

<b>35-55V</b> Continuous Input	<b>12V</b> Output	<b>67A</b> Current	<b>2000V dc</b> Isolation	<b>Quarter-brick</b> DC-DC Converter
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The BusQor BQ55120QZx67 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 BusQor series provides an isolated step down voltage from 48V to 12 or 9.6V intermediate bus with no regulation in a standard "quarter-brick" module. BusQor converters are ideal for creating the mid-bus voltage required to drive point-of-load (non-isolated) converters in intermediate bus architectures.

## BusQor®



*BQ55120QZB67 Model*

### Protection Features

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

### Mechanical Features

- Industry standard quarter-brick pin-out configuration
- Size: 1.51" x 2.34" (38.4x59.4mm), height: 0.517" (13.13mm)
- Total baseplate weight: 2.89 oz (81.8 g)

### Control Features

- On/Off control referenced to input side (negative logic only)
- Inherent current share (by droop method) for high current and parallel applications.

### Safety Features

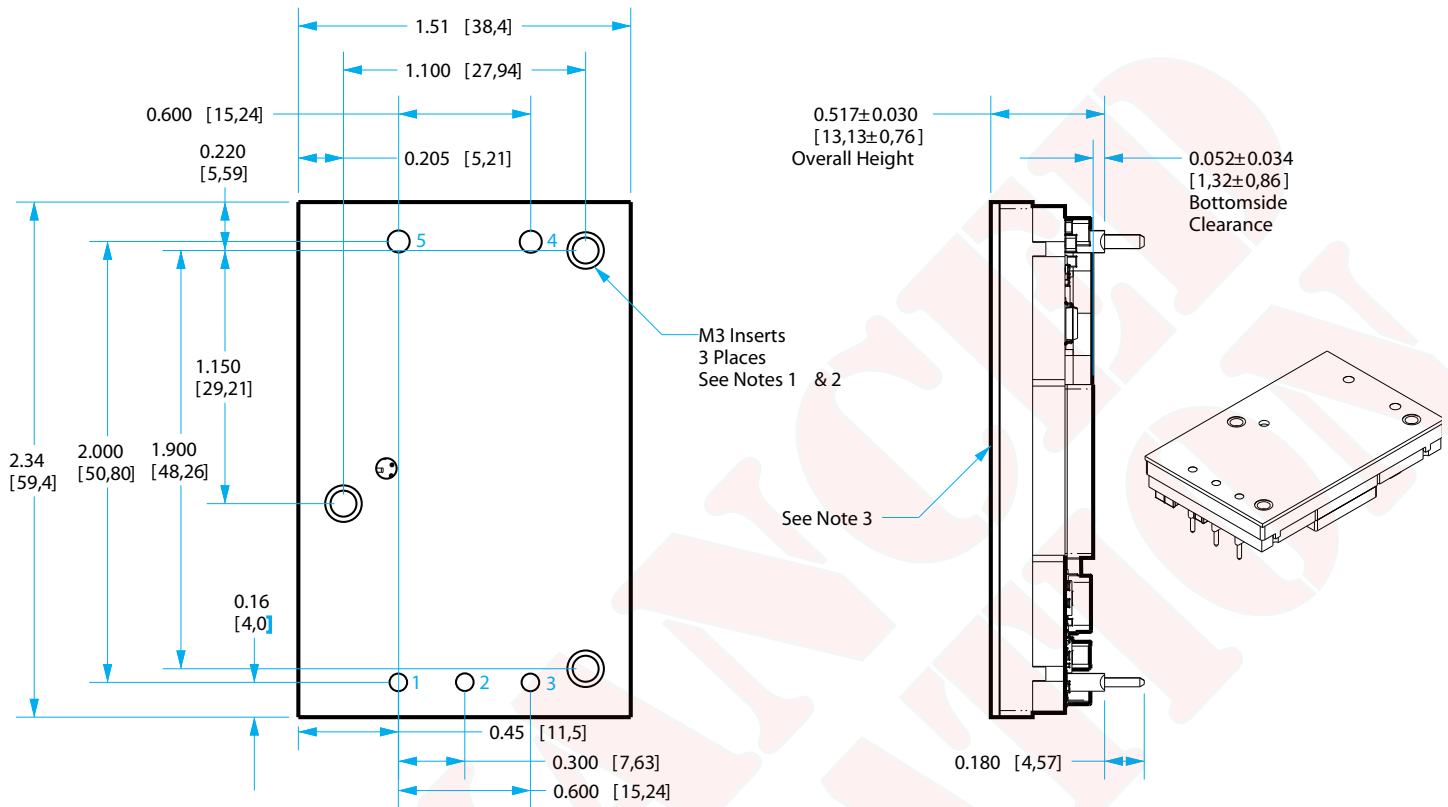
- UL 60950-1:2007
- CAN/CSA-C22.2 No. 60950-1:2007
- EN60950-1:A12:2011
- IEC 61000-4-2

### Operational Features

- High efficiency, 97.25% at full rated load current
- Delivers 67A full power with appropriate derating
- Operating input voltage range: 35-55V
- Fixed frequency switching provides predictable EMI
- No minimum load requirement

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### NOTES

- 1) M3 screws used to bolt unit's baseplate to other surfaces such as heatsinks must not exceed 0.10" (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) Other pin extension lengths available
- 5) Pins 1-3 are 0.040" (1.02mm) dia. with 0.080" (2.03mm) dia. standoff shoulders
- 6) Pins 4 and 5 are 0.062" (1.57mm) dia. with 0.100" (2.54mm) dia. standoff shoulders
- 7) All pins: Material: Copper Alloy  
Finish: Matte Tin over Nickel plate
- 8) Undimensioned components are shown for visual reference only
- 9) Weight: 2.7 oz (78 g) typical
- 10) All dimensions in inches(mm)  
Tolerances: x.xx in +/-0.02 (x.xmm +/-0.5mm)  
x.xxx in +/-0.010 (x.xxmm +/-0.25mm)

