

NON-ISOLATED DC/DC CONVERTERS

5 Vdc - 13.8 Vdc Input

0.6 Vdc - 5.0 Vdc/40 A Output

bel
POWER PRODUCTS

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
- Class 2, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)
- Wide Output Trim Range
- Output Over-Voltage Shutdown
- OCP/SCP
- Low Output Ripple
- Power Good Signal
- Remote On/Off



Description

The xRP2-40E1A0 is a non-isolated dc/dc converter that operates over a wide range of input voltage ($V_{in} = 5 \text{ Vdc} - 13.8 \text{ Vdc}$). 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 ($V_o=1.8 \text{ Vdc}$) | 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

$\frac{x}{1} \frac{R}{2} \frac{P2}{3} - \frac{40}{4} \frac{E}{5} \frac{1A}{6} \frac{0}{7} \frac{x}{8}$

- 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

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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 | | | | |
| $V_o \leq 2.8 \text{ V}$ | 5 V | 12 V | 13.8 V | |
| $V_o > 2.8 \text{ V}$ | $1.8 \cdot V_o$ | 12 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 ² t Inrush Current Transient | - | - | 1 A ² s | |
| 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.

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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.

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Jan. 12, 2015

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General Specifications

| Parameter | Min | Typ | Max | Notes |
|-------------------------------|----------------------|------------|------------|---|
| Efficiency | | | | Measured at Vin=12 V, full load. |
| Vo=5.0 V | 91% | 94% | - | |
| 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;ORP2-40E1A0) |
| | 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) | 1.45 × 1.10 × 0.50 | | | |
| Millimeters (L × W × H) | 36.83 × 27.94 × 12.7 | | | |
| Dimensions (vertical mount) | | | | |
| Inches (L × W × H) | 1.45 × 1.10 × 0.377 | | | |
| Millimeters (L × W × H) | 36.83 × 27.94 × 9.58 | | | |
| Weight | - | 19 g | - | |

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

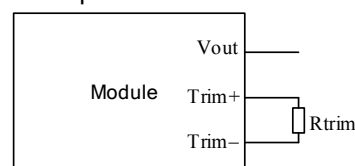
Control Specifications

| 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.

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



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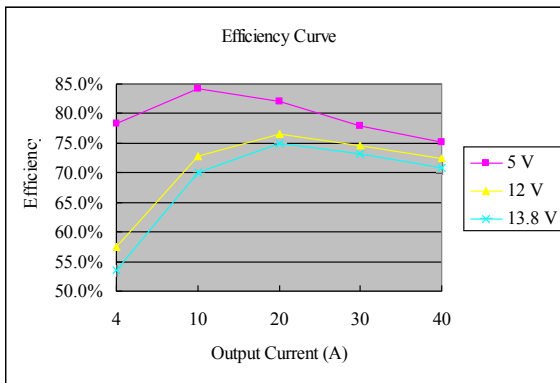
0.6 Vdc - 5.0 Vdc/40 A Output



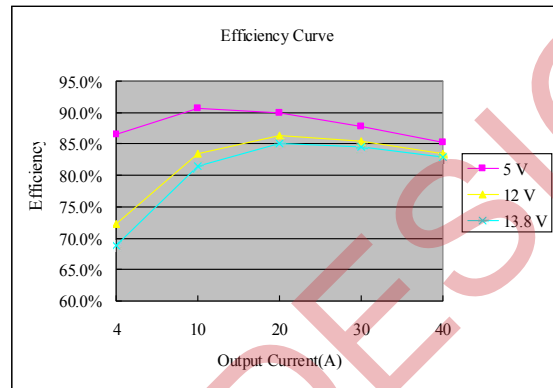
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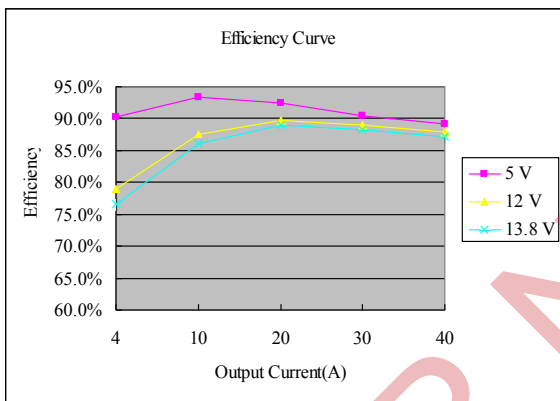
Efficiency Data



