

## NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

0.75 Vdc - 3.63 Vdc/10 A Output



Jan. 25, 2013

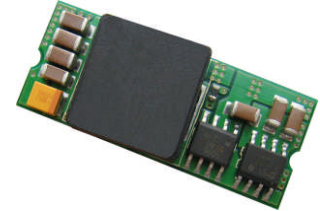
*Bel Power, Inc. , a subsidiary of Bel Fuse, Inc.*

**SRBC-10F2Ax**

**RoHS Compliant**

**Rev.C**

- Non-Isolated
- High Efficiency
- High Power Density
- Fixed Frequency(300 kHz)
- OCP/SCP
- Flexible Output Voltage Sequencing
- Remote Sense
- Certificated to UL60950-1/CSA C22.2 No.60950-1, 2rd edition, am1
- Under-Voltage Lockout (UVLO)
- Over Temperature Protection
- Wide Input Range
- Wide Trim Range
- Remote On/Off
- Converter Can Sink and Source Current



### Applications

- Networking
- Computers and peripherals
- Telecommunications

### Description

The Bel SRBC-10F2Ax modules are a series of non-isolated dc/dc converters that deliver up to 10 A of output current with full load efficiency of 95% at 3.3 Vdc output. These modules provide precisely regulated voltage programmable via external resistor from 0.75 Vdc to 3.63 Vdc over a wide range of input voltage (2.4 Vdc - 5.5 Vdc). These modules have a sequencing feature that enables designers to implement various types of output voltage sequencing when powering multiple voltages on a board. The open-frame construction and small footprint enable designers to develop cost and space-efficient solutions. Standard features include remote On/Off, remote sense, over current protection, short current protection, wide input, and programmable output voltage.

### 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 <sup>1</sup>	2.4 V - 5.5 V	10 A	36.3 W	95%	SRBC-10F2AL	SRBC-10F2A0

- Notes:** 1. These modules use a buck topology, so the output voltages must be 0.5 V less than the input voltage.  
2. Add "G" to the end of the Model Number to indicate Tray Packaging.

### Part Number Explanation

S R BC - 10 F 2A x  
1 2 3 4 5 6 7

1---Surface mount

2---RoHS 6, change "R" to "7" means RoHS 5

3---Series name

4---Series code

5---Wide input range (2.4-5.5V)

6---Wide trim

7---Option, "x" of the model part number to be 0-9, A-Z, which will represent the special request of customer.

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## Absolute Maximum Ratings

Parameter	Min	Typ	Max	Notes
Input Voltage (continuous)	-0.3 V	-	5.8 V	
Output Enable Terminal Voltage	-0.3 V	-	5.8 V	
Sequencing Voltage <sup>1</sup>	-0.3 V	-	V <sub>in</sub>	
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-10F2Ax 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 the sequencing feature is not used, tie the SEQ pin to V<sub>in</sub> or leave the SEQ pin floating.

## Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	2.4 V	-	5.5 V	V <sub>o, set</sub> ≤ V <sub>in</sub> -0.5 V
Input Current (full load)				
V <sub>o</sub> =3.3 V	-	7.0 A	8.0 A	
V <sub>o</sub> =2.5 V	-	5.5 A	9.5 A	
V <sub>o</sub> =1.8 V	-	4.0 A	9.0 A	
V <sub>o</sub> =1.5 V	-	3.5 A	7.5 A	
V <sub>o</sub> =1.2 V	-	3.0 A	6.0 A	
V <sub>o</sub> =0.75 V	-	2.0 A	4.0 A	
Input Current (no load)	-	80 mA	-	
Remote Off Input Current	-	15 mA	-	
Input Reflected Ripple Current (pk-pk)	-	140 mA	-	Tested with two 100 uF/10 V tantalum input capacitors & simulated source impedance of 1 uH, 5 Hz to 20 MHz.
Input Reflected Ripple Current (rms)	-	40 mA	-	
I <sup>2</sup> t Inrush Current Transient	-	-	0.2 A <sup>2</sup> s	
Turn-on Voltage Threshold	-	2.2 V	-	
Turn-off Voltage Threshold	-	2.0 V	-	

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

## Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point	-2% V <sub>o, set</sub>	-	2% V <sub>o, set</sub>	V <sub>in</sub> =5 V, I <sub>o</sub> =I <sub>o max</sub> full load
Output Voltage Set Point	-3% V <sub>o, set</sub>	-	3% V <sub>o, set</sub>	Over all operating input voltages, resistive loads & temperature conditions
Load Regulation	-	0.4% V <sub>o, set</sub>	-	I <sub>o</sub> =I <sub>o min</sub> to I <sub>o max</sub>
Line Regulation	-	0.3% V <sub>o, set</sub>	-	V <sub>in</sub> =V <sub>in min</sub> to V <sub>in max</sub>
Regulation Over Temperature (-40 °C to +85 °C)	-	0.5% V <sub>o, set</sub>	-	T <sub>ref</sub> =T <sub>amin</sub> to T <sub>amax</sub>
Output Current	0 A	-	10 A	
Current Limit Threshold	15 A	-	27 A	
Short Circuit Surge Transient	-	-	1.5 A <sup>2</sup> s	
Ripple and Noise (pk-pk)	-	25 mV	50 mV	Tested with 0-20 MHz, 10 uF/16 V tantalum capacitor & 1 uF/10 V TDK ceramic capacitor at the output
Ripple and Noise (rms)	-	8 mV	15 mV	

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## Output Specifications (continued)

