Technical Specification
IQ4HxxxHTXxxx

180-425V	475V	1.8-48V	300W	4250V dc	Half-brick
Continuous Input	Transient Input	Outputs	Max Power	Reinforced Insulation	DC-DC Converter

The InQor half-brick converter series is composed of next-generation, board-mountable, isolated (**REINFORCED INSULATION**), fixed switching frequency dc-dc converters that use synchronous rectification to achieve extremely high power conversion efficiency. Each module is supplied completely encased to provide protection from the harsh environments seen in many industrial and transportation applications.

Operational Features

- High efficiency, 82%-88% at full rated load current
- Delivers full power with minimal derating.
- Operating input voltage range: 180-425V
- Fixed frequency switching provides predictable EMI
- Current share,Clock synch,Start synch(Full Feature only)
- No minimum load requirement

Mechanical Features

- Industry standard Half-brick pin-out configuration
- Size: 2.386" x 2.486" x 0.512" (60.60 x 63.14 x 13.00 mm)
- Total weight: 4.9 oz (139 g)
- Flanged baseplate version available

Control Features

- On/Off control referenced to input side
- Remote sense for the output voltage compensates for output distribution drops
- Output voltage trim range of -20%, +10%

Safety Features

Reinforced Insulation

- Input-to-output isolation 4250V dc
- UL 60950-1 2nd Ed. 2007
- CAN/CSA-C22.2 No. 60950-1-07
- EN60950-1 Ed. 2.0
- CE Marked
- RoHS compliant (see last page)

Protection Features

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

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IQ4H-HT Family Electrical Characteristics

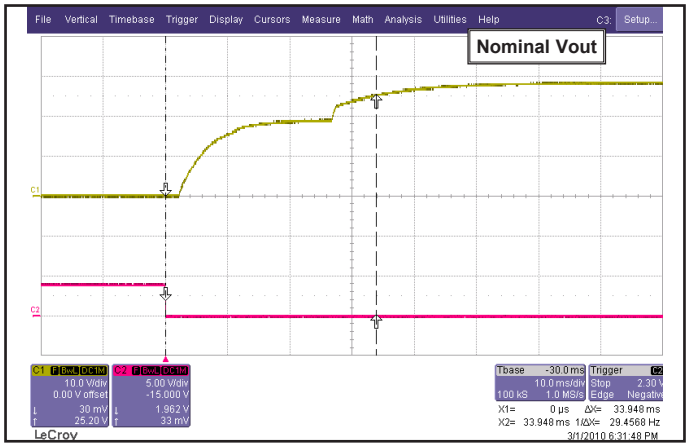
Ta = 25 °C, airflow rate = 300 LFM, Vin = 385V dc unless otherwise noted; full operating temperature range is -40 °C to +90 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					
Non-Operating			600	V	Continuous
Operating			425	V	Continuous
Operating Transient Protection			475	V	1Sec transient, square wave
Isolation Voltage					
Input to Output			4250	V dc	Reinforced Insulation
Input to Base-Plate			2300	V dc	Basic Insulation
Output to Base-Plate			2300	V dc	Basic Insulation
Operating Temperature	-40		90	°C	Baseplate temperature
Storage Temperature	-55		125	°C	
Voltage at ON/OFF input pin	-2		18	V	
INPUT CHARACTERISTICS					
Operating Input Voltage Range	180	385	425	V	475V transient for 1Sec; see Note 1
Input Under-Voltage Lockout					
Turn-On Voltage Threshold	169.0	174.0	178.0	V	
Turn-Off Voltage Threshold	158.0	162.0	166.0	V	
Lockout Voltage Hysteresis		10.0		V	
Input Over-Voltage Shutdown		500		V	
Recommended External Input Capacitance		3.3		µF	Typical ESR 8 Ω
Input Filter Component Values (L\C)		11\0.41		µH\µF	Internal values; see Figure E
DYNAMIC CHARACTERISTICS					
Turn-On Transient					
Turn-On Time		42		ms	Full load, Vout=90% nom.
Start-Up Inhibit Time	360	400	440	ms	-40 °C to +85 °C; Figure F
Output Voltage Overshoot		0		%	Maximum Output Capacitance
ISOLATION CHARACTERISTICS					
Isolation Voltage (dielectric strength)			4250	V	See Absolute Maximum Ratings
Isolation Resistance		100		MΩ	per EN 60255-5
Isolation Capacitance (input to output)		N/A		pF	See Note 2
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	510	550	590	kHz	Isolation stage switching freq. is half this
ON/OFF Control					
Off-State Voltage	2.4		18	V	
On-State Voltage	-1.0		0.8	V	
ON/OFF Control					Application notes Figures A & B
Pull-Up Voltage		5		V	
Pull-Up Resistance		68		kΩ	
Over-Temperature Shutdown OTP Trip Point		125		°C	Average PCB Temperature
Over-Temperature Shutdown Restart Hysteresis		10		°C	
RELIABILITY CHARACTERISTICS					
Calculated MTBF (Telcordia) TR-NWT-000332		837		10^3 Hrs.	Tb = 70°C
Calculated MTBF (MIL-217) MIL-HDBK-217F		928		10^3 Hrs.	Tb = 70°C
Field Demonstrated MTBF				10^3 Hrs.	See our website for details

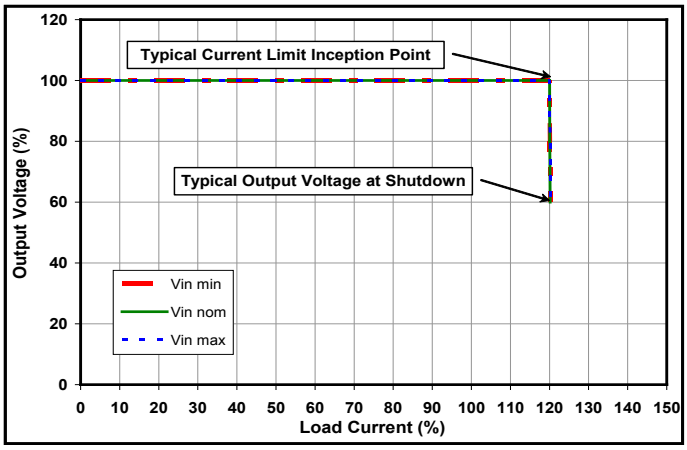
Note 1: Input Voltage Transient dv/dt=1 V/ us

Note 2: Isolation capacitance can be added external to the module.

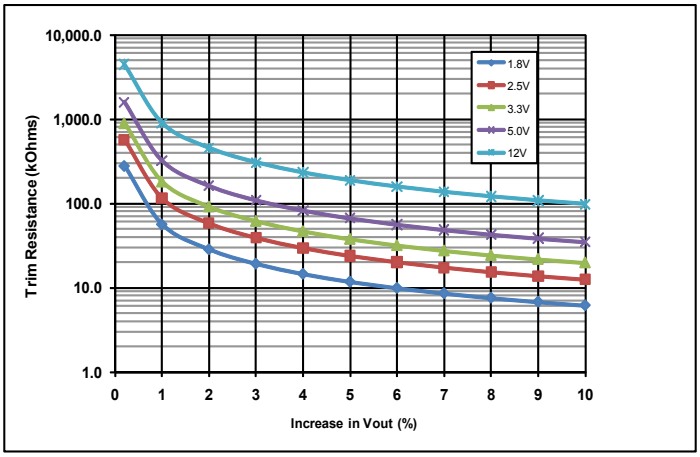
Family Figures (all output voltages)



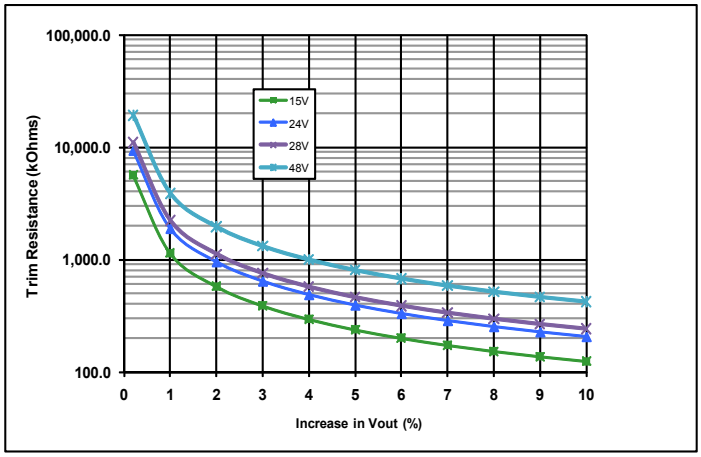
Common Figure 1: Typical startup waveform. Input voltage pre-applied, ON/ OFF Pin on Ch 2.



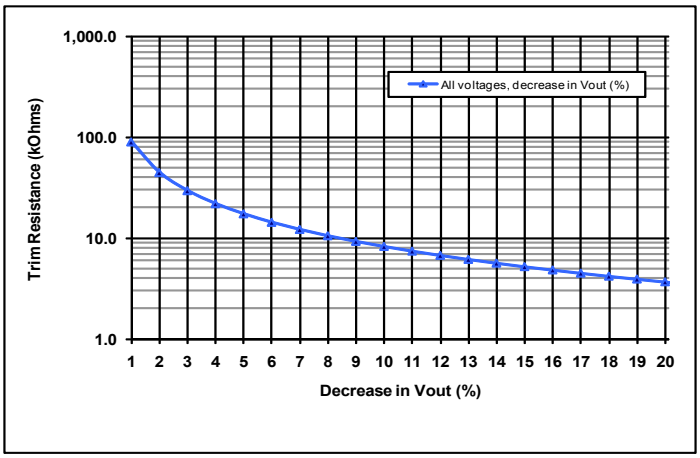
Common Figure 2: Output voltage vs. load current showing typical current limit curves and converter shutdown points.



Common Figure 3: Trim graph for trim-up 1.8 to 12V outputs.



Common Figure 4: Trim graph for trim-up 15 to 48V outputs.



Common Figure 5: Trim graph for trim down.

IQ4H018HTX70 Electrical Characteristics (1.8 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385V dc unless otherwise noted; full operating temperature range is -40 °C to +90 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
INPUT CHARACTERISTICS					
Maximum Input Current			1.4	A	Vin min; trim up; in current limit
No-Load Input Current		50	60	mA	
Disabled Input Current		5.0	10.0	mA	
Response to Input Transient		0.09		V	Peak, see Figure 6
Input Terminal Ripple Current		40		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			2.0	A	Fast acting external fuse recommended
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	1.782	1.800	1.818	V	
Output Voltage Regulation					
Over Line		±0.0020	±0.3	%	
Over Load		±0.0020	±0.3	%	
Over Temperature	-27.0	±3.0	27.0	mV	
Total Output Voltage Range	1.755		1.845	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 1
Peak-to-Peak	0	100	200	mV	Full load
RMS		50	100	mV	Full load
Operating Output Current Range	0		70	A	Subject to thermal derating
Output DC Current-Limit Inception	77	88	98	A	Output voltage 10% Low
Output DC Current-Limit Shutdown Voltage		0.90		V	
Back-Drive Current Limit while Enabled		7.0		A	Negative current drawn from output
Back-Drive Current Limit while Disabled		2.5		mA	Negative current drawn from output
Maximum Output Capacitance			35,000	µF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/µs)		60		mV	50% to 75% to 50% Iout max
Settling Time		150		µs	To within 1% Vout nom
Output Voltage Trim Range	-20		10	%	Across Pins 8&4; Common Figures 3-5; see Note 2 &3
Output Voltage Remote Sense Range			10	%	Across Pins 8&4
Output Over-Voltage Protection	2.1	2.3	2.4	V	Over full temp range
EFFICIENCY					
100% Load		79		%	See Figure 1 for efficiency curve
50% Load		78		%	See Figure 1 for efficiency curve

Note 1: Output is terminated with 1 µF ceramic and 15 µF low-ESR tantalum capacitors. For applications requiring reduced output voltage ripple and noise, consult SynQor applications support (e-mail: support@synqor.com)

Note 2: Trim-up range is limited below 10% at low line and full load.

Note 3: Maximum Trim-up is 10%. Applying 6.2V between trim pin and Vout(-) may damge the unit.

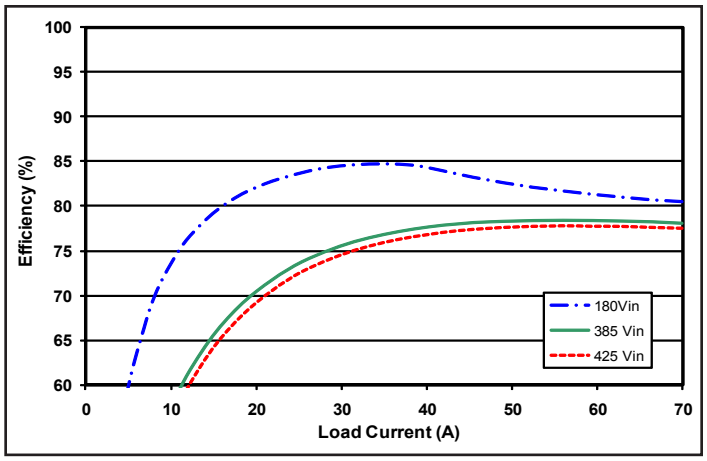


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

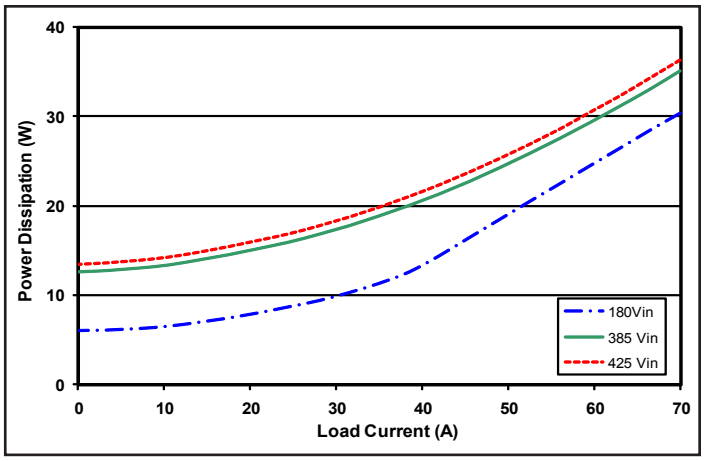


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

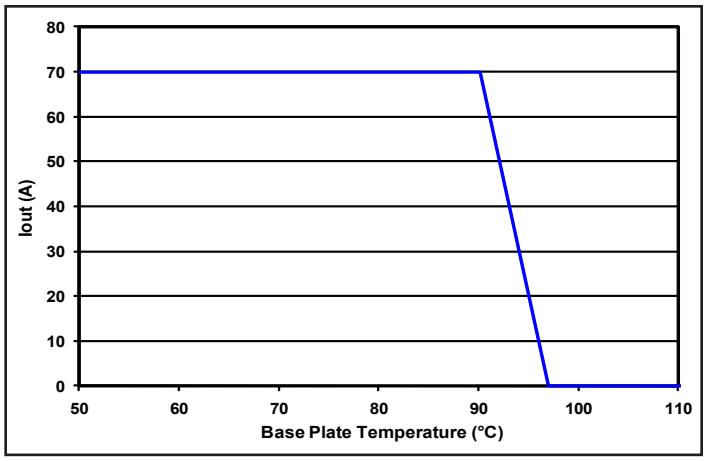


Figure 3: Open Frame converter max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

