QBU4005x450 450W 5:1 Fixed-Ratio Bus Converter

Features

- **450W capability over the whole input range**
- **Wide input voltage range: 36-60V**
- **High efficiency: 95.5% at 9.6V full load**
- **Excellent thermal performance**
- **Low profile: 2.3''x1.45''x0.40"**
- **Monotonic start-up into pre-bias load**
- **Parallel operation of multiple converters**
- **Input under/over voltage protection**
- **Output over-current protection**
- **Over temperature protection**
- **Basic insulation, 1500Vdc**
- **Designed to meet IEC 60950 standard**
- **RoHS compliant**

Applications

- **Intermediate Bus Architecture**
- **Wireless Networks**
- **Telecom / Datacom**
- **Electronic Data Processing / Servers**
- **Distributed Power Architectures**

Options

- **Baseplate**
- **Auto-restart after fault shutdown**
- **Negative/Positive enable logic**
- **Various lead lengths**

NetPower Technologies' QBU Series converters are high performance non-regulated bus converters in industrial standard quarter brick footprint (2.3''x1.45''x0.40''). With wide input range, low profile, high efficiencies, and excellent thermal performance in a single board, open frame design, QBU converters are ideal choice for many applications with intermediate bus power architecture (IBA).

The QBU converters are optimized for power conversion efficiency, and provide non-regulated output voltages over an input voltage range of 36V to 60V. The converters are designed to be able to provide maximum power over the whole input range, and can be paralleled to provide more power to the system. They feature also monotonic start-up under pre-bias conditions. Due to the high efficiency and good thermal management in the converter design, high output power can be obtained without a heatsink in practical applications. For applications in extreme thermal environments, a baseplate option is available. The converters are fully protected from abnormal input voltage, output current and/or operating temperature.

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	-0.3	60	Vdc
Input Voltage (non-operating)	Vi	-0.3	80	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

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

Electrical Characteristics

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
Operating Input Voltage	Vi	36	48	60	Vdc
Standby Input Current	Iin,Stdby	-	-	10	mA
Inrush Transient	I^2t	-	1	-	A^2s
Input Turn-on Voltage Threshold	-	-	35	35.8	V
Input Turn-off Voltage Threshold	-	31.8	32.5	-	V
Input Voltage ON/OFF Hysteresis	-	-	2.5	-	V
Input Over-voltage turn off		61.5	62.5	-	
Input Current	Iin, Max	-	-	18	A
Quiescent Input Current (Vin = 48V)	Iin, Qsnt	-	160	-	mA
Input Reflected-ripple Current, Peak-to-peak (5 Hz to 20 MHz, 12 µH source impedance)	-	-		-	mA
Input ripple rejection, 120 Hz			12		dB
Switching frequency	Fsw	90	160	240	KHZ

- **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: ION/OFF = 1.0mA VON/OFF = 0.0V Logic High: ION/OFF = 0.0µA Leakage Current	VON/OFF ION/OFF VON/OFF ION/OFF	-5 - - -	- - - -	0.8 1.0 15 50	V mA V µA
Isolation Resistance	-	10	-	-	MΩ
Calculated MTBF (Bellcore TR-332)			2.7		10^6-hour

Output Specifications

Parameter	Symbol	Min	Typical	Max	Unit
Output Voltage Set Point (Vi = 48 V; No load; Ta = 25°C)	Vo, set		9.6		V
Output Regulation:					
Over line change		6.6		12	V
Over load change			0.5	0.8	V
Temperature (Ta=-40°C to +85°C)			0.2		V
Output Ripple and Noise (20MHZ bandwidth): Peak-to-Peak RMS			 150 30		 mV mV
External Capacitance	Co, max			20000	uF
Output Current Limit Inception (Vin=48V, Ta=25°C)	Io, lim		63		A
Efficiency (Ta=25°C)					
Vin=48V, Po=300W			96.0		%
Vin=48V, Po=450W			95.5		%
Dynamic Response (Vi = 48V; Ta = 25°C; Load transient 0.1A/µs; tested with a 10uF tantalum and a 1.0uF ceramic capacitor at output.) Load step from 50% to 75% of full load: Peak deviation Settling time (to 10% band of Vo deviation) Load step from 50% to 25% of full load Peak deviation Settling time (to 10% band of Vo deviation)			 100 200 100 200		 mV µs mV µs
Turn-On Delay and Rise Time (Full load; Ta=25°C,) With Vin (Module enabled, then Vin=48V applied) (from Vin to Vo=0.1*Vo,nom) With Enable (Vin=48V applied, then enabled) (from enable to Vo=0.1*Vo,nom)			 200 1		 msec msec
Over-temperature Protection			120		°C
Hiccup delay (for auto restart option)			200		msec

