NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input 0.6 Vdc - 5.0 Vdc/40 A Output

Jan. 18, 2016

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

xRP2-40E1A0 RoHS Compliant Rev.F

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

Description

The xRP2-40E1A0 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 40 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)	Part Number Horizontal Mount	Part Number Vertical Mount
0.6 V - 5.0 V	5.0 V - 13.8 V	40 A	200 W	87%	0RP2-40E1A0	VRP2-40E1A0

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”.

Part Number Explanation

x	R	P2	–	40	E	1A	0	x
1	2	3		4	5	6	7	8

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, 40A output
5--- Wide input range (5-13.8V)
6---Wide output range (0.6-5V)
7---Enable, active high
8---Package

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	0 °C	-	70 °C	
Storage Temperature	-55 °C	-	125 °C	
Altitude	-	-	2000m	

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage Vo≤ 2.8 V Vo > 2.8 V	 5 V 1.8*Vo	 12 V 12 V	 13.8 V 13.8 V	
Input Current (full load)	-	-	30 A	
Input Reflected Ripple Current (pk-pk)	-	35 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°C.
Input Reflected Ripple Current (rms)	-	10 mA	-	
I^2t Inrush Current Transient	-	-	1 A^2s	
Turn-on Voltage Threshold	4.4 V	4.6 V	4.8 V	
Under Voltage Threshold	4.0 V	4.3 V	4.6 V	

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

Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point Vo≥1 V Vo<1 V	 -1.5 % Vo -10 mV	 - -	 +1.5 % Vo +10 mV	Vin=Vinmin, Io=Iomax
Load Regulation Vo≥2.5 V Vo<2.5 V	 - -	 - -	 0.6% Vo 12 mV	
Line Regulation Vo≥2.5 V Vo<2.5 V	 - -	 - -	 0.3% Vo 9 mV	
Regulation Over Temperature (0 °C to +70 °C)	-	-	0.02% Vo/C	
Output Current	0 A	-	40 A	
Current Limit Threshold	105% Io	130% Io	160% Io	
Output 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	 - - - - - -	 - - - - - -	 120 mV 60 mV 40 mV 40 mV 30 mV 30 mV	Test conditions: 0-20MHz BW, with a 1µF ceramic capacitor and a 10 uF Tantalum cap at output.
Output 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	 - - - - - -	 - - - - - -	 30 mV 30 mV 20 mV 20 mV 15 mV 15 mV	
Turn On Time	-	-	10 mS	
Rise Time	-	-	3 mS	
Overshoot at Turn on and off	-	-	0.5%	
Output Capacitance ESR≥1 mΩ	0 uF	-	4700 uF	
Transient Response				
0% ~ 50% Max Load	Vo=All	-	-	300 mV	Test conditions: di/dt = 10 A/uS; Vin =12 V;
Settling Time		-	-	100 uS	
50% ~ 0% Max Load		-	-	300 mV	
Settling Time		-	-	100 uS	

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

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				
Vo=5.0 V	91%	94%	-	Measured at Vin=12 V, full load.
Vo=3.3 V	89%	92%	-	
Vo=2.5 V	87%	90%	-	
Vo=1.8 V	84%	87%	-	
Vo=1.5 V	82%	85%	-	
Vo=1.2 V	79%	82%	-	
Vo=1.0 V	76%	79%	-	
Vo=0.6 V	68%	71%	-	
Switching Frequency	-	500 kHz	-	
Output Voltage Trim Range	0.6 V	-	5 V	Trim pin is open, Vo = 0.6 V.
Over Voltage Protection	110% Vo,set	115%Vo,set	130%Vo,set	Vin=12 V, Io=full load.
MTBF	2,392,000 hours			Calculated Per Bell Core SR-332 (Io = 80%Iomax; Vin=12 V; Ta = 25 °C;0RP2-40E1A0)
	3,061,000 hours			Calculated Per Bell Core SR-332 (Io = 80%Iomax; Vin=12 V; Ta = 25 °C;VRP2-40E1A0)
Dimensions (horizontal mount) Inches (L × W × H) Millimeters (L × W × H)	1.45 x 1.10 x 0.50 36.83 x 27.94 x 12.7			
Dimensions (vertical mount) Inches (L × W × H) Millimeters (L × W × H)	1.45 x 1.10 x 0.377 36.83 x 27.94 x 9.58			
Weight	-	19 g	-	

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

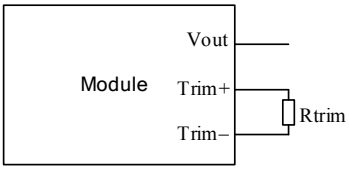
Control Specifications

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)	2.0 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	

Output Trim Equation

The Trim resistor should be connected between the Trim+ pin and Trim- pin.

