

## NON-ISOLATED DC/DC CONVERTERS

4.5V – 13.2V Input / 1.0V – 5.0V Output / 10A



BP05SRDB-10E

### SRDB-10E Series

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

### Description

The Bel SRDB-10E modules are a series of non-isolated, step down DC/DC power converters that operate from a nominal 4.5V to 13.2V source. These converters are available in a range of output voltages from 1.0V to 5.0V. The output is closely regulated and the efficiency of the 3.3V output module is typically 88% at full load. The modules are packaged in a compact, low profile, surface mount DIP package for ease of layout and space savings. 10A maximum output is also provided. Standard features include remote on/off, remote sense, over current and short circuit protection, UVLO and output voltage adjust. These products may be used almost anywhere low voltage silicon is employed and a 4.5V to 13.2V 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 Active Low | Part Number Active High |
|----------------|---------------|---------------------|-------------------|--------------------|------------------------|-------------------------|
| 5.0V           | 8V - 13.2V    | 10A                 | 50W               | 91%                | SRDB-10E500            | SRDB-10E50H             |
| 3.3V           | 4.5V - 13.2V  | 10A                 | 33W               | 88%                | SRDB-10E330            | SRDB-10E33H             |
| 2.5V           | 4.5V - 13.2V  | 10A                 | 25W               | 86%                | SRDB-10E250            | SRDB-10E25H             |
| 1.8V           | 4.5V - 13.2V  | 10A                 | 18W               | 82%                | SRDB-10E180            | SRDB-10E18H             |
| 1.5V           | 4.5V - 13.2V  | 10A                 | 15W               | 80%                | SRDB-10E150            | SRDB-10E15H             |
| 1.2V           | 4.5V - 13.2V  | 10A                 | 12W               | 77%                | SRDB-10E120            | SRDB-10E12H             |
| 1.0V           | 4.5V - 13.2V  | 10A                 | 10W               | 75%                | SRDB-10E100            | SRDB-10E10H             |

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## Absolute Maximum Ratings

| Parameter                      | Symbol | Min  | Typical | Max | Unit |
|--------------------------------|--------|------|---------|-----|------|
| Continuous Input Voltage       | Vin    | -0.3 |         | 16  | V    |
| Output Enable Terminal Voltage | Vouten | -0.5 |         | 7   | V    |
| Ambient Temperature            | Tamb   | 0    |         | 70  | °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                           | 1.0V - 3.3V<br>5.0V                                  | Vin    | 4.5<br>8 |         | 13.2<br>13.2                                | V                 |
| Input Current                                     | 5.0V<br>3.3V<br>2.5V<br>1.8V<br>1.5V<br>1.2V<br>1.0V | Iin    |          |         | 7.9<br>9.1<br>7.4<br>5.6<br>4.8<br>4<br>3.4 | A                 |
| No Load Input Current                             | Vin = 4.5V                                           | Iin    |          | 60      |                                             | mA                |
| No Load Input Current                             | Vin = 8.0V                                           | Iin    |          | 80      |                                             | mA                |
| No Load Input Current                             | Vin = 13.2V                                          | Iin    |          | 100     |                                             | mA                |
| Input Reflected Ripple Current <sup>1</sup>       | All                                                  |        |          | 40      | 80                                          | mA <sub>rms</sub> |
| Input Reflected Ripple Current (P-P) <sup>1</sup> | All                                                  |        |          | 120     | 200                                         | mApk              |
| I <sup>2</sup> t Inrush Current Transient         | All                                                  |        |          | 0.1     | 0.2                                         | A <sup>2</sup> s  |
| Turn On Voltage Threshold                         | All                                                  |        |          | 4       | 4.5                                         | V                 |
| Turn Off Voltage Threshold                        | All                                                  |        |          | 3.5     | 4.2                                         | V                 |

Note: Input capacitance two 270μF/16V, ESR = 0.018 Ω max at 100kHz @ 25° C.

1. With simulated source impedance of 500nH, 5Hz to 20MHz.

# NON-ISOLATED DC/DC CONVERTERS

4.5V – 13.2V Input / 1.0V – 5.0V Output / 10A



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## Output Specifications

| Parameter                             | Module | Symbol    | Min   | Typical | Max   | Units            |
|---------------------------------------|--------|-----------|-------|---------|-------|------------------|
| Output Voltage Set Point <sup>1</sup> | 5.0V   | Vout      | 4.900 | 5.0     | 5.100 | V                |
|                                       | 3.3V   |           | 3.234 | 3.3     | 3.366 |                  |
|                                       | 2.5V   |           | 2.450 | 2.5     | 2.550 |                  |
|                                       | 1.8V   |           | 1.764 | 1.8     | 1.836 |                  |
|                                       | 1.5V   |           | 1.470 | 1.5     | 1.530 |                  |
|                                       | 1.2V   |           | 1.176 | 1.2     | 1.224 |                  |
|                                       | 1.0V   |           | 0.980 | 1.0     | 1.020 |                  |
| Load Regulation                       | 5.0V   |           |       | 10      | 20    | mV               |
|                                       | 3.3V   |           |       | 7       | 14    |                  |
|                                       | 2.5V   |           |       | 6       | 12    |                  |
|                                       | 1.8V   |           |       | 6       | 12    |                  |
|                                       | 1.5V   |           |       | 6       | 12    |                  |
|                                       | 1.2V   |           |       | 5       | 10    |                  |
|                                       | 1.0V   |           |       | 5       | 10    |                  |
| Line Regulation                       | 5.0V   |           |       | 3       | 6     | mV               |
|                                       | 3.3V   |           |       | 3       | 6     |                  |
|                                       | 2.5V   |           |       | 2       | 5     |                  |
|                                       | 1.8V   |           |       | 2       | 5     |                  |
|                                       | 1.5V   |           |       | 2       | 5     |                  |
|                                       | 1.2V   |           |       | 2       | 5     |                  |
|                                       | 1.0V   |           |       | 2       | 5     |                  |
| Regulation Over Temperature           | 5.0V   |           |       | 30      | 60    | mV               |
|                                       | 3.3V   |           |       | 24      | 48    |                  |
|                                       | 2.5V   |           |       | 22      | 44    |                  |
|                                       | 1.8V   |           |       | 20      | 40    |                  |
|                                       | 1.5V   |           |       | 18      | 36    |                  |
|                                       | 1.2V   |           |       | 16      | 32    |                  |
|                                       | 1.0V   |           |       | 14      | 28    |                  |
| Total Output Voltage Regulation       | 5.0V   |           |       | 43      | 86    | mV               |
|                                       | 3.3V   |           |       | 34      | 68    |                  |
|                                       | 2.5V   |           |       | 30      | 61    |                  |
|                                       | 1.8V   |           |       | 28      | 57    |                  |
|                                       | 1.5V   |           |       | 26      | 53    |                  |
|                                       | 1.2V   |           |       | 23      | 47    |                  |
|                                       | 1.0V   |           |       | 21      | 43    |                  |
| Output Ripple and Noise <sup>2</sup>  | All    |           |       | 50      | 100   | mVp-p            |
| Output Ripple and Noise <sup>2</sup>  | All    |           |       | 15      | 30    | mVrms            |
| Output Current Range                  | All    | Iout      | 0     |         | 10    | A                |
| Output DC Current Limit               | All    | Ioutlim   | 12    |         | 25    | A                |
| Short Circuit Surge                   | All    | Ioutsurge |       | 0.1     | 0.2   | A <sup>2</sup> s |
| Turn on Time                          | All    | Ton       |       |         | 20    | ms               |
| Overshoot at Turn On                  | All    |           |       | 0       | 3%    | V                |
| Output Capacitance                    | All    | Cout      | 0     |         | 4000  | μF               |

