EXPERT-TÜNKERS GMBH

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Operating manual

Turntable control
SmartTurn

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1 General Information

1.1 Information about this manual

This manual enables safe and efficient maintenance of the device.

The manual is a component of the device and must be kept accessible to specialized personnel in the immediate vicinity of the device at all times.

The basic prerequisite for safe work is compliance with all safety instructions and handling instructions specified in this manual.

In addition, the local accident prevention guidelines and general safety regulations for the devices's area of implementation apply.

Illustrations in this manual are provided for basic understanding and can deviate from the actual model of the device.

1.2 Explanation of symbols

Warnings

Warnings are indicated by symbols in this operating manual. The warnings are introduced by signal words that express the scope of the hazard.
The warnings must be strictly heeded, you must act prudently to prevent accidents, personal injury, and property damage.

DANGER!

… indicates an imminent dangerous situation that can result in death or serious injury if it is not avoided.

WARNING!

… indicates a possible dangerous situation that can result in death or serious injury if it is not avoided.

CAUTION!

… indicates a possible dangerous situation that can result in minor injury if it is not avoided.

CAUTION!

… indicates a possible dangerous situation that can result in material damage if it is not avoided.

Tips and recommendations

NOTE!

... indicates useful tips and recommendations, as well as information for efficient and trouble-free operation.

1.3 Disclaimer

All information and instructions in this operating manual have been provided under due consideration of applicable guidelines, the current state of technology, as well as our many years of experience.

The manufacturer assumes no liability for damages due to:

- Failure to heed the instructions in the manual
- Non-intended use
- Deployment of untrained personnel
- Unauthorized conversions
- Technical changes
- Use of non-approved replacement parts

The actual scope of delivery can vary from the explanations and graphic representations provided in this manual in the case of special versions, if supplemental order options are desired, or on the basis of the latest technical changes.

In all other respects the agreed obligations in the delivery contract, the general terms and conditions, as well as delivery conditions of the manufacturer, and the statutory regulations valid at the time the contract was concluded, apply.

We reserve the right to make changes in the interest of enhancements and improvement of the performance characteristics.

1.4 Copyright

Treat this operating manual with confidentiality. It has been exclusively prepared for personnel working with the device. Provision of the operating manual to third-parties without written consent from the manufacturer is prohibited.

NOTE!

The content, texts, drawings, graphics, and other presentations are protected by copyright and are subject to commercial property rights Any improper use is punishable.

Duplication in any form - including excerpts - as well as exploitation and/or communication of the content are not permitted without a written declaration from the manufacturer. Actions to the contrary make damage compensation mandatory. We reserve the right to enforce additional claims.

1.5 Replacement parts

WARNING!
Safety risk if the wrong replacement parts are used!

Incorrect or defective replacement parts can cause damage, malfunction, or total failure; they can also impair safety.

Therefore:

– Only use manufacturer's original replacement parts.

Purchase replacement parts directly from the dealer. See page 2 for manufacturer's address

The replacement part list is in the Appendix

1.6 Guarantee terms

The guarantee terms are included in the manufacturer's terms and conditions, the order confirmation, or manufacturer's contract documents.

1.7 Customer service

Our customer service organization is available for technical information. See page 2 for contact data.

Our employees are always interested in new information and experiences associated with the application, and which could prove valuable in improving our products.

For questions or ordering of replacement parts, please specify the types and serial numbers.

2 Safety

This section provides an overview of all the important safety aspects for optimal protection of personnel, as well as for safe and trouble-free operation.

Significant hazards can occur if the handling instructions and safety instructions in this manual are not complied with.

Comply with the instructions in the Installation and Operating Manual - Turntables

DANGER!
Danger of severe or fatal injuries!

Therefore:

– Strictly ensure that you have read the Installation and Operating Manual - Turntables

NOTE!

The safety instructions in the Installation and Operating manual - Turntables, and in the technical documentation must be strictly complied with.

The turntable controller is included as a component in the scope of delivery of a turntable.

2.1 Responsibility of the customer

The device is used in industrial applications. Consequently the owner of the device is subject to legal industrial safety obligations.

In addition, the customer is responsible to ensure that the system is always in technically faultless condition.

Compliance with the instructions in the operating manual is the prerequisite for trouble-free operation and the fulfillment of possible guarantee claims.

The operating manual contains important service instructions therefore it must be kept in a safe location.

2.2 Personnel requirements

2.2.1 Qualifications

WARNING!
Danger of injury due to insufficient qualification!

Improper handling can cause serious injury or material damage.

Therefore:

– Only have activities performed by personnel who are qualified to perform these activities.

Only persons from whom it can be expected that they reliably execute their work are considered as personnel. Persons whose capability to react is impaired, for instance through drugs, alcohol, or medication, are not approved.

- Comply with age-specific and job-specific regulations that are applicable at the installation site when selecting personnel.

2.3 Intended use

NOTE!

The following is prohibited unless the unit is designed exclusively for the application:

- *Use in Ex areas.*
- *Use in the vicinity of acids, gases, and fumes.*

The use conditions have been specified in the project planning.

WARNING!
Danger due to non-intended use!

Any use that extends beyond the intended use, and/or any other use of the device can cause dangerous situations.

Therefore:

– Only use the device as intended.

– Strictly comply with all instructions in this operating manual.

Claims of any type due to damage arising from non-intended use are excluded.

The customer is solely liable for all damage in the case of non-intended use.

Turntable controller - *SmartTurn*

The ***SmartTurn*** turntable controller is **only** designed to operate EXPERT-TÜNKERS turntables with fixed indexing and lock angles of 20, 30, 40 and 60 degrees. The step time must be greater than 1.5s.

Do not operate other turntables with the ***SmartTurn*** controller.

2.4 Environmental protection

CAUTION!
Environmental hazard due to incorrect handling!

Incorrect handling of environmentally hazardous substances, particularly improper disposal, can cause significant environmental damage.

Therefore:

– Always comply with the instructions cited below.
– If environmentally harmful substances should inadvertently get into the environment, initiate suitable measures immediately. If in doubt notify the responsible municipal authority about the damage.

Dispose of the controller as electrical and electronic waste.

3 Technical data - turntable controller

***SmartTurn* sensor:**

Dimensions (without plug-in connector)	Approximately 130x 75x 32mm WHD
Ambient temperature	-25 to +70
Enclosure material	PBT
Degree of protection	IP67
Operating voltage	18-30 V DC
Operational current	0-100mA
Short-circuit protection	Clocked
Connection	M12x1 device plug-in connector

***SmartTurn* control unit:**

Dimensions (without plug-in connector)	Approximately 150x 112x 33mm WHD
Ambient temperature	0 to +50
Enclosure material	PBT
Degree of protection	IP65
Operating voltage	18-30 V DC
Operational current	0-150mA
Short-circuit protection	Clocked
Current carrying capacity outputs A1, A2	0 V
Current carrying capacity outputs A3-A9	0 V
Connections	X1, M23x1 device plug-in connector X2. M12x1 device socket X3, M12x1 device plug-in connector

4 Structure and function

4.1 Overview

Sensor

Fig. 1 Sensor

Control unit

Fig. 2 Control unit

The ***SmartTurn*** turntable controller consists of the components:

- Inductive sensor, incl. Position encoder.
- Control unit.
- Sensor cable.
- Diagnostics cable (optional).
- PLC interface cable (optional).

4.1.1 Device description

Sensor, Fig. 1:

The sensor is equipped with:

- A connection for the control unit.
- One green LED and two yellow LEDs.

All three LEDs are illuminated when the sensor is connected to the control unit.

Control unit, Fig. 2

The controller is equipped with:

- Three connections for PLC (X1), sensor (X2) and a diagnostics connection (X3).
- Eight LEDs that enable fast and easy diagnosis. Faults are indicated through flashing red LEDs. More information about faults is provided in the *section -> Faults*.

