NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 14 Vdc Input 0.75 Vdc - 5.0 Vdc/6 A Output

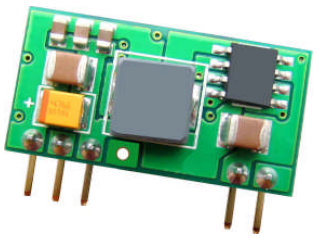
Jan. 25, 2013

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

VRBA-06E1Ax RoHS Compliant Rev.B

Features

- Non-Isolated
- High Efficiency
- High Power Density
- Fixed Frequency
- Active Low/High (Option)
- Under-Voltage Lockout (UVLO)
- Remote On/Off
- OCP/SCP
- Wide Input
- Wide Trim Range
- Certificated to UL60950-1/CSA C22.2 No.60950-1, 2rd edition, am1



Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The Bel VRBA-06E1Ax modules are a series of non-isolated dc/dc converters that can deliver up to 6 A of output current with full load efficiency of 92% at 5.0 Vdc output. These modules provide precisely regulated voltage programmable via external resistor from 0.75 Vdc to 5.0 Vdc over a wide range of input voltage. Their open-frame construction and small footprint enable designers to develop cost and space-efficient solutions. Standard features include remote On/Off, programmable output voltage and over current protection.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active Low	Model Number Active High
5.0 V	7.0 V -14 V	6 A	30.0 W	92%	VRBA-06E1AL	VRBA-06E1A0
0.75 V - 3.3 V	4.5 V - 14 V	6 A	19.8 W	88%	VRBA-06E1AL	VRBA-06E1A0

Notes: 1. Add “G” suffix at the end of the model numbers to indicate Tray Packaging.

Part Number Explanation

V	R	BA	–	06	E	1A	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 (4.5-14V)
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	-	15 V	
Output Enable Terminal Voltage	-0.3 V	-	15 V	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-55 °C	-	125 °C	

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

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage				
Vo, set ≤ 3.3 V	4.5 V	12 V	14 V	
Vo, set = 5.0 V	7.0 V	12 V	14 V	
Input Current (full load)				
Vo=5.0 V	-	2.75 A	4.8 A	
Vo=3.3 V	-	1.85 A	4.8 A	
Vo=1.8 V	-	1.05 A	3.2 A	
Vo=0.75 V	-	0.55 A	1.8 A	
Input Current (no load)				
Vo=5.0 V	-	-	100 mA	
Vo=0.75 V	-	-	20 mA	
Remote Off Input Current	-	3 mA	5 mA	
Input Reflected Ripple Current (pk-pk)	-	120 mA	200 mA	Tested with two 100 uF/25 V input Tantalum capacitors & simulated source impedance of 1uH, 5 Hz to 20 MHz.
Input Reflected Ripple Current (rms)	-	60 mA	100 mA	
I^2t Inrush Current Transient	-	0.002 A^2s	0.02 A^2s	
Turn-on Voltage Threshold				
Vo, set ≤ 3.3 V	-	4.3 V	4.5 V	
Vo, set = 5.0 V	-	6.0 V	6.5 V	
Turn-off Voltage Threshold				
Vo, set ≤ 3.3 V	-	4.0 V	4.3 V	Shut down or below 90% set point.
Vo, set = 5.0 V	-	5.5 V	6.0 V	

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

Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point	-2%Vo,set	-	2%Vo,set	Vin=12 V, Io=Io max
Output Voltage Set Point	-2.5%Vo,set	-	3.5%Vo,set	Over all operating input voltage, resistive load, and temperature conditions
Load Regulation	-	0.4%Vo,set	-	Io=Iomin to Iomax
Line Regulation	-	0.3%Vo,set	-	Vin=Vinmin to Vinmax
Regulation Over Temperature (-40°C to +85°C)	-	0.5%Vo,set	-	Tref=Tamin to Tamax
Output Current	0 A	-	6 A	
Current Limit Threshold	6.8 A	-	15 A	
Short Circuit Surge Transient	-	0.25 A^2s	-	

