Broken Tool Monitoring WK2A / WK2B

MIDDEX
ELECTRONIC

Version 13011

Introduction

The WK2A tool monitoring system replaces the well known WK2. The WK2 sensor remains the same. Also all cables for the WK2 are the same and compatible with the WK2A. The drive mechanism is controlled according to the position by speed and torque. This allows for checking tools from diameter 0.3mm (.012") independent of scanning angle and needle length.

A third seal, called the shavings deflector, between probe assembly and sensor housing prevents sensor malfunctions due to shaving deposits.

The position measuring is accomplished with a digital angular indicator. After switching the power on the probe moves to its fixed zero position. A teach-in is needed only for the setup of the system, or when tool or sensor positions are changed. The learned tool position remains in the non-volatile memory even after the power is switched off.

Teach cycle, teach-in for object scanning only (switch position O)

After power is switched on, the sensor shaft turns automatically to the zero position (home). This may turn the shaft up to 270° depending on its initial position. It is best not to mount the probe assembly for the first power on. After the sensor reaches its zero position, mount the probe assembly in the desired location.

Slide the mode switch on the controller to tool monitoring (position O, for Object monitoring). The LED RESULT is blinking red, indicating that the position information is lacking. The outputs FAULT and NotOK (pnp or npn) are also active.

Set the step switch to the maximum needed scanning angle. Push the teach button or activate the TEACH input and in object scanning mode, the probe will slowly turn to the selected position (unless prevented by an obstacle). The tool position is learned and retained in memory even when the power is switched off.

If the scanning angle is set short, the LED RESULT blinks red and the FAULT output (pnp and npn) is active.

Correction: Increase the scanning angle on the step switch until the LED RESULT will blink green after the next teach cycle.

Free space scanning (switch position F)

To monitor a scanning area for ejection control, or part feed control, set the mode switch to position F. Select the turning direction and scanning degrees with the corresponding switches. Select free space scanning up to 270° in clockwise or counter clockwise rotation.

Inputs

The input voltage is laid out for direct current 18 to 30V. The input resistance is approximately 1.5kOhm.

The TEST input starts the test cycle. During the return of the probe, the test result is switched to the output terminals.

The TEACH input or alternatively the TEACH button starts a teach cycle.

Outputs

The controller features three outputs (OK, NotOK, and FAULT) to indicate the test result. The FAULT output indicates an error in the setup, in the teach cycle, or in the test cycle. The outputs are available either as pnp or npn and are rated for maximum 0.1A.

The pnp-outputs switch to 24V and are wired with a recovery diode to 0V.

The npn-outputs switch to 0V and the recovery diode is wired to 24V.

The following functions are accessible under the front lid:

- Object or tool scanning, ranging from 15° to 270°, in clockwise or counter clockwise direction.
- The test result is displayed with LEDs.
- LEDs also indicate the main power and the external TEST signal.
- The OK, NotOK, and FAULT signals are switched (solid state) +24V (pnp-outputs) or 0V (npn-outputs) to the respective terminals.

OK output

In the object scanning mode the OK output becomes active if the tool is not broken. In the free space mode the OK becomes active if no object is found during scanning.

NotOK output

In the object scanning mode the NotOK output becomes active if the tool is broken. In the free space mode the NotOK output becomes active if an object is found during scanning.

FAULT output

The FAULT output becomes active if:
- the step switch is set to zero
- at tool is not found with the selected angle during the teach cycle
- the connecting cable between controller and sensor is defective or missing
- the sensor is not connected or defective
- an object prevents the return of the probe to the home position

LATCH (outputs latching)

DIP switch **off** (left position): the test result (OK, NotOK, FAULT) is kept on during the return of the sensor wand. Next the outputs are deactivated when the test signal goes low.

DIP switch **on** (right position): The outputs are stored until a new test cycle is initiated.

INV (inverting outputs)

DIP switch **on** (right position): The output signals are inverted.

1. DIP and Step Switch settings

1.1 DIP switch for the scanning direction L/R
L = turning direction left hand (DIP switch in left position):
After powering the controller up, the probe will move to the right stop. By activating the test input the probe will move to the left (counter clock-wise)
R = turning direction right hand (DIP switch in right position):
After powering the controller up, the probe will move to the left stop. By activating the test input the probe will move to the right (clock-wise)

1.2 DIP switch for scanning mode O/F
O = Object scanning (DIP switch in left position):
In the object mode an object (tool) is monitored. The tool position is learned with a teach cycle and is saved in the WK2A controller (non-volatile memory). If the probe, during scanning, finds an object within +/- 10° of the learned position, the outputs OK (pnp and npn) are activated.
F = Free space monitoring (DIP switch in right position):
In the free space mode the probe moves to the selected angle and back. The teach cycle is not used. If the probe encounters an obstacle within the selected angle, the NotOK outputs are activated (pnp and npn). If the probe moves to the set angle and back without encountering an obstacle the OK outputs are activated.

1.3 DIP switch latching, latching outputs
Outputs non-latching (switch in right position):
The test result is switched to the outputs OK, NotOK, and FAULT as soon as the probe encounters an obstacle or if it swings past the learned position. The outputs remain unchanged during the home run. After the probe reaches the home stop, the outputs remain activated as long as the test input is activated. Dropping the test input will drop the outputs.
Outputs latching (switch in left position)
The test result is switched to the outputs OK, NotOK, and FAULT as soon as the probe encounters an obstacle or if it swings past the learned position. The outputs remain unchanged until a new test or teach cycle is initiated. If a new test or teach cycle is started, all the outputs are switched off until a new test result is available.

1.4 DIP switch INV, inverting outputs
Outputs not inverting (switch in right position):
After powering the unit all outputs are off. To activate the outputs, +24V is switched to the pnp and 0V to the npn outputs. In the off condition, the pnp outputs are connected with a 10kOhm resistor to 0V, and the npn outputs with a 10kOhm resistor to +24V. Recovery diodes restrict the voltages when switching inductive loads.
Outputs inverted (switch in left position):
The outputs are inverted. After powering the unit all outputs are on. The pnp outputs are at +24V and the npn outputs at 0V. If an output is activated the outputs (pnp, npn) are switched off.

