NON-ISOLATED DC/DC CONVERTERS
3.3V Input / 1.2V – 2.5V Output / 5A

bel POWER PRODUCTS

BP05xRAH-05C

SRAH-05C / VRAH-05C Series

- 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-05C and VRAH-05C modules are a series of non-isolated, step down DC/DC power converters that operate from a nominal 3.3V source. These converters are available in a range of output voltages from 1.2V to 2.5V. 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 3.3V 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
2.5V	3.3V	5A	12.5W	91%	SRAH-05C250	VRAH-05C250
1.8V	3.3V	5A	9.0W	88%	SRAH-05C180	VRAH-05C180
1.5V	3.3V	5A	7.5W	86%	SRAH-05C150	VRAH-05C150
1.2V	3.3V	5A	6W	83%	SRAH-05C120	VRAH-05C120

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	-40		85	°C
Storage Temperature	Tstor	-40		105	°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	3		3.6	V
Input Current	2.5V 1.8V 1.5V 1.2V	Iin			4.8 4.0 3.5 3.0	A
No Load Input Current	All				90	mA
Remote Off Input Current				3	10	mA
Input Reflected Ripple Current[1]	All			30	45	mA_{rms}
Input Reflected Ripple Current (P-P)[1]	All			100	150	mApk
I^2t Inrush Current Transient	All			0.0005	0.001	A^2s
Turn On Voltage Threshold	All		2.6		2.7	V
Turn Off Voltage Threshold	All			2.5		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]	2.5V 1.8V 1.5V 1.2V	Vout	2.450 1.764 1.470 1.176	2.500 1.800 1.500 1.200	2.550 1.836 1.530 1.224	V
Load Regulation	All			5	10	mV
Line Regulation	All			3	5	mV
Regulation Over Temperature	All			20	30	mV
Total Output Voltage Regulation	All			28	45	mV
Output Ripple and Noise [2]	All			30	80	mVp-p
Output Ripple and Noise [2]	All			10	20	mVrms
Output Current Range	All	Iout	0		5	A
Output DC Current Limit	All	Ioutlim	6		10	A
Short Circuit Surge	2.5V 1.8V 1.5V 1.2V	Ioutsurge		0.07 0.07 0.07 0.07	0.1 0.1 0.1 0.1	A^2s
Turn on Time	All	Ton		7	15	ms
Overshoot at Turn On	All			0	1	%
Output Capacitance	All	Cout	0		2200	µF
Transient Response [3]						
ΔV 50% to 100% of Max Load	All			80	170	mV
Settling Time		Ts		80	120	µs
ΔV 100% to 50% of Max Load				80	170	mV
Settling Time		Ts		80	120	µs

Note: All specifications are typical at nominal input, full load at 25° C unless otherwise stated.
1. Vin = 3.3V, Iout = full load, Ta = 25° C.
2. 0 - 20MHz, 1µF ceramic cap and 10µF aluminum cap on output.
3. di/dt = 0.5A/1µS, Ta = 25° C without external load capacitance.

General Specifications

Parameter	Module	Symbol	Min	Typical	Max	Units
Efficiency[1]	2.5V 1.8V 1.5V 1.2V	η	 89 86 84 81	 91 88 86 83		%
Switching Frequency	All	Fsw	570	600	630	kHz
Output Voltage Trim Range[2]	2.5V 1.8V 1.5V 1.2V		 90 90 90 90		 105 110 110 110	%
Weight	All			4.9		g

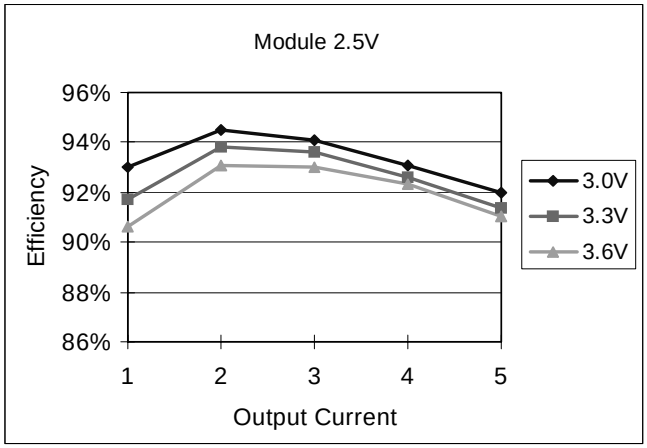
1. Vin=3.3V, full load and Ta=25° C.
2. See graphs on pages 10-12.

