

## NON-ISOLATED DC/DC CONVERTERS

9.0 Vdc - 18 Vdc Input

5 Vdc - 12 Vdc/1A Output

**bel**  
POWER PRODUCTS

**xRAH-01K Series    RoHS Compliant    Rev.A**

- Non-Isolated
- High Efficiency
- Fixed Frequency (450kHz)
- UL60950-1 Recognized (UL/cUL)
- Low Profile Package
- Remote On/Off
- Active Low/High



### Description

The Bel xRAH-01Kxxx is a part of the low cost non-isolated dc/dc converter Power Module series. The modules use a SMD or SIP package for ease of layout and space savings. The output is closely regulated and the efficiency of 9 Vdc output module is typically 86% 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
5 V	9 V - 18 V	1 A	5 W	81%	SRAH-01K50x	VRAH-01K50x
9 V	9 V - 18 V	1 A	9 W	86%	SRAH-01K90x	VRAH-01K90x
12 V	9 V - 18 V	1 A	12 W	87%	SRAH-01KX2x	VRAH-01KX2x

**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. Use "0" to replace "x" in the above part number to indicate Active High, and "L" to indicate Active Low.
3. 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	-	24 V	
Remote On/Off	-0.3 V	-	24 V	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-40 °C	-	125 °C	

### Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	9 V	-	18 V	
Remote Off Input Current	-	18 mA	25 mA	
Input Current (no load)	-	30 mA	45 mA	
Input Current (full load)				
Vo=5 V	-	-	0.8 A	
Vo=9 V	-	-	1.3 A	
Vo=12 V	-	-	1.8 A	
Input Reflected Ripple Current (pk-pk)				With simulated source impedance of 500 nH, 5 Hz to 20 MHz; Use one 100 uF/25 V tantalum capacitor at the input.
Vo=5 V	-	55 mA	80 mA	
Vo=9 V	-	75 mA	110 mA	
Vo=12 V	-	95 mA	130 mA	
Input Reflected Ripple Current (rms)				
Vo=5 V	-	15 mA	25 mA	
Vo=9 V	-	20 mA	30 mA	
Vo=12 V	-	30 mA	40 mA	
I <sup>2</sup> t Inrush Current Transient	-	0.003 A <sup>2</sup> s	0.01 A <sup>2</sup> s	
Turn-on Voltage Threshold	8.0 V	8.5 V	8.8 V	
Turn-off Voltage Threshold	7.2 V	7.6 V	8.2 V	

