NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input 0.8 Vdc - 3.63 Vdc/12 A Output

xRAH-12F1A0 RoHS Compliant Rev.A

- Non-Isolated
- Wide Trim
- Fixed Frequency (300 kHz)
- Remote Sense (SMD Module)
- OCP/SCP
- Remote On/Off
- Under Voltage Lockout (UVLO)
- UL60950-1 Recognized (UL/cUL)

Description

The Bel xRAH-12F1A0 modules are a series of non-isolated, step down dc/dc power converters that operate from 3.0 Vdc to 5.5 Vdc source. These converters are available in a range of output voltages from 0.8 Vdc to 3.63 Vdc. It is packaged in a compact, overmolded package rated at 12 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 94% at 3.3 Vdc output full load.

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	12 A	39.6 W	94%	SRAH-12F1A0	VRAH-12F1A0

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	-55 °C	-	125 °C	

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	3 V	-	5.5 V	
Input Current (no load)	-	100 mA	150 mA	
Input Current (full load)				
Vo=3.3 V	-	-	11 A	
Vo=2.5 V	-	-	10.5 A	
Vo=1.8 V	-	-	9.0 A	
Vo=1.5 V	-	-	8.1 A	
Vo=1.2 V	-	-	6.5 A	
Vo=0.9 V	-	-	5.2 A	
Remote Off Input Current	-	4 mA	8 mA	
Input Reflected Ripple Current (pk-pk)	-	250 mA	400 mA	With simulated source impedance of 500 nH, 5 Hz to 20 MHz; use a 270 uF/16 V cap with ESR=0.0018 ohm max at 100 kHz
Input Reflected Ripple Current (rms)	-	80 mA	120 mA	
I^2t Inrush Current Transient	-	0.09 A^2s	0.2 A^2s	
Turn on Voltage Threshold		2.1 V	-	
Turn off Voltage Threshold	-	2 V	-	

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

Output Specifications

Parameter			Min	Typ	Max	Notes
Output Voltage Set Point						
	Vo=3.3 V		3.234 V	3.3 V	3.366 V	Vin=5 V, Io= 50% load
	Vo=2.5 V		2.45 V	2.5 V	2.55 V	
	Vo=1.8 V		1.764 V	1.8 V	1.836 V	
	Vo=1.5 V		1.47 V	1.5 V	1.53 V	
	Vo=1.2 V		1.176 V	1.2 V	1.224 V	
	Vo=0.9 V		0.882 V	0.9 V	0.981 V	
Line Regulation			-	±3 mV	±6 mV	
Load Regulation			-	±4 mV	±8 mV	
Regulation Over Temperature (-40 °C to +85 °C)			-	±10 mV	±20 mV	
Output Current			0 A	-	12 A	
Current Limit Threshold			15 A	-	30 A	
Short Circuit Surge Transient			-	0.3 A^2s	0.6 A^2s	
Ripple and Noise (rms)			-	15 mV	25 mV	Test conditions: 0-20 MHz BW; 1 uF ceramic capacitor and 10 uF aluminum capacitor at the output.
Ripple and Noise (pk-pk)			-	50 mV	100 mV	
Turn on Time			-	5 mS	10 mS	
Overshoot at Turn on			-	0%	3%	
Output Capacitance			330 uF	-	4800 uF	
Transient Response						
50% ~ 100% Max Load	Overshoot	All	-	150 mV	250 mV	Test conditions: di/dt=0.5 A/us, Vin=5 V, with 330 uF external load capacitance.
	Settling Time		-	30 uS	60 uS	
100% ~ 50% Max Load	Overshoot		-	150 mV	250 mV	
	Settling Time		-	30 uS	60 uS	

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

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				
Vo=3.3 V	91%	94%	-	Vin=5 V, full load
Vo=2.5 V	89%	92%	-	
Vo=1.8 V	87%	90%	-	
Vo=1.5 V	85%	88%	-	
Vo=1.2 V	83%	86%	-	
Vo=0.9 V	81%	84%	-	
Efficiency				
Vo=1.8 V	87%	90%	-	Vin=3.3 V, full load
Vo=1.5 V	85%	88%	-	
Vo=1.2 V	83%	86%	-	
Vo=0.9 V	81%	84%	-	
Switching Frequency	250 kHz	300 kHz	350 kHz	
Output Trim Range	90%Vo	-	403%Vo	Wide Trim
	90%Vo	-	110%Vo	Narrow Trim
Remote Sense Compensation	-	-	0.2 V	SMD module
MTBF	7,501,004 hours			Calculated Per Bell Core SR-332 (Vin=5 V; Vo=1.8 V; Io = 9.6 A; Ta = 25 °C)

General Specifications (continued)

Parameter	Min	Typ	Max	Notes
Dimensions (surface mount) Inches (L × W × H) Millimeters (L × W × H)		0.78 x 0.70 x 0.32 19.81 x 17.78 x 8.13		
Dimensions (vertical) Inches (L × W × H) Millimeters (L × W × H)		0.70 x 0.308 x 0.65 17.78 x 7.82 x 16.51		
Weight	-	6 g	-	

Control Specifications

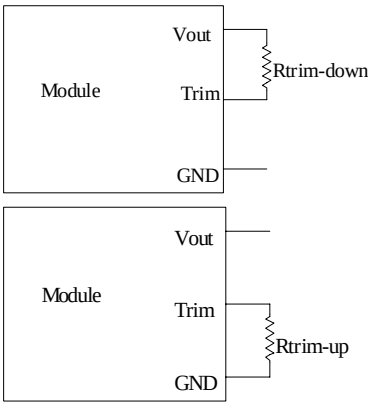
Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.3 V	-	0.8 V	Remote on/off pin open, unit on.
Signal High (Unit On)	2.2 V	-	5.5 V	

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 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.