LED	Function	Color
H1	System fault	Red
H2	Overrun forward	Red
H3	0-position	Yellow
H4	Overrun backward	Red
H5	End lock angle	Red
H6	Start forward on	Yellow
H7	Start backward on	Yellow
H8	Not assigned	-
H9	24 V power supply	Green

More extensive diagnoses is possible with the diagnostics software, via the diagnostics connection (X).

4.2 Functional description

The ***SmartTurn*** turntable controller is used to control Expert-Tünkers fixed indexing turntables with any desired indexing.

The turntable can be operated in reverse mode and continuous mode.

The drive motors can be actuated directly via contactors or frequency converters.

The position encoder is mounted on the drive roller determined by position. This ensures a unique position of the drive roller, as well as of the turntable.

The sensor analyses the position encoder and transfers the position value to the control unit.

The control unit monitors the position value and the PLC signals.

With each activation the drive roller is rotated 360 degrees forward or backward. Thus the turntable is always cycled one index.

If the turntable is in the 0 position, this is signaled to the PLC.

In reverse mode the forward and backward positions are output as a signal to the PLC.

Additional position sensing is necessary for turntables with more than 2 indexes or for continuous mode. For this possibility position sensing is supplied for the turntable plate as an option. In this case inductive sensors with individually-coded actuators are used.

Position sensing, standard:

Up to 15 positions are possible if there are no safety requirements.

Position sensing, safety:

1 to X positions with category 4 safety sensors.

Structure and function

Continuous mode

NOTE!

In normal operation the turntable only turns forward. The turntable controller cycles the turntable one clock cycle further with each "Forward on" activation.

The "Backward on" activation should only be possible in inching mode in the PLC.
At "Backward on" activation, in continuous mode turntable movement is not switched off by the turntable controller.

Reverse mode

NOTE!

The turntable turns forward/backward between 2 positions (usually 180 degrees). The turntable controller cycles the turntable into the other position.

Functional principle diagram

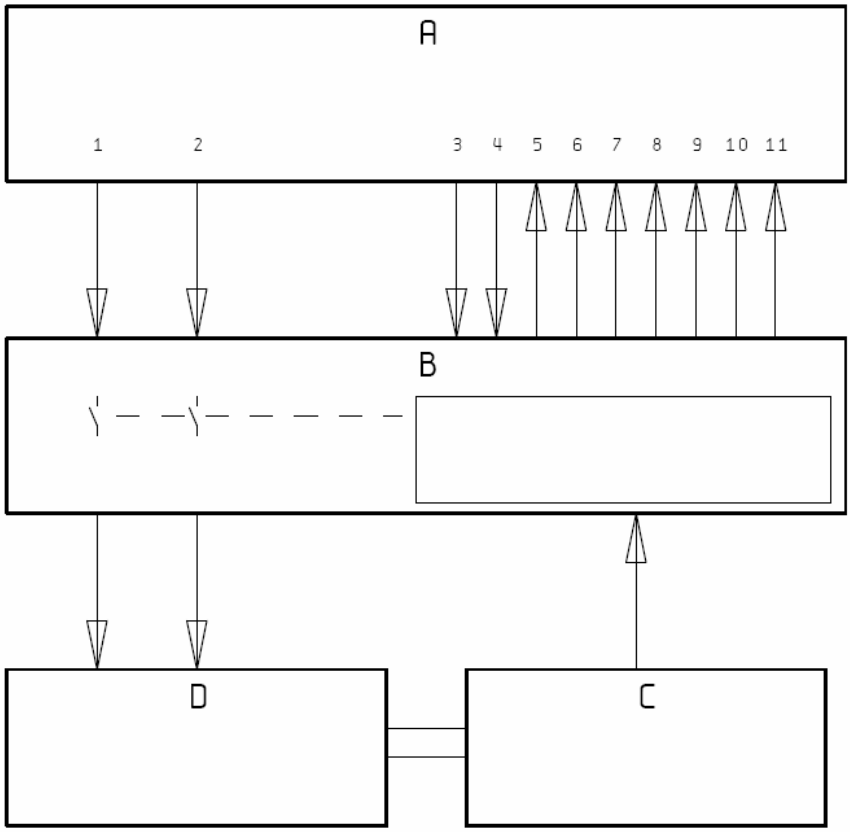


Fig. 3 Functional principle

A: PLC system controller

- 1 *"Forward"*
- 2 *"Backward"*
- 3 *"Slow"*
- 4 „*Operating mode"*
- 5 *"0-position"*
- 6 „*Overrun forward"*
- 7 „*Overrun back"*
- 8 „*End of the lock angle"*
- 9 *"Position forward"*
- 10 „*Position back"*
- 11 „*System fault"*

B: SmartTurn - control unit

- *"Position analysis - controller"*

C: SmartTurn - sensor

- *"Turntable position"*

D: „*Turntable drive"*

4.2.1 0-position optimization

With "Forward on" or "Backward on" the turntable controller checks the activated direction and the momentary position. If the result is OK, the output "Forward start" or "Backward start" is enabled.

The turntable will then start to rotate.

When the switch-off angle is reached, the output "Forward start" or "Backward start" is switched off and the turntable is stopped immediately.

With each rotation the turntable controller calculates the switch-off angle for the next rotation so that the turntable comes to a stop in the optimal 0-position.

When first switched on, a default value is used that is specific to the lock movement. Thereafter deviation from the optimal 0-position is determined and the switch-off angle is determined for the next rotation.

The 0-position is present when the position deviation does not exceed +/- 8 degrees based on the optimal 0-position.

If the turntable is in this position, the "0-position" signal is output to the PLC.

Calculation and optimization occur separately for forward and backward. Thus time-intensive settings at start-up are not necessary.

The turntable controller is self-adjusting and self-optimizing.

If, when switching on the operating voltage, a deviation to the last saved position is detected, then this results in a system fault.

NOTE!

See section -> System fault - note invalid sensor data, for additional instructions.

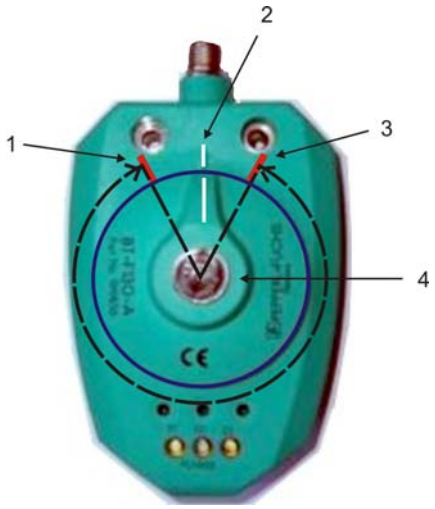


Fig. 4 0-position - sensor

0-position and switch-off angle at the sensor

1 Switch-off angle forward
2 0-position
3 Switch-off angle backward
4 Position encoder

CAUTION!
The turntable should not be activated with the "Slow on" activation in continuous mode

Therefore:

– Only use "Slow on" for inching mode, or if the turntable is started from an intermediate position.

NOTE!

There is no optimization for "Slow on" activation, in this case the system is always switched off at a fixed switch-off angle.

With "Backward on" activation in continuous mode, turntable movement is not switched off by the turntable controller.

"Reverse on" activation is only intended for inching mode in continuous mode to enable clearing, if necessary.

4.2.2 Brake wear monitor

If the switch off angle reaches the end of the lock movement, then the warning "End lock angle" is output to the PLC.

CAUTION!
Warning "End lock angle"!

Increased brake wear or abnormal conditions (e.g. due to overload) could be present that could damage the turntable.

Therefore:

– Check the brake on the motor.
– Check the turntable.

The turntable can still be operated, however the warning indicates that increased brake wear or abnormal conditions are present that could compromise safe turntable operation over a longer period of time.

NOTE!

Addition fault rectification instructions are provided in the section -> Sequence fault - warning end lock angle.

If the switch-off angle is more than 5 degrees outside of the lock movement, the warning "End lock angle" and "System fault" are output to the PLC.

The fault signals that increased brake wear or abnormal conditions are present that compromise safe operation of the turntable.

Further operation can cause damage to the drive elements.

CAUTION!
Switch-off over 5 degrees. Warning "End lock angle"!

