

NON-ISOLATED DC/DC CONVERTER

4.5 Vdc - 32 Vdc Input

1.2 Vdc - 5.0 Vdc/1 A Output

bel
POWER PRODUCTS

xRAH-01Hxx0

RoHS Compliant

Rev.A

- Non-Isolated
- Trim Function
- Low Profile Package (7.82 mm)
- UL60950-1 Recognized (UL/cUL)
- Remote On/Off
- OCP/SCP
- Under-Voltage Lockout (UVLO)



Description

The Bel xRAH-01Hxx0 series are part of the low cost non-isolated dc/dc converter series. These modules use a SMD or vertical mount package for ease of layout and space savings. The output is closely regulated and the efficiency of 5 Vdc output is typically 90% at full load. Typical features include remote on/off, input under voltage lockout, over current protection and short circuit protection.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Part Number Surface Mount	Part Number Vertical Mount
5.0 V	8.0 V - 32 V	1 A	5.0 W	90%	SRAH-01H500	VRAH-01H500
3.3 V	4.5 V - 32 V	1 A	3.3 W	86%	SRAH-01H330	VRAH-01H330
2.5 V	4.5 V - 32 V	1 A	2.5 W	83%	SRAH-01H250	VRAH-01H250
1.8 V	4.5 V - 32 V	1 A	1.8 W	79%	SRAH-01H180	VRAH-01H180
1.5 V	4.5 V - 32 V	1 A	1.5 W	76%	SRAH-01H150	VRAH-01H150
1.2 V	4.5 V - 32 V	1 A	1.2 W	73%	SRAH-01H120	VRAH-01H120

- 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	-	34 V	
Output Enable Terminal Voltage	-0.3 V	-	12 V	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-40 °C	-	125 °C	

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
Vo=5.0 V	8.0 V	20 V	32 V	
Vo=1.2 V-3.3 V	4.5 V	20 V	32 V	
Input Current (no load)	-	5 mA	8 mA	
Input Current (full load)				
Vo=5.0 V	-	-	0.30 A	
Vo=3.3 V	-	-	0.20 A	
Vo=2.5 V	-	-	0.16 A	
Vo=1.8 V	-	-	0.12 A	
Vo=1.5 V	-	-	0.11 A	
Vo=1.2 V	-	-	0.09 A	
Remote Off Input Current	-	2 mA	5 mA	

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Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
Input Reflected Ripple Current (pk-pk)	-	300 mA	420 mA	Tested with simulated source impedance of 500nH, 5 Hz to 20 MHz and one 100 uF/50 V electrolytic capacitor and a 3.3 uF/50 V ceramic capacitor at the input
Input Reflected Ripple Current (rms)	-	100 mA	160 mA	
I ² t Inrush Current Transient	-	0.02 A ² s	0.1 A ² s	
Turn on Voltage Threshold				
V _O =5.0 V	-	5.0 V	7.0 V	
V _O =1.2 V-3.3 V	-	4.1 V	4.5 V	
Turn off Voltage Threshold				
V _O =5.0 V	-	3.6 V	5.0 V	
V _O =1.2 V-3.3 V	-	3.3 V	4.0 V	

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

Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point				Test conditions: V _{in} =20 V, I _o =50% full load
V _O =5.0 V	4.90 V	5.0 V	5.10 V	
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	
Line Regulation				
V _O =5.0 V	-	±5 mV	±10 mV	
V _O =3.3 V	-	±3 mV	±6 mV	
V _O =2.5 V	-	±2 mV	±5 mV	
V _O =1.8 V	-	±2 mV	±4 mV	
V _O =1.5 V	-	±1 mV	±3 mV	
V _O =1.2 V	-	±1 mV	±2 mV	
Load Regulation				
V _O =5.0 V	-	±5 mV	±10 mV	
V _O =3.3 V	-	±3 mV	±6 mV	
V _O =2.5 V	-	±2 mV	±5 mV	
V _O =1.8 V	-	±2 mV	±4 mV	
V _O =1.5 V	-	±1 mV	±3 mV	
V _O =1.2 V	-	±1 mV	±2 mV	
Regulation Over Temperature (-40 °C to +85 °C)	-	±10 mV	±20 mV	
Output Current	0 A	-	1 A	
Current Limit Threshold	2 A	-	3 A	
Short Circuit Surge Transient	-	0.02 A ² s	0.1 A ² s	
Ripple and Noise (rms)	-	6 mV	10 mV	Test condition: 0-20 MHz BW
Ripple and Noise (pk-pk)	-	60 mV	100 mV	
Turn on Time	-	6 mS	30 mS	
Overshoot at Turn on	-	2%	5%	
Output Capacitance	0 uF	-	400 uF	

