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All specifications are typical @+25°C with nominal input voltage under full output load conditions, unless otherwise noted. Specifications subject to change without notice.

Martek Power Abbott, Inc. 2727 S. La Cienega Blvd, Los Angeles, CA 90034 USA Tel: (310) 202-8820 Fax: (310) 836-4926 http://www.martekpowerabbott.com sales.mpa@martekpower.com

PFC1000

1000 Watts Output Power

POWER FACTOR CORRECTED AC-DC CONVERTER

HOW TO ORDER

PFC I 1000 - I

- Series
- Unscreened (I) or Screened (M)
- Total Output Power
- I - M4 inserts

FEATURES

- Over Temperature Protection
- Output Overvoltage Protection
- Environmental Screening available
- Isolated Input AC Good TTL Signal (Open collector)
- Isolated Output DC Good TTL Signal (Open collector)
- Full 1000 Watts output power from 85V to 264 VAC at up to 100°C base plate temperature
- Meets CE101 of MIL - STD - 461E
- Meets all requirements of MIL - STD - 704E

INPUT CHARACTERISTICS

	Min.	Typ.	Max	Units
Input Voltage (Single Phase)	85		264	VAC
Input Frequency Range	47		440	Hz
Inrush Current			37	A
Power factor at Full Load [fig. I]				
115V_{in} / 60Hz	0.98	0.99		
115V_{in} / 400Hz	0.98	0.99		
230V_{in} / 50Hz	0.97	0.98		
Efficiency at Full Load [fig. III]				
115V_{in} / 60Hz	93	95		%
115V_{in} / 400Hz	93	95		%
230V_{in} / 50Hz	95	97		%

OUTPUT CHARACTERISTICS

	Min.	Typ.	Max.	Units
Nominal No Load Voltage Setting	375		385	V
Output Power (Full Load)			1000	W
Load Regulation (No Load - Full Load)			2	% V_{out}
Line Regulation (Low Line - High Line)			1	% V_{out}
Ripple P - P (60 Hz/115 VAC input) [fig. VII]			10	V
Overvoltage Protection	400	410	425	V
Transient Response: 25 - 75 - 25% or				
50 -100 - 50% step load				
Overshoot / Undershoot			12.5	V
Recovery time (to 1% of V_{out})			50	mS
Temperature Drift		0.01	0.02	%/°C

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TEMPERATURE CHARACTERISTICS

	Min.	Typ.	Max.	Units
Operating	-40		+100	°C
Storage - Ambient	-55		+105	°C
Over Temperature Shutdown		+105		°C
Thermal Resistance Case- Ambient		1.2		°C/W

ISOLATION CHARACTERISTICS

	Min.	Units
Isolation:		
Input/Output to Base	1000	VAC
Insulation resistance @ 500 VDC	100	MOhm

M- GRADE - ENVIRONMENTAL SCREENING

Stabilization Bake	+105°C for 24 hours similar to Mil-Std-883, M1108, Condition B
Temperature Cycling	10 cycles at -55°C to +105°C (transition period 5°C / minute) similar to Mil-Std-883, M1010, Condition B
Burn in	160 hours @ 85°C minimum
Final Testing	Full ATP

