OPERATING MANUAL
SIGMA SERIES
FRONT-ENDS & RECTIFIERS

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IMPORTANT NOTE

With effect from this revision the following parts referred to in this manual have been declared obsolete:

I²C option for RSF, RSG & RSJ rectifier modules
Controller type DSC1000 and any associated accessories

Information about this part is retained for the information of existing users only.

REV	DESCRIPTION	CHK'd & APPR'd / DATE
4	PCO# 45400	MM / 07-31-19

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1.0 INTRODUCTION

This Operating Manual should be read through carefully before installing and operating the Sigma Series Front-Ends and Rectifiers.

Sigma Series are 1U x 2U hot-swappable, modular rectifiers & front-ends which produce up to 650 watts output. There are 14 different models with different output voltages and power levels. The modules have automatic load sharing and output ORing diodes so they can be hot-swapped while the system is operating. Module output voltage can be controlled by 0V to +5V analog input.

Green LEDs indicate AC and DC power good. The rectifiers also have control and monitoring features and a +5V standby output. Operating temperature range is -20°C to +70°C.

Companion 19-inch shelves hold up to four modules which can also be operated in a N+1 redundant mode. Single and dual output bus models are available.

Figure 1 below shows four Sigma modules and four modules installed into one of the power shelves.

Figure 1 - Sigma Modules & Power Shelf

2.0 STANDARD FEATURES

- ◆ 1U x 2U Profile: 1.6 x 3.3 Inches
- ◆ -20°C to +70°C Operation
- ◆ 85 to 264VAC or 90 to 420VDC Input
- ◆ Up to 653W Module Output
- ◆ Up to 2612W Shelf Output
- ◆ >0.99 Power Factor
- ◆ Output Voltages: 12VDC and 54.4VDC
- ◆ 19" Rack/Shelf Holds 4 Units
- ◆ Single or Dual A/B DC Outputs
- ◆ Hot Swappable
- ◆ Integral ORing Diodes
- ◆ Class B EMI Filter
- ◆ Low Noise Variable Speed Fan
- ◆ I²C Serial Data Option
- ◆ 19- or 23-Inch Rack Mounting

3.0 SUMMARY OF PRODUCT LINE

3.1 STANDARD MODULES

MAX. POWER	OUTPUT VOLTAGE	OUTPUT CURRENT	AC INPUT VOLTAGE [1]	AC INPUT CURRENT [2]	MODEL NO. [3, 4]
653W 550W 400W	54.4VDC	12.0A 10.1A 7.4A	85-264VAC	6.5A / 3.2A 5.4A / 2.7A 4.0A / 2.0A	RSJ48/12 RSG48/10 RSF48/7
650W 550W 400W	48.0VDC	13.5A 11.5A 8.3A	85-264VAC	6.4A / 3.2A 5.5A / 2.7A 4.0A / 2.0A	TSJ7000 TSG7000 TSF7000
500W 350W	27.2VDC	18.4A 12.9A	85-264VAC	5.0A / 2.5A 3.5A / 1.7A	RSG24/18 RSF24/13
500W 350W	24.0VDC	20.8A 14.7A	85-264VAC	4.9A / 2.5A 3.5A / 1.7A	TSG5000 TSF5000
450W 300W	13.6VDC	33.0A 22.1A	85-264VAC	4.4A / 2.2A 3.0A / 1.5A	RSG12/33 RSF12/22
450W 300W	12.0VDC	37.5A 25.0A	85-264VAC	4.5A / 2.2A 3.0A / 1.5A	TSG3000 TSF3000

Notes:
1. All units will also operate from 90-420VDC. Consult sales for available 19" power shelf.
2. Input currents shown are nominal values at 120VAC/240VAC as appropriate.
3. To specify I²C Serial Communications append -Z to the model number. In the case of RSJ/RSG/RSF, only for use with the DSC1000.
4. To specify chassis-mount version (front-ends only) delete leading T from model number, e.g. TSJ7000 becomes SJ7000.

3.2 POWER SHELVES

MAX. POWER	DESCRIPTION	MAX. CURRENT	MODEL NO.
2612W	Single Output Bus 4 x IEC60320-C14 AC Input	150A	TSGR1U4A
2612W	Dual A/B Output Bus 4 x IEC60320-C14 AC Input	150A	TSGR1U4D

Blanking kit for unused position, order pt. no. 775-1473-0000.

4.0 SAFETY WARNINGS

4.1 These power supplies have hazardous external and internal voltages. They should be handled, tested and installed only by qualified technical persons who are trained in the use of power systems and are well aware of the hazards involved.

4.2 The input terminals are at hazardous voltage potentials. Do not touch this area when power is applied.

4.3 When operating this power supply, the chassis ground terminal must be connected to safety ground by means of a three-wire AC power line to minimize electrical shock hazard and to ensure low EMI (electromagnetic interference).

4.4 The internal voltages are at hazardous potentials. The power supply cover should not be removed. There are no user-serviceable components in these units. Removing the cover of the power supply will void the warranty.

5.0 WARRANTY (summary)

Sigma Series Front-Ends and Rectifiers are warranted for three (3) years from date of shipment against defects in material and workmanship. This warranty does not extend to products which have been opened, altered or repaired by persons other than persons authorized by the manufacturer or to products which become defective due to acts of God, negligence or the failure of customer to fully follow instructions with respect to installation, application or maintenance.

For a complete text of UNIPOWER's warranty conditions please request a copy from your local Sales Office.

6.0 UNPACKING AND INSPECTION

6.1 This unit was carefully tested, inspected and packaged for shipment from our factory. Upon receipt the unit should be carefully unpacked and inspected for any damage in shipment.

6.2 If there is evidence of damage, **do not attempt to install the unit**. The freight carrier should be notified immediately and a claim for the cost of the unit should be filed with the carrier for direct reimbursement. Be sure to include the model and serial number of the damaged unit in all correspondence with the freight carrier. Also save the shipping carton and packing material as evidence of damage for the freight carrier's inspection.

