



String Supervisor  
**Getting Started Manual**





String Supervisor  
**Getting Started Manual**

**Edition: March 2011**

FSIM01CI Rev. C

## SAFETY SYMBOLS

Always follow safety instructions to prevent accidents and potential hazards from occurring.

**WARNING**

This symbol means improper operation may result in serious personal injury or death.

**CAUTION**

Identifies shock hazards under certain conditions. Particular attention should be given because dangerous voltage may be present. Maintenance operation should be done by qualified personnel



Identifies potential hazards under certain conditions. Read the message and follow the instructions carefully.



Identifies shock hazards under certain conditions. Particular attention should be given because dangerous voltage may be present.

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### Edition of December 2010

This publication could present technical imprecision or misprints. The information here included will be periodically modified and updated, and all those modifications will be incorporated in later editions.

To consult the most updated information of this product you might access through our website [www.power-electronics.com](http://www.power-electronics.com) where the latest version of this manual can be downloaded.

**Revisions**

Date	Revision	Description
04 / 08 / 2010	A	First edition
09 / 12 / 2010	B	Update
22 / 03 / 2011	C	Updating Technical Characteristics

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The equipment and technical documentation are periodically updated. Power Electronics reserves the right to modify all or part of the contents of this manual without previous notice.

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# SAFETY INSTRUCTIONS

## IMPORTANT!

- Read this manual carefully to maximise the performance of this product and to ensure its safe use.
- Power Electronics accepts no responsibility or liability for any and all damage resulting from inappropriate use of the equipment.
- The information contained in the installation guide must be observed when installing the String Supervisor
- In this manual, safety messages are classified as follows:



## WARNING

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**Do not remove the cover while the power is applied or the unit is in operation.**  
Otherwise electric shock could occur.

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**Do not run the device with the front cover removed.**  
Otherwise you may get an electric shock due to the high voltage terminals.

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**Do not remove the cover except for periodic inspections or wiring, even if the input power is not applied.** Otherwise you may access the charged circuits and get an electric shock.

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**Operate the switches with dry hands.**  
Otherwise you may get an electric shock.

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**Do not use cables with damaged insulation.**  
Otherwise you may get an electric shock.

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**Do not subject the cables to abrasions, excessive stress, heavy loads or pinching.**  
Otherwise, you may get an electric shock.

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## CAUTION

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**Install the device on a non-flammable surface. Do not place flammable material nearby.**  
Otherwise fire could occur.

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**Disconnect the input power if the device gets damaged.**  
Otherwise it could result in a secondary accident or fire.

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**Do not apply power to a damaged device or to a device with parts missing even if the installation is complete.**  
Otherwise you may get an electric shock.

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**Do not allow lint, paper, wood chips, dust, metallic chips or other foreign matter into the device.**  
Otherwise fire or accident could occur.

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## WARNINGS

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### RECEPTION

- The STRING SUPERVISOR is carefully tested and perfectly packed before leaving the factory.
  - In the even of transport damage, please ensure that you notify the transport agency and POWER ELECTRONICS: 902 40 20 70 (International +34 96 136 65 57) or your nearest agent, within 24hrs from receipt of the goods.
- 

### UNPACKING

- Make sure model and serial number of the String Supervisor are the same on the box, delivery note and unit.
- 

### RECYCLING

- Packing of the equipments should be recycled. For this, it is necessary to separate different materials included (plastic, paper, cardboard, wood, ...) and deposit them on proper banks.
  - Waste products of electric and electronic devices should be selectively collected for their correct environmental management.
-

**CAUTION**

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**SAFETY**

- Before operating the device, read this manual thoroughly to gain an understanding of the unit. If any doubt exists then please contact POWER ELECTRONICS, (902 40 20 70 / +34 96 136 65 57) or your nearest agent.
  - Wear safety glasses when connecting the String Supervisor to the solar inverter and when operating the inverter with power applied and the front cover opened.
  - Install the device according to the instructions within this manual.
  - Do not place heavy objects on the device.
  - Ensure that the mounting orientation is correct.
  - Do not drop the String Supervisor or subject it to impact.
  - The String Supervisor devices contain static sensitive printed circuit boards. Use static safety procedures when handling these boards.
  - Avoid installing the device in conditions that differ from those described in the *Technical Characteristics* section.
- 

**TRIAL RUN**

- Verify all parameters before operating the device.
  - Always apply voltage and current signals to each terminal that are within levels indicated within this manual. Otherwise, damage to the device may result.
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**OPERATION PRECAUTIONS**

- Do not modify or alter anything within the device.
-

**CAUTION**

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**SPECIAL HAZARDS OF PHOTOVOLTAIC SYSTEMS**

Photovoltaic systems have special characteristics that can represent special hazards:

- An active power source is connected. This means that, regardless to the operating mode of the inverter, there may be voltage present, either from the photovoltaic generator and/or the FREESUN. This is especially important to consider when disconnecting particular parts of the system (the String Supervisor must be connected to the DC input in the inverter).
  - Very high DC voltages are present (no zero-crossing) which, in case of a fault or inappropriate use of fuses or plugs, may lead to arcing.
  - The short-circuit current of the photovoltaic generator is only slightly higher than the maximum operating current and is also dependent on the level of a solar irradiation.
  - A highly branched generator array may be difficult to disconnect if a fault develops (e. g. short circuit). We recommend the extra use of external DC circuit breakers for disconnecting the inverter and/or the DC main cables / String supervisors (DC circuit breakers are built-in). One circuit breaker should be allocated to each input, and these should be located near to de FREESUN as described in the standard VDE0100 part 7-712 and the VDI 6012 regulations.
  - The inverter contains capacitors on the AC and DC sides. The discharge time of the capacitors is longer than 10 minutes. For this reason, it is required to wait longer than this time before making any operation or maintenance actions related to the connection between the String Supervisor and the inverter.
-

# 1. INTRODUCTION

The photovoltaic installations are formed by the series and parallel connection of solar panels. Through series connection, strings of solar panels are formed. The total voltage of this string is the sum of each individual voltage of each panel. Through the parallel connection, the total voltage of each string is added.

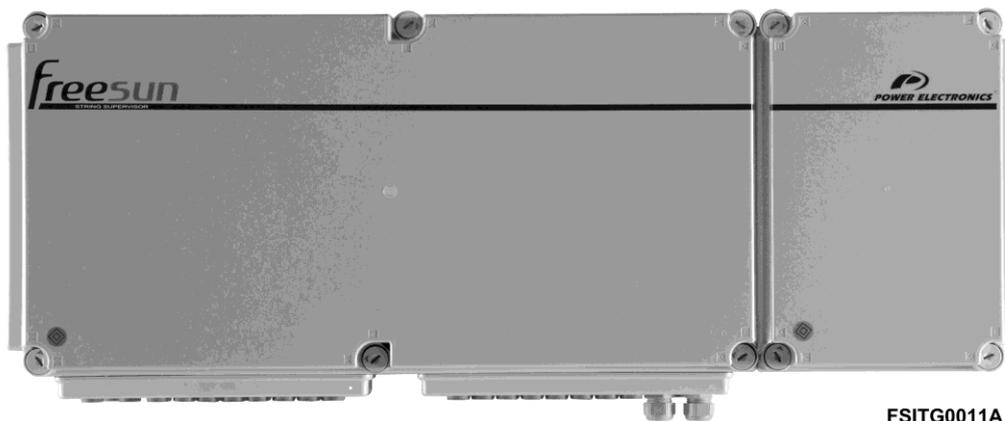


Figure 1.1: Panels connection diagram

In the end, all the strings meet in two unique points: the positive (+) and the negative (-) of the installation.

The main function of the string supervisor is the monitoring of the state of the strings, with the target of a rapid detection in case of a poor performance. To achieve this, the current supplied by each of the strings is measured by current “hall effect” transducers. With this measure, it is possible to analyze easily the yield of each of the strings. If a string produces less energy than the others, we can detect it as a result of the control from the string supervisor.

The string supervisor is a slave device of the solar inverter. Its function is to inform to the solar inverter. In order to achieve this, our String Supervisor implements the CAN and RS485 communication ports that will enable the user to choose between the communication bus CAN or Modbus RTU.

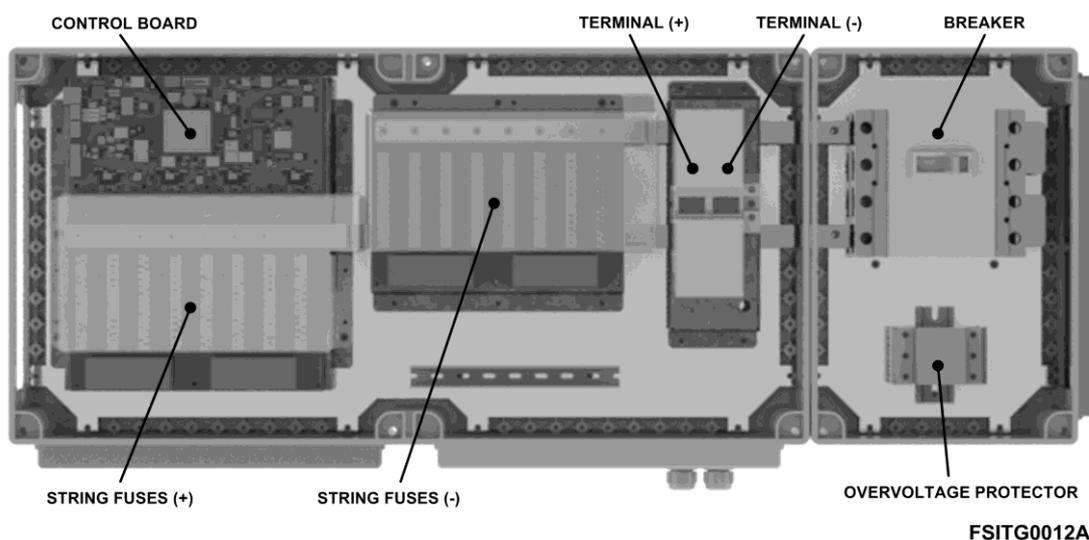


Figure 1.2: Internal view and components of the String Supervisor

## 2. STRING SUPERVISOR DESCRIPTION

The DC current generated by the panels, is transformed into AC current and synchronized in voltage and phase by the solar inverter, and injected into the electric distribution grid, getting by this economical profit selling the energy to the Company.

