NON-ISOLATED DC/DC CONVERTERS
5V Input / 0.9V – 3.3V Output / 8A

bel POWER PRODUCTS

BP06xRAH-08B

SRAH-08B / VRAH-08B 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-08B and VRAH-08B 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 0.9V to 3.3V. They are packaged in a compact, overmolded package rated at 8A. 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, output voltage adjust and industrial temperature range (-40° to +85° C). The output is closely regulated and the efficiency is typically 92% at full load. 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	8A	26.4W	92%	SRAH-08B330	VRAH-08B330
2.5V	5V	8A	20W	90%	SRAH-08B250	VRAH-08B250
1.8V	5V	8A	14.4W	86%	SRAH-08B180	VRAH-08B180
1.5V	5V	8A	12W	84%	SRAH-08B150	VRAH-08B150
1.2V	5V	8A	9.6W	82%	SRAH-08B120	VRAH-08B120
1.0V	5V	8A	8W	80%	SRAH-08B100	VRAH-08B100
0.9V	5V	8A	7.2W	79%	SRAH-08B090	VRAH-08B090
0.9V - 3.3V	5V	8A	26.4W	92%	SRAH-08B1A0	VVAH-08B1A0

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	-55		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	4.5		5.5	V
Input Current 3.3V 2.5V 1.8V 1.5V 1.2V 1.0V 0.9V		Iin			 7.3 5.6 4.3 3.6 3.0 2.5 2.3	A
No Load Input Current	All				80	mA
Remote Off Input Current				9	15	mA
Input Reflected Ripple Current[1]	All			50	80	mA_{rms}
Input Reflected Ripple Current (P-P)[1]	All			150	200	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			3.8	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 1.0V 0.9V	Vout	3.234 2.45 1.764 1.47 1.176 0.98 0.882	3.3 2.5 1.8 1.5 1.2 1.0 0.9	3.366 2.55 1.836 1.53 1.224 1.02 0.918	V
Load Regulation	3.3V 2.5V 1.8V 1.5V 1.2V 1.0V 0.9V			6 6 6 3 3 3 3	15 15 15 10 10 10 10	mV
Line Regulation	All			2	5	mV
Regulation Over Temperature (-40° to +85° C)	3.3V 2.5V 1.8V 1.5V 1.2V 1.0V 0.9V			20 20 10 10 5 5 5	33 25 18 15 10 10 10	mV
Total Output Voltage Regulation	3.3V 2.5V 1.8V 1.5V 1.2V 1.0V 0.9V			28 28 18 15 10 10 10	53 45 38 30 25 25 25	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		8	A
Output DC Current Limit	All	Ioutlim	10.4		20	A
Short Circuit Surge	3.3V 2.5V 1.8V 1.5V 1.2V 1.0V 0.9V	Ioutsurge		0.08 0.05 0.05 0.05 0.05 0.05 0.05	0.2 0.1 0.1 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		3300	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			130	165	mV
Settling Time		Ts		100	150	µs
ΔV 100% to 50% of Max Load				130	165	mV
Settling Time		Ts		100	150	µs
Transient Response [3]						
ΔV 50% to 100% of Max Load	2.5V			130	165	mV
Settling Time		Ts		30	60	µs
ΔV 100% to 50% of Max Load				120	165	mV
Settling Time		Ts		30	60	µs
Transient Response [3]						
ΔV 50% to 100% of Max Load	1.8V			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	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			90	125	mV
Settling Time		Ts		25	50	µs
ΔV 100% to 50% of Max Load				90	125	mV
Settling Time		Ts		25	50	µs
Transient Response [3]						
ΔV 50% to 100% of Max Load	1.0V			70	110	mV
Settling Time		Ts		25	50	µs
ΔV 100% to 50% of Max Load				70	110	mV
Settling Time		Ts		25	50	µs
Transient Response [3]						
ΔV 50% to 100% of Max Load	0.9V			70	110	mV
Settling Time		Ts		25	50	µs
ΔV 100% to 50% of Max Load				70	110	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/µS, Ta = 25° C without external load capacitance; when Vout=3.3V or 2.5V a 220µF aluminum cap is added at output.

General Specifications

Parameter	Module	Symbol	Min	Typical	Max	Units
Efficiency[1]	3.3V 2.5V 1.8V 1.5V 1.2V 1.0V 0.9V	η	89 87 83 81 79 77 76	92 90 86 84 82 80 79		%
Switching Frequency	All	Fsw	250	300	340	kHz
Output Voltage Trim Range[2] (Wide Trim)	1.8V		47.5		202	%
Output Voltage Trim Range[2] (Narrow Trim)	3.3V 2.5V 1.8V 1.5V 1.2V 1.0V 0.9V		90 90 90 90 90 90 95		110 110 110 110 110 110 110	%
Weight	All			4.7		g

1. Vin=5V, full load and Ta=25° C.
2. See graphs on page 13 - 20.

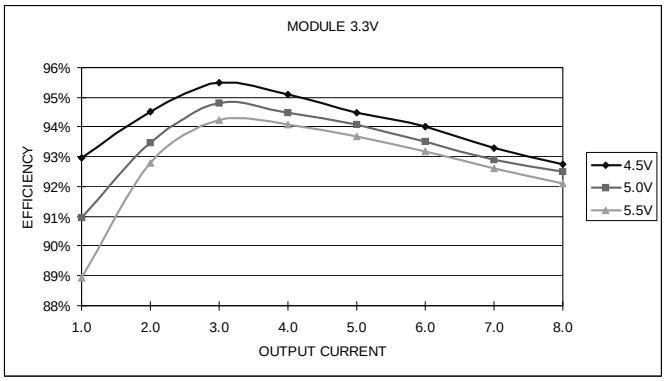
Control Specifications

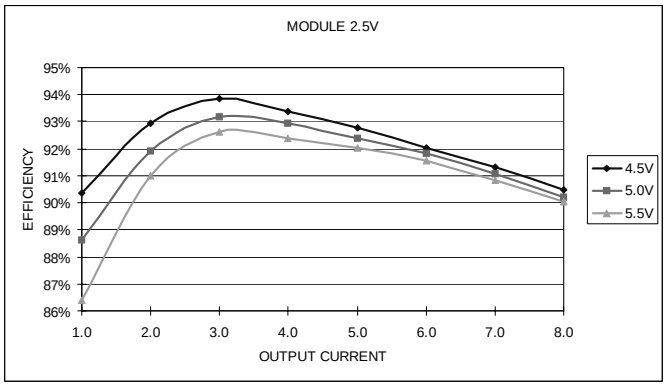
Parameter		Module	Symbol	Min	Typical	Max	Units
Remote On/Off [1]		All	Vouten				V
Signal Low (Unit Off)[2]	Vin = 4.5V	All		-0.3		1.35	V
	Vin = 5.5V					1.65	
Signal High (Unit On)[2]	Vin = 4.5V	All		3.15		5.5	V
	Vin = 5.5V			3.85			

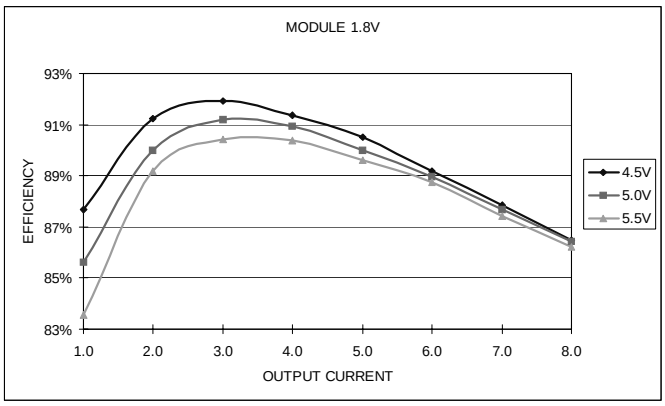
1. With remote on/off pin 1 open, the module is on.
2. Signal low and signal high varies based on Vin.

