NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 32 Vdc Input 1.2 Vdc - 5.0 Vdc/3 A Output

xRAH-03Hxx0 Series RoHS Compliant Rev.B

- Non-Isolated
- High Efficiency
- High Power Density
- Excellent Thermal Performance
- UL60950-1 Recognized (UL/cUL)
- Remote On/Off
- Input Under Voltage Lockout
- OCP/SCP
- Low Cost

Description

The Bel xRAH-03Hxx0 is part of the low cost non-isolated dc/dc power converter series. It is packaged in a compact, overmolded package rated at 3 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 of 3.3 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	3 A	15 W	92%	SRAH-03H500	VRAH-03H500
3.3 V	4.9 V - 32 V	3 A	10 W	90%	SRAH-03H330	VRAH-03H330
2.5 V	4.5 V - 32 V	3 A	7.5 W	88%	SRAH-03H250	VRAH-03H250
1.8 V	4.5 V - 32 V	3 A	5.4 W	85%	SRAH-03H180	VRAH-03H180
1.5 V	4.5 V - 32 V	3 A	4.5 W	83%	SRAH-03H150	VRAH-03H150
1.2 V	4.5 V - 32 V	3 A	3.6 W	81%	SRAH-03H120	VRAH-03H120

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	4.5 V	-	32 V	See “Part Selection” for more details.
Input Current (no load)	-	30 mA	-	
Input Current (full load)	-	-	3 A	
Remote Off Input Current	-	4 mA	-	
Input Reflected Ripple Current (pk-pk)	-	200 mA	400 mA	Tested with simulated source impedance of 500 nH, 5 Hz to 20 MHz and two 100 uF/50 V electrolytic capacitors and a 3.3 uF/50 V ceramic capacitor at the input.
Input Reflected Ripple Current (rms)	-	100 mA	150 mA	
I^2t Inrush Current Transient	-	0.02 A^2s	0.1 A^2s	
Turn on Voltage Threshold [1]	-	4.1 V	4.5 V	
Turn off Voltage Threshold [2]	-	3.3 V	4.0 V	

Notes: 1. The max Turn on Voltage threshold of the 3.3 V & 5.0 V output module will be relaxed to 4.9 V & 8.0 V respectively.
2. The max Turn off Voltage threshold of the 3.3 V output module will be relaxed to 4.5 V. The 5.0 V output module does not have such function.

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Output Specifications

Parameter			Min	Typ	Max	Notes
Output Voltage Set Point						
		Vo=5.0 V	4.900 V	5.0 V	5.100 V	Test conditions: Vin=12 V, Io=50% full load
		Vo=3.3 V	3.234 V	3.3 V	3.366 V	
		Vo=2.5 V	2.450 V	2.5 V	2.550 V	
		Vo=1.8 V	1.764 V	1.8 V	1.836 V	
		Vo=1.5 V	1.470 V	1.5 V	1.530 V	
		Vo=1.2 V	1.176 V	1.2 V	1.224 V	
Line Regulation						
		Vo=5.0 V	-	±10 mV	±15 mV	
		Vo=1.2 V-3.3 V	-	±5 mV	±10 mV	
Load Regulation						
		Vo=5.0 V	-	±10 mV	±15 mV	
		Vo=1.2 V-3.3 V	-	±5 mV	±10 mV	
Regulation Over Temperature (-40 °C to +85 °C)			-	30 mV	50 mV	
Output Current			0 A	-	3 A	
Current Limit Threshold			3.3 A	-	9 A	
Short Circuit Surge Transient						
		Vo=1.2 V-5.0 V	-	0.02 A^2s	0.1 A^2s	
Ripple and Noise (rms)						
		Vo=1.2 V-5.0 V	-	25 mV	50 mV	Tested with 0-20 MHz BW, with a 220 uF tantalum capacitor at the output.
Ripple and Noise (pk-pk)						
		Vo=1.2 V-5.0 V	-	60 mV	100 mV	
Turn on Time			-	15 mS	50 mS	
Overshoot at Turn on			-	2%	5%	
Output Capacitance			220 uF	-	1200uF	
Transient Response						
50% ~ 100% Max Load	Overshoot	Vo=5.0 V	-	150 mV	200 mV	Test conditions: di/dt = 0.5 A/uS; Vin = 12 V; with a 220 uF Tantalum capacitor at the output.
	Settling Time		-	100 uS	150 uS	
100% ~ 50% Max Load	Overshoot		-	150 mV	200 mV	
	Settling Time		-	100 uS	150 uS	
50% ~ 100% Max Load	Overshoot	Vo=3.3 V	-	130 mV	180 mV	
	Settling Time		-	100 uS	150 uS	
100% ~ 50% Max Load	Overshoot		-	130 mV	180 mV	
	Settling Time		-	100 uS	150 uS	
50% ~ 100% Max Load	Overshoot	Vo=1.8 V - 2.5 V	-	100 mV	150 mV	
	Settling Time		-	50 uS	100 uS	
100% ~ 50% Max Load	Overshoot		-	100 mV	150 mV	
	Settling Time		-	50 uS	100 uS	
50% ~ 100% Max Load	Overshoot	Vo=1.2 V -1.5 V	-	90 mV	140 mV	
	Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load	Overshoot		-	90 mV	140 mV	
	Settling Time		-	40 uS	80 uS	

