

NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.8 Vdc - 5.5 Vdc/8 A Output

bel
POWER PRODUCTS

xRAH-08E Series RoHS Compliant Rev.A

- Non-Isolated
- Fixed Frequency
- High Efficiency
- High Power Density
- Low Cost
- Remote On/Off
- Under-voltage Lockout (UVLO)
- OCP/SCP
- Wide Trim Range
- UL60950-1 Recognized (UL/cUL)



Description

The Bel xRAH-08Exxx modules are a series of non-isolated, step down dc/dc converters that operate from 4.5 Vdc to 14 Vdc source. These converters are available in a range of output voltages from 0.8 Vdc to 5.5 Vdc. It is packaged in a compact, overmolded package rated at 8 A. Optional lead forming provides a vertical mount product for minimal footprint or a surface mount option for a very low profile. The output is closely regulated and the efficiency for 5 Vdc output is typically 93% at full load.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Part Number Surface Mount	Part Number Vertical Mount
0.8 V - 3.63 V	4.5 V - 14 V	8 A	26.4 W	91%	SRAH-08E1A0	VRAH-08E1A0
4.5 V - 5.5 V	8 V - 14 V	8 A	44 W	93%	SRAH-08E500	VRAH-08E500

Notes: 1. Add "0" suffix at the end of the model number to indicate "Tube Packaging", and "R" for "Reel Packaging", and "G" for "Tray Packaging".

2. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers.

Absolute Maximum Ratings

Parameter	Min	Typ	Max	Notes
Input Voltage (continuous)	-0.3 V	-	15 V	
Output Enable Terminal Voltage	-0.3 V	-	14 V	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-55 °C	-	125 °C	

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
Vo=4.5 V-5.5 V	8.0 V	-	14 V	
Vo=0.9 V-3.63 V	4.5 V	-	14 V	
Input Current (full load)				
Vo=5.0 V	-	-	5.4 A	
Vo=3.3 V	-	-	6.7 A	
Vo=2.5 V	-	-	5.3 A	
Vo=1.8 V	-	-	3.2 A	
Vo=1.5 V	-	-	3.0 A	
Vo=1.2 V	-	-	2.8 A	
Vo=0.9 V	-	-	2.0 A	
Input Current (no load)	-	-	100 mA	
Remote Off Input Current	-	3 mA	10 mA	
Input Reflected Ripple Current (pk-pk)	-	250 mA	-	With simulated source impedance of 500 nH, 5 Hz to 20 MHz; use two 47 uF/16 V low ESR Tantalum capacitors.
Input Reflected Ripple Current (rms)	-	70 mA	-	

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Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
I ² t Inrush Current Transient	-	0.006 A ² s	0.02 A ² s	
Turn-on Voltage Threshold	-	4.3 V	-	xRAH-08E1A0
	-	7.6 V	-	xRAH-08E500
Turn-off Voltage Threshold	-	4.0 V	-	xRAH-08E1A0
	-	6.2 V	-	xRAH-08E500

Output Specifications

Parameter	Min	Typ	Max	Notes	
Output Voltage Set Point	V _o =5.0 V	4.900 V	5.0 V	5.100 V	Test condition: V _{in} =12 V, I _{out} =50% full load
	V _o =3.3 V	3.234 V	3.3 V	3.366 V	
	V _o =2.5 V	2.450 V	2.5 V	2.550 V	
	V _o =1.8 V	1.764 V	1.8 V	1.836 V	
	V _o =1.5 V	1.470 V	1.5 V	1.530 V	
	V _o =1.2 V	1.176 V	1.2 V	1.224 V	
	V _o =0.9 V	0.882 V	0.9 V	0.918 V	
Line Regulation	V _o =5.0 V	-	±15 mV	±25 mV	
	V _o =3.3 V	-	±10 mV	±16.5 mV	
	V _o =2.5 V	-	±8 mV	±12.6 mV	
	V _o =1.8 V	-	±5 mV	±9 mV	
	V _o =1.5 V	-	±5 mV	±9 mV	
	V _o =1.2 V	-	±4 mV	±8 mV	
Load Regulation	V _o =5.0 V	-	±15 mV	±25 mV	
	V _o =3.3 V	-	±10 mV	±16.5 mV	
	V _o =2.5 V	-	±8 mV	±12.5 mV	
	V _o =1.8 V	-	±5 mV	±9 mV	
	V _o =1.5 V	-	±5 mV	±9 mV	
	V _o =1.2 V	-	±4 mV	±8 mV	
Regulation Over Temperature (-40 °C to 85 °C)	-	30 mV	50 mV		
	-	30 mV	50 mV		
Output Current	0 A	-	8 A		
Current Limit Threshold	10 A	-	20 A		
Short Circuit Surge Transient	-	0.2 A ² s	-		
Ripple and Noise (rms)	V _o =5.0 V	-	30 mV	50 mV	BW = 0-20 MHz; with a 1 uf ceramic capacitor and a 10 uF/10 V Tantalum capacitor at the output.
	V _o =3.3 V-0.9 V	-	15 mV	30 mV	
Ripple and Noise (pk-pk)	V _o =5.0 V	-	100 mV	150 mV	
	V _o =3.3 V-0.9 V	-	50 mV	80 mV	
Turn on Time	-	8 mS	20 mS		
Overshoot at Turn on	-	0%	3%		
Output Capacitance	0 uF	-	3200 uF		