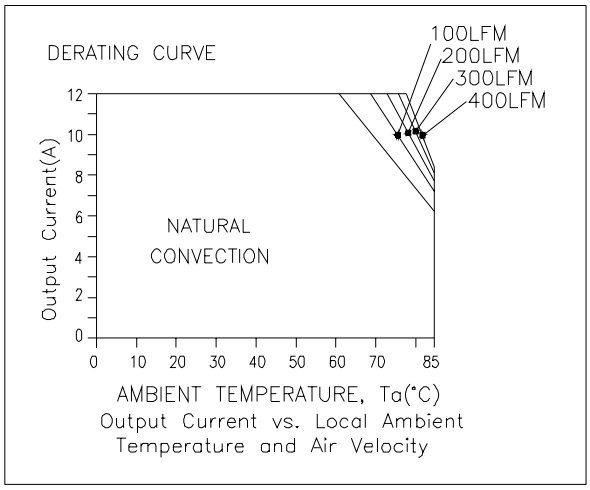
$$Rtrim\_down = \left(\frac{2.0058}{Vo - Vo,adj} - 10.197\right) Kohm$$

$$Rtrim\_up = \left(\frac{7.007}{Vo,adj - Vo} - 0.187\right) Kohm$$

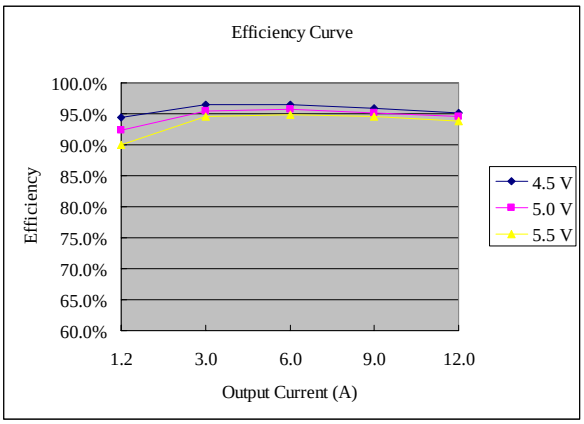


Note: Vo=0.9 V.

