FIBRO

FIBROTOR

ELECTROMECHANICAL UNIVERSAL ROTARY TABLES

PROJECT PLANNING MANUAL

Legal notice

This document has been created by

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"FIBROTOR Electromechanical Universal Rotary Tables" project planning manual

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1 FIBROTOR at a glance

The FIBROTOR rotary table series is designed for tasks that require fast indexing with optimised sequences of movement. Extremely long service lives, freedom from maintenance and very fast cycle times with the highest possible precision are properties of importance for every production facility. FIBROTOR rotary tables combine all these features and, as an additional highlight, has up to five years warranty. FIBROTOR rotary tables have been used successfully automation constructions as well as for light cutting applications.

1.1 Areas of application of the rotary table

The FIBROTOR rotary table is suitable for use as:

- Assembly table
- Welding table
- Positioning and machine-loading table

In addition, it can be used successfully in printing, packaging, honing and deburring machines.

The FIBROTOR rotary table can also be used for transport and conveyance tasks, for the drive of indexing belts or for all kinds of pressing applications and for machining processes in which low amounts of chips are generated.

1.2 The advantages of the rotary table

The FIBROTOR rotary table convinces with high axial and concentric runout accuracy due to a pre-loaded, large-dimensioned axial-radial bearing. Extremely short indexing times from station to station can also be implemented without a problem. In addition, the control cam and cam rollers create an optimum, soft sequence of movements.

2 Overview of the FIBROTOR product range

The FIBROTOR rotary table is divided into three classes based on various properties, functions and area of applications:

The highly standardised universal rotary table FIBROTOR ER represents the first class. This table shines due to extremely short delivery times, special price attractiveness and long service life.

The second class of the product range is formed by the premium version, the FIBROTOR EM. The premium type offers special designs according to customer desire, guarantees the highest speeds and shortest indexing times, as well as the selection of various additional functions and accessories. The FIBROTOR EM is also available as a flexible NC rotary table variant.

The FIBROTOR RT is ideally suited for applications that require a large centre hole. With its NC version RT.NC, it is the last product class of the FIBROTOR product range.

The NC variant of the EM and RT rotary tables enable the approach of any angle positions in each direction of rotation, variable rotation speeds and the shortest indexing times from position to position.

Fig.: FIBROTOR ER, FIBROTOR EM and FIBROTOR RT

3 Technical description of FIBROTOR

The structural design of FIBROTOR is characterised by a rigid mechanical structure. The basic unit consists of the following components:

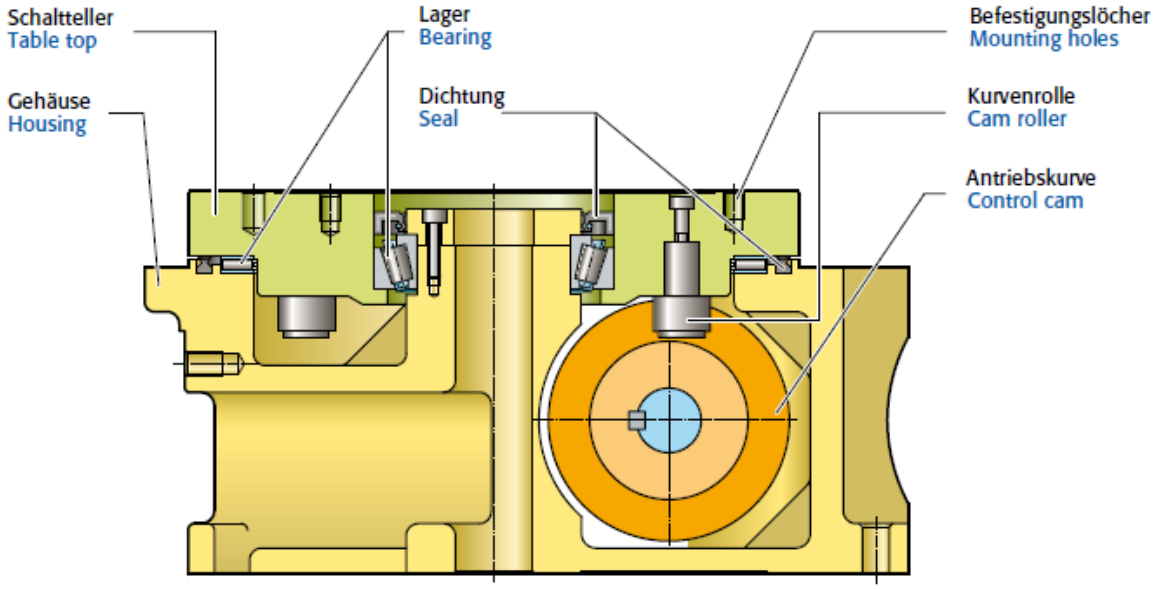


Fig.: Basic components of rotary table

3.1 Table top

The table top is operated with various motor types, gearboxes and control cams. This means that the rotational movements of the table top can be performed in any direction, however using the angle preset by the control cam.

3.2 Bearing

The table top has a large-dimensioned bearing with both axial and radial initial pre-loaded, while guaranteeing high axial and concentric runout accuracy at extremely high transport loads. In order to accommodate large tilting moments or tensile forces, additional reinforcing assemblies are available depending on the FIBROTOR type.

3.3 Drive

The operation is generated from the drive motor via a gearbox and the cam drive to the table top. Here, drive elements that tend to wear are absolutely not used. The cam rollers are pre-loaded on both sides on the control cam. This enables the play-free transition from standstill to movement and vice versa.

3.3.1 Control cam

In the case of the FIBROTOR rotary tables, all non-NC controlled rotary tables have a control cam with mechanical indexing and dwell phases. The NC models on the other hand have a control cam with a continuous gradient.

3.3.2 Cam rollers

The cam rollers used in the FIBROTOR rotary tables have a high stiffness, slide bearing and optimum crash behaviour. In addition, sagging is prevented by its thick-walled outer ring.

3.4 Operating parameters

The standard rotary table is designed for connection to the 3 x 400 V / 50 Hz power mains. During operation with a frequency inverter, the characteristic values featured in the specification must be observed. The acceleration and deceleration times are determined by the control cam. A ramp is not required on the three-phase brake motor.

3.5 Centre hole

The FIBROTOR is delivered with a large, free centre hole, which can be used optimally as a supply through hole. As of size EM.12/ER.12, a side through hole has been provided in the housing for power supply.

3.6 Air purge

The rotary table has a connection for the air purge between the housing and the table top (for position and connection thread see the dimensional drawing). The necessary compressed air must be provided by the supply facilities of the operator. The air purge must be regulated and purified by a control valve with a filter. The maximum permitted air purge pressure is 7 psi / 0.5 x 10^5 Pa / 0.5 bar.

Please note!

If a pressure of 7 psi / 0.5 x 10^5 Pa / 0.5 bar is exceeded, serious damage to the rotary table can occur. The air purge must conform to quality class 4 according to DIN-ISO 8573-1:

- Solids: Maximum particle size 15 µm; maximum particle density 8 mg/m^3
- Oil content: Maximum oil concentration 5 mg/m^3
- Water content: Maximum pressure condensation point + 3 °C

3.7 Lubrication

All FIBROTOR rotary tables have long-term lubrication with synthetic lubricants. The general ambient temperature for lubricants amounts to 0°C to 40°C. A change in lubricant is only required in the event of coolant and lubricant ingress, as well as in the event of a general overhaul of the device.

3.8 Service life

The layout is designed for a service life of 20,000 operating hours MTTF. The service life of the motor brake depends on the number of switching cycles per minute, the indexing time of the rotary table, the speed of the motor and the ambient temperature.

At the standard brake motor the service life of the motor brake amounts to 10 - 20 million switching cycles. The readjustment term amounts to 3 - 5 million switching cycles (see the operating instructions).

Frequent emergency stop operation can reduce the service life. A soft start after an emergency stop can be implemented using frequency inverters or soft starters.

3.9 Temperature range

Operation: Between + 15°C and +40°C

Storage: Between - 15°C and +60°C

4 Intended use

The purpose of the rotary table is to be mounted in other machines or in other partly completed machinery or equipment or to be assembled with them. It must not be subjected to loads above its maximum limits. In addition, the standard version is not suitable for the following:

- Operation in mobile or portable systems, on ships or in aircraft
- Operation in life support systems
- Operation in residential housing
- Operation beyond the limits of the specified performance data and operating parameters
- Use in explosive atmospheres
- Use in vacuum spaces

Corresponding special designs of the FIBROTOR rotary tables are available upon request.

5 Rotary tables with fix division: FIBROTOR ER, EM and RT

5.1 Technical description

5.1.1 Cam roller gearbox

The ER, EM and RT rotary tables have a fix, pre-set division. They have a control cam with a discontinuous gradient.

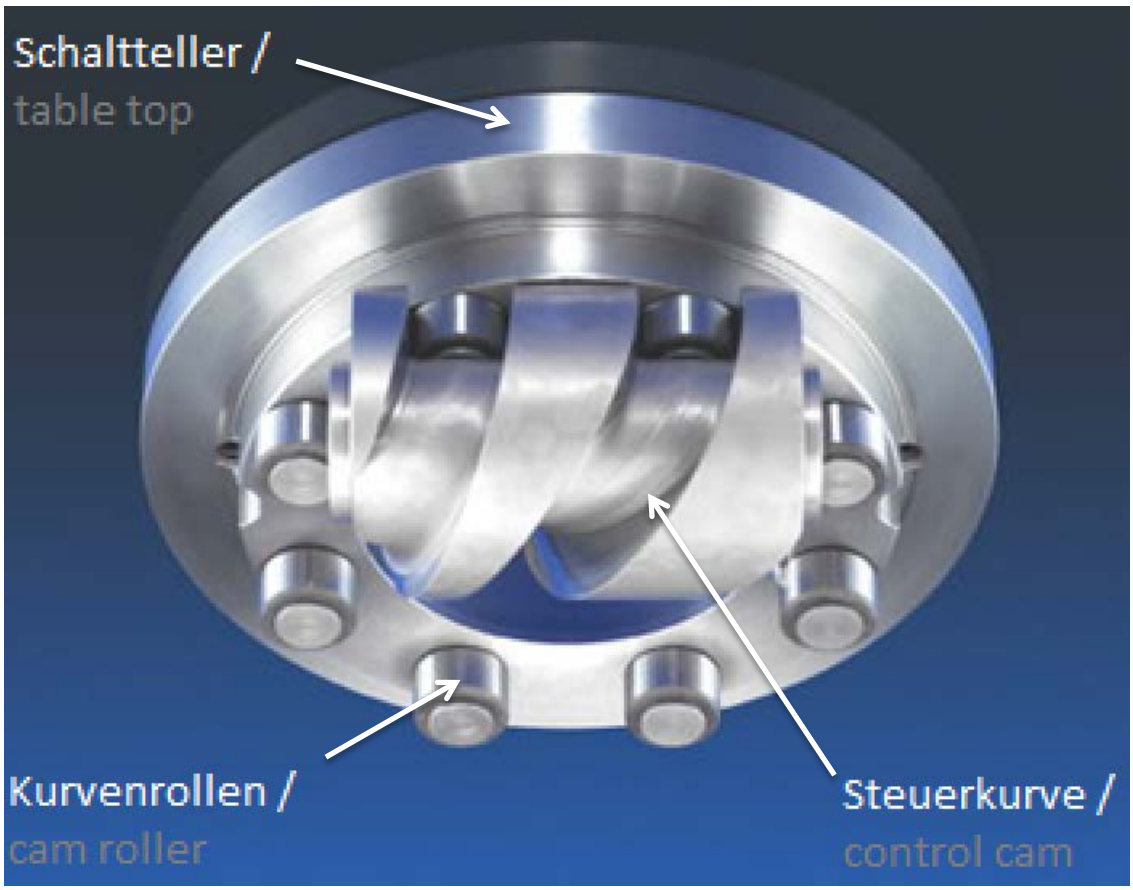


Fig.: FIBROTOR ER, EM and RT control cam

5.1.2 Motion sequence

The design of the control cam ensures that operation is smooth, even in the event of high loads. The indexing time can be taken from the indexing time tables in accordance with the mass moment of inertia. The data for the indexing time (ts in s) refer to the actual motion duration.

