

## NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input      0.75 Vdc - 3.63 Vdc/6 A Output

Jan. 25, 2013

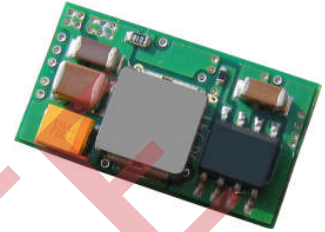
*Bel Power, Inc. , a subsidiary of Bel Fuse, Inc.*

**SRBA-06F2Ax**

**RoHS Compliant**

**Rev.C**

- Non-Isolated
- High Efficiency
- High Power Density
- Excellent Thermal Performance
- Low Cost
- Remote On/Off
- Flexible Output Voltage
- Sequencing
- Certificated to UL60950-1/CSA C22.2 No.60950-1, 2rd edition, am1
- Under-voltage Lockout (UVLO)
- OCP/SCP
- Wide Input
- Wide Trim Range
- Active Low/High (option)
- Able to Sink & Source Current
- Fixed Frequency (300 kHz)



### Applications

- Networking
- Computers and peripherals
- Telecommunications

### Description

The Bel SRBA-06F2Ax modules are a series of non-isolated dc/dc converters that deliver up to 6 A of output current with full load efficiency of 93% 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, over current protection, short circuit 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	6 A	21.8 W	93%	SRBA-06F2AL	SRBA-06F2A0

**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.  
3. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers.

### Part Number Explanation

S R BA - 06 F 2 x  
1 2 3 4 5 6 7

- 1---Surface mount    Vertical 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	-	5.5 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. SRBA-06F2Ax 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	-	-	4.73 A	
V <sub>o</sub> =2.5 V	-	-	5.49 A	
V <sub>o</sub> =1.8 V	-	-	5.11 A	
V <sub>o</sub> =1.5 V	-	-	4.31 A	
V <sub>o</sub> =1.2 V	-	-	3.57 A	
V <sub>o</sub> =0.75 V	-	-	2.40 A	
Input Current (no load)				
V <sub>o</sub> =3.3 V	-	50 mA	-	
V <sub>o</sub> =0.75 V	-	25 mA	-	
Remote Off Input Current	-	0.6 mA	-	
Input Reflected Ripple Current (pk-pk)	-	120 mA	-	Tested with simulated source impedance of 1uH, 5 Hz to 20 MHz.
Input Reflected Ripple Current (rms)	-	35 mA	-	
I <sup>2</sup> t Inrush Current Transient	-	-	0.04 A <sup>2</sup> s	
Turn-on Voltage Threshold	-	2.05 V	2.4 V	
Turn-off Voltage Threshold	1.8 V	2.0 V	-	

## 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, 50% 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 and temperature conditions
Adjustment Range Selected by External Resistor or Voltage	0.7525 V	-	3.63 V	
Load Regulation	-	0.4%V <sub>o, set</sub>	-	I <sub>o</sub> =0%~50% full load; I <sub>o</sub> =50%~100% full load
Line Regulation	-	0.3%V <sub>o, set</sub>	-	V <sub>in</sub> =V <sub>inmin</sub> to V <sub>inmax</sub>
Regulation Over Temperature (-40 °C to +85 °C)	-	0.4%V <sub>o, set</sub>	-	T <sub>ref</sub> =T <sub>amin</sub> to T <sub>amax</sub>
Output Current	0 A	-	6 A	
Current Limit Threshold	9 A	-	18 A	Hiccup mode
Short Circuit Surge Transient	-	0.32 A <sup>2</sup> s	-	

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### Output Specifications(continued)