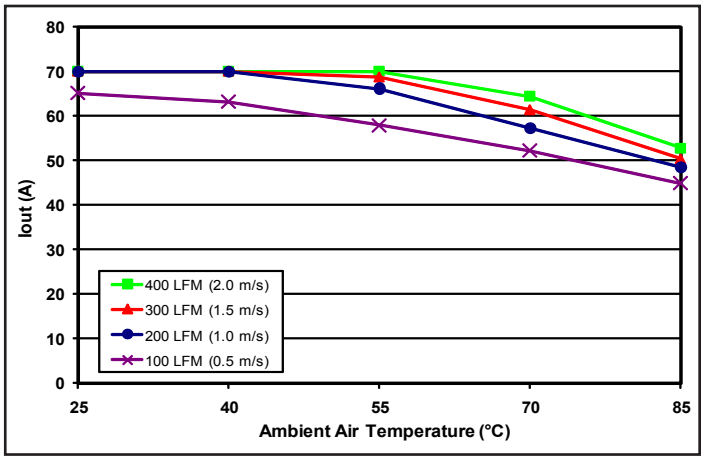


Figure 4: Encased converter (with 0.7" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

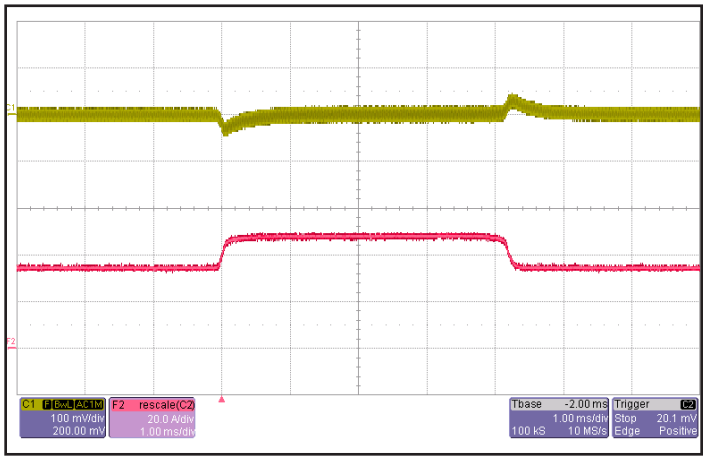


Figure 5: Output voltage response to step-change in load current (50%-100%-50% of Iout(max); dI/dt = 0.1A/µs). Load cap: 15µF tantalum cap and 1µF ceramic cap. Ch 1: Vout (100mV/div), Ch 2: Iout (20A/div).

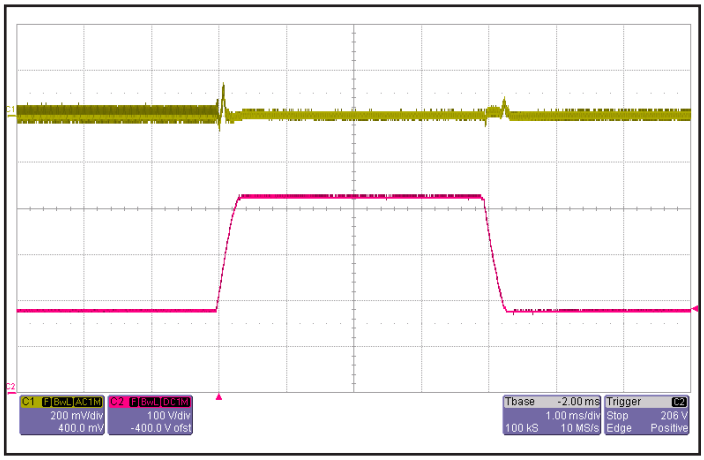


Figure 6: Output voltage response to step-change in input voltage (180V-425V-180V), at 70A load current. Load cap: 15µF tantalum capacitor and 1uF ceramic cap. Ch 1: Vout (200mV/div), Ch 2: Vin (100V/div).

IQ4H025HTX60 Electrical Characteristics (2.5 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385V dc unless otherwise noted; full operating temperature range is -40 °C to +90 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
INPUT CHARACTERISTICS					
Maximum Input Current			1.9	A	Vin min; trim up; in current limit
No-Load Input Current		50	60	mA	
Disabled Input Current		5.0	10.0	mA	
Response to Input Transient		0.12		V	Peak, see Figure 6
Input Terminal Ripple Current		40		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			2.0	A	Fast acting external fuse recommended
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	2.475	2.500	2.525	V	
Output Voltage Regulation					
Over Line		±0.0020	±0.3	%	
Over Load		±0.0020	±0.3	%	
Over Temperature	-37.5	±3.0	37.5	mV	
Total Output Voltage Range	2.437		2.563	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 1
Peak-to-Peak	0	90	120	mV	Full load
RMS		45	90	mV	Full load
Operating Output Current Range	0		70	A	Subject to thermal derating
Output DC Current-Limit Inception	77	88	98	A	Output voltage 10% Low
Output DC Current-Limit Shutdown Voltage		1.2		V	
Back-Drive Current Limit while Enabled		7.0		A	Negative current drawn from output
Back-Drive Current Limit while Disabled		2.5		mA	Negative current drawn from output
Maximum Output Capacitance			30,000	µF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/µs)		60		mV	50% to 75% to 50% Iout max
Settling Time		400		µs	To within 1% Vout nom
Output Voltage Trim Range	-20		10	%	Across Pins 8&4; Common Figures 3-5; see Note 2 &3
Output Voltage Remote Sense Range			10	%	Across Pins 8&4
Output Over-Voltage Protection	2.9	3.1	3.3	V	Over full temp range
EFFICIENCY					
100% Load		80		%	See Figure 1 for efficiency curve
50% Load		79		%	See Figure 1 for efficiency curve

Note 1: Output is terminated with 1 µF ceramic and 15 µF low-ESR tantalum capacitors. For applications requiring reduced output voltage ripple and noise, consult SynQor applications support (e-mail: support@synqor.com)

Note 2: Trim-up range is limited below 10% at low line and full load.

Note 3: Maximum Trim-up is 10%. Applying 6.2V between trim pin and Vout(-) may damge the unit.

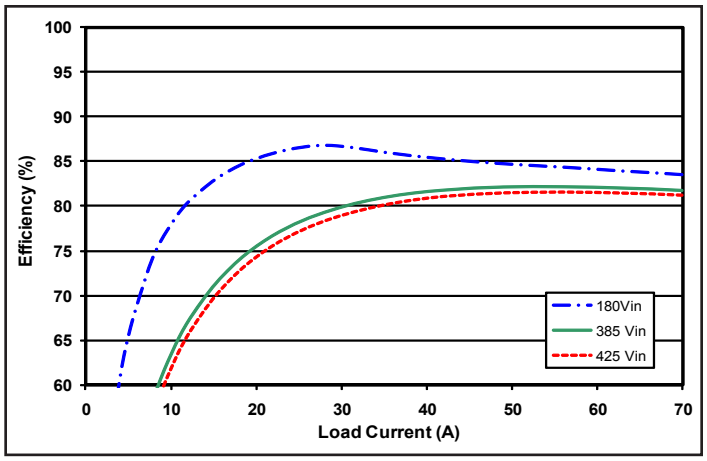


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

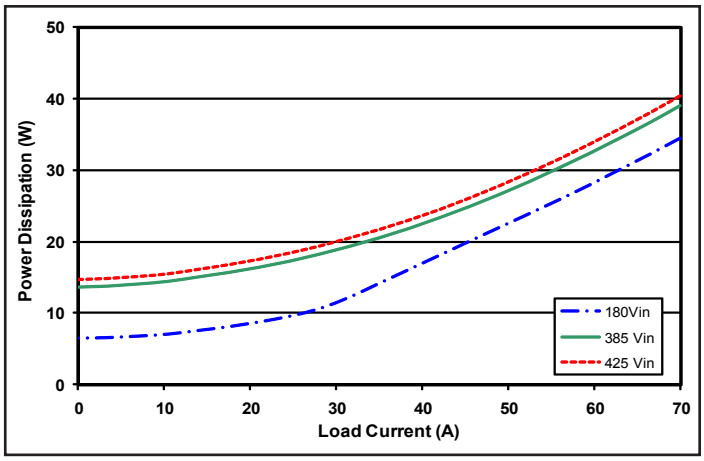


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

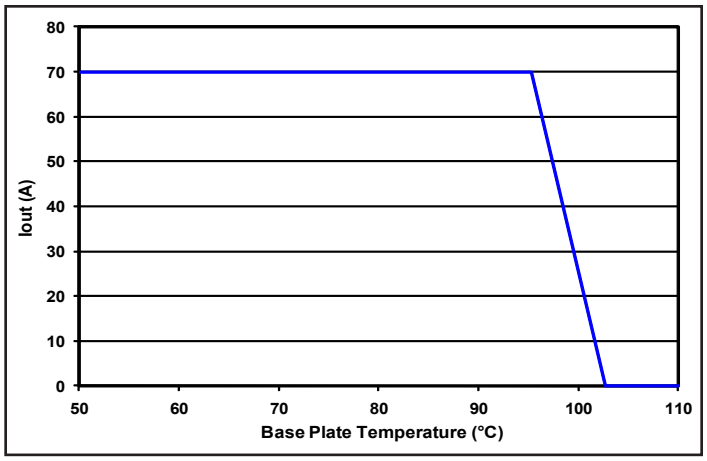


Figure 3: Open Frame converter max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

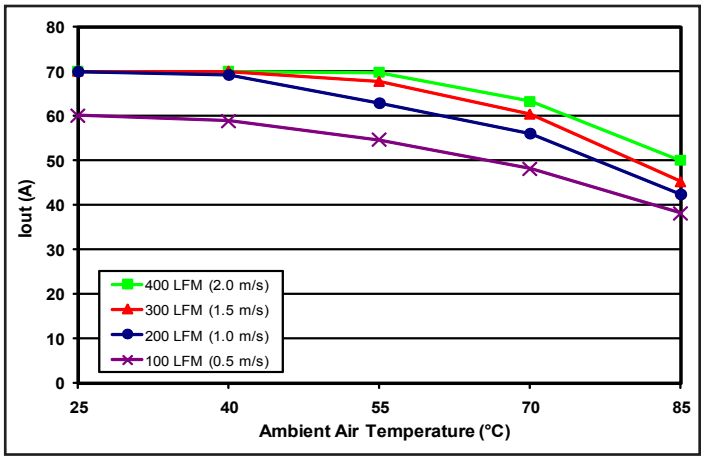


Figure 4: Encased converter (with 0.7" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

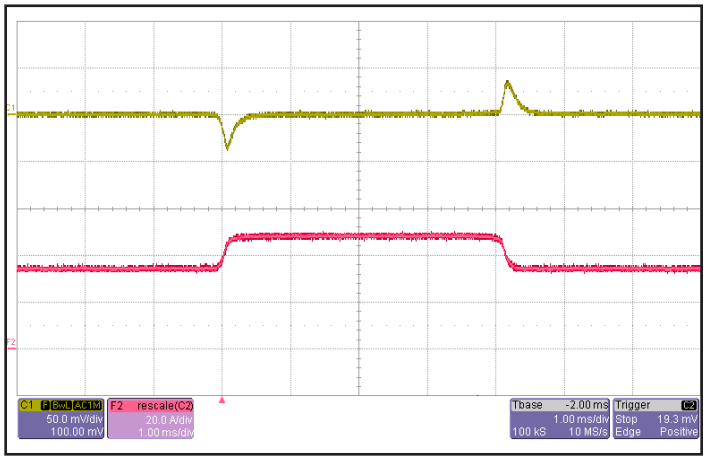


Figure 5: Output voltage response to step-change in load current (50%-100%-50% of Iout(max); dI/dt = 0.1A/µs). Load cap: 15µF tantalum cap and 1µF ceramic cap. Ch 1: Vout (50mV/div), Ch 2: Iout (20A/div).

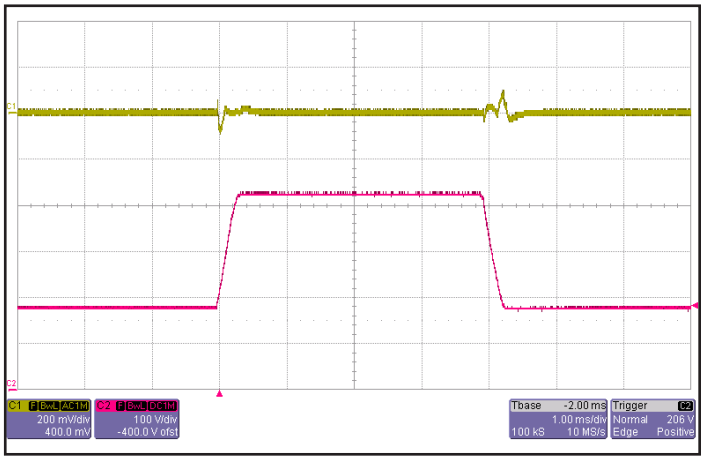


Figure 6: Output voltage response to step-change in input voltage (180V-425V-180V), at 70A load current. Load cap: 15µF tantalum capacitor and 1uF ceramic cap. Ch 1: Vout (200mV/div), Ch 2: Vin (100V/div).

