NON-ISOLATED DC/DC CONVERTERS

12 Vdc Input 0.9 Vdc - 5.0 Vdc/20 A Output

xRPF-20A1Ax RoHS Compliant Rev.E

- Non-Isolated
- Fixed Frequency (275 kHz)
- High Efficiency
- High Power Density
- Power Good Output Signal (open collector)
- Under-Voltage Lockout (UVLO)
- Wide Trim Range
- Converter Can Sink and Source Current
- OCP/SCP
- Remote On/Off
- Low Cost

Description

The Bel xRPF-20A1Ax is a new high density open frame non-isolated converter series for space sensitive applications. Each model has a wide input range (10.2 Vdc - 13.8 Vdc) and offers a wide range of output voltage (0.9 Vdc - 5.0 Vdc) with a 20 A load. An external resistor adjusts the output voltage from its pre-set value of 0.9 Vdc to any value up to the 5.0 Vdc maximum. Typical efficiency is 92% at Vo=5 Vdc, Vin=12 Vdc 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 Vertical Mount	Model Number Horizontal Mount
0.9 V - 5.0 V	12 V	20 A	100 W	92%	VRPF-20A1A0	0RPF-20A1A0
0.9 V - 5.0 V	12 V	20 A	100 W	92%	VRPF-20A1AB	0RPF-20A1AB

Notes: 1. Add “G” suffix at the end of the model number to indicate Tray Packaging.
2. “B” suffix version has both a filtered Power Good signal and the ability to have a Power Good signal pull up as low as 0.9 V (lowest programmable output voltage).
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	-	13.8 V	
Output Enable Terminal Voltage	-0.3 V	-	13.8 V	
Ambient Temperature	0 °C	-	80 °C	
Storage Temperature	-40 °C	-	125 °C	

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	10.2 V	-	13.8 V	
Input Current (Source) Vo=5.0 V Vo=2.5 V Vo=0.9 V	 - - -	 9.1 A 4.9 A 2.2 A	 - - -	
Input Current (Sink) Vo=2.5 V Vo=0.9 V	 - -	 -3.44 A -0.97 A	 - -	Able to sink 20 A output current at any output voltage up to and including 2.5 V.
Input Current (No Load)	-	95 mA	-	
Remote Off Input Current	-	5 mA	10 mA	

Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
Input Reflected Ripple Current (pk-pk)				Tested with simulated source impedance of 1.5 uH 5Hz to 20 MHz, and 2 × 270 uF/16 V Oscon capacitors (ESR ≤ 20 mΩ) at the input
Vo=5.0 V	-	280 mA	350 mA	
Vo=3.3 V	-	250 mA	320 mA	
Vo=2.5 V	-	200 mA	280 mA	
Vo=0.9 V	-	150 mA	250 mA	
Input Reflected Ripple Current (rms)				
Vo=5.0 V	-	80 mA	120 mA	
Vo=3.3 V	-	70 mA	100 mA	
Vo=2.5 V	-	45 mA	80 mA	
Vo=0.9 V	-	40 mA	60 mA	
External Input Capacitance	-	540 uF	-	
Turn-on Voltage Threshold	8.5 V	9.0 V	9.5 V	
Turn-off Voltage Threshold	7.0 V	7.6 V	8.3 V	

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

Output Specifications

Parameter	Min	Typ	Max	Notes
Output Voltage Set Point	-2.5%Vo,set	-	2.5%Vo,set	Vin=12 V, Io=Iomax, full load
Output Voltage Set Point	-3.5%Vo,set	-	3.5%Vo,set	Over all operating input voltage, resistive load, and temperature conditions
Load Regulation				Io=Iomin to Iomax
Vo=5.0 V	-	-	0.4%Vo,set	
Vo=3.3 V	-	-	0.4%Vo,set	
Vo=2.5 V	-	-	0.5%Vo,set	
Vo=0.9 V	-	-	1%Vo,set	
Line Regulation	-	-	0.5%Vo,set	Vin=Vinmin to Vinmax
Output Ripple and Noise (pk-pk)				Tested at 0-20 MHz BW, with a 680 uF/6.3 V Oscon capacitor (ESR ≤ 12 mΩ), 10uF/16V Tantalum capacitor, and 10nF ceramic capacitor at the output.
Vo=5.0 V	-	65 mV	80 mV	
Vo=3.3 V	-	60 mV	75 mV	
Vo=2.5 V	-	55 mV	70 mV	
Vo=0.9 V	-	45 mV	55 mV	
Output Ripple and Noise (rms)				
Vo=5.0 V	-	18 mV	25 mV	
Vo=3.3 V	-	15 mV	25 mV	
Vo=2.5 V	-	15 mV	20 mV	
Vo=0.9 V	-	10 mV	15 mV	
Output Current	0 A	-	20 A	
Current Limit Threshold	25 A	-	40 A	
Short Circuit Surge Transient	-	-	0.1 A^2s	
Turn on Time	-	5 mS	10 mS	
Overshoot at Turn on	-	0%Vo	3%Vo	
Output Capacitance				
Vo=5.0 V	680 uF	-	5080 uF	
Vo=2.5 V	680 uF	-	7840 uF	
Vo=0.9 V	680 uF	-	11000 uF	
Transient Response				
50% ~ 75% Max Load	Vo=0.9 V-5.0 V	-	100 mV	150 mV	di/dt=2.5 A/uS; Vin=12 V; with a 680 uF/6.3 V Oscon capacitor (ESR ≤ 12 mΩ), 10 uF/16 V Tantalum capacitor and 10 nF ceramic capacitor at the output.
Settling Time		-	40 uS	80 uS	
75% ~ 50% Max Load		-	100 mV	150 mV	
Settling Time		-	40 uS	80 uS	

