

NON-ISOLATED DC/DC CONVERTERS

2.4 Vdc - 5.5 Vdc Input

0.75 Vdc - 3.63 Vdc/6 A Output

bel
POWER PRODUCTS

VRBA-06F1Ax

RoHS Compliant

Rev.A

- Non-Isolated
- High Efficiency
- High Power Density
- Fixed Frequency (300 kHz)
- Able to Sink & Source Current
- Under-Voltage Lockout (UVLO)
- Wide Trim
- OCP/SCP
- Remote On/Off
- Active Low/High (option)



Description

The Bel VRBA-06F1Ax 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). 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-06F1AL	VRBA-06F1A0

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

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	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-55 °C	-	125 °C	

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

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Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	2.4 V	-	5.5 V	$V_{o, set} \leq V_{in} - 0.5 V$
Input Current (full load)				
$V_o = 3.3V$	-	-	4.73 A	
$V_o = 2.5V$	-	-	3.66 A	
$V_o = 1.8V$	-	-	4.09 A	
$V_o = 1.5V$	-	-	4.31 A	
$V_o = 1.2V$	-	-	3.57 A	
$V_o = 0.75V$	-	-	2.40 A	
Input Current (no load)				
$V_o = 3.3 V$	-	50 mA	-	
$V_o = 0.75 V$	-	25 mA	-	
Remote Off Input Current	-	0.6 mA	-	
Input Reflected Ripple Current (pk-pk)	-	120 mA	-	Tested with simulated source impedance of 1 μH , 5 Hz to 20 MHz, one 1000 μF /25 V AL capacitor and two 100 μF / 10 V Tantalum capacitor at the input.
Input Reflected Ripple Current (rms)	-	35 mA	-	
I^2t Inrush Current Transient	-	-	0.04 A ² 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% $V_{o, set}$	-	2% $V_{o, set}$	$V_{in} = 5 V$, 50% full load
Output Voltage Set Point	-3% $V_{o, set}$	-	3% $V_{o, set}$	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% $V_{o, set}$	-	$I_o = I_{omin}$ to 50% I_{omax}
Line Regulation	-	0.3% $V_{o, set}$	-	$V_{in} = 50\% V_{in, min}$ to $V_{in, max}$
Regulation Over Temperature (-40 °C to +85 °C)	-	0.4% $V_{o, set}$	-	$T_{ref} = T_{amin}$ to T_{amax}
Output Current	0 A	-	6 A	
Current Limit Threshold	9 A	-	18 A	
Short Circuit Surge Transient	-	0.32 A ² s	-	
Ripple and Noise (pk-pk)	-	40 mV	70 mV	Tested with 0-20 MHz, with 10 μF Tantalum capacitor & 1 μF /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				
$ESR \geq 1m\Omega$	0 μF	-	1000 μF	
$ESR \geq 10m\Omega$	0 μF	-	3000 μF	
Transient Response				
50% ~ 100% Max Load	$V_o = 0.75 V - 3.63 V$	-	130 mV	$di/dt = 2.5 A/\mu S$; $V_{in} = 5 V$; and with 10 μF Tantalum capacitor & 1 μF /10 V TDK ceramic capacitor at the output
Settling Time		-	25 μS	
100% ~ 50% Max Load		-	130 mV	
Settling Time		-	25 μS	

Note: All specifications are typical at nominal input, full load at 25 °C unless otherwise stated.

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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	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)	1.0 × 0.5 × 0.243			
Millimeters (L × W × H)	25.4 × 12.7 × 6.16			
Weight	-	5 g	-	

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

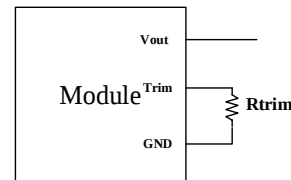
Control Specifications

Parameter	Min	Typ	Max	Notes
Remote On/Off				
Signal Low (Unit Off)	-0.2 V	-	0.3 V	VRBA-06F1A0; Remote On/Off pin open, Unit on.
Signal High (Unit On)	-	-	Vin, max	
Signal Low (Unit On)	-0.2 V	-	0.3 V	VRBA-06F1AL; Remote On/Off pin open, Unit on.
Signal High (Unit Off)	1.5 V	-	Vin, max	

Output Trim Equations

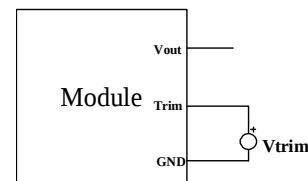
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

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



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.

