

## NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.75 Vdc - 3.63 Vdc/16 A Output

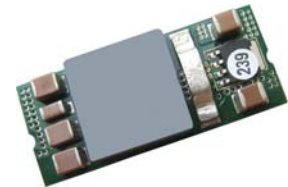
**bel**  
POWER PRODUCTS

SRBC-16E1Ax

RoHS Compliant

Rev.A

- Non-Isolated
- High Efficiency
- Fixed Frequency
- Low Cost
- Over Temperature Shutdown
- Logic Low/High (option)
- Industrial Temperature Range
- Under-voltage Lockout (UVLO)
- OCP/SCP
- Wide Trim
- Wide Input
- Remote Sense
- Remote On/Off



### Description

The Bel SRBC-16E1Ax is part of the non-isolated dc/dc converter series. The modules use a SMT package. These converters are available in a range of output voltages from 0.75 Vdc to 3.63 Vdc over a wide range of input voltage ( $V_{in} = 4.5 \text{ Vdc} - 14 \text{ Vdc}$ ). The efficiency is typically 92% at 3.3 Vdc output at full load.

### Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active Low	Model Number Active High
0.75 V - 3.63 V	4.5 V - 14 V	16 A	58 W	92%	SRBC-16E1AL	SRBC-16E1A0

- Notes:**
1. Add "G" suffix at the end of the model number to indicate Tray Packaging.
  2. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers.

### Absolute Maximum Ratings

Parameter	Min	Typ	Max	Notes
Input Voltage (continuous)	-0.3 V	-	15 V	
Output Enable Terminal Voltage	-0.3 V	-	15 V	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-55 °C	-	125 °C	

**Note:** All specifications are typical at 25 °C unless otherwise stated.

### Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
$V_{o,set} < 3.0$	4.5 V	-	14 V	
$V_{o,set} \geq 3.0$	$V_{o,set} + 1.5 \text{ V}$	-	14 V	
Input Current (full load)	-	-	15 A	This power module is not internally fused. An input line fuse must always be used
Input Current (no load)	-	100 mA	-	
Remote Off Input Current	-	2 mA	-	
Input Reflected Ripple Current (pk-pk)	-	-	400 mA	Tested with one 1000 uF/25 V AL input capacitor with ESR=0.03 ohm max and 6 × 47 uF/16 V Tantalum capacitors with ESR=0.013 ohm max at 100 kHz, & simulated source impedance of 1000 nH, 5 Hz to 20 MHz.
Input Reflected Ripple Current (rms)	-	-	150 mA	
$I^2t$ Inrush Current Transient	-	0.2 A <sup>2</sup> s	0.4 A <sup>2</sup> s	
Turn-on Voltage Threshold	-	4.2 V	-	
Turn-off Voltage Threshold	3.7 V	-	4.2 V	

## NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.75 Vdc - 3.63 Vdc/16 A Output



### Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point	-2% $V_{o,set}$	-	2% $V_{o,set}$	$V_{in}=12$ V, full load
Load Regulation	-	0.1% $V_{o,set}$	-	
Line Regulation	-	0.1% $V_{o,set}$	-	
Regulation Over Temperature (-40 °C to +85 °C)	-	0.3% $V_{o,set}$	-	
Output Current	0 A	-	16 A	
Current Limit Threshold	-	180% $I_{o,out}$	-	
Short Circuit Surge Transient	-	1 A <sup>2</sup> s	3 A <sup>2</sup> s	
Ripple and Noise (pk-pk)	-	30 mV	75 mV	Tested with 0-20 MHz BW, 10 uF tantalum capacitor & 1uF ceramic capacitor at the output
Ripple and Noise (rms)	-	12 mV	30 mV	
Turn on Time	-	12 mS	20 mS	
Overshoot at Turn on	-	-	1% $V_{o,set}$	
Output Capacitance	0 uF	-	5000 uF	
<b>Transient Response</b>				
50% ~ 100% Max Load	All	-	150 mV	di/dt=2.5 A/uS; $V_{in}=12$ V and with 2 x 150 uF polymer capacitor at the output.
Settling Time		-	50 uS	
100% ~ 50% Max Load		-	150 mV	
Settling Time		-	50 uS	

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

### General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency $V_o=3.3$ V $V_o=2.5$ V $V_o=1.8$ V $V_o=1.5$ V $V_o=1.2$ V $V_o=0.75$ V	- - - - - -	92% 90% 88% 87% 85% 79%	- - - - - -	Measured at $V_{in}=12$ V, $I_o=I_o-max$
Efficiency $V_o=3.3$ V $V_o=2.5$ V $V_o=1.8$ V $V_o=1.5$ V $V_o=1.2$ V $V_o=0.75$ V	- - - - - -	92% 90% 87% 86% 83% 78%	- - - - - -	Measured at $V_{in}=5$ V, $I_o=I_o-max$
Switching Frequency	200 kHz	230 kHz	260 kHz	
Over Temperature Shutdown	-	130 °C	-	
Output Trim Range (Wide Trim)	0.7525 V	-	3.63 V	
Remote Sense Compensation	-	-	0.5 V	
MTBF	2,666,488 hours			Calculated Per Bell Core SR-332 ( $I_o = 80\%I_{o,max}$ ; $V_{in}=12$ V; $V_o=3.3$ V; $T_a=25^\circ\text{C}$ )
Dimensions Inches (L x W x H) Millimeters (L x W x H)	1.3 x 0.53 x 0.315 33.02 x 13.46 x 8.00			
Weight	-	8 g	-	

**Note:** All specifications are typical at 25 °C unless otherwise stated.

## NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.75 Vdc - 3.63 Vdc/16 A Output

**bel**  
POWER PRODUCTS

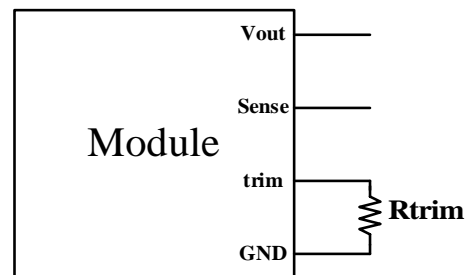
### Control Specifications

Parameter	Min	Typ	Max	Notes
<b>Remote On/Off</b>				
Signal Low (Unit Off)	-0.2 V	-	0.3 V	SRBC-16E1A0; Remote On/Off pin open, Unit on.
Signal High (Unit On)	-	-	V <sub>in</sub> , max	
Signal Low (Unit On)	-0.2 V	-	0.3 V	SRBC-16E1A1; Remote On/Off pin open, Unit on.
Signal High (Unit Off)	2.5 V	-	V <sub>in</sub> , max	

