NON-ISOLATED DC/DC CONVERTERS
12V Input / 1.5V – 5.0V Output / 3A

bel POWER PRODUCTS

BP05xRAH-03A

SRAH-03A / VRAH-03A 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-03A and VRAH-03A modules are a series of non-isolated, step down DC/DC power converters that operate from a nominal 12V source. These converters are available in a range of output voltages from 1.5V to 5.0V. They are packaged in a compact, overmolded package rated at 3A. 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 12V 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
5.0V	12V	3A	15W	91%	SRAH-03A500	VRAH-03A500
3.3V	12V	3A	9.9W	90%	SRAH-03A330	VRAH-03A330
2.5V	12V	3A	7.5W	88%	SRAH-03A250	VRAH-03A250
1.8V	12V	3A	5.4W	85%	SRAH-03A180	VRAH-03A180
1.5V	12V	3A	4.5W	84%	SRAH-03A150	VRAH-03A150

Absolute Maximum Ratings

Parameter	Symbol	Min	Typical	Max	Unit
Continuous Input Voltage	Vin	-0.3		13.2	V
Output Enable Terminal Voltage	Vouten	-0.3		13.2	V
Ambient Temperature	Tamb	-40		85	°C
Storage Temperature	Tstor	-40		125	°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	10.8		13.2	V
Input Current	5.0V 3.3V 2.5V 1.8V 1.5V	Iin			1.7 1.2 0.9 0.75 0.6	A
No Load Input Current	All				100	mA
Remote Off Input Current				3	10	mA
Input Reflected Ripple Current[1]	All			30		mA_{rms}
Input Reflected Ripple Current (P-P)[1]	All			140		mApk
I^2t Inrush Current Transient	All			0.005	0.01	A^2s
Turn On Voltage Threshold	All			9.4		V
Turn Off Voltage Threshold	All		8.0	9.0	10.0	V

Note: Input capacitance 270µF/16V, ESR = 0.03 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]	5.0V 3.3V 2.5V 1.8V 1.5V	Vout	4.920 3.247 2.460 1.771 1.476	5.0 3.3 2.5 1.8 1.5	5.080 3.353 2.540 1.829 1.524	V
Load Regulation	5.0V 3.3V 2.5V 1.8V 1.5V			10 10 5 5 5	16.5 16.5 10 10 10	mV
Line Regulation	5.0V 3.3V 2.5V 1.8V 1.5V			10 5 3 3 3	16 10 5 5 5	mV
Regulation Over Temperature	5.0V 3.3V 2.5V 1.8V 1.5V			20 12 8 5 5	30 25 20 10 10	mV
Total Output Voltage Regulation	5.0V 3.3V 2.5V 1.8V 1.5V			40 27 16 13 13	62.5 51.5 35 25 25	mV
Output Ripple and Noise [2]	All			40	100	mVp-p
Output Ripple and Noise [2]	All			10	20	mVrms
Output Current Range	All	Iout	0		3	A
Output DC Current Limit	All	Ioutlim	3.6		7.5	A
Short Circuit Surge	All	Ioutsurge		0.35	0.7	A^2s
Turn on Time	All	Ton		12	20	ms
Overshoot at Turn On [3]	All			0	3	%
Output Capacitance	All	Cout	0		1200	µF

Note: All specifications are typical at nominal input, full load at 25° C unless otherwise stated.
1. Vin = 12V, Iout = full load, Ta = 25° C.
2. 0 - 20 MHz, 0.1µF ceramic cap on output.
3. Overshoot at turn on output capacitance is 100µF.

Output Specifications

Parameter	Module	Symbol	Min	Typical	Max	Units
Transient Response [4]						
ΔV 50% to 100% of Max Load	5.0V			100	200	mV
Settling Time		Ts		40	80	µs
ΔV 100% to 50% of Max Load				100	200	mV
Settling Time		Ts		40	80	µs
Transient Response [4]						
ΔV 50% to 100% of Max Load	3.3V			80	150	mV
Settling Time		Ts		40	80	µs
ΔV 100% to 50% of Max Load				80	150	mV
Settling Time		Ts		40	80	µs
Transient Response [4]						
ΔV 50% to 100% of Max Load	2.5V			70	100	mV
Settling Time		Ts		40	80	µs
ΔV 100% to 50% of Max Load				70	100	mV
Settling Time		Ts		40	80	µs
Transient Response [4]						
ΔV 50% to 100% of Max Load	1.8V			70	100	mV
Settling Time		Ts		40	80	µs
ΔV 100% to 50% of Max Load				70	100	mV
Settling Time		Ts		40	80	µs
Transient Response [4]						
ΔV 50% to 100% of Max Load	1.5V			70	100	mV
Settling Time		Ts		40	80	µs
ΔV 100% to 50% of Max Load				70	100	mV
Settling Time		Ts		40	80	µs

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

General Specifications

Parameter	Module	Symbol	Min	Typical	Max	Units
Efficiency[1]	5.0V 3.3V 2.5V 1.8V 1.5V	η	89 88 86 83 82	91 90 88 85 84		%
Switching Frequency	5.0V 3.3V 2.5V 1.8V 1.5V	Fsw	470 340 270 270 270	500 370 300 300 300	530 400 330 330 330	kHz
Output Voltage Trim Range[2]	All		90		110	%
Weight	All			4.9		g

