OmniOn POWER

CAR2548TN series rectifier

Input: 90V_{ac} to 264V_{ac}; Output: -54V_{dc} @ 2500W; 3.3V_{dc} or 5 V_{dc} @ 1A

Description

The CAR2548TN series of Front-End rectifiers provide highly efficient isolated power from worldwide input mains in a compact 1U industry standard form factor in an unprecedented power density of 27W/in^3. These rectifiers complement the CAR2548 product line providing comprehensive solutions for systems connected either to commercial ac mains, 48/60V_{dc} power plants or telecom central offices. This plug and play approach offers significant advantages since systems can be reconfigured and repositioned readily 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. The industry standard PMBus compliant I^{2}C communications buss offers a full range of control and monitoring capabilities. The SMBusAlert signal pin alerts customers automatically of any state change within the power supply.

Applications

- -48V_{dc} distributed power architectures
- Cellular Base Stations
- Satellite Hubs
- Network Equipment
- Network Attached Storage

- Telecom Access Nodes
- Routers/Switches
- Broadband Switches
- ATE Equipment

Features

- Universal input with PFC
- Constant power characteristic
- 3 front panel LEDs: 1-input;2-output; 3 - fault
- Remote ON/OFF control of the -54V_{dc} output
- Remote sense (up to 0.5V) on the -54V_{dc} output
- No minimum load requirements
- Redundant parallel operation
- Active load sharing (single wire)
- Hot Plug-ability

- Efficiency: typically 92%
- Standby orderable either as 3.3V_{dc} or 5V_{dc}
- Auto recoverable OC & OT protection
- Operating temperature: -10 - 70°C (de-rated above 50°C)
- Digital status & control: I2C and PMBus serial bus
- EN/IEC/UL60950-1 2nd edition; UL, CSA and VDE
- EMI: class B FCC docket 20780 part 15, EN55032
- Meets EN6100 immunity and transient standards
- Shock & vibration: NEBS GR-63-CORE, level 3

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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 :Continues	All	V_{IN}	0	264	V_{AC}
Operating Ambient	All	T_A	-10	70[1]	°C
Storage Temperature	All	T_{stg}	-40	85	°C
I/O Isolation voltage (100% factory Hi-Pot tested)	All			1500	V_{dc}

[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)	All	F_{IN}	47	50/60	63	Hz
High Lie Operation 180-264 V_{ac}	All	W	0	-	2500	W
Low Line Operation 90-132 V_{ac}	All	W	0	-	1200	W
Main Output Turn_OFF	All	V_{IN}			85	V_{AC}
Maximum Input Current V_{IN}= 90V_{AC} (V_O= $V_{O, set}$, I_O=$I_{O, max}$) V_{IN}= 180V_{AC}	All	I_{IN}			16 16	A_{AC}
Cold Start Inrush Current (Excluding x-caps, 25°C, <10ms, per ETSI 300-132)	All	I_{IN}			50	A_{peak}
Efficiency (T_{amb}=25°C, V_{in}= 230V_{ac}, V_{out}= 54V_{dc})	All	η		92		%
Power Factor (V_{IN}=230V_{AC}, I_O=$I_{O, max}$)	All	PF		0.99		
Holdup time (V_{in}= 230V_{ac}, V_{out}= -54V_{dc},T_{amb} 25°C, I_O=$I_{O, max}$)	All	T		16.8		ms
Loss of Output Early warning Signal				2		ms
Ride through	All	T		8.3		ms
Leakage Current (V_{in}= 250V_{ac} ,F_{in} = 60Hz)	All	I_{IN}		3		mA_{rms}
Isolation Input/Output Input/Frame Output/Frame	All		3000 1500 100			V_{ac} V_{ac} V_{dc}

-54V_{DC} MAIN OUTPUT

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Power	All	P_{OUT}	0		2500	W_{dc}
Set point	All		-53.94	-54.00	-54.06	V_{dc}
Overall regulation (load, temperature, aging)	All	V_{OUT}	-2		+2	%
Ripple and noise[2]	All			540		mV_{p-p}
Turn-ON overshoot	All				+3	%
Turn-ON delay	All	T			2	Sec

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

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Electrical Specifications (continued)

-54V$_{DC}$ 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$_{OUT}$)	All				60	ms
Transient response 50% step [10%-60%, 50% - 100%] (dI/dt – 1A/µs, recovery 300µs)	All	V$_{OUT}$	-1350		+1350	mV$_{dc}$
Programmable range (hardware & software)	All		-45		-57	V$_{dc}$
Overvoltage protection, latched (recovery by cycling OFF/ON via hardware or software)	All		-58	-59	-60	V$_{dc}$
Output current V$_{out}$=-54V$_{dc}$	All	I$_{OUT}$	0		46.3	A$_{dc}$
Power limit 2500W	All	V$_{out}$	-42		-58	V$_{dc}$
Current limit Hiccup (programmable level)	All	I$_{out}$	106		126	% of FL
Active current share	All	I$_{out}$	-5		+5	% of FL