Characteristic Curves

The following curves provide typical characteristics for QBU4005x450 at 25°C.

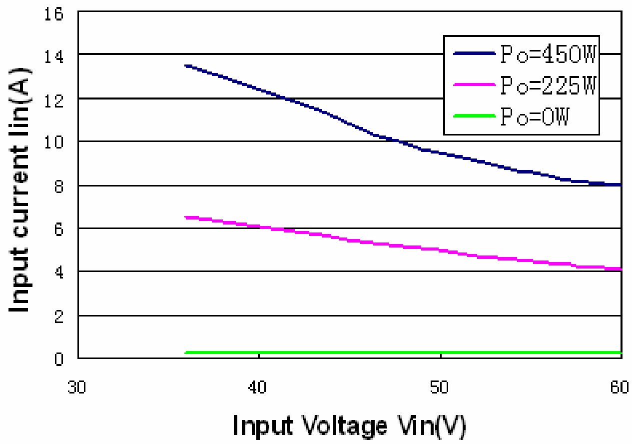

Figure.1 Typical Input Characteristics

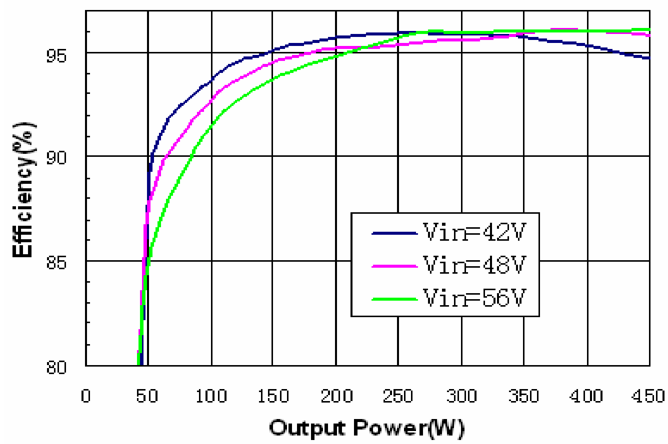

Figure.2 Efficiency Vs. Output Power

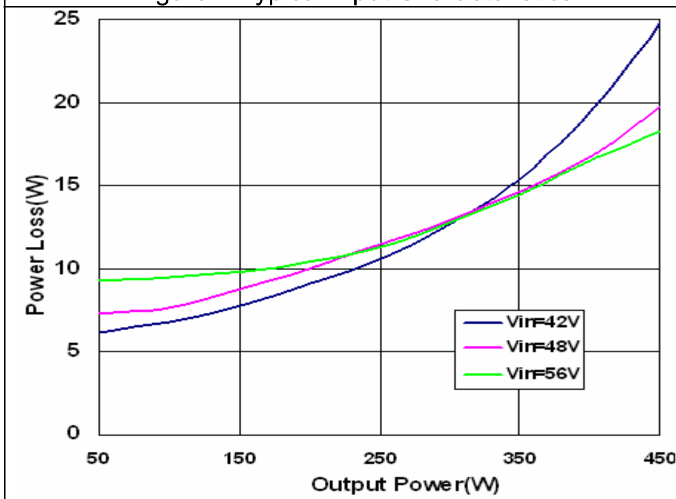

Figure.3 Typical Power Dissipation Vs. Input Voltage

