

## NON-ISOLATED DC/DC CONVERTERS

5.4 Vdc - 13.2 Vdc Input 1.0 Vdc - 5.0 Vdc Output / 20 A

**bel**  
POWER PRODUCTS

### SRDB-20ExxH Series RoHS Compliant Rev.A

- Non-Isolated
- OCP/SCP/OVP
- Low Profile Package
- Remote On/Off (Active High)
- Wide Input
- Remote Sense
- Under-Voltage Lockout (UVLO)



### Description

The Bel SRDB-20ExxH is part of the non-isolated dc/dc converter Power Module series. The modules use a DIP package for ease of layout and space savings. The output is closely regulated and the efficiency of 5 Vdc output module is typically 94% at full load.

### Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number
5.0 V	8.0 V - 13.2 V	20 A	100 W	94%	SRDB-20E50H
3.3 V	5.8 V - 13.2 V	20 A	66 W	92%	SRDB-20E33H
2.5 V	5.4 V - 13.2 V	20 A	50 W	91%	SRDB-20E25H
1.8 V	5.4 V - 13.2 V	20 A	36 W	88%	SRDB-20E18H
1.5 V	5.4 V - 13.2 V	20 A	30 W	87%	SRDB-20E15H
1.2 V	5.4 V - 13.2 V	20 A	24 W	85%	SRDB-20E12H
1.0 V	5.4 V - 13.2 V	20 A	20 W	84%	SRDB-20E10H

- Notes:** 1. Add "R" suffix at the end of the model number to indicate "Reel Packaging", and "G" for "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	-	16 V	
Output Enable Terminal Voltage	-0.3 V	-	16 V	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-40 °C	-	125 °C	

### Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
Vo=5.0 V	8 V	-	13.2 V	
Vo=3.3 V	5.8 V	-	13.2 V	
Vo=1.0-2.5 V	5.4 V	-	13.2 V	
Input Current (full load)				
Vo=5.0 V	-	-	15.1 A	
Vo=3.3 V	-	-	14.1 A	
Vo=2.5 V	-	-	13.3 A	
Vo=1.8 V	-	-	10.4 A	
Vo=1.5 V	-	-	8.4 A	
Vo=1.2 V	-	-	6.9 A	
Vo=1.0 V	-	-	5.9 A	

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### Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
Input Current (no load)				
Vo=5.0 V	-	200 mA	-	
Vo=3.3 V	-	150 mA	-	
Vo=2.5 V	-	135 mA	-	
Vo=1.8 V	-	120 mA	-	
Vo=1.5 V	-	100 mA	-	
Vo=1.2 V	-	85 mA	-	
Vo=1.0 V	-	80 mA	-	
Input Reflected Ripple Current (pk-pk)	-	130 mA	200 mA	With simulated impedance of 500 nH, 5 Hz to 20 MHz; use two 270 uF/16 V capacitors with ESR=0.018ohm max, at 100 kHz
Input Reflected Ripple Current (rms)	-	40 mA	70 mA	
I <sup>2</sup> t Inrush Current Transient	-	0.1 A <sup>2</sup> s	0.2 A <sup>2</sup> s	
Turn-on Voltage Threshold	4.35 V	4.48 V	4.60 V	
Turn-off Voltage Threshold	3.65 V	3.98 V	4.30 V	

**Note:** All specifications are typical at Vin=8 V, full load at 25 °C unless otherwise stated.

### Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point				
Vo=5.0 V	4.900 V	5.0 V	5.100 V	Test conditions: Vin=8 V; Iout=half load
Vo=3.3 V	3.234 V	3.3 V	3.366 V	
Vo=2.5 V	2.450 V	2.5 V	2.550 V	
Vo=1.8 V	1.764 V	1.8 V	1.836 V	
Vo=1.5 V	1.470 V	1.5 V	1.530 V	
Vo=1.2 V	1.176 V	1.2 V	1.224 V	
Vo=1.0 V	0.980 V	1.0 V	1.020 V	
Line Regulation				
Vo=5.0 V	-	±2 mV	±4 mV	
Vo=3.3 V	-	±1 mV	±3 mV	
Vo=2.5 V	-	±1 mV	±3 mV	
Vo=1.8 V	-	±1 mV	±3 mV	
Vo=1.5 V	-	±1 mV	±3 mV	
Vo=1.2 V	-	±1 mV	±3 mV	
Vo=1.0 V	-	±1 mV	±3 mV	
Load Regulation				
Vo=5.0 V	-	±3 mV	±7 mV	
Vo=3.3 V	-	±2 mV	±4 mV	
Vo=2.5 V	-	±2 mV	±4 mV	
Vo=1.8 V	-	±2 mV	±4 mV	
Vo=1.5 V	-	±1 mV	±3 mV	
Vo=1.2 V	-	±1 mV	±3 mV	
Vo=1.0 V	-	±1 mV	±3 mV	
Regulation Over Temperature (-40 °C to +85 °C)				
Vo=5.0 V	-	±15 mV	±30 mV	
Vo=3.3 V	-	±10 mV	±20 mV	
Vo=2.5 V	-	±9 mV	±18 mV	
Vo=1.8 V	-	±8 mV	±16 mV	
Vo=1.5 V	-	±7 mV	±14 mV	
Vo=1.2 V	-	±5 mV	±10 mV	
Vo=1.0 V	-	±5 mV	±10 mV	

