

Military COTS AC Line Filter

85 to 264Vrms Input Voltage	50/60Hz & 400Hz Versions	9Arms Output Current	1kW @ 115Vrms 2kW @ 230Vrms Output Power	195mΩ @ 100°C Max Series Resistance	>55dB @ 250kHz Differential & Common-mode Attenuation
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FULL POWER OPERATION: -55°C TO +100°C

MCOTS series of EMI AC Line Filters brings SynQor's field proven technology and manufacturing expertise to the industrial power applications marketplace. SynQor's innovative packaging approach ensures survivability in the most hostile environments. Compatible with the industry standard format, these filters have high differential-mode and common-mode attenuation and low series resistance. They follow conservative component derating guidelines and they are designed and manufactured to the highest standards.

MilCOTS



MACF-060-230-HT-N-M Module

Operational Features

- -55°C to +100°C Operation
- 9Arms output current
- Very low series resistance
- >55dB @ 250kHz Differential & Common-mode Attenuation
- All capacitors are safety-rated X7R multi-layer ceramic
- Meets common EMC standards in properly designed system with SynQor's MPFC module and MCOTS 270 converters
- 400Hz and 50/60 Hz versions

Mechanical Features

- Standard Size: 2.486" x 2.366" x 0.51" (63.14 x 60.60 x 12.7mm)
- Total weight: 5.0oz (142.3g)
- Flanged baseplate version available

Safety Features

- 2150Vdc input-to-case and input-to-gnd-pin high-potential test
- Safety rated class X2 line-to-line and class Y2 line-to-gnd capacitors
- Certified 60950-1 requirement for basic insulation (see Standards and Qualifications page)

Compliance Features

- MACF Series filters (with MPFC & MCOTS converters) are designed to meet:
- MIL-STD-461 for EMC
 - MIL-STD-1399
 - MIL-STD-704

