NON-ISOLATED DC/DC CONVERTERS
5V Input / 1.2V – 3.3V Output / 5A

bel POWER PRODUCTS

BP06xRAH-05B

SRAH-05B / VRAH-05B Series **RoHS Compliant**

- Nonisolated
- Compact, low profile surface mount package
- Fixed frequency
- High efficiency means less power dissipation
- Excellent thermal performance
- Optimized for cost
- Remote on/off
- Undervoltage lockout (UVLO)
- Over current and short circuit protection

Description

The Bel SRAH-05B and VRAH-05B modules are a series of non-isolated, step down DC/DC power converters that operate from a nominal 5V source. These converters are available in a range of output voltages from 1.2V to 3.3V. They are packaged in a compact, overmolded package rated at 5A. Optional lead forming provides a vertical mount product for minimal footprint or a surface mount option for a very low profile. Standard features include remote on/off, over current and short circuit protection, and output voltage adjust. These products may be used almost anywhere low voltage silicon is employed and a 5V source is available. Typical applications include file servers, routers, line cards and other computing and communications equipment.

Applications

- Distributed power architectures
- Data networking equipment
- Telecommunications
- Computers and peripherals

Part Number Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Part Number Surface Mount	Part Number Vertical Mount
3.3V	5V	5A	16.5W	92%	SRAH-05B330	VRAH-05B330
2.5V	5V	5A	12.5W	90%	SRAH-05B250	VRAH-05B250
1.8V	5V	5A	9.0W	86%	SRAH-05B180	VRAH-05B180
1.5V	5V	5A	7.5W	84%	SRAH-05B150	VRAH-05B150
1.2V	5V	5A	6W	82%	SRAH-05B120	VRAH-05B120

Absolute Maximum Ratings

Parameter	Symbol	Min	Typical	Max	Unit
Continuous Input Voltage	Vin	-0.3		6	V
Output Enable Terminal Voltage	Vouten	-0.3		6	V
Ambient Temperature	Tamb	0		70	°C
Storage Temperature	Tstor	-40		100	°C

Note: Use beyond the maximum ratings may cause a reliability degradation of the DC/DC converter or may permanently damage the device.

Input Specifications

Parameter	Module	Symbol	Min	Typical	Max	Units
Operating Input Voltage	All	Vin	4.5		5.5	V
Input Current 3.3V 2.5V 1.8V 1.5V 1.2V		Iin			 4.6 3.6 2.7 2.3 1.9	A
No Load Input Current	All			30		mA
Remote Off Input Current				4	8	mA
Input Reflected Ripple Current[1]	All			30	60	mA_{rms}
Input Reflected Ripple Current (P-P)[1]	All			100	150	mApk
I^2t Inrush Current Transient	All			0.02	0.05	A^2s
Turn On Voltage Threshold	All		4.19	4.3	4.5	V
Turn Off Voltage Threshold	All			3.9	4.49	V

Note: Input capacitance one 270µF/16V, ESR = 0.018 Ω max at 100kHz @ 25° C.
1. With simulated source impedance of 500nH, 5Hz to 20MHz.

Output Specifications

Parameter	Module	Symbol	Min	Typical	Max	Units
Output Voltage Set Point [1]	3.3V 2.5V 1.8V 1.5V 1.2V	Vout	3.234 2.45 1.764 1.47 1.176	3.3 2.5 1.8 1.5 1.2	3.366 2.55 1.836 1.53 1.224	V
Load Regulation	3.3V 2.5V 1.8V 1.5V 1.2V			6.0 6.0 6.0 6.0 6.0	15 15 15 15 15	mV
Line Regulation	3.3V 2.5V 1.8V 1.5V 1.2V			3.0 3.0 3.0 3.0 3.0	10 10 8 8 8	mV
Regulation Over Temperature	3.3V 2.5V 1.8V 1.5V 1.2V			20 20 10 10 8	33 25 18 15 12	mV
Total Output Voltage Regulation	3.3V 2.5V 1.8V 1.5V 1.2V				58 50 41 38 35	mV
Output Ripple and Noise [2]	All			50	100	mVp-p
Output Ripple and Noise [2]	All			15	25	mVrms
Output Current Range	All	Iout	0		5	A
Output DC Current Limit	All	Ioutlim	6.5		12.5	A
Short Circuit Surge	3.3V 2.5V 1.8V 1.5V 1.2V	Ioutsurge		0.08 0.05 0.05 0.05 0.05	0.2 0.1 0.1 0.1 0.1	A^2s
Turn on Time	All	Ton		12	20	ms
Overshoot at Turn On	All			0	3	%
Output Capacitance	All	Cout	0		2000	µF

Note: All specifications are typical at nominal input, full load at 25° C unless otherwise stated.
1. Vin = 5V, Iout = full load, Ta = 25° C.
2. 0 - 20MHz, 1µF ceramic cap and 10µF aluminum cap on output.