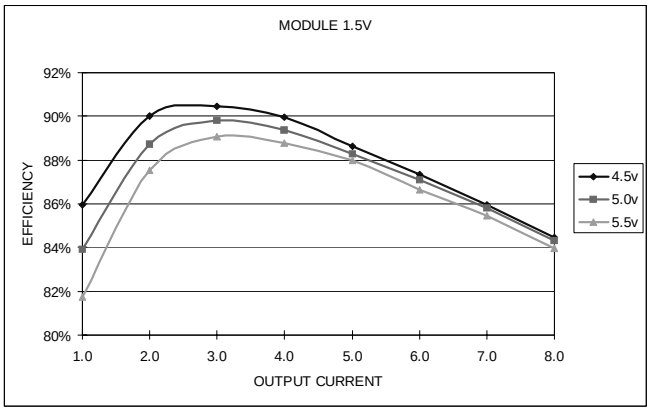
Note: On/off pin designed to work with an open collector/drain switch.

Efficiency Data

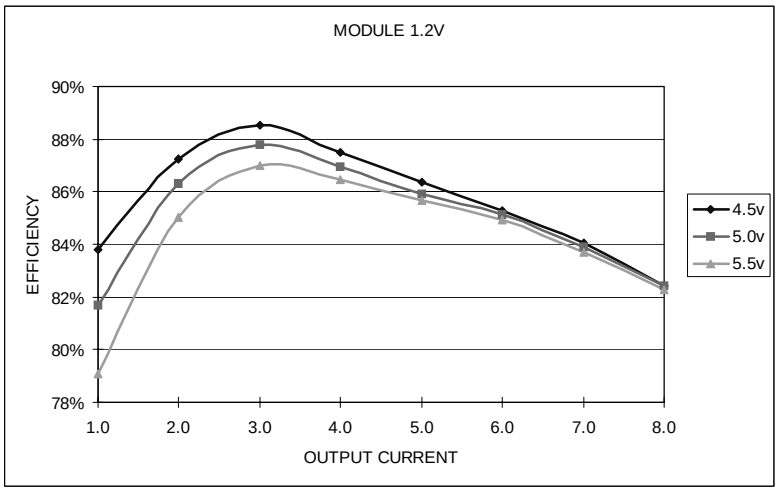


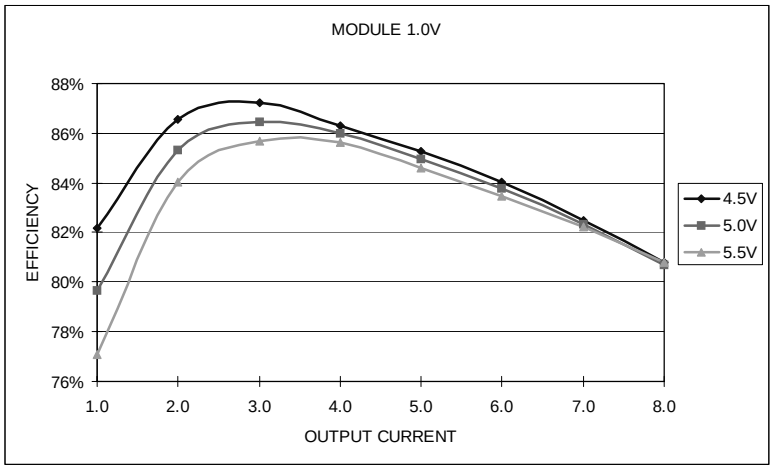


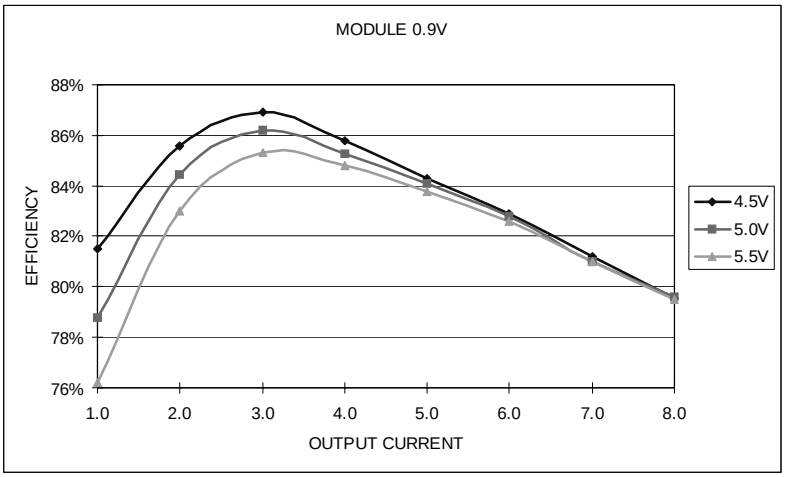




Efficiency Data

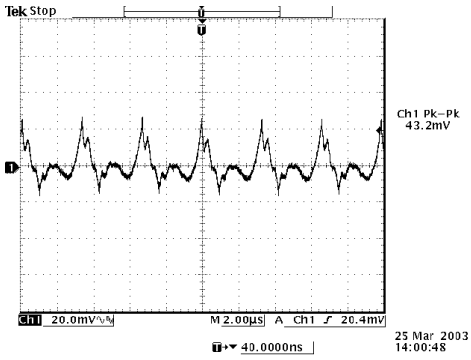




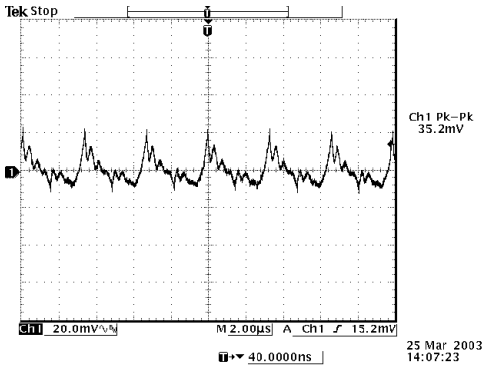


Ripple and Noise

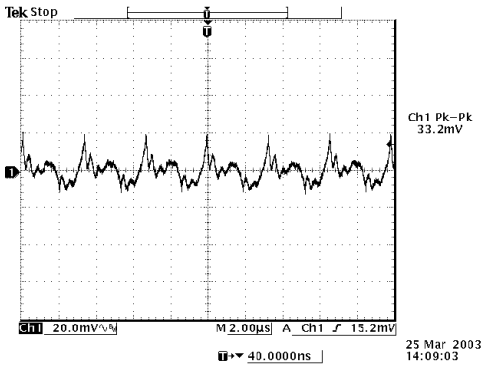
1µF ceramic cap and 10µF aluminum electrolytic cap added at the output.



