NON-ISOLATED DC/DC CONVERTER

12 Vdc Input 1.2 Vdc - 5.0 Vdc/15 A Output

VRPF-15A1AC RoHS Compliant Rev.A

- Non-Isolated
- Fixed Frequency (220 kHz)
- Wide Output Voltage Trim
- Current Sink Capability for Termination Applications
- UL60950-1 Recognized (UL/cUL)
- Under-Voltage Lockout (UVLO)
- OCP/SCP
- Remote On/Off
- Power Good Output Signal (open collector)

Description

The Bel VRPF-15A1AC is part of the low cost non-isolated dc/dc converter. The module uses a SIP package for ease of layout and space savings. The output is closely regulated and can be trimmed from 1.2 Vdc to 5.0 Vdc. The efficiency is typically 92% at 5.0 Vdc output at full load. Typical features include remote on/off, under-voltage lockout, over-current protection and short circuit protection.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number
1.2 Vdc - 5.0 Vdc	12 Vdc	15 A	75 W	92%	VRPF-15A1AC

Notes: 1. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers.
2. Add “G” suffix at the end of the model numbers listed above to indicate “Tray Packaging”.

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	0 °C	-	80 °C	
Storage Temperature	-40 °C	-	125 °C	

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	10.8 V	12 V	13.2 V	
Input Current (Source)				
Vo=5.0 V	-	6.9 A	-	
Vo=3.3 V	-	4.84 A	-	
Vo=2.5 V	-	3.65 A	-	
Vo=1.8 V	-	2.87 A	-	
Vo=1.5 V	-	2.50 A	-	
Vo=1.25 V	-	2.12 A	-	
Vo=1.2 V	-	2.02 A	-	
Input Current (Sink)				
Vo=5.0 V	-	-5.9 A	-	
Vo=3.3 V	-	-3.8 A	-	
Vo=2.5 V	-	-2.7 A	-	
Vo=1.8 V	-	-1.9 A	-	
Vo=1.5 V	-	-1.6 A	-	
Vo=1.25 V	-	-1.3 A	-	
Vo=1.2 V	-	-1.1 A	-	

Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
Remote Off Input Current	-	25 mA	30 mA	
Input Reflected Ripple Current (pk-pk)	-	-	330 mA	Tested with simulated source impedance of 500 nH 5 Hz to 20 MHz, and 5 × 10 uF/16 V ceramic capacitors at the input
Input Reflected Ripple Current (rms)	-	-	120 mA	
I^2t Inrush Current Transient	-	0.05 A^2s	0.1 A^2s	
Turn-on Voltage Threshold	-	9.8 V	10.4 V	
Turn-off Voltage Threshold	-	9.4 V	10.3 V	

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

Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point				
Vo=5.0 V	4.900 V	5.0 V	5.100 V	
Vo=3.3 V	3.234 V	3.3 V	3.366 V	
Vo=2.5 V	2.450 V	2.5 V	2.550 V	Test condition:
Vo=1.8 V	1.764 V	1.8 V	1.836 V	Vin=12 V, Iout=half load
Vo=1.5 V	1.470 V	1.5 V	1.530 V	
Vo=1.25 V	1.225 V	1.25 V	1.275 V	
Vo=1.2 V	1.176 V	1.2 V	1.224 V	
Load Regulation				
Vo=5.0 V	-	10 mV	25.0 mV	
Vo=3.3 V	-	8 mV	16.5 mV	
Vo=2.5 V	-	5 mV	12.5 mV	
Vo=1.8 V	-	4 mV	9.0 mV	
Vo=1.5 V	-	3 mV	7.5 mV	
Vo=1.25 V	-	3 mV	6.3 mV	
Vo=1.2 V	-	2.5 mV	6.0 mV	
Line Regulation				
Vo=5.0 V	-	5.0 mV	10.0 mV	
Vo=3.3 V	-	3.3 mV	6.6 mV	
Vo=2.5 V	-	2.5 mV	5.0 mV	
Vo=1.8 V	-	1.8 mV	3.6 mV	
Vo=1.5 V	-	1.5 mV	3.0 mV	
Vo=1.25 V	-	1.25 mV	2.5 mV	
Vo=1.2 V	-	1.2 mV	2.4 mV	
Regulation Over Temperature (0 °C to +80 °C)				
Vo=5.0 V	-	10 mV	20 mV	
Vo=3.3 V	-	9 mV	18 mV	
Vo=2.5 V	-	8 mV	15 mV	
Vo=1.8 V	-	7 mV	14 mV	
Vo=1.5 V	-	6 mV	13 mV	
Vo=1.25 V	-	5 mV	12 mV	
Vo=1.2 V	-	4 mV	12 mV	
Output Ripple and Noise (pk-pk)				
Vo=5.0 V	-	60 mV	75 mV	Tested at 0-20 MHz BW, with 5×10 uF/16 V ceramic capacitors at the input, and 5×10 uF/10 V ceramic capacitors and a 1000 uF electrolytic capacitor at the output.
Vo=3.3 V	-	50 mV	65 mV	
Vo=2.5 V	-	40 mV	60 mV	
Vo=1.8 V	-	35 mV	50 mV	
Vo=1.5 V	-	35 mV	50 mV	
Vo=1.25 V	-	30 mV	50 mV	
Vo=1.2 V	-	30 mV	50 mV	

Output Specifications (continued)