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

1. Vin = 8V, Iout = full load, Ta = 25° C.

2. Two 270μF/16V with ESR = 0.018 Ω max at input, 0 - 20MHz BW, 1μF ceramic cap and 10μF aluminum cap at output.

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## Output Specifications

| Parameter                       | Module                             | Symbol | Min | Typical | Max | Units |
|---------------------------------|------------------------------------|--------|-----|---------|-----|-------|
| Transient Response <sup>3</sup> |                                    |        |     |         |     |       |
| ΔV 50% to 100% of Max Load      | 8V to 13.2V Input<br>5V Output     |        |     | 120     | 200 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| ΔV 100% to 50% of Max Load      |                                    |        |     | 120     | 200 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| Transient Response <sup>3</sup> |                                    |        |     |         |     |       |
| ΔV 50% to 100% of Max Load      | 4.5V to 13.2V Input<br>3.3V Output |        |     | 90      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| ΔV 100% to 50% of Max Load      |                                    |        |     | 90      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| Transient Response <sup>3</sup> |                                    |        |     |         |     |       |
| ΔV 50% to 100% of Max Load      | 4.5V to 13.2V Input<br>2.5V Output |        |     | 80      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| ΔV 100% to 50% of Max Load      |                                    |        |     | 80      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| Transient Response <sup>3</sup> |                                    |        |     |         |     |       |
| ΔV 50% to 100% of Max Load      | 4.5V to 13.2V Input<br>1.8V Output |        |     | 80      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| ΔV 100% to 50% of Max Load      |                                    |        |     | 80      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| Transient Response <sup>3</sup> |                                    |        |     |         |     |       |
| ΔV 50% to 100% of Max Load      | 4.5V to 13.2V Input<br>1.5V Output |        |     | 80      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| ΔV 100% to 50% of Max Load      |                                    |        |     | 80      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| Transient Response <sup>3</sup> |                                    |        |     |         |     |       |
| ΔV 50% to 100% of Max Load      | 4.5V to 13.2V Input<br>1.2V Output |        |     | 80      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| ΔV 100% to 50% of Max Load      |                                    |        |     | 80      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| Transient Response <sup>3</sup> |                                    |        |     |         |     |       |
| ΔV 50% to 100% of Max Load      | 4.5V to 13.2V Input<br>1.0V Output |        |     | 80      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |
| ΔV 100% to 50% of Max Load      |                                    |        |     | 80      | 150 | mV    |
| Settling Time                   |                                    | Ts     |     | 60      | 100 | μs    |

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

3. di/dt = 0.5A/ $\mu s$ , Ta = 25° C with external 220 $\mu F$  Tan cap.

# NON-ISOLATED DC/DC CONVERTERS

## 4.5V – 13.2V Input / 1.0V – 5.0V Output / 10A



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## General Specifications

| Parameter                                         | Module                                               | Symbol | Min                                    | Typical                                | Max | Units |
|---------------------------------------------------|------------------------------------------------------|--------|----------------------------------------|----------------------------------------|-----|-------|
| Efficiency <sup>1</sup><br>Vin = 12V, Io = Io max | 5.0V<br>3.3V<br>2.5V<br>1.8V<br>1.5V<br>1.2V<br>1.0V | $\eta$ | 88<br>85<br>83<br>79<br>77<br>74<br>72 | 91<br>88<br>86<br>82<br>80<br>77<br>75 |     | %     |
| Switching Frequency                               | All                                                  | Fsw    | 250                                    | 310                                    | 370 | kHz   |
| Output Voltage Trim Range <sup>2</sup>            | All                                                  |        | 90                                     |                                        | 110 | %     |
| Remote Sense Compensation                         | All                                                  |        |                                        |                                        | 10  | %     |
| Weight                                            | All                                                  |        |                                        | 10.5                                   |     | g     |

1. Vin=12V, full load and Ta=25° C.

2. See graphs on pages 13 - 16.

Note: For 3.3V output module, when the input voltage is between 4.5Vdc to 5.0Vdc, the output voltage trim range is 90%-105%, and the remote sense compensation is 5%.

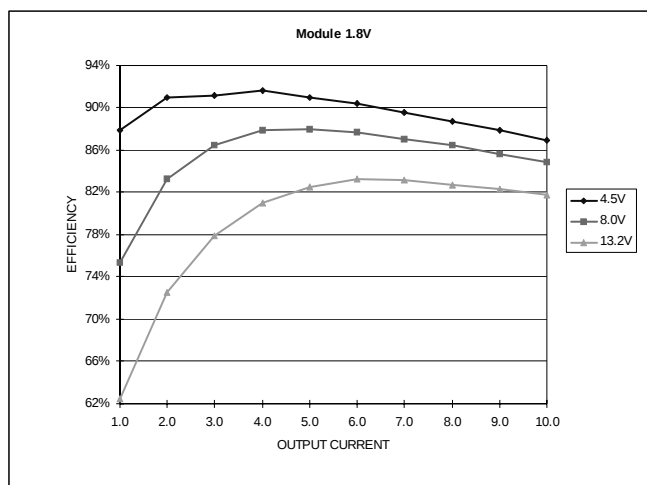
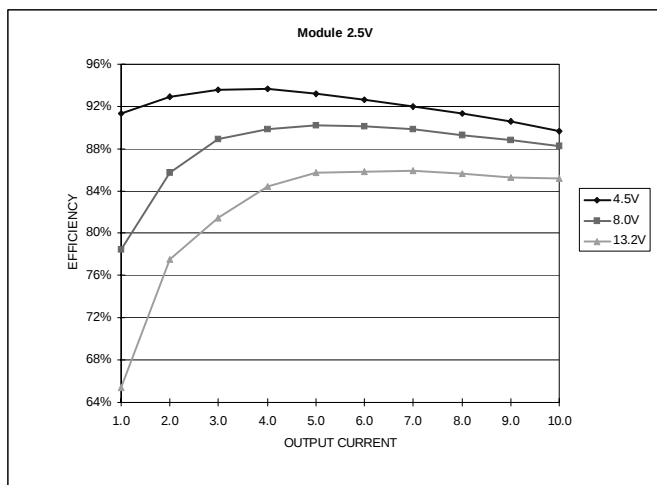
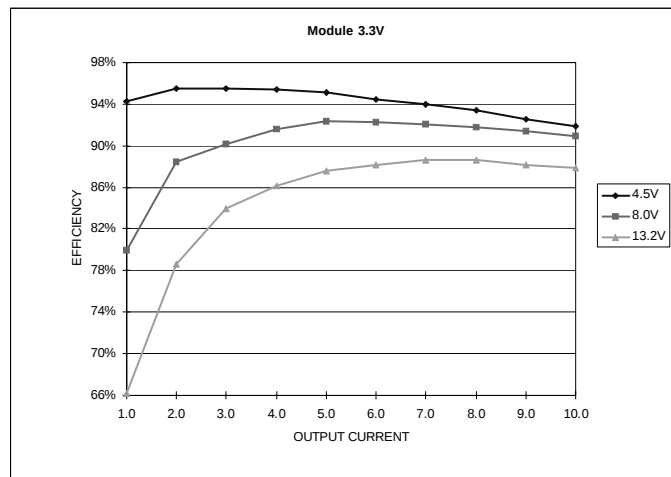
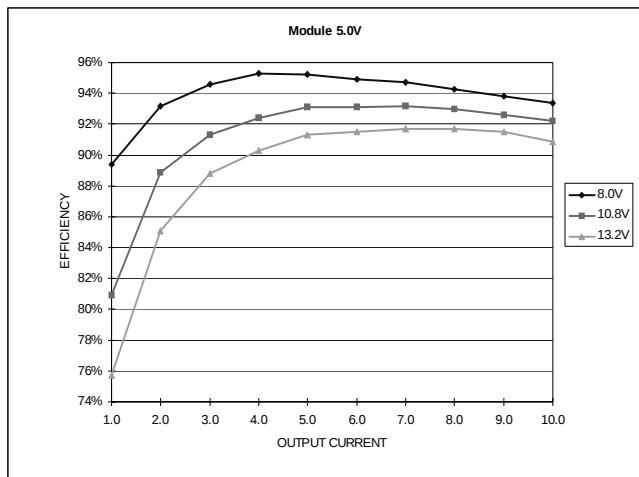
## Control Specifications