Parameter	Min	Typ	Max	Notes
Turn on Time	-	4 mS	8 mS	Turn on Time
Overshoot at Turn on	-	0% Vo,set	3% Vo,set	Overshoot at Turn on
Output Capacitance				Output Capacitance
ESR ≥ 1m ohm	0 uF	-	1000 uF	ESR ≥ 1m ohm
ESR ≥ 10m ohm	0 uF	-	4700 uF	ESR ≥ 10m ohm
<b>Transient Response</b>				
50% ~ 100% Max Load	-	130 mV	-	di/dt=2.5 A/uS; Vin=5 V; and with two 150 uF/16 V tantalum capacitors & 1uF/10 V ceramic capacitor at the output
Settling Time	-	50 uS	-	
100% ~ 50% Max Load	-	150 mV	-	
Settling Time	-	50 uS	-	
50% ~ 100% Max Load	-	130 mV	-	
Settling Time	-	50 uS	-	
100% ~ 50% Max Load	-	130 mV	-	
Settling Time	-	50 uS	-	
50% ~ 100% Max Load	-	120 mV	-	
Settling Time	-	50 uS	-	
100% ~ 50% Max Load	-	120 mV	-	
Settling Time	-	50 uS	-	
50% ~ 100% Max Load	-	120 mV	-	
Settling Time	-	50 uS	-	
100% ~ 50% Max Load	-	120 mV	-	
Settling Time	-	50 uS	-	
50% ~ 100% Max Load	-	130 mV	-	
Settling Time	-	50 uS	-	
100% ~ 50% Max Load	-	130 mV	-	
Settling Time	-	50 uS	-	
50% ~ 100% Max Load	-	120 mV	-	
Settling Time	-	50 uS	-	
100% ~ 50% Max Load	-	140 mV	-	
Settling Time	-	50 uS	-	

**Note:** All specifications are typical at nominal input (Vin=5 V), full load at 25 °C unless otherwise stated.

# NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

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## General Specifications

Parameter	Min	Typ	Max	Notes	
Efficiency	Vo=3.3 V	92%	95%	-	Measured at Vin=5 V, full load
	Vo=2.5 V	90%	93%	-	
	Vo=1.8 V	88%	91%	-	
	Vo=1.5 V	87%	90%	-	
	Vo=1.2 V	85%	88%	-	
	Vo=0.75 V	79%	82%	-	
Switching Frequency	250 kHz	300 kHz	350 kHz		
Over Temperature Shutdown	-	125 °C	-		
Output Trim Range (Wide Trim)	0.7525 V	-	3.63 V		
Remote Sense Compensation	-	10%	-		
MTBF	6,643,156 hours			Calculated Per Bell Core SR-332 (Io = Nominal; 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	-	6.6 g	-		

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

## Control Specifications

Parameter	Min	Typ	Max	Notes
Signal Low (Unit Off)	-0.3 V	-	0.3 V	SRBC-10F2A0; Remote On/Off pin open, Unit on.
Signal High (Unit On)	1.5 V	-	5.8 V	
Signal Low (Unit On)	-0.3 V	-	0.3 V	SRBC-10F2AL; Remote On/Off pin open, Unit on.
Signal High (Unit Off)	1.5 V	-	5.8 V	
Sequencing Voltage	0.05 V	-	Vin	Sequencing Voltage should be higher than output voltage.
Sequencing Slew Rate Capability	-	-	2 V/mS	
Sequencing Delay Time	10 mS	-	-	Delay from Vin, min to application of voltage on SEQ pin
Tracking Accuracy	Power-Up	-	100 mV	200 mV
	Power-Down	-	200 mV	400 mV

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**bel**

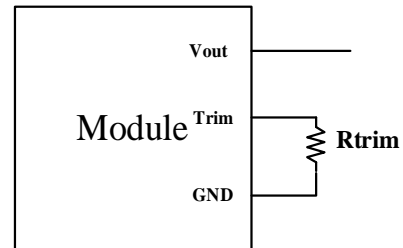
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### Output Trim Equations

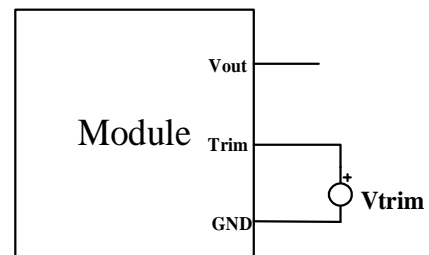
Equation for calculating the trim resistor (in k $\Omega$ ) given the desired adjusted voltage ( $V_{adj}$ ) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

$$R_{trim} = \frac{21.07}{V_{adj} - 0.7525} - 5.11$$



Equation for calculating the trim voltage (in V) given the desired adjusted voltage ( $V_{adj}$ ) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

$$V_{trim} = 0.7 - 0.1698 \times (V_{adj} - 0.7525)$$



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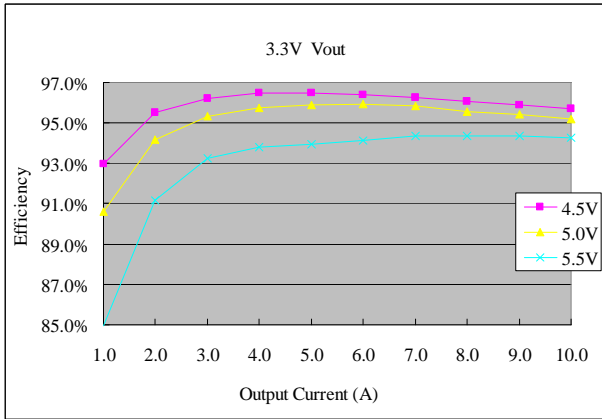
0.75 Vdc - 3.63 Vdc/10 A Output



