

## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

0.75 Vdc - 3.63 Vdc/6 A Output

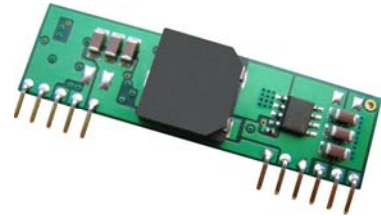
**bel**  
POWER PRODUCTS

xRPB-06F1Ax

RoHS Compliant

Rev.A

- Non-Isolated
- High Efficiency
- High Power Density
- Fixed Frequency (300 kHz)
- Power Good Output Signal
- Can Sink & Source Current
- Over Temperature Protection
- Under Voltage Lockout (UVLO)
- OCP/SCP
- Remote On/Off
- Remote Sense
- Wide Trim Range
- Active High/Low (Options)



### Description

The Bel xRPB-06F1Ax modules are a series of non-isolated high density open frame dc/dc converters that can deliver up to 6 A of output current with full load efficiency of 94% 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 ( $V_{in}=3.0\text{ Vdc} - 5.5\text{ Vdc}$ ). Standard features include remote On/Off, programmable output voltage, over current protection, over thermal shutdown and short circuit protection.

### Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active High	Model Number Active Low	Model Number Active Low
0.75 V - 3.63 V	3.0 V - 5.5 V	6 A	22 W	94%	VRPB-06F1A0	VRPB-06F1AL	VRPB-06F1AW <sup>1</sup>

**Notes:** 1. "W" indicates special coating.

2. Add "G" suffix at the end of the model number listed above to indicate Tray Packaging. Change the first letter of the model number from "V" to "O" for horizontal mount package.

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	-40 °C	-	125 °C	

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

### Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	$V_o \leq 1.8\text{ V}$	3.0 V	-	5.5 V
	$V_o=2.5-3.3\text{ V}$	4.5 V	-	5.5 V
Input Current (full load)	$V_o=3.3\text{ V}$	-	4.21 A	-
	$V_o=2.5\text{ V}$	-	3.26 A	-
	$V_o=1.8\text{ V}$	-	2.43 A	-
	$V_o=1.5\text{ V}$	-	2.07 A	-
	$V_o=1.2\text{ V}$	-	1.69 A	-
	$V_o=0.75\text{ V}$	-	1.14 A	-

## NON-ISOLATED DC/DC CONVERTERS

3.0 Vdc - 5.5 Vdc Input

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### Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
Input Current (no load)				
$V_o=3.3\text{ V}$	-	100 mA	-	
$V_o=0.75\text{ V}$	-	50 mA	-	
Remote Off Input Current	-	10 mA	-	
Input Reflected Ripple Current (pk-pk)	-	120 mA	-	Tested with simulated source impedance of 1 $\mu$ H, 5 Hz to 20 MHz.
Input Reflected Ripple Current (rms)	-	35 mA	-	
$I^2t$ Inrush Current Transient	-	-	0.04 A <sup>2</sup> s	
Turn-on Voltage Threshold	-	2.7 V	3.0 V	
Turn-off Voltage Threshold	1.8 V	2.6 V	-	

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

### Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point	-2% $V_{o,set}$	-	2% $V_{o,set}$	$V_{in}=5\text{ V}$ , 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	0.7525 V	-	3.63 V	Selected by external resistor or voltage
Load Regulation	-	0.4% $V_{o,set}$	-	$I_o=I_{o,min}$ to 50% $I_{o,max}$
Line Regulation	-	0.3% $V_{o,set}$	-	$V_{in}=V_{in,min}$ to $V_{in,max}$
Temperature Regulation	-	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 <sup>2</sup> s	-	
Ripple and Noise (pk-pk)	-	40 mV	70 mV	Tested with 0-20 MHz, with external 10 $\mu$ F Tantalum capacitor and 1 $\mu$ F/10 V TDK 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% $V_o$	
External Load Capacitance				
Min ESR $\geq 1\text{ m}\Omega$	0 $\mu$ F		1000 $\mu$ F	
Max ESR $\geq 10\text{ m}\Omega$	0 $\mu$ F		3000 $\mu$ F	
<b>Transient Response</b>				
50% ~ 100% Max Load	$V_o=0.75\text{ V} - 3.63\text{ V}$	-	150 mV	Test conditions: $di/dt=2.5\text{ A}/\mu\text{S}$ ; $V_{in}=5\text{ V}$ ; with external 10 $\mu$ F Tantalum capacitor and 1 $\mu$ F/10 V TDK ceramic capacitor at the output.
Settling Time		-	25 $\mu$ S	
100% ~ 50% Max Load		-	150 mV	
Settling Time		-	25 $\mu$ S	

**Note:** All specifications are typical at nominal input ( $V_{in}=5\text{ V}$ ), full load at 25 °C unless otherwise stated.