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Output Specifications (continued)

Parameter		Min	Typ	Max	Notes	
Transient Response						
50% ~ 100% Max Load	Overshoot	Vo=5.0 V	-	200 mV	300 mV	di/dt = 0.5 A/uS; Vin = 12 V; with a 1 uF ceramic capacitor and a 10 uF/10 V Tantalum capacitor at the output.
	Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load	Overshoot		-	200 mV	300 mV	
	Settling Time		-	50 uS	80 uS	
50% ~ 100% Max Load	Overshoot	Vo=3.3 V- 0.9 V	-	120 mV	180 mV	
	Settling Time		-	50 uS	80 uS	
100% ~ 50% Max Load	Overshoot		-	120 mV	180 mV	
	Settling Time		-	50 uS	80 uS	

Note: All specifications are typical at 12 V input, full load at 25 °C unless otherwise stated.

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				Measured at Vin=12 V, full load
Vo=5.0 V	89%	93%	-	
Vo=3.3 V	87%	91%	-	
Vo=2.5 V	86%	90%	-	
Vo=1.8 V	84%	88%	-	
Vo=1.5 V	82%	86%	-	
Vo=1.2 V	81%	85%	-	
Vo=0.9 V	76%	80%	-	
Switching Frequency	-	330 kHz	-	
Output Trim Range	90%Vo	-	403%Vo	x7AH-08E1A0 ¹
	90%Vo	-	110%Vo	x7AH-08E500 ²
Remote Sense Compensation	-	-	0.2V	
MTBF	7,801,334 hours			Calculated Per Bell Core SR-332 (Io = Nominal; Ta = 25 °C)
Dimensions (surface mount)				
Inches (L x W x H)	0.78 x 0.7 x 0.32			
Millimeters (L x W x H)	19.81 x 17.78 x 8.13			
Dimensions (vertical)				
Inches (L x W x H)	0.7 x 0.308 x 0.65			
Millimeters (L x W x H)	17.78 x 7.82 x 16.51			
Weight	-	6 g	-	

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

1. The output voltage is 0.9 V at trim pin is open.
2. The output voltage is 5.0 V at trim pin is open.

Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.3 V	-	0.8 V	Remote on/off pin open, unit on.
Signal High (Unit On)	2.4 V	-	14 V	

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POWER PRODUCTS

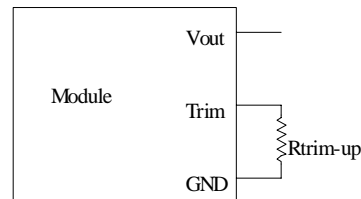
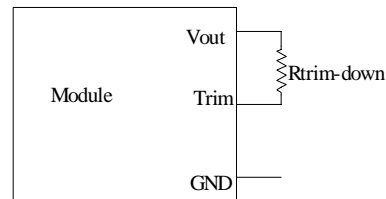
Output Trim Equations

1) xRAH-08E1A0

Equations for calculating the trim resistor (in kΩ) given the desired adjusted voltage (V_{adj}) and the nominal output voltage of the converter (V_{nom}) are shown below. The Trim Down resistor should be connected between the Trim pin and Vout. The Trim Up resistor should be connected between the Trim pin and Ground. Only one of the resistors should be used for any given application.

$$R_{trim-down} = \frac{1.076}{V_o - V_{adj}} - 5.631$$

$$R_{trim-up} = \frac{3.759}{V_{adj} - V_o} - 0.261$$



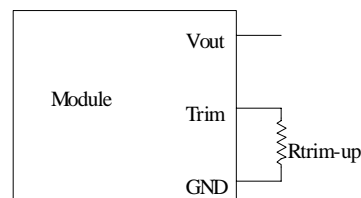
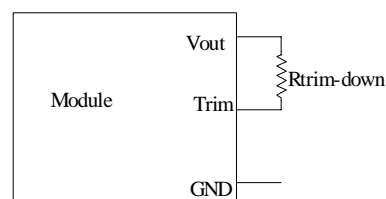
Note: Output voltage $V_o=0.9$ V when Rtrim_up is not connected.