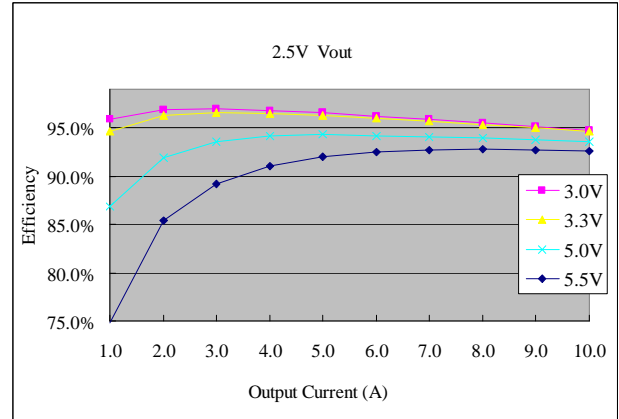
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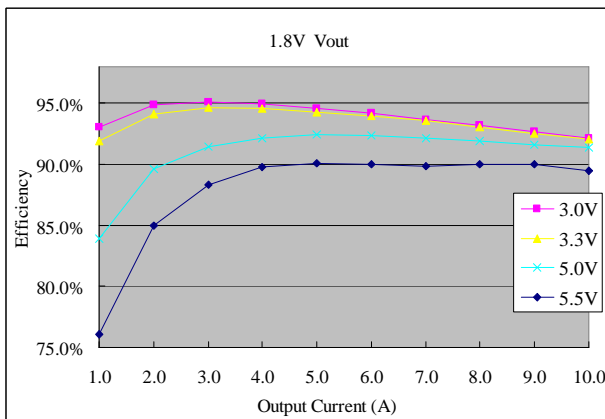
## Efficiency Data



