Avionic AC Line Filter

85 to 264 Vrms	5 Arms	500W @ 115 Vrms 1 kW @ 230 Vrms	180mΩ	>55dB @ 250 kHz
Input Voltage	Output Current	Output Power	Max Series Resistance	Differential-mode Attenuation (external capacitance required)

Full Power Operation: -40ºC to +100ºC

The AeroQor EMI AC Line Filters brings SynQor's field proven technology and manufacturing expertise to the Avionics COTS Component 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.

AeroQor

Designed and manufactured in the USA

Operational Features

- -40 °C to +100 °C Operation
- 5 Arms output current
- Very low series resistance
- High Differential & Common-mode Attenuation
- All capacitors are safety-rated X7R multi-layer ceramic
- Meets common EMC standards in properly designed system with SynQor APFIC modules.

In-Line Manufacturing Process

- AS9100 and ISO 9001 certified facility
- Full component traceability

Mechanical Features

- Industry standard Eighth-brick-size
- Size: 1.00" x 2.39" x 0.50" (25.4 x 60.6 x 12.7 mm)
- Weight: 2.0 oz (56 g)

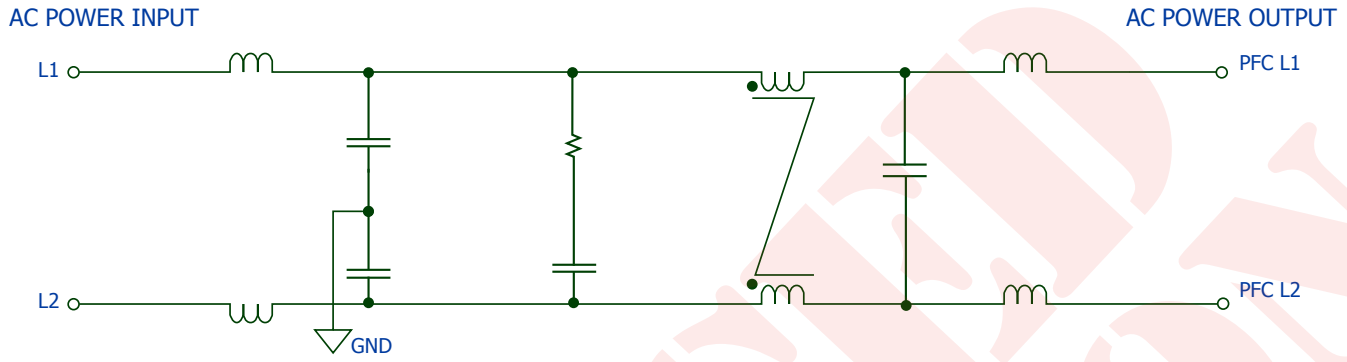
Specification Compliance

Pending
- RTCA-D0 160
- Airbus ADB0100.1.8
- Boeing 787B3-0147
- Boeing D6-36440
- Boeing D6-44588
- CE marked

