



Military COTS 3-Phase AC Line Filter

85 to 140 Vrms (L-N) Input Voltage	3 Arms Output Current	1.0 kW @ 115 Vrms (L-N) Output Power	700 mΩ @ 100°C Max Resistance per Phase	>40 dB @ 200 kHz Attenuation
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Full Power Operation: -55 °C to +100 °C

This MilCOTS 3-Phase AC EMI Line Filter is an essential building block of an AC-DC power supply. It is designed to be used in front of SynQor Isolated 3-Phase PFC module. This filter will allow compliance with key MIL-STD-461 EMI requirements, assuming proper system-level design. Compatible with the industry standard format, these filters have high differential-mode and common-mode attenuation and low series resistance. Manufactured to comply with a wide range of military standards, SynQor's innovative packaging approach ensures survivability in the most hostile environments.

*Mil***COTS™**



MACF-115-3PH-UNV-QG-N-M

Operational Features

- -55 °C to +100 °C baseplate temperature
- 3 Arms output current
- Low series resistance
- 40 dB @ 200 kHz noise attenuation (2.3 Arms per phase)
- Meets common EMC standards in properly designed system with SynQor's MPFIC module

Compliance Features

- MACF Series filters (with MPFC converters) are designed to meet:
- MIL-STD-704 (A-F)
 - MIL-STD-461 (C, D, E, F)
 - MIL-STD-1399
 - MIL-STD-810G

Safety Features

- Pending
- Input/Output to baseplate isolation 2150Vdc
 - CE Marked

Mechanical Features

- Standard Size: 2.386" x 1.536" x 0.500" (60.60 x 39.01 x 12.70 mm)
- Total weight: 3.3 oz (93 g)
- Flanged baseplate version available

In-Line Manufacturing Process

- AS9100 and ISO 9001 certified facility
- Full component traceability

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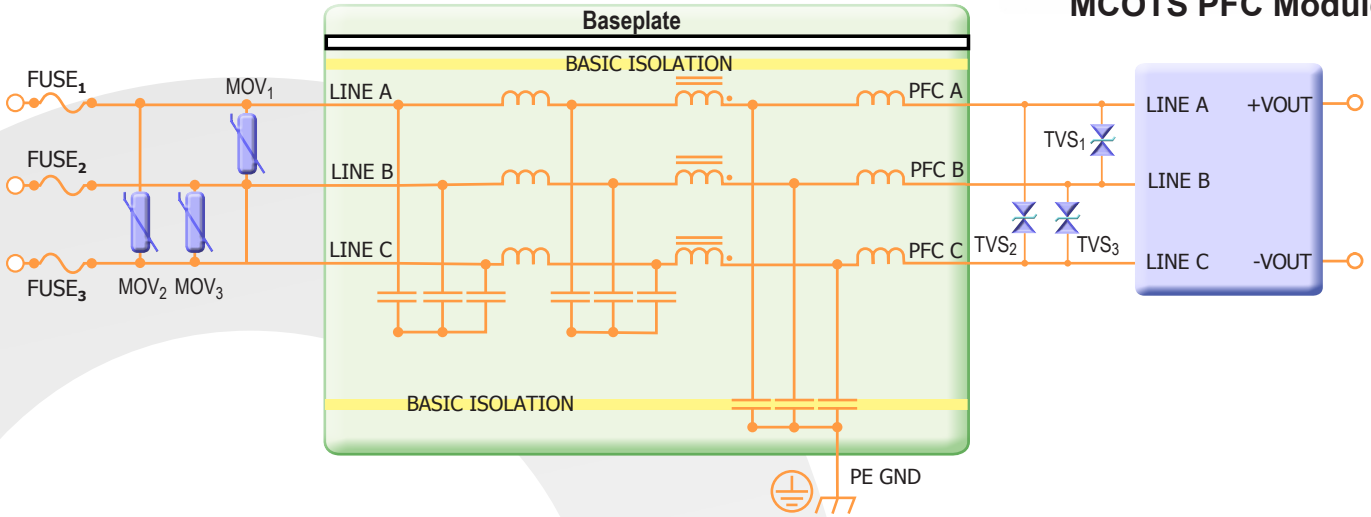