1.5 Step switch for maximum turning scanning angle
In the **object scanning** mode (O) the step switch restricts the angle in which the teach cycle tries to find an object. The selected angle should be slightly larger than the angle where the object is located.
For example, if an object is located at 80° the step switch should be set to 90°. This prevents a situation where the wrong object position is learned (say one at 120°) if the target object is not present.
A **teach cycle** is started with either the test input or the test push button behind the front lid. During the teach cycle, all outputs are inactive. If a tool is found between 15° and the set angle the OK output is activated (either pnp or npn). If a target tool is not found, the outputs NotOK and FAULT are activated and remain active until a successful teach cycle is completed.
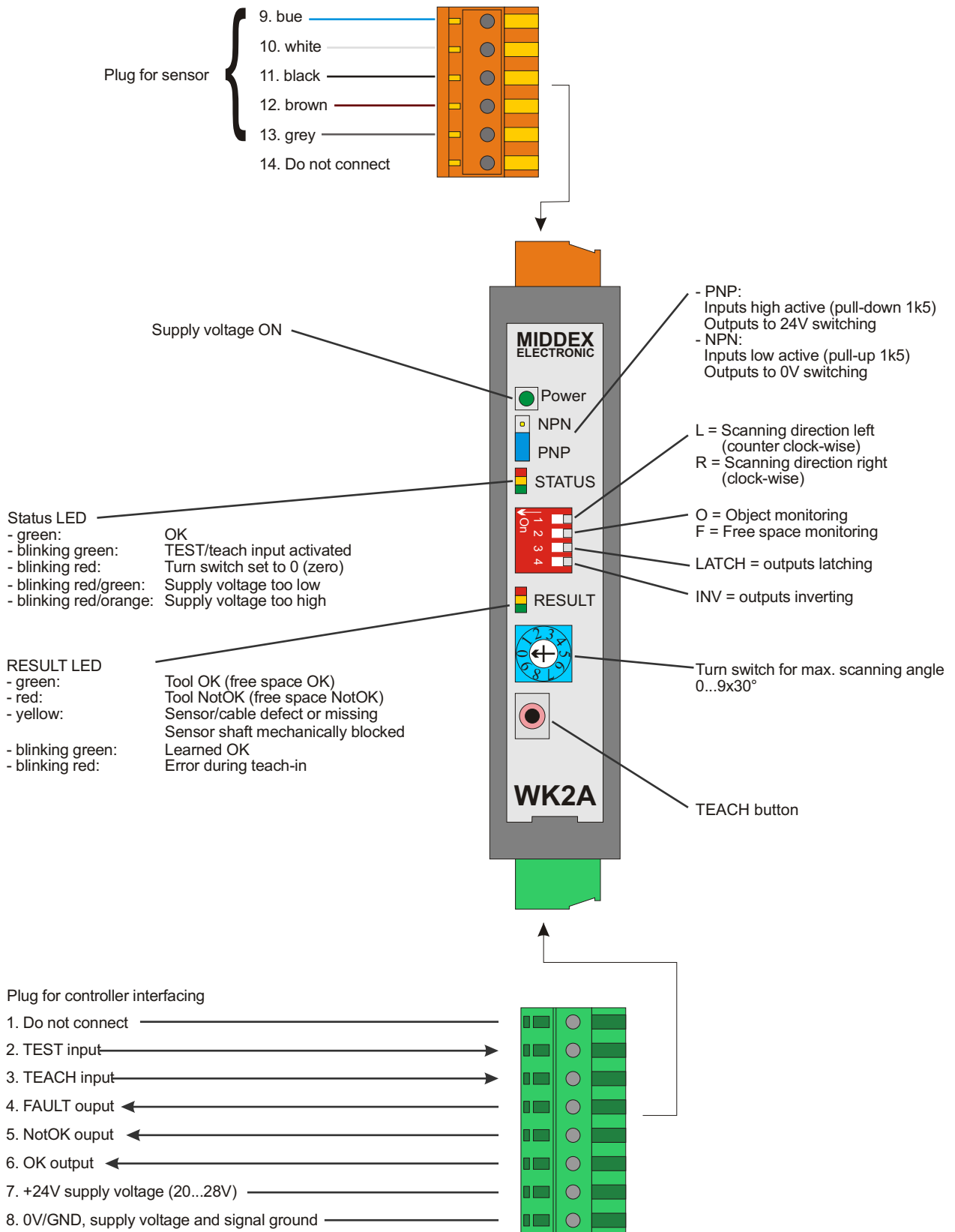In the **free space scanning** mode (F) the probe scans to the set angle and back. A teach cycle is not possible.

1.6 Jumper PNP/NPN
PNP: If the jumper is set to pnp, all in/outputs are active if a voltage of 24V is applied (high active). In the inactive state, the in/outputs are held to 0V through a resistor. This is the default for European and American controls.
NPN: If the jumper is set to npn, all in/outputs are active if a voltage of 0V is applied (low active). In the inactive state, the in/outputs are held to 24V (supply voltage) through a resistor. This is the default for Asia controls.
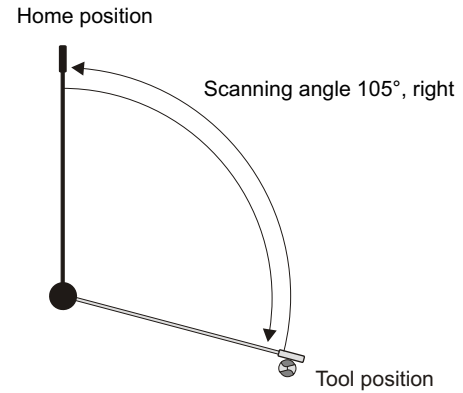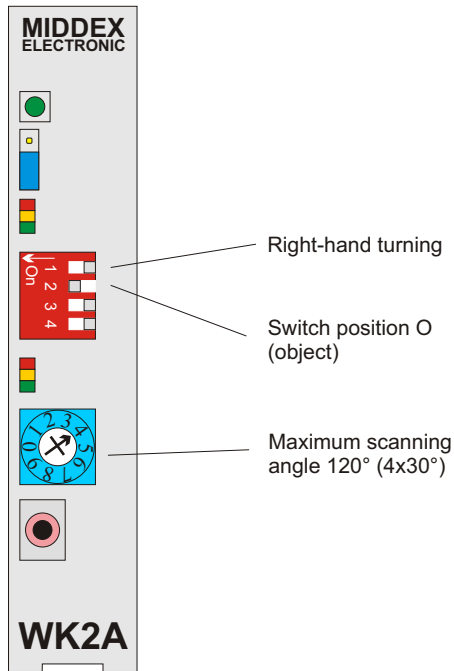
2. Connection, LEDs, and Settings Elements

Plug for sensor
- 9. bue
- 10. white
- 11. black
- 12. brown
- 13. grey
- 14. Do not connect

Supply voltage ON

- PNP:
  Inputs high active (pull-down 1k5)
  Outputs to 24V switching
- NPN:
  Inputs low active (pull-up 1k5)
  Outputs to 0V switching

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Power
NPN
PNP
STATUS

Status LED
- green: OK
- blinking green: TEST/teach input activated
- blinking red: Turn switch set to 0 (zero)
- blinking red/green: Supply voltage too low
- blinking red/orange: Supply voltage too high

L = Scanning direction left
    (counter clock-wise)
R = Scanning direction right
    (clock-wise)

O = Object monitoring
F = Free space monitoring

LATCH = outputs latching

INV = outputs inverting

RESULT

RESULT LED
- green: Tool OK (free space OK)
- red: Tool NotOK (free space NotOK)
- yellow: Sensor/cable defect or missing
                      Sensor shaft mechanically blocked
- blinking green: Learned OK
- blinking red: Error during teach-in

Turn switch for max. scanning angle
0...9x30°

WK2A

TEACH button

Plug for controller interfacing
1. Do not connect
2. TEST input
3. TEACH input
4. FAULT ouput
5. NotOK ouput
6. OK output
7. +24V supply voltage (20...28V)
8. 0V/GND, supply voltage and signal ground

3. Sample Applications

3.1 Example 1

Drill monitoring, scanning angle 105°, right-hand turning direction

Right-hand turning

Switch position O (object)

Maximum scanning angle 120° (4x30°)

Home position
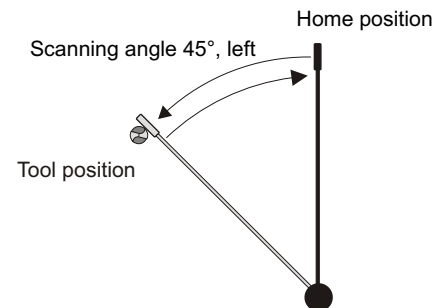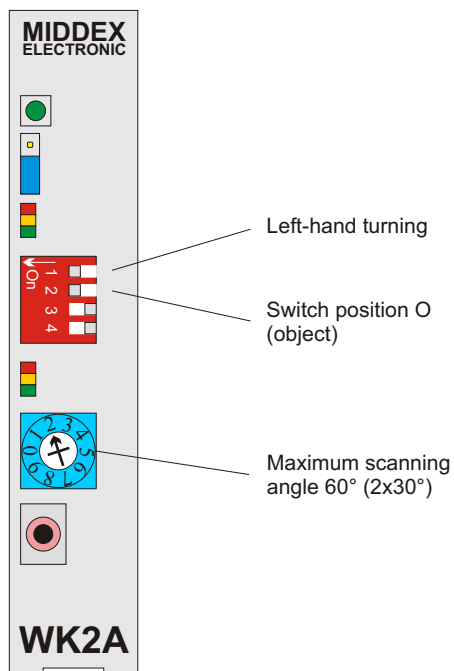
Scanning angle 105°, right

