SynQor

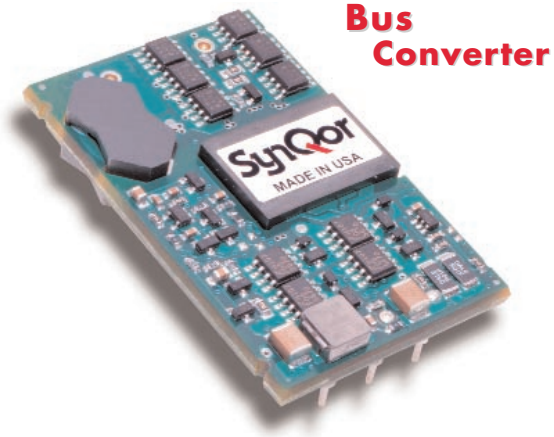
Technical Specification

Quarter Brick $48V_{in}$ $12V_{out}$ 20A

Narrow Input, Isolated DC/DC Bus Converter

The BusQor™ BQ50120QTA20 bus converter is a next-generation, board-mountable, isolated, fixed switching frequency dc/dc converter that uses synchronous rectification to achieve extremely high conversion efficiency. The power dissipated by the converter is so low that a heatsink is not required, which saves cost, weight, height, and application effort. The BusQor series provides an isolated step down voltage from 48V to 12V with no regulation in a standard "quarter-brick" module. BusQor converters are ideal for customers who need multiple outputs and wish to design their own point of load converters to work with a 12V rail.

BusQor™ Bus Converter



BQ50120QTA20 Module

Operational Features

- Ultra-high efficiency, >96% at full rated load current
- Delivers up to 20 amps (240 Watts) of output current (power) with minimal derating - no heatsink required
- Input voltage range: 42V – 53V provides 12V bus for distributed power architectures
- Fixed frequency switching provides predictable EMI performance

Mechanical Features

- Industry standard quarter-brick pin-out configuration
- Industry standard size: 1.45″ x 2.3″
- Total height only 0.43″, permits better airflow and smaller card pitch
- Total weight: 1.5 oz. (42 grams)

Control Features

- On/Off control referenced to input side (positive logic)

