



MCOTS-F-28-P-QT

**Passive Filter
Quarter-Brick**

MILITARY COTS EMI FILTER

-40V to +40V Continuous Input	30A Output Current	20mΩ @ 100°C Max. DC Resistance	>80dB @ 250kHz Differential Attenuation
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FULL POWER OPERATION: -55°C to +100°C

The Mil-COTS series of EMI filters brings SynQor's field proven technology and manufacturing expertise to the industrial power application 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, low DC resistance, and a stabilizing bulk capacitor resistor. They follow conservative component derating guidelines and they are designed and manufactured to the highest standards.

MilCOTS



Designed and Manufactured in the USA

Operational Features

- 30A output current
- Very low DC resistance
- >80 dB differential-mode attenuation at 250kHz
- >36dB common-mode attenuation at 250kHz
- Stabilizing bulk capacitor and damping resistor included
- All capacitors are X7R multi-layer ceramic
- Designed to all MIL-STD 461 EMI requirements (D, E)

Mechanical Features

- Size: 2.39" x 1.54" x 0.500"(60.6 x 39.0 x 12.7 mm)
- Total Weight: 3.53 oz. (100 g)
- Flanged baseplate version available

Safety Features

- 2250V input/output to case isolation
- Certified 60950-1 requirement for basic insulation (see Standards and Qualifications page)

In-Line Manufacturing Process

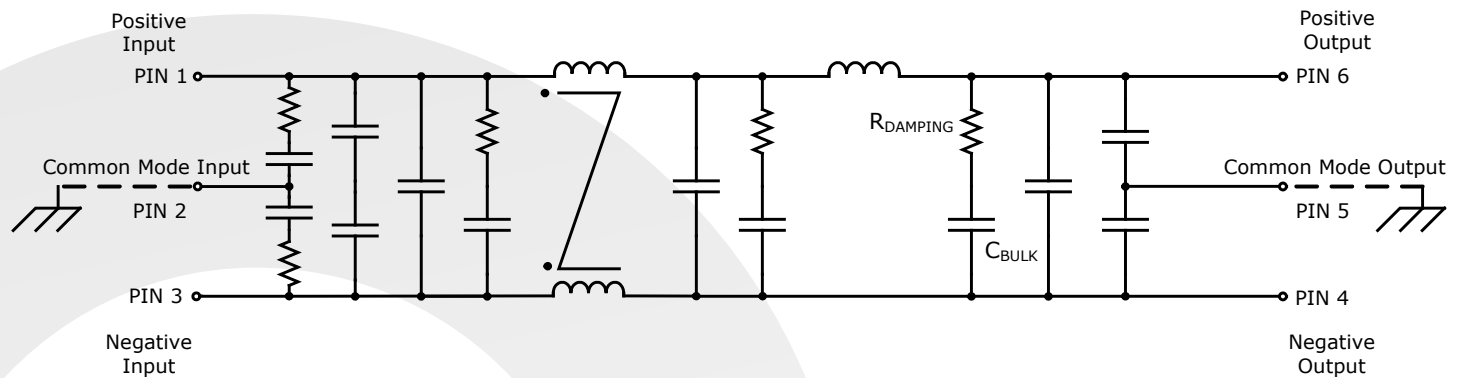
- AS9100 and ISO 9001:2008 Certified Facility
- Full component traceability

