

180-425 V Continuous Input	475 V Transient Input	5-48 V Outputs	600 W Max Power	4250 Vdc Reinforced Insulation	Full-brick DC-DC Converter
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The InQor® full-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, 88%-92% at full rated load current
- Delivers full power with minimal derating
- Operating input voltage range: 180-425 V
- Fixed frequency switching provides predictable EMI

Mechanical Features

- Industry standard Full-brick pin-out configuration
- Size: 4.686" x 2.486" x .512" (119.0 x 63.1 x 13.0 mm)
- Total weight: 9.9 oz (280g)
- Flanged baseplate version available

Control Features

- On/Off control is fully isolated
- Remote sense for improved output voltage control
- Wide output voltage trim range
- Optional: active current share for N+1 and parallel applications
- Optional: clock synchronization and startup synchronization

Safety Features

Reinforced Insulation

- UL 60950-1
- CAN/CSA C22.2 No. 60950-1
- EN 60950-1
- CE Marked
- RoHS compliant (see last page)

Protection Features

- Input under-voltage lockout
- Output current limit and short circuit protection
- Active backdrive current limit
- Output over-voltage protection
- Thermal shutdown
- Input over-voltage shut down

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IQ4H-FT Family Electrical Characteristics

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385 Vdc unless otherwise noted; full operating temperature range is -40 °C to +100 °C baseplate temperature with appropriate power derating. Specifications subject to change without notice.

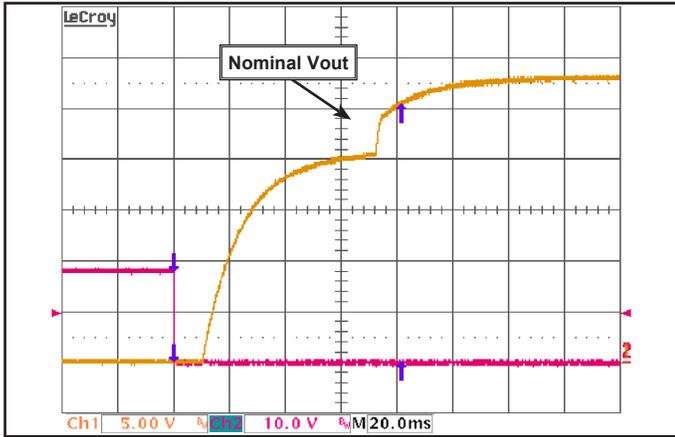
Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					
Non-Operating	-0.5		600	V	Continuous
Operating			425	V	Continuous
Operating Transient			475	V	1 s transient, square wave
Isolation Voltage					
Input to Output			4250	Vdc	Reinforced Insulation
Input to Baseplate			2300	Vdc	Basic Insulation
Output to Baseplate			2300	Vdc	Basic Insulation
Operating Temperature	-40		100	°C	Baseplate temperature
Storage Temperature	-45		125	°C	
Voltage at ON/OFF input pin	-2		18	V	
INPUT CHARACTERISTICS					
Operating Input Voltage Range	180	385	425	V	475 V transient for 1 s; see Note 1
Input Voltage Rise Time	500			µs	0 - 425 V
Input Under Voltage					
Turn-On Voltage Threshold	169.0	174.0	179.0	V	
Turn-Off Voltage Threshold	157.0	162.0	167.0	V	
Lockout Voltage Hysteresis		12.0		V	
Input Over-Voltage Shutdown		500		V	
Recommended External Input Capacitance		7		µF	Typical ESR 1Ω see Note 2
Input Filter Component Values (C\L\C)		.272\5.5\1.2		µF\µH\µF	Internal values; see Figure D
DYNAMIC CHARACTERISTICS					
Turn-On Transient					
Turn-On Time		90		ms	Full load, Vout = 90 % nom. (from enable)
Start-Up Inhibit Time	360	400	440	ms	-40 °C to +100 °C; see Figure E
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 3
TEMPERATURE LIMITS FOR POWER DERATING CURVES					
Semiconductor Junction Temperature			125	°C	Package rated to 150 °C
PCB Temperature			125	°C	UL rated max operating temp 130 °C
Transformer Temperature			125	°C	
Maximum Baseplate Temperature, Tb			100	°C	
FEATURE CHARACTERISTICS					
Switching Frequency	350	375	400	kHz	
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
Input Resistance		3		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		1.3		10 ⁶ Hrs.	Tb = 70 °C
Calculated MTBF (MIL-217) MIL-HDBK-217F		1.2		10 ⁶ Hrs.	Tb = 70 °C
Field Demonstrated MTBF		TBD		10 ⁶ Hrs.	See our website for details

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

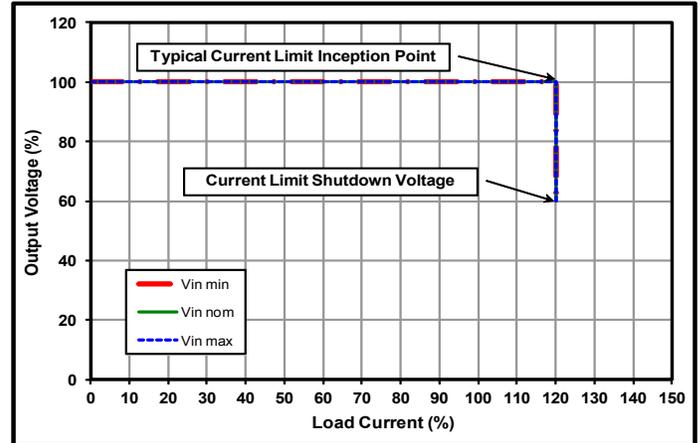
Note 2: An input capacitor with series resistance is necessary to provide system stability.

Note 3: Input to output isolation capacitance external to the module is recommended.

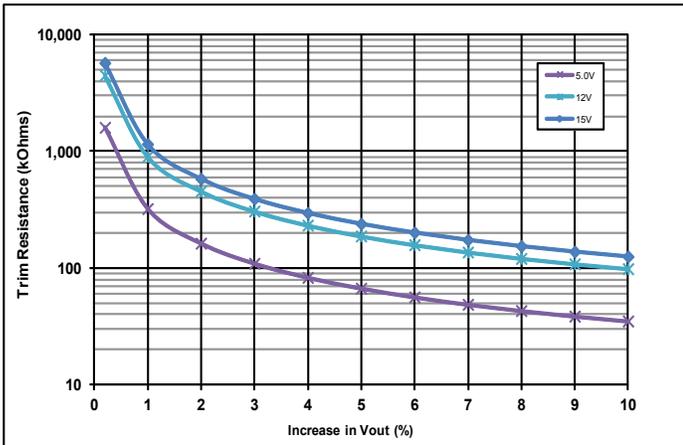
Family Figures (all output voltages)



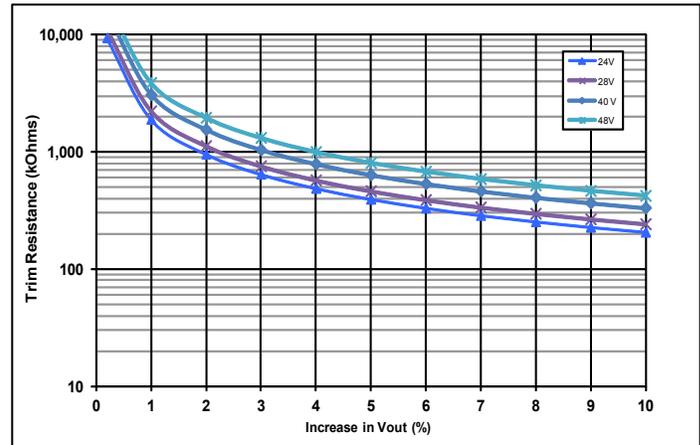
Common Figure 1: Start waveform with 1% load. Input voltage pre-applied, Ch 1: Vout(5V/div) Ch 2: ON/OFF Pin on.



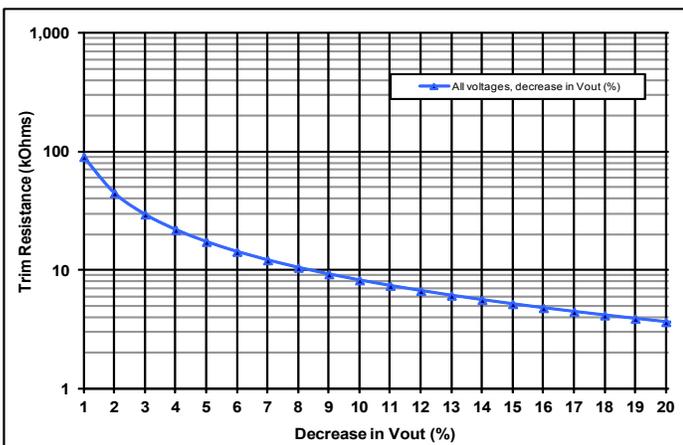
Common Figure 2: Output voltage vs. load current showing typical current limit curves and converter shutdown points.



Common Figure 3: Trim graph for trim-up 5 to 15V outputs.



Common Figure 4: Trim graph for trim-up 24 to 48V outputs.



Common Figure 5: Trim graph for trim down.

IQ4H050FTX80 Electrical Characteristics (5.0 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385 Vdc unless otherwise noted; full operating temperature range is -40 °C to +100 °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			3.4	A	Vin min; trim up; in current limit
No-Load Input Current (enabled)		30	60	mA	
Disabled Input Current		10.0	20.0	mA	
Response to Input Transient		0.50		V	Peak, see Figure 6
Input Terminal Ripple Current		365		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting fuse recommended; see Note 3
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	4.95	5.00	5.05	V	
Output Voltage Regulation					
Over Line		±0.1	±0.3	%	
Over Load		±0.1	±0.3	%	
Over Temperature	-75		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		170	280	mV	Full load
RMS		46	84	mV	Full load
Operating Output Current Range	0		80	A	Subject to thermal derating
Operating Output Current Range (Start up)	0.8		80	A	See Application notes
Output DC Current Limit Inception	88.0	100.0	112.0	A	Output voltage 10 % Low
Output DC Current Limit Shutdown Voltage		2.5		V	
Back-Drive Current Limit while Enabled		0.3		A	Negative current drawn from output pins
Back-Drive Current Limit while Disabled		4.0		mA	Negative current drawn from output pins
Maximum Output Capacitance			20,000	µF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/µs)		200		mV	50 % to 75 % to 50 % Iout max; see Figure 5
Settling Time		150		µs	To within 1 % Vout nom; see Figure 5
Output Voltage Trim Range	-20		10	%	Across Pins 13 & 18; See Note 2 & Note 4
Output Voltage Remote Sense Range			10	%	Across Pins 13 & 18
Output Over-Voltage Protection	5.6	6.3	6.9	V	Across Pins 13 & 18
Auxiliary power	7	8	10	V	Maximum current of 50 mA, Referenced to Vout(-)
EFFICIENCY					
100 % Load		87		%	
50 % Load		89		%	

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: Safety certification requires the use of a fuse rated at or below this value.

Note 4: Maximum Trim-up is 10 %. Applying more than 6.2 V between trim pin and Vout(-) may damage the unit.

