

## 400 Watts

- Up to 89% Efficiency
- 4:1 Input Range
- Industry Standard Full Brick Package
- -40 °C to +100 °C Operating Temperature
- Baseplate-cooled
- Remote On/Off & Remote Sense
- 3 Year Warranty



This specification describes the features and functions of QSB400 series of isolated DC-DC Converters. These are highly efficient, reliable and compact, high power density, single output baseplate cooled DC/DC converters packaged in an industry standard full brick format.

## Dimensions:

## QSB:

4.6 x 2.4 x 0.5"(116.8 x 61.0 x 12.7 mm)

## Models &amp; Ratings

Input Voltage	Output Voltage <sup>12</sup>	Output Current	Input Current		Efficiency	Max Capacitive Load	Model Number <sup>13</sup>
			No Load	Full Load			
9-36 V	5.0 V	80.0 A	600 mA	19.05 A	87.5%	10000 µF	QSB40024S05
	12.0 V	33.3 A	120 mA	19.36 A	86.0%	10000 µF	QSB40024S12
	24.0 V	16.6 A	120 mA	19.19 A	87.0%	4700 µF	QSB40024S24
	28.0 V	14.3 A	120 mA	19.19 A	87.0%	4700 µF	QSB40024S28
	48.0 V	8.30 A	120 mA	19.19 A	86.5%	2200 µF	QSB40024S48
18-75 V	5.0 V	80.0 A	300 mA	9.36 A	89.0%	10000 µF	QSB40048S05
	12.0 V	33.3 A	60 mA	9.41 A	88.5%	10000 µF	QSB40048S12
	24.0 V	16.6 A	60 mA	9.28 A	90.0%	4700 µF	QSB40048S24
	28.0 V	14.3 A	60 mA	9.27 A	90.0%	4700 µF	QSB40048S28
	48.0 V	8.30	60 mA	9.27 A	89.5%	2200 µF	QSB40048S48

## Notes

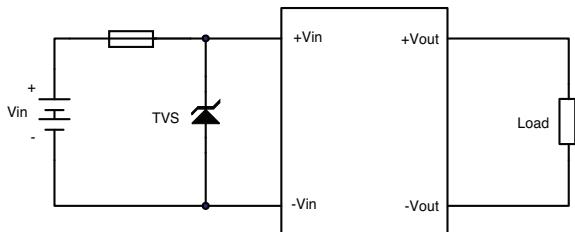
1. Add suffix 'P' to the model number to receive the unit with positive logic. Module on: <1 mA or open circuit, module off: 1-10 mA
2. Minimum of 330 µF capacitance required on output to maintain regulation. Except S05 models which require 680 µF

## Input

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Input Voltage	9/18		36/75	VDC	24 V/48 V
Input Current					See Models and Ratings table
Idle Current		50		mA	When inhibited
Input Reverse Voltage Protection					None
Input Filter					Pi Network
Undervoltage Lockout	Turn On: 8.5 Turn On: 17.0		Turn Off: 7.5 Turn Off: 15.5	V	24 Vin 48 Vin
Overvoltage Lockout	Turn On: 40.0 Turn On: 80.0		Turn Off: 42.0 Turn Off: 83.0	V	24 Vin 48 Vin

## Input

## Input Fusing and Safety Considerations



The QSB400 series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a 60A time delay fuse for 24Vin models, and 30A for 48Vin models. It is recommended that the circuit have a transient voltage suppressor diode TVS (24 Vin SMCJ40A: 48 Vin, SMCJ78A) across the input terminal to protect the unit against surge or spike voltage and input reverse voltage (as shown).

## Output

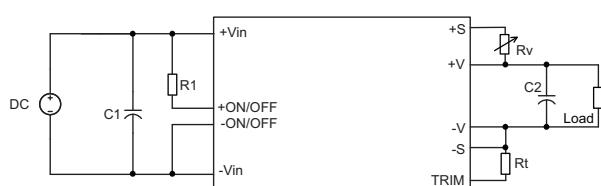
Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Output Voltage Trim	-20		+10	%	Of nominal output, see Application Notes
Initial Set Accuracy			$\pm 1.5$	%	
Minimum Load					No minimum load
Start Up Time		120		ms	
Line Regulation			$\pm 0.2$	%	Measured from high line to low line
Load Regulation			$\pm 0.5$	%	Measured from 0-100% load
Transient Response			$\pm 5$	%	Deviation, recovery to within 1% in 500 $\mu$ s, 25% step load change
Ripple & Noise		100 1		mV pk-pk % pk-pk	5 V models. Other models 1% pk-pk, 20 MHz bandwith (see note 1)
Oversupply Protection	115		140	%	
Overload Protection	110		150	%	Nominal output
Short Circuit Protection					Continuous, constant current
Thermal Shutdown	Case temperature 110 °C typical				
Temperature Coefficient		$\pm 0.03$		%/°C	

