

## DATASHEET

# BP040AC48ATEZ Global Platform High Efficiency Rectifier

**Input: 100-120/200-240 V<sub>AC</sub>; Default Output: ±54 V<sub>DC</sub> @ 2000W**

RoHS Compliant



The BP040AC48ATEZ Rectifiers provide significantly higher power density in the same form factor and efficiency improvements in the Compact Power Line of Rectifiers. The only difference between these rectifiers is output power limit. High-density front-to-back airflow is designed for minimal space utilization and is highly expandable for future growth. Wide-input enables the rectifier to be deployed internationally into a wide range of commercially available voltage sources. Configured with RS485 based communications busses, so that it could be positioned into a broad range of applications. Feature set flexibility makes this rectifier an excellent choice for applications requiring modular AC to -48V<sub>DC</sub> intermediate voltages, such as in distributed power.

## Applications

- 48V<sub>DC</sub> distributed power architectures
- Routers/ VoIP/Soft and other Telecom Switches
- LAN/WAN/MAN applications
- File servers, Enterprise Networks, Indoor wireless
- SAN/NAS/iSCSI applications

## Features

- Compact 1RU form factor with 42 W/in<sup>3</sup> density
- Constant power from 50-58V<sub>DC</sub>
- 2000W from nominal 200-240V<sub>AC</sub>
- Output voltage programmable from 42V-58V<sub>DC</sub>
- ON/OFF control of the main output
- Comprehensive input, output and overtemperature protection
- RS485 communications
- Precision measurement reporting such as input/output voltage & current
- Remote firmware upgrade capable
- Power factor correction (meets EN/IEC 61000-3-2 and EN 60555-2 requirements)
- Redundant, parallel operation with active load sharing
- Internally controlled Variable-speed fan
- Hot insertion/removal (hot plug)
- Three front panel LED indicators
- UL\* Recognized, UR, CE, EN62368
- CE mark meets 2006/95/EC directive<sup>§</sup>
- CB report available
- RoHS Directive 2011/65/EU and amended Directive (EU) 2015/863

\*UL is a registered trademark of Underwriters Laboratories, Inc.

†CSA is a registered trademark of Canadian Standards Association.

‡VDE is a trademark of Verband Deutscher Elektrotechniker e.V.

§This product is intended for integration into end-user equipment. All CE marking procedures of end-user equipment should be followed. (The CE mark is placed on selected products.)

\*\*ISO is a registered trademark of the International Organization of Standards.

## Technical Specifications

### Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only, functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect the device reliability.

| Parameter   | Symbol    | Min | Max  | Unit     |
|---|-----------|-----|------|----------|
| Input Voltage: Continuous                                   | $V_{IN}$  | 0   | 300  | $V_{AC}$ |
| Operating Ambient Temperature <sup>1</sup>                  | $T_A$     | -40 | 75   | °C       |
| Storage Temperature   | $T_{stg}$ | -40 | 85   | °C       |
| I/O Isolation voltage to Frame (100% factory Hi-Pot tested) |           |     | 1500 | $V_{AC}$ |

### Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage,  $V_o=54V_{DC}$ , resistive load, and temperature conditions.

| INPUT  |          |           |       |     |          |
|--|----------|-----------|-------|-----|----------|
| Parameter  | Symbol   | Min       | Typ   | Max | Unit     |
| Startup Voltage  | $V_{IN}$ | 80        | 85    | 90  | $V_{AC}$ |
| Low-line Operation   |          |           |       |     |          |
| High-line Operation  |          |           |       |     |          |
| Operating Voltage Range  |          |           |       |     |          |
| Low-line Configuration   |          |           |       |     |          |
| High-line Configuration  | 185      | 100 – 120 | 140   | 264 |          |
| Voltage Swell (no damage)  |          | 305       |       |     |          |
| Turn OFF Voltage   |          | 75        | 80    | 85  |          |
| Hysteresis   |          | 5         |       |     |          |
| Frequency  | $F_{IN}$ | 47        |       | 63  | Hz       |
| Source Impedance (NEC allows 2.5% of source voltage drop inside a building)  |          |           | 0.2   |     | $\Omega$ |
| Operating Current; at 110 $V_{AC}$   | $I_{IN}$ |           | 12.0  |     | $A_{AC}$ |
| at 240 $V_{AC}$  |          |           | 8.9   |     |          |
| Inrush Transient (264 $V_{RMS}$ , 25°C, excluding X-Capacitor charging)  | $I_{IN}$ |           | 25    | 40  | $A_{PK}$ |
| Idle Power (at 230 $V_{AC}$ , 25°C)  | $P_{IN}$ | 54V OFF   | 10    |     | W        |
| 54V ON @ $I_o=0$   |          |           | 15    | 20  |          |
| Leakage Current (250 $V_{AC}$ , 60Hz)  | $I_{IN}$ |           | 2.5   | 3.5 | mA       |
| Power Factor (50 – 100% load)  | PF       | 0.97      | 0.995 |     |          |
| Efficiency <sup>2</sup> , 230 $V_{AC}$ @ 25°C  | h        |           |       |     | %        |
| 10% of FL  |          |           |       |     |          |
| 20% of FL  |          |           |       |     |          |
| 50% of FL  |          |           |       |     |          |
| 100% of FL   |          |           |       |     |          |
| Holdup time / Ride Through time<br>(Output voltage > 42V (Not in compliance with Telcordia requirements: in regulation at full load at 60Hz and 175Vac. GR-947-CORE, section 3.7.)<br>(The Unit shall ride through a half cycle drop out at 50Hz.) | T        | 10        |       |     | ms       |
| Isolation (per EN60950)(consult factory for testing to this requirement)   | V        | 1500      |       |     | $V_{AC}$ |
| Input – Chassis/Signals  |          |           |       |     |          |
| Input – Output   |          |           |       |     |          |
| Output – Chassis/Signals   |          | 3000      |       |     | $V_{AC}$ |
|  |          | 500       |       |     | $V_{DC}$ |

<sup>1</sup>See the derating guidelines under the Environmental Specifications section.

<sup>2</sup>External DC source for FAN power supply.