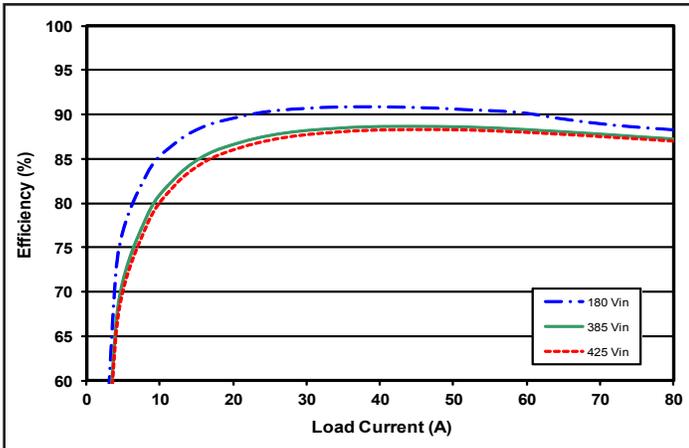


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

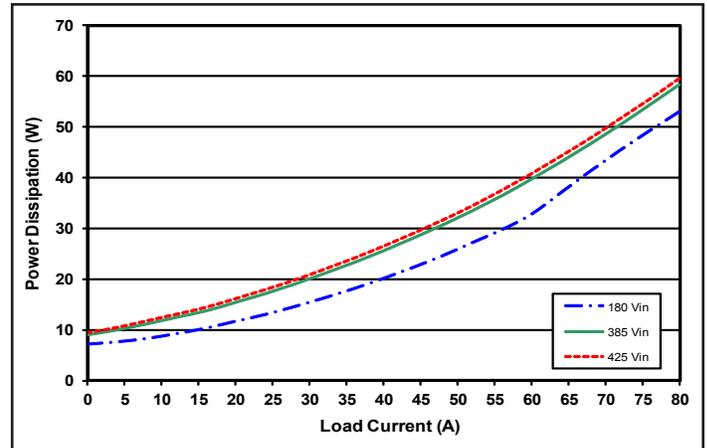


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

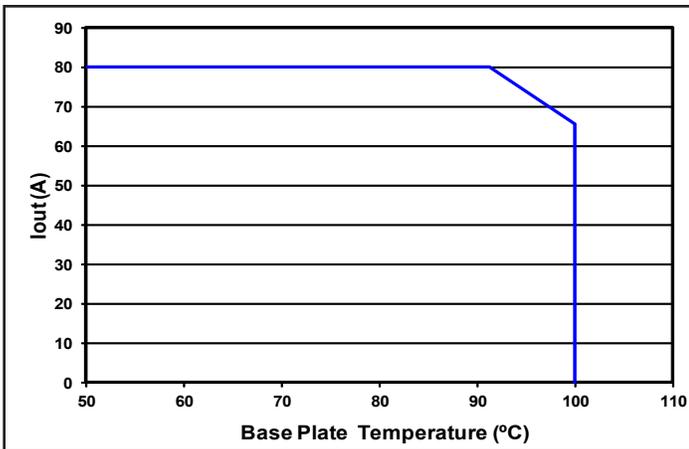


Figure 3: Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

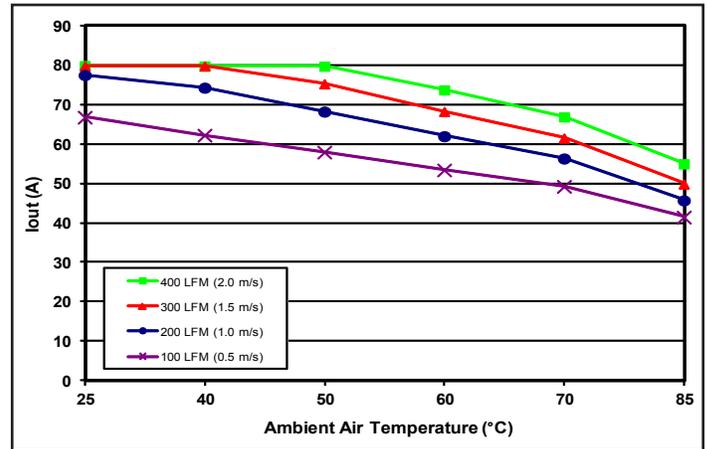


Figure 4: Encased converter (with 1.0” heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

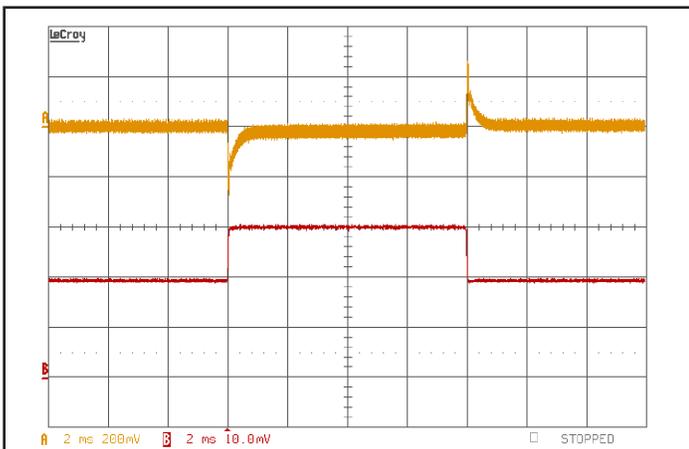


Figure 5: Output voltage response to step-change in load current (50 % -75 % -50 % of Iout(max); dI/dt = 0.1 A/μs). Load cap: 15 μF tantalum cap and 1 μF ceramic cap. Ch 1: Vout (200 mV/div), Ch 2: Iout (20 A/div).

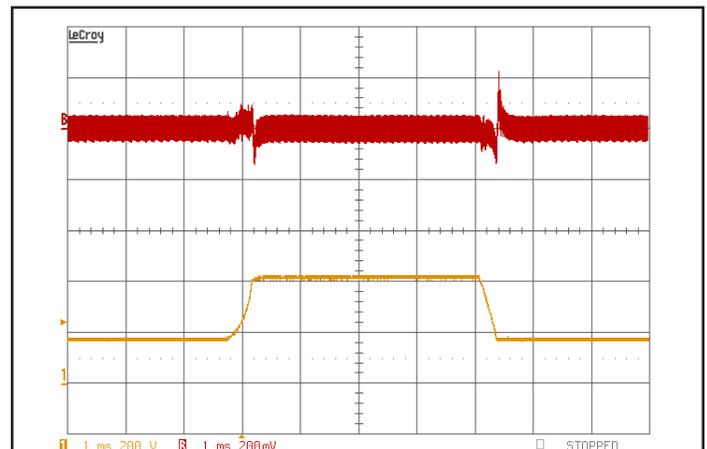


Figure 6: Output voltage response to step-change in input voltage (180 V - 425 V - 180 V), at 80 A load current. Load cap: 15 μF tantalum capacitor and 1 uF ceramic cap. Ch 1: Vin (200 V/div), Ch 2: Vout (200 mV/div).

IQ4H120FTX50 Electrical Characteristics (12 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385 Vdc unless otherwise noted; full operating temperature range is -40 °C to +100 °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			5.1	A	Vin min; trim up; in current limit
No-Load Input Current (enabled)		35	70	mA	
Disabled Input Current		10.0	20.0	mA	
Response to Input Transient		0.50		V	Peak, see Figure 6
Input Terminal Ripple Current		300		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting fuse recommended; see Note 3
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	11.88	12.00	12.12	V	
Output Voltage Regulation					
Over Line		±0.1	±0.3	%	
Over Load		±0.1	±0.3	%	
Over Temperature	-120		120	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		190	240	mV	Full load
RMS		49	70	mV	Full load
Operating Output Current Range	0		50	A	Subject to thermal derating
Operating Output Current Range (Start up)	0.5		50	A	See Application notes
Output DC Current Limit Inception	55.0	62.5	70.0	A	Output voltage 10 % Low
Output DC Current Limit Shutdown Voltage		6.0		V	
Back-Drive Current Limit while Enabled		0.2		A	Negative current drawn from output pins
Back-Drive Current Limit while Disabled		4.0		mA	Negative current drawn from output pins
Maximum Output Capacitance			10,000	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; see Figure 5
Settling Time		150		µs	To within 1 % Vout nom; see Figure 5
Output Voltage Trim Range	-20		10	%	Across Pins 13 & 18; See Note 2 & Note 4
Output Voltage Remote Sense Range			10	%	Across Pins 13 & 18
Output Over-Voltage Protection	13.5	15.0	16.5	V	Across Pins 13 & 18
Auxiliary power	7	8	10	V	Maximum current of 50 mA, Referenced to Vout(-)
EFFICIENCY					
100 % Load		90		%	
50 % Load		91		%	

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: Safety certification requires the use of a fuse rated at or below this value.

Note 4: Maximum Trim-up is 10 %. Applying more than 6.2 V between trim pin and Vout(-) may damage the unit.

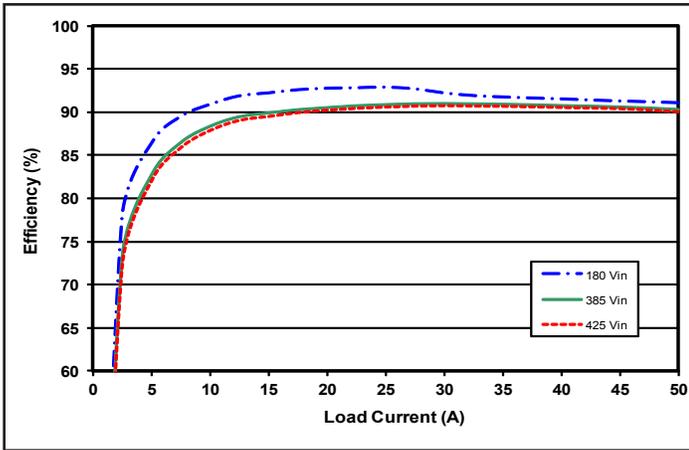


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

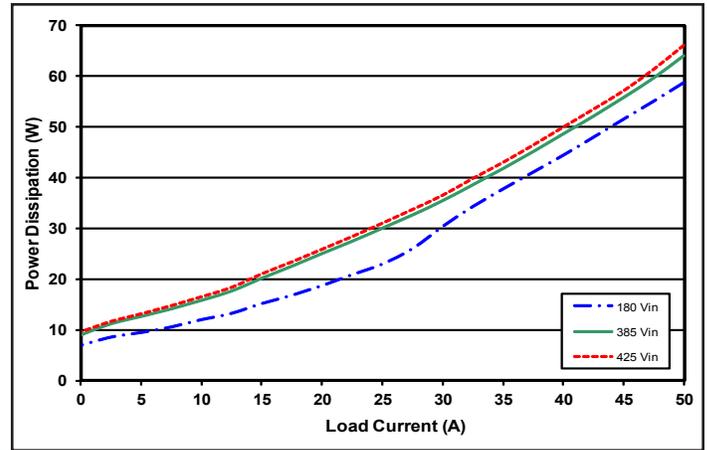


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

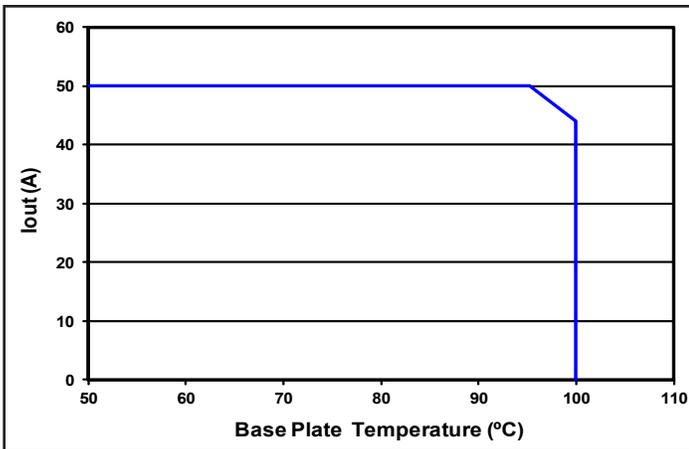


Figure 3: Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

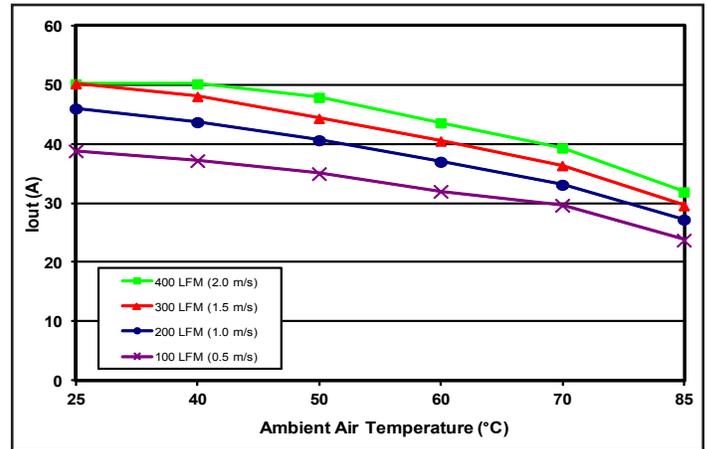


Figure 4: Encased converter (with 1.0" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

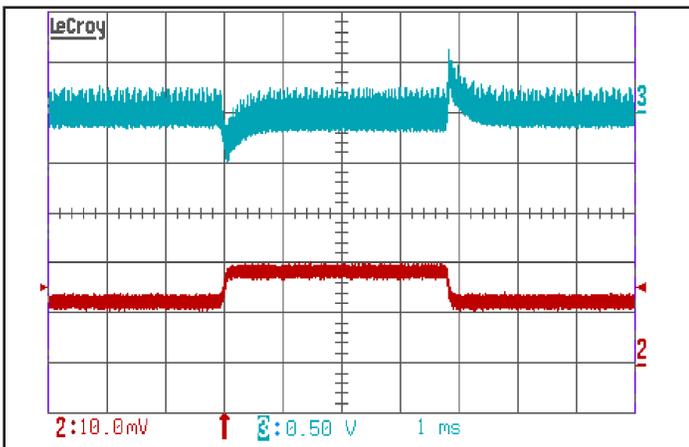


Figure 5: Output voltage response to step-change in load current (50% -75% -50% of I_{out}(max); dI/dt = 0.1 A/μs). Load cap: 15 μF tantalum cap and 1 μF ceramic cap. Ch 3: V_{out} (500 mV/div), Ch 2: I_{out} (20 A/div).

