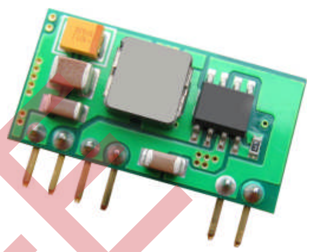
NON-ISOLATED DC/DC CONVERTERS

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.

VRBA-06F2Ax   RoHS Compliant   Rev.B



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

Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The Bel VRBA-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[1]	2.4 V - 5.5 V	6 A	21.8 W	93%	VRBA-06F2AL	VRBA-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" suffix at the end of the model number to indicate Tray Packaging.

Part Number Explanation

<u>V</u> <u>R</u> <u>BA</u> – <u>06</u> <u>F</u> <u>2A</u> <u>x</u>
1 2 3 4 5 6 7

1---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.

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 [1]	-0.3 V	-	Vin	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-55 °C	-	125 °C	

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

1. VRBA-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 not used sequencing feature, tie the SEQ pin to Vin or leave the SEQ pin floating.

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
Vo≤ 1.5 V	2.4 V	-	5.5 V	
Vo=1.8 V	3.0 V	-	5.5 V	
2.5 V≤ Vo ≤3.3 V	4.5 V	-	5.5 V	
Input Current (full load)				
Vo=3.3 V	-	-	4.73 A	
Vo=2.5 V	-	-	3.66 A	
Vo=1.8 V	-	-	4.09 A	
Vo=1.5 V	-	-	4.31 A	
Vo=1.2 V	-	-	3.57 A	
Vo=0.75 V	-	-	2.40 A	
Input Current (no load)				
Vo=3.3 V	-	50 mA	-	
Vo=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 1 uH, 5 Hz to 20 MHz, one 1000 uF/25 V AL capacitor and two 100 uF/ 10 V Tantalum capacitor at the input.
Input Reflected Ripple Current (rms)	-	35 mA	-	
I^2t Inrush Current Transient	-	-	0.04 A^2s	
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% Vo,set	-	2% Vo,set	Vin=5 V, 50% full load
Output Voltage Set Point	-3% Vo,set	-	3% Vo,set	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% Vo,set	-	Io=Iomin to 50%Iomax to 100%Iomax
Line Regulation	-	0.3% Vo,set	-	Vin=Vinmin to 50%Vinmax to 100%Vinmax
Regulation Over Temperature (-40 °C to +85 °C)	-	0.4% Vo,set	-	Tref=Tamin to Tamax
Output Current	0 A	-	6 A	
Current Limit Threshold	9 A	-	18 A	
Short Circuit Surge Transient	-	0.32 A^2s	-	

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 & 1 uF/10 V ceramic capacitor at the output.
Ripple and Noise (rms)	-	10 mV	30 mV	
Turn on Time	-	6 mS	10 mS	
Overshoot at Turn on	-	-	3%	
Output Capacitance Min ESR ≥ 1mohm Max ESR ≥ 10mohm	 0 uF 0 uF	 - -	 1000 uF 3000 uF	
Transient Response				
50% ~ 100% Max Load (Vo = 0.75 V - 3.63 V)	-	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 the output
Settling Time	-	25 uS	-	
100% ~ 50% Max Load (Vo = 0.75 V - 3.63 V)	-	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 Vo=3.3 V Vo=2.5 V Vo=1.8 V Vo=1.5 V Vo=1.2 V Vo=0.75 V	 - - - - - -	 93% 91% 88% 87% 84% 78%	 - - - - - -	Measured at Vin=5 V, full load
Switching Frequency	250 kHz	300 kHz	350 kHz	
Over Temperature Shutdown	-	135 °C	-	
Output Voltage Trim Range	0.7525 V	-	3.63 V	
MTBF		7,142,646 hours		Calculated Per Bell Core SR-332 (Vin=5 V; Vo=0.75 V; Io = 4.8 A; Ta = 25°C)
Dimensions Inches (L × W × H) Millimeters (L × W × H)		 1.0 x 0.5 x 0.243 25.4 x 12.7 x 6.16		
Weight	-	5 g	-	