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

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General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				
Vo=5.0 V	89%	92%	-	Measured at Vin=12 V, full load and Ta=25 °C
Vo=3.3 V	87%	90%	-	
Vo=2.5 V	85%	88%	-	
Vo=1.8 V	82%	85%	-	
Vo=1.5 V	80%	83%	-	
Vo=1.2 V	78%	81%		
Switching Frequency	200 kHz	300 kHz	400 kHz	
Output Trim Range (narrow trim)	90%Vo	-	110%Vo	
MTBF	8,120,000 hours			Calculated Per Bell Core SR-332 (Io = Nominal; Ta = 25 °C)
Dimensions (surface mount)				
Inches (L × W × H)	0.78 x 0.70 x 0.32			
Millimeters (L × W × H)	19.81 x 17.78 x 8.13			
Dimensions (vertical)				
Inches (L × W × H)	0.70 x 0.308 x 0.65			
Millimeters (L × W × H)	17.78 x 7.82 x 16.51			
Weight	-	5.1 g	-	

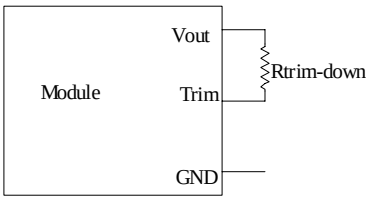
Control Specifications

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	

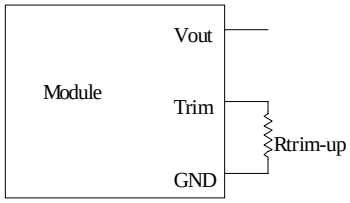
Output Trim Equations

Equations for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) and the nominal output voltage of the converter (Vnom) 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.

$$R_{trimdown} = \frac{A}{V_{nom} - V_{adj}} - B$$



$$R_{trimup} = \frac{C}{V_{adj} - V_{nom}} - D$$



Vnom	A	B	C	D
5.0	61.850	29.400	11.760	14.700
3.3	53.840	61.700	17.200	40.200
2.5	9.556	15.620	4.496	10.000
1.8	3.849	13.830	3.064	10.000
1.5	3.102	14.420	3.536	10.000
1.2	1.794	10.910	3.536	6.490

