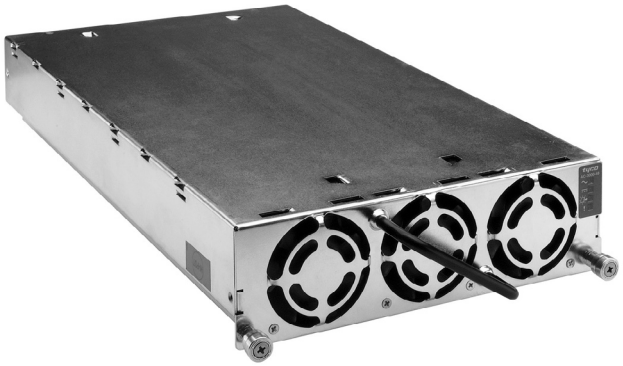
Data Sheet
January 2008

LINEAGE POWER

AC-3000-48 Front-End Power Supply

200 – 240 Vrms Input; ±[48 – 56.2] Vdc Output; 3000W



Applications

- 48Vdc distributed power architectures
- Product designed for ac and dc inputs
- Routers/switches
- LAN/WAN/MAN applications
- File servers
- Indoor wireless
- Telecommunications equipment
- Enterprise Networks
- Dial aggregate servers
- Advanced workstations
- Mass storage

Features

- Universal high-line ac input
- Constant power limit to 52Vdc
- SMBUS compliant i^2C communications
- Interfaces to two independent controllers
- IPMI compliance can be supported
- RS485 will be added in a future release
- Power factor correction (meets IEC* 1000-3-2 and EN 60555-2 requirements)
- Overvoltage and overcurrent protection
- Overtemperature warning and protection
- Redundant, parallel operation
- Remote ON/OFF
- Active load sharing w/sharing monitor
- Hot insertion/removal (hot plug)
- Power fail warning
- Input undervoltage lockout
- Front panel LED indicators
- UL* 60950 Recognized, CSA† C22.2 No. 60950-00 Certified, VDE‡0805 Licensed (IEC60950, 3rd edition)
- CE mark meets 73/23/EEC and 93/68/EEC directives§
- ISO** 9001 and ISO14001 certified manufacturing facilities

Description

The AC-3000 Rectifier provides the interface between commercial-ac and ±48Vdc based distributed systems. Optimized for dual commercial-ac feeds, two rectifiers are positioned across a 19” rack. Fully featured, these rectifiers protect the system in the event of a fault condition. Utilizing a steering circuit, dual I^2C communication busses support two independent, redundant controllers. An EEPROM contains FRU-ID, and a scratchpad.

In conjunction with the DC-3000-48 PEM and the PS-3000 shelf, the Sentry 3000 Platform enables positioning of the end product into either the telecom-dc or commercial-ac markets by a simple exchange of rectifiers and PEMs.

** UL is a registered trademark of Underwriters Laboratories, Inc.*
† CSA is a registered trademark of Canadian Standards Association.
‡ VDE is a trademark of Verband Deutscher Elektrotechniker e.V.
§ This product is intended for integration into end-user equipment. All the required procedures for CE marking of end-user equipment should be followed. (The CE mark is placed on selected products.)
***ISO is a registered trademark of the International Organization of Standards*

Specifications

Unless otherwise indicated, specifications apply over the standard test conditions specified in this document.

Input

‘	Min	Typ	Max	Units	Notes
Operating Input Voltage	175	–	264	V_{rms}	
Input Frequency	47	–	63	Hz	
Maximum Input Current	–	–	20	A_{rms}	
Inrush Transient Recovery Delay to Spec Limits Max I^2t energy surge	– – –	– – –	40 200 50	A_{peak} ms %	Energy surge determined by the energy surge rating of individual components.
Line Harmonics					Meet EN 61000-3-2 and EN-60555-2 at full rated load.
Holdup time	20	–	–	ms	Measurement starts at zero crossing of the ac voltage. Alarm issued via Power Good signal going HI 5ms prior to output voltages going out of limits. Output voltage allowed to decay to 40Vdc during this condition.
AC leakage current	–	–	3.5	mA	
Efficiency (200 – 240Vac)	89	–	–	%	
Power Factor (High Line 220, 240)	0.95	0.98	–		
EMC (conducted and radiated)					Exceeds FCC and CISPR 22 (EN55022) Class A limits by about 10db.
AC Low Line Protection	–	–	175	Vac	Auto restart commences after input recovers to normal range.
Input Overload					Fuse Protected.
Turn-ON Control					Provided by a short signal pin (enable) of the mating connector.

