SynQor®

MCOTS-C-28-12-QE
Single Output
Quarter-brick

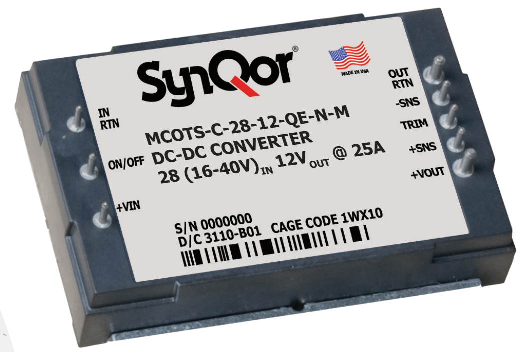
MILITARY COTS DC-DC CONVERTER

16-40V Continuous Input	16-50V Transient Input	12V Output	25A Output	95% @ 12.5A / 95% @ 25A Efficiency

Operation: -55°C to +100°C

The MilQor® series of Mil-COTS DC-DC converters brings SynQor's field proven high-efficiency synchronous rectification technology to the Military/Aerospace industry. SynQor's ruggedized encased packaging approach ensures survivability in demanding environments. Compatible with the industry standard format, these converters operate at a fixed frequency, and follow conservative component derating guidelines. They are designed and manufactured to comply with a wide range of military standards.

MilCOTS™



Designed and Manufactured in the USA

Safety Features

- 2250 V, 30 MΩ input-to-output isolation
- Certified 60950-1 requirement for basic insulation (see Standards and Qualifications page)

Mechanical Features

- Industry standard quarter-brick pin-out
- Size: 1.54" x 2.39" x 0.50" (39.0 x 60.6 x 12.7 mm)
- Total weight: 3.3oz (93.4g)
- Flanged baseplate version available

Operational Features

- High efficiency, 95% at full rated load current
- Operating input voltage range: 16-40 V
- Fixed frequency switching provides predictable EMI
- No minimum load requirement

Specification Compliance

MCOTS series converters (with an MCOTS filter) are designed to meet:

- MIL-HDBK-704 (A-F)
- RTCA/DO-160E Section 16
- MIL-STD-1275 (B,D)
- DEF-STAN 61-5 (Part 6)/(5 or 6)
- MIL-STD-461 (C, D, E, F)

Control Features

- On/Off control referenced to input return
- Remote sense for the output voltage
- Wide output voltage trim range of +10%, -50%

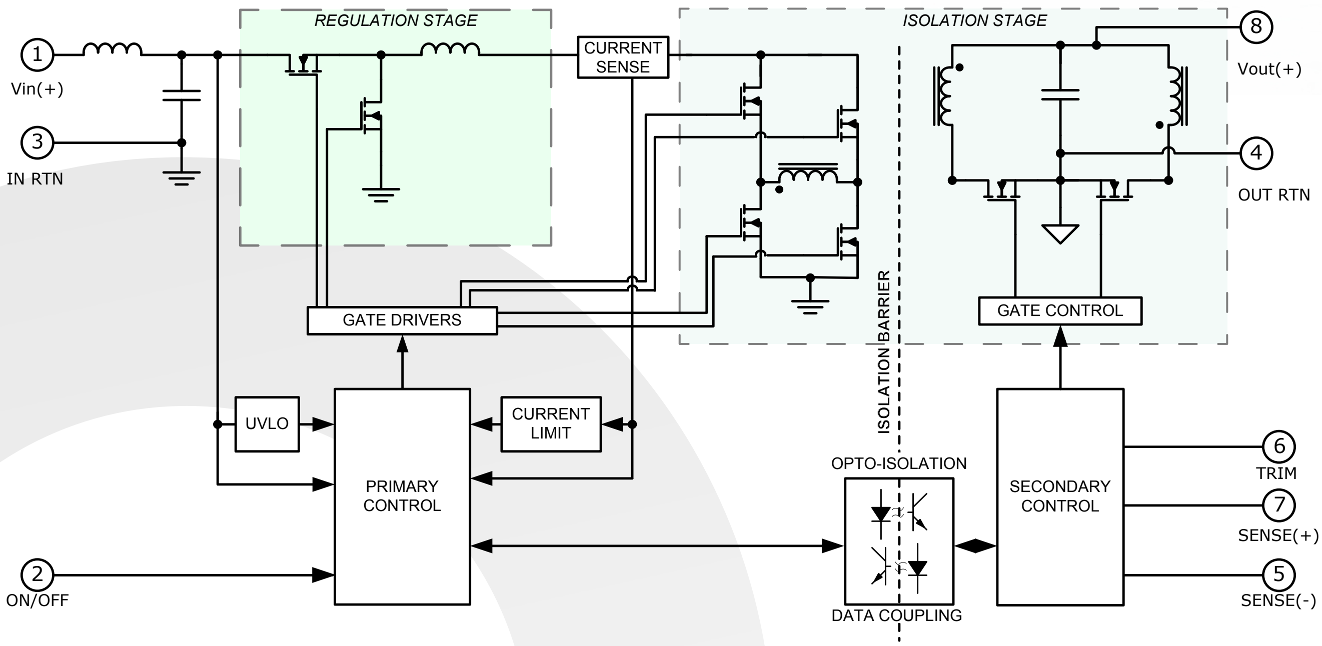
Protection Features

- Input under-voltage lockout
- Output current limit and short circuit protection
- Active back bias limit
- Auto-recovery output over-voltage protection
- Thermal shutdown

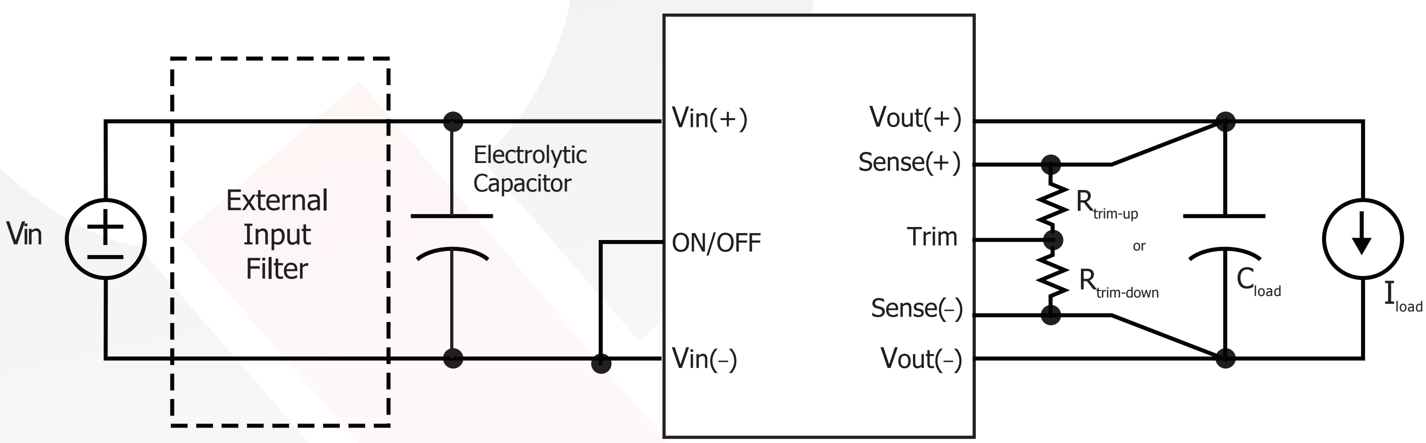
Screening/Qualification

- AS9100 and ISO 9001 certified facility
- Qualified to MIL-STD-810
- Available with S-Grade or M-Grade screening
- Pre-cap inspection per IPC-A-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-883, Method 2009
- Full component traceability