### PIN DESIGNATIONS

Pin	Name	Function
1	Vin(+)	Positive input voltage
2	ON/OFF	Logic control input to turn converter on/off.
3	Vin(-)	Negative input
4	Vout(-)	Negative output
5	Vout(+)	Positive output



# Technical Specification

**Input: 35-55V**  
**Output: 12V**  
**Current: 67A**  
**Package: Quarter-brick**

## BQ55120QZB67 Electrical Characteristics

Ta = 25 °C, airflow rate = 300 LFM, Vin = 48V dc unless otherwise noted; full operating temperature range is -40 °C to +100 °C base plate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
<b>ABSOLUTE MAXIMUM RATINGS</b>					
Input Voltage					
Non-Operating	-0.5		60	V	Continuous
Operating	35		55	V	Continuous
Isolation Voltage					
Input to Output			2000	V	
Operating Temperature	-40		100	°C	
Storage Temperature	-55		125	°C	
Voltage at ON/OFF input pin	-2		18	V	
<b>INPUT CHARACTERISTICS</b>					
Operating Input Voltage Range	35	48	55	V	
Input Under-Voltage Lockout					
Turn-On Voltage Threshold		33.4		V	
Turn-Off Voltage Threshold		31		V	
Lockout Voltage Hysteresis		2.4		V	
Input Over-Voltage Shutdown				V	
Turn-On Voltage Threshold		56.9		V	
Turn-Off Voltage Threshold		59.2		V	
Maximum Input Current			24.5	A	Vin = 35 V
No-Load Input Current			140	mA	
Disabled Input Current		3.5	5.5	mA	
Input Reflected-Ripple Current		25	40	mA	RMS through 10µH inductor
Input Terminal-Ripple Current		300		mA	RMS, full load
Recommended Input Fuse (see Note 1)			30	A	Fast blow external fuse recommended
Recommended External Input Capacitance		47		µF	Typical ESR 0.1-0.2 Ω
Input Filter Component Values (L/C)		0.22\30		µH\µF	Internal values; see Figure E
<b>OUTPUT CHARACTERISTICS</b>					
Output Voltage Set Point		12.0		V	
Output Voltage Regulation					
Over Line		41.7\5.0		%\V	
Over Load		4.2\500		%\mV	
Over Temperature		1.7\200		%\mV	
Total Output Voltage Range	8.200		13.750	V	Over sample, line, load, temperature & life
Output Voltage Ripple and Noise					20 MHz bandwidth; see Note 2
Peak-to-Peak		125	200	mV	Full load
RMS		40		mV	Full load
Operating Output Current Range	0		67	A	Subject to thermal derating
Output DC Current-Limit Inception		78		A	Output Voltage 10% Low
Output DC Current-Limit Shutdown Voltage		8		V	
Back-Drive Current Limit while Disabled		10		mA	Negative current drawn from output
Maximum Output Capacitance			5,000	µF	12.0 Vout at 33 A Resistive Load
<b>EFFICIENCY</b>					
100% Load		97.25		%	
50% Load		97.50		%	

## BQ55120QZB67 Electrical Characteristics (continued)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 48V dc unless otherwise noted; full operating temperature range is -40 °C to +100 °C base plate temperature with appropriate power derating. Specifications subject to change without notice.

Parameter	Min.	Typ.	Max.	Units	Notes & Conditions
<b>DYNAMIC CHARACTERISTICS</b>					
Output Voltage during Load Current Transient					
Step Change in Output Current (0.1 A/μs)		150		mV	50% to 75% to 50% Iout max
Settling Time		100		μs	To within 1% Vout nom
Turn-On Transient					
Turn-On Time (with 5mF output capacitance)		5	10	ms	Half load, Vout=90% nom.
Start-Up Inhibit Time		800		ms	-40 °C to +125 °C; Figure F
Output Voltage Overshoot		0		%	5 mF load capacitance
<b>ISOLATION CHARACTERISTICS</b>					
Isolation Voltage (dielectric strength)		2000		V	See Absolute Maximum Ratings
Isolation Resistance		30		MΩ	
Isolation Capacitance (input to output)		470		pF	See Note 3
Semiconductor Junction Temperature			125	°C	Package rated to 150 °C
Board Temperature			125	°C	UL rated max operating temp 130 °C
Transformer Core Temperature			130	°C	
Base Plate Temperature			100	°C	
<b>FEATURE CHARACTERISTICS</b>					
Switching Frequency	154	175	196	kHz	
ON/OFF Control (Option N)					
On-State Voltage	-1		0.8	V	
Off-State Voltage	2.4		18	V	
ON/OFF Control					
Pull-Up Voltage		3.3		V	Application notes Figures A & B
Pull-Up Resistance		100		kΩ	
Over-Temperature Shutdown OTP Trip Point	140		150	°C	Average PCB Temperature
Over-Temperature Shutdown Restart Hysteresis		10		°C	
<b>RELIABILITY CHARACTERISTICS</b>					
Calculated MTBF (Telcordia) TR-NWT-000332		TBD		10 <sup>6</sup> Hrs.	80% load, 200LFM, 40 °C Ta
Calculated MTBF (MIL-217) MIL-HDBK-217F		TBD		10 <sup>6</sup> Hrs.	80% load, 200LFM, 40 °C Ta
Field Demonstrated MTBF				10 <sup>6</sup> Hrs.	See our website for details

Note 1: UL's product certification tests were carried out using 30A fast blow fuse. Fuse interruption characteristics have to be taken into account while designing input traces. User should ensure that Input trace is capable of withstanding fault currents

Note 2: For applications requiring reduced output voltage ripple and noise, consult SynQor applications support (e-mail: support@synqor.com)

Note 3: Isolation capacitance can be added external to the module.

