

FPS-TB RACK INSTRUCTION MANUAL

| FPS-TB RACK SPECIFICATIONS | | | |
|----------------------------|---------------------------------------|-----|--|
| 1 | Number of power supply modules (*1) | --- | 1 x FPS1000 modules. |
| 2 | Maximum output power (*2) | W | 1000 |
| 3 | Input voltage / frequency range (*3) | --- | 85~265Vac continuous, 47~63Hz, Single phase |
| 4 | Maximum input current (at 100/200Vac) | A | 12.0/6.0 for each FPS1000 unit installed |
| 5 | AC input connector | --- | Terminal Board with un-removable screw |
| 6 | Output terminals | --- | Bus-bars.Refer to outline drawing. |
| 7 | Remote sensing (*4) | V | Possible. |
| 8 | Parallel operation | --- | Possible. Up to 3 racks with max 8xFPS 1000 units of the same voltage and current rating. |
| 9 | Series operation (*5) | --- | Possible. Up to 3x FPS1000 units of the same voltage and current rating |
| 10 | Remote On/Off control (*6) | --- | Separate control for each FPS 1000 unit , By electrical signal or dry contact On/Off logic is user selectable. Refer to instruction manual. |
| 11 | DC_OK signal | --- | Separate control for each FPS1000 unit, Open collector signal. On when Vout \geq 80% \pm 5%. Max.sink current: 10mA |
| 12 | AC fail signal | --- | Separate control for each FPS1000 unit ,Open collector signal. Refer to Instruction Manual |
| 13 | Over Temperature alarm signal | --- | Separate control for each FPS1000 unit ,Open collector signal. Refer to Instruction Manual |
| 14 | Vout voltage trimming | --- | Possible, via separate control for each FPS1000 unit .Refer to Instruction Manual. |
| 15 | Auxiliary power supply | --- | 11.2~12.5VDC.Maximum output current:0.25A, for each FPS1000 unit. |
| 16 | Operating temperature | --- | 0~50°C: 100% load. Derate 2%/°C, 50°C to 60°C. |
| 17 | Storage temperature | --- | -30~85°C |
| 18 | Operating humidity | --- | 10~90% RH, no condensation. |
| 19 | Storage humidity | --- | 10~95% RH, no condensation. |
| 20 | Vibration | --- | Built to meet ETS 300 019 |
| 21 | Shock | --- | Built to meet ETS 300 019 |
| 22 | Applicable safety standards | --- | UL60950-1, EN60950-1 |
| 23 | Withstand voltage | --- | Input-Output: 3000Vrms, 1min. Input-Ground: 2000Vrms, 1min. Output-Ground: 1414Vdc, 1min. |
| 24 | Insulation resistance | --- | More than 100Mohm at 25°C and 70% RH. Output-Ground: 500Vdc |
| 25 | Weight (Typ) | Kg | 0.4 |
| 26 | Size (W*H*D) | --- | 127x44x352.5mm. Refer to Outline Drawing. |
| 27 | Warranty | Yr | Two Years |

Notes:

- *1: The Output of the FPS1000 module are floating in the rack.
- *2: For input voltage lower than 100Vac, maximum output power derated by 10% of the power rating.
- *3: For cases where conformance to various safety standards (UL, EN etc.) is required, to be described as 100-240Vac (50/60Hz).
- *4: Remote sensing can compensate up to 1V drop on each load wire.
- *5: Not applicable for units with I²C bus option.
- *6: Factory default: ON/OFF_1 P.S. is on when AC is applied.

REAR PANEL IN/OUT CONNECTOR PINS FUNCTION DESCRIPTION

Refer to the following table for description of the control and supervisory signals provided at the rear In/Out connectors..J1.
Refer to Fig. 1-1~6-1 for typical connections for operation.