BLOCK DIAGRAM



TYPICAL CONNECTION DIAGRAM



MCOTS-C-28-12-QE ELECTRICAL CHARACTERISTICS

Tb = 25 °C, Vin = 28Vdc unless otherwise noted; full operating temperature range is -55 °C to +100 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					
Non-Operating	-1		55	V	Continuous
Operating			40	V	Continuous
Operating Transient Protection			50	V	1s transient, square wave
Isolation Voltage					
Input to Output			2250	V dc	
Input to Base-Plate			2250	V dc	
Output to Base-Plate			2250	V dc	
Operating Temperature	-55		+100	°C	Baseplate temperature
Storage Temperature	-65		+135	°C	
Voltage at ON/OFF input pin	-2		9	V	
INPUT CHARACTERISTICS					
Operating Input Voltage Range	16	28	40	V	50V transient for 1s
Input Under-Voltage Lockout					
Turn-On Voltage Threshold	14.7	15.2	15.7	V	
Turn-Off Voltage Threshold	13.4	13.9	14.4	V	
Lockout Voltage Hysteresis		1.3		V	
Recommended External Input Capacitance		220		µF	Typical ESR 0.1-0.2 Ω; Figure 13
Input Filter Component Values (C_1\\$L_{in}$\\$C_2$)		0.1\0.22\28.3		µF\µH\µF	Internal values; see Figure D
Maximum Input Current			26.1	A	Vin min; trim up; in current limit
No-Load Input Current		180	280	mA	
Disabled Input Current		5	8	mA	
Response to Input Transient		2		V	0.25V/µs input transient; See Figure 12
Input Terminal Ripple Current		380		mA	RMS
Recommended Input Fuse			30	A	Fast acting external fuse recommended
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	11.88	12.00	12.12	V	
Output Voltage Regulation					See Note 1
Over Line		±0.25	±0.35	%	
Over Load		±0.25	±0.35	%	
Over Temperature	-300		300	mV	
Total Output Voltage Range	11.62		12.38	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20MHz bandwidth; see Note 2
Peak-to-Peak		60	120	mV	Full load
RMS		14	30	mV	Full load
Operating Output Current Range	0		25	A	Subject to thermal derating
Output DC Current-Limit Inception	27.5	30.0	32.5	A	Output voltage 10% Low
Output DC Current-Limit Shutdown Voltage		5		V	
Back-Drive Current Limit while Enabled		5		A	Negative current drawn from output
Back-Drive Current Limit while Disabled		3		mA	Negative current drawn from output
Maximum Output Capacitance			12	mF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (5A/µs)		500		mV	50% to 75% to 50% Iout max, 100µF load cap
Settling Time		100		µs	To within 1% Vout nom
Output Voltage Trim Range	-50		10	%	Across Pins 7 & 5; Figure B
Output Over-Voltage Protection	13.8	14.4	15.0	V	Over full temp range
EFFICIENCY					
100% Load		95		%	See Figure 1 for efficiency curve
50% Load		95		%	See Figure 1 for efficiency curve

MCOTS-C-28-12-QE ELECTRICAL CHARACTERISTICS

Tb = 25 °C, Vin = 28Vdc unless otherwise noted; full operating temperature range is -55 °C to +100 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
DYNAMIC CHARACTERISTICS					
Turn-On Transient					
Turn-On Time		35		ms	Full load, Vout=90% nom.
Output Voltage Overshoot			2	%	Maximum Output Capacitance
ISOLATION CHARACTERISTICS					
Isolation Voltage (dielectric strength)		2250		V	See Absolute Maximum Ratings
Isolation Resistance		30		MΩ	
Isolation Capacitance (input to output)		1000		pF	See Note 3
TEMPERATURE LIMITS FOR POWER DERATING CURVES					
Semiconductor Junction Temperature			125	°C	Package rated to 150 °C
Board Temperature			125	°C	UL rated max operating temp 130 °C
Transformer Temperature			125	°C	
Maximum Baseplate Temperature, Tb			100	°C	
FEATURE CHARACTERISTICS					
Switching Frequency Regulation Stage	230	240	250	kHz	
Switching Frequency Isolation Stage	115	120	125	kHz	
ON/OFF Control					
Off-State Voltage	2.4		9.0	V	
On-State Voltage	-2.0		0.8	V	
ON/OFF Control					
Pull-Up Voltage	4.75	5.00	5.25	V	
Pull-Up Resistance		20		kΩ	
Over-Temperature Shutdown OTP Trip Point		120		°C	Average PCB Temperature
Over-Temperature Shutdown Restart Hysteresis		10		°C	
RELIABILITY CHARACTERISTICS					
Calculated MTBF per MIL-HDBK-217F		3.4		10^6 Hrs.	Ground Benign, 70°C Tb
Calculated MTBF per MIL-HDBK-217F		0.58		10^6 Hrs.	Ground Mobile, 70°C Tb

Note 1: Line and load regulation is limited by duty cycle quantization and does not indicate a shift in the internal voltage reference.
Note 2: For applications requiring reduced output voltage ripple and noise, consult SynQor applications support (e-mail: support@synqor.com).
Note 3: Higher values of isolation capacitance can be added external to the module.

STANDARDS COMPLIANCE

Parameter	Notes & Conditions
STANDARDS COMPLIANCE	
UL 60950-1	Basic Insulation
CAN/CSA C22.2 No. 60950-1	
EN 60950-1	

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.