Screening Qualifications

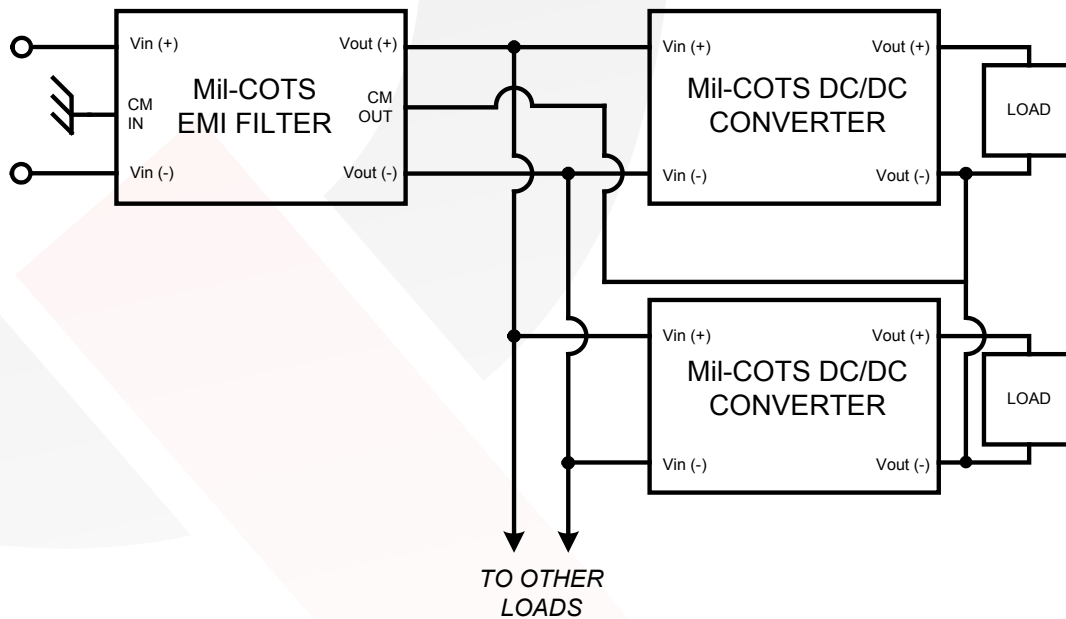
- Qualification consistent with MIL-STD-883
- Available with S-Grade or M-Grade screening
- Pre-cap inspection per IPC-610, Class III
- Temperature cycling per MIL-STD-883, Method 1010, Condition B, 10 cycles
- Burn-In at 100°C baseplate temperature
- Final visual inspection per MIL-STD-2008