Tool position

NOTE: Set the maximum angle on the controller equal or larger than the scanning angle. The teach-angle area equals the selected angle plus approximately 5°.
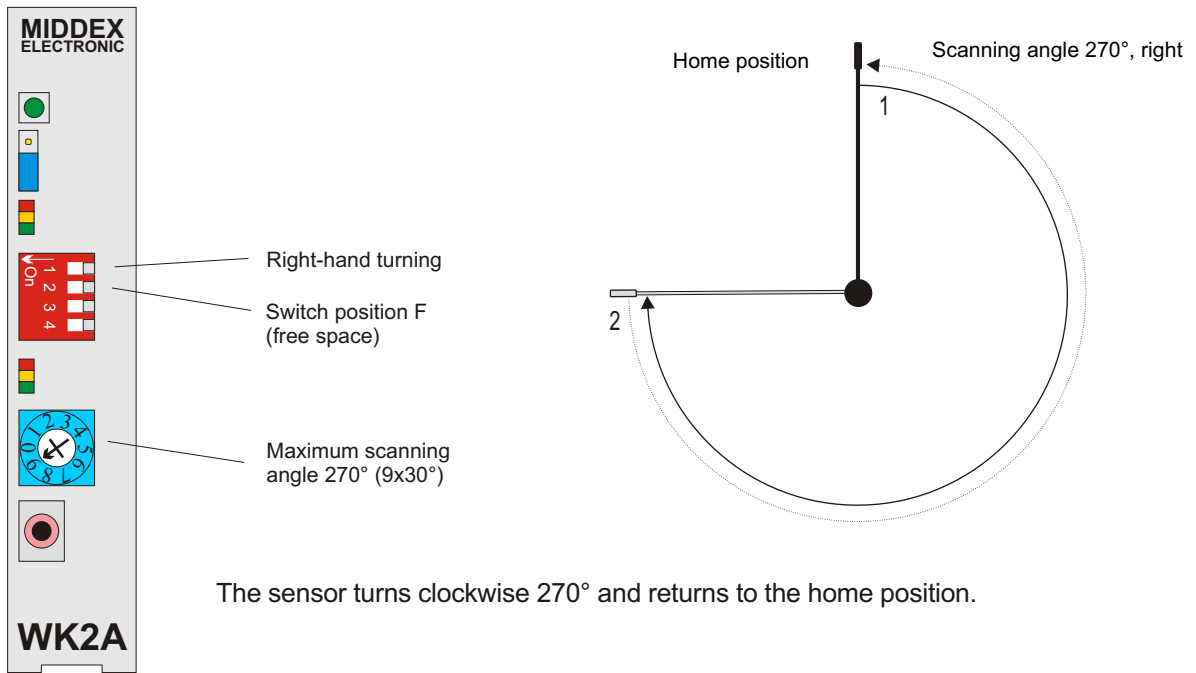
3.2 Example 2

Drill monitoring, scanning angle 45°, left-hand turning direction

Left-hand turning

Switch position O (object)

Maximum scanning angle 60° (2x30°)

Home position

Scanning angle 45°, left

Tool position

3.3 Example 3

Free space monitoring, scanning angle 270°, right-hand turning direction

Right-hand turning

Switch position F
(free space)

Maximum scanning
angle 270° (9x30°)

The sensor turns clockwise 270° and returns to the home position.
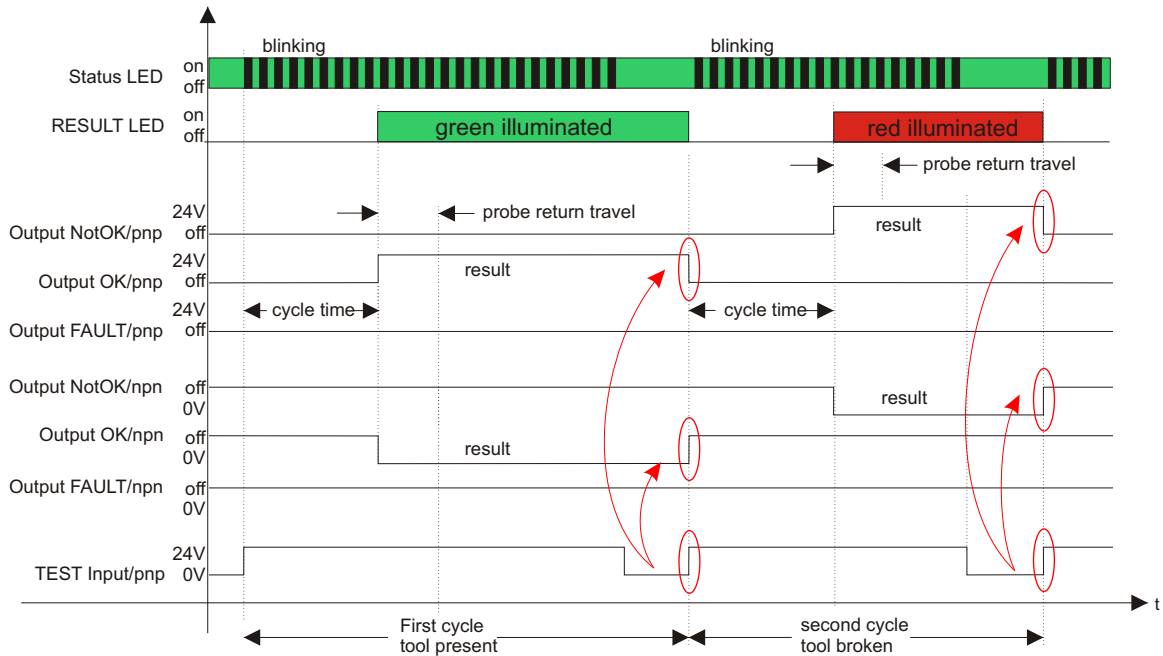
4. Timing Diagrams

