

# Technical Specification

## ACLF060HTx230

### AC LINE FILTER

<b>85 to 264Vrms</b> <b>Input Voltage</b>	<b>9Arms</b> <b>Output Current</b>	<b>1kW @ 115Vrms</b> <b>2kW @ 230Vrms</b> <b>Output Power</b>	<b>195mΩ @ 100°C</b> <b>Max Series Resistance</b>	<b>&gt;55dB @ 250kHz</b> <b>Differential &amp; Common-mode Attenuation</b>
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**FULL POWER OPERATION: -40°C TO +100°C**

The InQor 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.



*ACLF060HTC230RS-G Module*

#### Operational Features

- -40°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 PFC module and IQ4H converters.

#### Mechanical Features

- Standard Size: 2.486" x 2.366" x 0.51" (63.14 x 60.60 x 12.7mm)
- Total weight: 4.7oz (129.5g)
- Flanged baseplate version available

#### Safety Features

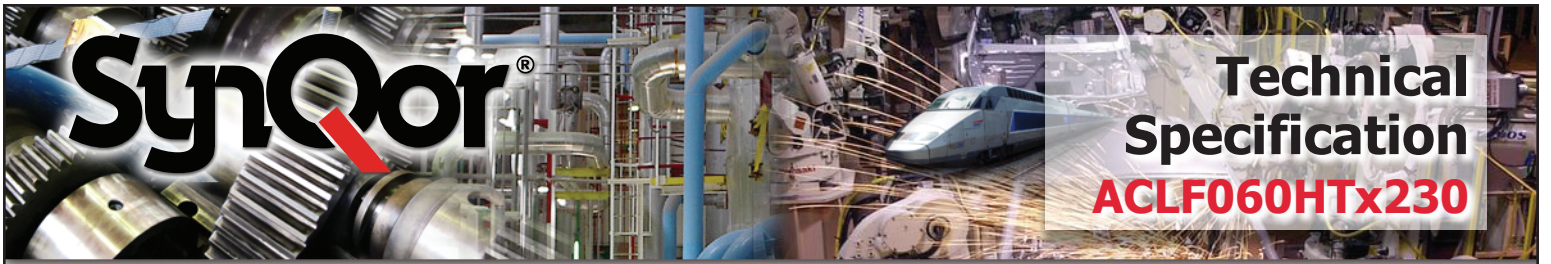
- 2150Vdc input-to-case and input-to-gnd-pin high-potential test
- Safety rated class X2 line-to-line and class Y2 line-to-gnd capacitors
- Certified 60950-1 requirement for basic insulation (see Standards and Qualifications page)

#### In-Line Manufacturing Process

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

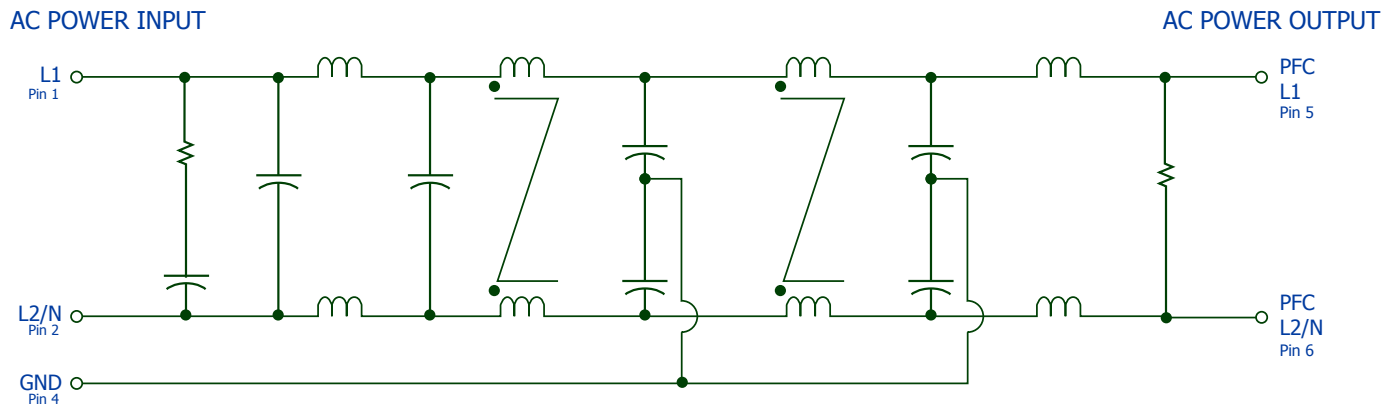
#### CONTENTS

	Page No.
Technical Diagrams . . . . .	2
Electrical Characteristics . . . . .	3
Basic Operations and Features . . . . .	4
Standards & Qualification Testing . . . . .	5
Encased Mechanical Diagram . . . . .	6
Flanged Mechanical Diagram . . . . .	7
Ordering Specifications. . . . .	8

