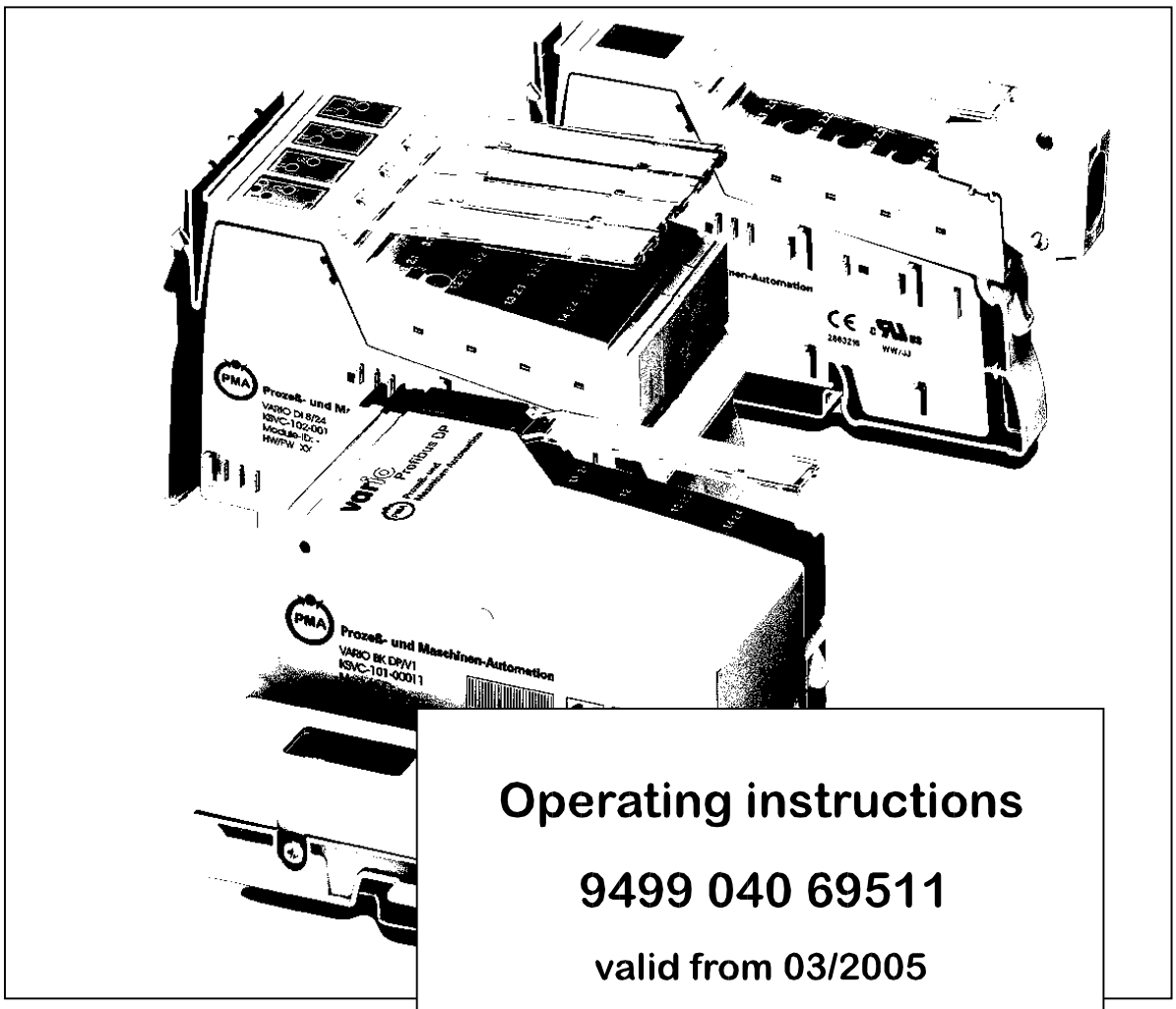
PMA Prozeß- und Maschinen-Automation GmbH

Modular controller system

KS vario



Operating instructions

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General notes

For safe operation of the instrument, read this operating manual carefully and follow the instructions.

The instructions for product operation and handling given below are intended exclusively for authorized electricians or personnel instructed by electricians, who are familiar with the applicable national standards. PMA GmbH liability for damage in case of faulty handling and resulting damage of PMA products and third-party products due to failure to comply with the information of this operating manual is precluded.

Symbol ***Caution*** relates to actions which may result in damage to the hardware or software, or in personnel injury (indirectly connected with dangerous peripheral process instrumentation).

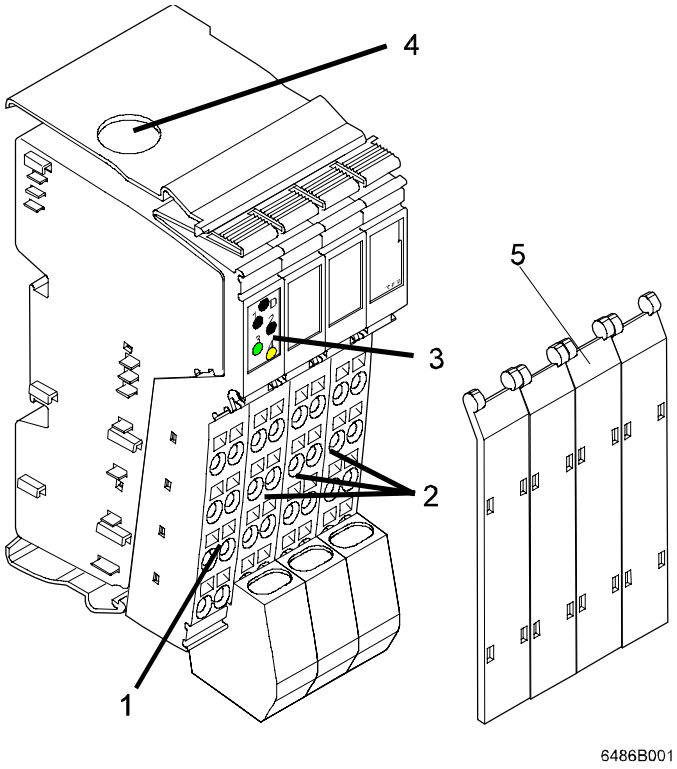
Symbol ***Note*** refers to conditions which have to be met under all circumstances for correct operation. Moreover, the symbol points to tips and advices for efficient instrument operation and software optimization.

Symbol ***Text*** refers to further, more detailed sources of information (manuals, data sheets, literature, etc. on the relevant subject, product, etc.

1 Introduction

KS VARIO is a freely configurable and parameterizable multi-channel controller system. It works in conjunction with the commercially available field bus systems - Ethernet, Profibus DP, CANopen and Modbus - via a bus coupler.

The controller system is provided with a separate RS232 interface for communication with a PC on which the "BlueControl" engineering tool is installed. Internal communication between bus coupler and controller or extension modules is via the internal bus.



KS VARIO module (controller)

1. Output terminal strip
2. Input terminal strip
3. Diagnosis and status indicator LEDs
4. RS232 interface for engineering tool
5. Labeling field

2 Instrument versions

2.1 KS VARIO basic module

These modules are complete controller modules with inputs, outputs and all controller functions.

The following KS VARIO basic module (controller) versions are available:

Type	Order no.	Numb. of		Inputs
		inp.	outp.	
Max. 4 controllers/module				
KS VARIO T4/RTD	KSVC-104-X0331 *)	4	6	Resistance thermometer Pt 100 to DIN IEC 751
KS VARIO T4/UTH	KSVC-104-X0431 *)	4	8	Thermocouples, various
Max. 30 controllers/module				
KS VARIO T6/RTD	KSVC-104-X0341 *)	6	6	Resistance thermometer Pt 100 to DIN IEC 751
KS VARIO T8/UTH	KSVC-104-X0441 *)	8	8	Thermocouples, various

X: Dependent of bus coupler, which, in turn, is dependent of the field bus, X must be replaced by:

0: Modbus / Profibus
1: CANopen
2: Interbus / Ethernet

To increase the number of control channels or of outputs, these basic modules can be extended by:

2.2 **Combined input/output modules** (I/O modules)

These modules, which are provided for extension of the controller modules are equipped with inputs and outputs dependent of version, but not with an own controller or alarm function. These functions are handled by the controller module.

Type	Order no.	Number		Inputs
		Inp	Outp	
KS VARIO RTD 6-DO6	KSVC-103-00341	6	6	Resistance thermometer Pt 100 to DIN IEC 751
KS VARIO UTH 4-DO8	KSVC-103-00431	4	8	Thermocouples, various
KS VARIO UTH 8-DO8	KSVC-103-00441	8	8	Thermocouples, various

or by separate input and output modules (see next page).

2.3 Separate input and output modules

2.3.1 Analog input modules:

Various analog input modules for analog input extension are available. These modules have only inputs. They can be used for processes with standard input signals, or if the number of control channels require an extension (up to 30 control channels per KS VARIO). For output of variables (alarms, output variables...) derived from these input values, extra output modules (analog or digital) must be provided.

Type	Order no.	Number of inputs	Input data
VARIO AI 2/SF	KSVC-103-00121	2	0/4...20mA; 0...10V
VARIO AI 8/SF	KSVC-103-00141	8	0/4...20mA; 0...10V
VARIO RTD 2	KSVC-103-00321	2	Resistance thermometer Pt100
VARIO UTH 2	KSVC-103-00421	2	Thermocouples, various

2.3.2 Digital output modules:

For a higher number of controller outputs than provided in basic module or extension modules (e.g. when using 3-point controllers), or when using analog input modules, digital output modules can be used.

Type	Order no.	Number of outputs	Output data
VARIO DO 2/24	KSVC-102-00221	2	24V; 0,5A
VARIO DO 4/24	KSVC-102-00231	4	24V; 0,5A
VARIO DO 8/24	KSVC-102-00241	8	24V; 0,5A
VARIO DO 16/24	KSVC-102-00251	16	24V; 0,5A
VARIO DOR 1/W	KSVC-102-01211	1	Relais output 1 change-over cont. 250V AC, 3A

2.4 Analog controller outputs

For realization of continuous controllers, analog output modules are available:

Type	Order no.	Number of outputs	Output data
VARIO AO 1/SF	KSVC-103-00211	1	0/4...20mA; 0...10V
VARIO AO 2/U/BP	KSVC-103-00221	2	0...10V

2.5 Digital input modules

For control of individual controller functions via digital inputs, digital input modules can be used:

Type	Order no.	Number of inputs	Input data
VARIO DI 2/24	KSVC-102-00121	2	24V, $R_i \approx 4{,}5\ k\Omega$
VARIO DI 4/24	KSVC-102-00131	4	24V, $R_i \approx 4{,}5\ k\Omega$
VARIO DI 8/24	KSVC-102-00141	8	24V, $R_i \approx 4{,}5\ k\Omega$
VARIO DI 16/24	KSVC-102-00151	16	24V, $R_i \approx 4{,}5\ k\Omega$

All modules can be connected in any reasonable combination.

Detailed technical data are given in the relevant data sheet.

The terminals of the various digital input modules listed in the following table have a direct connection with the segment voltage U_S (24V=).

Type	Terminals, which are connected with U_s
VARIO DI 2/24	1.2; 2.2
VARIO DI 4/24	1.2; 2.2; 1.5; 2.5
VARIO DI 8/24	1.2; 2.2; 3.2; 4.2; 5.2; 6.2; 7.2; 8.2
VARIO DI 16/24	1.2; 2.2; 3.2; 4.2; 5.2; 6.2; 7.2; 8.2 1.5; 2.5; 3.5; 4.5; 5.5; 6.5; 7.5; 8.5

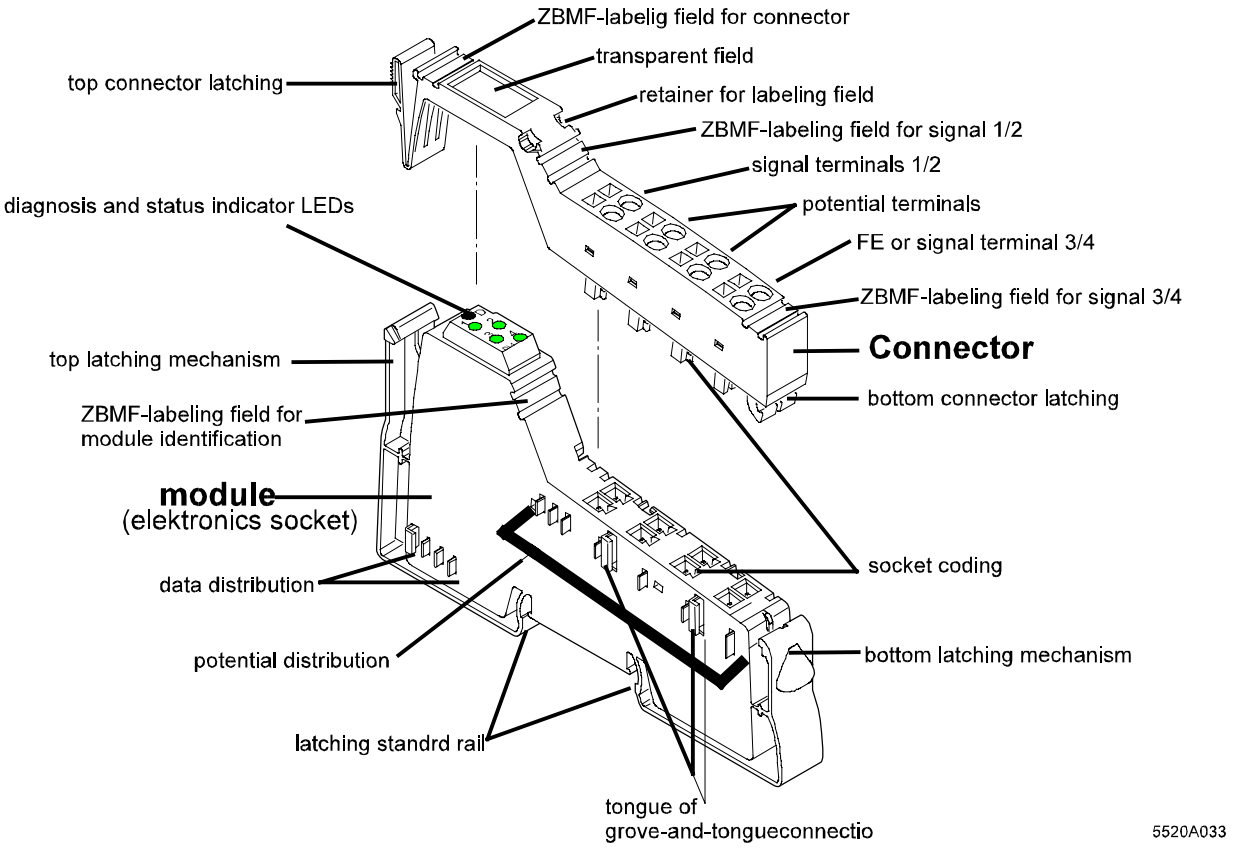
They must be used only for energization of the sensors (limit switches, light barriers, ind. proximity sensors, etc.) connected to this module.