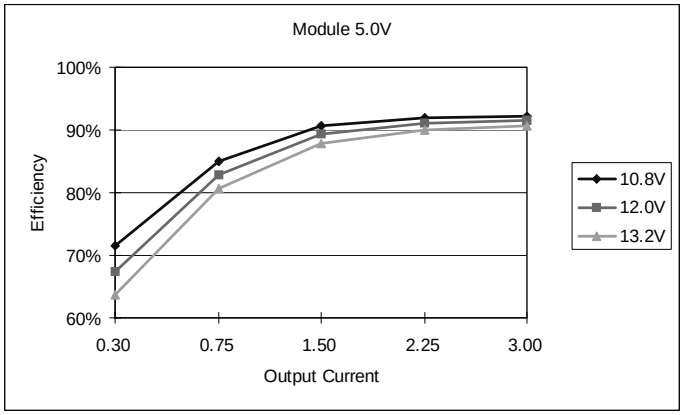
1. Vin=12V, full load and Ta=25° C.
2. See graphs on pages 11 - 13.

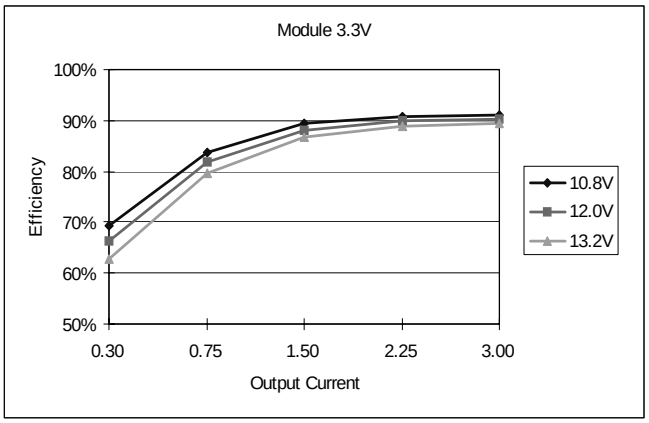
Control Specifications

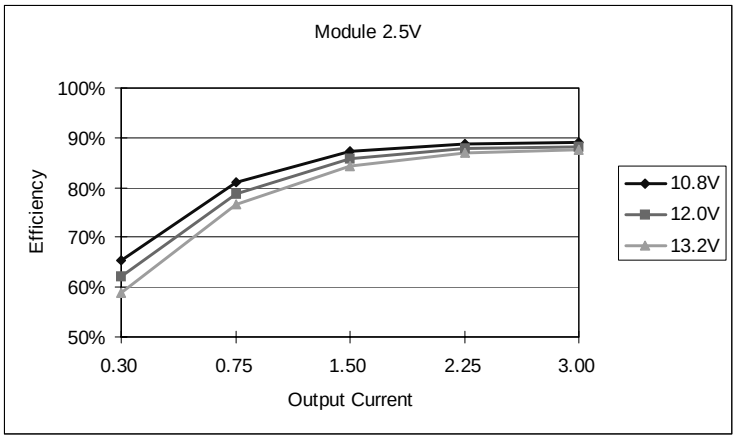
Parameter	Module	Symbol	Min	Typical	Max	Units
Remote On/Off [3]	All	Vouten				V
Signal Low (Unit Off)	All		-0.3		1	V
Signal High (Unit On)	All		2.8		13.2	V

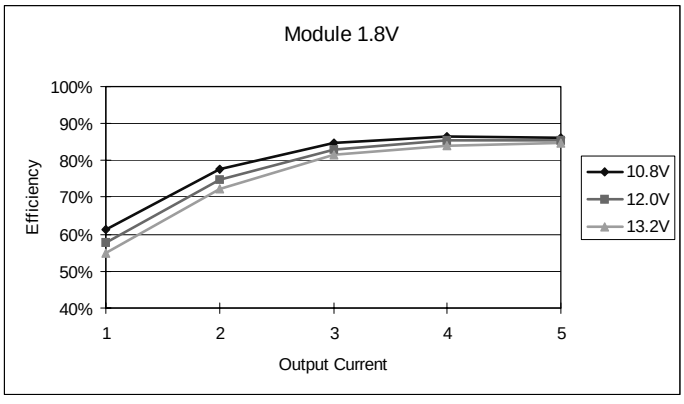
3. With remote on/off pin 1 open, the module is on.