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Output Specifications (continued)

Parameter		Min	Typ	Max	Notes
Transient Response					
50% ~ 100% Max Load	Overshoot	Vo=5.0 V	-	140 mV	170 mV
	Settling Time		-	100 uS	130 uS
100% ~ 50% Max Load	Overshoot		-	140 mV	170 mV
	Settling Time		-	100 uS	130 uS
50% ~ 100% Max Load	Overshoot	Vo=3.3 V	-	80 mV	120 mV
	Settling Time		-	150 uS	200 uS
100% ~ 50% Max Load	Overshoot		-	80 mV	120 mV
	Settling Time		-	150 uS	200 uS
50% ~ 100% Max Load	Overshoot	Vo=2.5 V	-	70 mV	110 mV
	Settling Time		-	120 uS	160 uS
100% ~ 50% Max Load	Overshoot		-	70 mV	110 mV
	Settling Time		-	120 uS	160 uS
50% ~ 100% Max Load	Overshoot	Vo=1.2 V - 1.8 V	-	60 mV	100 mV
	Settling Time		-	100 uS	130 uS
100% ~ 50% Max Load	Overshoot		-	60 mV	100 mV
	Settling Time		-	100 uS	130 uS

Test conditions:
 di/dt = 0.5 A/uS;
 Vin = 20 V

Note: All specifications are typical at 20 V input, full load at 25 °C unless otherwise stated.

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				Measured at Vin=20 V, full load
Vo=5.0 V	87%	90%	-	
Vo=3.3 V	83%	86%	-	
Vo=2.5 V	80%	83%	-	
Vo=1.8 V	76%	79%	-	
Vo=1.5 V	73%	76%	-	
Vo=1.2 V	70%	73%	-	
Switching Frequency				
Vo=5.0 V	130 kHz	150 kHz	170 kHz	
Vo=3.3 V	270 kHz	290 kHz	310 kHz	
Vo=2.5 V	190 kHz	220 kHz	250 kHz	
Vo=1.8 V	150 kHz	170 kHz	190 kHz	
Vo=1.5 V	130 kHz	150 kHz	170 kHz	
Vo=1.2 V	100 kHz	120 kHz	140 kHz	
Output Trim Range	90%Vo	-	110%Vo	
MTBF	8,040,762 hours			Calculated Per Bell Core SR-332 (Io = 0.8 A, Vo=1.8 V; Vin=20 V; Ta = 25 °C)
Dimensions (surface mount)				
Inches (L x W x H)	0.78 x 0.70 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)	0.70 x 0.308 x 0.65			
Millimeters (L x W x H)	17.78 x 7.82 x 16.51			
Weight	-	5.1 g	-	

Note: All specifications are typical at 20V input, full load at 25 °C unless otherwise stated.

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4.5 Vdc - 32 Vdc Input 1.2 Vdc - 5.0 Vdc/1 A Output



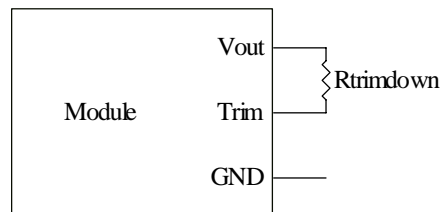
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit On)	-0.3 V	-	1 V	Remote on/off pin open, unit on.
Signal High (Unit Off)	2.8 V	-	12 V	

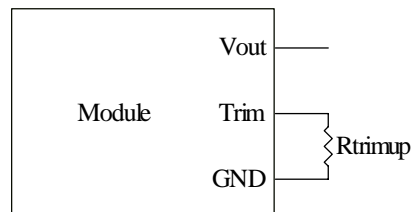
Output Trim Equations

Equations for calculating the trim resistor (in kΩ) given the desired adjusted voltage (V_{adj}) and the nominal output voltage of the converter (V_o) are shown below. The Trim Down resistor should be connected between the Trim pin and V_{out} . 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.