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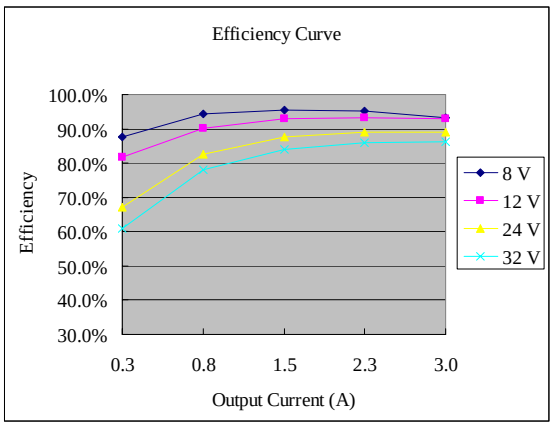
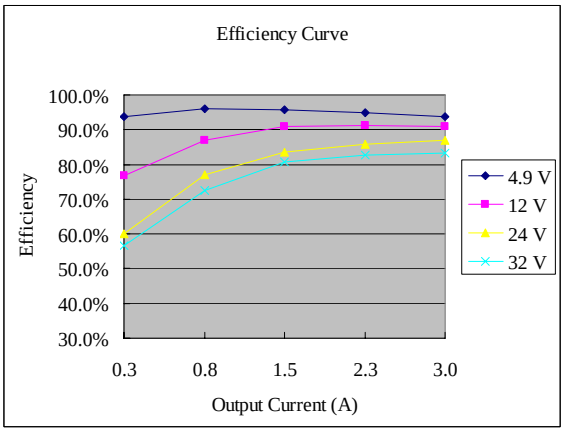
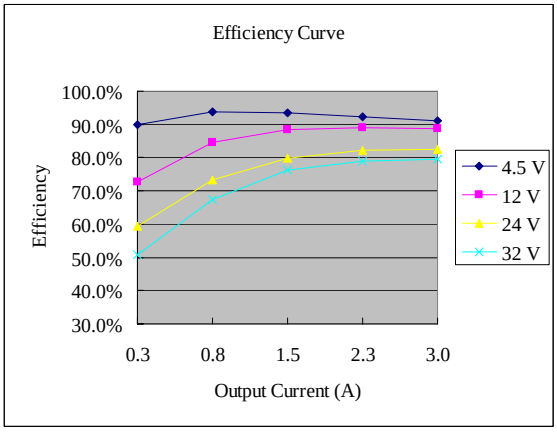
Efficiency Data