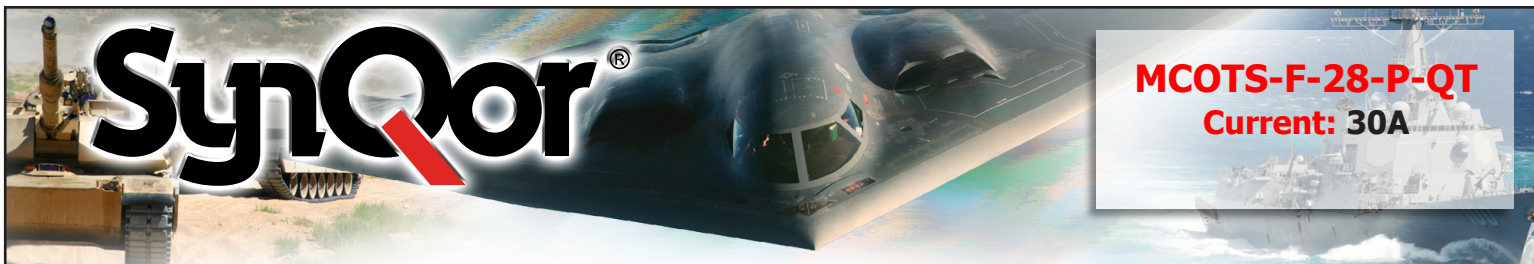


Fundamental Circuit Diagram



Typical Connection Diagram





MCOTS-F-28-P-QT
Current: 30A

MCOTS-F-28-P-QT ELECTRICAL CHARACTERISTICS

|Vin| ≤ 28V, |Iout| ≤ 30A unless otherwise specified

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					
Continuous	-40		40	V	
Transient (≤ 1 s)	-50		50	V	
Isolation Voltage	-2250		2250	V	Input/Output to Common-mode pins
Output Current			35	A	
Operating Case Temperature	-55		100	°C	Baseplate Temperature
Storage Case Temperature	-65		135	°C	
Lead Temperature (20 s)			300	°C	
RECOMMENDED OPERATION CONDITIONS					
Input Voltage					
Continuous	-40		40	V	
Transient (1 s, Rs* = 0 Ω)	-50		50	V	* Rs = Source Impedance
Output Power (continuous)	-30		30	A	
ELECTRICAL CHARACTERISTICS					
Output Voltage (continuous)	Vout = Vin - (Iin x Rdc)			V	
DC Resistance (Rdc)					Total
Tcase = 25°C			15	mΩ	
Tcase = 100°C			20	mΩ	
Power Dissipation					30A output current
TCASE = 25°C			13.5	W	
TCASE = 100°C			18	W	
Total Differential-Mode Capacitance		220		μF	Measured across input and output pins
Total Common-Mode Capacitance		0.15		μF	Measured between any pin to case
Bulk Capacitor		180		μF	
Damping Resistor		0.1		Ω	
Noise Attenuation					
Differential-Mode		80		dB	
Common-Mode		36		dB	
Isolation Resistance	100			MΩ	Any pin to common-mode pins
INPUT VOLTAGE SPIKE SUPPRESSION					
Output Voltage Deviation due to a Spike					
Input Voltage Spike (Centered on Vin)					
±250V, 100μs, Emax=15mJ	-5		5	ΔV	MIL-STD-1275D
±600V, 10μs, Rs* = 50Ω	-5		10	ΔV	RTCA/DO-160E/F/G
ISOLATION CHARACTERISTICS					
Isolation Voltage (any pin to common-mode pins)					
Continuous	-2000		2000	V	
Transient (≤ 100 μs)	-2250		2250	V	
Isolation Resistance (any pin to common-mode pins)	30			MΩ	
RELIABILITY CHARACTERISTICS					
Calculated MTBF (MIL-STD-217F2)					
GB @ Tcase = 70°C		15.3		10 ⁶ Hrs.	
GM @ Tcase = 70°C		0.8		10 ⁶ Hrs.	
Demonstrated MTBF				10 ⁶ Hrs.	See our website for details
WEIGHT CHARACTERISTICS					
Device Weight		100		g	

* Rs = Source Impedance



MCOTS-F-28-P-QT
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Basic Operation and Features

This module is a multi-stage differential-mode and common-mode passive EMI filter designed to interface a power source with one or more Mil-COTS DC-DC 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 capacitors are used. This Mil-COTS EMI filter includes a large bulk capacitor with a series damping resistor to correct for the unstabilizing effect of a converter's negative input resistance. A white paper discussing this negative input resistance and the need for corrective damping can be found on the SynQor website (see Input System Instability application note).

When used with SynQor's DC-DC converters, the MQME EMI filter is designed to pass all of the relevant MIL-STD-461C/D/E requirements to their most stringent limits. The MIL-STD-461 Compliance Matrix Table lists these requirements and describes the setup used to pass them. Figures 3 - 6 show results from selected conductive and radiated emissions tests.

A typical application would place the Mil-COTS filter close to the input of the DC-DC converter. The Input common-mode pin would be connected to the chassis ground that is common with the system input line filter or other earthed point used for EMI measurement. The output common-mode pin would be connected to the output ground or plane of the power converters with as low inductance a path as possible. 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 Mil-COTS 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 may cause the internal common-mode chokes to saturate and thus cause degraded common-mode rejection performance.

