



KSM-VX.X

EN

Installation and Operation

EN

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1 Information about these Instructions

1.1 Scope of Application

These documents describe the installation and the operation of a KSM Monitoring System.

This manual includes the following monitoring printed circuit boards:

KSM-VX.X-02/1000/100 (from V0.8)

KSM-VX.X-10/1000/040 (from V0.8)

KSM-VX.X-10/1000/040-T (from V0.8)

KSM-VX.X-02/1500/100 (from V0.8)

KSM-VX.X-10/1500/040 (from V0.8)

KSM-VX.X-10/1500/040-T (from V0.8)

1.2 User Groups

This manual is intended for installers and operators of a PV plant which has been implemented with a KSM monitoring system. It includes a description of the installation, the maintenance and the operation of the KSM monitoring system.

1.3 Explanation of the Symbols Used

The following levels of risk are used in this document.



Danger

Danger identifies an actual situation where failure to observe can lead to death.



Warning

Warning identifies an actual situation where failure to observe can lead to serious injury or death.



Caution

Caution identifies an actual situation where failure to observe can lead to injury.



Information

Information identifies an actual situation where failure to observe can lead to complications in the operating and / or in the operation.



Safekeeping of the Manuals

This instruction manual, the installation instructions, the data sheets, the operating instructions of the installed components and the circuit diagrams must be kept in the immediate vicinity of the KSM monitoring circuit boards. They must be accessible to operating and maintenance personnel at all times.

2 Safety Advice

All malfunctions which can affect safety must be rectified immediately. Unauthorized modifications and the use of spare parts which are not recommended by Klein GmbH can cause fire, material damage or electrical shocks. Access to the equipment for unauthorized persons is forbidden.

Information signs must be clearly legible and in the event of damage must be replaced immediately.

2.1 Correct and Proper Use

The correct and proper use of the KSM monitoring system is ensured only when all the instructions of this manual for installation, for the electrical connections and commissioning have been observed.

Deviations from the instructions in this manual are considered to be incorrect and improper use. Klein GmbH accepts no liability whatsoever for damage or injury arising from this.

To correct and proper use belong also:

- the observance of the safety advice stated here and in the following chapters
- the observance of the installation and operating instructions of the power inverter
- the observance of the equipment-related technical data
- the observance of the additional information for inverters for the earthed operation of the PV generator.

2.2 Working on the KSM Monitoring System

All work on the KSM monitoring system may be carried out only by qualified, technical personnel. Qualified means that the personnel must have had training relevant to the work and must be familiar with the contents of these instructions. The personnel must have read and fully understood the safety chapter of these instructions.

2.3 About this Manual

This manual has been prepared with the greatest possible care. Errors, nevertheless, cannot be ruled out. Klein GmbH accepts no liabilities whatsoever arising from possible errors in this manual.

2.4 Checking the Delivery

Check the equipment packaging and the equipment for damage and compare the delivered items with the delivery notes. In the event of damage to the equipment and / or unclear delivered items please inform Klein GmbH immediately (see the contact address in the attachments).

2.5 Storage

The KSM monitoring system must only be stored in areas where it is protected from dust and moisture.

2.6 Installation

The requirements named in the manual for the installation site, the installation method and the mounting position must be observed.

In addition the following points should be observed.

The installation site should be readily accessible and provide a secure footing when working on the equipment.

The KSM monitoring system is constructed in the latest state-of-the-art technology and to the recognized safety-related regulations. Nevertheless, faults and the development of an electric arc in the housing cannot be ruled out (see Chapter "Particular Risks from Photovoltaic Plants" Page 7)

The consequences could be the melting of the housing as well as fire and smoke development which present dangers for persons and / or material assets. This must be taken into account during the installation.

The installation must not be carried out in the vicinity of flammable materials. If this cannot be avoided then precautions must be taken which prevent the escalation of the fire and smoke development.

The installation must not be carried out in critical areas, escape routes or residential and office rooms.

2.7 Particular Risks from Photovoltaic Plants



Danger

Danger to life from electrical shock
An active power source is connected!

Photovoltaic plants have some special characteristics which present additional dangers which are pointed out in the following.

An active power source is connected, that means, depending upon the operating condition, that voltage from the photovoltaic generator and from the power inverter can be present. This must be taken into account especially when isolating the KSM monitoring system.

Very high DC voltages are present (no zero crossing) which, in the event of a fault or with improper use of safety devices or connectors, can lead to electric arcs.

The short circuit current of the photovoltaic generator is only marginally higher than the operating current and in addition dependent upon the irradiation - that means, that with short circuits in the plant the switching off of the safety device present is not always guaranteed.

In the event of a fault (for example, a short circuit) an extensively branched constructed generator can only be switched off with difficulty.

