

## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input, -5 Vdc/1 A, -5.2 Vdc/1 A, -12 Vdc/0.5 A Outputs



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

- Non-Isolated
- Fixed Frequency
- High Efficiency
- High Power Density
- UL60950-1 Recognized (UL/cUL)
- Low Cost
- Excellent Thermal Performance
- OCP/SCP
- Industrial Temperature Range



### Description

The Bel xRAH-01FxxN modules are non-isolated; step down dc/dc converters that operate from a 3 V - 5.5 V source. Output voltages are -5.0 V, -5.2 V, and -12 V. They are packaged in a compact, overmolded package rated at 1 A, 1 A, 0.5 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 is typically 88% at 1 A, -5 V output 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
-5.0 V	3.0 V - 5.5 V	1 A	5 W	88%	SRAH-01F50N	VRAH-01F50N
-5.2 V	3.0 V - 5.5 V	1 A	5.2 W	88%	SRAH-01F52N	VRAH-01F52N
-12 V	3.0 V - 5.5 V	0.5 A	6 W	88%	SRAH-01FX2N	VRAH-01FX2N

- 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	-	7 V	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-40 °C	-	125 °C	

### Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	3 V	-	5.5 V	
Input Current (full load) Vo= -5.0 V, -5.2 V Vo= -12 V	- -	- -	2.1 A 2.5 A	
Input Current (no load) Vo= -5.0 V, -5.2 V Vo= -12 V	- -	- -	150 mA 200 mA	
Input Reflected Ripple Current (pk-pk)	-	80 mA	160 mA	For -5 V & -5.2 V output, use a 680uF/6.3 V Os-con capacitor; For -12 V output, use 1000 uF electrolytic capacitor & 22 uF/10 V ceramic capacitor at the input.
Input Reflected Ripple Current (rms)	-	20 mA	50 mA	
I <sup>2</sup> t Inrush Current Transient	-	-	0.01 A <sup>2</sup> s	
Turn-on Voltage Threshold	-	2.63 V	-	
Turn-off Voltage Threshold Vo= -5.0 V, -5.2 V Vo= -12 V	0.4 V 1.0 V	- -	2.0 V 2.3 V	

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## Output Specifications

Parameter	Min	Typ	Max	Notes		
Output Voltage Set Point Vo= -5.0 V Vo= -5.2 V Vo= -12 V	-5.1 V -5.304 V -12.24 V	-5.0 V -5.2 V -12 V	-4.90 V -5.096 V -11.76 V	Vin=5.0 V, Iout=half load; with 220 uF/10 V tantalum capacitor & 0.1 uF ceramic capacitor (Vo= -5 V & -5.2 V) or two 47 uF/25 V tantalum capacitors & 0.1uF ceramic capacitor (Vo= -12 V).		
Line Regulation Vo= -5.0 V, -5.2 V Vo= -12 V	-20 mV -120 mV	-	20 mV 120 mV			
Load Regulation Vo= -5.0 V, -5.2 V Vo= -12 V	-60 mV -120 mV	-	60 mV 120 mV			
Regulation Over Temperature (-40 °C to +85 °C) Vo= -5.0 V, -5.2 V Vo= -12 V	-80 mV -240 mV	-	80 mV 240 mV			
Ripple and Noise (rms) Vo= -5.0 V Vo= -5.2 V Vo= -12 V	-	25 mV 25 mV 40 mV	40 mV 50 mV 70 mV	Test conditions: BW = 0-20 MHz; with 220 uF/10V tantalum capacitor & 0.1 uF ceramic capacitor (Vo= -5 V & -5.2 V) or two 47 uF/25 V tantalum capacitors & 0.1 uF ceramic capacitor (Vo= -12 V).		
Ripple and Noise (pk-pk) Vo= -5.0 V Vo= -5.2 V Vo= -12 V	-	90 mV 100 mV 120 mV	120 mV 130 mV 240 mV			
Output Current Range Vo= -5.0 V, -5.2 V Vo= -12 V	0 A 0 A	-	1 A 0.5 A			
Output DC Current Limit	-	200%	-			
Short Circuit Surge Transient	-	-	0.01 A <sup>2</sup> s			
Turn on Time	-	10 mS	30 mS			
Overshoot at Turn on	-	0%	3%			
Output Capacitance Vo= -5.0 V, -5.2 V Vo= -12 V	220 uF 100 uF	-	470 uF 150 uF			
<b>Transient Response</b>						
50% ~ 100% Max Load	Overshoot	Vo= -5.0 V, -5.2 V	-	80 mV	-	Test Conditions: di/dt = 0.1 A/uS; Vin = 5.0 V; Ta = 25°C and with 220 uF/10 V Tantalum capacitor & 0.1 uF ceramic capacitor (Vo= -5 V & -5.2 V) or two 47 uF/25 V tantalum capacitors & 0.1 uF ceramic capacitor (Vo=-12 V).
	Settling Time		-	40 uS	-	
100% ~ 50% Max Load	Overshoot		-	80 mV	-	
	Settling Time		-	40 uS	-	
50% ~ 100% Max Load	Overshoot	Vo= -12 V	-	130 mV	-	
	Settling Time		-	50 uS	-	
100% ~ 50% Max Load	Overshoot		-	130 mV	-	
	Settling Time		-	50 uS	-	

