CAR1812FP series rectifier

Input: 85V_{AC} to 264V_{AC}; Output: 12V_{DC} @ 1800W; 3.3 V_{DC} or 5 V_{DC} @ 1A

RoHS Compliant

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/in^3. 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 I^{2}C communications buss offers a full range of control and monitoring capabilities. The SMBAlert signal pin alerts customers automatically of any state change within the power supply.

Applications

- 12V_{dc} 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 12V_{dc} 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 3.3V_{dc} or 5V_{dc}
- Auto recoverable OC & OT protection
- Digital status & control: I^{2}C and PMBus serial bus
- UL and cUL approved to UL/CSA†62368-1, TUV (EN62368-1), CE§ 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

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 :Continues	All	V_{IN}	0	264	V_{ac}
Operating Ambient Temperature		T_A	-10	60[1]	°C
Storage Temperature		T_{stg}	-40	85	°C
I/O Isolation voltage to Frame (100% factory Hi-Pot tested)				1500	V_{ac}

[1] Derated above 50°C at 2.5%/°C

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_{IN}= 100V_{ac}		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 (T_{amb}=25°C, V_{out}= 12V_{dc}, I_O=$I_{O,\ max}$)	[230Vac / 110Vac] 100%load [230Vac / 110Vac] 50%load [230Vac / 110Vac] 20%load		η		92/89 94/91 92/88		%
Power Factor (V_{in}=230V_{ac}, I_O=$I_{O,\ max}$)			PF		0.99		
Holdup time[2] (V_{out}= 12V_{dc} T_{amb} 25°C, I_O=$I_{O,\ max}$)	V_{in}=220V_{ac} V_{in}=100V_{ac}		T		10 15		ms
Early warning prior to output falling below 10.8V_{dc}	V_{in}=220V_{ac} V_{in}=100V_{ac}				2 4		ms
Ride through			T		10		ms
Leakage Current	(V_{in}= 250V_{AC}, F_{in} = 60Hz)		I_{IN}		3		mAr ms
Isolation	Input/Output Input/Frame Output/Frame			3000 1500 100			V_{ac} V_{ac} V_{dc}

[2] 12V output can decay down to 10.8V

12Vdc MAIN OUTPUT

Parameter		Device	Symbol	Min	Typ	Max	Unit
Output Power	High Line Operation 180 – 264 Vac Low Line Operation 90 – 132 Vac	All	W	0 0	- -	1800 1200	W W
Set point			V_{out}	11.9	12.00	12.1	V_{dc}
Overall regulation (load, temperature, aging)				-3		+3	%
Ripple and noise[3]						120	mV_{p-p}
Turn-ON overshoot						+3	%
Turn-ON delay			T			2	sec

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

Electrical Specifications (continued)

$12V_{dc}$ 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 V_{in} = HL V_{in} = LL		I_{out}	0 0		150 100	A_{dc}
Current limit, Hiccup (programmable level)			110		135	% of FL
Active current share			-5		+5	% of FL

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	mV_{p-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.	
Altitude Operating			2250	m	7400 ft	
Power Derating			2.5	%/°C	51°C to 70°C (60°C max where TUV/VDE is required)	
Storage	-40		85	°C		
Altitude non-operating			8200	m	30,000 ft	
Overload Protection shutdown		125		°C		
restart		110				
Humidity Operating	30		95	%	Relative humidity, non-condensing	
Storage	10		95			
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	
		200,000		Hrs	Full load, demonstrated MTBF	
Audible Noise		45		Dba	25°C, half load, Fan speed controlled	

[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

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 i^2C 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. OmniOn Energy will provide separate application notes on the I^2C protocol. Contact your local OmniOn 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 $12V_{dc}$ 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 $12V_{dc}$ and the maximum sink current is 4mA. A Logic 1 (TTL HI level) turns ON the $12V_{dc}$ output, while a Logic 0 (TTL LO level) turns OFF the $12V_{dc}$ 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 $12V_{dc}$ 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 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 ≤ 4mA and the max voltage is $12V_{dc}$. 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 10kΩ resistor. Maximum sink current ≤ 4mA and the max voltage is $12V_{dc}$. 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 ≤ 4mA and the max voltage is $12V_{dc}$. 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 ≤ 4mA and the pull up resistor should be tied to $3.3V_{dc}$. 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	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

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

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 10kΩ 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 10kΩ 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.