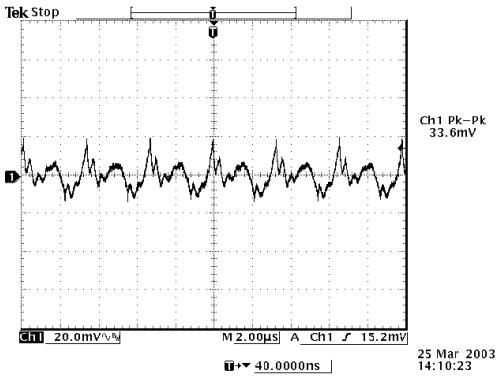
Ripple and noise at full load and 5Vdc input, 3.3Vdc output and Ta=25° C



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



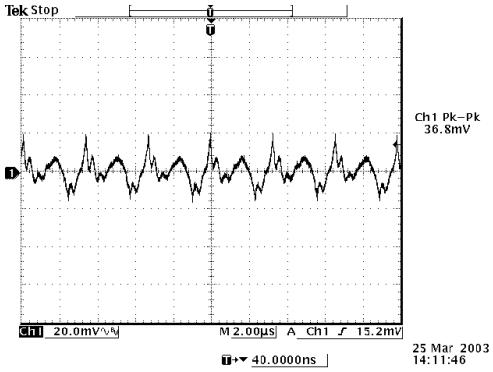
Ripple and noise at full load and 5Vdc input, 1.8Vdc output and Ta=25° C



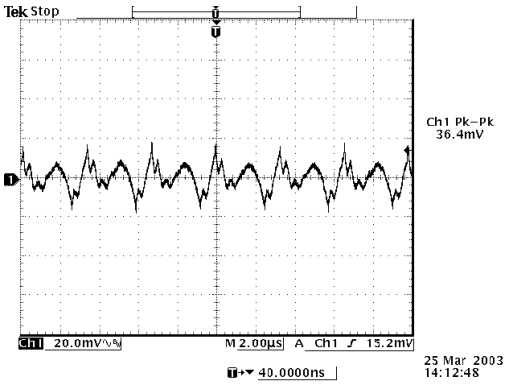
Ripple and noise at full load and 5Vdc input, 1.5Vdc output and Ta=25° C

Ripple and Noise

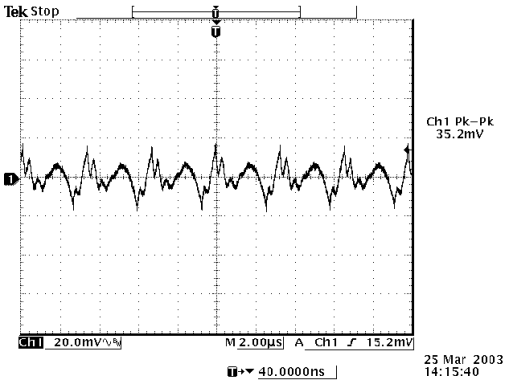
1µF ceramic cap and 10µF aluminum electrolytic cap added at the output.



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



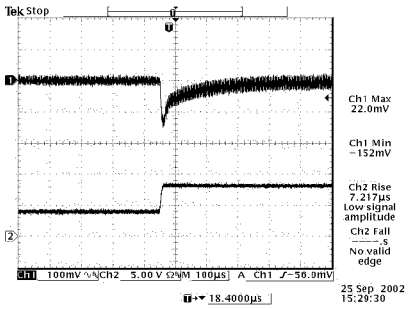
Ripple and noise at full load and 5Vdc input, 1.0Vdc output and Ta=25° C



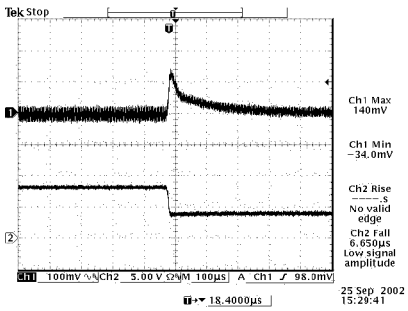
Ripple and noise at full load and 5Vdc input, 0.9Vdc output and Ta=25° C

Transient Response

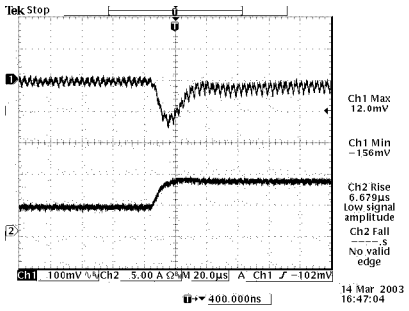
Transient response: di/dt = 0.5A/µS, no external load capacitance.
Note: 3.3Vdc and 2.5Vdc output with external 220uF aluminum capacitance.



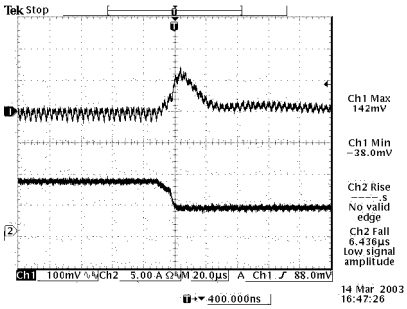
Vout=3.3V
50% to 100% load transients at 5V input and Ta=25° C



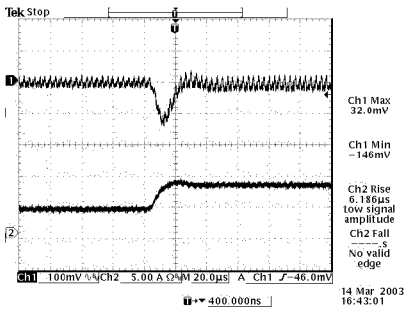
Vout=3.3V
100% to 50% load transients at 5V input and Ta=25° C



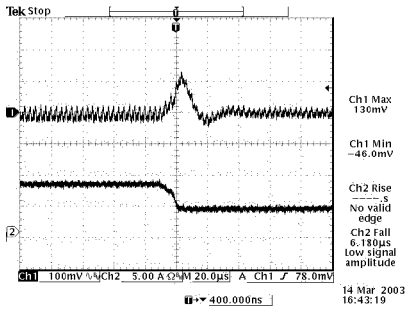
Vout=2.5V
50% to 100% load transients at 5V input and Ta=25° C



