Leading the Advancement of Power Conversion

QBC4120x033 Regulated 1/4-Brick Bus Converters

Features

- High efficiency, 95.5% (12V/33A)
- Regulated output (5% accuracy), 390W
- Wide input voltage range: 36 – 75V
- Available output voltage: 12V, 9.6V, 5V
- Industry standard footprint and pin out
- Low profile, 0.40" (10.2mm)
- Parallel operation
- Monotonic start-up
- No minimum load required
- Fixed frequency operation
- Basic insulation, 1500V
- UL60950 Certified

Applications

- Intermidiate Bus Power Architecture
- Telecom, Datacom, Networking
- Electronic Data Processing / Servers
- Distributed Power Architectures

Options

- Baseplate
- Auto-restart after fault shutdown
- Negative/Positive enable logic
- Case ground pin
- Various lead lengths

NetPower Technologies' QBC Series of low profile, high power quarter-brick bus converters deliver high efficiencies and excellent thermal performance in a single board, open frame design. The QBC converters provide regulated output voltages over an input voltage range of 36V to 75V. The output regulation accuracy is better than 5%. With the regulated output voltage, these converters can be used to power sensitive loads directly, or be part of an intermediate bus power architecture (IBA). In IBA applications, the almost constant bus voltage over input voltage, load current and temperature variation allows the bus capacitors and downstream point-of-load converters to be optimized. The availability of several voltages also allows the bust voltage to be optimized according to system requirements. For applications in extreme thermal environments, a baseplate option is offered for extra heat transfer.

The QBC Series converters also feature smooth and monotonic start-up from both the input voltage and the ON/OFF control under various load conditions (including pre-biased output). The QBC converters have a fast dynamic response and are stable over the full range of input voltage, load current, load capacitance, capacitor ESR, and temperature. The converters are fully protected from abnormal conditions of input/output voltages, output current and operating temperature.

† UL is a registered trademark of Underwriters Laboratory Inc.

Absolute Maximum Rating

Excessive stresses over these absolute maximum ratings can cause permanent damage to the converter. Also, exposure to absolute maximum ratings for extended periods of time can adversely affect the reliability of the converter. Operation should be limited to the conditions outlined under the Electrical Specification Section.

Parameter	Symbol	Min	Max	Unit
Input Voltage (continuous)	Vi	-0.5	75*	Vdc
Input Voltage (continuous, non-operating)	Vi	-	100	Vdc
I/O Isolation Voltage (for 1 minute)		1500	-	Vdc
Operating Ambient Temperature (See Thermal Consideration section)	To	-40	85**	˚C
Storage Temperature	Tstg	-55	125	˚C

*: The converter can stand 100V input for 100ms.

** For operation above 85ºC ambient temperature, please consult NetPower for derating guidance.

Electrical Specifications

These specifications are valid over the converter's full range of input voltage, resistive load, and temperature unless noted otherwise.

Input Specifications

Parameter	Symbol	Min	Typical	Max	Unit
Input Voltage	Vi	36	48	75	Vdc
Standby Input Current	$I_{in,Stdby}$	-	4	6	mA
Inrush Transient	I^2t	-	-	1.0	A^2s
Input Turn-on Voltage Threshold	-	34	35	36	V
Input Turn-off Voltage Threshold	-	32	33	34	V
Input Voltage ON/OFF Hysteresis	-	1	2	3	V

General Specifications

Parameter	Symbol	Min	Typical	Max	Unit
Remote Enable					
Negative Logic: Logic Low – Module On, Logic High – Module Off	-	-	-	-	-
Positive Logic: Logic High – Module On, Logic Low – Module Off	-	-	-	-	-
Logic Low: $I_{ON/OFF}$ = 1.0mA	$V_{ON/OFF}$	0	-	1.2	V
Logic Low: $V_{ON/OFF}$ = 0.0V	$I_{ON/OFF}$	-	-	1.0	mA
Logic High: $I_{ON/OFF}$ = 0.0µA	$V_{ON/OFF}$	-	-	15	V
Logic High: Leakage Current	$I_{ON/OFF}$	-	-	50	µA
Turn-on Time (Io = full load, Vo within 1% of setpoint)		-	4	8	ms
Output Current Sharing Accuracy (at rated load)	-	-	-	10	%
Over-temperature Protection	To	-	120	-	°C
Isolation Capacitance	-	-	2700	-	pF
Isolation Resistance	-	10	-	-	MΩ
Calculated MTBF (Bellcore TR-332)			1.9		10^6-hour