Output Specifications

Parameter	Module	Symbol	Min	Typical	Max	Units
Transient Response [3]						
ΔV 50% to 100% of Max Load	3.3V			120	165	mV
Settling Time		Ts		25	50	µs
ΔV 100% to 50% of Max Load				120	165	mV
Settling Time		Ts		25	50	µs
Transient Response [3]						
ΔV 50% to 100% of Max Load	2.5V			100	150	mV
Settling Time		Ts		25	50	µs
ΔV 100% to 50% of Max Load				100	150	mV
Settling Time		Ts		25	50	µs
Transient Response [3]						
ΔV 50% to 100% of Max Load	1.8V			100	150	mV
Settling Time		Ts		25	50	µs
ΔV 100% to 50% of Max Load				100	150	mV
Settling Time		Ts		25	50	µs
Transient Response [3]						
ΔV 50% to 100% of Max Load	1.5V			100	150	mV
Settling Time		Ts		25	50	µs
ΔV 100% to 50% of Max Load				100	150	mV
Settling Time		Ts		25	50	µs
Transient Response [3]						
ΔV 50% to 100% of Max Load	1.2V			100	150	mV
Settling Time		Ts		25	50	µs
ΔV 100% to 50% of Max Load				100	150	mV
Settling Time		Ts		25	50	µs

Note: All specifications are typical at nominal input, full load at 25° C unless otherwise stated.
3. di/dt = 0.5A/1µS, Ta = 25° C without external load capacitance.

General Specifications

Parameter	Module	Symbol	Min	Typical	Max	Units
Efficiency[1]	3.3V 2.5V 1.8V 1.5V 1.2V	η	 89 87 83 81 79	 92 90 86 84 82		%
Switching Frequency	All	Fsw	260	300	340	kHz
Output Voltage Trim Range[2]	All		90		110	%
Weight	All			4.7		g

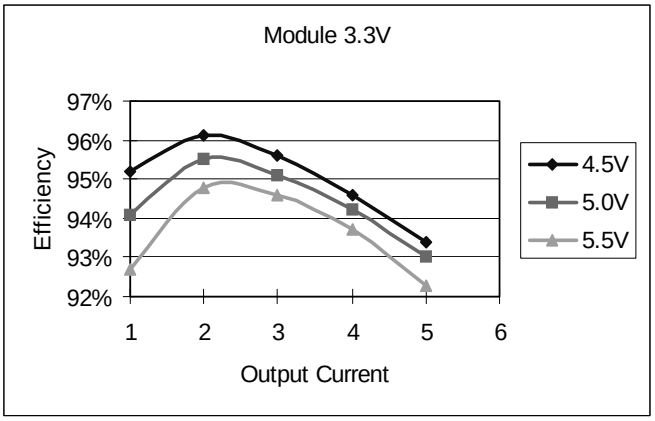
1. Vin=5V, full load and Ta=25° C.
2. See graphs on pages 10-12.

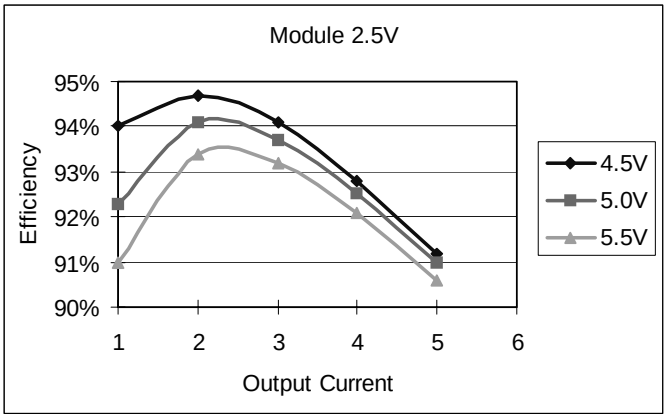
Control Specifications

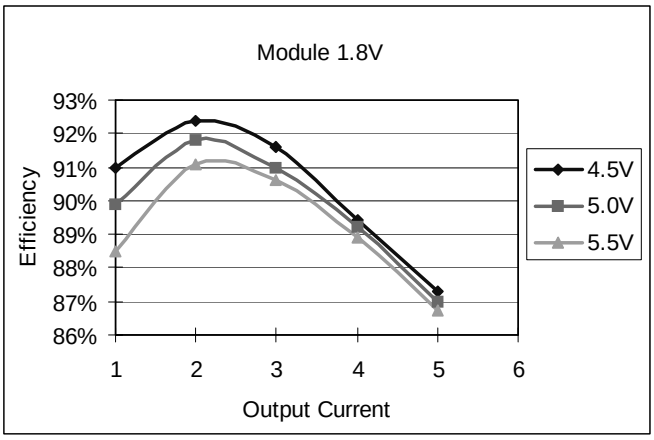
Parameter	Module	Symbol	Min	Typical	Max	Units
Remote On/Off [3]	All	Vouten				V
Signal Low (Unit On)	All		0		1	V
Signal High (Unit Off)	All		2.8		5.5	V

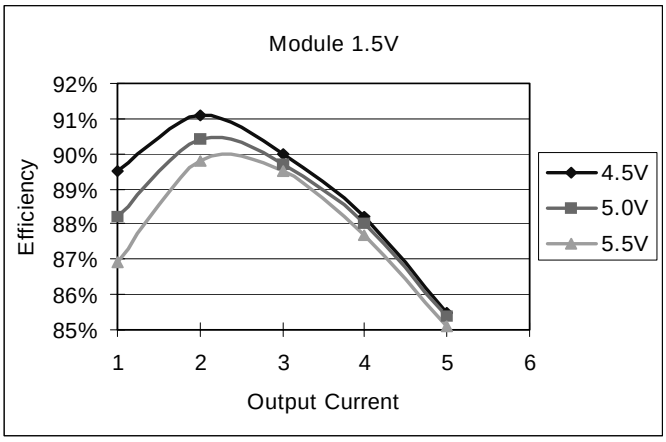
3. With remote on/off pin 1 open, the module is on.

