



Control System for Tool Breakage and Object Monitoring with PROFIBUS Interface and USB Interface

Operating Instructions

Issue 1.02

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Purpose

These operating instructions are part of the documentation of the BK MIKRO9. They provide service personnel and system advisors with the information required to install, commission, operate and maintain the system BK MIKRO9.

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1 Characteristics

BK MIKRO9 is a control system suitable for tool as well as for object and free space monitoring applications.

The complete BK MIKRO9 system comprises

- a control unit (I/O expansion module option),
- a sensor (scanner),
- a connection cable,
- various optional accessories.

BK MIKRO9 can be used universally for different types of monitoring by the integration of multifarious functions:

- Operation with PROFIBUS-connection.
Monitoring occurs with parameter specification (angle/tolerance etc.) of the PROFIBUS-master (SPS/PLC). With this mode of operation the full scope of device function is available.
- Operation with digital I/Os – Parametrizing with help of a PC.
Parametrizing of the tool object data is created on a PC, transferred to the control unit via USB, and digitally controlled (SPS) in the application. In connection with the extension module, up to 512 objects/tools can be learned and checked via selection inputs. With this mode of operation the full scope of function is available as well.
- Operation with digital I/Os – Parametrizing via toggle switches.
For easy handling even without PC the most important functions can be set at the extension module. The controlling of 512 possible objects/tools comes about with the SPS as well.

Principle of operation

The wand of the scanner scans tools, objects or critical process spaces free of potential, in line with machine cycles.

A control unit equipped with a micro-computer triggers the movement of the wand upon an external signal or about a PROFIBUS message and passes the scanning result and PROFIBUS messages on to the machine control via relay contacts.

The galvanically isolated inputs and outputs guarantee a high degree of operational safety and protection against interferences.

Further features

- Scanning in clockwise (CW) or counter-clockwise (CCW) direction
- 8 steps for scanning intensity
- Output relay contacts selectable as normally open or normally closed
- Ranges of tolerance for "OK" message adjustable
- Indication of the scanning result by two LEDs "OK" and "KO" on the control unit
- Detection of cable breaks
- Configuration software for program setting and tool data
- Various movement functions of the scanning wand
- Use of various scanners for different applications

1.1 Overview Control Units

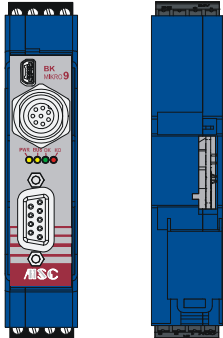
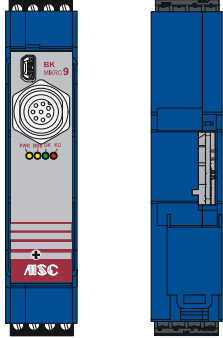
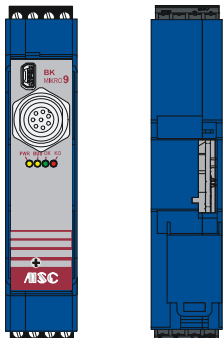
| BK MIKRO9 | | |
|---|---|---|
| Device type | Front and rear side | Connections |
| <p>BK MIKRO91 Premium with profibus interface</p> |  <p>Dimensions: 22.6 mm x 99 mm x 113.6 mm</p> | <ul style="list-style-type: none"> - PROFIBUS interface - Mini USB - Digital inputs - Relay outputs - Scanner connection - 3 connection terminals - Opening for top-hat rail connector |
| <p>BK MIKRO92 Premium without profibus interface</p> |  <p>Dimensions: 22.6 mm x 99 mm x 113.6 mm</p> | <ul style="list-style-type: none"> - Mini USB - Digital inputs - Relay outputs - Scanner connection - 3 connection terminals - Opening for top-hat rail connector |
| <p>BK MIKRO93 Basic without profibus interface</p> |  <p>Dimensions: 22.6 mm x 99 mm x 113.6 mm</p> | <ul style="list-style-type: none"> - Mini USB - Digital inputs - Relay outputs - Scanner connection - 3 connection terminals - Opening for top-hat rail connector |

Fig. 1-1: Overview BK MIKRO9 Control Unit – Front and rear side

1.2 Overview I/O Expansion Module

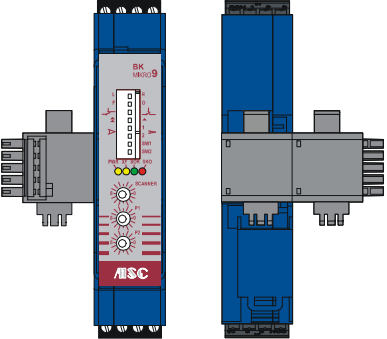
| BK MIKRO9 | | |
|--------------------------------|--|--|
| Device type | Front and rear side | Connections / switches |
| BK MIKRO9 I/O Expansion Module |  | <ul style="list-style-type: none"> - Digital I/Os - Toggle switches - Rotary switch - 4 connection terminals - Top-hat rail connector |
| | Dimensions: 22.6 mm x 99 mm x 113.6 mm | |

Fig. 1-2: Overview BK MIKRO9 I/O Expansion Module – Front and rear side

1.3 Overview Scanners


| BK MIKRO 7 | | |
|--|--|--|
| Device type | Scanner | Connection cable |
| Scanner – TK7A / TK7RL (without cable) |  <p>Wand length: 165 mm</p> | <ul style="list-style-type: none"> - Straight connector, 8 pin, 5 m - Angled connector, 8 pin, 5 m - Straight connector, 8 pin, 15 m - Angled connector, 8 pin, 15 m |

Fig. 1-3: Overview Scanner – TK7A / TK7RL

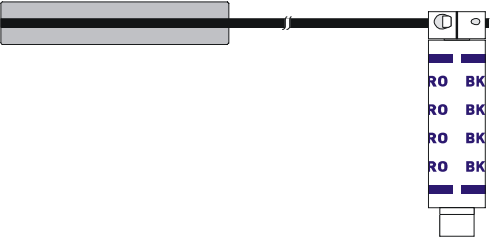
| BK MIKRO 8 | | |
|---|---|--|
| Device type | Scanner | Connection cable |
| Scanner – TK8A (incl. wand holder, without wand, without cable) |  <p>Wand length: 380 mm</p> | <ul style="list-style-type: none"> - Straight connector, 8 pin, 5 m - Angled connector, 8 pin, 5 m - Straight connector, 8 pin, 15 m - Angled connector, 8 pin, 15 m |

Fig. 1-4: Overview Scanner – TK8A

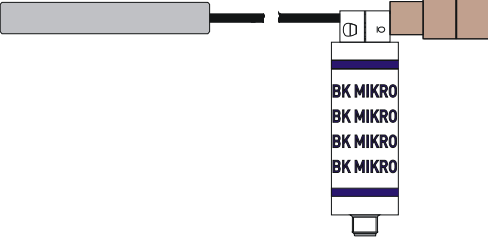
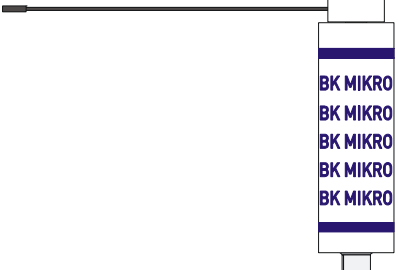
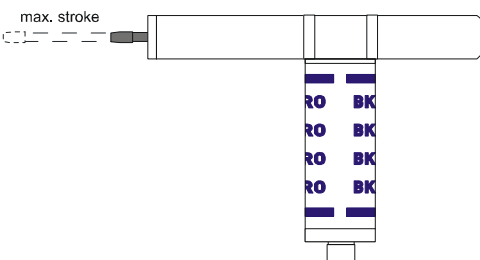
| BK MIKRO9 | | |
|--|---|--|
| Device type | Scanner | Connection cable |
| <p>Scanner – TK91A (incl. wand holder, without wand, without cable)</p> |  <p>Wand length: 610 mm</p> | <ul style="list-style-type: none"> - Straight connector, 8 pin, 5 m - Angled connector, 8 pin, 5 m - Straight connector, 8 pin, 15 m - Angled connector, 8 pin, 15 m |
| <p>Scanner – TK94A / TK94RL (without cable)</p> |  <p>Wand length: 165 mm</p> | <ul style="list-style-type: none"> - Straight connector, 8 pin, 5 m - Angled connector, 8 pin, 5 m - Straight connector, 8 pin, 15 m - Angled connector, 8 pin, 15 m |
| <p>Scanner – TK9LIN50/100 (without cable)</p> |  <p>Maximum stroke: of 50 / 100 mm</p> | <ul style="list-style-type: none"> - Straight connector, 8 pin, 5 m - Angled connector, 8 pin, 5 m - Straight connector, 8 pin, 15 m - Angled connector, 8 pin, 15 m |

Fig. 1-5: Overview Scanner – TK9

2 System Components

2.1 Control Unit

As a control unit three versions are offered:

- BK MIKRO91 Premium – with PROFIBUS interface: all functions
- BK MIKRO92 Premium – without PROFIBUS interface: all functions
- BK MIKRO93 Basic – without PROFIBUS interface: reduced function range for simple handling

Functionality overview

| Control Unit | PROFIBUS | Function I/O Module | Number of the functions | Features | Reduction |
|---------------|----------|--|-------------------------|-----------------------------|---|
| BKM91 Premium | X | - Toggle / Rotary switches - 2 Outputs - 10 Inputs | 512 | All | None |
| BKM92 Premium | – | - Toggle / Rotary switches - 2 Outputs - 10 Inputs | 512 | All | None |
| BKM93 Basic | – | - Toggle / Rotary switches - 1 Output | 1 | Only CheckObj and FreeSpace | Intensity Return travel Outputs No area adjustments Parameter reduction |

2.1.1 Characteristic properties

The BK MIKRO9 system control unit is housed in an insulating material housing of protection class II.

On the top and bottom side, the control unit is fitted with plug-in screw terminals to connect all machine inputs and outputs, supply voltage, and the scanner.

The scanner will be connected via a 8-wire cable to the scanner socket of the control unit.



Note:

The control unit – a build-in device – will be delivered in the 24 VDC variant.

2.1.2 Connection terminals

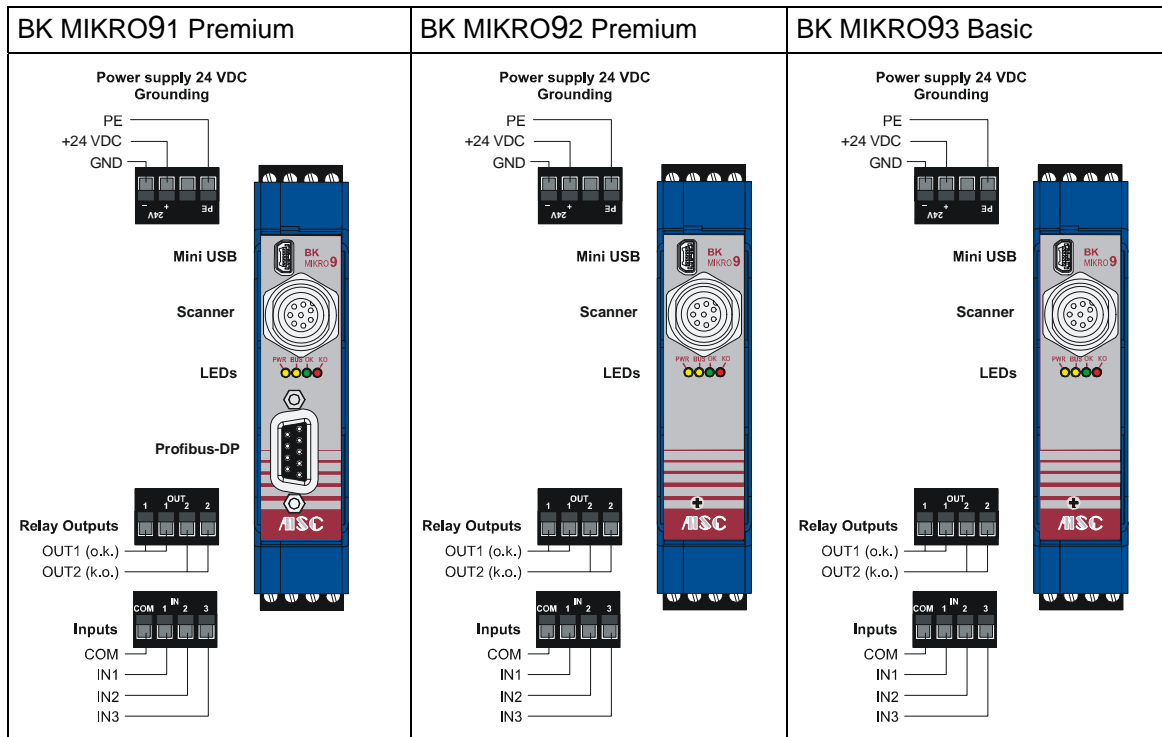


Fig. 2-1: BK MIKRO9 Control Unit – Front side with connections



Note:

These plugs may only be inserted or removed when the power supply has been disconnected.

These blocks are keyed so that they cannot be accidentally plugged into the wrong socket.



Note:

The nominal tightening torque for the clamping screws of the terminal connectors should be 0.5 – 0.6 Nm or 4.4 – 5.3 pound-inches (lbf in).

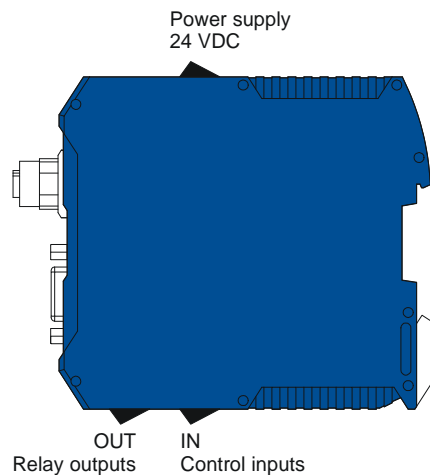


Fig. 2-2: BK MIKRO9 Control Unit – Connection positions

IN – control inputs

| | | |
|--|------------|---|
| | COM | Reference potential for control inputs and selection input |
| | 1 | "Teach" - control input An input level of +24 VDC relative to "COM" terminal will trigger a "Teach". The position stored during the "Teach" will remain stored even after the unit has been switched off. |
| | 2 | "Start" - control input An input level of +24 VDC relative to "COM" terminal will trigger a "Start" cycle (the real scanning process). |
| | 3 | Stop - control input An input level of +24 VDC relative to "COM" terminal will trigger a "Stop" (an operation will be disconnected). |

The inputs can be connected with positive or negative logic.

Positive logic:

- COM input must be put on GND.
- The particular input (IN 1 – 3) will be set on 24 V (high) by switching.
- As low-condition the input will be wired on GND or left open.

Negative logic :

- COM input must be put on 24 V.
- The particular input (IN 1 – 3) will be set on 0 V (high) with switching.
- Considered low-condition the input will be connected to 24 V or left open.

2.1.3 LEDs to indicate status information

Four light-emitting diodes (LEDs) on the front panel of the BK MIKRO9 control board are used to indicate status information.

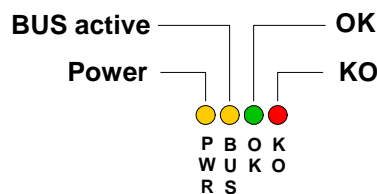


Fig. 2-3: Light-emitting diodes

| LED | Color | Designation | Function | Status |
|-----|--------|-------------|----------------------------------|----------|
| PWR | Yellow | Power | Power supply 24 VDC | On |
| BUS | Yellow | BUS aktive | USB active | On |
| | | | Data transmission (USB/PROFIBUS) | Flashing |
| | | | Bus not active | Out |
| OK | Green | OK | Scanning "OK" | On |
| KO | Red | KO | Scanning "KO" | On |

2.1.4 PROFIBUS interface

The PROFIBUS interface is realized as a floating RS-485 interface (electrically insulated).