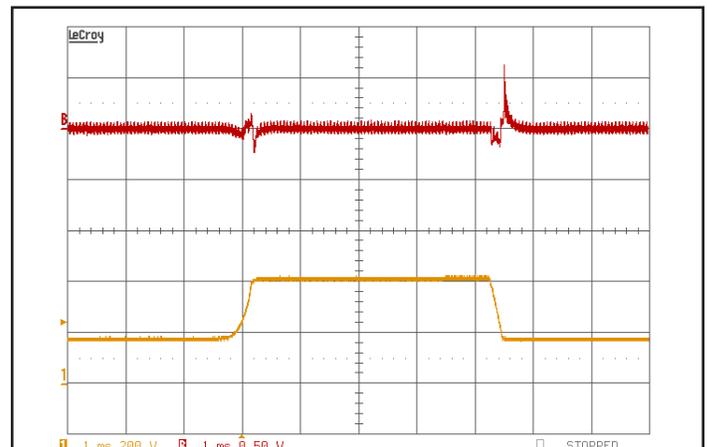


Figure 6: Output voltage response to step-change in input voltage (180 V - 425 V - 180 V), at 50 A load current. Load cap: 15 μF tantalum capacitor and 1 uF ceramic cap. Ch 1: V_{in} (200 V/div), Ch 2: V_{out} (0.50 V/div).

IQ4H150FTX40 Electrical Characteristics (15 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385 Vdc unless otherwise noted; full operating temperature range is -40 °C to +100 °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			5.1	A	Vin min; trim up; in current limit
No-Load Input Current (enabled)		30	60	mA	
Disabled Input Current		10.0	20.0	mA	
Response to Input Transient		0.50		V	Peak, see Figure 6
Input Terminal Ripple Current		478		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting fuse recommended; see Note 3
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	14.85	15.00	15.15	V	
Output Voltage Regulation					
Over Line		±0.1	±0.3	%	
Over Load		±0.1	±0.3	%	
Over Temperature	-150		150	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		120	240	mV	Full load
RMS		100	200	mV	Full load
Operating Output Current Range	0		40	A	Subject to thermal derating
Operating Output Current Range (Start up)	0.4		40	A	See Application notes
Output DC Current Limit Inception	44.0	50.0	56.0	A	Output voltage 10 % Low
Output DC Current Limit Shutdown Voltage		7.5		V	
Back-Drive Current Limit while Enabled		0.2		A	Negative current drawn from output pins
Back-Drive Current Limit while Disabled		4.0		mA	Negative current drawn from output pins
Maximum Output Capacitance			8,000	µF	Vout nominal at full load (resistive load)
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/µs)		300		mV	50 % to 75 % to 50 % Iout max; see Figure 5
Settling Time		750		µs	To within 1 % Vout nom; see Figure 5
Output Voltage Trim Range	-20		10	%	Across Pins 13 & 18; See Note 2 & Note 4
Output Voltage Remote Sense Range			10	%	Across Pins 13 & 18
Output Over-Voltage Protection	16.9	18.8	20.6	V	Across Pins 13 & 18
Auxiliary power	7	8	10	V	Maximum current of 50 mA, Referenced to Vout(-)
EFFICIENCY					
100 % Load		92		%	
50 % Load		92		%	

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: Safety certification requires the use of a fuse rated at or below this value.

Note 4: Maximum Trim-up is 10 %. Applying more than 6.2 V between trim pin and Vout(-) may damage the unit.

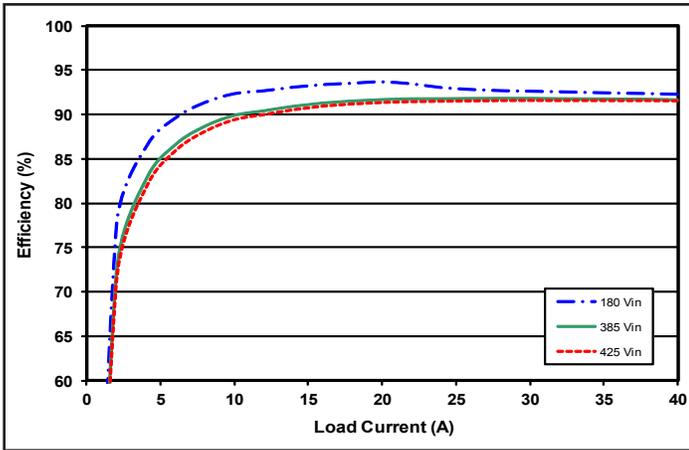


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

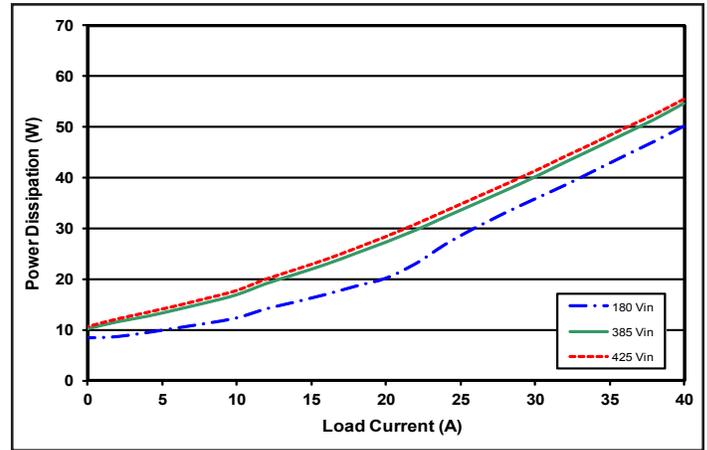


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

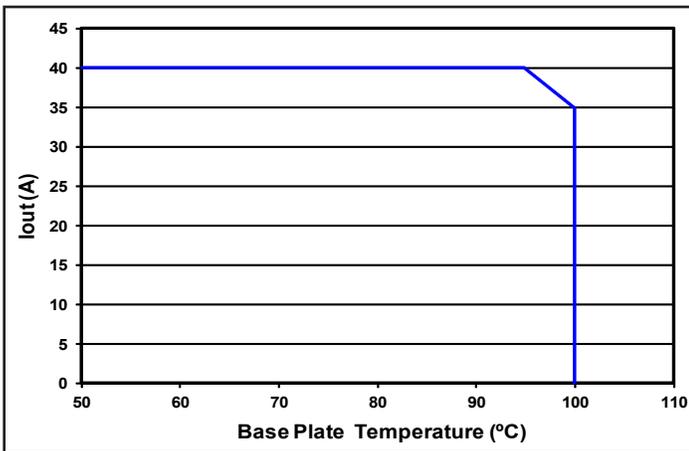


Figure 3: Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

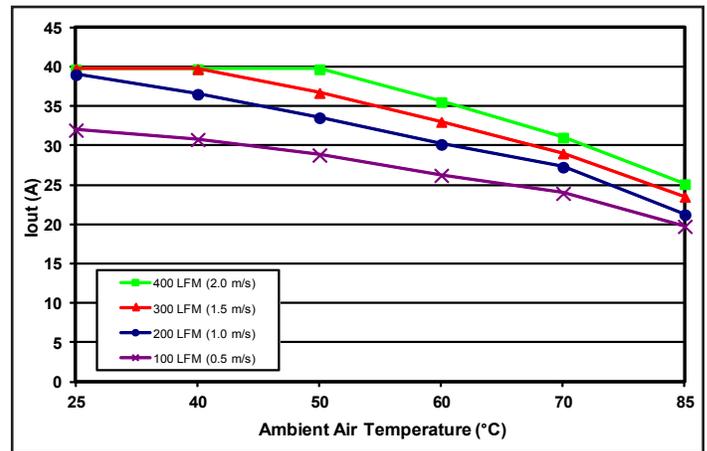


Figure 4: Encased converter (with 1.0” heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

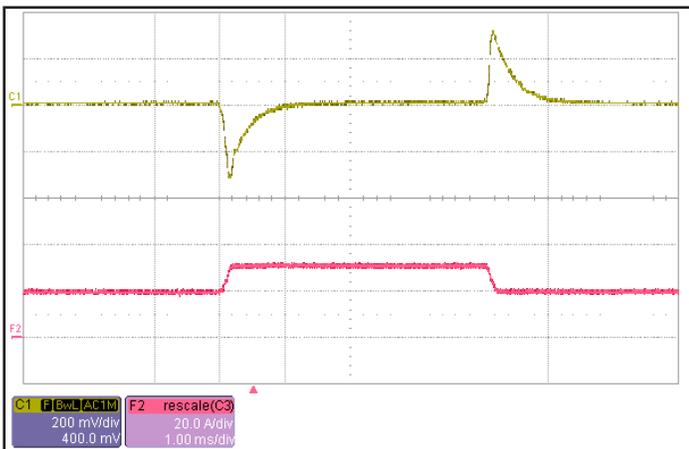


Figure 5: Output voltage response to step-change in load current (50% -75% -50% of Iout(max); dI/dt = 0.1 A/us). Load cap: 15 μF tantalum cap and 1 μF ceramic cap. Ch 1: Vout (200 mV/div), Ch 2: Iout (20 A/div).

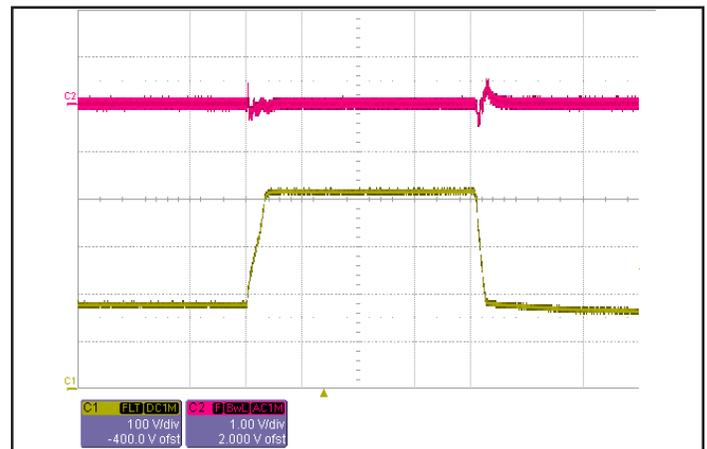


Figure 6: Output voltage response to step-change in input voltage (180 V - 425 V - 180 V), at 40 A load current. Load cap: 15 μF tantalum capacitor and 1 uF ceramic cap. Ch 1: Vin (100 V/div), Ch 2: Vout (1 V/div).

IQ4H240FTX25 Electrical Characteristics (24 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385 Vdc unless otherwise noted; full operating temperature range is -40 °C to +100 °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			5.1	A	Vin min; trim up; in current limit
No-Load Input Current (enabled)		37	64	mA	
Disabled Input Current		10.0	20.0	mA	
Response to Input Transient		0.50		V	Peak, see Figure 6
Input Terminal Ripple Current		350		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting fuse recommended; see Note 3
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	23.76	24.00	24.24	V	
Output Voltage Regulation					
Over Line		±0.1	±0.3	%	
Over Load		±0.1	±0.3	%	
Over Temperature	-250		250	mV	
Total Output Voltage Range	23.40		24.60	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 1
Peak-to-Peak		210	419	mV	Full load
RMS		48	96	mV	Full load
Operating Output Current Range	0		25.0	A	Subject to thermal derating
Operating Output Current Range (Start up)	0.25		25.0	A	See Application notes
Output DC Current Limit Inception	27.5	31.3	35.0	A	Output voltage 10 % Low
Output DC Current Limit Shutdown Voltage		12.0		V	
Back-Drive Current Limit while Enabled		0.2		A	Negative current drawn from output pins
Back-Drive Current Limit while Disabled		4.0		mA	Negative current drawn from output pins
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)		600		mV	50 % to 75 % to 50 % Iout max; see Figure 5
Settling Time		400		µs	To within 1 % Vout nom; see Figure 5
Output Voltage Trim Range	-20		10	%	Across Pins 13 & 18; See Note 2 & Note 4
Output Voltage Remote Sense Range			10	%	Across Pins 13 & 18
Output Over-Voltage Protection	27.0	30.0	33.0	V	Across Pins 13 & 18
Auxiliary power	7	8	10	V	Maximum current of 50 mA, Referenced to Vout(-)
EFFICIENCY					
100 % Load		90		%	
50 % Load		91		%	

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: Safety certification requires the use of a fuse rated at or below this value.