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

NON-ISOLATED DC/DC CONVERTERS

12 Vdc Input 0.9 Vdc - 5.0 Vdc/20 A Output

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency (Current Source)				Measured at Vin=12 V, full load.
Vo=5.0 V	89%	92%	-	
Vo=3.3 V	86%	89%	-	
Vo=2.5 V	83%	86%	-	
Vo=0.9 V	65%	69%	-	
Efficiency (Current Sink)				
Vo=2.5 V	79%	82%	-	
Vo=0.9 V	60%	63%	-	
Switching Frequency	240 kHz	275 kHz	310 kHz	
Output Voltage Trim Range	0.9 V	-	5.0 V	Vo=0.9 V when the Trim pin is open.
MTBF	5,570,000 hours			Calculated Per Bell Core SR-332 (Io = Nominal; Ta = 25 °C)
Dimensions				VRPF-20A1Ax
Inches (L × W × H)	1.2 x 1.1 x 0.457			
Millimeters (L × W × H)	30.48 x 27.94 x 11.6			
Dimensions				0RPF-20A1Ax
Inches (L × W × H)	1.2 x 1.1 x 0.508			
Millimeters (L × W × H)	30.48 x 27.94 x 12.91			
Weight	-	15 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	-	0.8 V	Remote On/Off pin open, unit on.
Signal High (Unit On)	2.4 V	-	13.8 V	
Power Good				
Power Good Levels	0.9 V	-	-	xRPF-20A1AB
Power Good Delay [1]	-	-	20 mS	

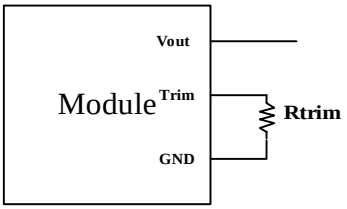
Notes: All specifications are typical at 25 °C unless otherwise stated.

1. 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 Equations

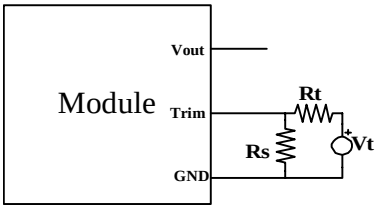
Equation for calculating the trim resistor (in kΩ) given the desired adjusted voltage (Vadj) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground. Trim values should not be less than 280Ω.

$$R_{trim} = \frac{1.17}{V_{adj} - 0.9}$$

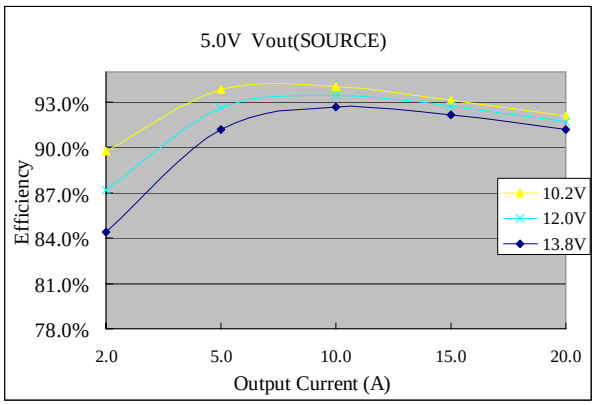


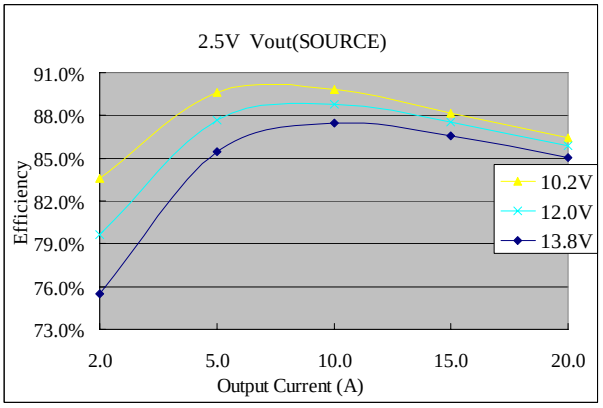
Equation for calculating the trim voltage (in V) given the desired adjusted voltage (Vadj) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