| Pin No | Function | Description |
|--------|------------------------|---|
| 1 | SDA (I ² C) | Serial Data used in the I ² C interface option. Refer to the I ² C interface description in the FPS1000 Instruction Manual. |
| 2 | SCL (I ² C) | Serial Clock used in the I ² C interface option. Refer to the I ² C interface description in the FPS1000 Instruction Manual. |
| 3 | SIGNAL_RETURN | Return for the following control and supervisory signals: On/Off, DC_OK, Over_temperature Alarm, AC_Fail, Auxiliary 12V supply. The Signal return is isolated from the output terminals. |
| 4 | ON/OFF_2 (*1) | On/Off control. To use this input, pin#12 and pin#13 must be shorted together. Short between On/Off_2 to pin#3: Off. Open On/Off_2: On. The maximum source current is 1.2mA |
| 5 | DC_OK | Open collector signal, referenced to pin 3 (Signal Return). On when the output voltage of FPS1000 unit is higher than $V_{out} \geq 80\% \pm 5\%$. The maximum sink current: 10mA and the maximum external voltage is 15V. |
| 6 | V_TRIM | Connection for output voltage trimming of FPS1000 unit. The voltage can be trimmed within its range specifications. |
| 7 | -SENSE | Negative sensing. The -Sense signal should be connected to the negative terminal of the load. The -Sense and +Sense leads should be twisted pair to minimize noise pick-up effect. The maximum load wires drop compensation is 1V/wire. |
| 8 | +SENSE | Positive sensing. The +Sense signal should be connected to the positive terminal of the load. The +Sense and -Sense leads should be twisted pair to minimize noise pick-up effect. The maximum load wires drop compensation is 1V/wire. |
| 9 | +12V_AUX | Auxiliary voltage output, 11.2~12.5V, referenced to pin 3 (Signal Return). The maximum load current is 0.25A. This output is not controlled by the On/Off control. |
| 10 | CS | Current sharing signal. When FPS1000 units are connected in parallel, the CS pins of the units should be connected to allow current balance between units. |
| 11 | AC_FAIL | Open collector signal, referenced to pin 3 (Signal Return). On when the input voltage of FPS1000 unit is $\geq 85V_{rms}$. The maximum sink current is 10mA, and the maximum external voltage is 15Vdc. |
| 12 | ON/OFF_1 (*1) | Turns the output of FPS1000 unit to On and Off by electrical signal or dry contact between pin 12 and pin 3 (Signal Return). 0~0.6V or Short: On, 2~15V or Open: Off. The maximum sink current is 2.6 mA (when using pin#12, it should be disconnected from pin#13). |
| 13 | ON/OFF LOGIC SELECT | Input used to select the On/Off control logic. Short this input to pin#12 when using On/Off_2 as On/Off control. Leave this input open when using On/Off_1 as On/Off control. |
| 14 | TEMP_ALARM | Open collector signal, referenced to pin 3 (Signal Return). On when the internal temperature of FPS1000 unit is within safe limit, Off approx. 10°C below Thermal shut down. The maximum sink current is 10mA and the maximum external voltage is 15V. |
| 15 | - LOCAL SENSE | When working in local sense mode, connect -Local Sense to -Sense (pin#7). When working in Remote sense mode, this input should be open. |
| 16 | + LOCAL SENSE | When working in local sense mode, connect +Local Sense to +Sense (pin#8). When working in Remote sense mode, this input should be open. |

Table 1: Rear In/Out connector pins function description (J1)

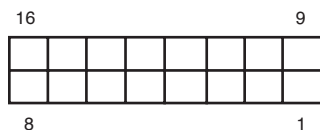
Note:

*1: On/Off_1 and On/Off_2 are reversed logic inputs.

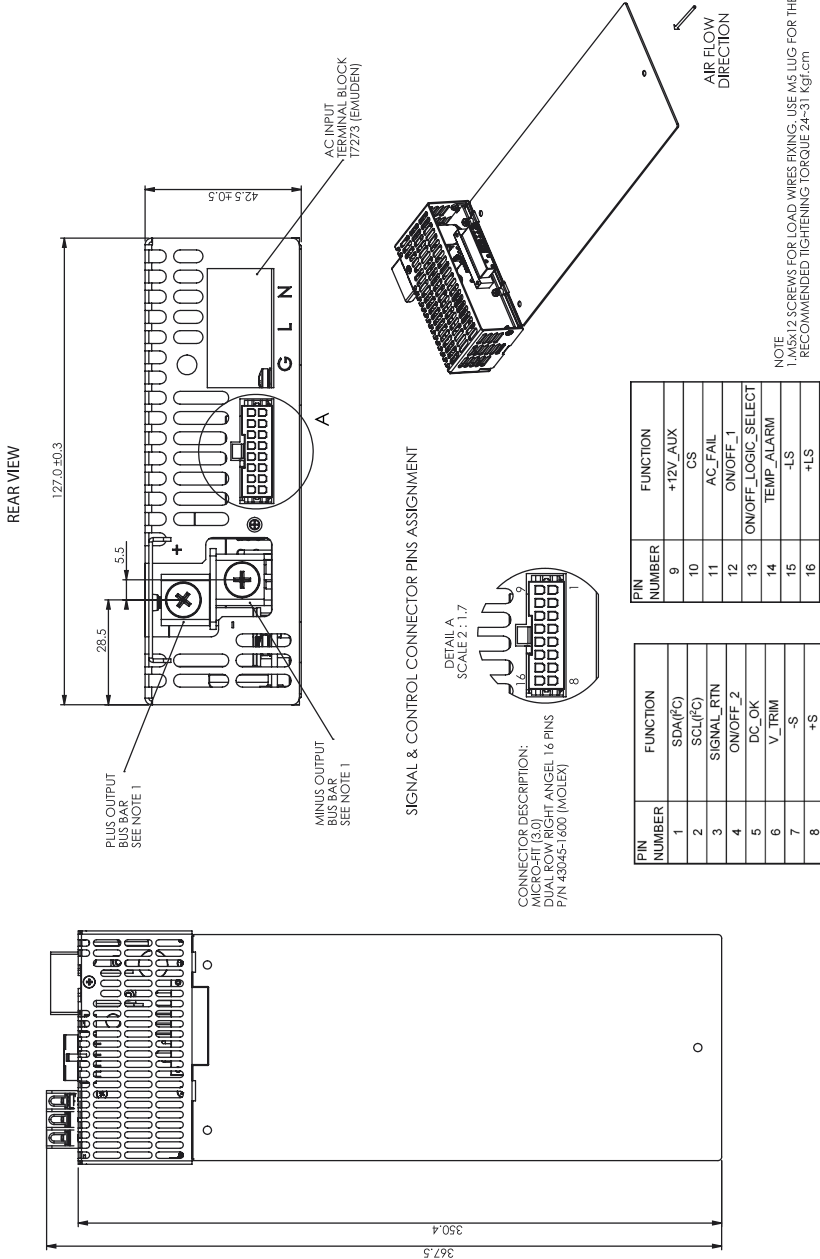
CONNECTOR PINOUT (REAR PANEL VIEW)

