

NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input 0.9 Vdc - 3.3 Vdc/3 A Output

bel
POWER PRODUCTS

xRAH-03F1A0

RoHS Compliant

Rev.A

- Non-Isolated
- High Efficiency
- Fixed Frequency (300 kHz)
- Low Cost
- UL60950-1 Recognized (UL/cUL)
- Remote On/Off
- Input Under Voltage Lockout
- OCP/SCP
- Wide Range Trim



Description

The Bel xRAH-03F1A0 module is a non-isolated, step down dc/dc converter that operates from 3.0 Vdc to 5.5 Vdc source. This converter is available in a range of output voltages from 0.9 Vdc to 3.3 Vdc. 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 efficiency of 3.3 Vdc module is typically 92% at 5 Vdc input and 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
0.9 Vdc - 3.3 Vdc	3.0 Vdc - 5.5 Vdc	3 A	10 W	92%	SRAH-03F1A0	VRAH-03F1A0

- 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	-	6 V	
Output Enable Terminal Voltage	-0.3 V	-	6 V	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-40 °C	-	125 °C	

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
Vo=3.3 V	4.5 V	-	5.5 V	
Vo=2.5 V	3.6 V	-	5.5 V	
Vo=0.9 V-1.8 V	3.0 V	-	5.5 V	
Input Current (no load)	-	-	70 mA	
Input Current (full load)				
Vo=3.3 V	-	-	2.5 A	
Vo=2.5 V	-	-	2.4 A	
Vo=1.8 V	-	-	2.2 A	
Vo=1.5 V	-	-	1.9 A	
Vo=1.2 V	-	-	1.6 A	
Vo=0.9 V	-	-	1.3 A	
Remote Off Input Current	-	5 mA	10 mA	
Input Reflected Ripple Current (pk-pk)	-	75 mA	-	Tested with simulated source impedance of 500 nH, 5 Hz to 20 MHz and two 270 uF/16 V Oscon caps with ESR=0.018 ohm max at 100 kHz
Input Reflected Ripple Current (rms)	-	25 mA	-	

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Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
I ² t Inrush Current Transient	-	0.004 A ² s	0.008 A ² s	
Turn on Voltage Threshold	-	-	2.9 V	Only for 0.9 V - 1.8 V output modules.
Turn off Voltage Threshold	2.2 V	2.4 V	-	

Note: All specifications are typical at nominal input (5 V), full load at 25 °C unless otherwise stated.

Output Specifications

Parameter	Min	Typ	Max	Notes		
Output Voltage Set Point				Test conditions: Vin=5 V, Io=50% full load		
Vo=3.3 V	3.217 V	3.3 V	3.383 V			
Vo=2.5 V	2.437 V	2.5 V	2.563 V			
Vo=1.8 V	1.755 V	1.8 V	1.845 V			
Vo=1.5 V	1.462 V	1.5 V	1.538 V			
Vo=1.2 V	1.170 V	1.2 V	1.230 V			
Vo=0.9 V	0.877 V	0.9 V	0.923 V			
Line Regulation						
Vo=3.3 V	-	10 mV	20 mV			
Vo=2.5 V	-	8 mV	16 mV			
Vo=1.8 V	-	6 mV	12 mV			
Vo=1.5 V	-	5 mV	10 mV			
Vo=1.2 V	-	4 mV	8 mV			
Vo=0.9 V	-	3 mV	6 mV			
Load Regulation						
Vo=3.3 V	-	17 mV	33 mV			
Vo=2.5 V	-	13 mV	25 mV			
Vo=1.8 V	-	9 mV	18 mV			
Vo=1.5 V	-	8mV	15 mV			
Vo=1.2 V	-	6 mV	12 mV			
Vo=0.9 V	-	5 mV	9 mV			
Regulation Over Temperature(-40 °C to +85 °C)						
Vo=3.3 V	-	72 mV	97 mV			
Vo=2.5 V	-	54 mV	72 mV			
Vo=1.8 V	-	39 mV	52 mV			
Vo=1.5 V	-	32 mV	43 mV			
Vo=1.2 V	-	26 mV	40 mV			
Vo=0.9 V	-	19 mV	40 mV			
Output Current	0 A	-	3 A			
Current Limit Threshold	5 A	-	12 A			
Short Circuit Surge Transient	-	0.022 A ² s	0.044 A ² s			
Ripple and Noise (rms)				Test condition: 0-20 MHz BW		
Vo=1.2 V-3.3 V	-	15 mV	25 mV			
Vo=0.9 V	-	10 mV	20 mV			
Ripple and Noise (pk-pk)						
Vo=1.2 V-3.3 V	-	50 mV	70 mV			
Vo=0.9 V	-	40 mV	60 mV			
Turn on Time	-	7 mS	12 mS			
Overshoot at Turn on	-	0%	3%			
Output Capacitance	0 uF	-	1200 uF			
Transient Response						
50% ~ 100% Max Load	Overshoot	All	-	150 mV	200 mV	Test conditions: di/dt = 0.5 A/uS; Vin = 5 V
	Settling Time		-	20 uS	40 uS	
100% ~ 50% Max Load	Overshoot		-	150 mV	200 mV	
	Settling Time		-	20 uS	40 uS	