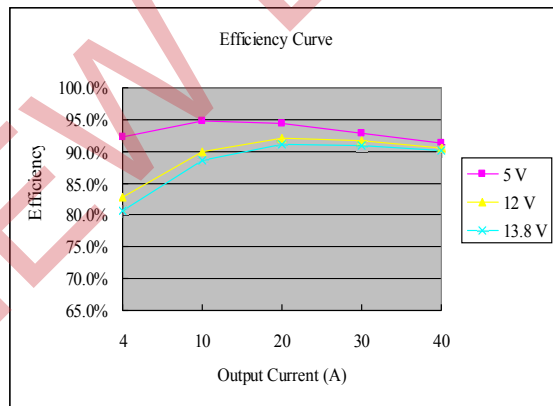
Vout = 0.6 V



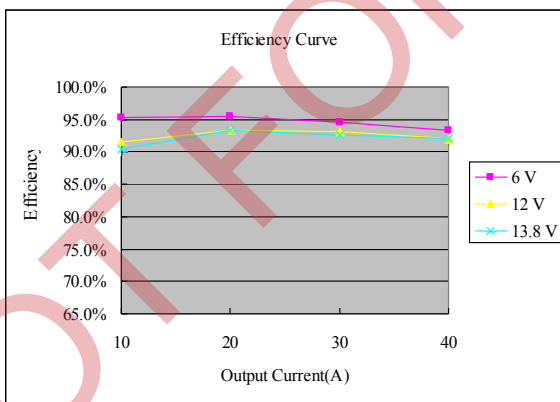
Vout = 1.2 V



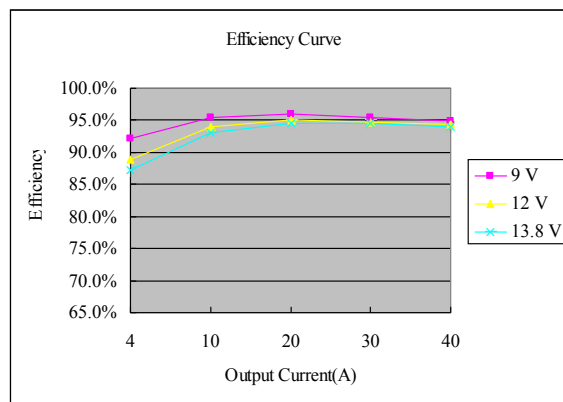
Vout = 1.8 V



Vout = 2.5 V



Vout = 3.3 V



Vout = 5.0 V

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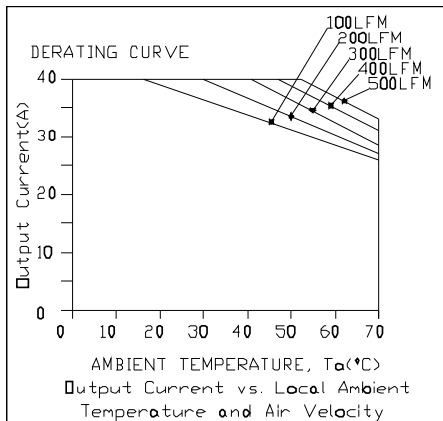
0.6 Vdc - 5.0 Vdc/40 A Output



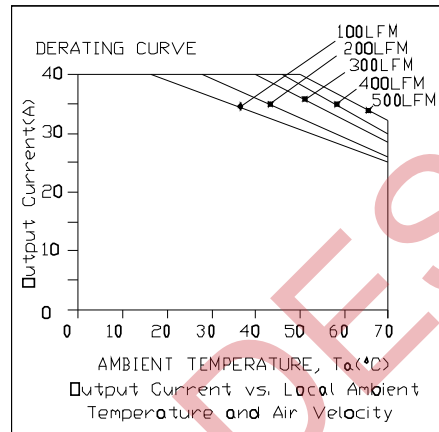
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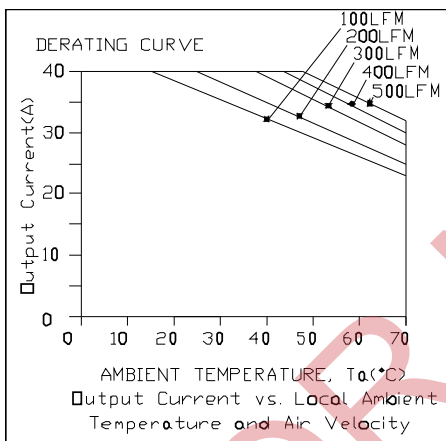
Thermal Derating Curves