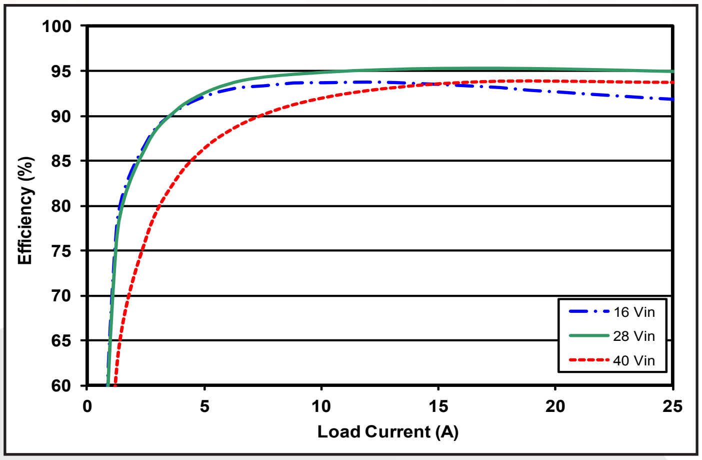


Figure 1: ***Efficiency*** *at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.*

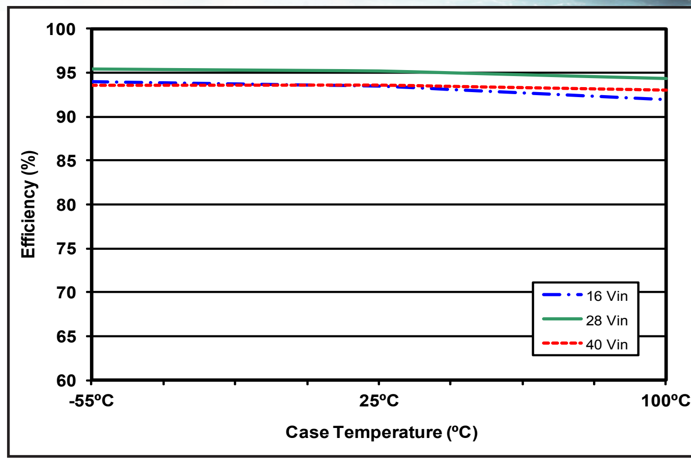


Figure 2: ***Efficiency*** *at nominal output voltage and 60% rated power vs. case temperature for minimum, nominal, and maximum input voltage.*

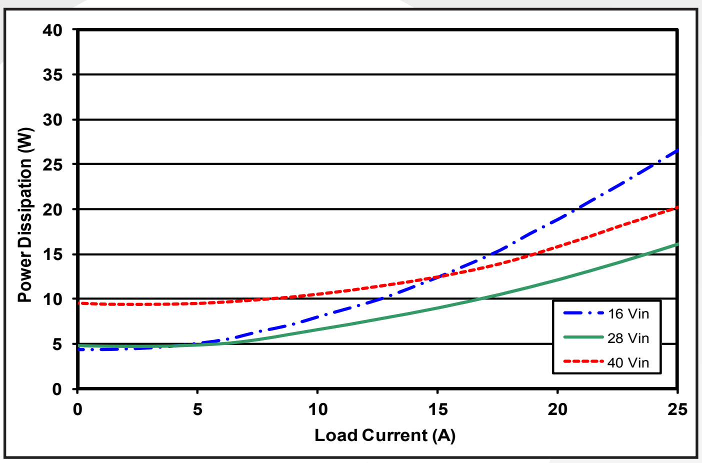


Figure 3: ***Power dissipation*** *at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at* T_{CASE}*=25°C.*

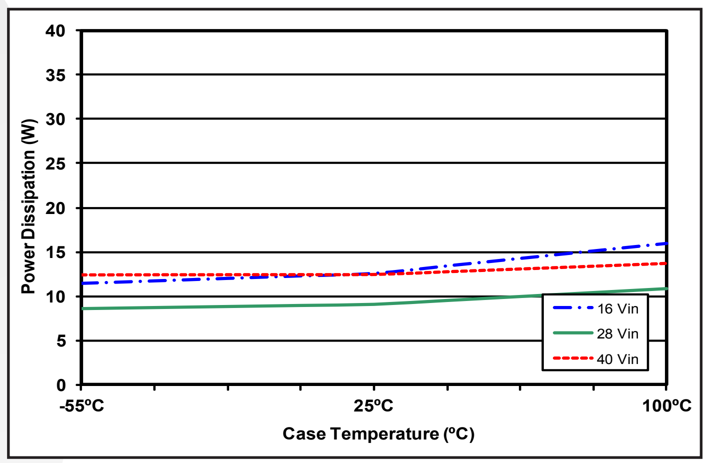


Figure 4: ***Power Dissipation*** *at nominal output voltage and 60% rated power vs. case temperature for minimum, nominal, and maximum input voltage.*

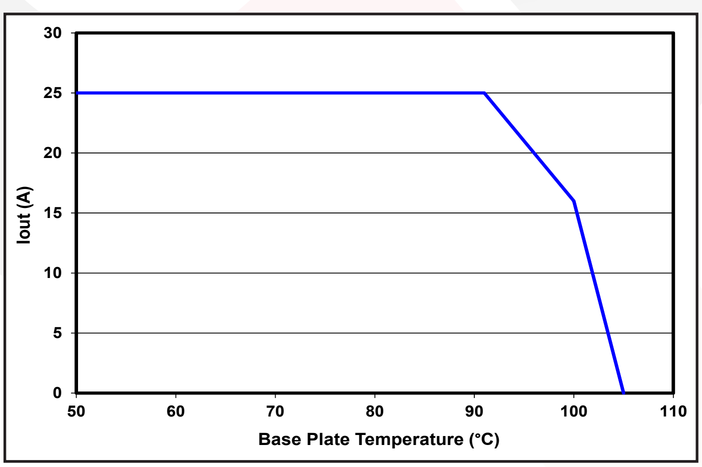


Figure 5: ***Thermal Derating*** *(maximum output current vs. base plate temperature) at nominal input voltage.*

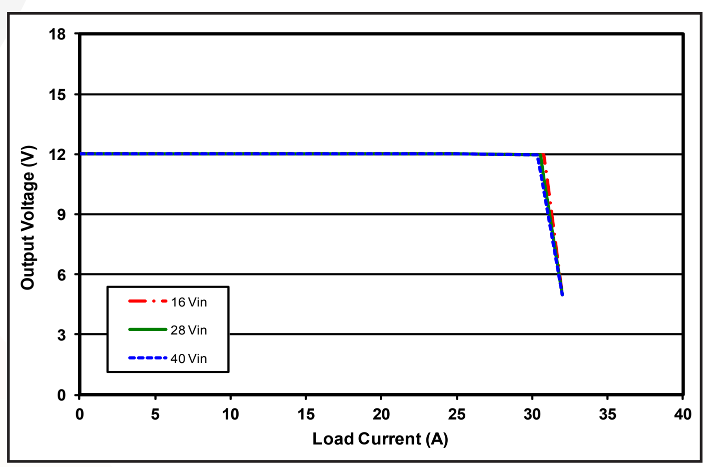


Figure 6: ***Output V-I Characteristics*** *(output voltage vs. load current) showing typical current limit curves. See Current Limit section in the Application Notes.*

