KSM-VX.X

EN

Installation and Operation

EN

Contents

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
KSM-VX.X-10/1000/020
KSM-VX.X-10/1000/040

In the version to V0.7

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.

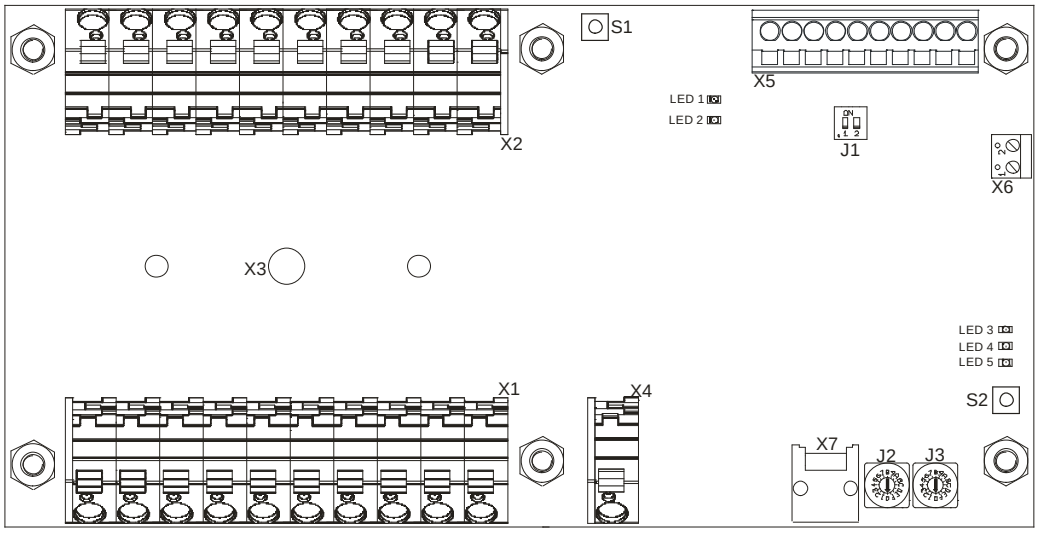


Illustration 1 Example Layout of the KSM Monitoring System

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 02/1000/100	KSM-VX.X 10/1000/020	KSM-VX.X 10/1000/040
X1	Measurement Input	01	01-05	01-05
X2	Measurement Input	02	06-10	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 measuring controller			
S2	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

