

# NON-ISOLATED DC/DC CONVERTERS

## 12V Input / 1.5V – 5.0V Output / 3A



BP02x7AH-03A

### S7AH-03A / V7AH-03A 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 S7AH-03A and V7AH-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%	S7AH-03A500	V7AH-03A500
3.3V	12V	3A	9.9W	90%	S7AH-03A330	V7AH-03A330
2.5V	12V	3A	7.5W	88%	S7AH-03A250	V7AH-03A250
1.8V	12V	3A	5.4W	85%	S7AH-03A180	V7AH-03A180
1.5V	12V	3A	4.5W	84%	S7AH-03A150	V7AH-03A150

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### 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	0		70	°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 <sup>1</sup>	All			30		mA <sub>rms</sub>
Input Reflected Ripple Current (P-P) <sup>1</sup>	All			140		mApk
I <sup>2</sup> t Inrush Current Transient	All			0.005	0.01	A <sup>2</sup> s
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.

# NON-ISOLATED DC/DC CONVERTERS

## 12V Input / 1.5V – 5.0V Output / 3A



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### Output Specifications

Parameter	Module	Symbol	Min	Typical	Max	Units
Output Voltage Set Point <sup>1</sup>	5.0V	Vout	4.920	5.0	5.080	V
	3.3V		3.247	3.3	3.353	
	2.5V		2.460	2.5	2.540	
	1.8V		1.771	1.8	1.829	
	1.5V		1.476	1.5	1.524	
Load Regulation	5.0V			10	16.5	mV
	3.3V			10	16.5	
	2.5V			5	10	
	1.8V			5	10	
	1.5V			5	10	
Line Regulation	5.0V			10	16	mV
	3.3V			5	10	
	2.5V			3	5	
	1.8V			3	5	
	1.5V			3	5	
Regulation Over Temperature	5.0V			20	30	mV
	3.3V			12	25	
	2.5V			8	20	
	1.8V			5	10	
	1.5V			5	10	
Total Output Voltage Regulation	5.0V			40	62.5	mV
	3.3V			27	51.5	
	2.5V			16	35	
	1.8V			13	25	
	1.5V			13	25	
Output Ripple and Noise <sup>2</sup>	All			40	100	mVp-p
Output Ripple and Noise <sup>2</sup>	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 <sup>2</sup> s
Turn on Time	All	Ton		12	20	ms
Overshoot at Turn On <sup>3</sup>	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.

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### Output Specifications

Parameter	Module	Symbol	Min	Typical	Max	Units
<b>Transient Response <sup>4</sup></b>						
$\Delta V$ 50% to 100% of Max Load	5.0V			100	200	mV
Settling Time		Ts		40	80	$\mu s$
$\Delta V$ 100% to 50% of Max Load				100	200	mV
Settling Time		Ts		40	80	$\mu s$
<b>Transient Response <sup>4</sup></b>						
$\Delta V$ 50% to 100% of Max Load	3.3V			80	150	mV
Settling Time		Ts		40	80	$\mu s$
$\Delta V$ 100% to 50% of Max Load				80	150	mV
Settling Time		Ts		40	80	$\mu s$
<b>Transient Response <sup>4</sup></b>						
$\Delta V$ 50% to 100% of Max Load	2.5V			70	100	mV
Settling Time		Ts		40	80	$\mu s$
$\Delta V$ 100% to 50% of Max Load				70	100	mV
Settling Time		Ts		40	80	$\mu s$
<b>Transient Response <sup>4</sup></b>						
$\Delta V$ 50% to 100% of Max Load	1.8V			70	100	mV
Settling Time		Ts		40	80	$\mu s$
$\Delta V$ 100% to 50% of Max Load				70	100	mV
Settling Time		Ts		40	80	$\mu s$
<b>Transient Response <sup>4</sup></b>						
$\Delta V$ 50% to 100% of Max Load	1.5V			70	100	mV
Settling Time		Ts		40	80	$\mu s$
$\Delta V$ 100% to 50% of Max Load				70	100	mV
Settling Time		Ts		40	80	$\mu s$

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

4. di/dt = 0.5A/1 $\mu$ S, Ta = 25° C without external load capacitance.