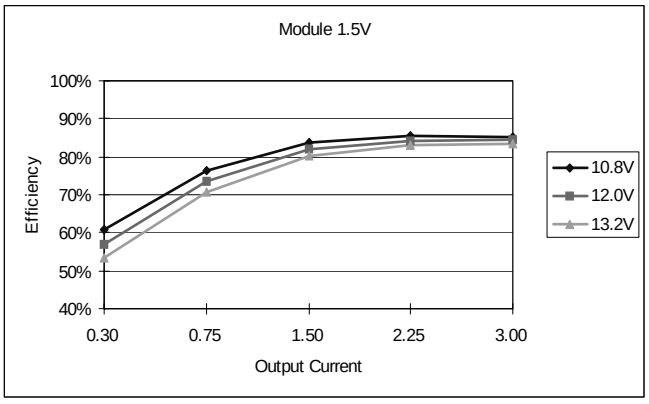
Efficiency Data







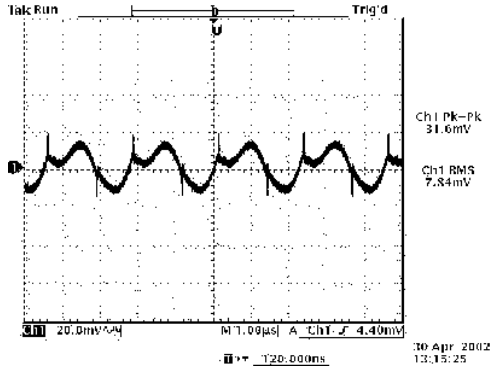




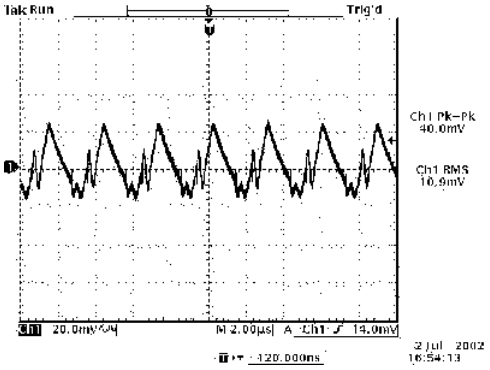
Note: On/off pin designed to work with an open collector/drain switch.

Ripple and Noise

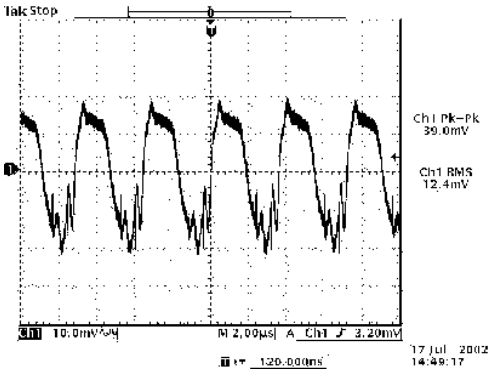
0.1µF ceramic cap added at the output.



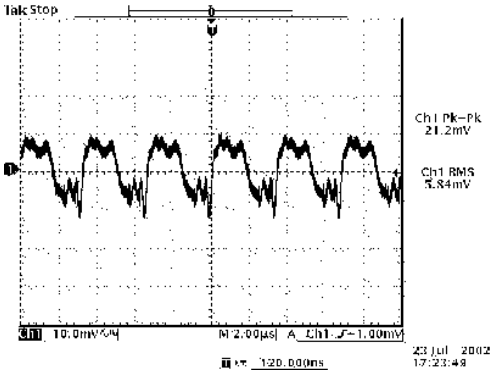
Ripple and noise at full load and 12Vdc input, 5.0Vdc output and Ta=25° C



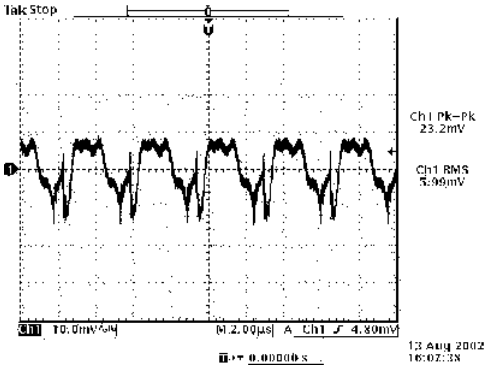
Ripple and noise at full load and 12Vdc input, 3.3Vdc output and Ta=25° C



Ripple and noise at full load and 12Vdc input, 2.5Vdc output and Ta=25° C



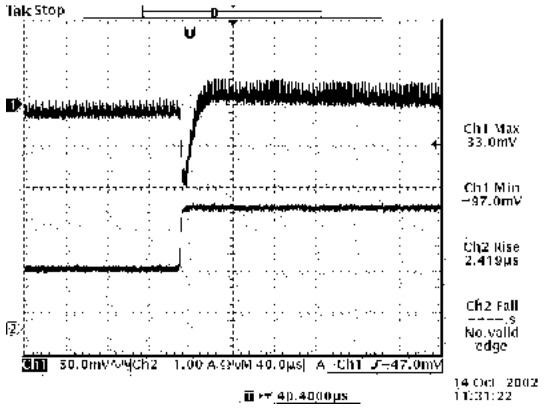
Ripple and noise at full load and 12Vdc input, 1.8Vdc output and Ta=25° C