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

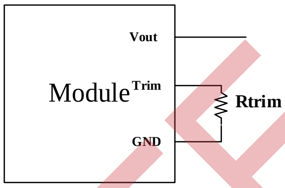
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.2 V	-	0.3 V	VRBA-06F2A0; Remote On/Off pin open, Unit on.
Signal High (Unit On)	-	-	Vin, max	
Signal Low (Unit On)	-0.2 V	-	0.3 V	VRBA-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 Vin, min to application of voltage on SEQ pin
Tracking Accuracy Power-Up Power-Down	 - -	 100 mV 200 mV	 200 mV 400 mV	

Output Trim Equations

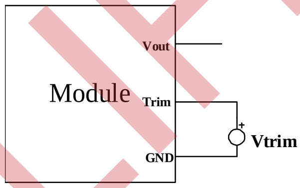
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

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

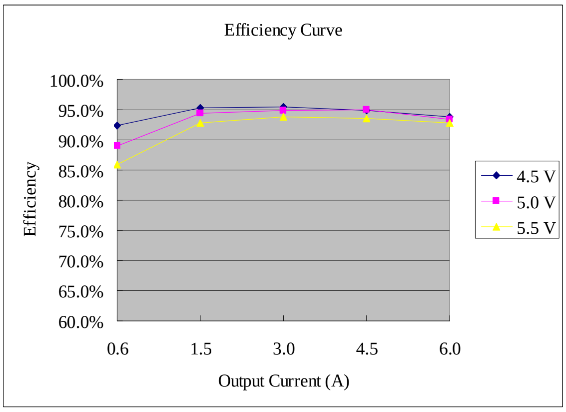


Equation for calculating the trim voltage (in V) given the desired adjusted voltage (Vadj) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

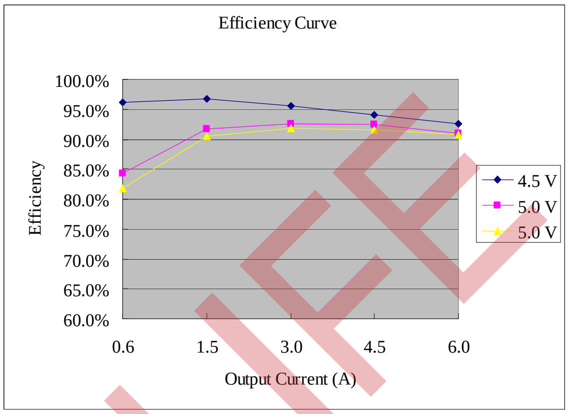
$$V_{trim} = 0.7 - 0.1698 \times (V_{adj} - 0.7525)$$



