meteo control
Energy & Weather Services

# String Monitoring Unit (SMU)

## 0825 | 1225 | 1625 | 2422

# Operating Manual

Version 20171221

## Copyright



## Contact data

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## Details regarding the manual

The original operating manual is written in German. All other language versions are translations of the original operating manual and are hereby identified as such.

# Contents

# 1. General notes

## 1.1 Safety instructions

Safety instructions warn of dangers when using the devices and explain how they can be avoided.

The safety instructions are classified according to the severity of the risk and are subdivided into four groups:

***DANGER***

Imminent danger

Failure to comply with the warning notice will lead to an imminent risk of death or serious physical injury!

***WARNING***

Possible danger

Failure to comply with the warning notice may lead to death or serious physical injury!

***CAUTION***

Hazard with a risk of material damage

Failure to comply with the warning notice may lead to minor injuries!

***ATTENTION***

Risk of material damage

Failure to comply with the warning notice will lead to material damage!

## 1.2 Warning symbols

Particular dangers are highlighted using warning symbols.

***ELECTRICAL HAZARD***

Risk of electrocution!

Failure to comply with the warning notice will lead to an imminent risk of serious injury or death.

## 1.3 Additional information

This symbol can be found next to notes, additional information and tips.

## 1.4 Text display

**Emphasized points** are shown in bold and indicate important information.

**Lists** are shown with bullet points (level 1) and dashes (level 2):

- List 1
  - Point A
  - Point B
- List 2

**Instructions** describe steps which are to be carried out in the given order.

1. Instruction 1
2. Instruction 2

↳ Result of the operation

**Button names** are shown in capitals and in "QUOTATION MARKS".

In **illustrations**, **item numbers** are used to indicate components.

The legend including item numbers and descriptions of the components is shown below the figure. Alternatively, direct references to components are made in the text.

# 2. Notes on this operating manual

This manual is a key aid when it comes to ensuring proper operation of the device. It contains important information and safety notes to help you use the devices correctly, economically and in the intended manner.

The manual helps to avoid dangers, to reduce repair costs and downtimes, and to increase the reliability and operating life of the devices.

This manual describes the installation, configuration and operation of the String Monitoring Units 0825, 1225, 1625 and 2422.

During installation, all the manuals for system modules and components must be taken into account.

***DANGER***

**Danger from improper handling of the device**

The personnel responsible for installation, operation and maintenance of the system must have read and understood the operating manual before the devices can be installed and used safely!

The manual and documentation must be kept by the system and be available at all times as required.

This manual is continually updated. The most up-to-date version of the operating manual can be found on our Internet site. *www.meteocontrol.de*

## 2.1 Warranty and liability

Details of the scope and form of the warranty as well as the warranty period are given in the meteocontrol GmbH General Terms and Conditions.

meteocontrol GmbH rejects any liability for damage arising from the non-observance of the operating manual.

This applies, in particular, to damage resulting from:

- Unintended use
- Incorrect operation
- Wrongly chosen materials and tools
- Faulty or non-executed maintenance and repairs

# 3. Safety instructions for operation

Before commencing the installation or commission and before maintenance, be sure to read and observe all the relevant warnings and safety information in this manual.

Installation, commissioning, operation and maintenance of the measuring boards must be carried out in the prescribed way, i.e. in accordance with the conditions described in this manual and the technical data for the relevant measuring board.

## 3.1 Intended use

The measuring boards of the String Monitoring Unit series are designed to monitor the direct current side of photovoltaic systems. Solar module strings (a number of solar modules connected together), hereinafter referred to as "strings", can be connected to the measuring boards. The measuring boards may be used only for such measurement tasks. Any other use is considered not as intended.

To ensure safe operation, the measuring boards may be operated only as specified in the instruction manual and technical data sheets. The relevant statutory and safety regulations that apply to the specific application must also be observed.

## 3.2 Personnel

These devices may be installed, commissioned and maintained only by a qualified electrician.

Given their specialist training, knowledge, experience and familiarity with the relevant standards and regulations, a qualified electrician is in a position not only to carry out work on electrical systems but also to recognize and avoid possible dangers unaided.

The qualified electrician must comply with the occupational health and safety laws in force.

Please note in particular:

- all national installation and set-up regulations (e.g. VDE in Germany),
- all generally accepted codes of practice,
- the information on transport, installation, operation, service, maintenance and disposal given in this manual,
- specific values, limits and information relating to operating and ambient conditions on type plates and in data sheets.

## 3.3 Particular risks

The measuring boards are used as components in solar installations and must therefore be integrated into their safety systems. They are not themselves safety components and cannot effect safety-related shutdowns. Additional components are needed for this purpose, and must be provided by the installer and operator of the system.

Once they are connected to solar modules, String Monitoring Units are permanently at a very high voltage, sufficient to cause death or serious injury if touched. You must therefore make sure that only qualified personnel have access to the measuring boards, and that the measuring boards are fitted with circuit breakers to de-energize them for maintenance purposes.

## 3.4 Protection concepts

- The modules should be provided with a cover to prevent direct contact in the string combiner box
- The measuring boards must be mounted in a sealed enclosure in such a way that they are accessible only to authorized personnel
- The String Monitoring Units must not be modified in any way
- Damaged devices must be taken out of operation immediately and checked by a qualified electrician
- Local regulations must be observed when using the devices
- The safety of the measuring boards and the user cannot be guaranteed if the safety precautions described are violated

## 3.5 Maintenance and cleaning

For installation and maintenance, the measuring boards must always be disconnected from the power supply. Before doing any work on the measuring board, check that the circuit breaker has been activated and the measuring board is de-energized.

In the event of a defect, failure or damage, do not attempt to repair any devices yourself or to resume operation. In such cases please always contact your customer service agent or meteocontrol.

## 3.6 Transport and storage

As soon as you receive the products, check that the packaging is intact and examine the measuring board for any obvious damage or defects. Check that the delivery is complete (accessories, documentation, tools etc.).