$$R_{TrimDown} = \frac{A}{V_o - V_{adj}} - B$$



$$R_{TrimUp} = \frac{C}{V_{adj} - V_o} - D$$

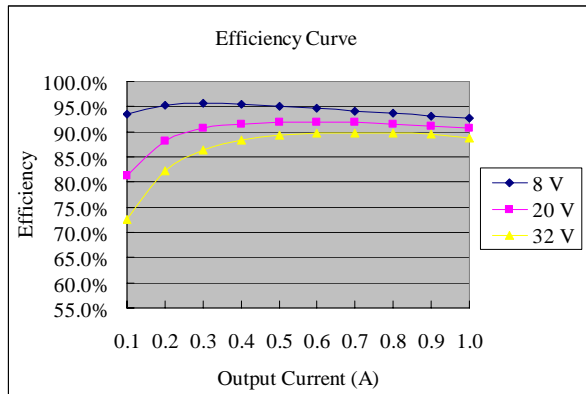


V_o	A	B	C	D
5.0	153.56	85.20	29.20	48.70
3.3	53.80	21.50	17.20	X
2.5	36.70	21.50	17.20	X
1.8	21.70	21.50	17.20	X
1.5	15.20	21.50	17.20	X
1.2	8.70	21.50	17.20	X

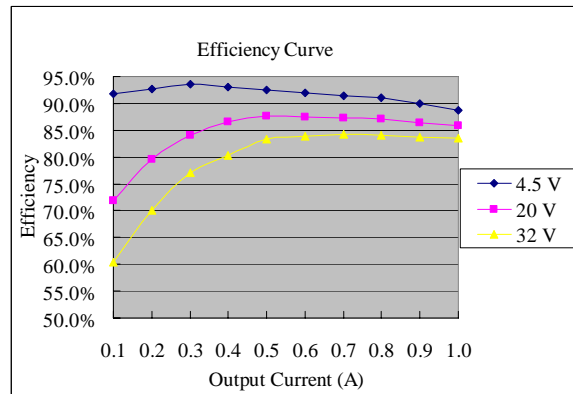
NON-ISOLATED DC/DC CONVERTER
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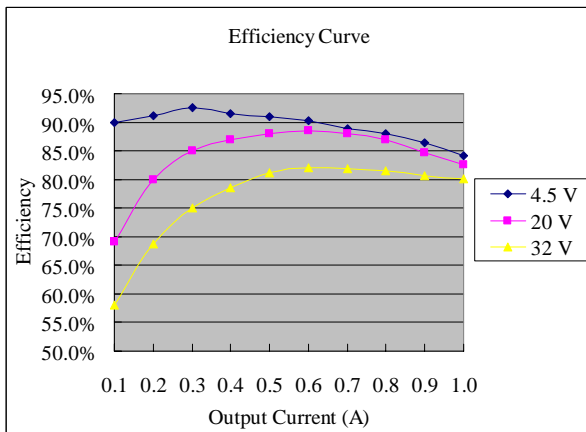
Efficiency Data



