

CAR1812FP series rectifier

Input: 85Vac to 264Vac; Output: 12Vdc @ 1800W; 3.3Vdc or 5 Vdc @ 1A



Applications

- 12Vdc distributed power architectures
- Datacom applications
- Mid to high-end Servers
- Enterprise Networking
- Network Attached Storage
- Telecom Access Nodes
- Routers/Switches
- Broadband Switches
- ATE Equipment

Features

- Universal input with PFC
- Constant power characteristic
- 2 front panel LEDs: 1-input;2-[output, fault, over temp]
- Remote ON/OFF control of the 12Vdc output
- Remote sense on the 12Vdc output
- No minimum load requirements
- Redundant parallel operation
- Active load sharing (single wire)
- Hot Plug-ability
- Efficiency: typically 92% @ 50% load
- Standby orderable either as 3.3Vdc or 5Vdc
- Auto recoverable OC & OT protection
- Digital status & control: I²C and PMBus serial bus
- UL and cUL approved to UL/CSA+62368-1, TUV (EN62368-1), CE^S Mark
- EMI: class B FCC docket 20780 part 15, EN55032
- Meets EN6100 immunity and transient standards
- Shock & vibration: NEBS GR-63-CORE, level 3
- Compliant to RoHS Directive 2011/65/EU and amended Directive (EU) 2015/863
- Compliant to REACH Directive (EC) No 1907/2006

Description

The CAR1812FP series of rectifiers provide highly efficient isolated power from worldwide input mains in a compact 1U industry standard form factor in an unprecedented power density of 21.7W/in³. These rectifiers are ideal for datacom applications such as enterprise networking, mid to high-end servers, and storage equipment, where mid to light load efficiency is of key importance given the nature of the power consumption of the end application.

The high-density, front-to-back airflow is designed for minimal space utilization and is highly expandable for future growth. The industry standard PMBus compliant I²C communications bus offers a full range of control and monitoring capabilities. The SMBAlert signal pin alerts customers automatically of any state change within the power supply.

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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 | Device | Symbol | Min | Max | Unit |
|---|--------|-----------------|-----|-----------------|-----------------|
| Input Voltage: Continuous | All | V _{IN} | 0 | 264 | V _{ac} |
| Operating Ambient Temperature | | TA | -10 | 60 ¹ | °C |
| Storage Temperature | | Tstg | -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, load, and temperature conditions.

| INPUT | | | | | | | |
|---|--------|-----------------|-----|---------|-------------------------------|-------------------|-----------------|
| Parameter | Device | Symbol | Min | Typ | Max | Unit | |
| Operational Range | All | V _{IN} | 90 | 110/230 | 264 | V _{ac} | |
| Frequency Range (ETSI 300-132-1 recommendation) | | F _{IN} | 47 | 50/60 | 63 | Hz | |
| Main Output Turn_OFF | | V _{IN} | | | 80 | V _{ac} | |
| Maximum Input Current (V _o = V _{o, set} , I _o =I _{o, max}) | | I _{IN} | | | 14.3 12.5 | A _{ac} | |
| Cold Start Inrush Current (Excluding x-caps, 25°C, <10ms, per ETSI 300-132) | | I _{IN} | | | 40 | A _{peak} | |
| Efficiency [230Vac / 110Vac] 100% load (T _{amb} =25°C, V _{out} = 12Vdc, I _o =I _{o, max}) [230Vac / 110Vac] 50% load [230Vac / 110Vac] 20% load | | η | | | 92 / 89 94 / 91 92 / 88 | % | |
| Power Factor (V _{in} =230Vac, I _o =I _{o, max}) | | PF | | | 0.99 | | |
| Holdup time ² (V _{out} = 12Vdc, T _{amb} 25°C, I _o =I _{o, max}) | | T | | | 10 15 | ms | |
| Early warning prior output falling below 10.8Vdc | | | | | 2 4 | ms | |
| Ride through | | T | | | 10 | ms | |
| Leakage Current (V _{in} = 250Vac, F _{in} = 60Hz) | | I _{IN} | | | 3 | mArms | |
| Isolation Input/Output Input/Frame Output/Frame | | | | 3000 | | | V _{ac} |
| | | | | 1500 | | | V _{ac} |
| | | | | 100 | | | V _{dc} |

| 12V _{dc} MAIN OUTPUT | | | | | | | |
|--|--------|------------------|------|-------|------|-----------------|-------------------|
| Parameter | Device | Symbol | Min | Typ | Max | Unit | |
| Output Power High Line Operation 180 – 264 Vac | All | W | 0 | - | 1800 | W | |
| | | | 0 | - | 1200 | W | |
| Set point | | | 11.9 | 12.00 | 12.1 | V _{dc} | |
| Overall regulation (load, temperature, aging) | | | -3 | | +3 | % | |
| Ripple and noise ³ | | V _{out} | | | | 120 | mV _{P-P} |
| Turn-ON overshoot | | | | | | +3 | % |

