EBU4004x200 200W 4:1 Fixed-ratio Bus Converter

Pb Free RoHS

Features

- **200W capability over the whole input range**
- **Wide input voltage range: 36-60V**
- **High efficiency: 96% @ 12Vout/200W, 48Vin**
- **Excellent thermal performance**
- **Low profile: 2.3''x0.9''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, 1500V**
- **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' EBU Series converters are high performance non-regulated bus converters in industrial standard eighth brick footprint (2.3''x0.9''x0.40''). With wide input range, low profile, high efficiencies, and excellent thermal performance in a single board, open frame design, EBU converters are ideal choice for many applications with intermediate bus power architecture (IBA).

The EBU 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	36	V
Input Turn-off Voltage Threshold	-	31.5	32.5	-	V
Input Voltage ON/OFF Hysteresis	-	-	2.5	-	V
Input Over-voltage turn off		60.5	61.5	-	
Input Current	Iin, Max	-	-	9	A
Quiescent Input Current (Vin = 48V)	Iin, Qsnt	-	110	-	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	130	200	260	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:					
$I_{ON/OFF}$ = 1.0mA	$V_{ON/OFF}$	-5	-	0.8	V
$V_{ON/OFF}$ = 0.0V	$I_{ON/OFF}$	-	-	1.0	mA
Logic High: $I_{ON/OFF}$ = 0.0µA	$V_{ON/OFF}$	-	-	15	V
Leakage Current	$I_{ON/OFF}$	-	-	50	µA
Isolation Resistance	-	10	-	-	MΩ
Calculated MTBF (Bellcore TR-332)			3.2		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		12.0		V
Output Regulation:					
Over line change		8.4		15	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			 50 30		 mV mV
External Capacitance	Co, max			5000	uF
Output Current Limit Inception (Vin=48V, Ta=25°C)	Io, lim		23		A
Efficiency (Vin=48V, Po=200W, Ta=25°C)			96.0		%
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)			 200 200 200 200		 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 0.7		 msec msec
Over-temperature Protection			120		°C
Hiccup delay (for auto restart option)			200		msec

Characteristic Curves

The following curves provide typical characteristics for EBU4004x200 at 25°C.