IQ4H033HTX60 Electrical Characteristics (3.3 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385V dc unless otherwise noted; full operating temperature range is -40 °C to +90 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
INPUT CHARACTERISTICS					
Maximum Input Current			2.0	A	Vin min; trim up; in current limit
No-Load Input Current		50	60	mA	
Disabled Input Current		5.0	10.0	mA	
Response to Input Transient		0.15		V	Peak, see Figure 6
Input Terminal Ripple Current		40		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting external fuse recommended
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	3.267	3.300	3.333	V	
Output Voltage Regulation					
Over Line		±0.0040	±0.3	%	
Over Load		±0.0040	±0.3	%	
Over Temperature		±2.0		mV	
Total Output Voltage Range	3.217		3.383	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 1
Peak-to-Peak	0	120	240	mV	Full load
RMS		45	90	mV	Full load
Operating Output Current Range	0		60	A	Subject to thermal derating
Output DC Current-Limit Inception	66	75	84	A	Output voltage 10% Low
Output DC Current-Limit Shutdown Voltage		1.6		V	
Back-Drive Current Limit while Enabled		5.0		A	Negative current drawn from output
Back-Drive Current Limit while Disabled		3.0		mA	Negative current drawn from output
Maximum Output Capacitance			25,000	µF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/µs)		75		mV	50% to 75% to 50% Iout max
Settling Time		350		uS	To within 1% Vout nom
Output Voltage Trim Range	-20		10	%	Across Pins 8&4; Common Figures 3-5; see Note 2 &3
Output Voltage Remote Sense Range			10	%	Across Pins 8&4
Output Over-Voltage Protection	3.8	4.1	4.4	V	Over full temp range
EFFICIENCY					
100% Load		86		%	See Figure 1 for efficiency curve
50% Load		84		%	See Figure 1 for efficiency curve

Note 1: Output is terminated with 1 µF ceramic and 15 µF low-ESR tantalum capacitors. For applications requiring reduced output voltage ripple and noise, consult SynQor applications support (e-mail: support@synqor.com)

Note 2: Trim-up range is limited below 10% at low line and full load.

Note 3: Maximum Trim-up is 10%. Applying 6.2V between trim pin and Vout(-) may damge the unit.

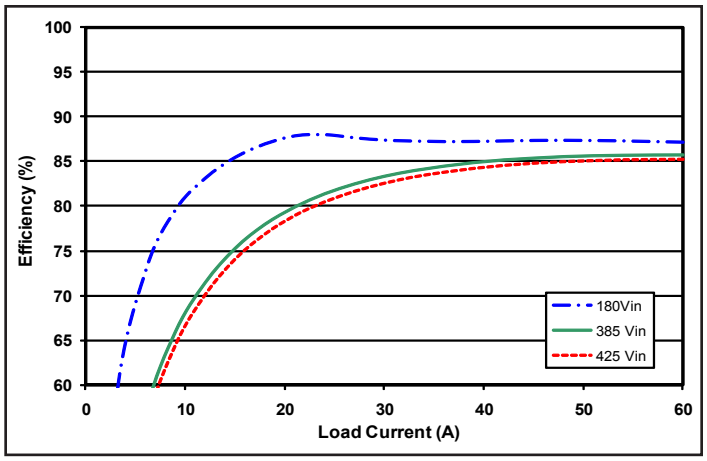


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

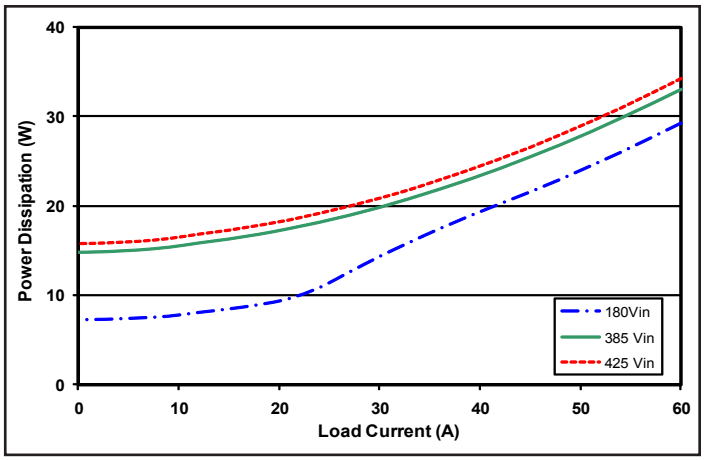


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

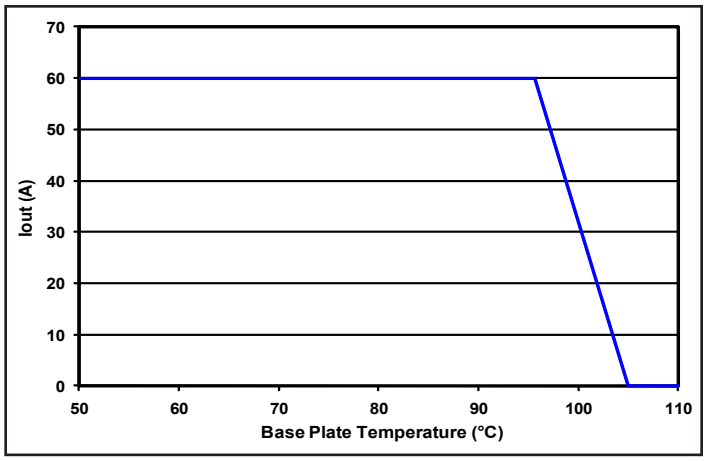


Figure 3: Open Frame converter max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

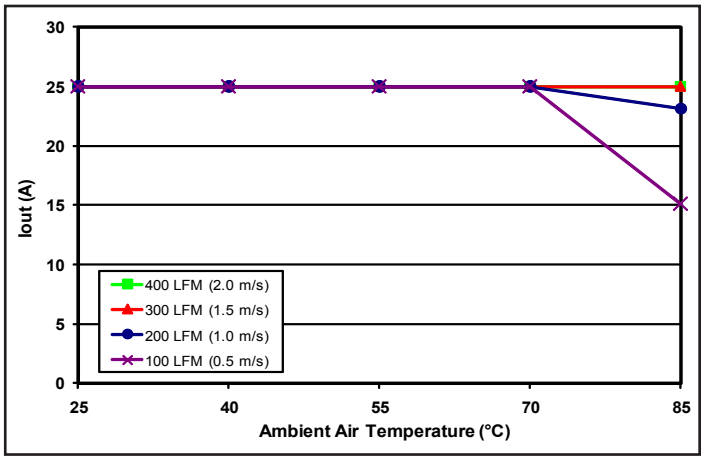


Figure 4: Encased converter (with 0.7" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

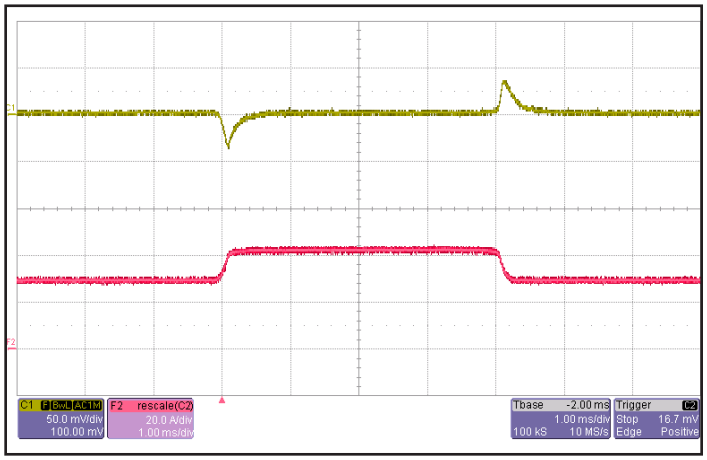


Figure 5: Output voltage response to step-change in load current (50%-100%-50% of Iout(max); dI/dt = 0.1A/µs). Load cap: 15µF tantalum cap and 1µF ceramic cap. Ch 1: Vout (50mV/div), Ch 2: Iout (20A/div).

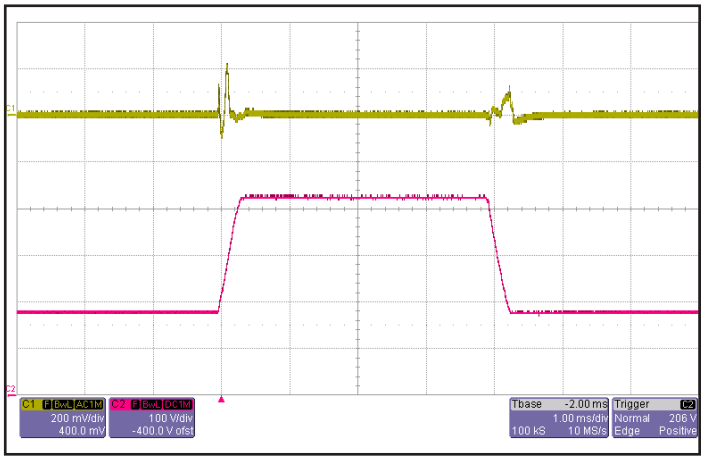


Figure 6: Output voltage response to step-change in input voltage (180V-425V-180V), at 60A load current. Load cap: 15µF tantalum capacitor and 1uF ceramic cap. Ch 1: Vout (200mV/div), Ch 2: Vin (100V/div).

IQ4H050HTX50 Electrical Characteristics (5.0 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385V dc unless otherwise noted; full operating temperature range is -40 °C to +90 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
INPUT CHARACTERISTICS					
Maximum Input Current			2.6	A	Vin min; trim up; in current limit
No-Load Input Current		42	60	mA	
Disabled Input Current		5.0	10.0	mA	
Response to Input Transient		0.23		V	Peak, see Figure 6
Input Terminal Ripple Current		46		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting external fuse recommended
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	4.950	5.000	5.050	V	
Output Voltage Regulation					
Over Line		±0.0049	±0.2000	%	
Over Load		±0.0047	±0.2000	%	
Over Temperature	-75.0		75.0	mV	
Total Output Voltage Range	4.875		5.125	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 1
Peak-to-Peak		99	194	mV	Full load
RMS		20	57	mV	Full load
Operating Output Current Range			50	A	Subject to thermal derating
Output DC Current-Limit Inception	54	63	70	A	Output voltage 10% Low
Output DC Current-Limit Shutdown Voltage		2.6		V	
Back-Drive Current Limit while Enabled		5.5		A	Negative current drawn from output
Back-Drive Current Limit while Disabled		2.5		mA	Negative current drawn from output
Maximum Output Capacitance			15,000	µF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/µs)		120		mV	50% to 75% to 50% Iout max
Settling Time		500		µs	To within 1% Vout nom
Output Voltage Trim Range	-20		10	%	Across Pins 8&4; Common Figures 3-5; see Note 2 &3
Output Voltage Remote Sense Range			10	%	Across Pins 8&4
Output Over-Voltage Protection	5.8	6.3	6.7	V	Over full temp range
EFFICIENCY					
100% Load		87		%	
50% Load		85		%	

Note 1: Output is terminated with 1 µF ceramic and 15 µF low-ESR tantalum capacitors. For applications requiring reduced output voltage ripple and noise, consult SynQor applications support (e-mail: support@synqor.com)

Note 2: Trim-up range is limited below 10% at low line and full load.

Note 3: Maximum Trim-up is 10%. Applying 6.2V between trim pin and Vout(-) may damge the unit.

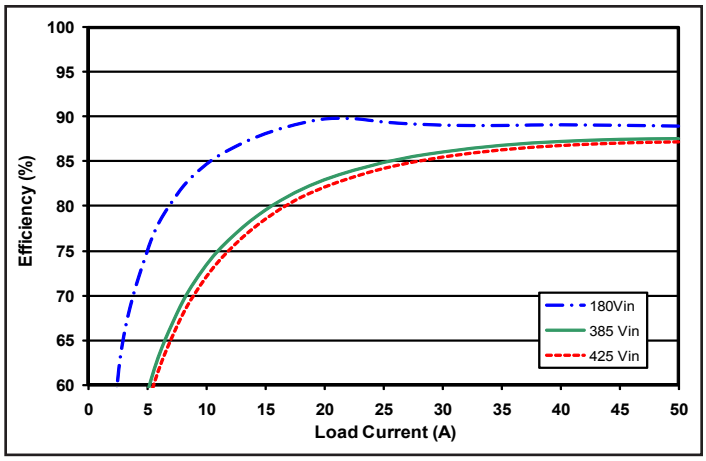


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

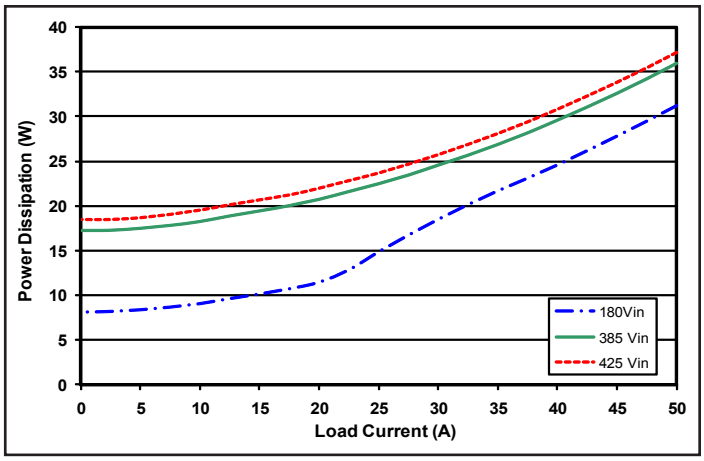


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

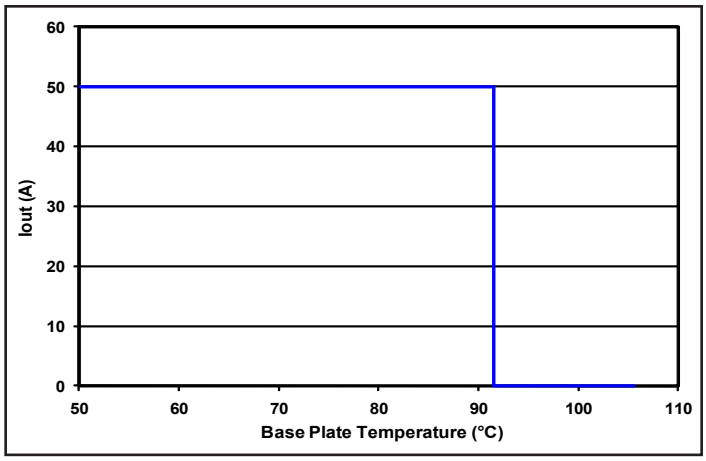


Figure 3:Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

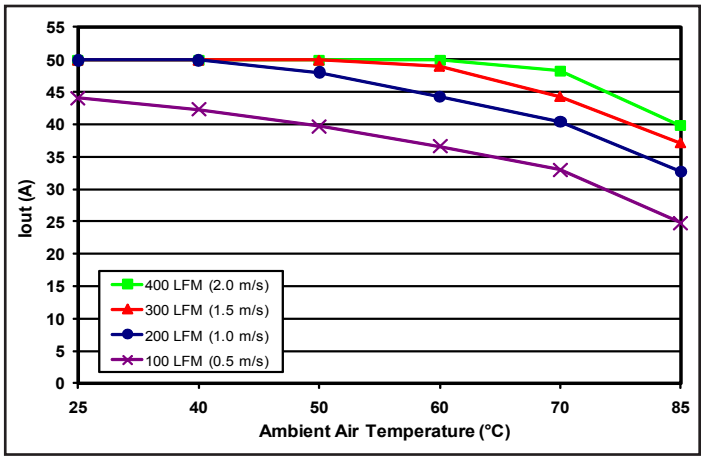


Figure 4: Encased converter (with 0.7" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

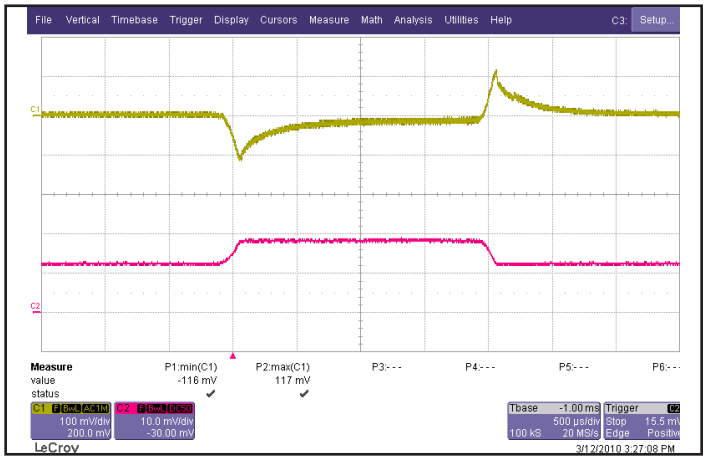


Figure 5: Output voltage response to step-change in load current (50%-75%-50% of Iout(max); dI/dt = 0.1A/µs). Load cap: 15µF tantalum cap and 1µF ceramic cap. Ch 1: Vout (100mV/div), Ch 2: Iout (20A/div).