QBC4120x033xxx (Vout = 12V, Iout = 33A)

Input Specifications

Parameter	Symbol	Min	Typical	Max	Unit
Input Current	$I_{in, Max}$	-	-	15	A
Quiescent Input Current (Vin = 48V)	$I_{in, Qsnt}$	-	120	170	mA
Input Reflected-ripple Current, Peak-to-peak (5 Hz to 20 MHz, 12 µH source impedance)	-	-	20	-	mA
Input Ripple Rejection			-40		dB

Output Specifications

Parameter	Symbol	Min	Typical	Max	Unit
Output Voltage Set Point (Vi = 48 V; Io = 50% of Iomax; Ta = 25°C)	-	11.6	12.0	12.4	Vdc
Output Voltage Set Point (over all conditions)	-	11.4	-	12.6	Vdc
Output Regulaton:					
Line Regulation (Vi = 36V to 75V, Io = 1/2 of load)	-	-		2.0	%Vo
Load Regulation* (Io = Io,min to Io,max, Vi = 48V)	-	-		4.0	%Vo
Temperature (Ta = -40°C to 85 °C)	-	-		2.0	%Vo
Output Voltage During Startup (48V input)					
Overshoot			0		V
Delay from enable signal to output rise to 10%			22		mS
Rise time from 10% to regulation band			5		mS
Output Ripple and Noise Voltage					
RMS	-	-	-	30	mVrms
Peak-to-peak (5 Hz to 20 MHz bandwidth, Vin = 48V)				80	mVp-p
External Load Capacitance	-	-	-	20,000	µF
Output Current	I_o	0	-	33	A
Output Power	P_o	0		390	W
Output Current-limit Trip Point	$I_{o,cli}$		40		A
Output Short-circuit Current			0		A
Efficiency (Vi = 48V; Io = Iomax, T_A = 25ºC)	η	-	95.5	-	%
Output Over Voltage trip point		13.5		16.5	V
Switching frequency	-	280	330	380	kHz
Dynamic Response (Vi = 48V; Ta = 25°C; Load transient 0.1A/µs)					
Load step from 50% to 75% of full load:					
Peak deviation			3		%Vo
Settling time (to 10% band of Vo deviation)			50		ms
Load step from 50% to 25% of full load					
Peak deviation			3		%Vo
Settling time (to 10% band of Vo deviation)			50		ms

***:** a droop helps current sharing in parallel operation. If tighter load regulation is desired, please consult NetPower sales and support team for customized product.

Characteristic Curves

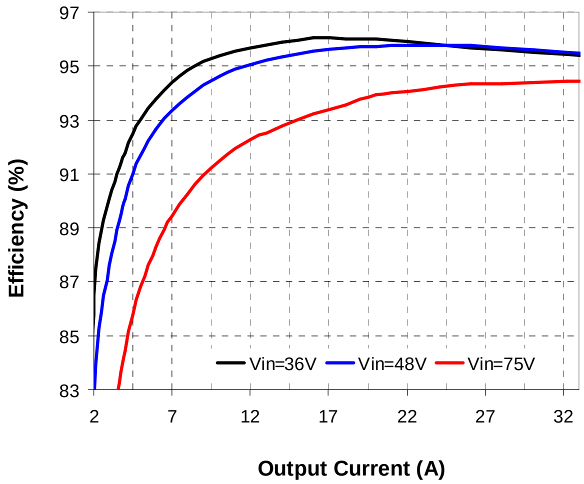


Figure 1. Efficiency vs. Load Current (25^{o}C)

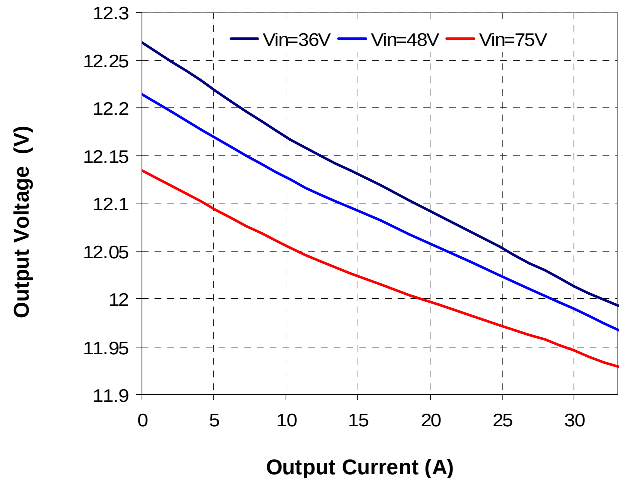


Figure 2. Output Load Regulation (25^{o}C)