Never use them for connection of the segment voltage.

3 KS VARIO module construction and dimensions

3.1 Construction principle

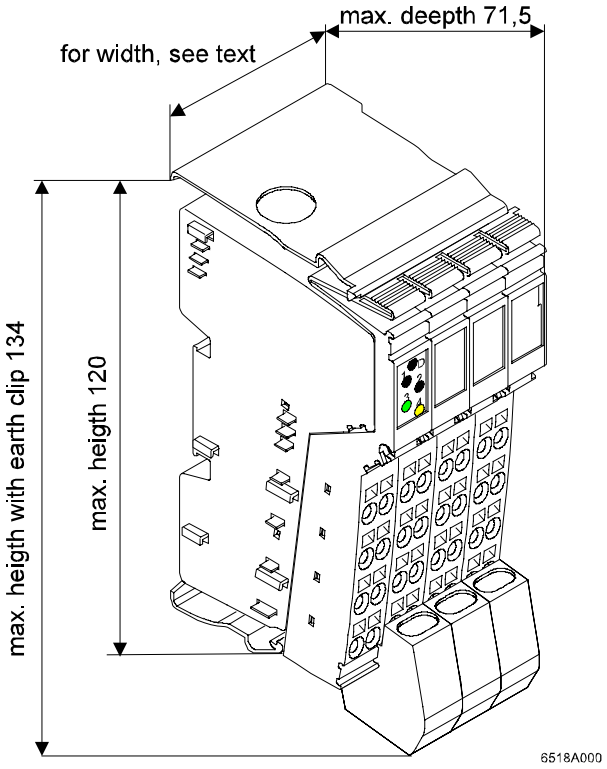
Independent of function and width, a KS VARIO module comprises the basic part (main electronics socket) and the plug-in connector.



Construction principle and component description of a KS VARIO module

3.2 KS VARIO module dimensions

The VARIO module dimensions are given in the following drawing.



KS VARIO module dimensions

3.2.1 Module width

The VARIO module width is 12,2mm; 24,4mm; and 48,8mm.
The width of a bus coupler is 90,5mm.

The width of an overall controller system is determined by the overall width of all components plus a 2,5 mm end piece and two 14 mm locking clamps.

3.2.2 Connector width

Independent of the basic part width, the width of the connector parts is 2 terminals. Accordingly, a basic part with 2 slots accommodates 1 connector, a basic part with 4 slots accommodates 2 connectors and a basic part with 8 slots accommodates 3 connectors.

3.2.3 Connector colour coding

The connectors are marked by different colours:

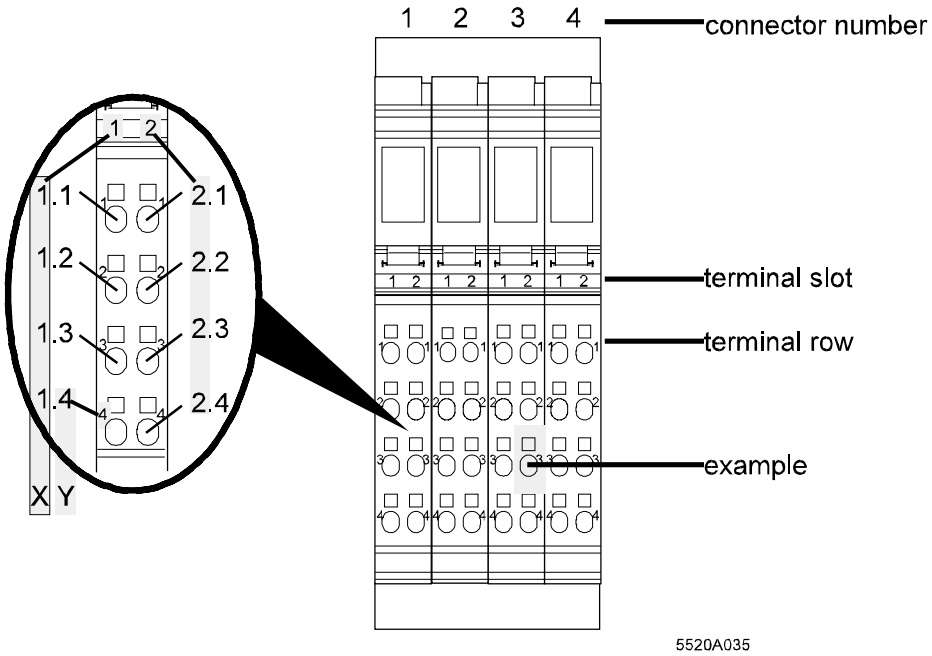
grey	signal connectors (KS VARIO module input and output signals)
black	power supply connector (Common feed terminal blocks)

In the black supply voltage connectors, the horizontal contacts are connected firmly as follows: 1.2 to 2.2; 1.3 to 2.3; 1.4 to 2.4

3.2.4 Terminal numbering

The connector numbers (sockets) on a module are provided with consecutive numbering from left to right. This connector numbering is not marked on the modules.

On each connector, the terminal points are marked with X.Y, whereby X indicates the terminal slot (1 or 2) and Y is the terminal row (1...4).



Terminal numbering

I.e. the exact description of a terminal is determined by slot and terminal point. I.e., for the connection shown in the figure, the numbering is: socket 3, terminal slot 2, terminal row 3 -> 3.2.3.

3.3 Steckerbelegung

3.3.1 Thermocouple inputs

KS VARIO T8 UTH und KS VARIO T4 UTH

Socket 1		Socket 2		Socket 3		Socket 4	
Terminal slot		Terminal slot		Terminal slot		Terminal slot	
1	2	1	2	1	2	1	2
outp. 1+	outp. 2+	Th.cpl.1+	Th.cpl.1-	Th.cpl.4+	Th.cpl.4-	Th.cpl.7+	Th.cpl.7-
outp. 3+	outp. 4+	Th.cpl.2+	Th.cpl.2-	Th.cpl.5+	Th.cpl.5-	Th.cpl.8+	Th.cpl.8-
outp. 5+	outp. 6+	Th.cpl.3+	Th.cpl. 3-	Th.cpl.6+	Th.cpl.6-	HC-IN 1	HC-IN 2
outp. 7+	outp. 8+	Screen	Screen	Screen	Screen	Screen	Screen

Terminals Th. El. 5 to Th. El. 8 are not connected on instrument KS VARIO T4 UTH. These terminals must not be used as "auxiliary connecting points".

3.3.2 Kind of Thermocouples

The following typs of thermocouples can be used with the KS VARIO

Th. couple typ	former description	Ident colour sheat/pos. lead	Range
L	Fe/Cu-Ni	violet	-100... 900°C
J	Fe/Cu-Ni	black	-100...1200°C
K	Ni-Cr/Ni	green	-100...1350°C
N	Nicrosil/Nisil	pink	-100...1300°C
S	Pt-10/Rh/Pt	orange	0...1760°C
R	Pt-13Rh/Pt	orange	0...1760°C
T	Cu/Cu-Ni	brown	-200....400°C
E	Ni-Cr/Cu-Ni	violet	-100...1000°C
B	Pt30Rht6Rh	grey	400...1820°C
C	W5Re/W26Re	not defined	0...2400°C
D	W3Re/W25Re	not defined	0...2320°C

The upper measurement limit of KS VARIO is the span end of the relevant thermocouple type.

The thermocouples are monitored for wrong polarity and break. Upscale/downscale output action is configurable.

Connect all thermocouples to the relevant channel terminals with correct polarity.

According to DIN/IEC 584, the colour of plus wire and sheath mark the thermocouple type, the minus wire is white.

3.3.3 Compensating leads

When using the internal temperature compensation, which requires continuation of the compensating lead up to KS VARIO, there can be an additional error:

Due to the type of sensor break detection used in KS VARIO, a current of approx. 1µA from the plus terminal via the compensating lead and the thermocouple to the instrument minus terminal is required. In conjunction with long leads, thin wire cross sections and high loop resistance of some compensating leads, there is a resulting voltage drop which is added to the actual theroelectric voltage. I.e. a higher temperature is measured. This additional error can be reduced by using compensating lead of higher cross section, or by using an external temperature compensation, or completely eliminated by determination of the cold-junction reference temperature via a KS VARIO channel.

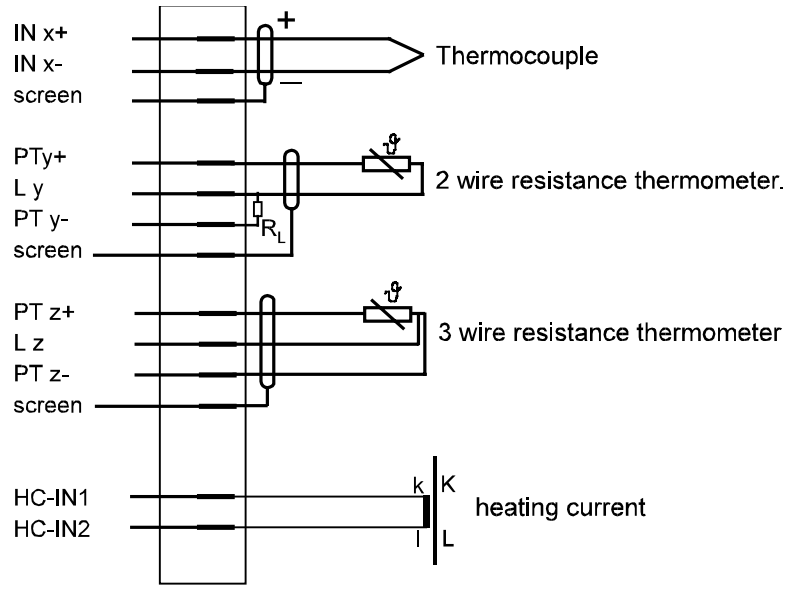
3.3.4 Resistance Thermometer

KS VARIO T4 RTD und KS VARIO T6 RTD

Socket 1		Socket 2		Socket 3		Socket 4	
Terminal slot		Terminal slot		Terminal slot		Terminal slot	
1	2	1	2	1	2	1	2
outp. 1+	outp. 2+	PT 1+	PT 2+	PT 3+	PT 4+	PT 5 +	PT 6+
outp. 3+	outp. 4+	L 1	L 2	L 3	L 4	L 5	L 6
outp. 5+	outp. 6+	PT 1-	PT 2-	PT 3-	PT 4-	PT 5-	PT 6-
HC-IN1	HC-IN2	Screen	Screen	Screen	Screen	Screen	Screen

Terminals PT 5 to PT 6 and L 5 to L6 are not connected on instrument KS VARIO T4 RTD. These terminals must not be used as "auxiliary connecting points".

3.3.5 Input circuit examples



x, y, z: The respective channell number 1...6, or 1...8 inbeisp.cdr

3.3.6 Unused inputs

Unused inputs if individual moduls must be terminated as follows:

Thermocouples (all versions): short circuit INx+ and INx-

Direct voltage (all versions): no termination required

Direct current (all versios): No termination required

Resistance thermometer: connect a spare resistor corresponding (approx.) to the span start across PT x+ and L x, and a link between L x and PT x.

Heating current: no termination required

3.4 Outputs

Detailed data are given in the data sheets.

3.4.1 Switching outputs

The specification of all switching outputs of KS VARIO modules is:

Transistor outputs (open collector),

Output voltage: 24V DC, positive switching (for loads with common minus connection)

voltage drop at full load: typ. 0,3V; max. 1V

max. output current rating: 70 mA; short circuit proof

3.4.2 Voltage outputs

Resolution: 2,667 mV

Output load: min. 2 kΩ

Risetime: approx. 0,24 V/µs (for 90%)

Basic error: ±0,02% (typ.)