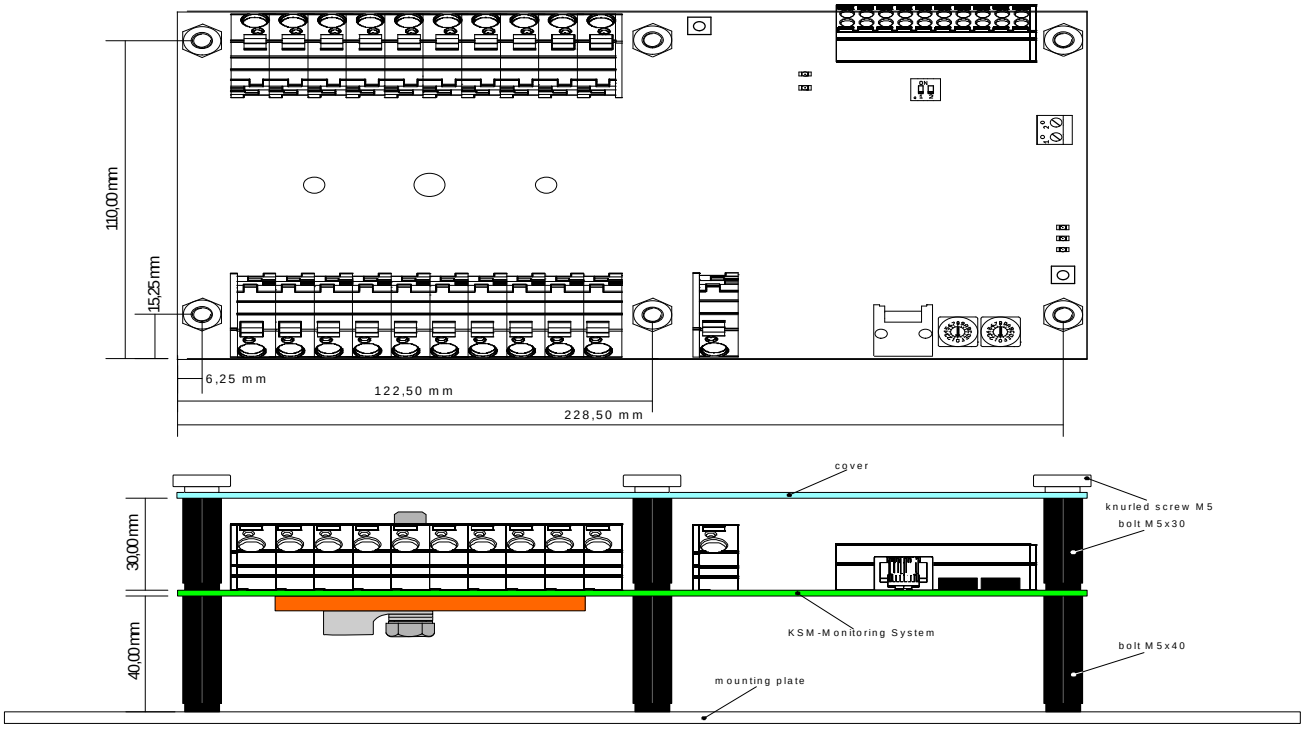


Illustration 2 Installation of the KSM Monitoring System

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.

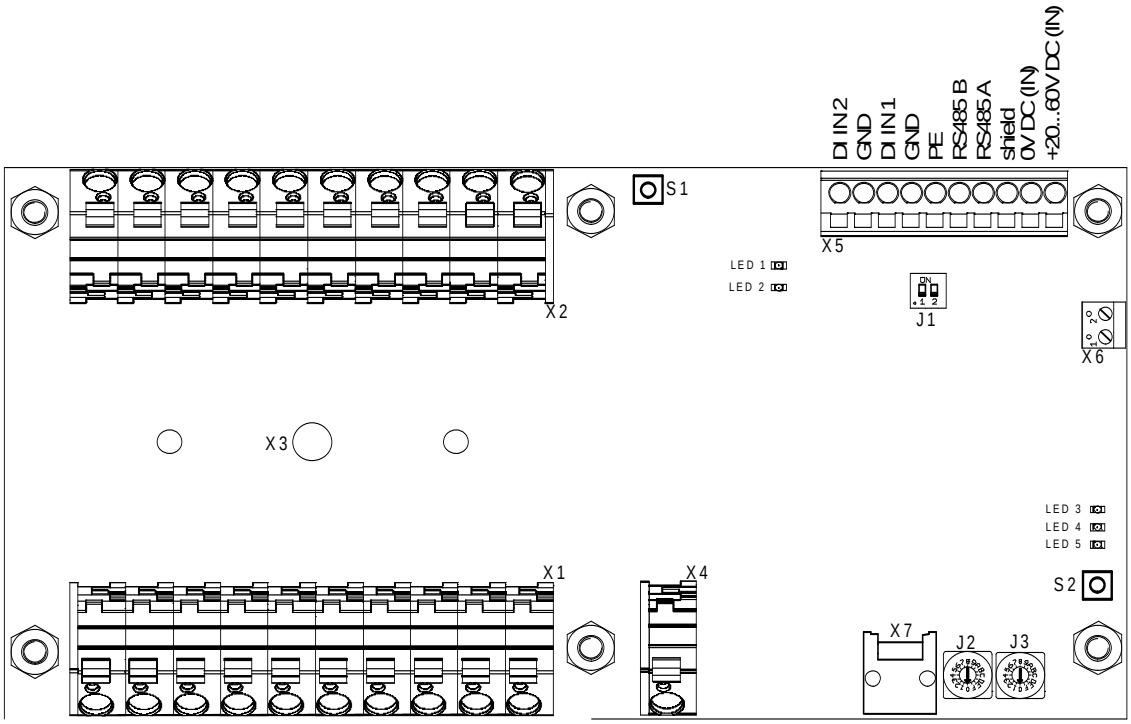


Illustration 3 Communications Port in the KSM Monitoring System

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 mm²
Cross section to	1.5 mm²
Conductor type 2	Fine stranded wire
Cross section from	0.2 mm²
Cross section to	1.5 mm²
Conductor type 3	Fine stranded with wire end ferrules with plastic collars
Cross section from	0.25 mm²
Cross section to	1.0 mm²
Conductor type 4	Fine stranded with wire end ferrules without plastic collars
Cross section from	0.25 mm²
Cross section to	1.0 mm²
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.