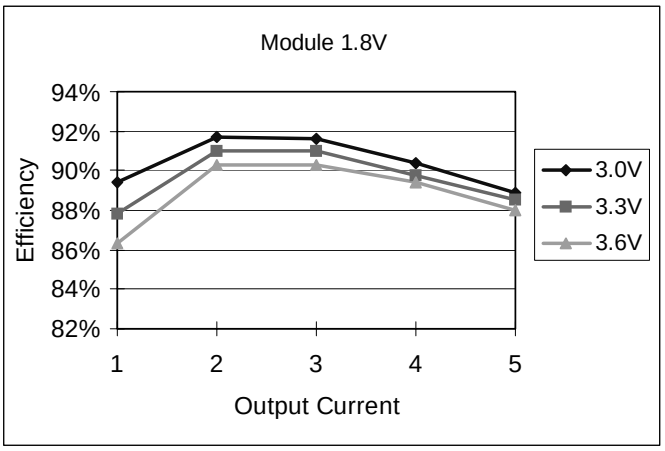
Control Specifications

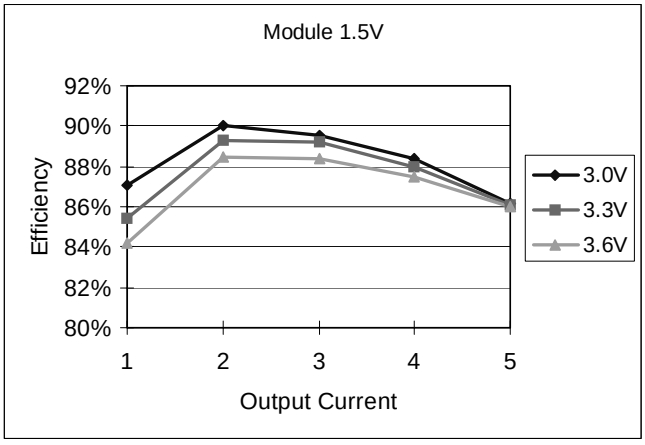
Parameter	Module	Symbol	Min	Typical	Max	Units
Remote On/Off [3]	All	Vouten				V
Signal Low (Unit Off)	All		-0.3		1	V
Signal High (Unit On)	All		1.8		3.6	V

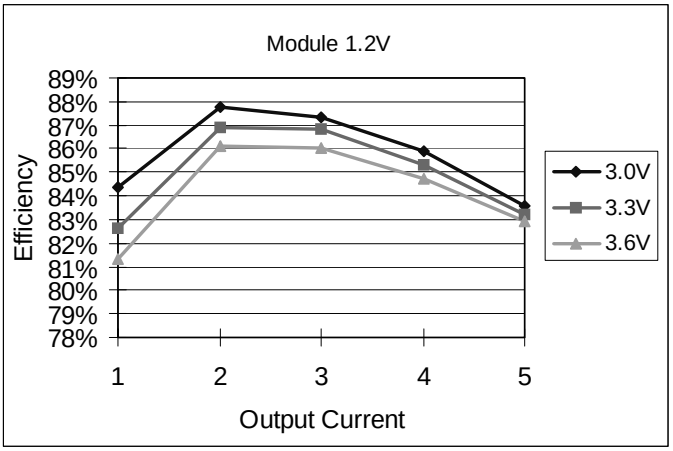
3. With remote on/off pin 1 open, the module is on.

Efficiency Data





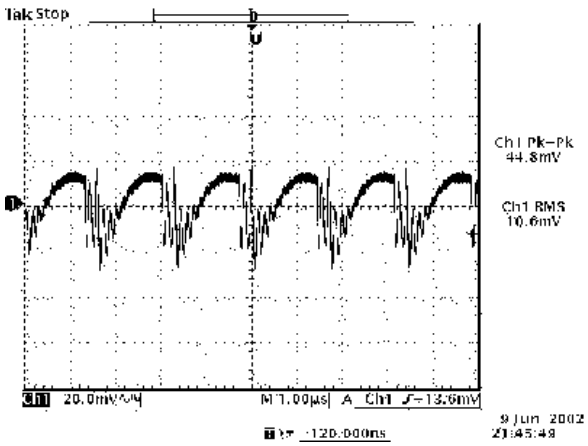




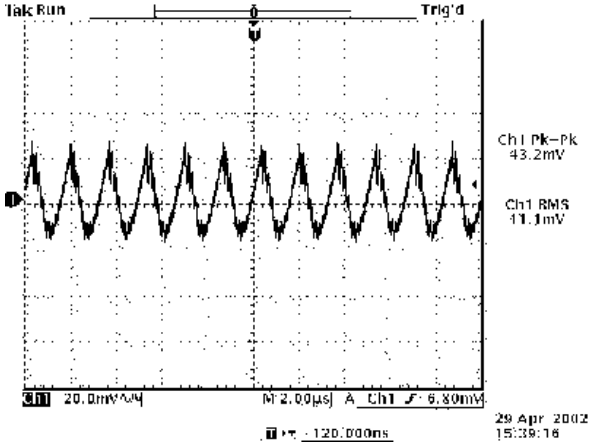
Note: On/off pin designed to work with an open collector/drain switch.

