

*The Polaris Series is a high current 100W  
quarter brick DC/DC converter with:*

- 100 Watts @ 100° Baseplate
- 67 Watts/cu. inch
- 1.2" x 2.4" x 0.5"
- Fixed Frequency Operation
- Remote Sense
- Output Voltage Trim
- Optional Heatsink
- UL and CSA approved
- Two Year Warranty

## CONTROL FUNCTIONS

- Remote Sense
- Primary and Secondary Output Enable

## PROTECTION FEATURES

- Over Temperature Protection
- Over Voltage Protection
- Over Current Protection

## TYPICAL CHARACTERISTICS

- Output Setpoint Accuracy:  $\pm 1.25\%$
- Load & Line Regulation:  $\pm 0.25\%$
- Noise & Ripple:
  - 75 mVp-p (1.5, 2.2V)
  - 100 mVp-p (3.3, 5.0V)
- Long Term Temperature Drift:  $\pm 0.5\%$
- Output Trim

# SPECIFICATIONS

## General Specifications

Operating Temperature	0°C to +100°C baseplate	
Storage Temperature	-40°C to +100°C	
Relative Humidity	10% to 95% RH, Non-condensing	
Vibration	10-500Hz 0.75g peak	
Weight	80gm, max. without heatsink	
Material Flammability	UL94V-2	
Safety	UL 1950, CSA C22.2 No. 950 approved <sup>1</sup>	
MTBF	MIL-HDBK-217	1,000,000 hours <sup>2</sup>

Notes: 1. Requires one fuse located in either the plus or minus side of the 48V supply; fuse rated for 8A max for all conditions.

2. 50-100% load; 40°C baseplate.

## Input Characteristics

Baseplate Temperatures from 0°C to +100°C.

Parameter			Test Condition	Requirement			Unit
Name	Var	Symbol		Min	Typ	Max	
Input Voltage		$V_I$		36		72	V
Input Low Line Power On V		$V_{Ion}$	Module Power On	30		35	V
Input Low Line Power Off V		$V_{Ioff}$	Module Shutdown	80		90	% $V_{Ion}$
No Load Input Power		$P_{IL}$	$V_I = V_{Inom}$	-		2.0	W
Input Capacitor (external to the converter)			rated 80V min	100		-	$\mu F$
Input Current	1.5V	$I_I$	$V_I = 36V, I_O = 24A, V_O = 1.5V$	-		1.5	A
	2.2V	$I_I$	$V_I = 36V, I_O = 24A, V_O = 2.2V$	-		2.1	A
	3.3V	$I_I$	$V_I = 36V, I_O = 24A, V_O = 3.3V$	-		3.0	A
	5.0V	$I_I$	$V_I = 36V, I_O = 16A, V_O = 5.0V$	-		3.0	A
Inrush Transient				-		0.5	$A^2s$
Efficiency	1.5V		$V_O = V_{Onom}, I_O = I_{O rated}, V_I = V_{Inom}$	68	70	-	%
	2.2V			72	74	-	%
	3.3V			78	80	-	%
	5.0V			82	84	-	%
Reflected Input Ripple			$V_I = 48V, I_O = 24A$	-		2.5	$A_{p-p}$
Maximum Losses at Local Sense	1.5V	$P_d$	$V_I = 48V, V_O = V_{Onom}$ $I_O = I_{Omax rated}, T_{Case} = 70^\circ C$	-		17.0	W
	2.2V	$P_d$		-		20.6	W
	3.3V	$P_d$		-		22.4	W
	5.0V	$P_d$		-		17.6	W

# SPECIFICATIONS

## Output Characteristics

Over the complete baseplate temperatures and input voltage ranges.

