BK MIKRO MODEL 7 & 7RL

Monitoring System for Tool, Object
and Free Space Monitoring

Technical Documentation – North American Edition
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TT Techna-Tool Inc.

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1　　Basic Information

1.1　　Warranty and Liability

Our "Terms and Conditions of Sale" shall apply as standard. All warranty and liability claims in the event of personal injury and/or damage to property shall be excluded if they can be traced to one or several of the following causes:

- Use outside the intended scope of the equipment design.
- Incorrect installation, commissioning, repair, and maintenance of the equipment.
- Operation of the equipment with defective safety facilities or incorrectly fitted or non-functional safety and protective facilities.
- Non-compliance with the notes in these operating instructions concerning transportation, storage, fitting, commissioning, operation, limit values, and maintenance.
- Unauthorized changes.
- Insufficient monitoring of parts subject to wear.
- Cases of catastrophe due to action by foreign bodies and acts of God.

In the case of software, warranty is further excluded in respect of:

- defects which are unavoidable considering the state of the art existing at the time of delivery or performance and the intended use and price of the equipment, with the exception of such faults whose acceptance would be unreasonable for the customer,
- software copies not supplied by us,
- software changed by the customer, even if the defect occurs in a part which has not been changed, unless it can be proven that the occurrence of the defect is completely unrelated to the change.

1.2　　Intended Use

BK MIKRO 7 is a control system to be used for tool, object and free space monitoring applications.

We will not accept any liability whatsoever for any and all damage caused by a different or additional use of this equipment.

Use within the intended scope of the design also includes:

- compliance with all instructions and notes contained in these operating instructions, and
- observance of all inspection, service, and maintenance intervals.

1.3　　Copyright

These operating instructions are intended for the operator and the operator's personnel only.

They contain instructions and notes which may not be disclosed to third parties, either in full or in part, by

- reproduction,
- circulation, or
- any other means.

Non-compliance may lead to prosecution under criminal law.

Safety

Explanation of Symbols and Notes

Immediate Danger

for life and limb of personnel and others.

Non-compliance will cause death or
most serious (crippling) injury.

Hazardous Situation

for life and limb of personnel and others.

Non-compliance may cause death or
most serious injury.

Potentially Hazardous Situation

Non-compliance may cause light injury;

also warning against damage to property.

Notes on Correct Handling

Non-compliance may cause damage to the product
and/or damage to parts/items in the vicinity.

Environmental Protection

Non-compliance may have an impact on the environment.

1.4   Hazards

The system BK MIKRO has been built to the technical state of the art and all recognized technical rules. Nevertheless, its use may cause hazards for life and limb of the user or third parties, or have a detrimental effect on the equipment or other property.

The system is to be used only

• within its intended design limits

• in a technically safe condition.

Faults which may have a detrimental effect on safety are to be remedied immediately.
Until such remedy is effected, the equipment may not be operated.

1.4.1   Electrical Hazards

Any work on the electrical power supply is to be carried out by a specialist electrical engineer only.

Switch off mains supply before opening up your equipment in order to avoid any direct electrical contact.

If work needs to be carried out on live components, a second person is to provide assistance and operate the mains switch in any emergency.

An open casing constitutes a health hazard due to high frequency electrical and magnetic fields. These HF electrical and magnetic fields might be hazardous for anyone with heart problems (heart pacemaker).

1.4.2   Mechanical Hazards

There are injury hazards caused by:

- Cuts caused by component edges
- Stabs by contact with moving wand
- Skin tears from touching the boards on their soldered sides
- Injuries to fingertips from inserting jumpers

Sensitive people may react allergically in the event of:
their skin coming into contact with metal parts
(soldering tin, metal brackets, screws, wires, etc.).

1.4.3   Thermal Hazards

Avoid any contact with DC/DC transducers, multiplexers, high performance ICs, transistors, voltage controls, etc. during operation and within 30 minutes after switching off the mains supply and external voltages.

Non-compliance with this instruction may cause burns.

1.5   Compliance with Safety Notes and Regulations

The fundamental requirement for safe handling and trouble free operation is an understanding of the basic safety notes and safety regulations.

These operating instructions contain the most important notes for safe operation of the system BK MIKRO.

The content of these notes – safety notes in particular – is to be complied with by all who work with this machine.

In addition, please observe all national regulations in respect of:

- accident prevention

- setting up electrical and mechanical plant

- radio interference suppression

1.6   Commitment

All personnel tasked with jobs at the BK MIKRO undertake,
before starting work,

- to observe the fundamental regulations on health and safety at work as well as on accident prevention,

- to read the chapter on safety as well as all warning notes contained in these operating instructions, and to confirm by their signature, that they have read and understood these.

At regular intervals there will be an inspection regarding this safety-conscious working of personnel.

1.7   Qualification

Trained specialist personnel only may work on the BK MIKRO.

Personnel competences are to be clearly established with regard to mounting, commissioning/start-up, operation, servicing, and maintenance.

Trained specialist personnel only may carry out the following activities:

- installation

- commissioning

- operation

- maintenance

Trainee personnel may work on the machine only when supervised by an experienced person.

1.8   Transportation, Storage, Disposal

Transportation

During transportation damage may occur.

Ensure transportation in original packaging only.

Storage

Incorrect storage might cause defects to occur.

Please note the details provided in "Technical Data".

Disposal

Electronic scrap has a negative impact on the environment.

To avoid any such impact on the environment, this equipment should only be disposed of via the proper channels for the recycling of electronic material.

Do not dispose of this equipment in the waste bin !

1.9   Suitable Fire Extinguishing Agents

In the event of fire hazardous

vapors and gases may occur.

Warning

In the event of fire

• disconnect system from all external connections

• disconnect mains plug

For extinguishing purposes, never use the following:

• water

• powder extinguisher (not suitable for electrical equipment)

• halon fire extinguisher (these damage the ozone layer)

Only use:

• residue-free carbon dioxide fire extinguishers

1.10   **Check List for Correct Handling**

Note:

If you forget to read the instructions provided for a particular step,
or if you peruse the instructions too quickly, you may act incorrectly
due to ignorance.

How to avoid incorrect action:

• Thoroughly read all instructions

• Carry out the instructions

• Confirm that the instructions have been carried out

This is how you never lose track:

☑   Following each step actually carried out,
immediately check the relevant box !

☐   Check delivery

☐   Physical environmental and operating conditions

☐   Energy requirement: type, quality, quantity

☐   Protective measures

☐   Installation

☐   Connection of peripheral devices

☐   Software

2   Characteristics

BK MIKRO 7 is a control system suitable for tool as well as for object and free space monitoring applications.

The complete BK MIKRO 7 system is comprised of:

• a control unit,

• a sensor (scanner),

• a connection cable.

BK MIKRO 7 is based on existing design concepts for tool, object and free space monitoring and can be used universally for different types of monitoring by the integration of multifarious functions:

• Tool monitoring
  Monitoring of the scanning position whose precise location has been previously entered by "Teach-in", e.g. to carry out a tool check before each working cycle.

• Object monitoring, free space monitoring
  Monitoring a scanning range freely selectable via two adjusting switches,
  e.g. to carry out tool checks for tools with varying diameters (object monitoring),
  or for ejection checks (free space monitoring).

Two types of scanners are available for various demands.
From this two different monitoring systems result.

BK7SC :   Scanner with mechanical backstop.

BK7RLSC :   Scanner without mechanical backstop.

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 and passes the scanning result 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 one direction or in both directions

• Scanning in clockwise (CW) or counter-clockwise (CCW) direction

• Two steps for scanning intensity

• Output relay contacts selectable as normally open or normally closed

• Two ranges of tolerance for "O.K." message

• Indication of the scanning result by two LEDs "O.K." and "K.O." on the control unit

• Detection of cable breaks

3   System Components

3.1   Control unit

3.1.1   Characteristic properties

The control unit is available in three models preconfigured for **different supply voltages**.
The relevant version will be marked on the rating plate: 24 VDC, 120 VAC, 230 VAC.