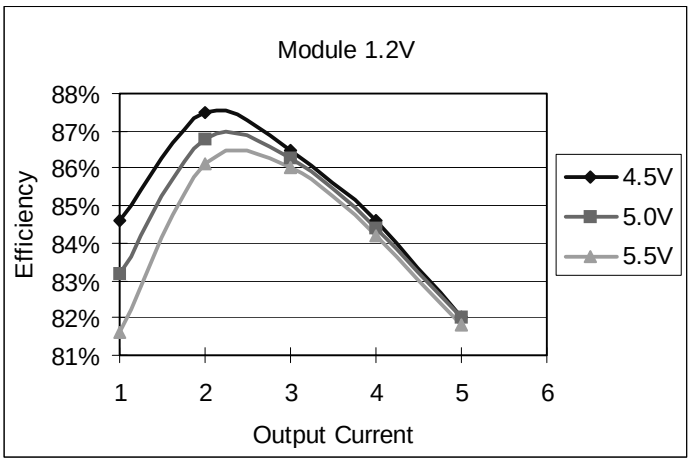
Efficiency Data





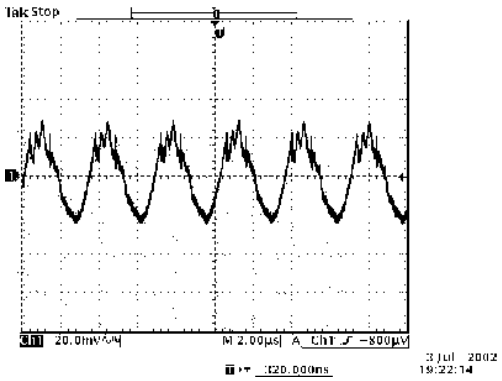




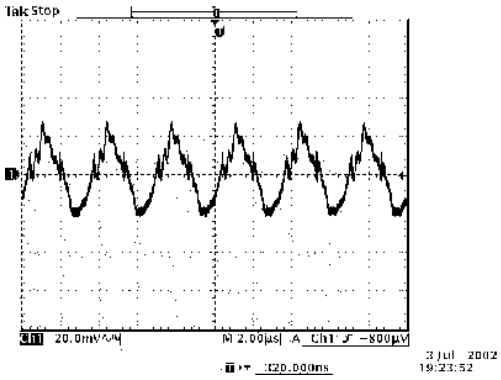


Ripple and Noise

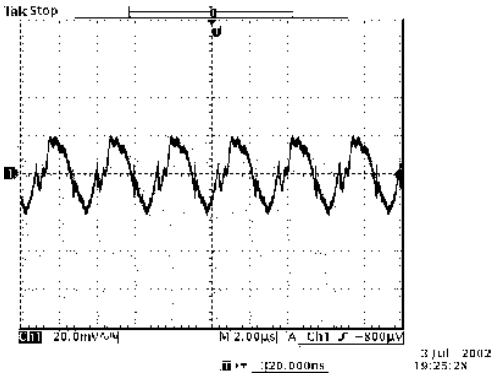
1µF ceramic cap and 10µF aluminum electrolytic cap added at the output.



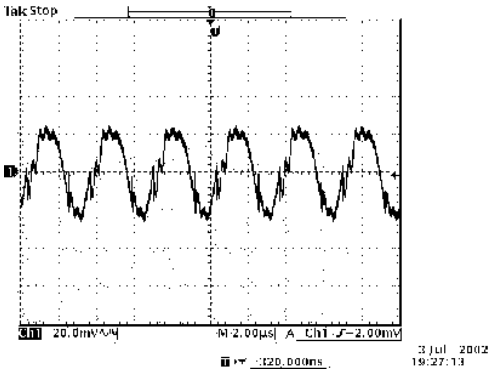
Ripple and noise at full load and 5Vdc input, 3.3Vdc output and Ta=25° C



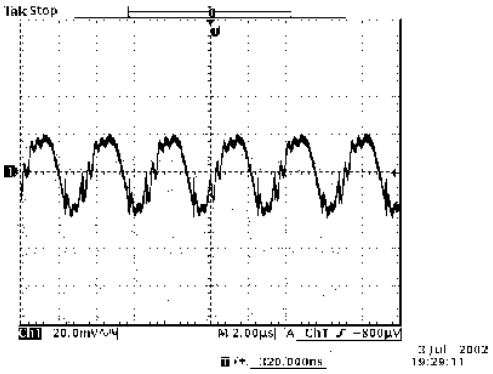
Ripple and noise at full load and 5Vdc input, 2.5Vdc output and Ta=25° C