A standard 9 pin Sub-D socket is used for plug.

The pin assignment of the 9 pin Sub-D socket corresponds to PROFIBUS standard.

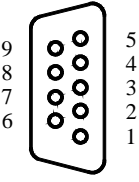
| Sub-D socket, 9 pin | Pin | Signal | Function |
|---|-----|-----------|--------------------------|
|  | 1 | N.C. | not connected |
| | 2 | N.C. | not connected |
| | 3 | RxD/TxD-P | Data line B |
| | 4 | RTS | Request To Send |
| | 5 | GND | Data reference potential |
| | 6 | 5V | 5 VDC |
| | 7 | N.C. | not connected |
| | 8 | RxD/TxD-N | Data line A |
| | 9 | N.C. | not connected |

Fig. 2-4: PROFIBUS-DP interface

2.1.5 USB connection

Connection to the PC can be established via USB at the front side of the control unit.

A common USB-cable (mini-B) is used.

2.1.6 Scanner connection

The scanner is connected to the 8-pole M12 circular plug-in connector with the control-cable in the control unit front.

2.2 I/O Expansion Module

2.2.1 Characteristic properties

The BKM9I/O extension module comes into operation if several in- or outputs are needed and for the ability to configure and control the control unit directly without PROFIBUS and USB.

The module will be connected with the control unit via top-hat rail connector. It will be supplied with power of the control unit, that means, no additional power supply is needed. The module offers 10 additional inputs, 2 digital outputs, several trigger switches and 3 rotary switches for controlling. Four LEDs are used for status / error display.

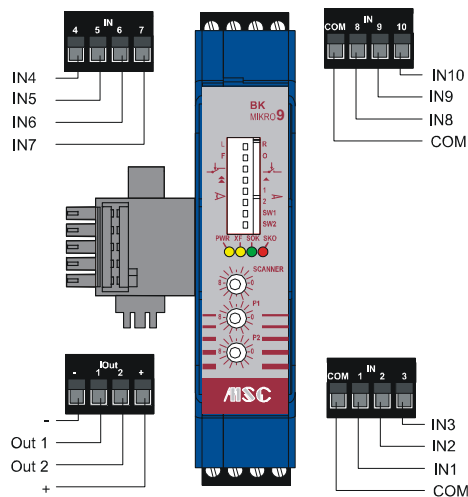


Fig. 2-5: I/O Expansion Module – Connections



Note:

These plugs may only be inserted or removed when the power supply has been disconnected.

Not characterized clamps are must be blank.



Note:

The nominal tightening torque for the clamping screws of the terminal connectors should be 0.5 – 0.6 Nm or 4.4 – 5.3 pound-inches (lbf in).

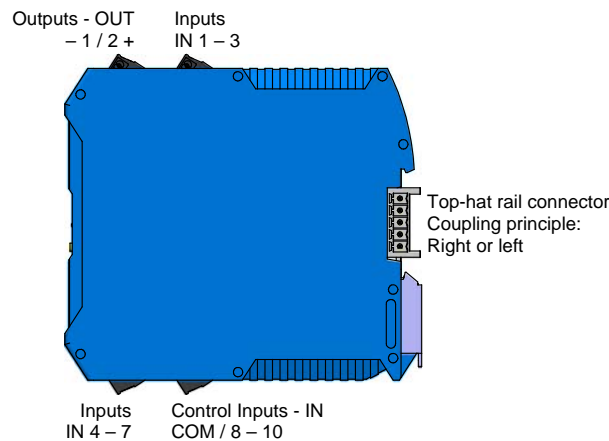


Fig. 2-6: I/O Expansion Module – Connections positions

2.2.2 Connection terminals

Control inputs

The additional module has a total of 10 additional digital inputs of which 9 are used for selecting the function to be started.

The function numbers selected via the inputs are from 0 to 511.

These control inputs are not available in connection with the BK MIKRO93 basic control unit and can be connected with positive or negative logic.

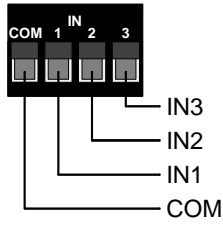
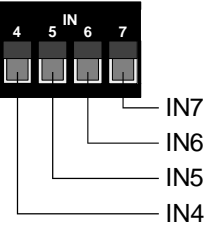
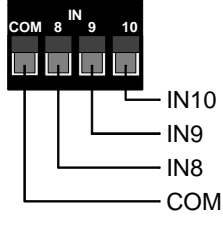
Positive logic:

- COM input must be put on GND.
- The particular input (IN 1 – 3) will be set on 24 V (high) by switching.
- As low-condition the input will be wired on GND or left open.

Negative logic :

- COM input must be put on 24 V.
- The particular input (IN 1 – 3) will be set on 0 V (high) with switching.
- Considered low-condition the input will be connected to 24 V or left open.

Unnecessary selection inputs may remain open. A signal must be pending for at least 40 ms to be effective.

| | | |
|---|------------|--|
|  | COM | Reference potential of inputs IN 1 – 3 Connect positive logic with GND Connect negative logic with 24 V |
| | 1 | Selection input 1 |
| | 2 | Selection input 2 |
| | 3 | Selection input 3 |
|  | 4 | Selection input 4 |
| | 5 | Selection input 5 |
| | 6 | Selection input 6 |
| | 7 | Selection input 1 7 |
|  | COM | Reference potential of control inputs 8 – 10. This inputs may remain open if 8 – 10 is not used. Positive logic: GND Negative logic: 24 V |
| | 8 | Selection input 8 |
| | 9 | Selection input 9 |
| | 10 | Reset input of outputs Outputs (e.g. OK, KO) can be reset with this input. |

Through the 9 selection inputs 512 different tool positions can be reached. The selection of the tool positions is effected in a binary way, that means that through activating and deactivating the different positions can be reached.

| e.g. Tool position | Selection inputs | | | | | | | | |
|-----------------------|------------------|----|----|----|----|----|----|----|----|
| | S9 | S8 | S7 | S6 | S5 | S4 | S3 | S2 | S1 |
| 0 | L | L | L | L | L | L | L | L | L |
| 23 | L | L | L | L | H | L | H | H | H |
| 176 | L | H | L | H | H | L | L | L | L |
| 511 | H | H | H | H | H | H | H | H | H |

L $\hat{=}$ Low

H $\hat{=}$ High

Digital outputs

Two further configurable active digital outputs are available with the I/O extension module.

Only these digital output is not available in connection with the BK MIKRO93 basic control unit (for counter alarm).

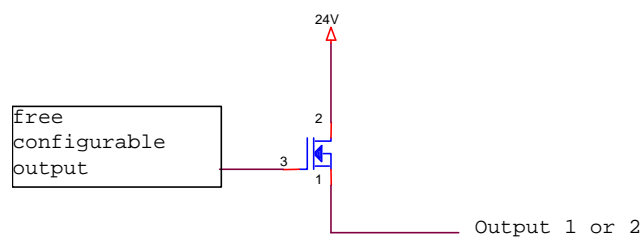


Fig. 2-7: I/O Expansion Module – Digital outputs

The outputs are listed as high-side-switches, which means, they behave like normal switches: Either they actively switch 24V (max. 0,5 A) on the output or the output is unused.

| | | |
|--|---|---|
| | - | Reference potential of the outputs (GND) |
| | 1 | Output 1 |
| | 2 | Output 2 |
| | + | 24V power supply |

2.2.3 Light-emitting diodes (LEDs)

Four LEDs on the front panel provide information about the current status of the auxiliary module BK MIKRO9:

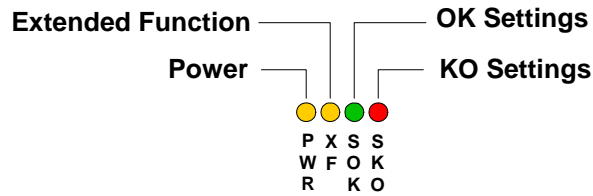


Fig. 2-8: I/O Expansion Module – Light-emitting diodes

| LED | Color | Designation | Function | Status |
|-------------------|--------|------------------|---|--------|
| Extended Function | Yellow | Power | Power supply 24 VDC | On |
| XF | Yellow | PROFIBUS address | PROFIBUS address (Rotary switch) I/O Expansion module active | Out |
| SOK | Green | OK settings | Signal for right switch settings and selection inputs | On |
| SKO | Red | KO settings | Signal for wrong switch settings and selection inputs | On |

2.2.4 Rotary switch

The "SCANNER" rotary switch is used for selecting the scanning head. A selection between 1 and 10 can be made. Position 15 is reserved for automatic scanner detection. Position 0 means that the PROFIBUS-address can be set via P1 and P2.

Both rotary-switches P1 and P2, positioned in the front plate of the control unit are means to set appropriate positions if the scanner setting is unequally 0. These positions are depicted in angular degree in the sections that are controlled during object and free space monitoring.

The settings are possible in steps of 24.0° (from 0.0° to 360.0°).

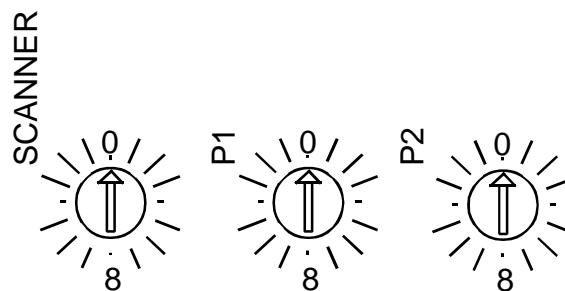


Fig. 2-9: I/O Expansion Module – Rotary switch

Selection of the scanners:

| | | |
|----|------------------|--|
| 0 | PROFIBUS setting | P1 and P2 display the PROFIBUS address. |
| 1 | TK8A | Scanner TK8A (Scanner with backstop) |
| 2 | TK7A | Scanner TK7A (Scanner with backstop) |
| 3 | TK8A Short Wand | Scanner TK8A with short wand (Scanner with backstop) |
| 4 | TK91A | Scanner TK91A (Scanner with backstop) |
| 5 | TK91A Fastlong | Scanner TK91A (Scanner without backstop) |
| 6 | TK94A/RL | Scanner TK94A/RL (Scanner with and without backstop) |
| 7 | TK9LIN50/100 | Scanner TK9LIN50/100 |
| 8 | TK Reserved 1 | - |
| 9 | TK Reserved 2 | - |
| 10 | TK Reserved 3 | - |
| 15 | TK Autodetect | The scanner is recognized automatically. |

The illustration shows the factory settings.



Invalid switch settings

P1=0 and P2 ≠ 0 Error

P1 ≠ 0 and P2=0 Error

cause red LED on the control unit to light.

Setting the profibus address via P1 and P2

With scanner selection = 0 via P1 and P2 the profibus address can be set in connection with the BK MIKRO91 control unit. The internally memorized address in the control unit is not regarded.

Settings via P1 and P2 occur hexadecimal. With P1 the rather significant bits are set and with P1 the less significant ones.

Example: Address 50dec = 32hex → P1 = 3, P2 = 2

Toggle switches

The following functions can be set using the rows of eight toggle switches on the front panel of the control unit.

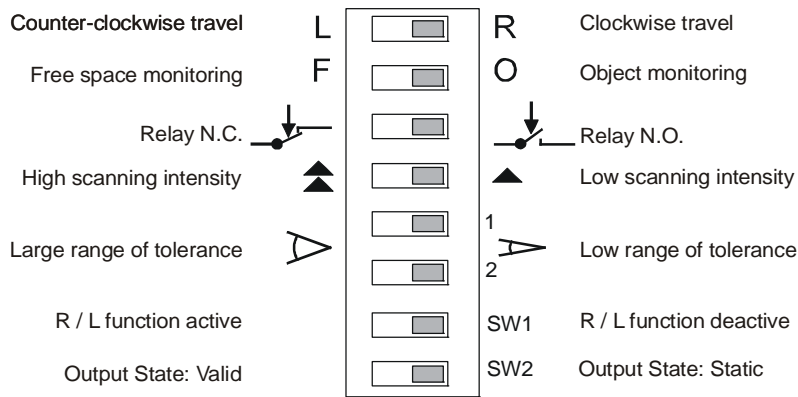


Fig. 2-10: I/O Expansion Module – Toggle switches



Note:
Settings as delivered: All switches are in the right-hand position!

Right / Left switch

Rotation direction of the scanning wand, i.e. direction in which the wand moves from the rest position.



Right =

Rotation clockwise

Rear view (of the cable connection side) on the scanning head, in the direction of the axis of rotation.

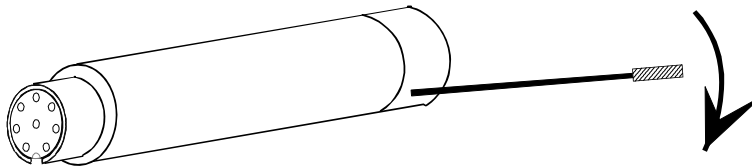


Fig. 2-11: Definition of the rotation direction

"Object / Free space monitoring" switch

"OK" message for

- presence (object monitoring) or
- object not present (free space monitoring) in the scanning range.

"N.C. / N.O. contact" switch

Functionality of the 4 outputs (see section "Digital outputs").

"Scanning intensity" switch

Adjustment of the speed and force of the scanning wand within the scanning range.

For the "Teach" and the "Start" cycle in the case of the OK message, this is:

| Switch position "Scanning Intensity" | Impact force |
|---|--------------|
| ▲ | small |
| ▲▲ | large |



Note:

If this switch is in the "small" position, the associated smaller impact force protects the wand against wear.

"Tolerance range" switch

Tolerance range for "OK" message, in relation to the target position, i.e, the position taught by "Teach" or the position set using switches:

| | |
|----------------------|------------------|
| 1-off, 2-off (small) | $\pm 0.1^\circ$ |
| 1-on, 2-off | $\pm 1.0^\circ$ |
| 1-off, 2-on | $\pm 3.0^\circ$ |
| 1-on, 2-on (large) | $\pm 10.0^\circ$ |

* on = switch position left
 * off = switch position right

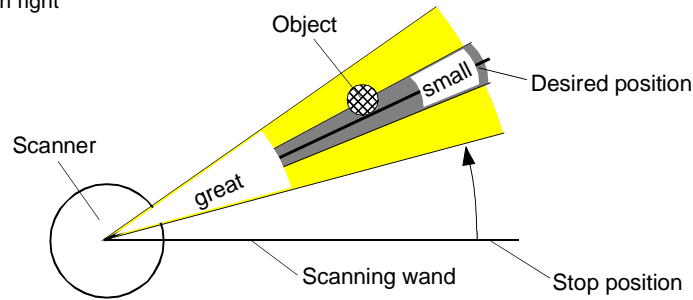


Fig. 2-12: Range of tolerance

SW1 switch

The wand is between two objects. With SW1 is activated the CW/CCW scanning, with "Teach" the wand travels first to left object and then to the right object. At a start both objects are scanned.

New Tool Settings:

With the RL-function are available 128 different RL tool kits (left and right tool). The tool selection occurs about the selection inputs of the I/O modules IN3 to IN8.

About IN1 and IN2 can be determined the scanned tool:

| IN2 | IN1 | Tool |
|-----|-----|---|
| 0 | 0 | The right and the left tool are scanned |
| 0 | 1 | The right tool is scanned |
| 1 | 0 | The left tool is scanned |
| 1 | 1 | The left and the right tool are scanned |

At a "Teach" always both tools must be available.