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

NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input 0.9 Vdc - 3.3 Vdc/3 A Output



General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				Measured at Vin=5 V, full load and Ta=25 °C
Vo=3.3 V	88%	92%	-	
Vo=2.5 V	86%	90%	-	
Vo=1.8 V	83%	87%	-	
Vo=1.5 V	80%	84%	-	
Vo=1.2 V	77%	81%	-	
Vo=0.9 V	75%	79%	-	
Switching Frequency	250 kHz	300 kHz	360 kHz	
Output Trim Range (wide trim)	100%Vo	-	403%Vo	Vo=0.9 V
MTBF	9,159,999 hours			Calculated Per Bell Core SR-332 (Vin=5 V; Vo=3.3 V; Io = 80% load; 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 g	-	

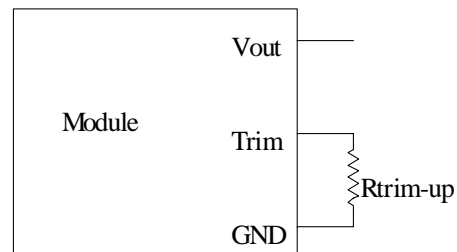
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.3 V	-	0.8 V	Remote on/off pin open, unit on.
Signal High (Unit On)	2.8 V	-	6 V	

Output Trim Equations

Equations for calculating the trim resistor given the desired adjusted voltage (Vadj) and the nominal output voltage of the converter (Vo) are shown below. 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.

$$R_{trim_up} = \left(\frac{3.712}{V_{adj_up} - V_o} - 1 \right) K\Omega$$



Note: Output voltage Vo=0.902V when Ttrim-up is not connected.

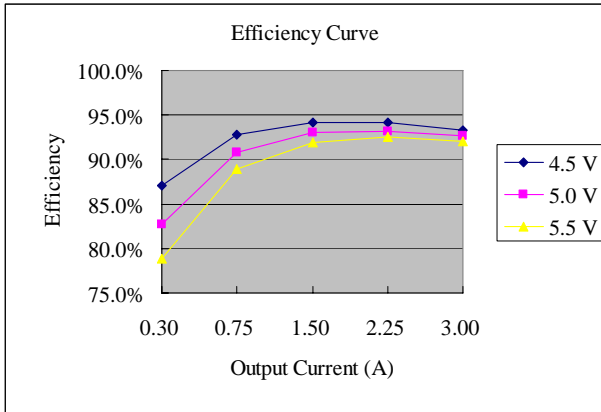
NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