The discontinuous movement path on the control cam of FIBROTOR ER, EM and RT result in an uneven rotating motion of the table top. Indexing and dwell phases are differentiated. The time for the control cam rotation is divided into a stipulated ratio between indexing and dwell time.

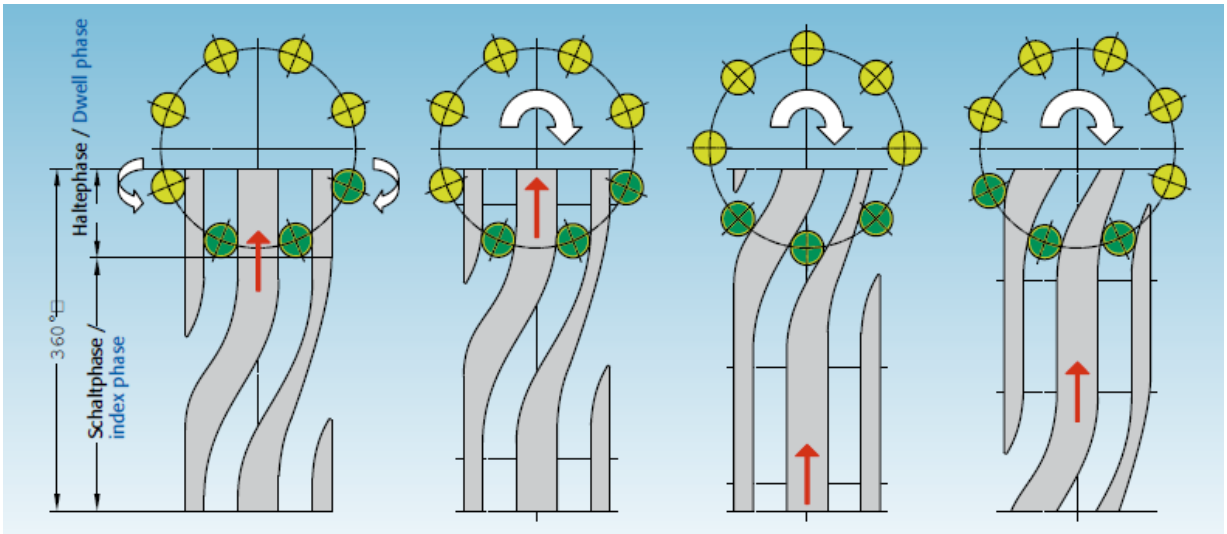


Fig.: Motion sequence of the dwell and indexing phases

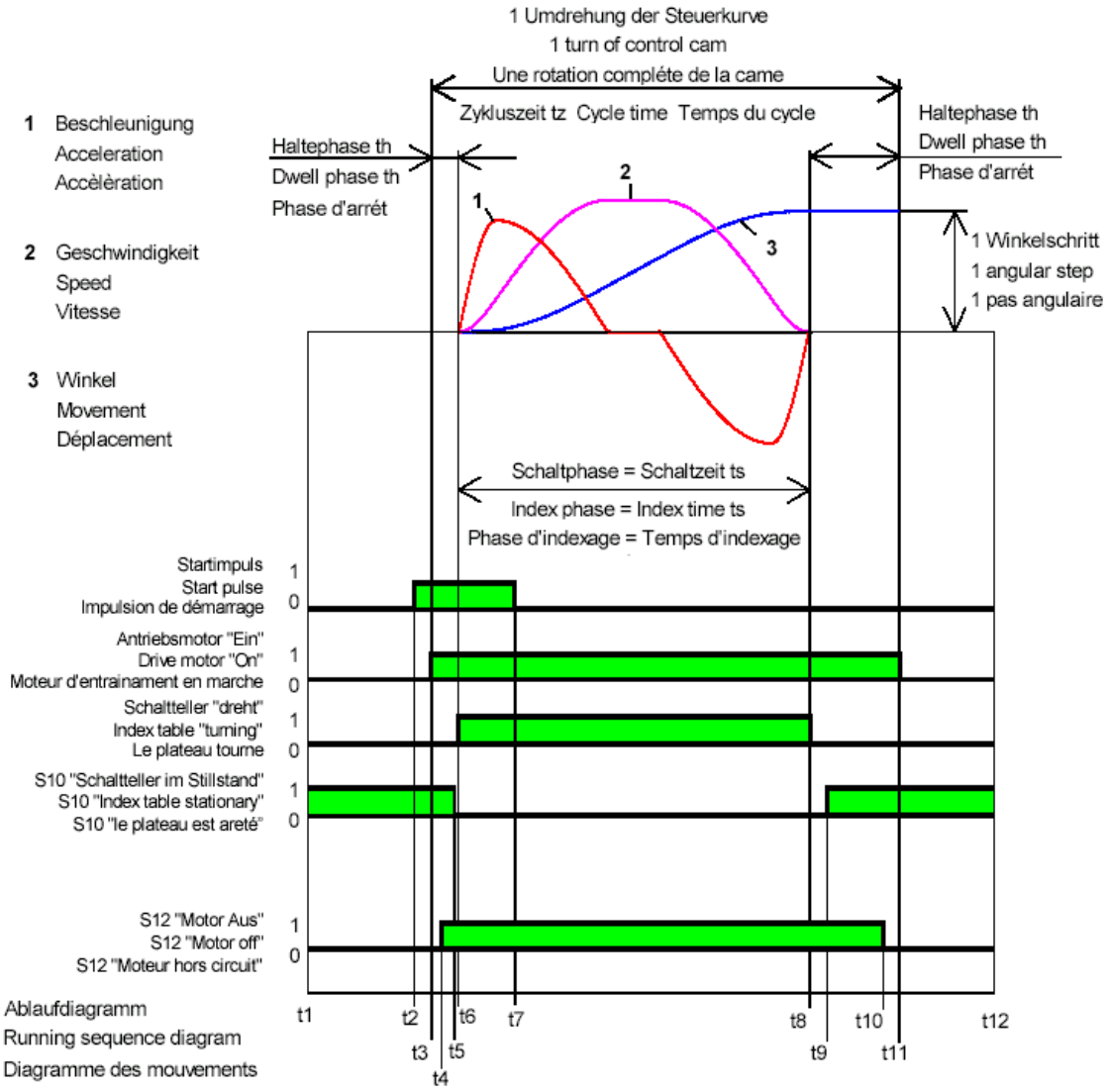


Fig.: Motion sequence diagram

5.1.2.1 Dwell phase

The phase in which the control cam hits the cam rollers at its "zero gradient," which means it does not change the position is called the dwell phase. The table top is at a standstill in this phase. The middle of the dwell phase is identified by a pointer at the drive shaft and a STOP sign on the fixing flange. At a division less than T16, the table top cycles one index increment further during a rotation of the control cam. As of a division of T16, the table top cycles 2 indexes increments further. In this case, the switch cams for the limit switches are designed in such a way that two pulses are emitted during one rotation.

5.1.2.2 Indexing phase

If the part of the control cam that has a gradient hits the cam rollers, they change their position and the table top is put into motion. The rotary table is in the indexing phase.

5.1.2.3 Positioning

If the table top is in the positioned dwell phase, it is held in an exact, play-free position by the control cam and the cam rollers. In the event of high tangential torques, a hydraulic table top clamping system can be used.

5.1.3 Indexing times

The indexing time t_S (see data sheet) corresponds with the mechanical indexing time (indexing phase of the control cam). The additional electrical indexing time amounts to 30 – 150 ms depending on the type of controller.

Example:

FIBROTOR® control card		approx. 20 ms
mechanical motor contactor	switch-on	approx. 30 – 60 ms
	switch-off	approx. 20 – 40 ms
electronic motor contactor	switch-on	approx. 20 ms
	switch-off	approx. 10 ms
Frequency inverter		approx. 150 ms

5.1.4 Direction of rotation

The direction of rotation of a rotary table with fix divisions is either clockwise (CW) or counter-clockwise (CCW).

Please note!

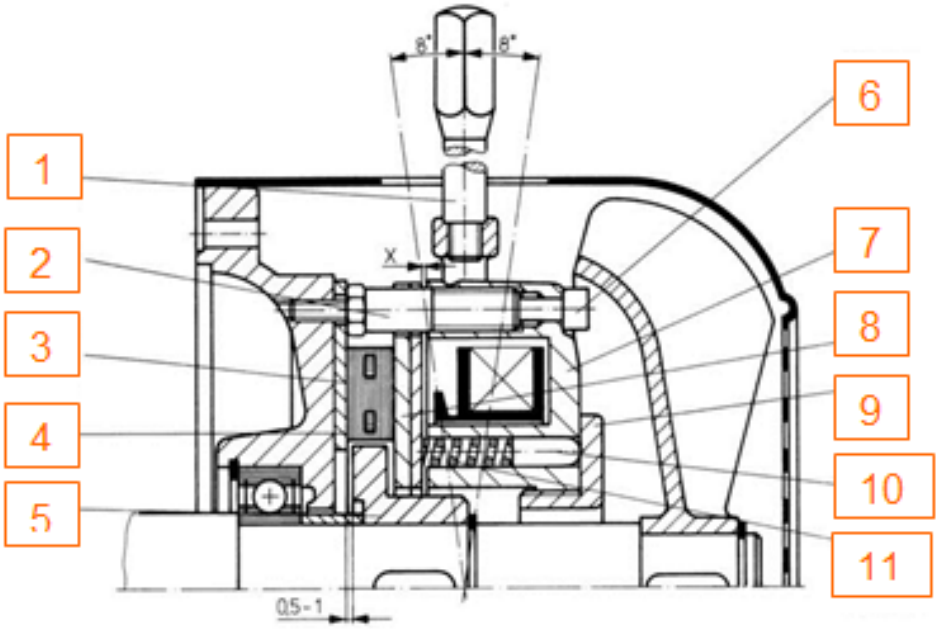
A change in direction of rotation during the rotational movement leads to the destruction of the driving elements.

5.1.5 Intermittent operation with brake motor

The limit switches S10 and S12 are factory set during the test run. According to the used controller, the switch cam might have to be readjusted. In the case of pendulum mode, we recommend attaching a position detector for various circuits and the use of over travel protection. A graduation process occurs from S12 to S12. The length of the dwell phase is displayed with a position diagram. As of division T16, there are several standstills on the circumference of the control cam. The drive must come to a standstill within the dwell phase (pointer in the "Stop" range).

5.1.5.1 Brake

The FIBROTOR electromechanical rotary tables are usually driven by a three-phase brake motor. The use of the spring-operated brake is not a problem. It only must be ensured that grease or oil does not penetrate the friction surface. Moderate dust build-up does not cause damage.



1	Handlüftung / manual brake	6	Zyl. Schraube DIN 912 + 6912 / cylindrical screw
2	Einstellstück / adjusting piece	7	Magnet / magnet
3	Zweite Reibfläche / second fricition surface	8	Anker / anchor
4	Belag / covering	9	Einstellring / adjustment
5	Nabe / hub	10	Druckbolzen / pushpin
		11	Druckfeder / compression spring

Fig.: Brake

Please note!

The max. indexing frequency according to the technical data should not be exceeded.

5.1.5.2 Braking voltage

The brake is released by supplying the stipulated control voltage. The brake is either directly connected to direct voltage, or alternating voltage is rectified by a rectifier built into the terminal box. Various coil designs are possible in order to adapt to the usual connection voltages.

5.1.5.3 Connection of the motor

The braking system connection is carried out via a rectifier built into the terminal box in accordance with the corresponding enclosed wiring diagram. The connection voltage to be applied is featured in the wiring diagram. In the direct current circuit an additional jumper is provided which will have to be replaced by a contact point in order to switch off on the direct current side. This achieves a considerably lower coast down. The switching contact is generally switched in parallel with the motor control switch.

Please note!

The motor may only be switched on in conjunction with the direct current brake. The rectifier is not connected to the mains. In case of operation on 60 Hz mains, the reduction gearbox must be designed for 60 Hz! The brake must only be switched on on the direct current side. In the event of an alternating current braking process, switching precision must be taken into account.

