

## NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input 0.75 Vdc - 3.63 Vdc/16 A Output

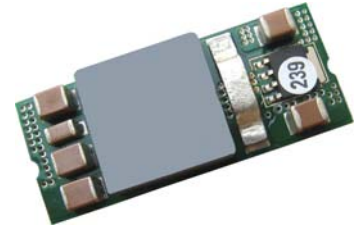
**bel**  
POWER PRODUCTS

**SRBC-16E2Ax**

**RoHS Compliant**

**Rev.A**

- Non-Isolated
- High Efficiency
- High Power Density
- Excellent Thermal Performance
- Low Cost
- Flexible Output Voltage Sequencing (option)
- Able to Sink & Source Current
- Industrial Temperature Range
- Under-voltage Lockout (UVLO)
- Over Temperature Protection
- OCP/SCP
- Wide Input
- Wide Trim
- Remote On/Off
- Active Low/High (option)
- Remote Sense



### Description

The Bel SRBC-16E2Ax 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 Bel SRBC-16E2Ax has a sequencing feature that enables designers to implement various types of output voltage sequencing when powering. 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-16E2AL	SRBC-16E2A0

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

### 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	
Sequencing Voltage <sup>1</sup>	-0.3 V	-	$V_{in}$	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-55 °C	-	125 °C	

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

1. SRBC-16E2Ax series of modules include a sequencing feature that enables users to implement various types of output voltage sequencing in their applications. This is accomplished via an additional sequencing pin. When not using the sequencing feature, either, tie the SEQ pin to  $V_{in}$  or leave it unconnected.

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### Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
Vo,set < 3.0 V	4.5 V	-	14 V	
Vo,set ≥ 3.0 V	Vo,set +1.5 V	-	14 V	
Input Current (full load)	-	-	15 A	
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 <sup>2</sup> t 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	

### Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point	-2% Vo,set	-	2% Vo,set	Vin=12 V, full load
Load Regulation	-	0.1% Vo,set	-	Io=Iomin to Iomax
Line Regulation	-	0.1% Vo,set	-	Vin=Vinmin to Vinmax
Regulation Over Temperature (-40 °C to +85 °C)	-	0.3% Vo,set	-	Tref=Tamin to Tamax
Output Current	0 A	-	16 A	
Current Limit Threshold	-	180% Io	-	
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, 10 uF tantalum capacitor & 1 uF TDK 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% Vo,set	
Output Capacitance	-	-	5000 uF	
<b>Transient Response</b>				
50% ~ 100% Max Load	All	-	150 mV	di/dt=2.5 A/uS; Vin=12 V; and with 2 × 150 uF polymer capacitors 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.

## NON-ISOLATED DC/DC CONVERTERS

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### General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency				
Vo=3.3 V	-	92%	-	Measured at Vin=12 V, full load
Vo=2.5 V	-	90%	-	
Vo=1.8 V	-	88%	-	
Vo=1.5 V	-	87%	-	
Vo=1.2 V	-	85%	-	
Vo=0.75 V	-	79%	-	
Efficiency				
Vo=3.3 V	-	92%	-	Measured at Vin=5 V, full load
Vo=2.5 V	-	90%	-	
Vo=1.8 V	-	87%	-	
Vo=1.5 V	-	86%	-	
Vo=1.2 V	-	83%	-	
Vo=0.75 V	-	78%	-	
Switching Frequency	200 kHz	230 kHz	260 kHz	
Over Temperature Shutdown <sup>1</sup>	-	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 (Io =80% Iomax; Vo=3.3 V; Vin=12 V; Ta = 25 °C)
Dimensions				
Inches (L x W x H)	1.30 x 0.53 x 0.315			
Millimeters (L x W x H)	33.02 x 13.46 x 8.00			
Weight	-	8 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)	-0.2 V	-	0.3 V	SRBC-16E2A0; Remote On/Off pin open, Unit on.
Signal High (Unit On)	-	-	Vin, max	
Signal Low (Unit On)	-0.2 V	-	0.3 V	SRBC-16E2AL; Remote On/Off pin open, Unit on.
Signal High (Unit Off)	2.5 V	-	Vin, max	
<b>Voltage Sequencing</b>				
Sequencing Delay Time	25 mS	-	-	Delay from Vinmin to application of voltage on SEQ pin
Sequencing Slew Rate Capability	-	-	2 V/mS	Vinmin to Vinmax; Iomin to Iomax; Vseq<Vo
Tracking Accuracy				
Power-Up	-	100 mV	200 mV	
Power-Down	-	200 mV	400 mV	

## NON-ISOLATED DC/DC CONVERTERS

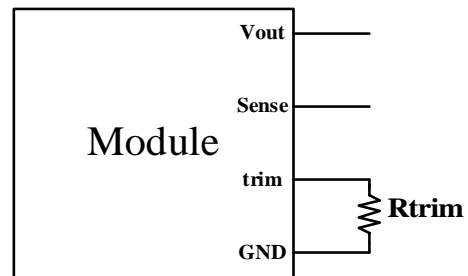
4.5 Vdc - 14 Vdc Input 0.75 Vdc - 3.63 Vdc/16 A Output

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POWER PRODUCTS

### Output Trim Equations

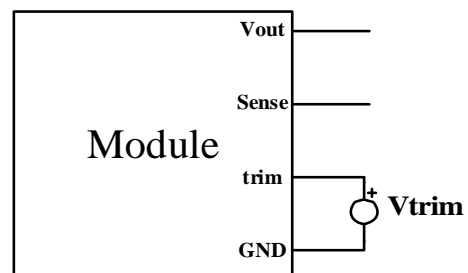
Equation for calculating the trim resistor (in  $\Omega$ ) given the desired output voltage ( $V_o$ ) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

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



Equation for calculating the trim voltage (in V) given the desired output voltage ( $V_o$ ) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