## Notes

1. Output Ripple and Noise measured with 10  $\mu$ F tantalum and 1  $\mu$ F ceramic capacitor across output.

## Output Voltage Adjustment

The Trim input permits the user to adjust the output voltage up or down according to the trim range specification (80% to 110% of nominal output). This is accomplished by connecting an external resistor between the +Vout and +Sense pin for trim up and between the TRIM and -Sense pin for trim down, see figure:



$C_1 = 330 \mu F / 50 V$  for  $V_{in} = 24 V$ ,  $1000 \mu F / 100 V$  for  $V_{in} = 48 V$   
For  $C_2$  see note 2 or max capacitive load in Models and Ratings table.  
Low ESR electrolytic capacitors are recommended.

The Trim pin should be left open if trimming is not being used. The output voltage can be determined by the following equations:

$$V_f = \frac{1.24 \times \left( \frac{R_t \times 33}{R_t + 33} \right)}{7.68 + \frac{R_t \times 33}{R_t + 33}}$$

Recommended Value of  $R_t$  is  $6.8k\Omega$ , therefore  $V_f = 0.525$

$$V_{out} = (V_{nom} + R_v) \times V_f$$

$$R_v = \frac{V_{out}}{V_f} - V_{nom}$$

Examples: 1. To trim 12 V unit up by 10%

$$R_v = \frac{13.2}{0.525} - 12 = 13.145k\Omega$$

2. To trim 24 V unit down by 20%

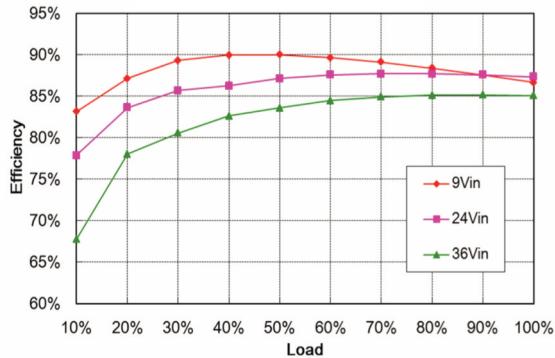
$$R_v = \frac{19.2}{0.525} - 24 = 12.57k\Omega$$

## General

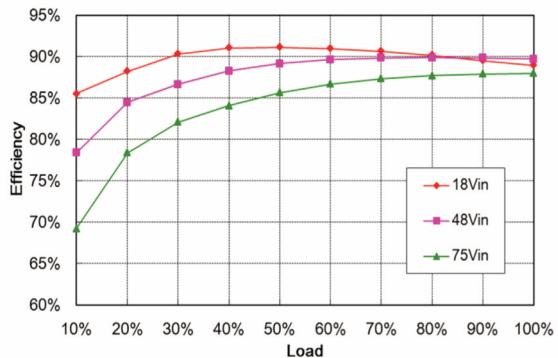
Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency	86		90	%	See Models and Ratings table
Isolation: Input to Output			1500	VDC	
Input to Case			1500	VDC	
Output to Case			1500	VDC	
Isolation Resistance		10		MΩ	
Isolation Capacitance		4000		pF	
Switching Frequency		230		kHz	
Power Density		79		W/in³	
Mean Time Between Failure		300		kHrs	MIL-HDBK-217F at 25 °C GB
Weight		0.57 (260)		lb (g)	