# NON-ISOLATED DC/DC CONVERTERS

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



## General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency (Current Source)				Measured at Vin=5 V, full load
Vo=3.3 V	-	94%	-	
Vo=2.5 V	-	92%	-	
Vo=1.8 V	-	89%	-	
Vo=1.5 V	-	87%	-	
Vo=1.2 V	-	85%	-	
Vo=0.75 V	-	79%	-	
Switching Frequency	250 kHz	300 kHz	350 kHz	
Output Voltage Trim Range	0.7525 V	-	3.63 V	
Remote Sense Compensation	-	-	10%Vo	
Over Temperature Shutdown	-	125 °C	-	
MTBF	6,929,838 hours			Calculated Per Bell Core SR-332 (Io = Nominal; Ta = 25 °C)
Dimensions				
Inches (L x W x H)	2.0 x 0.55 x 0.36			
Millimeters (L x W x H)	50.80 x 13.97 x 9.14			
Weight	-	7.5 g	-	

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

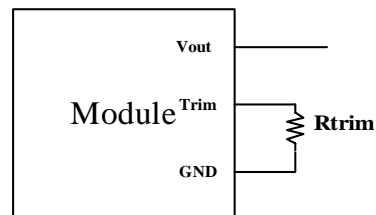
## Control Specifications

Parameter	Min	Typ	Max	Notes
<b>Remote On/Off</b>				
Signal Low (Unit Off)	-0.2 V	-	0.3 V	xRPB-06F1A0; Active High; Remote On/Off pin open, Unit on.
Signal High (Unit On)	-	-	Vin, max	
Signal Low (Unit On)	-0.2 V	-	0.3 V	xRPB-06F1AL & xRPB-06F1AW; Active Low; Remote On/Off pin open, Unit on.
Signal High (Unit Off)	1.5 V	-	Vin, max	
<b>Power Good Levels</b>				
High Level	2.1 V	-	-	
Low Level	-	-	1.05 V	

## Output Trim Equations

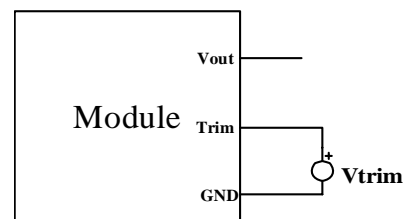
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) is shown below. The Trim resistor should be connected between the Trim pin and Ground.

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



Equation for calculating the trim voltage Vtrim (in V) given the desired adjusted voltage (Vadj) is shown below.

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



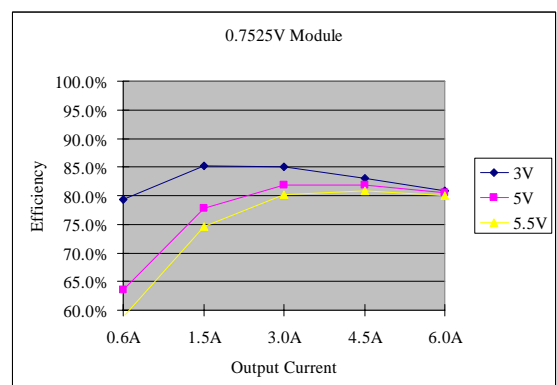
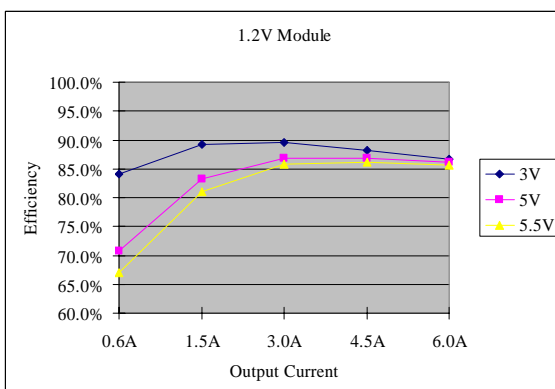
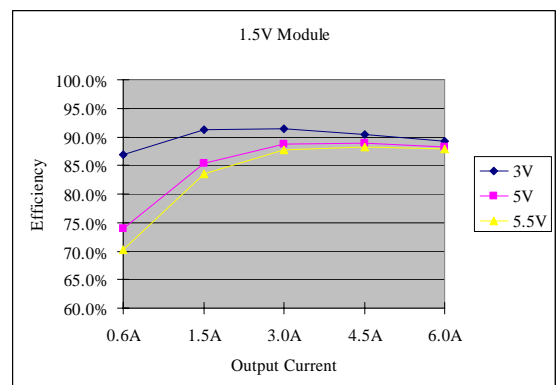
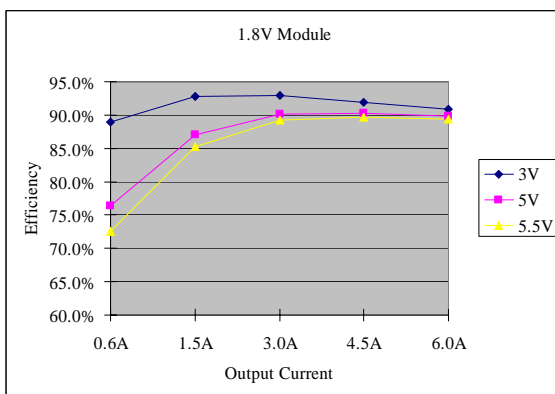
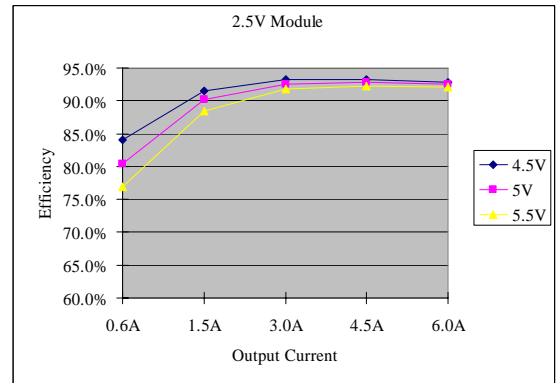
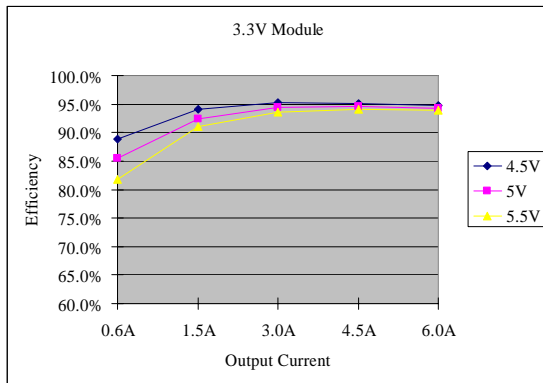
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## Efficiency Data