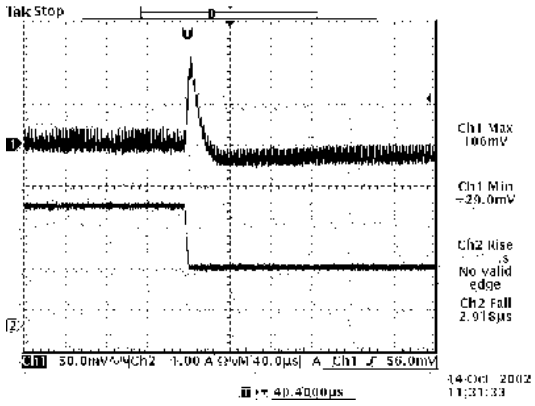
Ripple and noise at full load and 12Vdc input, 1.5Vdc output and Ta=25° C

Transient Response

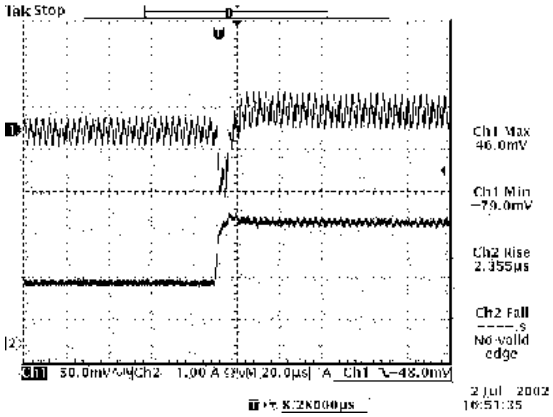
Transient response: di/dt = 0.5A/µS, no external load capacitance



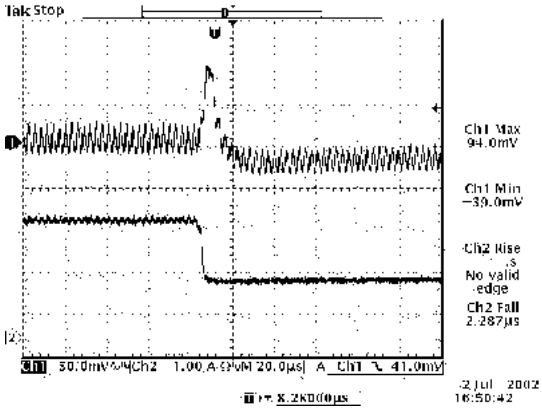
Vout=5.0V
50% to 100% load transients at 12V input and Ta=25° C



Vout=5.0V
100% to 50% load transients at 12V input and Ta=25° C



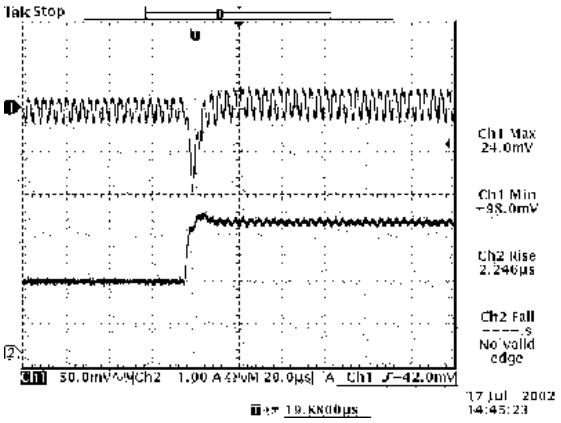
Vout=3.3V
50% to 100% load transients at 12V input and Ta=25° C



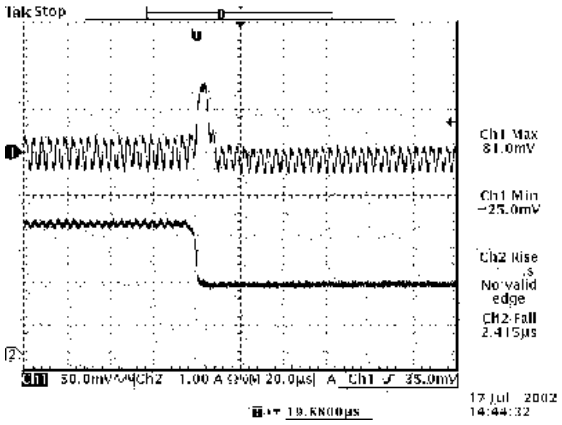
Vout=3.3V
100% to 50% load transients at 12V input and Ta=25° C

Transient Response

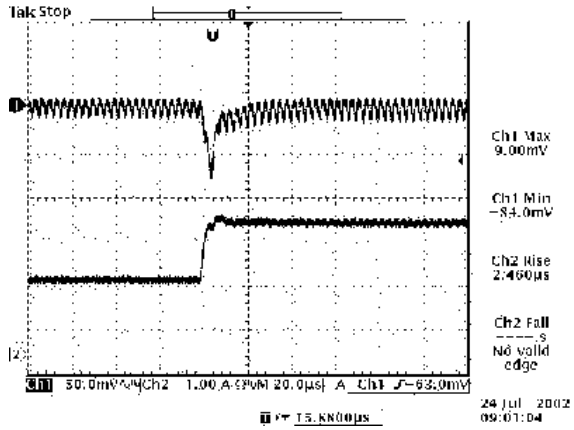
Transient response: di/dt = 0.5A/µS, no external load capacitance