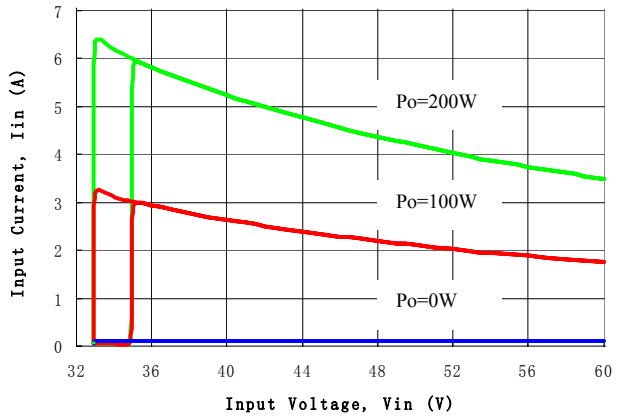


Figure 1. Typical Input Characteristics

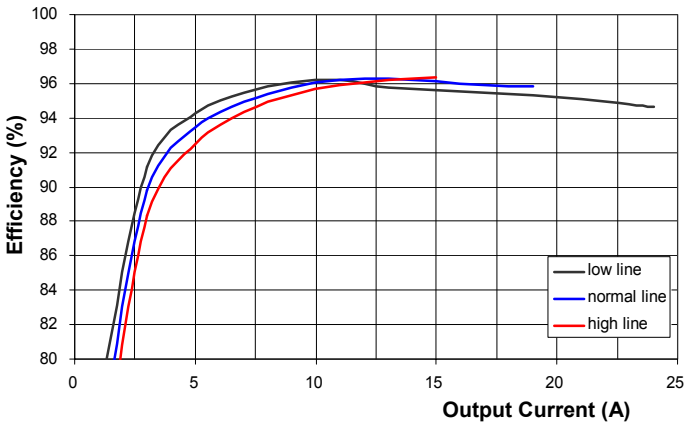


Figure 2. Efficiency Vs. Output Current

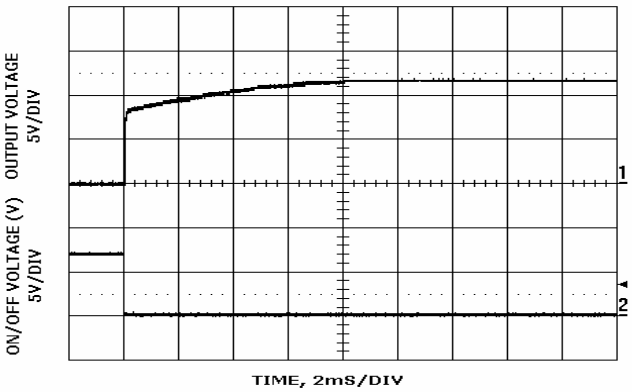


Figure 3. Start-up Using ON/OFF Control Vin=48V, Resistive Load (200W)

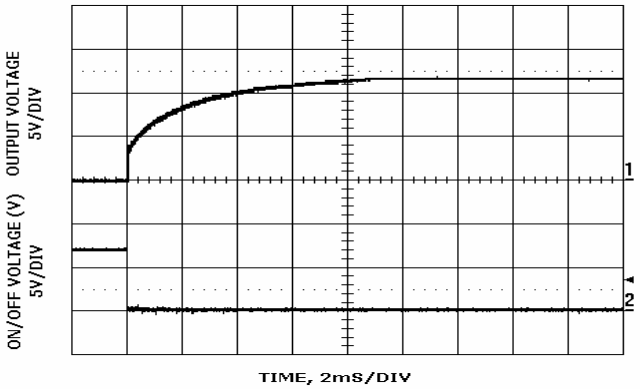


Figure 4. Start-up Using ON/OFF Control with 4700uF Capacitance Load, Vin=48V, Resistive Load (200W)

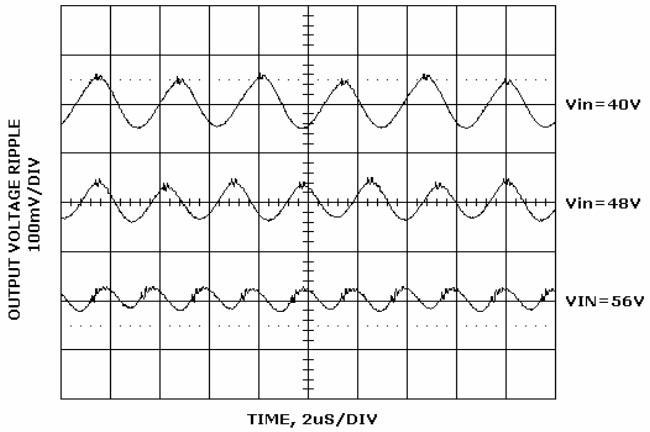


Figure 5. Typical Output Ripple, Po=200W

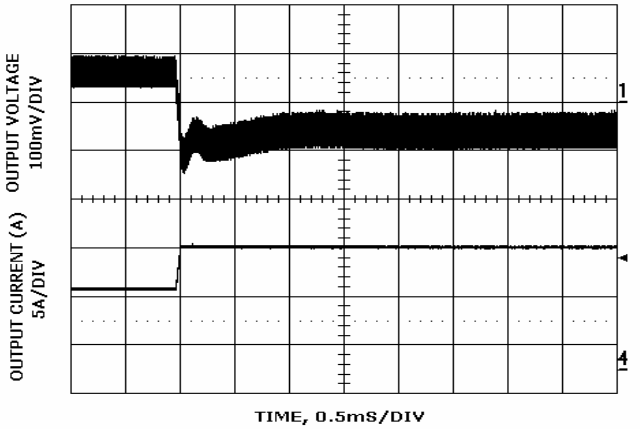


Figure 6. Transient Response to Step Increase from 50% to 75% Full Load, Vin=48V

Characteristic Curves (Continued)