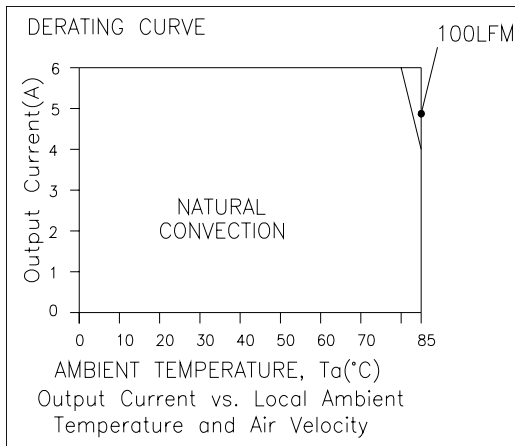
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3.0 Vdc - 5.5 Vdc Input

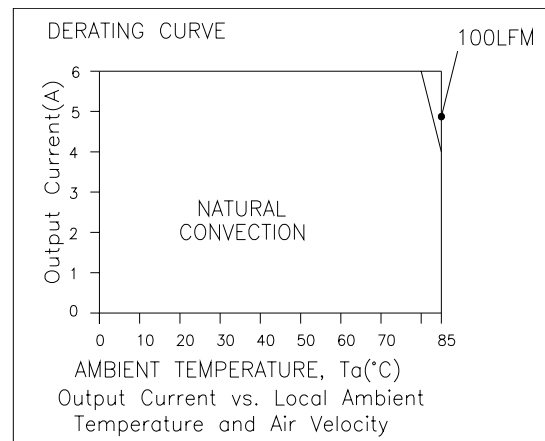
0.75 Vdc - 3.63 Vdc/6 A Output



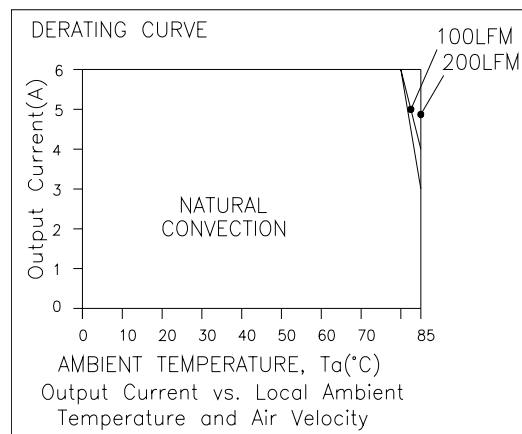
## Thermal Derating Curves



Vin=5 V, Vo=0.75 V



Vin=5 V, Vo=1.8 V



Vin=5 V, Vo=3.3 V

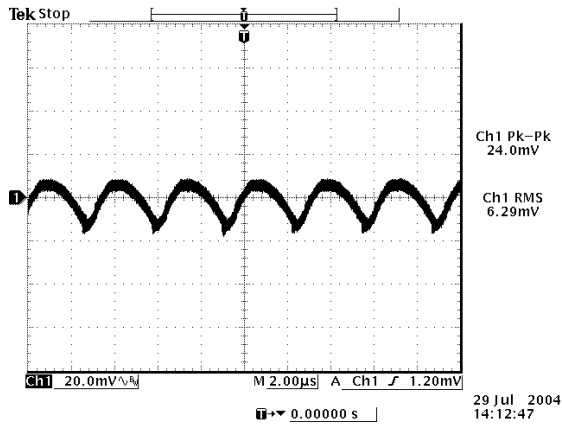
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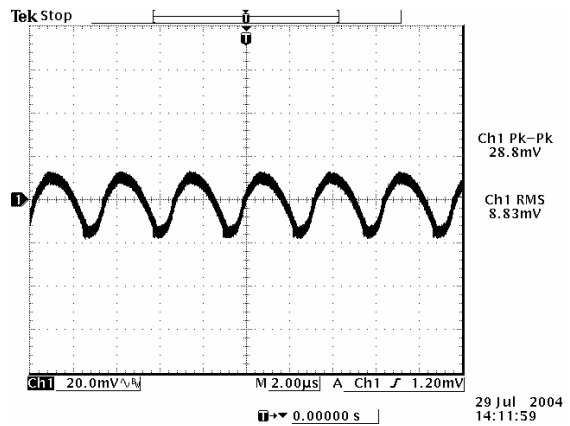
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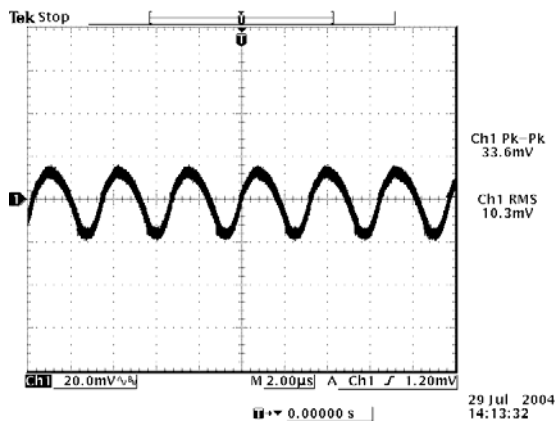