## Efficiency vs Load

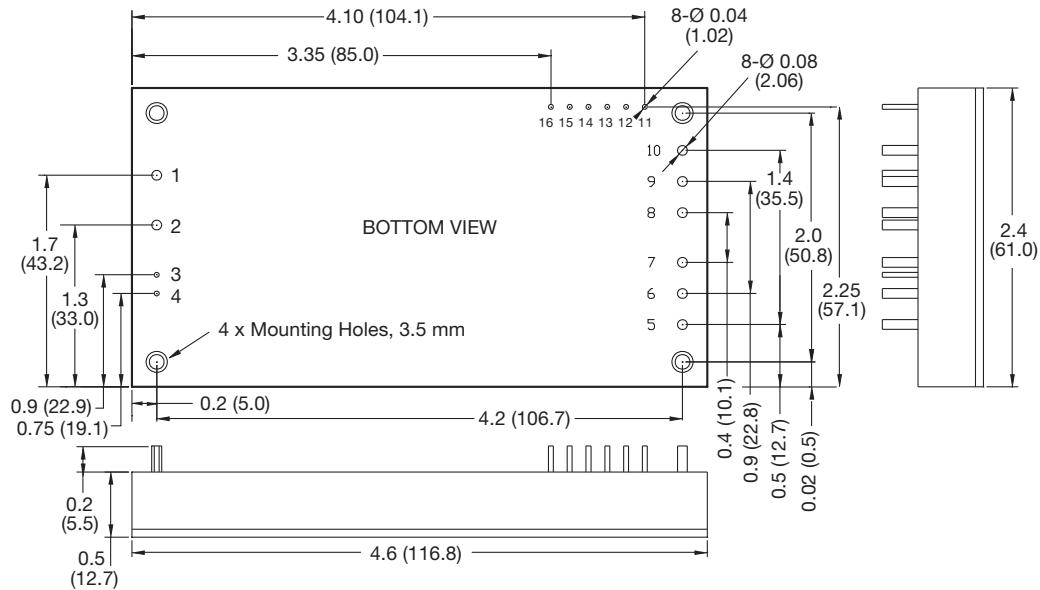
QSB40024S28



QSB40048S28



## Mechanical Details



PIN CONNECTIONS	
Pin	Function
1	-Vin
2	+Vin
3	-On/Off
4	+On/Off
5-7	+Vout
8-10	-Vout
11	-Sense
12	+Sense
13	Trim
14	Parallel
15	DC OK
16	Aux

## Notes

1. All dimensions are in inches (mm)  
 2. Weight: 0.57 lbs (260 g) approx

3. Tolerances: X.XX = ±0.02 (X.X = ±0.5)  
 X.XXX = ±0.01 (X.XX = ±0.25)

## Signals and Controls

Phenomenon	Standard	Test Level	Notes & Conditions
Remote On/Off	Reference to -ve input, Module on: 1-10 mA, Module off: <1 mA or open circuit		
Remote Sense	Compensates up to 10% of Vout nominal, total of output trim and remote sense		
DC OK	DC OK open collector signal (see note 1)		
Current Share	Parallel up to 4 modules using the parallel pin ±10% load share accuracy from 50% to 100% load.		
Auxiliary Output	10V ±3V/20 mA max, auxilliary return is -Sense pin		

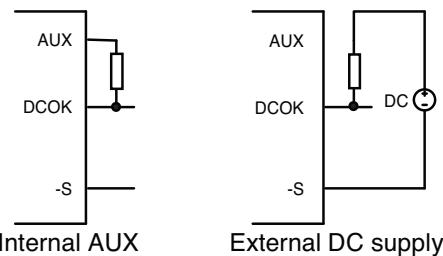
## Notes

1. Open collector signal is pulled low when DC is OK, floating when DC is NOT OK WRT-Sense pin. Maximum current is 20 mA

## DC OK Signal

Normal and abnormal operation of the converter can be monitored by using the DC OK signal. The signal is located at the secondary side and is an open collector referenced to the -Sense pin. The internal aux power supply or an external DC supply can be used as a pull up voltage. Max current is 20 mA.

This signal is LOW when the converter is operating normally and HIGH when the converter is disabled or when the converter is operating abnormally.

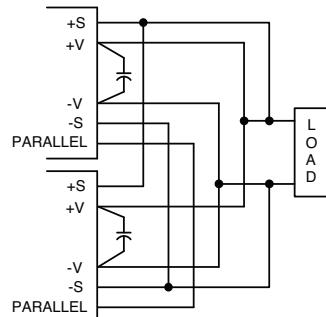


## Parallel Operation

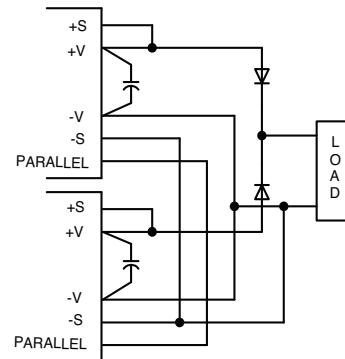
The QSB400 series are designed for parallel operation. When paralleled, the load current can be equally shared between the modules by connecting the Parallel pins together.