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

- The screw terminals have been arranged on two plug-in terminal blocks. These blocks are keyed so that they cannot be accidentally plugged into the wrong socket.

- When in operation, plastic caps cover the screws in the front. Wires to be connected are routed from the top or bottom of the unit.

The scanner will be connected via a 6-wire cable to the scanner socket of the control unit.
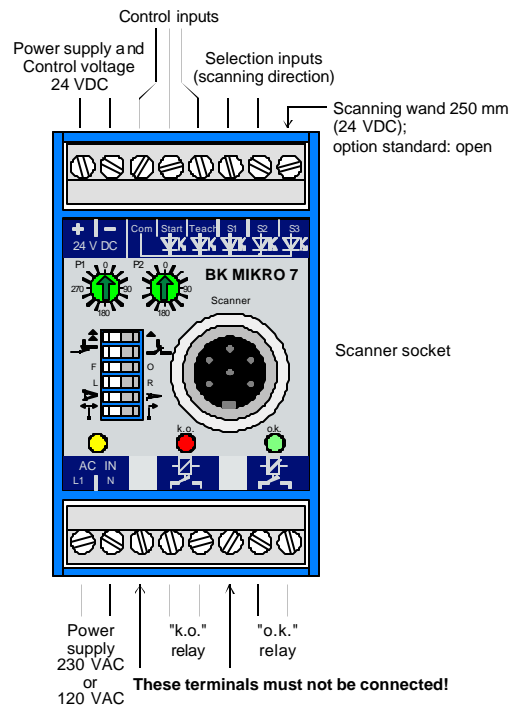
Fig. 3-1: Control unit – Connections

Note:

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

Caution

3.1.2   Technical data

Housing	Insulating material housing, protection class II, built-in unit
Protection type	IP 20
Dimensions (W x H x D)	45 mm x 75 mm x 107.5 mm
Case mountings	Sectional rail, 35 mm, to DIN EN 50022

Power supply voltage   24 VDC ±20%   PELV[1] I_{max} = 0.25 A
(depending on model)   120 VAC I_{max} = 0.05 A
230 VAC I_{max} = 0.025 A

Power consumption	6 VA max.
Control voltage (int./ext.)	24 VDC ±20% PELV [1]
Inputs	Galvanically isolated
– Input current	5 mA approx.
– Pulse duration	6 ms min.
Switched outputs	2 x 250 VAC / 30 VDC, 2 A max.
Making/breaking capacity	500 VA / 60 W (max.)
	10 mA min. at 10 V
Operational life of relay	5×10^7 switching cycles
Connections	Plug-in screw terminals for connecting
	– power supply
	– control inputs
	– selection inputs
	– relay outputs
	Scanner socket to DIN 45322, 6 pin
Climatological conditions	Classification 3K3 under EN 50178
Ambient temperature	0 ºC to +50 ºC
Storage temperature	–25 ºC to +80 ºC

General tolerances
ISO 2768 – mK
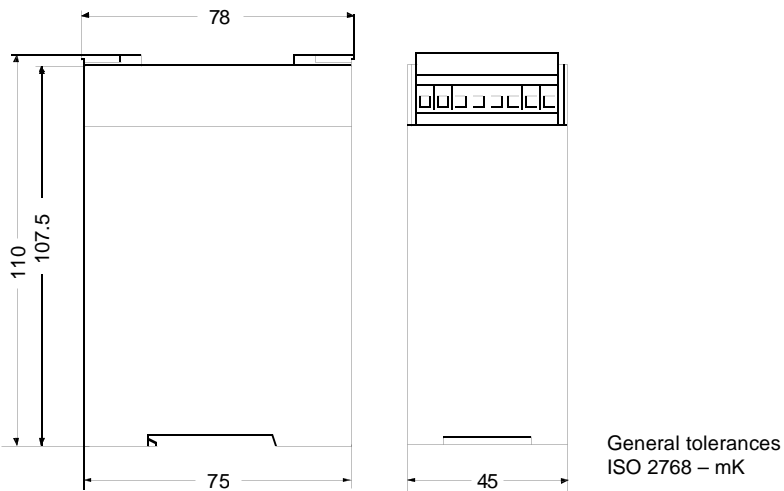
Fig. 3-2: Control unit – Dimensions

Note:

The control unit of BK MIKRO 7 is a **built-in unit**!

[1] PELV = Protected Extra Low Voltage
The voltage applied must meet the requirements for an extra low function
potential with safe disconnection (PELV).

Warning

3.1.3   Connections

Power supply

"24 VDC" model :

- "+" 24 VDC terminal

  Supply voltage input 24 VDC

- "–" 24 VDC terminal

  Reference potential of 24 VDC supply voltage

"120 VAC" and "230 VAC" models [2]:

- "L1" terminal

  Supply voltage input,
  depending on model: 120 VAC or 230 VAC

- "N" terminal

  Supply voltage input,
  depending on model: 120 VAC or 230 VAC

- "+" 24 VDC terminal

  Control voltage for "Start" and "Teach" controlling inputs
  24 VDC unregulated, output current 0.1 A max.

  If an external control voltage is applied, this terminal is not connected.

- "–" 24 VDC terminal

  When using the internal control voltage, this terminal must be connected to the "Com" control
  inputs terminal.

  If an external control voltage is applied, this terminal is not connected.

Note:

[2] Alternatively, "120 VAC" and "230 VAC" models may also be supplied with 24
VDC.

In this case, "L1" and "N" terminals must not be connected.

"+24 VDC" and "–24 VDC" terminals are to be connected as described above
for "24 VDC" model.

Control inputs

- "Com" terminal

  Reference potential for control inputs and selection inputs

- "Start" terminal

  An input level of +24 VDC relative to "Com" terminal will trigger a "Start" cycle
  (the real scanning process).

- "Teach" terminal

  An input level of +24 VDC relative to "Com" terminal will trigger a learning cycle
  (the "Teach-in").

Selection inputs

- "S1" terminal

  "S2" terminal

  "S3" terminal

  The input signal (static) of +24 VDC relative to "Com" terminal must be stable during 10 ms min. before "Teach" or "Start".

  The input S3 must be connected at a wand length of 250 mm. Concerning shorter wands, S3 remains unconnected. By connecting S3, the wand is slower and therefore it oscillates less.

S1/S2 selection inputs determine scanning direction !

The direction of scanning depends on connected scanner with corresponding switch position.

The meaning of "Clockwise/Counter-clockwise" toggle switch position on control unit may be changed by corresponding S1/S2 input signals.

S1 and S2 may be open. Then is: S1=0, S2=0.

	S1	S2	„CW/CCW"	Scanner BK7SC Scanning	Scanner BK7RLSC Scanning
Default setting ➔	**0**	**0**	**R**	CW	CW-CCW
	0	0	L	CCW	CCW-CW
	1	0	R	CW	CW [2]
	1	0	L	CW [1]	CW [1] [2]
	0	1	R	CCW [1]	CCW [1] [2]
	0	1	L	CCW	CCW [2]
	1	1	R	CCW [1]	CCW-CW [1]
	1	1	L	CW [1]	CW-CCW [1]

Note:

Default setting: S1 and S2 are not connected.

[1] Scanning direction differs from "CW/CCW" switch setting:
S1/S2 inputs change meaning of toggle switch.

[2] Stop position must be defined by a "Teach-in" in both directions or by a reference procedure in both directions. Missing stop position causes an error message, and pulses on control inputs are ignored.

Relay outputs

The terminals have been designed as dry relay contacts. By switch selection, they may be configured as either normally open or normally closed.

The contacts have been designed for 250 VAC and, by additional internal circuits, protected against inductive switch-off peaks of up to 19 W (2 ms).