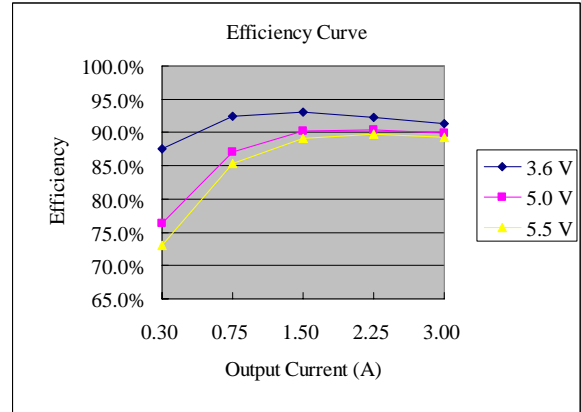
0.9 Vdc - 3.3 Vdc/3 A Output



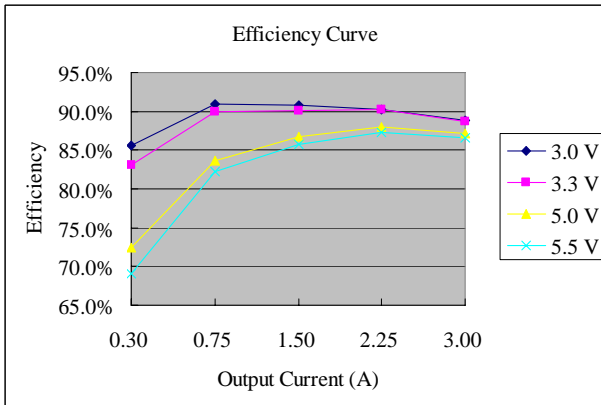
Efficiency Data



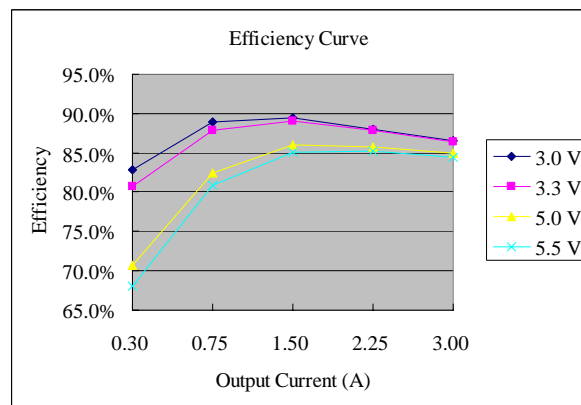
Vo=3.3 V



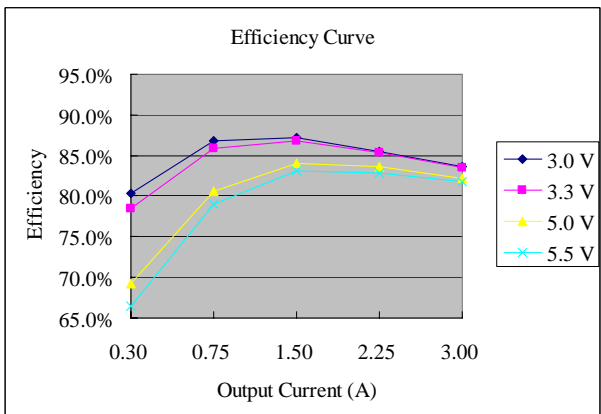
Vo=2.5 V



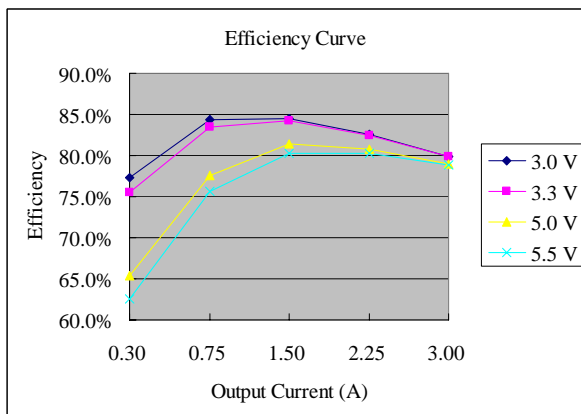
Vo=1.8 V



Vo=1.5 V



Vo=1.2 V



Vo=0.9 V

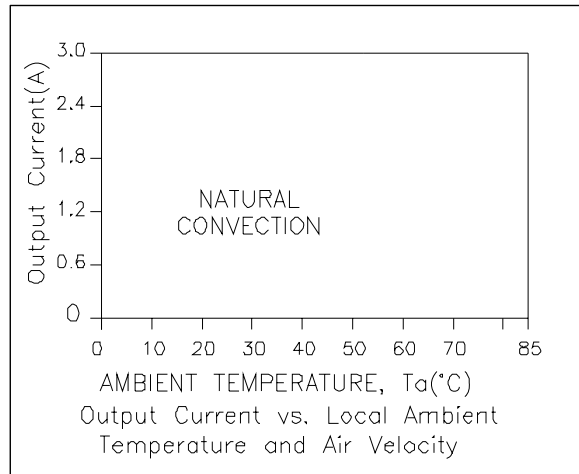
NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