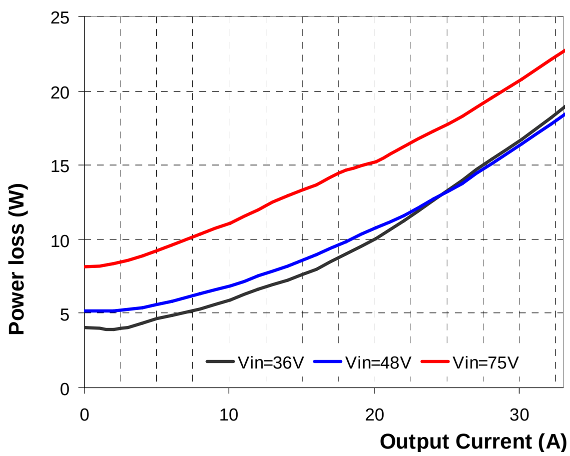


Figure 3. Power loss vs. Output Current

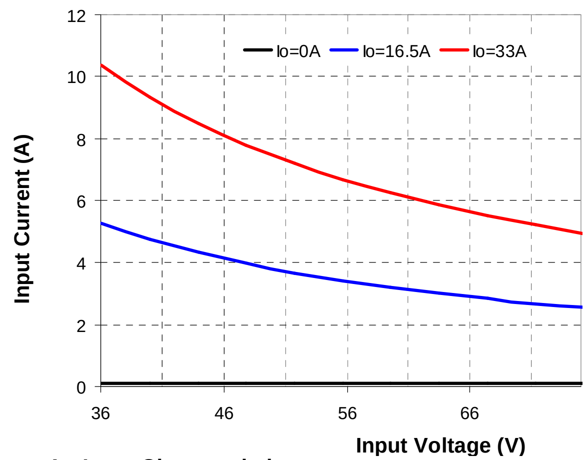


Figure 4. Input Characteristic

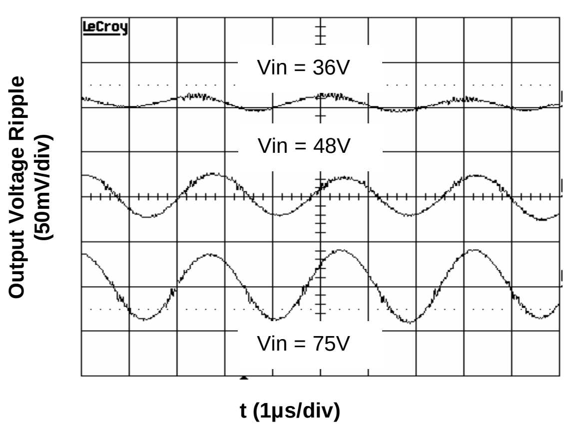


Figure 5. Output Ripple Voltage at Full Load

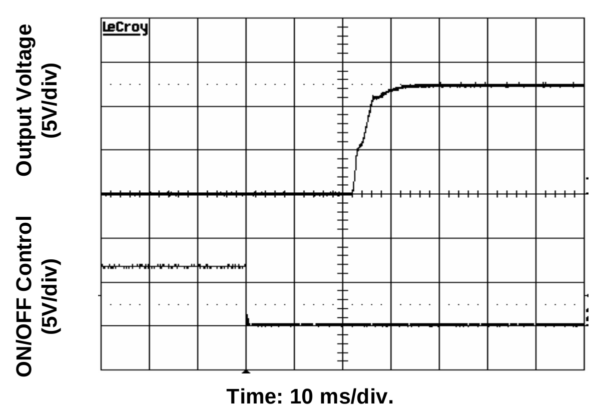
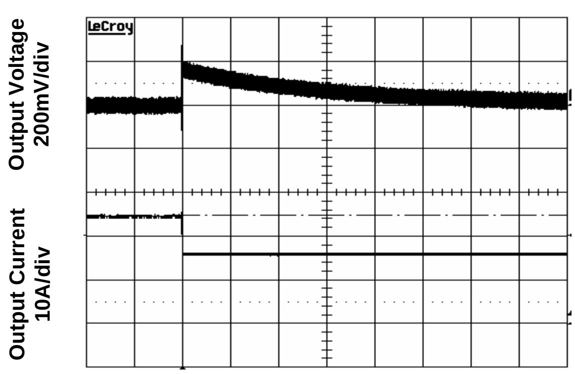
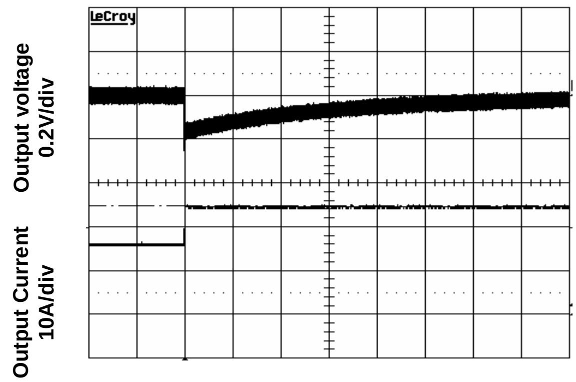


Figure 6. Start-Up from Enable Control Input voltage 48V, Output current 0A



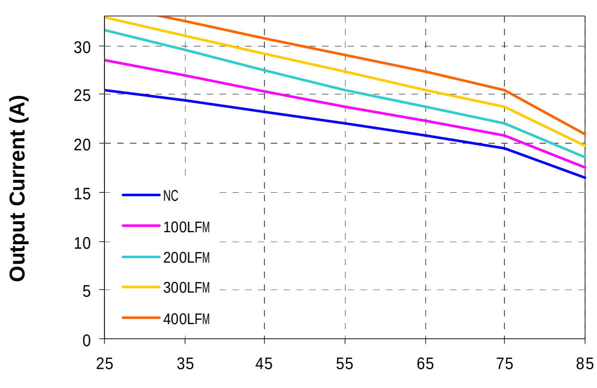
Time – t (10ms/div)