Output Specifications(continue)

Parameter	Min	Typ	Max	Notes
Ripple and Noise (pk-pk) Vo=5.0 V Vo=3.3 V Vo=0.75 V	 - - -	 100 mV 80 mV 35 mV	 140 mV 120 mV 70 mV	Tested with 0-20 MHz BW, with external 10 uF/10 V tantalum capacitor & 1 uF/10 V ceramic capacitor at the output
Ripple and Noise (rms) Vo=5.0 V Vo=3.3 V Vo=0.75 V	 - - -	 35 mV 25 mV 10 mV	 50 mV 40 mV 15 mV	
Turn on Time	-	6 mS	12 mS	
Overshoot at Turn on	-	0%	3%	
Output Capacitance ESR ≥ 1mohm ESR ≥ 10mohm	 0 uF 0 uF	 - -	 1000 uF 2200 uF	
Transient Response				
50% ~ 100% Max Load	Vo = 0.75 - 5.0 V	-	200 mV	350 mV	di/dt=2.5 A/uS; Vin=12 V; and with 10 uF/10 V tantalum capacitor & 1 uF/10 V ceramic capacitor at the output.
Settling Time		-	25 uS	50 uS	
100% ~ 50% Max Load		-	200 mV	350 mV	
Settling Time		-	25 uS	50 uS	

Note: All specifications are typical at nominal input (Vin=12 V), full load at 25 °C unless otherwise stated.

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency Vo=5.0 V Vo=3.3 V Vo=1.8 V Vo=0.75 V	 88% 85% 80% 68%	 92% 88% 84% 73%	 - - - -	Measured at Vin=12 V, Io=Io, max
Switching Frequency	220 kHz	250 kHz	280 kHz	
Output Voltage Trim Range (wide trim)	0.7525 V	-	5 V	
MTBF	3,260,000 hours			Calculated Per Bell Core TR-332 (Io = Nominal; 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			Vertical Mount
Weight	-	5 g	-	

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

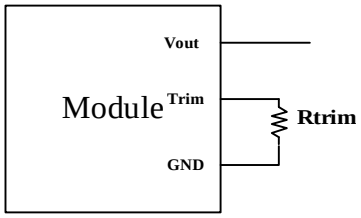
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.3 V	-	0.4 V	VRBA-06E1A0; Remote On/Off pin open, Unit on.
Signal High (Unit On)	2.5 V	-	14 V	
Signal Low (Unit On)	-0.3 V	-	0.4 V	VRBA-06E1AL; Remote On/Off pin open, Unit on.
Signal High (Unit Off)	2.5 V	-	14 V	

Output Trim Equations

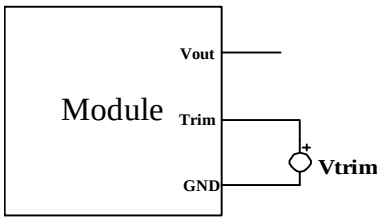
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