5.1.6 Inductive proximity switch

Electromechanical FIBROTOR rotary tables are provided with 2 contactless limit switches, size M 12 x 1.

- S10 "Table top at standstill"
- S12 "Motor off"
- Option: S11 "Motor off" during pendulum mode, position 1
- Option: S13 "Approach intermediate position"

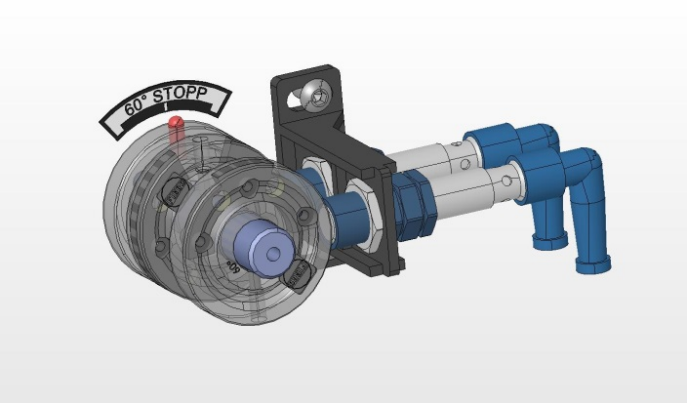


Fig.: Inductive proximity switch

Standard size of the limit switches according EN 50 008 A 12

- Fixing thread: M 12 x 1
- Basic technology: PNP
- Voltage range: 12 V – 30 V
- Switching capacity: 200 mA
- Basic function: Normally open contact
- Switching distance: 2 mm

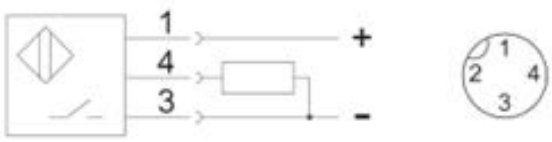


Fig.: Connection diagram of limit switches

5.2 Controller

The controller of the FIBROTOR ER, EM and RT models can be operated by a frequency inverter having FIBRO rotary table software or a microprocessor control card, for example.

5.2.1 Frequency inverter with FIBRO rotary table software

All essential properties and functions for uncomplicated and economical rotary table control are combined in the frequency inverter. It can be implemented and operated extremely easily. Using the frequency inverter, the indexing time is infinitely variable and/or adjustable in conjunction with an optional potentiometer.

Fig.: SEW frequency inverter

Fig.: SIEMENS frequency inverter

The frequency inverter with the FIBRO rotary table software also enables the following:

- Soft start in the rotation phase
- Rapid speed or creep speed
- Monitoring of the three-phase brake motor
- Minimum brake wear out
- External selection of the direction of rotation, "CW" or "CCW"
- Fault reset
- Stop function in the rotation phase
- Approach intermediate positions (optional)

5.2.1.1 Frequency inverter properties

- Compact device
- Integrated brake chopper
- Braking resistance
- Integrated EMC mains filter class B (single-phase) / class A (three-phase)
- Book form in protection class IP20 / NEMA

5.2.1.2 Easy operation and commissioning

- Shortest implemetation time
- Motor adaptation in case of standard control procedure U / f
- Integrated control unit with guided menu operation
- Comfortable parametrisation and diagnosis using PC software
- Less wiring complexity
- Connection of the limit switches directly to the frequency inverter or field bus systems
- Position detection using evaluation module

5.2.1.3 Application-related functionality

- High overload capability

  125% I_N continuous operation

  150% I_N for max. 60 seconds
  Max. 180% breakaway torque
- Integrated PI controller
- Expanded temperature range -10°C to +50°C
- Integrated protection and monitoring functions (short circuit, earth fault)

5.2.1.4 Options

- USB interface
- RS485 interface
- Field bus interface
- Line reactor (to support the overvoltage protection)
- Output choke (to suppress the power line radiation of the unscreened motor cable)

5.2.2 Microprocessor control card

The FIBROTOR control card (FSK) is a multifunctional electronic control system for the ER, EM and RT rotary table series. It is used for integration into existing machine controllers for the variation FIBROTOR with three-phase brake motor or with two-speed motor.

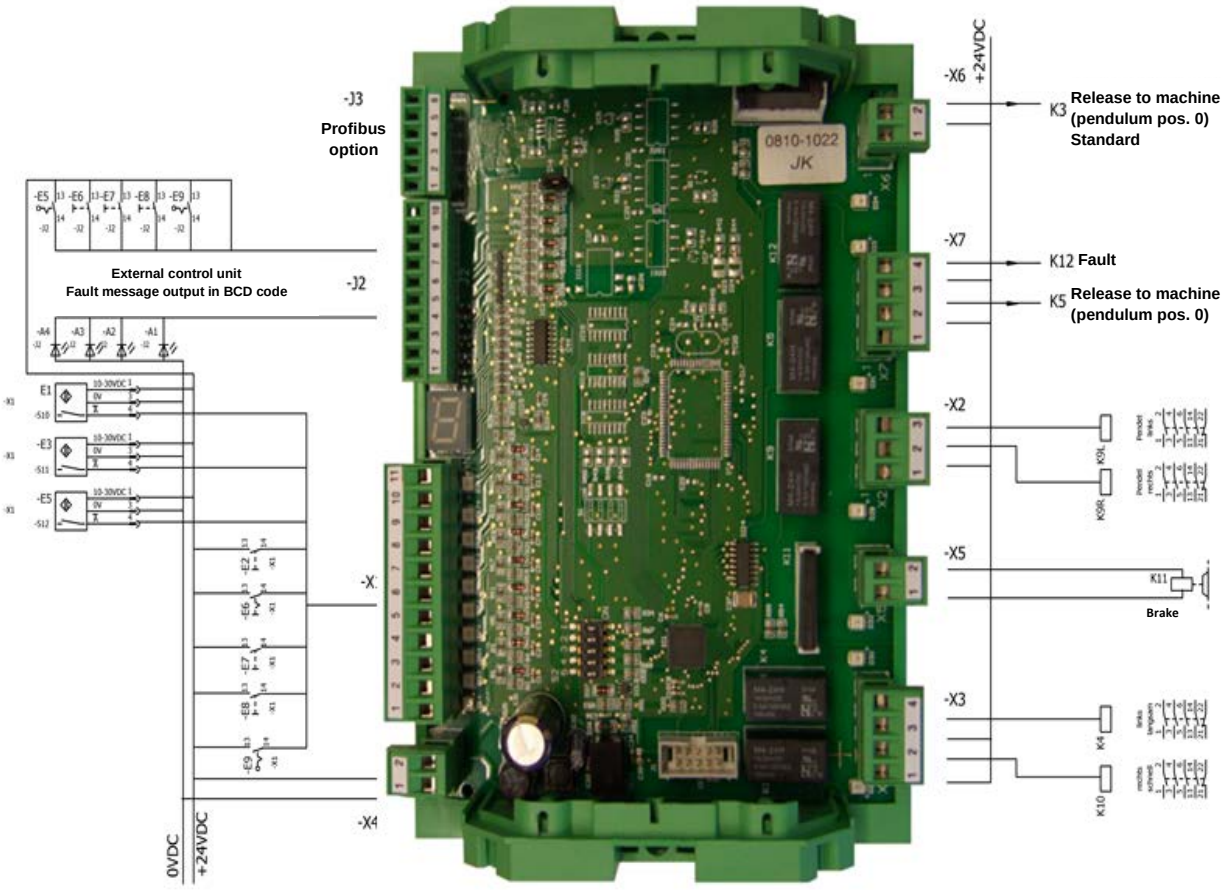


Fig.: Connection diagram of microprocessor control card

The essential features of the control card are as follows:

Housing (Phoenix housing)

- Lockable to every DIN top-hat rail
- Screwed plug terminals
- Dimensions (W x L x H) 130 x 178 x 50
- Protection class IP20

Connections

Inputs

- S10 Table top at standstill
  (pendulum position 0)
- S11 Pendulum position 1
- S12 Motor off
- CW operation start, CCW operation start
- Release brake
- Stop, reset
- Two-hand operation
- Thermal protection

Outputs

- CW operation, CCW operation
- Fast, slow
- Brake
- Fault
- Enable S10, enable S11

PLC

The fault messages can be imported through 4 BCD-encoded outputs using a PLC.

External control unit

An external control unit can be implemented for service cases through 5 inputs.

Program variants

- CW operation
- CCW operation
- Pendulum operation
- With standard motors
- With two-speed motors
- 2-hand operation

Variants

- FSK-B024/1 for break voltage 24 VDC
- FSK-B230/1 for break voltage 230 - 400 VAC

5.2.3 Complete control in control cabinet

The FIBROTOR controller for the FIBROTOR ER, EM and RT rotary tables and the motor supply elements are accommodated completely in a control cabinet with control elements.

Fig.: Complete control in control cabinet with control card

5.2.4 Fuse protection of drive

In any controller, an active power meter can be integrated for the protection of the mechanical drive. If a set motor output is undershot, e.g., due to sluggishness from jammed parts or a blockage of the table top, the active power meter switches off the three-phase motor and emits the "Fault" signal. The response sensitivity can be adjusted.

Voltage: 400 V, 3 AC
(special voltages on request)

Frequency: 50 Hz – 30 Hz

6 Rotary tables for flexible positioning: FIBROTOR EM.NC and RT.NC

6.1 Technical description

6.1.1 Cam roller gearbox

In case of rotary tables for flexible positioning, the control cam has a continuous gradient. Due to this linear movement path, any position can be approached.

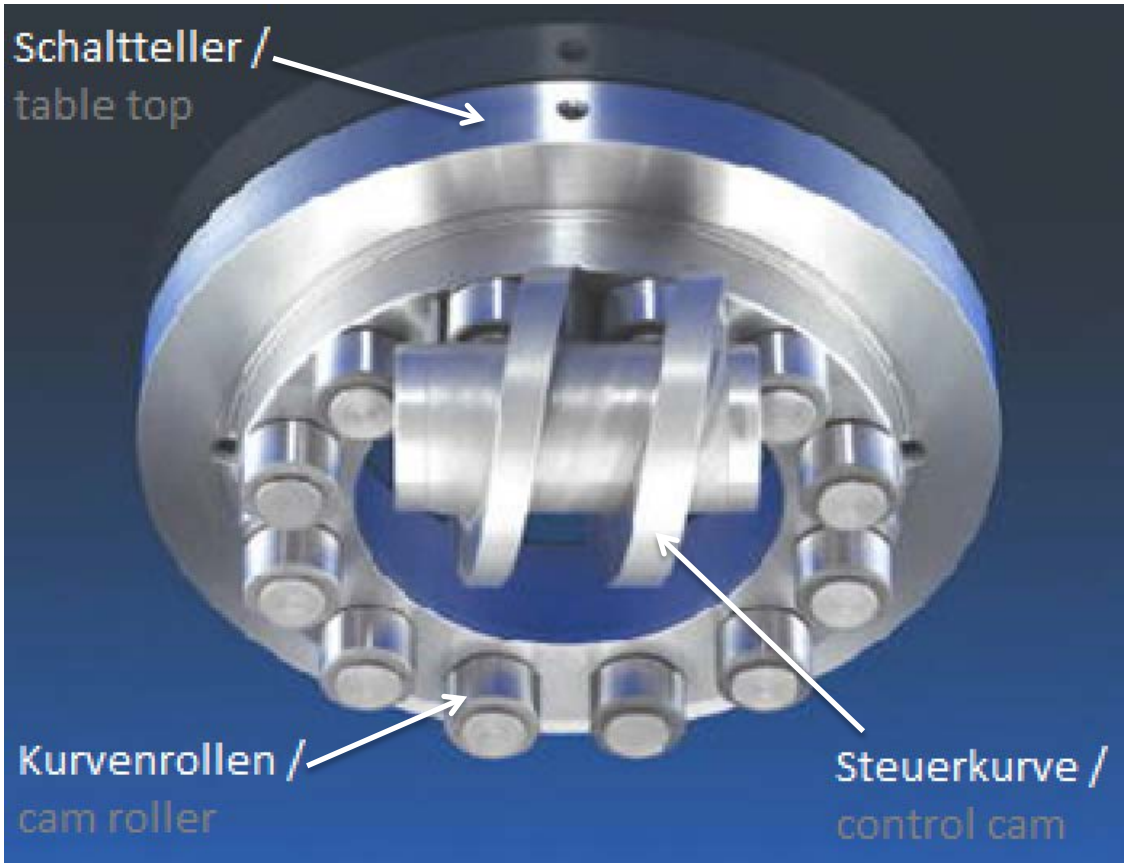


Fig.: FIBROTOR EM.NC and RT.NC control cam

6.1.2 Motion sequence

In the case of NC rotary tables, a regular motion sequence is achieved through a continuous gradient of the worm shaft. This motion sequence is regulated by an electrical NC controller. A partial movement of the motion sequence is as follows:

In the starting situation, the table top is in any position and the NC parking brake is supplied with power. After that, the data is input through the NC controller. The NC parking brake is released and is in a de-energised condition. After that, the acceleration and division graduation procedure is performed using a NC-controlled positioning motor. If the target position is reached, the worm shaft is stopped by the NC parking brake.