I- GRADE - ENVIRONMENTAL SCREENING

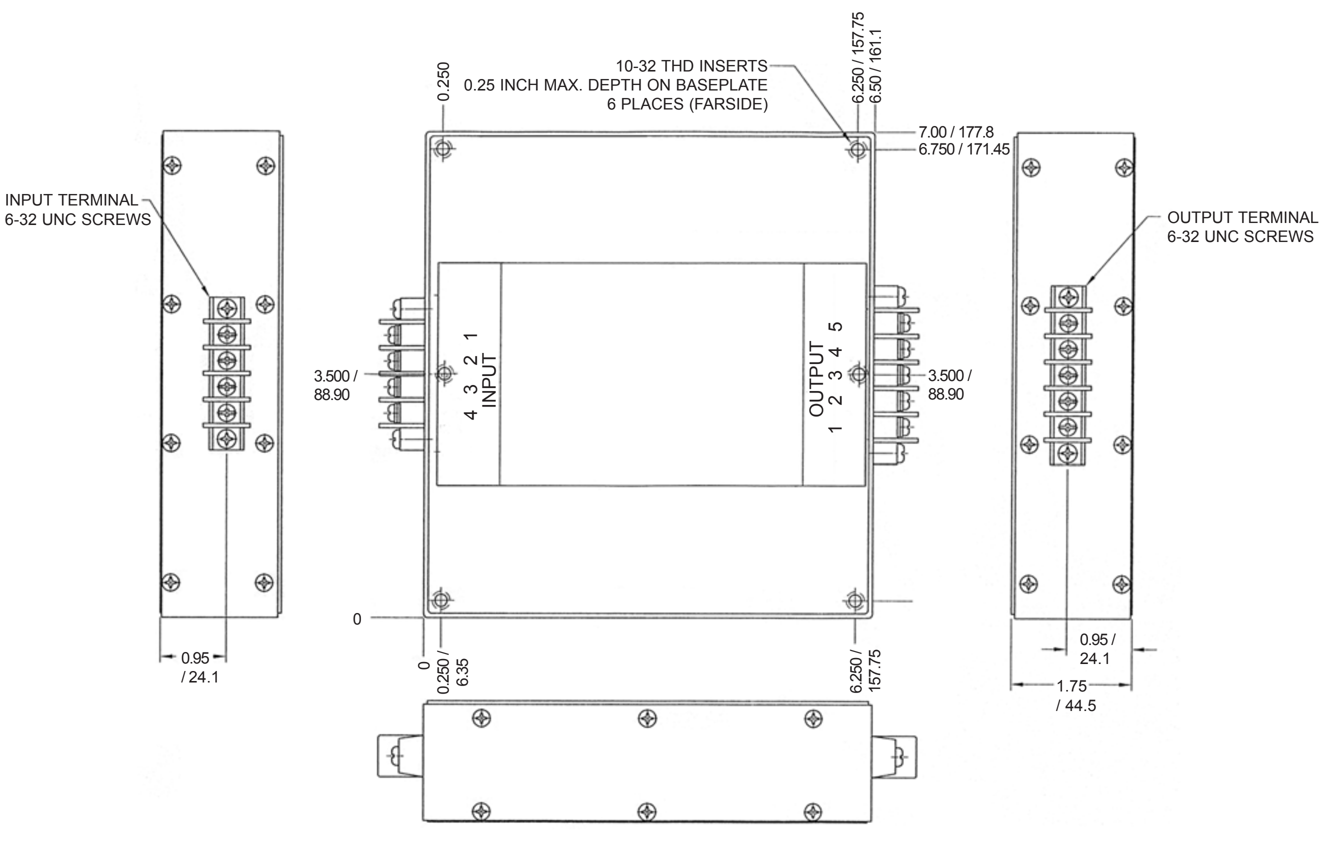
Burn in	16 hours @ 50°C minimum
Final Testing	Full ATP

See "Guide to Operation" for full details

MECHANICAL CHARACTERISTICS

Weight (Max.)	70 1990	oz. grams
Size	7.00 x 6.50 x 1.75 177.8 x 165.1 x 44.5	inch mm
Volume	79.6 1306.3	$inch^3$ cm^3
Material: Lid and Case Baseplate	 Aluminum Alloy 5052-H32 Aluminum Alloy 6061-T6	
Finish: Lid and Case Baseplate	 Black Anodized None	
Mounting: Standard Option - I	 10-32 Inserts Metric M4 - .7 Inserts	

CASE DRAWINGS



Tolerances:	inches	-	x.xx	= ±0.03	mm	-	x.x	= ±0.8
			x.xxx	= ±0.015			x.xx	= ±0.40

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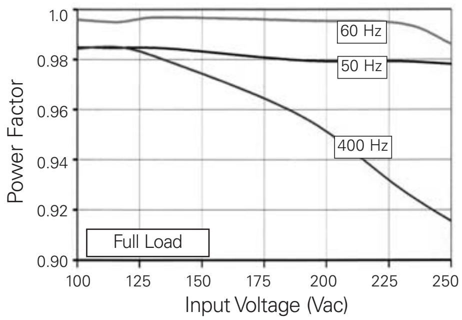
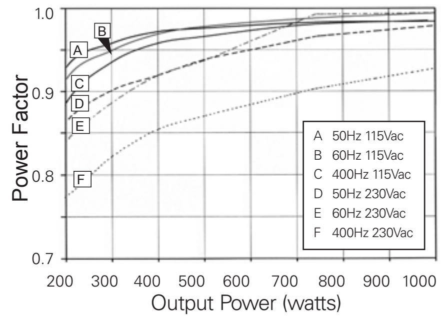
PERFORMANCE CHARACTERISTICS