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

# NON-ISOLATED DC/DC CONVERTERS

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5 Vdc - 12 Vdc/1A Output



## Output Specifications

Parameter	Min	Typ	Max	Notes	
Output Voltage Set Point				Test condition: Vin=12 V, Iout=full load	
Vo=5 V	4.90 V	5 V	5.10 V		
Vo=9 V	8.82 V	9 V	9.18 V		
Vo=12 V	11.76 V	12 V	12.24 V		
Line Regulation					
Vo=5 V	-	8 mV	15 mV		
Vo=9 V	-	15 mV	25 mV		
Vo=12 V	-	20 mV	35 mV		
Load Regulation					
Vo=5 V	-	15 mV	25 mV		
Vo=9 V	-	25 mV	45 mV		
Vo=12 V	-	35 mV	60 mV		
Regulation Over Temperature (-40°C to +85 °C)					
Vo=5 V	-	50 mV	80 mV		
Vo=9 V	-	70 mV	100 mV		
Vo=12 V	-	90 mV	140 mV		
Output Current	0.005 A	-	1 A		
Output DC Current Limit	1.1 A	-	1.8 A		
Ripple and Noise (rms)				Test conditions: BW = 0-20 MHz; with $\pi$ filter (Co1=10 uF, L=0.47 uH, Co2=10 uF) at the output	
Vo=5 V	-	3 mV	5 mV		
Vo=9 V	-	3 mV	5 mV		
Vo=12 V	-	4 mV	6 mV		
Ripple and Noise (pk-pk)				Test conditions: BW = 0-20 MHz; with two 10 uF ceramic capacitors at the output.	
Vo=5 V	-	10 mV	15 mV		
Vo=9 V	-	15 mV	20 mV		
Vo=12 V	-	20 mV	30 mV		
Ripple and Noise (rms)				Test conditions: BW = 0-20 MHz; with two 10 uF ceramic capacitors at the output.	
Vo=5 V	-	15 mV	25 mV		
Vo=9 V	-	25 mV	35 mV		
Vo=12 V	-	35 mV	50 mV		
Ripple and Noise (pk-pk)				Test conditions: BW = 0-20 MHz; with two 10 uF ceramic capacitors at the output.	
Vo=5 V	-	40 mV	70 mV		
Vo=9 V	-	70 mV	100mV		
Vo=12 V	-	110 mV	160mV		
Turn On Time					
Vo=5 V	-	20 mS	30 mS		
Vo=9 V	-	30 mS	45 mS		
Vo=12 V	-	30 mS	45 mS		
Overshoot at Turn on	-	0%	5%		
Output Capacitance	0 uF	-	47 uF		
<b>Transient Response</b>					
50% ~ 75% Max Load	Overshoot	5.0 V	-	200mV	di/dt = 0.5 A/uS; Vin = 12 V; and with two 10 uF ceramic capacitors at the output
	Settling Time		-	100uS	
75% ~ 50% Max Load	Overshoot	9.0 V	-	200mV	
	Settling Time		-	100uS	
50% ~ 75% Max Load	Overshoot	9.0 V	-	300mV	
	Settling Time		-	150uS	
75% ~ 50% Max Load	Overshoot	9.0 V	-	300mV	
	Settling Time		-	150uS	
50% ~ 75% Max Load	Overshoot	12.0 V	-	350mV	
	Settling Time		-	150uS	
75% ~ 50% Max Load	Overshoot	12.0 V	-	350mV	
	Settling Time		-	150uS	

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

## NON-ISOLATED DC/DC CONVERTERS

9.0 Vdc - 18 Vdc Input

5 Vdc - 12 Vdc/1A Output



### General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				
Vo=5 V	77%	81%	-	Measured at Vin=12 V, full load
Vo=9 V	82%	86%	-	
Vo=12 V	83%	87%	-	
Switching Frequency	400 kHz	450 kHz	480 kHz	
MTBF	14,760,000 hours			Calculated Per Bell Core TR-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	-	5 g	-	

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

### Control Specifications

Parameter	Min	Typ	Max	Notes
<b>Remote On/Off</b>				
Signal Low (Unit On)	-0.3 V	-	0.4 V	xRAH-01KxxL, Remote On/Off pin open, unit off.
Signal High (Unit Off)	2.5 V	-	Vin	
Signal Low (Unit Off)	-0.3 V	-	0.4 V	xRAH-01Kxx0, Remote On/Off pin open, unit on.
Signal High (Unit On)	2.5 V	-	Vin	