Ripple and Noise

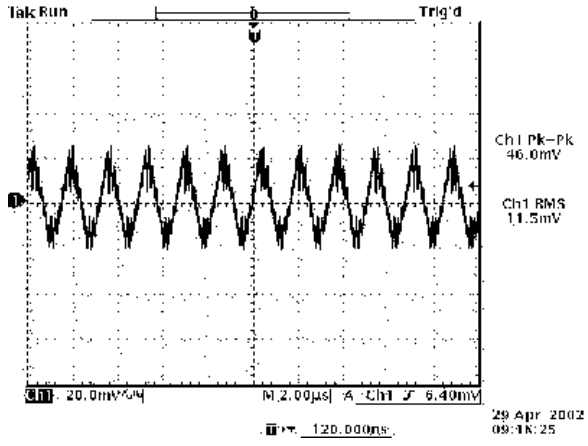
1µF ceramic cap and 10µF aluminum cap added at the output.



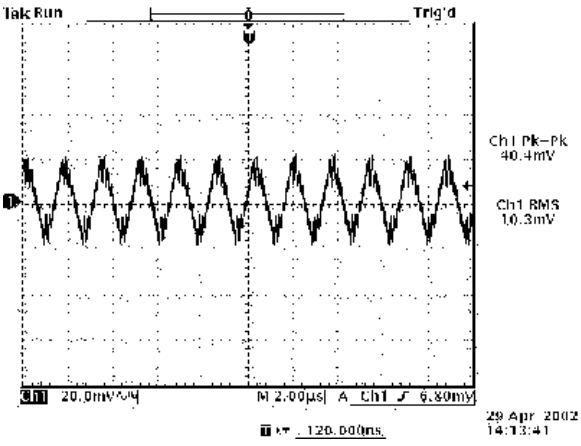
Ripple and noise at full load and 3.3Vdc input, 2.5Vdc output and Ta=25° C



Ripple and noise at full load and 3.3Vdc input, 1.8Vdc output and Ta=25° C



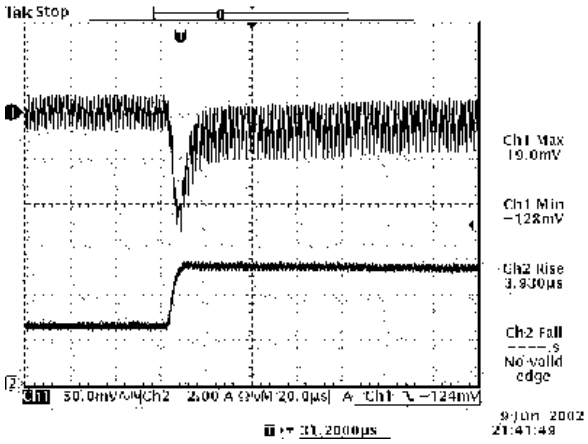
Ripple and noise at full load and 3.3Vdc input, 1.5Vdc output and Ta=25° C



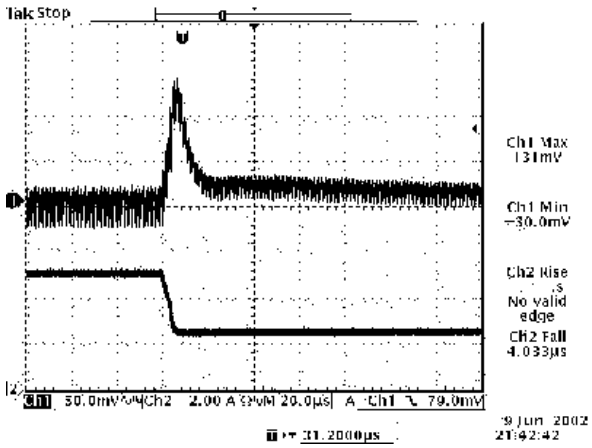
Ripple and noise at full load and 3.3Vdc input, 1.2Vdc output and Ta=25° C