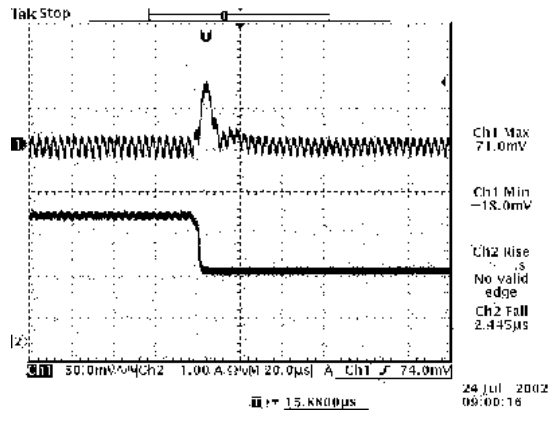
Vout=2.5V
50% to 100% load transients at 12V input and Ta=25° C



Vout=2.5V
100% to 50% load transients at 12V input and Ta=25° C



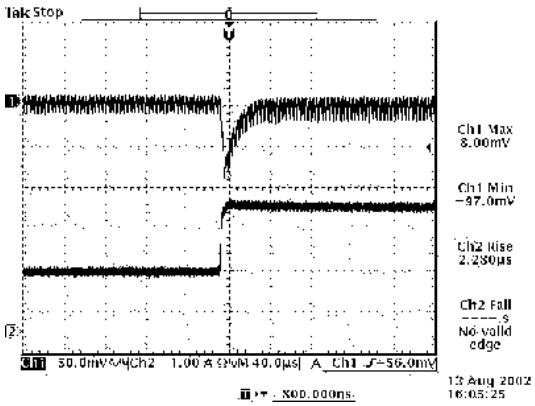
Vout=1.8V
50% to 100% load transients at 12V input and Ta=25° C



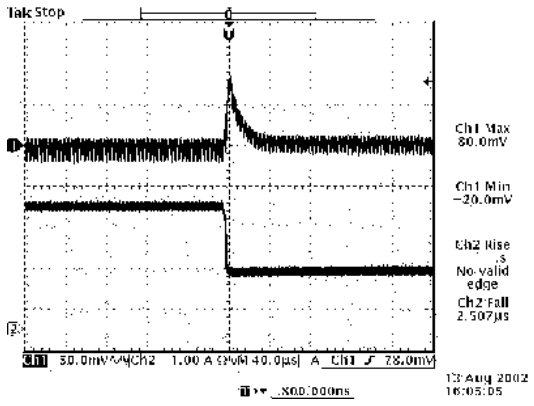
Vout=1.8V
100% to 50% load transients at 12V input and Ta=25° C

Transient Response

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



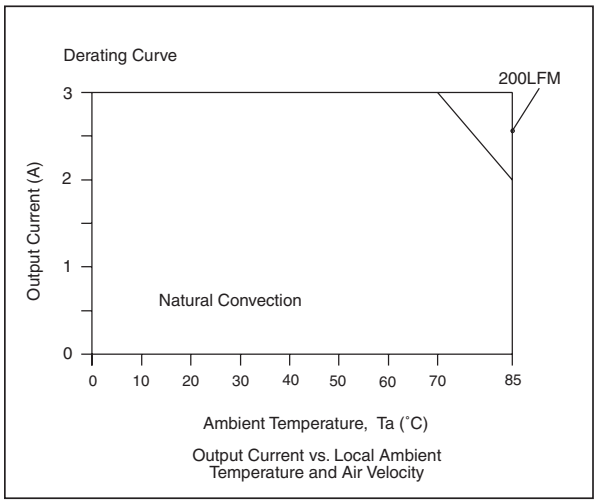
Vout=1.5V
50% to 100% load transients at 12V input and Ta=25° C



Vout=1.5V
100% to 50% load transients at 12V input and Ta=25° C

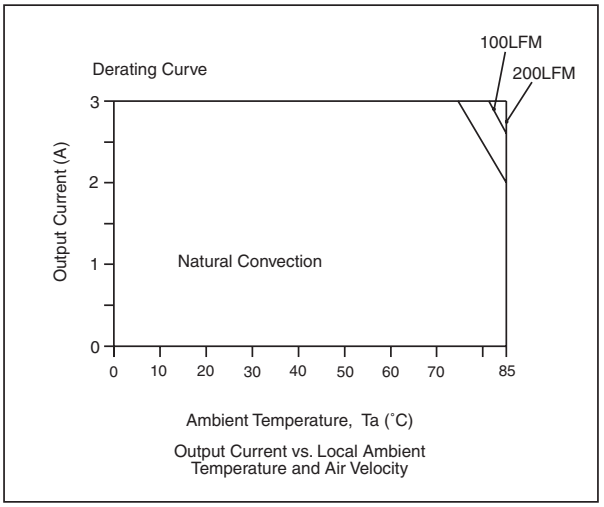
Thermal Considerations

xRAH-03A500



Output Current vs. Local Ambient Temperature and Air Velocity

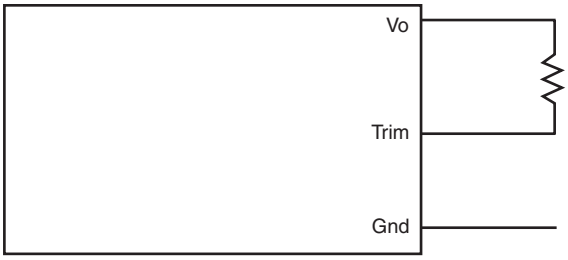
xRAH-03A150 **xRAH-03A250**
xRAH-03A180 **xRAH-03A330**