Note 4: Maximum Trim-up is 10 %. Applying more than 6.2 V between trim pin and Vout(-) may damage the unit.

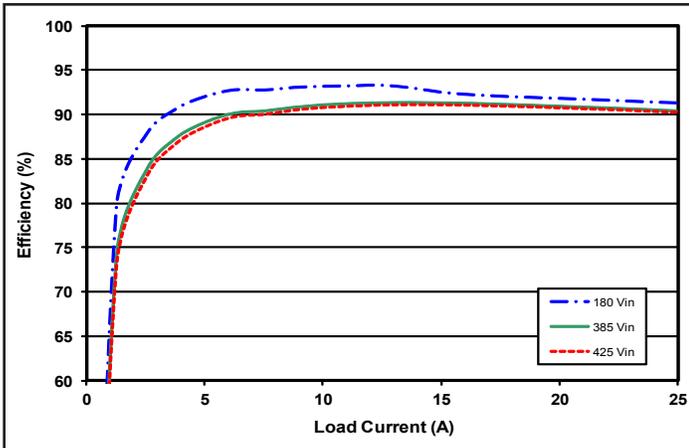


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

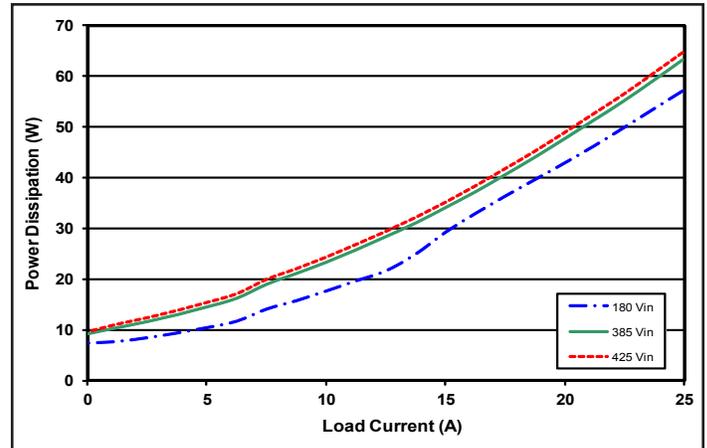


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

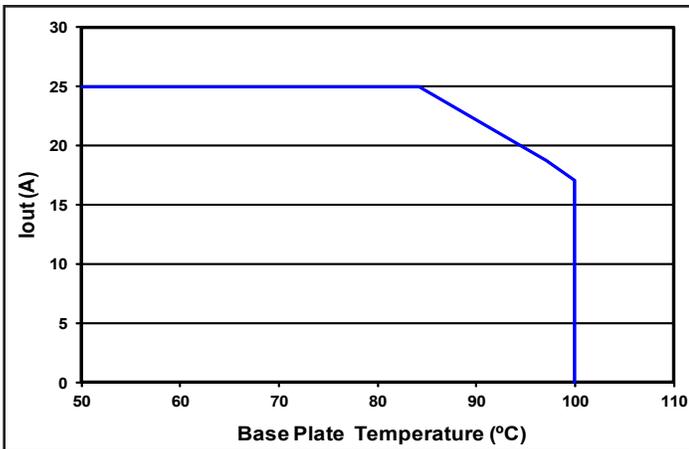


Figure 3: Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

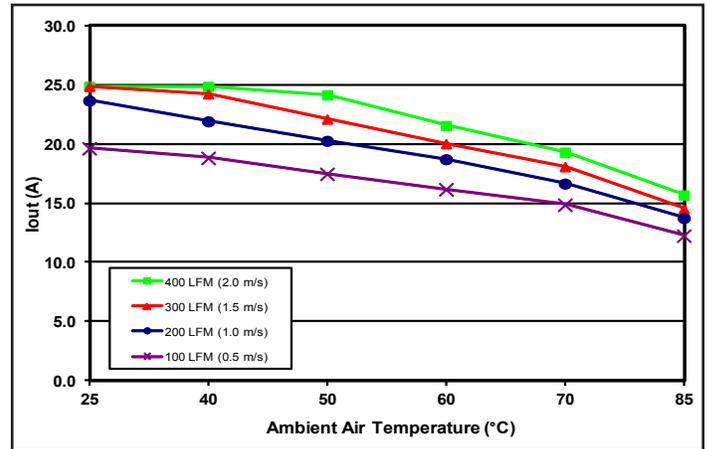


Figure 4: Encased converter (with 1.0" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

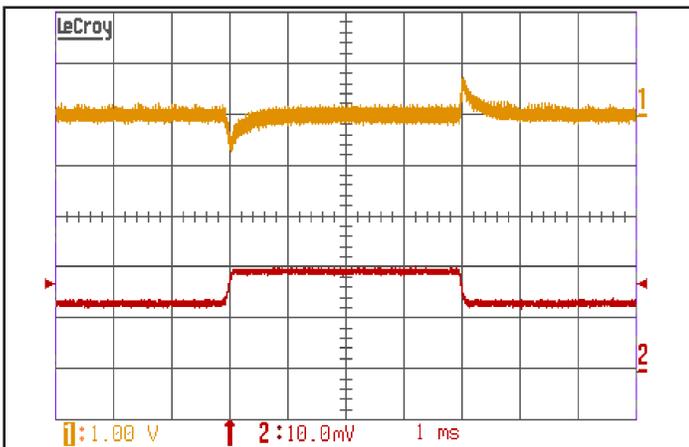


Figure 5: Output voltage response to step-change in load current (50% -75% -50% of I_{out}(max); dI/dt = 0.1 A/μs). Load cap: 15 μF tantalum cap and 1 μF ceramic cap. Ch 1: V_{out} (1 V/div), Ch 2: I_{out} (10 A/div).

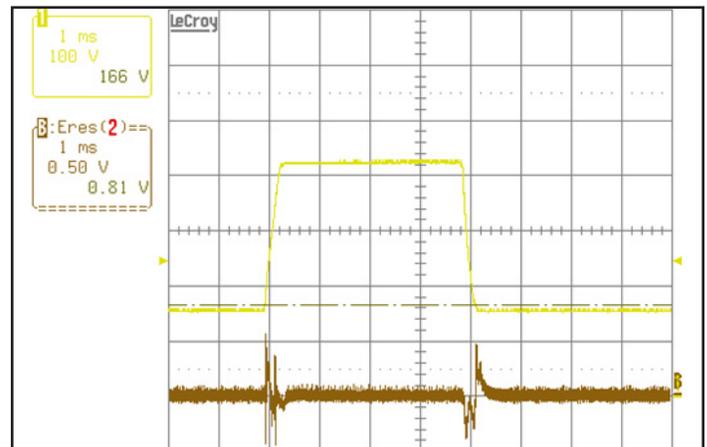


Figure 6: Output voltage response to step-change in input voltage (180 V - 425 V - 180 V), at 25 A load current. Load cap: 15 μF tantalum capacitor and 1 uF ceramic cap. Ch 1: V_{in} (100 V/div), Ch 2: V_{out} (0.5 V/div).

IQ4H280FTX21 Electrical Characteristics (28 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385 Vdc unless otherwise noted; full operating temperature range is -40 °C to +100 °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			5.1	A	Vin min; trim up; in current limit
No-Load Input Current (enabled)		35	70	mA	
Disabled Input Current		10.0	20.0	mA	
Response to Input Transient		0.54		V	Peak, see Figure 6
Input Terminal Ripple Current		478		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting fuse recommended; see Note 3
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	27.72	28.00	28.28	V	
Output Voltage Regulation					
Over Line		±0.1	±0.3	%	
Over Load		±0.1	±0.3	%	
Over Temperature	-220		220	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		135	270	mV	Full load
Operating Output Current Range	0		21.4	A	Subject to thermal derating
Operating Output Current Range (Start up)	0.21		21.4	A	See Application notes
Output DC Current Limit Inception	22.6	25.7	28.8	A	Output voltage 10 % Low
Output DC Current Limit Shutdown Voltage		14.0		V	
Back-Drive Current Limit while Enabled		0.4		A	Negative current drawn from output pins
Back-Drive Current Limit while Disabled		4.0		mA	Negative current drawn from output pins
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)		830		mV	50 % to 75 % to 50 % Iout max; see Figure 5
Settling Time		460		µs	To within 1 % Vout nom; see Figure 5
Output Voltage Trim Range	-20		10	%	Across Pins 13 & 18; See Note 2 & Note 4
Output Voltage Remote Sense Range			10	%	Across Pins 13 & 18
Output Over-Voltage Protection	31.5	35.0	38.5	V	Across Pins 13 & 18
Auxiliary power	7	8	10	V	Maximum current of 50 mA, Referenced to Vout(-)
EFFICIENCY					
100 % Load		90		%	
50 % Load		91		%	

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: Safety certification requires the use of a fuse rated at or below this value.

Note 4: Maximum Trim-up is 10 %. Applying more than 6.2 V between trim pin and Vout(-) may damage the unit.

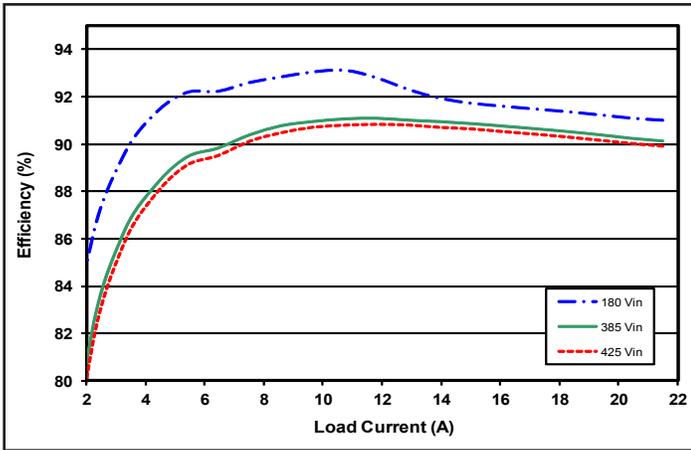


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

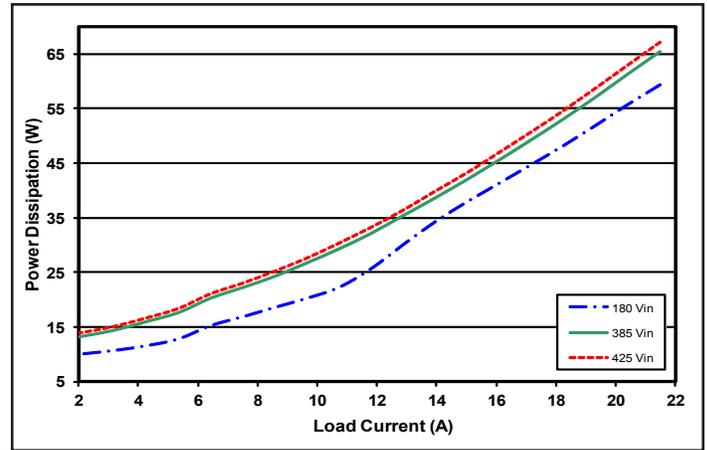


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

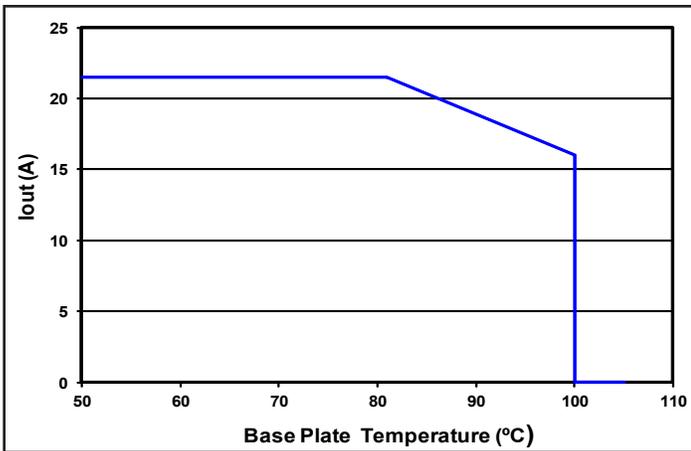


Figure 3: Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

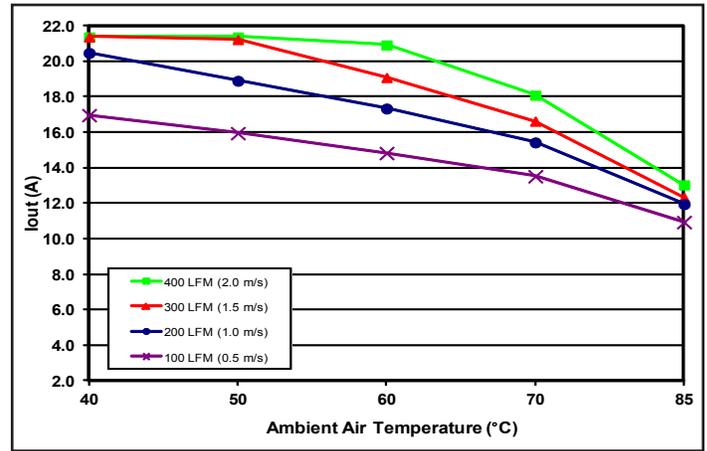


Figure 4: Encased converter (with 1.0" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