$$R_{trim} = \frac{10.507}{V_{adj} - 0.7525} - 1$$

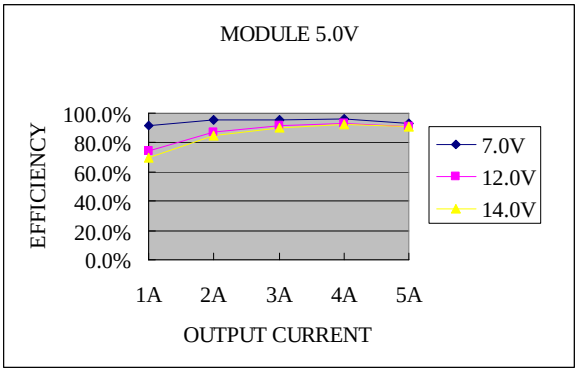


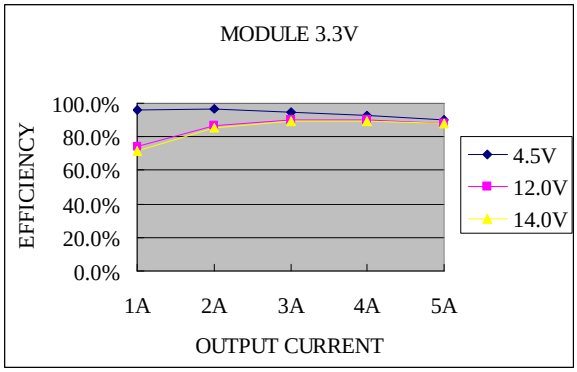
Equation for calculating the trim voltage (in V) given the desired adjusted voltage (Vadj) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

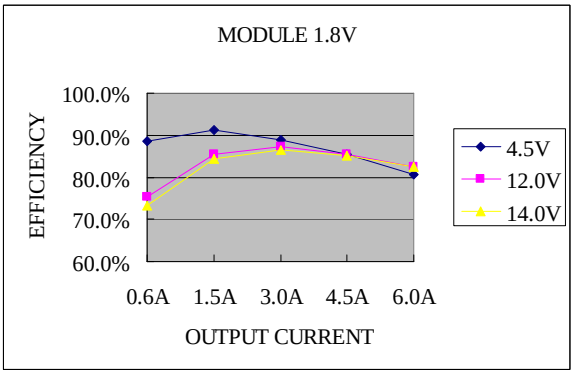
$$V_{trim} = 0.7 - 0.0667 \times (V_o - 0.7525)$$