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



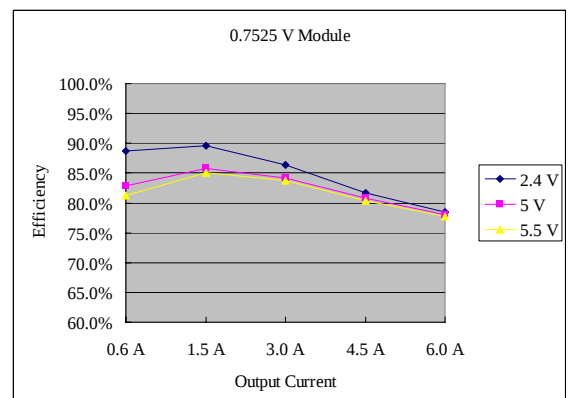
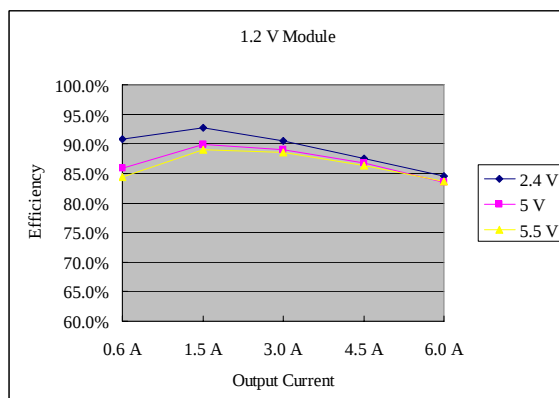
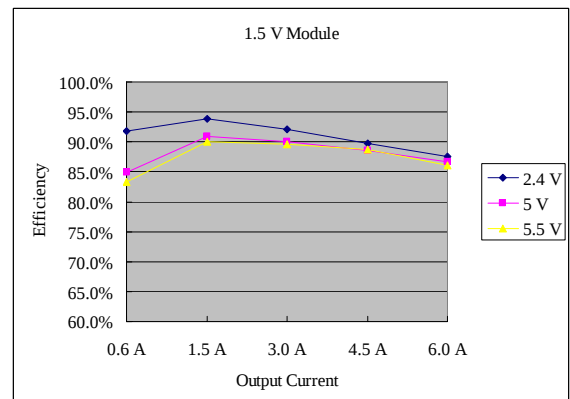
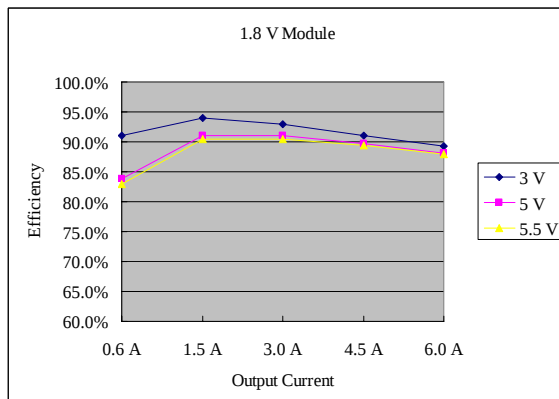
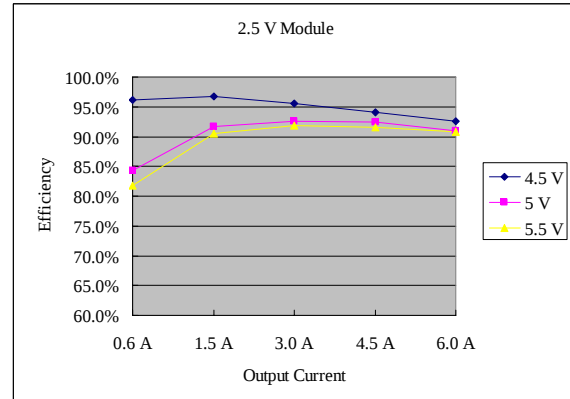
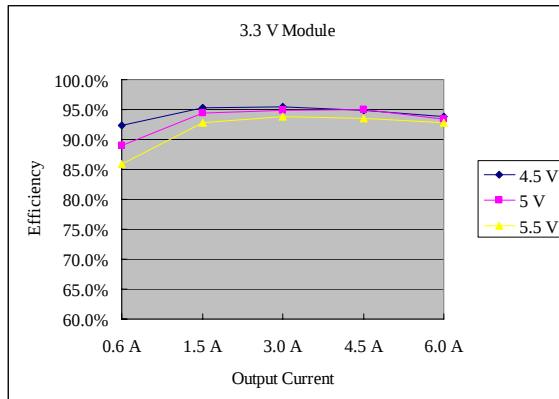
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Efficiency Data