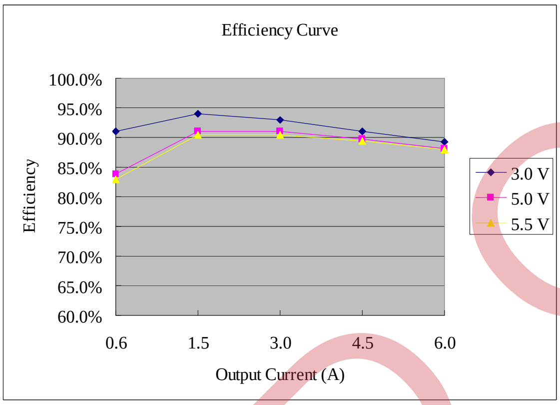
Efficiency Data



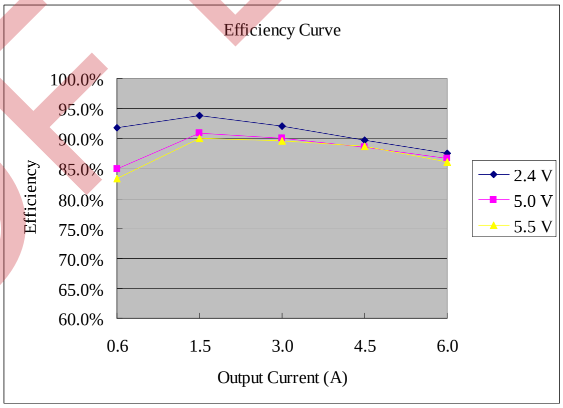
Vo=3.3 V



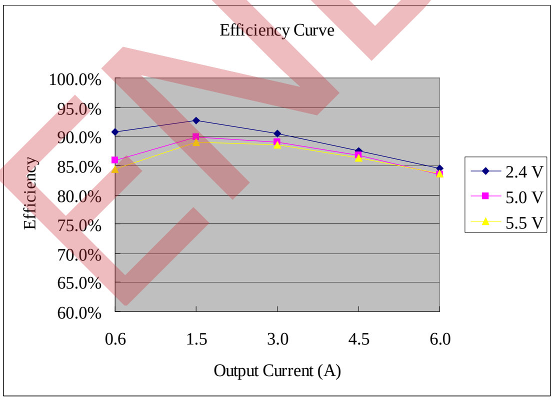
Vo=2.5 V



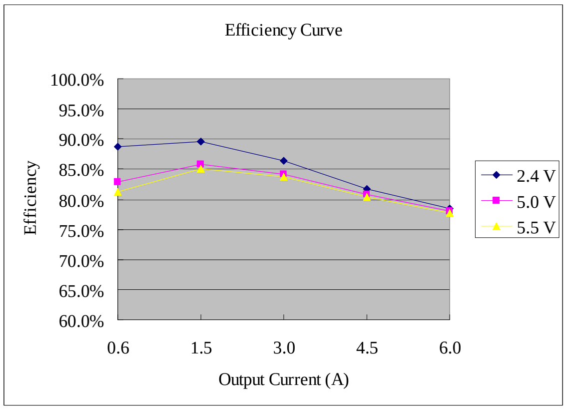
Vo=1.8 V



Vo=1.5 V

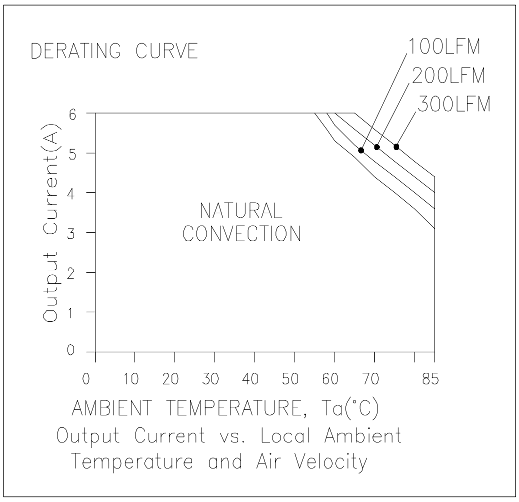


Vo=1.2 V

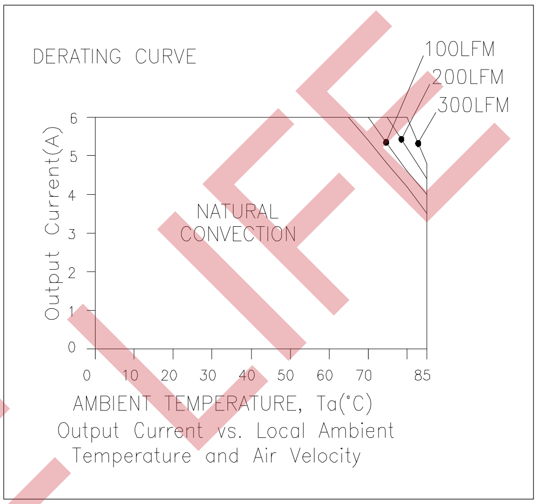


Vo=0.7525 V

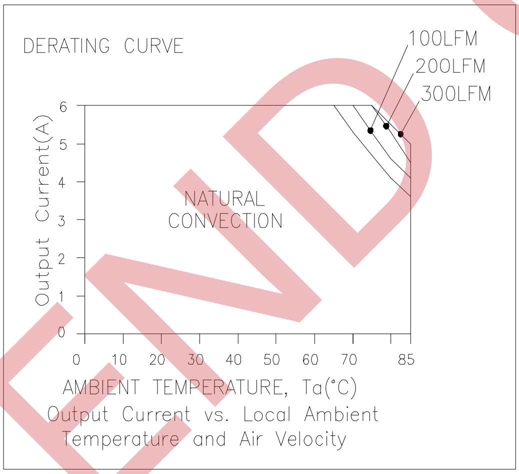
Thermal Derating Curves