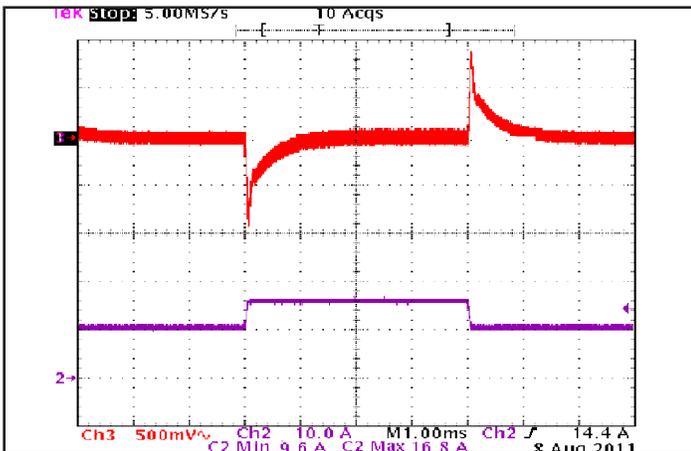


Figure 5: Output voltage response to step-change in load current (50% -75% -50% of $I_{out(max)}$; $dI/dt = 0.1 A/\mu s$). Load cap: 15 μF tantalum cap and 1 μF ceramic cap. Ch 3: V_{out} (500 mV/div), Ch 2: I_{out} (10A/div).

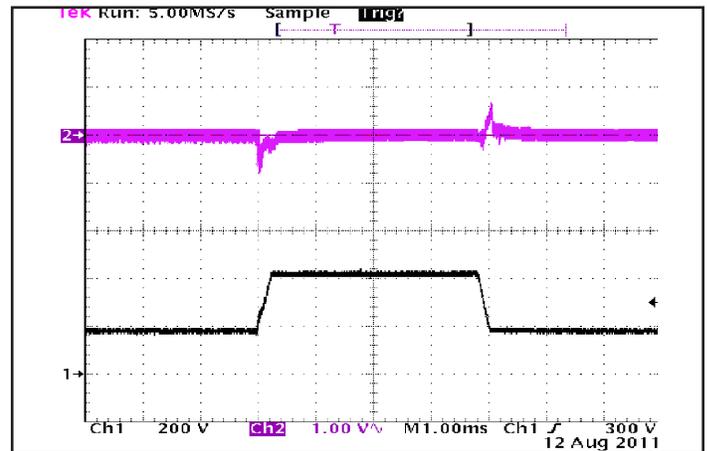


Figure 6: Output voltage response to step-change in input voltage (180 V - 425 V - 180 V), (1 V/ μs), at 21.4 A load current. Load cap: 15 μF tantalum capacitor and 1 μF ceramic cap. Ch 1: V_{in} (200 V/div), Ch 2: V_{out} (1 V/div).



Technical Specification

Input: 180-425 V
Output: 40.0 V
Current: 15 A
Part No.: IQ4H400FTX15

IQ4H400FTX15 Electrical Characteristics (40 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385 Vdc unless otherwise noted; full operating temperature range is -40 °C to +100 °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			5.1	A	Vin min; trim up; in current limit
No-Load Input Current (enabled)		35	70	mA	
Disabled Input Current		10.0	20.0	mA	
Response to Input Transient		0.75		V	Peak, see Figure 6
Input Terminal Ripple Current		500		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting fuse recommended; see Note 3
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	39.60	40.00	40.40	V	
Output Voltage Regulation					
Over Line		±0.1	±0.3	%	
Over Load		±0.1	±0.3	%	
Over Temperature	-220		220	mV	
Total Output Voltage Range	39.00		41.00	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 1
Peak-to-Peak		150	300	mV	Full load
RMS		50	100	mV	Full load
Operating Output Current Range	0		15.0	A	Subject to thermal derating
Output DC Current Limit Inception	15.5	18	20	A	Output voltage 10 % Low
Output DC Current Limit Shutdown Voltage		15.2		V	
Back-Drive Current Limit while Enabled		0.5		A	Negative current drawn from output pins
Back-Drive Current Limit while Disabled		4.0		mA	Negative current drawn from output pins
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)		950		mV	50 % to 75 % to 50 % Iout max; see Figure 5
Settling Time		600		µs	To within 1 % Vout nom; see Figure 5
Output Voltage Trim Range	-20		10	%	Across Pins 13 & 18; See Note 2 & Note 4
Output Voltage Remote Sense Range			10	%	Across Pins 13 & 18
Output Over-Voltage Protection	45	48	51	V	Across Pins 13 & 18
Auxiliary power		5		V	Referenced to Vout(-); See Note 5
EFFICIENCY					
100 % Load		92		%	
50 % Load		92		%	

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: Safety certification requires the use of a fuse rated at or below this value.

Note 4: Maximum Trim-up is 10 %. Applying more than 6.2 V between trim pin and Vout(-) may damage the unit.

Note 5: Maximum current of 50 mA; See the Auxiliary Output of Application Section (page 18) for more information

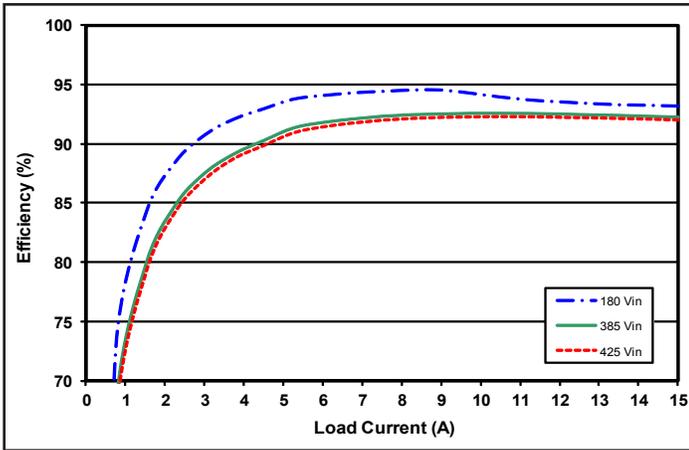


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

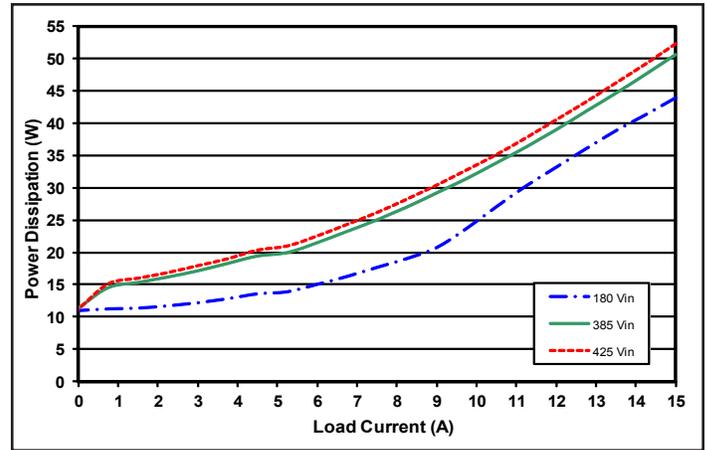


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

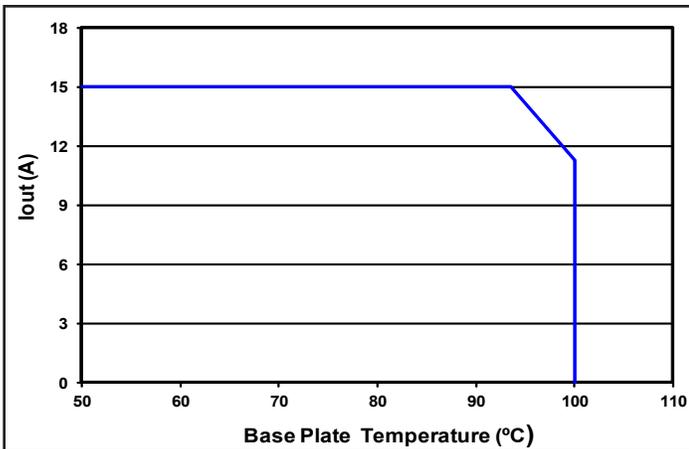


Figure 3: Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

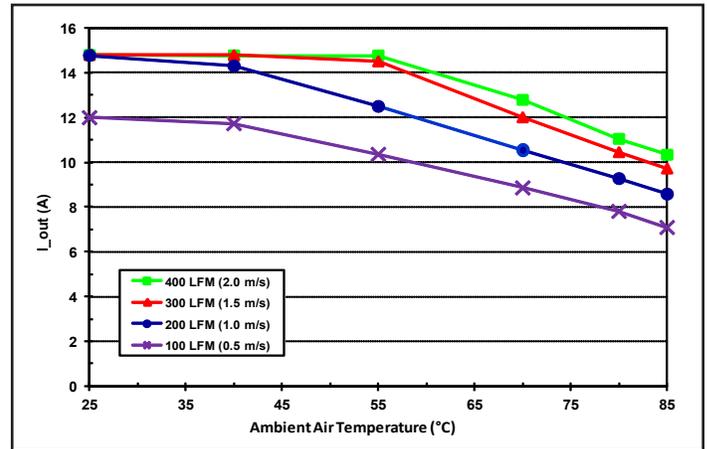


Figure 4: Encased converter (with 1.0" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

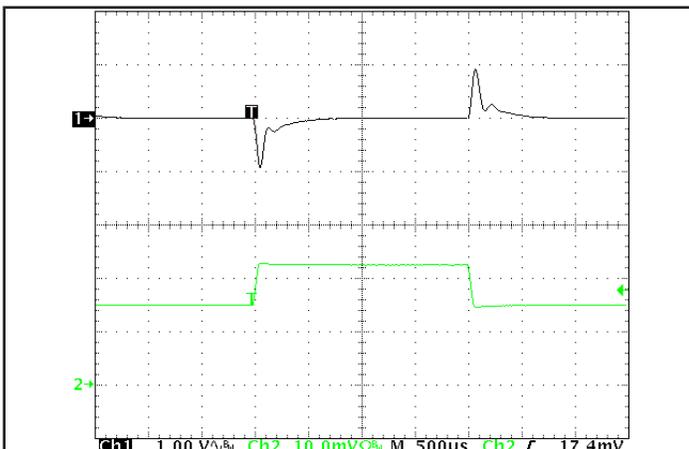


Figure 5: Output voltage response to step-change in load current (50% -75% -50% of I_{out}(max); dI/dt = 0.1 A/μs). Load cap: 15 μF tantalum cap and 1 μF ceramic cap. Ch 1: V_{out} (1 V/div), Ch 2: I_{out} (5 A/div).