## Ripple and Noise Waveforms



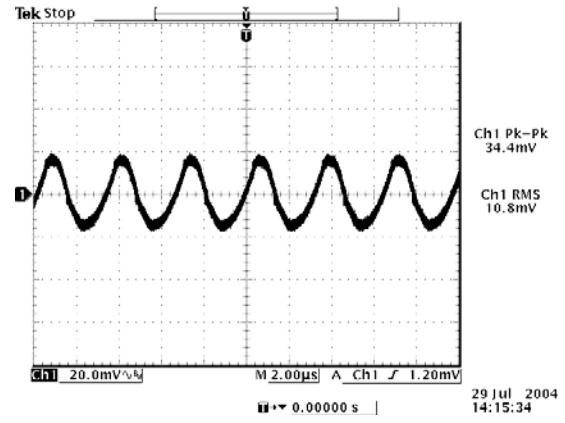
Ripple and noise at full load  $V_o=0.75$  V



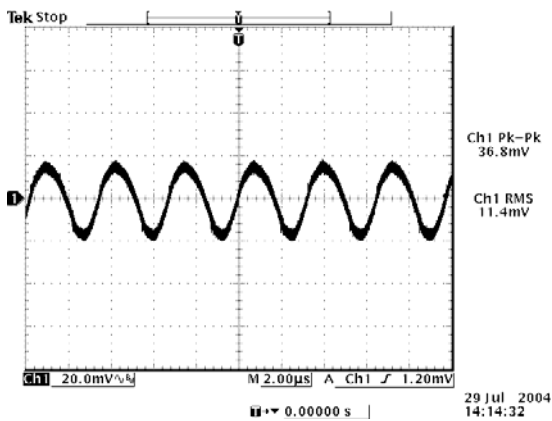
Ripple and noise at full load  $V_o=1.2$  V



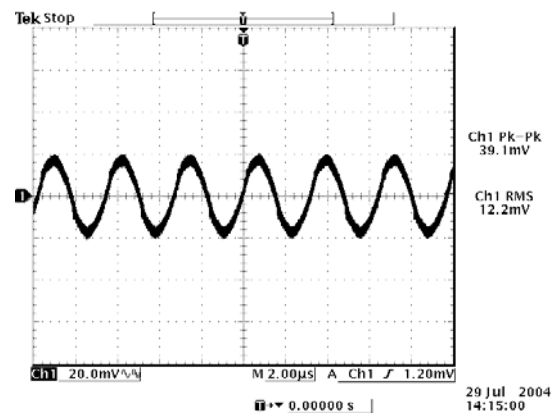
Ripple and noise at full load  $V_o=1.5$  V



Ripple and noise at full load  $V_o=1.8$  V



Ripple and noise at full load  $V_o=2.5$  V



Ripple and noise at full load  $V_o=3.3$  V

**Note:** Ripple and Noise at 5.0 Vdc input, 0-20 MHz BW, with a 1  $\mu$ F/10 V and a 10  $\mu$ F/10 V tantalum cap at the output,  $T_a=25$  deg C.