SW2 Output State switch

The digital outputs are switching only "Teach" or "Start" (Valid) as the signal request or are valid up to the next "Teach/Start" (Static).

2.3 Scanner

2.3.1 Characteristic properties

The scanner housing is cylindrical and smooth, thus permitting easy installation (e.g. by using the mounting bracket). The scanner is designed for easy access for servicing and changing the wand. Aligning the scanner is easy and requires no additional instruments or aids.

Optionally various scanner of different BK MIKRO systems can be connected to the control unit BK MIKRO9.

Following chart shows the main features:

| Type | Axis (Ø) | Unit (Ø) | High (mm) | Scanning wand length max. (mm) | Plate | Time of 180° rotation (approx. sec) | Repeat accuracy max. (+/-°) |
|-----------|----------|----------|-----------|--------------------------------|-------|-------------------------------------|-----------------------------|
| TK7A/RL* | 3 mm | 20 mm | 79 mm | 250 mm | No | 0.4 s | 1.2 |
| TK8A* | 3 mm | 20 mm | 79 mm | 380 mm | Yes | 1.3 s | 0.15 |
| TK91A* | 4 mm | 32 mm | 107.5 mm | 610 mm | Yes | 1.8 s | 0.05 |
| TK94A/RL* | 4 mm | 32 mm | 117.5 mm | 250 mm | No | 0.25 s | 1.2 |
| | | | | Hub length max. | | Time of 1 hub (approx. sec.) | Repeat accuracy max. (mm) |
| TK9LIN50 | – | 32 mm | 103.5 mm | 50 mm | – | 1.4 s | 0.05 |
| TK9LIN100 | – | 32 mm | 103.5 mm | 100 mm | – | 1.8 s | 0.05 |

* Type description:

- A ⇒ Scanner with wand holder backstop
(no external dead stop for home positioning necessary).
- RL ⇒ Scanner, capable of right/left run
(with external backstop or controlling of two tools simultaneously).

A customized adaptation of the motor-parameter may be necessary for demands that differ from denoted wand lengths or scanning times in the chart above. Please contact the producer if the values listed above exceed.

The scanner can be selected with the configuration software or the rotary switch of the extension module. Parameter values and technical data are listed below.

If a scanner does not match the control unit setting, the scanner type needs to be altered in the control unit before connecting. Movement can occur due to different resolution and gear ratio. This may result in maximum overstepping and scanner damage.

**Note:**

Connecting a scanner, which does not correspond to the settings of the control unit, can damage the scanner.

**Note:**

Wrong scanner parameters lead to wrong measurement results.

**Note:**

If angles $> 270^\circ$ is possible with a scanner with backstop, that the internal backstop is started and it triggers a "wrong OK".

That means also for the TK9LIN50 and TK9LIN100 scanners with sizes about 50 mm or 100 mm.

Automatic recognition of the scanners

The scanner of the TK9 series are recognized automatically with the "TK Autodetect" parameter setting (Parameters 6, scanner): no more especially adjustments are necessary via PROFIBUS, the PC software or the expansion module.

**Note:**

The TK7A/RL and TK8A scanners can not be recognized automatically.

If "TK Autodetect" is active and no scanner of the series TK9 is connected, the TK8A scanner will be adjusted automatically, i.e. only the TK7A/RL scanner must be adjusted via PROFIBUS, PC software or the expansion module.

2.3.2 Scanner TK7A and TK7RL

We offer two types of scanners for the different applications.

The sole difference between the two scanners is that the rotary movement of TK7A's wand is limited by a screw inside the housing, the mechanical backstop.

TK7A – Scanner with mechanical backstop

Scanner for scanning in one direction: clockwise or counter-clockwise

TK7RL – Scanner without mechanical backstop

Scanner for scanning in both directions: CW-CCW or CCW-CW, in special cases for scanning in one direction: CW or CCW



Note:

- Due to its small diameter, a wand is easily overlooked.
- Your wand is a wearing part! Each contact with a rotating object will cause corresponding wear on the wand. This may even lead to the metal wand breaking.

Due to the injury hazard this causes, users should exercise particular caution within any BK MIKRO rotating area.

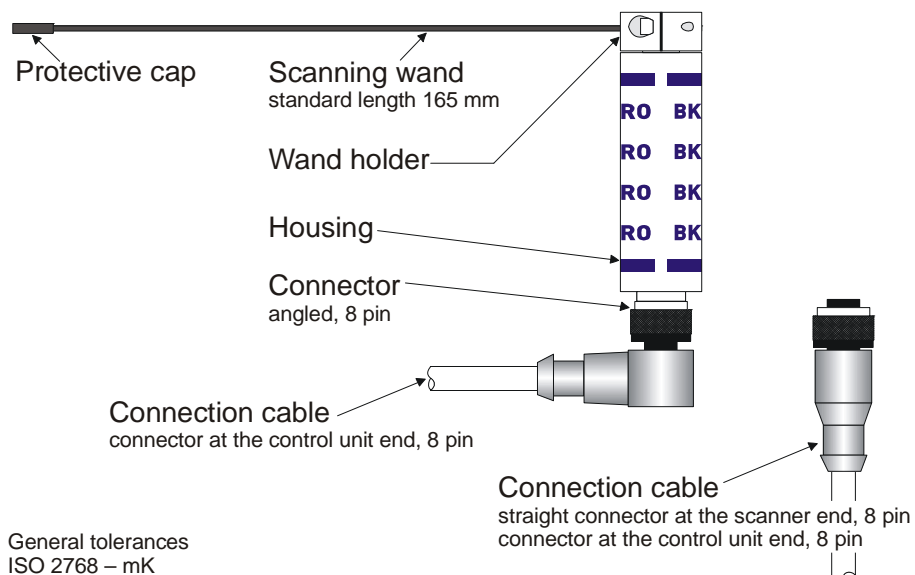


Fig. 2-13: Scanner TK7A / TK7RL



Note:

To prevent injury, your wand will be supplied complete with a protective cap.

2.3.3 Scanner TK8A

The TK8A scanner offers two special features:

- Scanning wands are available in lengths up to 380 mm
This allows greater distances between the scanner and tools or objects that it is checking.
- Scanning plate at the scanning wand
This makes it possible to use the scanner directly at the tool magazine to make positive contact with the tool's tip.

The TK8A scanner has a mechanical backstop that limits the rotary movement of the wand. Using scanner TK8A with a different control unit than BK MIKRO9 may damage the scanner and control unit.



Note:

Wrong scanner parameters lead to wrong measurement results.



Note:

The wand is a wearing part.

Due to the injury hazard, users should exercise particular caution within any BK MIKRO rotating area.

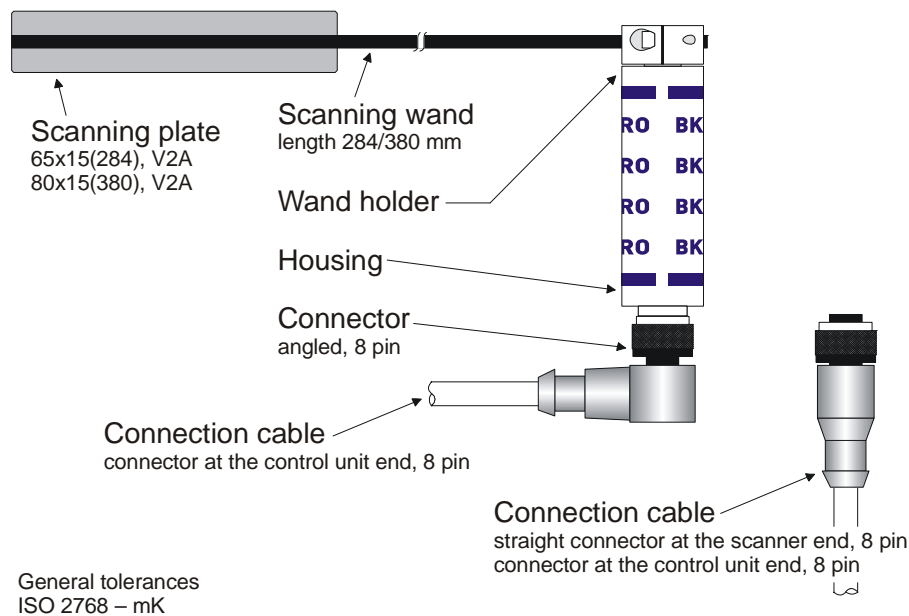


Fig. 2-14: Scanner TK8A

2.3.4 Scanner TK91A

- Scanning wands are available in lengths up to 610 mm
This allows greater distances between the scanner and tools or objects that it is checking.
- Scanning plate at the scanning wand
This makes it possible to use the scanner directly at the tool magazine to make positive contact with the tool's tip.

The TK91A scanner has a mechanical backstop that limits the rotary movement of the wand. Using scanner TK91A with a different control unit than BK MIKRO9 may damage the scanner and control unit.



Note:
The wand is a wearing part.
Due to the injury hazard, users should exercise particular caution within any BK MIKRO rotating area.

Example:
TK91A with 3 balance weights

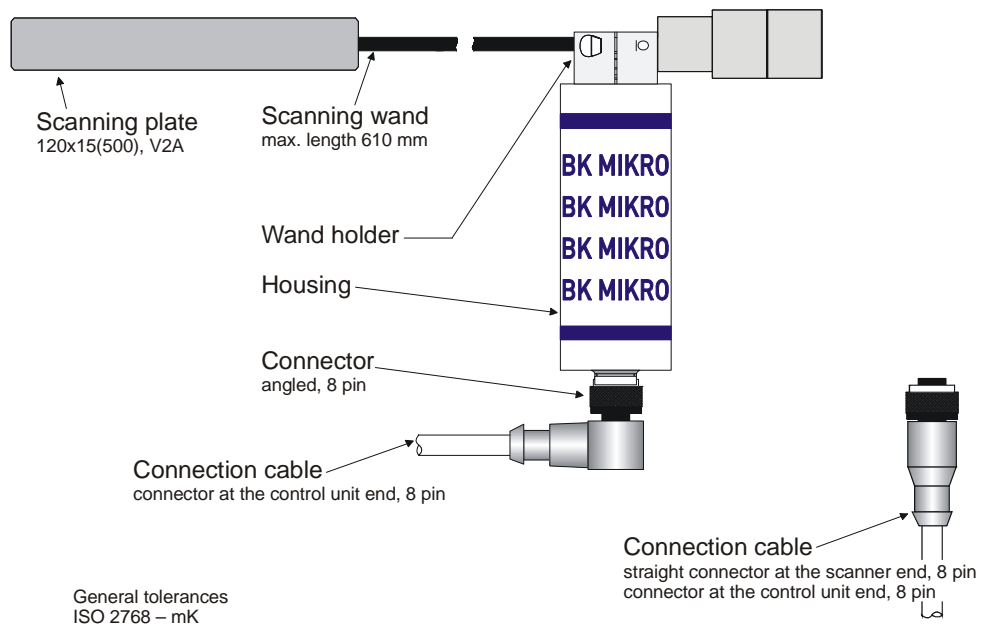


Fig. 2-15: Scanner TK91A with 3 balance weights

2.3.5 Balance weights for TK91A

A balance weight may be necessary for long scanning wands that are not capable of horizontal scanning. The more balanced a wand is, the better the scanning result. A balance weight set (Art.-no. 62 04 282) with one small and two large weights are available for balancing.

Use of the balance weights for wands of different lengths

| | | |
|--------------------|-------------------|-----------------------|
| Wand length 380 mm | 2 Balance weights | 1 x small + 1 x large |
| Wand length 510 mm | 3 Balance weights | 1 x small + 2 x large |
| Wand length 610 mm | 3 Balance weights | 1 x small + 2 x large |



Note:

The measuring result may worsen at horizontal installment without balance weight. Function of the BKM9 system in extreme installment positions and with long wands without balance weight can not be guaranteed for.

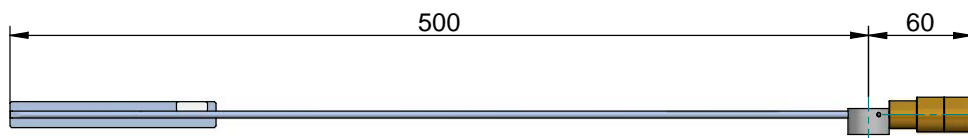


Fig. 2-16: Dimensions in mm with 3 balance weights

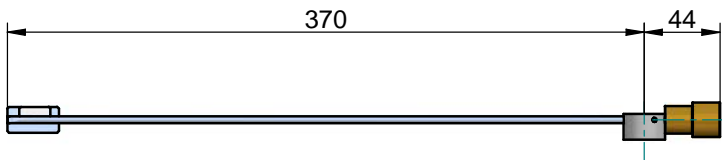


Fig. 2-17: Dimensions in mm with 2 different balance weights

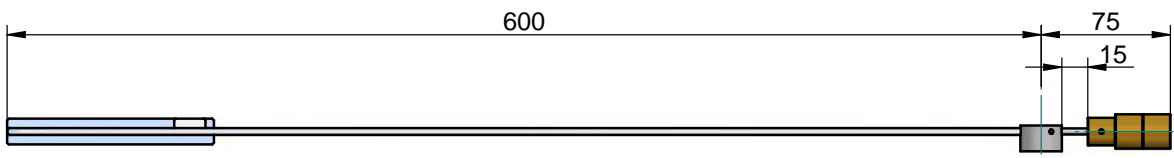


Fig. 2-18: Dimensions in mm with 3 different balance weights



Note:

A distance of 15 mm between wand holder and balance weights is necessary for a wand length of 610 mm!

2.3.6 Scanner TK94A and TK94RL

We offer two types of scanners for the different applications.

The sole difference between the two scanners is that the rotary movement of TK94A wand is limited by a screw inside the housing, the mechanical backstop.

TK94A – Scanner with mechanical backstop

Scanner for scanning in one direction: CW or CCW

TK94RL – Scanner without mechanical backstop

Scanner for scanning in both directions: CW-CCW or CCW-CW, in special cases for scanning in one direction: CW or CCW



Note:

- Due to its small diameter, a wand is easily overlooked.
- Your wand is a wearing part! Each contact with a rotating object will cause corresponding wear on the wand. This may even lead to the metal wand breaking.

Due to the injury hazard this causes, users should exercise particular caution within any BK MIKRO rotating area.

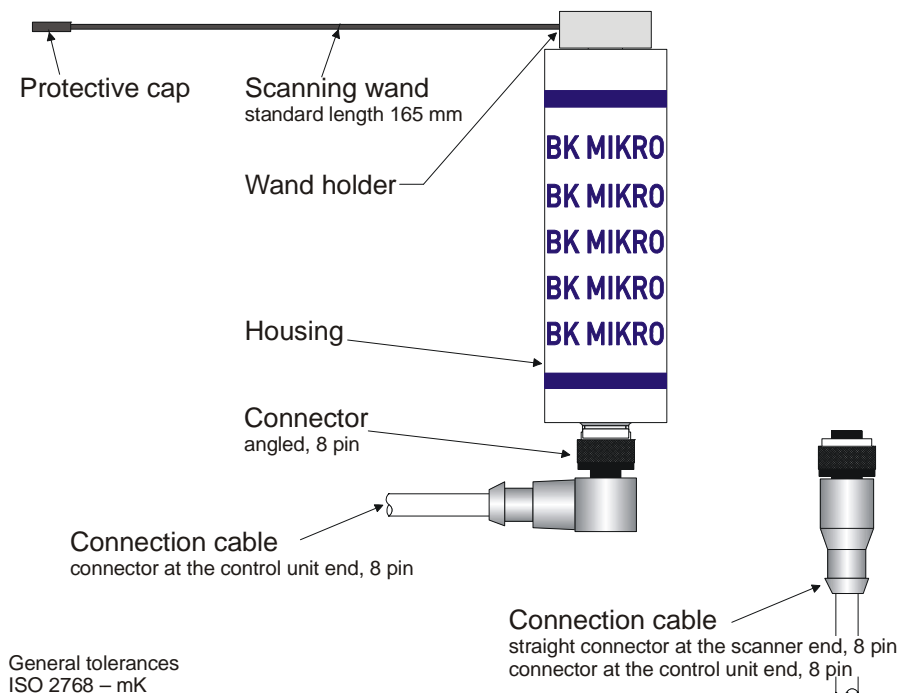


Fig. 2-19: Scanner TK94A / TK94RL



Note:

To prevent injury, your wand will be supplied complete with a protective cap.