AUXILIARY OUTPUT

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

Environmental, Reliability

Parameter	Min	Typ	Max	Units	Notes
Ambient Temperature					
Operating	-10[3]		50	°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
Storage	-40		85	°C	
Altitude non-Operating			8200	m	30,000 ft
Humidity					
Operating	30		95	%	Relative humidity, non-condensing
Storage	10		95		
Shock and Vibration					
acceleration			6	G$_{rms}$	NEBS GR-63-CORE, Level 3, 20—2000Hz, min 30
Earthquake Rating	4			Zone	NEBS GR-63-CORE, all floors, Seismic Zone 4 De-
MTBF		100,000		Hrs	Full load, 50°C ambient, per Bellcore RPP

[3] 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.

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Electrical Specifications (continued)

EMC

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

** Radiated emissions compliance is contingent upon the final system configuration.

Technical Specifications (continued)

Status and Control

Some parameters 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. OmniOn Energy will provide separate application notes on the I²C 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 from -45V$_{dc}$ to -57V$_{dc}$. The equation of this signal is:

V$_{out}$ = 44.3 + (V$_{prog}$ * 3.33) where V$_{prog}$ = 0.2 to 3.8V$_{dc}$

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 main -54V$_{dc}$ output voltage presence . 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 1mA. A Logic 1 (TTL HI level) turns ON the -54V$_{dc}$ output, while a Logic 0 (TTL LO level) turns OFF the -54V$_{dc}$ output.

A turn OFF command either through this signal

(Remote ON/OFF) or firmware commanded would turn OFF the 12V output.

Enable: This is a short signal pin that controls the presence of the -54V$_{dc}$. 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

Output current monitor (I$_{mon}$): A voltage level proportional to the delivered output current is present on this pin. The signal level is 0.2V per amp ± 0.25V.

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 reduce within normal operational levels. At that time the signal reverts back to its open collector (HI) state.

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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 ≤ 20mA 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 needs 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 ≤ 20mA 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 incorporated within the CAR2548TN modules 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 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.

The following PMBus protocol commands are not supported:

FAN_COMMAND_1	0 x 21
STATUS_FAN_1_2	0 x 81
READ_VIN	0 x 88
READ_IIN	0 x 89
READ_FAN_SPEED_1	0 x 90
READ_FAN_SPEED_2	0 x 91
READ_PIN	0 x A3

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
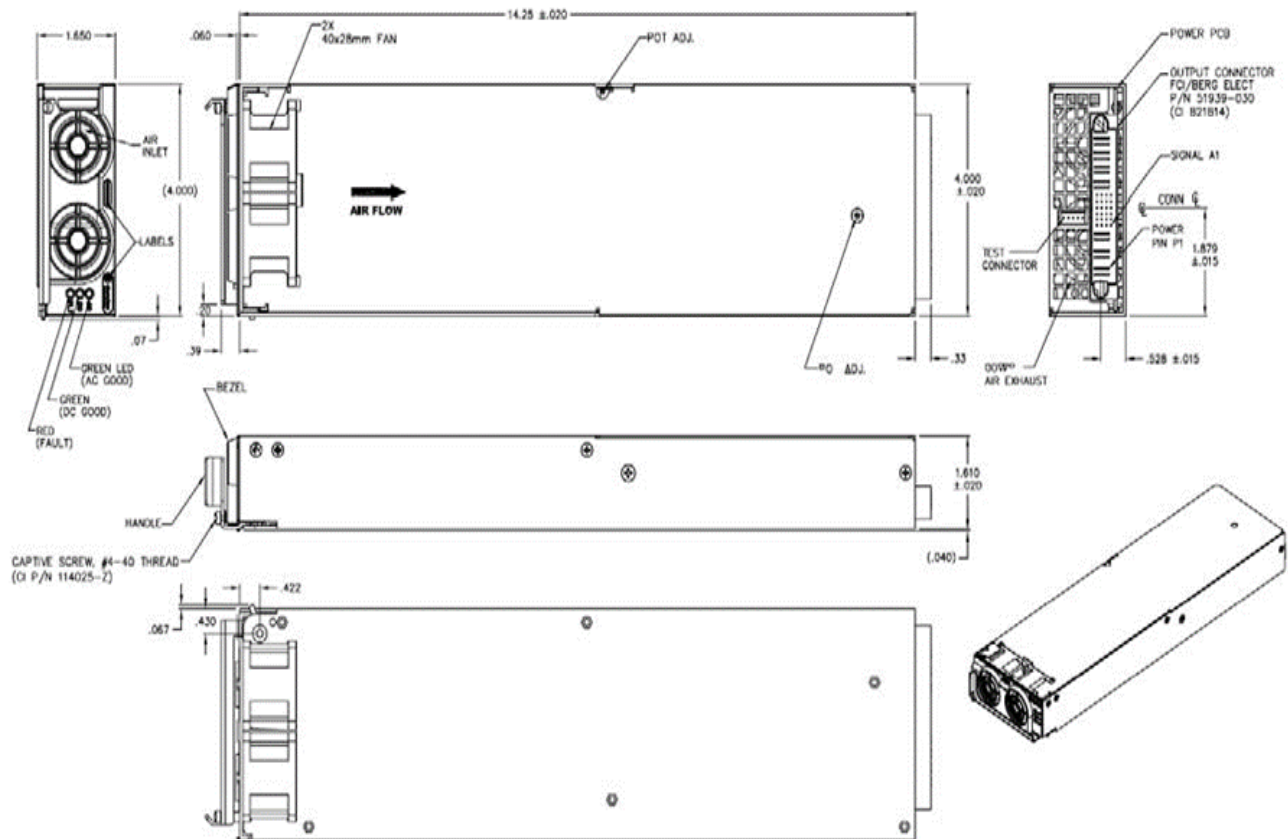
Technical Specifications (continued)