J1 CONECTOR DESCRIPTION

MALE HEADER: P/N-43045-1600 (MOLEX)
FEMALE HOUSING (PLUG): P/N-43025-1600 (MOLEX)
FEMALE TERMINAL: P/N-43030 (MOLEX)



FPS-TB Outline Drawing



FPS1000 POWER SUPPLY AND FPS-TB SAFETY INSTRUCTIONS

IMPORTANT SAFETY INSTRUCTIONS

Operating personnel must not remove the FPS1000 units and the FPS-TB rack cover.

No internal adjustment or component replacement is allowed by non Densel-Lambda qualified service personnel. Never replace components with power cable connected. To avoid injuries, always disconnect power, discharge circuits and remove external voltage sources before touching components. These products are not authorized for use as critical components in nuclear control systems, life support systems or equipment for use in hazardous environments without the express written approval of the managing director of Densel-Lambda.

Restricted Access Area: The equipment should only be installed in a Restricted Access Area.

Access should be available to service personnel only.

WICHTIGE SICHERHEITSHINWEISE

Bedienungspersonal oder Anwender dürfen die Gehäusabdeckung des FPS-1000 und des FPS-TB nicht entfernen.

Ersatzteiltausch - und Änderungen dürfen nur von autorisiertem Densel-Lambda SERVICE-Personen bzw. Organisationen durchgeführt werden. Vor Austausch von Bauteilen ist das Netzkabel bzw. die Versorgungsspannung zu trennen.

Energieversorgungsanschlüsse sind immer zu trennen, um Personenverletzungen durch gefährliche Energieinhalte und Spannungen auszuschließen.

Die Stromkreise sind zu entladen, externe Spannungsquellen sind zu entfernen bevor Bauteile bzw. Komponenten getauscht werden.

Der direkte Zugriff auf das Racksystem ist nur dem geschulten Service-Personal erlaubt.

SAFETY APPROVALS

UL 60950-1 and CSA22.2 No.60950-1 - UL Recognized. C-UL for Canada.

IEC 60950-1 - CB Report and Certificate.

EN 60950-1 - CE mark.

Marking by the CE Symbol indicates compliance to the Low Voltage Directive of the European Union.

A "Declaration of Conformity" in accordance with the preceding directives and standards has been made and is on file at our EU representative TDK LAMBDA UK, located at Kingsley Avenue, Ilfracombe, Devon EX34 8ES, UK.

A "Declaration of Conformity" may be accessed via company website www.uk.tdk-lambda.com/technical-data.

SAFETY-CLASS OF INSULATION

The FPS1000 and FPS-TB are designed for the following safety parameters: Material group IIIa, Pollution degree 2, Overvoltage category II, Class I (earthed), indoor use as part of an overall equipment such that the FPS product is accessible to service personnel only.

GROUNDING

These products are Safety Class I instruments. To minimize shock hazard, the instruments chassis must be connected to an electrical ground. The instruments must be connected to the AC power supply mains through a three conductor power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet.

For instruments designed to be hard-wired to the supply mains, the protective earth terminal must be connected to the safety electrical ground before any other connection is made.

Any interruption of the protective ground conductor, or disconnection of the protective earth terminal will cause a potential shock hazard that might cause personal injury.