# NON-ISOLATED DC/DC CONVERTERS

## 12V Input / 1.5V – 5.0V Output / 3A



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### General Specifications

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

1. Vin=12V, full load and Ta=25° C.

2. See graphs on pages 11 - 13.

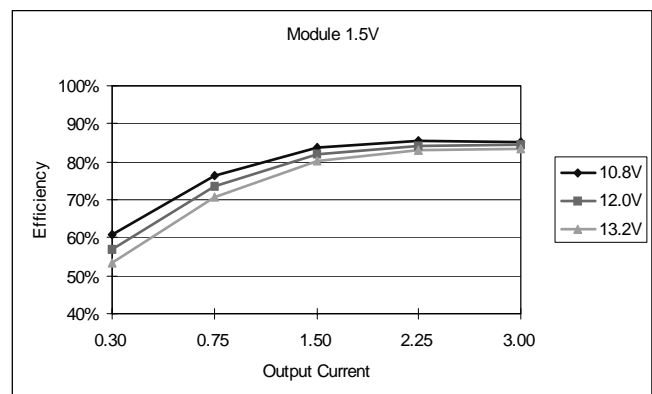
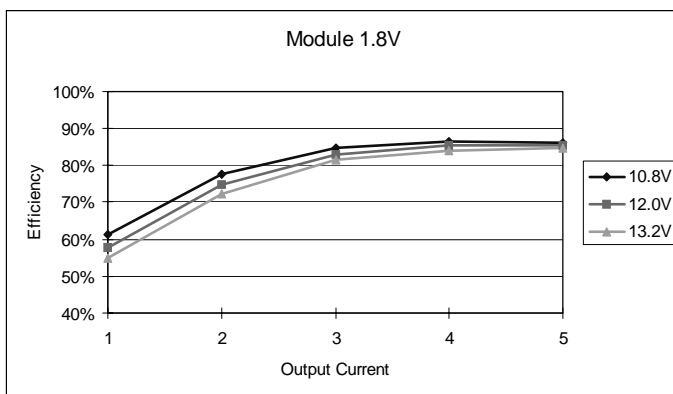
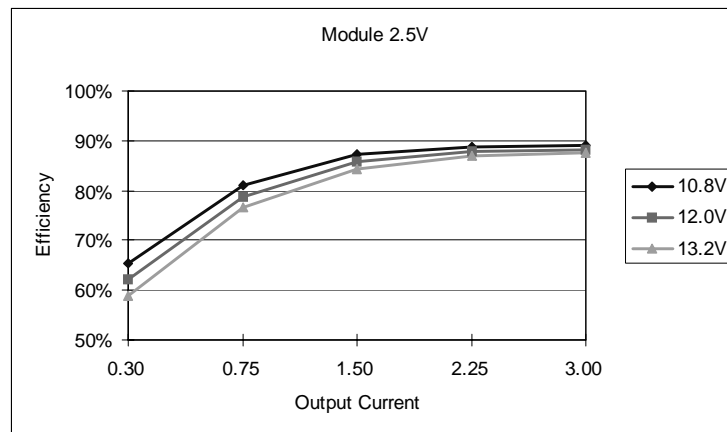
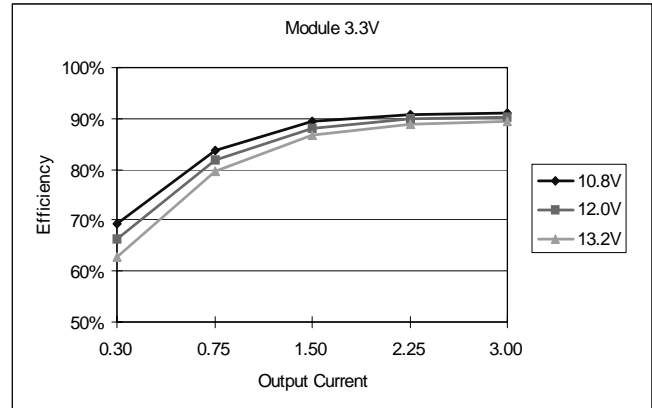
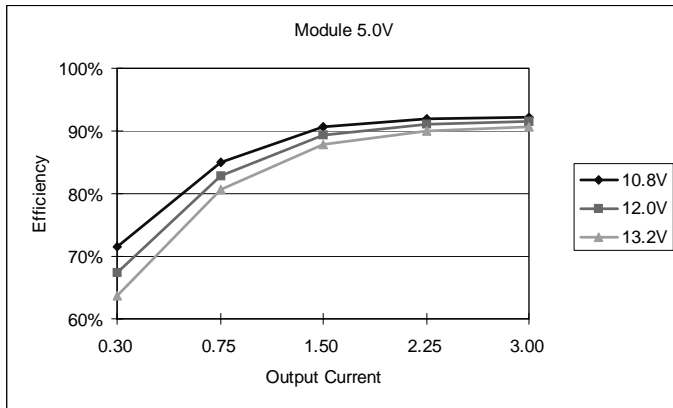
### Control Specifications

Parameter	Module	Symbol	Min	Typical	Max	Units
Remote On/Off <sup>3</sup>	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.

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### Efficiency Data



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

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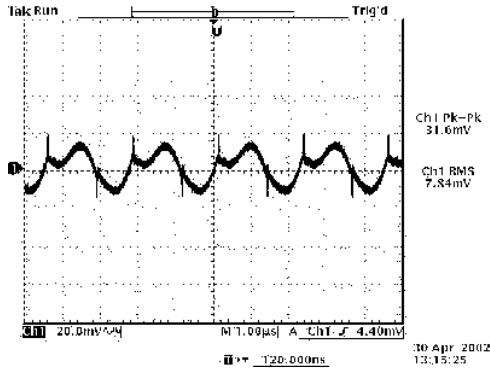
12V Input / 1.5V – 5.0V Output / 3A