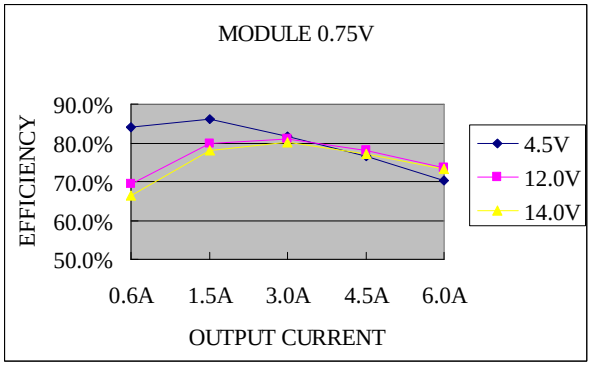


Efficiency Data

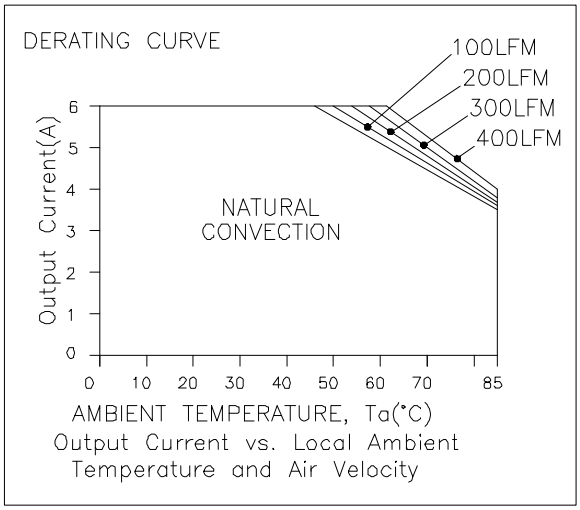




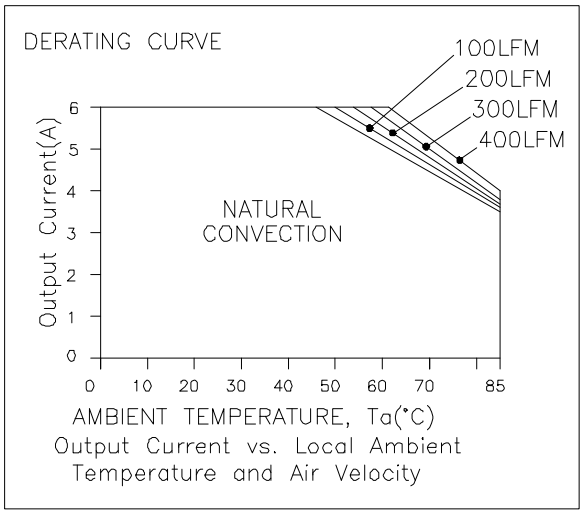




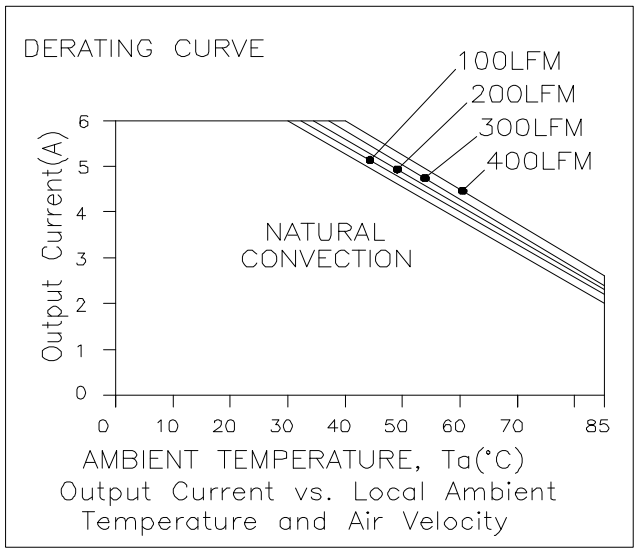
Thermal Derating Curves



Vo=0.75 V

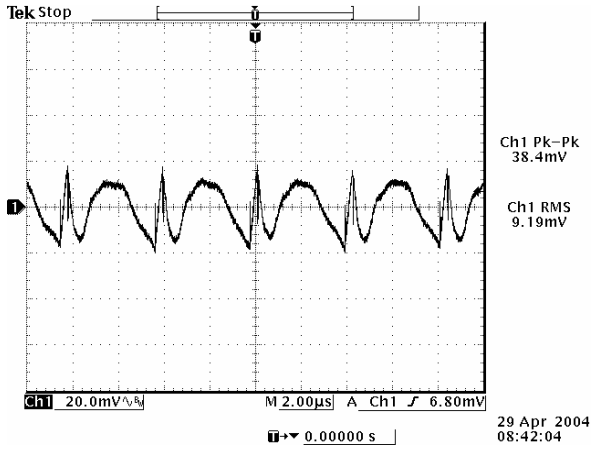


Vo=2.5 V

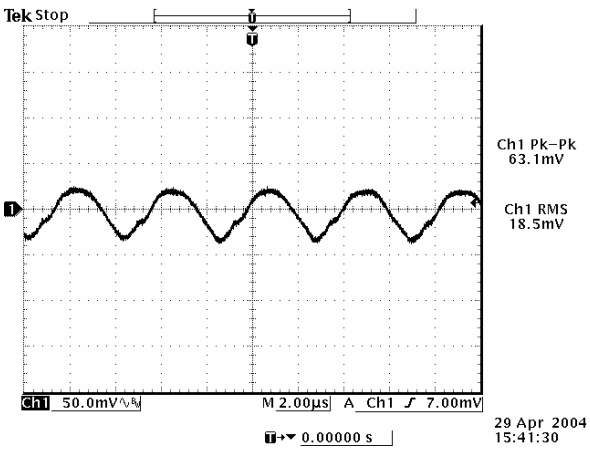


Vo=5 V

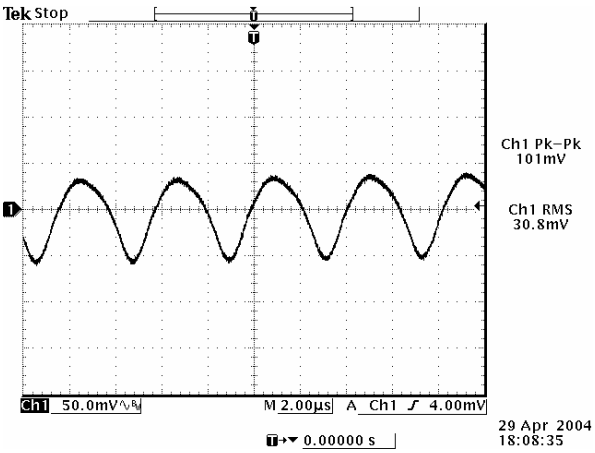
Ripple and Noise Waveforms