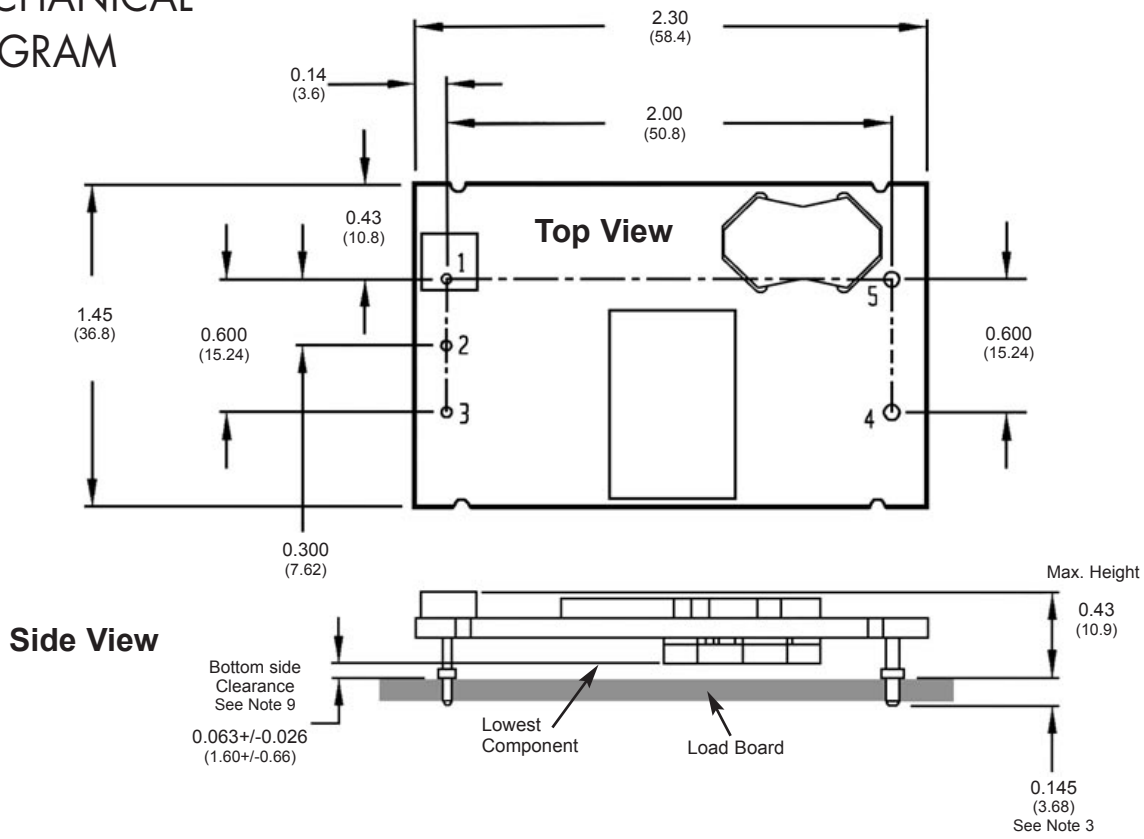
Protection Features

- Input under-voltage lockout and over-voltage shutdown protects against abnormal input voltages
- Output current limit and short circuit protection
- Output over-voltage protection
- Thermal shutdown

Safety Features

- 2000V, 10 MΩ input-to-output isolation
- UL/cUL 60950 recognized (US & Canada), basic insulation rating
- TUV certified to EN60950
- Meets 72/23/EEC and 93/68/EEC directives
- Meets UL94V-0 flammability requirements

MECHANICAL DIAGRAM



NOTES

1) Pins 1-3 are 0.040″ (1.02mm) diameter with 0.080″ (2.03 mm) diameter standoff shoulders.
2) Pins 4 and 5 are 0.062″ (1.57 mm) diameter with 0.100″ (2.54 mm) diameter standoff shoulders.
3) Other pin extension lengths available. Recommended pin length is 0.03″ (0.76mm) greater than the PCB thickness.
4) All Pins: Material - Copper Alloy
   Finish - Tin/Lead over Nickel plate
5) Undimensioned components are shown for visual reference only.
6) All dimensions in inches (mm)
   Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm)
   x.xxx +/-0.010 in. (x.xx +/-0.25mm)
7) Weight: 1.5 oz. (42 g) typical
8) Workmanship: Meets or exceeds IPC-A-610C Class II
9) UL/TUV standards require a clearance greater than 0.04″ (1.02mm) between input and output for Basic insulation. This issue should be considered if any copper traces are on the top side of the user's board. Note that the ferrite cores are considered part of the input/primary circuit.

PIN CONNECTIONS

Pin No.	Name	Function
1	Vin(+)	Positive input voltage (42V - 53V)
2	ON/OFF	TTL input to turn converter on and off, referenced to Vin(-), with internal pull up.
3	Vin(-)	Negative input voltage
4	Vout(-)	Negative output voltage
5	Vout(+)	Positive output voltage

BQ50120QTA20 ELECTRICAL CHARACTERISTICS

T_A=25°C, airflow rate=300 LFM, V_{in}=48Vdc unless otherwise noted; full operating temperature range is -40°C to +100°C ambient temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					
Non-Operating			60	V	continuous
Operating			56	V	continuous
Isolation Voltage (input to output)			2000	V	Basic level, Pollution Degree 2
Operating Temperature	-40		100	°C	
Storage Temperature	-55		125	°C	
Voltage at ON/OFF input pin	-2		18	V	
INPUT CHARACTERISTICS					
Operating Input Voltage Range	42	48	53	V	
Input Under-Voltage Lockout					
Turn-On Voltage Threshold		42.5		V	
Turn-Off Voltage Threshold		39.3		V	
Lockout Hysteresis Voltage		3.2		V	
Input Over-Voltage Shutdown					
Turn-Off Voltage Threshold		55.0		V	
Turn-On Voltage Threshold		50.1		V	
Maximum Input Current			6.3	A	100% Load, 42 Vin
No-Load Input Current			0.17	A	
Disabled Input Current		7.5	15	mA	
Inrush Current Transient Rating		0.01		A^2s	
Input Reflected-Ripple Current		5		mA	RMS through 10µH inductor; Figs. 12 & 14
Recommended Input Fuse			25	A	fast blow external fuse recommended
Input Filter Component Values (C\L\C)		1\1.5\2		µF\µH\µF	internal values, see Figure E
Recommended External Input Capacitance	33	47		µF	see Figure 12
OUTPUT CHARACTERISTICS					
Output Voltage Set Point		12.00		V	48Vin, no load
Output Voltage Regulation					
Over Line		±20 \ 2.4		%\V	Figure 4
Over Load		±4.1 \ 500		%\mV	Figure 4
Over Temperature		±1.7 \ 200		%\mV	Figure 4
Total Output Voltage Range	9.7		13.3	V	over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20MHz bandwidth; Fig. 12 & 15
Peak-to-Peak		130		mV	Full Load, see Figures 12 & 15
RMS		15		mV	Full Load, see Figures 12 & 15
Operating Output Current Range	0		20	A	
Output DC Current-Limit Inception		24.8		A	Output Voltage 10% Low; Fig. 16
Output DC Current-Limit Shutdown Voltage		8		V	
Current Share Accuracy (2 units paralleled)		±10		%	% of rated output current
Back-Drive Current Limit while Disabled		10		mA	Max negative current drawn from output
Maximum Output Capacitance			3,000	µF	12Vout at 20A Resistive Load
DYNAMIC CHARACTERISTICS					
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1A/µs)		200		mV	50% to 75% to 50% Iout max; Figure 11
Settling Time		100		µs	to within 1% Vout nom
Turn-On Transient					
Turn-On Time		500		µs	Full load, Vout=90% nom.; Figs. 9 & 10
Start-Up Inhibit Time		63		ms	-40°C to +125°C; Figure F
Output Voltage Overshoot		5		%	5,000 µF load capacitance, Iout = 0A
EFFICIENCY					
100% Load		96.5		%	Figures 1-3
50% Load		96.3		%	Figures 1-3
TEMPERATURE LIMITS FOR POWER DERATING CURVES					
Semiconductor Junction Temperature			125	°C	Package rated to 150°C
Board Temperature			125	°C	UL rated max operating temp 130°C
Transformer Temperature			125	°C	See Figures 5 - 8 for derating curves
ISOLATION CHARACTERISTICS					
Isolation Voltage		2000		V	
Isolation Resistance		10		MΩ	
Isolation Capacitance			470	pF	

