



KSM-VX.X

EN

Installation and Operation

EN

Contents

- EN..... 1
- 1 Information about these Instructions..... 3
 - 1.1 Scope of Application..... 3
 - 1.2 User Groups..... 3
 - 1.3 Explanation of the Symbols Used 4
- 2 Safety Advice 5
 - 2.1 Correct and Proper Use 5
 - 2.2 Working on the KSM Monitoring System 5
 - 2.3 About this Manual..... 5
 - 2.4 Checking the Delivery..... 6
 - 2.5 Storage..... 6
 - 2.6 Installation..... 6
 - 2.7 Particular Risks from Photovoltaic Plants..... 7
 - 2.8 Particular Risks from Earthed PV Plants 8
 - 2.9 Electrical Connection 9
 - 2.10 Isolation..... 10
 - 2.11 Commissioning, Maintenance and Repair 11
 - 2.12 General Advice..... 11
- 3 Layout..... 12
 - 3.1 Component Labelling in the KSM Monitoring System 12
- 4 Installing the KSM Monitoring System 13
- 5 Connection 14
 - 5.1 Connection of the Supply Terminal 14
 - 5.1.1 Wire Stripping Length and Supply Terminal Cross Sections 15
 - 5.1.2 Digital Inputs..... 15
 - 5.1.3 Functional Earth 15
 - 5.1.4 Modbus Interface..... 16
 - 5.1.5 Supply Voltage 16
 - 5.2 Connection of the Measurement Channels..... 17
 - 5.2.1 Wire Stripping Length and Measurement Connections Cross Sections 17
 - 5.3 Connection of the DC Main Cable..... 18
 - 5.3.1 Torque Overview Table 18
- 6 RS-485 Communication..... 19
 - 6.1 Interface Parameters 19
 - 6.2 Termination 19
 - 6.3 Setting the Bus Addresses 20
 - 6.4 Registers and Functions 21
 - 6.4.1 Abbreviations 21

- 6.4.2 Registers 21
- 6.5 Functions 23
 - 6.5.1 Quick Measurement 23
 - 6.5.2 Delayed Response 23
- 7 Signal / Display 24
 - 7.1 LED- Functions 24
- 8 Contact 25
- 9 Index of Illustrations 25
- 10 Index of Tables..... 25

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-10/1000/040 (from V0.8.2)

KSM-VX.X-10/1500/040 (from V0.8.2)

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, 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 belongs 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 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.