Parameter	Min	Typ	Max	Notes
Ripple and Noise (pk-pk)	-	40 mV	70 mV	Tested with 0-20 MHz, with 10 uF tantalum capacitor & 1uF/10 V ceramic capacitor at output
Ripple and Noise (rms)	-	10 mV	30 mV	
Turn on Time	-	6 mS	10 mS	
Overshoot at Turn on	-	0%	3%	
Output Capacitance				
ESR $\geq$ 1mohm	0 uF	-	1000 uF	
ESR $\geq$ 10mohm	0 uF	-	3000 uF	
<b>Transient Response</b>				
50% ~ 100% Max Load	-	130 mV	-	di/dt=2.5 A/ uS; Vin=5 V; and with 10 uF tantalum capacitor & 1 uF/10 V TDK ceramic capacitor at output
Settling Time	Vo = 0.75 V - 3.63 V	25 uS	-	
100% ~ 50% Max Load	-	130 mV	-	
Settling Time	-	25 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				Measured at Vin=5 V, full load
Vo=3.3 V	-	93%	-	
Vo=2.5 V	-	91%	-	
Vo=1.8 V	-	88%	-	
Vo=1.5 V	-	87%	-	
Vo=1.2 V	-	84%	-	
Vo=0.75 V	-	78%	-	
Switching Frequency	250 kHz	300 kHz	350 kHz	
Over Temperature Shutdown	-	135 °C	-	
Output Voltage Trim Range	0.7525 V	-	3.63 V	
MTBF	6,976,379 hours			Calculated Per Bell Core SR-332 (Vin=5 V; Vo=0.75 V, Io = 4.8 A; Ta = 25 °C)
Dimensions				
Inches (L x W x H)	0.8 x 0.45 x 0.25			
Millimeters (L x W x H)	20.32 x 11.42 x 6.36			
Weight	-	5 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	Active High: SRBA-06F2A0; Remote On/Off pin open, Unit on.
Signal High (Unit On)	-	-	Vin, max	
Signal Low (Unit On)	-0.2 V	-	0.3 V	Active Low: SRBA-06F2AL; Remote On/Off pin open, Unit on.
Signal High (Unit Off)	1.5 V	-	Vin, max	
Sequencing Voltage	0 V	-	Vin	Sequencing Voltage applied on SEQ pin should be higher than output voltage.
Sequencing Slew Rate Capability	-	-	2 V/ mS	
Sequencing Delay Time	10 mS	-	-	Delay from Vinmin 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**

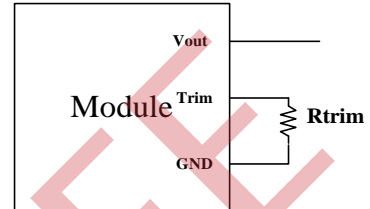
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### Output Trim Equations

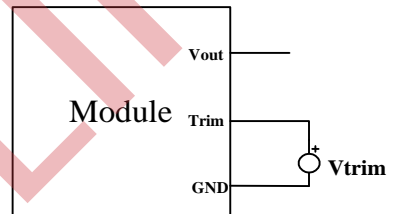
Equation for calculating the trim resistor (in k $\Omega$ ) given the desired adjusted voltage ( $V_{adj}$ ) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

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



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.

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



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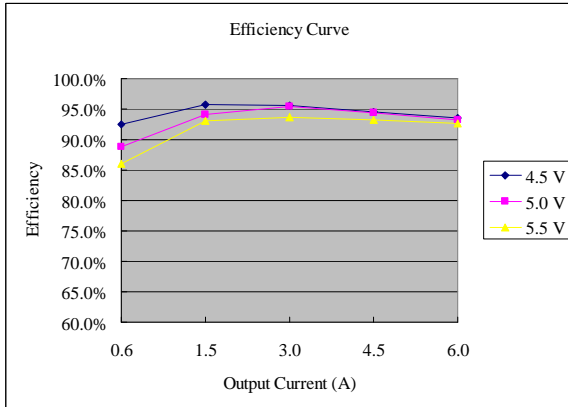
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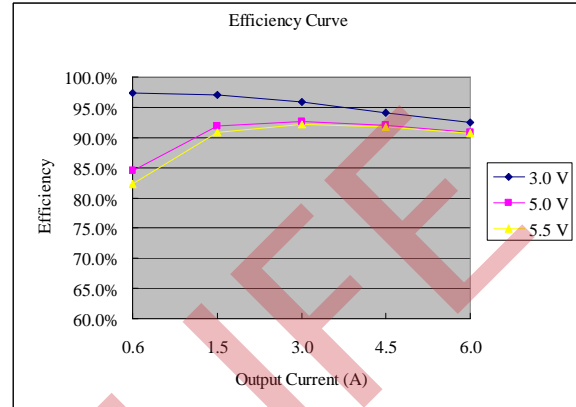
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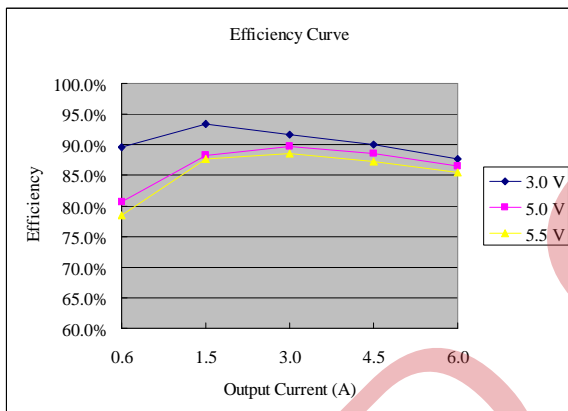
## Efficiency Data