0.9 Vdc - 3.3 Vdc/3 A Output

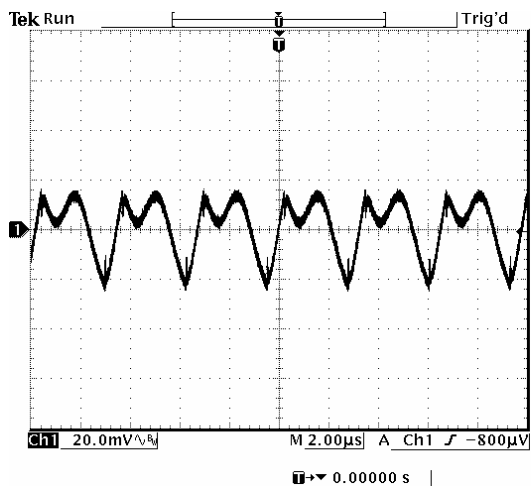


Thermal Derating Curve

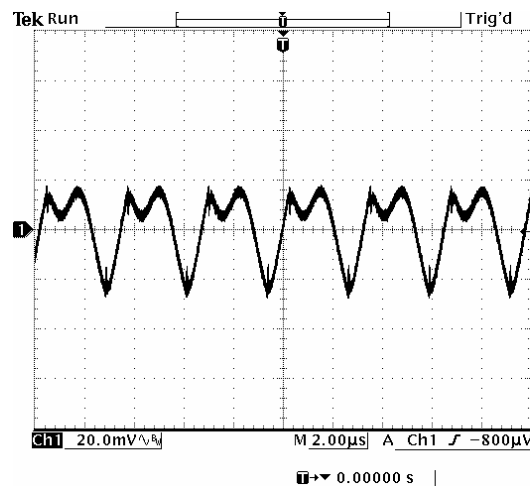


xRAH-03F1A0

Ripple and Noise Waveforms



Vo=0.9 V

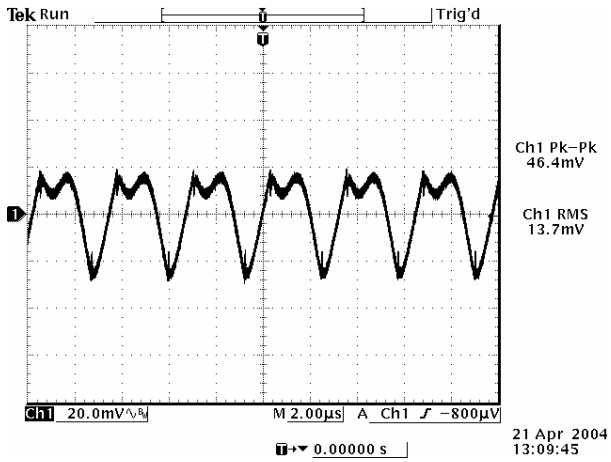


Vo=1.2 V

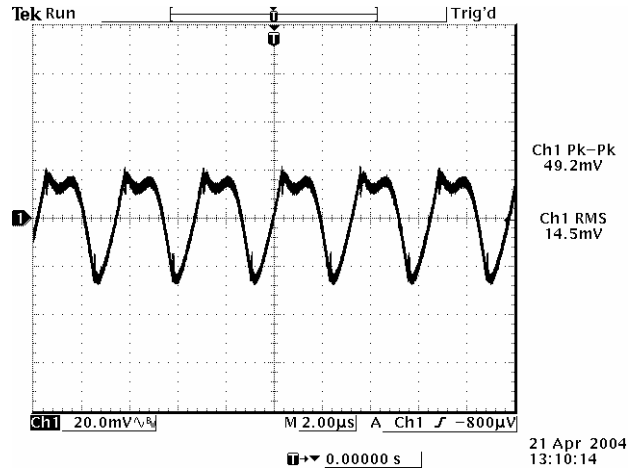
NON-ISOLATED DC/DC CONVERTERS
 3.0 Vdc - 5.5 Vdc Input 0.9 Vdc - 3.3 Vdc/3 A Output



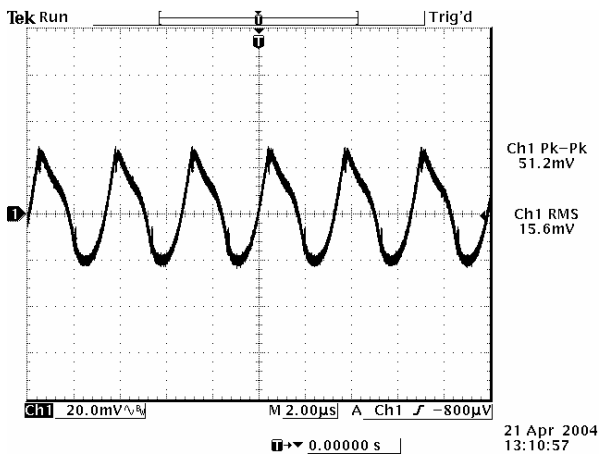
Ripple and Noise Waveforms (continued)