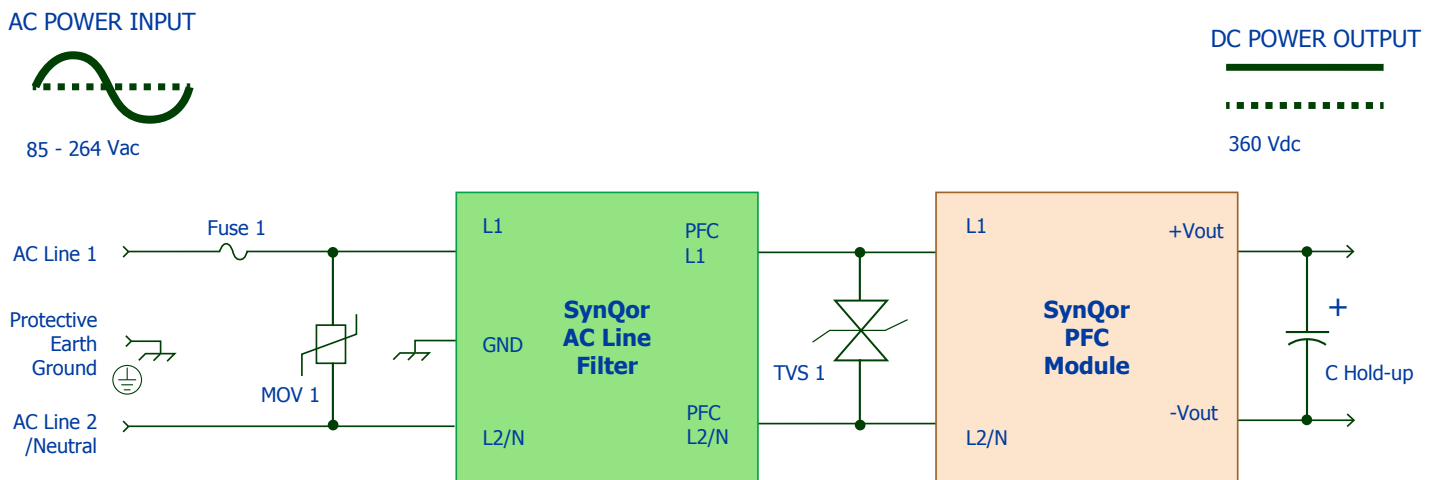


## Technical Diagrams

### 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, 390 $\mu$ F; (United Chemi-Con ELXS451VSN391MR50S)  
 Fuse 1: 250VAC, 12.5A; (Littelfuse 0216012.5MXEP)

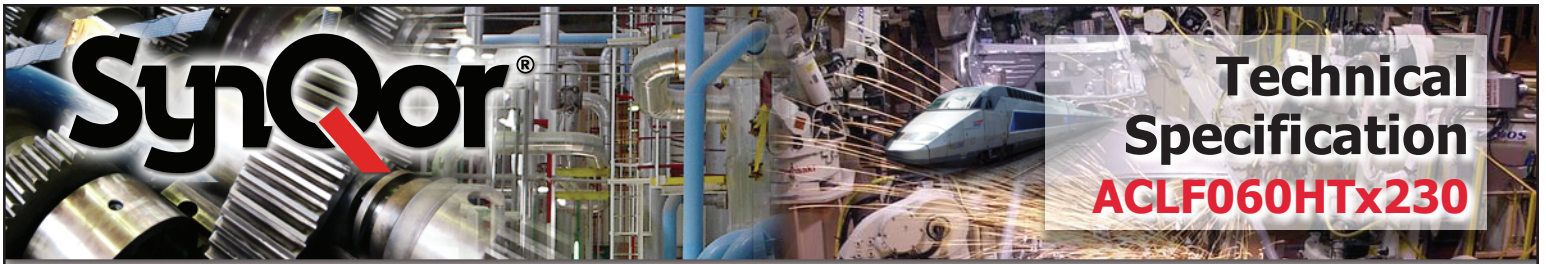
### ACLF060HTx230 Electrical Characteristics