Technical Diagrams

Circuit and Typical Application Diagram

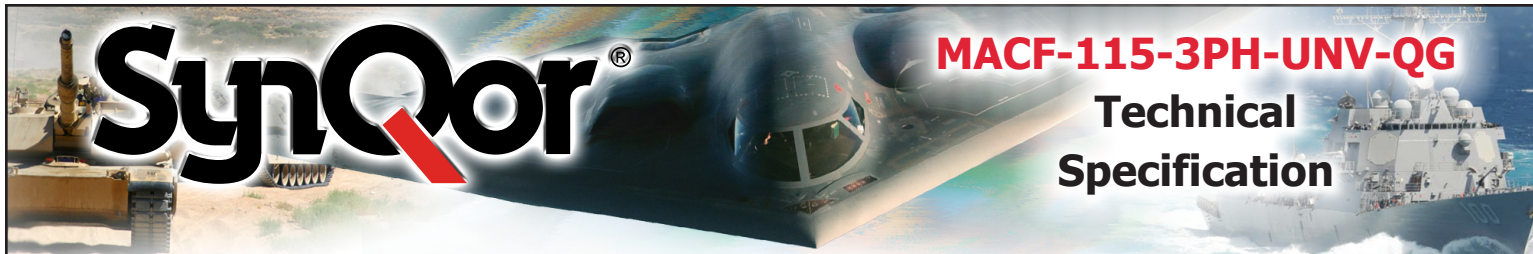
**MACF-115-3PH-UNV-QG
SynQor 3-Phase AC Line Filter**

**SynQor Isolated
3-Phase
MCOTS PFC Module**



Suggested Parts:

- MOV 1-3 : 300 Vrms, 60 J ; EPCOS S10K300E2
- TVS 1-3 : 430 Vpk, 20 J; Littelfuse AK3-430C or Bourns PTVS-430C-TH
- Fuse 1-3 : 250 Vrms, 10 A; Littelfuse 0216010.XEP



MACF-115-3PH-UNV-QG

Technical Specification

MACF-115-3PH-UNV-QG Electrical Characteristics

Operating Conditions: Vin = 115 Vrms L-N (199 Vrms L-L) @ 400 Hz; 2.3 Arms per phase; baseplate temperature 25 °C unless otherwise noted. Full operating baseplate temperature is -55 °C to 100 °C. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					
Continuous			200	Vrms L-N	346 Vrms L-L
Transient			900	Vpk L-L	100 ms transient
Isolation Voltage			2150	Vdc	Input/Output to baseplate/PE GND
Operating Case Temperature	-55		100	°C	Baseplate temperature
Storage Case Temperature	-65		135	°C	
RECOMMENDED OPERATING CONDITIONS					
Input Voltage (Continuous)	85	115	140	Vrms L-N	147 to 242 Vrms L-L
Input Frequency	45		800	Hz	
Output Current Range			3.0	Arms	Per phase
ELECTRICAL CHARACTERISTICS					
Series Resistance Rs					Per phase
Tcase = 25 °C		500		mΩ	
Tcase = 100 °C			700	mΩ	
Total Power Dissipation					
Zero Load, 400 Hz		2.0		W	
Zero Load, 60 Hz		1.3		W	
3 Arms (per phase) @ 400 Hz, Tcase = 25 °C		16		W	
3 Arms (per phase) @ 400 Hz, Tcase = 100 °C			21	W	Guaranteed by design
Total Differential Capacitance		0.40		μF	Per Phase, Y connected
Internal Resistance (line-line)		3.0		MΩ	Discharges capacitors for safe handling
Reactive Power (per phase)		13		VAR	At 400 Hz; scales with line frequency
Common-Mode Capacitance (per phase)		4.7		nF	
Differential-Mode Attenuation, 200 kHz		50		dB	See Figure A
Common-Mode Attenuation, 200 kHz		40		dB	See Figure A
Isolation Resistance	100			MΩ	Any pin to PE GND
RELIABILITY CHARACTERISTICS					
Calculated MTBF (MIL-217) MIL-HDBK-217F		141.6		10 ⁶ Hrs.	Ground Benign, Tb = 70 °C
Calculated MTBF (MIL-217) MIL-HDBK-217F		10.4		10 ⁶ Hrs.	Ground Mobile, Tb = 70 °C
Field Demonstrated MTBF				10 ⁶ Hrs.	See our website for details



BASIC OPERATION AND FEATURES

This module is a differential-mode and common-mode passive EMI filter designed to interface a 3-Phase AC power source with a SynQor Isolated 3-Phase PFC module.

A typical application would place the MCOTS AC line filter close to the AC input power entry point. The AC line filter's PE GND pin would be connected to the chassis ground that is common with AC input power protective earth 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 inputs & outputs of multiple MCOTS 3-Phase AC line filters directly in parallel. Connecting filters in this manner may result in slightly imbalanced currents to flow in the three paths of each filter. These imbalanced currents will cause the internal common-mode chokes to saturate and thus degrade common-mode attenuation.