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

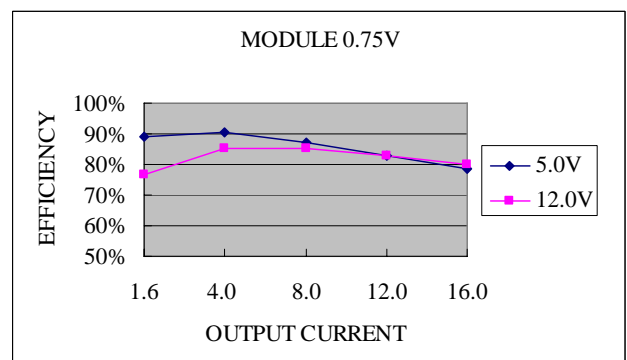
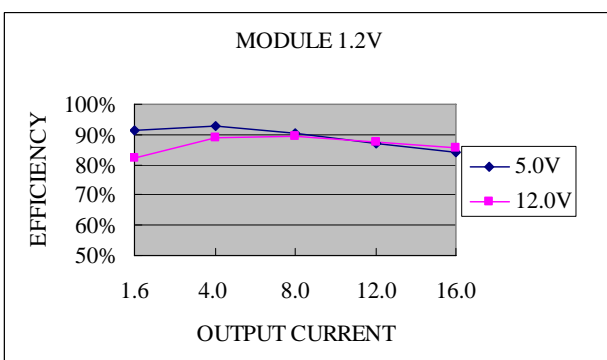
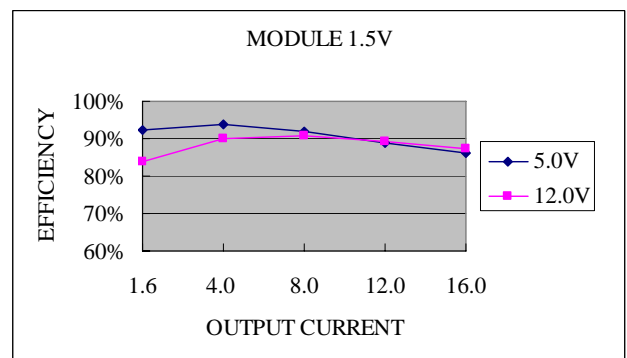
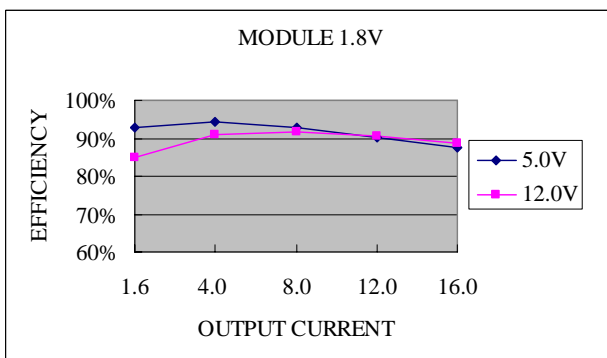
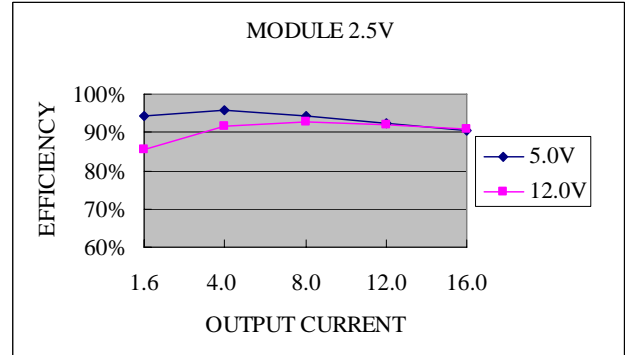
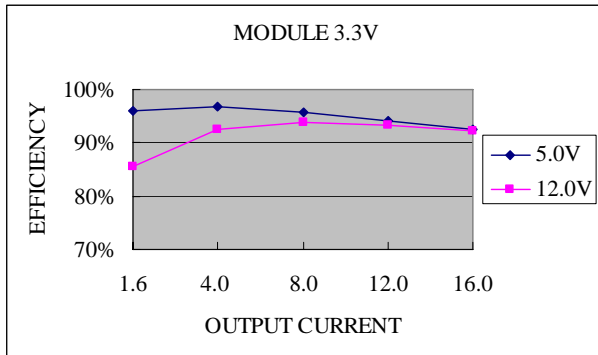


# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input 0.75 Vdc - 3.63 Vdc/16 A Output



## Efficiency Data

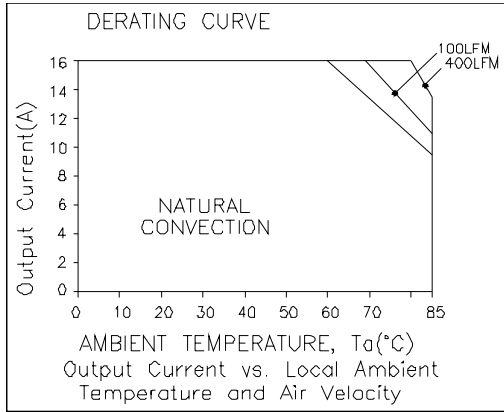


# NON-ISOLATED DC/DC CONVERTERS

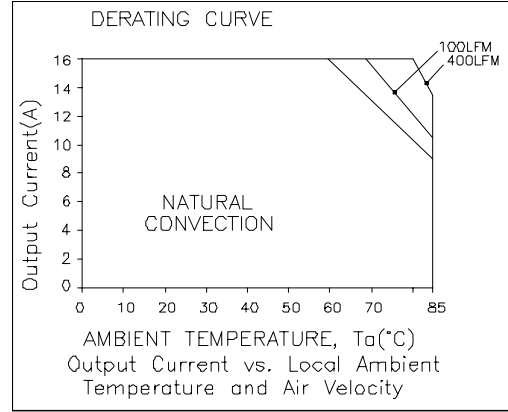
4.5 Vdc - 14 Vdc Input 0.75 Vdc - 3.63 Vdc/16 A Output