## Technical Specifications (continued)

### Electrical Specifications (Continued)

| 54V <sub>DC</sub> MAIN OUTPUT  |  |                          |     |                         |   |
|--|--|--------------------------|-----|-------------------------|---|
| Parameter  | Symbol   | Min                      | Typ | Max                     | Unit  |
| Output Power @ low line input 100 – 120V <sub>AC</sub><br>@ high line input 200 – 240V <sub>AC</sub>   | W  | 1200<br>2000             |     |                         | W <sub>DC</sub>   |
| Factory set default set point  |  |                          | 54  |                         | V <sub>DC</sub>   |
| Overall regulation (load, temperature, aging) 0 – 45°C, LOAD > 1A<br>> 45°C  | V <sub>OUT</sub>   | -1<br>-2                 |     | +1<br>+2                | %   |
| Output Voltage Set Range<br>Set by RS485   |  | 44                       |     | 58                      | V <sub>DC</sub>   |
| Output Current - @ 1200W (100 – 120V <sub>AC</sub> ), 54V/50V<br>@ 2000W (200 – 240V <sub>AC</sub> ), 54V/50V  | I <sub>out</sub>   | 1                        |     | 22.2/24.0<br>37.0/40.0  | A <sub>DC</sub>   |
| Current Share ( > 50% FL)  |  | -5                       |     | 5                       | %FL   |
| Output Ripple ( 20MHz bandwidth, load > 1A)<br>RMS (5Hz to 20MHz)<br>Peak-to-Peak (5Hz to 20MHz)   | V <sub>OUT</sub>   |                          |     | 100<br>250 <sup>3</sup> | mV <sub>rms</sub><br>mV <sub>p-p</sub>  |
| External Bulk Load Capacitance   | C <sub>OUT</sub>   | 0uF to at least 10000uF  |     |                         | mF  |
| Turn-On (monotonic turn-ON from 30 – 100% of V <sub>nom</sub> above 5°C)<br>Delay  |  |                          | 5   |                         | s   |
| Rise Time – RS-485 mode <sup>4</sup>   | T  |                          | 5   |                         | s   |
| Output Overshoot   | V <sub>OUT</sub>   |                          |     | 2                       | %   |
| Load Step Response ( I <sub>O,START</sub> > 2.5A )<br>DI <sup>5</sup>  | I <sub>OUT</sub>   |                          |     | 50                      | %FL   |
| DV   | V <sub>OUT</sub>   | -5                       | 2.0 | 5                       | V <sub>DC</sub>   |
| Response Time  | T  |                          | 2   |                         | ms  |
| Overload<br>Power limit @ high line down to 50V <sub>DC</sub><br>Power limit @ low line down to 50V <sub>DC</sub><br>High line current limit if V <sub>out</sub> > 39V <sub>DC</sub> [2000W]<br>Low line current limit<br>Output shutdown (commences as voltage decays below this level) | P <sub>OUT</sub><br>P <sub>OUT</sub><br>I <sub>OUT</sub><br>I <sub>OUT</sub><br>V <sub>OUT</sub>   | 2000<br>1200<br>40<br>24 |     |                         | W <sub>DC</sub><br>W <sub>DC</sub><br>A <sub>DC</sub><br>A <sub>DC</sub><br>V <sub>DC</sub> |
| System power up  | Upon insertion the rectifier will delay an overload shutdown for 20 seconds allowing for the insertion and startup of multiple rectifiers within a system. |                          |     |                         |   |
| Overvoltage – 200ms delayed shutdown   | V <sub>OUT</sub>   |                          |     | < 60                    | V <sub>DC</sub>   |
| Immediate shutdown   |  | > 65                     |     |                         |   |
| Latched shutdown   | Three restart attempts are implemented within a 1 minute window prior to a latched shutdown.   |                          |     |                         |   |
| Over-temperature warning (prior to commencement of shutdown)   |  |                          | 5   |                         |   |
| Shutdown (below the max device rating being protected)   | T  |                          | 20  |                         | °C  |
| Restart attempt Hysteresis (below shutdown level)  |  |                          | 10  |                         |   |
| Output remote sense capability   |  |                          |     | 1 <sup>6</sup>          | V <sub>DC</sub>   |
| Output back-bias operating voltage   | V <sub>OUT</sub>   | 40                       | 48  | 60                      | V <sub>DC</sub>   |

<sup>3</sup>500mVp-p max when the load <= 1A.

<sup>4</sup>Below -5°C, the rise time is approximately 5 minutes to protect the bulk capacitors. Rise time can be changed to 100ms, contact factory for details.

<sup>5</sup>di/dt (output current slew rate) 1A/μs.

<sup>6</sup>Max output voltage clamped to 58V, this function just for single unit application.

## Technical Specifications (continued)

### General Specifications

| Parameter        | Min   | Typ      | Max | Units       | Notes   |
|------------------|---|----------|-----|-------------|---|
| Reliability      |   | 450,000  |     | Hours       | Full load, 25°C ; MTBF per SR232 Reliability protection for electronic equipment, issue 2, method I, case III |
| Service Life     |   | 10       |     | Years       | Full load, excluding fans   |
| Unpacked Weight  |   | 1.2/2.64 |     | Kgs/<br>Lbs |   |
| Packed Weight    |   | 1.5/3.3  |     | Kgs/<br>Lbs |   |
| Heat Dissipation | 70 Watts or 238 BTUs @80% load, 98 Watts or 334 BTUs @100% load |          |     |             |   |

### Signal Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions. Signals are referenced to Logic\_GRD unless noted otherwise. Fault need to be pulled HI by external pull-up resistors. Max sink current: 5mA

| Parameter   | Symbol   | Min                     | Typ    | Max       | Unit            |
|---|--|-------------------------|--------|-----------|-----------------|
| ON/OFF 54V output OFF<br>54V output ON (should be connected to Logic_GRD) | $V_{OUT}$  | 0.7V <sub>DD</sub><br>0 | —      | 5<br>0.5  | V <sub>DC</sub> |
| Interlock   | [short pin shorted to V <sub>OUT</sub> (-) on system side] |                         |        |           |                 |
| Module Present  | [short pin shorted to Logic_GRD internally]                |                         |        |           |                 |
| Remote sense +  | Connector to Vout positive terminal with 20 ohm            |                         |        |           |                 |
| Remote sense -  | Connector to Vout negative terminal with 20 ohm            |                         |        |           |                 |
| Fault# Logic HI (No fault is present)<br>Logic LO (Fault is present)      | V  | 0.7V <sub>DD</sub><br>0 | —<br>— | 12<br>0.4 | V <sub>DC</sub> |