Transient Response

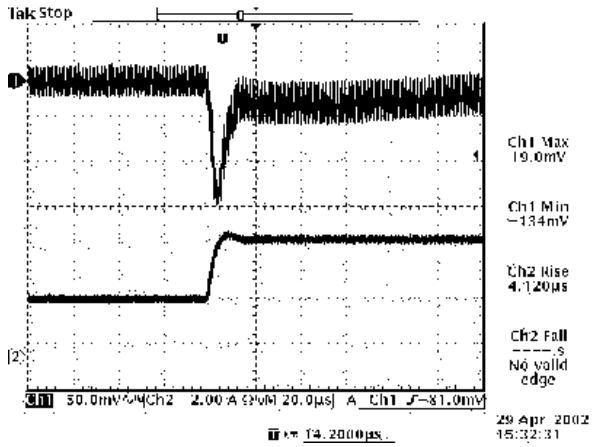
Transient response: di/dt = 0.5A/µS, no external load capacitance



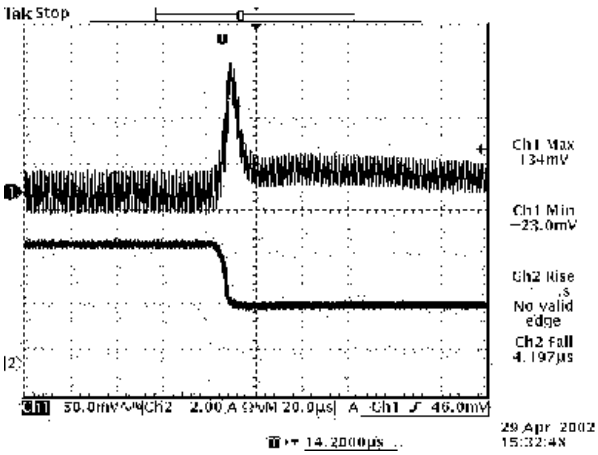
Vout=2.5V
50% to 100% load transients at 3.3V input and Ta=25° C



Vout=2.5V
100% to 50% load transients at 3.3V input and Ta=25° C



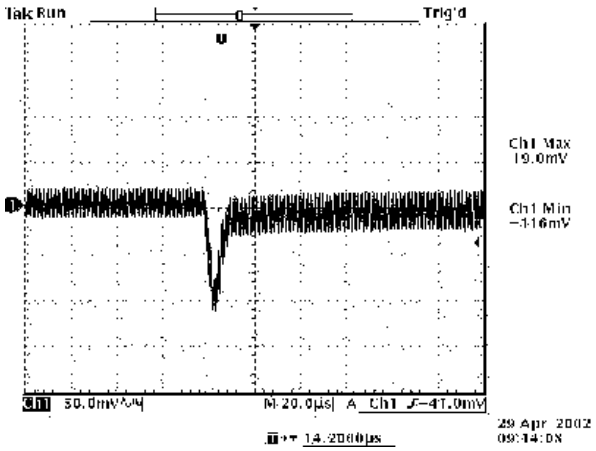
Vout=1.8V
50% to 100% load transients at 3.3V input and Ta=25° C



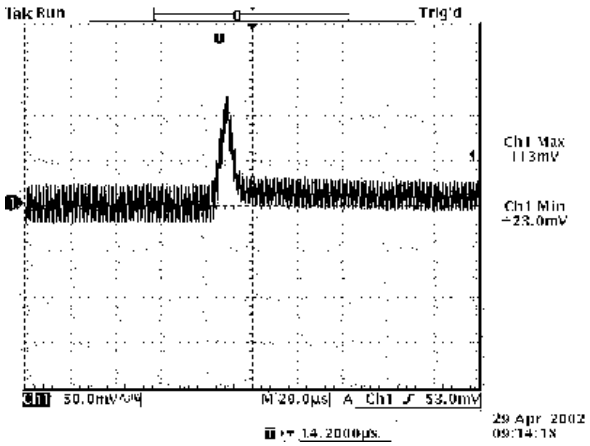
Vout=1.8V
100% to 50% load transients at 3.3V input and Ta=25° C

Transient Response

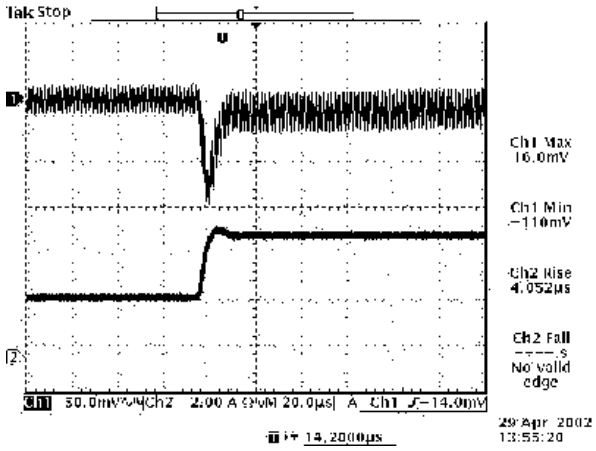
Transient response: di/dt = 0.5A/µS, no external load capacitance



