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# Compact Power Line

## CP1800AC52 Front-End Power Supply

Input: 100-120/200-240 Vac; Outputs:  $\pm(44-58)$  Vdc at 1800W; +5 Vdc at 4W



### Applications

- 48Vdc distributed power architectures
- Power over Ethernet
- Routers/Switches
- VoIP/Soft Switches
- LAN/WAN/MAN applications
- File servers
- Indoor wireless
- Telecommunications equipment
- Enterprise Networks
- SAN/NAS/iSCSI applications
- Advanced workstations

### Features

- Compact 1-RU form factor providing 20 W/in<sup>3</sup>
- Constant power from 48 – 58 Vdc
- 1800W from nominal 200 – 240 Vac
- 1200W from nominal 100 – 120 Vac
- Output voltage programmable from 44V – 58 Vdc; output defaulted to 52V
- PMBus compliant dual I<sup>2</sup>C and RS485 serial bus communications
- Power factor correction (meets EN/IEC 61000-3-2 and EN 60555-2 requirements)
- DC Output over-voltage and over-current protection
- AC Input over-voltage and under-voltage protection
- Over-temperature warning and protection
- Redundant, parallel operation with active load sharing and redundant +5V Aux power
- Remote ON/OFF
- Hot insertion/removal (hot plug)
- Four front panel LED indicators
- UL\* Recognized to UL60950-1, CAN/ CSA<sup>†</sup> C22.2 No. 60950-1, and VDE<sup>‡</sup> 0805-1 Licensed to IEC60950-1
- CE mark meets 2006/95/EC directive<sup>§</sup>
- Variable-speed fan control

**The CP1800AC52 Front-End Power Supplies** in the Compact Power Line platform are specifically designed to operate as an integral part of a complete distributed power system. The high-density, front-to-back airflow rectifier is designed for minimal space utilization and is highly expandable for future growth. The rectifier is provided with RS485 and dual-redundant I<sup>2</sup>C communications busses that allow it to be used in a broad range of applications. The flexible feature set makes this front-end rectifier an excellent choice for applications requiring modular ac-to-dc bulk intermediate voltages, such as in distributed power.

\* 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 the required procedures for CE marking 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.

\*\*\* For PoE applications, order the CP2000AC54PE, which is 100% factory hipot-tested per IEEE802.3af.

**Specifications**

| Input  |                  |                            |                   |       |  |
|--|------------------|----------------------------|-------------------|-------|--|
| Parameter  | Min              | Typ                        | Max               | Units | Notes  |
| Startup Input Voltage<br>1200W Operation<br>1800W Operation                                  |                  |                            | 85<br>175         |       | The power supply automatically configures its operating mode based on the voltage level it reads on first turn ON. (This information is retained as long as internal bias is maintained.)  |
| Operating Voltage Range<br>1200W Configuration<br>1800W Configuration<br>1800W Configuration | 85<br>175<br>150 | 120/200/240<br>200/240     | 275<br>275<br>175 | Vac   | If started within low input line range.<br>If started within high input line range.<br>Will derate to 80% of full load; will shutdown below 150Vac.  |
| Permitted Excursions   | 275              |                            | 300               |       | May not meet all requirements, but will maintain output regulation.  |
| Surges   | 300              |                            | 325               |       | May shut down but will not get damaged.  |
| Input Frequency  | 44               |                            | 66                | Hz    |  |
| Input Current  |                  | 13.3<br>11.2<br>9.8<br>8.2 |                   | A     | At 100 Vac<br>At 120 Vac<br>At 200 Vac<br>At 240 Vac   |
| Inrush Transient   |                  | 25                         |                   | Apk   | Measured at 25°C for all line conditions; does not include X-Capacitors charging.  |
| Input Leakage Current  |                  | 1.5                        |                   | mA    | Measured at 265Vac, 60Hz   |
| Power Factor   |                  | 0.98                       |                   |       | From 50% to 100% load.   |
| Efficiency   |                  | 90<br>93                   |                   | %     | At 100 Vac with Vout > 52V and Pout > 50%.<br>At 230 Vac with Vout > 52V and Pout > 50%.   |
| Holdup Time  |                  | 15<br><br>20               |                   | ms    | Measurement starts at zero crossing of the ac voltage. Alarm issued via PFW signal going LO 5 ms prior to output voltages going out of limits. Measurements made at 75% full load and voltage allowed to decay to 49.5V. Holdup time is inversely proportional to delivered output load.<br><br>For loads below 1200W. |