Safety Consideration: 1. Evaluated for use with maximum 30A branch circuit protection.
2. Evaluated for use with Pluggable Type B or permanently connected equipment only. Not intended for use with Pluggable Type A applications.

Specifications (continued)

Output

Parameter		Min	Center	Max	Units	Notes
Output Voltage Setpoint	48 48P 48RS 52	-46 +46	-56.2 +56.2 -52 -52	-56.2 +56.2 -52 -52	Vdc	Factory adjust setpoints: AC-3000-48: -56.2 Vdc AC-3000-48P: +56.2 Vdc AC-3000-48RS: -52 Vdc AC-3000-52: -52 Vdc Analog and program adjustable to other voltages.
Setpoint Accuracy		-1	–	+1	%	
Overall Regulation		-2	–	+2	%	Includes all variations due to specified load range, drift, and environmental conditions.
Output Power (52 - 56.2Vdc)		0	–	3000	W	Power limited to 3000W
Current Share		-10	–	+10	%FL	Single wire.
Turn-ON Overshoot		–	–	5	%	Percent of nominal input voltage.
Output Ripple and Noise RMS (5HZ to 20MHz) Peak-to-Peak (5HZ to 20MHz)		 – –	 – –	 250 500	 mV_{rms} mV_{p-p}	Measured across 1µF Tantalum, 0.1µF Ceramic, V_I=$V_{I,nom}$, TA= 25°C, I_O = $I_{O,max}$ See Test Configuration section
External Bulk Load Capacitance		0	–	10,000	µF	
Dynamic Load Response (ΔI) di/dt slSlew Rate: 1A/µs (ΔV) Response Time		– – –	– – 100	50 3.5 –	% Vdc ms	Percent of full load.
Turn-ON Delay (Monotonic Turn-ON)		– –	– –	1 100	s ms	From when Power On is asserted. From 30% to 100% of V_{nom}
Hot Plug						Insertion or removal of a power supply from a functioning system will not cause disruption of normal system operation.
Over-Current Protection		105	–	130	%FL	The rectifier will attempt a continuous restart from overcurrent shutdown.
Over-Voltage Protection		58	–	60	Vdc	Short duration tarnsient to 65Vdc is permitted. Three restarts will be attempted. If it shuts down three times it will remain latched.
Over-Temperature Protection						Thermal warning is provided 5°C prior to shutdown. The rectifier will restart once the temperature cools down to within operational range.

Standard Test Conditions

Parameter	Min	Max	Units	Notes
Input Voltage	200, 220 and 240		Vac	50 and 60 Hz
Load Configuration Standby, 5.1Vdc Standby, 56.2Vdc Normal, 5.1Vdc Normal, 56.2Vdc	 0.05 0 0.05 0	 0.1 0 0.1 53.4	 Adc 	

Specifications (continued)

Environmental

Parameter		Min	Max	Units	Notes
Operating Ambient Temperature		0	55	°C	
Non-Operating Ambient Temperature		-40	85	°C	
Operating and Storage Humidity		5	95	%RH	Non-condensing
Operating Altitude		0	3000	meters	101.3 kPa to 70.1 kPa
Non-Operating Altitude		0	12,000	meters	101.3 kPa to 19.2 kPa
Shock	Operating	5		G_{peak}	11 ms duration, 10 shocks per face, half sine waveform
	Non-Operating	30			
Vibration	Operating	0.5		G_{peak}	5-500-5Hz, sinusoidal, 1 octave/min, 2 sweeps on each axis, 4 dwells
	Non-Operating	1.2			
Immunity Requirements (per IEC1000)					
ESD, Contact Discharge		6		kV	Metallic surfaces, 50 discharges
Radiated Electromagnetic Fields		10		V/m	80% modulation at 1 kHz
Electrical Fast Transient/Burst-Power (Line-Earth, Neutral-Earth, GRD-Earth)		4		kV	1 minute per IEC 61000-4-4, Level 3
	Signal Pins	1		kV	
Voltage Surge	Line-Line	2		kV	500V increments
	Line/Neutral-Earth	4		kV	
Line Conducted Immunity					per ENC61000-4-6
Reliability		250,000		Hrs	At ambient of 25°C at full load.