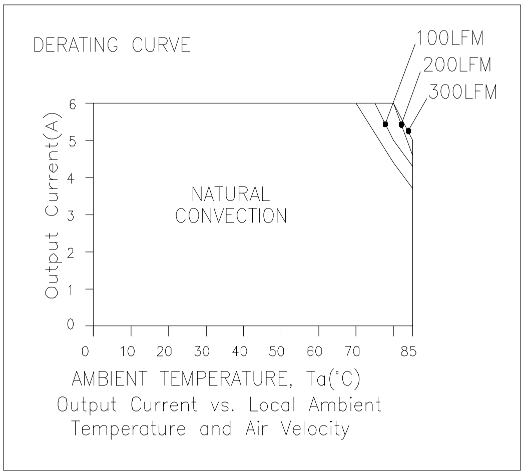
Vin=5 V, Vo = 3.3 V



Vin=5 V, Vo = 0.75 V

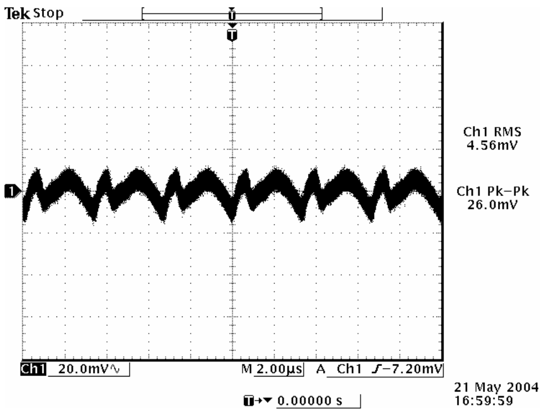


Vin=4.5 V, Vo = 2.5 V

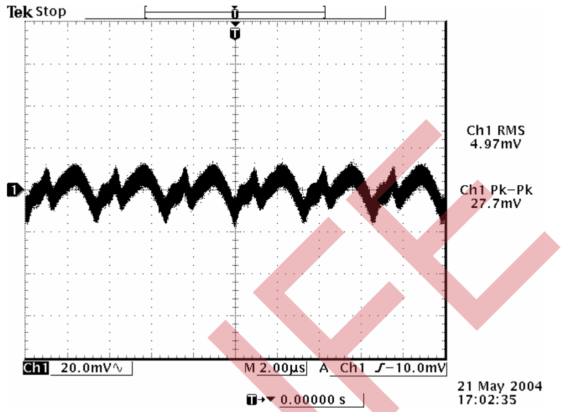


Vin=3.3 V, Vo = 0.75 V

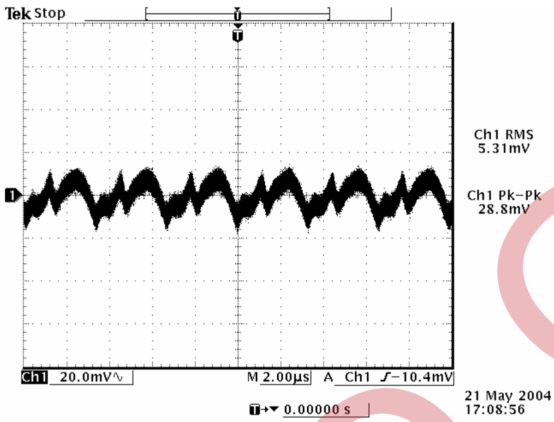
Ripple and Noise Waveforms



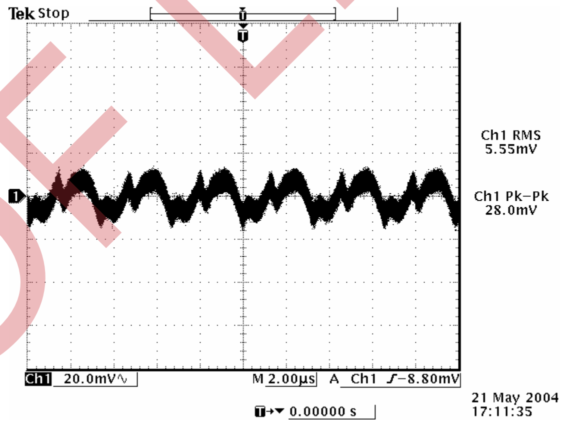
Ripple and noise at full load, Vin=5.0 V, Vo=0.7525 V