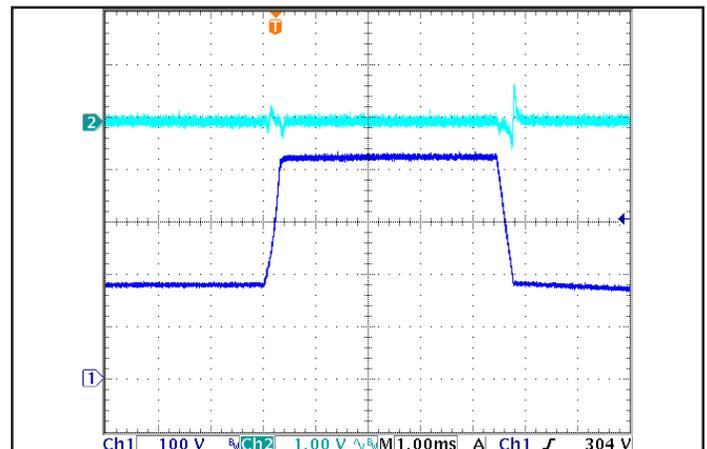


Figure 6: Output voltage response to step-change in input voltage (180 V - 425 V - 180 V), at 15 A load current. Load cap: 15 μF tantalum capacitor and 1 uF ceramic cap. Ch 1: V_{in} (100 V/div), Ch 2: V_{out} (1 V/div).



Technical Specification

Input: 180-425 V
Output: 48.0 V
Current: 12.5 A
Part No.: IQ4H480FTX13

IQ4H480FTX13 Electrical Characteristics (48 Vout)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 385 Vdc unless otherwise noted; full operating temperature range is -40 °C to +100 °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			5.1	A	Vin min; trim up; in current limit
No-Load Input Current (enabled)		35	70	mA	
Disabled Input Current		10.0	20.0	mA	
Response to Input Transient		1.20		V	Peak, see Figure 6
Input Terminal Ripple Current		546		mA	RMS, Full load, 20 MHz bandwidth
Recommended Input Fuse			5.0	A	Fast acting fuse recommended; see Note 3
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	47.52	48.00	48.48	V	
Output Voltage Regulation					
Over Line		±0.1	±0.3	%	
Over Load		±0.1	±0.3	%	
Over Temperature	-220		220	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		370	740	mV	Full load
RMS		110	220	mV	Full load
Operating Output Current Range	0		12.5	A	Subject to thermal derating
Operating Output Current Range (Start up)	0.13		12.5	A	See Application notes
Output DC Current Limit Inception	13.1	15.0	16.8	A	Output voltage 10 % Low
Output DC Current Limit Shutdown Voltage		24.0		V	
Back-Drive Current Limit while Enabled		0.3		A	Negative current drawn from output pins
Back-Drive Current Limit while Disabled		4.0		mA	Negative current drawn from output pins
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)		1600		mV	50 % to 75 % to 50 % Iout max; see Figure 5
Settling Time		650		µs	To within 1 % Vout nom; see Figure 5
Output Voltage Trim Range	-20		10	%	Across Pins 13 & 18; See Note 2 & Note 4
Output Voltage Remote Sense Range			10	%	Across Pins 13 & 18
Output Over-Voltage Protection	54.0	60.0	66.0	V	Across Pins 13 & 18
Auxiliary power	7	8	10	V	Maximum current of 50 mA, Referenced to Vout(-)
EFFICIENCY					
100 % Load		91		%	
50 % Load		92		%	

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: Safety certification requires the use of a fuse rated at or below this value.

Note 4: Maximum Trim-up is 10 %. Applying more than 6.2 V between trim pin and Vout(-) may damage the unit.

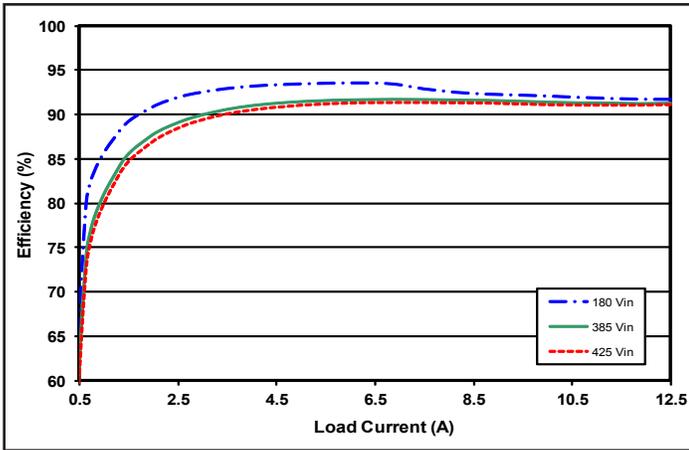


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

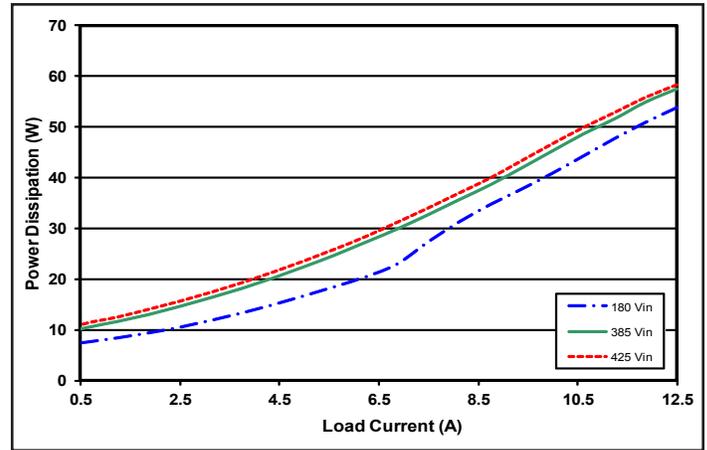


Figure 2: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25 °C.

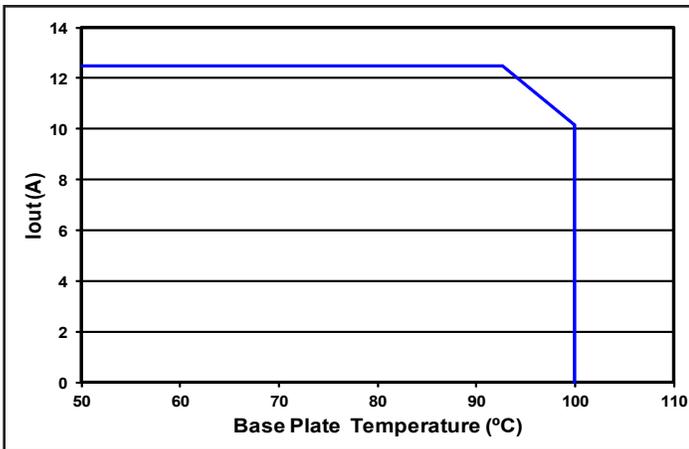


Figure 3: Encased converter max. output power derating vs. base plate temperature (nominal input voltage).

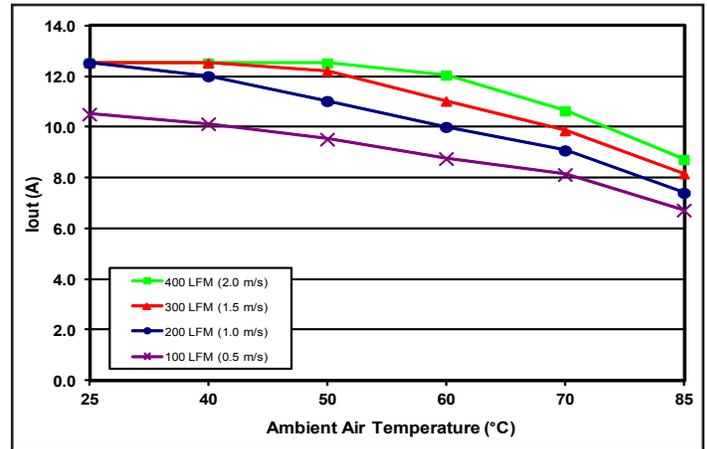


Figure 4: Encased converter (with 1.0" heatsink) max. output power derating vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM. Air flows across the converter from input to output (nominal input voltage).

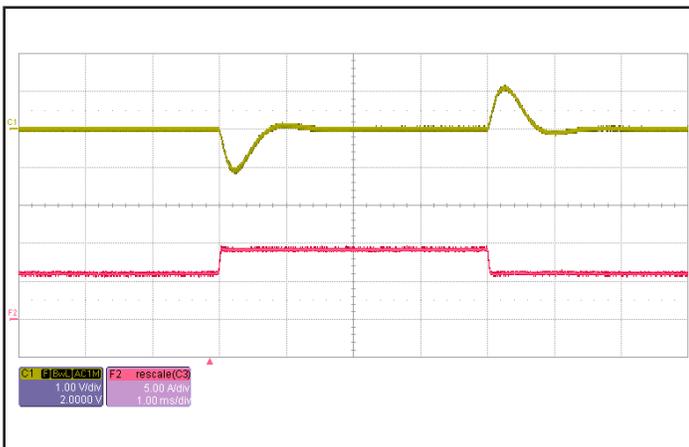


Figure 5: Output voltage response to step-change in load current (50% -75% -50% of Iout(max); dI/dt = 0.1 A/μs). Load cap: 15μF tantalum cap and 1μF ceramic cap. Ch 1: Vout (1 V/div), Ch 2: Iout (5 A/div).

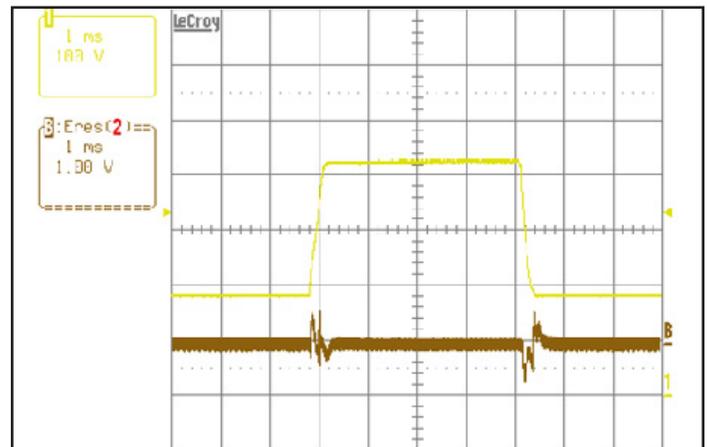


Figure 6: Output voltage response to step-change in input voltage (180 V - 425 V - 180 V), at 12.5 A load current. Load cap: 4 uF ceramic cap. Ch 1: Vin (100 V/div), Ch 2: Vout (1 V/div).

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. The switching frequency of second stage is half of the switching frequency of first stage and locked in phase. 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 converter 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 use the industry standard footprint and pin-out configuration.

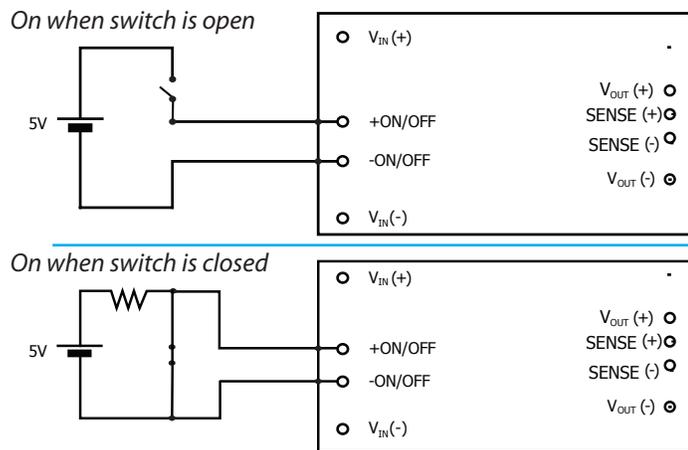


Figure A: Example of two configurations for the enable signal

CONTROL FEATURES

ON/OFF(+) and ON/OFF(-) (Pin 3 and 4) - Remote ON/OFF: The ON/OFF inputs, Pins 3 and 4, permits the user to turn the converter on or off. These two inputs are fully isolated from both the input and the output side of the power converter, allowing the user the option to manage the converter from the input or the output end. The user's on/off control signal is applied between the ON/OFF(+) pin and the ON/OFF(-) pins. Figure A details two possible circuits for driving the ON/OFF pin. Figure B is a detailed look of the internal ON/OFF circuitry.

REMOTE SENSE(+) and SENSE(-) (Pins 11 and 12): The SENSE inputs correct for voltage drops along the conductors that connect the converter's output pins to the load. Pin 11 should be connected to Vout(+) and Pin 12 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

$$[V_{out(+)} - V_{out(-)}] - [V_{sense(+)} - V_{sense(-)}] \leq \text{Sense Range \%} \times V_{out}$$

Pins 11 and 12 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 set value.

The voltage at the output terminals of the module will be trimmed up by the control circuit to compensate for voltage drops between the output pins of the module and the remote sense point. Note that the over-voltage protection (OVP) circuit senses the voltage at the output pins of the module. It is possible to inadvertently trip the OVP protection circuit if the voltage drop between the output pins and the sense point becomes too large. Hence, the remote sensing feature should be used only to compensate for small values of voltage drops to avoid triggering OVP due to a line or load transient.