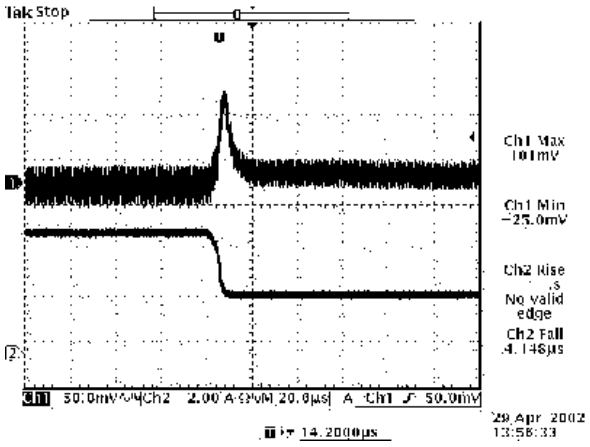
Vout=1.5V
50% to 100% load transients at 3.3V input and Ta=25° C



Vout=1.5V
100% to 50% load transients at 3.3V input and Ta=25° C



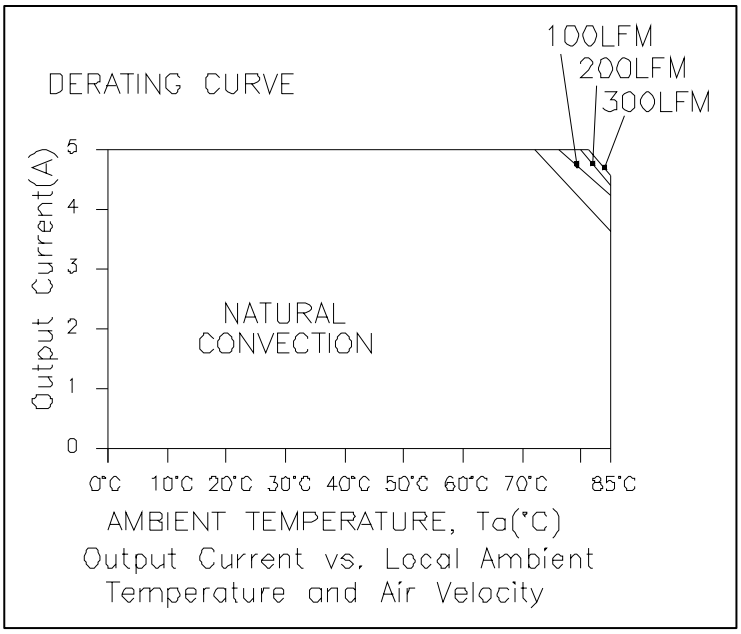
Vout=1.2V
50% to 100% load transients at 3.3V input and Ta=25° C



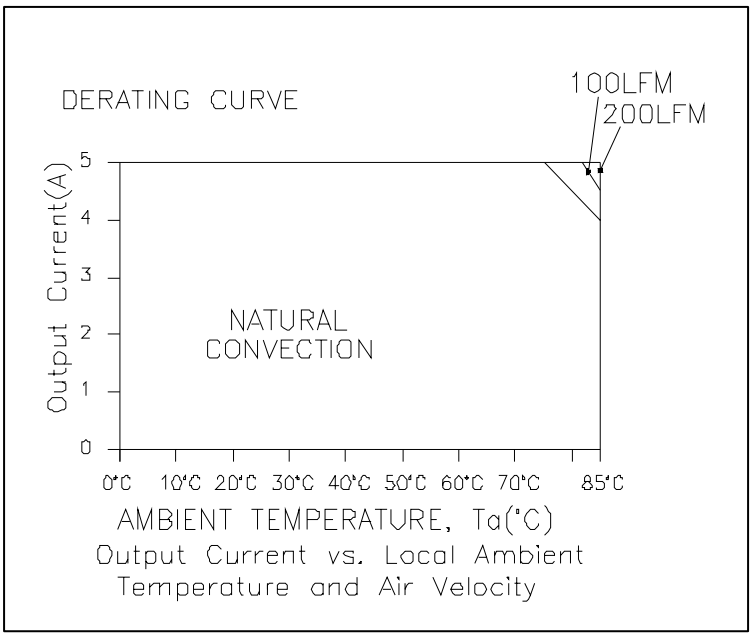
Vout=1.2V
100% to 50% load transients at 3.3V input and Ta=25° C