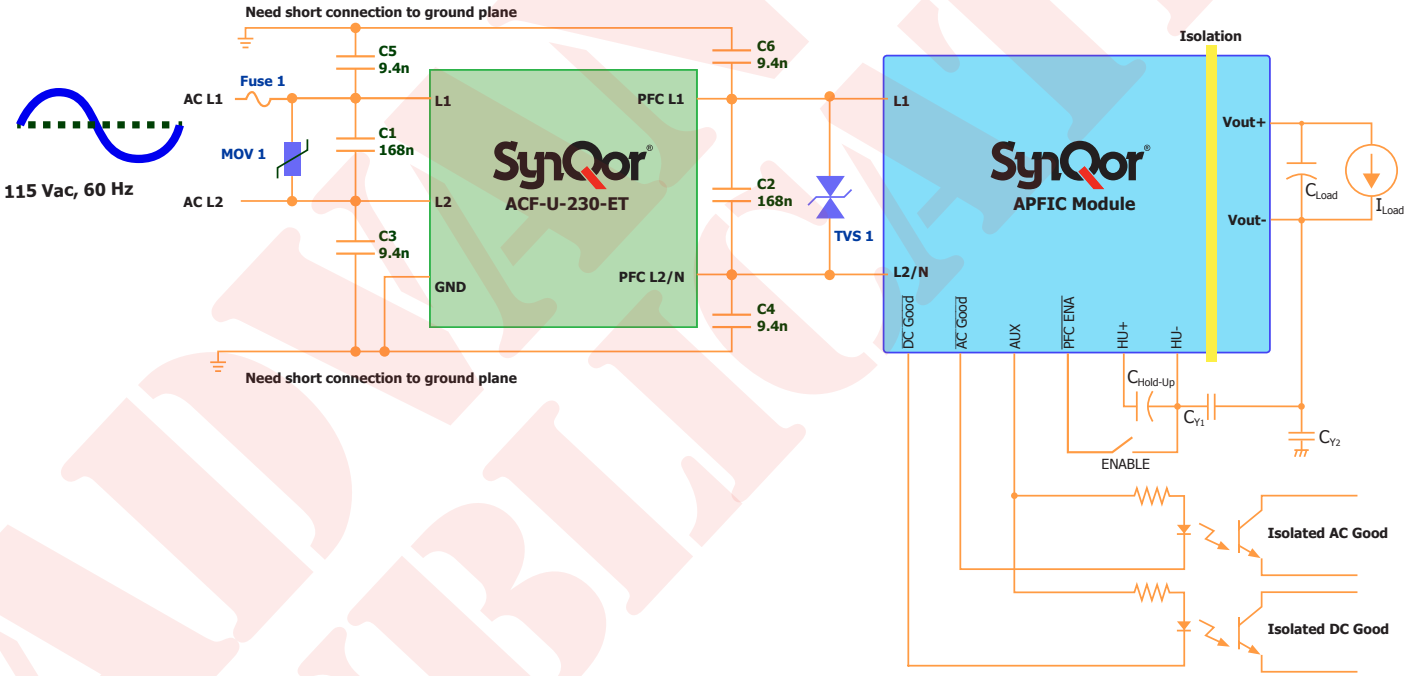
Contents

Technical Diagrams

Fundamental Circuit Diagram



Typical Connection Diagram



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, 6.3A; (Littelfuse 021606.3MXEP)
C1, C2:	Three 56nF in parallel; (Murata GA355XR7GB563KW06L)
C3, C4, C5, C6:	Two 4.7nF in parallel; (Murata GA355DR7GF472KW01L)

ACF-U-230-ET-x Electrical Characteristics

Operating conditions of Vin <= 264Vrms, Iout <= 5Arms unless otherwise specified, and baseplate temperature = 25°C unless otherwise noted; full operating baseplate temperature range is -40 °C to +100 °C. Specifications subject to change without notice.

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)			5	Arms	
Output Current (Surge)			150	A^2 S	
Operating Temperature	-40		100	°C	Baseplate temperature
Storage Temperature	-55		125	°C	
RECOMMENDED OPERATING CONDITIONS					
Input Voltage (Continuous)			250	Vrms	
Output Current (Continuous)			5	Arms	
Input Frequency	45		800	Hz	
ELECTRICAL CHARACTERISTICS					
Output Voltage (Continuous)		Vout = Vin - (Iin x Rs)		V	
Series Resistance Rs					Total
Tcase = 25ºC		120		mΩ	
Tcase = 100ºC			180	mΩ	
Power Dissipation					5Arms output current
Tcase = 25ºC		3.0		W	
Tcase = 100ºC			4.5	W	
Total Differential-Mode Capacitance		0.5		µF	Measured across input or output pins
Total Common-Mode Capacitance		10		nF	Measured between gnd pin and any other pin
Leakage current in PE GND Pin			0.45	mArms	250Vac L-N 50Hz with no external Y cap, See Note 1
Leakage current in PE GND Pin			3.5	mArms	250Vac L-N 400Hz with no external Y cap, See Note 1
Noise Attenuation					See Fig 1
Isolation Resistance	100			MΩ	Any pin to gnd pins
RELIABILITY CHARACTERISTICS					
Calculated MTBF per Telcordia SR-332, Issue 2		144		10^6 Hrs.	Tb = 70 °C
Calculated MTBF per MIL-HDBK-217F		98		10^6 Hrs.	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 APFIC 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. Only X7R multi-layer ceramic safety rated capacitors are used.