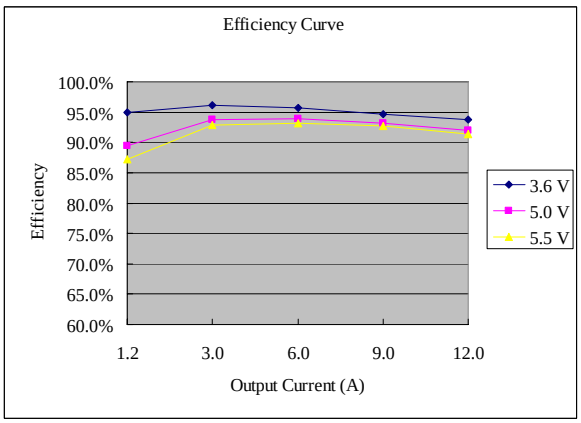
Thermal Derating Curve



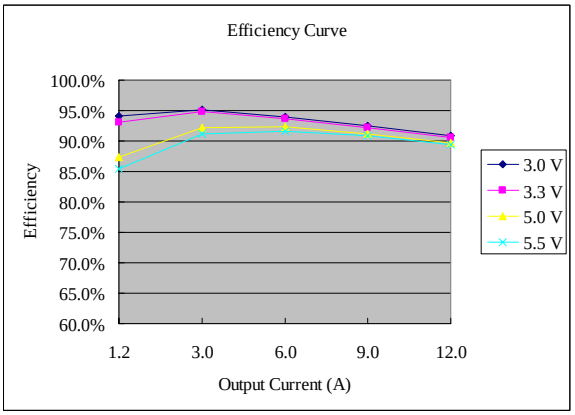
Efficiency Data



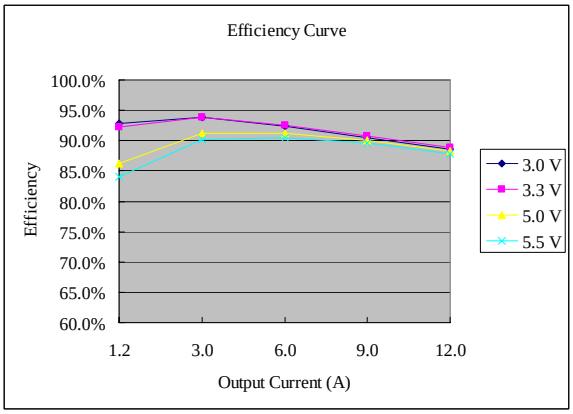
Vo=3.3 V



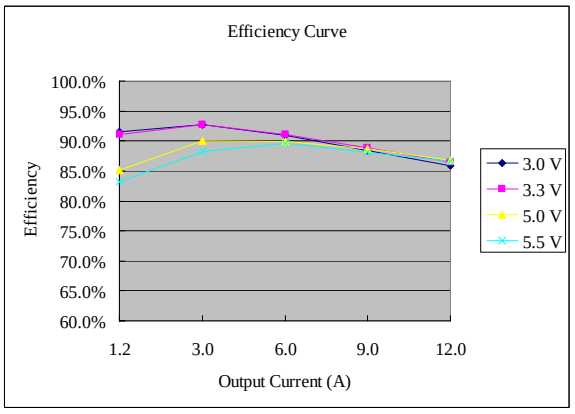
Vo=2.5 V



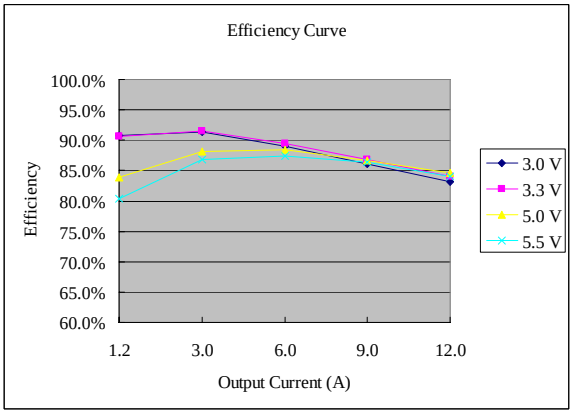
Vo=1.8 V



Vo=1.5 V

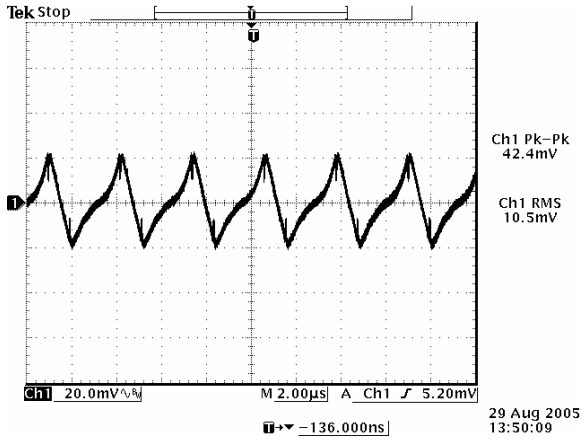


Vo=1.2 V

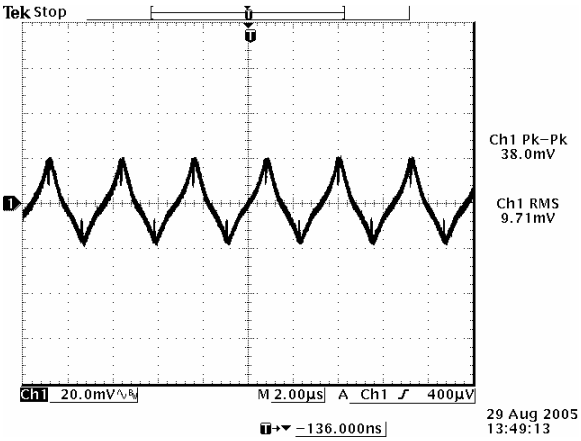


Vo=0.9 V

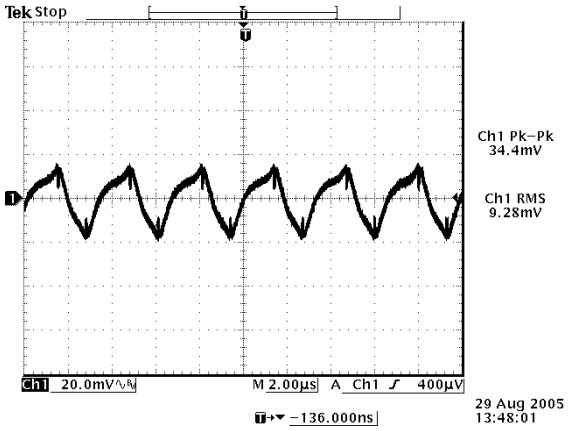
Ripple and Noise Waveforms



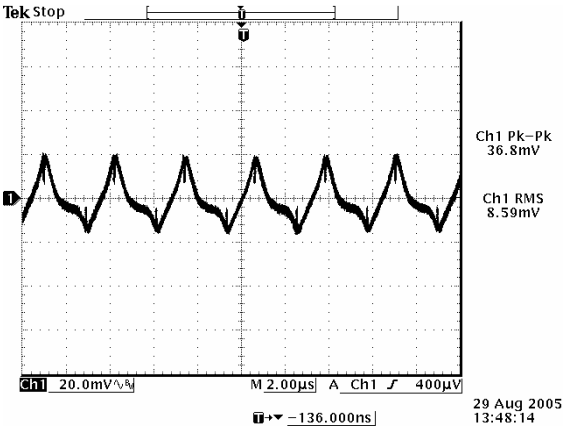
Ripple and noise at max load Vin=5 V, Vo=3.3 V



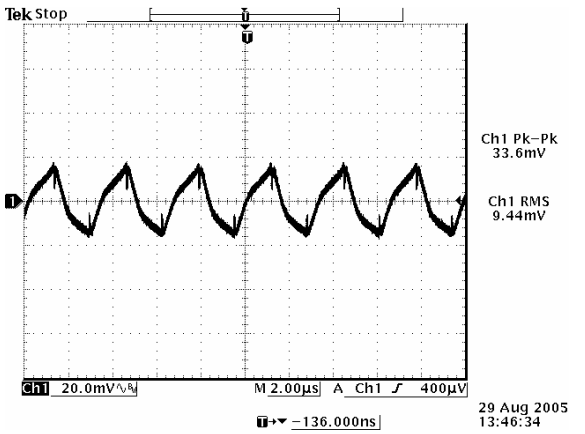
Ripple and noise at max load Vin=5 V, Vo=2.5 V