ELECTRICAL CHARACTERISTICS (Continued)

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
FEATURE CHARACTERISTICS					
Switching Frequency		150		kHz	
ON/OFF Control (Option P)					
Off-State Voltage	-1.0		0.8	V	
On-State Voltage	2.4		18	V	
ON/OFF Control (Option N)					
Off-State Voltage	2.4		18	V	
On-State Voltage	-1.0		0.8	V	
ON/OFF Control (Either Option)					Figures A, B
Pull-Up Voltage		TBD		V	
Pull-Up Resistance		TBD		kΩ	
Output Over-Voltage Protection		13.75		V	Over full temp range; no load
Over-Temperature Shutdown		120		°C	Average PCB Temperature
Over-Temperature Shutdown Restart Hysteresis		10		°C	
RELIABILITY CHARACTERISTICS					
Calculated MTBF		TBD		10^6 Hrs.	Telcordia TR-NWT-000332; 80% load,300LFM, 40°C T_a
Calculated MTBF		2.0		10^6 Hrs.	MIL-HDBK-217F; 100% load, 300LFM, 40°C T_a
Demonstrated MTBF		TBD		10^6 Hrs.	Field demonstrated MTBF

STANDARDS COMPLIANCE

Parameter	Notes
STANDARDS COMPLIANCE	
UL/cUL 60950	File # E194341, Basic insulation & pollution degree 2
EN60950	Certified by TUV
72/23/EEC	
93/68/EEC	
Needle Flame Test (IEC 695-2-2)	test on entire assembly; board & plastic components UL94V-0 compliant
IEC 61000-4-2	ESD test, 8kV - NP, 15kV air - NP
GR-1089-CORE	Section 7 - electrical safety, Section 9 - bonding/grounding

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

QUALIFICATION TESTING

Parameter	# Units	Test Conditions
QUALIFICATION TESTING		
Life Test	32	95% rated Vin and load, units at derating point, 1000 hours
Vibration	5	10-55Hz sweep, 0.060" total excursion,1 min./sweep, 120 sweeps for 3 axis
Mechanical Shock	5	100g minimum, 2 drops in x and y axis, 1 drop in z axis
Temperature Cycling	10	-40°C to 100°C, unit temp. ramp 15°C/min., 500 cycles
Power/Thermal Cycling	5	Toperating = min to max, Vin = min to max, full load, 100 cycles
Design Marginality	5	Tmin-10°C to Tmax+10°C, 5°C steps, Vin = min to max, 0-105% load
Humidity	5	85°C, 85% RH, 1000 hours, 2 minutes on and 6 hours off
Solderability	15 pins	MIL-STD-883, method 2003

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

OPTIONS

SynQor provides various options for Logic Sense, Pin Length and Feature Set for this family of DC/DC converters. Please consult the SynQor website (www.synqor.com) for information on available options.

PATENTS

SynQor is protected under various patents, including but not limited to U.S. Patent # 5,999,417.

