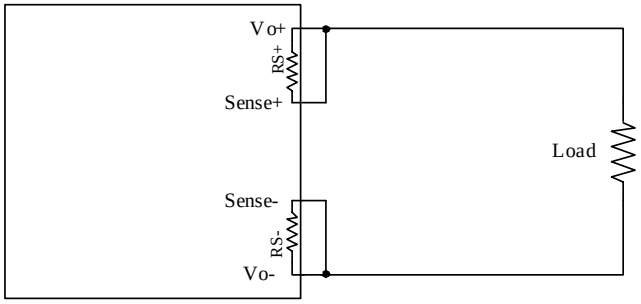
Remote Sense

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+ (100 ohm) from Vo+ to Sense+ and a resistor RS- (51 ohm)) from Vo- to Sense- inside of this module.

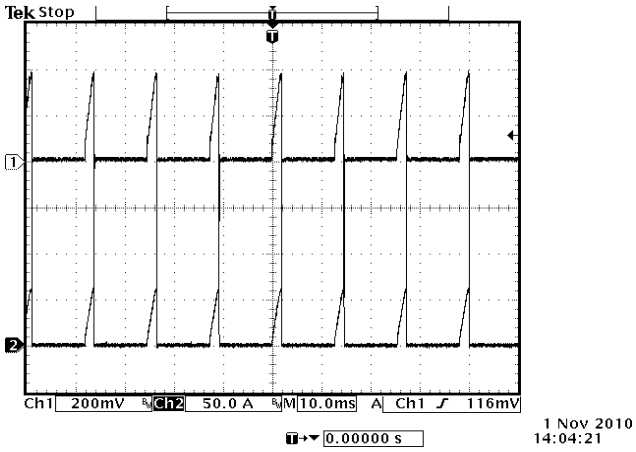


6. If not using remote sense compensation, please connect sense directly to output at module's pin, that is, connect sense+ to Vo+ and sense- to Vo- at module's pin, the shorter the better. see below figure.

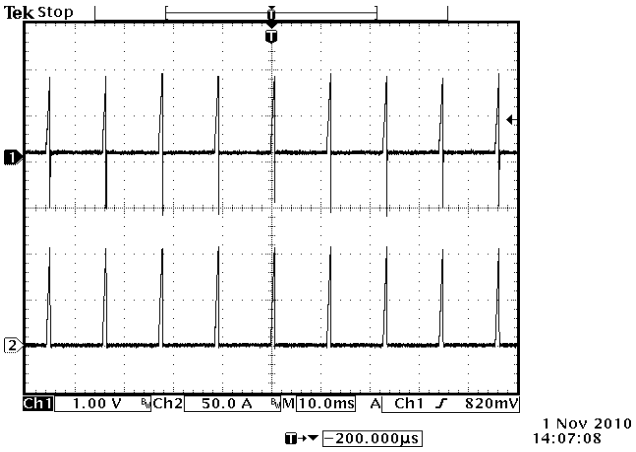


Over Current Protection

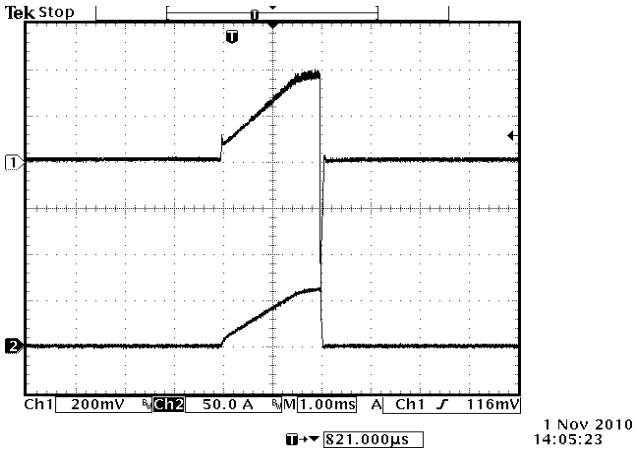
To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry and can endure current limiting for a few mili-seconds. If the over current condition persists beyond a few milliseconds, the module will shut down into hiccup mode and restart once every 12mS. The module operates normally when the output current goes into specified range. The typical average output current is 3A during hiccup.