## NON-ISOLATED DC/DC CONVERTERS

5.4 Vdc - 13.2 Vdc Input 1.0 Vdc - 5.0 Vdc Output / 20 A



### Output Specifications (continued)

Parameter	Min	Typ	Max	Notes	
Output Current	0 A	-	20 A		
Current Limit Threshold	24 A	-	40 A		
Short Circuit Surge Transient	-	0.075 A <sup>2</sup> s	0.15 A <sup>2</sup> s		
Ripple and Noise <sup>1</sup> (rms)	-	20 mV	40 mV	With 1 uF ceramic capacitor at the output	
Ripple and Noise <sup>1</sup> (rms)	-	10 mV	20 mV	With 680 uF tantalum capacitor at the output	
Ripple and Noise <sup>1</sup> (pk-pk)		60 mV	100 mV	With 1 uF ceramic capacitor at the output	
Ripple and Noise <sup>1</sup> (pk-pk)		30 mV	60 mV	With 680 uF tantalum capacitor at the output	
Turn on Time	-	20 mS	40 mS		
Overshoot at Turn on	-	0%	3%		
Output Capacitance	680 uF	-	8000 uF		
<b>Transient Response</b>					
50% ~ 100% Max Load	Vo=5 V	-	120 mV	200 mV	Test conditions: di/dt = 0.5 A/uS; Vin=8 V; with external 680 uF tantalum capacitor.
Settling Time		-	50 uS	100 uS	
100% ~ 50% Max Load		-	120 mV	200 mV	
Settling Time		-	50 uS	100 uS	
50% ~ 100% Max Load	Vo=1.8 V- 3.3 V	-	100 mV	150 mV	
Settling Time		-	50 uS	100 uS	
100% ~ 50% Max Load		-	100 mV	150 mV	
Settling Time		-	50 uS	100 uS	
50% ~ 100% Max Load	Vo=1.5 V	-	100 mV	150 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	100 mV	150 mV	
Settling Time		-	40 uS	80 uS	
50% ~ 100% Max Load	Vo=1.2 V	-	100 mV	150 mV	
Settling Time		-	40 uS	80 uS	
100% ~ 50% Max Load		-	100 mV	150 mV	
Settling Time		-	50 uS	100 uS	
50% ~ 100% Max Load	Vo=1.0 V	-	90 mV	130 mV	
Settling Time		-	40uS	80 uS	
100% ~ 50% Max Load		-	90 mV	130 mV	
Settling Time		-	40 uS	80 uS	

**Notes:** All specifications are typical at full load at 25 °C unless otherwise stated.

1. Test conditions of the output ripple and noise: two 270 uF/16 V capacitors with ESR=0.018 ohm max at the input; Vin=8 V, Io=20 A; 0-20 MHz BW.

# NON-ISOLATED DC/DC CONVERTERS

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## General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				Measured at Vin=8 V at full load.
Vo=5.0 V	91%	94%	-	
Vo=3.3 V	89%	92%	-	
Vo=2.5 V	88%	91%	-	
Vo=1.8 V	85%	88%	-	
Vo=1.5 V	84%	87%	-	
Vo=1.2 V	82%	85%	-	
Vo=1.0 V	81%	84%	-	
Switching Frequency	480 kHz	600 kHz	720 kHz	
Over Voltage Protection (Latch)	108.5%	115%	120%	Can be reset by cycling the input supply voltage or remote on/off.
Output Trim Range	90%Vo	-	110%Vo	
Remote Sense Compensation		-	10%	
MTBF	3,154,461 hours			Calculated Per Bell Core SR-332 (Io = 16 A, Vin=8 V, Vo=3.3 V; Ta = 25 °C)
Dimensions				
Inches (L x W x H)	1.22 x 0.827 x 0.345			
Millimeters (L x W x H)	30.99 x 21.0 x 8.76			
Weight	-	11 g	-	

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

## Control Specifications

Parameter	Min	Typ	Max	Notes
<b>Remote On/Off</b>				
Signal Low (Unit Off)	0 V	-	1 V	Remote on/off pin open, unit on.
Signal High (Unit On)	2.5 V	-	13.2 V	

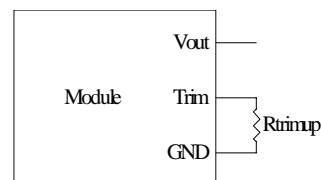
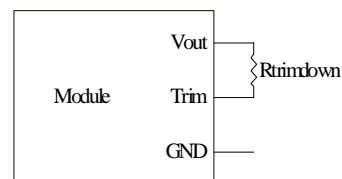
## Output Trim Equations

Equations for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) and the nominal output voltage of the converter (Vnom) are shown below. The Trim Down resistor should be connected between the Trim pin and Vout. The Trim Up resistor should be connected between the Trim pin and Ground. Only one of the resistors should be used for any given application.

$$R_{trim\_down} = \left( \frac{A}{V_{nom} - V_{adj}} - B \right)$$

$$R_{trim\_up} = \left( \frac{C}{V_{adj} - V_{nom}} - D \right)$$

Vnom	A	B	C	D
5.0V	30.955	15.805	5.884	8.450
3.3V	3.961	3.407	1.266	1.825
2.5V	1.834	3.397	0.861	2.320
1.8V	1.927	6.916	1.533	5.000
1.5V	1.353	5.851	1.533	3.935
1.2V	0.099	0.446	0.196	0.201
1.0V	0.102	0.684	0.401	0.183