Parameter	Min	Typ	Max	Notes
Output Ripple and Noise (rms)				
Vo=5.0 V	-	18 mV	30 mV	Tested at 0-20 MHz BW, with 5×10 uF/16 V ceramic capacitors at the input, and 5×10 uF/10 V ceramic capacitors and a 1000 uF/16 V electrolytic capacitor at the output.
Vo=3.3 V	-	15 mV	25 mV	
Vo=2.5 V	-	12 mV	20 mV	
Vo=1.8 V	-	12 mV	20 mV	
Vo=1.5 V	-	10 mV	15 mV	
Vo=1.25 V	-	10 mV	15 mV	
Vo=1.2 V	-	10 mV	15 mV	
Output Current	0 A	-	15 A	
Current Limit Threshold	19.5 A	-	37.5 A	
Short Circuit Surge Transient				
Vo=5.0 V	-	0.1 A^2s	0.3 A^2s	
Vo=3.3 V	-	0.1 A^2s	0.3 A^2s	
Vo=2.5 V	-	0.1 A^2s	0.3 A^2s	
Vo=1.8 V	-	0.3 A^2s	0.6 A^2s	
Vo=1.5 V	-	0.4 A^2s	0.8 A^2s	
Vo=1.25 V	-	0.4 A^2s	0.8 A^2s	
Vo=1.2 V	-	0.4 A^2s	0.8 A^2s	
Turn on Time	-	20 mS	100 mS	
Overshoot at Turn on	-	0%	3%	
Output Capacitance				
Vo=5.0 V	1050 uF	-	5080 uF	
Vo=3.3 V	1050 uF	-	6000 uF	
Vo=2.5 V	1050 uF	-	7840 uF	
Vo=1.8 V	1050 uF	-	8500 uF	
Vo=1.5 V	1050 uF	-	9000 uF	
Vo=1.25 V	1050 uF	-	9500 uF	
Vo=1.2 V	1050 uF	-	9680 uF	
Transient Response				
50% ~ 75% Max Load	Vo=5.0 V	-	100 mV	200 mV
Settling Time		-	100 uS	200 uS
75% ~ 50% Max Load		-	100 mV	200 mV
Settling Time		-	100 uS	200 uS
50% ~ 75% Max Load	Vo=3.3 V	-	80 mV	165 mV
Settling Time		-	100 uS	200 uS
75% ~ 50% Max Load		-	80 mV	165 mV
Settling Time		-	100 uS	200 uS
50% ~ 75% Max Load	Vo=1.25 V - 2.5 V	-	60 mV	125 mV
Settling Time		-	100 uS	200 uS
75% ~ 50% Max Load		-	60 mV	125 mV
Settling Time		-	100 uS	200 uS
50% ~ 75% Max Load	Vo=1.2 V	-	60 mV	120 mV
Settling Time		-	100 uS	200 uS
75% ~ 50% Max Load		-	60 mV	120 mV
Settling Time		-	100 uS	200 uS

Test conditions:
di/dt = 0.1 A/uS; Vin = 12 V; with 5×10 uF ceramic capacitors and a 1000 uF/16 V electrolytic at the output

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

NON-ISOLATED DC/DC CONVERTER

12 Vdc Input 1.2 Vdc - 5.0 Vdc/15 A Output

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency (Current Source)				Measured at Vin=12 V, full load.
Vo=5.0 V	90%	92%	-	
Vo=3.3 V	87%	89%	-	
Vo=2.5 V	84%	87%	-	
Vo=1.8 V	80%	82%	-	
Vo=1.5 V	78%	80%	-	
Vo=1.25 V	76%	79%	-	
Vo=1.2 V	76%	79%	-	
Efficiency (Current Sink)				
Vo=5.0 V	88%	91%	-	
Vo=3.3 V	84%	87%	-	
Vo=2.5 V	81%	84%	-	
Vo=1.8 V	77%	80%	-	
Vo=1.5 V	73%	76%	-	
Vo=1.25 V	68%	71%	-	
Vo=1.2 V	68%	71%	-	
Switching Frequency	200 kHz	220 kHz	240 kHz	
Output Voltage Trim Range	1.2 V	-	5.0 V	Vo=1.2 V when the Trim pin is open.
MTBF	3,664,032 hours			Calculated Per Bell Core SR-332 (I_O = 12 A, Vin=12 V; T_a = 25 °C)
Dimensions				
Inches (L × W × H)	1.2 x 1.0 x 0.457			
Millimeters (L × W × H)	30.48 x 25.4 x 11.6			
Weight	-	14.2 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 V	-	1 V	Remote On/Off pin open, the module is ON.
Signal High (Unit On)	2.4 V	-	13.2 V	
Power Good				
Power Good Delay [1]	-	-	10 mS	
Signal Low [2]	-	0.3 V	-	
Current Sink	-	5 mA	-	

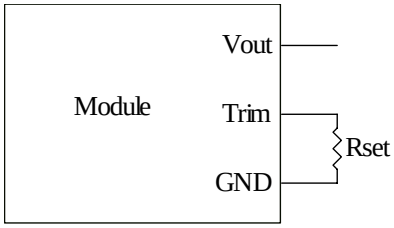
Notes: All specifications are typical at 25 °C unless otherwise stated.

1. Power good delay time is the time from output voltage in full regulation to power good asserted.
2. The power good signal is an open collector output. When the output of the module reaches 90% of the nominal set point, the power good pin is set high.

Output Trim Equation

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

$$Vadj = \left(\frac{0.992}{5.62K} + \frac{0.992}{Rset} \right) \cdot 1.18K + 0.992$$



Where, Vadj is the required voltage setpoint, Rset is the resistance required between TRIM and GND.