4.1 Outputs not latching (LATCH = off, left); Outputs not inverted (INV = off, left)

Activating the TEST input starts the test cycle. The probe moves in the selected turning direction. Reaching the check position, the OK or NotOK LED is lit immediately. The output OK or NotOK is activated (pnp output = 24V, npn output = 0V) and remains activated until the test input is dropped. If the test input is dropped during scanning, the outputs remain active until the probe is at the home position. The OK and NotOK LEDs remain lit until a new TEST cycle is started.
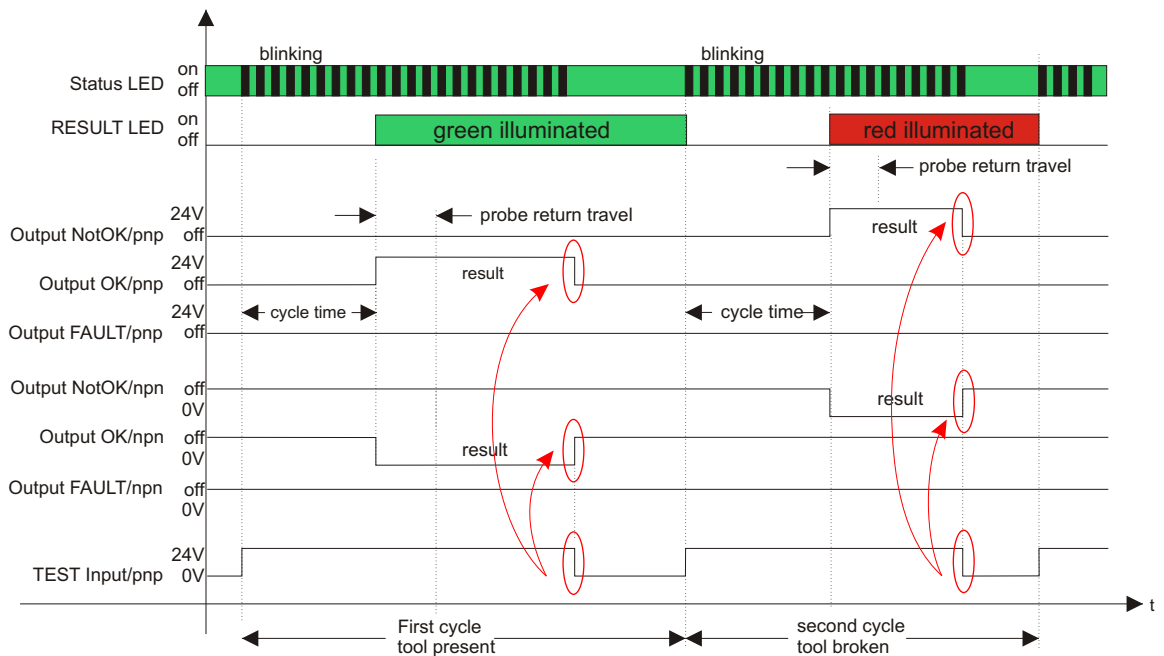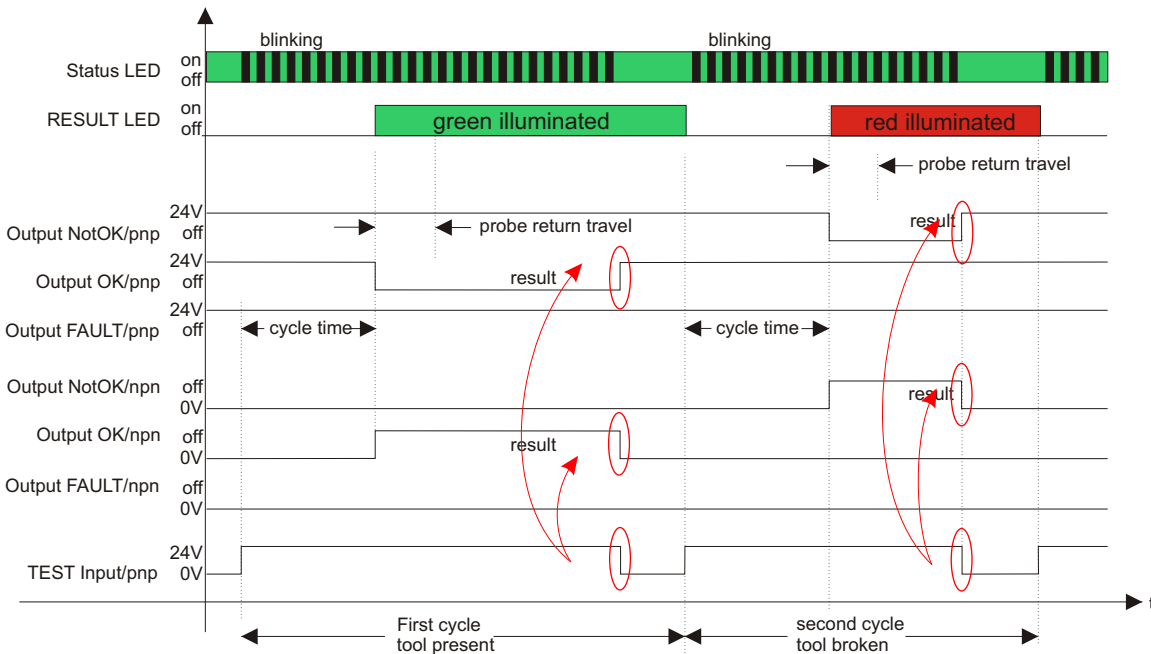
4.2 Outputs latching (LATCH = on, right); Outputs not inverted (INV = off, left)

Activating the TEST input starts the test cycle, the probe moves in the selected turning direction. Reaching the check position, the OK or NotOK LED is lit immediately. The output OK or NotOK is activated (pnp output = 24V, npn output = 0V) and remains activated until a new test or teach cycle is started. The OK and NotOK LEDs remain lit until a new TEST cycle is started.


4.3 Outputs not latching (LATCH = off, left); Outputs inverted (INV = on, right)

Powering up the unit will activate all outputs (pnp outputs = 24V; npn outputs = 0V). Activating the TEST input starts the test cycle, and the probe starts moving in the selected turning direction. Reaching the check position, the OK or NotOK LED is lit immediately. The output OK or NotOK is deactivated (pnp output = 0V, npn output = 24V) and remains deactivated until the test input is dropped. If the test input is dropped during scanning the outputs remain deactivated until the probe is at the home position. The OK and NotOK LEDs remain lit until a new TEST cycle is started.

4.4 Outputs latching (LATCH = on, right); Outputs inverted (INV = on, right)

Powering up the unit will activate all outputs (pnp outputs = 24V; npn outputs = 0V). Activating the TEST input starts the test cycle, and the probe starts moving in the selected turning direction. Reaching the check position, the OK or NotOK LED is lit immediately. The output OK or NotOK is deactivated (pnp output = 0V, npn output = 24V) and remains deactivated until a new teach or test cycle is started. The OK and NotOK LEDs remain lit until a new TEST cycle is started.
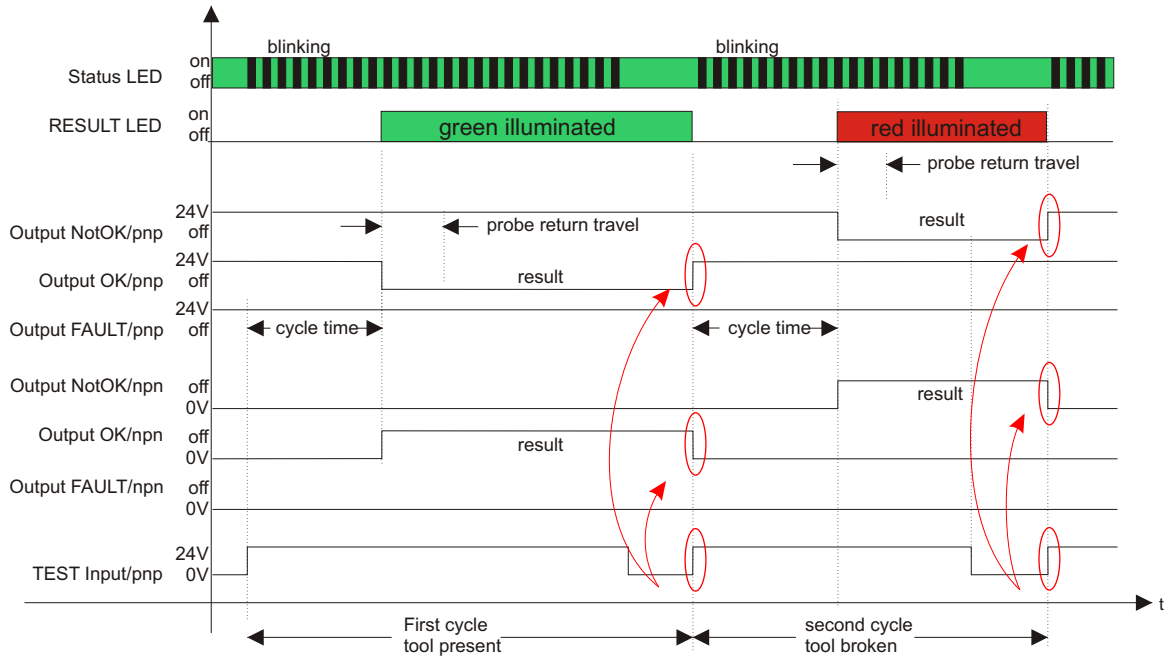
5. Compatibility to Controller WK2

The connections and functions of the controller WK2A are compatible with the controller WK2 if the DIP switches LATCH and INV are switched to the **off** position (right).