Ripple and noise at full load and 5Vdc input, 1.8Vdc output and Ta=25° C



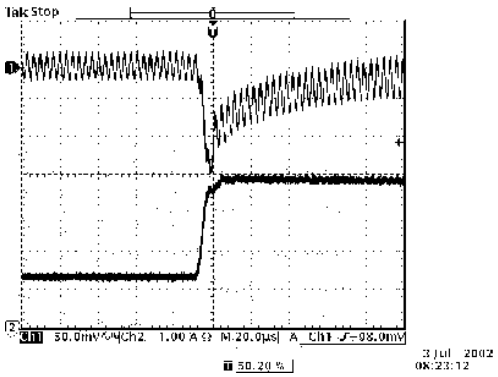
Ripple and noise at full load and 5Vdc input, 1.5Vdc output and Ta=25° C



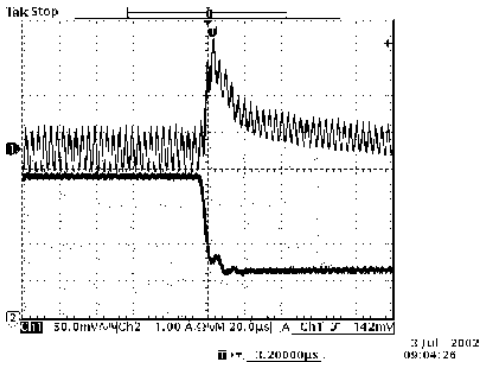
Ripple and noise at full load and 5Vdc input, 1.2Vdc output and Ta=25° C

Transient Response

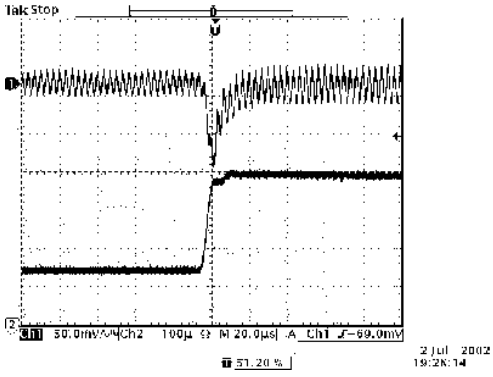
Transient response: di/dt = 0.5A/µS, no external load capacitance



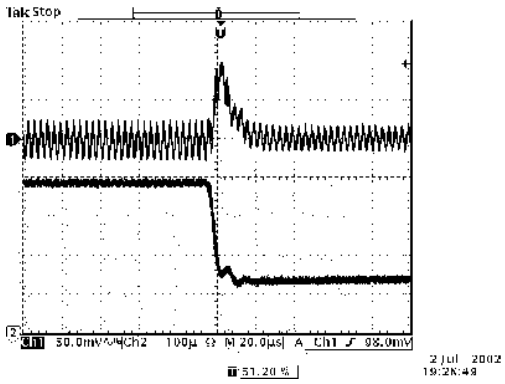
Vout=3.3V
50% to 100% load transients at 5V input and Ta=25° C



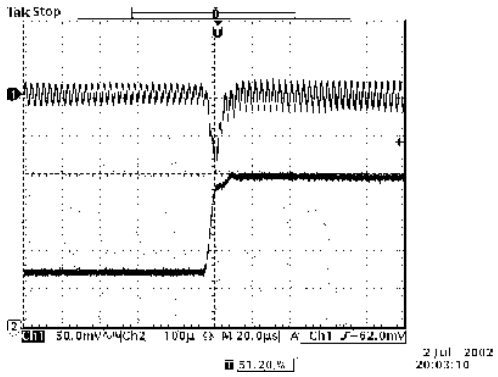
Vout=3.3V
100% to 50% load transients at 5V input and Ta=25° C



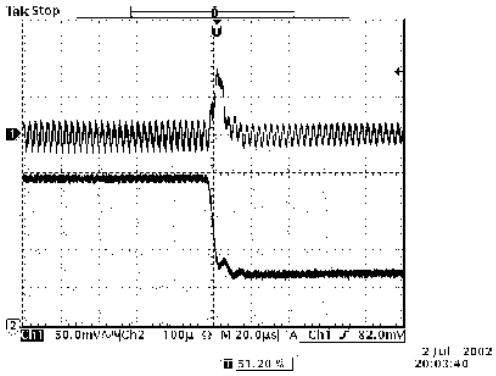
Vout=2.5V
50% to 100% load transients at 5V input and Ta=25° C



Vout=2.5V
100% to 50% load transients at 5V input and Ta=25° C



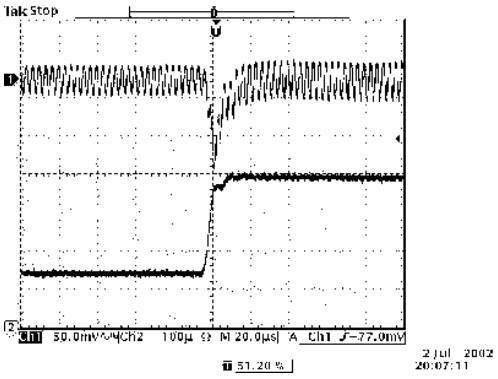
Vout=1.8V
50% to 100% load transients at 5V input and Ta=25° C