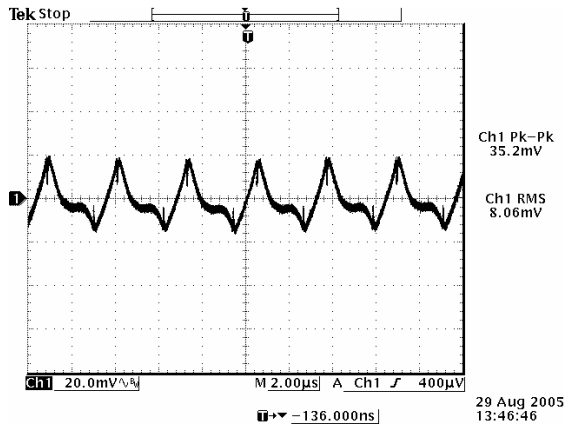
Ripple and noise at max load Vin=3.3 V, Vo=1.8 V



Ripple and noise at max load Vin=5 V, Vo=1.8 V

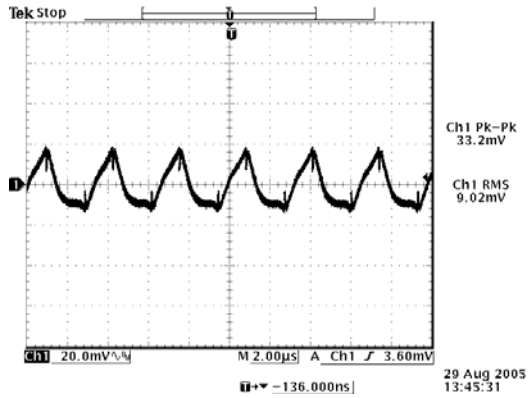


Ripple and noise at max load Vin=3.3 V, Vo=1.5 V

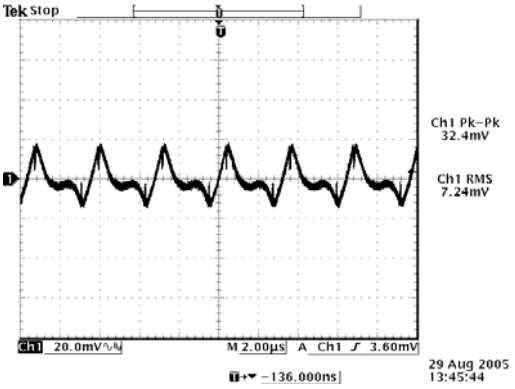


Ripple and noise at max load Vin=5 V, Vo=1.5 V

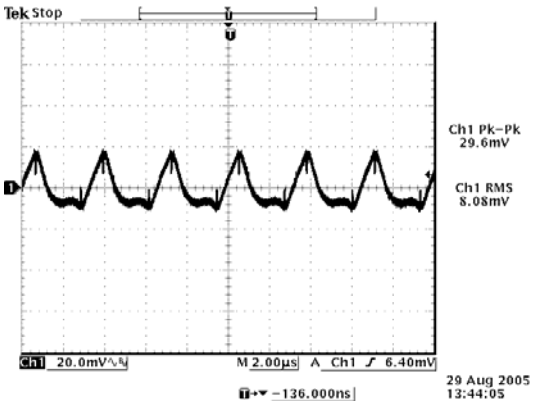
Ripple and Noise Waveforms (continued)



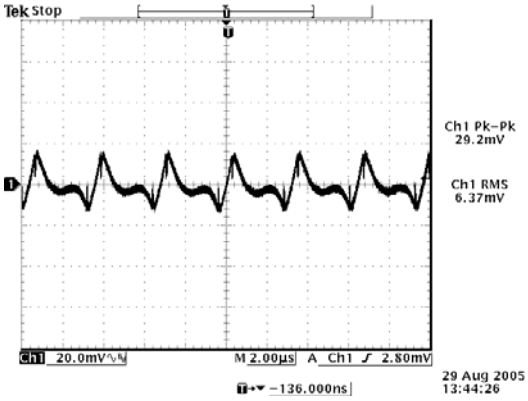
Ripple and noise at max load Vin=3.3 V, Vo=1.2 V



Ripple and noise at max load Vin=5 V, Vo=1.2 V



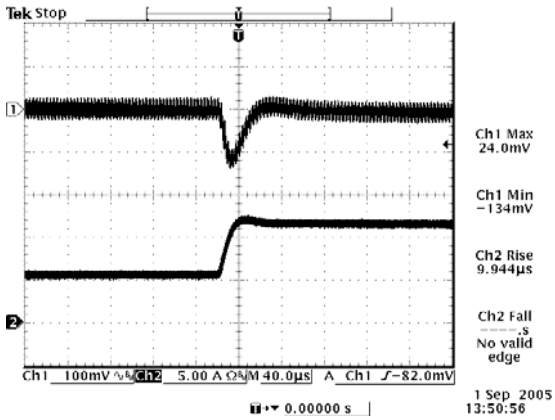
Ripple and noise at max load Vin=3.3 V, Vo=0.9 V