Option: Air barrier light connection

To protect the scanner TK94A/RL better against coolant and swarf, we recommend the use of the air barrier light connection, at this air barrier light connection must be connected a compressed air hose.

With especially aggressive coolant, we recommend the air barrier adapter, see chapter 2.5.

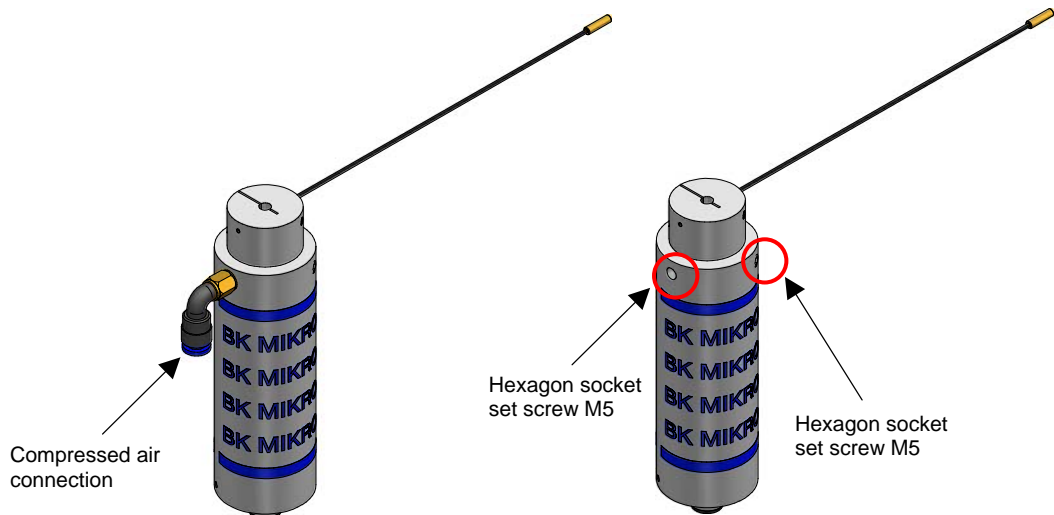


Fig. 2-20: Option: Air barrier light connection TK94A / TK94RL

Two compressed air connections of the TK94A/RL are included, which can be installed if required. In the two borings of the scanner, two hexagon socket set screw M5 are inside as a protection, these must be removed before the compressed-air connections can be installed. As pressure is recommended 0.5 bars.

2.3.7 Scanner TK9LIN50/100

The "LIN" series is designed for verify functions in longitudinal scanning, where rotary scanning is inappropriate or impossible e.g. with cavities, bore holes or limited space.

Any scanning range between stop position and maximum stroke can be used.

Two types of scanners with a different stroke are available:

- TK9LIN50 with 50 mm stroke
- TK9LIN100 with 100 mm stroke

In case of use the TK9LIN50/100 scanner is measured basically instead of grade the length and unit mm.



Note:

- Your wand is a wearing part!

Due to the injury hazard this causes, users should exercise particular caution within any BK MIKRO rotating area.

Example:
TK9LIN50

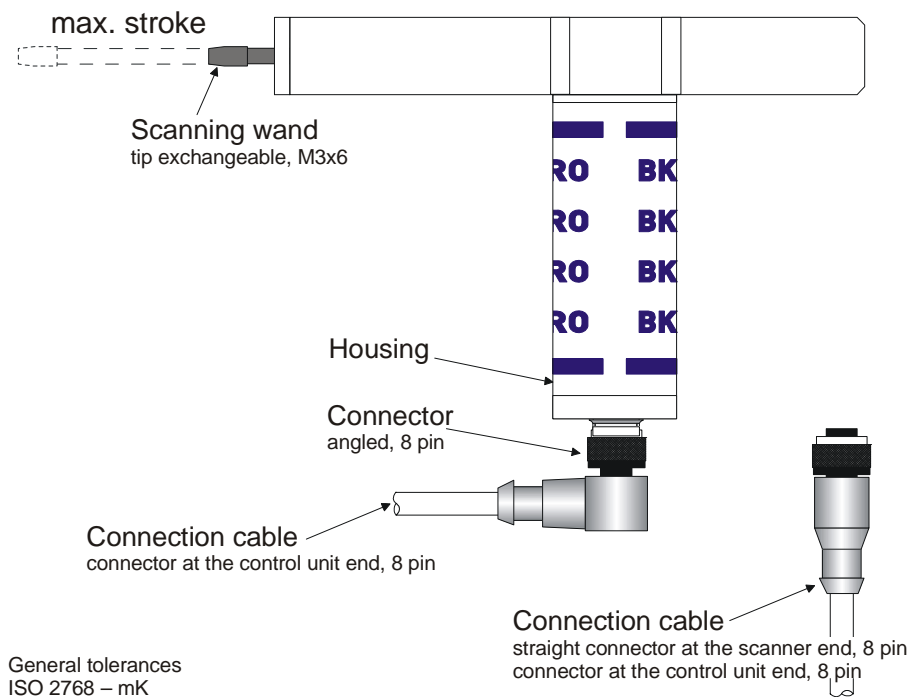


Fig. 2-21: Scanner TK9LIN50



Note:

In case of use the TK9LIN scanner all positions are indicated in mm. The mm refers to the move of the wand, e. g. ObjektPos 23.75 mm.

Option: Compressed air balance

As an option the TK9LIN50/100 scanner have a compressed air balance connection. Its possible that the scanner intakes liquids with the time and will be filled is in areas with coolant (liquids). About the compressed air balance connection can run-off the intakes liquid.

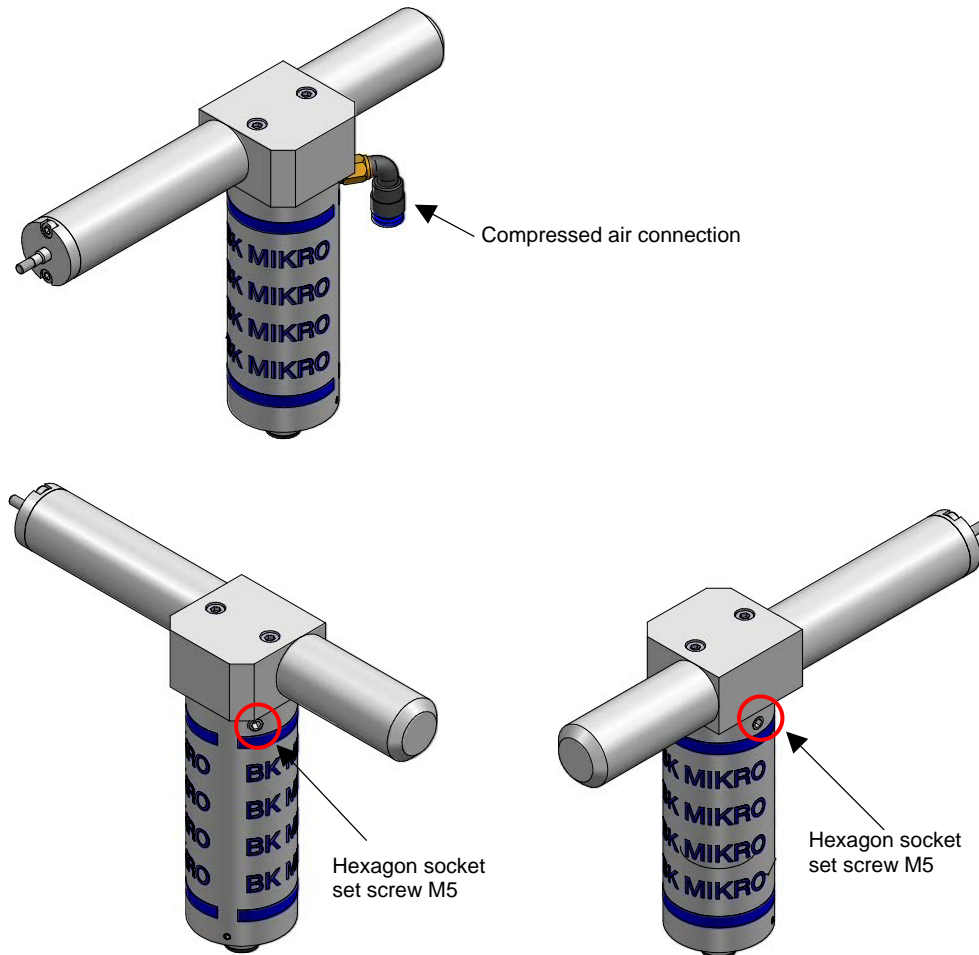


Fig. 2-22: Option: compressed air balance TK9LIN50/100

Two compressed air connections of the TK9LIN50/100 are included, which can be installed if required. In the two borings of the scanner, two hexagon socket set screw M5 are inside as a protection, these must be removed before the compressed-air connections can be installed. On the compressed-air connections must be applied a compressed air hose, whose end is open and stands at a protected place against liquids. With this measure can be increased the service life of the wand under liquids.

2.4 Exchanging of the Scanning Wand

The wand can be easily removed from the wand holder by loosening the hexagon socket (M3). Insert new wand into the wand holder and tighten.

Notes for wand exchange

Wands of **solid material**: (Art.-no.: 6204022, 6204215, 6204216, 6204231 or similar)



These wands may be shortened or bent as pleased.

Wands of **hollow material**: (Art.-no.: 6204260, 6204266, 6204270 or similar)



Wands may be shortened as pleased. However, bending is not recommended. To prevent crushing, the wand must not be hollow in the section of the scanners positioning screw.

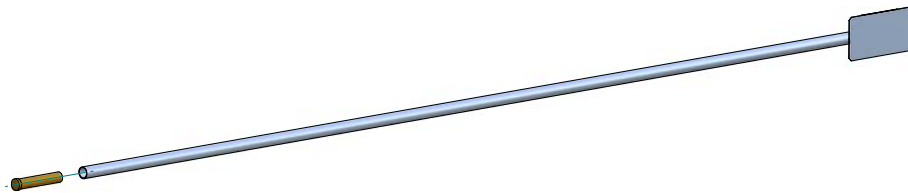


Fig. 2-23: Scanner TK91A – blind plug



Note:

If a hollow wand needs shortening, the provided blind plug or the pole for the balance weight set must be connected at the open end before installation.

2.5 Air Barrier Adapter

Development of the air barrier adapter has been mainly conducted for the use of BK MIKRO scanner in harsh and aggressive environments.




The adapter keeps away liquids and splints from important gaskets with a air barrier adapter. This will lead to an increased scanner life-cycle.



Note

Unfavorable compositions of cooling agents or emulsions may harm the gaskets. The gear mechanism can be blocked and internal electronics may be destroyed if liquids enter the scanner housing.

Various air barrier adapters are designed for selective scanner and scanning wands.

| Accessories and Spare Parts | For Scanner | Article no. |
|--|-------------------|-------------|
| BKM Air barrier adapter Axis $\varnothing = 3$ mm, Wand $\varnothing = 3$ mm  | TK7A/RL TK8A | 62 04 027 |
| BKM Air barrier adapter Axis $\varnothing = 3$ mm, Wand $\varnothing = 1.2$ mm  | TK8A | 62 04 028 |
| BKM Air barrier adapter Axis $\varnothing = 4$ mm, Wand $\varnothing = 1.2$ mm or 4 mm  | TK91A TK94A/RL | 62 04 029 |

Please find installation notes in the appropriate operation manual. (Art.-no. **68 36 266**)

2.6 Connection cable

Control unit and scanner are connected with a 8-wire PUR-cable:

- 8-pole casted plug on the side facing the control unit.
- 8-pole casted plug (straight or angled) facing the scanner.
- Length 5 m or 15 m, extendable up to approx. 25 m with extension cable.
- Suitable for drag chain.



Note:

To increase the operational life of this cable, it should not be subject to more than a minimum amount of movement during operating cycles.

3 Operating Modes

There are three operating modes for the BK MIKRO9 system. According to system configuration the modes are available.

- Via PROFIBUS the system can be completely configured and operated.
- "Digital I/Os" with external expansion for configuration and function selection up to 512 tools.
- Additionally a mini USB-connection is available by that the system can be configured and programmed without an external expansion.

3.1 Operating Mode PROFIBUS-DP

3.1.1 Address setting

The PROFIBUS address setting can be placed via PC or BK Config 9 program with help of the BKM9I/O extension module. The BK MIKRO91 control unit will be delivered with 50 dec.

Setting of the PROFIBUS address via P1 and P2

With scanner selection = 0 via P1 and P2, the profibus address can be set in connection with the BK MIKRO91 control unit. The internally memorized address in the control unit is not regarded.

Settings via P1 and P2 occur hexadecimal. With P1 the rather significant bits are set and with P1 the less significant ones.

Example: Address 50 dec = 32 hex → P1 = 3, P2 = 2

Baud rates

| Supported baud rates | |
|----------------------|-------|
| 9.6 | kbaud |
| 19.2 | kbaud |
| 45.45 | kbaud |
| 93.75 | kbaud |
| 187.5 | kbaud |
| 500 | kbaud |
| 1.5 | MBaud |
| 3 | MBaud |
| 6 | MBaud |
| 12 | MBaud |

The baud rate is identified automatically.

3.1.2 General function sequence

Commands and parameterizing data to the BK MIKRO91 control unit are sent and received by the PLC.

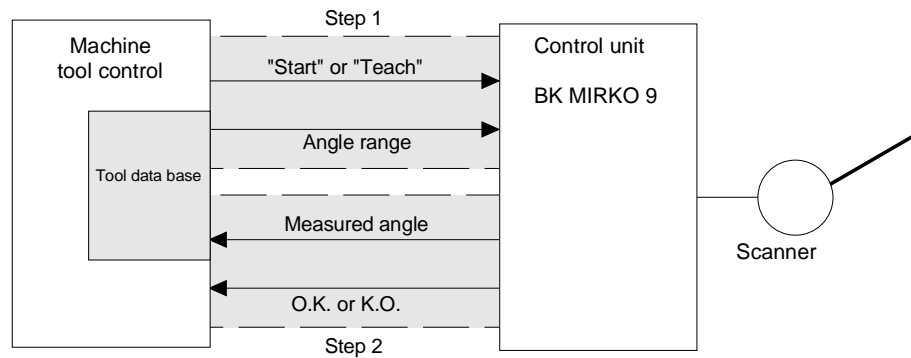


Fig. 3-1: Function sequence

The scanner moves CW or CCW (according to settings) to the zero position (= internal backstop) during switch-on of the control unit.

For this operation it is necessary that the internal backstop can be reached without obstacle between wand and zero position (e.g. object or tool).

3.1.3 Scanning in one direction

Angle set value via data base

In order to check a tool (e.g. drill), the control unit receives a target angle from the machine control system via PROFIBUS. This value has been calculated according to the tool length which is filed in the tool data base. Then the measurement can begin by setting the "start" bit.

If the wand contacts an object within the measuring range, an OK message will be transmitted via PROFIBUS. The digital output for OK message is switched to high or low level.

