

## NON-ISOLATED DC/DC CONVERTERS

3 Vdc - 3.6 Vdc Input    12 Vdc/0.8 A & 15 Vdc/0.6 A Output

**bel**  
POWER PRODUCTS

### xRAH-01CXx0 Series    RoHS Compliant    Rev.A

- Non-Isolated
- High Efficiency
- Fixed Frequency (550 kHz)
- Low Profile Package
- Trim Function (option)
- Allows Burst Mode Operation at Low Load Currents
- UL60950-1 Recognized (UL/cUL)



### Description

The Bel xRAH-01CXx0 is part of the low cost non-isolated dc/dc converter series. The modules use a SMD or SIP package or vertical package for ease of layout and space savings. The output is closely regulated and the efficiency of 12 Vdc output module is typically 86% at full load. Typical features include allows burst mode operation at low load currents and trim function (option).

### Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Part Number Surface Mount	Part Number Vertical Mount
12 V	3 V - 3.6 V	0.8 A	9.6 W	86%	SRAH-01CX20	VRAH-01CX20
15 V	3 V - 3.6 V	0.6 A	9.0 W	85%	SRAH-01CX50	VRAH-01CX50

- 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)	2.8 V	-	4 V	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-40 °C	-	125 °C	

### Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	3 V	-	3.6 V	
Input Current (no load)	-	15 mA	-	
Input Current (full load)				
	Vo=12V	-	4.3 A	
	Vo=15V	-	4 A	
Input Reflected Ripple Current (pk-pk)	-	100 mA	150 mA	With simulated source impedance of 500 nH, 5 Hz to 20 MHz; Use 270 uF/16 V capacitor with ESR = 0.018 ohm max. at 100KHz at 25 °C
Input Reflected Ripple Current (rms)	-	30 mA	60 mA	
I <sup>2</sup> t Inrush Current Transient	-	0.02 A <sup>2</sup> s	0.05 A <sup>2</sup> s	
Turn-on Voltage Threshold	-	2.8 V	2.9 V	

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### Output Specifications

Parameter		Min	Typ	Max	Notes	
Output Voltage Set Point	Vo=12 V	11.58 V	12 V	12.42 V	Test condition: Vin=3.3V, Iout=full load	
	Vo=15 V	14.475 V	15 V	15.525 V		
Line Regulation	Vo=12 V	-	20 mV	40 mV		
	Vo=15 V	-	20 mV	40 mV		
Load Regulation	Vo=12 V	-	60 mV	120 mV		
	Vo=15 V	-	75 mV	150 mV		
Regulation Over Temperature (-40 °C to +85 °C)	Vo=12 V	-	45 mV	80 mV		
	Vo=15 V	-	60 mV	100 mV		
Output Current	Vo=12 V	0 A	-	0.8 A		
	Vo=15 V	0 A	-	0.6 A		
Ripple and Noise (rms)	Vo=12 V; Io=0 A	-	25 mV	50 mV	Test conditions: BW = 0-20 MHz; 1 uF Ceramic capacitor and 33 uF Tantalum capacitor at the output	
	Vo=15 V; Io=0 A	-	25 mV	50 mV		
	Vo=12 V; Io=0.8 A	-	25 mV	50 mV		
	Vo=15 V; Io=0.6 A	-	35 mV	60 mV		
Ripple and Noise (pk-pk)	Vo=12V; Io=0A	-	85 mV	120 mV		
	Vo=15V; Io=0A	-	100 mV	150 mV		
	Vo=12V; Io=0.8A	-	60 mV	100 mV		
	Vo=15V; Io=0.6A	-	100 mV	150 mV		
Rise Time		-	5 mS	-		
Overshoot at Turn on		-	0%	5%		
Output Capacitance		33 uF	-	330 uF	The min output capacitance is 33 uF Tantalum capacitor at the output	
<b>Transient Response</b>						
50% ~ 100% Max Load	Overshoot	All Outputs	-	130 mV	200 mV	di/dt = 0.1 A/uS; Vin = 3.3 V; and with 33 uF Tantalum capacitor at the output
	Settling Time		-	100 uS	200 uS	
100% ~ 50% Max Load	Overshoot		-	130 mV	200 mV	
	Settling Time		-	100 uS	200 uS	