- "K.O." relay terminals

  These two terminals are used to indicate a fault message (K.O.).

- "O.K." relay terminals

  These two terminals are used to indicate a no fault message, i.e. a good cycle (O.K.).

Note:

Relay as normally closed contact:	active	=	open
	inactive	=	closed
Relay as normally open contact:	active	=	closed
	inactive	=	open

When there is **no power** to the unit, the **contacts always** will be **open**.

Even when using relay as normally closed, they are open
(like the active status) when the power supply is not connected.

3.1.4   Light-emitting diodes

Three light-emitting diodes (LEDs) on the front panel provide information about the current status of the BK MIKRO 7 monitoring system:

- Power supply / Status
  Yellow LED to indicate supply voltage and status

- "K.O." relay
  Red LED to indicate fault message

- "O.K." relay
  Green LED to indicate no fault message

- Error messages
  Flashing red and green LED to indicate
  illegal switch settings and incorrect selection inputs
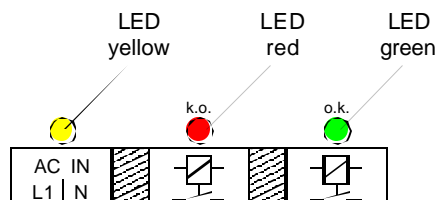
Fig. 3-3: Control unit – Light-emitting diodes

3.1.5   Rotary switches

The two rotary switches P1 and P2 on the control unit front panel are used to

• select the scanning mode ("Teach" or "Switch").

• set the angular positions of the ranges, noted in degrees,
  that are controlled by object monitoring or free space monitoring.

The position settings are possible in steps of 22.5°.
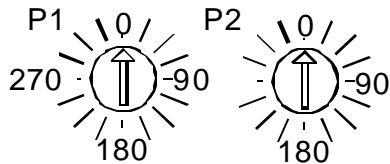
<div align="right">Fig. 3-4: Control unit – Rotary switches</div>

The figure shows the setup on delivery.

The meaning of the rotary switches is determined by the selected scanner together with the corresponding "Scanner" switch position.

Toggle switch	Rotary switch	Meaning
for scanner BK7SC:	P1=0 P2=0	Scanning using teach mode
	P1 $\geq$ 0 P2 > P1 P2 $\leq$ 270	Scanning after setting scanning range (object monitoring and free space monitoring), at which: P1=start position (without tolerance) P2=end position (without tolerance)
for scanner BK7RLSC:	P1=0 P2=0	Scanning using teach mode
	0<P1<360 0<P2<360	Scanning after setting scanning ranges (only object monitoring, no free space monitoring), at which: P1=range CW (rotation from stop position) P2=range CCW (rotation from stop position) Ranges of tolerance selectable: ±3° and ±10°

Illegal switch settings

• P1=0 and P2$\neq$0   Error

• P1$\neq$0 and P2=0   Error

will cause flashing red and green LED.

Minimum angle = 5°

The minimum distance between the object and the wand must be an angle
of this value, so that scanning can start really, otherwise a "K.O." fault
message will be indicated.

3.1.6 Toggle switches

Using the six toggle switches arranged next to each other on the control unit front panel, the following functions may be set.
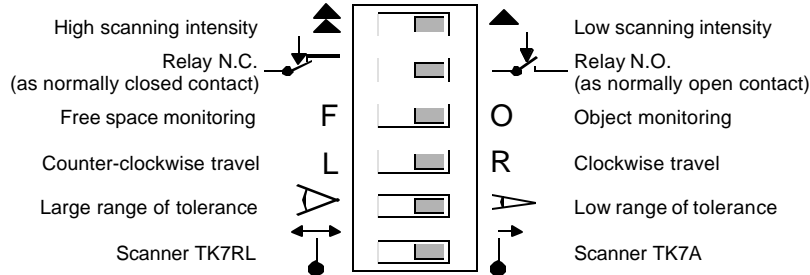
Fig. 3-5: Control unit – Toggle switches

Note:

Setup on delivery: All switches are toggled to the right !

When using scanner BK7RLSC: "Scanner" switch to the left !

"Scanning intensity" switch

Speed and force of scanner's wand in its scanning range.

For "Teach-in" and "Start" cycle, in case of a good message, they amount to:

"Scanning intensity" switch position	Impact Forces
▲	approx. 200 mN
▲▲	approx. 500 mN

The values are valid for a wand of 150 mm length, measured on its scanning tip.

Note: If this switch is in the "low" position, the lower impact force of the scanner will protect the wand from wear and tear.

"Normally open contact / Normally closed contact" switch

Mode of operation for the two output relays (see section "Relay outputs").

"Object monitoring / Free space monitoring" switch

"O.K." result for
– finding an object (object monitoring) or
– not finding an object (free space monitoring) in the scanning window.

Note: Free space monitoring is admissible only in combination with range setting by rotary switches P1 and P2 and connected scanner BK7SC with toggle switch set to "BK7SC".

"Clockwise / Counter-clockwise" switch (CW/CCW)

Direction of rotation, i.e. direction to which scanner moves starting from stop position.

Clockwise = When rotating to the right
> Scanner viewed from behind (the connection side),
> looking up length of scanner.
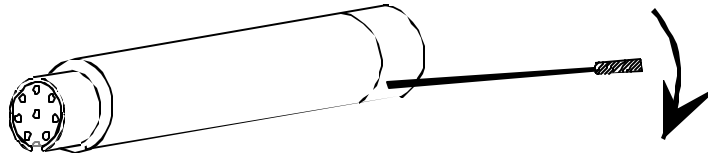
Fig. 3-6: Definition of the rotation direction

Note: Switch position may be changed by selection inputs S1, S2 and S3
          (see table in section "Selection inputs").

"Tolerance range" switch

Range of tolerance for "O.K." message referred to the desired position,
i.e. position learned by "Teach-in" or set by switches:

small	±3°
great	±10°
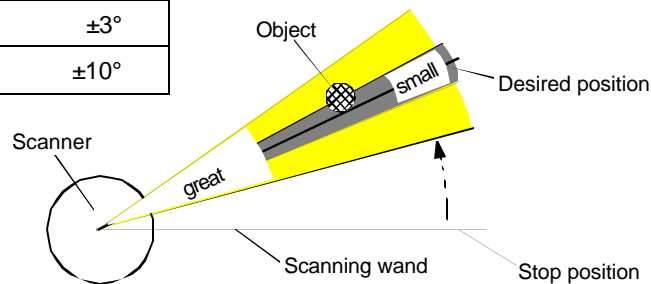
Fig. 3-7: Range of tolerance

Note: No range of tolerance exists for scanning in one direction using switch mode.

"Scanner" switch

Selection of the scanner.

BK7SC	Scanner BK7SC, i.e. use scanner with mechanical backstop!
BK7RLSC	Scanner BK7RLSC, i.e. use scanner without mechanical backstop!

3.1.7   Notes on technical safety

according to DIN VDE 160

$C\hspace{-0.1em}E$ according to EMC directive 89/336/EEC

for the models with power supply 24 VDC and 120 VAC

The control unit comprises the following circuits, all isolated from each other:

K.O. output (2 terminals)	safely isolated from all other circuits
O.K. output (2 terminals)	safely isolated from all other circuits
AC power supply (L1, N)	safely isolated from all other circuits
DC power supply (+24 V, −24 V)	safely isolated from K.O. output, O.K. output, and AC power supply
Control inputs (Com, Start, Teach)	safely isolated from K.O. output, O.K. output, and AC power supply
Selection inputs (S1, S2, S3)	safely isolated from K.O. output, O.K. output, and AC power supply
Scanner connections	safely isolated from K.O. output, O.K. output, and AC power supply

Inputs
– control inputs
  (Com, Start, Teach)
– selection inputs
  (S1, S2, S3)
– Pulse inputs from scanner
	opto-decoupled,
	no safely isolation from each other

3.2   Scanner

3.2.1   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.