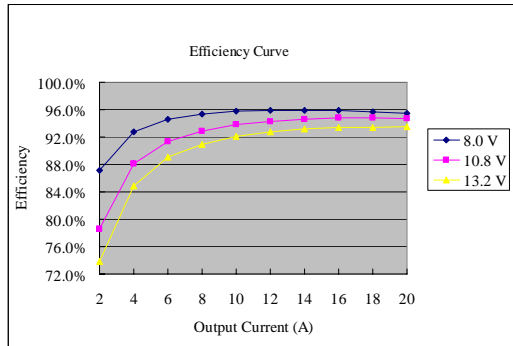


# NON-ISOLATED DC/DC CONVERTERS

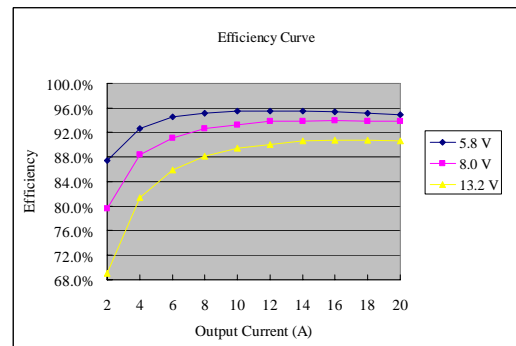
5.4 Vdc - 13.2 Vdc Input 1.0 Vdc - 5.0 Vdc Output / 20 A



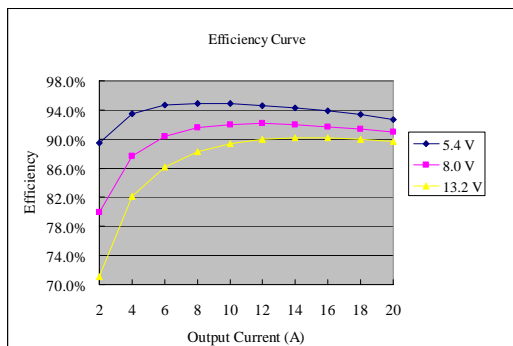
## Efficiency Data



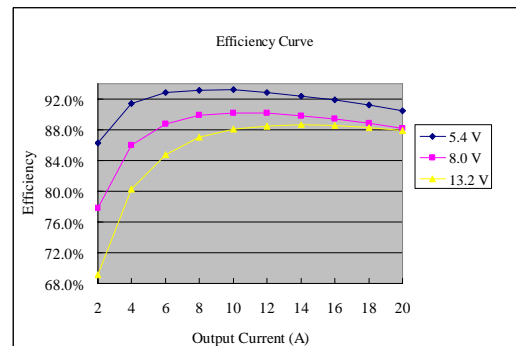
Vo=5.5 V



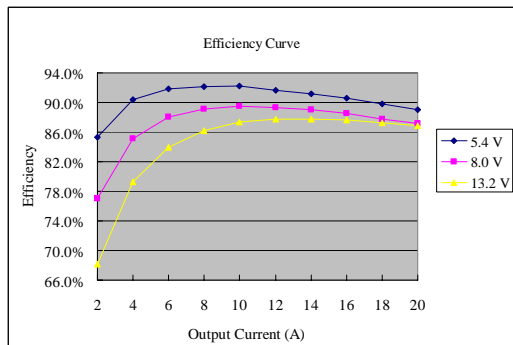
Vo=3.3 V



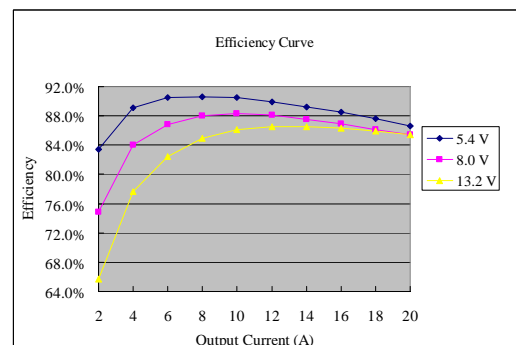
Vo=2.5 V



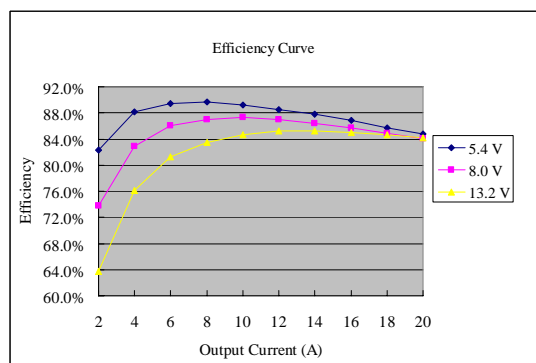
Vo=1.8 V



Vo=1.5 V



Vo=1.2 V



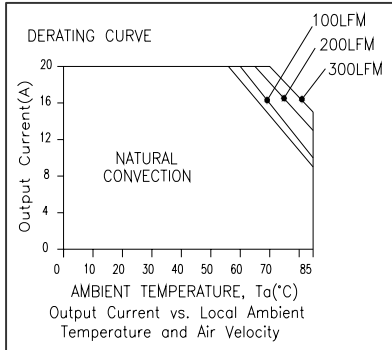
Vo=1.0 V

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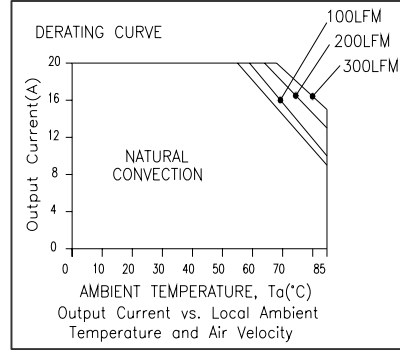
5.4 Vdc - 13.2 Vdc Input 1.0 Vdc - 5.0 Vdc Output / 20 A