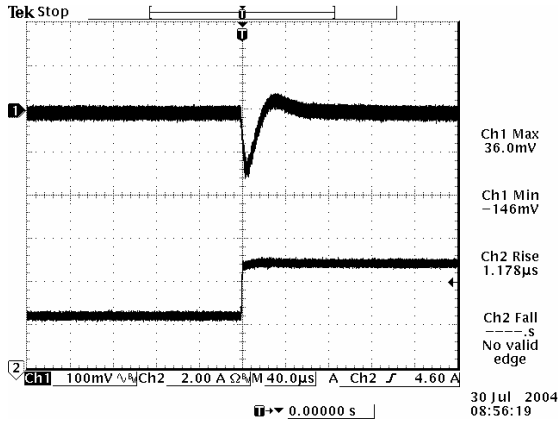
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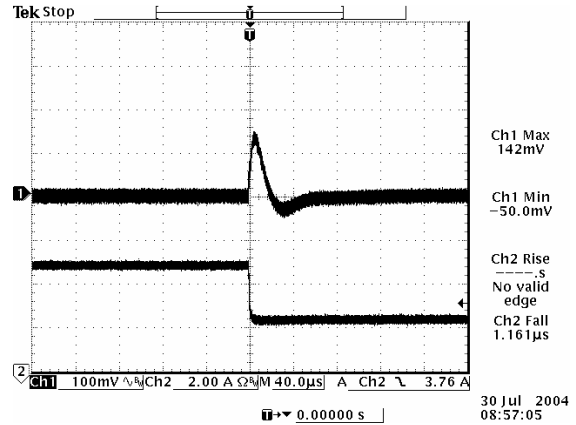
0.75 Vdc - 3.63 Vdc/6 A Output



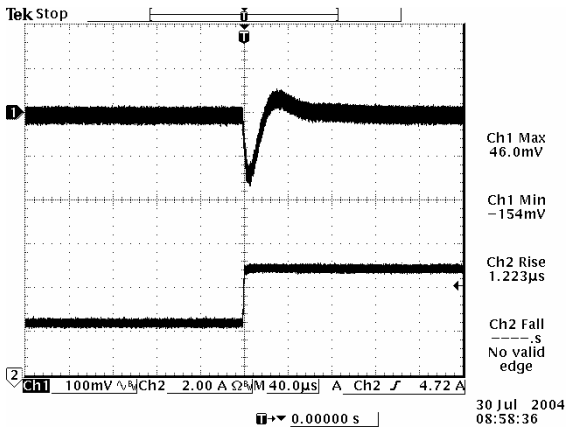
## Transient Response Waveforms



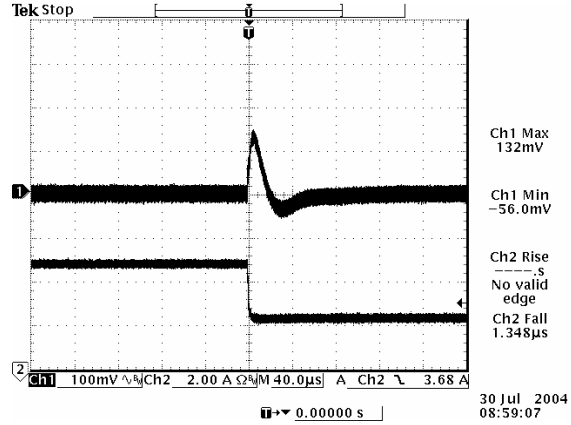
Transients 50% to 100% load 0.75 Vdc output



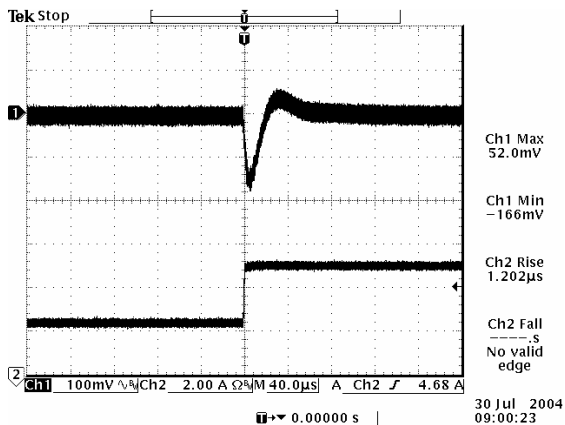
Transients 100% to 50% load 0.75 Vdc output



