Technical Specification

$48V_{in}$ $0.95\text{-}1.7V_{out}$ $130W_{out}$

130 Watt, Ultra-fast Transient, Isolated DC/DC Converter

The HyperQor™ PowerPod converter is a next-generation, isolated, dc/dc converter designed specifically to power the Intel Itanium2 processor and satisfy its hyper-fast transient requirements. Using SynQor's advanced high efficiency topology, the HyperQor converter can deliver up to 130 Watts of power (100A) with extremely low internal power dissipation. Tested to be compatible with Intel 64 bit processors, the HyperQor features an industry standard form factor, a specially designed connector, and a programmable output, which can supply from 0.95v to 1.7v, in 32 steps, programmed using 5 data bits.

HyperQor® Power Pod

SynQor's HyperQor PowerPod

Operational Features

- Ultra-high efficiency, 87% (1.5V at 87A), contributes less heat to enclosure, can operate with no heatsink in many applications
- 43.2V – 52.8V input range
- Programmable output voltage (5 bit V_{ID})
- Output di/dt is compatible with latest generation processor families

Mechanical Features

- Industry standard footprint
- Ultra low inductance output connector
- Captive mounting hardware
- Universal heatsink mounting
- Single multi-layer PCB contains all electronic and power components, no subassemblies
- Open frame version available for space and cost savings, call factory for more information

Control Features

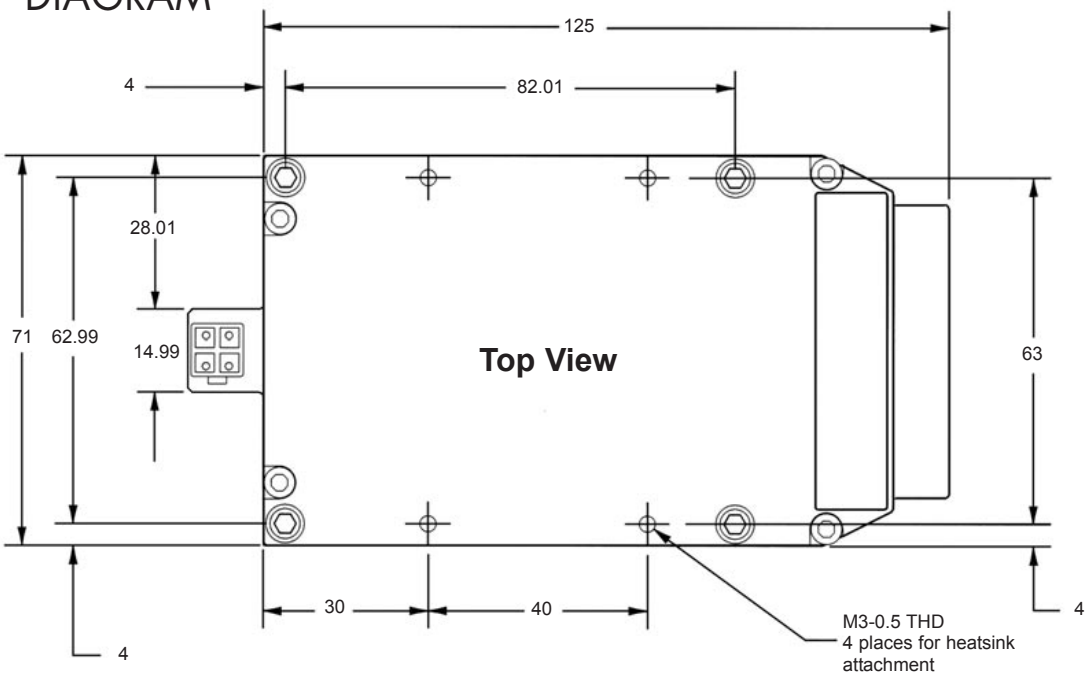
- 5 bit V_{ID}
- Output enable signal
- Processor present signal
- Power good signal

Safety/Protection Features

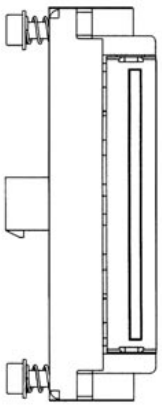
- 500V, 10 MΩ input-to-output isolation
- Input under-voltage lockout
- Internal electronic input fuse
- Output current limit and short circuit protection
- Open/shorted sense lines protection
- Output under-voltage protection
- Output over-voltage protection
- Output clamp
- Thermal shutdown
- Contains no electrolytic or tantalum capacitors