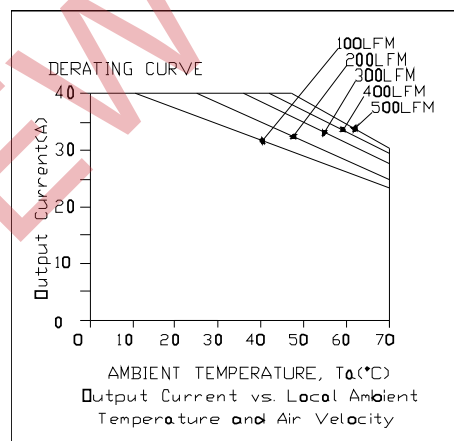
Vin=12 V, Vo=0.6 V



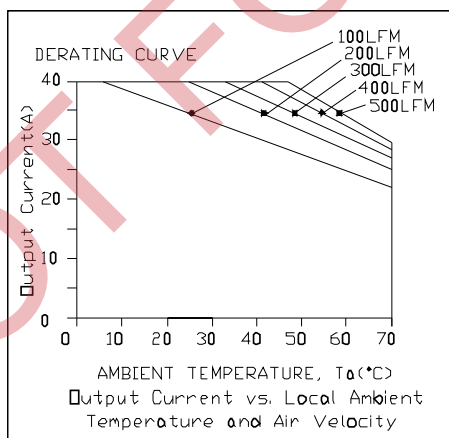
Vin=12 V, Vo=1.2 V



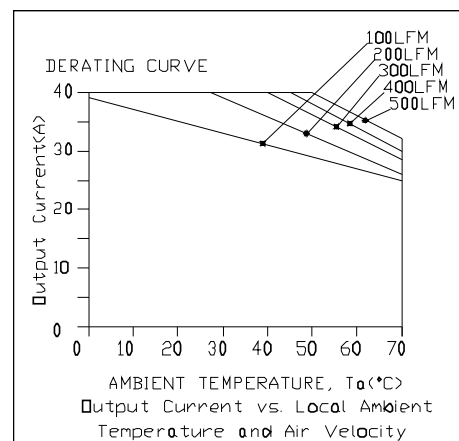
Vin=12 V, Vo=1.8 V



Vin=12 V, Vo=2.5 V



Vin=12 V, Vo=3.3 V



Vin=12 V, Vo=5.0 V

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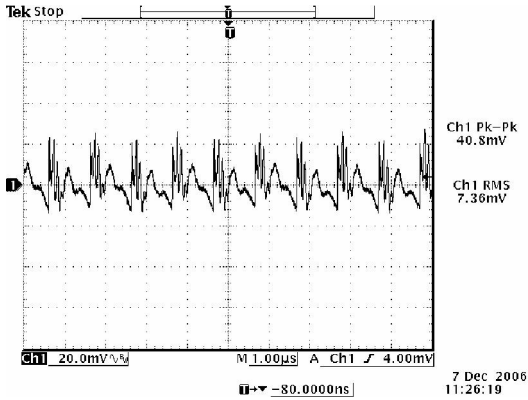
5 Vdc - 13.8 Vdc Input 0.6 Vdc - 5.0 Vdc/40 A Output