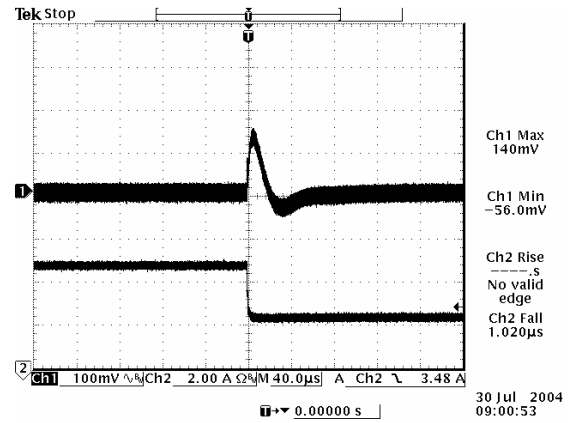
Transients 50% to 100% load 1.2 Vdc output



Transients 100% to 50% load 1.2 Vdc output



Transients 50% to 100% load 1.5 Vdc output



Transients 100% to 50% load 1.5 Vdc output

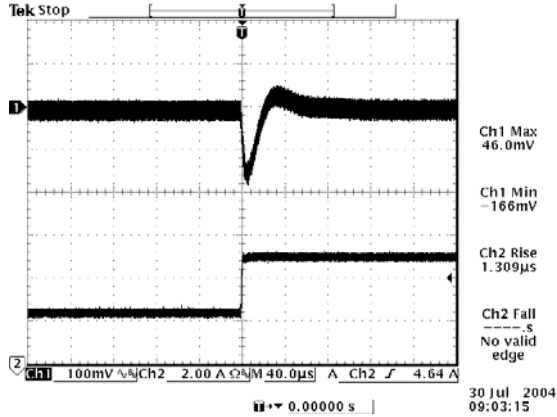
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3.0 Vdc - 5.5 Vdc Input

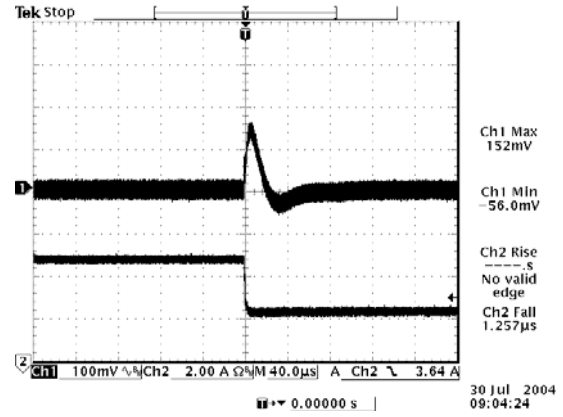
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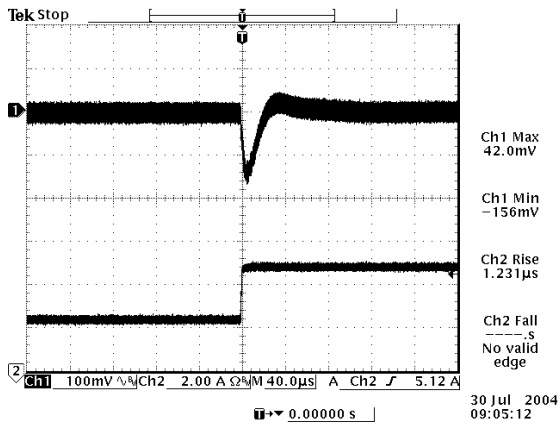
## Transient Response Waveforms (continued)



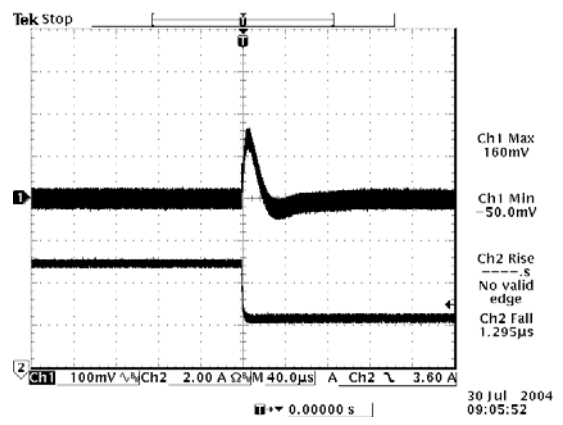
Transients 50% to 100% load 1.8 Vdc output