Thermal Considerations

SRAH-05C

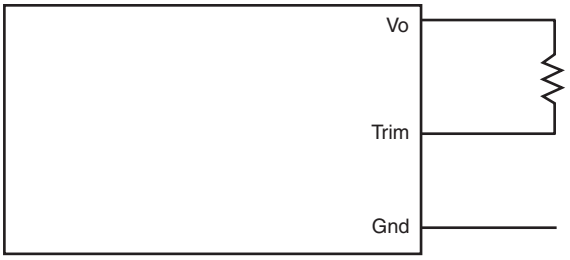


VRAH-05C

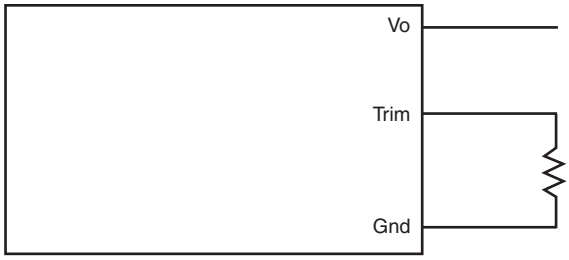


Output Voltage Set-Point Adjustment

Trim Down Test Circuit



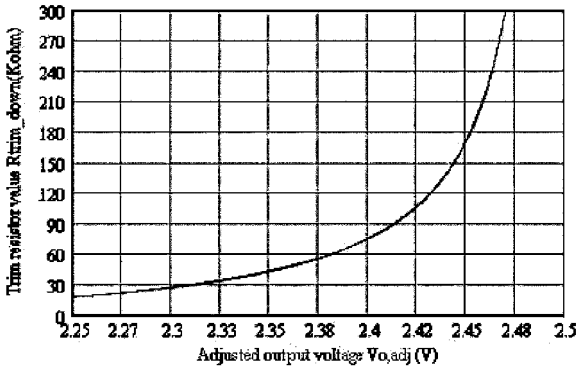
Trim Up Test Circuit



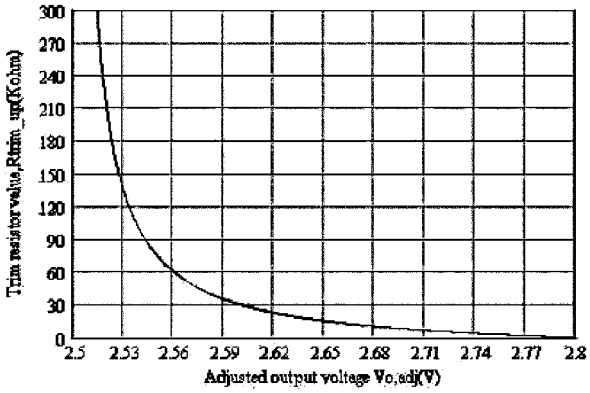
Output Voltage Set-Point Adjustment

xRAH-05C250 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{9.5565}{Vo - Vo,\ adj} - 20.32\right) \text{Kohm}$$



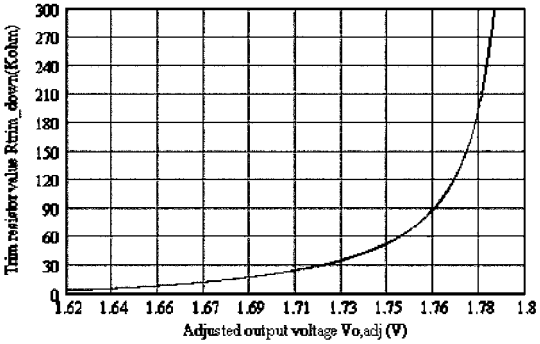
$$\text{Rtrim up} = \left(\frac{4.496}{Vo,\ adj - Vo} - 14.7\right) \text{Kohm}$$



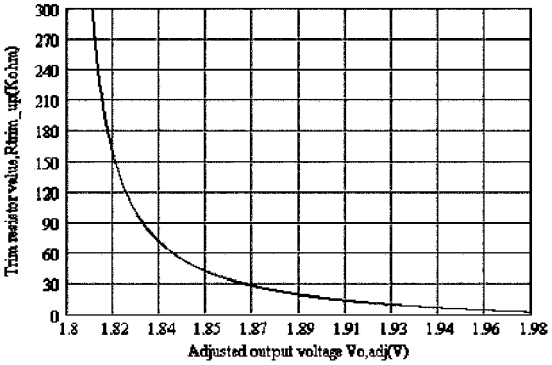
Output Voltage Set-Point Adjustment

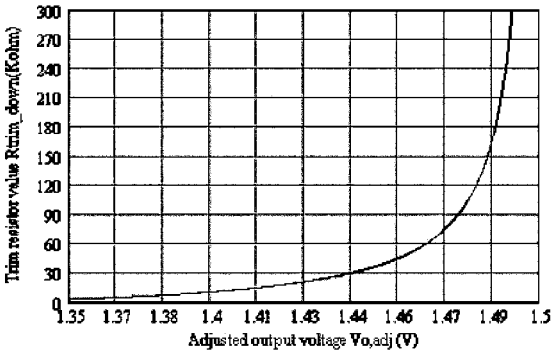
xRAH-05C180 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{3.8488}{Vo - Vo,\ adj} - 18.54\right) \text{Kohm}$$