6.3 UNIPOWER LLC will cooperate fully in case of any shipping damage investigation.

6.4 Always save the packing materials for later use in shipping the unit. Never ship this unit without proper packing.

7.0 MODULE SPECIFICATIONS

INPUT
Voltage Range ..... See Model Table
Power Factor ..... >0.99
Total Harmonic Distortion, Max. 5%
Frequency 47-63Hz
Inrush Current Limiting, Max. ..... 30A Peak
EMI Filter, Conducted ..... FCC20780 pt. 15J Curve B
EN55022
Curve B
Fast Transients EN61000-4-4
Surges EN61000-4-5
Remote Adjust ..... 0 to +5V
Input Protection [1] ..... Internal Fuse, 10A

OUTPUT
Current & Voltage ..... See Model Table
Output Power 300-653W
Voltage Adjustment Range ..... ±5%
Standby Output ..... +5V@250mA
Line & Load Regulation, Max. 2%
Holdup Time ..... 10msec.
Overvoltage Protection ..... Latch Off
Filtering: Wideband Noise, 20MHz BW [2]
48V/54.4V ..... 500mV pk-pk
24V/27.2V ..... 250mV pk-pk
12V/13.6V ..... 125mV pk-pk
Current Limit ..... 105-110% Rated Current
Efficiency [3] 85-90%

SAFETY UL60950-1 2nd Ed., CSA22.2 No. 60950-1 2nd Ed., EN60950-1 2nd Ed.

STATUS INDICATORS
AC GOOD ..... Green LED
DC GOOD ..... Green LED

ALARM SIGNALS (Logic LO, TTL compatible)
ACOK ..... AC present, 5V standby operating
DCOK ..... DC output within -10% of nominal

SERIAL COMMUNICATIONS
I²C ..... Optional, append add -Z to model number

ENVIRONMENTAL
Operating Temp. Range ..... -20°C to +70°C
-40°C start-up, reduced performance
Output Current Derating ..... 2.5%/°C, 50°C to 70°C
Storage Temp. Range ..... -40°C to + 85°C
Environment ..... Pollution Degree 2
Humidity ..... 0% to 95%, Non-Condensing
ESD ..... Bellcore GR-1089-Core and EN61000-4-2
MTBF, 35ºC (Bellcore) ..... 200,000 Hours
Cooling ..... Integral Ball Bearing Fan
Acoustic Noise @ 1m (module) 52-61dB

PHYSICAL SPECIFICATIONS
Case Material ..... Aluminum
Case Dimensions, Inches (mm) ..... 1.6 H x 3.3 W x 11.0 D
(40.6 x 83.8 x 279.4)
Weight ..... 2.1 lbs. (0.95 kg.)

Notes:
1. External protection required when operating from HVDC.
2. 20MHz bandwidth. Measure with 0.1µF ceramic and 10µF tantalum capacitors in parallel across the output.
3. Typical efficiency is at low end of range for 12V output and at high end of range for 48V output.

8.0 FRONT PANEL DESCRIPTION

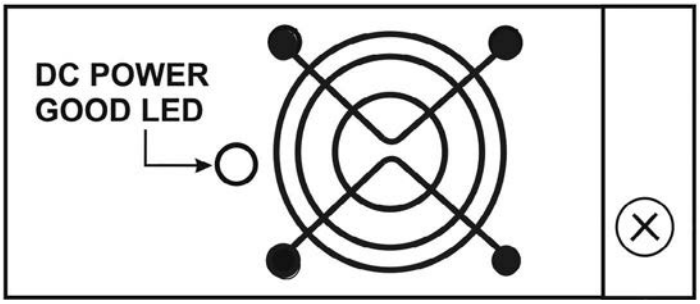


Figure 2 - Sigma Module Front Panel Detail

8.1 FRONT PANEL INDICATORS

The green DCOK front panel indicator represents the DCOK signal and will mimic its state which indicates the output status of the power module.

For normal operation this LED should be illuminated.

9.0 DESCRIPTION OF OPERATION

9.1 Power Outputs

The power output terminals provide the main output power of the unit. The output voltage is adjustable by means of a potentiometer accessible through the top cover of the module or by using the analogue remote adjust pin. Note that all of the power pins must be used for correct operation and to avoid overheating of the connector. The power output terminals are isolated from chassis ground to a maximum voltage of 2000Vdc.

9.2 I/O Signals

The # symbol in the following text is used to denote an active low signal.

9.2.1 Sense +Ve, Sense –Ve

The sense signals are intended to be connected to the point of load so that voltage drop in the load cables can be compensated for. The amount of compensation is limited to 0.25V per wire. Care must be taken when using the sense signals as if the power connections to the load are interrupted by disconnection or circuit breaker with the senses still connected then damage may occur to the power supply and sense wiring. Sense +Ve and Sense -Ve are internally connected to the module output power terminals using 10 Ohm resistors so that if the senses are not connected the output will still be regulated.

Standby Return is internally connected to Sense -Ve and should be used as the return path for all of the I/O signals and standby supply to avoid voltage drops causing errors in the sensed voltage.

9.2.2 Current Share

This signal is connected between all modules required to share a load. This signal is capable of driving up to 16 modules. The return path for this signal is -Ve Sense which should also be connected between all modules for correct sharing operation.

9.2.3 Current Monitor (function not available when the I²C option is fitted)

This analogue signal provides a voltage proportional to the output load current of the module. The return path for this signal is -Ve Sense. The full scale voltage for nominal full load current is 5.0V.

9.2.4 V Trim

This signal can be used to adjust the output voltage. The return path for this signal is -Ve Sense.

The characteristic of remote adjust varies for different models. The table below shows the typical characteristic for the Front-End models. If remote adjust is not required, the pin can be left open circuit.