MECHANICAL DIAGRAM

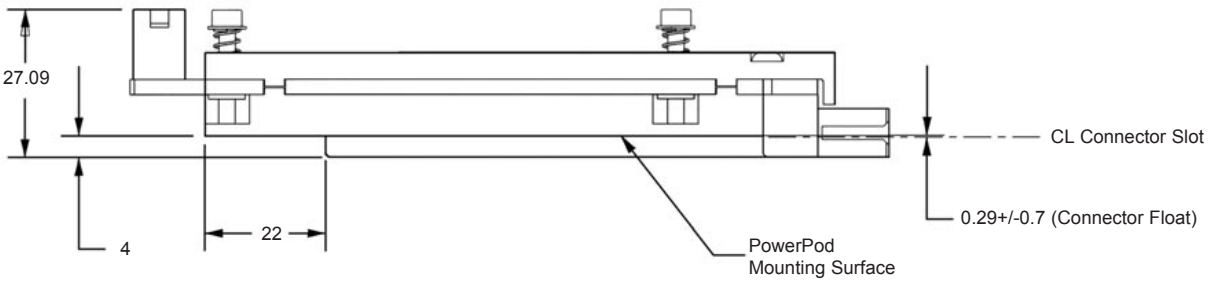
Baseplated Version



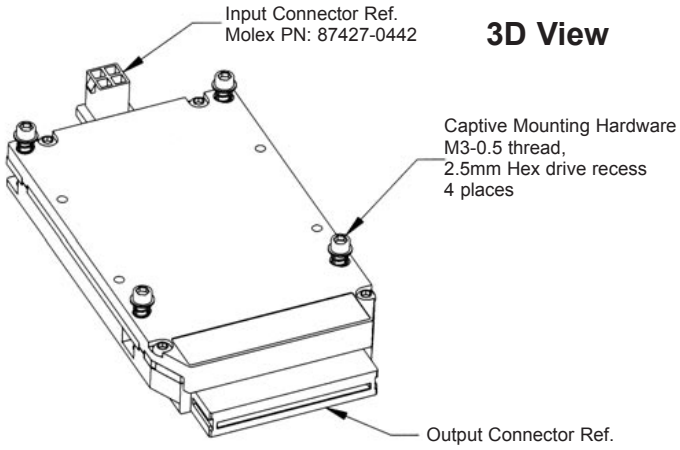
Connector View



Side View



3D View

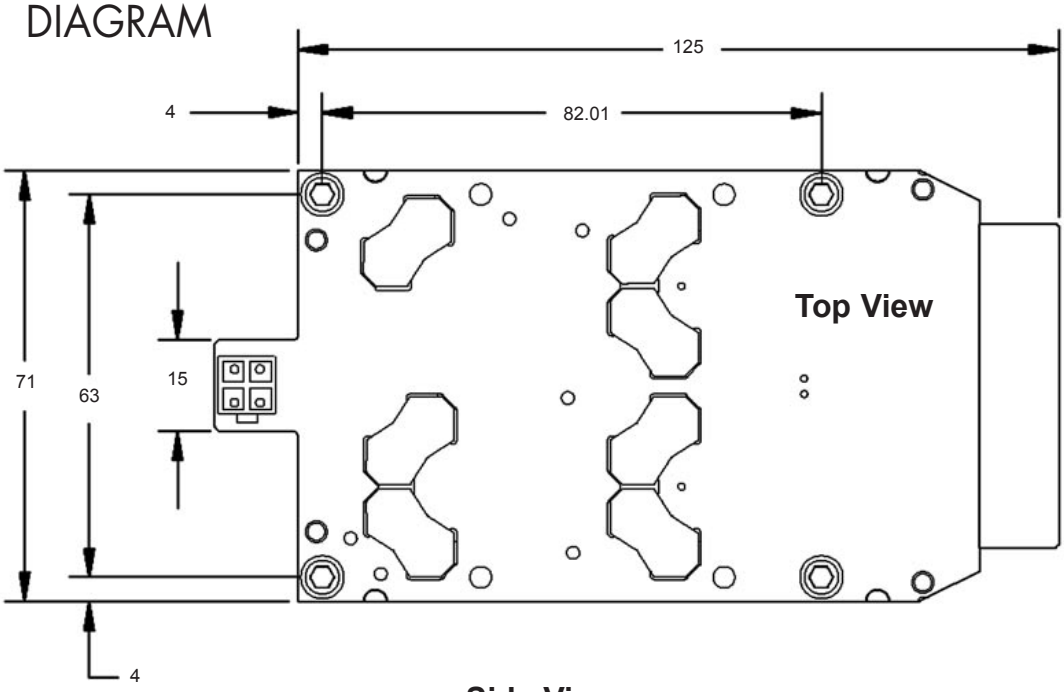


NOTES

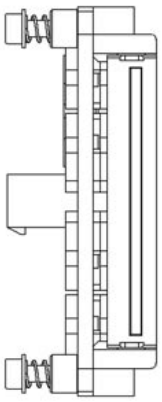
1) All dimensions in millimeters and are for reference only
2) Tolerances: x.x +/-0.25 mm
   x.xx +/-0.125 mm
3) Weight: 11.1 oz. (345 g) typical
4) Workmanship: Meets or exceeds IPC-A-610C Class II