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

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## General Specifications

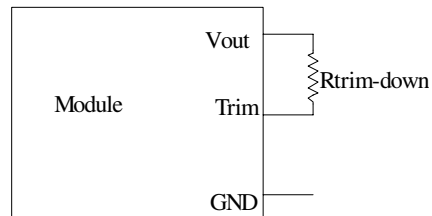
Parameter	Min	Typ	Max	Notes
Efficiency Vo=12 V Vo=15 V	82% 81%	86% 85%	- -	Measured at Vin=3.3 V, full load
Switching Frequency	500 kHz	550 kHz	650 kHz	
Output Trim Range	90% Vo	-	110% Vo	
MTBF	13,296,605 hours			Calculated Per Bell Core SR-332 (Vin=3.3 V; Vo=12 V; Io = 0.64 A; Ta = 25 °C)
Dimensions (surface mount) Inches (L x W x H) Millimeters (L x W x H)	0.78 x 0.7 x 0.32 19.81 x 17.78 x 8.13			
Dimensions (vertical) Inches (L x W x H) Millimeters (L x W x H)	0.7 x 0.308 x 0.65 17.78 x 7.82 x 16.51			
Weight	-	5.2 g	-	

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

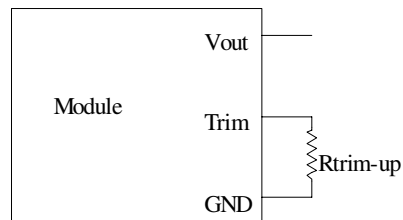
## Output Trim Equations

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.

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



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



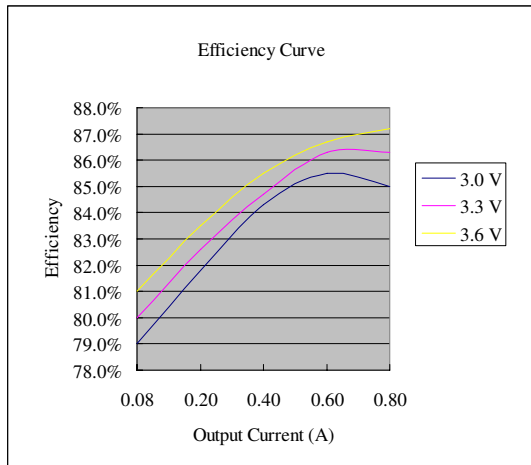
Vnom	A	B	C	D
12	164.640	21.850	11.760	7.150
15.055	209.542	20.600	11.760	5.900

# NON-ISOLATED DC/DC CONVERTERS

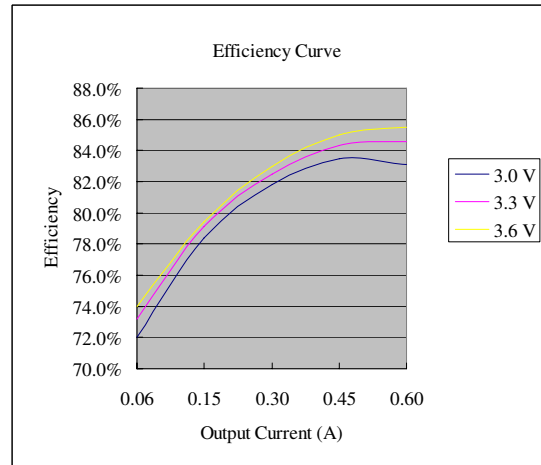
3 Vdc - 3.6 Vdc Input    12 Vdc/0.8 A & 15 Vdc/0.6 A Output