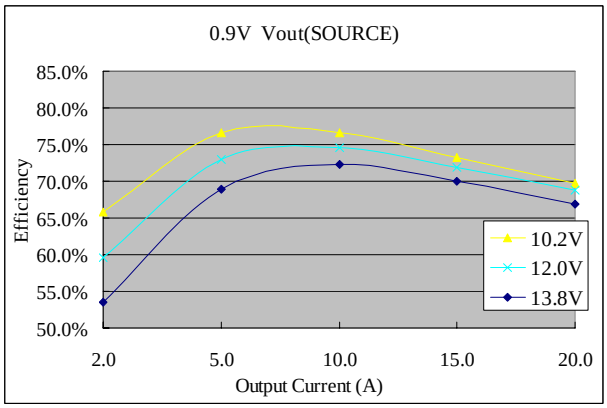
$$Rt = \frac{Rs \times (1.3Vt - 1.17)}{1.17 - Rs \times (V_{adj} - 0.9)}$$



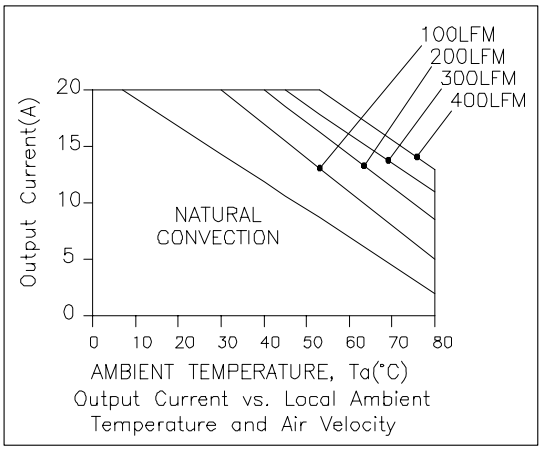
Efficiency Data



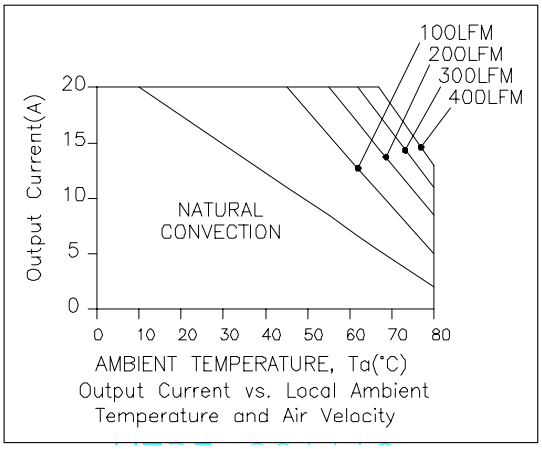




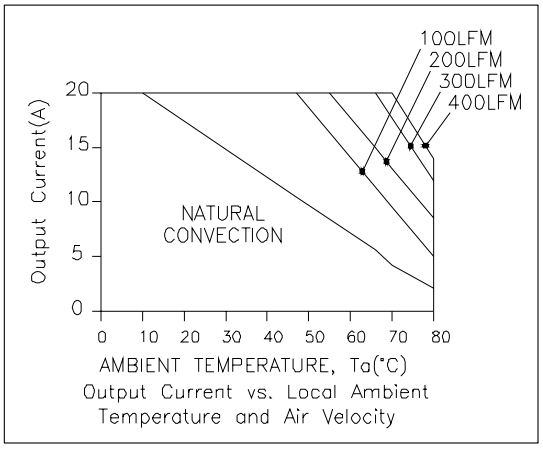
Thermal Derating Curves



Vo=5 V; Vin=12 V

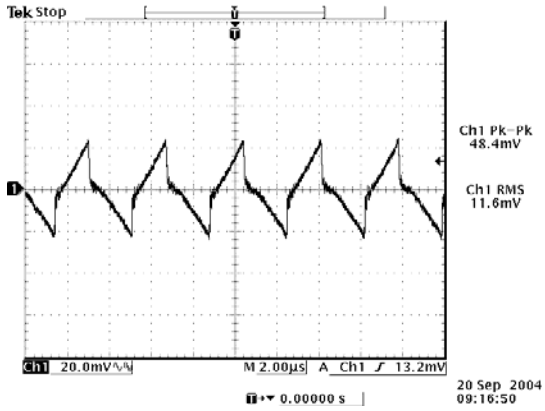


Vo=2.5 V; Vin=12 V

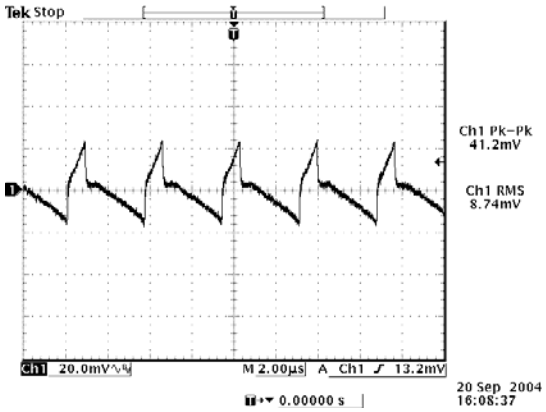