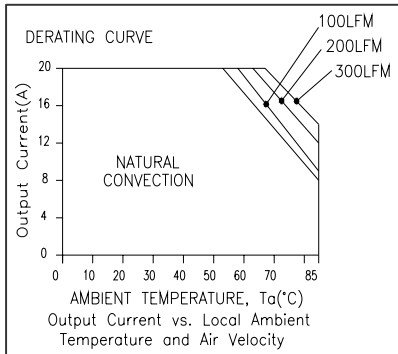
## Thermal Derating Curves



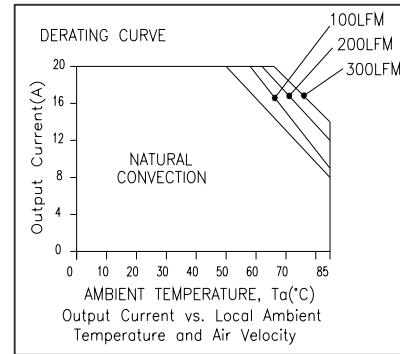
SRDB-20E10H (Vin=8 V)



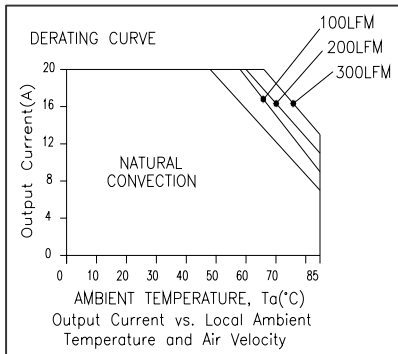
SRDB-20E12H (Vin=8 V)



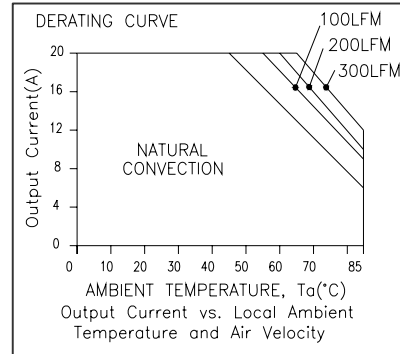
SRDB-20E15H (Vin=8 V)



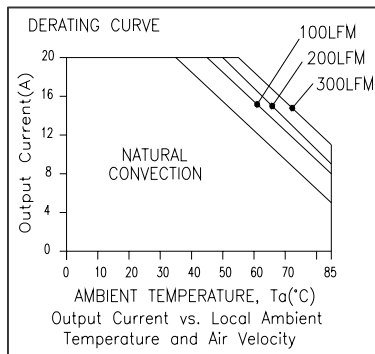
SRDB-20E18H (Vin=8 V)



SRDB-20E25H (Vin=8 V)



SRDB-20E33H (Vin=8 V)



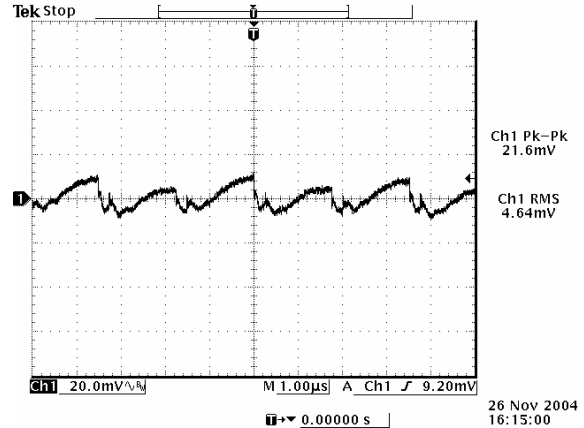
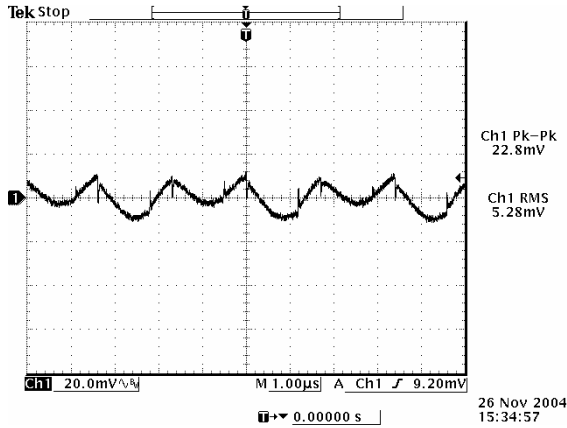
SRDB-20E50H (Vin=8 V)