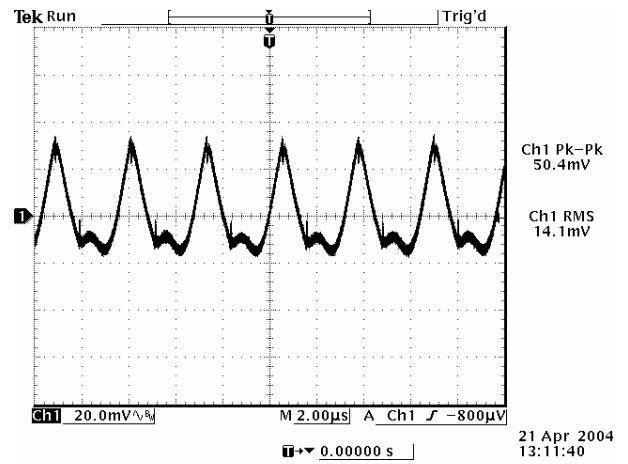
Vo=1.5 V



Vo=1.8 V



Vo=2.5 V



Vo=3.3 V

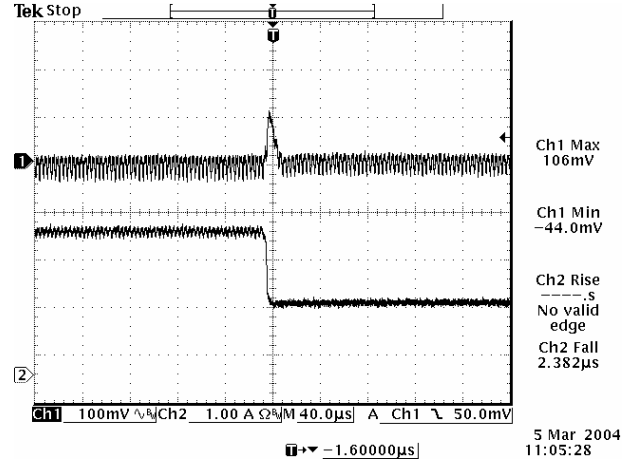
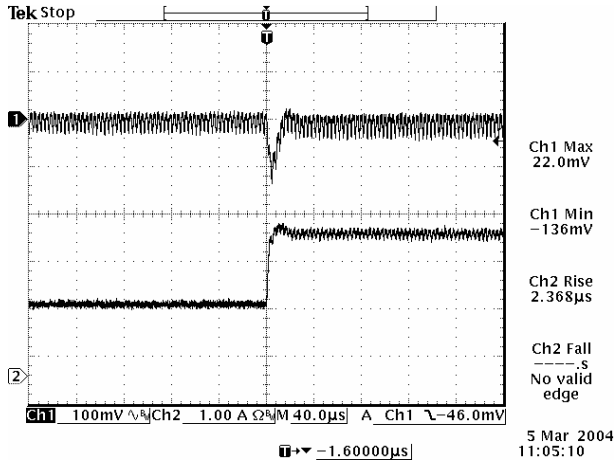
Note: Ripple and noise at full load, 5 Vdc input, and Ta=25 deg C.

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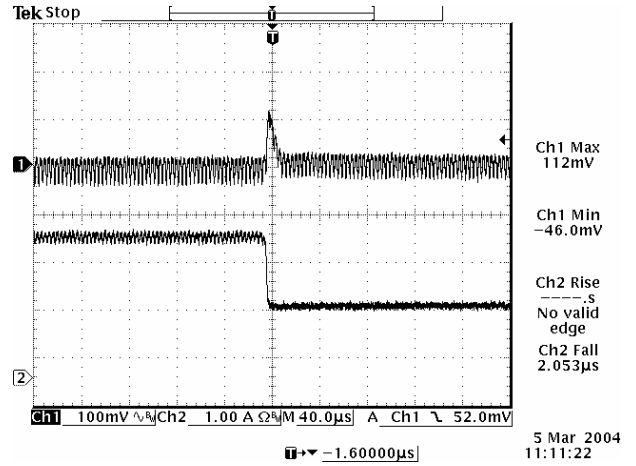
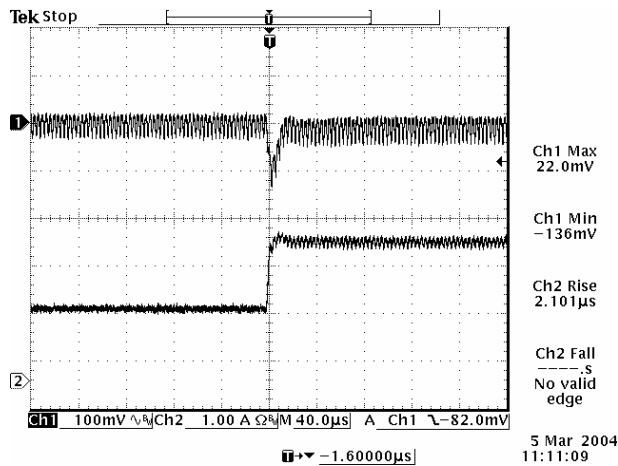