2) xRAH-08E500

Equations for calculating the trim resistor (in kΩ) given the desired adjusted voltage (V_{adj}) and the nominal output voltage of the converter (V_{nom}) are shown below. The Trim Down resistor should be connected between the Trim pin and Vout. The Trim Up resistor should be connected between the Trim pin and Ground. Only one of the resistors should be used for any given application.

$$R_{trim-down} = \frac{23.100}{V_o - V_{adj}} - 5.631$$

$$R_{trim-up} = \frac{3.759}{V_{adj} - V_o} - 0.261$$



Note: Output voltage $V_o=5$ V when Rtrim_up is not connected.

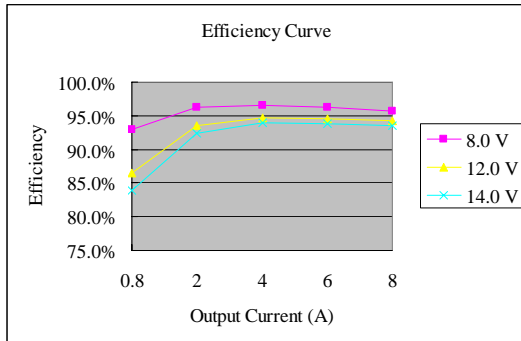
NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

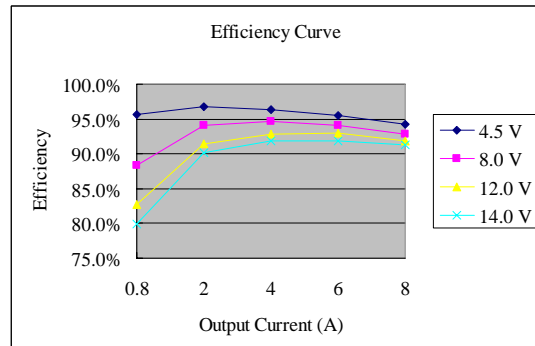
0.8 Vdc - 5.5 Vdc/8 A Output



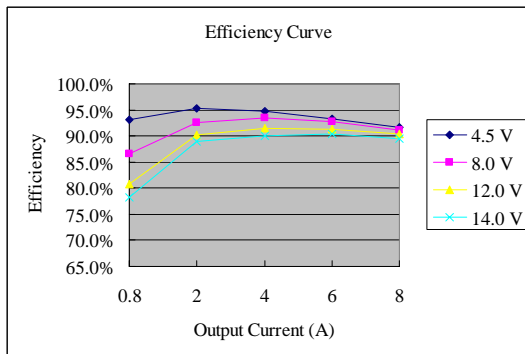