Auxiliary Output: The auxiliary output is loosely regulated and referenced to the Vsense- pin of the converter. The auxiliary voltage will droop as the load current is increased from no load to the maximum 50 mA. Note - the 40 V output version uses a linear regulator to provide a more precise auxiliary 5 Vdc output over the entire load range.

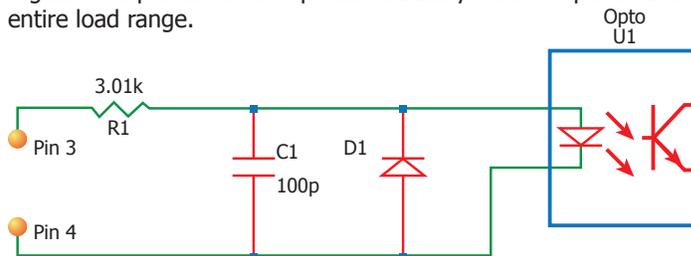


Figure B: Internal ON/OFF pin circuitry

OUTPUT VOLTAGE TRIM (Pin 10): 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 10 and Pin 12 (SENSE(-)). For a desired decrease of the nominal output voltage, the value of the resistor should be

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

where

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

To increase the output voltage, the user should connect a resistor between Pin 10 (TRIM) and Pin 11 (SENSE(+)). For a desired increase of the nominal output voltage, the value of the resistor should be:

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

where

$$V_{\text{out}} = \text{Nominal Output Voltage}$$

Trim graphs(Fig.3, Fig4 and Fig5) 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. Note that if the unit is started at no load the output voltage may, under some conditions, regulate above its rated value. This condition will be corrected once the load is increased above 1%, and it will stay corrected even if the load is lowered to zero.

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 E.

Output Current Limit: The output current 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 "auto-restart" mode where it repeatedly turns on and off at a 2.5 Hz (nominal) frequency until the overload 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.

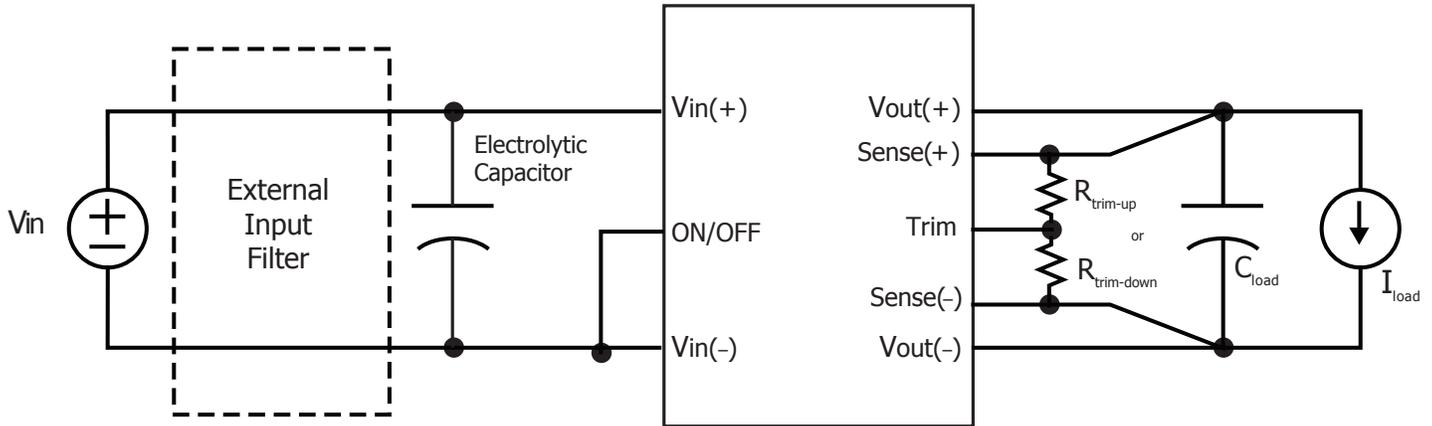


Figure C: Typical application circuit (negative logic unit, permanently enabled).

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.

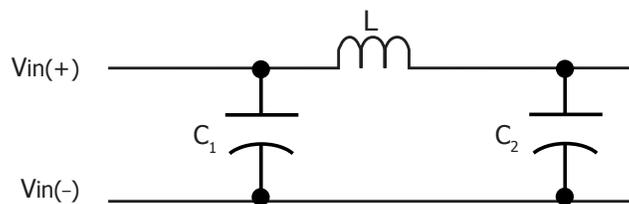


Figure D: Internal Input Filter Diagram (Component values listed on page2)

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. For example, when an output short is present the module will shutdown, remain off for the startup inhibit period, and then attempt to restart. This results in a 2.5Hz auto restart mode of operation 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_{Bp} , is 100 °C. Refer to the thermal derating curve, Figure 5, to see the available output current at baseplate temperatures below 100 °C.

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.

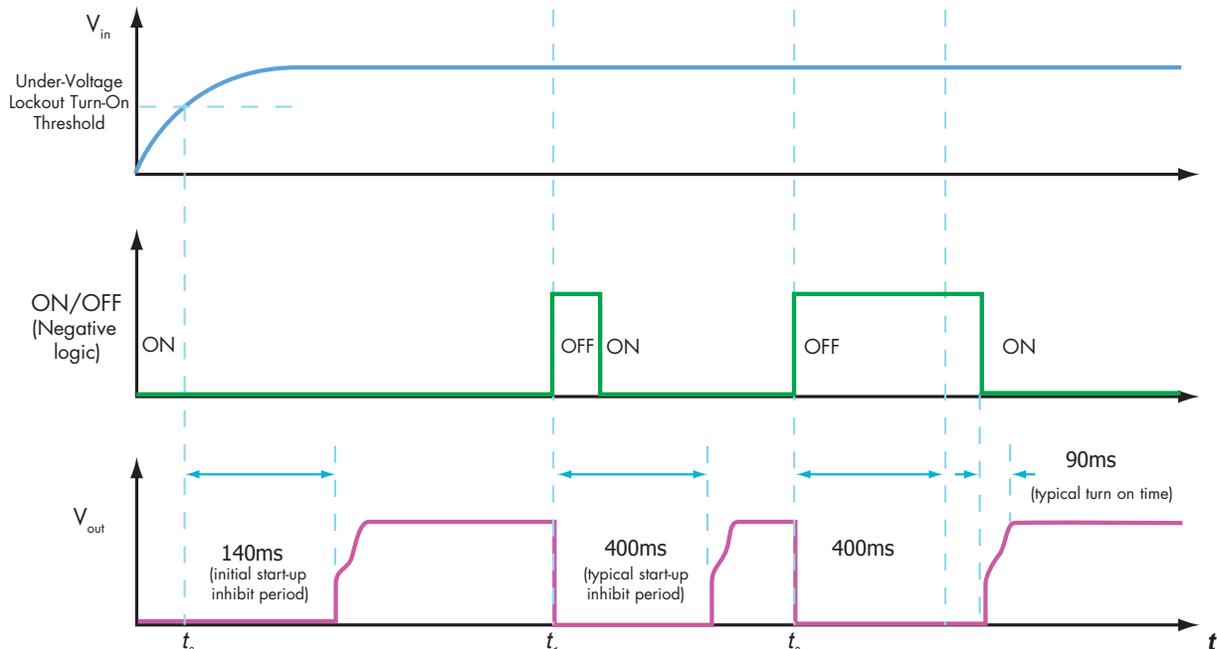


Figure E: Startup Inhibit Period (turn-on time not to scale)

Full-Featured Application Notes

This section provides some basic application information for the full-feature version of the InQor 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 the rated output voltage of the converter.

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

I Share (pin 9)-Active Current Share: Some applications benefit from connecting the outputs of multiple converters in parallel. Typical applications include systems that require power levels higher than the rated power of one converter, or systems that require N+1 (less than 30) redundancy for increased reliability and availability. The active current share feature of the IQ4H Full Brick is a secondary side referenced circuit that ensures that modules configured to operate in parallel will share load current to a significant degree ($\pm 5\%$ typical at full rated current). This feature is implemented by directly connecting the I share pins and the Start Sync pins of multiple units together. Note also that it is important to connect the SENSE(+) and SENSE(-) pins of each of the parallel modules in the same physical location to ensure the most accurate level of current sharing. The voltage at the I Share pin will range from approximately 1 volt (at no load) to 2.2 volts (at full rated current), referenced to the secondary-side ground, VSENSE(-). For best performance in current shared mode, the following connections must be implemented:

- I share pins of multiple units must be connected together.
- Start Sync pins of multiple units must be connected together (see details below)
- SENSE(+) and SENSE(-) pins of each module must be tied together at the same physical location, preferably at the end of power out cable or trace.

SyncOut (pin2) - Synchronization Output: The Synchronization Output is a primary side referenced feature which provides the ability for a user to access a waveform switching synchronously with the pulse width modulator (pwm) clock of the module. The SyncOut signal of one module can be used as the input to multiple other modules, or modules can be "daisy chained" with the SyncOut pin of one connected to the SyncIn pin of the next.

Start Sync (pin 8) - Start Synchronization: The Start Synchronization feature is a secondary side referenced circuit that will allow a more consistent start-up sequence when the output of multiple modules are connected in parallel. 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 go into an auto-restart mode of operation that 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 sequence. For details about the auto-restart mode or repeated startup attempts, please see the "Startup Inhibit Period" note in the Technical Specification.

SyncIn (pin 1) – External Clock Synchronization: The Clock Synchronization is a primary side referenced feature which allows 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 within the limits specified in the IQ4H-FT Family Electrical Characteristics Table. Note that increasing the converter's frequency will tend to reduce efficiency.

The Clock Synchronization feature allows the user the following choices:

- Change the switching frequency of the converter from the factory pre-set value to a value in the specified range.
- Synchronize the switching of all converters in a current shared mode to a common external frequency.
- Improve susceptibility of an adjacent sensitive circuit by moving the converter frequency away from its most sensitive frequency. All the above are also effective means of designing and managing EMI filtering to comply with the specified EMC standards.
- All synchronization signals (including an external clock) should be referenced to the negative terminal of input voltage, Vin(-).
- The high level of the signal should be between 3.5 & 5.0V.
- The low level should be between -0.5V and +1.2V.
- The duty cycle of a signal applied to the SyncIn pin should be between 20% and 80%.

