



KS 816
Multiple transmitter
and temperature controller

KS 816

KS 816

KS 816

16

Operating instructions

9499 040 55811

valid from: 8391

©PMA Prozeß- und Maschinen-Automation GmbH 1997. Printed in Germany
All rights reserved. No part of this document may be reproduced
or published in any form or by any means without prior written
permission by the copyright owner.

A publication of PMA Prozeß- und Maschinen- Automation GmbH

Subject to change without notice.
PMA Prozeß- und Maschinen-Automation GmbH
P.O. Box 31 02 29
D 34058 Kassel
Germany

Restriction of warranty:

No warranty is given for the complete correctness of this manual, because errors can never be avoided completely despite utmost care. Hints are always welcome and gratefully accepted.

Contents

1 Safety hints	5
1.1 Electromagnetic compatibility	5
2 General	6
2.1 Versions	6
3 Installation	7
3.1 Mounting	7
3.2 Dismounting	8
4 Electrical connection	9
4.1 Terminals	9
4.2 Galvanic isolations	10
4.3 Power supply	10
4.4 Fuses	10
5 Inputs	11
5.1 Thermocouple inputs (IN1+/IN1- ... IN16+/IN16-)	11
5.1.1 Cold junction temperature compensation	12
5.2 Direct voltage	13
5.2.1 Range :-100mV...+100mV IN1T+...IN16T+	13
5.2.2 Range : -10V...+10V IN1U+...IN16U+	13
5.3 Resistance thermometer (IN1+/IN1-/IPT1 ... IN16+/IN16-/IPT16).....	13
5.4 0/4...20mA standard current signal (IN1+...IN16-)	13
5.5 Screening of input leads	13
5.6 Input circuit examples.....	14
6 Outputs	15
6.1 Operation as a transmitter.....	15
6.2 Alarm function	15
7 Overall connecting diagram KS 816	16
8 Digital interfaces	17
8.1 Engineering tool interface.....	17
8.2 BUS interfaces	17
8.2.1 BUS connector	17
8.3 COM2 interface	17
8.4 Termination resistors.....	19
9 Indicator LEDs	19
10 Maintenance and behaviour in case of failure	20
10.1 Cleaning	20
10.2 Trouble-shooting	20

1 Safety hints

Following the enclosed safety hints 9499 047 07101 is indispensable!

For hints on the mains unit to be used, see section 4.3 Power supply.