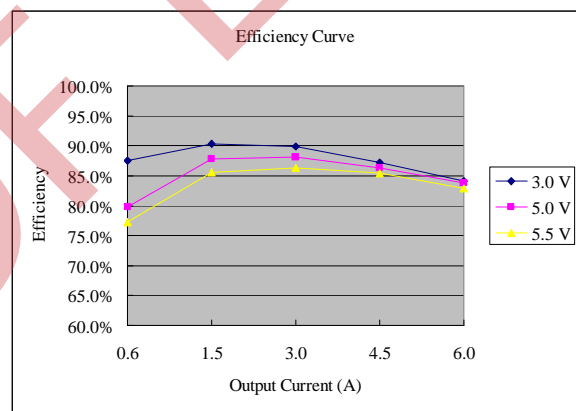
$V_o=3.3\text{ V}$



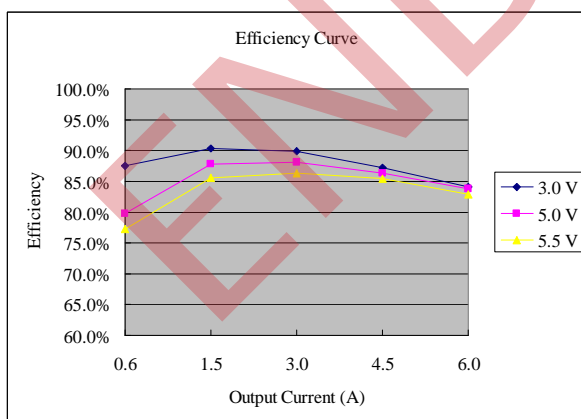
$V_o=2.5\text{ V}$



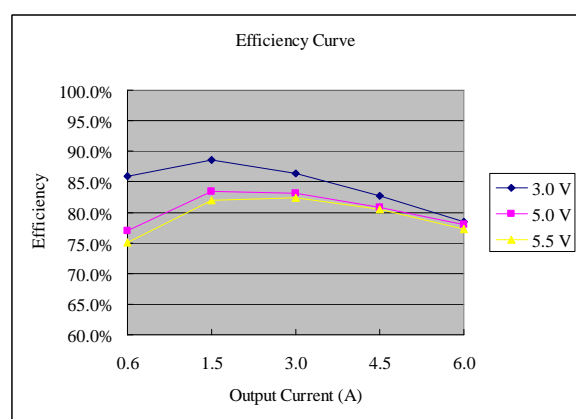
$V_o=1.8\text{ V}$



$V_o=1.5\text{ V}$



$V_o=1.2\text{ V}$



$V_o=0.7525\text{ V}$

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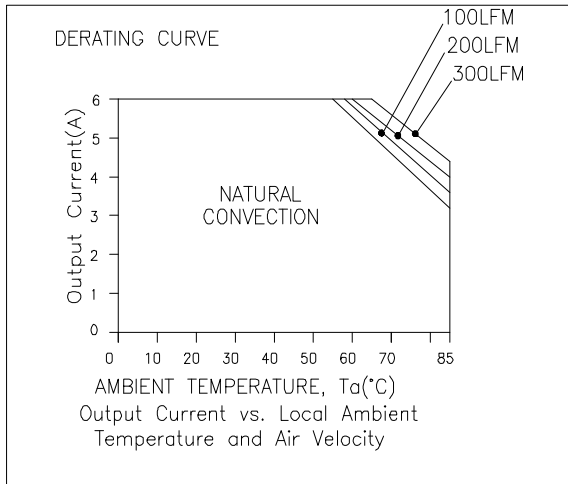
0.75 Vdc - 3.63 Vdc/6 A Output



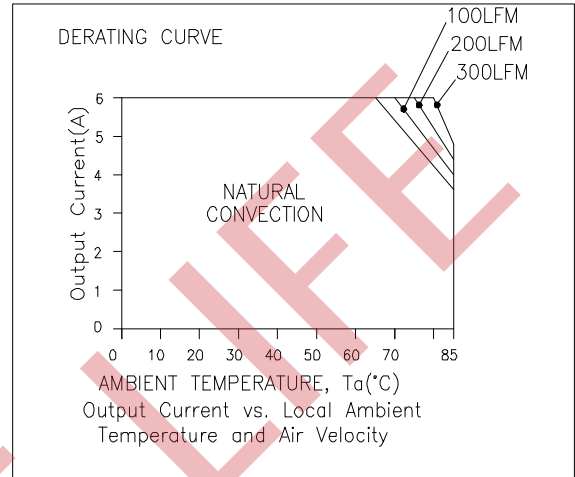
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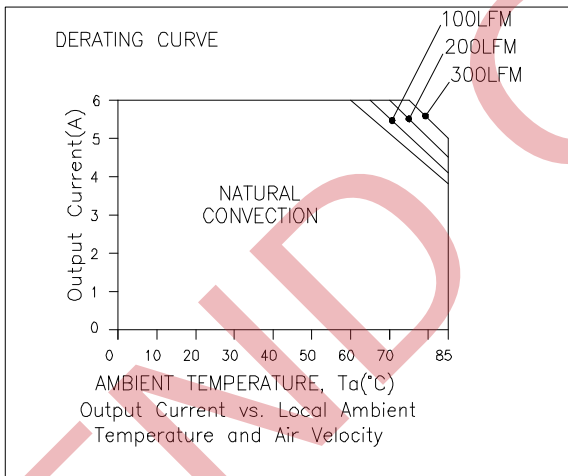
## Thermal Derating Curves