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

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
<b>ABSOLUTE MAXIMUM RATINGS</b>					
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 <sup>2</sup> S	
Operating Case Temperature	-40		100	°C	Baseplate temperature
Storage Case Temperature	-45		135	°C	
Lead Temperature (20 s)			300	°C	
<b>RECOMMENDED OPERATING CONDITIONS</b>					
Input Voltage (Continuous)			250	Vrms	
Output Current (continuous)			9	Arms	
<b>ELECTRICAL CHARACTERISTICS</b>					
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
Leakage current in PE GND Pin 50/60Hz version			1.9	mArms	250Vac L-N 50Hz See Note 1
Noise Attenuation					See Fig 1
Isolation Resistance	100			MΩ	Any pin to gnd pins
<b>RELIABILITY CHARACTERISTICS</b>					
Calculated MTBF per Telcordia SR-332, Issue 2		9.3		10 <sup>6</sup> Hrs.	Tb = 70 °C
Calculated MTBF per MIL-HDBK-217F		5.9		10 <sup>6</sup> Hrs.	Tb = 70 °C
Field Demonstrated MTBF				10 <sup>6</sup> Hrs.	See our website for details
<b>EMC CHARACTERISTICS</b>					
Conducted emissions	EN55011 and EN55022, FCC part15				Level B
Line frequency harmonics	EN61000-3-2				Class A
Voltage fluctuations	EN61000-3-3				Clause 5b
ESD air	EN61000-4-2				Level 3
ESD contact	EN61000-4-2				Level 3
Radiated immunity	EN61000-4-3				Level 3
Fast transients	EN61000-4-4				Level 3
Line surge immunity	EN61000-4-5				Level 3
Conducted immunity	EN61000-4-6				Level 3
Power freq. mag. field	EN61000-4-8				3 A/m
Voltage dip immunity	EN61000-4-11				Perf Criteria A, A, B <5% UT 10 ms, 70% UT 500 ms, 40% UT 100 ms

Meets EMC standards in properly designed system with SynQor PFC and IQ4H converters.

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

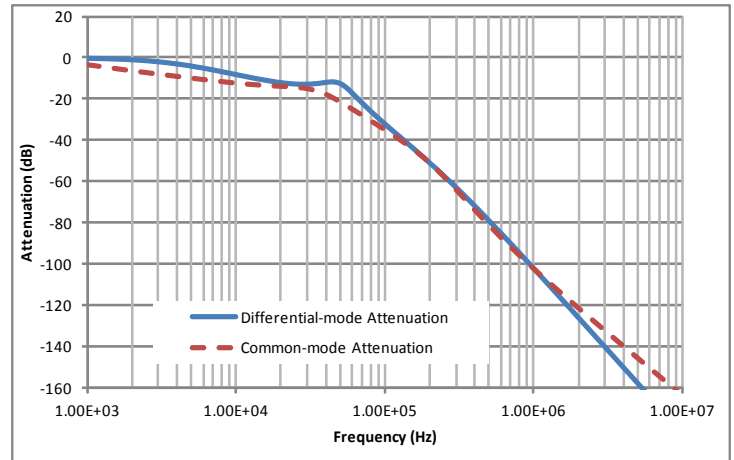


## BASIC OPERATION AND FEATURES

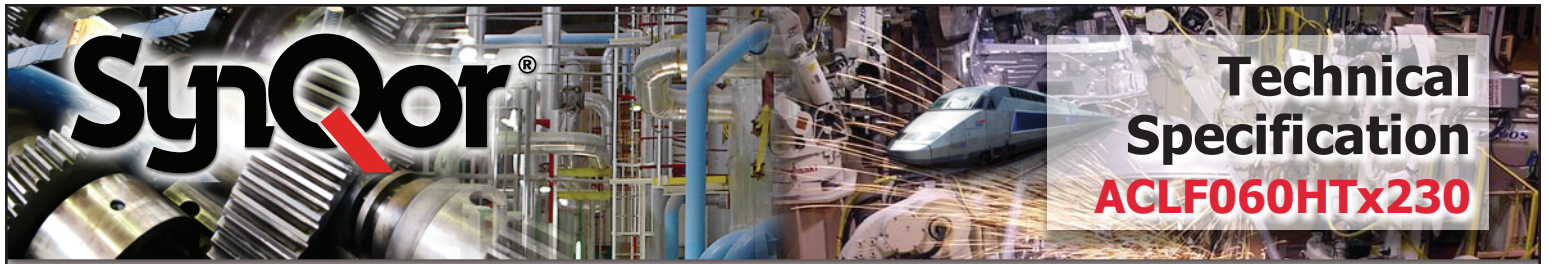
This module is a multi-stage differential-mode and common-mode passive EMI filter designed to interface an AC power source with a SynQor PFC module and one or more SynQor converters (or other loads that create EMI). Each stage of this filter is well damped to avoid resonances and oscillations, and only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

A typical application would place the InQor 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 InQor 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.