Parameter			Test Condition		Requirement			Unit
Name	Var	Symbol			Min	Typ	Max	
Output Voltage (nominal)	1.5V	$V_{Onom}$			–	1.5	–	V
	2.2V	$V_{Onom}$			–	2.2	–	V
	3.3V	$V_{Onom}$			–	3.3	–	V
	5.0V	$V_{Onom}$			–	5.0	–	V
Rated Output Current	1.5V	$I_O$	$V_O = V_{Onom}$		0	–	25	A
	2.2V	$I_O$	$V_O = V_{Onom}$		0	–	25	A
	3.3V	$I_O$	$V_O = V_{Onom}$		0	–	25	A
	5.0V	$I_O$	$V_O = V_{Onom}$		0	–	20	A
Initial Output Voltage Tolerance (with remote sense)			$V_{adj} = \text{open}, T_C = +25^\circ\text{C}$ $V_I = V_{Inom}, I_O = I_{Orated}$		-1.25	–	1.25	% $V_{Onom}$
Noise and Ripple	1.5V		20MHz <sub>p-p</sub> bandwidth, $V_I = 36-72\text{V}, I_O = 0$ amps to 100%			–	75	mV <sub>p-p</sub>
	2.2V					–	75	mV <sub>p-p</sub>
	3.3V					–	100	mV <sub>p-p</sub>
	5.0V					–	100	mV <sub>p-p</sub>
Static Load and Line Regulation			$V_I = 36-72\text{V}, I_O = 0.2$ amps to 100%		–	–	0.25	% $V_{Onom}$
Long Term Temperature Drift					-0.5	–	0.5	% V
Output Voltage Trim	1.5V	$V_{Otrim}$	$V_{IN} = 48\text{V}$ $V_O = V_{Onom}$	Rtrim=13200	1.683	–	1.717	V
				Rtrim=42200	1.336	–	1.363	V
	2.2V	$V_{Otrim}$		Rtrim=140768	2.287	–	2.333	V
				Rtrim=8250	1.683	–	1.717	V
	3.3V	$V_{Otrim}$		Rtrim=41905	3.430	–	3.500	V
				Rtrim=122825	3.103	–	3.166	V
	5.0V	$V_{Otrim}$		Rtrim=118000	5.197	–	5.303	V
				Rtrim=105511	4.703	–	4.798	V
Output Voltage Trim	1.5V	$V_{Otrim}$	$I_O = 50\%$ of $I_{Omax}$	Vtrim=1.404	1.683	–	1.717	V
				Vtrim=0.700	1.336	–	1.363	V
	2.2V	$V_{Otrim}$		Vtrim=1.149	2.287	–	2.333	V
				Vtrim=0.313	1.683	–	1.717	V
	3.3V	$V_{Otrim}$		Vtrim=2.808	3.430	–	3.500	V
				Vtrim=2.156	3.103	–	3.166	V
	5.0V	$V_{Otrim}$		Vtrim=2.869	5.197	–	5.303	V
				Vtrim=2.130	4.703	–	4.798	V

# SPECIFICATIONS

## Output Characteristics (continued)

Over the complete baseplate temperatures and input voltage ranges. Airflow adjusted at 500LFM with 0.9" high heatsink.

