Weidmüller

SOLAR STRING MONITORING SYSTEM

en User guide

4000002958 Solar SMS Master

4000002959 Solar SMS Slave 8IN25A

4000003982 Solar SMS Slave 8IN50A

4000002961 Solar SMS Slave 12IN25A

4000003983 Solar SMS Slave 12IN50A

01/02/2024 – v0.4

Content

1. Introduction

Solar String Monitoring System (Solar SMS) is a string monitoring device used to monitor the status of the DC side in a PV system. This product allows to measure current of different number of strings: 8, 12, 16, 20, 24, 28 or 32 as well as the output voltage of the DC string.

The Solar SMS is a high-end solution, reliable and proved.

It is highly recommended that you read thoroughly read this user guide as it contains important safety and performance-related information.

Since Solar String Monitoring System necessitates many technical considerations, a highly reliable and robust solution has been provided in Weidmueller. Some features are highlighted as follows:

- Our Solar SMS solution is a rugged, industrial measurement equipment which meets all the circumstances of such a harsh-environment application including withstanding the same temperature range under full load, the surges due to indirect lightning strikes, the dusty and/or humid atmospheres.
- The Solar SMS is totally modular allowing to install only the necessary Hall effect sensors inside the PV DC Combiner Box to optimize the final design in terms of cost and space.
- The Solar SMS is meant to measure, among other variables, string current and system voltage under the tough electromagnetic interferences typically found in PV plants. That is why it has successfully passed EMC tests under industrial-grade immunity requirements.
- The Solar SMS measures current by means of Hall effect sensors. These sensors allow to do a non-intrusive measurement of the current going through the cable. Furthermore, they do not produce heat inside the PV DC Combiner Box.
- The Solar SMS is certified for safety and EMC in an independent accredited laboratory in the European Union, using the latest available IEC/EN standards.
- The Solar SMS fulfills the latest RS-485 and Modbus industry standards and can be easily integrated into a SCADA or a PLC/datalogger because Weidmüller discloses all the register map information to you in this user guide.
- The Solar SMS can be upgraded with an accessory to extend it capabilities allowing radiofrequency communications based on LoRaWAN® protocol, keeping it robust and compact because this accessory is plugged on top of the Solar SMS Master module main PCB.

2. Safety, application, disclaimers, support

2.1. Precautionary statements

This user guide contains statements that you have to observe to ensure your personal safety, as well as to prevent damage to property. These precautionary statements are graded according to the degree of the hazard.

	DANGER Indicates that death or severe personal injury will result if the relevant information is not considered.

	WARNING Indicates that death or severe personal injury may result if the relevant information is not considered.

	CAUTION Indicates that minor personal injury or property damage may result if the relevant information is not considered.

	NOTICE Indicates that an unintended result or situation can occur if the relevant information is not considered.

2.2. Safety information

	**DANGER** It is mandatory to completely read this user guide before attempting to install, operate, maintain, or troubleshoot the equipment. Failure to do so creates a life hazard to the persons involved; that is why the equipment is marked with the ISO 7000–0434B caution icon (). This user guide must be available for future reference to any person that will deal with the equipment.

	**DANGER** Any use of this equipment different to the “intended use” declared in this user guide can lead to severe injuries, death and/or property damage. Moreover, doing so will automatically void the warranty and any claims from the customer against Weidmüller.

	**DANGER** This is an industrial equipment meant to be installed, operated, maintained, and troubleshot by skilled persons able to understand the electric shock hazards involved. Always isolate the wires connected to supply the device.

	**DANGER** The skilled persons installing, maintaining, or troubleshooting this equipment must have the right tools available and be trained in how to use them. They must also be familiar and follow all the locally applicable occupational safety and health regulations.

	**CAUTION** Take the necessary precautions regarding electrostatic discharge when manipulating this device.

2.3. Intended use

This equipment is meant to be permanently installed inside a PV DC Combiner Box with the purpose of monitoring DC voltage and current plus some additional field variables (internal temperature and two digital inputs). The measured values can be accessed from a Modbus RTU client (typically a SCADA or a PLC) via a RS-485 cable.

The accurate measurements performed by this device have multiple uses. The list below is not meant to be exhaustive:

- Detecting blown fuse-links: if the current of one input drops to zero permanently during daylight, this is a clear indication of a blown fuse (or a more severe DC issue such as a broken wire, a damaged PV module, etc.).
- Detecting reverse current: if the current of one input drops to zero only during certain periods of daylight but it recovers after a while, this could be due to the fact that in reality the current is momentarily becoming negative. Negative current is reverse current.
- Detecting underperforming strings (due to module mismatching, shading, defects, etc.): some very obvious cases can be detected by just inspecting instant current measurements, but it is recommended to use DC performance ratio (R_P, see IEC 61724) calculations to find “hidden” underperforming strings.
- Detecting worn out surge protective devices: if the remote alert of a Weidmüller SPD is wired to a digital input of the Solar SMS, the Modbus client can detect SPD cartridges that reached the end of their life.
- Detecting DC switch-disconnectors status: accidentally left open after a maintenance session (a switch-disconnector with a dry contact must be used).
- Detecting PV DC Combiner Boxes with internal hot spots: thanks to the temperature measurement function of the Solar SMS, an accidental hot spot (i.e. a loose connection) inside a PV DC Combiner Box can be remedied before it becomes a fire accident.
- Prioritizing maintenance actions: by combining all the measurements above, the maintenance staff can better decide what tasks in the DC side have higher priority due to the lost energy production or the risk level.