Increased brake wear or abnormal conditions (e.g. due to overload) are present.

Therefore:

– Do not continue to operate the turntable.
– Check the motor on the brake and replace if necessary.
– Check the turntable.

NOTE!

Additional fault rectification instructions are provided in the section -> System fault - end of lock angle reserve reached.

4.2.3 Overflow monitor

If the 0-position is overrun during a rotation the warning "Overrun forward" or "Overrun backward" is output.

The warning is signaled to the PLC.

In reverse mode the fault is deleted by activation of the opposite direction, and by leaving the overrun.

In continuous mode the fault is deleted with a subsequent "Forward on" activation. In continuous mode there is no "Overrun back" warning.

NOTE!

Additional fault rectification instructions are provided in the section -> Sequence fault - Overrun forward / backward.

4.2.4 System monitoring

All important system components are monitored.

If an uncertain state that compromises safe operation of the turntable is detected, then the "System fault" output is set and the two outputs A1 and A2 are switched off immediately. Each activation is ignored by the PLC, the turntable movements are blocked.

System faults can be:

- Missing sensor data (sensor, sensor cable, or position encoder is defective).
- Invalid sensor data (deviation of the position data after switching on 24 V).
- Impermissible mode change.
- Short circuit on the outputs.
- End of lock angle reserve is reached.
- Internal device fault.
- Additional instructions on fault rectification are provided in the section -> *System fault.*

NOTE!

Additional instructions on fault rectification are provided in the section -> System fault.

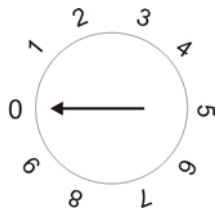
4.2.5 Device settings - control unit

There are three setting possibilities on the control unit, S1, S2, and S3. S1, S2, and S3 are behind a screw-fastened cover.

- S1 Lock movement drive roller settings.
- S2 Reset system faults
- S3 Rotary direction, clockwise rotation - counter-clockwise rotation, drive roller

S1: Lock movement, drive roller settings

Rotary switch



1 = 20° lock movement
2 = 30° lock movement
3 = 40° lock movement
4 = 60° lock movement

Fig. 5 Rotary switch - lock movement

Use the rotary switch to set the respective lock movement of the drive roller.

When commissioned in the factory the drive roller is set appropriately. The default value is position 2 = 30 degrees. Settings other than positions 1-4 have no function.

NOTE!

If the device is replaced the value must be set appropriately.

S2 Reset system fault

Use the button to reset system faults on the device.

NOTE!

Additional instructions on fault rectification are provided in the section -> System faults.

S3 Rotary direction clockwise rotation - counter-clockwise rotation, drive roller

Fig. 6

R = clockwise rotation (default value)

L = counter-clockwise rotation

The rotary movement of the turntable plate depends on the rotary direction of the drive motor, and on the incline of the drive roller.

The turntable controller checks whether the forward/backward activation and the rotary direction of the drive roller agree.

Clockwise

In this setting the turntable controller expects drive roller / position encoder rotation to the right (clockwise) at "*Forward on"*.

For *"Backward on"* left (counter-clockwise) rotation of the drive roller / position encoder is expected.

Counter-clockwise

In this setting the turntable controller expects drive roller / position encoder rotation to the left (counter-clockwise) at "*Forward on"*.

At *"Backward on"* right (clockwise) rotation of the drive roller / position encoder is expected.

With the reversal of rotary direction, the rotary direction check of the drive roller can be reversed.

Clockwise is the factory setting.

If the rotary direction of the drive roller does not agree with the setting, then this is detected as a fault at activation and the fault *"Wrong rotary direction"* is triggered.

If the device is replaced the rotary direction must be set appropriately.

NOTE!

Additional instructions in the section -> System faults - wrong rotary direction forward / backward.

Structure and function

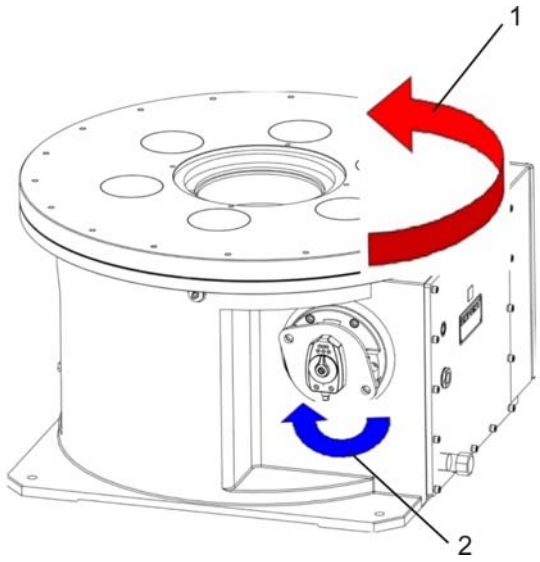


Fig. 7 Rotary direction example

Example:

Turntable with drive roller and left ascending groove. Counter-clockwise rotation should occur on the turntable plate at *"Forward on"* activation.

Connect motor so that clockwise rotation occurs at "Forward on" activation on the drive roller.

Setting the drive roller rotary direction: ***Clockwise***

1 Counter-clockwise rotation of the turntable plate
2 Clockwise rotation of the drive roller

4.3 Connections

Supply voltage

The control unit is operated with 24 V DC. The power is supplied via the PLC interface. The inputs/outputs have 24 V DC level, the outputs are short-circuit resistant.

4.3.1 Control unit, see Fig.

Designation	Connection	Description / plug-in connector
X1	PLC	Flange plug-in connector, M23x1, 19-pin
X2	Sensor	Flange socket, M12x1, 5-pin
X3	Diagnostics	Flange connector M12x1, 5-pin

Abb. 8

4.3.1.1 Pin assignment control unit

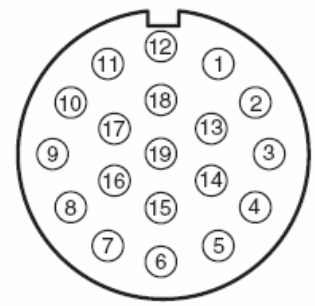


Fig. 9 Pin assignment control unit - X1

X1 - PLC interface

Pin	Pin assignment	Function
19	24 V	24 V DC supply
6	0 V	Reference potential
12	PE	Protective conductor
1	E1	Input forward on
2	A1	Output forward start
3	E2	Input backward on
4	A2	Output backward start
5	E3	Input slow on
6	0 V	Reference potential
7	E4	Input mode
8	A3	Output 0-position
9	A4	Output overrun forward
10	A5	Output overrun backward
11	A6	Output system fault
12	PE	Protective conductor
13	A7	Output end lock angle
14	A8	Output position front
15	A9	Output position back
16		NC
17		NC
18		NC
19	24 V	24 V DC supply

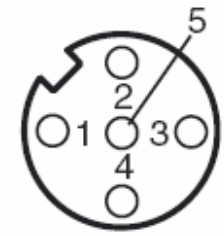


Fig. 10 Pin assignment control unit - X2

X2- sensor interface

Pin	Pin assignment	Function
1	24 V	24 V DC supply
2	T+	Cycle input
3	0 V	Reference potential
4	T-	Cycle input
5	X	NC

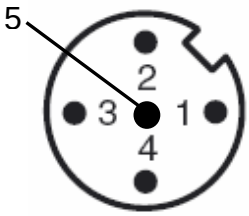


Fig. 11 Pin assignment control unit - X3

X3 - Diagnostics interface (RS232)

Pin	Pin assignment	Function
1	NC	NC
2	TXD	TXD
3	GND	GND
4	RXD	RXD
5	X	NC

4.3.2 Sensor, see Fig. 1

Designation	Connection	Description / plug-in connector
-	Control unit	Flange connector M12x1, 5-pin

4.3.2.1 Pin assignment sensor

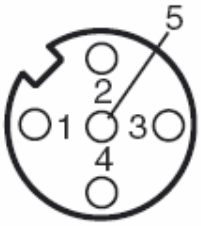


Fig. 12 Pin assignment sensor

X1 Data interface

Pin	Pin assignment	Function
1	24 V	24 V DC supply
2	T+	Cycle output
3	0 V	Reference potential
4	T-	Cycle output
5	X	N.a.