Overall tolerance offset + gain + linearity + drift error: ±0,16%

3.4.3 Current outputs

Resolution:	0,305µA	
Max. output load:	500 Ω	
Rise time:	2 mA/µs	
Basic error:	±0,15%	
Overall tolerance	offset + gain + linearity + drift error:	±0,30%

3.4.4 Relay outputs

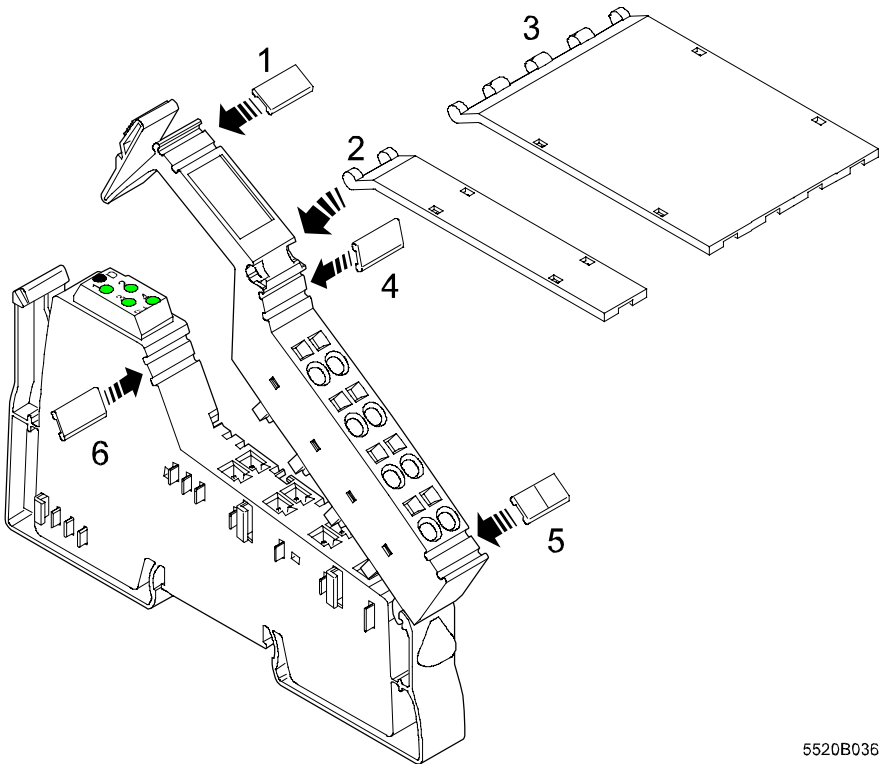
Contact type: change-over

Contact:	$AgSnO_2$, hard gold plated
Contact rating:	253 V AC, 250 V DC, max.
Switching current:	3 A max.

When using this relay module as a "calibrating relay" for a strain gauge pressure sensor, this relay must not have been used for switching other loads previously because of the risk of an increased contact resistor instability or resistance due to switching.

3.5 Inscription

In addition to the terminal imprint, sockets and terminal points can be provided with labeling fields.



Inscription facilities

Various types of module, socket and terminal inscriptions are possible:

1 Each connector can be fitted with incriptions on a zack marker.

2/3 Optionally, a large, transparent labeling field can be used. This labeling field is available in 2 widths:
for one connector (2)
for four connectors (3)

Mark the module or connector in plain text on a paper strip and insert the strip into grooves behind the labeling field.

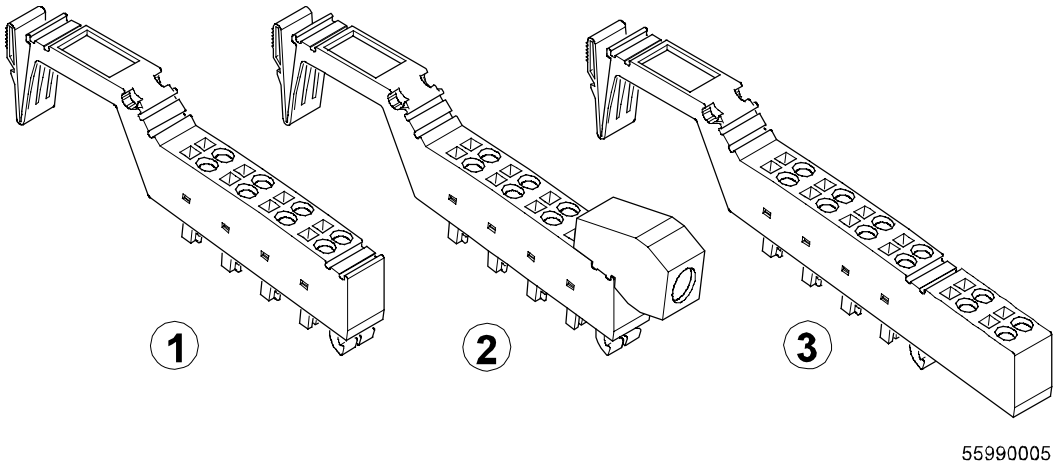
The components required for inscription are listed in a Phoenix component catalogue entitled "CLIPLINE".

4/5 Possible signal inscriptions: 4 is provided for signals 1/2 and 5 is provided for signals 3/4.

6 Possible inscriptions for the module itself. With the connector fitted, this inscription is covered.

3.6 Connectors

The following connector versions are used:



Connector versions

1. Standard connector

Use the grey standard connector for connecting analog output signals or digital input and output signals.

The black standard connector is provided for energizing the power supply modules.

2. Screened connector

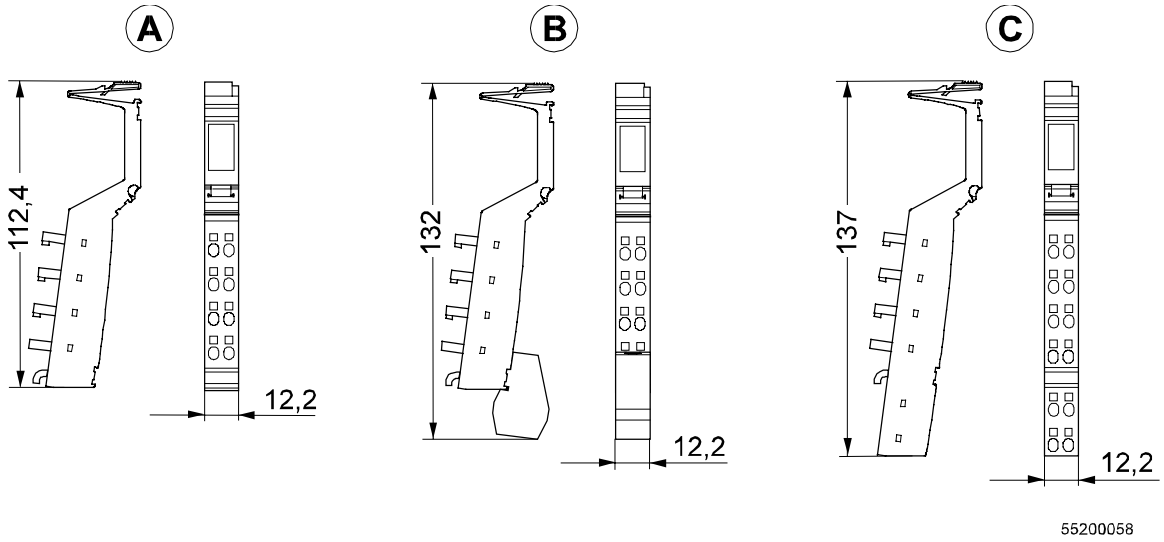
This grey connector is used for signals connected via screened leads (analog input signals, remote bus cables...). The lead screening is connected to functional earth via the screening terminal.

A free, external screening terminal system can also be used instead of these integrated screening terminals.

3. Extended double signal connector

This grey connector is used for connection of four signals in 3-wire technology (e.g. digital input and output signals).

3.6.1 Connector dimensions



4 Mounting/dismounting and connecting VARIO modules

4.1 Mounting instructions

4.1.1 Unpacking the modules

ESD hints

To protect the modules against electrostatic discharge, the operating personnel have to discharge themselves electrostatically before unpacking and packing, opening switchboxes and control cabinets, and before touching the terminals.

Unpacking

The modules are delivered in an ESD-protective box containing a supplement with hints for installation, which should be read carefully.

Unpacking, packing, mounting and dismounting may be done only by qualified personnel. The hints for protection against ESD must be followed.

4.2 General information on mounting/dismounting

Never do any mounting and dismounting work, when the supply voltage is connected!

Before removing a module from the station or before inserting a module into the station, disconnect the complete station from the supply voltage! Re-connect the voltage only after building up the complete station.

Place of installation The KS-VARIO modules have protection type IP 20, i.e. the modules are provided only for use in closed control cabinets or switch boxes (terminal boxes).

Mounting rail All KS-VARIO modules are mounted on a 35 mm standard rail. For stability reasons, the distance between mounting screws on the rail should not exceed 200 mm.

Mounting is done at right angles to the standard rail, to ensure easy mounting and dismounting, also under difficult space conditions.

End plate Mechanical closure on the right side of a VARIO station is by an end plate. This plate is without electrical function. It protects the contacts of the station against contact and contamination. The end plate is packed with the bus coupler and need not be ordered separately. The left end of a station is always a bus station and doesn't require an end plate.

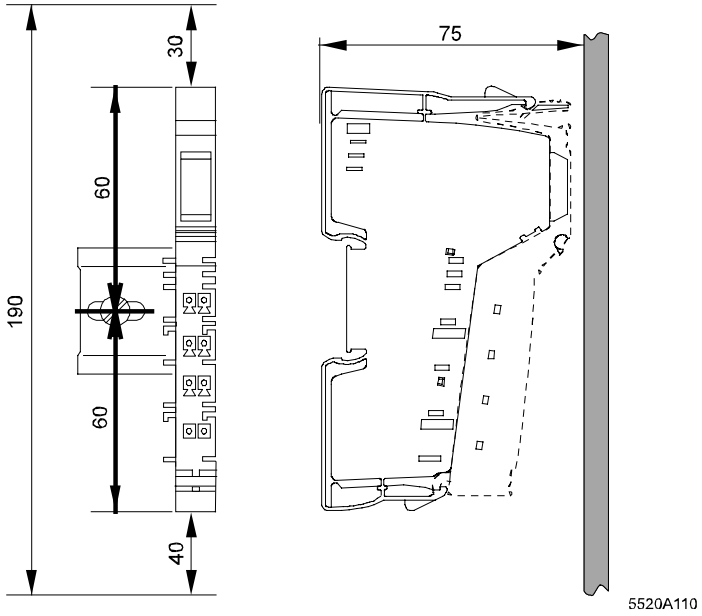
End lock For blocking a VARIO station correctly on the standard rail, end locks must be

provided on both sides of the VARIO station. These ensure correct locking of a VARIO station on the standard rail and serve as lateral blind elements.

E.g. end locks make Phoenix
CLIPFIX 35 (art. no. 30 22 21 8; package quantity: 50; for snap-on mounting without tool) or
E/UK (art. no. 12 Ol 44 2; quantity: 50; for mounting by means of screws) can be used.

Space requirement

For mounting and subsequent maintenance, a KS VARIO station requires the minimum distances shown in the drawing.



Space requirement for mounting

With lower distances, the minimum cable bending radius, installation handling and clarity are not ensured.

4.2.1 VARIO module order

When mounting, the modules within a VARIO station should be mounted in an order dependent of power consumption of the peripheral units from the potential distributor U_S.

As the voltage is fed into the potential distributor U_S at each power supply terminal, current determination always requires consideration of the section (main circuit) between bus module and the following power supply module, or between this power supply module and the following power supply module.
Unless a further power supply module is used, the overall station is a main circuit which is energized by the bus coupler.

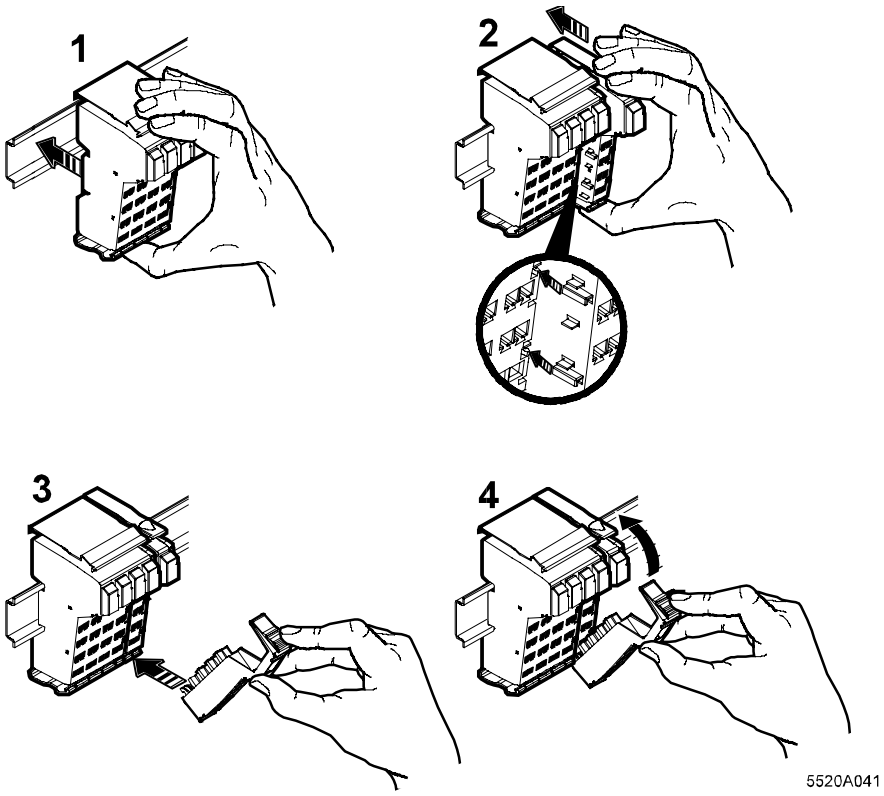
The bus coupler must be followed by controller module KS VARIO Tx/UTH, or KS VARIO Tx/RTD. Generally, the order of the following modules is uncritical. To avoid voltage drops in the following modules, however, these should be the digital output modules (higher current consumption due to the external load).