MECHANICAL DIAGRAM

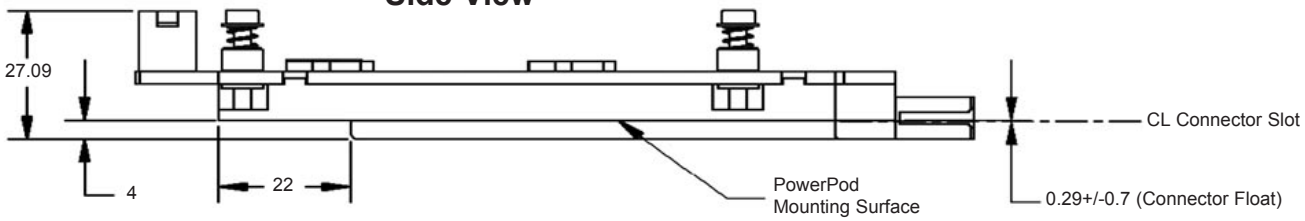
Open Frame Version



Connector View



Side View

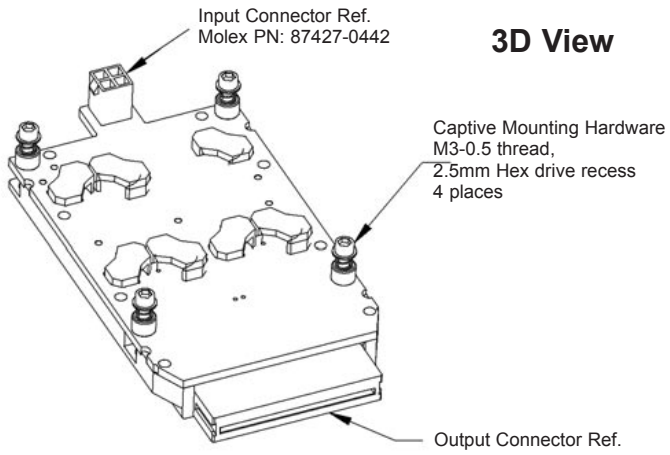


NOTES

1) All dimensions in millimeters and are for reference only
2) Tolerances: x.x +/-0.25 mm
   x.xx +/-0.125 mm
3) Weight: TBD oz. (TBD g) typical
4) Workmanship: Meets or exceeds IPC-A-610C Class II

For information on open frame versions of this module, call SynQor factory.

3D View



HQ50VIDPTB10 ELECTRICAL CHARACTERISTICS

T_A=25°C, airflow rate=300 LFM, V_{in}=48Vdc unless otherwise noted; full operating temperature range is -40°C to +100°C ambient 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			60	V	continuous
Operating			55	V	continuous
Isolation Voltage (input to output)			500	V	Basic insulation level, Pollution degree 2
Operating Temperature	-40		100	°C	
Storage Temperature	-55		125	°C	
Voltage at OUTEN pin	-0.3		4.0	V	
PPODGD Pull-Up Voltage	-0.3		4.0	V	
PPODGD Pull-Up Current			5	mA	
INPUT CHARACTERISTICS					
Operating Input Voltage Range	43.2	48	52.8	V	
Input Under-Voltage Lockout					
Turn-On Voltage Threshold	40	41	42.7	V	
Turn-Off Voltage Threshold	38	39	40	V	
Lockout Hysteresis Voltage	1.5	2.0	2.5	V	
Maximum Input Current			6.0	A	100% Load
No-Load Input Current		0.03		A	at 1.3Vout
Disabled Input Current		1.6	3	mA	
Input Current Transient Rating			0.3	A/µs	all allowable load transients, any frequency
Common Mode Noise			2	Vpp	across 10 Ohms, 20 MHz scope bandwidth
Input Reflected-Ripple Current		10		%Iin Max	peak to peak
Recommended Input Fuse		none required			internal electronic fuse
Recommended External Input Capacitance		none required			fully operational with internal input cap.
OUTPUT CHARACTERISTICS					
Output Voltage Set Point and Static Regulation	-0.75		0.75	%Vout	50% load
Total Output Voltage Range		1.0		%Vout	over Vin, Iout, temperature & life
Output Voltage Ripple and Noise		1	3	%Vout	peak to peak, 20MHz bandwidth
Operating Output Current Range	0		100	A	130 Watt ouput power limit
Output DC Current-Limit Shutdown		125	150	A	
STARTUP CHARACTERISTICS					
OUTEN Debounce Time	2.5		4.5	ms	Figure 3
Output Voltage Rise-Time		1.0		ms	10% to 90%
PPODGD Assertion Time	1.0	1.5	2.5	ms	from 10% Vout
Output Voltage Overshoot			0	%	
SHUTDOWN CHARACTERISTICS					
Delay from OUTEN	10		350	µs	Figure 5
Output Voltage Fall-Time			10	µs	all shutdowns, Crowbar clamped
PPODGD De-assertion Time			20	µs	from output fall
Output Voltage Undershoot			0	%	non-inductive load
DYNAMIC CHARACTERISTICS (1.3Vout)					
Output Voltage during Load Current Transient					
Single Positive Transient			-5	%Vout	75% to 100% Iout max; Figure 7
Single Negative Transient			5	%Vout	100% to 75% Iout max; Figure 8
Repetitive, arbitrary duty cycle, F<1MHz			±7	%Vout	guaranteed by design, no test in prod.
DYNAMIC CHARACTERISTICS (1.5Vout)					
Output Voltage during Load Current Transient					
Single Positive Transient			-5	%Vout	75% to 100% Iout max; Figure 7
Single Negative Transient			5	%Vout	100% to 75% Iout max; Figure 8
Repetitive, arbitrary duty cycle, F<1MHz			±7	%Vout	guaranteed by design, no test in prod.
EFFICIENCY (1.3Vout)					
100% Load		86.0		%	Figure 1
80% Load		88.0		%	
60% Load		89.0		%	
40% Load		89.5		%	
EFFICIENCY (1.7Vout)					
100% Load		90.0		%	Figure 1
80% Load		91.0		%	
60% Load		91.0		%	
40% Load		90.5		%	
MEASURED TEMPERATURES					
Maximum Temperatures Measured					Full rated output power, 85°C baseplate
Power Semiconductor Junction Temperature			92	°C	Package rated to 150°C
Board Temperature			93	°C	UL rated max operating temp 130°C
Transformer Temperature			93	°C	

Note: For more detailed data on other output voltages, please contact factory. Specifications subject to change without notice.