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



Jan. 12, 2015

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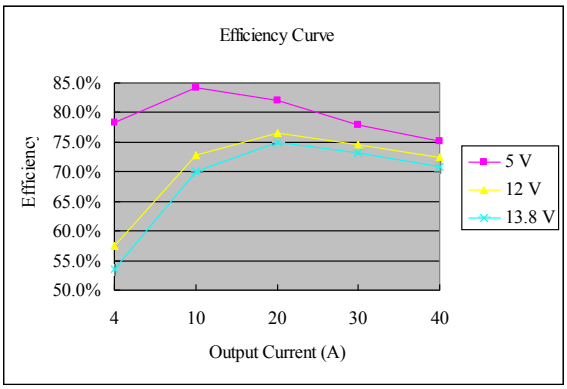
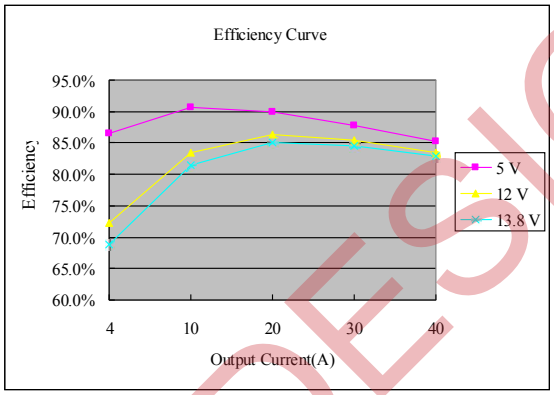
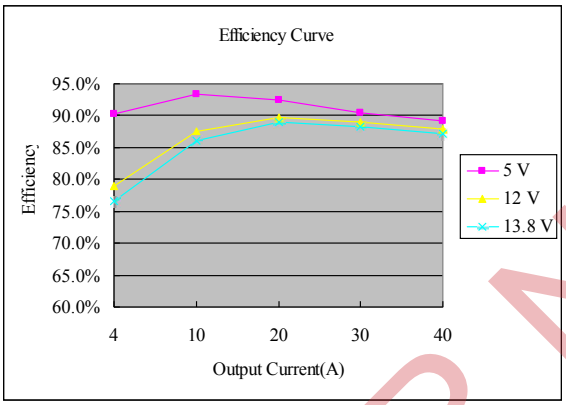
Efficiency Data