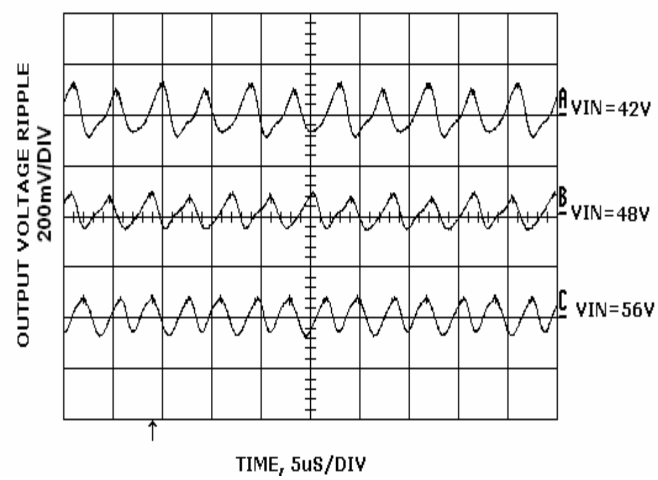

Figure.4 Typical Output Ripple, Po=450W

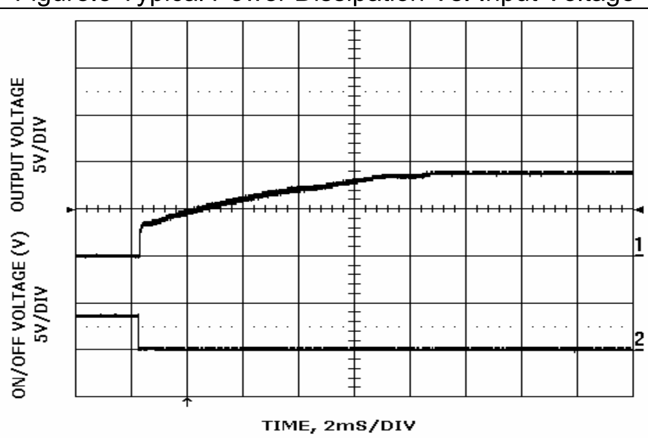

Figure.5 Start-up Using ON/OFF Control
Vin=48V, Resistive Load (450W)

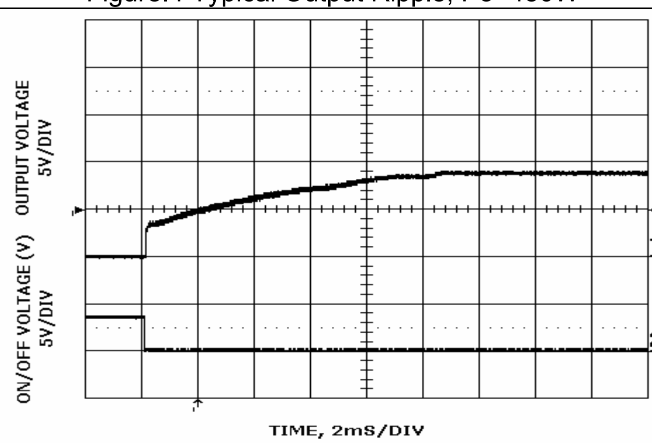

Figure.6 Start-up Using ON/OFF Control with 20000uF Capacitance Load, Vin=48V, Resistive Load (450W)

Characteristic Curves (Continued)