Power Good Signal Level Set

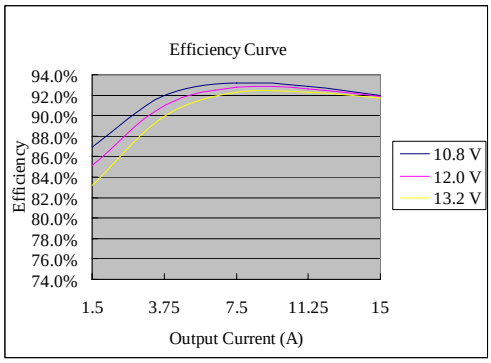
Equation for calculating the power good threshold (in kΩ) given the desired adjusted voltage (Vadj) is shown below. The PWRGD_SET resistor should be connected between the PWRGD_SET pin (Pin 9) and GND.

Output Voltage	PWRGD_THRESHOLD Set Resistor (1%tol)
5V	Short (Zero Ohm)
3.3V	1.78k
2.5V	4.22k
1.8V	11.8k
1.5V	26.1k
1.25V	169k
1.2V	Open (no resistor)

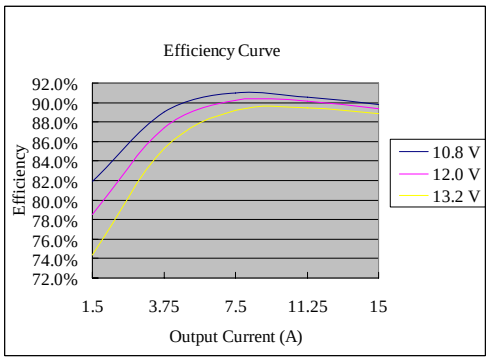
$$PWRGD\_THRESHOLD = 6.19K \left(\frac{1.24}{2.21K + Rset} - 18.86 \cdot 10^{-6} \right) + 1.24$$

Where, Rset is the resistance required between PWRGD_SET and GND.