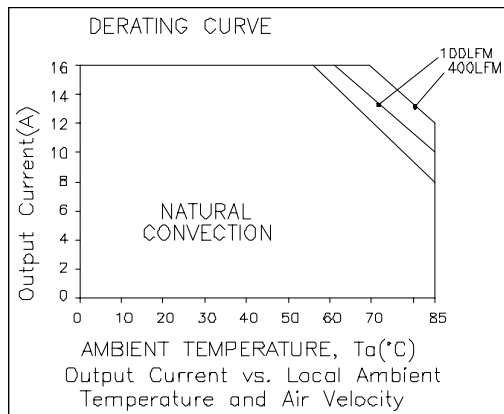
## Thermal Derating Curves



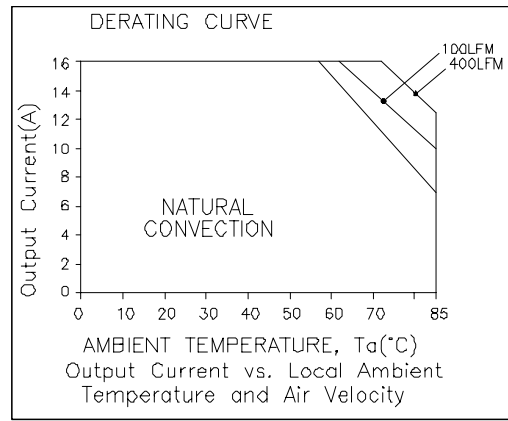
$V_{in}=5\text{ V}, V_o=0.75\text{ V}$



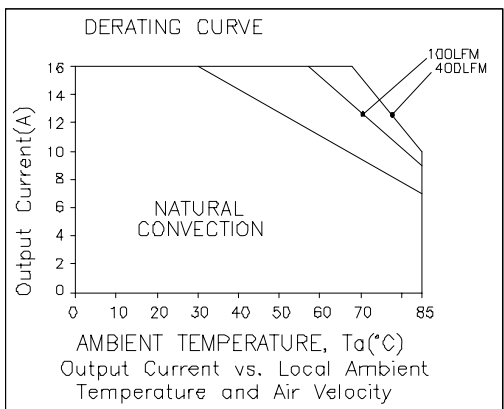
$V_{in}=12\text{ V}, V_o=0.75\text{ V}$



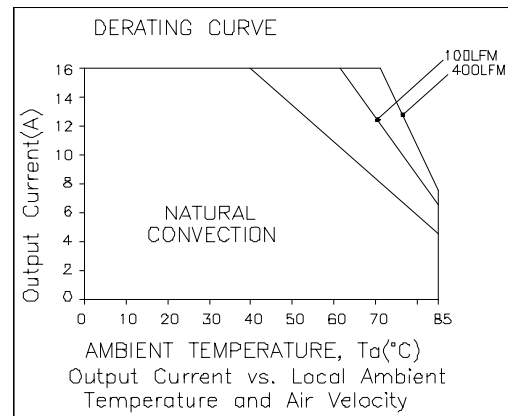
$V_{in}=5\text{ V}, V_o=1.8\text{ V}$



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



$V_{in}=5\text{ V}, V_o=3.3\text{ V}$



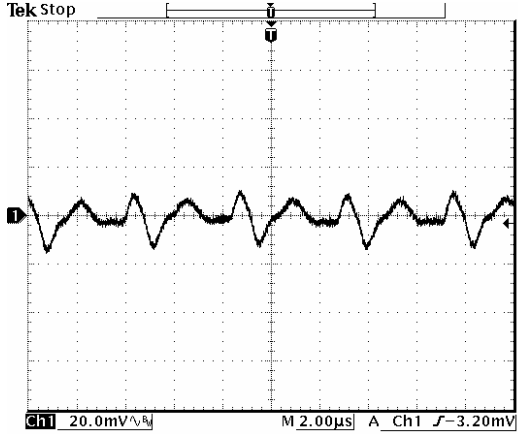
$V_{in}=12\text{ V}, V_o=3.3\text{ V}$

# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input 0.75 Vdc - 3.63 Vdc/16 A Output