## Efficiency Data

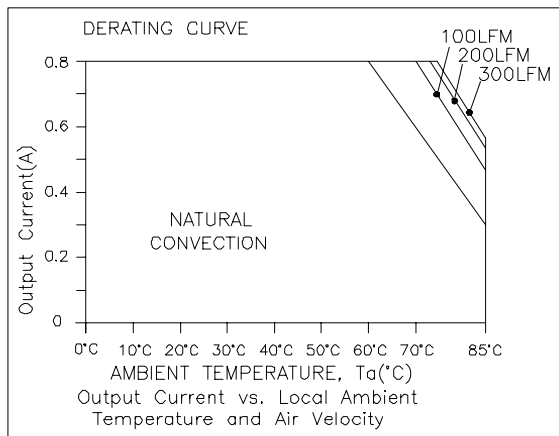


xRAH-01CX20

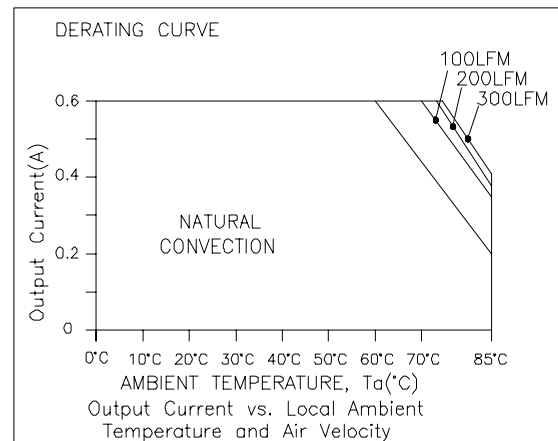


xRAH-01CX50

## Thermal Derating Curves



xRAH-01CX20



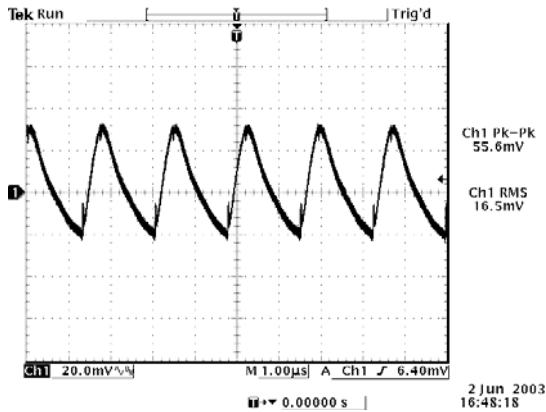
xRAH-01CX50

# NON-ISOLATED DC/DC CONVERTERS

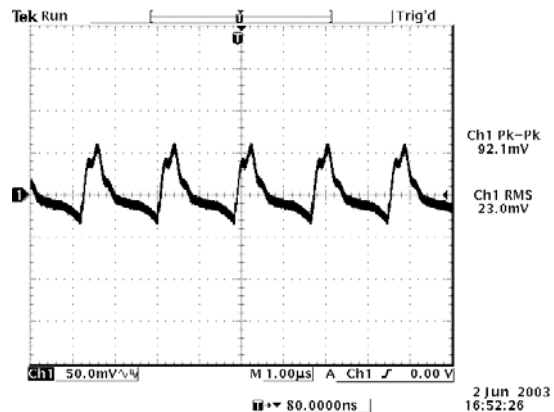
3 Vdc - 3.6 Vdc Input    12 Vdc/0.8 A & 15 Vdc/0.6 A Output



## Ripple and Noise Waveforms



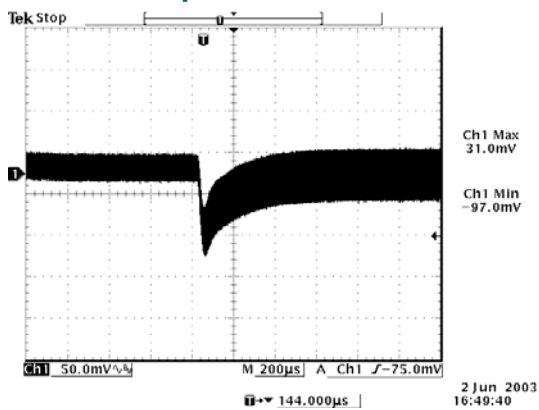
3.3 Vdc input, 12 Vdc output



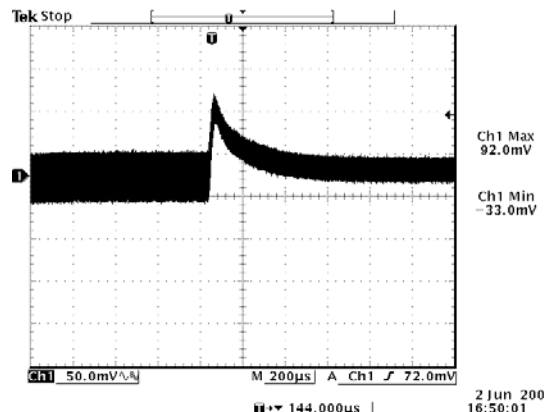
3.3 Vdc input, 15 Vdc output

**Note:** Ripple and noise at full load, 1  $\mu$ F ceramic cap and 33  $\mu$ F tantalum cap at the output, and  $T_a=25$  deg C.