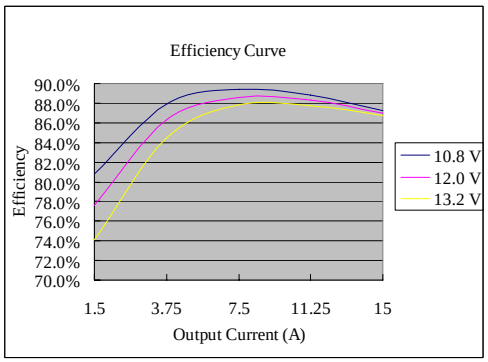
Efficiency Data



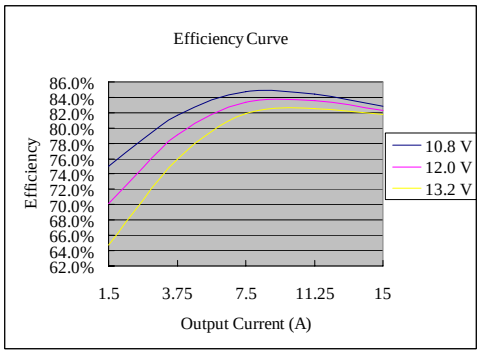
Vo=5.0 V



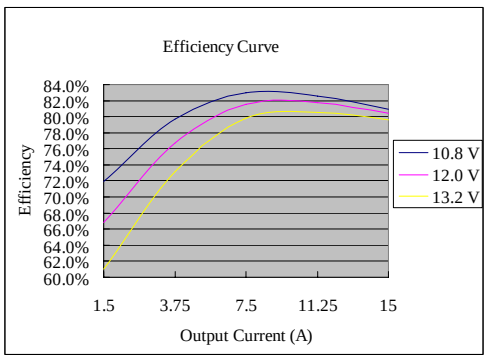
Vo=3.3 V



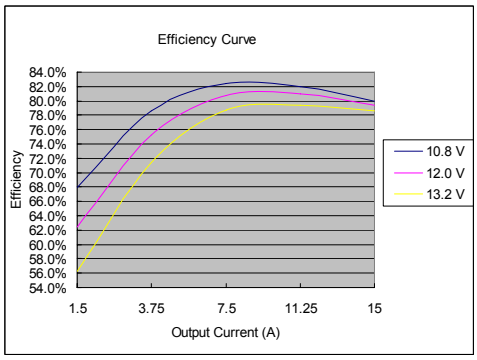
Vo=2.5 V



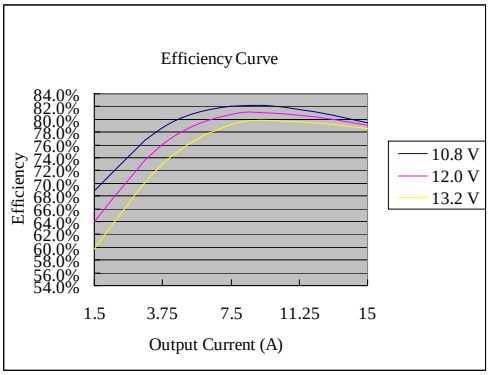
Vo=1.8 V



Vo=1.5 V

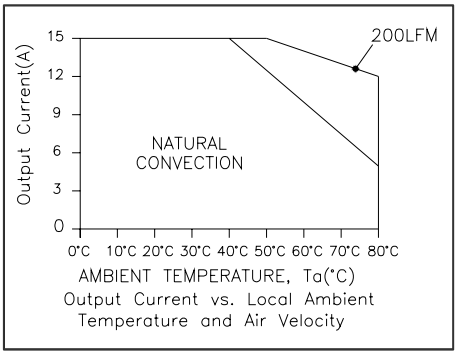


Vo=1.25 V

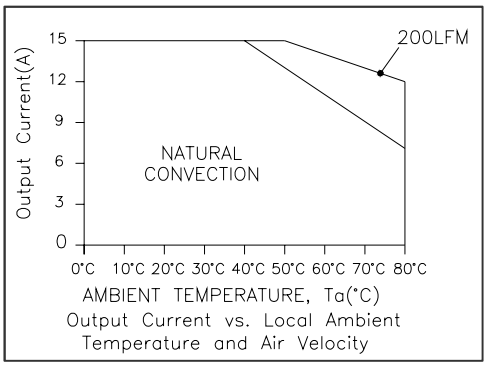


Vo=1.2 V

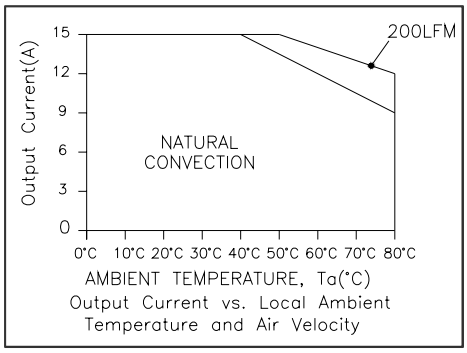
Thermal Derating Curves



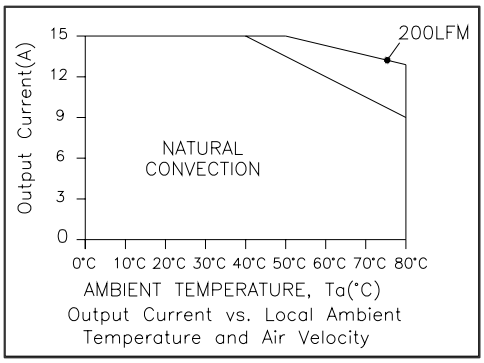
Vo = 5.0 V



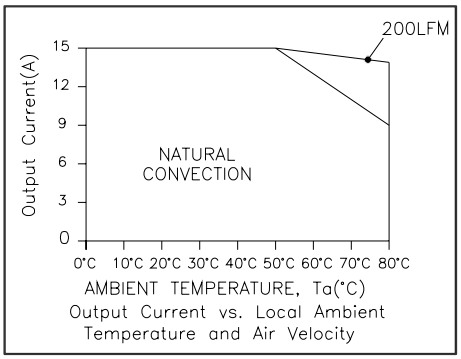
Vo = 3.3 V



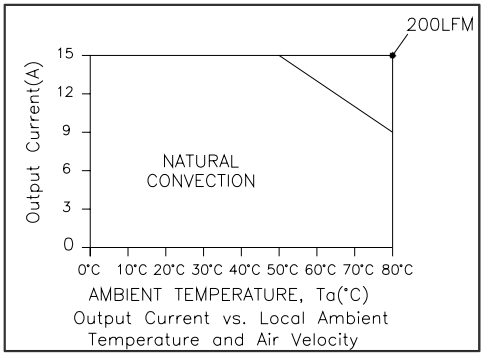
Vo = 2.5 V



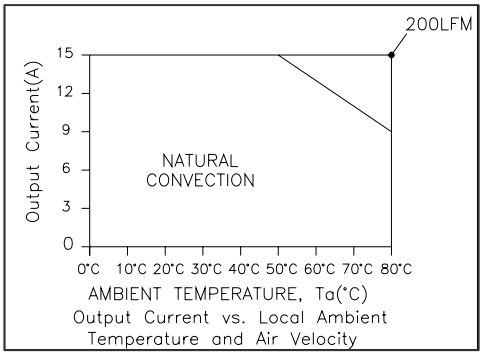
Vo = 1.8 V



Vo = 1.5 V



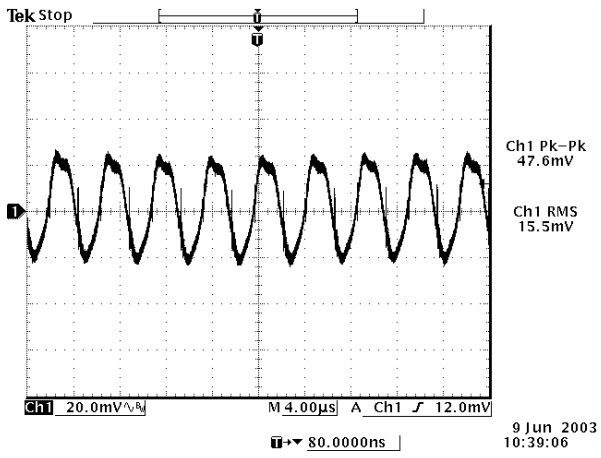
Vo = 1.25 V



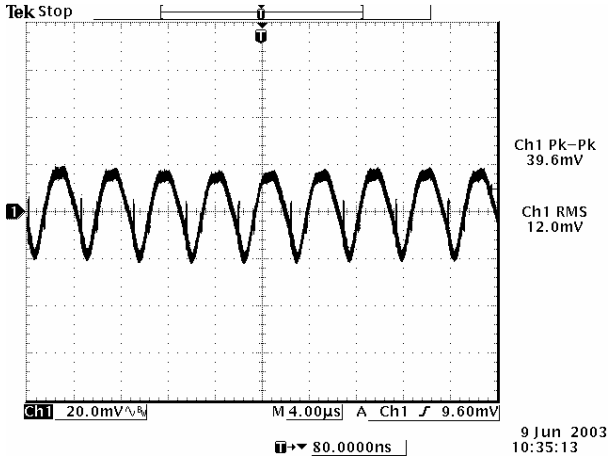
Vo = 1.2 V

Test Condition: The module is mounted on 2 OZ two-layer FR4 board.