Remote Adjust Voltage	Output Voltage		
	48VDC	24VDC	12VDC
0	32.1	16.5	8.7
0.5	35.3	18.0	9.4
1.0	38.4	19.5	10.0
1.5	41.6	21.0	10.7
2.0	44.7	22.5	11.4
2.5	47.9	24.0	12.0
3.0	51.0	25.5	12.7
3.5	54.2	27.0	13.4
V/V slope	6.3	3.0	1.33

9.2.5 +5V Standby

This is the standby supply. The 5V supply is always present when the AC is within the operating range of the module. The maximum current available from is 250mA. The return for this power rails is Standby Return. This standby supply has an internal ORing diode so that it may be connected together with other 5V standby rails directly on the backplane.

9.2.6 #AC Power Fail

This signal provides an output that indicates the status of the AC input. The signal is normally low for the OK state. The output is capable of supporting voltages of up to 5V and will sink current up to 30mA. The return path for this signal is -Ve Sense. The AC Good signal will give typically 2ms of warning at full load before the output loses regulation. This signal is internally pulled up to +5V via a 10k resistor. To ensure correct functioning it should be pulled up externally to +5V Standby via a 2k2 resistor.

9.2.7 #DC Power Good

This signal provides an output that indicates that the DC output voltage is below a defined threshold. This level is nominally 90% of the nominal output voltage. The signal is normally low for the OK state. The output is capable of supporting voltages of up to 5V and will sink current up to 30mA. The return path for this signal is Standby Return. This signal is internally pulled up to +5V via a 10k resistor. To ensure correct functioning it should be pulled up externally to +5V Standby via a 2k2 resistor.

9.2.8 #Overtemp. Warning

This signal provides an output that indicates that the power supply internal temperatures are within a safe operating range. The OK state is for temperatures less than 80°C. The signal is normally low for the OK state. The output is capable of supporting voltages of up to 5V and will sink current up to 30mA. The return path for this signal is Standby Return. This signal is internally pulled up to +5V via a 10k resistor. To ensure correct functioning it should be pulled up externally to +5V Standby via a 2k2 resistor.

9.2.9 Module Present

This signal can be used to detect if a module is present. It is connected to Standby Return when the module is present. This signal can sink up to 30mA.

9.2.10 Enable

This signal is used to enable the power supply. It has a short pin on the connector and is intended to control hot-plugging to avoid burning connector pins caused by arcing of high currents. The return path for this signal is Standby Return. The Enable pin should be connected to sense -Ve on the backplane for correct operation.

9.2.11 #Inhibit

This signal can be used to control the main output of the power supply in order to turn it on and off. A low signal on this pin will turn the main output off. The control pin is returned to Standby Return. The driving circuit should be capable of sinking and sourcing at least 0.5mA.

9.2.12 SCL, SDA

These are the serial data bus (I^2C) signals used for digital communication when that option (-Z) is fitted.

9.2.13 GA0, GA1, GA2

These are the I^2C interface address lines. They are used to set the hardware address of each module on the backplane. Each module should have a unique address when connected using the same serial bus.

The address lines should either be tied high (to 5VSB) for '1' or low (-Ve Sense) for '0'. The return path for these lines is -Ve Sense.

10.0 MECHANICAL SPECIFICATIONS

The mechanical dimensions of the Sigma module are shown in figure 3 below. Fixing points are provided for applications where hot-swapping is not required.

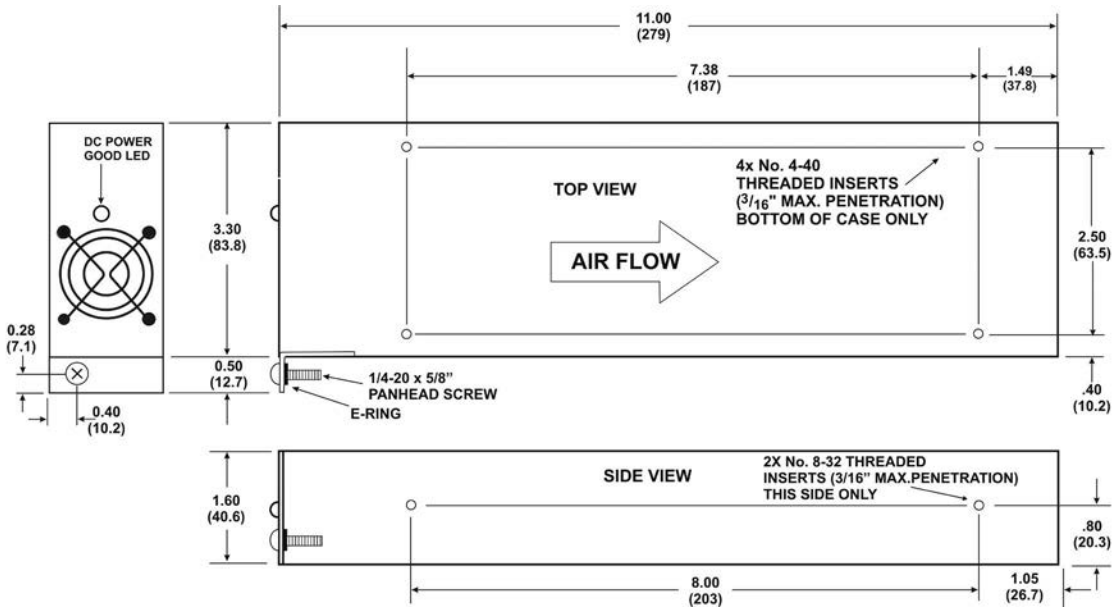


Figure 3 - Sigma Module Dimensions

11.0 SAFETY AND INDUSTRY STANDARDS

11.1 Sigma modules and power shelves meet the following safety standards:
UL60950-1, 2nd Edition
CSA22.2 No. 60950-1, 2nd Edition
EN60950-1, 2nd Edition

11.2 Sigma modules and power shelves are CE Marked to indicate conformance with the European Union's Low Voltage Directive.