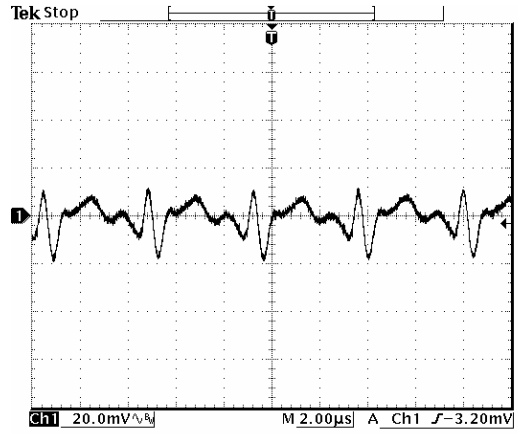
## Ripple and Noise Waveforms



Ch1 Pk-Pk  
26.0mV  
Ch1 RMS  
5.31mV

19 Apr 2004  
13:08:34

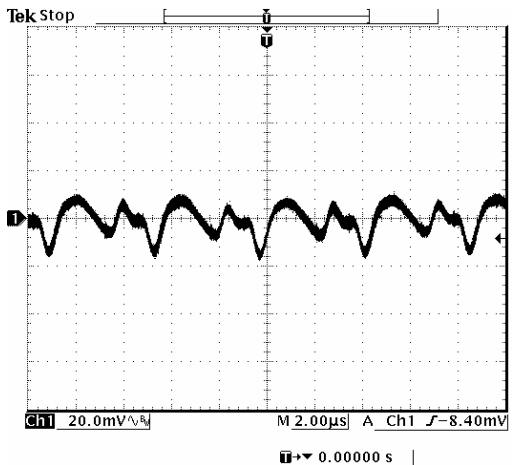
Vin=5 V, Vo=0.7525 V



Ch1 Pk-Pk  
30.8mV  
Ch1 RMS  
6.17mV

19 Apr 2004  
13:09:02

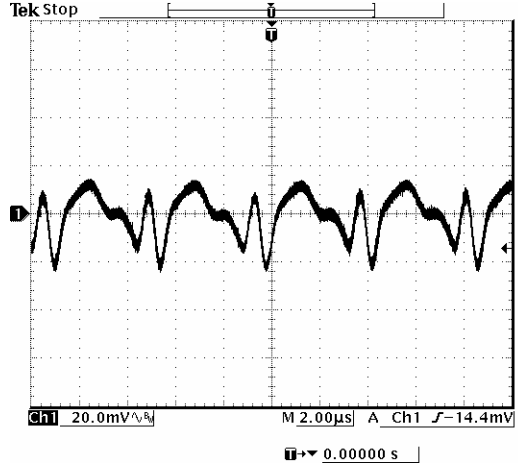
Vin=12 V, Vo=0.7525 V



Ch1 Pk-Pk  
26.8mV  
Ch1 RMS  
6.02mV

21 Apr 2004  
11:16:37

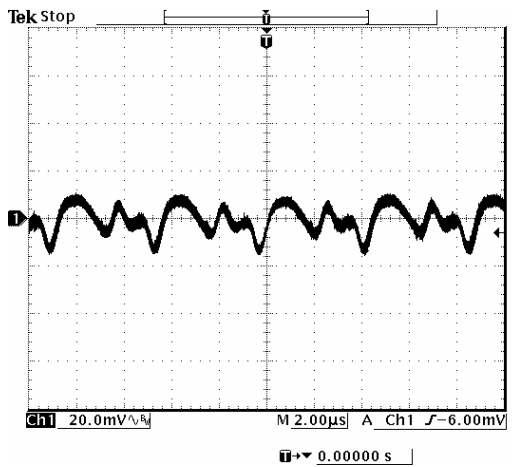
Vin=5 V, Vo=1.2 V



Ch1 Pk-Pk  
37.6mV  
Ch1 RMS  
9.06mV

21 Apr 2004  
11:16:55

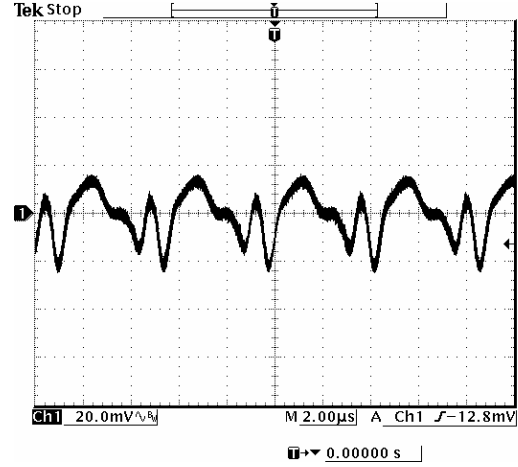
Vin=12 V, Vo=1.2 V



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

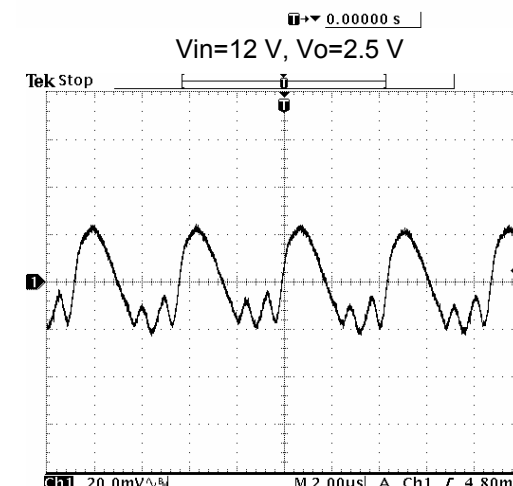
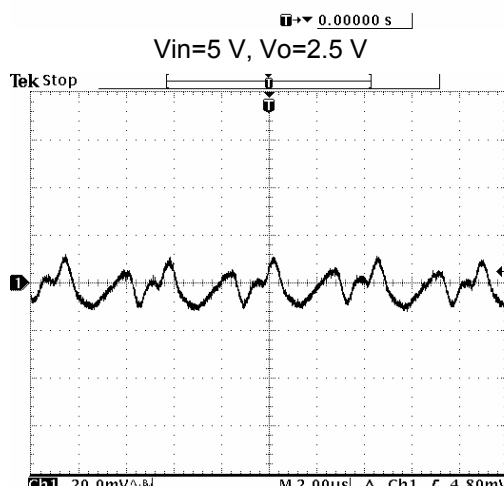
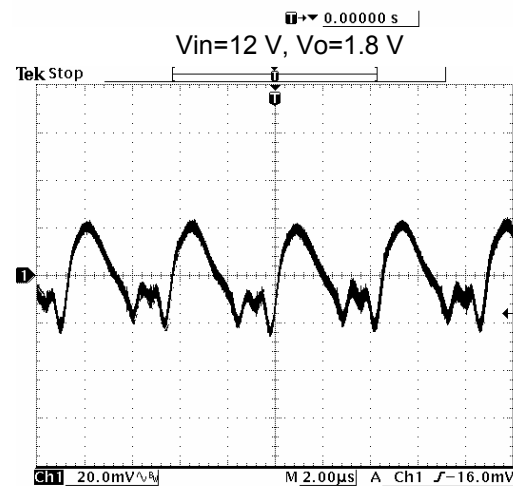
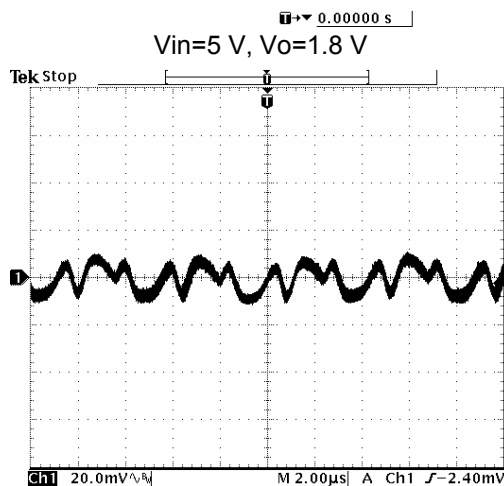
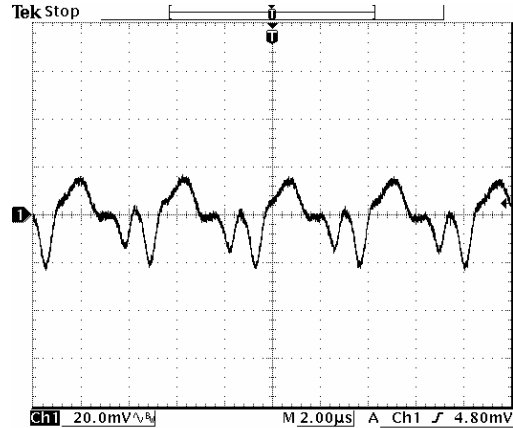
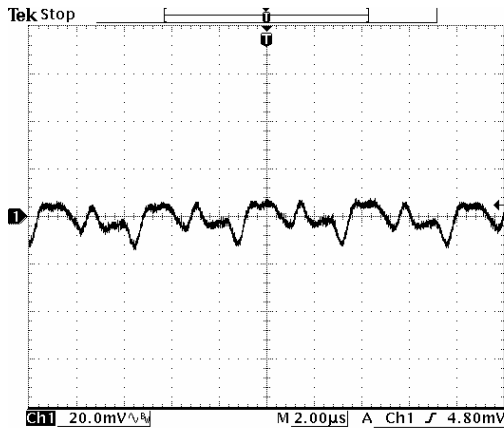
Vin=12 V, Vo=1.5 V