We offer two types of scanners for the different applications.

The sole difference between the two scanners is that the rotary movement of BK7SC's wand is limited by a screw inside the housing, the mechanical backstop.

BK7SC – Scanner with mechanical backstop

Requirement: "Scanner" switch on control unit set to "BK7SC"

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

When a supply voltage is applied, the scanner will always move to its mechanical backstop, the so-called stop position. The scanner will be held in this position by applying a low voltage until a pulse on the "Teach" or "Start" screw triggers a scanning cycle.

BK7RLSC – Scanner without mechanical backstop

Requirement: "Scanner" switch on control unit set to "BK7RLSC"

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

When a supply voltage is applied, the scanner persists in its momentary position. It can be turned to an other position by hand. Only after a pulse on the "Teach" or "Start" screw,
it moves into its stop position, that was calculated just now, and will be held there by applying a low voltage.

Using scanners BK7SC and BK7RLSC with a different control unit than BK MIKRO 7 may damage the scanner and control unit.

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.

Warning

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

3.2.2   Technical data

Housing	Anodized aluminum
Protection type	IP 67
Wand length	165 mm (standard), exchangeable wand
Scanning angle	
– BK7SC	270° max. (scanner with mechanical backstop)
– BK7RLSC	360° max. (scanner without mechanical backstop)
Control unit connection	Small circular connector, M12x1, 8 pin
Ambient temperature	0 ºC to +80 ºC
Storage temperature	–25 ºC to +85 ºC
Scanning cycles	> 5 million at minimum scanning intensity

circ. 150 — ø20

ø1.2

9.5

Protective cap

Scanning wand
standard length 165 mm

Wand holder

RO   BK
RO   BK
RO   BK
RO   BK

59

max. 98

max. 114

Housing

Connector
angled, 8 pin

26.5

42.5

Connection cable
connector at the control unit end, 6 pin

Connection cable
straight connector at the scanner end, 8 pin
connector at the control unit end, 6 pin

General tolerances
ISO 2768 – mK
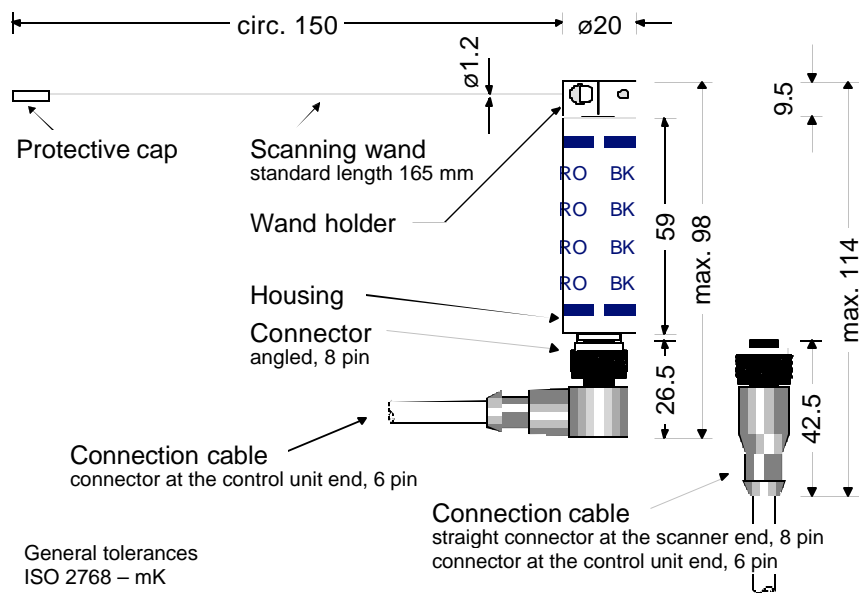
Fig. 3-8: Scanner

Note:

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

3.2.3   How to change

After undoing hollow screw (M3), the wand can easily be removed from its holder.
Insert new wand into holder and tighten.

3.3   Connection cable

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

- 6 pin small circular connector to DIN 45322 at the control unit end.

- 8 pin molded plug at the scanner end.

- Length 5 m, can be extended to a maximum length of approximately 25 m
  with extension cables.

Pin configuration (at the control unit end)

Small circular connector to DIN 45322, 6 pin

1	wh	white
2	br	brown
3	gn	green
4	ye	yellow
5	gr	gray
6	pi	pink
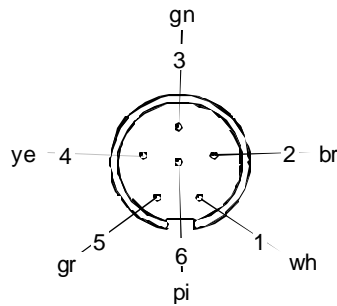
Fig. 3-9: Connection cable – Pin configuration

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.

- If this plug needs to be removed during fitting, please ensure that this pin configuration is followed on reassembly.

4   Mode of Operation

BK MIKRO 7 can be operated in different ways:

- Scanning in one direction
- Scanning in both directions
- Monitoring with learning function (Teach mode)
- Monitoring with setting scanning range (Switch mode)
- Monitoring as object monitoring or free space monitoring

All modes allow return travel monitoring.

4.1   Scanning process

Applying a pulse to "Start" or "Teach" terminal will trigger a scanning cycle. During scanning operation, both relay outputs will be inactive (LED "O.K." and "K.O." not illuminated).

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.

The monitoring range will then be traversed at the preset scanning speed and its related force which is to be used to scan an object or range.

During the entire operation, all pulses generated by the scanner's internal encoder will be continuously processed.

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.

"Start" cycle with CW travel
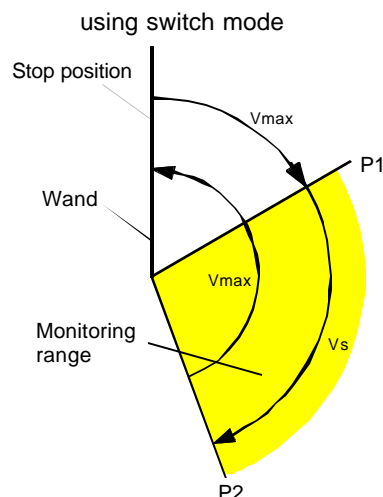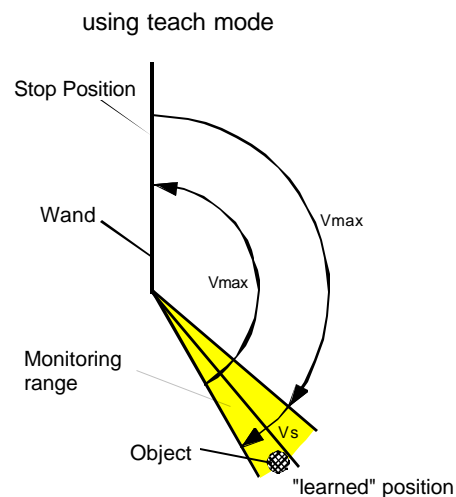
Monitoring range = Range of tolerance for "O.K." message

Fig. 4-1: "Start" cycle for scanning in one direction

v_{max} = max. speed of scanner

v_S = speed of scanner preset by "Scanning intensity" toggle switch

4.2   Output of results

- Fault message (K.O.)

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

- Good cycle message (O.K.)

    − without return travel monitoring
       Results will be indicated on reaching the scanner's stop position.
       <u>Note:</u> 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 **"O.K." state** , the "O.K." relay will be active,
while the "K.O." relay remains inactive.

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

Note:

"K.O." 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.

4.3   Return travel monitoring

BK MIKRO 7 allows monitoring the return travel of the wand.

The signal length on "Start" input determines whether the return travel will be monitored:
Before return travel begins, i.e. in the reversing point of the scanner (in the second reversing point for scanning in both directions), the system will re-read the current "Start" signal status.