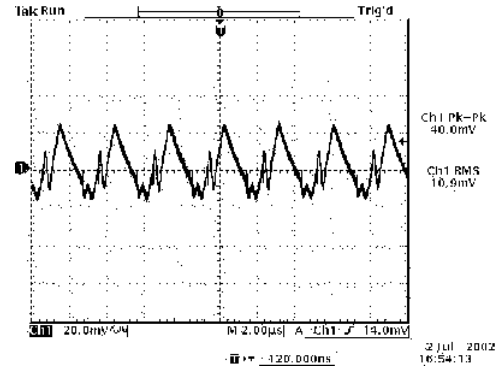
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## Ripple and Noise

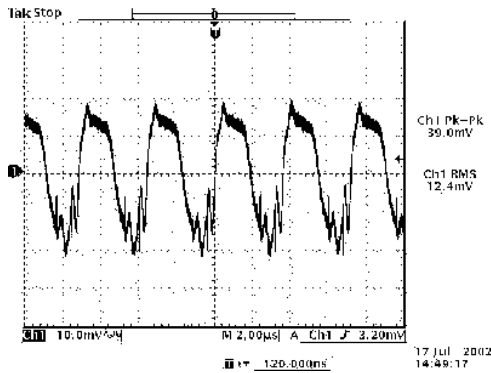
0.1µF ceramic cap added at the output.



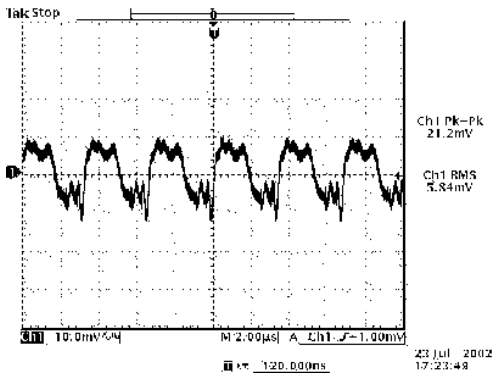
Ripple and noise at full load and 12Vdc input, 5.0Vdc output and Ta=25° C



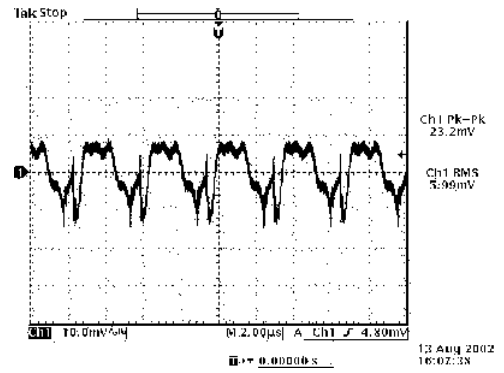
Ripple and noise at full load and 12Vdc input, 3.3Vdc output and Ta=25° C



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

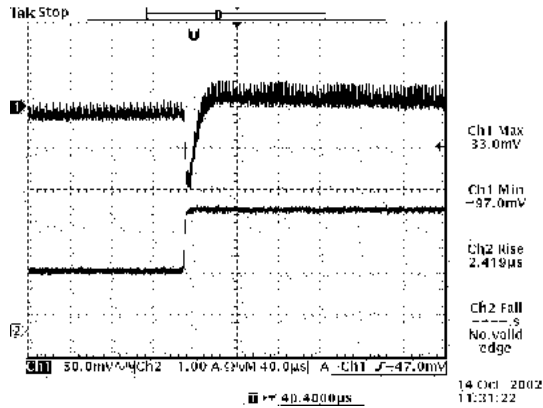


Ripple and noise at full load and 12Vdc input, 1.5Vdc output and Ta=25° C

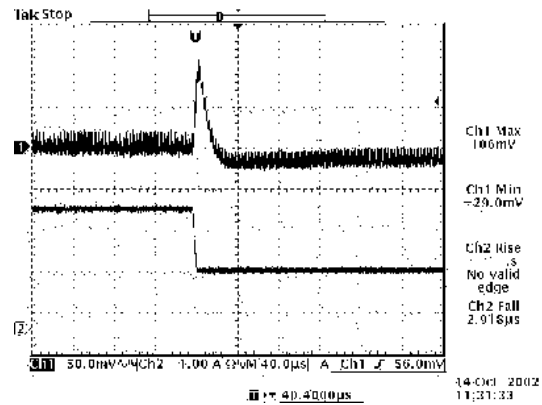
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### Transient Response

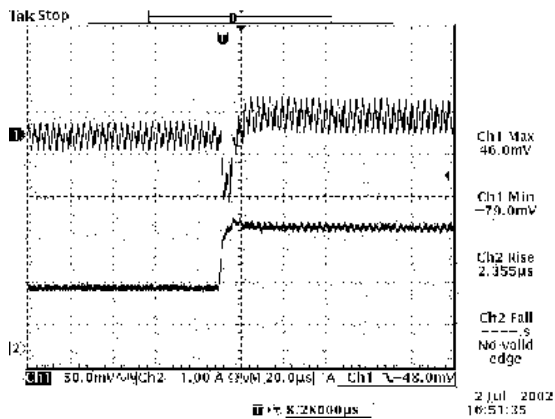
Transient response:  $di/dt = 0.5A/\mu S$ , no external load capacitance