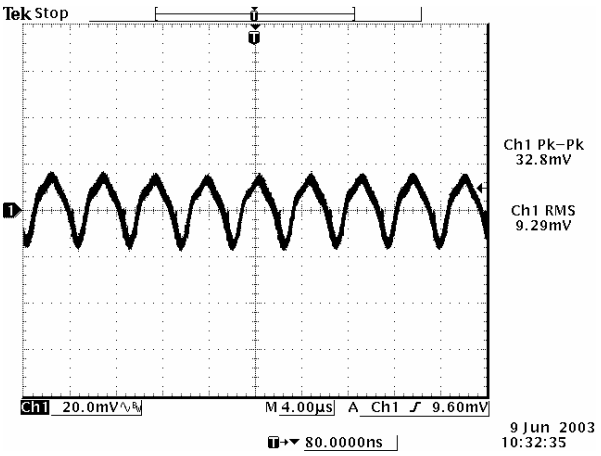
Ripple and Noise Waveforms



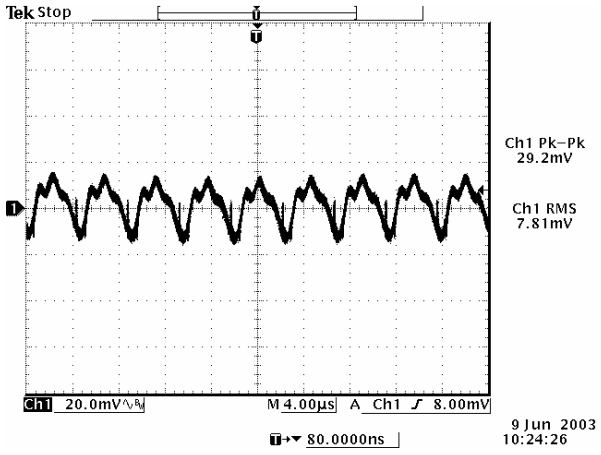
Vo=5.0 V



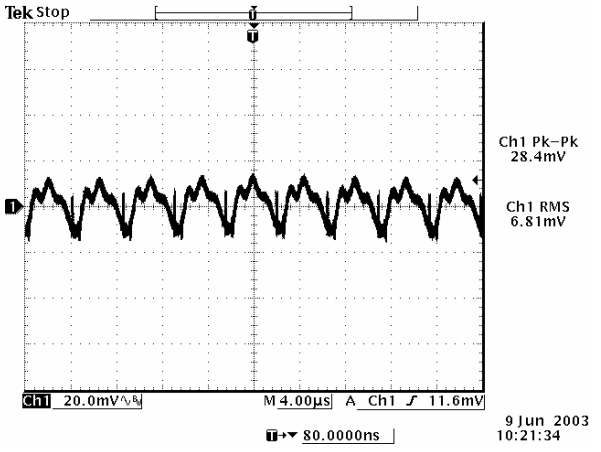
Vo=3.3 V



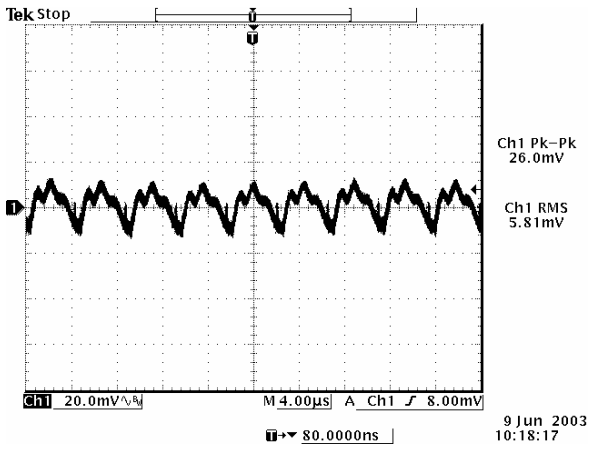
Vo=2.5 V



Vo=1.8 V

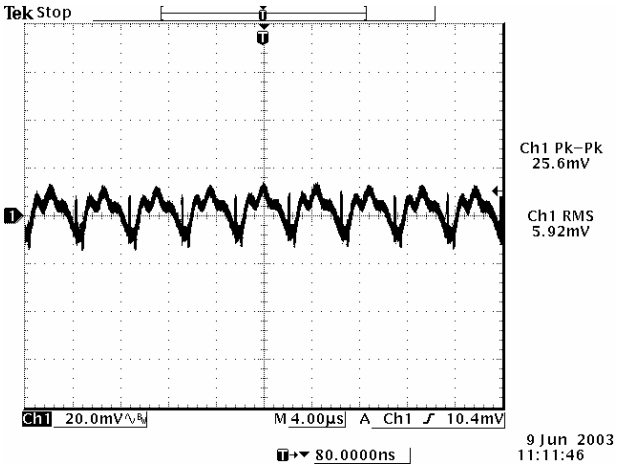


Vo=1.5 V



Vo=1.25 V

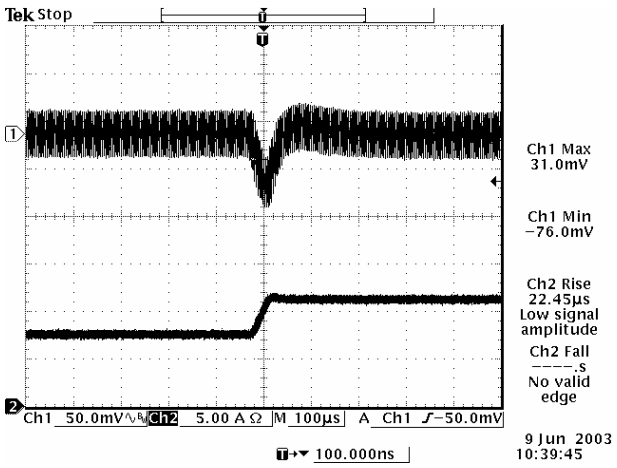
Ripple and Noise Waveforms (continued)