- Return travel monitoring enabled, if "Start" signal is still present in reversing point.

- Return travel monitoring off, if "Start" signal has already been removed in reversing point.

Return travel monitoring will detect malfunctions!
Example for suitable use of return travel monitoring: BK MIKRO 7 has successfully monitored the object. But the wand is stopped by an obstacle on its return travel, cannot return into its stop position, and will block the transport of the tool.

Result with return travel monitoring	"K.O."	Machine stops!
Result without return travel monitoring	"O.K."	Damage of object/machine!

5   BK MIKRO 7 with scanner BK7SC – Scanning in one direction

Note: "Scanner" toggle switch set to "BK7SC" =
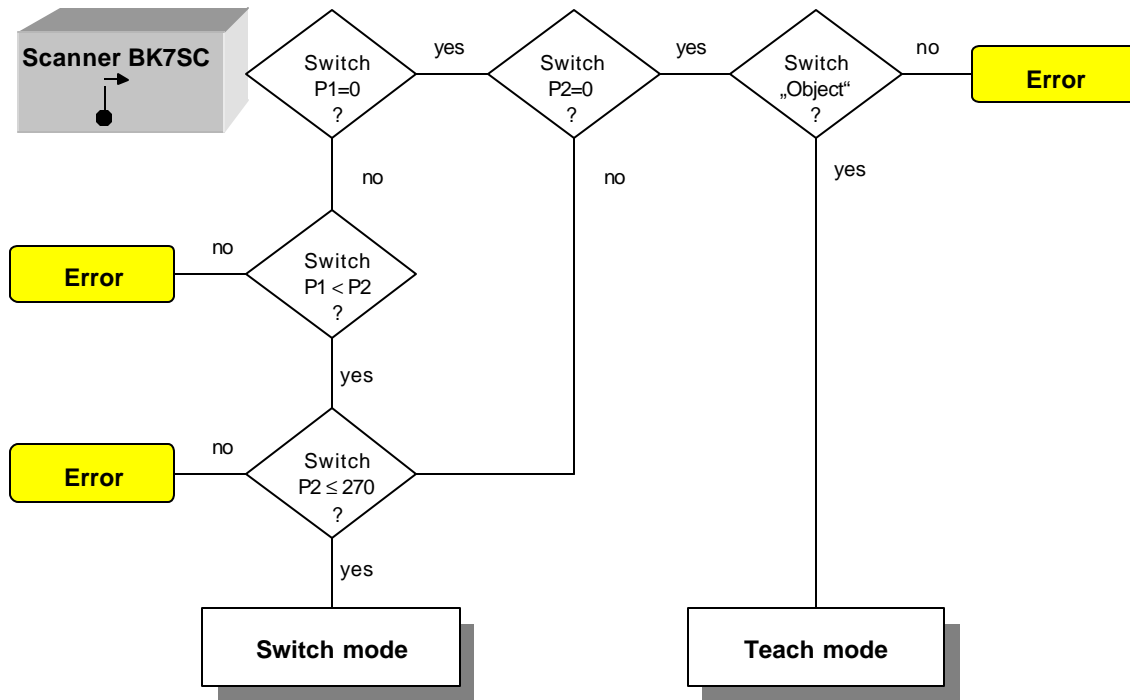

Fig. 5-1: Handling BK MIKRO 7 with scanner BK7SC

Note:

The selection inputs S1 and S2

- influence the rotation direction of the scanner,

- but do not cause any error messages.

Error messages will be indicated by flashing red and green LED.

5.1   Teach mode = monitoring with learning function

Requirement: Rotary switches P1=0 and P2=0

The scanning range will be determined by a learning cycle (external control signal).

This mode of operation is the typical mode for **tool detection** applications:
The system will check for the presence of the tool at the learned position.

5.1.1   "Teach-in", the learning cycle

The scanner will travel in its preset direction of rotation with its preset speed.

- If a tool is detected, its position will be stored,
  and the scanner returns to its stop position with maximum speed.
  In addition, the "O.K." relay will be activated.

- If the scanner rotates to a maximum of 270° without detecting any tool,
  the "K.O." relay will be activated.

  Following "Start" pulses will detect "K.O.".

Learning cycle with CCW travel

"learned" position

Object

Vs

Vmax

Wand

Stop position
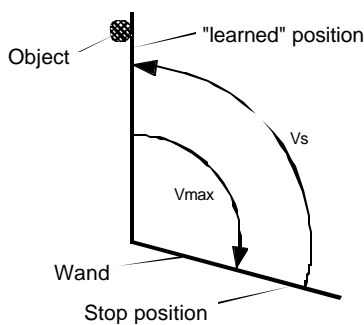
The figure shows a learning cycle with setting:
Switch "L" and S1=0, S2=0, i.e.
CCW travel of the scanner.

v_{max} = max. speed of scanner

v_S = speed of scanner preset by
        "Scanning intensity" toggle switch

Fig. 5-2: "Teach-in" for scanning in one direction

Note:

A **position** learned during "Teach-in" **will remain stored**, even after removal of power to the unit.

No changes after "Teach-in" and before "Start" mode, concerning:
- Tool geometry (layout and dimensions)
- S1/S2 selection inputs
- "CW/CCW" toggle switch

5.1.2   "Start", the real scanning process

The scanner will travel to the previously "learned" position of the object to check for its presence.
- If the tool is within the monitoring range,
  the "O.K." relay will be activated.

- If the tool is not detected, i.e. either it is missing or there is an obstacle within the scanner
  rotating area, the "K.O." relay will be activated.

5.2   Switch mode = monitoring with setting scanning range

Requirement: Rotary switches 0 £ P1 < P2 £ 270

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

In this mode of operation, BK MIKRO 7 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.

Note: A Pulse in the "Teach" terminal does not take effect.

5.2.1   Control operation "Object monitoring"

Using "Object monitoring", the control unit will change into an "O.K." 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.

5.2.2   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 "O.K." 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",
a **broken wand** will always trigger an **"O.K." signal**.

Note:

• "Scanning intensity" toggle switch set to "high"
  will enable scanning operation at a higher speed.

• Life expectancy of the wand will not be reduced,
  since the unit will rarely contact a part using "Free space monitoring".

5.2.3   Deflection of wand

Rotation angles will be detected by scanner encoder pulses. These pulses are derived from the rotation of the motor. For scanning, a metal needle (wand) is used which, depending on the scanning force, can be deflected. As the scanner motor is still turning when the end of this wand has already come to a stop, differences between the set and actual rotation ranges will result.

For all speeds, wand deflection is compensated to a range of less than 10°. Deflection will depend, however, on wand length.

5.2.4   Examples for range settings

Direction of rotation:	CW
No fault range starts:	45°
No fault range ends:	180°
No fault range:	135°

Direction of rotation:	CW
No fault range starts:	180°
No fault range ends:	270°
No fault range:	90°

Direction of rotation:	CCW
No fault range starts:	45°
No fault range ends:	180°
No fault range:	135°