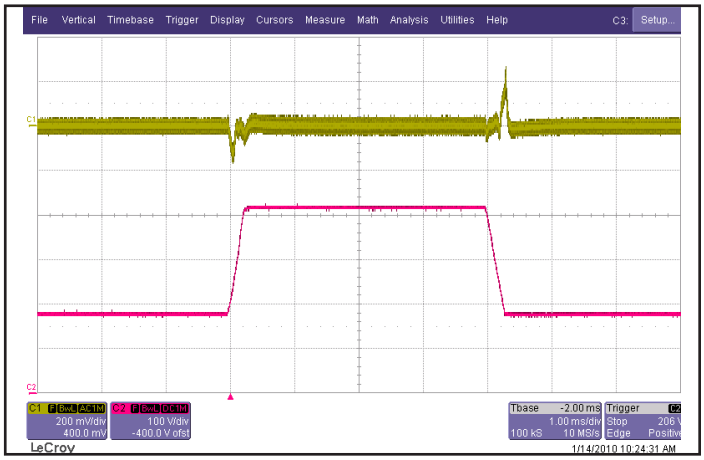


Figure 6: Output voltage response to step-change in input voltage (180V - 425V - 180V), at 50A load current. Load cap: 15µF tantalum capacitor and 1uF ceramic cap. Ch 1: Vout (200mV/div), Ch 2: Vin (100V/div).

IQ4H120HTX25 Electrical Characteristics (12 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385V dc unless otherwise noted; full operating temperature range is -40 °C to +90 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
INPUT CHARACTERISTICS					
Maximum Input Current			3.0	A	Vin min; trim up; in current limit
No-Load Input Current		38	50	mA	
Disabled Input Current		5.0	10.0	mA	
Response to Input Transient		1.00		V	Peak, see Figure 6
Input Terminal Ripple Current		56		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting external fuse recommended
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	11.88	12.00	12.12	V	
Output Voltage Regulation					
Over Line		±0.0023	±0.3000	%	
Over Load		±0.0030	±0.3000	%	
Over Temperature	-240		240	mV	
Total Output Voltage Range	11.70		12.30	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 1
Peak-to-Peak	0	182	240	mV	Full load
RMS		49	70	mV	Full load
Operating Output Current Range	0		25	A	Subject to thermal derating
Output DC Current-Limit Inception	27	31	35	A	Output voltage 10% Low
Output DC Current-Limit Shutdown Voltage		5.8		V	
Back-Drive Current Limit while Enabled		7.6		A	Negative current drawn from output
Back-Drive Current Limit while Disabled		2.5		mA	Negative current drawn from output
Maximum Output Capacitance			5,000	µF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/µs)		500		mV	50% to 75% to 50% Iout max
Settling Time		450		µs	To within 1% Vout nom
Output Voltage Trim Range	-20		10	%	Across Pins 8&4; Common Figures 3-5; see Note 2 &3
Output Voltage Remote Sense Range			10	%	Across Pins 8&4
Output Over-Voltage Protection	14	15	16	V	Over full temp range
EFFICIENCY					
100% Load		87		%	
50% Load		86		%	

Note 1: Output is terminated with 1 µF ceramic and 15 µF low-ESR tantalum capacitors. For applications requiring reduced output voltage ripple and noise, consult SynQor applications support (e-mail: support@synqor.com)

Note 2: Trim-up range is limited below 10% at low line and full load.

Note 3: Maximum Trim-up is 10%. Applying 6.2V between trim pin and Vout(-) may damge the unit.

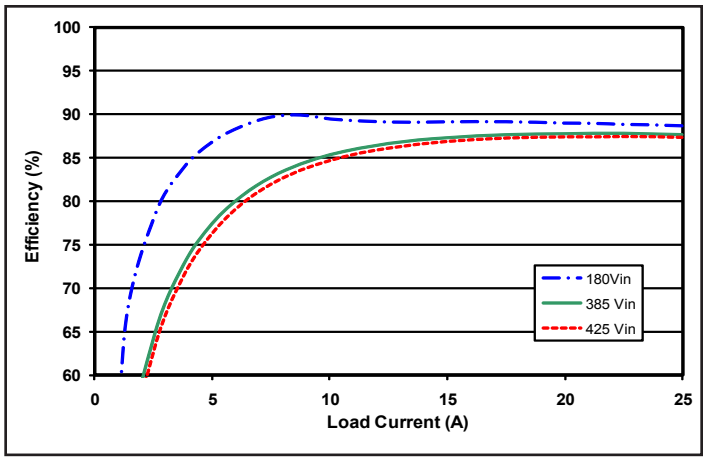


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

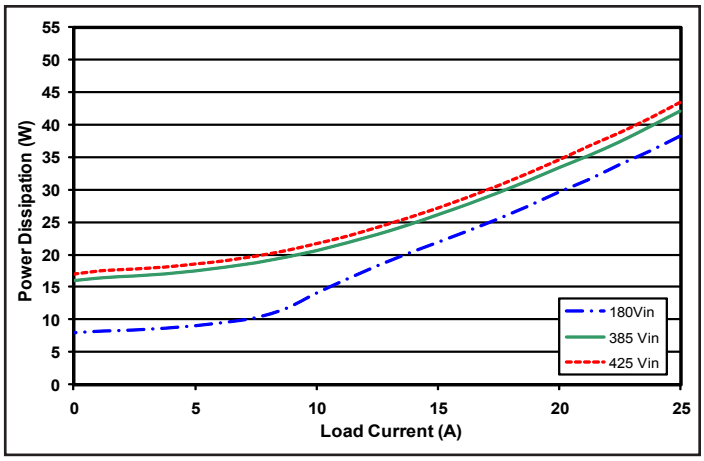


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

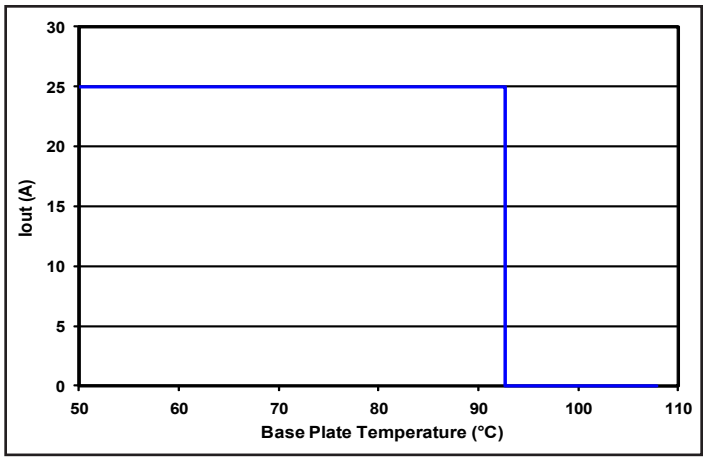


Figure 3:Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

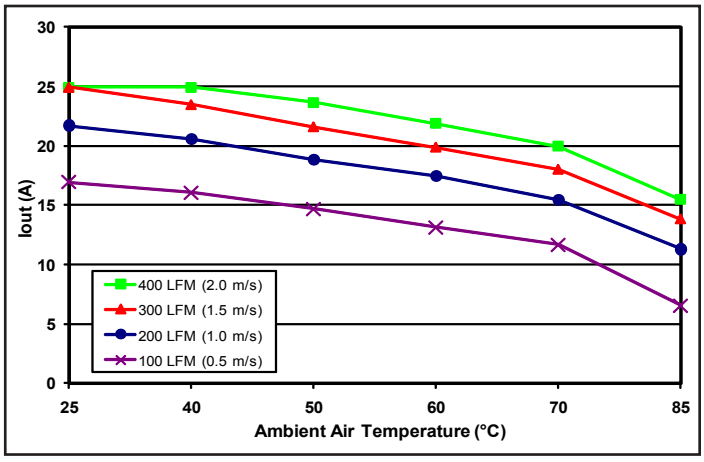


Figure 4: Encased converter (with 0.7" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

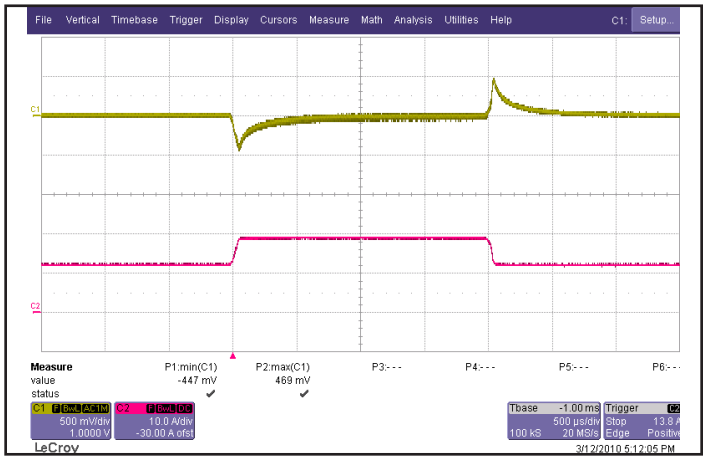


Figure 5: Output voltage response to step-change in load current (50%-75%-50% of Iout(max); dI/dt = 0.1A/µs). Load cap: 15µF tantalum cap and 1µF ceramic cap. Ch 1: Vout (500mV/div), Ch 2: Iout (10/div).

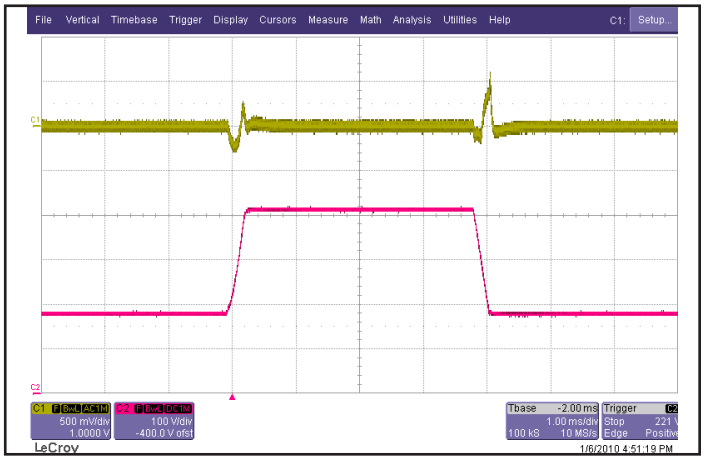


Figure 6: Output voltage response to step-change in input voltage (180V - 425V - 180V), at 25A load current. Load cap: 15µF tantalum capacitor and 1uF ceramic cap. Ch 1: Vout (500mV/div), Ch 2: Vin (100V/div).

IQ4H150HTX20 Electrical Characteristics (15 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385V dc unless otherwise noted; full operating temperature range is -40 °C to +90 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
INPUT CHARACTERISTICS					
Maximum Input Current			3.0	A	Vin min; trim up; in current limit
No-Load Input Current		43	60	mA	
Disabled Input Current		5.0	10.0	mA	
Response to Input Transient		0.67		V	Peak, see Figure 6
Input Terminal Ripple Current		51		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting external fuse recommended
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	14.85	15.00	15.15	V	
Output Voltage Regulation					
Over Line		±0.0022	±0.3000	%	
Over Load		±0.0024	±0.3000	%	
Over Temperature	-309	±18	309	mV	
Total Output Voltage Range	14.62		15.38	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 1
Peak-to-Peak		200	325	mV	Full load
RMS		42	84	mV	Full load
Operating Output Current Range			20	A	Subject to thermal derating
Output DC Current-Limit Inception	22	25	28	A	Output voltage 10% Low
Output DC Current-Limit Shutdown Voltage		6.9		V	
Back-Drive Current Limit while Enabled		3.5		A	Negative current drawn from output
Back-Drive Current Limit while Disabled		2.0		mA	Negative current drawn from output
Maximum Output Capacitance			4,000	µF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/µs)		500		mV	50% to 75% to 50% Iout max
Settling Time		250		µs	To within 1% Vout nom
Output Voltage Trim Range	-20		10	%	Across Pins 8&4; Common Figures 3-5; see Note 2 &3
Output Voltage Remote Sense Range			10	%	Across Pins 8&4
Output Over-Voltage Protection	17	19	20	V	Over full temp range
EFFICIENCY					
100% Load		89		%	
50% Load		86		%	

Note 1: Output is terminated with 1 µF ceramic and 15 µF low-ESR tantalum capacitors. For applications requiring reduced output voltage ripple and noise, consult SynQor applications support (e-mail: support@synqor.com)

Note 2: Trim-up range is limited below 10% at low line and full load.

Note 3: Maximum Trim-up is 10%. Applying 6.2V between trim pin and Vout(-) may damge the unit.

