PF1200-4801

1200 Watt Hot-Swap/Redundant Front-End Switching Power Supply
48V Primary Output with 5VSB @ 250mA

Introduction

The PF1200-4801 Front-End Modules from SAE Power deliver 1200W of highly reliable isolated 48VDC with 5V standby power. These supplies are ideal for usage in today's distributed power architectures.

These suppplies offer state-of-the-art status and control functions in both analog (TTL) and Digital (I^2C) signal sets. This feature allows engineers more flexibilty and control in their system designs. The functions include remote on/off control, power supply present, voltage adjustment, current monitor, AC OK, DC OK, remote sense, current share, fan fail and overtemperature warning. Multiple Racks may be interconnected for additional power and redundancy.

These supplies have been mechanically designed to accomodate 1U (horizontal) or 3U (vertical) mounting. Measuring only 10.25 x 4.83 x 1.60", these supplies are designed to fit the majority of today's distributed power applications. Customers may mount these supplies in SAE Power's standard off-the-shelf 1U or 3U high 19" rack mount chassis or directly into the OEM system. The hot-swap / blind-mate connectors enable customers fast and easy integration of these supplies with no down-time.

Key Features

- 1200 Watt Output Power over entire range from 90 to 264VAC
- Universal AC Input with Active Power Factor Correction
- Full Load operating temperature range from –10 to +50°C
- 1U x 3U form factor (1.6 x 4.83 x 10.25")
- Excellent combination of both High Reliability and Low Cost
- Up to 3,600W in 1U 19" Rack
- Up to 10,800W in 3U 19" Rack
- Full hot-swap capability, with low insertion/extraction force
- Front panel LED's for AC OK and DC OK
- Temperature controlled fan speed, for low noise and long life
- Configurable I^2C interface status and control
- Single wire active current share
- Operating Parameters adjustable via Analog or Digital Interface
- N+1 or N+M Redundancy
- Integral isolation (OR-ing) mosfets
- Stand-by power of 5V @ 250mA
- Full array of status & control signals (digital & analog)
- Remote sense: up to 0.5V cable losses compensation
- No minimum load required
- Main 48V Output may be referenced as positive or negative
- RoHS compliant

Typical Applications

- Distributed Power Architectures
- Server Equipment
- LAN / WAN / SAN Applications
- Network Equipment
- Automated Test Equipment
- Network Attached Storage

Specifications are subject to change without notice

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Input Specifications

PARAMETER	MIN	TYP	MAX	UNIT	NOTE
Input Voltage	90	-	264	VAC	Brownouts below input range will not damage the supply
Turn-On Voltage	-	-	90	VAC	
Turn-Off Voltage	85	-	-	VAC	
Input Transient (Operational)	-	-	300	VAC	Not to exceed 20ms
Input Frequency	47	-	63	Hz	ETSI 300132-1 Compliant
Inrush Current	-	-	30	Amps	Measured at 25°C for all line conditions, cold start, half cycle average
Input Current	-	-	15.2	Amps	Maximum
Input Protection	- -	- -	20 250	Amps VAC	Dual Fused (Both Line & Neutral), Type 3AB Axial
Operational Efficiency	-	88%	-	%	Full Load and 230 VAC Operation including OR-ing function
Power Factor	0.98	-	-	PF	Meets IEC61000-3-2 Limits for Harmonic Current Emission
Leakage Current	-	-	1.0	mArms	at 230VAC / 60Hz Operation per module
Hold-Up Time	20	-	-	ms	Assuming 90VAC, 25°C and Full Load Operation

Output Specifications

PARAMETER	MIN	TYP	MAX	UNIT	NOTE
Output (Setpoint) 48V: 5VSB:	47.5 4.75	48.0 5.0	48.5 5.25	VDC VDC	Consult Factory for unique setpoint requirement
Adjustment Range	-5	-	+5	%	Apply analog volatage between VoAdj Pin and Standby Return Pins of 0~2.5V (OV =-5% / 1.25V = 48V / 2.5V = +5%)
Output Power	-	-	1200	Watts	
Output Current 48V: 5VSB:	- -	- -	25 0.250	Amps	
Current Share	-	-	10	%	Single Wire Current Share Accuracy in % of full load
Regulation 48V: 5VSB:	- -	- -	1 5	% %	Maximum for any combination of line, load and temperature regulation
Ripple Noise	-	0.5	1	%	20MHz bandwidth
Transient Response	- -	- -	5 300	% μs	Maximum Deviation for a 50% step load (<1Aμs) for load conditions >10% of Iout
Turn-On Over-Shoot	-	-	None	-	Monotonic start-up to 48V with no overshoot
Turn-On Delay	-	-	1.5	Secs	Applying AC Input (Cold Start)
Remote On Delay Time	-	-	500	ms	AC present >2 seconds and output is enabled
Remote Off Delay Time	-	-	10	ms	Output in regulation >2 seconds and output is inhibited
Over-Current Protection	110	-	-	%	Constant Current Foldback. Current limit is adjustable via digital signal (auto-reset). Contact factory for custom setpoint.
Over-Voltage Protection	-	-	56	VDC	Latched Off - Recycle AC Input or Apply Remote Off / On to reset
Over-Temp Protection	-	-	85	°C	Self protecting shutoff with auto-recovery and hysteresis