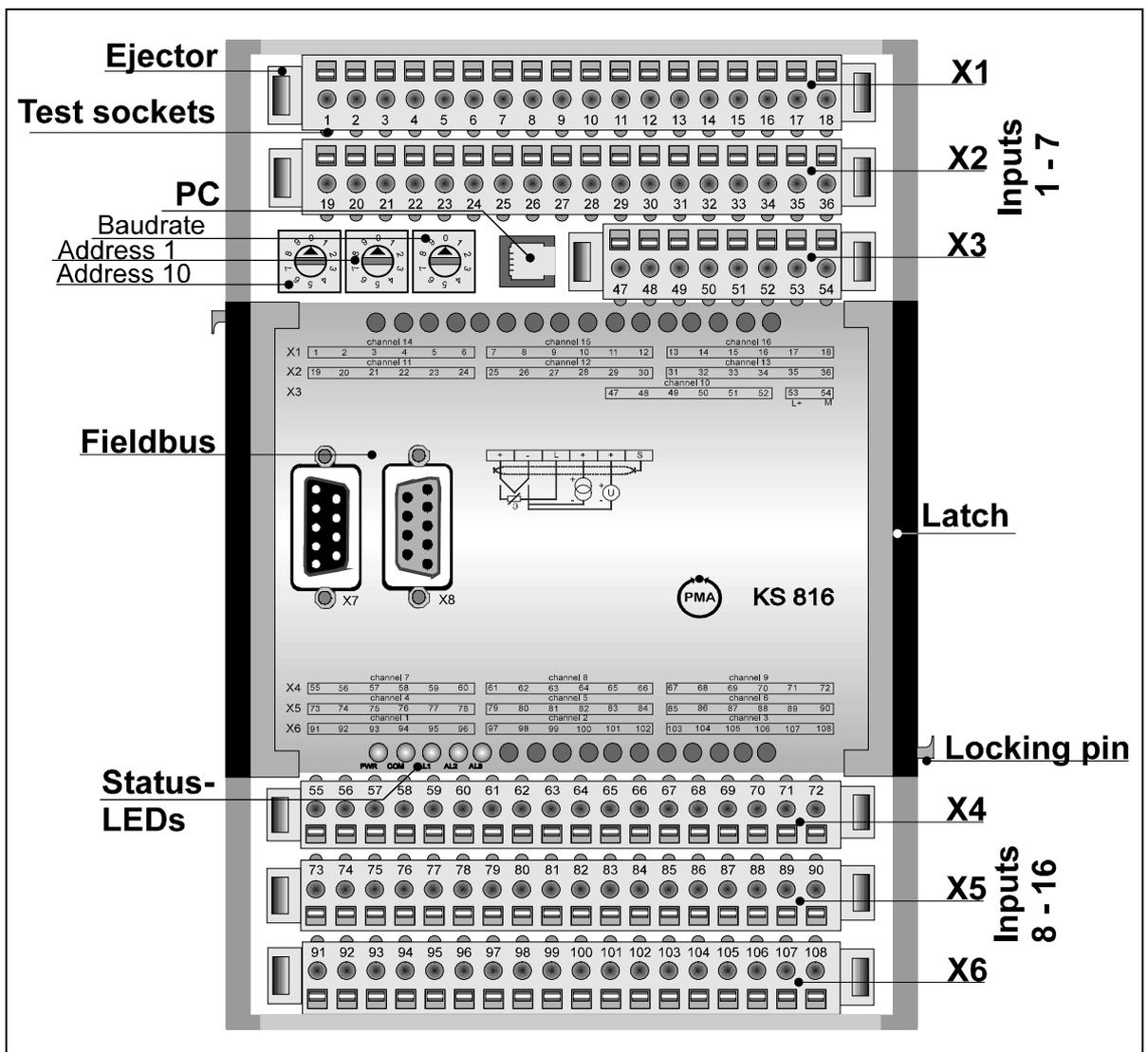
1.1 Electromagnetic compatibility

The unit conforms to European guideline 89/336/EEC and is provided with CE marking. The following European generic standards are met:

Electromagnetic emission: EN 50081-1 and electromagnetic immunity: EN 50082-2

For compliance with EN50082-2, the analog input leads must be screened.

The unit is suitable for use in industrial areas (in residential areas, it may cause RF interference). The electromagnetic emission can be reduced decisively by installing the unit in a grounded metal control cabinet).



2 General

KS 816 is a microcomputer-based multi-loop temperature controller. Functions "set-point reduction" and "heating/cooling with four alarms" make it particularly suitable for temperature control on plastics processing machinery, heated moulds, packaging machines, tempering units and similar thermal processes. With high-power heating elements (e.g. in hot-runner moulds), the selectable functions "start-up circuit" and "output hold" in case of sensor break ensure increased element life and prevent interruptions during production. The self-tuning feature guarantees very short start-up times.

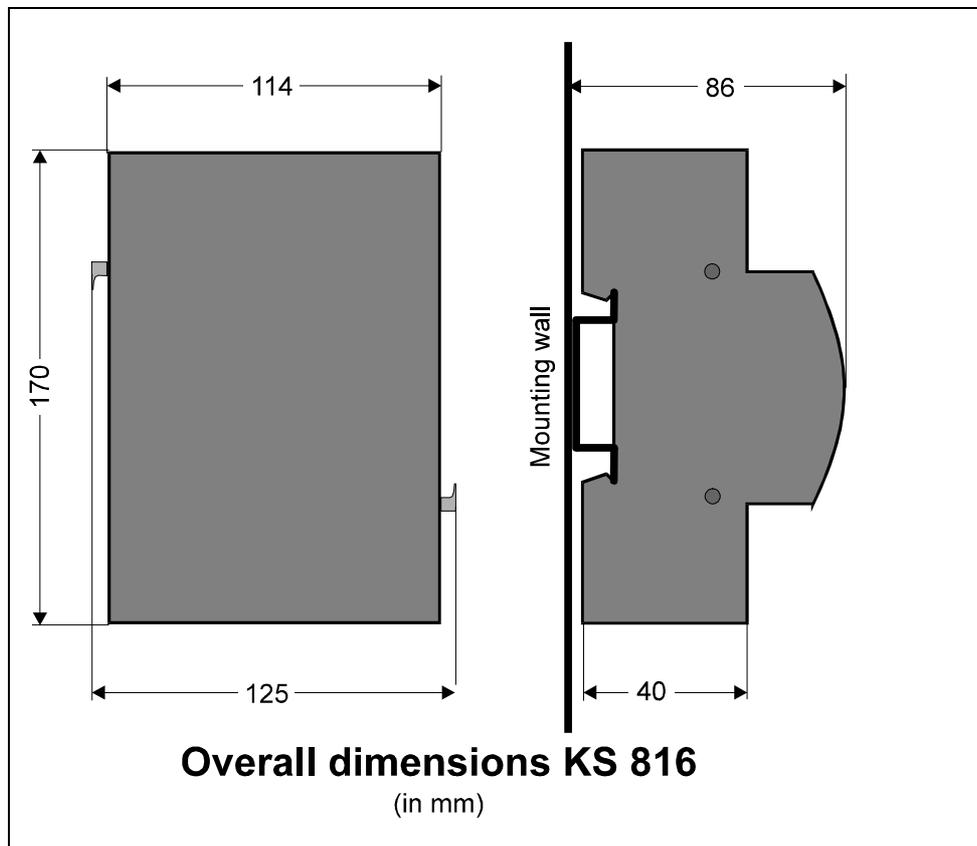
2.1 Versions

This operating note is valid for three versions, which are only distinguished by the communication interface.