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

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3.0 Vdc - 5.5 Vdc Input, -5 Vdc/1 A, -5.2 Vdc/1 A, -12 Vdc/0.5 A Outputs

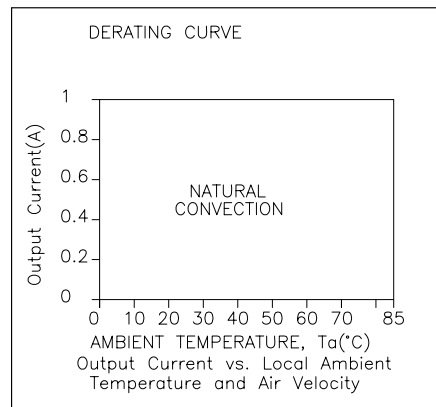


## General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency	84%	88%	-	Vin=5 V; Io=Iomax
Switching Frequency	250 kHz	300 kHz	350 kHz	
MTBF	4,883,163 hours			Calculated Per Bell Core SR-332 (Io = 80%Iomax; Ta = 25 °C)
Dimensions (surface mount)				SRAH-01FxxN
Inches (L x W x H)	0.78 x 0.7 x 0.32			
Millimeters (L x W x H)	19.82 x 17.78 x 8.13			
Dimensions (vertical)				VRAH-01FxxN
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	-	4.9 g	-	

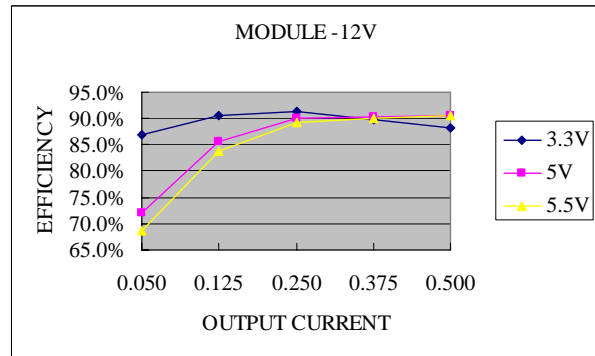
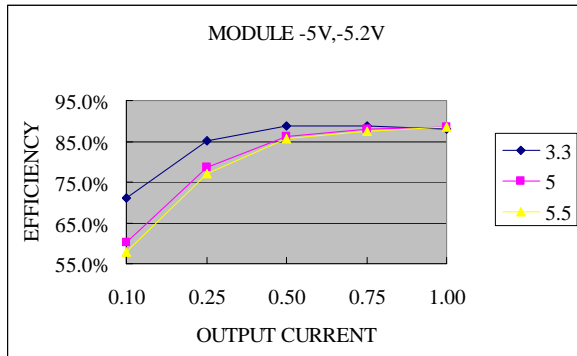
**Note:** All specifications are typical at 25 °C unless otherwise stated.