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Environmental Specifications

PARAMETER	MIN	TYP	MAX	UNIT	NOTE
Operating Temperature	-10	-	+70	°C	Derate Output Power 2.5% per °C above 50°C
Cooling	-	-	-	-	Temperature controlled ball bearing fans for low noise and long life.
Storage Temperature	-40	-	+85	°C	
Operating Humidity	10	-	95	%	Non-Condensing
Storage Humidity	10	-	95	%	Non-Condensing
Operating Altitude	-	-	2,250	Meters	700-1100mbar
Storage Altitude	-	-	10,000	Meters	300-1100mbar
Shock & Vibration	6	-	-	G rms	Designed to meet NEBS GR-63-CORE Level 3 (20-200Hz, 30 min, 6 G rms acceleration), TELECORDIA GR-63-CORE, GR-487-CORE Seismic Zone 4.
Reliability - Bellcore RPP	-	250,000	-	Hours	Assuming Full Load and 50°C Operation

Isolation Specifications

Parameter	Description
Input to Output	3000 Vrms (Dielectric Factory Test)
Input to Ground	1500 VAC per EN60950
Output to Ground	500 VDC per IEEE802

Electromagnetic Compatibility

Parameter	Description
Electrostatic Discharge	EN61000-4-2, +/- 4kV Contact, +/- 8kV Air Discharge
Radiated Susceptibility	EN61000-4-3, 26-1000MHz, 10V/M, 80% AM
EFT / Bursts	EN61000-4-4, ± 2KV
Surges	EN61000-4-5, ±2KV Line-Earth, ±1KV Line-Line
Conducted Immunity	EN61000-4-6, 0.15 - 800MHz, 10V, 80% AM
Voltage Dips	EN61000-4-11, 95% Dip & 10ms, 30% Dip & 500ms
Voltage Interruptions	EN61000-4-11, 20% Reduction, 5s
Radiated Emissions	EN55022 Class B, EN61204 Class B (In Rack or customer enclosure)
Conducted Emissions	EN55022 Class B, EN61204 Class B
Harmonic Current	EN61000-3-2 Class D
Fluctuations / Flicker	EN61000-3-3

International Standards

Parameter	Description
Safety Approvals	cTUVus EN60950, CE Mark (LVD)

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Status & Control Signals

These 1U power modules contain a microprocessor control circuit that provides active control of the power conversion, cooling and external digital and analog interface. The microprocessor control employes a SMBus interface, compatible with I2C signaling, at the power unit and optionally at sub-racks levels. This control is implemented using flash memory, which is in-system reprogrammable over the SMBus interface. The signals provided at the power unit connector are described in the physical interface section. The logical interface section provides a brief description of the available SMBus interface and protocol.

Sub-Rack Physical and Logical Interface

The sub-rack interface exposes the features of the power unit interface to the outside world. and is available as both a passive-backplane and a modular digital/analog backplane incorporating a microprocessor-controlled IO Bridge board. The passive-backplane provides for communication using the SMBus and or physical signals as described later. The use of SMBus is optional as the system will run without it. The IO Bridge configuration provides the ability to connect the sub-rack to other racks or networks such as RS485-based, Ethernet or other physical and logical protocols, at the same time providing selected power unit control signals such as remote sense, PSON, alarms etc.

Power Unit Physical Interface

Each signal available at the connector is described below. Where indicated, an internal pull-up resistor is present. The pull-up is a combination of the VSB supply and an internal source of +5V diode OR-ed together. All of the control signals are referred to STANDBYRTN except the +SENSE and –SENSE, +VOUT and –VOUT. The output is floating +/- 60V with respect to the controls permitting arbitrary output polarity. The output and controls are not DC referenced internally to protective earth by high-value resistors to bleed off any accumulated charge on bypass capacitors.