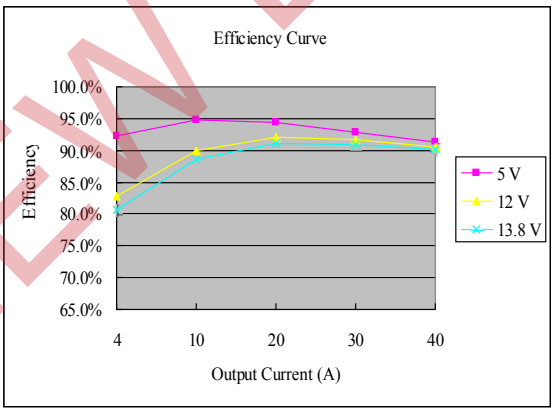
Vout =0.6 V



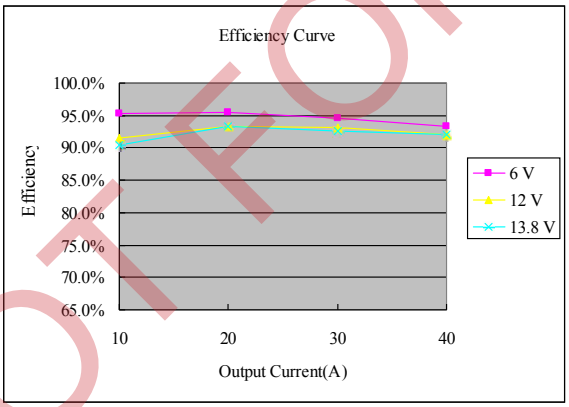
Vout =1.2 V



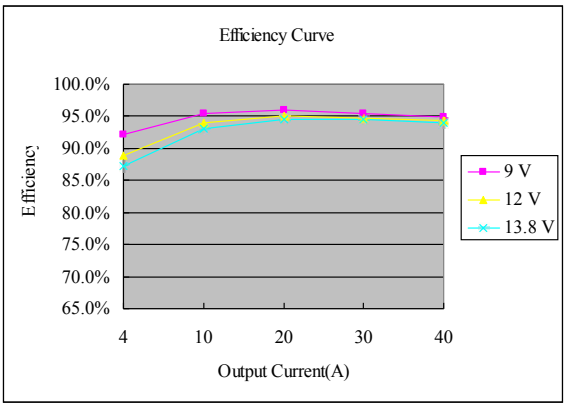
Vout =1.8 V



Vout =2.5 V

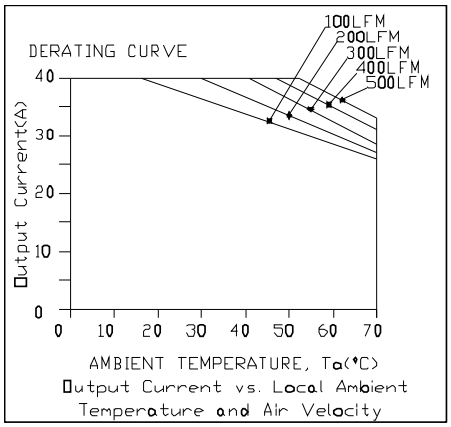


Vout =3.3 V

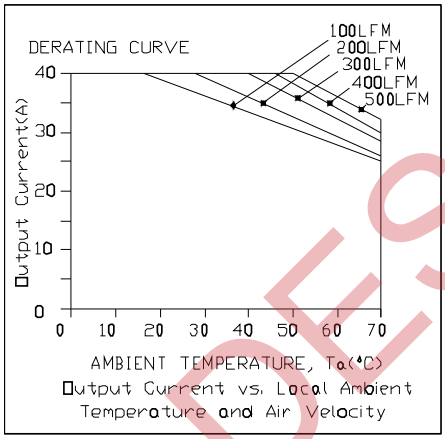


Vout =5.0 V

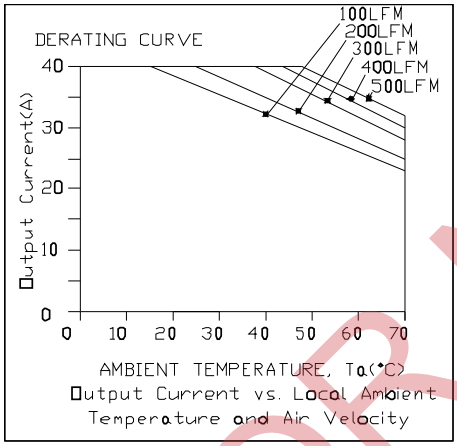
Thermal Derating Curves



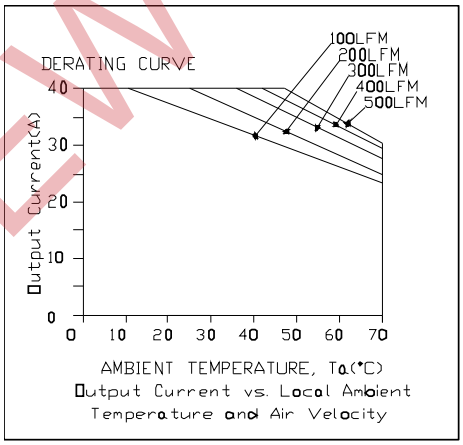
Vin=12 V, Vo=0.6 V



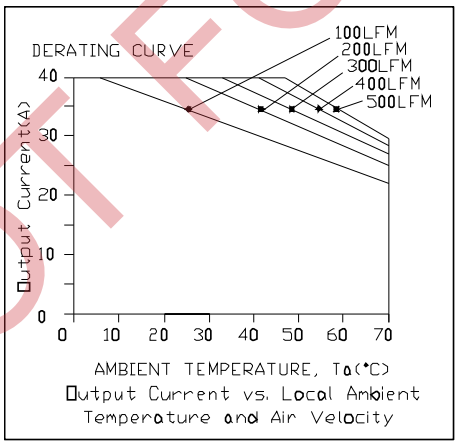