## Thermal Derating Curve



xRAH-01F50N

## Efficiency Data

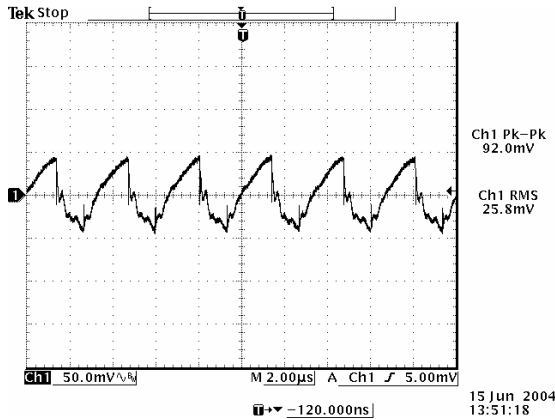


# NON-ISOLATED DC/DC CONVERTERS

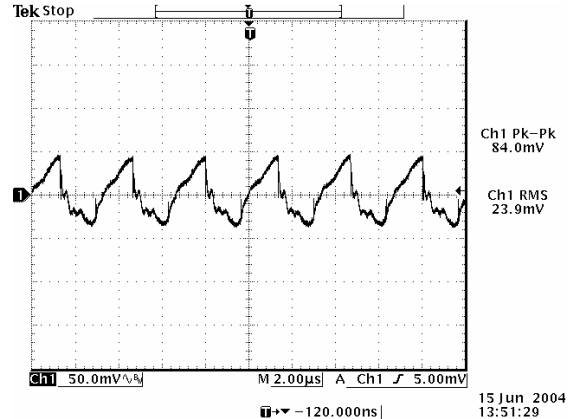
3.0 Vdc - 5.5 Vdc Input, -5 Vdc/1 A, -5.2 Vdc/1 A, -12 Vdc/0.5 A Outputs



## Ripple and Noise Waveforms

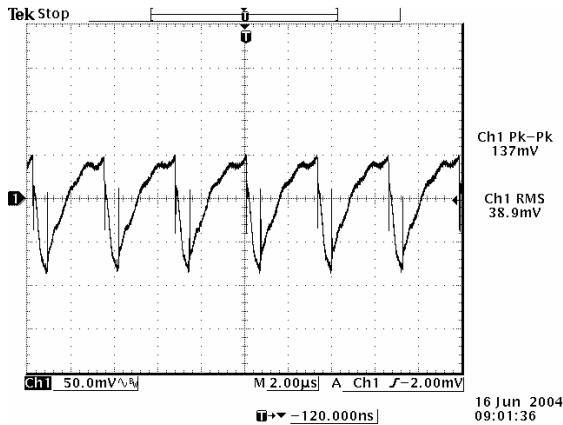


3.3 V input, -5 V output

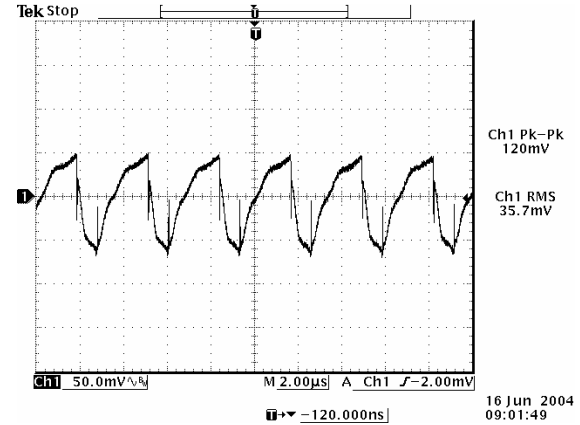


5 V input, -5 V output

**Note:** Ripple and noise at full load, with a 220 uF/10 V tantalum capacitor and a 0.1uF ceramic capacitor at the output, Ta=25 deg C.