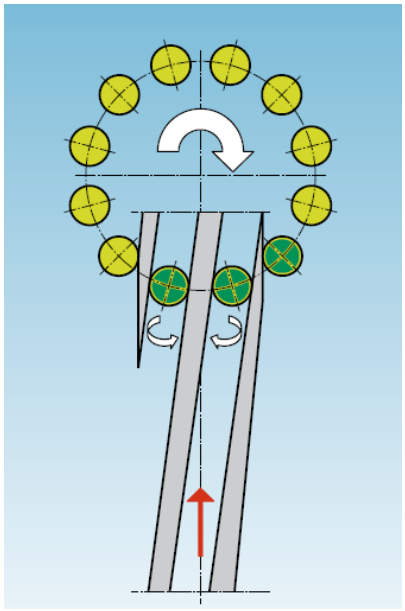


Fig.: Regular motion sequence

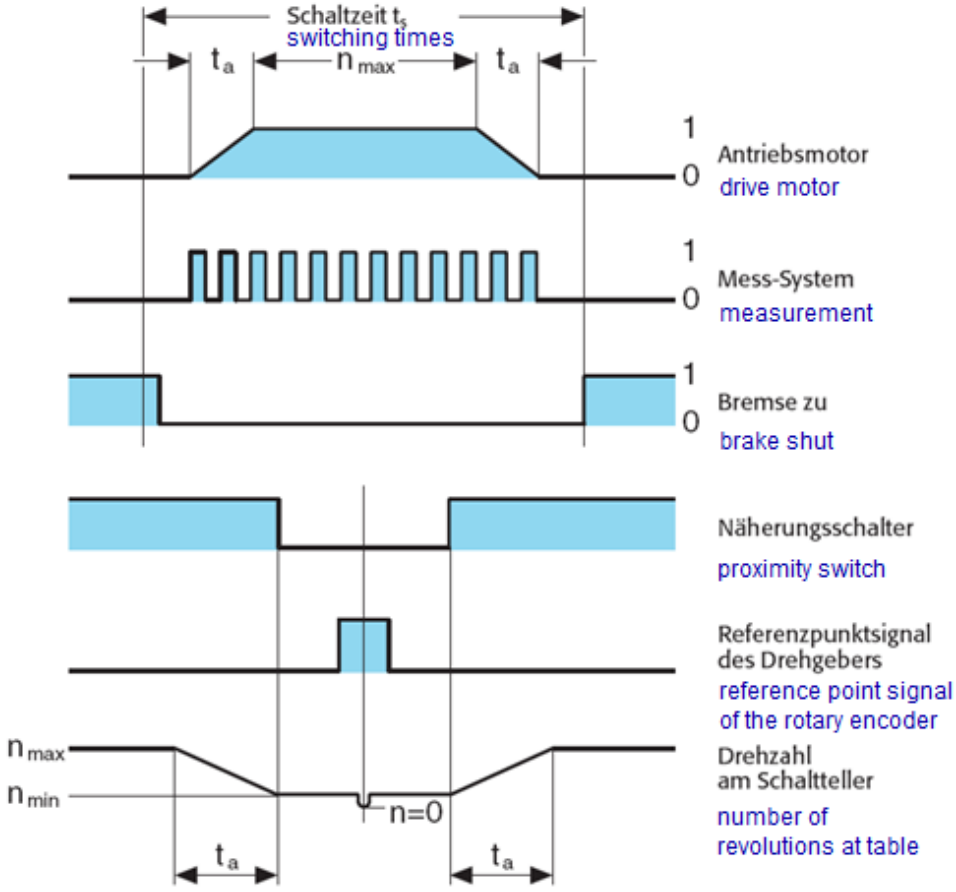


Fig.: Motion sequence

6.1.3 Positioning

The positioning in the target position is implemented using an electronic NC parking brake for the FIBROTOR EM.NC and FIBROTOR RT.NC. This brake positions the table top by locking the worm shaft in the target position without play.

The functional principle of the NC parking brake is as follows:

If the coil is supplied with power, a magnetic field forms. The anchor plate is pressed onto the braking coil carrier with friction lining. The shaft is braked. The brake torque runs from the coil carrier through the friction lining, anchor plate and membrane transmission spring to the flange and the shaft. If the solenoid coil is de-energised, the membrane transmission spring pulls the anchor plate away from the coil carrier. The shaft can run through freely.

6.1.4 irection of rotation

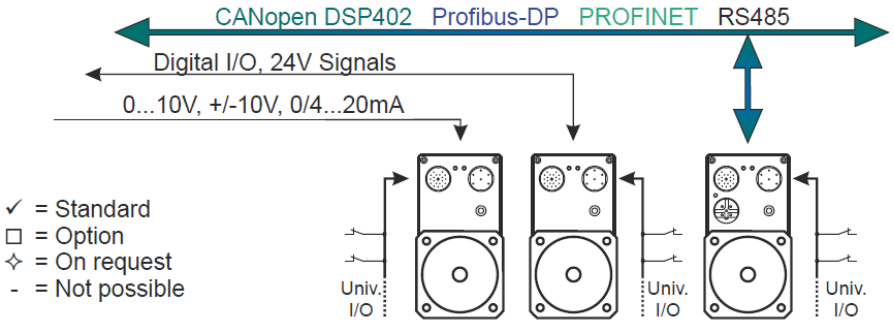
The direction of rotation of EM.NC and RT.NC is clockwise (CC) or counter-clockwise as required.

6.2 Controller

6.2.1 FIBRODRIVE *plus*

FIBRODRIVE *plus* is a freely programmable CNC axis positioning controller. The input voltage amounts to 230 V/AC or 400 V/AC optionally. In connection with a FIBRO rotary table, a complete rotary table axis is available to a user for the expansion and supplementation of the user's application.

esiMot Features



6.2.1.1 Monitoring

Status LEDs	2	2	3
Signalling e.g. for:			
- Motor temperature (I^2t)	✓	✓	✓
- Motor temperature PTC (at esiMot7)	✓	✓	✓
- Output stage temperature	✓	✓	✓
- Ballast power internal	✓	✓	✓
- Overvoltage/Undervoltage	✓	✓	✓
- Elapsed hour meter	✓	✓	✓
Electronic type plate	✓	✓	✓

6.2.1.2 Equipment

esiMot XL - Type	Without Fieldbus xx/x.1xx.xx Amplifier mode	Without Fieldbus xx/x.2xx.xx Positioning mode	With Fieldbus xx/x.3-7xx.xx All modes
Integrated servo-amplifier	✓	✓	✓
Integrated positioning logic (position loop)	-	✓	✓
Digital 4Q speed and torque regulator	✓	✓	✓
Position acquisition**			
- Resolver	✓	✓	✓
- Absolute encoder Multi-Turn	-	□	□
Fieldbusses (see order code)	-	-	□
Analog set value	✓	-	✧
Digital inputs	4	8	8 / ✧6
Digital outputs	1	2	2 / ✧4
Encoder output A/B/0 24V	✓	-	✧
Integrated ballast circuit and -resistor	✓	✓	✓
Connection for external ballast resistor	✓	✓	✓
Wrong polarity protection	✓	✓	✓
Safe Torque Off EN 13849-1 Cat. 3 PL e	□	□	□
Stand still brake	□	□	□
RS232 Programming interface (19,2kBaud)	✓	✓	✓

6.2.1.3 Functions and programming

Programming/Parameter setting			
- via RS232 Interface	✓	✓	✓
- via Fieldbus	-	-	✓
- Position-Teach-In	-	✓	-
Reference run management	-	✓	✓
Limit switch (Hard- and Software)	-	✓	✓
Automatic brake management	-	□	□
Free programmable move records	-	15	15
- velocity	-	✓	✓
- Acceleration/Deceleration (separate adjustable)	-	✓	✓
- On-the-fly record change	-	✓	✓
- Dwell time	-	✓	✓
- Set outputs (M-functions)	-	✓	✓
Regulating modes			
- Electronic shaft/electronic gear	-	✓	✓
- Speed / Torque (PI-Regulation)	✓	✓	✓
- Absolute, Relative, Modulo Postion (P-Regulation)	✓	✓	✓

6.2.2 CNC single-axis controller

The CNC single-axis control system is a freely programmable CNC positioning controller. It enables easy programming and comfortable operation through menu-guided sequences. In addition, it implements complete control in the table housing and a simple input of the division, angle, segments and absolute positions. In addition, the clamp and brake sequence is regulated automatically. The CNC single-axis controller is available with a hand wheel connection, with an RS232 serial interface and in various design versions.

Fig.: CNC single-axis controller, front

Fig.: CNC single-axis controller Back

6.2.2.1 Motor versions

- NC 651.CDS 22.81.LC (230 V), up to max. motor torque 5 Nm
- NC 651.CPS 20.81.LC (400 V), up to max. motor torque 16 Nm

6.2.2.2 Connection options

- Memory expansion to 760 program records
- USB / RS232 interface with menu-guided software for archiving programs
- USB / RS232 interface with online programming
- BCD interface for program selection
- BCD interface for external position setting

6.2.2.3 Operating modes

- Referencing
- Automatic mode
- Program entry
- Manual mode
- Parameter entry

6.2.2.4 Equipping features

- Function-related control panel
- Membrane keyboard
- LCD plain-text display
- Multilingual user catalogue
- Fault message in plain text
- Flexible angle input
- Division 1 - 999
- 180 program records / 1 - 90 programs
- Free programming of division and distances with absolute and incremental measuring within a program
- Fail-safe saving of all data
- Resolution 3 600 000 Ink / 360°
- $\sin^2$ function
- Software travel limit
- Programmable speeds
- Pluggable inputs and outputs

6.2.2.5 Technical data

210 V technology

- Dimensions: W x H x T = 361 x 288 x 330, without plug
- Weight approx. 12 kg
- Connecting voltage 230 V AC
- Fuse rating 10 A
- Ambient temperature 0 – 45°C

600 V technology

- Dimensions: W x H x T = 469 x 389 x 290, without plug
- Weight approx. 17 kg
- Connecting voltage 400 V 3AC
- Fuse rating 10 A
- Ambient temperature 0 – 45°C

6.3 Measuring systems for EM.NC and RT.NC

For the recording of the table top position, only absolute encoders in various designs and precisions are used. The determination procedure is performed according to the respective application and NC controller used.

The following measuring system arrangements are possible:

6.3.1 Indirect measurement on the motor shaft

In particular in the case of digital servo drives the measuring system is placed directly on the motor shaft. The precision and play of the reduction gearbox are included in the measurement result. The tolerances of the cam roller gearbox are also included in the measurement. The centre hole remains free for power supply and other applications.

6.3.2 Indirect measurement on the control cam

The encoder is arranged in the cam shaft axis. The tolerances of the cam roller gearbox are included in the measurement. For achievable indexing accuracies, see the data sheets. The centre hole remains free for power supply and other applications.

6.3.3 Direct measurement on the table top (EM.NC)

The measuring system is attached to the axis of the table top. The measuring accuracy is, to a great extent, dependent on the accuracy of the measuring system. Other fault influences such as gearbox play are prevented. This version is suitable for applications with particularly high precision requirements. The measuring system is operated through the centre hole. Not possible in conjunction with the centring flange.