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

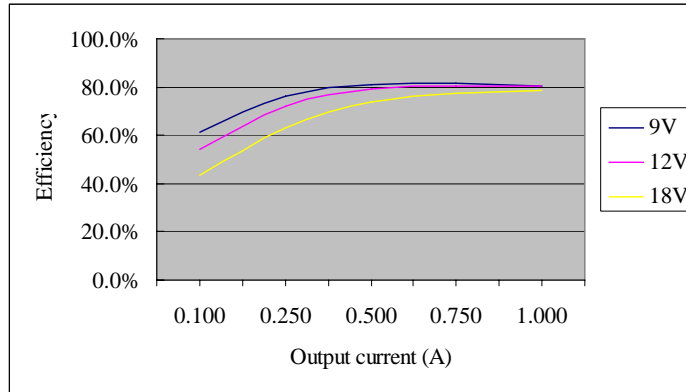
# NON-ISOLATED DC/DC CONVERTERS

9.0 Vdc - 18 Vdc Input

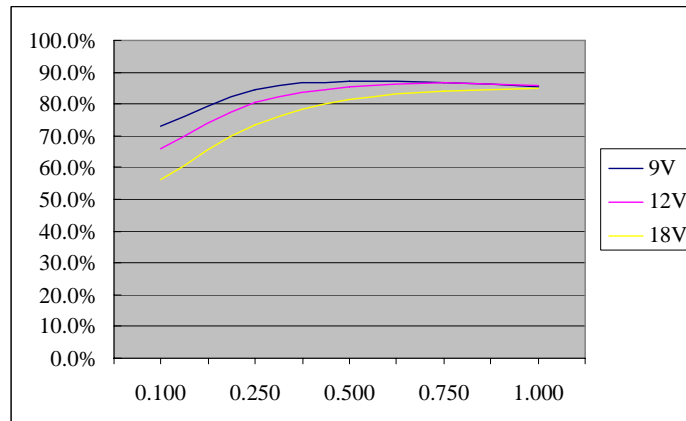
5 Vdc - 12 Vdc/1A Output



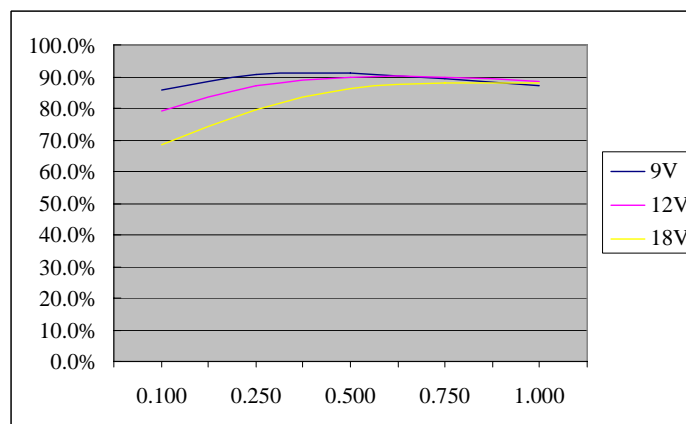
## Efficiency Data



x7AH-01K500



x7AH-01K900



x7AH-01KX20

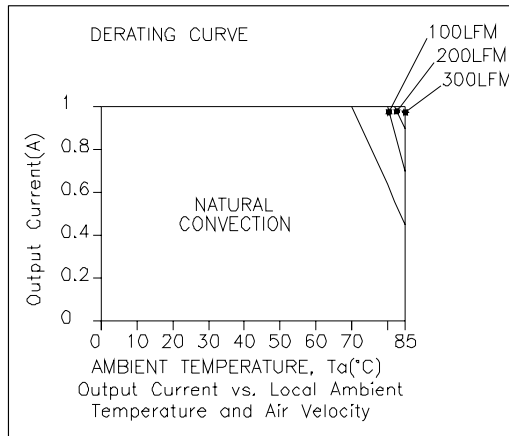
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9.0 Vdc - 18 Vdc Input