### Output Trim Equations

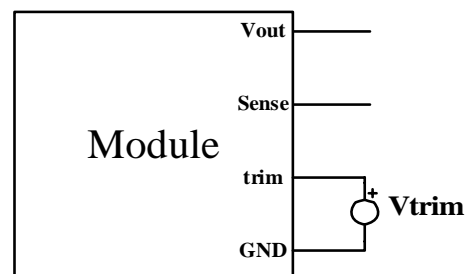
Equation for calculating the trim resistor (in  $\Omega$ ) given the desired output voltage (V<sub>o</sub>) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

$$R_{trim} = \frac{10500}{V_o - 0.7525} - 1000$$



Equation for calculating the trim voltage (in V) given the desired output voltage (V<sub>o</sub>) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

$$V_{trim} = 0.7 - 0.0667 \times (V_o - 0.7525)$$



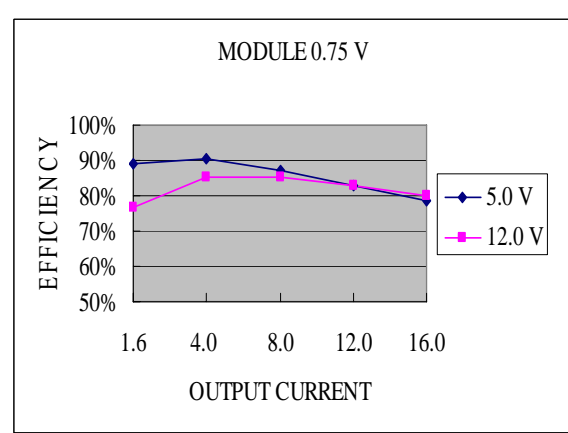
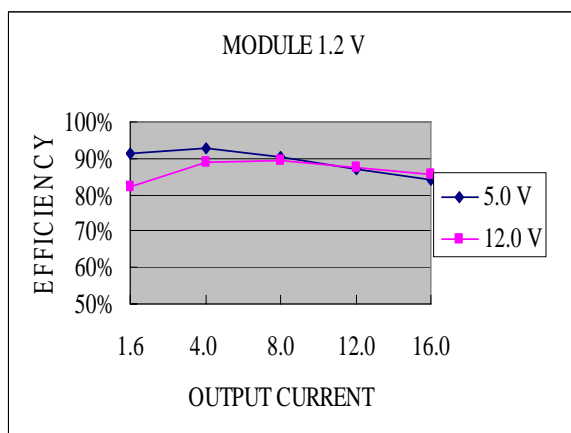
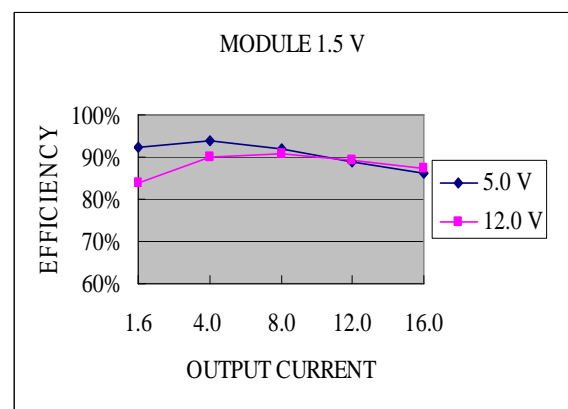
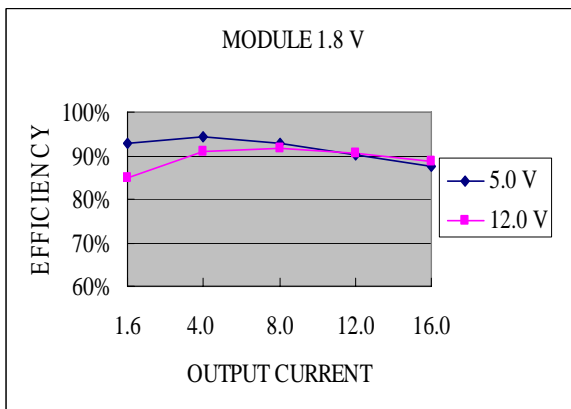
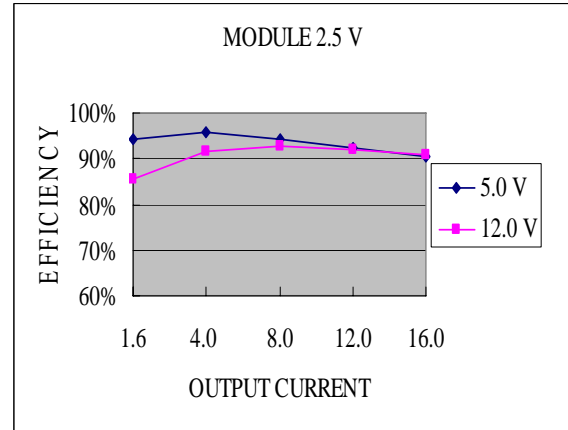
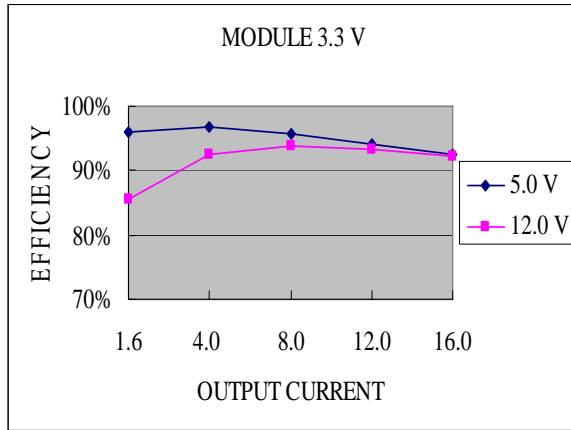
# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.75 Vdc - 3.63 Vdc/16 A Output



## Efficiency Data



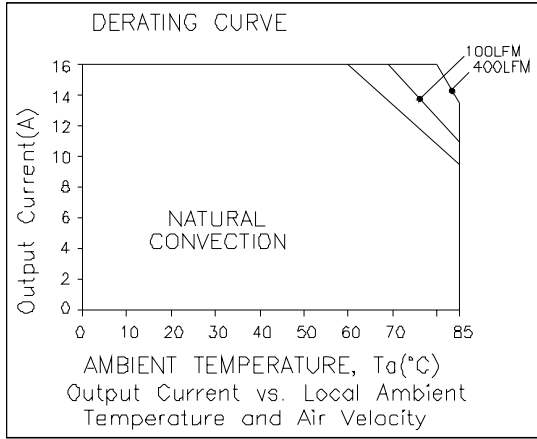
# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