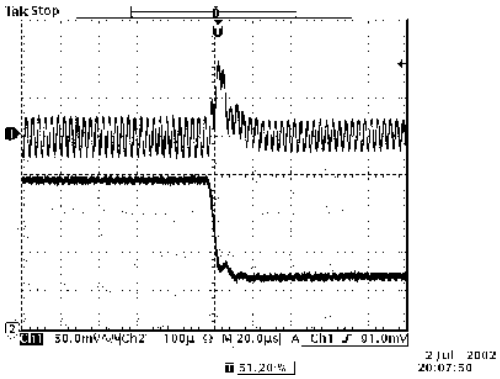
Vout=1.8V
100% to 50% load transients at 5V input and Ta=25° C

Transient Response

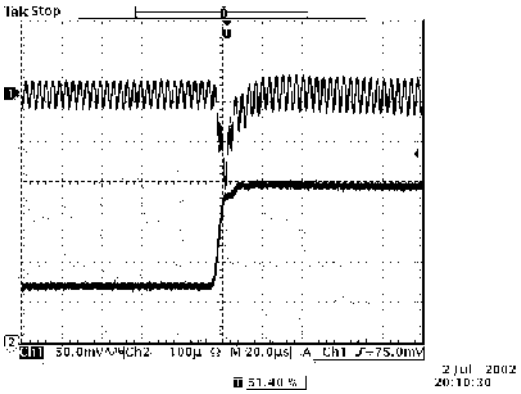
Transient response: di/dt = 0.5A/µS, no external load capacitance



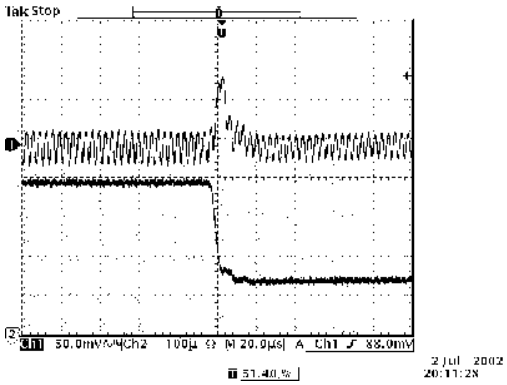
Vout=1.5V
50% to 100% load transients at 5V input and Ta=25° C



Vout=1.5V
100% to 50% load transients at 5V input and Ta=25° C



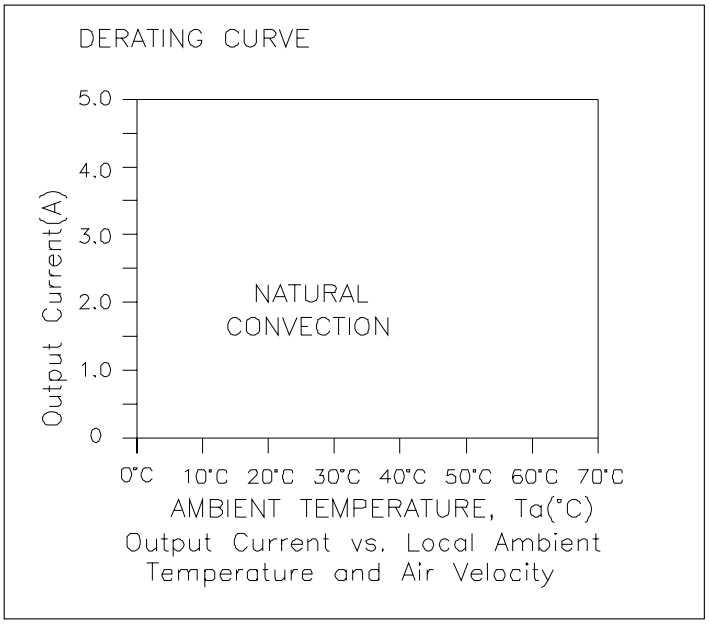
Vout=1.2V
50% to 100% load transients at 5V input and Ta=25° C



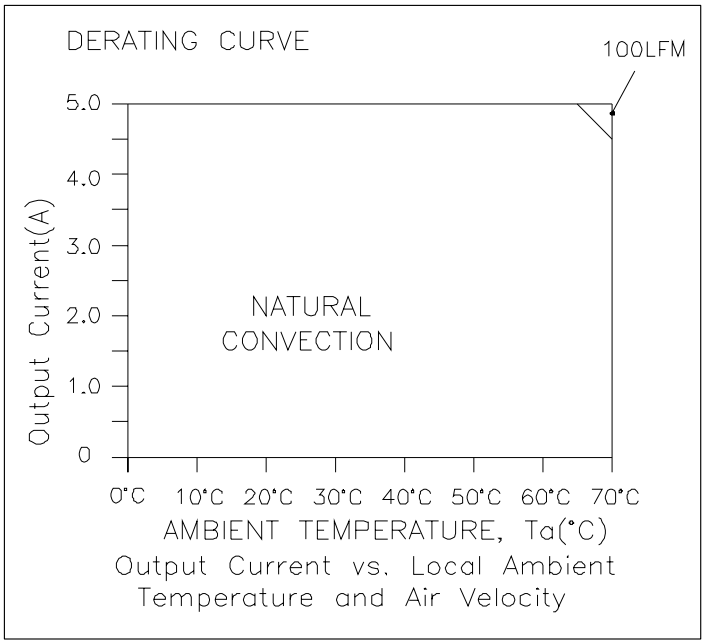
Vout=1.2V
100% to 50% load transients at 5V input and Ta=25° C

