SynQor

Advancing The Power Curve

Output Load Current Calculations

Application Note 01-10-01 Rev. A

Summary:

This application note provides details on how to calculate output load currents for the majority of SynQor's dc/dc converters. The paper includes the necessary equations and values needed for these calculations.

Introduction

An advantage of the SynQor open frame construction is that the converter output load can be measured without adding a current loop or external shunt resistors to the designer's PCB board under test. On the top side of SynQor's dc/dc converters is a current sense resistor. The output load current is proportional to the voltage drop across this sense resistor. This calculation is detailed below.

Output Load Calculation Equation

A current sense resistor referenced to the primary input is used in Equation 1 below to calculate the output load current.

Equation 1 $$I_{load} = \left(V_{Rsense(load)} - V_{Rsense(no\ load)}\right) \times \text{Scale Factor}$$

where:

- I_{load} = output load current
- $V_{Rsense(load)}$ = voltage across the sense resistor with converter under load
- $V_{Rsense(no\ load)}$ = voltage across the sense resistor with converter at zero load, (typically this value is very small, especially on BusQor modules)
- Scale Factor = a constant dependent on output voltage and product family (see Table 1)

		Scale Factor Values by Product Family & Output Voltage													
Family/Size	**Series**	**1.0 V**	**1.2 V**	**1.5 V**	**1.8 V**	**2.0 V**	**2.5 V**	**3.3 V**	**5.0 V**	**9.0 V**	**12 V**	**15 V**	**18 V**	**26 V**	**52.5 V**
***Power*Qor Eighth-brick**	Mega (EML)		500	400	350		500	400	250		100				
	Giga (EGL)	550	500	800	700		500	400	600		100				
***Power*Qor Quarter-brick**	Mega (QML)			400	350		500	400	500						
	Giga (QGA)		400	400	350	300	500	400	500		200	175	175		
	Tera (QTA)	800	800	800	933		1000	800	857		500				
	Peta (QPA)	2800	2400	1800	1600		1714	1600							
	24Vin QGA				700			1143	1000		400	320			
	18-75Vin QGA						2000	1500	1000						
***Power*Qor Half-brick**	Kilo (HKA)		485	485	424	600	500	533	500						
	Mega (HMA)		800	800	700	800	667	800	667						
	Giga (HGA)		1067	1067	933	1200	1000	1143	667		400	213			
	Tera (HTA)		1600	1600	1400	1200	1429	1067	667		267	222	178	TBD	TBD
	Peta (HPA)		2667	3600	2950		2200	1800	1200		714				
	HNA (legacy)		1600	1600	1400	1200	1000	800	500		200	167			
***Dual*Qor Quarter-brick**	Kilo (QKA)[1]								231						
	Mega (QMA)[1]								231						
	Giga (QGL)		500	400	350		500	400	250						
***Bus*Qor**	EB Tera (ETL)									1000	820				
	QB Tera (QTA)									1524	800				
	HB Tera (HTA)									TBD					
	HB Exa (HEA)										600				

1. Assumes all the power is on the 5.0V rail.

Note: All input voltages are nominal 48V nominal, unless otherwise noted.

Table 1: *Summary of Scale Factor values used in Equation 1 by product family and output voltage.*

The voltage drop across the sense resistor is in the millivolt range. Therefore, proper measuring techniques must be used to ensure accuracy. The Scale Factor values used in Equation 1 are defined in Table 1 shown below. For example, if the voltage sense value on a 3.3Vout quarter-brick (PQ48033QGA25xxx) measures 0.045V at load and approximately zero at no load, then the output load current will equal:

Equation 2 $$18\text{A} = (0.045\text{V} - 0) \times 400$$

Locating the Sense Resistor

The sense resistor is always located on the top side of the converter and typically towards the middle of the unit. Figures 1 - 3 below highlight the location of the sense resistor (Rsense) on the *Power*Qor eighth-brick, quarter-brick and half-brick units. Note that some converter series have two sense resistors working in parallel. Figure 4 highlights the typical locations of the 2 sense resistors for a *Dual*Qor dual output quarter-brick (QGL series only). The resistor on the high side (in photo) provides measurement of current output of the higher voltage rail while the resistor on the low side (in photo) provides measurement of current output of the lower voltage rail. The *Dual*Qor QMA/QKA series have only one resistor that is located near the center of the module similar to the *Power*Qor quarter-brick series