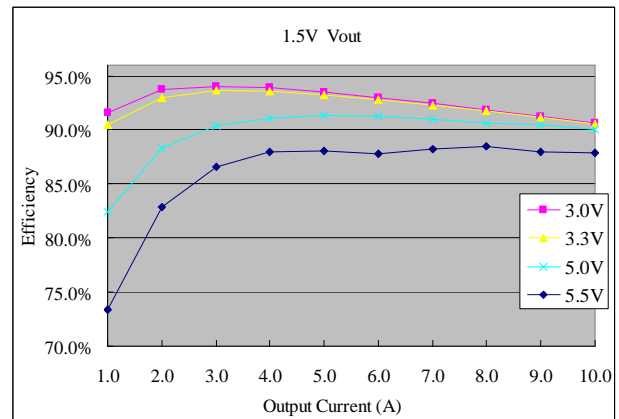
Vo=3.3 V



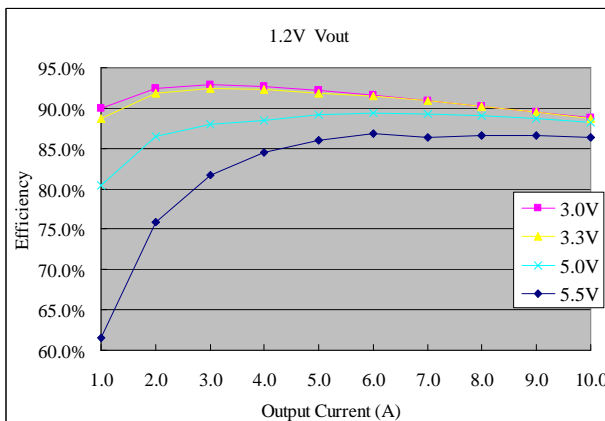
Vo=2.5 V



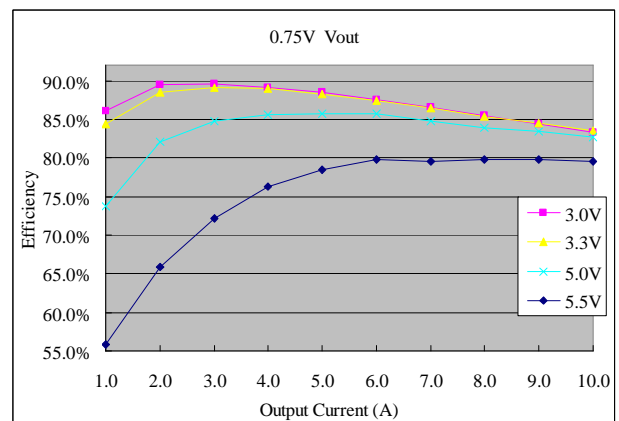
Vo=1.8 V



Vo=1.5 V



Vo=1.2 V



Vo=0.7525 V

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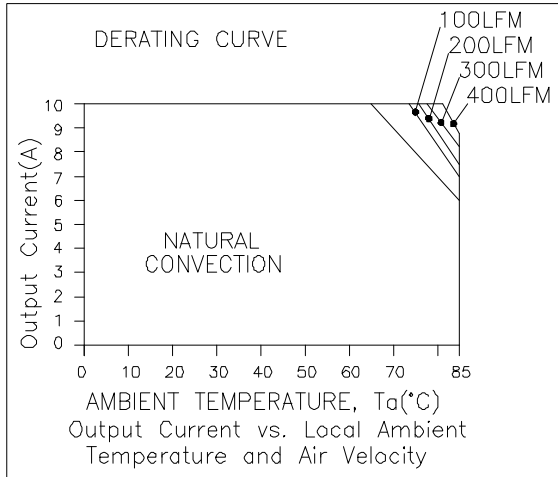
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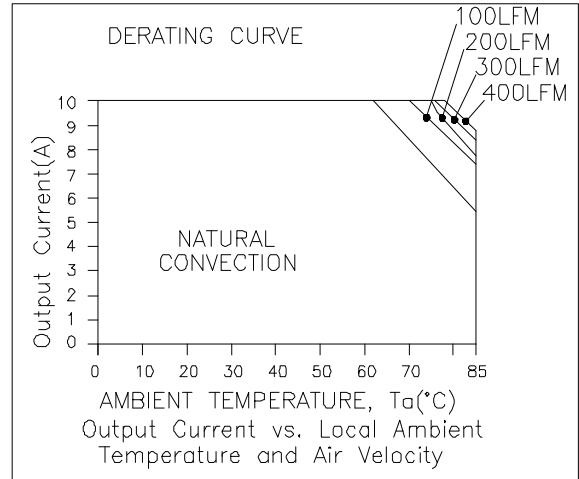
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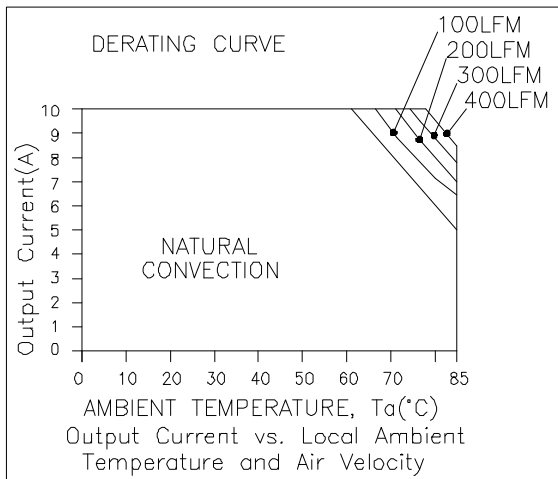
## Thermal Derating Curves



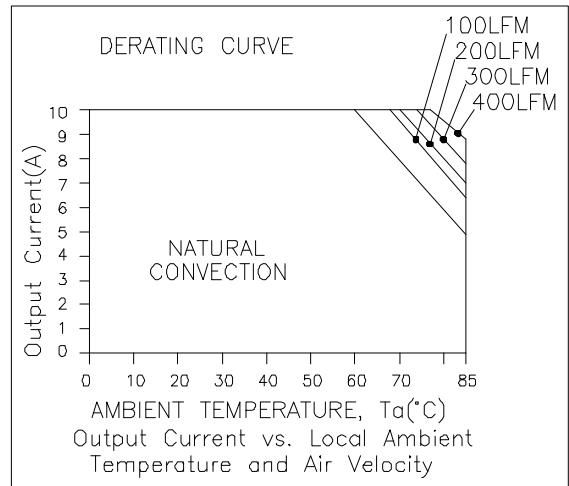
Vin=5.0 V, Vo=0.75 V



Vin=5.0 V, Vo=1.5 V



Vin=5.0 V, Vo=2.5 V



Vin=5.0 V, Vo=3.3 V

# NON-ISOLATED DC/DC CONVERTERS

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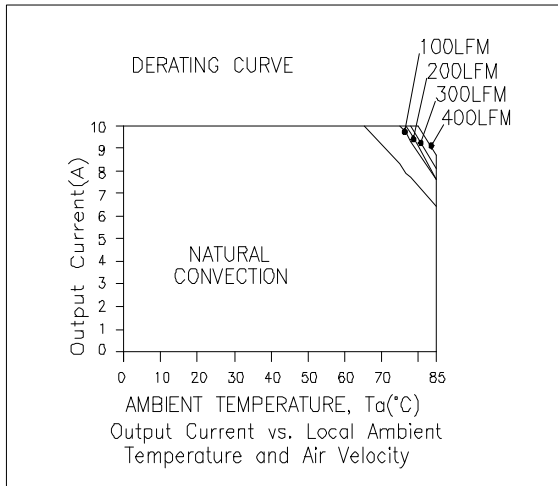
0.75 Vdc - 3.63 Vdc/10 A Output



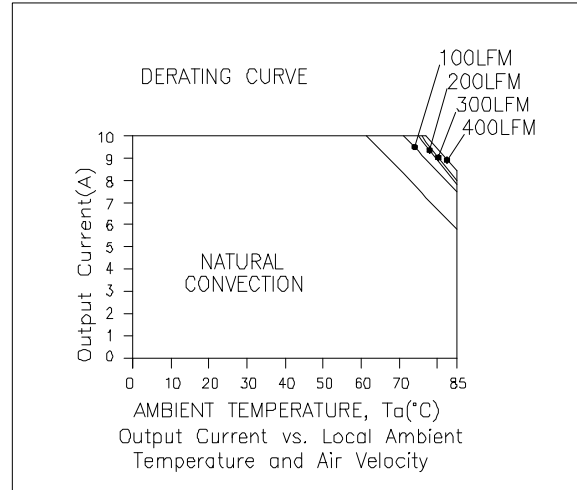
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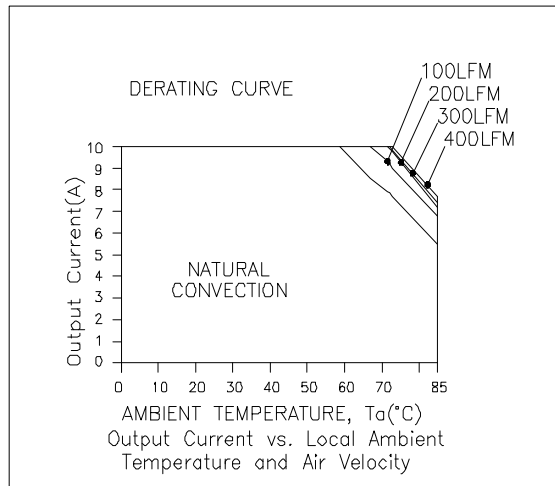
## Thermal Derating Curves (continued)