4.4 Optional components and accessories

Position sensing - standard

For simple position sensing without safety requirement up to a max. of 15 positions.

Contactless detection of turntable position through sensors and actuators based on transponder technology, thus wear-free and maintenance free.

One actuator per index is mounted on the turntable plate and thus a unique position of the turntable is supplied.

Version 1:

For a max. of 8 positions via position sensor and corresponding number of coded actuators. Output of the position via 8 NO contacts, pluggable connection.

Version 2:

For a max. of 15 positions via position sensor and corresponding number of coded actuators. Output of the position is binary-coded via 4 NO contacts and strobe output, pluggable connection.

Position sensing - safety

For position sensing of controller category 4

Contactless detection of turntable position through sensors and actuators based on transponder technology, thus wear-free and maintenance free.

A Klaschka SIDENT IV safety switch that is approved for controller category 4 SIL 3 is used.

Each sensor includes an individually-coded actuator, thus a high level of safety relative to manipulation is achieved. An appropriate number of sensors and actuators must be mounted depending on the index.

The 2-channel outputs can be directly routed to inputs of a safety PLC or a conventional safety switching device, pluggable connection.

Scope of delivery of the position sensing:

Sensors and actuators are mounted on the turntable ready to connect.

5 Installation and commissioning

CAUTION!
Danger due to defective installation and commissioning!

Installation and commissioning errors can cause significant material damage.

Therefore:

– Only have trained, specialized personnel with sufficient experience install and commission the turntable.

5.1 Safety

Personnel

- Only trained, skilled personnel should perform installation and commissioning work.
- Only qualified electricians should perform work on the electrical equipment.

Electrical equipment

DANGER!
Life-threatening danger due to electric shock!

There is a life-threatening hazard when touching live components. Switched-on electrical components can move unexpectedly and can cause serious injuries.

Therefore:

– Safeguard the danger zone prior to starting all tasks.

– Ensure that there are no unauthorized persons in the danger zone.

Safeguarding against restart

DANGER!
Life-threatening danger if restarted without authorization!

When installing and commissioning, there is danger of the power supply being switched on without authorization. This poses a life-threatening hazard for persons in the danger zone.

Therefore:

– Prior to starting all tasks switch off all energy supplies and safeguard them from being switched on again.

Reverse mode

CAUTION!
Material damage in reverse mode!

When commissioning in reverse mode the drive roller should not be in the overrun area. This would result in incorrect positions and cause damage.

Therefore:

– Do not traverse the drive roller into the overrun area.

5.2 Mounting instructions

Expert-Tünkers mounts the sensor and the position encoder on the drive shaft during the manufacturing process.

The customer can mount the control unit at suitable and easily accessible points with the connections facing down.

Avoid shocks. Take the length of the sensor cable into consideration when selecting the position.

5.2.1 Connecting to the power supply

- Installation and setup of the power supply is executed by the customer.

5.3 Electrical installation

Connect the sensor and control unit via sensor cables. Only use the specified sensor cable.

Connect the control unit and higher-level controller (PLC) via PLC interface cable. Layout sensor and PLC interface cable separate from high-voltage cables.

SmartTurn installation overview

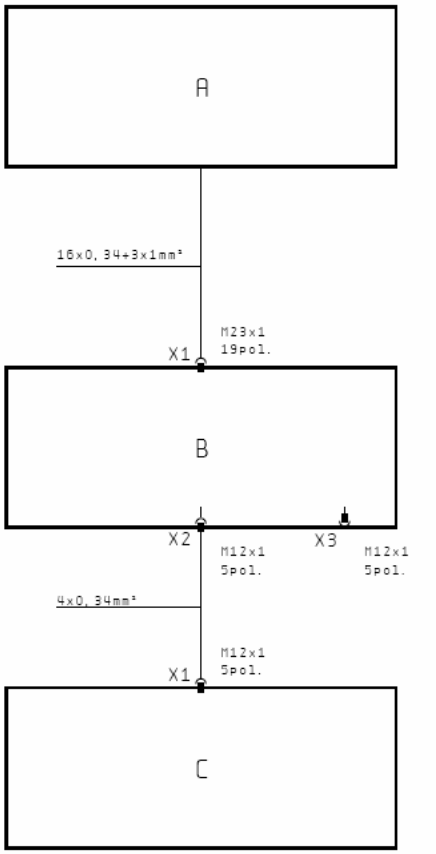


Fig. 13 Installation overview

A Plant controller
B Control unit
C Sensor

5.3.1 Description - PLC signals

All inputs and outputs are PNP-switching and potential-connected to 0VDC.

All outputs are short-circuit proof.

To protect the outputs, contactor coils that are connected to the outputs must be equipped with a varistor protective circuit. The contactor dropout time should not exceed 25ms.

NOTE!

Protective circuits other than varistors can significantly extend the contactor dropout time and should not be used. The danger exists that the turntable will be switched off too late, and thus the end of the lock movement will be reached prematurely, or overrun disturbances can occur.

Outputs A1 and A2 can be loaded with max. 0.6A at 24VDC (14W). Outputs A3 to A7 can be loaded with a maximum of 0.25A at 24VDC (6W).

SmartTurn power supply

The permissible operating voltage for the SmartTurn control unit is between 18 and 30 V DC.

Pin	Connection
19	+24 V DC supply
6	0 V DC, reference potential inputs/outputs
12	PE

5.3.1.1 Inputs

E1 - forward one (pin 1)

The PLC sets the signal when the turntable should be turned one cycle forward.
The signal must be applied for the entire duration of the rotation.

E2 – backward one (pin 3)

The PLC sets the signal when the turntable should be turned one cycle backward.
The signal must be applied for the entire duration of the rotation.

E3 – slow on (pin 5)

The PLC sets the signal when the turntable should rotate at creep speed.
This is necessary, for example when the turntable does not start from the 0-position.

CAUTION!
Damage to drive elements at operating speed!
Material damage can occur on the drive elements!
Therefore:
– Do not start the turntable from a non-defined position.

E4 – operating mode (pin7)

The input must be permanently wired with 24 V or 0 V.

24 V must be applied on the input if the turntable will be operated in continuous mode.

0 V must be applied on the input if the turntable will be operated in reverse mode.

The mode of the turntable is communicated with the signal and appropriate checks are activated.

5.3.1.2 Outputs

A1 – forward start (pin 2)

Turntable rotation *forward* is enabled.

Output A1 is switched on when input E1 is activated.

Output A1 remains switched on until the turntable has reached the calculated switch-off angle in order to optimally come to a stop in the 0-position.

A1 – backward start (pin 4)

Turntable rotation *backward* is enabled.

Output A2 is switched on when input E2 is activated.

Output A2 remains switched on until the turntable has reached the calculated switch-off angle in order to optimally come to a stop in the 0-position.

A3 – 0- position (pin 8)

The output (A3) is switched on when the drive roller is located in the defined lock movement position window of +/- 8 degrees.

The turntable is then in its basic position.

A1 – overrun forward (pin 9)

Output A4 is switched on, if after a start *Forward* the turntable has overrun the 0-position.

Output A4 is also used when the turntable is in the forward position and an incorrect activation occurs from the PLC; 0-position (A2=on) + position forward (A8=on) + forward start (A1=off). If the PLC now switches forward start on (A1=on) again, the fault overrun forward (A4=on) will be set. The output 0-position (A2) continues to remain set. If the input forward start (A1) is switched off, then the fault overrun forward (A4) will be switched off again.

NOTE!

If the fault occurs you must follow the instructions in *section -> 6.2.1* Overrun forward / backward .

⇨From firmware version 2.40

The overrun faults forward/backward A4 and A5 are set together if the two inputs forward on E4 and backward E5 are simultaneously activated for longer than 120 ms. In this case the outputs forward start (A1) and backward start (A2) are switched off and blocked until E1 and E2 are off again.