PFC1000

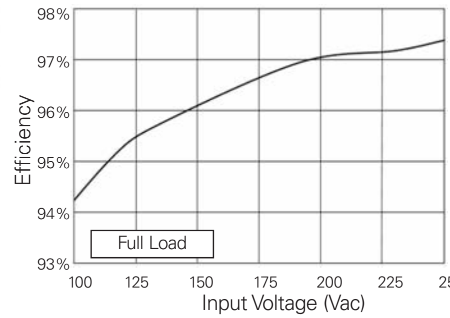
I. Power Factor vs. Input Voltage



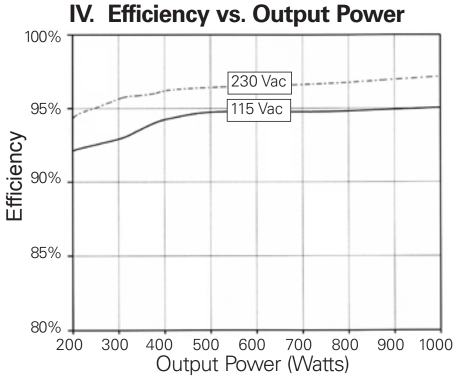
II. Power Factor vs. Output Power



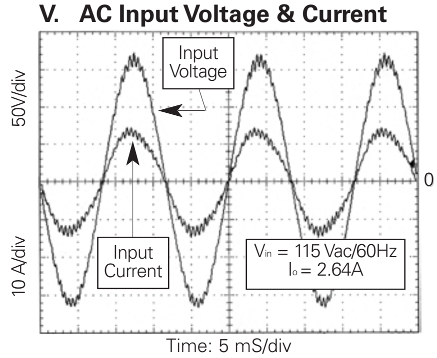
III. Efficiency vs. Input Voltage



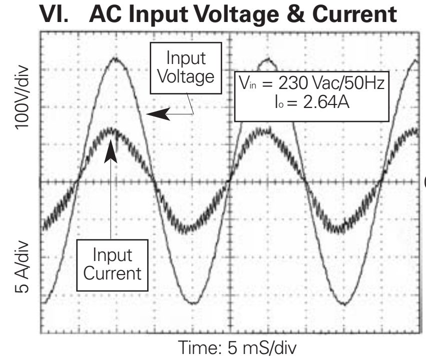
IV. Efficiency vs. Output Power



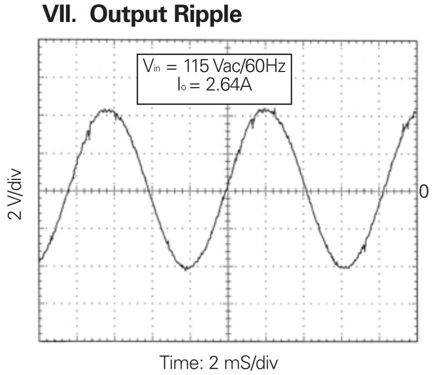
V. AC Input Voltage & Current



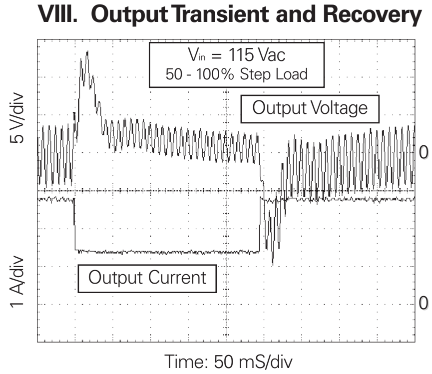
VI. AC Input Voltage & Current



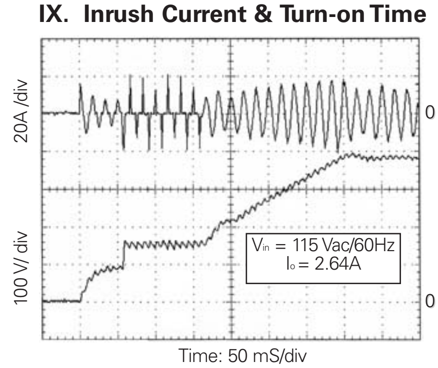
VII. Output Ripple



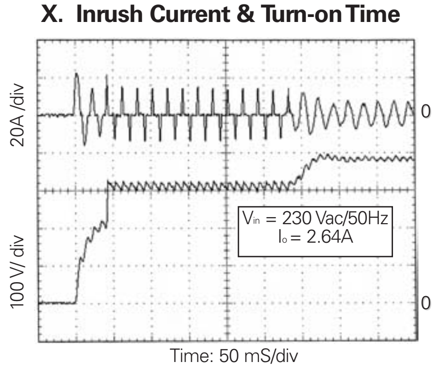
VIII. Output Transient and Recovery



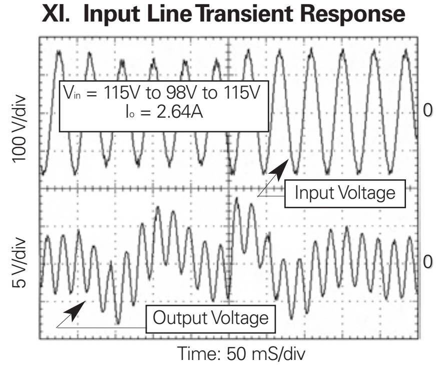
IX. Inrush Current & Turn-on Time



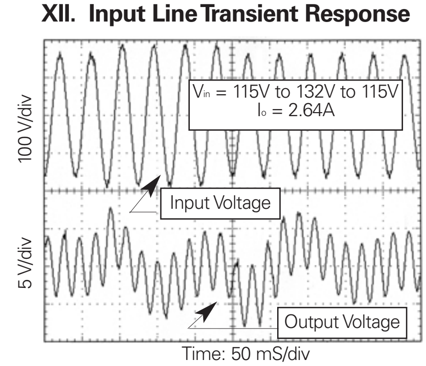
X. Inrush Current & Turn-on Time



XI. Input Line Transient Response



XII. Input Line Transient Response



All specifications are typical @+25°C with nominal input voltage under full output load conditions, unless otherwise noted. Specifications subject to change without notice.