$V_{in}=3.3\text{ V}$ ,  $V_o=0.75\text{ V}$



$V_{in}=3.3\text{ V}$ ,  $V_o=1.5\text{ V}$



$V_{in}=3.3\text{ V}$ ,  $V_o=2.5\text{ V}$



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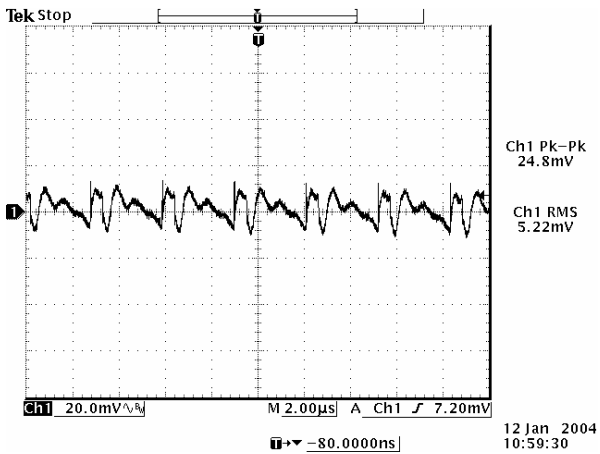
0.75 Vdc - 3.63 Vdc/10 A Output



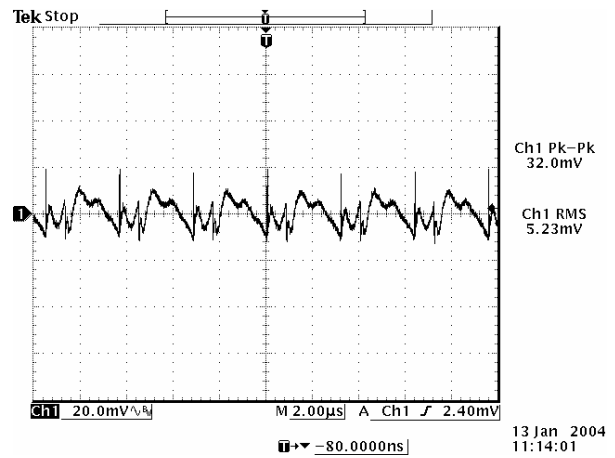
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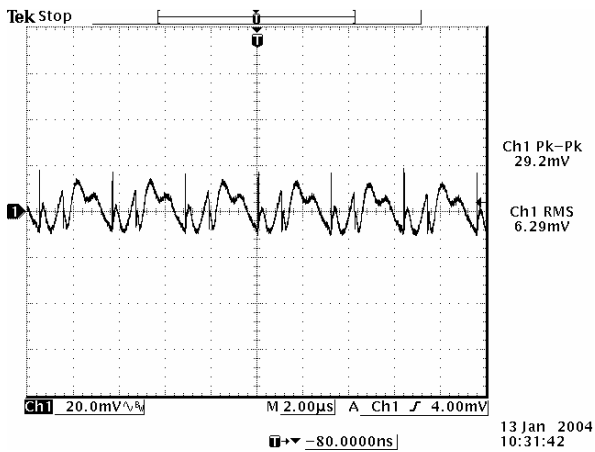
## Ripple and Noise Waveforms



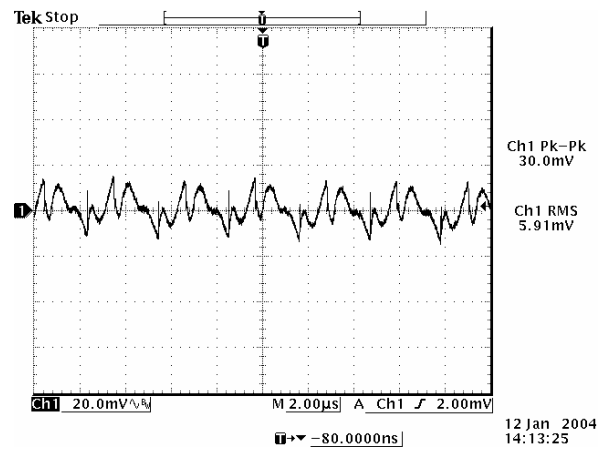
Ripple and noise at full load, 0.75 V output



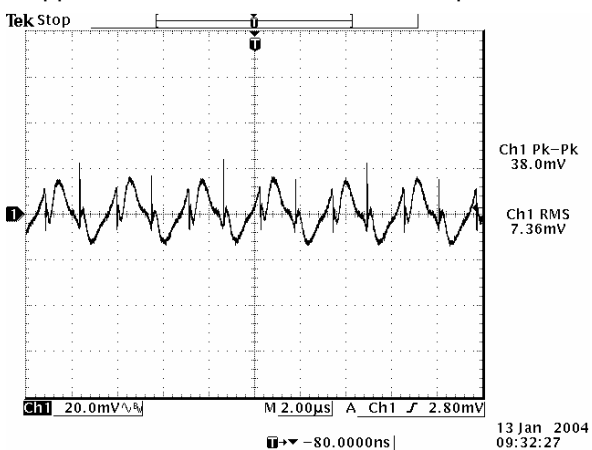
Ripple and noise at full load, 1.2 V output