Transient Response Waveforms



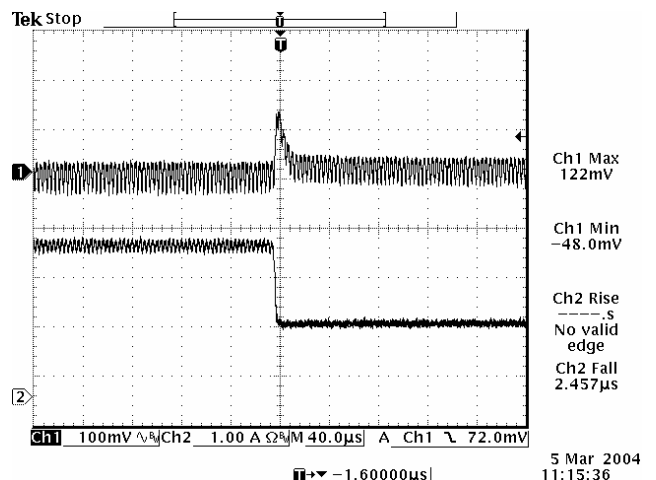
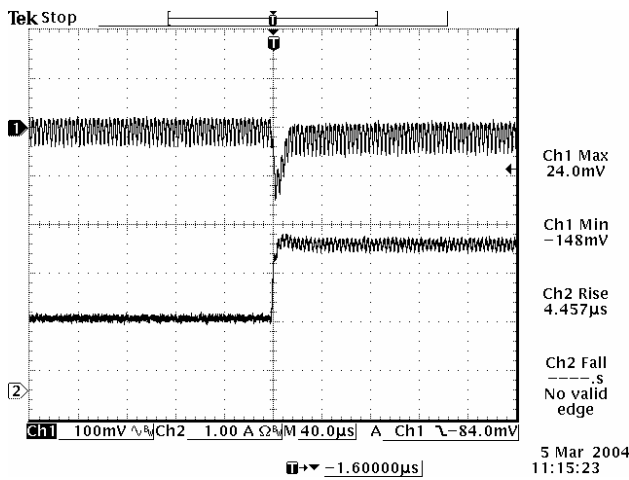
50% to 100% load Transient at $V_{in}=5\text{ V}$, $V_o=0.9\text{ V}$

100% to 50% load Transient at $V_{in}=5\text{ V}$, $V_o=0.9\text{ V}$



50% to 100% load Transient at $V_{in}=5\text{ V}$, $V_o=1.2\text{ V}$

100% to 50% load Transient at $V_{in}=5\text{ V}$, $V_o=1.2\text{ V}$



50% to 100% load Transient at $V_{in}=5\text{ V}$, $V_o=1.5\text{ V}$

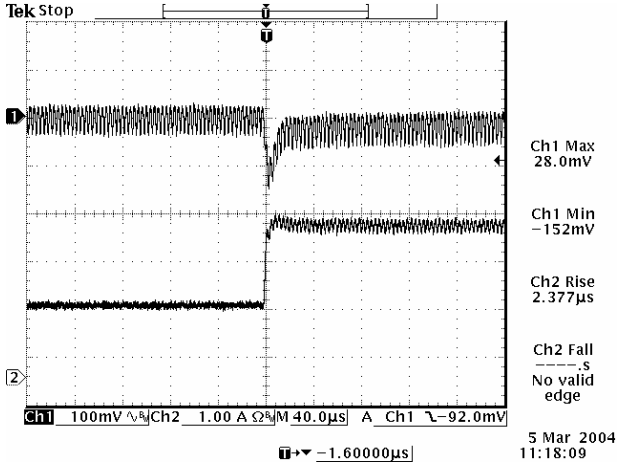
100% to 50% load Transient at $V_{in}=5\text{ V}$, $V_o=1.5\text{ V}$