Vin=12 V, Vo=1.2 V



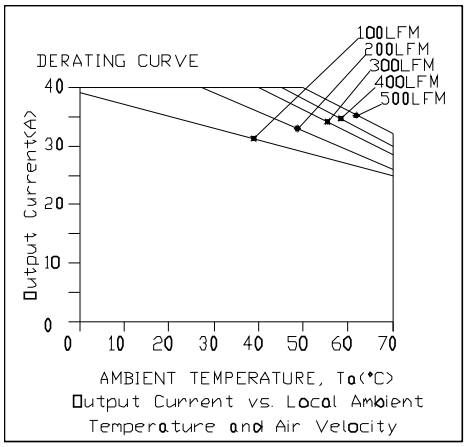
Vin=12 V, Vo=1.8 V



Vin=12 V, Vo=2.5 V

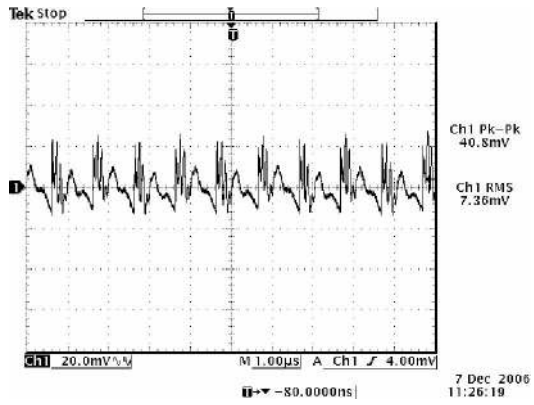


Vin=12 V, Vo=3.3 V

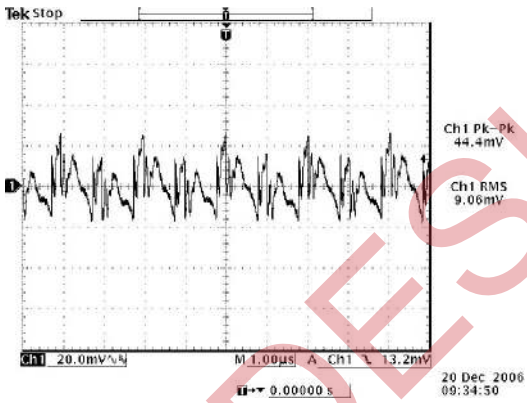


Vin=12 V, Vo=5.0 V

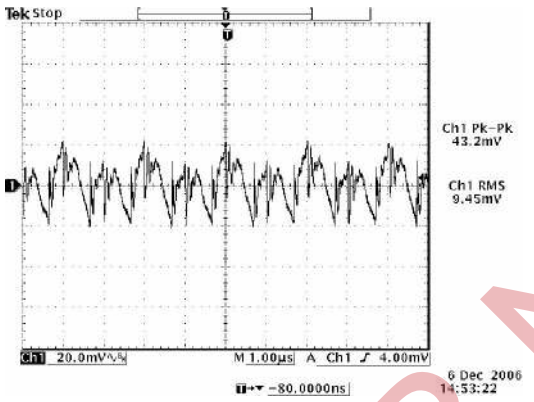
Ripple and Noise Waveforms



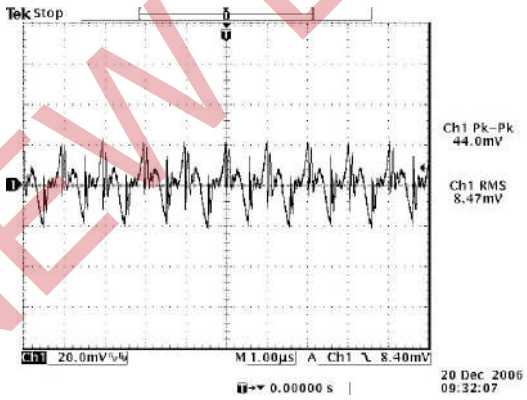
12 Vdc input, 0.6 Vdc/40 A output



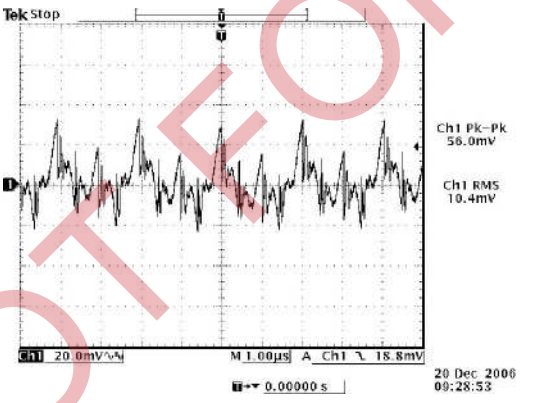
12 Vdc input, 1.2 Vdc/40 A output