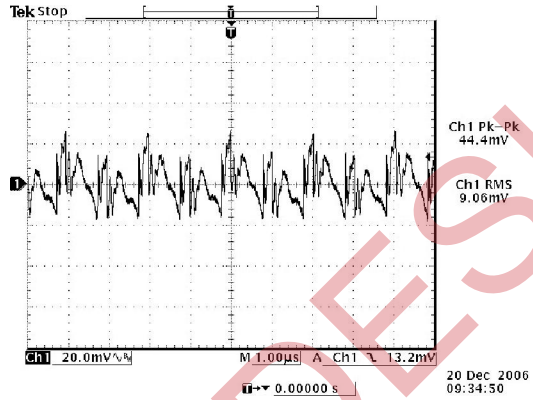
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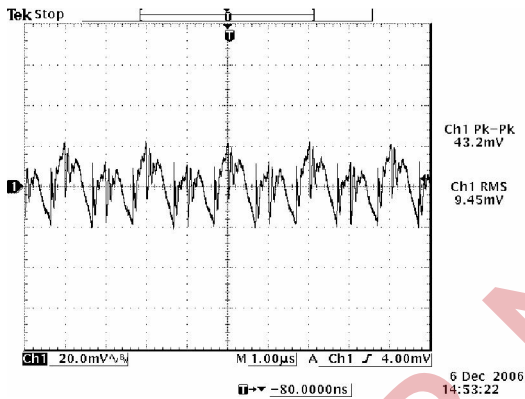
Ripple and Noise Waveforms



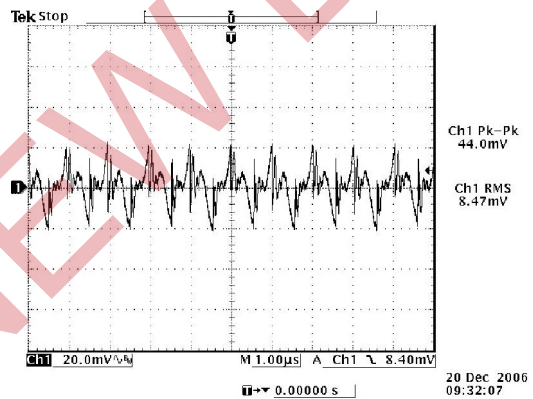
12 Vdc input, 0.6 Vdc/40 A output



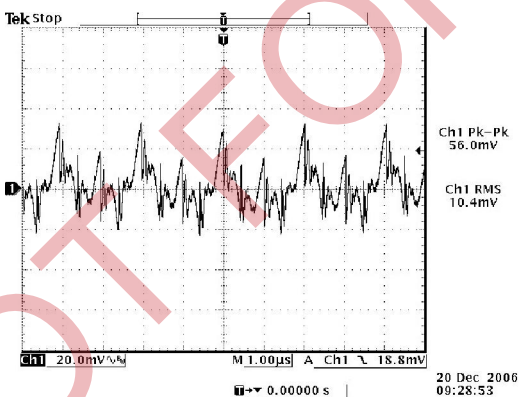
12 Vdc input, 1.2 Vdc/40 A output



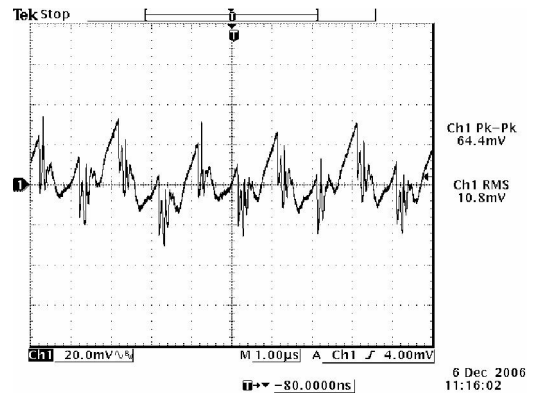
12 Vdc input, 1.8 Vdc/40 A output



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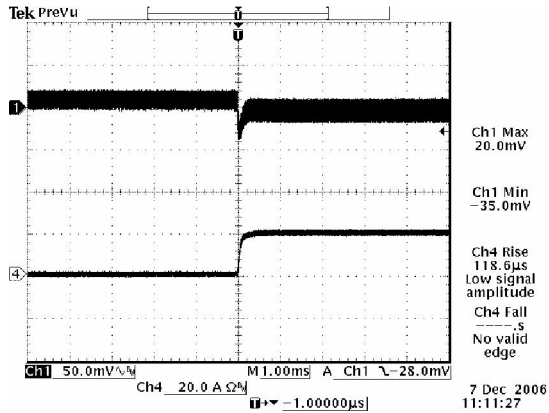
5 Vdc - 13.8 Vdc Input 0.6 Vdc - 5.0 Vdc/40 A Output