## Standards Compliance & Qualification Testing

Parameter	Notes & Conditions
<b>STANDARDS COMPLIANCE</b>	
UL 60950-1:2007	Basic insulation
CAN/CSA-C22.2 No. 60950-1:2007	
EN60950-1:A12:2011	
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
<b>QUALIFICATION TESTING</b>		
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

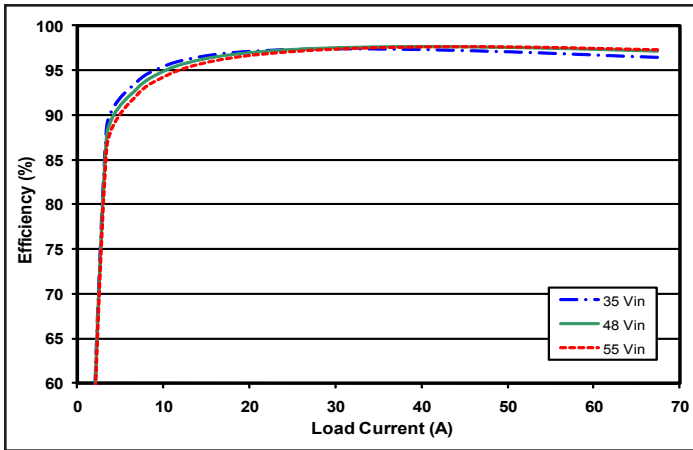


Figure 1: Efficiency at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

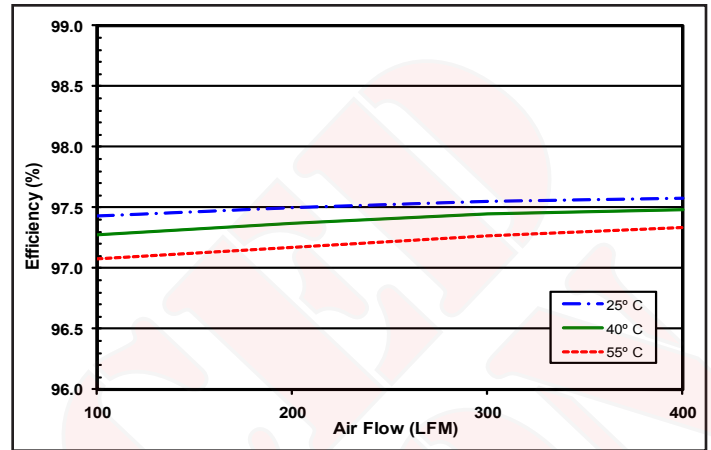


Figure 2: Efficiency at nominal output voltage and 60% rated power vs. airflow rate for ambient air temperatures of 25°C, 40°C, and 55°C (nominal input voltage).

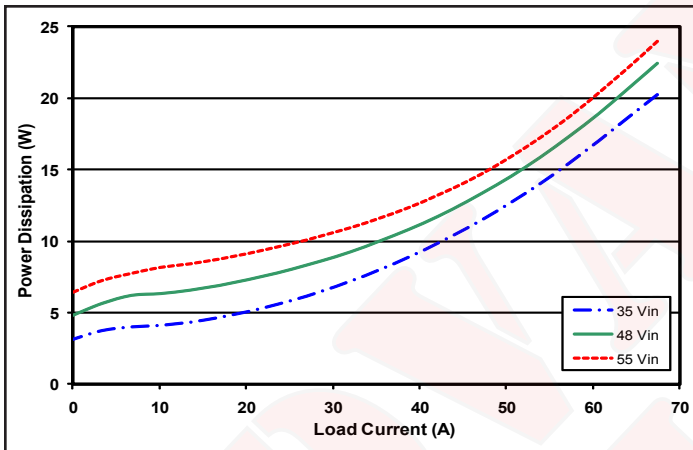


Figure 3: Power dissipation at nominal output voltage vs. load current for minimum, nominal, and maximum input voltage at 25°C.

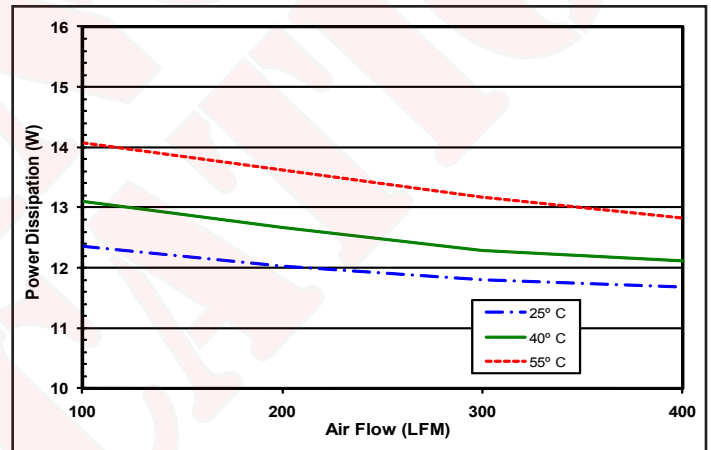


Figure 4: Power dissipation at nominal output voltage and 60% rated power vs. airflow rate for ambient air temperatures of 25°C, 40°C, and 55°C (nominal input voltage).