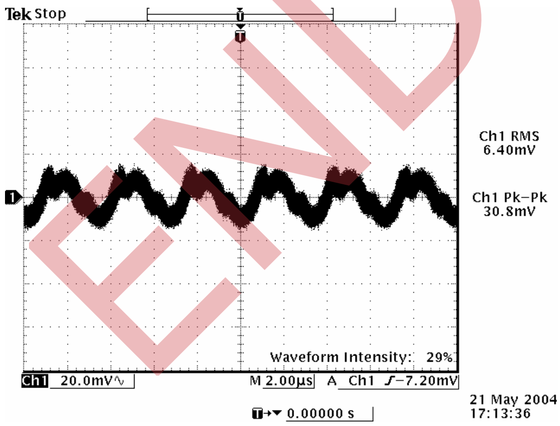
Ripple and noise at full load, Vin=5.0 V, Vo=1.2 V



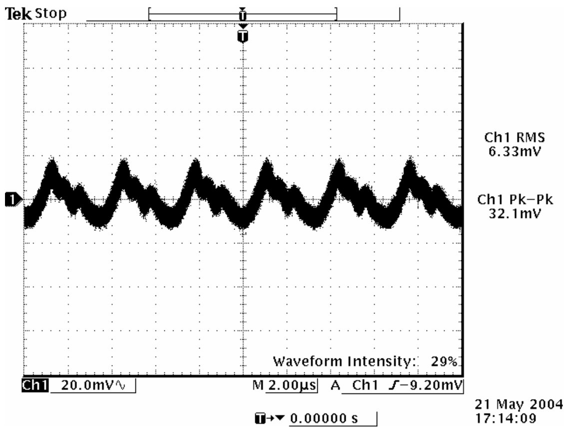
Ripple and noise at full load, Vin=5.0 V, Vo=1.5 V



Ripple and noise at full load, Vin=5.0 V, Vo=1.8 V



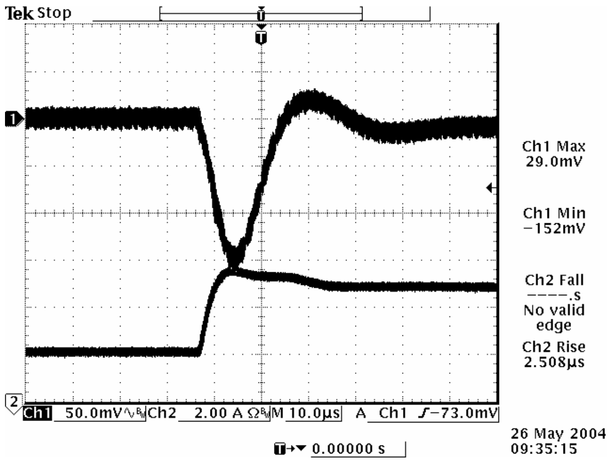
Ripple and noise at full load, Vin=5.0 V, Vo=2.5 V



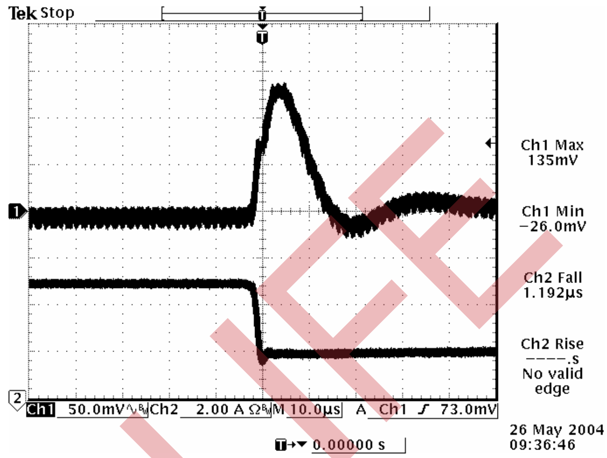
Ripple and noise at full load, Vin=5.0 V, Vo=3.3 V

Note: Ripple and noise is tested at 0-20 MHz BW, 10 uF/10 V tantalum capacitor and 1 uF/10 V ceramic capacitor, Ta=25 deg C.