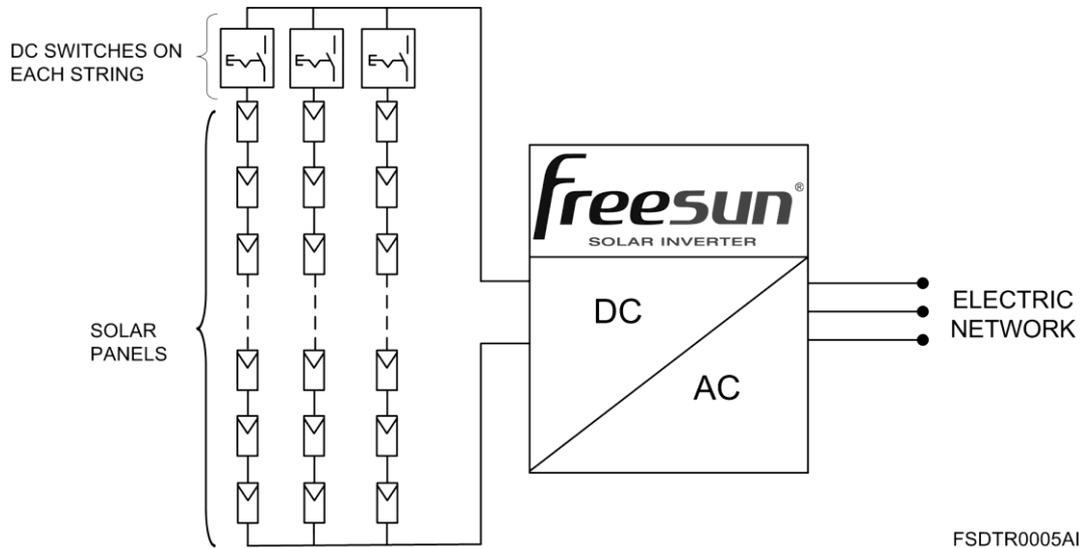


Figure 2.1: Panel connection diagram

The state of the installation is crucial for its optimization. If a solar panel is damaged, dirty or disconnected, it will affect to all the string (they are connected in series), significantly decreasing the energy generated.

Each String Supervisor has a protection that prevents the installation from overvoltages. The String Supervisor detects the state of the overvoltage protection. Like this, if the protection becomes out of order due to a limitation provoked by a very high overvoltage, it will inform the inverter of the situation so that maintenance personnel can proceed to its replacement.

The String Supervisor has a fuse in each of the panel strings that disconnects the corresponding panel in case of an overload. If the fuse melts down, it would be detected by the string supervisor, as the current of the string would be zero.

The String Supervisor has an unload switch, that allows the total insulation of the positive and negative string, in order to enable maintenance without stopping the energy production.

The following diagram shows the main components of the String Supervisor:

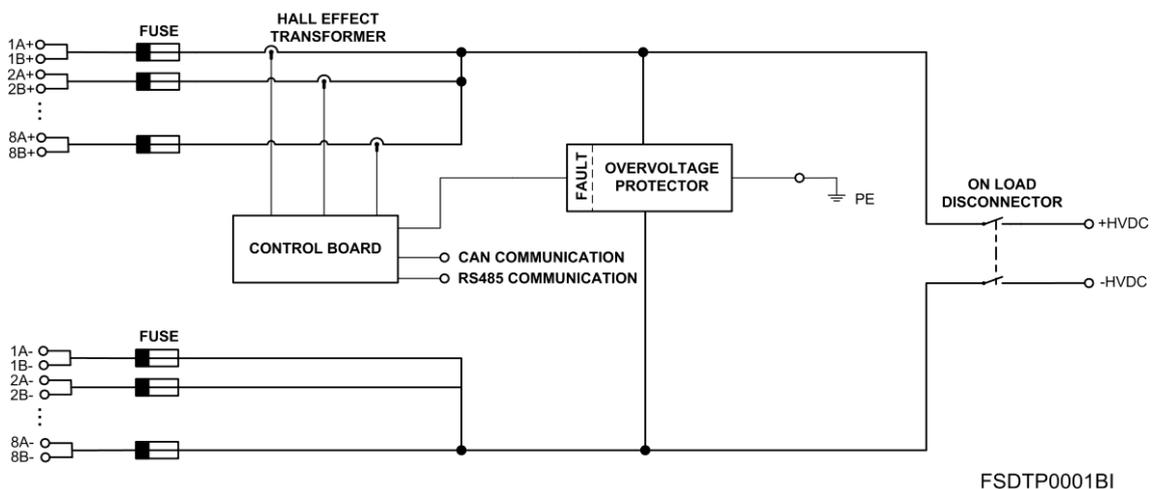


Figure 2.2: Component diagram of the String Supervisor

### 3. TECHNICAL CHARACTERISTICS

INPUT	INPUT VOLTAGE	Permissible maximum DC voltage 1000V
	MEASUREMENT CHANNELS	8
	DC CURRENT INPUTS	16 inputs (2 inputs per measurement channel maximum)
	MEASUREMENT RANGES PER CHANNEL	5 measurement ranges: 5A, 9A, 12A, 14A y 17A
	CABLE CROSS SECTION	4mm <sup>2</sup> – 6mm <sup>2</sup> max.
	OVERVOLTAGE PROTECTION	Yes
	DISCONNECTOR SWITCH	It is available a load break disconnector switch for complete isolation of (+) side and (-) side of the solar inverter panels.
OUTPUT	DC VOLTAGE	1000V
	DC CURRENT	80A, 144A, 192A, 224A, 250A
	CABLE CROSS SECTION	70mm <sup>2</sup>
	DISCONNECTOR SWITCH	250A / 1000VDC
	CABLE GLANDS	70mm <sup>2</sup>
CONTROL CIRCUIT	SUPPLY	24VDC (3 x 0.5mm <sup>2</sup> shielded)
	STRING SUPERVISOR BOXES PER INVERTER	6 [1]
	FUSE CONTROL	Yes
	OVERVOLTAGE PROTECTION STATUS	Yes
	STRING CURRENT MEASUREMENT	Yes, every 2 strings in the (+) side
PROTECTIONS	FUSES	Possible range of fuses: 10A, 12A, 16A, 20A y 25A 1 Fuse per measurement channel in the (+) side, 1 Fuse per measurement channel in the (-) side
	DC OVERVOLTAGE PROTECTIONS	Overvoltage protection Type II
COMMUNICATIONS	COMMUNICATION PORTS	CAN and RS485
	BAUDRATE	20/50/10/250/500kbps, autoselectable
	COMMUNICATIONS SIGNALS	CAN: (CANH, CANL, GND) RS485: (RS485-A, RS485-B, GND)
	WIRE TYPE	CAN: 2x2x0.75mm <sup>2</sup> (Twisted pair, shielded) RS485: 2x2x0.5mm <sup>2</sup> (Twisted pair, shielded)
	LENGTH	CAN: Between 75m and 100m at 500Kbps RS485: 1200m at 100Kbps
	TERMINATION RESISTOR	Required, 120Ω on last device
STRING SUPERVISOR IDENTIFICATION	STRING SUPERVISOR IDENTIFICATION	By two rotary switches
ENCLOSURE	MATERIAL	Polycarbonate
	ELECTRICAL INSULATION	Totally insulated
	DIMENSIONS [WxHxD] (mm)	1050x420x230mm
	WEIGHT (kg)	19.4 kg
	ASSEMBLY	Outdoor, in the shade
	FLAMMABILITY	Enclosure material self extinguishing , halogen free (UL94-5V)
	PROTECTION DEGREE	IP65
ENVIRONMENT	TEMPERATURE RANGE	From -20°C to +60°C
	RELATIVE HUMIDITY	From 15 to 95% (0..95% non-condensing)
	ALTITUDE	1000m above sea level
	POLLUTION DEGREE	Type II
REGULATIONS	CERTIFICATION CE DIRECTIVES	Yes 2006/95/CE, 2004/108/CE
	EMC	EN 61000-6-2 EN 61000-6-4
	SAFETY	EN 62109-1
	SPAIN	RD 1663

[1] For other configurations please consult with Power Electronics.

## 4. DIMENSIONS

The following table shows the weight and dimensions of the String Supervisor:

Reference	Description	Dimensions (mm)			Weight (kg)
		W	H	D	
SFS08	String Supervisor IP65	1047.5	420	230	19.4

The attached figure shows in detail the dimensions of the String Supervisor from different perspectives:

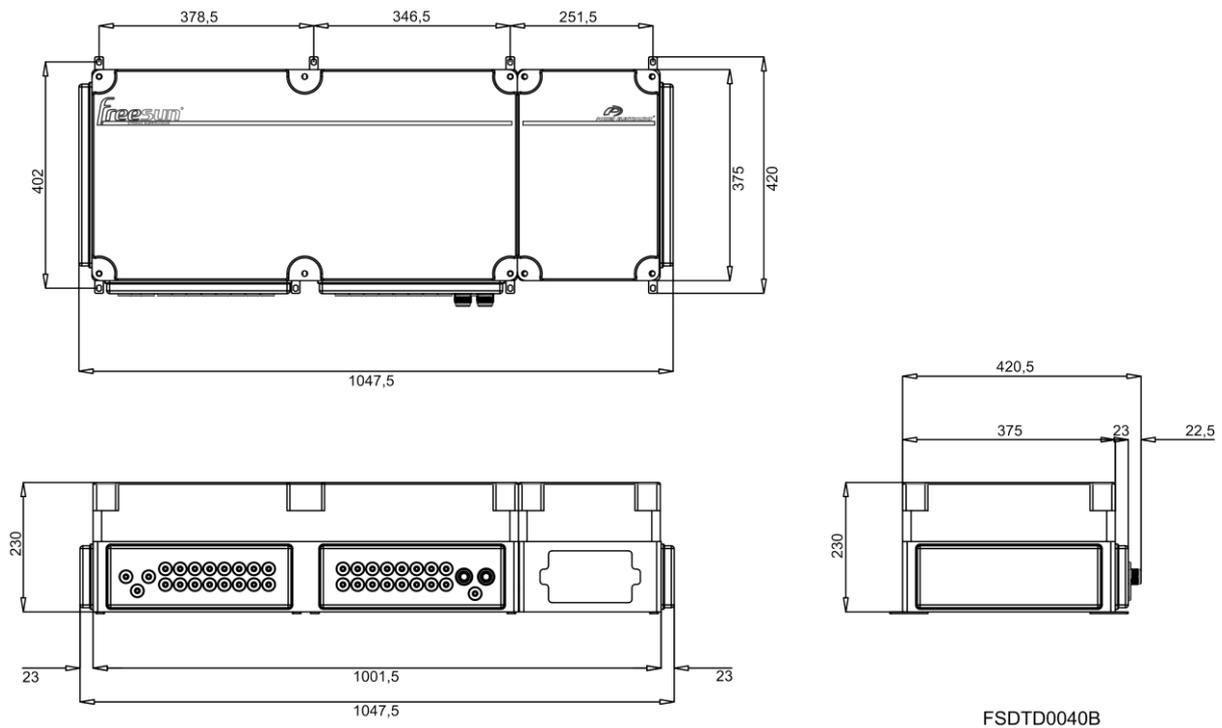
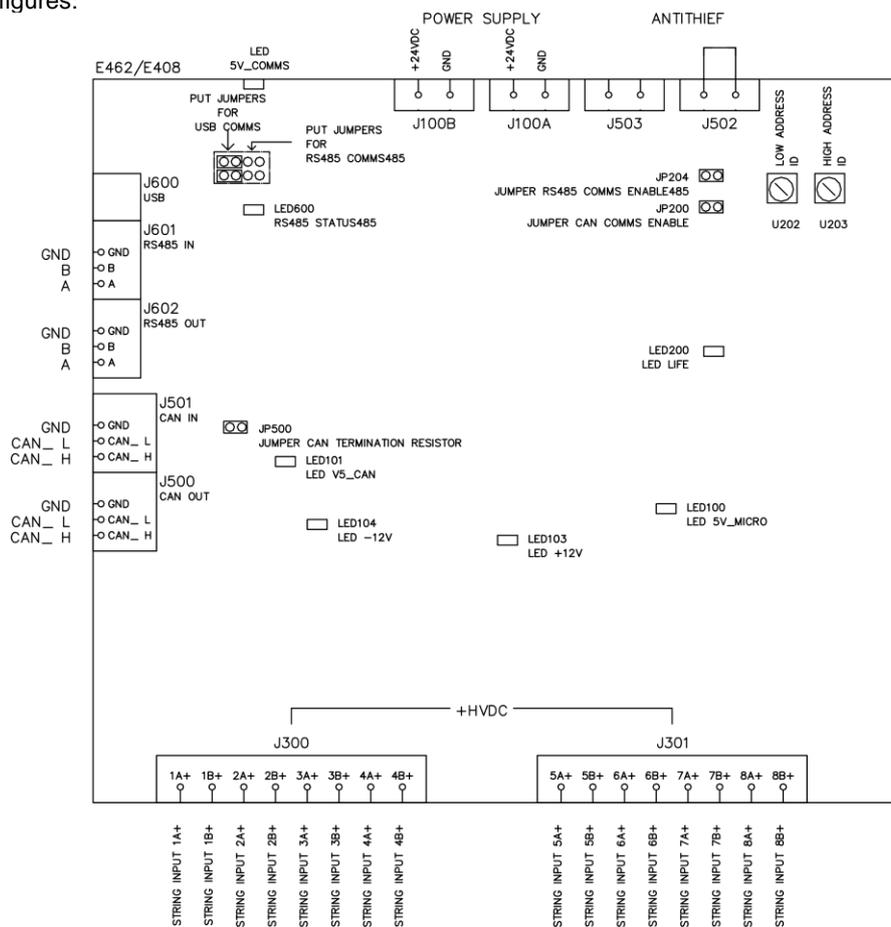


Figure 4.1: Dimensions of the String Supervisor

# 5. INSTALATION AND CONNECTION

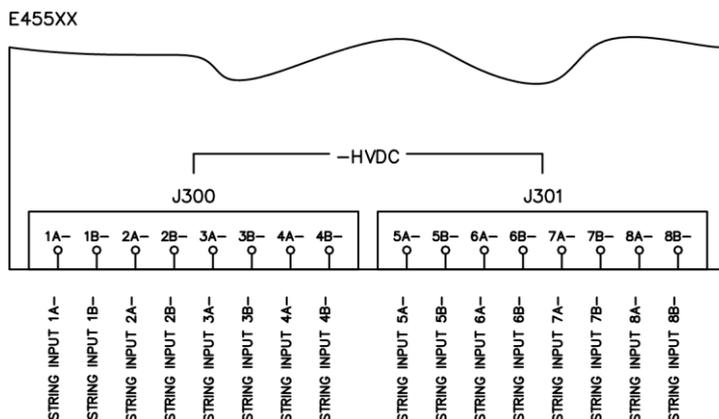
## 5.1. Location of the Jumpers and Connectors of the String Supervisor