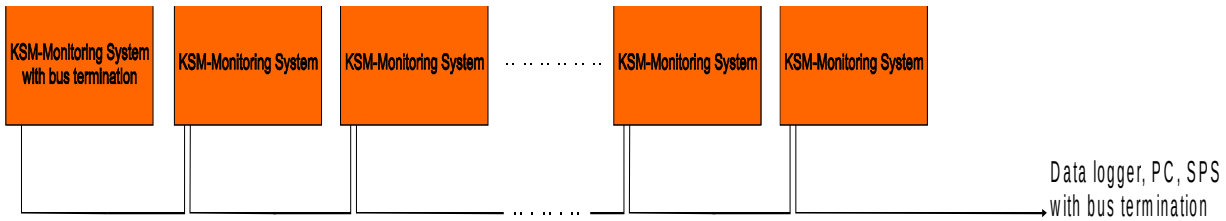


Illustration 4 Wiring RS-485 Bus

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.

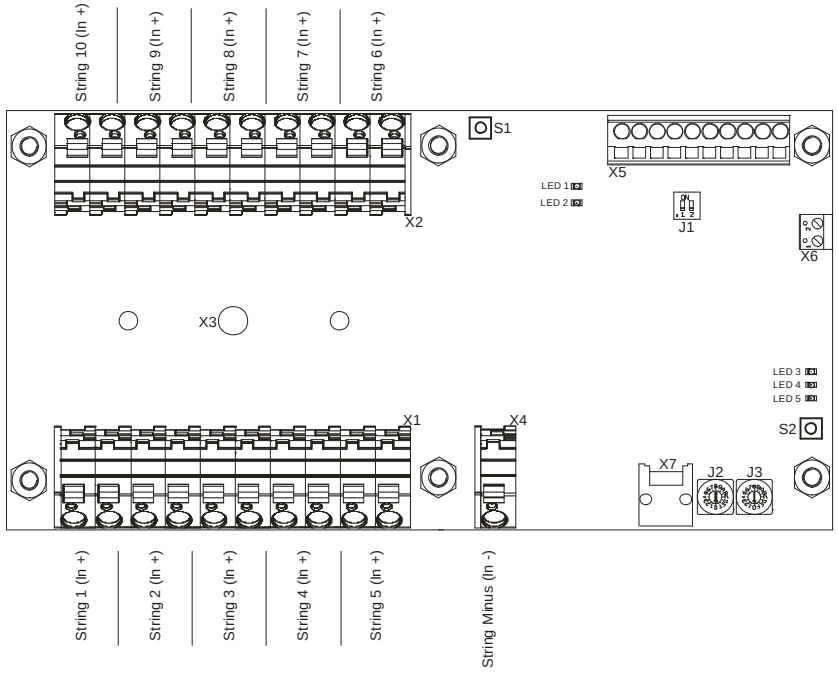


Illustration 5 Input Connection in the KSM Monitoring System

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 mm²
Cross section to	6.0 mm²
Conductor type 2	Fine stranded wire
Cross section from	0.2 mm²
Cross section to	6.0 mm²
Conductor type 3	Fine stranded with wire end ferrules with plastic collars
Cross section from	0.25 mm²
Cross section to	4.0 mm²
Conductor type 4	Fine stranded with wire end ferrules without plastic collars
Cross section from	0.25 mm²
Cross section to	4.0 mm²
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.

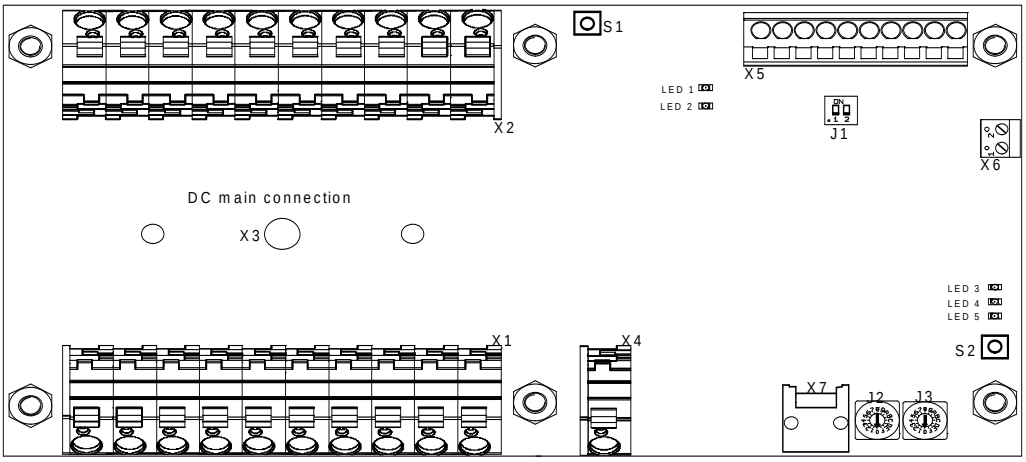
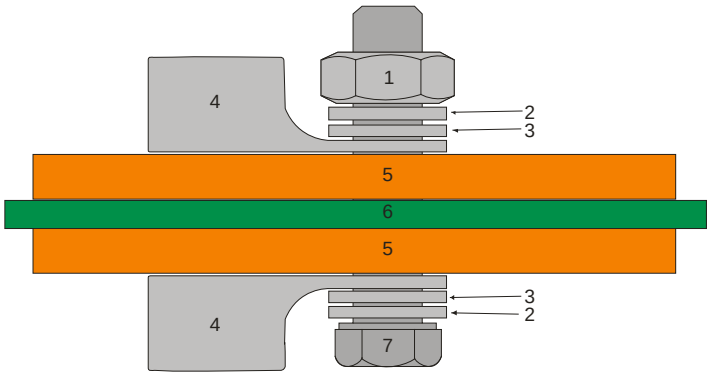