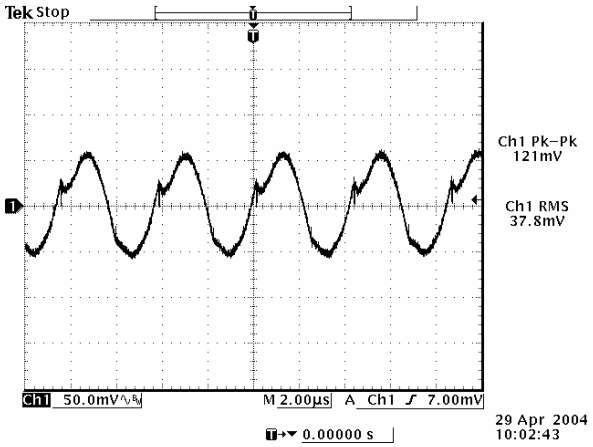
12 V input, 0.75 V output



12 V input, 1.8 V output



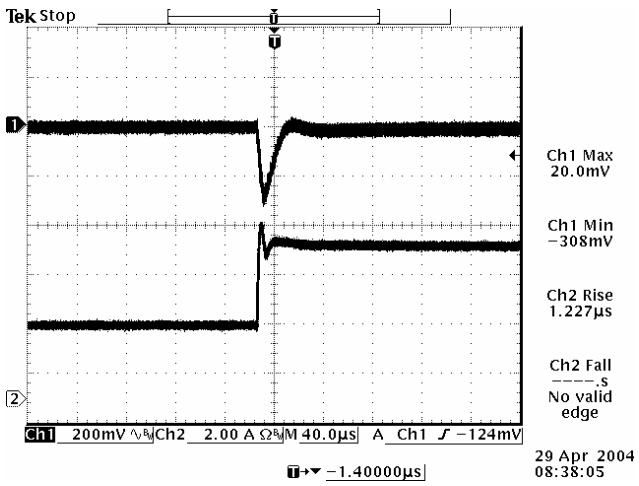
12 V input, 3.3 V output



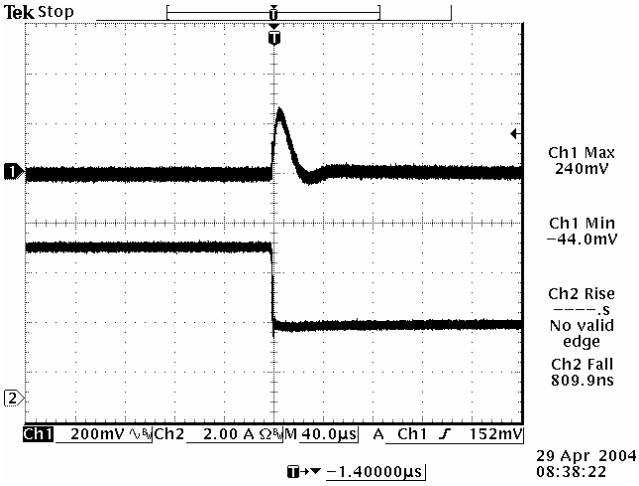
12 V input, 5.0 V output

Note: Ripple and noise at full load, 0-20 MHz BW, with 10 uF/10 V tantalum capacitor and 1 uF/10 V ceramic capacitor at the output, Ta=25 deg C.