Figure 7. Transient Load Response. Test Cond.: Transient load from 24.75A to 16.5A, Input voltage 48V, Slew rate 0.1A/µs



Time – t (10ms/div)

Figure 8. Transient Load Response. Test Cond.: Transient load from 16.5A to 24.75A, Input voltage 48V, Slew rate 0.1A/µs.



Ambient Temperature (ºC)

Figure 9. Current Derating Curve for Airflow Direction 3. (Ref. Figure 10 for Airflow Direction; Vin = 48V open frame unit)

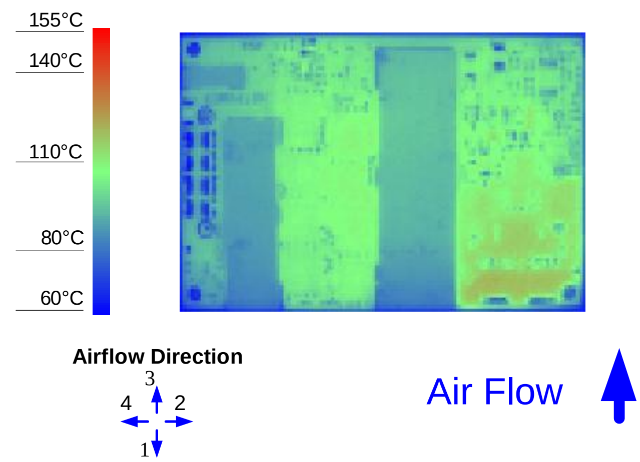
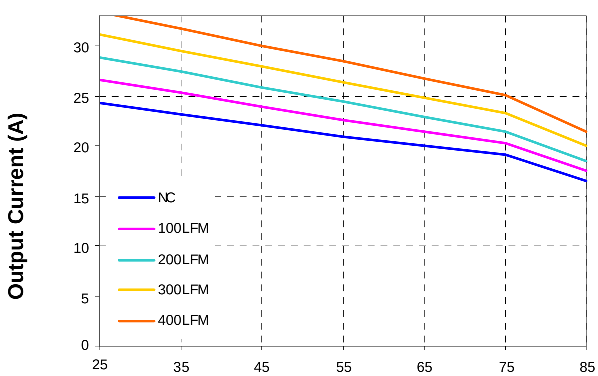
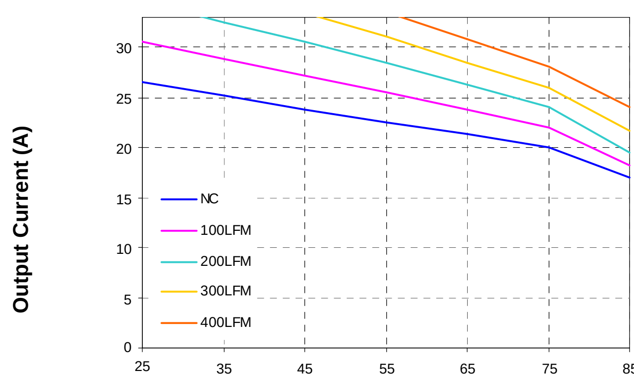