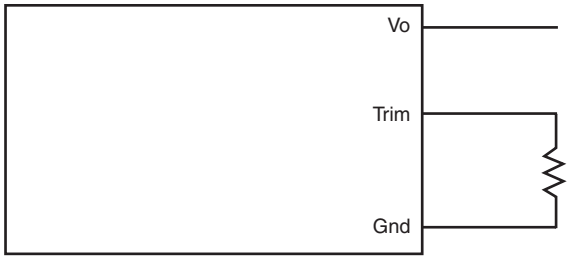
Output Current vs. Local Ambient Temperature and Air Velocity

Output Voltage Set-Point Adjustment

Trim Down Test Circuit



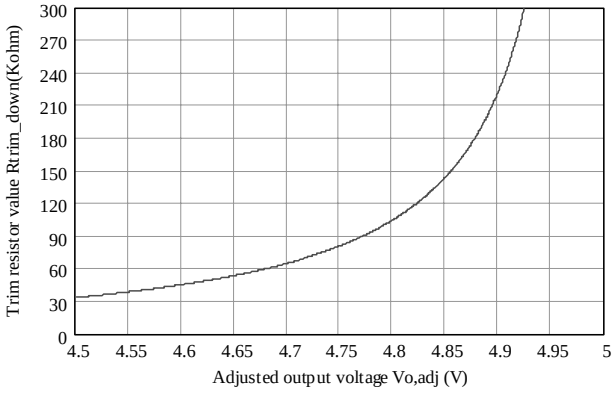
Trim Up Test Circuit



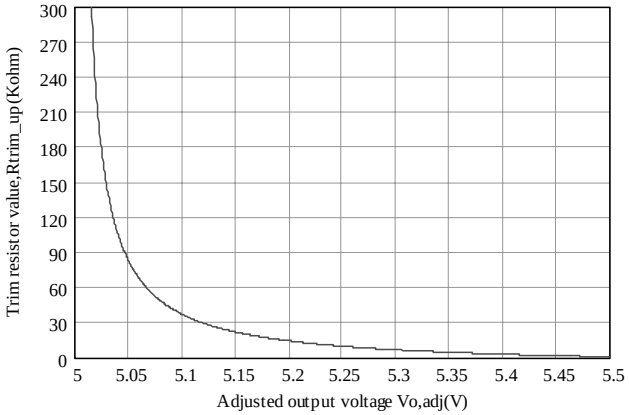
Output Voltage Set-Point Adjustment

xRAH-03A500 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{23.703}{Vo - Vo,\ adj} - 13.87\right)\ \text{Kohm}$$



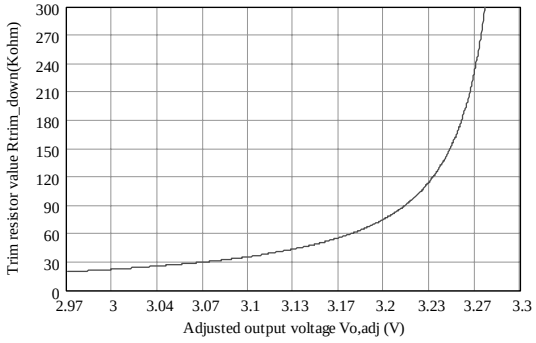
$$\text{Rtrim up} = \left(\frac{4.496}{Vo,\ adj - Vo} - 8.25\right)\ \text{Kohm}$$



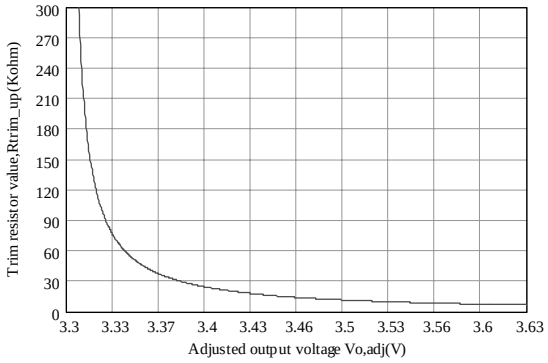
Output Voltage Set-Point Adjustment

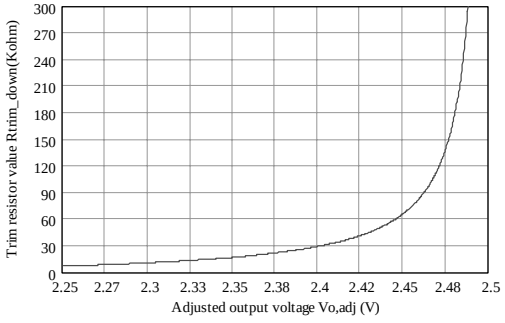
xRAH-03A330 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{7.92}{\text{Vo} - \text{Vo, adj}} - 4.38\right) \text{ Kohm}$$