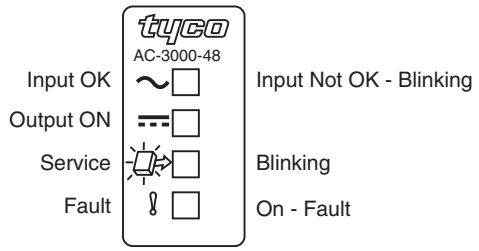
Status and Control

The rectifier is designed to either operate stand-alone without a communications bus or it could be interfaced to an external communications bus.

The first revision of the product is designed to interface to two separate host controllers via the i^2C communications protocol. In this configuration the system determines which host controller is in control via the Master-control pin C1 of the output connector. Software complies with SMBUS revision 2.

Front Panel LEDs

There are four LEDs on the front panel as shown:



Input: Blinking indicates that the input voltage level is out-of-limits.

Service: Blinking indicates that the power supply can be removed from service.

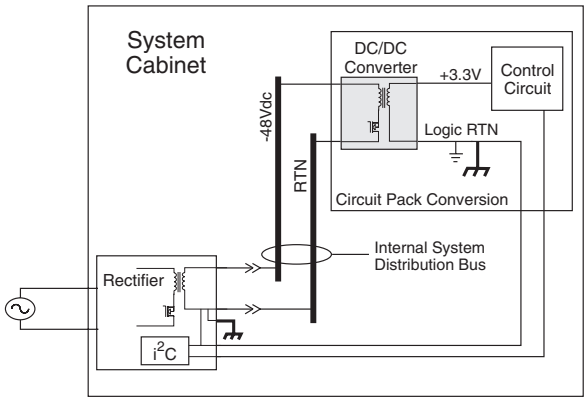
Blinking is 0.5 seconds ON and 0.5 seconds OFF

Fault: Constant ON of the red FAULT LED indicates that a rectifier failure has occurred.

LED Test: The LEDs can be tested or a unit ID can be announced via software commands under i^2C control. The LED test command instructs all four LEDs and rear connector signals to blink continuously. This feature enables visual identification and verification of signal integrity of a particular power supply.

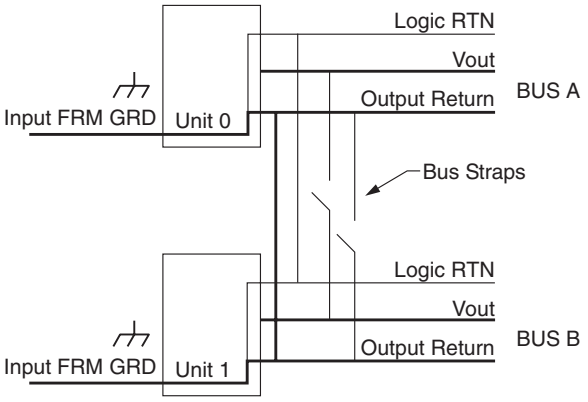
Grounding

To satisfy the need for a single backplane that can accommodate both the AC-3000 rectifier and the DC-3000 PEM, the output return of the power supply is tied to frame ground inside the power supply. (See the application note for further information).



System Grounding Plan

The diagram below shows the recommended connections. These connections are provided from Lineage Power with the PS-3000 shelf.



Rectifier Interconnect

Stand-Alone Communications Features

Service (Ok-to-Remove)

A GRD on this signal turns-ON the SERVICE LED to inform maintenance craft that the power supply may be removed from the powered system.