¹ Derated above 50°C at 2.5%/°C

² 12V output can decay down to 10.8V

³ Measured across a 10μf electrolytic and a 0.1μf ceramic capacitors in parallel. 20MHz bandwidth

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| | | | | | | |
|---------------|--|---|--|--|---|-----|
| Turn-ON delay | | T | | | 2 | sec |
|---------------|--|---|--|--|---|-----|

| 12V _{dc} MAIN OUTPUT (continued) | | | | | | | |
|--|--------|--------|------------------|-----|------|-----------------|-------------------|
| Parameter | Device | Symbol | Min | Typ | Max | Unit | |
| Remote ON/OFF delay time | All | | | | 40 | ms | |
| Turn-ON rise time (10 – 90% of V _{out}) | | | | | 50 | ms | |
| Transient response 50% step [10%-60%, 50% - 100%] (di/dt – 1A/μs, recovery 300μs) | | | V _{out} | -5 | | +5 | %V _{out} |
| Programmable range (hardware & software) | | 10.8 | | | 13.2 | V _{dc} | |
| Overvoltage protection, latched (recovery by cycling OFF/ON via hardware or software) | | 13.8 | | | 15.8 | V _{dc} | |
| Output current | | | I _{out} | 0 | | 150 | A _{dc} |
| V _{in} = HL | | | | 0 | | 100 | |
| V _{in} = LL | | | | 110 | | 135 | % of FL |
| Current limit, Hiccup (programmable level) | | | | -5 | | +5 | % of FL |
| Active current share | | | | | | | |

| STANDBY OUTPUT | | | | | | | |
|---|--------|------------------|-----|-----------|-----|-----------------|-----------------|
| Parameter | Device | Symbol | Min | Typ | Max | Unit | |
| Set point | All | V _{stb} | | 3.3 / 5.0 | | V _{dc} | |
| Overall regulation (load, temperature, aging) | | V _{stb} | -5 | | +5 | % | |
| Ripple and noise | | | | | | 50 | mVp-p |
| Output current | | I _{out} | 0 | | | 1 | A _{dc} |
| Overload protection - | | | | | | | |
| Overvoltage protection | | | | | | | |
| Isolation Output/Frame | | | | 100 | | | V _{dc} |

| Environmental, Reliability | | | | | |
|--------------------------------------|------------------|------------|-----------------|-------|---|
| Parameter | Min | Typ | Max | Units | Notes |
| Ambient Temperature Operating | -10 ⁴ | | 70 ⁵ | °C | Air inlet from sea level to 5,000 feet. 7400 ft 51°C to 70°C (60°C max where TUV/VDE is required) |
| Altitude Operating | | | 2250 | m | |
| Power Derating | | | 2.5 | %/°C | |
| Storage | -40 | | 85 | °C | 30,000 ft |
| Altitude non-operating | | | 8200 | m | |
| Overload Protection shutdown restart | | 125 110 | | °C | |
| Humidity Operating Storage | 30 10 | | 95 95 | % | Relative humidity, non-condensing |
| Shock and Vibration acceleration | | | 6 | Grms | NEBS GR-63-CORE, Level 3, 20 -2000Hz, minimum 30 minutes |
| Earthquake Rating | 4 | | | Zone | NEBS GR-63-CORE, all floors, Seismic Zone 4 Designed and tested to meet NEBS specifications. |
| Reliability 25°C | | 320,000 | | Hrs | Full load, MTBF per Bellcore RPP |
| 50°C | | 100,000 | | Hrs | Full load, MTBF per Bellcore RPP |

⁴ Designed to start at an ambient down to -40°C; meet spec after ≅ 30 min warm up period, may not meet operational limits below -10°C.