The main connectors, jumpers and led indicators that are important for the user are described in the next figures:



FSDTP0005AI

Figure 5.1: Positive Terminals



FSDTP0006BI

Figure 5.2: Negative Terminals

E  
N  
G  
L  
I  
S  
H

## 5.2. Wiring String Supervisor – Freesun

The connection between the Freesun and the String Supervisor can be done in two ways depending on the series. The Freesun LVT Series will have a CAN interface and the Freesun HE and HES series will be connected through RS485. The two types of connection are described below:

### 5.2.1. String Supervisor Wiring – Freesun LVT Series

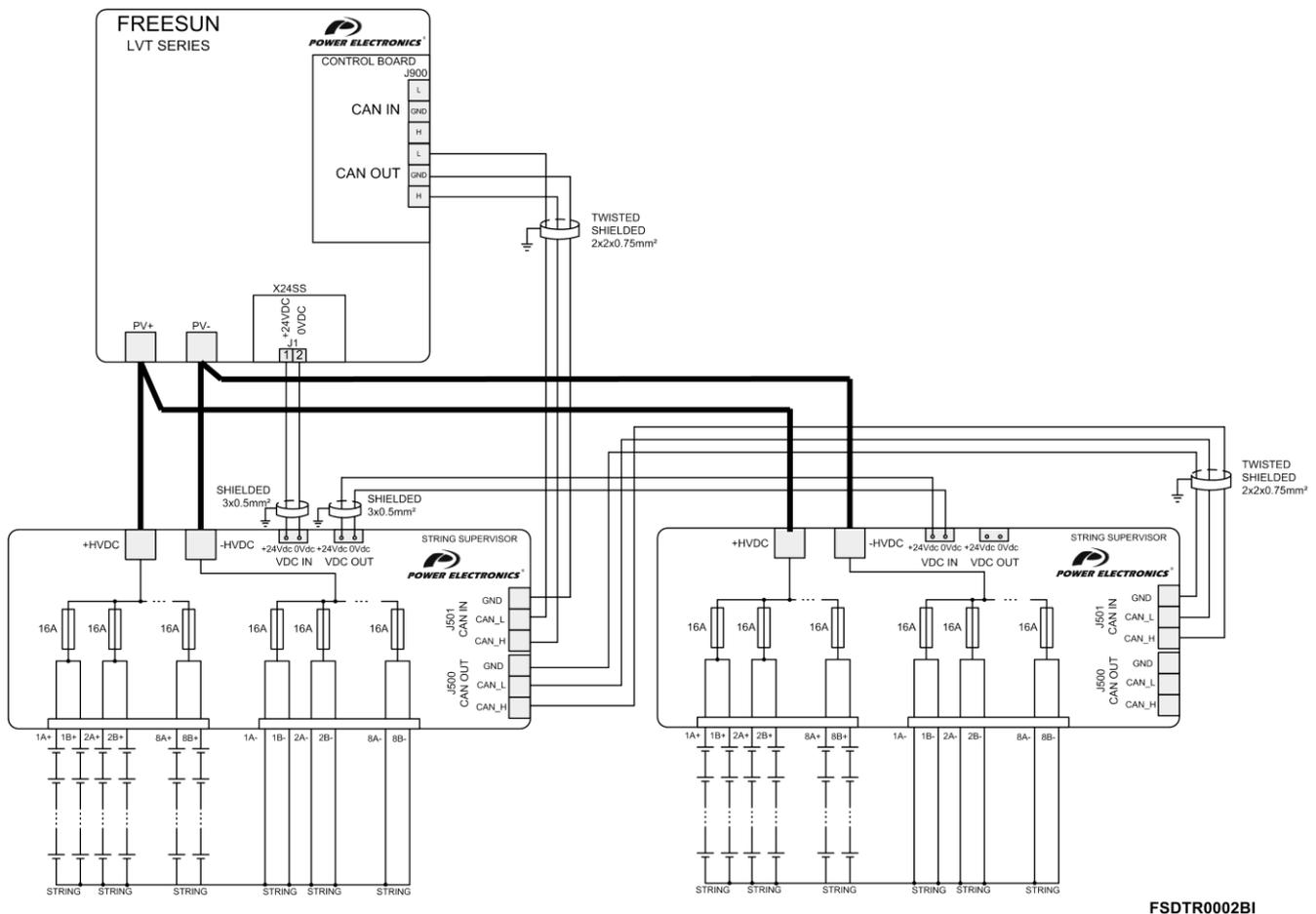


Figure 5.3: Connection with String Supervisor for Freesun LVT Series.

#### CONSIDERATIONS

The cable for CAN connection between the solar inverter and the String Supervisor must meet the following specifications to ensure proper operation:

- Family: CAN-BUS 2x2x0.75mm<sup>2</sup> VIOLET
- Section: 0.75mm<sup>2</sup>
- Colour code: DIN 47100
- Ext. cover: PVC
- Characteristic impedance: 120Ω

The recommended maximum cable length is between 75m and 100m for a data transmission speed of 500Kbps. For longer distances please contact Power Electronics.

Excessive bending of CAN cables can reduce their ability to meet the CAN specification. Standard 'Thick' cables shall have a bending radius of greater than 75mm (3"). Standard 'Thin' cables shall have a bending radius of greater than 50mm (2").