A typical application would place the AeroQor 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 AeroQor 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.

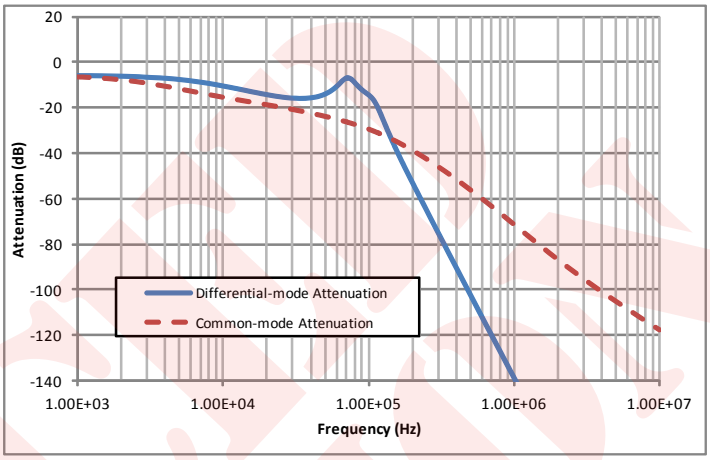


Figure 1: *Typical Common Mode and Differential Mode Attenuation provied by the filter as a function of frequency. Source and load resistance are 50Ω.*