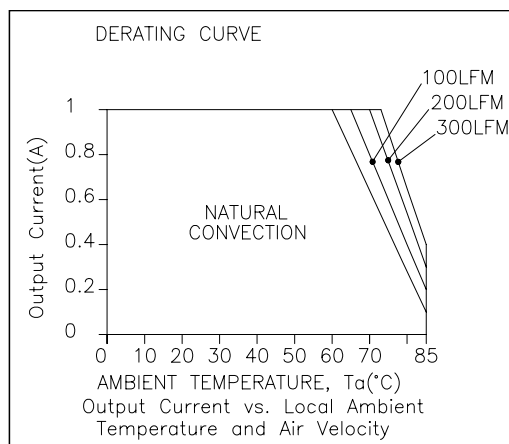
5 Vdc - 12 Vdc/1A Output



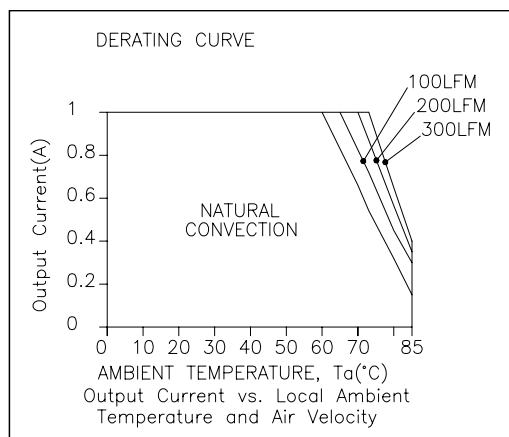
## Thermal Derating Curves



Vin=12 V, Vo=5 V



Vin=12 V, Vo=9 V



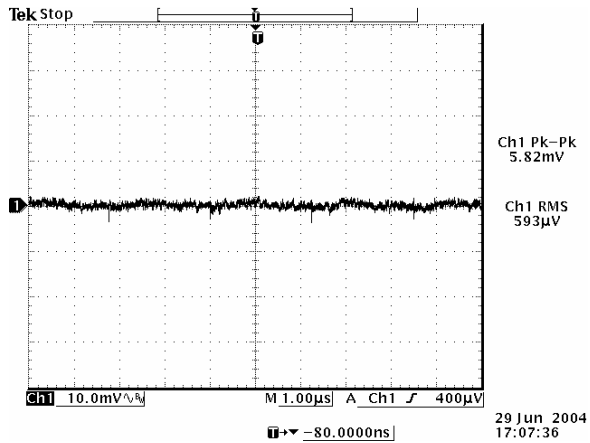
Vin=12 V, Vo=12 V

# NON-ISOLATED DC/DC CONVERTERS

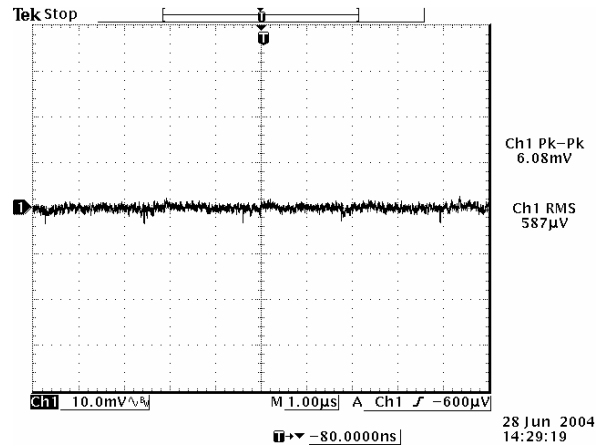
9.0 Vdc - 18 Vdc Input      5 Vdc - 12 Vdc/1A Output



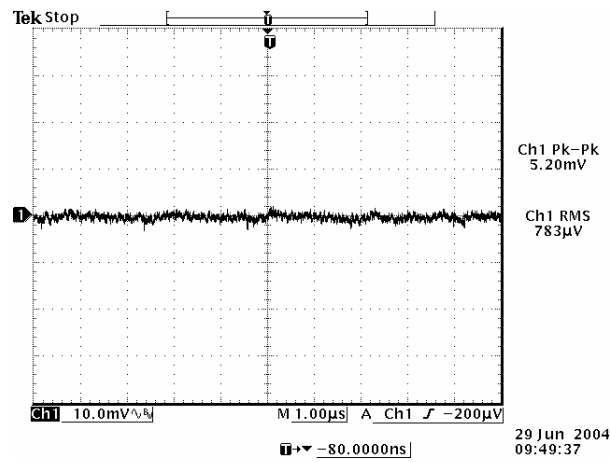
## Ripple and Noise Waveforms



12 Vdc input, 5 Vdc output



12 Vdc input, 9 Vdc output



12 Vdc input, 12 Vdc output

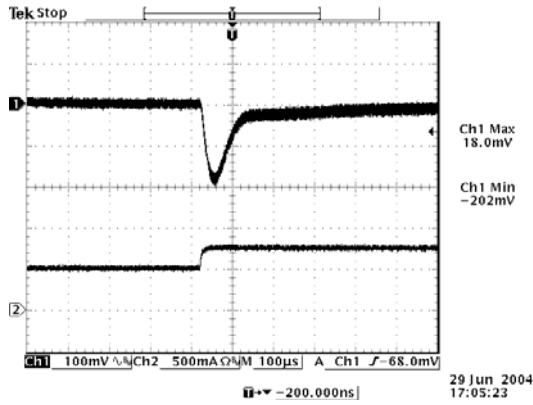
**Note:** Ripple and noise at no load, with two 10 uF ceramic capacitors at the output, and Ta=25 deg C.