These generic cable types are available in a variety of different offerings such as FLEX, HAZ-DUTY, CLASS I (600V), UV RESISTANT, etc.

### 5.2.2. String Supervisor Wiring – Freesun HE and HES Series

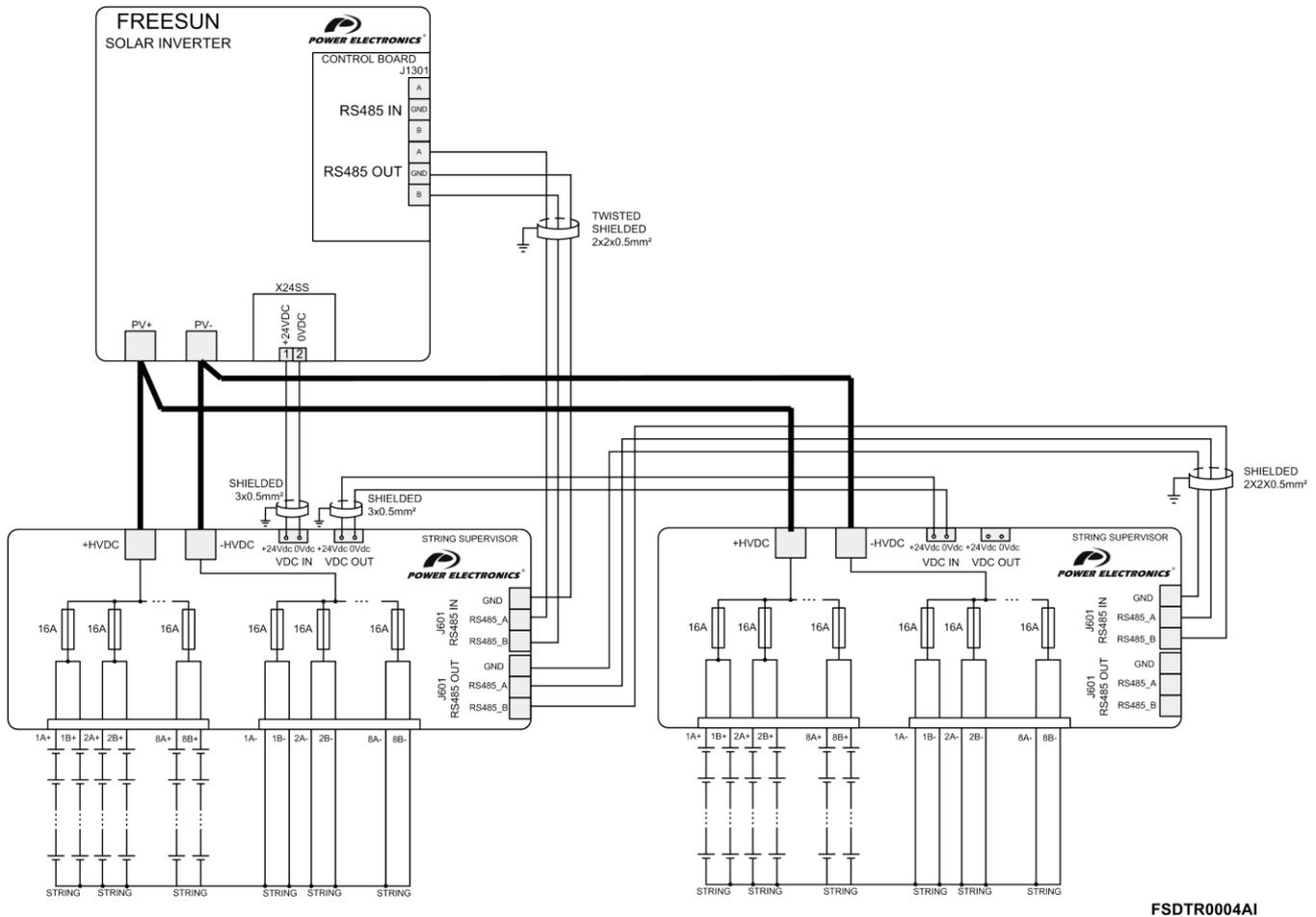


Figure 5.4: Connection with String Supervisor for Freesun HE and HES Series

#### CONSIDERATIONS

The cable for RS485 connection between the solar inverter and the String Supervisor must meet the following specifications to ensure proper operation:

- Family: 2x2x0.5mm<sup>2</sup>
- Section: 0.5mm<sup>2</sup>
- Colour code: DIN 47100
- Ext. cover: PVC
- Characteristic impedance: 120Ω

The recommended maximum cable length is 1200m for a data transmission speed of 100Kbps. For longer distances please contact Power Electronics.

Excessive bending of RS485 cables can reduce their ability to meet the RS485 specification. Standard 'Thick' cables shall have a bending radius of greater than 75mm (3"). Standard 'Thin' cables shall have a bending radius of greater than 50mm (2").

These generic cable types are available in a variety of different offerings such as FLEX, HAZ-DUTY, CLASS I (600V), UV RESISTANT, etc.