3.3 V input, -12 V output



5 V input, -12 V output

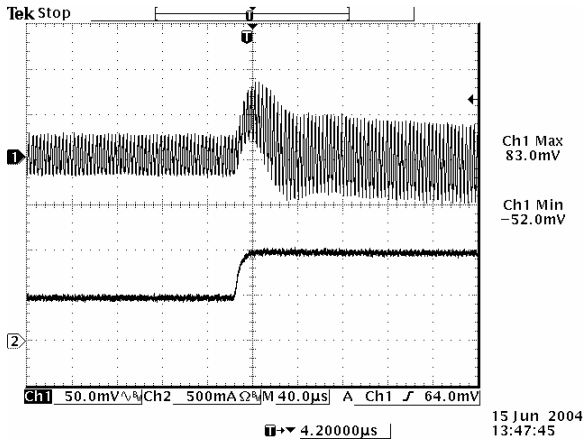
**Note:** Ripple and noise at full load, with a 2\*47uF/25 V tantalum capacitor and a 0.1uF ceramic capacitor at the output, Ta=25 deg C.

# NON-ISOLATED DC/DC CONVERTERS

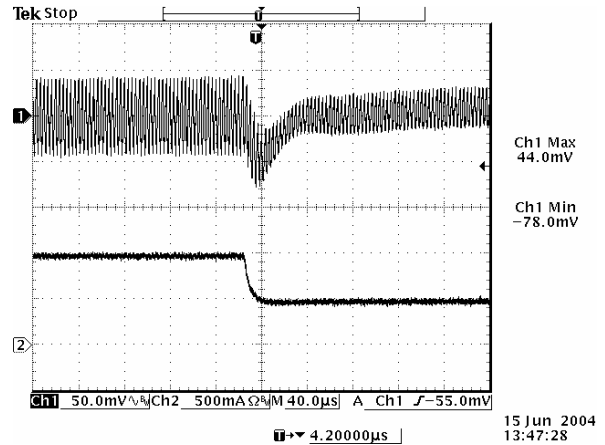
3.0 Vdc - 5.5 Vdc Input, -5 Vdc/1 A, -5.2 Vdc/1 A, -12 Vdc/0.5 A Outputs



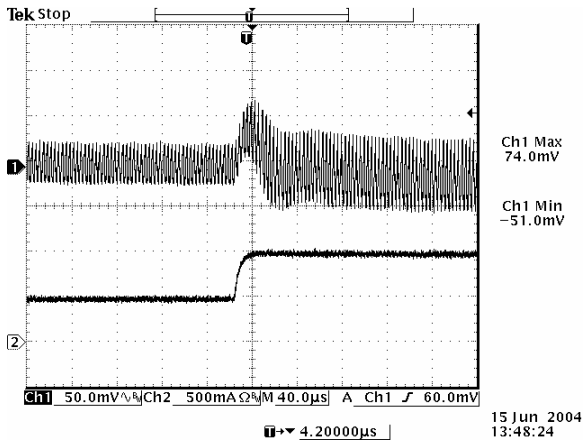
## Transient Response Waveforms



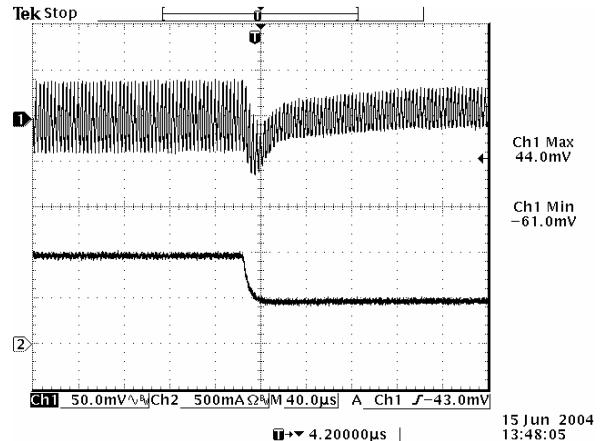
50% to 100% load Transient at  $V_{in}=3.3\text{ V}$ ,  $V_o=-5\text{ V}$