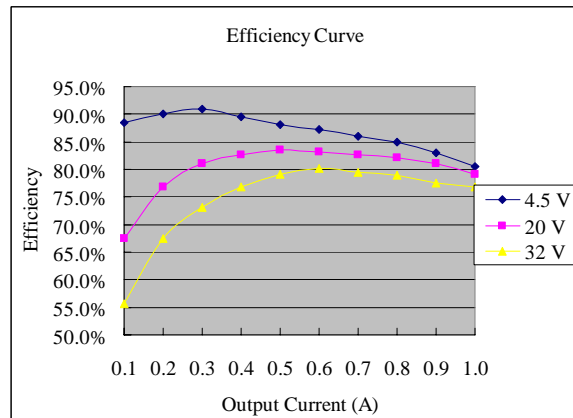
xRAH-01H500



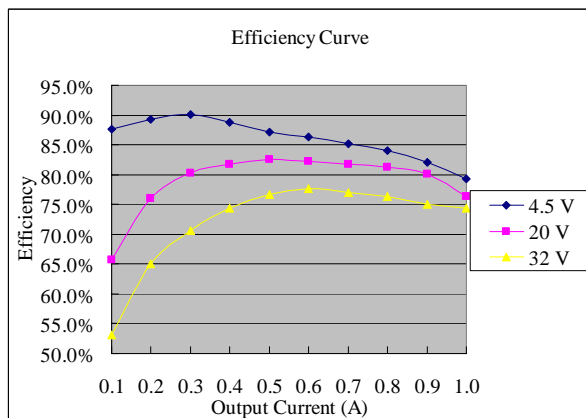
xRAH-01H330



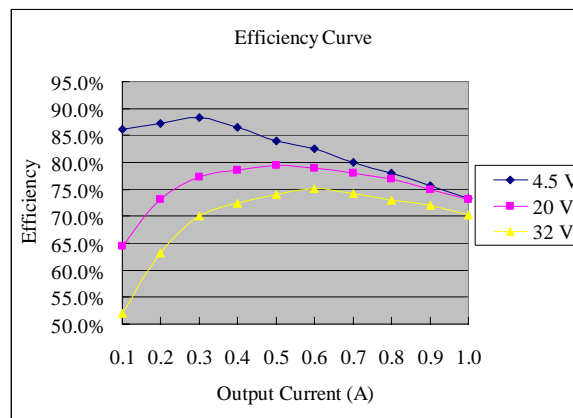
xRAH-01H250



xRAH-01H180



xRAH-01H150



xRAH-01H120

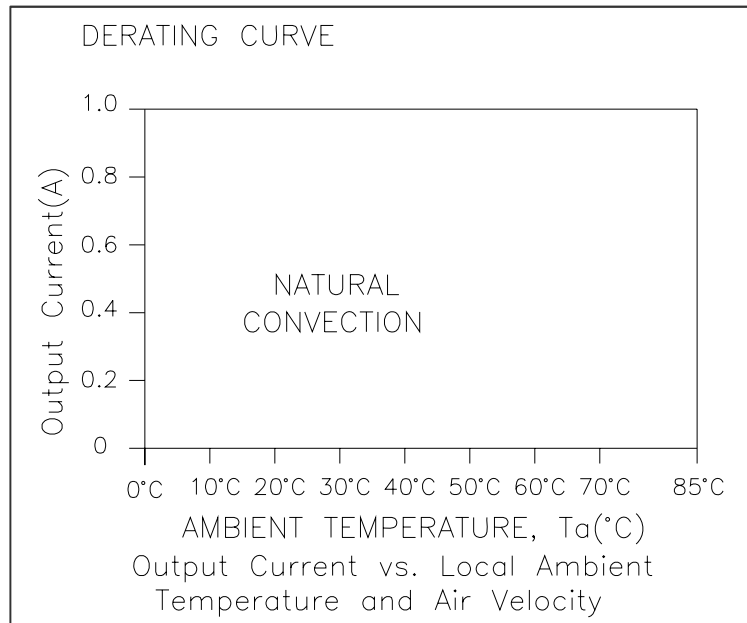
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Thermal Derating Curve



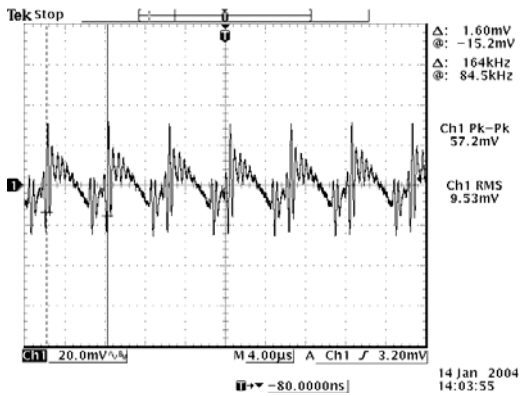
Test Condition: Derating curve is tested at nominal input voltage.

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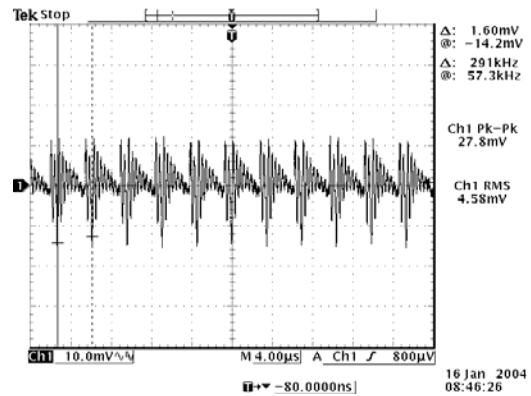
4.5 Vdc - 32 Vdc Input 1.2 Vdc - 5.0 Vdc/1 A Output