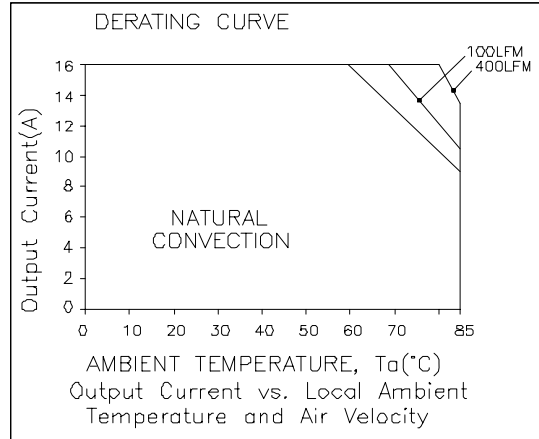
0.75 Vdc - 3.63 Vdc/16 A Output



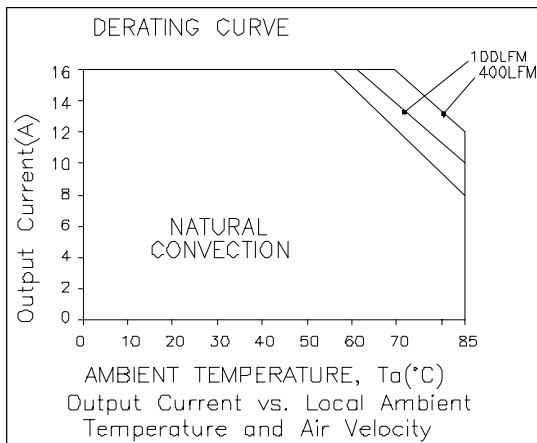
## Thermal Derating Curves



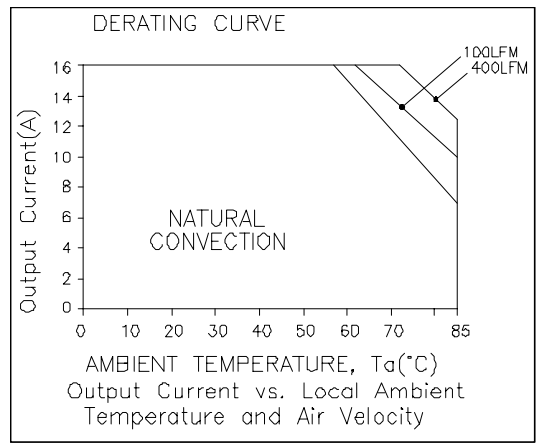
$V_o=0.75\text{ V}; V_{in}=5.0\text{ V}$



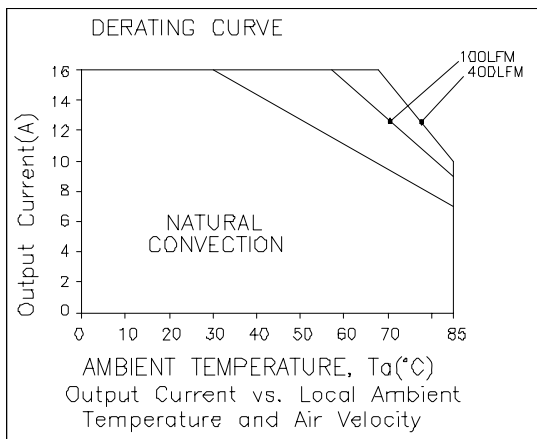
$V_o=0.75\text{ V}; V_{in}=12.0\text{ V}$



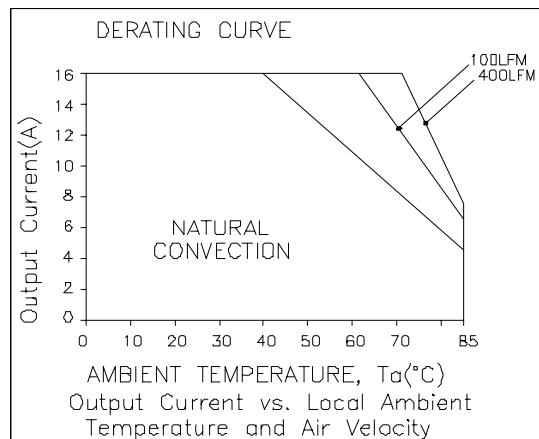
$V_o=1.8\text{ V}; V_{in}=5.0\text{ V}$



$V_o=1.8\text{ V}; V_{in}=12\text{ V}$



$V_o=3.3\text{ V}; V_{in}=5.0\text{ V}$



$V_o=3.3\text{ V}; V_{in}=12\text{ V}$

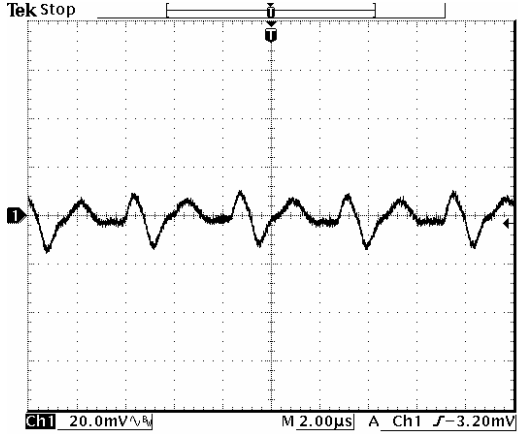
# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.75 Vdc - 3.63 Vdc/16 A Output