### Digital Interface Specifications

| Parameter  | Conditions | Symbol                | Min  | Typ | Max   | Unit            |
|--|------------|-----------------------|------|-----|-------|-----------------|
| <b>Measurement System Characteristics</b>          |            |                       |      |     |       |                 |
| Clock stretching                                   |            | T <sub>stretch</sub>  |      |     | 25    | ms              |
| I <sub>OUT</sub> measurement range                 | Direct     | I <sub>rng</sub>      | 0    |     | 50    | A <sub>DC</sub> |
| I <sub>OUT</sub> measurement accuracy 25°C         |            | I <sub>out(acc)</sub> | -2.5 |     | +2.5  | % of FL         |
| V <sub>OUT</sub> measurement range                 | Direct     | V <sub>out(rng)</sub> | 0    |     | 70    | V <sub>DC</sub> |
| V <sub>OUT</sub> measurement accuracy <sup>7</sup> |            | V <sub>out(acc)</sub> | -1   |     | +1    | %               |
| Temp measurement range                             | Direct     | Temp <sub>(rng)</sub> | 0    |     | 150   | °C              |
| Temp measurement accuracy <sup>8</sup>             |            | Temp <sub>(acc)</sub> | -5   |     | +5    | °C              |
| V <sub>IN</sub> measurement range                  | Direct     | V <sub>in(rng)</sub>  | 0    |     | 320   | V <sub>AC</sub> |
| V <sub>IN</sub> measurement accuracy @ 25°C        |            | V <sub>in(acc)</sub>  | -2   |     | 2     | %               |
| I <sub>IN</sub> measurement range                  | Direct     | I <sub>in(rng)</sub>  | 0    |     | 20    | I <sub>AC</sub> |
| I <sub>IN</sub> measurement accuracy @ 25°C        |            | I <sub>in(acc)</sub>  | -4   |     | +4    | % of FL         |
| P <sub>IN</sub> measurement range                  | Direct     | P <sub>in(rng)</sub>  | 0    |     | 2500  | W <sub>in</sub> |
| P <sub>IN</sub> measurement accuracy@ 25°C         | Direct     | P <sub>in(acc)</sub>  | -3   |     | +3    | % FL            |
| Fan Speed measurement range                        |            |                       | 0    |     | 28000 | RPM             |
| Fan Speed measurement accuracy                     |            |                       | -10  |     | 10    | %               |
| Fan speed control range                            |            |                       | 0    |     | 100   | %               |

<sup>7</sup>Above 2.5A of load current

<sup>8</sup>Within 30° of the default warning and fault levels.

# Technical Specifications (continued)

## Environmental Specifications

| Parameter                        | Min              | Typ     | Max        | Units     | Notes  |
|----------------------------------|------------------|---------|------------|-----------|--|
| Ambient Temperature              | -40 <sup>9</sup> |         | 75         | °C        | Air inlet from sea level to 4,000 meters.                          |
| Exhaust Air Temperature          |                  |         | 15         | °C        | Maximum allowed internal temperature rise                          |
| Storage Temperature              | -40              |         | 85         | °C        |  |
| Operating Altitude               |                  |         | 4000/13120 | m / ft    |  |
| Non-operating Altitude           |                  |         | 8200/27000 | m / ft    |  |
| Power Derating with Altitude     |                  |         | 2.0        | %/305 m   | Above 2000/6560 m/ft;<br>Above 4000m de-rate 4% per 305m (1000 ft) |
|                                  |                  |         | 4.0        | %/1000 ft |  |
| Power Derating with Temperature  |                  |         | 2.0        | %/°C      | 55°C to 75°C   |
| Acoustic noise                   |                  | 55      |            | dbA       | Full load, 25°C  |
| Over Temperature Protection      |                  | 125/110 |            | °C        | Shutdown / restart [internally measured points]                    |
| Humidity                         | Operating        | 5       | 95         | %         | Relative humidity, non-condensing                                  |
|                                  | Storage          | 5       | 95         | %         |  |
| Shock and Vibration acceleration |                  |         | 2.4        | Grms      | IPC-9592B, Class II  |

<sup>9</sup>Designed to start and work at an ambient as low as -40°C, but may not meet operational limits until above -10°C.

## Cold Climate Startup Behavior

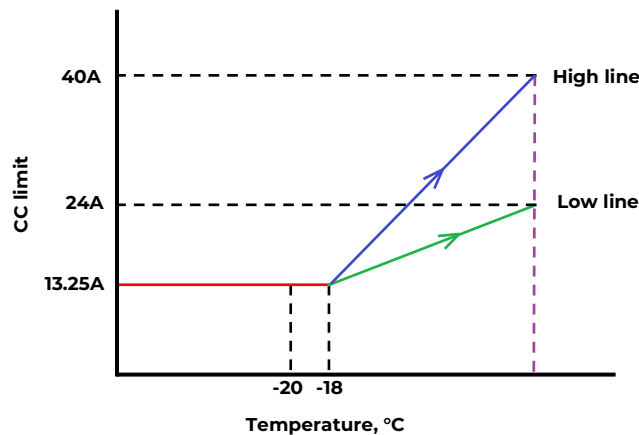


Figure 1. Warm - up sequence curve\*

\*Cold startup current will self-protect the unit as follows:

When internal startup temperature below -20°C is detected, The starting current will be limited to 13.25A until the internal temperature increases above -18°C at which time the rectifier will gradually increase output current to full current over a 5 minute period. After 5 minutes, the output current will be released to full current demand as governed by input voltage.

## Technical Specifications (continued)

| EMC                    |                             |   |  |  |
|------------------------|-----------------------------|---|--|--|
| Parameter              | Measurement                 | Standard  | Level                                  | Test   |
| AC input <sup>10</sup> | Conducted emissions         | EN55032, FCC Docket 20780 part 15, subpart J<br>Meets EN 55032 Class B with a 6dB Margin<br>Meets Telcordia GR1089-CORE by a 3dB margin | B                                      | 0.15 – 30MHz                                       |
|                        | Radiated emissions          | Class B with a 3dB Margin with shelf EN55032 to comply with system enclosure. Class B with 0dB Margin                                   | B                                      | 30 – 10000MHz                                      |
|                        | Line harmonics              | EN61000-3-2<br>THD (230V, FL, 25°C)   | Table 1<br>5%                          |  |
| Parameter              | Measurement                 | Standard  | Criteria <sup>11</sup>                 | Test   |
| AC Input Immunity      | Line sags and interruptions | EN61000-4-11  | B                                      | -30%, 10ms, -60%, 100ms, -100%, 5sec               |
|                        |                             | Output will stay above 40V <sub>DC</sub> @ 75% load<br>Sag must be higher than 80V <sub>rms</sub> .                                     | A                                      | 25% line sag for 2 seconds<br>1 cycle interruption |
|                        | Lightning surge             | EN61000-4-5, Level 4, 1.2/50µs – error free   | A                                      | 4kV com, 2kV diff                                  |
|                        |                             | ANSI C62.41-2002 100kHz ring wave<br>1.2/50µs-8/20µs<br>550ns EFT burst   | B, Table 2<br>B, Table 3<br>B, Table 7 | 6kV/0.5kA<br>6kV, 3kA<br>2kV, severity II          |
|                        |                             | Fast transients   | EN61000-4-4, Level 3                   | B  |
| Enclosure immunity     | Conducted RF fields         | EN61000-4-6, Level 3  | A                                      | 130dBµV, 0.15-80MHz, 80% AM                        |
|                        | Radiated RF fields          | EN61000-4-3, Level 3  | A                                      | 10V/m, 80-1000MHz, 80% AM                          |
|                        |                             | ENV 50140   | A                                      |  |
|                        | ESD                         | EN61000-4-2, Level 4  | B                                      | 8kV contact, 15kV air                              |

<sup>10</sup>Emissions requirements can be verified using either the J2007001 or J85480 OmniOn Power shelf. Standalone the additional margin is not required.