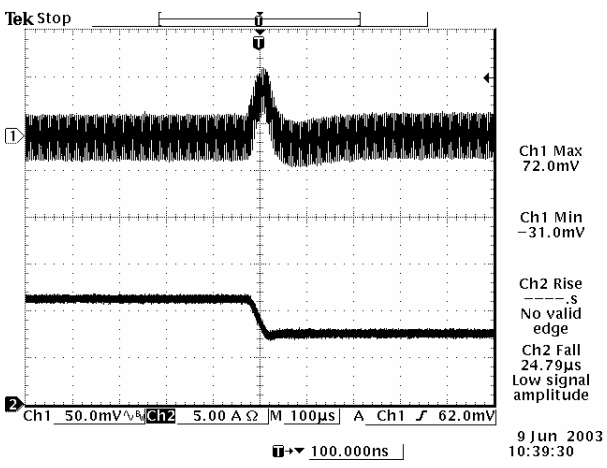
Vo=1.2 V

Note: Ripple and Noise at Max Load, 12 V Input, with 5x10 uF/10 V ceramic capacitor and an 1000 uF/16 V electrolytic at the output, Ta=25 deg C

Transient Response Waveforms

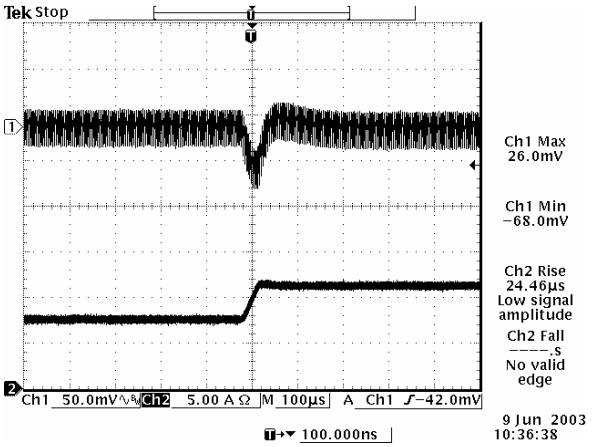


Transients 50% to 75% load, 5 Vdc Output

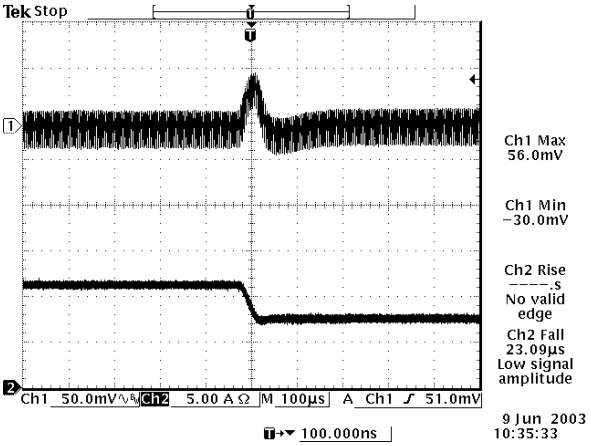


Transients 75% to 50% load, 5 Vdc Output

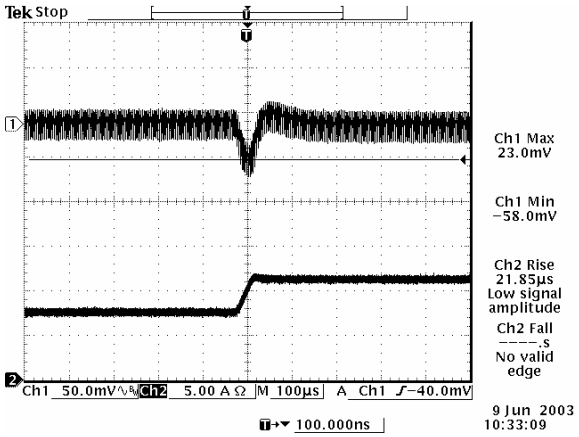
Transient Response Waveforms (continued)



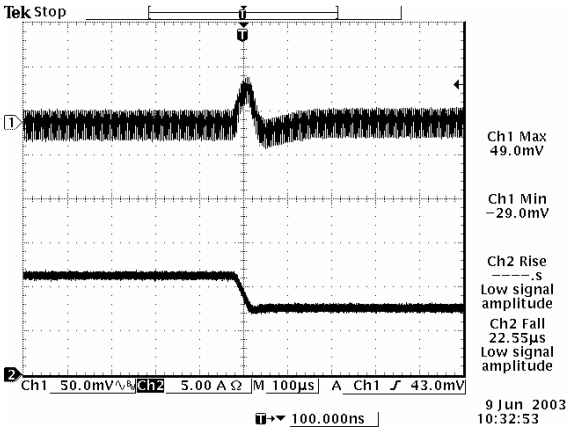
Transients 50% to 75% load, 3.3 Vdc Output