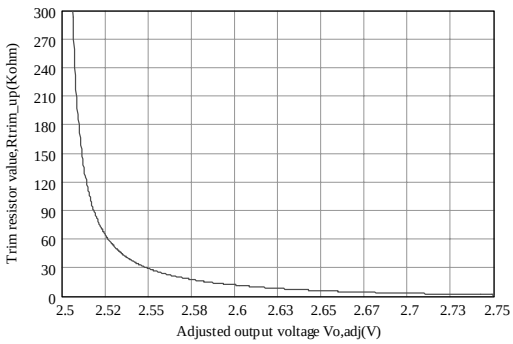
$$\text{Rtrim up} = \left(\frac{2.536}{\text{Vo, adj} - \text{Vo}} - 1.21\right) \text{ Kohm}$$





xRAH-03A250 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{3.694}{\text{Vo} - \text{Vo, adj}} - 7.77\right) \text{ Kohm}$$

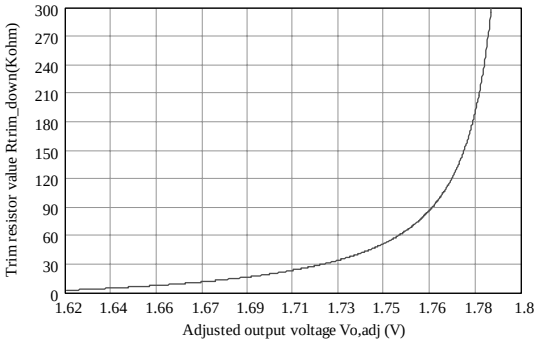


$$\text{Rtrim up} = \left(\frac{1.72}{\text{Vo, adj} - \text{Vo}} - 5.62\right) \text{ Kohm}$$

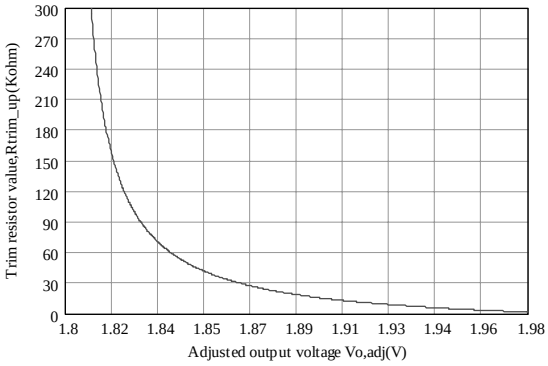
Output Voltage Set-Point Adjustment

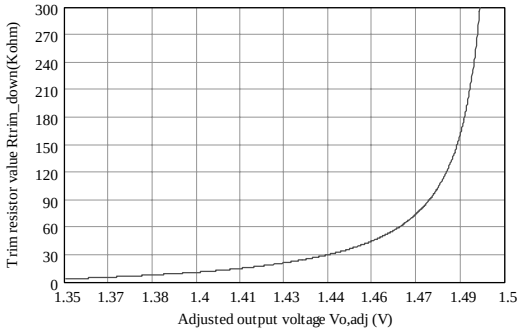
xRAH-03A180 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{3.849}{Vo - Vo,\ adj} - 19.23\right) \text{Kohm}$$



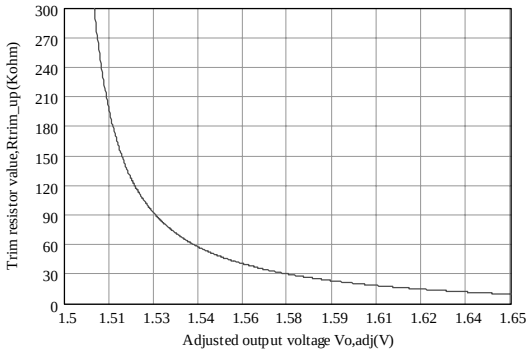
$$\text{Rtrim up} = \left(\frac{3.064}{Vo,\ adj - Vo} - 15.4\right) \text{Kohm}$$





xRAH-03A150 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{2.698}{Vo - Vo,\ adj} - 14.83\right) \text{Kohm}$$