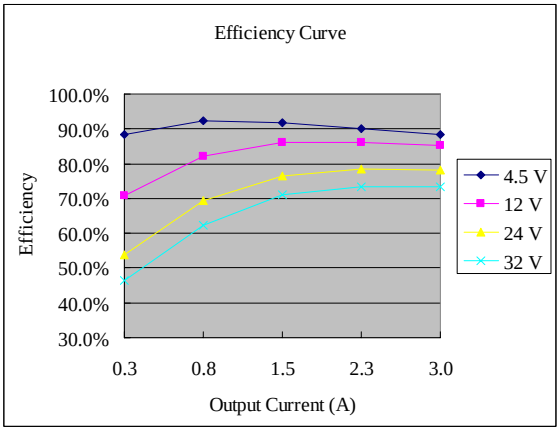
Vo=5.0 V



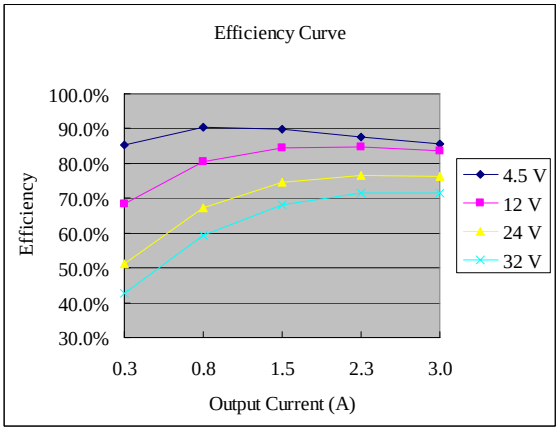
Vo=3.3 V



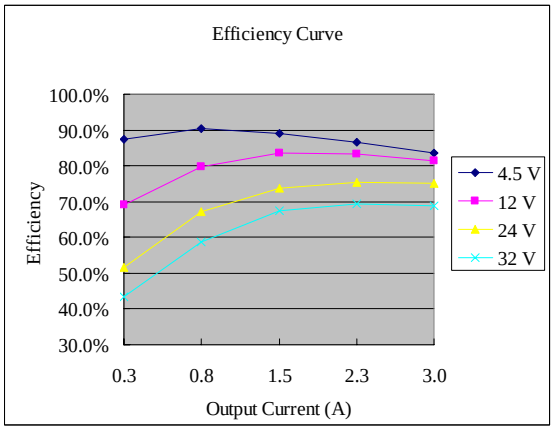
Vo=2.5 V



Vo=1.8 V



Vo=1.5 V



Vo=1.2 V

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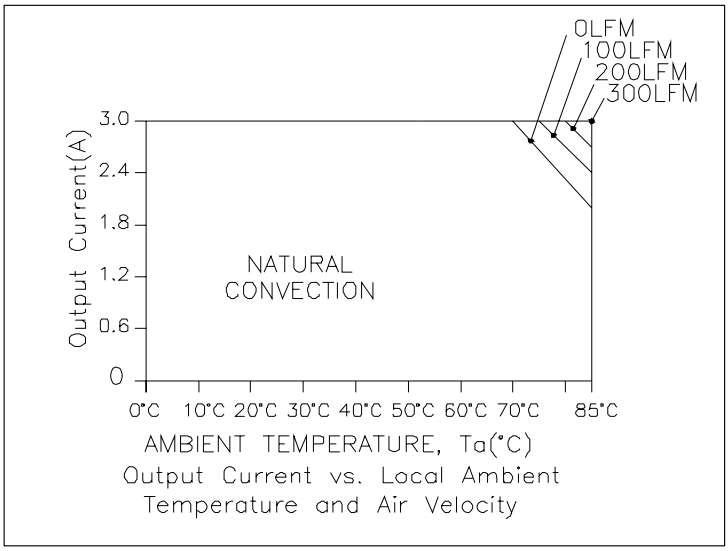
Thermal Derating Curve



Output Current vs. Local Ambient Temperature and Air Velocity

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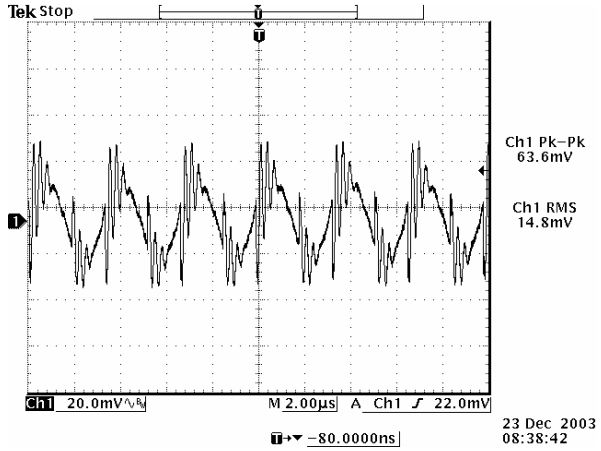
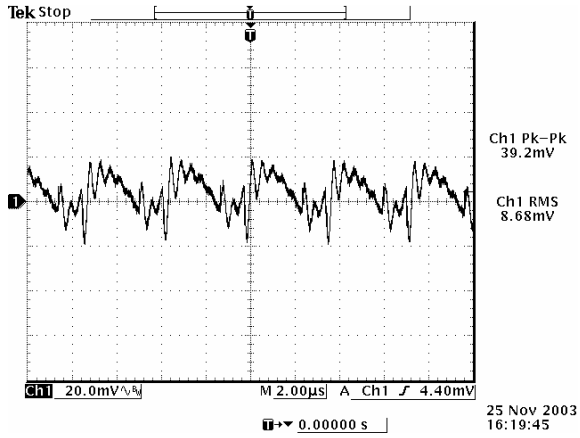
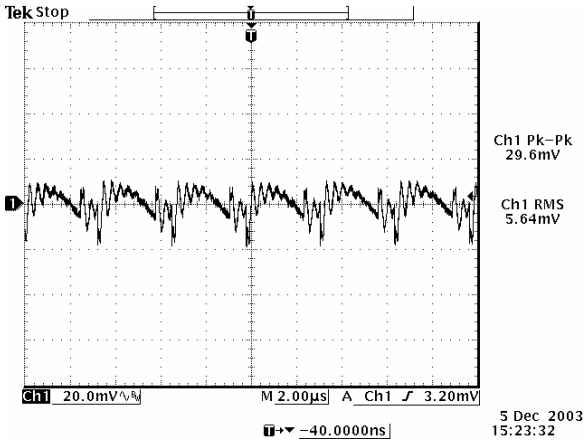
Ripple and Noise Waveforms



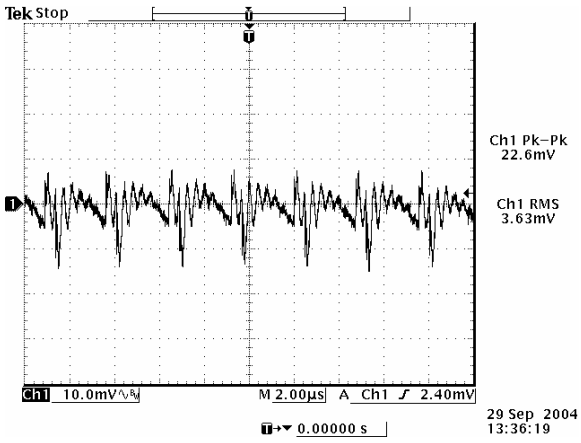
Ripple and noise at max load 5.0 Vdc output