| Parameter                  | Module      | Symbol | Min | Typical | Max | Units |
|----------------------------|-------------|--------|-----|---------|-----|-------|
| Remote On/Off <sup>3</sup> | All         | Vouten |     |         |     | V     |
| Signal Low (Unit Off)      | S7DB-10ExxH |        | 0   |         | 0.9 | V     |
| Signal High (Unit On)      |             |        | 2.1 |         | 5   | V     |
| Signal Low (Unit On)       | S7DB-10Exx0 |        | 0   |         | 0.9 | V     |
| Signal High (Unit Off)     |             |        | 2.1 |         | 5   | V     |

3. With remote on/off pin 8 open, the module is on.

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### Efficiency Data



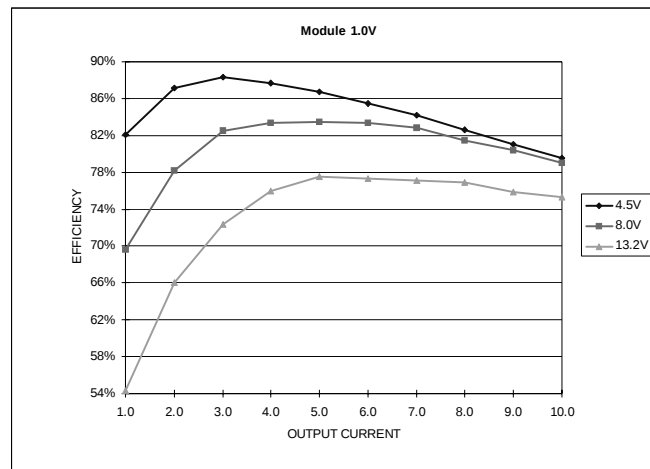
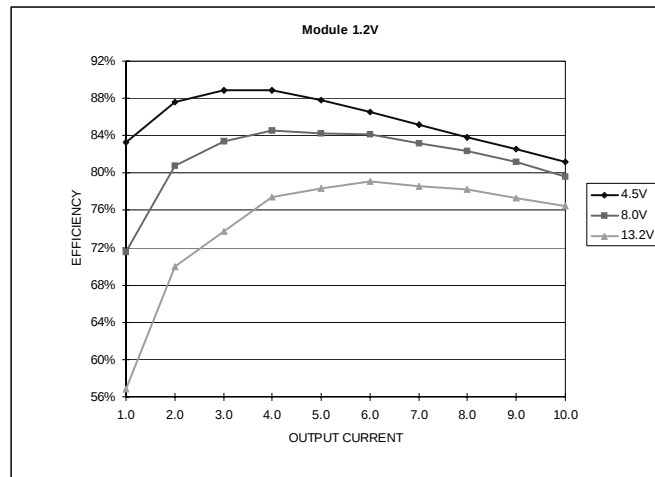
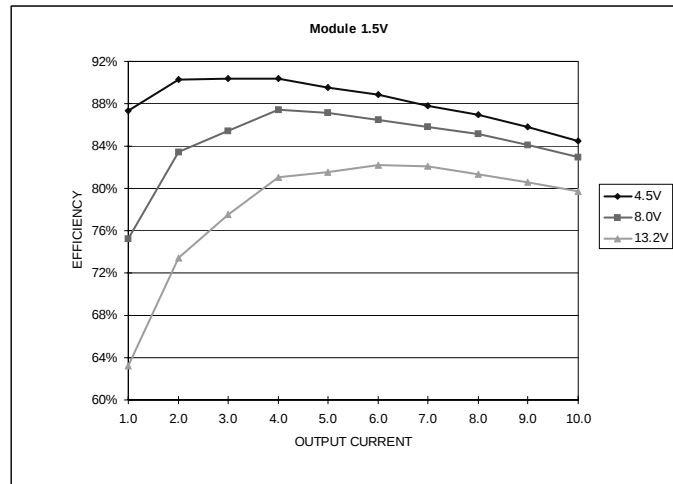
# NON-ISOLATED DC/DC CONVERTERS

4.5V – 13.2V Input / 1.0V – 5.0V Output / 10A



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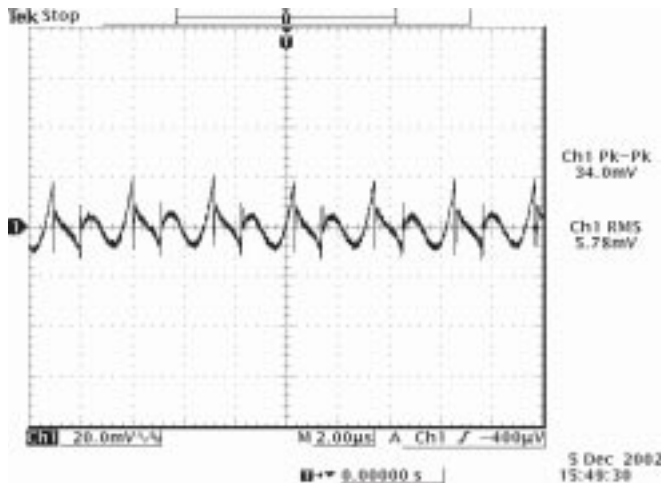
## Efficiency Data



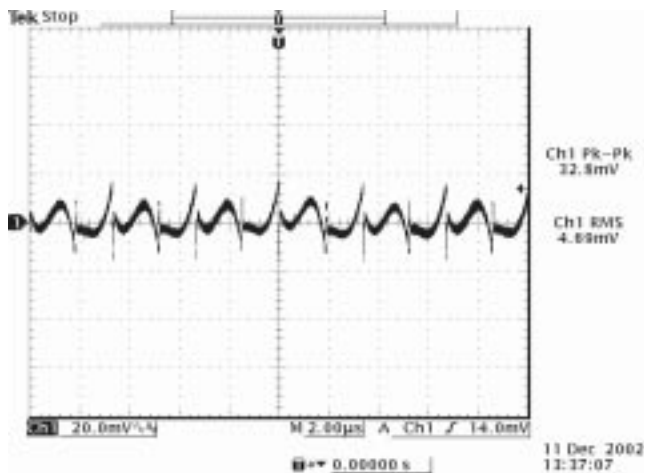
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### Ripple and Noise