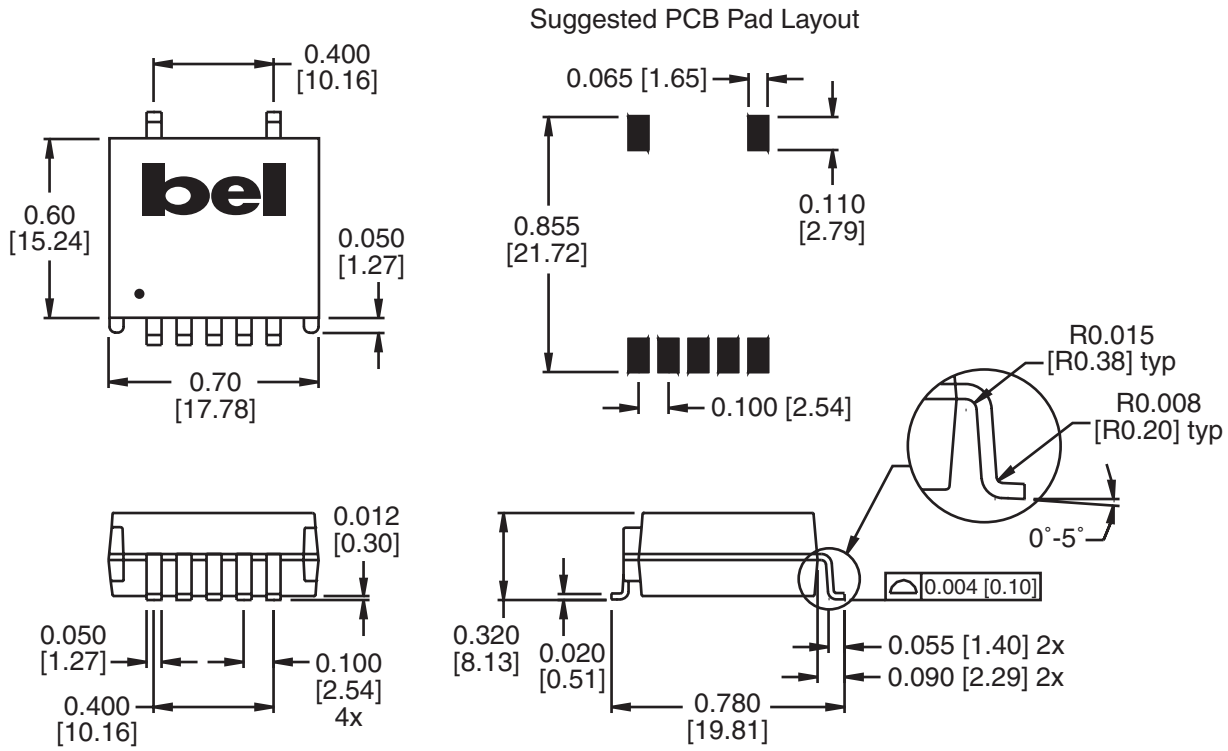


$$\text{Rtrim up} = \left(\frac{3.064}{Vo,\ adj - Vo} - 11\right) \text{Kohm}$$

BP05xRAH-03A

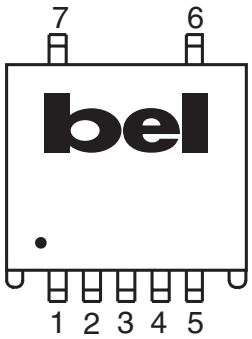
Mechanical

SRAH-03A



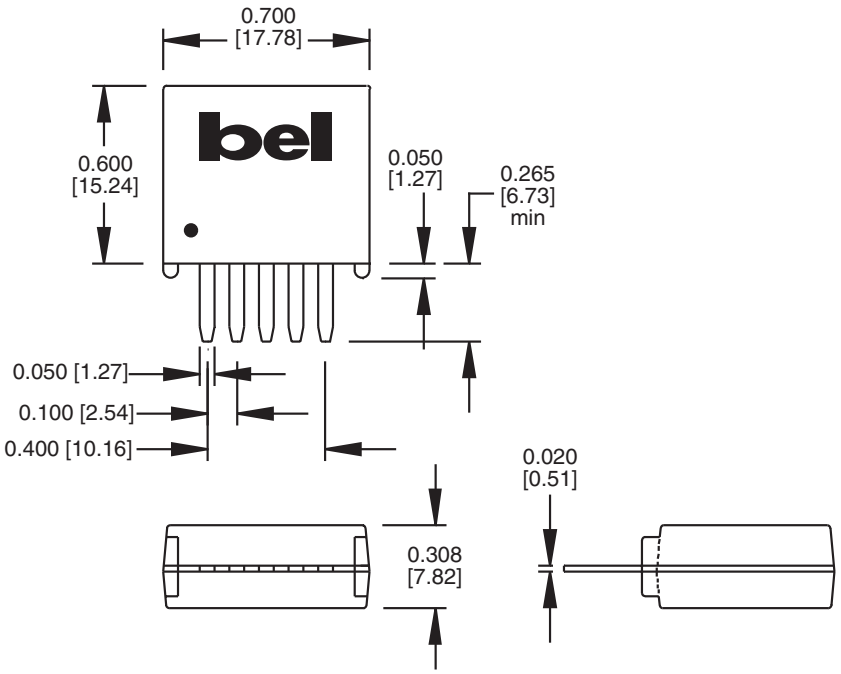
Dimensions are in inches [millimeters].
Standard dimension tolerance is ±0.005 [0.13] unless otherwise noted.

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



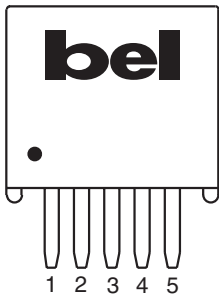
Mechanical

VRAH-03A



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.

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