*WARNING*

A damaged device must not be put into operation!

In such cases please contact your customer service agent or meteocontrol.

*ATTENTION*

To avoid possible damage, always use the original packaging when transporting or shipping the device.

Protect the device from dust and moisture.

# 4. Technical description

## 4.1 String Monitoring Unit functionality

The String Monitoring Unit was specially developed for measuring electrical values (string currents, system voltage and power) of the PV generator within a PV system. Independently of the inverters, the DC side of a photovoltaic system (PV system) can be precisely monitored and errors and faults can be detected and corrected early on. For instance:

- contamination with pollen, dust or soot,
- weather influences such as hail or snow,
- installation errors,
- manufacturing errors,
- theft and vandalism.

The measuring boards have a Modbus interface for control purposes and for exporting data. It is possible to combine a number of measuring boards in a single system, for instance if more solar module strings need to be connected than there are inputs available on the String Monitoring Unit.

There are four possible variants which differ in terms of the number of channels available for measuring electrical values and the measuring range.

### String Monitoring Unit 0825

This measuring board has 8 inputs for measuring string currents up to 25 A and the system voltage.

### String Monitoring Unit 1225

This measuring board has 12 inputs for measuring string currents up to 25 A and the system voltage.

### String Monitoring Unit 1625

This measuring board has 16 inputs for measuring string currents up to 25 A and the system voltage.

### String Monitoring Unit 2422

This measuring board has 24 inputs for measuring string currents up to 22 A and the system voltage.

# 5. Device overview

## 5.1 Front side of the String Monitoring Unit 0825

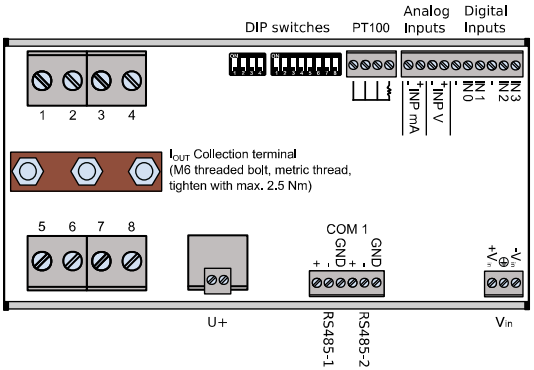



*Fig. 1: Device overview – front side of the String Monitoring Unit 0825*

| | | | |
|---|---|---|---|
| 1 … 8 | Inputs for measuring string currents | INP mA | Analog input 0 … 20 mA for current signal |
| $I_{OUT}$ | Output for total current on common terminal | INP V | Analog input 0 … 10 V for voltage signal |
| U+ | Input for measuring system voltage across all strings | IN0 … IN3 | Digital inputs |
| DIP | DIP switches for setting the communication parameters | RS485 | Bus interface, duplicated and connected through internally |
| PT100 | Input for temperature sensor (PT100 in three-wire connection) | $V_{in}$ | Power supply (22 … 27 V DC) |

## 5.2 Front side of the String Monitoring Unit 1225

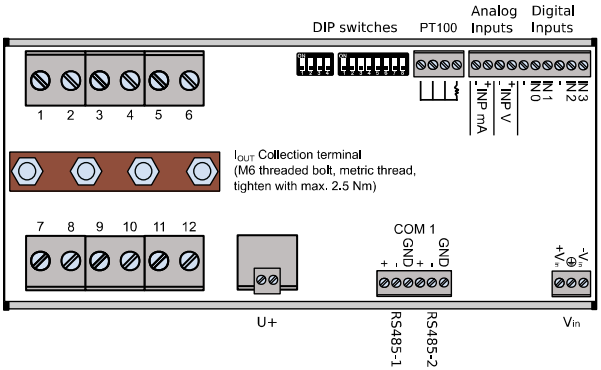



*Fig. 2: Device overview – front side of the String Monitoring Unit 1225*

| | | | |
|---|---|---|---|
| 1 … 12 | Inputs for measuring string currents | INP mA | Analog input 0 … 20 mA for current signal |
| $I_{OUT}$ | Output for total current on common terminal | INP V | Analog input 0 … 10 V for voltage signal |
| U+ | Input for measuring system voltage across all strings | IN0 … IN3 | Digital inputs |
| DIP | DIP switches for setting the communication parameters | RS485 | Bus interface, duplicated and connected through internally |
| PT100 | Input for temperature sensor (PT100 in three-wire connection) | $V_{in}$ | Power supply (22 … 27 V DC) |

## 5.3 Front side of the String Monitoring Unit 1625

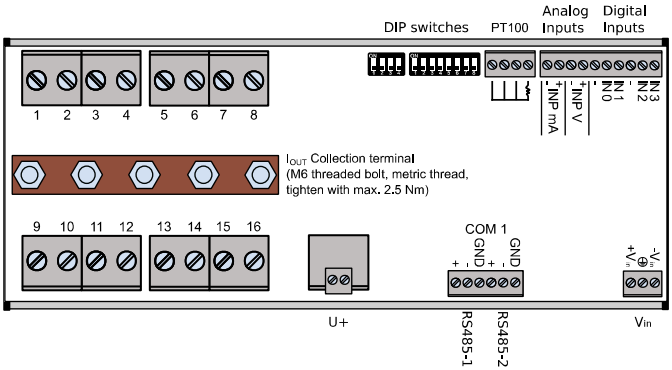



*Fig. 3: Device overview – front side of the String Monitoring Unit 1625*

| | | | |
|---|---|---|---|
| 1 … 16 | Inputs for measuring string currents | INP mA | Analog input 0 … 20 mA for current signal |
| $I_{OUT}$ | Output for total current on common terminal | INP V | Analog input 0 … 10 V for voltage signal |
| U+ | Input for measuring system voltage across all strings | IN0 … IN3 | Digital inputs |
| DIP | DIP switches for setting the communication parameters | RS485 | Bus interface, duplicated and connected through internally |
| PT100 | Input for temperature sensor (PT100 in three-wire connection) | $V_{in}$ | Power supply (22 … 27 V DC) |