<sup>11</sup>Criteria A: The product must maintain performance within specification limits. Criteria B: Temporary degradation which is self recoverable. Criteria C: Temporary degradation which requires operator intervention.

# Technical Specifications (continued)

## Characteristic Curves

The following figures provide typical characteristics for the BP040AC48ATEZ rectifier and 25°C.

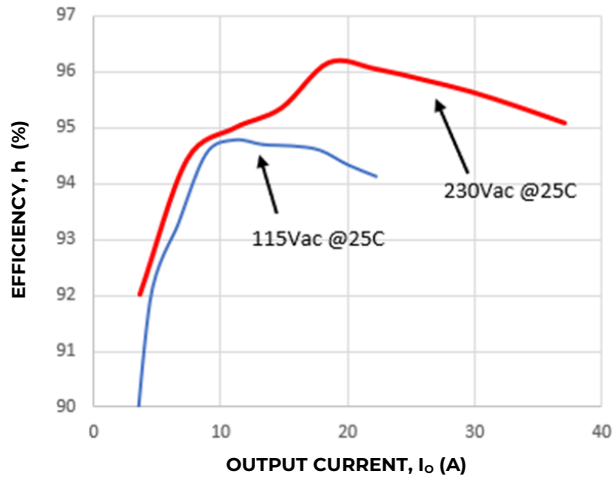


Figure 2. Rectifier Efficiency versus  $I_o$  Output Current.

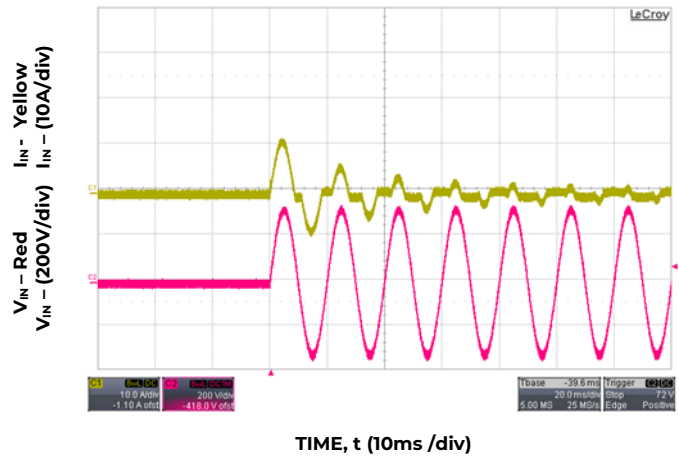


Figure 3. Inrush current  $V_{IN} = 230V_{AC}$ ,  $0^\circ$  phase angle

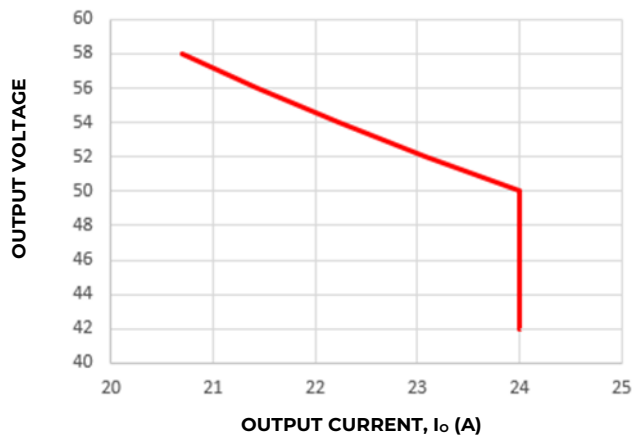


Figure 4. 54V<sub>DC</sub> output: Power limit, Current limit and shutdown profile at  $V_{IN} = 90V_{AC}$

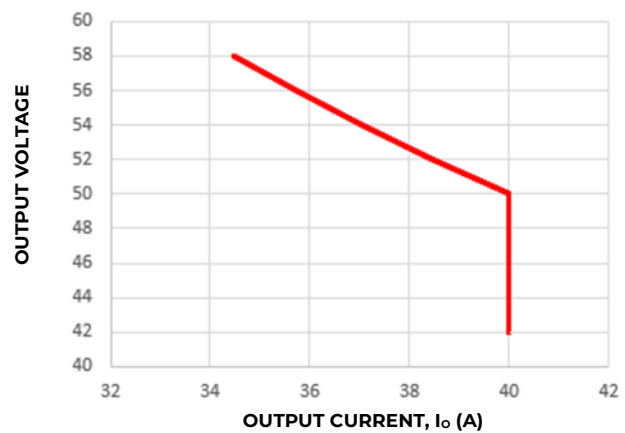


Figure 5. 54V<sub>DC</sub> output: Power limit, Current limit and shutdown profile at  $V_{IN} = 185V_{AC}$

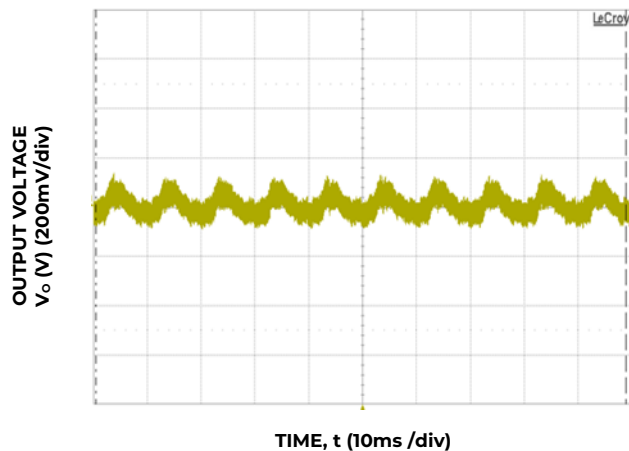


Figure 6. 54V<sub>DC</sub> output ripple and noise, full load,  $V_{IN} = 185V_{AC}$ , 20MHz bandwidth

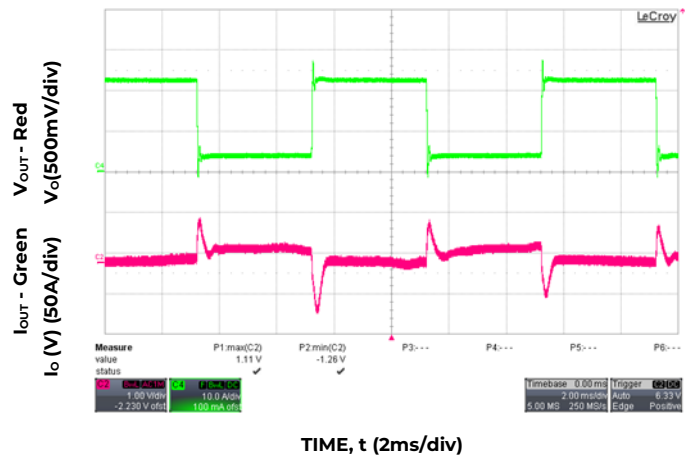


Figure 7. Transient response 54V<sub>DC</sub> load step 10 - 60%, Slew rate: 1A/ $\mu$ s,  $V_{IN} = 230V_{AC}$

# Technical Specifications (continued)

## Characteristic Curves (continued)

The following figures provide typical characteristics for the BP040AC48ATEZ rectifier and 25°C.