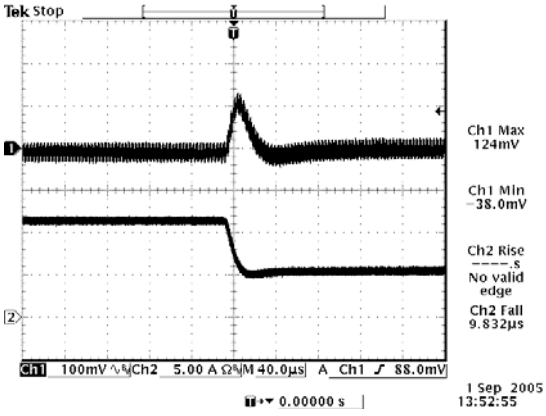
Ripple and noise at max load Vin=5 V, Vo=0.9 V

Note: Ripple and Noise with a 10 uF aluminum cap and 1 uF ceramic cap at the output, Ta=25 deg C.

Transient Response Waveforms

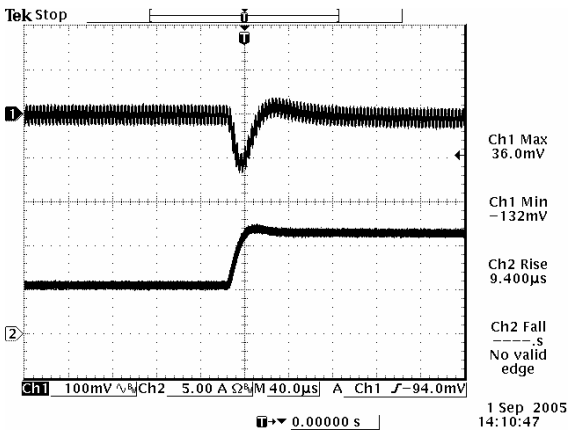


Transients 50% to 100% load Vin=5 V, Vo=3.3 V

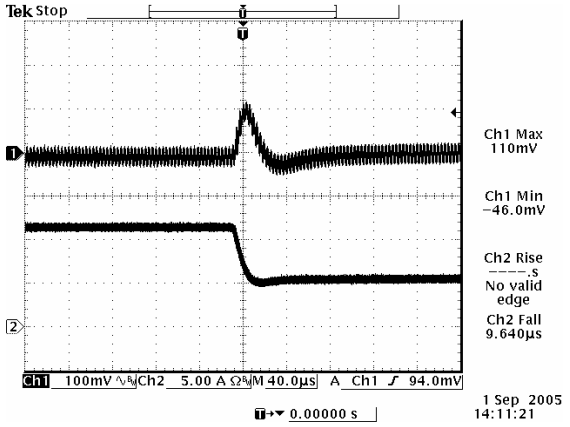


Transients 100% to 50% load Vin=5 V, Vo=3.3 V

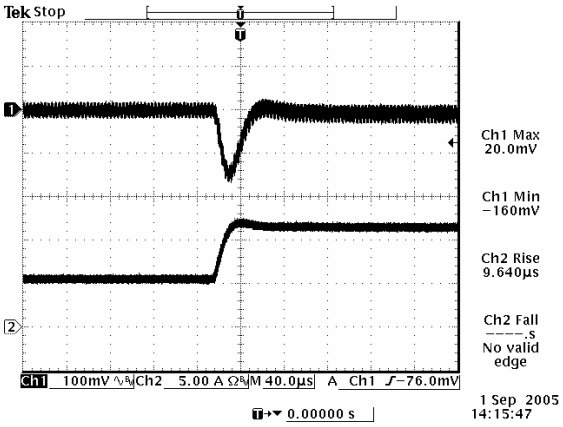
Transient Response Waveforms (continued)



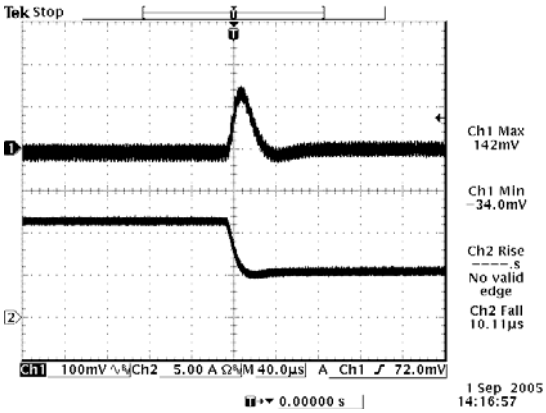
Transients 50% to 100% load Vin=5 V, Vo=2.5 V



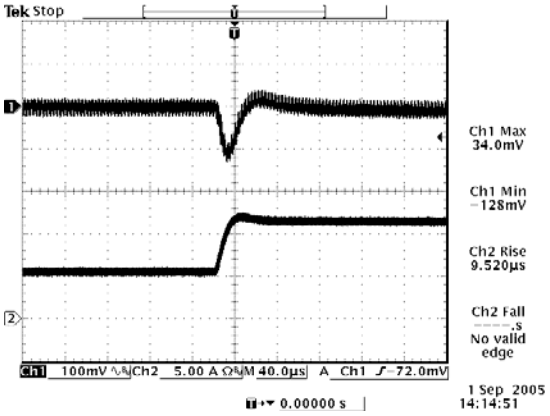
Transients 100% to 50% load Vin=5 V, Vo=2.5 V