	**DANGER** If the Solar SMS is used in a manner not specified by Weidmüller, the protection provided by the equipment may be impaired.

	**WARNING** This equipment shall not be used for measurements on mains circuits. For detailed ratings of the PV-side terminals check the corresponding section in this user guide. Failure to observe this requirement will create an electric shock hazard.

	**NOTICE** Even though DC-side power and energy measurements can be derived from the measurements taken with this equipment, the Solar SMS is not intended to be a power meter or an energy meter.

2.4. Disclaimers

This user guide has been written with due care and attention. However, unless otherwise required by law, we do not guarantee that the data, images, and drawings are accurate or complete nor do we accept any liability for it. Weidmüller's general terms and conditions of sale apply in their respective valid form. The equipment specifications and the contents of this user guide are subject to change without notice.

2.5. Manufacturer contact details

Contact your local Weidmüller sales representative for support and service information about this equipment. Alternatively, you can contact Weidmüller's headquarters:

Weidmüller Interface GmbH & Co. KG
Klingenbergstraße 26
32758 Detmold
T +49–5231 14-0
F +49–5231 14–292083
www.weidmueller.com

3. Installation

	**WARNING** Installation of this equipment must be performed in a non-dusty environment with the following characteristics: • temperature: 5 °C to 40 °C • maximum relative humidity: 80 % for temperatures up to 31 °C decreasing linearly to 50 % at 40 °C

	**DANGER** During mounting, wiring, configuration, maintenance and troubleshooting of this equipment there shall be no live voltage present in the PV DC Combiner Box. Failure to skip this step creates a life hazard to the persons involved due to the up to 1.5 kV voltages typically found in PV systems.

	**NOTICE** According to EN 61326-1:2013 and IEC 61000-4-2:2008 this product is classified under ESD protection class B (4kV). This need to be considered when handling the product. The criteria for handling products with ESD protection class B are shown in IEC 61340-5-1:2007.

3.1. Mounting requirements

The product is intended to be fixed equipment according to IEC 61010-1:2010 ed3.0. This product is meant to be mounted to an EN 50022 top hat rail (such as Weidmüller's TS 35 range) inside a PV DC Combiner Box fulfilling IEC 61439-2 (or equivalent local standard) and only accessible to authorized people. The enclosure of the PV DC Combiner Box shall fulfill IEC 62208 (or equivalent local standard) to ensure protection against direct contact, indirect contact and spread of fire. The IEC 60529 ingress protection code of the PV DC Combiner Box shall be at least IP65, ideally IP66. The IEC 62262 degree of protection against external mechanical impacts of the PV DC Combiner Box shall be at least IK09, ideally IK10.

If the enclosure of the PV DC Combiner Box is made of steel, it must be connected to the protection earth and must include a rated DC switch-disconnector in order to disconnect the supply of the Solar SMS.

The device has a pollution degree 2 and an overvoltage protection category CAT II. The maximum altitude of installation is 2000 meters.

Thermal considerations

- This product does not need forced convection (i.e. a fan) to operate reliably.
- There is nonspecific mounting orientation besides to be installed onto the terminal rail.
- Leave enough space around the product to allow natural-convection air flow.
- This product shall not be installed in the close vicinity of powerful heat sources.
- Wires passing though the modules containing Hall effect sensors must be installed and wired with the current flowing in the direction of the arrow printed on the PCB.
- It is important to review the connections and to put back in place the plastic top cover to guarantee the electrical safety of the equipment.
- The PV DC Combiner Box design shall guarantee that the air temperature around the PCB of this equipment is between –20 °C and +70 °C.
- Weidmüller's range of PV DC Combiner Boxes is engineered with these considerations in mind and the designs are validated with IEC/TR 60890 thermal models and/or multipoint temperature rise tests. Contact your Weidmüller' sales representative for additional information.

3.2. Wiring of PV inputs

The “PV side” consists of CN1/CN4. CN1 is the PV positive input voltage and CN4 is the PV negative input voltage. Electric schema is shown in figure 1.

⚠	**DANGER** There must be a way to isolate this equipment from the dangerous voltages of the PV modules and the DC input of the inverter. Failure to observe this requirement creates an electrical shock hazard. The recommended solution is to install the following devices easily accessible and near this equipment (typically inside the PV DC Combiner Box): • fuse-disconnectors (placed electrically between the PV modules and this equipment). • an IEC 60947-3 certified DC-21B switch-disconnector (placed electrically between this equipment and the inverter). The fuse-disconnectors and the switch-disconnector should be marked in the PV DC Combiner Box as devices for the disconnection of this equipment.

⚠	**WARNING** The PV-side wires (power supply) shall have the right length so that they do not apply a mechanical strain to this equipment. Failure to observe this requirement creates fire and electrical shock hazards and may also damage this equipment.