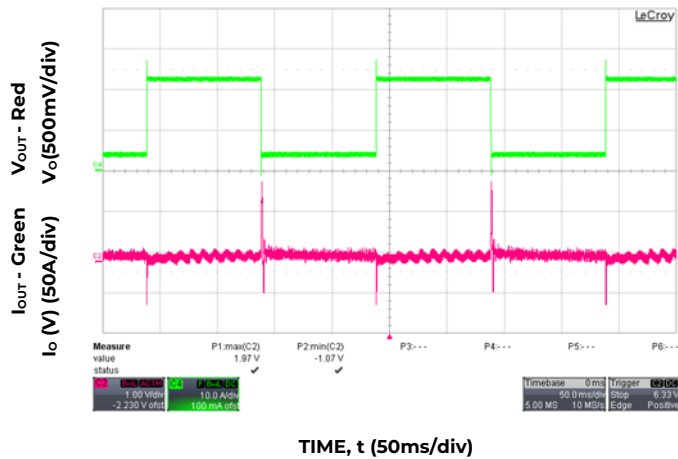


Figure 8 . Transient response 54V<sub>DC</sub> load step 10 – 60%, Slew rate: 1A/μs, V<sub>IN</sub> = 230V<sub>AC</sub>

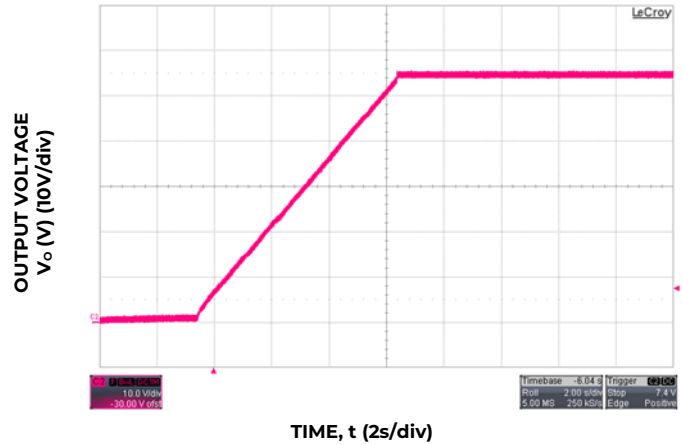


Figure 9. 54V<sub>DC</sub> soft start, full load, V<sub>IN</sub> = 230V<sub>AC</sub> - RS485 mode with 10000μf external capacitance

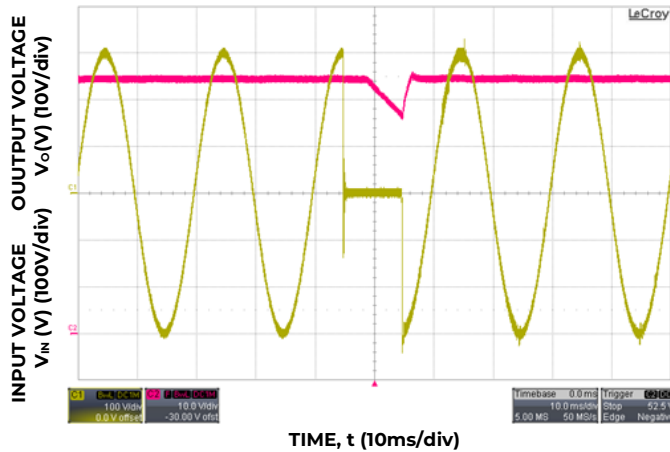


Figure 10. Ride through missing 1/2 cycle, full load, V<sub>IN</sub> = 230V<sub>AC</sub>

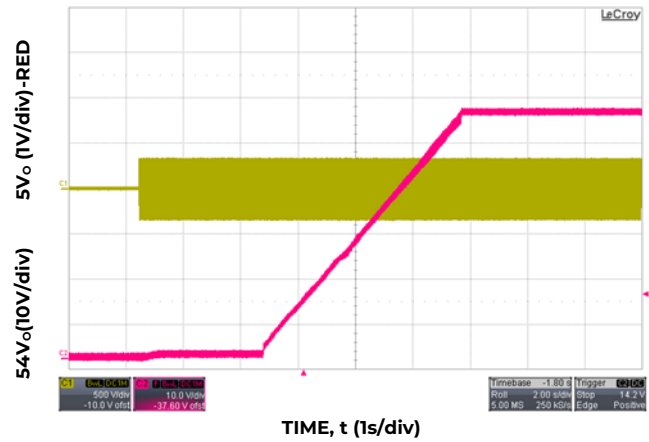


Figure 11. Turn-On at full load V<sub>IN</sub> = 230V<sub>AC</sub>

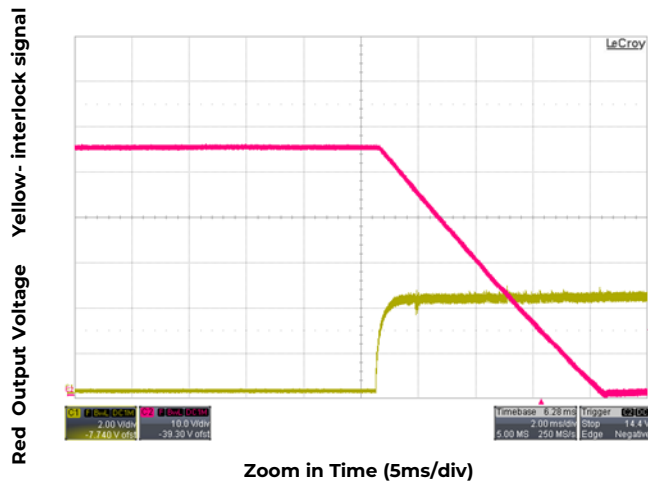


Figure 12. Time delay from interlock reverse and output shut down. interlock signal can be used as quick turn off signal

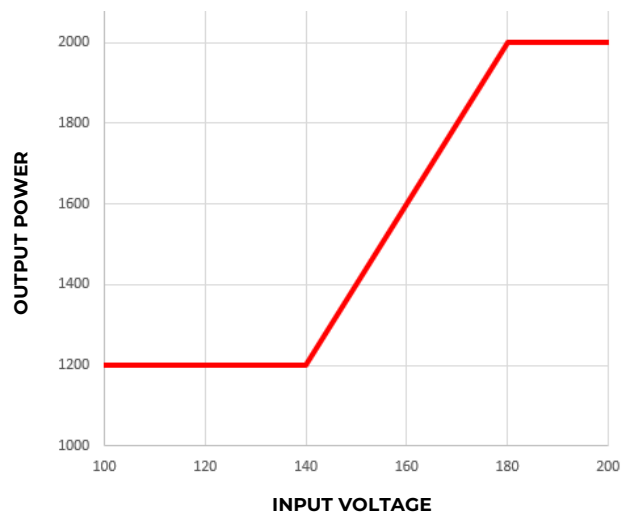


Figure 13. Output power derating below V<sub>IN</sub> of 185V<sub>AC</sub>



## Technical Specifications (continued)

### Control and Status

The Rectifier provides three means for monitor/control: analog, or the OmniOn Power Galaxy-based RS485 protocol.