There are two different parallel operations for QSB400 series, one is parallel operation when load can't be supplied by only one power unit; the other is for N+1 redundant operation.

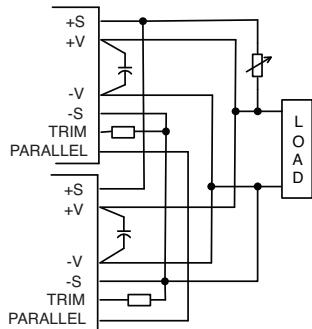
## Parallel Operation



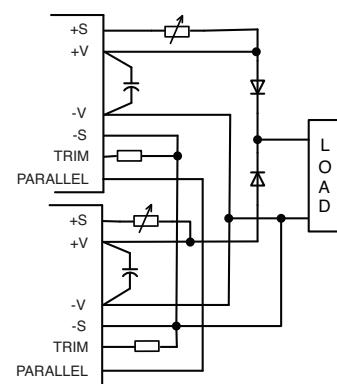
## N+1 redundant connection



## Parallel Operation with adjustable output



## N+1 redundant connection adjustable output voltage



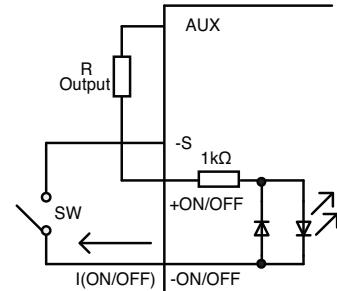
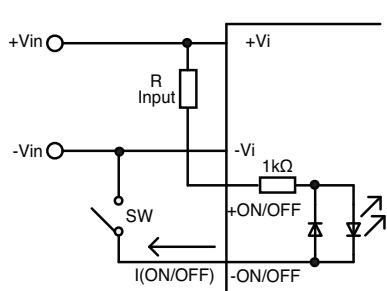
**Remote ON/OFF Control**

The converter's output ON/OFF function can be controlled from the input side or the output side.

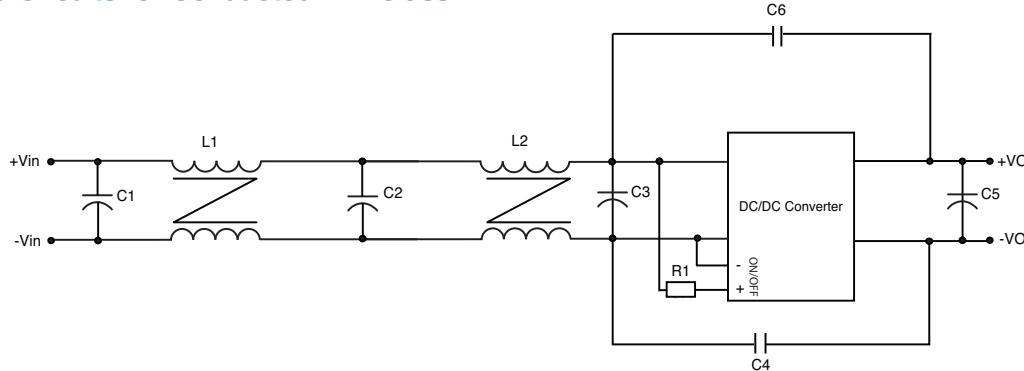
Output voltage turns on when current flows through the ON/OFF pins by closing the switch. The maximum current through the ON/OFF pin is 10mA, and is determined by current limit resistor R.

Turning output ON and OFF from the input side, recommended R value is 12K (1.0 W) for 48Vin and 6K (0.5W) for 24Vin.

Turning output ON and OFF from the output side, recommended R value is 4.3k (0.1W).

**EMC: Emissions**

Phenomenon	Standard	Test Level	Notes & Conditions
Conducted	EN55022, level A conducted, with external components. See application notes.		

**EMC Considerations****Suggested Circuits for Conducted EMI Class A**

C1	C2	C3	C4	C5	C6	L1	L2
470uF/100V	470uF/100V	470uF/100V	2200pF/2kV	330 μF	2200pF/2kV	0.8mH	8mH

**Notes**

470uF/100V NIPPON CHEMI-CON KMF series aluminum capacitors and C4, C6 ceramic capacitors.

C5 is 680 μF for 5V output.

L1: Common mode choke, core p/n T60006-L2025-L0380-05, 4 turns per side, 2 mm or larger diameter wire.

L2: Common mode choke, core p/n T60006-L2030-W517-03, 9 turns per side, 2 mm or larger diameter wire.