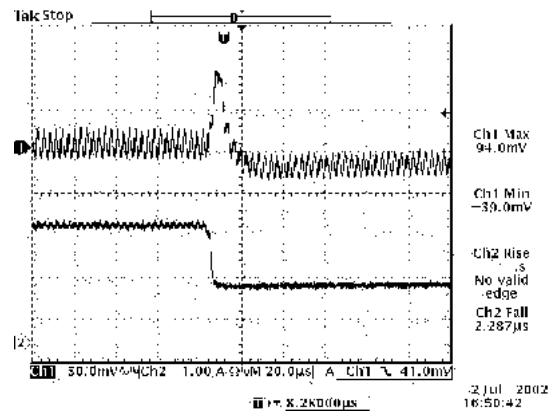
Vout=5.0V  
50% to 100% load transients at 12V input and Ta=25° C



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



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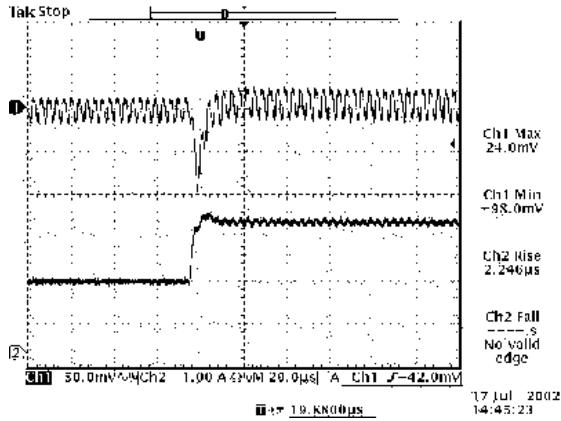
## 12V Input / 1.5V – 5.0V Output / 3A



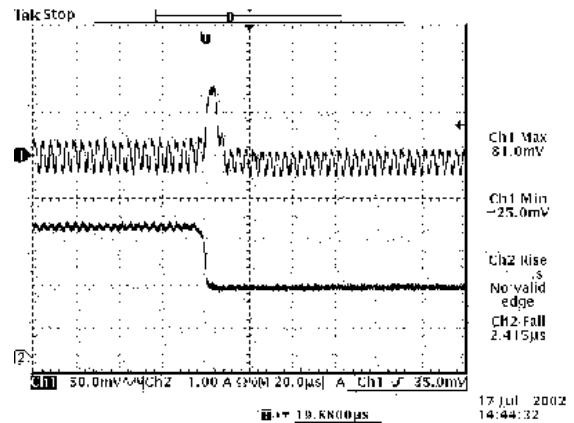
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### Transient Response

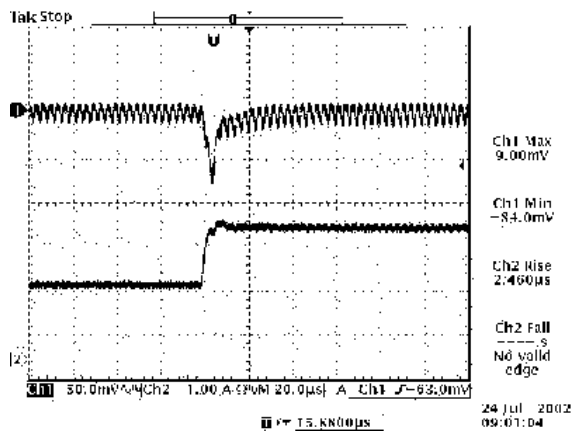
Transient response:  $di/dt = 0.5A/\mu S$ , no external load capacitance



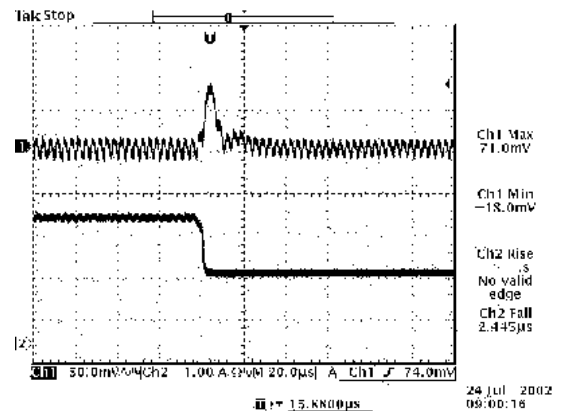
Vout=2.5V  
50% to 100% load transients at 12V input and Ta=25° C