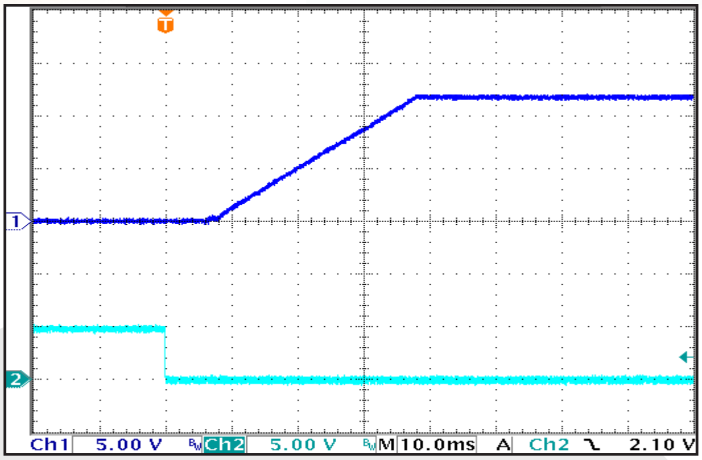


***Figure 7**: **Typical Startup Waveform**, input voltage pre-applied, ON/OFF Pin on Ch 2. Ch 1: Vout (5V/div), Ch 2: ON/OFF Pin (5V/div), Time (10mS/div).*

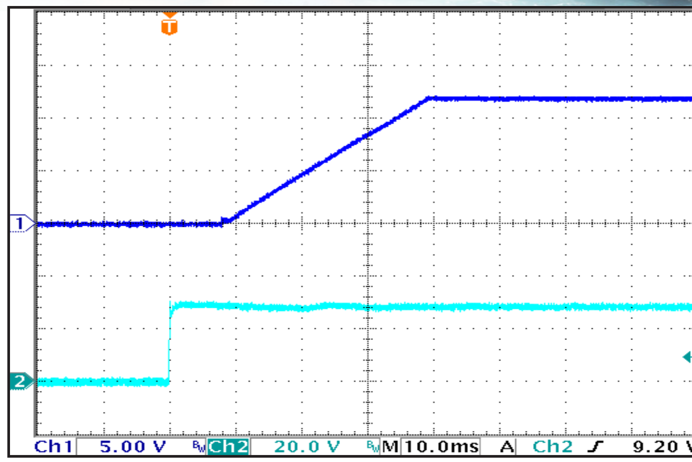


***Figure 8**: **Turn-on transient** at full resistive load and zero output capacitance initiated by Vin. ON/OFF Pin previously low. Ch 1: Vout (5V/div), Ch 2: Vin (20V/div), Time (10mS/div).*

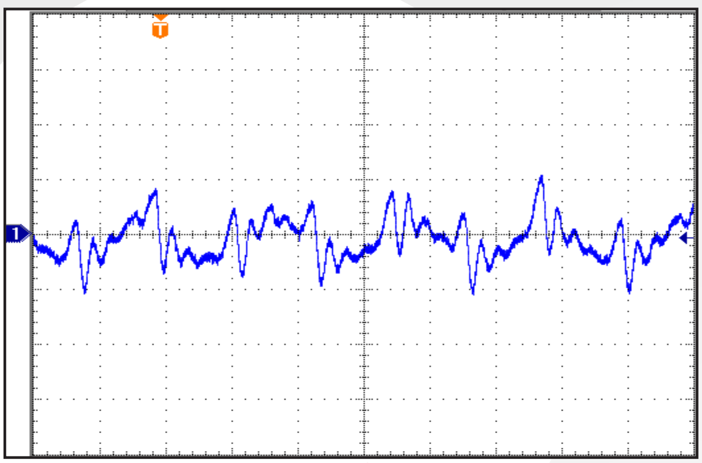


***Figure 9**: **Input Terminal Current Rpple**, i_C, at full rated output current and nominal input voltage with 220µF electrolytic capacitor. Bandwidth: 20MHz (See Figure 13). Ch 1: Input current (1A/div), Time (2uS/div).*

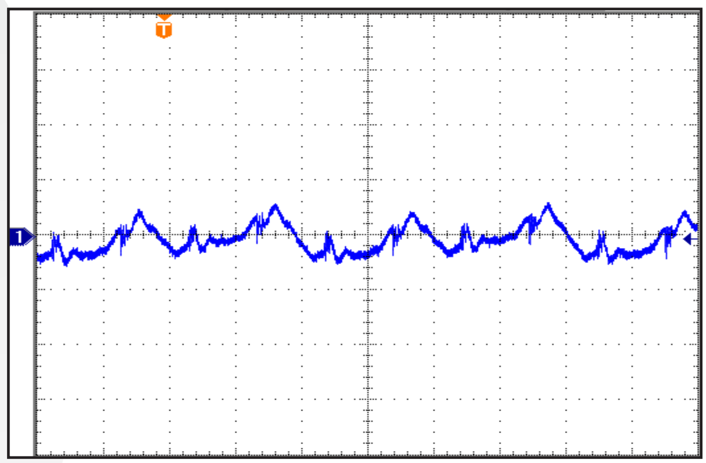


***Figure 10**: **Output Voltage Ripple**, Vout, at nominal input voltage and rated load current. Load capacitance: 1µF ceramic capacitor and 100µF electrolytic capacitor. Bandwidth: 20 MHz (See Figure 13). Ch 1: Vout (50mV/div), Time (4uS/div).*

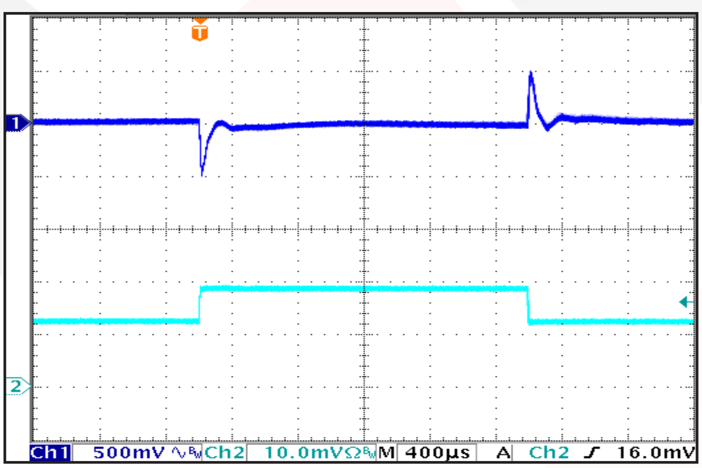


***Figure 11**: **Output Voltage Response to Step-Change in Load Current** (50%-75%-50% of Iout(max); di/dt = 5 A/µS). Load cap: 1 µF ceramic and 100 µF electrolytic capacitors. Ch 1: Vout (500mV/div), Ch 2: Iout (10A/div), Time (400uS/div).*