Thermal Considerations

SRAH-05B

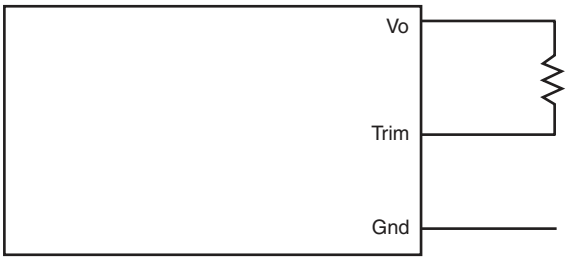


VRAH-05B

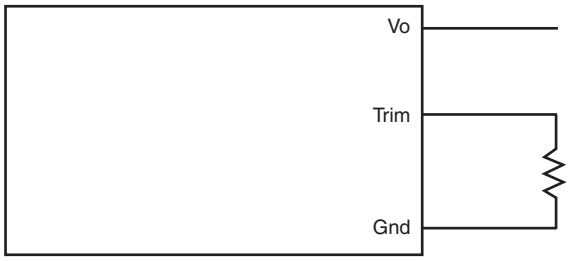


Output Voltage Set-Point Adjustment

Trim Down Test Circuit



Trim Up Test Circuit

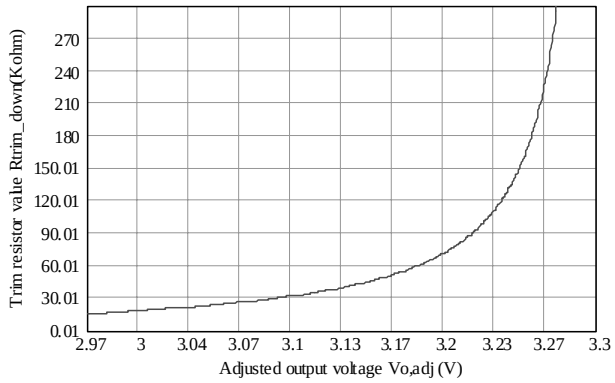


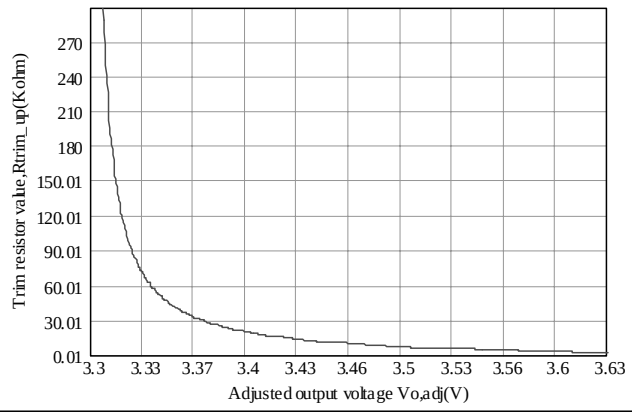
Output Voltage Set-Point Adjustment

xRAH-05B330 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{7.914}{Vo - Vo,\ adj} - 8.27\right) \text{Kohm}$$

$$\text{Rtrim up} = \left(\frac{2.528}{Vo,\ adj - Vo} - 5.11\right) \text{Kohm}$$