Efficiency Data



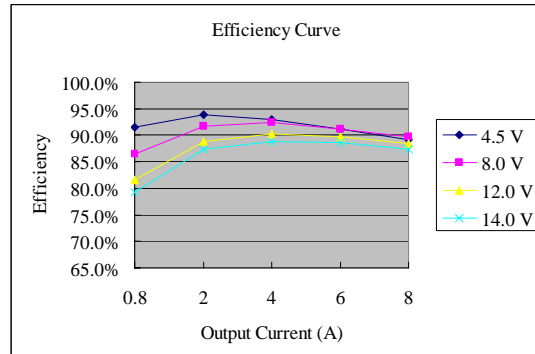
Vo=5.0 V



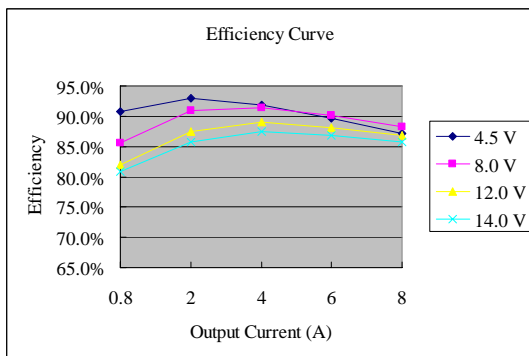
Vo=3.3 V



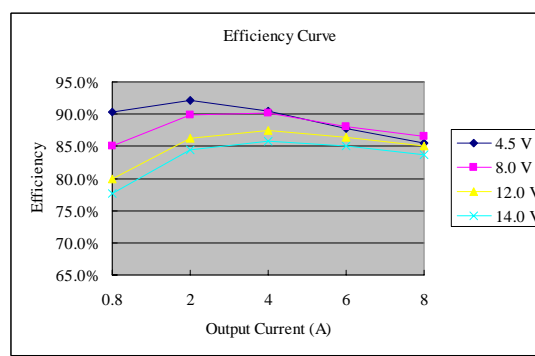
Vo=2.5 V



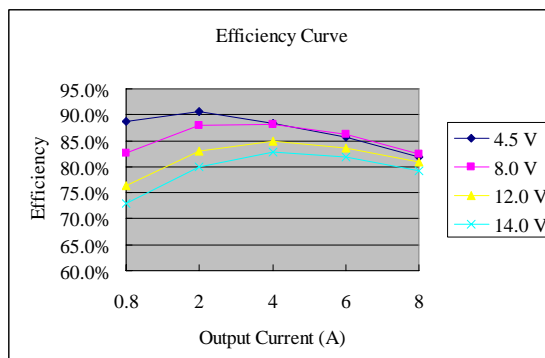
Vo=1.8 V



Vo=1.5 V



Vo=1.2 V



Vo=0.9 V

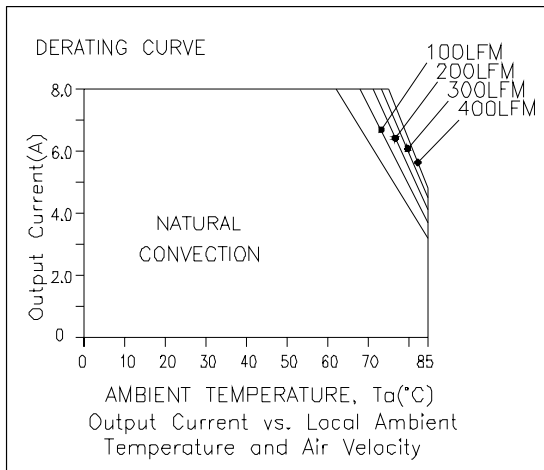
NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

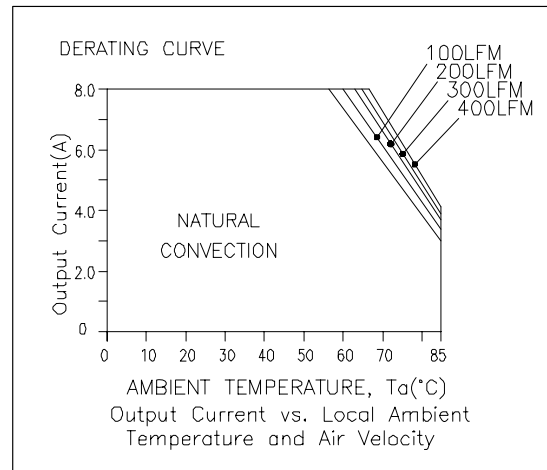
0.8 Vdc - 5.5 Vdc/8 A Output



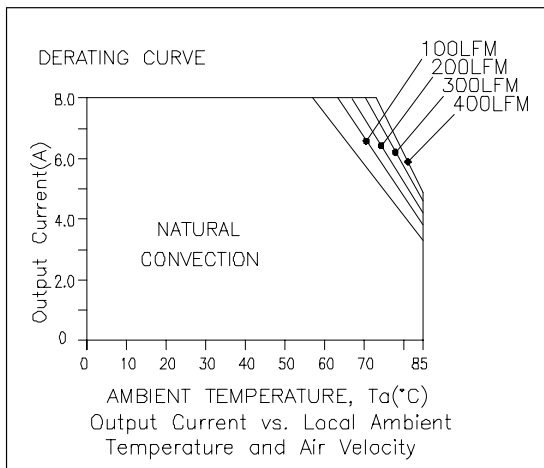
Thermal Derating Curves



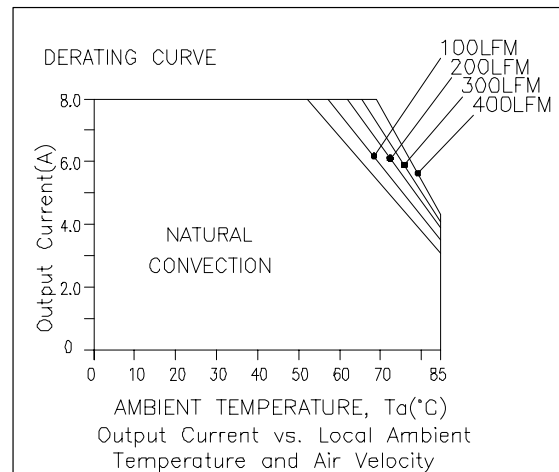
VRAH-08E1A0



SRAH-08E1A0



VRAH-08E500



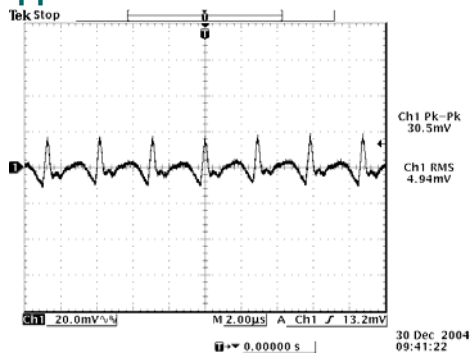
SRAH-08E500

NON-ISOLATED DC/DC CONVERTERS

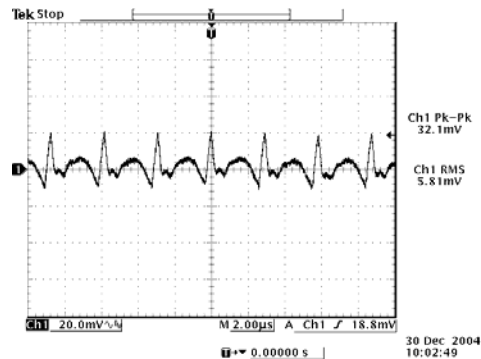
4.5 Vdc - 14 Vdc Input 0.8 Vdc - 5.5 Vdc/8 A Output