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

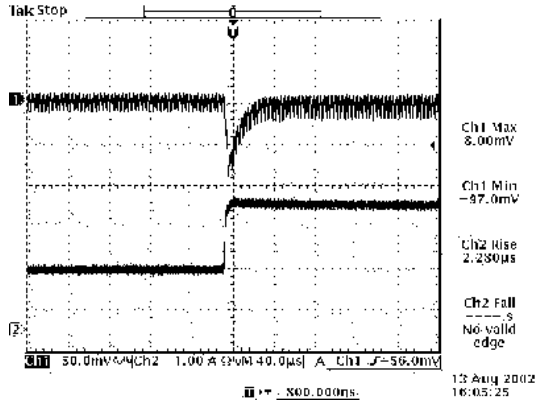


Vout=1.8V  
100% to 50% load transients at 12V input and Ta=25° C

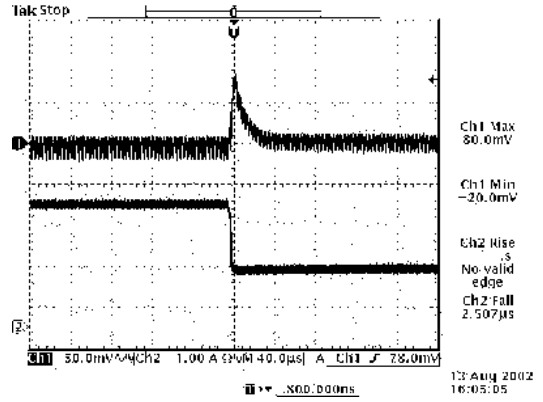
BP02x7AH-03A

### Transient Response

Transient response:  $di/dt = 0.5A/\mu S$ , no external load capacitance



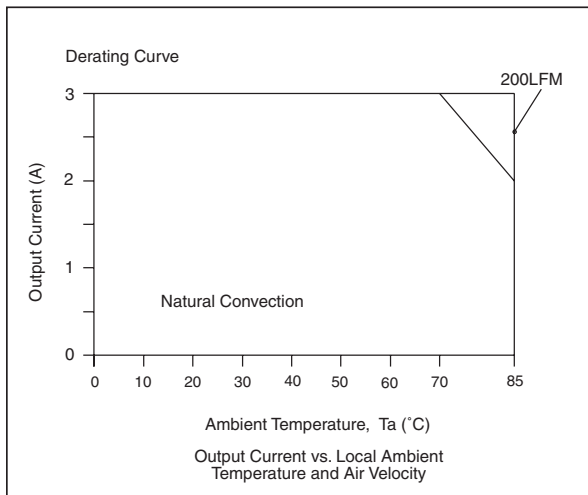
Vout=1.5V  
50% to 100% load transients at 12V input and Ta=25° C



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

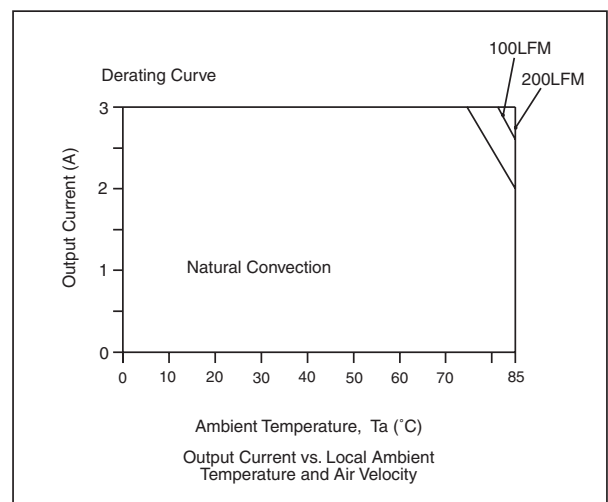
### Thermal Considerations

x7AH-03A500



x7AH-03A150  
x7AH-03A180

x7AH-03A250  
x7AH-03A330



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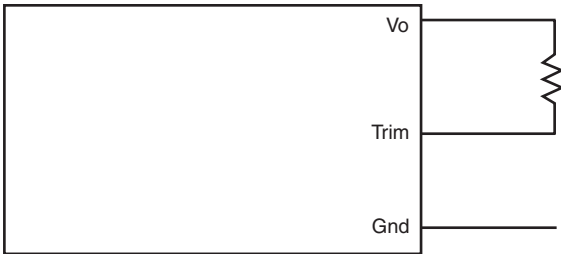
12V Input / 1.5V – 5.0V Output / 3A



