CAR2512FP

2500W
1U High 12V, Front-End Power Module

DETAILED SPECIFICATION

Revised 9/16/08

TABLE OF CONTENTS

1. GENERAL

Cherokee's latest 2500W Front end is a universal input operating switch mode power supply module. It is part of the CAR2500 family offered as either a front-end (48Vdc or 12Vdc) and a -48Vdc rectifier

With an unprecedented power density of ~25W/in^3, the CAR2512FP is designed for a maximum output power of 2500W (208A @ 12Vout, high line operation) in a 1U package. Up to Four (4) units can be mounted together in a 1U high 19" shelf. Cherokee also offers the rack.

Features of the CAR2512FP Front-end include:
Compact 1U Profile
ULTRA High Power Density of 25W/in^3
Constant Current Characteristic
N+1 Redundancy with Hot Plug-ability
Active Load Sharing (Single Wire)
3.3V Standby Voltage (5V Optional)
Remote On/Off
Remote Sense (up to 0.25V compensation per leg)
No Minimum Load Requirements
Digital Communication I2C Bus / and PM Bus
Microcontroller Equipped
Various control and monitoring features
Visual LED Indicators
Four (4) CAR2512 Modules per Rack (7.5KW N+1 Capability/ or 10KW Total Power)

1. INPUT SPECIFICATIONS

Input Voltage
      Range: 180-264Vac
                              * Unit derates to 1000W from 180Vac to 140Vac

Input Frequency
      Range: 47-63Hz (ETSI 300132-1 recommendation)

Under-Voltage
      The power supply switches off when mains voltage goes beyond the specified range. If this occurs, the green LED(AC Good) is switched OFF on the front panel to generate a specific alarm. Turn off ≤ 140Vac

Maximum Input Current
        16A (nominal load, Vin = 180Vac), assuming an Efficiency of 89%

Power Factor
        0.99 typical at nominal line & full load

Efficiency
        91.5%, at 12Vdc output, with characterization below and 230Vac
        (including OR'ing MOSFETS)

        Eff. @ 10% load = 86%
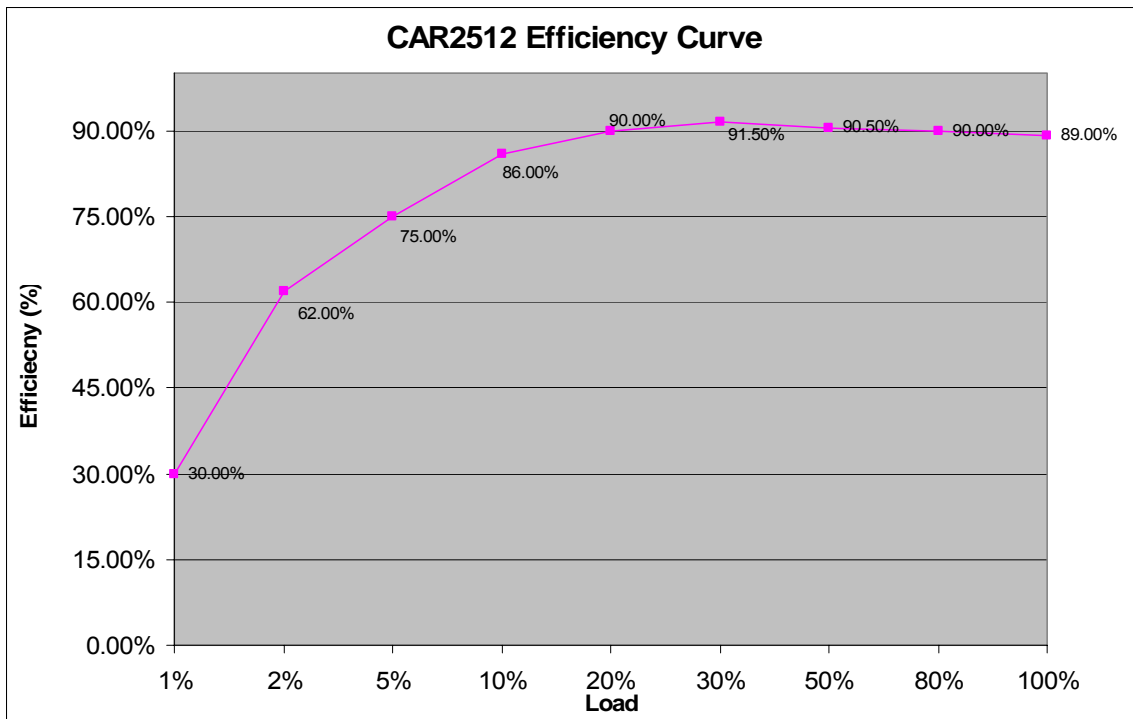   **Eff. @ 20% load = 90%**
        Eff. @ 30% load = 91.5%
        Eff. @ 50% load = 90.5%
        Eff. @ 80% load = 90%
        Eff. @ 100% load = 88%