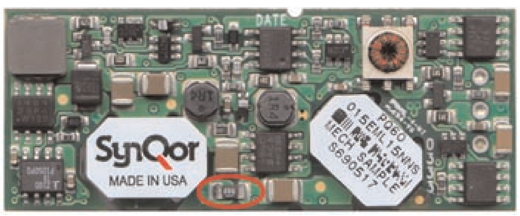

Figure 1: *Photograph showing typical location of the sense resistor for Power Qor Eighth-brick product families.*

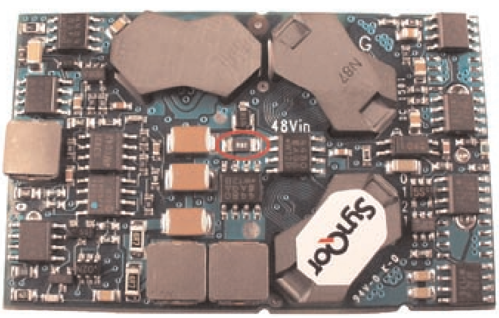

Figure 2: *Photograph showing typical location of the sense resistor for PowerQor Quarter-brick product families.*

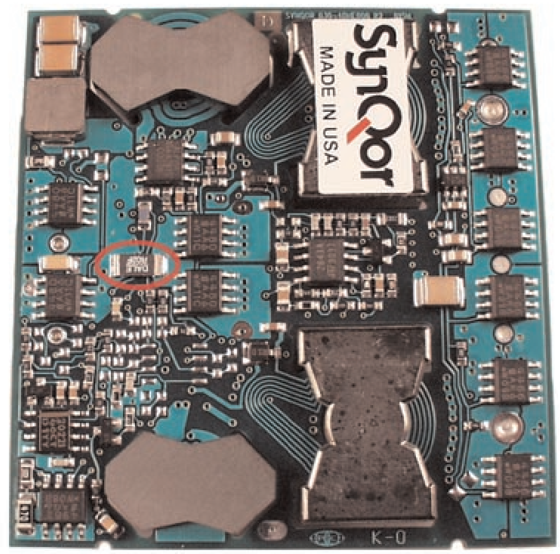

Figure 3: *Photograph showing typical appearance of the sense resistor for PowerQor Half-brick product families.*

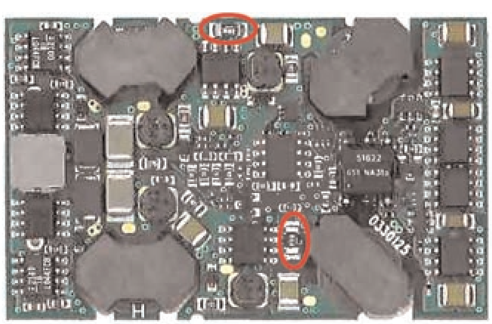

Figure 4: *Photograph showing typical locations of the sense resistors for DualQor dual output quarter-brick Giga series (QGL).*

Measuring Voltage across the Sense Resistor

Since the sense resistor is located on the primary side of the converter, every precaution must be taken to avoid electrical shock from the voltages and power levels that may be present in that area. Only trained personnel should attempt to take these measurements and care should be taken to avoid damaging the sense resistor or other nearby components. Care should be taken to use sharp probe leads when performing this measurement. Any form of soldering to attach measruement lead wires is not recommended. Accidental shorting of adjacent parts will damage the converter.

The sense resistor is referenced to the Vin(-) pin so caution should be exercised when measuring in systems that have -48V inputs. For that reason, the best measurement technique is to use a battery powered DVM. Do NOT attempt this measurement with an oscilloscope and 10:1 probe. The signal is only a few millivolts and the noise observed will swamp the desired signal.

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