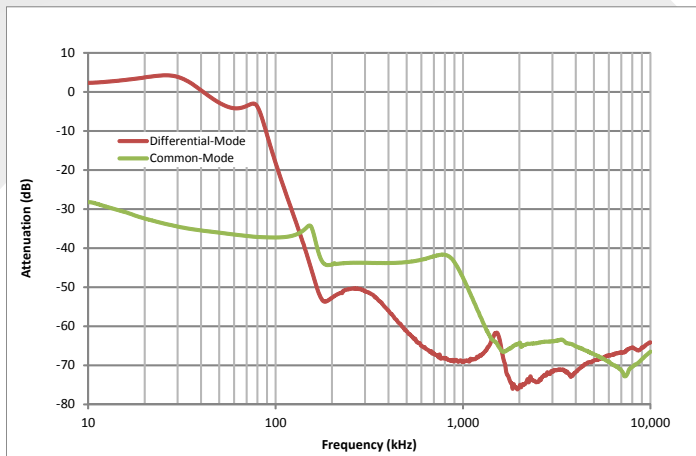


Figure A: Typical Common Mode and Differential Mode Attenuation as a function of frequency. Source resistance is 50Ω.

Figure B:



Qualification Testing & Screening

Mil-COTS MIL-STD-810G Qualification Testing

MIL-STD-810G Test	Method	Description
Fungus	508.6	Table 508.6-I
Altitude	500.5 - Procedure I	Storage: 70,000 ft / 2 hr duration
	500.5 - Procedure II	Operating: 70,000 ft / 2 hr duration; Ambient Temperature
Rapid Decompression	500.5 - Procedure III	Storage: 8,000 ft to 40,000 ft
Acceleration	513.6 - Procedure II	Operating: 15 g
Salt Fog	509.5	Storage
High Temperature	501.5 - Procedure I	Storage: 135 °C / 3 hrs
	501.5 - Procedure II	Operating: 100 °C / 3 hrs
Low Temperature	502.5 - Procedure I	Storage: -65 °C / 4 hrs
	502.5 - Procedure II	Operating: -55 °C / 3 hrs
Temperature Shock	503.5 - Procedure I - C	Storage: -65 °C to 135 °C; 12 cycles
Rain	506.5 - Procedure I	Wind Blown Rain
Immersion	512.5 - Procedure I	Non-Operating
Humidity	507.5 - Procedure II	Aggravated cycle @ 95% RH (Figure 507.5-7 aggravated temp - humidity cycle, 15 cycles)
Random Vibration	514.6 - Procedure I	10 - 2000 Hz, PSD level of 1.5 g ² /Hz (54.6 g _{rms}), duration = 1 hr/axis
Shock	516.6 - Procedure I	20 g peak, 11 ms, Functional Shock (Operating no load) (saw tooth)
	516.6 - Procedure VI	Bench Handling Shock
Sinusoidal vibration	514.6 - Category 14	Rotary wing aircraft - helicopter, 4 hrs/axis, 20 g (sine sweep from 10 - 500 Hz)
Sand and Dust	510.5 - Procedure I	Blowing Dust
	510.5 - Procedure II	Blowing Sand