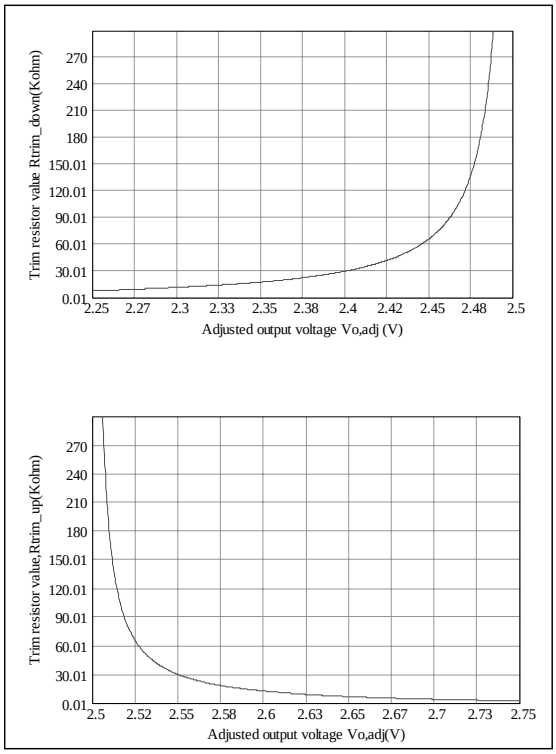


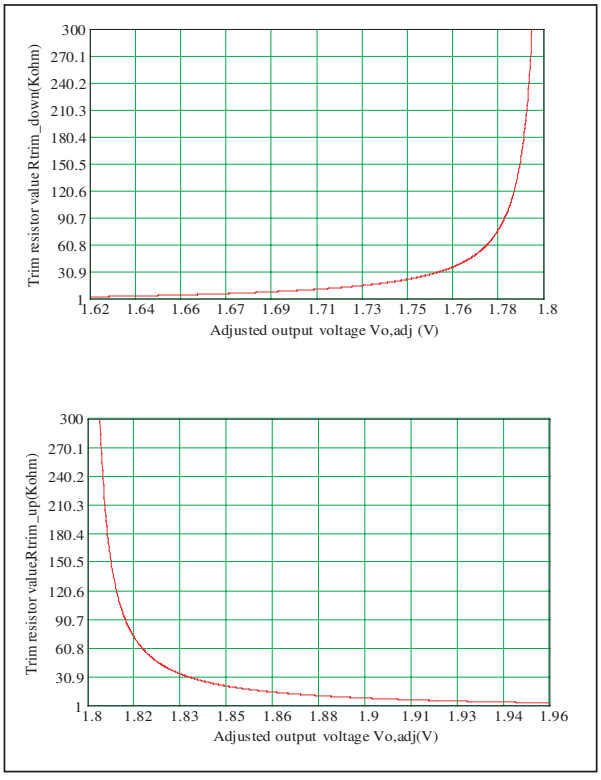
Output Voltage Set-Point Adjustment

xRAH-05B250 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{3.664}{Vo - Vo,\ adj} - 6.79\right)\ \text{Kohm}$$

$$\text{Rtrim up} = \left(\frac{1.72}{Vo,\ adj - Vo} - 4.64\right)\ \text{Kohm}$$





xRAH-05B180 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{1.509}{Vo - Vo,\ adj} - 5.52\right)\ \text{Kohm}$$

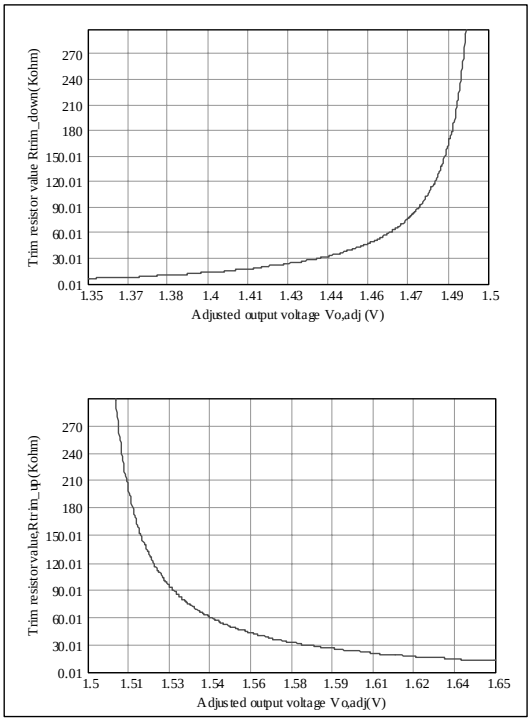
$$\text{Rtrim up} = \left(\frac{1.2}{Vo,\ adj - Vo} - 4.02\right)\ \text{Kohm}$$

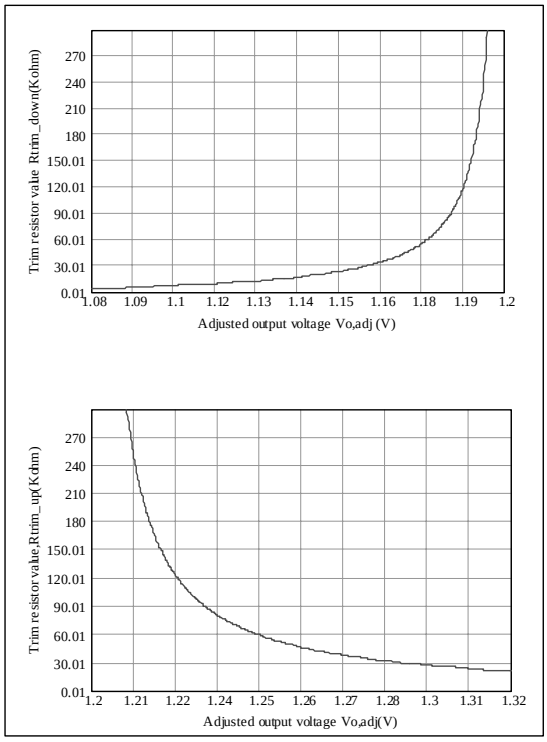
Output Voltage Set-Point Adjustment

xRAH-05B150 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{2.702}{Vo - Vo,\ adj} - 11.7\right) \text{ Kohm}$$

$$\text{Rtrim up} = \left(\frac{3.064}{Vo,\ adj - Vo} - 7.87\right) \text{ Kohm}$$