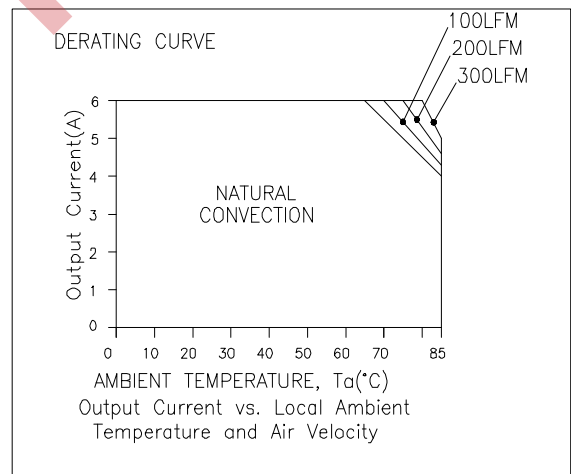
Vin=5.0 V, Vo=3.3 V



Vin=5.0 V, Vo=0.75 V



Vin=3.3 V, Vo=2.5 V



Vin=3.3 V, Vo=0.75 V

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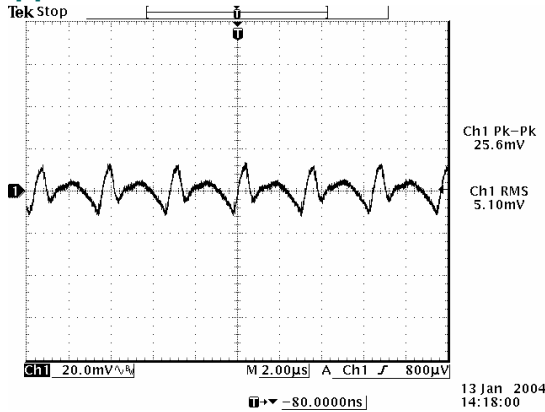
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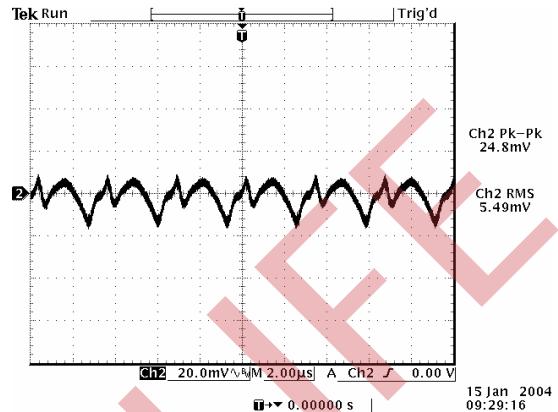
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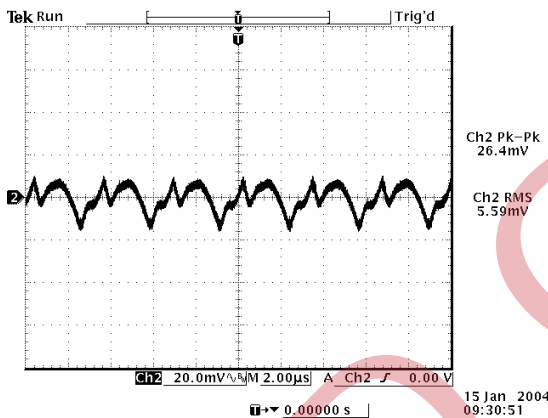
## Ripple and Noise Waveforms



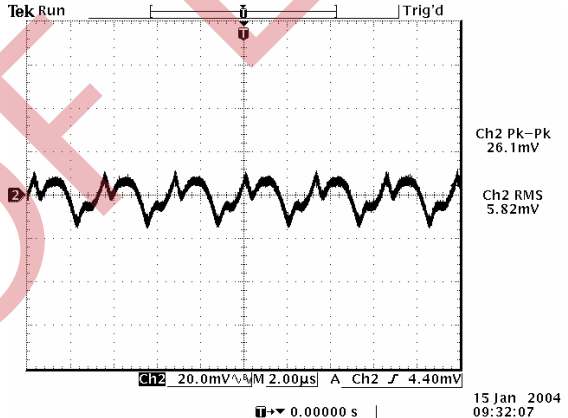
Ripple and noise at full load,  $V_{in}=5.0$  V,  $V_o=0.7525$  V