NOTE!

If the fault occurs you must follow the instructions in *section -> 6.2.1* Overrun forward / backward .

A5 – overrun backward (pin 10)

Output A5 is switched on, if after a *"Start backward*" the turntable has overrun the 0-position. The fault is only generated in reverse mode

Output A5 is also used when the turntable is in the back position and an incorrect activation occurs from the PLC; 0-position (A2=on) + position back (A8=on) + backward start (A1=off). If the PLC now switches backward start on (A1=on) again, then the fault overrun backward (A4=on) will be set. The output 0-position (A2) continues to remain set. If the input backward start (A2) is switched off, then the fault overrun forward (A5) will be switched off again.

NOTE!

If the fault occurs you must follow the instructions in section -> 6.2.1 *Overrun forward / backward .*

⇨From firmware version 2.40

The overrun faults forward/backward A4 and A5 are set together if the two inputs forward on E4 and backward E5 are simultaneously activated for longer than 120 ms. In this case the outputs forward start (A1) and backward start (A2) are switched off and blocked until E1 and E2 are off again.

NOTE!

If the fault occurs you must follow the instructions in section -> 6.2.1 *Overrun forward / backward .*

A6 – system faults (pin 11)

Output A6 is switched on if faults are detected that compromise safe operation of the turntable. System faults can only be acknowledged on the turntable controller via the reset button.

NOTE!

When the fault occurs the instructions in section -> Monitor system *must be complied with.*

A7 – end lock angle (pin 13)

The A7 output is switched on if the switch-off angle has reached the end of the drive roller lock movement.

NOTE!

When the fault occurs the instructions in section -> Monitoring brake wear *must be complied with.*

A8 – position forward (pin 14)

Output A8 is switched on if the turntable is located in the *forward* position.

A8 – position back (pin 15)

Output A9 is switched on if the turntable is located in the *Back* position.

The output is only activated in reverse mode.

5.3.2 System integration in the plant control system

Controller power unit

The brake application time of the brake used should not exceed 25ms.

Switch the brake directly and not via the PLC.

The respectively valid safety guidelines for motor-brake activation must be complied with.

When using SEW motors, Expert-Tünkers recommends the use of a type BMKB1.5 brake rectifier.

If a brake rectifier, other than type BMKB1.5 is used, then it must always be wired on the direct current and alternating current sides so that the brake can work with fast application.

If motors from different manufacturers are used, then the wiring must be adapted in accordance with the specifications.

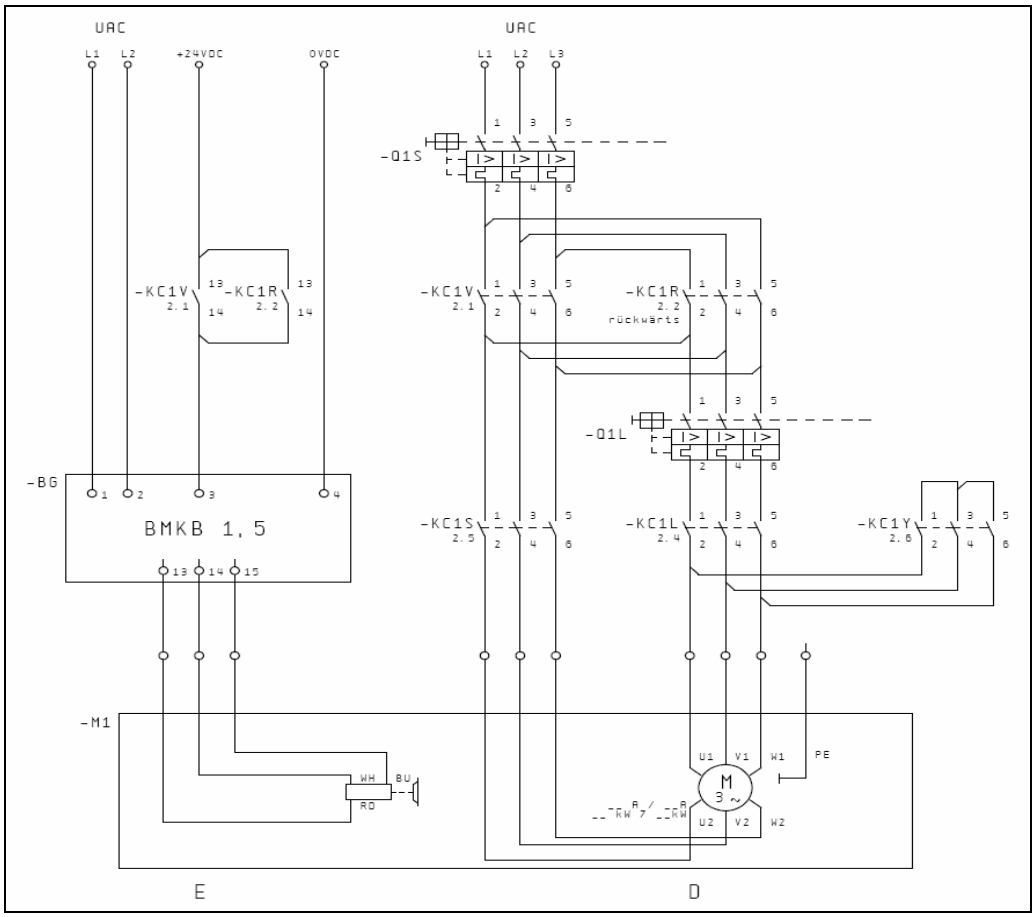


Fig. 14 SEW brake motor, switchable polarity with BMKB1.5 brake rectifier

E: *Brake* D: *Drive motor*

Power contactor activation

Connections 1-5 of the *SmartTurn* must be disconnected from the power circuits of the power contactors.

The signal A1- "forward start" must be wired to a coupling relay or auxiliary contactor - K1V and its NO contact must be integrated in the current path of the KC1V contactor "turntable forward".

The signal A2- "backward start" must be wired to a coupling relay or auxiliary contactor - K1V and its NO contact must be integrated in the current path as the KC1R contactor "turntable backward".

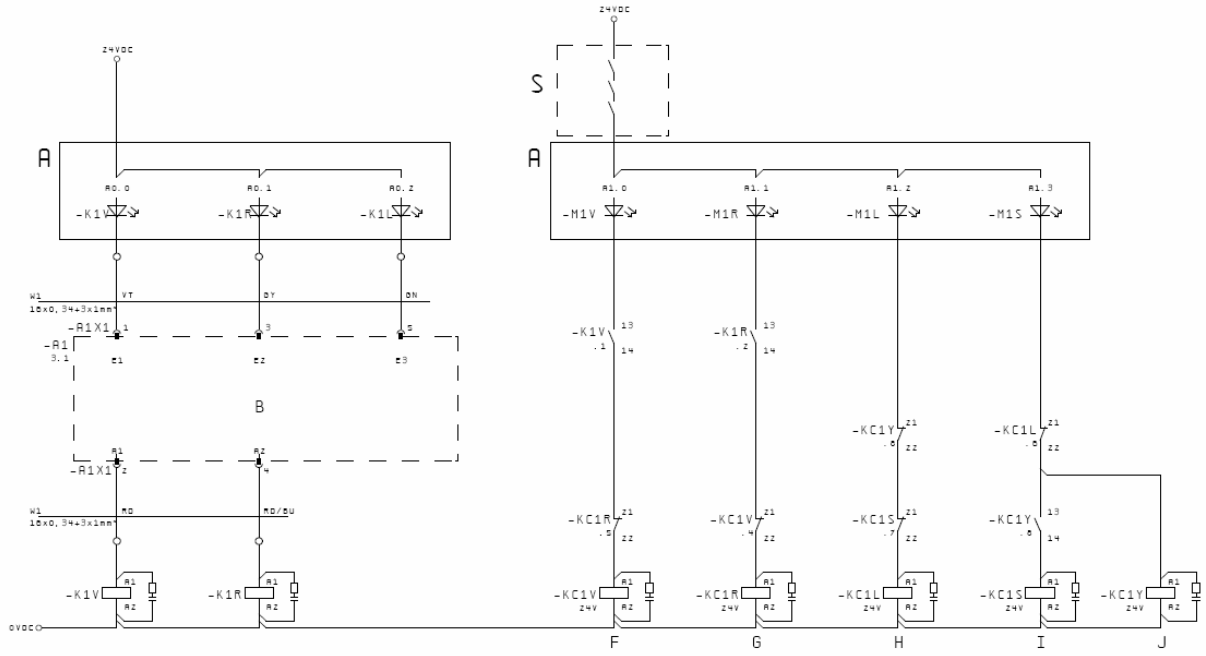


Fig. 15

Example Fig. 16 Contactor control motor, pole changing

A: PLC
B: SmartTurn
- E1 *"Forward on"*
- A1 *"Forward start"*
- E2 *"Backward on"*
- A2 "*Backward start"*
- E3 *"Slow on"*