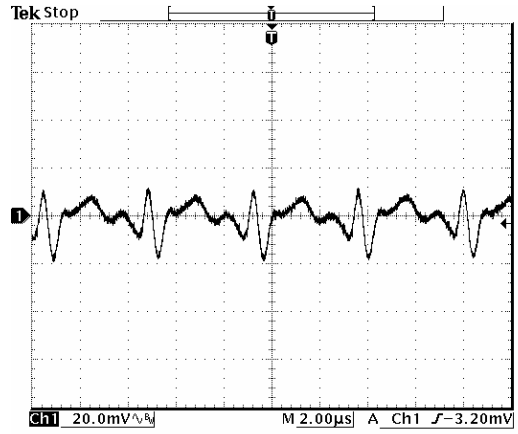
## Ripple and Noise Waveforms



Ch1 Pk-Pk  
26.0mV  
Ch1 RMS  
5.31mV

19 Apr 2004  
13:08:34

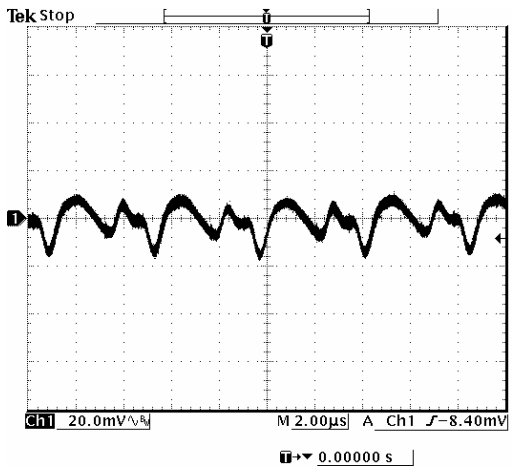
Vin=5 V, Vo=0.7525 V



Ch1 Pk-Pk  
30.8mV  
Ch1 RMS  
6.17mV

19 Apr 2004  
13:09:02

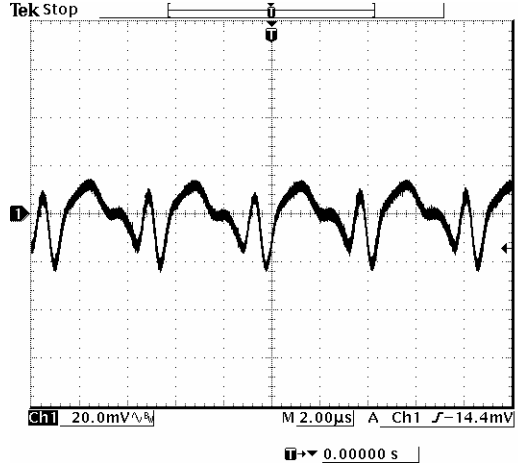
Vin=12 V, Vo=0.7525 V



Ch1 Pk-Pk  
26.8mV  
Ch1 RMS  
6.02mV

21 Apr 2004  
11:16:37

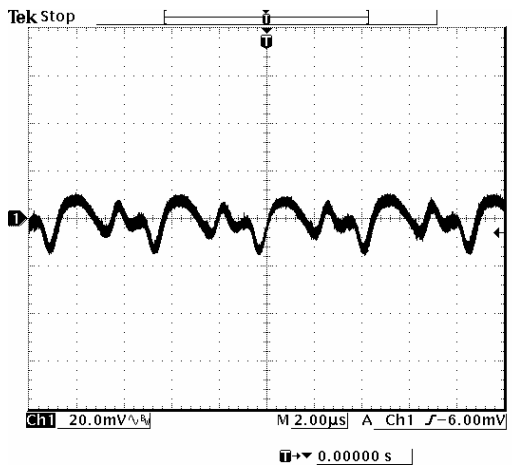
Vin=5 V, Vo=1.2 V



Ch1 Pk-Pk  
37.6mV  
Ch1 RMS  
9.06mV

21 Apr 2004  
11:16:55

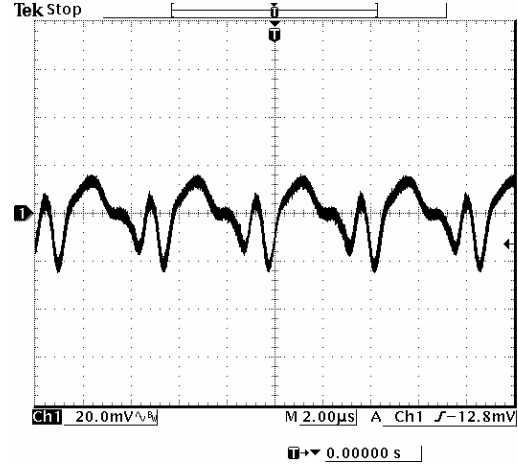
Vin=12 V, Vo=1.2 V



Ch1 Pk-Pk  
24.4mV  
Ch1 RMS  
5.71mV

21 Apr 2004  
11:17:27

Vin=5 V, Vo=1.5 V



Ch1 Pk-Pk  
39.2mV  
Ch1 RMS  
9.75mV

21 Apr 2004  
11:17:50

Vin=12 V, Vo=1.5 V

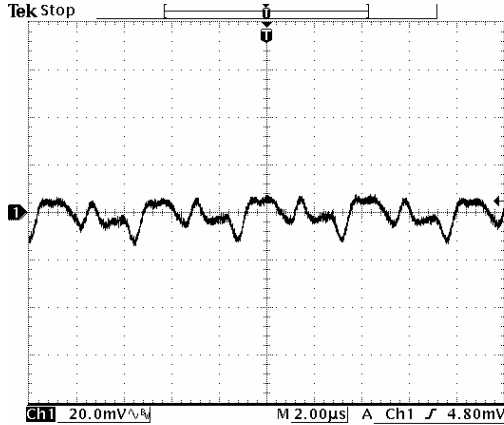
# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

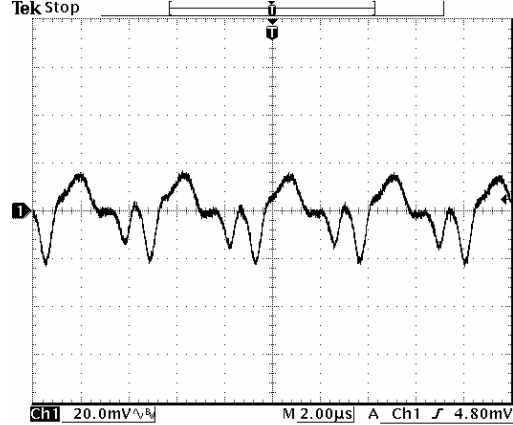
0.75 Vdc - 3.63 Vdc/16 A Output



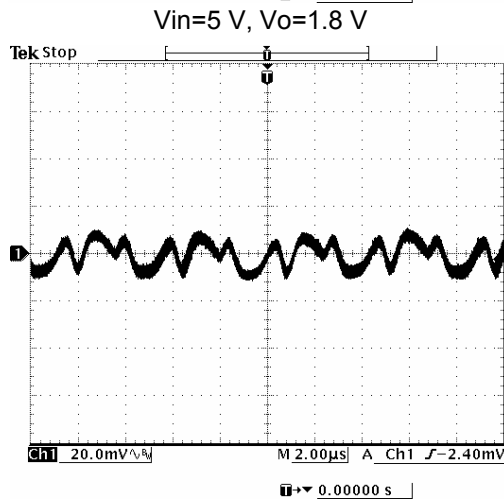
## Ripple and Noise Waveforms (continued)