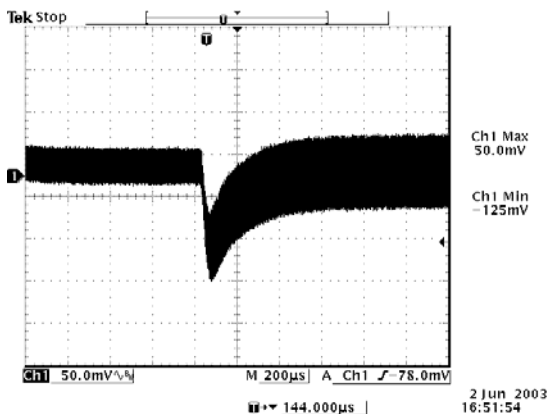
## Transient Response Waveforms



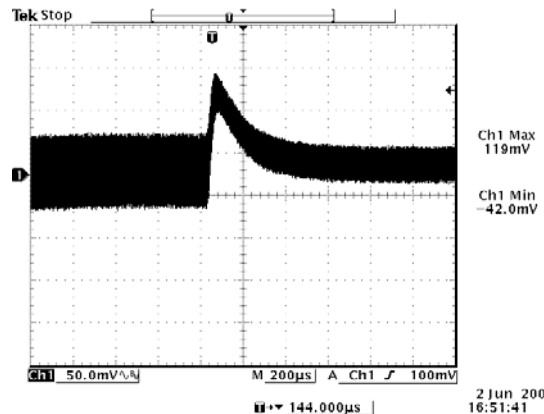
50% to 100% load transient at  $V_{in}=3.3$  V,  $V_o=12$  V



100% to 50% load transient at  $V_{in}=3.3$  V,  $V_o=12$  V



50% to 100% load transient at  $V_{in}=3.3$  V,  $V_o=15$  V



100% to 50% load transient at  $V_{in}=3.3$  V,  $V_o=15$  V

**Note:** Transient response at  $di/dt=0.1$  A/ $\mu$ S, with an external 33  $\mu$ F tantalum load cap at the output, and  $T_a=25$  deg C.

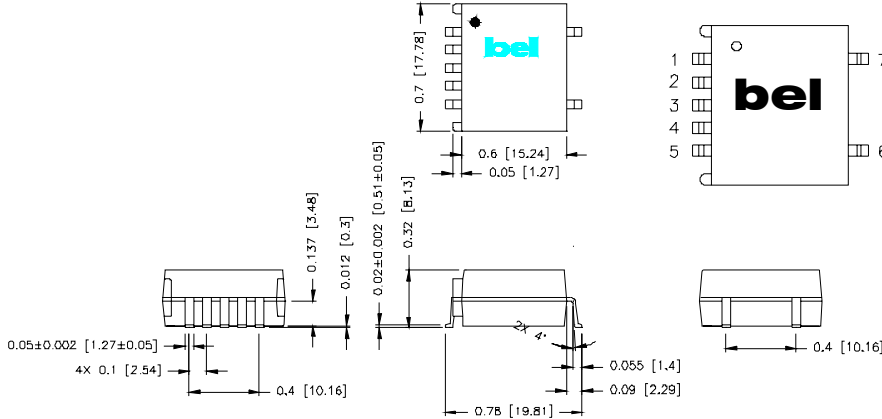
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## Mechanical Outline

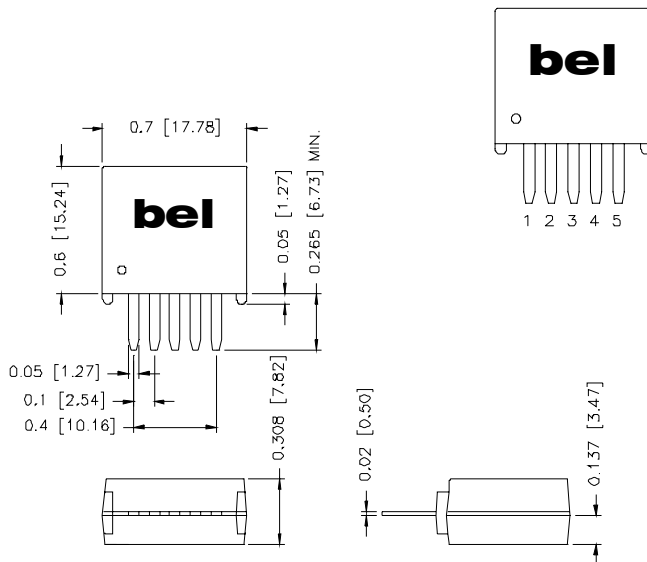
### SRAH-01CXx0



### Pin Connections

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

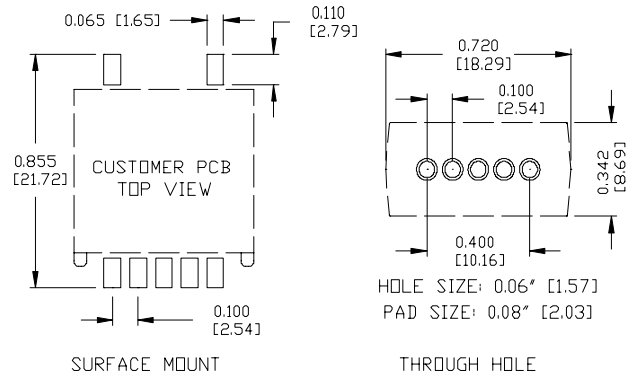
### VRAH-01CXx0



### Pin Connections

Pin	Function
1	N/A
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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