2.8 Particular Risks from Earthed PV Plants

The plus or minus of the PV generator is earthed via a GFDI (GFDI, ground fault detection interruption) safety device. This applies to all models with the type identifiers PO or OM. With all other types with the identifier PM isolated operation of the PV generator takes place.



Attention

Additional earthing in the PV generator or in the free-standing distributor is not allowed!



Attention

See the additional information for power inverters for the earthed operation of the PV generator.

The earthing of the PV generator can be automatically disconnected by the GFDI at all times.



Caution

The GFDI does not give personal protection, only equipment protection!

2.9 Electrical Connection

The electrical connection must be made in accordance with this manual and the technical data of the equipment.



Warning

The equipotential bonding must be connected!



Information

Input fuses must be provided for the measurement channel to protect the KSM monitoring system.

With the insertion of the input fuses the connection of the DC voltage of the connected inputs takes place.

The input fuses may only be inserted when the following conditions have been satisfied:

- All connections have been made in accordance with this manual.
- The DC main cables are connected to the power inverter or the DC main distributor and are isolated (reverse voltage from the inverter not possible).
- The polarity of the DC voltage on the inputs has been checked and there is no short circuit present!
- The absence of short circuits to earth of the strings has been verified via an insulation test.



Warning

Before the insertion of the input fuse, the polarity and absence of short circuits to earth of the inputs must be established. The fuses must only be inserted or withdrawn in the load-free condition and using personal protective equipment.

2.10 Isolation



Warning

Caution, reverse voltage from the inverter!

The KSM monitoring system must be isolated when working on it. The isolation must be done from both sides, that is, the DC main cables to the inverter must be disconnected via the switch disconnectors and the connected strings via the respective string fuses PV + and PV – . If no DC isolator is available in the PV plant then the DC fuses on the inverter must be withdrawn in order to avoid reverse voltage from the inverter.



Information

We recommend the use of DC isolators for the isolation of the inverter and / or the KSM monitoring system. This also enables the safe isolation of plant components in the event of faults or fire.



Information

Working on the KSM monitoring system is permitted only in the voltage-free condition and in compliance with the VDE Guidelines.

Disconnect from the power supply

Secure against unintentional reclosing of the isolation switches

Establish the absence of voltage

Short circuit and earth

Where necessary, provide covers or barriers for neighbouring live parts



Warning

The fuse holders are still live even with the input fuses withdrawn!

2.11 Commissioning, Maintenance and Repair

All work on the KSM monitoring system may only be carried out when the equipment has been safely disconnected from the PV voltage, secured against unintentional reconnection and the absence of voltage has been established. This work may be carried out only by qualified technical personnel who are familiar with the operating of the plant.

2.12 General Advice

Burns

Immediately following the isolation of the equipment some components, for example, fuses, can be very hot due to their operation.



Caution

We recommend the wearing of safety gloves when working on the equipment.

3 Layout

In the following overview illustrations, various components and connection areas of a KSM monitoring system are represented schematically.

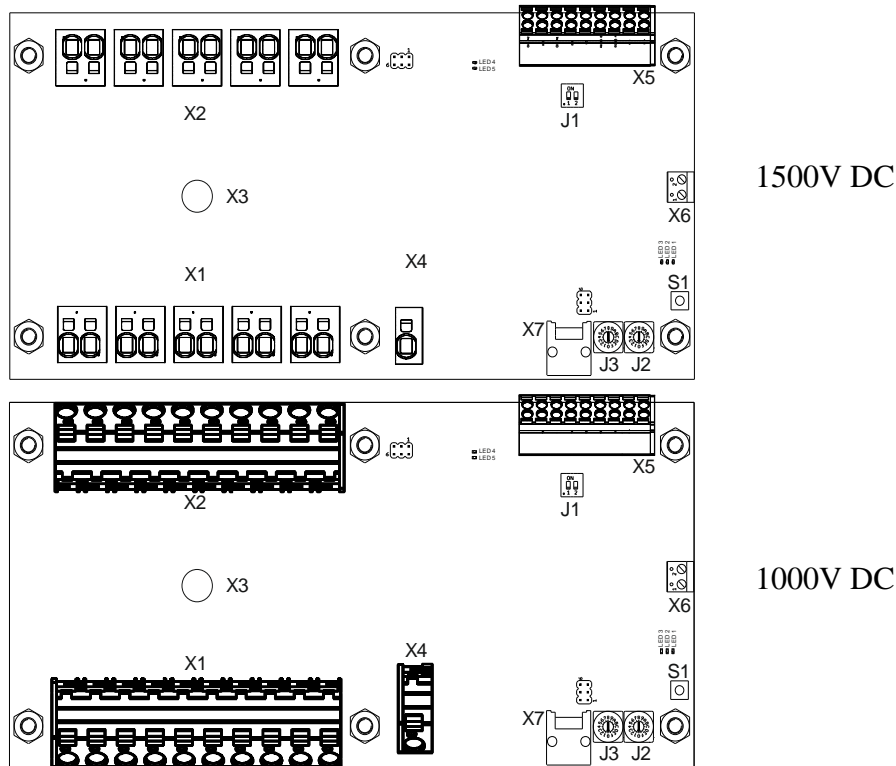


Illustration 1 Example Layout of the KSM Monitoring System

Illustration 1 similar, layout dependent on the design of the KSM monitoring system