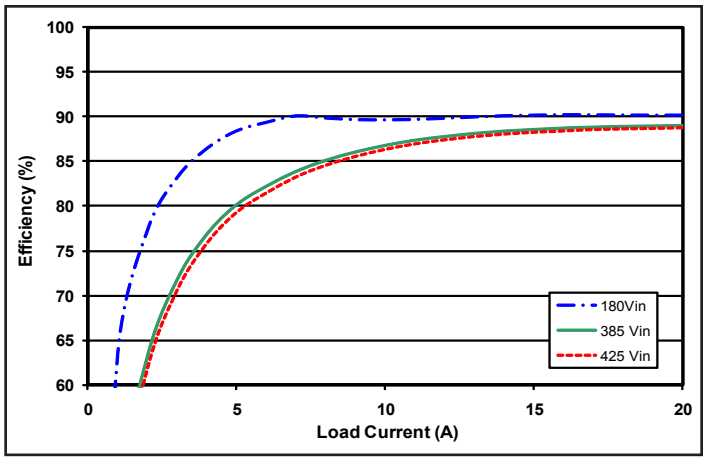


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

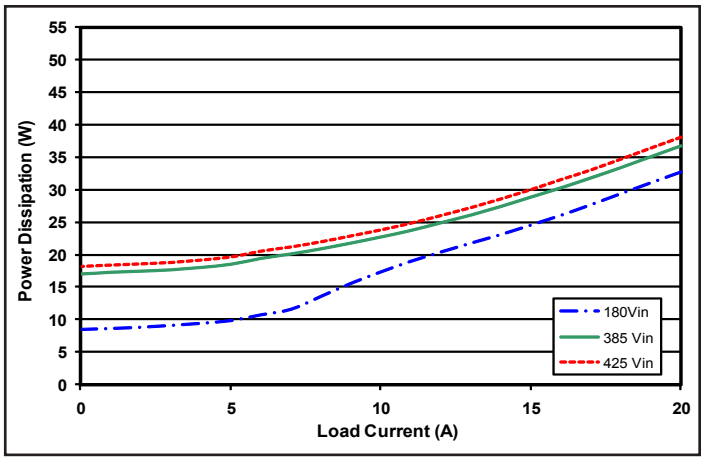


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

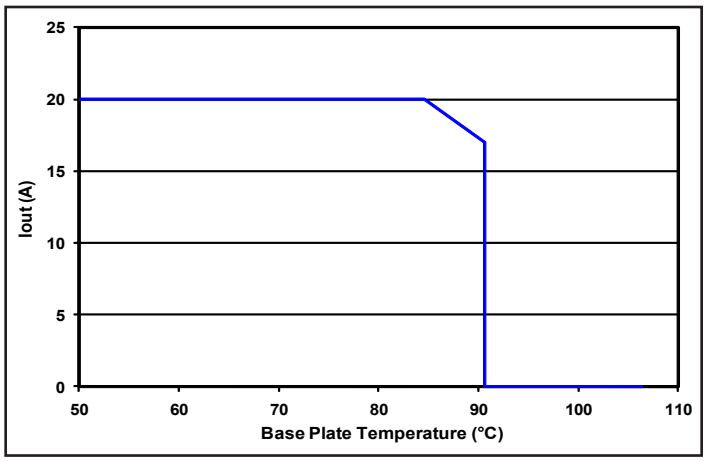


Figure 3:Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

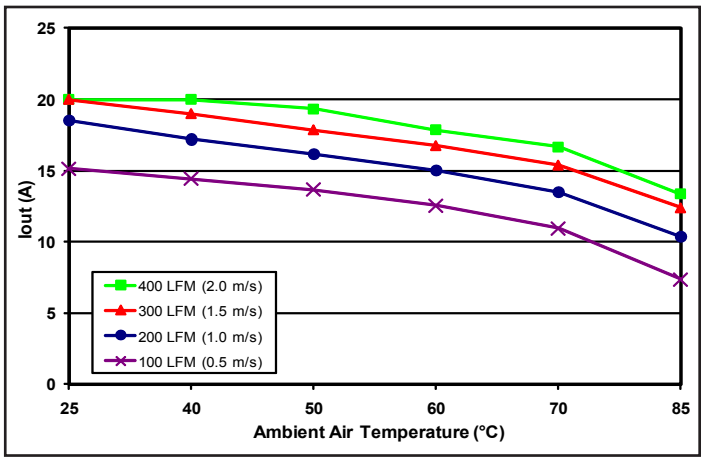


Figure 4: Encased converter (with 0.7" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

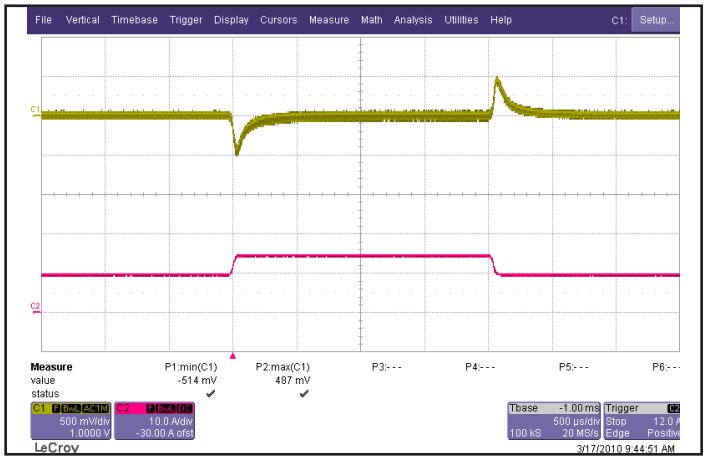


Figure 5: Output voltage response to step-change in load current (50%-75%-50% of Iout(max); dI/dt = 0.1A/µs). Load cap: 15µF tantalum cap and 1µF ceramic cap. Ch 1: Vout (500mV/div), Ch 2: Iout (10A/div).

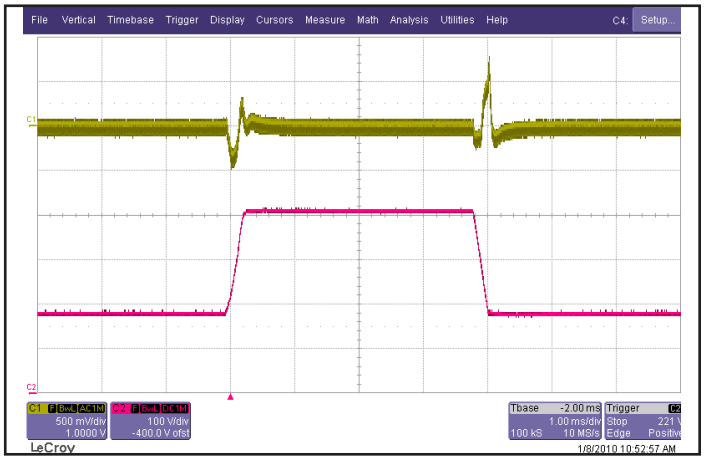


Figure 6: Output voltage response to step-change in input voltage (180V - 425V - 180V), at 20A load current. Load cap: 15µF tantalum capacitor and 1uF ceramic cap. Ch 1: Vout (500mV/div), Ch 2: Vin (100V/div).

IQ4H240HTX12 Electrical Characteristics (24 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385V dc unless otherwise noted; full operating temperature range is -40 °C to +90 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
INPUT CHARACTERISTICS					
Maximum Input Current			3.0	A	Vin min; trim up; in current limit
No-Load Input Current		50	60	mA	
Disabled Input Current		5.0	10.0	mA	
Response to Input Transient		0.95		V	Peak, see Figure 6
Input Terminal Ripple Current		55		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting external fuse recommended
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	23.76	24.00	24.24	V	
Output Voltage Regulation					
Over Line		±0.0054	±0.3000	%	
Over Load		±0.00067	±0.3000	%	
Over Temperature	-110	±54	110	mV	
Total Output Voltage Range	3.40		4.60	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 1
Peak-to-Peak		235	469	mV	Full load
RMS		50	100	mV	Full load
Operating Output Current Range			12.5	A	Subject to thermal derating
Output DC Current-Limit Inception	13	15	17	A	Output voltage 10% Low
Output DC Current-Limit Shutdown Voltage		14.0		V	
Back-Drive Current Limit while Enabled		1.0		A	Negative current drawn from output
Back-Drive Current Limit while Disabled		1.5		mA	Negative current drawn from output
Maximum Output Capacitance			3,000	µF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/µs)		700		mV	50% to 75% to 50% Iout max
Settling Time		250		µs	To within 1% Vout nom
Output Voltage Trim Range	-20		10	%	Across Pins 8&4; Common Figures 3-5; see Note 2 &3
Output Voltage Remote Sense Range			10	%	Across Pins 8&4
Output Over-Voltage Protection	28	30	32	V	Over full temp range
EFFICIENCY					
100% Load		89		%	
50% Load		86		%	

Note 1: Output is terminated with 1 µF ceramic and 15 µF low-ESR tantalum capacitors. For applications requiring reduced output voltage ripple and noise, consult SynQor applications support (e-mail: support@synqor.com)

Note 2: Trim-up range is limited below 10% at low line and full load.

Note 3: Maximum Trim-up is 10%. Applying 6.2V between trim pin and Vout(-) may damge the unit.

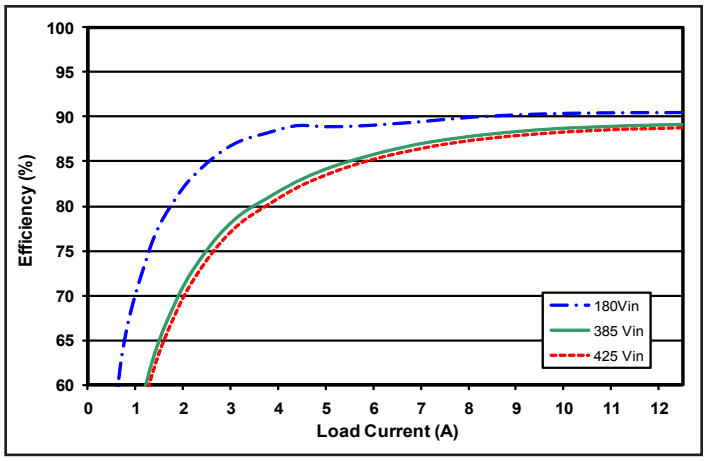


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

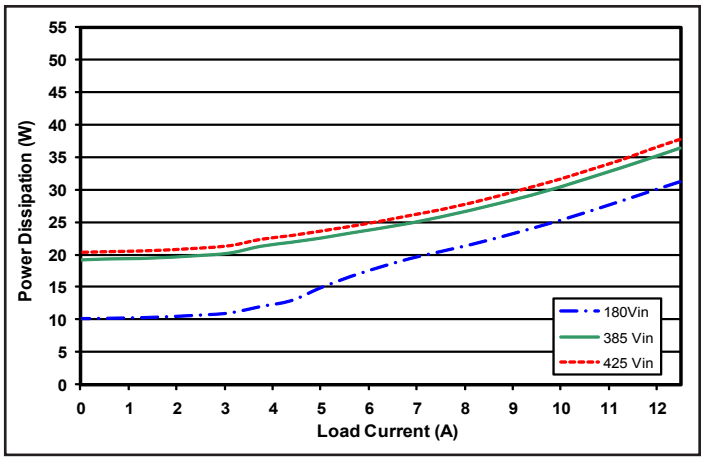


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

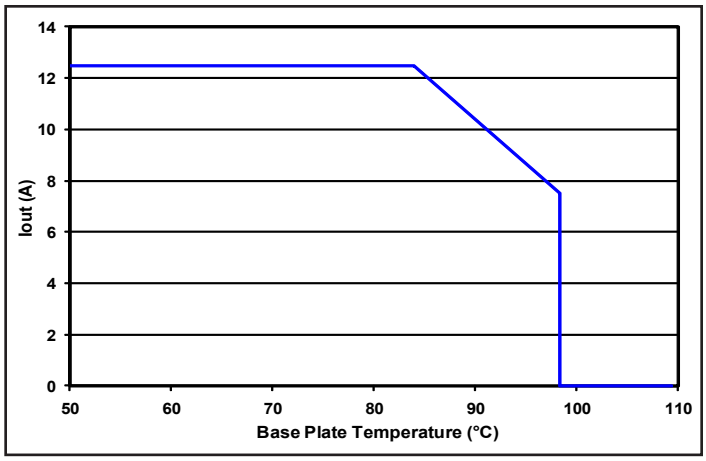


Figure 3:Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

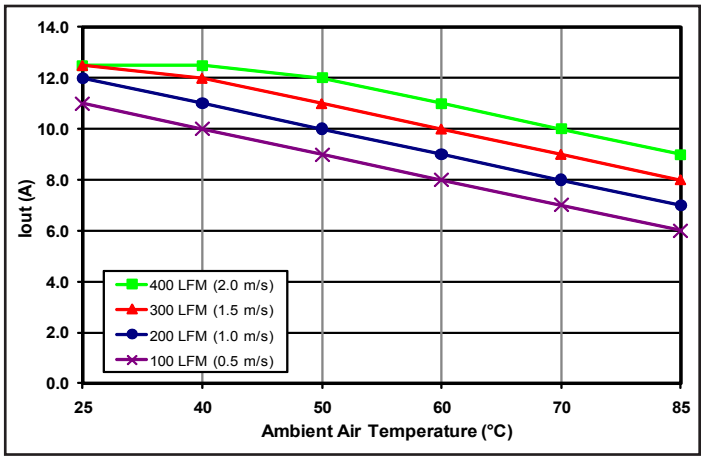


Figure 4: Encased converter (with 0.7" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

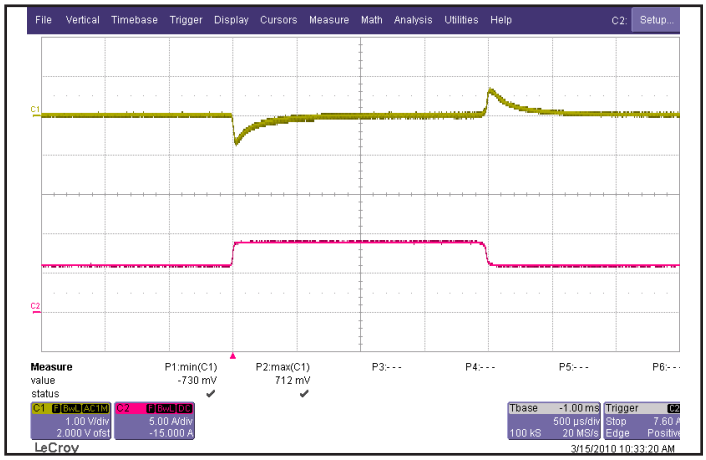


Figure 5: Output voltage response to step-change in load current (50%-75%-50% of Iout(max); dI/dt = 0.1A/µs). Load cap: 15µF tantalum cap and 1µF ceramic cap. Ch 1: Vout (1V/div), Ch 2: Iout (5A/div).

Figure 6: Output voltage response to step-change in input voltage (180V - 425V - 180V), at 12.5A load current. Load cap: 15µF tantalum capacitor and 1uF ceramic cap. Ch 1: Vout (500mV/div), Ch 2: Vin (100V/div).