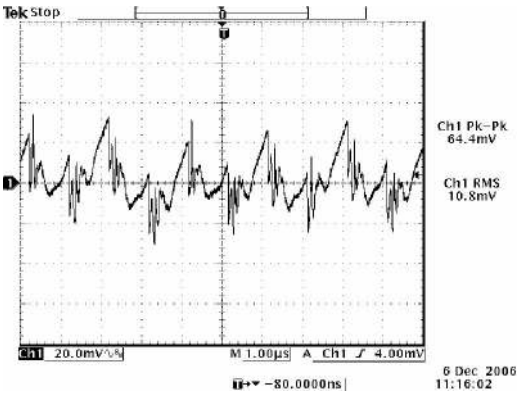
12 Vdc input, 1.8 Vdc/40 A output



12 Vdc input, 2.5 Vdc/40 A output



12 Vdc input, 3.3 Vdc/40 A output



12 Vdc input, 5.0 Vdc/40 A output

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

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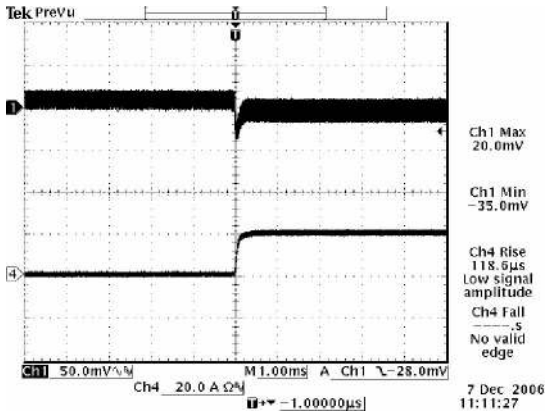
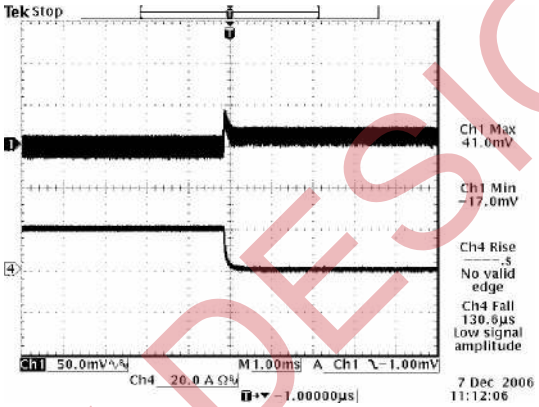
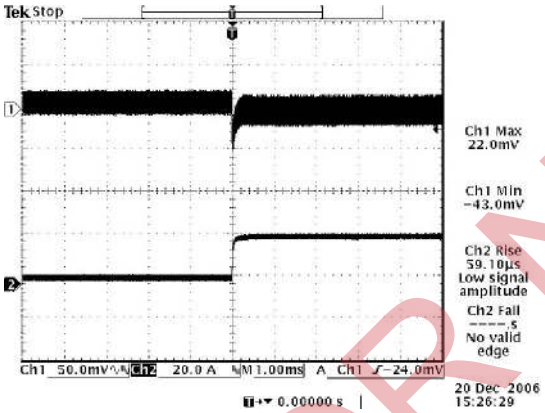
Transient Response Waveforms