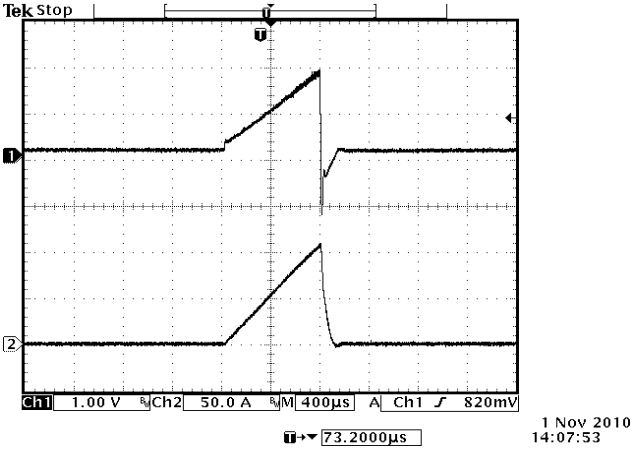


Vout= 0.6V, Vin=12V@Ta=25℃



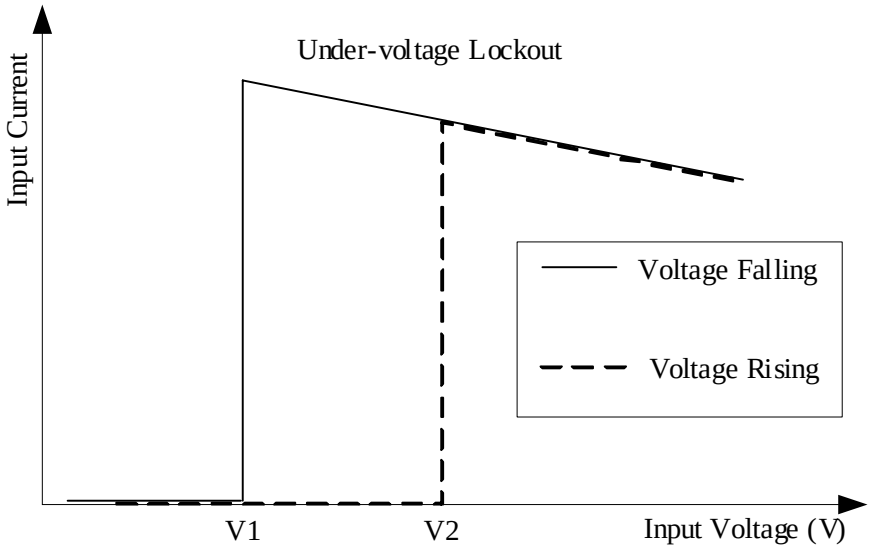
Vout= 5.0V, Vin=12V@Ta=25℃





Expansion of on time portion of above figure

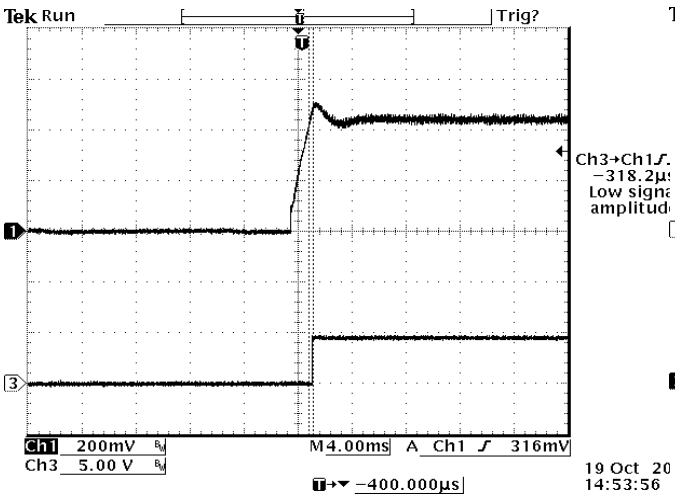
Input Under-voltage Lockout



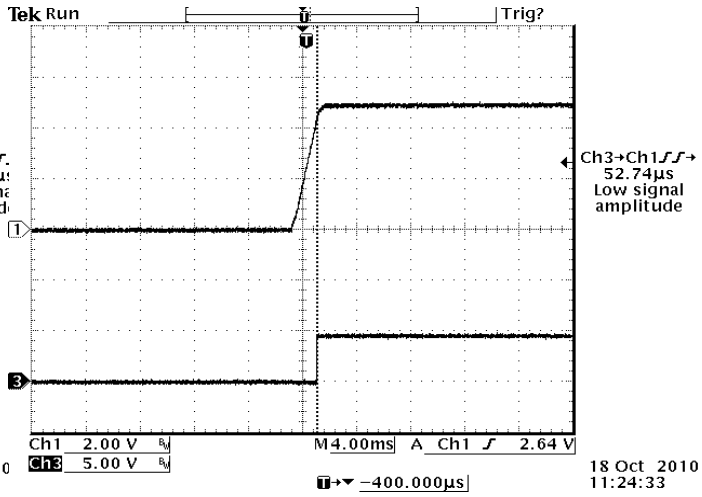
V1=4.1V
V2=4.6V

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 5.3V.
4. When the output reaches 90% of the nominal set-point, the power good pin will be pulled high.