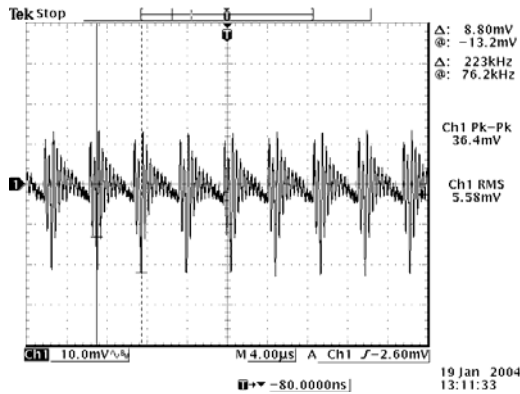
Ripple and Noise Waveforms



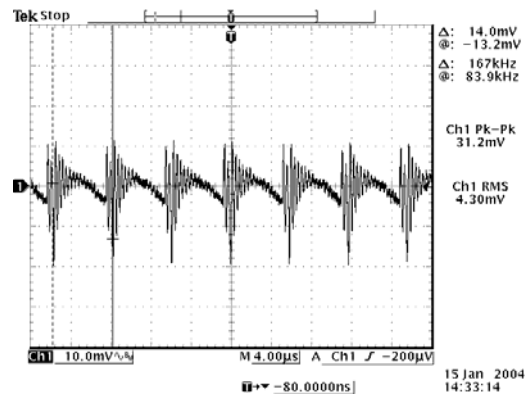
20 Vdc input, 5.0 Vdc output



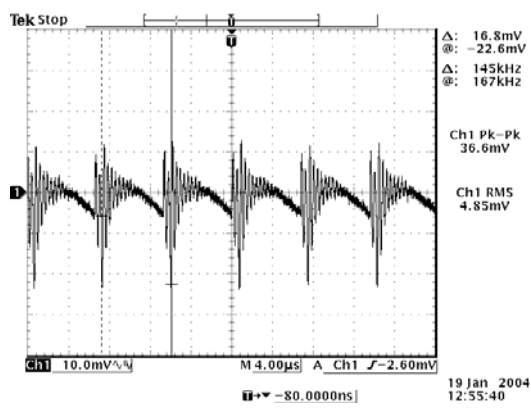
20 Vdc input, 3.3 Vdc output



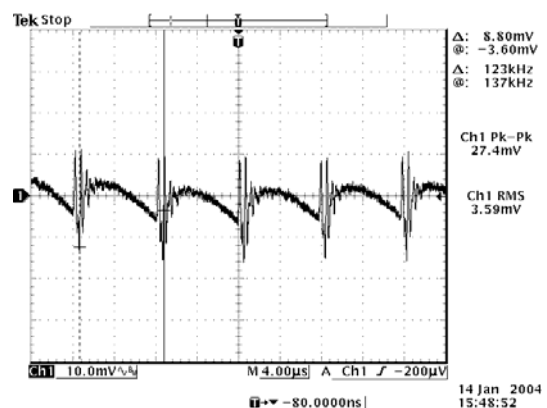
20 Vdc input, 2.5 Vdc output



20 Vdc input, 1.8 Vdc output



20 Vdc input, 1.5 Vdc output



20 Vdc input, 1.2 Vdc output

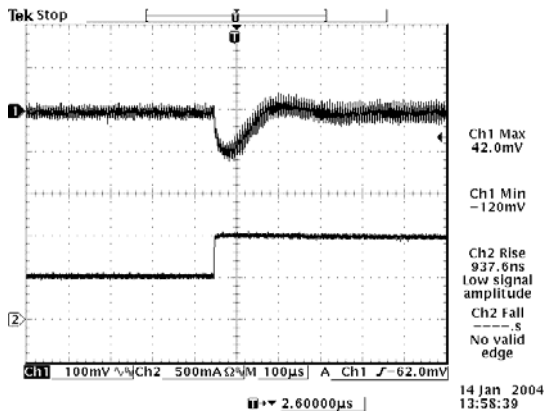
Note: Ripple and noise at max load, 0-20MHz BW, Ta=25 deg C.