11.3 Input conducted EMI meets FCC20780 part 15J Curve B and EN55022 Curve B.

11.4 Input harmonics, meets EN61000-3-2 Class D

11.5 Immunity, meets the following:
Input fast transients, line to line – EN61000-4-4, level 3, criteria A
Input surges, line to line – EN61000-4-5, level 3, criteria A
Input surges, line to ground – EN61000-4-5, level 4, criteria A
ESD – EN61000-4-2, level 4, criteria A
Radiated – EN61000-4-3, criteria A (10V/m)
Dips, Interruptions & Variations – EN61000-4-11, criteria B/C

12.0 OPERATING INFORMATION

12.1 Input Voltage and Connection - The Sigma Series operates from worldwide AC input voltages in the range of 85 to 264 VAC at 47 to 63 Hz. The three-wire AC connection is made to pins 22, 23 & 24 on the rear mounted Positronic connector. See the connector diagram and Pin Connections table in Figure 4.

All units will also operate from 90-420VDC.

12.2 Output Connections - The main output is provided on pins 1 to 4 on the connector. Two pins (1 & 2) are connected together internally for the +V Out; two other pins (3 & 4) are connected together internally for the V Return. The output is fully floating and may be configured for positive or negative operation.

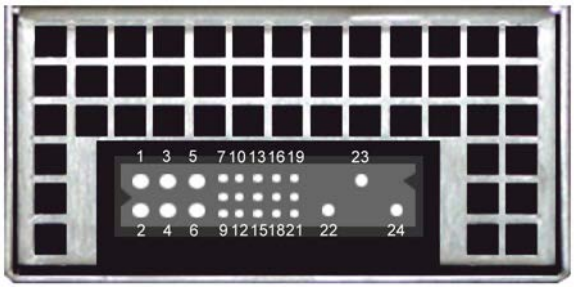


Figure 4 - Sigma Module connection details

PIN	FUNCTION	PIN	FUNCTION
1	+V Out [1]	13	Module Present
2	+V Out [1]	14	GA1 [3]
3	V Return [1]	15	AC Power Fail
4	V Return [1]	16	V Trim
5	Sense +Ve	17	Overtemp. Warning
6	Sense -Ve	18	Current Share
7	Enable [2]	19	Current Monitor
8	GA2 [3]	20	+5V Standby [4]
9	GA0 [3]	21	DC Power Good
10	Inhibit	22	Chassis Ground
11	SDA [3]	23	AC Line
12	SCL [3]	24	AC Neutral

1. For proper operation all +V out pins must be connected together and all V Return pins must be connected together.
2. For unit to operate, pin 7 must be at logic LO or shorted to pin 6.
3. These pins provide the I²C functions when option -Z is present.
4. The +5V standby return is to –Sense (pin 6).

12.3 **Mating Interface Board** - Figure 5 shows a mating interface board which is available for simplifying the testing of a Sigma module. As shown in the photograph, provision is made for input and output connections as well as the control and monitoring signals and I²C interface.

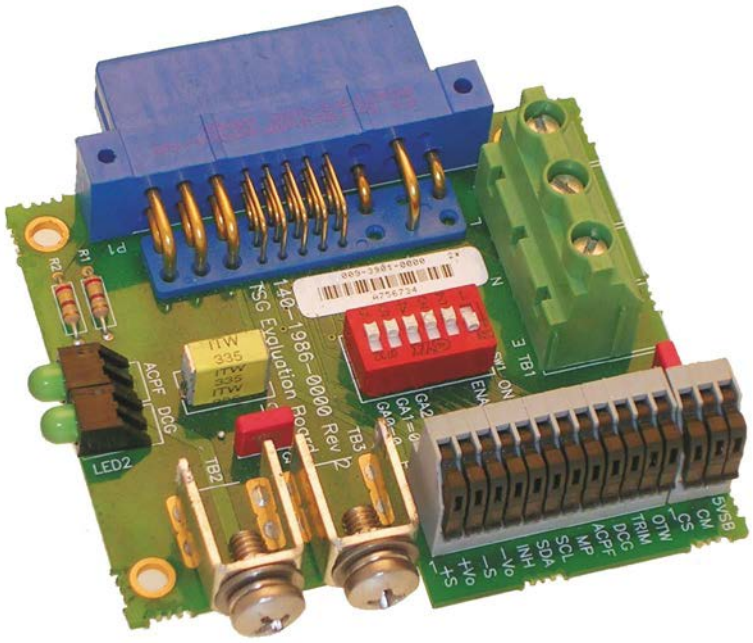


Figure 5 - Sigma Mating Interface Board

12.4 **Output Voltage** - The output voltage is factory set to its nominal value to an accuracy of ±1%. The voltage can be adjusted to any value within the range ±5% of nominal using the trim potentiometer or the remote adjust input (section 9.2.5).

12.5 **Output Power & Current** - The table on page 5 shows the maximum output power and current ratings for the various models.

When the output voltage is adjusted below the nominal voltage shown in the table the maximum current indicated will apply. Conversely, when the output voltage is adjusted above the nominal voltage shown the maximum power indicated will apply.

The maximum output power may be drawn up to +50°C air inlet temperature. Above +50°C the total output power must be derated by 2.5%/°C, up to an absolute maximum air inlet temperature of +70°C. Note that dependent on actual airflow through the unit output power may be further limited or a temperature alarm indicated at lower temperatures.

12.6 **Overvoltage Protection** - The power supply has a fixed internal O.V.P. protection circuit. The O.V.P. level is approximately 130% of the nominal output voltage.

12.7 **Overcurrent and short circuit protection** - The power supply will provide a constant current limit in the event of an overload on the output.