In-Line Manufacturing Process

- AS9100 and ISO 9001:2008 certified facility
- Full component traceability

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Technical Specification

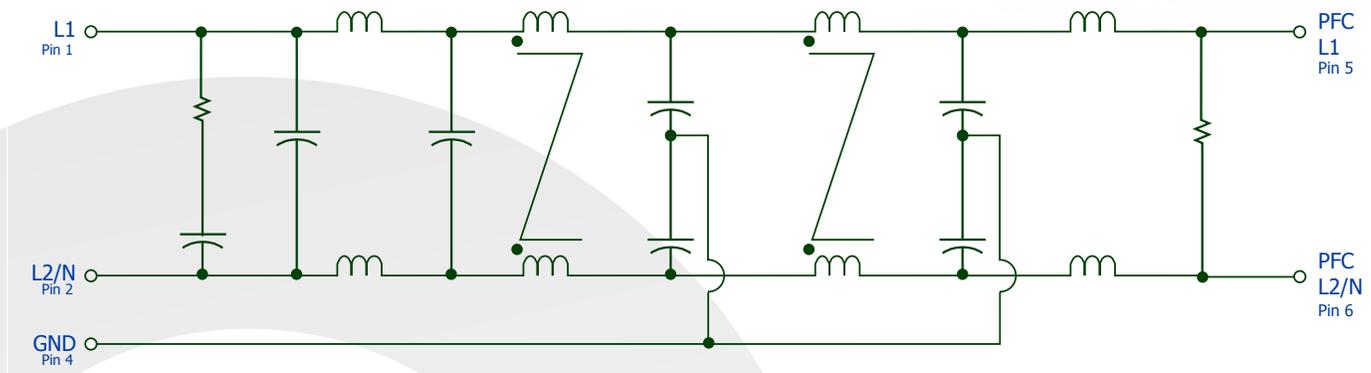
MACF-xxx-230-HT

Technical Diagrams

Fundamental Circuit Diagram

AC POWER INPUT

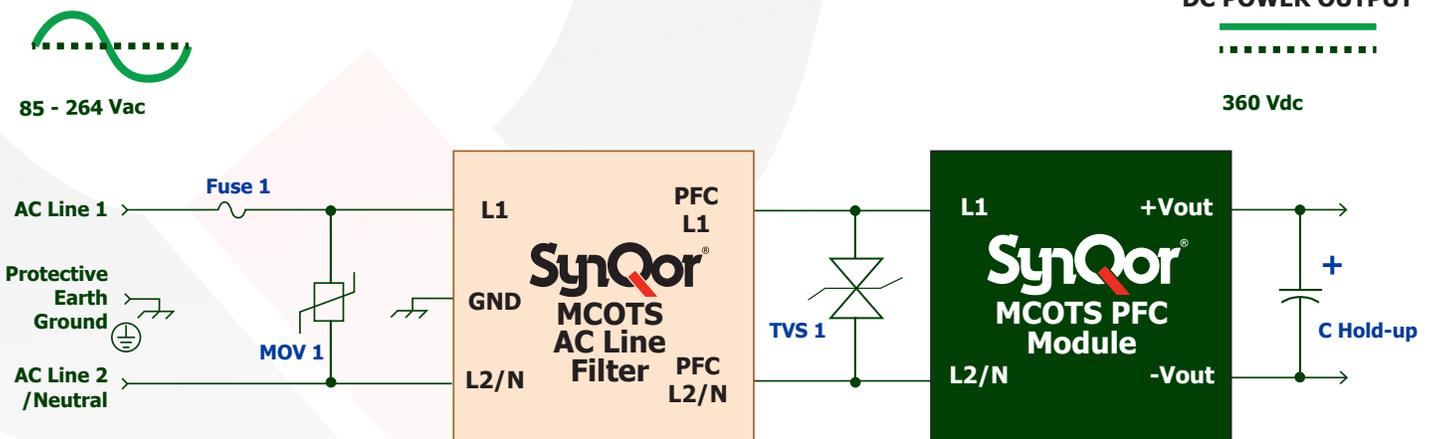
AC POWER OUTPUT



Typical Connection Diagram

AC POWER INPUT

DC POWER OUTPUT



MOV 1: 300VAC, 60J; (EPCOS S10K300E2)
 TVS 1: 400V, 3J; (Two VISHAY 1.5KE200CA devices connected in series)
 C Hold-up: 450V, 390µF; (United Chemi-Con ELXS451VSN391MR50S)
 Fuse 1: 250VAC, 12.5A; (Littelfuse 0216012.5MXEP)



Technical Specification

MACF-xxx-230-HT

MACF-xxx-230-HT Electrical Characteristics

Vin <= 264Vrms, Iout <= 9Arms unless otherwise specified

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
ABSOLUTE MAXIMUM RATINGS					
Input Voltage (Continuous)			264	Vrms	
Isolation Voltage			2150	Vdc	Input/output to gnd pin & baseplate
Output Current (Continuous)			9	Arms	
Output Current (Surge)			400	A ² S	
Operating Case Temperature	-55		100	°C	Baseplate temperature
Storage Case Temperature	-65		135	°C	
Lead Temperature (20 s)			300	°C	
RECOMMENDED OPERATING CONDITIONS					
Input Voltage (Continuous)			250	Vrms	
Output Current (Continuous)			9	Arms	
ELECTRICAL CHARACTERISTICS					
Output Voltage (Continuous)	Vout = Vin - (Iin x Rs)			V	
Series Resistance Rs					Total
Tcase = 25°C		130		mΩ	
Tcase = 100°C			195	mΩ	
Power Dissipation					9Arms output current
Tcase = 25°C		10.5		W	
Tcase = 100°C			15.8	W	
Total Differential-Mode Capacitance		1.5		μF	Measured across input or output pins
Total Common-Mode Capacitance 50/60Hz version		2 x 20		nF	Measured between gnd pin and any other pin
Total Common-Mode Capacitance 400Hz version		2 x 13		nF	Measured between gnd pin and any other pin
Leakage current in PE GND Pin 50/60Hz version			1.9	mArms	250Vac L-N 50Hz See Note 1
Leakage current in PE GND Pin 400Hz version			2.8	mArms	115Vac L-N 400Hz See Note 1
Noise Attenuation					See Fig 1
Isolation Resistance	100			MΩ	Any pin to gnd pins
RELIABILITY CHARACTERISTICS					
Calculated MTBF (MIL-217) MIL-HDBK-217F		5.9		10 ⁶ Hrs.	Ground Benign, Tb = 70 °C
Calculated MTBF (MIL-217) MIL-HDBK-217F		0.339		10 ⁶ Hrs.	Ground Mobile, Tb = 70 °C
Field Demonstrated MTBF				10 ⁶ Hrs.	See our website for details

Note 1: If the neutral line is interrupted, leakage current may reach twice this level.