Angle set value via "Teach"

If a tool without data base entry should be checked, it will be necessary to perform a "Teach" procedure before. The angle set value has to be larger than the effective angle. The value serves only as limit of the angle range during this cycle.

If the wand contacts an object within the angle range, an OK message will be triggered and the measured angle will be transmitted via PROFIBUS to the machine control system.

This angle can be filed in the tool data base to the corresponding tool. To check the tool, the stored angle value (with tolerance) is transmitted to the control unit. Then the measurement can begin by setting the bit "start".

"Start" cycle with CW travel

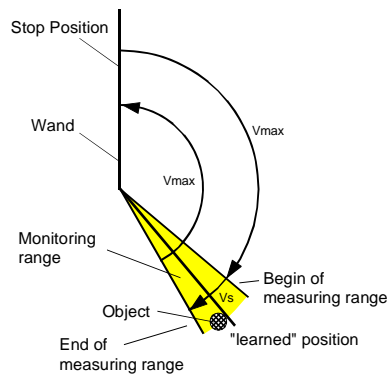


Fig. 3-2: "Start" cycle with CW travel

Monitoring range = learned (defaulted) position ± tolerance

- V_{max} = max. speed of scanning wand
- V_s = speed of scanning wand preset by "Scanning intensity"

3.1.4 Activation of the tool table (PC configuration software BK MIKRO9)

With the program BK-Config BKM9 different attributes and functions can be programmed for different tools. Every tool have a number and is performed in a table. With the help via USB-interface the table can be loaded into the control unit.

Normally the table is activated via the I/Os of the expansion module. This is also possible via PROFIBUS.

If the "Tabelle" bit is set in the control word AW2, the angle set value AW3 get a new definition: due to the tool number (Table position) can be selected. The "Start" bit in the control word AW2 is executed the function of the table.

With a "Teach" the function is also executed and the object position new learned. The "GoBack", "GoPos", "Preposition" bits and the tolerance byte have no significance at active "Table" bit. Due to this procedure can be started functions, which are not directly can be reached via profibus, e.g CCW/CW scanning.

3.1.5 Scanning in both directions (only via PROFIBUS)

A new stop position between two objects (tools) can be allocated the wand by a freely definable angle set value with the function "Go position".

No objects (tools) must be within the movement area of the wand during this process! After the wand has reached this new stop position, the two objects can be charged and sampled. The scanning direction can be defined by the angle set value.

Function

If the bits "Go position" and "Start" or "Go position" and "Teach" are set simultaneously, the wand will begin with the scanning cycle.

The wand moves back to the stored new stop position after the scanning cycle. An OK or KO message will be transmitted to the machine control system simultaneously.

The direction of rotation is defined with the angle set value:

If the angle is larger than the stop position, the wand will move away from the zero position.

If the angle is smaller than the stop position, the wand will move towards the zero position.

The wand can be moved back to the zero position by setting the bit "Go Back".

Requirement: the two objects should have been removed before!

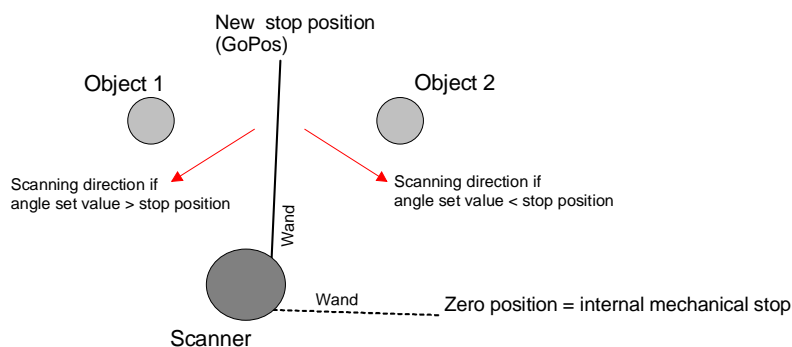


Fig. 3-3: Scanning CW / CCW



Note:

This function is not possible with TK9LIN50/100 scanner!

3.1.6 Reference travel

Using the "Reference travel" function, the scanning wand can be assigned to a new HomePosition by specifying the angle of an object. In doing so, the complete measuring system is reconfigured so that the position of the object precisely matches the specified position. This function is usually used if the parameters of a measuring system have changed, e.g. after replacement of a scanning head.

Sequence

If the "Go Back" and "Teach" bits are set at the same time, the scanning wand starts the scanning process. The object found is then scanned three times in order to improve the accuracy of the measurement. A new rest position (zero position) is calculated afterwards so that an object is now located exactly in the specified position (as in the old system, e.g. before scanning head replacement).

3.1.7 Time-optimized scanning

The scanning procedure of the wand can be timely optimized at the outward as well as the return journey. This will result in idle time savings of the tool.

- Outward journey
 - with help of the command "Preposition"
- Return journey
 - with parameter "collision-free area" (CollFrArea) and the bit "collision-free area" (CollFrArea)
 - with parameter "time frame value" (CollChgTime) and the bit "time range" (CollChgArea)

Outward journey

The command "Preposition" moves the wand into the proximity of the object to be monitored before the actual scanning procedure starts and while the tool can still be positioned. Thereby the factual scanning time, for the time when the object must remain idle decreases immensely.

For example, the wand is prepositioned by command "Preposition" while the tool moves out of the tool magazine. That means, the wand moves with up to 10° to the specified angle and remains idle. Now the command "Start" initiates the scanning procedure if the tool is positioned correctly.

Advantage is the reduced travel distance of 10° to the tool.

The command "Start" can be initiated even if the wand has not completely executed the "Preposition" command.



Note:

Always send a "Zero" between commands "Preposition" and "Start".

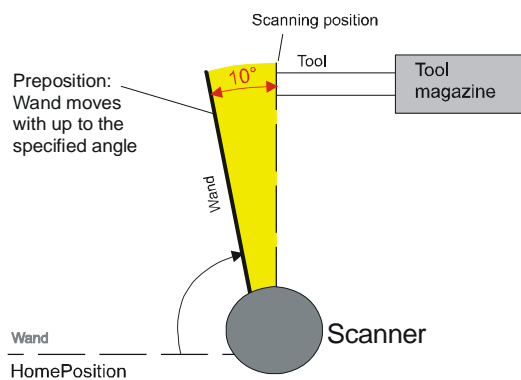


Fig. 3-4: Time-optimized scanning – Preposition

Return travel

The tool shall be moved before the wand reaches home-position.

- The parameter "Collision-free area" defines an area, e.g. the largest tool, as no collision between wand and tool is possible.

Bit "Collision-free area" indicated that the wand presently is located in the defined collision-free area.

The tool magazine, for example, can be moved as soon as this bit is set.

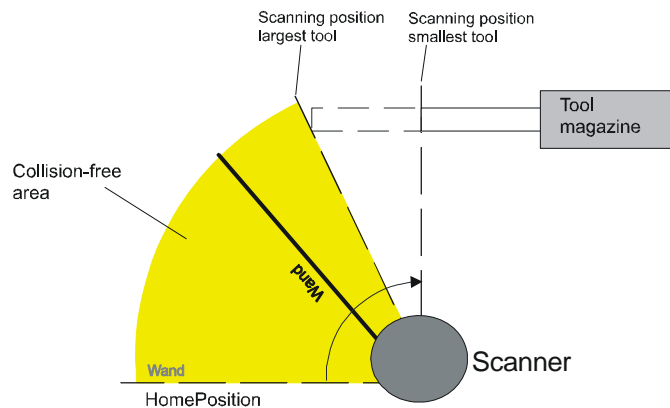


Fig. 3-5: Time-optimized scanning – "Collision-free area"

- Furthermore, idle times in the system, e.g. by moving toward the tool magazine can be avoided. The parameter "Time frame value" determines the required time for this procedure.

The bit "time frame" is set before the bit "collision-free area", which is determined in the parameter "time frame value".

Thus, e.g. moving towards the tool magazine can be initiated already when the wand has not arrived yet in the collision-free area. By the time the tool magazine is actually moving, the wand has reached the collision-free area already.

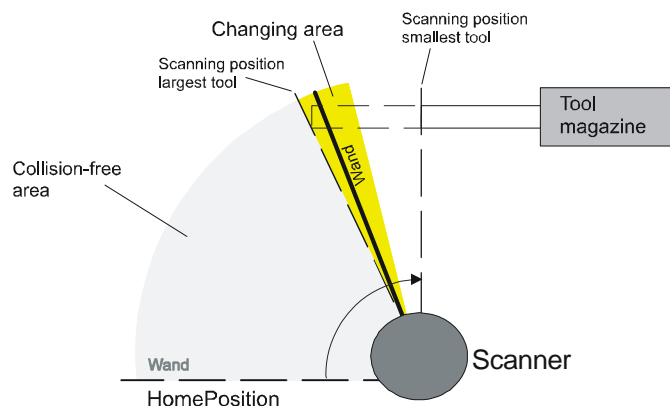


Fig. 3-6: Time-optimized scanning – "Time frame"

3.1.8 GSD File

The appropriate GSD file for BK MIKRO9 is named "MSCT05CF.gsd" and posted in the Internet at:

<http://www.bk-mikro.com>

3.1.9 PROFIBUS DP Protocol

Configuration

PLC → BK MIKRO9: 3 data words output (2 bytes each)

| Output words | | Function |
|--------------|------------|--------------------------|
| AW1 | Bit 0...15 | Parameter identification |
| AW2 | Bit 0...15 | Control word |
| AW3 | Bit 0...15 | Angle set value |

BK MIKRO9 → PLC: 3 data words input (2 bytes each)

| Input words | | Function |
|-------------|------------|--------------------------|
| EW1 | Bit 0...15 | Parameter identification |
| EW2 | Bit 0...15 | Status word |
| EW3 | Bit 0...15 | Angle |

Data from PLC to BK MIKRO9 control unit will be transmitted via control words of the PROFIBUS (process channel).

Data from BK MIKRO9 control unit to PLC will be transmitted via status words.

Data transmission runs cyclically.

3.1.10 PROFIBUS data format

Various PLC`s interpret the byte sequence of the output and input words differently. Thus, the bits 7-0 and 15-8 possibly get mixed up.

Like in the example below, the data is preset and transferred in the "Little Endian" format.

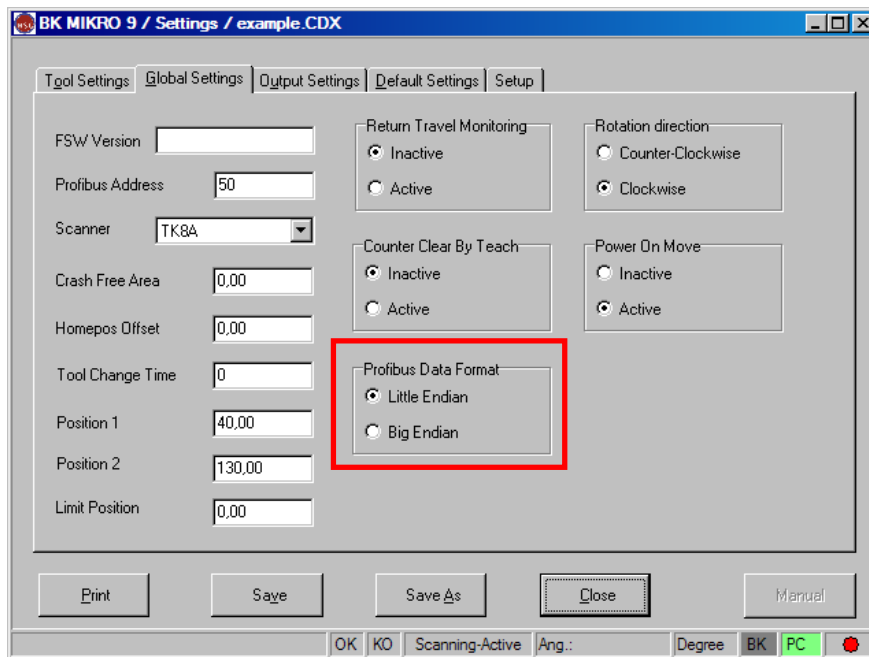
Little Endian AW 2

| | | | | | | | | | | | | | | | |
|-----------|----|----|----|----|----|---|---|-------|---|--------|-------|--------|-------|-------|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Tolerance | | | | | | | | Table | | PrePos | GoPos | GoBack | TEACH | START | |

Big Endian AW 2

| | | | | | | | | | | | | | | | |
|-------|----|----|--------|-------|--------|-------|-------|-----------|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Table | | | PrePos | GoPos | GoBack | TEACH | START | Tolerance | | | | | | | |

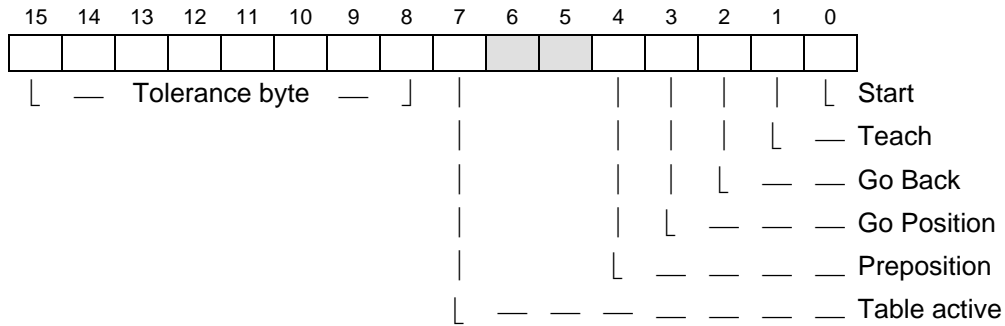
The particular byte sequence can be altered with help of the BK-Config BKM9 PC-program. This means, messages can be sent and received in either the Little Endian or the Big Endian format.



Process data: Output words 2 and 3

From PLC to BK MIKRO9 control unit

Control word AW2

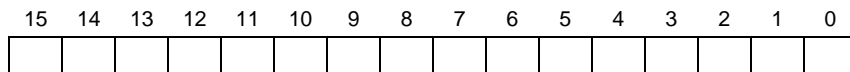


| Tolerance byte | |
|----------------|------------|
| Value | Degree [°] |
| 0 | Param. |
| 1 | 0.1 |
| 2 | 0.2 |
| 3 | 0.3 |
| ... | ... |
| 255 | 25.5 |

Tolerance: Specification of the angle in multiples of 0.1 degree [°]

Accept value of parameter no. 5 (Tolerance range)

Angle set value AW3



| Angle set value | |
|-----------------|------------|
| Value | Degree [°] |
| 0 | 0 |
| 1 | 0.01 |
| 2 | 0.02 |
| 3 | 0.03 |
| ... | ... |
| 65535 | 655.35 |

Angle set value: Specification of the angle in multiples of 0.01 degree [°]

Angle min. 8°: 320 hex = 0000 0011 0010 0000
 Angle max. 300°: 7530 hex = 0111 0101 0011 0000

| Winkelvorgabe | |
|---------------|----------|
| Wert | Grad [°] |
| 0 | 0° |
| 1 | 0.01° |
| 2 | 0.02° |
| 3 | 0.03° |
| ... | ... |
| 65535 | 655.35° |

Winkelvorgabe: Angabe des Winkels in Vielfachen von 0.01 Grad [°]

Min. Winkel 8°: 320 hex = 0000 0011 0010 0000
 Max. Winkel 300°: 7530 hex = 0111 0101 0011 0000

Status words: Input words 2 and 3

From BK MIKRO9 control unit to PLC

Status word EW2

| | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|----------------------------------|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Wand in stop position |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Scanning active |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | OK |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | KO |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Scanning area not reached |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Time frame (CollChgArea) |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Collision-free area (CollFrArea) |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Error: Cable break |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Error: Scanner |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Error: Control unit |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Error: Wand |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Error: Angle set value |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Error: Control word |
| | | | | | | | | | | | | | | └ | └ |
| | | | | | | | | | | | | | | | Error: Parameter |

Angle EW3

| | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ | █ |

| Angle | |
|-------|------------|
| Value | Degree [°] |
| 0 | 0 |
| 1 | 0.01 |
| 2 | 0.02 |
| 3 | 0.03 |
| ... | ... |
| 65535 | 655.35 |

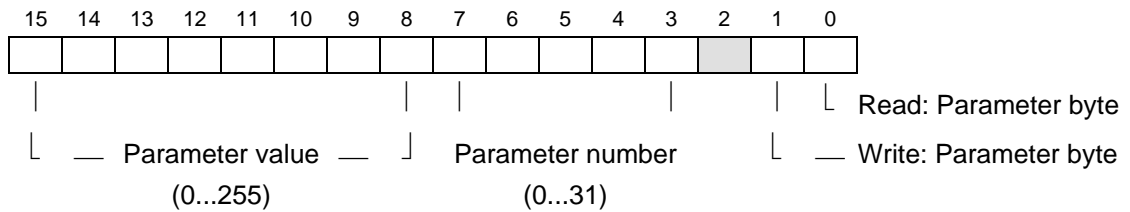
Angle: Specification of the angle in multiples of 0.01 degree [°]

Parameter

The transmission of the parameters runs also cyclically via the process channel of the PROFIBUS.