ELECTRICAL CHARACTERISTICS (Continued)

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
ISOLATION CHARACTERISTICS					
Isolation Voltage	500			V	
Isolation Resistance	10			MΩ	
Isolation Capacitance		3300		pF	
FEATURE CHARACTERISTICS					
Switching Frequency	350	450	500	kHz	100% static load
Control Pins (VID, OUTEN)					
Internal Pull-Up Voltage	3.0		3.6	V	
Internal Pull-Up Resistance		5		kΩ	
Output Voltage VID	0.95		1.7	V	
Output Voltage Remote Sense Range			+10	%Vout	
Output Over-Voltage Protection		112		%	of maximum VID; over full temp range
Output Under-Voltage Shutdown		91		%Vout	from set VID
Over-Temperature Shutdown		115		°C	Average PCB Temperature
Over-Temperature Shutdown Restart Hysteresis		10		°C	
Electronic Fuse Trip Current	7		10	A	Input current limit
Max Connector Drop Shutdown			0.3	V	connector output voltage - sensed voltage
RELIABILITY CHARACTERISTICS					
Calculated MTBF (Telcordia)		1.55		10^6 Hrs.	TR-NWT-000332; 80% load,300LFM, 55ºC T_a
Calculated MTBF (MIL-217)		TBD		10^6 Hrs.	MIL-HDBK-217F; 80% load, 300LFM, 55ºC T_a
Demonstrated MTBF		TBD		10^6 Hrs.	Field demonstrated MTBF

STANDARDS COMPLIANCE

Parameter	Notes
STANDARDS COMPLIANCE	
Needle Flame Test (IEC 695-2-2)	test on entire assembly; board & plastic components UL94V-0 compliant
IEC 61000-4-2	ESD test, 8kV - NP, 15kV air - NP (Normal Performance)
GR-1089-CORE	Section 7 - electrical safety, Section 9 - bonding/grounding

• An external input fuse must always be used to meet these safety requirements

QUALIFICATION TESTING

Parameter	# Units	Test Conditions
QUALIFICATION TESTING		
Life Test	32	95% rated Vin and load, units at derating point, 1000 hours
Vibration	5	10-55Hz sweep, 0.060" total excursion,1 min./sweep, 120 sweeps for 3 axis
Mechanical Shock	5	100G minimum, 3 drops in x and y axis, 1 drop in 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, 85% RH, 1000 hours, 2 minutes on and 6 hours off
ADDITIONAL INTEL TESTS		
High Temperature Bake	5	200 hours at 125°C
Mechanical Shock	5	75G, 4ms dwell; 2 drops on each of 6 axis
On/Off Cycling	6	Minimum load 600 times; Maximum load 3200 times
Vibration	5	4.8G RMS random vibration from 5-500Hz; 10 minutes each on 3 axis
Durability	5	60 plug and unplug cycles

• Extensive characterization testing of all SynQor products and manufacturing processes is performed to ensure that we supply robust, reliable product. Contact factory for more information about Proof of Design and Proof of Manufacturing processes.

OPTIONS

SynQor provides various packaging options for this family of DC/DC converters. Please consult the last page of this specification sheet for information on available options.

PATENTS

SynQor is protected under various patents, including but not limited to U.S. Patent numbers: 5,999,417; 6,222,742 B1; 6,594,159 B2; 6,545,890 B2.

Performance Curves

$48V_{in}$ $0.95\text{-}1.7V_{out}$ $130W_{out}$

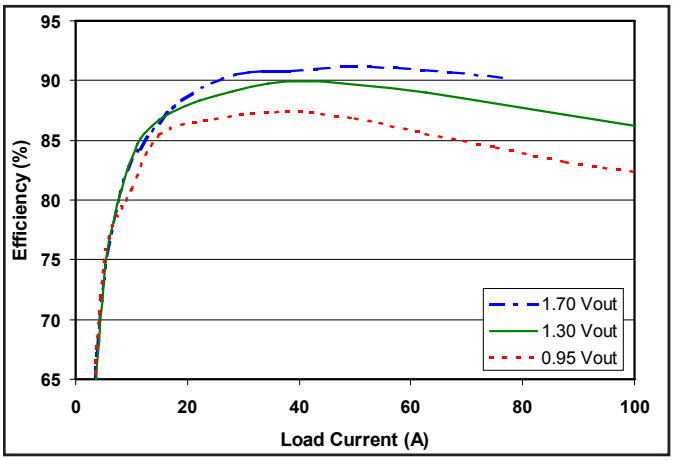


Figure 1: *Efficiency at nominal output voltage vs. load current for 1.7, 1.3 and 0.95Vout at 25°C. Data is measured at output of connector.*

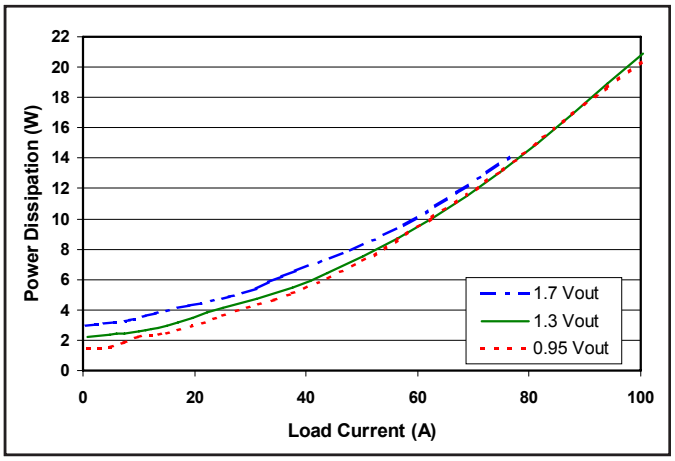


Figure 2: *Power dissipation at nominal output voltage vs. load current for 1.7, 1.3 and 0.95Vout at 25°C. Data is measured at output of connector.*