| Main Output             |     |     |              |       |  |
|-------------------------|-----|-----|--------------|-------|--|
| Parameter               | Min | Typ | Max          | Units | Notes  |
| Maximum Output Power    |     |     | 1200<br>1800 | W     | At low-line input from 100-120Vac nominal.<br>At high-line input from 200-240Vac nominal.      |
| Output Voltage Setpoint |     | 52  |              | Vdc   | Output floats with respect to frame ground.  |
| Setpoint Accuracy       | -1  |     | +1           | %     |  |
| Overall Regulation      | -2  |     | +2           | %     | Includes all variations due to specified load range, drift, and environmental conditions.      |
| Output Voltage Range    | 44  |     | 58           | Vdc   | Set either by I <sup>2</sup> C, RS485, or analog margining.                                    |
| Maximum Output Current  |     |     | 23<br>34.6   | A     | At 1200W, 52V and 100-120Vac.<br>At 1800W, 52V and 200-240Vac.                                 |
| Current Share           |     |     | 10           | %FL   | Single-wire connection. Maintains tolerance to average of all other rectifiers. Loads > 50% FL |

**Specifications** (continued)

| Output (continued)   |     |               |                 |                           |   |
|--|-----|---------------|-----------------|---------------------------|---|
| Parameter  | Min | Typ           | Max             | Units                     | Notes   |
| Output Ripple<br>RMS (5Hz to 20MHz)<br>Peak-to-Peak (5Hz to 20MHz)<br>Psophometric Noise                     |     |               | 250<br>500<br>2 | mVrms<br>mVpk-pk<br>mVrms | Measured with 20MHz bandwidth under any condition of loading. Minimum load is 1A.   |
| External Bulk Load Capacitance   | 0   |               | 5,000           | μF                        | External capacitance can be increased but the power supply will not meet its turn-ON rise time requirement.   |
| Turn-On<br>Delay<br>Rise Time <sup>1</sup> - Standard (PMBus)<br>-Telecom (RS-485) <sup>2</sup><br>Overshoot |     | 5<br>100<br>5 |                 | s<br>ms<br>s<br>%         | Monotonic Turn_On from 30% to 100% of Vnom above -5°C operation.<br>Monotonic Turn_On from 60% to 100% of Vnom below -5°C operation.  |
| Load Step Response<br>ΔI<br>ΔV<br>Response Time  |     | 20            | 50<br>3.5       | %FL<br>Vdc<br>ms          | ΔI/Δt slew rate 1A/μs.<br>Settling time to within regulation requirements.  |
| Power Limit  | 48  |               | 58              | Vdc                       | Limited to 1200W at 100 - 120 Vac.<br>Limited to 1800W at 200 - 240 Vac.  |
| Over-current Protection  |     | 37            |                 | Adc                       | Below 36Vdc, hiccup will commence with an ON time of less than 4 seconds. The ON time duty cycle is about 10%. A latched shutdown can be selected using I2C instructions.   |
| Over-voltage Protection  | 58  |               | 60              | Vdc                       | In the default state, three restarts within a 1 minute window will be attempted. Using I2C instructions a latched shutdown mode can be selected.  |
| Over-temperature Warning   |     | 5             |                 | °C                        | Before shutdown. The default state will shut down and restart automatically when the unit sufficiently cools down. Using I2c instructions a latched shutdown mode can be selected. [Note: There is only a single latched shutdown command. If set, all three protection modes; OV, OC and OT, are reconfigured simultaneously]. |

1. Below -5°C, the rise time is approximately 5 minutes to protect the bulk capacitors.

2. Complies with GR947 which calls for a minimum rise time proportional to output load.

| Auxiliary Output        |       |     |      |         |                 |
|-------------------------|-------|-----|------|---------|-----------------|
| Parameter               | Min   | Typ | Max  | Units   | Notes           |
| Power                   |       |     | 3.75 | W       |                 |
| Output Voltage Setpoint |       | 5   |      | Vdc     |                 |
| Overall Regulation      | -5    |     | 5    | %       |                 |
| Ripple and Noise        |       | 50  | 100  | mVpk-pk | 20MHz bandwidth |
| Over-voltage Clamp      |       |     | 7    | Vdc     |                 |
| Output Current          | 0.005 |     | 0.75 | Adc     |                 |
| Over-current Limit      | 110   |     | 175  | %FL     |                 |