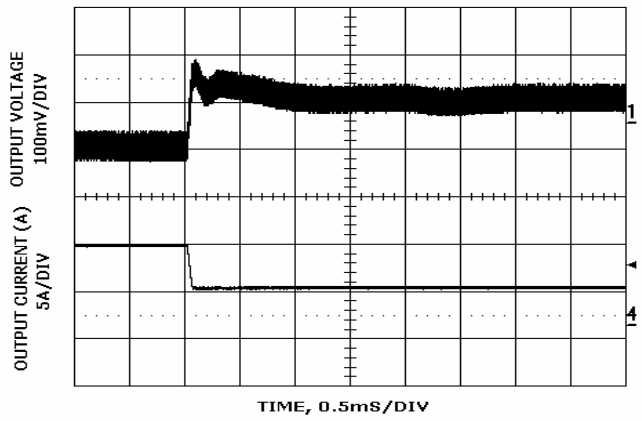


Figure7. Transient Response to Step Increase from 50% to 25% Full Load, Vin=48V

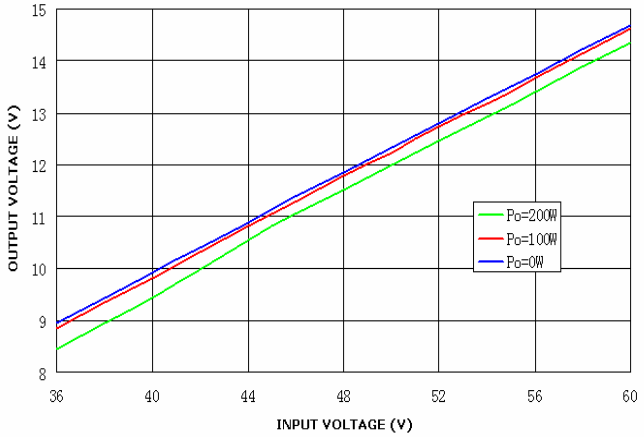


Figure 8. Typical Output Voltage Vs. Input Voltage

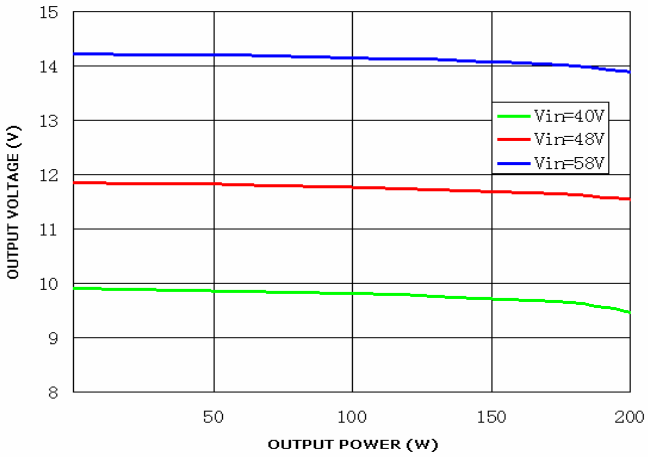


Figure9. Typical Output Voltage Vs. Output Power

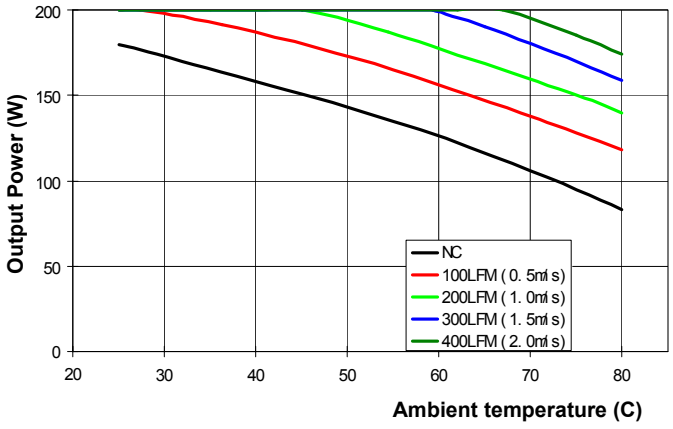


Figure 10. Output Power Derating, Airflow Direction from Input to Output (Parallel)