BASIC OPERATION AND FEATURES

This module is a multi-stage differential-mode and common-mode passive EMI filter designed to interface an AC power source with a SynQor MCOTS PFC module and one or more SynQor converters (or other loads that create EMI). Each stage of this filter is well damped to avoid resonances and oscillations, and only X7R multi-layer ceramic safety rated capacitors are used.

A typical application would place the MCOTS AC line filter close to the AC input power entry point. The AC Line Filter GND pin would be connected to the chassis ground that is common with AC input power protective earth (PE GND) or other earthed point used for EMI measurement. There are no connections to the metal baseplate, which may also be connected to the chassis ground if desired.

Do not connect the outputs of multiple MCOTS AC line filters in parallel. Connecting filters in this manner may result in slightly unequal currents to flow in the positive and return paths of each filter. These unequal currents will cause the internal common-mode chokes to saturate and thus cause degraded common-mode rejection performance.

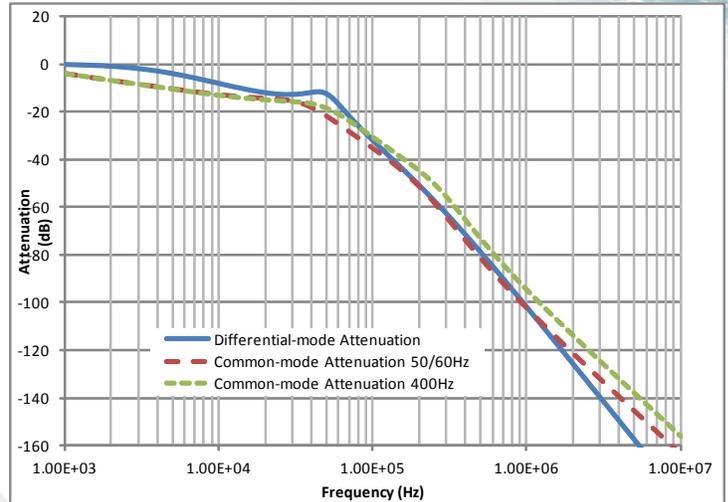


Figure 1: Typical Common Mode and Differential Mode Attenuation provided by the filter as a function of frequency. Source and load resistance are 50Ω.



Standards & Qualification Testing

Parameter	Notes & Conditions
STANDARDS COMPLIANCE	

UL 60950-1/R2011-12	Basic Insulation
CAN/CSA-C22.2 No. 60950-1/A1:2011	
EN60950-1/A12:2011	Certified by TUV

All Filter versions meet EN60950-1 leakage current requirements with a 250Vrms L-N 50/60Hz input.

The 400Hz filter version also meets EN60950-1 leakage current requirements with a 115 Vrms L-N 400Hz input but not with a 250Vrms L-N 400Hz input.

Note: An external input fuse must always be used to meet these safety requirements, see the Typical Connection Diagram.

Contact SynQor for official safety certificates on new releases or download from the SynQor website.

Parameter	# Units	Test Conditions
QUALIFICATION TESTING		

Life Test	32	95% rated Vin and load, units at derating point, 1000 hours
Vibration	5	10-55 Hz sweep, 0.060" total excursion, 1 min./sweep, 120 sweeps for 3 axis
Mechanical Shock	5	100g minimum, 2 drops in x, y, and z axis
Temperature Cycling	10	-55 °C to 100 °C, unit temp. ramp 15 °C/min., 500 cycles
Power/Thermal Cycling	5	Toperating = min to max, Vin = min to max, full load, 100 cycles
Design Marginality	5	Tmin-10 °C to Tmax+10 °C, 5 °C steps, Vin = min to max, 0-105% load
Humidity	5	85 °C, 95% RH, 1000 hours, continuous Vin applied except 5 min/day
Solderability	15 pins	MIL-STD-883, method 2003
Altitude	2	70,000 feet (21 km), see Note