	Screw terminal WK2	Plug terminal WK2A/B
+24V	1	7. +24V supply voltage
0V	2	8. 0V/GND
Input TEST	3	2. TEST input
Output OK	4	6. OK output
Output NotOK	5	5. NotOK output
Output FAULT	6	4. FAULT output
Sensor wire blue	7	9. blue
Sensor wire white	8	10. white
Sensor wire black	9	11. black
Sensor wire brown	10	12. brown
Sensor wire grey	11	13. grey
Input TEACH	12	3. TEACH input

6. Error Indications

6.1 Error   RESULT LED is lit yellow
Source   a) The connecting cable between controller and sensor is defective or missing.
b) An obstacle prevents the return of the probe to the home position.
c) Sensor or connecting cable is defective.

Solution   a) Connect cable or check cable leads for continuity and replace cable if needed.
b) Remove obstacle.
c) Return sensor to manufacturer or distributor.

6.2 Error   RESULT LED is blinking red
Source   a) The controller has not learned the selected angle.

Solution   a) Correct/make setup and start teach cycle.

6.3 Error   Only a short signal appears at the OK or NotOK terminal
Source   a) The TEST input is dropped during scanning.

Solution   a) Increase signal time on TEST input (see timing diagram page 6).
   or set switch LATCH to latching (on position, left).

6.4 Error   The tool is damaged during scanning contact
Source   a) The impact moment is too high.

Solution   a) For small tools use the WK2B controller (WK2 sensor, WK2 cable).
   For tiny tools use the WK5 system (controller WK5, WK5 sensor, WK5 cable).

7. Input Wiring

If the jumper behind the front lid is set to pnp, the inputs are activated to +24V. The load 1.5kOhm resistor is connected to 0V.
If this jumper is set to npn, the inputs are activated to 0V. The load 1.5kOhm resistor is connected to +24V/supply voltage.
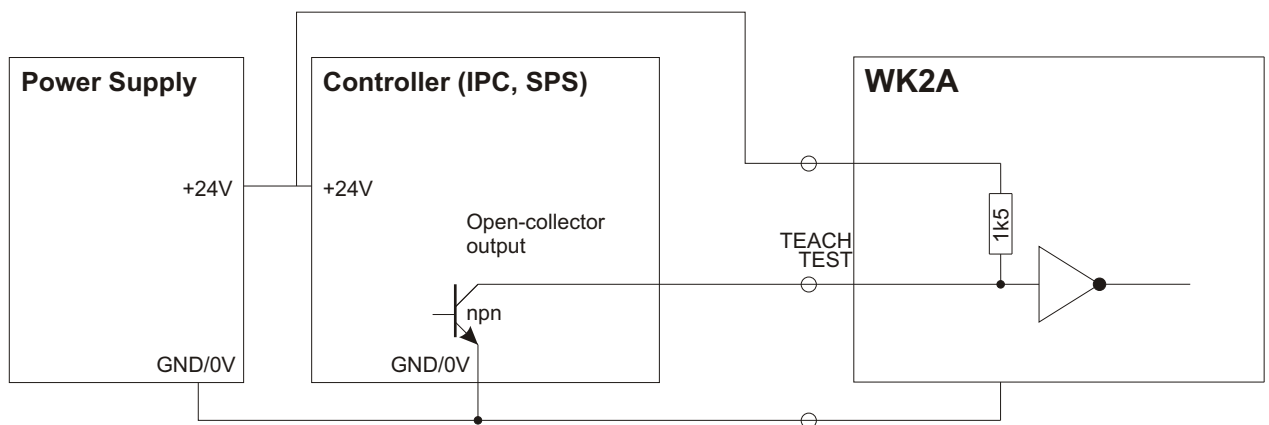
7.1 Driving with 24V outputs