3.1 Component Labelling in the KSM Monitoring System

| | | KSM-VX.X 02/XXXX/100 | KSM-VX.X 10/XXXX/040 |
|----|--------------------------|-------------------------|-------------------------|
| X1 | Measurement Input | 01 | 01-05 |
| X2 | Measurement Input | 02 | 06-10 |
| X3 | DC main output | | |
| X4 | Voltage input minus | | |
| | | | |
| X5 | Supply terminal | | |
| X6 | Voltage supply expansion | | |
| X7 | CAN-BUS for expansion | | |
| | | | |
| J1 | Termination RS485 Bus | | |
| J2 | Address coding 2 | | |
| J3 | Address coding 1 | | |
| S1 | Reset master controller | | |

4 Installing the KSM Monitoring System

The KSM monitoring System can be installed directly in the generator terminal box.



Attention

When installing the KSM monitoring system, take care that no moisture is trapped in the housing. Installation when it is raining or there is high humidity can interfere with or even damage the electronics in later operation!



Attention

Choose the installation site so that the KSM monitoring system is protected from direct sunlight and is installed so as to be readily accessible for maintenance work.

It is recommended that the KSM monitoring system be installed on the mounting plate with a clearance of 50mm.

Dimensions of the KSM monitoring system

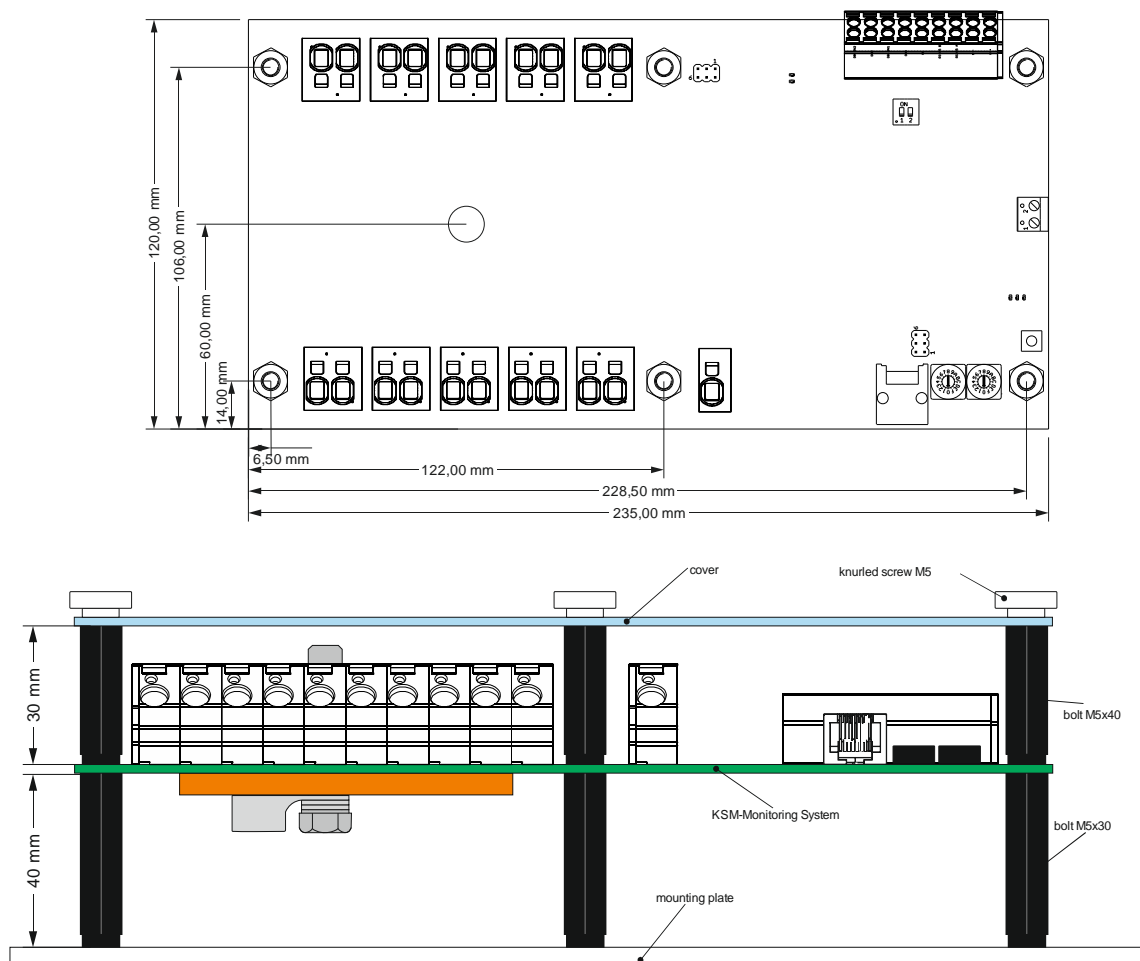


Illustration 2 Installation of the KSM Monitoring System

5 Connection

5.1 Connection of the Supply Terminal



Warning

Before connecting the supply terminal, all KSM monitoring systems operating in a string must be isolated, both inverter side and string side.

The connection is made on the spring-loaded terminal X5 located on the KSM monitoring system. For the insertion of the individual wires into the connection terminals, the wire stripping lengths must be adhered to so that a secure connection between the wire and the spring-loaded terminal is ensured. The non-adherence to the wire stripping length can have a bad connection as a consequence.