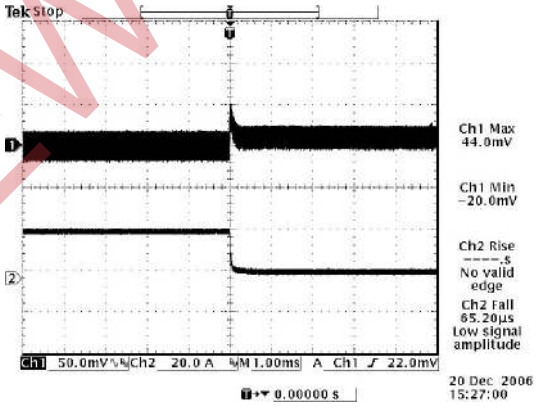
Vout= 0.6 V 0%-50% Load Transients



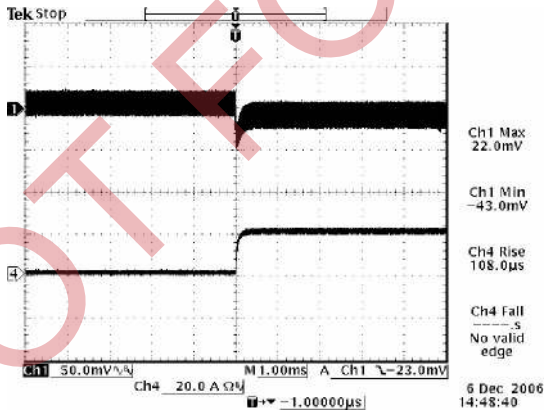
Vout=0.6 V 50%-0% Load Transients



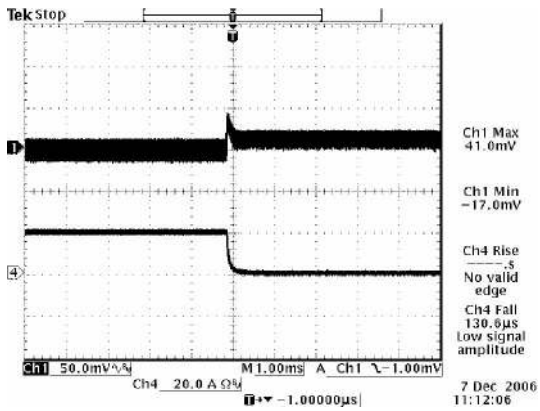
Vout=1.2 V 0%-50% Load Transients



Vout=1.2 V 50%-0% Load Transients

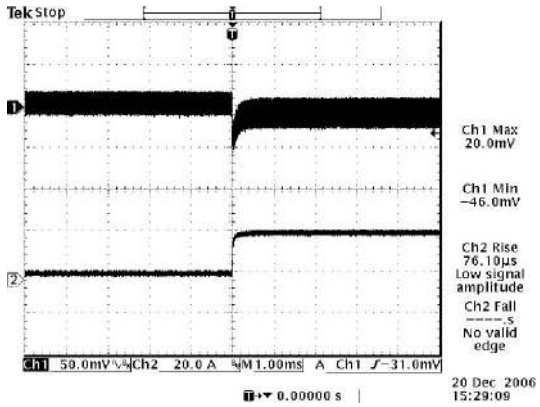


Vout=1.8 V 0%-50% Load Transients

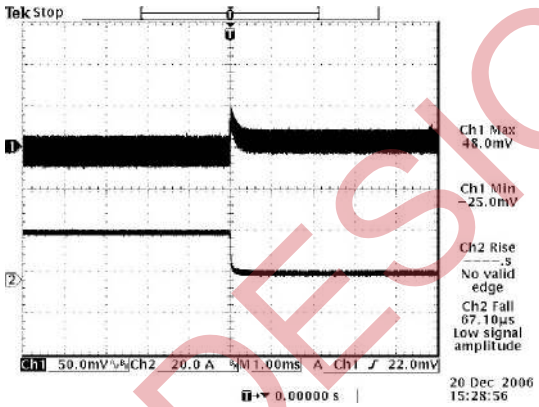


Vout=1.8 V 50%-0% Load Transients

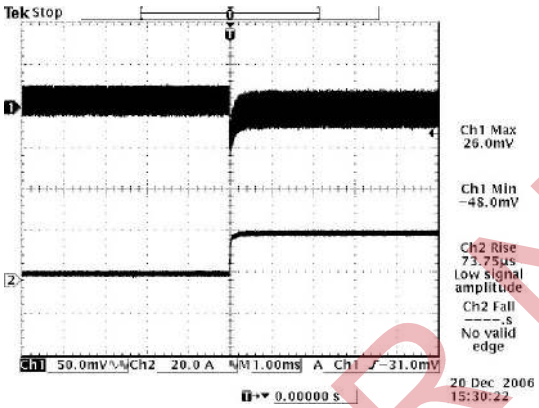
Transient Response Waveforms (continued)