Vo=0.9 V; Vin=12 V

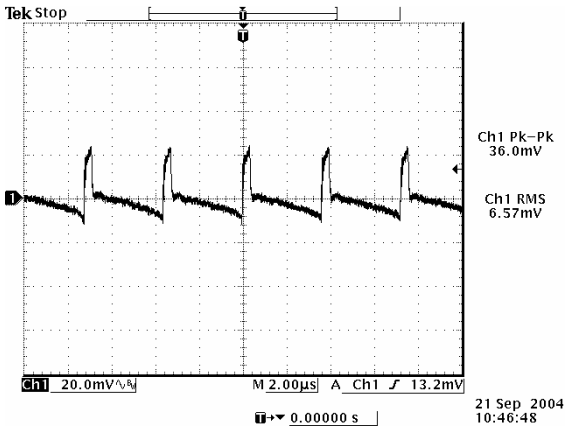
Ripple and Noise Waveforms



12 V input, 5.0 V output



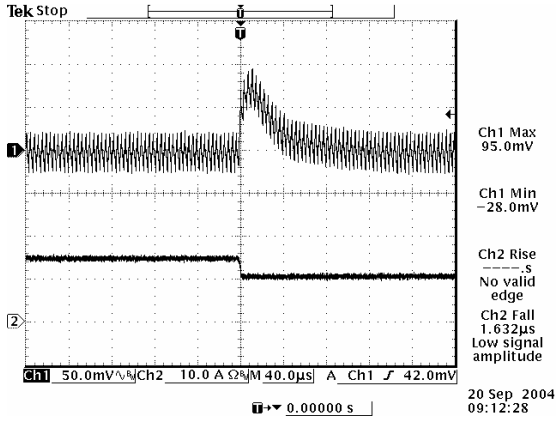
12 V input, 2.5 V output



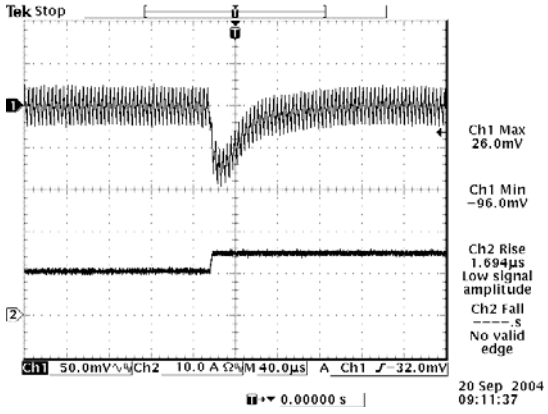
12 V input, 0.9 V output

Note: Ripple and noise at full load, 0-20MHz BW, with 680 uF/6.3 V Oscon cap, 10 uF/16 V Tan cap and 10 nF ceramic cap at the output, Ta=25 deg C.