Details of analog control based protocol is provided in this data sheet. OmniOn Power will provide separate application notes on the Galaxy RS485 based protocol for users to interface to the rectifier. Contact your local OmniOn Power representative for details.

#### Device address in RS485 mode:

Slot addressing

A "0" indicates the shelf pulls the pin low.

A "1" indicates the shelf is open.

| Slots | U2 | U1 | U0 |
|-------|----|----|----|
| 1     | 0  | 0  | 0  |
| 2     | 0  | 0  | 1  |
| 3     | 0  | 1  | 0  |
| 4     | 0  | 1  | 1  |
| 5     | 1  | 0  | 0  |
| 6     | 1  | 0  | 1  |
| 7     | 1  | 1  | 0  |
| 8     | 1  | 1  | 1  |

Shelf addressing

A "0" indicates the shelf pulls the pin low.

A "1" indicates the shelf is open.

| Rotary switch |      |      |      |
|---------------|------|------|------|
| Shelf         | SID2 | SID1 | SID0 |
| 0             | 1    | 1    | 1    |
| 1             | 1    | 1    | 0    |
| 2             | 1    | 0    | 1    |
| 3             | 1    | 0    | 0    |
| 4             | 0    | 1    | 1    |
| 5             | 0    | 1    | 0    |
| 6             | 0    | 0    | 1    |
| 7             | 0    | 0    | 0    |

**Global Broadcast:** This is a powerful command because it instruct all rectifiers to respond simultaneously. A read instruction should never be accessed globally. The rectifier should issue an 'invalid command' state if a 'read' is attempted globally.

For example, changing the 'system' output voltage requires the global broadcast so that all paralleled rectifiers change their output simultaneously.

This command can also turn OFF the 'main' output or turn ON the 'main' output of all rectifiers simultaneously. Unfortunately, this command does have a side effect.

Only a single rectifier needs to pull down the ninth acknowledge bit. To be certain that each rectifier responded to the global instruction, a READ instruction should be executed to each rectifier to verify that the command properly executed. The GLOBAL BROADCAST command should only be executed for write instructions to slave devices.

**Remote sense (RS+, RS-):** The power supply has both positive and negative remote sense connections that can be connected to the positive and negative rails of the main output near the load. The compensation capability is 1V, if the power supply no need remote sense connections, keep it floating.

**ON/OFF:** Controls the main 54V<sub>DC</sub> output when analog control protocol is selected. This pin must be pulled low to turn **ON** the rectifier. The rectifier will turn **OFF** if either the **ON/OFF** or the **Interlock** pin is released. This signal is referenced to Logic\_GRD. Note that in RS485 mode this pin is ignored.

**Interlock:** This is a shorter pin utilized for hot-plug applications to ensure that the rectifier turns **OFF** before the power pins are disengaged. It also ensures that the rectifier turns **ON** only after the power pins have been engaged. Must be connected to V\_OUT ( - ) for the rectifier to be ON.

**8V\_INT:** Single wire connection between rectifiers, Provides bias to the DSP of an unpowered rectifier.

## Technical Specifications (continued)

### Status Signals

**Module Present:** This signal is tied to Logic\_GRD inside the rectifier. Its intent is to provide a signal to the system that a rectifier is physically present in the slot.

**Fault#:** A TTL compatible status signal representing whether a Fault occurred. This signal needs to be pulled HI externally through a resistor. This signal goes LO for any failure that requires rectifier replacement. These faults may be due to:

- Fan failure
- Over-temperature shutdown
- Over-voltage shutdown
- Internal Rectifier Fault

### General performance descriptions

**Default state:** Rectifiers are programmed in the default state to automatically restart after a shutdown has occurred. The default state can be reconfigured by changing non-volatile memory (Store\_user\_code).

**Delayed overcurrent shutdown during startup:** Rectifiers are programmed to stay in a constant current state for up to 20 seconds during power up. This delay has been introduced to permit the orderly application of input power to a subset of paralleled rectifiers during power up. If the overload persists beyond the 20 second delay, the rectifier will revert back into its programmed state of overload protection.

**Unit in Power Limit or in Current Limit:** When output voltage is  $> 36V_{DC}$  the Output LED will continue blinking.

When output voltage is  $< 36V_{DC}$ , if the unit is in the RESTART mode, it goes into hiccup. When the unit is ON the output LED is ON, when the unit is OFF the output LED is OFF.

When the unit is in latched shutdown the output LED is OFF.

To restart after a latch off either of five restart mechanisms are available.

1. The hardware pin **ON/OFF** may be cycled OFF and then ON.
2. Remove and reinsert the unit.
3. Turn OFF and then turn ON AC power to the unit.
4. Changing firmware from **latch off** to **restart**.

Each of these commands must keep the rectifier in the OFF state for at least 2 seconds, with the exception of changing to **restart**.

A successful restart shall clear all alarm registers, set the **restarted successful** bit of the **Status\_2** register.

A power system that is comprised of a number of rectifiers could have difficulty restarting after a shutdown event because of the non-synchronized behavior of the individual rectifiers. Implementing the latch-off mechanism permits a synchronized restart that guarantees the simultaneous restart of the entire system.

A synchronous restart can be implemented by;

1. Issuing a GLOBAL OFF and then ON command to all rectifiers,
2. Toggling Off and then ON the ON/OFF (ENABLE) signal
3. Removing and reapplying input commercial power to the entire system.

The rectifiers should be turned OFF for at least 20 – 30 seconds in order to discharge all internal bias supplies and reset the soft start circuitry of the individual rectifiers.

## Technical Specifications (continued)

### Hot plug procedures

Careful system control is recommended when hot plugging a rectifier into a live system. It takes about 15 seconds for a rectifier to configure its address on the bus based on the analog voltage levels present on the backplane. If communications are not stopped during this interval, multiple rectifiers may respond to specific instructions because the address of the hot plugged rectifier always defaults to xxxx000 (depending on which device is being addressed within the rectifier) until the rectifier configures its address.