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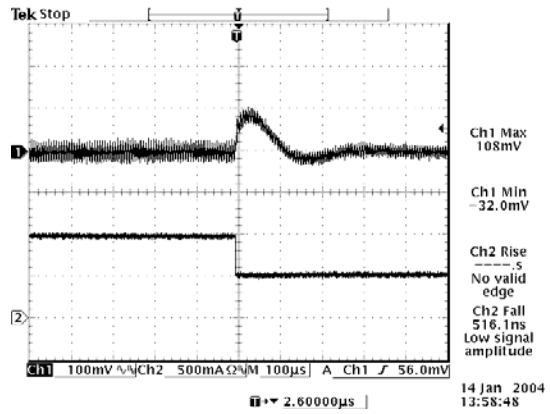
4.5 Vdc - 32 Vdc Input 1.2 Vdc - 5.0 Vdc/1 A Output



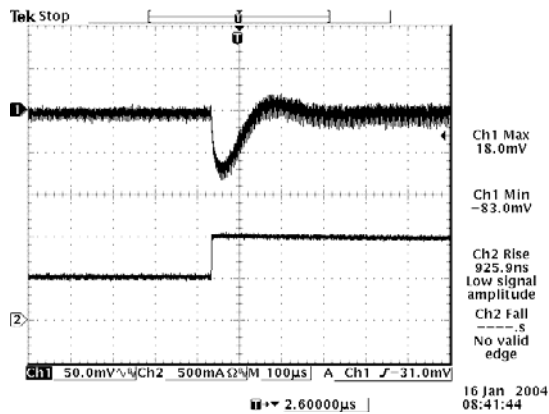
Transient Response Waveforms



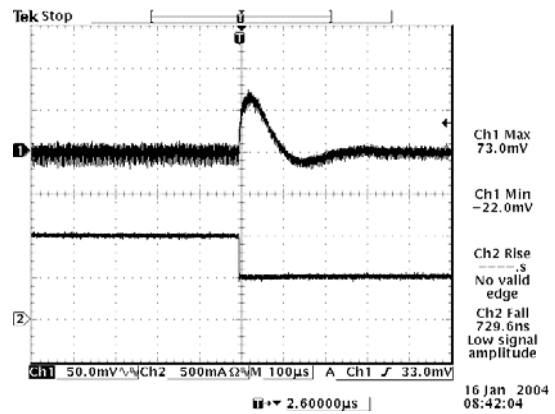
50% to 100% load, 5.0 Vdc output



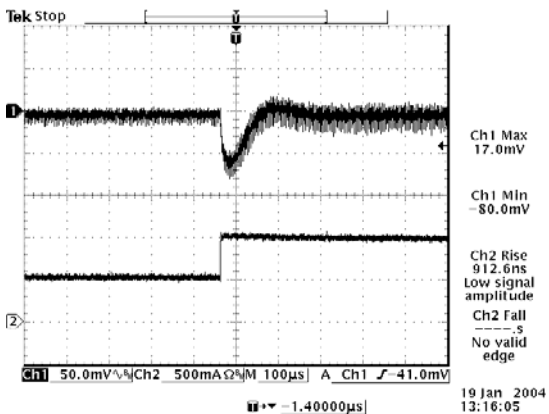
100% to 50% load, 5.0 Vdc output



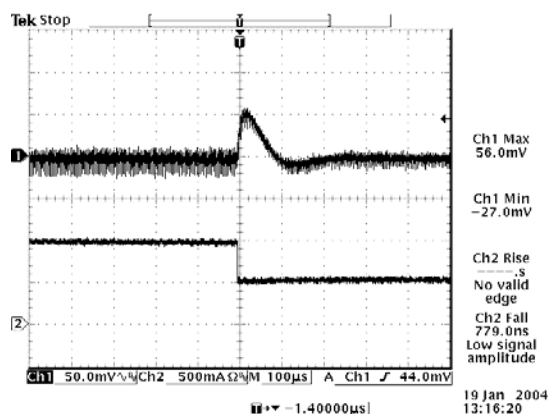