Performance Curves

Quarter Brick $48V_{in}$ $12V_{out}$ 20A

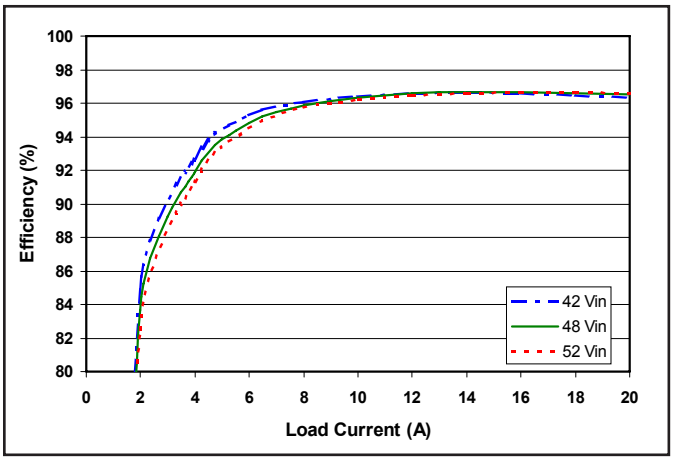


Figure 1: *Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.*

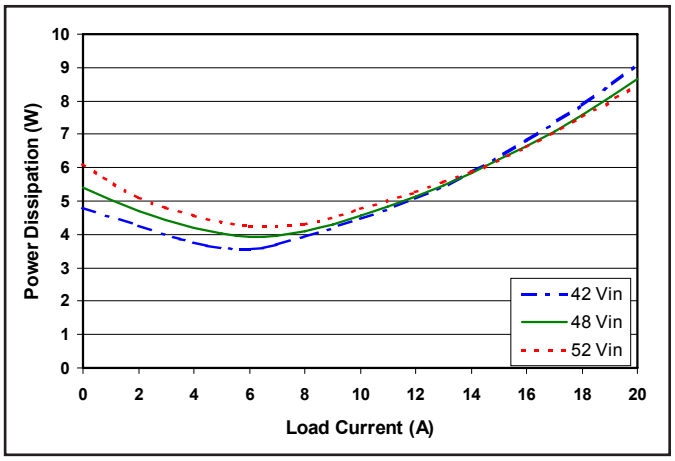


Figure 2: *Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.*

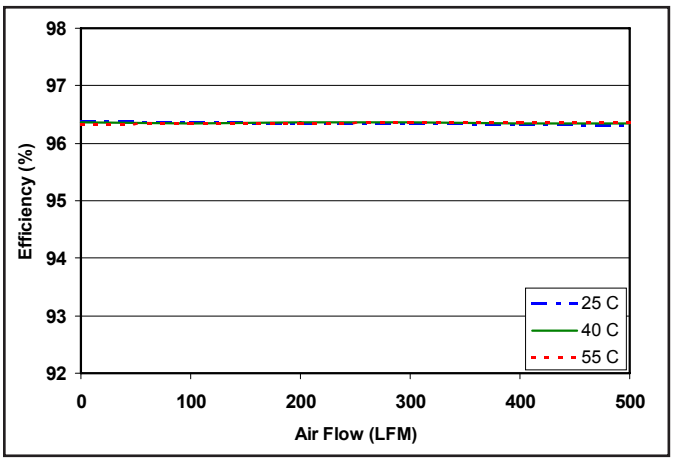


Figure 3: *Efficiency at nominal output voltage and 60% rated power vs. airflow rate for ambient air temperatures of 25°C, 40°C, and 55°C (nominal input voltage).*

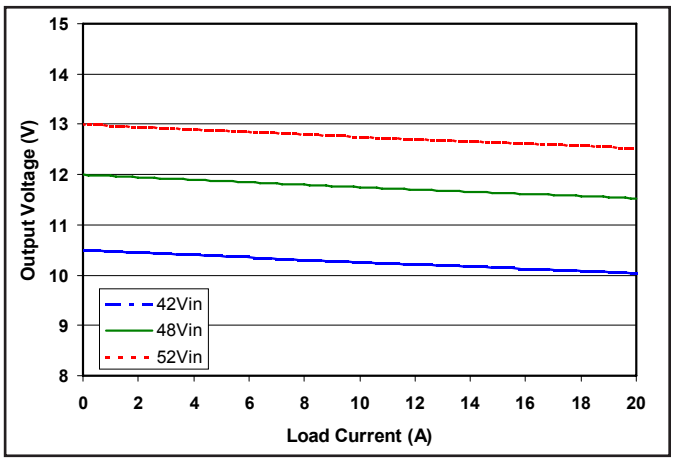


Figure 4: *Output voltage regulation vs. load current for minimum, nominal, and maximum input voltage at 25°C.*