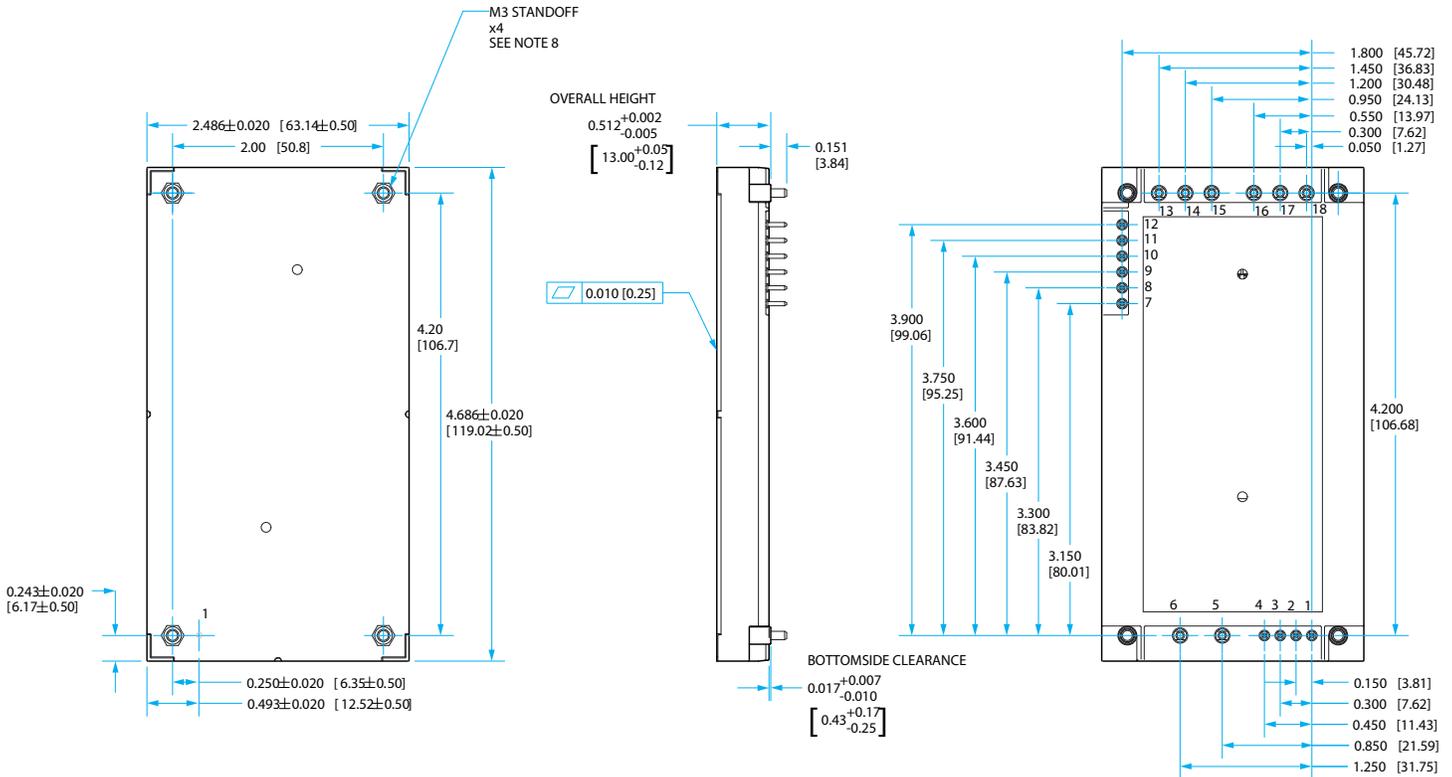
Standards & Qualification Testing

Parameter	Notes & Conditions
STANDARDS COMPLIANCE	
UL 60950-1	Reinforced Insulation
CAN/CSA C22.2 No. 60950-1	
EN 60950-1	
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	100 g minimum, 2 drops in x, y, and z axis
Temperature Cycling	10	-40 °C to 100 °C, unit temp. ramp 15 °C/min., 500 cycles
Power/Thermal Cycling	5	Toperating = min to max, Vin = min to max, full load, 100 cycles
Design Marginality	5	Tmin-10 °C to Tmax+10 °C, 5 °C steps, Vin = min to max, 0-105 % load
Humidity	5	85 °C, 95 % RH, 1000 hours, continuous Vin applied except 5 min/day
Solderability	15 pins	MIL-STD-883, method 2003
Altitude	2	70,000 feet (21 km), see Note

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



NOTES

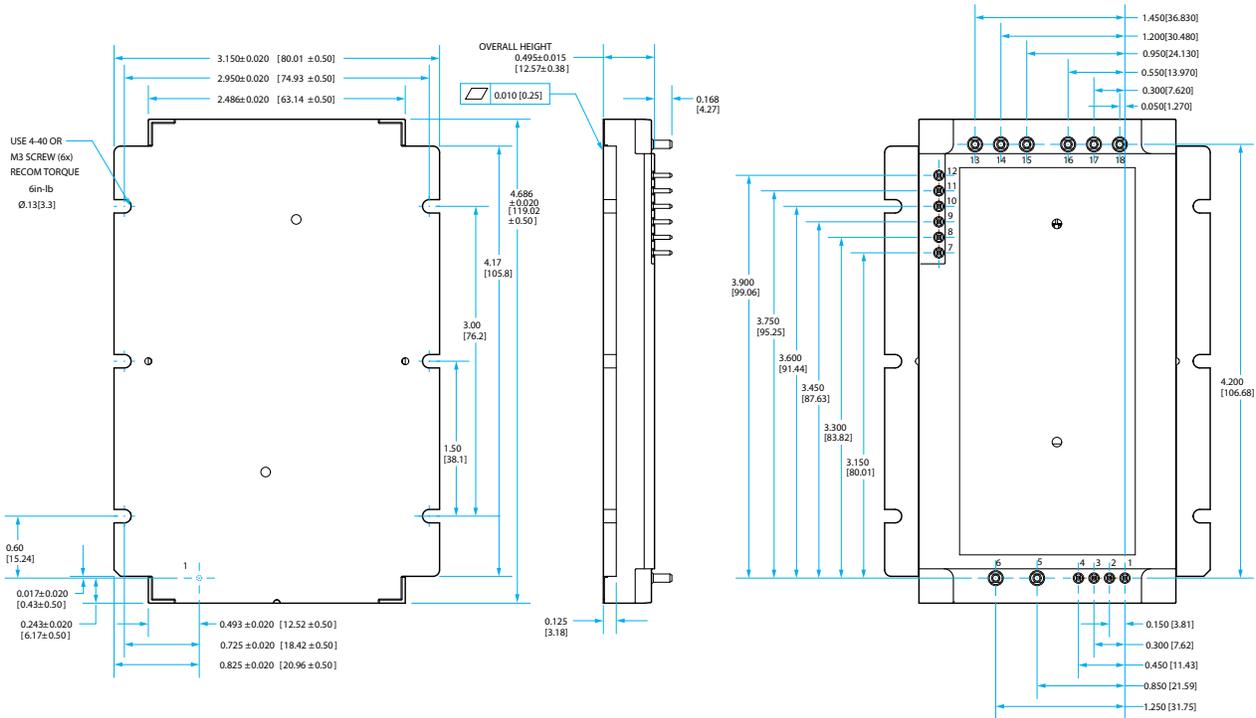
- 1) Pins 1-4, 7-12 are 0.040" (1.02mm) diameter, with 0.080" (2.03mm) diameter standoff shoulders.
- 2) Pins 5-6, 13-18 are 0.080" (2.03 mm) diameter with 0.125" (3.18mm) diameter standoff shoulders.
- 3) All Pins: Material - Copper Alloy; Finish - Matte Tin over Nickel plate
- 4) Undimensioned components are shown for visual reference only.
- 5) Applied torque per screw should not exceed 6in-lb (0.7Nm).
- 6) Baseplate flatness tolerance is 0.010" (0.25mm) TIR for surface.
- 7) Weight: 9.9oz (280g) typical
- 8) Threaded or non-threaded options available.
- 9) Workmanship: Meets or exceeds IPC-A-610 Class II
- 10) 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	Label	Name	Function
1	SYNC IN	SynIn	Synchronization Input (full feature only)
2	SYNC OUT	SynOut	Synchronization Output (full feature only)
3	+ON/OFF	ON/OFF(+)	Turn converter on and off, referenced to - ON/OFF
4	-ON/OFF	ON/OFF(-)	Fully isolated ground
5	+VIN	Vin(+)	Positive input voltage
6	-VIN	Vin(-)	Negative input voltage
7	Vaux	Vaux	Auxiliary power, referenced to Vout(-)
8	START SYNC	Start Sync	Startup synchronization (full feature only)
9	ISHARE	I Share	Single wire parallel signal (full feature only)
10	TRIM	TRIM	Output voltage trim (see note 1)
11	+SENSE	SENSE(+)	Positive remote sense (see note 2)
12	-SENSE	SENSE(-)	Negative remote sense (see note 3)
13	-VOUT	Vout(-)	Negative output voltage
14	-VOUT	Vout(-)	Negative output voltage
15	-VOUT	Vout(-)	Negative output voltage
16	+VOUT	Vout(+)	Positive output voltage
17	+VOUT	Vout(+)	Positive output voltage
18	+VOUT	Vout(+)	Positive output voltage

Pin Designations Notes:

- 1) Leave TRIM pin open for nominal output voltage.
- 2) SENSE(+) should be connected to Vout(+) remotely or at converter.
- 3) SENSE(-) should be connected to Vout(-) remotely or at converter.
- 4) Pins 1, 2, 8, and 9 are populated on full feature versions only.



NOTES

- Applied torque per M3 or 4-40 screw should not exceed 6in-lb (0.7Nm).
- Pins 1-4, 7-12 are 0.040" (1.02mm) diameter, with 0.080" (2.03mm) diameter standoff shoulders.
- Pins 5-6, 13-18 are 0.080" (2.03 mm) diameter with 0.125" (3.18mm) diameter standoff shoulders.
- All Pins: Material - Copper Alloy; Finish - Matte Tin over Nickel plate
- Undimensioned components are shown for visual reference only.
- Baseplate flatness tolerance is 0.010" (.25mm) TIR for surface.
- Weight: 10.3oz (293g) typical
- Workmanship: Meets or exceeds IPC-A-610 Class II
- All dimensions in inches (mm)
Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm)
x.xxx +/-0.010 in. (x.xxx +/-0.25mm)

PIN DESIGNATIONS

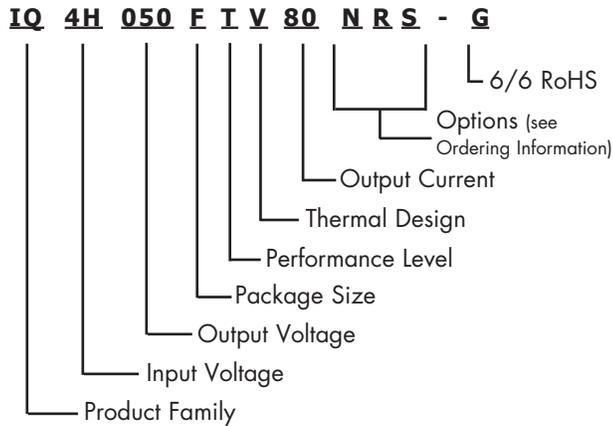
Pin	Label	Name	Function
1	SYNC IN	SyncIn	Synchronization Input (full feature only)
2	SYNC OUT	SyncOut	Synchronization Output (full feature only)
3	+ON/OFF	ON/OFF(+)	Turn converter on and off, referenced to - ON/OFF
4	-ON/OFF	ON/OFF(-)	Fully isolated ground
5	+VIN	Vin(+)	Positive input voltage
6	-VIN	Vin(-)	Negative input voltage
7	Vaux	Vaux	Auxiliary power, referenced to Vout(-)
8	START SYNC	Start Sync	Startup synchronization (full feature only)
9	ISHARE	I Share	Single wire parallel signal (full feature only)
10	TRIM	TRIM	Output voltage trim (see note 1)
11	+SENSE	SENSE(+)	Positive remote sense (see note 2)
12	-SENSE	SENSE(-)	Negative remote sense (see note 3)
13	-VOUT	Vout(-)	Negative output voltage
14	-VOUT	Vout(-)	Negative output voltage
15	-VOUT	Vout(-)	Negative output voltage
16	+VOUT	Vout(+)	Positive output voltage
17	+VOUT	Vout(+)	Positive output voltage
18	+VOUT	Vout(+)	Positive output voltage

Pin Designations Notes:

- Leave TRIM pin open for nominal output voltage.
- SENSE(+) should be connected to Vout(+) remotely or at converter.
- SENSE(-) should be connected to Vout(-) remotely or at converter.
- Pins 1, 2, 8, and 9 are populated on full feature versions 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 and to order:

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 and the additional characters for options. InQor units are only available with 6/6 RoHS compliance indicated by "-G".

Model Number	Input Voltage	Output Voltage	Output Current
IQ4H050FTw80xyz	180-425 V	5 V	80 A
IQ4H120FTw50xyz	180-425 V	12 V	50 A
IQ4H150FTw40xyz	180-425 V	15 V	40 A
IQ4H240FTw25xyz	180-425 V	24 V	25 A
IQ4H280FTw21xyz	180-425 V	28 V	21.4 A
IQ4H400FTw15xyz	180-425 V	40 V	15 A
IQ4H480FTw13xyz	180-425 V	48 V	12.5 A

The following options must be included in place of the **wxyz** spaces in the model numbers listed above.

Options Description: wxyz			
Thermal Design w	Enable Logic x	Pin Style y	Feature Set z
C - Encased with Threaded Baseplate V - Encased with Flanged Baseplate D - Encased with Non-Threaded Baseplate	N-Negative	R - 0.180"	S - Standard F - Full Feature

Not all combinations make valid part numbers, please contact SynQor for availability.

PATENTS

SynQor holds numerous U.S. patents, one or more of which apply to most of its power conversion products. Any that apply to the product(s) listed in this document are identified by markings on the product(s) or on internal components of the product(s) in accordance with U.S. patent laws. SynQor's patents include the following:

5,999,417	6,222,742	6,545,890	6,594,159	6,894,468	6,896,526
6,927,987	7,050,309	7,072,190	7,085,146	7,119,524	7,269,034
7,272,021	7,272,023	7,558,083	7,564,702	7,765,687	7,787,261
8,023,290	8,149,597	8,493,751	8,644,027	9,143,042	

Warranty

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