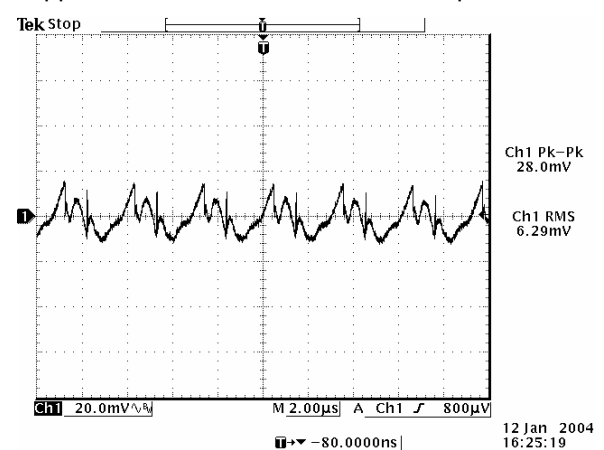
Ripple and noise at full load, 1.5 V output



Ripple and noise at full load, 1.8 V output



Ripple and noise at full load, 2.5 V output



Ripple and noise at full load, 3.3 V output

**Note:** Ripple and noise at 5.0 V input, 0-20MHz BW, 10 uF/16 V tantalum cap and 1uF/10 V ceramic capacitor, Ta=25 deg C.

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2.4 Vdc - 5.5 Vdc Input

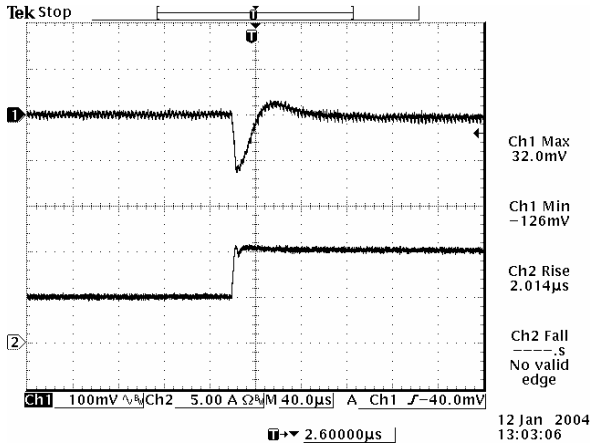
0.75 Vdc - 3.63 Vdc/10 A Output



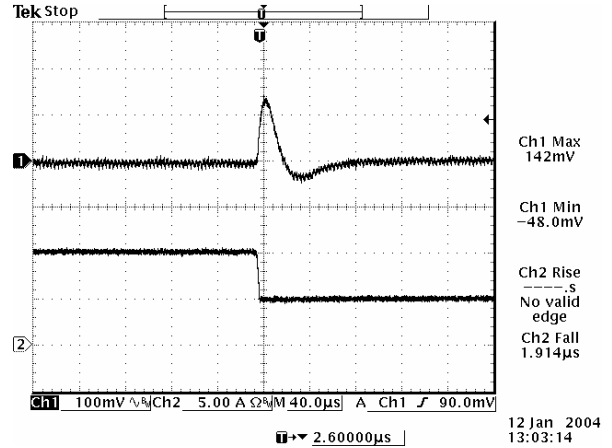
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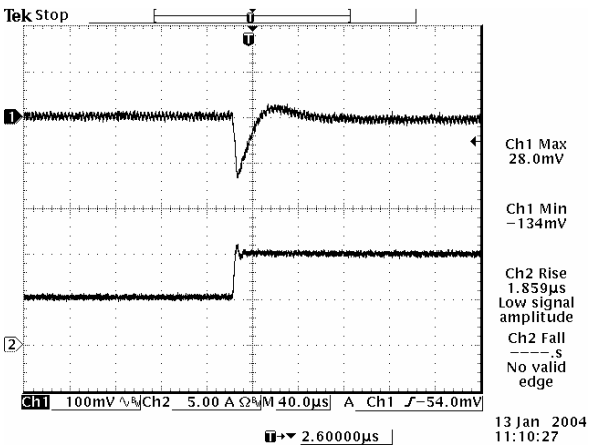
## Transient Response Waveforms