Figure 10. Thermal Image for Airflow Direction 3 (26A output, 55°C ambient, 200 LFM, Vin = 48V open frame unit)



Ambient Temperature (ºC)

Figure 11. Current Derating Curve for Airflow Direction 4. (Ref. Figure 10 for Airflow Direction; Vin = 48V open frame unit)



Ambient Temperature (ºC)

Figure 12. Current Derating Curve with Base-Plate. (Vin = 48V)

Feature Descriptions

Remote ON/OFF

The converter can be turned on and off by changing the voltage or resistance between the ON/OFF pin and Vin(-). The QBC Series of converters is available with factory selectable positive logic or negative enabling logic.

For the negative control logic, the converter is ON when the ON/OFF pin is at a logic low level, and OFF when the ON/OFF pin is at a logic high level. With positive control logic, the converter is ON when the ON/OFF pin is at a logic high level and OFF when the ON/OFF pin is at a logic low level.

With the internal pull-up circuitry, a simple external switch between the ON/OFF pin and Vin(-) can control the converter. A few example circuits for controlling the ON/OFF pin are shown in Figs. 13, 14 and 15.

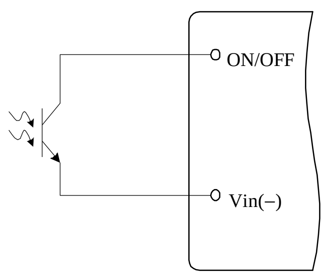


Figure 13. **Opto Coupler Enable Circuit**

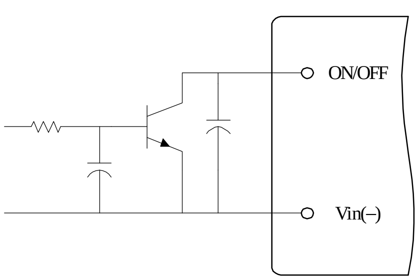


Figure 14. Open Collector Enable Circuit

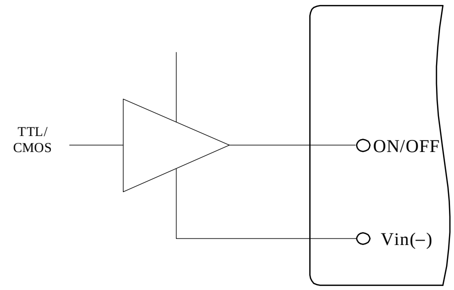


Figure 15. Direct Logic Drive

The logic-low level is from 0V to 1.2V, and the maximum switch current during logic low is 1mA. The external switch must be capable of maintaining a logic-low level while sinking this current. The maximum ON/OFF pin voltage, generated by the converter internal circuitry for logic-high level, is less than 15V. The maximum allowable leakage current from this pin at logic-high level is 50μA.

Input Under-Voltage Lockout

This feature prevents the converter from turning on until the input voltage reaches 35V (typical). It turns the converter off when the input voltage falls below 33V (typical). A 2V hysteresis prevents oscillations.

Output Over-Current Protection

As a standard feature, the converter latches off when the load current exceeds the current limit. The converter can be restarted by toggling the ON/OFF switch, or by recycling the input voltage. With the auto-restart option, the converter will operate in a hiccup mode (repeatedly trying to restart) until the over-current condition is cleared.