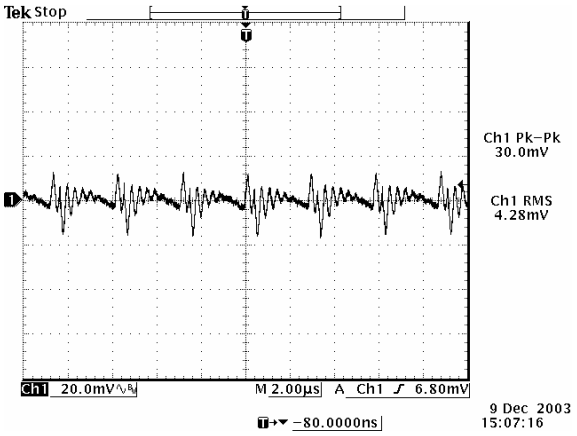
Ripple and noise at max load 3.3 Vdc output



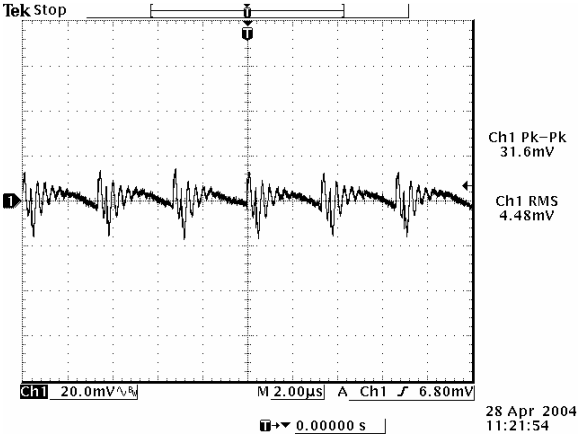
Ripple and noise at max load 2.5 Vdc output



Ripple and noise at max load 1.8 Vdc output



Ripple and noise at max load 1.5 Vdc output



Ripple and noise at max load 1.2 Vdc output

Note: Ripple and Noise at 12 Vdc input, 0-20 MHz BW, with a 220 uF tantalum cap at the output, Ta=25 deg C.

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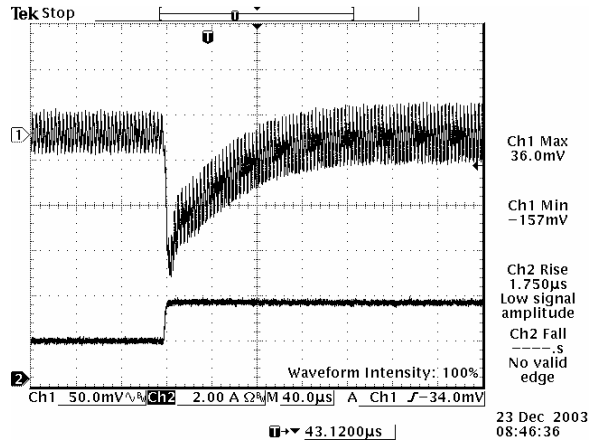
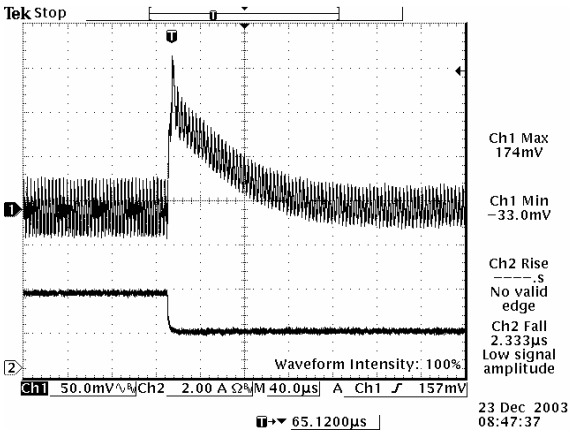
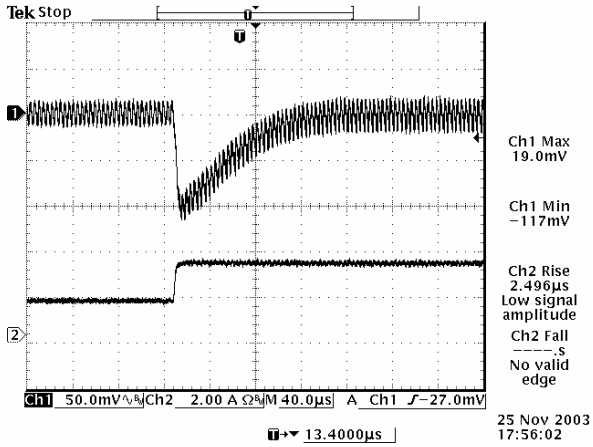
Transient Response Waveforms