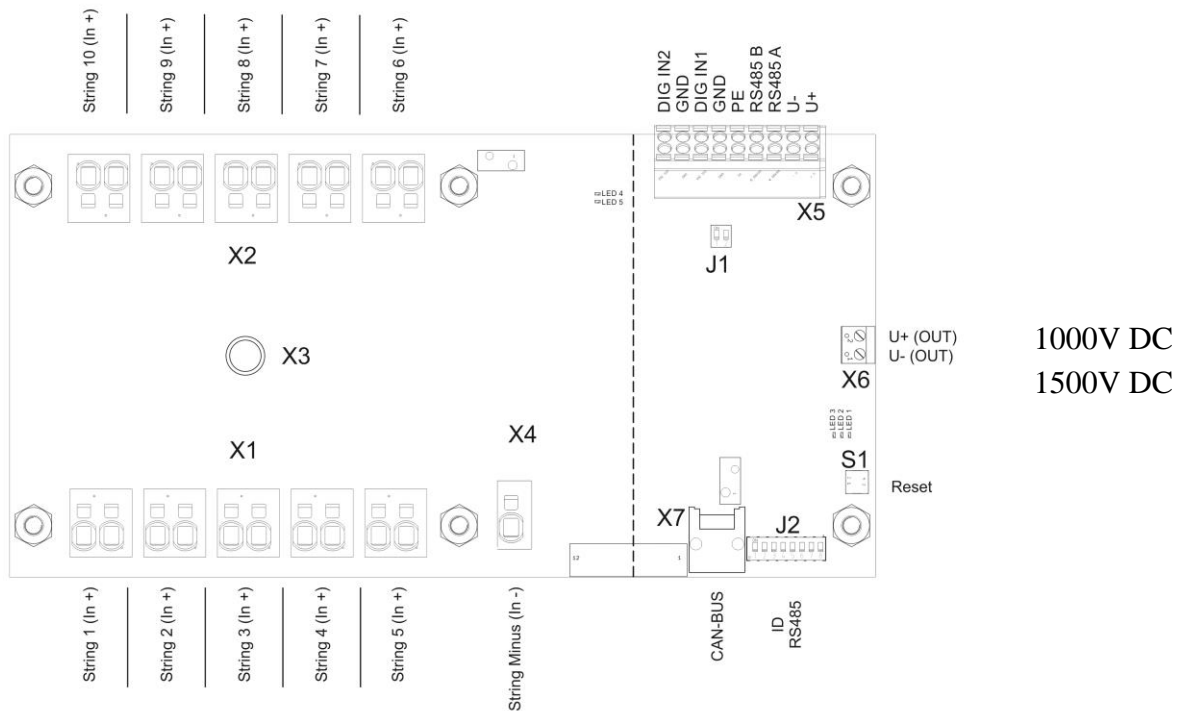


Illustration 1 Example Layout of the KSM Monitoring System

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

3.1 Component Labelling in the KSM Monitoring System

X1	Measurement Input	01-05
X2	Measurement Input	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	
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 40 mm.

Dimensions of the KSM monitoring system

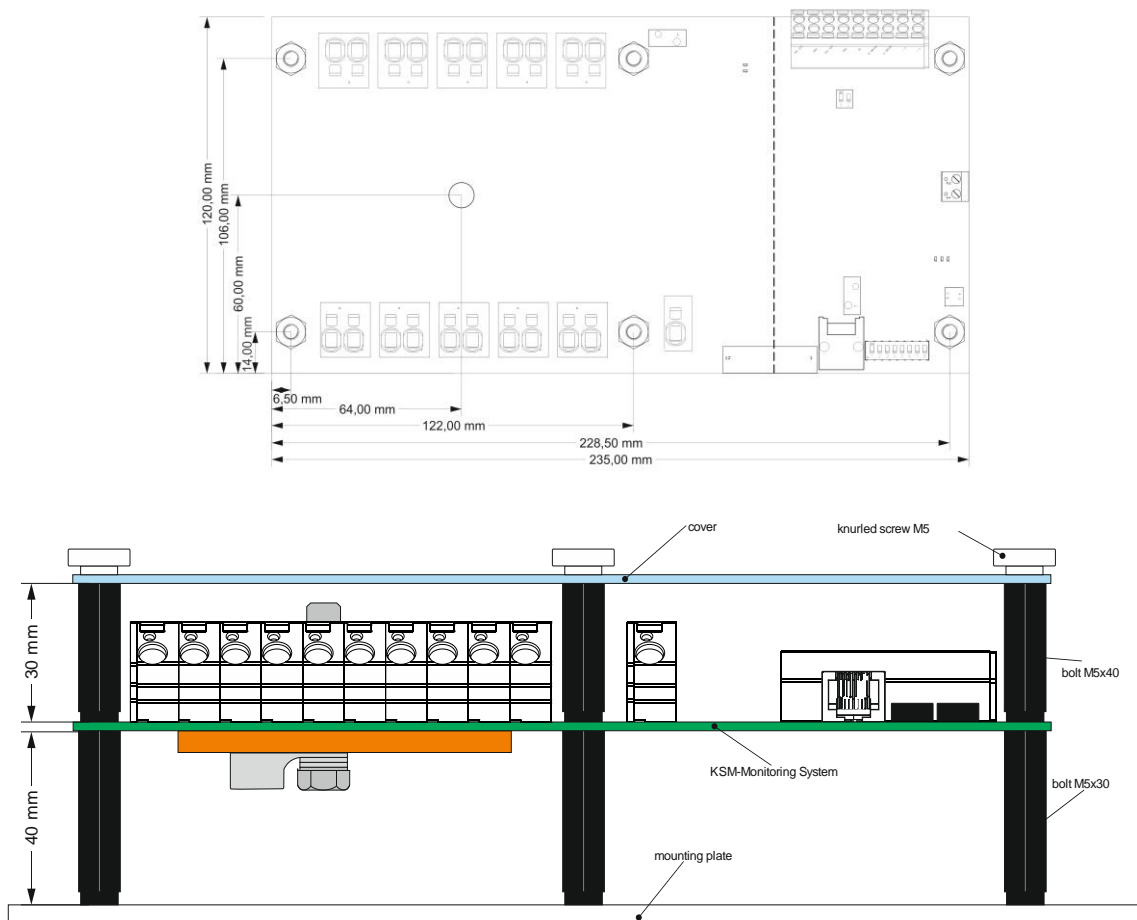


Illustration 2 Installation of the KSM Monitoring System

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.