The analog input and output modules should be installed at the end of a VARIO system.

In very large systems, installation of a main circuit for the analog modules, separated by a power supply terminal, is purposeful.

The module power consumption is given in the BlueControl engineering tool used for KS VARIO, and in each module data sheet.

4.3 Mounting



Mounting a KS-VARIO module

At first, snap on the modules required to build up the station at right angles to the standard rail without connecting terminals (1).

Take care that all tongues and grooves of adjacent modules are intermeshing (2).

The adjacent modules are interconnected by grooves and tongues. This connection ensures safe potential distribution.

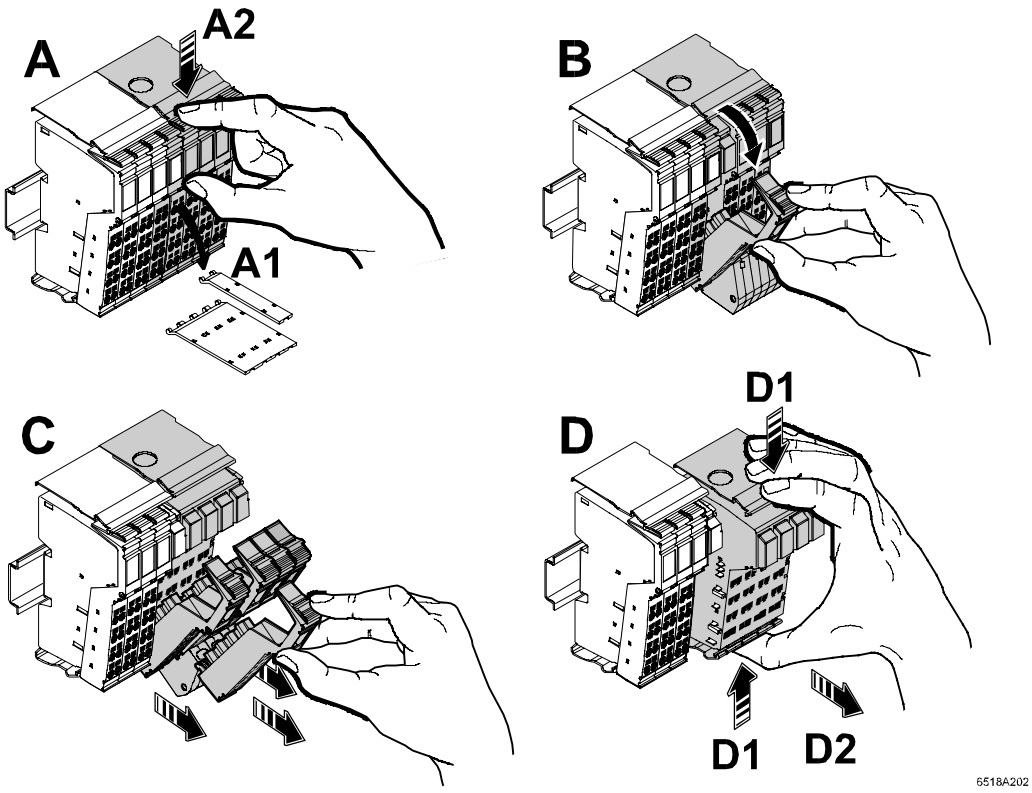
Now, plug the connectors into the relevant modules.

For this, insert the lower connector latch into the lower blocking mechanism (3).

Press the connector towards the module, until it clicks into the upper blocking mechanism (4).

The grooves in the module are not continued into the connector. To snap on a module, there must not be a connector right beside the module. A connector in this position must be removed.

4.4 Dismounting



Dismounting a KS VARIO module

Dismounting is done analogously, in reversed order. Mounting:

Remove any labeling fields, if fitted (A1). Remove all connectors from the module to be dismounted: Press on the upper connector latching to release the connector (A2) and tip the connector forwards (B). Now, lift the connector out of the lower connector latching (C). Remove the connector of the module left beside the module to be removed according to the same procedure. Press the upper and lower latching and withdraw the module at right angles to the standard rail. (D).

4.5 Replacing

Module replacement consists of the successive activities of dismounting and subsequent mounting. When mounting, take care that all grooves and tongues of adjacent modules are in meshing.

4.6 Electrical connections

The pin allocation of individual modules is given in the relevant data sheets.

4.6.1 Connection type/cable cross section

Connection type/ cable cross section	
Cable connection type for small signal and low voltage level	Spring clamps
Cable cross section (typical)	0,2...2,5mm² / AWG24 - 14 (massive or flexible with or without end crimps)
Permissible current load	max. 5A
Conductor extraction forces for 0,2mm² conductors for 1,5mm² conductors	 10 N 40 N

4.7 Earthing conception

Distinction of functional earth (FE) and protective earth (PE) in a VARIO station is made.

4.7.1 Functional earth (FE)

The functional earth improves the interference suppression. Alle bus units must be earthed, to keep data transmission free of interference, and interference grounding.
1,5 mm^2 stranded wire must be used for earthing.
The functional earth is a low-impedance current path between current circuits and earth, which is intended for improving the interference suppression rather than for protective purposes.

The functional earth FE is intended for grounding the interference rather than as a protective measure for persons.

The functional earth is taken from the grounded bus module or power supply module through the overall VARIO station via the potential distributor FE.

For reliable functional earthing of the station, various points must be taken into account.

A tongue on the bottom of bus and power supply modules provides an electrical connection to the standard rail. The standard rail is connected to protective earth by mounting and by means of the earthing terminals, whereby these terminals are also earthed.

To ensure a reliable functional earth contact also in case of contamination of the standard rail or contact damage, the bus module must be connected additionally via the FE terminal.

The other VARIO modules are grounded automatically via the potential distributor FE by clicking the modules into each other.

4.7.2 Screening concept

The screening serves to prevent interference effects on the system.

In the VARIO system, the remote bus cables and the connecting cables towards terminals for analog signals are screened.

The screening should be connected below the collar by means of the largest possible surface.

Ensure good contact of connector and module.

Don’t strip off more than 8mm of the wire insulation.

If possible, connect analog sensors and actuators using pairwisely twisted, screened leads. Screening connection is via the screening connector or via external screening terminals.

4.8 Connecting cables

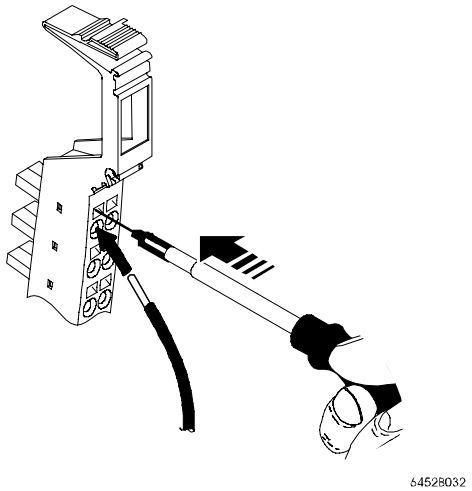
When using a VARIO station, screened and non-screened cables are used.

The cables for peripheral instruments, supply voltages and remote bus are connected via spring clamp terminals. Cross-sections within 0,2 mm^2 and 2,5 mm^2 (AWG 24 - 14) are possible.

The max. permissible length of sensor and actuator cables is 30m.

For the pin allocation, see the relevant data sheet.

4.8.1 Non-screened cables



Strip off 8 mm of the cable insulation.

Using cables without end crimps is provided. When using end crimps, these should be crimped safely.

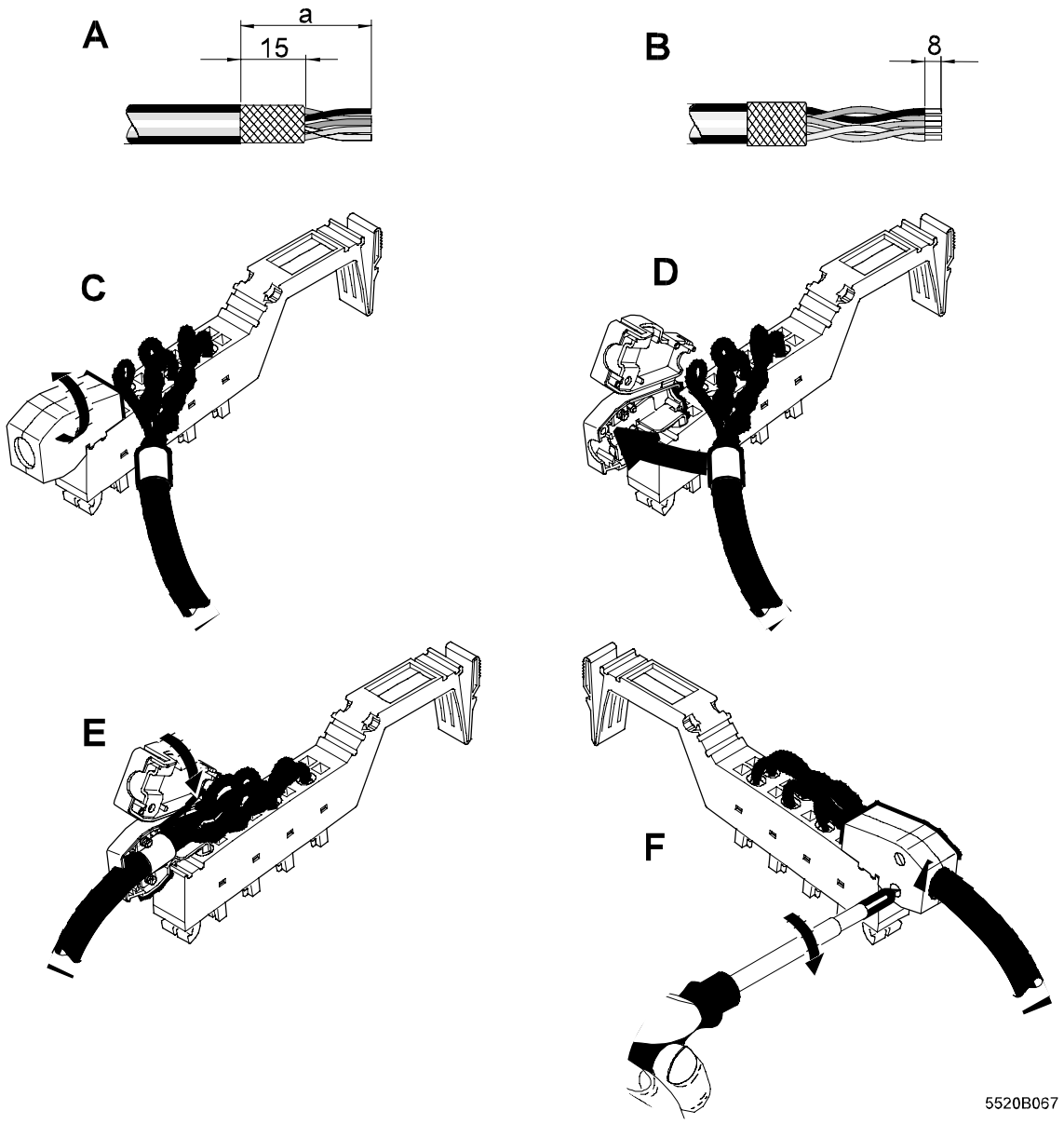
Insert a screwdriver (0,6 x 3,5) into the (square) slot of the terminal point so that the wire fits into the (round) spring aperture.

Withdraw the screwdriver from the aperture, whereby the wire is clamped.

After installation, we recommend marking the wires and terminal points by inscriptions.

4.8.2 Screened cables

For pin allocation, see the module data sheet.



Remove the external cable sheathing to the required length: length (a) in Fig. A.
The length is dependent of the connector position for connection of the wires and of whether the wires shall be fitted generously or closely between screening terminal and connecting point.

Reduce the length of the screening meshing to 15 mm.
Put the screening meshing around the outer cable sheathing. (B)
If necessary, remove the protective film.
Strip off 8mm of wire insulation. (B)

If possible, twisted wires should remain twisted nearly up to the terminal point.

Insert a screwdriver (0,6 x 3,5) into the (square) slot of the relevant terminal point so that the

wire fits into the (round) spring aperture.

Remove the screwdriver from the aperture, whereby the wire is clamped.

Open the plastic cap of the screening connection. (C)

Open the screening collar and insert the upper part of the collar into the snap-in hole of the upper part provided for this purpose. The orientation of the screening collar can be changed: for thin cables, the collar can be mounted with the bulging side pointing towards the cable.