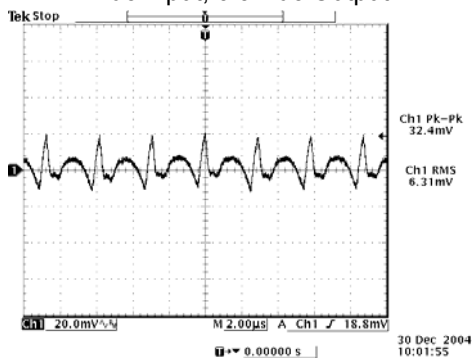
Ripple and Noise Waveforms



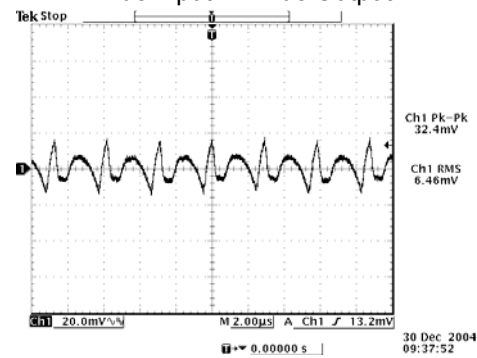
12 Vdc Input, 0.9 Vdc Output



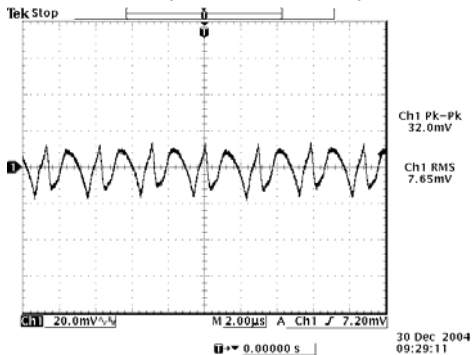
12 Vdc Input 1.2 Vdc Output



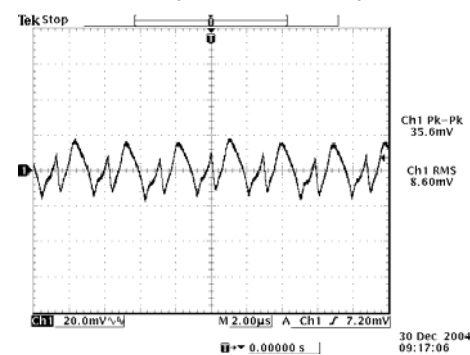
12 Vdc Input, 1.5 Vdc Output



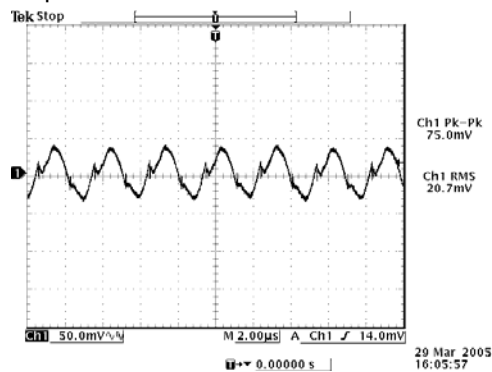
12 Vdc Input 1.8 Vdc Output



12 Vdc Input, 2.5 Vdc Output



12 Vdc Input 3.3 Vdc Output



12 Vdc Input, 5 Vdc Output

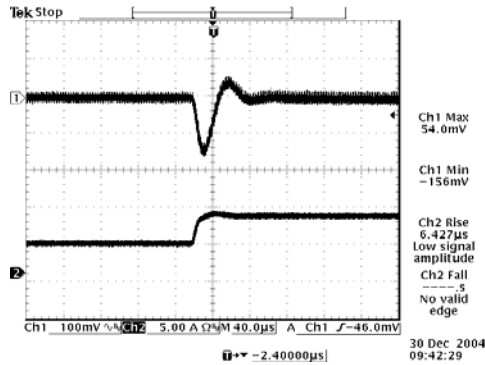
Note: Ripple and noise at full load, with a 1µF ceramic cap and a 10µF tan cap, Ta=25 deg C.