(Not available for RT.NC)

7 Drive motors

7.1 AC brake motor

230/400 V AC, 50 Hz, ±10% DIN IEC38
266/460 V AC, 60 Hz, ±10% DIN IEC38
Brake 400 V AC
Including bimetal thermal protection
Standard drive in style B14
Protection class IP54

Special voltages and increased protection class on request

7.2 Hydraulic motor

For particularly compact drive solutions or special customer requirements

7.3 Air motor

For use in machines with pneumatic drive or in (ATEX) protected areas

7.4 AC servo motor

For EM.NC and RT.NC rotary tables or highest indexing frequency and large speed control range

Adapter and couplings are available for almost all motor makes.

7.5 Drive motor in special design

Special voltages and special designs are available on request.

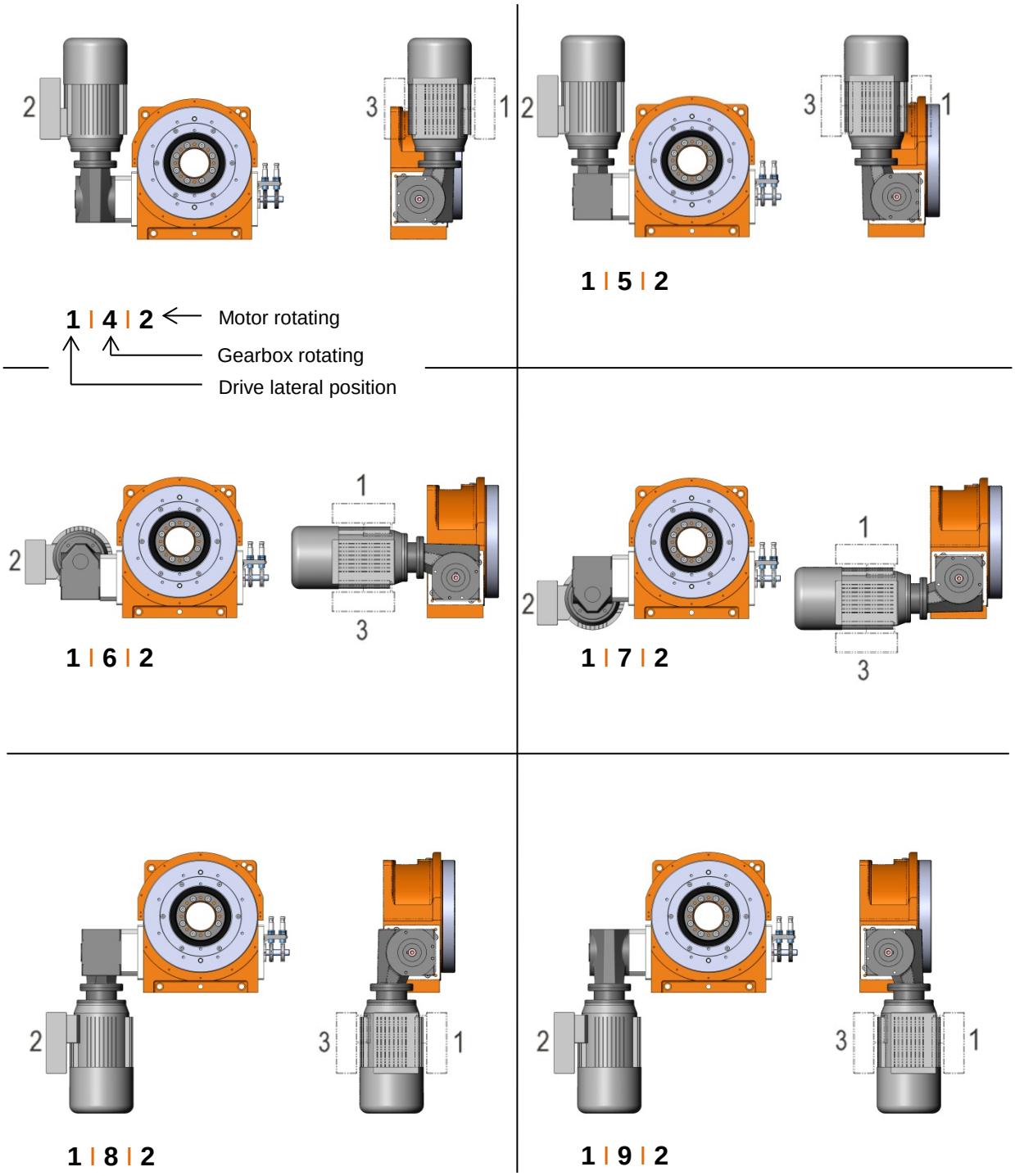
7.6 Wothout motor

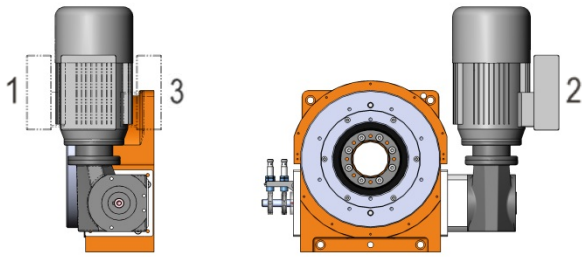
Prepared for motor attachment with gearbox or for drive directly on the control cam shaft

8 Drive arrangements

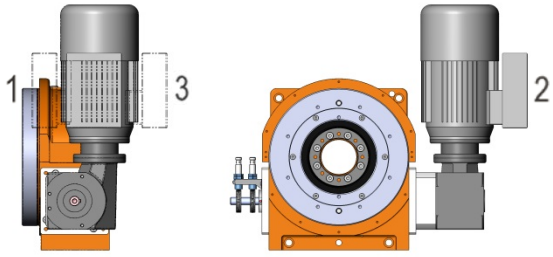
A variety of drive arrangements are available for optimum integration of the rotary table into the machine.