# NON-ISOLATED DC/DC CONVERTERS

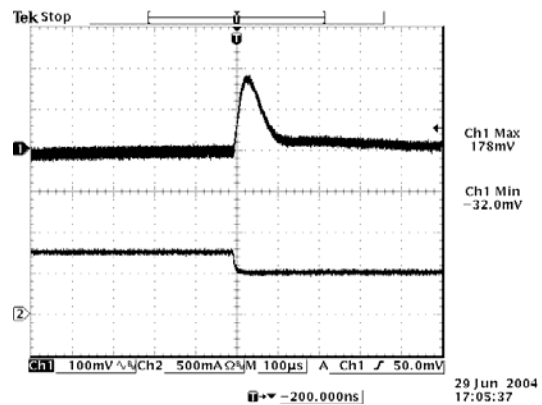
9.0 Vdc - 18 Vdc Input      5 Vdc - 12 Vdc/1A Output



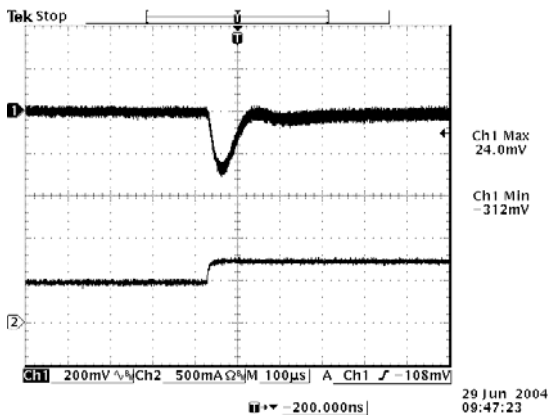
## Transient Response Waveforms



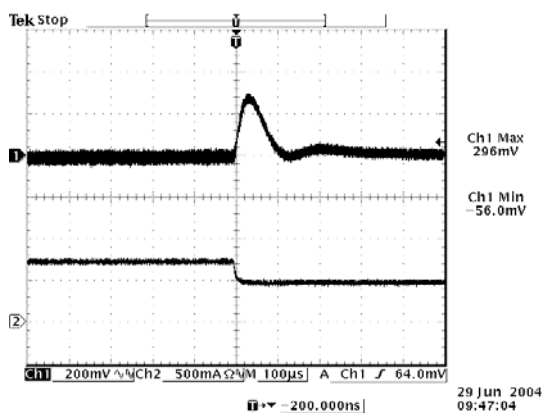
50% to 75% load transient at 5 Vdc output



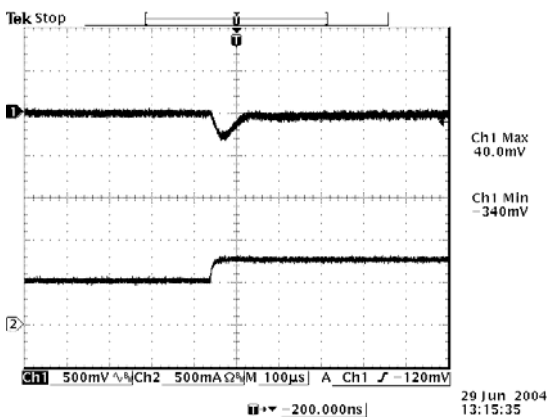
75% to 50% load transient at 5 Vdc output



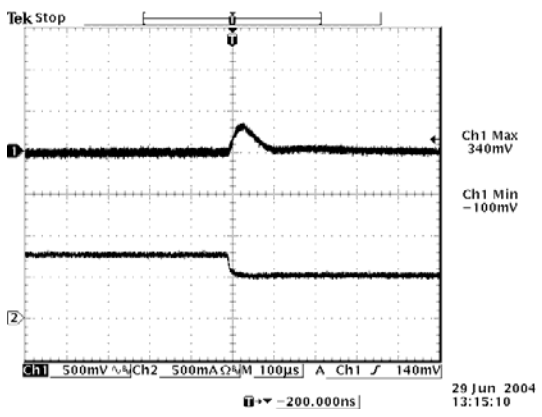
50% to 75% load transient at 9 Vdc output



75% to 50% load transient at 9 Vdc output



50% to 75% load transient at 12 Vdc output



75% to 50% load transient at 12 Vdc output

**Note:** Transient response at 12 Vdc input,  $di/dt=0.5 \text{ A}/\mu\text{S}$ , with two 10  $\mu\text{F}$  ceramic capacitors at the output, and  $T_a=25 \text{ deg C}$ .