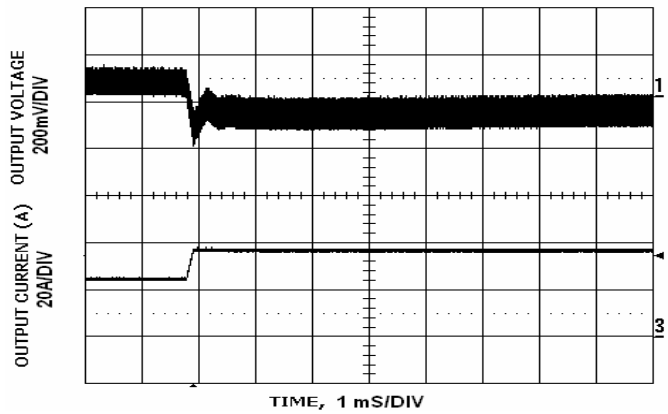

Figure.7 Transient Response to Step Increase from 50% to 75% Full Load, Vin=48V

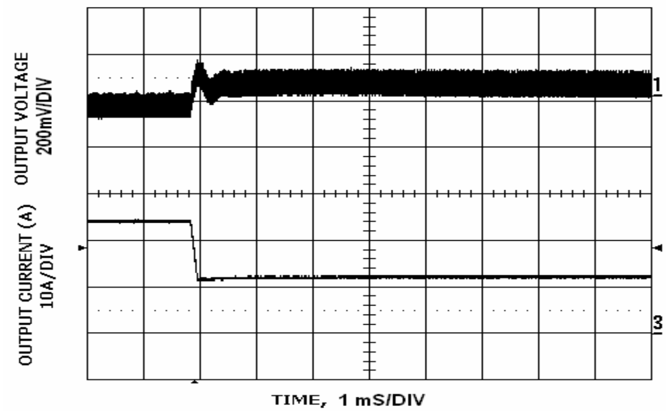

Figure.8 Transient Response to Step Increase from 50% to 25% Full Load, Vin=48V

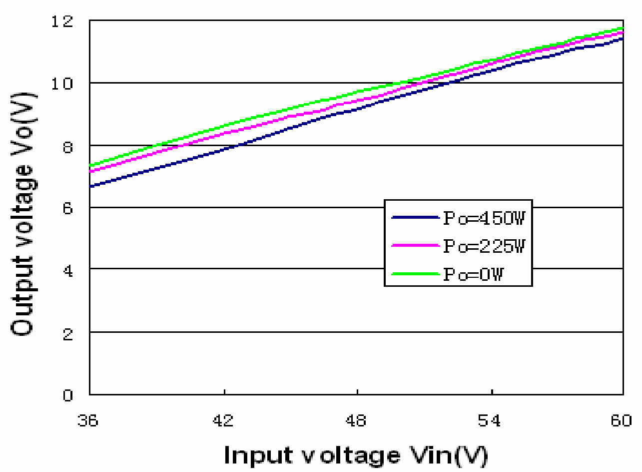

Figure.9 Typical Output Voltage Vs. Input Voltage

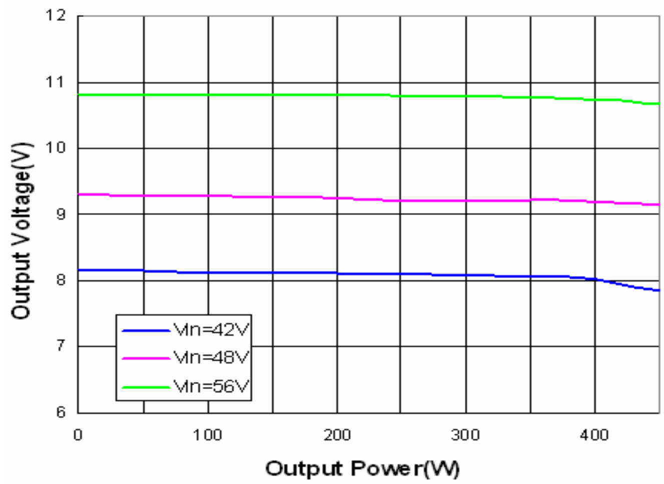

Figure.10 Typical Output Voltage Vs. Output Power

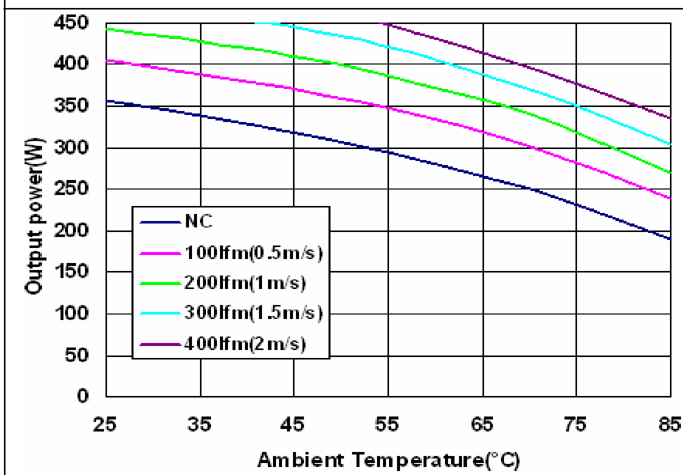

Figure.11 Output Power Derating, (Open Frame Unit Using Solder Interface)

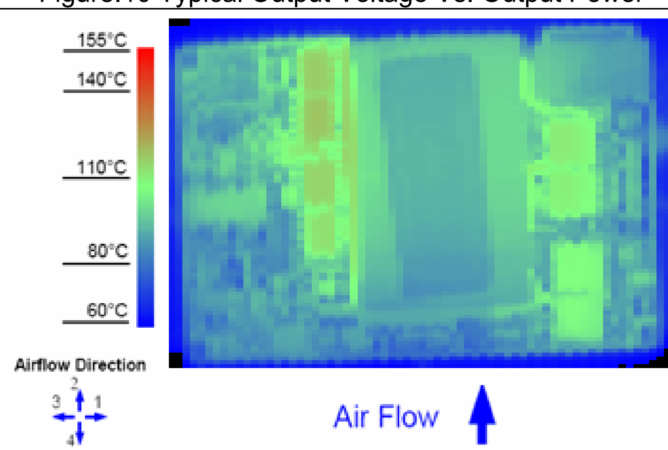

Figure.12 Thermal Image for Airflow Direction 2 (Vin=48V, Po=390W, 55°C Ambient, 200LFM, Open Frame Unit Using Solder Interface)

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 QBU 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.

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.

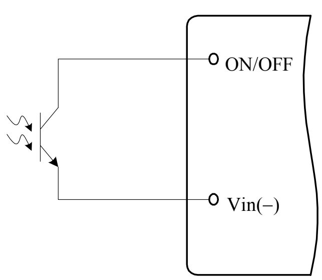

Figure 13. Opto Coupler Enable Circui

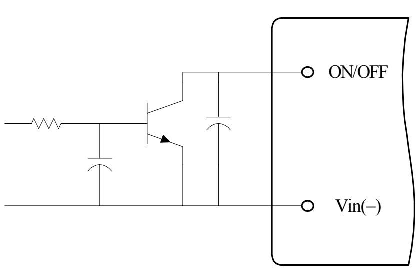

Figure 14. Open Collector Enable Circuit

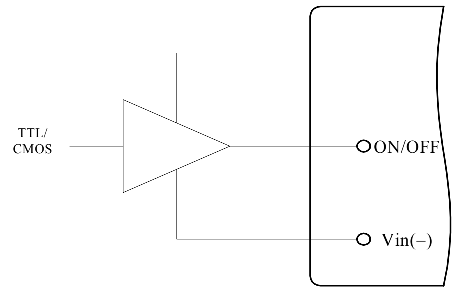

Figure 15. Direct Logic Drive

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 32.5V (typical). A 2.5V 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.

Input Over-Voltage Protection

If the input voltage reaches 62.5V (typical), the module will be turned off to protect internal circuits and load. It will be turned on when input voltage falls below 59.5V (typical).

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 QBU 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 100 μF 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.

Parallel Operation

It's possible to parallel several QBU converters to achieve higher output power. The conduction loss inside the converters and along the power distribution path provides an inherent droop to balance the currents among the converters in parallel.

To achieve good current sharing among the paralleled converters, it's important to make sure the power paths on both the input side and output side have similar resistance among the converters.