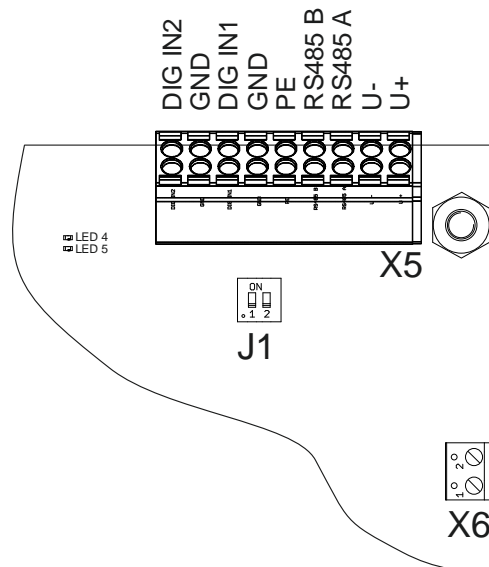


Illustration 3 Communications Port in the KSM Monitoring System

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

i Information

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

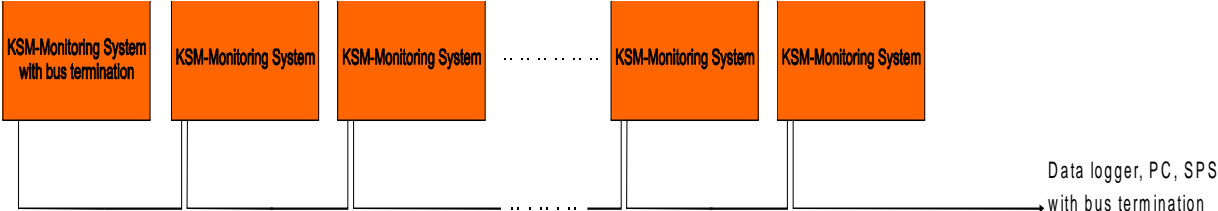


Illustration 4 Wiring RS-485 Bus

5.1.5 Supply Voltage

i Information

The power supply must be galvanically isolated.

The voltage range of the power supply 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.

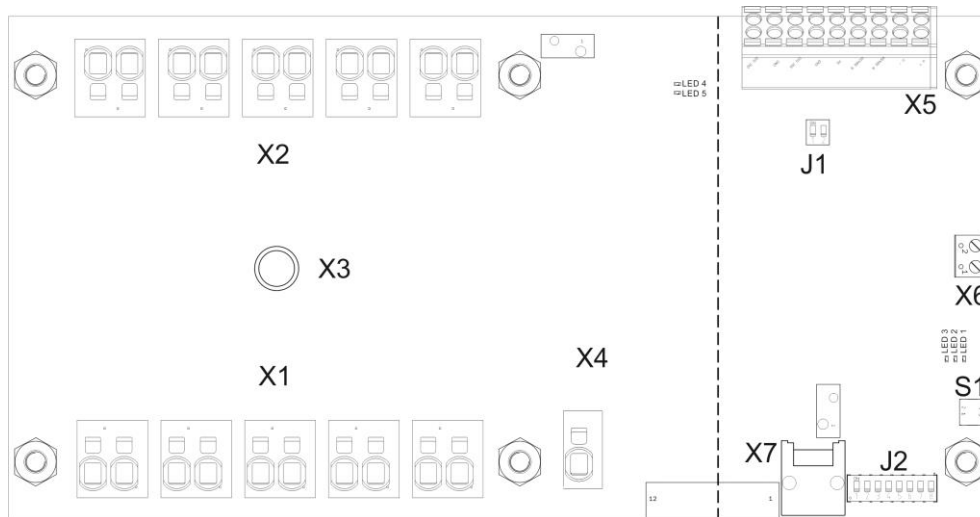


Illustration 5 Input Connection in the KSM Monitoring System

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.