INPUT RATINGS

Do not use AC supply which exceeds the input voltage and frequency rating of these instruments. The input voltage and frequency rating is: 100-240V~, 50/60Hz. For safety reasons, the mains supply voltage fluctuations should not exceed +/-10% of nominal voltage.

The leakage current of the end use equipment should not exceed 3.5mA.

FPS-TB RACK AC INPUT

CAUTION:

Risk of electrical shock and energy hazard. Disconnecting one power supply disconnects only one power supply module. To isolate the unit completely, disconnect all power supplies.

ACHTUNG:

Spannungsführende Teile - Gefahr durch elektrischen Schlag oder hohe Energieinhalte.

Alle Netzstecker der einzelnen Komponenten bzw. der Einschübe müssen getrennt werden, damit das System "spannungsfrei" ist.

ATTENTION:

Risque de choc et de danger e'lectriques. Le de'branchement d'une seule alimentation stabilise'e ne de'branche uniquement qu'un module "Alimentation Stabilise'e".

Pour isoler completement le module en cause, il faut de'brancher toutes les alimentations stabilise'es.

SAFETY SYMBOLS

CAUTION Risk of Electrical Shock.



Instruction manual symbol. The instrument will be marked with this symbol when it is necessary for the user to refer to the instruction manual.



Indicates hazardous voltage.



Indicates ground terminal.



Protective Ground Conductor Terminal

WARNING

Denotes hazard. An attention to a procedure is called. Not following the procedure correctly could result in personal injury. A WARNING sign should not be skipped and all indicated conditions must be fully understood and met.

CAUTION

Denotes hazard. An attention to a procedure is called. Not following the procedure correctly could result in damage to the equipment.

ENERGY HAZARD

The FPS1000 and FPS-TB products are capable of providing hazardous energy.

Manufacturers final equipment must provide protection to service personnel against inadvertent contact with these models output terminals. If set such that hazardous energy can occur then the output terminals or connections therefore must not be user accessible.

OVERCURRENT PROTECTION:

A readily accessible Listed branch circuit overcurrent protective device rated 20 A must be incorporated in the building wiring.

FUSES

There are no user replaceable fuses in the FPS1000 and FPS-TB products. Internal fuses are sized for fault protection and if a fuse was opened it would indicate that service is required. Fuse replacement should be made by qualified technical personnel. FPS-TB rack contains no fuses. FPS1000 units fuses rating are described below.

F101: F20A H 250Vac

F102: 6.3A 400Vdc

SICHERHEITSHINWEISE

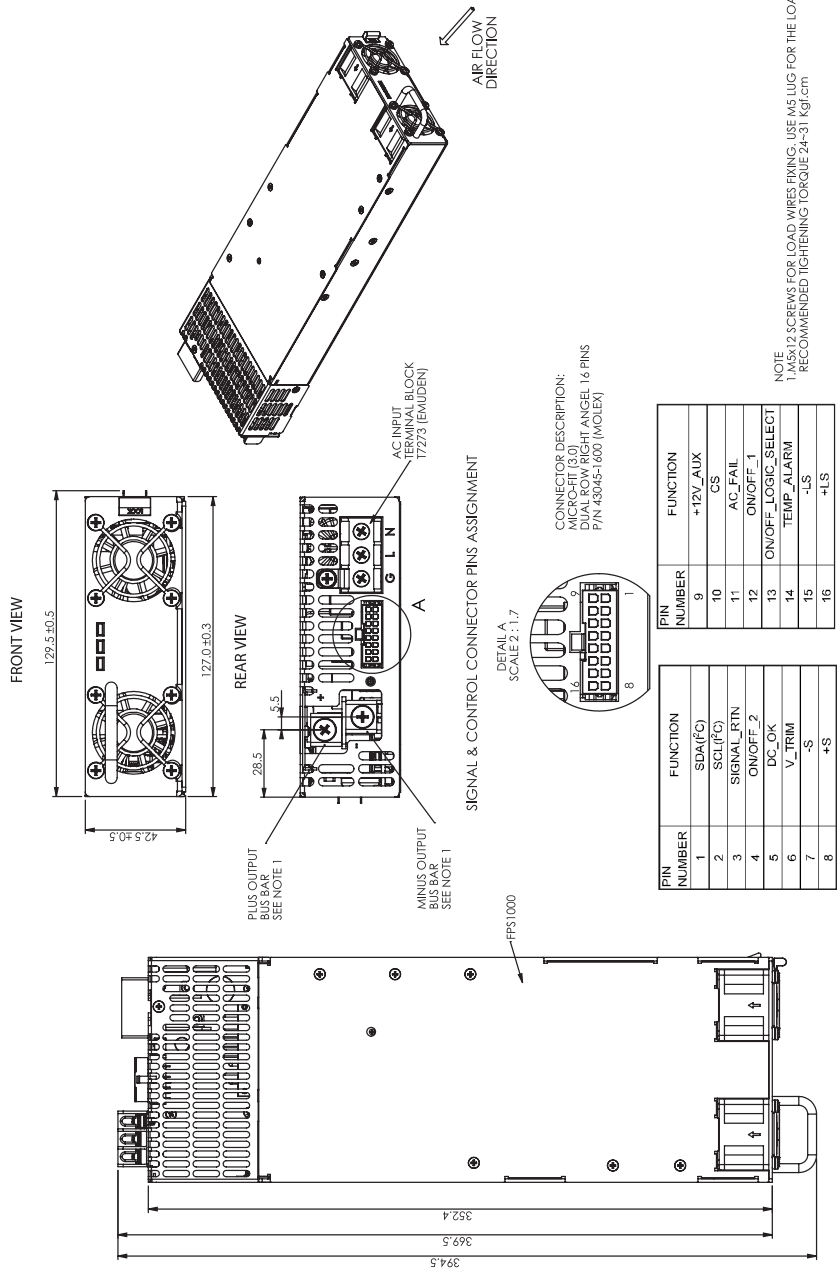
Vor Anschluss an die Netzversorgung ist die Aufstellanleitung zu beachten!