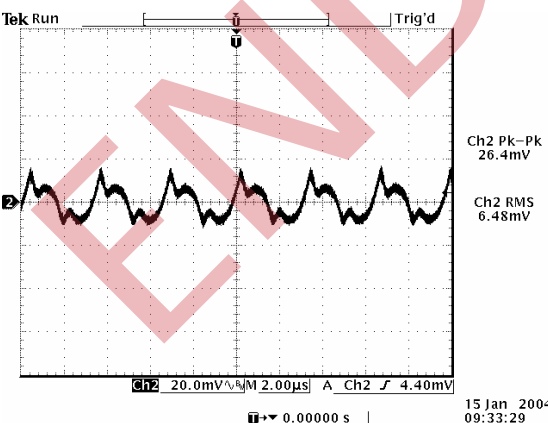
Ripple and noise at full load,  $V_{in}=5.0$  V,  $V_o=1.2$  V



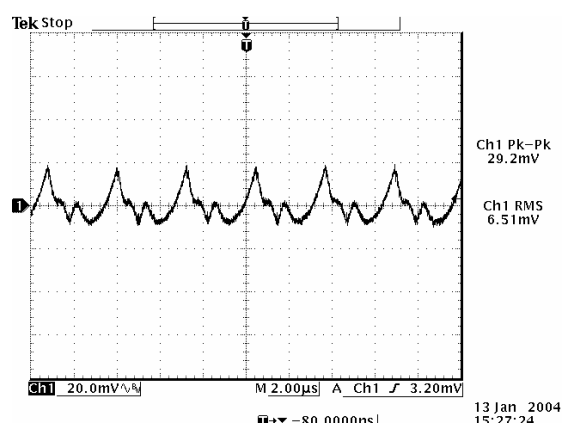
Ripple and noise at full load,  $V_{in}=5.0$  V,  $V_o=1.5$  V



Ripple and noise at full load,  $V_{in}=5.0$  V,  $V_o=1.8$  V



Ripple and noise at full load,  $V_{in}=5.0$  V,  $V_o=2.5$  V



Ripple and noise at full load,  $V_{in}=5.0$  V,  $V_o=3.3$  V

**Note:** Ripple and noise is tested at 0-20 MHz BW, 10  $\mu$ F/10 V tantalum capacitor and 1  $\mu$ F/10 V ceramic capacitor,  $T_a=25$  deg C.

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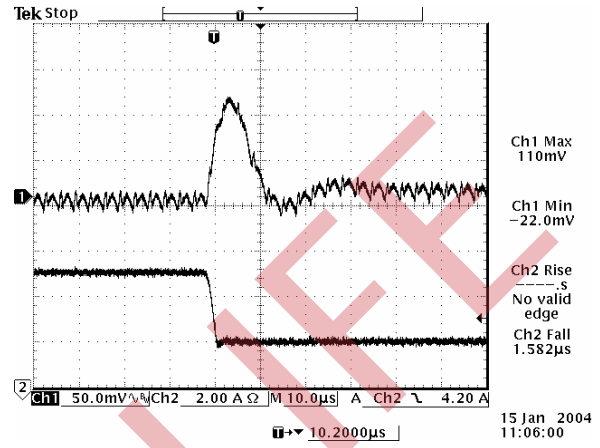
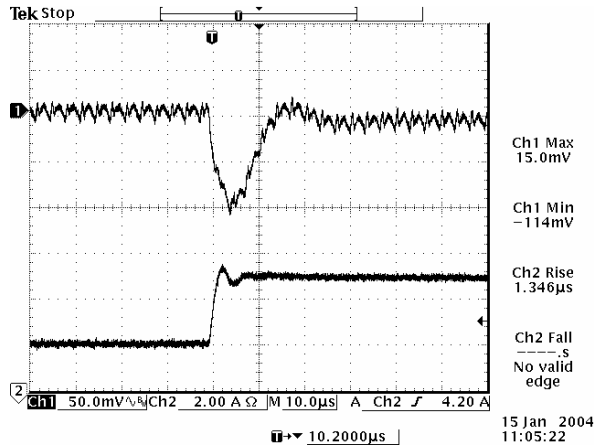
0.75 Vdc - 3.63 Vdc/6 A Output