12.8 **Remote Sensing** - Remote sensing connections are made to pins 5 and 6 on the connector. Remote sensing is not available on the +5V Standby output. Remote sensing is used to regulate the output voltage at the point of load by compensating for the voltage drop in the wires to the load. The +Sense lead (pin 5) must be connected to the +Ve side of the load and the - Sense lead (pin 6) to the –Ve side of the load. The sense leads should be a color-coded, twisted pair of AWG no. 22 or 24 copper wire.

Remote sensing can compensate for a total voltage drop of 0.5V, or 0.25V per load wire. The sense leads should not exceed 10 feet (3 meters) in length. If remote sensing is not required, the sense leads may be left open for local sensing at the output terminals. Be careful not to reverse the sense lead connections, as this could damage the unit.

12.9 **Alarm, Control & Supervisory Signals** – All alarm, control and supervisory signals are available on the connector at the rear of the unit. See section 9.2 for a complete description.

All logic signals are TTL level compatible are referenced to –Ve Sense.

12.10 **I²C Serial Bus** – This is available on the connector at the rear of the unit. See section 20 for details.

13.0 PARALLEL OPERATION

13.1 **Parallel Connection** - Two or more Sigma modules can be operated in parallel by connecting their outputs in parallel and connecting their current share terminals together (pin 18). The Sigma 19-inch rack power shelves permit conveniently operating two or three units in parallel in either redundant mode or non-redundant mode.

13.2 **Redundant Operation** - Connecting two Sigma modules in parallel, with or without the compatible 19-inch rack, so that the full output load current can be carried by one unit results in 1+1 redundant operation. While operating normally, the load current is shared approximately equally between the two units. Should one Sigma module fail, the full load is then maintained by the other unit. The failed unit can then be replaced (hot-swap) without affecting the load current. This operation is facilitated by an ORing diode built into the module. 1+1 redundancy with quick replacement of a failed unit results in virtually infinite MTBF. 2+1 redundancy works the same way except that the full load is carried by two out of three units respectively.

13.3 **Non-Redundant Operation - Higher output load currents can be realized by operating two or three or four modul**es in the non-redundant mode to achieve up to 1306 watts for two modules, 1959 watts for three modules or 2612 watts for three modules. The units are connected in parallel the same as before. In this case if one unit fails, the load will lose power since only part of the load current can now be supplied by the remaining module(s), which will go into current limit. The failed unit can be quickly replaced, however, without turning the power off (hot-swap) to restore load current.

The number of Sigma modules that can be operated in parallel is 16. The most convenient way to parallel large numbers of units is to connect multiple Sigma 19-inch rack power shelves in parallel.

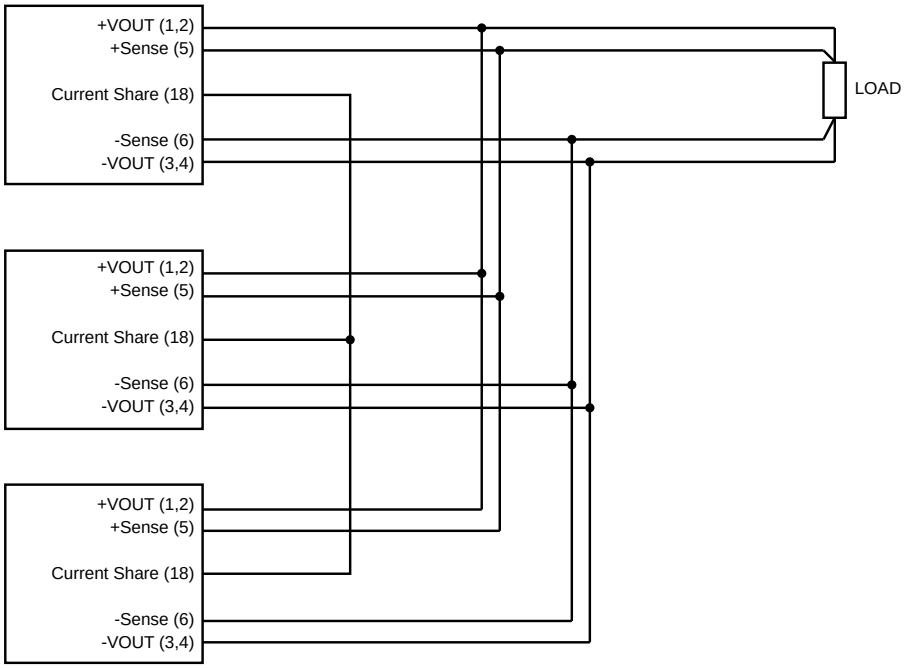


Figure 6 - Connection Diagram for Parallel Operation

14.0 INSTALLATION

Sigma Series modules are designed for mounting into the Sigma Series power shelves or similar OEM housing. Fixing in place is achieved by means of a Pozidrive screw that is also used to push the module home into the mating connector. For non hot-swap applications fixing points are provided on two faces. See figure 3 on page 11 for details.

A mating interface board is available for module evaluation or testing, see section 12.3 on page 13 of this manual.

15.0 COMPATIBLE 19-INCH RACKS

There are four 19-inch compatible power shelves offering various input connections. These power shelves have the following features:

- Standard 19-Inch Rack-Mounting
- Only 1U High
- Hot-Swap Operation
- Single and Dual Bus Options
- Holds up to four Sigma Modules

15.1 Ordering Guide

MAXIMUM POWER	DESCRIPTION	MAXIMUM CURRENT	MODEL NUMBER
2612W	Single Output Bus 4 x IEC60320-C14 AC Input	150A	TSGR1U4A
2612W	Dual Output Bus 4 x IEC60320-C14 AC Input	150A	TSGR1U4D