**Specifications** (continued)

| Physical         |               |
|------------------|---------------|
| Length (in./mm)  | 13.85 / 351.8 |
| Width (in./mm)   | 4.00 / 101.6  |
| Height (in./mm)  | 1.66 / 42.2   |
| Weight (lb / kg) | 4.6 / 2.1     |

| Output (continued)  |   |         |               |                     |   |
|---|---|---------|---------------|---------------------|---|
| Parameter   | Min   | Typ     | Max           | Units               | Notes   |
| Operating Temperature   | -5  |         | 55            | °C                  | The rectifier will start up to -40°C.   |
| Extended Operating Temperature  | 55  |         | 75            | °C                  | With 2%/°C power derating above 55°C.   |
| Storage Temperature   | -40   |         | 85            | °C                  |   |
| Humidity  | 5   |         | 95            | %                   | Relative humidity, non-condensing   |
| Altitude  | -60<br>-200   |         | 4000<br>13000 | m<br>ft             | For operation above 2500m (5000 ft.), maximum operating temperature is derated by 2°C per 305m (1000 ft.).                |
| Shock and Vibration<br>Operational Test<br>Test Levels<br>Drop and Tip Over |   |         |               |                     | IEC 68-2<br>IEC 721-3-2<br>IEC 68-2-31  |
| Earthquake Rating   | 4   |         |               | Zone                | Per Telcordia GR-63-CORE, all floors, when installed in CP Shelf.   |
| Acoustic Noise  |   | 45      |               | dBA                 | Noise is proportional to fan speed, load and ambient temperature.   |
| Harmonic Emissions  | Per EN/IEC61000-3-2   |         |               |                     |   |
| Radiated Emissions*   | FCC and CISPR22 (EN55022) - Class B   |         |               |                     |   |
| Conducted Emissions - ac  | FCC and CISPR22 (EN55022) Class B<br>Telcordia GR-1089-CORE - Class A   |         |               |                     |   |
| Conducted Emissions - dc  | Telcordia GR-1089-CORE and CISPR22 (EN55022) - Class A  |         |               |                     |   |
| ESD   | Error free per EN/IEC 61000-4-2 Level 3 (6 kV contact discharge, 8 kV air discharge).   |         |               |                     |   |
| Radiated Immunity   | Error free per EN/IEC 61000-4-3 Level 3 (10 V/m).   |         |               |                     |   |
| Electrical Fast Transient Burst   | Error free per EN/IEC 61000-4-4 Level 3 (2 kV, 5 kHz repetition rate)   |         |               |                     |   |
| Lightning Surge<br>Error Free<br>Damage Free                                | EN/IEC61000-4-5 Level 4 (4 kV common mode, 2 kV differential mode).<br>ANSI C62.41 Level A3 (6 kV common and differential mode) |         |               |                     |   |
| Conducted Immunity  | Error free per EN/IEC 61000-4-6 Level 3 (10Vrms).   |         |               |                     |   |
| Reliability (calculated)  |   | 400,000 |               | Hours               | At ambient of 25°C at full load per Telcordia SR-332, Reliability Prediction for Electronic Equipment, Method I Case III. |
| Isolation<br>Input-Chassis/Signals<br>Input - Output<br>Output-Chassis      | 1500<br>3000<br>500   |         |               | Vrms<br>Vrms<br>Vdc | Per EN60950.<br>Consult factory for testing to this requirement<br>Internal Lineage standard                              |
| Service Life  |   | 10      |               | Years               | 25°C ambient, full load excluding fans.   |

\*Radiated emissions compliance was met using a Lineage shelf. This shelf includes output common and differential mode capacitors that assist in meeting compliance.

### **Status and Control**

The rectifier provides three means for monitor/control: analog, PMBus compliant I2C, or RS485 for interfacing to Lineage controllers or battery plants.

Details of analog controls are provided in this data sheet under Signal Definitions. Tyco Electronics will provide separate application notes on PMBus protocol for users to interface to the CPL rectifiers. Contact your local Tyco representative for details.