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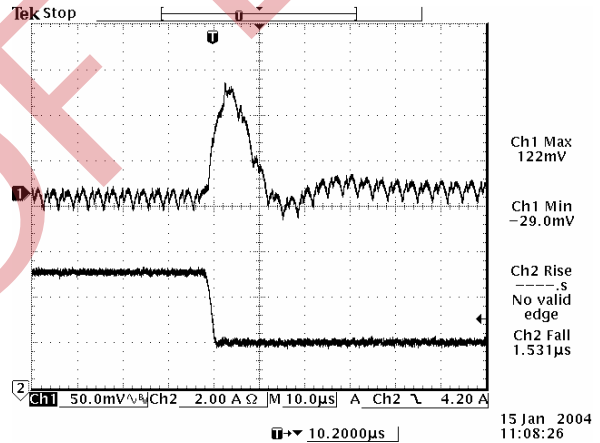
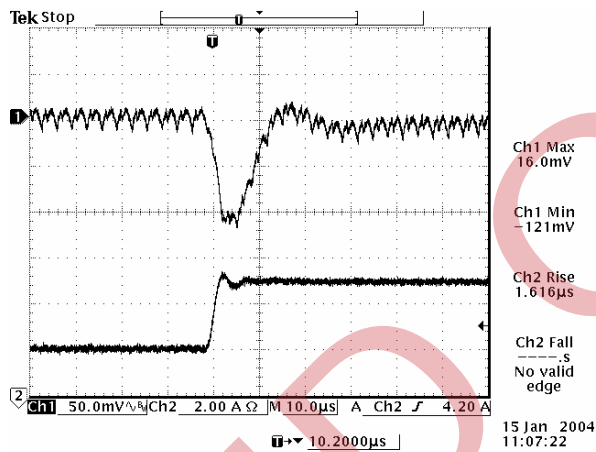
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## Transient Response Waveforms



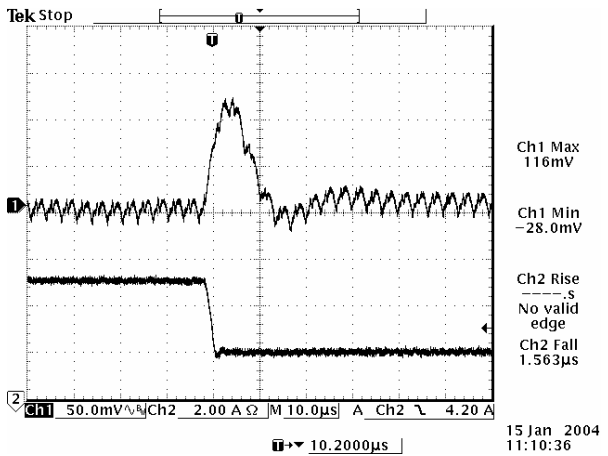
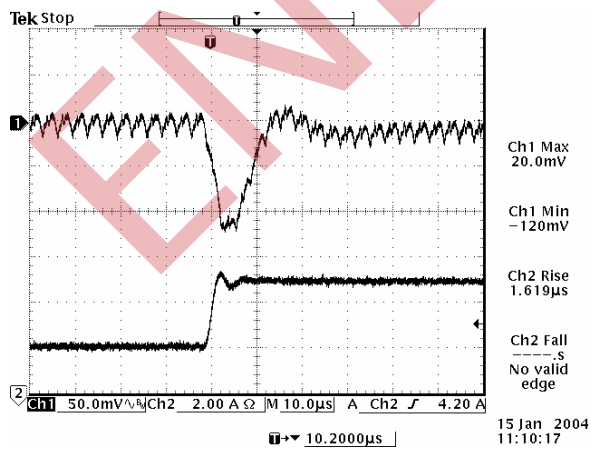
50% to 100% load step at  $V_{in}=5\text{ V}$ ,  $V_o=0.75\text{ V}$