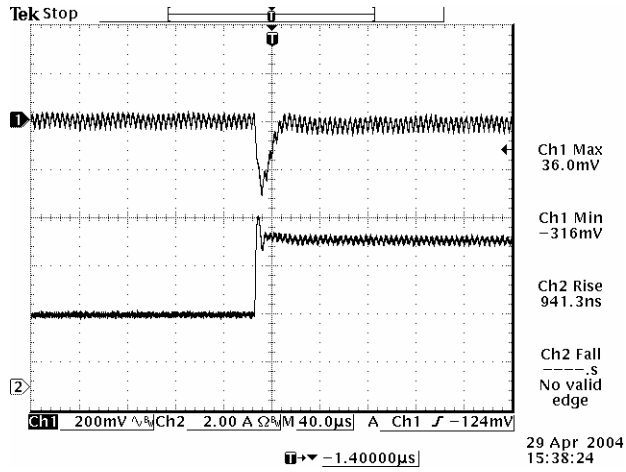
Transient Response Waveforms



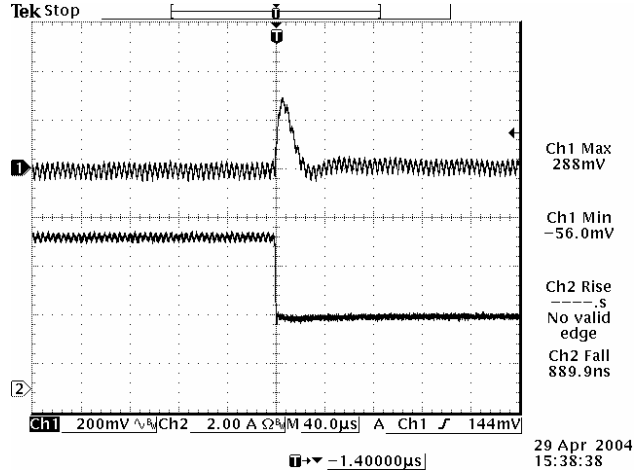
50% to 100% load step at Vin=12 V, Vo=0.75 V