1. Absicherung: F101: F20A H 250VAC, F102: 6.3A 400VDC
2. Der maximale Ableitstrom der Gesamtanlage darf 3.5mA nicht ueberschreiten.
3. Die Gehaeuseabdeckung darf nur im stromlosen Zustand geoeffnet werden.

ACHTUNG:

Sicherungen duerfen nur durch geschulte Service Personen getauscht werden.

FPS1000-TB Outline Drawing



FPS1000 & FPS-TB CONNECTIONS FOR OPERATION

1. REMOTE SENSING*

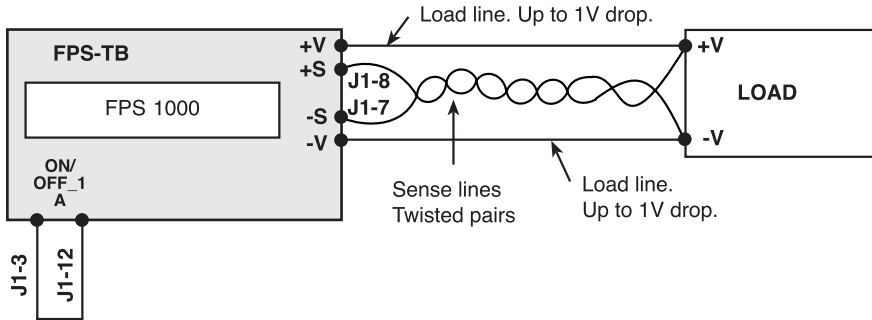


Fig 1-1

* In Local sense applications, the +/- sense have to be connected to the +/-Local Sense terminals of the FPS-TB prior to operating the FPS1000 units plugged in.

2. ON/OFF CONTROL

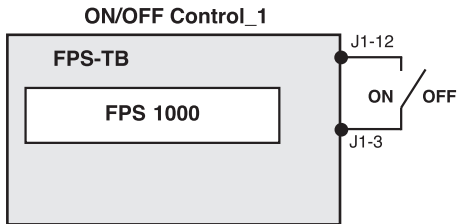


Fig 2-1

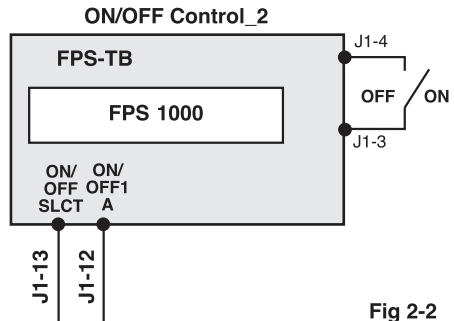


Fig 2-2

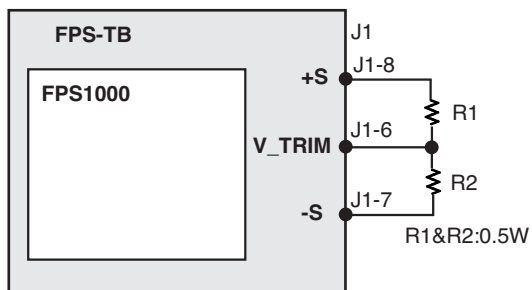
Connection for negative logic:
 Closed: On Open: Off
 Factory default: ON/OFF Control_1

Connection for positive logic:
 Closed: Off Open: On

3. OUTPUT VOLTAGE TRIMMING

Fig 3-1 shows typical connection for FPS1000 inside the rack.