NON-ISOLATED DC/DC CONVERTERS

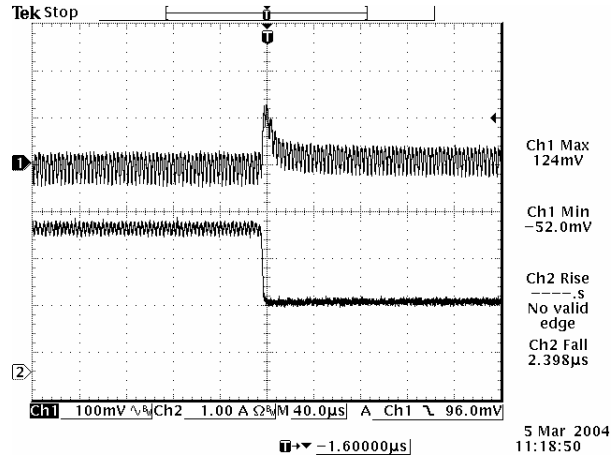
3.0 Vdc - 5.5 Vdc Input 0.9 Vdc - 3.3 Vdc/3 A Output



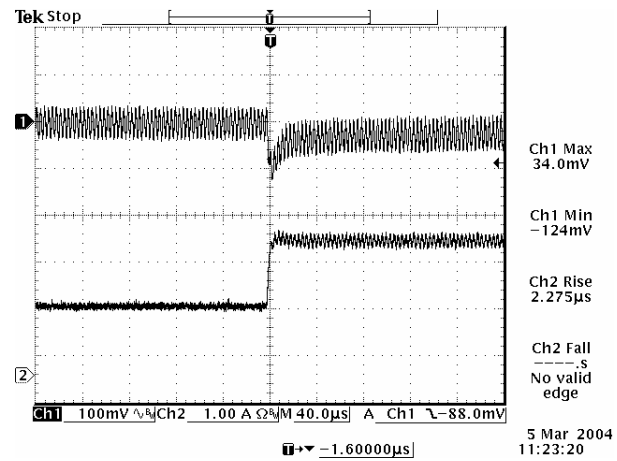
Transient Response Waveforms (continued)



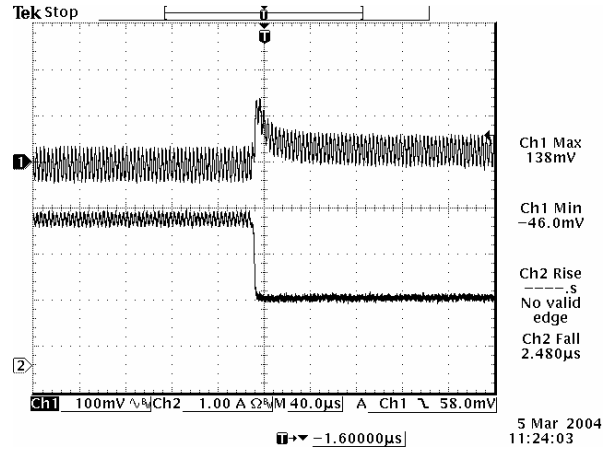
50% to 100% load Transient at Vin=5 V, Vo= 1.8 V



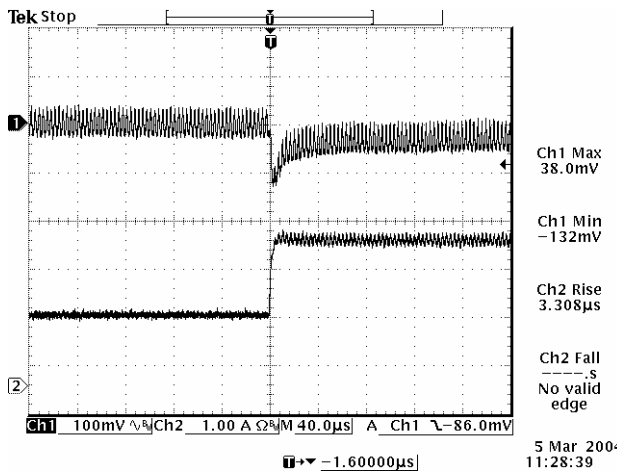
100% to 50% load Transient at Vin=5 V, Vo= 1.8 V