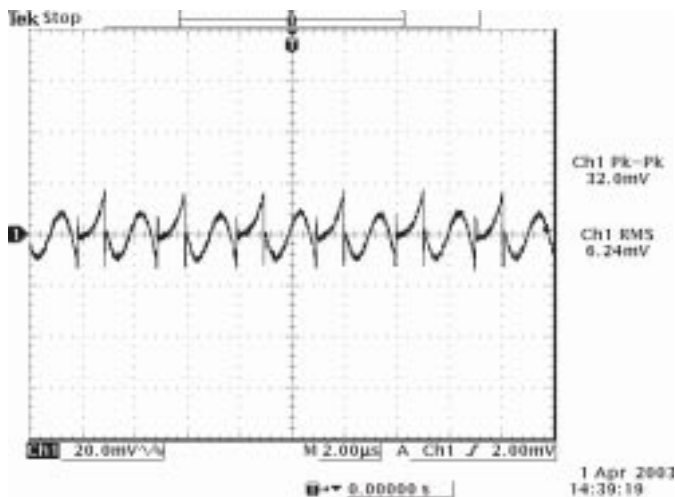
1 $\mu$ F ceramic cap and 10 $\mu$ F aluminum electrolytic cap added at the output.



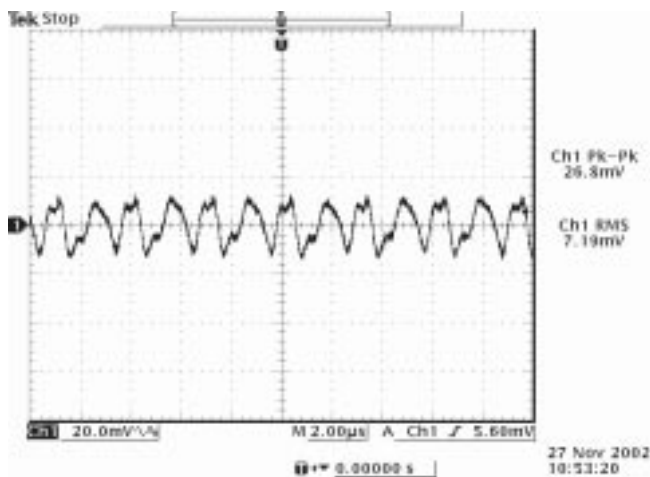
Ripple and noise at full load and 8Vdc input, 5.0Vdc output and Ta=25° C



Ripple and noise at full load and 8Vdc input, 3.3Vdc output and Ta=25° C



Ripple and noise at full load and 8Vdc input, 2.5Vdc output and Ta=25° C



Ripple and noise at full load and 8Vdc input, 1.8Vdc output and Ta=25° C

# NON-ISOLATED DC/DC CONVERTERS

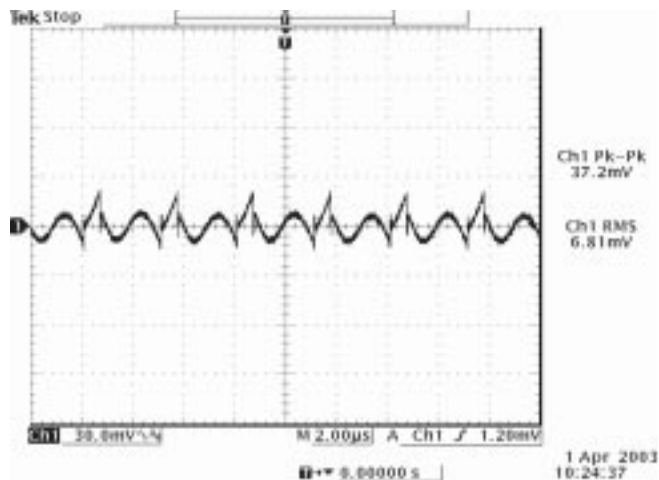
4.5V – 13.2V Input / 1.0V – 5.0V Output / 10A



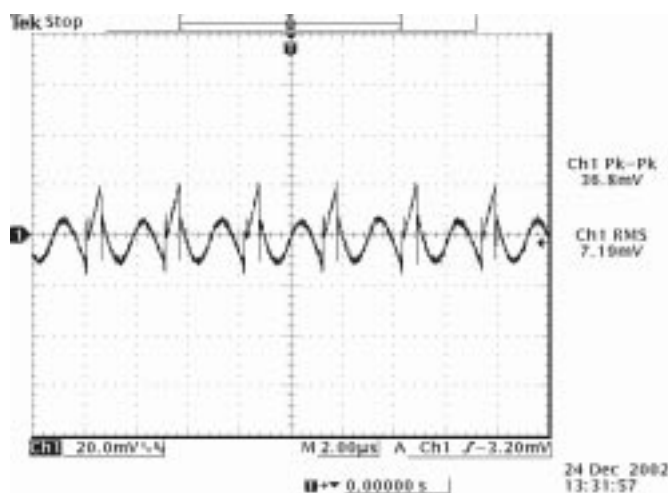
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## Ripple and Noise

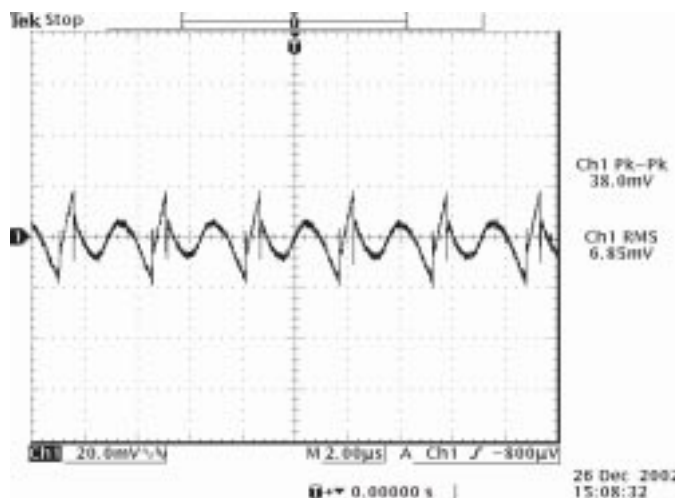
1 $\mu$ F ceramic cap and 10 $\mu$ F aluminum electrolytic cap added at the output.