Mil-COTS Converter and Filter Screening

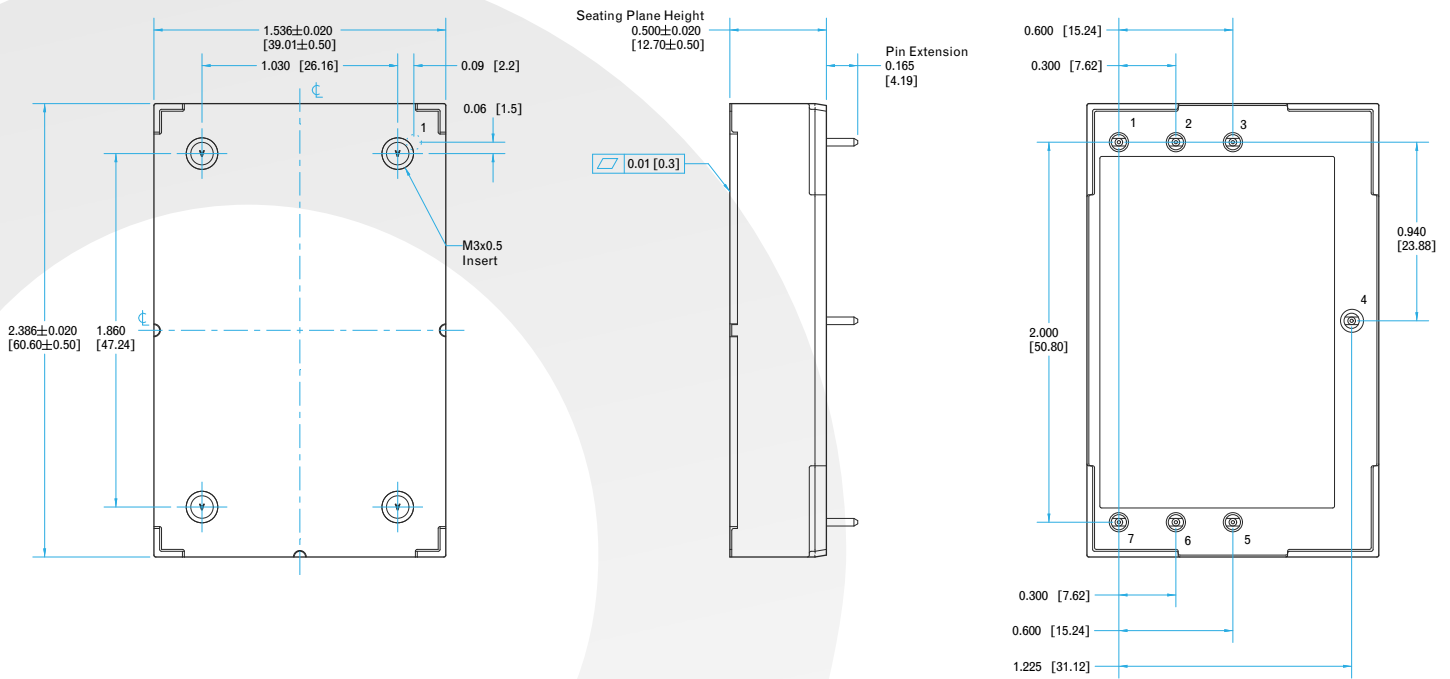
Screening	Process Description	S-Grade	M-Grade
Baseplate Operating Temperature		-55 °C to +100 °C	-55 °C to +100 °C
Storage Temperature		-65 °C to +135 °C	-65 °C to +135 °C
Pre-Cap Inspection	IPC-A-610, Class III	•	•
Temperature Cycling	MIL-STD-883F, Method 1010, Condition B, 10 Cycles		•
Burn-In	100 °C Baseplate	12 Hours	96 Hours
Final Electrical Test	100%	25 °C	-55 °C, +25 °C, +100 °C
Final Visual Inspection	MIL-STD-883F, Method 2009	•	•

Parameter	# Units	Test Conditions
QUALIFICATION TESTING		
Life Test	5	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.