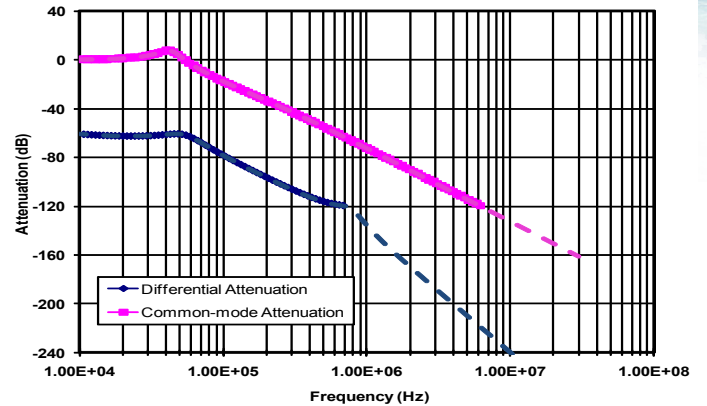


Figure A: Calculated Common Mode and Differential Mode Attenuation provided by the filter as a function of frequency assuming no other parasitic coupling in the system. Both input lines are assumed to be connected to chassis ground through 50Ω resistors. The filter case is also assumed to be connected to chassis ground.

EMI

Military Standard 461 Compliance Matrix

Mil-Std-461	MIL-STD-461D/E/F	
	Requirement	Most Stringent Limit Listed
Conducted Emissions	CE101	Submarine Basic Curve
	CE102	
Conducted Susceptibility	CS101	Curve #2 461F Only Curve #5 Basic Waveform I _{max} = 10A
	CS106	
	CS114	
	CS115	
	CS116	
Radiated Emissions	RE101	Navy
	RE102†	Submarine Fixed Wing Internal, >25 meters Nose to Tail
Radiated Susceptibility	RS101	Army Aircraft External
	RS103	

MCOTS	<ul style="list-style-type: none"> • MCOTS-F-28-P Filter • MCOTS-28-05S Converter • 120W Resistive load • Metal Chassis Plane • MCOTS-F-270-P Filter • MCOTS-270-05-QT Converter • 120W Resistive load
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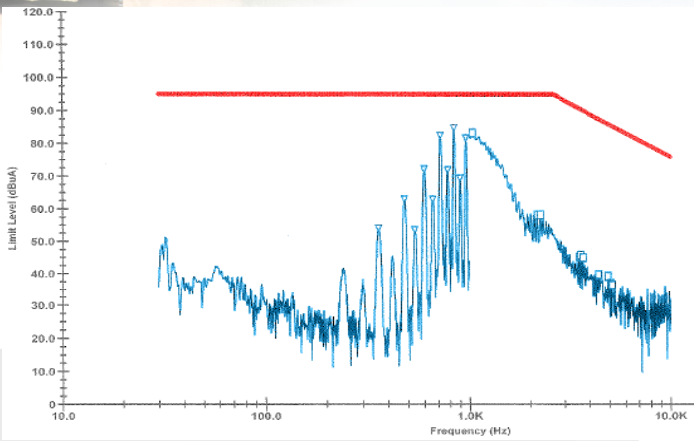


Figure 1: MIL-STD-461E Method CE101 Low Frequency Conducted Emissions. Limit line (in red) is the 'Submarine Applications DC Curve'.

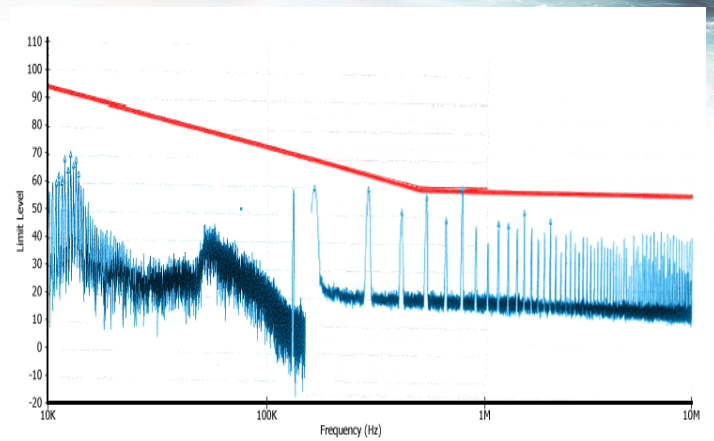


Figure 2: MIL-STD-461E Method CE102 High Frequency Conducted Emissions. Limit line (in red) is the 'Basic Curve'.

