400 Watts
QSB Series



- 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

Specification

Input

Input Voltage Range	• 24 V (9-36 V), 48 V (18-75 V)
Input Current	• See table
Idle Current	• 50 mA
Input Reverse Voltage Protection	• None
Input Filter	• Pi network
Undervoltage Lockout	• 24 Vin: turn on 8.5 V, turn off 7.5 V 48 Vin: turn on 17.0 V, turn off 15.0 V
Overvoltage Lockout	• 24 Vin: turn off 42.0 V, turn on 40.0 V 48 Vin: turn off 83.0 V, turn on 80.0 V

Output

Output Voltage Trim	• 80-110% of nominal ouput, see application notes
Initial Set Accuracy	• ±1.5% max
Minimum Load	• No minimum load required
Line Regulation	• ±0.2% max measured from high line to low line
Load Regulation	• ±0.5% max measured from 0-100% load
Start Up Time	• 120 ms typical
Transient Response	• 5% max deviation, recovery to within 1% in 500 µs, 25% step load change
Ripple & Noise	• 5 V models: 100 mV pk-pk, other models 1% pk-pk, 20 MHz bandwidth (see note 1)
Overvoltage Protection	• 115-140%
Short Circuit Protection	• Continuous, constant current
Over Load Protection	• 110-150% nominal output
Thermal Shutdown	• Case temperature 110 °C typical
Temperature Coefficient	• ±0.03%/°C
Remote Enable	• Referenced to -ve input, Module on: 1-10 mA. Module off: < 1 mA or open circuit Optional '-P' version Module on: <1 mA or open circuit Module off: 1-10 mA. Internal 1kΩ current limit resistor is fitted.
Remote Sense	• Compensates up to 10% of Vout nominal, total of output trim and remote sense
Current Share	• Parallel up to 4 modules using the parallel pin ±10% load share accuracy from 50% to 100% load
Auxilliary Output	• 10 V ±3 V/20 mA max Auxilliary return is -Sense Pin

General

Efficiency	• See tables
Isolation Voltage	• 1500 VDC Input to Output 1500 VDC Input to Case 1500 VDC Output to Case
Isolation Resistance	• $10^7\Omega$
Isolation Capacitance	• 4000 pF typical
Switching Frequency	• 230 kHz typical
DC OK Signal	• DC OK open collector signal (see note 4)
Power Density	• 79 W/in^3
MTBF	• 300 kHrs typical to MIL-HDBK-217F at 25 °C, GB

Environmental

Operating Base Plate Temperature	• -40 °C to +100 °C, see derating curve
Storage Temperature	• -55 °C to +105 °C
Operating Humidity	• Up to 90% non-condensing
Cooling	• Baseplate-cooled, see derating curve
Shock	• 75g pk, sawtooth wave for 10 ms, 3 pulses per face, all 6 faces tested on all 3 axes
Vibration	• 15-2000 Hz at 4g, 1 hour per axis

EMC & Safety

Emissions	• EN55022, level A conducted, with external components. See application notes.

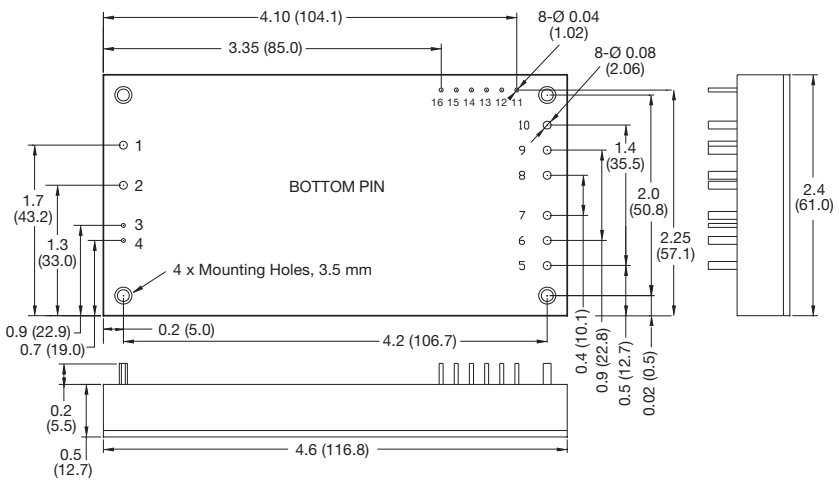
Models & Ratings

Input Voltage	Output Voltage	Output Current	Input Current		Efficiency	Max Capacitive Load	Model Number[2]
			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. *Output Ripple and Noise measured with 10 µF tantalum and 1 µF ceramic capacitor across output.*
2. *Add suffix 'P' to the model number to receive the unit with positive logic Remote On/Off.*
3. *Minimum of 330 µF capacitance required on output to mantain regulation. Except S05 models which require 680 µF*
4. *Open collector signal is pulled low when DC is OK, floating when DC is NOT OK WRT-Sense pin. Maximum current is 20 mA*