CAR2512 Efficiency Curve

Input Fuse
        One fuse (line) – 20A & 250Vac
        Type 3AB Axial

Relative Harmonics (of input current)

According to IEC 1000-3-2. Limits for harmonic current emissions for class D equipment

Inrush Current

Max 40A peak (Measured at 25ºC for all line conditions typical duration 10ms)

Input Leakage Current

3mArms (250Vac & 60Hz)

Switching Frequency

400khz typical or optimized for Efficiency gains

Hold-up Time

12ms at full load measured down to 10.8V (with 230Vac). An early warning signal is provided 3ms prior to loss of output power. Ride thru is 10ms typically

3.   OUTPUT SPECIFICATIONS

Output Voltage
    Nominal output: 12Vout (Floating Output)
    Tolerance: ±0.1V
    Standby voltage: 3.3V (@ 1.0A) ± 5% (5V Optional)

Voltage Range
    10.8V to 13.2Vdc

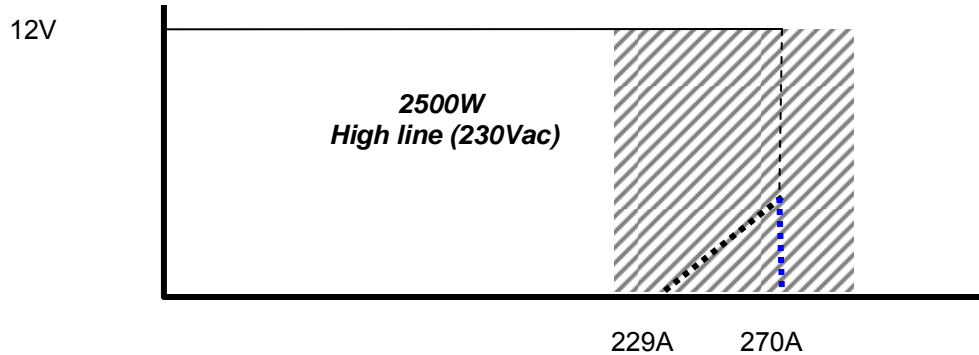Output Current
    208A @ 12V
    Minimum Load: 0A

Output Power

Min.(@10.8V)	Nom. .(@12V)	Max .(@13.2V)
2246W	2500W	2500W

Current Limit
    Adjustable via I2C interface
    Constant current characteristic & power limited to 2500W

Current Limit
    The unit is self-protected via constant current limit characteristic between
    the range of 110% - 130% of Iout nominal.

Microprocessor can offer hiccup mode protection or constant current down to a
direct short circuit. Short circuit protection is indefinite and self-resetting.

Line/Load/Temperature Regulation

$\leq \pm$ 2% of Vnom for any combination of line, load & temperature

Over-voltage Protection

Trip level: $\geq$ +14.8Vdc $\pm$ 1V

Reset condition by recycling the AC input or applying Remote ON/OFF

Dynamic Response

dIout/dt	$\leq$ 1A/µs
Deviation	$\leq$ 5% Vout (for a 50% step load)*
Recovery time	300us

* For system load conditions > 10% Iout max.