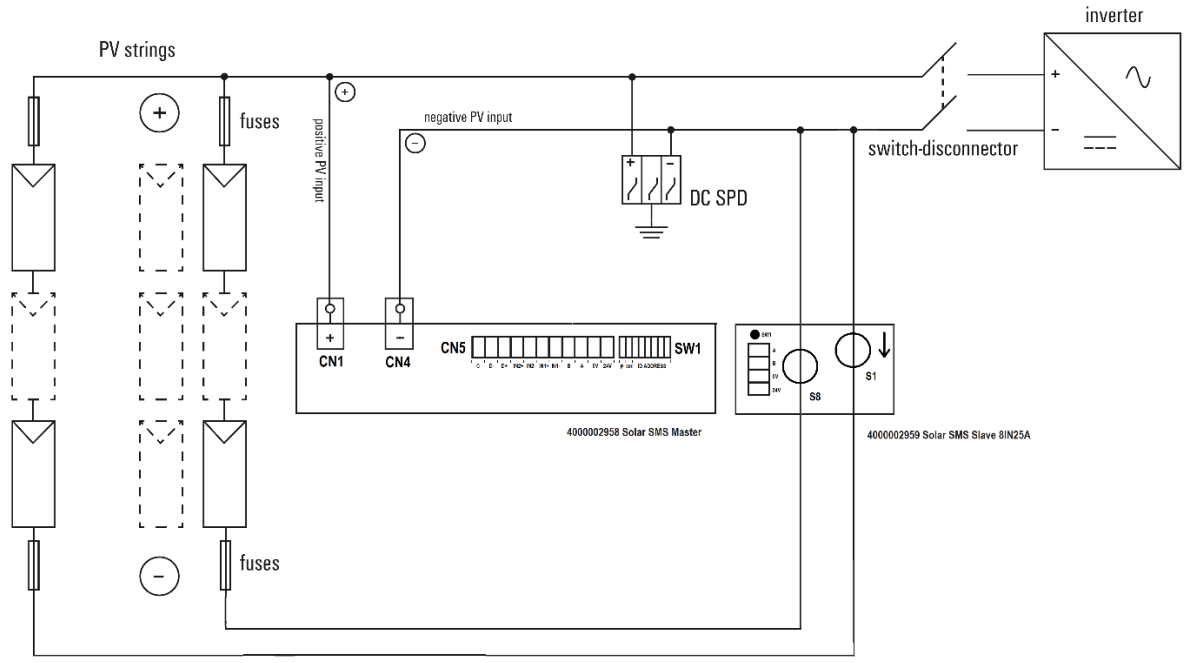

Figure 1

The power supply input of this equipment is floating with regards to the rest of the circuit. This is accomplished by means of a dedicated DC/DC converter which provides a double insulation barrier between the power supply input and the PV-side terminals.

From the user perspective, this means full safety even under severe surges. This equipment is self-powered directly from the string voltage, powered from 200 VDC up to 1500 VDC as shown in figure 2.

⚠	**CAUTION**
	This equipment is marked with “1500VDC MAX.” label; “-“ and “+” symbols because it is fed with DC power up to 1500 VDC.

Connector CN4/CN1	
Stranded wire cross section (with plastic collar ferrule)	0.5 - 16 mm^2
Stranded wire cross section (with wire end ferrule)	
Stripping length for stranded wire with end ferrule with cross section from 0.5 mm^2 to 16 mm^2	18 mm

⚠	**WARNING**
	The power supply cable shall have the right length, so that it does not apply a mechanical strain to this equipment. Failure to observe this requirement creates an electrical shock hazard and may also damage this equipment.

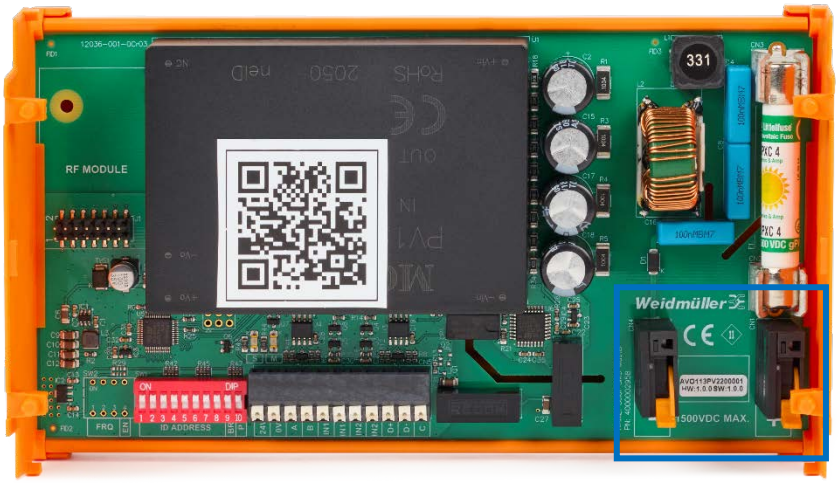

Figure 2

3.3. Wiring of digital inputs

⚠	**DANGER** Digital inputs must be manipulated with the Solar SMS Master powered off. Digital inputs have a basic insulation.

This product includes two digital inputs (pins IN1/IN2 from connector CN5 as shown in figure 3), designed to detect an ‘open’ dry contact as logical “1” and ‘closed’ dry contact as logical “0”. These inputs are galvanically isolated from the internal circuitry.

⚠	**WARNING** The digital input cables shall have the right length so that they do not apply a mechanical strain to this equipment. Failure to observe this requirement creates an electrical shock hazard and may also damage this equipment.