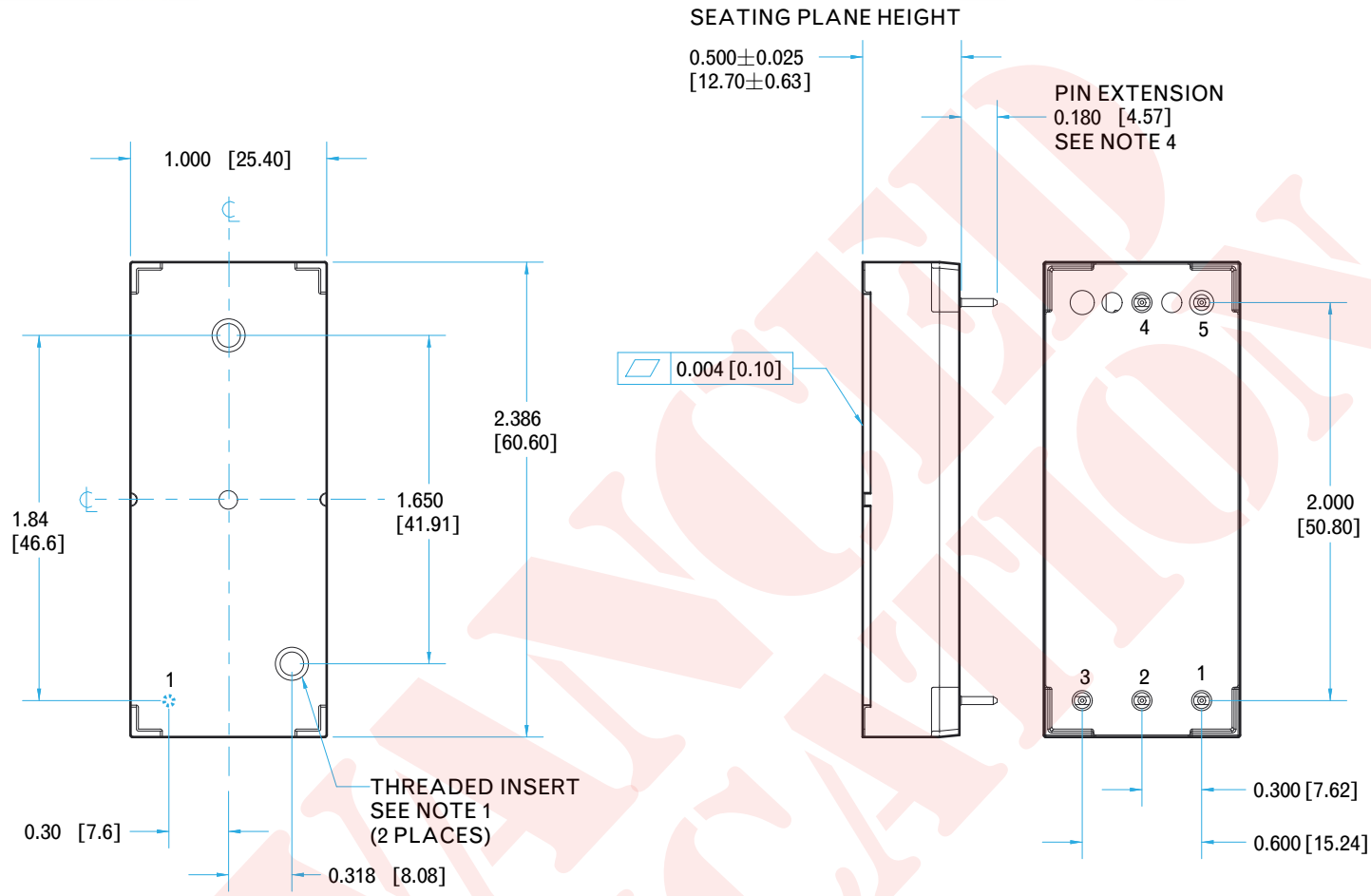
Standards & Qualification

Category Description	Single-Phase 115Vrms Specification Compliance
Input Voltage	787B3-0147, D6-44588, Airbus ADB0100.1.8, RTCA/DO-160G
Switching Transients	787B3-0147, D6-44588, Airbus ADB0100.1.8, RTCA/DO-160G, EN61000-4-4, EN61000-4-5
Voltage Spikes	787B3-0147, D6-44588, Airbus ADB0100.1.8, RTCA/DO-160G, EN61000-4-6
Frequency Transients	787B3-0147, D6-44588, Airbus ADB0100.1.8, RTCA/DO-160G
Harmonic Content	787B3-0147, D6-44588, Airbus ADB0100.1.8, RTCA/DO-160G, EN61000-3-2, MIL-STD-1399
DC Content on Input Voltage	787B3-0147, D6-44588, Airbus ADB0100.1.8, RTCA/DO-160G
Audio Frequency Conducted Susceptibility	D6-36440, RTCA/DO-160G
Audio Frequency Conducted Emissions	D6-36440, RTCA/DO-160G
Induced Signal Susceptibility	D6-36440, RTCA/DO-160G, EN61000-4-6
Conductive Emissions	D6-36440, RTCA/DO-160G, CE101, CE102, EN55011/22
Magnetic Effect	D6-36440, RTCA/DO-160G, EN61000-4-11
Radiated Emissions	D6-36440, RTCA/DO-160G, RE101, RE102, EN 61000-4-3
Electrostatic Discharge	D6-36440, RTCA/DO-160G, EN61000-4-2
Electrical Bonding and Grounding	D6-36440, D6-44588, UL 60950-1
Lightning Requirements	D6-36440, D6-16050-5, RTCA/DO-160G
Reliability	Telcordia, MIL-HDBK-217F

Parameter	# Units	Test Conditions
QUALIFICATION TESTING		
Cold Temperature - Ground Survival	5	RTCA/DO-160G section 4.5.1
Hot Temperature - Ground Survival	5	RTCA/DO-160G section 4.5.3
Cold Temperature - Operating	5	RTCA/DO-160G section 4.5.2
Hot Temperature - Operating	5	RTCA/DO-160G section 4.5.4
Temperature Variation	5	RTCA/DO-160G section 5.3.1
Temperature Cycling	5	MIL-STD-810G Method 503.5 – Procedure I
Humidity	3	RTCA/DO-160G section 6.3.1 (Category A)
Waterproofness - Condensing	3	RTCA/DO-160 section 10.3.1 (Category Y)
Fungus Resistance	1	MIL-STD-810G Method 508.6
Vibration - Fixed Wing and Helicopter	5	RTCA/DO-160G sections 8.5.2 (Level B4), 8.8.3 (Levels G and F1)
Operational Shock and Crash Safety	5	RTCA/DO-160G section 7.2.1, 7.3.1, and 7.3.3 (Category B)
Altitude - Steady State	5	RTCA/DO-160G section 4.6.1; 70,000 ft (21 km), see note
Altitude - Decompression	5	RTCA/DO-160G section 4.6.2
Loss of Cooling	5	DO-160G Section 4.5.5
Design Marginality	5	Tmin-10 °C to Tmax+10 °C, 5 °C steps, Vin = min to max, 0-105% load
Life Test	32	95% rated Vin and load, units at derating point, 1000 hours
Solderability	15 pins	MIL-STD-883, method 2003