Parameter Name	Var	Symbol	Test Condition	Requirement			Unit
				Min	Typ	Max	
Total Remote Sense Compensation (round trip)			$V_I = V_{Imin}, I_O = I_{Omax}$ rated	–	–	100	mV
Output Overvoltage Protection (Latching)	1.5V			2.00	–	2.30	V
	2.2V			2.64	–	2.86	V
	3.3V			3.96	–	4.29	V
	5.0V			6.00	–	6.50	V
Output Voltage Protection Response Time		$T_{OVP}$	$V_O = V_{Onom}, I_O = I_{orated}$	–	–	150	$\mu$ s
Current Limit (nominal)	1.5V	$I_{olim}$	$V_O = V_{Onom}, V_I = 48V$	27	–	–	A
	2.2V	$I_{olim}$		27	–	–	A
	3.3V	$I_{olim}$		27	–	–	A
	5.0V	$I_{olim}$		22	–	–	A
Short Circuit Current	1.5V		$V_O = 0.2$ to $0.4V, V_I = 72V$	–	–	38	A
Transient Response, $V_O$ Deviation from Steady State			$I_O = 25-75\% I_{max}$ @ $0.1A/\mu$ sec (di/dt), positive or negative step <sup>1</sup>	–	–	150	mV
Settling Time (to $\pm 1\%$ )				–	–	250	$\mu$ s
Turn On Time		$t_{on}$	$V_{Imin}$ to $V_{Imax}$	1	–	20	ms
Turn on Ramp Time		$t_{ramp}$	$V_{Imin}$ to $V_{Imax}$ , 10-90% rise time	1	–	10	ms
Turn Off Time (to 10% initial value)		$t_{off}$	$V_{Imin}$ to $V_{Imax}$	–	–	1.0	ms
External Load Capacitance			ESR@10,000 $\mu$ f = 2m $\Omega$	100		10,000	$\mu$ f
Over Temperature Shutdown (Latching)		$T_{BASEPLATE}$		–	–	125	$^{\circ}$ C
Isolation Resistance (1500V <sub>DC</sub> ) Input-Output				10	–		M $\Omega$

Notes: 1. 940 $\mu$ f (2, 470 $\mu$ F tantalum capacitor) solid tantalum capacitor placed across output.

# SPECIFICATIONS

## Control Signal Characteristics

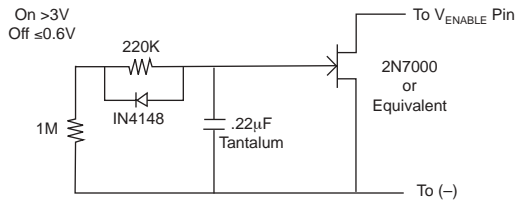
Parameter Name	Symbol	Test Condition	Requirement		Unit
			Min	Max	
P_Enable_L and S_Enable_L	$V_{ENABLE\ LOW}$	Module Enabled	0	0.8	V
Function Controls	$V_{ENABLE\ HIGH}$	Module Disabled	2.5	6.0	V
P_Enable_L and S_Enable_L	$I_{ENABLE\ LOW}$	Source Current ( $V_{ENABLE} = 0.8V$ )	-	-1.0	mA
Function Controls	$R_{ENABLE\ LOW}$	Module Enabled	-	100	$\Omega$
P_Enable_L and S_Enable_L	$R_{ENABLE\ LOW}$	Module Disabled	200K	-	K $\Omega$
Function Controls	$I_{ENABLE\ LOW}$	Source Current ( $R_{ENABLE} = 100\Omega$ )	-	-0.5	mA

## Enable Controls

Primary Enable_L	Secondary Enable_L	Output Voltage
Low	Low	On
High or Open	Low	Off
Low	High or Open	Off
High or Open	High or Open	Off