Ripple and noise at full load and 8Vdc input, 1.5Vdc output and Ta=25° C



Ripple and noise at full load and 8Vdc input, 1.2Vdc output and Ta=25° C

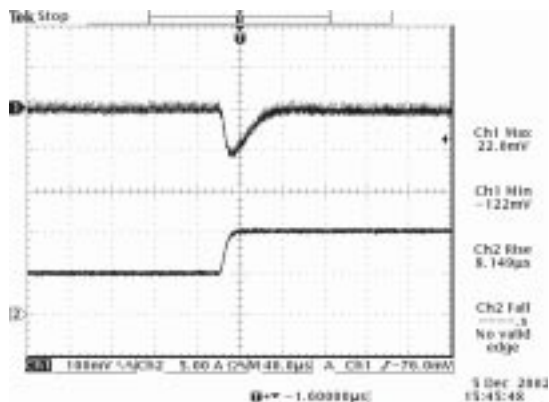


Ripple and noise at full load and 8Vdc input, 1.0Vdc output and Ta=25° C

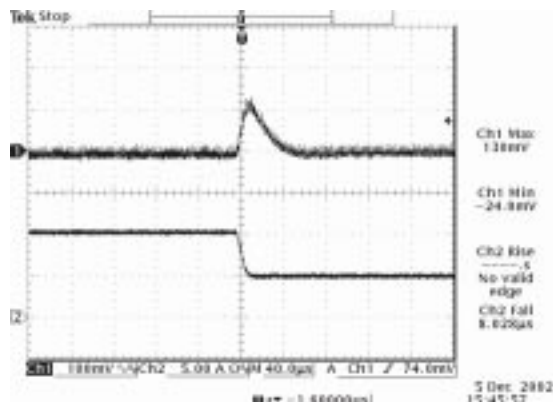
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### Transient Response

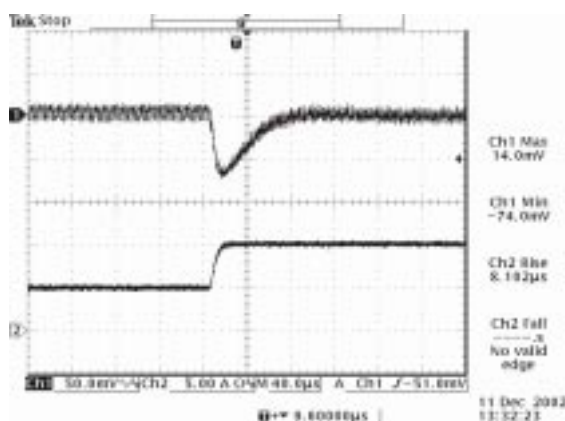
Transient response:  $di/dt = 0.5A/\mu S$ , with external 220 $\mu F$  Tan capacitor.



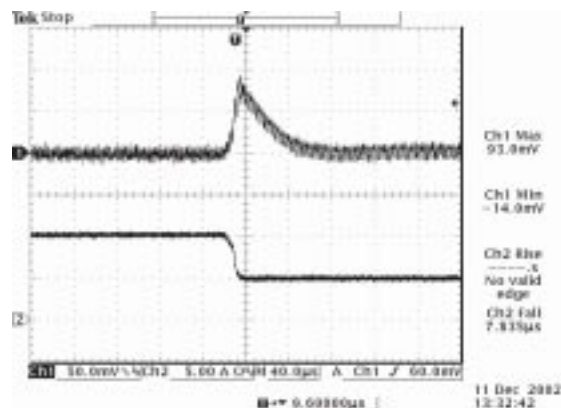
Vout=5.0V  
50% to 100% load transients at 8V input and Ta=25° C



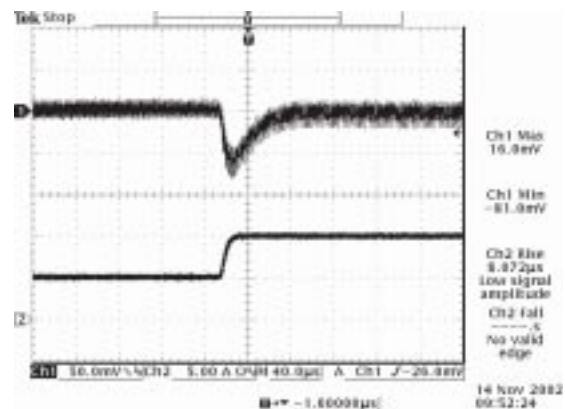
Vout=5.0V  
100% to 50% load transients at 8V input and Ta=25° C



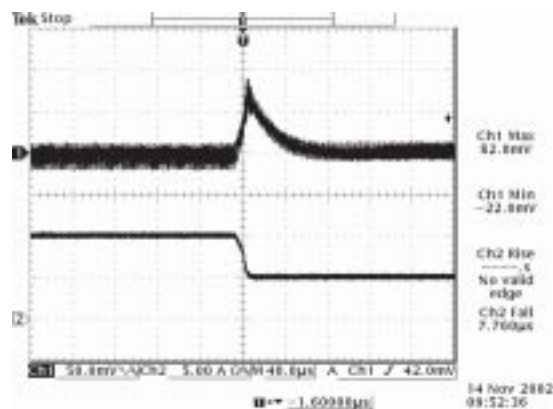
Vout=3.3V  
50% to 100% load transients at 8V input and Ta=25° C



Vout=3.3V  
100% to 50% load transients at 8V input and Ta=25° C



Vout=2.5V  
50% to 100% load transients at 8V input and Ta=25° C



Vout=2.5V  
100% to 50% load transients at 8V input and Ta=25° C

# NON-ISOLATED DC/DC CONVERTERS

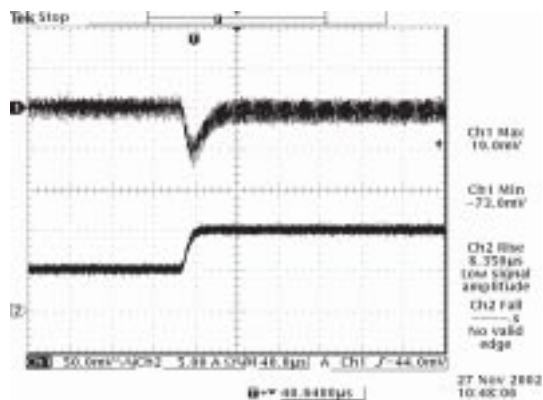
4.5V – 13.2V Input / 1.0V – 5.0V Output / 10A



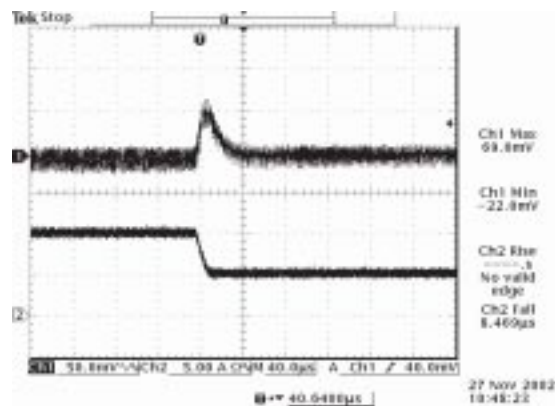
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## Transient Response

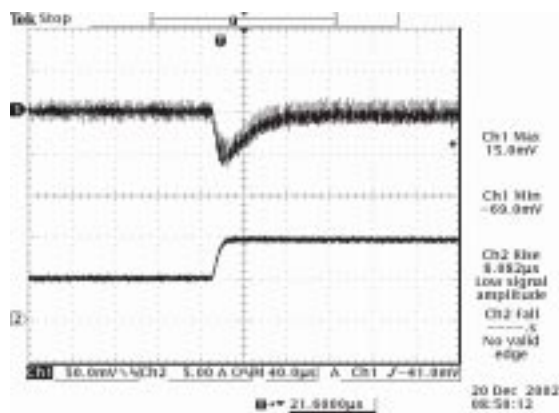
Transient response:  $di/dt = 0.5A/\mu S$ , with external  $220\mu F$  Tan capacitor.