Output Over-Voltage Protection

If the voltage across the output pins exceeds the output voltage protection threshold as shown in the Specifications Table, the converter will shut down to protect the converter and the load.

As a standard feature, the converter will shut down and latch off when this occurs. The converter can be restarted by toggling the ON/OFF switch, or by recycling the input voltage. With the auto-restart option, the converter will operate in hiccup mode until the over-voltage cause is cleared.

Thermal Shutdown

As a standard feature, the converter will shut down and latch off if an over-temperature condition is detected. The converter has a temperature sensor located within the converter's circuit board, which detects the thermal condition of key components of the converter.

The thermal shutdown circuit is designed to turn the converter off when the temperature at the sensor reaches 120°C. The module can be restarted by toggling the ON/OFF switch, or by recycling the input voltage. With the auto-restart option, the converter will resume operation after the converter cools down.

Design Considerations

Input Source Impedance

The stability of the QBC converters, as with any DC/DC converter, may be compromised if the source impedance is too high or too inductive. It's desirable to keep the input source AC impedance as low as possible. The converters are designed to be stable without an additional input capacitor for typical source impedance. However, it is recommended to use at least a 100µF low ESR electrolytic capacitor at the input of the converter to reduce the potential impact of the source impedance. This electrolytic capacitor should have sufficient RMS current rating over the operating temperature range to avoid overheating.

Safety Considerations

The QBC Series of converters are designed in accordance with EN 60950 Safety of Information Technology Equipment Including Electrical Equipment. The converters are designed to meet 1500V Basic Insulation requirements in UL 60950, Safety of Information Technology Equipment and applicable Canadian Safety Requirement, and ULC 60950. Flammability ratings of the PWB and plastic components in the converter meet 94V-0.

For the QBC series converters to meet basic insulation requirements when a baseplate or heatsink are used, the case pin must be left floating, or connected to a primary or secondary circuit through a capacitor with the appropriate voltage rating. If no baseplate or heatsink are used, the case pin can be connected directly to any primary circuit.

To protect the converter and the system, an input line fuse is highly recommended on the input end that is not grounded.

A normal-blow fuse with a maximum rating of 25A should be connected at the ungrounded input lead of each QBC series converter.

Parallel Operation

QBC converters can be used in parallel to meet higher system power demand by connecting the corresponding input and output of each converter together. A QBC converter's output voltage decreases slightly with the increase of output current. Such droop characteristics can help the converters in parallel to share the load current when put into parallel operation.

It's important to maintain symmetric layout of all converters' input and output power traces to achieve good current sharing. ORing diodes or MOSFETs may be needed in parallel operation. For more details of parallel operation, please consult with NetPower's support team.

Thermal Considerations

The QBC Series of converters can operate in various thermal environments. Due to the high efficiency and optimal heat distribution, these converters exhibit excellent thermal performance. Most heat-generating components are mounted on the topside of the module, so the heat can be easily removed by conduction, convection, and radiation. Proper cooling can be verified by monitoring the temperature of the key components. Figure 16 shows recommended temperature monitoring points for open frame converters. The temperature at these locations should not exceed 120 °C continuously. For a converter with a baseplate, the base can be monitored in actual application. The baseplate temperature should not exceed 105°C continuously if the load current is more than 15A, or 110°C if the load current is less to 15A.

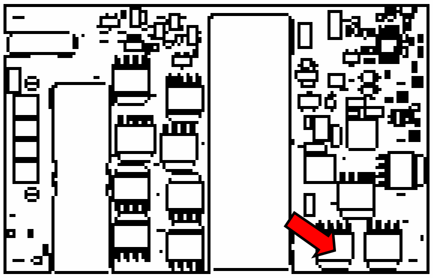


Figure 16. **Temperature Monitoring Locations**

The maximum allowable output power of any power converter is usually determined by the electrical design and the maximum operating temperature of its components. The QBC series of converters has been tested comprehensively under various conditions to generate the derating curves with consideration for long term reliability.