Please note that when several converters are in parallel, the difference in the switching frequencies of the converters may create low frequency oscillation in the ripple voltages and currents due to beat frequency effect. To reduce such beat frequency noise, it is desired to put local high frequency filters at the input and output of each converter.

Safety Considerations

The QBU 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.

To protect the converter and the system, an input line fuse is highly recommended on the input end that is not grounded. A fast-acting fuse with a maximum rating of 25A should be connected at the ungrounded input lead of each QBU series converter.

The optional case pin in a converter is connected to the optional baseplate. If basic insulation is to be achieved in the system, any trace directly connected to the case pin should have minimum 28 mil creepage distance to any input or output circuit.

Thermal Considerations

The QBU 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. The temperature at these locations should not exceed 120 °C continuously.

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 QBU series of converters has been tested comprehensively under various conditions to generate the derating curves with consideration for long term reliability.

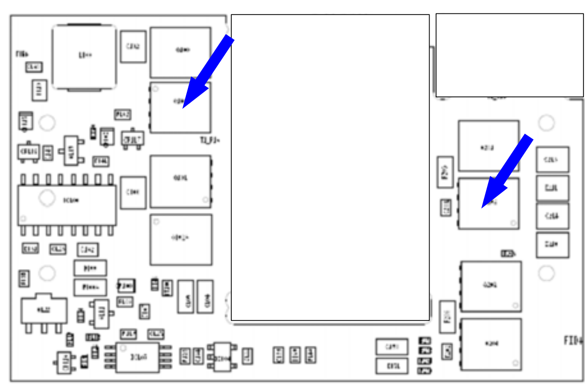

Figure 16. Temperature Monitoring Locations

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. The thermal derating curves in this datasheet 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 1'' long 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 Baseplated/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.

Figure 11 shows 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 QBU series converters can use a baseplate to further enhance their thermal performance. The maximum height of a QBU 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. The case pin can be used to couple the baseplate or heatsink to a stable potential to reduce EMI noise. Usually, the case pin can be connected to input or output source or return through a capacitor with a voltage rating higher than the required isolation voltage between the baseplate and the connected circuit.