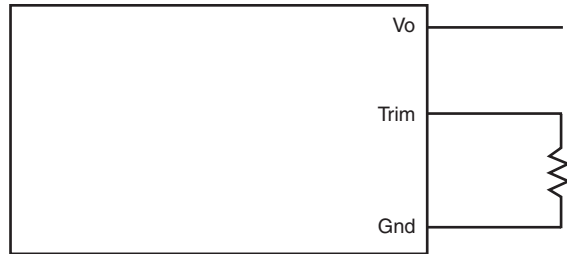
BP02x7AH-03A

## Output Voltage Set-Point Adjustment

Trim Down Test Circuit



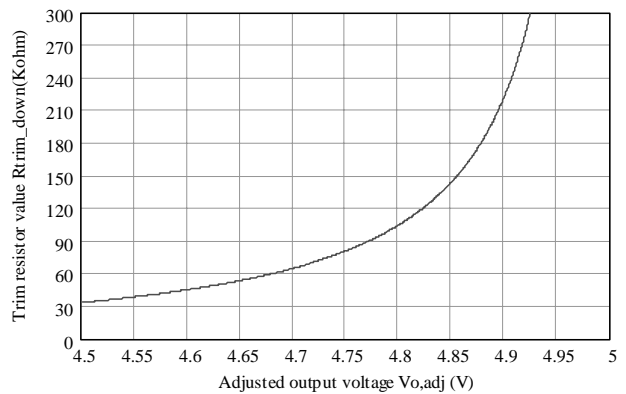
Trim Up Test Circuit



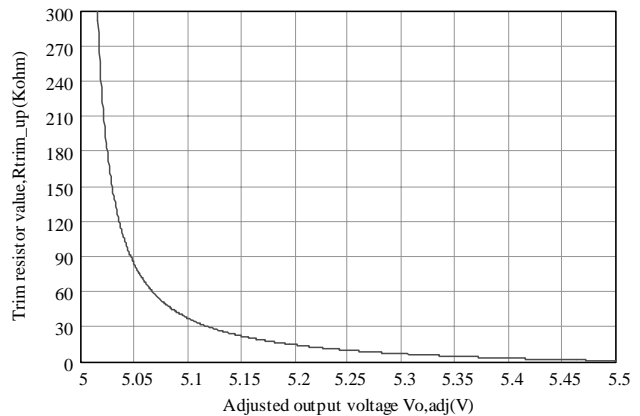
## Output Voltage Set-Point Adjustment

### x7AH-03A500 Trim Resistor Calculation

$$R_{\text{trim down}} = \left( \frac{23.703}{V_o - V_{o, \text{adj}}} - 13.87 \right) \text{ Kohm}$$



$$R_{\text{trim up}} = \left( \frac{4.496}{V_{o, \text{adj}} - V_o} - 8.25 \right) \text{ Kohm}$$

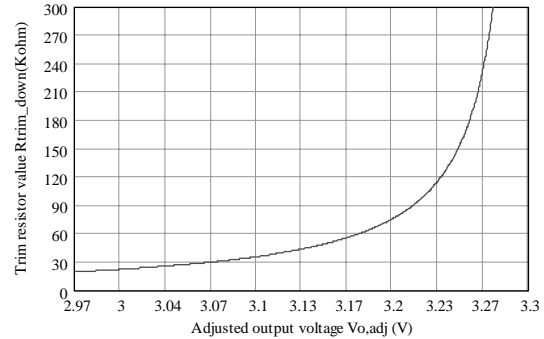


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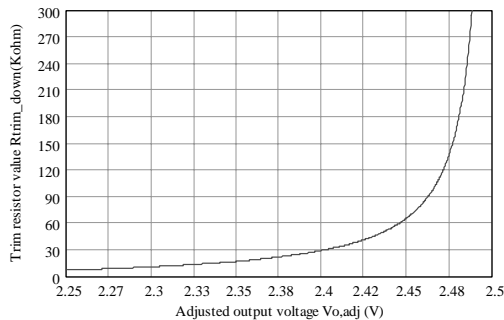
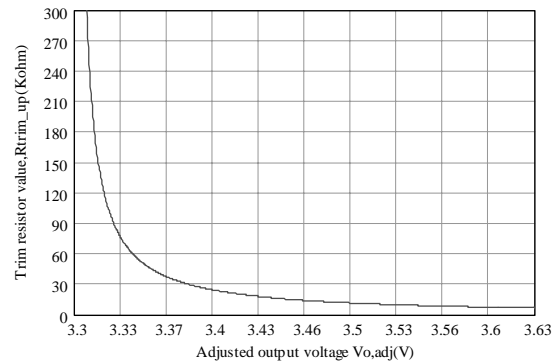
### Output Voltage Set-Point Adjustment

#### x7AH-03A330 Trim Resistor Calculation

$$R_{\text{trim down}} = \left( \frac{7.92}{V_o - V_{o, \text{adj}}} - 4.38 \right) \text{ Kohm}$$

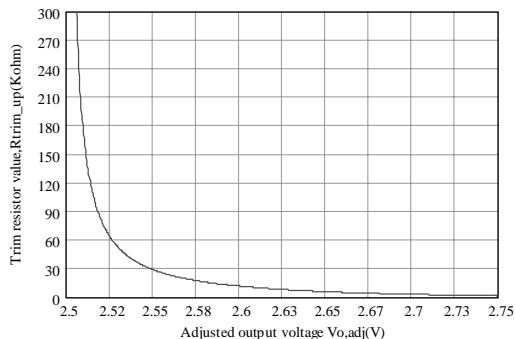


$$R_{\text{trim up}} = \left( \frac{2.536}{V_{o, \text{adj}} - V_o} - 1.21 \right) \text{ Kohm}$$



#### x7AH-03A250 Trim Resistor Calculation

$$R_{\text{trim down}} = \left( \frac{3.694}{V_o - V_{o, \text{adj}}} - 7.77 \right) \text{ Kohm}$$



$$R_{\text{trim up}} = \left( \frac{1.72}{V_{o, \text{adj}} - V_o} - 5.62 \right) \text{ Kohm}$$