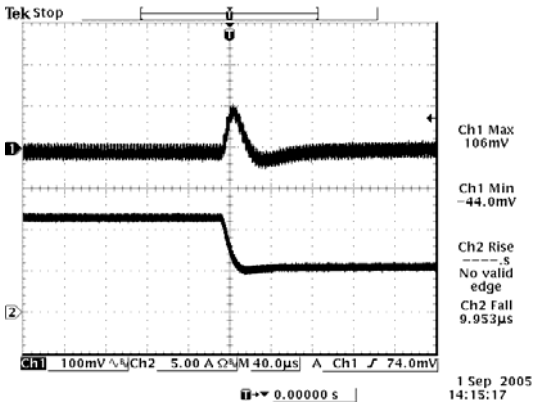
Transients 50% to 100% load Vin=3.3 V, Vo=1.8 V



Transients 100% to 50% load Vin=3.3 V, Vo=1.8 V

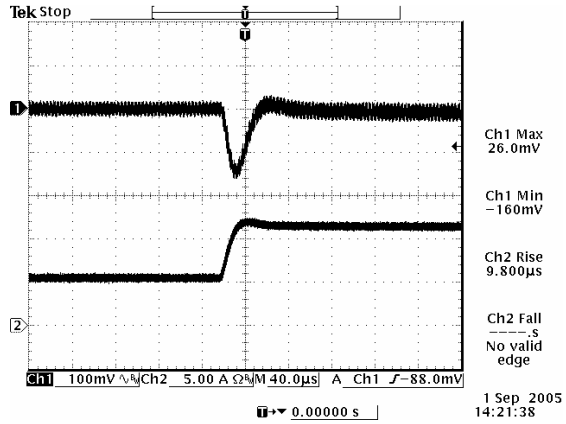


Transients 50% to 100% load Vin=5 V, Vo=1.8 V

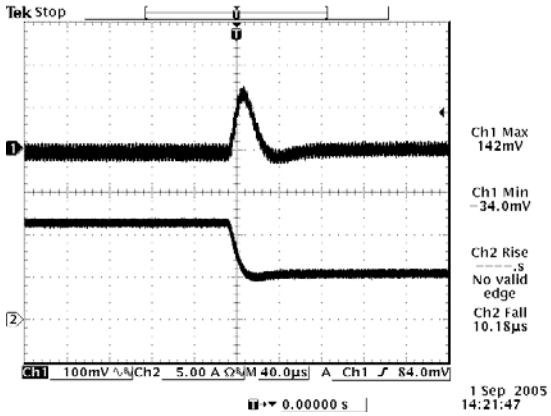


Transients 100% to 50% load Vin=5 V, Vo=1.8 V

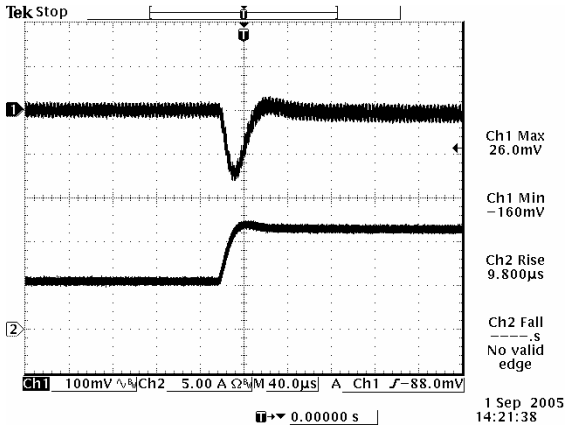
Transient Response Waveforms (continued)



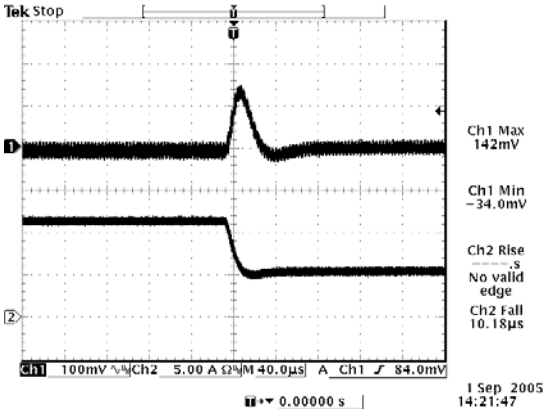
Transients 50% to 100% load Vin=3.3 V, Vo=1.5 V



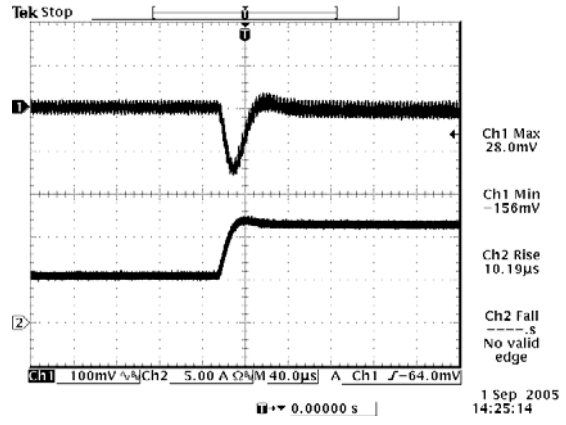
Transients 100% to 50% load Vin=3.3 V, Vo=1.5 V