Mechanical Details



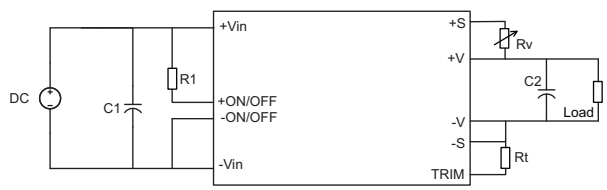
PIN CONNECTIONS	
Pin	Function
1	-Vin
2	+Vin
3	-On/Off
4	+On/Off
5-7	+Vout
8-10	-Vout
11	-Sense
12	+Sense
13	Trim
14	Parallel
15	DC OK
16	Aux

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)

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:



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

$$Vf = \frac{1.24 \times \left(\frac{Rt \times 33}{Rt + 33} \right)}{7.68 + \frac{Rt \times 33}{Rt + 33}}$$

Recommended Value of Rt is 6.8kΩ, therefore Vf = 0.525

$$Vout = (Vnom + Rv) \times Vf$$

$$Rv = \frac{Vout}{Vf} - Vnom$$

Examples:

1. To trim 12 V unit up by 10%

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

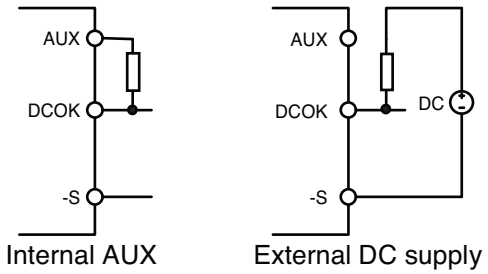
2. To trim 24 V unit up by 20%

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

Application Notes

DC OK Signal

Normal and abnormal operation of the converter can be monitored by using the DC OK signal. Output of this signal monitor is located at the secondary side and is an open collector output with the -Sense pin as the ground reference. The internal aux power supply or an external DC supply can be used as a pull up voltage.



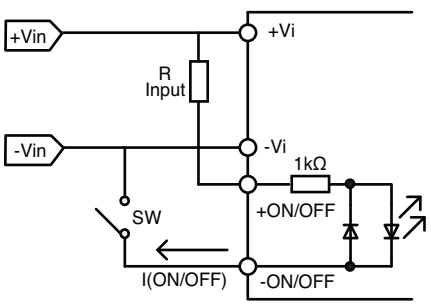
This signal is LOW when the converter is operating normally and HIGH when the converter is disabled or when the converter is operating abnormally.

Remote ON/OFF Control

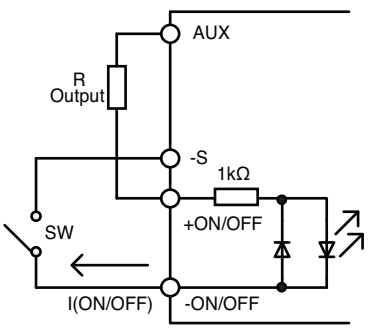
The converter's output ON/OFF function can be controlled from the input side or the output side.

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

(A) Turning output ON and OFF from the input side, recommended R value is 30K (0.5W) for 48Vin and 15K (0.25W) for 24Vin.



(B) Turning output ON and OFF from the output side, recommended R value is 5.1k (0.1W).

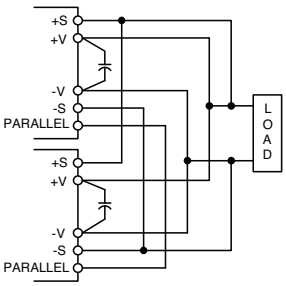


Parallel Operation

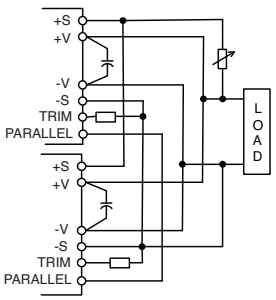
The QSB400 series are designed for parallel operation. When paralleled, the load current can be equally shared between the modules by connecting the Parallel pins together.

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.

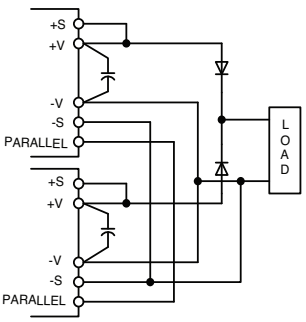
(a) Parallel Operation



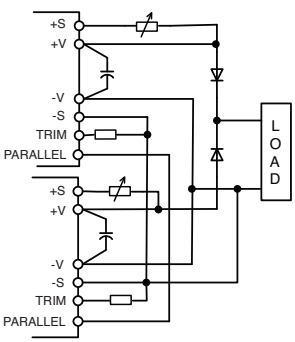
(b) Parallel Operation with adjustable output