SDA
- SMBus I2C compatible serial data line
- 5V and 3V compatible
- no internal pull-up on this line

SCL
- SMBus I2C compatible serial clock line
- 5V and 3V compatible
- Internal pull-up on this line.

A0
- Power Unit address input bit 0 (least significant bit)
- Sets the address for SMBus and LS_BUS communications
- Internal pull-up

A1
- Power Unit address input bit 1
- Sets the address for SMBus and LS_BUS communications
- Internal pull-up

ACOK/A2
- normally low output which goes high to indicate loss of AC input
- open-collector signal
- internal pull-up may be de-populated as factory hardware option
- active state may be changed (reversed) as firmware option
- alternatively used as address bit A2 input as firmware option

PSMODE
- Power Unit input used to activate optional interface features
- Firmware option determines physical and logical interface configuration – so power units may be used in different sub-racks or systems without change
- Internal pull-up

PWOK/A3
- normally low output goes high to indicate output voltage alarm
- open-collector signal
- internal pull-up may be de-populated as factory hardware option
- active state may be changed (reversed) as firmware option
- alternatively used as address bit A3 input as firmware option

LS_BUS
- open collector bidirectional digital signal
- internal pull-up may be de-populated as factory hardware option
- used for communication directly between Power Units for load share control

FANFAIL
- normally low output which goes high to indicate fan failure alarm
- open-collector signal
- no internal pull-up
- active state may be changed (reversed) as firmware option

OTWN/ALT
- normally low output goes high to indicate over-temperature alarm
- open-collector signal
- no internal pull-up
- active state may be changed (reversed) as firmware option
- alternatively used as SMBus alert signal as firmware option

+SENSE
- positive remote sense connection (local regulation operates without connection of sense leads)

-SENSE
- negative remote sense connection (local regulation operates without connection of sense leads)

5VSB
- +5V 0.25A standby supply output
- Operates independently of main outputs

VSB12
- +12-14V 0.2A unregulated output
- Internal sub-rack use only to power paralleled controller circuits during fault

FANOVRD
- +12-15V / 1A input provides external source of fan power

VOADJ
- analog input to adjust output margin +/- 5% by applying a voltage from 0-2.5V (0 = -5% / 1.25=12V / 2.5 = +5%)
- input impedance >50K ohms

STANDBYRTN
- common return
- return for all control signals except +SENSE, -SENSE
- should be tied to PE ground in system for ESD and SELV reasons as with any logic signals.

PSPRESENT
- internally connected to STANDBYRTN to indicates PS presence
- internal impedance is 10 ohms

CURMON
- analog output from 0 to 5V proportional to main output current

PSKILL
- input connected to STANDBYRTN to enable the power unit
- short last-mate/first-break pin on PS connector for hot-plug
- open connecion disables PS and microprocessor controls
- signal has internal pull-up to voltage that is between 5-8V

PSON
- input when driven high (+5V) will enable the power unit
- no internal pull-up
- when driven from low to high will reset internal watchdog circuit if activated, restarting microprocessor controls
- when driven from low to high will enable recovery from over-voltage latch off

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Power Supply Logical Interface:

The logical interface consists of the discrete signals described above. All of the digital inputs and outputs are defined in firmware hence their use is configurable and changeable as a firmware option. For example additional address bits may be defined or alert signals to send to a system controller. The SMBus interface which is compatible with I2C implements messaging based on the SMBus specification. The SDA and SCL lines comply with the requirements of SMBDAT and SMBCLK. The microprocessor controller has control of the power converters. It takes inputs from output voltage and current sensors, controls fan speed and can report all of these inputs for monitoring purposes. There is additional logic providing for monitoring of temperatures and voltages including the input voltage in the primary circuits of the supply. The control capabilities are limited only by the firmware applied – arbitrary timing of output voltage shutdown, turn-on, alarm warning times etc. is available as a firmware option. The most basic configuration has the following commands available, all using SMBus messaging protocols. The data format for voltages, temperatures and currents is a scaled 16-bit signed 2's complement integer.