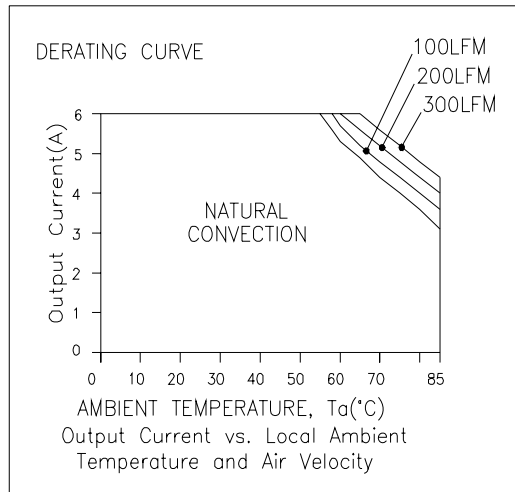
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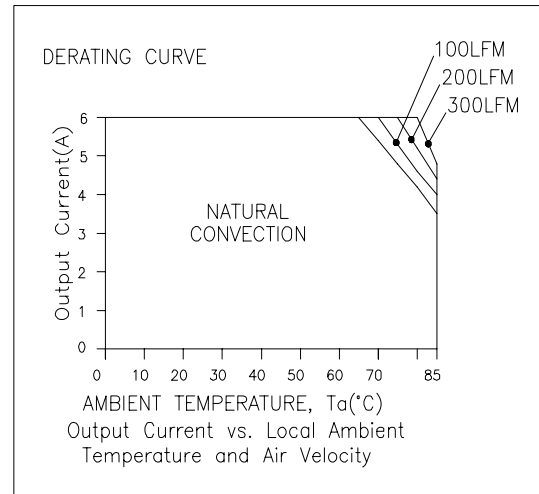
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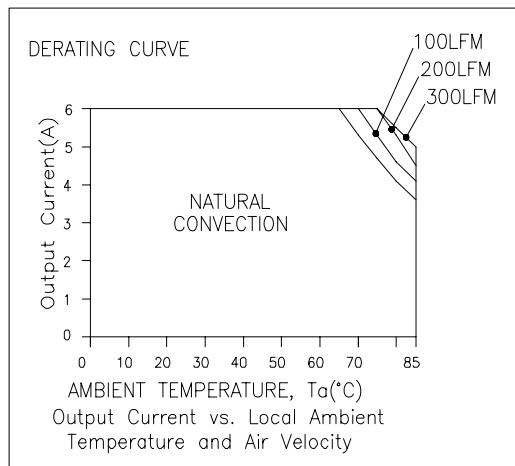
Thermal Derating Curves



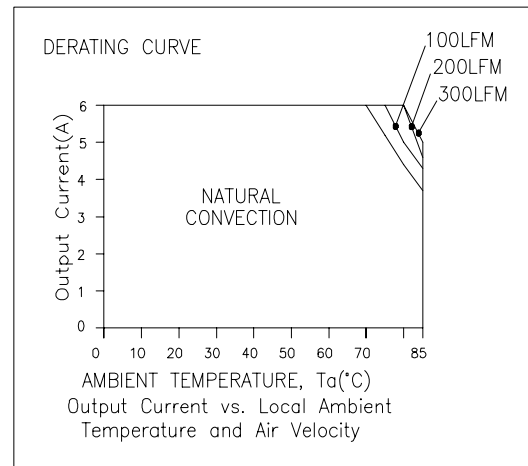
$V_{in}=5\text{ V}$, $V_o = 3.3\text{ V}$