⁵ 60°C max where TUV/VDE is required

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| | | | | | |
|---------------|--|---------|--|-----|---------------------------------------|
| | | 200,000 | | Hrs | Full load, demonstrated MTBF |
| Audible Noise | | 45 | | DbA | 25°C, half load. Fan speed controlled |

| EMC | | | | |
|--------------------|---------------------|---|----------------------------------|-----------------------------|
| Parameter | Criteria | Standard | Level | Test |
| AC input | Conducted emissions | EN55032, FCC Docket 20780 part 15, subpart J EN61000-3-2 | A* | 0.15 – 30MHz 0 – 2 KHz |
| | Radiated emissions | EN55032 | A* | 30 – 10000MHz |
| | Voltage dips | EN61000-4-11 | B | -30%, 10ms |
| | | | B | -60%, 100ms |
| | | | B | -100%, 5sec |
| | Voltage surge | EN61000-4-5 | A | 4kV, 1.2/50µs, common mode |
| A | | | 2kV, 1.2/50µs, differential mode | |
| immunity | Fast transients | EN61000-4-4 | B | 5/50ns, 2kV (common mode) |
| Enclosure immunity | Conducted RF fields | EN61000-4-6 | A | 130dBµV, 0.15-80MHz, 80% AM |
| | Radiated RF fields | EN61000-4-3 | A | 10V/m, 80-1000MHz, 80% AM |
| | | ENV 50140 | A | |
| | ESD | EN61000-4-2 | B | 4kV contact, 8kV air |

* Note: Contact the factory for a recommended external EMI filter to meet Class B emissions

Status and Control

Some functions have two means of monitor/control; A signal level that represents the analog value being measured or controlled, or, reading/writing via the i²C port the measured value or the control command.

Unless otherwise noted, control via the signals pins is 'active' so long that a firmware based command is not initiated. Once firmware initiates a command that is also represented on a signal pin, the firmware takes over and replaces the hardware based control signal. Firmware control is maintained until bias power to the processor is interrupted. Once bias power is removed the processor resets and the analog signal pin control is 'active' until firmware takes over control.

Details of analog controls are provided in this data sheet under Signal Definitions. GE Energy will provide separate application notes on the I²C protocol. Contact your local GE Energy representative for details.

Signal Definitions

All signals and outputs are referenced to Output return. These include 'Vstb return' and 'Signal return'.

Input Signals

Load share (Ishare): This is a single wire analog signal that is generated and acted upon automatically by power supplies connected in parallel. The Ishare pins should be tied together for power supplies if active current share among the power supplies is desired. No resistors or capacitors should get connected to this pin.

Remote ON/OFF: Controls the presence of the main 12Vdc output voltage. This is an open collector, TTL level control signal. This signal needs to be pulled HI externally through a resistor. Maximum collector voltage is 12Vdc and the maximum sink current is 4mA. A Logic 1 (TTL HI level) turns ON the 12Vdc output, while a Logic 0 (TTL LO level) turns OFF the 12Vdc output.

This signal is not overwritten by the firmware ON/OFF instruction. The default firmware setting is ON. An OFF command either through this signal or firmware would turn OFF the power supply.

The default state re-initializes if bias power is interrupted to the processor.

Enable: This is a short signal pin that controls the presence of the 12Vdc main output. This pin should be connected to 'output return' on the system side of the output connector. The purpose of this pin is to ensure that the output turns ON after engagement of the power

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blades and turns OFF prior to disengagement of the power blades.

Write protect (WP): This signal protects the contents of the EEPROM from accidental over writing. When left open the EEPROM is write protected. A LO (TTL compatible) permits writing to the EEPROM. This signal is pulled HI internally by the power supply.

Output signals

AC OK: A TTL compatible status signal representing whether the input voltage is within the anticipated range. This signal needs to be pulled HI externally through a resistor. Maximum sink current $\leq 4\text{mA}$ and the max voltage is 12Vdc. Open collector (HI) on this signal indicates that the input voltage is applied within the specified input range.

DC OK: A TTL compatible status signal representing whether the output voltage is present. This signal is internally pulled HI to 3.3V via a 10k Ω resistor. Maximum sink current $\leq 4\text{mA}$ and the max voltage is 12Vdc. Open collector (HI) on this signal indicates that the output voltage is present.

Fault: A TTL compatible status signal representing whether a Fault occurred. This signal needs to be pulled HI externally through a resistor. Maximum sink current $\leq 4\text{mA}$ and the max voltage is 12Vdc. Open collector (HI) on this signal indicates that no Fault is present.

This signal activates for OTP, OVP, OCP, AC fault or No output.

PS Present: This pin is connected to 'output return' within the power supply. Its intent is to indicate to the system that a power supply is present. This signal may need to be pulled HI externally through a resistor.

SMBAlert: A TTL compatible status signal, representing the SMBusAlert# feature of the PMBus compatible I²C protocol in the power supply. This signal needs to be pulled HI externally through a resistor. Maximum sink current $\leq 4\text{mA}$ and the pull up resistor should be tied to 3.3Vdc. Open collector (HI) on this signal indicates that no Interrupt has been triggered.