If the inputs of the WK2A are driven with 24V the jumper behind the front cover needs to be set to pnp (lower position). Connect Ground/0V of the WK2A with the Ground/0V of the machine controller (industrial PC or SPS). The 24V outputs of the machine controller are connected to the TEST+ and TEACH+ inputs.
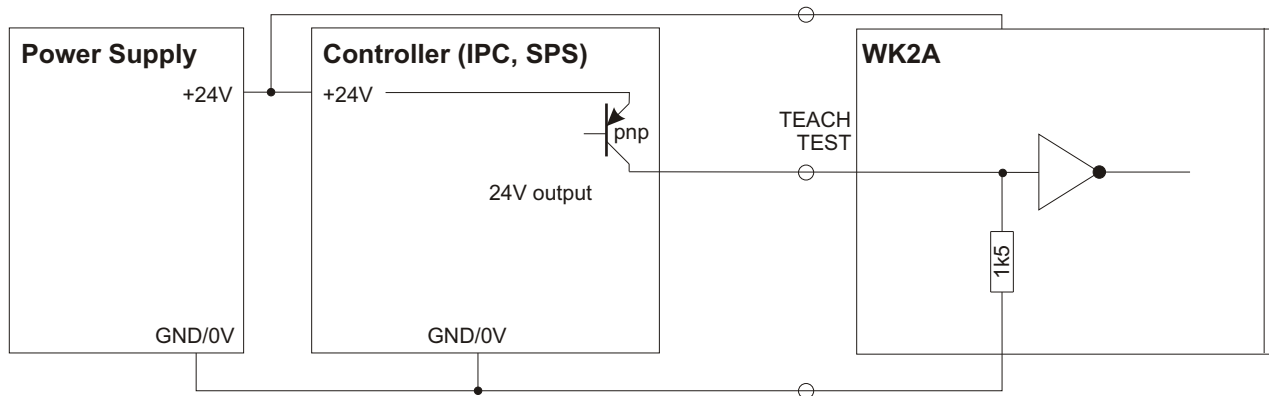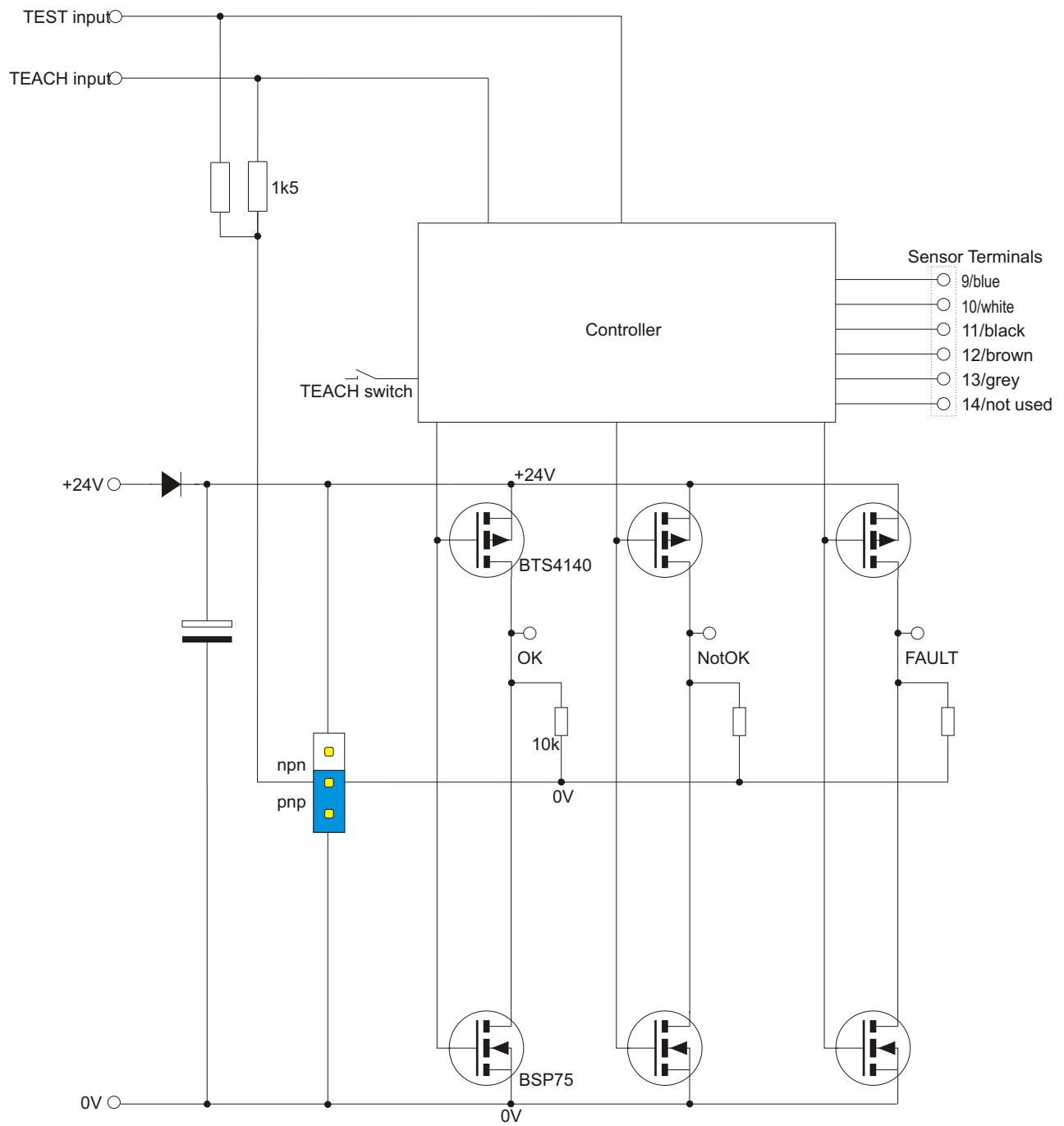

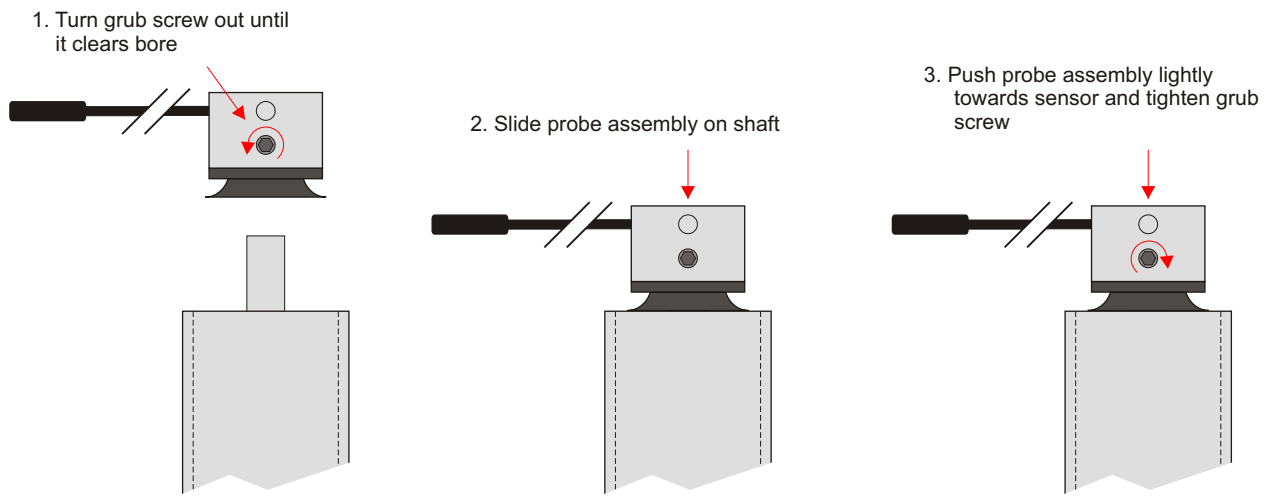## 7.2 Driving with open collector outputs

If the inputs of the WK2A are driven with open collector outputs (to 0 switching), the jumper behind the front cover needs to be set to npn (upper position). Connect the ground/0V of the machine controller (industrial PC or SPS) with the ground/0V of the WK2A. The open collector outputs of the machine controller are connected to the TEST- and TEACH- inputs.
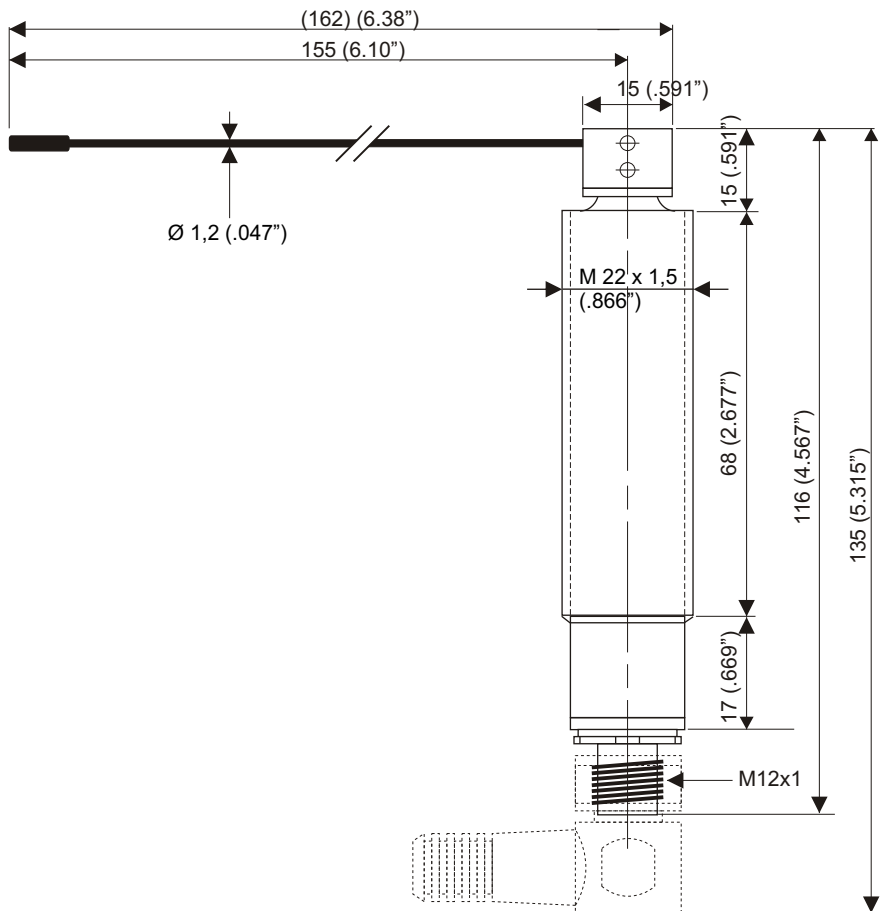
8. Controller Schematics WK2A