# NON-ISOLATED DC/DC CONVERTERS

5.4 Vdc - 13.2 Vdc Input 1.0 Vdc - 5.0 Vdc Output / 20 A

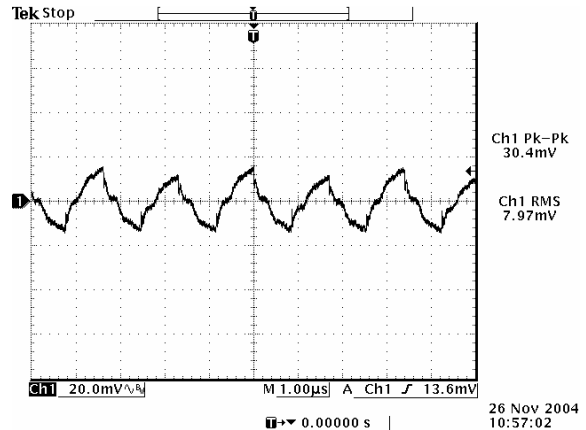
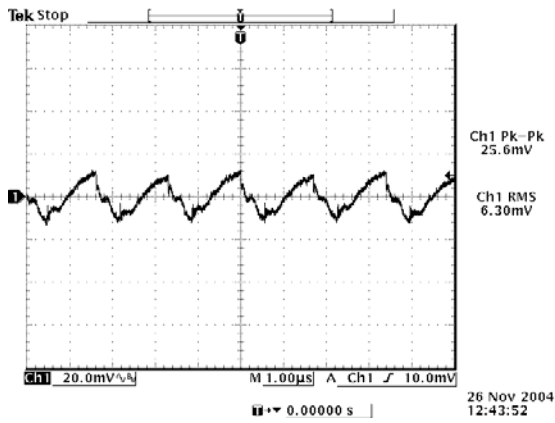


## Ripple and Noise Waveforms



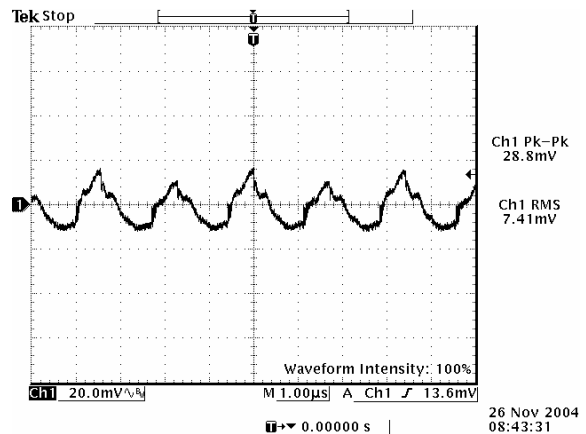
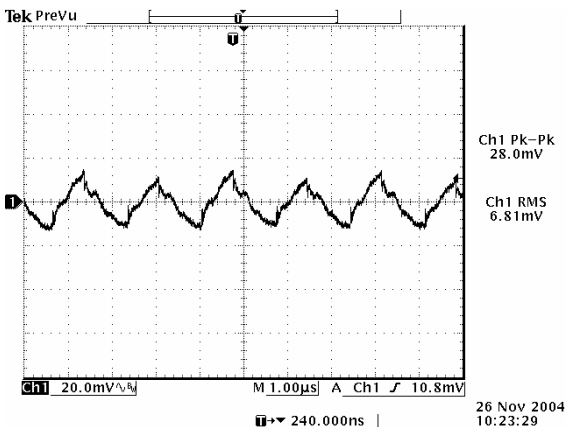
Ripple and noise at max load 5 Vdc output

Ripple and noise at max load 3.3 Vdc output



Ripple and noise at max load 2.5 Vdc output

Ripple and noise at max load 1.8 Vdc output



Ripple and noise at max load 1.5 Vdc output

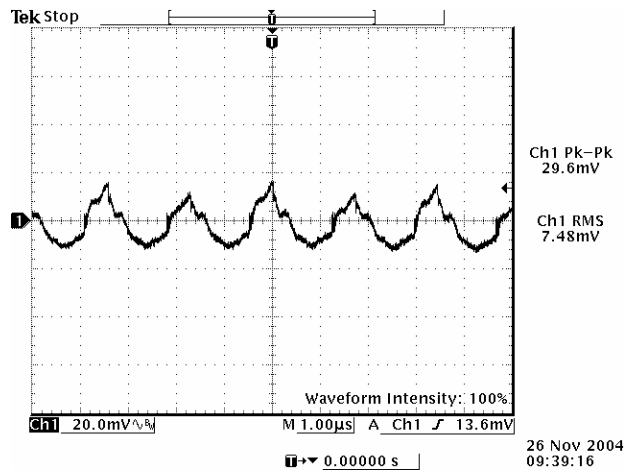
Ripple and noise at max load 1.2 Vdc output

# NON-ISOLATED DC/DC CONVERTERS

5.4 Vdc - 13.2 Vdc Input    1.0 Vdc - 5.0 Vdc Output / 20 A



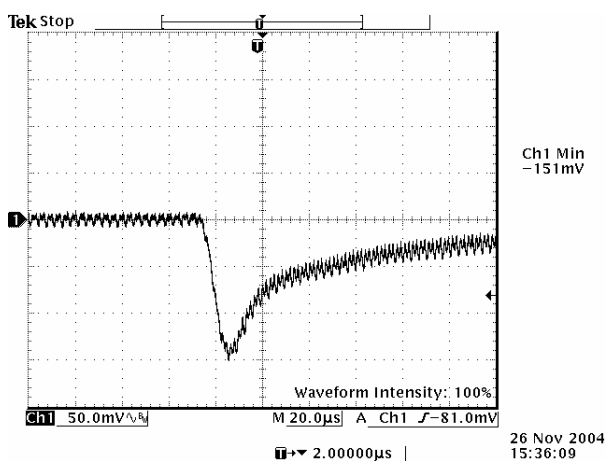
## Ripple and Noise Waveforms (continued)