IQ4H280HTX11 Electrical Characteristics (28 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385V dc unless otherwise noted; full operating temperature range is -40 °C to +90 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
INPUT CHARACTERISTICS					
Maximum Input Current			3.0	A	Vin min; trim up; in current limit
No-Load Input Current		40	60	mA	
Disabled Input Current		5.0	10.0	mA	
Response to Input Transient		1.50		V	Peak, see Figure 6
Input Terminal Ripple Current		50		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting external fuse recommended
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	27.72	28.00	28.28	V	
Output Voltage Regulation					
Over Line		±0.005	±0.3000	%	
Over Load		±0.005	±0.3000	%	
Over Temperature	-140	±50	140	mV	
Total Output Voltage Range	27.30		28.70	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 1
Peak-to-Peak		190	380	mV	Full load
RMS		54	108	mV	Full load
Operating Output Current Range			10.7	A	Subject to thermal derating
Output DC Current-Limit Inception	12	13	15	A	Output voltage 10% Low
Output DC Current-Limit Shutdown Voltage		16.0		V	
Back-Drive Current Limit while Enabled		1.3		A	Negative current drawn from output
Back-Drive Current Limit while Disabled		4.0		mA	Negative current drawn from output
Maximum Output Capacitance			3,000	µF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/µs)		750		mV	50% to 75% to 50% Iout max
Settling Time		250		µs	To within 1% Vout nom
Output Voltage Trim Range	-20		10	%	Across Pins 8&4; Common Figures 3-5; see Note 2 &3
Output Voltage Remote Sense Range			10	%	Across Pins 8&4
Output Over-Voltage Protection	33	35	37	V	Over full temp range
EFFICIENCY					
100% Load		89		%	
50% Load		87		%	

Note 1: Output is terminated with 1 µF ceramic and 15 µF low-ESR tantalum capacitors. For applications requiring reduced output voltage ripple and noise, consult SynQor applications support (e-mail: support@synqor.com)

Note 2: Trim-up range is limited below 10% at low line and full load.

Note 3: Maximum Trim-up is 10%. Applying 6.2V between trim pin and Vout(-) may damge the unit.

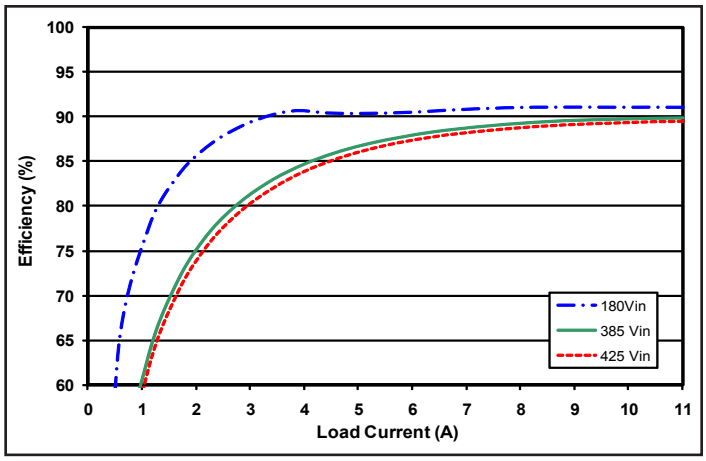


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

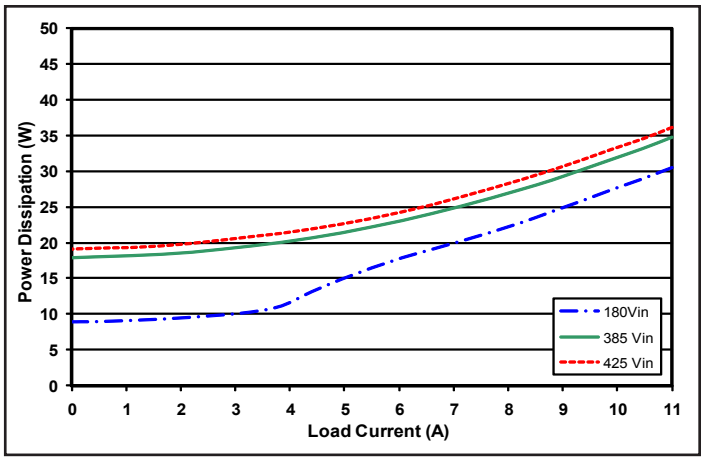


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

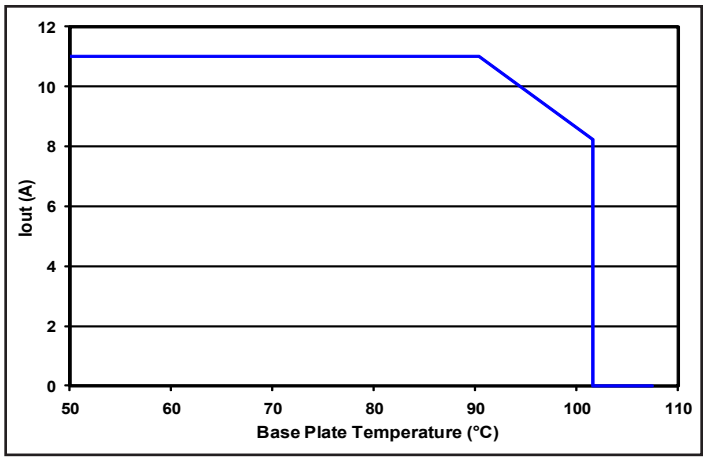


Figure 3:Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

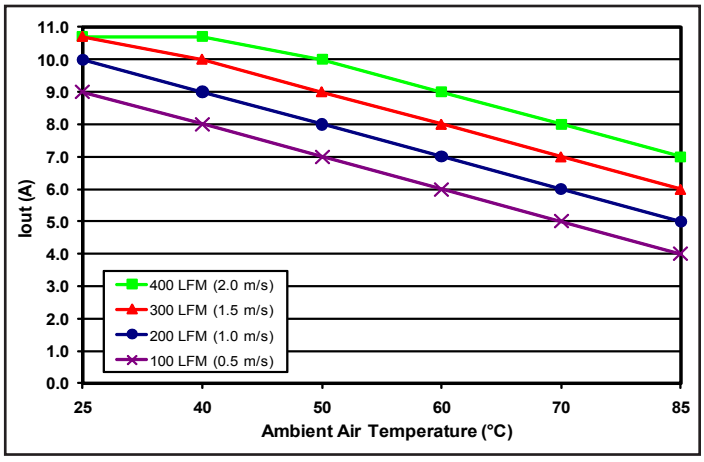


Figure 4: Encased converter (with 0.7" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

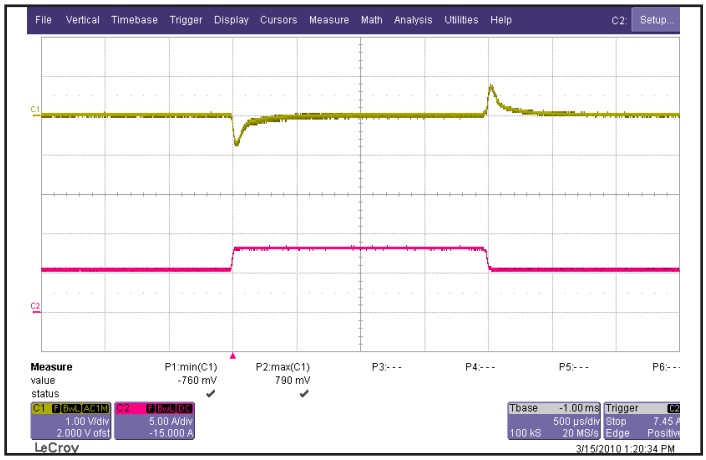


Figure 5: Output voltage response to step-change in load current (50%-75%-50% of Iout(max); dI/dt = 0.1A/µs). Load cap: 15µF tantalum cap and 1µF ceramic cap. Ch 1: Vout (1V/div), Ch 2: Iout (5/div).

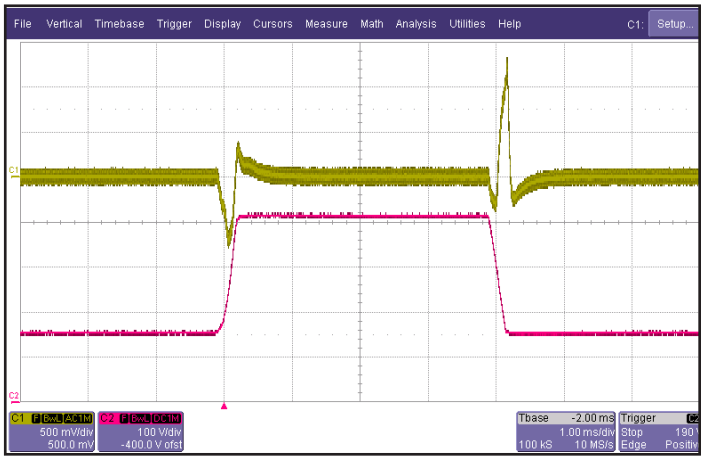


Figure 6: Output voltage response to step-change in input voltage (180V - 425V - 180V), at 10.7A load current. Load cap: 15µF tantalum capacitor and 1uF ceramic cap. Ch 1: Vout (500mV/div), Ch 2: Vin (100V/div).

IQ4H480HTX06 Electrical Characteristics (48 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385V dc unless otherwise noted; full operating temperature range is -40 °C to +90 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
INPUT CHARACTERISTICS					
Maximum Input Current			2.7	A	Vin min; trim up; in current limit
No-Load Input Current		46	60	mA	
Disabled Input Current		5.0	10.0	mA	
Response to Input Transient		1.20		V	Peak, see Figure 6
Input Terminal Ripple Current		45		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting external fuse recommended
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	47.52	48.00	48.48	V	
Output Voltage Regulation					
Over Line		±0.01	±0.3000	%	
Over Load		±0.01	±0.3000	%	
Over Temperature	-720	±100	720	mV	
Total Output Voltage Range	46.80		49.20	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 1
Peak-to-Peak	0	370	740	mV	Full load
RMS		110	220	mV	Full load
Operating Output Current Range	0		6.3	A	Subject to thermal derating
Output DC Current-Limit Inception	7	7.9	9	A	Output voltage 10% Low
Output DC Current-Limit Shutdown Voltage		27.0		V	
Back-Drive Current Limit while Enabled		1.2		A	Negative current drawn from output
Back-Drive Current Limit while Disabled		2.0		mA	Negative current drawn from output
Maximum Output Capacitance			1,000	µF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/µs)		900		mV	50% to 75% to 50% Iout max
Settling Time		250		µs	To within 1% Vout nom
Output Voltage Trim Range	-20		10	%	Across Pins 8&4; Common Figures 3-5; see Note 2 &3
Output Voltage Remote Sense Range			10	%	Across Pins 8&4
Output Over-Voltage Protection	56	60	64	V	Over full temp range
EFFICIENCY					
100% Load		89		%	
50% Load		87		%	

Note 1: Output is terminated with 1 µF ceramic and 15 µF low-ESR tantalum capacitors. For applications requiring reduced output voltage ripple and noise, consult SynQor applications support (e-mail: support@synqor.com)

Note 2: Trim-up range is limited below 10% at low line and full load.

Note 3: Maximum Trim-up is 10%. Applying 6.2V between trim pin and Vout(-) may damge the unit.

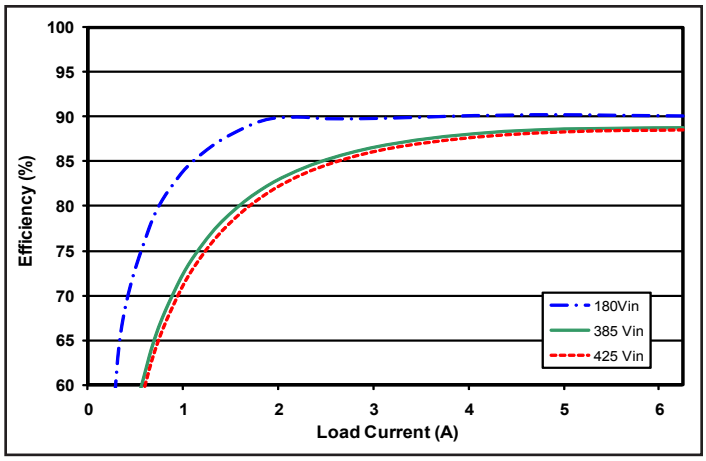


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

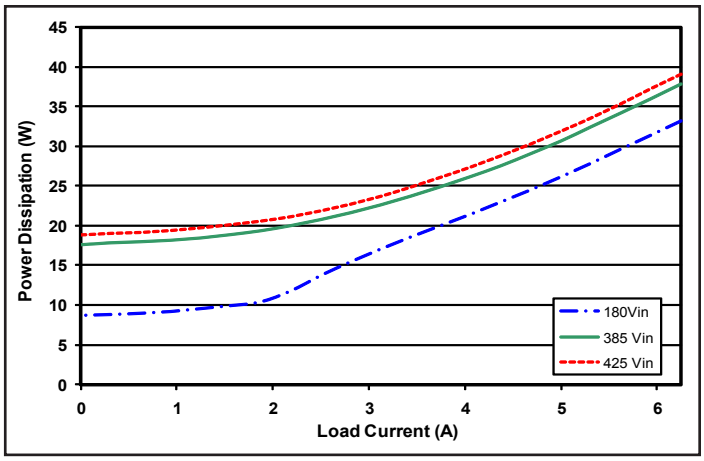


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

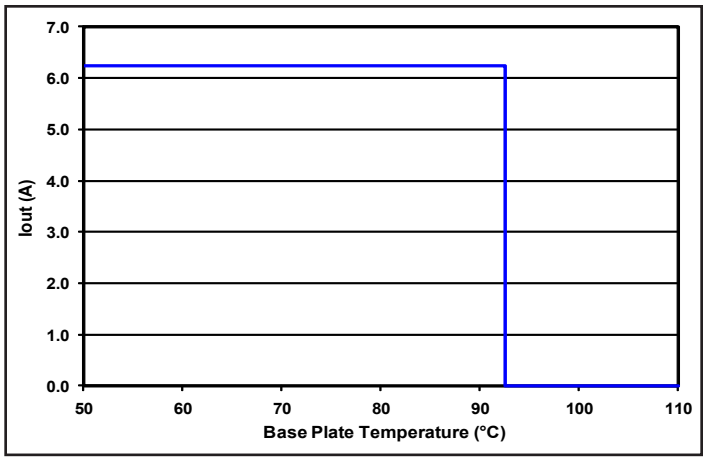


Figure 3:Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

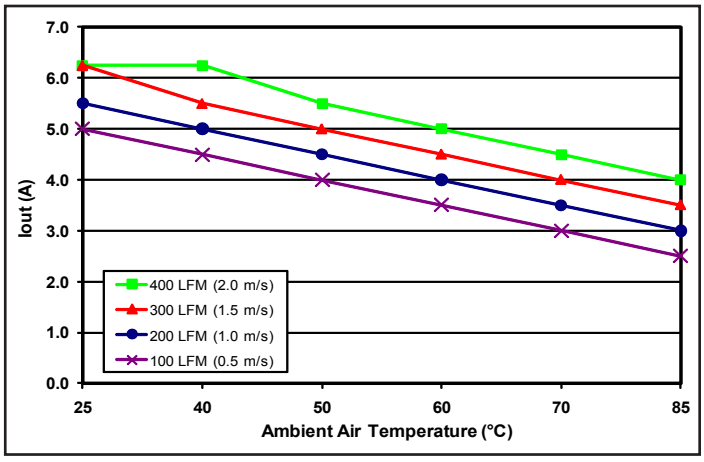


Figure 4: Encased converter (with 0.7" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