Insert the cable(s) wrapped into the screening meshing. (D)

Shut the screening terminal cap. (E)

Tighten the screws of the screening collar moderately.

Tighten the screws at the screening terminal moderately using a screwdriver. (F)

4.9 Connecting the supply voltages

All supply voltages of a VARIO station must come from voltage sources which ensure safe galvanic isolation to SELV.

For operation of a VARIO station, 2 voltages are required.

1. U_{BK} This voltage (24V DC) energizes the bus coupler module itself. The following voltages are derived:

U_{L+} the logic voltage (7,5V DC) for energization of the logic section of all modules connected to the bus coupler.

U_{ANA} the analog voltage for energization of all modules with analog outputs connected to the bus coupler.

U_{L-} This is the common ground of voltages U_{L+} and U_{ANA}.

U_{L+} and U_{ANA} are galvanically isolated from the U_{BK}, but interconnected (common minus line).

Voltages U_L and U_{ANA} are used by the complete VARIO station. These voltages are <u>not</u> interrupted by inserted power supply modules (VARIO PWR IN24).

Voltage connection U_M as shown in some drawings is not used presently.

2. U_S The segment voltage is used to energize the actuators connected to the output module and any sensors connected to the input modules.

Power supply module VARIO PWR IN/24 can be used to divide a VARIO station into "segments".

This <u>is possible</u>, if different output circuits should be switched separately, without switching off the function of the overall station.

Division into segments <u>is compulsory</u>, if the total current of a station exceeds 8 A. As the max. current load of the contacts on the module side is limited to 8 A, division into segments is required, if this value is exceeded:
Power supply module VARIO PWR IN/24 can be used to divide supply voltage U_S into several segments (sub-circuits).

Bus connections, module logic energization and analog voltage remain unchanged.

This method provides division of stations with high current load into segments. The voltage of the individual segments can be taken from a power supply unit, because division into segments serves only for division into (switchable) circuits and reduction of the module contact current load.

Supply voltage U_S should be installed and provided with a fuse independent of the bus coupler supply voltage (U_{BK}). Thus the internal bus can continue operating also, when

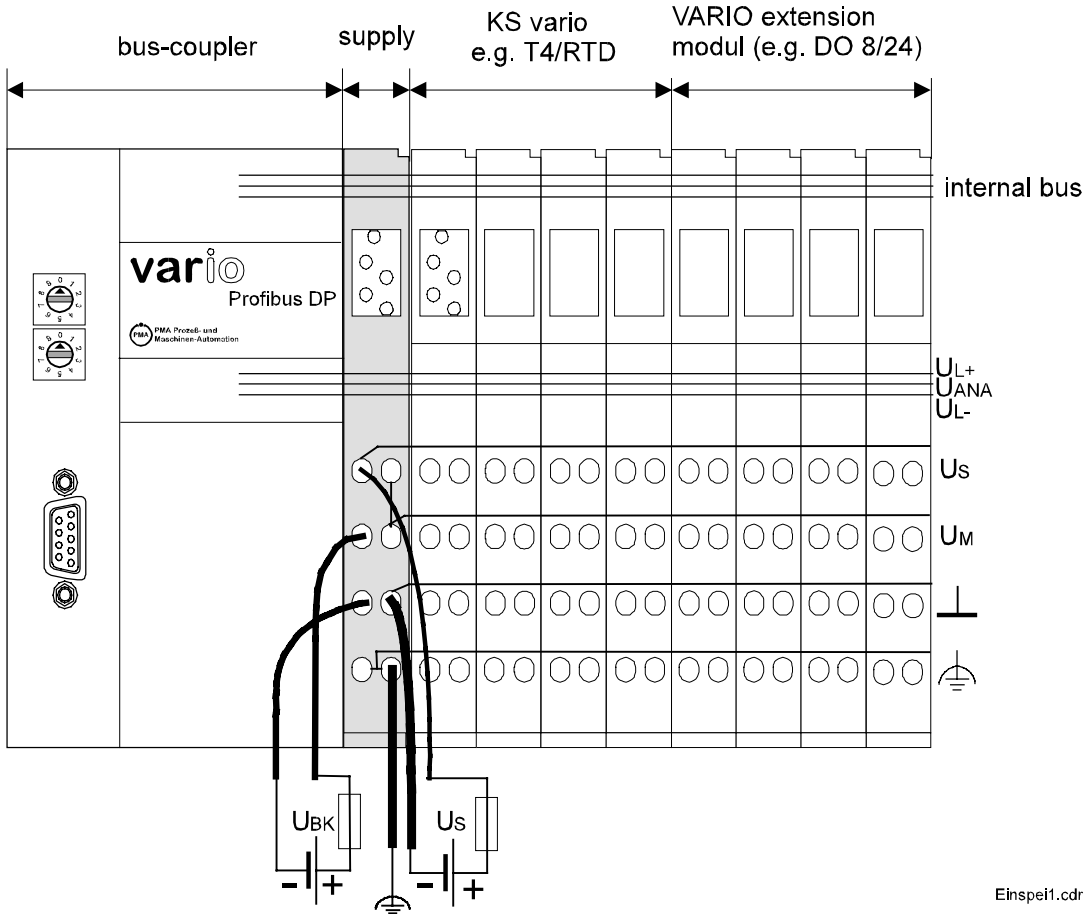
peripheral parts are switched off. The field bus is not affected by a bus coupler power failure.

The supply voltages can be connected by means of unscreened cables.

The pin allocation for connecting the supply voltages is given in the module-specific module data sheets.

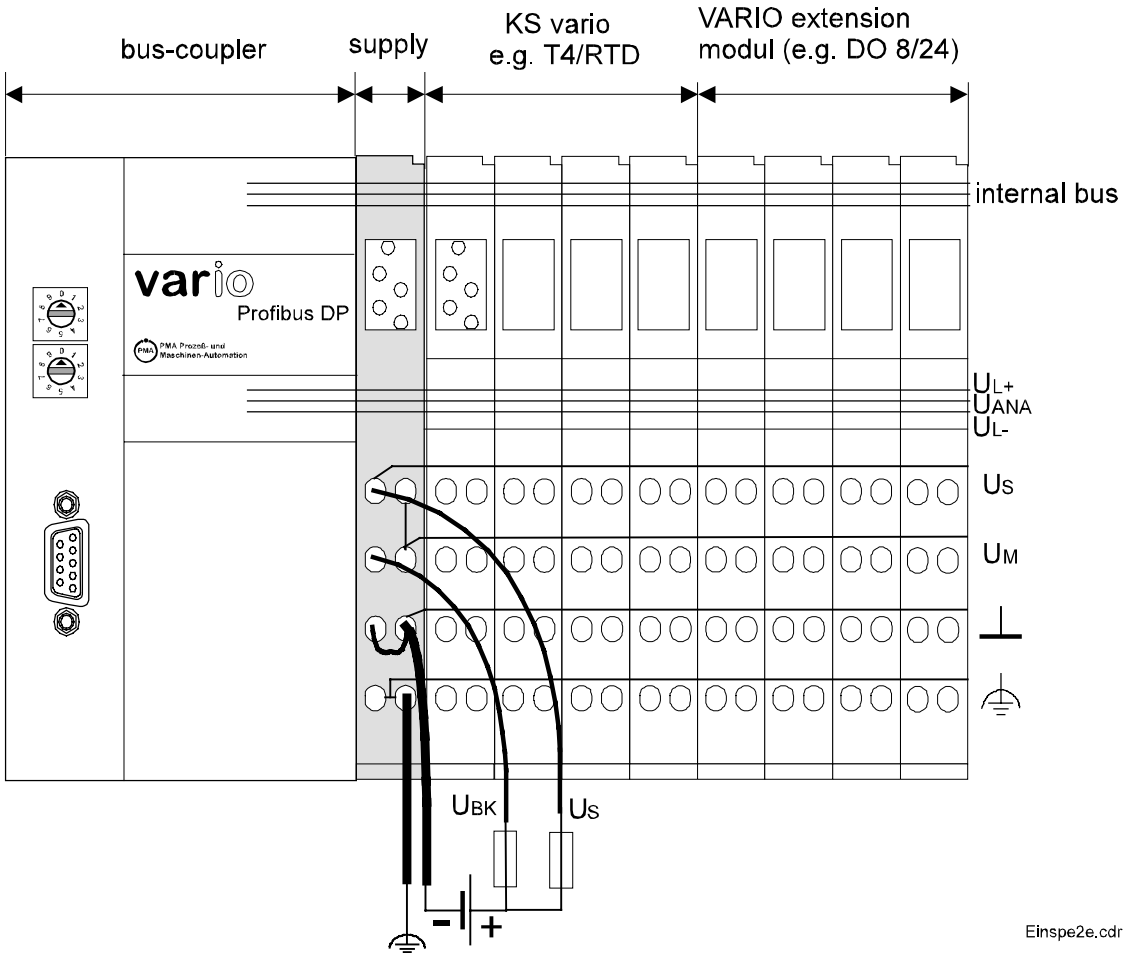
4.9.1 VARIO station energization examples

Example 1:



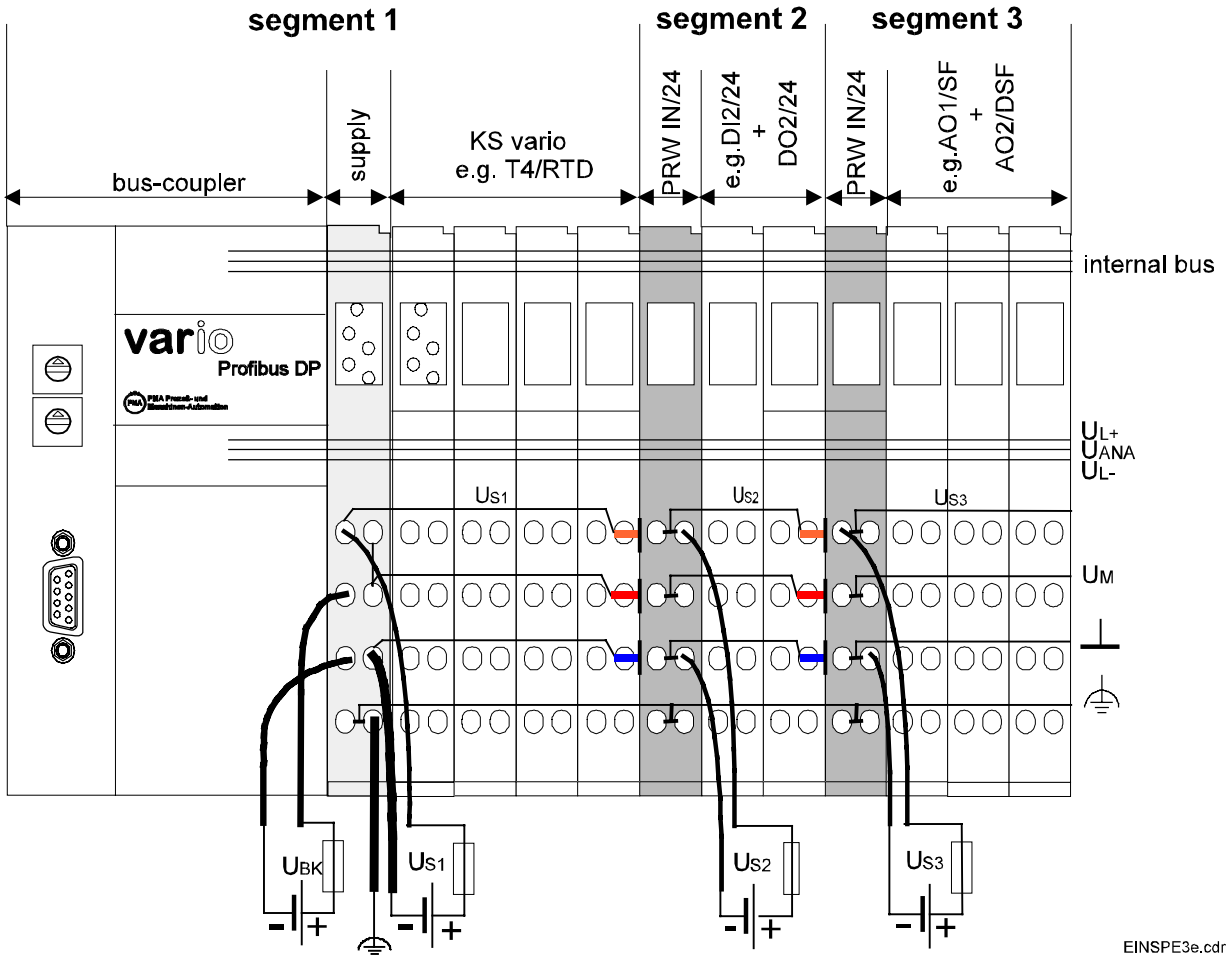
The above example shows the energization of a smaller KS KS VARIO station with 1 segment and separate energization of bus coupler and segment. This constellation offers the advantage that the field bus remains active in case of a segment voltage failure and that this failure can be signalled to the control system.