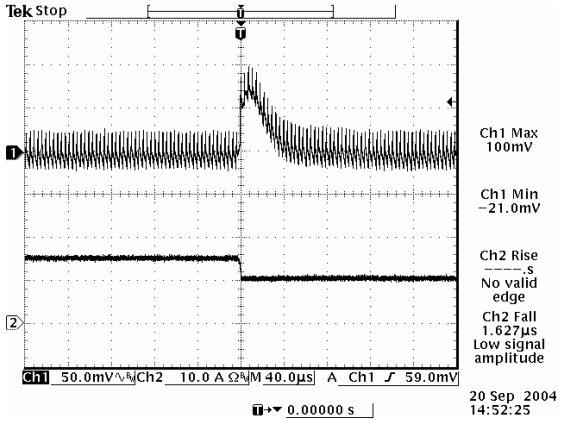
Transient Response Waveforms



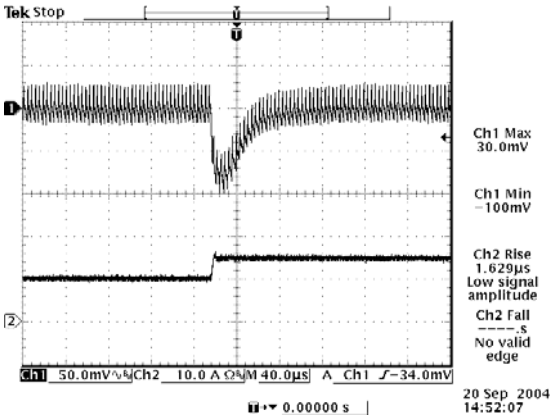
75% to 50% load step, 5.0 Vdc output



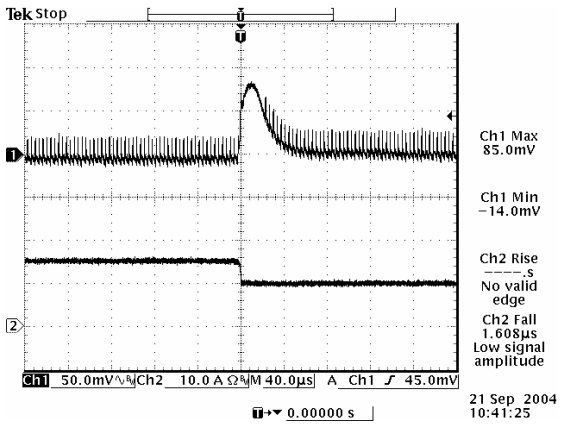
50% to 75% load step, 5.0 Vdc output



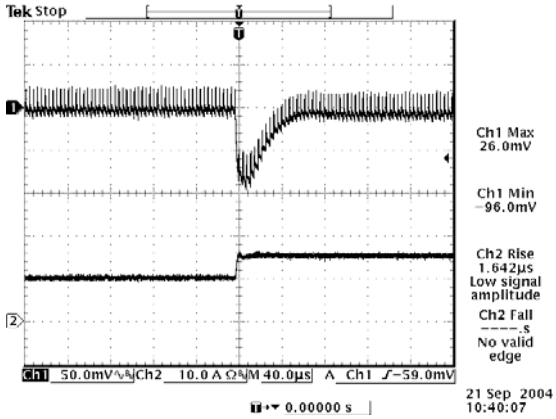
75% to 50% load step, 2.5 Vdc output



50% to 75% load step, 2.5 Vdc output



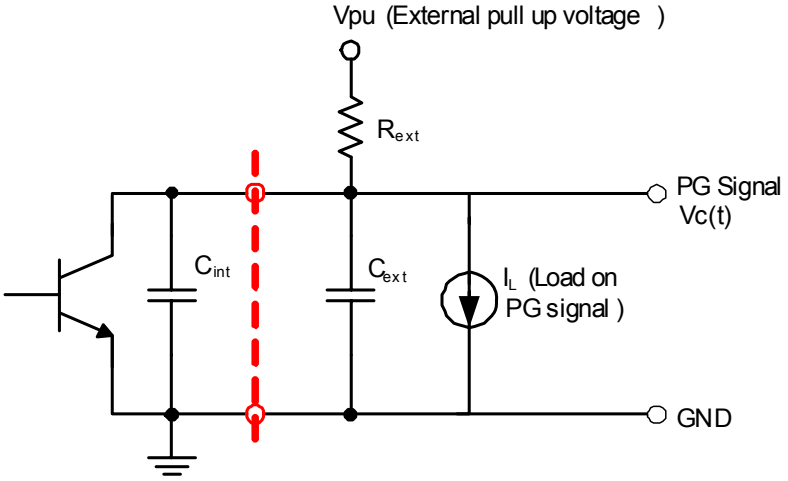
75% to 50% load step, 0.9 Vdc output



50% to 75% load step, 0.9 Vdc output

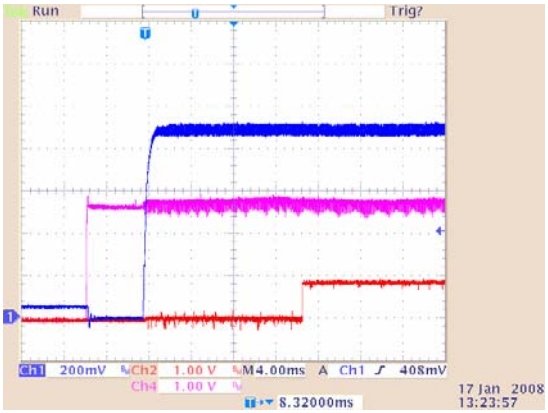
Note: Transient response at di/dt=2.5 A/uS, with a 680 uF/6.3 V Oscon cap, a 10 uF/16 V Tan cap and a 10 nF ceramic cap at the output, Ta=25 deg C.