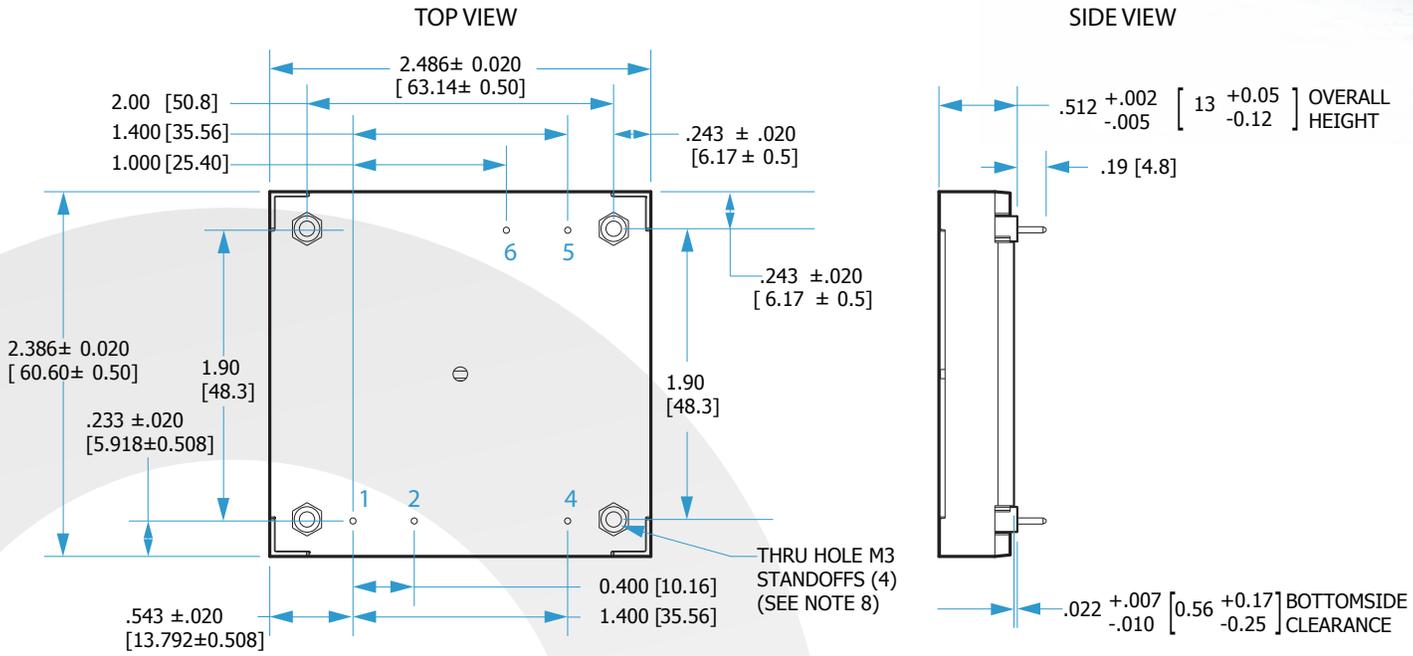
Note: A conductive cooling design is generally needed for high altitude applications because of naturally poor convective cooling at rare atmospheres.



Technical Specification

MACF-xxx-230-HT

Encased Mechanical Diagram



NOTES

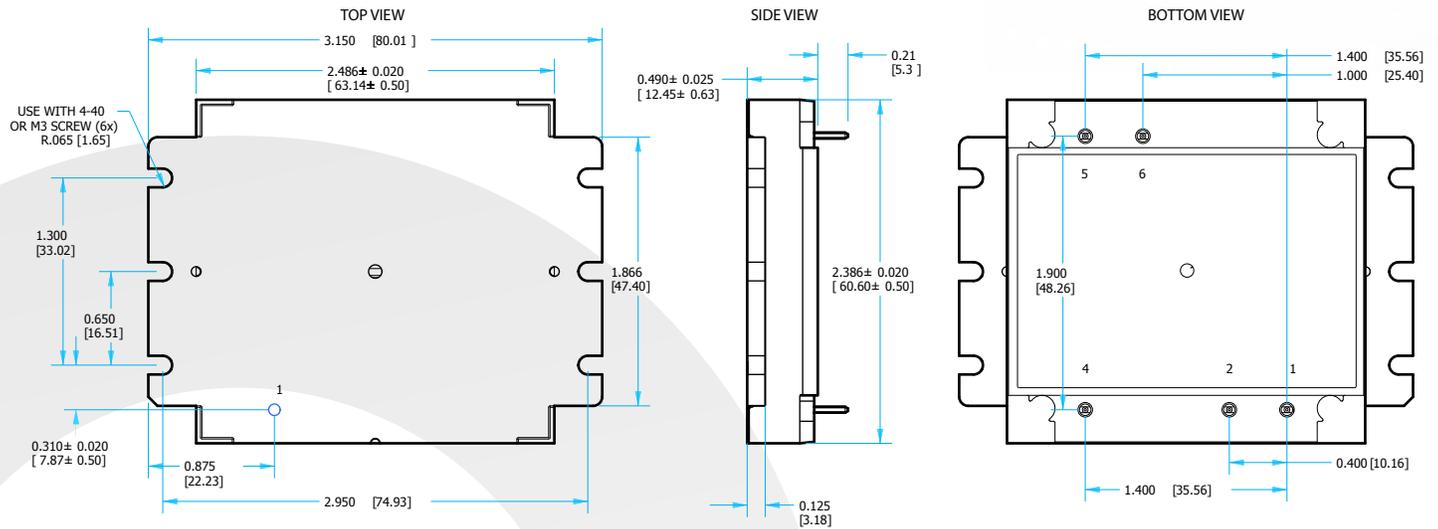
- Applied torque per screw should not exceed 6in-lb. (0.7 Nm).
- Baseplate flatness tolerance is 0.004" (.10 mm) TIR for surface.
- Pins are 0.040" (1.02mm) diameter, with 0.080" (2.03mm) diameter standoff shoulders.
- All Pins: Material - Copper Alloy
Finish: Matte Tin over Nickel plate
- Undimensioned components only for visual reference.
- Total weight: 5.0oz (142.3g)
- Threaded and Non-Threaded options available
- All dimensions in inches (mm)
Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm)
x.xxx +/-0.010 in. (x.xx +/-0.25mm)
- unless otherwise noted.
- Workmanship: Meets or exceeds current IPC-A-610 Class II