### **Hot Plug**

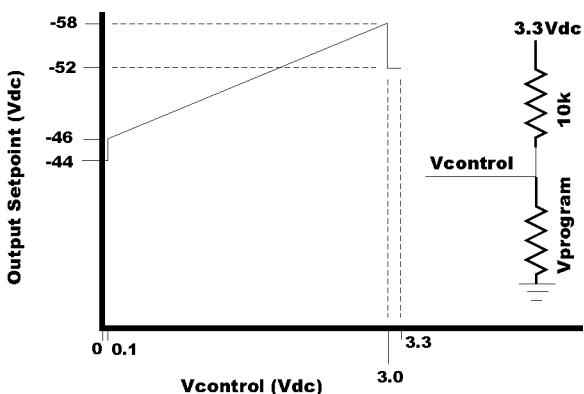
When rapidly extracting and reinserting modules care should be taken to allow for discharging the internal bias supply so that a predictable restart could be achieved. The way to ensure that the circuit sufficiently discharges is to observe the spinning of the fans after an extraction. The unit should not be reinserted until the fans stop spinning.

### **Control Definitions**

All signals are referenced to Logic GRD unless otherwise noted. See the Signal Definitions Table at the end of this document for further description of all the signals.

### **Input Signals**

**Margining:** Setpoint of the rectifier can be changed via this input pin. Programming can be either a voltage source or a resistance divider. Accuracy is dependent on the overall divider if resistive programming is used. The margining pin is connected to 3.3Vdc via a 10kΩ resistor inside the rectifier. See graphs below.



An open circuit on this pin reverts the voltage level back to the original setting.

**Module Present Signal:** This signal has dual functionality. It can be used to alert the system when a module is inserted. Has a 500Ω resistor in series between this signal and Logic GRD. An external pull-up should not raise the voltage on the pin above 0.25Vdc. If raised the pin is raised to 5Vdc the write\_protect feature of the EEPROM is enabled.

**Protocol Select:** Establishes the communications mode of the power supply, between analog/I2C and RS-485 modes. For RS485, connect 10kΩ pull-down resistor to 54\_OUT(-DC).

**Enable:** On/Off control when either PMBus communications or analog functions are utilized as configured by the Protocol pin. This pin must be pulled low to turn **ON** the main output of the power supply. The power supply will turn **OFF** if either the **Enable** or the **ON/OFF** pin is released. The **Enable** function does not work with the RS-485 protocol. This signal is referenced to Logic\_GRD.

**ON/OFF:** This is a short pin utilized for hot-plug applications to ensure that the power supply turns **OFF** before the power pins are disengaged. It also ensures that the power supply turns **ON** only after the power pins have been engaged. Must be connected to 54\_OUT (-DC).

### **Output Signals**

**Alert #:** PMBus interrupt signal.

**Fault:** This signal goes LO for any failure that requires rectifier replacement. Some of these faults may be due to:

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

**Power Capacity:** A HI on this pin indicates rectifier configured for 1800W operation; a LO indicates rectifier configured for 1200W operation.

**Alarm Table**

| Condition                                      | Power Supply LED State |                |                  |              | Monitoring Signals<br>(Referenced to Logic_GRD) |     |                 |                   |
|--|------------------------|----------------|------------------|--------------|---|-----|-----------------|-------------------|
|  | AC OK<br>Green         | DC OK<br>Green | Service<br>Amber | Fault<br>Red | Fault   | OTW | PFW             | Module<br>Present |
| OK   | 1                      | 1              | 0                | 0            | HI  | HI  | HI              | LO                |
| Thermal Alarm<br>(5C before shutdown)          | 1                      | 1              | 1                | 0            | HI  | LO  | HI              | LO                |
| Thermal Shutdown                               | 1                      | 0              | 1                | 1            | LO  | LO  | LO              | LO                |
| Defective Fan                                  | 1                      | 0              | 0                | 1            | LO  | HI  | LO              | LO                |
| Blown AC Fuse in Unit                          | 1                      | 0              | 0                | 1            | LO  | HI  | LO              | LO                |
| No AC <15mS (single unit)                      | 0                      | 1              | 0                | 0            | HI  | HI  | LO <sup>3</sup> | LO                |
| AC Present but not within limits               | Blinks                 | 0              | 0                | 0            | HI  | HI  | LO              | LO                |
| AC not present <sup>1</sup>                    | 0                      | 0              | 0                | 0            | HI  | HI  | LO              | LO                |
| Boost Stage Failure                            | 1                      | 0              | 0                | 1            | LO  | HI  | LO              | LO                |
| Over Voltage Latched Shutdown                  | 1                      | 0              | 0                | 1            | LO  | HI  | LO              | LO                |
| Over Current                                   | 1                      | Blinks         | 0                | 0            | HI  | HI  | LO              | LO                |
| Non-catastrophic Internal Failure <sup>2</sup> | 1                      | 1              | 0                | 1            | LO  | HI  | HI              | LO                |
| 1 Missing Module                               |                        |                |                  |              |   |     |                 | HI                |
| Standby (remote)                               | 1                      | 0              | 0                | 0            | HI  | HI  | LO              | LO                |
| Service Request (PMBus mode)                   | 1                      | 1              | Blinks           | 0            | HI  | HI  | HI              | LO                |
| Communications Fault (RS485 mode)              | 1                      | 1              | 0                | Blinks       | HI  | HI  | HI              | LO                |