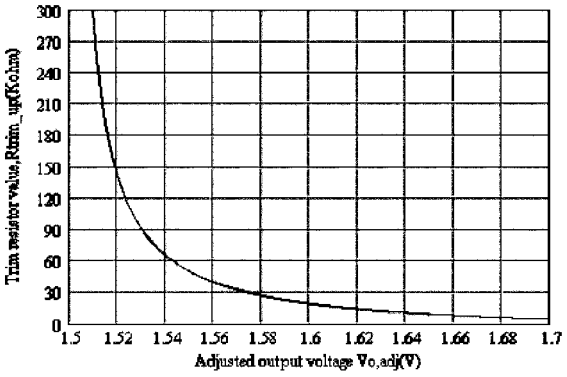
$$\text{Rtrim up} = \left(\frac{3.064}{Vo,\ adj - Vo} - 14.7\right) \text{Kohm}$$





x7AH-05C150 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{2.6977}{Vo - Vo,\ adj} - 15.33\right) \text{Kohm}$$

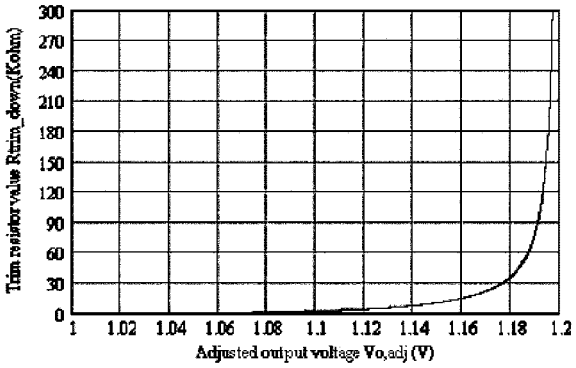


$$\text{Rtrim up} = \left(\frac{3.064}{Vo,\ adj - Vo} - 11.5\right) \text{Kohm}$$

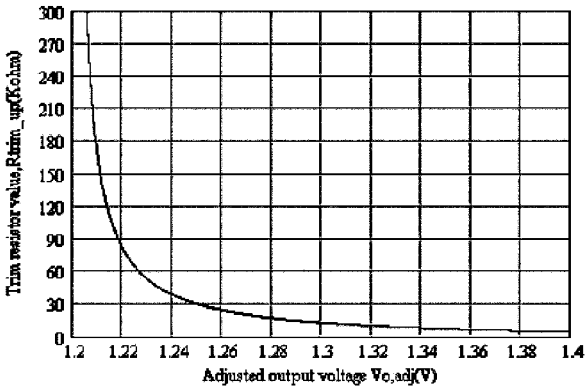
Output Voltage Set-Point Adjustment

xRAH-05C120 Trim Resistor Calculation

$$\text{Rtrim down} = \left(\frac{0.8501}{Vo - Vo,\ adj} - 6.79\right) \text{Kohm}$$