- Refer to Table 1.



FPS1000-12

$$R_2 = 0.0324 \cdot V_{out}^2 - 1.1298 \cdot V_{out} + 9.9342$$

$$R1(K\Omega) = 5(K\Omega) - R2(K\Omega)$$

FPS1000-24

$$R_2 = 0.0785 \cdot V_{out}^2 - 5.819 \cdot V_{out} + 105.132$$

$$R1(K\Omega) = 20(K\Omega) - R2(K\Omega)$$

FPS1000-32

$$R_2 = 0.0463 \cdot V_{out}^2 - 4.5805 \cdot V_{out} + 109.49$$

$$R1(K\Omega) = 20(K\Omega) - R2(K\Omega)$$

FPS1000-48

$$R_2 = 0.0497 \cdot V_{out}^2 - 7.2795 \cdot V_{out} + 259.04$$

$$R1(K\Omega) = 50(K\Omega) - R2(K\Omega)$$

Fig 3-1

4. SUPERVISORY SIGNALS

Signals are accessible at the J1 connector on the rear panel of the rack.

Fig 4-1 shows typical connection for FPS1000 inside the rack.

- Refer to Table 1.

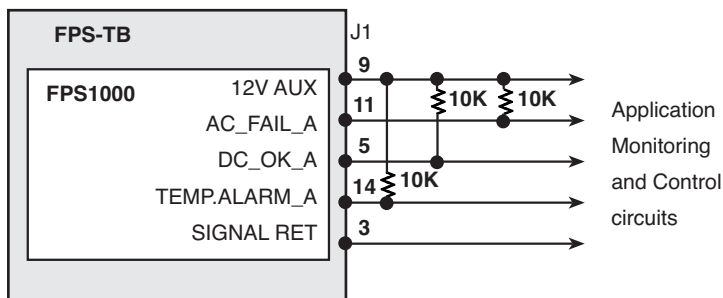


Fig 4-1

Note: AC_FAIL, DC_OK and TEMP.ALARM are open collector signals.

5. PARALLEL OPERATION

5.1. Remote sensing and current balance

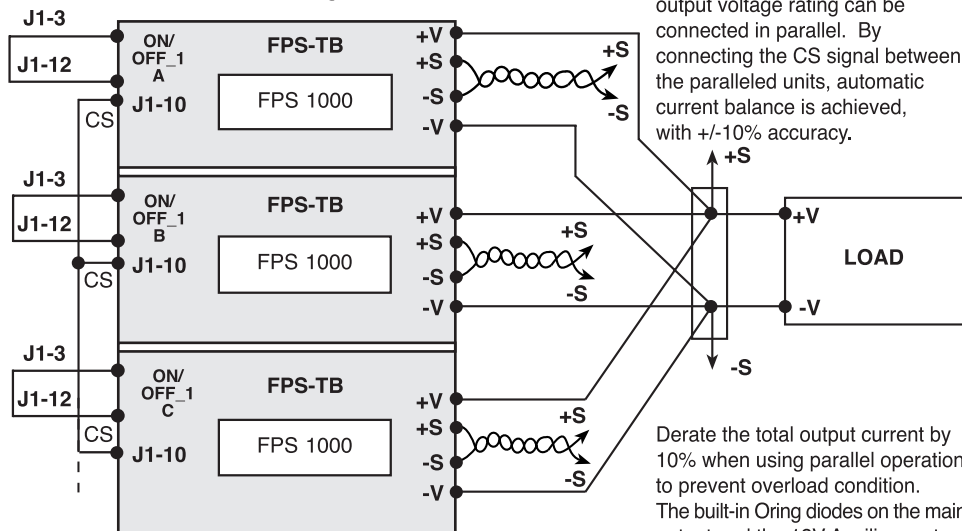


Fig 5-1

6. SERIES OPERATION

Up to 3 units of the same voltage and current rating can be used for increased output voltage. It is recommended that diodes be connected in parallel with each unit output to prevent reverse voltage. Each diode should be rated to at least the power supply rated output voltage and output current.