Check Present
- the SMBus quick command is used to determine power unit presence

Get Output Status
- the output voltages and currents are returned using an SMBus block read protocol

Get Temperature Status
- the temperature status including hot spot temperature(s) is returned using an SMBus block read protocol
- the warning and shutdown levels and timing may be adjusted to a particular application as a firmware option

Get Fan Status
- the fan operating or failed status including operating speeds are returned using an SMBus block read protocol

Get Input Status
- the input voltage status and measurement of input voltage is returned using an SMBus block read protocol

Get Firmware Information
- returns the firmware revision information using the SMBUS block read protocol

Get Factory Information
- returns the power unit model, serial number and date code information using the SMBus block read protocol

Other Functions
Additional functions exist to place the power unit controller in a so-called bootstrap mode. In this mode additional commands exist to enable the verification (CRCs) and loading of firmware. As a factory firmware option additional nonvolatile memory may be accessible for customer-applied inventory or other data. The upgrade of firmware over the SMBus incorporates additional security and error detection to prevent inadvertent modification or failed firmware upgrades, incorporating a 16-bit CRC and binary firmware image transfer.

Please request the 1U Family Interface brochure for additional details.

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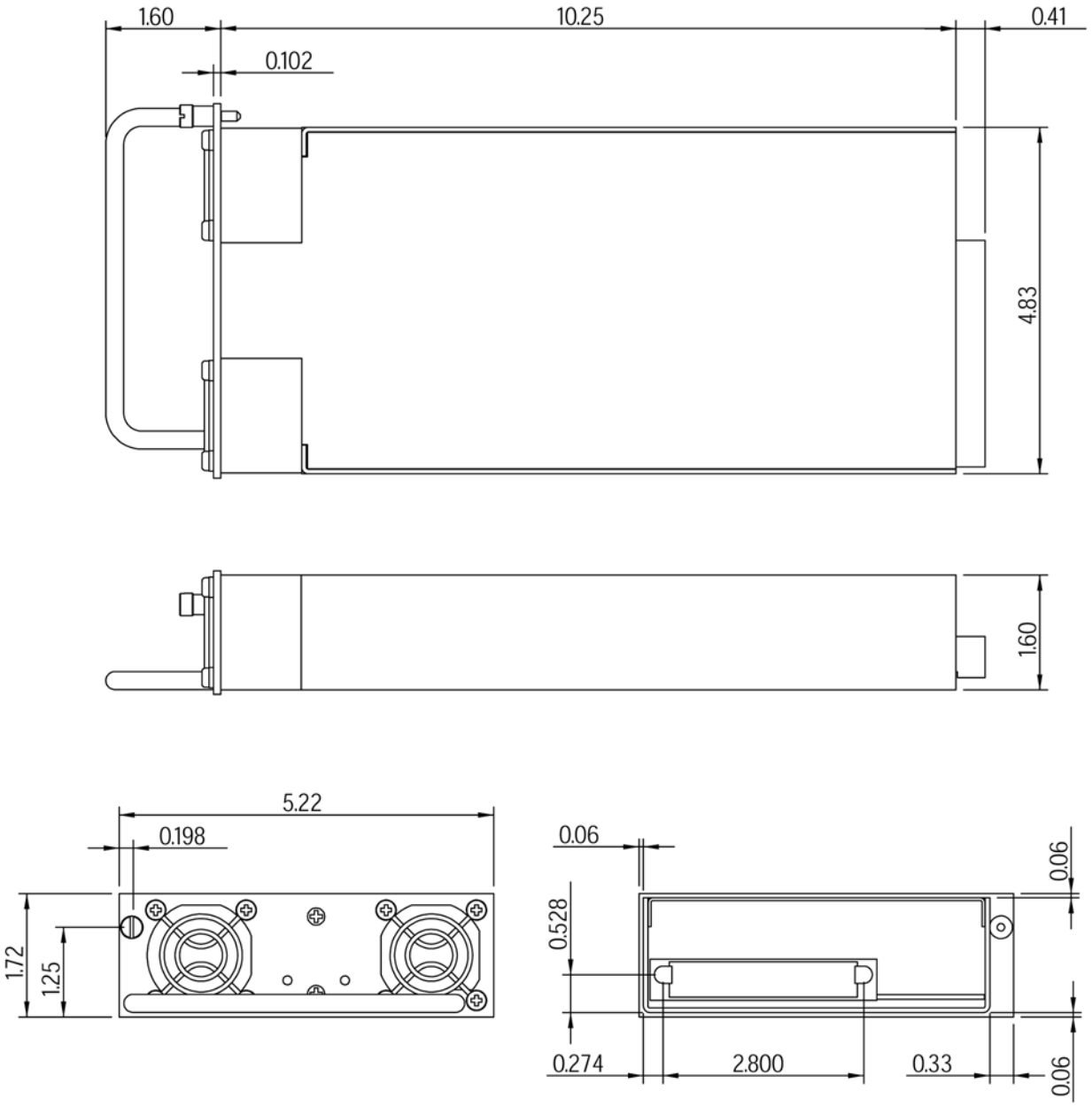
Mechanical Details