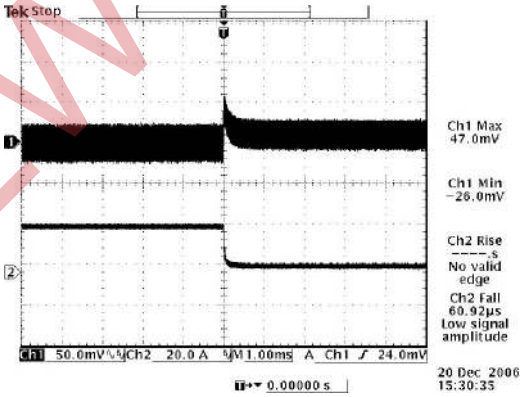
Vout= 2.5 V 0%-50% Load Transients



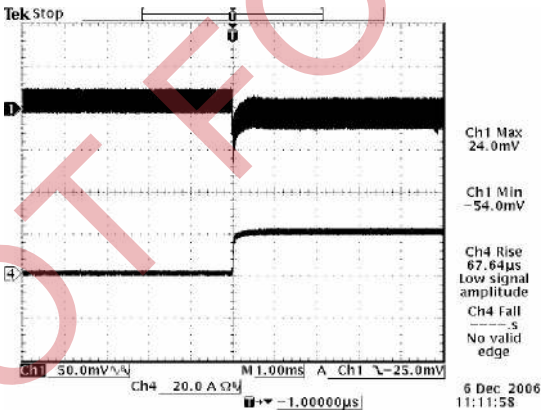
Vout=2.5 V 50%-0% Load Transients



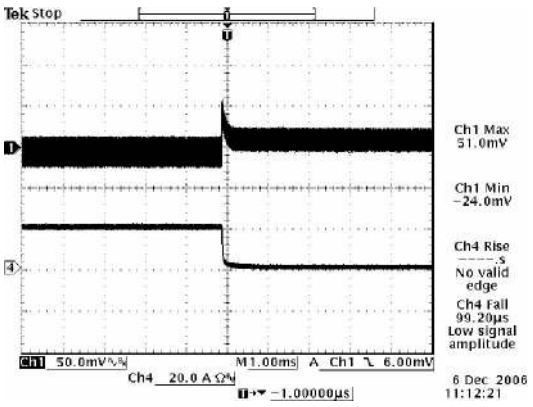
Vout=3.3 V 0%-50% Load Transients



Vout=3.3 V 50%-0% Load Transients



Vout=5 V 0%-50% Load Transients



Vout=5 V 50%-0% Load Transients

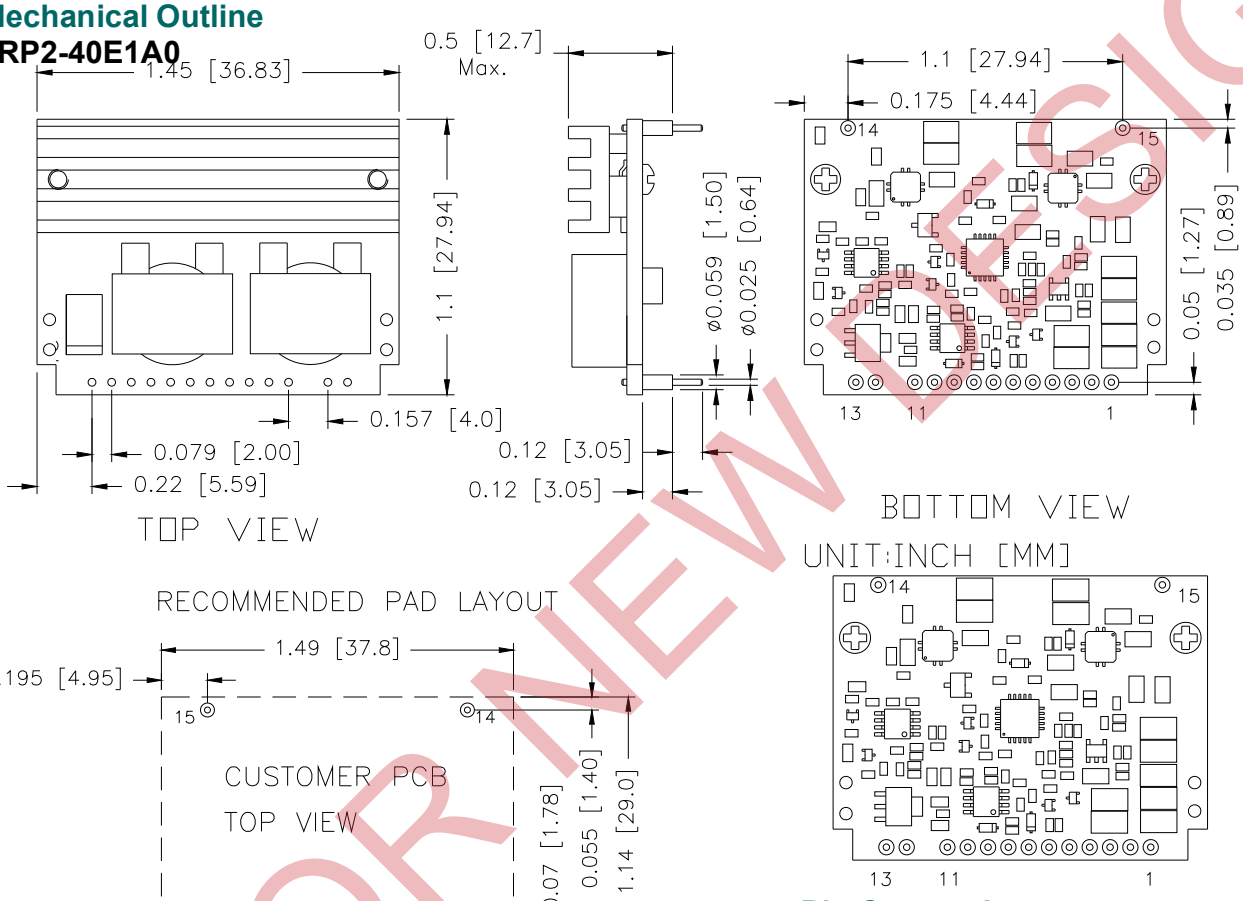
Note: Transient response at di/dt = 10 A/uS, with extemal electrolytic cap 4700 uF, and Ta=25 deg C.