NON-ISOLATED DC/DC CONVERTERS

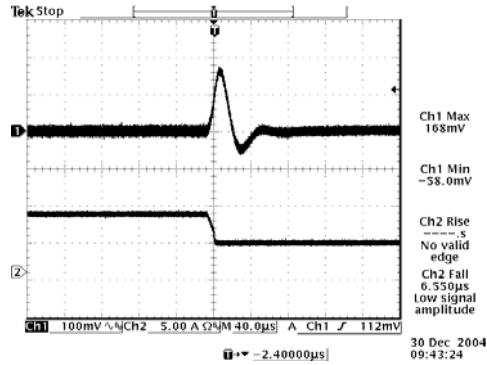
4.5 Vdc - 14 Vdc Input 0.8 Vdc - 5.5 Vdc/8 A Output



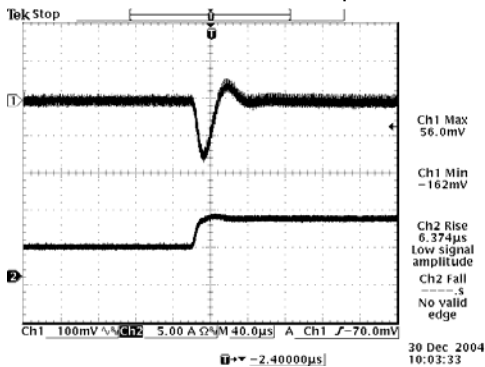
Transient Response Waveforms



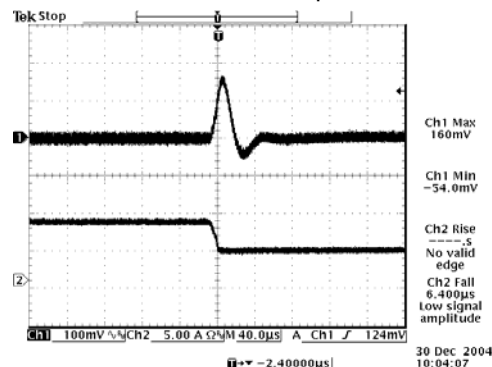
50% to 100% load 12 Vdc Input 0.9 Vdc Output



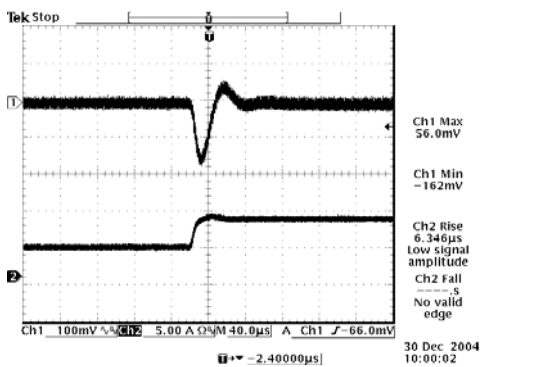
100% to 50% load 12 Vdc Input 0.9 Vdc Output



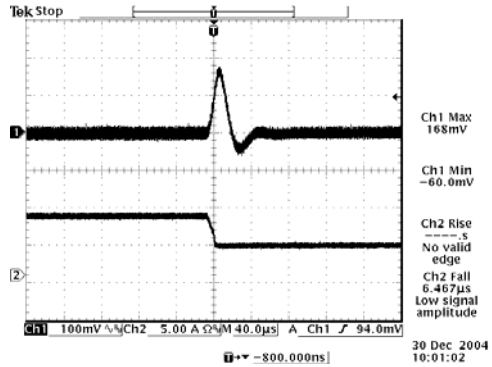
50% to 100% load 12 Vdc Input 1.2 Vdc Output



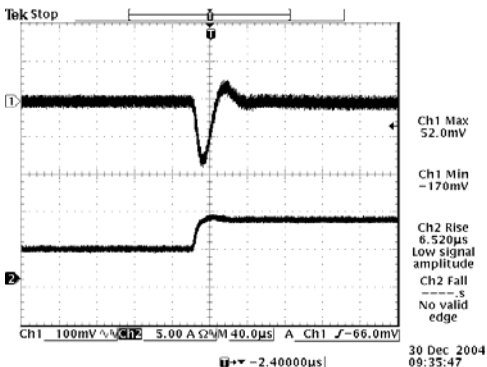
100% to 50% load 12 Vdc Input 1.2 Vdc Output



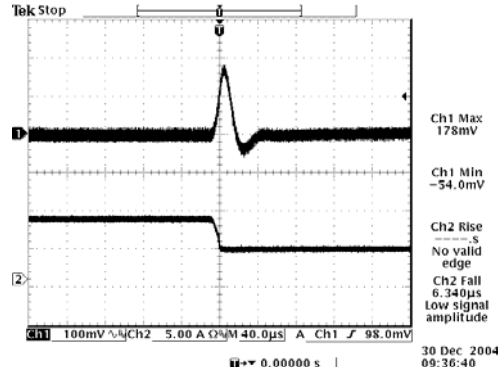
50% to 100% load 12 Vdc Input 1.5 Vdc Output