# 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)



Vin=5 V, Vo=3.3 V

Vin=12 V, Vo=3.3 V

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

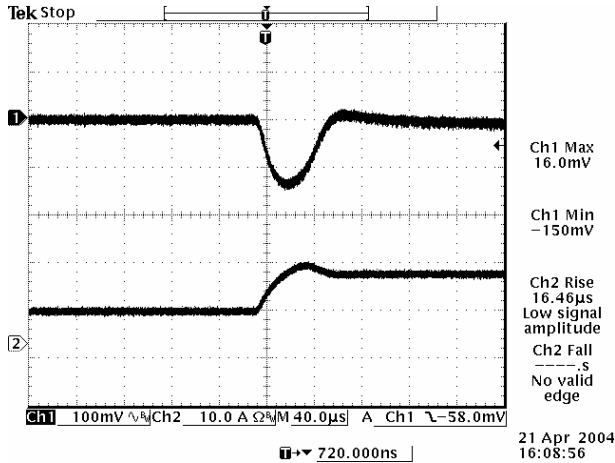


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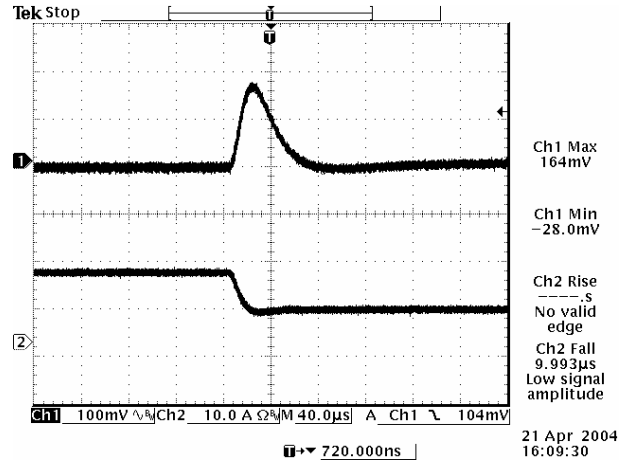
4.5 Vdc - 14 Vdc Input 0.75 Vdc - 3.63 Vdc/16 A Output



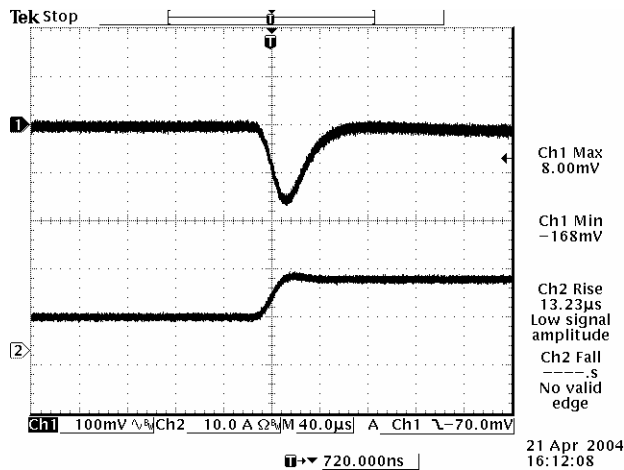
## Transient Response Waveforms



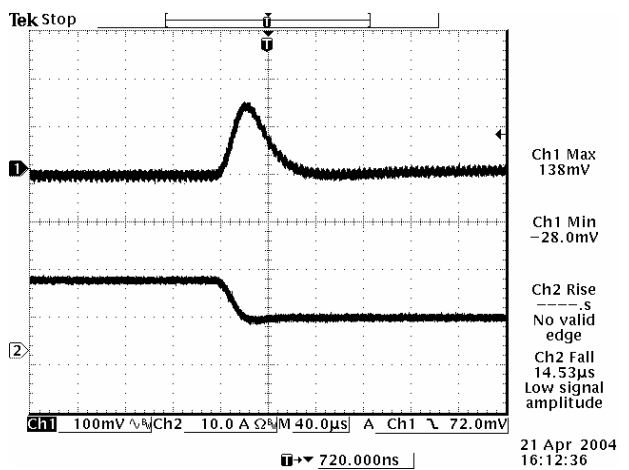
50% to 100% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=0.75\text{ V}$



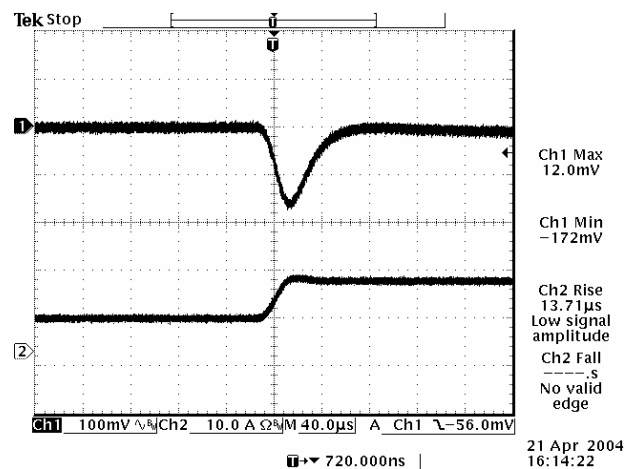
100% to 50% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=0.75\text{ V}$



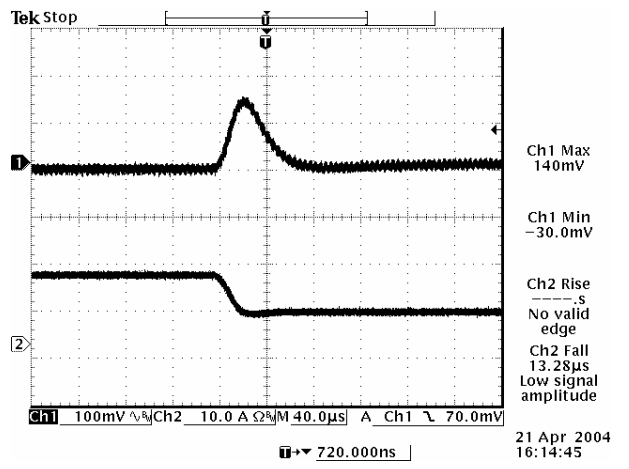
50% to 100% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=1.2\text{ V}$



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



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



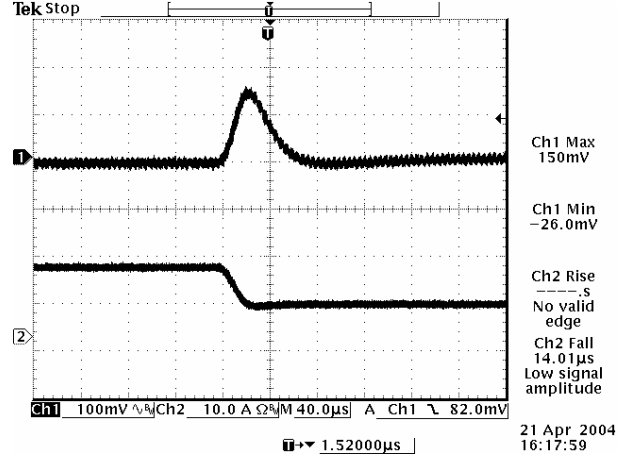
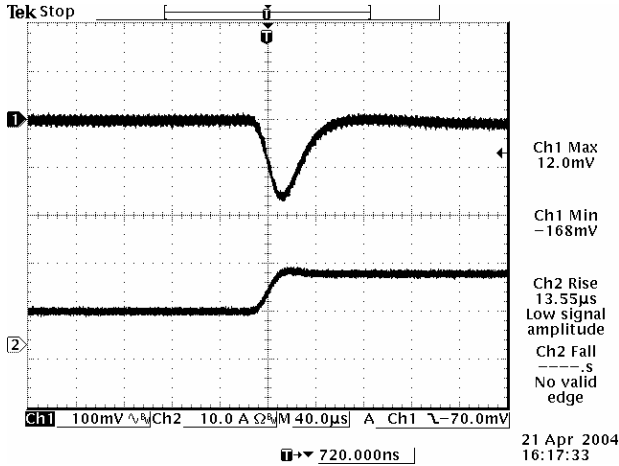
100% to 50% load Transient at  $V_{in}=5\text{ V}$ ,  $V_o=1.5\text{ V}$

# NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input 0.75 Vdc - 3.63 Vdc/16 A Output

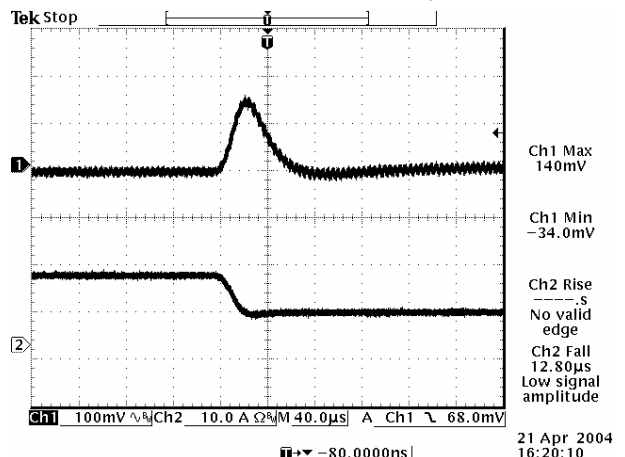
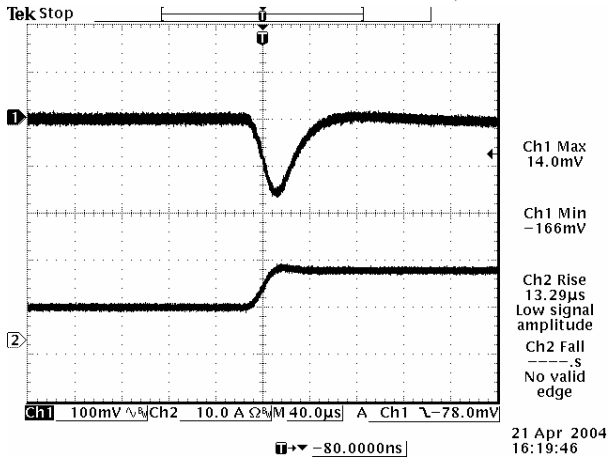


## Transient Response Waveforms (continued)



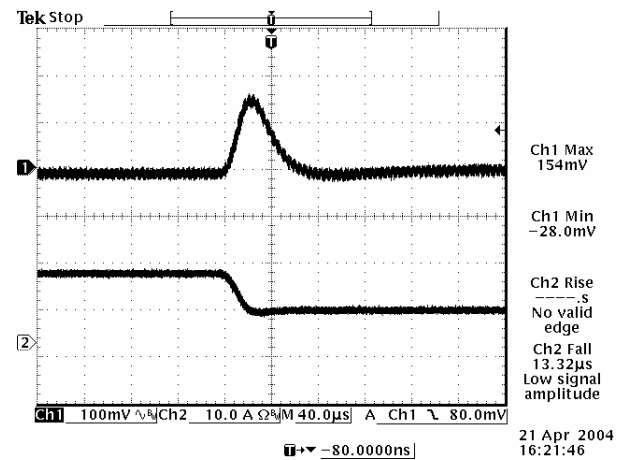
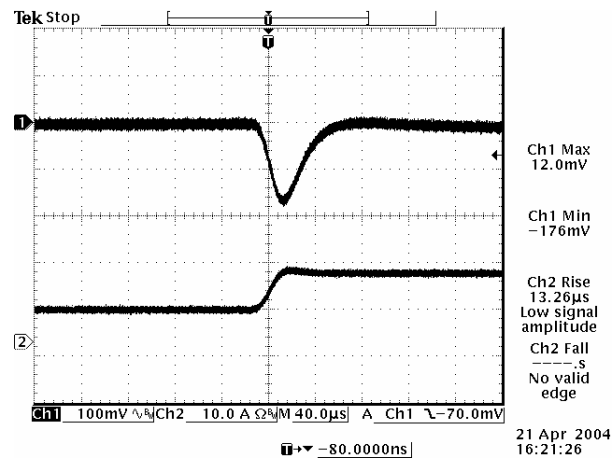
50% to 100% load Transient at Vin=5 V, Vo=1.8 V

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



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



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

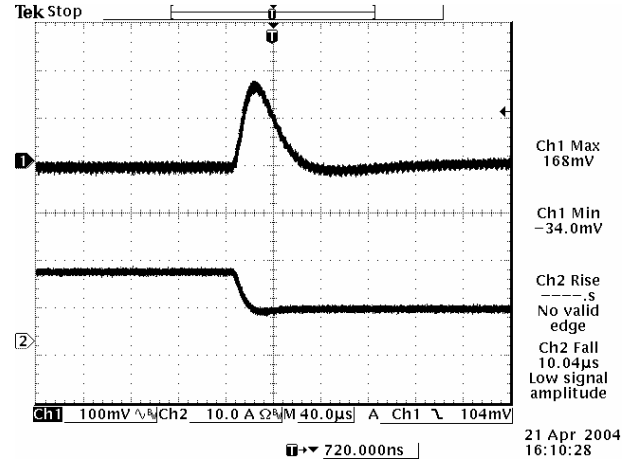
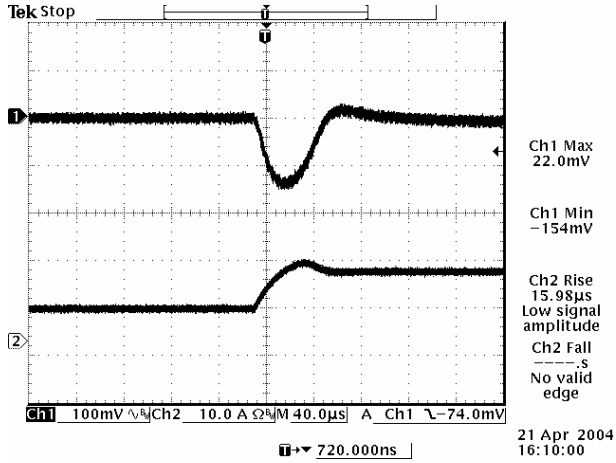
100% to 50% load Transient at Vin=5 V, Vo=3.3 V