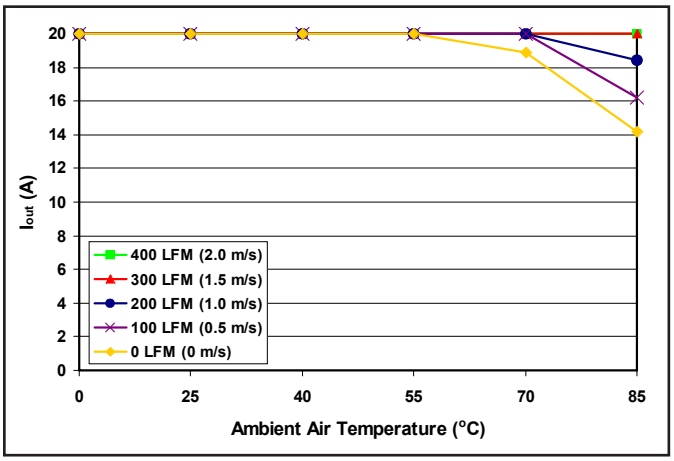


Figure 5: *Maximum output power derating curves vs. ambient air temperature for airflow rates of 0 LFM through 400 LFM with air flowing from pin 3 to pin 1 (nominal input voltage).*

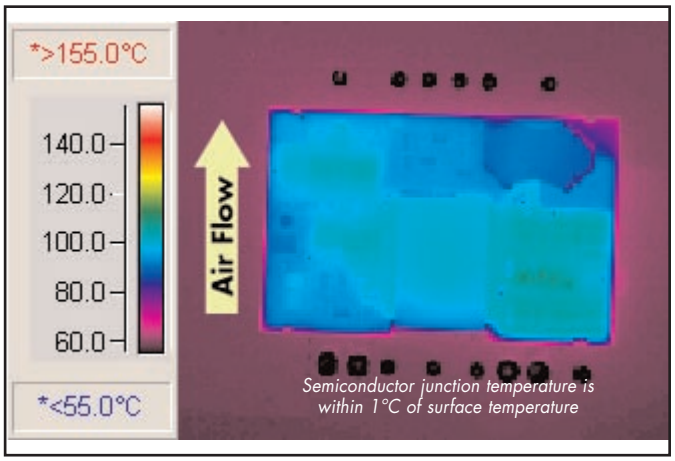


Figure 6: *Thermal plot of converter at 20 amp load current (240W) with 55°C air flowing at the rate of 200 LFM. Air is flowing across the converter from pin 3 to pin 1 (nominal input voltage).*

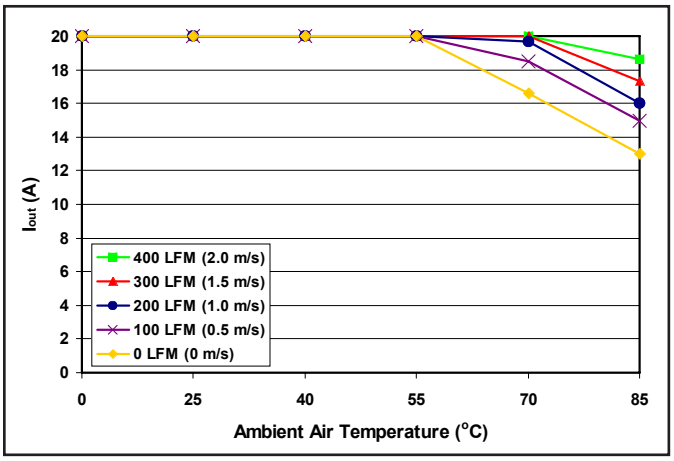


Figure 7: *Maximum output power derating curves vs. ambient air temperature for airflow rates of 0 LFM through 400 LFM with air flowing from input to output (nominal input voltage).*

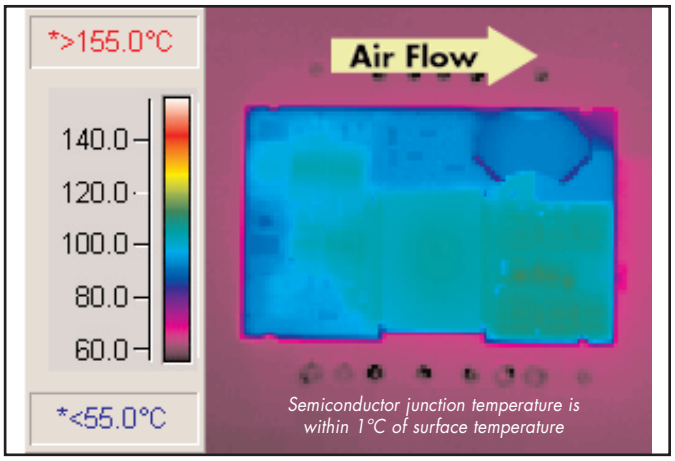


Figure 8: *Thermal plot of converter at 20 amp load current (240W) with 55°C air flowing at the rate of 200 LFM. Air is flowing across the converter from input to output (nominal input voltage).*