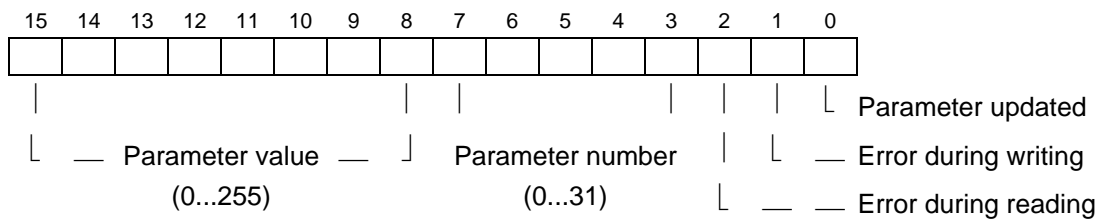
From PLC to BK MIKRO9 control unit

Parameter identification AW1



From BK MIKRO9 control unit to PLC

Parameter identification EW1



Parameter list

| Number | Name | Default | Min. | Max. | Format | Description |
|--------|-----------------------------|---------|------|-------|--|--|
| 0 | Scanning intensity | 0 | 0 | 7 | Dec | 0 = Low 1 = High 2 = Intermediate level 1 3 = Intermediate level 2 4 = Intermediate level 3 5 = Intermediate level 4 6 = Intermediate level 5 7 = Intermediate level 6 |
| 1 | Out1 Relay output | 1 | 0 | 1 | Bool | 0 = InActive normally open 1 = Active normally closed |
| 2 | Out2 Relay output | 1 | 0 | 1 | Bool | 0 = InActive normally open 1 = Active normally closed |
| 3 | Monitoring | 1 | 0 | 7 | Dec | 0 = Free space 1 = Object 2 = GoPos 3 = GoBack 4 = Touch 5 = Reference travel 6 = Object (both sides) 7 = Free space (both sides) |
| 4 | Rotation direction | 1 | 0 | 1 | Bool | 0 = Left 1 = Right |
| 5 | Tolerance range | 300 | 2 | 65535 | 0.1°/mm unit (PB) 0.01°/mm unit (USB) | 3.00°/mm (Default) |
| 6 | Scanner | 0 | 1 | 129 | Dec | 0 = AutoDetect 1 = TK8A 2 = TK7A 3 = TK8A Short Wand 4 = TK9A 5 = TK9A Fast long 6 = TK94A/RL 7 = TK9LIN50/100 8 = TK Reserved 1 9 = TK Reserved 2 10 = TK Reserved 3 128 = User Scanner 1 129 = User Scanner 2 |
| 7 | P1 Low byte | 160 | 0 | 255 | 0.01°/mm unit | Position 1 |
| 8 | P1 High byte | 15 | 0 | 255 | 2.56°/mm unit | 40.00°/mm (Default) |
| 9 | P2 Low byte | 200 | 0 | 255 | 0.01°/mm unit | Position 2 |
| 10 | P2 High byte | 50 | 0 | 255 | 2.56°/mm unit | 130.00°/mm (Default) |
| 11 | Return travel monitoring | 0 | 0 | 1 | Bool | 0 = Outputs do not change. 1 = If wand does not come back during return travel, KO output will be active. |
| 12 | Power On | 1 | 0 | 1 | Bool | 0 = Wand will not travel after Power On. 1 = Wand will travel to stop position after Power On. |
| 13 | Output setting | 0 | 0 | 1 | Bool | 0 = Outputs will set at the object position 1 = Outputs will set at the Home-Position |
| 14 | Output back setting | 0 | 0 | 1 | bool | 0 = Outputs will set back at the next scanning. 1 = Outputs will set back with a fallen "Start"-Signal. |
| 15 | HomePos offset | 0 | 1 | 255 | °/ unit | 0 = Inactive 1..255 |
| 16 | Reserved | - | - | - | - | - |
| 17 | Reserved | - | - | - | - | - |
| 18 | Home-position-Offset | 0 | 0 | 255 | 0.1°/mm unit (PB) 0.01°/mm unit (USB) | 0.00°/mm (Default – adopt scanner parameter) |
| 19 | Time frame value | 0 | 0 | 255 | 1ms unit | 0ms (Default – tool replacement area = tool free-space) |
| 20 | Collision-free area | 0 | 0 | 255 | 1°/mm unit (PB) 0.01°/mm unit (USB) | 0.00°/mm (Default – adopt scanner parameter) |

| | | | | | | |
|----|------------------------------|-----------|---|-----|-------------|---|
| 21 | Monitoring unit | 0 | 0 | 1 | Bool | 0 = Grad 1 = Millimeter |
| 22 | Distance Low byte | 0 | 0 | 255 | 0.01mm unit | 0.00mm (Default) |
| 23 | Distance High byte | 0 | 0 | 255 | 2.56mm unit | |
| 24 | Reference angle Low byte | 0 | 0 | 255 | 0.01° unit | 0.00° (Default) |
| 25 | Reference angle High byte | 0 | 0 | 255 | 2.56° unit | |
| 26 | Tool length Low byte | 0 | 0 | 255 | 0.01mm unit | 0.00mm (Default) |
| 27 | Tool length High byte | 0 | 0 | 255 | 2.56mm unit | |
| 28 | BKM variant | Read_only | | | Hex | 10h = Basic93 20h = Premium91 21h = Premium92 22h = Premium911 |
| 28 | BKM variant | Read_only | | | Hex | 10h = Basic 20h = Premium |
| 29 | Date month | Read_only | | | Dec | Date month |
| 30 | Date year | Read_only | | | Dec | Date year |
| 31 | FW version | Read_only | | | Dec | Software version |

Declarations concerning parameters

The table shows the allocation of parameters 0 ... 31.

There are parameters that can be read and to which can be written, as well as read_only parameters that can only be read.

An attempt to write a read_only parameter causes an error message.

0. Scanning intensity
Scanning intensity determines permissible force and permissible speed during learning cycle and/or within tolerance range of start cycle. There are 8 steps of setting.
- 1./2. Out1, Out2
Using these parameters, the relay output 1, relay output 2 can be defined as to how they should behave in the "active" condition.

After switch-on these outputs are always on the set state "normally closed" or "normally open" without a scanning has occurred before.
3. Monitoring
Using this parameter, object or free space monitoring can be specified.
In the case of object monitoring, an object is scanned and the OK output is active for the presence of the object in the specified range or the KO output is active if the object is not present.
In the case of free space monitoring, it is checked whether the specified range for the wand can be exceeded without encountering an obstacle.
A learning cycle in this mode is practically meaningless.
The ranges are specified either using the angle and tolerance definitions or using the P1 and P2 position parameters. If the angle defined here is 0, P1 and P2 are used as the tolerance range.
The "Tolerance range" parameter value is used as the +/- tolerance range if 0 is input for the tolerance here.
The wand travels to a specified position (GO Position) for the positioning run which is specified by the object position.
For "Go Back", the wand travels in a specified direction until it encounters an obstacle (in the normal case, this is the internal end stop). A HomePosition is defined and set for this position.
For the contour monitoring (touch), the wand travels against an object until the monitoring is stopped. The current position of the wand is monitored in doing so. Outputs for "warning" and "error" ranges are then set or reset corresponding to the wand position. It can be established from this monitoring, e.g. whether a scanned product is the 1st, 2nd or 3rd choice.
In the case of scanning on both sides, objects or free spaces can be monitored in both directions (with respect to the starting position).

4. Rotation direction
Using this parameter the scanning direction can be changed.
As soon as the parameter is changed, the wand starts to the "new stop position" and will set a "new" reference position.

5. Tolerance range
The tolerance range can be set by this parameter. With this information the tolerance range has not to be set in start cycle.

Tolerance range = 0 in control word: +/- parameter value is used as tolerance range.

6. Scanner
Settings of the scanner (for further applications).

**Note:**

The system must be rebooted for alterations of the scanner parameter to ensure correct data transferal.

- 7./8. Position 1: P1 Low byte, P1 High byte and
- 9./10. Position 2: P2 Low byte, P2 High byte

Using these parameters the angle set value can be preset by P1 and P2.
These values are used as range set value as soon as angle set value = 0.

11. Return travel monitoring
Using this parameter the OK output can be activated in case of non-attaining the stop position. If return travel monitoring is not active, this information can also be interrogated in bit
"Wand in stop position" via PROFIBUS.

12. Power On
Using this parameter it can be prevented that the wand starts moving immediately after switch-on of the power supply.

Usually set parameter to 0: Default!

13. Setting outputs
The outputs can be switched either for the object position or not until the rest position.

- 14. **Resetting outputs**
The outputs can be reset either with the next scan or with the falling "Start" signal.
- 18. **HomePosition**
The wands "HomePosition" can be altered between 0.1° and 25.5° prior to mechanical backstop.
- 19. **Time frame value**
This value determines when the bit "time frame1" will be set (before the bit "collision-free area").
- 20. **Collision-free area**
Here the "Collision-free area" of the wand is defined (e.g. outside a tool magazine).
- 21. **Monitoring unit**
All objects and free spaces can be monitored in two different ways:
 - in degree units: all information are in degrees [°]
 - in millimeter units: all information are in millimeters [mm]



Note:

In order to use the millimeter mode, the following three parameters must be configured as reference for millimeter conversion: Distance, Reference angle and Tool length.

22./23. **Distance**

This parameter corresponds to the distance between the wand axis and the tool at the 90° position of the tool to the wand.

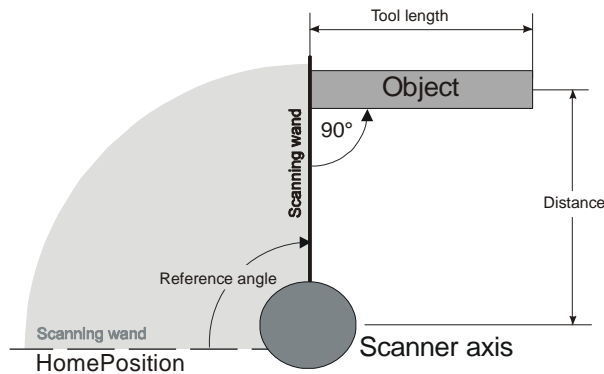


Fig. 3-7: Distance



Note:

In order to use the millimeter mode, the following three parameters must be configured as reference for millimeter conversion: Distance, Reference angle and Tool length.



Note:

This function is not possible with TK9LIN50/100 scanner!

24./25. Reference angle

This parameter corresponds to the angle between the tool and the rest position at the 90° position of the tool to the wand.

**Note:**

In order to use the millimeter mode, the following three parameters must be configured as reference for millimeter conversion: Distance, Reference angle and Tool length.

26./27. Tool length

This parameter corresponds to the tool length at the 90° position of the tool to the wand.

**Note:**

In order to use the millimeter mode, the following three parameters must be configured as reference for millimeter conversion: Distance, Reference angle and Tool length.

3.2 Operating Mode Digital I/O

The wand moves into home-position when turning-on the control unit. That means, turning to the left or right on the internal backstop, depending on the preset parameters.

That's why there is to provide, that the wand can move freely into home-position without previous stop at an object or tool.

"Teach" cycle

If a pulse to the "Teach" input is set, the wand will begin with the scanning cycle. The wand swivels out until it contacts on an object. This position will be stored in the control units internal data base. The number of the tool is defined by the selected teach input.

The default values for tolerance and scanning intensity can be adjusted with the configuration software or with the DIP switches.

Whether the wand has not contacted any object during the "Teach" cycle, it moves to the angle which is above of the "Teach" position parameter, returns and sets the "KO" message.

"Start" cycle with CW travel

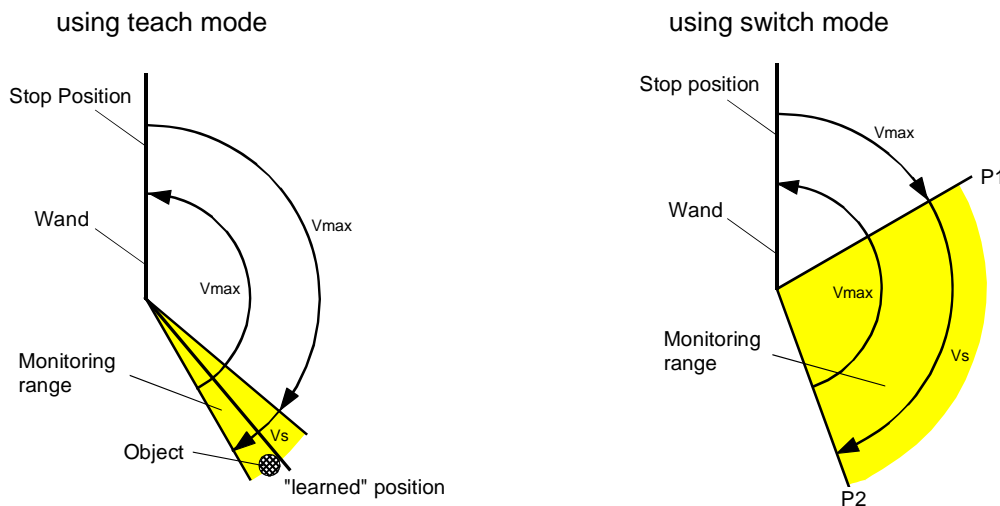


Fig. 3-8: "Start" cycle with scanning in both directions

Monitoring range = Range of tolerance for "OK" message

- V_{max} = max. speed of scanner
- V_s = speed of scanner preset by "Scanning intensity" toggle switch

The tool number that you would like to check needs to be selected with the correct binary pattern, then the "start" impulse is applied. The wand will then begin the scanning process.

If the wand contacts the object at the learned position, an "OK" message will be set. If the wand stopped before the monitoring range or exceeds the area, a "KO" message will be set.

The wand swivels with high speed and slows down to scan the monitoring range with reduced speed and strength.

For the real scanning process, i.e. after a "Start" pulse, initially, the scanner will travel at maximum speed to the start of a given monitoring range. However, its motor will slow down to a preselected scanning speed in time before a learned position using teach mode or a preselected angle set by rotary switch using switch mode is reached.

Subsequently, passing through the area to be monitored and scanned occurs with the set intensity.

If the system detects that the scanner no longer moves or has exceeded the end of the monitoring range, the direction of rotation immediately changes, and the scanner will return at maximum speed into its stop position.