Assembly Note

Modules were designed for vertical insertion into host board. Experiments should be performed to make sure that the units meet the intended tilt specification. A fixture may be needed to make the module stand upright in assembly

Mechanical Outline

0RP2-40E1A0



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+		

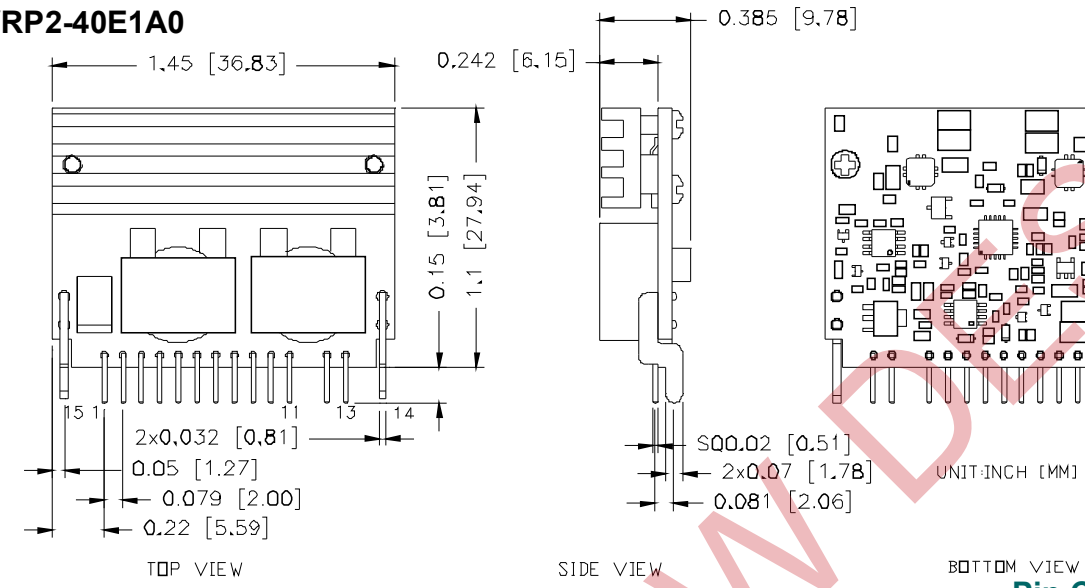
Note: This module is recommended and compatible with Pb-Free Wave Soldering and must be soldered using a peak solder temperature of no more than 260 ºC for less than 5 seconds.

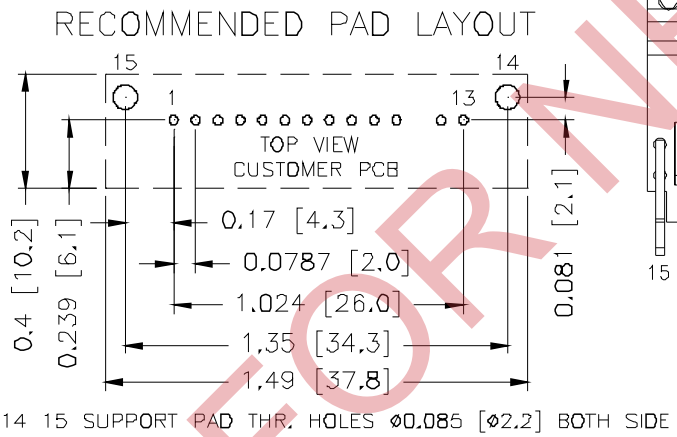
Notes:

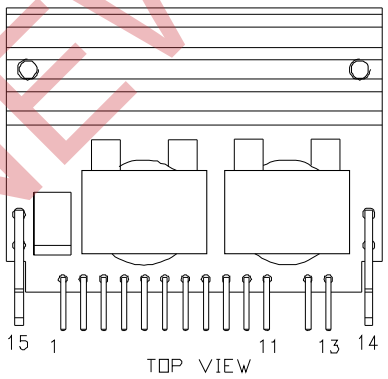
1) Pins: Material - Copper Alloy;
   Finish – 3 micro inches minimum Gold over 50 micro inches minimum Nickel plate.
2) Undimensioned components are shown for visual reference only.
3) All dimensions in inches (mm);Tolerances: x.xx +/-0.020 in[0.51mm], x.xxx +/-0.010 in[0.25mm].

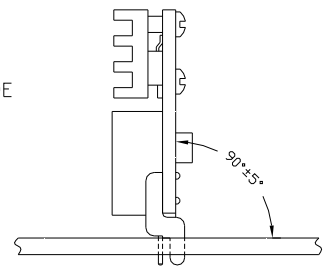
Mechanical Outline

VRP2-40E1A0









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.

Notes:

1) Function Pins: Material - Copper Alloy;
Finish – 3 micro inches minimum Gold over 50 micro inches minimum Nickel plate.
Support Pins: Material - Copper Alloy;
Finish –200 micro inches minimum Tin 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 +/-0.020 in[0.51mm], x.xxx +/-0.010 in[0.25mm].

Revision History

Date	Revision	Changes Detail	Approval
2015-1-12	E	Update MD.	YP Zhou
2016-01-18	F	Add Assembly Note. Update mechanical drawing.	Falling Tao

RoHS Compliance

Complies with the European Directive 2011/65/EU, calling for the elimination of lead and other hazardous substances from electronic products.

CORPORATE

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