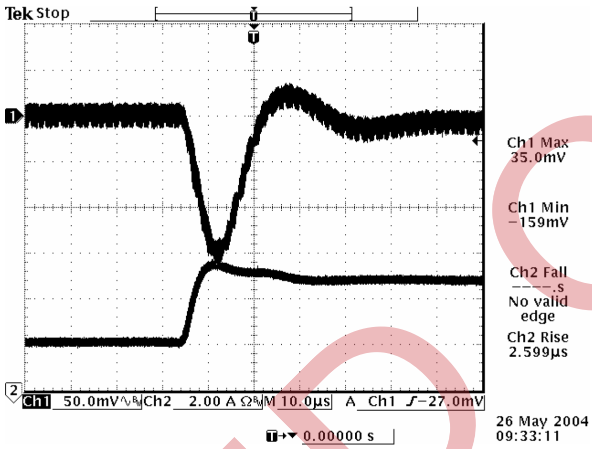
Transient Response Waveforms



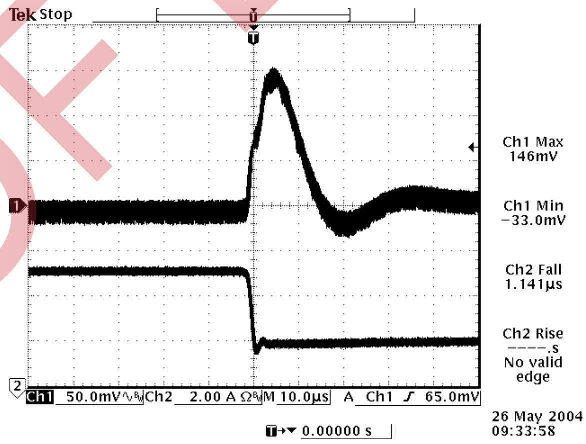
50% to 100% load step at Vin=5 V, Vo=0.75 V



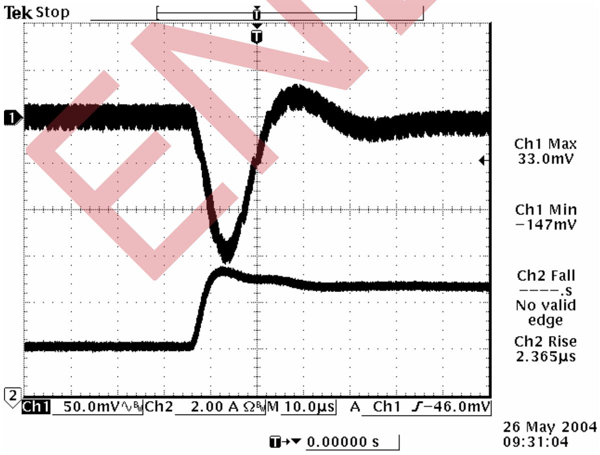
100% to 50% load step at Vin=5 V, Vo=0.75 V



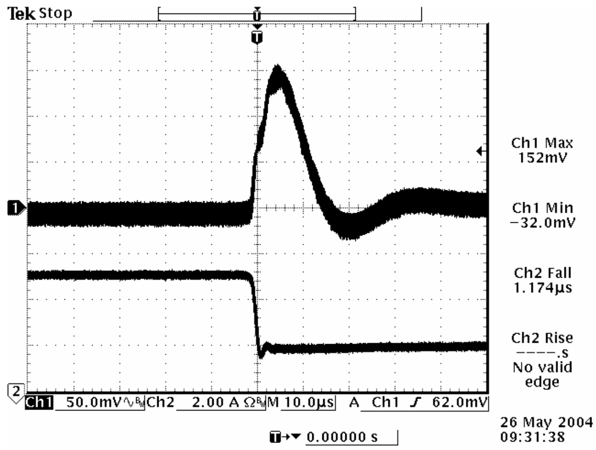
50% to 100% load step at Vin=5 V, Vo=1.2 V