15.2 Connection Details - Rear views are shown in figures 7a and 7b below.

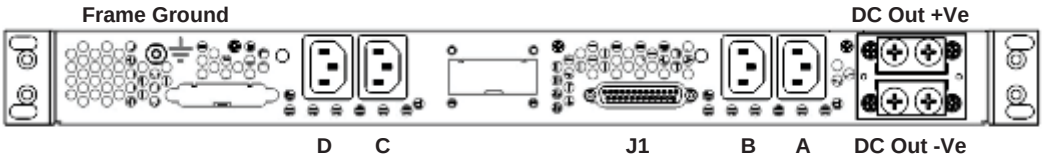


Figure 7a - Model TSGR1U4A Single Output Bus

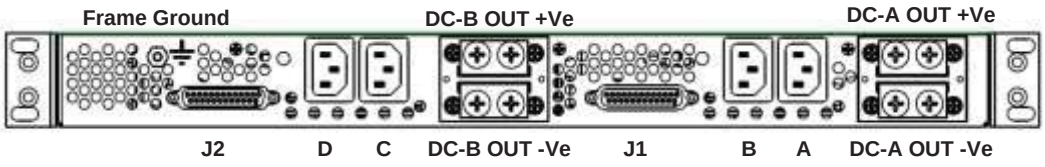


Figure 7b - Model TSGR1U4D Dual Output Bus

AC inputs are supplied separately to each module either via IEC60320-C14 connectors connectors. A, B, C and D are for modules A to D respectively. Module A is on the left side when views from the front.

These shelves are not suitable for HVDC input. Please consult sales for a suitable alternative solution.

On the single bus TSGR1U4A the DC output is supplied on a two bus bars with ¼-20 screw terminals. These bus bars are internally connected to all four module positions inside the unit. The maximum capacity of these bus bars is 150A.

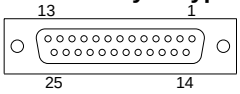
The dual bus TSGR1U4D has two bus pairs of bus bars with ¼-20 screw terminals. The pair designate DC-A are internally connected to module positions A and B inside the unit while the pair designated DC-B are internally connected to module positions C and D inside the unit. Buses A and B are isolated from each other and fully floating so that each side can be used with different voltage modules and configured for different polarities.

J1 and J2 (TSGR1U4D only) are 25-way D-type sockets providing the alarm, control and supervisory signals. The following table and figure show the pinout for these connectors. Details of each pin function can be found in section 9.2.

15.2.1 J1 - TSGR1U4A - Single Bus

PIN	FUNCTION	PIN	FUNCTION
1	Inhibit	14	AC Power Fail – A
2	Not used	15	DC Power Good – A
3	Overtemp. Warning – A	16	AC Power Fail – B
4	Overtemp. Warning – B	17	DC Power Good – B
5	Overtemp. Warning – C	18	AC Power Fail – C
6	Overtemp. Warning – D	19	DC Power Good – C
7	Remote Adjust – D	20	AC Power Fail – D
8	5V Standby 2	21	DC Power Good – D
9	SDA	22	Sense –Ve
10	Current Share	23	Sense –Ve
11	Sense +Ve	24	Remote Adjust – A
12	Remote Adjust – B	25	Remote Adjust – C
13	SCLK		

J1 – 25-Way D-Type

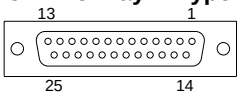


NOTES: 1. These pins are open when the I²C option is fitted.
2. Current rating of +5V standby is 250mA per module.
3. All signals are referenced to –Ve Sense.

15.2.1 J1 (A bus) & J2 (B bus) - TSGR1U4D - Dual Bus

PIN	FUNCTION	PIN	FUNCTION
1	Inhibit	14	AC Power Fail – A or C
2	Not used	15	DC Power Good – A or C
3	Overtemp. Warning – A or C	16	AC Power Fail – B or D
4	Overtemp. Warning – B or D	17	DC Power Good – B or D
5	Not used	18	Not used
6	Not used	19	Not used
7	Not used	20	Not used
8	5V Standby 2	21	Not used
9	SDA	22	Sense –Ve
10	Current Share	23	Sense –Ve
11	Sense +Ve	24	Remote Adjust – A or C
12	Remote Adjust – B or D	25	Remote Adjust – C or D
13	SCLK		

J1 – 25-Way D-Type



NOTES: 1. These pins are open when the I²C option is fitted.
2. Current rating of +5V standby is 250mA per module.
3. All signals are referenced to –Ve Sense.

16.0 MECHANICAL DIMENSIONS

MODEL NUMBER	HEIGHT	WIDTH	REAR EXTENSION	TOTAL DEPTH
TPCMR1U3	1.72” (43.7mm)	17.19” (437mm)	1.10” (27.9mm)	12.66” (332mm)
TPCPR1U3A			1.10” (27.9mm)	12.66” (332mm)
TPCPR1U3B			1.59” (40.4mm)	13.15” (334mm)
TPCPR1U3C			3.32” (84.3mm)	14.88” (378mm)

Front panel to back panel depth is 11.56 inches (294mm).
All shelves are supplied with mounting kits for 19” and 23” relay racks / cabinets.

17.0 INSTALLATION

17.1 Mounting - Sigma Series 19-inch rack-mount power shelves are provided with universal rack- brackets that allows them to be mounted into a 1U high space in both 19-inch and 23-inch racks. The brackets can be located at various positions in the side of the shelf to allow for offset mounting in the rack.

To minimise obstruction to ventilation UNIPOWER advises that any equipment mounted directly above the Sigma power shelf should be shorter in overall depth.

17.2 Input Power Connections - Input power connections are made to the IEC60320-C14 mounted at the rear of the power shelf. Each module position has its own input connector. UNIPOWER can supply various line cords; see the current datasheet for details. It is recommended that each input feed is protected by its own circuit breaker.

17.5 DC Output Connections - DC output connections are provided at the rear of the power shelf on two bus bars (TSGR1U4A) or two pairs of bus bars (TSGR1U4D). The output polarity can be configured either positive or negative as desired. UNIPOWER can supply various pre-made DC load cables; see the current datasheet for available options. Users wishing to fabricate their own DC cables should note that such cables should be rated to handle at least 150A.