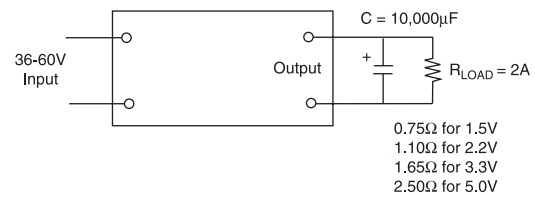
## Enable Circuit

### Turn on Time

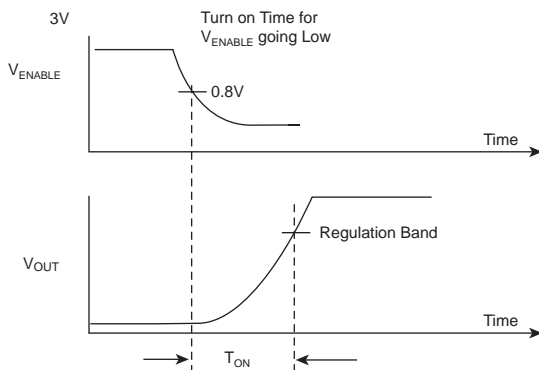


## Output Load Conditions

### (Turn On)

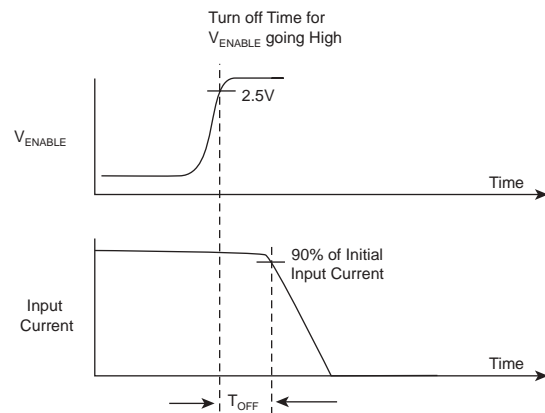


## Turn on Time



## Output Voltage

### Turn off Time



**Signal Characteristics:** Per table on page 5.

## Input Signals:

**Enable\_L:** This unit has both primary and secondary output enable:

**Primary Enable\_L:** This input signal is used to enable the output of the converter when activated (active Low). The signal is referenced to the input side (-Vin pin 11).

**Secondary Enable\_L:** This input signal is used to enable the output of the converter when activated (active Low). The signal is referenced to the output side (-Sense).

## Enable Controls

Primary Enable_L	Secondary Enable_L	Output Voltage
Low	Low	On
High or Open	Low	Off
Low	High or Open	Off
High or Open	High or Open	Off

**Output Voltage Adjust:** The output voltage of the converter can be adjusted above or below the nominal output voltage as specified in the Output Characteristics Table. The range of adjustment above the nominal output voltage is limited by the internal overvoltage trip point settings. The overvoltage trip point settings do not change with output voltage adjustments.

**Output Voltage Turn On Time:** The external circuit used to turn on the converter's "enable circuit" is per the Figure on page 5.

**Voltage Programming:** A voltage may be applied between the "Trim" pin (pin 4) and the "- Sense" pin (pin 1) to adjust the output voltage up or down from the nominal output.  $V_O$  is the desired output voltage.

For the GPP1V5-15 and GPP1V5-25, the trim voltage for these two units is:

$$V_{TRIM} = \frac{90.5}{44.97} * V_O - \frac{12.1}{6} \text{ Volts}$$

For the GPP2V2-15 and GPP2V2-25, the trim voltage for these two units is:

$$V_{TRIM} = \frac{11.4935}{8.3862} * V_O - \frac{12.1}{6} \text{ Volts}$$

For the GPP3V3-15 and GPP3V3-25, the trim voltage for these two units is:

$$V_{TRIM} = \frac{4.067}{2.06} * V_O - \frac{12.1}{3} \text{ Volts}$$

For the GPP5V0-15 and GPP5V0-20, the trim voltage for these two units is:

$$V_{TRIM} = \frac{1.829 * V_O - 6.05}{1.238} \text{ Volts}$$

## Resistor Programming:

Output voltage may be adjusted down from the nominal output voltage with a resistor connected between the "Trim" pin (pin 4) and the "-Sense" pin (pin 1).

For the GPP1V5-15 and GPP1V5-25, the trim resistor,  $R_{trim}$  for these two units is:

$$R_{TRIM} = \frac{(18.1379 - 18.100 * V_O)}{V_O - 1.499} \text{ Kohms}$$

For the GPP2V2-15 and GPP2V2-25, the trim resistor,  $R_{trim}$  for these two units is:

$$R_{TRIM} = \frac{169.1217 - 114.935 * V_O}{6.35 * V_O - 13.977} \text{ Kohms}$$

For the GPP3V3-15 and GPP3V3-25, the trim resistor,  $R_{trim}$  for these two units is:

$$R_{TRIM} = \frac{2}{5} * \frac{(249.26 - 122.01 * V_O)}{2.49 * V_O - 8.24} \text{ Kohms}$$

For the GPP5V0-15 and GPP5V0-20, the trim resistor,  $R_{trim}$  for these two units is:

$$R_{TRIM} = \frac{18.29 * V_O - 60.50}{5 - V_O} \text{ Kohms}$$

Output voltage may be adjusted up from the nominal output voltage with a resistor connected between the "Trim" pin (pin 4) and the "+ Sense" pin (pin 2).