9407 481 00001	KS 816-RS with RS485 / RS422 interface and ISO 1745 protocol
9407 481 30001	KS 816-DP for Profibus DP (in preparation)
9407 481 60001	KS 816-CAN for CANopen

3 Installation

3.1 Mounting



KS 816 is provided for mounting on rails 35 x 7,5 (top-hat rail) to EN 50 022, EN 50 035, EN 50 045.

Grounding is via a spring on the top-hat rail. Therefore, note that there must be a good conducting connection with the grounded mounting wall (layer of lacquer instead of conducting mounting wall, Eloxal, ...). If necessary, the clip-on rail must be grounded with a separate connection.

Single unit: For mounting, pull the two lateral catches upwards by approx. 5 mm via a stop and snap the unit onto the rail. Press the catches down to fix the unit to the rail.

Several units: For mounting several units side by side, snap the first unit onto the rail and lock only the side at which no further unit must be mounted. Mount the second unit accordingly, approx. 2 cm beside the first one, and connect it to the first one by shifting it laterally (pins locked into position). Press down the second catch of the first unit only now.

3.2 Dismounting

For dismounting, the leads need not be disconnected. Before removing the upper parts of the connectors, the upper parts and the corresponding lower parts must be marked, because these terminals are distortion-proof but not confusion-proof. For releasing the upper part of a terminal, the two red ejectors of a terminal row must be pressed towards the p.c.b. using a screwdriver, if necessary. To release the unit from the mounting rail, pull the two lateral catches forwards by approx. 5 mm (unit is released) and remove the unit from the rail by tipping it upwards or downwards.

For replacing an "inner" unit of several ones mounted side by side, start by releasing the catch of a unit (and the catch of the next one!) at one end of the row and shift the unit laterally. Repeat this procedure up to the unit to be replaced. When its catches are released at both sides, it can be removed from the rail by tipping it up or downwards.

4 Electrical connection

- The max. permissible voltage against ground of the input and signal leads is 50 V_{eff}.
- Power supply leads must be kept separate from signal and input leads.
- For output protection and interference suppression, connected contactors must be provided with protective circuitry to manufacturer specifications.

4.1 Terminals

All terminals leading to the process are designed as (plug-in type) screw or screwless spring-clamp terminals.
The terminals are not delivered with the unit and must be ordered separately.
Make: **PHOENIX COMBICON**
Two types are available:

Screw terminal	5 x FRONT-MSTB 2,5/18-ST-5,08	1 x FRONT-MSTB 2,5/8-ST-5,08
PMA order no.	9407 799 00001	9407 799 00011
Spring-clamp terminal	5 x FK-MSTBP 1,5/18-ST-5,08	8-pole only screw terminals
PMA order no.	-----	-----

Note: The spring-clamp terminals are shown in the KS 816 figures. These have a separate "test socket".
With screw terminals, the screw heads are used for test measurements.

Connecting capacity

	FRONT-MTSB 2,5/...-ST		FK-MSTBP 1,5/...-ST	
	rigid	flexible ¹⁾	rigid	flexible ¹⁾
One conductor	0,2 - 2,5	0,25 - 2,5	0,2 - 1,5	0,25 - 1,5
Several conductors [mm²] ²⁾	0,2 - 1,5	0,25 - 1,0	0,2 - 1,0	0,5 - 0,75 ³⁾