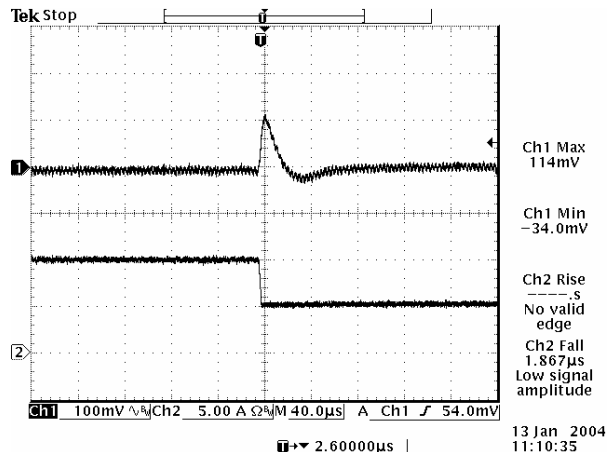
50% to 100% load step at 0.75 V output



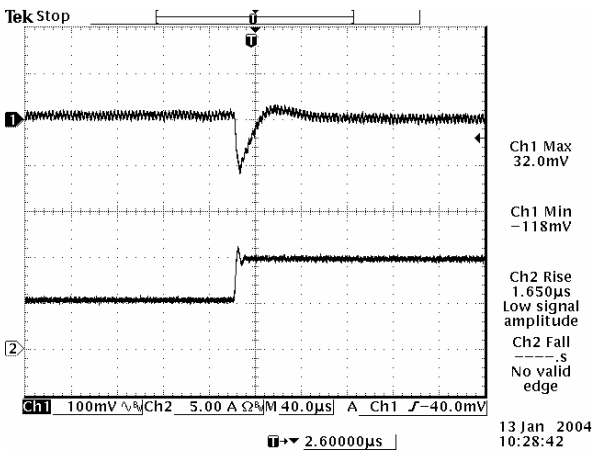
100% to 50% load step at 0.75 V output



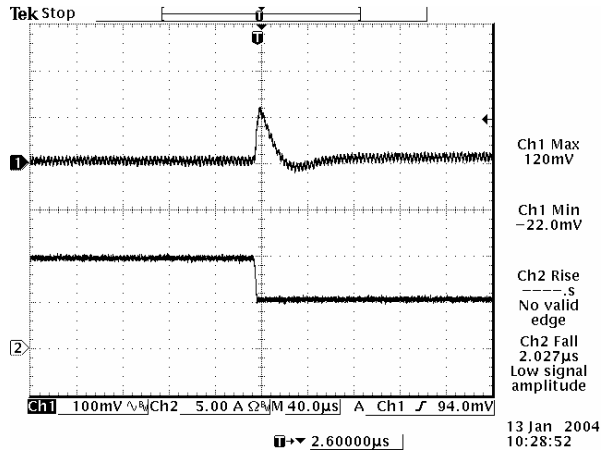
50% to 100% load step at 1.2 V output



100% to 50% load step at 1.2 V output



50% to 100% load step at 1.5 V output



100% to 50% load step at 1.5 V output

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2.4 Vdc - 5.5 Vdc Input

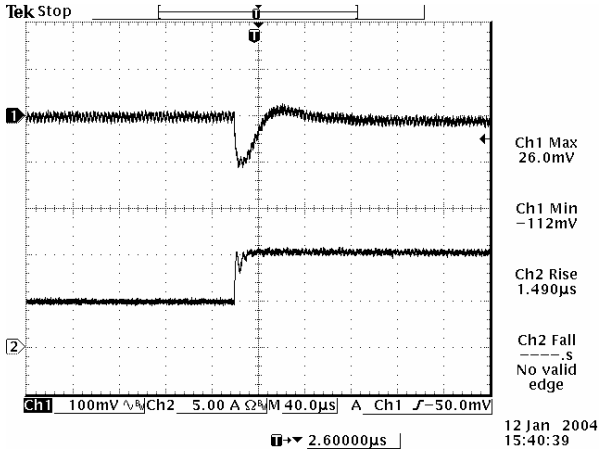
0.75 Vdc - 3.63 Vdc/10 A Output



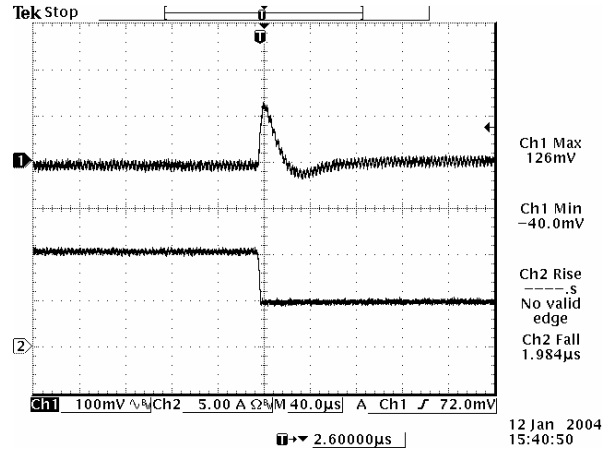
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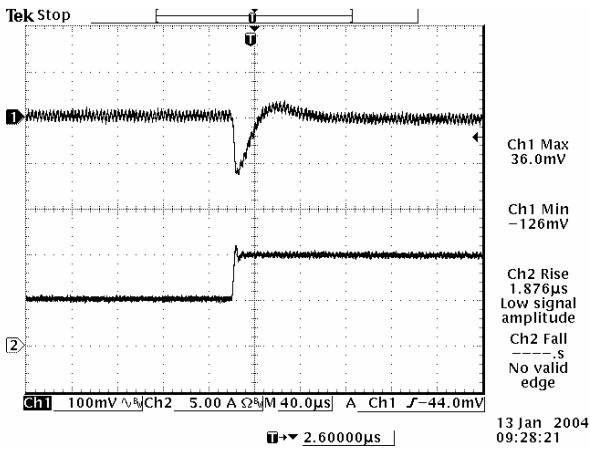
## Transient Response Waveforms (continued)