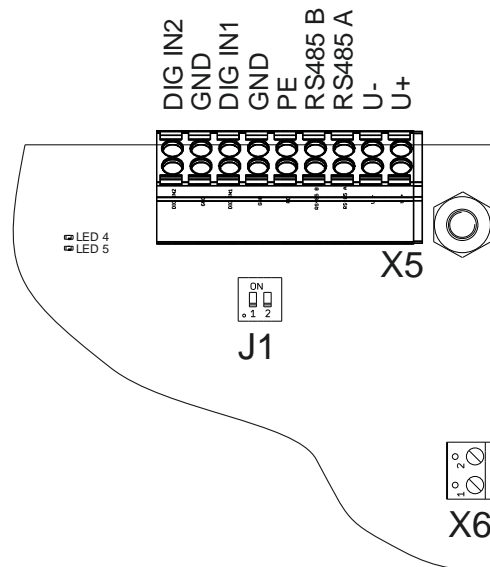


Illustration 3 Communications Port in the KSM Monitoring System

5.1.1 Wire Stripping Length and Supply Terminal Cross Sections

Table 1 Spring-loaded Terminals Technical Data

| | |
|-------------------------------|--|
| Conductor type 1 | Single wire |
| Cross section from | 0.2 mm ² |
| Cross section to | 1.5 mm ² |
| Conductor type 2 | Fine stranded wire |
| Cross section from | 0.2 mm ² |
| Cross section to | 1.5 mm ² |
| Conductor type 3 | Fine stranded with wire end ferrules with plastic collars |
| Cross section from | 0.25 mm ² |
| Cross section to | 1.0 mm ² |
| Conductor type 4 | Fine stranded with wire end ferrules without plastic collars |
| Cross section from | 0.25 mm ² |
| Cross section to | 1.0 mm ² |
| | |
| Wire stripping length from | 9 mm |
| Wire stripping length from to | 10 mm |

5.1.2 Digital Inputs



Information

The digital inputs 1 and 2 are not potential-free!

The inputs are connected to the internal operating voltage. Switch the inputs to earth only via, for example, relay contacts or optocouplers.

5.1.2.1 Usual Assignment of the Digital Inputs

DI IN 1 : Main switch of a generator terminal box

DI IN 2 : Overvoltage protection of a generator terminal box

5.1.3 Functional Earth

The functional earth must be connected in order to earth the internally fitted overvoltage arresters.

5.1.4 Modbus Interface



Information

Use twisted cables with shielding, for example, Li-2YCYv cable.

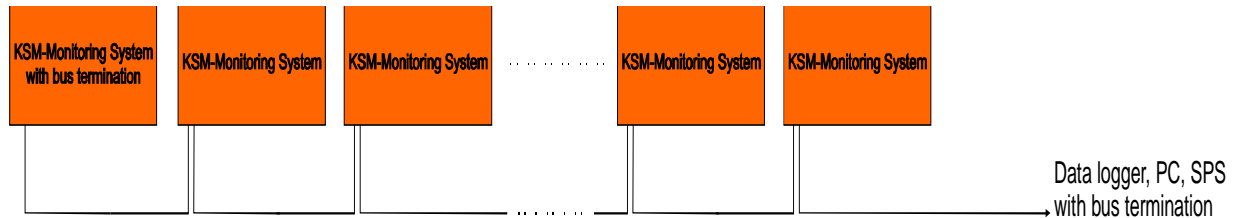


Illustration 4 Wiring RS-485 Bus

5.1.5 Supply Voltage



Information

The power supply used must be galvanically isolated.

The voltage range of the power supply used may lie between 20V and 60V maximum.