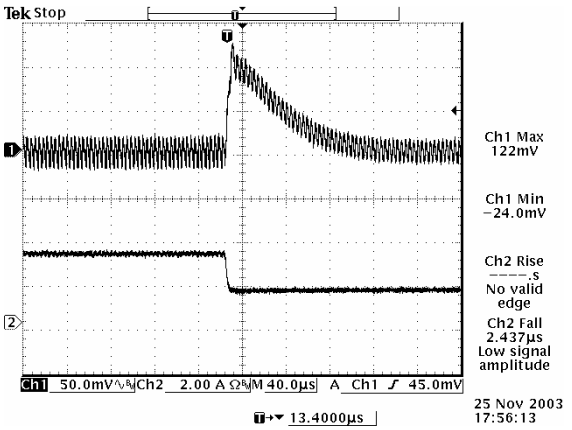
Transients 50% to 100% load 5 Vdc output



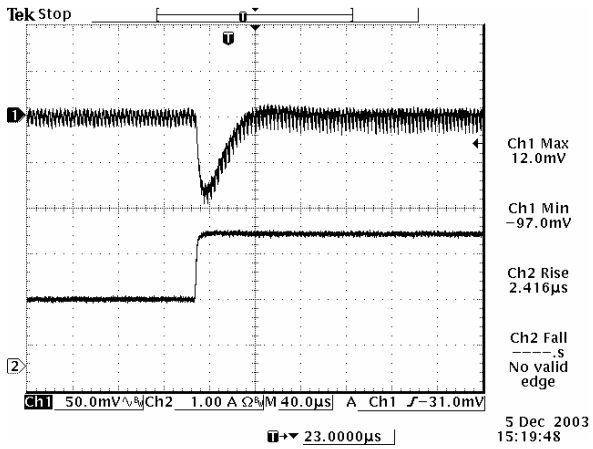
Transients 100% to 50% load 5 Vdc output



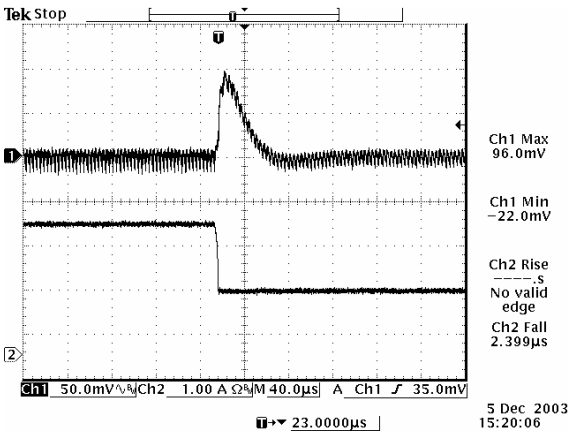
Transients 50% to 100% load 3.3 Vdc output