Example 2:



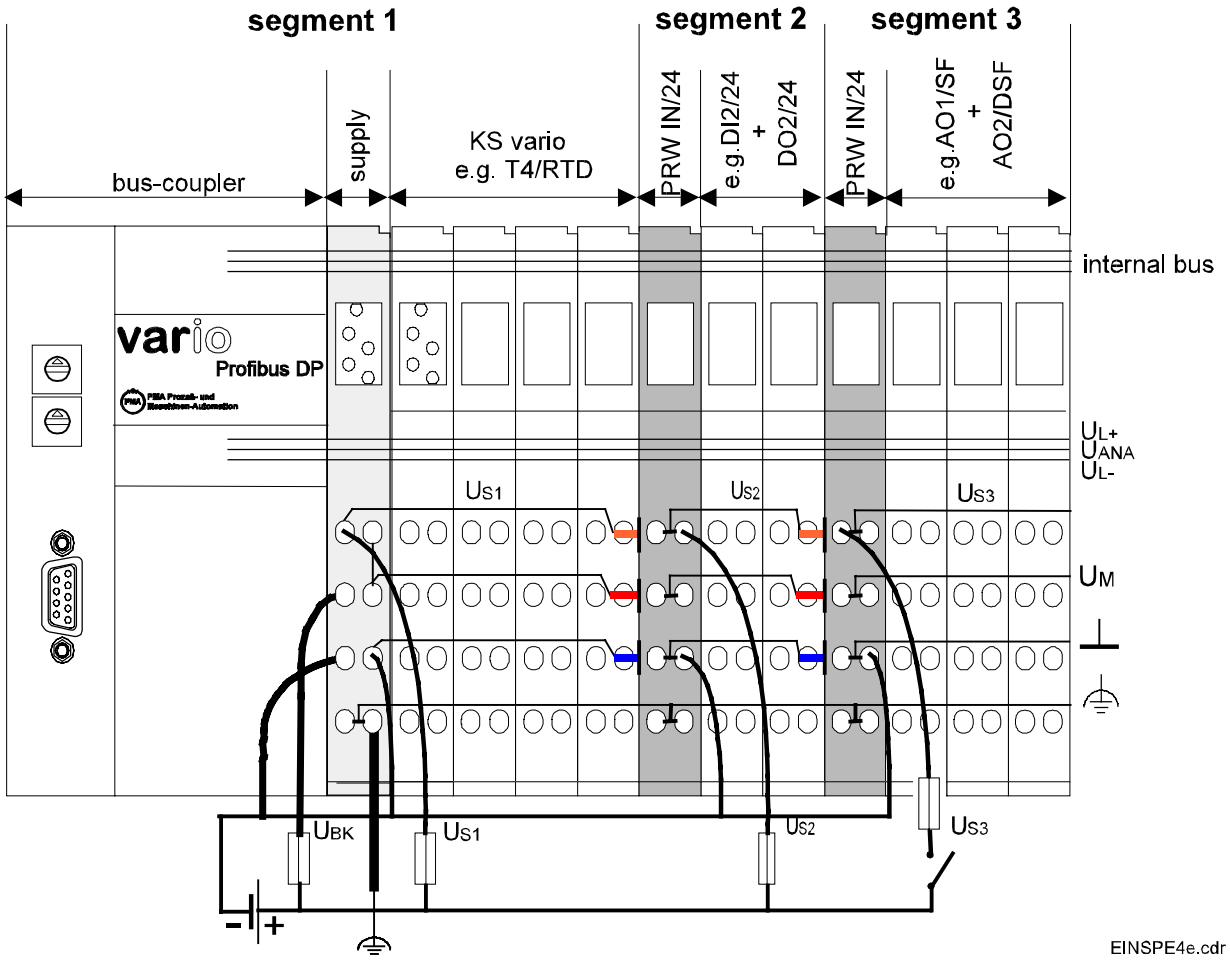
Example 2 is also a small VARIO station, but with common energization for bus coupler and segment. In case of segment voltage failure, no error message is sent to the control system by this station. Dependent on field bus type and how error messages are processed in the control system, this bus coupler without supply voltage may block the field bus.
A separate fuse for protection of the two circuits is always required.

Example 3:



Example 3 shows the ideal wiring case of a larger VARIO station: bus coupler and each segment are energized separately.
Such a method of energization can be required, when the current consumption in the 1st segment exceeds 7 A, i.e. when the max. module contact current is exceeded.
Separation of a 3rd switchable segment might be required, if the (machine) part connected via segment 3 is not needed temporarily and must be shut down.

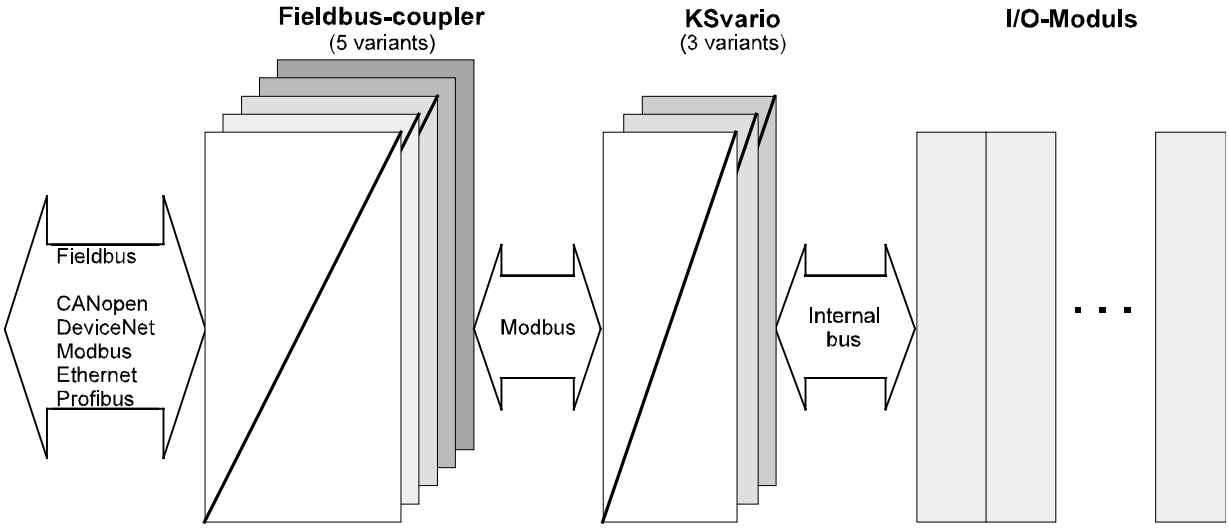
Example 4:



With energization from a common voltage source, the same conditions as in example 1 and 2 are applicable.

5 KS VARIO system bus structure

The bus structure of control system KS VARIO is as shown below:



On the left side of a KS VARIO station, a bus coupler with integrated power supply for the complete station is mounted. The bus coupler converts the field bus signals into a Modbus signal. This signal is taken to a KS VARIO controller module, which generates an internal bus signal for communication with the following VARIO modules.

A bus coupler module divides a system into segments, i.e. the unit enables individual branches (parts) to be switched off during operation.

A bus coupler module must be energized with a non-switched voltage, i.e. the voltage must not be switched off by switching off the system branch, if the overall bus system operation must continue. Failure of the supply voltage at a bus module causes overall system standstill.

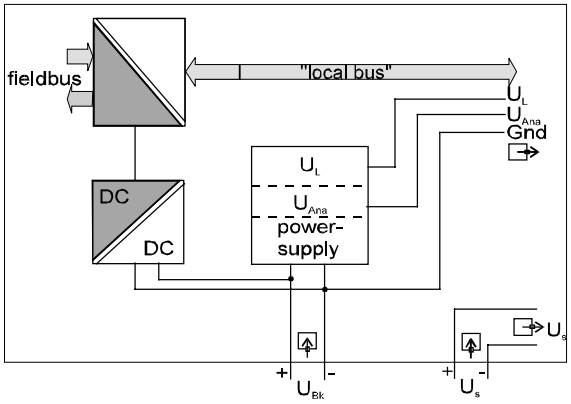
The bus coupler module tasks are:

coupling of field bus and local bus
I/O module supply with logic voltage
I/O module supply with "segment voltage" (voltage for switching outputs)
data signal refreshment (repeater function)
potential isolation between bus segments
connection and disconnection of the local bus via firmware

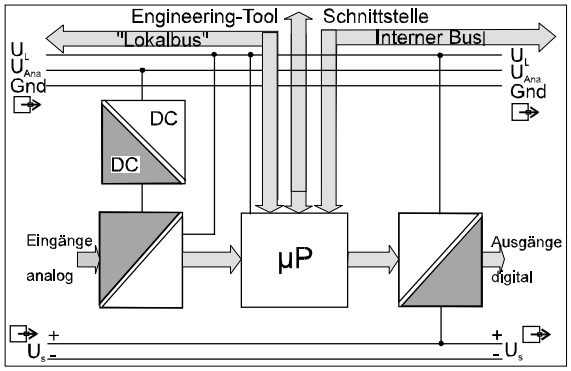
5.1 Galvanic isolations

The galvanic isolations of KS VARIO controller modules are shown in the following diagram.

Fieldbus-coupler



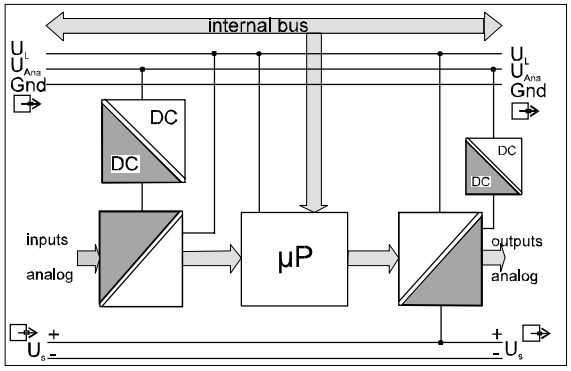
Reglermodul
KS-VARIO



Analog inputmodul

resp.

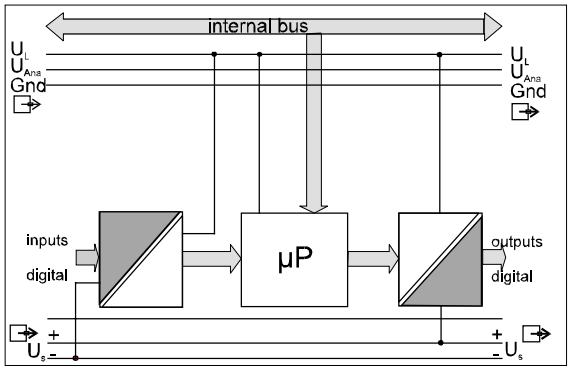
analog Outputmodul



digital inputmodul

resp.

digital outputmodul



galvtren.cdr

Identical hatchings within a module show galvanic connections.

All outputs are galvanically isolated from inputs and microprocessor, but galvanically connected with each other.

All inputs are galvanically connected.

When extending a KS VARIO controller module by other input or output modules, the inputs of these extensions are galvanically isolated from the adjacent modules. Each module is provided with a voltage transformer for energization of the analog part.
The (switching) outputs of the extensions are galvanically connected with the basic module outputs. Energization is from the (common) segment voltage.

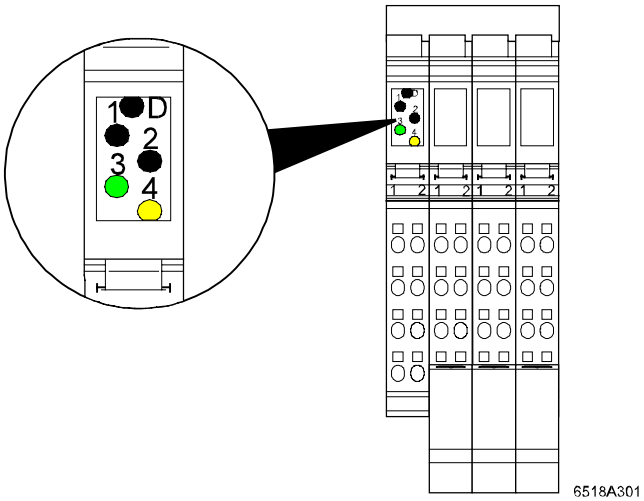
When dividing larger systems into segments, i.e. energization of individual segments from different power supply units, the output voltages are also galvanically isolated.

As shown in the figures overleaf, a VARIO station comprises 3 different bus systems.
1. field bus
2. local bus
3. internal bus

Internal VARIO buses mentioned in 2. and 3. had to be introduced for protocol and speed reasons.
Conversion between field bus and local bus is in the bus coupler. The local bus is not always identical (3 versions), i.e. d.h. there are 3 different temperature controller module versions for the local bus. (The internal bus is identical with all instruments.)
For this reason, replacing only the bus coupler in case of field bus replacement is not sufficient; the temperature controller module must be replaced as well.

5.2 Diagnosis and status indicator LEDs

The KS VARIO controller module front panel is fitted with five LEDs, which indicate the instrument status.