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



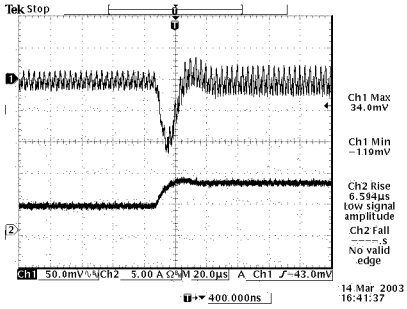
Vout=1.8V
50% to 100% load transients at 5V input and Ta=25° C



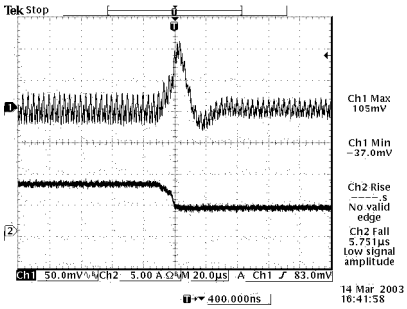
Vout=1.8V
100% to 50% load transients at 5V input and Ta=25° C

Transient Response

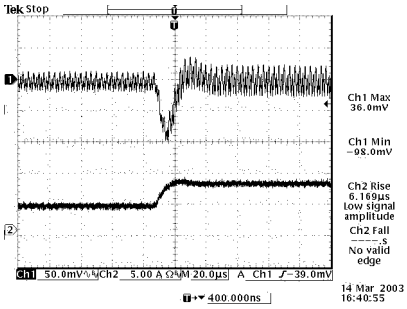
Transient response: di/dt = 0.5A/µS, no external load capacitance



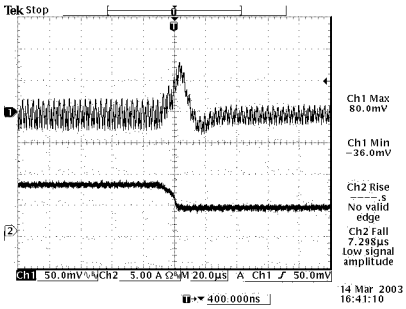
Vout=1.5V
50% to 100% load transients at 5V input and Ta=25° C



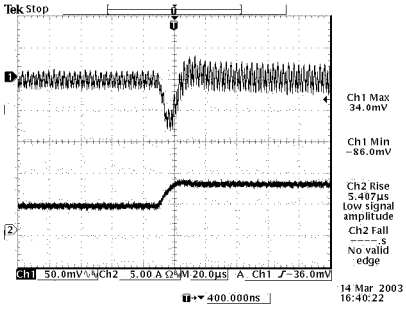
Vout=1.5V
100% to 50% load transients at 5V input and Ta=25° C



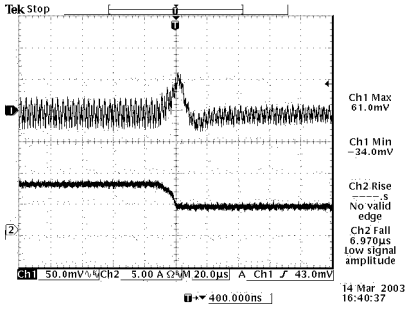
Vout=1.2V
50% to 100% load transients at 5V input and Ta=25° C



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



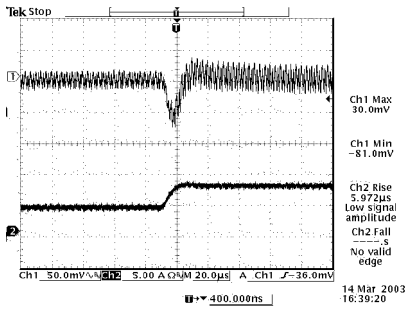
Vout=1.0V
50% to 100% load transients at 5V input and Ta=25° C



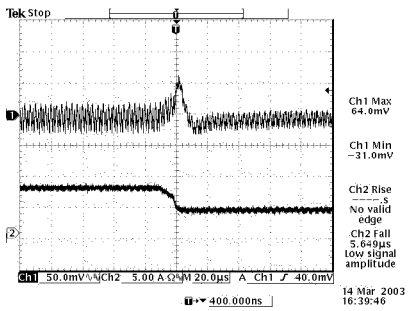
Vout=1.0V
100% to 50% load transients at 5V input and Ta=25° C

Transient Response

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



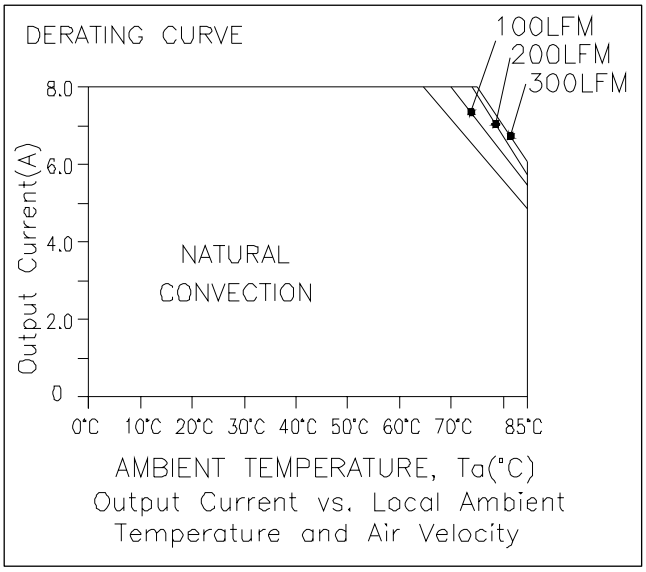
Vout=0.9V
50% to 100% load transients at 5V input and Ta=25° C



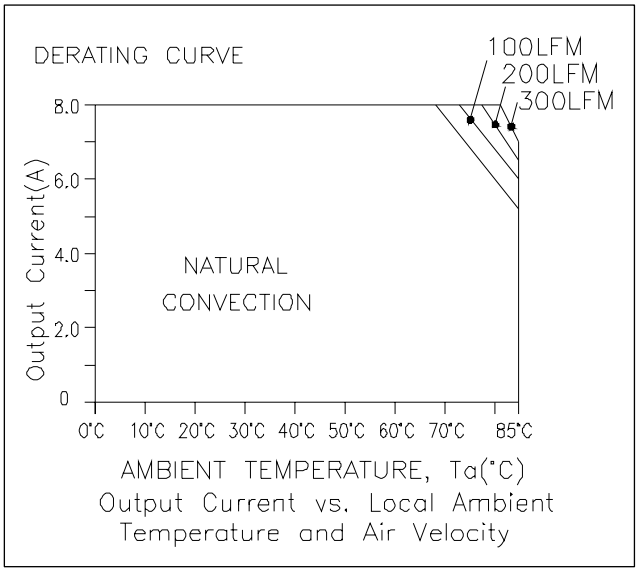
Vout=0.9V
100% to 50% load transients at 5V input and Ta=25° C