⚠	**CAUTION** The cables connected to the digital inputs shall each be less than 3 meters long in order to maintain EMC compliance.

Figure 3

Connector CN5 (IN1-/IN1+ and IN2-/IN2+)	
Stranded wire cross section (with plastic collar ferrule)	0.25 - 0.75 mm^2
Stranded wire cross section (with wire end ferrule)	0.25 - 1.5 mm^2
Stripping length for stranded wire with end ferrule with cross section from 0.25 mm^2 to 0.75 mm^2	10 mm

3.4. Wiring of RS-485 ports

⚠	**DANGER**
	RS-485 ports must be manipulated with the Solar SMS Master powered off.

This product includes internal RS-485 port (pins 24V/0V/A/B from connector CN5 as shown in figure 4) designed to communicate with any Slave SMS product to be connected to any variant of Solar SMS Slave 8IN25A, Solar SMS Slave 8IN50A, Solar SMS Slave 12IN25A, and Solar SMS Slave 12IN50A.

⚠	**CAUTION**
	Pay attention when wiring RS-485 cables. A wrong installation can create a lack of communications, but also, it can damage the equipment. All the units shipped out from Weidmüller have their RS-485 ports thoroughly tested right at the end of the production line. Weidmüller will not cover under warranty Solar SMS units that have their RS-485 transceiver IC damaged due to wrong wiring and/or due to surges.

⚠	**CAUTION**
	RS-485 wiring requires technical skills and tools different to those of available to regular electricians. Ensure that this step of the equipment installation is performed by staff with the right skills and tools. This user guide cannot be a replacement for field bus wiring experience and Weidmüller cannot be made liable for any damages resulting from improper wiring.

⚠	**CAUTION**
	This equipment complies with the latest RS-485 and Modbus standards, which are the official sources of information. The installation staff must refer to the following documents, which always have priority over any wiring recommendations given in this user guide: • TIA/EIA–485–A: “Electrical characteristics of generators and receivers for use in balanced multipoint systems” • TIA TSB–89–A: “Application guidelines for TIA/EIA–485–A” • “Modbus application protocol specification” v1.1b • “Modbus over serial line specification and implementation guide” v1.02

Figure 4

Connector CN5 (24V/0V/A/B)	
Stranded wire cross section (with plastic collar ferrule)	0.25 - 0.75 mm^2
Stranded wire cross section (with wire end ferrule)	0.25 - 1.5 mm^2
Stripping length for stranded wire with end ferrule with cross section from 0.25 mm^2 to 0.75 mm^2	10 mm

This product also includes external RS-485 port (pins D+/D-/C from connector CN5 as shown in figure 5), designed to communicate with third-party products.

The RS-485 port of this equipment is floating with regards to the rest of the circuit. This is accomplished by means of dedicated DC/DC converters. From the user perspective, this means reliable communications, no ground loops and full safety, even under severe surges.

In the table below you'll find a correspondence between alternate names for RS-485 pins. The reason for choosing D+/D- over B/A or D1/D0 in this equipment is to avoid confusion with certain third-party products on the market with erroneously swapped B/A and D1/D0 pins. The names D+/D- cannot lead to confusion.

Function	Non-inverting pin	Inverting pin	Reference pin
RS-485 standard	B	A	C
Modbus standard	D1	D0	Common
Weidmüller	D+	D-	C

The RS-485 cable used to wire this equipment must fulfill the following specifications:

- Shielded twisted pair with 1.5 or 2 pairs (preferably 1.5 pairs)
- Braid shield, not foil shield
- 120 Ω characteristic impedance
- Cross section of individual wires 0.2 mm2 (AWG24) or larger

The following are two examples of proper RS-485 cable:

- Belden: 3106 A
- Lapp Cable Unitronic Bus LD 2×2×0.22 (part number 2170204)

Modbus terminology:

- The Solar SMS is a slave and a server from the viewpoint of the Modbus standard.
- A SCADA or the program running in a PLC/datalogger is a client from the viewpoint of the Modbus standard.
- A RS-485 to Ethernet converter or the hardware of a PLC/datalogger is a master from the viewpoint of the RS-485 standard.

Guidelines for RS-485 field wiring of this equipment when installed inside PV DC Combiner Box:

- The RS-485 bus topology must be a daisy chain.
- Short stubs (< 2 meters) are allowed inside the PV DC Combiner Box.
- Even though the RS-485 standard allows up to 1200 meters bus length at low bit rates (i.e. 9600 bps and 19200 bps), we recommend staying below 500 meters.
- Each end of the bus requires a 120 Ω 10% ½ W termination resistor between D+ and D- (see the RS-485 wiring diagram from figure 6). One end of the bus will be the RS-485 master (which may or may not include an internal termination option) and the other end will be inside the PV DC Combiner Box farthest away from the master (in terms of RS-485 cable distance).
- This equipment loads the RS-485 bus with 1/8 UL (Unit Load).
- It is recommended not to mix Solar SMS and other RS-485 slaves in the same bus.
- When daisy-chaining PV DC Combiner Boxes, the D+ and D- of each Solar SMS should use one twisted pair of the cable, leaving the remaining wire (in cables with 1.5 pairs) or the remaining twisted pair (in cables with 2 pairs) for the C connection. Always make sure that D+, D- and C use the right color-coded wire of the cable. It is a must to connect the C pin of all the Solar SMS and the RS-485 master together (see the RS-485 wiring diagram from figure 6).