Parameter	Description
Module Dimensions	10.25 x 4.83 x 1.60", extraction handle extends 1.60", connector extends 0.41"
Faceplate Dimensions	5.22 x 1.72"
Connector	FCI PowerBlade Series # 51939-147, mates with FCI # 51915-062
Material	Aluminum, Faceplate painted off-white, body is gold chromate
Weight	Each module weighs 3.85lbs /1.76kg

Mechanical Drawing



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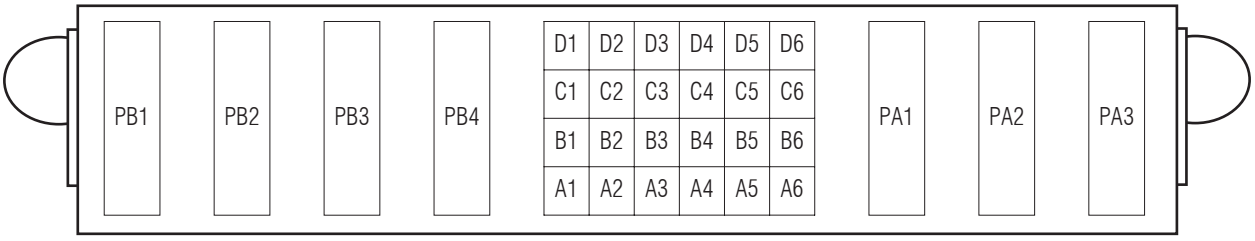
Pin Assignments

Signal Name	Pin	Description
GND	PA1	AC Ground (Chassis Ground)
ACN	PA2	AC Input (Neutral)
ACL	PA3	AC Input (Line)
+V	PB1, PB2	+V1 (Main) Output
-V	PB3, PB4	-V1 (Main) Return
VSB12	A1	+12VDC / 500mA Standby Power (Internal use only, redundantly powers paralleled supply microprocessors)
5VSB	A2	+5VDC / 250mA Standby Power
FANOVRD	A3	Optional External Fan Input Power (12V / 1A)
PSON	A5	Power Supply Enable (TTL Active High)
PSKILL	A6	Hot-Swap Enable / Disable via mechanical short pin
STANDBYRTN	B1, B2	Signals & 5VSB Return (Isolated from output voltage)
PSPRESENT	B3	Power Supply is Present (Internally connected to GND2)
VOADJ	B4	Analog Output Voltage Adjustment
CURMON	B5	Analog Output Current Monitor
AO	C1	I2C Power Unit Address Input bit 0
A1	C2	I2C Power Unit Address Input bit 1
AC OK/A2	C3	AC Present (TTL Active Low), Alternatively used as addres bit A2 input as firmware option
PWOK/A3	C4	Output Power OK (TTL Active low), Alternatively used as addres bit A3 input as firmware option
+SENSE	C5	+Remote Sense Connection (compensates for <500mV drop)
-SENSE	C6	-Remote Sense Connection (compensates for <500mV drop)
SCL	D1	SMBus I2C compatible serial clock line
SDA	D2	SMBus I2C compatible serial data line
PSMODE	D3	Input used to active optional interface features
LS_BUS	D4	Digital Current Share Bus / Single Wire Current Share (no customer connection is permitted)
FANFAIL	D5	Fan Failure Signal (TTL Active High)
OTWN/ALT	D6	Overtemperature warning, Alternatively used as SMBus alert signal as firware option



FCI PowerBlade Connector Part # 51939-147, Mates with FCI PowerBlade Part # 51915-062