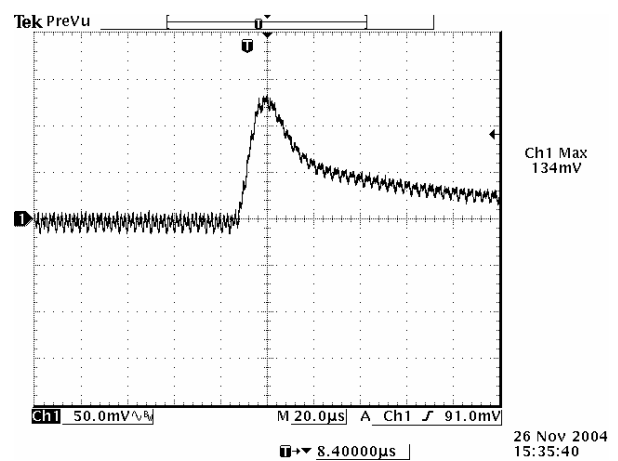
Ripple and noise at max load 1.0 Vdc output

**Note:** Ripple and Noise at 8 V input, with 680 uF tantalum capacitor at the output, and Ta=25 deg C.

## Transient Response Waveforms



Transients 50% to 100% load 5 Vdc output



Transients 100% to 50% load 5 Vdc output

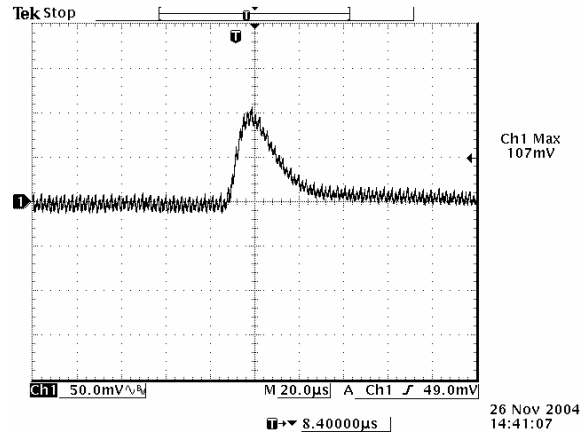
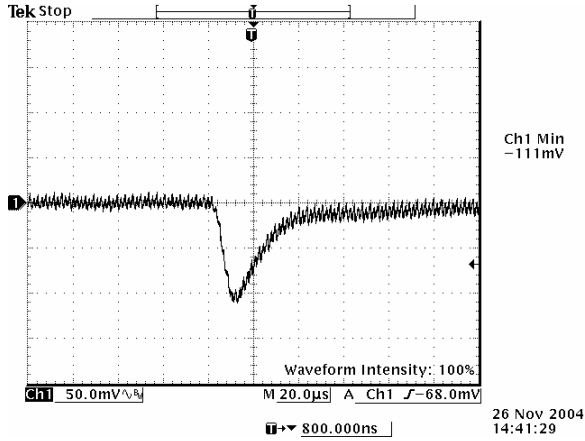


# NON-ISOLATED DC/DC CONVERTERS

5.4 Vdc - 13.2 Vdc Input 1.0 Vdc - 5.0 Vdc Output / 20 A

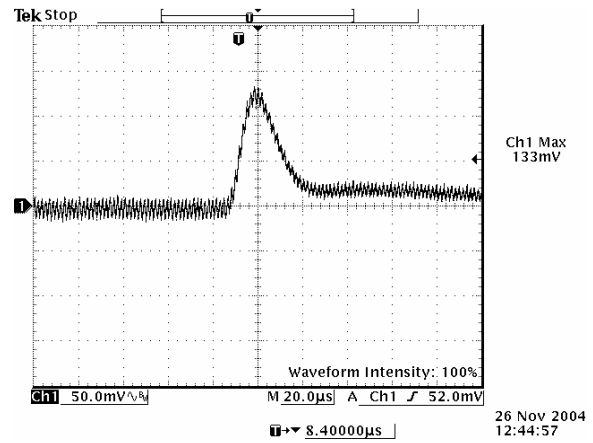
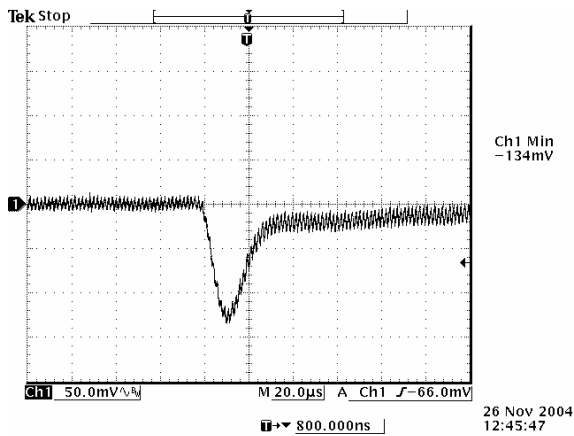


## Transient Response Waveforms (continued)



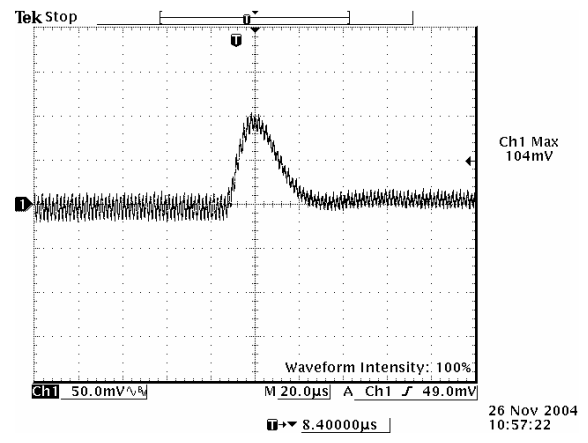
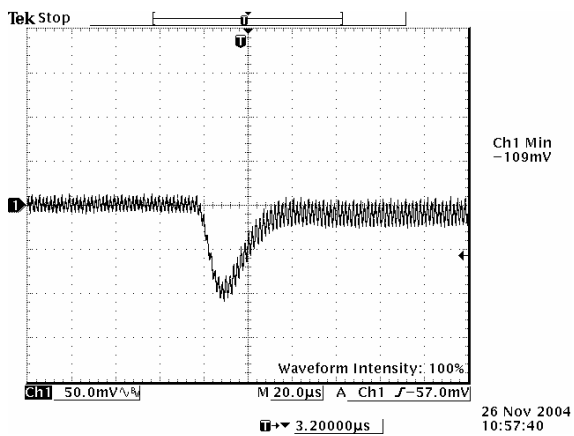
Transients 50% to 100% load 3.3 Vdc output