## 5.4 Front side of the String Monitoring Unit 2422

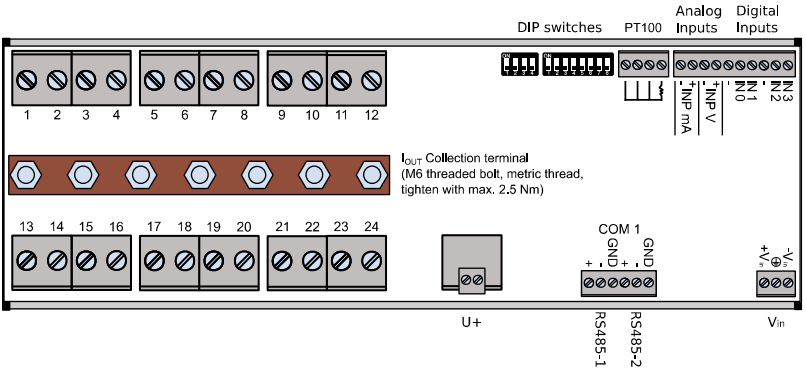



*Fig. 4: Device overview – front side of the String Monitoring Unit 2422*

| | | | |
|---|---|---|---|
| 1 … 24 | Inputs for measuring string currents | INP mA | Analog input 0 … 20 mA for current signal |
| $I_{OUT}$ | Output for total current on common terminal | INP V | Analog input 0 … 10 V for voltage signal |
| U+ | Input for measuring system voltage across all strings | IN0 … IN3 | Digital inputs |
| DIP | DIP switches for setting the communication parameters | RS485 | Bus interface, duplicated and connected through internally |
| PT100 | Input for temperature sensor (PT100 in three-wire connection) | $V_{in}$ | Power supply (22 … 27 V DC) |

# 6. Installation

## 6.1 Safety instructions for installation

***DANGER***

**Risk of electrocution!**

Fatal injuries or death from contact with cables and terminals. Cables carry voltages of up to 1,500 V.

- Only connect or disconnect cables while the power supply is switched off.
- Take measures to prevent the power supply being switched on again.

***ATTENTION***

**Damage due to incorrectly connected cables!**

Incorrectly connected cables can lead to damage or destruction of the measuring inputs and the device.

- Connect cables only to the sockets provided for this purpose.
- Observe the polarity while connecting cables.

***ATTENTION***

**Damage due to overvoltage!**

Overvoltages or surge voltages may damage or destroy the device.

- Protect the power supply against overvoltages.

## 6.2 Installation

### 6.2.1 Cables and wiring

#### Cable types

- Bus cabling
  Data cables, RS485, RS422, twisted and shielded: Li2YCYv (TP) 2×2×0.5 mm² [2) 1)]
  Network cables: CAT 6
- Sensors (temperature sensors)
  Sensor cables: LiYCY 2×2×0.5 mm²

#### Maximum permissible cable lengths:

- Bus cabling (data cable RS485) 1200 m [2) 3)]
- Sensors 100 m

[1)] We recommend using the cable type UNITRONIC® Li2YCYv (TP) manufactured by Lapp Kabel, or an equivalent cable type. This cable is suitable for laying in soil.

[2)] For longer cable lengths, repeaters must be used.

[3)] Several separate cables of this length require a hub.

#### Shielding

meteocontrol recommends grounding the cable shield at only one point, otherwise connecting it only between the individual measuring boards.

### 6.2.2 Integration of the String Monitoring Unit into a PV system

Fig. 5 shows typical circuitry for connecting the String Monitoring Units 0825, 1225, 1625 or 2422 within a PV system.

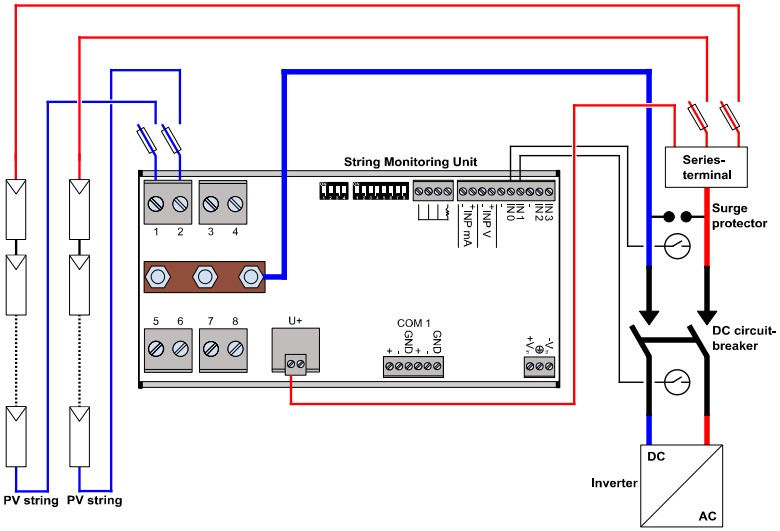



*Fig. 5: Typical circuitry for a String Monitoring Unit*

The interconnections between individual photovoltaic modules (PV strings) go to the inputs. This makes it possible to measure the currents of the individual strings. The total current is fed out via the copper rail. The system voltage of the PV generator (strings of the PV system) is measured via the input U+ (positive voltage).

Please note that the connection process calls for a number of additional components such as fuses, surge arresters, DC circuit breakers or auxiliary contacts, which are not included in delivery of the String Monitoring Units.

### 6.2.3 Connecting a PT100 temperature sensor

PT100 temperature sensors are connected to the String Monitoring Units with a three-wire connection. Fig. 6 shows how a sensor is connected.