Encased Mechanical Diagram



NOTES

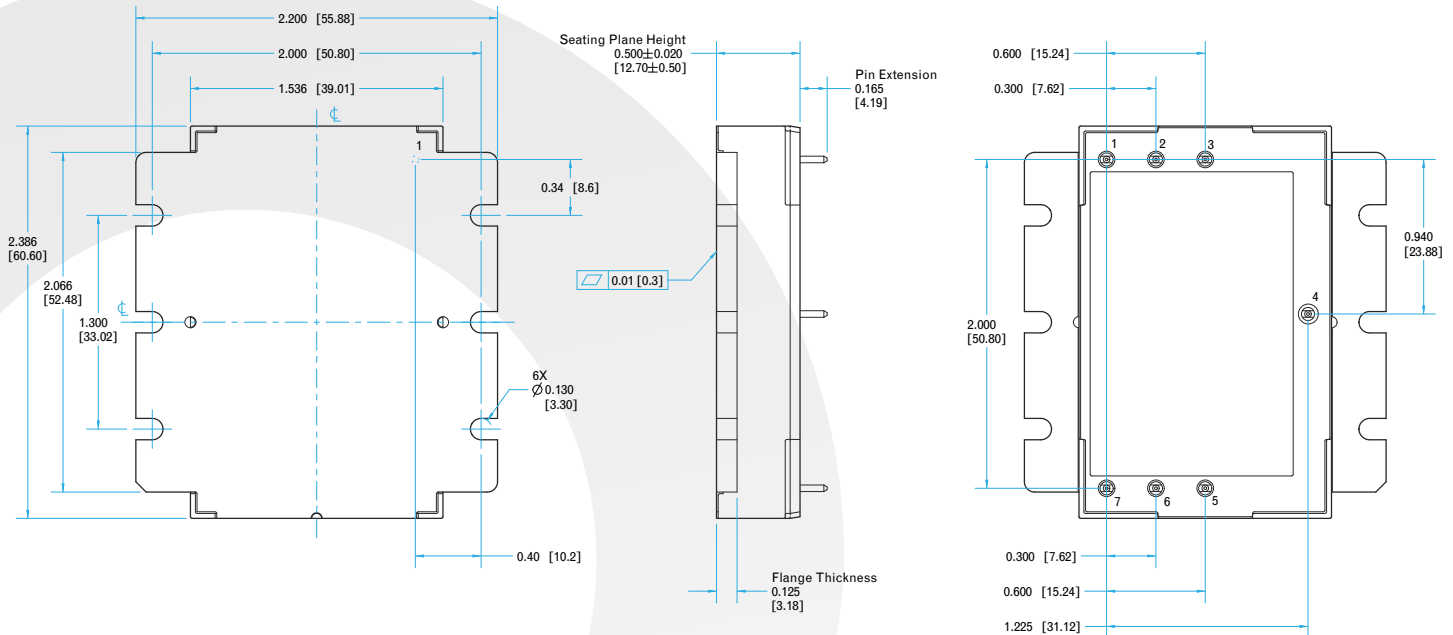
- 1) Applied torque per M3 screw is not to exceed 6 in-lb (0.7 Nm)
Screw is not to exceed 0.100" (2.54 mm) below the surface of the baseplate
- 2) Pins are 0.040" (1.02 mm) dia. with 0.080" (2.03 mm) dia. standoffs
- 3) All Pins: Material - Copper Alloy
Finish: Matte Tin over Nickel plate
- 4) Total weight: 3.3 oz (93 g)
- 5) Tolerances: x.xx +/-0.02 in. (x.x +/-0.5 mm)
x.xxx +/-0.010 in. (x.xx +/-0.25 mm)

PIN DESIGNATIONS

Pin	Name	Function
1	LINE A	AC Line Input A
2	LINE B	AC Line Input B
3	LINE C	AC Line Input C
4	PE GND	Protective Earth
5	PFC C	Filter Output C
6	PFC B	Filter Output B
7	PFC A	Filter Output A



Flanged Mechanical Diagram



NOTES

- 1) Applied torque per M3 or 4-40 screw is not to exceed 6 in-lb (0.7 Nm)
- 2) Pins are 0.040" (1.02 mm) dia. with 0.080" (2.03 mm) diameter standoffs
- 3) All Pins: Material - Copper Alloy
Finish: Matte Tin over Nickel plate
- 4) Weight: 3.5 oz (99 g)
- 5) All dimensions in inches (mm)
Tolerances: x.xx +/-0.02 in. (x.x +/-0.5 mm)
x.xxx +/-0.010 in. (x.xx +/-0.25 mm)

PIN DESIGNATIONS

Pin	Name	Function
1	LINE A	AC Line Input A
2	LINE B	AC Line Input B
3	LINE C	AC Line Input C
4	PE GND	Protective Earth
5	PFC C	Filter Output C
6	PFC B	Filter Output B
7	PFC A	Filter Output A



MACF-115-3PH-UNV-QG

Technical Specification

Ordering Specifications

Family	Input Voltage	Phase	Filter Configuration	Package	Thermal Design	Screening Level
MACF	115	3PH	UNV	QG	N	S
MACF: AC Line Filter	115: 85 to 140 Vrms (L-N)	3PH: 3-Phase	UNV: 45 - 800 Hz	QG: Quarter-Brick Giga	N: Encased Threaded F: Flanged	S: S-Grade M: M-Grade

Part Number Example: **MACF-115-3PH-UNV-QG-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.

Parameter

STANDARDS COMPLIANCE

Input/Output to baseplate isolation 2150 Vdc
CE Marked

Notes & Conditions

PENDING

Basic Insulation to Baseplate

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.

Contact SynQor for further information and to order:

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PATENTS

SynQor holds numerous U.S. patents, one or more of which apply to most of its power conversion products. Any that apply to the product(s) listed in this document are identified by markings on the product(s) or on internal components of the product(s) in accordance with U.S. patent laws. SynQor's patents include the following:

6,545,890 6,894,468 6,896,526 6,927,987 7,050,309 7,085,146
 7,119,524 7,765,687 7,787,261 8,149,597 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.