# Technical Specification

## ACLF060HTx230

### Standards & Qualification Testing

Parameter	Notes & Conditions
<b>STANDARDS COMPLIANCE</b>	
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.

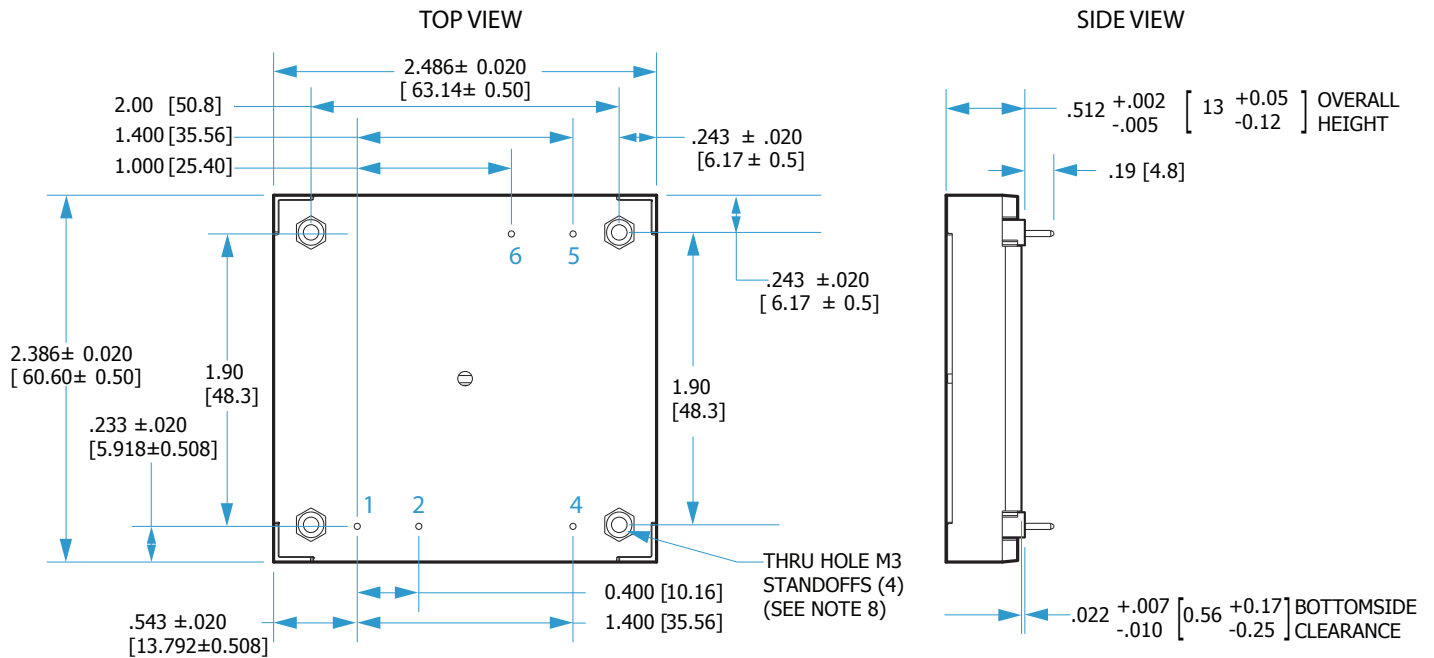
Note: An external input fuse must always be used to meet these safety requirements, see the Typical Connection Diagram.

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

Parameter	# Units	Test Conditions
<b>QUALIFICATION TESTING</b>		
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	-40 °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