	CAUTION
⚠	• IMPORTANT: in each PV DC Combiner Box always wire the C pin first and afterwards the D+ and D- pins. • It is very important NOT to connect the shield to the C pin in any PV DC Combiner Box (see the RS-485 wiring diagram from figure 6). Daisy-chained shield running non-stop from end to end of the RS-485 bus. Leave the shield floating (i.e. unconnected) at the far end of the RS-485 bus (i.e. the PV DC Combiner Box farthest from the RS-485 master in terms of cable length). Tie the shield directly to protective earth at the RS-485 master end. • Tie the C pin to protective earth at the RS-485 master end (see RS-485 wiring diagram from figure 6). Before doing this, ensure that the C pin is not connected to protective earth anywhere else in the whole RS-485 bus (keep in mind that some RS-485 masters may already tie internally the C pin to protective earth or to their power supply ground!). This connection makes sure that the RS-485 common-mode voltage stays close to earth potential instead of rising to dangerous voltages due to stray capacitances and conductance in the network. • Check communication schema on next page.

	CAUTION
⚠	Damages to the RS-485 transceiver IC of this equipment due to the following wiring errors will not be covered under warranty: • Connecting the C pin of this equipment to protective earth anywhere except in one point (at the master end). This connection may already be done internally inside the RS-485 master. • Connecting the C pin of this equipment to the cable shield inside a PV DC Combiner Box. • Using non-twisted pair or non-shielded cables. • Not connecting RS-485 cables as it appears on the figure 6.

	WARNING
⚠	The RS-485 cables shall have the right length so that they do not apply a mechanical strain to this equipment. Failure to observe this requirement creates an electrical shock hazard and may also damage this equipment.

Figure 5

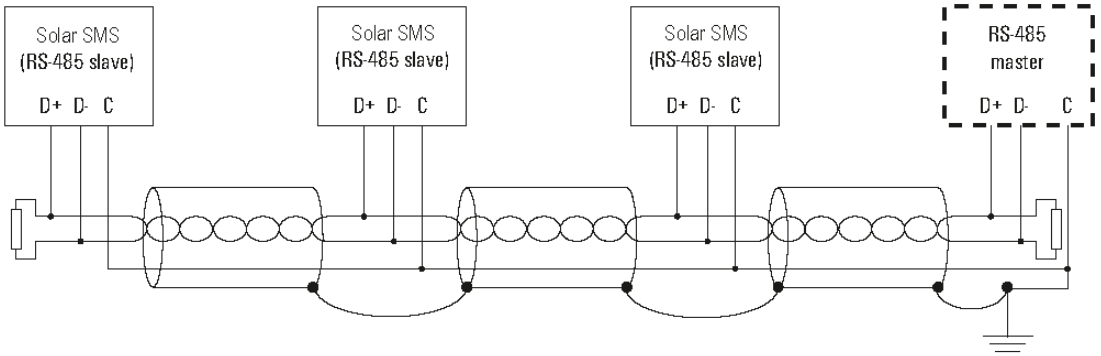

Figure 6

3.5. DIP switch configuration

Use the DIP switch (SW1) to configure the Modbus device address and the RS-485 serial settings. The first eight positions marked as “ID ADDRESS” are used to configure the ID of the Solar SMS device. The last two positions marked as “BR” and “P” are used to configure the RS-485 serial settings.

The following table specifies the binary coding of the Modbus device address via DIP switch. The factory default slave address is 1 (i.e SW1.1 in the ‘ON’ position and SW1.2 to SW1.8 in the ‘OFF’ position). As an example, the DIP switch coding for Modbus address 175 is shown (10101111 in binary).

	SW1.1	SW1.2	SW1.3	SW1.4	SW1.5	SW1.6	SW1.7	SW1.8
Weight	2^0 (LSB)	2^1	2^2	2^3	2^4	2^5	2^6	2^7 (MSB)
Address increment	1	2	4	8	16	32	64	128
Example Modbus address 175	ON	ON	ON	ON	OFF	ON	OFF	ON

RS-485 serial settings (SW1.9 and SW1.10):

- SW1.9 – data signaling rate
  - OFF: 9600 bps (factory default)
  - ON: 19200 bps
- SW1.10 – parity bit
  - OFF: NONE (factory default)
  - ON: EVEN

In order to modify ID number (or Modbus device address), data signaling rate (or baudrate) or parity parameters, a power cycle is needed. In order for any change be effective, the process must be as follows:

- Configure the desired ID (SW1.1 and SW1.8), baud rate or parity (SW1.9 and SW1.10).
- Switch-off the device and wait 5 seconds (any LED might be ON).
- Switch-on again the device.

NOTICE

All the devices belonging to one RS-485 bus must have the same serial settings and the Modbus device address of each Solar SMS cannot be used more than once.

	NOTICE After modifying any DIP switch setting, the changes need to be applied by powering off and then back on the equipment.

	NOTICE Regardless of the SW 1.10 parity bit setting there is always ONE stop bit.