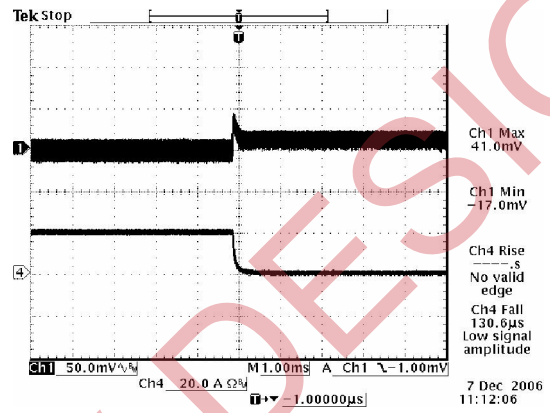
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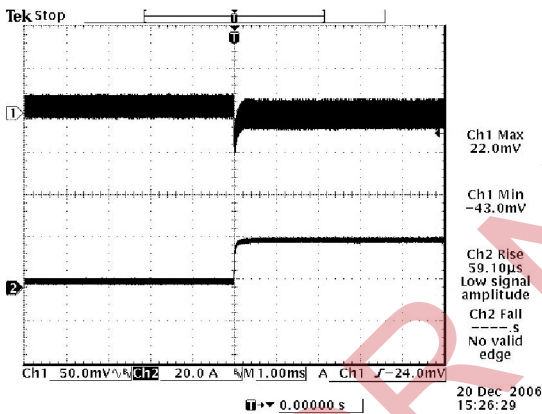
Transient Response Waveforms