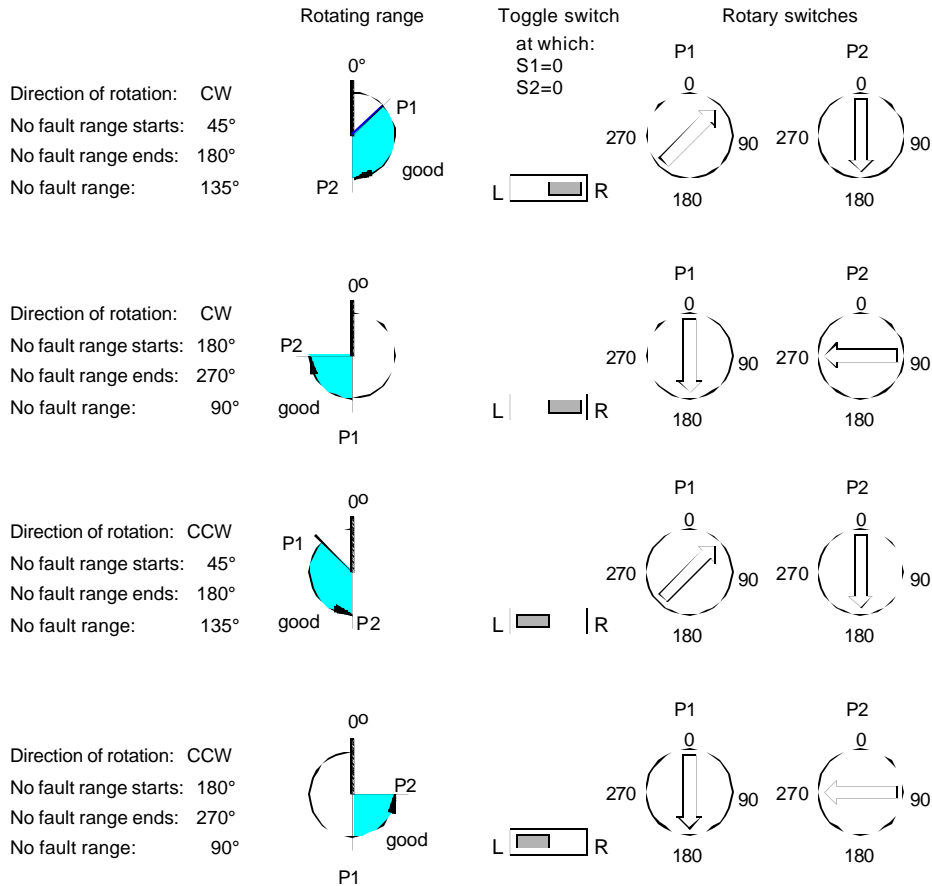| Direction of rotation:	CCW
No fault range starts:	180°
No fault range ends:	270°
No fault range:	90°

Fig. 5-3: Range settings using rotary switches for scanning in one direction

6   BK MIKRO 7 with scanner BK7RLSC – Scanning in both directions

Note: **"Scanner" toggle switch set to "BK7RLSC"** ⟷ ● =

Only object monitoring, no free space monitoring !

Special cases make possible scanning in one direction!

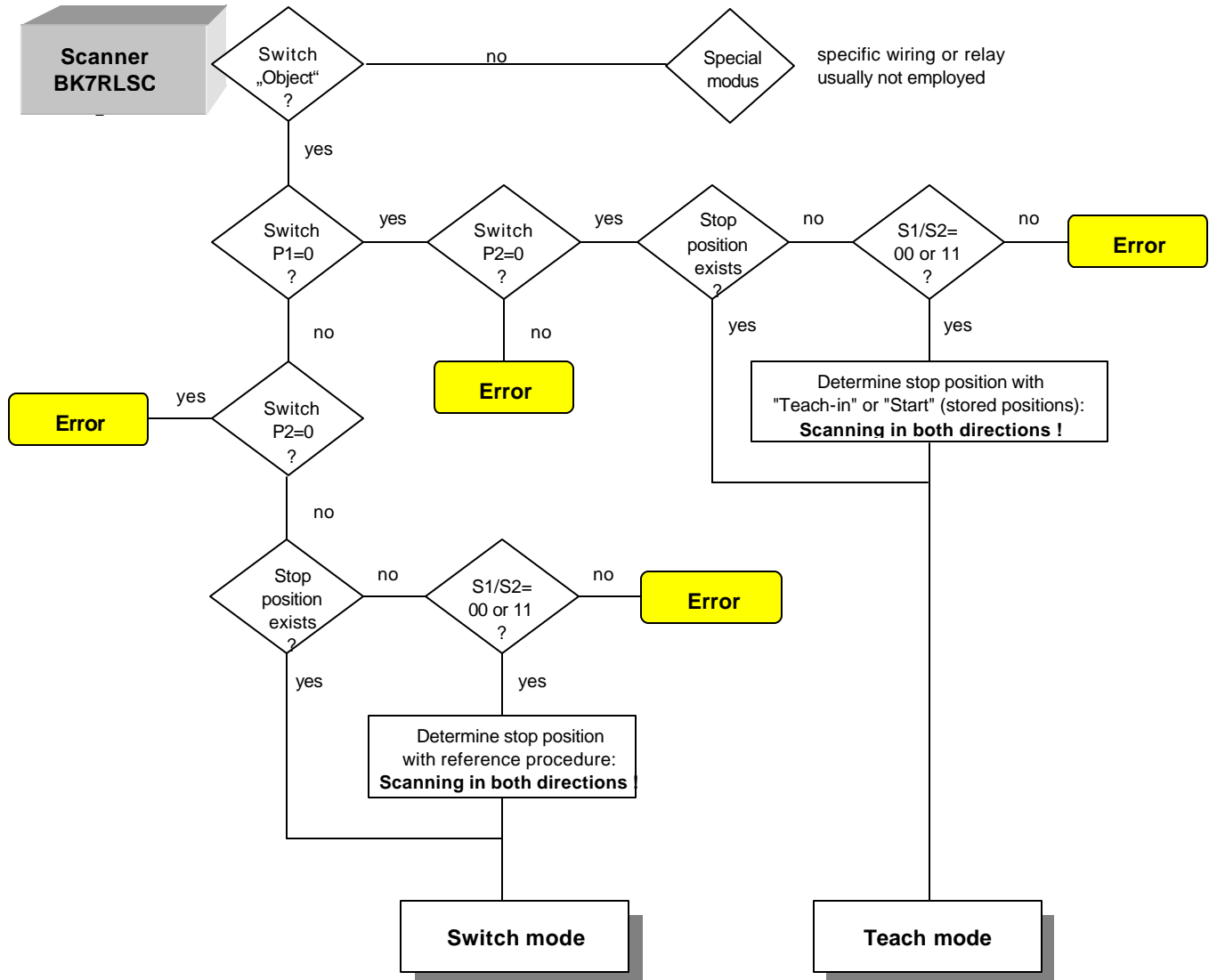Fig. 6-1: Handling BK MIKRO 7 with scanner BK7RLSC

Note:

The stop position of the wand must be determined by scanning in both directions
(S1/S2 = 00 or 11), whether with learning function or with reference procedure.

After that a scanning in one direction (S1/S2 = 01 or 10) is possible,
even a "Teach-in" in one direction for only one object.

Error messages will be indicated by flashing red and green LED.

6.1   Teach mode = monitoring with learning function

Requirement: Rotary switches P1=0 and P2=0

The scanning ranges will be determined by a learning cycle (external control signal).

This mode of operation is the typical mode for **tool detection** applications:
The system will check for the presence of the tools at the learned positions.
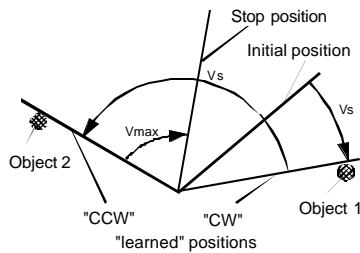
6.1.1   "Teach-in", the learning cycle

The scanner will first travel from its initial position with its selected speed in the preset direction.

If a tool is detected, its position will be stored.

Then the wand will travel in opposite direction with its preset speed
to determine the position of the second tool, and also store this position.

- Using this two positions the system will calculate the new zero position of the wand as the center between the two tools.

  Finally the wand will turn into its zero position, the stop position, and will be held there by applying a low voltage. In addition the "O.K." relay will be activated.

- If the system can detect only one tool or not a single one, the "K.O." relay will be activated.

  After such a faulty learning action, the wand will return to its old stop position.
  Following "Start" pulses will detect "K.O.".