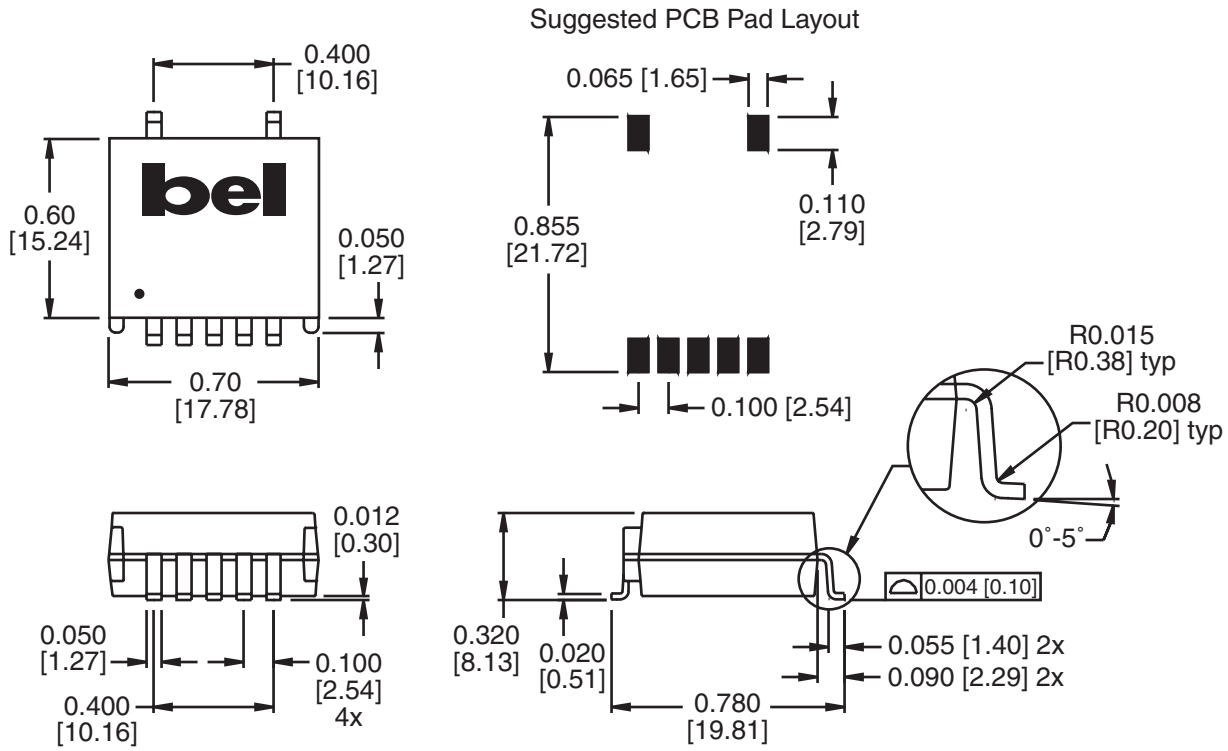


$$\text{Rtrim up} = \left(\frac{1.72}{Vo,\ adj - Vo} - 4.64\right) \text{Kohm}$$



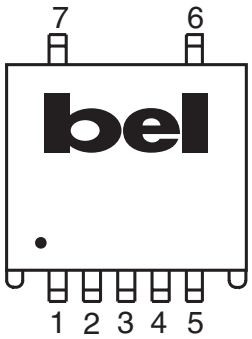
Mechanical

SRAH-05C



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

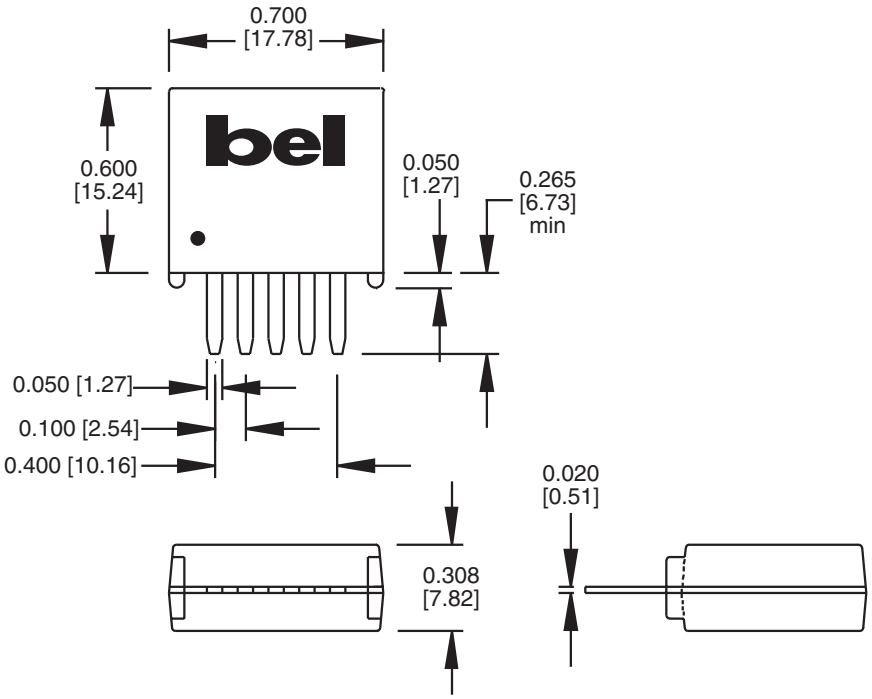
Pin	Function
1	Remote On/Off
2	+Vin
3	Ground
4	+Vo
5	Trim
6	No Connection
7	No Connection



BP05xRAH-05C

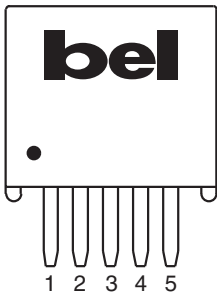
Mechanical

VRAH-05C



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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