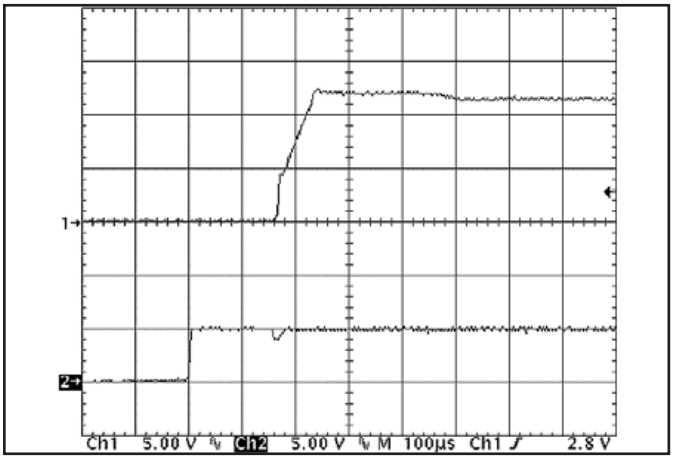


Figure 9: *Turn-on transient at full load (resistive load) (100 µs/div).*
Top Trace: Vout (5V/div)
Bottom Trace: ON/OFF input (5V/div)

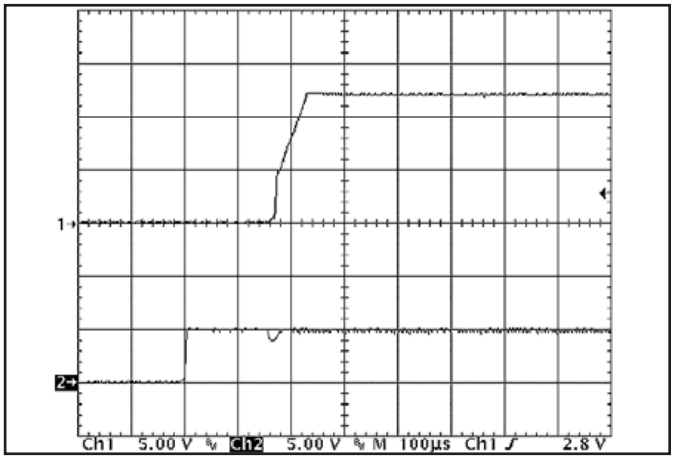


Figure 10: *Turn-on transient at zero load (100 µs/div).*
Top Trace: Vout (5V/div)
Bottom Trace: ON/OFF input (5V/div)

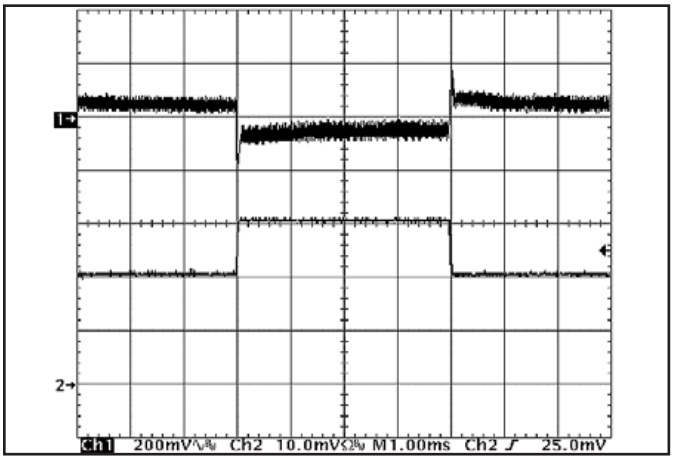


Figure 11: *Output voltage response to step-change in load current (50%-75%-50% of Iout(max); dI/dt = 0.1A/µs). Load cap: 15µF, 100 mΩ ESR tantalum capacitor and 1µF ceramic capacitor. Top trace: Vout (200mV/div), Bottom trace: Iout (5A/div).*