8.1 Angular gearbox

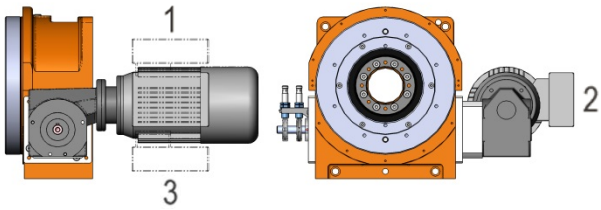




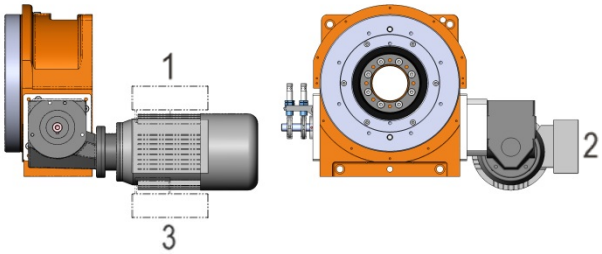
2 | 4 | 2



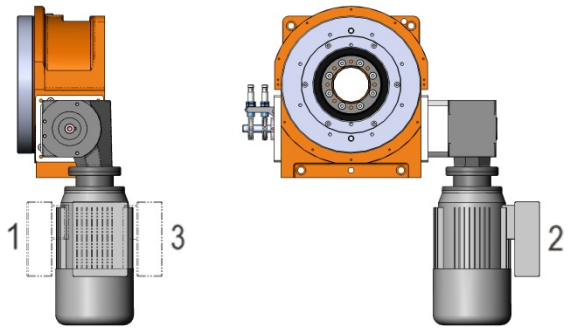
2 | 5 | 2



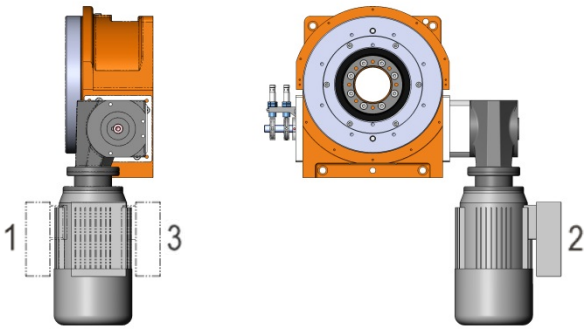
2 | 6 | 2



2 | 7 | 2

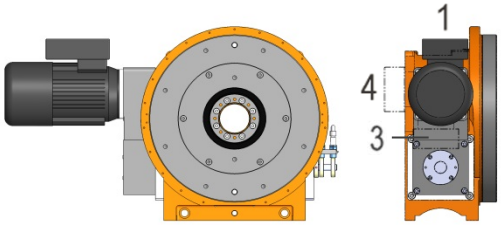


2 | 8 | 2

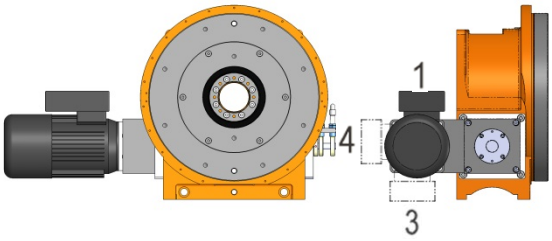


2 | 9 | 2

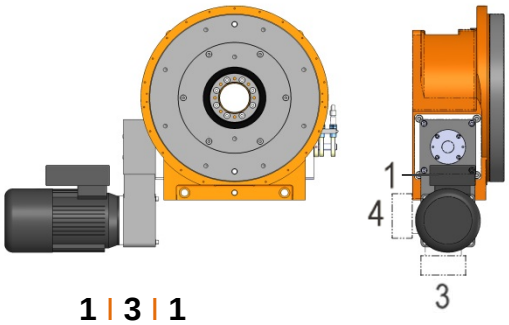
8.2 Parallel shaft gearbox



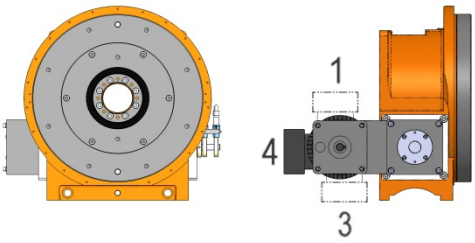
1 | 1 | 1



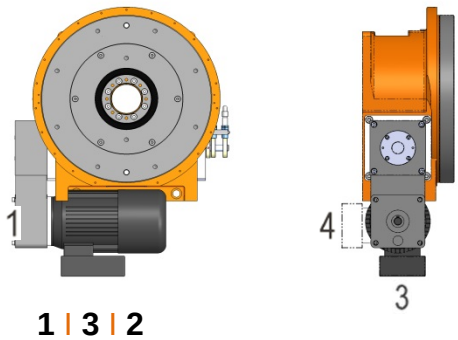
1 | 2 | 1



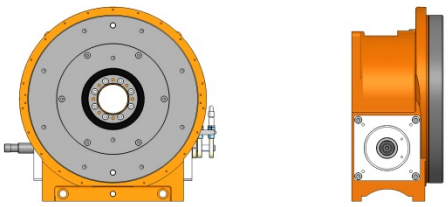
1 | 3 | 1



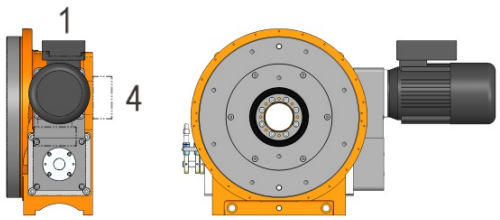
1 | 2 | 2



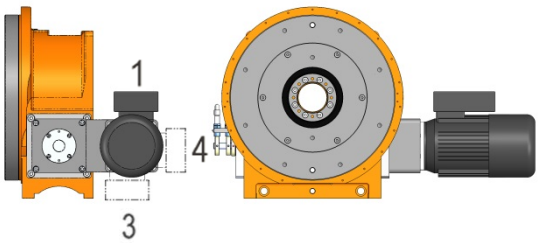
1 | 3 | 2



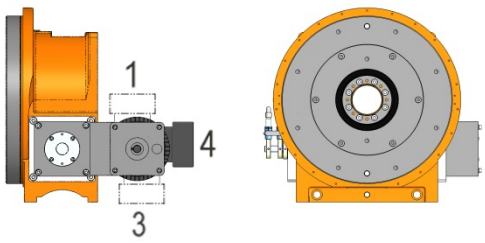
1 | 0 | 0



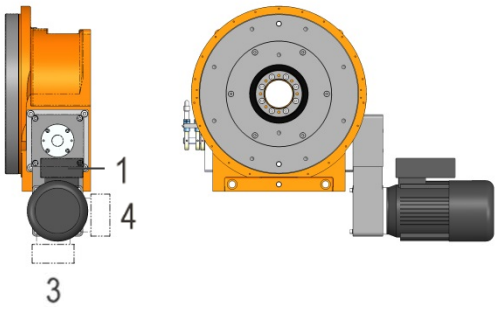
2 | 1 | 1



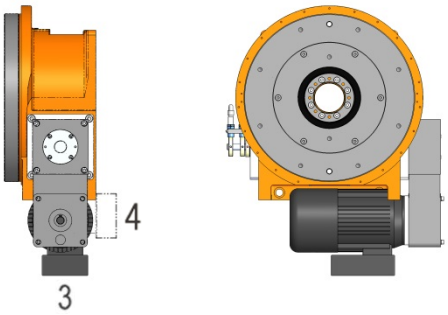
2 | 2 | 1



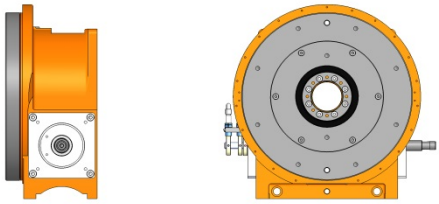
2 | 2 | 2



2 | 3 | 1

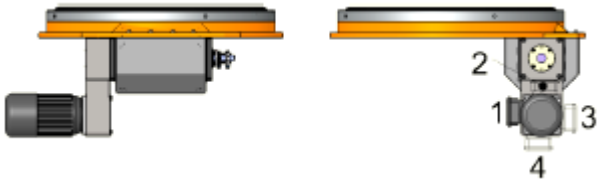


2 | 3 | 2



2 | 0 | 0

8.3 RT and RT.NC



1 | 2 | 1 ← Motor rotating

Gearbox rotating

Drive lateral position

1 | 2 | 2

2 | 2 | 1

2 | 2 | 2

9 Accessories

9.1 Position detection and over travel protection

9.1.1 Mechanical over travel protection (EM and EM.NC)

During pendulum mode between various positions, the mechanical safety limit switch is used to prevent collisions with tools or cable breakage due to over travel.

9.1.2 Position detection on the table top (EM)

In order to request the individual positions a position detector (BCD Code) can be attached.

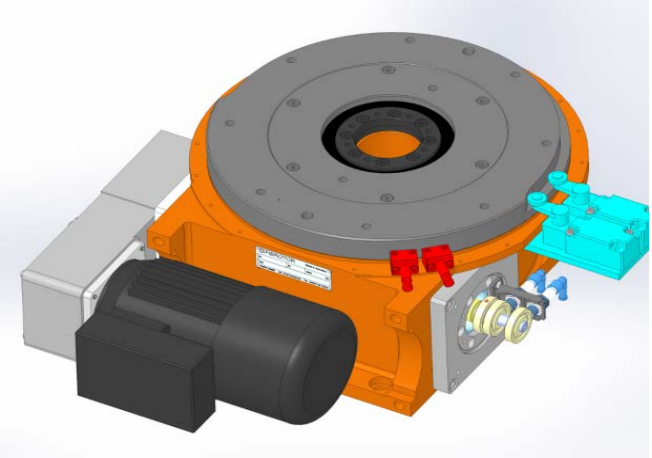


Fig.: Mechanical over travel protection and position detection on the table top

9.1.3 Intelligent position detection (ER, EM and RT)

The intelligent position detection is a module for outputting the table top position. It can also be used as electronic over travel protection during pendulum mode. The module replaces the standard limit switches and completely maps its function. In addition, it offers protection against spray water thanks to protection class IP65.

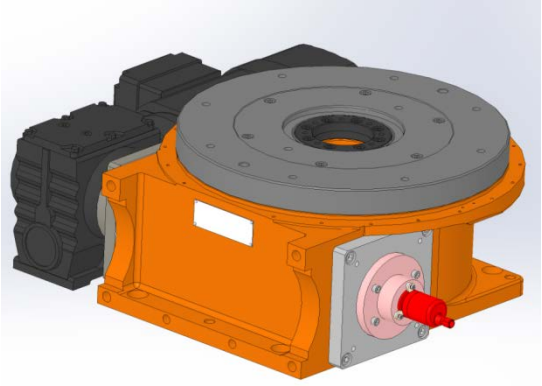


Fig.: Intelligent position detection

9.2 Additional modules

9.2.1 Centring ring

The centring ring enables the assembly of the additional table top. It is provided with a fit of k6 so that the additional table top is usually manufactured with a centre hole with a fit of H7.

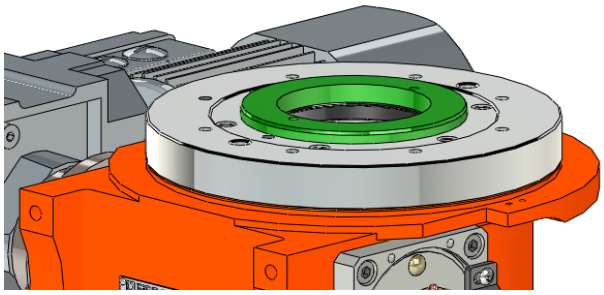


Fig.: Centring ring

9.2.2 Centring flange

For the mounting of the upper fixed table top, the standard flange can be replaced by a lifted centring flange. The height H5 can be changed as desired.

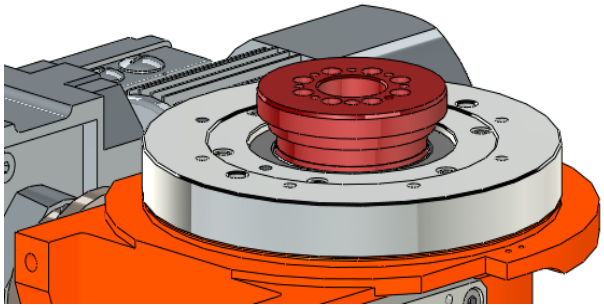


Fig.: Centring flange

9.2.3 Centring ring and centring flange

The centring ring and centring flange can be combined:

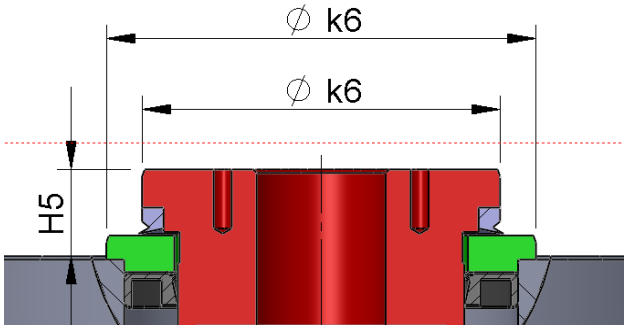


Fig.: Dimensioning of centring ring and centring flange

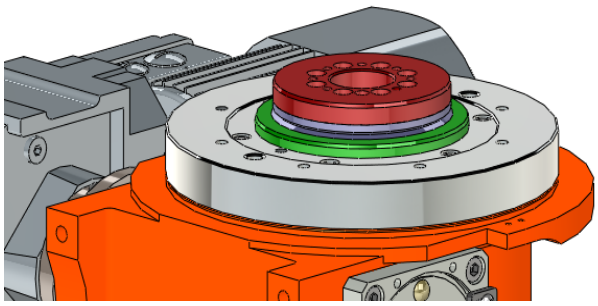


Fig.: Centring ring and centring flange

9.2.4 Strengthened table top bearing (EM and EM.NC)

The table top is pre-loaded against the housing in a play-free manner using a second axial needle bearing. The strengthened table top bearing permits higher tilting moments on the positioned and rotating table top:

(Cannot be combined with hydraulic table top lock)

- Tilting moment on the positioned table top (+200%)
- Tilting moment on the rotating table top (+300%)

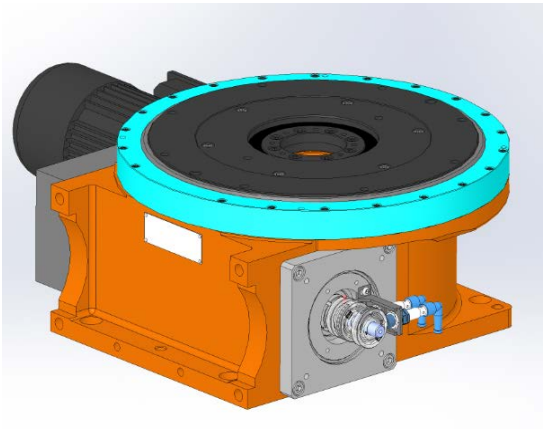


Fig.: Strengthened table top bearing

9.2.5 Hydraulic table top lock (EM and EM.NC)

In its positioned state, the table top is connected with the housing in a friction-locked and backlash-free manner by means of hydraulically pressurised clamp. Higher tangential loads are possible and the gearbox parts are relieved.

- Operating pressure: 64 +10 bar
- Clamping time approx.: 0.4s
- Release time approx.: 0.2s.

A hydraulic unit and/or pneumo-hydraulic clamping unit are available as an accessory.

(Cannot be combined with a strengthened table top bearing)

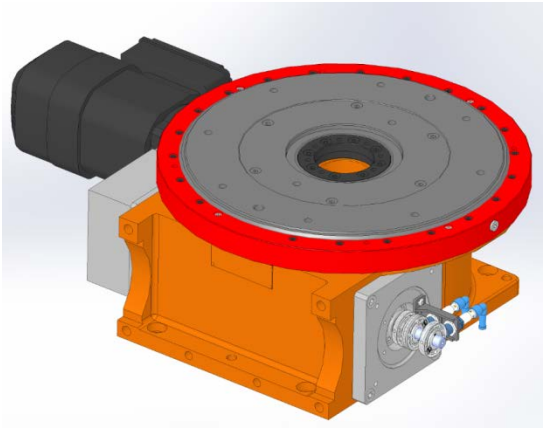
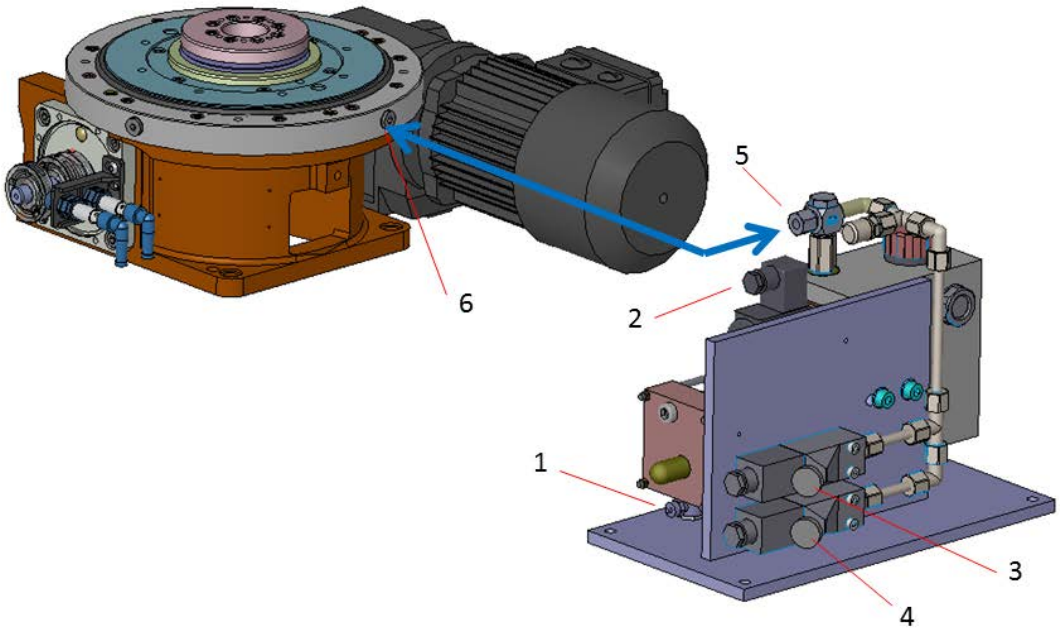


Fig.: Hydraulic switching plate clamping

Please note!