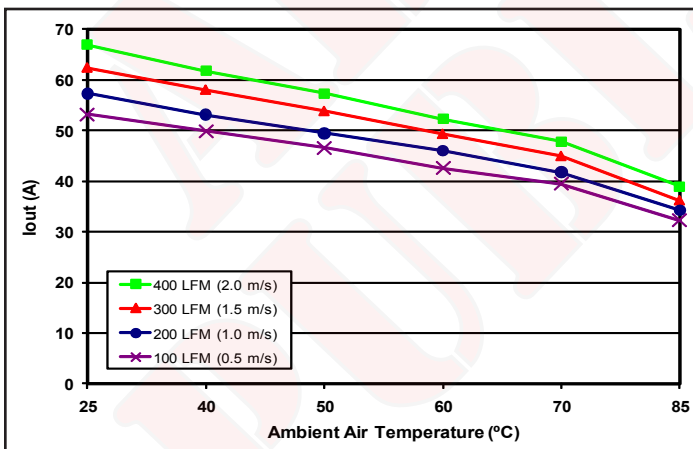


Figure 5: Maximum output current derating curve vs. ambient air temperature (with baseplate only) at different airflow rates with air flowing from output to input (nominal input voltage).

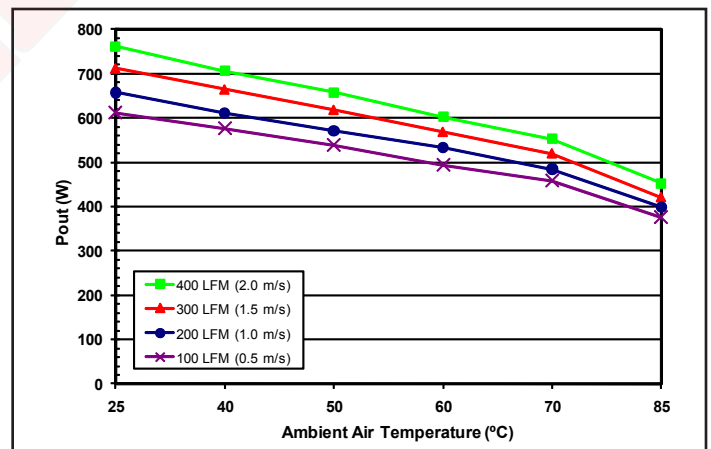


Figure 6: Maximum output power derating curve vs. ambient air temperature (with baseplate only) at different airflow rates with air flowing from output to input (nominal input voltage).

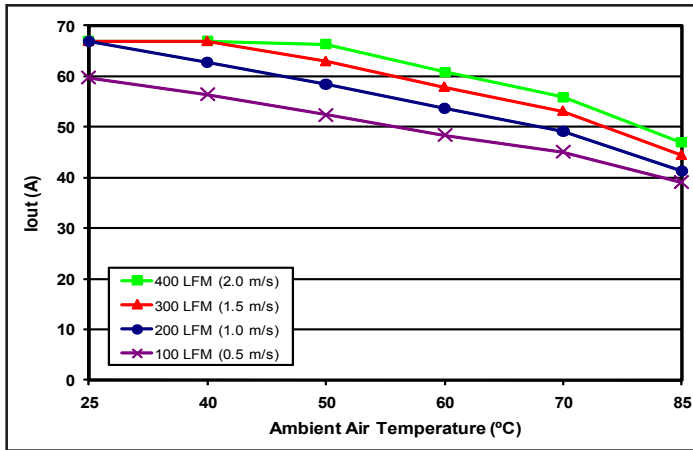


Figure 7: Maximum output current derating curve vs. ambient air temperature (with both baseplate and 1/4" heat sink) at different airflow rates with air flowing from output to input (nominal input voltage).

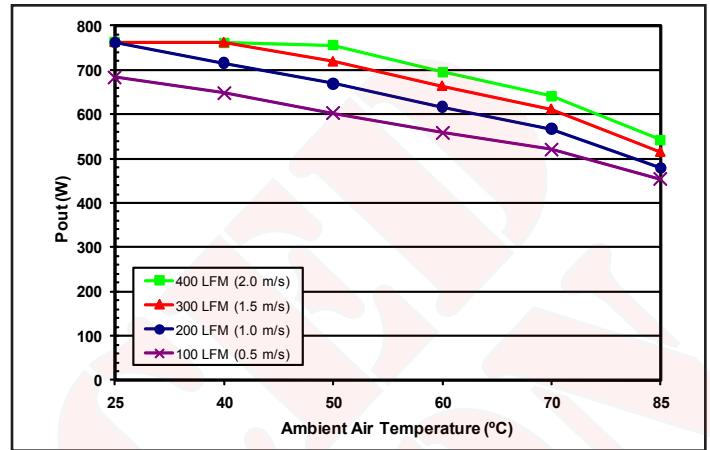


Figure 8: Maximum output power derating curve vs. ambient air temperature (with both baseplate and 1/4" heat sink) at different airflow rates with air flowing from output to input (nominal input voltage).

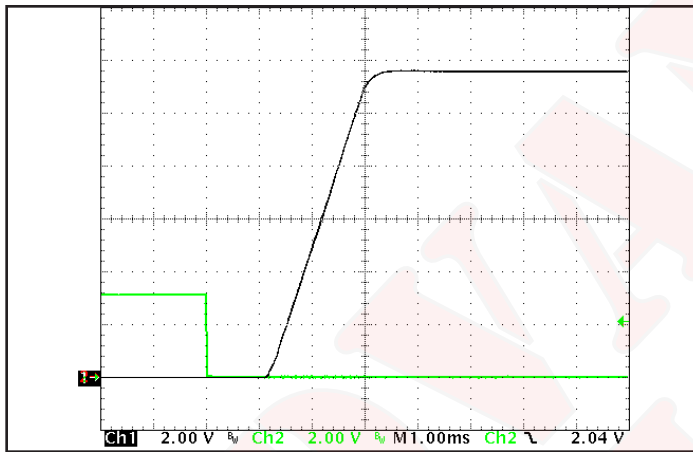


Figure 9: Turn-on transient at half load (resistive load) (1 ms/div). Load cap: 15µF tantalum capacitor and 5mF ceramic capacitor bank. Input voltage pre-applied. Ch 1: Vout (2V/div). Ch 2: ON/OFF input (2 V/div).