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



$V_{in}=4.5\text{ V}$, $V_o = 2.5\text{ V}$



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

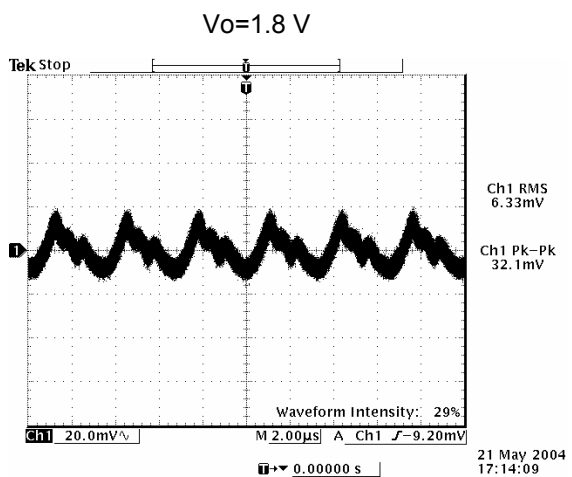
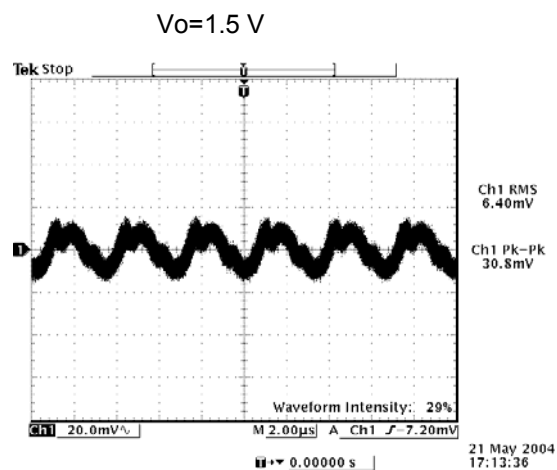
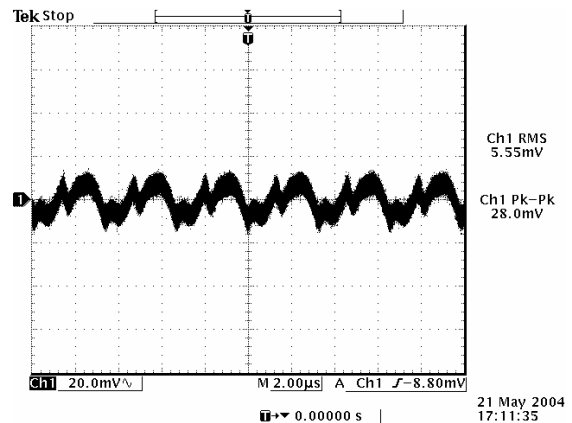
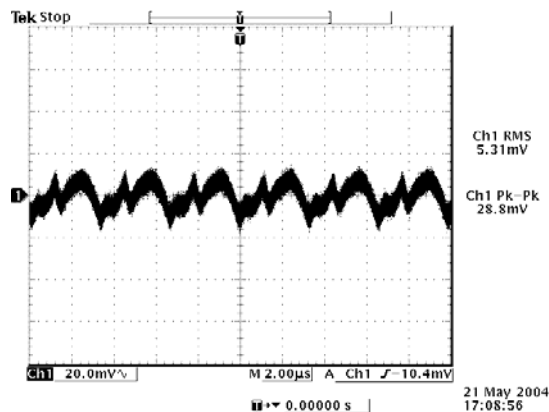
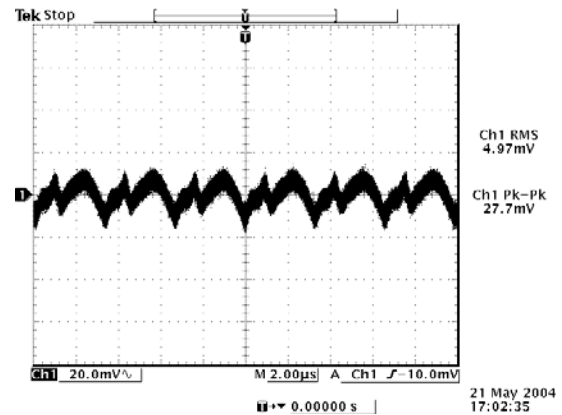
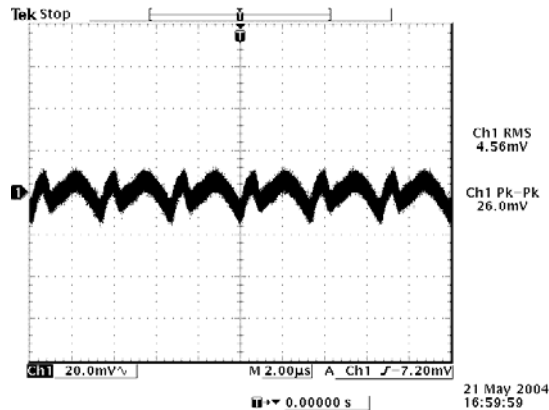
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Ripple and Noise Waveforms