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

Encased Mechanical



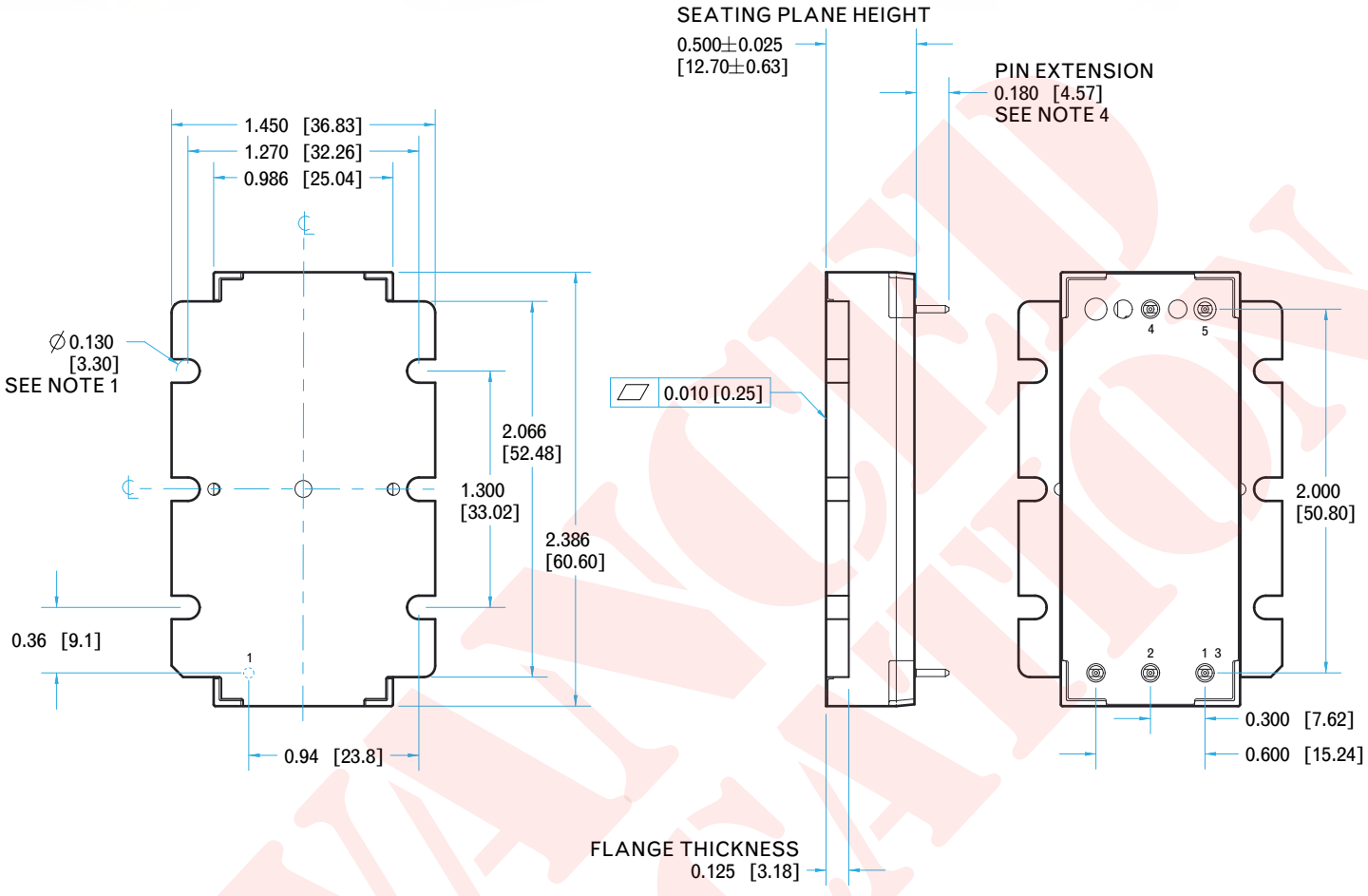
NOTES

1) Applied torque per M3 screw is not to exceed 6in-lb (0.7 Nm). Screw should not exceed 0.100" (2.54mm) below the surface of the baseplate.
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) Total weight: 2.0oz (56g)
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	Label	Name	Function
1	L1	L1	AC Line 1
2	L2/N	L2/N	AC Line 2 / Neutral
3	PE GND	PE GND	Protective Earth
4	PFC L2/N	PFC L2/N	PFC Input Line 2 / Neutral
5	PFC L1	PFC L1	PFC Input Line 1