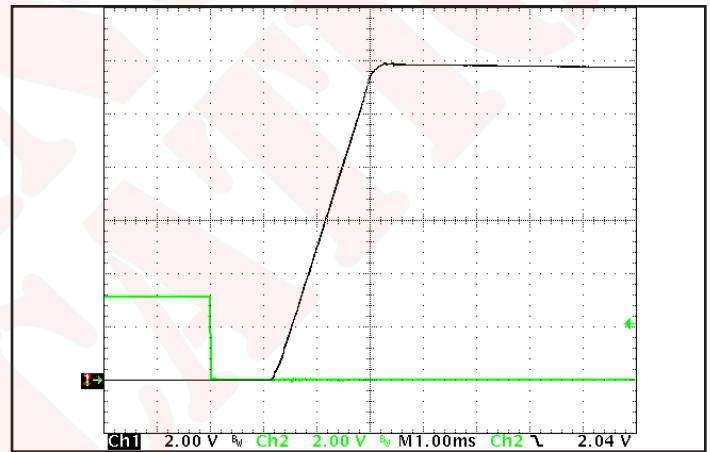


Figure 10: Turn-on transient at zero load (1 ms/div). Load cap: 15µF tantalum capacitor and 5mF ceramic capacitor bank. Ch 1: Vout (2V/div), Ch 2: ON/OFF input (2 V/div).

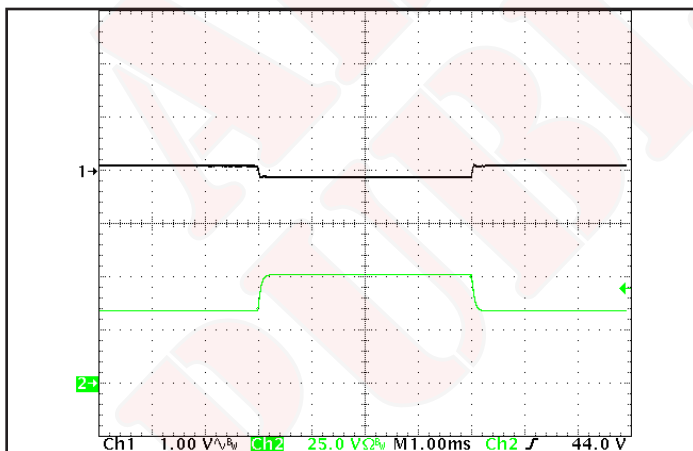


Figure 11: Output voltage response to step-change in load current (50%-75%-50% of Iout(max); dI/dt = 0.1A/µs). Load cap: 15µF tantalum cap and 1µF ceramic cap. Ch 1: Vout (1V/div), Ch 2: Iout (25A/div).

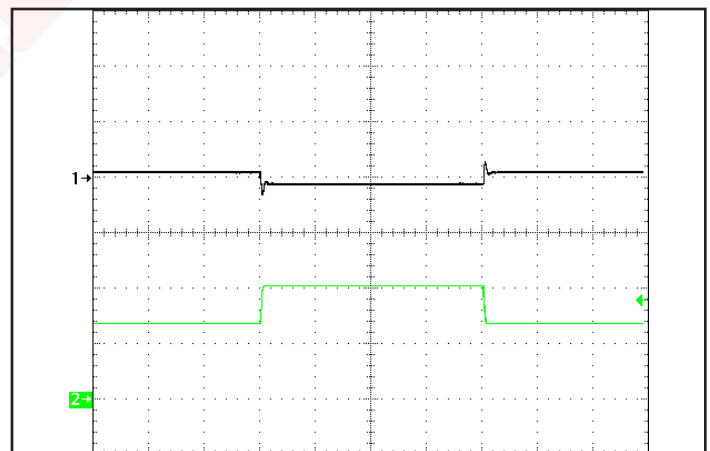


Figure 12: Output voltage response to step-change in load current (50%-75%-50% of Iout(max); dI/dt = 1A/µs). Load cap: 15µF, 30 mΩ ESR tantalum cap and 1µF ceramic cap. Ch 1: Vout (1V/div), Ch 2: Iout (25A/div).

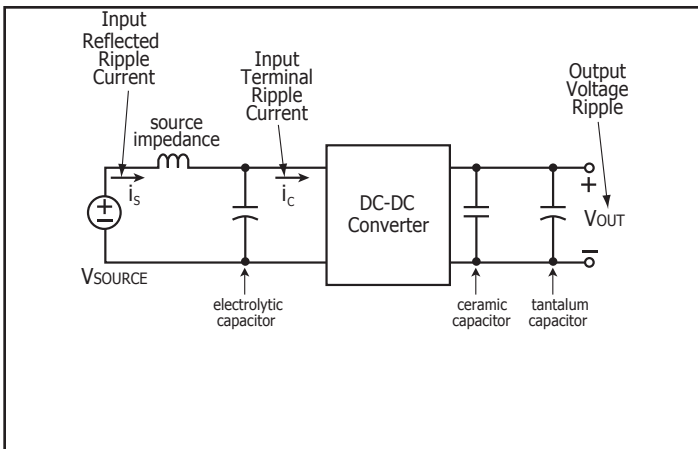


Figure 13: Test set-up diagram showing measurement points for Input Terminal Ripple Current (Figure 14), Input Reflected Ripple Current (Figure 15) and Output Voltage Ripple (Figure 16).