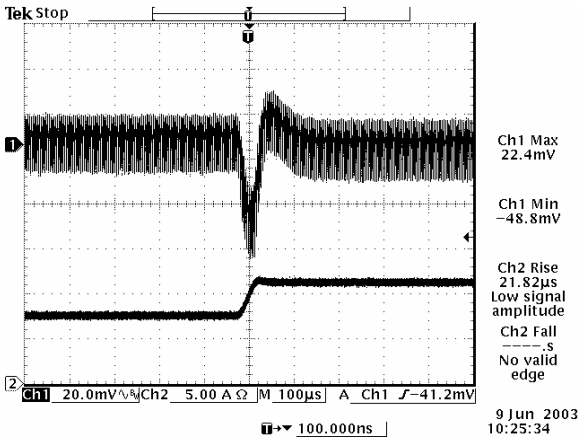
Transients 75% to 50% load, 3.3 Vdc Output



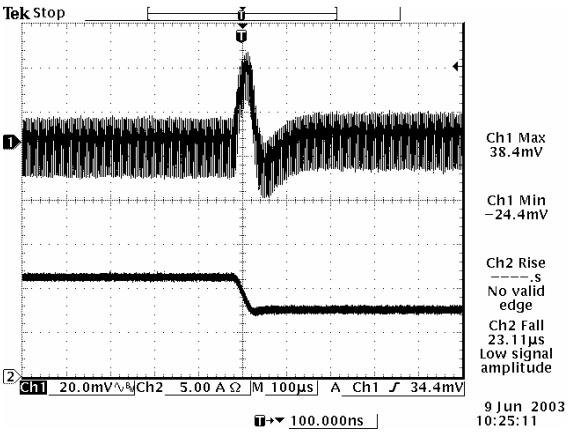
Transients 50% to 75% load, 2.5 Vdc Output



Transients 75% to 50% load, 2.5 Vdc Output

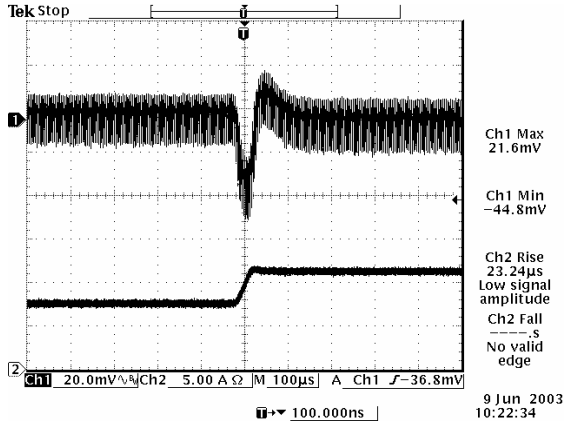


Transients 50% to 75% load, 1.8 Vdc Output

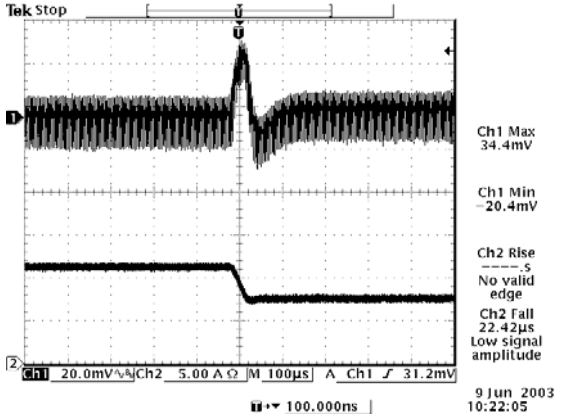


Transients 75% to 50% load, 1.8 Vdc Output

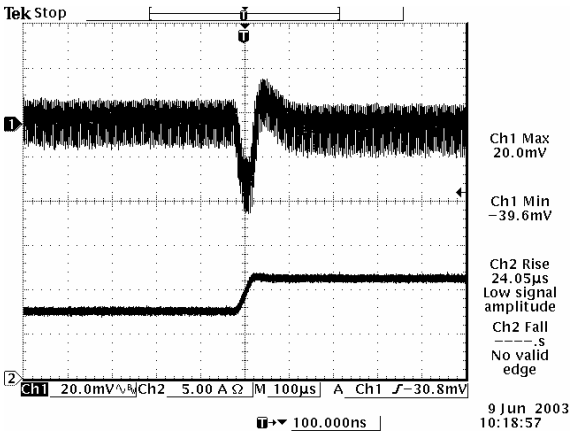
Transient Response Waveforms (continued)



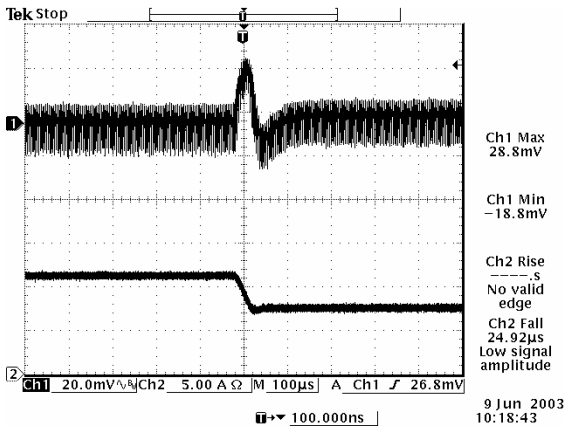
Transients 50% to 75% load, 1.5 Vdc Output