¹⁾ with end crimps

²⁾ 2 conductors of equal cross-section

³⁾ with TWIN end crimps

Make: **WAGO multi-connector system MIDI**

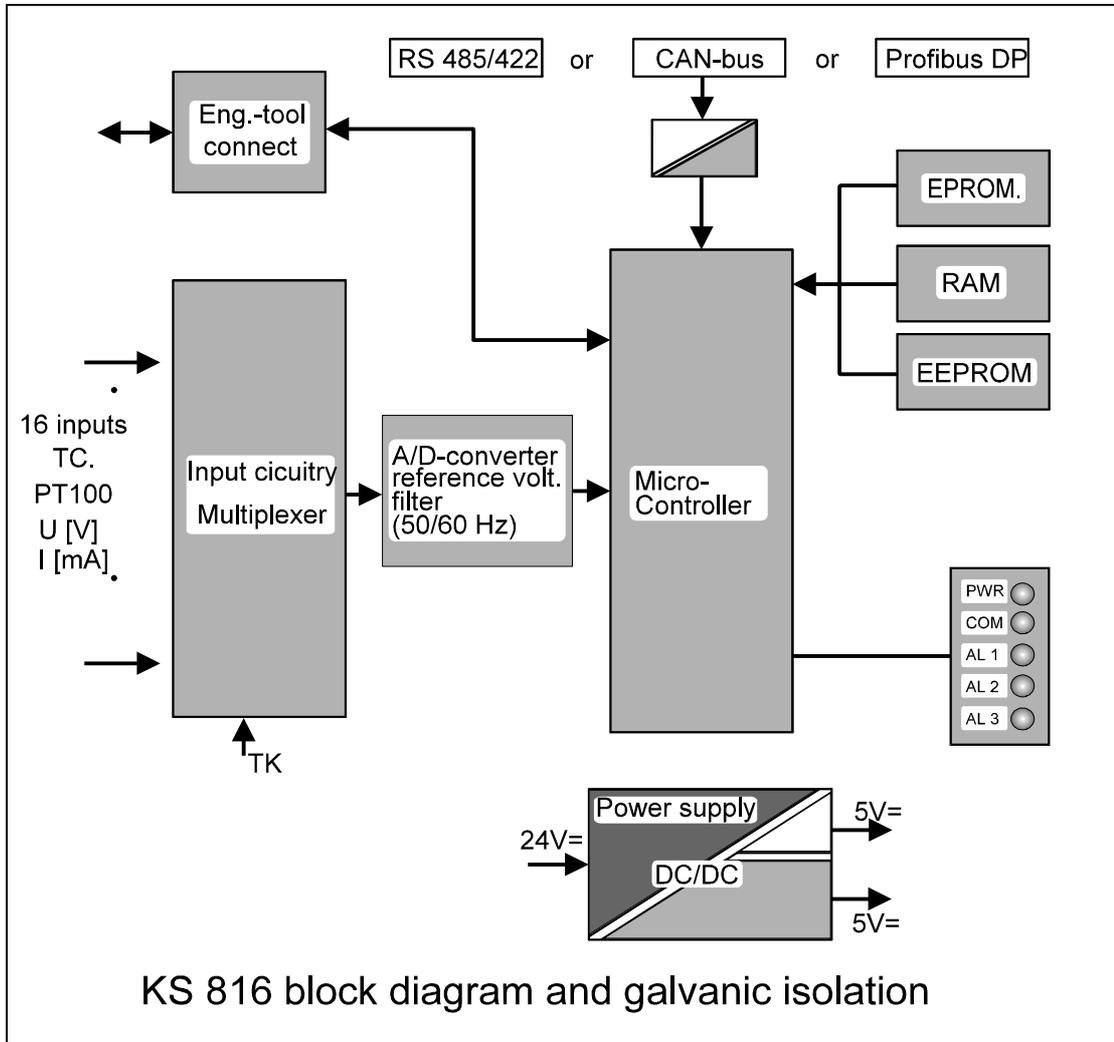
Spring-clamp terminal 5 x connector strip CAGE CLAMP connection
WAGO-order-no. 231-318/026-000
PMA-order-no. 9463 000 05341
1 x connector strip with CAGE CLAMP connection
WAGO-order-no. 231-308/026-000
PMA-order-no. 9463 000 05321

Connecting capacity only one conductor: 0,08 - 2,5 mm², single-wire,
multi-wire, fine wire,
end crimp, cable shoe

4.2

Galvanic isolations

The KS 816 galvanic isolations are shown below:
 Identical block shading means that the blocks are galvanically connected. (All inputs are galvanically connected.)



4.3 Power supply

KS 816 is designed for 24V DC nominal supply voltage, range 18V to 30V, 5% ripple. The supply voltage must meet the conditions for protective low voltage (SELV) to CEI 364-4-41 [VDE 0100-410].

Power supply load by one KS 816: approx. 5 W

Energization is via terminals 7 (+) and 8 (-) of connector X3.

4.4 Fuses

Each unit must be protected with a separate 2A slow-blowing fuse (fitted in the terminal). We recommend using terminals with built-in fuses.

Unless LED "PWR" is lit with the supply voltage applied (check fuse and polarity), the unit is defective and must be returned to the manufacturer.

5 Inputs

(The complete KS 816 connecting diagram is given in section 7.).

Illustrations with connecting examples are given in section 5.6.

For all inputs, the following rules are applicable:

Unused inputs must be short-circuited!

Thermocouples and DC voltage:

Terminal + and - of an input must be connected.

Resistance thermometer:

Configure unused controllers as for thermocouples or voltage. Shortcircuit the + and - terminal of an input.

The inputs of channel 1...16 are the process value inputs of individual channels and can be configured for thermocouple, resistance thermometer or voltage. Within an instrument, "mixed operation" of inputs is possible. Accordingly, each individual channel can be configured freely for controller (continuous, 2- or 3-wire) or for transmitter (0...20mA or 4...20mA) operation.