Power Good

A LO output indicates that power is in working order. Once the power good signal is established two basic events shall change this signal;

- If commercial power failed, the Power Good signal will change to a HI level 5 milliseconds before the output voltage of the rectifier goes below 40Vdc.
- If an internal failure occurred the Power Good signal might not change its state in time before the output crashes. However, so long as the bias supply is still running the Power Good signal will change states to a HI level.

This signal is an open collector capable of sinking up to 16mA.

ENABLE Signal

This short pin of the signal array of the mating connector must be grounded to output ground for the rectifier to turn-ON. This short pin ensures that either turn-ON or turn-OFF of the rectifier commences while all pins are engaged.

Enable can also be used to immediately turn OFF the rectifier by breaking this ground connection.

To Re-start after a latched shutdown, first break the connection, wait 100ms, then re-engage the ground connection.

Fault

This signal goes LO for any failure that requires rectifier replacement. Some of these faults are:

- Fan failure
- Overtemperature
- Overtemperature shutdown
- Overvoltage shutdown

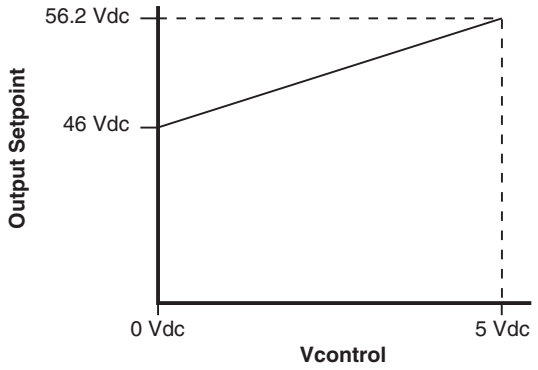
Isolation Test

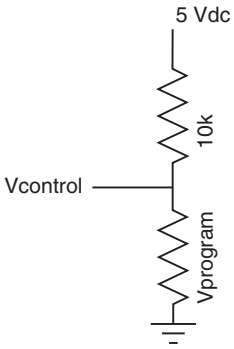
A logic LO pull down of this signal (pulled up to 5Vdc internally via 10kΩ) starts an internal test of the Or'ing function feature of the rectifier. Within 1.5 seconds the test will complete. A change in the STATUS register state during the 1.5-second test time indicates that the Or'ing function feature test failed.

Margining

Setpoint of the rectifier can be changed via this input pin. Programming can be either a voltage source or a resistance divider. The margining pin is connected to 5Vdc via a 10kΩ resistor inside the rectifier. See graphs below.

An open circuit on this pin reverts the voltage level back to the original setting. (Note: In case of conflict with an i^{2}C issued margining instruction, the lower setting instruction shall prevail)





MODULE_PRESENT[0:1] Signal

This is a three-level signal that is separately buffered to each of the two controllers. The signal must be referenced externally by the using system to 3.3Vdc via a 10kΩ resistor.

Signal	Condition	Typ	Units
High	RECTIFIER not present	3.3	Vdc
Midlevel	RECTIFIER operational	1.65	
Low	Internal failure	0.4	

Overtemp

If the temperature of the rectifier gets too close to a shutdown level, within 5°C of shutdown, this signal changes to a LO state.

I^{2}C Communications

Two independent external system controllers can control the rectifier. The using system via the Master Control signal pin of the mating connector tells the rectifier which of the two controllers is the master. Only one master can communicate with the power supply at any one time.

A serial EEPROM (ATMEL AT24C64 or equivalent) is located external to the micro-controller. The EEPROM is organized in 8 bit words (8192 x 8) and has a capacity of 64K. This EEPROM has its own assigned address. It is used for storing Lineage Power factory control information in the high memory locations. Lower memory locations below the Lineage Power data are provided for user applications. User factory control information and operational information are just some of the tasks that could be recorded and retrieved by the user.

The user is responsible for maintaining the integrity of factory-stored data.