Guide to Operation

I. Electrical Description

The PFC1000 is a 1 kilo-Watt AC-DC high power converters that convert a single phase, wide range of voltage (85V - 264V) and frequency (47Hz - 440Hz) AC input to a regulated 380 VDC output with very high input power factor. The high input power factor is achieved by forcing its input current to follow the waveform of the input voltage. Also, the converter used of a passive "lossless" snubber circuit to minimize the noise while increasing converter efficiency and reduced the stress on the major power components. The switching frequency of this converter is fixed at about 80kHz. Fixed frequency operation would greatly simplify EMI filtering design. A companion EMI filter module, PFF1000 is available.

II. Mechanical Description

General

The PFC1000 AC-DC converter is housed in a rectangular case with an aluminum base plate to facilitate heat transfer. The size of the converter is 6.50"(W) x 7.00"(L) x 1.75"(H). The case/cover of the converter is black anodized. Its base plate has four (4) standard #10-32 inserts with maximum 0.25" depth for mounting. As an option, these four standard #10-32 inserts could be replaced with Metric M4 - .7 inserts for customer use Metric screws. Customers who intend to use Metric-mounting hardware shall specify this option with the correct part number for this option.

The high efficiency of the this AC-DC converter reduces heat dissipation and minimizes heat sinking requirements i.e., typical dissipation of the 1000 watt converter operation at full load will be between 30 and 50 watts. Though this reduces heat-sinking requirements, the base plate temperature must be maintained below +100ºC for military versions and +71ºC for industrial versions or permanent damage may occur.

Installation and Mounting

Before mounting the converter, be sure that the mounting surface and converter base plate is clean. Heat sink mounting surfaces must be smooth, flat to within 0.005 and cover the entire base plate of the converter. Based on the calculated power dissipation (see Application Notes on Common Equations for sample calculation) the heatsink should have adequate heat dissipation characteristics. To facilitate heat transfer, apply thermal compound to the base of the module before mounting it to the heat sink. It is extremely important to achieve a good thermal interface between the base of the converter and the heatsink. We highly recommend the use of thermal grease or some other type of conducting material. Failure to achieve a good thermal interface may result in damage to the converter.

III. Military Specifications

The military version of PFC1000 AC-DC converter is designed to meet the following military environmental specifications:

Specification	*Condition*	*Method*	*Procedure*	*Test Condition*
MIL-STD-704E	Voltage Transient			180V/10ms
MIL-STD-810F	Vibration	514.5	1	Up to 10gs, each axis for 1 hour
MIL-STD-810F	Humidity	507.4		95% humidity, non-condensing for 10 days
MIL-STD-810F	Temp/Altitude	520.2	3	40 hours from -40°C to +71°C
MIL-STD-810F	Acceleration	513.5	2	14gs each axis
MIL-STD-810F	Temperature Shock	503.4		-55°C to +105°C (non-operating, 1 hour each cycle)
MIL-STD-901D	High Impact Shock	Grade A, Class I	Type A	5 foot hammer drop

Certified test reports pending.

When used with the PFF1000 EMI filter, the PFC1000 have been tested and found to meet the requirements of MIL-STD-461C & MIL-STD-461E for conducted emissions/interference on the input power leads [CE01 (30Hz-15kHz) and CE03 (15kHz-50MHz)] for MIL-STD-461C, [CE101 (30Hz-10kHz) and CE102 (10kHz-10MHz)] for MIL-STD-461E. In addition, the PFC1000 converter is designed to meet MIL-STD-461E for radiated interference [RE101 (Magnetic field, 30Hz-100kHz), RE102 (Electric field (10kHz-18GHz)], conducted susceptibility [CS101 (30Hz-150kHz), CS114 (10kHz-200MHz), CS115 (Impulse excitation) and CS116 (damped sinusoidal transient)] and radiated susceptibility [(RS101 (Magnetic field 30Hz-100kHz), RS103 Electric field 2MHz-40GHz)]. Full test reports pending.

IV. Product Features

AC Power Good signal

The AC power good signal is provided by an optically coupled open collector circuit that indicates the AC input voltage is present or not. When the input voltage is above 80±4V, the optically coupled output transistor is on. When the input voltage is below 80±4V, the optically coupled output transistor is off. See application notes for more details.

DC Power Good/Built-in test signal

A DC power good signal is provided to allow for the monitoring of the output voltage. Same as the AC good signal's output, the output stage of this signal is an optically coupled open collector. The optically coupled transistor is on when the output voltage is within the range of 350±5V and 400±5V. The optically coupled transistor is off when the output voltage is out side the 350±5V and 400±5V range. See application notes for more details.

Over Temperature Protection

An over temperature shut down circuit is provided to protect the converter from being over heated. When the temperature at the center of the base plate is above the rated high operating temperature, the unit will automatically shut down. Once that temperature is reduced to about 85% of the rated high operating temperature, power will be automatically restored.

Output Over Voltage Protection

The converter provides an internal "non-latching" overvoltage protection circuit. Should an overvoltage condition occur the converter will shut off and that the output voltage will fall. When the output is too low, the converter will be on again.

V. Reliability

Reliability Calculation

In order to achieve superior reliability, the design of the converter adhere to the stringent component derating guidelines of NAVMAT P4855-1.