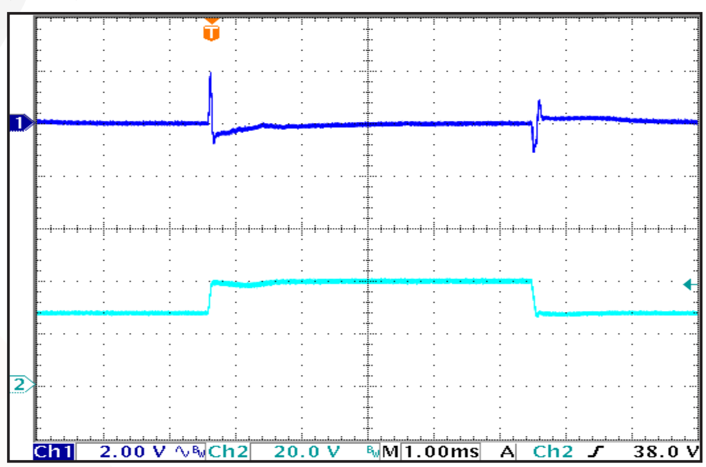


***Figure 12**: **Output Voltage Response to Step-Change in Input Voltage** (250V/mS). Load cap: 100 µF electrolytic output capacitance. Ch 1: Vout (2V/div), Ch 2: Vin (20V/div), Time (1mS/div).*

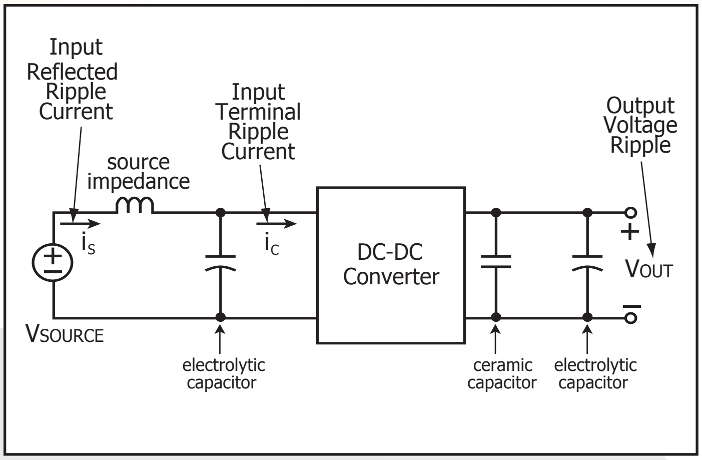


***Figure 13**: **Test Set-up Diagram** showing measurement points for Input Terminal Ripple Current (Figure 9) and Output Voltage Ripple (Figure 10).*

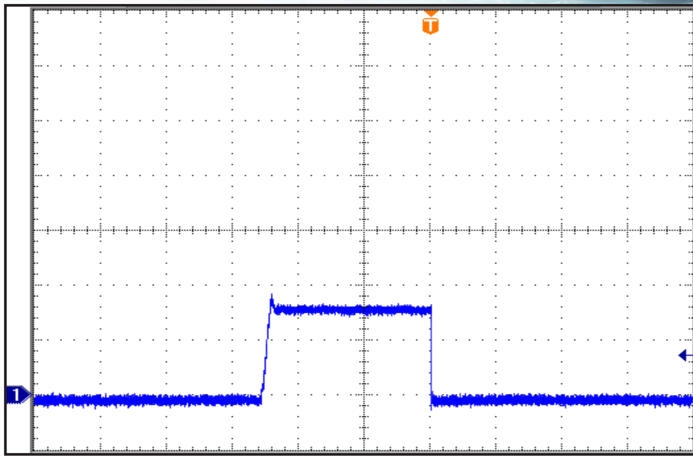


***Figure 14**: **Output Short Load Current** as a function of time when the converter attempts to turn on into a 1 mΩ short circuit. Ch 1: Load current (20A/div), Time (20mS/div).*

BASIC OPERATION AND FEATURES

This converter series uses a two-stage power conversion topology. The first stage keeps the output voltage constant over variations in line, load, and temperature. The second stage uses a transformer to provide the functions of input/output isolation and voltage step-down to achieve the low output voltage required.

Both the first stage and the second stage switch at a fixed frequency for predictable EMI performance. Rectification of the transformer's output is accomplished with synchronous rectifiers. These devices, which are MOSFETs with a very low on-state resistance, dissipate significantly less energy than Schottky diodes, enabling the converter to achieve high efficiency.

Dissipation throughout the converter is so low that it does not require a heatsink for operation in many applications; however, adding a heatsink provides improved thermal derating performance in extreme situations. To further withstand harsh environments and thermally demanding applications, the converter is available totally encased. See Ordering Information page for available thermal design options.

SynQor quarter-brick converters use the industry standard footprint and pin-out.

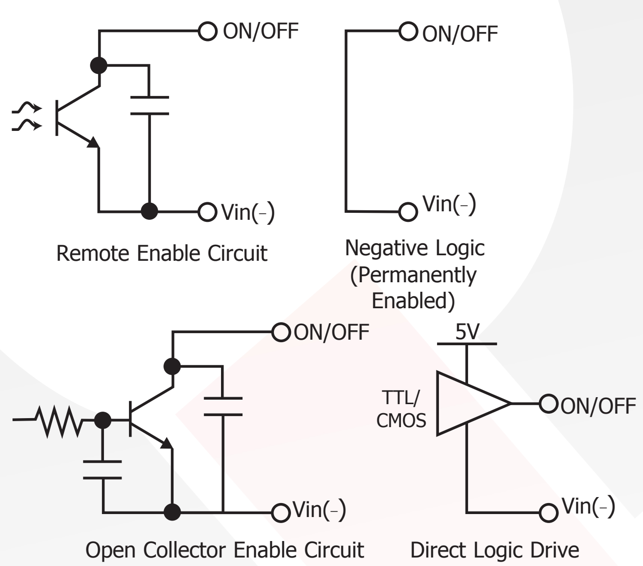


Figure A: Various Circuits for Driving the ON/OFF Pin.

CONTROL FEATURES

REMOTE ON/OFF (Pin 2): The ON/OFF input, Pin 2, permits the user to control when the converter is on or off. This input is referenced to the return terminal of the input bus, Vin(-).

The ON/OFF signal is active low (meaning that a low turns the converter on). Fig A details possible circuits for driving the ON/OFF pin.

REMOTE SENSE Pins 7(+) and 5(-): The SENSE(+) and SENSE(-) inputs correct for voltage drops along the conductors that connect the converter's output pins to the load.

Pin 7 should connect to Vout(+) and Pin 5 should connect to Vout(-) at the point on the board where regulation is desired. If these connections are not made, the converter will deliver an output voltage that is slightly higher than its specified value.

Note: the output over-voltage protection circuit senses the voltage across the output (pins 8 and 4) to determine when it should trigger, not the voltage across the converter's sense leads (pins 7 and 5). Therefore, the resistive drop on the board should be small enough so that output OVP does not trigger, even during load transients.

OUTPUT VOLTAGE TRIM (Pin 6): The TRIM input permits the user to adjust the output voltage across the sense leads up or down according to the trim range specifications. SynQor uses industry standard trim equations.