100% to 50% load Transient at  $V_{in}=3.3\text{ V}$ ,  $V_o=-5\text{ V}$



50% to 100% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=-5\text{ V}$



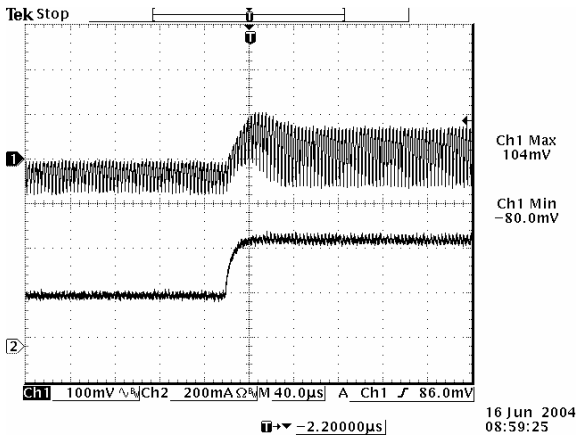
100% to 50% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=-5\text{ V}$

**Note:** Transient Response at  $di/dt=0.1\text{ A}/\mu\text{s}$ , with a 220  $\mu\text{F}/10\text{ V}$  tantalum capacitor and a 0.1 $\mu\text{F}$  ceramic capacitor at the output,  $T_a=25\text{ deg C}$ .

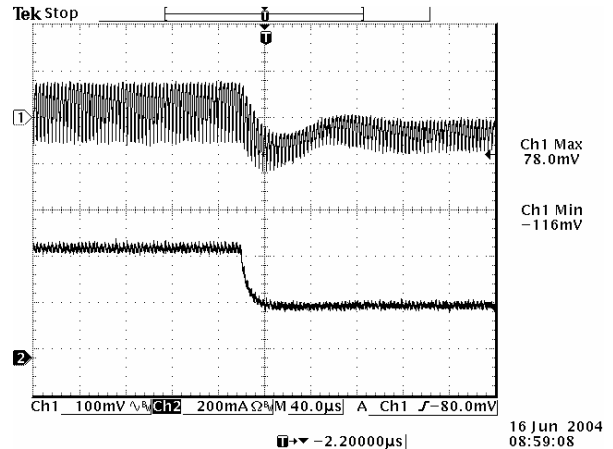
**NON-ISOLATED DC/DC CONVERTERS**  
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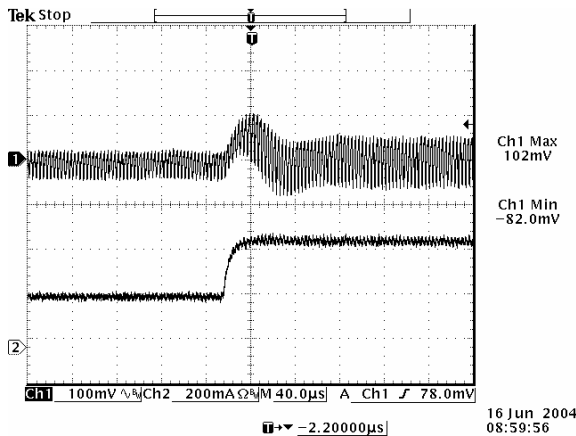
**Transient Response Waveforms (continued)**