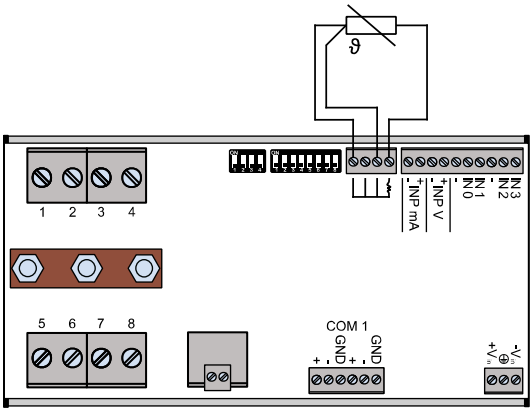



*Fig. 6: Connecting a PT100 temperature sensor*

## 6.3 Communication settings

### 6.3.1 Supported functions

#### 03 Read holding registers

Exports the binary content of the slave's holding registers

#### 04 Read input registers

Exports the binary content of the slave's input registers

#### 06 Preset single register

Writes a value to the slave's register

#### 16 (10Hex) preset multiple registers

Writes a value to a number of the slave's registers

| | Address basis | Read function code | Write function code |
|---|---|---|---|
| Input register | 30001 | 0x04 | --- |
| Holding register | 40001 | 0x03 | 0x06, 0x10 |

### 6.3.2 Modbus parameters

Baud rate: 2,400, 4,800, 9,600 (factory setting), 19,200 bps

Data format: 8N1 (factory setting), 8E1, 8O1

Can be set via Modbus

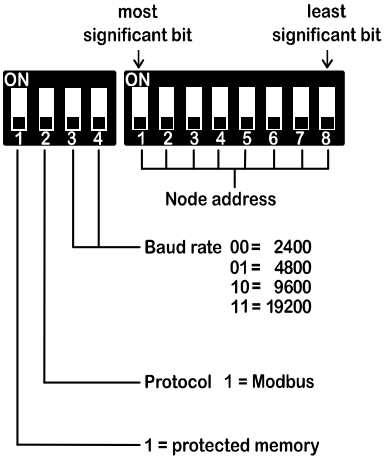
Timeout: 1 ms

### 6.3.3 Byte sequence

The data in the 16-bit Modbus registers is provided in big-endian format (high byte before low byte).

### 6.3.4 Configuring the communication settings

The two DIP switches on the String Monitoring Units are used to configure the protocol and the bus settings.




DIP switch 1

| PIN | Meaning |
|---|---|
| 1 | Write protection<br>0 = Values may be written<br>1 = Values may not be written |
| 2 | Protocol setting<br>1 = Modbus RTU |
| 3, 4 | Baud rate setting<br>00 = 2,400 bps<br>01 = 4,800 bps<br>10 = 9,600 bps<br>11 = 19,200 bps |

### DIP switch 2

The device's bus address is specified using the second DIP switch.

The following table shows the addresses of the individual switches if they are enabled. If a number of switches are set to ON, the numbers add up to form the bus address.

| PIN | Meaning |
|---|---|
| 1 | $2^7 = 128$ |
| 2 | $2^6 = 64$ |
| 3 | $2^5 = 32$ |
| 4 | $2^4 = 16$ |
| 5 | $2^3 = 8$ |
| 6 | $2^2 = 4$ |
| 7 | $2^1 = 2$ |
| 8 | $2^0 = 1$ |

This way, a bus address between 1 and 255 can be allocated. The address 0 is not a valid bus address for Modbus slaves.

### Examples


Protocol = Modbus
Parity = none
Baud rate = 19,200
Address = 2


Protocol = Modbus
Parity = none
Baud rate = 9,600
Address = 55

### 6.3.5 Communication connection

If you want to connect more than one device to the bus, you must daisy-chain the connection.

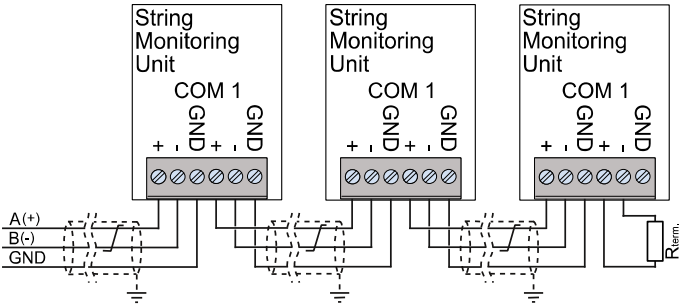



*Fig. 7: Daisy-chain cabling*

Different devices can only be queried together if they use the same communication protocol and the same serial communication parameters (baud rate, data bits, parity, stop bits).

The first and the last device on the bus must be terminated with a 120 Ω resistor $R_{term.}$.

By this way, up to 128 devices can be queried via a single bus

### 6.3.6 Modbus register list

Please note that not all registers contain valid values depending on the String Monitoring Unit chosen and the current measuring channels available in each case.

String Monitoring Unit 0825: 8 current measuring channels

String Monitoring Unit 1225: 12 current measuring channels

String Monitoring Unit 1625: 16 current measuring channels

String Monitoring Unit 2422: 24 current measuring channels

All registers have a sample rate of 100 ms.

The registers of current measurement values contain the moving average of the last 16 measured values.