Power Good (PG) Waveforms for xRPF-20A1AB

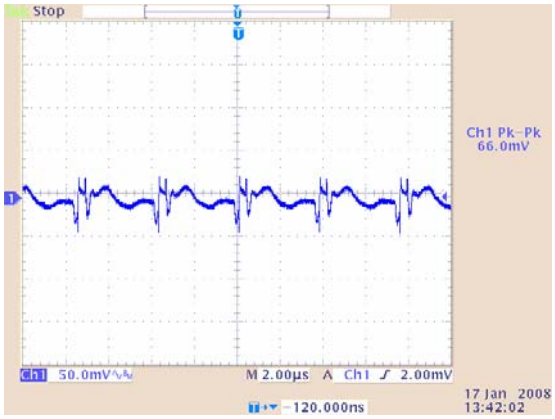


1. Cint is fixed, Cint=100 pF
2. Rext and Cext can be ajusted by customer.
3. IL is the load on PG signal

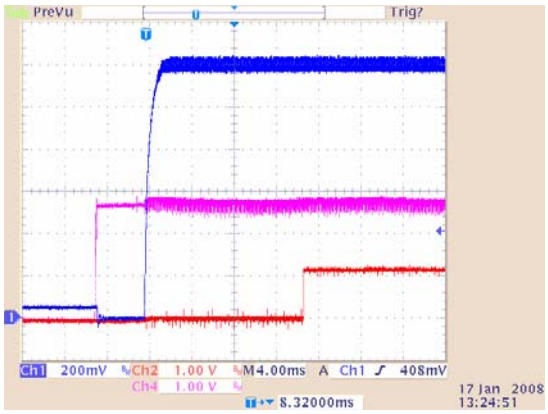
$$Vc(t) = (Vpu - I_L * R_{ext}) - (Vpu - I_L * R_{ext}) * e^{-\frac{t}{R_{ext} * (C_{int} + C_{ext})}}$$



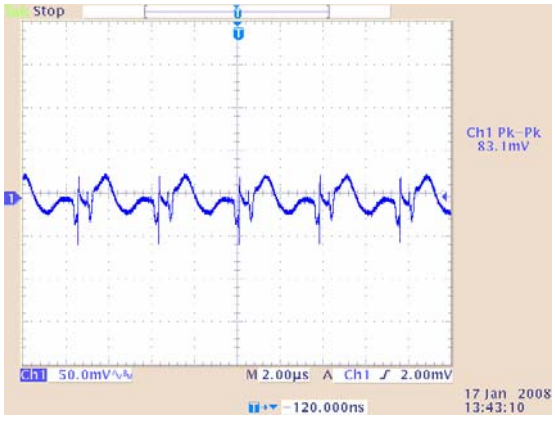
Typical Start-up Using Remote ON/OFF
(Vin=12.0 V, Vout=0.9 V, Io=20 A)
CH1:Output Voltage CH2:PG CH4:Remote ON/OFF



PG Ripple and Noise
(Vin=12.0 V, Vout=0.9 V, Io=20 A)

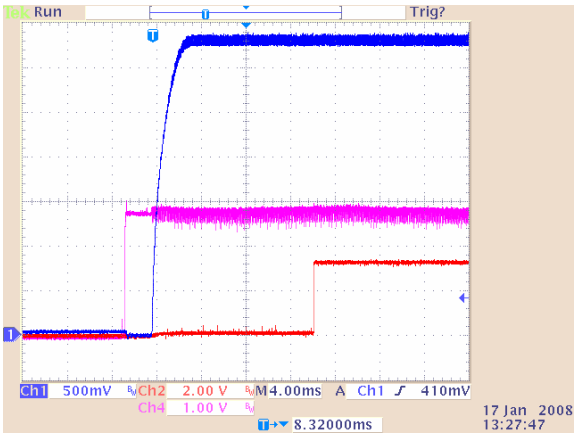


Typical Start-up Using Remote ON/OFF
(Vin=12.0 V, Vout=1.2 V, Io=20 A)
CH1:Output Voltage CH2:PG CH4:Remote ON/OFF

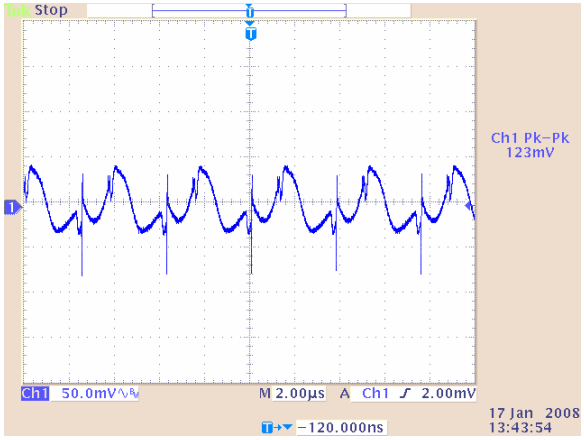


PG Ripple and Noise
(Vin=12.0 V, Vout=1.2 V, Io=20 A)