(c) N+1 redundant connection

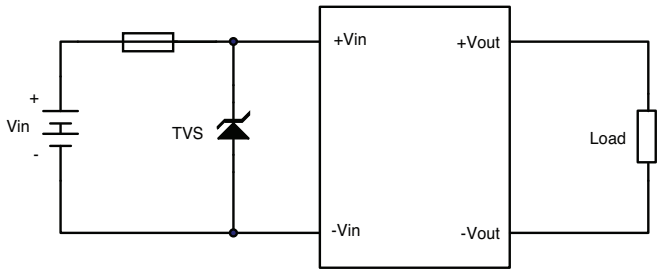


(d) N+1 redundant connection adjustable output voltage



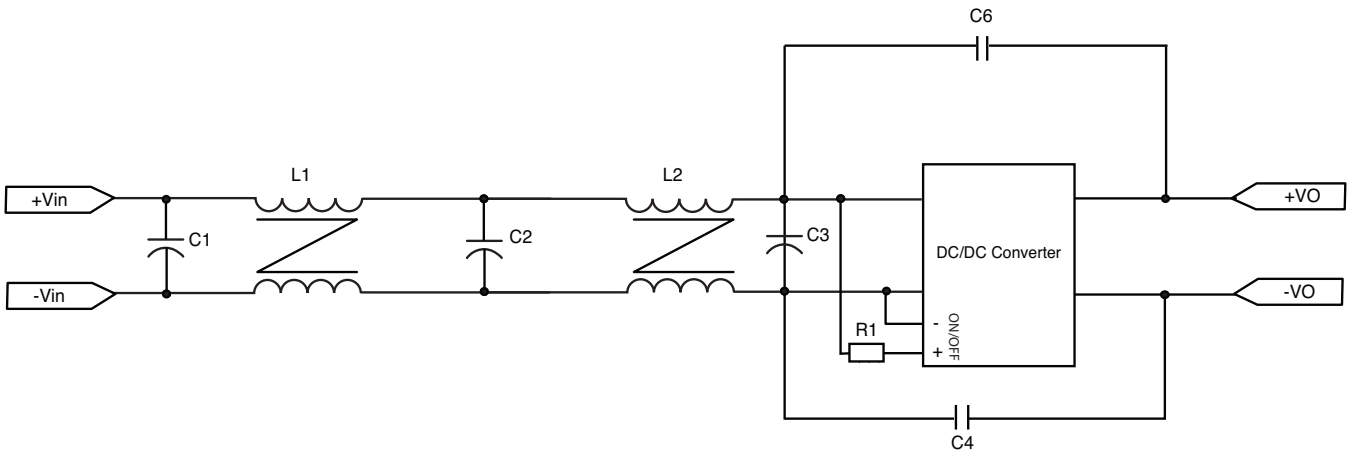
Input Fusing and Safety Considerations

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) across the input terminal to protect the unit against surge or spike voltage and input reverse voltage (as shown).



EMC Considerations

Suggested Circuits for Conducted EMI Class A

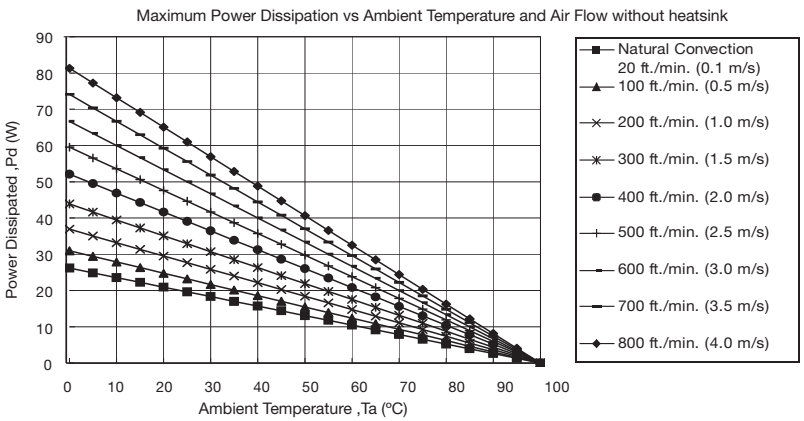


C1	C2	C3	C4	C6	L1	L2
470uF/100V	470uF/100V	470uF/100V	2200pF/2kV	2200pF/2kV	0.8mH	8mH

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

Thermal Resistance Information

Derating Curve



Air Flow Rate	Typical R_{ca}
Natural Convection 20 ft. / min (0.1 ms)	3.82 °C/W
100 ft./min (0.5 ms)	3.23 °C/W
200 ft./min (1.0 ms)	2.71 °C/W
300 ft./min (1.5 ms)	2.28 °C/W
400 ft./min (2.0 ms)	1.92 °C/W
500 ft./min (2.5 ms)	1.68 °C/W
600 ft./min (3.0 ms)	1.50 °C/W
700 ft./min (3.5 ms)	1.35 °C/W
800 ft./min (4.0 ms)	1.23 °C/W

R_{ca} = Thermal resistance from case to ambient