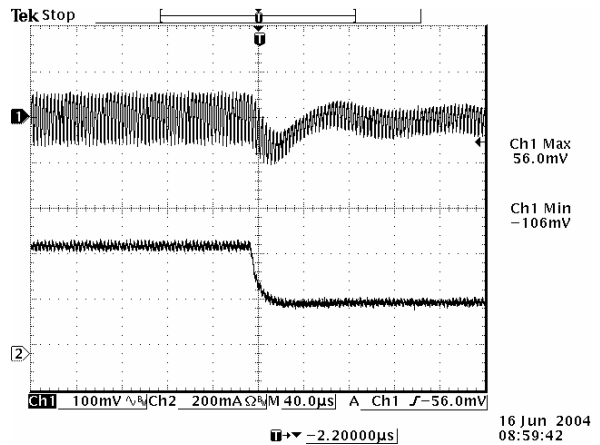
50% to 100% load Transient at Vin=3.3 V, Vo=-12 V



100% to 50% load Transient at Vin=3.3 V, Vo=-12 V



50% to 100% load Transient at Vin=5 V, Vo=-12 V



100% to 50% load Transient at Vin=5 V, Vo=-12 V

**Note:** Transient Response at di/dt=0.1 A/uS, with a 2\*47uF/25Vtantalum capacitor and a 0.1uF ceramic capacitor at the output, Ta=25 deg C.

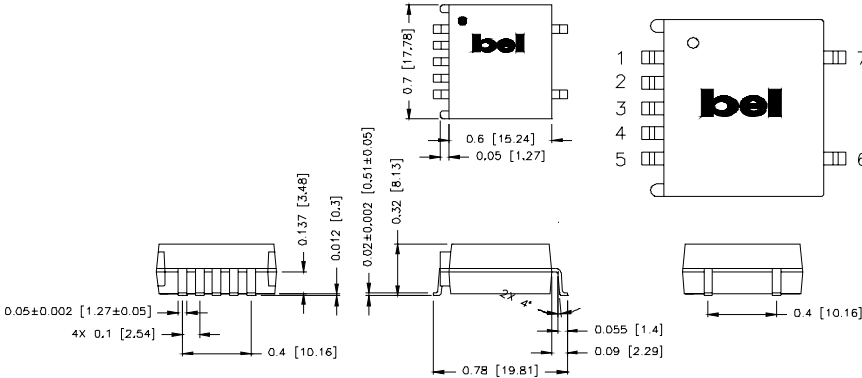
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## Mechanical Outline

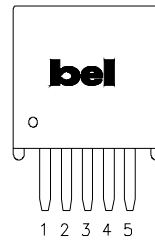
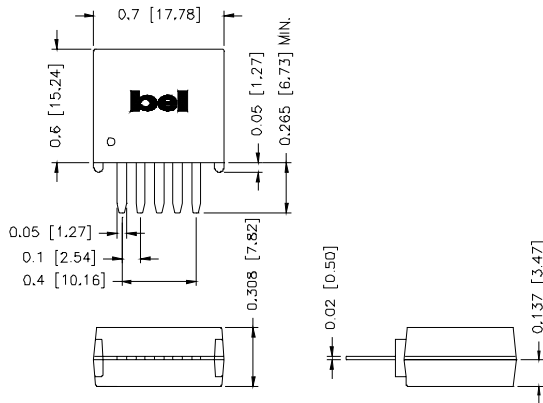
### SRAH-01FxxN



### Pin Connections

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

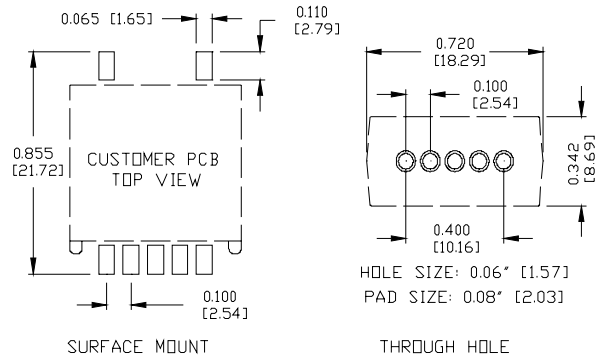
### VRAH-01FxxN



### Pin Connections

Pin	Function
1	N/A
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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