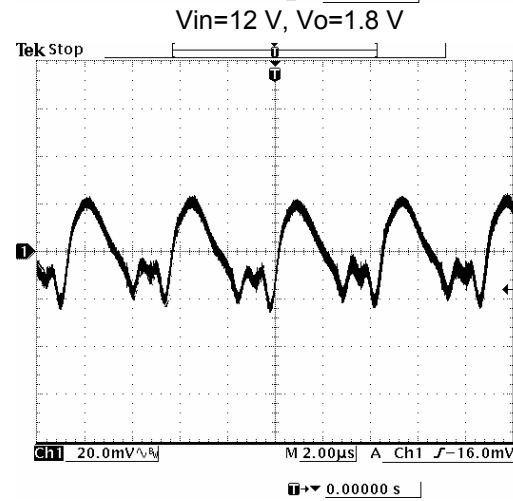
19 Apr 2004  
16:39:59



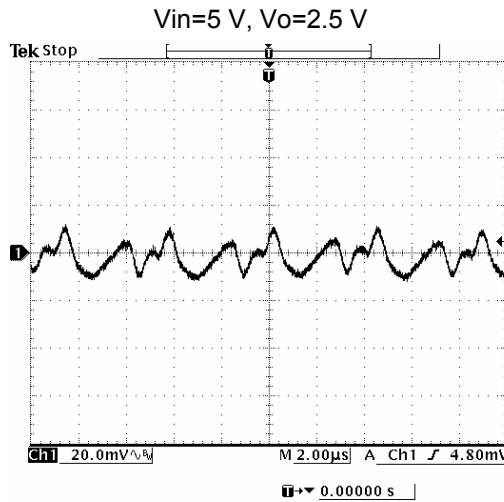
19 Apr 2004  
16:40:22



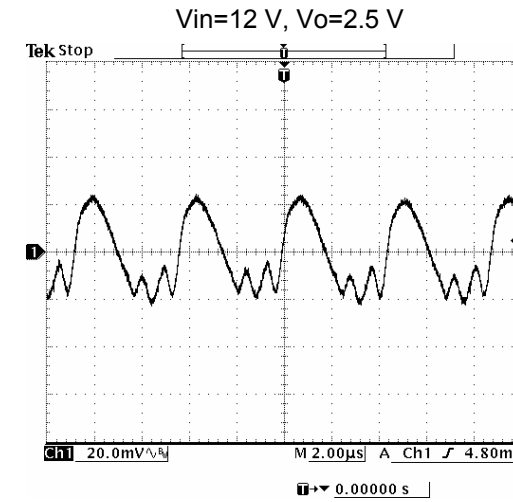
21 Apr 2004  
11:19:45



21 Apr 2004  
11:20:04



20 Apr 2004  
09:45:28



20 Apr 2004  
09:45:53

Vin=5 V, Vo=3.3 V

Vin=12 V, Vo=3.3 V

**Note:** Ripple and noise at full load, with 10µF tantalum capacitor and 1µF ceramic at the output, and Ta=25°C.

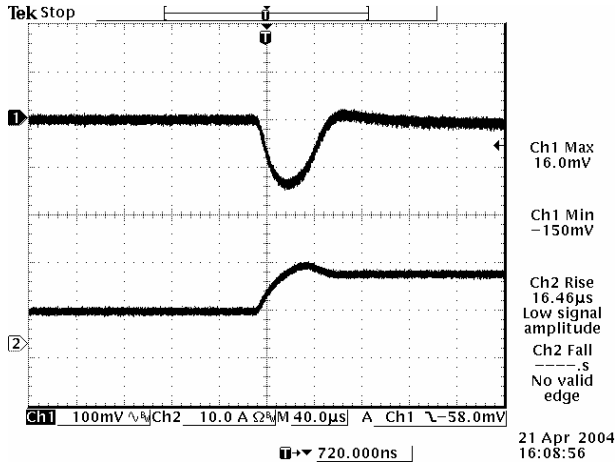
# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

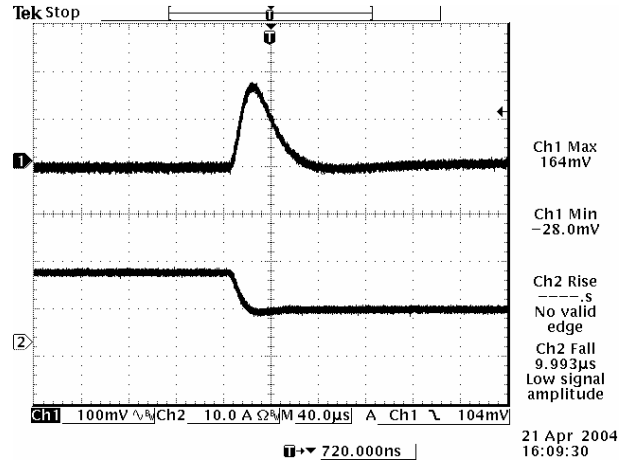
0.75 Vdc - 3.63 Vdc/16 A Output



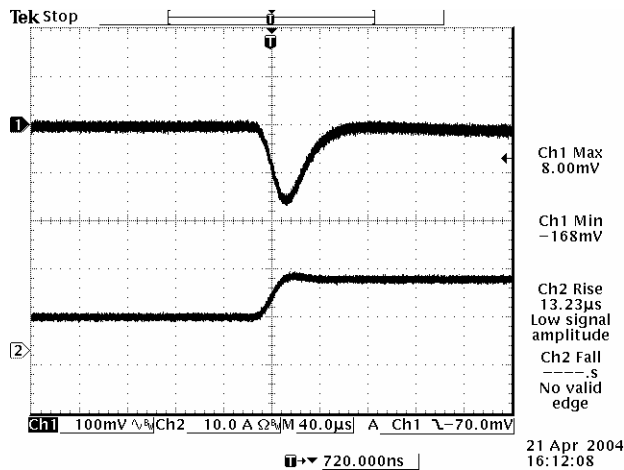
## Transient Response Waveforms



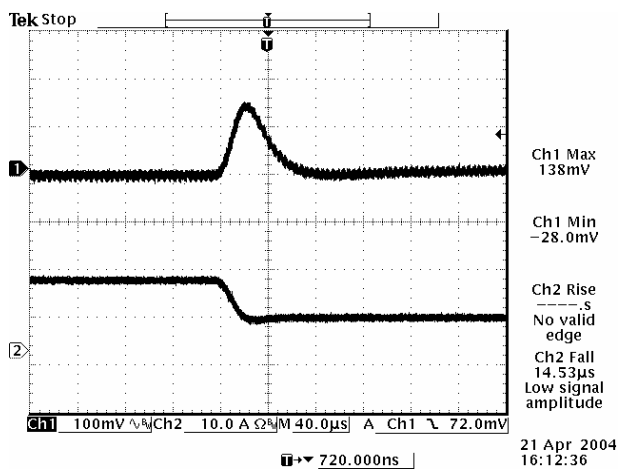
50% to 100% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=0.75\text{ V}$



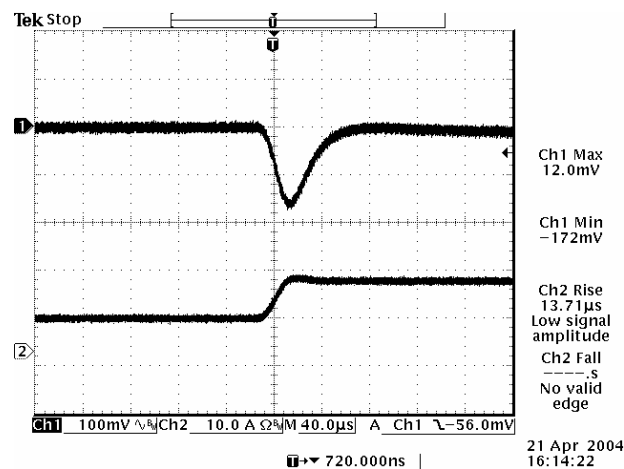
100% to 50% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=0.75\text{ V}$



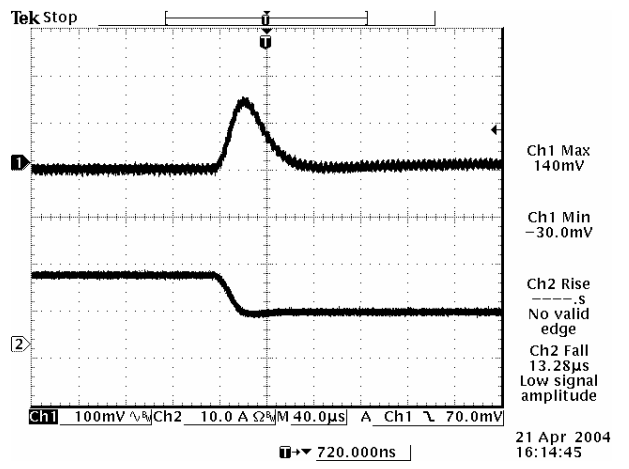
50% to 100% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=1.2\text{ V}$



100% to 50% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=1.2\text{ V}$



50% to 100% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=1.5\text{ V}$



100% to 50% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=1.5\text{ V}$



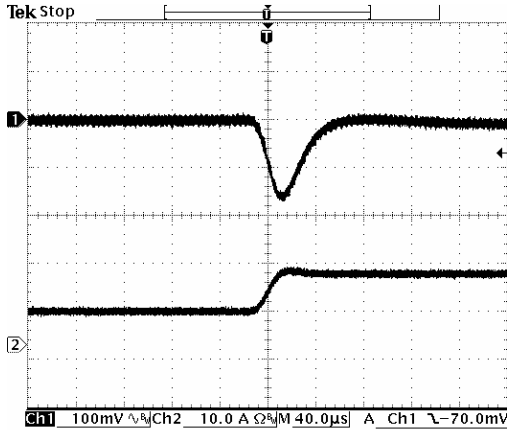
# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