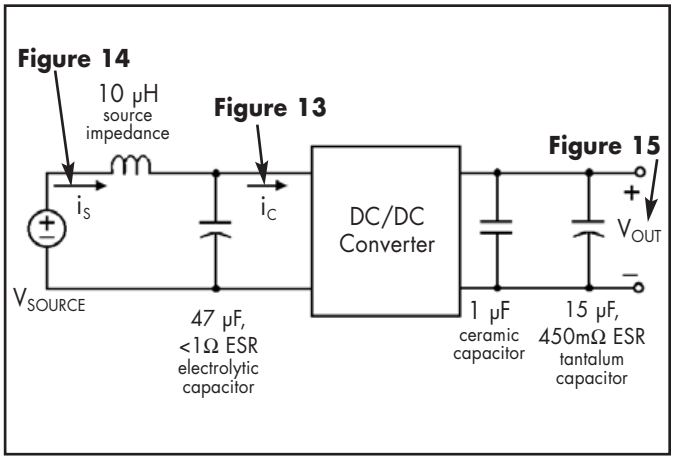


Figure 12: *Test set-up diagram showing measurement points for Input Terminal Ripple Current (Figure 13), Input Reflected Ripple Current (Figure 14) and Output Voltage Ripple (Figure 15).*

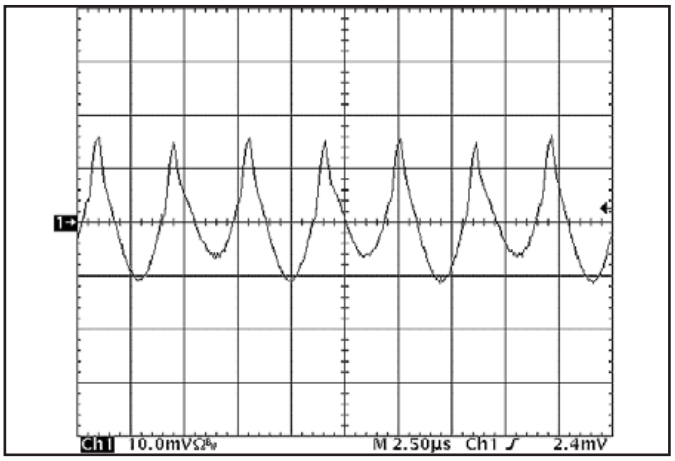


Figure 13: *Input Terminal Ripple Current, i_C, at full rated output current and nominal input voltage with 10µH source impedance and 47µF electrolytic capacitor (100 mA/div). See Figure 12.*

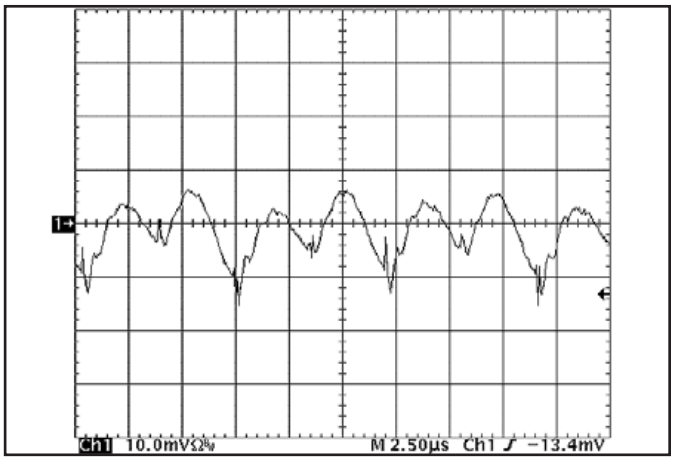


Figure 14: *Input reflected ripple current, i_S, through a 10 µH source inductor at nominal input voltage and rated load current (5 mA/div). See Figure 12.*

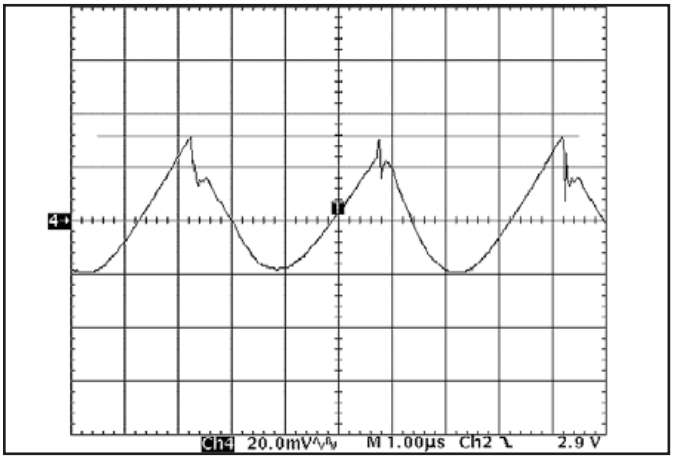


Figure 15: *Output voltage ripple at nominal input voltage and rated load current (20 mV/div). Load capacitance: 1µF ceramic capacitor and 15µF tantalum capacitor. Bandwidth: 20 MHz. See Figure 12.*