EMC Considerations

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 Information

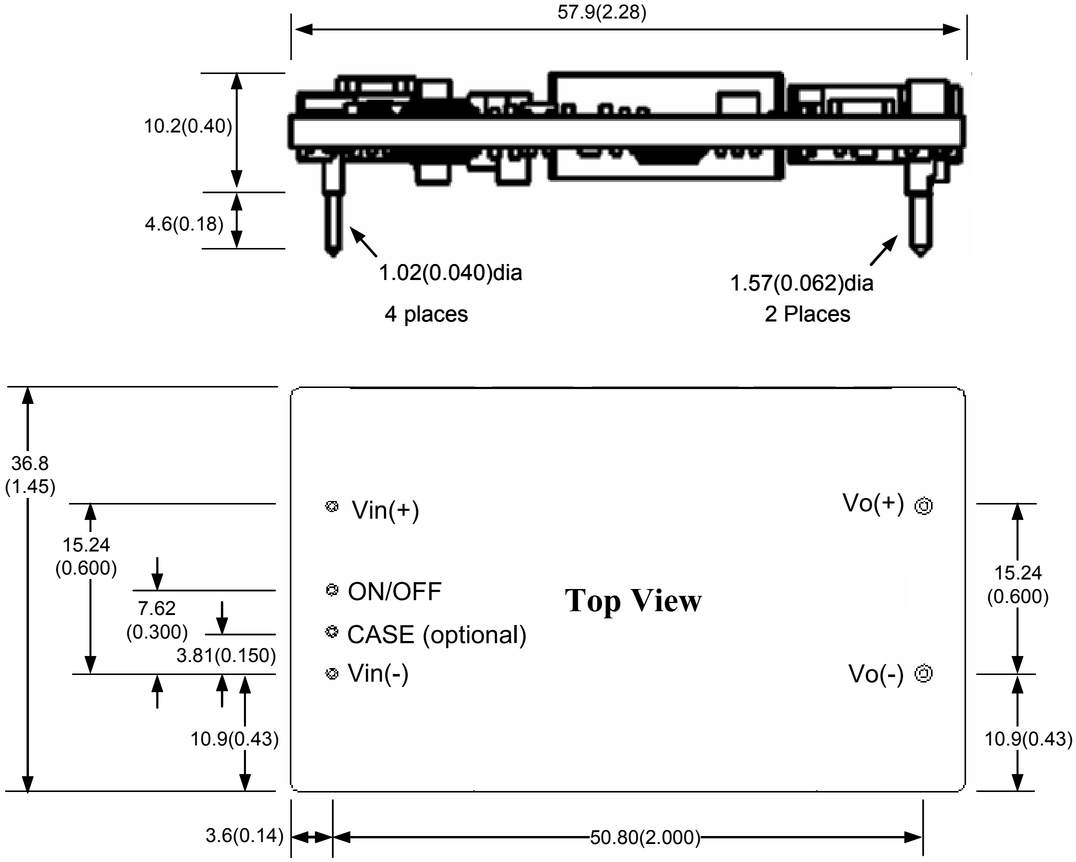

Figure 17. Open frame converter

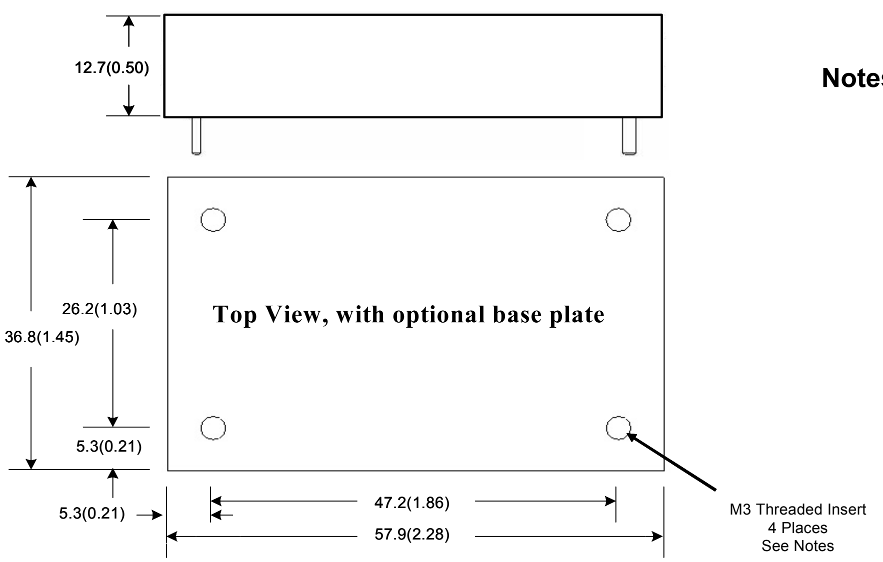

Figure 18. Converter with optional baseplate

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, Matte Tin, or Gold 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 3.25mm (0.125 in)max.

Part Numbering System

QBU	4	004	N	200	R	2	1	
Series Name:	**Nominal Input Voltage:**	**Output Voltage:**	**Enabling Logic:**	**Rated Output Power:**	**Pin Length:**	**Electrical Option:**	**Mechanical Options**	
							Lead-free, ROHS Compliant	**Leaded (ROHS-5 Compliant)**
	4: 48V	Input/output ratio 004: 4:1 005: 5:1	**P:** Positive **N**: Negative	Unit: W 300 = 300W 450 = 450W	**K** - 0.110" **N** - 0.145" **R** - 0.180" **S** – SMT*	**0:** None **2:** Auto-restart	**5:** None **6:** Baseplate	**0:** None **1:** Baseplate

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

Part Numbering Example: **QBU4005N300N21**

Denotes a quarter brick un-regulated 5:1, 300W rating bus converter with negative remote control logic, 0.145" pin length, auto-restart feature, and a baseplate.

For more information, please contact:

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Warranty

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