F: *"Turntable forward"*
G: *"Turntable backward"*
H: *"Turntable slow"*
I: *"Turntable fast"*
J: *"Turntable fast" - star (wye) contactor"*

S: *Emergency stop, protective grate, sliding door, light curtain etc.*

PLC signals

SmartTurn signals A3 to A9 can optionally be routed to PLC inputs or contactor relays.

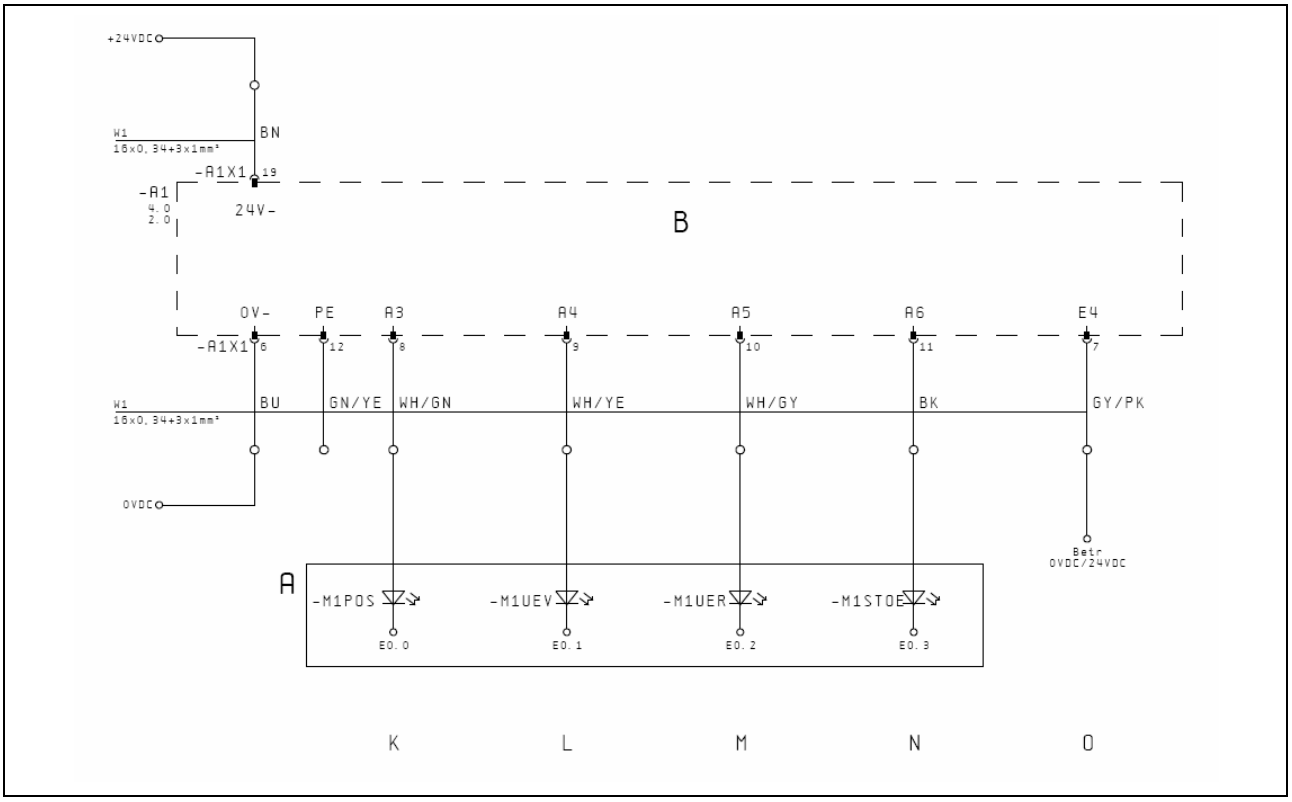


Fig. 17 Signals on PLC inputs

A: PLC

- K: „*0-position"*
- L: *"Overflow forward"*
- M: *"Overflow backward"*
- N: *"System fault"*
- O: *"Operating mode"*
  - 24 V DC = continuous mode
  - 0 V DC = Reverse mode

B: SmartTurn - control unit

- A3: *"0-position"*
- A4: *"Overrun forward"*
- A5: *"Overflow back"*
- A6: „*System fault"*
- E4: *"Continuous mode - reverse mode"*

5.3.3 PLC programming

Reverse mode

The following diagram shows the signal exchange with the PLC as an example.

Function	Signal	Pin
Operating mode	E4	7
Forward on	E1	1
Forward start	A1	2
Backward on	E2	3
Backward start	A2	4
Slow on	E3	5
0-position	A3	8
Position forward	A8	14
Position back	A9	15
System fault	A6	11
Motor is turning		

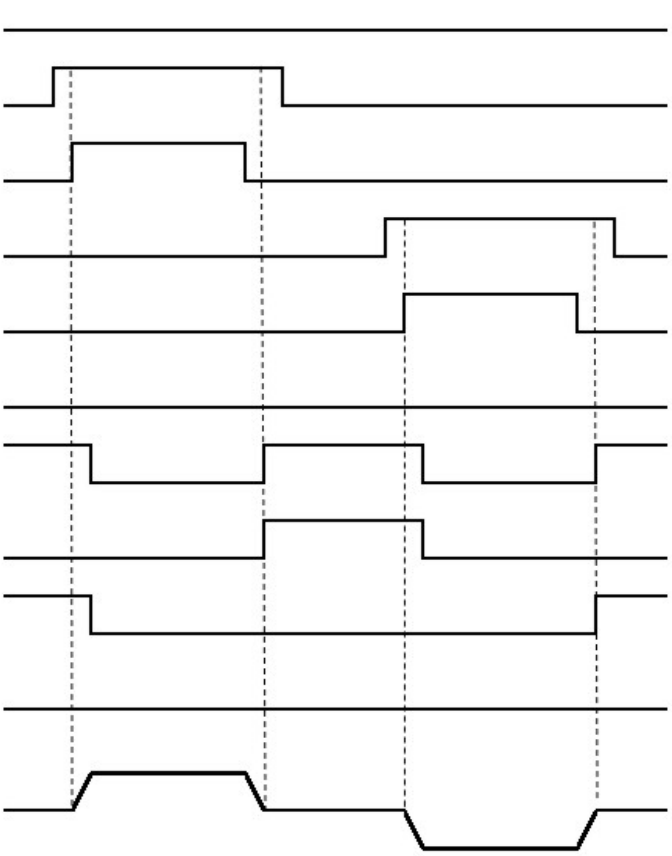


Fig. 18 Sequence graphic - reverse mode

Continuous mode

The following diagram shows the signal exchange with the PLC as an example.