Thermal derating curves are highly influenced by derating guide, the test conditions and test setup, such as test temperatures, the interface method between the converter and the test fixture board, spacing and construction (especially copper weight, holes and openings) of the fixture board and the spacing board, temperature measurement method, and the ambient temperature measurement point. NetPower's QBC thermal derating curves are obtained by thermal tests in a wind-tunnel at 25ºC, 55ºC, 70ºC, and 85ºC. The converter's power pins are soldered to a 2-layer test fixture board through 18 AWG wires. The space between the test board and a PWB spacing board is 1". Usually, the end system board has more layer count, and has better thermal conduction than our test fixture board. For thermal considerations specific to your application environment, please contact NetPower's technical support team for assistance.

Heat Transfer without a Baseplate or Heatsink

Convection heat transfer is the primary cooling means for converters without a baseplate. Therefore, airflow speed is important for any intended operating environment. Increasing the airflow over the converter enhances the heat transfer via convection.

Figures 9, 11 and 12 show the current derating curves under nominal input voltage. To maintain long-term reliability, the module should be operated within these curves in steady state. Note: the natural convection condition can be measured from 0.05 - 0.15 m/s (10 - 30 LFM).

Heat Transfer with a Baseplate or Heatsink

The QBC series converters can use a baseplate to further enhance their thermal performance. The maximum height of a QBC converter with a baseplate is 0.50''. A baseplate works as a heat spreader, and thus can improve the heat transfer between the converter and its ambient.

An additional heatsink or cold-plate can be attached to the baseplate using M3 screws. The heatsink/cold plate further improves the thermal performance of the converter. For high volume applications, NetPower also offers an integrated heatsink option. The integrated-heatsink option combines the baseplate and heatsink into one assembly, with fins in the transverse direction. The maximum converter height with this option is not greater than 0.75''. The integrated heatsink thermally outperforms the combination of a baseplate with a 0.5'' heatsink.

An optional case pin is available with the baseplate and integrated heatsink options.

EMC Considerations

The QBC series of converters meet the EN55022 class B and FCC part 15J requirements with an external filter. The EMC performance of the QBC converters is related to the layout and filtering design of the system board. Careful layout and adequate filtering around the module are important to confine noise generated by the converter, and to optimize the system EMC performance.

For assistance with designing for EMC compliance, please contact NetPower's technical support team at support@netpowercorp.com.

Mechanical Drawing dimensions in mm(inch)