The following table is the tabulated Mean Time Between Failure (MTBF) for industry version (I version) calculated per MIL-HBDK-217F Notice 2 under nominal input / full load for different environmental factor with different temperature. The first column lists all the environmental factors and that the first row lists the operating temperature from 0 degree C (0°C) to 80 degree C (80°C).

I- Grade	0 °C	10 °C	20 °C	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C
GB	878,835	689,396	525,404	387,464	275,971	190,156	127,436	83,715	54,368
GF	187,366	145,913	112,764	86,483	65,804	49,655	37,149	27,556	20,276
GM	85,500	69,084	55,195	43,652	34,206	26,583	20,504	15,708	11,961
MF	54,140	44,503	36,323	29,444	23,710	18,967	15,073	11,901	9,334
ML	22,635	18,674	15,299	12,456	10,087	8,132	6,530	5,228	4,174
CL	1,500	1,273	1,072	897	747	618	510	420	345
SF	1,566,700	1,206,210	886,538	620,095	414,112	266,525	167,417	103,928	64,418
AIC	80,368	64,695	51,873	41,427	32,942	26,064	20,505	16,026	12,437
AIF	43,799	34,961	27,927	22,332	17,873	14,310	11,453	9,155	7,303
ARW	31,073	25,482	20,749	16,788	13,507	10,814	8,620	6,847	5,420
AUC	50,991	40,796	32,528	25,856	20,493	16,195	12,760	10,021	7,845
AUF	28,359	22,615	18,046	14,415	11,528	9,228	7,392	5,923	4,745
NS	110,040	89,220	71,915	57,617	45,854	36,212	28,344	21,965	16,842
NU	44,494	36,685	30,112	24,616	20,043	16,251	13,115	10,530	8,406

The following table is the tabulated Mean Time Between Failure (MTBF) for military version (M version) calculated per MIL-HBDK-217F Notice 2 under nominal input / full load for different environmental factor with different temperature. The first column lists all the environmental factors and that the first row lists the operating temperature from 0 degree C (0°C) to 80 degree C (80°C).

M-Grade	0 °C	10 °C	20 °C	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C
GB	2,293,210	1,902,470	1,537,480	1,206,110	915,864	672,659	478,837	332,022	225,797
GF	545,830	434,757	342,702	267,656	207,307	159,342	121,608	92,200	69,485
GM	225,965	188,742	155,318	126,095	101,155	80,319	63,229	49,424	38,412
MF	146,643	123,857	103,564	85,784	70,439	57,378	46,400	37,275	29,767
ML	60,158	51,079	42,918	35,720	29,480	24,158	19,681	15,960	12,897
CL	3,851	3,358	2,900	2,482	2,107	1,775	1,486	1,238	1,027
SF	4,312,120	3,526,460	2,774,120	2,087,690	1,500,290	1,033,240	687,705	447,266	287,373
AIC	234,209	192,305	156,872	127,227	102,632	82,368	65,767	52,240	41,276
AIF	130,214	105,862	85,859	69,539	56,277	45,520	36,799	29,727	23,988
ARW	83,594	70,482	58,802	48,589	39,811	32,385	26,187	21,075	16,898
AUC	148,915	121,361	98,274	79,145	63,446	50,663	40,323	32,005	25,343
AUF	85,285	69,044	55,774	44,998	36,284	29,255	23,591	19,029	15,354
NS	313,425	260,352	214,477	175,334	142,278	114,597	91,590	72,607	57,072
NU	121,211	102,689	86,344	72,112	59,858	49,407	40,564	33,132	26,923

Standard Military Grade Module Screening

Each military grade converter under goes environmental screening based upon the parameters outlined in MIL-STD-883 and NAVMAT P4855-1. The screening and process steps consist of the following;

1- Stabilization Bake; +105°C for 24 hours per MIL-STD-883, M1108 Condition B
2- Voltage Isolation and Parametric Testing at 25°C
3- Module encapsulation and sealing
4- Temperature Cycling (non-operational); 10 cycles minimum, at -55°C to +105°C, 36 minute transition with a 1 hour dwell at each temperature extreme. Procedure reference MIL-STD-883, M1010, condition B and NAVMAT P4855-1.
5- Voltage Isolation and Parametric Testing at 25°C
6- Long Term Operational Burn In; 160 hours of powered operation under load. Modules are continuously cycled from +85°C to thermal shut down point (+105°C) during the 160 hours.
7- Voltage Isolation and Parametric Testing at 25°C
8- Visual Inspection

Additional testing is available including parametric testing at temperature or extended burn in time. Consult factory for more information. Additional testing or customer specific testing will require additional charges.

Accelerated Life Testing

An accelerated life test was performed on representative sample units of the converter to determine the long-term effects on performance. Units were subjected to 500 thermal cycles (non-operational) of -55°C to +105°C. At every 50th cycle, converters were given full parametric testing. At the conclusion of the 500th cycle all converters were found to operate within published specifications.