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

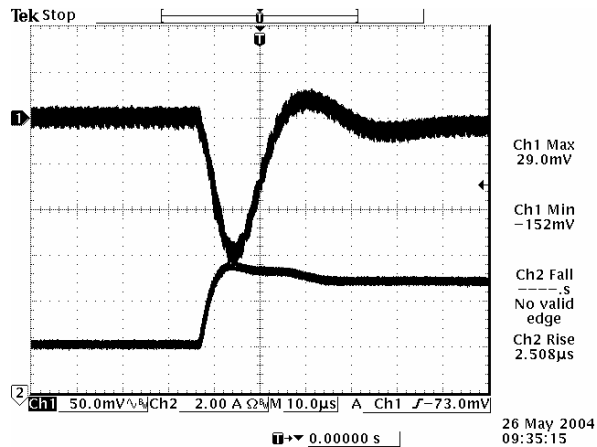
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2.4 Vdc - 5.5 Vdc Input

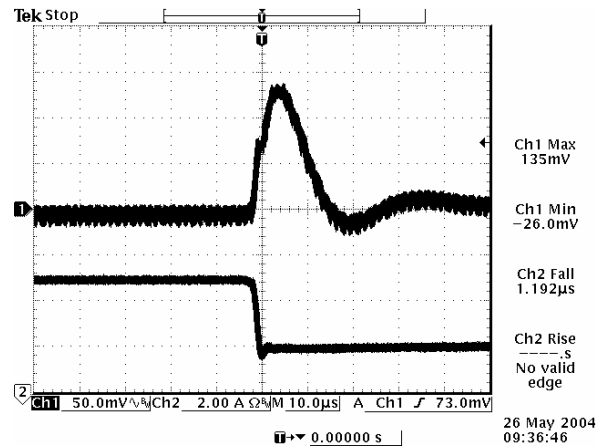
0.75 Vdc - 3.63 Vdc/6 A Output



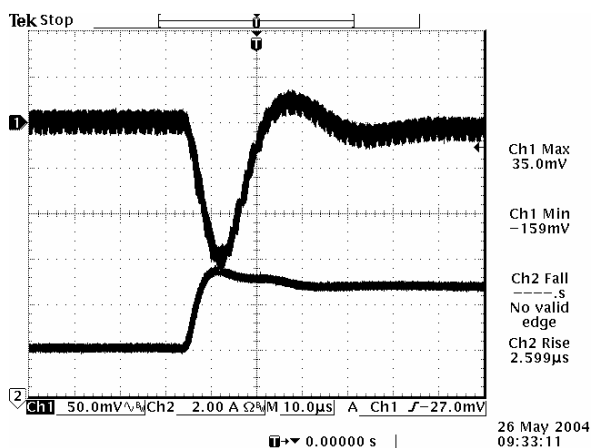
Transient Response Waveforms



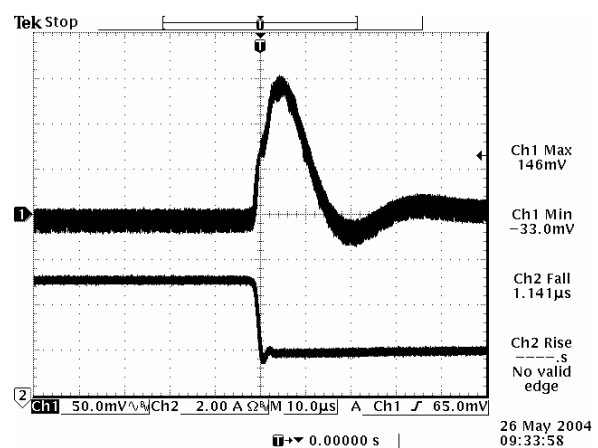
50% to 100% load step at 5 V input, 0.75 V output



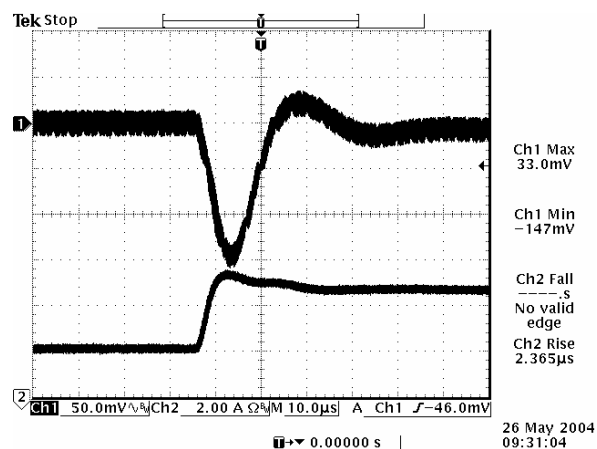