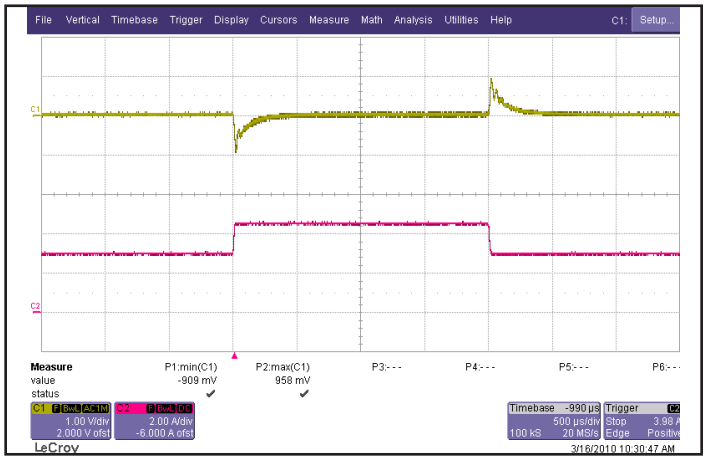


Figure 5: Output voltage response to step-change in load current (50%-75%-50% of Iout(max); dI/dt = 0.1A/µs). Load cap: 15µF tantalum cap and 1µF ceramic cap. Ch 1: Vout (1V/div), Ch 2: Iout (2A/div).

Figure 6: Output voltage response to step-change in input voltage (180V - 425V - 180V), at 6.25A load current. Load cap: 15µF tantalum capacitor and 1uF ceramic cap. Ch 1: Vout (1V/div), Ch 2: Vin (100V/div).

BASIC OPERATION AND FEATURES

This converter series uses a two-stage power conversion topology. The first stage is a buck-converter that 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-up or step-down to achieve the 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 far less energy than Schottky diodes. This is the primary reason that the converter has such high efficiency, even at very low output voltages and very high output currents.

These converters are offered totally encased to withstand harsh environments and thermally demanding applications. 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.

This series of converters uses the industry standard footprint and pin-out configuration.

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). Figure A details four possible circuits for driving the ON/OFF pin. Figure B is a detailed look of the internal ON/OFF circuitry.

REMOTE SENSE(+) (Pins 7 and 5): The SENSE(+) inputs correct for voltage drops along the conductors that connect the converter's output pins to the load. Pin 7 should be connected to Vout(+) and Pin 5 should be connected to Vout(-) at the point on the board where regulation is desired. A remote connection at the load can adjust for a voltage drop only as large as that specified in this datasheet, that is

$$[\text{Vout}(+) - \text{Vout}(-)] - [\text{Vsense}(+) - \text{Vsense}(-)] \leq$$

$$\text{Sense Range \% x Vout}$$

Pins 7 and 5 must be connected for proper regulation of the output voltage. 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.

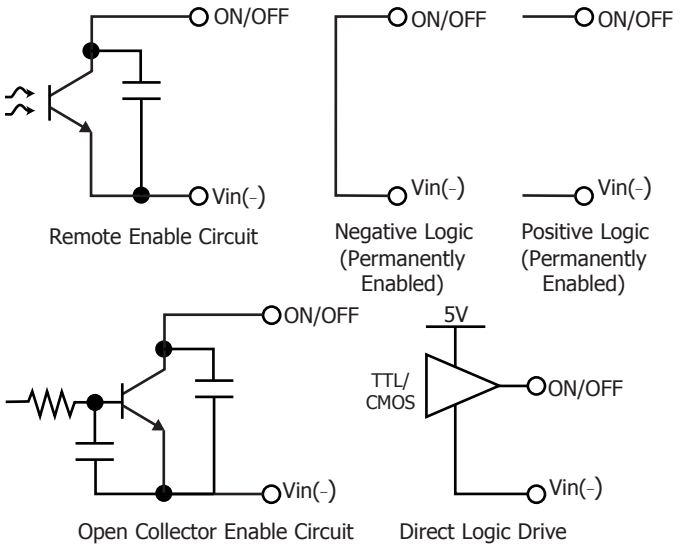


Figure A: *Example of Intermediate Bus Architecture using BusQor bus converter and NiQor non-isolated converters*

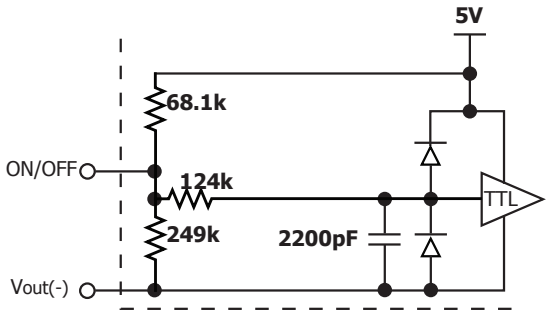


Figure B: *Internal ON/OFF pin circuitry*

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.

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

$$\text{Rtrim-down} = \left(\frac{90.9}{\Delta\%} \right) - 0.909 \ (\text{k}\Omega)$$

where

$$\Delta\% = \left| \frac{\text{Vnominal} - \text{Vdesired}}{\text{Vnominal}} \right| \times 100\%$$

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:

$$\text{Rtrim-up} = \left(\frac{1.0V_{OUT} \times (100+\Delta\%)}{1.225\Delta\%} - \frac{90.9}{\Delta\%} - 0.909 \right) (\text{k}\Omega)$$

where

Vout = Nominal Output Voltage

Trim graphs show 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.

It is not necessary for the user to add capacitance at the Trim pin. The node is internally bypassed 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: The converter is designed to turn off when the input voltage is too low, helping avoid an input system instability problem, described in more detail in the application note titled "Input System Instability" available on www.SynQor.com . The lockout circuitry is a comparator with DC hysteresis. When the input voltage is rising, it must exceed the typical Turn-On Voltage Threshold value (listed on the specification page) before the converter will turn on. Once the converter is on, the input voltage must fall below the typical Turn-Off Voltage Threshold value before the converter will turn off. Also see Figure D.

Output Current Limit: The maximum current limit remains constant as the output voltage drops. However, once the impedance of the load across the output is small enough to make the output voltage drop below the specified Output DC Current-Limit Shutdown Voltage, the converter turns off.

The converter then enters a "hiccup" mode where it repeatedly turns on and off at a 2.23 Hz (nominal) frequency with 11% duty cycle until the short circuit condition is removed. This prevents excessive heating of the converter or the load board.

Output Over-Voltage Limit: 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 400 ms the converter will automatically restart.

Over-Temperature Shutdown: A temperature sensor 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 value.

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: Figure C provides a typical circuit diagram which details the input filtering and voltage trimming.

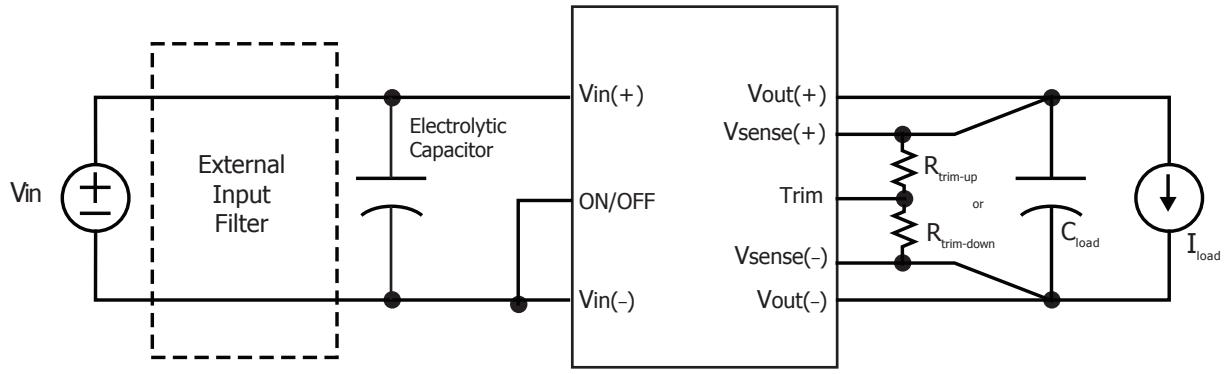


Figure C: *Typical application circuit (negative logic unit, permanently enabled).*

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

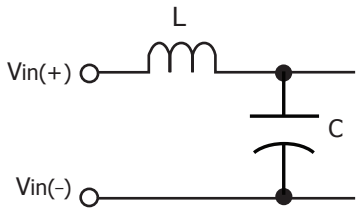


Figure D: *Internal Input Filter Diagram (Component values listed on page2)*

Startup Inhibit Period: The Startup Inhibit Period ensures that the converter will remain off for approximately 400 ms when it is shut down for any reason. When an output short is present, this generates a 2.23 Hz "hiccup" mode, which prevents the converter from overheating. In all, there are seven ways that the converter can be shut down, initiating a Startup Inhibit Period:

- Input Under-Voltage Lockout
- Input Over-Voltage Lockout
- Output Over-Voltage Protection
- Over Temperature Shutdown
- Current Limit
- Short Circuit Protection
- Turned off by the ON/OFF input

Figure E shows three turn-on scenarios, where a Startup Inhibit Period is initiated at t_0, t_1, and t_2:

Before time t_0, when the input voltage is below the UVL threshold, the unit is disabled by the Input Under-Voltage Lockout feature. When the input voltage rises above the UVL threshold, the Input Under-Voltage lockout is released, and a Startup Inhibit Period is initiated. At the end of this delay, the ON/OFF pin is evaluated, and since it is active, the unit turns on.

At time t_1, the unit is disabled by the ON/OFF pin, and it cannot be enabled again until the Startup Inhibit Period has elapsed.

When the ON/OFF pin goes high after t_2, the Startup Inhibit Period has elapsed, and the output turns on within the typical Turn-On Time.

Thermal Considerations: The maximum operating base-plate temperature, T_B, is 90 ºC. Refer to the thermal derating curve, Figure 5, to see the available output current at baseplate temperatures below 90 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, $R_{TH_{BA}}$, of the chosen heatsink between the base-plate and the ambient air for a given airflow rate. This information is usually available from the heatsink vendor. The following formula can then be used to determine the maximum power the converter can dissipate for a given thermal condition:

$$P_{diss}^{max} = \frac{T_B - T_A}{R_{TH_{BA}}}$$

This value of power dissipation can then be used in conjunction with the data shown in Figure 3 to determine the maximum load current (and power) that the converter can deliver in the given thermal condition.

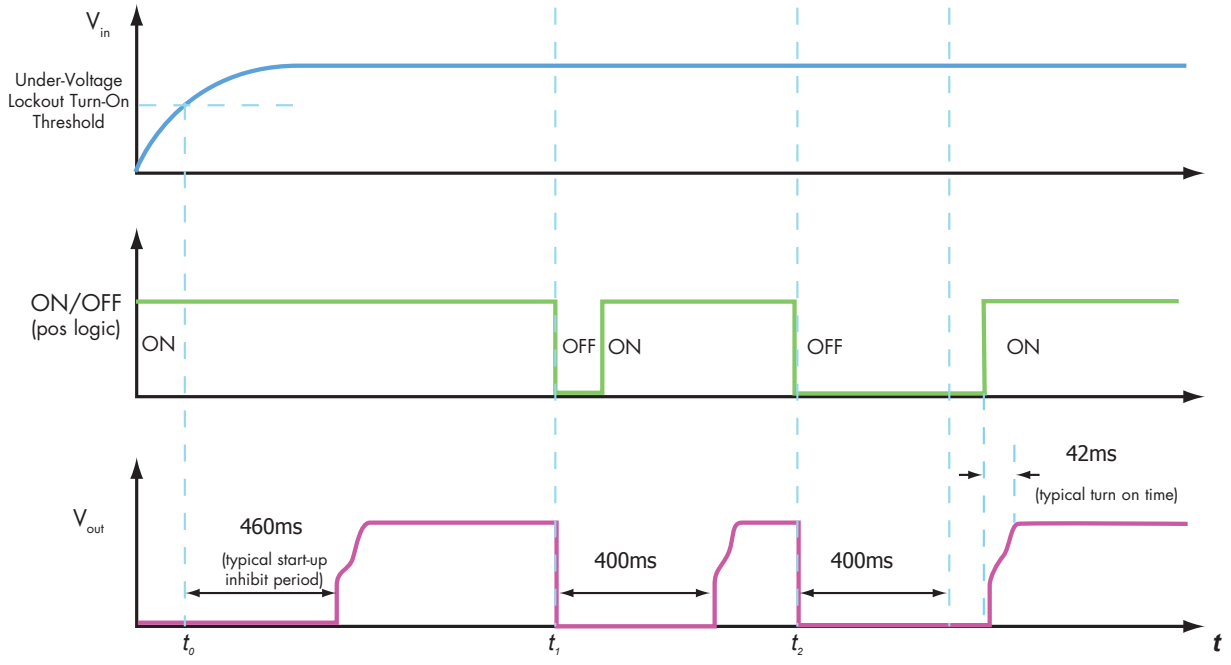


Figure F: Startup Inhibit Period (turn-on time not to scale)

Full-Featured Application Notes

This section provides some basic application information for the full-feature version of the MCOTS series converter.

All units in this product family include back-drive protection to simplify the use of multiple converters in a parallel or sequencing application. However, any voltage applied to the output of the converter should be kept below 110% of the rated output voltage of the converter.

In addition to back-drive protection, these units include the following features (pins):

Current Share (pin C): The active current share feature allows for N+1 and parallel applications. To achieve load sharing, directly connect the I share pins of multiple units. The load current will share equally among the multiple units (±5% at full rated current). It is important that the Vin(-) pins of the sharing units be directly connected and NOT placed outside of an EMI filter or other impedance path. The voltage at the I Share pin will range from 0.4 to 4 volts (at full rated current), referenced to the primary-side ground, Vin(-).