Transients 100% to 50% load 3.3 Vdc output



Transients 50% to 100% load 2.5 Vdc output

Transients 100% to 50% load 2.5 Vdc output



Transients 50% to 100% load 1.8 Vdc output

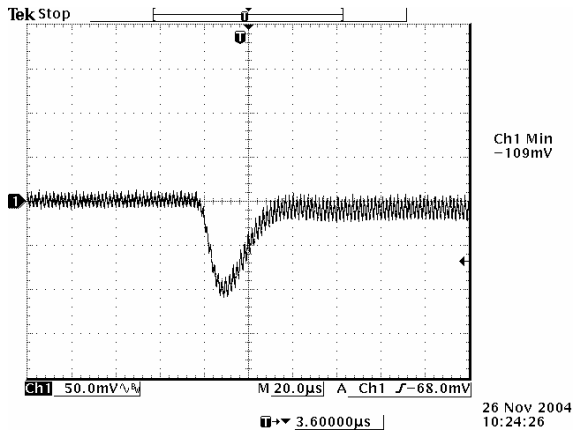
Transients 100% to 50% load 1.8 Vdc output

# NON-ISOLATED DC/DC CONVERTERS

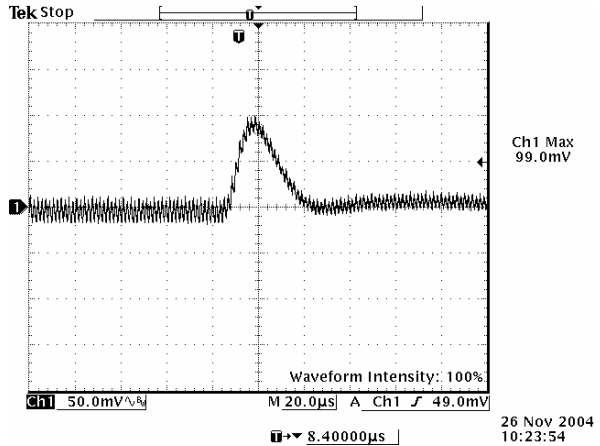
5.4 Vdc - 13.2 Vdc Input 1.0 Vdc - 5.0 Vdc Output / 20 A



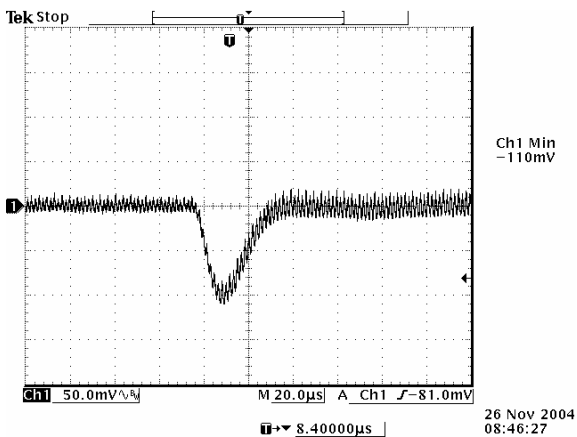
## Transient Response Waveforms (continued)



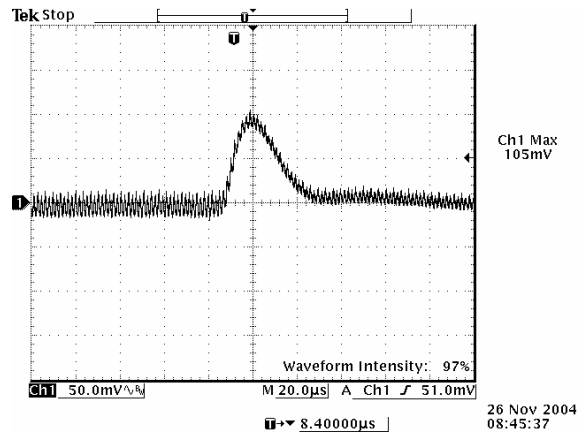
Transients 50% to 100% load 1.5 Vdc output



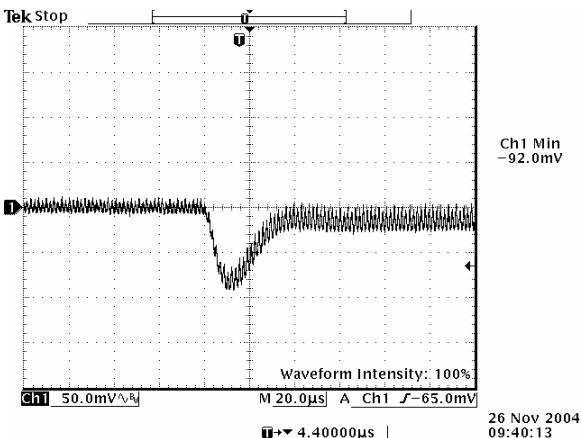
Transients 100% to 50% load 1.5 Vdc output