5.1 Thermocouple inputs (IN1+/IN1- ... IN16+/IN16-)

The following thermocouple types to DIN/EN 60584 can be connected:

Thermocouple type	Old description	Colour neg. wire	Range
L	Fe/Cu-Ni (IEC)	violet	0... 900°C
J	Fe/Cu-Ni (DIN)	black	0... 900°C
K	Ni-Cr/Ni	green	0...1350°C
N	Nicrosil/Nisil	pink	0...1300°C
S	Pt-10Rh/Pt	orange	0...1760°C
R	Pt-13Rh/Pt	white	0...1760°C
T	Cu/Cu-Ni	brown	0... 400°C
W *)	W5Re/w26Re	not defined	0...2300°C
E	Ni-Cr/Cu-Ni	violet	0...1000°C

*) not to DIN/EN

The upper measuring limit of KS 816 is defined by the upper temperature limit of the thermocouple type. The thermocouples are monitored for wrong polarity and break. The action can be configured (upscale/downscale).

All thermocouples must be connected with correct polarity to terminals INx+ and INx-.

With thermocouples to DIN 43710, the plus arm is red and the minus arm corresponds to the thermocouple colour.

Acc. to DIN/IEC 584, the plus arm has the colour of the thermocouple type and the minus arm is white.

Connections INxPt remain free.

The controller inputs are not galvanically isolated. Therefore, thermocouple measurements above approx. 700°C and unsuitable thermocouples imply a risk of measurement errors.

This effect is due to the fact that the isolation value between protective tube and thermocouple, dependent of construction type and insulation material, decreases to values of some kOhm from these values. Additionally, ionization of hot gases can cause potential differences between the thermocouples, which can cause measurement errors or trouble due to compensating currents.

For the same reason, there may be problems when using mixed grounded and insulated thermocouples.

The max. permissible potential difference between thermocouples is $7V_{pp}$.

We urgently recommend to avoid using mixed thermocouples.

If using grounded and insulated thermocouples in an installation should be unavoidable due to other reasons, the negative arm of the insulated thermocouple must be grounded at KS 816.

Already grounded thermocouples must not be grounded for a second time!

When replacing insulated thermocouples by non-insulated ones, removing the ground connection of the negative arm at KS 816 is indispensable.

5.1.1 Cold junction temperature compensation

The four possibilities of temperature compensation are:

1. The temperature compensation is ineffective (for PT 100- or U/I inputs)
2. Internal temperature compensation. Compensating lead is used up to the KS 816.
3. External temperature compensation. Compensating lead is used only up to the cold junction reference, the lead between reference and KS 816 can be of copper
4. Cold junction reference remote measurement. Input IN16 can be configured so that it operates as input of the temperature sensor of a remote cold junction reference.

The thermocouples of the individual channels are taken up to a common reference by means of compensating leads. The lead between reference and KS 816 can be of copper. The 16th input is used for measuring the reference temperature and for correcting the input voltage accordingly. Because of the measuring accuracy, the sensor should be a resistance thermometer. When using this temperature compensation method in an installation with several KS 816 units, this method must be used for each individual unit.

5.2 Direct voltage

5.2.1 Range :-100mV...+100mV IN1T+...IN16T+

Direct voltages up to 100 mV can be connected instead of the thermocouples. These values can be scaled via corresponding software settings. The input resistance is approx. 100 kOhm.

5.2.2 Range : -10V...+10V IN1U+...IN16U+

Inputs INxU+ are provided for direct voltages within -10V and +10V. These values can be scaled via corresponding software settings. The input resistance is approx. 100kOhm.

5.3 Resistance thermometer (IN1+/IN1-/IPT1 ... IN16+/IN16-/IPT16)

Pt 100, 2 or 3-wire connection

Type PT 100 resistance thermometers acc. to DIN/IEC 751 can be connected in 2 or 3 wire circuit.

The max. measuring range is -100,0 ... 850,0°C, temperature-linear.

3-wire connection is possible without lead resistance adjustment, provided that the cross-section of individual wires is equal.

With 2-wire connection, a calibrating resistor corresponding to the lead resistance must be included. (If possible, 2-wire connection should not be used.)

The sensor is monitored for short circuit or break.

The action (upscale/downscale) is configurable.

5.4 0/4...20mA standard current signal (IN1+...IN16-)

For 0/4...20mA standard current signal. The values can be scaled via corresponding software settings.

The input resistance is 5 Ohm, i.e. the voltage requirement is 100 mV.

When operating KS 816 with current inputs, interlock diodes at the terminals must be provided so that the current is not cut off when removing the terminals.