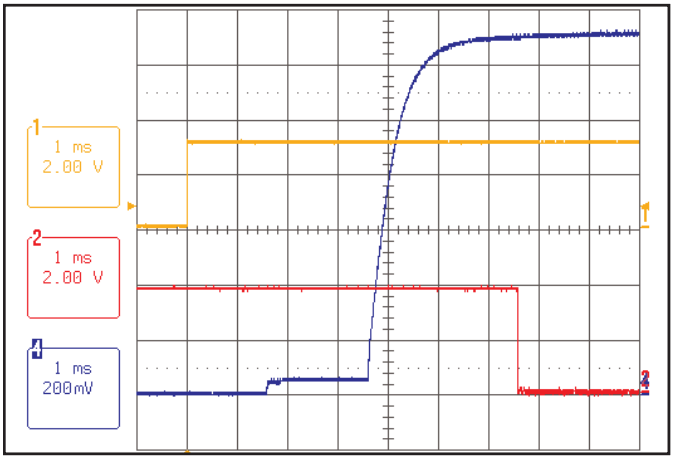


Figure 3: *Startup waveforms for 1.3Vout module (1ms/div). Yellow trace (ch1) = OUTEN (2V/div); Blue trace (ch4) = Output Voltage (200mV/div); Red trace (ch2) = PPODGD (2V/div).*

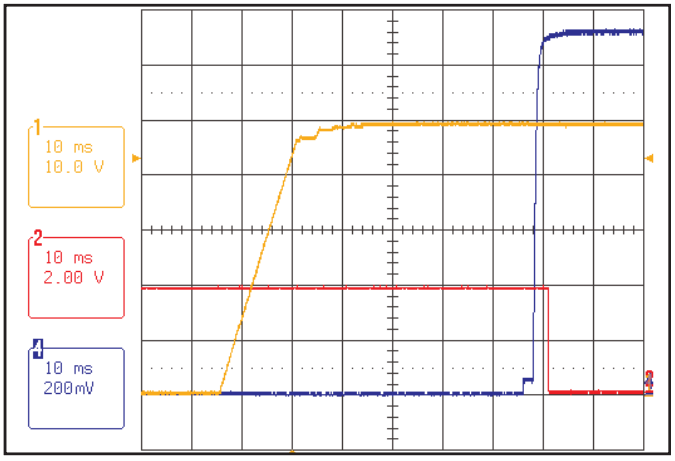


Figure 4: *Turn-On from input voltage rise for 1.3Vout module (10 ms/div). Yellow trace (ch1) = Input Voltage (10V/div); Blue trace (ch4) = Output Voltage (200mV/div); Red trace (ch2)= PPODGD (2V/div).*

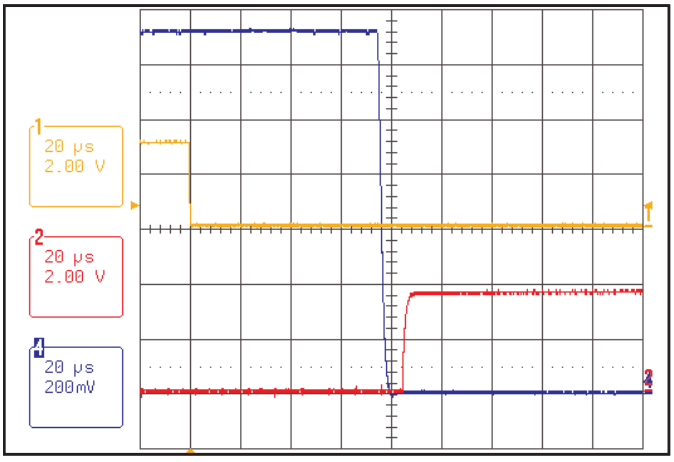


Figure 5: *Shutdown waveforms for 1.3Vout module (20µs/div). Yellow trace (ch1) = OUTEN (2V/div); Blue trace (ch4) = Output Voltage (200mV/div); Red trace (ch2) = PPODGD (2V/div).*

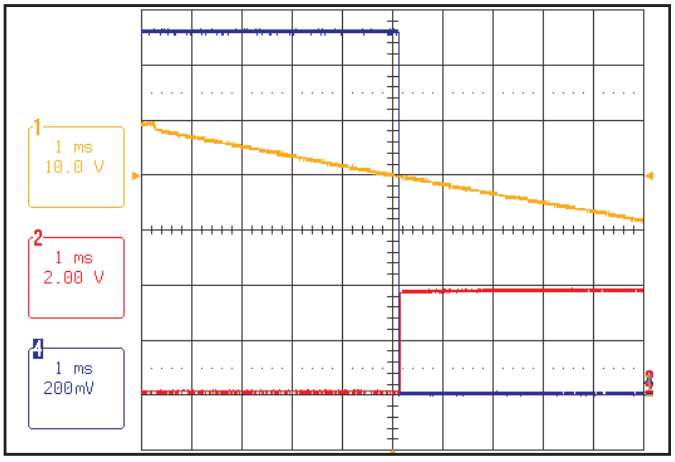


Figure 6: *Turn-Off from input voltage fall for 1.3Vout module (1.0 ms/div). Yellow trace (ch1) = Input Voltage (10V/div); Blue trace (ch4) = Output Voltage (200mV/div); Red trace (ch2) = PPODGD (2V/div).*