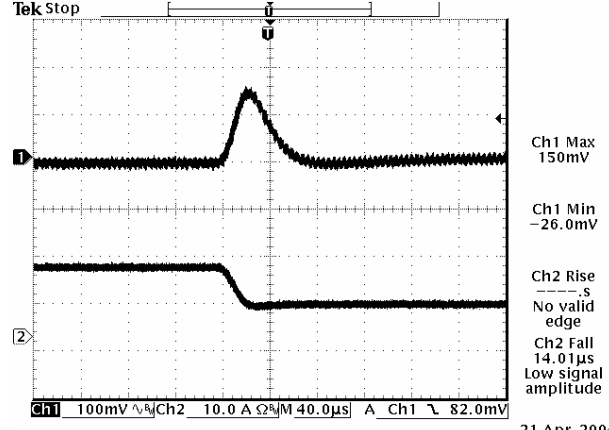
0.75 Vdc - 3.63 Vdc/16 A Output



## Transient Response Waveforms (continued)



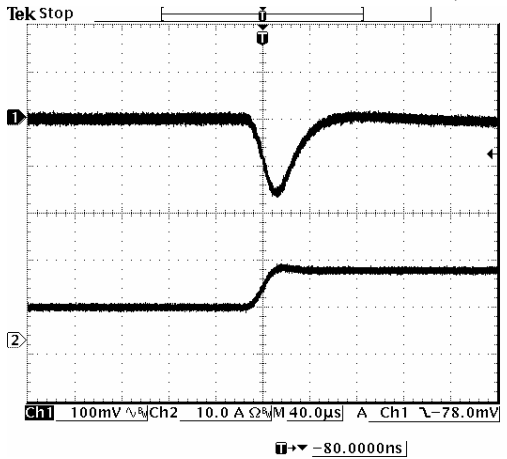
21 Apr 2004 16:17:33



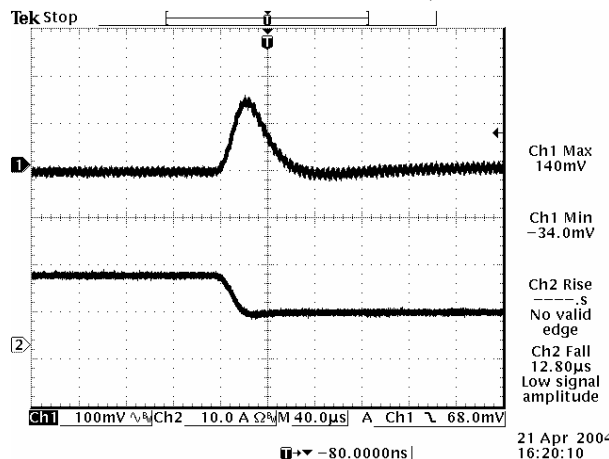
21 Apr 2004 16:17:59

50% to 100% load Transient at Vin=5 V, Vo=1.8 V

100% to 50% load Transient at Vin=5 V, Vo=1.8 V



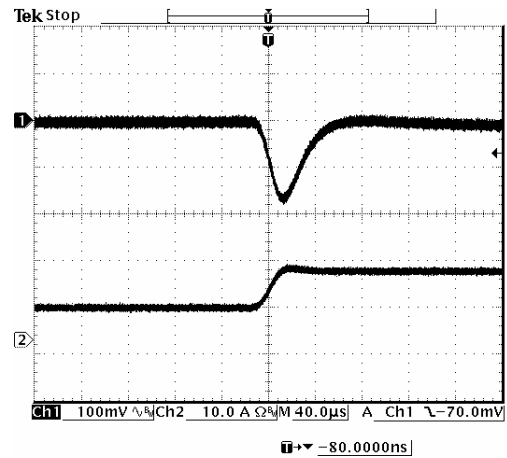
21 Apr 2004 16:19:46



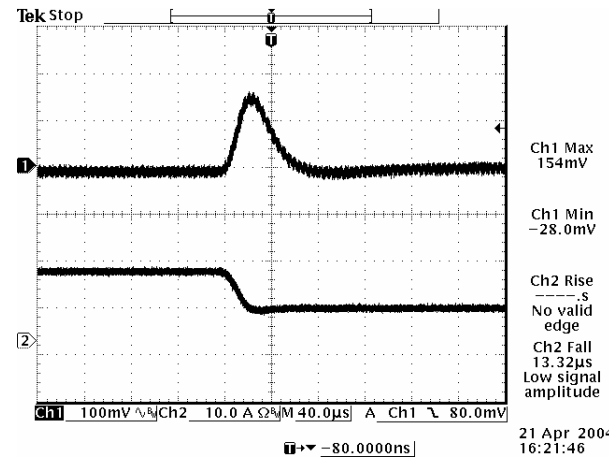
21 Apr 2004 16:20:10

50% to 100% load Transient at Vin=5 V, Vo=2.5 V

100% to 50% load Transient at Vin=5 V, Vo=2.5 V



21 Apr 2004 16:21:26



21 Apr 2004 16:21:46

50% to 100% load Transient at Vin=5 V, Vo=3.3 V

100% to 50% load Transient at Vin=5 V, Vo=3.3 V

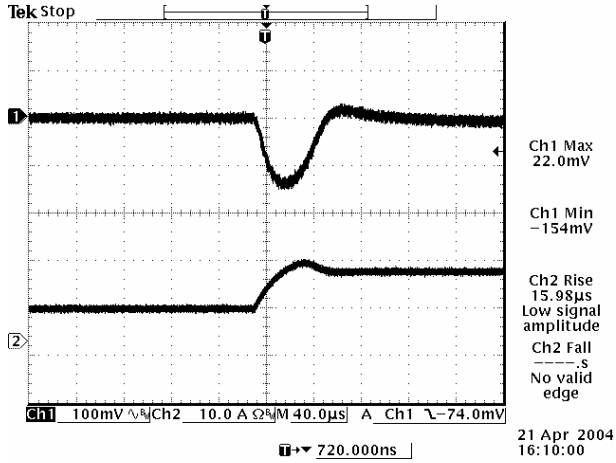
# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