# NON-ISOLATED DC/DC CONVERTERS

12V Input / 1.5V – 5.0V Output / 3A

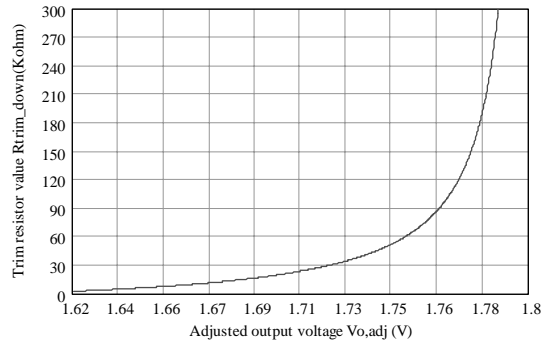


BP02x7AH-03A

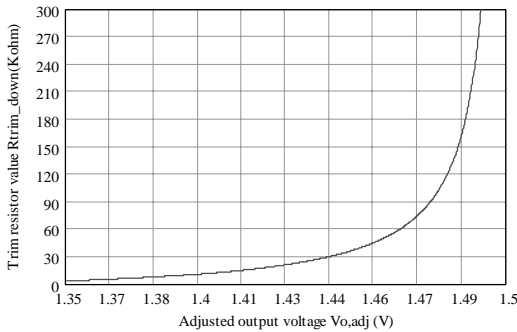
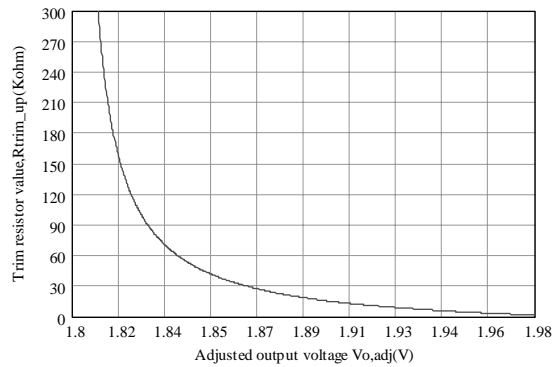
## Output Voltage Set-Point Adjustment

### x7AH-03A180 Trim Resistor Calculation

$$R_{\text{trim down}} = \left( \frac{3.849}{V_o - V_{o, \text{adj}}} - 19.23 \right) \text{ Kohm}$$

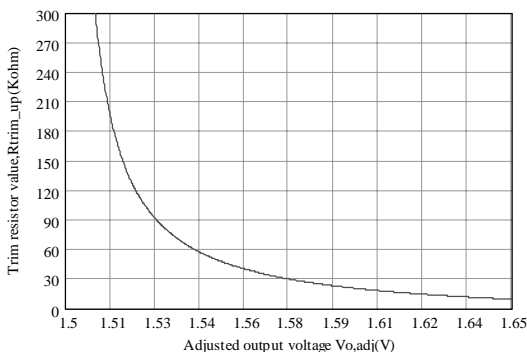


$$R_{\text{trim up}} = \left( \frac{3.064}{V_{o, \text{adj}} - V_o} - 15.4 \right) \text{ Kohm}$$



### x7AH-03A150 Trim Resistor Calculation

$$R_{\text{trim down}} = \left( \frac{2.698}{V_o - V_{o, \text{adj}}} - 14.83 \right) \text{ Kohm}$$