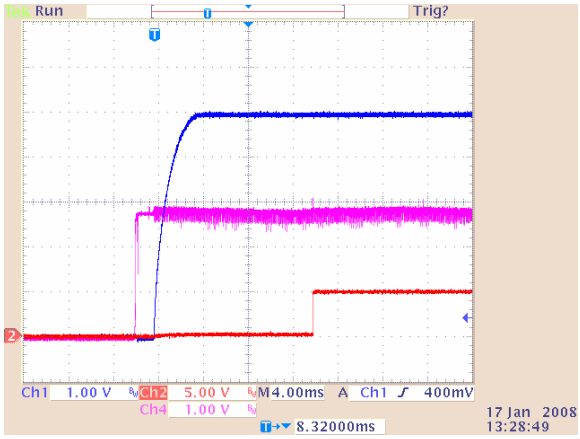
Power Good (PG) Waveforms for xRPF-20A1AB (continued)



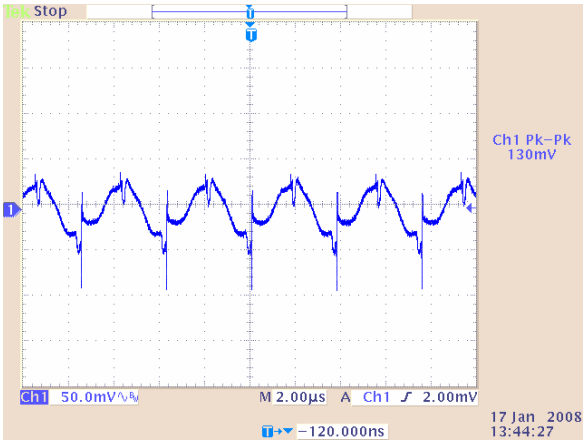
Typical Start-up Using Remote ON/OFF
(Vin=12.0 V, Vout=3.3 V, Io=20 A)
CH1:Output Voltage CH2:PG CH4:Remote ON/OFF



PG Ripple and Noise
(Vin=12.0 V, Vout=3.3 V, Io=20 A)



Typical Start-up Using Remote ON/OFF
(Vin=12.0 V, Vout=5.0 V, Io=20 A)
CH1:Output Voltage CH2:PG CH4:Remote ON/OFF

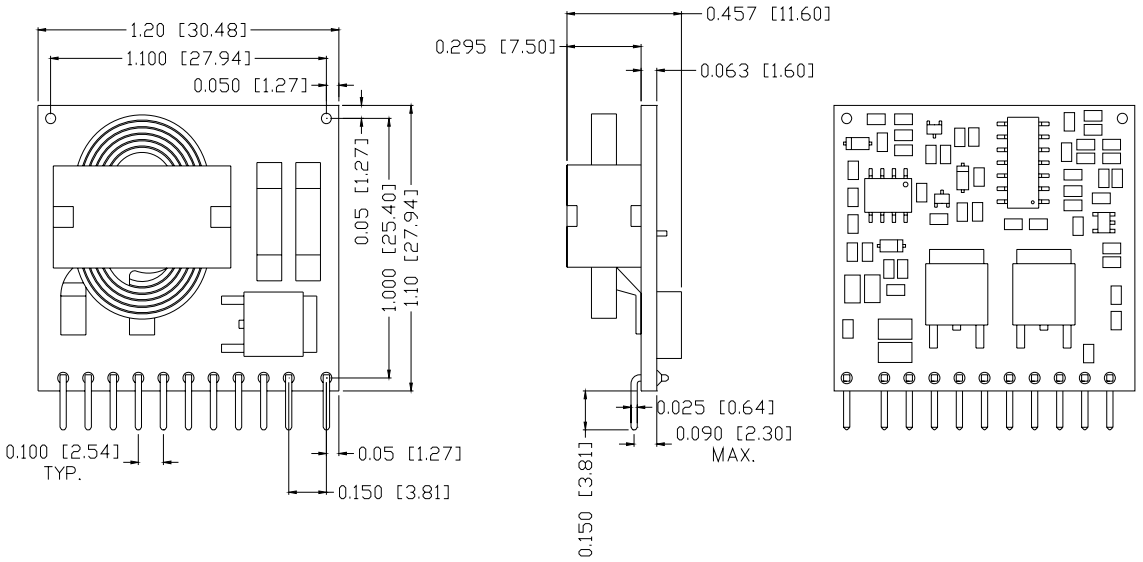


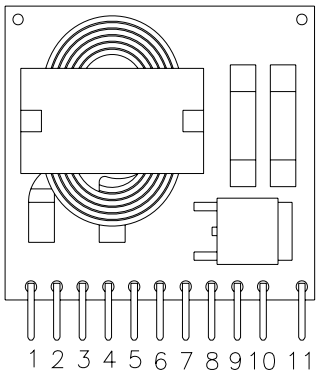
PG Ripple and Noise
(Vin=12.0 V, Vout=5.0 V, Io=20 A)

Note: Waveforms above derived under the following conditions: Vpu=Vout, Rext=510 ohms, no external capacitor or load applied.