Performance Curves

$48V_{in}$ $0.95\text{-}1.7V_{out}$ $130W_{out}$

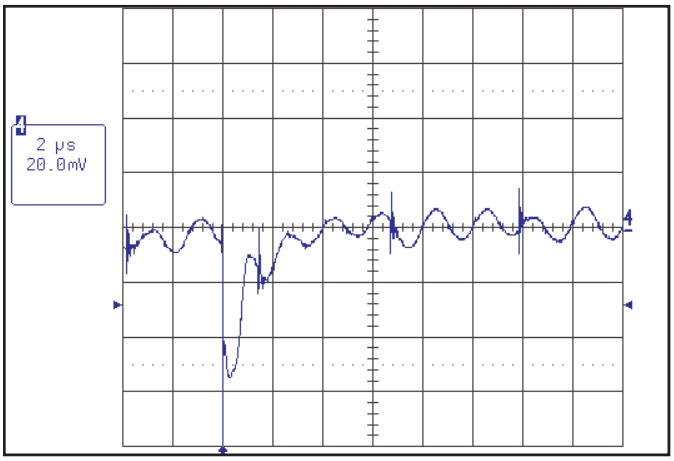


Figure 7: *Output voltage response to a single positive load current transient (75 to 100A; di/dt = 100A/µs) at load side output connector with 50µF distributed ceramic capacitance. Vout (20mV/div). See Note 1 below.*

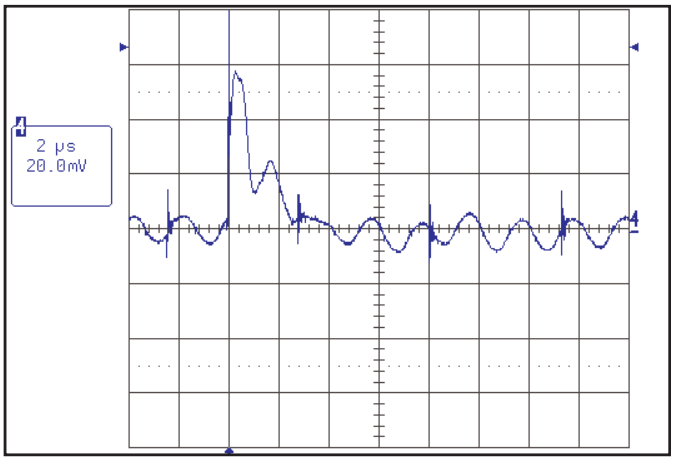


Figure 8: *Output voltage response to a single negative load current transient (100 to 75A; di/dt = 100A/µs) at load side output connector with 50µF distributed ceramic capacitance. Vout (20mV/div). See Note 1 below.*

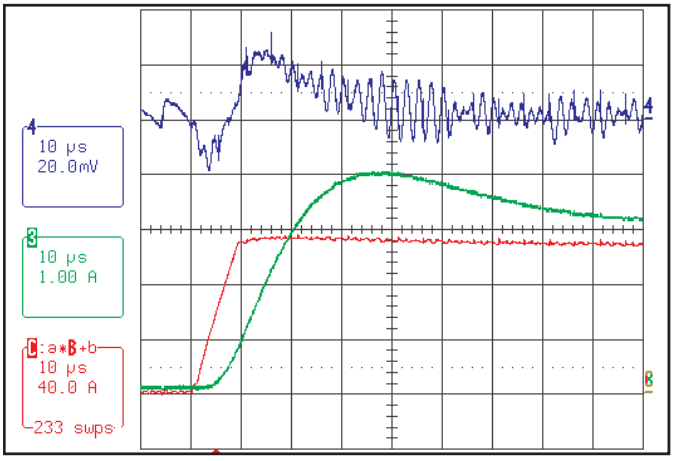


Figure 9: *Output voltage response to a load current transient (0-100A; di/dt = 10A/µs) for 1.3V module. Blue trace (ch4) = Vout (20mV/div); Green trace (ch3) = Input Current (1A/div); Red trace (chC)= Output Current (40A/div).*

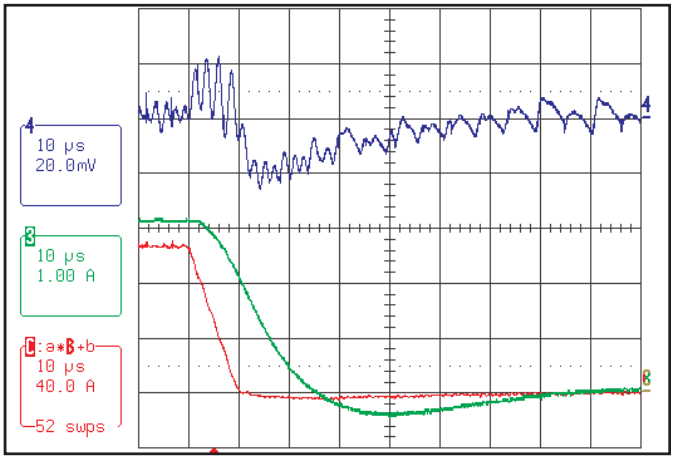


Figure 10: *Output voltage response to a load current transient (100-0A; di/dt = 10A/µs) for 1.3V module. Blue trace (ch4) = Vout (20mV/div); Green trace (ch3) = Input Current (1A/div); Red trace (chC) = Output Current (40A/div).*

Note 1: *For Figures 7 & 8 above, the shape of each response varies depending on the exact time of the transient relative to a switching cycle. The peak deviation of the pictured transient responses is at the worst case.*