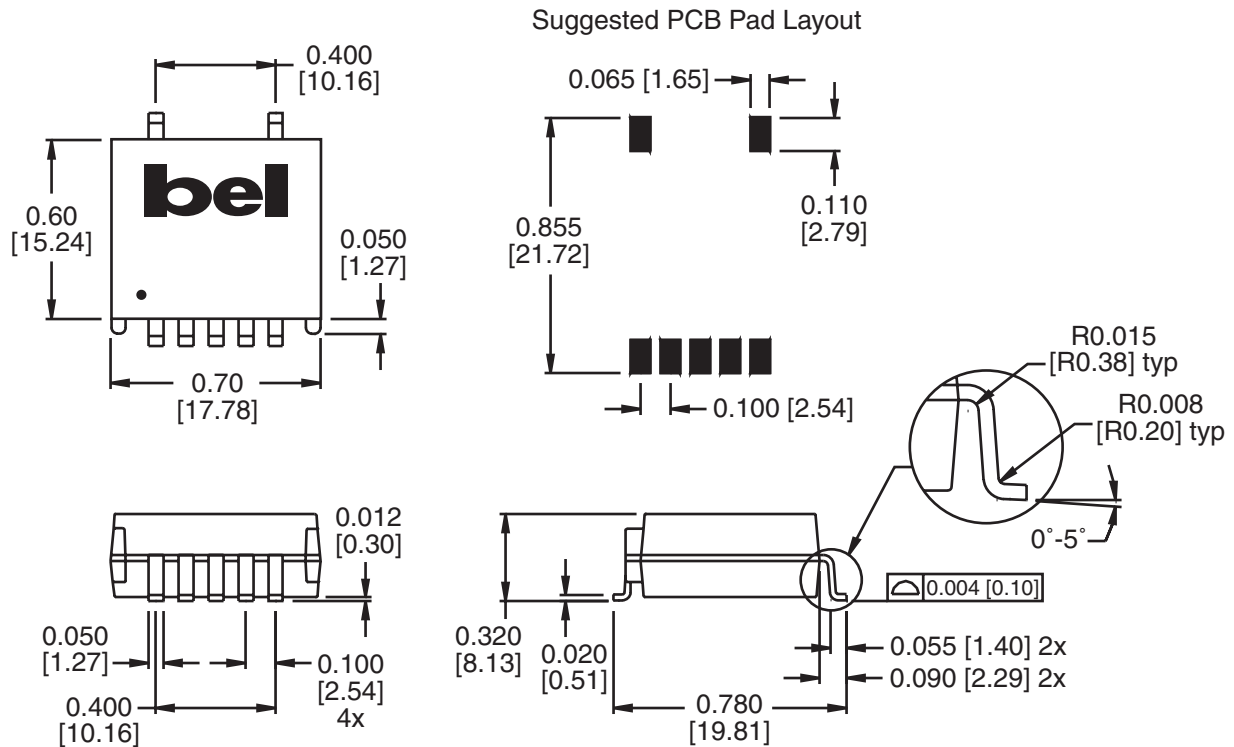


$$R_{\text{trim up}} = \left( \frac{3.064}{V_{o, \text{adj}} - V_o} - 11 \right) \text{ Kohm}$$

BP02x7AH-03A

### Mechanical

S7AH-03A



Dimensions are in inches [millimeters].  
Standard dimension tolerance is  $\pm 0.005$  [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



# NON-ISOLATED DC/DC CONVERTERS

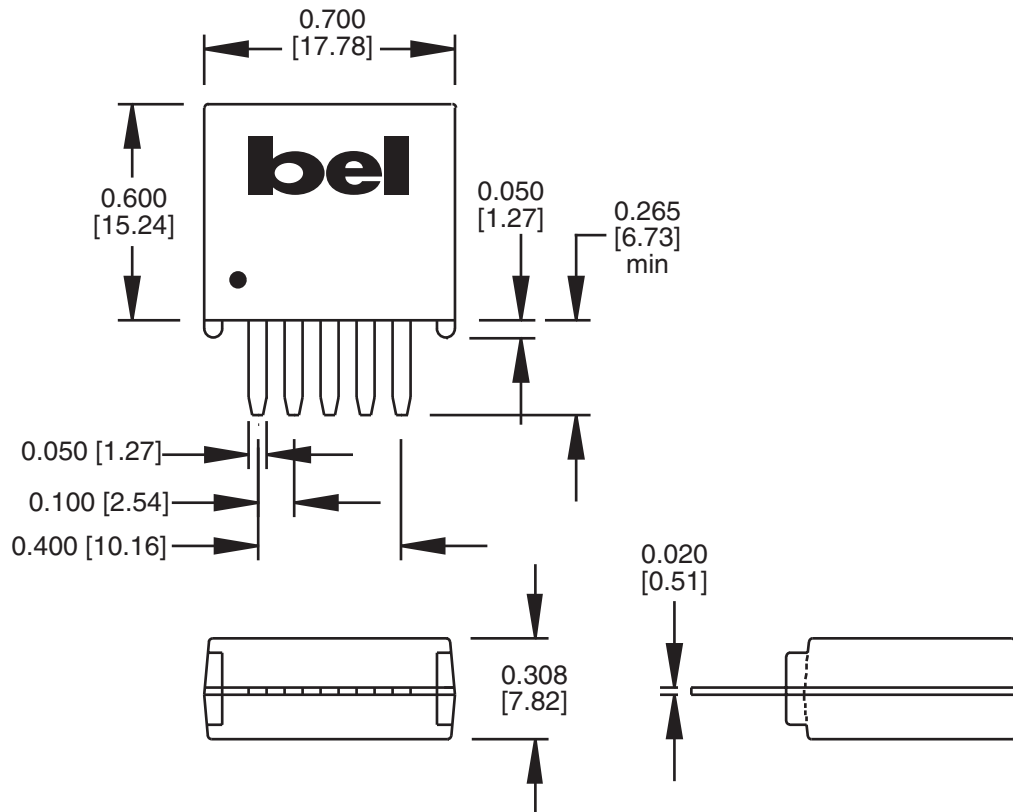
12V Input / 1.5V – 5.0V Output / 3A



BP02x7AH-03A

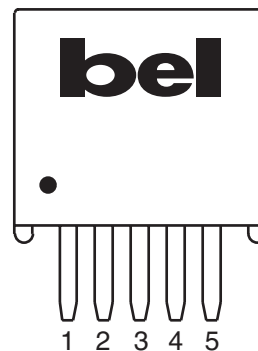
## Mechanical

V7AH-03A



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

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



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