Turn on/off Delay Time

Mains on delay time	$\leq$ 2s
Remote on delay time	$\leq$ 40ms
Remote off delay time	$\leq$ 40ms

Turn-on Rise Time

$\leq$ 60ms

Ripple and Noise

$\pm$ 1% (pk-pk) @ 20MHz with 0.1µF ceramic and 10µF electrolytic caps at the output

4. SIGNALS AND CONTROLS

For specific signal protocol please contact factory.
All digital signals are referenced to the -Vout Return (alarm return) or chassis ground.

Output Voltage Programming (Vprog)

The output voltage is programmable from 10.8Vdc to 13.2Vdc.

Analog input signal - voltage determining the front-end output voltage. Vout = 10.8v +Vprog , for Vprog between 0v to 2.4v. If Vprog is higher then 3v, or left open, the programming signal will be ignored and Vout will be set to12v, as set by the potentiometer.

Output Current Monitoring (I Monitor)
Analog output signal.
Voltage proportional to the front-end output current (0.1V/Amp).

Load Share/Paralleling (I share)

Analog signal. Single wire connection.
Ishare bus voltage at full load: 5V for a single supply.
Unit will load share within ±5% of full load.

Remote ON-OFF

TTL compatible. Open collector (High) for normal operation.
Sink curent: 1mA. Max collector voltage: 12Vdc
Logic 1 (TTL High) or open enables unit (ON); Logic 0 (TTL Low) or short shuts unit down (OFF).
Cycling this signal resets the over-voltage protection memory.

AC OK

TTL compatible. Open collector (High) for normal operation.
Sink curent: 20mA. Max collector voltage: 12Vdc
AC OK indicates that AC is applied within the specified input range for the front-end.

DC OK

TTL compatible. Open collector (High) for normal operation.
Sink curent: 20mA. Max collector voltage: 12Vdc

Temperature OK

TTL compatible. Open collector (High) for normal operation.
Sink curent: 20mA. Max collector voltage: 12Vdc
In the event of an over temperature condition, the unit protects itself by providing a low warning signal for 10 seconds (typical) and then shutting off. Auto restart after the condition is cleared.

Fault

TTL compatible. Open collector (High) for normal operation.
Sink curent: 20mA. Max collector voltage: 12Vdc
This alarm is an open collector signal referenced to -Vout Return or chassis ground. The signal indicates that a failure has been detected in the unit (OTP, OVP, AC Fail or No Input).

Signal Return

All signals are referenced to the -Vout Return or chassis ground pin.

PS Present

Digital signal delivered when the module is present (active low, strap to return signal inside the supply with a pull up resistor)

Module Enable

Power supply will turn on when pin engages to Output Return. It is required to tie the Mating Connector pin to the Output Return.

Hot Swap

Unit is equipped with internal Or-ing mosfets in the +12 Vout leg and designed for hot swap operation.

LEDs

AC OK (Green)
DC OK (bicolor LED) Green for OK, Red for Fault.

TEST CONDITION	AC OK	DC OK	FAULT	MONITORING SIGNAL*			
				FAULT	DC OK	AC OK	TEMP OK
1 NORMAL OPERATION UNIT	Green	Green	OFF	High	High	High	High
2 LOW/ or NO AC 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 THERMO ALARM	Green	Green	Red	Low	High	High	Low

NOTE: TEST CONDITION # 2 HAD TWO MODULES PLUG IN. ONE MODULE RUNNING AND THE OTHER MODULE WITH NO AC.

Digital Functions/Features

Serial Number/Part Number – module information read-back (EEPROM)
Voltage programming (programmable within stated operating range)
AC Good
DC Good
Fault
Thermal warning
Remote ON/OFF
Fan speed control
Digital Voltage programming
Digital Input Power Consumption
Programmable current limit

5. I2C Serial Communication w/ Microcontroller

The I2C interface incorporated within the CAR2512FP modules includes facilities to monitor various operating parameters within the unit and transmits these on demand over an industry standard I2C Serial bus. I2C operation will over-ride analog signal operation when this option is selected.

Electrical Interface
Address lines (A0, A1 &A2)
These external address lines allow up to four (4) CAR2512FP modules to be addressed on a single I2C bus.
Serial Clock
This line is clocked by the processor that controls the I2C serial bus. It should be tied to a +5V supply via a pull up resistor.
Serial Data
This line is a bi-directional data line. It should be tied to a +5V supply via a pull up resistor.