Thermal Considerations

SRAH-08B

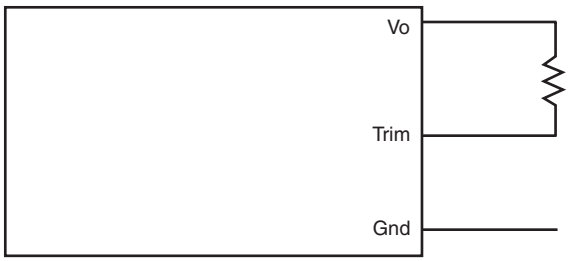


VRAH-08B

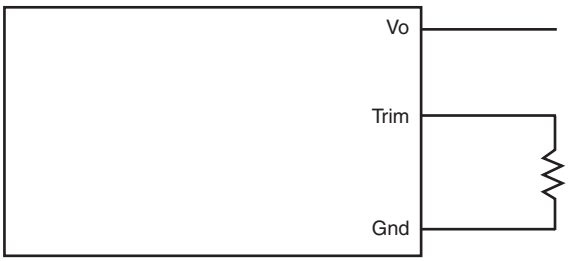


Output Voltage Set-Point Adjustment

Trim Down Test Circuit



Trim Up Test Circuit

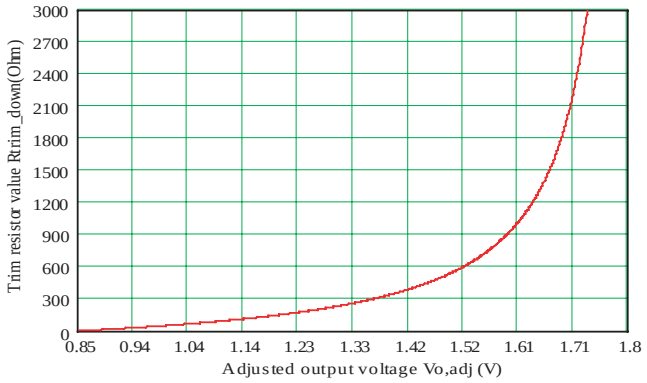


xRAH-08B1A0 Trim Resistor Calculation

$$R_{trim-down} = \left(\frac{250.362}{Vo - Vo,adj} - 261.1\right)ohm$$

where,

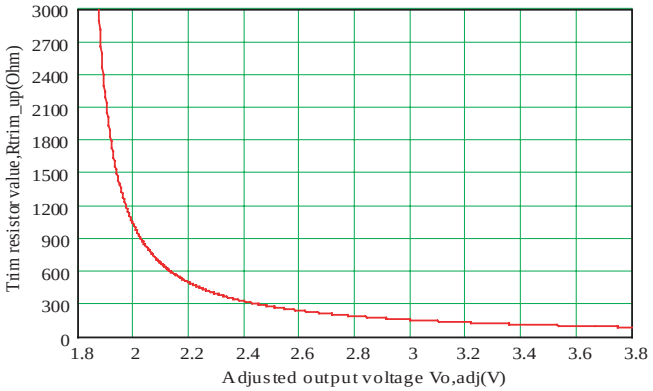
Vo is the nominal output voltage setpoint when trim pin is open ,Vo=1.805V
Vo,adj is the adjusted output voltage.
Rtrim-down is the resistance required between TRIM and Vo.



$$R_{trim-up} = \left(\frac{199.2}{Vo,adj - Vo} - 12.1\right)ohm$$

where,

Vo is the nominal output voltage setpoint when trim pin is open ,Vo=1.805V
Vo,adj is the adjusted output voltage.
Rtrim-up is the resistance required between TRIM and GND.



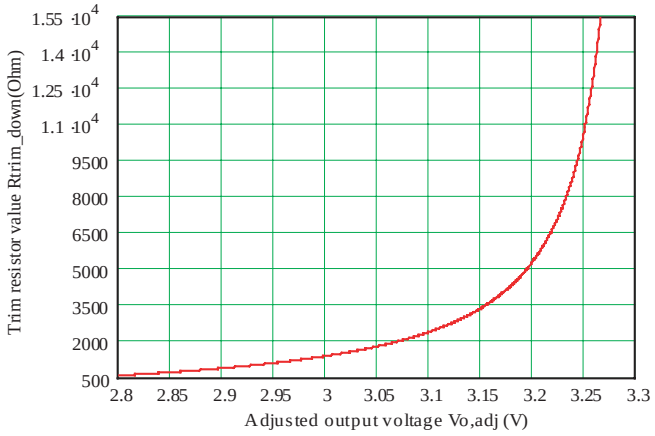
Output Voltage Set-Point Adjustment

xRAH-08B330 Trim Resistor Calculation

$$R_{trim-down} = \left(\frac{623.741}{Vo - Vo,adj} - 651\right) ohm$$

where,

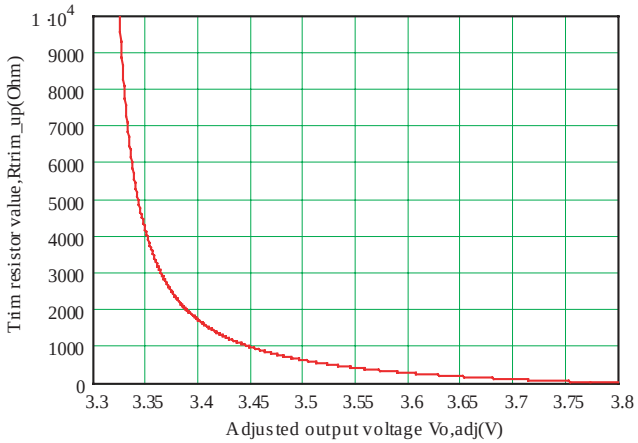
Vo is the nominal output voltage setpoint when trim pin is open ,Vo=3.305V
Vo,adj is the adjusted output voltage.
Rtrim-down is the resistance required between TRIM and Vo.



$$R_{trim-up} = \left(\frac{199.2}{Vo,adj - Vo} - 402\right) ohm$$

where,

Vo is the nominal output voltage setpoint when trim pin is open ,Vo=3.305V
Vo,adj is the adjusted output voltage.
Rtrim-up is the resistance required between TRIM and GND.