17.5.1 Connecting Multiple Shelves in Parallel

Up to four power shelves can be connected together to create higher capacity power systems than can be achieved with a single shelf.

17.6 Signal Connections - These connections are made to the D-type connector described in section 15. Wire size for all signal connections should be 22-24AWG.

17.6.1 Connecting Multiple Shelves in Parallel

To ensure proper power sharing between parallel connected power shelves it is important to make sure that current share and –Ve Sense are connected between each shelf. See sections 15.2 for details.

17.7 Cooling - The Sigma power modules incorporate a variable speed DC ball bearing fan. Airflow is from the front to rear with exhaust ventilation holes at the rear of the power shelf. To minimise obstruction to ventilation there should be a minimum of 3 inches (76mm) free space behind and in front of the power shelf when it is installed in the rack. UNIPOWER also recommends that any equipment mounted directly above the Sigma power shelf should be shorter in overall depth so as to not obstruct any ventilation holes in the top surface.

18.0 MAINTENANCE

No routine maintenance is required on the Sigma series except for periodic cleaning of dust and dirt around the front ventilation grill. A small vacuum nozzle should be used for this purpose.

19.0 SETUP AND TESTING

19.1 The Sigma can be initially tested mounted in a rack or on a test bench. If two or more units are to be tested in a rack, they should first be individually tested in Position A (left side) of the rack.

19.2 With the input power source turned off, connect input power wires to the input terminals of the mating interface board, the Sigma mating connector or in the case of a power shelf the input connector or terminal block on the A side of the rack. Make sure that the safety ground wire is connected. Do not touch the output terminals when input power is present.

19.3 Connect a resistive power load across the proper output pins, terminals or bus bars. The load should be 20% to 50% of the full load value and can be either a power resistor or electronic load set to the resistive mode. Make sure that the power resistor has adequate heat sinking and cooling.

19.4 Connect a color-coded, twisted pair (22 or 24AWG) from the remote sense pins to the load. The +Ve Sense must go to the positive side of the load and the –Ve Sense to the negative side of the load. Also connect the Enable pin to the -Ve Sense. This must be done for the unit to operate. When using the mating interface board or a power shelf, the Enable pin is automatically connected to -Ve Sense. The units are then controlled by the Inhibit inputs.

19.5 Checking Front Panel LEDs - With the Sigma module on the bench or in Position A of the power shelf, turn on (or plug in) the power source. Both LEDs should be on.

19.6 Checking the Output Voltage - Measure the output voltage at its load with a digital voltmeter. The voltage should be within ±1% of its nominal value.

19.7 Checking the Inhibit Input - Unplug the input power source. Connect a wire from the Inhibit input to –Ve Sense. Turn the input power source back on. The DCOK LED should remain off. Check the output voltage with a digital voltmeter. It should read zero volts.

19.8 Checking the AC OK and DC OK Signals - Next check the voltage on the AC OK pin with respect to –Ve Sense. The voltage should be a logic LO, +0.5V or less. Finally, check the voltage on the DC OK pin with respect to –Ve Sense. The voltage should be a logic HI, approximately +5V. These signals need pull-up resistors to 5V Standby using 10K Ohm resistors.

Disconnect the wire between the Inhibit and –Ve Sense pins. The DCOK LED should turn on. Check the output voltage on the DC OK pin as described above. The voltage should be a logic LO, +0.5V or less.

19.9 Testing other Sigma modules - For a power shelf with two or three Sigma modules, the other modules should be plugged into Position A in the rack and tested in the same manner as above in Sections 19.2 to 19.8.

19.10 Testing the Complete Power System - With the input power source off or disconnected, insert all Sigma modules into the power shelf. Connect a resistive power load of approximately 80% of full load value for a single Sigma across the output. Connect a color-coded, twisted pair of remote sense leads to the load, being careful to connect the correct polarity.

Note the comments in section 9.2.1 regarding circuit breakers or fuses in the output power feed.

19.11 Turn on or plug in the input power source. Check the voltage across the load with a digital voltmeter. The voltage should be within about ± 1% of its nominal value. The LEDs should be on for all units.

19.12 While the rack is operating, disengage module A (left one) and check the output voltage. It should be very close to the previous value and the LEDs should remain on for module B (and C and D) which are now carrying the load. Re-insert module A and repeat the procedure by disengaging and re-engaging modules B, C and D in turn. The complete power shelf has now been shown to operate properly in the redundant mode with hot swapping. Disconnect the input power source.

20.0 USING THE I²C SERIAL BUS INTERFACE

The I²C interface that is incorporated into the Sigma includes facilities to monitor various operating parameters within the unit and transmit these to a host computer on demand over an industry standard I²C Serial bus.

Three forms of data are available. These allow the user to monitor the actual status of an individual unit, manage system loading through measurement of the actual load on the output and also control inventory through an inbuilt EEPROM containing specific data about each individual unit.

The implementation of I²C that has been utilized in Sigma is a subset of more complete implementations such as IPMI. The information that follows should provide enough information for system designers to make decisions on how to utilize the available information within their overall system philosophy.

20.1 I²C devices employed

20.1.1 PCF8574 - is an 8-bit digital register manufactured by Philips that is used to provide various module status information.

20.1.2 PCF8591 - T is a Quad A/D converter manufactured by Philips that is used to provide output voltage and current readings.

20.1.3 24C02 - is a 256 byte EEPROM manufactured by ST used to store inventory information. The content of this device can be altered or added to at time of manufacture to meet specific user needs.

20.1.4 MAX6633 – is a 12-bit temperature measurement device manufactured by Maxim that provides an indication of the internal temperature of the Sigma module.