Microprocessor (uP) Design Feature

The following information represents a summary of functions provided by the microprocessor (P/N PIC16F873) design feature.

General Fuctions:

Analog Sensing – Output Voltage Sensing (Anode of Oring Device), Current Monitor and Temperature, Efficiency Optimization (Adjustable peaking between 30-50% load)

Analog/PWM Control - External Voltage Programming, I2C Voltage Programming, I2C Current Limit Programming, Fan Speed Control, Constant Power Control

Digital Reporting – Line sense, ACOK, DCOK, TEMP_OK, FAULT, Interrupt, OVSD, AC Voltage

Digital Control – ON/OFF

EEPROM – Internal to IC (1K, 128 bytes)

Communications – SDA, SCL, Addressing (8 unique addresses)

Programming (Factory setting only) – PGC, PGD, MCLR

6. PMBUS Product Requirements

Product communicates using the same signals I2C.
The PMBUS interface incorporated within the CAR2512FP modules includes facilities to monitor various operating parameters within the unit and transmits these on demand over an industry standard PMBUS Serial bus. PMBUS operation will over-ride analog signal operation when this option is selected.

Thus the CAR2512FP is equipped which either analog, I2C or PMBus means of control and monitoring.

PMBUS Product Requirements:
I. Interoperability with I2C (as called stated in Appendix B of SMB v2.0)
    a. Power supply must operate either in standard I2C mode or PMBus protocol based by auto-sensing command structure.
    b. PMBus frequency must be support 400kHz
    c. AC Specifications (must comply as stated in Table 2 – of Section 5.2.6 of PMB v1.1X2)
    d. DC Specifications (must comply with High Power DC Specifications of Section 3.1.3 SMBus v2.0)
II. Signals and Controls
    a. 7 bit addressing (DO NOT use reserved Addresses in Appendix B of SMB v2.0)
        • Device must also respond to Global Broadcast address of 00h
    b. /SMBALERT (Active low)
        • Output pin (use INTERRUPT pin as I2C)
    c. WP – Write Protect of Memory (Section 3.1.3 SMB v2.0)
    d. Protocol Select (Active High)
        • High on signal means to communicate using I2C
        • Low on signal means to communicate in PMBUS
III. Functionality
    a. Device is always a slave mode (Never contends to be master)
    b. Reporting of device Fault condition using SMBALERT (Interrupt mechanism to communicated with host Appendix A of SMB v2.0)
    c. Self Power ON
IV. Protocol/ Command Structures Supported
    a. Block Write- Block Read Process Call (Section 5.5.8 SMB v2.0)
    b. Group Command Protocol (Section 5.2.3 PMB v1.1X2)
    c. Direct Mode supported for all command/data transfers (Section 7.2 PMB v1.1X2)

V. Control and Monitoring Commands
  a. VOUT_MODE
      - READ ONLY command that states we operate at "DIRECT MODE"
  b. VOUT_COMMAND
      - Input control command with program the power supply's Vout.
  c. COEFFICIENTS COMMAND
      - used in conjunction with "DIRECT MODE"

  d. CLEAR_FAULTS
      - Clears fault status register
  e. VOUT_OV_FAULT_LIMIT
      - Vout Over Voltage
  f. VOUT_UV_FAULT_LIMIT
      - Vout under voltage
  g. IOUT_OC_FAULT_LIMIT
      - Iout over current
  h. IOUT_UC_FAULT_LIMIT
      - Iout under current
  i. IIN_OC_FAULT_LIMIT
      - Input Current Over Current
  j. POWER_GOOD_ON
      - Vout at which the DC good signal should be asserted
  k. POWER_GOOD_OFF
      - Vout at which the DC good signal should be negated
  l. OT_FAULT_LIMIT
      - Over temperature point , in degrees Celsius, OT should be asserted
  m. STATUS_BYTE
      - Status register reporting
  n. STATUS_WORD
      - Status register reporting
  o. STATUS_CML
      - Status register reporting
  p. READ_VIN
      - Host performs Read ONLY Vin
  q. READ_VOUT
      - Host performs Read ONLY Vout
  r. READ_IOUT
      - Host performs Read ONLY Output Current
  s. READ_TEMPERATURE
      - Host performs Read ONLY Temperature
  t. READ_FAN_SPEED