For the GPP1V5-15 and GPP1V5-25, the trim resistor,  $R_{trim}$  for these two units is:

$$R_{TRIM} = \frac{(18.1379 - 9.106 * V_O)}{V_O - 1.499} \text{ Kohms}$$

For the GPP2V2-15 and GPP2V2-25, the trim resistor,  $R_{trim}$  for these two units is:

$$R_{TRIM} = \frac{169.1217 - 31.073 * V_O}{6.35 * V_O - 13.977} \text{ Kohms}$$

For the GPP3V3-15 and GPP3V3-25, the trim resistor,  $R_{trim}$  for these two units is:

$$R_{TRIM} = \frac{2}{5} * \frac{(249.26 - 60.21 * V_O)}{2.49 * V_O - 8.24} \text{ Kohms}$$

# APPLICATION NOTES

For the GPP5V0-15 and GPP5V0-20, the trim resistor,  $R_{\text{trim}}$  for these two units is:

$$R_{\text{TRIM}} = \frac{60.50 - 5.91 * V_o}{V_o - 5} \text{ Kohms}$$

## Thermal Considerations:

Thermal considerations are an important factor in the reliable operation of the converter. The maximum operating baseplate temperature is 100°C. The maximum recommended operating baseplate temperature is 90°C. The baseplate temperature is a function of the losses within the converter, the converter ambient temperature, and airflow across the heat sink.

The reference baseplate temperature is measured at the center coordinates of the baseplate.

The baseplate temperature can be approximated by the following equation:

$$T_{\text{BASEPLATE}} = P_{\text{OUTPUT}} * \frac{1 - \eta}{\eta} * R_{\text{BASEPLATE-AMBIENT}} + T_{\text{AMBIENT}}$$

Where:

- $T_{\text{BASEPLATE}}$  is the temperature of the baseplate.
- $T_{\text{ambient}}$  is the local ambient temperature around the converter
- $\eta$  is the efficiency of the converter (see Table on page 5)
- $R_{\text{baseplate-ambient}}$  is the thermal resistance from the baseplate to the ambient environment. This is a function of the heat sink and air velocity.

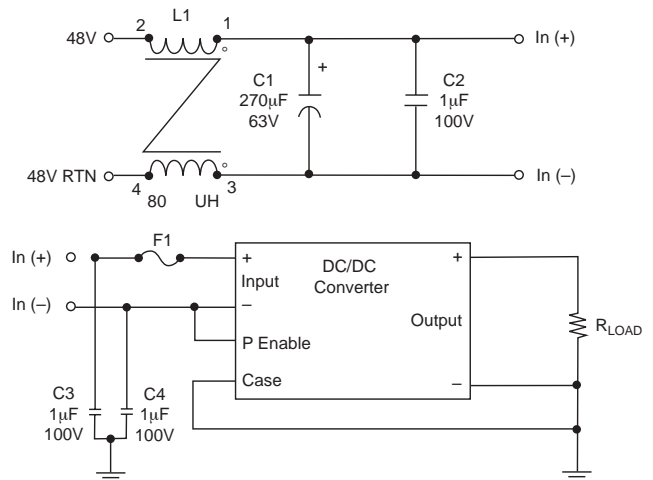
**Thermal Shutdown:** The converter shall shutdown under a thermal overload. This is a latched condition and either the input voltage has to be recycled or the primary enable signal (P\_ENABLE\_L) has to be recycled to reset normal operation.

**Overcurrent Protection:** The converter shall survive any overload condition indefinitely including short circuit. The values of current limit and short circuit shall be per the Output Characteristics Table.