5.2 Connection of the Measurement Channels

The connection of the measurement leads is made via the spring-loaded terminals, X1, X2 and X4, fitted in the KSM monitoring system. For the insertion of the measuring leads into the spring-loaded terminals the wire stripping lengths must be adhered to so that a secure connection between the input cable and the spring-loaded terminal is ensured. The non-adherence to the wire stripping length can have bad connections as a consequence which could lead to damage to the KSM monitoring system.

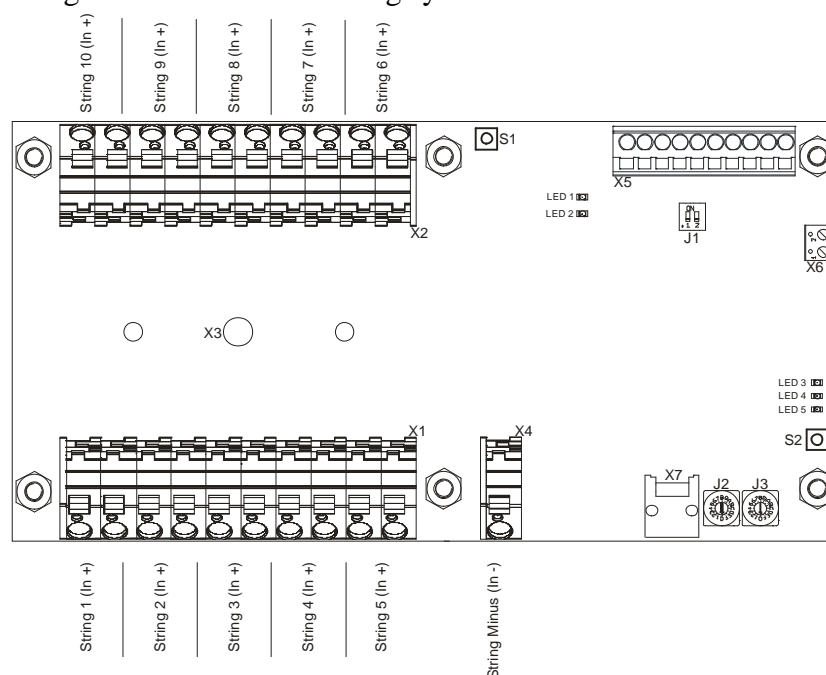


Illustration 5 Input Connection in the KSM Monitoring System

5.2.1 Wire Stripping Length and Measurement Connections Cross Sections

Table 2 Technical Data Measurement Line Spring-loaded Terminals

| | |
|----------------------------|--|
| Conductor type 1 | Single wire |
| Cross section from | 0.2 mm ² |
| Cross section to | 6.0 mm ² |
| Conductor type 2 | Fine stranded wire |
| Cross section from | 0.2 mm ² |
| Cross section to | 6.0 mm ² |
| Conductor type 3 | Fine stranded with wire end ferrules with plastic collars |
| Cross section from | 0.25 mm ² |
| Cross section to | 4.0 mm ² |
| Conductor type 4 | Fine stranded with wire end ferrules without plastic collars |
| Cross section from | 0.25 mm ² |
| Cross section to | 4.0 mm ² |
| Wire stripping length from | 11 mm |
| Wire stripping length to | 12 mm |

5.3 Connection of the DC Main Cable

The connection of the main output cable is made via the fixing hole, X3, located in the KSM monitoring system. A cable lug for an M8 screw is required for the fitting of the main cable. This must be fitted as shown in Illustration 7.