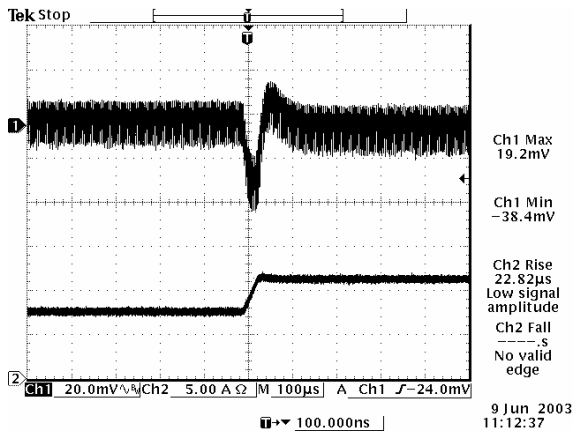
Transients 75% to 50% load, 1.5 Vdc Output



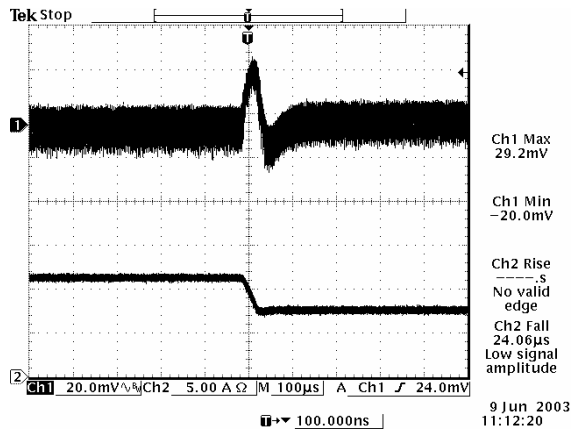
Transients 50% to 75% load, 1.25 Vdc Output



Transients 75% to 50% load, 1.25 Vdc Output



Transients 50% to 75% load, 1.2 Vdc Output



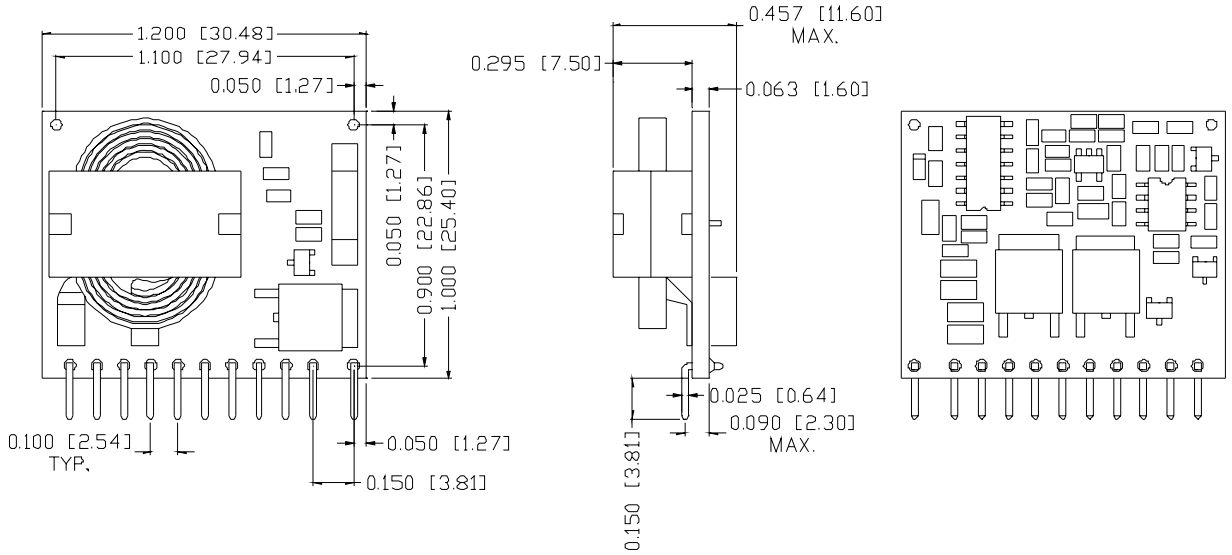
Transients 75% to 50% load, 1.2 Vdc Output

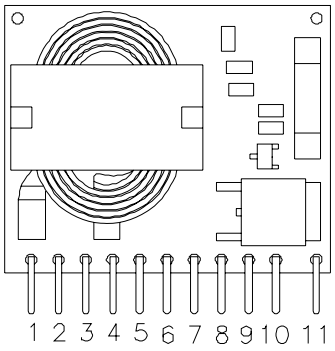
Note: Transient Response at Vin=12 Vdc, di/dt=0.1 A/uS, with external load capacitor 5x10 uF/10 V ceramic capacitor and an 1000 uF/16 V electrolytic at the output, and Ta=25 deg C.

NON-ISOLATED DC/DC CONVERTER

12 Vdc Input 1.2 Vdc - 5.0 Vdc/15 A Output

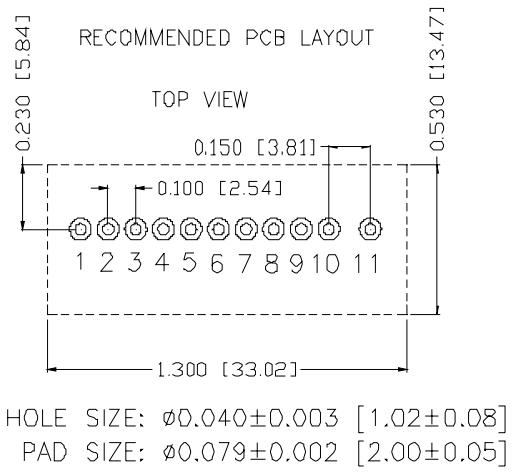
Mechanical Outline





Pin Connections

Pin	Function
1	Vout
2	Vout
3	Vout
4	Trim
5	Output Enable
6	Power Good
7	Ground
8	Ground
9	PWRGD_SET
10	Vin
11	Vin



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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