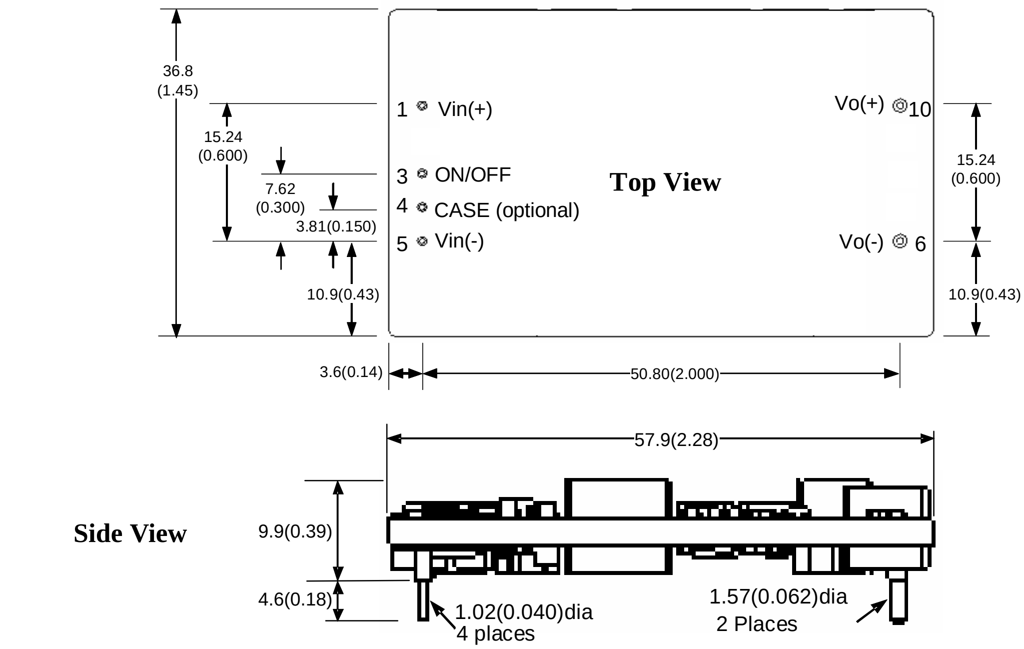


Figure 17. Open Frame Converter

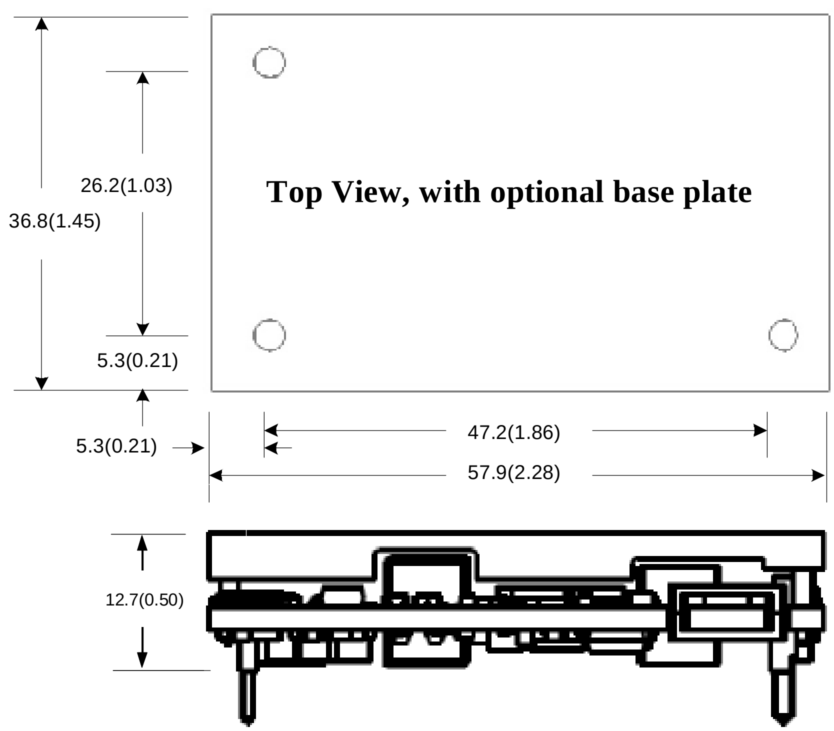


Figure 18. Converter with Baseplate

Notes

1) All dimensions in mm (inches)
Tolerances:.x ± .5 (.xx ± 0.02)
.xx ± .25 (.xxx ± 0.010)
2) Input and function pins are 1.02mm (0.040") dia. with 1.68mm (0.066") dia. standoff shoulders.
3) Output pins are 1.57 mm (0.062") dia.
4) All pins are coated with 90%/10% solder finish, Gold, or Matte Tin over Nickel underplating
5) Weight: 45 g open frame converter
65 g baseplated converter
6) Workmanship: Meet or exceeds IPC-A-610 Class II
7) Torque applied on screw should not exceed 6in-lb. (0.7 Nm)
8) Baseplate flatness tolerance is 0.10mm (0.004") TIR for surface
9) If M3 screws are used to attach heatsink to the base plate, the screw length from the top surface of baseplate going down should not exceed 2.5mm (0.1 in)max.

NetPower
Leading the Advancement of Power Conversion

Part Numbering System

Series Name	Input Voltage	Output Voltage	ON/OFF Logic	Output Current	Pin Feature	Electrical Options	Mechanical Options	
							1	
QBC	**4**	**120**	**N**	**033**	**N**	**2**	**Lea-free, (RoHS Compliant)**	**Leaded (RoHS-5 Compliant)**
QBC	**4-** 36-75V	Unit: 0.1V **120**-12V	**P**- positive **N**- negative	Unit: A **033**-33A	**K** - 0.110" **N** - 0.145" **R** - 0.180" **S**: SMT	**0**- no option **2**- auto-restart	**5**- no option **6**- baseplate **8**- case pin with baseplate;	**0**- no option **1**- baseplate **3**- case pin with baseplate;

Note: SMT pins are solder ball pin at the same locations as the through-hole pins. The recommended copper pad and stencil opening diameter is 0.12''.

Part Numbering Example: **QBC4120N033N21**

Denotes a quarter brick module with 48V input (36V - 75V), 12Vout, negative remote control logic, 33Aout, 0.145" pin length, auto-restart feature, and a baseplate.

For more information, please contact:
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E-mail: sales@netpowercorp.com
Address: 1680 Prospect #200, Richardson, TX 75081

Warranty