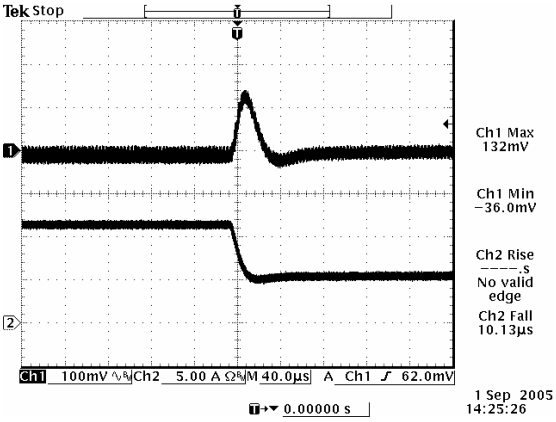
Transients 50% to 100% load Vin=5 V, Vo=1.5 V



Transients 100% to 50% load Vin=5 V, Vo=1.5 V

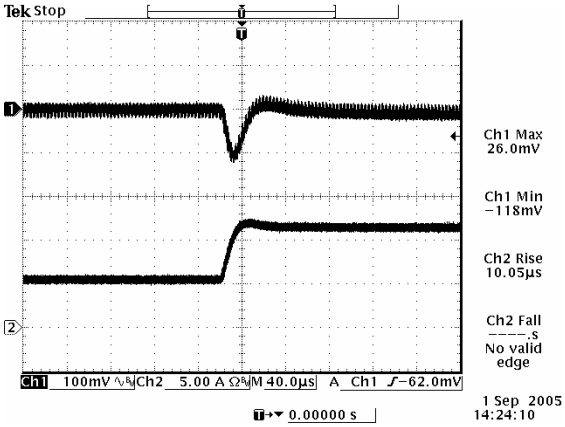


Transients 50% to 100% load Vin=3.3 V, Vo=1.2 V

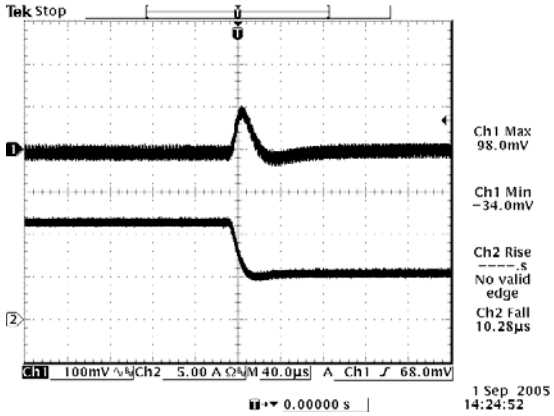


Transients 100% to 50% load Vin=3.3 V, Vo=1.2 V

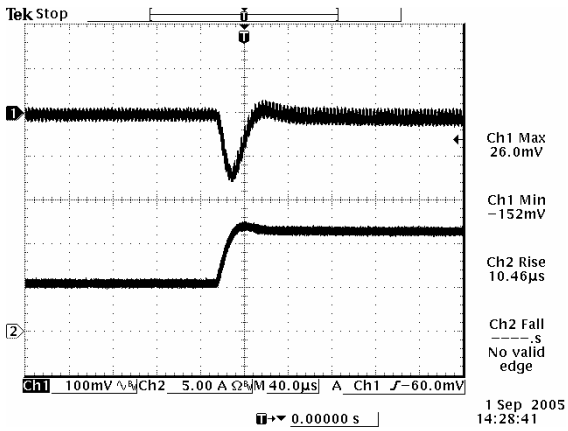
Transient Response Waveforms (continued)



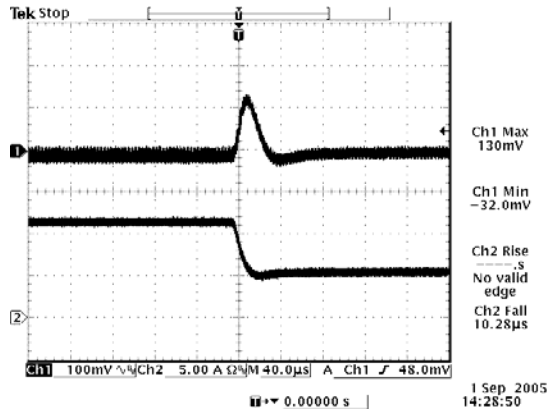
Transients 50% to 100% load Vin=5 V, Vo=1.2 V



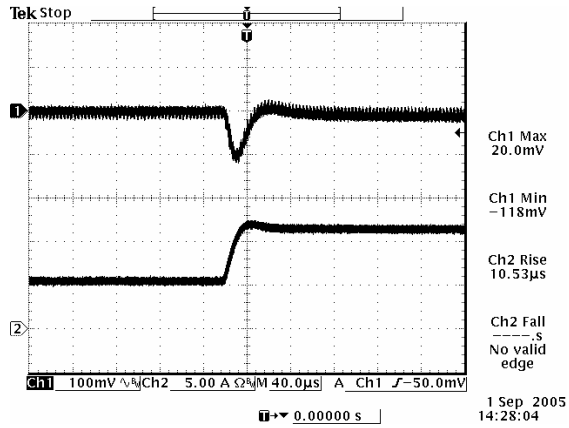
Transients 100% to 50% load Vin=5 V, Vo=1.2 V