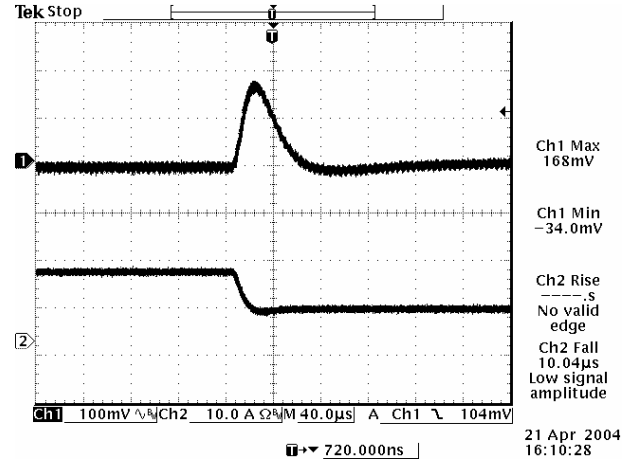
0.75 Vdc - 3.63 Vdc/16 A Output



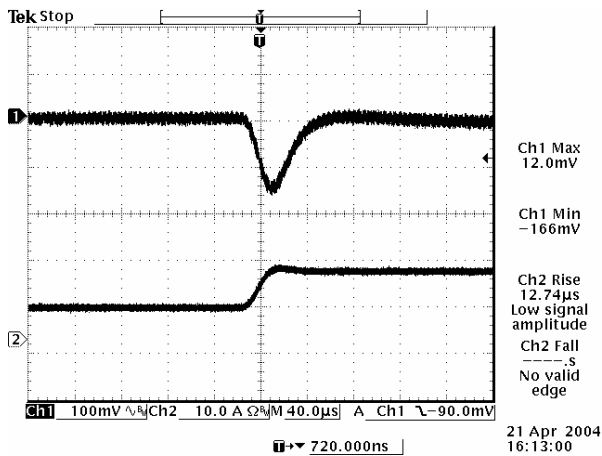
## Transient Response Waveforms (continued)



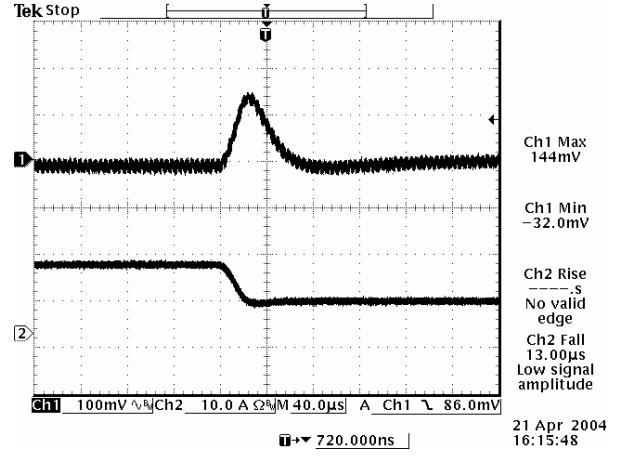
50% to 100% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=0.75\text{ V}$



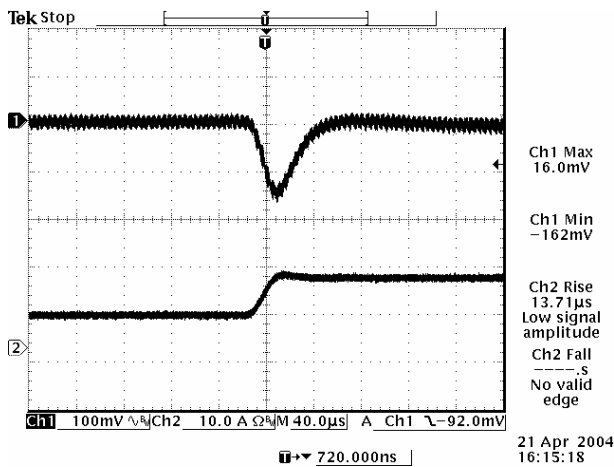
100% to 50% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=0.75\text{ V}$



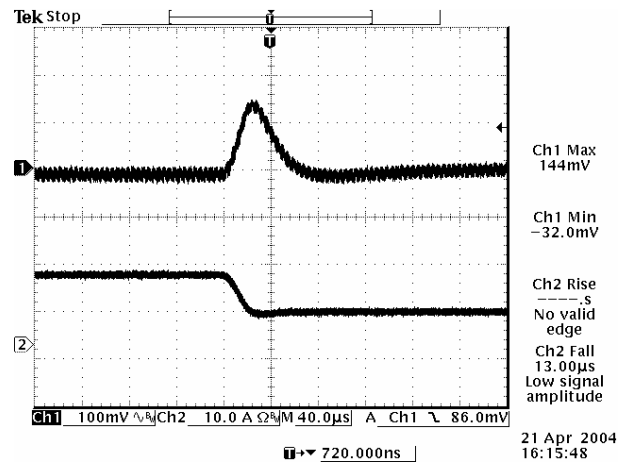
50% to 100% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=1.2\text{ V}$



100% to 50% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=1.2\text{ V}$



50% to 100% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=1.5\text{ V}$



100% to 50% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=1.5\text{ V}$

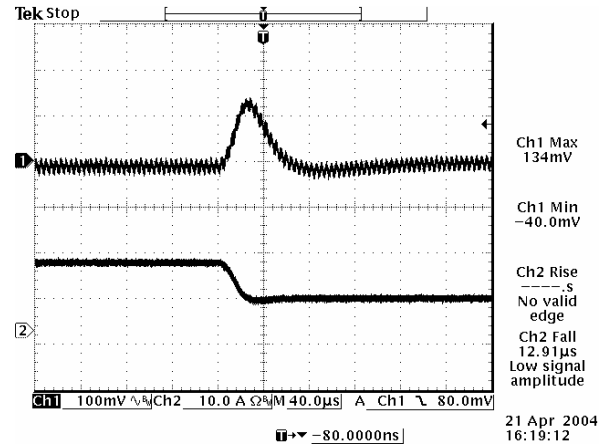
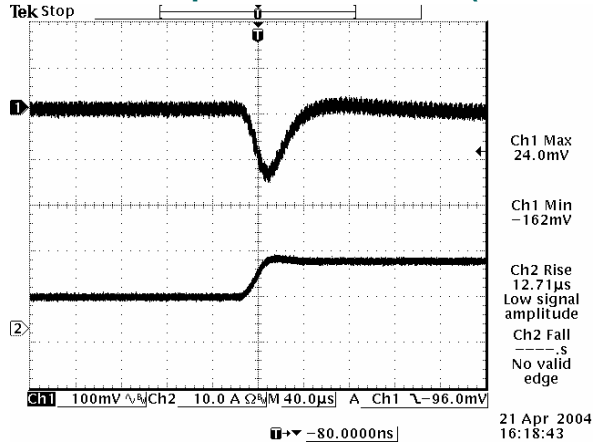
# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.75 Vdc - 3.63 Vdc/16 A Output

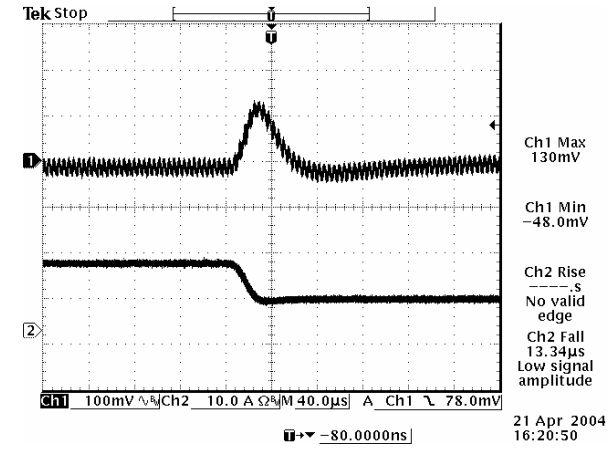
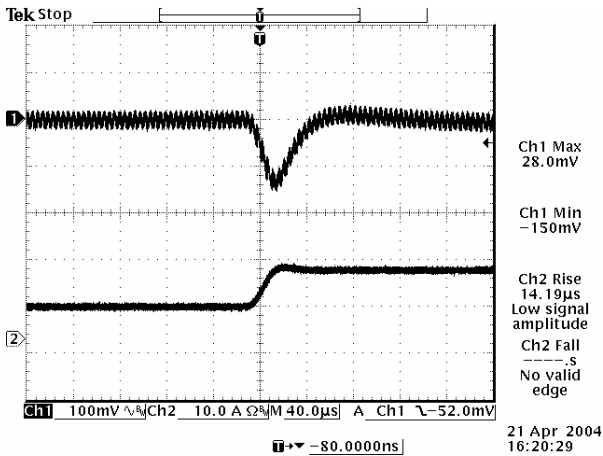