100% to 50% load step at Vin=12 V, Vo=0.75 V

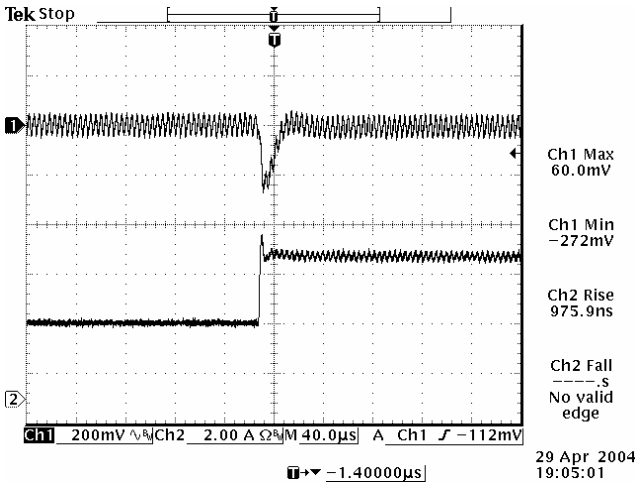


50% to 100% load step at Vin=12 V, Vo=1.8 V

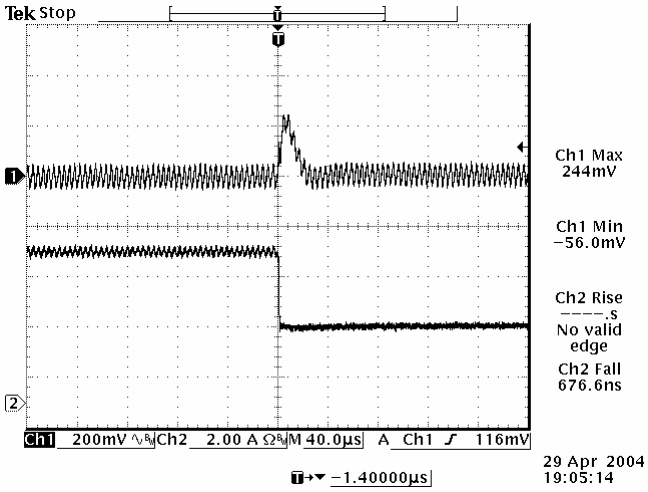


100% to 50% load step at Vin=12 V, Vo=1.8 V

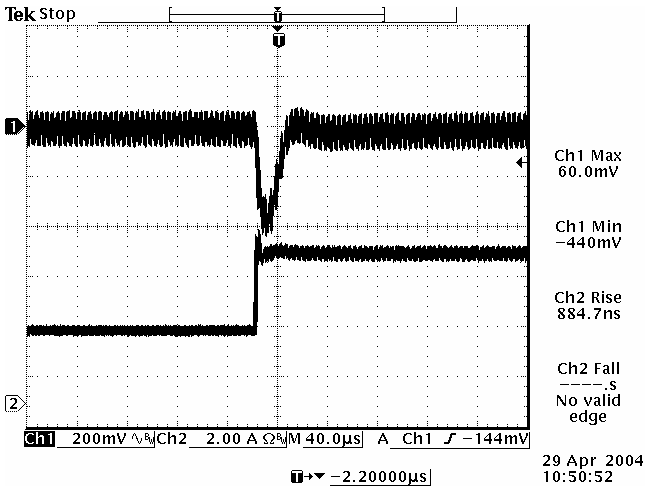
Transient Response Waveforms (continued)



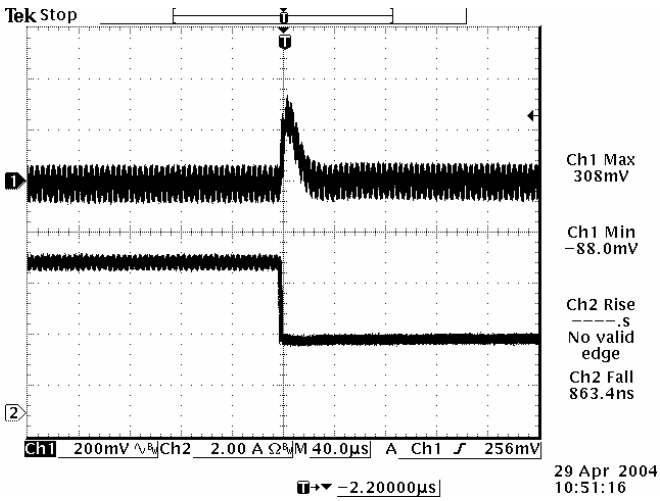
50% to 100% load step at Vin=12 V, Vo=3.3 V