#### Readable registers

| Register | Format | Description | Unit | Access |
|---|---|---|---|---|
| 30001 | int16 | Digital inputs<br>See detailed information on "Digital input status" | --- | Read |
| 30002 | int16 | Channel 1 current | mA | Read |
| 30003 | int16 | Channel 2 current | mA | Read |
| 30004 | int16 | Channel 3 current | mA | Read |
| 30005 | int16 | Channel 4 current | mA | Read |
| 30006 | int16 | Channel 5 current | mA | Read |
| 30007 | int16 | Channel 6 current | mA | Read |
| 30008 | int16 | Channel 7 current | mA | Read |
| 30009 | int16 | Channel 8 current | mA | Read |
| 30010 | int16 | Channel 9 current | mA | Read |
| 30011 | int16 | Channel 10 current | mA | Read |
| 30012 | int16 | Channel 11 current | mA | Read |
| 30013 | int16 | Channel 12 current | mA | Read |
| 30014 | int16 | Channel 13 current | mA | Read |
| 30015 | int16 | Channel 14 current | mA | Read |
| 30016 | int16 | Channel 15 current | mA | Read |

| Register | Format | Description | Unit | Access |
|---|---|---|---|---|
| 30017 | int16 | Channel 16 current | mA | Read |
| 30018 | int16 | Channel 17 current | mA | Read |
| 30019 | int16 | Channel 18 current | mA | Read |
| 30020 | int16 | Channel 19 current | mA | Read |
| 30021 | int16 | Channel 20 current | mA | Read |
| 30022 | int16 | Channel 21 current | mA | Read |
| 30023 | int16 | Channel 22 current | mA | Read |
| 30024 | int16 | Channel 23 current | mA | Read |
| 30025 | int16 | Channel 24 current | mA | Read |
| 30034 | int16 | Current measurement status (Channel 1 … Channel 16)<br>See detailed information on "Current measurement status" | --- | Read |
| 30035 | int16 | Current measurement status (Channel 17 … Channel 24)<br>See detailed information on "Current measurement status" | --- | Read |
| 30040 | int16 | System voltage<br>Range 0 V … 1,500 V | V | Read |
| 30042 | int16 | Analog input (0 … 10 V)<br>Range 0 … 1000 | --- | Read |
| 30043 | int16 | Analog input (0 … 20 mA)<br>Range 0 … 1000 | --- | Read |
| 30044 | int16 | PT100 temperature<br>Range -22 °C … 83 °C | °C | Read |
| 30045 | int16 | Measuring board temperature<br>Range -20 °C … 120 °C | °C | Read |
| 30047 | int16 | Total current | A | Read |
| 30048 | int32 | System power<br>Transmission order: Little-endian (low word before high word) | W | Read |

| Register | Format | Description | Unit | Access |
|---|---|---|---|---|
| 30052 | int16 | Channel 1 current average value[1)] | mA | Read |
| 30053 | int16 | Channel 2 current average value[1)] | mA | Read |
| 30054 | int16 | Channel 3 current average value[1)] | mA | Read |
| 30055 | int16 | Channel 4 current average value[1)] | mA | Read |
| 30056 | int16 | Channel 5 current average value[1)] | mA | Read |
| 30057 | int16 | Channel 6 current average value[1)] | mA | Read |
| 30058 | int16 | Channel 7 current average value[1)] | mA | Read |
| 30059 | int16 | Channel 8 current average value[1)] | mA | Read |
| 30060 | int16 | Channel 9 current average value[1)] | mA | Read |
| 30061 | int16 | Channel 10 current average value[1)] | mA | Read |
| 30062 | int16 | Channel 11 current average value[1)] | mA | Read |
| 30063 | int16 | Channel 12 current average value[1)] | mA | Read |
| 30064 | int16 | Channel 13 current average value[1)] | mA | Read |
| 30065 | int16 | Channel 14 current average value[1)] | mA | Read |
| 30066 | int16 | Channel 15 current average value[1)] | mA | Read |
| 30067 | int16 | Channel 16 current average value[1)] | mA | Read |
| 30068 | int16 | Channel 17 current average value[1)] | mA | Read |
| 30069 | int16 | Channel 18 current average value[1)] | mA | Read |
| 30070 | int16 | Channel 19 current average value[1)] | mA | Read |
| 30071 | int16 | Channel 20 current average value[1)] | mA | Read |
| 30072 | int16 | Channel 21 current average value[1)] | mA | Read |
| 30073 | int16 | Channel 22 current average value[1)] | mA | Read |
| 30074 | int16 | Channel 23 current average value[1)] | mA | Read |
| 30075 | int16 | Channel 24 current average value[1)] | mA | Read |

[1)] Average value over 6 seconds

### Detailed information on digital input status

| Bit | Digital input | Remarks |
|---|---|---|
| 0 | IN 0 | 0 = Not active<br>1 = Active |
| 1 | IN 1 | |
| 2 | IN 2 | |
| 3 | IN 3 | |

### Detailed information on current measurement status

| | Bit | Channel current measurement | Remarks |
|---|---|---|---|
| Register 30034 | 0 | Channel 1 | 0 = Measured value below 200 mA<br>1 = Measured value above 200 mA |
| | 1 | Channel 2 | |
| | 2 | Channel 3 | |
| | 3 | Channel 4 | |
| | 4 | Channel 5 | |
| | 5 | Channel 6 | |
| | 6 | Channel 7 | |
| | 7 | Channel 8 | |
| | 8 | Channel 9 | |
| | 9 | Channel 10 | |
| | 10 | Channel 11 | |
| | 11 | Channel 12 | |
| | 12 | Channel 13 | |
| | 13 | Channel 14 | |
| | 14 | Channel 15 | |
| | 15 | Channel 16 | |

| | Bit | Channel current measurement | Remarks |
|---|---|---|---|
| Register 30035 | 0 | Channel 17 | 0 = Measured value below 200 mA<br>1 = Measured value above 200 mA |
| | 1 | Channel 18 | |
| | 2 | Channel 19 | |
| | 3 | Channel 20 | |
| | 4 | Channel 21 | |
| | 5 | Channel 22 | |
| | 6 | Channel 23 | |
| | 7 | Channel 24 | |