**Overvoltage Protection:** The converter shall be protected against any overvoltage across Vout pins by shutting down the output at the values specified in the Output Characteristics Table. This is a latched condition and either the input voltage has to be recycled or the primary enable signal (P\_ENABLE\_L) has to be recycled to reset normal operation.

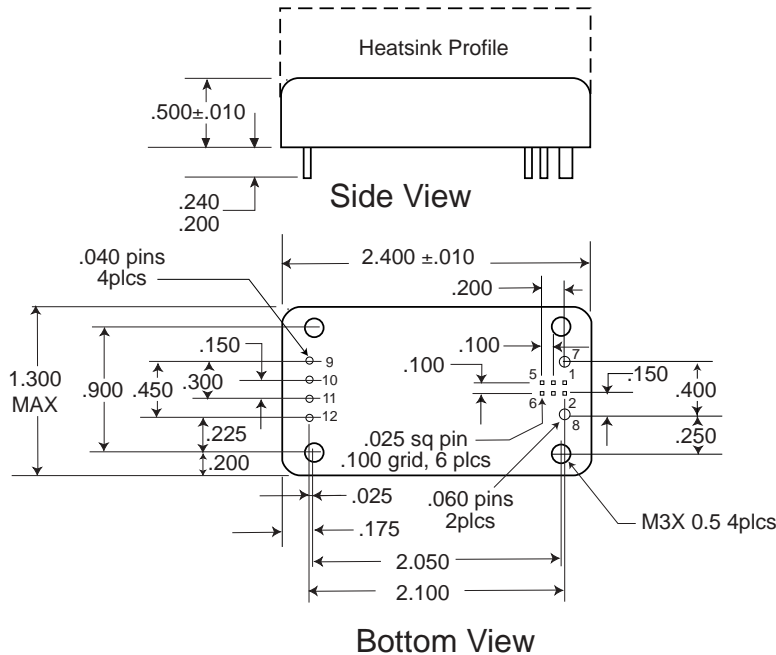
## Recommended Input Filter, Fuse and Case

**Connections:** A fuse is required in series with the plus or minus side of the 48V input to meet safety requirements. The following input filter circuit is recommended for all applications. The fuse should be inserted between the capacitors and the plus or minus input of the converter. The case should be connected to the output return.



- L1 Common Mode Inductor
- C1 270µF, 63V Aluminum Electrolytic Capacitor
- C2-C4 1µF, 100V Ceramic capacitor

# PACKAGE DETAIL



## Pin Assignments

Pin No.	Designation	Pin Size (inch)	Tolerance (inch)
1	-Sense	0.025 Sq	±0.001
2	+Sense	0.025 Sq	±0.001
3	S_Enable_L (Secondary Enable)	0.025 Sq	±0.001
4	Trim	0.025 Sq	±0.001
5	NC	0.025 Sq	±0.001
6	NC	0.025 Sq	±0.001
7	-Vout	0.060	±0.002
8	+Vout	0.060	±0.002
9	Case	0.040	±0.002
10	P_Enable_L (Primary Enable)	0.040	±0.002
11	-Vin	0.040	±0.002
12	+Vin	0.040	±0.002

# ORDERING INFORMATION

Model Number	Output Voltage	Max Current	Efficiency (Typ)
<b>GPP5V0-20</b>	5.0V	20 A	84%
<b>GPP5V0-15</b>	5.0V	15 A	85%
<b>GPP3V3-25</b>	3.3V	25 A	80%
<b>GPP3V3-15</b>	3.3V	15 A	82%

Model Number	Output Voltage	Max Current	Efficiency (Typ)
<b>GPP2V2-25</b>	2.2V	25 A	73%
<b>GPP2V2-15</b>	2.2V	15 A	75%
<b>GPP1V5-25</b>	1.5V	25 A	70%
<b>GPP1V5-15</b>	1.5V	15 A	71%

\* Heatsinks required: available on request.

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