100% to 50% load step at 5 V input, 0.75 V output



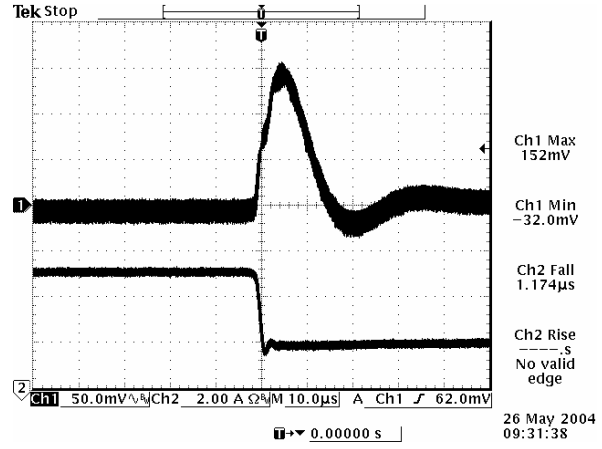
50% to 100% load step at 5 V input, 1.2 V output



100% to 50% load step at 5 V input, 1.2 V output



50% to 100% load step at 5 V input, 1.5 V output



100% to 50% load step at 5 V input, 1.5 V output

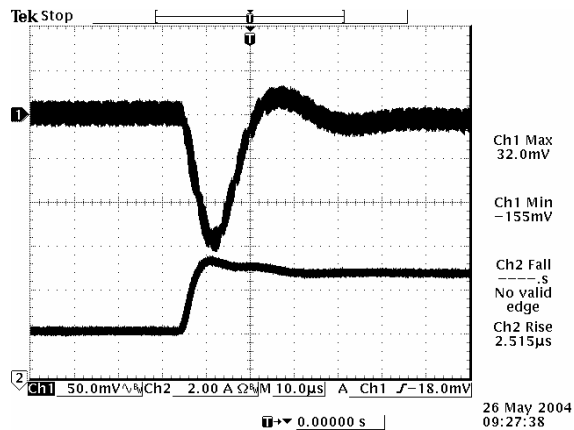
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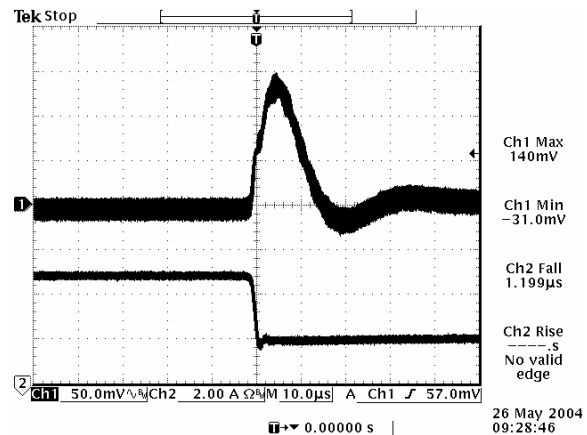
0.75 Vdc - 3.63 Vdc/6 A Output