Function	Signal	Pin
Operating mode	E4	7
Forward on	E1	1
Forward start	A1	2
Backward on	E2	3
Backward start	A2	4
Slow on	E3	5
0-position	A3	8
Position forward	A8	14
Position back	A9	15
System fault	A6	11
Motor is turning		

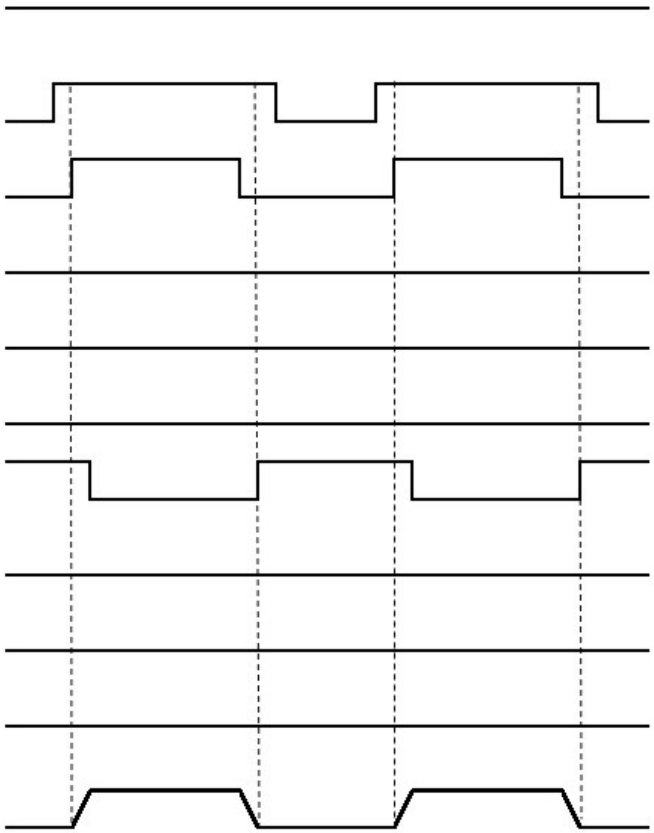


Fig. 19 Sequence graphic - continuous mode

5.4 Commissioning

NOTE!

The turntable is commissioned in the factory by EXPERT-TÜNKERS.

When the turntable is commissioned it is tested and the mode is adjusted to customer specifications in reverse mode or continuous mode.

When the operating voltage is switched-on on the turntable controller, the input must be simultaneously assigned with the appropriate level. Subsequent level change is not permissible and results in a system fault.

Another commissioning process is only necessary when:

- The control unit is replaced
- The mode is changed
- or a system fault makes this necessary.

NOTE!

See section -> System faults.

All data is saved in the control unit, failsafe. With the commissioning process a default value specific to the lock movement is used as switch-off angle. Thereafter deviation from the optimal 0-position is determined and the switch-off angle is determined for the next turn.

Commissioning sequence

1. Turn drive roller (position encoder) in the movement range, at least 45 degrees outside of the 0-position. The turntable will then be between the positions *"Front"* and *"Back"* (only necessary in reverse mode).
2. Adjust lock movement of the roller bearing on the rotary switch.
3. Set clockwise rotation / counter-clockwise rotation of the drive roller.
4. Switch on the operating voltage.
5. Press the reset button 3s - system fault LED goes out.
6. Turn the turntable several times at operation speed.

NOTE!

If the turntable stops several times without fault in the 0-position the self-adjustment and the commissioning processes are concluded.

Position of the position encoder when commissioning in reverse mode.

Fig. 20 Position encoder in reverse mode

1 Blocked area +/- 45 degrees in front of 0-position.
2 Permitted range.
3 Position of the position encoder.
4 Movement range.

5.4.1 Re-commissioning in the plant

When re-commissioning the turntable in the plant the settings made during the commissioning process must be checked and any adaptations to local conditions must be executed.

Re-commissioning sequence

1. Switch on the operating voltage.
2. Turn the turntable several times at creep speed.
3. Check direction of motor rotation, drive roller.
4. If necessary change direction of motor rotation and set clockwise / counter-clockwise drive roller direction.
5. Press the reset button 3s - system fault LED goes out
6. Turn the turntable several times at operating speed.

If the turntable stops several times without fault in the 0-position, the self-adjustment and re-commissioning are concluded.

NOTE!

After first-time operation of the turntable with the customer load, or after changes to the load, overrun faults could occur. In this case it is necessary to turn the turntable several times at operating speed until the turntable controller has concluded the optimization process.

6 Faults

Possible fault causes and the tasks to correct these faults are described in the following section.

Contact the manufacturer if there are faults that cannot be corrected by following the instructions below; see the service address in the Appendix.

Behavior in the event of fault

The following always applies:

1. Determine the cause of the fault.
2. Immediately inform the responsible parties at the installation site of the fault.
3. Have authorized specialists eliminate the fault.

6.1 Safety

Personnel

- Some tasks should only be executed by experts with special training or by the manufacturer.
- Only qualified electricians should perform work on the electrical equipment.

6.2 Sequence faults

Sequence faults are faults that can occur during normal operation through brake wear,

and/or due to impermissible turntable operation, e.g. due to overload, change in load, or incorrect activation of the brake and motor.

NOTE!

The fault tables below are provided to help you localize and rectify the fault.

Or contact one of the EXPERT-TÜNKERS service addresses.

6.2.1 Overrun forward / backward

The fault is generated if the turntable does not come to a stop in the 0-position and overruns the 0-position by more than 8 degrees.

The fault is also generated when the turntable is in the forward or backward position and an incorrect activation is executed by the PLS.

⇨From firmware version 2.40

The fault is also generated if the two inputs forward on (E1) and backward on (E2) are simultaneously activated by the controller for longer than 120 ms. In this case the outputs forward start (A1) and backward start (A2) are switched off and blocked until E1 and E2 are off again. If E1 and E2 are off, after 3s the overrun faults forward/backward A4 and A5 are reset. In the SmartTurn_V14 EXE diagnostics software when the fault occurs, the fault message "Both Inputs On" is set, this fault message remains until reset or switch-off of the 24V supply. See also section 6.2.4 "Input forward and backward on" (Both Inputs On)

NOTE!

With older firmware versions the faulty activation by the PLC results in a system fault.

Possible causes:	Measures
Brake pads are worn or the brake is defective	Check the air gap of the brake and adjust Replace the brake if necessary
The brake is incorrectly connected or is not quickly applied	Check the activation of the brake and correct if necessary
Excessive brake application time	Use a brake with shorter application time (under 25ms).
Turntable overloaded	Reduce the load to the calculated value
Turntable cycle time too short	Reduce the motor speed so that the turntable cycle time is not underranged
The direction of drive rotation does not agree with the set rotary direction	Set the direction of drive roller rotation on switch S3, change the direction of motor rotation if necessary
In reverse mode, wrong rotary direction activation through the PLC: - Activation of forward start even though the turntable is in the forward position. - Activation of backward start even though the turntable is in the back position.	Avoid wrong activation through the PLC. - Switch off forward start, correct PLC activation - Switch off backward start, correct PLC activation

Faults

Possible causes:	Measures
Wrong protective circuit on the power contactors and/or the braking contactor	Only use varistor protective circuits, other protective circuits can significantly extend the contactor dropout time, and thus extend the turntable stop distance.
Sudden significant load change	Turn the turntable several times so that the switch-off angle can be adapted
Forward on (E1) and backward on (E2) are activated simultaneously by the PLC for longer than 120 ms	Check and correct the PLC activation

Reset fault

NOTE!

Eliminate cause.

In reverse mode the fault is deleted by activation *of the opposite direction* and leaving the overrun.

In continuous operation the fault is deleted with a subsequent *"Forward on"* activation.

6.2.2 Warning end lock angle (lock angle reserve)

The brake pads wear out in the course of operation. The turntable controller compensates for this by offsetting the switch-off angle.

If the end of the lock movement is reached then the warning "*End lock angle"* is output to the PLC.

The turntable can still be operated. However we recommend that you check the brake at the next possibility and replace it if necessary.

If the brake is not checked, over time this fault results in a system fault *"End lock angle"* and further operation is disabled.

Possible causes:	Measures
Brake pads are worn or the brake is defective	Check the air gap of the brake and adjust Replace the brake if necessary
Turntable overloaded	Reduce the load to the calculated value
Turntable cycle time too short	Reduce the motor speed so that the turntable cycle time is not underranged

Reset fault

NOTE!