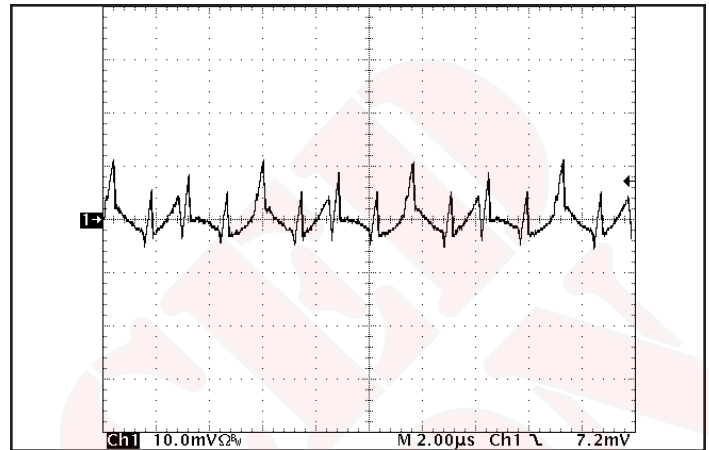


Figure 14: Input Terminal Ripple Current,  $i_c$ , at full rated output current and nominal input voltage with  $10\mu\text{H}$  source impedance and  $47\mu\text{F}$  electrolytic capacitor (500 mA/div). See Figure 13.

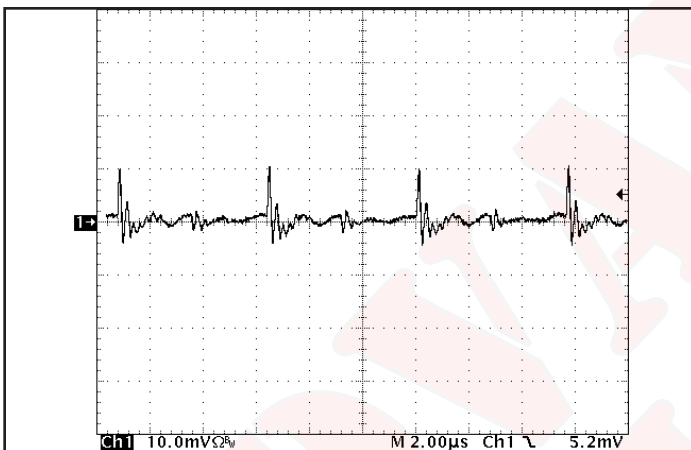


Figure 15: Input reflected ripple current,  $i_s$ , through a  $10\mu\text{H}$  source inductor, using a  $47\mu\text{F}$  electrolytic input capacitor (100mA/div). See Figure 13.

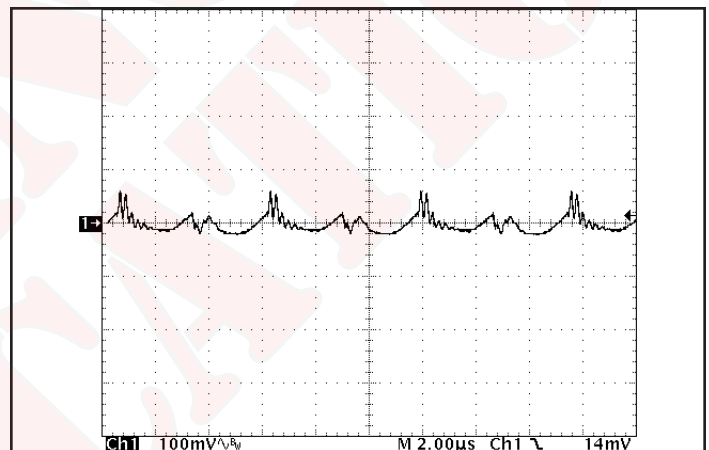


Figure 16: Output voltage ripple at nominal input voltage and rated load current (100mV/div). Load capacitance:  $1\mu\text{F}$  ceramic capacitor and  $15\mu\text{F}$  tantalum capacitor. Bandwidth: 20MHz. See Figure 13.

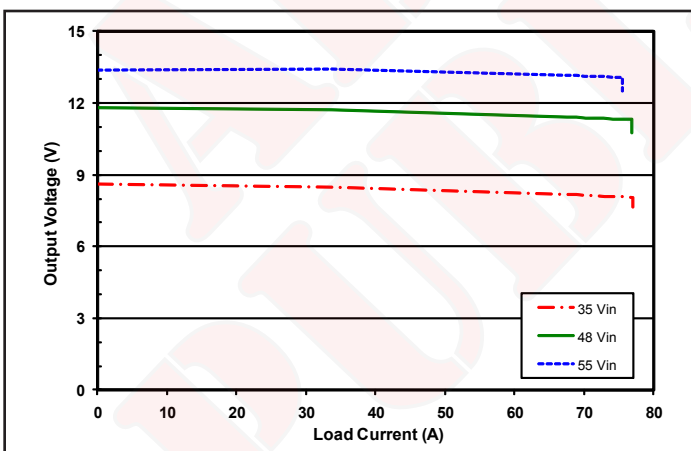


Figure 17: Output voltage vs. load current for different input voltages showing typical current limit curves.