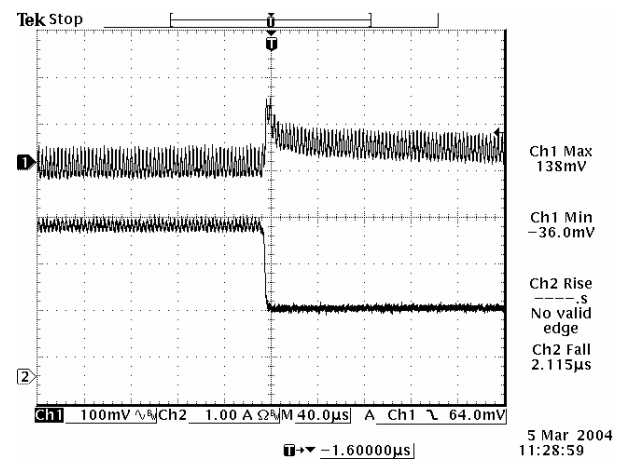
50% to 100% load Transient at Vin=5 V, Vo= 2.5 V



100% to 50% load Transient at Vin=5 V, Vo= 2.5 V



50% to 100% load Transient at Vin=5 V, Vo= 3.3 V



100% to 50% load Transient at Vin=5 V, Vo= 3.3 V

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

NON-ISOLATED DC/DC CONVERTERS

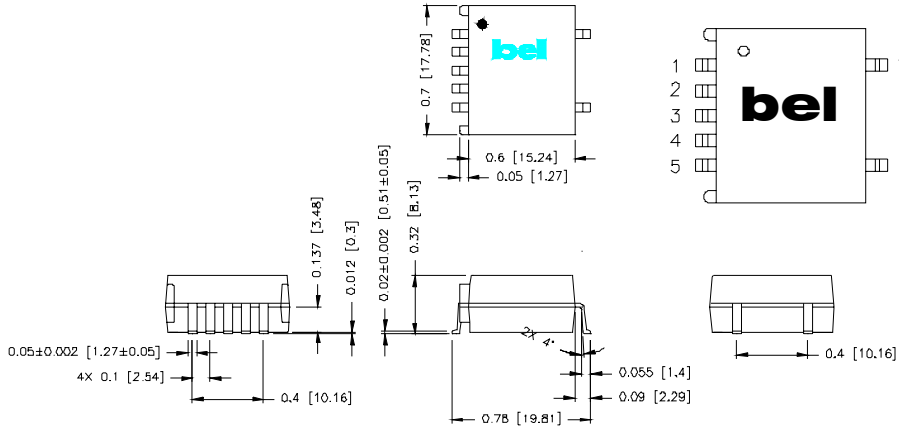
3.0 Vdc - 5.5 Vdc Input

0.9 Vdc - 3.3 Vdc/3 A Output



Mechanical Outline

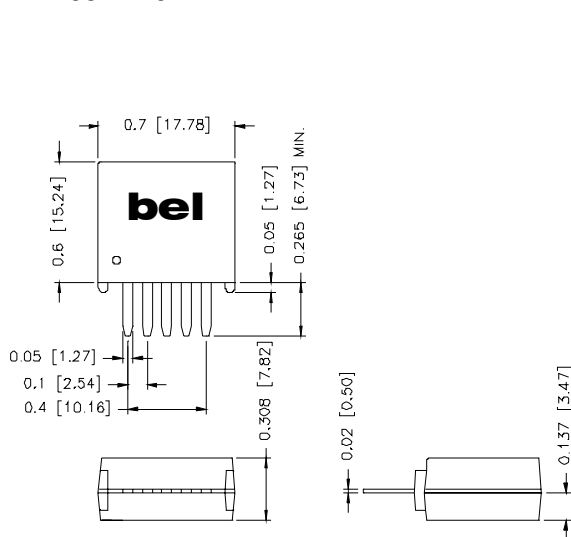
SRAH-03F1A0



Pin Connections

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

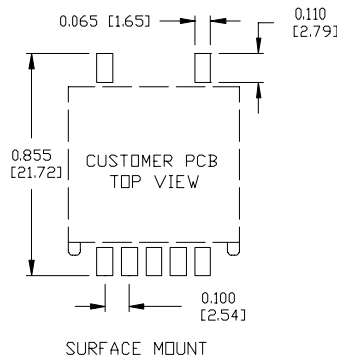
VRAH-03F1A0



Pin Connections

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

RECOMMENDED PCB PAD LAYOUT



HOLE SIZE: 0.06" [1.57]
PAD SIZE: 0.08" [2.03]

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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