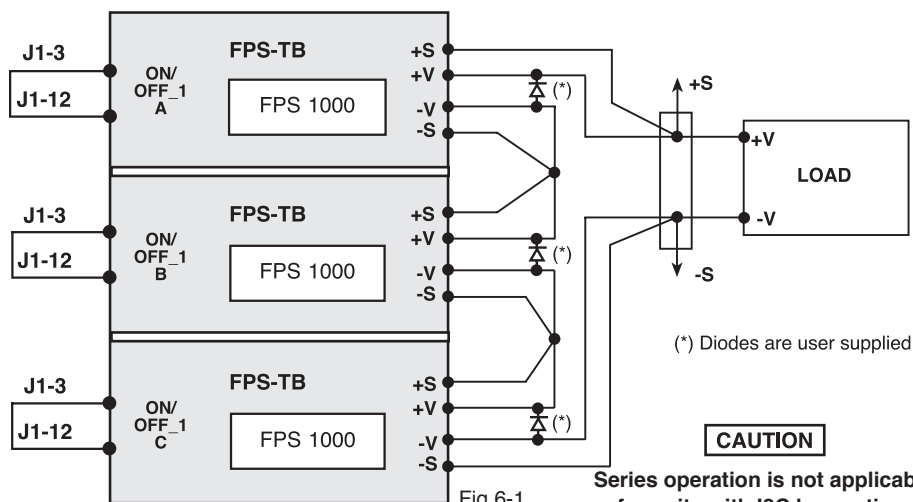


Fig 6-1

FPS-TB I²C BUS INTERFACE OPTION

MODULES LOCATION

FPS1000 module
can be plugged into the FPS-TB rack.

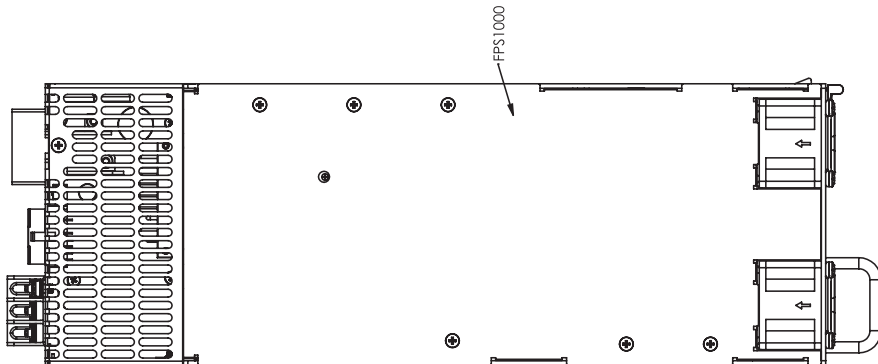


Fig 7-1

Note1: Forced air cooling allow minimum 50mm of unrestricted air space at the rear of the unit.
Do not obstruct air flow to the unit front panel

ADDRESSING (A0, A1, A2).

The address line of the FPS1000 units installed in the FPS-TB rack are internally fixed.
Refer to the following table for details:

| | A0 | A1 | A2 |
|------------|----|----|----|
| Module "A" | 1 | 1 | 1 |
| Module "B" | 0 | 1 | 1 |
| Module "C" | 1 | 0 | 1 |

Note: Address are applicable when modules FPS1000/S (I2C option) are used

I²C BUS INTERFACE OPTION

INTRODUCTION

The I²C interface option includes facilities to monitor operating parameters of the power supply. The parameters are then transferred to the host PC if demanded, over a standard I²C bus.

The following data can be monitored for the individual units connected to the I²C bus:

1. Status of the unit.
2. Actual output voltage, output current and internal temperature of the unit.
3. Manufacturing related data (model, serial number, manufacturing date etc...).

ADDRESSING (A0, A1, A2).

The address of each FPS1000 unit is internally fixed.

Refer to the addressing table for details.

SERIAL CLOCK

This line is clocked by the processor which controls the I²C bus. It should be connected to +5V (referenced to -Sense) via a pull-up resistor of 2K Ω . The I²C interface is designed to run with a serial clock speed of 100KHz.

SERIAL DATA

This line is a bidirectional data line. It should be connected to +5V (referenced to -Sense) via a pull-up resistor of 2K Ω .

OPERATION AND FUNCTIONS

1. DIGITAL STATUS

Digital status functions are provided by a PCF8574, 8-bit Register. It provides a single 8-bit word when read by the I²C controller.

Fault is indicated by "1" and Good level is indicated by "0". The register information is as follows:

| BIT | FUNCTION | MEANING |
|-----|-----------------------------|--|
| 0 | Output Fail | Output voltage is < 80% +/-5% of Vo rated |
| 1 | Over Temperature Protection | Internal temperature is over 80°C. Supply turns off. |
| 2 | Temperature Alarm | Internal temperature is over 70°C. Supply is on. |
| 3 | Fan Fail | Failure of an internal fan. |
| 4 | AC Input Fail | Input voltage < 85Vac |
| 5 | Not Used | Always "0". |
| 6 | Not Used | Always "0". |
| 7 | Not Used | Always "0". |

PCF8574 slave address:

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-------|---|---|---|---|----|----|----|-----|
| Value | 0 | 1 | 0 | 0 | A2 | A1 | A0 | R/W |