Depending on the result of scanning the corresponding relay will be activated, and the LED belonging to will indicate the result at the control unit.

3.2.1 Switch mode = monitoring with setting scanning range

Requirement: Rotary switches $0 \leq P1 < P2 \leq 270$

Rotary switch P1 and P2 settings will define the scanning range.

In this mode of operation, BK MIKRO is suitable for **monitoring tools** with differing diameters (object monitoring) as well as for **ejection monitoring** (free space monitoring):

Two rotary switches are used to define a scanning range which is to be monitored before each working cycle.

With P1 is defined the start and with P2 the end of a scanning range. During the object monitoring an "OK" will be transmitted, if the wand contacts an object in the scanning range.

3.2.2 Control operation "Object monitoring"

Using "Object monitoring", the control unit will change into an "OK" state, i.e. it will issue a good message, if during a scanning cycle the operation sequence described below is followed:

- The scanner leaves its stop position.
- The angle preset via rotary switch P1 has been exceeded.
- The angle preset via rotary switch P2 has not been reached.

3.2.3 Control operation "Free space monitoring"

The control operation "Free space monitoring" differs from the object monitoring mode in that within its monitoring range no object must be detected.

Its "OK" state is characterized by:

- The scanner leaves its stop position.
- The angle preset via rotary switch P2 has been exceeded.



Caution:

When performing "Free space monitoring", **broken wand** will always trigger an **"OK" signal**.

3.2.4 Output of results

- Fault message (KO)

A fault message will be output immediately on detection.
The scanner will return to its stop position.

- Good cycle message (OK)

- without return travel monitoring:

Results will be indicated on reaching the scanner's stop position.



Note:

Its return travel will not influence scanning results.

- with return travel monitoring:

On reaching the stop position, scanning process results will be indicated.

This ensures that the scanner will have left the monitoring range at the time the results are output and that there are no further waiting periods to be considered.

In the **"OK" state**, the "OK" relay will be active, while the "KO" relay remains inactive.

In **all other cases**, "KO" will be indicated, i.e. the "OK" relay will be inactive, the "KO" relay will be active.



Note:

"KO" will not only be indicated when a tool has broken but also when the scanner cannot leave its stop position for any reason (e.g. mechanical "sticking", cable break etc.).

The results of a scanning cycle will remain latched until the following cycle starts.

3.3 Function Mini-USB

Configuration program for BK MIKRO9

It is possible to control and parameterize the control unit BK MIKRO9 via USB-interface of a host-PC with the help of the configuration program "System Setup BK MIKRO9".

After starting the configuration program, the start-page will appear where various functions can be selected in the menu.

Up to 512 functional attributes like specified angle, tolerance and dead stop power can be defined in the programming operation.

The present status of tool monitoring in detailed format is displayed in manual mode.

Furthermore, the wand can be operated or set manually (=>Manual Mode). A trace function for long-term monitoring is available (=>Trace).

Please find more information in the help menu of the program. The free program can be downloaded at:

<http://www.bk-mikro.com/de/>

4 Technical Data

4.1 Control Unit

| | |
|---|---|
| Housing | Insulating material housing, protection class II, built-in unit |
| Protection type | IP 20 |
| Dimensions (W x H x D) | 22.6 mm x 99 mm x 113.6 mm |
| Case mountings | Sectional rail, 35 mm, to DIN EN 50022 |
| Power supply voltage | 24 VDC $\pm 20\%$ SELV ¹⁾ $I_{max} = 1 A$ |
| Power consumption | 24 VA max. |
| Control voltage | 24 VDC $\pm 20\%$ SELV ¹⁾ |
| Inputs - Input current - Pulse duration | Galvanically isolated 5 mA approx. 30 ms min. |
| Switched outputs | 2 x 30 VDC, 1 A max. |
| Operational life of relay | 5x10 ⁵ switching cycles (depending on switching current) |
| Connections | Plug-in screw terminals for connecting - power supply, relay outputs, control inputs Scanner, small circular socket, 8 pin Mini-USB PROFIBUS, Sub-D socket, 9 pin, (only BKM91 Premium) |
| Climatological conditions | Classification 3K3 under EN 50178 |
| Ambient temperature | 0 °C to +50 °C |
| Storage temperature | -25 °C to +80 °C |

¹⁾ The voltage applied must meet the requirements for an safety-low voltage (SELV) according to EN 60950. DC Power input LV (Limited Voltage) and LC (Limited Current) according to UL 508. A protection approved according to UL248 with a maximum of 4A should be switched between the voltage supply and the BK MIKRO9 control unit.

Mechanical Dimensions

- Mechanical Dimensions are considered for all control units BK MIKRO9.

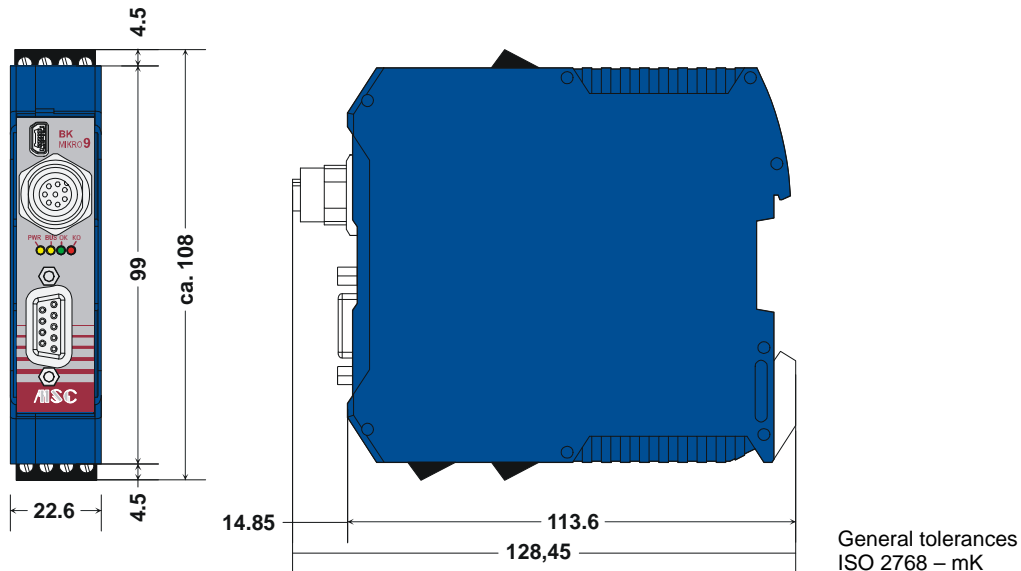


Fig. 4-1: Mechanical Dimensions – Control Unit BK MIKRO9

4.2 I/O Expansion Module

| | |
|---|--|
| Housing | Insulating material housing, protection class II, built-in unit |
| Protection type | IP 20 |
| Dimensions (W x H x D) | 22.6 mm x 99 mm x 113.6 mm |
| Power supply voltage | 24 VDC $\pm 20\%$ SELV ¹⁾ |
| Inputs – Input current – Pulse duration | Galvanically isolated 5 mA approx. 30 ms min. |
| Switched outputs | 2 High side switch with maximum output current 0.5 A |
| Connections | Plug-in screw terminals for connecting – 10 Inputs, 2 Outputs (with power supply voltage) |
| Climatological conditions | Classification 3K3 under EN 50178 |
| Ambient temperature | 0 °C to +50 °C |
| Storage temperature | –25 °C to +80 °C |

¹⁾ The voltage applied must meet the requirements for an safety-low voltage (SELV) according to EN 60950. DC Power input LV (Limited Voltage) and LC (Limited Current) according to UL 508. A protection approved according to UL248 with a maximum of 4A should be switched between the voltage supply and the BK MIKRO9 control unit.

Mechanical Dimensions

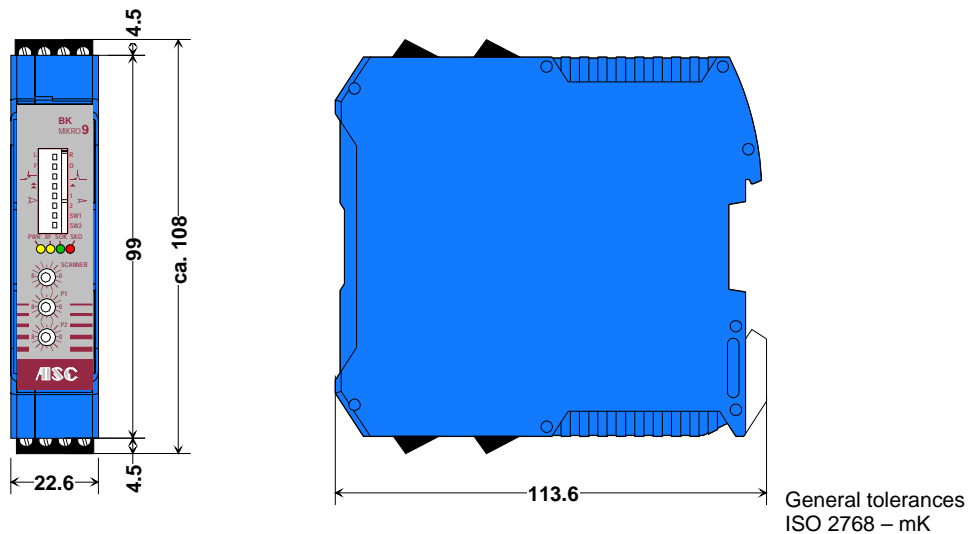


Fig. 4-2: Mechanical Dimensions – I/O Expansion Module

4.3 Scanner TK7A and TK7RL

| | |
|-------------------------------------|--|
| Housing | Anodized aluminum |
| Protection type | IP 67 |
| Scanning wand length | 250 mm (standard), Ø: 1.2 mm, scanning wand exchangeable |
| Scanning angle – TK7A – TK7RL | max. 270° (-A) max. 360° (-RL) |
| Control unit connection | Small circular connector, M12x1, 8 pin |
| Ambient temperature | 0 °C to +80 °C |
| Storage temperature | -25 °C to +85 °C |
| Scanning cycles | > 5 million at minimum scanning intensity |

Mechanical Dimensions

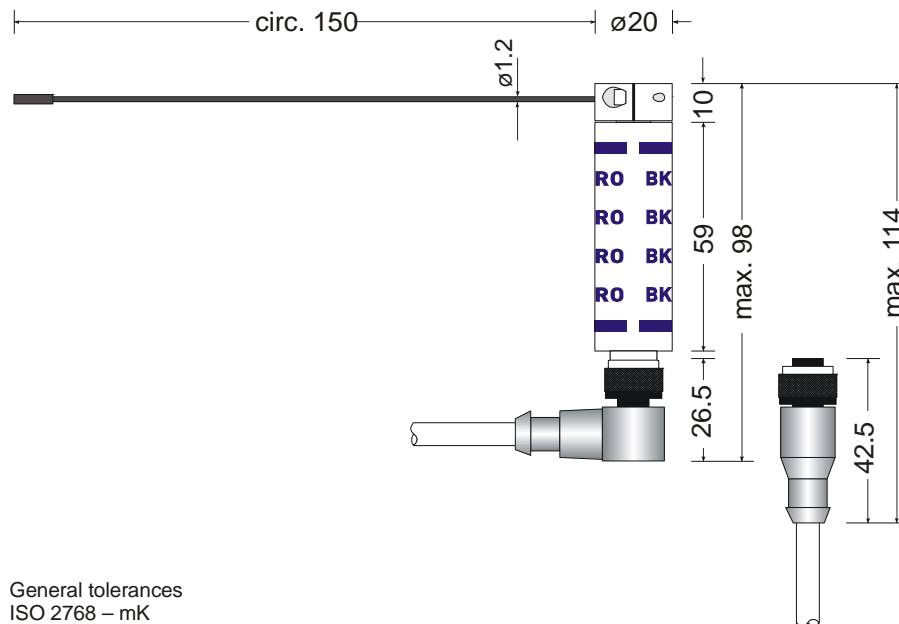


Fig. 4-3: Mechanical Dimensions – Scanner TK7A / TK7RL

4.4 Scanner TK8A

| | |
|-------------------------|---|
| Housing | Anodized aluminum |
| Protection type | IP 67 |
| Scanning wand length | 380 mm, with plate 80 mm x 15 mm, 284 mm, with plate 65 mm x 15 mm, wand exchangeable |
| Scanning angle | 300° max. (with backstop) |
| Control unit connection | Small circular connector, M12x1, 8 pin |
| Ambient temperature | 0 °C to +80 °C |
| Storage temperature | -25 °C to +85 °C |
| Scanning cycles | > 5 million at minimum scanning intensity |

Mechanical Dimensions

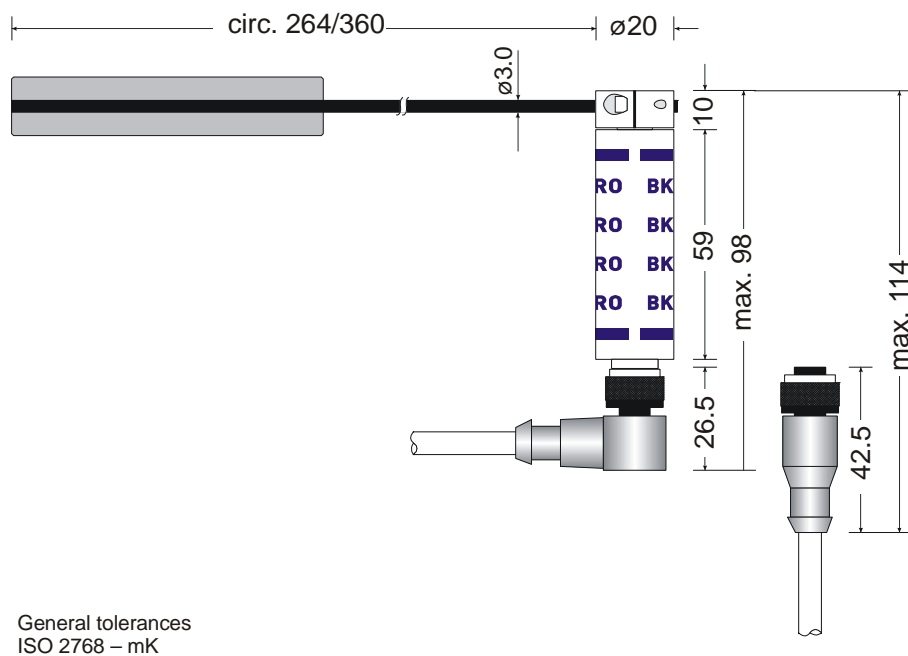


Fig. 4-4: Mechanical Dimensions – Scanner TK8A

4.5 Scanner TK91A

| | |
|-------------------------|---|
| Housing | Anodized aluminum |
| Protection type | IP 67 |
| Scanning wand length | Up to 610 mm max., with plate 120 mm x 15 mm |
| Scanning angle | 300° max. (-A) |
| Control unit connection | Small circular connector, M12x1, 8 pin |
| Ambient temperature | 0 °C to +80 °C |
| Storage temperature | -25 °C to +85 °C |
| Scanning cycles | > 5 million at minimum scanning intensity |