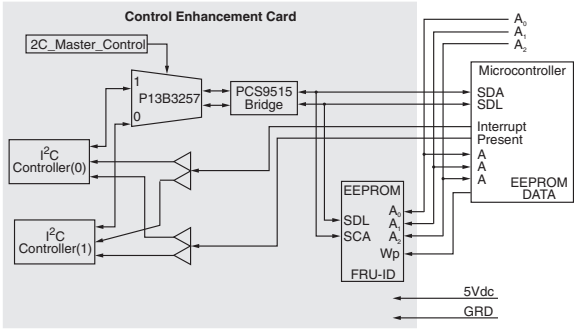
Addressing

Up to eight different power supplies can be discriminately addressed via the three hardware setpoints.

Addressing cannot be changed once the power supply is operational. Dynamic addressing is not supported.

Redundant i^{2}C Communications

The first revision of the product is designed to interface to two separate host controllers via the i^{2}C communications protocol. In this configuration the system determines which host controller is in control via the Master-control pin C1 of the output connector. A ground on this input selects controller 1 the communicator.



Dual Controller I^{2}C Interface

Ground Reference
I^2C bus ground return and control ground inside the rectifier are referenced to the same common point.

Interrupt
This output pin signals the system that a change of state has occurred and immediate attention is requested.

Control and Measurement Functions
- ON/OFF
- Reset
- Margin
- Diode test
- LED / hardware signal test
- Re-program of secondary micro-controller
- Modification of control/shutdown limits
- Output voltage level read
- Output current level read
- Internal temperature level read
- Control state of the rectifier
- Alarm state of rectifier

Fan Operation

The fans are designed to operate only when required.

Variable speed control ensures the quietest operation possible.

Micro-Controller Programmability

Software residing in the power supply micro-controller can be re-programmed either through the output connector of the power supply or via the control connector of the shelf. Updates, modifications or improvements are easily incorporated without changing the power supply or sending it back to the factory.

Some internal set-points are user adjustable.

EEPROM Features and Programmability

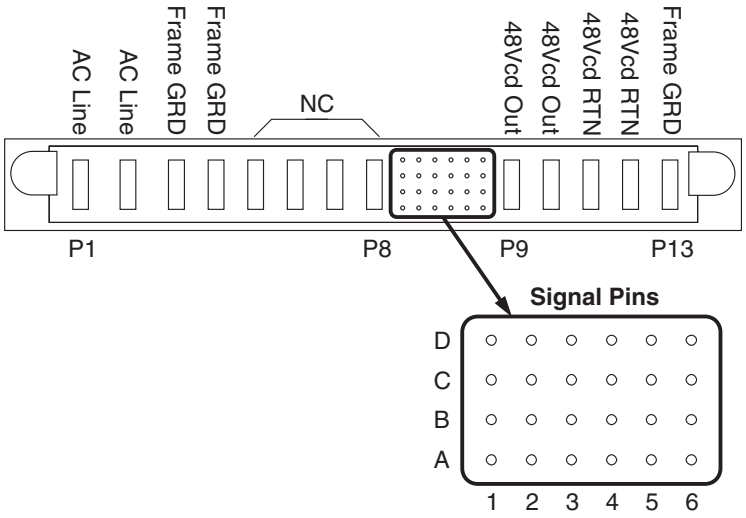
An external EEPROM connected across the communications bus is used for FRU-ID and as a scratchpad. The device cannot be accessed by the power supply. This EEPROM is used strictly for identification and user access purposes.

FRU-ID resides in the upper quarter of memory of the EEPROM. Although these parameters are normally write-protected, they can be modified if desired. The Program Mode pin of the output connector is used to enable the programming of the micro controller and the EEPROM. A HI (5Vdc) on the Program Mode pin disables the write protect feature of the external EEPROM.

Once the write-protect feature is disabled, the entire EEPROM is erasable and re-write able. Writing into the EEPROM can be accomplished with the power supply ON or OFF so long as the external 5V bias powers the communication circuitry.