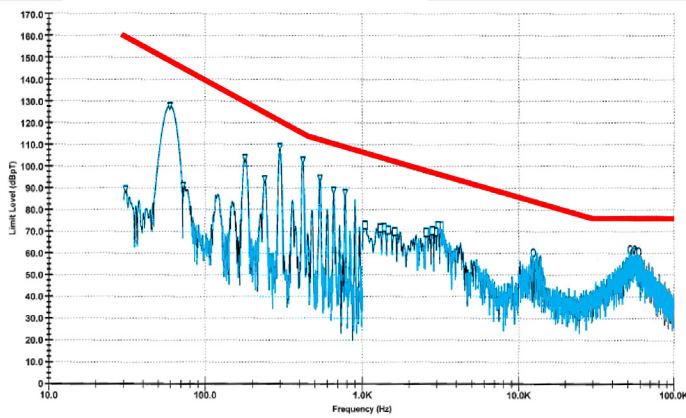


Figure 3: MIL-STD-461E Method RE101 Low Frequency Radiated Emissions. Limit line (in red) is the 'Standard Curve'.

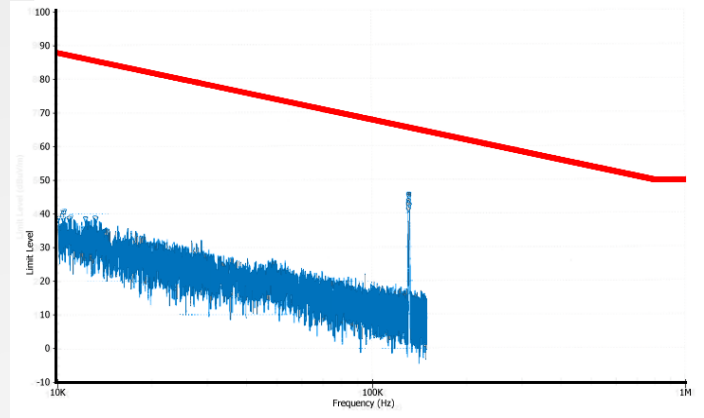
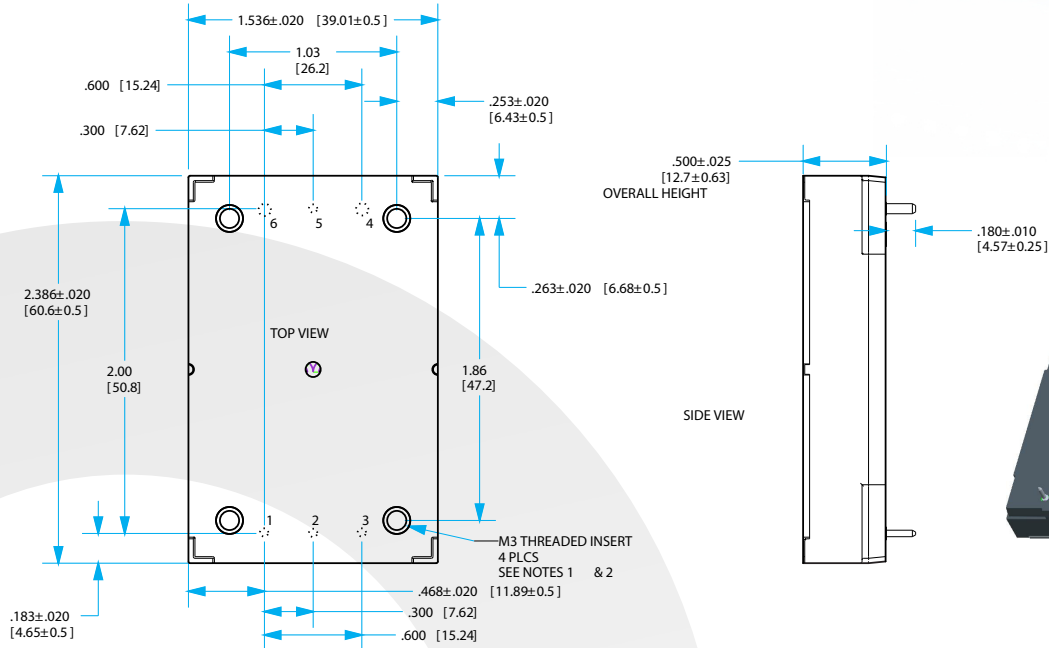