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General Application Notes

The PFC1000 is a 1 kilo-Watt AC-DC high power converters that convert a single phase, wide range of voltage (85V - 264V) and frequency (47Hz - 440Hz) AC input to a regulated 380 VDC output with very high input power factor. The high input power factor is achieved by forcing its input current to follow the waveform of the input voltage. Also, the converter used of a passive "lossless" snubber circuit to minimize the noise while increasing converter efficiency and reduced the stress on the major power components. The switching frequency of this converter is fixed at about 80kHz. Fixed frequency operation would greatly simplify EMI filtering design. A companion EMI module, PFF1000, is available.

The PFC1000 AC-DC converter is housed in a rectangular case with an aluminum base plate to facilitate heat transfer. The size of the converter is 6.50"(W) x 7.00"(L) x 1.75"(H). The case/cover of the converter is black anodized. Its base plate has four (4) standard #10-32 inserts with maximum 0.25" depth for mounting. As an option, these four standard #10-32 inserts could be replaced with Metric M4 - .7 inserts for customer using Metric screws. Customers who intend to use Metric-mounting hardware shall specify this option with the correct part number for this option.

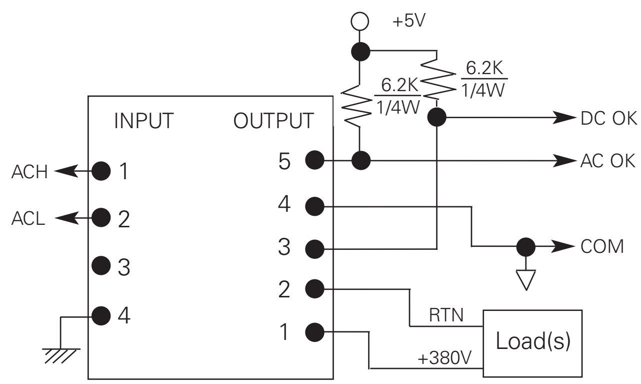
The high efficiency of the this AC-DC converter reduces heat dissipation and minimizes heat sinking requirements i.e., typical dissipation of the 1000 watt converter operation at full load will be between 30 and 50 watts. Though this reduces heat-sinking requirements, the base plate temperature must be maintained below +100ºC for military versions and +71ºC for industrial versions or permanent damage may occur.

Before mounting the converter, be sure that the mounting surface and converter base plate is clean. Heat sink mounting surfaces must be smooth, flat to within 0.005 and cover the entire base plate of the converter. Based on the calculated power dissipation (see Application Notes on Common Equations for sample calculation) the heatsink should have adequate heat dissipation characteristics. To facilitate heat transfer, apply thermal compound to the base of the module before mounting it to the heat sink. It is extremely important to achieve a good thermal interface between the base of the converter and the heatsink. We highly recommend the use of thermal grease or some other type of conducting material. Failure to achieve a good thermal interface may result in damage to the converter.

A number of protection features, as well as electrical and thermal derating of internal components allows for high reliability throughout the entire operating ranges. There are two operating ranges available, -40 °C to +71°C (for industrial applications) and -40 °C to +100 °C (for military applications). All -40 °C to +100 °C units ("M" level) are fully screened in accordance with MIL-STD-833. Qualification test reports to MIL-STD-810F and MIL-STD-901D - pending.

The most basic use of the power converter is shown in Figure 1. An input fuse is always recommended to protect both the source and the converter in the event of failures. Bus fuse type MDX or equivalent slow-blow is recommended with a current rating 15A for 115V operation and a 7.5A one for 230V operation.

Figure 1. Basic application setup



Wire Gage & Distance to Load

If the resistance resistance of the wire,printed circuit board runs or connectors used to connect a converter to system components is too high, excessive voltage drop will result between the converter and system components, degrading overall system performance such as poor load regulation and transient response. It is important to keep the physical distance between the converter and its loading electronic systems as short as possible. Also, the selection of wires and connectors for the input and output connection should be such that the DC resistance of the wires and connectors is minimum. The size of the wire should be selected in according to the maximum current that it has to handle with reasonable margin.

Note: Obviously, any poor connections made to the power distribution bus may present a problem. Terminal strips, spade lugs and edge connectors must be free of any corrosion, dust or dirt. If parallel lines or connections are available for routing converter output currents, they should be utilized.

Ripple & Noise

Output ripple and noise (sometimes referred to as PARD or "Periodic and Random Deviations") can be defined as unwanted variations in the output voltage of a power supply. For the Power factor corrected converter, the output noise is seen as a series of pulses with a high frequency content ridding on top of a ripple which is the second harmonic of the input line frequency and is therefore measured as a peak value (i.e., specified as "peak-to-peak"). When compare to the ripple of second harmonic of the input line frequency, the high frequency and spike portion of the ripple and noise is insignificant.

Martek Power Abbott power supplies are specified and tested in our factory with a 25 MHz or 10 Mhz bandwidth oscilloscope. Measurements taken by a scope set at higher frequencies (i.e. 300 MHz) may produce significantly different results due to noise coupling on to the probe from sources other than the power supply.