Serial Bus Communications

The I²C interface facilitates the monitoring and control of various operating parameters within the unit and transmits these on demand over an industry standard I²C Serial bus.

All signals are referenced to 'Signal Return'.

Device addressing: The microcontroller (MCU) and the EEPROM have the following addresses:

| Device | Address | Address Bit Assignments (Most to Least Significant) | | | | | | | |
|--------|---------|--|---|---|---|----|----|----|-----|
| MCU | 0xBx | 1 | 0 | 1 | 1 | A2 | A1 | A0 | R/W |
| EEPROM | 0xAx | 1 | 0 | 1 | 0 | A2 | A1 | A0 | R/W |

Address lines (A2, A1, A0): These signal pins allow up to eight (8) modules to be addressed on a single I²C bus. The pins are pulled HI internal to the power supply. For a logic LO these pins should be connected to 'Output Return'

Serial Clock (SCL): The clock pulses on this line are generated by the host that initiates communications across the I²C Serial bus. This signal is pulled up internally to 3.3V by a 10k Ω resistor. The end user should add additional pull up resistance as necessary to ensure that rise and fall time timing and the maximum sink current is in compliance to the I²C specifications.

Serial Data (SDA): This line is a bi-directional data line. This signal is pulled up internally to 3.3V by a 10k Ω resistor. The end user should add additional pull up resistance as necessary to ensure that rise and fall time timing and the maximum sink current is in compliance to the I²C specifications.

EEPROM

The microcontroller has 96 bytes of EEPROM memory available for the system host.

Another separate EEPROM IC will provide another 128 bytes of memory with write protect feature. Minimum information to be included in this separate EEPROM: model number, revision, date code, serial number etc.

See the communications protocol for further information.

Communications Protocol

The I²C protocol is described in detail by the *I²C and PMBus Serial Communications Protocol for the CAR Family of Power Supplies* application note.

LEDs

Two LEDs are located on the front faceplate. The AC_OK LED provides visual indication of the INPUT signal function. When the LED is ON GREEN the power supply input is within normal design limits.

The second LED DC/FLT provides visual indication of three different states of the power supply. When the LED is GREEN then there are no faults and the DC output is present. When the LED is AMBER then a fault condition exists but the power supply still provides output power. When the LED is RED then a fault condition exists and the power supply does not provide output power.

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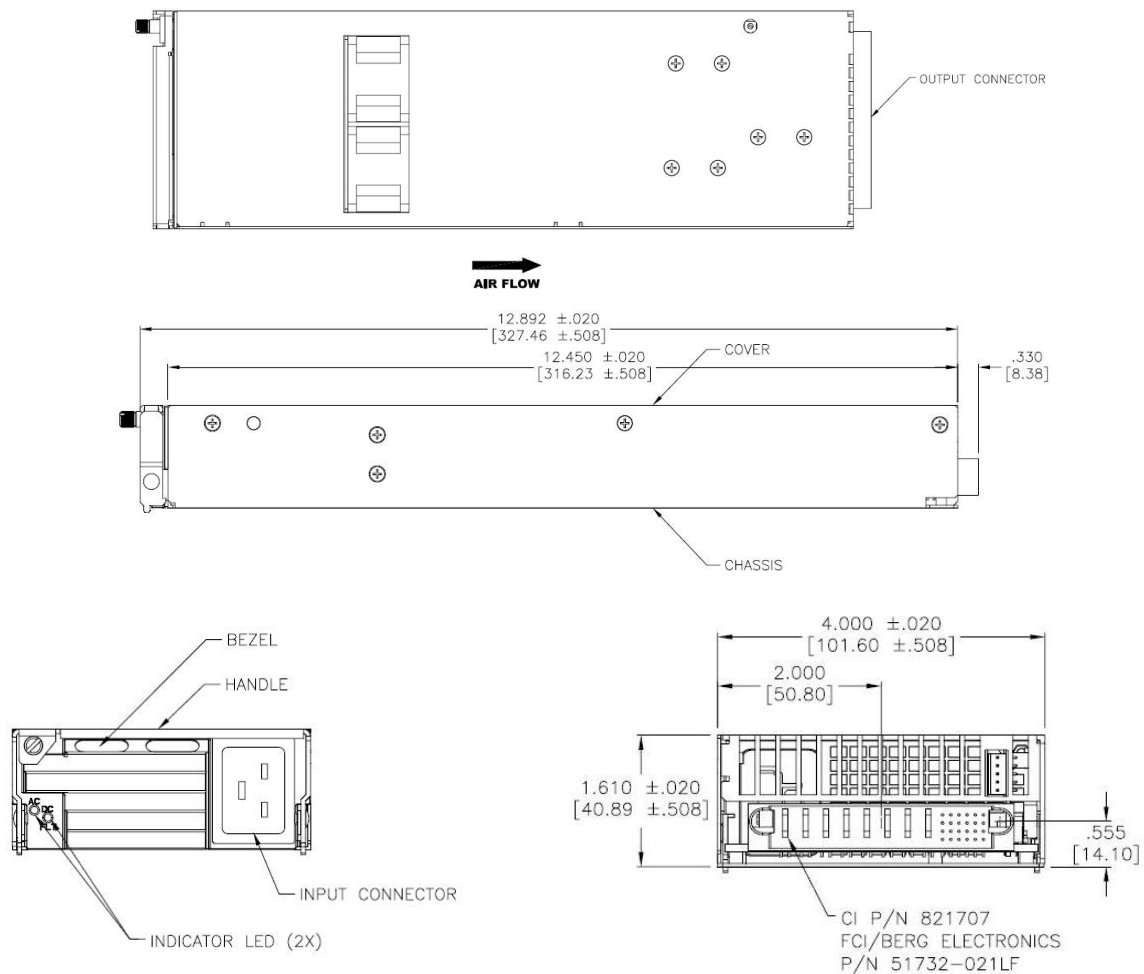
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Alarm Table