2. EEPROM FUNCTIONS

A 256 bytes EEPROM is included in the I²C option. The EEPROM type is AT24C02 and it is programmed at the factory with the following data:

| ADDRESS | BYTES | DATA |
|---------|-------|------------------------|
| 0 | 4 | Number of fields |
| 4 | 16 | Manufacturer |
| 20 | 20 | Serial number |
| 40 | 16 | Revision |
| 56 | 16 | Country of manufacture |
| 72 | 16 | Model name |
| 88 | 16 | Output voltage |
| 104 | 16 | Date of manufacture |
| 254 | 2 | Checksum |

The slave EEPROM address is:

| | | | | | | | | |
|-------|---|---|---|---|----|----|----|-----|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Value | 1 | 0 | 1 | 0 | A2 | A1 | A0 | R/W |

3. ANALOG FUNCTIONS

Analogue functions are provided by a single PCF8591, 4-channel 8-bit A/D converter. When this device is read by the serial bus controller it provides an 8-bit word with the following information:

Channel 1: Output voltage, channel 2: Output current, channel 3: Internal temperature.

The PCF8591 slave address is:

| | | | | | | | | |
|-------|---|---|---|---|----|----|----|-----|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Value | 1 | 0 | 0 | 1 | A2 | A1 | A0 | R/W |

The PCF8591 device initially requires a control byte to be written to the configuration register. The control byte is as follows:

| | | | | | | | | |
|-------|---|---|---|---|---|---|---|---|
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Value | 0 | A | 0 | 0 | 0 | B | C | D |

When a single channel is to be read, A,B,C and D should be determined as follows:

| | | | | |
|-------------|---|---|---|---|
| A/D channel | A | B | C | D |
| Voltage | 0 | 0 | 0 | 0 |
| Current | 0 | 0 | 0 | 1 |
| Temperature | 0 | 0 | 1 | 0 |

To read all channels with a single control byte, A and B have to be "1", C and D have to be "0". This control byte sets the A/D so that on every read data from each channel is read. Note that on each read, a conversion is started for a particular channel and the result which will be displayed and will be of the previous read. (i.e. the previous channel).

Thus second read cycle gives result of the actual channel.

Note: the first result from a sequence of reads should not be considered.

A/D SCALING

The A/D readback has to be scaled to obtain a correct value for the voltage, current and the temperature. Note that the voltage reading is made inside the power supply unit before the "Oring" diode and is typically 0.5V higher than the actual output voltage.

The following scaling should be employed:

$$\text{VALUE} = \text{BYTE VALUE} \times \text{RESOLUTION}$$

Refer to the following table for the scaling of the A/D channels:

| FPS1000-12/S | Range | Resolution | Accuracy |
|--------------|---------|--------------|----------------------|
| Voltage | 0~15V | 0.0586 V/Bit | +/-2% of full scale |
| Current | 0~80A | 0.312 A/Bit | +/-10% of full scale |
| Temperature | 0~100°C | 0.391°C/Bit | +/-3°C of full scale |

| FPS1000-24/S | Range | Resolution | Accuracy |
|--------------|---------|-------------|----------------------|
| Voltage | 0~30V | 0.1171V/Bit | +/-2% of full scale |
| Current | 0~50A | 0.1953A/Bit | +/-10% of full scale |
| Temperature | 0~100°C | 0.391°C/Bit | +/-3°C of full scale |

| FPS1000-32/S | Range | Resolution | Accuracy |
|--------------|---------|-------------|----------------------|
| Voltage | 0~40V | 0.1563V/Bit | +/-2% of full scale |
| Current | 0~50A | 0.1953A/Bit | +/-10% of full scale |
| Temperature | 0~100°C | 0.391°C/Bit | +/-3°C of full scale |

| FPS1000-48/S | Range | Resolution | Accuracy |
|--------------|---------|-------------|----------------------|
| Voltage | 0~60V | 0.2344V/Bit | +/-2% of full scale |
| Current | 0~25A | 0.0977A/Bit | +/-10% of full scale |
| Temperature | 0~100°C | 0.391°C/Bit | +/-3°C of full scale |

The measurement range is from 0 to the maximum value listed in the range column. The resolution or scale of reading is linear over the entire range and provides a linear output on the A/D converter.

Model: FPS1000-48 /S

Measurements and calculation examples

Output voltage readback

1. Output voltage (at the output terminals): 48.0V
2. Voltage before the "Oring" diode: 48.0V+0.5V=48.5V
3. Hex readback: CE (1100 1110).
4. Convert the hex readback to decimal: 206
5. Calculate measured Vout: $V_{out} = 206 \times 0.2344 = 48.286V$

CAUTION

Series operation is not applicable for units with I²C bus option.