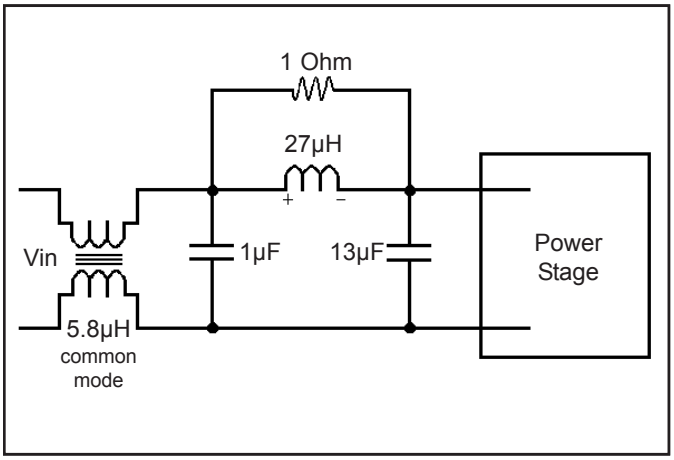


Figure 11: *Internal Input Filter Diagram*

Performance Curves

$48V_{in}$ 0.95-1.7V_{out} 130W_{out}

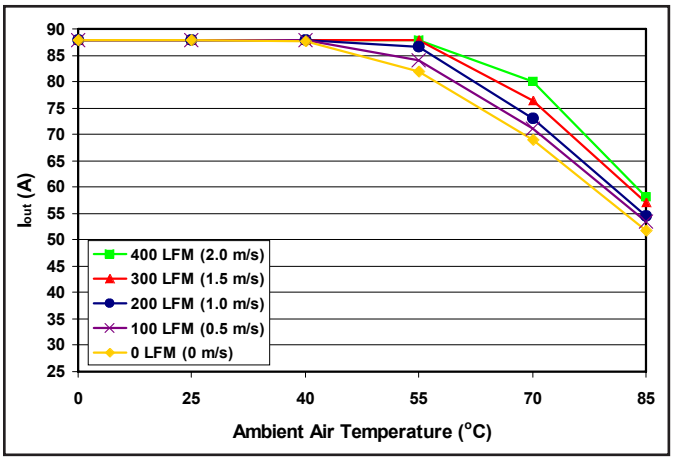


Figure 12: *Maximum output power derating curves for open frame version of module at* ***1.5Vout*** *and nominal Vin vs. ambient air temp for airflow rates 0-400 LFM with air flowing from output to input.*

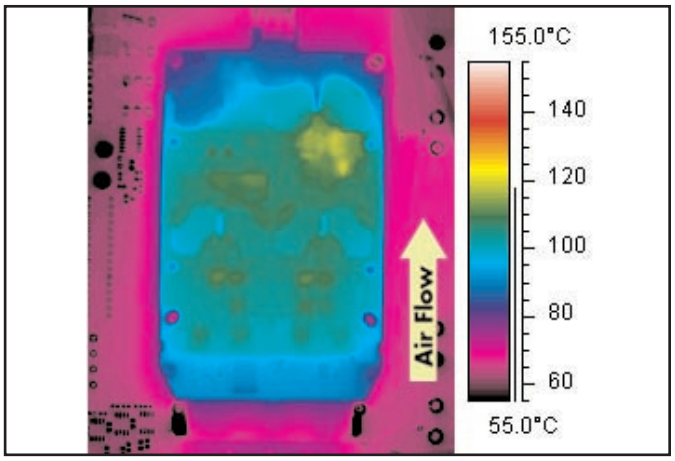


Figure 13: *Thermal plot of open frame converter at* ***1.5Vout*** *and 87A load current (130W) with 55°C air flowing at the rate of 200 LFM. Air is flowing across the converter from output to input (nominal Vin).*

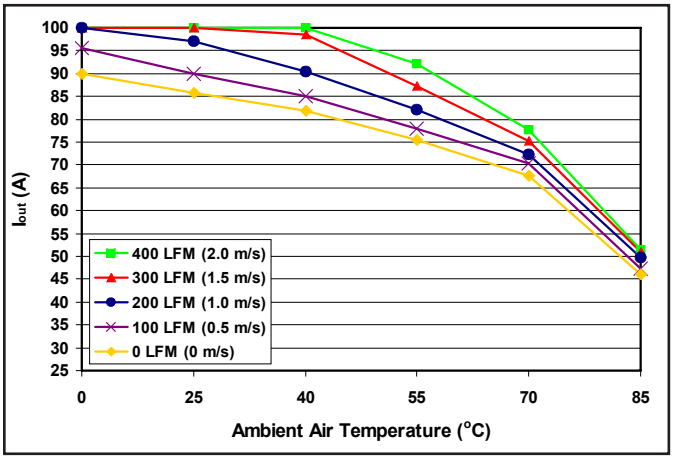


Figure 14: *Maximum output power derating curves for open frame version of module at* ***1.3Vout*** *and nominal Vin vs. ambient air temp for airflow rates 0-400 LFM with air flowing from output to input.*