20.2 Electrical Interface

20.2.1 Addressing (GA0,GA1,GA2)

Three external address lines are employed allowing up to eight Sigma modules to be addressed on a single I²C bus. Module addressing is achieved through hard-wiring the address lines to -Sense or the +5V auxiliary supply via a 100-ohm resistor on the system back-plane. In this way it is the location or position of the module rather than any particular module that is identified by an individual address.

20.2.2 Serial Clock (SCLK)

This line is clocked by the processor which controls the I²C serial bus. It should be tied to +5V via a pull-up resistor in the range 3k to 10k.

20.2.3 Serial Data (SDA)

This line is a bidirectional data line. It should be tied to +5V via a pull-up resistor in the range 3k to 10k.

20.2.4 Bus speed

The I²C bus as used in Sigma is designed to run with a serial clock speed 100kHz.

20.3 Operation and Functions

20.3.1 Digital Functions

Digital status functions are provided by a PCF8574 8-bit I/O port device. When this device is read by the I²C bus controller a single 8-bit word provides the information given in the following table.

BIT	FUNCTION	GOOD STATE	MEANING
0	Input Power Fail	0	A “1” provides warning of input supply failure.
1	Output Power Good	0	Output voltage is within specified limits.
2	Temperature Warning	0	Temperature exceeds normal operating limit.
3	Fan #1 Good	1	Fan running at >80% nominal speed.
4	-	1	Not used
5	-	1	Not used
6	-	1	Not used
7	Temperature Alarm	1	Ambient temperature exceeds 70°C, unit switched off. Also indicates OVP and Inhibit activated.

PCF8574 slave address

BIT	7	6	5	4	3	2	1	0
VALUE	0	1	0	0	GA2	GA1	GA0	R/W

HEX ADDRESS RANGE
0x40 – 0x4E

Note that if a zero is written to bit 7 in a data byte, the unit will be inhibited. The default state is enabled.

20.3.3 Analogue Functions

Analogue status functions are provided by two PCF8591 4-channel 8-bit A/D converter devices. When these devices are read by the I²C bus controller a single 8-bit word provides the information given in the following table.

Device U1			
A/D	FUNCTION	A/D	FUNCTION
1	Output voltage	3	Not used
2	Output current	4	Not used

PCF8591 slave address – device U1

BIT	7	6	5	4	3	2	1	0
VALUE	1	0	0	1	GA2	GA1	GA0	R/W

HEX ADDRESS RANGE
0x90 – 0x9E

The PCF8591 devices initially require a control byte (04 Hex) to be written to the configuration register. This control byte sets the device so that on each successive read the data from the next A/D is read.

Note that on each read a conversion is started for a particular channel and the result will be read from the previous channel, thus the first result from a sequence of reads should always be discarded.

A/D Converter scaling

To obtain a correct voltage or current measurement it is necessary to employ a scaling factor in the controlling software. Note that all voltage measurements are made inside the PSU module, before the 'ORing' devices, and are typically 0.2V higher than the actual module output voltage. The calculation given in the following table should be employed.

Value = (byte read x scaling factor)

Output Voltage	Scaling	Tolerance	
48V	0.24	±2%	V Measure (U1 A/D Chan. 1).
	0.125	±10% *	I Measure (U1 A/D Chan. 2).

*of full scale

20.3.4 EEPROM Functions

The EEPROM is a 2048 bit (256 byte) device which is pre-programmed at the factory with the data given in the following table.

Note that other data may be specified to special order. Please consult sales.

Address Range	Data
0-15	Model Number
16-31	Manufacturing Part Number
32-47	Serial Number
48-63	Modification Level
64-79	Manufacturer
80-95	Country of Manufacture
96-255	Not used

Note: Data is organized such that each field of data can be accessed by a page read (16 bytes).

24C02 slave address

BIT	7	6	5	4	3	2	1	0
VALUE	1	0	1	0	GA2	GA1	GA0	R/W

HEX ADDRESS RANGE
0xA0 – 0xAE

20.3.5 Temperature Measurement Functions

The internal temperature of the unit is measured using a MAX6633. This device provides a 12-bit measurement at a resolution of 0.0625°C.

MAX6633 slave address

BIT	7	6	5	4	3	2	1	0
VALUE	1	0	1	0	GA2	GA1	GA0	0

HEX ADDRESS RANGE
0x80 – 0x8E

For further information or support in using the I²C serial bus features incorporated into the Sigma series please contact applications support.

21.0 TROUBLESHOOTING GUIDE

21.1 If you encounter difficulties in getting a Sigma module or complete power system to operate properly please check all connections carefully and use the following as a troubleshooting guide.

a) If the DCOK LED is OFF and there is no voltage on the output then the unit may be inhibited. To enable the unit make sure that the Inhibit input is connected to the +5V Standby supply.

b) If the DCOK LED is OFF and the voltage on the output is low then the output has been set below the DCOK detection point. If the remote adjust feature is being used ensure that the control voltage is set at a level sufficient to bring the output voltage within limits.

Product support can be obtained using the following addresses and telephone numbers.

Corporate office:
UNIPOWER, LLC
210 N University Dr
Coral Springs, FL 33071
United States

Manufacturing facility:
UNIPOWER, LLC
65 Industrial Park Rd
Dunlap, TN 37327
United States

Manufacturing facility:
UNIPOWER Slovakia SRO
ZLATOVSKA 1279
Business Center 22
91105 Trencin, Slovakia

Phone: +1-954-346-2442
Toll Free: 1-800-440-3504
Web site – www.unipowerco.com

When contacting UNIPOWER, please be prepared to provide:

1. The product model number, spec number, S build number, and serial number - see the equipment nameplate on the front panel
2. Your company's name and address
3. Your name and title
4. The reason for the contact
5. If there is a problem with product operation:
   - Is the problem intermittent or continuous?
   - What revision is the firmware?
   - What actions were being performed prior to the appearance of the problem?
   - What actions have been taken since the problem occurred?