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

Note: Test condition #2 has 2 modules working in parallel. One module is running and the other has no AC.
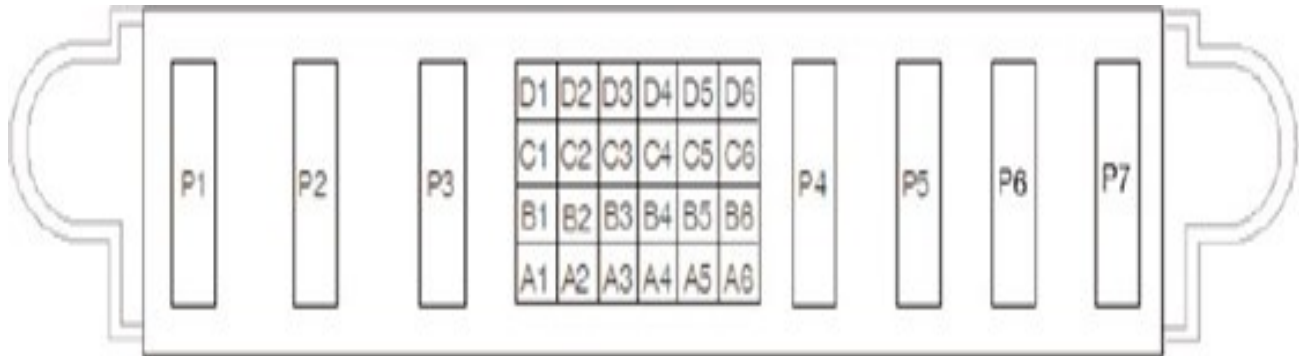
Outline Drawing

Technical Specifications (continued)

Connector

Mating Connector: FCI Berg P/N: 51939-030

Mating connector: FCI Berg P/N: 51939-015

Pin	Function	Pin	Function	Pin	Function	Pin	Function
A1	V_{stb} [3.3V]	B1	Fault	C1	I_{SHARE}	D1	V_{Prog}
A2	V_{stb} [3.3V] Return	B2	I Monitor (I_{MON})	C2	N/C	D2	OVP Test Point
A3	Signal Return	B3	PS Present	C3	Over Temp Warning	D3	Remote ON/OFF
A4	Write Protect (WP)	B4	Enable: "0" –ON "1" - OFF	C4	I^{2}C Address (A0)	D4	DC OK
A5	Remote Sense (+)	B5	SDA (I2C 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	Line	P2	Neutral	P3	Chassis		
P4	-48V_{dc}	P5	-48V_{dc}	P6	Output Return	P7	Output Return

Ordering Information

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

PRODUCT	DESCRIPTION	PART NUMBER
2500W rectifier	-48V_{out} rectifier w/Bezel, 3.3V_{aux}	CAR2548TNB-1A
10KW SHELF	Shelf for CAR2548TN holds 4 units	ACE254RUW-1A

Contact Us

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Change History (excludes grammar & clarifications)

Revision	Date	Description of the change
3.2	01/03/2021	Updated as per template
3.3	05/30/2023	Correction in electrical specification table on page – 3
3.4	11/03/2023	Updated as per OmniOn template

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