To decrease the output voltage, the user should connect a resistor between Pin 6 (TRIM) and Pin 5 (SENSE(-) input). For a desired decrease of the nominal output voltage, the value of the resistor should be:

$$R_{trim\text{-}down} = \left(\frac{511\%}{\Delta\%} - 10.22 \right) \text{k}\Omega$$

where

$$\Delta\% = \left| \frac{V_{nominal} - V_{desired}}{V_{nominal}} \right| \times 100\%$$

To increase the output voltage, the user should connect a resistor between Pin 6 (TRIM) and Pin 7 (SENSE(+) input). For a desired increase of the nominal output voltage, the value of the resistor should be:

$$R_{trim\text{-}up} = 5.11 \left[\frac{\left(\frac{V_{nominal}}{1.225} - 2 \right) \times V_{desired} + V_{nominal}}{V_{desired} - V_{nominal}} \right] \text{k}\Omega$$

The Trim Graph in Figure B shows the relationship between the trim resistor value and Rtrim-up and Rtrim-down, showing the total range the output voltage can be trimmed up or down.

Note: The TRIM feature does not affect the voltage at which the output over-voltage protection circuit is triggered. Trimming the output voltage too high may cause the over-voltage protection circuit to engage, particularly during transients.

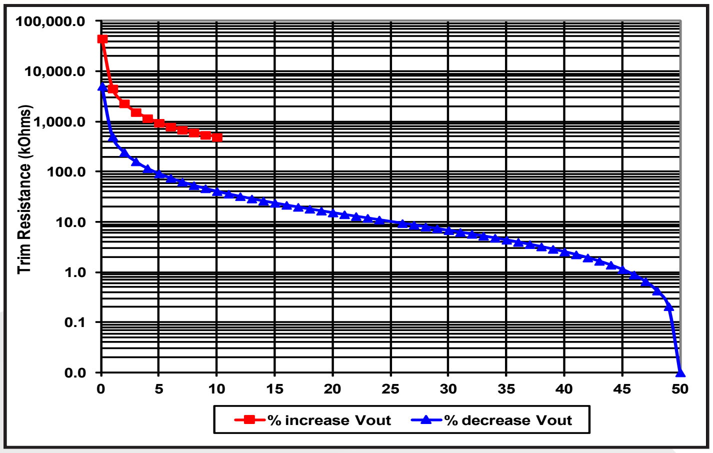


Figure B: Trim Graph.

It is not necessary for the user to add capacitance at the TRIM pin. The node is internally filtered to eliminate noise.

Total DC Variation of Vout: For the converter to meet its full specifications, the maximum variation of the DC value of Vout, due to both trimming and remote load voltage drops, should not be greater than that specified for the output voltage trim range.

PROTECTION FEATURES

Input Under-Voltage Lockout (UVLO): The converter is designed to turn off when the input voltage is too low, helping to avoid an input system instability problem, which is described in more detail in the application note titled "Input System Instability" on the SynQor website. When the input is rising, it must exceed the typical "Turn-On Voltage Threshold"* before the converter will turn on. Once the converter is on, the input must fall below the typical "Turn-Off Voltage Threshold"* before the converter will turn off.

Output Current Limit (OCP): If the output current exceeds the "Output DC Current Limit Inception" value*, then a fast linear current limit controller will reduce the output voltage to maintain a constant output current. If as a result, the output voltage falls below the "Output DC Current Limit Shutdown Voltage"* for more than 50 ms, then the unit will enter into hiccup mode, with a 500 ms off-time. The unit will then automatically attempt to restart.

Back-Drive Current Limit: If there is negative output current of a magnitude larger than the "Back-Drive Current Limit while Enabled" specification*, then a fast back-drive limit controller will increase the output voltage to maintain a constant output current. If this results in the output voltage exceeding the "Output Over-Voltage Protection" threshold*, then the unit will shut down.

Output Over-Voltage Limit (OVP): If the voltage across the output pins exceeds the "Output Over-Voltage Protection" threshold*, the converter will immediately stop switching. This prevents damage to the load circuit due to 1) excessive series resistance in output current path from converter output pins to sense point, 2) a release of a short-circuit condition, or 3) a release of a current limit condition. Load capacitance determines exactly how high the output voltage will rise in response to these conditions. After 500 ms the converter will automatically restart.

Over-Temperature Shutdown (OTP): A thermistor on the converter senses the average temperature of the module. The thermal shutdown circuit is designed to turn the converter off when the temperature at the sensed location reaches the "Over-Temperature Shutdown" value*. It will allow the converter to turn on again when the temperature of the sensed location falls by the amount of the "Over-Temperature Shutdown Restart Hysteresis"*.

Startup Inhibit Period: The Startup Inhibit Period ensures that the converter will remain off for approximately 500 ms when it is shut down due to a fault. This generates a 2 Hz "hiccup mode," preventing the converter from overheating. There are multiple ways the converter can be shut down, initiating a Startup Inhibit Period:

- Output Over-Voltage Protection
- Current Limit
- Short Circuit Protection
- Disabling via ON/OFF input

* See Electrical Characteristics section.

APPLICATION CONSIDERATIONS

Input System Instability: This condition can occur because any DC-DC converter appears incrementally as a negative resistance load. A detailed application note titled "Input System Instability" is available on the SynQor website which provides an understanding of why this instability arises, and shows the preferred solution for correcting it.

Application Circuits: A typical circuit diagram, Figure C below details the input filtering and voltage trimming.

Input Filtering and External Input Capacitance: Figure D below shows the internal input filter components. This filter dramatically reduces input terminal ripple current, which otherwise could exceed the rating of an external electrolytic input capacitor. The recommended external input capacitance is specified in the Input Characteristics section of the Electrical Specifications. More detailed information is available in the application note titled "EMI Characteristics" on the SynQor website.

Output Filtering and External Output Capacitance: The internal output filter components are shown in Figure D below. This filter dramatically reduces output voltage ripple. Some minimum external output capacitance is required, as specified in the Output Characteristics area of the Electrical Characteristics section. No damage will occur without this capacitor connected, but peak output voltage ripple will be much higher.

Thermal Considerations: For baseplated and encased versions, the max operating baseplate temperature, TB, is 100 ºC. Refer to the Thermal Derating Curves in the Technical Figures section to see the available output current at baseplate temperatures below 100 ºC.

A power derating curve can be calculated for any heatsink that is attached to the base-plate of the converter. It is only necessary to determine the thermal resistance, RTHBA, of the chosen heatsink between the baseplate and the ambient air for a given airflow rate. This information is usually available from the heatsink vendor. The following formula can the be used to determine the maximum power the converter can dissipate for a given thermal condition if its base-plate is to be no higher than 100 ºC.

$$P_{diss}^{max} = \frac{100\ ºC - T_A}{R_{THBA}}$$

This value of maximum power dissipation can then be used in conjunction with the data shown in the Power Dissipation Curves in the Technical Figures section to determine the maximum load current (and power) that the converter can deliver in the given thermal condition.

For convenience, Thermal Derating Curves are provided in the Technical Figures section.