- Host performs Read ONLY Fan Speed
    u. READ_POUT
        - Host performs Read ONLY Output Power
  VI. MFR Specific Commands Supported
        - Manufacturer's rating of product.
    b. PMBUS_REVISION
    c. INVENTORY INFORMATION
    d. MFR_ID
    e. MFR_MODEL
    f. MFR_REVISION
    g. MFR_LOCATION
    h. MFR_DATE
    i. MFR_SERIAL
    j. MFR_VIN_MIN
    k. MFR_VIN_MAX
    l. MFR_IIN_MAX
    m. MFR_PIN_MAX
    n. MFR_VOUT_MIN
    o. MFR_VOUT_MAX
    p. MFR_IOUT_MAX
    q. MFR_POUT_MAX
    r. MFR_TAMBIENT_MAX
    s. MFR_TAMBIENT_MIN
  VII. Other Misc. Commands
    a. CAPABILITY
        - Host performs READ ONLY of key capabilities
    b. QUERY
        - Host queries to see support for a command

7. SAFETY ASPECTS

Applicable Standards
    IEC 950 (per EN 60950)
    CSA C22.2-950
    UL 1950
    CE Mark (LVD)

Isolation
        Input – ground: 1500Vac
        Output – ground: 100Vdc
        Input – Output: 3000Vac

8. EMC SPECIFICATIONS

Immunity

Port	Phenomena	Test	Criteria	Ref Standard
Enclosure	Conducted RF fields Immunity	130dBµV 0.15MHz - 80MHz (80% AM)	A	EN 61000-4-6
	Radiated RF fields Immunity	10V/m 80MHz - 1000MHz (80% AM)	A	EN 61000-4-3
			A	ENV 50140
	ESD	8KV air 4KV contact	B	EN 61000-4-2
AC input	Fast transients Common mode	(5/50ns) 2KV	B	EN 61000-4-4
	Voltage dips Voltage interr.	-30%, 10ms -60%, 100ms -100%, 5000ms > 95% 5 s	A B B	EN 61000-4-11
	Surg common mode differential mode	(1.2 / 50µs) 4KV 2KV	A	EN 61000-4-5

Emission (size dependent – per Engineering)