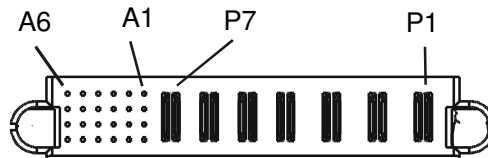
<sup>1</sup> This signal is correct if the rectifier is back biased from other rectifiers in the shelf.

<sup>2</sup> Any detectable fault condition that does not result in the power supply 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

**Output Connector**

Mating connector: AMP 1450572-1



|          | Signal |          |          |           |         | Output Power |                 | Input Power     |          |                |                     |                  |
|----------|--------|----------|----------|-----------|---------|--------------|-----------------|-----------------|----------|----------------|---------------------|------------------|
|          | 6      | 5        | 4        | 3         | 2       | 1            | P7              | P6              | P5       | P4             | P3                  | P2               |
| <b>A</b> | SCL_0  | MOD_PRES | PFW      | LOGIC_GRD | RS_485+ | UNIT_ADDR    | 52_OUT<br>(-DC) | 52_OUT<br>(+DC) | Reserved | EARTH<br>(GND) | LINE-2<br>(Neutral) | LINE-1<br>(Line) |
| <b>B</b> | SCL_1  | OTW      | Alert#_0 | Alert#_1  | RS_485- | 8V_INT       |                 |                 |          |                |                     |                  |
| <b>C</b> | SDA_0  | Margin   | Enable   | Reset     | Ishare  | Protocol     |                 |                 |          |                |                     |                  |
| <b>D</b> | SDA_1  | Fault    | 5VA      | Power_Cap | ON/OFF  | SHELF_ADDR   |                 |                 |          |                |                     |                  |

Connector is viewed from the rear positioned inside the power supply.

Signal pins columns 1 and 2 are referenced to 52\_OUT (-DC).

Signal pins columns 3 through 6 are referenced to Logic GRD.

Last-to-make first-to-break pins.

First-to-make last-to-break longest pin implemented in the mating connector.

**Signal Definitions**

Hardware alarm signals (FAULT, PFW, OTW) and operational indicator POWER\_CAP are open drain FETs. These signals should be pulled HI to either 3.3V or 5V. Maximum sink current 5mA. During the ON state, these signal indicators should not draw more than 5mA each. HI state voltage should not exceed 10Vdc. All signals are referenced to Logic\_GRD unless otherwise stated.