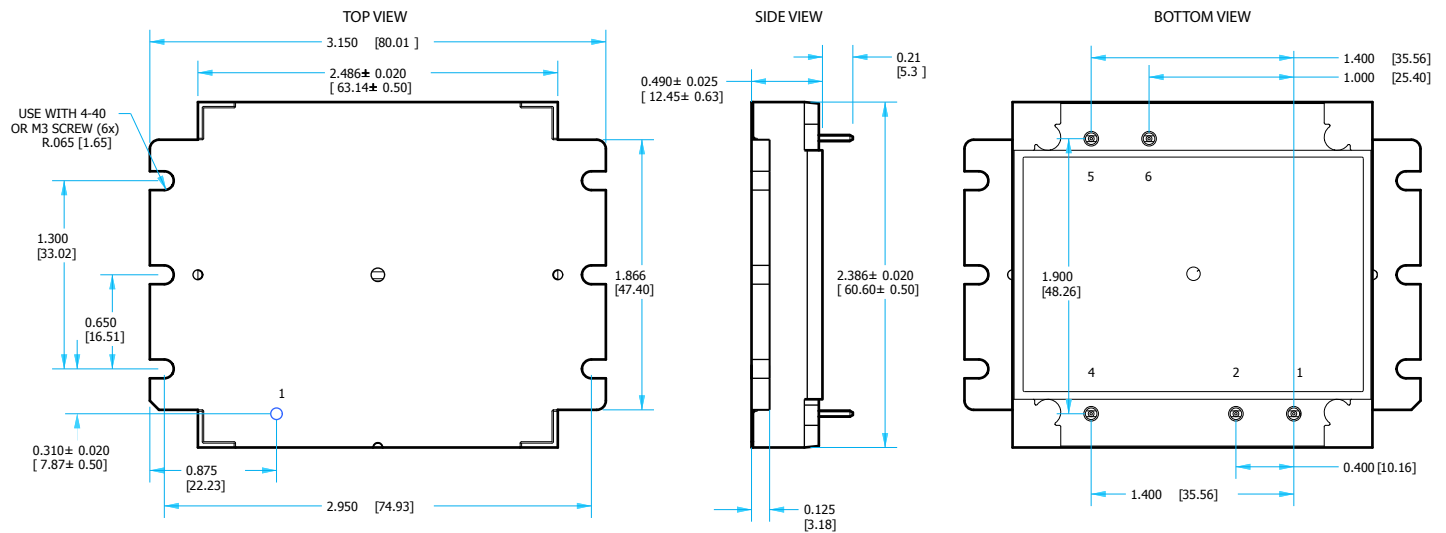
### NOTES

- 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: 4.7oz (129.5g)
- 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

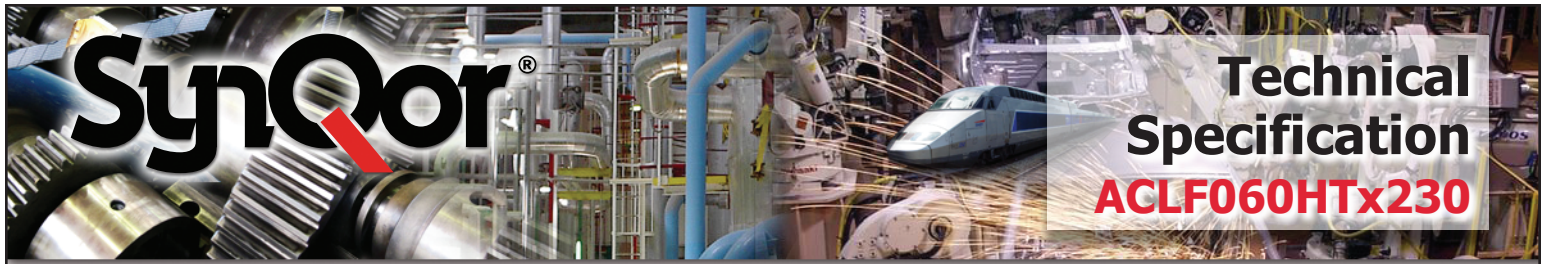


## NOTES

- 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: 4.8oz (135.8g)
- 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



## Ordering Specifications

Product Family	Input Frequency	Package	Performance Series	Thermal Design	Input Voltage	Pin Length	Features	-	G
ACLF	060	H	T	C	230	R	S	-	G
<b>ACLF</b> :AC Line Filter	<b>060</b> :50/60 Hz	<b>H</b> :Half-brick	<b>T</b> :Tera:	<b>C</b> :Encased <b>D</b> :Non-Threaded <b>V</b> :Flanged	<b>230</b> :85 to 264Vrms	<b>R</b> :.180"	<b>S</b> :Standard	-	<b>G</b> :RoHS Compliant

### APPLICATION NOTES

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

### 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](mailto:rohs@synqor.com).

### ORDERING INFORMATION

The tables below show the valid model numbers and ordering options the filters in this product family. When ordering SynQor filters, please ensure that you use the complete part number including options. A "-G" suffix indicates the product is 6/6 RoHS compliant.

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

Part Number Example: **ACLF060HTC230RS-G**

### 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

### Contact SynQor for further information and to order:

**Phone:** 978-849-0600  
**Toll Free:** 888-567-9596  
**Fax:** 978-849-0602  
**E-mail:** [power@synqor.com](mailto:power@synqor.com)  
**Web:** [www.synqor.com](http://www.synqor.com)  
**Address:** 155 Swanson Road  
 Boxborough, MA 01719  
 USA

### WARRANTY

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

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