100% to 50% load 12 Vdc Input 1.5 Vdc Output



50% to 100% load 12 Vdc Input 1.8 Vdc Output



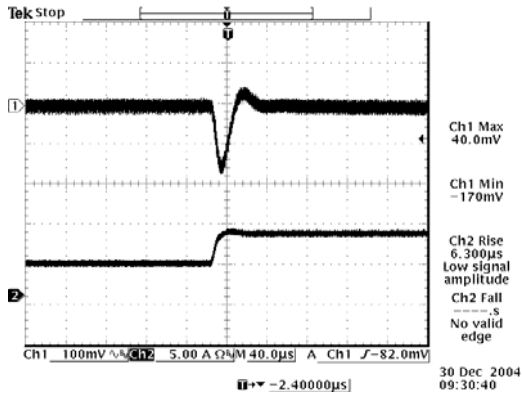
100% to 50% load 12 Vdc Input 1.8 Vdc Output

NON-ISOLATED DC/DC CONVERTERS

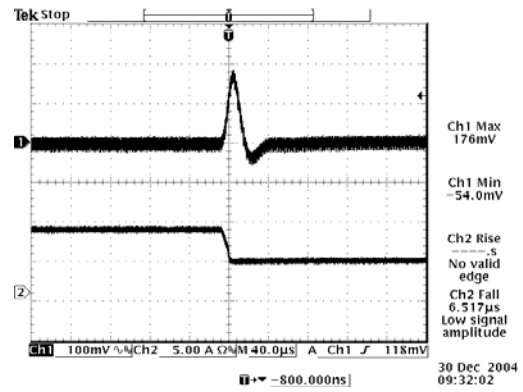
4.5 Vdc - 14 Vdc Input 0.8 Vdc - 5.5 Vdc/8 A Output



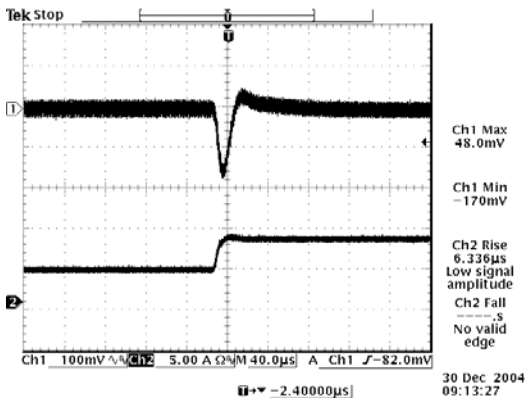
Transient Response Waveforms (continued)



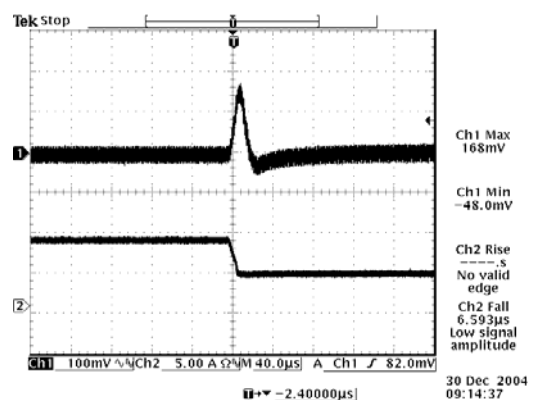
50% to 100% load 12 Vdc Input 2.5 Vdc Output



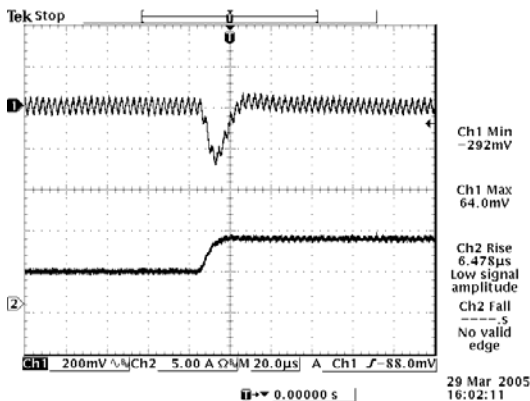
100% to 50% load 12 Vdc Input 2.5 Vdc Output