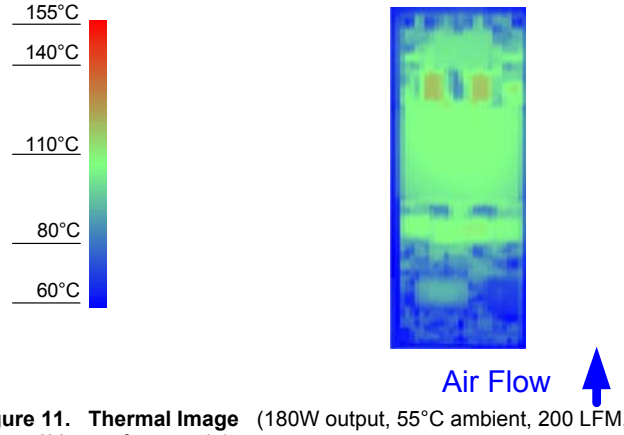


Figure 11. Thermal Image (180W output, 55°C ambient, 200 LFM, Vin = 48V open frame unit)

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 EBU 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. 12, 13 and 14.

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.

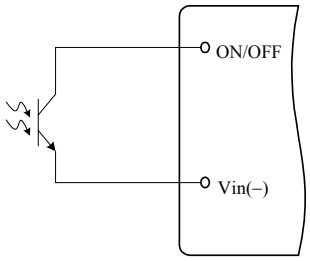


Figure 12. Opto Coupler Enable Circuit

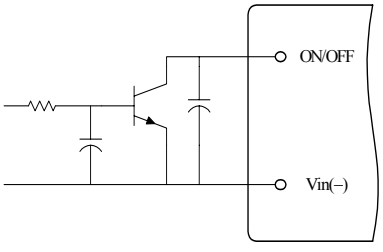


Figure 13. Open Collector Enable Circuit

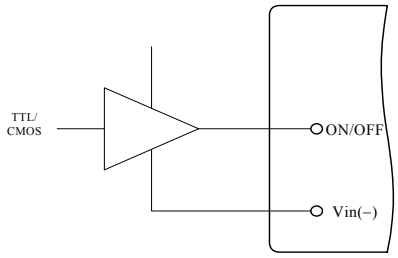


Figure 14. Direct Logic Drive

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.

The trigger-point of output over-current protection is designed to change with the input voltage so full power can be reached over the whole range of input.

Input Over-Voltage Protection

If the input voltage reaches 61.5V (typical), the module will be turned off to protect internal circuits and load. It will be turned on when input voltage falls below 57.5V (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 EBU 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.

Safety Considerations

The EBU 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 20A should be connected at the ungrounded input lead of each EBU series converter.

Thermal Considerations

The EBU 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 15 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 EBU series of converters has been tested comprehensively under various conditions to generate the derating curves with consideration for long term reliability.

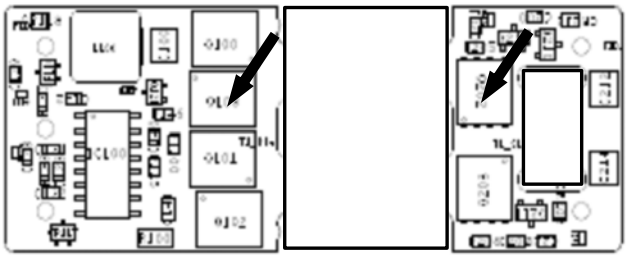


Figure 15. Temperature Monitoring Locations

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 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.

Figure 10 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 EBU series converters can use a baseplate to further enhance their thermal performance. The maximum height of a EBU 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.