3.6. Solar SMS Slaves configuration

All variants of Solar SMS Slave use Modbus RTU protocol in “slave” mode, returning reading data (current measurements) to the “master” (the Solar SMS Master unit) when asked. The baudrate is fixed at 19200 bps (factory default).

All and each Solar SMS Slave (regardless the variant we do have) are internally connected as daisy-chain configuration to the Solar SMS Master unit and are equipped with a push-button (SW1) as can be seen in figure 7.

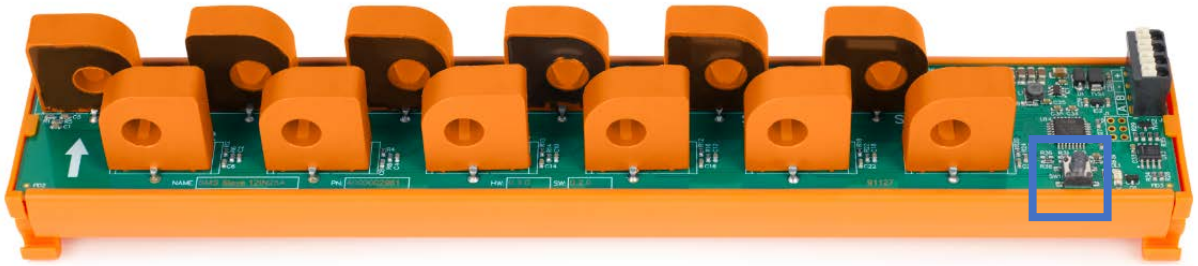

Figure 7

The push-button is meant to set the device address of each and all Solar SMS Slave daisy-chained to the Solar SMS Master unit. The push-button must be pressed in the desired order we do want to assign the current channels order (8 up to 32). In order to do so, a Modbus address must be given to each module and shown explained below:

- Ensure that all Solar SMS Slave units are powered on.
- Shortly press the push-button of the first Solar SMS Slave unit to be configured to enter in “waiting address state” (green LED will blink slowly).
- Solar SMS Master will send a broadcast message with the assigned address number.
- Solar SMS Slave will save the address in the flash memory.
- Solar SMS Slave Modbus address is configured and assigned to the unit.

Repeat the process for all and each Solar SMS Slave daisy-chained to the Solar SMS Master unit.

Note:

- Address assignment is concluded when the process is done within the first 60 seconds after powering on all devices. So there are 60 seconds after power is on to assign the address to all and each connected Solar SMS Slave devices.
- Push-button must be pressed for 5 seconds to reset Modbus address of a Solar SMS Slave unit. Then, the process for assigning a Modbus address must be followed again.

4. Integration with a Modbus RTU client

This equipment has been designed with commercial and utility-sized PV plants in mind. In this type of sites, the Modbus RTU client(s) sending requests to the Solar SMS Master is/are normally …

- … a set of PLCs (typically one PLC per inverter shelter) acting as local dataloggers. In this case a SCADA software will send Modbus requests to the PLCs instead of the Solar SMS Masters.

or …

- … a SCADA software located in the control room sending requests directly to the Solar SMS Masters.

In the case (2), where the SCADA sends Modbus requests directly to the Solar SMS Masters, the appropriate RS-485 masters for the field buses are the following Weidmüller Serial/Ethernet converters, installed in the inverter shelters. Contact your Weidmüller sales representative for further information.

	CAUTION
	Some Serial/Ethernet converters internally tie the RS-485 pin C to their power supply GND. Failure to observe this particularity could permanently destroy the RS-485 transceiver ICs and this damage would not be covered by Weidmüller's warranty. Ensure there are no ground loops (i.e. different paths to protective earth) in the RS-485 bus' pin C.

In terms of configuration of the SCADA or PLC acting as Modbus client, follow these recommendations:

- Set the Modbus client timeout to 1 second.
- The recommended practical polling interval per slave is 20 seconds. This is a good tradeoff between unnecessary network traffic (and database size) and time resolution. Keep in mind that the sun, the clouds and the MPP of the inverter do not change significantly in 20 seconds!
- For the most efficient use of the PV site network bandwidth, we recommend that all the Modbus registers of each Solar SMS Master are read in one single, function code 0x04 "read input registers".
- The averaging window length is 2.5 seconds.

The system is providing several measurements and alarm information via Modbus. This information is listed below. More details can be found at the end of the document under Annex B section.

- Averaged PV system voltage.
- Averaged PV current for each input.
- Averaged PCB temperature.
- Status of the digital inputs.
- Alarm flag: PV system undervoltage (user-configurable threshold).
- Alarm flag: Individual input undercurrent (user-configurable threshold).
- Alarm flag: Blown fuse.
- Alarm flag: PCB over temperature (fixed threshold 70 °C).

5. Maintenance and service

	**DANGER** The maintenance of this equipment can only be performed when there are no live voltages present in this equipment and after it has cooled down for at least 15 minutes. Failure to observe this requirement creates electrical shock and burn hazards.

	**WARNING** The pollution degree of the conductor board is achieved using conformal coating that meets ANSI/UL 746E. Scratches or surface damage can reduce the insulation protection of the device. Thus, the board must be handled with care.

This equipment needs very little maintenance if mounted in a proper PV DC Combiner Box. These are the only maintenance tasks required every two years (increase the frequency of maintenance sessions if the device operates in very polluted/dusty environment and/or is frequently subject to large temperature variations).