Mechanical Dimensions

For example:
TK91A with 510 mm scanning wand length and 3 balance weights

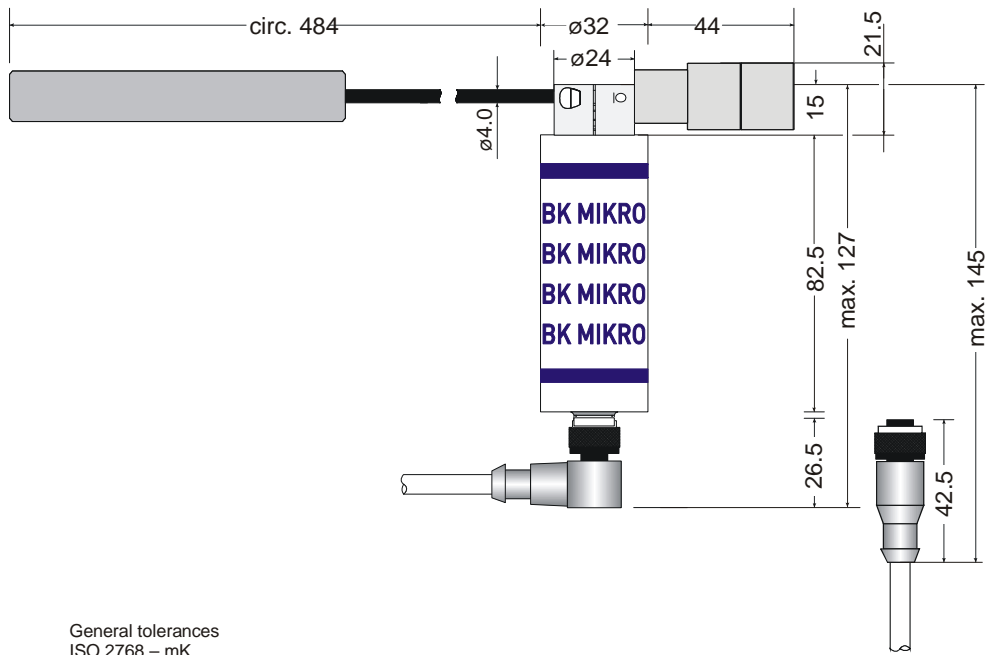


Fig. 4-5: Mechanical Dimensions – Scanner TK91A

4.6 Scanner TK94A

| | |
|-------------------------|--|
| Housing | Anodized aluminum |
| Protection type | IP 67 |
| Scanning wand length | 165 mm (standard), \varnothing : 1.2mm, scanning wand exchangeable |
| Scanning angle | 300° max. (-A) |
| Control unit connection | Small circular connector, M12x1, 8 pin |
| Ambient temperature | 0 °C to +80 °C |
| Storage temperature | -25 °C to +85 °C |
| Scanning cycles | > 5 million at minimum scanning intensity |

Mechanical Dimensions

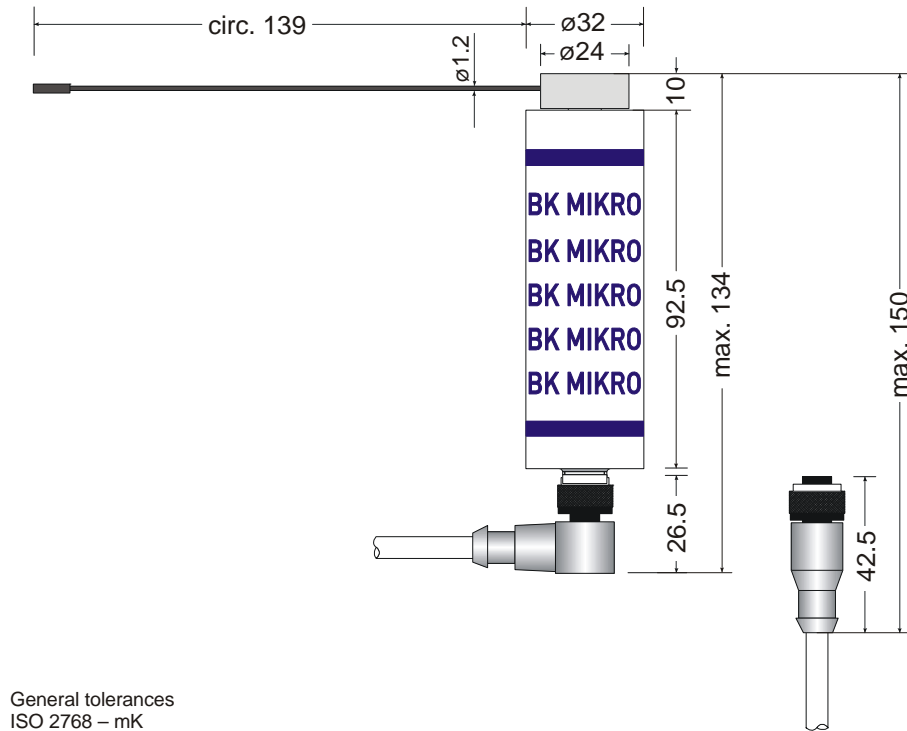


Fig. 4-6: Mechanical Dimensions – Scanner TK94A

Option: air barrier light adapter



Fig. 4-7: Mechanical Dimensions – Option Air barrier light adapter

4.7 Scanner TK9LIN50

| | |
|-------------------------|---|
| Housing | Anodized aluminum |
| Protection type | IP 64 |
| Scanning tip | Exchangeable, thread M3x6 |
| Scanning wand length | Up to 67 mm |
| Scanning angle | 50 mm max. stroke |
| Control unit connection | Small circular connector, M12x1, 8 pin |
| Ambient temperature | 0 °C to +80 °C |
| Storage temperature | -25 °C to +85 °C |
| Scanning cycles | > 5 million at minimum scanning intensity |

Mechanical Dimensions

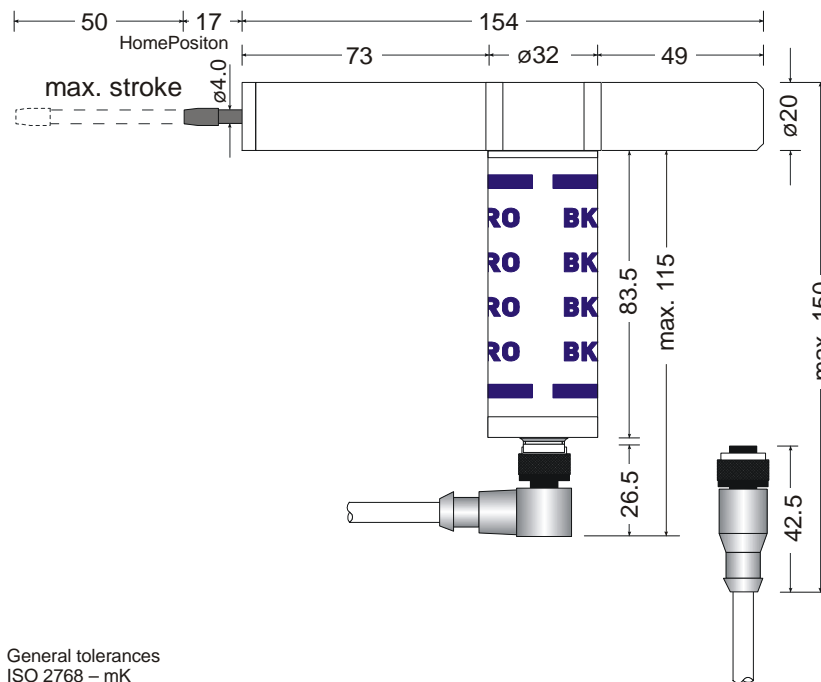


Fig. 4-8: Mechanical Dimensions – Scanner TK9LIN50

Option: compressed air connection

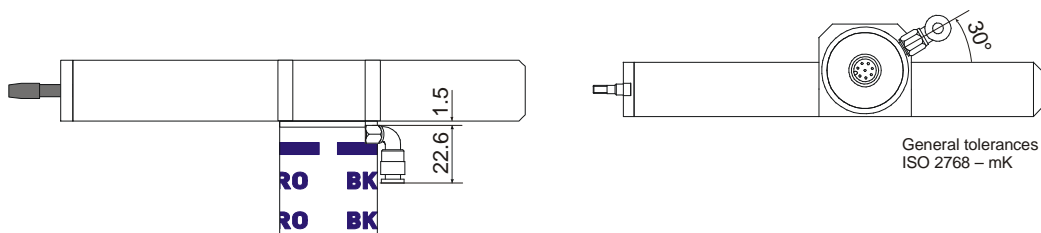


Fig. 4-9: Mechanical Dimensions – Option compressed air connection

4.8 Scanner TK9LIN100

| | |
|-------------------------|---|
| Housing | Anodized aluminum |
| Protection type | IP 64 |
| Scanning tip | Exchangeable, thread M3x6 |
| Scanning wand length | Up to 67 mm |
| Scanning angle | 100 mm max. stroke |
| Control unit connection | Small circular connector, M12x1, 8 pin |
| Ambient temperature | 0 °C to +80 °C |
| Storage temperature | -25 °C to +85 °C |
| Scanning cycles | > 5 million at minimum scanning intensity |

Mechanical Dimensions

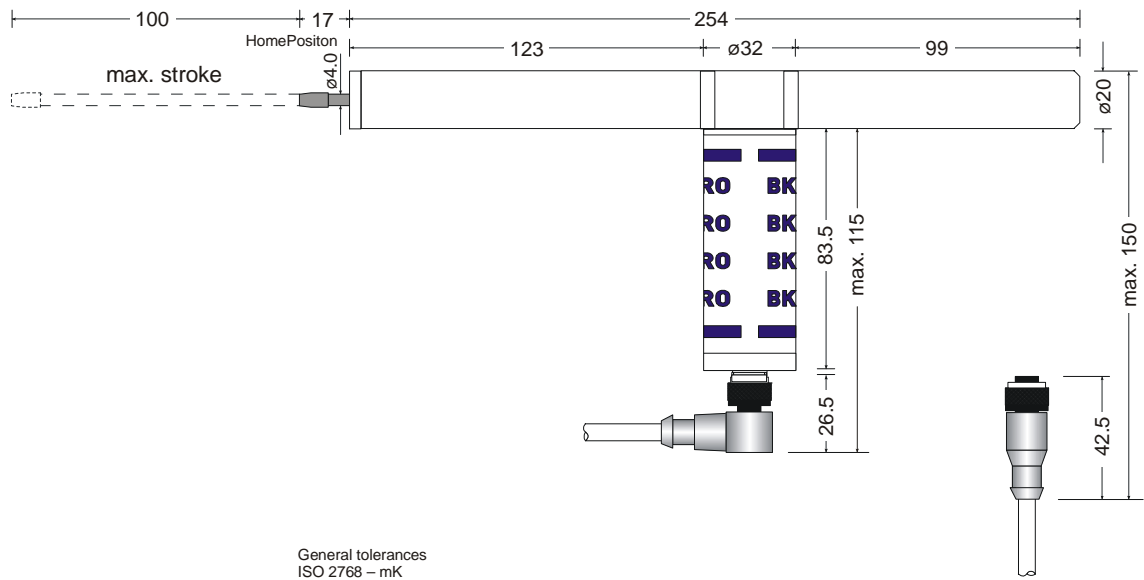


Fig. 4-10: Mechanical Dimensions – Scanner TK9LIN100

Option: Compressed air connection

Example:
TK9LIN50

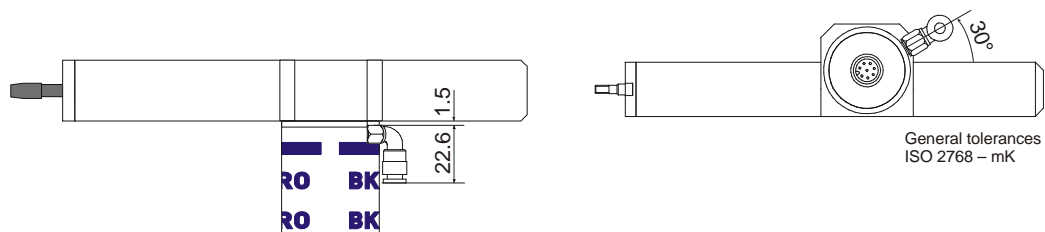


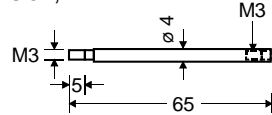
Fig. 4-11: Mechanical Dimensions – Option compressed air connection

4.9 Accessories

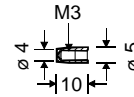
4.9.1 Scanning wand set

Scanner TK9LIN50/100

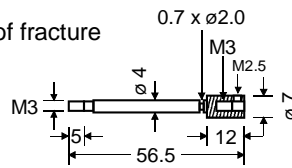
Scanning tip extension,
M3



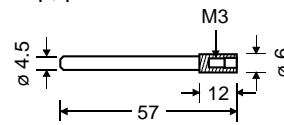
Scanner tip, brass



Adapter (with point of fracture
in case of damage),
M3



Scanner tip, plastic



Wand holder

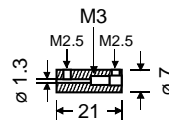


Fig. 4-12: Scanner – Accessories

5 Installation Notes

5.1 Interference prevention

All inputs are opto-decoupled and thus maximally protected against interference voltage peaks, as caused, for example, by inductive sources.

Relay outputs are protected by varistors against inductive interference voltage peaks. Depending on the type of load used, further interference suppression measures may be necessary.

To ensure optimum operational safety, suppression measures, if required, must be taken at the source, i.e. directly where interference is caused.



Possible additional noise filters:

- RC combination (included in the contactor suppliers' product ranges)
- Varistors
- Diodes

6 Ordering Information

| Control Unit | Article No. |
|-------------------------------|-------------|
| BK MIKRO91 Premium with PB | 63 04 242 |
| BK MIKRO92 Premium without PB | 63 04 243 |
| BK MIKRO93 Basic | 63 04 244 |
| BK MIKRO9I/O Expansion Module | 63 04 247 |

| Scanner | Article No. |
|-------------------------------|-------------|
| TK7A, with scanning wand | 63 04 234 |
| TK7RL, with scanning wand | 63 04 235 |
| TK8A, without scanning wand | 63 04 237 |
| TK91A, without scanning wand | 63 04 245 |
| TK94A, without scanning wand | 63 04 249 |
| TK94RL, without scanning wand | 63 04 252 |
| TK9LIN50 | 63 04 250 |
| TK9LIN100 | 63 04 251 |

| Connection | Length | Article No. |
|--|--------|-------------|
| BK MIKRO9 : Control Unit – Scanner | | |
| Control cable, straight connector, 8 pin | 5 m | 62 04 251 |
| Control cable, angled connector, 8 pin | 5 m | 62 04 252 |
| Control cable, straight connector, 8 pin | 15 m | 62 04 253 |
| Control cable, angled connector, 8 pin | 15 m | 62 04 286 |

| Accessories and spare parts | Article No. |
|---|-------------|
| Scanning wands TK7A / TK7RL / TK94A / TK94RL: | |
| – thickness 1.2 mm, length 165 mm | 62 04 022 |
| – thickness 1.2 mm, length 250 mm | 62 04 216 |
| Scanning wands TK8A: | |
| – thickness 3 mm, length 380 mm, plate 80x15 | |
| Scanning wands TK91A: | |
| – thickness 4 mm, length 380 mm, plate 30x15 | 62 04 284 |
| – thickness 4 mm, length 510 mm, plate 120x15 | 62 04 279 |
| – thickness 4 mm, length 610 mm, plate 120x15 | 62 04 285 |
| Scanning wands TK9LIN50/100: | |
| – Scanning wand set: Adapter (with point of fracture in case of damage) M3, scanning tip extension M3, scanning tip brass, scanning tip plastic M3 | 62 04 904 |
| Balance weight set (2x Ø 20 mm, 1x Ø 16 mm) | 62 04 282 |
| Mounting bracket | 61 07 082 |
| BKM air barrier adapter | 62 04 029 |

| Operating Instructions | Article No. |
|------------------------|-------------|
| BK MIKRO9 | 68 36 262 |

| Basic system |
|---|
| 63 04 242 + 62 04 279 + 62 04 251 + 63 04 245 |