TEST input

TEACH input

1k5

Controller

Sensor Terminals
- 9/blue
- 10/white
- 11/black
- 12/brown
- 13/grey
- 14/not used

TEACH switch

+24V

+24V

BTS4140

OK

NotOK

FAULT

10k

npn

pnp

0V

BSP75

0V

0V

9. Mounting the Probe Assembly

1. Turn grub screw out until it clears bore

2. Slide probe assembly on shaft

3. Push probe assembly lightly towards sensor and tighten grub screw

10. Mounting the Probe Assembly

10.1 Sensor Dimensions

(162) (6.38")
155 (6.10")
15 (.591")
Ø 1,2 (.047")
15 (.591")
M 22 x 1,5 (.866")
68 (2.677")
116 (4.567")
135 (5.315")
17 (.669")
M12x1

10.2 Cable Dimensions

Sensor side

Ø 14 (.55”)

WK2A controller plug side

Ø 5 (.2”)

blue (9)
white (10)
black (11)
brown (12)
grey (13)

26 (1.02”)

39 (1.54”)

5 - 20m (16’ - 65’)

WK2A controller plug side

Sensor side

blue (9)
white (10)
black (11)
brown (12)
grey (13)

Ø 5 (.2”)

15 (.059”)

40 (1.57”)

10m (32’)
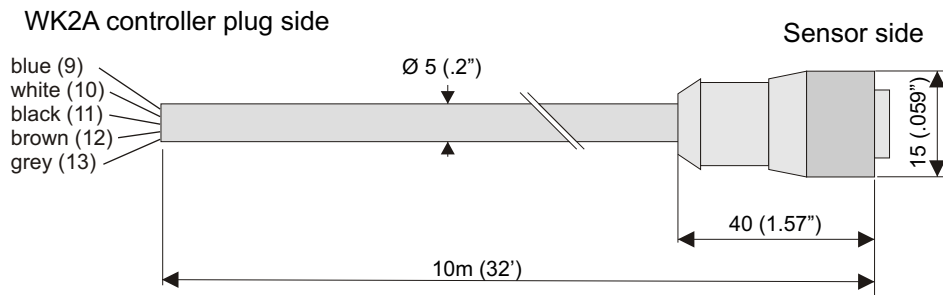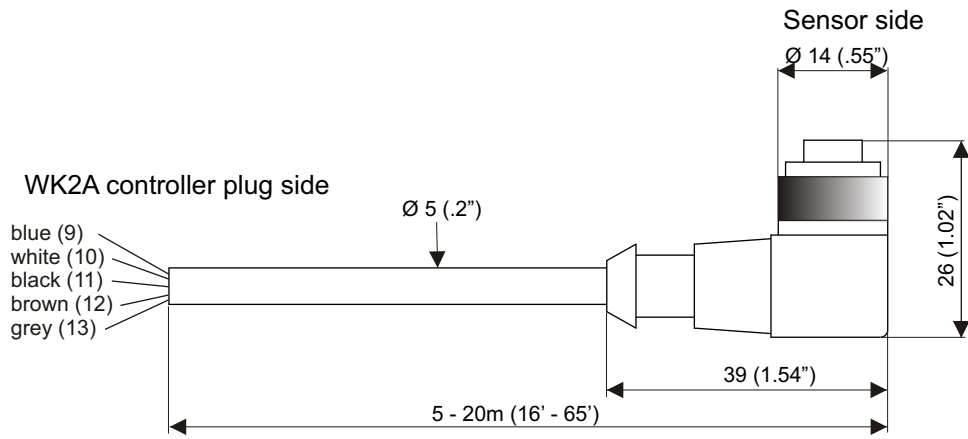
10.4 WK2A Controller Dimensions
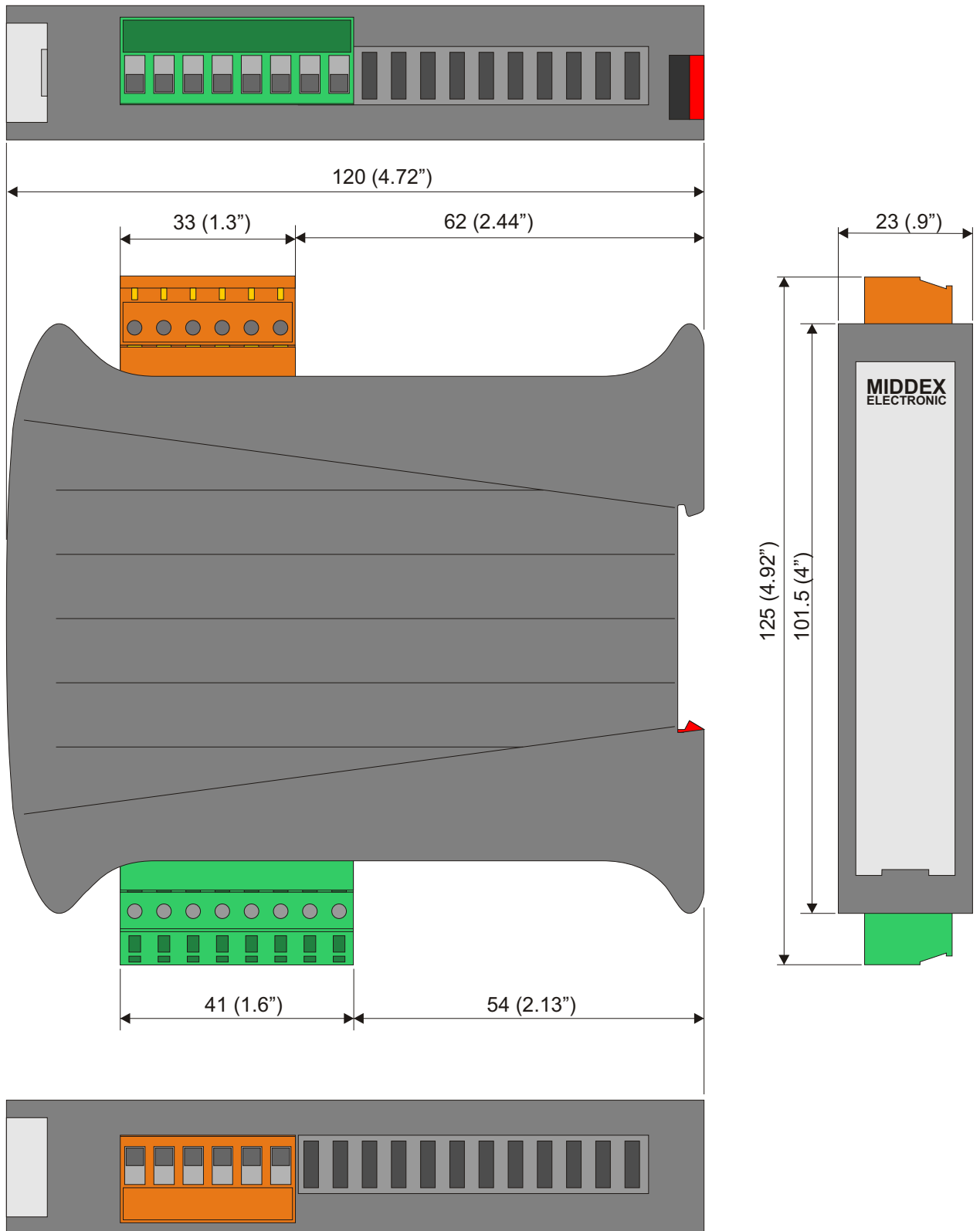
11. Technical Data