Learning cycle with CW-CCW travel

The figure shows a learning cycle with setting:
Switch "R" and S1=0, S2=0, i.e.
first CW travel, then CCW travel of the scanner.

v_{max} = max. speed of scanner

v_S = speed of scanner preset by "Scanning intensity" toggle switch

Fig. 6-2: "Teach-in" for scanning in both directions

Note:

Positions learned during "Teach-in" **will remain stored**, even after removal of power to the unit.

No changes after "Teach-in" and before "Start" mode, concerning:
- Tool geometry (layout and dimensions)

Changes of S1/S2 selection inputs or "CW/CCW" toggle switch are allowed after "Teach-in".

6.1.2   "Start", the real scanning process

The scanner will travel to the previously "learned" positions of the objects to check for their presence. In so doing, the wand will first move in the preset direction, then in opposite direction.

- If the tools are within the monitoring ranges,
  the "O.K." relay will be activated.

- If one of the two tools is not detected, i.e. either it is missing or there is an obstacle within the scanner rotating area, the "K.O." relay will be activated.

"Start" cycle with CW-CCW travel using teach mode
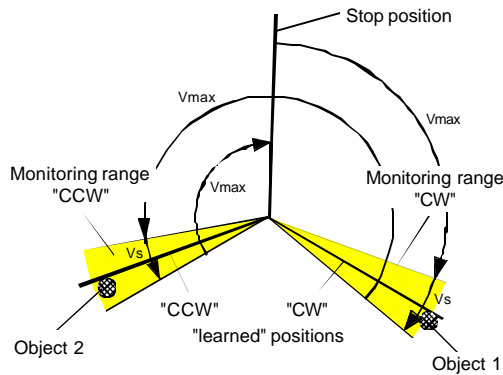
The figure shows a "Start" cycle with setting:
Switch "R" and S1=0, S2=0, i.e.
first CW travel, then CCW travel of the scanner.

v_{max} = max. speed of scanner

v_S = speed of scanner preset by "Scanning intensity" toggle switch

Fig. 6-3: "Start" cycle for scanning in both directions

Note:

The rotation sequence of "Start" cycle may differ from that of learning cycle.

Scanning in one direction is possible (select corresponding inputs S1, S2), when stop position is detected.

6.2   Switch mode = monitoring with setting scanning ranges

Requirement: Rotary switches 0 < P1 < 360 and 0 < P2 < 360

Rotary switch P1 and P2 settings will define two scanning ranges.

In this mode of operation, BK MIKRO 7 allows **only object monitoring**:
Two rotary switches are used to define two scanning ranges
which are to be monitored before each working cycle.

Note: A Pulse in the "Teach" terminal does not take effect.

6.2.1   Reference procedure

The first "Start" cycle after supply voltage has been applied, finds out the stop position of the
scanner by a so-called reference procedure.

Note: Carry out reference procedure with "Scanning in both directions".

1. After "Start" pulse the scanner rotates to the first object with selected speed in
   preset direction.

2. From there it moves back in opposite direction for the preset value of the selected direction to the
   so-called stop position, e.g. P1 means CW rotation.

3. Without stop it travels on at most towards the second value into the reversing point,
   when a second object is not found before.

4. After that the scanner will return to its stop position.

Result:

"O.K."	Both objects detected	Movement as described above.
"K.O."	No object detected	Rotation towards 360°, back to initial position, that becomes stop position.
	First object detected, no second object within the preset range	Movement as described above, stop position is determined by the detected first object.

Reference procedure is necessary:

- after interruption of power supply

- after changing the switch settings P1 or P2

- after changing the "Scanner" switch from "BK7SC" back to "BK7RLSC"

Note:

Only after a reference procedure the scanner persists in its stop position while
power supply is applied.

The S1/S2 selection inputs and the "CW/CCW" toggle switch determine the
sequence of rotation directions.

Changes of S1/S2 selection inputs or of toggle switch "CW/CCW" are allowed
after reference procedure.

6.2.2   Control operation "Object monitoring"

The second "Start" pulse starts the real scanning process of object monitoring
within two ranges.

The control unit will change into an "O.K." 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.

- Both objects are detected within the rotation ranges P1 and P2.

"Start" cycle with CW-CCW travel using switch mode
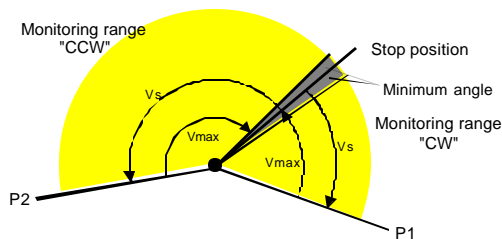
The figure shows a "Start" cycle with setting:
Switch "R" and S1=0, S2=0, i.e.
first CW travel, then CCW travel of the scanner.

v_{max} = max. speed of scanner

v_S = speed of scanner preset by
"Scanning intensity" toggle switch

Fig. 6-4: Range setting using rotary switches for scanning in both directions

6.3   Scanning in one direction with scanner BK7RLSC

Requirement:

As soon as the stop position has been detected, i.e. after a "Teach-in" with
scanning in both directions or a reference procedure with scanning
in both directions, the scanning in one direction is possible with scanner
BK7RLSC, too.

For scanning in one direction set the selection inputs S1 and S2 corresponding

to the description in table of section "Selection inputs".
Do not change setting of "Scanner" switch.

Teach mode

- Scanning in one direction of already "learned" objects

  A "Start" will monitor both of the known objects individually:
  Scanning in CW direction or in CCW direction.

- Scanning in one direction of "new" objects

  Scanning in one direction allows also learning the position of unknown objects.

  Stop position remains valid: The wand will return to its stop position, determined by "Teach-
                                      in" in both directions, in any case.

Switch mode

- Scanning in one direction of the preset monitoring ranges

  A "Start" pulse will monitor both of the monitoring ranges individually:
  Scanning in CW direction or in CCW direction.

7   Cycle Times

Scanning times

The following **cycle times** hold for systems with scanner BK7SC or BK7RLSC:

"Intensity" Switch	BK7SC – Scanning in one direction			BK7RLSC – Scanning in both direction		
	Angle	"Teach"	"Start"	Angle	"Teach"	"Start"
▲	15°	210 ms	150 ms	±15°	320 ms	260 ms
▲▲	15°	170 ms	120 ms	±15°	210 ms	190 ms
▲	90°	580 ms	280 ms	±45°	720 ms	370 ms
▲▲	90°	330 ms	250 ms	±45°	360 ms	300 ms
▲	180°	1000 ms	390 ms	±90°	1200 ms	470 ms
▲▲	180°	520 ms	370 ms	±90°	550 ms	410 ms
▲	270°	1440 ms	510 ms	±180°	2400 ms	720 ms
▲▲	270°	700 ms	470 ms	±180°	1100 ms	630 ms

Note:

"Cycle" time means: wand returned to stop position.

"Measuring time" for "K.O." in a "Start" cycle $\approx$ ½ cycle time
when using scanner BK7SC, i.e. for scanning in one direction.

Times hold for setting "Tolerance" switch to "small",
switch set to "great" will slightly increase "Start" cycle times!

8   Status Indication

8.1   Yellow LED

Fast flashing = Self-test

After power-up, the system will carry out a self-test
indicated by fast flashing of this yellow LED.

Steady illumination = Ready to operate

Following its self-test, the system is ready to operate.
The LED stops flashing and remains steady.

Slow flashing = Scanner fault

The system has detected a scanner fault:

- Scanner is missing or has motor fault.

- Control cable is not correctly connected, e.g. even cable break.

Outputs will be switched inactive, the unit will remain in its present state,
indicated by slow flashing of this yellow LED.

8.2   Red LED / Green LED

Steady illumination = Indication following scanning cycle

The red LED indicates a fault message.

The green LED indicates a no fault message.

Flashing = Illegal settings

A flashing red and green LED simultaneously indicates that one or more of the switches is incorrectly
set, and/or the S1/S2 selection inputs have been connected incorrectly.