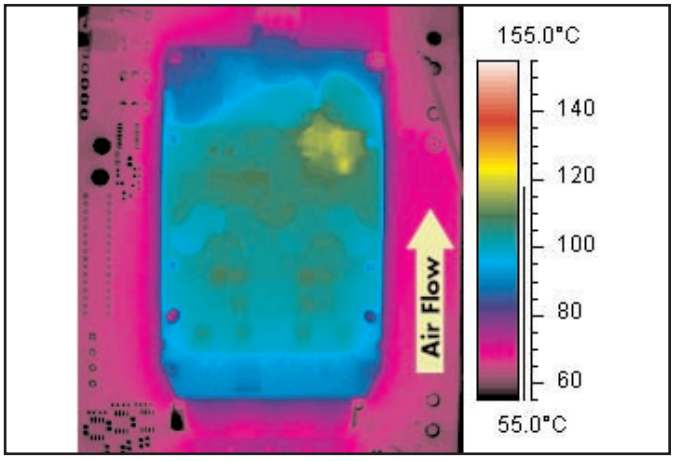


Figure 15: *Thermal plot of open frame converter at* ***1.3Vout*** *and 83A load current (108W) with 55°C air flowing at the rate of 200 LFM. Air is flowing across the converter from output to input (nominal Vin).*

BASIC OPERATION AND FEATURES

The SynQor *Hyper*Qor PowerPod meets or exceeds industry specifications for power supplies used to power the Intel Itanium2 processor. The converter supplies an isolated 0.95V-1.7V output, with an input in the range of 43.2V-52.8V. The converter contains an input filter and common mode choke, and no further input filtering is required.

CONTROL SIGNALS

5 bit VID: The output voltage is set by the 5 bit VID input digital signals. VID signals are TTL-compatible with internal pull up resistors to 3.3V. If all inputs are open the converter will disable.

Output Enable: The output enable signal enables the converter and resets all converter faults except output over voltage and sense lines protection faults. A high signal on output enable turns the converter on. Cycling output enable low then high to reset faults.

Processor Present: The CPUPres signal is tied internally to OUT(-) through a 50Ω resistor. This signals to the system that the PowerPod is attached to the CPU board.

Power Good: The power good signal is asserted low after the output of the converter becomes valid. Power good is an open collector signal, and is set floating when the converter output is off.

PROTECTION FEATURES

Electronic Input Fuse: The *Hyper*Qor PowerPod has a self-resetting internal electronic input fuse. The input fuse will disconnect the PowerPod from the input power if the converter draws excess current. If the 48V input bus impedance is less than 0.5Ω, an internal short across the input rail will not disturb the 48V input bus significantly. Other PowerPods connected to the same 48V bus will continue to operate properly.

Thermal Shutdown, Current Limit, Input UVLO: Thermal shutdown, current limit, and input undervoltage lockout are all latching faults. If one of these faults is triggered, the module shuts down and remains off until input voltage is cycled or the output enable signal is cycled.

Output OVP, Open/Shorted Sense Leads: Output overvoltage faults latch the converter off. The *Hyper*Qor PowerPod will not attempt to restart until the input voltage is brought to zero and then back to its nominal state. In order to protect against circumstances where the processor card is not fully inserted into the PowerPod output connector, the converter also has protection features on the voltage sense leads. If the voltage on the sense pins differs from the voltage on the output pins by more than approximately 0.5V, an OVP-style fault is tripped, requiring the input to be cycled low then high to reset the fault.

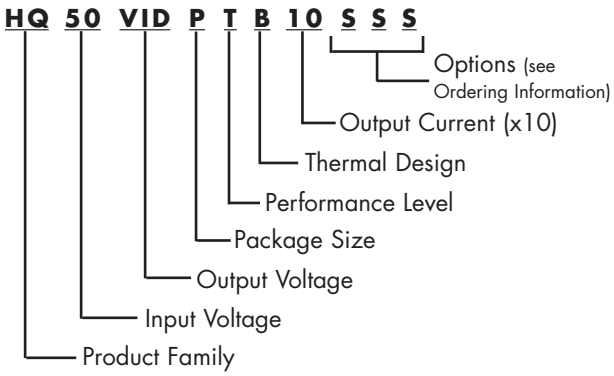
Output Clamp: When the SynQor converter has input power, but is off due to either a fault of the state of the output enable, an output clamp is active. The output clamp provides a low impedance connection between the output(+) and the output(-) rails, and will prevent significant voltage from being present on the output.

Technical Specification

$48V_{in}$ $0.95\text{-}1.7V_{out}$ $130W_{out}$

PART NUMBERING SYSTEM

The part numbering system for SynQor's *Hyper*Qor DC/DC converters follows the format shown in the example below.



The first 12 characters comprise the base part number and the last 3 characters indicate available options.

Application Notes

A variety of application notes and technical white papers can be downloaded in pdf format at www.synqor.com.

ORDERING INFORMATION

The tables below show the valid model numbers and ordering options for converters in this product family. When ordering SynQor converters, please ensure that you use the complete 15 character part number consisting of the 12 character base part number and the additional 3 characters for options. The "B" in the 10th character of the part number indicates a baseplated version. The open frame versions of this product has an "A" in this position. Please consult SynQor factory for more information.

Model Number	Input Voltage	Output Voltage	Max Output Current
HQ50VIDPTB10*xyz*	43.2 - 52.8 V	0.95 - 1.7 V	100 A
HQ50VIDPTA10*xyz*	43.2 - 52.8 V	0.95 - 1.7 V	100 A

The following option choices must be included in place of the *x y z* spaces in the model numbers listed above.

Options Description: *x y z*		
Board Type	**Connector Type**	**Feature Set**
S - Single board	S - Standard	S - Standard

Contact SynQor for further information:

Phone: 978-849-0600
Toll Free: 888-567-9596
Fax: 978-849-0602
E-mail: sales@synqor.com
Web: www.synqor.com
Address: 155 Swanson Road
Boxborough, MA 01719

Warranty
SynQor offers a three (3) year limited warranty. Complete warranty information is listed on our web site or is available upon request from SynQor.