50% to 100% load, 3.3 Vdc output



100% to 50% load, 3.3 Vdc output



50% to 100% load, 2.5 Vdc output



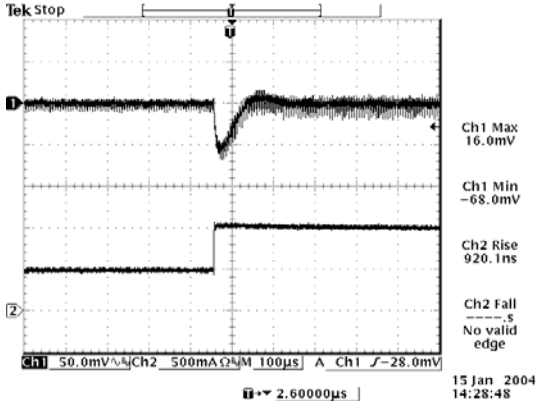
100% to 50% load, 2.5 Vdc output

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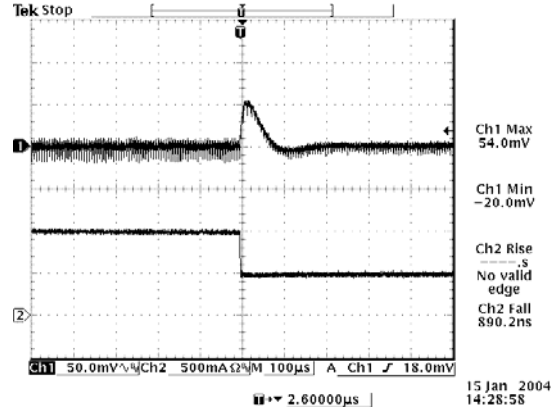
4.5 Vdc - 32 Vdc Input 1.2 Vdc - 5.0 Vdc/1 A Output



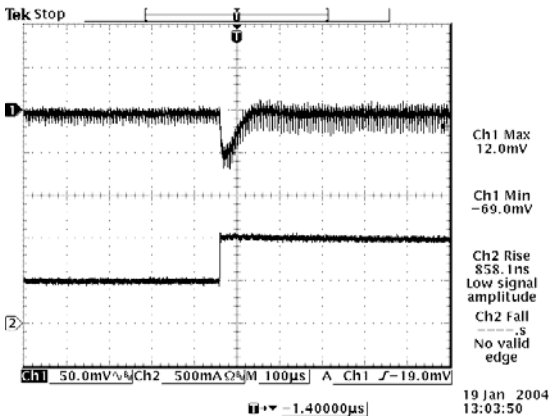
Transient Response Waveforms (continued)