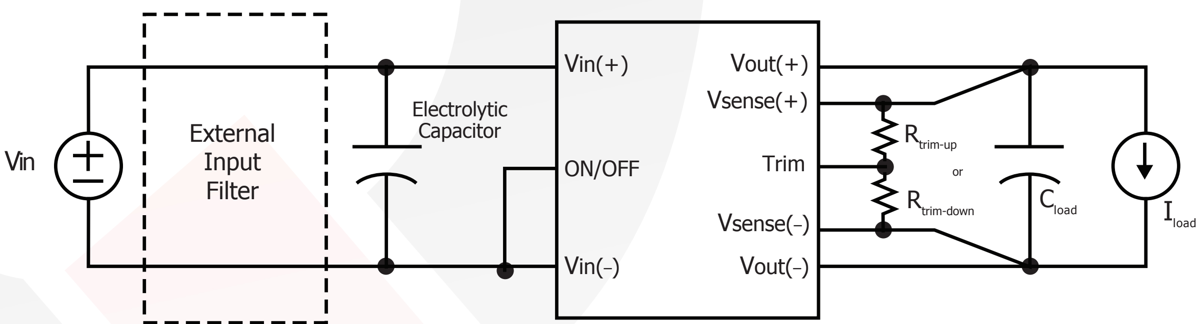


Figure C: ***Typical Application Circuit*** *(negative logic unit, permanently enabled).*

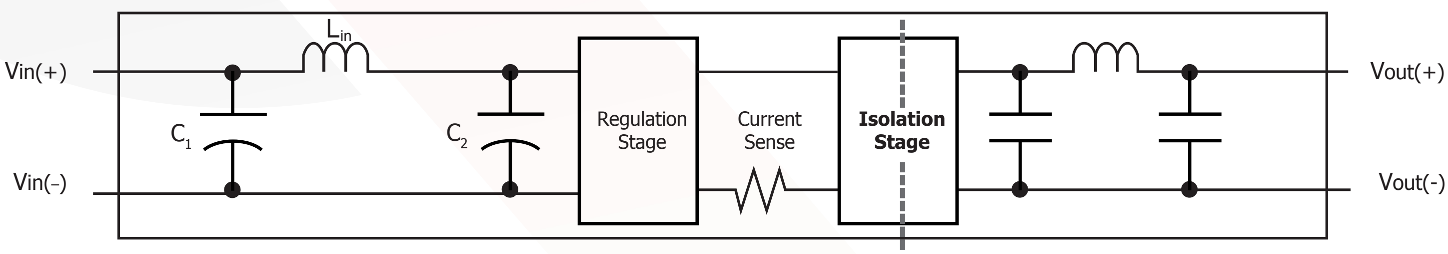
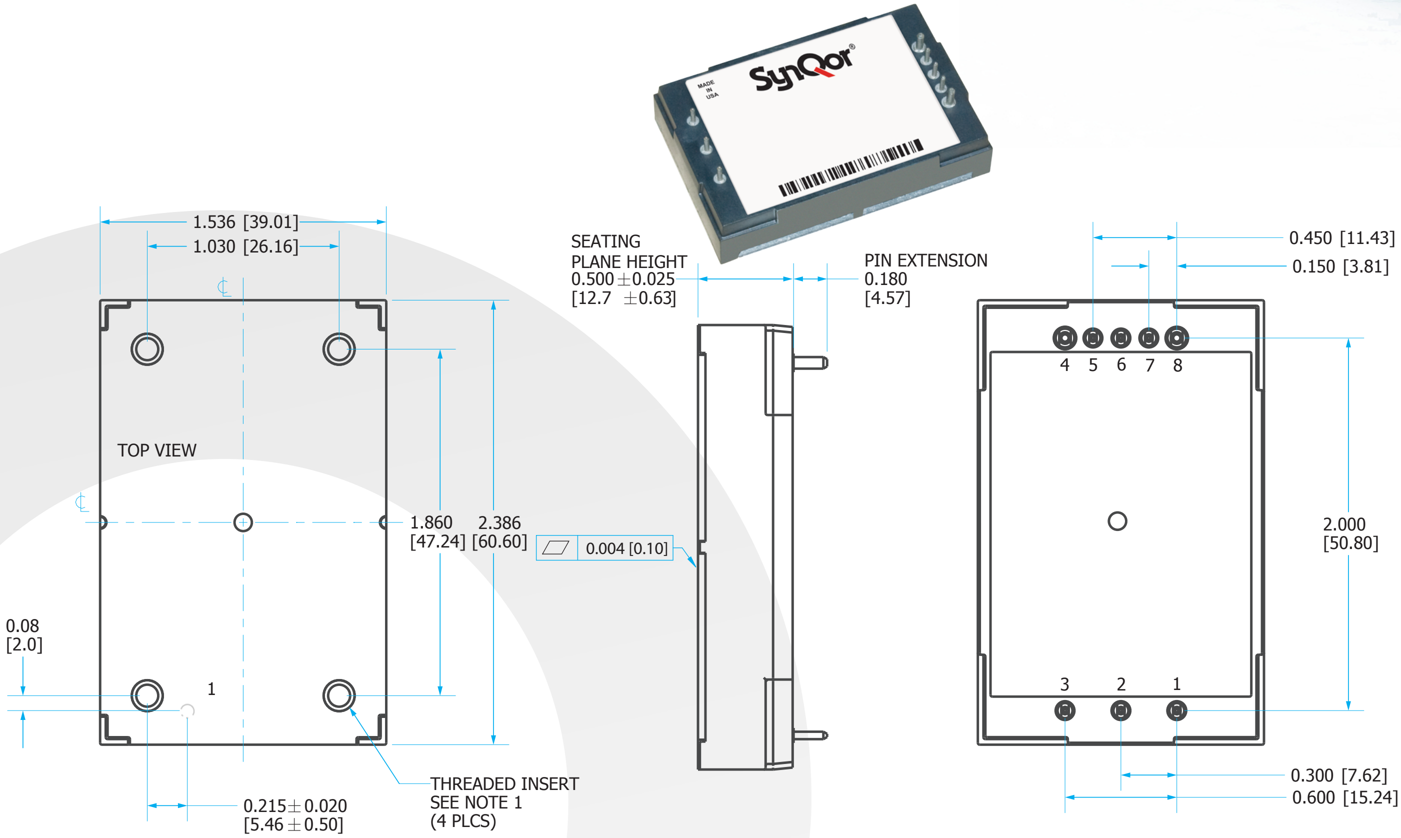


Figure D: Internal Input and Output Filter Diagram *(component values listed in Electrical Characteristics section).*