100% to 50% load step at Vin=5 V, Vo=1.2 V

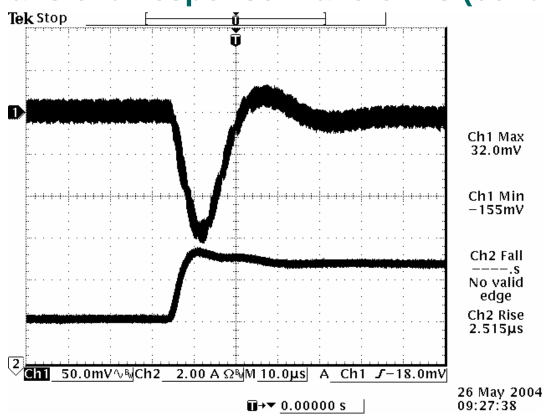


50% to 100% load step at Vin=5 V, Vo=1.5 V

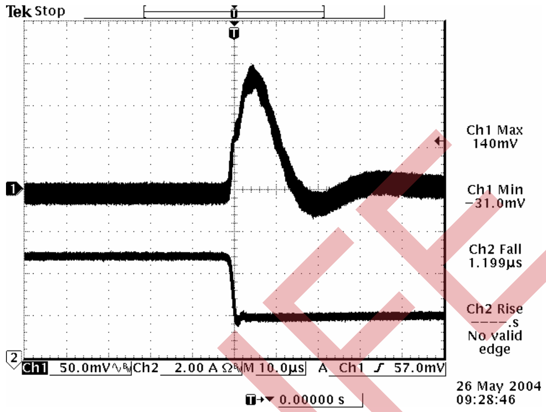


100% to 50% load step at Vin=5 V, Vo=1.5 V

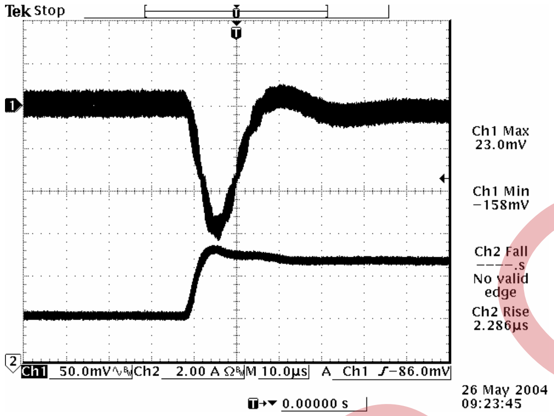
Transient Response Waveforms (continued)



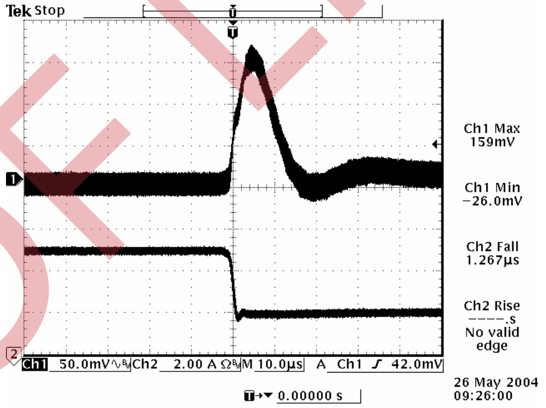
50% to 100% load step at Vin=5 V, Vo=1.8 V



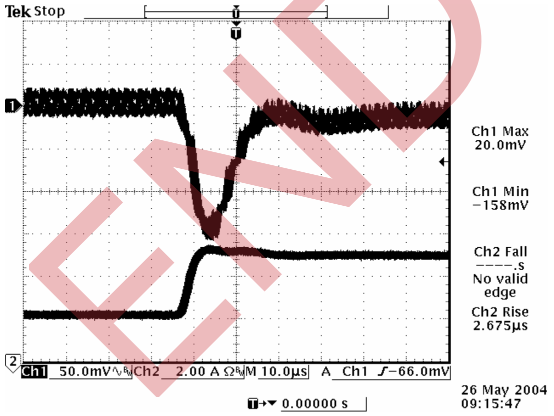
100% to 50% load step at Vin=5 V, Vo=1.8 V



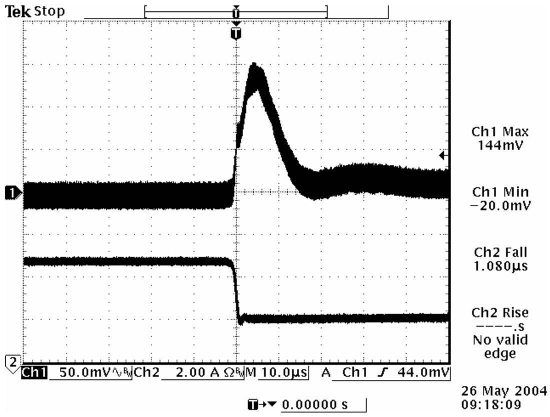
50% to 100% load step at Vin=5 V, Vo=2.5 V