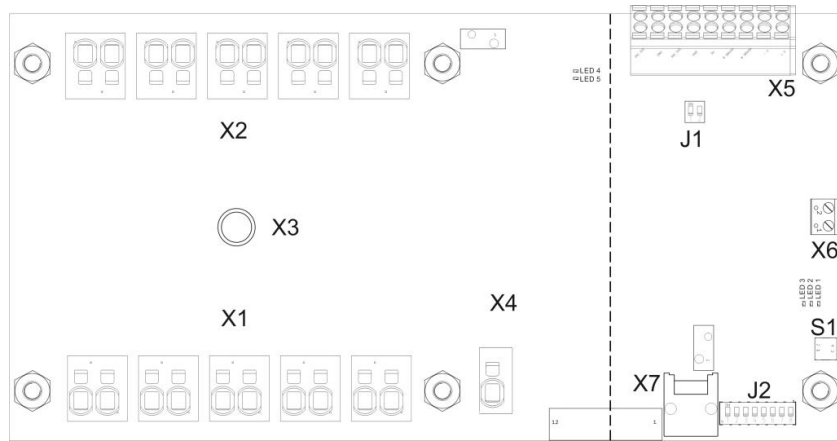
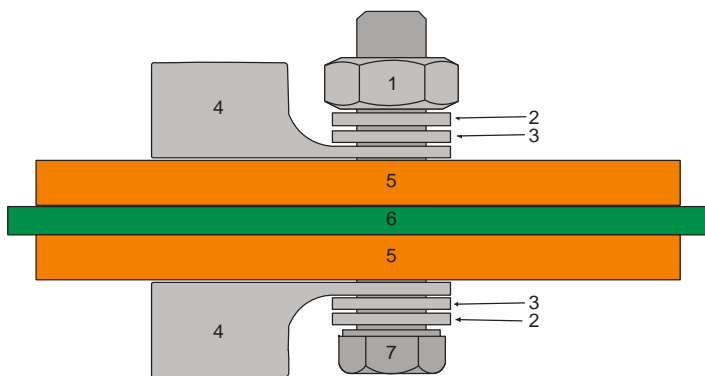


Illustration 6 Main Cable Connection in the KSM Monitoring System




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	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.

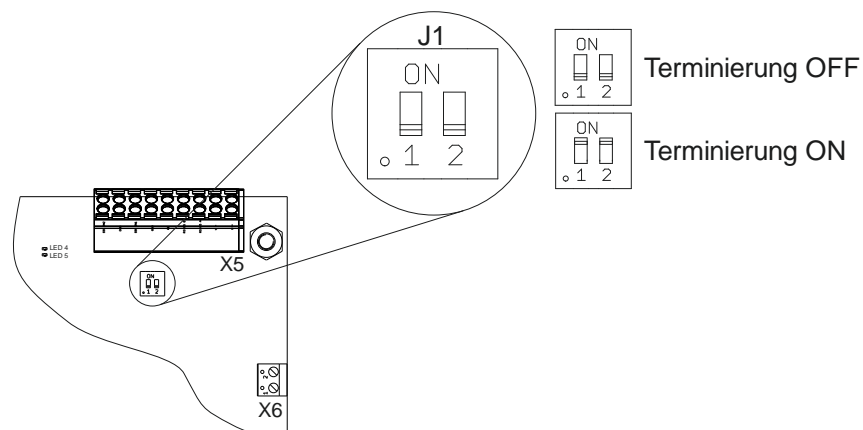


Illustration 8 Termination of the KSM Monitoring System

6.3 Setting the Bus Addresses

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

The addresses are coded in BIN format and are in the range from 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.

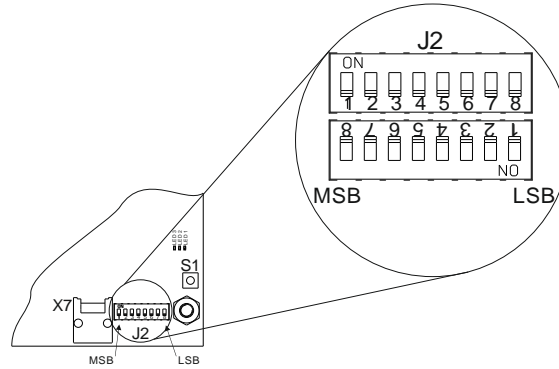


Illustration 9 Address Coding Switches of the KSM Monitoring System

Example: Setting the bus address 78 corresponding to the binary number 01001110. Set the address coding switch J2 to (MSB) 01001110 (LSB), dipswitch position OFF = 0 and ON = 1.