Connector Pin Definitions

Output Connector: AMP 1450230-3 or FCI-PwrBlade equivalent

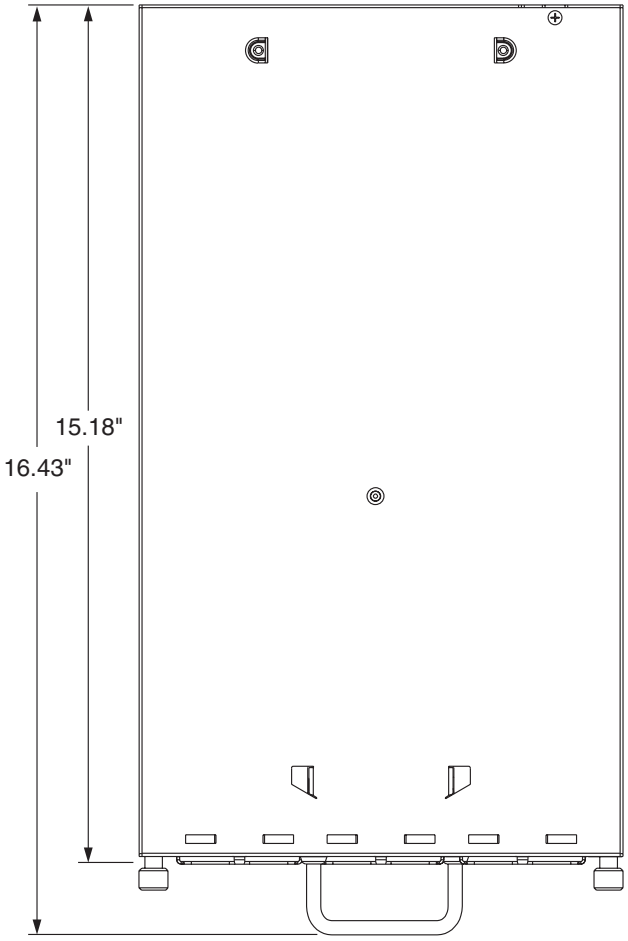


Signal Pins

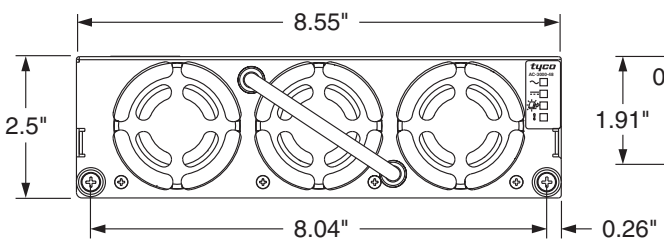
D1	Present-0	**D2**	Interrupt-0	**D3**	SDA-0	**D4**	SCL-0	**D5**	Mclear	**D6**	Enable
C1	Master-Control	**C2**	Margining	**C3**	Fault	**C4**	Overtemp	**C5**	Program Mode	**C6**	Logic GRD
B1	A_0	**B2**	A_1 / PGC	**B3**	A_2 / PGD	**B4**	Power Good	**B5**	Service	**B6**	Isolation Test
A1	Present-1	**A2**	Interrupt-1	**A3**	SDA-1	**A4**	SCL-1	**A5**	Ishare	**A6**	5Vdc

Short signal pin, breaks first and mates last.

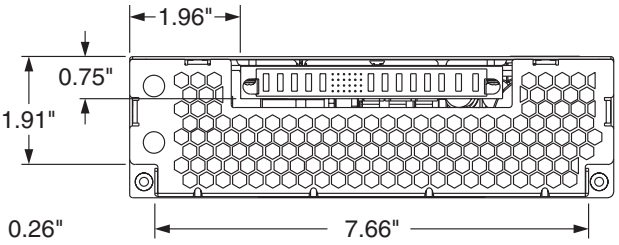
Outline Drawings



Top View



Front View as Positioned in Shelf



Rear View as Positioned in Shelf

Ordering Information

Product	Description	Comcode
AC-3000-48	Dual redundant i^2C, factory setting: -56.2 Vdc	108975632
AC-3000-48P	Dual redundant i^2C, factory setting: +56.2 Vdc	108982364
AC-3000-48RS	RS-485, factory setting: -52 Vdc	108991320
AC-3000-52	Dual redundant i^2C, factory setting: -52 Vdc	108994323

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