The recommended procedure for hot plug is the following: The system controller should be told which rectifier is to be removed. Thus informing the installer that the identified rectifier can be removed from the system. The system controller should then poll the `rectifier_present` signal to verify when the rectifier is re-inserted. It should time out for 15 seconds after this signal is verified. At the end of the time out all communications can resume.

### Failure Predictions

Alarm warnings that do not cause a shutdown are indicators of a potential future failure of the rectifier. For example, if a thermal sensor failed, a warning is issued but an immediate shutdown of the rectifier is not warranted.

Other potential predictive failure mechanisms can be derived from information such as fan speed when multiple fans are used in the same rectifier. If the speed of the fans varies by more than 20% from each other, this is an indication of an impending fan wear out.

The goal is to identify problems early before a protective shutdown would occur that would take the rectifier out of service.

### Remote upgrade

This section describes at a high-level the recommended re-programming process for the three internal micro controllers inside the rectifier when the re-programming is implemented in live, running, systems.

The process has been implemented in visual basic by OmniOn Power Critical Power for controller based systems positioned primarily for the telecommunications industry. OmniOn Power Critical Power will share its development with customers who are interested to deploy the re-programming capability into their own controllers.

For some customers internal system re-programming is either not feasible or not desired. These customers may obtain a re-programming kit from OmniOn Power Critical Power. This kit contains a turn-key package with the re-program firmware.

**The Upgrade Package:** This package contains the following files;

- **Manifest.txt** – The manifest describes the contents of the upgrade package and any incidental information that may be useful, for example, what this upgrade contains or why is this upgrade necessary. This file contains the version number and the compatibility code of the upgraded program for each of the three processors
- **Program.bin** – The upgraded program contents are located here. Each processor to be upgraded will have its own file.
- Below is an example of an upgrade package
- Contents of the upgrade are in a zip file  
BP040ACM48TEZ.zip
- Unzipping the contents shows the following files  
BP040ACM48TEZ.pfc.bin  
BP040ACM48TEZ.sec.bin  
manifest.txt

## Technical Specifications (continued)

- Opening manifest.txt shows the following
  - # Upgrade manifest file
  - # Targets: BP040AC48ATEZ PFC and SEC
  - # Date: Tue 01/14/2014 14:25:09.37
  - # Notes:
- Program contents
  - >p, CP3x00AC54TE \_P01, CP3x00AC54TEZ \_PFC.bin,1,18
  - >s, CP3x00AC54TE \_S01, CP3x00AC54TEZ \_SEC.bin,1,1



compatibility code    new program    revision number

Wink: 0.25 seconds ON, 0.75 seconds OFF

Fast Blink: 0.25 seconds ON. 0.25 seconds OFF

**Upgrade Status Indication:** The FAULT LED is utilized for indicating the status of the re-programming process.

| Status        | Fault LED  | Description                                      |
|---------------|------------|--|
| Idle          | OFF        | Normal state                                     |
| In boot block | Wink       | Application is good                              |
| Upgrading     | Fast blink | Application is erased or programming in progress |
| Fault         | ON         | Erase or re-program failed                       |

### Black box

Contents of the black box and more detailed information about the specifics of the feature are described in a separate document. The intent here is to provide a high level summary. This feature includes the following;

1. A rolling event Recorder
2. Operational Use Statistics

#### The rolling event recorder

The purpose of the black box is to provide operational statistics as well as fault retention for diagnostics following either recoverable or non-recoverable fault events. Sufficient memory exists to store up to 5 time-stamped snapshot records (pages) that include the state of the status and alarm registers and numerous internal measurement points within the rectifier.

Each record is stored into nonvolatile memory at the time when a black box trigger event occurs. Once five records are stored, additional records over-write the oldest record. The memory locations will be cleared, when the product is shipped from the OmniOn Power factory.

#### Operational use statistics

This feature of the black box includes information on the repetition and duration of certain events in order to understand the long-term operational state of the rectifier. The events are placed into defined buckets for further analysis. For example; the rectifier records how long was the output current provided in certain load ranges.

#### Accessing the event records

The event records are accessed by uploading the entire contents of the black box of the rectifier into a folder assigned by the user. OmniOn Power provides a Graphical User Interface (GUI) that decodes the contents of the black box into a set of records that can be reviewed by the user.

## Technical Specifications (continued)

**Table 1: Alarm and LED state summary**

| Condition                                      | Rectifier LED State |             |           | Monitoring Signals |                |
|--|---------------------|-------------|-----------|--------------------|----------------|
|  | AC OK Green         | DC OK Green | Fault Red | Fault              | Module Present |
| OK   | 1                   | 1           | 0         | HI                 | LO             |
| Thermal Alarm (5°C before shutdown)            | 1                   | 1           | 0         | HI                 | LO             |
| Thermal Shutdown                               | 1                   | 0           | 1         | LO                 | LO             |
| Defective Fan                                  | 1                   | 0           | 1         | LO                 | LO             |
| AC Present but not within limits               | Blinks              | 0           | 0         | HI                 | LO             |
| AC not present <sup>1</sup>                    | 0                   | 0           | 0         | HI                 | LO             |
| Boost Stage Failure                            | 1                   | 0           | 1         | LO                 | LO             |
| Over Voltage Latched Shutdown                  | 1                   | 0           | 1         | LO                 | LO             |
| Over Current                                   | 1                   | Blinks      | 0         | HI                 | LO             |
| Non-catastrophic Internal Failure <sup>2</sup> | 1                   | 1           | 1         | LO                 | LO             |
| Standby (remote)                               | 1                   | 0           | 0         | HI                 | LO             |
| Communications Fault (RS485 mode)              | 1                   | 1           | Blinks    | HI                 | LO             |

<sup>1</sup> This signal is correct if the rectifier is back biased from other rectifiers in the shelf.

<sup>2</sup> Any detectable fault condition that does not cause a shutting down. For example, ORing FET failure, boost section out of regulation, etc.

<sup>3</sup> Signal transition from HI to LO is output load dependent.