Illustration 6 Main Cable Connection in the KSM Monitoring System



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	¼
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.

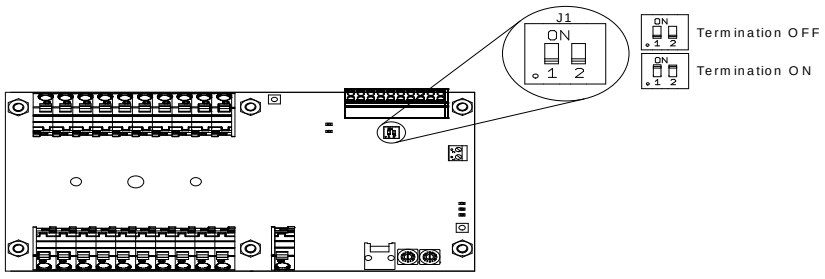


Illustration 8 Termination of the KSM Monitoring System

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 and S2.

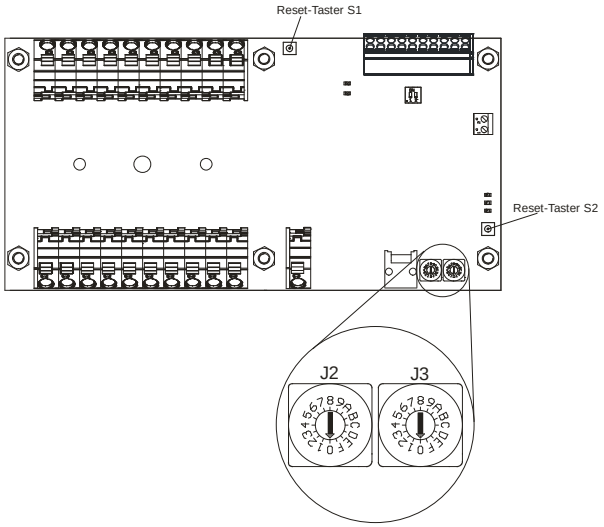


Illustration 9 Address Coding Switches of the KSM Monitoring System

Example: Setting the bus address 78 corresponding to the hexadecimal number 4E. Set the address coding switch J2 to 4 and the address coding switch J3 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	HEX32	Serial number measurement board	0xXXXXXXXX		R
0032, 0033	HEX32	Firmware version measurement board	0xXXXXXXXX		R
0034	UINT16	Firmware year	JJJJ		R
0035	HEX16	Firmware day and month (HEX)	0xTTMM		R
0036	UINT16	Quick measurement	0=OFF 1=ON	Status	R/W
0037	UINT16	Delayed response	0...250	ms	R/W
0038	UINT16	Modbus Address measurement board	1...120		R
0039	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
0040, 0041	Float32	Temperature sensor 1 (PT1000)	-40.0...125.0	°C	R
0042, 0043	Float32	Temperature sensor 2 (PT1000)	-40.0...125.0	°C	R
0044, 0045	Float32	4-20mA Input 1	4...20	mA	R
0046, 0047	Float32	4-20mA Input 2	4...20	mA	R
0048, 0049	Float32	0-10V Input 1	0...10	U	R
0050, 0051	Float32	0-10V Input 2	0...10	U	R
0052	UINT16	Relay Output	0=OFF 1=ON	Status	R/W

6.5 Functions

6.5.1 Quick Measurement

With the 0036 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 0037 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 0037 register.

7 Signal / Display

7.1 LED- Functions

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

8 Contact

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