Transients 100% to 50% load 3.3 Vdc output



Transients 50% to 100% load 2.5 Vdc output



Transients 100% to 50% load 2.5 Vdc output

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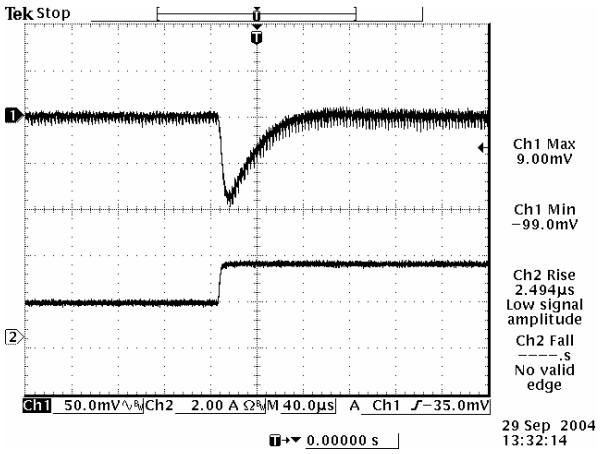
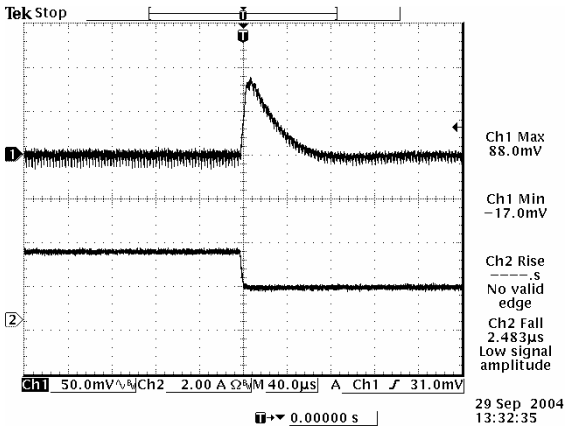
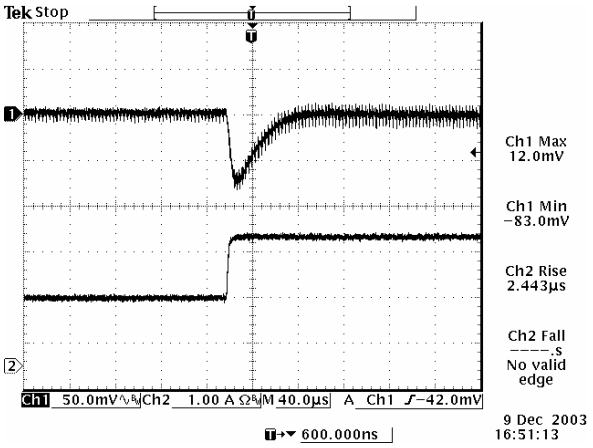
Transient Response Waveforms (continued)



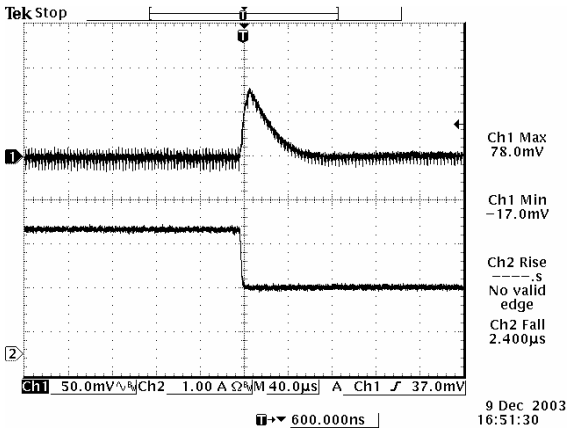
Transients 50% to 100% load 1.8 Vdc output



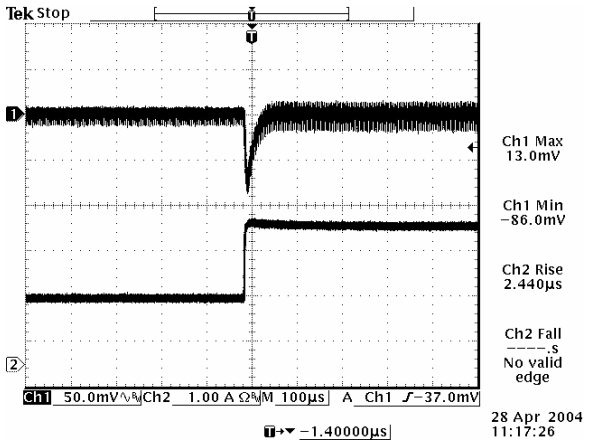
Transients 100% to 50% load 1.8 Vdc output