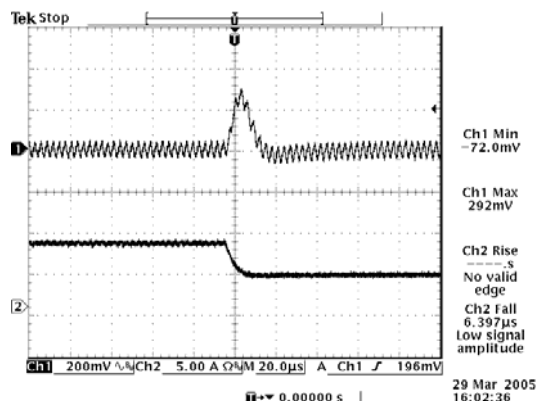
50% to 100% load 12 Vdc Input 3.3 Vdc Output



100% to 50% load 12 Vdc Input 3.3 Vdc Output



50% to 100% load 12 Vdc Input 5 Vdc Output



100% to 50% load 12 Vdc Input 5 Vdc Output

Note: Transient response at $di/dt=0.5 \text{ A}/\mu\text{S}$, with a 1 μF ceramic cap and a 10 $\mu\text{F}/10 \text{ V}$ tan cap at the output, $T_a=25 \text{ deg C}$.

NON-ISOLATED DC/DC CONVERTERS

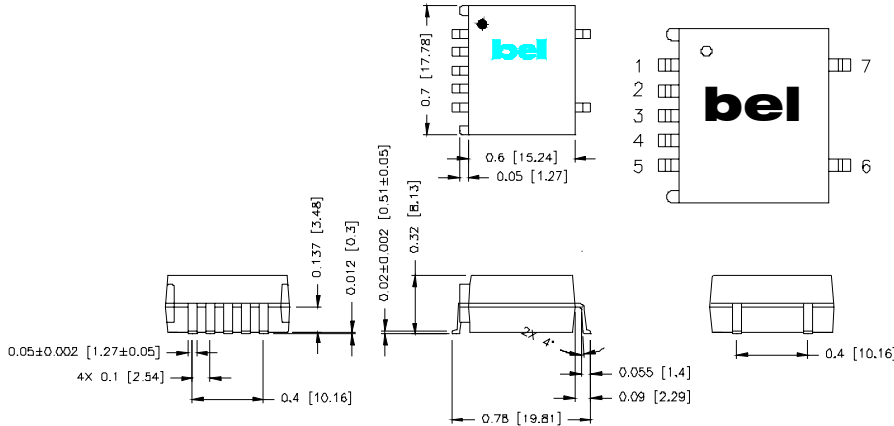
4.5 Vdc - 14 Vdc Input

0.8 Vdc - 5.5 Vdc/8 A Output



Mechanical Outline

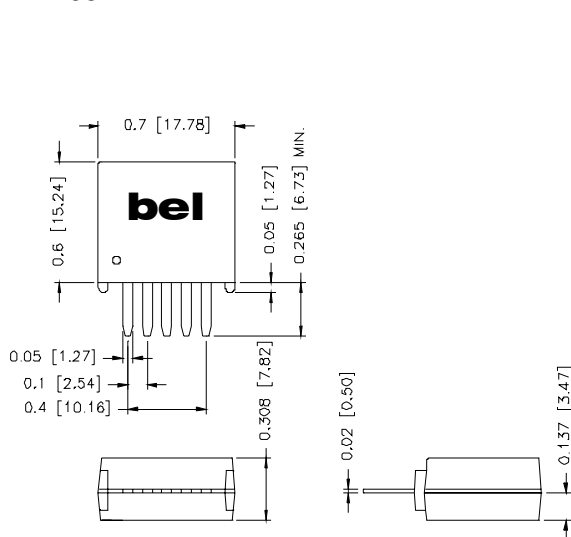
SRAH-08Exxx



Pin Connections

Pin	Function
1	Remote On/Off (option)
2	Vin
3	Ground
4	Vout
5	Trim (option)
6	Sense (option)
7	N/A

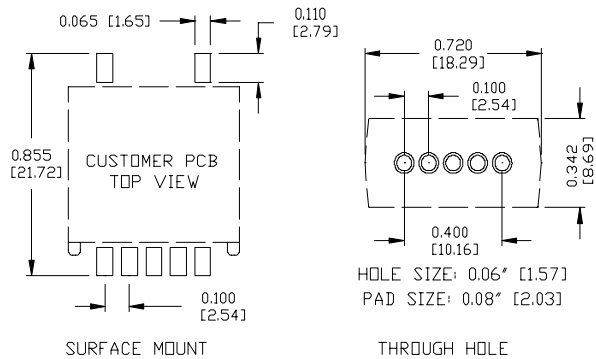
VRAH-08Exxx



Pin Connections

Pin	Function
1	Remote On/Off (option)
2	Vin
3	Ground
4	Vout
5	Trim (option)

RECOMMENDED PCB PAD LAYOUT



RoHS Compliance

Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products. These parts are not however compatible with the higher temperatures associated with lead free solder processes and must be soldered using a reflow profile with a peak temperature of no more than 240 °C.



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