8.3   Error messages – Flashing red and green LED

Check the following settings to remove the error messages.

- "Scanner" toggle switch (BK7SC/BK7RLSC)

- "Object monitoring / Free space monitoring" toggle switch (O/F)

- Rotary switches P1 and P2

- Selection inputs S1 and S2

The error messages are distinguished by connected scanner
with corresponding setting of toggle switch to "BK7SC" or "BK7RLSC".

Scanner BK7SC, "Scanner" switch set to BK7SC

Teach mode [requires: P1=0, P2=0]	Error	Correction
no free space monitoring, only object monitoring	F	O

| Switch mode [requires: 0 £ P1 < P2 £ 270]	Error	Correction
Signal to "Teach" without effect, only "Start" pulse !		
for object monitoring or free space monitoring	P1 ≥ P2	P1 < P2
	P2 > 270	P2 ≤ 270

Scanner BK7RLSC, "Scanner" switch set to BK7RLSC

Teach mode [requires: P1=0, P2=0]	Error	Correction
no free space monitoring, only object monitoring	*	O
Determination of stop position only with "Teach-in"	S1/S2=01	00 or 11
in both directions: Selection inputs S1/S2 = 00 or 11	S1/S2=10	00 or 11
Having determined the stop position "Teach-in" in one direction is also possible besides scanning in one direction. Note: Stop position will not change!		

| Switch mode [requires.: P1 > 0, P2 > 0]	Error	Correction
Signal to "Teach" without effect, only "Start" pulse !		
no free space monitoring, only object monitoring	*	O
for object monitoring	P1=0, P2 > 0	P1 > 0
	P2=0, P1 > 0	P2 > 0
Determination of stop position only with reference procedure	S1/S2=01	00 oder 11
in both directions: Selection inputs S1/S2 = 00 or 11	S1/S2=10	00 oder 11
Having determined the stop position scanning in one direction is also possible.		

* Special function of the relays
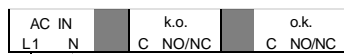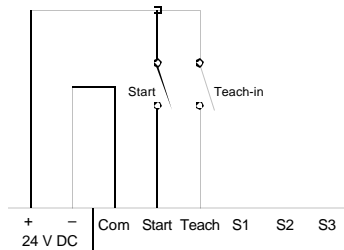
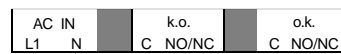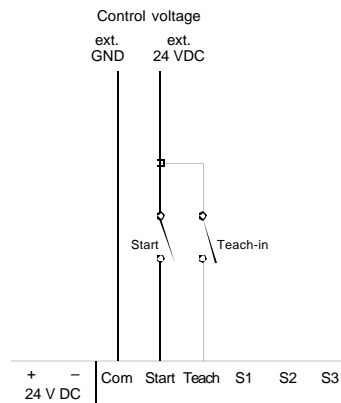## 8.4   Installation Notes

8.5   Control voltage connection
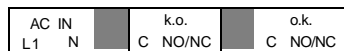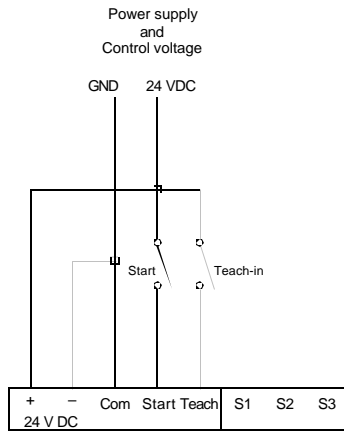
BK MIKRO 7
24 VDC
common power and control voltage supply
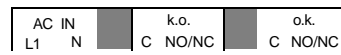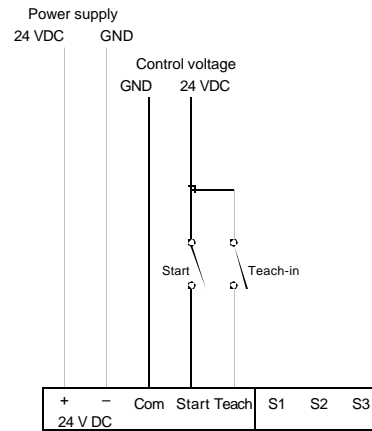
BK MIKRO 7
24 VDC
separate control voltage

BK MIKRO 7
230 VAC (120 VAC)
internal control voltage

BK MIKRO 7
230 VAC (120 VAC)
external control voltage

Fig. 8-1: Control voltage connection

8.6   Mounting bracket

Techna-Tool Inc. offers a mounting bracket for the scanner as an accessory.

BK7-8MB (Article no. 61 07 165) contains the following parts:

Designation	Material	Part no.
Mounting bracket	AlCuMgPb, F 38, thickness 8, naturally anodized	1, 2
2 cheese head screws with hexagonal hole M3x40	8.8 zinced	3
2 self-securing nuts M3	8 zinced	4
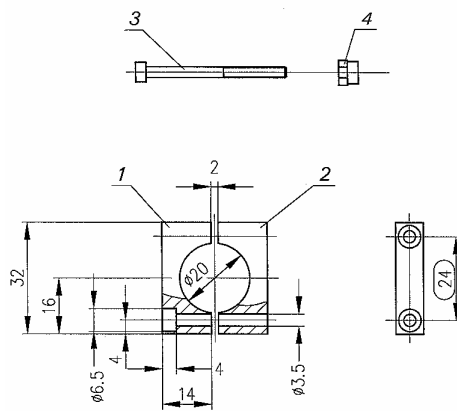
General tolerances ISO 2768 – mK
burred edges

Fig. 8-2: Mounting bracket

8.7   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 source, i.e. directly where interference is caused.

Possible additional noise filters:

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

9   Ordering Information

Control unit	Article no.
BK7CTRL 120 VAC (also works w 24VDC)	63 04 222
BK7CTRL230 230 VAC	63 04 221

Scanner	Article no.
BK7SC (scanner with mechanical backstop)	63 04 234
BK7RLSC (scanner without mechanical backstop)	63 04 235

Connection BK MIKRO 7 : Control unit – Scanner	Length	Article no.
BK7C5 Control cable, straight connector*	5 m	62 04 248
BK7C10 Control cable, straight connector*	10 m	N/A
BK7C15 Control cable straight connector*	15 m	62 04 250
*Cables available with right angle connector		
BK7EC5 Extension cable	5 m	62 04 210
BK7EC10 Extension cable	10 m	62 04 211
BK7EC15 Extension cable	15 m	62 04 212
BK7ECTC Extension cable incl. mounting socket	2 m	62 04 213

Accessories and spare parts		Article no.
Scanning wands BK MIKRO 7:		
– BKPIN345P Length 165 mm (standard)	10 pieces	62 04 022
– BKPIN250P Length 250 mm	10 pieces	62 04 216
– BKTSPIN6 HSS, length 165 mm	1 piece	62 04 215
– BKTSPIN250 HSS, length 250 mm	1 piece	62 04 231
BKPHSC7 Wand holder for short breakable chips incl. wand	1 piece	62 04 263
BKPH7 Wand holder incl. wand	1 piece	62 04 026
BK7-8MB Mounting bracket		61 07 165

Operating Instructions	Issue	Article no.
BK MIKRO 7	2.00	68 36 231

BK MIKRO 7

Operating Instructions

Logbuch

Ausgabe	Datum	Datei-Name	Charakteristik
1.00	10.02.00	BA_100_e_BK MIKRO 7.doc	Basis: Version 1.00 deutsch
2.00	16.10.03	BA_200_e_BK MIKRO 7.doc	Basis: Version 2.00 deutsch

Erstellt	am: 16.10.2003	von: Corina Bader
Geprüft	am: ……………………	von: ………………………………..………………
Freige geben	am: ……………………	von: ………………………………..………………