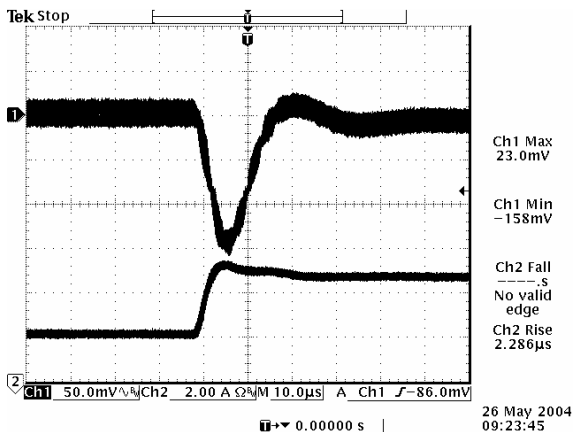
Transient Response Waveforms (continued)



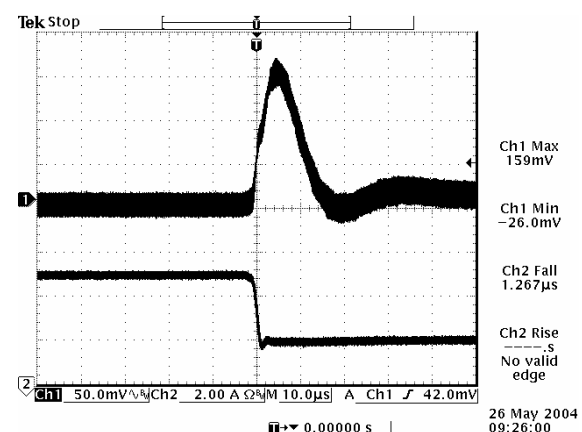
50% to 100% load step at 5 V input, 1.8 V output



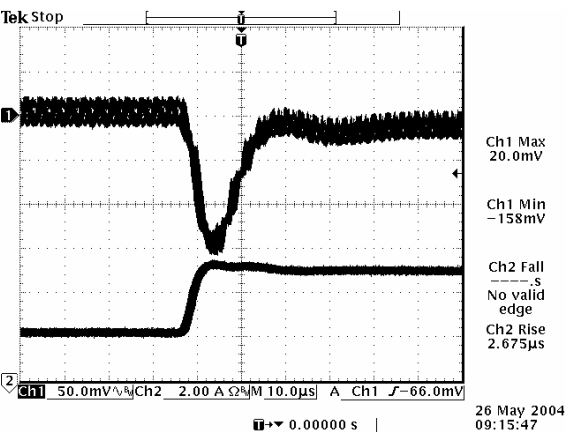
100% to 50% load step at 5 V input, 1.8 V output



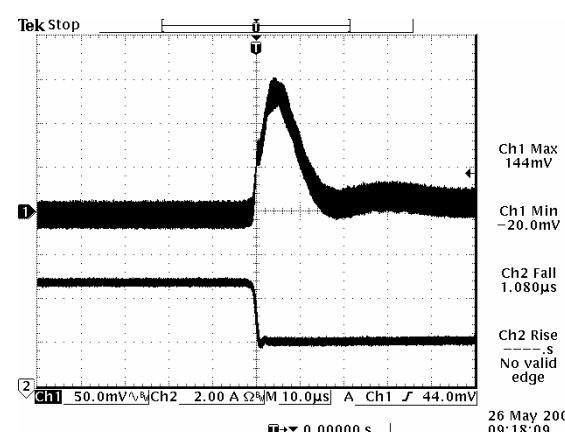
50% to 100% load step at 5 V input, 2.5 V output