- Check the supply voltage with a multimeter.
- Make sure the equipment remains well secured to the PV DC Combiner Box DIN rail.
- Visually inspect the RS-485 wiring.
- Visually inspect the amount of dust/dirt on the equipment cover and on the PCB surface. In case cleaning is needed, it shall be done with just a damp cloth. No other solvent can be used to clean this equipment.
- Visually inspect the metal contacts of the terminal blocks. If there are signs of corrosion, the equipment may need to be serviced by Weidmüller.

	**WARNING** This product can only be serviced by Weidmüller. Failure to observe this requirement voids the warranty and can lead to dangerous situations. Contact your Weidmüller sales representative for service information.

	**WARNING** Before operating the device, the DC switch disconnector must be open to power off the Solar SMS device. Using a current clamp check that there is no current flowing into the Solar SMS. If the onboard PCB fuse-link is blown, it must be replaced by using a gPV type fuse-link of 4 ADC and 1500 VDC nominal rated voltage.

5.1. LED signals

Solar SMS Master LED signals

The Solar SMS Master is equipped with two signal LEDs which indicate the system's status without use of further equipment.

Green LEDs are present at Solar SMS Master module, providing information about the supply voltage of the unit (the LED marked as "M") and the communications activity with connected Solar SMS Slaves daisy-chained and with the SCADA or a PLC/datalogger (the LED marked as "S") as shown in figure 8.

Figure 8

When the Solar SMS Master is connected for the first time to the voltage supply, both green LEDs (marked as "M" and "S") turns on, indicating that the device is powered on. If communication between Solar SMS Master and any Solar SMS Slaves is stablished, LED marked as "S" starts to blink meaning Solar SMS Master is transmitting. The same way, when the communication between Solar SMS Master and the SCADA or a PLC/datalogger is established, the LED marked as "S" starts to blink, meaning the Solar SMS Master is transmitting data.

Solar SMS Slave LED signals

The Solar SMS Slave is equipped with one signal LED which indicates the system's status without use of further equipment.

The green LED on the Solar SMS Slave module (on each and all variants possible), provides information about the supply voltage and the internal RS-485 communications activity with Solar SMS Master connected (LED marked as "DL1") as shown in figure 9.

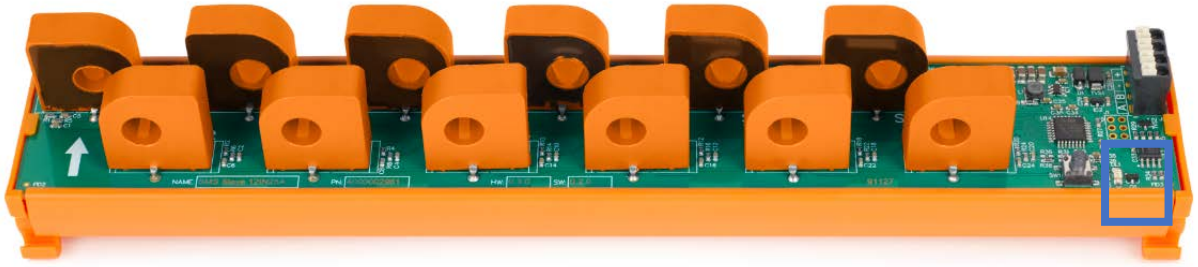

Figure 9

When the Solar SMS Slave is for the first time connected to the voltage supply (note that the supply voltage will come from Solar SMS Master wiring), the green LED (marked as “DL1”) turns on indicating that the device is powered on. Immediately after, “DL1” will start to blink slow meaning Solar SMS Slave has no ID address assigned yet and awaiting to be configured (see section 3.6 Solar SMS Slaves configuration). If the communication between Solar SMS Slave and Solar SMS Master is established, “DL1” starts to blink fast, meaning that the Solar SMS Slave is transmitting data and communicating with the Solar SMS Master unit.

LED signals table

Unit	LED	Color	Status	Description
Solar SMS Master	M	Green	ON	The product is supplied with voltage and can operate
			Blinking	There is RS-485 activity (transmitting/receiving from/to SCADA or a PLC/datalogger)
			OFF	The product is not supplied (with 24 VDC)
	S	Green	ON	The product is supplied with voltage and can operate
			Blinking	There is RS-485 activity (transmitting/receiving from/to Solar SMS Slave)
			OFF	The product is not supplied (with 24 V)

Unit	LED	Color	Status	Description
Solar SMS Slave	DL1	Green	ON	The product is supplied with voltage and can operate
			Slow Blinking	No ID address assigned yet (default ID address is 0)
			Fast Blinking	There is RS-485 activity (transmitting/receiving from/to Solar SMS Master)
			OFF	The product is not supplied (with 24 VDC)

5.2. Solar SMS Slave module replacement

A non-working Solar SMS Slave module can be detected because all current values measurements are 0 ADC event though current is coming from the PV modules and PV DC Combiner Box operation is correct.

In order to replace the faulty Solar SMS Slave module, it is needed to power off the device, disconnect the module and replace it for a brand-new module. Finally, it is necessary to enroll the new Solar SMS Slave following the configuration steps described in section *3.6 Solar SMS Slaves configuration*.