## Writable registers

| Register | Format | Description | Unit | Access |
|---|---|---|---|---|
| 40001 | int16 | Parity setting<br>1 = None<br>2 = Even<br>3 = Odd | --- | Write |
| 40002 | int16 | Channel 1 current offset[2)] | --- | Write |
| 40003 | int16 | Channel 2 current offset[2)] | --- | Write |
| 40004 | int16 | Channel 3 current offset[2)] | --- | Write |
| 40005 | int16 | Channel 4 current offset[2)] | --- | Write |
| 40006 | int16 | Channel 5 current offset[2)] | --- | Write |
| 40007 | int16 | Channel 6 current offset[2)] | --- | Write |
| 40008 | int16 | Channel 7 current offset[2)] | --- | Write |
| 40009 | int16 | Channel 8 current offset[2)] | --- | Write |
| 40010 | int16 | Channel 9 current offset[2)] | --- | Write |
| 40011 | int16 | Channel 10 current offset[2)] | --- | Write |
| 40012 | int16 | Channel 11 current offset[2)] | --- | Write |
| 40013 | int16 | Channel 12 current offset[2)] | --- | Write |
| 40014 | int16 | Channel 13 current offset[2)] | --- | Write |
| 40015 | int16 | Channel 14 current offset[2)] | --- | Write |

| Register | Format | Description | Unit | Access |
|---|---|---|---|---|
| 40016 | int16 | Channel 15 current offset[2)] | --- | Write |
| 40017 | int16 | Channel 16 current offset[2)] | --- | Write |
| 40018 | int16 | Channel 17 current offset[2)] | --- | Write |
| 40019 | int16 | Channel 18 current offset[2)] | --- | Write |
| 40020 | int16 | Channel 19 current offset[2)] | --- | Write |
| 40021 | int16 | Channel 20 current offset[2)] | --- | Write |
| 40022 | int16 | Channel 21 current offset[2)] | --- | Write |
| 40023 | int16 | Channel 22 current offset[2)] | --- | Write |
| 40024 | int16 | Channel 23 current offset[2)] | --- | Write |
| 40025 | int16 | Channel 24 current offset[2)] | --- | Write |

[2)] Settable offset for the current measured value, default = 0

| | | | | |
|---|---|---|---|---|
| 40040 | int16 | Voltage offset[3)] | --- | Write |
| 40041 | int16 | Not used | --- | Write |
| 40042 | int16 | Analog input offset (0 … 10 V)[3)] | --- | Write |
| 40043 | int16 | Analog input offset (0 … 20 mA)[3)] | --- | Write |
| 40044 | int16 | PT100 temperature offset[3)] | --- | Write |
| 40045 | int16 | Measuring board temperature offset[3)] | --- | Write |

[3)] Settable offset for the measured value, default = 0

| | | | | |
|---|---|---|---|---|
| 40052 | int16 | Channel 1 current amplification[4)] | --- | Write |
| 40053 | int16 | Channel 2 current amplification[4)] | --- | Write |
| 40054 | int16 | Channel 3 current amplification[4)] | --- | Write |
| 40055 | int16 | Channel 4 current amplification[4)] | --- | Write |
| 40056 | int16 | Channel 5 current amplification[4)] | --- | Write |
| 40057 | int16 | Channel 6 current amplification[4)] | --- | Write |
| 40058 | int16 | Channel 7 current amplification[4)] | --- | Write |
| 40059 | int16 | Channel 8 current amplification[4)] | --- | Write |

| Register | Format | Description | Unit | Access |
|---|---|---|---|---|
| 40060 | int16 | Channel 9 current amplification[4)] | --- | Write |
| 40061 | int16 | Channel 10 current amplification[4)] | --- | Write |
| 40062 | int16 | Channel 11 current amplification[4)] | --- | Write |
| 40063 | int16 | Channel 12 current amplification[4)] | --- | Write |
| 40064 | int16 | Channel 13 current amplification[4)] | --- | Write |
| 40065 | int16 | Channel 14 current amplification[4)] | --- | Write |
| 40066 | int16 | Channel 15 current amplification[4)] | --- | Write |
| 40067 | int16 | Channel 16 current amplification[4)] | --- | Write |
| 40068 | int16 | Channel 17 current amplification[4)] | --- | Write |
| 40069 | int16 | Channel 18 current amplification[4)] | --- | Write |
| 40070 | int16 | Channel 19 current amplification[4)] | --- | Write |
| 40071 | int16 | Channel 20 current amplification[4)] | --- | Write |
| 40072 | int16 | Channel 21 current amplification[4)] | --- | Write |
| 40073 | int16 | Channel 22 current amplification[4)] | --- | Write |
| 40074 | int16 | Channel 23 current amplification[4)] | --- | Write |
| 40075 | int16 | Channel 24 current amplification[4)] | --- | Write |

[4)] Settable amplification for the current measured value, default = 1000 (which means a deduction of 1)

| | | | | |
|---|---|---|---|---|
| 40090 | int16 | Voltage amplification[5)] | --- | Write |
| 40091 | int16 | Not used | --- | Write |
| 40092 | int16 | Analog input amplification (0 … 10 V)[5)] | --- | Write |
| 40093 | int16 | Analog input amplification (0 … 20 mA)[5)] | --- | Write |
| 40094 | int16 | PT100 temperature amplification[5)] | --- | Write |
| 40095 | int16 | Measuring board temperature amplification[5)] | --- | Write |

[5)] Settable amplification for the current measured value, default = 1000 (which means a deduction of 1)

## 6.4 Connection procedure

1. Connect the ground wire.
2. Connect the power supply.
3. If required, connect up the interface connections (RS485/Modbus). Use a shielded, twisted cable for this. Connect the bus devices preferably in a chain (one after the other). The modules are provided with a duplicate internal connection interface for the chained circuit: use the first bus interface as an input and the second as output to the next bus device. For connections with a star topology or stubs, please use the 6 Port RS485 HUB S (meteocontrol item number 421.641).
4. Set the bus address of the String Monitoring Unit using the DIP switches.
5. The bus lines should be terminated with 120 Ω resistors at the first and the last bus device.
6. If necessary, connect the signal from the auxiliary contact of the DC circuit breaker and the signal from the auxiliary contact of the overvoltage protection devices to the digital inputs of the String Monitoring Unit.
7. If necessary, connect further sensor systems to the appropriate inputs of the String Monitoring Unit.
8. Connect the individual strings
   (1 to 8, 1 to 12, 1 to 16 or 1 to 24)
9. Connect the cable for measuring the system voltage to U+.