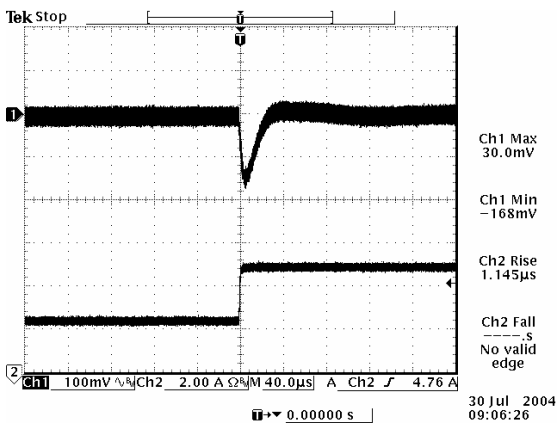
Transients 100% to 50% load 1.8 Vdc output



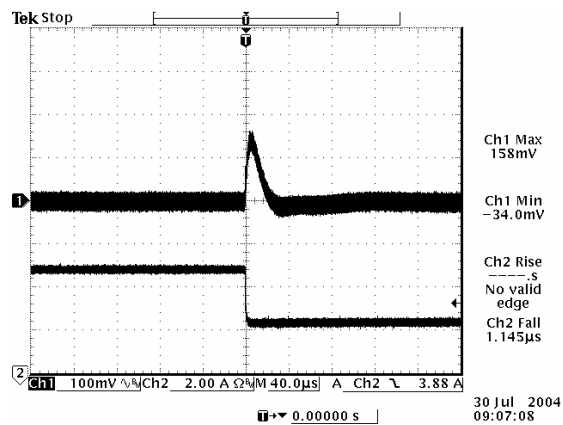
Transients 50% to 100% load 2.5 Vdc output



Transients 100% to 50% load 2.5 Vdc output



Transients 50% to 100% load 3.3 Vdc output



Transients 100% to 50% load 3.3 Vdc output

**Note:** Transient Response at 5.0 V input,  $di/dt=2.5$  A/ $\mu$ s, with a 10  $\mu$ F/10 V tantalum cap, a 1  $\mu$ F/10 V ceramic cap at the output,  $T_a=25$  deg C.



# NON-ISOLATED DC/DC CONVERTERS

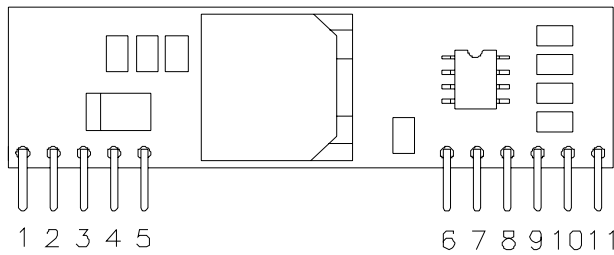
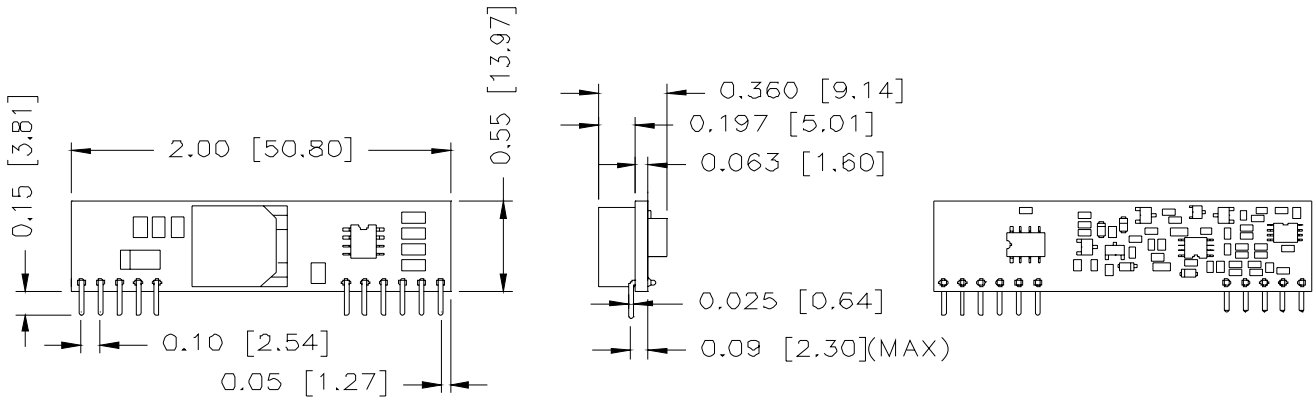
3.0 Vdc - 5.5 Vdc Input