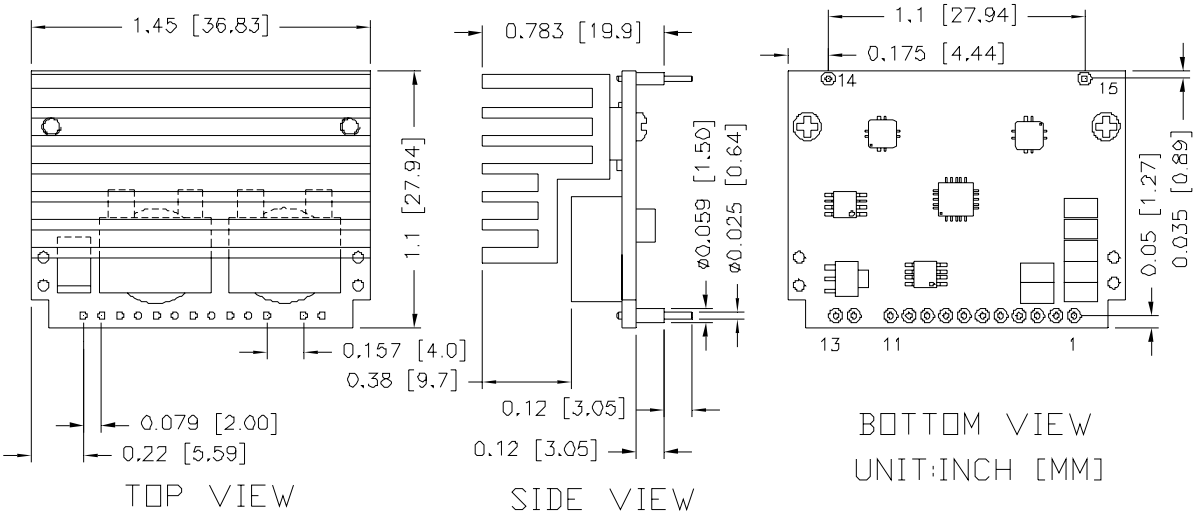
Typical Start-up Using Remote ON/OFF
Vin=12.0V, Vout=0.6V, Io=50A
CH1: Output Voltage
CH3: PG

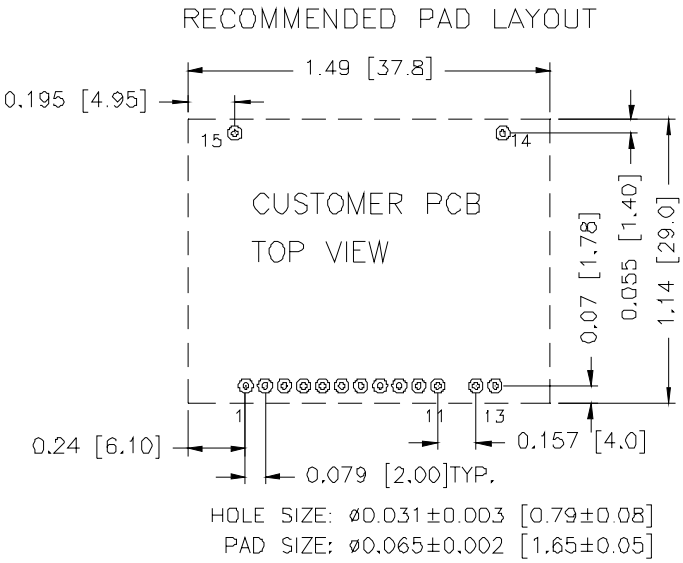


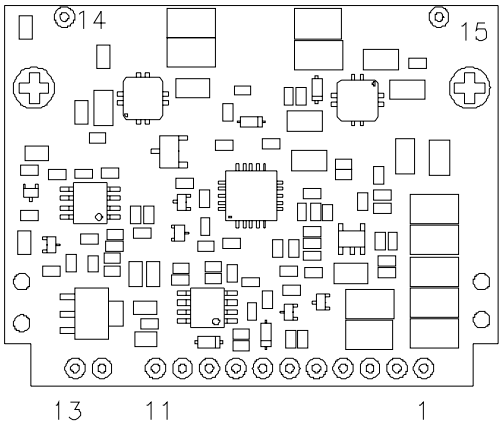
Typical Start-up Using Remote ON/OFF
Vin=12.0V, Vout=5V, Io=50A
CH1: Output Voltage
CH3: PG