Eliminate cause.

Unscrew the cover on the turntable controller and press the reset button for at least 3s.

Press the reset button and the default values will be used for turntable control.

6.2.3 End of lock angle reserve reached (end of lock angle reserve)

If the switch-off angle is more than 5 degrees outside of the lock movement, the warning *"End lock angle"* and *"System fault"* are output to the PLC simultaneously.

Do not continue to operate the turntable. Further operation can cause damage to the drive elements.

CAUTION!
Switch-off over 5 degrees.
Further operation can cause damage to the drive elements!
Therefore:
– Do not continue to operate the turntable.
– Eliminate the cause.

Possible causes:	Measures
Brake pads are worn or the brake is defective	Check the brake and replace it if necessary
Mech. damage on the turntable	Check turntable for mechanical damage

Reset fault

NOTE!
Eliminate cause.

Unscrew the cover on the turntable controller and press the reset button for at least 3s.

Press the reset button and the default values will be used for turntable control.

6.2.4 Input forward and backward on (Both Inputs On)

Possible from firmware 2.40 and with SmartTurn_V14EXE diagnostics software.

The fault is also generated if the two inputs forward on (E1) and backward on (E2) are simultaneously activated by the controller for longer than 120 ms. In this case the outputs forward start (A1) and backward start (A2) are switched off and blocked until E1 and E2 are off again. If E1 and E2 are off, after 3s the overrun faults forward/backward A4 and A5 are reset.

In the SmartTurn_V14 EXE diagnostics software when the fault occurs, the fault message "Both Inputs On" is set, this fault message remains until reset or switch-off of the 24V supply.

NOTE!

If the fault occurs you must follow the instructions in *section -> 6.2.1* Overrun forward / backward .

NOTE!

With older firmware versions the faulty activation by the PLC results in a system fault.

Possible causes:	Measures
Forward on (E1) and backward on (E2) are activated simultaneously by the PLC for longer than 120 ms	Check and correct the PLC activation

6.3 System faults

System faults are faults that compromise safe operation of the turntable.

If a system fault is detected, then the two outputs *A1* and *A2* are blocked and the *"System fault" A6* output is output as group fault.

A detailed fault analysis is possible via the diagnostic interface with the diagnostic software.

The following system faults are displayed in the diagnostic software.

Extended diagnostics with the data logger tool

With a separate data logger tool you can read out the last 10s prior to occurrence of the fault, thus all relevant diagnostic data is secured and allows detailed fault analysis. The diagnostics data will remain accessible until the system fault is deleted on the turntable controller.

Use of the tool requires consultation with Expert Tünkers.

6.3.1 Sensor fault (sensor defect)

Possible causes:	Measures
Sensor is defective	Check sensor and replace if necessary
Position encoder is defective or is not in the detection range of the sensor	Check the position sensor, replace if necessary
Sensor cable is defective or loose	Check the position sensor, replace if necessary **Reverse mode**: ■ Turn drive roller (position encoder) a min. of 45 degrees outside of the 0-position in the movement range between the positions *"Front"* and *"Back"* ■ Press the reset button 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed **Continuous mode**: ■ Press the reset button 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed

6.3.2 Invalid sensor data (changed sensor position)

If after switching on the operating voltage, a deviation from the last saved position is detected, this results in a fault.

Possible causes:	Measures
Turntable has been dismantled and no longer has the same position The turntable has been turned without operating voltage applied on the turntable controller Failure of the 24V power supply while the turntable is turning	**Reverse mode**: ■ Turn drive roller (position encoder) a min. of 45 degrees outside of the 0-position in the movement range between the positions *"Front"* and *"Back"* ■ Press the reset button 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed **Continuous mode**: ■ Press the reset button 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed

Press the reset button and the default values will be used for turntable control.

NOTE!

Comply with the supplemental instructions in the section -> Commissioning.

6.3.3 Short circuit at output

Possible causes:	Measures
Activated contactor coil defective	Check the contactor coil, replace if necessary
Excessive power consumption of the activated contactor coil	Only use contactor coils with a max. power consumption of 14W at 24 V DC
Contactor coil without protective circuit	Always wire contactor coils with Varistor protective circuit
Short circuit due to wiring fault	Check wiring and change

Reset fault

NOTE!

Eliminate cause.

Unscrew the cover on the turntable controller and press the reset button for at least 3s.

Press the reset button and the default values will be used for turntable control.

6.3.4 Change mode (changed rotary mode)

The mode deviates from the saved mode or impermissible level change on input E4 "Mode"

Possible causes:	Measures
Mode change from continuous mode to reverse mode	Turn drive roller (position encoder) a min. of 45 degrees outside of the 0-position in the movement range between the positions "Front" and "Back" ■ Press the reset button 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed
Change mode from reversing mode to continuous mode	■ Press the reset button 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed

Press the reset button and the default values will be used for turntable control.

NOTE!

Comply with the supplemental instructions in the section -> Commissioning.

6.3.5 Change mode (changed rotary direction)

Rotary direction deviates from the saved rotary direction or change rotary direction right/left on switch S3.

Possible causes:	Measures
Reverse mode / change S3	Turn drive roller (position encoder) a min. of 45 degrees outside of the 0-position in the movement range between the positions "Front" and "Back" ■ Press the reset button 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed
Continuous mode / change S3	■ Press the reset button 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed

Press the reset button and the default values will be used for turntable control.

NOTE!

Comply with the supplemental instructions in the section -> Commissioning.

6.3.6 Changed lock angle

Lock angle setting deviates from the saved lock angle setting or change of the lock angle on switch S1.

Possible causes:	Measures
Reverse mode / continuous mode	■ Press the reset button 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed

Press the reset button and the default values will be used for turntable control.

NOTE!

Comply with the supplemental instructions in the section -> Commissioning.

6.3.7 Wrong rotary direction (direction forward / backward)

At each start the rotary direction of the drive roller is checked against the setting on switch S3 clockwise/counter-clockwise.

Possible causes:	Measures
The actual rotary direction of the drive roller does not agree with the setting on S3 clockwise/counter-clockwise Reverse mode	■ Turn drive roller (position encoder) min. 45 degrees outside of the 0-position in the movement range between the positions "Front" and "Back" ■ Change the motor rotary field or change setting S3 so that the desired rotary direction of the turntable forward/backward agrees with the setting on S3 ■ Press the reset button 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed
Continuous mode	■ Press the reset button 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed

Press the reset button and the default values will be used for turntable control.

NOTE!

Comply with the supplemental instructions in the section -> Commissioning.

6.3.8 Internal device fault (secure state)

Possible causes:	Measures
SmartTurn control unit defective	Replace ***SmartTurn*** control unit. Accept the S1, S3 settings. **Reverse mode**: ■ Turn drive roller (position encoder) min. 45 degrees outside of the 0-position in the movement range between the positions "Front" and "Back" ■ Press the reset button for 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed **Continuous mode**: ■ Press the reset button for 3s ■ System fault LED goes out ■ Turn the turntable several times at operating speed

NOTE!

Press the reset button and the default values will be used for turntable control.

6.4 Start up after corrected fault

After correcting the fault execute the following steps to start up again:

1. Reset the emergency-stop devices.
2. Acknowledge the fault on the controller.
3. Ensure that that no one is in the danger zone.

7 SmartTurn – spare parts

Designation	Part number
Sensor	502765
Sensor actuator	504480
Control unit	502766
Sensor cable 5m	504775
Diagnostics cable 5m	504887
Position sensing - standard for max. 8 positions: ● Sensor ● Transponder ● Connecting line 10m	 X* X* 506000
Position sensing - standard for max. 15 positions: ● Sensor ● Transponder ● Connecting line 10m	 X* X* 506000
Position sensing - safety: ● Sensor ● Transponder ● Connecting line 10m	 505986 505987 505988
PLC interface 5m	646303
PLC interface 10m	X*
PLC interface 20m	X*

X* Contact one of the EXPERT-TÜNKERS service addresses.

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