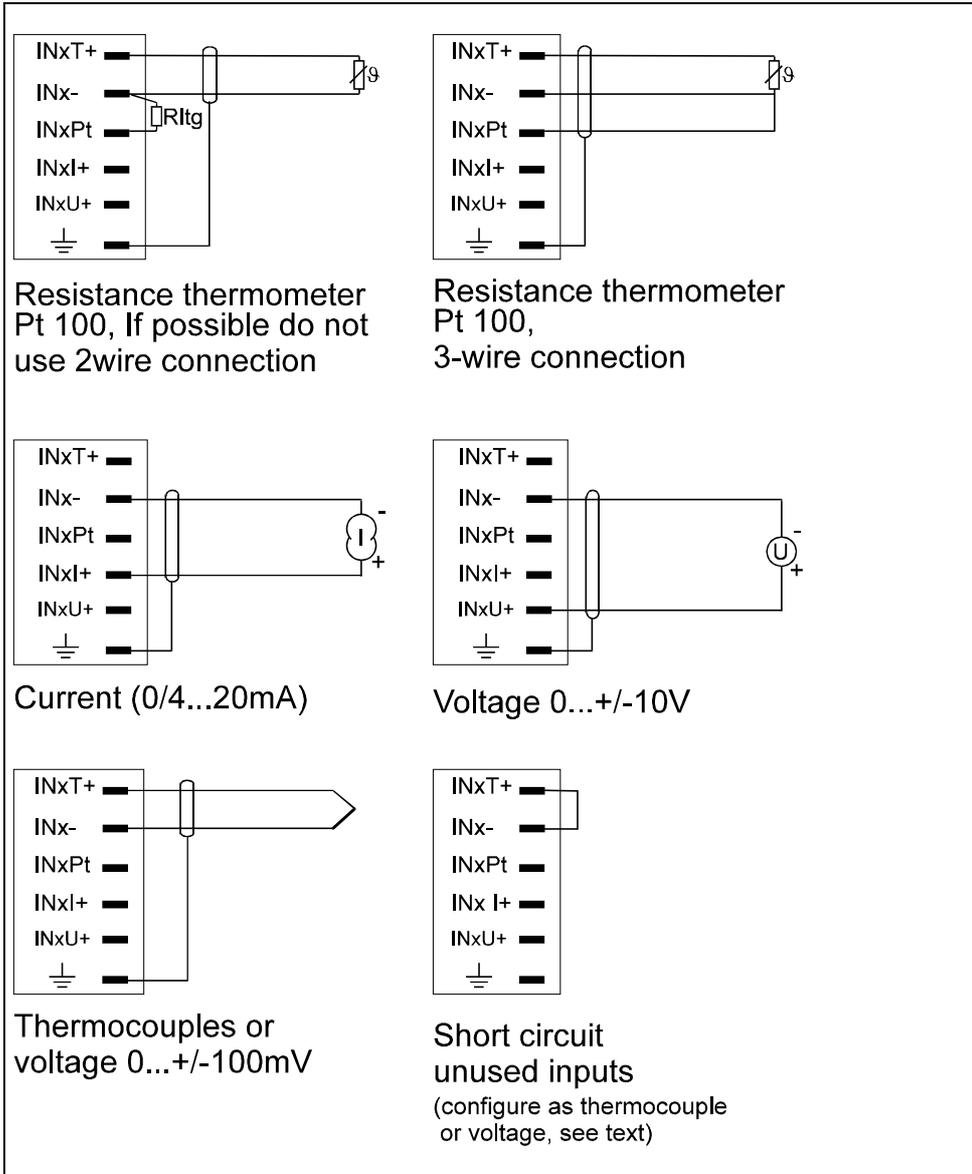
5.5 Screening of input leads

With long leads and/or considerable interference, we recommend using screened connecting leads. The two methods for connecting the screening are:

1. Each input is provided with a grounded connection to which the screening of the incoming cable must be connected. These interconnected screenings must be connected with ground potential (protective earth) via one of the ground terminals by means of a short cable (approx. 20 cm).
2. Use of a commercially available connecting system.

5.6

Input circuit examples



6 Outputs

KS 816 has no outputs in the conventional sense. These are output via the (field) bus as

- correcting variable in %, for continuous controllers and
- digital information (on/off) for switching controllers

Control of the final elements (relays, contactors, solid-state relays, magnetic valves) must be provided by a suitable output card of the control system.

6.1 Operation as a transmitter

Each KS 816 channel can be configured as a transmitter. This can be done only via software, by means of the engineering tool, or via the bus by means of the control system. The controller function is switched off and only the (corrected) process value is transmitted via the bus. The 4 limit values for each channel can be activated also in the transmitter function. Conversion into (0...10V; 0/4...20mA) standard signal must be provided in the control system.

When using as a transmitter, the following information must be taken into account: As the KS 816 scanning interval is approx. 1 s, the measurement values are also updated only at intervals of one second.

KS 816 is not suitable for applications in which the measured value must be updated continuously, e.g. pressure measurement with peak value detection.