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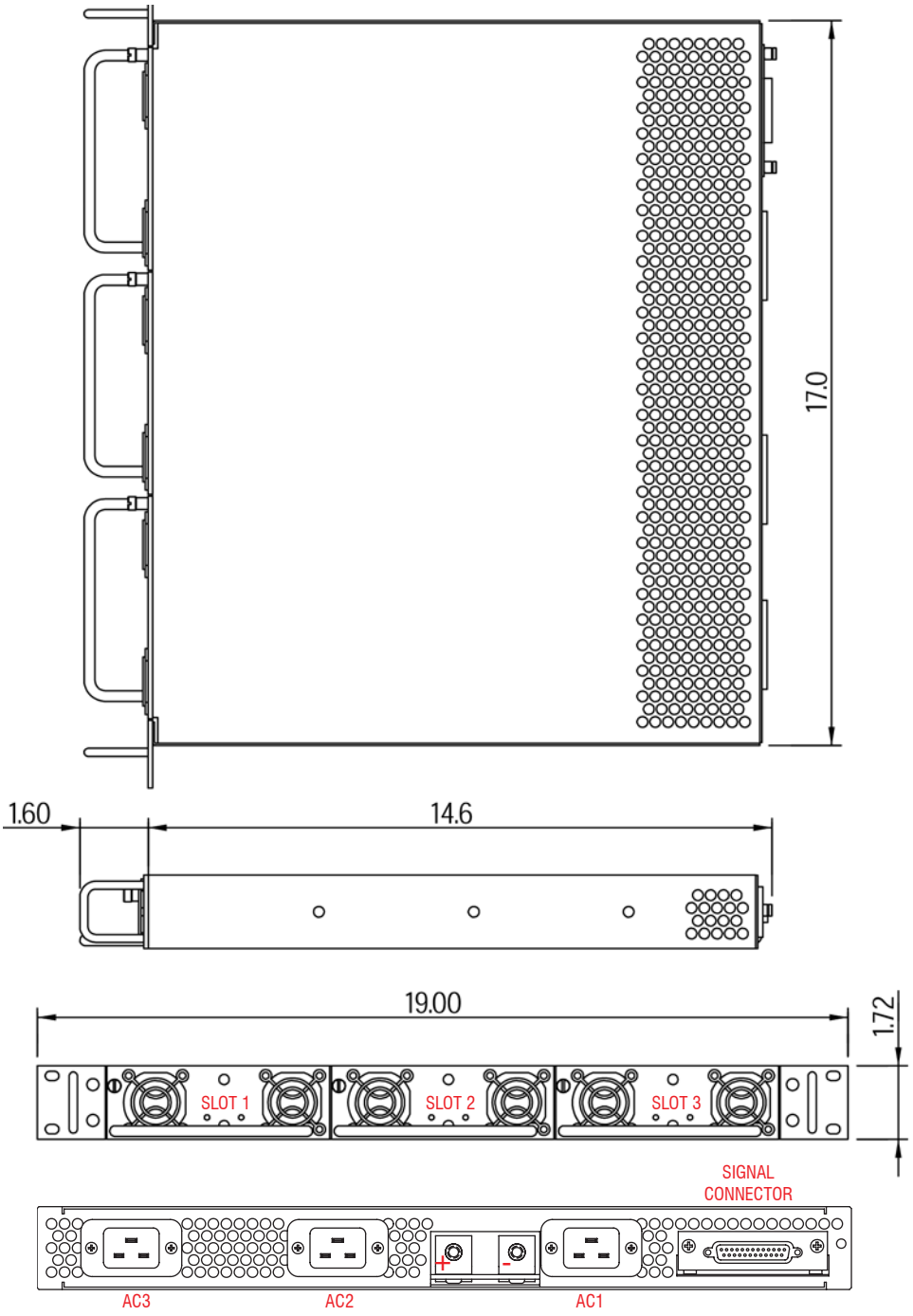
Optional 1U High 19" Rack Mount Chassis - Part # 1U100SA Mechanical Drawing

Parameter	Description
Chassis Dimensions	17" (L) x 14.6" (W) x 1.72" (H)
Faceplate	19" (W) x 1.72" (H)
Material	Steel, RoHS compliant yell chromate finish
Connector	DB25 Connector (Tyco 747846-3 or 747846-4 or equivalent)
Weight	Each chassis weighs 9.605lbs /4.36kg (un-populated)



Standard Connector Pin Assignments	
Pin	Function
1	PWOK/A3_3
2	PWOK/A3_2
3	PWOK/A3_1
4	ACOK/A2_1
5	ACOK/A2_3
6	ACOK/A2_2
7	-SENSE
8	+SENSE
9	SPARE PIN
10	SCL
11	OTWN/ALT *
12	CUR MON 3
13	PSPRESENT_3
14	SDA
15	VSB
16	CUR MON 1
17	CUR MON 2
18	VO ADJ 1
19	VO ADJ 2
20	VO ADJ 3
21	LS_BUS
22	PSON *
23	PSPRESENT_1
24	PSPRESENT_2
25	STANDBY RTN

* PSON and OTWN/ALE are "wire OR'd" to all modules.

Suggested AC Cable:
Interpower P/N 86226020

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