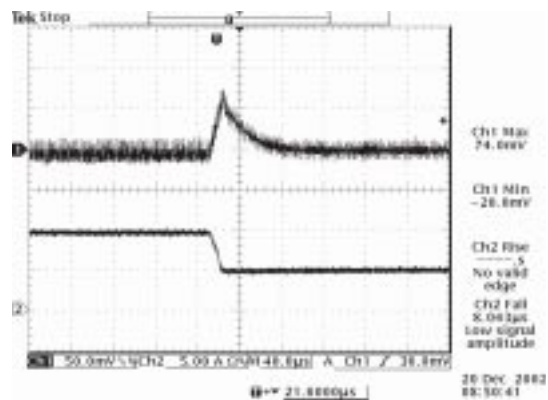
Vout=1.8V  
50% to 100% load transients at 8V input and Ta=25° C



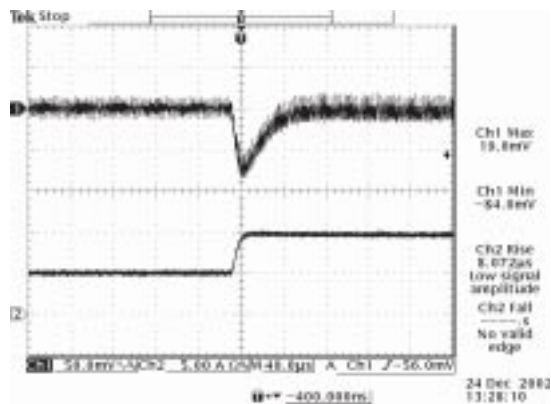
Vout=1.8V  
100% to 50% load transients at 8V input and Ta=25° C



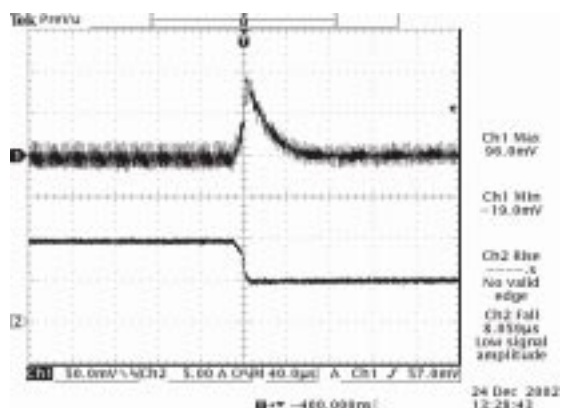
Vout=1.5V  
50% to 100% load transients at 8V input and Ta=25° C



Vout=1.5V  
100% to 50% load transients at 8V input and Ta=25° C



Vout=1.2V  
50% to 100% load transients at 8V input and Ta=25° C

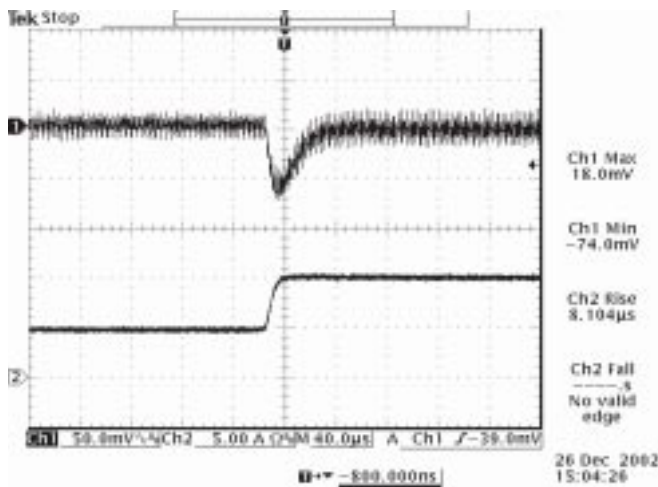


Vout=1.2V  
100% to 50% load transients at 8V input and Ta=25° C

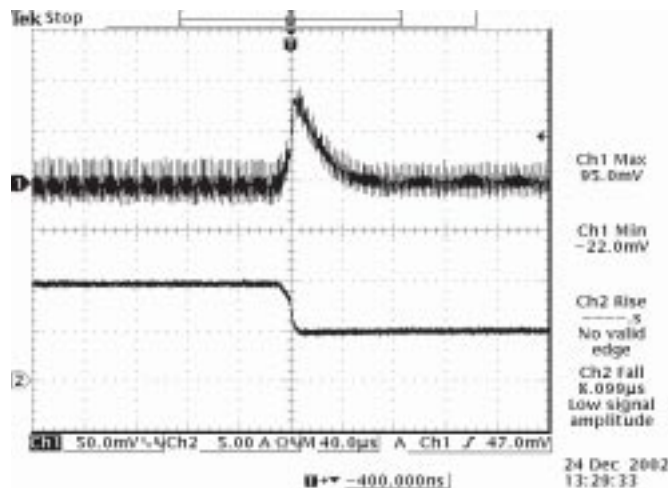
BP05SRDB-10E

### Transient Response

Transient response:  $di/dt = 0.5A/\mu S$ , with external 220 $\mu F$  Tan capacitor.

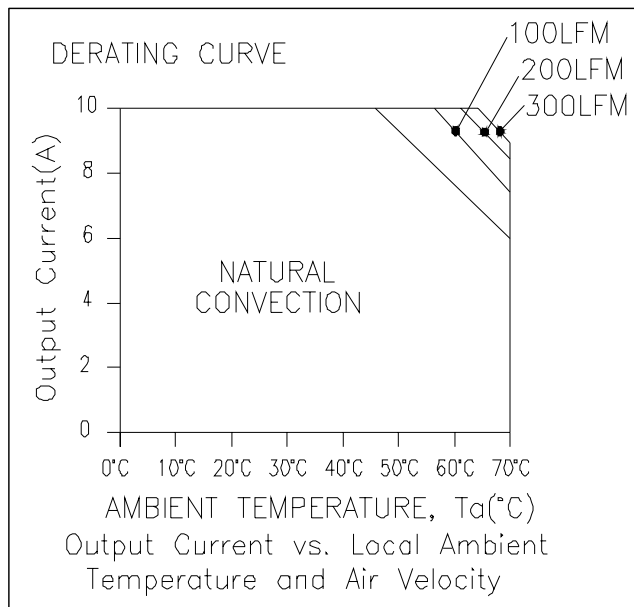


Vout=1.0V  
50% to 100% load transients at 8V input and Ta=25° C



Vout=1.0V  
100% to 50% load transients at 8V input and Ta=25° C

### Thermal Considerations



# NON-ISOLATED DC/DC CONVERTERS

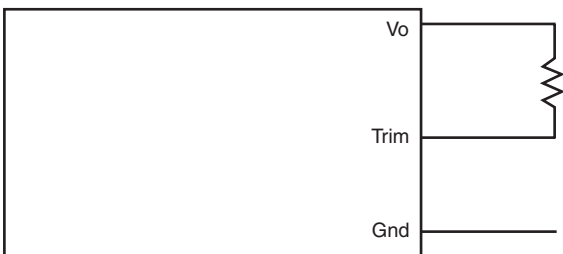
4.5V – 13.2V Input / 1.0V – 5.0V Output / 10A