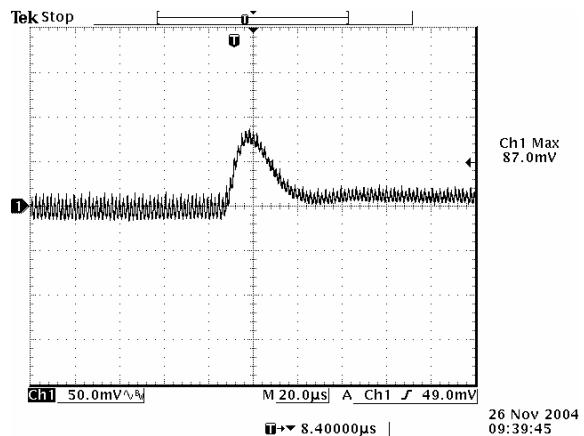
Transients 50% to 100% load 1.2 Vdc output



Transients 100% to 50% load 1.2 Vdc output



Transients 50% to 100% load 1.0 Vdc output



Transients 100% to 50% load 1.0 Vdc output

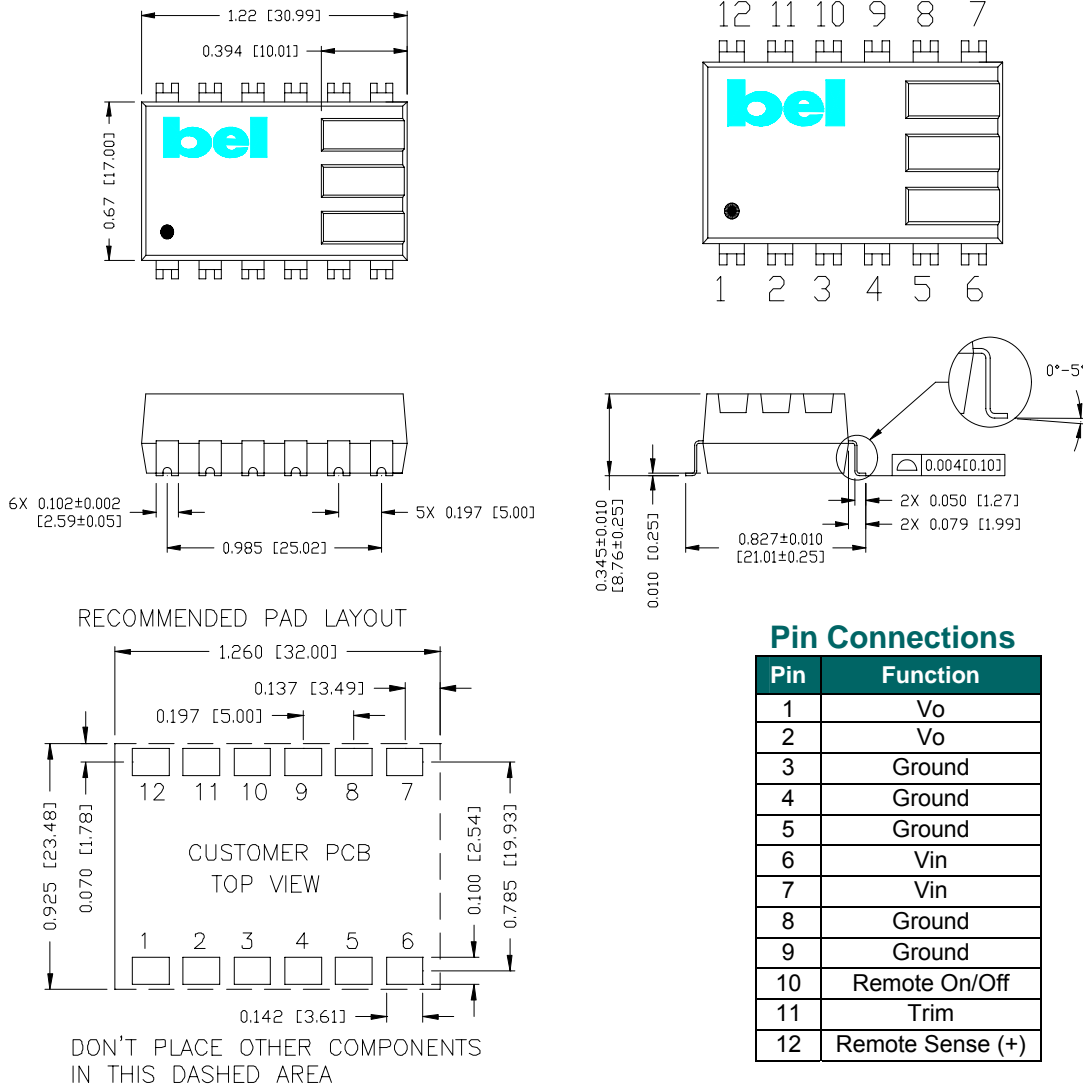
**Note:** Transient response at 8 V input,  $di/dt=0.5$  A/ $\mu$ s, with external 680  $\mu$ F tantalum capacitor,  $T_a=25$  deg C.

# NON-ISOLATED DC/DC CONVERTERS

5.4 Vdc - 13.2 Vdc Input 1.0 Vdc - 5.0 Vdc Output / 20 A



## Mechanical Outline



**Note:** Though there are 5 GND pins (3,4,5,8,9), it is highly recommended that all of them should be used in the system application, because of the current and the thermal conduction.

## 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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