## 6. CONFIGURATION, SETTING AND COMISIONING

The slave number of the String can be identified as ID SS: “X” where “X” is the slave number configured in the rotary switches located in the String Supervisor boards.

Each String Supervisor has an ID, so in an installation with several, in order to recognise each of them by the inverter, they will have to be set differently.

Therefore, before energizing the String Supervisor, the two rotary switches inside the device must be configured. In order to do so, open the front cover and handle these selectors.

The left wheel sets the lower value; the right wheel sets the higher value. As said before, each String Supervisor must be identified differently in sequence modifying the position of the switches. The codification is hexadecimal.



When installing the String Supervisor, it is necessary to make some adjustments on the main screen in order to display data on the screen. The following adjustments will be made:

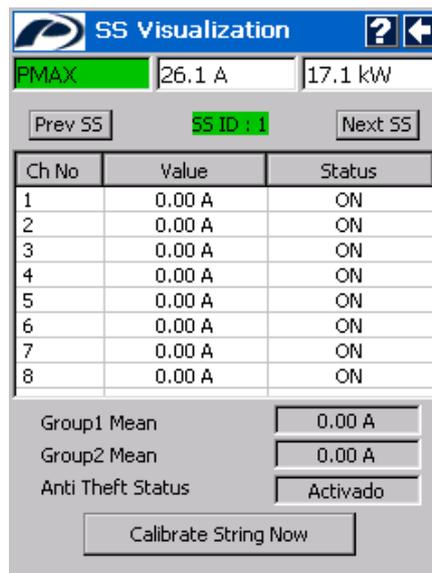
- Change parameter [G1.12 String Connected] to YES.
- In the [G10.3.1 Bus Select] parameter, select CAN if working with Freesun LVT, or RS485 if working with Freesun HE or HES. The appropriate choice of the selection involves the wiring installation as described in this manual (either CAN or RS485 communication).
- Once the changes in the settings are done, it is necessary to disconnect the auxiliary supply from the control board and reconnect it in order for the changes to take effect.

The following step is to detect the String Supervisor devices:

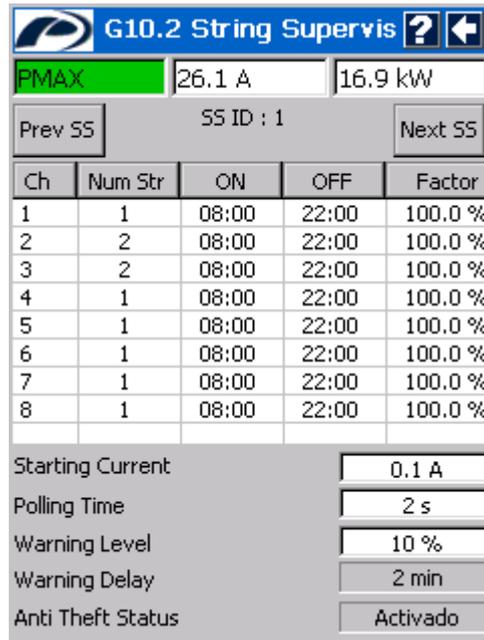
- In the subgroup G10.1, click on [Scan the Bus] and wait 30 seconds. If everything is configured correctly, the number of String Supervisors connected to the inverter will appear. Click on [Save the new Configuration].



- After this, in the String Supervisor Visualization group and in the G10.2 subgroup, after saving the settings in G10.1 two IDs of the String Supervisor (SS ID) will appear. These IDs can be seen clicking on [Prev SS] or [Next SS].



Once inside group G10.2:

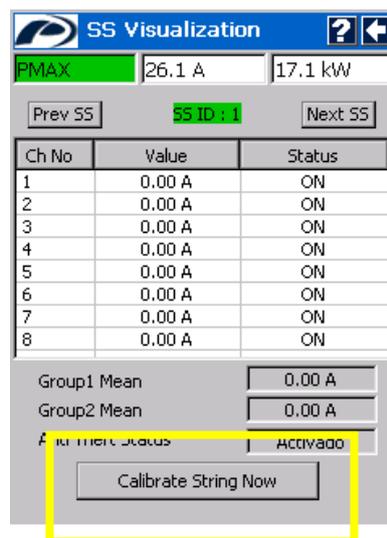


- A maximum of 16 strings can be controlled by one String Supervisor. As the String Supervisor only has 8 channels, de values of [Num Str] can be 0, 1 or 2. This is why the user has to select in each channel the total number of series in the string.

In this screen other parameters will be selected as: the time range in which the current measurement will work, the factor starting time, poling time and Warning Delay. All this information can be found in detail in the Software and Programming manual of the solar inverter.

- At this point (making sure the inverter is OFF) the current transformers of the String Supervisors must be calibrated: in the Visualization group of the String Supervisor, the [Ch No] will be seen from 1 to 8 with currents [Value] different to zero.

These are default values that have to be set to 0. The circuit is opened and the current s on the strings is zero. Press “Calibrate String Now” to calibrate the strings. Like this, the Amperes of [Value] will be zero and the channels will be properly calibrated.



Now the String Supervisors are well configured and the inverter can be switched on. However, the user is encouraged to consult directly the visualization groups of the String Supervisor to verify a proper adjustment.



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