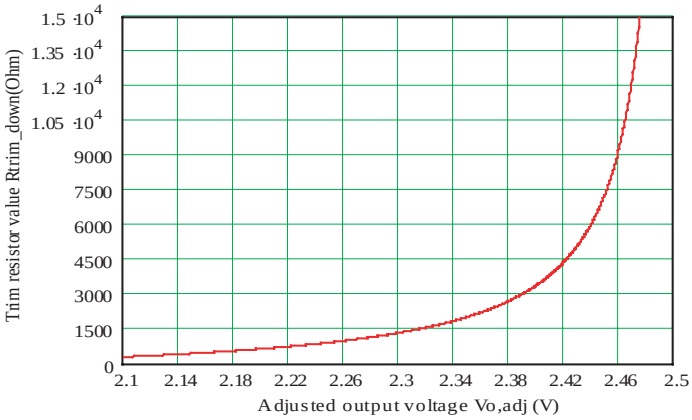
Output Voltage Set-Point Adjustment

xRAH-08B250 Trim Resistor Calculation

$$R_{trim-down} = \left(\frac{423.933}{Vo - Vo,adj} - 760\right) ohm$$

where,

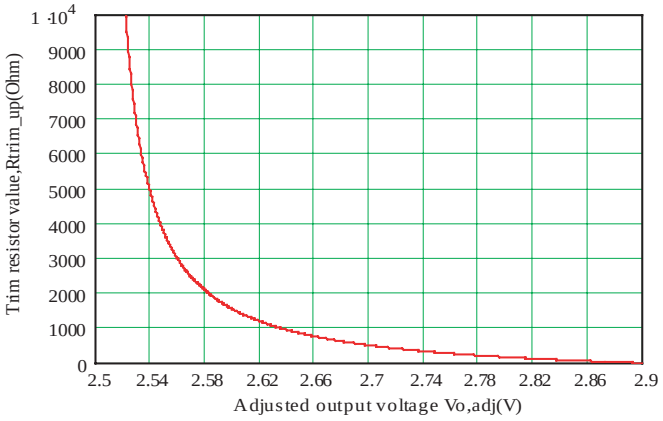
Vo is the nominal output voltage setpoint when trim pin is open ,Vo=2.503V
Vo,adj is the adjusted output voltage.
Rtrim-down is the resistance required between TRIM and Vo.



$$R_{trim-up} = \left(\frac{199.2}{Vo,adj - Vo} - 511\right) ohm$$

where,

Vo is the nominal output voltage setpoint when trim pin is open ,Vo=2.503V
Vo,adj is the adjusted output voltage.
Rtrim-up is the resistance required between TRIM and GND.



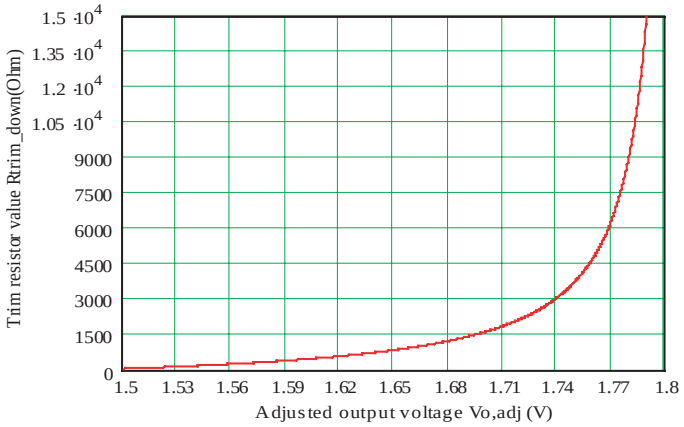
Output Voltage Set-Point Adjustment

xRAH-08B180 Trim Resistor Calculation

$$R_{trim-down} = (\frac{250.362}{Vo - Vo,adj} - 760)ohm$$

where,

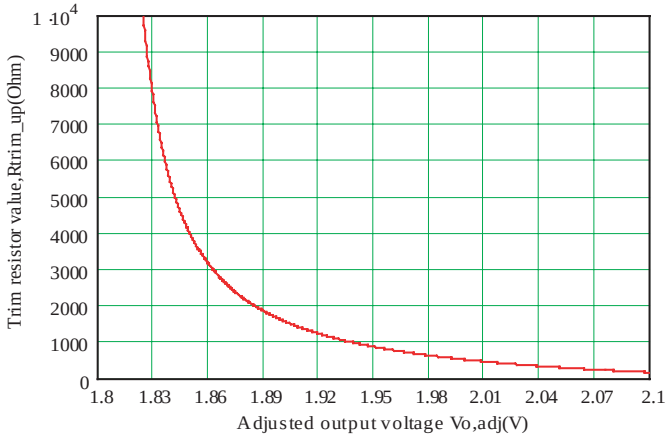
Vo is the nominal output voltage setpoint when trim pin is open ,Vo=1.805V
Vo,adj is the adjusted output voltage.
Rtrim-down is the resistance required between TRIM and Vo.



$$R_{trim-up} = (\frac{199.2}{Vo,adj - Vo} - 511)ohm$$

where,

Vo is the nominal output voltage setpoint when trim pin is open ,Vo=1.805V
Vo,adj is the adjusted output voltage.
Rtrim-up is the resistance required between TRIM and GND.



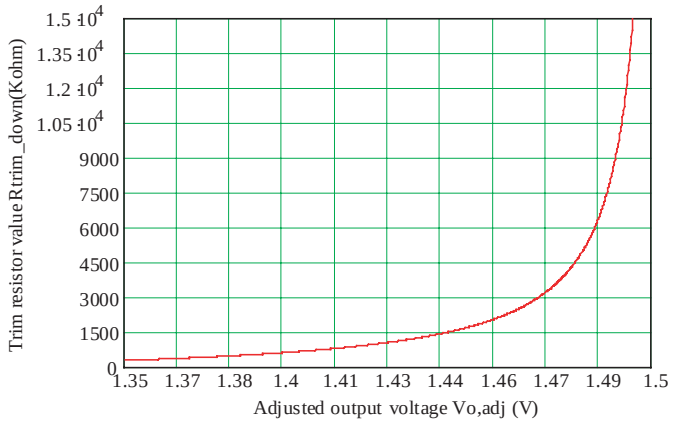
Output Voltage Set-Point Adjustment

xRAH-08B150 Trim Resistor Calculation

$$R_{trim-down} = (\frac{122.255}{Vo - Vo,adj} - 522)ohm$$

where,

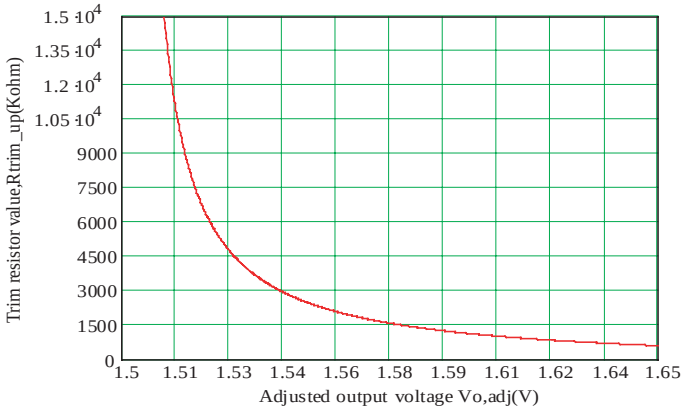
Vo is the nominal output voltage setpoint when trim pin is open ,Vo=1.503V
Vo,adj is the adjusted output voltage.
Rtrim-down is the resistance required between TRIM and Vo.



$$R_{trim-up} = (\frac{139.2}{Vo,adj - Vo} - 348)ohm$$

where,

Vo is the nominal output voltage setpoint when trim pin is open ,Vo=1.503V
Vo,adj is the adjusted output voltage.
Rtrim-up is the resistance required between TRIM and GND.