Ripple & Noise Measurement Techniques

The length of all measurements leads (especially the ground lead) should be minimized. We recommend measurement as close to the converter's output terminal block as possible. This can be accomplished by connecting a short bus wire (generally 0.5 inches or less, making a loop at the end to place in the probe) to the negative and positive outputs on the terminal strip, then place the tip of the probe on the +output and ground ring (or ground band) on the -output for a true ripple measurement. This is displayed in Figure 2.

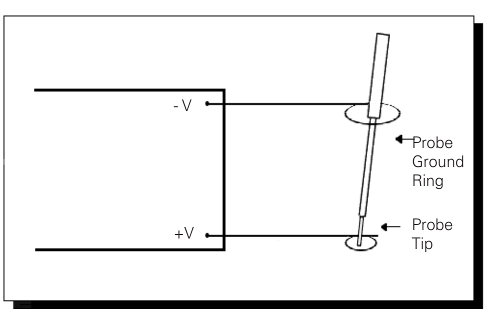


Figure 2.

Ripple & Noise Reduction Techniques

In applications where the output ripple of the converter is higher then desired various techniques could be employed to reduce output ripple and noise (PARD). One method is to add additional capacitance in parallel with the output leads of the converter. As it was mentioned previously, the main output noise and ripple for the converter is the second harmonic of the line frequency. Therefore, the frequency of the main ripple is very low, particularly when the input line frequency is 50Hz or 60Hz. It would take a substantial amount of additional capacitance to reduce a noticeable output ripple. Be aware that excessive additional output capacitance may cause converter oscillations. The additional external capacitance added to the converter's output shall be limited to 1000uF maximum.

Parallel Operation

In general, the PFC1000 AC-DC converter is not designed for parallel operation over the whole input voltage range and whole frequency range. However, for a particular operating voltage range, for example 115V or 230V only, not 115V - 230V, and with a single operating frequency, for example 50Hz or 60Hz only, not 50Hz - 60Hz, the converters could be factory modified and adjusted for parallel operation to increase the supply power. Consult the factory for more detail.

Series Operation

The PFC1000 is not designed for any kind of series operation. Connecting the converter for series operation, either series the input or series the output, will create hazardous operating conditions and may cause severe damage to the converter.

Power Good Signal

AC Power Good signal

As it has been mentioned previously, the AC Power Good signal is provided by an optically coupled open collector circuit that indicates the AC input voltage is present or not. When the input voltage is above 80±4V, the optically coupled output transistor is on. When the input voltage is below 80±4V, the optically coupled output transistor is off. The emitter of this transistor and the emitter of the DC Power Good signal's output transistor are tied together to form a common. This common could be connected to anywhere that the user wants without creating any hazardous high potential conditions. Since it is an open collector output, the user needs to supply the pull up resistor and the TTL supply voltage. With the user supplied pull up resistor and supply voltage, the TTL logic for this output is that Logic Zero means AC input is present. The current sinking capability for this open collector output is 0.75mA maximum for maintaining a logic zero at 0.5V or less output voltage. Thus, the value for a 5V TTL pull up resistor should be 6.2k Ohm or larger to ensure that logic zero is less than 0.5V under any operating temperature within the range of -40°C - +100°C.

DC Power Good/Built-in-test signal

As it has been mentioned previously, a DC Power Good signal is provided to allow for the monitoring of the output voltage. Same as the AC Power Good signal's output, the output stage of this signal is an optically coupled open collector/emitter. The optically coupled transistor is on when the output voltage is within the range of 350±5V and 400±5V. The optically coupled transistor is off when the output voltage is outside the 350±5V and 400±5V range. As mentioned in the AC Power Good signal section, the emitter of this transistor and the emitter of the AC Power Good signal's output transistor are tied together to form a common. This common could be connected to anywhere the user wants without creating any hazardous high potential conditions. Since it is an open collector output, the user needs to supply the pull up resistor and the TTL supply voltage. With the user supplied pull up resistor and supply voltage, the TTL logic for this output is that Logic Zero means DC output is within the range of 350±5V and 400±5V. The current sinking capability for this open collector output is 0.75mA maximum for maintaining a logic zero at 0.5V or less output voltage. Thus, the value for a 5V TTL pull up resistor should be 6.2k Ohm or larger to ensure that logic zero is less than 0.5V under any operating temperature within the range of -40°C - +100°C.

Output Voltage other than 380V

For particular application that requires different output voltage, it is possible to have the DC output voltage be set to different value other than the normal 380V. Please consult factory for particular application and modification.

Electro-Magnetic Interference (EMI) Filter PFF1000

For applications where electromagnetic interference is a concern, the PFF1000, a passive input line EMI filter, may be installed at the input of the converter (see Figure 3). With the PFF1000 filter, the converter complies with CE01 and CE03 of MIL-STD-461C and CE101 and CE102 of MIL-STD-461E on the input leads. Test reports characterizing both filter and the converter for conducted and radiated emission as well as for susceptibility are available. The PFF1000 filter guarantee conducted emissions on the input leads only. All test reports are certified by an independent testing laboratory.