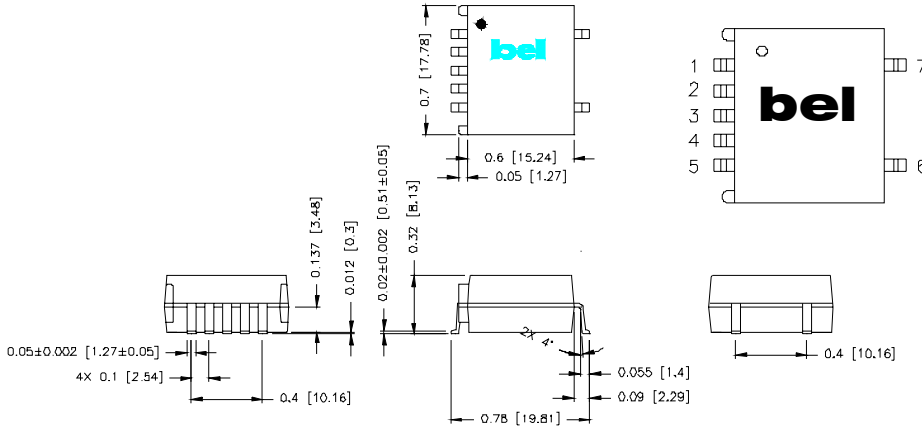
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## Mechanical Outline

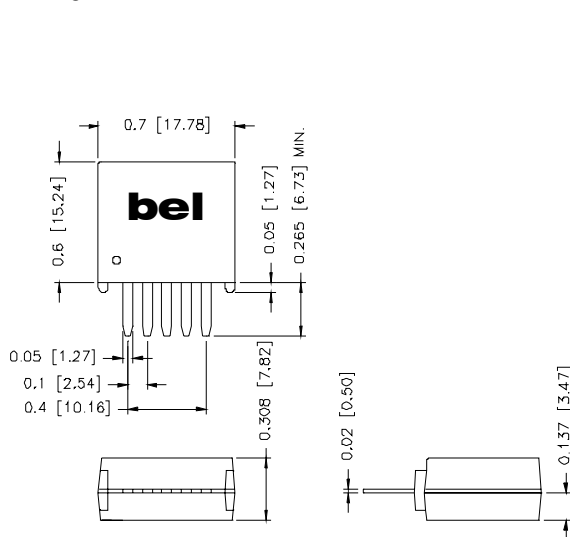
### SRAH-01Kxxx



### Pin Connections

Pin	Function
1	On/Off
2	Vin
3	Ground
4	Vout
5	N/A
6	N/A
7	N/A

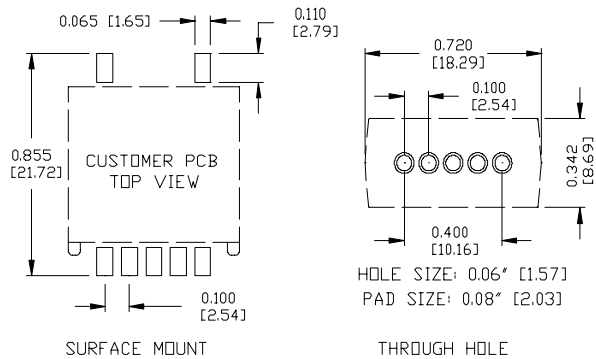
### VRAH-01Kxxx



### Pin Connections

Pin	Function
1	On/OFF
2	Vin
3	Ground
4	Vout
5	N/A

### 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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