↳ The String Monitoring Unit is now fully connected and can be put into operation.

# 7. Technical data

## 7.1 Technical data – String Monitoring Unit 0825

### Module

| | |
|---|---|
| Dimensions (W x H x D): | 197 x 108 x 52 mm |
| Type of installation | DIN EN mounting rail |
| Weight: | 465 g |
| Operating temperature: | -20 … +80 °C |
| Operating environment: | Do not expose to corrosive gases |

### Supply

| | |
|---|---|
| Supply voltage: | 22…27 V DC |
| Power consumption: | < 3 W |
| Conductor connection: | 0.34 … 2.5 mm², wire stripping length 7 … 8 mm |

### Communication

| | |
|---|---|
| Standard: | RS485 |
| Data format: | 8N1 (factory setting), 8E1, 8O1<br>Can be set via Modbus |
| Protocols: | Modbus RTU |
| Baud rate: | 2,400 bps, 4,800 bps, 9,600 bps (factory setting), 19,200 bps |
| Bus address: | Is set via DIP switches |

### Input current

| | |
|---|---|
| Number: | 8 |
| Measuring range: | 0…25 A DC |
| Precision: | ≤ 0.5 % |
| Conductor connection: (screw terminal) | ≤ 6 mm², tightening torque: 1 Nm, wire stripping length 6 … 7 mm |

### Output current

| | |
|---|---|
| Number: | 1 |
| Maximum total current: | 200 A DC |
| Conductor connection: | M6 threaded bolts, metric thread, for ring cable lug; max. torque 2.5 Nm |

### Input voltage

| | |
|---|---|
| Number: | 1 |
| Measuring range: | 0…1,500 V DC |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | ≈0.5 … 2 mm², tightening torque: 1 Nm, wire stripping length: 6 … 7 mm |

### Input temperature

| | |
|---|---|
| Number: | 1 |
| Type: | PT100 with three-wire connection |
| Measuring range: | 0 … 300 °C |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Digital input

| | |
|---|---|
| Number: | 4 |
| Type: | PNP digital inputs, 24 V DC |
| Maximum input current: | 24 V DC |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Analog current input

| | |
|---|---|
| Number: | 1 |
| Type: | Current input |
| Measuring range: | 0 … 20 mA |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Analog voltage input

| | |
|---|---|
| Number: | 1 |
| Type: | Voltage input |
| Measuring range: | 0 … 10 V |
| Conductor connection: (screw terminal) | ≈0.5 … 2 mm², tightening torque: 1 Nm, wire stripping length 6 … 7 mm |

## 7.2 Technical data – String Monitoring Unit 1225

### Module

| | |
|---|---|
| Dimensions (W x H x D): | 241 x 108 x 52 mm |
| Type of installation | DIN EN mounting rail |
| Weight: | 550 g |
| Operating temperature: | -20 … +80 °C |
| Operating environment: | Do not expose to corrosive gases |

### Supply

| | |
|---|---|
| Supply voltage: | 22…27 V DC |
| Power consumption: | < 3 W |
| Conductor connection: | 0.34 … 2.5 mm², wire stripping length 7 … 8 mm |

### Communication

| | |
|---|---|
| Standard: | RS485 |
| Data format: | 8N1 (factory setting), 8E1, 8O1<br>Can be set via Modbus |
| Protocols: | Modbus RTU |
| Baud rate: | 2,400 bps, 4,800 bps, 9,600 bps (factory setting), 19,200 bps |
| Bus address: | Is set via DIP switches |

### Input current

| | |
|---|---|
| Number: | 12 |
| Measuring range: | 0…25 A DC |
| Precision: | ≤ 0.5 % |
| Conductor connection: (screw terminal) | ≤ 6 mm², tightening torque: 1 Nm, wire stripping length 6 … 7 mm |

### Output current

| | |
|---|---|
| Number: | 1 |
| Maximum total current: | 300 A DC |
| Conductor connection: | M6 threaded bolts, metric thread, for ring cable lug; max. torque 2.5 Nm |

### Input voltage

| | |
|---|---|
| Number: | 1 |
| Measuring range: | 0…1,500 V DC |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | ≈0.5 … 2 mm², tightening torque: 1 Nm, wire stripping length: 6 … 7 mm |

### Input temperature

| | |
|---|---|
| Number: | 1 |
| Type: | PT100 with three-wire connection |
| Measuring range: | 0 … 300 °C |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Digital input

| | |
|---|---|
| Number: | 4 |
| Type: | PNP digital inputs, 24 V DC |
| Maximum input current: | 24 V DC |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Analog current input

| | |
|---|---|
| Number: | 1 |
| Type: | Current input |
| Measuring range: | 0 … 20 mA |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Analog voltage input

| | |
|---|---|
| Number: | 1 |
| Type: | Voltage input |
| Measuring range: | 0 … 10 V |
| Conductor connection: (screw terminal) | ≈0.5 … 2 mm², tightening torque: 1 Nm, wire stripping length: 6 … 7 mm |

## 7.3 Technical data – String Monitoring Unit 1625

### Module

| | |
|---|---|
| Dimensions (W x H x D): | 267 x 108 x 52 mm |
| Type of installation | DIN EN mounting rail |
| Weight: | 795 g |
| Operating temperature: | -20 … +80 °C |
| Operating environment: | Do not expose to corrosive gases |

### Supply

| | |
|---|---|
| Supply voltage: | 22…27 V DC |
| Power consumption: | < 3 W |
| Conductor connection: | 0.34 … 2.5 mm², wire stripping length: 7 … 8 mm |

### Communication

| | |
|---|---|
| Standard: | RS485 |
| Data format: | 8N1 (factory setting), 8E1, 8O1<br>Can be set via Modbus |
| Protocols: | Modbus RTU |
| Baud rate: | 2,400 bps, 4,800 bps, 9,600 bps (factory setting), 19,200 bps |
| Bus address: | Is set via DIP switches |