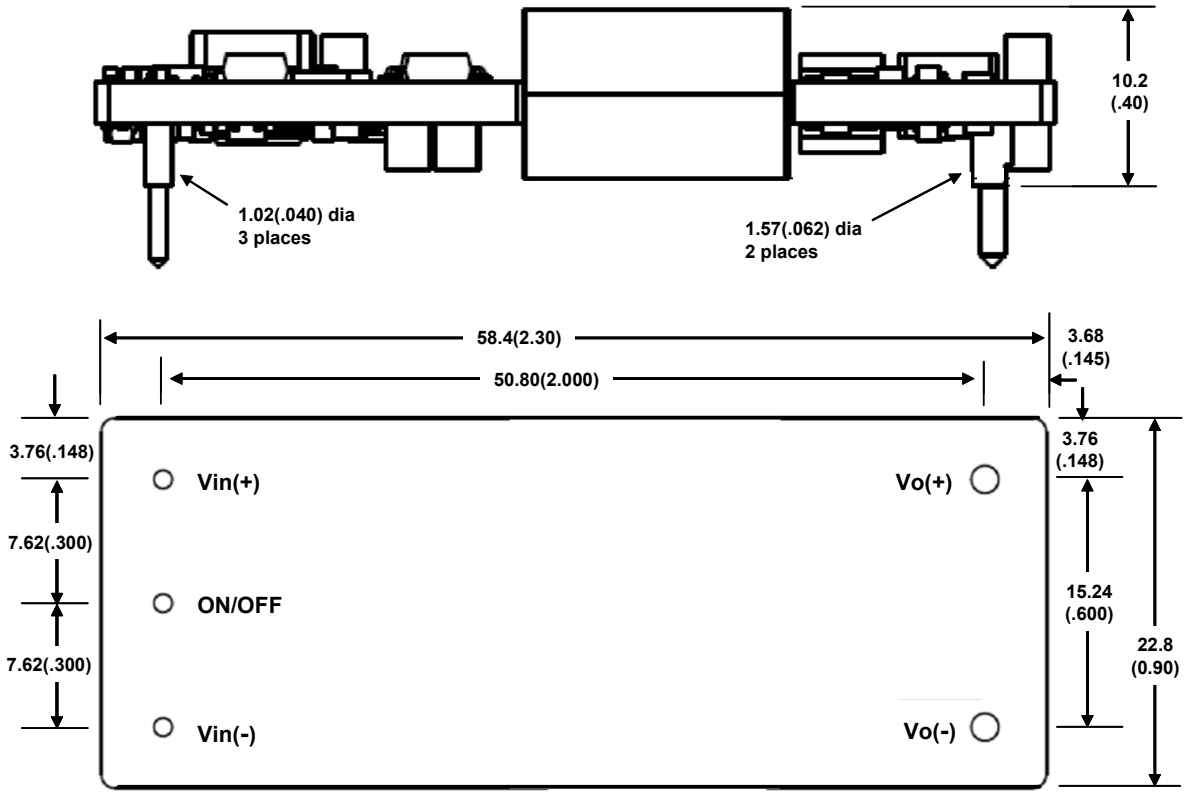
An additional heatsink or cold-plate can be attached to the baseplate using M3 screws. The heatsink/cold plate further improves the thermal performance of the converter. For high volume applications, NetPower also offers an integrated heatsink option. The integrated-heatsink option combines the baseplate 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. Please contact NetPower for details if the integrated heatsink option is desired.

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



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) Height: 9.4mm (0.37 in.) +/-0.635mm (0.025 in.)
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

Part Numbering System

EBU	4	004	N	200	R	2	1	
							Mechanical Options	
Series Name:	**Nominal Input Voltage:**	**Output Voltage:**	**Enabling Logic:**	**Rated Output Power:**	**Pin Length:**	**Electrical Option:**	**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 200 = 200W	**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: **EBU4004N200N21**

Denotes an eighth brick un-regulated 4:1, 200W 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