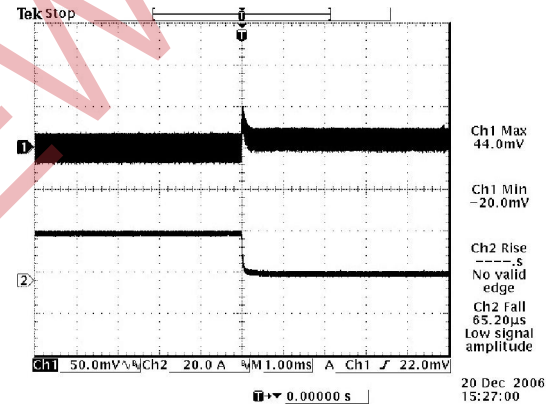
Vout=0.6 V 0%-50% Load Transients



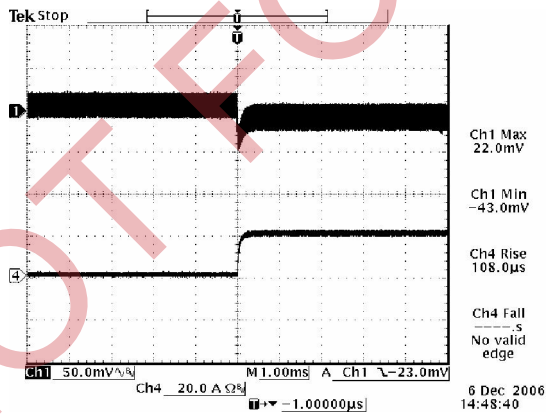
Vout=0.6 V 50%-0% Load Transients



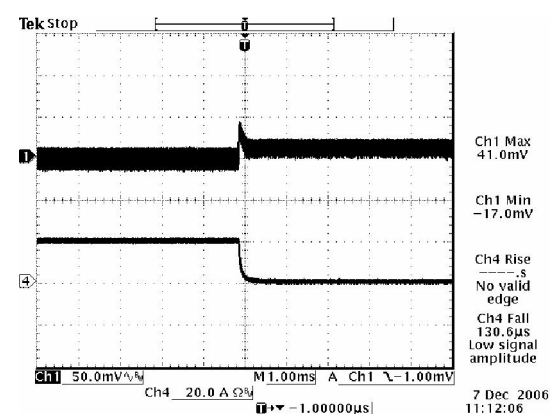
Vout=1.2 V 0%-50% Load Transients



Vout=1.2 V 50%-0% Load Transients



Vout=1.8 V 0%-50% Load Transients



Vout=1.8 V 50%-0% Load Transients

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5 Vdc - 13.8 Vdc Input

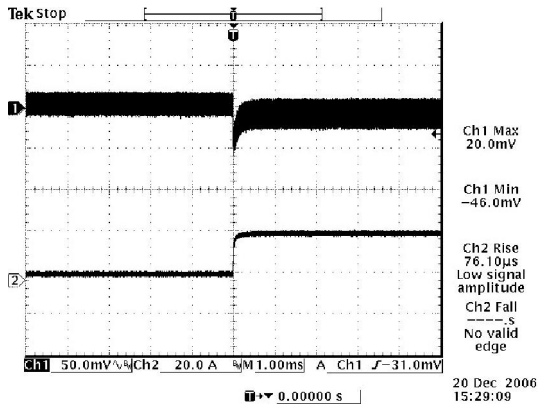
0.6 Vdc - 5.0 Vdc/40 A Output



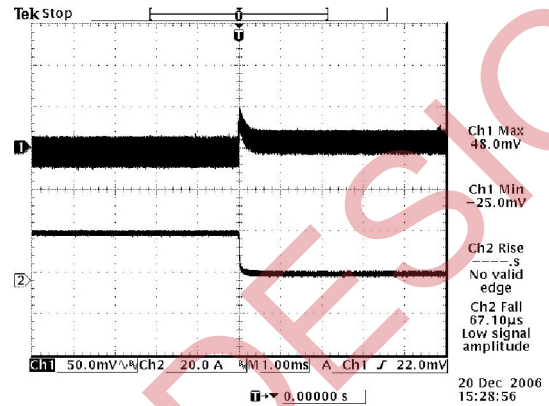
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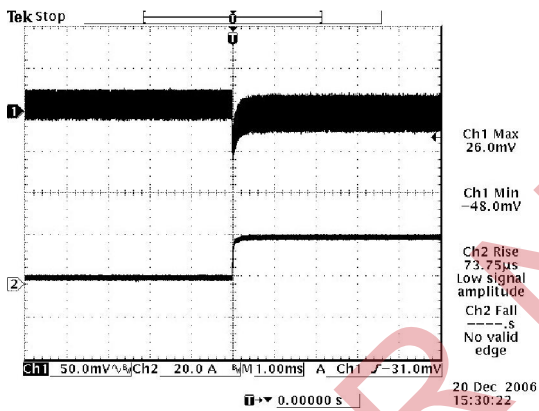
Transient Response Waveforms (continued)