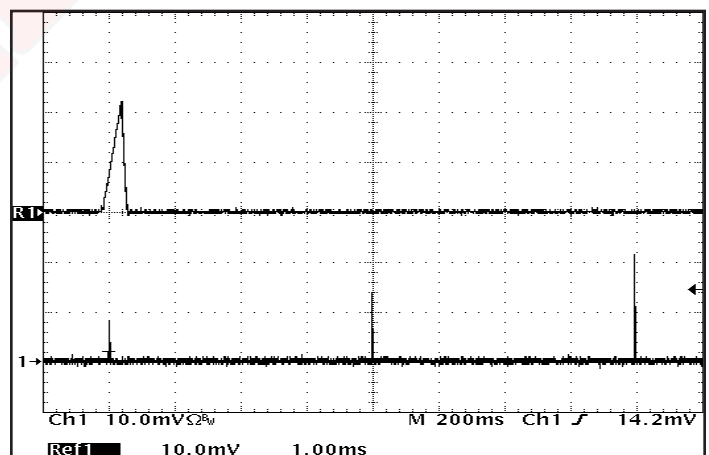


Figure 18: Load current (50A/div) as a function of time when the converter attempts to turn on into a  $1\text{m}\Omega$  short circuit. Top trace (1ms/div) is an expansion of the on-time portion of the bottom trace.

### BASIC OPERATION AND FEATURES

With voltages dropping and currents rising, the economics of an Intermediate Bus Architecture (IBA) are becoming more attractive, especially in systems requiring multiple low voltages. IBA systems separate the role of isolation and voltage scaling from regulation and sensing. The BusQor series bus converter provides isolation and an unregulated voltage step down in one compact module, leaving regulation to simpler, less expensive non-isolated converters.

In Figure A below, the BusQor module provides the isolation stage of the IBA system. The isolated bus then distributes power to the non-isolated buck regulators to generate the required voltage levels at the points of load. In this case, the bucks are represented with SynQor's NiQor series of non-isolated DC/DC converters. In many applications requiring multiple low voltage outputs, significant savings can be achieved in board space and overall system costs

When designing an IBA system with bus converters, the designer can select from a variety of bus voltages. While there is no universally ideal bus voltage, most designs employ one of the following: 12V, 9.6V, 7.5V, 5V, or 3.3V. Higher bus voltages can lead to lower efficiency for the buck regulators but are more efficient for the bus converter and provide lower board level distribution current. Lower bus voltages offer the opposite trade offs.

SynQor's BusQor modules act as a true dc transformer. The output voltage is proportional to the input voltage, with a specified "turns ratio" or voltage ratio, plus minor drop from the internal resistive losses in the module. When used in IBA systems, the output variation of the BusQor must be in accordance with the input voltage range of the non-isolated converters being employed.

The BusQor architecture is very scalable, meaning multiple bus converters can be connected directly in parallel to allow current sharing for higher power applications.

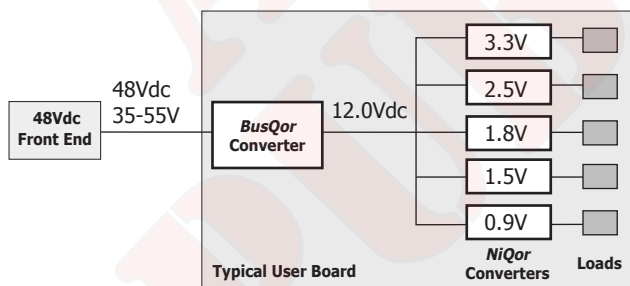


Figure A: Example of Intermediate Bus Architecture using BusQor bus converter and NiQor non-isolated converters

### 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(-).

In the negative logic version, the ON/OFF signal is active low (meaning that a low turns the converter on). Figure B is a detailed look of the internal ON/OFF circuitry.

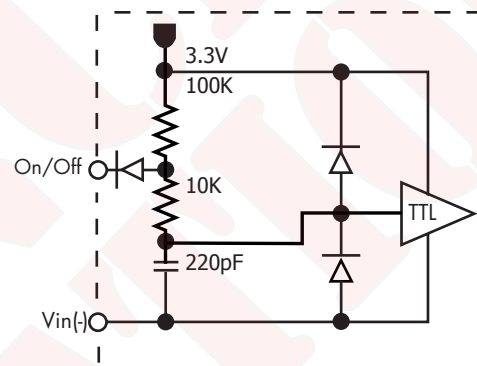


Figure B: Internal ON/OFF pin circuitry

## 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". 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 of the BusQor module is electronically protected against output overloads. When an overload current greater than the "DC Current-Limit Inception" specification is drawn from the output, the output shuts down to zero volt in a period of 10ms typical (see Figure D). The shutdown period lasts for a typical period of 800ms (Figure D) after which the BusQor tries to power up again. If the overload persists, the output voltage will go through repeated cycles of shutdown and restart with a duty cycle of 1.25% (On) and 98.75% (Off) respectively. The BusQor module returns (auto resetting) to normal operation once the overload is removed. The BusQor is designed to survive in this mode indefinitely without damage and without human intervention.