6.2 Alarm function

The alarms are also output via the (field) bus:

Process value alarm (absolute process value monitoring)

Control deviation (process value - set-point)

Correcting variable

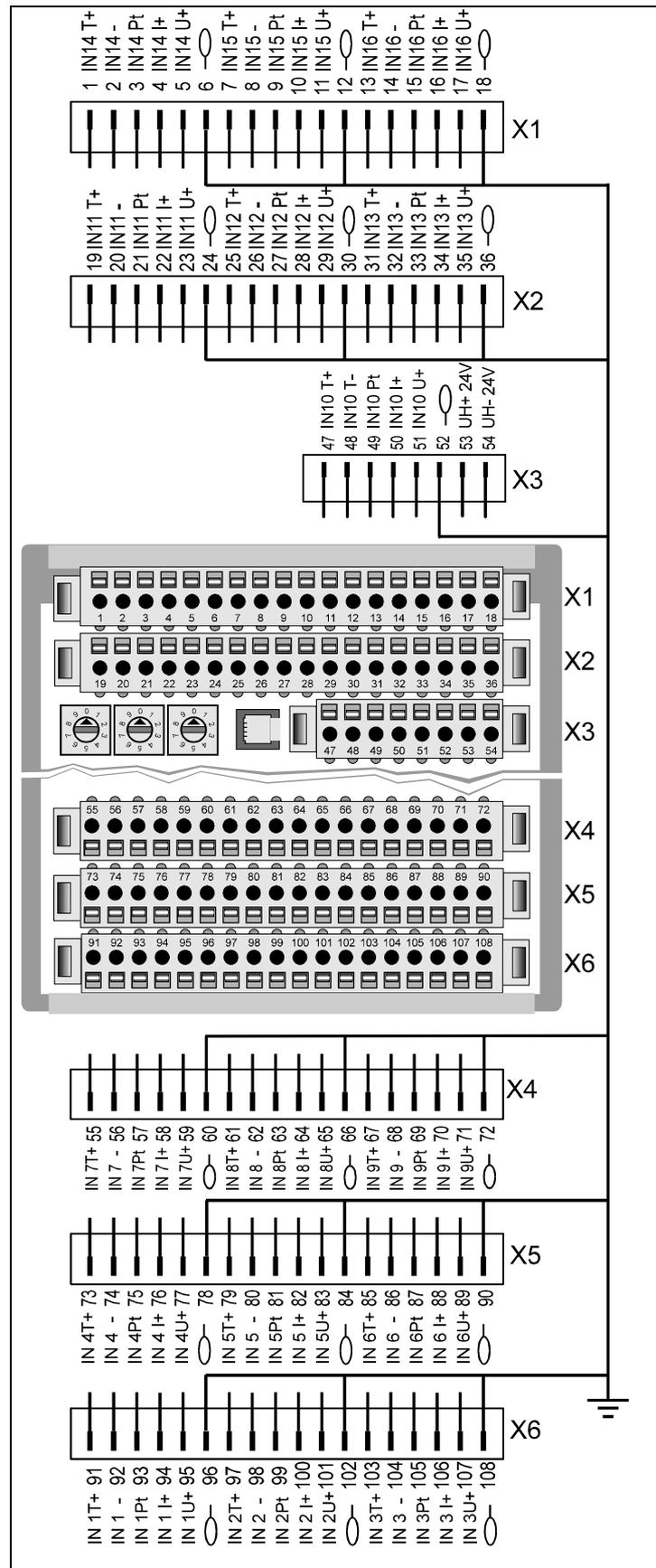
Set-point

Limit values

4 limit values can be adjusted for each of the 16 channels: 2 low alarms and 2 high alarms

7

Overall connecting diagram KS 816



8 Digital interfaces

The only possibility to communicate with controller KS 816 is via the digital interfaces. Process value read out as well as set-point or control parameter changing are via these interfaces.

The two interface types are:

8.1 Engineering tool interface

The PC interface is provided on all instrument versions. It is a special interface according to the ISO 1745 protocol. The relevant software, i.e. the engineering tool, provides access to all controller values.

E.g. for uncomplicated applications or tests, configuring an individual unit and operating the control loops normally are possible via this interface.

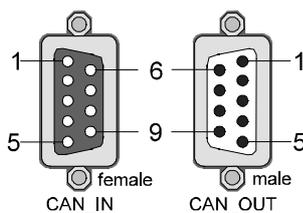
Connection is at the 4/4 FCC68 data connector (Western telephone connector) via a special PC adaptor, order no. 9407 998 00001.

8.2 BUS interfaces

This interface is used for connecting the KS 816 to a PLC, a PC or a visualization unit. Dependent of instrument version, it is used for CANbus, Profibus or as RS 422/485 (see section 2.1).

The 9-pole sub-D connector and the socket are equivalent. They are used for "making a loop" through the bus with several connected units.

8.2.1 BUS connector

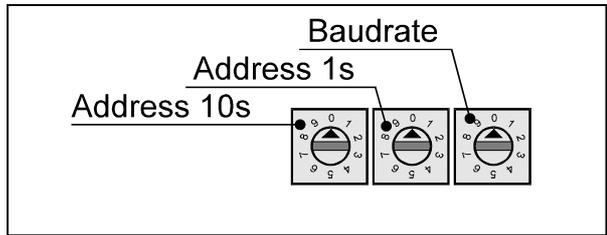


Connector sockets and pins with identical name are connected.
n.c.: Do not use these contacts!