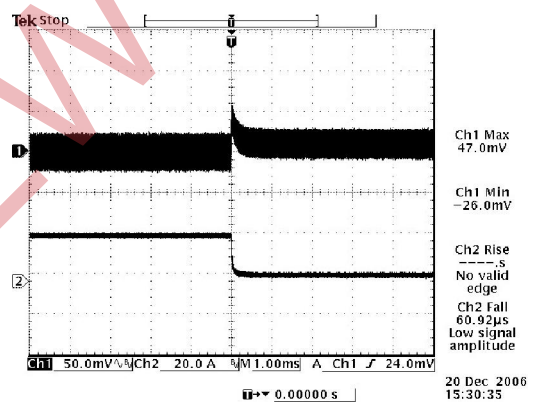
Vout=2.5 V 0%-50% Load Transients



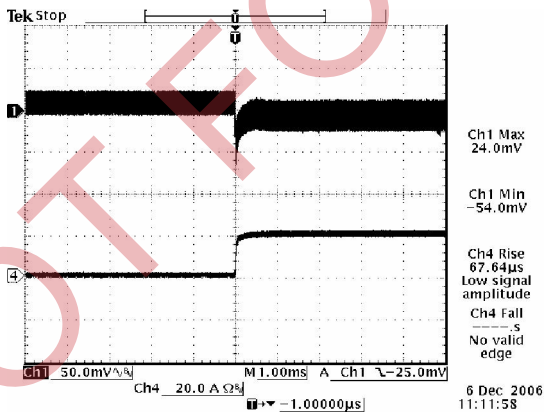
Vout=2.5 V 50%-0% Load Transients



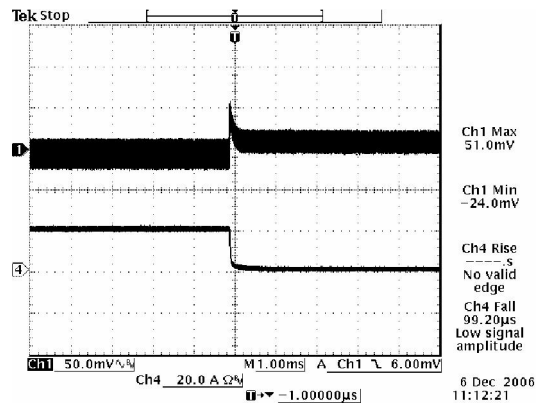
Vout=3.3 V 0%-50% Load Transients



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 external electrolytic cap 4700 uF, and Ta=25 deg C.

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



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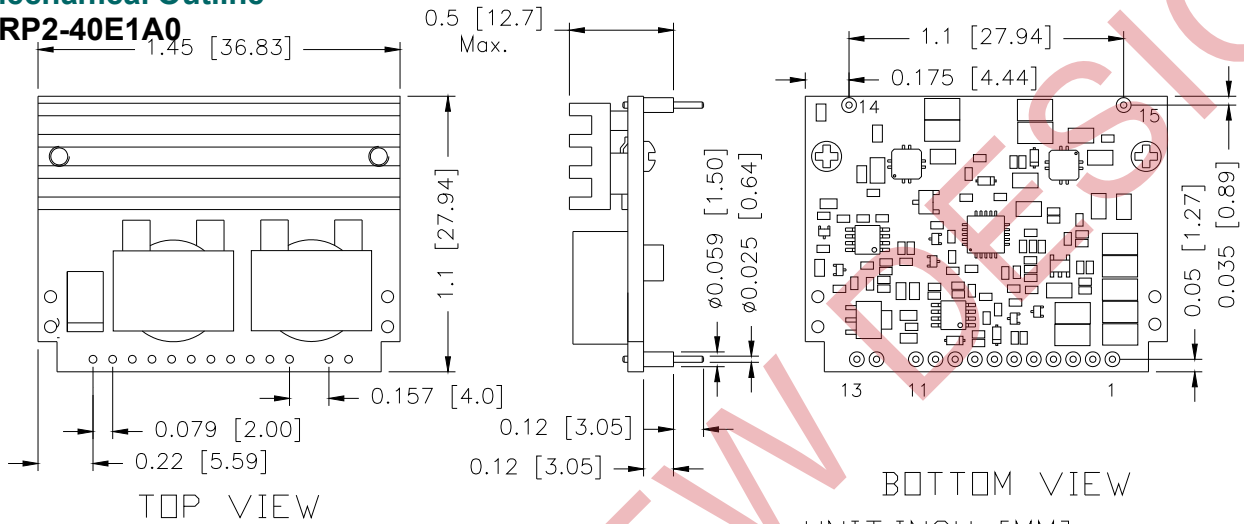
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Assembly Note

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

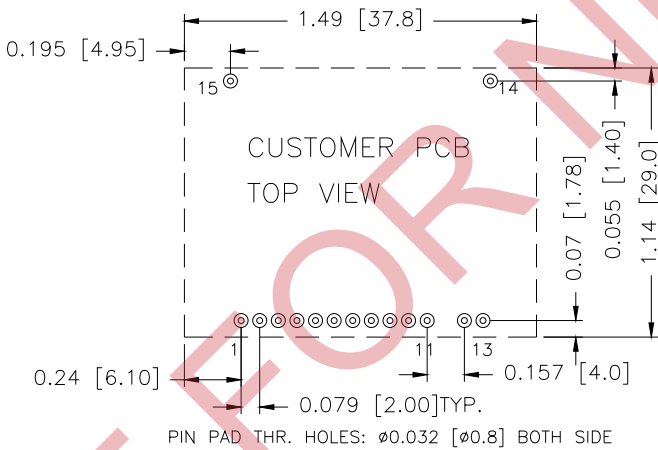


TOP VIEW

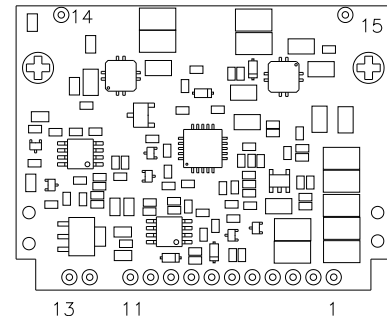
BOTTOM VIEW

UNIT: INCH [MM]