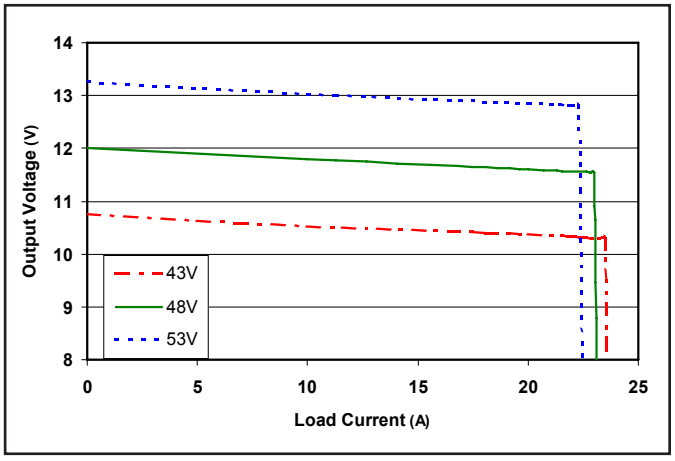


Figure 16: *Output voltage vs. load current showing typical current limit curves and converter shutdown points.*

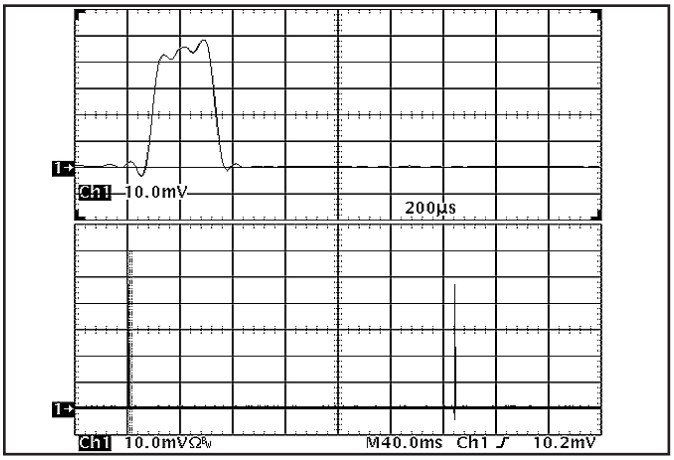
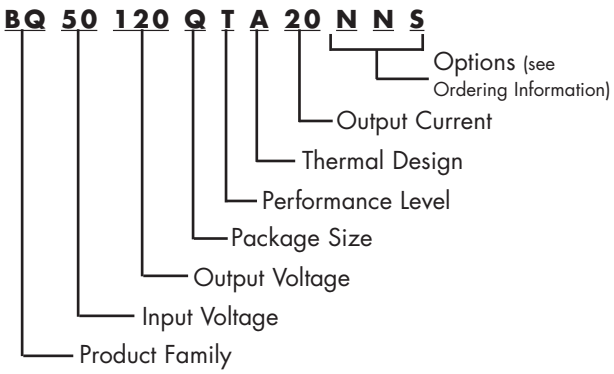


Figure 17: *Load current (20A/div) as a function of time when the converter attempts to turn on into a 1 mΩ short circuit. Top trace (200µs/div) is an expansion of the on-time portion of the bottom trace.*

PART NUMBERING SYSTEM

The part numbering system for SynQor's *Bus*Qor DC bus 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. Although there are no default values for enable logic and pin length, the most common options are negative logic and 0.145" pins. These part numbers are more likely to be readily available in stock for evaluation and prototype quantities.

Application Notes

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

ORDERING INFORMATION

The tables below show the valid model numbers and ordering options for converters in this product family. When ordering SynQor converters, please ensure that you use the complete 15 character part number consisting of the 12 character base part number and the additional 3 characters for options.

Model Number	Input Voltage	Output Voltage	Max Output Current
BQ50120QTA20*xyz*	42 - 53 V	12 V	20 A

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

Options Description: *x y z*		
Enable Logic	**Pin Length**	**Feature Set**
P - Positive N - Negative	K - 0.110" N - 0.145" R - 0.180" Y - 0.250"	S - Standard

Contact SynQor for further information:

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