Figure 4: MIL-STD-461E Method RE102 High Frequency Radiated Emissions. Limit line (in red) is the 'Submarine Internal to Pressure Hull Curve'.



Encased Mechanical Diagram



NOTES

- 1) M3 SCREWS USED TO BOLT UNIT'S BASEPLATE TO OTHER SURFACES SUCH AS HEATSINK MUST NOT EXCEED 0.100" (2.54mm) DEPTH BELOW THE SURFACE OF THE BASEPLATE.
- 2) APPLIED TORQUE PER SCREW SHOULD NOT EXCEED 6in-lb (0.7Nm).
- 3) BASEPLATE FLATNESS TOLERANCE IS 0.004" (.10mm) TIR FOR SURFACE.
- 4) PINS 1-3 & 5 ARE 0.040" (1.02mm) DIA. WITH 0.080" (2.03mm) DIA. STANDOFF SHOULDERS
- 5) PINS 4 & 6 ARE 0.062" (1.57mm) DIA. WITH 0.100" (2.54mm) DIA STANDOFF SHOULDERS.
- 6) ALL PINS: MATERIAL: COPPER ALLOY
FINISH: MATTE TIN OVER NICKEL PLATE
- 7) UNDIMENSIONED COMPONENTS ARE SHOWN FOR VISUAL REFERENCE ONLY
- 8) WEIGHT 2.92oz. (82.7g)
- 9) ALL DIMENSIONS IN INCHES(mm)
TOLERANCES: X.XXIN +/-0.02 (X.Xmm +/-0.5mm)
X.XXXIN +/-0.010 (X.XXmm +/-0.25mm)

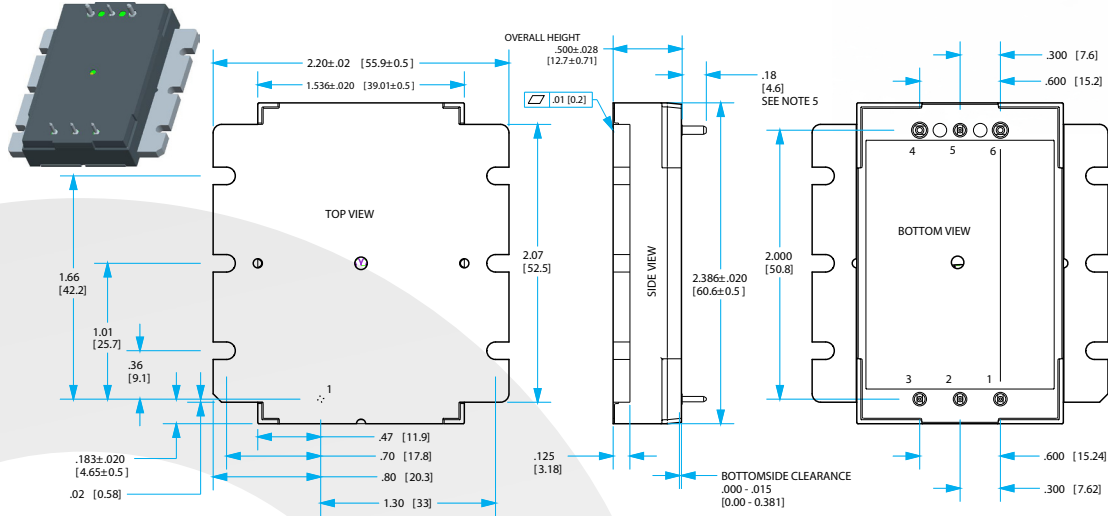
PIN DESIGNATIONS

Pin	Name	Function
1	Vin (+)	Positive input voltage
2	COM IN	Common mode input
3	Vin (-)	Negative input voltage
4	Vout (-)	Negative output voltage
5	COM OUT	Common mode output
6	Vout (+)	Positive output voltage