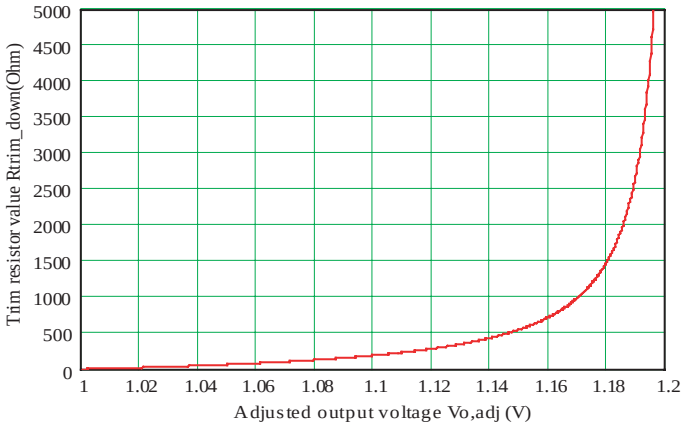
Output Voltage Set-Point Adjustment

xRAH-08B120 Trim Resistor Calculation

$$R_{trim-down} = \left(\frac{40.38}{Vo - Vo,adj} - 200\right) ohm$$

where,

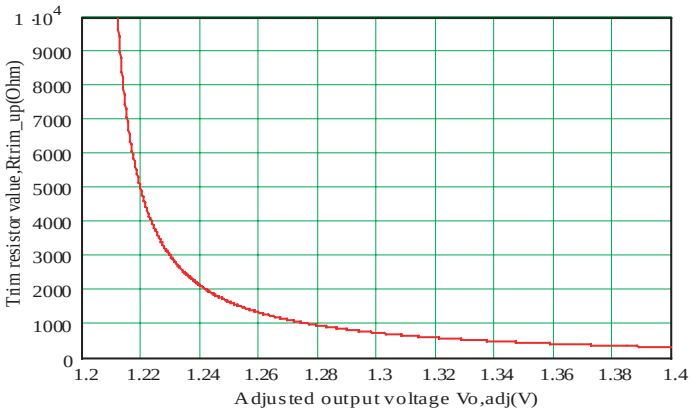
Vo is the nominal output voltage setpoint when trim pin is open ,Vo=1.204V
Vo,adj is the adjusted output voltage.
Rtrim-down is the resistance required between TRIM and Vo.



$$R_{trim-up} = \left(\frac{80}{Vo,adj - Vo} - 100\right) ohm$$

where,

Vo is the nominal output voltage setpoint when trim pin is open ,Vo=1.204V
Vo,adj is the adjusted output voltage.
Rtrim-up is the resistance required between TRIM and GND.



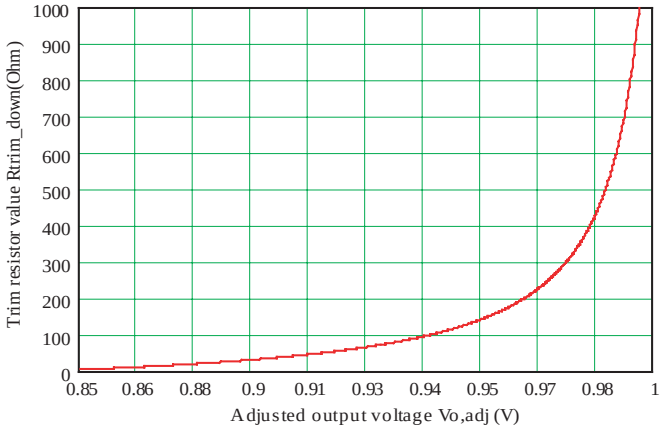
Output Voltage Set-Point Adjustment

xRAH-08B100 Trim Resistor Calculation

$$R_{trim-down} = \left(\frac{10.544}{Vo - Vo,adj} - 63.2\right) ohm$$

where,

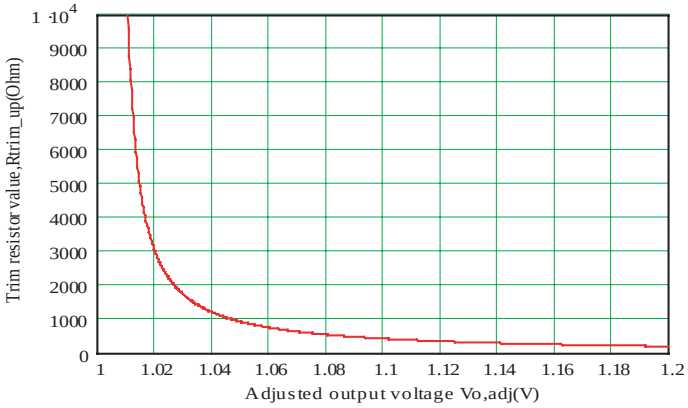
Vo is the nominal output voltage setpoint when trim pin is open ,Vo=1.006V
Vo,adj is the adjusted output voltage.
Rtrim-down is the resistance required between TRIM and Vo.



$$R_{trim-up} = \left(\frac{40.88}{Vo,adj - Vo} - 12.1\right) ohm$$

where,

Vo is the nominal output voltage setpoint when trim pin is open ,Vo=1.006V
Vo,adj is the adjusted output voltage.
Rtrim-up is the resistance required between TRIM and GND.



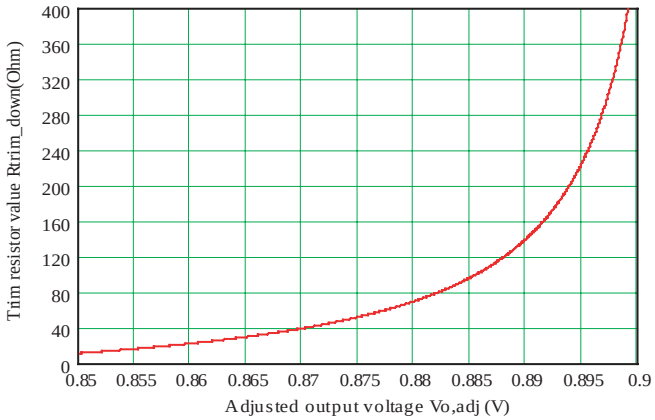
Output Voltage Set-Point Adjustment

xRAH-08B090 Trim Resistor Calculation

$$R_{trim-down} = \left(\frac{2.751}{Vo - Vo,adj} - 38.2\right) ohm$$

where,

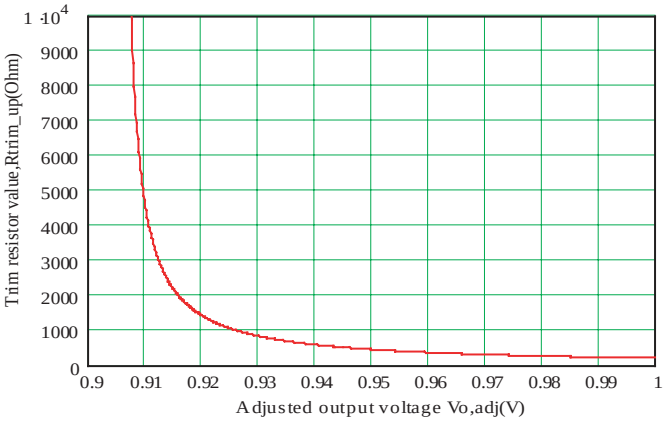
Vo is the nominal output voltage setpoint when trim pin is open ,Vo=0.905V
Vo,adj is the adjusted output voltage.
Rtrim-down is the resistance required between TRIM and Vo.