Mechanical Outline

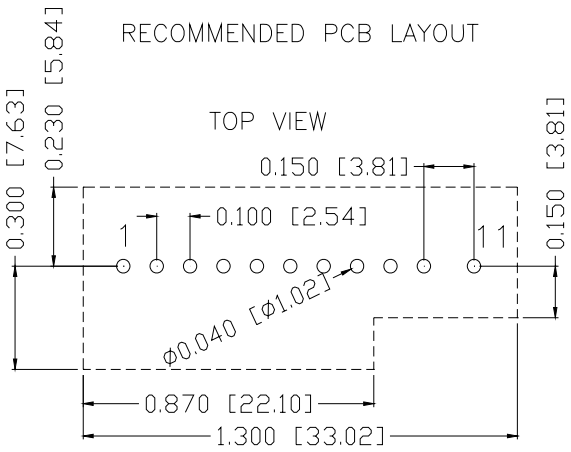
VRPF-20A1Ax





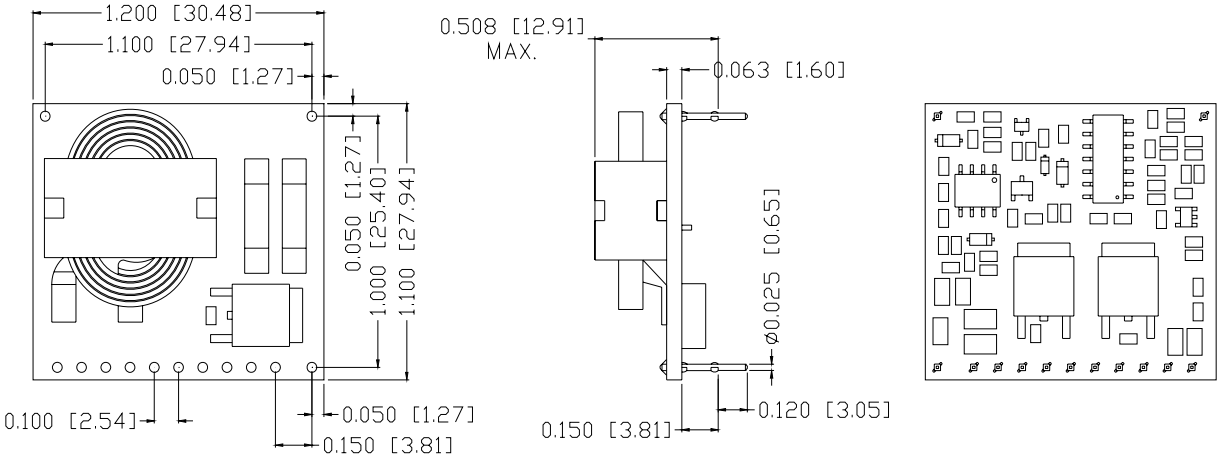
Pin Connections

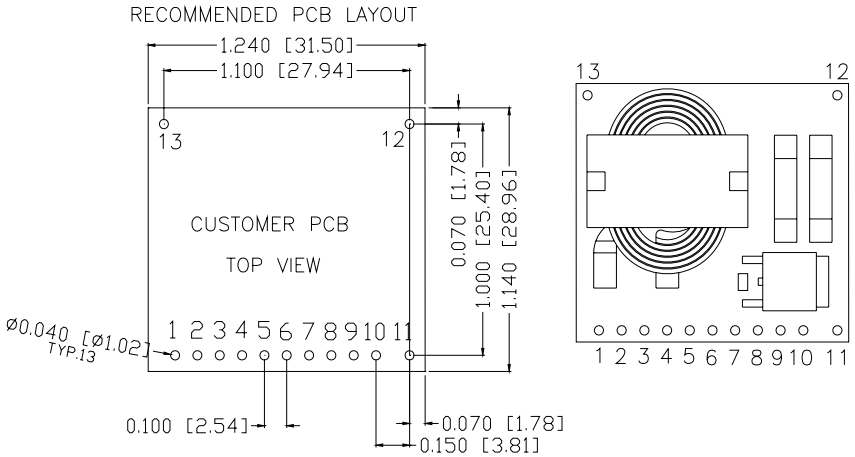
Pin	Function
1	Vout
2	Vout
3	Vout
4	Trim
5	Remote On/Off
6	Power Good
7	Ground
8	Ground
9	Reserved
10	Vin
11	Vin



Mechanical Outline (continued)

0RPF-20A1Ax





Pin Connections

Pin	Function
1	Vout
2	Vout
3	Vout
4	Trim
5	Remote On/Off
6	Power Good
7	Ground
8	Ground
9	Pwrgd_set
10	Vin
11	Vin
12	Support Pin
13	Support Pin

RoHS Compliance

Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products.

CORPORATE

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