DATASHEET

CAR1212FP series

Input: 85V_{ac} to 264V_{ac}; Output: 12V_{dc} @ 1250W; 5 V_{dc} @ 0.5A

Description

The CAR1212FP series of rectifiers provide highly efficient isolated power from world-wide commercial AC mains. Offered in the industry standard compact 1U form factor, these rectifiers complement the CAR1212DC converter line, providing comprehensive solutions for systems connected either to commercial ac mains or 48/60V_{dc} power plants. This plug and play approach, between AC and DC input units, has significant advantages since systems can be readily reconfigured by simply replacing the power supply.

The high-density, front-to-back airflow is designed for minimal space utilization and is highly expandable for future growth.

Features

- Universal input with PFC
- Constant power characteristic
- 3 front panel LEDs:
- Remote ON/OFF control of the 12V_{dc} output
- Remote sense on the 12V_{dc} output
- No minimum load requirements
- Active load sharing (single wire)
- Hot Plug-ability
- Efficiency: typically 89% at high line
  85% at low line
- Standby : 5V_{dc}
- Auto recoverable OC & OT protection
- Operating temperature: -10 - 70°C (de-rated above 50°C)
- Digital status & control: I^2C serial bus
- UL and cUL approved to UL/CSA†62368-1, TUV (EN62368-1), CE§ Mark
- EMI: class A 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

Applications

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

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	Device	Symbol	Min	Max	Unit
Input Voltage: Continuous	All	V_{IN}	0	264	V_{dc}
Operating Ambient Temperature		T_A	-10	70[1]	°C
Storage Temperature		T_{stg}	-40	85	°C
I/O Isolation voltage to Frame (100% factory Hi-Pot tested)				1500	V_{dc}

Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions.

INPUT

Parameter		Device	Symbol	Min	Typ	Max	Unit
Operational Range		All	V_{IN}	85	110/230	264	V_{ac}
Frequency Range recommendation)	(ETSI 300-132-1		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=$I_{O, max}$)	V_{IN}= 100V_{ac} V_{IN}= 180V_{ac}		I_{IN}			12 8.1	A_{ac}
Cold Start Inrush Current (Excluding x-caps, 25°C, <10ms, per ETSI 300-132)			I_{IN}			35	A_{peak}
Efficiency (T_{amb}=25°C, V_{in} = 230V, V_{out}= 12V, $I_{O, max}$)	high line low line		η		89 85		%
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)	V_{in}= 220V_{ac}, 1250W V_{in}= 100Vac, 1000W		T		16.7 20		ms ms
Ride through					10		ms
Leakage Current	(V_{in}= 250V_{ac}, F_{in} = 60Hz)		I_{IZ}		3		mArms
Isolation	Input/Output			3000			V_{ac}
	Input/Frame			1500			V_{ac}
	Output/Frame			50			V_{dc}

[1] Derated above 50°C at 2.5%/°C

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

Technical Specifications (continued)

Electrical Specifications (continued)

$12V_{dc}$ MAIN OUTPUT

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Power $V_{in} \geq 180V_{ac}$	All	W	-	-	1250	W
$V_{in} \geq 175V_{ac}$					1000	
$V_{in} \geq 90V_{ac}$			-	-	900	
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
Remote ON/OFF delay time					20	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)			11.4		12.6	V_{dc}
Overvoltage protection, latched (recovery by cycling OFF/ON via hardware or software)			14.5	15	15.5	V_{dc}
Output current V_{in} = HL		I_{out}	0		104	A_{dc}
V_{in} = LL					83.5	
Current limit, Hiccup (programmable level) HL / LL			110		145	% of FL
Active current share			-5		+5	% of FL

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

AUXILIARY OUTPUT

Parameter	Device	Symbol	Min	Typ	Max	Unit
Set point	All	V_{out}		5.0		V_{dc}
Overall regulation (load, temperature, aging)	All	V_{out}	-5		+5	%
Ripple and noise	All				50	mV_{p-p}
Output current	All	I_{out}	0		0.5	A_{dc}
Isolation Output/Frame	All		50			V_{dc}

Environmental, Reliability

Parameter		Min	Typ	Max	Units	Notes
Ambient Temperature						
Operating		-10		50	°C	Air inlet from sea level to 5,000 feet.
Altitude Operating				1524/5k	m / ft	
Power Derating				2.5	%/°C	51°C to 70°C
				2.0	C/1000 ft	Above 5,000 ft
Storage		-40		85	°C	
Altitude non-operating				8200/30k	m / ft	
Acoustic noise				45	dbA	Full load, 25°C
Over Temperature Protection			110/95		°C	Shutdown / restart
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, min 30 minutes
Earthquake Rating		4			Zone	NEBS GR-63-CORE, all floors, Seismic Zone 4 Designed and tested to meet NEBS specifications.
MTBF			320,000		hrs	Full load, 25°C per Bellcore RPP Full load, 50°C per Bellcore RPP

Technical Specifications (continued)

Electrical Specifications (continued)

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	A	-30%, 10ms
			C	-60%, 100ms
			C	-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

Technical Specifications (continued)

Status and 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 'V_{stb} return' and 'Signal return'.