Mechanical Outline

0RP2-50E3A0





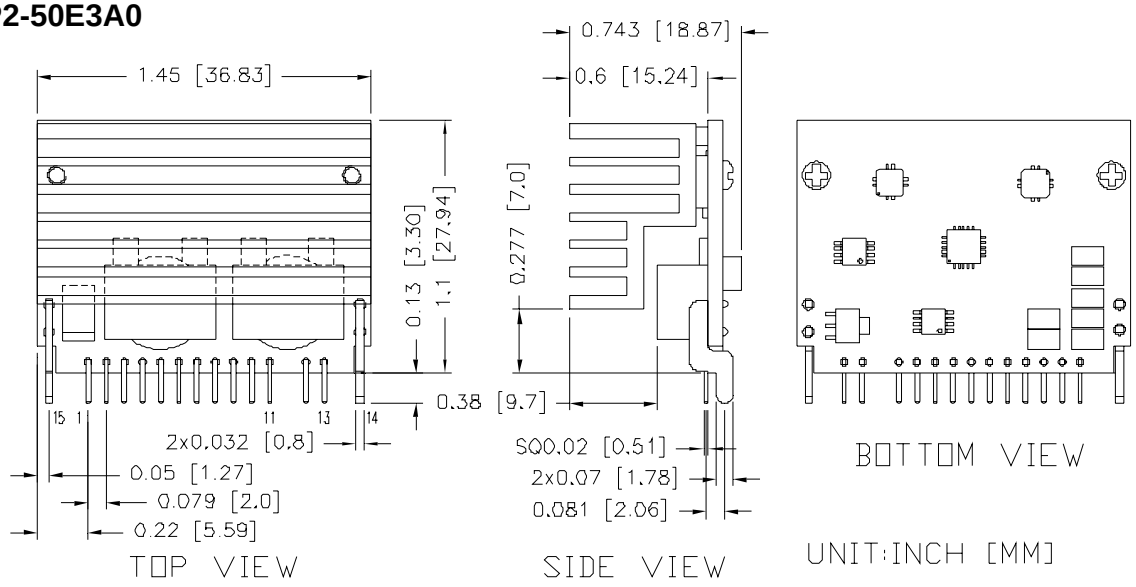


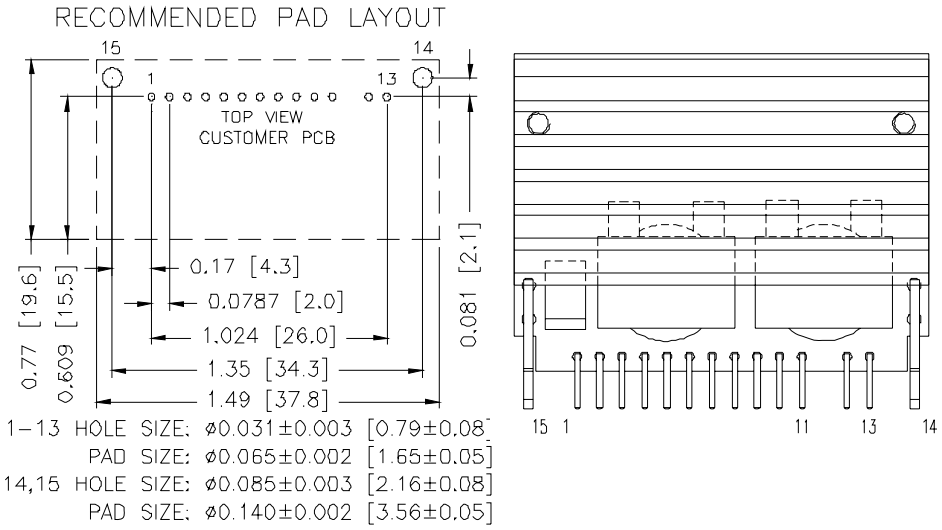
Pin Connections

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)

VRP2-50E3A0





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).

Revision History

Date	Version	Changes Detail	Approval
2010-11-02	PA	First release	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.

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