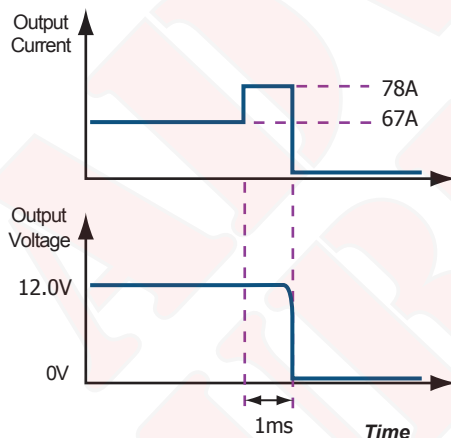


Figure C: Output Overload protection diagram (not to scale)

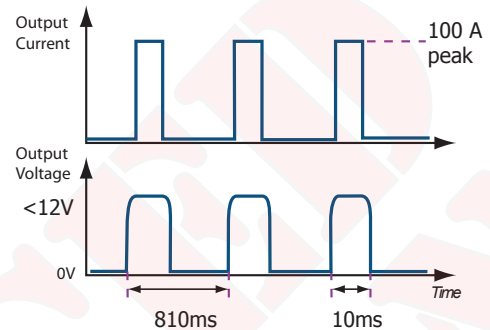


Figure D: Output Short Circuit and Auto-Resetting protection diagram (not to scale)

**Output Short Circuit Protection:** When the output of the BusQor module is shorted, a peak current of typically 100 A will flow into the short circuit for a period of about 1ms. The output of the BusQor will shutdown to zero for ~ 800mS (Figure D). At the end of the shutdown period the BusQor module tries to power up again. If the short circuit persists, the output voltage will go through repeated cycles of shutdown and restart with a duty cycle of 1.25% (On) and 98.75% (Off) respectively. The BusQor module returns (auto resetting) to normal operation once the short circuit is removed. The BusQor is designed to survive in this mode indefinitely without damage and without human intervention.

In the Auto resetting mode, also referred to as "Hiccup" mode, the power drawn from the 48V input is about 3 Watts, most of which is dissipated into the external fault. It is important that copper traces and pads from the output circuit be designed to withstand the short term peaks, although the average current into the fault may be as low as 0.1A typical. See Figure 18 for appropriate waveform.

**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.



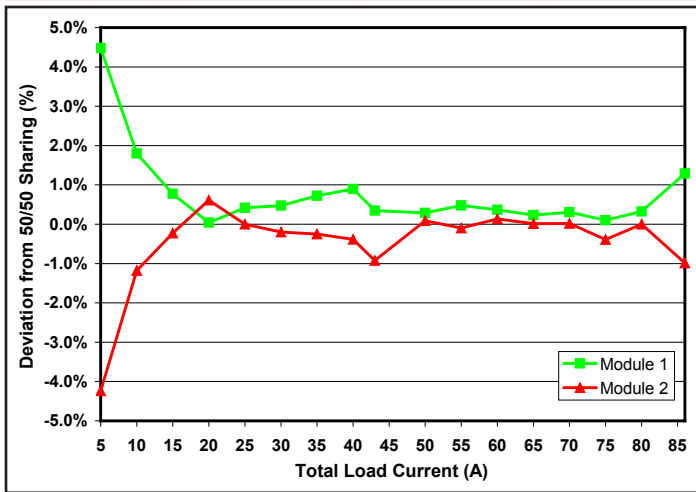


Figure G: Current share performance of 2 paralleled modules

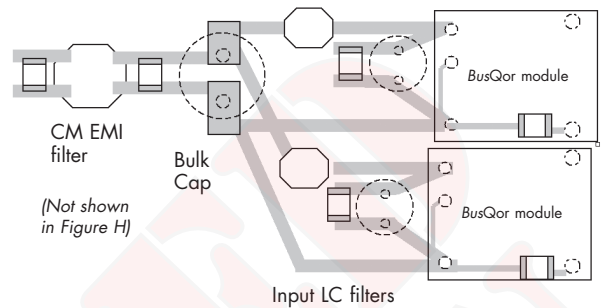


Figure H: Recommended PCB layout for input circuit 48Vin

The current share performance of two paralleled modules is illustrated in the graph in Figure H. In this graph the percent deviation from ideal sharing (50%) is plotted for each module versus the total output load current at 48Vin.

**Current Sharing:** BusQor modules are designed to operate in parallel without the use of any external current share circuitry. A typical circuit for paralleling two BusQor modules is shown in Figure G. An output capacitor is recommended across each module and located close to the converter for optimum filtering and noise control performance. Dedicated input inductors are recommended but are considered optional. Input capacitors must be located close to the converter module. PCB layout in the input circuit should be such that high frequency ripple currents of each module is restricted to a loop formed by the input capacitors and the input terminals of the BusQor module. See Figure H for details on PCB layout. Contact SynQor application engineering for further assistance on PCB trace design.

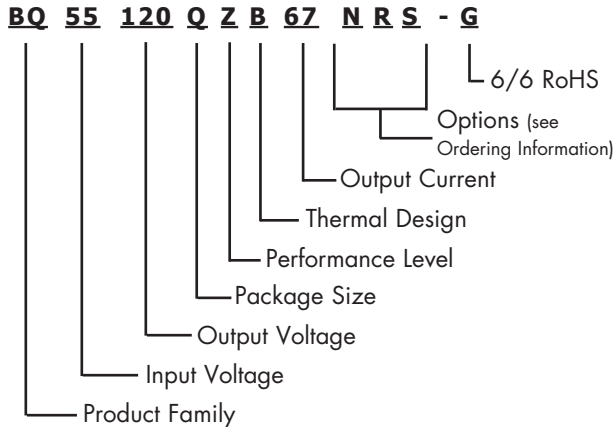


# Ordering Information

**Input: 35-55V**  
**Output: 12V**  
**Current: 67A**  
**Package: Quarter-brick**

## 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](mailto:rohs@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 characters for options. Add "-G" to the model number for 6/6 RoHS compliance.

Model Number	Input Voltage	Output Voltage	Max Output Current
<b>BQ55120QZB67xyz-G</b>	<b>35-55V</b>	<b>12V</b>	<b>67A</b>

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

Options Description: <b>wxyz</b>			
Thermal Design	Enable Logic	Pin Style	Feature Set
B - Baseplated	N - Negative	K - 0.110" N - 0.145" R - 0.180" Y - 0.250"	S - Standard

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	8,023,290	8,149,597		

### Warranty

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

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