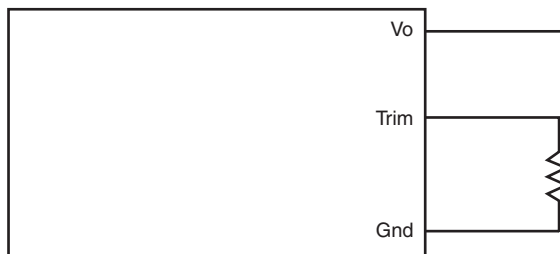
BP05SRDB-10E

## Output Voltage Set-Point Adjustment

Trim Down Test Circuit



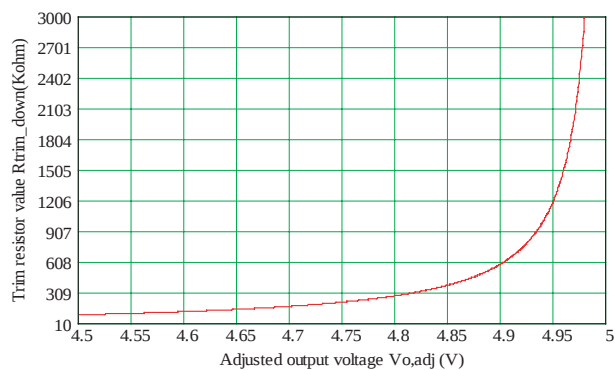
Trim Up Test Circuit



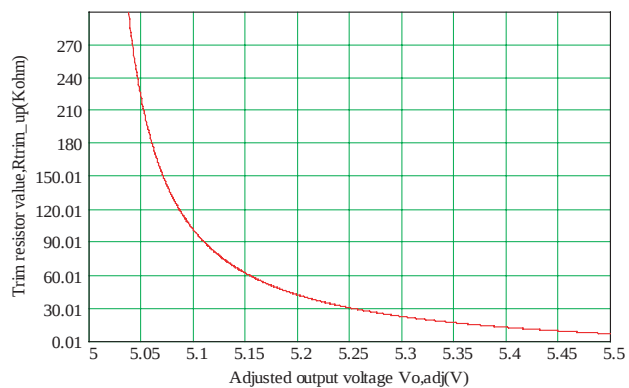
## Output Voltage Set-Point Adjustment

### SRDB-10E50x Trim Resistor Calculation

$$R_{trim\_down} = \left( \frac{61.91}{V_o - V_{o,adj}} - 31.61 \right) \text{Kohm}$$



$$R_{trim\_up} = \left( \frac{11.768}{V_{o,adj} - V_o} - 16.9 \right) \text{Kohm}$$

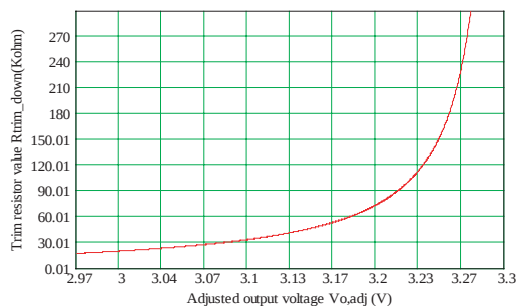


BP05SRDB-10E

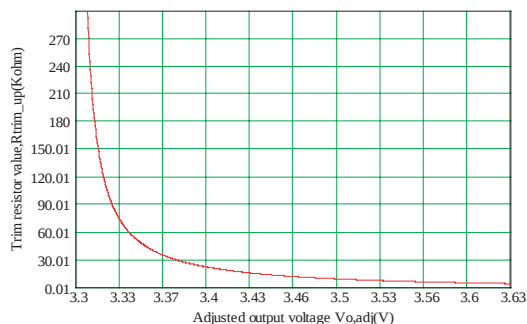
## Output Voltage Set-Point Adjustment

### SRDB-10E33x Trim Resistor Calculation

$$R_{trim\_down} = \left( \frac{7.964}{V_o - V_{o,adj}} - 6.82 \right) \text{Kohm}$$

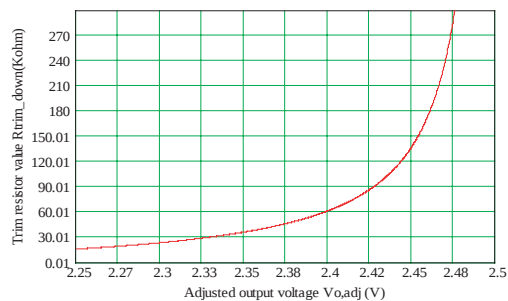


$$R_{trim\_up} = \left( \frac{2.536}{V_{o,adj} - V_o} - 3.65 \right) \text{Kohm}$$

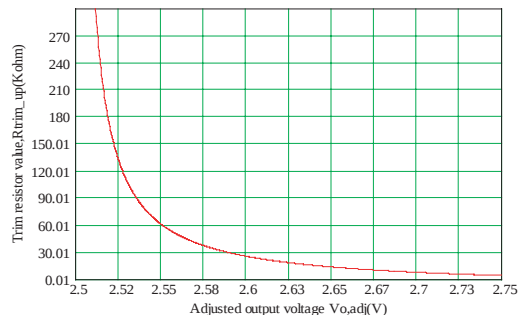


### SRDB-10E25x Trim Resistor Calculation

$$R_{trim\_down} = \left( \frac{7.568}{V_o - V_{o,adj}} - 14.43 \right) \text{Kohm}$$



$$R_{trim\_up} = \left( \frac{3.544}{V_{o,adj} - V_o} - 10 \right) \text{Kohm}$$



# NON-ISOLATED DC/DC CONVERTERS

4.5V – 13.2V Input / 1.0V – 5.0V Output / 10A

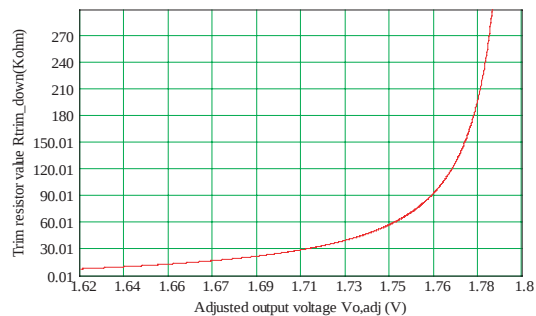


BP05SRDB-10E

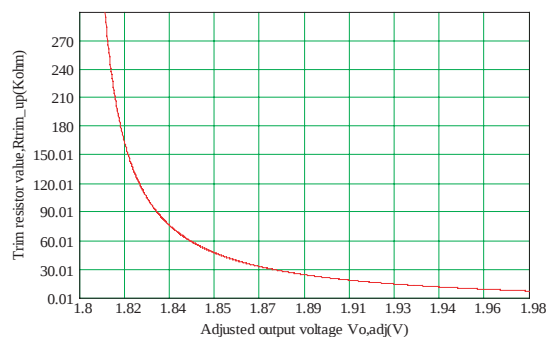
## Output Voltage Set-Point Adjustment

### SRDB-10E18x Trim Resistor Calculation

$$R_{trim\_down} = \left( \frac{3.869}{V_o - V_{o,adj}} - 13.84 \right) \text{Kohm}$$