The signification of diagnosis and status indicator LEDs is:

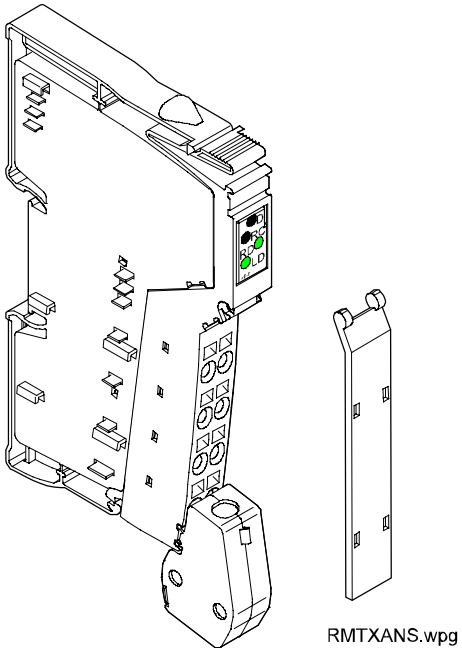
LED		Signification
D	**green LED**	**bus diagnosis (internal bus)**
	on	internal bus active without error
	blinking	error internal bus
	off	no supply
1	**green LED**	**RUN**
	on	in operation
	blinking	EEPROM defefetiv
	off	out of operation
2	**green LED**	**self-tuning**
	on	self-tuning busy
	blinking	self-tuning not successful and canceled
	off	self-tuning completed / out of operation
3	**yellow LED**	**alarm**
	on	stored alarm
	blinking	presently active alarm: limit-alarm, heatingcurrent-alarm, SSR-alarm
	off	no alarm

4	**red LED**	**error**
	blinking	loop-alarm, sensor fail
	off	no error

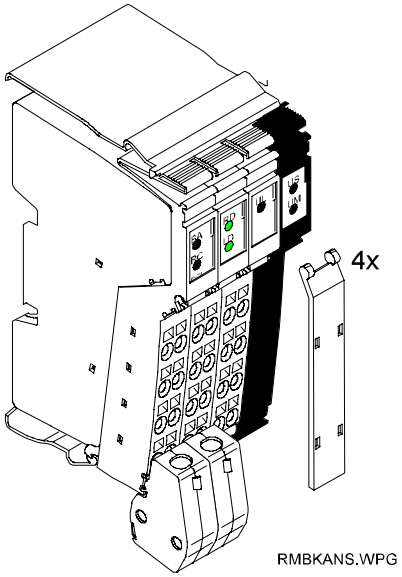
6 Local branching from a KS vario station

6.1 General

Modules VARIO RM TX, order no. KSVC-101-00211 and
VARIO RM BK , order no. KSVC-101-00201
can be used for local branching from a KS vario station.



VARIO RM TX bus branching module



VARIO RM BK coupler module for remote I/Os

These modules can be used for branching a tap line from the internal bus, in order to connect more distant I/O modules as a "sub-station" with the basic KS vario station. Branching is a possibility to save expensive cabling (compensating lead) with ample machinery and systems.

Branching in star or chain configuration is possible.
The VARIO RM TX module is the **bus branching module** in a KS vario station and should always be installed **directly behind a KS vario**. **No other function module may be installed between the KS vario controller module and the bus branching module.** For star-shaped branching from the internal bus, several branching modules can be installed in direct succession behind each other. This bus branching module provides a galvanically isolated branch of the internal bus (not of the field bus!). The overall length of each branch can be up to 400 m. This branch from the internal bus is called **remote bus**.
The "receiver" at the end of the remote branch is a **coupler module for remote I/Os**:
VARIO RM BK. This coupler module is the "bus coupler" of a KS vario sub-station.

If necessary, another bus branching module can be installed directly behind a coupler module for remote I/Os.

The number of modules (ALL except the controller module) in a KS vario station must not exceed 20.
(This number is also limited to 20 in the system configuration by means of the engineering tool.)

The coupler module for I/Os provides

galvanically isolated de-coupling between the internal bus of the sub-station and the incoming remote bus,

another galvanically isolated connection for a following sub-station and

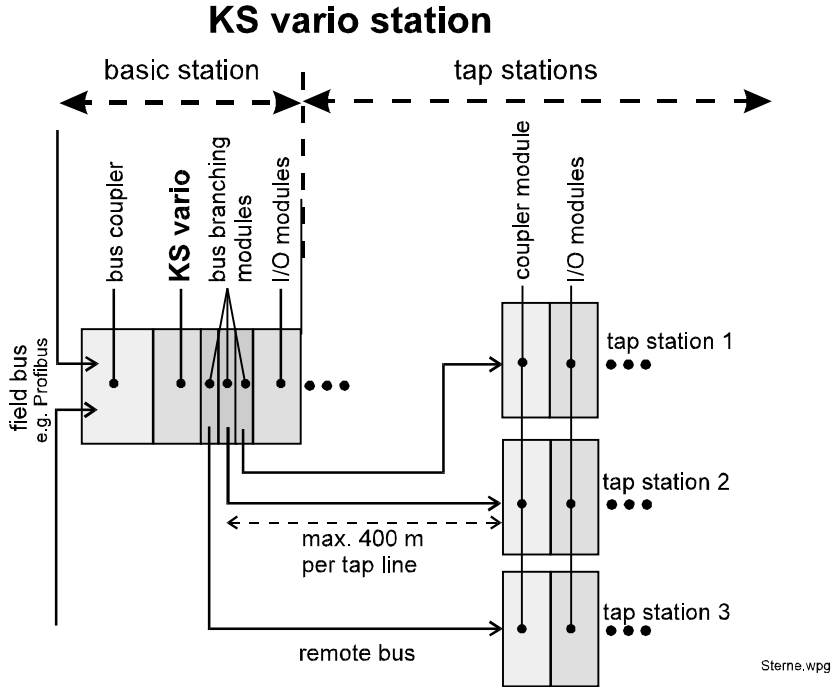
energization of this sub-station.

If necessary, an individual (galvanically isolated) supply voltage can be used for each sub-station. However, using the same auxiliary voltage as for the basic station is also possible.

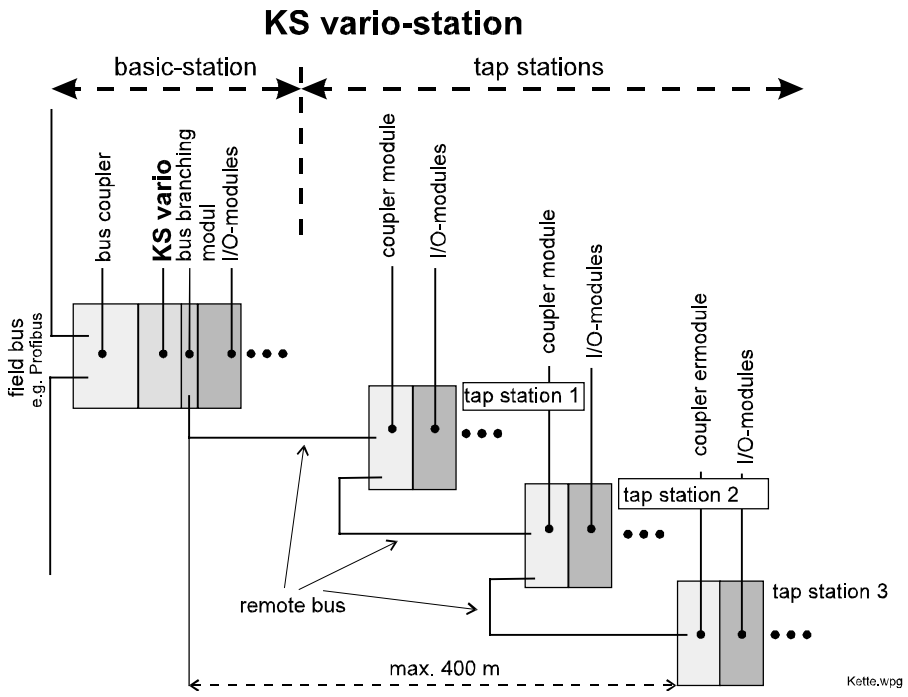
Connection of another KS vario controller module to a sub-station is not permissible.
The only KS vario controller module is installed behind the bus coupler of the basic station.

Tap lines are used only for "extension" of this controller module in the basic station.
Further tap line branching (chain-shaped configuration) from a sub-station is possible: either at the output of the coupler module for I/Os or another bus branching module, which must be installed directly behind the coupler module.

The maximum permissible overall length with chain-shaped branching is 400m. With star-shaped branching, each branch may be 400 m long.



Star-shaped structure of a KS vario station



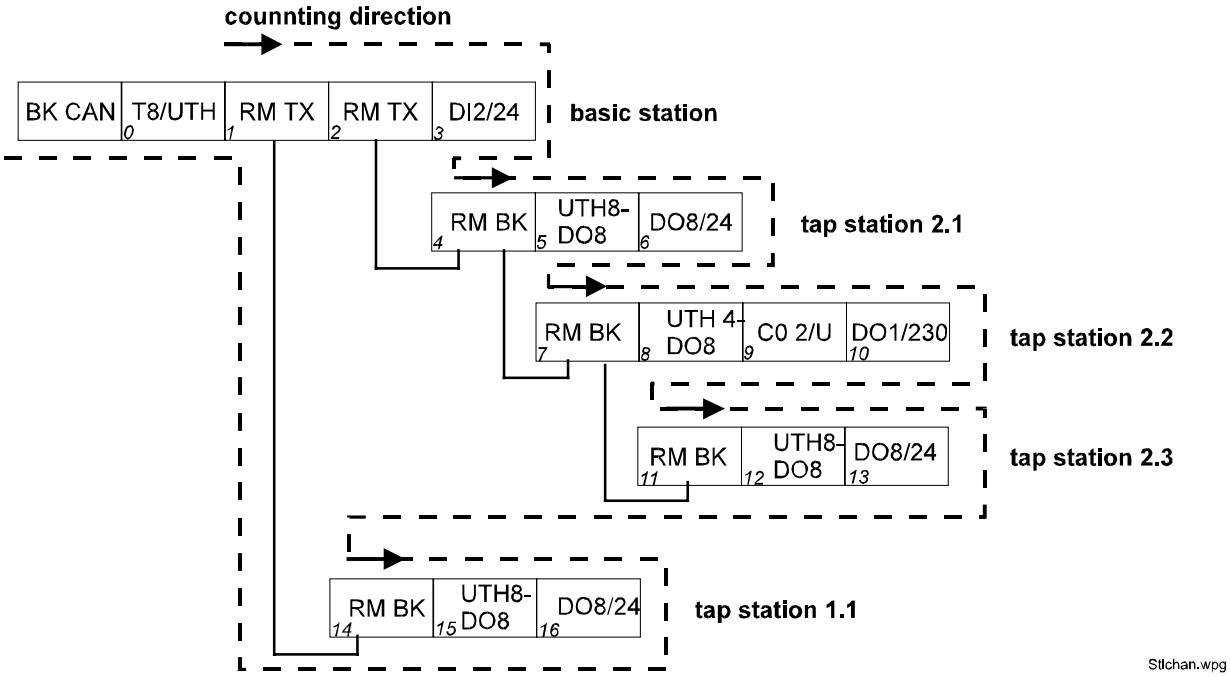
Chain-shaped structure of a KS vario station

Terminating resistors at the end of a remote bus tap line are not required.

6.2 Local branching configuration

As already mentioned, the system configuration in the engineering must correspond exactly to the order of modules, i.e. changes are permissible only, if hardware **and** engineering are changed.

System configuration of a KS vario station with local branching is according to the following scheme:
Counting starts behind the controller module (no. 0) and follows the direction shown by the dashed arrow line.



The order of modules in the system configuration of the KS vario station shown above is as follows:

No.	Module description	No.	Module description
0 (fixed)	T8/UTH	9	CO 2/U
1	RM TX	10	DO1/230
2	RM TX	11	RM BK
3	DI2/24	12	UTH8-DO8
4	RM BK	13	DO8/24
5	UTH8-DO8	14	RM BK
6	DO8/24	15	UTH8-DO8
7	RM BK	16	DO8/24
8	UTH4-DO8		

Special software or software settings for a tap station are not required. Management of tap stations is by the KS vario controller module.

6.3 Cable for the remote bus

We recommend using cable with the following specification for the remote bus:

Characteristic data	Setpoint
Number of wires	3 x 2, twisted pairs, with common screening
Wire cross-section	min. 0,2 mm²
DC resistance	max. 9,6 Ω/100m
Impedance	120 Ω ±20 % at f = 0,064 MHz 100 Ω ±15 Ω at f > 1MHz
Dielectric strength Between conductors Between conductors and screening	 1000 $V_{r.m.s.}$, 1 min 1000 $V_{r.m.s.}$, 1 min
Insulation resistance	min. 150 MΩ for 1 km cable
Coupling resistance	250 mΩ/m
Operating capacitance (at 800 Hz)	max. 60 nF for 1 km cable
Crosstalk attenuation (per 100 m) at 0,772 MHz at 1 MHz at 2 MHz at 4 MHz at 8 MHz at 10 MHz at 16 MHz at 20 MHz	 61 dB 59 dB 55 dB 50 dB 46 dB 44 dB 41 dB 40 dB
Image attenuation coefficient (per 100 m) at 0,256 MHz at 0,772 MHz at 1 MHz at 4 MHz at 10 MHz at 16 MHz at 20 MHz	 1,5 dB 2,4 dB 2,7 dB 5,2 dB 8,4 dB 11,2 dB 11,9 dB
Temperature range	20 °C to 70°C
Colour coding of wires	according to DIN 47100
Max. outside diameter	8 mm
Min. bending radius	64 mm

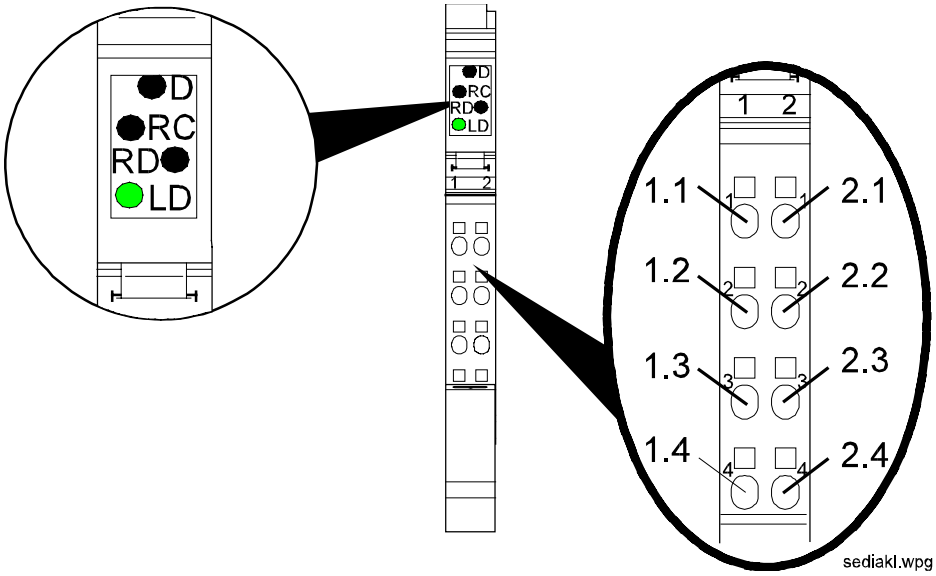
Deviations from the mechanical properties are permissible, if the electrical properties comply with the specifications.