100% to 50% load step at Vin=12 V, Vo=3.3 V



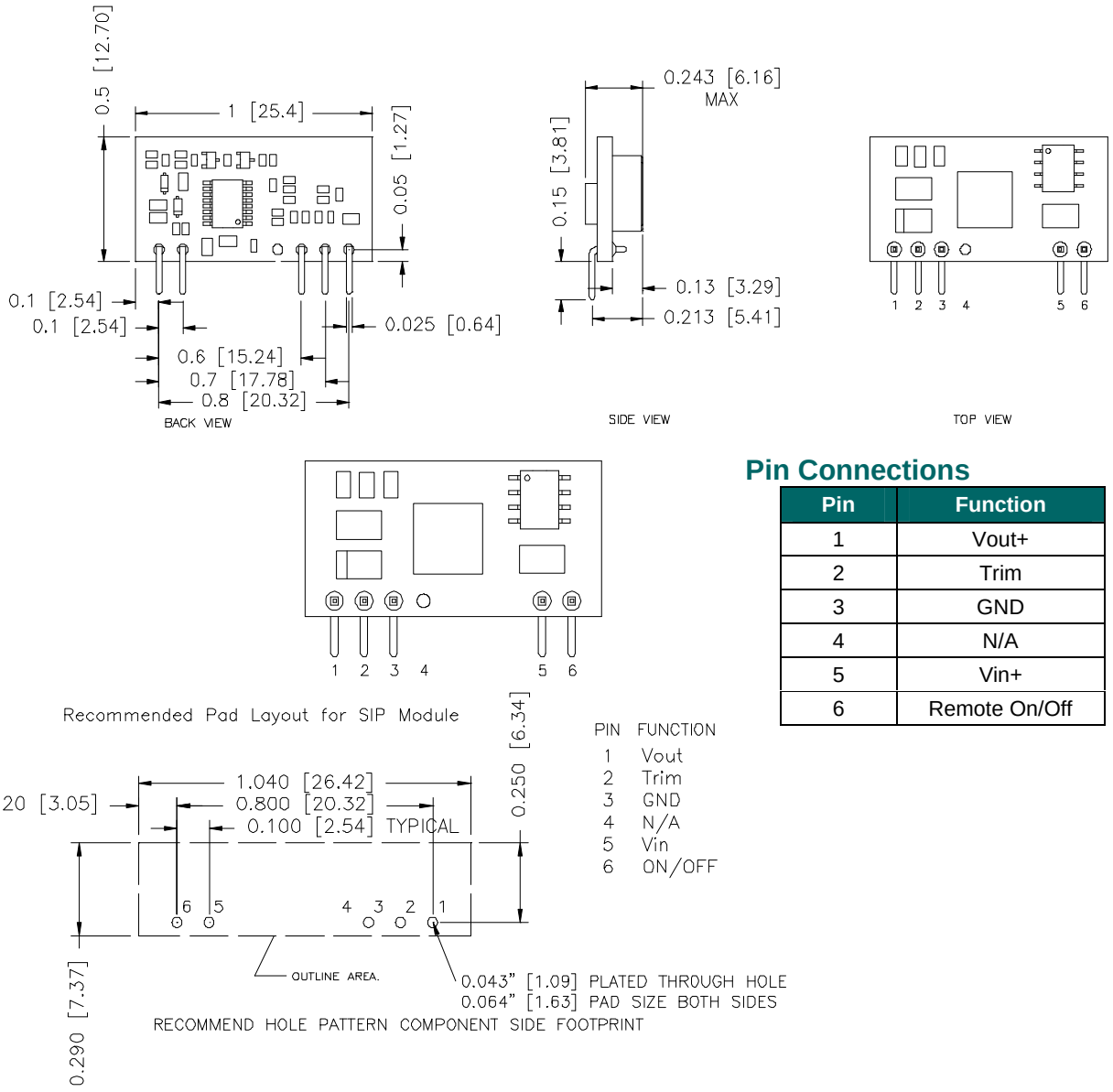
50% to 100% load step at Vin=12 V, Vo=5 V



100% to 50% load step at Vin=12 V, Vo=5 V

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

Mechanical Outline



Pin Connections

Pin	Function
1	Vout+
2	Trim
3	GND
4	N/A
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; RoHS	Lynn
2013-01-25	B	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.

CORPORATE

Bel Fuse Inc.
206 Van Vorst Street
Jersey City, NJ 07302
Tel 201-432-0463
Fax 201-432-9542
www.belfuse.com

FAR EAST

Bel Fuse Ltd.
8F/ 8 Luk Hop Street
San Po Kong
Kowloon, Hong Kong
Tel 852-2328-5515
Fax 852-2352-3706
www.belfuse.com

EUROPE

Bel Fuse Europe Ltd.
Preston Technology Management Centre
Marsh Lane, Suite G7, Preston
Lancashire, PR1 8UD, U.K.
Tel 44-1772-556601
Fax 44-1772-888366
www.belfuse.com