RECOMMENDED PAD LAYOUT



PIN PAD THR. HOLES: $\varnothing 0.032$ [$\varnothing 0.8$] BOTH SIDE



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 °C 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].

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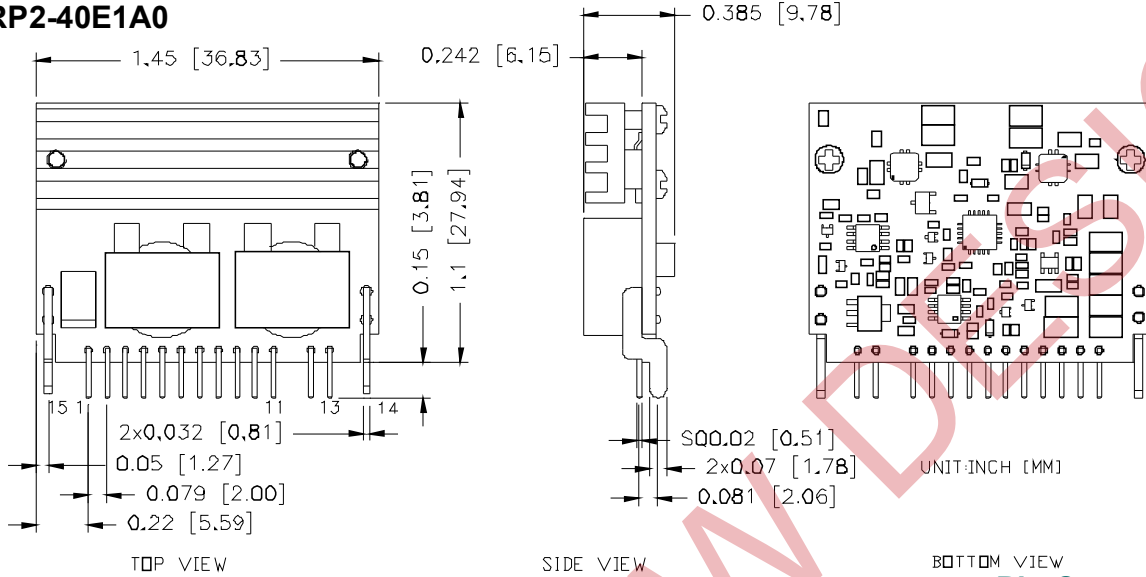


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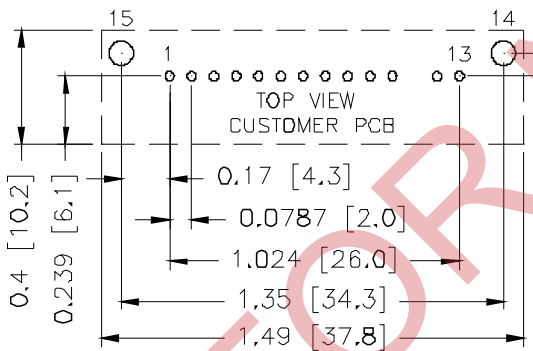
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Mechanical Outline

VRP2-40E1A0



RECOMMENDED PAD LAYOUT



14 15 SUPPORT PAD THR. HOLES ϕ 0.085 [ϕ 2.2] BOTH SIDE
 1~13 PIN PAD THR. HOLES: ϕ 0.032 [ϕ 0.8] BOTH SIDE

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 °C for less than 5 seconds.

Notes:

- 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.
- Undimensioned components are shown for visual reference only.
- All dimensions in inches (mm); Tolerances: x.xx +/-0.020 in[0.51mm], x.xxx +/-0.010 in[0.25mm].

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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.



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CORPORATE

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