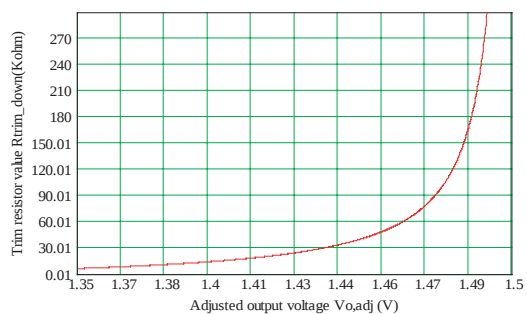


$$R_{trim\_up} = \left( \frac{3.072}{V_{o,adj} - V_o} - 10 \right) \text{Kohm}$$

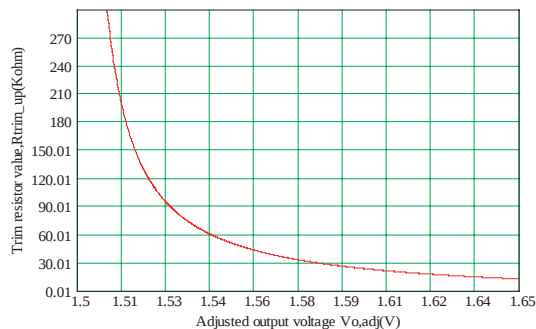


### SRDB-10E15x Trim Resistor Calculation

$$R_{trim\_down} = \left( \frac{2.716}{V_o - V_{o,adj}} - 11.71 \right) \text{Kohm}$$



$$R_{trim\_up} = \left( \frac{3.072}{V_{o,adj} - V_o} - 7.87 \right) \text{Kohm}$$

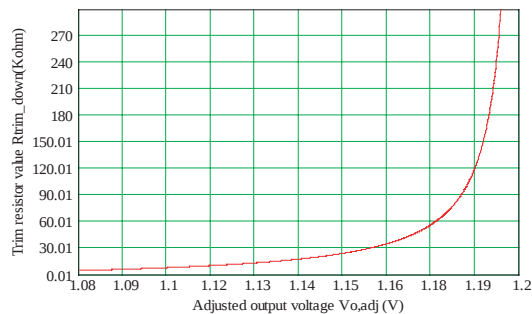


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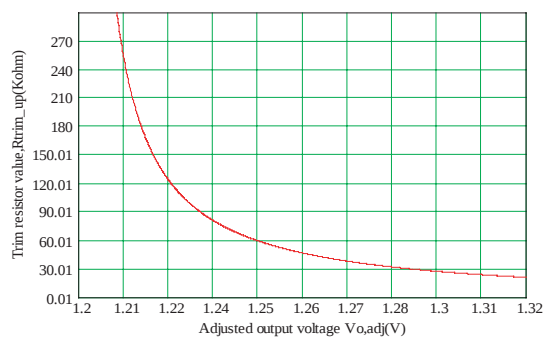
## Output Voltage Set-Point Adjustment

### SRDB-10E12x Trim Resistor Calculation

$$R_{trim\_down} = \left( \frac{1.562}{V_o - V_{o,adj}} - 8.48 \right) \text{Kohm}$$

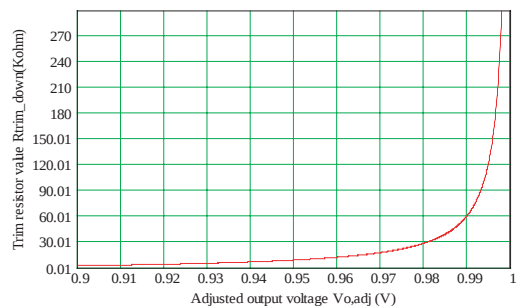


$$R_{trim\_up} = \left( \frac{3.072}{V_{o,adj} - V_o} - 4.64 \right) \text{Kohm}$$

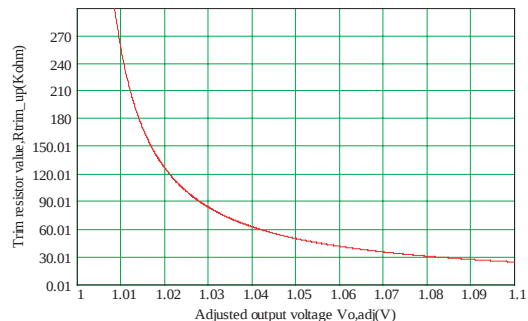


### SRDB-10E10x Trim Resistor Calculation

$$R_{trim\_down} = \left( \frac{0.658}{V_o - V_{o,adj}} - 4.17 \right) \text{Kohm}$$



$$R_{trim\_up} = \left( \frac{2.536}{V_{o,adj} - V_o} - 1 \right) \text{Kohm}$$



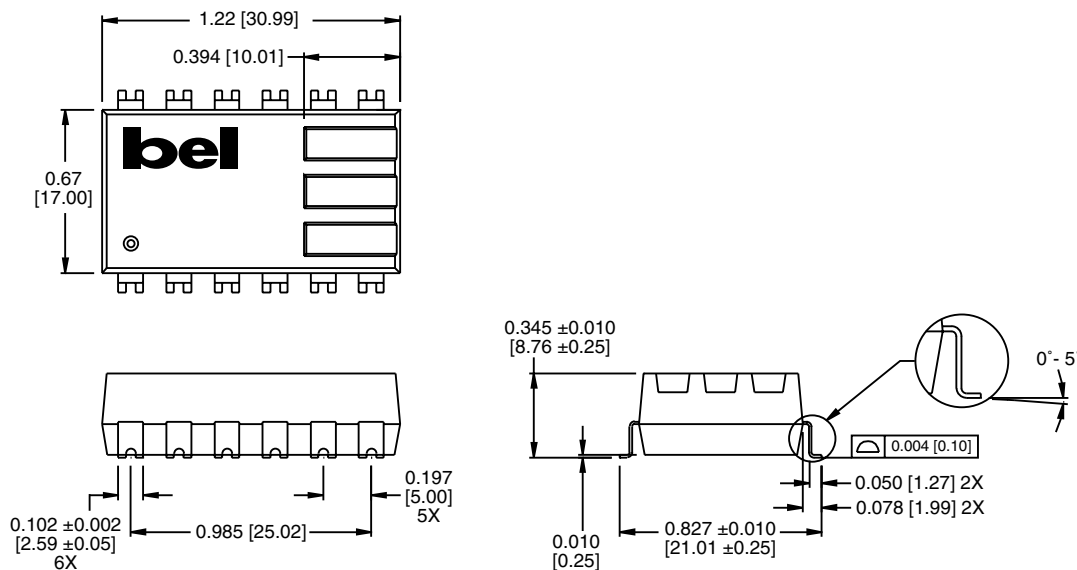
# NON-ISOLATED DC/DC CONVERTERS

4.5V – 13.2V Input / 1.0V – 5.0V Output / 10A



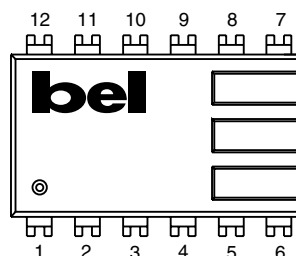
BP05SRDB-10E

## Mechanical



| Pin | Function         |
|-----|------------------|
| 1   | Ground           |
| 2   | Ground           |
| 3   | Ground           |
| 4   | Ground           |
| 5   | +Vin             |
| 6   | +Vin             |
| 7   | Trim             |
| 8   | Remote On/Off    |
| 9   | Remote Sense (+) |
| 10  | +Vo              |
| 11  | +Vo              |
| 12  | +Vo              |

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



## 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 240°C.



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## 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