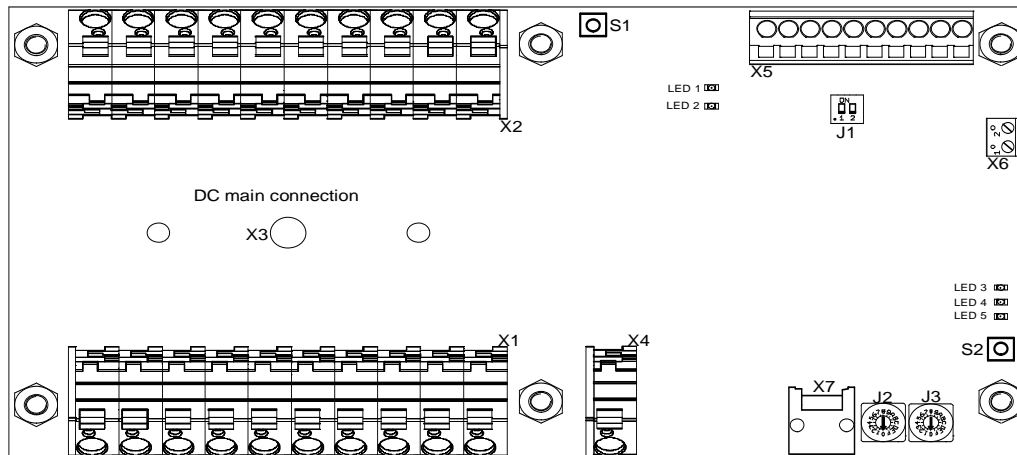
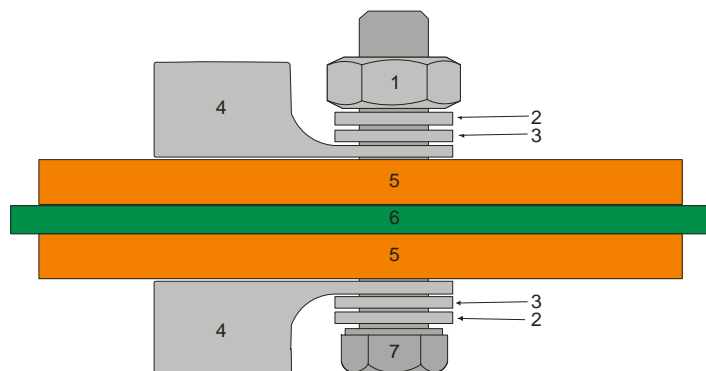


Illustration 6 Main Cable Connection in the KSM Monitoring System

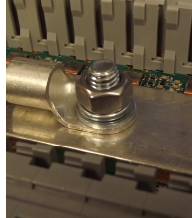


| | |
|---|-----------------------------|
| 1 | Nut M8 |
| 2 | Spring washer M8 |
| 3 | Plain washer M8 |
| 4 | Cable lug M8 |
| 5 | Copper rail |
| 6 | Measurement system KSM |
| 7 | Hexagonal screw M8x35 (8.8) |

Illustration 7 Buildup of the Main Cable Connection Fixing Point

5.3.1 Torque Overview Table

Table 3 Torque

| Standard metric screw thread | Recommended | |
|------------------------------|-------------|--|
| M8 (8.8) | 11Nm | DC Main Connection |
| | |  |

6 RS-485 Communication

6.1 Interface Parameters

The KSM monitoring system is operated with the Modbus RTU protocol.

Table 4 Interface Parameters

| | |
|---------------|---------------|
| Baud rate | 19 200 Baud |
| Format | 8n1 |
| Unit Load | 1/4 |
| Byte order | MSBit – LSBit |
| Word order | LSBit – MSBit |
| Address range | 1-120 |
| | |

6.2 Termination

Each of the last KSM monitoring systems of a string must be terminated at the RS485 wiring. As standard, the KSM monitoring system is not terminated in the default setting so that free configuration of the KSM monitoring system can take place on site.

To activate the termination, set the DIP switch (J1) on the KSM monitoring system to ON (see Illustration 8).



Information

The termination resistors may only be activated at the endpoints of the bus line. If more termination resistors other than the endpoints are activated it can lead to malfunctions in and failure of the complete bus line.

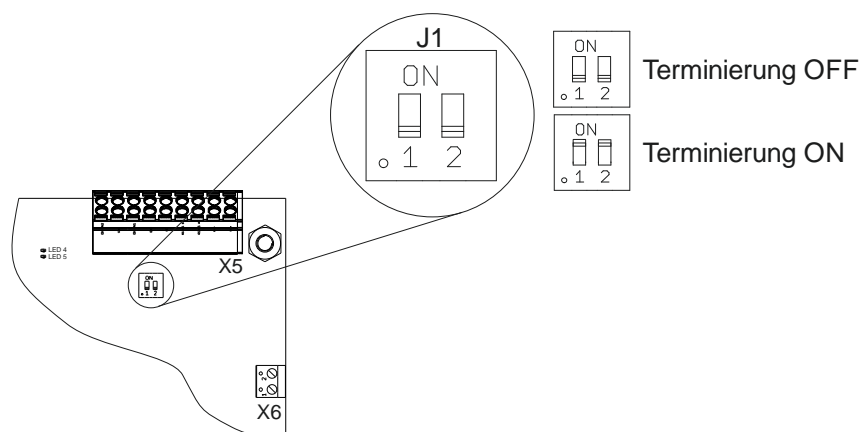


Illustration 8 Termination of the KSM Monitoring System

6.3 Setting the Bus Addresses

Using a screwdriver, set the desired addresses on the address coding switches J2 and J3 of the KSM monitoring system.

The addresses are coded in HEX format and lie in the range 1 to 120.

Each address may be assigned only once in a bus segment. After setting the bus addresses the KSM monitoring system must carry out a reset, for this, press the buttons S1.