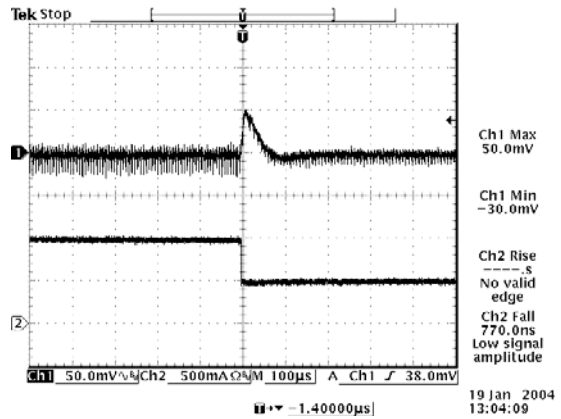
50% to 100% load, 1.8 Vdc output



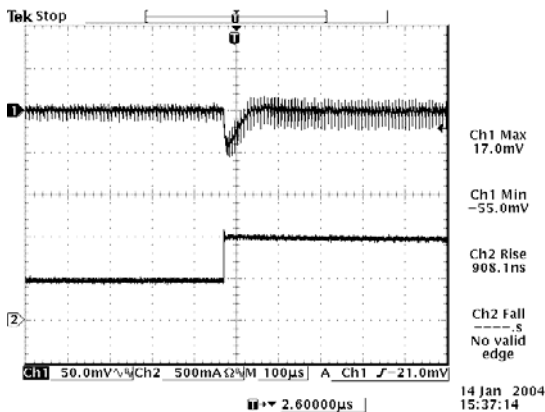
100% to 50% load, 1.8 Vdc output



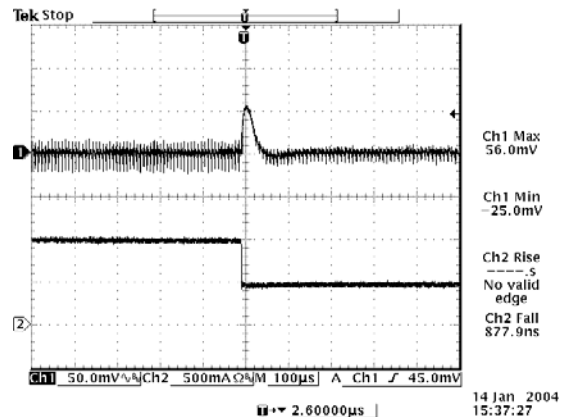
50% to 100% load, 1.5 Vdc output



100% to 50% load, 1.5 Vdc output



50% to 100% load, 1.2 Vdc output



100% to 50% load, 1.2 Vdc output

Note: Transient Response at 20 Vdc input, di/dt=0.5 A/uS, Ta=25 deg C.

NON-ISOLATED DC/DC CONVERTER

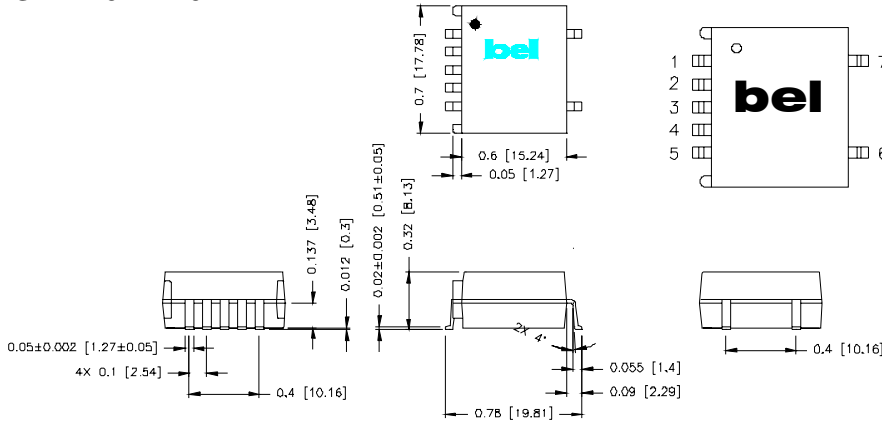
4.5 Vdc - 32 Vdc Input

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Mechanical Outline

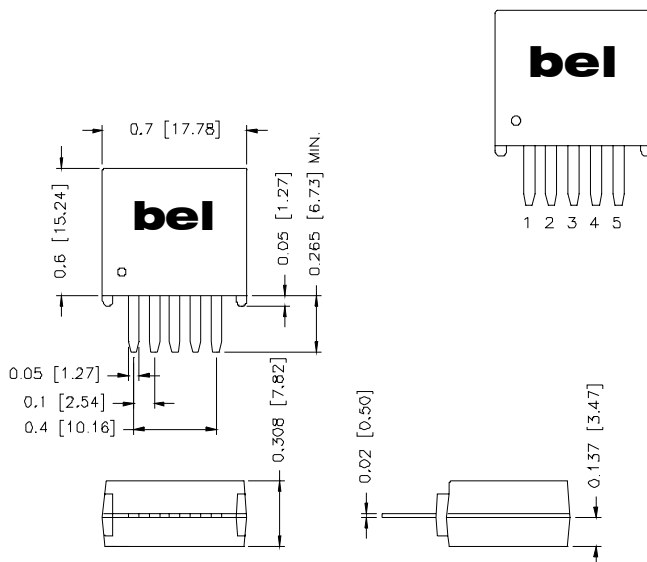
SRAH-01Hxx0



Pin Connections

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

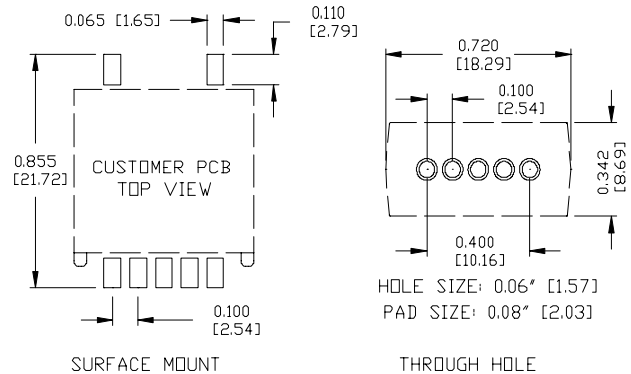
VRAH-01Hxx0



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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