Mechanical Drawing – Normal Thermal Design Option



NOTES

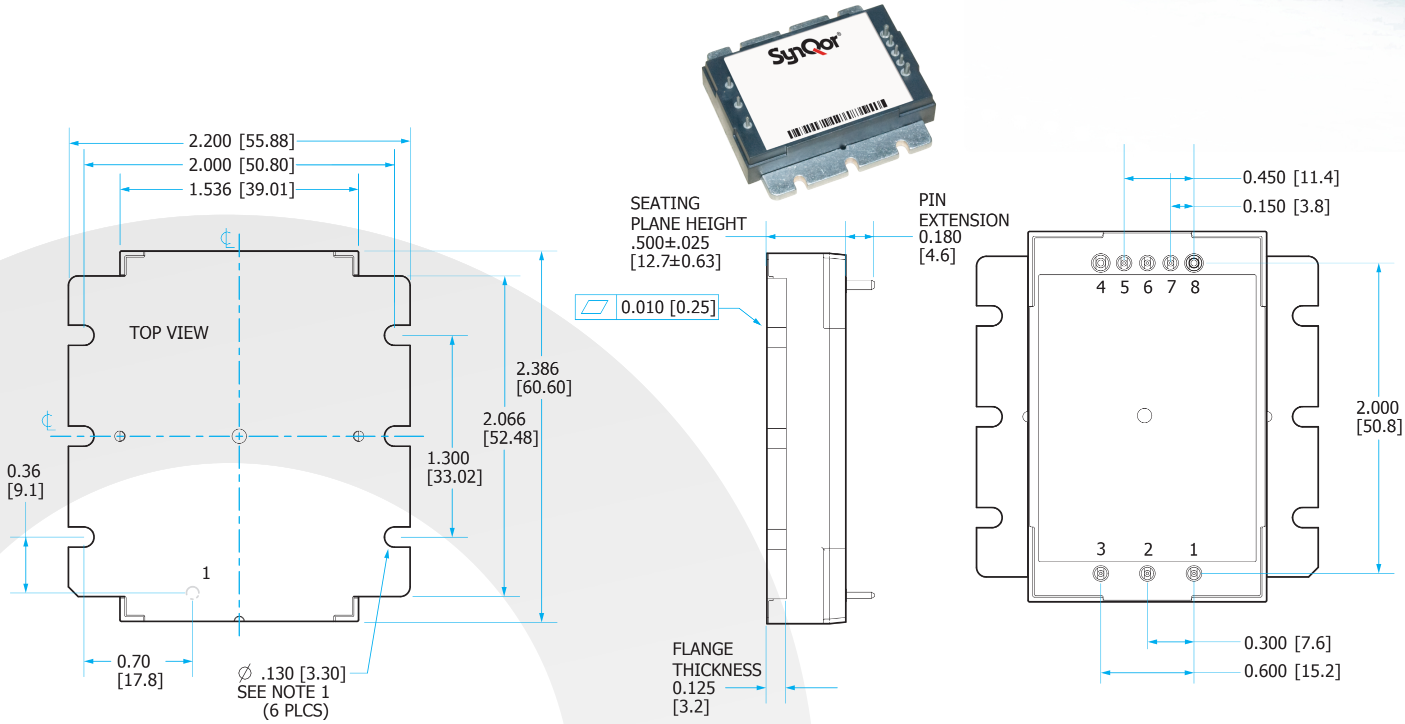
1) APPLIED TORQUE NOT TO EXCEED 6in-lb(0.7Nm)
M3 SCREW SHOULD NOT EXCEED 0.100" (2.54mm) DEPTH BELOW THE SURFACE OF THE BASEPLATE.
2) BASEPLATE FLATNESS TOLERANCE IS 0.004" (.10mm) TIR FOR SURFACE.
3) PINS 1-3. 5-7 ARE 0.040" (1.02mm) DIA. WITH 0.080" (2.03mm) DIA. STANDOFFS.
4) PINS 4 AND 8 ARE 0.062" (1.57mm) DIA. WITH 0.100" (2.54mm) DIA STANDOFFS
5) ALL PINS: MATERIAL: COPPER ALLOY
FINISH: MATTE TIN OVER NICKEL PLATE
6) WEIGHT: 3.3 oz. (93.4 g)
7) 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	ON/OFF	TTL input to turn converter on and off, referenced to Vin(–), with internal pull up.
3	IN RTN	Input return
4	OUT RTN	Output return
5	SENSE(–)	Negative remote sense[1]
6	TRIM	Output voltage trim[2]
7	SENSE(+)	Positive remote sense[3]
8	Vout(+)	Positive output voltage

Notes:
1) SENSE(–) should be connected to Vout(–) either remotely or at the converter.
2) Leave TRIM pin open for nominal output voltage.
3) SENSE(+) should be connected to Vout(+) either remotely or at the converter.

Mechanical Drawing – Flanged Thermal Design Option



NOTES

1) APPLIED TORQUE NOT TO EXCEED 6in-lb(0.7Nm)
2) BASEPLATE FLATNESS TOLERANCE IS 0.010" (.25mm) TIR FOR SURFACE.
3) PINS 1-3. 5-7 ARE 0.040" (1.02mm) DIA. WITH 0.080" (2.03mm) DIA. STANDOFFS.
4) PINS 4 AND 8 ARE 0.062" (1.57mm) DIA. WITH 0.100" (2.54mm) DIA STANDOFFS
5) ALL PINS: MATERIAL: COPPER ALLOY
   FINISH: MATTE TIN OVER NICKEL PLATE
6) WEIGHT: 3.5 oz (101.1 g)
7) ALL DIMENSIONS IN INCHES(mm)
   TOLERANCES: X.XXIN +/-0.02 (X.Xmm +/-0.5mm)
   X.XXXIN +/-0.010 (X.XXmm +/-0.25mm)

PIN DESIGNATIONS - CONVERTER

Pin	Name	Function
1	Vin(+)	Positive input voltage
2	ON/OFF	TTL input to turn converter on and off, referenced to Vin(–), with internal pull up.
3	IN RTN	Input return
4	OUT RTN	Output return
5	SENSE(–)	Negative remote sense[1]
6	TRIM	Output voltage trim[2]
7	SENSE(+)	Positive remote sense[3]
8	Vout(+)	Positive output voltage

Notes:
1) SENSE(–) should be connected to Vout(–) either remotely or at the converter.
2) Leave TRIM pin open for nominal output voltage.
3) SENSE(+) should be connected to Vout(+) either remotely or at the converter.

Mil-COTS Qualification

Test Name	Details	# Tested (# Failed)	Consistent with MIL-STD-883F Method
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 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	•	•

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

Ordering Information/ Part Numbering

Example MCOTS-C-28-12-QE-N-M

Not all combinations make valid part numbers, please contact SynQor for availability. See product summary page for details.

Family	Product	Input Voltage	Output Voltage	Package	Heatsink Option	Screening Level	Options
MCOTS	**C:** Converter	**28:** 16-40V	**05:** 5V **12:** 12V **15:** 15V **28:** 28V **50:** 50V	**QE:** QuarterBrick Exa	**N:** Normal Threaded **NC:** Normal Threaded, with Conformal Coating **F:** Flanged **FC:** Flanged, with Conformal Coating	**S:** S-Grade **M:** M-Grade	**[ ]:** Standard Feature

APPLICATION NOTES

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

7,050,309 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.