The clamping should never be activated during the rotation motion of the table top (also not at emergency stop!). The rotary table should never start against closed clamping. This leads to damages. When the clamping is activated, the table top and the housing are connected to each other in a friction-locked manner. The max. clamping pressure and the max. operating pressure should not be exceeded. At higher pressures, the clamping elements can be damaged. The activation of the tangential forces may take place only within the limits defined by the technical specification. If the tangential moments at the clamped table top are exceeded, the clamping elements and, possibly, the driving elements are destroyed.

9.2.5.1 Connection diagram of table top clamp



- 1 Pneumatic connection 6 bar
- 2 Control valve 24 VDC
- 3 Pressure switch S1 / setting range 2-20 bar
- 4 Pressure switch S3 / setting range 10-100 bar
- 5 Pressure output, hydraulics
- 6 Pressure connection, table top clamp

Settings

S1: 2 bar check whether clamp released

S3: 64 bar check whether clamped

9.2.5.2 Functional diagram of table top positioning

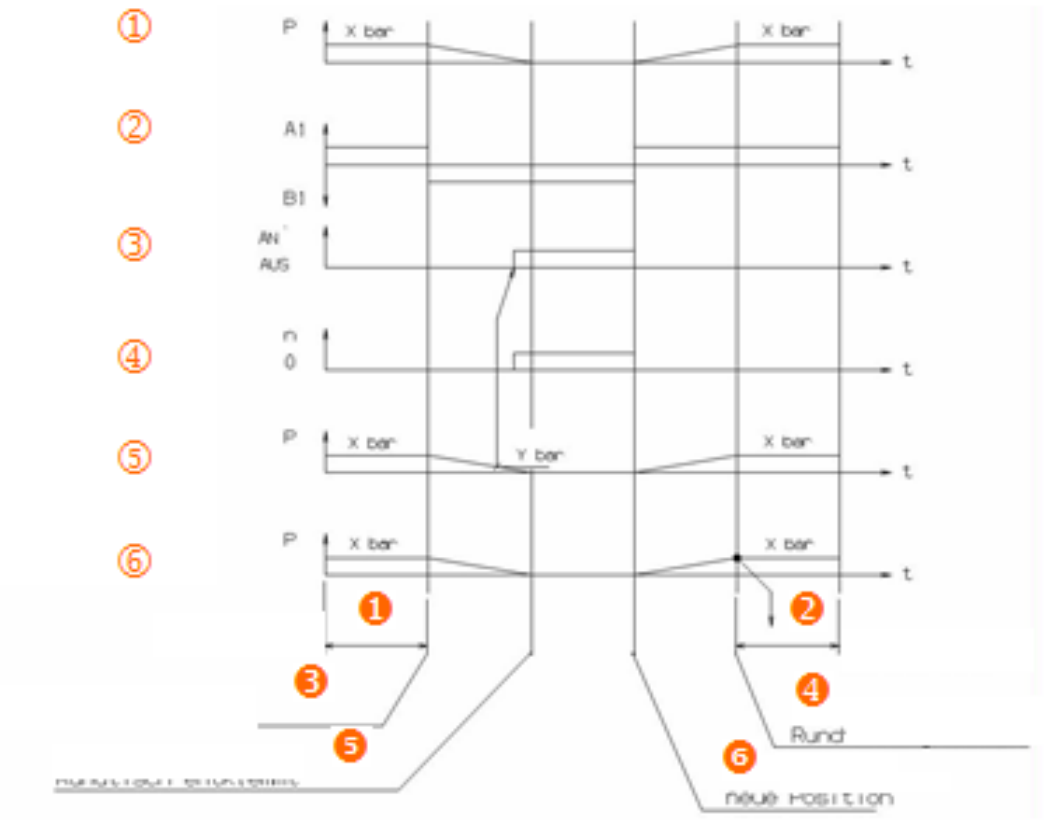


Fig.: Functional diagram of table top positioning

① = Table top clamp
② = 4/2-way directional valve
③ = Motor for “Turn table top”
④ = Turn table top
⑤ = Pressure switch
⑥ = Pressure switch
X = Clamping pressure

1 = Starting position
2 = New starting position of table top
3 = 4/2-way directional valve at B1
4 = Table top clamped
5 = Clamp released
6 = New table top position
Y = Pressure ≤ 2 bar

9.2.6 Built-in version

The built-in version lets you mount the rotary table direct to the bottom of the machine table through threads at the top of the housing. Optionally, you can fasten the housing using a mounting ring.

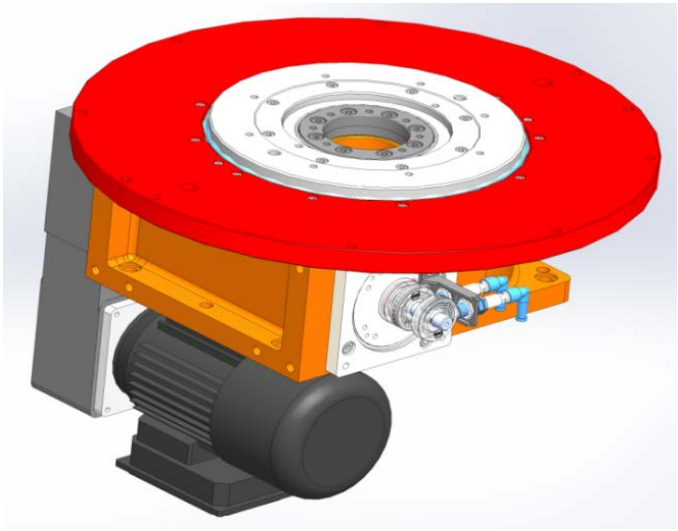


Fig.: Integrated model with thread

9.2.7 Vertical and upside down design

Optionally, the FIBROTOR rotary table can be equipped for vertical use. In addition, the vertical design is available with or without a base plate.

Please note!

In case of vertical design, the control cam must be at the bottom, as shown; otherwise sufficient lubrication of the drive elements is not possible. The control cam only has in this position the possibility to pick up and spread the lubricant.

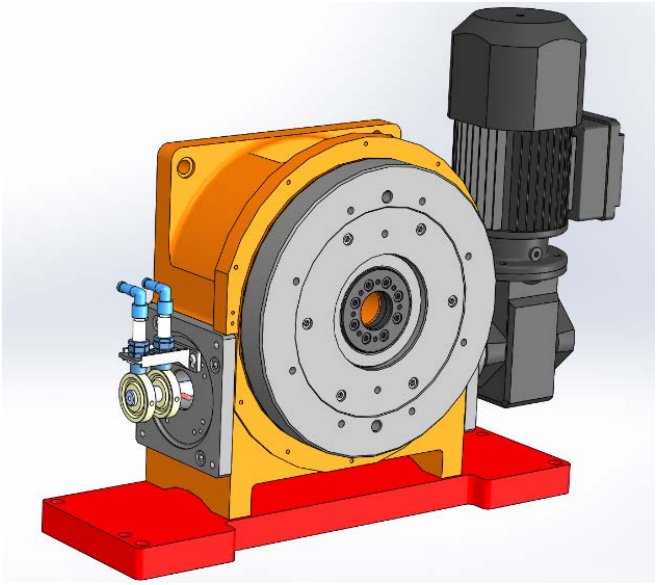


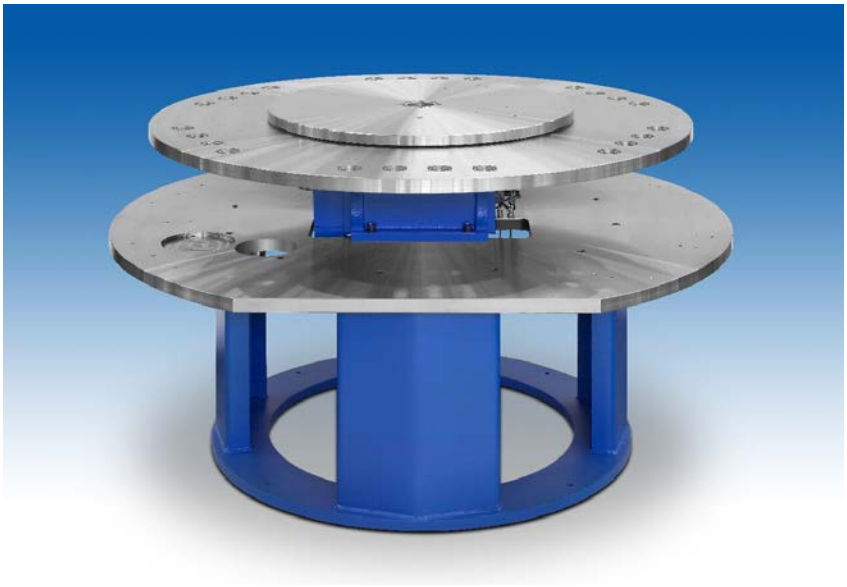
Fig.: Vertical model

Also, the FIBROTOR rotary table can be implemented as an upside down model.

9.3 Additional table tops and fix table tops

At FIBRO, circular discs are kept on stock to implement short delivery times for additional table tops and fix table tops.

Additional table tops and/or fix table tops are screwed and dowelled. A profile seal is available to seal the space between the additional table top and the fix table top at a gap dimension of 1 mm. The surfaces of the additional table tops and fix table tops are precision-turned. If desired, the surface can be anodised, natural anodization EV 1 (0.017-0.020 mm), without pickling.



Drill templates and additional machining according to customer drawing are possible.

Fig.: Rotary table without additional table top, upper and lower Fix table tops and machine stand

9.3.1 Additional table top

For the individual sizes, additional table tops from Ø 320 mm to Ø 3,000 mm are available.

Material: Steel St52 or aluminium AlMg4.5Mn

9.3.2 Fixed upper table top

To assemble or support equipment or machining units from Ø 160 mm to Ø 800 mm.

9.3.3 Fixed lower table top

The "fixed lower table top" is mounted to the machine stand. It is available from Ø 800 mm to Ø 3,000 mm.

9.3.4 Preferred series

Dimensions in [mm]	Weight	Mass moment of inertia
Ø 630 x 20	17.14 kg	0.85 kgm²
Ø 700 x 25	26.46 kg	1.62 kgm²
Ø 800 x 22	30.41 kg	2.43 kgm²
Ø 800 x 25	34.56 kg	2.47 kgm²
Ø 1000 x 22	47.52 kg	5.94 kgm²
Ø 1000 x 25	54.00 kg	6.75 kgm²
Ø 1250 x 25	84.37 kg	16.50 kgm²

9.3.5 Axial and radial runout

Radial runout of the centring borehole

Size	Radial runout without centring ring in [mm]	Centring in [mm]	Radial runout in [mm]	Total radial runout in [mm]	Radial runout of additional table top in [mm]
10	0.02	Ø 40	0.02	0.04	0.05
11	0.01	Ø 75	0.02	0.03	0.04
12	0.01	Ø 110	0.02	0.03	0.04
13	0.01	Ø 150	0.02	0.03	0.04
15	0.015	Ø 160	0.02	0.035	0.05
16	0.015	Ø 220	0.02	0.035	0.05
17	0.02	Ø 260	0.02	0.04	0.06
18	0.02	Ø 300	0.02	0.04	0.06
19	0.02	Ø 300	0.02	0.04	0.06

Axial runout

Additional table top	0.01 mm / 100 mm
"Upper" fix table top	0.02 mm / 100 mm
"Lower" fix table top	0.02 mm / 100 mm

9.3.6 Guidelines for drill templates in additional table tops and fix table tops

To prevent unnecessary costs, the fit and thread depths should be kept as short as possible. The tap holes in the additional table top and "lower" fix table top can be drilled through. The holes in the "upper" fix table top should be blind holes. FIBRO has provided the fix table tops and additional table tops with corresponding transport threads.