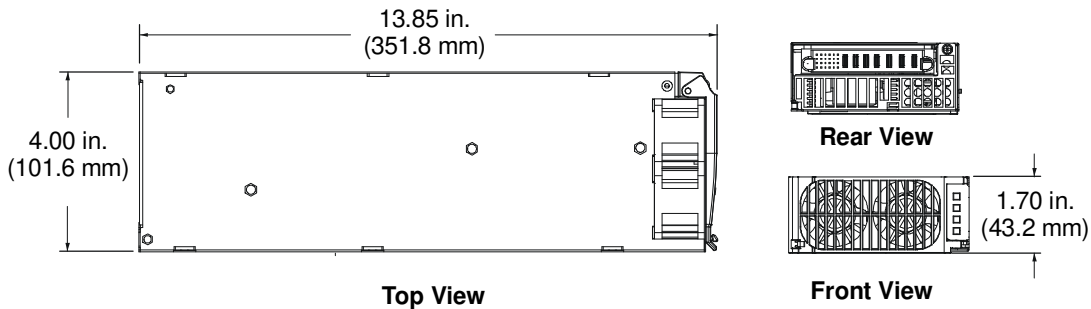
| Function                   | Label                | Type         | Description   |
|----------------------------|----------------------|--------------|---|
| Output Enable              | Enable               | Input        | If shorted to LOGIC_GRD, the rectifier output is enabled when using I <sup>2</sup> C mode of operation. May also be toggled to reset a latched OFF rectifier. Function not available in RS485 mode.                             |
| Power Fail Warning         | PFW                  | Output       | An open drain FET; normally HI, indicating output power is present. Changes to LO at least 5msec before the output voltage is lost.   |
| I <sup>2</sup> C Interrupt | Alert#_0<br>Alert#_1 | Output       | Interrupt signal via I <sup>2</sup> C lines indicating that service is requested from the host controller. This signal pin is pulled up to 3.3V via a 10k $\Omega$ resistor and switches to active LO when an interrupt occurs. |
| Rectifier Fault            | Fault                | Output       | Indicates that an internal fault exists. An open drain FET; normally HI, changes to LO.   |
| Module Present             | MOD_PRES             | Output       | Short pin, see Status and Control description for further information on this signal.   |
| ON/OFF                     | ON/OFF               | Input        | Short pin, connects last and breaks first; used to activate and deactivate output during hot-insertion and extraction, respectively. Ref: 52_OUT (-DC)  |
| Protocol select            | Protocol             | Input        | Used to place rectifier in either RS485 or analog/ I <sup>2</sup> C control/communication mode. Ref: 52_OUT (-DC).  |
| Margining                  | Margin               | Input        | Allows changing of output voltage through an analog voltage input or via resistor divider.  |
| Over-Temperature Warning   | OTW                  | Output       | An open drain FET; normally HI, changes to LO approximately 5°C prior to thermal shutdown.  |
| Power Capacity             | POWER_CAP            | Output       | Used to indicate rectifier operation mode; HI indicates 1800W operation and LO indicates 1200W operation.   |
| Rectifier address          | Unit_addr            | Input        | Voltage level addressing of rectifiers within a single shelf. Ref: 52_OUT (-DC).  |
| Shelf Address              | Shelf_addr           | Input        | Voltage level addressing of rectifiers within multiple shelves. Ref: 52_OUT (-DC).  |
| Back bias                  | 8V_INT               | Input/Output | Diode OR'ed 8Vdc drain; used to back bias microprocessors and DSP of failed rectifier from operating rectifiers. Ref: 52_OUT (-DC).   |
| Mux Reset                  | Reset                | Input        | Resets the I <sup>2</sup> C lines to I <sup>2</sup> C line 0.   |
| Standby power              | 5VA                  | Input/Output | 5V at 0.75A provided for external use by either adjacent power supplies or the using system.  |
| Current Share              | Ishare               | Input/Output | A single wire interface between each of the power unit forces them to share the load current. Ref: 52_OUT (-DC).  |
| I <sup>2</sup> C Line 0    | SCL_0,<br>SDA_0      | Input        | I2C line 0.   |
| I <sup>2</sup> C Line 1    | SCL_1,<br>SDA_1      | Input        | I2C line 1.   |
| RS485 Line                 | RS485 +/-            | Input        | RS485 line.   |



**Front Panel LEDs**

|                            | Analog Mode                         | I <sup>2</sup> C Mode   | RS485 Mode   |
|----------------------------|-------------------------------------|---|--|
| <input type="checkbox"/> ~ | ←                                   | <b>ON:</b> Input ok<br><b>Blinking:</b> Input out of limits     | →  |
| <input type="checkbox"/> ≡ | ←                                   | <b>ON:</b> Output ok<br><b>Blinking:</b> Overload               | →  |
| <input type="checkbox"/> ✖ | <b>ON:</b> Over-temperature Warning | <b>ON:</b> Over-temperature Warning<br><b>Blinking:</b> Service | <b>ON:</b> Over-temperature Warning                    |
| <input type="checkbox"/> ! | ← <b>ON:</b> Fault →                |   | <b>ON:</b> Fault<br><b>Blinking:</b> Not communicating |

**Dimensions**



**Ordering Information**

| Item                 | Description   | Comcode   |
|----------------------|---|-----------|
| CP1800AC52 Rectifier | Factory set at 52Vdc for the main output @ 34.6A, and 5Vdc aux output @ 0.75A | 108994546 |

Contact the factory for more information or for product availability of other faceplate colors such as black or graphite.



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