Pin allocation			
Contact	Profibus	Canbus	Rs422/485
1	n.c.	n.c.	n.c.
2	n.c.	CAN-L	GND
3	RxD/TxD-P	CAN-GND	TXD-B
4	n.c.	n.c.	RXD-B
5	DGND	n.c.	RGND
6	VP (+5V)	CAN-GND	n.c.
7	n.c.	CAN-H	GND
8	RxD/TxD-N	n.c.	TXD-A.
9	n.c.	n.c.	RXD-A

8.3 COM2 interface

Address and Baudrate for the COM2 interface can be adjusted via hardware or software for each KS 800.



Via hardware, the **address** is adjustable within "01" and "99". In position "00", the address stored in EEPROM which can be changed via software will be used when switching on. Priority is given to the address adjusted via switch position. This address cannot be changed via software.

The same applies to the **Baudrate**: in Position "0", the EEPROM Baudrate is effective at first. This address can be changed via software. The digits on the switch correspond to the values used for determination of the Baudrate during configuration in C902.

Switch position	RS485	CANbus
0	from EEPROM or via software	from EEPROM or via software
1	2400 Bd	20 kBd
2	4800 Bd	125 kBd
3	9600 Bd	500 kBd
4	19200 Bd	1 Mbd
5	invalid setting	10 kBd
6	invalid setting	50 kBd
7	invalid setting	250 kBd
8	invalid setting	800 kBd
9	invalid setting	invalid setting

As the baudrate is adjusted automatically with the PROFIBUS DP-version, manual adjustment is omitted.

8.4

Termination resistors

All KS 816 versions are delivered without termination resistors at the bus connections.

The resistors required for each bus must be added externally at the last unit on both ends of the bus cable: either in the last connector (socket) or in a separate termination connector (socket), which plugs into the free bus connection of the last unit.

CAN-BUS: 9-pole sub-D socket with termination resistor. Only termination resistor, not suitable for connecting a cable. PMA order no. 9407 800 90021

PROFIBUS: e.g. Siemens, bus connector, types: 6ES7972-OBB10-OXAO or 6ES7972-OBB20-OXAO, or 6GK1 500-OEAOO. This connector is not available from PMA.

The standards or standard drafts valid for the relevant bus system are applicable.

9 Indicator LEDs

There are 5 LEDs with the following signification above the lower input terminals:

PWR

This LED is on with the supply voltage applied.

COM

With **CAN_BUS** and **RS422/485**, this LED indicates data transmission between KS 816 and control system (PC or visualization) by flashing.

With **PROFIBUS**, the 4 different statuses are:

LED off: error signalling for "no bus access" (not addressed by the master)

LED on: OK cyclic data transmission running.

LED blinks: (2Hz) data transmission interrupted.

LED blinks: (4Hz) PROFIBUS parameters or configuration error.

AL1...AL3

With KS 816 configured so that it provides alarm functions, these LEDs are lit, when the relevant alarm is pending.

10 Maintenance and behaviour in case of failure

KS 816 requires no special maintenance and does not contain parts which require preventive maintenance or care.

10.1 Cleaning

If necessary, the aluminium and plastics parts must be cleaned carefully with spirit. Do not use agents which contain solvents or scouring powder.

10.2 Trouble-shooting

To start with, all possibilities of error in other equipment and connections (input leads, cables, equipment connected in the output circuit) should be examined. If the error cannot be located with the hints given in this section, we recommend returning the unit to the manufacturer.

PMA Prozeß- und Maschinen- Automation GmbH
Service Department
Miramstraße 87

If the trouble is due to failure of a fuse, the cause must be determined and removed. The spare fuse must be of the same rating as the original type. If the PWR LED is not lit despite correct supply voltage polarity, KS 816 is defective and must be returned to the manufacturer for repair.

Before disconnecting the unit, switch off the power supply of the installation and check that other equipment in the installation is not affected.

WARNING!
When safe operation seems not possible any more, shut down the unit and protect it against accidental switch-on.

For dismantling the unit, see section 3.2



UL-Zulassung

Damit das Gerät die Anforderungen der UL-Zulassung erfüllt, sind folgende Punkte zu beachten:

- Nur Leiter aus 60 / 75 oder 75°C Kupfer (Cu) verwenden..
- Die Klemmschrauben sind mit einem Drehmoment von 0,5 - 0,6 Nm anzuziehen.

UL certification

For compliance with UL certificate, the following information must be taken into account:

- Use only 60 / 75 or 75°C copper (Cu) wire.
- Tighten the terminal-screws with a torque of 0,5 - 0,6 Nm