**Table 2: Signal Definitions**

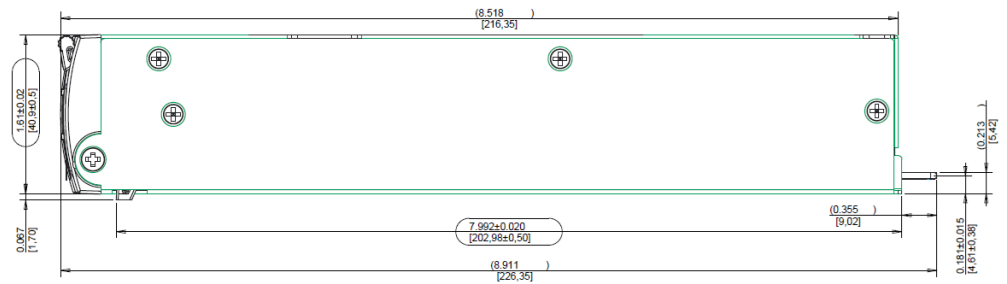
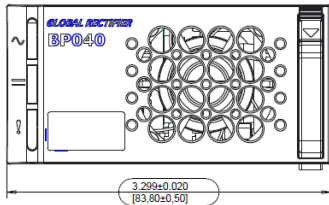
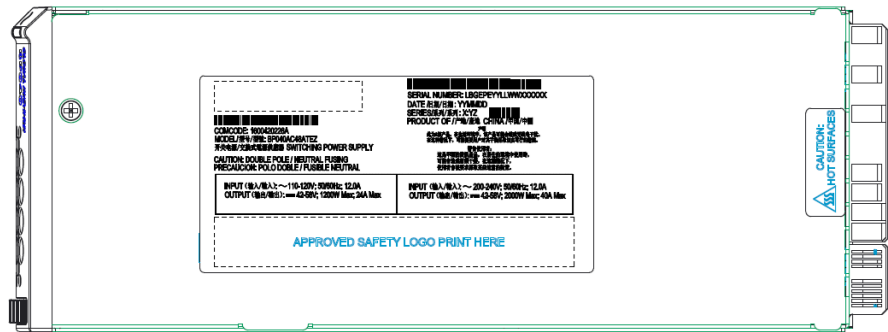
All hardware alarm signals (Fault#, PG#, OTW#) are open drain FETs. These signals need to be pulled HI to either 3.3V or 5V. Maximum sink current 5mA. An active LO signal ( $< 0.4V_{DC}$ ) state. All signals are referenced to Logic\_GRD unless otherwise stated.

| Function                    | Label<br>RS485 | Description  |
|-----------------------------|----------------|--|
| Interlock                   | Interlock      | Short pin, controls main output during hot-insertion and extraction. Ref: Vout ( - )     |
| Back bias                   | 8V_INT         | Used to back bias the DSP from operating Rectifiers. Ref: Vout ( - ).                    |
| Remote sense +              | RS+            | Connected to the load terminal, compensate the Vdrop on load wire                        |
| Remote sense -              | RS-            | Connected to the load terminal, compensate the Vdrop on load wire                        |
| Current Share+              | Ishare+        | A single wire active-current-share interconnect between rectifiers Ref: Vout ( - ).      |
| Current Share-              | Ishare-        |  |
| RS485 address               | Slot_ID        | Slot_ID  |
| RS485 address               | Shelf_ID       | Shelf_ID   |
| Logic ground                | LGND           | Isolated ground, Logic_GRD reference   |
| Module ON/OFF               | PS-ON/OFF      | Module enable/disable signal, If shorted to Logic_GRD main output is ON                  |
| Rectifier Fault             | Fault#         | Open drain FET; normally HI, changes to LO.  |
| Module Present              | MOD_PRES       | Short pin, see Status and Control description for further information on this signal.    |
| Unit address0/PFW           | U0             | Unit address0 / Open drain FET; normally HI, changes to LO prior to the output shutdown. |
| Unit address1/<br>Margining | U1             | Unit address1 / Changes the set point of the main output.                                |
| Shelf2/Standby power        | S2             | Shelf address2 / 5V at 0.5A provided for external use                                    |

# Technical Specifications (continued)

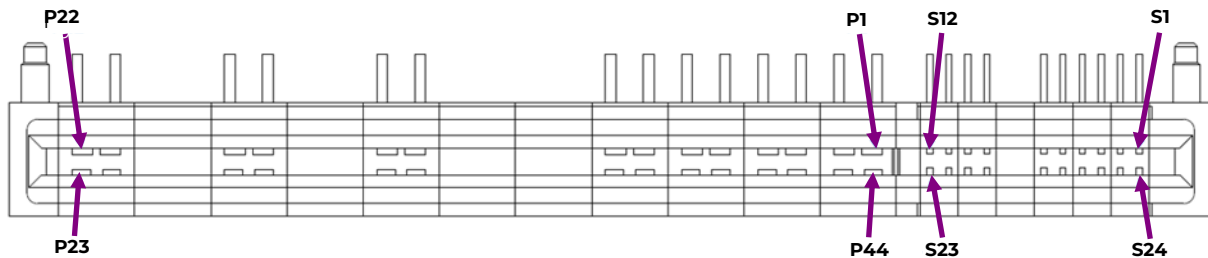
## Mechanical Outline

### Dimensions



Output mating Connector: right angle card edge, FCI 10163410-001LF

RS485 version:



| INPUT POWER  |                  |             | OUTPUT POWER |         | SIGNAL  |           |          |          |         |       |     |     |     |          |          |           |  |
|--------------|------------------|-------------|--------------|---------|---------|-----------|----------|----------|---------|-------|-----|-----|-----|----------|----------|-----------|--|
| P21,P22      | P17,P18          | P13,P14     | P5-P8        | P1-P4   | S12     | S11       | S10      | S9       | S8      | S7    | S6  | S5  | S4  | S3       | S2       | S1        |  |
| LINE-1 (HOT) | LINE-2 (Neutral) | EARTH (GND) | Vout +       | Vout -  | RS -    | RS +      | ISHARE - | ISHARE + | OMITTED | FAULT | U0  | U1  | U2  | RS_485 + | RS_485 - |           |  |
| P23,P24      | P27,P28          | P31,P32     | P37-P40      | P41-P44 | SLOT_ID | Interlock | 8V_INT   | SHELF_ID | OMITTED | S0    | S1  | S2  | S22 | LGND     | MOD_PRES | PS-ON/OFF |  |
|              |                  |             |              |         | S13     | S14       | S15      | S16      | S17     | S18   | S19 | S20 | S21 | S22      | S23      | S24       |  |

## Technical Specifications (continued)

### Ordering Information

Please contact your OmniOn Power Sales Representative for pricing, availability and optional features.

**Table 3: Device Codes**

| Device code   | Input voltage           | Output voltage      | Output current            | Ordering code |
|---------------|-------------------------|---------------------|---------------------------|---------------|
| BP040AC48ATEZ | 100-120 V <sub>AC</sub> | ±54 V <sub>DC</sub> | 22.2/24.0 A <sub>DC</sub> | 1600420226A   |

## Change History (excludes grammar & clarifications)

| Version | Date       | Description of the Change  |
|---------|------------|--|
| 1.1     | 11/02/2022 | Initial Release  |
| 1.2     | 03/23/2023 | 80plus, I <sup>2</sup> C and PMbus information removed, Cold climate start up behavior section added, Updated image of mechanical outline. |
| 1.3     | 10/30/2023 | Updated as per OmniOn template   |



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