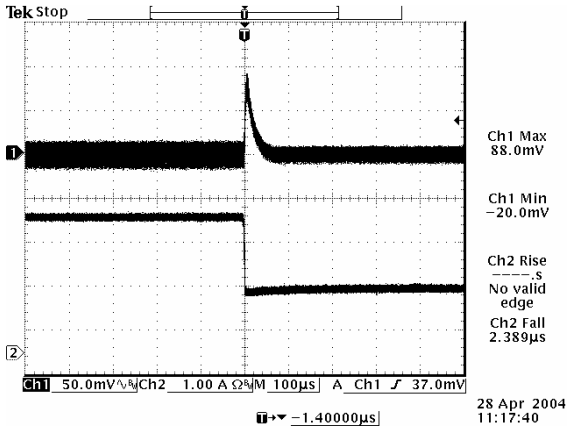
Transients 50% to 100% load 1.5 Vdc output



Transients 100% to 50% load 1.5 Vdc output



Transients 50% to 100% load 1.2 Vdc output



Transients 100% to 50% load 1.2 Vdc output

Note: Transient Response at 12 V input, di/dt=0.5 A/uS, with 220 uF tantalum cap at the output, Ta=25 deg C.

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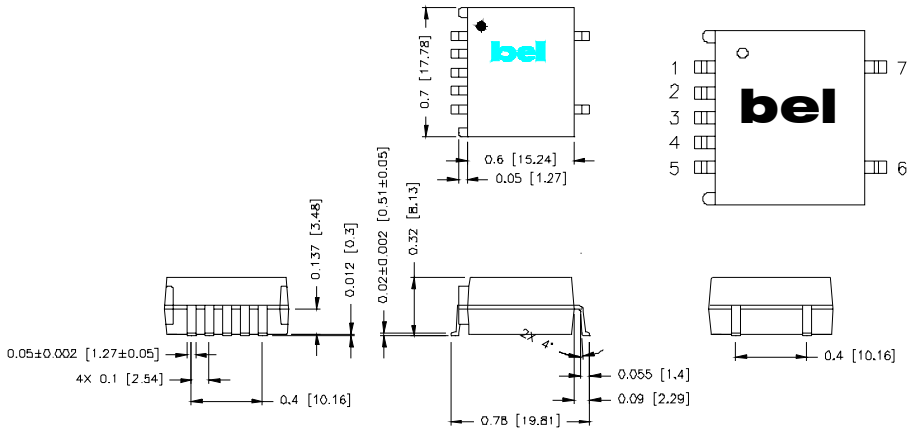
NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 32 Vdc Input 1.2 Vdc - 5.0 Vdc/3 A Output

Mechanical Outline

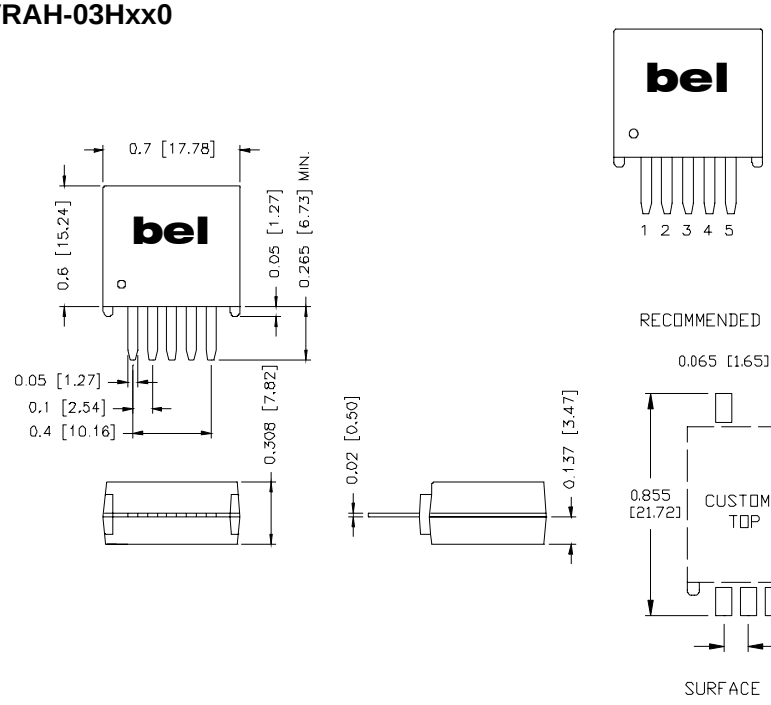
SRAH-03Hxx0



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-03Hxx0



Pin Connections

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

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 ºC.

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