100% to 50% load step at 5 V input, 2.5 V output



50% to 100% load step at 5 V input, 3.3 V output



100% to 50% load step at 5 V input, 3.3 V output

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

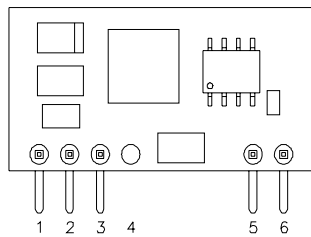
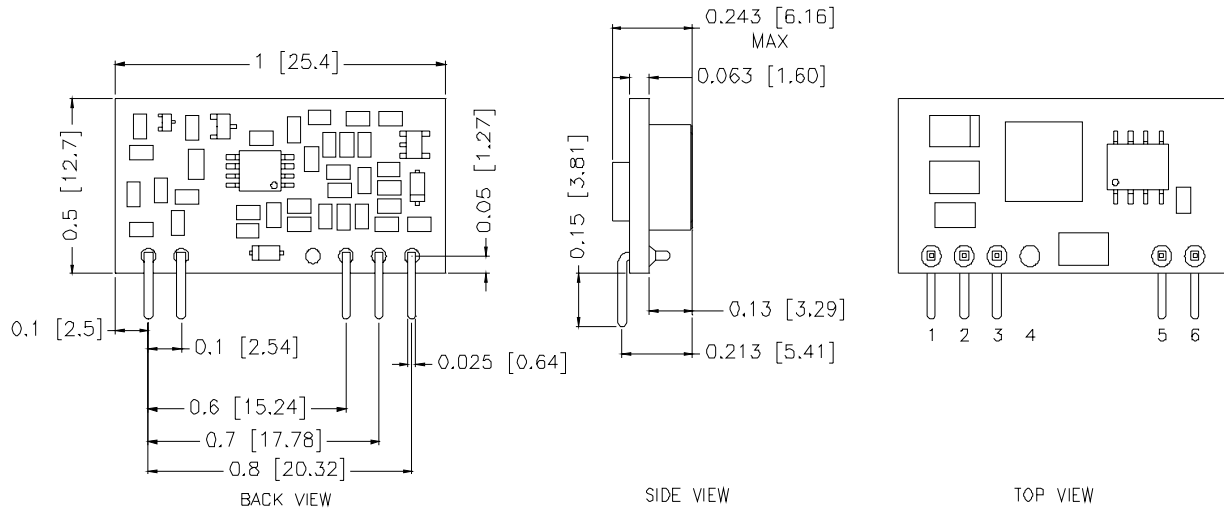
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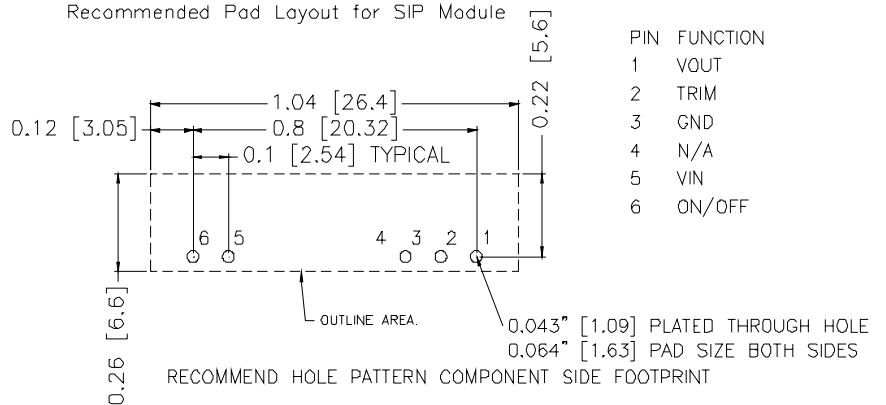


Mechanical Outline



TOP VIEW

Recommended Pad Layout for SIP Module



PIN	FUNCTION
1	VOUT
2	TRIM
3	GND
4	N/A
5	VIN
6	ON/OFF

Pin Connections

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

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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