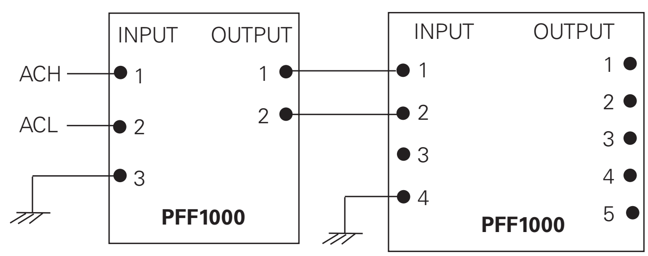


Figure 3.

Common Equations

Calculation of Input Current

Calculating the required current draw for your converter is as follows.

$$\text{Maximum Input current} = \frac{\left[\dfrac{\text{Output Power}}{(\text{Efficiency})*(\text{Power Factor})}\right]}{\text{Minimum Steady State Input Line}}$$

The above calculation will yield the converter's input current. For example:
Outoput Power: 1000 Watt
Steady State Low Line: 103.5 VAC
Efficiency; 93% at 103.5 VAC line, full load (see charts in Performance Characteristics) assuming 5% safety factor efficiency is then 88% @ 103.5 VAC. The Power factor is 0.98.

$$\text{Input Current} = \frac{\left[\dfrac{1000\ \text{watts}}{(0.88)*(0.98)}\right]}{103.5\ \text{VAC}}, \quad \text{Input Current} = 11.2\ \text{Amps}$$

The worst case steady state input current to PFC1000 converter operating at full load with an input of 103.5 VAC is 11.2 Amps.

Power Dissipation

The calculation of the total power dissipated from the converter will be essential for thermal management of the device. Unlike other types of electronic devices DC/DC converters tend to generate a significant amount of heat. This heat is channeled (by design) to the bottom or baseplate of the module. The following equations assist when designing a suitable heat sink.

The basic equation is: $P_{Diss} = P_{in} - P_{out}$

Where P_{out} is defined as the maximum load condition and P_{in} is defined as a function of P_{out} and efficiency. The equation is therefore:

$$P_{Diss} = \left[\frac{P_{out}}{\text{Efficiency}}\right] - P_{out}$$

The energy loss calculated from the above equation will be dissipated via the converter's baseplate in the form of heat. A key parameter in this equation is the converter efficiency. Efficiency will be dependent upon the line and load characteristics of the application.

The above calculation will yield the converter's power dissipation. For example:
Output Power: 1000 watts
Efficiency; 93% at 103.5 VAC line, 100% load (see charts in Performance Characteristics) assuming 5% safety factor efficiency is then 88%

$$P_{Diss} = \left[\frac{1000}{0.88}\right] - 1000, \quad P_{Diss} = 136\ \text{Watts}$$

The maximum power dissipated from the converter under these conditions will be 136 watts.

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Warranty & Repair

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The Company warrants that all of its Products will be free from defects in material and workmanship for twelve months. The Company shall, at its option, and as the Customer's and user's role and exclusive remedy, issue a credit in the amount of the then-applicable price of such Product, or repair or replace any such Product which is defective under the terms of the foregoing warranty, free of charge.

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I. A, B, C, M, NW, PFC, W and LV Series: One (1) year warranty.
II. CB, HM, NB, NL and SM Series: Three (3) years warranty.

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I. A, B, C, M, NW, PFC, W and LV Series: Martek Power Abbott will repair products covered by our warranty. To return products a Return Material Authorization Number is required. Products beyond the warranty will be repaired only after the customer has authorized quoted repair charges. Any Martek Power Abbott product over seven(7) years old from the date of original shipment will not be serviced or repaired.
II. CB, HM, NB, NL and SM Series: During warranty period, Martek Power Abbott will repair or replace (at Martek Power Abbott's discretion) products found to be defective. Martek Power Abbott will not repair products that are out of warranty.

***After Repair Warranty**
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II. CB, NL, NB and SM Series: Upon completion of repair, the products will be under warranty for a period of one year. Regardless of the date of repair, no product from the CB, NL, NH, NB and SM Series will be serviced or warranted beyond three (3) years from the date of original shipment.

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All returning goods must be accompanied by a Return Material Authorization (RMA) number. The RMA number must be clearly marked on the outside of the shipping carton. To receive and RMA number contact Martek Power Abbott at (310) 202-8820, extension 276. Please be prepared with the correct model and serial number of the product to be returned. For out of warranty products a company purchase order will be required for processing.

Evaluation Charges
All out of warranty products returned to Martek Power Abbott are subject to a $50.00 evaluation charge. If the returned product is found to be in need of repair, and these repairs are authorized, the $50.00 evaluation fee will be waived.

Repair Charges
Repair charges for all models are quoted per Martek Power Abbott published repair price list RPL97-07D. The repair charges do not include any additional processing or testing fees (i.e. ESS testing).

Shipping Instructions
All returning goods must have a RMA number marked on the carton. The number should be marked on a minimum of 2 sides of the carton, 3 inches (76mm) high, 6 inches (152mm) long. All goods must be shipped prepaid. Martek Power Abbott reserves the right to refuse all shipments received without a RMA number.