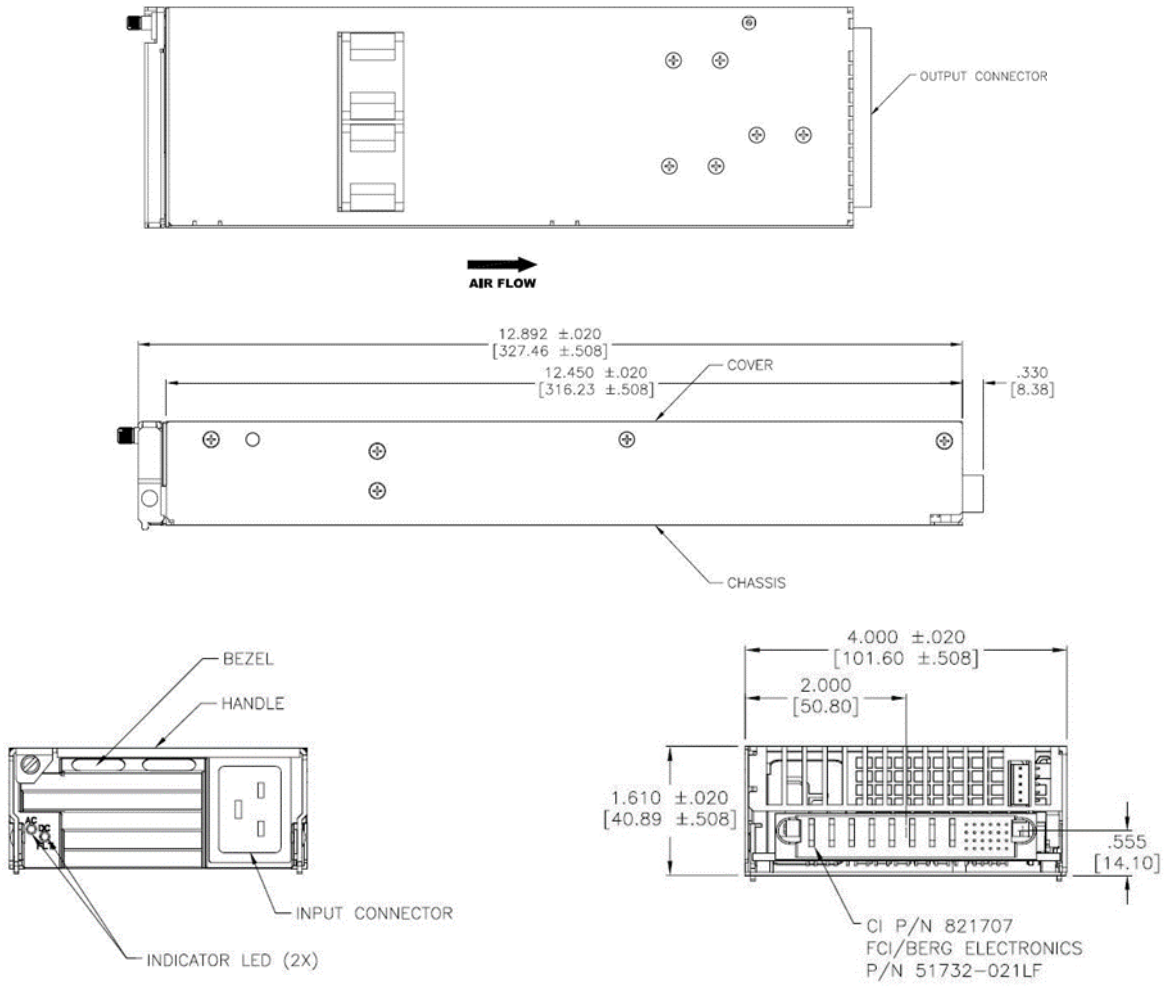
The second LED DC/FLT provides visual indication of three different states of the power supply. When the LED is GREEN then there are no faults and the DC output is present. When the LED is AMBER then a fault condition exists but the power supply still provides output power. When the LED is RED then a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

Alarm Table

Test Condition		LED Indicator		Monitoring Signals			
		LED1 INPUT OK	Tri-Color LED2 DC / FLT	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

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

Outline Drawing

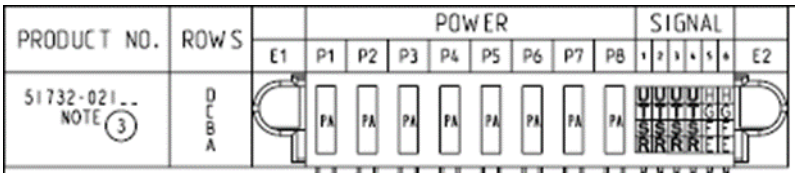


Connector Pin Assignments

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

Output Connector: FCI Berg P/N: 51732-021 or equivalent

Mating connector: 51762-10402400ABLF (right angle mount



Pin	Function	Pin	Function	Pin	Function	Pin	Function
A1	V_{stb}	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	I2C Address (A0)	D4	DC OK
A5	Remote Sense (+)	B5	SDA (I^2C bus)	C5	I2C Address (A1)	D5	AC OK
A6	Remote Sense (-)	B6	SCL (I^2C bus)	C6	I2C Address (A2)	D6	SMBAlert
P1– P4	Output Return					P5– P8	$+V_{out}$

Ordering Information

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

PRODUCT	DESCRIPTION	PART NUMBER
1800W Rectifier	+12Vout w/Bezel, 3.3Vstb	CAR1812FPBXXZ01A

Contact Us

For more information, call us at

+1-877-546-3243 (US)

+1-972-244-9288 (Int’l)

Change History (excludes grammar & clarifications)

Revision	Date	Description of the change
2.3	12/09/2021	Updated as per template
2.4	03/14/2023	Deleted Obsolete Product
2.5	06/21/2023	Temp Alarm Warning monitoring signal FAULT value corrected in Alarm Table on Page – 6
2.6	11/01/2023	Updated as per OmniOn template

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