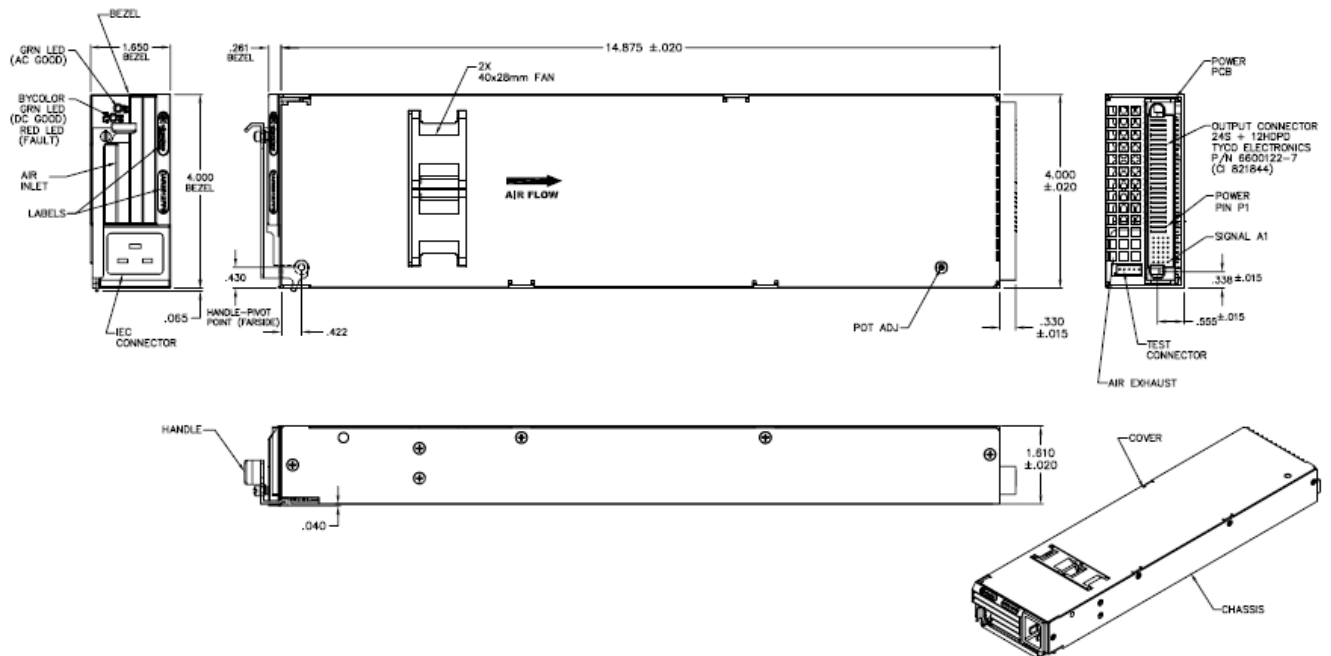| Port	Frequency-range	Limits	Reference Standard
AC input (conducted)	0.15 – 30MHz	A	EN 55022 FCC Docket 20780 Part 15, Subpart J Class B.
	0 – 2KHz	-	EN 61000-3-2
Enclosure (radiated)	30 - 230MHz 230 - 1000MHz	B	EN 55022

9. MECHANICAL SPECIFICATIONS

Dimensions
  Height: 1.65" (with bezel)
  Width: 4.00"
  Depth: 14.875" (inclusive of bezel and I/O signal connector)

Outline Drawing

10.   CONNECTIONS

Input Connector: IEC320 C19

Output Connector: Tyco P/N 6600122-7
Mating Connector: Tyco P/N 6450171-5

A1	Vstb [3.3V]	C1	I Share	P1	Return
A2	PS Present	C2	Protocol Select	P2	Return
A3	Signal Return	C3	Temp OK	P3	Return
A4	Write Protect	C4	PmBus Address (A0)	P4	Return
A5	Remote Sense (+)	C5	PmBus Address (A1)	P5	Return
A6	Remote Sense (-)	C6	PmBus Address (A2)	P6	Return
				P7	+V
B1	Fault	D1	V Prog	P8	+V
B2	I Monitor	D2	OVP Test Point	P9	+V
B3	Module Enable	D3	Remote ON/OFF	P10	+V
B4	Vstb [3.3V] Return	D4	DC OK	P11	+V
B5	SDA	D5	AC OK	P12	+V
B6	SCL	D6	Interrupt		

11.   ENVIRONMENTAL SPECIFICATIONS

Temperature
        Operating ambient: -10°C to +70°C
        Active derating between: 51°C to +70°C @ 2.5°C/W
        Storage: -40°C to +85°C
        Cooling: Horizontal airflow back to front with built in fan

Humidity
        Operating relative humidity: 30 to 95 % non-condensing

Storage: 10 to 95 % non-condensing
Altitude – Pressure Drop
    Operating (up to 2250m):   700 – 1100mbar
    Non-operating: 300 – 1100mbar

MTBF
    250,000 hrs at ambient 25 °C at full load (per SR332). Reliablility prediction for electronic equipment, method 1, class III.

Service Life
    10 years. 25 °C Ambient, full load, excluding fans.

Acoustic Noise
    55dba at full load. Noise maybe lowered with fan speed control proportional to fan speed, load and ambient temperature.

12.   PART NUMBER SELECTION

PRODUCT	DESCRIPTION	PART NUMBER
2500W Front-End	+12 Vout Front-End with Face Plate	CAR2512FPB-Y01A
2500W Rectifier	-48 Vout Rectifier with Face Plate	CAR2548TNB-Y01A
2500W Front-End	+48 Vout Rectifier with Face Plate	CAR2548FPB-Y01A