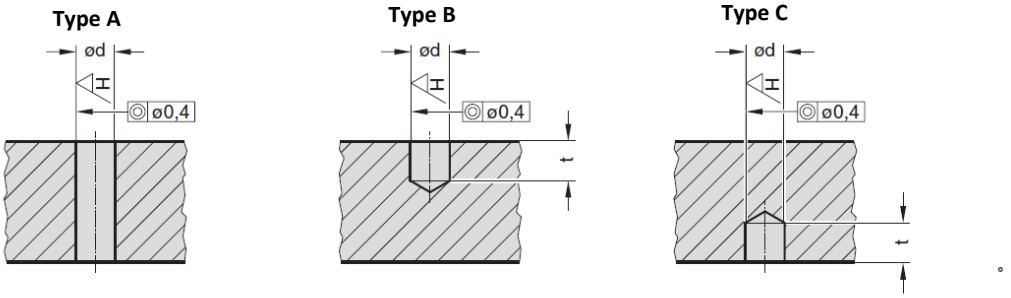
General recommendation:

Fit length = 2 x nominal diameter

Thread length = 2 x thread diameter

Type B Borehole

Only in exceptional cases

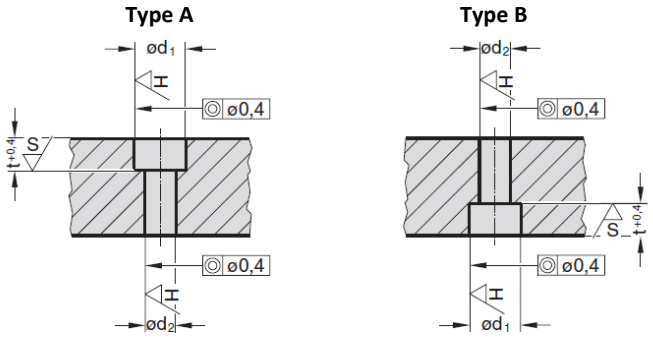


d/t	∅ 5,5	∅ 6,6	∅ 9	∅ 11	∅ 13,5	∅ 17,5	∅ 22	∅ 26	∅ 33
Use	M 5	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30

Type S Countersink

Countersink DIN 74 – KM

for cheese-head screws DIN 912

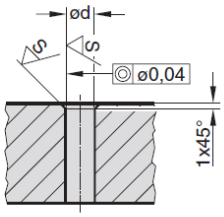


$d_1/t/d_2$	∅ 10/5,7/5,5	∅ 11/6,6/6,6	∅ 15/9/9	∅ 18/11/11	∅ 20/13/13,5	∅ 26/17,5/17,5
Use	M 5	M 6	M 8	M 10	M 12	M 16

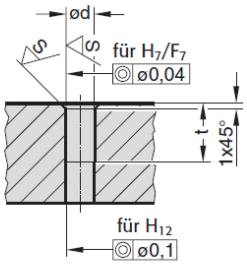
Type P Locating hole

Standard: $t = 2 \times d$

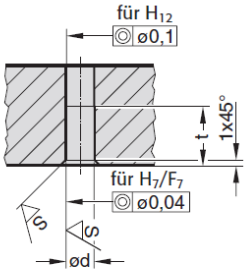
Type A



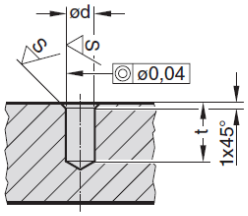
Type B



Type C

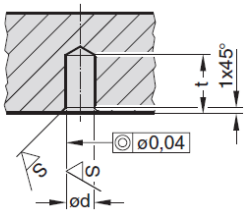


Type D



Type E

Only in exceptional cases



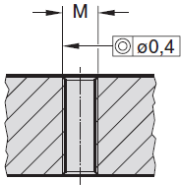
max. fit length

d	t
∅ 4 – ∅ 7,7	14 mm
∅ 7,8 – ∅ 9,7	27 mm
∅ 9,8 – ∅ 11,7	30 mm
∅ 11,8 – ∅ 13,7	38 mm
∅ 13,8 – ∅ 15,7	45 mm
∅ 15,8 – ∅ 19,7	53 mm
ab ∅ 19,8	60 mm

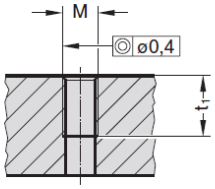
Type G Thread

Standard: $t_1 = 2 \times M$

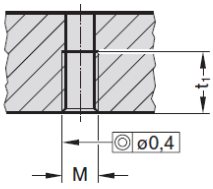
Type A



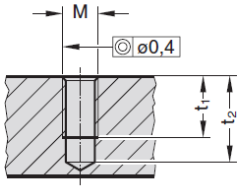
Type B



Type C

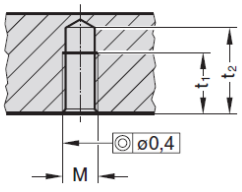


Type D



Type E

Only in exceptional cases



max. thread depth

M	t_1
M4	10 mm
M5	12 mm
M6	15 mm
M8	20 mm
M10	25 mm
M12	28 mm
M16	35 mm
M20	40 mm
M24	48 mm

$d/t_1/t_2$	M4/8/12	M5/10/13	M6/12/17	M8/16/22	M10/18/25	M12/20/28	M16/24/33	M20/30/41	M24/36/48

9.3.7 Sealing of additional table top/upper fix table top

With a gap dimension of 1 mm (H6-H3), sealing can be applied between the additional table top and the upper fix table top.

9.4 Machine stands

Our new standard machine stand range is currently being revised.

Please contact us for more information!

10 Operating duration basics

10.1 Definition

The operating duration is the period of time in hours until a shell area of a defined size has been achieved. The operating duration of a properly installed electromechanical FIBROTOR rotary table is normally achieved as soon as an alternating load has generated a shell or breakout of a certain size on a rolling or sliding segment.

10.2 Mean time to failure (MTTF)

In conformity testing, the mean time to failure (MTTF) is used to evaluate the safety of the machine. It is a statistical variable/index determine by means of tests or empirical values. It does not specify a guaranteed service life or failure-free time. The MTTF is calculated from the reliability function R(t). It applies to non-repairable and repairable units under the assumption that the unit under consideration is as new after repair. The average operating duration until failure amounts to 20,000 hours in the case of the FIBROTOR electromechanical rotary table series.

10.3 Practical operating duration

The operating duration of the FIBROTOR electromechanical rotary tables is regularly verified in testing. Service life studies are available for all sizes.

11 Protection against overloads

11.1 Permissible loading of the table top

To achieve the perfect and lasting functioning of the rotary table, loads or mass moments of inertia of the assembled device plates, pick-ups, etc. must not exceed the permitted values in the indexing time tables and/or specification.

11.2 Protection of the drive elements from damage

The additional assmenblies, equipment and units must be designed and/or monitored in such a way that a blockage during the graduation procedure is absolutely not possible. In case of blockages and collisions of the table top, the drive elements could be damaged. If the table top comes to a stop between 2 stations due to a fault, such as a power failure, the table top may be brought to the basic position only using the drive. The cam mechanism is self-locking in the end position areas; for this reason, the table top can be moved only using the drive. If an impermissible tangential moment is applied to the table top when the rotary table is at a standstill, the drive elements could be damaged.

When the rotary table is operating in normal mode (start from the base position), the mass moment of inertia created gently accelerates and decelerates through the cam drive. During an emergency stop (the rotary table is stopped in the indexing phase by the motor brake or accelerated again by the three-phase motor), a sudden acceleration occurs. This leads to a increased load of the driving elements and thus to a reduced service life.

In order to reduce this torque peak we would suggest adopting the following measures:

- Use of the FIBRO frequency inverter
- Extension of the indexing time or reduction in the mass moment of inertia
- Soft start and creep speed with frequency inverter
- Optimally adapted brake torque on the motor

11.3 Unwanted operating modes

The permissible mass moments of inertia for the FIBROTOR electromechanical rotary tables result from acceleration and friction moments, as well as external forces (e.g., transport load moments in case of vertical use). In following operating modes that deviate from normal operation, the drive elements of the rotary table are subjected to a higher load.

11.3.1 Jogging mode

Jogging mode at the nominal speed of the drive motor is not permitted. If jogging mode is required, a frequency inverter must be used. In jogging mode, creeping speed must always be used. If jogging mode is used, the drive elements are subjected to a considerably higher load at every stop of the motor and restart during the indexing phase of the control cam. The load depends on the brake and nominal torque of the motor, the position of the control cam (transmission angle), the mass moment of inertia on the input and output and the efficiency of the transmission gear.

11.3.2 Emergency stop of FIBROTOR ER, EM and RT

In case of an emergency stop, the rotary table is braked between 2 stations, resulting in a sudden acceleration. During braking and restarting, the drive elements, as in the case of jogging mode, are subject to higher loads. Frequent emergency stop operation can reduce the service life. A soft start after an emergency stop can be implemented using frequency inverters or soft starters. The use of a FIBRO frequency inverter has been preconfigured.

11.3.3 Emergency stop of FIBROTOR EM.NC and RT.NC

To avoid mechanical overloads on the rotary table, the acceleration time t_a (see “Technical Data”) must not be undershot, even in the event of an emergency stop. There are 4 emergency stop modes:

Deceleration of the AC servomotor on the NC controller:

The motor slows down the built-up masses in the set acceleration time t_a.

Deceleration time ≥ acceleration time t_a

Coastdown of the AC servomotor (without an own motor brake) after the NC controller is switched off:

The coastdown of the rotary table depends on the built-up mass moment of inertia, the speed and the efficiency of the rotary table.

Deceleration time ≥ acceleration time t_a

Emergency stop with motor brake:

Here, the defined motor torque must not by exceeded by the brake torque.

Deceleration time ≥ acceleration time t_a

Slowdown of the AC servomotor using the peak current:

In this operating mode, the maximum permissible peak current must be checked.

Deceleration time ≥ acceleration time t_a

11.3.4 Collision

In case of a collision of the rotary table, the drive elements are subjected to an extremely high load. The amount of kinetic energy of the system and the possible deceleration distances due to elastic deformation determine the forces that could lead to damage to the drive elements.

11.3.5 Overload

An overload is present if the dynamic forces lie above the use case defined in the project planning due to an excessive mass moment of inertia, transport load moment, tilting and/or friction moment or excessive speeds.

11.3.6 Stop outside of the dwell phase

An incorrect adjustment of the limit switch, an overload or brake wear can lead to the rotary table not coming to a stop in the basic position area (dwell phase) during intermittent mode. During braking and restarting, the drive elements, as in the case of jogging mode, are subject to higher loads.

11.4 Consequences of unwanted operating modes

An overload of the rotary table leads to a shortened service life, a permanent breakage or a forced rupture of the drive elements.

11.4.1 Reduction of the service life

The increased loads on the drive elements (gearbox, control cam and cam rollers) must be taken into consideration in the calculation of the service life. The number of emergency stop activations and amount of forces occurring influence the service life. In case of an emergency stop frequency of up to 3 deactivations per shift week, a service life of 20,000 operating hours MTTF results. In case of higher emergency stop activations, the statistical service life reduces. High deactivation frequencies can occur during commissioning in jogging mode or at manual operation stations with photoelectric barriers.

11.4.2 Destruction of the drive elements

Collisions cause higher loads and could lead to failure due to forced rupture or residual forced rupture. The amount of damage depends on the load that occurs. A one-time collision can stress drive elements beyond the ultimate strength limit and lead to forced rupture or cracking with later residual forced rupture.

12 Hyperlinks

12.1 Links to inquiry documents

FIBROTOR ER

FIBROTOR EM

FIBROTOR RT

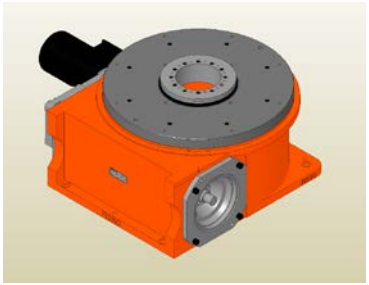
FIBROTOR EM.NC

FIBROTOR RT.NC

12.2 Link to data sheet collection

FIBROTOR data sheet collection

12.3 Link to CAD data



FIBROTOR CAD data

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