## Transient Response Waveforms (continued)



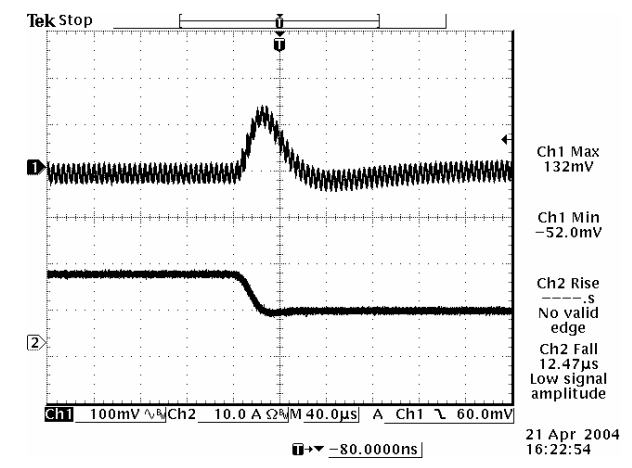
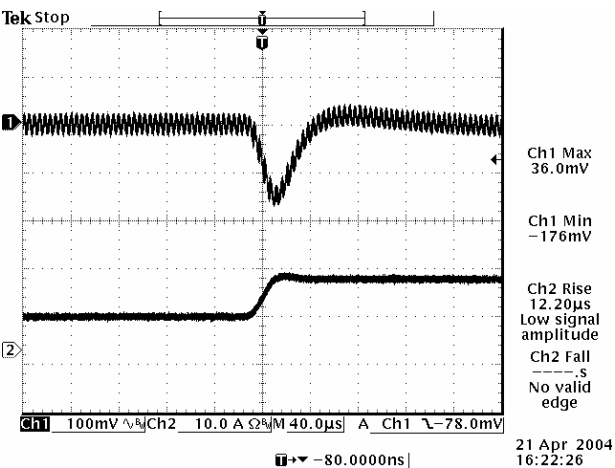
50% to 100% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=1.8\text{ V}$

100% to 50% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=1.8\text{ V}$



50% to 100% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=2.5\text{ V}$

100% to 50% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=2.5\text{ V}$



50% to 100% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=3.3\text{ V}$

100% to 50% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=3.3\text{ V}$

**Note:** Transient response with external load capacitance  $C_{ext}=2 \times 150\mu\text{F}$  (Polymer capacitors), and  $T_a=25^\circ\text{C}$ .

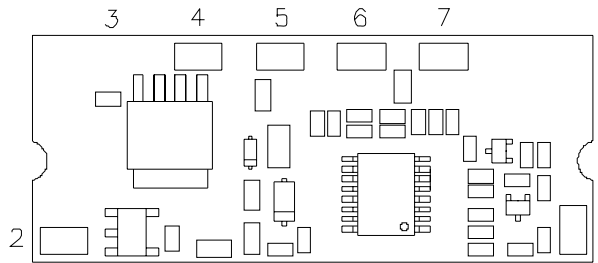
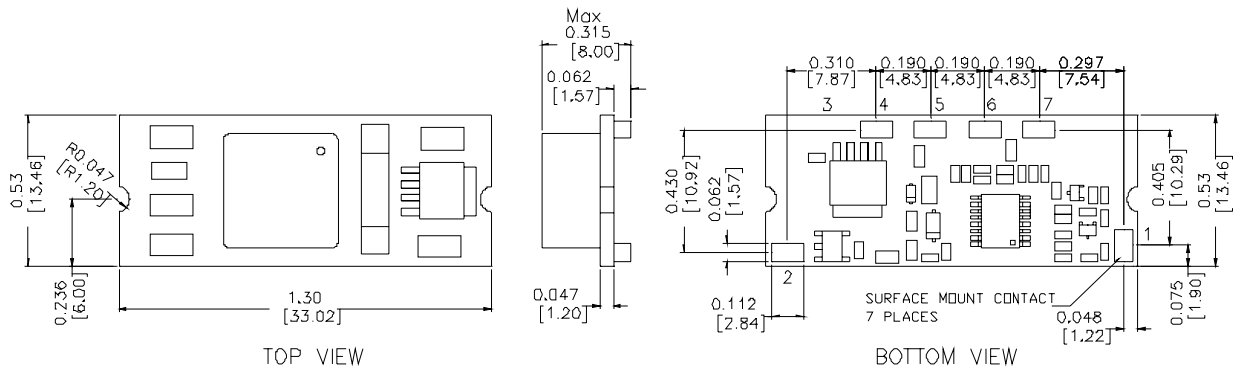
# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input

0.75 Vdc - 3.63 Vdc/16 A Output



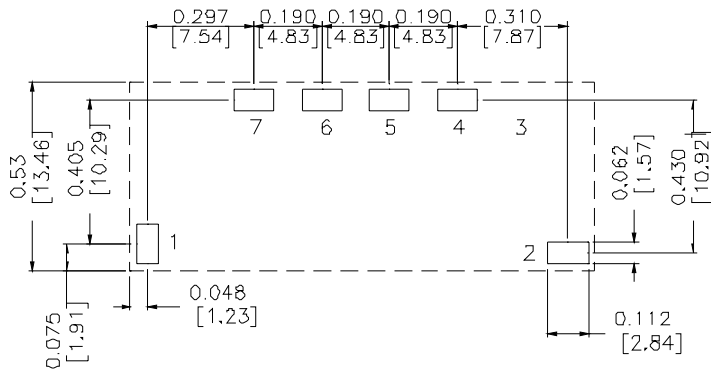
## Mechanical Outline



RECOMMENDED PCB PAD LAYOUT

## Pin Connections

Pin	Function
1	On/Off
2	Vin
3	N/A
4	Ground
5	Vout
6	Trim
7	Sense



### PAD SIZE:

MIN: 0.14" \* 0.095" (3.56mm \* 2.41mm)

MAX: 0.165" \* 0.11" (4.19mm \* 2.79mm)

## RoHS Compliance

Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products.



©2007 Bel Fuse Inc. Specifications subject to change without notice. 011807

### CORPORATE

**Bel Fuse Inc.**  
206 Van Vorst Street  
Jersey City, NJ 07302  
Tel 201-432-0463  
Fax 201-432-9542  
[www.belfuse.com](http://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](http://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](http://www.belfuse.com)