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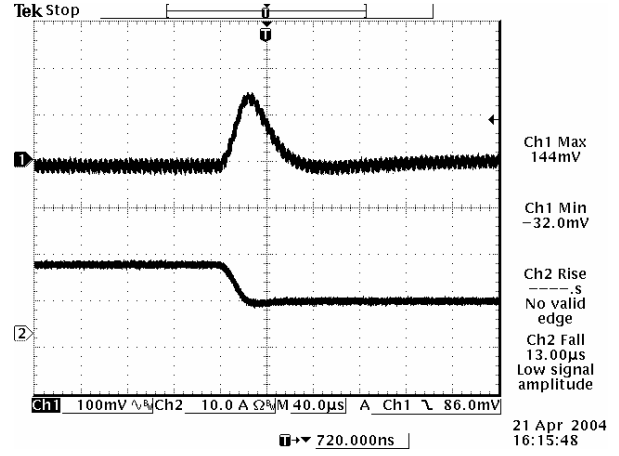
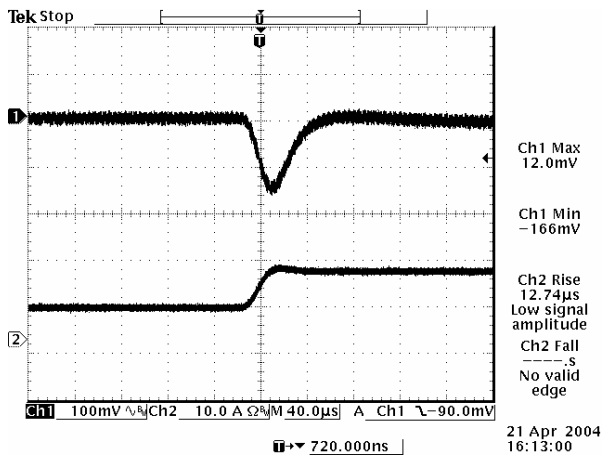


## Transient Response Waveforms (continued)



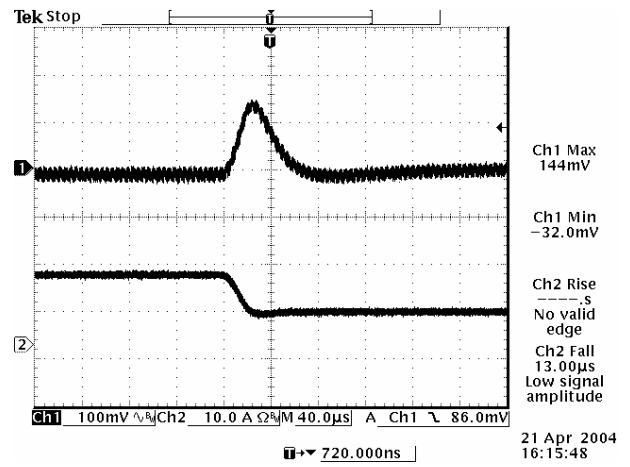
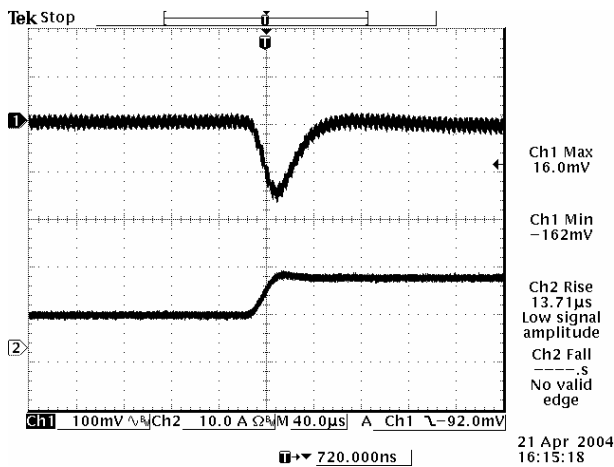
50% to 100% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=0.75\text{ V}$

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  $V_{in}=12\text{ V}$ ,  $V_o=1.5\text{ V}$

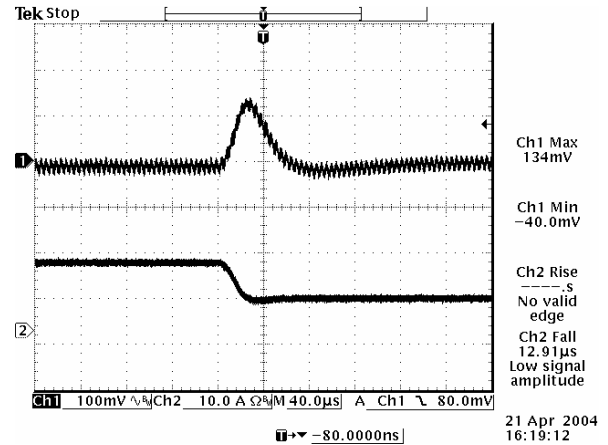
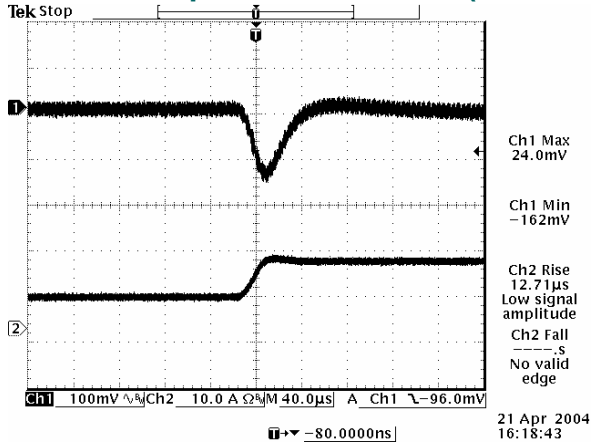
100% to 50% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=1.5\text{ V}$