MCOTS-F-28-P-QT
Current: 30A

Flanged Encased Mechanical Diagram



NOTES

- 1) APPLIED TORQUE PER SCREW SHOULD NOT EXCEED 5in-lb
- 2) BASEPLATE FLATNESS TOLERANCE IS 0.01" (.2mm) TIR FOR SURFACE.
- 3) PINS 1-3 & 5 ARE 0.040" (1.02mm) DIA. WITH 0.080" (2.03mm) DIA. STANDOFF SHOULDERS
- 4) PINS 4 & 6 ARE 0.062" (1.57mm) DIA. WITH 0.100" (2.54mm) DIA STANDOFF SHOULDERS.
- 5) ALL PINS: MATERIAL: COPPER ALLOY
FINISH: MATTE TIN OVER NICKEL PLATE
- 6) UNDIMENSIONED COMPONENTS ARE SHOWN FOR VISUAL REFERENCE ONLY
- 7) WEIGHT 3.18oz. (90.2g)
- 8) ALL DIMENSIONS IN INCHES(mm)
TOLERANCES: X.XXIN +/-0.02 (X.Xmm +/-0.5mm)
X.XXXIN +/-0.010 (X.XXmm +/-0.25mm)

PIN DESIGNATIONS

Pin	Name	Function
1	Vin (+)	Positive input voltage
2	COM IN	Common mode input
3	Vin (-)	Negative input voltage
4	Vout (-)	Negative output voltage
5	COM OUT	Common mode output
6	Vout (+)	Positive output voltage



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Mil-COTS Qualification

Test Name	Details	# Tested (# Failed)	Consistent with MIL-STD-883F Method	Consistent with MIL-STD-883F Method 5005
Life Testing	Visual, mechanical and electrical testing before, during and after 1000 hour burn-in @ full load	15 (0)	Method 1005.8	
Shock-Vibration	Visual, mechanical and electrical testing before, during and after shock and vibration tests	5 (0)		MIL-STD-202, Methods 201A & 213B
Humidity	+85°C, 95% RH, 1000 hours, 2 minutes on / 6 hours off	8 (0)	Method 1004.7	
Temperature Cycling	500 cycles of -55°C to +100°C (30 minute dwell at each temperature)	10 (0)	Method 1010.8	Condition A
Solderability	15 pins	15 (0)	Method 2003	
DMT	-65°C to +110°C across full line and load specifications in 5°C steps	7 (0)		
Altitude	70,000 feet (21 km), see Note	2 (0)		

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

Mil-COTS DC-DC 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-610, Class III	•	•
Temperature Cycling	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-2008	•	•

STANDARDS COMPLIANCE

Parameter **Notes & Conditions**

STANDARDS COMPLIANCE

UL 60950-1:2007	Basic Insulation
CAN/CSA C22.2 No. 60950-1:2007	
EN 60950-1/A12:2011	

Note: An external input fuse must always be used to meet these safety requirements. Contact SynQor for official safety certificates on new releases or download from the SynQor website.



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Ordering Information

Family	Product	Input Voltage	Filter Type	Package	Thermal Design	Screening Level
MCOTS	F: Filter	28: -40V to +40V 48: -80V to +80V 270: -500V to +500V	P: Passive T: Transient	QT: Quarter Brick HT: Half Brick	N: Normal Threaded F: Flanged	S: S-Grade M: M-Grade

Example MCOTS-F-28-P-QT-N-S

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

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.

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	

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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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