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



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

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



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

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



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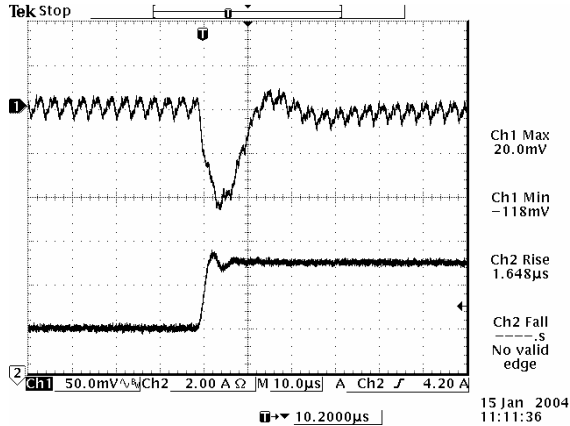
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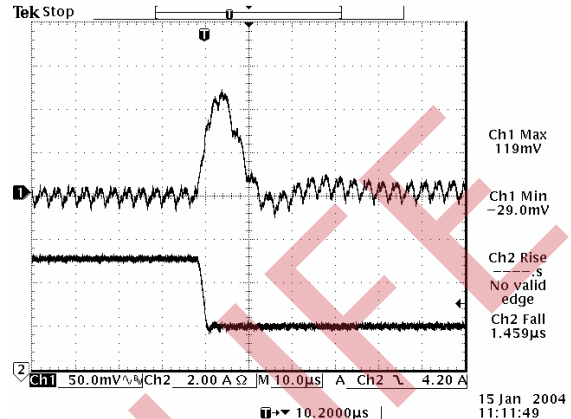
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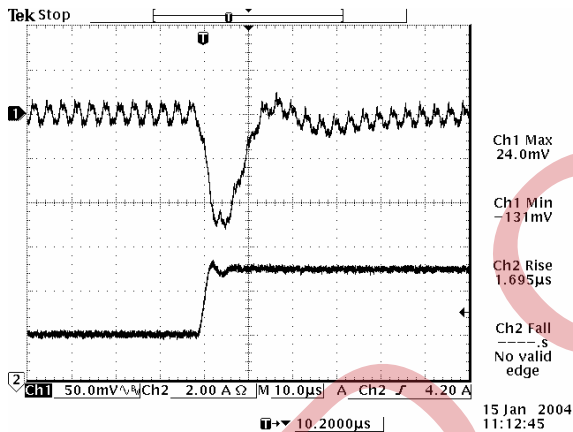
## Transient Response Waveforms (continued)



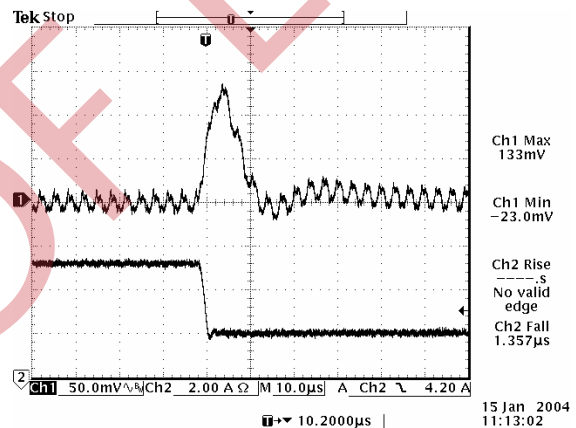
50% to 100% load step at  $V_{in}=5\text{ V}$ ,  $V_o=1.8\text{ V}$



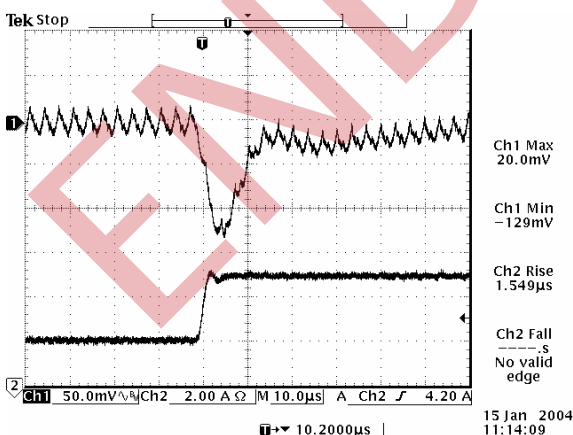
100% to 50% load step at  $V_{in}=5\text{ V}$ ,  $V_o=1.8\text{ V}$



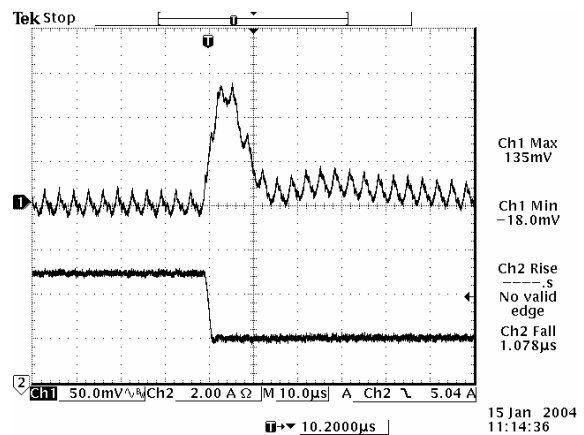
50% to 100% load step at  $V_{in}=5\text{ V}$ ,  $V_o=2.5\text{ V}$



100% to 50% load step at  $V_{in}=5\text{ V}$ ,  $V_o=2.5\text{ V}$



50% to 100% load step at  $V_{in}=5\text{ V}$ ,  $V_o=3.3\text{ V}$



100% to 50% load step at  $V_{in}=5\text{ V}$ ,  $V_o=3.3\text{ V}$

**Note:** Transient response is tested at  $di/dt=2.5\text{ A}/\mu\text{S}$ , with 10  $\mu\text{F}/10\text{ V}$  tantalum capacitor and 1  $\mu\text{F}/10\text{ V}$  ceramic capacitor,  $T_a=25\text{ deg C}$ .