Encased Mechanical with Flange



NOTES

1) Applied torque per M3 or 4-40 screw is not to exceed 6 in-lb (0.7 Nm)
2) Baseplate flatness tolerance is 0.010" (.25 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: 2.2oz (62g)
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	Label	Name	Function
1	L1	L1	AC Line 1
2	L2/N	L2/N	AC Line 2 / Neutral
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4	PFC L2/N	PFC L2/N	PFC Input Line 2 / Neutral
5	PFC L1	PFC L1	PFC Input Line 1

Ordering Information

Part Numbering Scheme					
Family	**Input Frequency**	**Input Voltage**	**Package Size**	**Thermal Design**	**RoHS**
ACF	**U:** 45 - 800 Hz	**230:** 85 to 264Vrms	**ET:** Eighth-Brick Tera	**C:** Encased Threaded **V:** Flanged	**G:** RoHS

Example: ACF-U-230-ET-C-G

RoHS Compliance: The EU led RoHS (Restriction of Hazardous Substances) Directive bans the use of Lead, Cadmium, Hexavalent Chromium, Mercury, Polybrominated Biphenyls (PBB), and Polybrominated Diphenyl Ether (PBDE) in Electrical and Electronic Equipment. This SynQor product is 6/6 RoHS compliant. For more information please refer to SynQor's RoHS addendum available at our RoHS Compliance / Lead Free Initiative web page or e-mail us at rohs@synqor.com.

Validation, Verification & Certification

USA Manufacturing Facility: AS9100 & ISO 9001 Certified

SynQor considers in-house manufacturing to be a core competency and strategic advantage. All SynQor products are manufactured in our manufacturing facility at our corporate headquarters in Boxborough, MA, USA, utilizing state-of–the art equipment and proprietary assembly techniques. By maintaining both AS9100 and ISO9001 certifications, SynQor is able to provide the same level of attention to detail in our manufacturing processes as we do in our products. We utilize proprietary in-house developed manufacturing data and document control systems that allow us to operate in a paperless manufacturing environment, providing both maximized manufacturing efficiency and flexibility. Ultimately, our manufacturing expertise remains in-house, allowing us to maintain complete control over the quality and traceability of our product down to the component level to meet the most stringent customer and industry requirements.

Design, Engineering & Manufacturing Process

SynQor employs a stringent, ECO controlled, 5-stage product development process, starting with product concept design and ending with manufacturing integration. We believe that a solid design and DFM review process leads to efficient manufacturing, higher performance, and enhanced reliability. By designing for reliability, SynQor greatly reduces the chance of field defects and increases product integrity.

Concept Design	Design & Verification	Proof of Design	Proof of Manufacturing	Manufacturing Integration
• Generate electrical specification • Review performance requirements • Design simulation • Schematic • Qualify new components • Breadboard • Prelim thermal analysis	• Full layout • DFM/DFT Review • Build engineering prototypes • Debug circuit • Worst-case electrical testing • Component stress analysis • Stability analysis • Abnormal electrical testing • Specification review • Preliminary datasheet	• Build units and electrically characterize • Verify electrical performance • Verify component stress analysis • Statistical variations • Thermal analysis and imaging • HALT testing • Complete datasheet	• Controlled Production Build • ATE testing • Yield analysis • Validate and finalize manufacturing processes and Tooling • 1000 hour life test • Qualification testing (humidity, vibration, DMT, PTC, thermal and mechanical shock, altitude and solderability)	• Processes transfer • Full documentation release (SCD's, BOM, processes, procedures, etc.) • Release qualification reports • Release final datasheet • Transfer units to finished goods

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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 6,594,159 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.