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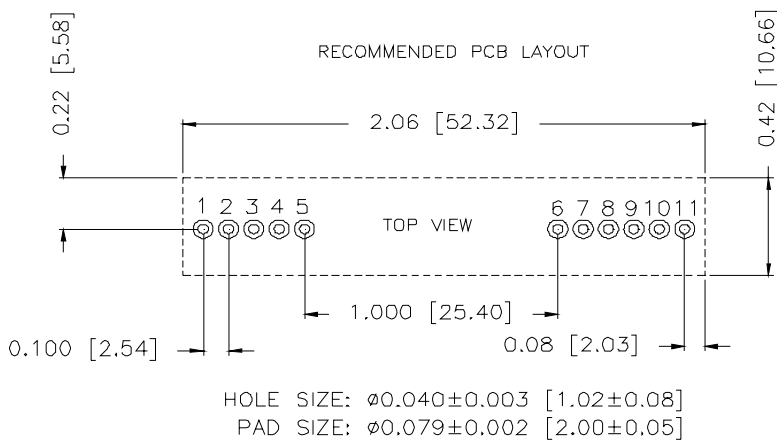
## Mechanical Outlines

### VRPB-06F1Ax



## Pin Connections

Pin	Function
1	+Vout
2	+Vout
3	Remote Sense
4	+Vout
5	Ground
6	Ground
7	+Vin
8	+Vin
9	Power Good
10	Trim
11	Remote On/Off



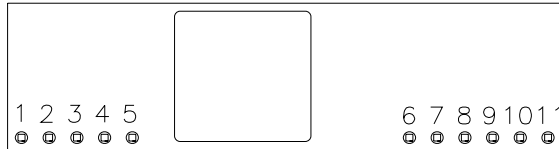
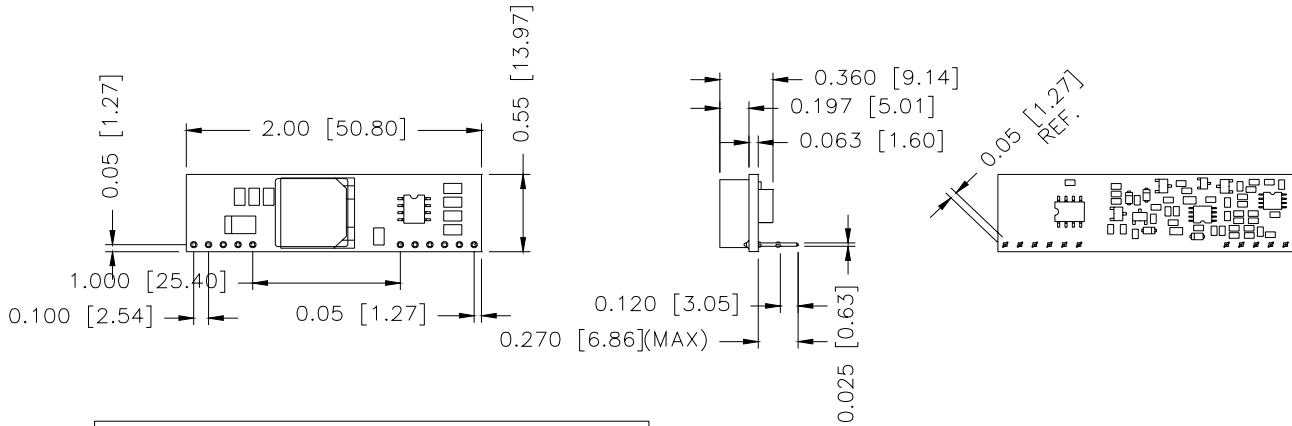
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## Mechanical Outlines (continued)

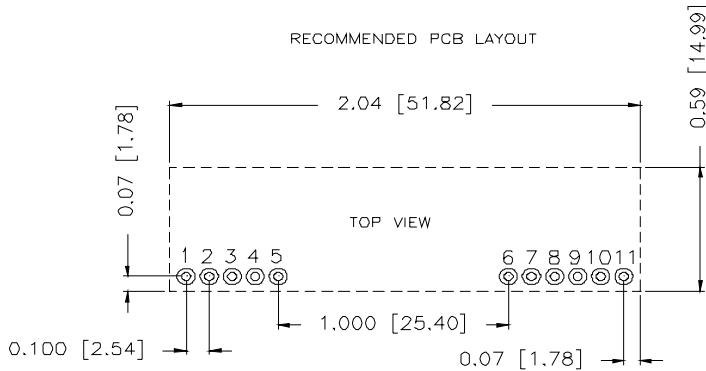
### 0RPB-06F1Ax



### Pin Connections

Pin	Function
1	+Vout
2	+Vout
3	Sense
4	+Vout
5	Ground
6	Ground
7	+Vin
8	+Vin
9	Power Good
10	Trim
11	Remote On/Off

### RECOMMENDED PCB LAYOUT



HOLE SIZE:  $\varnothing 0.040 \pm 0.003$  [1.02  $\pm$  0.08]  
 PAD SIZE:  $\varnothing 0.079 \pm 0.002$  [2.00  $\pm$  0.05]

### 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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