### Input current

| | |
|---|---|
| Number: | 16 |
| Measuring range: | 0…25 A DC |
| Precision: | ≤ 0.5 % |
| Conductor connection: (screw terminal) | ≤ 6 mm², tightening torque: 1 Nm, wire stripping length 6 … 7 mm |

### Output current

| | |
|---|---|
| Number: | 1 |
| Maximum total current: | 400 A DC |
| Conductor connection: | M6 threaded bolts, metric thread, for ring cable lug; max. torque 2.5 Nm |

### Input voltage

| | |
|---|---|
| Number: | 1 |
| Measuring range: | 0…1,500 V DC |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | ≈0.5 … 2 mm², tightening torque: 1 Nm, wire stripping length: 6 … 7 mm |

### Input temperature

| | |
|---|---|
| Number: | 1 |
| Type: | PT100 with three-wire connection |
| Measuring range: | 0 … 300 °C |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Digital input

| | |
|---|---|
| Number: | 4 |
| Type: | PNP digital inputs, 24 V DC |
| Maximum input current: | 24 V DC |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Analog current input

| | |
|---|---|
| Number: | 1 |
| Type: | Current input |
| Measuring range: | 0 … 20 mA |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Analog voltage input

| | |
|---|---|
| Number: | 1 |
| Type: | Voltage input |
| Measuring range: | 0 … 10 V |
| Conductor connection: (screw terminal) | ≈0.5 … 2 mm², tightening torque: 1 Nm, wire stripping length: 6 … 7 mm |

## 7.4 Technical data – String Monitoring Unit 2422

### Module

| | |
|---|---|
| Dimensions (W x H x D): | 326 x 108 x 52 mm |
| Type of installation | DIN EN mounting rail |
| Weight: | 880 g |
| Operating temperature: | -20 … +80 °C |
| Operating environment: | Do not expose to corrosive gases |

### Supply

| | |
|---|---|
| Supply voltage: | 22…27 V DC |
| Power consumption: | < 3 W |
| Conductor connection: | 0.34 … 2.5 mm², wire stripping length: 7 … 8 mm |

### Communication

| | |
|---|---|
| Standard: | RS485 |
| Data format: | 8N1 (factory setting), 8E1, 8O1<br>Can be set via Modbus |
| Protocols: | Modbus RTU |
| Baud rate: | 2,400 bps, 4,800 bps, 9,600 bps (factory setting), 19,200 bps |
| Bus address: | Is set via DIP switches |

### Input current

| | |
|---|---|
| Number: | 24 |
| Measuring range: | 0…22 A DC |
| Precision: | ≤ 0.5 % |
| Conductor connection: (screw terminal) | ≤ 6 mm², tightening torque: 1 Nm, wire stripping length: 6 … 7 mm |

### Output current

| | |
|---|---|
| Number: | 1 |
| Maximum total current: | 528 A DC |
| Conductor connection: | M6 threaded bolts, metric thread, for ring cable lug; max. torque 2.5 Nm |

### Input voltage

| | |
|---|---|
| Number: | 1 |
| Measuring range: | 0…1,500 V DC |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | ≈0.5 … 2 mm², tightening torque: 1 Nm, wire stripping length: 6 … 7 mm |

### Input temperature

| | |
|---|---|
| Number: | 1 |
| Type: | PT100 with three-wire connection |
| Measuring range: | 0 … 300 °C |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Digital input

| | |
|---|---|
| Number: | 4 |
| Type: | PNP digital inputs, 24 V DC |
| Maximum input current: | 24 V DC |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Analog current input

| | |
|---|---|
| Number: | 1 |
| Type: | Current input |
| Measuring range: | 0 … 20 mA |
| Precision: | < 1.5 % |
| Conductor connection: (screw terminal) | 0.34 … 2.5 mm², tightening torque: 1 Nm, wire stripping length: 7 … 8 mm |

### Analog voltage input

| | |
|---|---|
| Number: | 1 |
| Type: | Voltage input |
| Measuring range: | 0 … 10 V |
| Conductor connection: (screw terminal) | ≈0.5 … 2 mm², tightening torque: 1 Nm, wire stripping length: 6 … 7 mm |

# 8. Environmental protection and disposal

Old devices which no longer work should be disposed of in accordance with national and local environmental and recycling regulations. Electronic components may not be disposed of along with household waste.

# 9. Appendix

## 9.1 EC Declaration of Conformity

meteo control
Energy & Weather Services

EG - KONFORMITÄTSERKLÄRUNG
EC DECLARATION OF CONFORMITY

CE

| | |
|---|---|
| Hersteller:<br>*Manufacturer:* | meteocontrol GmbH |
| Anschrift:<br>*Address:* | Spichererstrasse 48<br>D – 86157 Augsburg<br>Germany |
| Produkt:<br>*Product:* | 421925 String Monitoring Unit 0825 (SMU 0825)<br>421926 String Monitoring Unit 1225 (SMU 1225)<br>421927 String Monitoring Unit 1625 (SMU 1625)<br>421928 String Monitoring Unit 2422 (SMU 2422) |

Wir erklären, dass die genannten Produkte folgenden Dokumenten und Normen entsprechen:
*We declare that the products described above are in compliance with the following documents and norms:*

CE Marking Directive 93/68
Low Voltage Directive 73/23

| | |
|---|---|
| Electrical safety: | EN 60204-1<br>EN 62109-1 |
| Electromagnetic compatibility: | Directive 2004/108/EC<br>Directive 89/336 |
| Electromagnetic immission: | EN 61000-6-2<br>EN 61326-1<br>EN 61326-2-5 |
| Electromagnetic emission: | EN 61000-6-4 |

Augsburg, December 21, 2017
Ort, Datum
*Place, date*

Jens Wening
Technischer Direktor
*Technical Director*

## 9.2 List of figures

meteo control

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