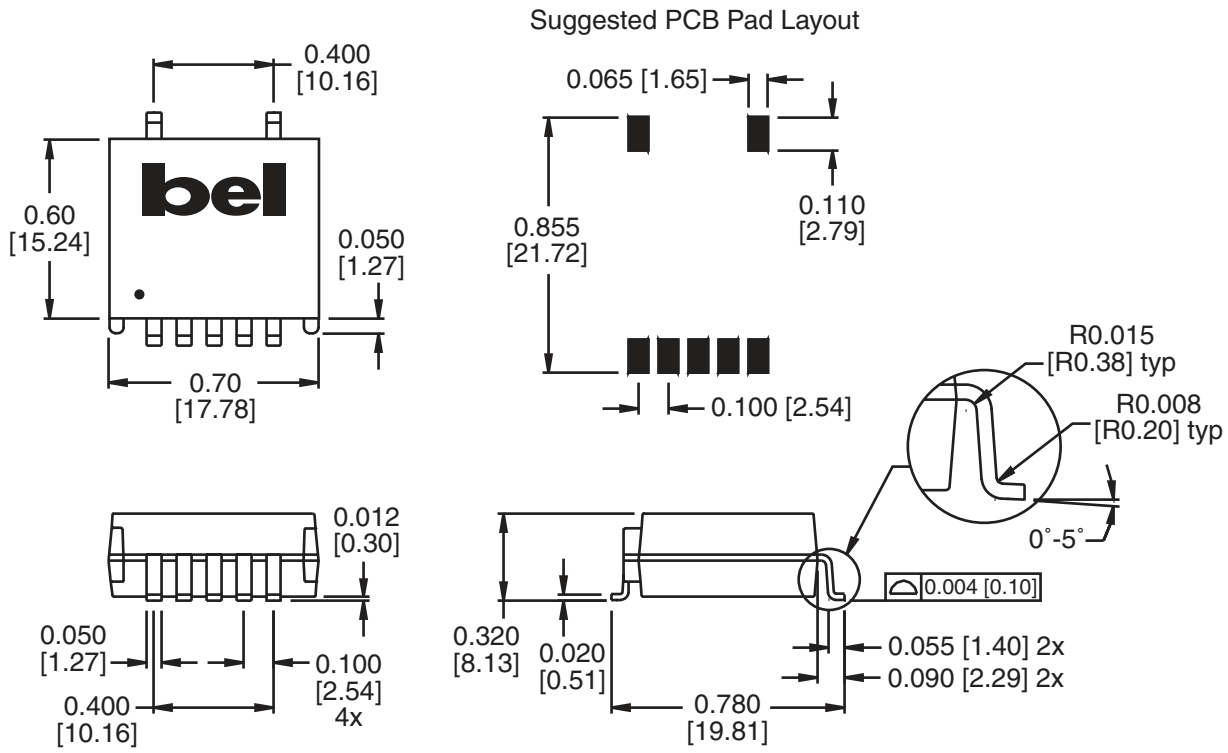
xRAH-05B120 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{1.545}{Vo - Vo,\ adj} - 8.47\right) \text{ Kohm}$$

$$\text{Rtrim up} = \left(\frac{3.064}{Vo,\ adj - Vo} - 4.64\right) \text{ Kohm}$$

Mechanical

SRAH-05B

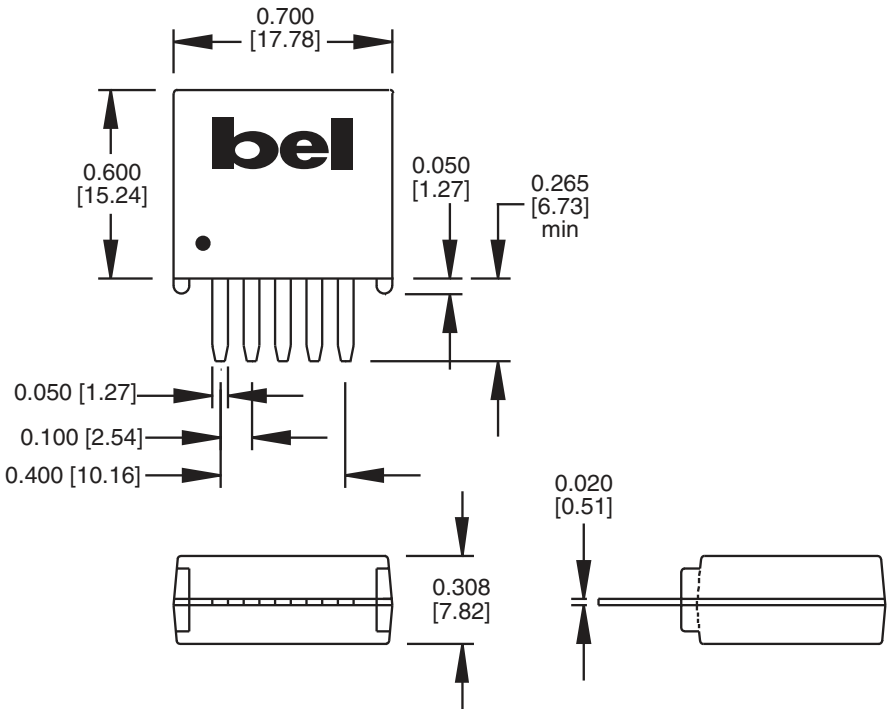


Dimensions are in inches [millimeters].
Standard dimension tolerance is ±0.005 [0.13] unless otherwise noted.

Pin	Function
1	Remote On/Off
2	+Vin
3	Ground
4	+Vo
5	Trim
6	No Connection
7	No Connection

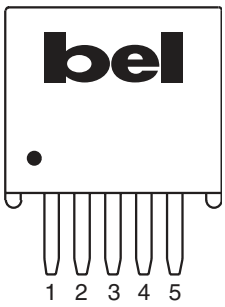
Mechanical

VRAH-05B



Dimensions are in inches [millimeters].
Standard dimension tolerance is ±0.005 [0.13] unless otherwise noted.

Pin	Function
1	Remote On/Off
2	+Vin
3	Ground
4	+Vo
5	Trim



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 240ºC.

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