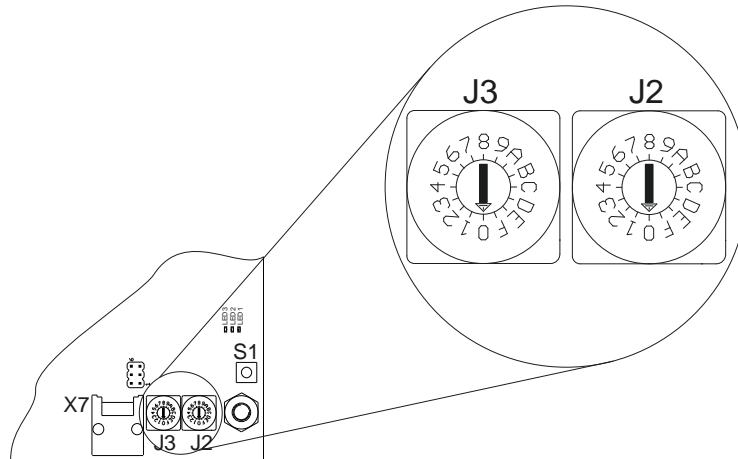


Illustration 9 Address Coding Switches of the KSM Monitoring System

Example: Setting the bus address 78 corresponding to the hexadecimal number 4E. Set the address coding switch J3 to 4 and the address coding switch J2 to E.

Table 5 Conversion Chart Decimal - Hexadecimal

| Desired Address (DEC) | Coding switch setting (HEX) | Desired Address (DEC) | Coding switch setting (HEX) | Desired Address (DEC) | Coding switch setting (HEX) | Desired Address (DEC) | Coding switch setting (HEX) |
|-----------------------|-----------------------------|-----------------------|-----------------------------|-----------------------|-----------------------------|-----------------------|-----------------------------|
| 1 | 01 | 31 | 1F | 61 | 3D | 91 | 5B |
| 2 | 02 | 32 | 20 | 62 | 3E | 92 | 5C |
| 3 | 03 | 33 | 21 | 63 | 3F | 93 | 5D |
| 4 | 04 | 34 | 22 | 64 | 40 | 94 | 5E |
| 5 | 05 | 35 | 23 | 65 | 41 | 95 | 5F |
| 6 | 06 | 36 | 24 | 66 | 42 | 96 | 60 |
| 7 | 07 | 37 | 25 | 67 | 43 | 97 | 61 |
| 8 | 08 | 38 | 26 | 68 | 44 | 98 | 62 |
| 9 | 09 | 39 | 27 | 69 | 45 | 99 | 63 |
| 10 | 0A | 40 | 28 | 70 | 46 | 100 | 64 |
| 11 | 0B | 41 | 29 | 71 | 47 | 101 | 65 |
| 12 | 0C | 42 | 2A | 72 | 48 | 102 | 66 |
| 13 | 0D | 43 | 2B | 73 | 49 | 103 | 67 |
| 14 | 0E | 44 | 2C | 74 | 4A | 104 | 68 |
| 15 | 0F | 45 | 2D | 75 | 4B | 105 | 69 |
| 16 | 10 | 46 | 2E | 76 | 4C | 106 | 6A |
| 17 | 11 | 47 | 2F | 77 | 4D | 107 | 6B |
| 18 | 12 | 48 | 30 | 78 | 4E | 108 | 6C |
| 19 | 13 | 49 | 31 | 79 | 4F | 109 | 6D |
| 20 | 14 | 50 | 32 | 80 | 50 | 110 | 6E |
| 21 | 15 | 51 | 33 | 81 | 51 | 111 | 6F |
| 22 | 16 | 52 | 34 | 82 | 52 | 112 | 70 |
| 23 | 17 | 53 | 35 | 83 | 53 | 113 | 71 |
| 24 | 18 | 54 | 36 | 84 | 54 | 114 | 72 |
| 25 | 19 | 55 | 37 | 85 | 55 | 115 | 73 |
| 26 | 1A | 56 | 38 | 86 | 56 | 116 | 74 |
| 27 | 1B | 57 | 39 | 87 | 57 | 117 | 75 |
| 28 | 1C | 58 | 3A | 88 | 58 | 118 | 76 |
| 29 | 1D | 59 | 3B | 89 | 59 | 119 | 77 |
| 30 | 1E | 60 | 3C | 90 | 5A | 120 | 78 |

6.4 Registers and Functions

6.4.1 Abbreviations

Table 6 Abbreviations and Data Types

| Abbreviation | Description |
|--------------|-----------------------------------|
| UINT16 | Data type Unsigned Integer, 16Bit |
| UINT32 | Data type Unsigned Integer, 32Bit |
| HEX16 | Data type Hexadecimal, 16Bit |
| HEX32 | Data type Hexadecimal, 32Bit |
| Float32 | Data type Float, 32Bit |
| R | Only read only access possible |
| R/W | Read and write access possible |