Connecting two cables should be avoided to prevent losses due to reflections at the connection and impairment of the screening efficiency. In particular, this applies to the connection of cables of different type.

Unless compliance with the electrical cable data and/or avoiding cable connections are possible, individual checking is required to find out if safe operation is possible despite the differences. For connection technology, see paragraph 4.8.

6.4 Bus branching module VARIO RM TX

The bus branching module must be installed directly behind a KS vario controller or a coupler module for remote I/Os. Theoretically, up to 15 bus branching modules can be connected in direct sequence (star-shaped configuration of sub-stations). However, this quantity is not purposeful, because an insufficient number of modules for the actual function would be left due to the limited number of modules.



Diagnostic LEDs and pin allocation of the bus branching module

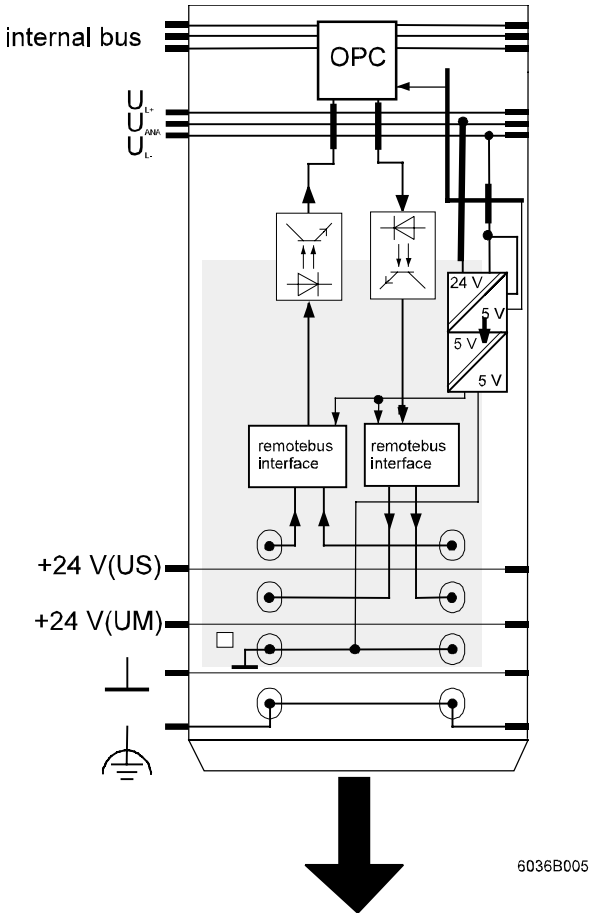
Diagnostic LEDs

Descr.	Colour	Signification
D	green	Diagnostics
RC	green	Remote bus cable check
RD	yellow	Remote bus switched off
LD	yellow	Remote bus tap/local bus switched off
	red	Remote bus tap/local bus switched off without retro-action after error

Pin allocation

Pin	Allocation	
1.1	$\overline{DO}$	receive
2.1	DO	receive
1.2	$\overline{DI}$	send
2.2	DI	send
1.3	GND	
2.3	not connected	
1.4 2.4	screening	directly connected with function earth FE

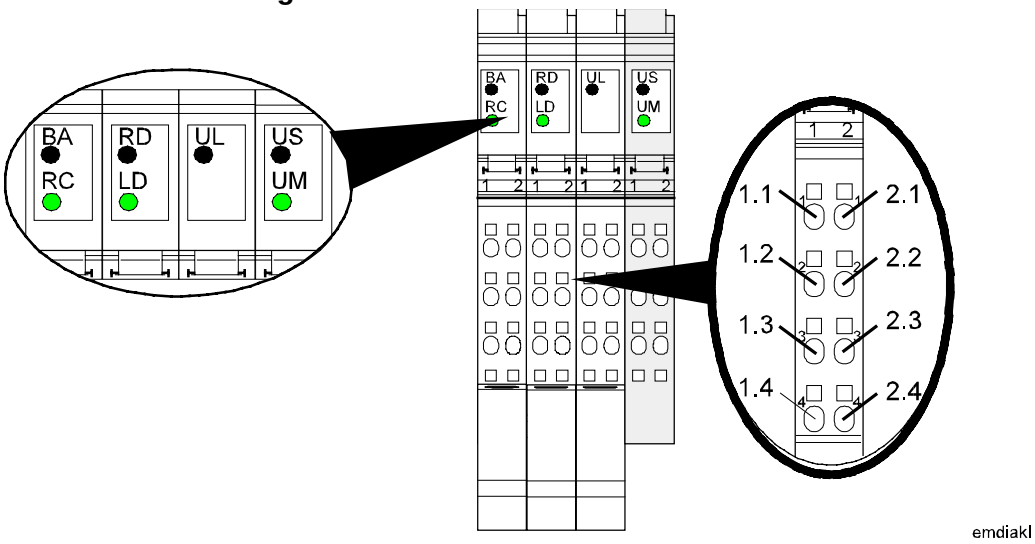
6.4.1 Galvanic isolation of the bus branching module



The galvanic isolation of the bus branching module is shown above.
A separate external supply voltage is not required.

6.5 Coupler module for remote I/Os

6.5.1 Pin allocation and diagnostic LEDs



6.5.1.1 Connector 1 Incoming remote bus

Pin	Allocation	
1.1	$\overline{DO1}$	receive
2.1	DO1	receive
1.2	$\overline{DI1}$	send
2.2	DI1	send
1.3	F-GND	reference potential
2.3	not connected	
1.4, 2.4	screening	The screening is connected capacitively with function earth FE.

6.5.1.2 Connector 2 Outgoing remote bus

Pin	Allocation	
1.1	$\overline{DO2}$	send
2.1	DO2	send
1.2	$\overline{DI2}$	receive
2.2	DI2	receive
1.3	F-GND	reference potential
2.3	not connected	
1.4, 2.4	Screening	The screening is connected directly with function earth FE

6.5.1.3 Connector 3 coupler module energization

This power supply connector is protected against wrong polarity and transient voltage peaks. Short circuit protection must be ensured by an external fuse.

Pin	Allocation	
1.1, 2.1	do not use, internal connection.	
1.2, 2.2	24 V DC U_{BK}	Coupler module energization
1.3, 2.3	BK-GND	GND of coupler module. Coupler module reference potential
1.4, 2.4	FE	Function earth. Earthing of coupler module and Vario tap station. Connected with the DIN rail via the spring on the housing bottom. The function earth serves only for interference suppression.

6.5.1.4 Connector 4 **power supply connector** (energization of the tap station)

Pin	Allocation	
1.1, 2.1	24 V DC U_S	24 V segment power supply, for energizing the I/O modules used in this station
1.2, 2.2	24 V DC U_M	24 V main power supply
1.3, 2.3	GND	Reference potential of U_S and/or U_M
1.4, 2.4	FE	See terminal 3

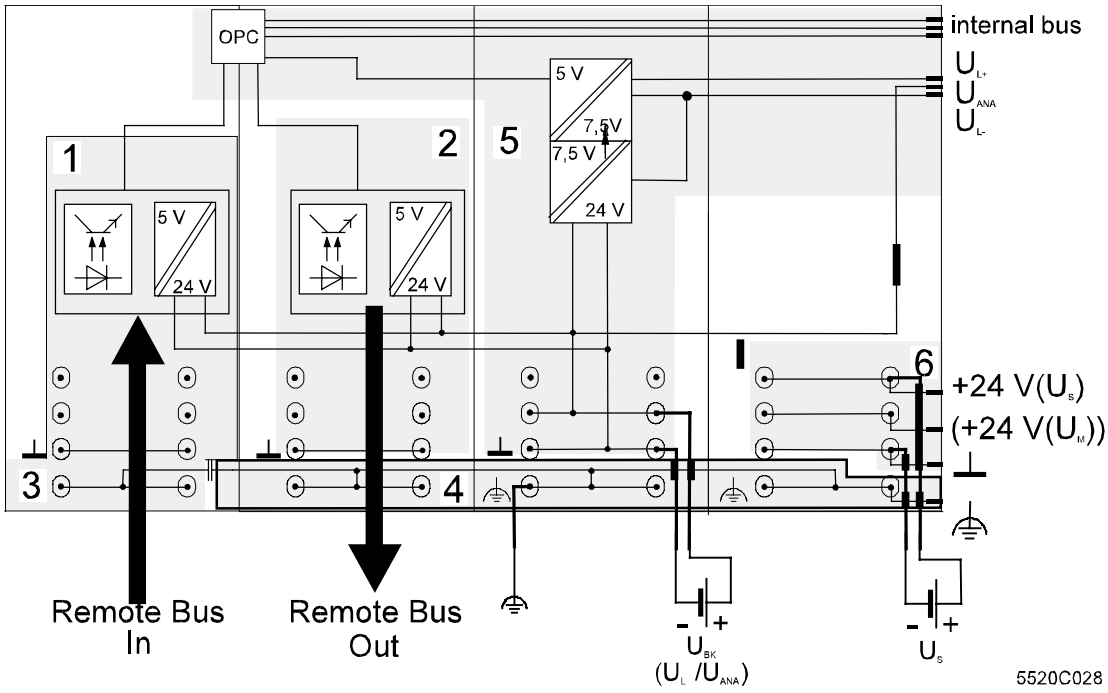
Presently, voltage U_M is not used. Terminals 1.2 and 2.2 can remain without connection. For energization of the digital input and output modules connected to this sub-station, voltage U_S is sufficient. (Analog output modules are energized by the coupler module supply voltage.)

Caution! Don't confuse the connectors, in order to prevent destruction of modules.

One of the FE terminals must be connected to earth via a stranded cable of shortest possible length.

Descr.	Colour	Signification
BA	green	Bus active
RC	green	Remote bus cable check
RD	yellow	Outgoing remote bus switched off
LD	yellow	Local bus switched off
UL	green	24 V bus module supply/7,5 V logic and interface supply
US	green	24 V segment supply
UM	green	24 V main supply

6.5.2 Galvanic isolation of coupler module



As shown above, incoming (1) and outgoing (2) remote bus are isolated from each other and from the internal bus (2) of the tap station. The same applies to the power supply for the coupler module (5) and the power supply for the connected function modules (6). The screening of the incoming remote bus (3) is connected capacitively with the coupler module (4) earth. Unless galvanic isolation between voltages is required, energization from a common source is also possible.

7 Maintenance and behaviour in case of trouble

Multi-channel controller KS VARIO and extension modules do not require any special maintenance. No parts need preventive maintenance or care.

7.1 Trouble shooting

To start with, all possibilities of trouble sources in peripheral units or related leads should be checked (measurement cables, wiring, instruments connected in the output circuit). Unless the source of trouble can be located by checking these items, the unit should be returned to the manufacturer:

PMA Prozeß- und Maschinen-Automation GmbH
Service-Abteilung
Miramstraße 87
D 34123 Kassel

If the error was found to be due to failure of a fuse the cause must be determined and corrected. The spare fuse ratings must be identical to the original type.
Unless LED 1 is lit despite intact fuse and correct supply voltage polarity the bus coupler is defective and must be returned to the manufacturer for repair.

7.2 Shut down

Before taking the instrument out of operation, it must be completely disconnected from the supply voltage. Check that other equipment connected in the overall system is not affected.

If safe operation seems to be not possible any more, the instrument must be taken out of operation and protected against accidental switch-on.

7.3 Cleaning

If necessary, the plastic components of a KS VARIO station can be cleaned using a soft cloth. Do not use cleaners containing solvents or scouring powder (inscription on label!).

7.4 Customer Support Hotline

For further questions related to KS VARIO which are not covered by this operating manual, customers are invited to contact us from Monday to Friday, between 8 a.m. and 16 p.m. The telephone numbers are:

Customer Support:	**49 561 505 3091**
Ext. repair department:	**49 561 505 1257**
Ext. sales department:	**49 561 505 1307**
e-mail:	**mailbox@pma-online.de**

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