Controller

Protection:	IP20
Interference susceptibility:	to EMV specifications, carries CE logo
Mounting:	EN rail (DIN rail)
Supply voltage/power draw:	24VDC (20-28VDC)/5W (no outputs load)
Outputs:	solid state
	pnp outputs switching to +24V, 10kOhm to 0V
	npn outputs switching to 0V, 10kOhm to 24V
Output current load:	100mA maximum, short protected for 1 minute
Stocking temperature:	0° to +70°C (0° to 158°F)
Working temperature:	0° to +50°C (32° to 122°F)
Signal voltage:	20 to 35VDC approximately
	5mA opto-decoupled signal inputs
	diode-protected against cross wiring
Signal input resistance:	approximately 1.5kΩ
Sensor plug:	6 terminals, orange
Signal plug:	8 terminals, green

Sensor

Sensor body:	special steel chromed
Mounting nut:	M22x1.5, SW27
Protection:	IP68
Protection connector plug:	IP67
Interference susceptibility:	to EMV specifications, carries CE logo
	the sensor housing to be grounded with machine ground
Probe length:	standard 160mm (6") (included with sensor) max. 200mm (8")
Scanning angle:	maximum 270° in both directions
Smallest tool diameter:	approximately 0.3mm (.012")
Temperature range:	0° to +70°C (32° to 158°F)
Maximum shaft loads:	radial 100N, axial 5N

Typical cycle times

Scanning angle 30°:	150ms
Scanning angle 60°:	180ms
Scanning angle 90°:	220ms
Scanning angle 120°:	240ms
Scanning angle 150°:	260ms
Scanning angle 180°:	280ms
Scanning angle 210°:	310ms
Scanning angle 240°:	340ms
Scanning angle 270°:	360ms

12. Controller WK2B for small tools

The WK2B controller was optimized for smaller tools. The same sensor and cables are used like for the WK2A and older WK2. The WK2B replaces the old WK2 controller V12.09.

The torque was reduced. Also the scanning speed with which the probe contacts the tool was reduced. This increases the scanning time by approximately 20%.
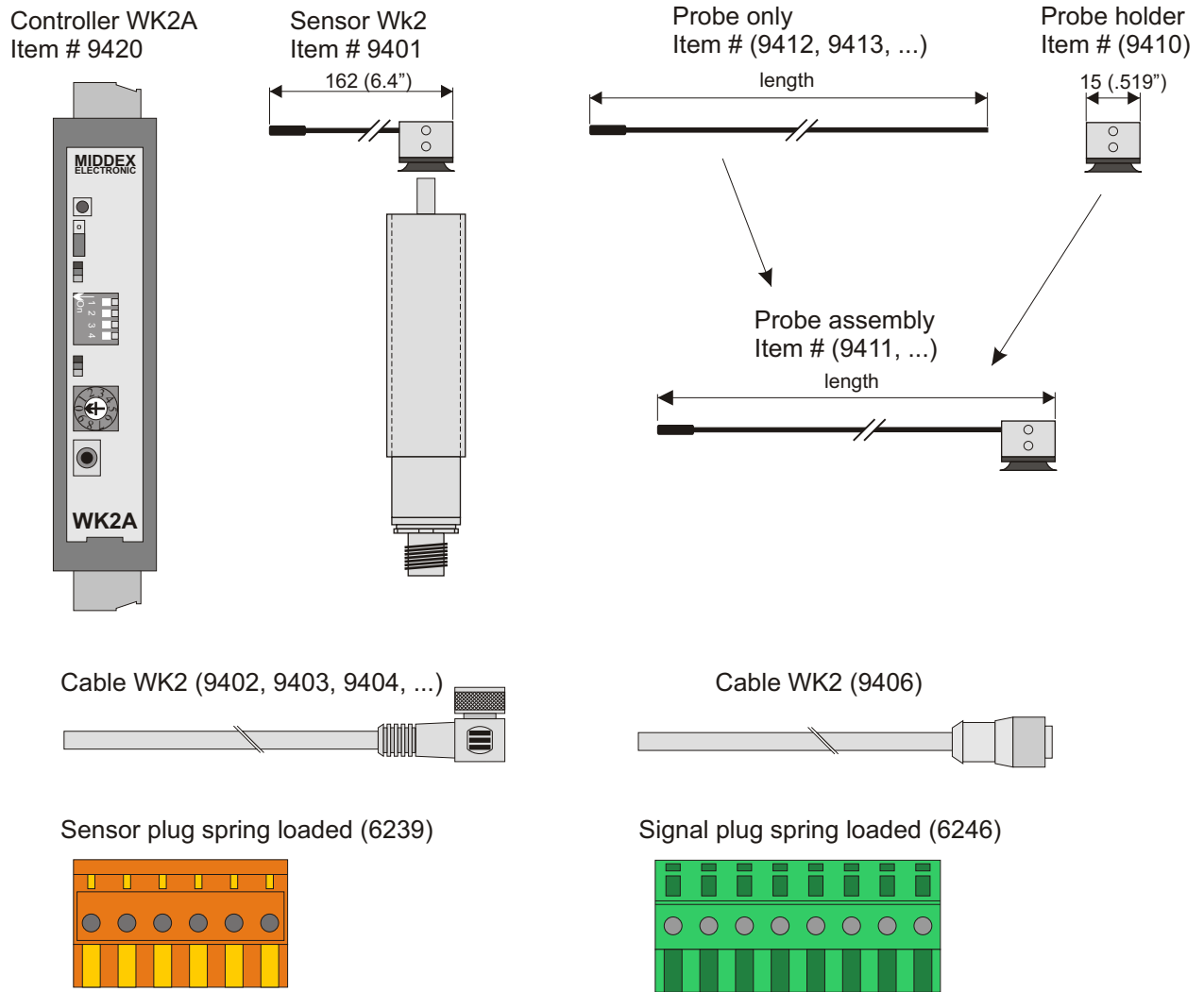
All functions and setup elements as well as in/outputs are identical with the WK2A and WK2B controllers.

For very small tools we recommend the WK5 system especially optimized for tiny and hard tools. The WK5 system uses the WK5 sensor and WK5 cables which are not compatible with the WK2A and WK2B systems.

13. Order Information

Part	Type	Item #
Controller:	WK2A	9420
Sensor complete with probe assembly:	WK2	9401
Cable 5m (16') 90° connector:		9402
Cable 10m (32') 90° connector:		9403
Cable 20m (65') 90° connector:		9404
Cable 10m (32') straight connector:		9406
Probe assembly standard:	160mm (6")	9411
Probe holder only with seal:		9410
Probe only, steel with carbide end:	160mm (6")	9412
Probe only, steel with carbide end:	200mm (8")	9413

Sensor plug, 6 terminals, spring loaded, orange
Signal plug, 8 terminals, spring loaded, green

Controller WK2A
Item # 9420

Sensor Wk2
Item # 9401
162 (6.4")

Probe only
Item # (9412, 9413, ...)
length

Probe holder
Item # (9410)
15 (.519")

Probe assembly
Item # (9411, ...)
length

Cable WK2 (9402, 9403, 9404, ...)

Cable WK2 (9406)

Sensor plug spring loaded (6239)

Signal plug spring loaded (6246)