6.4.2 Registers

Table 7 Register Assignment Basic Variant

| Register | Data Type | Description | Range of Values | Unit | R/W |
|------------|-----------|------------------------------------|------------------|--------|-----|
| 0000 | UINT16 | Digital input 1 | 0=OFF 1=ON | Status | R |
| 0001 | UINT16 | Digital input 2 | 0=OFF 1=ON | Status | R |
| 0002, 0003 | Float32 | String current 1 | -5.00...+20.00 | A | R |
| 0004, 0005 | Float32 | String current 2 | -5.00...+20.00 | A | R |
| 0006, 0007 | Float32 | String current 3 | -5.00...+20.00 | A | R |
| 0008, 0009 | Float32 | String current 4 | -5.00...+20.00 | A | R |
| 0010, 0011 | Float32 | String current 5 | -5.00...+20.00 | A | R |
| 0012, 0013 | Float32 | String current 6 | -5.00...+20.00 | A | R |
| 0014, 0015 | Float32 | String current 7 | -5.00...+20.00 | A | R |
| 0016, 0017 | Float32 | String current 8 | -5.00...+20.00 | A | R |
| 0018, 0019 | Float32 | String current 9 | -5.00...+20.00 | A | R |
| 0020, 0021 | Float32 | String current 10 | -5.00...+20.00 | A | R |
| 0022, 0023 | Float32 | Total current | -50.00...+200.00 | A | R |
| 0024, 0025 | Float32 | String voltage | -5.0...+1000.0 | V | R |
| 0026, 0027 | Float32 | Total power | 0...+200 | kW | R |
| 0028, 0029 | Float32 | Temperature measurement board | -40.0...125.0 | °C | R |
| 0030, 0031 | Float32 | Supply voltage | 0,00 ... +70,00 | V | R |
| 0032, 0033 | HEX32 | Serial number measurement board | 0xFFFFFFFF | | R |
| 0034, 0035 | HEX32 | Firmware version measurement board | 0xFFFFFFFF | | R |
| 0036 | UINT16 | Firmware year | JJJJ | | R |
| 0037 | HEX16 | Firmware day and month (HEX) | 0xTTMM | | R |
| 0038 | UINT16 | Quick measurement | 0=OFF 1=ON | Status | R/W |
| 0039 | UINT16 | Delayed response | 0...250 | ms | R/W |
| 0040 | UINT16 | Modbus Address measurement board | 1...120 | | R |
| 0041 | UINT16 | Comfort module connected | 0=No 1=Yes | Status | R |

Table 8 Register Assignment Comfort Module

| Register | Data Type | Description | Range of Values | Unit | R/W |
|------------|-----------|-------------------------------|-----------------|--------|-----|
| 0042, 0043 | Float32 | Temperature sensor 1 (PT1000) | -40.0...125.0 | °C | R |
| 0044, 0045 | Float32 | Temperature sensor 2 (PT1000) | -40.0...125.0 | °C | R |
| 0046, 0047 | Float32 | 4-20mA Input 1 | 4...20 | mA | R |
| 0048, 0049 | Float32 | 4-20mA Input 2 | 4...20 | mA | R |
| 0050, 0051 | Float32 | 0-10V Input 1 | 0...10 | U | R |
| 0052, 0053 | Float32 | 0-10V Input 2 | 0...10 | U | R |
| 0054 | UINT16 | Relay Output | 0=OFF 1=ON | Status | R/W |

Table 9 Register Assignment temperature module

| Register | Datentyp | Beschreibung | Wertbereich | Einheit | R/W |
|------------|----------|-----------------------------|---------------|---------|-----|
| 0042, 0043 | Float32 | Temperaturfühler 1 (PT1000) | -40,0...125,0 | °C | R |
| 0044, 0045 | Float32 | Temperaturfühler 2 (PT1000) | -40,0...125,0 | °C | R |

6.5 Functions

6.5.1 Quick Measurement

With the 0038 register (quick measurement) a short time averaging of the measured value can be switched off or on.

This short time averaging averages the values over approx. 10 seconds.

6.5.2 Delayed Response

In the 0039 register, a delay of the response to a query via the Modbus interface can be set in the event that the response of the Modbus slaves (KSM monitoring system) is too quick and, therefore, the risk arises that the responses are not recognized as they are already available on the bus only a short time after the query.

For this the additional delay is specified in milliseconds in the 0039 register.

7 Signal / Display

7.1 LED- Functions

- LED1:
 - Flashing: Communication comfort module
- LED2:
 - Flashing: Communication measuring module
- LED3:
 - Flashing: Communication MOD-Bus
- LED4:
 - Flashing: Measuring activity
- LED5:
 - Continuous light: Internal controller error
 - Flashing: Internal communication error

8 Contact

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