# NON-ISOLATED DC/DC CONVERTERS

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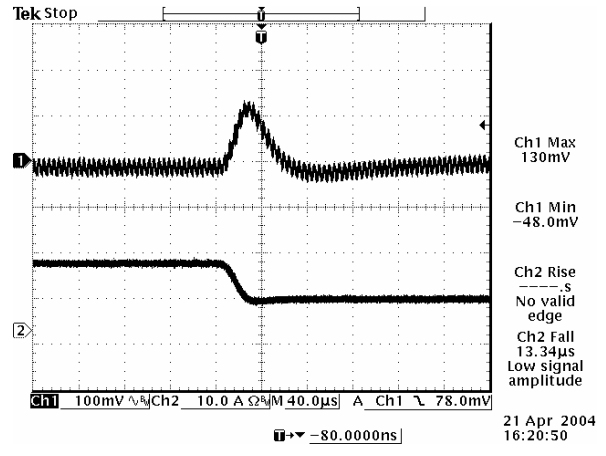
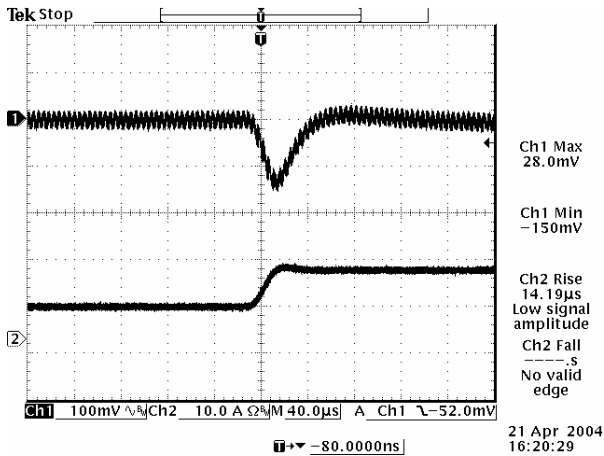


## Transient Response Waveforms (continued)



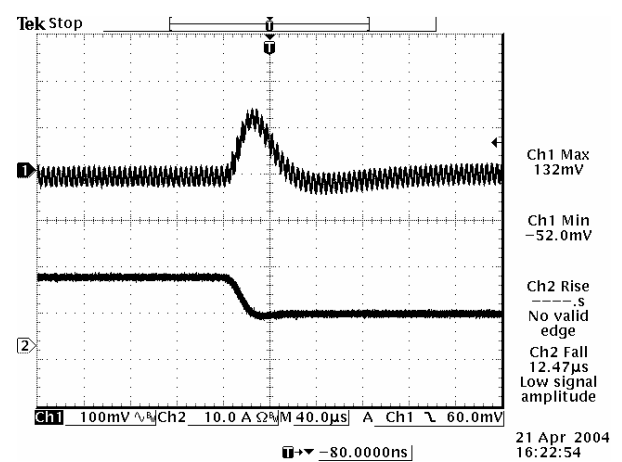
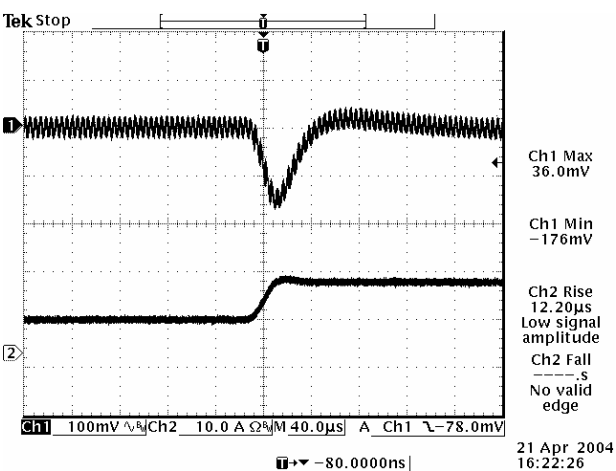
50% to 100% load Transient at  $V_{in}=12\text{ V}$ ,  $V_o=1.8\text{ V}$

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

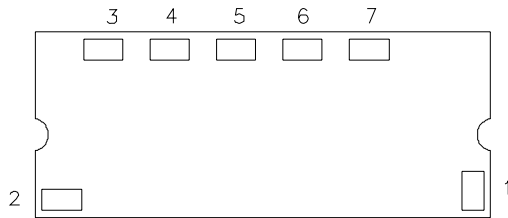
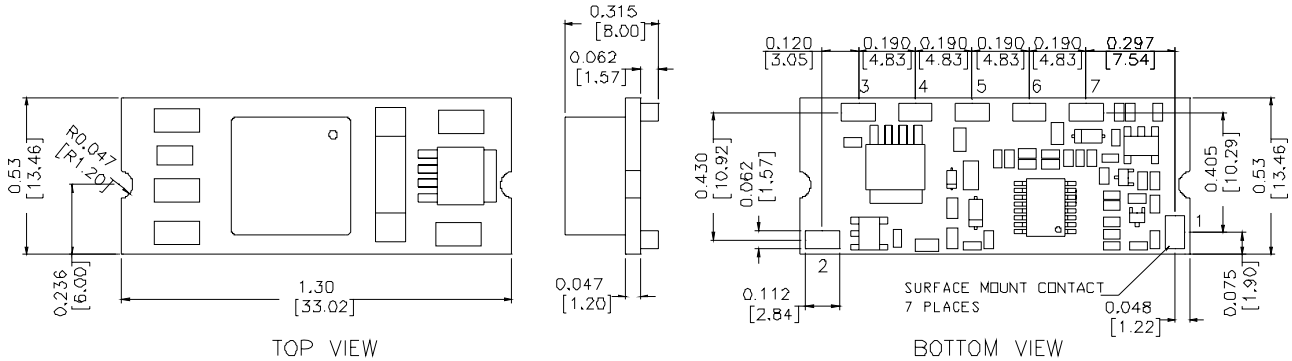
**Note:** Transient response with external load capacitance  $C_{ext}=2 \times 150\mu\text{F}$  (Polymer capacitors), and  $T_a=25^\circ\text{C}$ .

# NON-ISOLATED DC/DC CONVERTERS

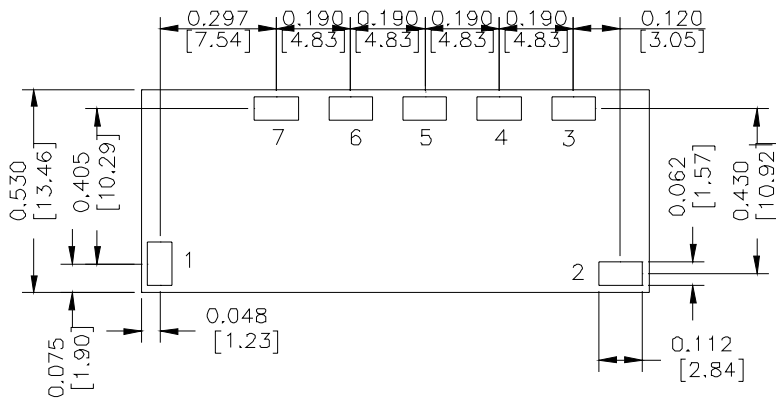
4.5 Vdc - 14 Vdc Input 0.75 Vdc - 3.63 Vdc/16 A Output



## Mechanical Outline



### RECOMMENDED PAD LAYOUT



### Pin Connections

Pin	Function
1	Remote On/Off
2	Vin
3	SEQ
4	Ground
5	Vout
6	Trim
7	Remote 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.



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Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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