Table 5 Conversion Chart Decimal - Binary

gewünschte Adresse (DEZ)	Kodierschalterstellung (BIN)	gewünschte Adresse (DEZ)	Kodierschalterstellung (BIN)	gewünschte Adresse (DEZ)	Kodierschalterstellung (BIN)	gewünschte Adresse (DEZ)	Kodierschalterstellung (BIN)
1	0000001	31	00011111	61	00111101	91	01011011
2	0000010	32	00100000	62	00111110	92	01011100
3	0000011	33	00100001	63	00111111	93	01011101
4	0000100	34	00100010	64	01000000	94	01011110
5	0000101	35	00100011	65	01000001	95	01011111
6	0000110	36	00100100	66	01000010	96	01100000
7	0000111	37	00100101	67	01000011	97	01100001
8	00001000	38	00100110	68	01000100	98	01100010
9	00001001	39	00100111	69	01000101	99	01100011
10	00001010	40	00101000	70	01000110	100	01100100
11	00001011	41	00101001	71	01000111	101	01100101
12	00001100	42	00101010	72	01001000	102	01100110
13	00001101	43	00101011	73	01001001	103	01100111
14	00001110	44	00101100	74	01001010	104	01101000
15	00001111	45	00101101	75	01001011	105	01101001
16	00010000	46	00101110	76	01001100	106	01101010
17	00010001	47	00101111	77	01001101	107	01101011
18	00010010	48	00110000	78	01001110	108	01101100
19	00010011	49	00110001	79	01001111	109	01101101
20	00010100	50	00110010	80	01010000	110	01101110
21	00010101	51	00110011	81	01010001	111	01101111
22	00010110	52	00110100	82	01010010	112	01110000
23	00010111	53	00110101	83	01010011	113	01110001
24	00011000	54	00110110	84	01010100	114	01110010
25	00011001	55	00110111	85	01010101	115	01110011
26	00011010	56	00111000	86	01010110	116	01110100
27	00011011	57	00111001	87	01010111	117	01110101
28	00011100	58	00111010	88	01011000	118	01110110
29	00011101	59	00111011	89	01011001	119	01110111
30	00011110	60	00111100	90	01011010	120	01111000

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	UINT16	Reserved	-	-	R
0043, 0044	Float32	Temperature sensor 1 (PT1000)	-40.0...125.0	°C	R
0045, 0044	Float32	Temperature sensor 2 (PT1000)	-40.0...125.0	°C	R
0047, 0048	Float32	4-20mA Input 1	4...20	mA	R
0049, 0050	Float32	4-20mA Input 2	4...20	mA	R
0051, 0052	Float32	0-10V Input 1	0...10	U	R
0053, 0054	Float32	0-10V Input 2	0...10	U	R
0055	UINT16	Relay Output	0=OFF 1=ON	Status	R/W

Table 9 Register Assignment temperature module

Register	Datentyp	Beschreibung	Wertbereich	Einheit	R/W
0042	UINT16	Reserved	-	-	R
0043, 0044	Float32	Temperature sensor 1 (PT1000)	-40,0...125,0	°C	R
0045, 0046	Float32	Temperature sensor 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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9 Index of Illustrations

Illustration 1	Example Layout of the KSM Monitoring System	12
Illustration 2	Installation of the KSM Monitoring System	13
Illustration 3	Communications Port in the KSM Monitoring System	14
Illustration 4	Wiring RS-485 Bus	16
Illustration 5	Input Connection in the KSM Monitoring System	17
Illustration 6	Main Cable Connection in the KSM Monitoring System	18
Illustration 7	Buildup of the Main Cable Connection Fixing Point.....	18
Illustration 8	Termination of the KSM Monitoring System	19
Illustration 9	Address Coding Switches of the KSM Monitoring System.....	20

10 Index of Tables

Table 1	Spring-loaded Terminals Technical Data.....	15
Table 2	Technical Data Measurement Line Spring-loaded Terminals.....	17
Table 3	Torque	18
Table 4	Interface Parameters	19
Table 5	Conversion Chart Decimal - Binary.....	20
Table 6	Abbreviations and Data Types	21
Table 7	Register Assignment Basic Variant.....	21
Table 8	Register Assignment Comfort Module	22
Table 9	Register Assignment temperature module	22