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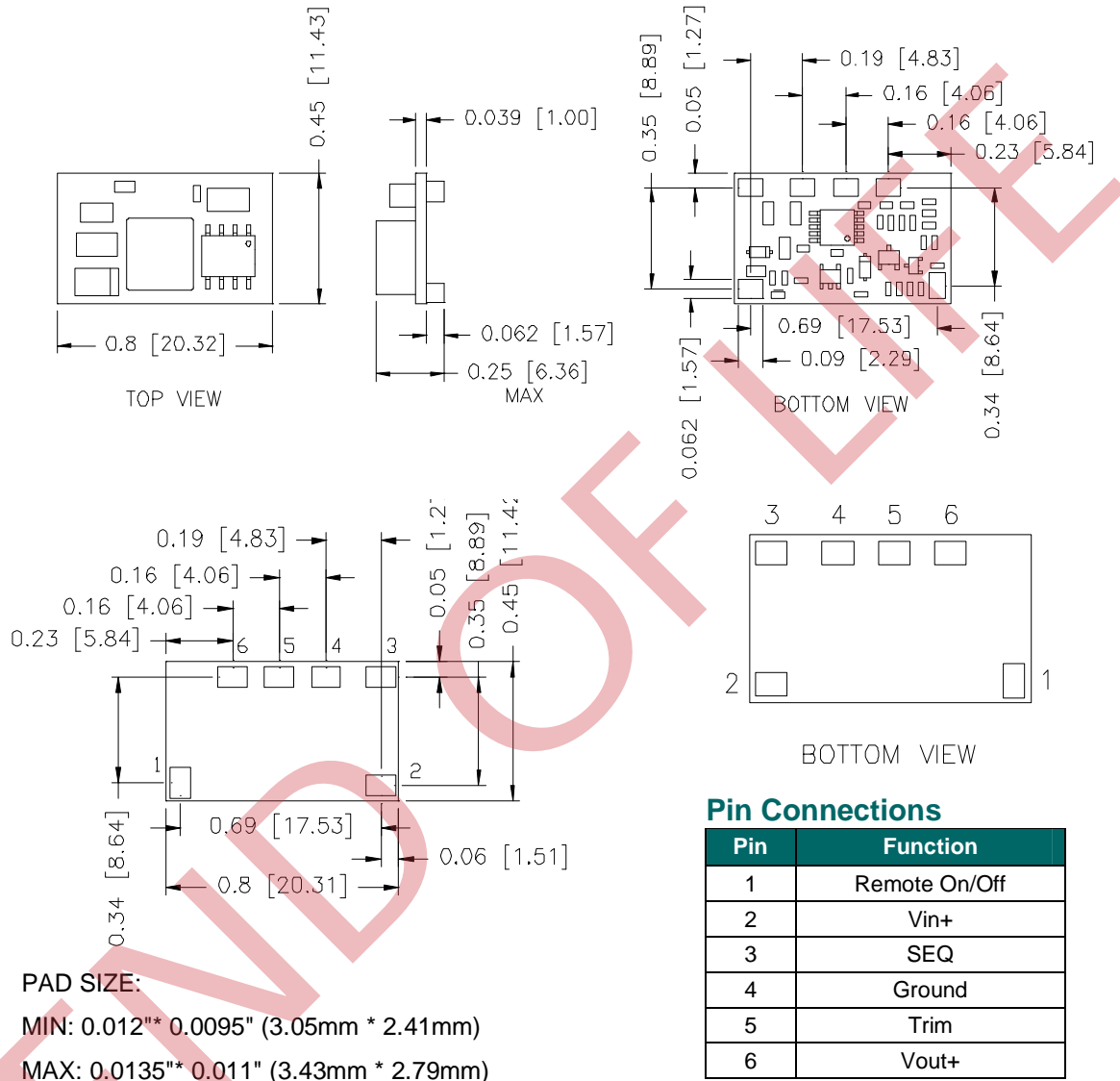
0.75 Vdc - 3.63 Vdc/6 A Output



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## Mechanical Outline



**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
2006-12-13	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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