Start Sync (pin B): The Start Synchronization pin will allow a more consistent start-up sequence. To operate this feature, connect together the Start-Sync pins of multiple current-sharing units. This will permit immediate start-up with loads greater than the current limit of a single unit. Without this connection, any set of converters attempting to asynchronously start (or re-start) with a load greater than the current limit of a single unit will "hiccup". This "hiccup" mode will continue until one converter attempts a start at the same time as the minimum number of additional units necessary to sustain the load condition. For example, three 50 amp units starting into a 90 amp load would require two units to simultaneously attempt a start. The Start Sync connection synchronizes these starting attempts and provides a more consistent and reliable start-up sequqnce. For details about the "hiccup" mode or repeated startup attempts, please see the "Startup Inhibit Period" note in the Technical Specification.

Clock Sync (pin A): The External Clock Synchronization pin provides the ability for the user to control the EMI signature and synchronize sensitive circuitry to quiet periods in the converter operation. With this option, the converter can be synchronized to an external clock signal whose frequency is greater than that of the free-running internal clock. However, substantially raising the converter's frequency will reduce its efficiency. Therefore, the recommended frequency range for the external clock synchronization signal applied to this pin is 600kHz to 630kHz.

The following requirements should also be met:

- The external clock signal should be referenced to the negative input voltage, Vin(-)
- The high level of the signal should be between 3.5V and 5.0V.
- The low level should be between -0.5V and +1.2V.
- Do not apply a clock sync or change frequency while unit is runnig.
- Do not apply a clock signal lower than 595kHz.

Standards & Qualification Testing

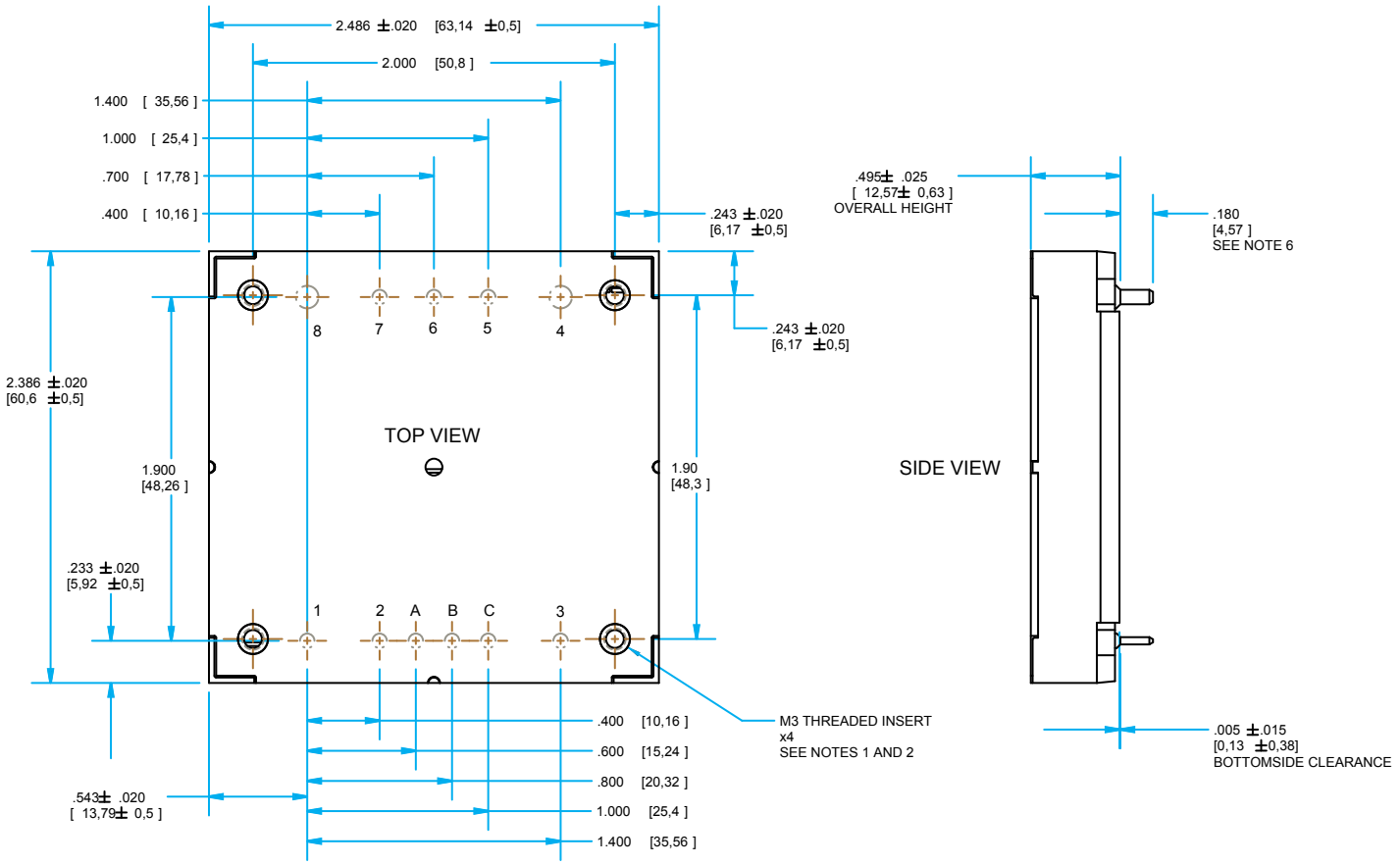
Parameter	Notes & Conditions
STANDARDS COMPLIANCE	
UL 60950-1 2nd Ed. 2007	Reinforced Insulation
CAN/CSA-C22.2 No. 60950-1-07	
EN60950-1 Ed. 2.0	
CE Marked	2006/95/EC Low Voltage Directive
IEC 61000-4-2	ESD test, 8 kV - NP, 15 kV air - NP (Normal Performance)

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.

Parameter	# Units	Test Conditions
QUALIFICATION TESTING		
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, 85% 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.

Standard Mechanical Diagram



NOTES

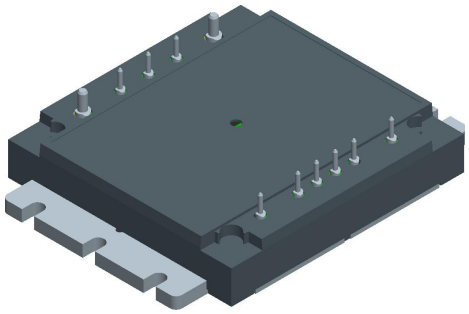
1) M3 screws used to bolt unit's baseplate to other surfaces such as heatsink must not exceed 0.100 (2.54mm) depth below the surface of the baseplate.
2) Applied torque per screw should not exceed 6in-lb (0.7Nm).
3) Baseplate flatness tolerance is 0.004" (.10mm) TIR for surface
4) Pins 1-3, 5-7, A, B, & C are 0.040" (1.02mm) dia. with 0.080" (2.03mm) dia. standoff shoulders
5) Pins 4 and 8 are 0.080" (2.03mm) dia. with .125" (3.18) dia. standoff shoulders
6) Other pin extension lengths available
7) All Pins: Material: Copper Alloy
   Finish: Matte Tin over Nickel plate
8) Undimensioned components are shown for visual reference only
9) Weight: 4.8oz (135g)

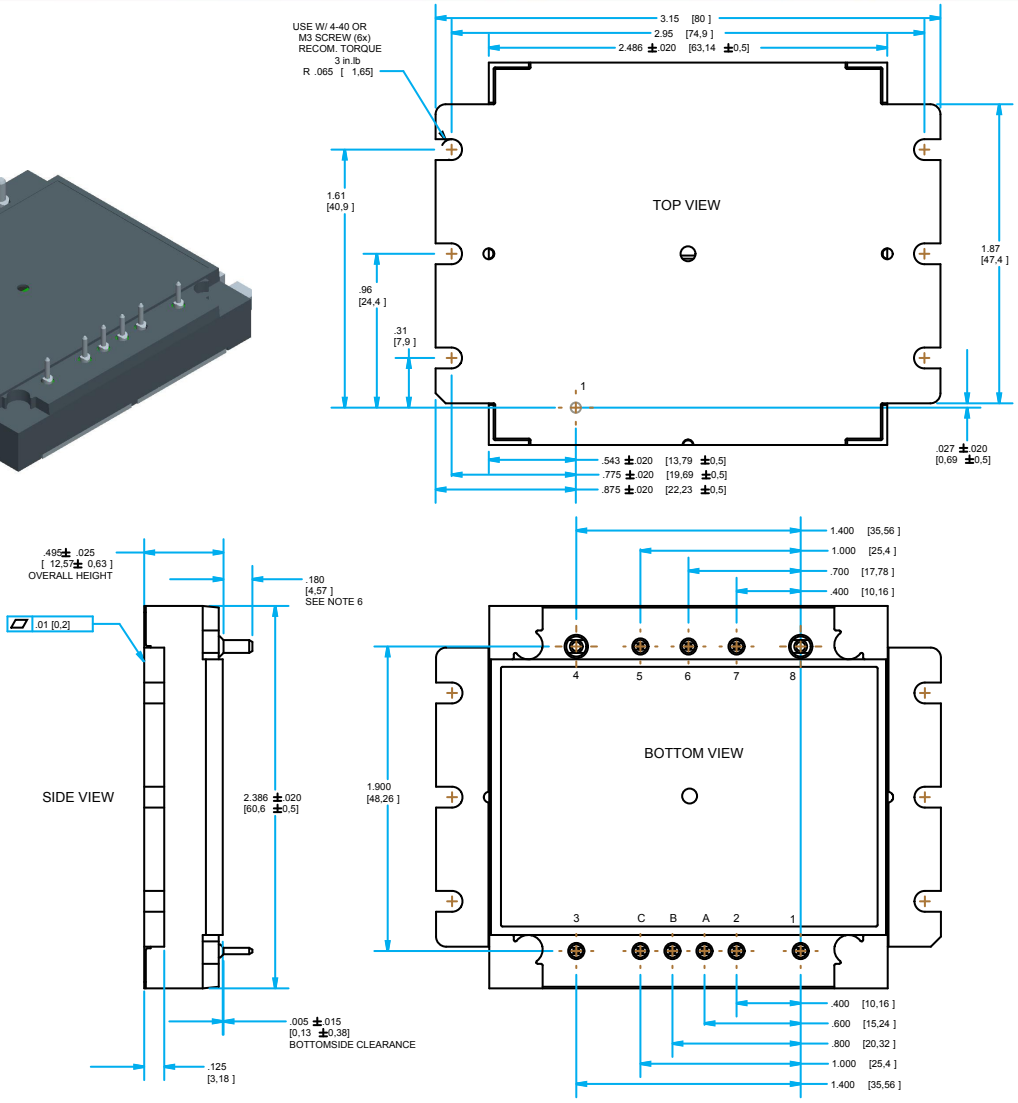
PIN DESIGNATIONS

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.
A	Clock Sync	Clock synchronization (Full Feature Option)
B	Start Sync	Startup synchronization (Full Feature Option)
C	Ishare	Single wire parallel signal (Full Feature Option)
3	Vin(–)	Negative input voltage
4	Vout(–)	Negative output voltage
5	SENSE(–)	Negative remote sense(see note 1)
6	TRIM	Output voltage trim (see note 2)
7	SENSE(+)	Positive remote sense (see note 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.
4) Pins A, B, and C are populated on Full Feature version only.

Flanged Mechanical Diagram





NOTES

1) Applied torque per screw should not exceed 5in-lb. (3in-lb recommended).
2) Baseplate flatness tolerance is 0.01" (.2mm) TIR for surface.
3) Pins 1-3, 5-7, A, B, & C are 0.040" (1.02mm) diameter with 0.080" (2.03mm) diameter standoff shoulders
4) Pins 4 and 8 are 0.080" (2.03mm) diameter with .125" (3.18) diameter standoff shoulders
5) Other pin extension lengths available
6) All Pins: Material: Copper Alloy
   Finish: Matte Tin over Nickel plate
7) Undimensioned components are shown for visual reference only.
8) Weight: 5.0oz (141g)
9) All dimensions in inches (mm)
   Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm)
   x.xxx +/-0.010 in. (x.xx +/-0.25mm)

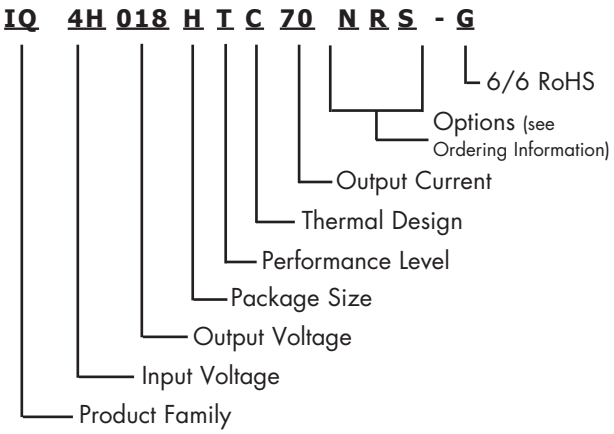
PIN DESIGNATIONS

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.
A	Clock Sync	Clock synchronization (Full Feature Option)
B	Start Sync	Startup synchronization (Full Feature Option)
C	Ishare	Single wire parallel signal (Full Feature Option)
3	Vin(–)	Negative input voltage
4	Vout(–)	Negative output voltage
5	SENSE(–)	Negative remote sense(see note 1)
6	TRIM	Output voltage trim (see note 2)
7	SENSE(+)	Positive remote sense (see note 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.
4) Pins A, B, and C are populated on Full Feature version only.

PART NUMBERING SYSTEM

The part numbering system for SynQor's 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. The "-G" suffix indicates 6/6 RoHS compliance.

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.

Contact SynQor for further information:

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

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 characters for options. Add "-G" to the model number for 6/6 RoHS compliance.

Model Number	Input Voltage	Output Voltage	Output Current
IQ4H018HTw70xyz	180-425V	1.8V	70A
IQ4H025HTw70xyz	180-425V	2.5V	70A
IQ4H033HTw60xyz	180-425V	3.3V	60A
IQ4H050HTw50xyz	180-425V	5V	50A
IQ4H120HTw25xyz	180-425V	12V	25A
IQ4H150HTw20xyz	180-425V	15V	20A
IQ4H240HTw13xyz	180-425V	24V	12.5A
IQ4H280HTw11xyz	180-425V	28V	10.7A
IQ4H480HTw06xyz	180-425V	48V	6.3A

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

Options Description			
Thermal Design	**Enable Logic**	**Pin Style**	**Feature Set**
C - Encased V - Encased with Flanged Baseplate	N - Negative	R - 0.180"	S - Standard F - Full Feature

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

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

Warranty

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

Information furnished by SynQor is believed to be accurate and reliable. However, no responsibility is assumed by SynQor for its use, nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of SynQor.