	**WARNING** This product can only be serviced by Weidmüller. Failure to observe this requirement voids the warranty and can lead to dangerous situations. Contact your Weidmüller sales representative for service information.

	**WARNING** Before operating the device, the DC switch disconnector must be open to power off the Solar SMS device. By using a current clamp check that there is no current flowing into the Solar SMS.

6. Specifications and regulatory information

This equipment device fulfills the essential requirements of the Low Voltage Directive (LVD) 2014/35/EU and the Electromagnetic Compatibility (EMC) Directive 2014/30/EU and therefore, is entitled to be CE marked.

Waste Electrical and Electronic Equipment (WEEE) directive 2012/19/EU

Purchasing this equipment gives you the right to return it to Weidmüller, free of charge, at the end of its service life. Weidmüller will then professionally recycle and dispose of your device in accordance with the applicable laws. Electrical equipment must not be disposed through the “normal waste disposal channels”. All devices that fall under the WEEE directive must feature this logo.

Annex A: List of acronyms

DC:	Direct Current
DIP:	Dual In-line Package
EMC:	ElectroMagnetic Compatibility
ESD:	ElectroStatic Discharge
IC:	Integrated Circuit
LSB:	Least Significant Bit
MPP:	Maximum Power Point
MSB:	Most Significant Bit
PCB:	Printed Circuit Board
PDU:	Protocol Data Unit (Modbus frame)
PLC:	Programmable Logic Controller
PV:	PhotoVoltaic
RS-485:	TIA/EIA-485-A “Electrical characteristics of generators and receivers for use in balanced multipoint systems”
SPD:	Surge Protective Device

Annex B: Modbus register table

The commands are all according to the Modbus RTU protocols available from the Modbus® organization (www.modbus.org).

The commands can be tested using software tools, such as the program Modbus Poll (from www.modbustools.com).

The following commands are implemented:

Function name	Function code	Hexadecimal
Read Input Register	04	0x04
Write Single Register	06	0x06

Notes:

- Some users and even PLC and SCADA systems use the obsolete Modicon format for registers' addresses. As an example, input register 23 would be written as 30023 using the old Modicon format.
- The values of the average power registers can be calculated by the Modbus client instead of being transmitted. This saves network bandwidth.

The register map of the Modbus used to perform communication is showed in the table below:

Register name	Register address	Register description	Min	Max	Unit	Read / Write	Data type	Size	Modbus function code	Modbus object	Default value	Notes
MODEL_ID	1	Number identifying the HW variant	-	-	uint	Read only	UINT	1	04	Input register	-	-
HW_VERS	2	Hardware version	10000	65535	(see Notes)	Read only	UINT	1	04	Input register	-	Tens of thousands: major release number / Thousands and hundreds: minor release number / Tens and units: patch level number (example: 65535 means HW version 6.55.35)
FW_VERS	3	Firmware version	10000	65535	(see Notes)	Read only	UINT	1	04	Input register	-	Tens of thousands: major release number / Thousands and hundreds: minor release number / Tens and units: patch level number (example: 65535 means FW version 6.55.35)
TEMP	4	PCB temperature	-200	800	ºC x 10	Read only	INT	1	04	Input register	-	-
PV_VOLT	5	PV system voltage	0	1800	Volts	Read only	UINT	1	04	Input register	-	-
PV_CURRENT_01	6	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_02	7	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_03	8	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_04	9	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_05	10	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_06	11	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_07	12	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_08	13	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_09	14	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_10	15	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_11	16	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_12	17	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_13	18	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)

PV_CURRENT_14	19	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_15	20	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_16	21	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_17	22	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_18	23	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_19	24	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_20	25	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_21	26	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_22	27	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_23	28	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_24	29	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_25	30	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_26	31	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_27	32	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_28	33	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_29	34	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_30	35	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_31	36	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
PV_CURRENT_32	37	Individual input current	0	25000/50000	mA	Read only	UINT	1	04	Input register	-	Depends on configuration (Hall effect sensors current: 25A or 50A)
FLG_EV	38	Various event flags	0x0000	0x000F	Bitfield	Read only	UINT	1	04	Input register	-	b0: set to '1' if TEMP > 70 ºC b1: set to '1' if PV_VOLT < THR_UV b2: set to '1' if digital input 1 is open b3: set to '1' if digital input 2 is open
FLG_BF	39-40	Binary flags for blown fuses	0x0000 0000	0xFFFF FFFF	Bitfield	Read only	UNIT	2	04	Input register	0x0000 0000	bX: set to '1' if PV_CURRENT_XX <= THR_UC. If a certain bit is disabled in MSK_INPUT_EN, the corresponding bit in

												FLG_BF will be 0 (register addrees 39 --> LSB / register address 40 --> MSB)
THR_UV	41	User-defined undervoltage threshold	200	1500	Volt	Read / Write	UINT	1	04 / 06	Holding register	200	-
THR_UC	42	User-defined undercurrent threshold	0	25000/50000	mA	Read / Write	UINT	1	04 / 06	Holding register	0	-
MSK_INPUT_EN	43-44	Mask to enable individual current inputs	0x0000 0000	0xFFFF FFFF	Bitfield	Read / Write	UINT	2	04 / 06	Holding register	0xFFFF FFFF	To avoid false events about blown fuse and undercurrent (register addrees 43 --> LSB / register address 44 --> MSB)

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