PIN DESIGNATIONS

Pin	Name	Function
1	L1	AC Line 1
2	L2/N	AC Line 2 / Neutral
4	PE GND	Protective Earth
5	PFC L1	PFC Input Line 1
6	PFC L2/N	PFC Input Line 2 / Neutral



Flanged Mechanical Diagram



NOTES

- 1) Applied torque per screw should not exceed 6in-lb. (0.7 Nm).
- 2) Baseplate flatness tolerance is 0.004" (.10 mm) TIR for surface.
- 3) Pins are 0.040" (1.02mm) diameter, with 0.080" (2.03mm) diameter standoff shoulders.
- 4) All Pins: Material - Copper Alloy
 Finish: Matte Tin over Nickel plate
- 5) Undimensioned components only for visual reference.
- 6) Weight: 5.2oz (149.18g)
- 7) All dimensions in inches (mm)
 Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm)
 x.xxx +/-0.010 in. (x.xx +/-0.25mm)
 - unless otherwise noted.
- 8) Workmanship: Meets or exceeds current IPC-A-610 Class II

PIN DESIGNATIONS

Pin	Name	Function
1	L1	AC Line 1
2	L2/N	AC Line 2 / Neutral
4	PE GND	Protective Earth
5	PFC L1	PFC Input Line 1
6	PFC L2/N	PFC Input Line 2 / Neutral



Technical Specification

MACF-xxx-230-HT

Ordering Specifications

Family	Input Frequency	Input Voltage	Package	Thermal Design	Screening Level
MACF	060	230	H	N	S
MACF: AC Line Filter	060: 50/60 Hz 400: 400 Hz	230: 85 to 264Vrms	HT: Half-Brick Tera	N: Encased Threaded D: Non-Threaded F: Flanged	S: Standard M: Military

Part Number Example: **MACF-060-230-HT-N-M**

APPLICATION NOTES

A variety of application notes and technical white papers can be downloaded in pdf format from our website.

ORDERING INFORMATION

Not all combinations make valid part numbers, please contact SynQor for availability. See the Product [Summary web page](#) for more options.

PATENTS

SynQor holds the following U.S. patents, one or more of which apply to each product listed in this document. Additional patent applications may be pending or filed in the future.

5,999,417	6,222,742	6,545,890	6,577,109	6,594,159	6,731,520
6,894,468	6,896,526	6,927,987	7,050,309	7,072,190	7,085,146
7,119,524	7,269,034	7,272,021	7,272,023	7,558,083	7,564,702
7,765,687	7,787,261	8,023,290	8,149,597	8,493,751	8,644,027

WARRANTY

SynQor offers a two (2) year limited warranty. Complete warranty information is listed on our website or is available upon request from SynQor.

Information furnished by SynQor is believed to be accurate and reliable. However, no responsibility is assumed by SynQor for its use, nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of SynQor.

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