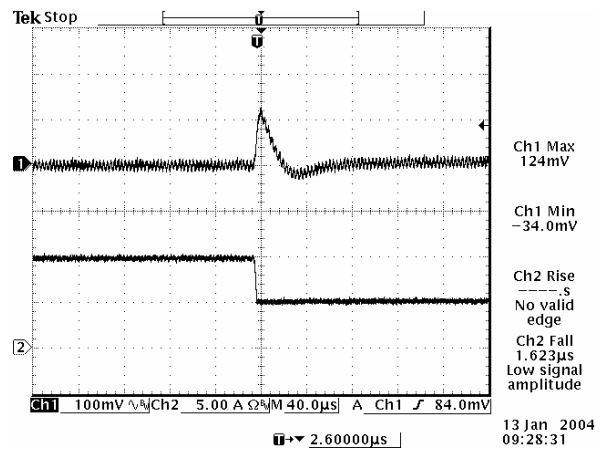
50% to 100% load step at 1.8 V output



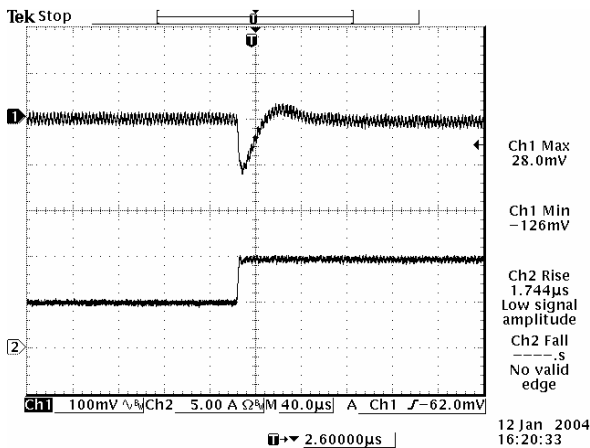
100% to 50% load step at 1.8 V output



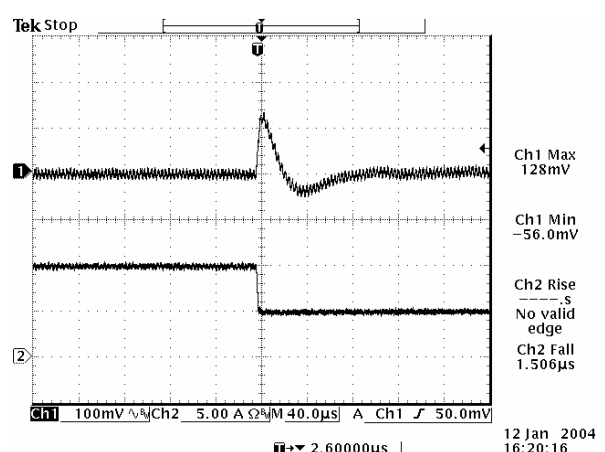
50% to 100% load step at 2.5 V output



100% to 50% load step at 2.5 V output



50% to 100% load step at 3.3 V output



100% to 50% load step at 3.3 V output

**Note:** Transient response at 5.0 V input,  $di/dt=2.5$  A/ $\mu$ S, with two 150  $\mu$ F/16 V tantalum capacitors and 1  $\mu$ F/10 V ceramic capacitor,  $T_a=25$  deg C.

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2.4 Vdc - 5.5 Vdc Input

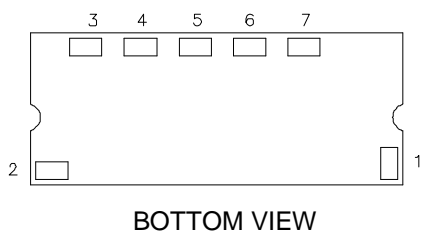
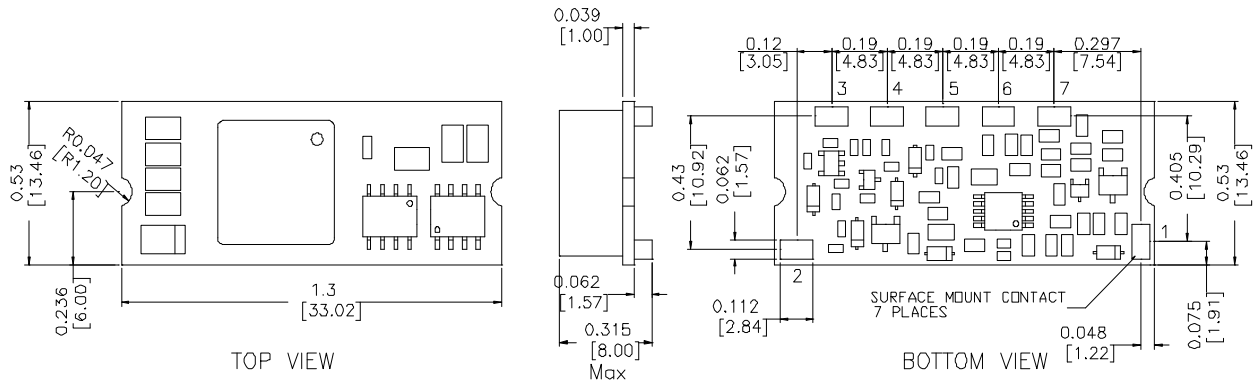
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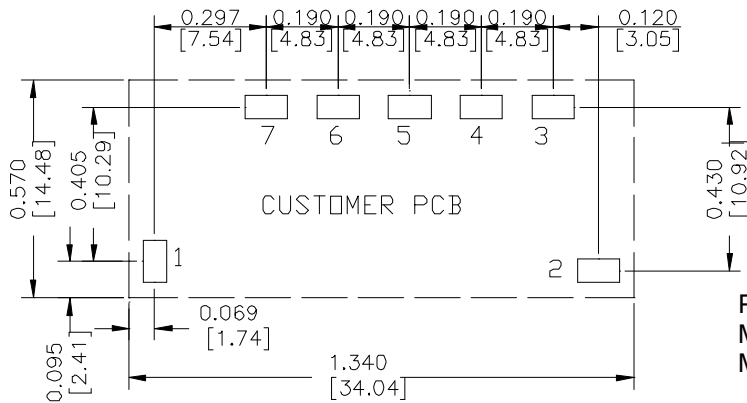
## Mechanical Outline



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)

**Note:** 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 245 °C.

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### Revision History

Date	Revision	Changes Detail	Approval
2007-01-17	A	Change version to A	Lynn
2011-08-25	B	Update the reflow solder temperature.	HL
2013-01-25	C	Update UL.	HL

### 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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#### CORPORATE

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#### FAR EAST

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Fax 852-2352-3706  
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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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