| Test Condition | | LED Indicator | | Monitoring Signals | | | |
|----------------|--------------------|------------------|-------------------------|--------------------|-------|----------|---------|
| | | LED1 INPUT OK | Tri-Color LED2 DC OK | FAULT | DC OK | INPUT OK | TEMP OK |
| 1 | Normal Operation | Green | Green | High | High | High | High |
| 2 | Low or NO INPUT | Off | Red | Low | Low | Low | High |
| 3 | OVP | Green | Red | Low | Low | High | High |
| 4 | Over Current | Green | Red | Low | Low | High | High |
| 5 | Temp Alarm Warning | Green | Orange | Low | High | High | Low |
| 6 | Fault Over Temp | Green | Red | Low | Low | High | Low |
| 7 | Remote ON/OFF | Green | Red | Low | Low | High | High |

Note: Test condition #2 had 2 modules plug in. One module is running and the other one is with no AC.

Outline Drawing



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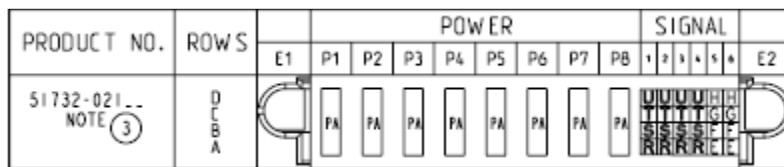
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Connector Pin Assignments

Input Connector: IEC320, C20 ; Mating connector: IEC320, C19

Output Connector: FCI Berg P/N: 51732-021 or equivalent
Mating connector: 51762-10802400ABLF (right angle mount)



| Pin | Function | Pin | Function | Pin | Function | Pin | Function |
|---------------|--------------------|-----|----------------------------|-----|-------------------------------|---------|---------------|
| A1 | Vstb | B1 | Fault | C1 | ISHARE | D1 | N/C |
| A2 | Vstb Return | B2 | N/C | C2 | N/C | D2 | N/C |
| A3 | Signal Return | B3 | Enable: "0" –ON "1" –OFF | C3 | N/C | D3 | Remote ON/OFF |
| A4 | Write Protect (WP) | B4 | PS Present | C4 | I ² C Address (A0) | D4 | DC OK |
| A5 | Remote Sense (+) | B5 | SDA (I ² C bus) | C5 | I ² C Address (A1) | D5 | AC OK |
| A6 | Remote Sense (-) | B6 | SCL (I ² C bus) | C6 | I ² C Address (A2) | D6 | SMBAlert |
| P1 - P4 | | | | | | P5 – P8 | |
| Output Return | | | | | | +Vout | |

Ordering Information

Please contact your GE Energy Sales Representative for pricing, availability and optional features.

| PRODUCT | DESCRIPTION | PART NUMBER |
|-----------------|--------------------------|------------------|
| 1800W Rectifier | +12Vout w/Bezel, 3.3Vstb | CAR1812FPBXXZ01A |
| 1800W Rectifier | +12Vout w/o Bezel, 5Vstb | CAR1812FPXX5Z01A |

Contact Us

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