Input Signals

Voltage programming (V_{prog}):

An analog voltage on this signal can vary the output voltage ± 5% from 11.4V_{dc} to 12.6V_{dc}. The equation of this signal is:

$V_{out} = 11.4 + (V_{prog} * 0.3)$ $0 < V_{prog} < 4$

If V_{prog} is > 4V or left open the programming signal is ignored and the unit output is set at the setpoint of 12V_{dc}.

Load share (I_{share}):

This is a single wire analog signal that is generated and acted upon automatically by power supplies connected in parallel. The I_{share} 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 20mA. 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. Used only for factory programming

Output signals

Output current monitor (I_{mon})

A voltage level of 0.05V / A proportional to the delivered output current is present on this pin. Accuracy ±10% of FL at loads > 25% of FL.

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 ≤ 20mA 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 needs to be pulled HI externally through a resistor. Maximum sink current ≤ 20mA and the max voltage is 12V_{dc}. Open collector (HI) on this signal indicates that the output voltage is present.

Over temp warning

A TTL compatible status signal representing whether an over temperature exists. This signal needs to be pulled HI externally through a resistor. Maximum sink current ≤ 20mA and the max voltage is 12V_{dc}. Open collector (HI) on this signal indicates that temperatures are normal.

If an over temperature should occur, this signal would pull LO for approximately 10 seconds prior to shutting down the power supply. The unit would restart if internal temperatures recover within normal operational levels. At that time the signal reverts back to its open collector (HI) state.

Technical Specifications (continued)

Output signals (continued)

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.

Interrupt (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 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 not pulled up internally. The end user should add pull up resistance to $5V_{dc}$ 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 not pulled up internally . The end user should add pull up resistance to $5V_{dc}$ as necessary to ensure that rise and fall time timing and the maximum sink current is in compliance to the I²C specifications.

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.

The Y01A suffix module supports only the I²C command set.

I/O Expander option (PCF8574ATD-T)

The CAR1212FPx without extended i²c communications (blank under the software option) has a single status/control byte I/O expander that is accessible via default address 0 x 7Eh (A2, A1, A0 are pilled HI). This byte takes the form;

7	6	5	4	3	2	1	0
n/s	n/s	Fault	ON/OFF	Temp_OK	n/s	DCOK	ACOK

n/s – not supported

Bits 0, 1, 3, and 5 are 'read_only' and are HI [1] during normal operation. The rectifier needs to be biased externally in order to 'read' its operational state without the presence of input power.

Bit 4 is a 'read/write' bit that can be used to verify the ON/OFF commanded state or change the commanded output of the rectifier. In order to turn the output OFF this bit needs to be pulled LO [0].

No PEC support is provided. Standard i²c commands apply.

LEDs

Three 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.

When the DC_OK LED is GREEN the DC output is present.

When the FAULT_LED is RED then a fault condition exists and the power supply may not provide output power. The table below further defines these states:

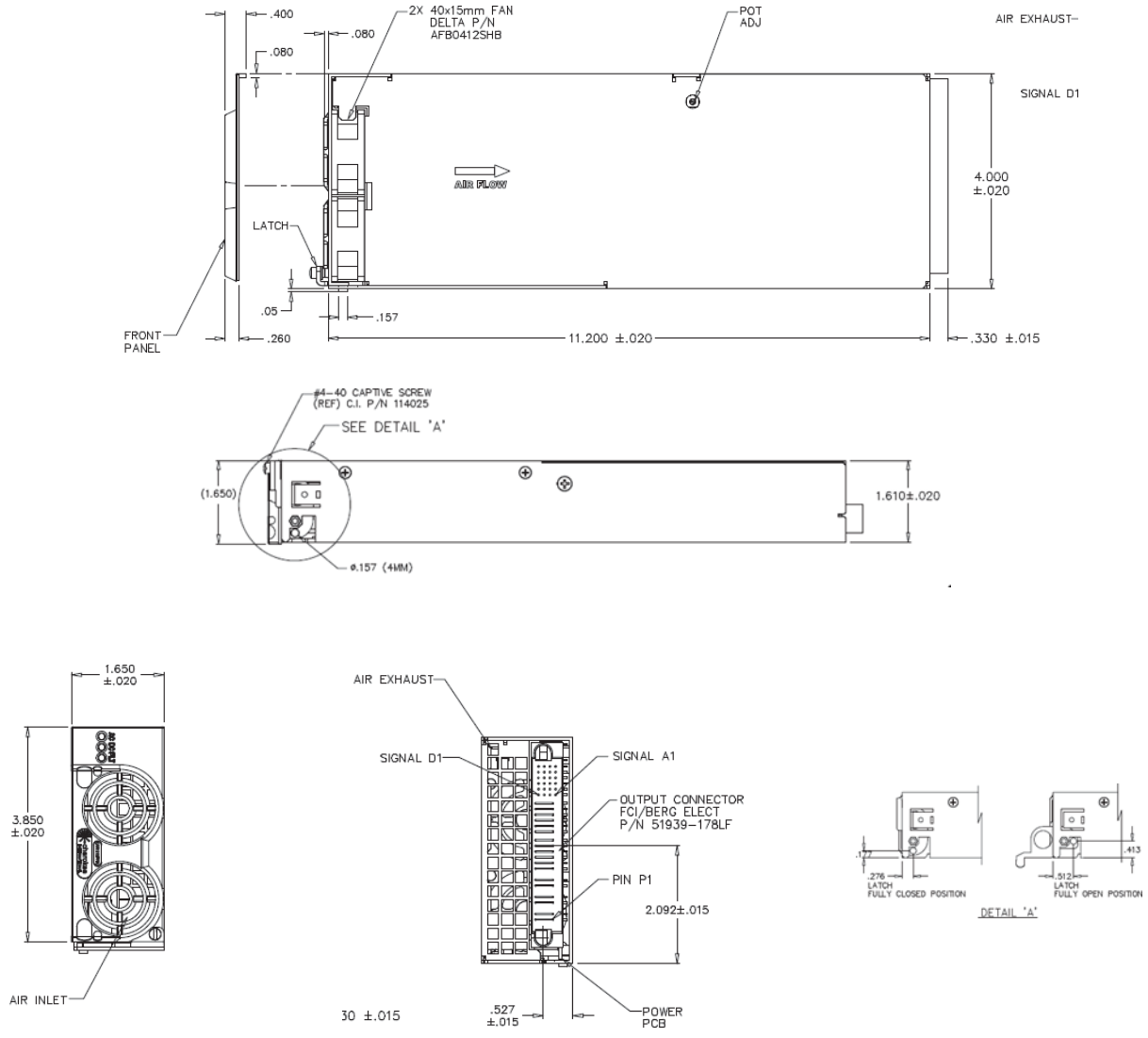
Technical Specifications (continued)

Alarm Table

	Test Condition	LED Indicator			Monitoring Signals			
		AC OK	DC OK	FAULT	FAULT	DC OK	INPUT OK	TEMP OK
1	Normal Operation	Green	Green	OFF	High	High	High	High
2	Low or NO INPUT	OFF	OFF	Red	Low	Low	Low	High
3	OVP	Green	OFF	Red	Low	Low	High	High
4	Over Current	Green	OFF	Red	Low	Low	High	High
5	Over Temp Alarm	Green	Green	Red	Low	High	High	Low
6	Over Temp Fault	Green	OFF	Red	Low	Low	High	Low

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

Outline Drawing



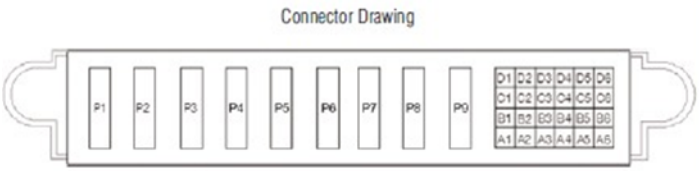
Technical Specifications (continued)

Connector Pin Assignments

Mating Connector: FCI/Berg P/N 51939-178

Mating connector: Primary Source: FCI berg P/N 51866-025 (right angle mounting)

or FCI berg P/N 51940-117 (straight mounting)



Pin	Function	Pin	Function	Pin	Function	Pin	Function
A1	V_{stb} [5V]	B1	Fault	C1	I_{Share}	D1	V_{Prog}
A2	V_{stb} [5V] Return	B2	I Monitor (IMON)	C2	No connect	D2	OVP Test Point
A3	Signal Return	B3	Enable: "0" –ON "1" - OFF	C3	Over Temp Warning	D3	Remote ON/OFF
A4	Write Protect (WP)	B4	PS Present	C4	I^2C Address (A0)	D4	DC OK
A5	Remote Sense (+)	B5	SDA (I^2C bus)	C5	I^2C Address (A1)	D5	AC OK
A6	Remote Sense (-)	B6	SCL (I^2C bus)	C6	I^2C Address (A2)	D6	SMBAlert

P1	Line	P2	Neutral	P3	Chassis		
P4 – P6	Output Return					P7– P9	$+12V_{out}$

Ordering Information

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

PRODUCT	DESCRIPTION	PART NUMBER
1250W Rectifier	$+12V_{out}$, $5V_{aux}$, with face plate, I^2C option, RoHS 6 of 6	CAR1212FPBCXZ01A

Contact Us

For more information, call us at

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+1-972-244-9288 (Int'l)

Change History (excludes grammar & clarifications)

Revision	Date	Description of the change
4.3	12-22-2021	Updated as per template
4.4	03-07-2023	Deleted Obsolete Products
4.5	01-03-2024	Updated as per OmniOn template

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