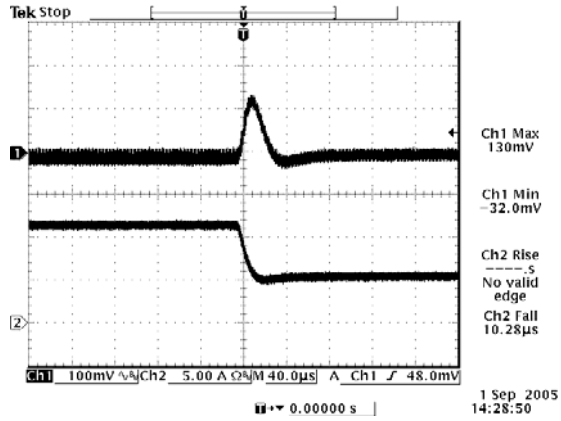
Transients 50% to 100% load Vin=3.3 V, Vo=0.9 V



Transients 100% to 50% load Vin=3.3 V, Vo=0.9 V



Transients 50% to 100% load Vin=5 V, Vo=0.9 V



Transients 100% to 50% load Vin=5 V, Vo=0.9 V

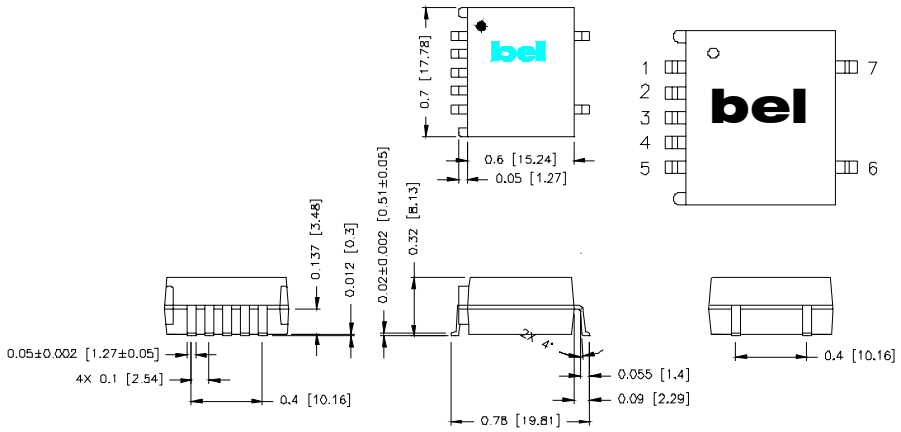
Note: Transient response at di/dt=0.5 A/uS, 1 uF ceramic cap and 330 uF aluminum cap at the output, Ta=25 deg C.

NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input 0.8 Vdc - 3.63 Vdc/12 A Output

Mechanical Outline

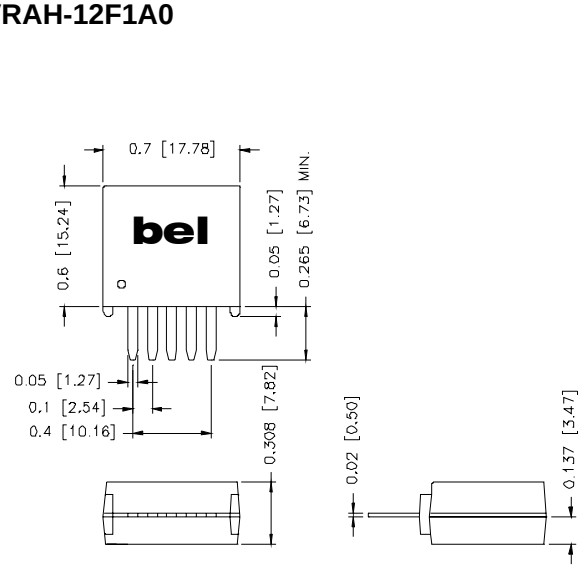
SRAH-12F1A0



Pin Connections

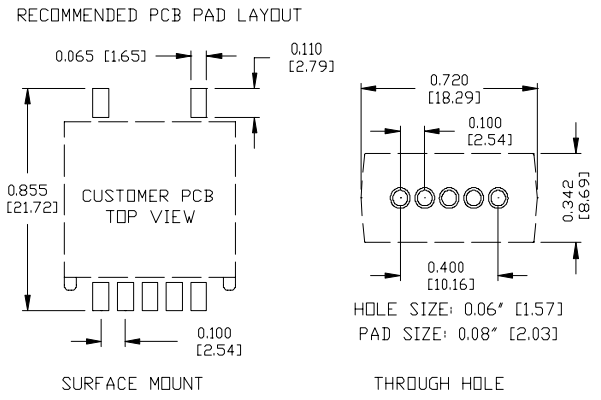
Pin	Function
1	Remote On/Off (option)
2	Vin
3	Ground
4	Vout
5	Trim (option)
6	Sense (option)
7	N/A

VRAH-12F1A0



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.

CORPORATE

Bel Fuse Inc.
206 Van Vorst Street
Jersey City, NJ 07302
Tel 201-432-0463
Fax 201-432-9542
www.belfuse.com

FAR EAST

Bel Fuse Ltd.
8F/ 8 Luk Hop Street
San Po Kong
Kowloon, Hong Kong
Tel 852-2328-5515
Fax 852-2352-3706
www.belfuse.com

EUROPE

Bel Fuse Europe Ltd.
Preston Technology Management Centre
Marsh Lane, Suite G7, Preston
Lancashire, PR1 8UD, U.K.
Tel 44-1772-556601
Fax 44-1772-888366
www.belfuse.com