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



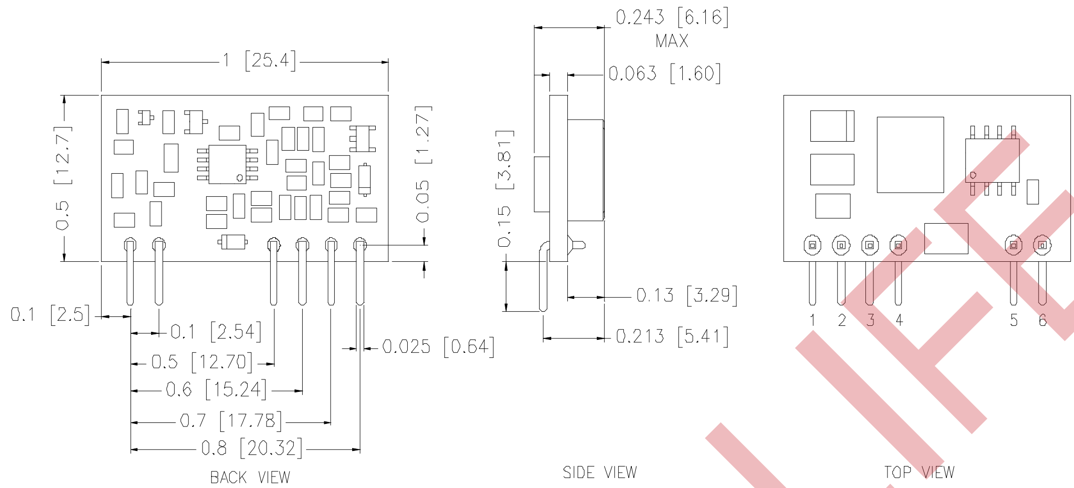
50% to 100% load step at Vin=5 V, Vo=3.3 V

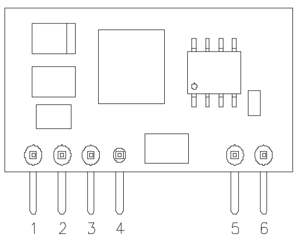


100% to 50% load step at Vin=5 V, Vo=3.3 V

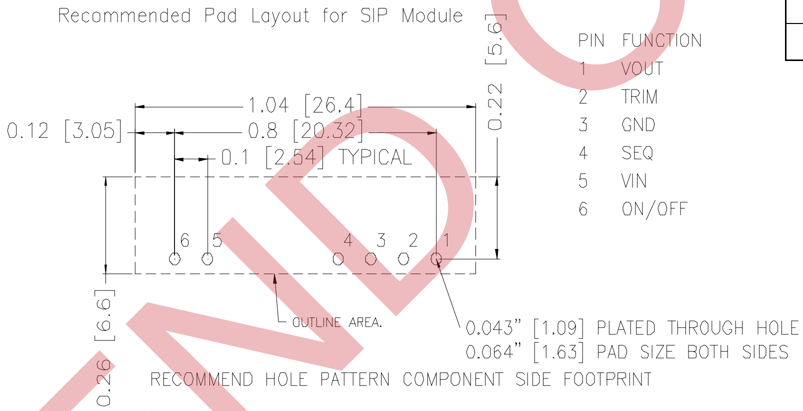
Note: Transient response is tested at di/dt=2.5 A/uS, with 10 uF/10 V tantalum capacitor and 1 uF/10 V ceramic capacitor, Ta=25 deg C.

Mechanical Outline





Recommended Pad Layout for SIP Module



RECOMMEND HOLE PATTERN COMPONENT SIDE FOOTPRINT

Pin Connections

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

Note:

1) All Pins: Material - Copper Alloy;
Finish – 3 micro inches minimum Gold over 50 micro inches minimum Nickel plate.
2) Undimensioned components are shown for visual reference only.

3) All dimensions in inches (mm); Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm) x.xxx +/-0.010 in. (x.xx +/-0.25mm).

Revision History

Date	Revision	Changes Detail	Approval
2007-01-12	A	Change version to A	Lynn
2013-01-25	B	Add 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.

RoHS 2002/95/EC

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