$$R_{trim-up} = \left(\frac{20.88}{Vo,adj - Vo} - 12.1\right) ohm$$

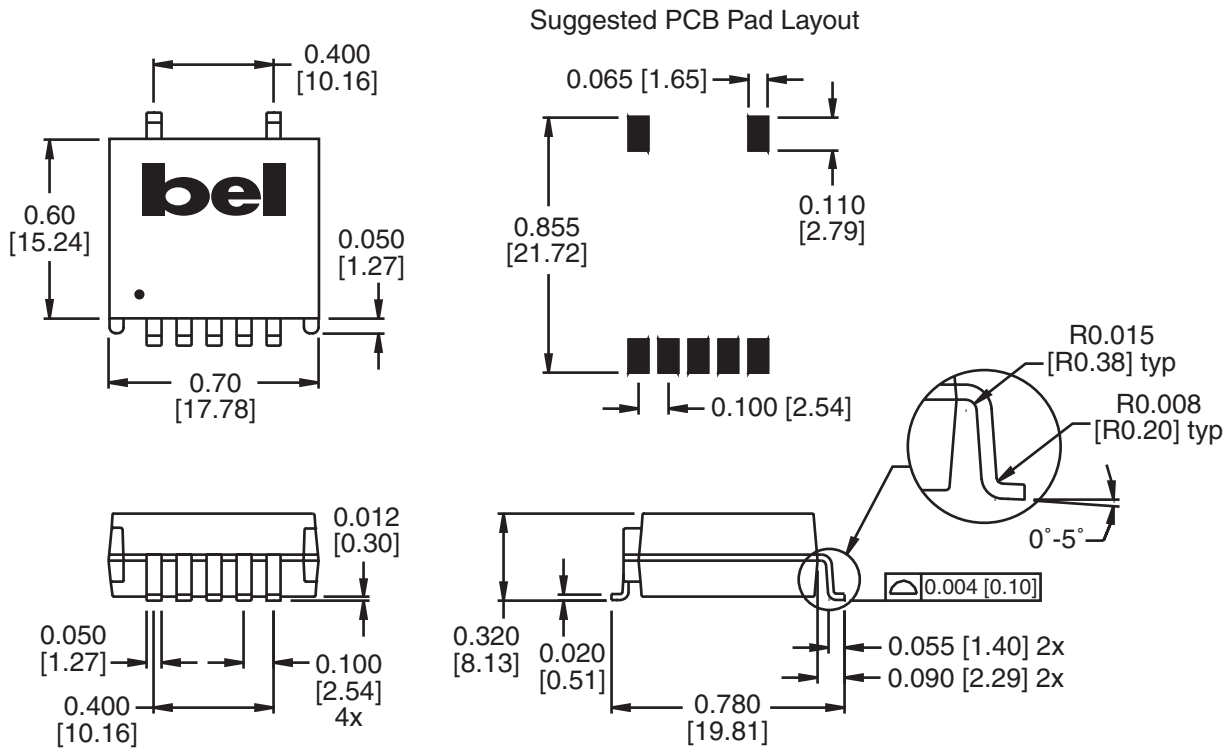
where,

Vo is the nominal output voltage setpoint when trim pin is open ,Vo=0.905V
Vo,adj is the adjusted output voltage.
Rtrim-up is the resistance required between TRIM and GND.



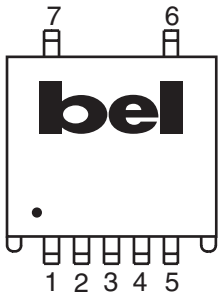
Mechanical

SRAH-08B



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

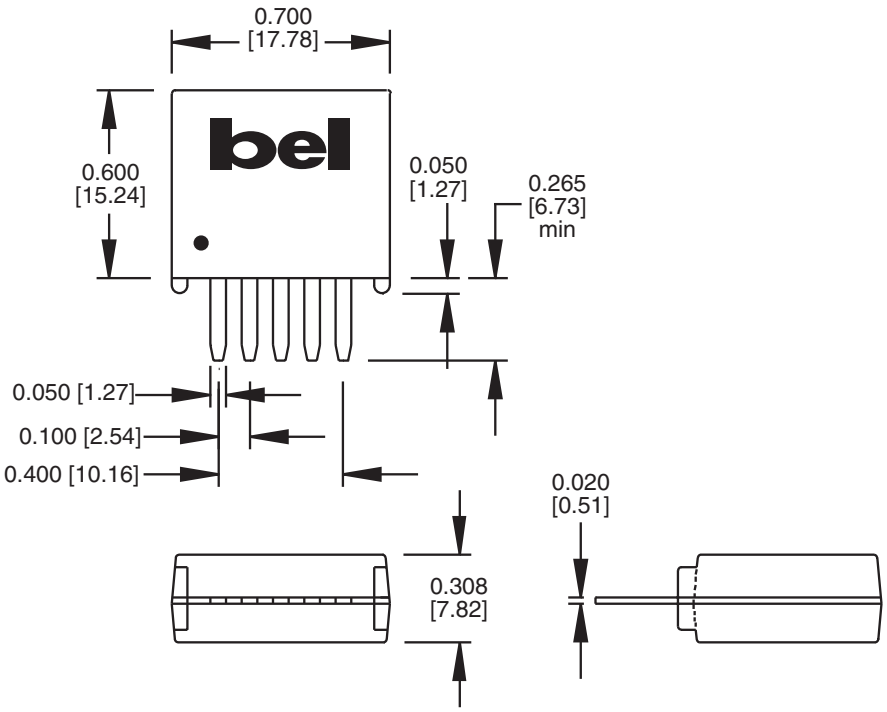
Pin	Function
1	Remote On/Off
2	+Vin
3	Ground
4	+Vo
5	Trim
6	No Connection
7	No Connection



BP06xRAH-08B

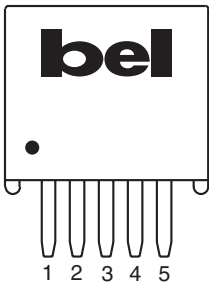
Mechanical

VRAH-08B



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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